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How to Use This Manual

General

1. Overview

- (a). This manual provides the general description for finishing maintenance services. The maintenance quality and efficiency will be improved provided you follow the description.
- (b). The common maintenance operation can fall into the following three main procedures:
 - Diagnosis;
 - Dismantlement and installation, replacement, installation and inspection, and debugging;
 - Final inspection.
- (c). This manual describes the first procedure “Diagnosis” (See Chapter 04 Diagnosis) and the second procedure “Testing & Adjustment, Dismantlement & Installation, Disassembly & Assembly”, but does not refer to the third procedure “Final Inspection”.

Hint:

Chapter 04 Diagnosis only describes the electrical part, and refer to the fault symptom table in each chapter for the mechanical part.

- (d). This manual does not describe the following important operations which are necessary in practical maintenance:
 - Jack the vehicle up with a jack or safety support bench;
 - Clean parts dismantled, if necessary;
 - Visual inspection.

2. Preparations

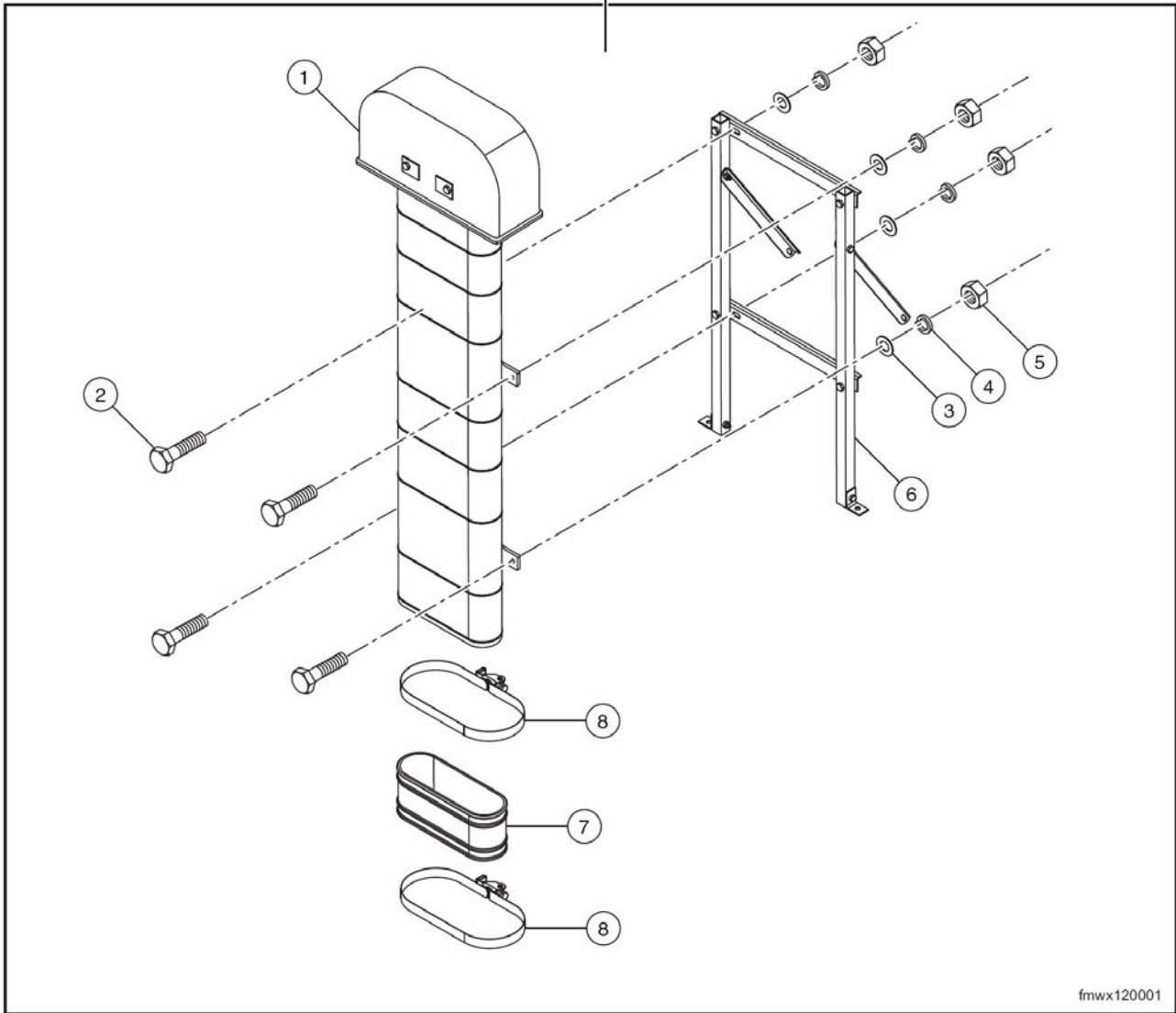
- (a). This manual lists special tools, recommended tools, equipment and auxiliary materials necessary for maintenance service in Chapter 02 “Preparations”. Please follow the operation procedures strictly to use them correctly.

3. Maintenance Procedures

- (a). Part drawings, which are inserted as required, provide a detailed description to the systems.
- (b). Part drawings are exploded drawings that clearly describe the assembly relationship of parts, the part names are also given in a list below each of those part drawings.

Example:

Assembly Relationship of Parts



fmwx120001

1	High-mounted Intake Pipe Assembly
2	Hex Head Bolt
3	Flat Washer
4	Spring Washer

5	Hex Nut, Style 1
6	High-mounted Intake Pipe Bracket Assembly
7	High-mounted Intake Pipe Bracket Assembly
8	Worm Drive Type Hose Hoop, Type A

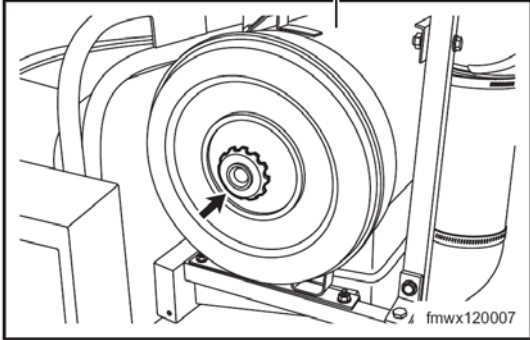
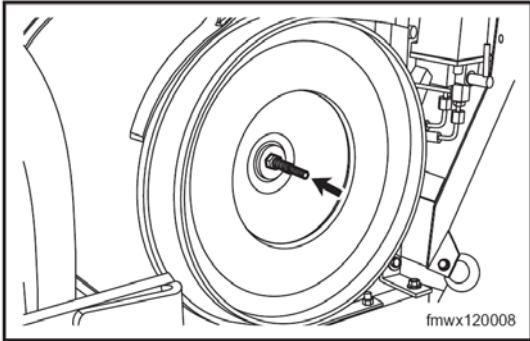
List of Part Names

Introduction – How to Use This Manual

- (a). Where the installation procedures are just opposite to the removal procedures, this manual only provides a description to key parts.
- (b). This manual employs illustrations for the key parts and operations in the procedures, provides a detailed description to them, and lists operation methods, standard values and precautions.
- (c). This manual has the illustrations the same with the similar models of engines. Under this condition, the information provided may be inconsistent with the practical condition.
- (d). The procedures are described in the following order:
- Operation steps give “What to Do” and “Where to Do”.
 - Operation step titles give “What to Do”.
 - Operation steps give how to “Finish the Task”, and provide the help information for operation such as “Hint” and “Caution”.

01

Example:

Illustration for Operaiton Step	Operation Step Title	Description for Operation Step
	3. Disassemble the air filter assembly	
	(a).	Dismantle the sealing round cover handle of the air filter assembly.
	(b).	Dismantle the fixing nuts of the main filter element.
		• Clean the main filter element with compressed air, and replace it if necessary.
	Caution:	
	Do not fall dust on the safety filter element. When using compressed air, wear appropriate goggles and protective masks. Or flying debris and dirt may cause personal injuries.	
	Maintenance Specification Information	Maintenance Warning Information

Introduction – How to Use This Manual**1. Maintenance Specification**

- (a). The maintenance specifications are listed in bold letters in this manual, and it is unnecessary for you to refer to them while stopping the work on hand. Chapter 03 “Maintenance Specification” in this manual also introduces relevant contents for your quick searching.

2. “Warning”, “Caution” and “Hint”

Warning	As represented in bold, it indicates possible injuries to persons.
Caution	As represented in bold, it indicates possible damages to parts and equipment.
Hint	It provides an additional description, which is helpful to improve the work efficiency of maintenance.

3. International System of Units (SI)

- (a). The “unit” in this manual is based on the international system of units (SI).

Example:

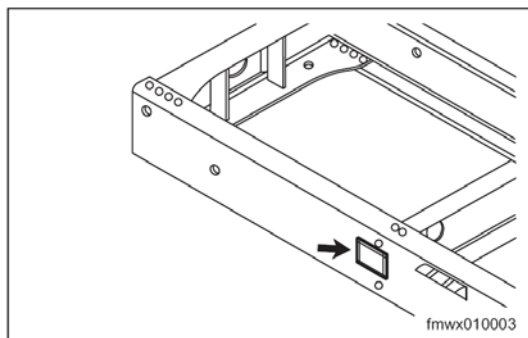
Torque: 180N•m

4. Application Models

1G27128000033	3251DLPJB-01ZA02	3251DLPJB-05Z0041A
1G25128000011	3251DLPJB-00ZA05	BJ3251DLPJB-02ZA01
1G25132000001	3251DLPJB-05ZA01	3251DLPJB-05Z0031B-00Z8/00000-00-H
1G24128000034	3253DLPJB-0RZA01	3251DLPJB-00ZA061D-M6ZCK0000-00-H
1G32130000032	3253DLPJB-S2ZA01	3251DLPJB-01Z005/BJ3251DLPJB-1
1G25128000136	3251DLPJB-00ZA07	

Vehicle Identification Mark

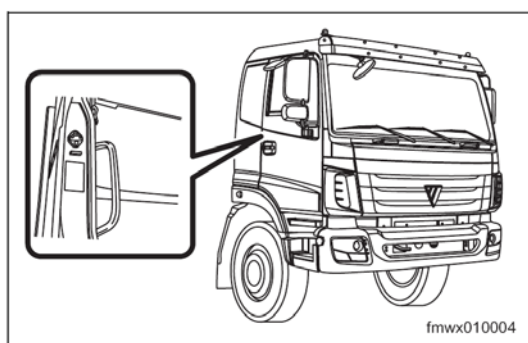
Vehicle Identification



1. Vehicle Identification Number (VIN)

- (a). The vehicle identification number is engraved outside the right longitudinal beam of the frame.

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2. VIN Nameplate

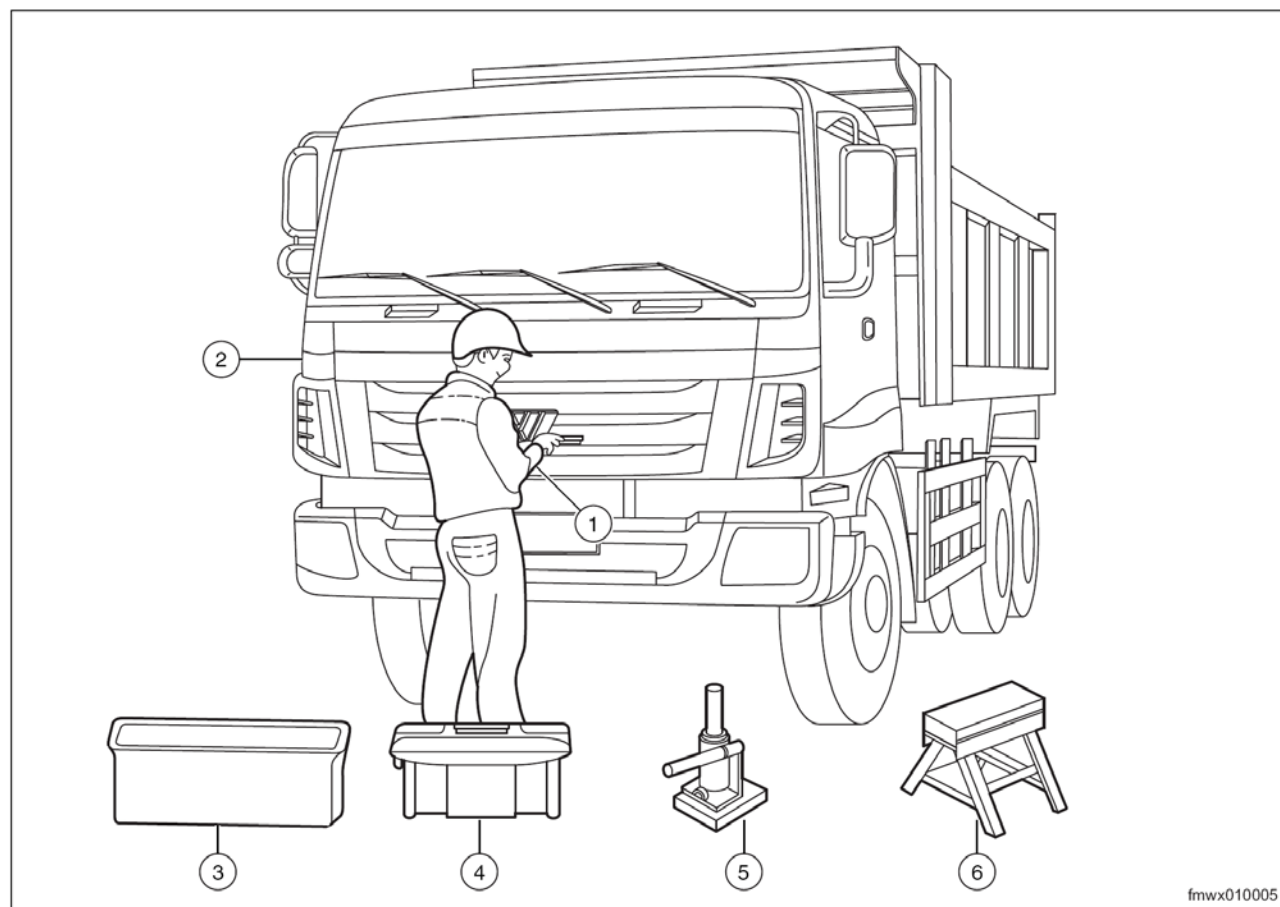
- (a). The VIN nameplate is arranged on the right door pillar of the cab.

Maintenance Guide

Preparation

1. Precautions for Operation

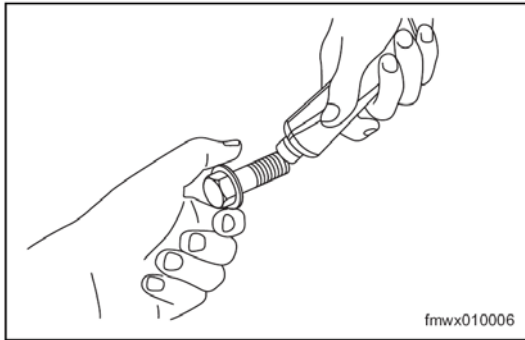
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fmwx010005

1	Clothing	Make sure to wear the uniform, safety shoes and safety helmet.
2	Vehicle Protection	Install steel bars, guard and seat cover before maintenance operation.
3	Parts Dismantled	- Put the parts dismantled in sequence in order so as to avoid disordering or staining those parts. - Replace the disposable parts such as washer, O-ring and lock nut according to the description in the manual.
4	Tool Box	Before operation, prepare the tool rack, special tools for maintenance, meters, vehicle oil, rag and parts for replacement.
5	Maintenance	- Take effective measures after analysis and diagnosis of the faults. - Inspect the whole machine condition, distortion and damage conditions before dismantling the parts. - Mark after dismantlement so as to avoid damaging the machine's performance. - If necessary, clean the parts dismantled, and inspect the parts before installation. - Remove the negative cable from the battery wiring terminal before starting the electrical works.
6	Safe Operation	- Make sure to paying attention to others' safety if there are two or more persons work together. - Inspect the ventilation condition of the workshop when conducting maintenance with the engine running. - Make sure to protect yourself from burning or injury when operating the high-temperature, rotating, moving or vibrating parts. - When jacking up the vehicle, set a safety seat near the supporting point. - When lifting the vehicle, use safety equipment.

Maintenance Hint

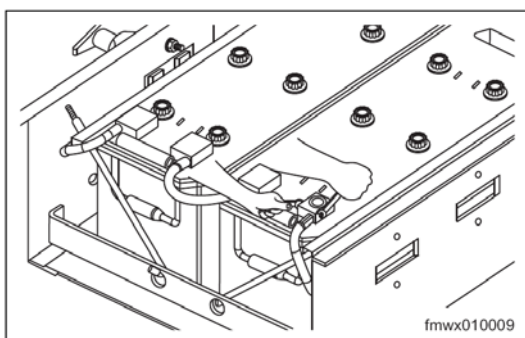
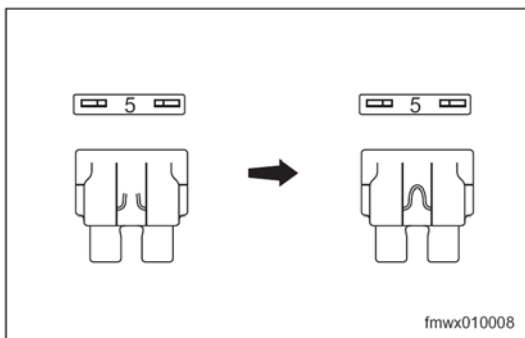
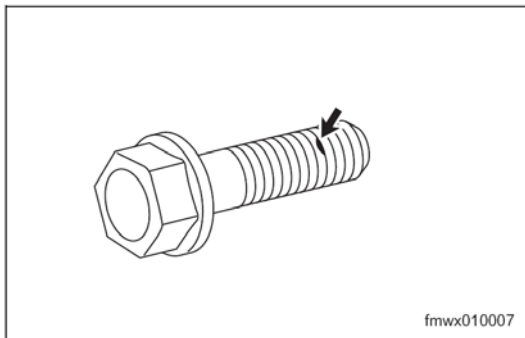


2. Pre-coated Parts

- (a). The pre-coated parts are studs, nuts and other parts that have been coated with sealant in the factory.
- (b). The pre-coated parts that are re-fastened, loosened or removed by any means shall be re-coated with the required sealant.
- (c). When using the pre-coated parts again, remove the original sealant and dry them by compressed air. Then coat bolts, nuts or threads with the required sealant.
- (d). Wait for a period of time until the sealant is solidified if the sealant is needed.

3. Washer

- (a). If necessary, add the sealing ring on the washer to avoid leakage.



4. Stud, Nut and Screw

- (a). Inspect carefully whether there are more than three threads of the stud, nut and screw are damaged before use. Replace the stud, nut and screw if there are more than three threads damaged.
- (b). Abide by all the relevant specification concerning the bolt tightening torque strictly. Make sure to use a torque wrench.

5. Fuse

- (a). When replacing the fuse, make sure that the rated current intensity of the new fuse is correct. Never use the fuse exceeding the rated value or lower than the rated value.

6. Battery

- (a). During inspection or repair, disconnect the cable from the negative (-) terminal which is grounded with the vehicle body if the battery needs to be disconnected.
- (b). In order to avoid damage to the battery wiring terminal, loosen the wiring terminal nut, and lift up the cable directly and then remove. Do not distort or prize.
- (c). Clean the battery wiring terminal with the workshop rag. Do not scrape with a file and other grinding tools.
- (d). Loosen the nut; install the cable terminal on the battery wiring terminal and tighten the nut. Do not strike the cable terminal on the wiring terminal with a hammer.

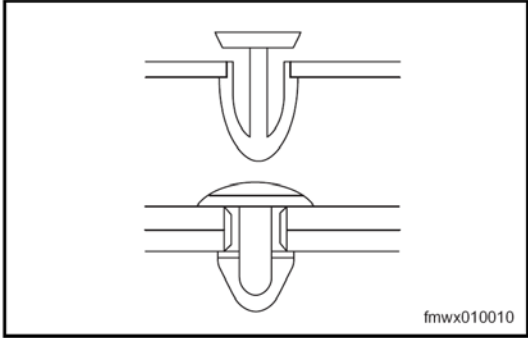
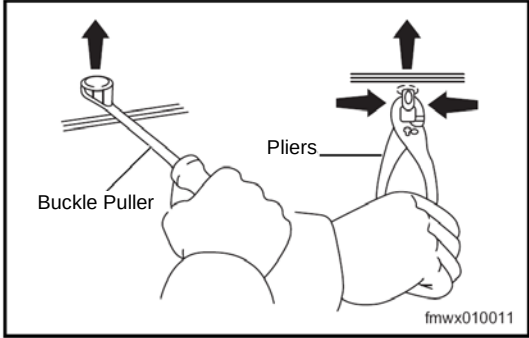
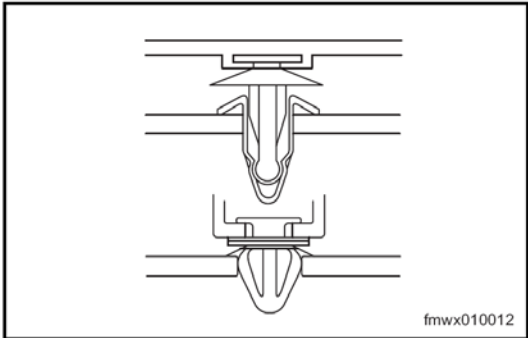
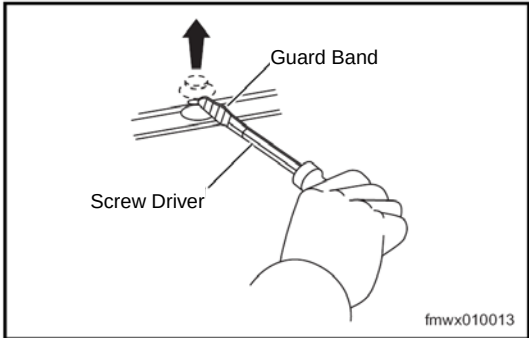
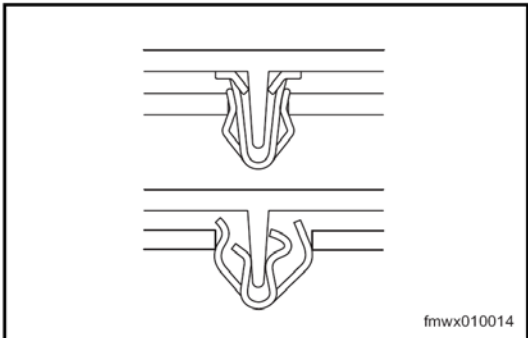
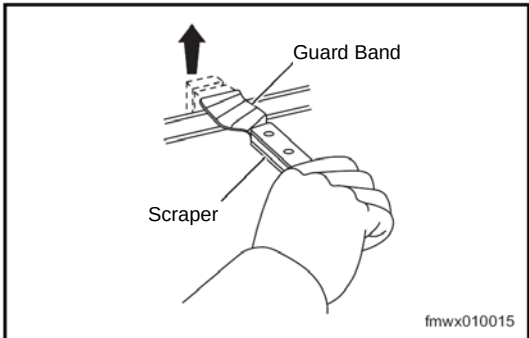
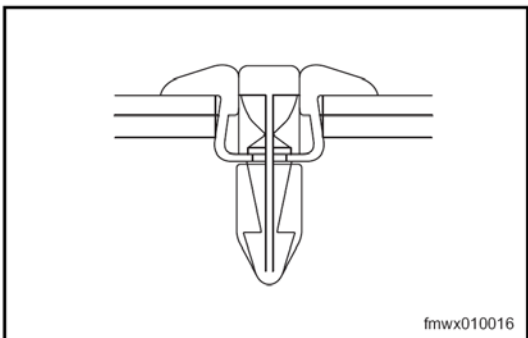
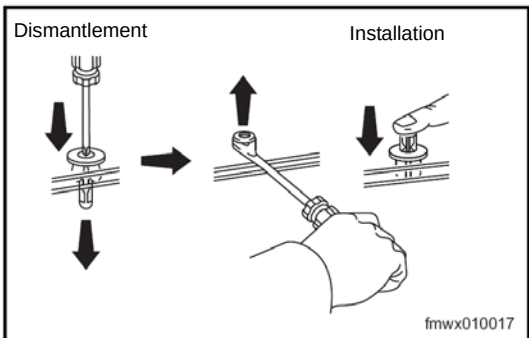
7. Buckle

(a). The operating method of the buckles used for vehicle maintenance is shown as follows:

Hint:

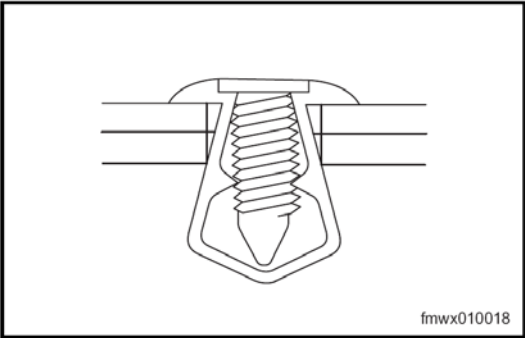
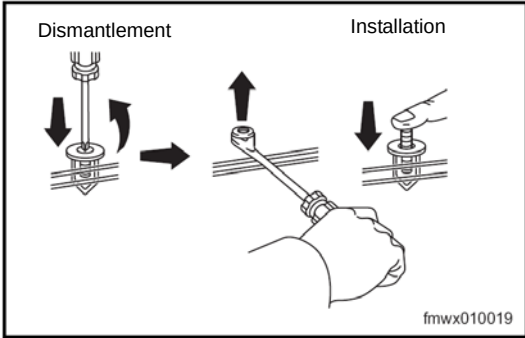
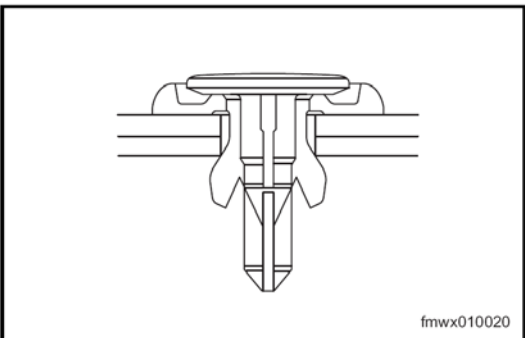
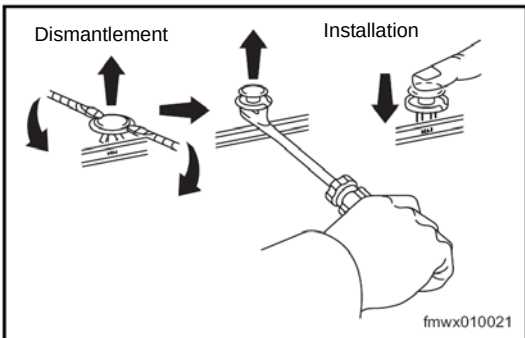
Replace it with a new one if a buckle is damaged during maintenance.

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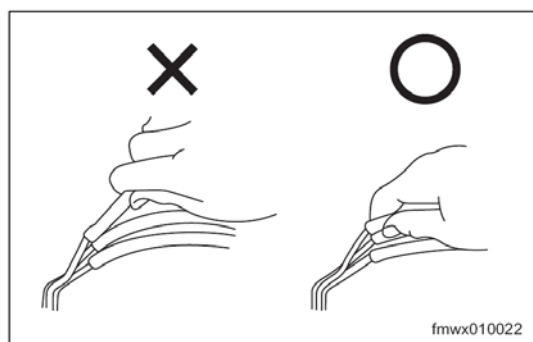
Shape (Example)	Dismantlement/Installation
	
	
	
	



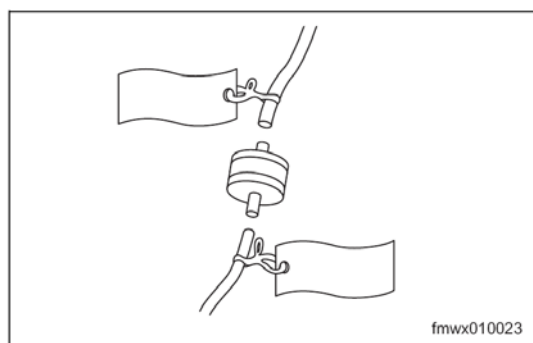
Introduction – Maintenance Guide

Shape (Example)	Dismantlement/Installation
 fmwx010018	 fmwx010019
 fmwx010020	 fmwx010021

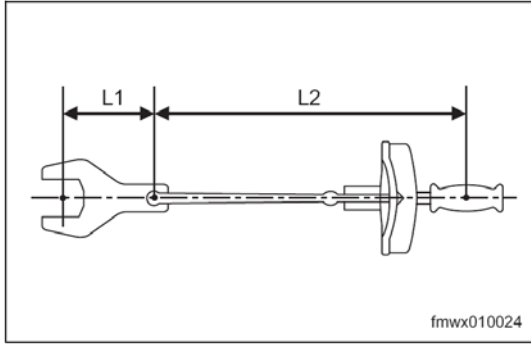
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**8. Dismantle and install the vacuum pipe**

- (a) When dismantling and installing the vacuum hose, make sure to hold the end of the hose, and never pull or drag the middle.



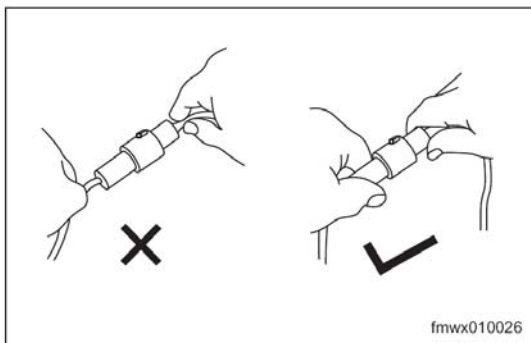
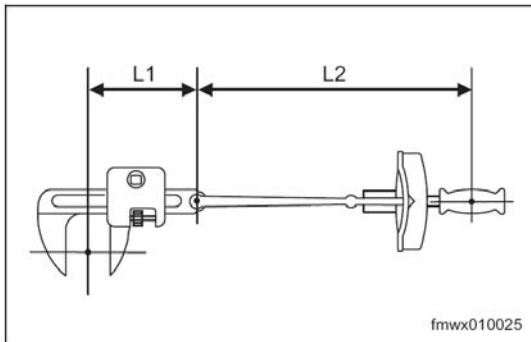
- (b). After disconnect the vacuum hose joint, mark with a label for identification in connection.
- (c). After a piece of work, inspect again to ensure that the vacuum hose is connected correctly.
- (d). When using a vacuum meter, do not connect the hose with the too large joint. Adjust the size of the joint step by step. The vacuum pipe may cause air leakage once stretched.



9. Use the torque wrench with lengthening tool

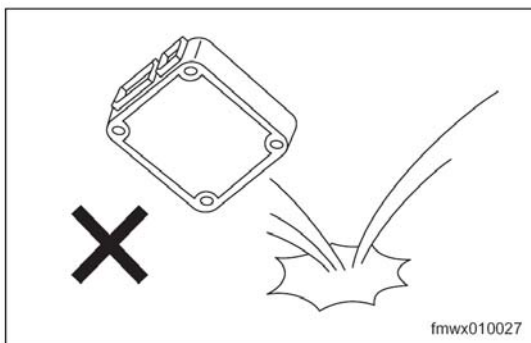
- When using a special maintenance tool or torque wrench with lengthening tool, it shows that the actual torque has overloaded if the displayed value of the wrench reaches the torque range.
- The manual marks out only the special torque value. When using the special maintenance tool or torque wrench with lengthening tool, calculate the torque value according to the following formula.
- Formula $T' = T \times L2 / (L1 + L2)$

T'	Torque wrench reading (N•m)
T	Actual torque (N•m)
L1	Length of special maintenance tool or lengthening handle (mm)
L2	Length of torque wrench (mm)



10. Dismantle and install electrical components

- When disconnecting the electrical connector by pulling, pull the connector instead of the wire.
- Be careful not to drop the electrical components such as sensor or relay. Replace the electrical components if they drop onto the solid ground.
- Never use the impact wrench to dismantle or install the temperature controlled switch or temperature sensor.
- When inspecting the continuity on the wire connector, insert the tester probe carefully to avoid bending the terminal.

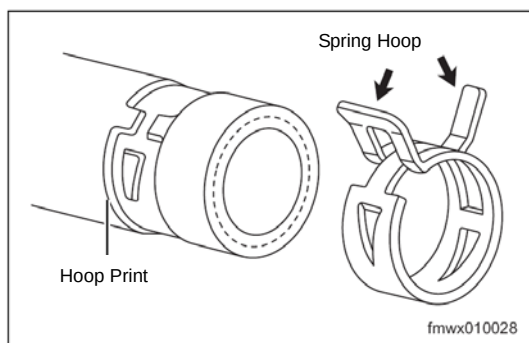


11. Dismantle and install the fuel control system parts

- Instructions of working site for dismantling and installing the fuel control system parts.
 - Make sure to choose a well-ventilated place, around where there is no equipment or objects possible to generate open fire, including welding machine, grinding machine, electric drill, motor and oven.
 - Never choose a filling station or a place near it, because the whole space may have

been filled with fuel vapor.

- (b). Dismantle and install the fuel control system parts.
- Make sure to prepare fire extinguishers before operation.
 - In order to prevent generating static electricity, make sure to ground the whole vehicle, fuel tank, etc., and be careful not to splash water to prevent the contact from sliding.
 - Never use any electrical equipment such as motor or working lamp to avoid sparks or high temperature.
 - Never use an iron hammer to prevent generating sparks.
 - Make sure to separate rags from fuel when disposing of them.



12. Operate the hose hoop

- (a). Before dismantling the hose, inspect the inserting depth of the joint and the position of the hoop so as to re-install accurately.
- (b). If the hoop deforms or has dents, replace it.
- (c). If the hose is usable, make sure to clamp the hoop on its original print left.
- (d). For the spring hoop, after installing it, apply force as shown by the arrows to adjust its clamping force.

13. Installation methods of key fasteners

- (a). Cylinder head nut: Tighten the cylinder head nuts the specified torque gradually several times according to the principle of the middle nuts first and then the side ones and diagonal crossing. Loosen them gradually according to the provisions when dismantling the cylinder. If the cylinder head nuts are tightened unevenly or out of balance, it will cause the cylinder head top to warp or deform. If the nuts are tightened excessively, the bolts will stretch and deform, and the engine body and threads will be damaged. If the nuts fail to be tightened, it will cause the cylinder to leak air, water or oil, and the hot gas in the cylinder will burn the cylinder gasket.
- (b). Flywheel nut: When installing, the flywheel nuts must be tightened, and lock with the thrust washer by folding edge. If the flywheel nuts fail to be tightened, it will generate knocking noise when the diesel engine is operating, and more seriously, damage the crankshaft cone, cut the keyway, twist off the crankshaft and cause serious accidents. In addition, note that the angle of the thrust washer can be folded once only.
- (c). Connecting rod bolt: The connecting rod bolts, which are made of high-quality steel, are capable of bearing very large impact, and can not be substituted by common bolts. Apply even torque when tightening them, tighten two connecting bolts alternately to the specified torque step by step several times, and finally lock with galvanized wires. If the connecting rod bolts are tightened excessively, the bolts will be stretched and deformed, and even broken, to cause break block accidents; if the bolts fail to be tightened, the bearing clearance increases, which will generate knocking noise and impact load, even cause bearing burning and shaft seizure and connecting rod fracture accidents.
- (d). Main bearing bolt: Ensure the installation accuracy and fastening of the main bearing. Tighten the main bearing bolts to the specified torque two or three times in an order to the middle bolts first and then the side ones. When tightening by one turn, inspect whether the crankshaft can rotate flexibly. The damages caused by too large or small tightening torque on the main bearing bolts are basically the same with those caused by too large or small

tightening torque on the connecting rod bolts.

- (e). Balance block bolt: When installing, tighten the balance block bolts in order to the specified torque gradually several times. The balance block shall be installed in its original position, or it will lose the balance function.
- (f). Rocker arm seat nut: For the rocker arm seat nuts, do frequent regular inspection along with maintenance in use. If the rocker arm seat nuts are loose, the valve clearance will increase, the valve will delay to open and close in advance, the lasting time for valve opening will shorten, which will cause insufficient air supply to the diesel engine, unclean exhaust gas, decreased power and increased fuel consumption.
- (g). Injector nozzle lock nut: When installing the fuel injector, tighten its lock nuts to the specified torque. Meanwhile, it is better to tighten the nuts repeatedly several times, do not tighten once. If the injector nozzle lock nuts are tightened too much, the lock nuts will deform, and the needle valve is easy to seize; if they fail to be tightened, the fuel injector will leak fuel, the injector pressure will fall, the spraying will be poor, and the fuel injection will increase.

Vehicle Jacking and Supporting Points

1. Pay attention to the vehicle's condition when jacking the vehicle up.

- (a). Principle: Make sure to jack up the vehicle in unloaded state, and never operate in loaded state.
- (b). After dismantling heavy parts such as engine and transmission, the gravity of the whole vehicle will offset. Make sure to place balance block to prevent the vehicle from turnover, or support with a jack at the specified jacking point.

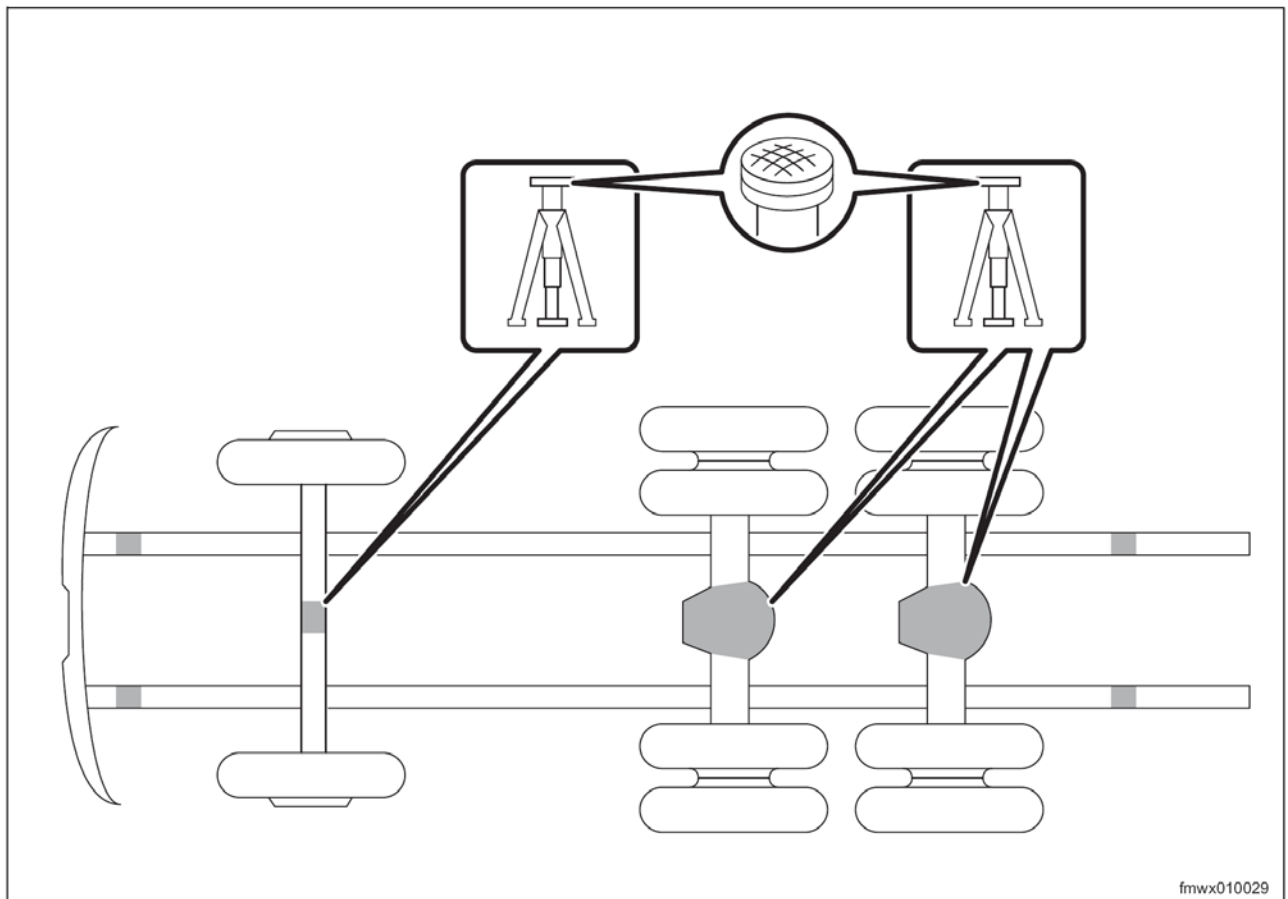
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2. Precaution for jack and safety support bench

- (a). Make sure to conduct safe operation according to the description of this manual.
- (b). Never try to lift the tires by a crow bar to prevent damaging the wheels and tires.
- (c). Stop the vehicle on a flat road, and pull the parking brake tightly.
- (d). Shift the gear shift lever to the reverse gear.
- (e). Make sure to chock the tire which is diagonally opposite to the point to be jacked.
- (f). Use a jack with rubber block to jack the vehicle up.

Warning:

- **Never jack up the whole vehicle to avoid damage to the vehicle, and evenly injury to persons.**
- **Make sure to jack up the vehicle at the specified jacking points.**

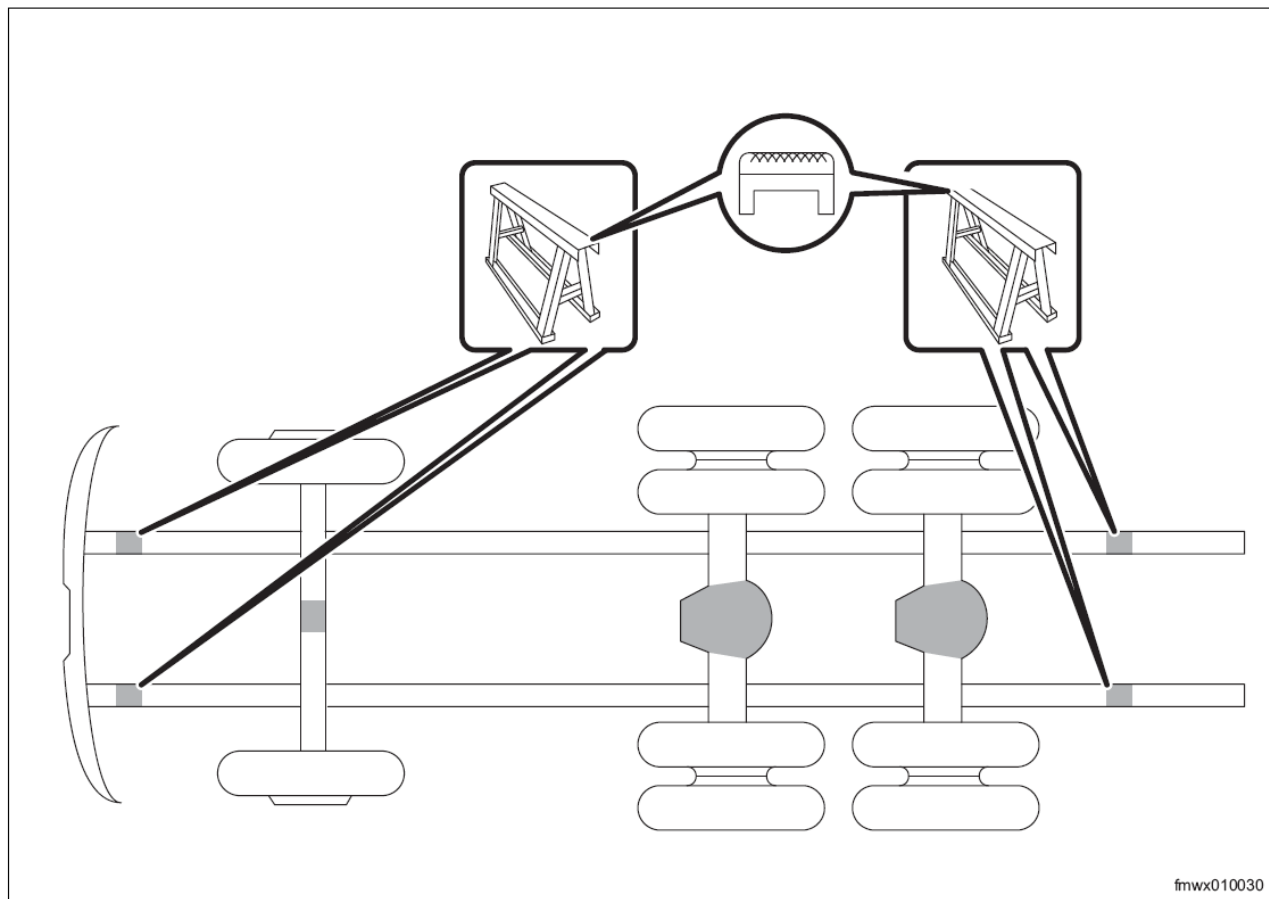


- (g). After jacking the vehicle up by the jack, support the vehicle by safety benches with rubber block if necessary.

Warning:

- Never jack up the whole vehicle to avoid damage to the vehicle, and evenly injury to persons.
- Make sure to jack up the vehicle at the specified jacking points.

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Preparations

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Preparations	02-57
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Preparations	02-58
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Preparations	02-68

Fuel(WP10)

Preparations

Special Tool



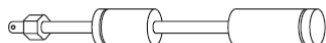
Fuel Filter Wrench

Oil-water Separator



Fuel Sensor Wrench

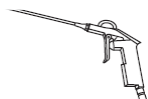
Fuel Sensor



Fuel Injector Puller

Fuel Injector

Recommended Tool



Air Duster Gun



Inner Hex Spanner

Equipment

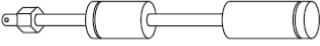
Torque Wrench

0-25 kgf.m

Accessory

Diesel Fuel

Preparations - Fuel (WP12)**Fuel(WP12)****Preparations****Special Tool**

	Fuel Filter Wrench	Oil-water Separator
	Fuel Sensor Wrench	Fuel Sensor
	Fuel Injector Puller	Fuel Injector

02

Recommended Tool

	Air Duster Gun	
	Inner Hex Spanner	

Equipment

Torque Wrench	0-25 kgf.m
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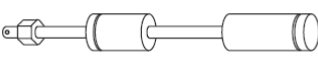
Accessory

Diesel Fuel	
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Fuel(WD615)

Preparations

Special Tool

	Fuel Filter Wrench	Oil-water Separator
	Fuel Sensor Wrench	Fuel Sensor
	Fuel Injector Puller	Fuel Injector

Recommended Tool

	Air Duster Gun	
	Inner Hex Spanner	

Equipment

Torque Wrench	0-25 kgf.m
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Accessory

Diesel Fuel	
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Preparations - Intake

Intake

Preparations

Recommended Tool

	Air Duster Gun	Air Filter
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Exhaust, Turbocharger(WP10)

Preparations

Recommended Tool

	Inner Hex Spanner	Turbocharger
---	-------------------	--------------

02

Equipment

Torque Wrench	
Torque Wrench	

Preparations - Exhaust, Turbocharger (WP12)

Exhaust, Turbocharger(WP12)

Preparations

Recommended Tool

	Inner Hex Spanner	Turbocharger
---	-------------------	--------------

02

Equipment

Torque Wrench	
Torque Wrench	

Exhaust, Turbocharger(WD615)

Preparations

Recommended Tool

	Inner Hex Spanner	Turbocharger
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02

Equipment

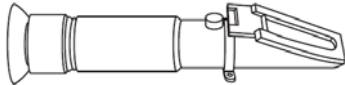
Torque Wrench	0-50 kgf.m
Torque Wrench	200—1000 kgf.m

Preparations - Cooling(WP10)

Cooling (WP10)

Preparations

Recommended Tool

	Ice Point Tester	Coolant
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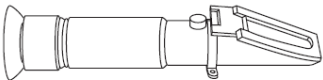
Equipment

Torque Wrench	0-50 kgf.m
Torque Wrench	200—1000 kgf.m

Cooling (WP12)

Preparations

Recommended Tool

	Ice Point Tester	Coolant
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02

Equipment

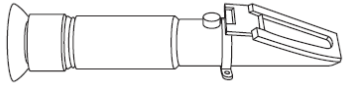
Torque Wrench	0-50 kgf.m
Torque Wrench	200—1000 kgf.m

Preparations - Cooling (WD615)

Cooling (WD615)

Preparations

Recommended Tool

	Ice Point Tester	Coolant
---	------------------	---------

02

Equipment

Torque Wrench	0-50 kgf.m
Torque Wrench	200—1000 kgf.m

Lubrication (WP10)

Preparations

Recommended Tool

	Inner Hex Spanner	Oil Cooler
	Oil Cooler Wrench	Oil Cooler

Equipment

Torque Wrench	0-50 kgf.m
---------------	------------

Preparations - Lubrication (WP12)

Lubrication(WP12)

Preparations

Recommended Tool

	Inner Hex Spanner	Oil Cooler
	Oil Cooler Wrench	Oil Cooler

02

Equipment

Torque Wrench	0-50 kgf.m
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Lubrication(WD615)

Preparations

Recommended Tool

	Inner Hex Spanner	Oil Cooler
	Oil Cooler Wrench	Oil Cooler

Equipment

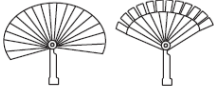
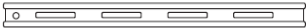
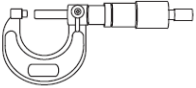
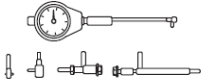
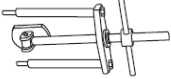
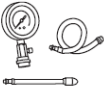
Torque Wrench	0-50 kgf.m
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Preparations - EngineMechanical(WP10)

Engine Mechanical (WP10)

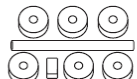
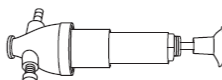
Preparations

Recommended Tool

	Engine Roll-over Stand	Engine Assembly
	Thickness Gauge	Valve Clearance, Piston Ring Gap, Cylinder Head
	Plane Meter	Cylinder Head
	Outside Micrometer	Crankshaft, Camshaft
	Inside Micrometer	Cylinder Liner, Crankshaft, Camshaft
	Magnetic Stand	Crankshaft
	Crankshaft Oil Seal Driver	Crankshaft Oil Seal
	Connecting Rod Bushing Reamer	Connecting Rod
	Liner Puller	Cylinder Head
	Cylinder Compressor Gauge	Cylinder
	Puller	Timing Gears

Preparations - EngineMechanical(WP10)

02

	Valve Dismantling Device	Valve
	Valve Guide Punch	Valve
	Valve Seat Reamer	Valve
	Valve Guide Reamer	Valve
	Valve Lapping Machine	Valve

Equipment

Torque Wrench	0-50 kgf.m
Torque Wrench	50 — 200 kgf.m

Accessory

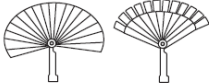
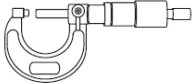
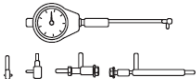
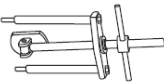
Oil	
Trichloroethylene Cleaner	
510 Glue	
Molybdenum Dioxide Powder	

Preparations - Engine Mechanical (WP12)

Engine Mechanical (WP12)

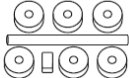
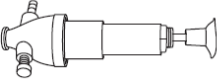
Preparation

Recommended Tool

	Engine Roll-over Stand	Engine Assembly
	Thickness Gauge	Valve Clearance, Piston Ring Gap, Cylinder Head
	Plane Meter	Cylinder Head
	Outside Micrometer	Crankshaft, Camshaft
	Inside Micrometer	Cylinder Liner, Crankshaft, Camshaft
	Magnetic Stand	Crankshaft
	Crankshaft Oil Seal Driver	Crankshaft Oil Seal
	Connecting Rod Bushing Reamer	Connecting Rod
	Liner Puller	Cylinder
	Cylinder Compressor Gauge	Cylinder
	Puller	Timing Gears

02-20

Preparations - Engine Mechanical (WP12)

	Valve Dismantling Device	Valve
	Valve Guide Punch	Valve
	Valve Seat Reamer	Valve
	Valve Guide Reamer	Valve
	Valve Lapping Machine	Valve
	Inside Hexagon Bolt Dismantling Device of Air Compressor	Air Compressor

Equipment

Torque Wrench	0-50 kgf.m
Torque Wrench	50 — 200 kgf.m

Accessory

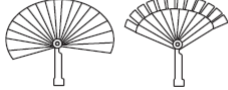
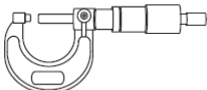
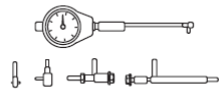
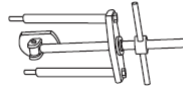
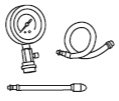
Oil	
Trichloroethylene Cleaner	
510 Glue	
Molybdenum Dioxide Powder	

Preparations - Engine Mechanical (WD615)

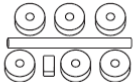
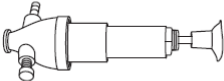
Engine Mechanical (WD615)

Preparations

Recommended Tool

	Engine Roll-over Stand	Engine Assembly
	Thickness Gauge	Valve Clearance, Piston Ring Gap, Cylinder Head
	Plane Meter	Cylinder Head
	Outside Micrometer	Crankshaft, Camshaft
	Inside Micrometer	Cylinder Liner, Crankshaft, Camshaft
	Magnetic Stand	Crankshaft
	Crankshaft Oil Seal Driver	Crankshaft Oil Seal
	Connecting Rod Bushing Reamer	Connecting Rod
	Liner Puller	Cylinder
	Cylinder Compressor Gauge	Cylinder
	Puller	Timing Gears

Preparations - Engine Mechanical (WD615)

	Valve Dismantling Device	Valve
	Valve Guide Punch	Valve
	Valve Seat Reamer	Valve
	Valve Guide Reamer	Valve
	Valve Lapping Machine	Valve

Equipment

Torque Wrench	0-50 kgf.m
Torque Wrench	50 — 200 kgf.m

Accessory

Oil	
Trichloroethylene Cleaner	
510 Plane Glue	
Molybdenum Dioxide Powder	

Preparations - Engine Control

Engine Control

Preparations

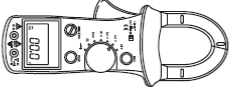
Equipment

Torque Wrench	0-25 kgf.m
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Starting, Preheating System (WP10)

Preparations

Recommended Tool

	Inductive Galvanometer	Starter
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02

Equipment

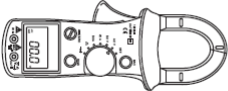
Torque Wrench	0-50 kgf.m
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Preparations - Starting, Preheating System (WP12)

Starting, Preheating System(WP12)

Preparations

Recommended Tool

	Inductive Galvanometer	Starter
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02

Equipment

Torque Wrench	0-50 kgf.m
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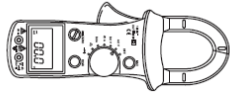
02-26

Preparations - Starting, Preheating System (WD615)

Starting, Preheating System (WD615)

Preparations

Recommended Tool

	Inductive Galvanometer	Starter
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02

02

Equipment

Torque Wrench	0-50 kgf.m
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Preparations - Charging System (WP10)

Charging System (WP10)

Preparations

Recommended Tool

	Universal Electric Tester	Generator
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02

Equipment

Torque Wrench	0-50 kgf.m
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02-28

Preparations - Charging System (WP12)

Charging System (WP12)

Preparations

Recommended Tool

	Universal Electric Tester	Generator
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Equipment

Torque Wrench	0-50 kgf.m
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Preparations - Charging System (WD615)

Charging System(WD615)

Preparations

Recommended Tool

	Universal Electric Tester	Generator
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02

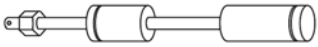
Equipment

Torque Wrench	0-50 kgf.m
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Front Suspension

Preparations

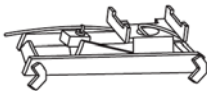
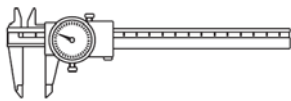
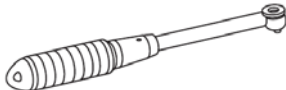
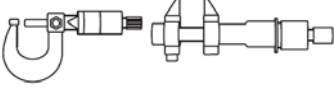
Special Tool

	Puller of Plate Spring Pin Shaft	Plate Spring
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02

02

Recommended Tool

	Hydraulic Jack	Vehicle
		Front Axle
	Tape Measure	Plate Spring
	Vernier Caliper	Plate Spring
	Torque Wrench(200 ~ 1000 N.m)	
	Torque Wrench(50 ~ 200 N.m)	
	Torque Wrench(0 ~ 50 N.m)	
	Micrometer	Plate Spring Pin Shaft

Accessory

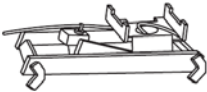
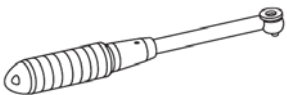
Grease Lubricant	NO.2 Lithium Base Grease
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Preparations - Rear Suspension

Rear Suspension

Preparations

Recommended Tool

	Hydraulic Jack	Lift Vehicle
	Tape Measure	Bumper Block Clearance
	Torque Wrench(200 ~1000N.m)	
	Torque Wrench(50 ~200 N.m)	

02

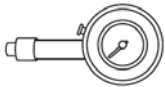
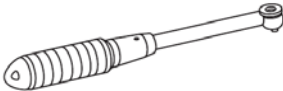
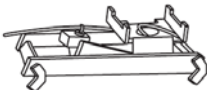
Accessory

Grease Lubricant	Gear Oil SAE85W/90
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Wheel and Tire

Preparations

Recommended Tool

	Barometer	Tire
	Torque Wrench(200 ~1000N.m)	Tire
	Hydraulic Jack	Lift Vehicle

02

02

Equipment

Aerator	
Dynamic Balancing Machine	
Tire Press	
Air Impact Wrench	

Preparations - Front Axle (Ankai)

Front Axle (Ankai)

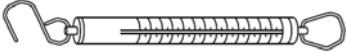
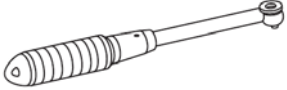
Preparations

Special Tool

	Puller	Bulb
	Bearing Puller	Wheel Bearing

02

Recommended Tool

	Hex Wrench Set	Hub Bolt
	Copper Bar	Front Hub Bearing
	Spring Balance	Bearing Pre-tighten Moment
	Torque Wrench	Bolt
	Tape Measure	Toe-in

Accessory

Grease Lubricant	NO.3 Lithium Base Grease in Summer
Grease Lubricant	NO.2 Lithium Base Grease in Winter
Flat Sealant	598
Thread Fastening Glue	262

Front Axle (Triring)

Preparations

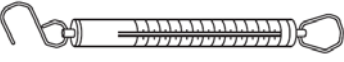
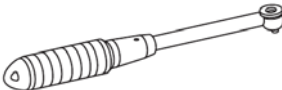
Special Tool

	Hub Puller	Hub
	Knuckle King Pin Puller	Knuckle

02

02

Recommended Tool

	Hex Wrench Set	Hub Bolt
	Copper Bar	Front Hub Bearing
	Spring Balance	Bearing Pre-tighten Moment
	Torque Wrench	Bolt
	Tape Measure	Toe-in

Accessory

Grease Lubricant	NO.3 Lithium Base Grease in Summer
Grease Lubricant	NO.2 Lithium Base Grease in Winter
Flat Sealant	598

Preparations - Rear Axle

Rear Axle

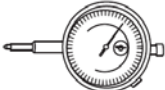
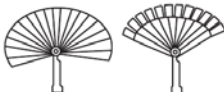
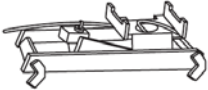
Preparations

Special Tool

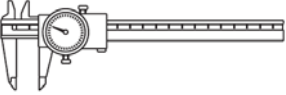
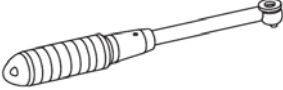
	Bolt Sleeve	Wheel Edges Slotting Nut
	Bearing Puller	Bearing

02

Recommended Tool

	Hex Wrench Set	Flanged Nut
	Dial Gauge with Magnetic Stand	Axle Shaft
		Rear Hub
		Driving Gear
		Driven Gear
		Planetary Gear
		Axle Shaft Gear
	Spring Balance	Bearing Pre-tighten Moment
	Hot Forming Tools	Bearing Inner Race
	Thickness Gauge	
	Hydraulic Jack	Main Reducer Assembly
		Rear Axle Assembly
	Tape Measure	Axle Shaft Gear

Preparations - Rear Axle

	Vernier Caliper	Rear Axle Housing
		Adjusting Washer of Driving Gear Bearing Seat
		Adjusting Washer of Driving Gear Bearing Seat
		Thrust Washer of Planetary Gear
	Copper Bar	Axle Shaft
		Rear Wheel Hub
		Rear Wheel Hub Bearing
		Differential Assembly
	Circlip Pliers	Wheel
	Grease Gun	Rear Hub
	Torque Wrench (200 ~ 1000N.m)	Rear Axle
	Torque Wrench(50 ~ 200 N.m)	

Equipment

V-Stage	
Bench Vice	
Bench press	

Accessory

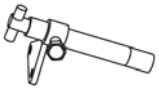
Grease Lubricant	
Gear OilSAE85W/90	
598 Plane Sealant	
262 Thread Lock Glue	
Red Lead Powder	

Preparations - Service Brake

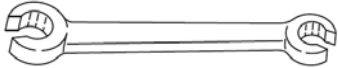
Service Brake

Preparations

Special Tool

	Brake Shoe Grinding Machine	Brake Shoe
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Recommended Tool

	Oil Pipe Wrench	Oil Pipe
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Equipment

Torque Wrench	0-25 kgf.m
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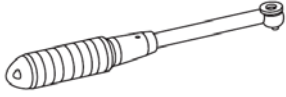
Accessory

Grease Lubricant	Lithium Base Grease
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Parking Brake

Preparations

Recommended Tool

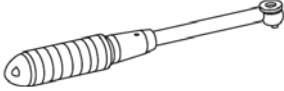
	Oil Pipe Wrench	Oil Pipe
	Torque Wrench	Bolt

Preparations - Frame

Frame

Preparations

Recommended Tool

	Oil Pipe Wrench	Oil Pipe
	Torque Wrench	Bolt

02

Accessory

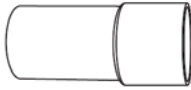
Low Temperature Anti-wear Hydraulic Oil	L-HV32 GB11118.1
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Intermediate Axle (Steyr)

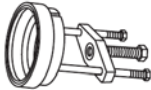
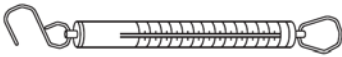
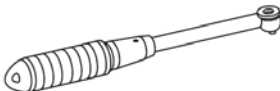
Preparations

Special Tool

02

	Installing Tube Processor of Rear Axle Bearing	Inner Bearing of Rear Axle
	Axle End Nut Wrench	Hub

Recommended Tool

	In-out Flange Nut Socket	In-out Flange Nut
	Inner Bearing of Rear Hub Extractor	Inner Bearing of Rear Hub
	Extractor of Differential Bearing and Drive Gear Bearing	Differential Bearing and Drive Gear Bearing
	Copper Bar	
	Spring Balance	
	Torque Wrench	

Equipment

Torque Wrench	50-200 N.m
Torque Wrench	200-1000 N.m

Accessory

Plane Sealant	598 Plane Sealant
Thread Lock Glue	262 Thread Lock Glue
Gear Oil	AP1GL-5 Grade,SAE85W/90 Viscosity

Preparations - Intermediate Axle (Steyr)

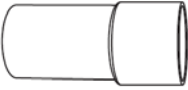
Grease Lubricant	NO.3 Lithium Base Grease in Summer
Grease Lubricant	NO.2 Lithium Base Grease in Winter

Intermediate Axle (Benz)

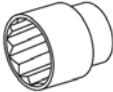
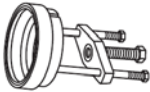
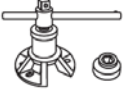
Preparations

Special Tool

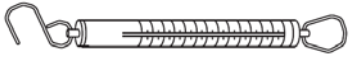
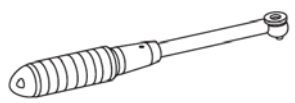
02

	Installing Tube Processor of Rear Axle Bearing	Inner Bearing of Rear Axle
	Axle End Nut Wrench	Hub

Recommended Tool

	In-out Flange Nut Socket	In-out Flange Nut
	Replacement Tool of Sealing Ring	Intermediate Axle
	Inner Bearing of Rear Hub Extractor	Inner Bearing of Rear Hub
	Extractor of Differential Bearing and Drive Gear Bearing	Differential Bearing and Drive Gear Bearing
	Hook Wrench	Through Shaft Adjusting Nut
	Effortless Wrench	Flange Locknut
	Inner Locknut Wrench of Inter-axial Differential	Inner Locknut of Inter-axial Differential
	Copper Bar	

Preparations - Intermediate Axle (Benz)

	Spring Balance	
	Torque Wrench	

02

Equipment

Torque Wrench	50-200 N.m
Torque Wrench	200-1000 N.m

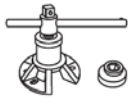
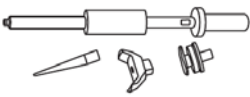
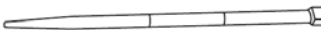
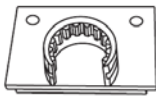
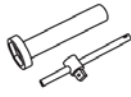
Accessory

Plane Sealant	598 Plane Sealant
Thread Lock Glue	262 Thread Lock Glue
Gear Oil	AP1GL-5 Grade, SAE85W/90 Viscosity
Grease Lubricant	NO.3 Lithium Base Grease in Summer
Grease Lubricant	NO.2 Lithium Base Grease in Winter

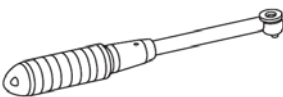
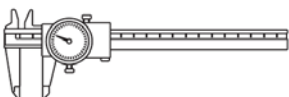
Transmission(RT-11509C)

Preparations

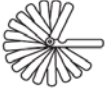
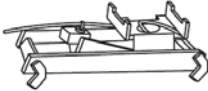
Special Tool

	Effortless Wrench	Nut with Collar
	Sling Tool	Vice Box
	Combined Type Axle Puller	Reverse Gear Shaft
		Countershaft Bearing
	Flange Nut Special Tool	Flange Nut
	Rear Bearing Extractor	Countershaft Rear Bearing
	Main Shaft Fixing Seat	Main Shaft Installation
	Primary Shaft Nut Extractor	Primary Shaft Nut
	Countershaft Front Bearing Extractor	Countershaft Front Bearing

Recommended Tool

	Torque Wrench	
	Vernier Caliper	Reverse Gear Shaft

Preparations - Transmission (RT-11509C)

	Snap Ring Pliers	Main Shaft Brake Hoop
		Primary Shaft Brake Hoop
		Countershaft Brake Hoop
	Clearance Gauge	Gear Clearance
	Hydraulic Car	Transmission

02

Equipment

Roll-over Stand of Transmission Dismounting	
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Accessory

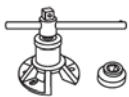
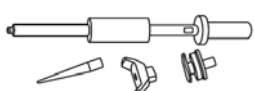
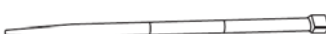
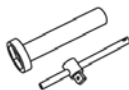
Grease Lubricant	
Gear Oil SAE 85W/90	13L
598 Plane Sealant	
262 Thread Lock Glue	

Transmission(9JS135)

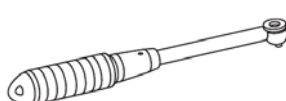
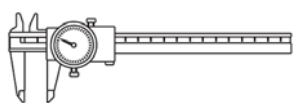
Preparations

Special Tool

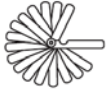
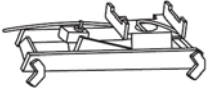
02

	Effortless Wrench	Nut with Collar
	Sling Tool	Vice Box
	Combined Type Axle Puller	Reverse Gear Shaft
		Countershaft Bearing
	Flange Nut Special Tool	Flange Nut
	Rear Bearing Extractor	Countershaft Rear Bearing
	Main Shaft Fixing Seat	Main Shaft Installation
	Primary Shaft Nut Extractor	Primary Shaft Nut
	Countershaft Front Bearing Extractor	Countershaft Front Bearing

Recommended Tool

	Torque Wrench	
	Vernier Caliper	Reverse Gear Shaft

Preparations - Transmission (9JS135)

	Snap Ring Pliers	Main Shaft Brake Hoop
		Primary Shaft Brake Hoop
		Countershaft Brake Hoop
	Clearance Gauge	Gear Clearance
	Hydraulic Car	Transmission

02

Equipment

Roll-over Stand of Transmission Dismounting	
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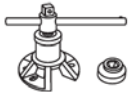
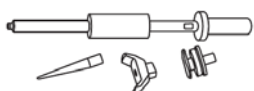
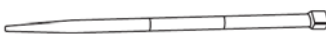
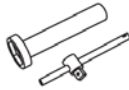
Accessory

Grease Lubricant	
Gear Oil SAE85W/90	13L
598 Plane Sealant	
262 Thread Lock Glue	

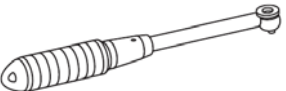
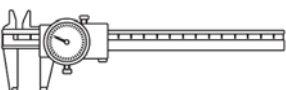
Transmission(12JSD160)

Preparations

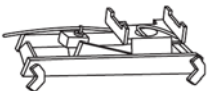
Special Tool

	Effortless Wrench	Nut with Collar
	Sling Tool	Vice Box
	Combined Type Axle Puller	Reverse Gear Shaft
		Countershaft Bearing
	Flange Nut Special Tool	Flange Nut
	Rear Bearing Extractor	Countershaft Rear Bearing
	Main Shaft Fixing Seat	Main Shaft Installation
	Primary Shaft Nut Extractor	Primary Shaft Nut
	Countershaft Front Bearing Extractor	Countershaft Front Bearing

Recommended Tool

	Torque Wrench	
	Vernier Caliper	Reverse Gear Shaft

Preparations - Transmission (12JSD160)

	Snap Ring Pliers	Main Shaft Brake Hoop
		Primary Shaft Brake Hoop
		Countershaft Brake Hoop
	Clearance Gauge	Gear Clearance
	Hydraulic Car	Transmission

02

Equipment

Roll-over Stand of Transmission Dismounting	
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Accessory

Grease Lubricant	
Gear Oil SAE85W/90	17L
598 Plane Sealant	
262 Thread Lock Glue	

Clutch

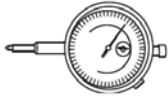
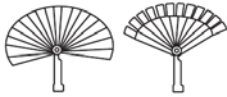
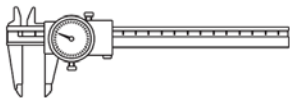
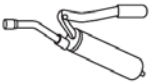
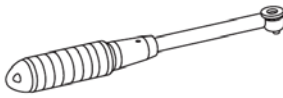
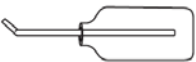
Preparations

Special Tool

	Clutch Aligning Bar	Clutch Driven Disc
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02

Recommended Tool

	Dial Gauge with Magnetic Stand	Driven Disc
	Thickness Gauge	Driven Disc
		Pressure Disc
	Tape Measure	Clutch Pedal
	Vernier Caliper	Driven Disc
		Pressure Disc
	Grease Gun	Clutch Fork Spring Bearing
	Torque Wrench(200 ~1000N.m)	
	Torque Wrench(50 ~200 N.m)	
	Grease Cup	Clutch Evacuation

Equipment

V-stage	
Bench Vice	

Accessory

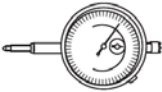
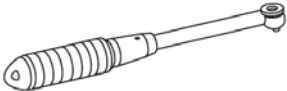
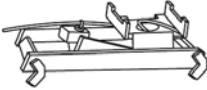
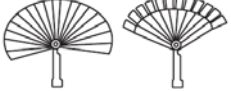
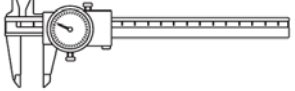
NO.2 Lithium Base Grease	
PTFE Tape	
V - 3 Clutch Oil	

Preparations - Drive Shaft

Drive Shaft

Preparations

Recommended Tool

	Dial Indicator	Drive Shaft
		Cross Shaft
	Torque Wrench (200 ~1000N.m)	Drive Shaft Service Bolt
	Hydraulic Jack	Drive Shaft
	Thickness Gauge	Drive Shaft
	Vernier Caliper	Cross Shaft
	Snap Ring Pliers	Cross Shaft

02

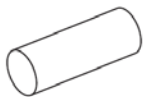
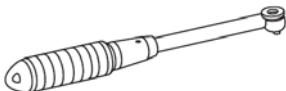
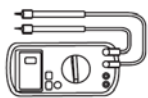
Equipment

V-stage	
Bench Vice	

Power Take-off

Preparations

Recommended Tool

	Copper Bar	Axle Shaft
		Rear Wheel Hub
		Rear Wheel Hub Bearing
		Differential Assembly
	Torque Wrench(200 ~1000N.m)	Power Take-off Bolt
	Torque Wrench(50 ~200 N.m)	
	Bearing Puller	Output Shaft Bearing
	Bearing Installing Tool	Output Shaft Bearing
	Digital Multimeter	Power Take-off Solenoid Valve

Equipment

Bench press	
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Accessory

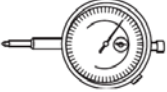
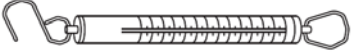
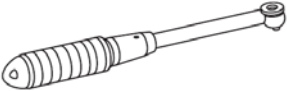
NO.2 Lithium Base Grease	
Gear Oil SAE85W/90	
598 Plane Sealant	
242 Thread Lock Glue	
Raw Material Glue	

Preparations - Steering Wheel and Steering Column

Steering Wheel and Steering Column

Preparations

Recommended Tool

	Dial Gauge with Magnetic Stand	Steering Column Drive Shaft
	Spring Balance	Steering Wheel Steering Force
	Puller	Steering Wheel
	Torque Wrench(200 ~1000N.m)	
	Torque Wrench(50 ~200 N.m)	

02

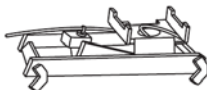
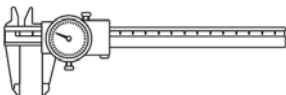
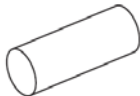
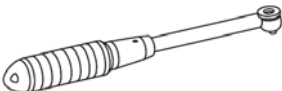
Equipment

V-stage	
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Power Steering Mechanism

Preparations

Recommended Tool

	Oil Pressure Gauge	Steering Oil Pump
		Steering Gear
	Puller	Steering Drag Link
	Spring Balance	Steering Wheel Steering Force
	Hydraulic Jack	Lifting Vehicle
	Vernier Caliper	Drag Link Taper-type Axle
	Copper Bar	Steering Plumbing Arm
	Torque Wrench(200 ~1000N.m)	
	Torque Wrench(50 ~200 N.m)	

Accessory

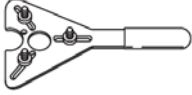
Steering Fluid	
Hydraulic Circuit Sealant	
Red Lead Powder	

Preparations - Heater and A/C

Heater and A/C

Preparations

Special Tool

	R-134a Refrigerant Recovery/ Recycle / Fill System	Refrigerant
	Driver Plate Support	Electromagnetic Clutch

02

Equipment

Torque Wrench	
Torque Wrench	

Accessory

Refrigeration Oil	PAG
Refrigerant	R-134a

02-56

Preparations - Seat Belt

Seat Belt

Preparations

Equipment

Torque Wrench	
Torque Wrench	

Preparations - Battery

Battery

Preparations

Special Tool

	Charger	Battery
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02

Recommended Tool

	Areometer	Electrolyte
	Discharge Tongs	Battery

Equipment

Torque Wrench	
Torque Wrench	

Accessory

Distilled Water	
Concentrated Sulfuric Acid	

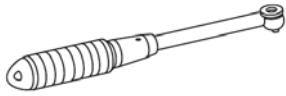
02-58

Preparations - Lighting

Lighting

Preparations

Recommended Tool



Torque Wrench

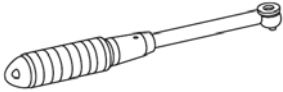
Bolt

Preparations - Windshield Wiper and Washer

Windshield Wiper and Washer

Preparations

Recommended Tool

	Torque Wrench	Bolt
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Audio System

Preparations

Recommended Tool

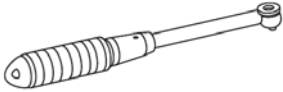
	Trim Panel Remover	Trim Panel
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Preparations - Horn

Horn

Preparations

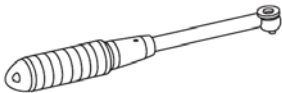
Recommended Tool

	Torque Wrench	Bolt
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Glass, Window Lifter, Rear-view Mirror

Preparations

Recommended Tool

	Glass Sucker	Glass
	Inside Hex. Wrench	Inside Hex. Bolt
	Torque Wrench	Bolt

Accessory

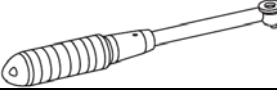
Sealant	CEMEDINE POS Sealant
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Preparations - Cigarette Lighter on Dash

Cigarette Lighter on Dash

Preparations

Recommended Tool

	Trim Panel Remover	Trim Panel
	Torque Wrench	Bolt

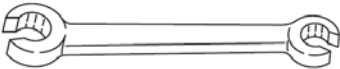
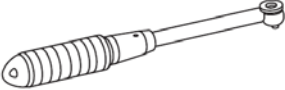
02

Accessory

Buckle	
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Seat Preparations

Recommended Tool

	Fuel Pipe Wrench	Fuel Pipe
	Torque Wrench	Bolt

Accessory

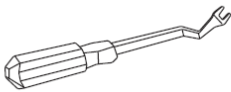
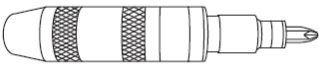
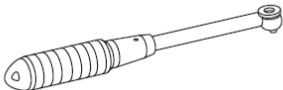
Grease Lubricant	Lithium Base Grease
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Preparations – Door, Lock, Door Handle

Door, Lock, Door Handle

Preparations

Recommended Tool

	Buckle Tool	Buckle
	Shock Driver	Sunk Screw
	Torque Wrench	Bolt

02

Accessory

Buckle	
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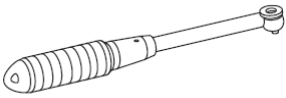
02-66

Preparations - Interior & Exterior Trim Parts

Interior & Exterior Trim Parts

Preparations

Recommended Tool

	Torque Wrench	Bolt
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Accessory

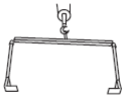
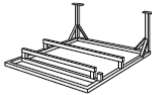
Buckle	
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Preparations - Cab

Cab

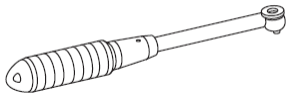
Preparations

Special Tool

	Cab Traveling Crane	Lifting Cab
	Cab Fixing Bracket	Placing Cab

02

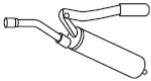
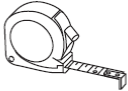
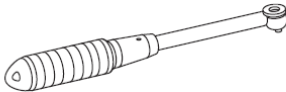
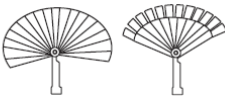
Recommended Tool

	Torque Wrench	Bolt
	Hex Wrench Set	Bolt

Hydraulic Dump System

Preparations

Recommended Tool

	Grease Gun	Rotating Shaft
	Tape Measure	
	Sleeper (100mmx100mmx1000mm)	
	Torque Wrench(200 ~ 1000 N.m)	
	Torque Wrench(50 ~ 200 N.m)	
	Thickness Gauge	Triangle Arm
	Gallus 2m*1T	
	Gallus 2mx2t	
	Gallus1mx1t	
	Needle Nose Plier	Cotter Pin

Equipment

Crane	10t
V-stage	
Soldering Machine	
Abrasive Wheel Cutting Machine	
Angle Grinder	
container special crane	

Accessory

Grease Lubricant	NO.2 Lithium Base Grease
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Preparations - Hydraulic Dump System

Pipe Orifice Sealant	1577 Sealant
Thread Lock Glue	1262 Thread Lock Glue

Maintenance Specification

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Maintenance Specification – Fuel (WP10)

Fuel (WP10)

Maintenance Data

Common rail pressure	160Mpa
Metering valve resistance	c2.6~3.4Ω (1500r/min)
Fuel injector opening pressure	29~30 Mpa

03

Torque Requirements

Fastener	N.m
Fuel tank pulling belt fixing nut (M10)	45±5
Fuel tank pulling belt fixing nut (M12)	81±8
Fuel tank pulling belt fixing nut (M16)	202±20
Fuel tank inlet/outlet fuel pipe	46±6
Oil-water separator seat fixing bolt (M10)	45±5
Oil-water separator seat fixing bolt (M12)	81±8
Inlet and outlet fuel pipes link bolt	46±6

Fuel (WP12)

Maintenance Data

Common rail pressure	160Mpa
Metering valve resistance	2.6~3.4Ω(1500r/min)
Fuel injector opening pressure	29~30 Mpa

03 Torque Requirements

Fastener	N.m
Fuel tank pulling belt fixing nut (M10)	45±5
Fuel tank pulling belt fixing nut (M12)	81±8
Fuel tank pulling belt fixing nut (M16)	202±20
Fuel tank inlet/outlet fuel pipe	46±6
Oil-water separator seat fixing bolt(M10)	45±5
Oil-water separator seat fixing bolt(M12)	81±8
Inlet and outlet fuel pipes link bolt	46±6

Fuel (WD615)

Torque Requirements

Fastener	N.m
Fuel tank pulling belt fixing nut (M10)	45±5
Fuel tank pulling belt fixing nut (M12)	81±8
Fuel tank pulling belt fixing nut (M16)	202±20
Fuel tank inlet/outlet fuel pipe	46±6
Oil-water separator seat fixing bolt(M10)	45±5
Oil-water separator seat fixing bolt(M12)	81±8
Inlet and outlet fuel pipes link bolt	46±6

03

Air Intake

Torque Requirements

Fastener	N.m
Upper intake pipe assembly fixing bolt	23±2
Safety filter element fixing nut	45±5
Main filter element fixing nut	45±5

Air Exhaust, Turbo-charging (WP10)

Torque Requirements

Fastener	N.m
Exhaust pipe bolt	60±10
Heat insulation cover fixing bolt	25±5
Bolt of exhaust pipe fixing bracket	45±5
Muffler bracket fixing nut	80±10
Turbine fixing bolt	45±5

Air Exhaust, Turbo-charging (WP12)

Torque Requirements

Fastener	N.m
Exhaust pipe bolt	60±10
Heat insulation cover fixing bolt	25±5
Bolt of exhaust pipe fixing bracket	45±5
Muffler bracket fixing nut	80±10
Turbine fixing bolt	45±5

Air Exhaust, Turbo-charging (WD165)

Torque Requirements

Fastener	N.m
Exhaust pipe bolt	60±10
Heat insulation cover fixing bolt	25±5
Bolt of exhaust pipe fixing bracket	45±5
Muffler bracket fixing nut	80±10
Turbine fixing bolt	45±5

03

Cooling (WP10)

Maintenance Data

Item		Item
Cooling method		Water-cooled forced circulation
Type of radiator		Corrugated radiator
Water pump	Type	Centrifugal
	Rated speed	3648 r/min
Thermostat	Type	Wax-type, core-combination
	Opening temperature	80±2 °C
	Full opening temperature	95 °C
Fan	Type	O-shaped fan
Intercooler	Type	Corrugated with flat pipe, air-cooled

Torque Requirements

Fastener	N.m
Auxiliary water tank fixing bolt	23±2
Radiator slotted nut	70
Wind-collecting cover fixing bolt	20
Intercooler fixing bracket	23±2
Intercooler fixing bolt	23±2
Cooling fan fixing bolt	20

Maintenance Specification – Cooling (WP12)

Cooling (WP12)

Maintenance Data

Item		Item
Cooling method		Water-cooled forced circulation
Type of radiator		Corrugated radiator
Water pump	Type	Centrifugal
	Rated speed	3648 r/min
Thermostat	Type	Wax-type, core-combination
	Opening temperature	80±2 °C
	Full opening temperature	95 °C
Fan	Type	O-shaped fan
Intercooler	Type	Corrugated with flat pipe, air-cooled

03

Torque Requirements

Fastener	N.m
Auxiliary water tank fixing bolt	23±2
Radiator slotted nut	70
Wind-collecting cover fixing bolt	20
Intercooler fixing bracket	23±2
Intercooler fixing bolt	23±2
Cooling fan fixing bolt	20

Cooling (WD615)

Maintenance Data

Item		Item
Cooling method		Water-cooled forced circulation
Type of radiator		Corrugated radiator
Water pump	Type	Centrifugal
	Rated speed	3648 r/min
Thermostat	Type	Wax-type, core-combination
	Opening temperature	80±2 °C
	Full opening temperature	95 °C
Fan	Type	O-shaped fan
Intercooler	Type	Corrugated with flat pipe, air-cooled

Torque Requirements

Fastener	N.m
Auxiliary water tank fixing bolt	23±2
Radiator slotted nut	70
Wind-collecting cover fixing bolt	20
Intercooler fixing bracket	23±2
Intercooler fixing bolt	23±2
Cooling fan fixing bolt	20



Maintenance Specification – Lubricating (WP10)

Lubricating (WP10)

Maintenance Data

Item		Item
Lubricating method		Pressure lubrication
Lubricating oil capacity (oil pan)		23 L (first filling of 25 L)
Oil pressure		350~550kPa
Oil pressure at idle speed		≥ 100kPa
Oil filter	Type	Spin-type with paper filter element, double-cylinder parallel
Oil pump	Type	Gear pump (single-stage pump for general application, two-stage pump for special application)
	Safety valve opening pressure	1550±150kPa
Oil cooler	Type	Water-cooled
	Bypass valve opening pressure	600±36kPa
	Pressure withstand testing pressure	1500kPa
Clearance between driving/driven gear and pump chamber wall		≤ 0.3mm
Meshing clearance of driving/driven gear	Standard value	0.05mm
	Limit value	0.20mm

Torque Requirements

Fastener	N.m
Oil pan fixing bolt	25
Oil drain bolt	25
Oil pump fixing bolt	62.5±2.5
Oil cooler fixing bolt	25

Lubricating (WP12)

Maintenance Data

Item		Item
Lubricating method		Pressure lubrication
Lubricating oil capacity (oil pan)		23 L (first filling of 25 L)
Oil pressure		350~550kPa
Oil pressure at idle speed		≥ 100kPa
Oil filter	Type	Spin-type with paper filter element, double-cylinder parallel
Oil pump	Type	Gear pump (single-stage pump for general application, two-stage pump for special application)
	Safety valve opening pressure	1550±150kPa
Oil cooler	Type	Water-cooled
	Bypass valve opening pressure	600±36kPa
	Pressure withstand testing pressure	1500kPa
Clearance between driving/driven gear and bump chamber wall		≤ 0.3mm
Meshing clearance of driving/driven gear	Standard value	0.05mm
	Limit value	0.20mm

Torque Requirements

Fastener	N.m
Oil pan fixing bolt	25
Oil drain bolt	25
Oil pump fixing bolt	62.5±2.5
Oil cooler fixing bolt	25



Maintenance Specification – Lubricating (WD615)

Lubricating (WD615)

Maintenance Data

Item		Item
Lubricating method		Pressure lubrication
Lubricating oil capacity (oil pan)		23 L (first filling of 25 L)
Oil pressure		350~550kPa
Oil pressure at idle speed		≥ 100kPa
Oil filter	Type	Spin-type with paper filter element, double-cylinder parallel
Oil pump	Type	Gear pump (single-stage pump for general application, two-stage pump for special application)
	Safety valve opening pressure	1550±150kPa
Oil cooler	Type	Water-cooled
	Bypass valve opening pressure	600±36kPa
	Pressure withstand testing pressure	1500kPa
Clearance between driving/driven gear and bump chamber wall		≤ 0.3mm
Meshing clearance of driving/driven gear	Standard value	0.05mm
	Limit value	0.20mm

03

Torque Requirements

Fastener	N.m
Oil pan fixing bolt	25
Oil drain bolt	25
Oil pump fixing bolt	62.5±2.5
Oil cooler fixing bolt	25

Engine Mechanical (WP10)

Maintenance Data

Item		Standard Value
Main bearing clearance		0.095~0.171mm
Clearance of connecting rod bearing		0.059~0.135mm
Crankshaft axial clearance		0.102~0.305mm
Axial clearance of connecting rod plane		0.15~0.35mm
Connecting rod small-end sleeve x piston pin clearance		0.04~0.061mm
Piston pin seat x piston pin clearance		0.005~0.018mm
Opening clearance of cold piston ring	First ring	0.35~0.55mm
	Second ring	0.4~0.6mm
	Oil ring	0.2~0.4mm
Side clearance of cold piston ring	First ring	
	Second ring	0.08~0.115mm
	Oil ring	0.04~0.075mm
Intake valve stem x valve guide clearance		0.02~0.048mm
Exhaust valve stem x valve guide clearance		0.025~0.053mm
Valve sinkage	Exhaust	1.08~1.48mm
	Intake	0.85~1.05mm
Distance of cylinder liner top above body upper part		0.05~0.10mm
Camshaft axial clearance		0.1~0.4mm
Camshaft axial clearance		0.04~0.12mm
Tappet x tappet hole clearance		c0.025~0.089mm
Cylinder liner outer diameter x interference and clearance of body cylinder liner hole		-0.02~0.023mm
Rocker arm x rocker arm axial clearance		0.012~0.066mm
Timing gear x side clearance of intermediate gear		0.015~0.33mm
Valve clearance	Intake	0.3mm
	Exhaust	0.4mm
	EVb (cold state)	0.25mm

Name	Heating Temperature	Suggested Heating Time
Crankshaft gear	Inductive heating, 180 °C	-

Maintenance Specification – Engine Mechanical (WP10)

Piston	60 °C	10 minutes
Flywheel ring gear	150 °C	10 minutes
Front flange of crankshaft	Inductive heating, 290 °C	-
Note: it is suggested to use the box-type electric furnace (3.6Kw 6A 380V 50Hz) with a maximum heating temperature of 400 °C as the heating furnace.		

Loctite Sealant Range	Main Application	Parts to be Sealed
242	Applied to thread surface for locking to prevent loosening from vibration, medium strength	Stud of timing gear chamber
		Stud of timing gear chamber
		Timing gear bolt of camshaft
		Intermediate idler bolt
		Filter seat bolt
		Oil cooler seat bolt
		Oil cooler seat bolt
		Air compressor shaft-end thread
		Rear plug of main oil duct
		Safety valve plug
		Main oil duct's pressure limiting valve thread
		Suction filter bolt
262	Applied to thread surface for permanent locking and sealing to prevent loosening from vibration	Auxiliary bolt of cylinder head
271	For loose fastening	Bowl plug of auxiliary oil duct
		Bowl plug of main oil duct
		Air compressor outlet x connecting elbow according to circumference
277	For sealing between core and hole	Bowl plug of cylinder block's water chamber
		Bowl plug of camshaft hole
		Bowl plug of cylinder head
		Cylinder head copper sleeve
		Bowl plug of intake pipe
		Part of oil-gas separator elbow connected to cylinder block
		Exhaust valve's lower spring seat bottom
		Part of pipe joint assembly connected to water pipe joint

Maintenance Specification – Engine Mechanical (WP10)

510	Applied to bright metal surface for sealing	Joint surface between cylinder block and crankcase
		Body front and rear surface
		Joint surface between air compressor and timing gear chamber
		Joint surface between filter seat and crankcase

Torque Requirements

Fastener		N.m
Main bearing bolt	First time	Tighten in the required order
	Second time	80
	Third time	275±25
Cylinder head bolt	First time	Tighten main and auxiliary bolts in the required order by 40±10
	Second time	100 tighten auxiliary bolts
	Third time	200 tighten main bolts
	Fourth time	Tighten auxiliary bolts and nuts for 90°
	Fifth time	Tighten main bolts for 90°
Connecting rod bolt	First time	Tighten symmetrically
	Second time	120
	Third time	Further tighten 90°±5°, inspect torque 210
Flywheel bolt	First time	Tighten symmetrically
	Second time	70±10
	Third time	Further tighten two 90°
Flywheel housing bolt	First time	50±10 tighten symmetrically
	Second time	Further tighten 120°±5°, inspect torque 255
Intermediate gear bolt	First time	60±5 pre-tighten
	Second time	Further tighten 90°±5°, inspect torque 112.5
Oil pump's intermediate gear shaft fixing bolt		62.5±2.5
Rocker arm seat bolt		105±5
Camshaft gear fixing bolt		50±10 tighten symmetrically
Fuel injector fixing bolt		Tighten symmetrically and note the consistence of lateral clearance, 11±1
Crankshaft damper connecting bolt		65±5 tighten symmetrically
Air compressor gear fixing nut		210±10
High-pressure fuel pipe nut	Fuel injector end	22.5±2.5
	High-pressure pump end	30±5

Engine Mechanical (WP12)

Maintenance Data

Item		Standard Value
Main bearing clearance		0.095~0.171mm
Clearance of connecting rod bearing		0.059~0.135mm
Crankshaft axial clearance		0.102~0.305mm
Axial clearance of connecting rod plane		0.15~0.35mm
Connecting rod small-end sleeve x piston pin clearance		0.04~0.061mm
Piston pin seat x piston pin clearance		0.005~0.018mm
Opening clearance of cold piston ring	First ring	0.35~0.55mm
	Second ring	0.4~0.6mm
	Oil ring	0.2~0.4mm
Side clearance of cold piston ring	First ring	
	Second ring	0.08~0.115mm
	Oil ring	0.04~0.075mm
Intake valve stem x valve guide clearance		0.02~0.048mm
Exhaust valve stem x valve guide clearance		0.025~0.053mm
Valve sinkage	Exhaust	1.08~1.48mm
	Intake	0.85~1.05mm
Distance of cylinder liner top above the body upper part		0.05~0.10mm
Camshaft axial clearance		0.1~0.4mm
Camshaft axial clearance		0.04~0.12mm
Tappet x tappet hole clearance		0.025~0.089mm
Cylinder liner outer diameter x interference and clearance of body cylinder liner hole		-0.02~0.023mm
Rocker arm x rocker arm axial clearance		0.012~0.066mm
Timing gear x side clearance of intermediate gear		0.015~0.33mm
Valve clearance	Intake	0.3mm
	Exhaust	0.4mm
	EVB (cold state)	0.25mm

Name	Heating Temperature	Suggested Heating Time
Crankshaft gear	Inductive heating, 180 °C	-

Maintenance Specification – Engine Mechanical (WP12)

Piston	60 °C	10 minutes
Flywheel ring gear	150 °C	10 minutes
Front flange of crankshaft	Inductive heating, 290 °C	-
Note: it is suggested to use the box-type electric furnace (3.6Kw 6A 380V 50Hz)with a maximum heating temperature of 400 °C as the heating furnace.		

Loctite Sealant Range	Main Application	Parts to be Sealed
242	Applied to the thread surface for locking and sealing to prevent loosening from vibration, medium strength	Stud of timing gear chamber
		Thrust washer of camshaft
		Timing gear bolt of camshaft
		Intermediate idler bolt
		Filter seat bolt
		Oil cooler seat bolt
		Air compressor shaft-end thread
		Rear plug of main oil duct
		Safety valve plug
		Main oil duct's pressure limiting valve thread
		Suction filter bolt
262	Applied to the thread surface for permanent locking and sealing to prevent loosening from vibration	Auxiliary bolt of cylinder head
271	For loose fastening	Bowl plug of auxiliary oil duct
		Bowl plug of main oil duct
		Air compressor outlet x connecting elbow according to circumference
277	For sealing between core and hole	Bowl plug of cylinder block's water chamber
		Bowl plug of camshaft hole
		Bowl plug of cylinder head
		Cylinder head copper sleeve
		Bowl plug of intake pipe
		Part of oil-gas separator elbow connected to cylinder block
		Exhaust valve's lower spring seat bottom
		Part of pipe joint assembly connected to water pipe joint

Maintenance Specification – Engine Mechanical (WP12)

510	Applied to bright metal surface for sealing	Joint surface between cylinder block and crankcase
		Body front and rear surface
		Joint surface between air compressor and timing gear chamber
		Joint surface between filter seat and crankcase

03

Torque Requirements

Fastener		N.m
Main bearing bolt	First time	Tighten in the required order
	Second time	80
	Third time	275±25
Cylinder head bolt	First time	Tighten main and auxiliary bolts in the required order by 40±10
	Second time	100 tighten auxiliary bolts
	Third time	200 tighten main bolts
	Fourth time	Tighten auxiliary bolts and nuts by 90°
	Fifth time	Tighten main bolts by 90°
Connecting rod bolt	First time	Tighten symmetrically
	Second time	120
	Third time	Further tighten 90°±5°, inspect torque 210±40
Flywheel bolt	First time	Tighten symmetrically
	Second time	70±10
	Third time	Further tighten two 90°
Flywheel housing bolt	First time	50±10 tighten symmetrically
	Second time	Further tighten 120°±5°, inspect torque 255±25
Intermediate gear bolt	First time	60±5 pre-tighten
	Second time	Further tighten 90°±5°, inspect torque 112.5±12.5
Oil pump's intermediate gear shaft fixing bolt		62.5±2.5
Rocker arm seat bolt		105±5 N.m
Camshaft gear fixing bolt		Tighten symmetrically with 34±2 N.m
Fuel injector fixing bolt		Tighten symmetrically and note the consistence of lateral clearance, 11±1
Crankshaft damper connecting bolt		65±5 tighten symmetrically with
Air compressor gear fixing bolt		210±10
High-pressure fuel pipe nut	Fuel injector end	22.5±2.5
	High-pressure pump end	30±5

Engine Mechanical (WD615)

Maintenance Data

Item		Standard Value
Main bearing clearance		0.095~0.171mm
Clearance of connecting rod bearing		0.059~0.135mm
Crankshaft axial clearance		0.102~0.305mm
Axial clearance of connecting rod plane		0.15~0.35mm
Connecting rod small-end sleeve x piston pin clearance		0.04~0.061mm
Piston pin seat x piston pin clearance		0.005~0.018mm
Opening clearance of cold piston ring	First ring	0.35~0.55mm
	Second ring	0.4~0.6mm
	Oil ring	0.2~0.4mm
Side clearance of cold piston ring	First ring	-
	Second ring	0.08~0.115mm
	Oil ring	0.04~0.075mm
Intake valve stem x valve guide clearance		0.02~0.048mm
Exhaust valve stem x valve guide clearance		0.025~0.053mm
Valve sinkage	Exhaust	1.08~1.48mm
	Intake	0.85~1.05mm
Distance of cylinder liner top above the body upper part		0.05~0.10mm
Camshaft axial clearance		0.1~0.4mm
Camshaft bearing clearance		0.04~0.12mm
Tappet x tappet hole clearance		0.025~0.089mm
Cylinder liner outer diameter x interference and clearance of body cylinder liner hole		-0.02~0.023mm
Rocker arm x rocker arm axial clearance		0.012~0.066mm
Timing gear x side clearance of intermediate gear		0.015~0.33mm
Valve clearance	Intake	0.3mm
	Exhaust	0.4mm
	EVB (cold state)	0.25mm

Name	Heating Temperature	Suggested Heating Time
Crankshaft gear	Inductive heating, 180 °C	-

Maintenance Specification – Engine Mechanical (WD615)

Piston	60 °C	10 minutes
Flywheel ring gear	150 °C	10 minutes
Front flange of crankshaft	Inductive heating, 290 °C	-
Note: it is suggested to use the box-type electric furnace (3.6Kw 6A 380V 50Hz)with a maximum heating temperature of 400 °C as the heating furnace.		

Loctite Sealant Range	Main Application	Parts to be Sealed
242	Applied to the thread surface for locking and sealing to prevent loosening from vibration, medium strength	Stud of timing gear chamber
		Thrust washer of camshaft
		Timing gear bolt of camshaft
		Intermediate idler bolt
		Filter seat bolt
		Oil cooler seat bolt
		Air compressor shaft-end thread
		Rear plug of main oil duct
		Safety valve plug
		Main oil duct's pressure limiting valve thread
		Suction filter bolt
262	Applied to the thread surface for permanent locking and sealing to prevent loosening from vibration	Auxiliary bolt of cylinder head
271	For loose fastening	Bowl plug of auxiliary oil duct
		Bowl plug of main oil duct
		Air compressor outlet x connecting elbow according to circumference
277	For sealing between core and hole	Bowl plug of cylinder block's water chamber
		Bowl plug of camshaft hole
		Bowl plug of cylinder head
		Cylinder head copper sleeve
		Bowl plug of intake pipe
		Part of oil-gas separator elbow connected to cylinder block
		Exhaust valve's lower spring seat bottom
		Part of pipe joint assembly connected to water pipe joint

510	Applied to bright metal surface for sealing	Joint surface between cylinder block and crankcase
		Body front and rear surface
		Joint surface between air compressor and timing gear chamber
		Joint surface between filter seat and crankcase

Torque Requirements

Fastener		N.m
Main bearing bolt	First time	Tighten in the required order
	Second time	80
	Third time	275±25
Cylinder head bolt	First time	Tighten main and auxiliary bolts in the required order by 40±10
	Second time	100 tighten auxiliary bolts
	Third time	200 tighten main bolts
	Fourth time	Tighten auxiliary bolts and nuts by 90°
	Fifth time	Tighten main bolts by 90°
Connecting rod bolt	First time	Tighten symmetrically
	Second time	120
	Third time	Further tighten 90°±5°, inspect torque 210
Flywheel bolt	First time	Tighten symmetrically
	Second time	70±10
	Third time	Further tighten two 90°
Flywheel housing bolt	First time	50±10 tighten symmetrically
	Second time	Further tighten 120°±5°, inspect torque 255
Intermediate gear bolt	First time	60±5 pre-tighten
	Second time	Further tighten 90°±5°, inspect torque 112.5
Oil pump's intermediate gear shaft fixing bolt		62.5±2.5
Rocker arm seat bolt		105±5
Camshaft gear fixing bolt		34±2 tighten symmetrically
Fuel injector fixing bolt		Tighten symmetrically and note the consistence of lateral clearance, 11±1
Crankshaft damper connecting bolt		65±5 tighten symmetrically
Air compressor gear fixing bolt		210±10
High-pressure fuel pipe nut	Fuel injector end	22.5±2.5
	High-pressure pump end	30±5

Engine Control

Torque Requirements

Fastener	N.m
Accelerator pedal fixing bolt	25
Accelerator pedal fixing bolt	25
Fuel pressure sensor	25
Crankshaft position sensor	25
Camshaft position sensor	25
Oil pressure sensor	25
Intake pressure sensor	25
Intercooler intake pressure sensor	25

03

Starting, Preheating System (WP10)

Maintenance Data

Item		Specification
Starting method		Electric start
Starter	Model	HEF95-L24V
	Voltage	24 V
Cold start	Without auxiliary starting device	-10 °C
	With auxiliary starting device	-30 °C

Torque Requirements

Fastener	N.m
Ignition switch fixing bolt	25
Starter fixing nut	60
Heater fixing nut	25



Starting, Preheating System (WP12)

Maintenance Data

Item		Specification
Starting method		Electric start
Starter	Model	HEF95-L24V
	Voltage	24 V
Cold start	Without auxiliary starting device	-10 °C
	With auxiliary starting device	-30 °C

03

Torque Requirements

Fastener	N.m
Ignition switch fixing bolt	25
Starter fixing nut	60
Heater fixing nut	25

Starting, Preheating System (WD615)

Maintenance Data

Item		Specification
Starting method		Electric start
Starter	Model	HEF95-L24V
	Voltage	24 V
Cold start	Without auxiliary starting device	-10 °C
	With auxiliary starting device	-30 °C

Torque Requirements

Fastener	N.m
Ignition switch fixing bolt	25
Auxiliary starting switch fixing nut	25
Starter fixing nut	25
Heater fixing nut	25

Maintenance Specification – Charging System

Charging System

Maintenance Data

Item		Specification
Generator	Type	Integrated with rectification and voltage regulation
	Power	1000 W and 1540 W
	Voltage	28 V

03

Torque Requirements

Fastener	N.m
Generator fixing bolt	60

Charging System

Maintenance Data

Item		Specification
Generator	Type	Integrated with rectification and voltage regulation
	Power	1000 W and 1540 W
	Voltage	28 V

03

Torque Requirements

Fastener	N.m
Generator fixing bolt	60

Maintenance Specification – Charging System

Charging System

Maintenance Data

Item		Specification
Generator	Type	Integrated with rectification and voltage regulation
	Power	1000 W and 1540 W
	Voltage	28 V

03

Torque Requirements

Fastener	N.m
Generator fixing bolt	60

Front Suspension

Maintenance Data

Item		Parameter
Front leaf spring pin shaft outer diameter	Standard value	φ30mm
	Limit value	φ29.93~29.97mm
Front leaf spring sleeve inner diameter	Standard value	φ30 mm
	Limit value	φ30.11 30.194mm
Free state height of leaf spring assembly	Standard value	Left 135mm; right 120mm
	Limit value	Left 129~141mm; right 114~126mm
Front leaf spring and front buffer block height (no load)	Standard value	124mm
	Limit value	118~130mm

Torque Requirements

Fastener	N.m
Front bumper upper fastening bolt	222±22
Front bumper lower fastening bolt	222±22
U-shape connecting bolt fastening nut	280±20
Front leaf spring pin shaft fixing bolt	83±8
Stabilizer bar U-shape connecting plate fastening bolt	83±8
Stabilizer bar and stabilizer bar connecting piece connecting bolt	140±14
Rear leaf spring pin shaft fastening bolt	83±8



Maintenance Specification – Rear Suspension

Rear Suspension

Maintenance Data

Item		Parameter
Leaf spring free state floating height		60±6mm
Buffer gap of buffer block	Standard value	145mm
	Limit value	139~151mm
Rear balance shaft leaf spring clearance		1,040mm
Rear balance shaft total length		Less than 1352mm

03

Torque Requirements

Fastener	N.m
Lower thrust rod fastening bolt	525±25
Buffer block fastening bolt	50±5
Leaf spring puncturing bolt	100±20
U-shape bolt fastening nut	510±20
Rear balance shaft fastening nut	312±24
Adjustable plate connecting bolt	83±8
Rear stabilizer bar and rear axle housing connecting bolt	222±22
Rear stabilizer bar U-shape connecting plate fastening bolt	83±8

Wheel & Tire

Maintenance Data

Item		Parameter
Tire specification		12.00R20
Tire pressure	Front wheel	830kPa
	Rear wheel	830kPa
Tire wear limit		2mm

Torque Requirements

Fastener	N.m
Tire nut	575±25

Maintenance Specification – Front Axle (Ankai)

Front Axle (Ankai)

Maintenance Data

Size and fit clearance of each position of front shaft (mm)

Position	Standard Size	Fit Clearance	Wear Limit
Main pin upper shaft diameter	41.975~41.991	0.018~0.059	0.16
Upper sleeve inner diameter	42.009~42.034		
Main pin lower shaft diameter	46.975~46.991	0.018~0.059	0.16
Lower sleeve inner diameter	47.009~47.034		
Main pin countershaft diameter	45.07~45.084	Interference	
Front shaft pin hole inner diameter	45.0~45.025	0.045~0.084	
Brake camshaft diameter	39.936~39.975	0.155~0.256	0.35
Sleeve inner diameter	40.130~40.192		
Brake shoe roller shaft outer diameter	20.040~20.092	0.08~0.165	
Roller inner diameter	19.927~19.96		

Basic Parameters of 6.5T Front Shaft

Rated shaft load (KG)	6500
Deadweight (steel ring and tire excluded)(KG)	About 450
Front wheel maximum turn angle (inner/outer)	45°/33°
Toe-in (diagonal tire at the outer edge of the rim)	0~2
Main pin inclination	3°
Main pin caster	1°
Front wheel camber	1°

Torque Requirements

Fastener	N.m
Steel ring fastening bolt	575±25
Brake adjusting arm bracket fixing bolt	140
Brake shoe shaft fastening nut	300
Steering crank arm fixing nut	305±30
Axle end bearing rotating torque	5.5
Front leaf spring U-shape bolt	280±20
Front bumper bracket fixing bolt	268

Front Axle (Tri-Ring)

Torque Requirements

Fastener	N.m
Brake shoe pin shaft fixing bolt	270±30
Brake sub-chamber fixing bolt	160
Steering drag link arm fixing nut	315±25
Steering tie rod arm fixing nut	315±25
Knuckle upper cover fixing bolt	160
Cotter pin bolt	275±25
Wheel hub cover fixing bolt	22.5±2.5
Pre-tightening moment	8±2
Wheel hub fixing nut	300
Wheel pin nut	600



Maintenance Specification – Rear Axle

Rear Axle

Maintenance Data

Item		Parameter
Rated shaft load (KG)		13000
Maximum input rotation (rpm)		3500
Axle base		1800~1860mm
Axle housing thickness (mm)		16
		20
Speed ratio		Maximum input torque (N.m)
i=4.80		16680
i=5.73		13731
i=6.72		11770
Rear axle total weight (lubrication oil and tire excluded)(kg)		About 780
Lubrication oil level	Main reducer (L)	8
	Left wheel reducer (L)	2
	Right wheel reducer (L)	2
Driving gear bearing pre-tightening force (N)		15±5
Driving gear and driven gear mesh clearance (mm)		0.2~0.4
Differential bearing pre-tightening force (N)		29±13
Clearance between differential sun gear and planet gear (mm)		0.18-0.5

03

Torque Requirements

Fastener	N.m
Brake base plate fastening bolt	300±20
Wheel slotted nut	350±50
Left differential housing and right differential housing connecting bolt	195
Driven gear and differential housing connecting bolt	325
Main reducer nut with collar	775±25
Driving gear bearing bracket and main reducer housing connecting bolt	110
Main reducer and rear axle housing connecting bolt	125±15
Wheel cover and wheel assembly	60±15
Differential bearing cap nut	235±20
Differential lock round nut	200±20

Maintenance Specification – Rear Axle

Upper thrust rod and rear axle upper bracket connecting bolt	500±25
Lower thrust rod and rear axle lower bracket connecting bolt	500±25
Stabilizer bar and rear axle connecting bolt	221±22
Wheel oil drain bolt	100 ±20
Wheel oil filling bolt	100 ±20
Main reducer oil drain bolt	235 ±35
Main reducer oil filling bolt	235 ±35

Service Brake

Torque Requirements

Fastener	N.m
Brake pedal fixing bolt	25
Main brake valve driving bolt	25
Dryer bracket fixing bolt	60
Relay valve fixing nut	25
Differential valve fixing nut	25
Front brake chamber fixing nut	97
Rear brake chamber fixing nut	97
Brake shoe fixing nut	250
Exhaust brake butterfly valve fixing bolt	25

Parking Brake

Torque Requirements

Fastener	N.m
Hand brake valve fixing bolt	23

Frame

Torque Requirements

Fastener	N.m
Rear mounting upper lock fixing bolt	63
Rear mounting lower lock fixing bolt	63
Tilting cylinder fixing bolt	160
Hand pump assembly fixing nut	97
Rear mounting lower frame welding assembly fixing nut	97
Extended beam fixing bolt	63
Rocker arm assembly fixing bolt	97
Damping gasket assembly fixing bolt	63

Intermediate Axle (Steyr)

Maintenance Data

Item		Parameter
Rated shaft load (kg)		13000
Maximum input rotation (rpm)		3500
Total speed ratio	i=4.80	23540
	i=5.73	19620
	i=6.72	17170
Brake drum diameter X width (mm)		φ420X185
Brake type		Chamber brake cam type
Brake pressure (bar)		6.5
Brake friction plate and brake drum friction coefficient		0.39
Total brake efficiency		0.89
Parking brake type		Spring stored energy air brake
Axle total weight (tire and lubrication oil excluded)(kg)		
Intermediate Axle		About 860
Rear axle		About 770
Lubrication oil filling level (L)	Intermediate axle main reducer	8.3
	Rear axle main reducer (L)	8.3
	Wheel reducer (L)	2.0 each

Torque Requirements

Fastener	N.m
Left differential housing X right differential housing	205±25
Driven bevel gear X wheel differential housing	320±20
Differential assembly X main differential housing	235±2X0
Slotted nut	310±10
Bearing pressure plate X driving gear bearing	220±20
Front differential housing X rear differential housing	210
Nut with collar	800±50
Gap bridge box X main differential housing	100±20
Mesh sleeve	200±20

Maintenance Specification – Intermediate Axle (Steyr)

Main reducer assembly X axle housing	125±15
Oil baffle plate	60±15
Driving gear shaft baffle plate	180
Driving cylindrical gear shaft sleeve slotted nut	300
Differential lock fixing slotted nut	200
Bearing cover X bracket	210

Intermediate Axle (Benz)

Maintenance Data

Item		Parameter
Rated shaft load (KG)		13000
Spring clearance (mm)		950 1030
Rim type applied		8.0-20 or 8.5-20
Tire type used		11.00R20, 12.00R20
Total speed ratio	i5.26	19519
	i=5.92	19519
	i=6.73	17170
Brake drum diameter X width (mm)		φ420X185
Brake type		Chamber brake cam type
Brake pressure (bar)		6.5
Brake friction plate and brake drum friction coefficient		0.39
Total brake efficiency		0.89
Parking brake type		Spring stored energy air brake
Axle total weight (tire and lubrication oil excluded)(kg)		
Intermediate axle		About 860
Rear axle		About 770
Lubrication oil filling level (L)	Intermediate axle main reducer	16
	Rear axle main reducer (L)	12
	Wheel reducer (L)	3.5 each

Torque Requirements

Fastener	N.m
Input shaft nut with collar	950±50
Main reducer housing connecting bolt	155±15
Intermediate axle gap bridge box connecting bolt	280±20
Driven cylindrical gear lock nut	675±25
Wheel hub bearing lock nut	350±50

Maintenance Specification – Transmission (RT-11509C)

Transmission (RT-11509C)

Maintenance Data

Item		Parameter
Torque		1490 N.m
Output power		265 kw
Rated rotation		2600 rpm
Speed ratio	1 st gear	12.42
	2 nd gear	8.29
	3 rd gear	6.08
	4 th gear	4.53
	5 th gear	3.36
	6 th gear	2.47
	7 th gear	1.81
	8 th gear	1.35
	9 th gear	1.00
Reverse gear		12.99
Weight		270 kg
Oil filling level		13 L
Main shaft reverse gear axial clearance		0.13~0.3mm
Main shaft reverse gear axial clearance		0.13~0.3mm
Main shaft 2 nd gear axial clearance		0.13~0.3mm
Main shaft 3 rd gear axial clearance		0.13~0.3mm
Clearance between reverse gear wheel and driving wheel		0.3~0.9mm

03

Torque Requirements

Fastener	N.m
Clutch housing 6-M16X1.5	257±13
Clutch housing 4-M12	121±14
Primary shaft bearing cover 6-M10	54±6
Primary shaft gear M54X1.5 – left	372±34
Double H control device 8-M10X1	54±6
Upper cover 16-M10	54±6

Maintenance Specification – Transmission (RT-11509C)

Shift fork set screw 5-M12~1.2S	78±10
Auxiliary gear box shift fork 2-M12X1.5	78±10
Air filter bracket 2-M6	16.9±3.4
Output shaft M50X1.5	643±34
Auxiliary gear box rear cover 19--M10	54±6
Oil drain hole Z3 / 4"	67±7
Oil filling hole 21	91±10
Auxiliary gear box driving gear locating disc 6-M10	54±6
Reverse intermediate gear shaft 2-M16X1.5	74±7
Auxiliary gear box countershaft rear cover 8-M10	54±6
Bottom power take-off cover 8-M12	78±10
Countershaft brake 8-M10	54±6
Transmission side window cover 6-M10	28±3
Primary shaft rear bearing cover 6-M10	54±6
Gear shift cylinder housing 4-M10	54±6
Cylinder cover 4-M10	54±6
Clutch housing bottom cover 4-M8	24±4
Countershaft 2-M16X1.5	142±20



Maintenance Specification – Transmission (9JS135)

Transmission (9JS135)

Maintenance Data

Item		Parameter
Torque		1350 N.m
Output power		242 kw
Rated rotation		2600 rpm
Speed ratio	1 st gear	8.08
	2 nd gear	5.93
	3 rd gear	4.42
	4 th gear	3.36
	5 th gear	2.41
	6 th gear	1.76
	7 th gear	1.32
	8 th gear	1.00
	9 th gear	12.11
Reverse gear		12.66
Weight		12.66
Oil filling level		13 L
Main shaft reverse gear axial clearance		0.13~0.3mm
Main shaft reverse gear axial clearance		0.13~0.3mm
Main shaft 2 nd gear axial clearance		0.13~0.3mm
Main shaft 3 rd gear axial clearance		0.13~0.3mm
Clearance between reverse gear wheel and driving wheel		0.3~0.9mm

03

Torque Requirements

Fastener	N.m
Clutch housing 6-M16X1.5	257±13
Clutch housing 4-M12	121±13
Primary shaft bearing cover 6-M10	54±6
Primary shaft gear M54X1.5 – left	372±34
Double H control device 8-M10X1	54±6
Upper cover 16-M10	54±6

Maintenance Specification – Transmission (9JS135)

Shift fork set screw 5-M12~1.2S	78±10
Auxiliary gear box shift fork 2-M12X1.5	78±10
Air filter bracket 2-M6	16.9±3.4
Output shaft M50X1.5	643±34
Auxiliary gear box rear cover 19--M10	54±6
Oil drain hole Z3 / 4"	67±7
Oil filling hole 21	91±10
Auxiliary gear box driving gear locating disc 6-M10	54±6
Reverse intermediate gear shaft 2-M16X1.5	74±7
Auxiliary gear box countershaft rear cover 8-M10	54±6
Bottom power take-off cover 8-M12	78±10
Countershaft brake 8-M10	54±6
Transmission side window cover 6-M10	28±3
Primary shaft rear bearing cover 6-M10	54±6
Gear shift cylinder housing 4-M10	54±6
Cylinder cover 4-M10	54±6
Clutch housing bottom cover 4-M8	24±4
Countershaft 2-M16X1.5	142±20

Maintenance Specification – Transmission (12JSD160)

Transmission (12JSD160)

Maintenance Data

Item		Parameter
Torque		1600 N.m
Output power		285 kw
Rated rotation		2600 rpm
Speed ratio	1 st gear	12.10
	2 nd gear	9.41
	3 rd gear	7.31
	4 th gear	5.71
	5 th gear	4.46
	6 th gear	3.48
	7 th gear	2.71
	8 th gear	2.11
	9 th gear	1.64
	10 th gear	1.28
	11 th gear	1.00
	12 th gear	0.78
	Reverse gear 1	11.56
	Reverse gear 2	2.59
Weight		350kg
Oil filling level		17L

03

Torque Requirements

Fastener	N.m
Clutch housing 6-M16X1.5	257±13
Clutch housing 4-M12	121±13
Primary shaft bearing cover 6-M10	54±6
Primary shaft gear M54X1.5 – left	372±34
Double H control device 8-M10X1	54±6
Upper cover 16-M10	54±6
Shift fork set screw 5-M12~1.2S	78±10

Auxiliary gear box shift fork 2-M12X1.5	78±10
Air filter bracket 2-M6	16.9±3.4
Output shaft M50X1.5	643±34
Auxiliary gear box rear cover 19-M10	54±6
Oil drain hole Z3 / 4"	67±7
Oil filling hole 21	91±10
Auxiliary gear box driving gear locating disc 6-M10	54±6
Reverse intermediate gear shaft 2-M16X1.5	74±7
Auxiliary gear box countershaft rear cover 8-M10	54±6
Bottom power take-off cover 8-M12	78±10
Countershaft brake 8-M10	54±6
Transmission side window cover 6-M10	28±3
Primary shaft rear bearing cover 6-M10	54±6
Gear shift cylinder housing 4-M10	54±6
Cylinder cover 4-M10	54±6
Clutch housing bottom cover 4-M8	24±4
Countershaft 2-M16X1.5	142±20
Nut with collar	643±34

Clutch

Maintenance Data

Item	Parameter
Clutch model	GF430
Clutch driven disc outer diameter (mm)	430
Maximum transmission torque (N.m)	2000
Number of driven disc	1
Pressure plate pressing force (N)	22500±1800
Friction area (cm)	2010
Separating force (N)	7800
Total thickness of driven disc (mm)	10±0.3
Separating ring thickness (mm)	9
Clutch control mechanism	Liquid control and air support force
Clutch housing model	SAE1
Driven disc runout level (mm)	0.5

03

Torque Requirements

Fastener	N.m
Clutch oil cup fastening nut	12
Clutch master cylinder fastening bolt	64
Clutch master cylinder push rod fastening bolt	28
Clutch bracket and carriage connecting bolt 2	8
Clutch bracket and dashboard beam connecting bolt	28
Clutch bracket bottom connecting bolt	12
Clutch cylinder fastening bolt	28
Clutch pressure plate fastening bolt	28
Clutch shift fork support shaft fastening nut	160

Drive Shaft

Maintenance Data

Item		Parameter
Drive shaft type		Tubular roller bearing constant velocity cross shaft universal joint
Outer diameter (mm)		Maximum instantaneous torque allowed (N.m)
Flange outer diameter 150		6200
Flange outer diameter 165		7000~15000
Flange outer diameter 180		17000
Drive shaft extension sleeve spline module		2.5
Universal joint maximum turn angle		35°
Drive shaft runout level (mm)	Standard value	0.6
	Limit value	1.0
Ball spline fit clearance (mm)	Standard value	0.02~0.01
	Limit value	0.3
Clearance between universal joint and needle bearing (mm)	Standard value	0.02~0.09
	Limit value	0.15
Cross shaft axial wear loss (mm)	Standard value	0.01
	Limit value	0.03
Middle support axial clearance (mm)	Limit value	0.50
Drive shaft tube diameter (mm)		80
		85
		92
		100
		104
		110
		140



Maintenance Specification – Drive Shaft

Shaft wall thickness (mm)	3.5
	5
	6.5
	6
	8
	6
	6

03

Torque Requirements

Fastener	N.m
Transmission output flange and intermediate drive shaft connecting bolt	198±20
Intermediate drive shaft and intermediate axle input flange connecting bolt	198±20
Intermediate axle output flange and axial drive shaft connecting bolt	face gear visible 198±20, invisible 215±25
Axial drive shaft and rear axle flange connecting bolt	face gear visible 198±20, invisible 215±25

Power Take-off

Maintenance Data

Item	Parameter
Model	QH50
Structure type	Double shaft single way air control
Input rotation	2600r/min
Output torque	500N.m
Speed ratio	0.818
Power take-off solenoid valve air pressure	0.7~0.8Mpa

Torque Requirements

Fastener	N.m
Output shaft flange fastening bolt	45
Bearing cap fastening bolt	95
Power take-off cylinder fastening bolt	23
Power take-off pistol fastening bolt	9
Power take-off cap fastening bolt	28
Power take-off housing and transmission auxiliary gearbox connecting bolt	37
Power take-off drive shaft connecting bolt	37

Maintenance Specification – Steering Wheel & Steering Column

Steering Wheel & Steering Column

Maintenance Data

Item	Parameter
Steering wheel	
Diameter	480mm
Free stroke	5°
Rotation number	2.5 circles both for left and right
Front and rear adjustable angle	±5°
Upper and lower adjustable height	20mm
Steering force	Less than 32N
Steering column	
Steering column straightness	0.5mm
Cross shaft and axial clearance	≤ 0.1mm
Cross shaft specification (axial diameter X length)	φ19x48

03

Torque Requirements

Fastener	N.m
Steering wheel fastening nut	70±10
Steering column fastening bolt	23±2
Steering drive shaft and steering gear shaft connecting bolt	60±10
Ignition switch fastening bolt	10±1
Protective pipe fastening bolt	10±1

Power Steering Mechanism

Maintenance Data

Item	Parameter
Steering fluid	
Model	ATF-III
Steering fluid consumption	3.5L
Working temperature	-40~120°
Fluid level rises engine idle speed → shut down	1~2mm
Steering pump	
Working pressure	170 bar
Steering gear	
Lingering time for steering wheel in limit position	< 5s
Screw rotation number	6.68
Working pressure	150bar
Cycling roller path spiral direction	Left
Cycling ball diameter	8
Cycling ball number	29
Cycling auxiliary diameter	38.1

Torque Requirements

Fastener	N.m
Steering pump fastening bolt	23±2
High pressure oil reservoir connecting nut	120±10
Steering gear fastening bolt	565±15
Steering gear bracket fastening bolt	325±25
Steering gear oil return pipe (low pressure pipe) connecting nut	120±10
Steering gear and steering drive shaft connecting bolt	60±10
Steering oil reservoir fastening bolt	23±2
Oil pipe clamp fastening bolt	23±2

Maintenance Specification – Heater & Air Conditioner

Heater & Air Conditioner

Maintenance Data

Coolant Pressure		Pressure Value
Low pressure side	Idling speed	20~40Mpa
High pressure side	Idling speed	160~200MPa

Replace pipeline of the whole system	ml
--------------------------------------	----

03

Coolant	Filling Volume
R-134a	400 g

Torque Requirements

Fastener	N.m
High pressure cooling pipe	22
Low pressure cooling pipe	31
Condenser X cooling pipe	10

Seat Belt

Torque Requirements

Fastener	N.m
Seat belt retractor assembly	60
Seat belt 6	60
Driver's seat buckle assembly	60
Intermediate seat buckle assembly	60
Passenger's seat and intermediate seat buckle assembly	60

Maintenance Specification – Battery

Battery

Maintenance Data

Weather Condition	Fully Charged Battery Electrolyte Proportion at 15 °C	
	Winter	Summer
Areas of winter temperature below - 40 °C	1.31	1.27
Areas of winter temperature above - 40 °C	1.29	1.25
Areas of winter temperature above - 30 °C	1.28	1.25
Areas of winter temperature above - 20 °C	1.27	1.24
Areas of winter temperature above 0 °C	1.24	1.24

03

Discharge level	Fully charged		25 %		50 %		75 %		100 %	
Electrolyte proportion and freezing point	Proportion 15 °C	Freezing point 0 °C	Proportion 15 °C	Freezing point 0 °C	Proportion 15 °C	Freezing point 0 °C	Proportion 15 °C	Freezing point 0 °C	Proportion 15 °C	Freezing point 0 °C
	1.310	-76	1.270	-58	1.230	-36	1.190	-22	1.150	-14
	1.290	-70	1.250	-50	1.210	-28	1.170	-18	1.130	-10
	1.280	-69	1.240	-42	1.200	-25	1.160	-16	1.120	-9
	1.270	-58	1.230	-36	1.190	-22	1.150	-14	1.110	-8
	1.250	-50	1.210	-28	1.170	-18	1.130	-10	1.090	-6
	1.240	-42	1.200	-25	1.160	-16	1.120	-9	1.080	-5

Torque Requirements

Fastener	N.m
Battery switch fixing bolt	20
Battery switch X cable	20
Battery X cable	20

Lighting

Torque Requirements

Fastener	N.m
Front combination lamp fixing bolt	63
Interior lamp fixing bolt	23

Wiper & Washer

Torque Requirements

Fastener	N.m
Connecting rod mechanism fixing bolt	23
Wiper motor fixing nut	63
Wiper motor X connecting rod mechanism	63
Washer fixing bolt	23

Audio System

Torque Requirements

Fastener	N.m
Radio & tape player fixing screw	7

Horn

Torque Requirements

Fastener	N.m
Horn fixing bolt	23

Glass, Window Lifter, Rear-view Mirror

Torque Requirements

Fastener	N.m
Door guide rail fixing bolt	9
Glass lifter fixing bolt	9
Rear-view mirror hex fixing screw	20
Front down view mirror fixing bolt	20
Side down view mirror fixing nut	24

Dashboard, Instrument, Cigarette Lighter

Torque Requirements

Fastener	N.m
Dashboard sub-assembly fixing bolt	40
Front pillar handle fixing bolt	8

Seats

Torque Requirements

Fastener	N.m
Driver's seat fixing bolt and nut	40
Assistant driver's seat fixing bolt and nut	40
Middle seat fixing bolt and nut	20
Angle adjustment gear assembly fixing bolt 6	63
Driver's seat slide rail assembly fixing bolt	63
Seat damper assembly connecting bolt	63

Door, Lock, Door Handle

Torque Requirements

Fastener	N.m
Front door hinge fixing bolt	30

Interior & Exterior Trim Parts

Torque Requirements

Fastener	N.m
Front bumper support pipe fixing bolt	100
Front bumper fixing bolt	40
Front bumper X anti-collision beam	100
Front bumper X headlamp fixing bracket	40
Front tilting cover hinge fixing bolt	40
Left guard railing fixing bolt	97
Right guard railing fixing bolt	97

03

Maintenance Specification – Cab

Cab

Torque Requirements

Fastener	N.m
Tilting shaft nut	181±18

Hydraulic Dump System

Maintenance Data

Item	Parameter		
Lifting time (no load lifting, descending)	Middle top (container length $\leq 6\text{m}$)	Middle top (container length $\geq 6\text{m}$)	Front top
	$\leq 20\text{s}$	$\leq 60\text{s}$	$\leq 50\text{s}$
Maximum lifting angle	Container length $\leq 6\text{m}$		Container length $\geq 6\text{m}$
	$50^{\circ}\pm 2^{\circ}$		$48^{\circ}\pm 2^{\circ}$
Cylinder natural settlement	When container is empty, cylinder natural settlement $\leq 10\text{mm/min}$; in overload 10% working condition, carriage lift 10° and 20° respectively and stay for 5min, container natural settlement shall not exceed 2.5°		

Torque Requirements

Fastener	N.m
PT lifting valve installation bolt	15
Oil pump high pressure pipe joint	7
Air pipe quick coupling	2.5
Front top cylinder lower bracket installation bolt	210
Front top cylinder upper bracket installation bolt	210
Front top cylinder oil pipe joint	75
Middle top hydraulic cylinder oil pipe joint	140
Steering valve high pressure oil pipe joint	140
PT lifting valve high pressure oil pipe joint	75
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Engine Control-WP

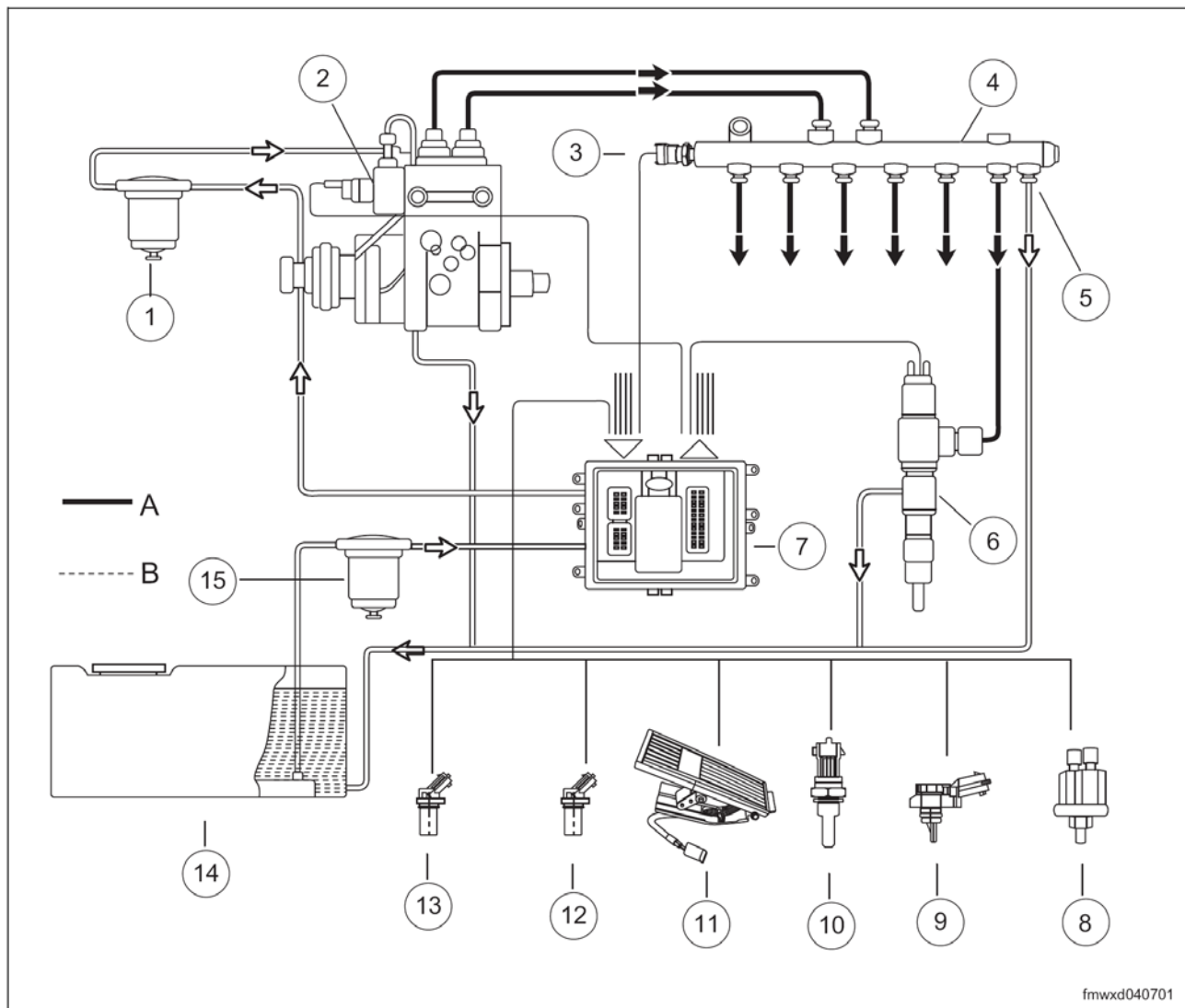
Precautions

1. Switch off the general power supply or switch off the negative cable of battery before inspecting and maintaining the engine fuel pipelines.
2. Ensure that the cigarettes, open flames and indicators, arc equipment and switches are separated away from workspace upon the operations of the fuel pipelines due to that the fuel is flammable. In addition, it is necessary to allocate the ventilation equipment in workspace for avoiding personal injury or death.
3. The pressure in fuel high-pressure pipeline can reach 160Mpa when the engine is operating. Therefore, in order to avoid personal injury, it is strictly prohibited to loosen any fuel pipe joint when the engine is operating.
4. Each component of high-pressure common-rail fuel injection system is the element featuring with high precision and high gap. Therefore, the absolute clean work environment is of great importance upon conducting operations for this high-pressure common-rail fuel injection system. It is required to use special plugs for all openings to have sealing treatment.
5. Inspect and affirm that there has no dirt or impurity around the fuel line joint before switching off the fuel system pipelines. Clean out them if there has any dirt or impurity because they will damage the fuel system or engine.
6. Do not forcibly bend or distort the oil pipe of fuel system.
7. Switch off the general power supply or switch off the negative cable of battery upon dismounting the electrical components of high-pressure common-rail fuel injection system so as to ensure the right installation of positive and negative poles of power supply.
8. When the ignition switch is "ON", it is prohibited to switch off any 24V electrical devices. Otherwise, it may generate high self-induction voltage which causes damage to electrical components.
9. When it is needed to conduct power jump starting, the dismounting of jumper wire must be conducted under the situation that the ignition switch is switched off.
10. Switch off the general power supply or switch off the negative cable of battery upon conducting the operation of stud arc welding.
11. When conducting the overhaul of the electric control system, it is not admitted to use testing lamp but the high-impedance numerical multi-meter or the special inspection equipment of electric control system to inspect the sensor of electric control system and the engine control unit upon the overhaul of electric control system. It is banned to use earthing fire test or wire-removal fire blowing method to inspect the circuit.
12. It is prohibited to use water to wash the engine control unit and other electronic devices.

Functions and Operating Descriptions

- Common-rail fuel injection system comprises of low-pressure oil line, high-pressure oil line, information collecting part and control & executive component. Low-pressure oil line includes oil tank, fuel coarse filter with manual fuel pump, low-pressure fuel feed pump and fuel fine filter. High-pressure oil line includes high-pressure oil pump, common-rail pipe and fuel injector. Information collecting part is made up of crankshaft position sensor, camshaft position sensor, electronic throttle, water temperature sensor, air intake pressure temperature sensor, oil pressure temperature sensor, common-rail pressure sensor. Control & executive component is composed of engine control unit (ECU), fuel metering valve and solenoid valve of fuel injector. The oil return pipe of system provides the way for the redundant fuel that flows through the high-pressure oil pump and fuel injector. And the fuel flowing from the pressure limiting valve due to that the common-rail pressure exceeds the defined pressure can also flow back to the oil tank through the oil return pipe.

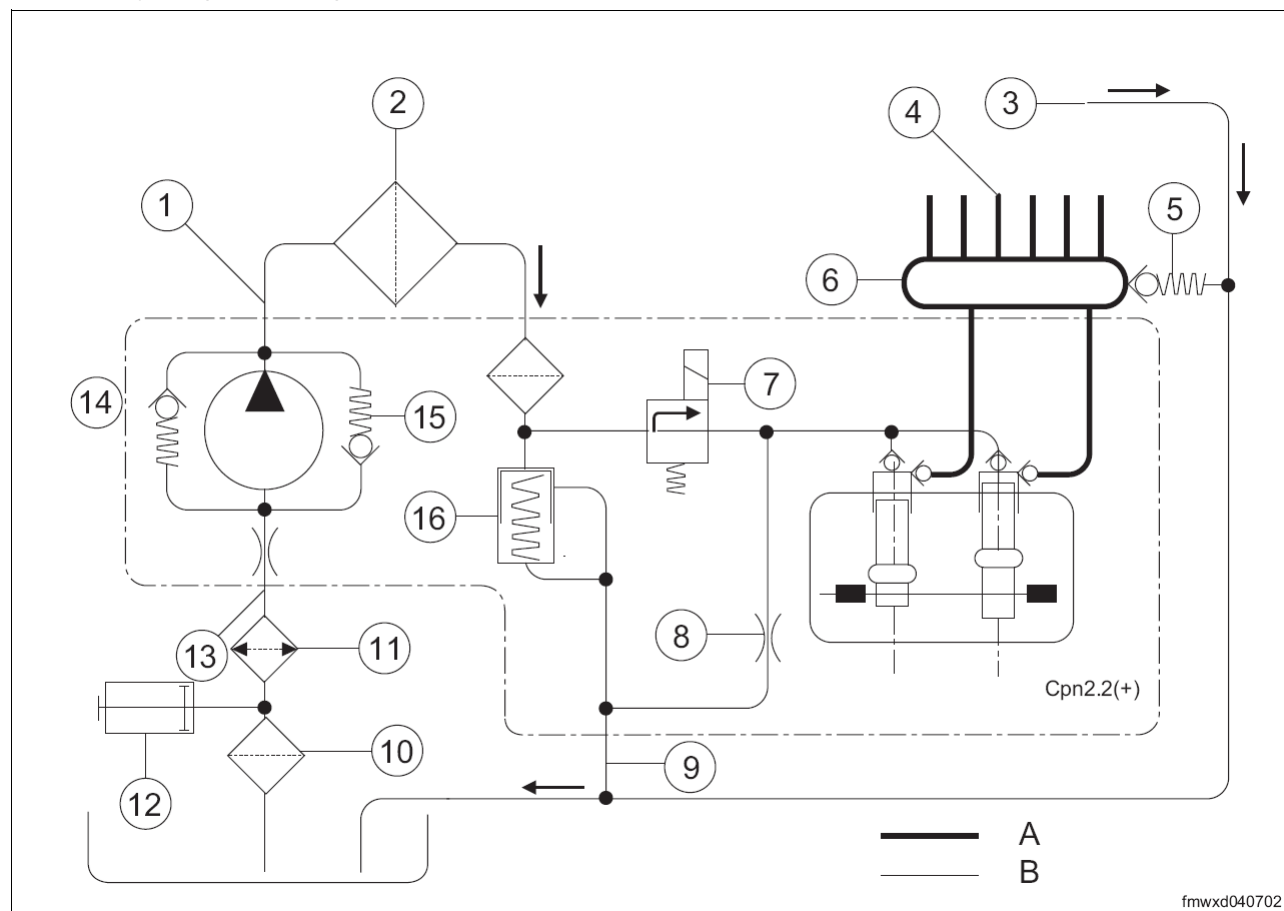
System Part Drawing



Diagnosis - Cigarette Lighter

A	High-pressure Section
B	Low-pressure Section
1	Fine Filter
2	High-pressure Oil Pump
3	Common-rail Pressure Sensor
4	High-pressure Common Rail
5	Pressure Limiting Valve
6	Fuel Injector
7	Engine Control Unit

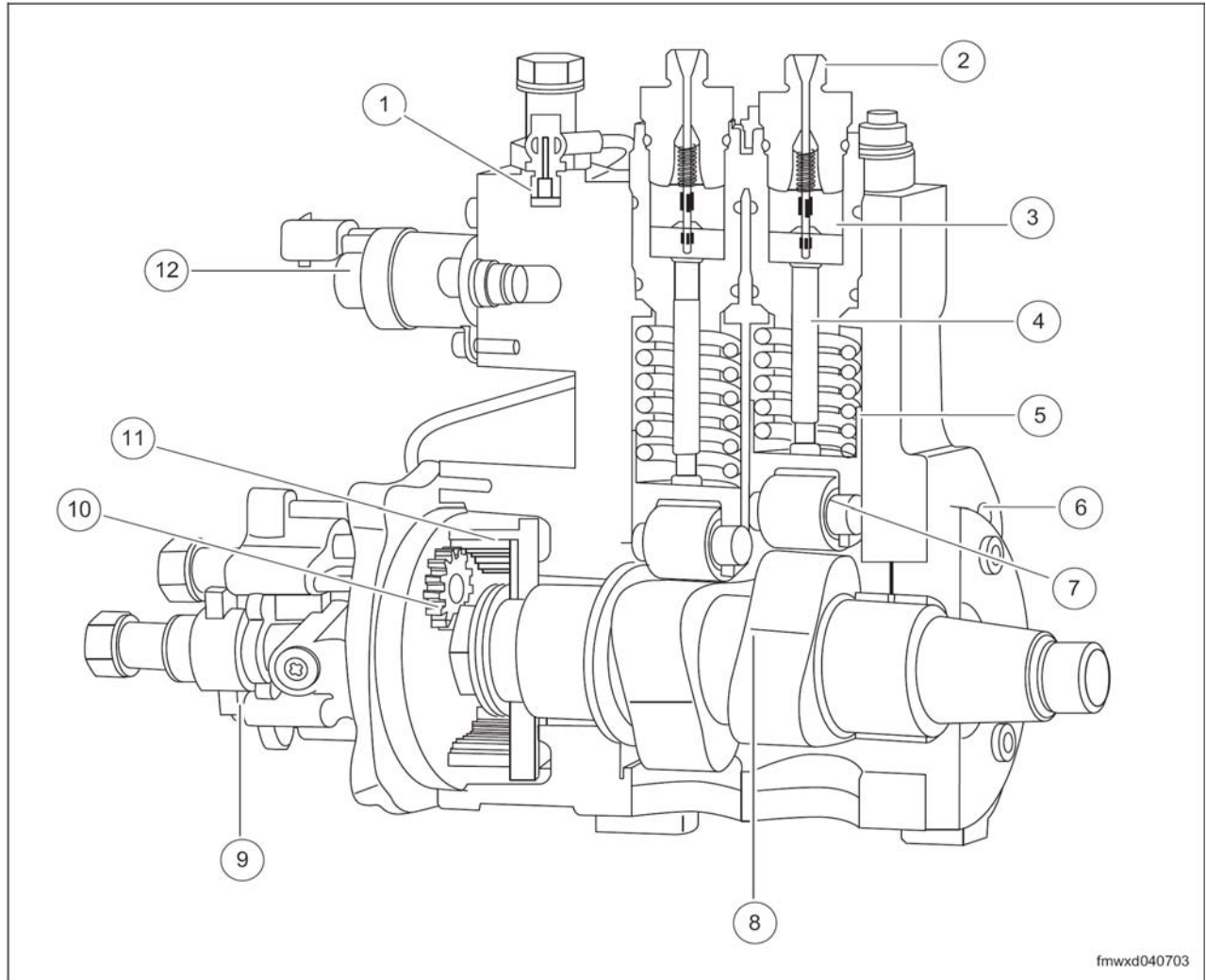
8	Oil-pressure Temperature Sensor
9	Air Intake Temperature Position Sensor
10	Water Temperature Sensor
11	Throttle Position Sensor
12	Camshaft Position Sensor
13	Crankshaft Position Sensor
14	Oil Tank
15	Fuel Coarse Filter with Manual Fuel Pump

Diagnosis - Cigarette Lighter**Elementary Diagram of High-pressure Common-rail Oil Line**

A	High-pressure Section
B	Lower-pressure Section
1	Outlet Back Pressure of Gear Pump: <9.0bar (Absolute Pressure)
2	Fine Filter
3	Oil-return Back Pressure of Fuel Injector: 0~1bar (Relative Pressure)
4	Fuel Injector
5	Pressure Limiting Valve
6	Common Rail
7	Flow Metering Valve

8	Zero Oil-Supply Orifice
9	Oil-Return Back Pressure of Oil Pump<1.2bar (Absolute Pressure)
10	Coarse
11	ECU Cooler Pan
12	Manual Fuel Pump
13	Oil Inlet Pressure of Gear Pump: 0.35~1.00bar (Relative Pressure)

2. High-pressure Oil Pump



1	Zero Oil-Supply Orifice
2	High Oil Outlet
3	2 Body Type I/O Valve
4	Surface Carburizing Plunger
5	Plunger Spring
6	Lubricating Oil Inlet

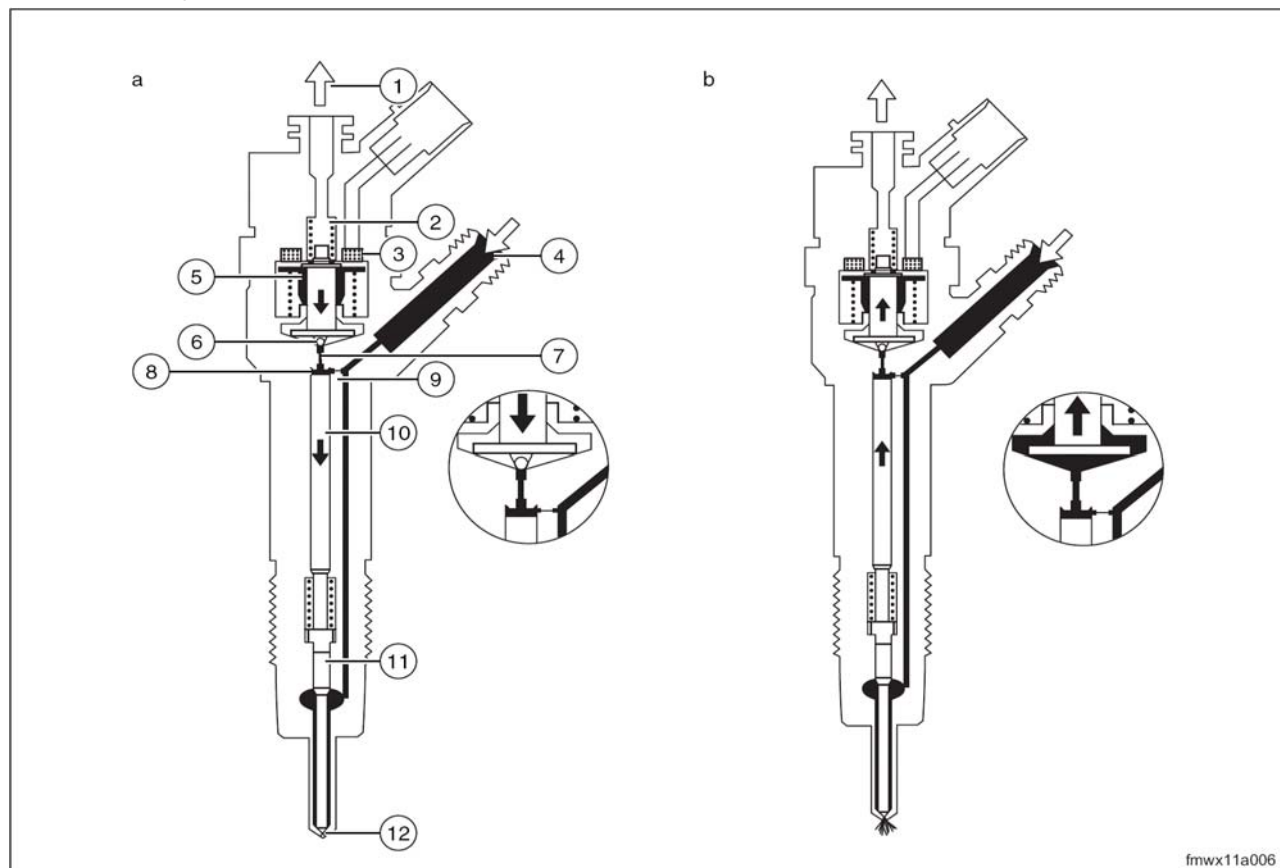
7	Carburizing Roller Pin
8	Concave Cam
9	Gear Pump ZP5
10	Pinion Gear
11	Internal Gear
12	Flow Metering Valve

- (a). Common-rail fuel injection system adopts the BOSCH CPN2.2 (+) high-pressure pump.
- (b). High-pressure pump has both the low-pressure oil line and high-pressure oil line. High-pressure pump has two tasks: on the one hand, the gear pump which is siamesed with high-pressure pump is the fuel feed pump for low-pressure oil line, which is responsible for pumping oil from fuel coarse filter and ECU, and supplying oil for high-pressure oil pump via fuel fine filter; on the other hand, it provides 160 Mpa high-pressure fuel for high-pressure common rail via two-group plunger or high-voltage oil pump.
- (c). The flow metering valve which is installed in the inlet pipeline of high-pressure oil pump is mainly responsible for receiving ECU instructions, randomly changing the oil level that enters into the high-pressure pump so as to change high-pressure oil supply pressure of high-voltage pump and the common-rail pressure.
- When the oil metering unit fails, the engine will be limited to operate within the scope of

1,500 r/min rotated speed.

- The resistance value of flow metering valve shall be within the scope of 2.60 ~ 3.15 Ω .
- ECU regulates the fuel level which flows into high-pressure pump through the on-off time of pulse signal. It is noteworthy that: when the coil of fuel metering valve is not charged with electricity, the metering valve is all-pass which can provide maximum fuel level. In other words, it can cause the highest common-rail pressure.

3. Fuel Injector



fmwx11a006

1	Oil Return Joint
2	Position Return Spring
3	Solenoid Valve Coil
4	Inlet Joint
5	Solenoid Valve Core
6	Ball Valve

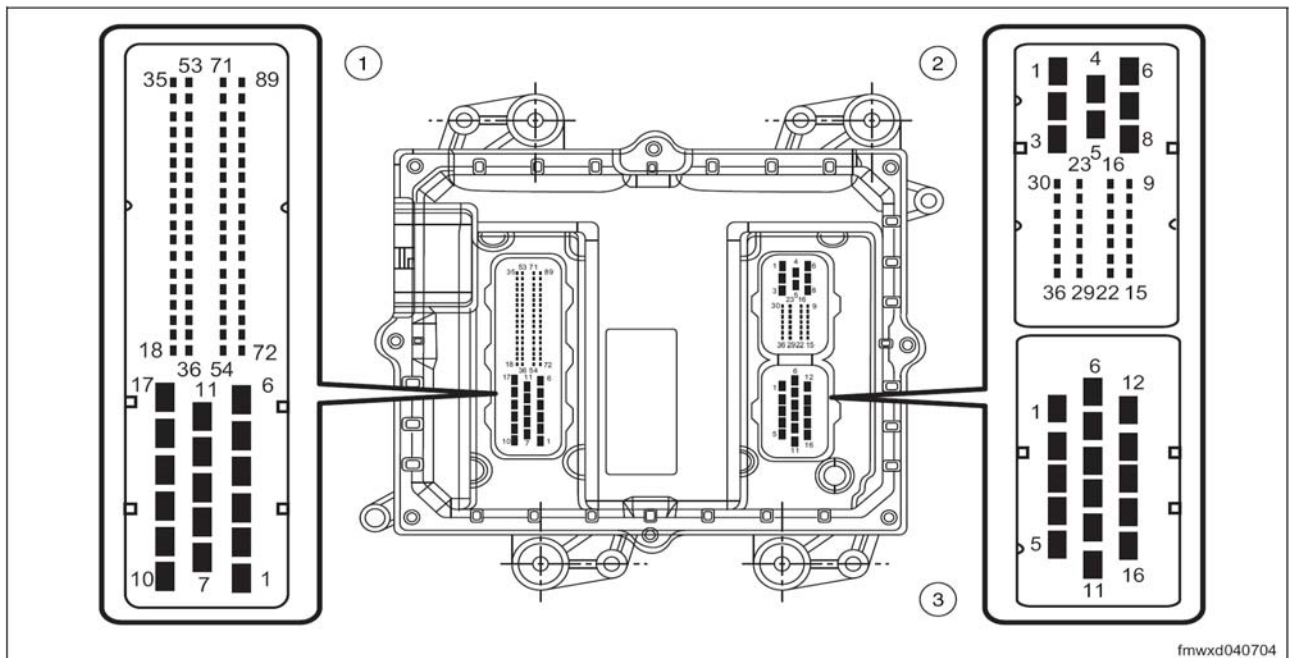
7	Oil Drain Hole
8	Control Cavity
9	Inlet Hole
10	Plunger
11	Needle Valve
12	Nozzle

- (a). The fuel injector can be split into a series of functional parts: cellular-type fuel injector, hydraulic servo system and solenoid valve.
- (b). The high-pressure fuel that comes from the high-pressure common rail enters into fuel injector from inlet joint, and flows into control cavity from inlet hole. The pressure of this high-pressure oil generates downward pressure on the upper section of plunger. Meanwhile, the high-pressure fuel enters into the inferior cavity and acts on the lower annular area of needle valve, which creates upward acting force that pushes the plunger upward. Because the sectional area on the plunger is bigger than the annular area under needle valve, the downward power that acts on the plunger is obviously greater than upward power which acts on the needle valve. At this moment, under the role of both downward power of plunger and spring power of needle valve, the needle valve tightly weighs on the fuel injector. The nozzle is closed at this time and the fuel injector is in quit injecting

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condition.

- (c). When ECU is put through with the solenoid valve of fuel injector, solenoid valve core is attracted to be upward. The ball valve that weighs on oil drain hole opens it. Through oil-pressure unloading acts on the control cavity from the throttle inlet hole, the oil pressure acting on the downward annular section of needle valve overcomes the spring pressure and immediately jacks up the needle valve. Therefore the jet hole of the nozzle is open and it starts to inject oil. When the voltage signal of ECU disappears, the solenoid valve core enables the ball valve to close the oil drain hole under the role of retrospect spring. The plunger immediately makes the needle valve crashed in the plug seat through the action of high-pressure oil in control cavity. Thus it seals the oil drain hole and the fuel injector stops injection. Due to that the lift and shut of needle valve are determined by difference between hydraulic pressures on upper section of plunger and lower annular area of needle valve, thus the power to lift the solenoid valve core is not necessarily to be great. Therefore, the reaction speed of fuel injector is quick, which is commonly in the range of 0.1 ~ 0.3 ms. Thus the accurate and quick injection can be realized.
- (d). Generally, the resistance value of fuel injection is 0.9 Ω .

4. Engine Control Unit

1	Pin Jack
2	Pin Jack

3	Pin Jack
---	----------

Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
1.01	Not Used (The Same Below)			
1.02	ECU Power+ _3	1.05	Battery Voltage	
1.03	ECU Power+ _4	1.05	Battery Voltage	
1.04	Positive Power Supply Output 1 (High End Drive)	1.05	Battery Voltage-0.26V	
1.05	ECU Power- _3	Body	0V	
1.06	ECU Power- _4	Body	0V	
1.07				

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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
1.08	ECU Power+ _1	1.05	Battery Voltage	
1.09	ECU Power+ _2	1.05	Battery Voltage	
1.10	ECU Power-_1	Body	0V	
1.11	ECU Power-_2	Body	0V	
1.12				
1.13	Fan Relay 2	1.05	Battery Voltage-0.26V	
1.14				
1.15				
1.16				
1.17				
1.18				
1.19				
1.20				
1.21				
1.22	Diagnosis Lamp	1.05		
1.23				
1.24	Idling Lift Switch 1, Inner Earth	1.05	0V	
1.25	Idling Lift Switch 1, Signal	1.24	4.9~5.1V	
1.26	Idling Lift Switch 2, Signal	1.05	4.9~5.1V	
1.27				
1.28	Idling Lift Switch 2, Earth	1.05	0V	
1.29	Digital Earth	1.05	0V	
1.30	Inner Earth	1.05	0V	
1.31	Cruise Control Button “ Setup/ Acceleration”	1.05	0~0.0102V	High Level: >3.98V Low Level: <1.79V
1.32	Diesel Engine Starting Switch Signal			High Level: >3.75V Low Level: <2.18V
1.33	Diesel Engine Output Signal	1.05		
1.34	CAN_L	1.05/1.35	2~3V	High Level: >900mV Low Level: <500mV

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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
1.35	CAN_H	1.05/1.34	2~3V	High Level: >900mV Low Level: <500mV
1.36				
1.37	Starting Relay High End	1.05	Relay: No Start 3.5 V, Start 24V	
1.38	Cold Start Lamp	1.05	2.91~3.91V	
1.39	Warning Lamp	1.05	2.91~3.91V	
1.40	T15			ECU Activation Voltage: 3.35~24V
1.41	Main Brake Switch	1.05	0V	High Level: >3.75V Low Level: <2.18V
1.42	Air Conditioner Request Switch	1.26	0V	High Level: >3.75V Low Level: <2.18V
1.43	Oil-Water Separation Water Level Sensor	1.05	4.9~5.1V	
1.44	Parking Brake	1.05	4.755~5.25V	
1.45				
1.46	Cruise Control Button "Recover"	1.05	0~0.0102V	High Level: >3.98V Low Level: <1.97V
1.47	Diesel Engine Stop Switch	1.05		
1.48	Low Idle Switch	1.05/1.29	5.53~5.9V	High Level: >3.75V Low Level: <2.18V
1.49	Redundant Brake Switch	1.05	0V	High Level: >3.75V Low Level: <2.18V
1.50	Starting Relay Low End	1.05	Relay: No Start 3.5V, Start 0V	
1.51				
1.52				
1.53				
1.54				
1.55	Air Intake Preheating Relay	1.05	Vbat-0.45V	
1.56	Water-in-oil Warning Lamp	1.05	2.91~3.91V	
1.57				
1.58	Fan Relay 2 Earth			

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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
1.59	Air Intake Preheating Relay Earth	Body	0V	
1.60				
1.61	T50 Starting Switch	1.05/1.59	0V I	Input High Level: >3.61V Input Low Level: <2.33V
1.62	Torque Limiting Signal (Multi-state Switch)	1.65	4.9~5.1V	
1.63				
1.64	Cruise Control Button "Setup/Slowdown"	1.05	0~0.0102V	
1.65	Torque Limiting Inner Earth	Body	0V	
1.66	Clutch Switch Signal	1.05	0V	High Level: >3.75V Low Level: <2.18V
1.67	Fan Speed Sensor Earth	Body	0V	
1.68	Fan Speed Sensor Power	1.67	4.9~5.1V	
1.69	Fan Speed Sensor Signal	1.67	4.84~5.16V	High Level: >3.69V Low Level: <2.25V
1.70	Vehicle Speed Sensor Earth	Body	0V	
1.71	Speed Sensor Signal	1.70	4.05~4.34V	
1.72	Diagnostic Request Switch	1.05	0~0.0102V	High Level: >3.69V Low Level: <2.25V
1.73				
1.74	Cruise Control Button "Switch"	1.05	0~0.0102V	High Level: >3.98V Low Level: <1.97V
1.75				
1.76	Accelerator Pedal Position Sensor 2 Earth	Body	0V	
1.77	Accelerator Pedal Position Sensor 1 Power	1.78	4.9~5.1V	
1.78	Accelerator Pedal Position Sensor 1 Earth	Body	0V	
1.79	Accelerator Pedal Position Sensor 1 Signal	1.78	0V	Without Press: 0.75V Press to the Floor: 3.84V
1.80	Accelerator Pedal Position Sensor 2 Signal	1.76	0V	Without Press: 0.375V Press to the Floor: 1.92V
1.81	Oil Filter Pressure Difference Sensor	1.83	5.75~5.85V	
1.82				

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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
1.83	Oil Filter Pressure Difference Sensor Earth	Body	0V	
1.84	Accelerator Pedal Position Sensor 2 Power	1.83	4.9~5.1V	
1.85	Neutral Gear Switch	1.05/1.29	0~0.0105V	
1.86				
1.87				
1.88				
1.89	K Wire	1.05	Battery Voltage	
2.01	Fan Solenoid Valve	1.05	2.91~3.91V	
2.02				
2.03	Power Positive Output 2 (High-end Drive)	1.05	Battery Voltage	
2.04	Fuel Heating Solenoid Valve	1.05	Vbat-0.45V	
2.05	Fuel Heating Solenoid Valve Inner Earth	Body	0V	
2.06	Exhaust Brake Solenoid Valve	1.05	2.91~3.91V	
2.07				
2.08				
2.09	Camshaft Speed Sensor Signal	2.10	231~260mV	
2.10	Camshaft Speed Sensor Earth	1.05	0V	
2.11	Air Conditioner Compressor Relay	1.05	2.91~3.91V	
2.12	Rail Pressure Sensor Earth	1.05	0V	
2.13	Rail Pressure Sensor Power	2.12	4.9~5.1V	
2.14	Rail Pressure Sensor Signal	2.12	4.9~5.1V	
2.15	Coolant Temperature Sensor	2.26	4.9~5.1V	
2.16	Remote Throttle Sensor 1 Power	1.05	4.9~5.1V	
2.17	Remote Throttle Sensor 1 Earth	Body	0V	
2.18	Remote Throttle Sensor 2 Earth	Body	0V	
2.19	Crankshaft Speed Sensor Earth	1.05	0V	
2.20				
2.21	Remote Throttle Sensor 1 Signal	2.17	0V	Without Press: 0.75V Press to the Floor: 3.84V
2.22	Remote Throttle Sensor Signal	2.18	0V	Without Press: 0.375V Press to the Floor: 1.92V

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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
2.23	Crankshaft Speed Sensor Signal	2.19	231~260mV	
2.24	Oil Pressure Sensor Earth	Body	0V	
2.25	Inlet Pressure, Temperature Sensor Earth	Body	0V	
2.26	Coolant Temperature Sensor Earth	Body	0V	
2.27	Oil Pressure Sensor Signal	2.24	5.243~5.406	
2.28	Oil Pressure Sensor Signal	2.24	4.9~5.1V	
2.29	Exhaust Brake Switch	2.17	0V	High-Level: > 3.57 V Low Level: < 2.35 V
2.30				
2.31	Remote Throttle Sensor 2 Power	2.17	4.9~5.1V	
2.32	Oil Pressure Sensor Power	2.17	4.9~5.1V	
2.33	Air-Inlet Boost Pressure Sensor Power	2.17	4.9~5.1V	
2.34	Air-Inlet Boost Pressure Sensor Signal	2. 25	5.243 ~ 5.406	
2.35	Fuel Temperature Signal	2.26	4.9 ~ 5.1 V	
2.36	Air Inlet Temperature Sensor Signal	2.25	4.9~5.1V	
3.01	Fuel Injector 1 Capacitance High End 2 (Cylinder 5 Fuel Injector High End)	1.02		
3.02	Fuel Injector 2 Capacitance High End 2 (Cylinder 6 Fuel Injector High End)			
3.03	Fuel Injector3 Capacitance High End 2 (Cylinder 4 Fuel Injector High End)			
3.04	Fuel Injector 1 Capacitance High End 1 (Cylinder 1 Fuel Injector High End)			
3.05	Fuel Injector1 Capacitance High End 1 (Cylinder 3 Fuel Injector High End)			
3.06	Fuel Injector 3 Capacitance High End 1 (Cylinder 2 Fuel Injector High End)			
3.07				
3.08				
3.09	Flow Metering Unit Power(BAT+)	1.05	Vbat-0.26V	
3.10	Flow Metering Unit Power PWM	1.05	2.91~3.91V	
3.11	Fuel Injector 3 Capacitance High End 1 (Cylinder 2 Fuel Injector High End)			
3.12	Fuel Injector 2 Capacitance High End 1 (Cylinder 3 Fuel Injector High End)			

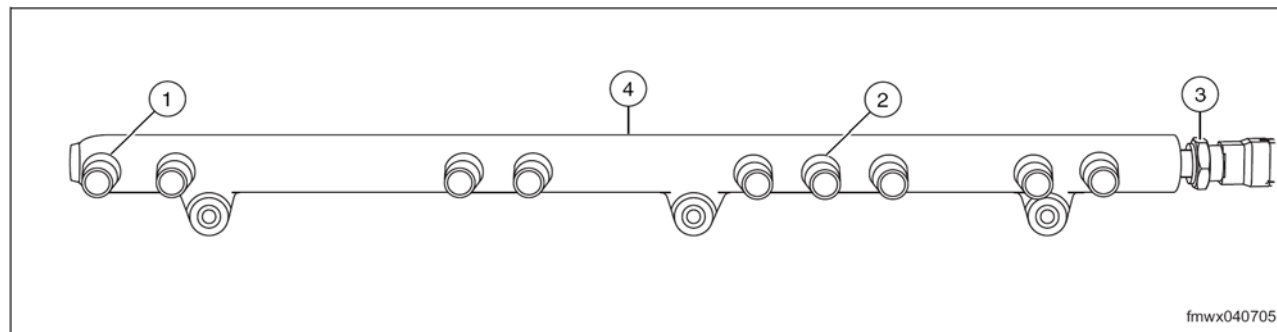
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Pin No.	Pin Description	Reference Pin	Open-circuit Voltage	Signal-input Effective Voltage
3.13	Fuel Injector 1 Capacitance High End 1 (Cylinder 1 Fuel Injector High End)			
3.14	Fuel Injector 3 Capacitance High End 2 Cylinder 4 Fuel Injector High End)			
3.15	Fuel Injector 2 Capacitance High End 2 (Cylinder 6 Fuel Injector High End)			
3.16	Fuel Injector 1 Capacitance High End 2 (Cylinder 5 Fuel Injector High End)			

04

- a). Engine control unit (ECU) is the control center of the electronic-controlled injection system of engine, which mainly decides and controls the injection time to adjust the outlet oil quantity by the signals from engine speed sensor and throttle position sensor. Therefore, the fundamental principal is that: according to the input signals from engine speed (crankshaft position) and throttle position sensor, the engine control unit firstly calculates the basic injection quantity, and then corrects the quantity according to the signals from sensors as per the water temperature, air inlet temperature and inlet pressure, and makes feedback corrections on the signals from phase sensor (camshaft position sensor) so as to determine the optimum injection quantity. Electronic-controlled diesel injection system consists of sensors, ECU and executive body. Its tasks are to electronically control the injection system and to realize the real-time control on the injection quantity and injection timing with operational states. By using speed, temperature and pressure sensors, real-time inspected parameters can be synchronically input into engine control unit (ECU) and compared with the stored parameter values. After treatment and calculation, we can control the executive bodies (like injection pump and preheating) according to the optimum value and drive the injection system to get the optimum diesel operating state.
- (b). To some extent, ECU ensures the operational safety and reliability. For instance, in order to make sure the safety in starting the engine, a neutral gear switch is installed on the transmission. The neutral gear switch and the control line of the engine are both controlled by the EUC. When starting the engine, if the transmission is not at the neutral gear, the starting line of the engine is an open circuit, which cannot start the engine. As the driver turns on the air conditioner, the idle speed of the ECU controls the increasing of idle speed of engine to avoid flameout of the speed. And such as, PTO power output, ECU controlling engine adapts to change in load and automatic regulation of torque output, etc.
- (c). ECU possesses the ability of self diagnosis of fault. It reflects the diesel operational fault caused by the electronic-controlled fuel injection system in the form of flash fault code which is easier to be stored and be inspected out directly or through fault diagnostic apparatus, facilitating quick and accurate fault treatment.
- (d). ECU has another function called "limp home", which means that before the diesel fault influencing the operating reliability and safety has not been removed, ECU can input a "default value" to every executive component. The "default value" is the preset instruction that can only maintain general operation without the influence on the fault expansion. Under this condition, the engine speed can not exceed 1,500 r/min and cannot make full use of total power. Thus, the driver can only drive the vehicle home or maintenance point reluctantly. It cannot resume normal until the fault has been removed.
- (e). The radiating of ECU is achieved by the low-pressure fuel.

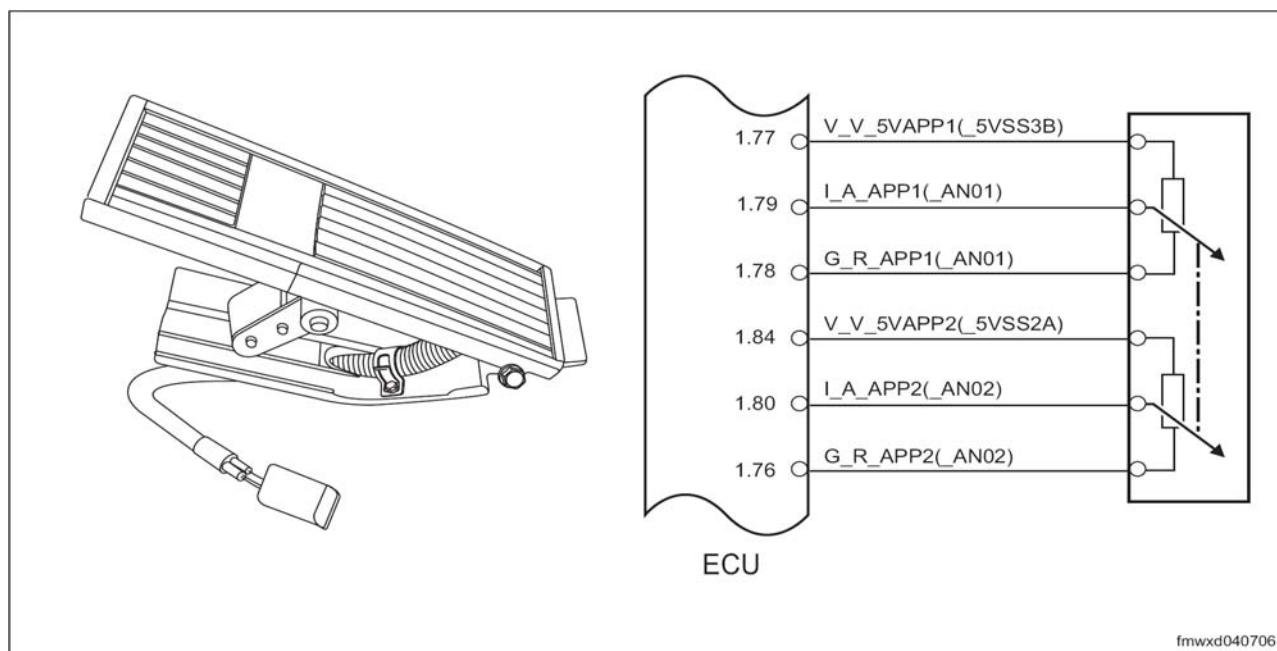
5. Common Rail and Common-rail Pressure Sensor



1	Pressure Limiting Valve	3	Common-rail Pressure Sensor
2	Oil Inlet	4	Common Rail

- Common-rail pipe is fuel pressure storing device. On the one hand, it distributes the high-pressure fuel supplied by high-pressure oil pump to each fuel injector; on the other hand, it weakens the supply pressure impulse of high-pressure oil pump and the pressure oscillation from injector so as to limit the pressure fluctuation of high-pressure oil line in a certain scope. At the same time, fuel pressure inside the common-rail pipe is manipulated by fuel metering valve controlled by ECU, which can determine the oil supply of the injector according to working conditions of diesel engine. A common-rail pressure sensor is installed on the left of the common-rail pipe, by which the fuel pressure inside the pipe is transmitted to ECU at any time to facilitate ECU to change fuel pressure value inside the common-rail through adjusting fuel flow valves.
- A pressure limiting valve is installed on the common-rail pipe, which will open when the pressure inside the pipe is over 160 Mpa to limit the maximum pressure inside the pipe under the set valve(160Mpa).
- The common-rail pressure sensor is installed on the right of the pipe. When ignition switch is turned on, the voltage between 2.14-2.12 is 0.5V, and the voltage at idling speed between 2.14-2.12 is 1.2~1.5V. The variation of rail pressure sensor is 0.5~4.5V.

6. Throttle Position Sensor



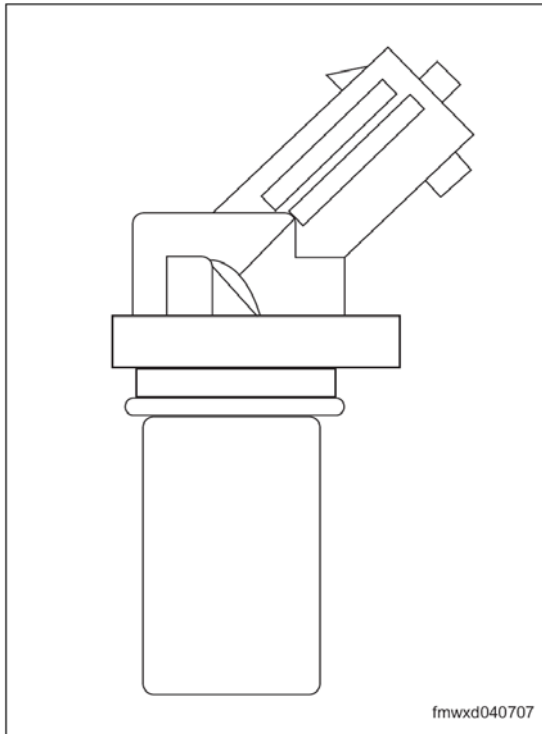
- Electrometer throttle position sensor works under the theory of bleeder circuit. ECU provides a voltage of 5V to sensor circuit. Accelerator pedal connects the brush of the slid rheostat inside the sensor through the revolving shaft, and when the position of throttle position sensor changes, the

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- voltage between the brush and earth terminal changes too, and the compression circuit inside ECU transforms the voltage into position signal of accelerator pedal.
- (b). To ensure the normal output of the signals by sensor, the throttle position sensor outputs two sets of voltage signals to ECU, among which one set has doubled values as those of the other set. Output voltage of throttle position sensor is in proportion to pedal travel.
 - (c). The output voltage signals of throttle position sensor normally fall into: APP1:0.75-3.84V; APP2:0.375-1.92V.
 - (d). When the throttle position sensor fails, the engine speed will be limited at a high idling speed of 1,000 r/min.

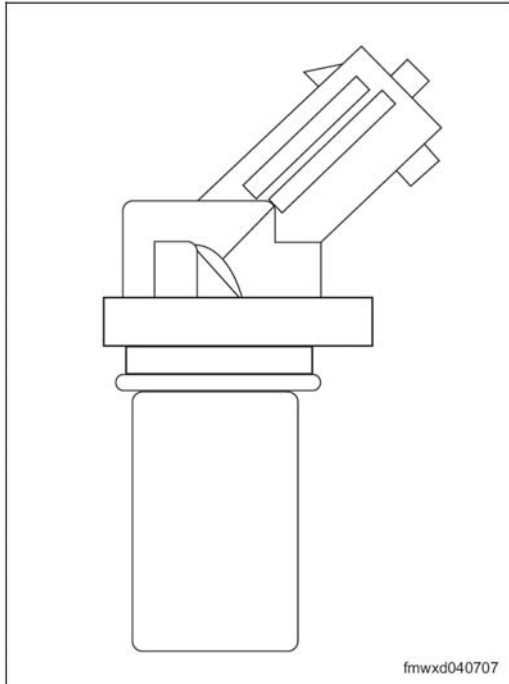
7. Crankshaft Position Sensor

04



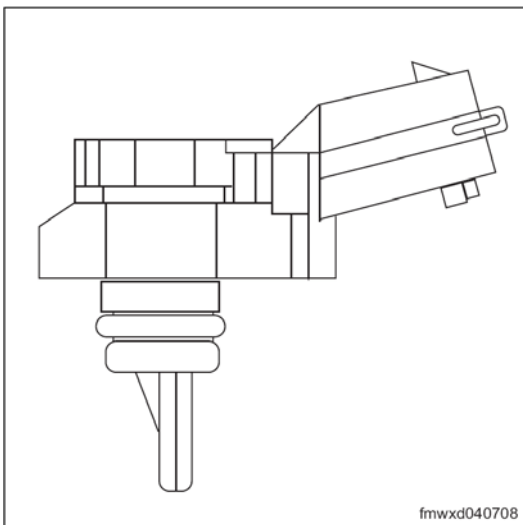
- (a). Crankshaft position sensor is a magneto-electric sensor.
- (b). There are 58 equidistant teeth or slots on the flywheel. However, in front of one top dead center of cylinder compression, two teeth are lacked. As the engine operates, the coils of crankshaft position sensor response to the pulse signals. Every time the engine rotates a circle, the sensor outputs 58 short pulses and one long pulse to ECU. The pulse signals overlie with input signals by camshaft position sensor, thus ECU can judge the working position of each cylinder so as to offer evidence to injection timing.
- (c). Space between crankshaft position sensor and flywheel shall be $1\pm0.5\text{mm}$.
- (d). Resistance of crankshaft position sensor is $770\sim950\Omega$.
- (e). If crankshaft position sensor fails, the engine would be difficult to start or fails to start.

8. Camshaft Position Sensor



- (a). Camshaft position sensor is installed on the high-pressure pump shell of the corresponding position for high-pressure oil pump camshaft gear disk. There are 7 teeth on the gear disk of the high-pressure oil pump camshaft, among which 6 teeth are distributed angle-equally, one teeth on the position of corresponding cylinder compression top dead center. Each time high-pressure oil pump rotates one circle, the sensor outputs 7 pulses to ECU, among which 6 pulses are equidistance pulses and one is not. The signals overlies with output signals by crankshaft position sensor, thus ECU can judge the working position of each cylinder so as to offer evidence to injection timing.
- (b). Resistance of camshaft position sensor is 770~950Ω.
- (c). At idling speed, voltage between 2.09 and earth wire is 3.2-4.9V.
- (d). If camshaft position sensor fails, the engine would be difficult to start or fails to start. If camshaft sensor goes wrong, engine speed would be limited at the state of "limp home" at 1,500 r/min.

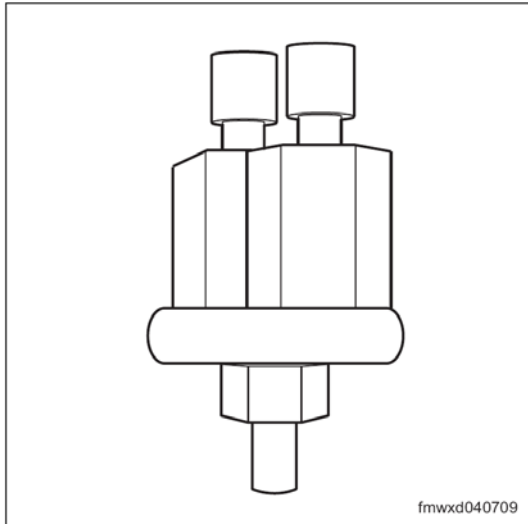
9. Inlet Pressure & Temperature Position Sensor



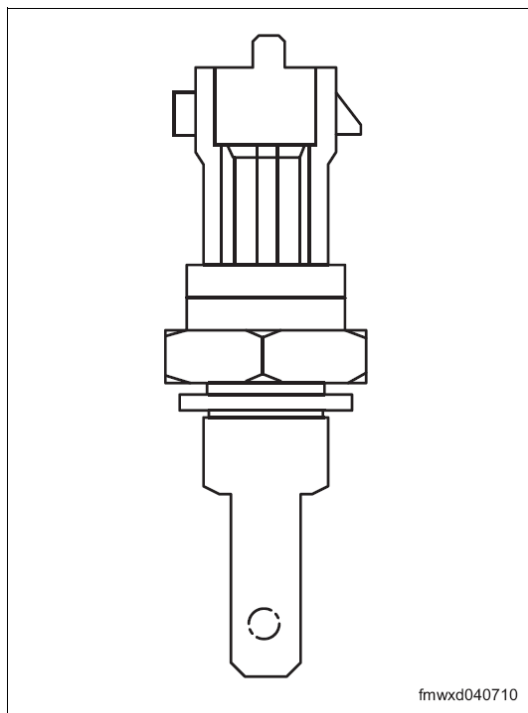
- (a). Inlet pressure & temperature position sensor sends signals of inlet temperature and pressure to ECU at any times, modifies fuel injection quantity, and accurately controls injection quantity, injection time and idling speed.

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- (b). If inlet pressure & temperature sensor fails, engine speed would be limited at the state of "limp home" at 1,500 r/min.
- (c). At idling speed, voltage between 2.34 and 2.25 is 0.5~0.8V, and voltage variation between 2.34 and 2.25 is 0.2~4.8V.

10. Oil Pressure & Temperature Sensor

- (a). Oil pressure & temperature sensor integrates pressure with temperature so as to input oil temperature and pressure signals to ECU.
- (b). Resistances of oil pressure and temperature sensor, varying with temperature, are about between 87~48,000Ω. And the output pressure signals are about 0.2~4.8.
- (c). If output signals from oil pressure and temperature sensor are abnormal, ECU will limit engine operation for protection.

11. Water Temperature Sensor

- (a). Water temperature sensor utilizes thermistor with negative temperature coefficient. As the temperature drops, its resistance increases, and it sends engine temperature signals to ECU at any times.

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- (b). Water temperature sensor resistance, varying with temperature, is about between 0~45K Ω .
- (c). If water temperature sensor fails, engine speed would be limited at the state of “limp home” at 1,500 r/min.

General Steps for Fault Diagnosis

Following diagnostic steps can help you find out the causes for the faults:

Step	Inspection Contents		Measures
1	Confirm the customers' complaint. - Ask the customers about the time, symptom, condition and position of the faults. - Ask the customers whether the vehicle is maintained before and the maintained position; whether the vehicle is added with other equipments.		See Step 2.
2	Appearance Inspection - Inspect the system parts for any deficiency or obvious damage or aging. - Inspect the lines and connectors for releasing or loosening.		See Step 3
3	Basic Inspection - Inspect the battery. - Carry out basic inspection of idling speed and injection timing. - Inspect the fuel pressure. Refer to this chapter, "Basic Inspection".		See Step 4
4	Diagnostic Apparatus Detection Inspect whether there is fault code and abnormal data stream. Whether there is fault code?	Yes	see Step 5
		No	see Step 6
5	Overhaul the Faults According to Fault Code. Refer to this chapter, "Flash Fault Code List".		See Step 7
6	Overhaul the Faults According to Symptoms. Refer to this chapter, "Fault SymptomTable".		
7	Verification of Maintenance After repairing the vehicle, inspect whether the maintenance is achieved thoroughly. It is particularly important for intermittent fault verification maintenance work.		

Reading and Erasing of Flash Fault Code

If the engine control fails, there are two ways to read the fault code:

1. Read through the flash code of diesel engine flash code lamp.
2. Read through fault diagnostic apparatus.

1. Flash Code

- (a). Flash code is the fault code obtained from the flash frequency of the flash code lamp on the instrument.
- (b). After the flash fault code appears, remove the fault according to the code and the corresponding fault description.
- (c). Delete the flash fault code as soon as the fault is removed.

2. SAE Code

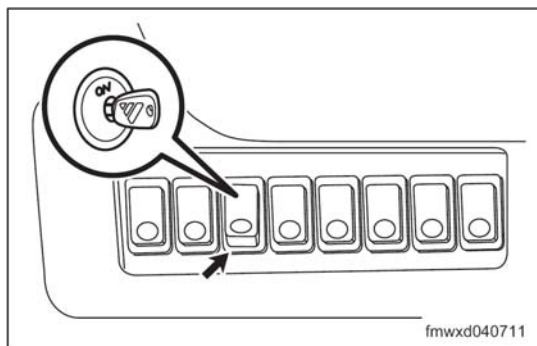
This kind of code can only be read through special fault detector.

When removing the fault of the vehicle equipped with on-board diagnosis (OBD), the vehicle shall be connected with the special diagnostic equipment with OBD function. Thus all output data from ECU unit of the vehicle can be read. If the ECU control unit detects the fault, OBD regulations require on-board computer to light the fault indicator on the apparatus board.

Caution: before the fault code is read, make sure the voltage of battery is normal (not less than 22V).

Make sure that the engine fault indicator works well.

Refer to this chapter, "Fault Indicator is Off and Fault Indicator Fails to Flash (In the operation the fault diagnosis switch)".



1. Read flash fault code

- (a). Turn on ignition switch.
- (b). Press and free the fault diagnostic switch.

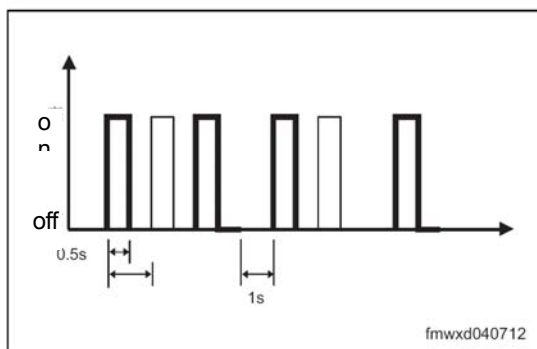
- (c). The fault indicator lamp will flash, and then read and record the flash code.

Each code consists of three units. Time interval of the code of each unit flashing is 0.5s, and the interval between the units is 1s. e.g. "321"

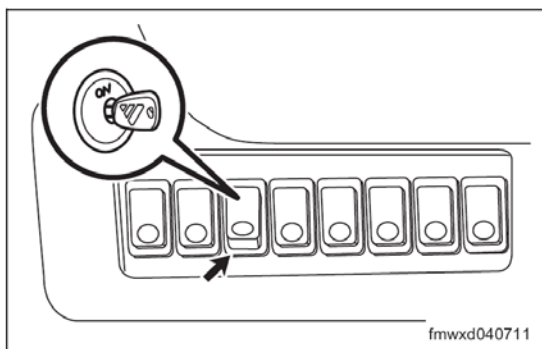
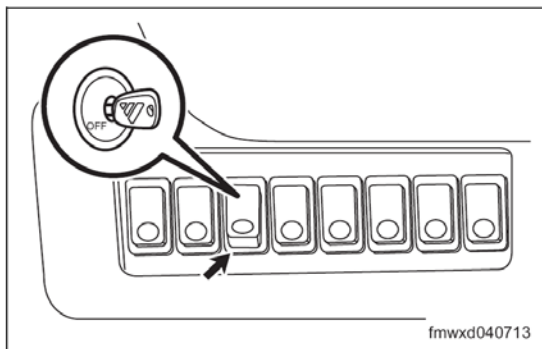
Hint: one operation of fault diagnostic switch only obtains one flash code. All codes are obtained when the first code appears again. When the diagnostic switch is "ON", the flash code lamp keeps on.

ECU error memory can memorize at most 10 errors.

Hint: for the corresponding contents of the flash codes, refer to this chapter, "Flash Fault Code List".



Diagnosis - Cigarette Lighter



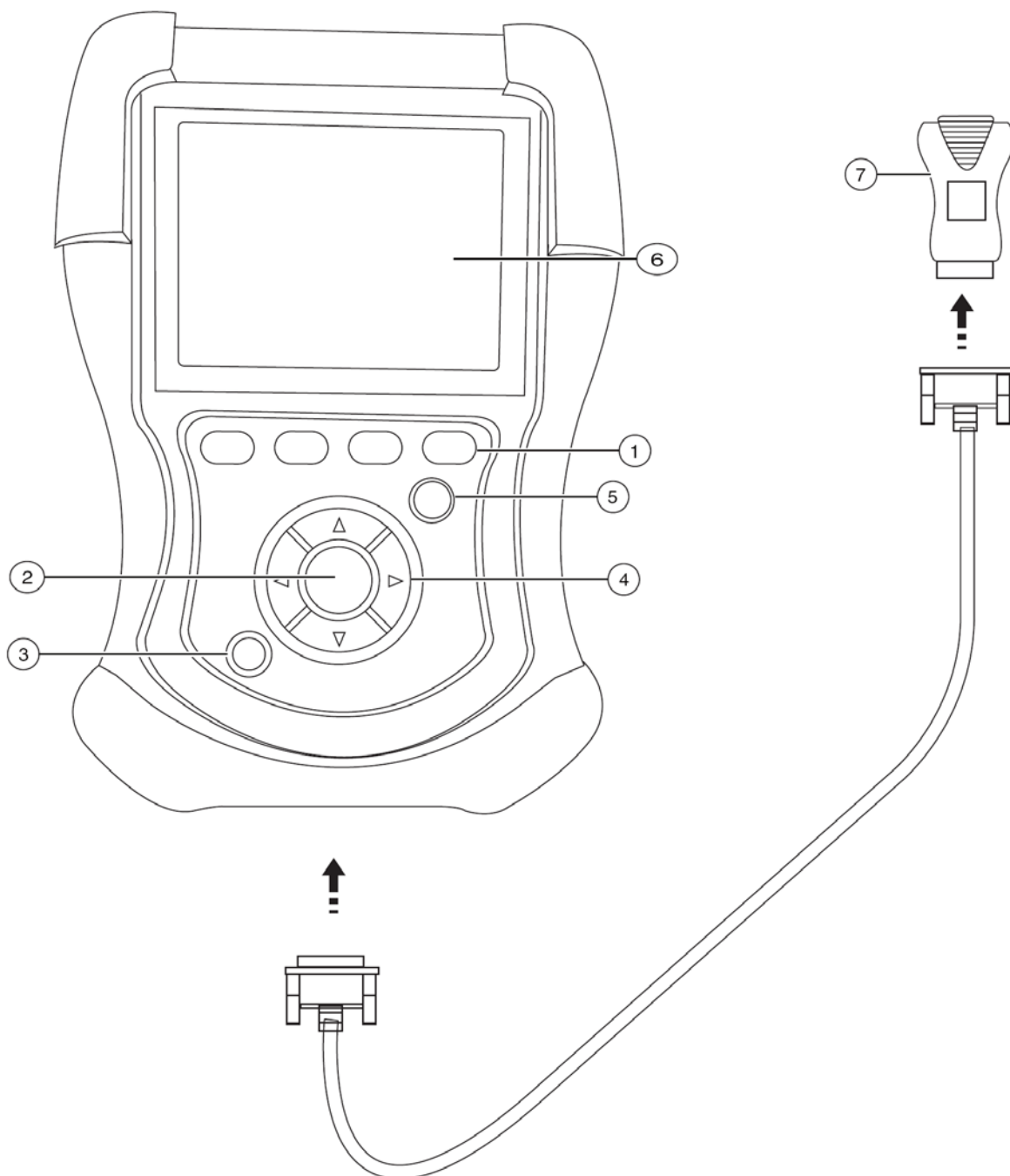
2. Erase flash fault code

Caution: delete the flash fault code as soon as the fault is removed.

- (a). Turn off ignition switch. Press the fault diagnostic switch and keep pressing.
- (b). Then turn on ignition switch. Keep pressing the fault diagnostic switch for 4~8s and release.
- (c). Re-read the flash fault code, and if there is still fault code, removal is needed.

KT600 Diagnostic Apparatus Usage and Fault Test

04



fmwxd040714

1	Multifunction Auxiliary Key	5	Return to Previous Menu
2	Enter into Menu, Confirm Selected Option	6	T-Touch Color Screen

Diagnosis - Cigarette Lighter

3	Power Switch	7	Auman Special Joint Conversion
4	Direction Selection Key		

Diagnostic Apparatus Power Supply Mode

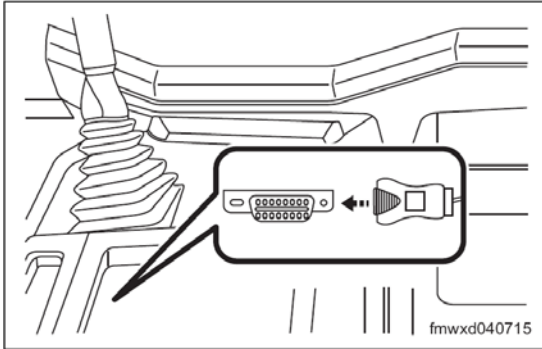
1. **~230V Alternating Current Power Supply.**
2. **Battery Power Supply.**
3. **Diagnostic Apparatus Battery Power Supply (Charge).**

Diagnosis - Cigarette Lighter

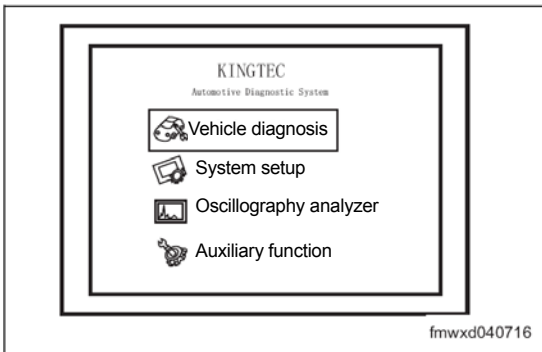
Caution: before the fault code is read, make sure the voltage of battery is normal (not less than 22V).
Caution: diagnostic apparatus of different versions cannot be exactly identical to the diagnostic interface of different vehicle types. Following are the examples showing partial functions of diagnostic apparatus.

Hint: if diagnostic apparatus cannot communicate with ECU, refer to this chapter, "Diagnostic Apparatus Fails to Communicate".

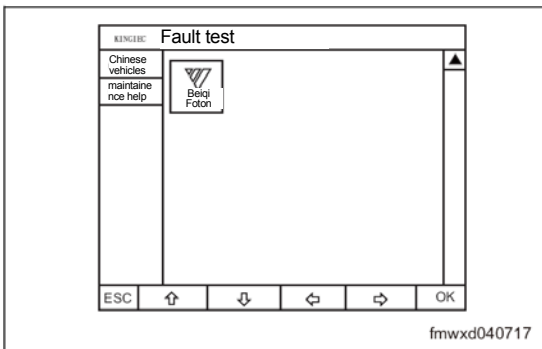
04

**1. Connect diagnostic apparatus**

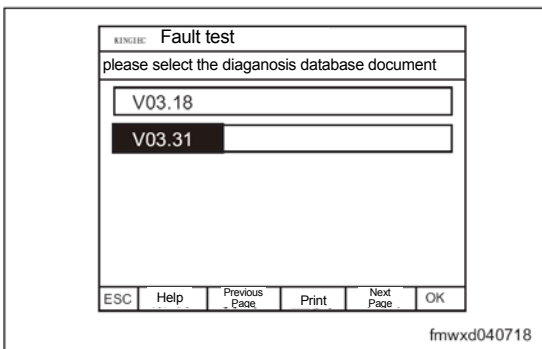
- (a). Turn on ignition switch.
- (b). Connect diagnostic apparatus to the diagnostic joint of the engine.

**2. Enter into main menu**

- (a). Turn on diagnostic apparatus power.
- (b). Select "Vehicle Diagnosis".



- (c). Select "Beiqi Foton" icon.



- (d). Select "V03.31" version.

Diagnosis - Cigarette Lighter

KINGHC Fault test

Beiqi Foton 05, 42\03, 31

Limousine	Pickup Truck
SUV	Light Truck
Light Truck	Auman Heavy Duty Truck
Engineering Van	OBD
PU201	

ESC Help Previous Page Print Next Page OK

fmwxd040719

(e). Select "Auman Heavy Trucks".

KINGHC Fault test

Beiqi Foton 05, 42\03, 31 \Auman

Engine
ABS

ESC Help Previous Page Print Next Page OK

fmwxd040720

(f). Select "Engine".

04

KINGHC Fault test

Beiqi Foton 05, 42\03, 31 \Auman\ENG

Shanghai Diesel Engine
Wuxi Diesel Engine
Chaoyang Diesel Engine
Yuchai Diesel Engine
Perkins Engine
Cummins Engine
Foton Engine

ESC Help Previous Page Print Next Page OK

fmwxd040721

(g). Select "Weichai Engine".

(h). Select "Bosch Diesel Common Rail System_24V".

KINGHC Fault test

Beiqi Foton 05, 42\03, 31 \Auman\ENG\weichai

Bosch Diesel Common Rail System CAN Bus-24V
H3 Vehicle Body System
WoodWard CNG System-24V

ESC Help Previous Page Print Next Page OK

fmwxd040722

(i). Select "EDC7UC31"

KINGHC Fault test

Beiqi Foton 05, 42\03, 31 \Auman\ENG\weichai\Bosch Common Rail

EDC7UC31

ESC Help Previous Page Print Next Page OK

fmwxd040723

KINGCIB Fault test					
Beiqi Foton (V05, 42\03, 31) Auman (ENG)Weifang Diesel Bosh Common Rail Weifang Diesel					
Dynamic Data Diagnosis Weifang Diesel Maintenance Manual					
ESC	Help	Previous Page	Print	Next Page	OK

fmwxd040724

3. Read and erase fault code

(a). Select "static data diagnosis".

KINGCIB Fault test					
北汽福田 (V05, 42\03, 31) Auman (ENG)Weifang Diesel Bosh Common Rail Weifang Diesel					
Dynamic Data Diagnosis Weifang Diesel Maintenance Manual					
ESC	Help	Previous Page	Print	Next Page	OK

fmwxd040724

(b). Select "read fault code".

KINGCIB Fault test					
\03, 31\ Ouman (ENG)Weifang Diesel \Bosh Common Rail Weifang Diesel					
Read version information Erase fault code Functional test					
ESC	Help	Previous Page	Print	Next Page	OK

fmwxd040725

(c). Select "erase fault code".

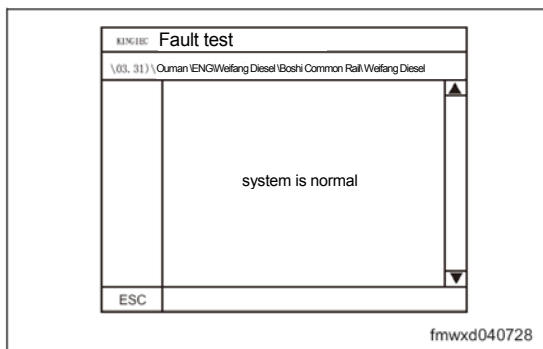
KINGCIB Fault test					
\03, 31\ Ouman (ENG)Weifang Diesel \Bosh Common Rail Weifang Diesel					
Fault Code: 1 The common rail difference is lower than the minimum threshold value and the injection quantity is lower than the threshold value. Fault Code: 188 The filtered MeUn current is lower than the minimum tolerated current					
ESC		Save			

fmwxd040726

KINGCIB Fault test					
\03, 31\ Ouman (ENG)Weifang Diesel \Bosh Common Rail Weifang Diesel					
Read version information Read fault code Functional test					
ESC	Help	Previous Page	Print	Next Page	OK

fmwxd040727

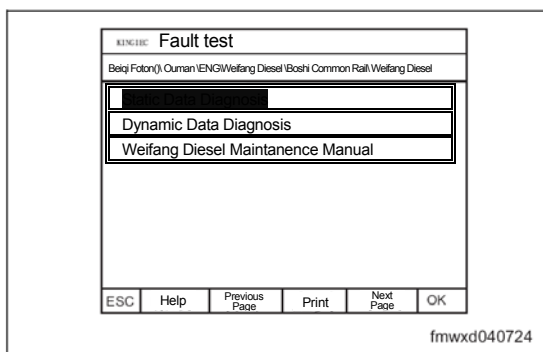
Diagnosis - Cigarette Lighter



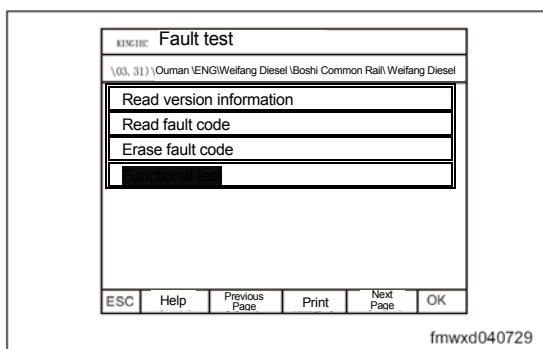
4. Cylinder cutout test

- (a). Select "static data diagnosis".

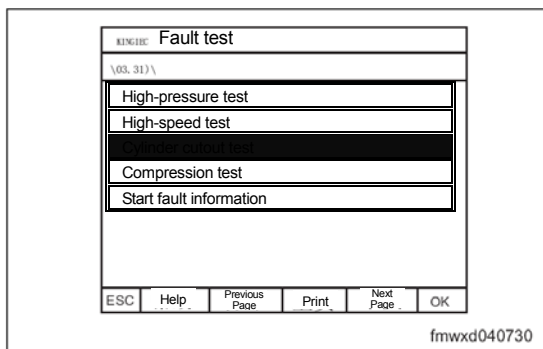
04



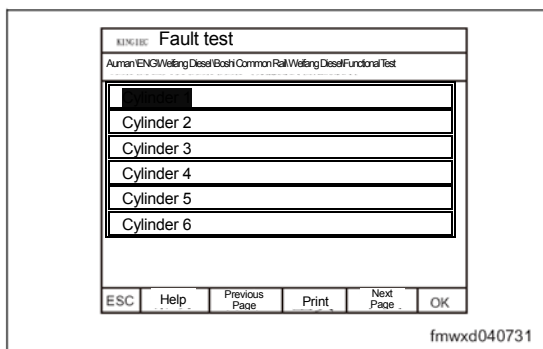
- (b). Select "function test".



- (c). Select "cylinder cutout test".



- (d). Select each cylinder test.



FAULT test

Wefang Diesel/Boshi Common Rail/Wefang Diesel/Functional Test/Cylinder output test

☐	Cylinder 2	The action is being performed, please observe the symptoms. Rotation speed of engine:
☐	Cylinder 3	
☐	Cylinder 4	
☐	Cylinder 5	
☐	Cylinder 6	

ESC Help Previous Page Print Next Page OK

fmwxd040732

FAULT test

Wefang Diesel/Boshi Common Rail/Wefang Diesel/Functional Test/Cylinder output test

☐	Cylinder 2	Test is finished; please press any key to exit!
☐	Cylinder 3	
☐	Cylinder 4	
☐	Cylinder 5	
☐	Cylinder 6	

ESC Help Previous Page Print Next Page OK

fmwxd040733

FAULT test

Beiqi Foton/Auman/ENG/Wefang Diesel/Boshi Common Rail/Wefang Diesel

Static Data Diagnosis

Wefang Diesel Maintenance Manual

ESC Help Previous Page Print Next Page OK

fmwxd040734

5. Read data stream

- (a). Select "dynamic data diagnosis".

FAULT test

Beiqi Foton/Auman/ENG/Wefang Diesel/Boshi Common Rail/Wefang Diesel

Action test

ESC Help Previous Page Print Next Page OK

fmwxd040735

- (b). Select "read data stream".

FAULT test

Auman/ENG/Wefang Diesel/Boshi Common Rail/Wefang Diesel/Functional Test

☐	Battery voltage	27.57V
☐	Rotation of engine	700r/min
☐	Accelerator pedal position sensor 1	0.75V
☐	Accelerator pedal position sensor 2	0.38V
☐	Calculated accelerator pedal sensor	0%
☐	Pre-injection 1 injection time	440微妙
☐	Main injection duration time	751微妙
☐	Injection quantity	16.4mg

ESC Help Previous Page Print Next Page OK

fmwxd040736

Diagnosis - Cigarette Lighter

Reference List of Data Stream

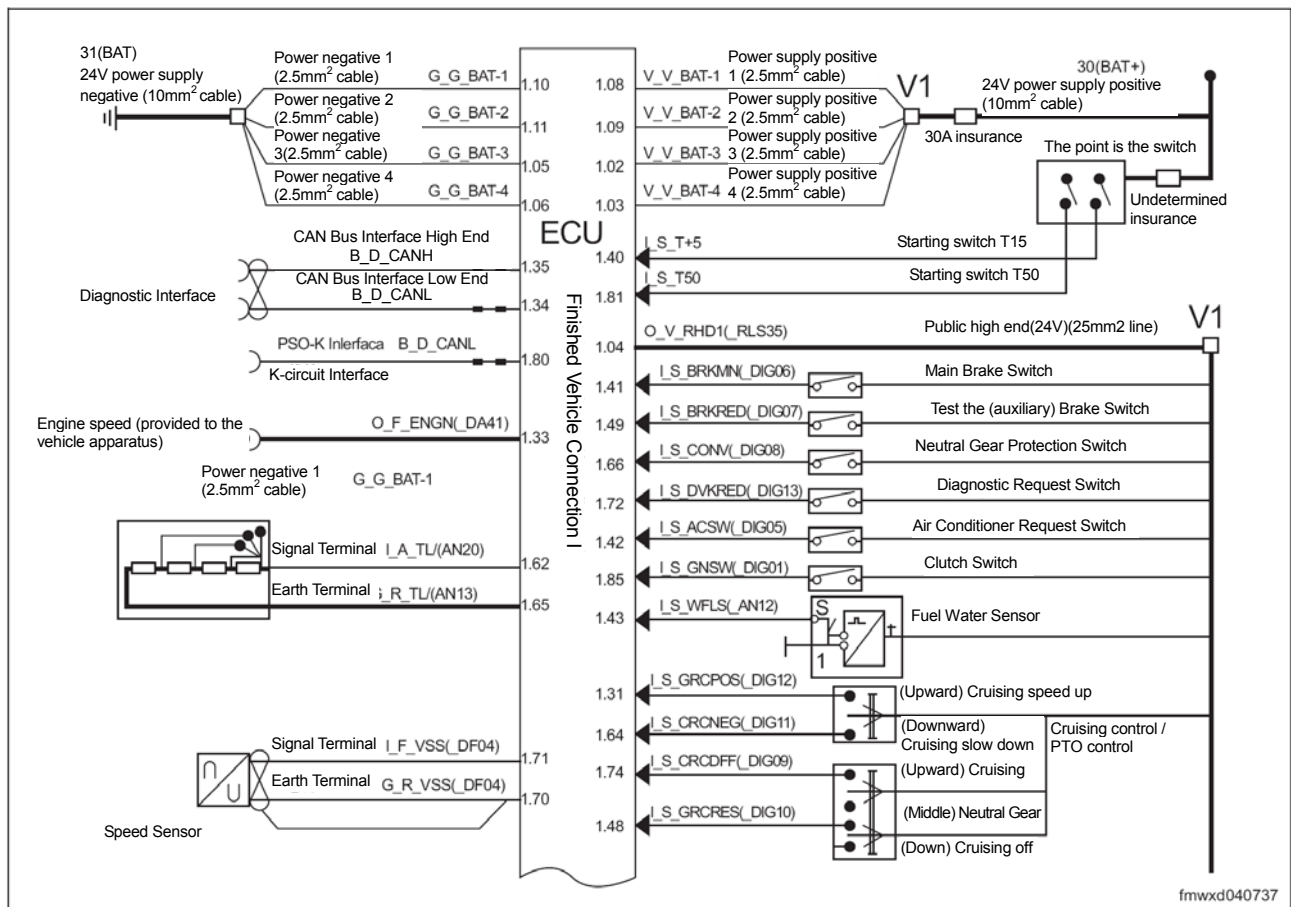
Name of Data Stream	High Speed	Idle Speed	Static
Engine speed (r / min)	2396	598	0
Coolant temperature (°C)	76.13	71.63	76.53
Battery voltage (V)	28.17	28.33	27.00
Accelerator Pedal Position Sensor 1 (V)	3.80	0.74	0.74
Accelerator Pedal Position Sensor 2 (V)	A1.92	0.38	0.38
Calculated Accelerator Pedal Position (%)	100	0	0
Pre-spray 1 fuel injection time (μs)	0	529	0
Main injection duration (μs)	686	516	0
Injection quantity (mg)	26.0	5.6	58.7
Rated fuel rail pressure (MPa)	86.3	41.8	40.0
Actual fuel rail pressure (MPa)	86.8	42.2	0.0
Accumulator Pressure Sensor voltage (V)	2.43	1.42	0.49
Fuel Adjustment Unit Trigger (mA)	1324	1443	401
Fuel dosage unit pulse rate factor (%)	17.68	19.08	7.13
Coolant Temperature Sensor voltage (V)	1.06	1.18	1.05
Atmospheric Pressure Sensor voltage (V)	4.04	4.03	4.03
Atmospheric pressure (hPa)	1022	1021	1021
Actual boost pressure (hPa)	1306	1024	1016
Voltage, air intake temperature (V)	2.85	2.89	2.56
Air intake temperature (°C)	28.9	28.0	35.4
Engine oil temperature (°C)	82.3	77.9	78.0
Fuel temperature (°C)	76.1	76.1	76.3
Operating speed	0	0	0
Engine Control Fault Indicator is off	Closed	Closed	Closed
Brake Switch 1 is on	Closed	-	-
Brake Switch 2 off	-	Open	Open
Clutch Switch is not operated	Closed	Closed	Closed
Engine Fault Indicator	ON	ON	ON
Brake Master Switch logic value	OFF	OFF	OFF

Diagnosis - Cigarette Lighter

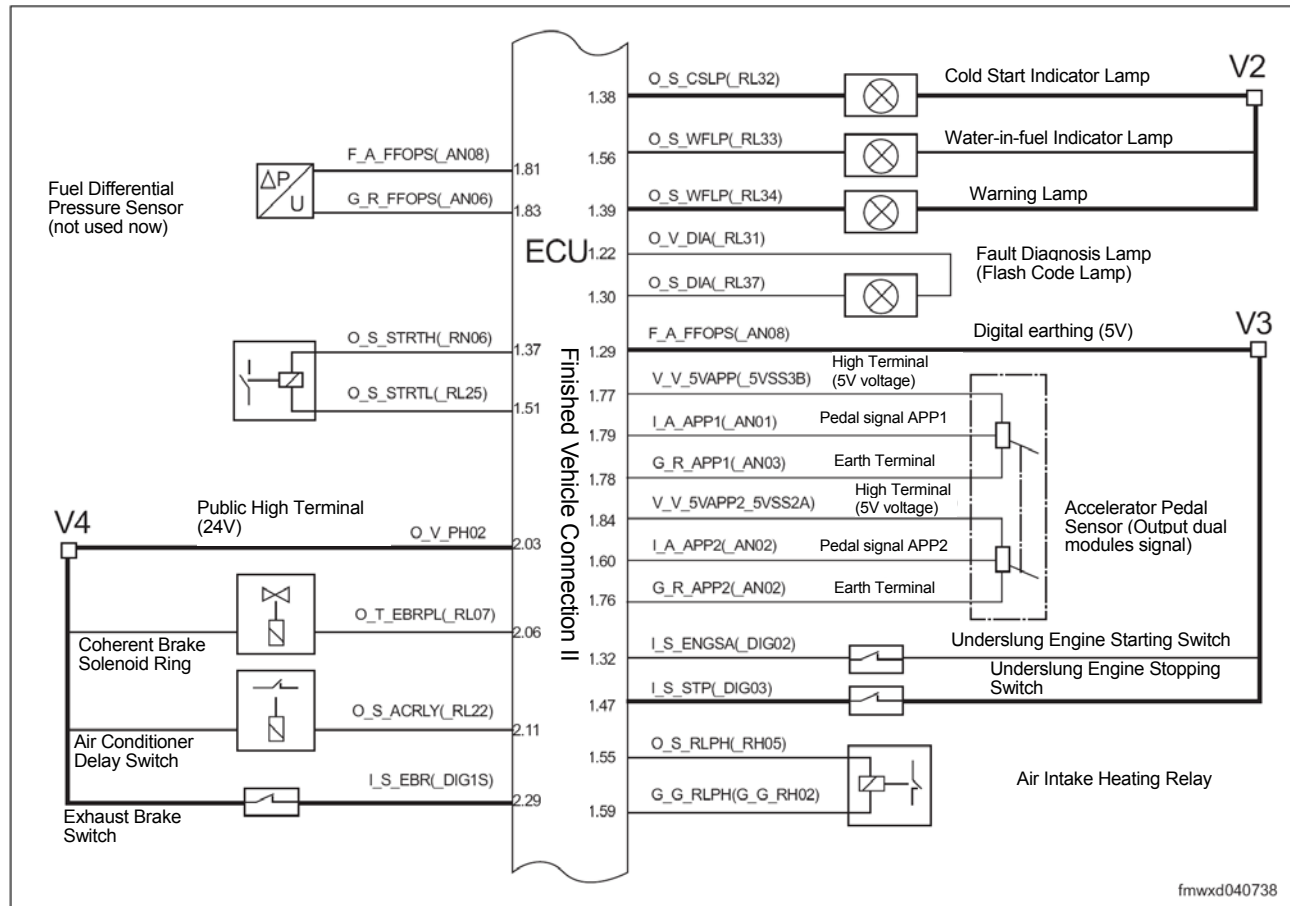
Name of Data Stream	High Speed	Idle Speed	Static
Brake Auxiliary Switch logic value	ON	ON	ON
Clutch Switch	Not operated	Not operated	Not operated
Air conditioner switch	ON	ON	ON

Diagnosis - Cigarette Lighter

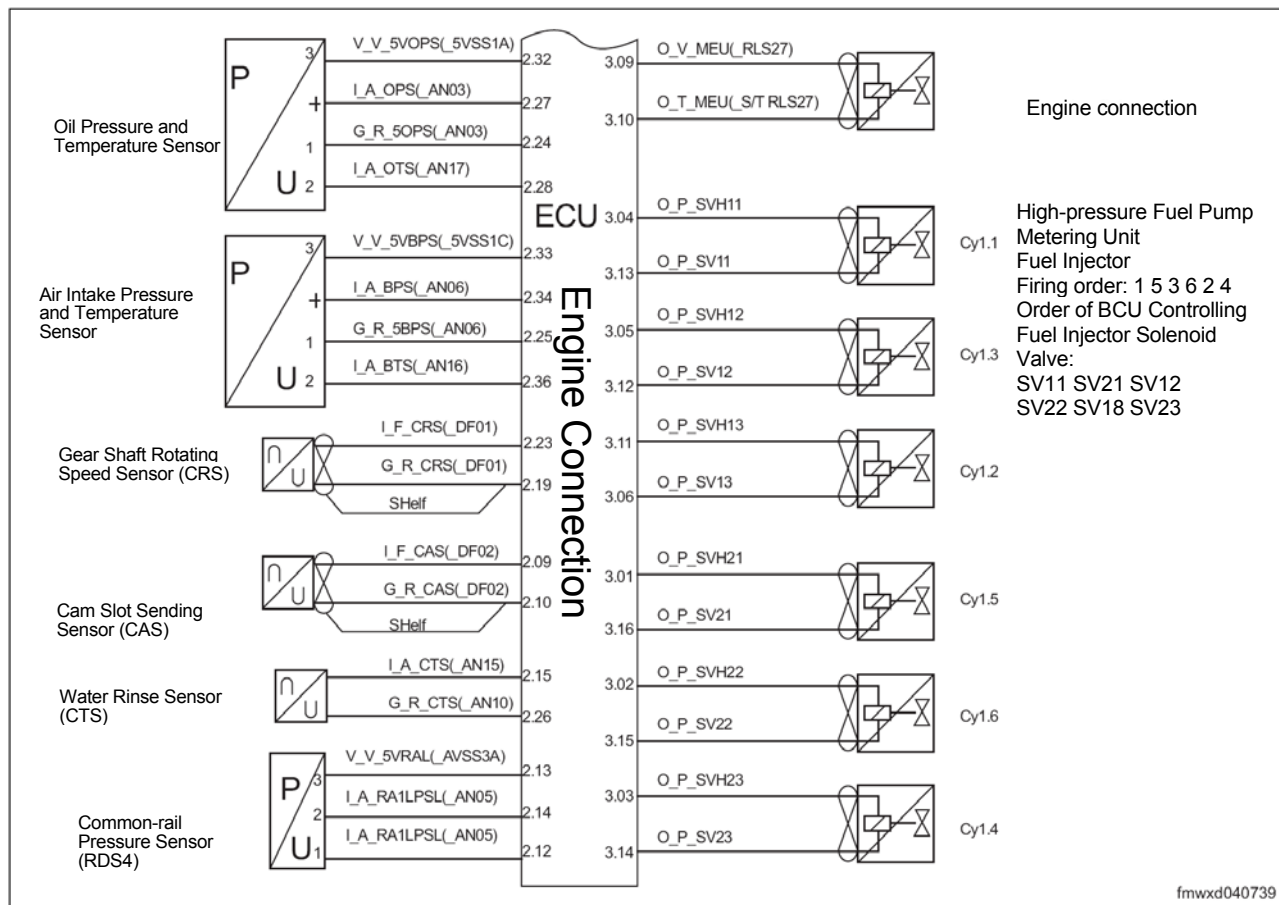
Electric Schematic Diagram



Diagnosis - Cigarette Lighter



Diagnosis - Cigarette Lighter



Basic Inspection

Steps	Inspection Contents		Measures
1	Inspect the battery voltage • Turn off the ignition switch. • Use the battery testing tools to inspect the battery Whether the battery is normal?	Yes	See Step 2
		No.	Replace the battery
2	Inspect the rotation of the engine • Start the engine. • Inspect whether the engine is rotating. Whether the engine is rotating?	Yes	See Step 3
		No.	Inspect the starting system fault of the engine Refer to "Chapter 04, Diagnosis - Starting / Preheating System"
3.	Inspect the operation of the engine • After starting the engine, observe the operation of the engine • Identify the fault. The engine can not start, or it can start but can not operate normally. Whether the engine can start?	Yes	See Step 4
		No.	See Step 6
4	Inspect the low-pressure fuel supply system • Inspect whether there is sufficient fuel in the tank for use. • Inspect whether the fuel tank and pipe are bent or blocked. • Inspect whether the fuel pipe is disconnected or leaking. • Inspect whether there is air in the low-pressure fuel pipe. When necessary, exhaust air in the fuel system. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" Whether the above faults exist?	Yes	Overhaul the fault parts.
		No.	See Step 5.
5	Inspect the engine common-rail system • Use the diagnostic apparatus to inspect whether there is a fault in the engine common-rail system • Use diagnostic apparatus to inspect whether the parameters of the engine common-rail system are normal. Whether there is a fault code?	Yes	Diagnose according to the fault symptoms. Refer to this Chapter, "Fault Symptom Table"
		No.	Diagnose according to the fault code Refer to this Chapter, "Flash Fault Code Table" Refer to this Chapter, "Reference List of Data Stream"
6.	Inspect the air intake and outlet system • Inspect whether the air filter is blocked; if necessary, replace the filter. • Inspect whether the vortex supercharger is damaged. • Inspect whether the exhaust brake operation is abnormal; whether the exhaust butterfly valve sticks and blocks the exhaust pipe. Whether the above faults exist?	Yes	Overhaul the fault parts.
		No.	See Step 7.
7	Inspect ignition timing • Inspect whether the ignition timing is normal. Whether the ignition timing is normal?	Yes	Inspect the engine machinery system.
		No.	Adjust the ignition timing.

Diagnosis - Cigarette Lighter

Fault Symptom Table

Use the following table to help you find the fault. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

Fault Symptoms	Suspected Position	References
The diagnostic apparatus fails to communicate.	1. Fault diagnosis circuit/ K circuit	Chapter 04, Diagnosis-Engine Control-WP, Diagnostic Apparatus Fails to Communicate
	2. ECU	
The fault indicator is off	1. Fault indicator bulb	Chapter 04, Diagnosis-Engine Control-WP, Fault Indicator Lamp is Off
	2. Circuit of the fault indicator	
	3. ECU	
The fault indicator fails to flash (In operating the fault diagnosis switch)	1. Fault diagnosis switch	Chapter 04, Diagnosis-Engine Control-WP, Fault Indicator Fails to Flash
	2. ECU	
Fail to start	1. Battery	Chapter 04, Diagnosis-Engine Control-WP, Fail to start
	2. Starting system circuit/relay/fuse	
	3. Engine control system circuit	
	4. Engine crankshaft sensor, camshaft position sensor	
	5. Fuel insufficient	
	6. Fuel pipe bending, blocked or leakage	
	7. There is air in the fuel circuit system	
	8. Fuel injector	
	9. High-pressure oil pump	
	10. Common-rail pipe and its pressure control device (pressure limiting valve)	
	11. ECU	
	12. Engine machinery	

Diagnosis - Cigarette Lighter

Fault Symptoms	Suspected Position	References
04 Hard Starting	1. Battery	Chapter 04, Diagnosis-Engine Control-WP, Hard Starting
	2. Engine	
	3. Engine crankshaft sensor, camshaft position sensor	
	4. Fuel type is incorrect	
	5. Fuel insufficient	
	6. Fuel pipe bending, blocked or leakage	
	7. There is air in the fuel circuit system	
	8. Preheating system	
	9. Water temperature sensor (winter)	
	10. Exhaust brake and its butterfly valve	
	11. Fuel injector	
	12. Common-rail pipe and its pressure control device (pressure limiting valve)	
	13. Engine machinery	
Automatically flame out after starting	1. Starting system circuit/relay/fuse	Chapter 04, Diagnosis-Engine Control-WP, Automatically Flame out after Starting
	2. Engine control system circuit	
	3. Fuel insufficient	
	4. Fuel pipe bending, blocked or leakage	
	5. There is air in the fuel circuit system	
	6. Speed sensor, water temperature sensor, oil pressure and temperature sensor	
	7. Common-rail pipe and its pressure control device (pressure limiting valve)	
	8. ECU	
	9. Engine machinery	

Diagnosis - Cigarette Lighter

Fault Symptoms	Suspected Position	References
Power insufficient	1. Air filter and inlet pipe	Chapter 04, Diagnosis-Engine Control-WP, Power Insufficient
	2. Fuel type is incorrect	
	3. Fuel pipe bending, blocked or leakage	
	4. Turbo-supercharger	
	5. Throttle position sensor, crankshaft position sensor, water temperature sensor, air intake pressure and temperature sensor, common-rail pressure sensor	
	6. Exhaust brake and its butterfly valve	
	7. Intercooler	
	8. Manifold leakage	
	9. Fuel injector	
	10. High-pressure oil pump	
	11. Engine machinery	
	12. Clutch, transmission drive part	
Excessive black smoke	1. Air filter and inlet pipe	Chapter 04, Diagnosis-Engine Control-WP, Excessive Black Smoke
	2. Turbo-supercharger	
	3. Water temperature sensor	
	4. Fuel injector	
	5. Engine machinery	
White or blue smoke fuming	1. Water temperature sensor	Chapter 04, Diagnosis-Engine Control-WP, White or Blue Smoke
	2. Excessive oil	
	3. Turbo-supercharger	
	4. Engine machinery	
Unstable idle speed	1. Fuel type is incorrect	Chapter 04, Diagnosis-Engine Control-WP, Unstable Idle Speed
	2. Fuel pipe bending, blocked or leakage	
	3. There is air in the fuel circuit system	
	4. Speed sensor	
	5. Engine machinery	
	6. Fuel injector	
	7. High-pressure oil pump	
	8. Engine vibration bracket	

Flash Fault Code List

Flash Fault Codes	Fault Code Parts	References
1-1-1	AD converter error inside ECU	Chapter 04, Diagnosis-Engine Control-WP, 1-1-1 AD Converter Error inside ECU
1-1-2	Sync signal error	Chapter 04, Diagnosis-Engine Control-WP, 1-1-2 Sync Signal Error 1-1-3 Sync Signal Error 1-1-4 Sync Signal Error
1-1-3	Sync signal error	
1-1-4	Sync signal error	
1-1-5	Error of time handling unit in the ECU	Chapter 04, Diagnosis-Engine Control-WP, 1-1-5 Error of Time Handling Unit in the ECU 1-1-6 ECU Inner Error
1-1-6	ECU inner error	
1-2-1	Starting relay error	Chapter 04, Diagnosis-Engine Control-WP, 1-2-1 Starting Relay Error
1-2-2	Ignition switch "ON" (T15) error	Chapter 04, Diagnosis-Engine Control-WP, 1-2-2 Ignition Switch "ON" (T15) Error
1-2-3	Ignition switch "START"(T50) error	Chapter 04, Diagnosis-Engine Control-WP, 1-2-3 Ignition Switch "START"(T50) Error
1-2-4	Battery fault	Chapter 04, Diagnosis-Engine Control-WP, 1-2-4 Battery Fault
1-2-5	FMTC non-monotonic pulse spectrum	Chapter 04, Diagnosis-Engine Control-WP, 1-2-5 FMTC Non-monotonic Pulse Spectrum
1-3-1	ECU inner sensor power supply module	Chapter 04, Diagnosis-Engine Control-WP, 1-3-1 ECU Inner Sensor Power Supply Module inside
1-3-2	Main relay error	Chapter 04, Diagnosis-Engine Control-WP, 1-3-2 Main Relay Error
1-3-3	Rail pressure sensor	Chapter 04, Diagnosis-Engine Control-WP, 1-3-3 Rail Pressure Sensor
1-3-4	Common-rail pressure limiting valve problem	Chapter 04, Diagnosis-Engine Control-WP, 1-3-4 Common-rail Pressure Limiting Valve Problem
1-3-5	Flow measurement unit error	Chapter 04, Diagnosis-Engine Control-WP, 1-3-5 Flow Measurement Unit Error
1-3-6	Common-rail Pressure Limiting Valve	Chapter 04, Diagnosis-Engine Control-WP, 1-3-6 Common-rail Pressure Limiting Valve

Diagnosis - Cigarette Lighter

Flash Fault Codes	Fault Code Parts	References
1-4-1	Cylinder 1 fuel injector error	Chapter 04, Diagnosis-Engine Control-WP, 1-4-11 Cylinder Fuel Injector Error 1-4-22 Cylinder Fuel Injector Error 1-4-33 Cylinder Fuel Injector Error 1-4-44 Cylinder Fuel Injector Error 1-4-55 Cylinder Fuel Injector Error 1-4-66 Cylinder Fuel Injector Error
1-4-2	Cylinder 2 fuel injector error	
1-4-3	Cylinder 3 fuel injector error	
1-4-4	Cylinder 4 fuel injector error	
1-4-5	Cylinder 5 fuel injector error	
1-4-6	Cylinder 6 fuel injector error	
1-5-1	Capacitance 1 (control 1.2.3 fuel injectors) error	Chapter 04, Diagnosis-Engine Control-WP, 1-5-1 Capacitance 1 (Control 1.2.3 Fuel Injectors) Error 1-5-2 Capacitance 2 (Control 4.5.6 Fuel Injectors) Error
1-5-2	Capacitance 2 (control 4.5.6 fuel injectors) error	
1-5-3	Control fuel injector clip CY33X error	Chapter 04, Diagnosis-Engine Control-WP, 1-5-3 Control Fuel Injector Clip CY33X Error
1-5-4	Fuel injector with the minimum normal working not reached	Chapter 04, Diagnosis-Engine Control-WP, 1-5-4 Fuel Injector with the Minimum Normal Working not Reached
1-5-5	Limitation to fuel injection inside ECU	Chapter 04, Diagnosis-Engine Control-WP, 1-5-5 Limitation to Fuel Injection inside ECU
2-1-1	Water in oil	Chapter 04, Diagnosis-Engine Control-WP, 2-1-1 Water in Oil
2-2-1	Pedal sensor 1, 2 errors	Chapter 04, Diagnosis-Engine Control-WP, 2-2-1 Pedal Sensor 1, 2 Errors
2-2-2	Clutch switch error	Chapter 04, Diagnosis-Engine Control-WP, 2-2-2 Clutch Switch Error
2-2-3	Brake switch error, single brake switch error	Chapter 04, Diagnosis-Engine Control-WP, 2-2-3 Brake Switch Error, Single Brake Switch Error
2-2-5	Throttle and brake reliable detection error	Chapter 04, Diagnosis-Engine Control-WP, 2-2-5 Throttle and Brake Reliable Detection Error
2-2-6	Diesel engine protection (speeding)	Chapter 04, Diagnosis-Engine Control-WP, 2-2-6 Diesel Engine Protection (Speeding) 2-2-7 Diesel Engine Protection
2-2-7	Diesel engine protection	
2-2-8	Diesel engine torque overshooting	Chapter 04, Diagnosis-Engine Control-WP, 2-2-8 Diesel Engine Torque Overshooting
2-2-9	Remote throttle pedal	Chapter 04, Diagnosis-Engine Control-WP, 2-2-9 Remote Throttle Pedal
2-3-1	Air intake pressure sensor	Chapter 04, Diagnosis-Engine Control-WP, 2-3-1 Air Intake Pressure Sensor

Diagnosis - Cigarette Lighter

Flash Fault Codes	Fault Code Parts	References
2-3-2	Atmospheric pressure sensor	Chapter 04, Diagnosis-Engine Control-WP, 2-3-2 Atmospheric Pressure Sensor
2-3-3	Air intake temperature sensor	Chapter 04, Diagnosis-Engine Control-WP, 2-3-3 Air Intake Temperature Sensor
2-4-1	Cooling water temperature sensor	Chapter 04, Diagnosis-Engine Control-WP, 2-4-1 Cooling Water Temperature Sensor
2-4-2	High water temperature alarm	Chapter 04, Diagnosis-Engine Control-WP, 2-4-2 High Water Temperature Alarm
2-4-3	High, low pressure alarm of oil pressure sensor	Chapter 04, Diagnosis-Engine Control-WP, 2-4-3 High, Low Pressure Alarm of Oil Pressure Sensor
2-4-4	Oil temperature sensor fault, high oil temperature alarm	Chapter 04, Diagnosis-Engine Control-WP, 2-4-4 Oil Temperature Sensor Fault, High Oil Temperature Alarm
2-4-5	Water temperature sensor test	Chapter 04, Diagnosis-Engine Control-WP, 2-4-5 Water Temperature Sensor Testing
2-5-1	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	Chapter 04, Diagnosis-Engine Control-WP, 2-5-1 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-2 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-3 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-4 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-5 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-6 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage) 2-5-7 High-pressure Fuel Pipe/ Low-pressure Fuel Pipe Problem (Oil Leakage)
2-5-2	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-5-3	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-5-4	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-5-5	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-5-6	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-5-7	High-pressure fuel pipe/ low-pressure fuel pipe problem (oil leakage)	
2-6-1	ECU system recovery	Chapter 04, Diagnosis-Engine Control-WP, 2-6-1 ECU System Recovery
2-6-2	Speeding detection	Chapter 04, Diagnosis-Engine Control-WP, 2-6-2 Speeding Detection
2-6-3	ECU clip CJ940	Chapter 04, Diagnosis-Engine Control-WP, 2-6-3 ECU Clip CJ940 2-6-4 ECU Clip and Watchdog
2-6-4	ECU Clip and Watchdog	
2-6-5	EEPROM (Electrical erasable read-only memory)	Chapter 04, Diagnosis-Engine Control-WP, 2-6-5 EEPROM (Electrical Erasable Read-only Memory)
3-1-1	Air exhaust brake solenoid valve	Chapter 04, Diagnosis-Engine Control-WP, 3-1-1 Air Exhaust Brake Solenoid Valve
3-1-2	Fan solenoid valve (PWM), relay, speed sensor	

Diagnosis - Cigarette Lighter

Flash Fault Codes	Fault Code Parts	References
3-1-3	Air conditioning compressor relay	Chapter 04, Diagnosis-Engine Control-WP, 3-1-3 Air Conditioning Compressor Relay
3-2-1	Air intake heating relay	Chapter 04, Diagnosis-Engine Control-WP, 3-2-1 Air Intake Heating Relay
3-2-2	Air intake heating relay	3-2-2 Air Intake Heating Relay
3-2-3	Air intake heating relay	3-2-3 Air Intake Heating Relay
3-2-4	Speed sensor	Chapter 04, Diagnosis-Engine Control-WP, 3-2-4 Speed Sensor
3-2-7	Multi-state switch	Chapter 04, Diagnosis-Engine Control-WP, 3-2-7 Multi-state Switch
3-3-1	System lamp	Chapter 04, Diagnosis-Engine Control-WP, 3-3-1 System Lamp
3-3-2	Cold starting lamp, warning lamp	Chapter 04, Diagnosis-Engine Control-WP, 3-3-2 Cold Starting Lamp, Warning Lamp
3-3-4	Water-in-oil lamp, warning lamp	Chapter 04, Diagnosis-Engine Control-WP, 3-3-4 Water-in-oil Lamp, Warning lamp
3-4-1	Cruising switch	Chapter 04, Diagnosis-Engine Control-WP, 3-4-1 Cruising Switch
3-4-2	Air exhaust brake switch	Chapter 04, Diagnosis-Engine Control-WP, 3-4-2 Air Exhaust Brake Switch
3-4-3	Underslung starting switch	Chapter 04, Diagnosis-Engine Control-WP, 3-4-3 Underslung Starting Switch
5-1-1	Cylinder1 fire detection	Chapter 04, Diagnosis-Engine Control-WP, 5-1-11 Cylinder Fire Detection 5-1-22 Cylinder Fire Detection 5-1-33 Cylinder Fire Detection 5-1-4 Multi-cylinder Fire Detection 5-3-14 Cylinder Fire Detection 5-3-25 Cylinder Fire Detection 5-3-36 Cylinder Fire Detection
5-1-2	Cylinder 2 fire detection	
5-1-3	Cylinder 3 fire detection	
5-1-4	Multi-cylinder fire detection	
5-3-1	Cylinder 4 fire detection	
5-3-2	Cylinder 5 fire detection	
5-3-3	Cylinder 6 fire detection	
5-3-4	External test	Chapter 04, Diagnosis-Engine Control-WP, 5-3-4 External Test 5-2-1 External Test 5-2-2 External Test 5-2-3 External Test
5-2-1	External test	
5-2-2	External test	
5-2-3	External test	
5-4-1	Sync signal problem	Chapter 04, Diagnosis-Engine Control-WP, 5-4-1 Sync Signal Problem

Diagnostic Apparatus Fails to Communicate

Description

Hint: refer to this chapter "KT600 Diagnostic Apparatus Usage and Fault Test".

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

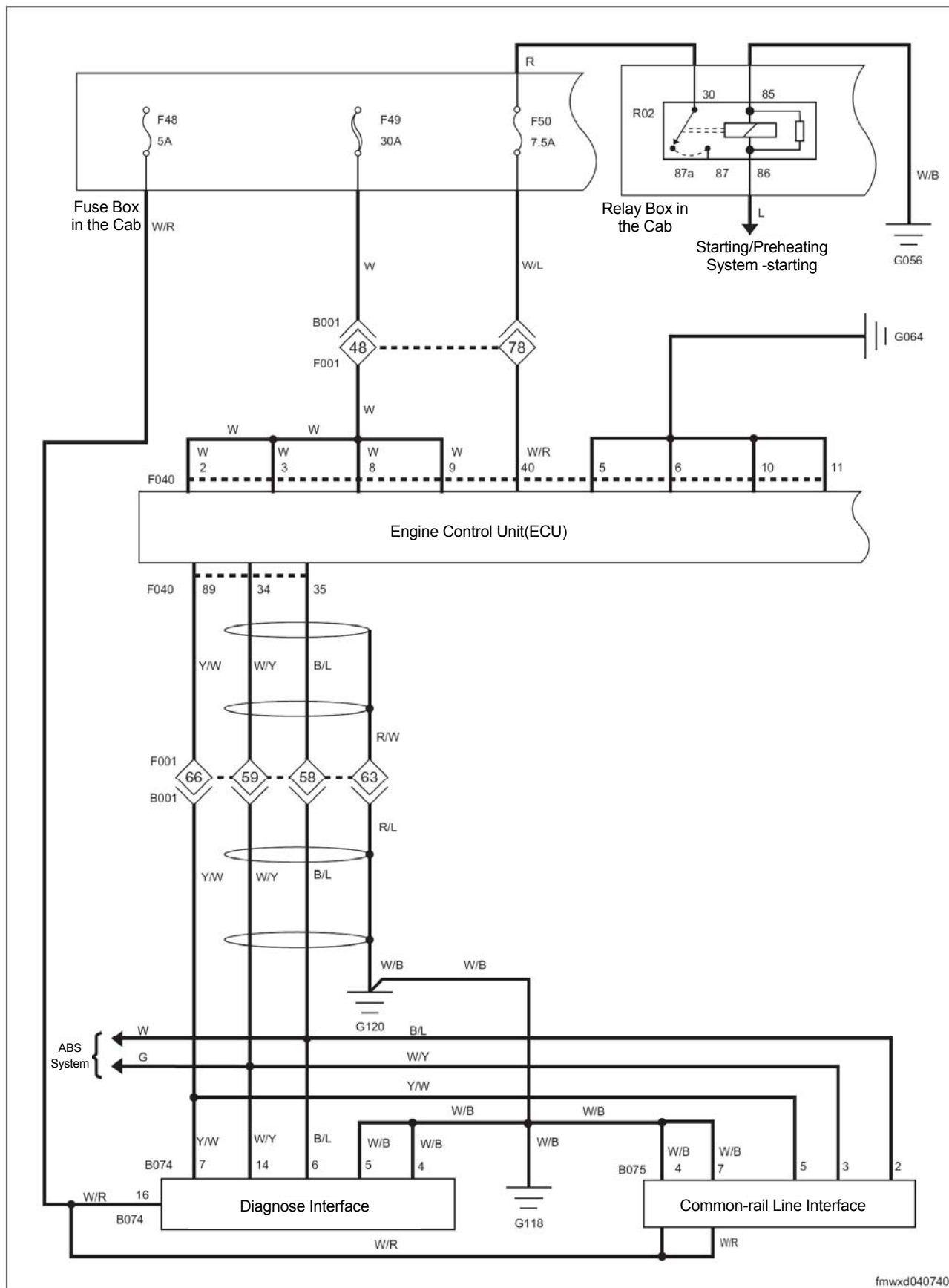
Refer to this chapter "General Steps for Fault Diagnosis".

Parts that may cause faults

1. **Diagnostic system circuit/fuse (damaged, Fused).**
2. **ECU (damaged)**

Diagnosis - Cigarette Lighter

Circuit Diagram



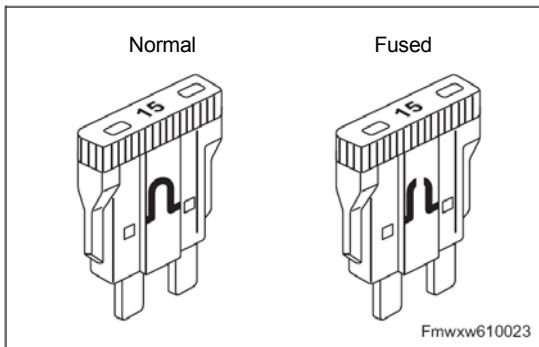
Diagnosis Steps**1. Connect the diagnostic apparatus**

- a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter "KT600 Diagnostic Apparatus Usage and Fault Test".
- b). Operate the diagnostic apparatus according to the instruction for use.

Can the diagnostic apparatus communicate with ECU?

Yes > system is normal

No > see Step 2

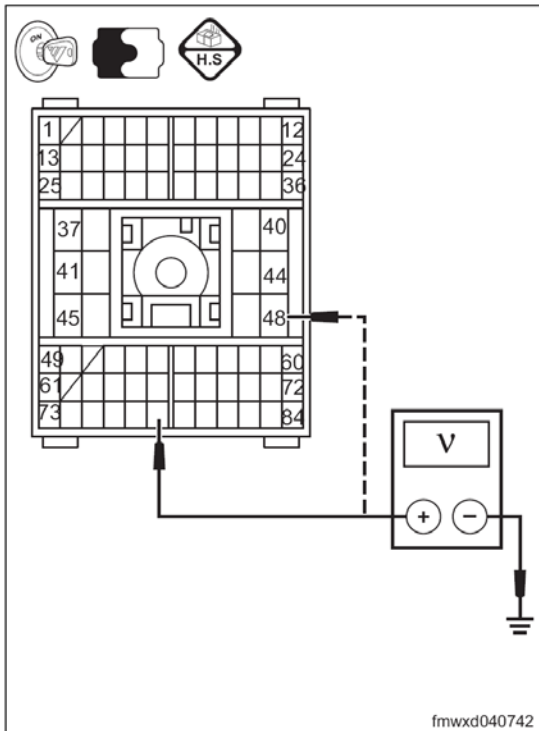
2. Inspect the ECU power fuse

- a). Turn off ignition switch.
- b). Inspect the fuse box and fuse in the cab: F48 (5 A), F49 (5 A) and F50 (7.5 A).

Is the inspection result normal?

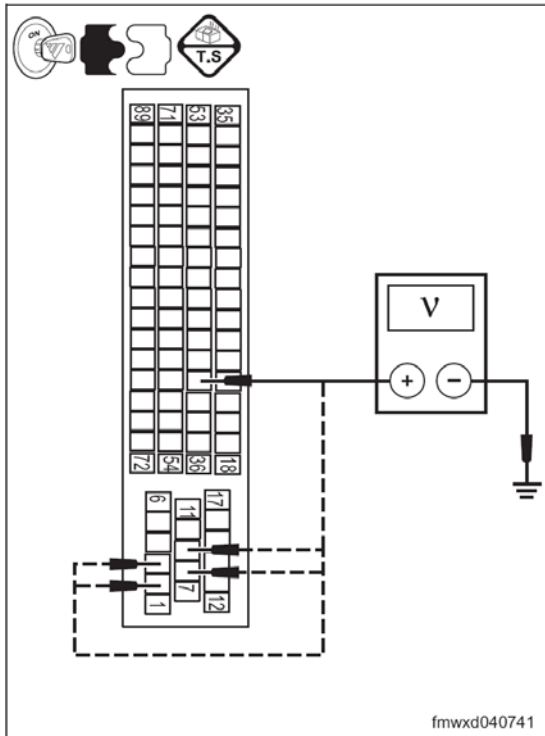
Yes > see Step 3

No > Overhaul fuse line and replace rated capacity fuse

3. Inspect ECU power circuit

- (a). Turn on ignition switch.
- (b). Use the multi-meter to measure voltage to earth of pin 48, 78 of wiring harness connector F001 at front frame.

Diagnosis - Cigarette Lighter



(c). Disconnect ECU connector F040.

Caution:

Turn off the ignition switch when disconnecting or connecting wiring harness connector.

(d). Use multi-meter to measure voltage to earth of pin 2, 3, 8, 9, 40 of wiring harness connector F040 of ECU.

Voltage standard value: battery voltage

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Is the voltage value normal?

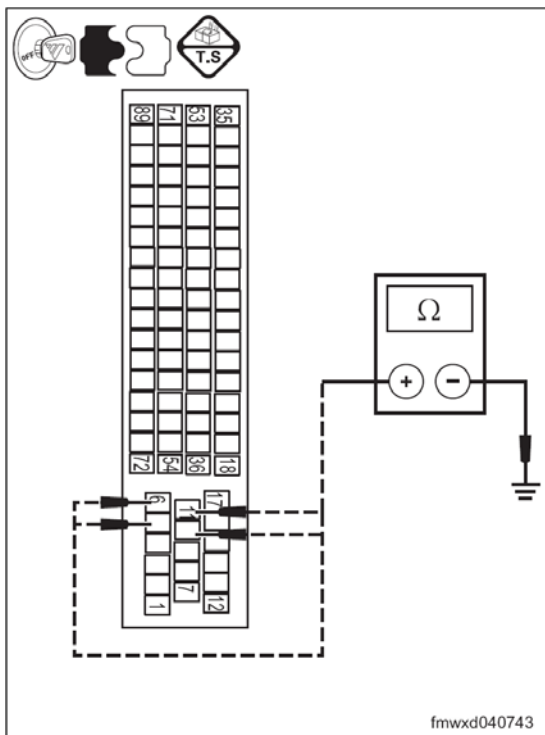
Yes > see Step 4

No > if voltage to earth of pin 48, 78 of front wiring harness connector F001 is abnormal, overhaul the open circuit fault of the wiring harness fuse of body.

Fault:

> if voltage to earth of pin 2, 3, 8, 9, 40 of ECU connector F040 is abnormal, overhaul the open circuit fault of the wiring harness fuse of front frame.

4. Inspect line earth of ECU



(a). Turn off ignition switch.

(b). Use multi-meter to measure resistance to earth of pin 5, 6, 10, 11 of connector F040 of ECU.

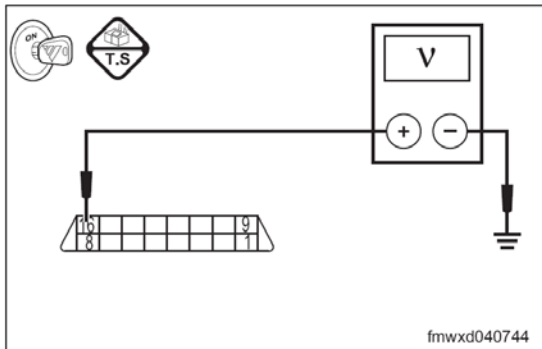
Resistance: $\leq 2\Omega$

Is the resistance value normal?

Yes > see Step 5

No > Inspect line earth open circuit fault of front frame wiring harness

5. Inspect power circuit of diagnostic interface



- a) Turn on ignition switch.
- b) Use multi-meter to measure voltage to earth of pin 16 of connector B074 of diagnostic interface.

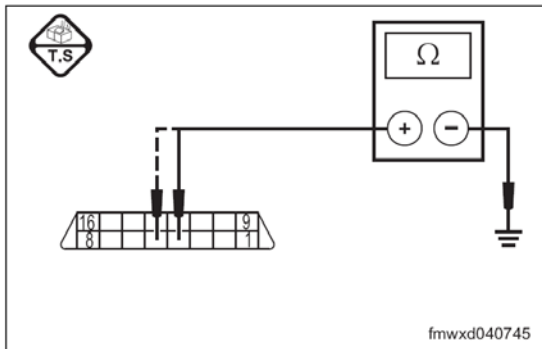
Voltage standard value: battery voltage

Is the voltage value normal?

Yes > see Step 6

No > Inspect power circuit open circuit fault of diagnostic interface of body wiring harness

6. Inspect line earth of diagnostic interface



- a) Use multi-meter to measure resistance to earth of pin 4, 5 of connector B074 of diagnostic interface.

Resistance: $\leq 2\Omega$

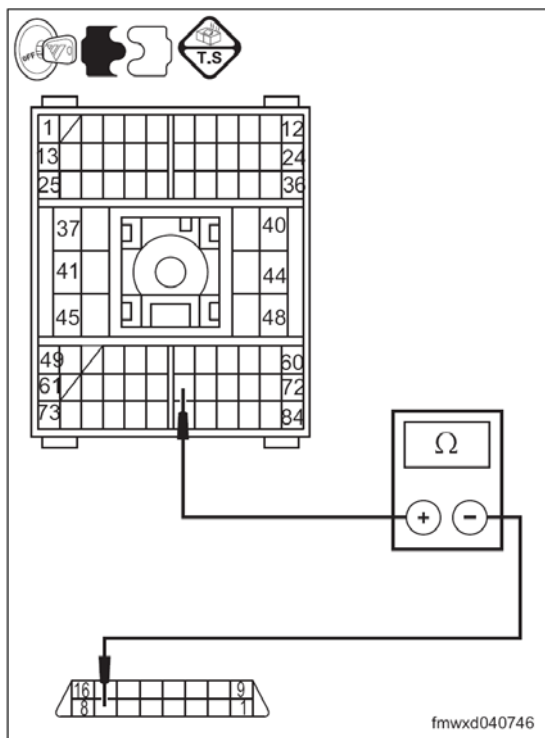
Is the resistance value normal?

Yes > see Step 7

No > Overhaul line earth open circuit fault of diagnostic interface of wiring harness of body

Diagnosis - Cigarette Lighter

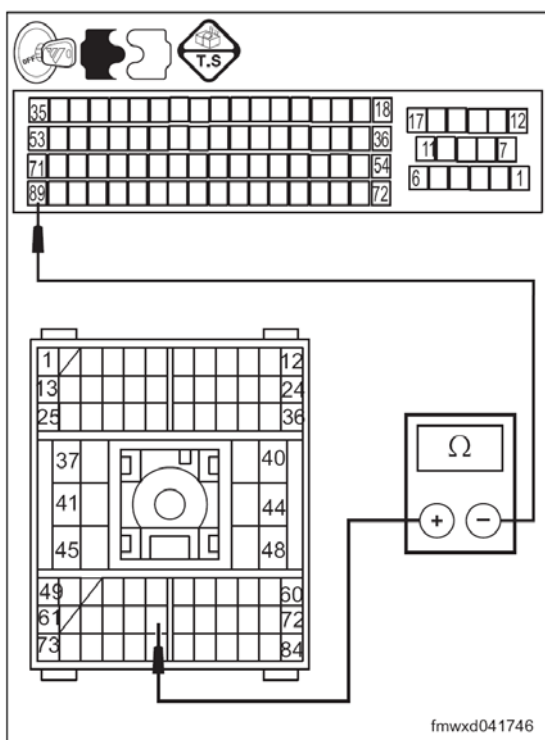
7. Inspect communication line K of diagnostic interface



- a). Turn off ignition switch.
- b). Disconnect ECU connector F040.
- c). Use multi-meter to measure continuity between pin 7 of connector B074 of diagnostic interface and pin 66 of connector B001 of wiring harness of body.

Resistance: $\leq 2\Omega$

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- d). Use multi-meter to measure continuity between pin 66 of connector F001 of wiring harness of body and pin 89 of ECU connector F040

Is the circuit conductible?

Yes > replace the ECU

No > overhaul communication line K open circuit fault of diagnostic interface

Fault Indicator is Off

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

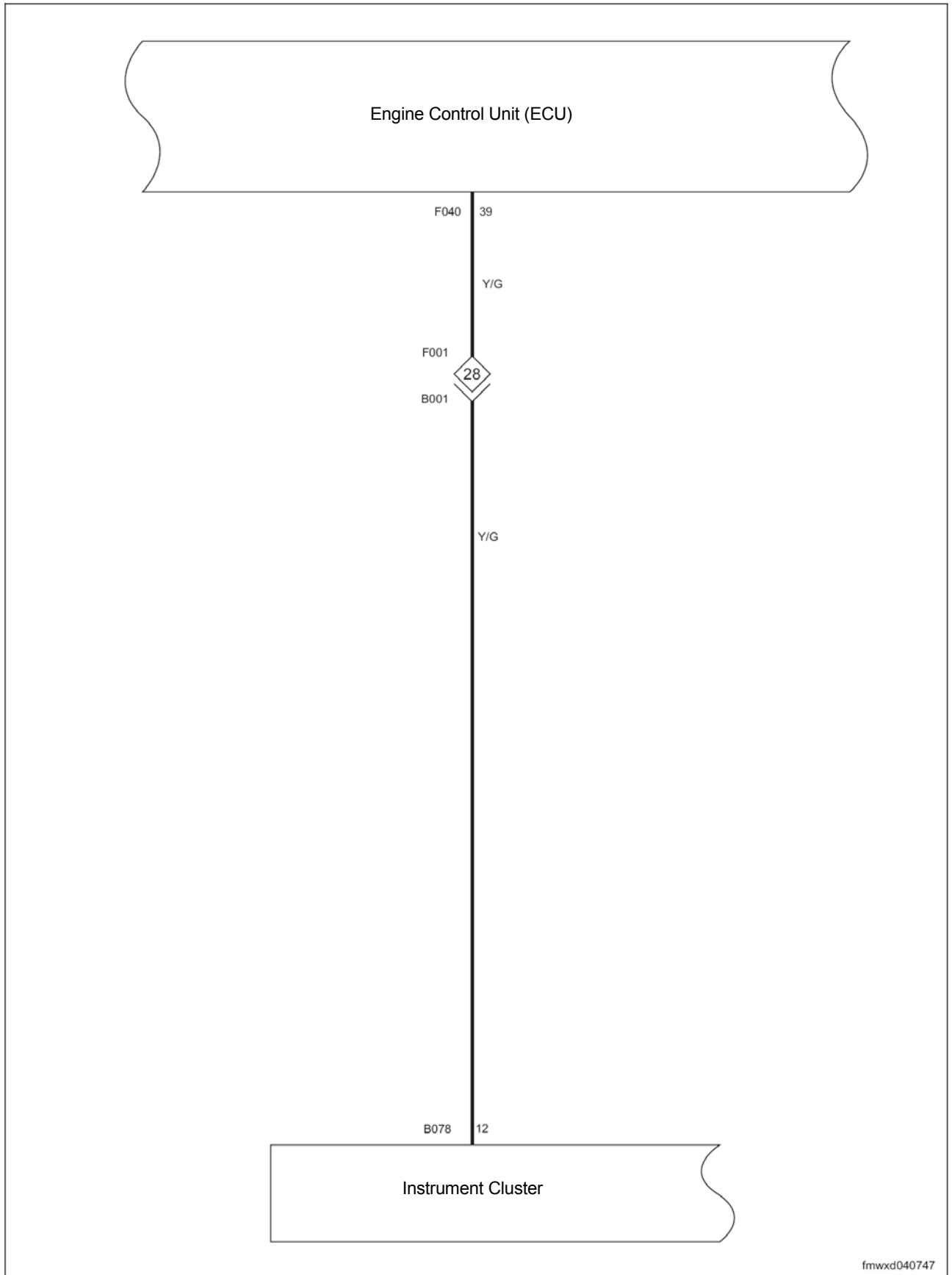
Under normal circumstances, the engine fault indicator will light up at the moment the ignition switch is turned on, and then go off. If the engine fails, the indicator is normally on, an engine fault diagnosis is needed; if the engine fault indicator is off, a fault clearing towards indicator is needed.

Parts that may cause faults

1. **Fault indicator circuit/fuse (damaged, Fused).**
2. **Fault indicator bulb (burned-out).**
3. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnosis Steps**1. Connect the diagnostic apparatus**

- a) Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- b) Operate the diagnostic apparatus according to the instruction for use.
- c) Read the fault code

Whether the fault code 3-3-1 exists?

Yes > diagnose according to the flash fault code, refer to this chapter "Flash Fault Code List "

No > see Step 2

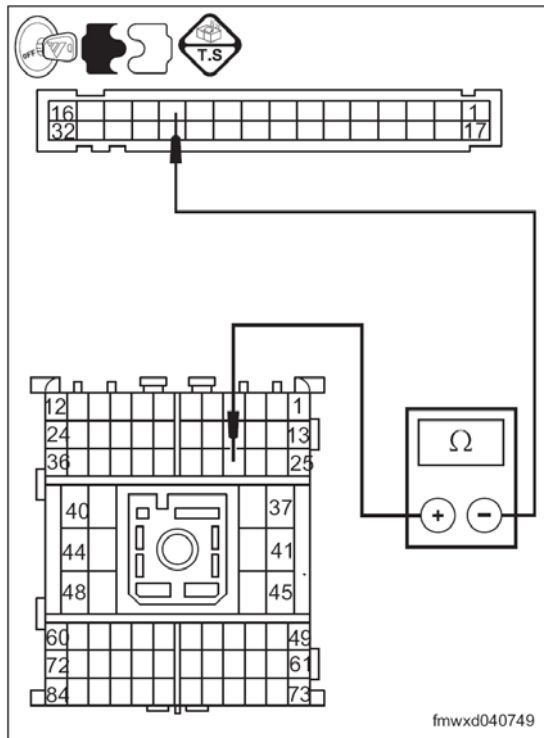
2. Inspect the engine fault indicator bulb

- a) Dismantle the instrument and inspect whether the engine fault indicator bulb is damaged or not.

Is the engine fault indicator bulb damaged?

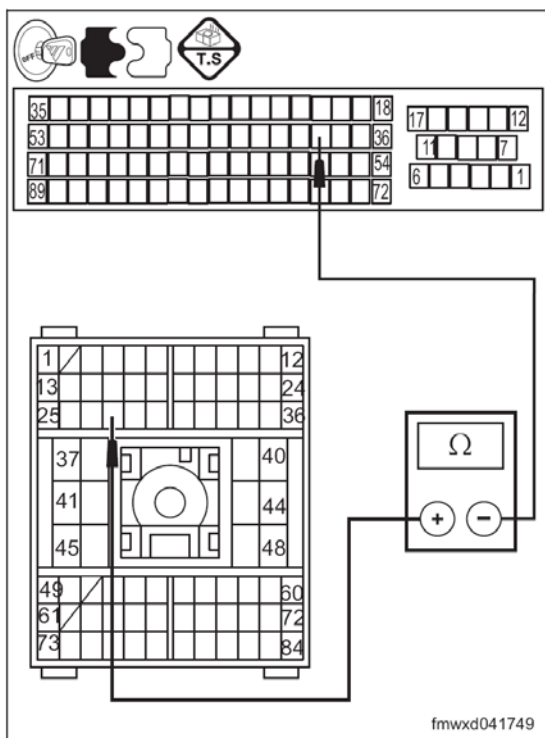
Yes > replace the engine fault indicator bulb

No > see Step 3

3. Inspect the engine fault indicator circuit

- a). Turn off ignition switch.
- b). Disconnect ECU connector F040.
- c). Use multi-meter to measure continuity between pin 12 of instrument connector B078 and pin 28 of connector B001 of wiring harness of body.

Diagnosis - Cigarette Lighter



- (d). Use multi-meter to measure continuity between pin 28 of connector F001 of front frame wiring harness and pin 39 of ECU connector F040.

Is the circuit connectional?

Yes > replace the ECU

No > overhaul communication line K open circuit fault of diagnostic interface

Fault Indicator Fails to Flash (In the operation the fault diagnosis switch)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

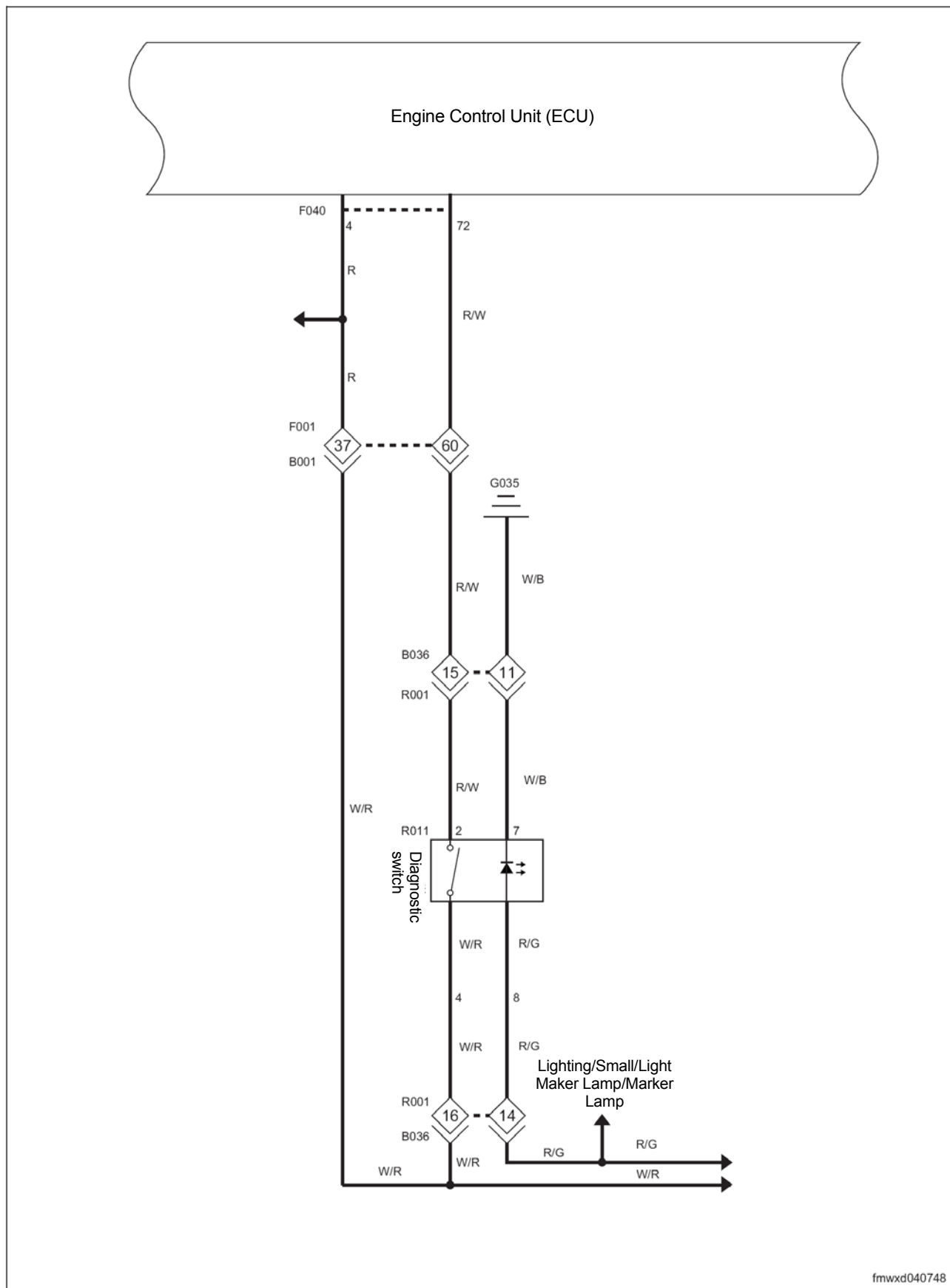
Under normal circumstances, when the ignition switch is turned on, the engine fault indicator will flash (there will be fault code if any fault exists) each time operate the fault diagnostic switch. If keep the fault diagnostic switch on, the flash fault code lamp will still on.

Parts that may cause fault

1. **Fault diagnostic switch circuit (damaged)**
2. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



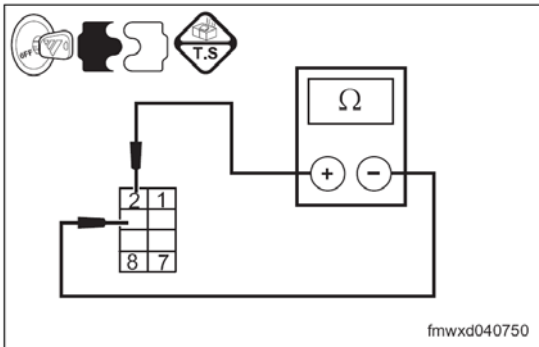
Diagnosis Steps**1. Connect the diagnostic apparatus**

- a) Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- b) Operate the diagnostic apparatus according to the instruction for use.
- c) Read the fault code

Does the fault code exist?

Yes > diagnose according to the flash fault code, refer to this chapter "Flash Fault Code List"

No > see Step 2

2. Inspect fault diagnostic switch

- a). Turn off ignition switch.
- b). Disconnect wiring harness connector of fault diagnostic switch.
- c). Use multi-meter to measure continuity between pin 2 and pin 4 of fault diagnostic switch.

Resistance:

Condition	Pin Measurement	Standard Value
Press switch	2-4	$\leq 2\Omega$
Release switch	2-4	$\geq 10M\Omega$

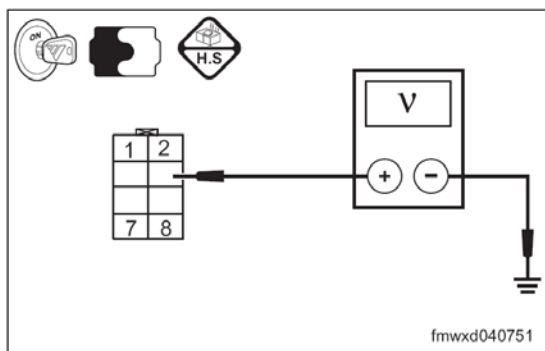
Is the fault diagnostic switch normal?

Yes > see Step 3

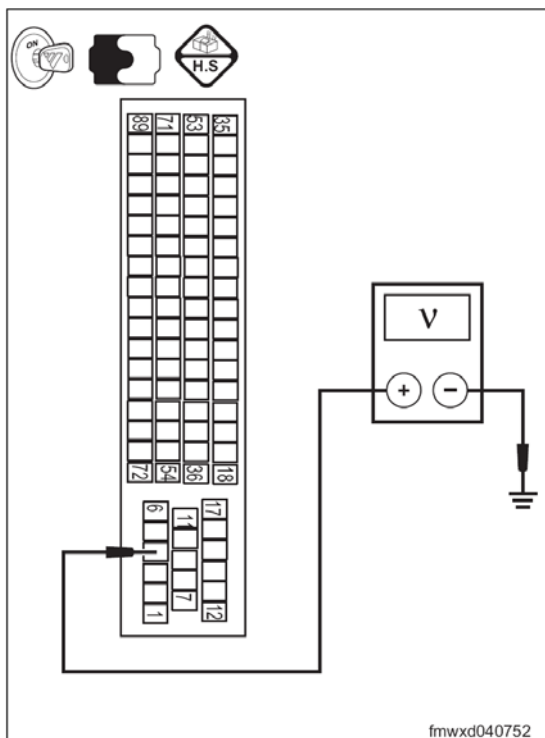
No > replace the fault diagnostic switch

Diagnosis - Cigarette Lighter

3. Inspect ECU power output



- Connect wiring harness connector of fault diagnostic switch.
- Turn on ignition switch.
- Use multi-meter to measure voltage to earth of pin 4 of fault diagnostic switch connector R011.



- Use multi-meter to measure voltage to earth of pin 4 of ECU connector F040

Voltage standard value: battery voltage

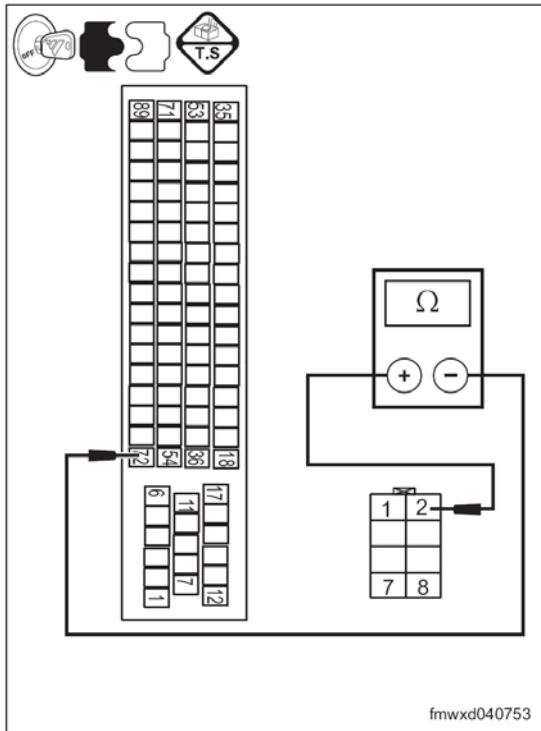
Is the voltage value normal?

Yes > see Step 4

No > if only the voltage to earth of pin 4 of fault diagnostic switch connector R011 is abnormal, overhaul the fault of open circuit from ECU to fault diagnostic switch.

> if the voltage to earth of pin 4 of ECU connector F040 is abnormal, replace the ECU.

4. Inspect line earth of ECU



- Turn off ignition switch.
- Disconnect ECU connector F040 and fault diagnostic switch connector R011.
- Use multi-meter to measure continuity between pin 72 of ECU connector F040 and pin 2 of fault diagnostic switch connector R011.

Hint:

The connection between pin 72 of ECU connector F040 and pin 2 of fault diagnostic switch connector R011 has got through pin 15 of wiring harness connector R001 and B036, as well as pin 60 of wiring harness connector B001 and F001.

Is the circuit connectional?

Yes > replace the ECU

No > Overhaul the fault of open circuit from pin 72 of ECU connector F040 to pin 2 of fault diagnostic switch connector R011.

Fail to start

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection fully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect whether the circuit and the connector is disconnected or loosened.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **Battery (underpowered)**
2. **Starting system circuit/relay/fuse (damaged, Fused).**
3. **Engine control system circuit (ECU power circuit fault, protective neutral gear switch circuit fault, under vehicle turning off switch fault).**
4. **Engine crankshaft position sensor, camshaft position sensor (sensor and circuit fault, signal loss, sensor signal desynchrony caused by broken flywheel ring gear).**
5. **Inadequate fuel (deficient, too dirty, too much water, wrong fuel type).**
6. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
7. **Air in the fuel piping system (fuel pipe joint is loosened).**
8. **Fuel injector (damaged, pressure release).**
9. **High-pressure oil pump (damaged, pressure release).**
10. **Common-rail pipe and its pressure control system (pressure limiting valve)(damaged, pressure release).**
11. **ECU (damaged).**
12. **Engine machinery (timing error etc.).**

Diagnosis Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure fuel pipe; when disconnecting any low-pressure fuel pipe, use an appropriate container for the fuel outflow.

2. Inspect the engine rotation condition

(a). Start the engine

Caution:

The starting period shall not be too long as not to overheat the starter.

(b). Inspect whether the engine is operating.

Is the engine operating?

Yes > see Step 3

No > Inspect engine starting system fault. Refer to "Chapter 04 Diagnosis--Starting/Preheating System"

Hint:

- Make sure that the transmission is at the neutral gear.
- Overhaul the neutral gear switch and its circuit fault (by emergency start of wringing ignition switch for more than 5s. if the starter begins to work, it means that neutral gear switch and its circuit fault does exist.)
- Overhaul underlung flameout switch and its circuit fault (underlung flameout switch shall be turned off).

3. Connect the diagnostic apparatus

- (a) Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b) Operate the diagnostic apparatus according to the instruction for use.
- (c) Read the data stream.
- (d) Read the fault code.

Hint:

If faults of crankshaft position sensor and camshaft position sensor can be seen from data stream or fault code in the diagnostic apparatus for overhaul of sensors and its circuit fault as well as flywheel.

Whether there is fault code that cause starting fault?

Yes > diagnose according to the flash fault code, refer to this chapter "Flash Fault Code List"

No > see Step 4

> if the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream"

4. Inspect the fuel

- (a) Open the fuel tank cap to inspect and ensure that the fuel is sufficient and the fuel is clean without too much water and the type is right

Whether the fuel has the above problems?

Yes > add or replace the right type of fuel

No > see Step 5

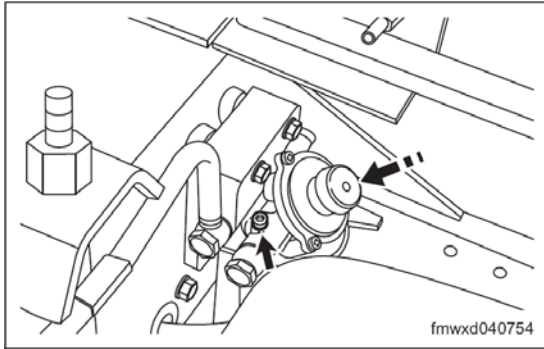
Diagnosis - Cigarette Lighter**5. Inspect fuel coarse filter and fine filter**

- (a) Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, replace them with new ones.

Whether the fuel coarse filter and fine filter have the above problem?

Yes > replace them with new ones

No > see Step 6

6. Inspect whether air has been taken into the low-pressure fuel pipe.

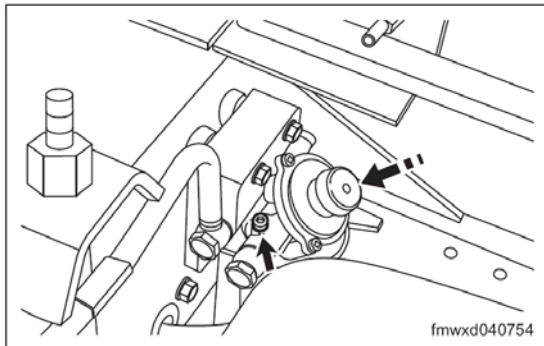
- a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- b). Observe the status of fuel outflow from the air bleed bolt.

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Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 7

No > see Step 8

7. Discharge air from fuel low pressure oil channel

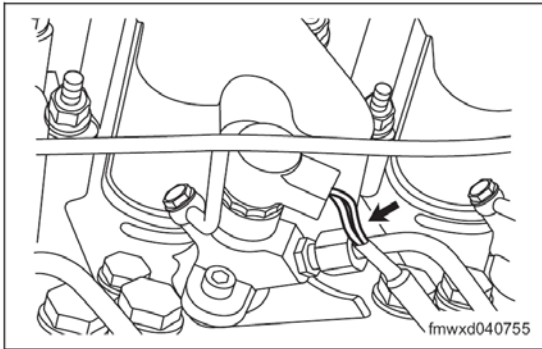
- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No > see Step 8

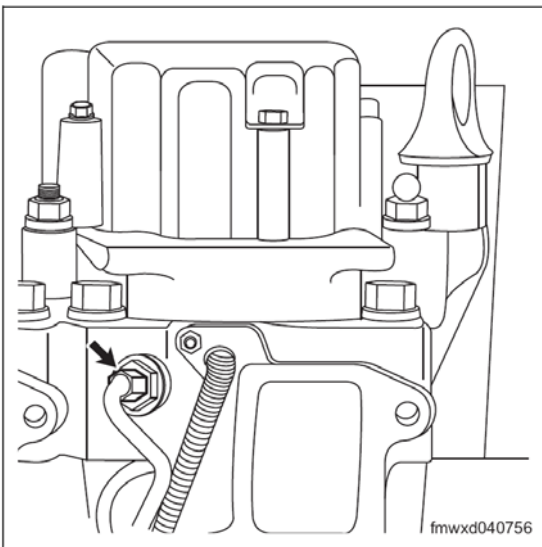
8. Exhaust air in the high-pressure fuel pipe



- (a). Loosen high-pressure fuel pipe of one cylinder.
- (b). Use starter to keep the engine operating until there is continuous fuel flowed out from high-pressure fuel pipe.
- (c). Tighten high-pressure fuel pipe of this cylinder.
- (d). Start the engine

Hint:

Frequent dismantlement of high-pressure fuel pipe connector is not recommended.

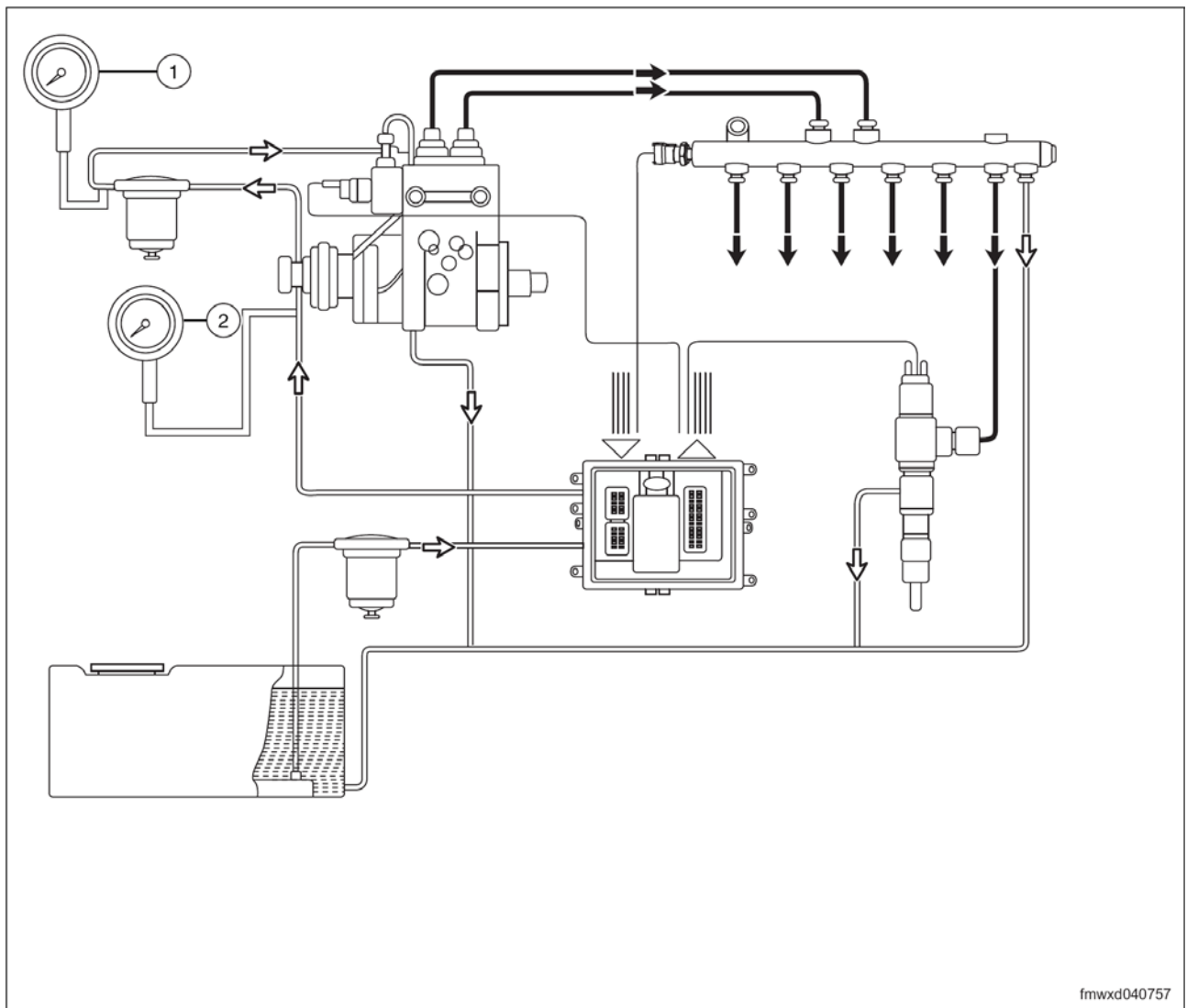


Does the engine work?

Yes > system is normal

No > see Step 9

Diagnosis - Cigarette Lighter



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9. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Use starter to keep the engine operating and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 1 shall increase while the pressure value of pressure gauge 2 shall decrease. And the pressure value of pressure gauge 1 shall be more than that of pressure gauge 2.

Whether the pressure value of pressure gauge 1 is less than that of pressure gauge 2?

Yes > the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one.

No > see Step 10

10. Inspect whether the low-pressure fuel pipe is blocked

(a) Use starter to keep the engine operating and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

No > see Step 11

11. Inspect the high-pressure common rail fuel pressure of the engine

(a). Use starter to keep the engine operating.

(b). Use diagnostic apparatus to read "actual fuel rail pressure" from data stream

Hint:

Under normal circumstances, when starter operates, "actual fuel rail pressure" showed by diagnostic apparatus shall be not less than "16Mka".

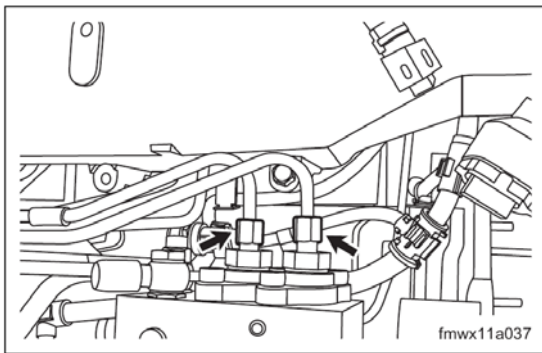
Is the "actual fuel rail pressure" showed by diagnostic apparatus more than "16Mka"?

Yes > Inspect fuel injector fault and replace a new one

> see Step 15

No > see Step 12

12. Inspect engine high-pressure oil pump



(a). Disconnect two outlet pipes of high-pressure oil pump respectively.

(b). Use starter to keep the engine operating.

(c). Observe oil columns' heights of two oil outlets of high-pressure oil pump with eye estimation.

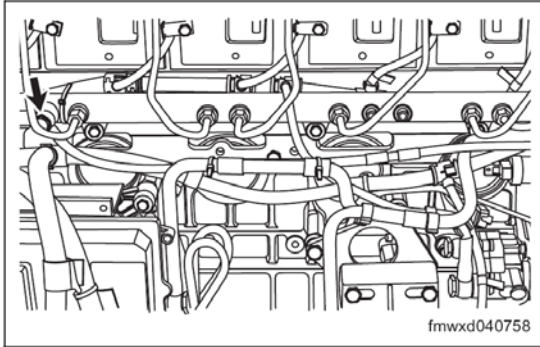
Hint:

When engine works at the rotation speed of 200~250RPM, it is normal that oil column from oil outlet of high-pressure oil pump is about 4~5cm high

Is the oil column from oil outlet shorter than 4cm?

Yes > high-pressure oil pump is damaged and a new one is needed

No > see Step 13

Diagnosis - Cigarette Lighter**13. Inspect the common rail and the pressure limiting valve**

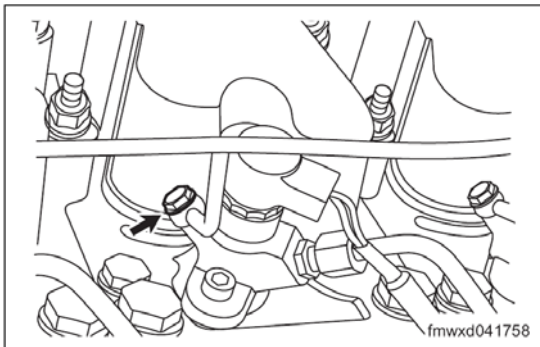
- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Use starter to keep the engine operating.
- (c). Observe whether there is fuel outflow in the oil outlet of the pressure limiting valve.

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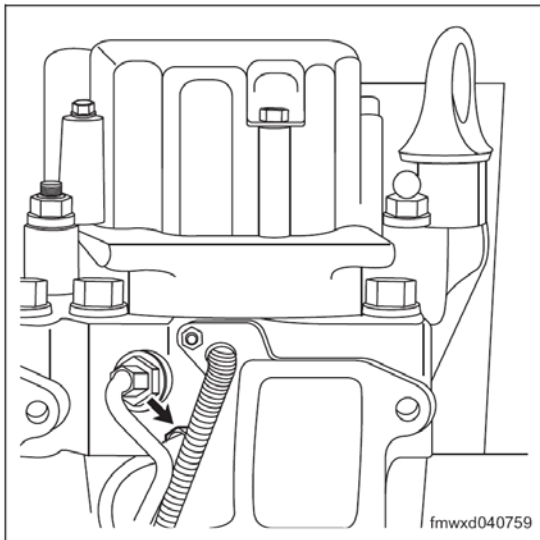
Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

No > see Step 14

14. Inspect oil return of fuel injector

- (a). Disconnect the return pipe joint of the oil injector
- (b). Use starter to keep the engine operating.
- (c). observe whether there is fuel outflow in the oil outlet of the fuel injector.



Whether the oil outlet of the fuel injector has fuel outflow?

Yes > Overhaul the fuel injector and replace the damaged one with a new one

No > see Step 15

Diagnosis - Cigarette Lighter

15. Inspect the mechanical system of engine

- (a) Inspect timing gears; refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".
- (b) Inspect compression pressure of the cylinder, refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".
- (c) Inspect relevant parts of the piston/crank shaft and so on, refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".

Whether there are problems in the above parts?

Yes>overhaul the fault parts

No>overhaul ECU and the circuit

Hard Starting

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect the circuits and connectors for releasing or loosing.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **Battery (underpowered).**
2. **Starter (damaged, inadequate rotation speed or slipping).**
3. **Engine crankshaft position sensor, camshaft position sensor (the sensor or the flywheel ring gear is too dirty; the sensor and the circuit have fault which make sensor signal synchronism too slow).**
4. **The fuel type is not right.**
5. **Inadequate fuel (Inadequate fuel in the oil tank, this may cause air entrainment when bumping).**
6. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
7. **There is air in the fuel pipe system (the interface of the fuel pipe is loosened).**
8. **Preheating system (the preheating system fails to work in winter, resulting to the difficult starting).**
9. **Water temperature sensor (damaged or the wiring harness connection has fault, resulting that the preheating system is out of work in winter).**
10. **Exhaust brake and butterfly valve (sticking, exhaust pipe blocked).**
11. **Fuel injector (damaged, pressure release).**
12. **Common-rail pipe and pressure control device (pressure limiting valve) (damaged, pressure release).**
13. **Engine machinery (timing error, piston, tile, etc.).**

Diagnosis Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Inspect the engine rotation condition

(a) Start the engine.

Caution:

The starting period shall not be too long as not to overheat the starter.

(b) Inspect whether the engine is too low.

Hint:

Under normal circumstances, when starting the engine, the rotation speed of the engine shall not be lower than 200RPM.

Whether the rotation speed of the engine is too low?

Yes>Inspect engine starting system fault, refer to "Chapter 04 Diagnosis-Starting/Preheating System".

>see Step 17

No>see Step 3

3. Connect the diagnostic apparatus

(a) Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".

(b) Operate the diagnostic apparatus according to the instruction for use.

(c) Read the data stream.

(d) Read the fault code.

Hint:

The faults of the crank shaft position sensor and camshaft position sensor can be seen in the data stream or fault codes from the diagnostic apparatus for overhaul of the sensor and the circuit fault; excessive gap fault between sensor and flywheel; dirty gap fault between sensor and flywheel.

Standard value:

Space between crank shaft position sensor and flywheel ring gear: 1.0 ± 0.5 mm

Whether there is fault code that cause difficult starting?

Yes>diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No>see Step 4

> if the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream".

4. Inspect fuel

(a) Open the fuel tank cap to inspect and ensure that the fuel is sufficient and the fuel is clean without too much water and the type is right.

Whether the fuel has the above problems?

Yes>add or replace the right type of fuel

No>see Step 5

5. Inspect coarse filter and fine filter of the fuel

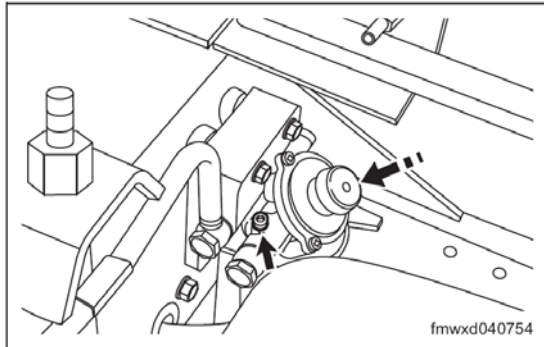
(a) Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, replace them with new ones

Whether the fuel coarse filter and fine filter have the above problem?

Yes>replace them with new ones

No>see Step 6

6. Inspect whether air has been taken into the low-pressure fuel pipe.



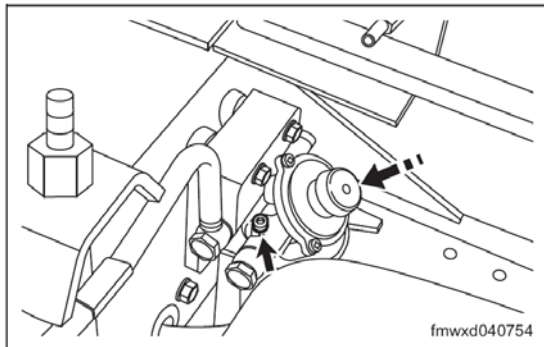
- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes>see Step 7

No>see Step 8

7. Fuel low-pressure pipeline exhausting



- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes>inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No>see Step 8

8. Inspect water temperature sensor

- (a). Use the diagnostic apparatus to read the “coolant temperature (°C)” in the data stream.

Hint:

Under normal circumstances, when cooling vehicle, the “coolant temperature (°C)” shown by the diagnostic apparatus shall be almost the same with the ambient temperature.

Is the coolant temperature (°C) shown by the diagnostic apparatus almost the same with the ambient temperature?

Yes>see Step 9

No>overhaul the water temperature sensor and the circuits.

9. Inspect preheating heater

- (a). At the relatively lower ambient temperature, when starting the cooling vehicle, inspect whether the preheating heater is working.

Whether the preheating heater is working?

Yes>see Step 10

No>overhaul the preheating heater and the circuits, refer to “Chapter 04 Diagnosis-Starting/Preheating System”.

10. Inspect butterfly valve of exhaust brake

- (a). When the ignition switch is turned off, inspect the location of the butterfly valve of exhaust brake.

Whether the butterfly valve of exhaust brake is open?

Yes>see Step 11

No>overhaul the sticking fault of the exhaust brake butterfly valve.

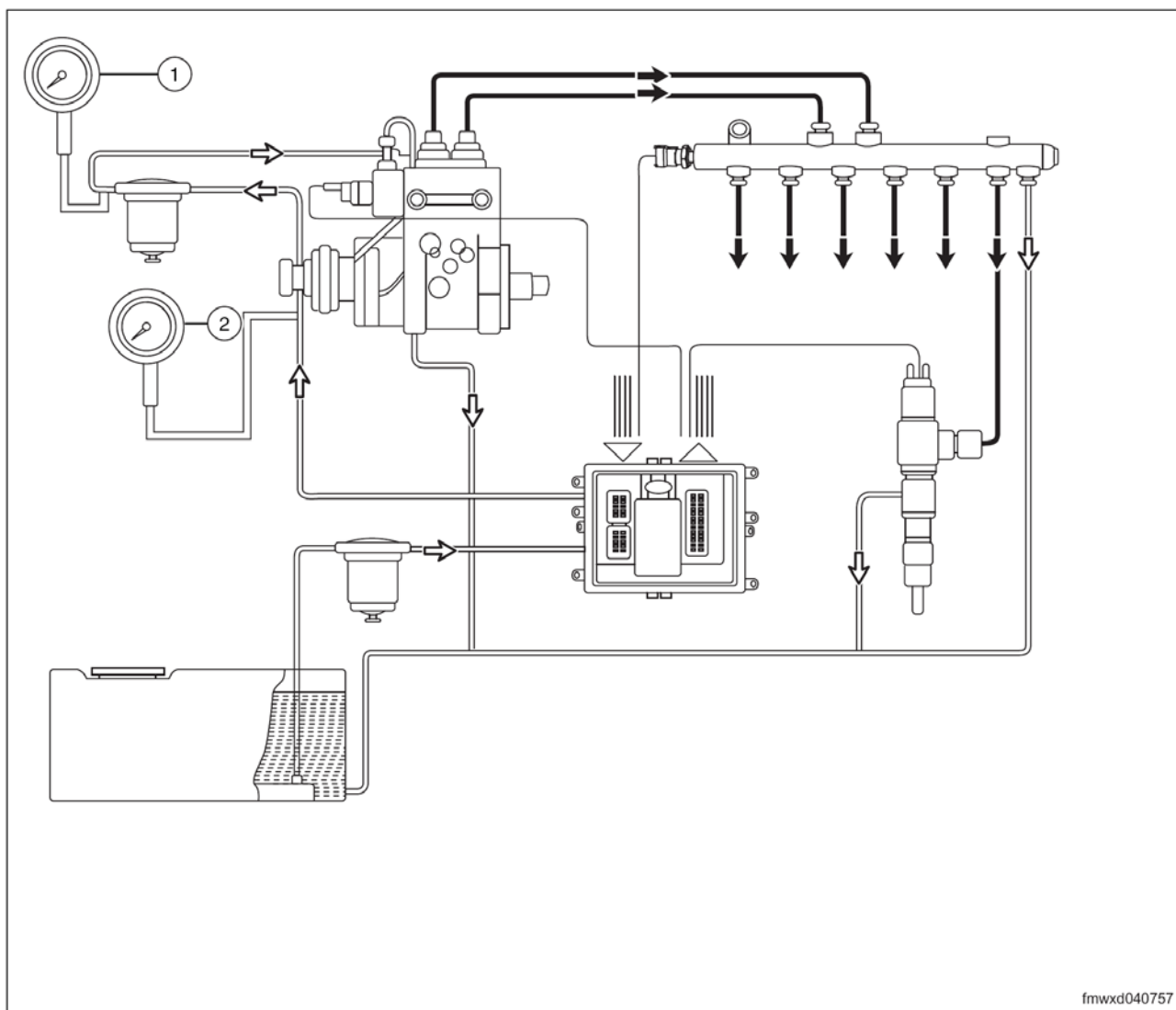
11. Inspect the working condition of the exhaust brake

- (a). At the same time when starting the engine, inspect whether the butterfly valve of exhaust brake is working.

Whether the butterfly valve of exhaust brake is working?

Yes>overhaul the abnormal working condition of the exhaust brake.

No>see Step 12



12. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, at the high speed rotation, the pressure value of the pressure gauge 1 can reach 900KPa.

Whether the pressure value of the pressure gauge 1 can reach 900KPa?

Yes>see Step 13

No>The gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one.

13. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

04

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes>the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained.

No>see Step 14

14. Inspect the high-pressure common rail fuel pressure of the engine

- (a). Engine is operating.

- (b). Use the diagnostic apparatus to conduct "high-pressure test".

Hint:

Under normal circumstances, in the "high-pressure test", the "actual fuel rail pressure" shall reach the high pressure value set in the "high-pressure test". If the high-pressure value set in the "high-pressure test" can not be reached, it shows that the high-pressure common rail pipe has leakage.

Whether the "actual fuel rail pressure" shown by the diagnostic apparatus can reach the high-pressure value set in the "high-pressure test" ?

Yes>see Step 15

No>see Step 16

15. Inspect fuel injector

- (a). Engine is operating.

- (b). Use the diagnostic apparatus to conduct the "cylinder cutout test".

Hint:

Under normal conditions, in the "cylinder cutout test", when one cylinder stops working, the engine will shake. If the engine does not shake when one cylinder stops working, it shows that the oil injector of such cylinder is damaged or such cylinder is leaking.

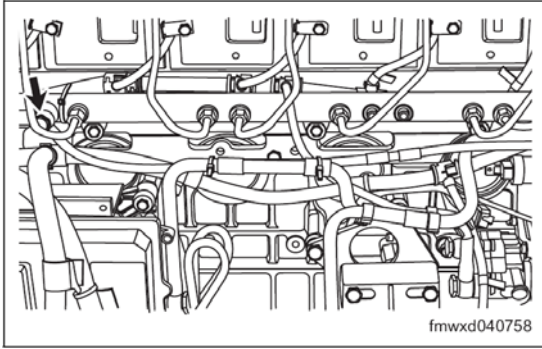
Whether the engine shakes when one cylinder shakes?

Yes>see Step 16

No>replace the fuel injector of the cylinder with a new one.

>see Step 18

Diagnosis - Cigarette Lighter

16. Inspect common rail and the pressure limiting valve

- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual fuel rail pressure" from the data stream..

Hint:

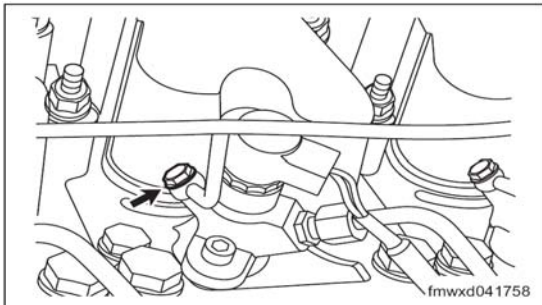
Under normal circumstances, when the engine is operating and the "actual fuel rail pressure" shown by the diagnostic apparatus is higher than 160MPa, the pressure limiting valve will release pressure, that is, the releasing pressure of pressure limiting valve will be 160Mpa.

- (c). When the engine functions and the actual fuel rail pressure shown by the diagnostic apparatus is lower than 160MPa, observe whether the oil outlet of the pressure limiting valve has fuel outflow.

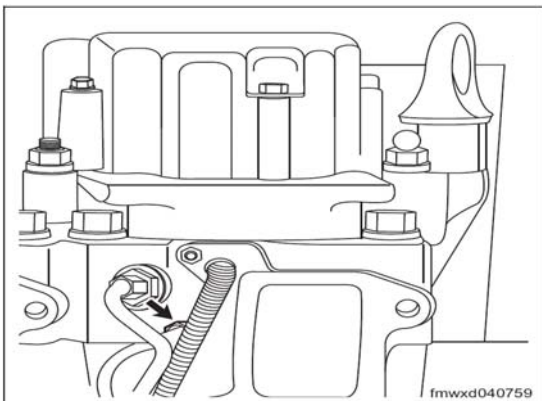
Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes>the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones.

No>see Step 17

17. Inspect oil return at fuel injector

- (a). Disconnect the return pipe joint of the oil injector.
- (b). During operating of the engine, before it catches fire, observe whether there is fuel outflow in the oil outlet of the oil return pipe of the oil injector.



Whether the oil outlet of the oil return pipe of the oil injector has fuel outflow?

Yes>overhaul the oil injector and replace the damaged one.

No>see Step 18

Diagnosis - Cigarette Lighter

18. Inspect mechanical system of the engine

- (a). Inspect timing gears, refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".
- (b). Inspect compression pressure of the cylinder, refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".
- (c). Inspect whether the piston, the crankshaft, or other relevant parts clamps, refer to Chapter 16A "Engine machinery"; Chapter 16B "Engine machinery".

Whether there are problems in the above parts?

Yes>overhaul the fault parts

No>overhaul ECU and the circuit

Automatic Flameout after Starting

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect the circuits and connectors for releasing or loosing.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **The starting system circuit/relay/fuse (the ignition switch is abnormal).**
2. **Engine control system circuit (ECU power circuit fault; bottom ignition switch fault).**
3. **Inadequate fuel (Inadequate fuel in the oil tank, this may cause air entrainment when bumping).**
4. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
5. **There is air in the fuel pipe system (the interface of the fuel pipe is loosened).**
6. **Vehicle speed sensor, water temperature sensor, oil pressure and temperature sensor(damaged or input error signal, as a result, the ECU make the engine on a self-protection status).**
7. **Common-rail pipe and pressure control device (pressure limiting valve) (damaged, pressure release).**
8. **ECU (damaged).**
9. **Engine machinery (engine cooling system , engine oil lubricating system).**

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis, refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Inspect the coolant level and the engine oil level of the engine

Hint:

If the coolant and the engine oil are insufficient, the indicator on the instrument will be on.

Whether the coolant and the engine oil are insufficient?

Yes > add the right types of coolant and engine oil

No > see Step 3

3. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the data stream.
- (d). Read the fault code.

Hint:

The faults of the speed sensor, water temperature sensor and oil pressure and temperature sensor can be seen in the data stream or fault codes from the diagnostic apparatus for maintenance of sensor and circuit faults.

Whether there are fault codes that cause flameout after starting?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 4

> If the data stream is abnormal, diagnose according to the reference list of data stream and refer to this chapter, "Reference List of Data Stream".

4. Inspect fuel

- (a). Open the fuel tank cap to inspect and ensure that the fuel is sufficient.

Whether the fuel has the above problems?

Yes > add the right type of fuel

No > see Step 5

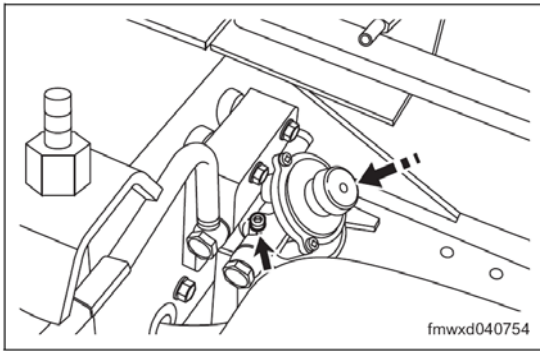
5. Inspect the fuel coarse filter and fine filter

- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, replace them with new ones.

Whether the fuel coarse filter and fine filter have the above problem?

Yes > replace them with new ones

No > see Step 6

Diagnosis - Cigarette Lighter**6. Inspect whether air has been taken into the low-pressure fuel pipe**

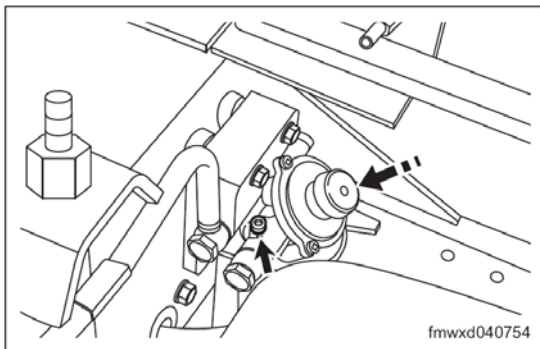
- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- (b). Observe the status of fuel outflow from the air bleed bolt.

04

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 7

No > see Step 8

7. Exhaust air in the low-pressure fuel pipe

- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No > see Step 8

8. Inspect the speed sensor, water temperature sensor and oil pressure and temperature sensor

- (a). Use the diagnostic apparatus to read the "coolant temperature (°C)", "engine oil temperature (°C)" and "driving speed".

Whether the above parameters shown in the diagnostic apparatus are abnormal?

Yes > overhaul related sensors and circuits

No > see Step 9

9. Inspect the starting system circuit/relay/fuse

- (a). Unplug and plug back the starting system-related relay/fuse.
- (b). Unplug and plug the starting system-related wire harness connectors and ensure that all connectors are firmly connected.
- (c). Refer to "Chapter 04 Diagnosis-Starting/ Preheating System".

Whether faults have been eliminated after the above maintenance?

Yes > system is normal

No > see Step 10

10. Inspect the ignition switch

- (a). Operate the ignition switch for several times to inspect whether the ignition switch is abnormal.
- (b). Refer to “Chapter 04 Diagnosis – Starting/ Preheating System”.

Whether the ignition switch is abnormal?

Yes > replace the ignition switch

No > see Step 11

11. Inspect the engine control system circuit

- (a). Unplug and plug back the engine control system-related fuses.
- (b). Unplug and plug the ECU-related wire harness connectors and ensure that all connectors are firmly connected.

Whether faults have been eliminated after the above maintenance?

Yes > system is normal

No > see Step 12

12. Inspect the underslung flameout switch

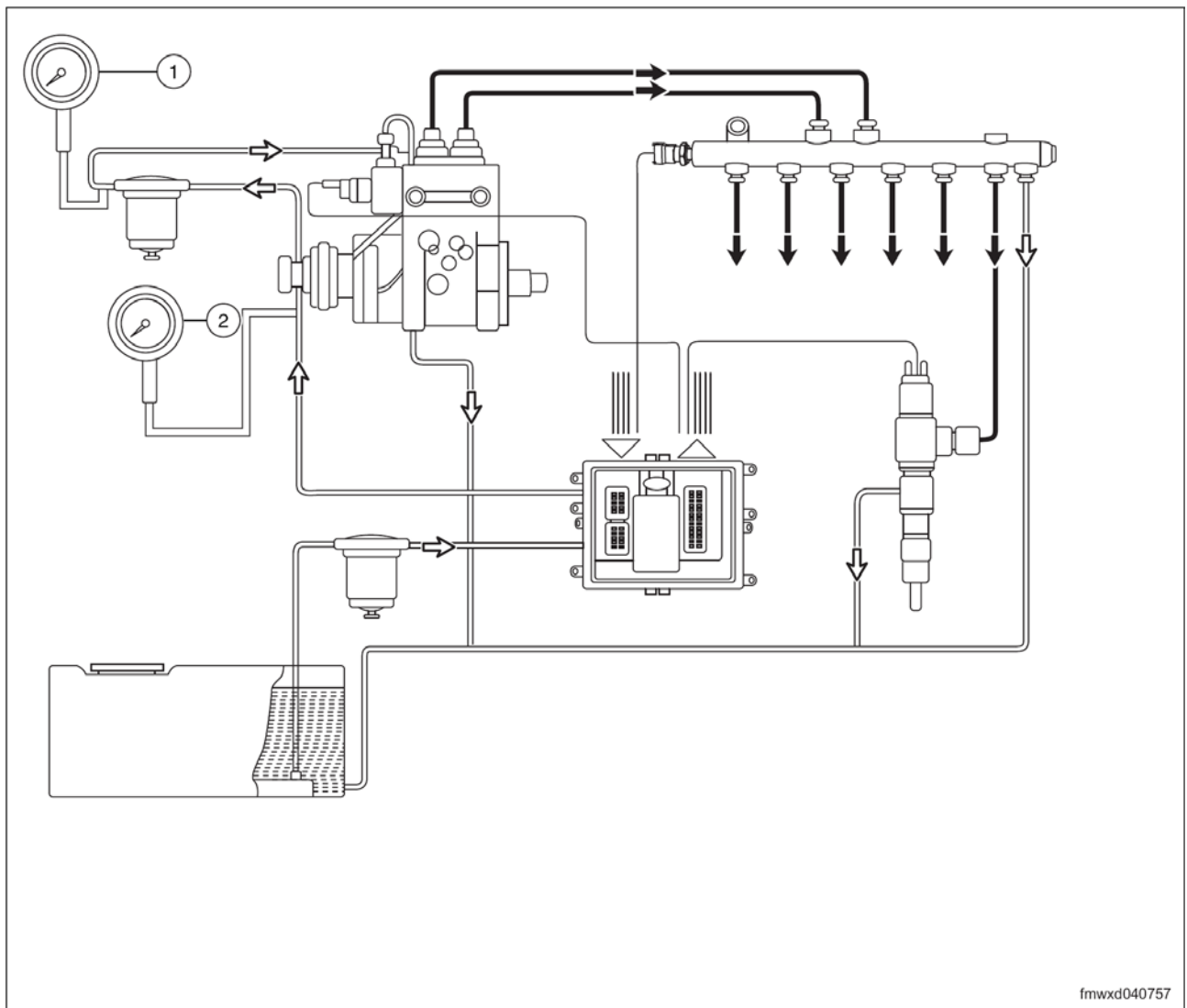
- (a). Operate the flameout switch for several times to inspect whether the flameout switch is abnormal.
- (b). Inspect whether the connection wire harness of the underslung flameout switch is damaged or connected to metal parts.

Whether the above problems exist?

Yes > replace the underslung flameout switch or maintain the connection wire harness of the underslung flameout switch

No > see Step 13

Diagnosis - Cigarette Lighter



04

13. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:**Exhaust air in the fuel pipe after connecting the pressure gauge.**

- (b). Operate the engine and observe the pressure gauge at different rotation speed.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and fault parts maintained

No > see Step 14

14. Inspect the high-pressure common rail fuel pressure of the engine

- (a). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual fuel rail pressure" from the data stream.

Hint:

Diagnosis - Cigarette Lighter

Under normal circumstances, when the engine is operated, the diagnostic apparatus shall that the “actual fuel rail pressure” is basically consistent with the “rated fuel rail pressure”, and when the load has no sudden change, the “actual fuel rail pressure” is also relatively stable with no sudden change.

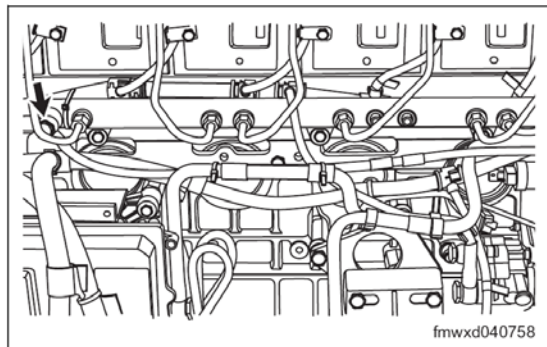
Whether the diagnostic apparatus shows that the “actual fuel rail pressure” is fairly different from the “rated fuel rail pressure” or has sudden changes?

Yes > see Step 15

No > see Step 16

04

15. Inspect the common rail and the pressure limiting valve



- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Operate the engine at different rotation speed and observe whether there is fuel outflow in the oil outlet of the pressure limiting valve.

Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

No > see Step 16

16. Inspect the mechanical system of the engine

- (a). Inspect the engine cooling system, refer to “Chapter 14A Cooling” and “Chapter 14B Cooling”.

Hint:

Ensure that the cooling fan, water pump, temperature saver, etc. are normal to prevent the water temperature being too high.

- (b). Inspect the engine oil lubricating system, refer to “Chapter 15A Lubricating” and “Chapter 15B Lubricating”.

Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > Overhaul ECU and the circuit

Power Shortage

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect whether the circuit and the connector is disconnected or loosened.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **Air filter and inlet pipe (blocked or distorted).**
2. **The fuel type is not right.**
3. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
4. **Turbocharger (damaged, inefficient).**
5. **Throttle position sensor, crankshaft position sensor, water temperature sensor, air intake pressure and temperature sensor and common rail pressure sensor (fault sensors and circuits, signal loss, unstable signal).**
6. **Exhaust brake and butterfly valve (sticking, exhaust pipe blocked)**
7. **Intercooler (blocked, leaking).**
8. **Supercharger air intake pipe (leaking)**
9. **Fuel injector (damaged, pressure release).**
10. **High-pressure pump (damaged, pressure release).**
11. **Engine machinery (timing error, piston, tile, etc.).**
12. **Clutch, transmission drive part (clutch slipping, transmission drive part damaged or stuck).**

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Inspect the air filter and the air intake pipe

Hint:

The indicator on the instrument will alarm if the air filter is blocked.

04

Whether the air filter is too dirty or blocked?

Yes > replace it with a new one

No > see Step 3

3. Inspect the intercooler, supercharger air intake pipe and air intake pipe.

- (a). Operate the engine at different rotation speed.
- (b). Inspect the intercooler's appearance for damage and leakage.
- (c). Inspect the supercharger's appearance for distortion and leakage.
- (d). Inspect the air intake pipe's appearance for distortion and leakage.

Whether the above problems exist?

Yes > maintain the fault parts

No > see Step 4

4. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the data stream.
- (d). Read the fault code.

Hint:

The faults of the throttle position sensor, crankshaft position sensor, water temperature sensor, air intake pressure and temperature sensor or common rail pressure sensor can be seen in the data stream or fault codes from the diagnostic apparatus for the overhaul of sensors and circuits.

Whether there are fault codes that cause power shortage?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 5

> if the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream".

5. Inspect fuel

- (a). Open the fuel tank cap to inspect and ensure that the fuel is clean and the type is right.

Whether the fuel has the above problems?

Diagnosis - Cigarette Lighter

Yes > replace it with the right type of fuel

No > see Step 6

6. Inspect the fuel coarse filter and fine filter

- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, then replace them.

Whether the fuel coarse filter and fine filter have the above problems?

Yes > replace them with new ones

No > see Step 7

7. Inspect the exhaust brake butterfly valve

- (a). When the ignition switch is turned off, inspect the position of the exhaust brake butterfly valve.

Whether the exhaust brake butterfly valve is fully turned on?

Yes > see Step 8

No > overhaul the sticking fault of the exhaust brake butterfly valve.

8. Inspect the working conditions of the exhaust brake

- (a). Start the engine and inspect whether the exhaust air butterfly valve is operating.

Whether the exhaust brake butterfly valve is operating?

Yes > overhaul the abnormal working faults of the exhaust brake.

No > see Step 9

9. Inspect the turbocharger

- (a). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual boost pressure" from the data stream .

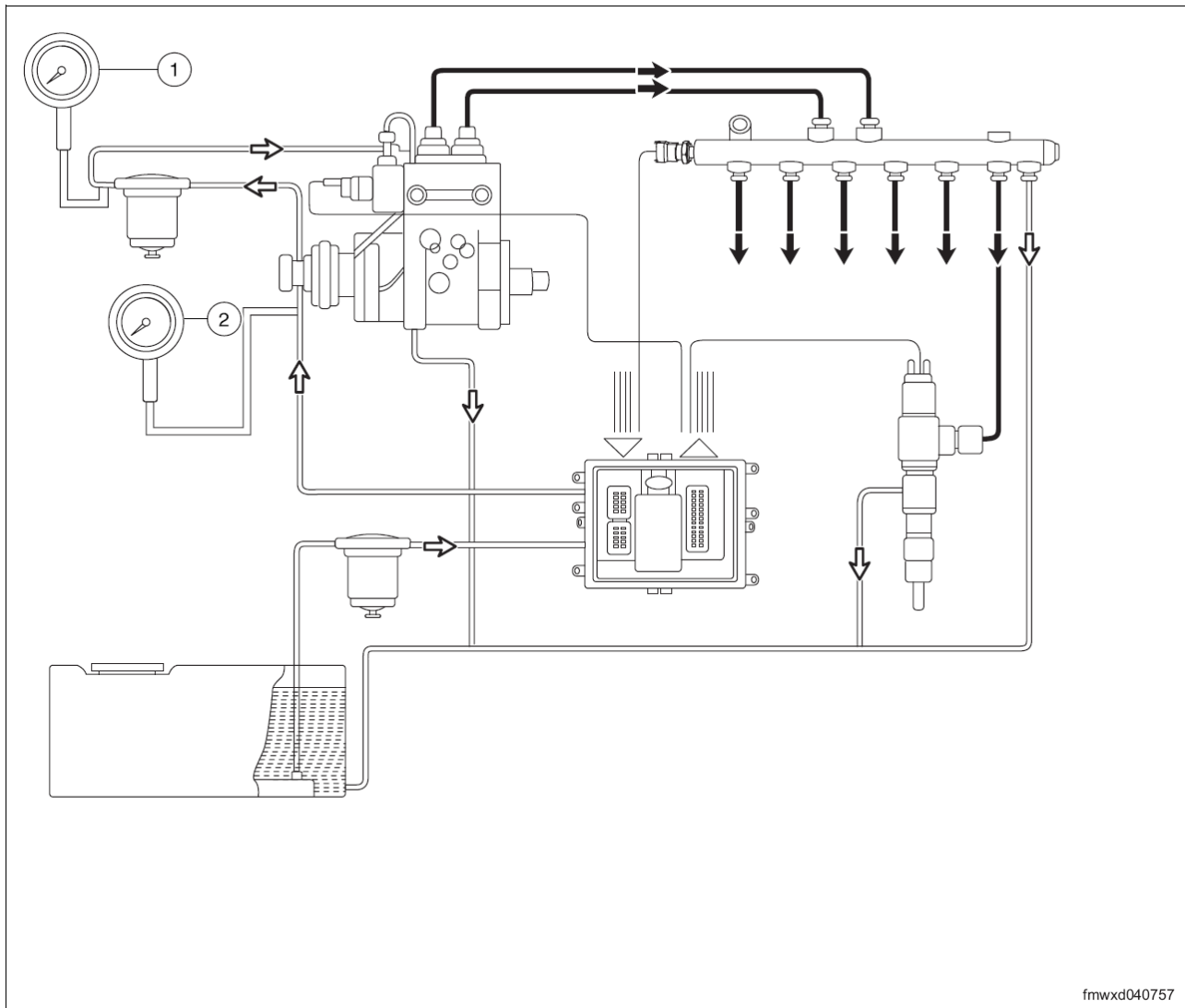
Hint:

Under normal circumstances, when the engine is operating, the "actual boost pressure" shown by the diagnostic apparatus shall be no less than the "atmospheric pressure".

Whether the "actual boost pressure" shown by the diagnostic apparatus is less than the "atmospheric pressure"?

Yes > inspect whether the impeller of the turbocharger is damaged or leaking; if yes, replace it with a new one.

No > see Step 10



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10. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 1 can reach 900 KPa at a high rotation speed.

Whether the pressure value of pressure gauge can reach 900Kpa?

Yes > see Step 11

No > the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one

11. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

Diagnosis - Cigarette Lighter

(b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

No > see Step 12

12. Inspect the high-pressure common rail fuel pressure of the engine

(a). The engine is operating.

(b). Use the diagnostic apparatus to conduct the "high-pressure test".

Hint:

Under normal circumstances, in the "high-pressure test", the "actual fuel rail pressure" shall reach the high pressure value set in the "high-pressure test".

If the high-pressure value set in the "high-pressure test" can not be reached, it shows that the high-pressure common rail pipe has leakage.

Whether the "actual fuel rail pressure" shown by the diagnostic apparatus can reach the high-pressure value set in the "high-pressure test"?

Yes > see Step 13

No > see Step 14

Whether the above problems exist?

Yes > replace the underslung flameout switch or maintain the connection wire harness of the underslung flameout switch

No > see Step 13

13. Inspect the fuel injector

(a). The engine is operating.

(b). Use the diagnostic apparatus to conduct the "cylinder cutout test".

Hint:

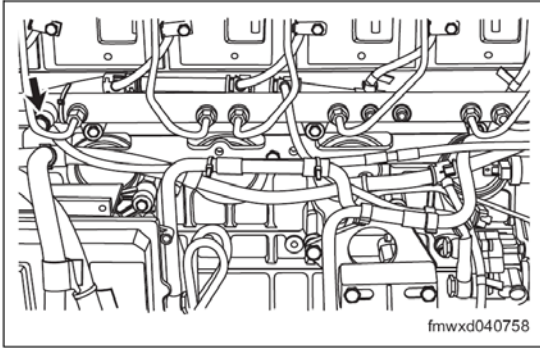
Under normal conditions, in the "cylinder cutout test", when one cylinder stops working, the engine will shake. If the engine does not shake when one cylinder stops working, it shows that the fuel injector of such cylinder is damaged or such cylinder is leaking.

Whether the engine shakes when one cylinder shakes?

Yes > see Step 14

No > replace the fuel injector of the cylinder with a new one

> see Step 18

14. Inspect the common rail and the pressure limiting valve

- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual fuel rail pressure" from the data stream.

Hint:

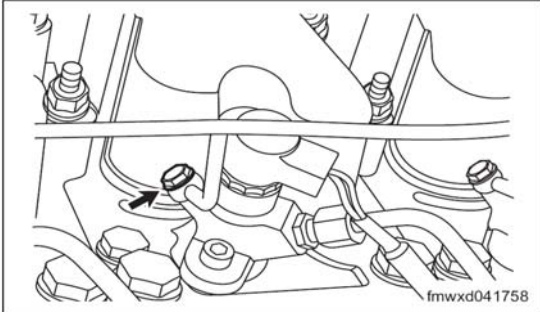
Under normal circumstances, when the engine is operating and the "actual fuel rail pressure" shown by the diagnostic apparatus is higher than 160MPa, the pressure limiting valve will release pressure, that is, the releasing pressure of pressure limiting valve will be 160Mpa.

- (c). When the engine functions and the actual fuel rail pressure shown by the diagnostic apparatus is lower than 160MPa, observe whether the oil outlet of the pressure limiting valve has fuel outflow

Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

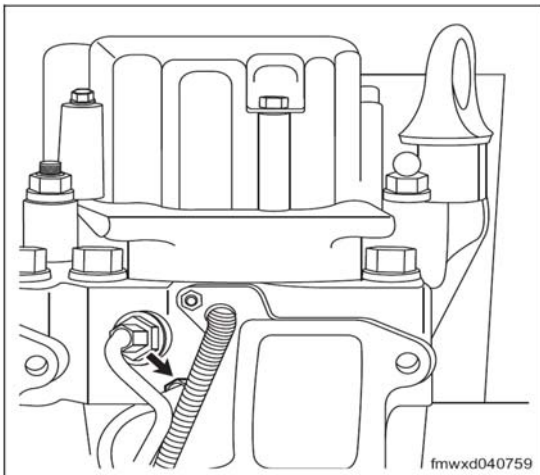
No > see Step 15

15. Inspect oil return at fuel injector

- (a). Respectively disconnect the return pipe joint at each cylinder's fuel injector.
- (b). Compare the oil return volume of each cylinder's fuel injector.

Hint:

Under normal circumstances, the oil return volume of each cylinder's fuel injector is nearly the same when the engine functions. If the oil return volume of one cylinder's fuel injector is higher than others, it indicates the fuel injector of this cylinder is damaged.



Whether the oil return volume of one cylinder's fuel injector is higher than other cylinders?

Yes> replace the fuel injector of the cylinder

No > see Step 16

Diagnosis - Cigarette Lighter

16. Inspect the high-pressure fuel pump

- (a). Overhaul such faults as the pressure relief and inefficiency of the high-pressure fuel pump.

Whether the high-pressure fuel pump releases pressure and functions inefficiently?

Yes > replace the high-pressure fuel pump.

No > see Step 17

17. Inspect clutch and transmission drive part

- (a). Inspect whether the clutch slips; refer to "Chapter 32 Clutch".
(b). Inspect whether the transmission drive assembly is abnormal.
(c). Inspect whether the brake is abnormal.

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Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > see Step 18

18. Inspect the mechanical system of the engine

- (a). Inspect timing gear; refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".
(b). Inspect compression pressure of the cylinder. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".
(c). Inspect whether the piston, the crankshaft, or other relevant parts clamps. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".

Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > overhaul ECU and the circuit

Excessive Black Smoke

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect whether the circuit and the connector are disconnected or loosened.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **Air filter and inlet pipe (blocked or distorted).**
2. **Turbocharger (damaged, inefficient).**
3. **3. Water Temperature Sensor (the sensor and its line fail and the signals are wrong).**
4. **Fuel injector (damaged, seized).**
5. **Engine machinery (timing error).**

Diagnosis - Cigarette Lighter

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Inspect the air filter and the air intake pipe

Hint:

The indicator on the instrument will alarm if the air filter is blocked.

Is the air filter too dirty or blocked?

Yes > replace it with a new one

No > see Step 3

3. Inspect the intercooler, supercharger air intake pipe and air intake pipe.

- (a). Operate the engine at different rotation speed.
- (b). Inspect the intercooler's appearance for damage, crack and leakage.
- (c). Inspect the supercharger's appearance for distortion and leakage.
- (d). Inspect the air intake pipe's appearance for distortion and leakage.

Whether the above problems exist?

Yes > maintain the fault parts

No > see Step 4

4. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the data stream.
- (d). Read the fault code.

Whether there are fault codes that cause excessive black smoke?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 5

> if the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream".

5. Inspect the water temperature sensor

- (a). Read the coolant temperature (°C) in the data stream by the diagnostic apparatus.

Hint:

Under the normal circumstances, the coolant temperature (°C) shown by the diagnostic apparatus shall be almost the same with actual temperature.

Is the coolant temperature (°C) shown by the diagnostic apparatus almost the same with actual temperature?

Yes > see Step 6

Yes > overhaul the water temperature and the circuit

6. Inspect the turbocharger

- (a). Operate the engine at different rotation speed and use the diagnostic apparatus to read the “actual boost pressure” from the data stream.

Hint:

Under normal circumstances, when the engine is operating, the “actual boost pressure” shown by the diagnostic apparatus shall be no less than the “atmospheric pressure”.

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Is the “actual boost pressure” shown by the diagnostic apparatus less than the “atmospheric pressure”?

Yes > Inspect whether the impeller of the turbocharger is damaged or leaking; if yes, replace it with a new one.

No > see Step 7

7. Inspect the fuel injector

- (a). The engine is operating.
- (b). Use the diagnostic apparatus to conduct the “cylinder cutout test”.

Hint:

Under normal conditions, in the “cylinder cutout test”, when one cylinder stops working, the engine will shake. If the engine does not shake when one cylinder stops working, it shows that the fuel injector of such cylinder is damaged or such cylinder is leaking.

Does the engine shake when one cylinder shakes?

Yes > see Step 8

No > replace the fuel injector of the cylinder

> see Step 8

8. Inspect the mechanical system of the engine

- (a). Inspect the timing gear; refer to “Chapter 16A Engine Machinery” and “Chapter 16B Engine Machinery”.
- (b). Inspect compression pressure of the cylinder. Refer to “Chapter 16A Engine Machinery” and “Chapter 16B Engine Machinery”.

Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > overhaul ECU and the circuit

White or Blue Smoke

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect whether the circuit and the connector are disconnected or loosened.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **Water temperature sensor (the sensor and its line fail and the signals are wrong).**
2. **Excessive oil (burning oil).**
3. **Turbocharger (leaking).**
4. **Engine machinery (timing error).**

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".
2. Inspect the oil level

Do the oil excessively filled?

Yes> adjust the oil level to the normal level.

No > see Step 3

3. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the data stream.
- (d). Read the fault code.

Whether there are fault codes that cause white or blue smoke?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 4

> if the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream".

4. Inspect the water temperature sensor

- (a). Read the coolant temperature (°C) in the data stream by the diagnostic apparatus.

Hint:

Under the normal circumstances, the coolant temperature (°C) shown by the diagnostic apparatus shall be almost the same with actual temperature.

Is the coolant temperature (°C) shown by the diagnostic apparatus almost the same with actual temperature?

Yes > see Step 5

Yes > overhaul the water temperature and the circuit

5. Inspect the turbocharger

- (a). Dismantle the turbocharger in order to inspect whether there is a oil leakage at the turbocharger.

Is there any oil leakage at the turbocharger?

Yes> replace the turbocharger with a new one.

No > see Step 6

6. Inspect the mechanical system of the engine

- (a). Inspect the timing gear; refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".
- (b). Inspect compression pressure of the cylinder. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".

Whether there are problems in the above parts?

Diagnosis - Cigarette Lighter

Yes > overhaul the fault parts

No > overhaul ECU and the circuit

Unstable Idle Speed

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Before the fault inspection, make visual inspection carefully. The visual inspection is helpful in finding faults without further inspection and therefore is time saving.

The visual inspection includes:

1. **Inspect whether the circuit and the connector are disconnected or loosened.**
2. **Inspect whether the ECU circuit has jumper wires of additional non-manufacturer equipment.**
3. **Inspect whether the ECU earthing has stains and is firmly fixed to the right position.**
4. **Inspect whether the fuel pipe is bent, blocked, disconnected or leaking.**
5. **Inspect whether the pipes and tubes related to the intake and exhaust system and the oil lubricating system have cracks or distortion and are connected correctly.**
6. **Inspect whether the engine-related parts are lost or broken.**

Parts that may cause faults

1. **The fuel type is not right.**
2. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
3. **Air exists in fuel pipeline (the air shall be exhausted).**
4. **Vehicle speed sensor (the sensor is damaged and the signal is unstable, thus causing the unstable idle speed).**
5. **Fuel injector (damaged, abnormal working)**
6. **High-pressure fuel pump (damaged, abnormal working).**
7. **Engine damper bracket (damaged).**
8. **Engine machinery (timing error, piston, tile, etc.).**

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Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Inspect the engine bracket

(a). Inspect whether the rubber of the engine bracket is damaged or aged.

Is the rubber of the engine bracket damaged or aged?

Yes> Replace the engine bracket

No > See Step 3

3. Connect the diagnostic apparatus

(a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".

(b). Operate the diagnostic apparatus according to the instruction for use.

(c). Read the data stream.

(d). Read the fault code.

Whether there are fault codes that cause the unstable idle speed?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 4

> If the data stream is abnormal, diagnose according to the reference list of data stream, refer to this chapter, "Reference List of Data Stream".

Hint:

The faults of the speed sensor, water temperature sensor and oil pressure and temperature sensor can be seen in the data stream or fault codes from the diagnostic apparatus for maintenance of sensor and circuit faults.

4. Inspect the fuel

(a). Open the fuel tank cap to inspect and ensure that the fuel is clean and the type is right.

Whether the fuel has the above problems?

Yes > replace it with the right type of fuel

No > see Step 5

5. Inspect the fuel coarse filter and fine filter

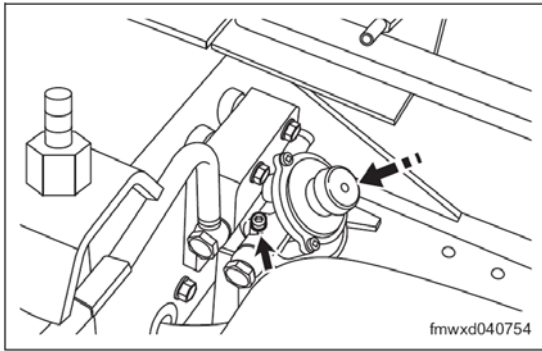
(a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, then replace them.

Do the fuel coarse filter and fine filter have the above problems?

Yes > replace them with new ones

No > see Step 6

6. Inspect whether air has been taken into the low-pressure fuel pipe



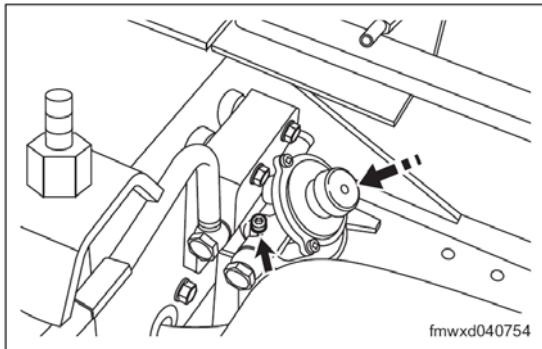
- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 7

No > see Step 8

7. Exhaust air in the low-pressure fuel pipe



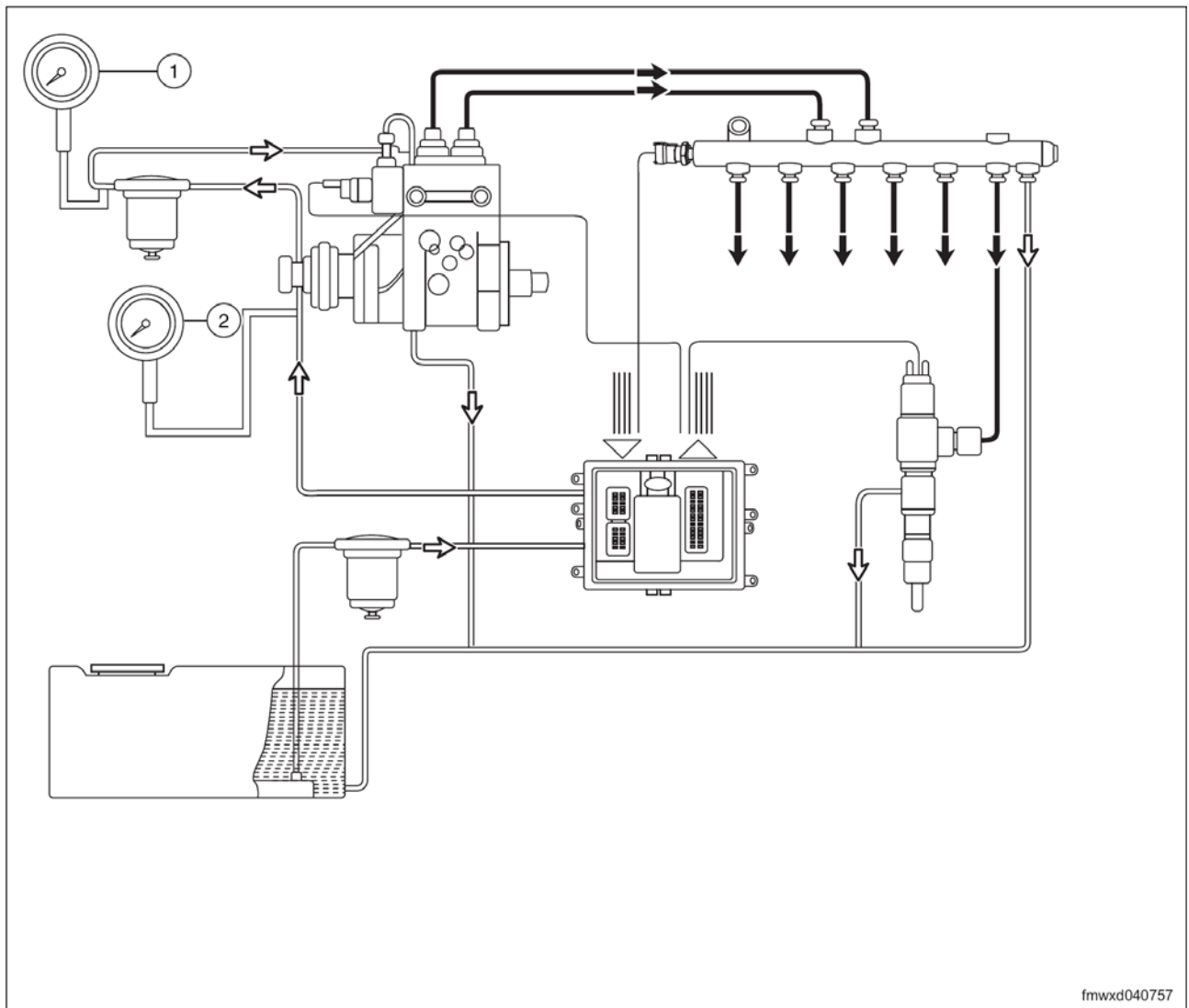
- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No > see Step 8

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8. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:**Exhaust air in the fuel pipe after connecting the pressure gauge.**

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 1 can reach 900 KPa at a high rotation speed.

Whether the pressure value of pressure gauge can reach 900Kpa?

Yes > see Step 9

No > the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one

9. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

(b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

No > see Step 10

10. Inspect the high-pressure common rail fuel pressure of the engine

(a). The engine is operating.

(b). Use the diagnostic apparatus to conduct the "high-pressure test".

Hint:

Under normal circumstances, in the "high-pressure test", the "actual fuel rail pressure" shall reach the high-pressure value set in the "high-pressure test".

If the high-pressure value set in the "high-pressure test" can not be reached, it shows that the high-pressure common rail pipe has leakage.

Whether the "actual fuel rail pressure" shown by the diagnostic apparatus can reach the high-pressure value set in the "high-pressure test"?

Yes > see Step 11

No > see Step 12

11. Inspect the oil injector

(a). The engine is operating.

(b). Use the diagnostic apparatus to conduct the "cylinder cutout test".

Hint:

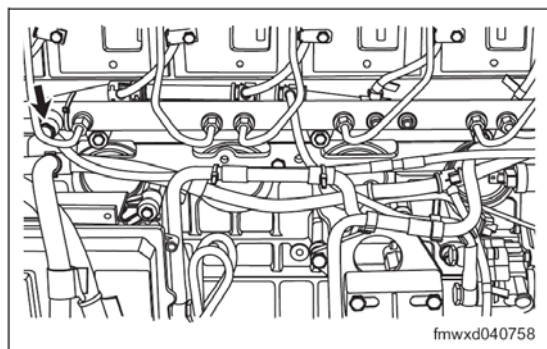
Whether the engine shakes when one cylinder shakes?

Yes > see Step 12

No > replace the oil injector of the cylinder with a new one

> see Step 16

12. Inspect the common rail and the pressure limiting valve



(a). Disconnect the return pipe joint of the pressure limiting valve.

(b). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual fuel rail pressure" from the data stream.

Hint:

Under normal circumstances, when the engine is operating and the "actual fuel rail pressure" shown by the diagnostic apparatus is higher than 160MPa, the pressure limiting valve will release pressure, that is, the releasing

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pressure of pressure limiting valve will be 160Mpa.

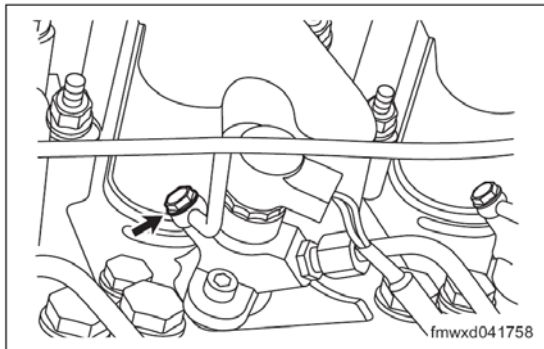
- (c). When the engine functions and the actual fuel rail pressure shown by the diagnostic apparatus is lower than 160MPa, observe whether the oil outlet of the pressure limiting valve has fuel outflow.

Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

No > see Step 13

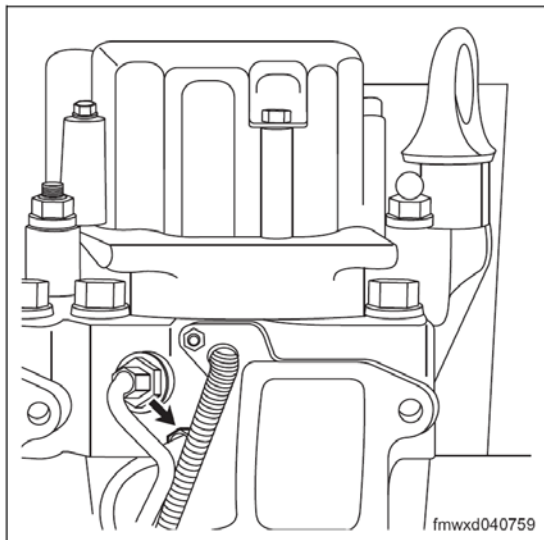
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13. Inspect oil return at fuel injector

- (a). Respectively disconnect the oil return pipe joint at each cylinder's fuel injector.
- (b). Compare the oil return volume of each cylinder's fuel injector.

Hint:

Under normal circumstances, the oil return volume of each cylinder's fuel injector is nearly the same when the engine functions. If the oil return volume of one cylinder's fuel injector is higher than others, it indicates the fuel injector of this cylinder is damaged.



Whether the oil return volume of one cylinder's fuel injector is higher than other cylinders?

Yes > replace the fuel injector of the cylinder

No > see Step 14

14. Inspect high-pressure fuel pump

- (a). Overhaul the faults of pressure release and low efficiency of high-pressure fuel pump.

Whether the high-pressure fuel pump releases pressure and functions inefficiently?

Yes > replace the high-pressure fuel pump.

No > see Step 15

15. Inspect clutch and transmission drive part

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- (a). Inspect whether the clutch slips. Refer to "Chapter 32 Clutch".
- (b). Inspect whether the transmission drive assembly is abnormal.
- (c). Inspect whether the brake is abnormal.

Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > see Step 16

16. Inspect the mechanical system of the engine

- (a). Inspect timing gear. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery"
- (b). Inspect compression pressure of the cylinder. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery"
- (c). Inspect whether the piston, the crankshaft, or other relevant parts clamps. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".

Whether there are problems in the above parts?

Yes > overhaul the fault parts

No > Overhaul ECU and the circuit

1-1-1 Error of AD Convertor in the ECU

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Error in ECU signal handling causes engine failed or even inability of starting; ECU will record the faults.

Parts that may cause faults

1. ECU (damaged)

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other faults?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Disconnect and connect ignition switch once again

- (a). Turn off the ignition switch and then turn it on after several seconds
- (b). Read the fault code.

Do the fault codes exist currently?

Yes > replace ECU

No > see Step 3

3. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > the system is normal.

No > replace ECU.

1-1-2 Sync Signal Error

1-1-3 Sync Signal Error

1-1-4 Sync Signal Error

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

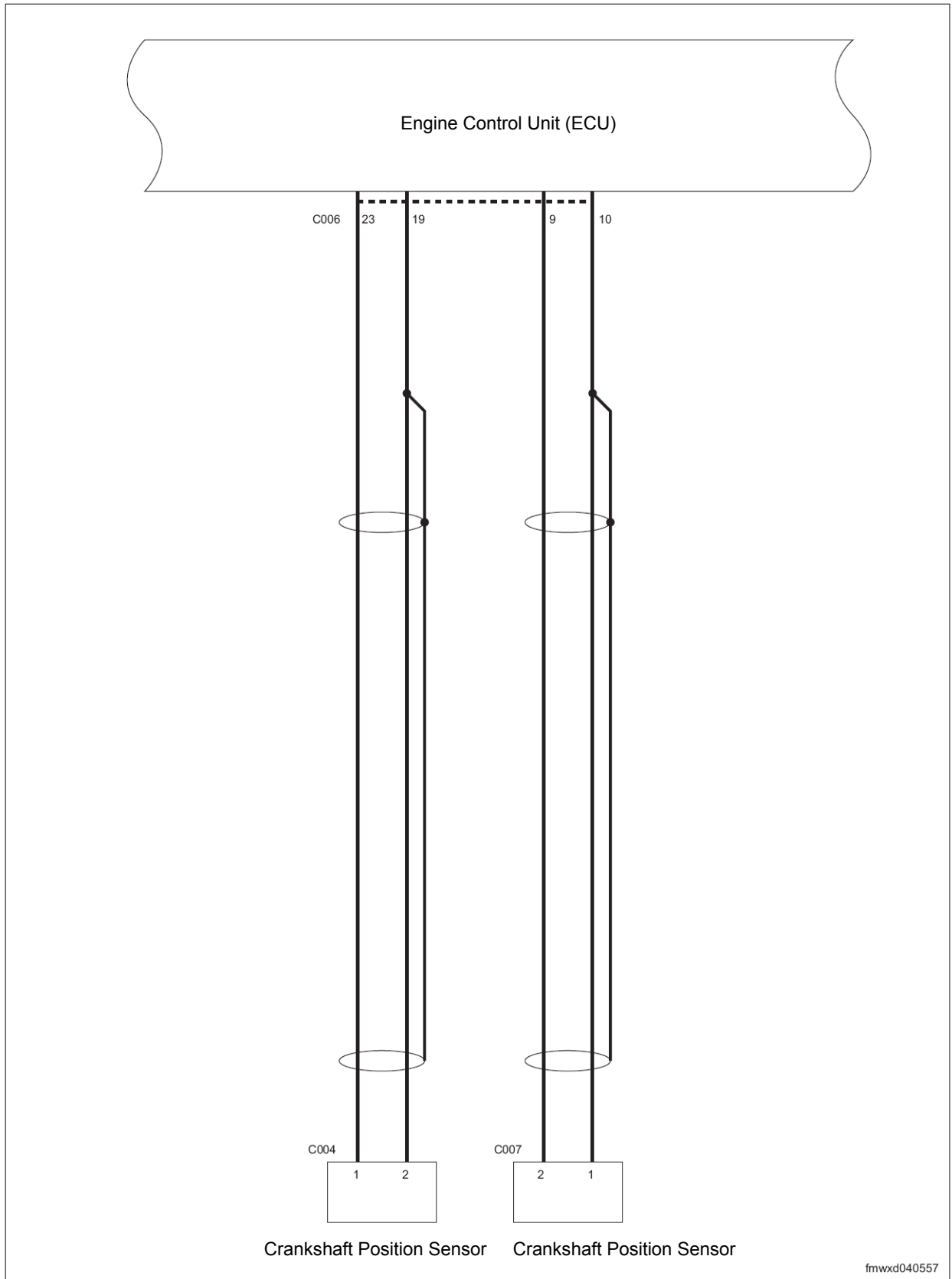
ECU determines engine timing by signals of crankshaft position sensor and camshaft position sensor. When ECU receives false sync signals from crankshaft position sensor and camshaft position sensor, it may result in difficulty in starting, black smoking, abnormal engine sound and ECU will record the fault.

Parts that may cause faults

1. **Crankshaft position sensor and camshaft position sensor circuit (shorted or opened)**
2. **Crankshaft position sensor and camshaft position sensor (soiled, damaged or incorrectly installed)**
3. **Flywheel ring gear (soiled, damaged, or incorrectly installed)**
4. **High-pressure fuel pump signal gear (damaged)**
5. **ECU (damaged)**

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Circuit Diagram



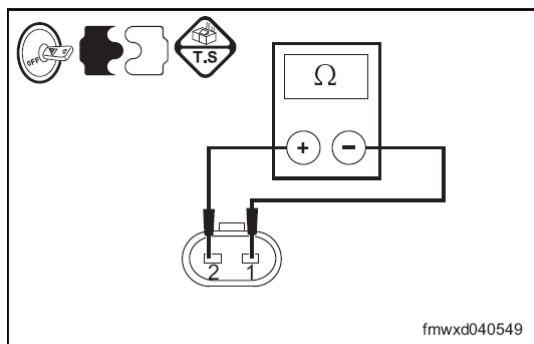
Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (d). Read the fault code.

Is there any other faults?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect crankshaft position sensor and camshaft position sensor

- (a). Turn off ignition switch
- (b). Disconnect the wiring harness connectors C004 and C007 of crankshaft position sensor and camshaft position sensor,.
- (c). Use multi-meter to measure the resistance between pin 1 and pin 2 of crankshaft position sensor and camshaft position sensor

Resistance:

Part	Standard Value
Crankshaft Position Sensor	770~950Ω
Camshaft Position Sensor	770~950Ω

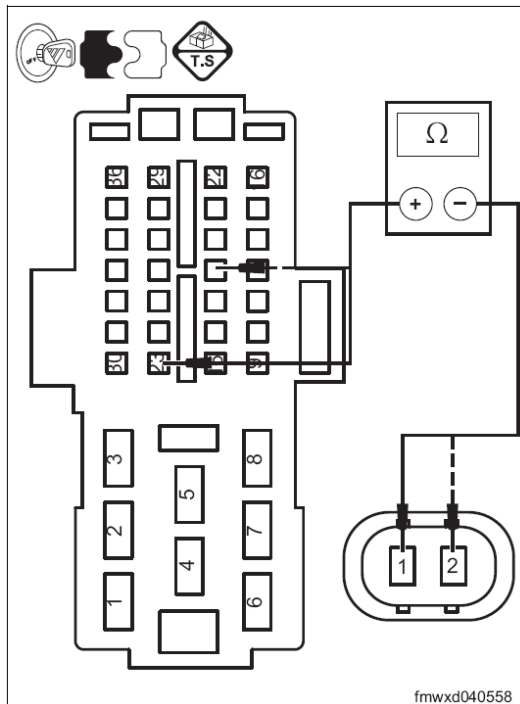
Is the inspection result normal?

Yes > see Step 3

No > Replace crankshaft position sensor or camshaft position sensor

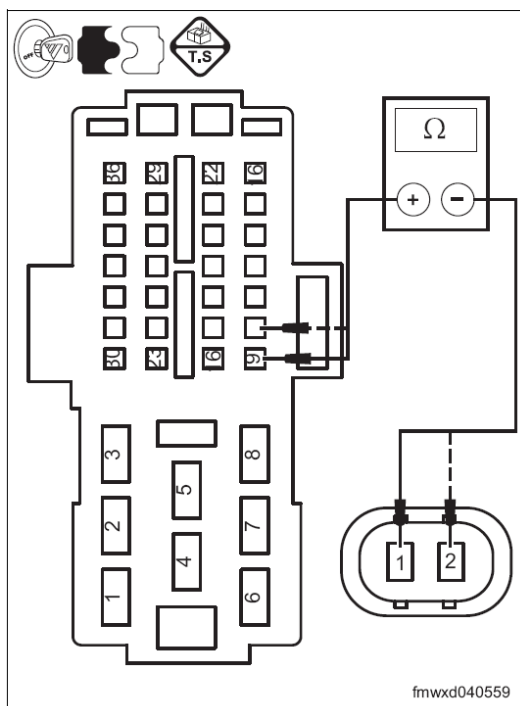
Diagnosis - Cigarette Lighter

3. Inspect the circuits from crankshaft position sensor and camshaft position sensor to ECU



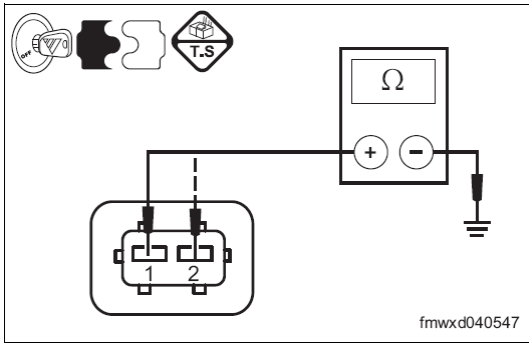
- (a). Turn off ignition switch
- (b). Disconnect ECU connector C006.
- (c). Keep disconnected the wiring harness connector C004 and C007 of crankshaft position sensor and camshaft position sensor.
- (d). Use multi-meter to measure the resistance between pin 23 of C006 and pin 1 of C004, and between pin 19 of C006 and pin 2 of C009.

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- (e). Use multi-meter to measure the resistance between pin 10 of C006 and pin 1 of C007, and between pin 9 of C006 and pin 2 of C009.

Resistance $\leq 2 \Omega$



- (f). Use multi-meter to measure the resistance between pin 1 of crankshaft position sensor and earth, and between pin 2 of camshaft position sensor and earth.

Resistance > 10 MΩ

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Is the inspection result normal?

Yes > see Step 4

No > inspect fault in the circuits from crankshaft position sensor and camshaft position sensor to ECU.

4. Inspect the appearance of the sensor

- Dismantle the crankshaft position sensor and the camshaft position sensor.
- Inspect the sensor for whether the installment is correct or not. There shall be no damage on the appearance. The probe shall not be too dirty.

Hint:

The space between the crankshaft position sensor and the flywheel shall be 1.0 ± 0.5 mm.

Whether the above problems exist?

Yes > clean, reinstall or replace the sensor.

No > see Step 5

5. Inspect the flywheel ring gear and the signal gear of the high-pressure fuel pump

- Inspect the flywheel ring gear and the signal gear of the high-pressure fuel pump. The installment shall be correct. There shall be no damage on the appearance. The probe shall not be too dirty.

Whether the above problems exist?

Yes > clean the signal gear or replace the flywheel ring gear or the high-pressure fuel pump.

No > see Step 6

6. Erase fault code

- Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault code be erased?

Yes > the system is normal.

No > replace ECU.

1-1-5 Error of Time Handling Unit in the ECU

1-1-6 ECU Inner Error

Description

Hint:

Refer to this chapter, "KT600 Diagnostic Apparatus Usage and Fault Test".

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

The error in ECU inner time unit results in insufficient engine power, flameout and inability of starting. ECU will record the faults.

Parts that may cause faults

1. ECU (damaged).

Diagnostic Steps

1. Connection Diagnostic Apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicles; refer to this Chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Disconnect and connect ignition switch once again

- (a). Turn off the ignition switch and then turn it on after several seconds
- (b). Read the fault code.

Do the fault codes exist currently?

Yes > replace ECU

No > see Step 3

3. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-2-1 Error of Starting Relay

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When abnormality occurs in starting the relay, the engine cannot be started. ECU will record the fault.

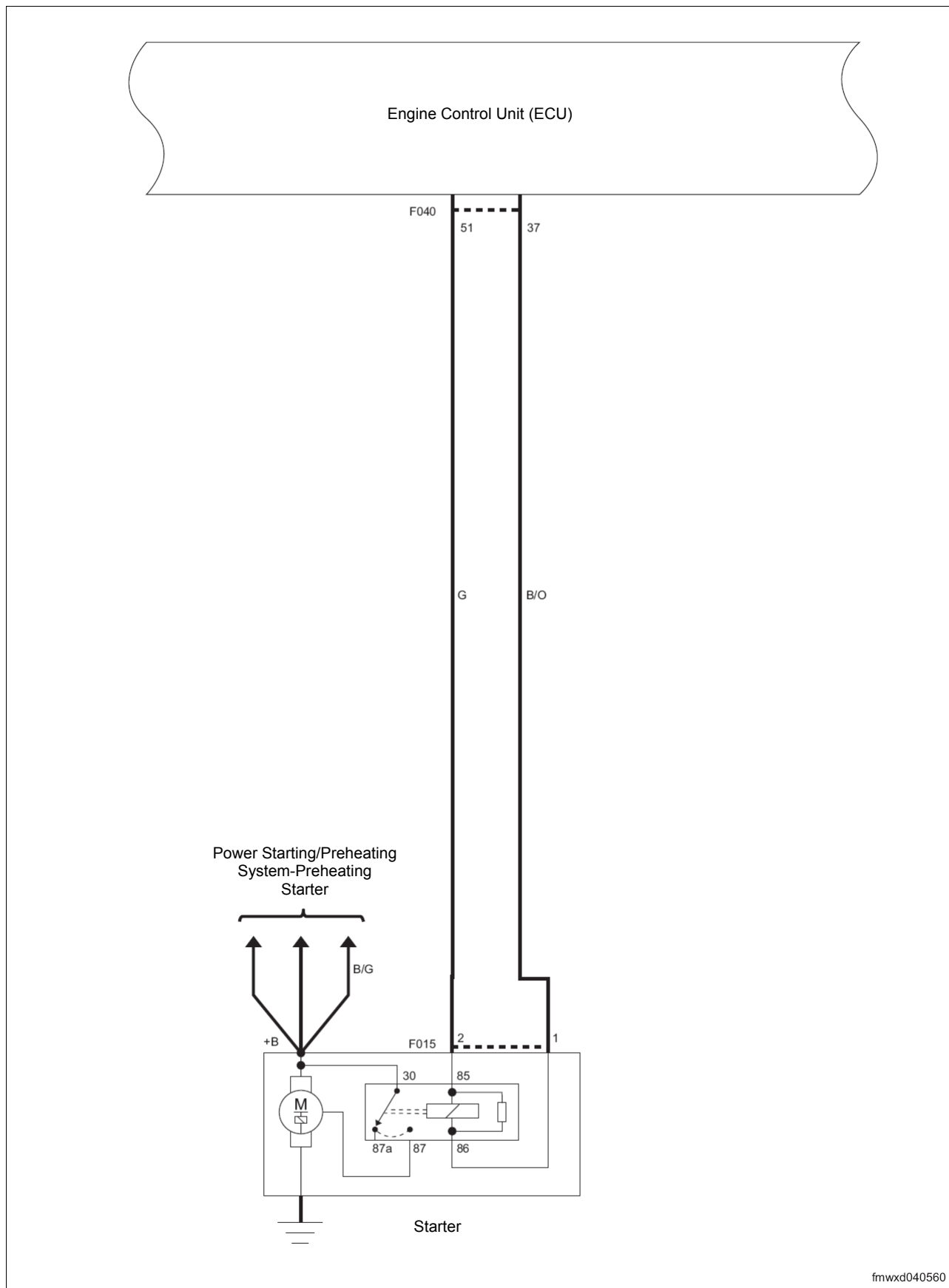
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Parts that may cause faults

1. Starting relay circuit (shorted or opened).
2. Starting relay (damaged).
3. ECU (damaged)

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Circuit Diagram



Diagnostic Steps

1. Connect the diagnostic apparatus

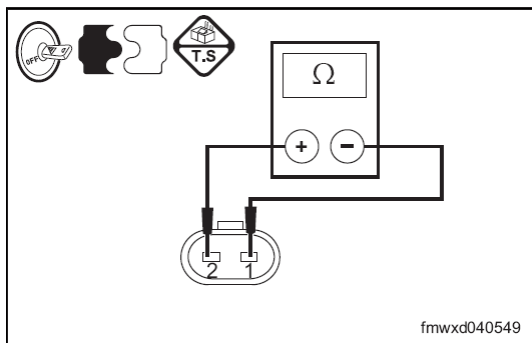
- Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect the starting relay.



- Turn off ignition switch.
- Disconnect the connector F015 of the starting relay.
- Use multi-meter to measure the resistance between the starting relay controlling pins 1 and 2 of the starter.

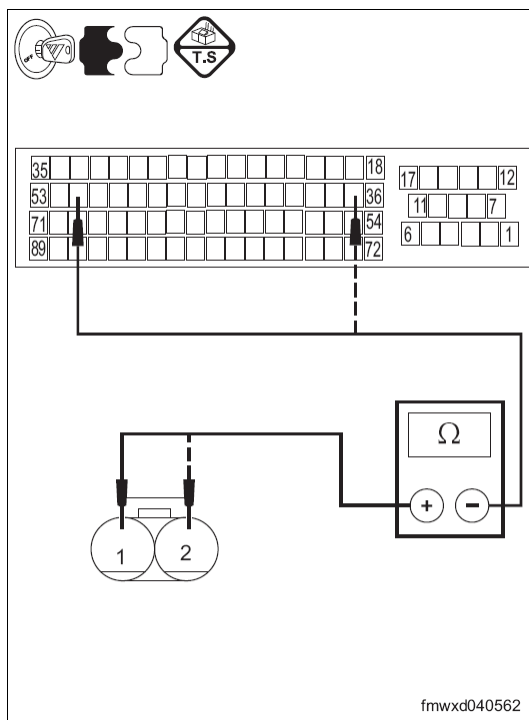
Resistance: 200~400Ω

Is the inspection result normal?

No > see Step 3

No > replace the starting relay or the starter.

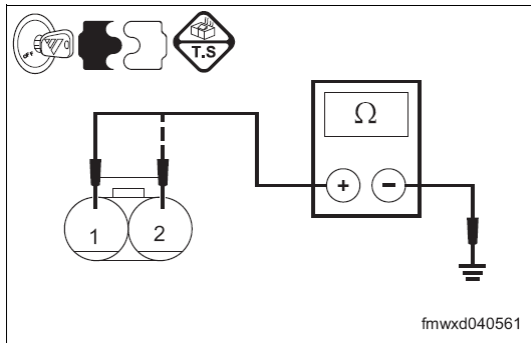
3. Inspect the starting relay to the ECU circuit.



- Turn off ignition switch.
- Disconnect the connector F040 of ECU.
- Use multi-meter to measure the resistance between pin 37 of F040 and pin 1 of F015, and between pin 51 of F040 and pin 2 of F015.

Resistance: $\leq 2 \Omega$

Diagnosis - Cigarette Lighter



- (d). Use multi-meter to measure the resistance between pins 1 and 2 of the connector F015 of the starting relay and the earth.

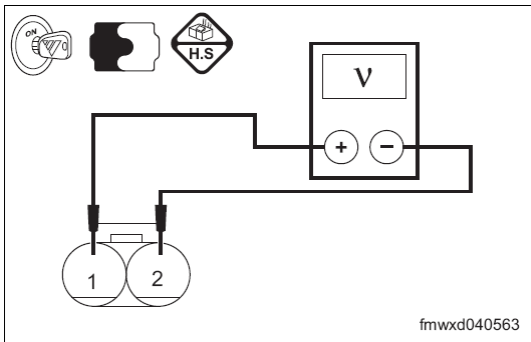
Resistance: > 10 MΩ

Is the inspection result normal?

No > see Step 3

No > repair or replace the circuit from starting relay to ECU

4. Inspect the starting relay control



- (a). Connect ECU connector F040 and the starting relay connector F015.
 (b). Turn the ignition switch to START.
 (c). Use the multi-meter to measure the voltage between pin 1 and pin 2 of the starting relay connector F015.

Caution:

When the transmission is on neutral gear and the ignition switch turns to START, the engine may start.

Be careful.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the starting relay or the starter, and erase fault code.

Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

No > replace ECU

1-2-2 Error of Ignition Switch “ON” (T15)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, “General Steps for Fault Diagnosis”.

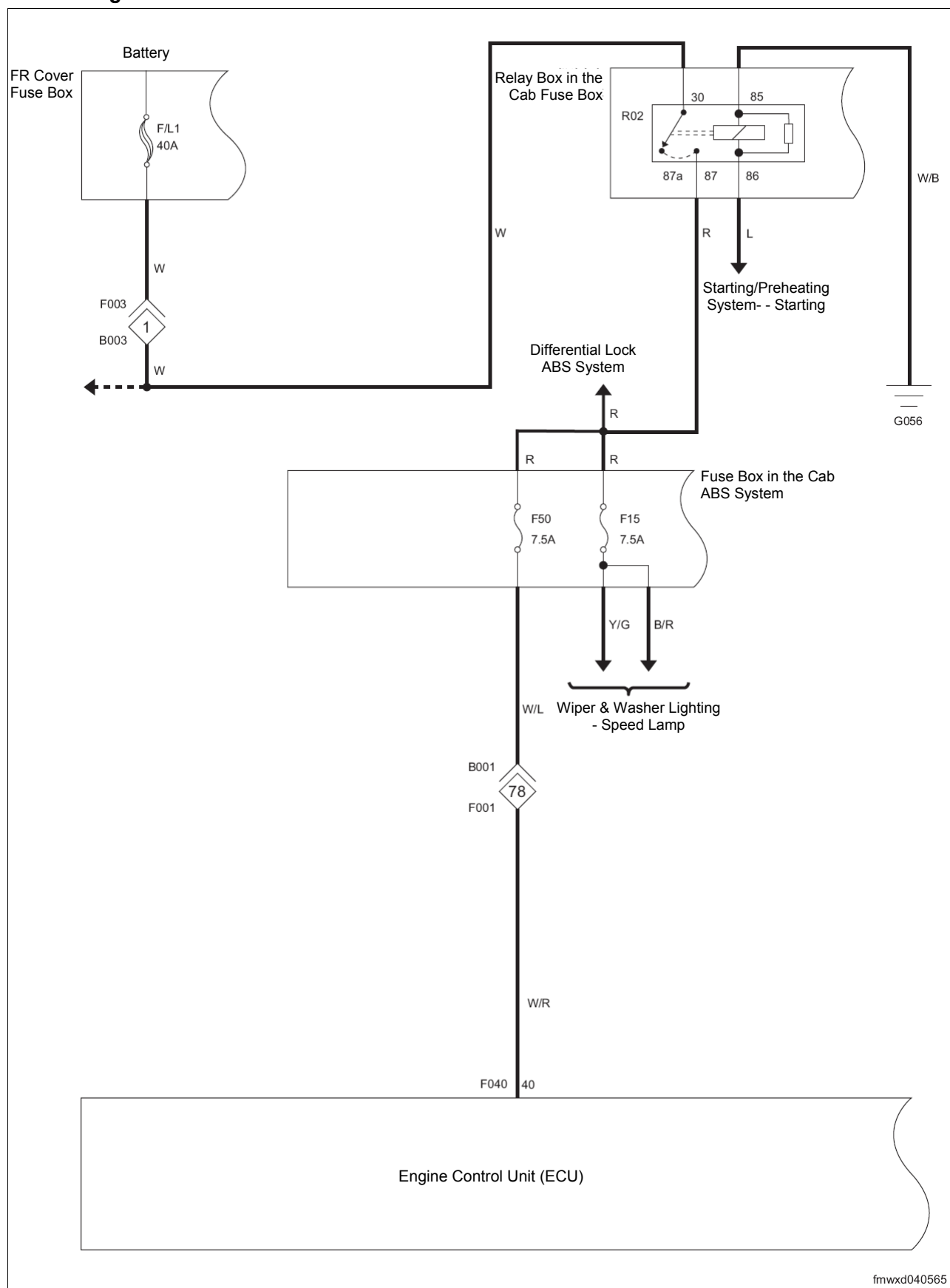
When the ignition switch is at ON, ECU receives the wrong signal of ignition switch ON; ECU will record the fault.

Parts that may cause faults

1. ECU (IG) Fuse Circuit (shorted, opened).
2. ECU (IG) Fuse (damaged).
3. ECU (damaged)

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnosis - Cigarette Lighter

Hint:

If there is no electricity on ECU (IG) fuse, inspect and repair IG power circuit fault; refer to “Chapter 04 Diagnosis – Starting/ Preheating System”.

4. Erase fault code

(a). Erase fault code; refer to this chapter, “Reading and Erasing of Flash Fault Codes”.

Can fault code be erased?

Yes > the system is normal.

No > replace ECU

1-2-3 Error of Ignition Switch “START” (T50)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, “General Steps for Fault Diagnosis”.

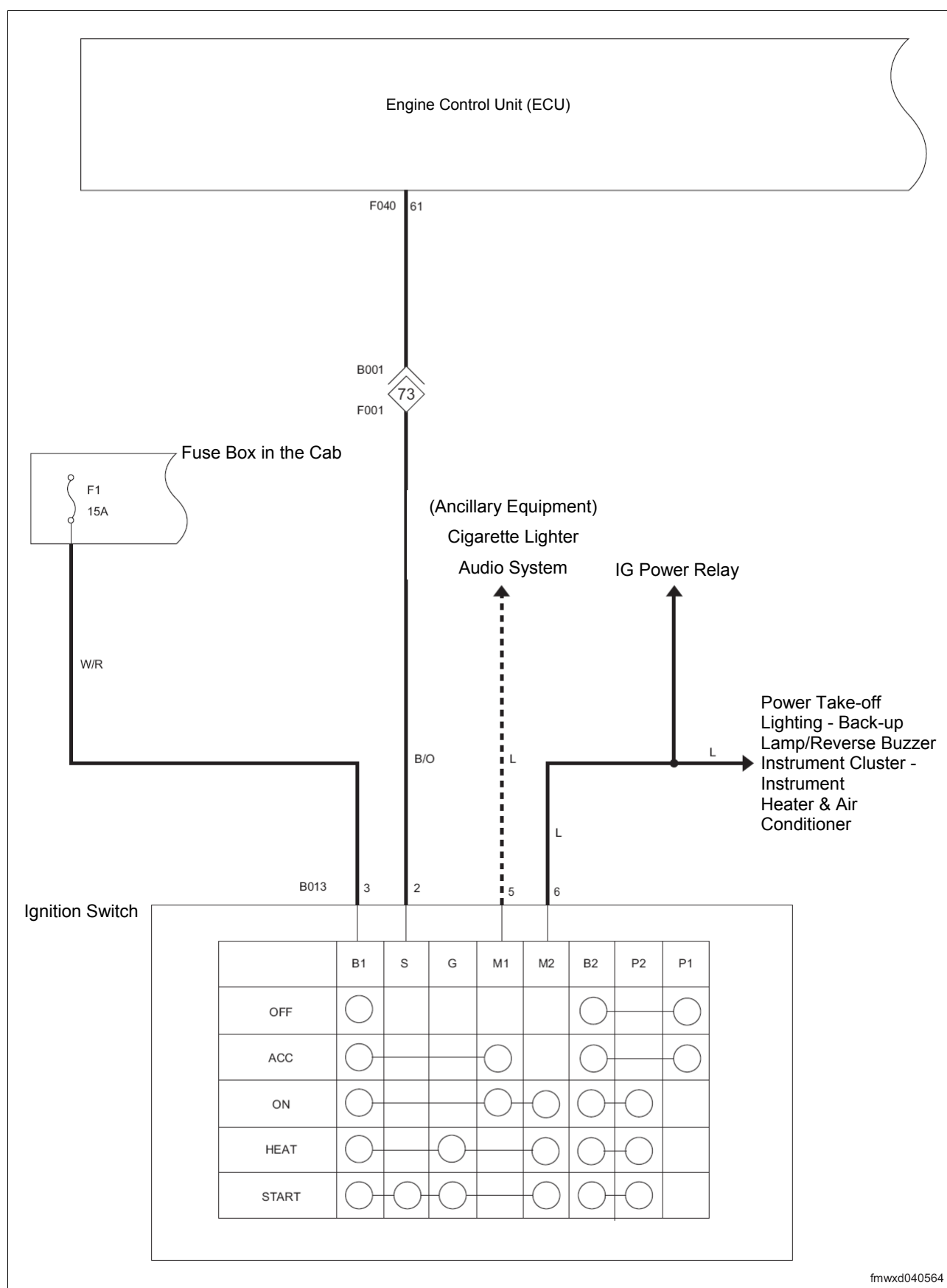
When the ignition switch turns to START, ECU receives the wrong signal of ignition switch START, ECU will record the fault.

Parts that may cause faults

1. Ignition switch circuit (shorted or opened)
2. Ignition switch fuse (damaged).
3. Ignition switch (damaged).
4. ECU (damaged)

Diagnosis - Cigarette Lighter

Circuit Diagram



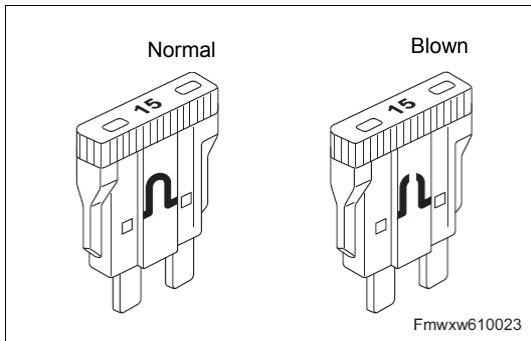
Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (d). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

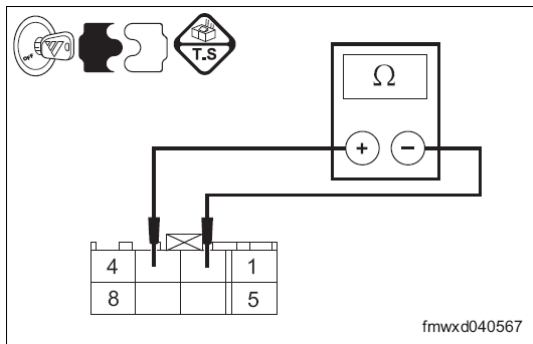
2. Inspect the ignition switch fuse.

- (a). Turn off ignition switch.
- (b). Inspect the fuse in the fuse box in the cab: F1 (15 A).

Is the inspection result normal?

No > see Step 3

No > overhaul the fuse circuit and replace the rated fuse

3. Inspect the ignition switch

- (a). Disconnect ignition switch connector B013.
- (b). Turn the ignition switch to START.
- (c). Use the multi-meter to measure the resistance between pin 2 and pin 3 of ignition switch connector B013.

Resistance: $\leq 2 \Omega$

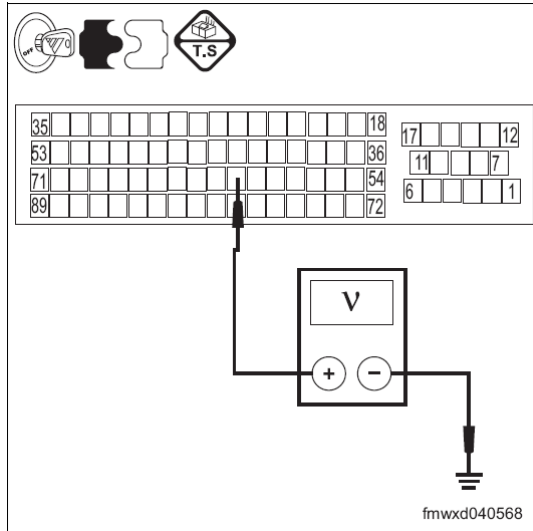
Is the inspection result normal?

Yes > see Step 4

No > replace the ignition switch

Diagnosis - Cigarette Lighter

4. Inspect ECU (START) power input circuit



- Connect ignition switch connector B013 and disconnect ECU connector F040.
- Turn the ignition switch to START.
- Use the multi-meter to measure the voltage between pin 61 of ECU connector F040 and the earth.

Standard voltage value: battery voltage

04

Is the inspection result normal?

Yes > see Step 4

No > repair ECU (START) power input circuit

Hint:

If there is no electricity in the ignition switch fuse, inspect and repair power circuit fault; refer to "Chapter 04 Diagnosis – Starting/ Preheating System".

5. Erase fault codes

- Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > the system is normal.

No > replace ECU

1-2-4 Battery Fault

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

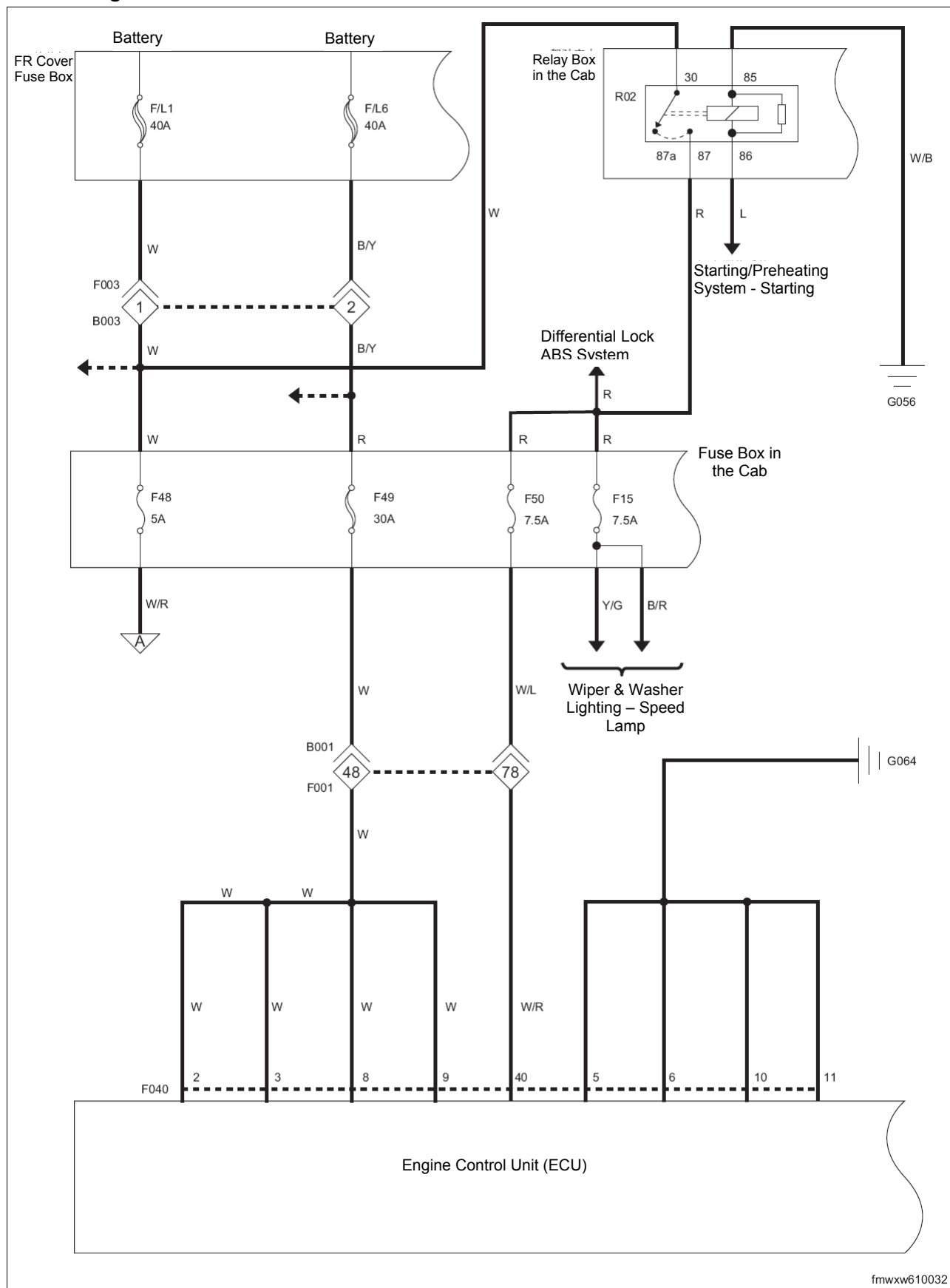
When the battery voltage is too high (>36V) or too low (<6V), compression test may not be conducted, and ECU will record the fault.

Parts that may cause faults

1. **Battery (damaged).**
2. **Engine (damaged).**
3. **ECU power supply harness (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect the battery

- (a). Conduct battery test, refer to "Chapter 53 Battery – Battery, Detection and Adjustment".

3. Inspect the engine

- (a). Start the engine and inspect the charging of the engine, refer to "Chapter 19, Charging System – Charging System, Detection and Adjustment".

Hint: the engine output voltage shall be between 26V to 28V.

Is the inspection result normal?

Yes > see Step 4

No > replace the engine

4. Inspect ECU power supply harness

- (a). Inspect the connection of ECU power supply wiring and earthed wiring, which shall be correct and reliable.
- (b). Inspect the connection of battery armature and cables, which shall be correct and reliable.
- (c). Inspect the connection of engine armature harness, which shall be correct and reliable.

Is the inspection result normal?

Yes > see Step 5

No > repair or replace the harness

5. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > the system is normal

No > replace ECU.

1-2-5 EMTC Non-monotonic Map

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU calibration error leads to ECU records fault.

04

Parts that may cause faults

1. ECU (error, damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Reprogram ECU

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Reprogram ECU.
- (d). Read the fault code.

Can fault codes be erased?

Yes > the system is normal.

No > replace ECU

1-3-1 Sensor Power Module in the ECU

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Error in ECU inner sensor power module results in insufficient engine power and black smoke.

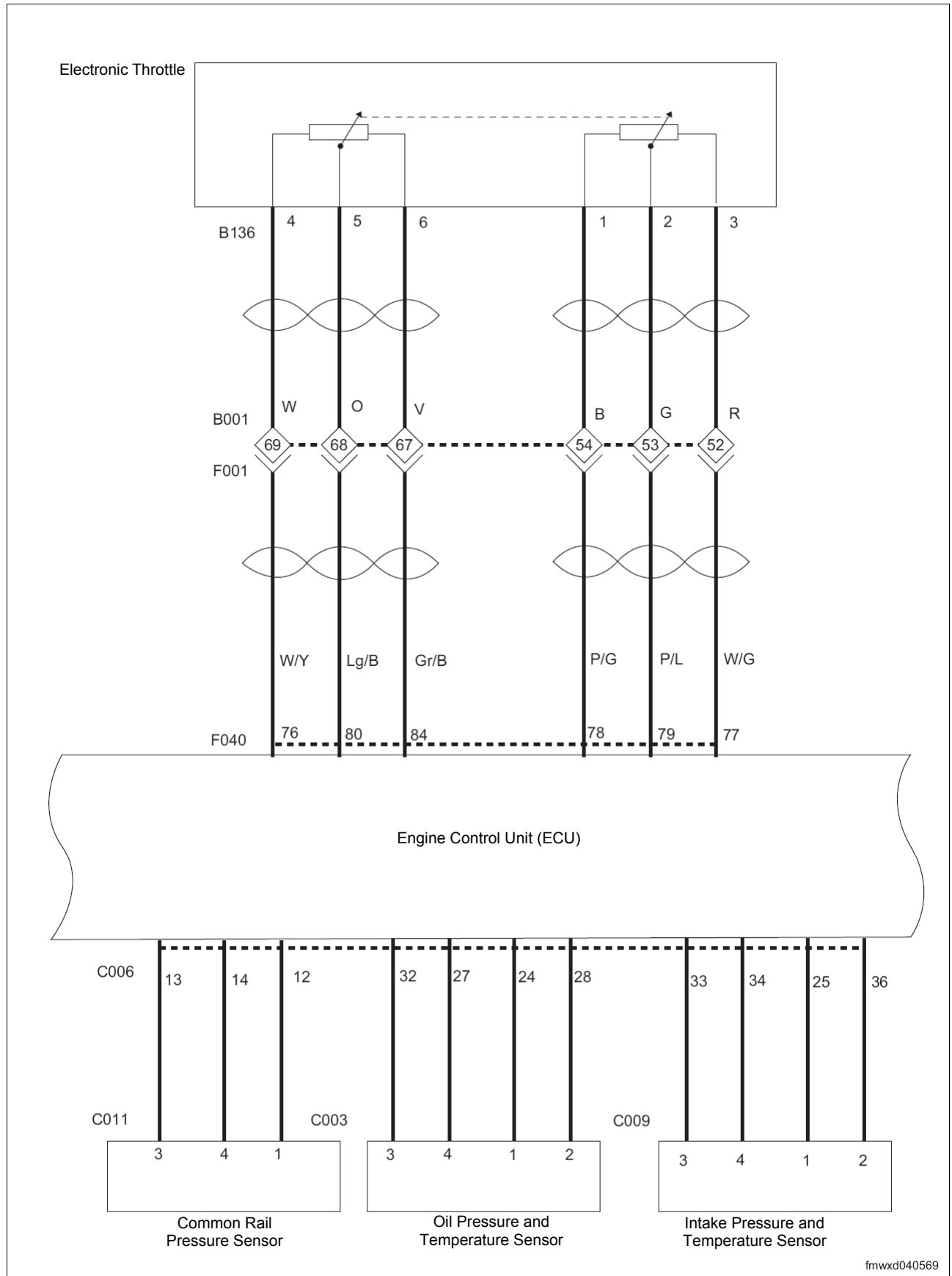
04

Parts that may cause faults

1. **Intake pressure sensor circuit (sensor 5V power shorted to 24V power and to earth).**
2. **Oil pressure sensor circuit (sensor 5V power shorted to 24V power and to earth).**
3. **Throttle position sensor circuit (sensor 5V power shorted to 24V power and to earth).**
4. **Common rail pressure sensor circuit (sensor 5V power shorted to 24V power and to earth).**
5. **Intake pressure sensor (damaged, internal short).**
6. **Oil pressure sensor (damaged, internal short).**
7. **Throttle position sensor (damaged, internal short).**
8. **Common rail pressure sensor (damaged, internal short).**
9. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect sensor and its power circuit

- (a). Inspect throttle position sensor 5V power circuit 1 (F040 pin 77 to B136 pin 3) and 5V power circuit 2 (F040 pin 84 to B136 pin 6), which shall not be shorted to 24V power or to the earth. Refer to this chapter, "2-2-1 Error of Pedal Sensor 1, 2".
- (b). Inspect intake pressure sensor 5V power circuit (C006 pin 33 to C009 pin 3), which shall not be shorted to 24V power circuit or to the earth. Refer to this chapter, "2-3-1 Intake Pressure Sensor".
- (c). Inspect oil pressure sensor 5V power circuit (C006 pin 32 to C003 pin 3), which shall not be shorted to 24V power circuit or to the earth. Refer to this chapter, "2-4-3 High and Low Pressure Warning for Oil Pressure Sensor".
- (d). Inspect common rail pressure sensor 5V power circuit (C006 pin 13 to C011 pin 3), which shall not be shorted to 24V power circuit or to the earth. Refer to this chapter, "1-3-3 Common Rail Sensor".

Is the inspection result normal?

Yes > see Step 3

No > repair or replace harness, or replace sensor

3. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-3-2 Main Relay Error

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

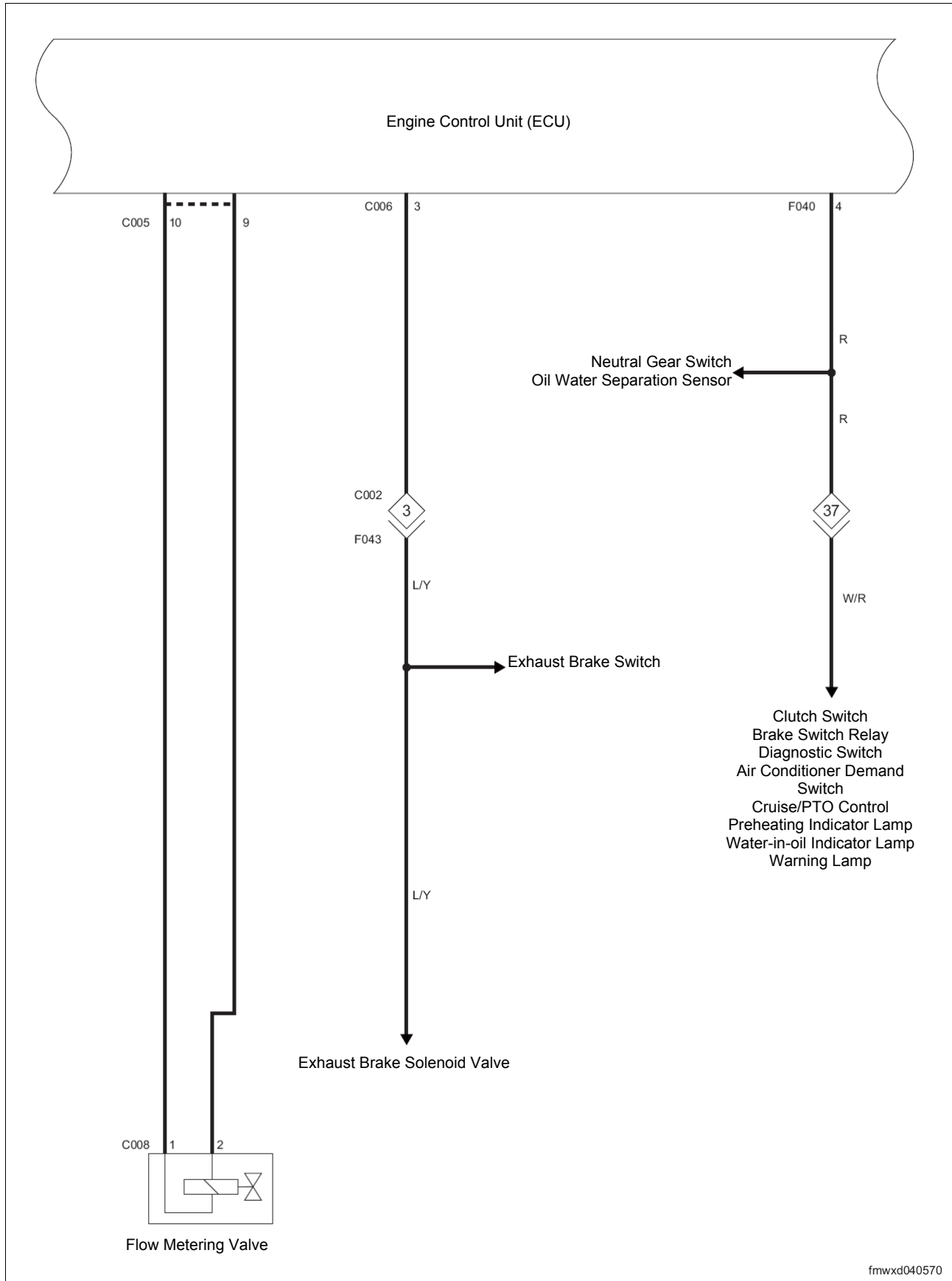
Error of ECU inner 24V power output main replay results in insufficient engine power, and ECU will record the fault.

04

Parts that may cause faults

1. **Flow metering valve circuit (shorted, shorted to earth).**
2. **Flow metering valve (damaged).**
3. **ECU 24V power output circuit (shorted to earth).**
4. **ECU (damaged).**

Circuit Diagram



Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect flow metering valve circuit

- (a). Inspect flow metering valve circuit C005 pin 10 to C008 pin 1, C005 pin 9 to C008 pin 2, which shall not be shorted or shorted to earth.
- (b). Inspect flow metering valve; its inner part shall not be shorted.

Hint:

The resistance of flow metering valve is 2.60~3.15Ω.

- (c). Refer to "1-3-5 Flow Metering Unit Error" of this chapter.

Is the inspection result normal?

Yes > see Step 3

No > repair or replace harness, or replace flow metering valve

3. Inspect ECU 24V power output (C006 pin 3 power output circuit)

- (a). Inspect exhaust brake solenoid valve power input circuit and exhaust brake solenoid valve, which shall not be shorted or shorted to earth. Refer to this chapter, "3-1-1 Exhaust Brake Solenoid Valve".
- (b). Inspect exhaust brake switch power input circuit, which shall not be shorted. Refer to this chapter, "3-4-2 Exhaust Brake Switch".

Is the inspection result normal?

Yes > see Step 4

No > repair or replace harness, or replace shorted parts.

4. Inspect ECU 24V power output (F040 pin 4 power output circuit)

- (a). Inspect neutral gear switch power input circuit, which shall not be shorted to earth.
- (b). Inspect oil water separation sensor power input circuit, which shall not be shorted or be shorted to earth. Refer to this chapter, "2-2-1 Water in Oil".
- (c). Inspect clutch switch power input circuit, which shall not be shorted to earth. Refer to this chapter, "2-2-2 Clutch Switch Error".
- (d). Inspect brake switch relay power input circuit, which shall not be shorted to earth. Refer to this chapter, "2-2-3 Brake Switch Error, Single Brake Switch Error".

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- (e). Inspect diagnostic switch power input circuit, which shall not be shorted to earth. Refer to this chapter, "Fault of Fault Indicator (in Operation of Fault Diagnostic Switch)".
- (f). Inspect air conditioner demand switch power input circuit, which shall not be shorted. Refer to this chapter, "3-1-3 Air Conditioner Compressor Relay".
- (g). Inspect cruise/PTO control power input circuit, which shall not be shorted to earth. Refer to this chapter, "3-4-1 Cruise Switch".
- (h). Inspect preheating indicator power input circuit, which shall not be shorted to earth. Refer to this chapter, "3-3-2 Cold Start Lamp, Warning Lamp".
- (i). Inspect water in oil indicator power input circuit, which shall not be shorted to earth. Refer to this chapter, "3-3-4 Water in Oil Lamp, Warning Lamp".

04

Is the inspection result normal?

Yes > see Step 5

No > repair or replace harness, or replace shorted parts.

5. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > the system is normal.

No > replace ECU

1-3-3 Rail Pressure Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

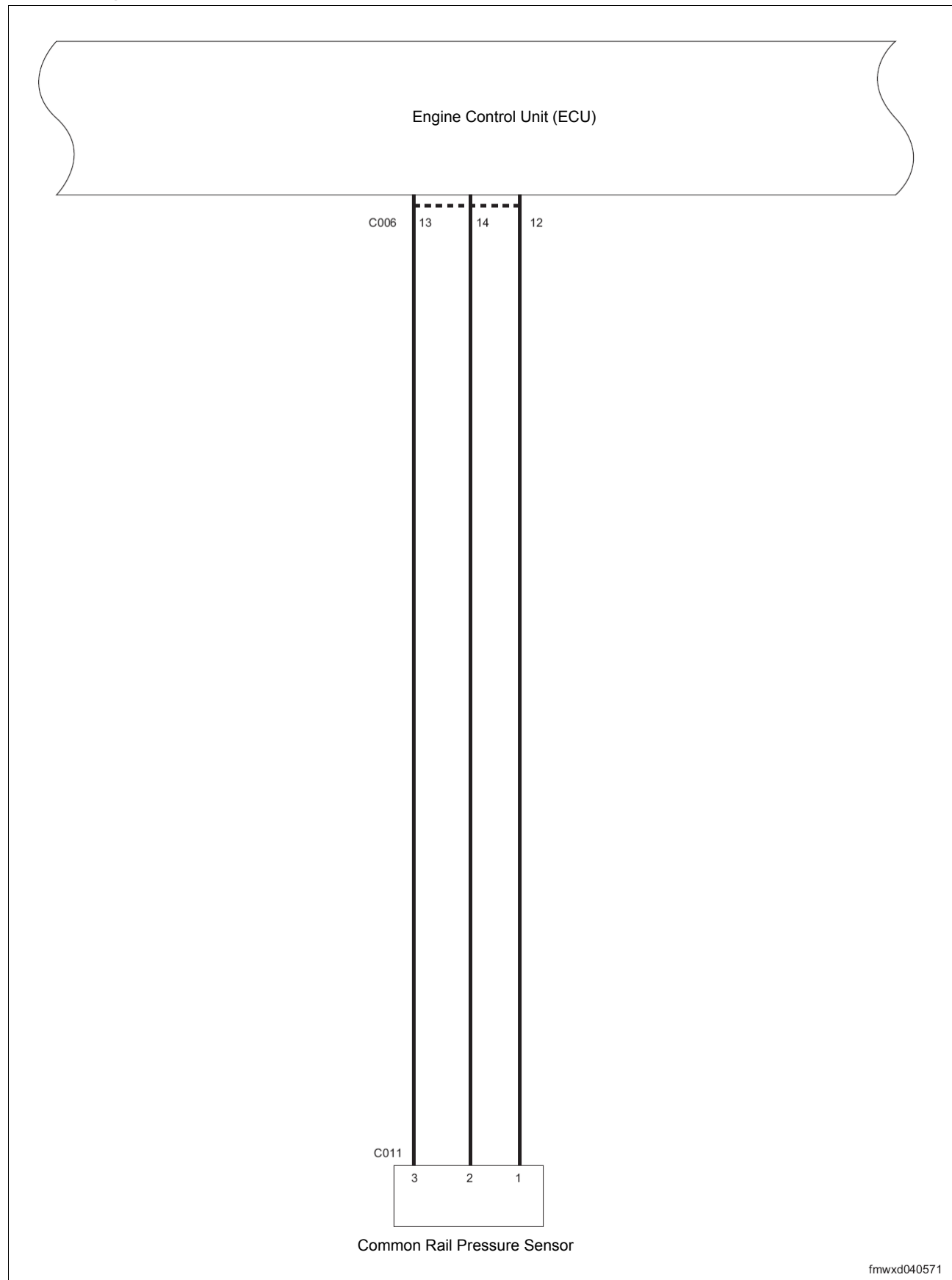
Common rail pressure sensor and its circuit faults result in insufficient engine power, and ECU will record the faults.

04

Parts that may cause faults

1. Common rail pressure sensor circuit (opened, shorted).
2. Common rail pressure sensor (damaged).
3. ECU (damaged).

Circuit Diagram



Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

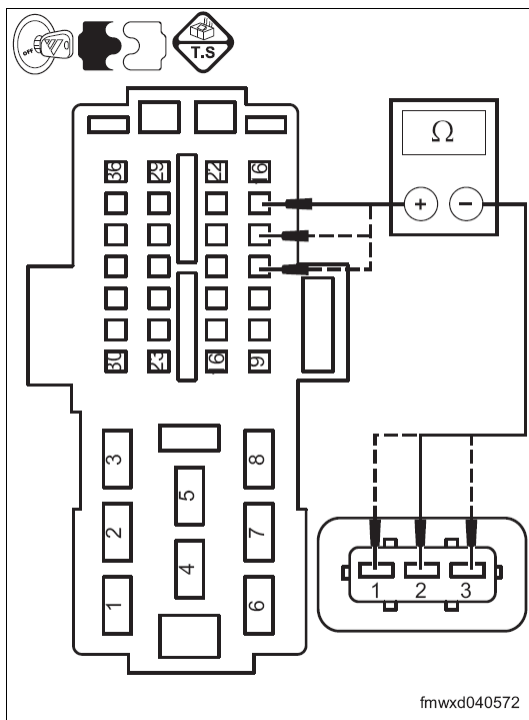
2. Inspect the appearance of common rail pressure sensor

- (a). Turn off ignition switch.
- (b). Inspect sensor installation which shall be correct and reliable.
- (c). Dismantle sensor harness connection, and the connector connection shall be reliable.

Whether the above problems exist?

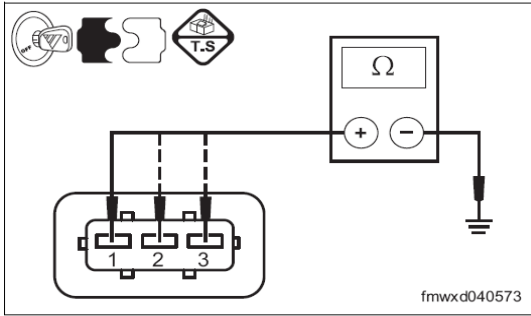
Yes > maintain the fault parts

No > see Step 3

3. Inspect the circuit from common rail pressure sensor to ECU

- (a). Turn off ignition switch.
- (b). Disconnect ECU connector C006 and common rail pressure sensor harness connector C011.
- (c). Use the multi-meter to measure the resistance between C006 pin 13 and C011 pin 3, C006 pin 14 and C011 pin 2 and C006 pin 12 and C011 pin 1.

Resistance: $\leq 2 \Omega$



- (d). Use the multi-meter to measure the resistance between common rail pressure sensor connector C011 pin 1, 2 and 3 and the earth.

Resistance: >10 MΩ

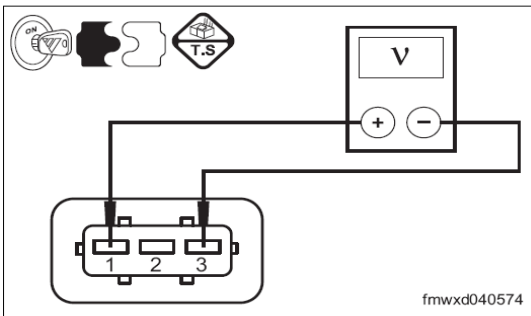
04

Is the inspection result normal?

Yes > see Step 4

No > overhaul the faults in the circuit from common rail pressure sensor to ECU

4. Inspect the common rail pressure sensor power circuit



- (a). Connect ECU connector C006 and common rail pressure sensor harness connector C009.
 (b). Turn on ignition switch.
 (c). Use the multi-meter to measure the voltage between common rail pressure sensor connector C011 pin 3 and pin 1.

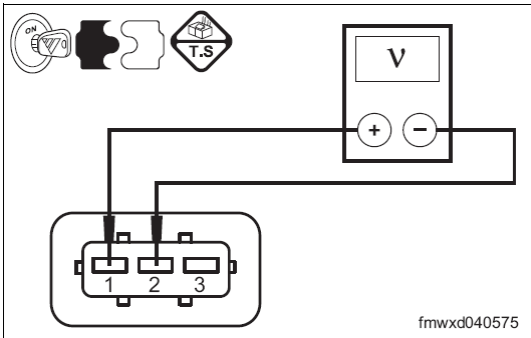
Standard voltage value: 4.9~5.1V

Is the inspection result normal?

Yes > see Step 5

No > replace ECU

5. Inspect the common rail pressure sensor pressure signal circuit



- (a). Turn on ignition switch.
 (b). Use the multi-meter to measure the voltage between common rail pressure sensor connector C011 pin 2 and pin 1.

Static voltage standard value: 0.5V

Static rail pressure standard value: 0bar

- (c). Engine idling.
 (d). Use the multi-meter to measure the voltage between common rail pressure sensor connector C011 pin 2 and pin 1.

Idling voltage standard value: 1.2~1.5V

Idling rail pressure standard value: 340~450 bar

- (e). Use diagnostic apparatus to read "actual fuel rail pressure" in the data stream and compare to measured voltage.

Hint:

Diagnosis - Cigarette Lighter

Under normal circumstances, the range of variation for voltage signal is: 0.5~4.5V (rail pressure variation: 0~1800 bar).

Is the inspection result normal?

Yes > see Step 6

No > replace common rail pressure sensor and erase fault codes

Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

6. Erase fault codes

(a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > the system is normal.

No > replace ECU

1-3-4 Problem of Common Rail Pressure Limiting Valve

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

If the common rail pressure sensor and flow metering valve are fault, or fuel oil circuit the unsmooth oil-feeding and oil-return, causing the over-striking of the rail pressure. ECU will record the fault which causes insufficient engine power.

04

Parts that may cause faults

1. Common rail pressure sensor (abnormal)
2. Flow metering valve (abnormal)
3. Fuel oil deficiency (The deficiency of fuel oil in the oil tank may cause the air suction while jolting)
4. The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).
5. Air exists in fuel pipeline (the air shall be exhausted).

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

2. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.

Are there any following and other fault codes?

1-3-3 Rail Pressure Sensor, 1-3-5 Flow Metering Unit Error

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 3

3. Inspect fuel

- (a). Open the fuel tank cap to inspect and ensure that the fuel is sufficient without too much impurities and contains no excessive water, and the fuel type is matched.

Whether the fuel has the above problems?

Yes > replace it with the right type of fuel

No > see Step 4

4. Inspect the fuel coarse filter and fine filter

Diagnosis - Cigarette Lighter

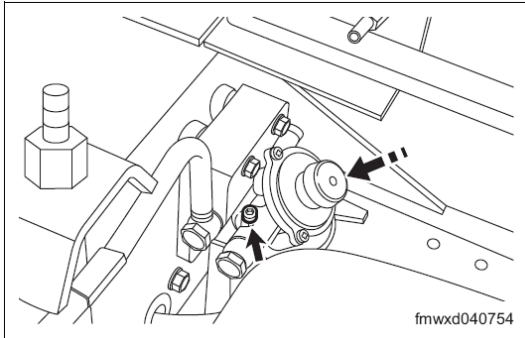
- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, then replace them.

Whether the fuel coarse filter and fine filter have the above problems?

Yes > replace them with new ones

No > see Step 5

5. Inspect whether air has been taken into the low-pressure fuel pipe



- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- (b). Observe the status of fuel outflow from the air bleed bolt.

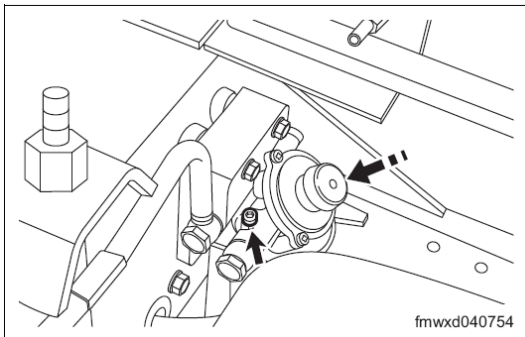
04

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 6

No > see Step 7

6. Exhaust air in the low-pressure fuel pipe

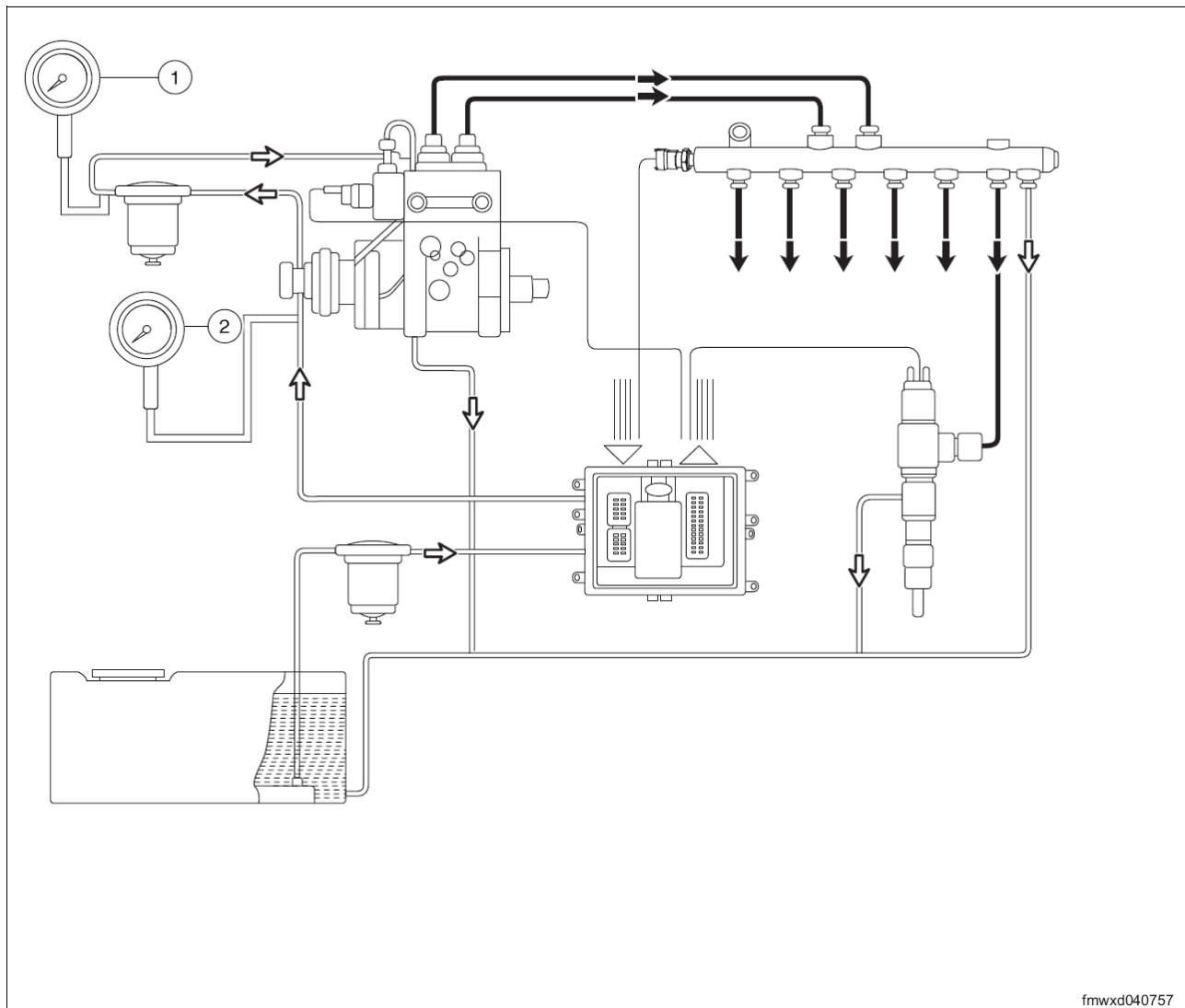


- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No > see Step 7



7. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 1 can reach 900 KPa at a high rotation speed.

Whether the pressure value of pressure gauge can reach 900Kpa?

Yes > see Step 9

No > the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one

8. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

Diagnosis - Cigarette Lighter

(b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

No > see Step 9

9. Erase fault codes

(a) Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-3-5 Flow Metering Unit Error

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

The fault of flow metering valve and its circuit causes insufficient engine power. ECU will record the faults.

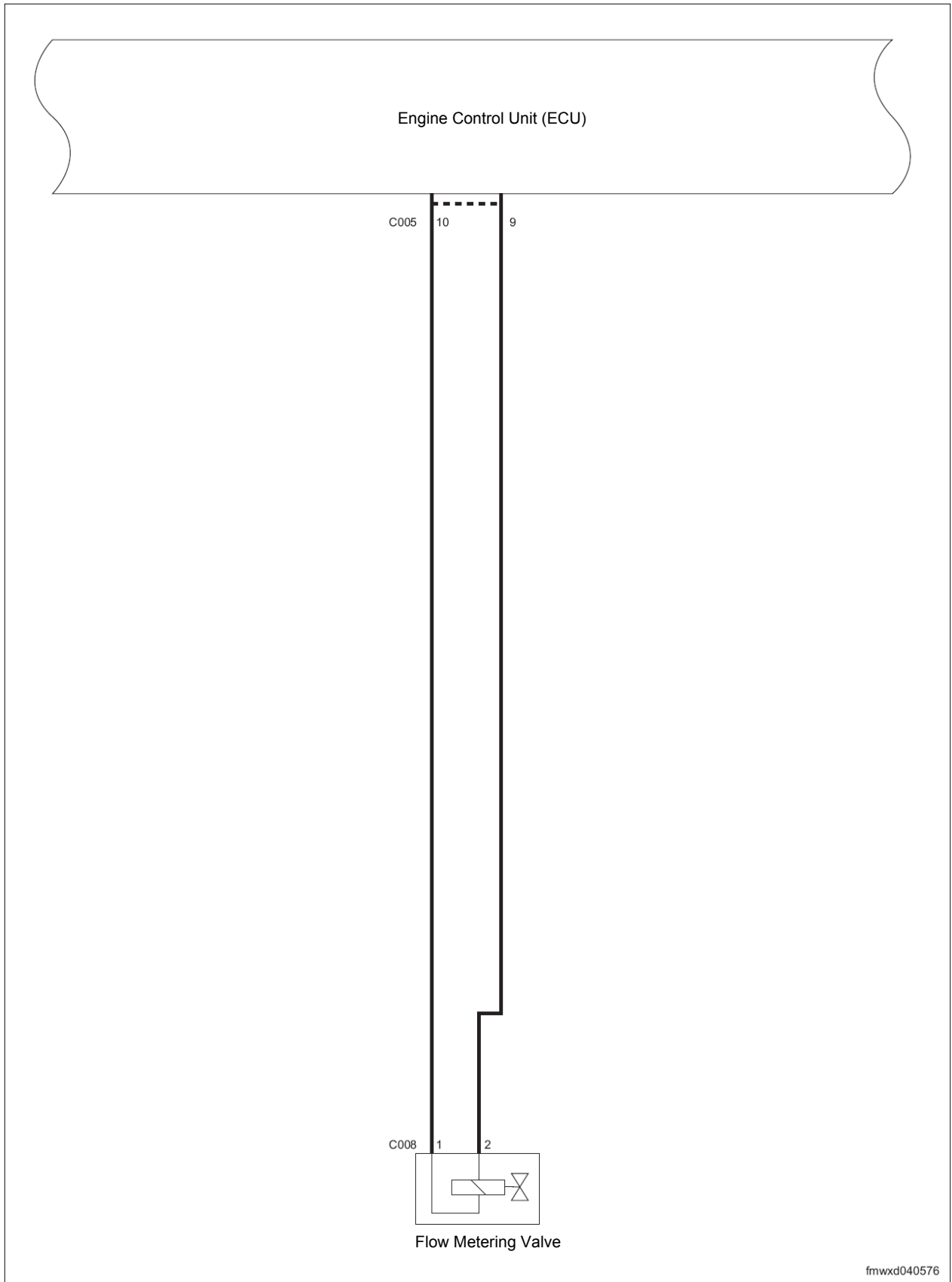
04

Parts that may cause faults

1. **Circuit of flow metering valve (opened, shorted).**
2. **Flow metering valve (damaged)**
3. **ECU (damaged)**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

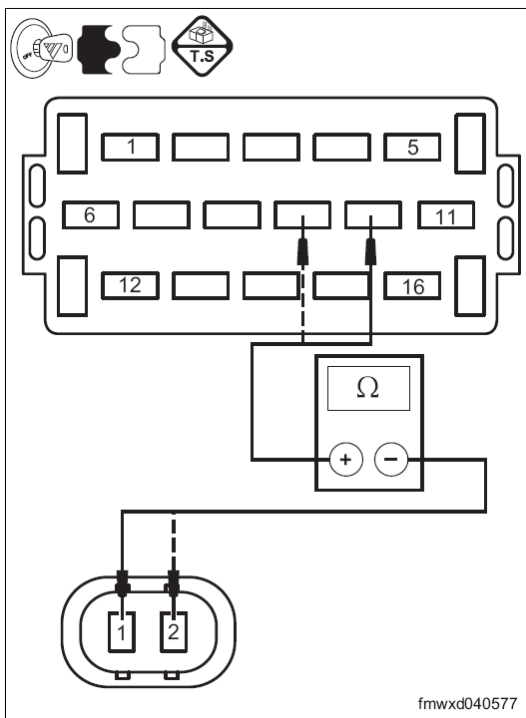
2. Inspect the appearance of flow metering valve

- (a) Turn off ignition switch
- (b). Inspect sensor installation which shall be correct and reliable.
- (c). Dismantle sensor harness connection, and the connector connection shall be reliable.

Whether the above problems exist?

Yes > maintain the fault parts

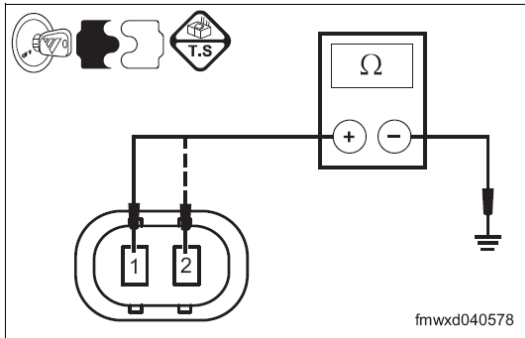
No > see Step 3

3. Inspect circuit from flow metering valve to ECU

- (a). Turn off ignition switch
- (b). Disconnect ECU connector C005 and wiring harness C008 of flow metering valve.
- (c). Use the multi-meter to measure pin 10 of C005 and pin 1 of C008, pin 9 of C005 and pin 2 of C008.

Resistance: $\leq 2 \Omega$

Diagnosis - Cigarette Lighter



- (d). Use the multi-meter to measure the resistance between pin 1 & pin 2 of flow metering valve wiring harness connector C008 and the earth.

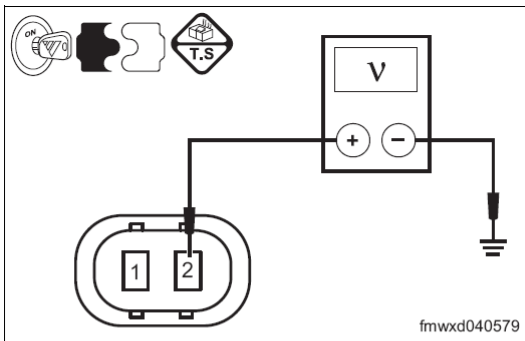
Resistance: >10 MΩ

Is the inspection result normal?

Yes > see Step 4

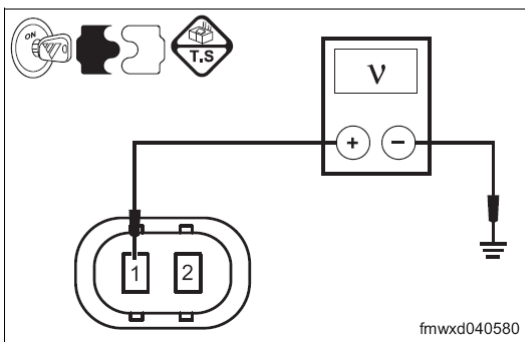
No > overhaul faults in the circuit from flow metering valve to ECU

4. Inspect flow metering valve power circuit



- (a). Connect ECU connector C005.
 (b). Keep disconnected the flow metering valve wiring harness connector C008
 (c). Turn on ignition switch.
 (d). Use the multi-meter to measure voltage between pin 2 of flow metering valve wiring harness connector C008 and the earth.

Standard voltage value: battery voltage



- (e). Use the multi-meter to measure the voltage between pin 1 of flow metering valve wiring harness connector C008 and the earth.

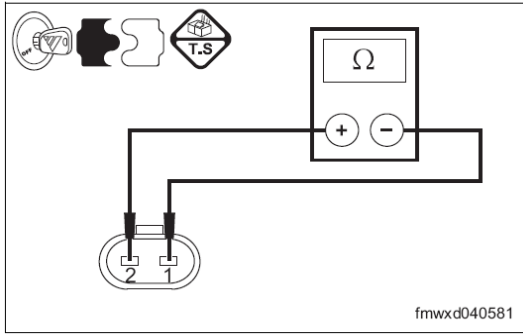
Standard voltage value: 2.91~3.91V

Is the inspection result normal?

Yes > see Step 5

No > replace ECU

5. Inspect the flow metering valve



- (a). Turn off ignition switch.
- (b). Use the multi-meter to measure the resistance between pin 2 and pin 1 of flow metering valve.

Standard resistance value: 2.60~3.15 Ω

Is the inspection result normal?

Yes > see Step 6

no > replace the flow metering valve and erase fault code.

Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

6. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-3-6 Common Rail Pipe Pressure Limiting Valve

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Once abnormal fluctuation of fuel pressure is monitored by common rail pressure sensor, ECU will record the fault.

04

Parts that may cause faults

1. **Fuel oil deficiency (The deficiency of fuel oil in the oil tank may cause the air suction while jolting)**
2. **The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).**
3. **Air exists in fuel pipeline (the air shall be exhausted).**
4. **Common rail pipe and its pressure control device (pressure limiting valve) (damaged, pressure release).**

Diagnostic Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow.

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 3

3. Inspect fuel

- (a). Open the fuel tank cap to inspect and ensure that the fuel is sufficient without too much impurities and contains no excessive water, and the fuel type is matched.

Whether the fuel has the above problems?

Yes > replace it with the right type of fuel

No > see Step 4

4. Inspect the fuel coarse filter and fine filter

- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, then replace them.

Whether the fuel coarse filter and fine filter have the above problems?

Yes > replace them with new ones

No > see Step 5

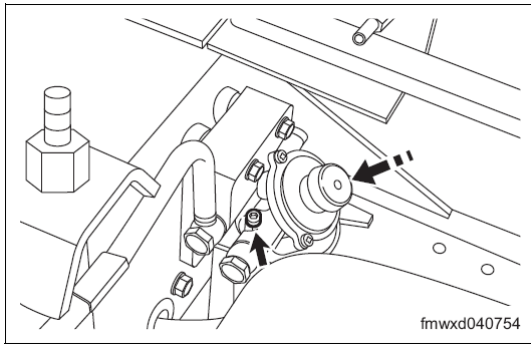
4. Inspect the fuel coarse filter and fine filter

- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, then replace them.

Whether the fuel coarse filter and fine filter have the above problems?

Yes > replace them with new ones

No > see Step 5

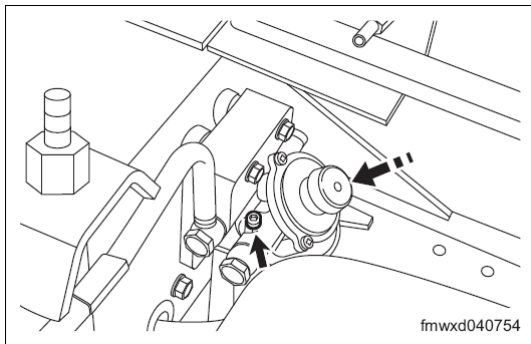
Diagnosis - Cigarette Lighter**5. Inspect whether air has been taken into the low-pressure fuel pipe**

- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 6

No > see Step 7

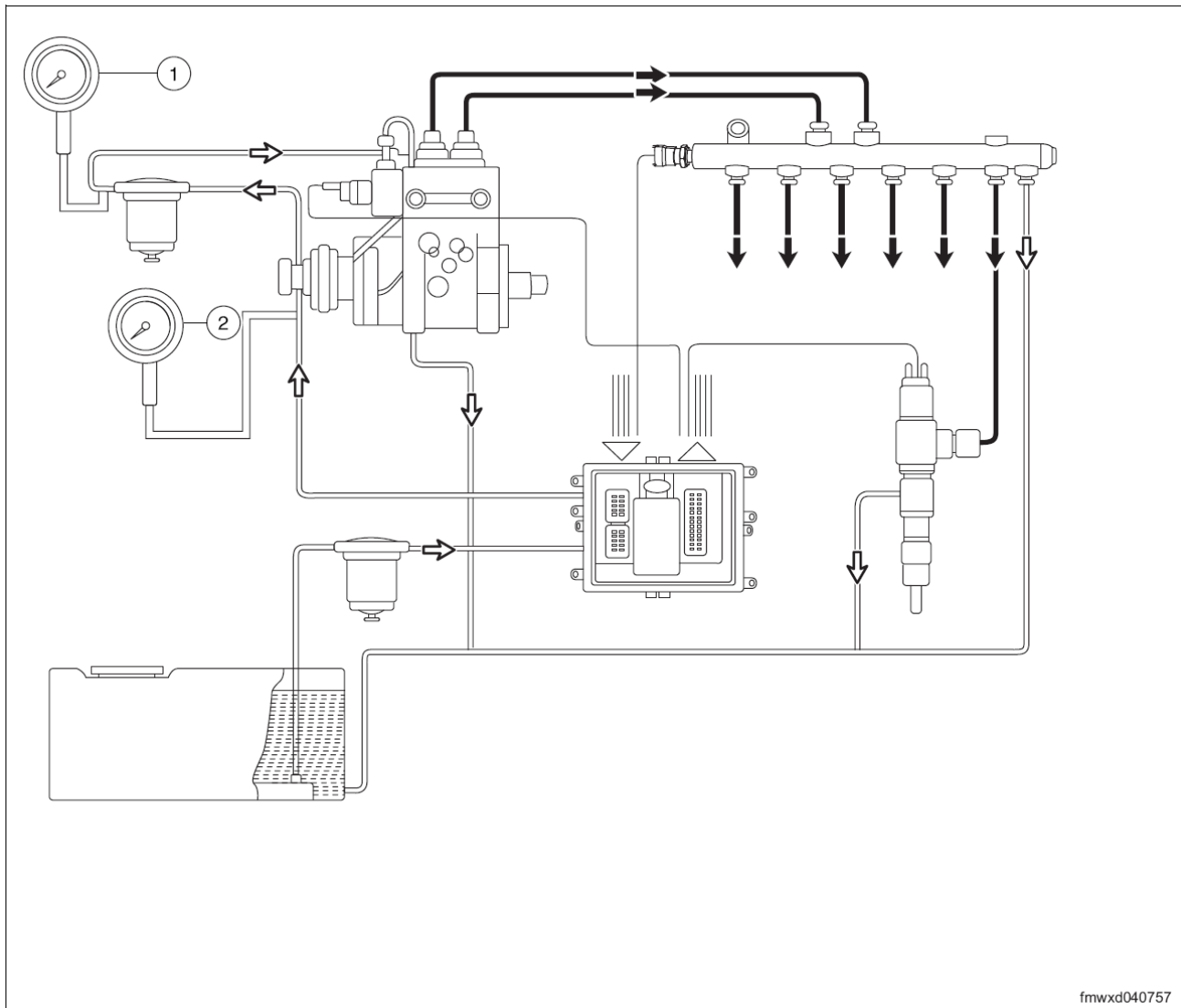
6. Exhaust air in the low-pressure fuel pipe

- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

No > see Step 7



fmwxd040757

7. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

Under normal circumstances, the pressure value of pressure gauge 1 can reach 900 KPa at a high rotation speed.

Whether the pressure value of pressure gauge can reach 900Kpa?

Yes > see Step 10

No > the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one

8. Inspect whether the low-pressure fuel pipe is blocked

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

Diagnosis - Cigarette Lighter

(b). Operate the engine at different rotation speed and observe the pressure gauge.

Hint:

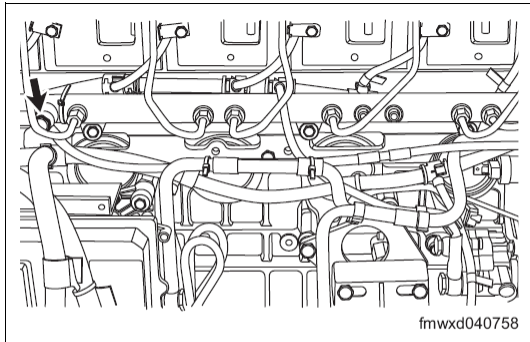
Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

No > see Step 9

9. Inspect the common rail and the pressure limiting valve



- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Operate the engine at different rotation speed and use the diagnostic apparatus to read the “actual fuel rail pressure” from the data stream.

Hint:

Under normal circumstances, when the engine is operating and the “actual fuel rail pressure” shown by the diagnostic apparatus is higher than 160MPa, the pressure limiting valve will release pressure, that is, the releasing pressure of pressure limiting valve will be 160Mpa.

- (c). When the engine functions and the actual fuel rail pressure shown by the diagnostic apparatus is lower than 160MPa, observe whether the oil outlet of the pressure limiting valve has fuel outflow.

Whether the oil outlet of the pressure limiting valve has fuel outflow?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

No > see Step 10

10. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, “Reading and Erasing of Flash Fault Codes”.

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-4-1 Error of Cylinder 1 Fuel Injector

1-4-2 Error of Cylinder 2 Fuel Injector

1-4-3 Error of Cylinder 3 Fuel Injector

1-4-4 Error of Cylinder 4 Fuel Injector

1-4-5 Error of Cylinder 5 Fuel Injector

1-4-6 Error of Cylinder 6 Fuel Injector

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

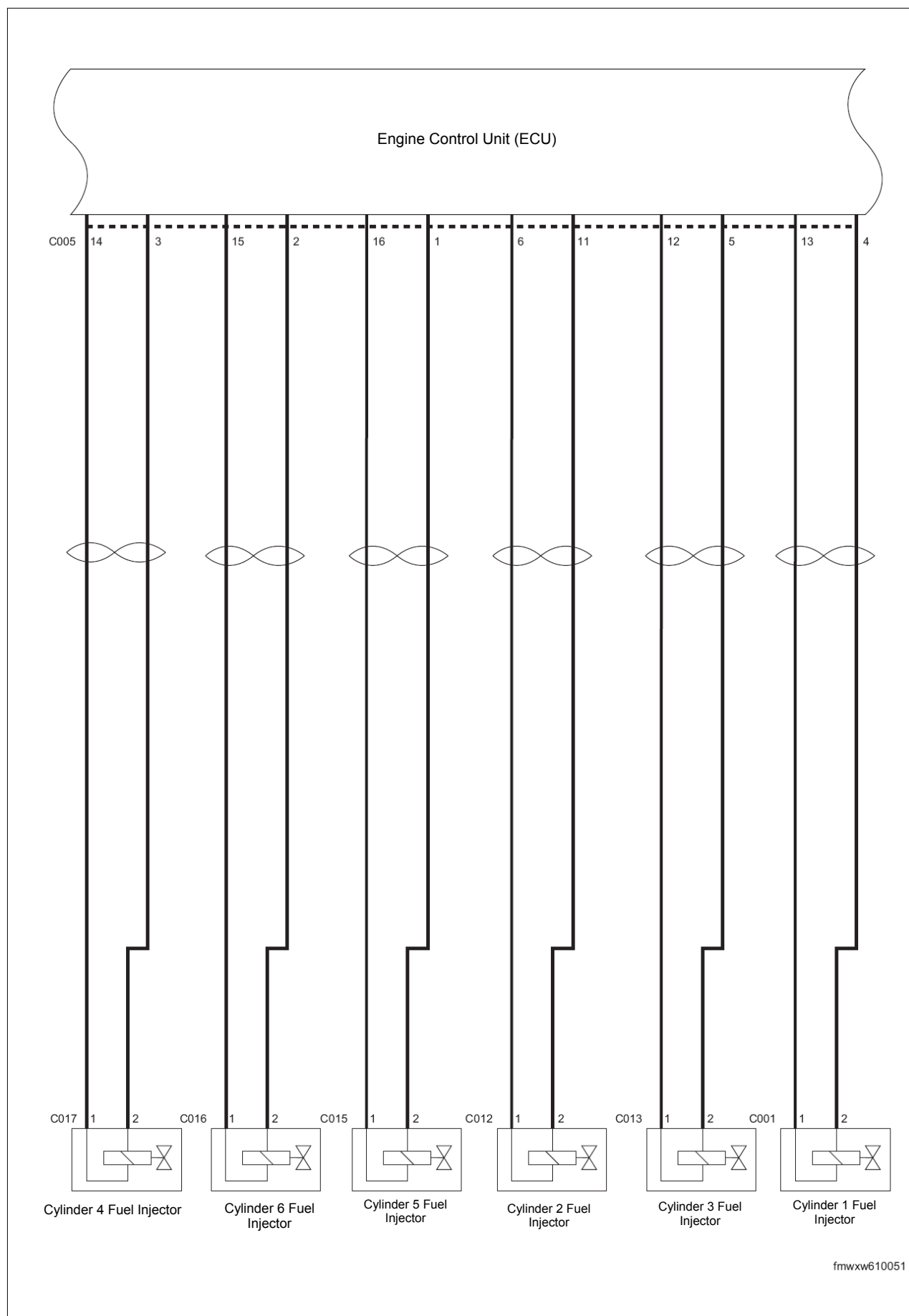
Fuel injector and its circuit faults cause insufficient engine power. ECU will record the faults.

Parts that may cause faults

1. Fuel injector circuit (opened or shorted).
2. Fuel injector (damaged).
3. ECU (damaged).

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps

1. Connect the diagnostic apparatus

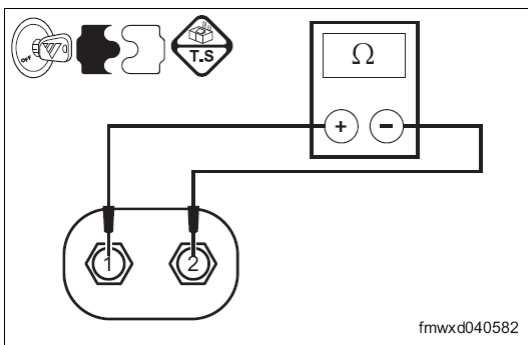
- Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect the fuel injector



- Turn off ignition switch
- Disconnect the fuel injector connector C001 (C012, C013, C013, C017, C015 and C016).
- Use the multi-meter to measure the resistance between pin 1 and pin 2 of the fuel injector.

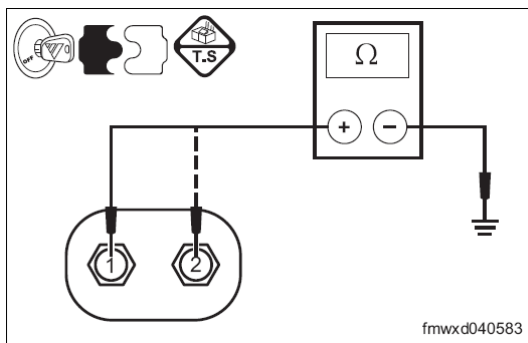
Standard resistance value: 0.9 Ω

Is the inspection result normal?

Yes > see Step 3.

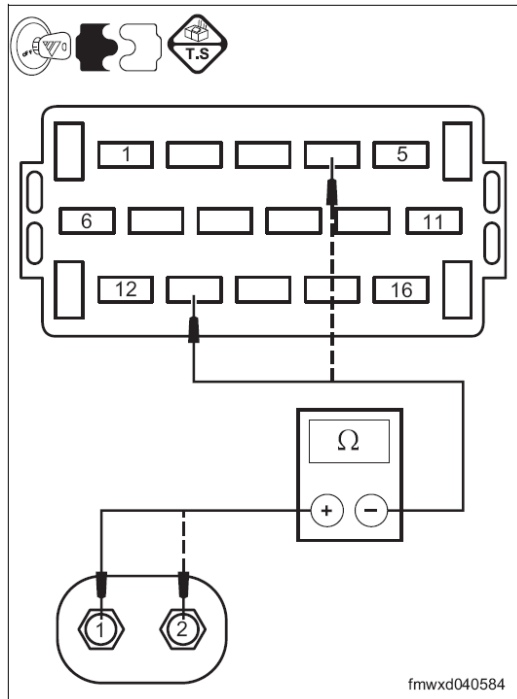
No > replace the fuel injector.

3. Inspect the circuit from fuel injector to ECU



- Disconnect ECU connector C005 and the fuel injector connector C001 (C012, C013, C017, C015 and C016).
- Use multi-meter to measure the resistance between pins 1 and 2 of the fuel injector connector C001 (C012, C013, C017, C015 and C016) and the earth.

Resistance: > 10 MΩ

Diagnosis - Cigarette Lighter

- (c) Use multi-meter to measure the resistance between C005 pin 13 and C001 pin 1 (C005 pin 6 and C012 pin 1, C005 pin 12 and C013 pin 1, C005 pin 14 and C017 pin 1, C005 pin 16 and C015 pin 1, C005 pin 15 and C016 pin 1).
- (d) Use multi-meter to measure the resistance between C005 pin 4 and C001 pin 2 (C005 pin 22 and C012 pin 2, C005 pin 5 and C013 pin 2, C005 pin 3 and C017 pin 2, C005 pin 1 and C015 pin 2, C005 pin 2 and C016 pin 2).

Resistance: $\leq 2 \Omega$

04

Is the inspection result normal?

Yes > see Step 4.

No > repair or replace the circuit from fuel injector to ECU.

4. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal

No > replace ECU.

1-5-1 Capacitor 1 (Controlling Fuel Injectors 1, 2 and 3) Error

1-5-2 Capacitor 2 (Controlling Fuel Injectors 4, 5 and 6) Error

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU will record the fault if faults in fuel injector and its circuit result in error of the capacitor controlling the fuel injector.

Parts that may cause faults

1. fuel injector and its circuit (abnormal).
2. ECU (damaged).

Circuit Diagram

Refer to this chapter, "1-4-1 Error of Cylinder 1 Fuel Injector, 1-4-2 Error of Cylinder 2 Fuel Injector, 1-4-3 Error of Cylinder 3 Fuel Injector, 1-4-4 Error of Cylinder 4 Fuel Injector, 1-4-5 Error of Cylinder 5 Fuel Injector, 1-4-6 Error of Cylinder 6 Fuel Injector – Circuit Diagram".

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read fault code.

Does any of the following or other fault codes exist?

1-4-1 1-cylinder injector error, 1-4-2 2-cylinder injector error, 1-4-3 3-cylinder injector error, 1-4-4 4-cylinder injector error, 1-4-5 5-cylinder injector error, 1-4-6 6-cylinder injector error

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

2. Disconnect again and switch on ignition switch

- (a). Place the ignition switch in OFF position, and turn to place the ignition switch in ON position after waiting for a few seconds.
- (b). Read fault code.

Is the fault code the one that currently exists?

Yes > replace ECU

No > see Step 3

3. Erase Fault code

- (a). Erase fault code and refer to this chapter "Reading and Erasing of Flash Fault Codes".

Diagnosis - Cigarette Lighter

Can the fault code be erased?

Yes > system is normal

No > replace ECU

1-5-3 Control Fuel Injector Chip CY33X Error

Description

Before the fault inspection, verify the faults reported by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU internal error, ECU will record the fault.

04

Parts that may have caused the fault

1. ECU (damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read fault code.

Does any other fault code exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

2. Disconnect again and switch on ignition switch

- (a). Place the ignition switch on OFF, and turn to place the ignition switch on ON after waiting for a few seconds.
- (b). Read fault code.

Is the fault code the one that currently exists?

Yes > replace ECU

No > see Step 3

3. Erase fault code

- (a). Erase fault code and refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can the fault code be erased?

Yes > system is normal

No > replace ECU

1-5-4 Unattained Least Normal-Operation Injector

Description

Before the fault inspection, verify the faults reported by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU will record the fault if there are errors that exceed 3-cylinder fuel injector and their circuit faults that cause the flame-out of engine.

04

Parts that may have caused the fault

1. **Fuel injector circuit (opened, shorted).**
2. **Fuel injector (damaged).**
3. **ECU (damaged).**

Circuit Diagram

Refer to "This Section, 1-4-1 1-Cylinder Injector Error, 1-4-2 2-Cylinder Injector Error, 1-4-3 3-Cylinder Injector Error, 1-4-4 4-Cylinder Injector Error, 1-4-5 5-Cylinder Injector Error, 1-4-6 6-Cylinder Injector Error"—Circuit Diagram

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read fault code.

Does any of the following or other fault codes exist?

1-4-1 1-cylinder injector error, 1-4-2 2-cylinder injector error, 1-4-3 3-cylinder injector error, 1-4-4 4-cylinder injector error, 1-4-5 5-cylinder injector error, 1-4-6 6-cylinder injector error

Yes > diagnose according to the flash fault codes, refer to this chapter "Flash Fault Code List"

No > see Step 2

2. Disconnect again and switch on ignition switch

- (a). Place the ignition switch on OFF, and turn to place the ignition switch on ON after waiting for a few seconds.
- (b). Read fault code.

Is the fault code the one that currently exist?

Yes > replace ECU

No > see Step 3

3. Erase fault code

- (a). Erase fault code and refer to this chapter "Reading and Erasing of Flash Fault Codes".

Diagnosis - Cigarette Lighter

Can the fault code be erased?

Yes > system is normal

No > replace ECU

1-5-5 ECU Internal Restrictions on Fuel Injection

Description

Before the fault inspection, verify the faults reported by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU interior strategy is designed to protect engine and impose restrictions on fuel injection quantity. ECU will record the fault.

04

Parts that may have caused the fault

1. ECU (damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read fault code.

Whether there exist the following or other fault codes?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

2. Disconnect again and switch on ignition switch

- (a). Place the ignition switch in OFF, and turn to place the ignition switch in ON after waiting for after a few seconds.
- (b). Read fault code.

Is the fault code the one that currently exist?

Yes > replace ECU

No > see Step 3

3. Erase Fault code

- (a). Erase fault code and refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can the fault code be erased?

Yes > system is normal

No > replace ECU

2-1-1 Water in Oil

Description

Before the fault inspection, verify the faults reported by the customers by confirming the vehicle condition as failed or normal. Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the strainer catchment is full, or oil-water separator sensor and its wiring harness has fault, water-in-oil indicator light will be enlightened and ECU will record the fault.

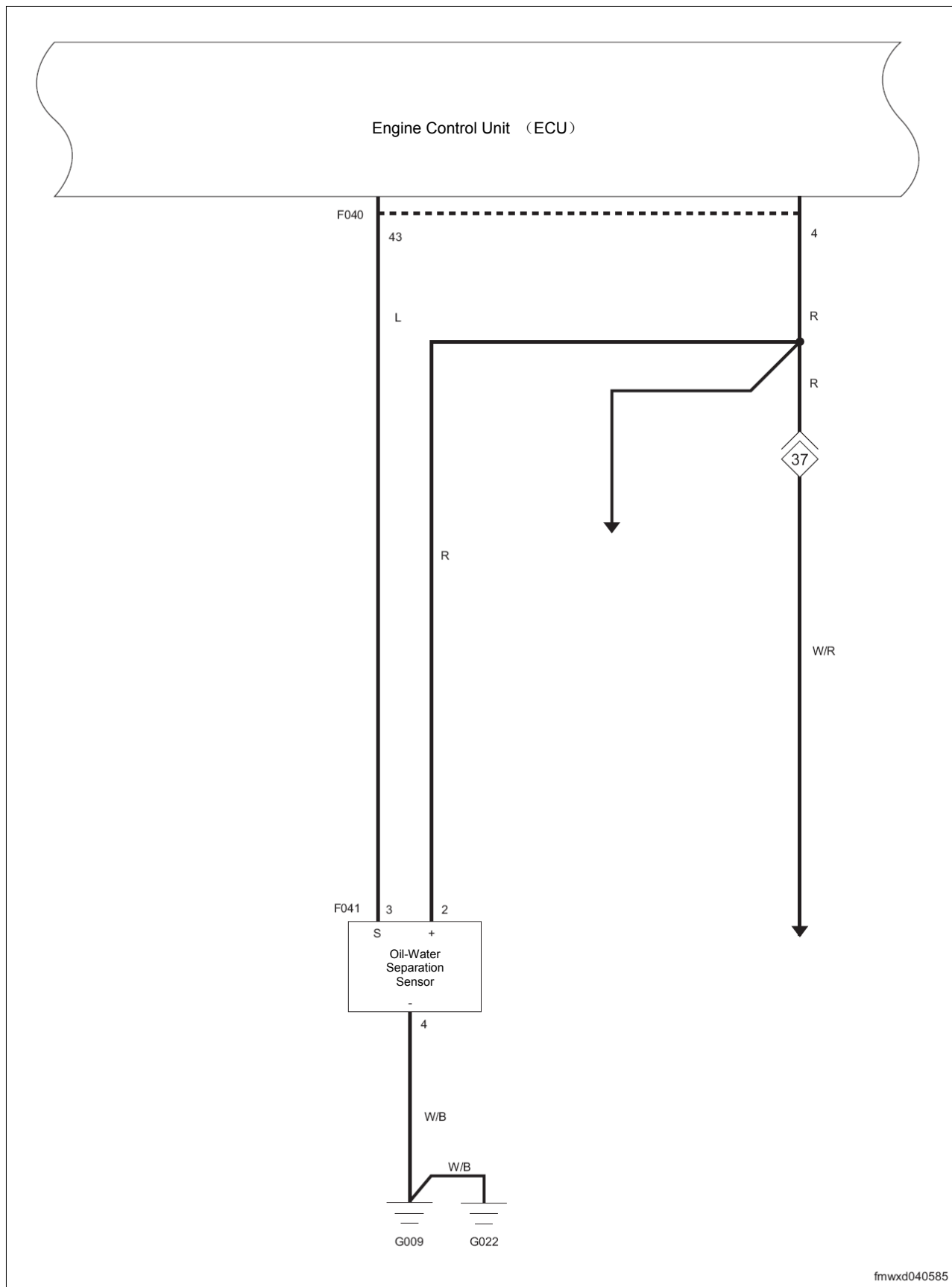
04

Possibly Fault Part

1. Coarse filter (Catchment is already full).
2. Oil-Water separation sensor (damaged).
3. Oil-Water separation sensor harness (shorted).
4. ECU (damaged).

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read fault code.

Does any fault code exist?

Yes > diagnose according to the flash fault codes, refer to this chapter "Flash Fault Code List"

No > see Step 2

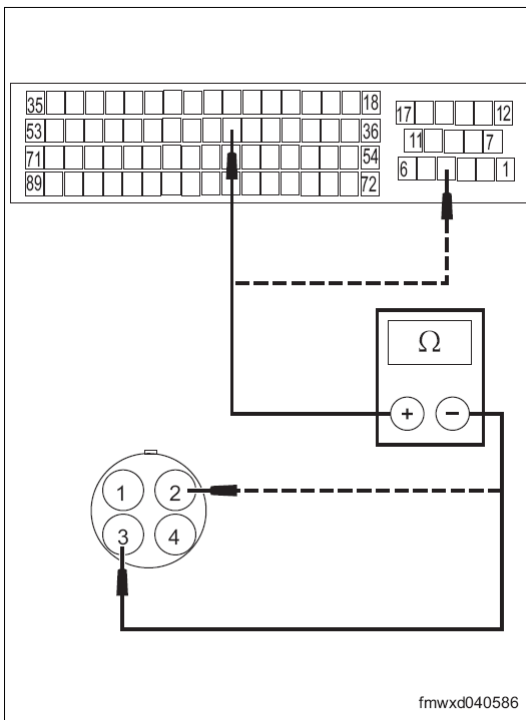
2. Inspect oil-water separator

- (a). Inspect oil-water separator catchment.

Is the catchment of oil-water separator already full?

Yes > discharge the water in the filter, or replace the diesel coarse filter

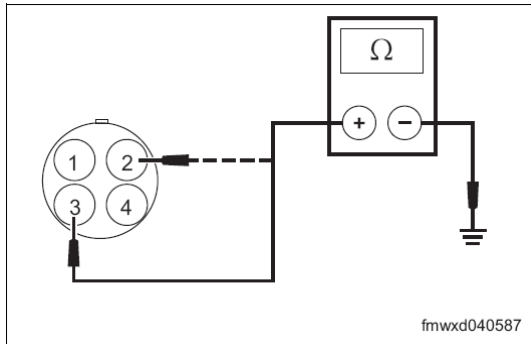
No > see Step 3

3. Inspect the circuit from oil-water separator to ECU

- (a). Turn off the ignition switch.
- (b). Disconnect ECU socket connector F040 and oil-water separation sensor socket connector F041.
- (c). Use the multi-meter to measure the resistance between pin 43 of F040 and pin 3 of F041, pin 4 of F040 and pin 2 of F041.

Resistance: $\leq 2 \Omega$

Diagnosis - Cigarette Lighter



- (d). Use the multi-meter to measure the resistance between pin 2 and pin 3 of F041 and earth connection.

Resistance: > 10 M Ω

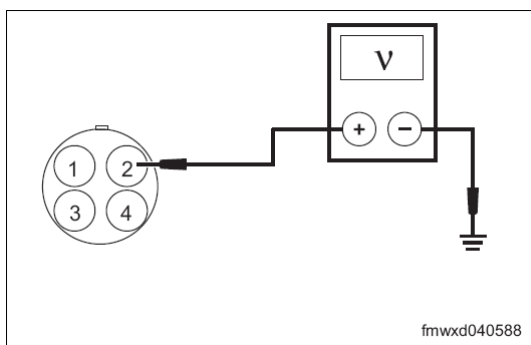
Is the result of inspection normal?

Yes > see Step 4

No > repair or replace the circuit from oil-water separation sensor to ECU

04

4. Inspect the power circuit of oil-water separation sensor



- Connect ECU socket connector F040.
- Keep the oil-water separation sensor socket connector F041 switching off.
- Set the ignition switch in ON position.
- Use the multi-meter to measure the resistance between pin 2 of F041 and earth connection.

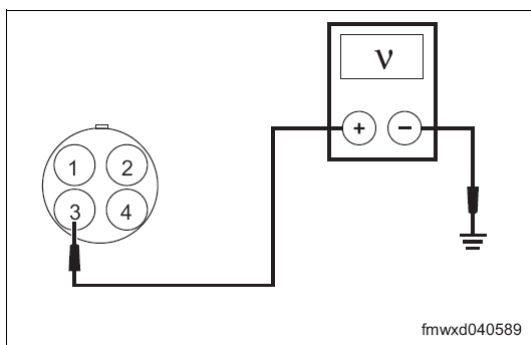
Voltage standard value: battery voltage

Is the inspection result normal?

Yes > see Step 5

No > replace ECU

5. Inspect the circuit of oil-water separation sensor signal



- Switch on the ignition switch.
- Use the multi-meter to measure the voltage between pin 3 of F041 and earth connection.

Voltage standard value: 4.9 ~ 5.1 V.

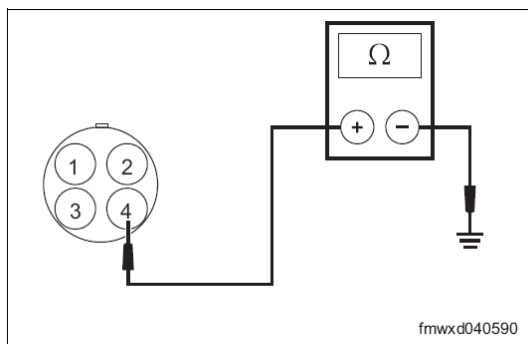
Is the inspection result normal?

Yes > see Step 6

No > replace ECU

6. Inspect the earthing circuit of oil-water separation sensor

Diagnosis - Cigarette Lighter



- (a). Use the multi-meter to measure the resistance between pin 4 of F041 and earth connection.

Resistance: $\leq 2 \Omega$

04

Is the inspection result normal?

Yes > replace oil-water separation sensor and erase fault code

Refer to this chapter "Reading and Erasing of Flash Fault Code".

No > overhaul the earthing circuit of oil-water separation sensor

2-2-1 Pedal Sensor 1, 2 Error

Description

Before the fault inspection, verify the faults reported by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

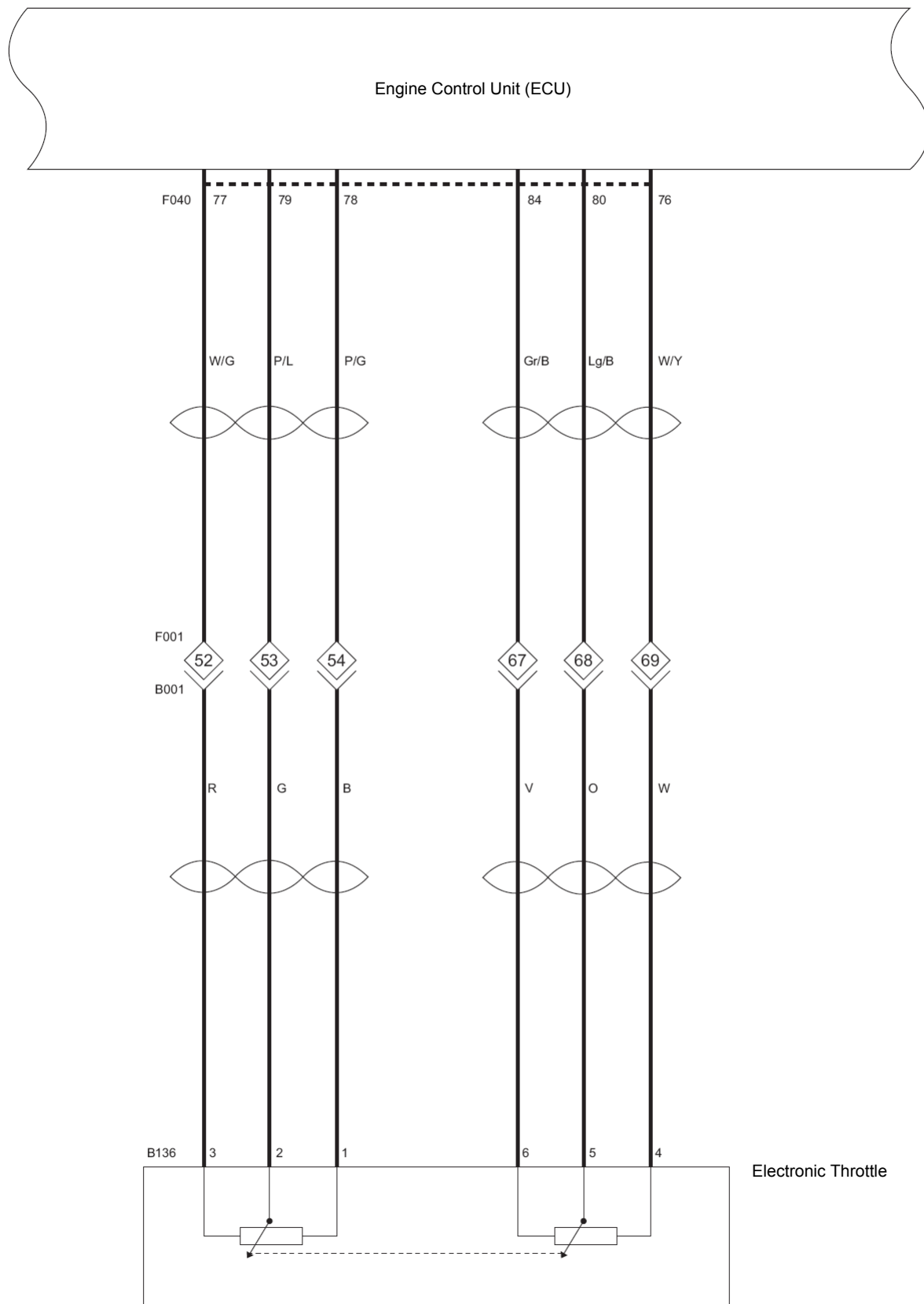
If the accelerator pedal sensor and its circuit have faults, the rotated speed of engine is kept in about 1000RMP and the accelerator cannot be throttled up or throttled down.

04

Parts that may have cause the fault

1. **Accelerator Pedal Sensor Circuit (shorted or opened).**
2. **Accelerator Pedal Sensor.**
3. **ECU (damaged).**

Circuit Diagram



fmwxw610038

Diagnostic Steps

1. Connect the diagnostic apparatus

- Connect the Foton special-purpose diagnostic apparatus KT 600 to the vehicles; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- Read fault code.

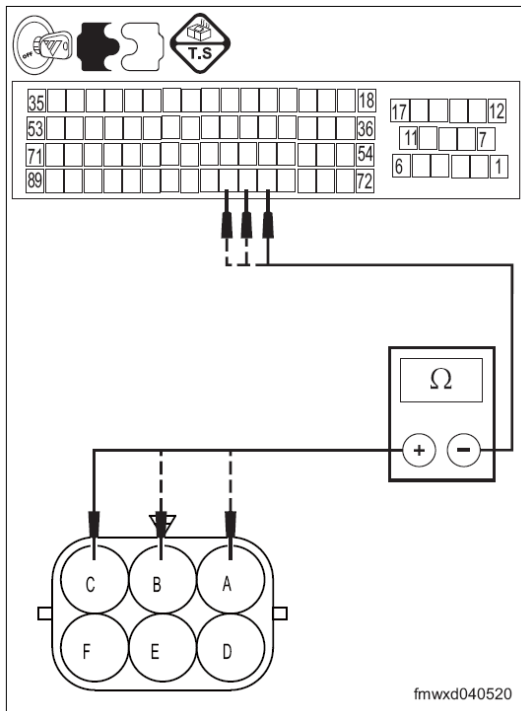
Whether the fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

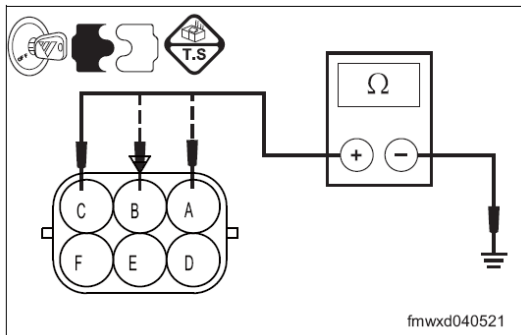
04

2. Inspect the Circuit of Accelerator Pedal Sensor



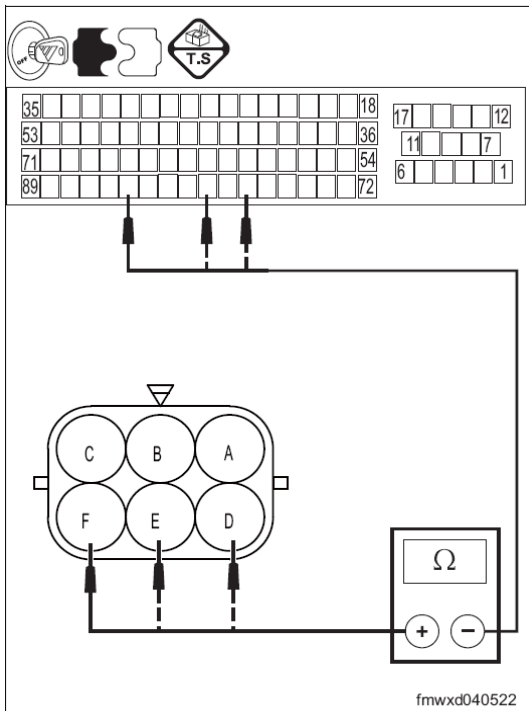
- Turn off the ignition switch.
- Switch off ECU socket connector F040 and electronic throttle socket connector B136.
- Use the multi-meter to measure the resistance between pin 77 of F040 and pin 3 (C) of B136, pin 79 of F040 and pin 2 (B) of B136 and pin 78 of F040 and pin 1 (A) of B136.

Resistance: $\leq 2 \Omega$



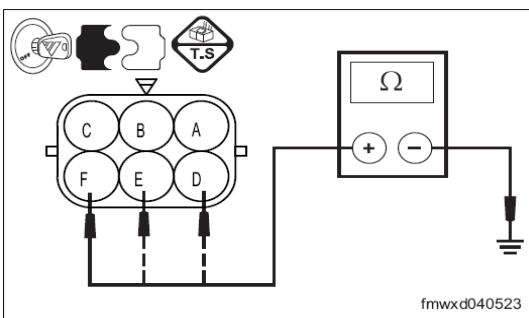
- Use the multi-meter to measure the resistance between accelerator pedal sensor socket connector pin 3 (C), 2 (B), 1 (A) of B136 and earth connection.

Resistance: $> 10 M \Omega$



- (e). Use the multi-meter to measure the resistance between pin 84 of F040 and pin 6 (F) of B136, pin 80 of F040 and pin 5 (E) of B136, pin 78 of F040 and pin 4 (D) of B136.

Resistance: $\leq 2 \Omega$



- (f). Use the multi-meter to measure the resistance between accelerator pedal sensor socket connector pin 6 (F), 5 (E), 4 (D) of B136 and earth connection.

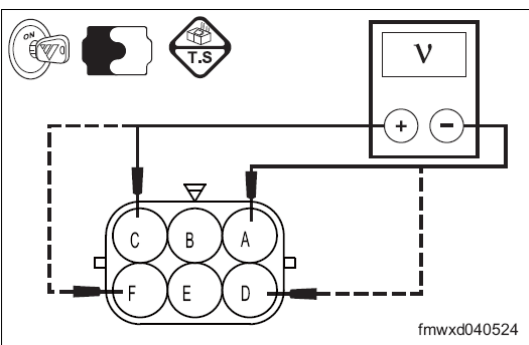
Resistance: $> 10 M \Omega$

Is the inspection result normal?

Yes > see Step 3

No > repair or replace the line fault from ECU to accelerator pedal sensor.

3. Inspect the Power of Accelerator Pedal Sensor



- (a). Connect the ECU socket connector F040, electronic throttle socket connector B136.
- (b). Turn on the ignition switch.
- (c). Use the multi-meter to measure the voltage between accelerator pedal sensor socket connector B136, pin 3 (C) and pin 1 (A) and the voltage between accelerator pedal sensor socket connector B136 pin 6 (F) and pin 4 (D).

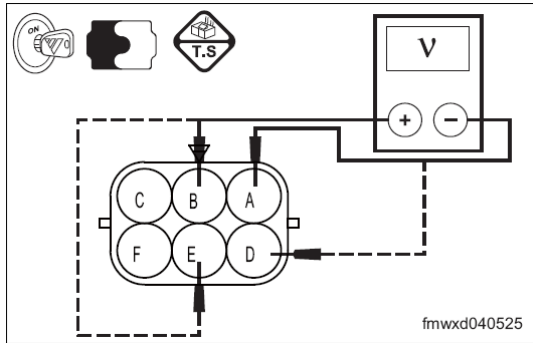
Standard value of voltage: 4.9 ~ 5.1 V

Is the inspection result normal?

Yes > see Step 4

No > replace ECU

4. Inspect the signal of accelerator pedal sensor

Diagnosis - Cigarette Lighter

- (a). When the accelerator pedal is not pressed down, use the multi-meter to measure the voltage between the accelerator pedal sensor socket connector pin 2 (B) of B136 and pin 1 (A) and the voltage between accelerator pedal sensor socket connector pin 5 (E) of B136 and pin 4 (D).

Voltage standard value:

Between pin 2 (B) of B136 and pin 1 (A): 0.75 V

Between pin 5 (E) of B136 and pin 4 (D): 0.375 V

- (b). When the accelerator pedal is pressed down, use the multi-meter to measure the voltage between accelerator pedal sensor socket connector pin 2 (B) of B136 and pin 1 (A) and the voltage between accelerator pedal sensor socket connector pin 5 (E) of B136 and pin 4 (D).

Voltage standard value:

Between pin 2 (B) of B136 and pin 1 (A): 3.84 V

Between pin 5 (E) of B136 and pin 4 (D): 1.92 V

Is the inspection result normal?

Yes > see Step 5

No > replace the accelerator pedal assembly, erase fault code and refer to this chapter "Reading and Erasing of Flash Fault Code".

5. Erase fault code

- (a). Erase the fault code and refer to this chapter "Reading and Erasing of Flash Fault Code".

Can the fault code be erased?

Yes > system is normal

No > replace ECU

2-2-2 Clutch Switch Fault

Description

Before any inspection of the faults the clients have reported, verification is needed to distinguish whether it is a failed or normal condition. Ask the clients whether they used proper engine oil and fuel, and whether they added other non-manufacturer retrofitting equipments.

Refer to “This Chapter, General Steps for Fault Diagnosis”.

If the clutch switch or its circuit breaks down, the car cannot navigate a cruise.

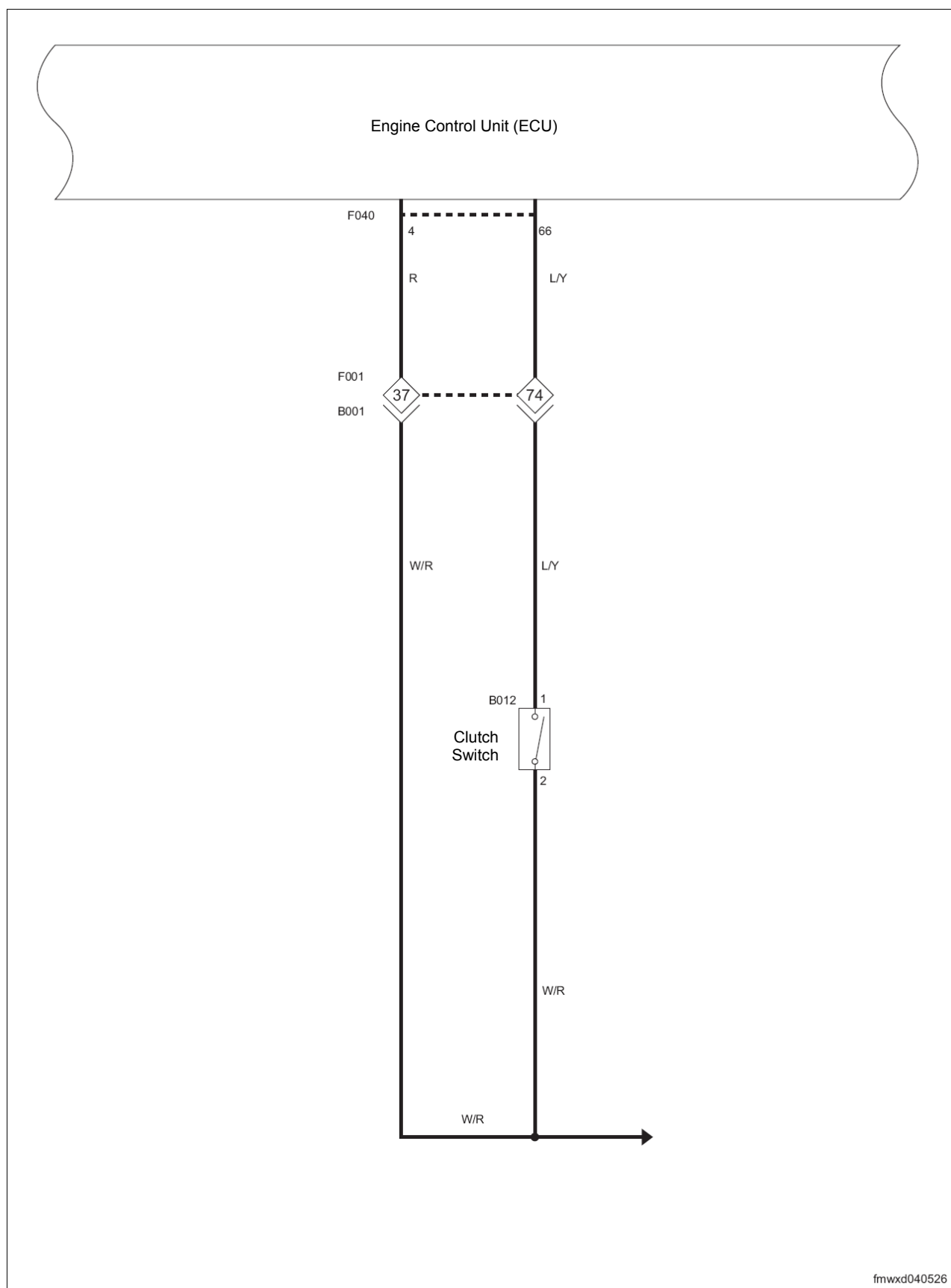
04

Parts that may have caused the fault

Clutch Switch Circuit (Shorted, Opened).

2. Clutch Switch (Damaged).
3. ECU (Damaged).

Circuit Diagram

Diagnosis - Cigarette Lighter

04

Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the Foton special-purpose diagnostic apparatus, KT600 to the cars, refer to "This

Diagnosis - Cigarette Lighter

Chapter, KT600 Diagnostic Apparatus Appliance and Fault Test".

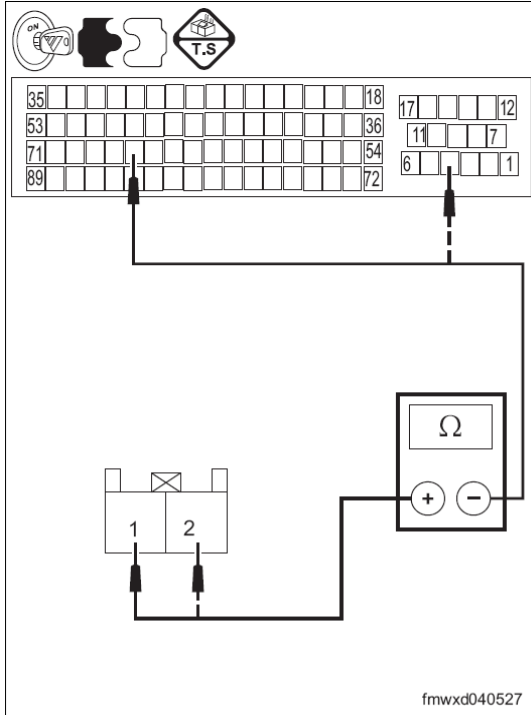
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read out the fault code.

Whether there is fault code or not?

Yes > Diagnosis according to Flash Fault Code, refer to "This Chapter, Lists for Flash Fault Code".

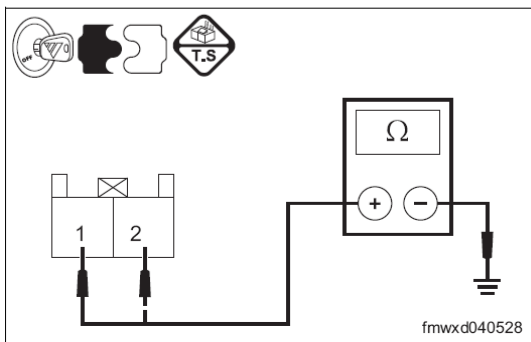
No > See Step 2

2. Inspect the Clutch Switch Circuit



- (a). Place ignition switch on "OFF".
- (b). Disconnect ECU connector F040 and clutch switch connector B012.
- (c). Measure the resistances between pin 66 of F040 and pin 1 of B012, and between pin 4 of F040 and pin 2 of B012 by multi-meter.

Resistance: $\leq 2 \Omega$



- (d). Measure the resistances between pin 1, pin 2 of clutch switch connector B012 and earth connection by multi-meter.

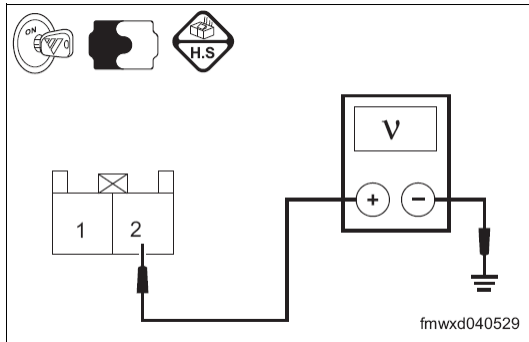
Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes > See Step 3

No > Repair or replace ECU of clutch switch circuit.

3. Inspect the clutch switch power

Diagnosis - Cigarette Lighter

- (a). Connect ECU connector F040 and clutch switch connector B012.
- (b). Place ignition switch at "ON".
- (c). Measure the voltage between pin 2 of clutch switch connector B012 and earth connection by multi-meter.

Standard Voltage Value: Storage Battery Voltage

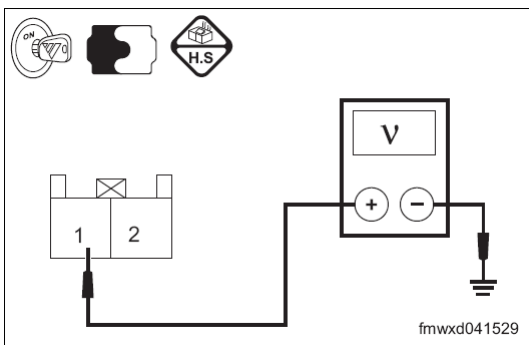
Is the inspection result normal?

Yes > See Step 4

No > Replace ECU

04

4. Inspect the clutch switch signal



- (a). Place ignition switch at "ON".
- (d). Measure the voltage between pin 1 of clutch switch connector B012 and earth connection by multi-meter.

Voltage:

Condition	Measurement of Pin	Standard Value
Press the Clutch	Car Body	> 3.75 V
Release the Clutch	Car Body	< 2.18 V

Is the inspection result normal?

Yes > See Step 5

No > Adjust the Clutch Switch Path or Replace the Clutch Switch. Remove the Fault Code.

Refer to "This Chapter, Reading and Removal of Flash Fault Code".

5. Erase Fault Code

- (a) Erase the fault code, refer to "This Chapter, Reading and Erasing of Flash Fault Code".

Can the fault code be erased?

Yes > No Faults Detected

No > Replace ECU

2-2-3 Brake Switch Fault, Single Brake Switch Fault

Description

Before any inspection of the faults the clients have reported, verification is needed to distinguish whether it is the failed or the normal condition. Ask the clients that whether they used proper engine oil and fuel, and whether they added other not-manufacturer retrofitting equipments.

Refer to "This Chapter, General Steps for Fault Diagnosis".

If the clutch switch or its circuit breaks down, the car cannot navigate a cruise.

If the car cannot navigate a cruise, press the brake pedal before any cruise. If it still cannot work, proceed following diagnostic procedure.

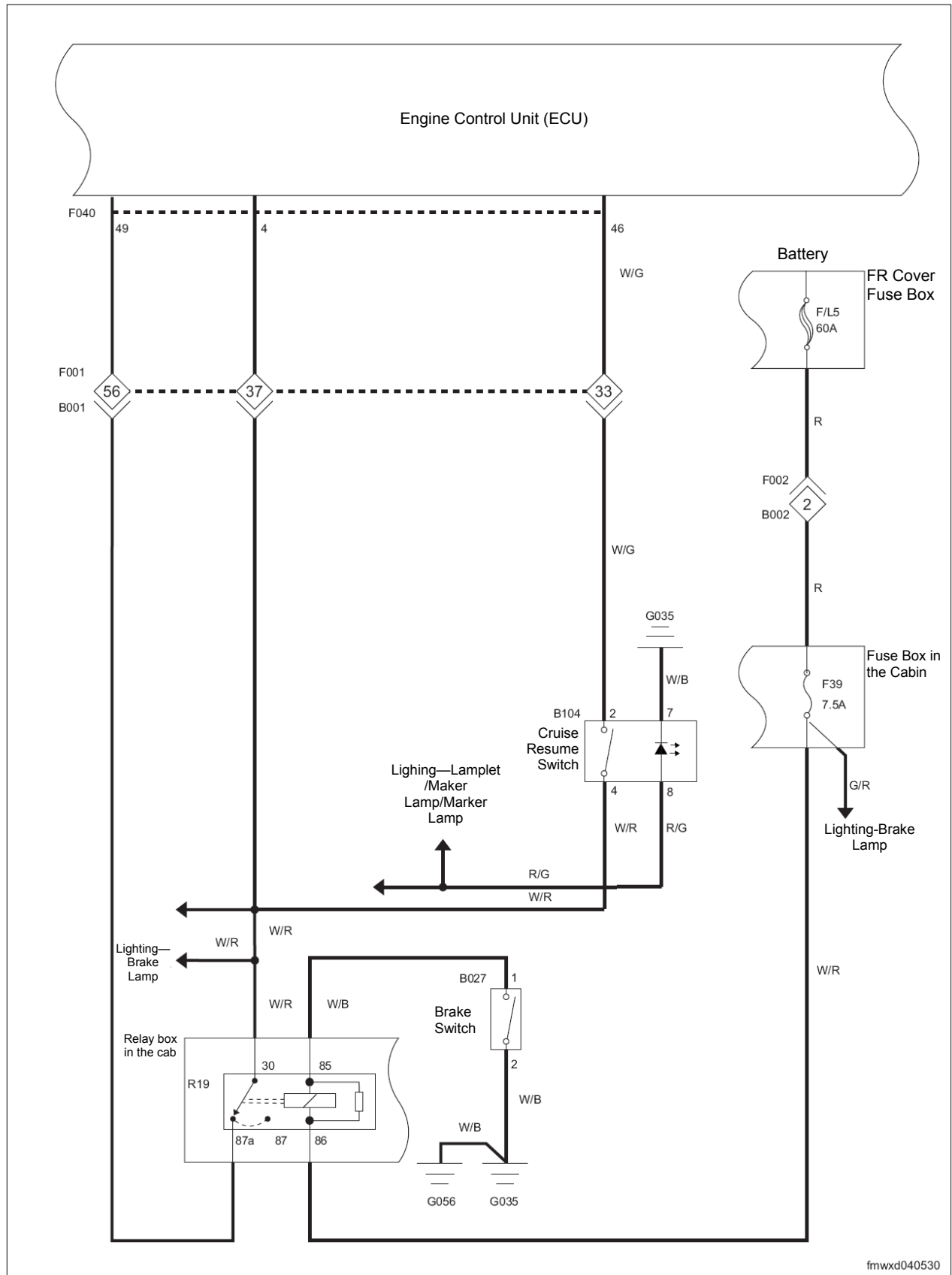
Diagnosis - Cigarette Lighter

Parts that may have caused the fault

1. Brake Switch, Brake Switch Relay Circuit (Shorted, Opened).
2. Brake Switch (Damaged).
3. Brake Switch Relay (Damaged).
4. ECU (Damaged).

Circuit Diagram

Diagnosis - Cigarette Lighter



Diagnostic Steps

1. Connect the diagnostic apparatus

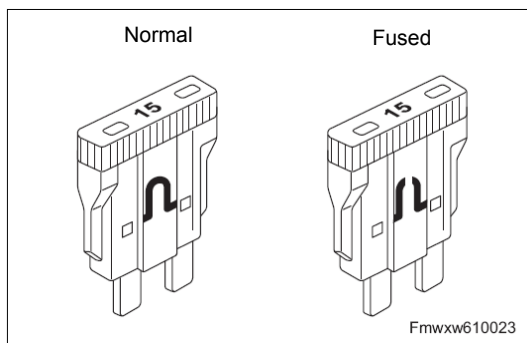
- (a). Connect the Foton special-purpose diagnostic apparatus, KT600 to the cars, refer to "This Chapter, KT600 Diagnostic Apparatus Appliance and Fault Test".
- (b). Operate the diagnostic apparatus according to Instructions for Diagnostic Apparatus.
- (c). Read out the fault code.

Whether there is fault code or not?

Yes > Diagnosis according to Flash Fault Code, refer to "This Chapter, Lists for Flash Fault Code".

No > See Step 2

2. Inspect brake switch fuse



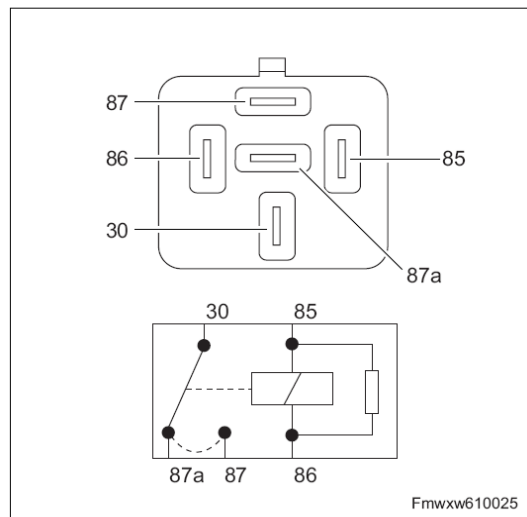
- (a). Place ignition switch at "OFF".
- (b). Inspect the Fuse in Cabin Fuse Box: F39 (7.5 A).

Is the inspection result normal?

Yes > See Step 3

No > Repair fuse circuit, and replace rated fuse

3. Inspect brake switch relay



- (a). Place ignition switch at "OFF".
- (b). Dismantle Brake Switch Relay R19.
- (c). Detect Brake Switch Relay R19.

Condition	Measurement of Pin	Standard Value
Normally	85 – 86	200~400Ω
	30 – 87	≤ 2 Ω
	30 – 87a	> 10 MΩ
Exert Voltage of 24V to 85 and 86	30 – 87	> 10 MΩ
	30 – 87a	≤ 2 Ω

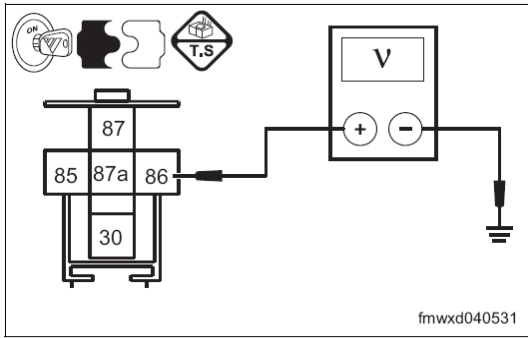
Is the inspection result normal?

Yes > See Step 4

No > Replace brake switch relay R19

Diagnosis - Cigarette Lighter

4. Inspect control power of brake switch relay



- Place ignition switch on "ON".
- Measure the voltage between pin 86 of brake switch relay R19 and earth connection by multi-meter.

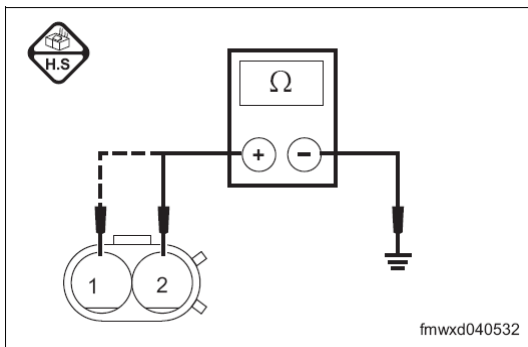
Standard voltage value: Storage Battery Voltage

Is the inspection result normal?

Yes > See Step 5

No > Repair the fault from fuse F39 (7.5 A) to brake switch relay R19

5. Inspect brake switch



- Measure the resistance between pin 1 of brake switch connector B027 and earth connection by multi-meter.

Resistance:

Condition	Measurement of Pin	Standard Value
Earth Connection of Brake Switch	2-Body	$\leq 2 \Omega$
Press Brake Pedal	1-Body	$\leq 2 \Omega$
Release Brake Pedal	1-Body	$> 10 M\Omega$

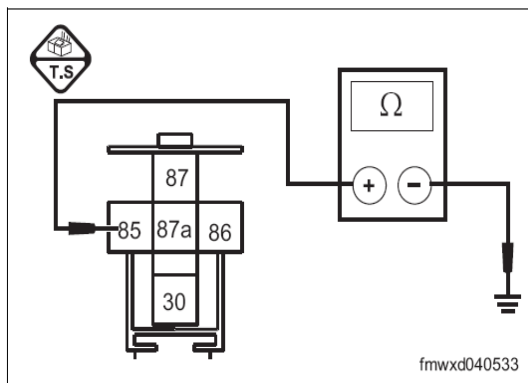
Hint: make sure sufficiency of air in the air reservoir.

Is the inspection result normal?

Yes > See Step 6

No > Replace brake switch, or repair the earth connecting circuit of brake switch

6. Inspect brake switch circuit



- Measure the resistance between seat pin 85 of brake switch relay R19 and earth connection by multi-meter.

Resistance:

Condition	Measurement of Pin	Standard Value
Press Brake Pedal	85—Body	$\leq 2 \Omega$
Release Brake Pedal	85—Body	$> 10 M\Omega$

Hint: make sure sufficiency of air in the air reservoir.

Is the inspection result normal?

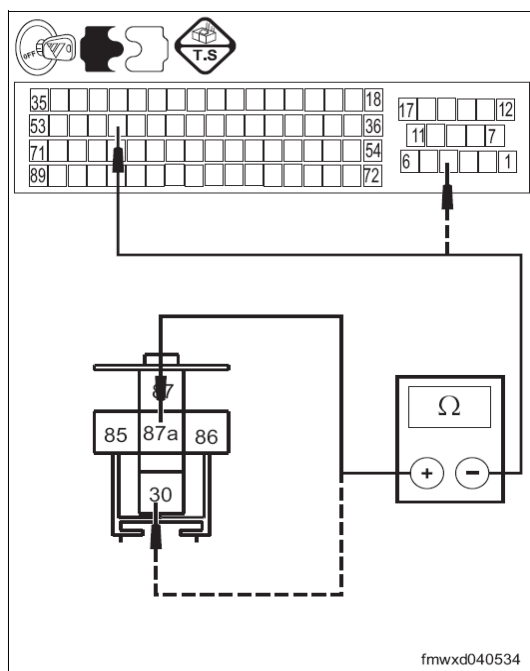
Yes > See Step 7

No > Repair the fault from brake switch to brake switch relay R19

7. Inspect the circuit from brake switch relay R19 to ECU

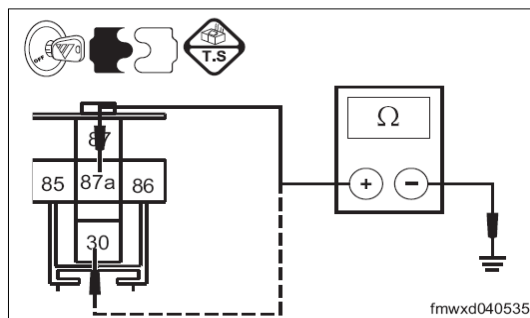
- (a). Turn off the ignition switch.
- (b). Disconnect ECU connector F040 and dismantle brake switch relay R19.
- (c). Measure the resistances between pin 49 of F040 and seat pin 87a of brake switch relay R19, and between pin 4 of F040 and seat pin 30 of brake switch relay R19 by multi-meter.

Resistance: $\leq 2 \Omega$



- (d). Measure the resistance between seat pin 87a, seat pin 30 of brake switch relay R19 and earth connection by multi-meter.

Resistance: $> 10 M\Omega$



Diagnosis - Cigarette Lighter

Is the inspection result normal?

Yes > See Step 8

No > Inspect and repair the circuit fault from brake switch relay R19 to ECU, and remove fault code

Refer to "This Chapter, Reading and Removal of Flash Fault Code".

8. Removal of fault code

Remove the fault code, refer to "This Chapter, Reading and Removal of Flash Fault Code".

Can the fault code be erased?

Yes > No faults detected

No > Replace ECU

2-2-5 Accelerator and Brake Credible Detection Fault

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this Chapter "General Steps for Fault Diagnosis".

While the accelerator pedal and the brake pedal are pressed at the same time, ECU records the fault.

04

Parts that may cause the fault

1. **Accelerator Pedal (Deficient Returning).**
2. **Accelerator Sensor (Abnormal).**
3. **Brake Switch (Abnormal in Connection).**
4. **Brake System (Abnormal).**

Diagnostic Steps

1. **Connect the diagnostic apparatus**
 - (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
 - (b). Operate the diagnostic apparatus according to the instruction for use.
 - (c). Read the fault code.

Whether there is other fault code or not?

Yes > Diagnosis according to flash fault code, refer to "This Chapter, Lists for Flash Fault Code".

No > See Step 2

2. **Inspect accelerator pedal**

- (a). Inspect returning spring of accelerator pedal. It shall perform well in returning.

Does accelerator pedal perform well?

Yes > See Step 3

No > Repair or replace accelerator pedal assembly

3. **Inspect accelerator pedal sensor**

Inspect accelerator pedal sensor, refer to "This Chapter, 2-2-1 Pedal Sensor 1, 2 Faults".

Does accelerator pedal sensor have faults?

Yes > Repair or replace accelerator pedal sensor

No > See Step 4

4. **Inspect brake switch**

- (a). Inspect brake switch, refer to this Chapter, "2-2-3 Brake Switch Fault, Single Brake Switch Fault".

Diagnosis - Cigarette Lighter

Does brake switch have faults?

Yes > Repair or replace brake switch

No > See Step 5

5. Inspect brake system

(a). Inspect brake system, refer to "Chapter 26 Service Brake".

Does brake system have faults?

Yes > Repair brake system

No > See Step 6

6. Erase fault code

(a). Erase the fault code, refer to this Chapter "Reading and Erasing of Flash Fault Code".

Can the fault code be erased?

Yes > No Faults Detected

No > Replace ECU

2-2-6 Diesel Engine Protection (Overdrive)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this Chapter "General Steps for Fault Diagnosis".

When the engine revolving speed reaches over 2650RPM, ECU will keep track of the fault and reduce the power output to protect the engine.

Parts that may have caused the fault

1. Clutch (slipping)
2. Transmission, Transmission Gear (abnormal)
3. Engine Machinery (abnormal)
4. Topping (abnormal in changes of power output)

Diagnostic Procedures

1. Connect the Diagnostic Apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault codes?

Yes > diagnose with Flash Fault Codes. Refer to this Chapter, "List of Flash Fault Codes".

No > see Step 2

2. Inspect the Clutch.

- (a). Inspect the clutch. Refer to "Chapter 32 Clutch".

Is the clutch in good condition?

Yes > see Step 3

No overhaul or renew clutch parts

3. Inspect the transmission, transmission gear

- (a). Inspect transmission and transmission gear of the accelerator.

Is there any problem with the transmission and transmission gear?

Yes overhaul or renew transmission and transmission gear parts.

No > see Step 4.

4. Inspect the engine machinery

- (a). Inspect the machinery parts as gear, flywheel, crank shaft, tile etc. in the engine. Refer to "Chapter 16A Engine Machinery" and "Chapter 16B Engine Machinery".

Is there any problem with the engine machinery?

Diagnosis - Cigarette Lighter

Yes > overhaul and renew engine machinery parts.

No > see Step 5.

5. Erase the fault codes

(a). Erase the fault codes. Refer to this Chapter “Reading and Erasing of Flash Fault Codes”.

Can the fault codes be erased?

Yes > the system is normal.

No > replace ECU.

2-2-7 Diesel Engine Protection

2-2-8 Diesel Engine Torsion Overshoot

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this Chapter "General Steps for Fault Diagnosis".

For vehicles with automatic transmission, when the engine output torsion is much too bigger, that is to say, the transmission input torsion is too much bigger; ECU will keep track of the fault and reduce the power out to protect the engine.

Parts that may have caused the fault

1. ECU (damaged)

Diagnostic Procedures

1. Connect the Diagnostic Apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault codes?

Yes > diagnose with Flash Fault Codes. Refer to "This Chapter, List of Flash Fault Codes".

No > see Step 2.

2. Re-disconnect and Connect the Ignition Switch

- (a). Turn off the ignition switch, and wait for several seconds to turn on it.
- (b). Read the Fault Code.

Do the fault codes currently exist?

Yes > replace the ECU.

No > see Step 3.

3. Erase the fault codes

- (a). Erase the fault codes. Refer to this Chapter "Reading and Erasing of Flash Fault Codes".

Can the fault codes be erased?

Yes > the system is normal.

No > replace ECU.

2-2-9 Remote Accelerator Pedal

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this Chapter "General Steps for Fault Diagnosis".

When the remote accelerator pedal fails to respond, ECU will keep track of the fault.

04

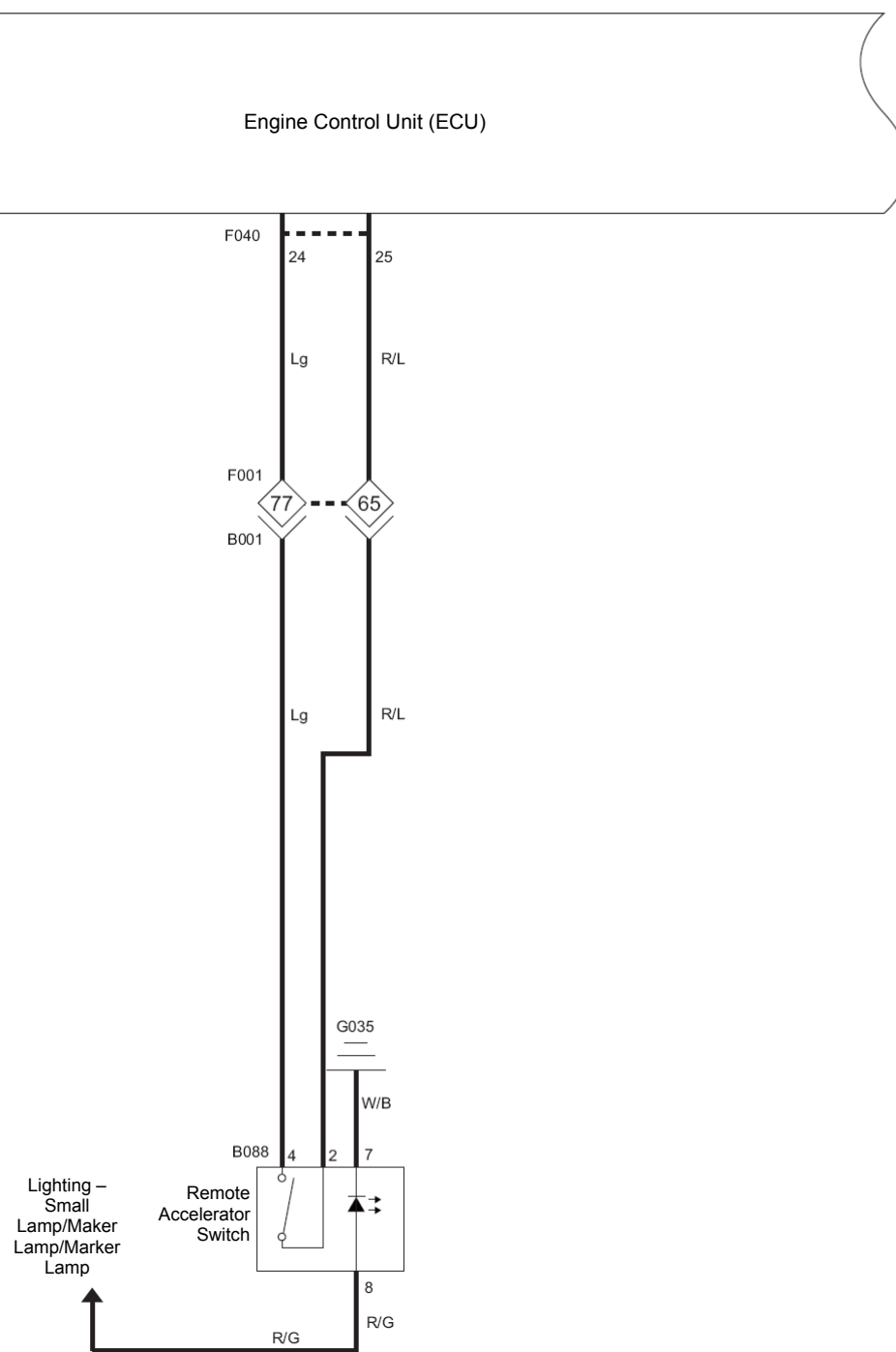
Parts that may cause the fault

1. **Switching circuit of remote accelerator (shorted or opened)**
2. **Remote accelerator switch (damaged)**
3. **ECU (damaged)**

Diagnosis - Cigarette Lighter

Circuit Diagram

04



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Diagnosis - Cigarette Lighter

Diagnostic Procedures

1. Connect the diagnostic apparatus

- Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

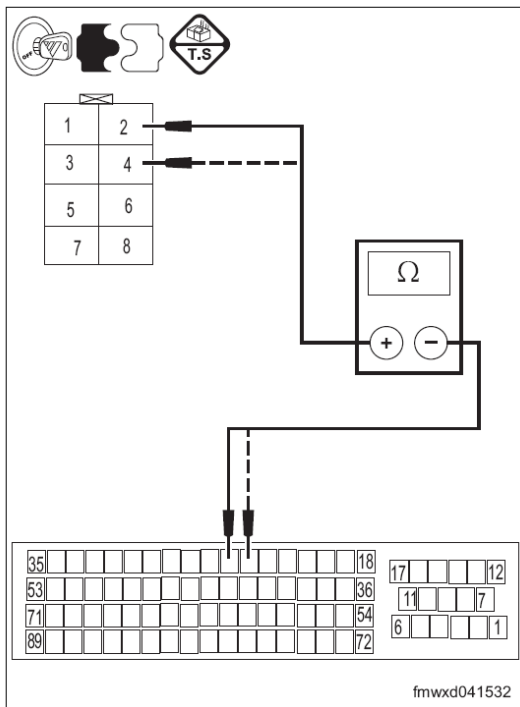
Is there any other fault code?

Yes > diagnose with Flash Fault Codes. Refer to this Chapter, "List of Flash Fault Codes".

No > see Step 2.

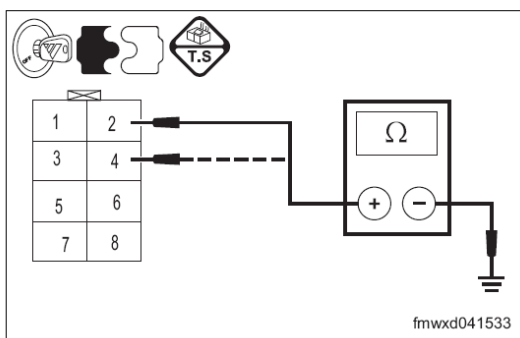
04

2. Inspect the circuit between remote accelerator switches and ECU



- Turn off the ignition switch.
- Disconnect ECU and connect the plug-in F040, remote accelerator switch wiring and plug-in B088.
- Use the multi-meter to measure the resistance between F040 pin 24 and B088 pin 4, as well as resistance between F040 pin 25 and B088 pin 2.

Resistance: $\leq 2 \Omega$



- Use the multi-meter to measure the resistance between remote accelerator switch wiring plug-in B088 pin 2 and pin 4 and earthing.

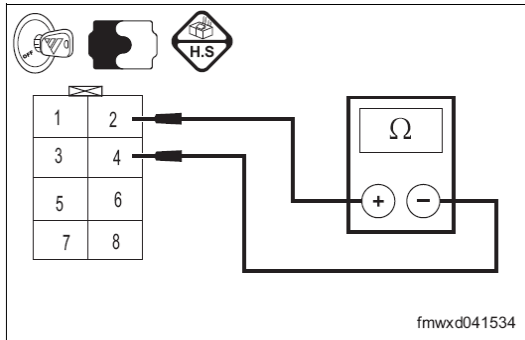
Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes > see Step 3.

No > repair the circuit fault between remote accelerator switch and ECU.

3. Inspect the remote accelerator switch



- Connect ECU and connect the plug-in F040, remote accelerator switch wiring and plug-in B088.
- Turn off the ignition switch.
- Use the multi-meter to measure the conduction between remote accelerator switch wiring plug-in B088 pin 2 and pin 4.

Resistance:

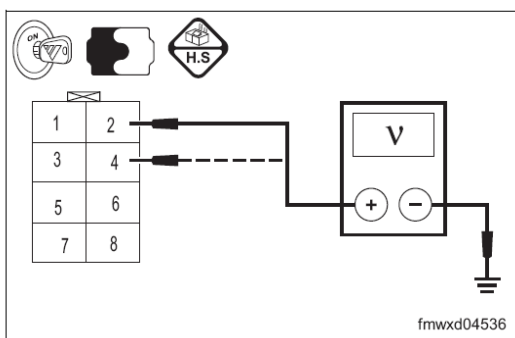
Condition	Measuring Pin	Standard Value
Release the Switch	2—4	> 10 MΩ
Press the Switch	2—4	≤ 2 Ω

Is the inspection result normal?

Yes > see Step 4.

No > replace the remote accelerator switch.

4. Inspect the remote accelerator switch signal



- Turn on the ignition switch.
- Use the multi-meter to measure the voltage between remote accelerator switch wiring plug-in B088 pin 2 and pin 4 and earthing.

Voltage:

Condition	Measuring Pin	Standard Value
Release the Switch	2 – Vehicle Body	4.9~5.1 V
	4 – Vehicle Body	0V

Is inspection result normal?

Yes > see Step 5.

No > replace the ECU.

5. Erase the fault codes

- Erase the fault codes. Refer to this Chapter “Reading and Erasing of Flash Fault Codes”.

Can the fault codes be erased?

Yes > the system is normal.

No > replace ECU.

2-3-1 Intake Pressure Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

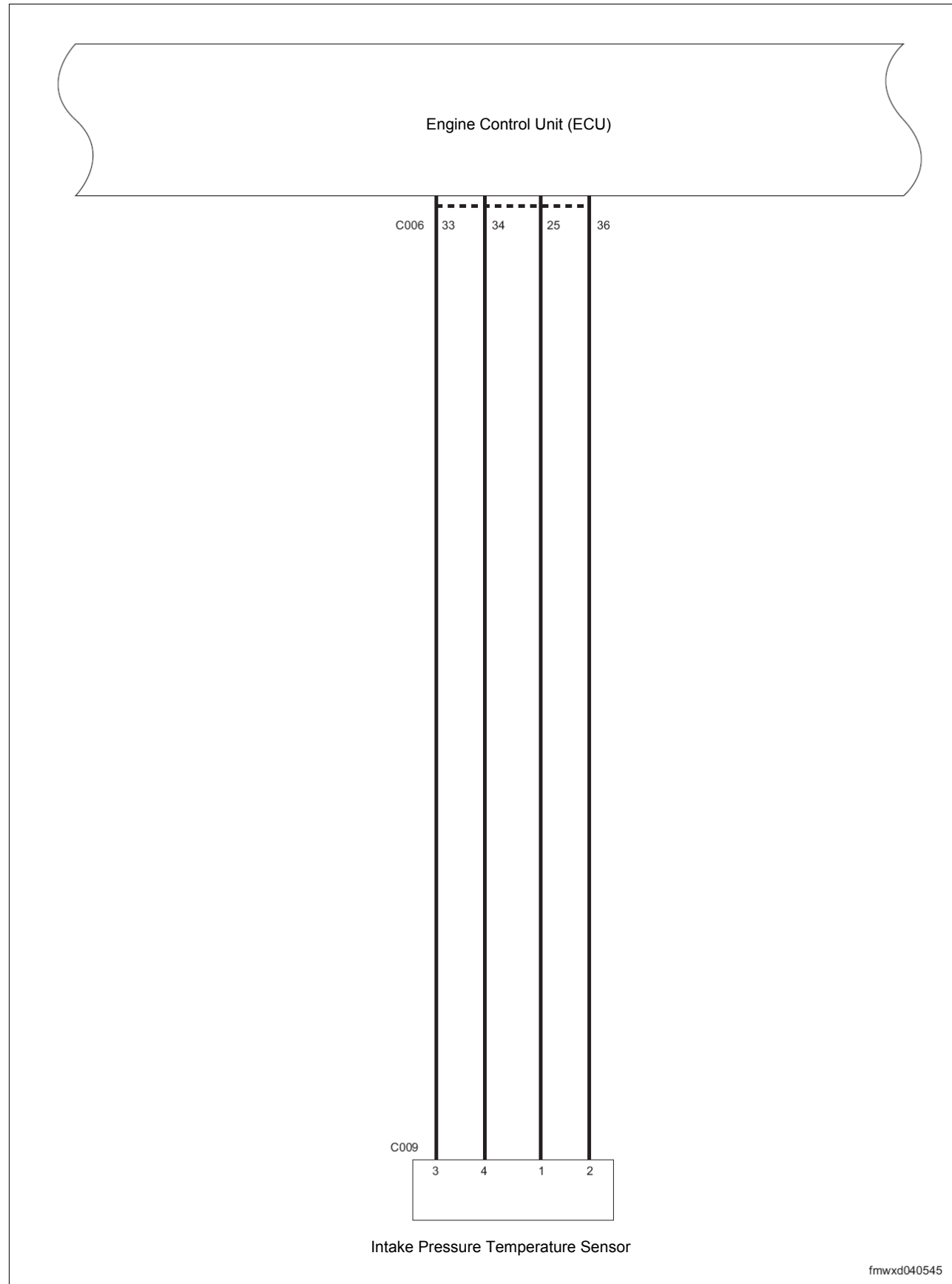
When intake pressure sensor fails to work, ECU will make fault record and turn into the mode of "Limp Home".

04

Parts that may cause faults

1. **Circuit of intake pressure temperature sensor (short circuit, open circuit).**
2. **Intake pressure temperature sensor (blocked, damaged).**
3. **ECU (damaged).**

Circuit Diagram



Diagnosis Steps

Diagnosis - Cigarette Lighter**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

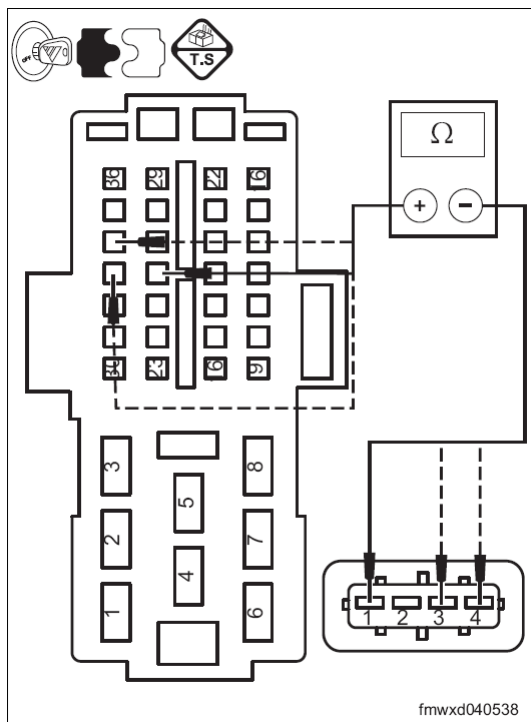
2. Inspect the appearance of intake pressure temperature sensor

- a). Turn off the ignition switch.
- b). Inspect the installation of sensor and make sure that the installation is proper and reliable.
- c). Dismantle the sensor and inspect it. The sensor shall not be too dirty or blocked.

Whether the above problems exist?

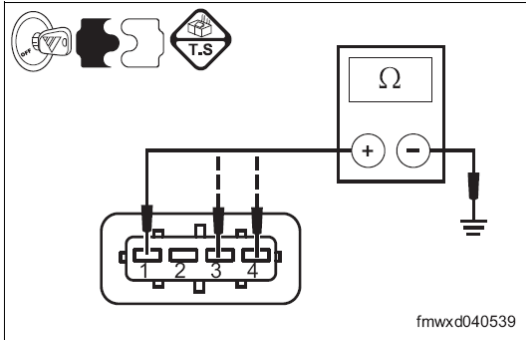
Yes > overhaul the fault parts

No > see Step 3

3. Inspect the circuit from intake pressure temperature sensor to ECU

- (a). Turn off the ignition switch.
- (b). Disconnect connector C006 of ECU and harness connector C009 of intake pressure temperature sensor.
- (c). Use multi-meter to measure resistance between pin 33 of connector C006 and pin 3 of connector C009, resistance between pin 34 of connector C006 and pin 4 of connector C009, resistance of pin 25 of connector C006 and pin 1 of connector C009.

Resistance: $\leq 2 \Omega$

Diagnosis - Cigarette Lighter

- (d). Use multi-meter to measure resistance between pin 3, 4, 1 of harness connector C009 of intake pressure temperature sensor and earth connection.

Resistance: > 10 MΩ

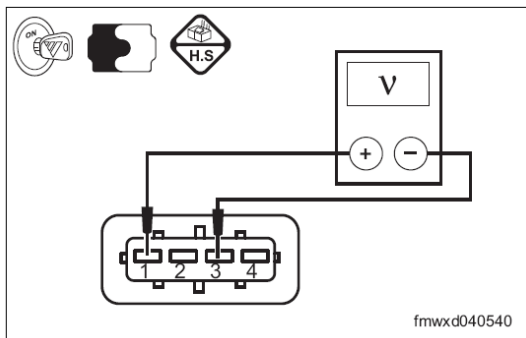
04

Is the inspection result normal?

Yes > see Step 4

No > overhaul the circuit fault from intake pressure temperature sensor to ECU

4. Inspect power circuit of intake pressure temperature sensor



- (a). Connect connector C006 of ECU and harness connector C009 of intake pressure temperature sensor.
- (b). Turn on ignition switch.
- (c). Use multi-meter to measure voltage between pin 3 and pin 1 of connector C009 of intake pressure temperature sensor.

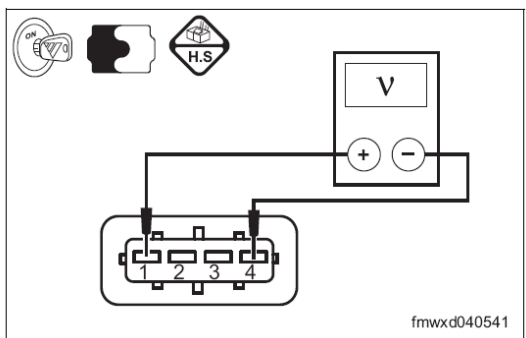
Voltage standard value: 4.9~5.1V

Is the inspection result normal?

Yes > see Step 5

No > replace ECU

5. Inspect signal circuit of intake pressure temperature sensor



- (a). The engine is operating.
- (b). Use multi-meter to measure voltage between pin 4 and pin 1 of connector C009 of intake pressure temperature sensor.

Idling voltage standard value: 0.5~0.8V

Hint:

Under normal circumstances, variation range of voltage signals: 0.2~4.8V

Is the inspection result normal?

Yes > see Step 6

No > replace the intake pressure temperature sensor and erase the fault code

Refer to this chapter, "Reading and Erasing the Flash Fault Code".

6. Erase fault code

- (a) Erase fault code, refer to this chapter, "Reading and Erasing the Flash Fault Code".

Diagnosis - Cigarette Lighter

Can the fault code be erased?

Yes > system is normal

No > replace ECU

2-3-2 Atmosphere Pressure Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Atmosphere pressure sensor is within ECU, and ECU will make fault record if there is any problem with atmosphere pressure sensor.

04

Parts that may cause faults

1. Shell of ECU (too dirty, inlet blocked).
2. Atmosphere Pressure Sensor (damaged).
3. ECU (damaged).

Diagnosis procedure

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Inspect the appearance of intake pressure temperature sensor

- (a). Turn off the ignition switch.
- (b). Inspect the shell of ECU.

Is the shell of ECU too dirty; or is the inlet opening blocked?

Yes > Clean the shell of ECU and erase fault code

No > see Step 3

3. Erase fault code

- (a). Erase fault code, refer to this chapter, "read and erase flash fault code".

Can the fault code be erased?

Yes > system is normal

No > replace ECU

2-3-3 Intake Temperature Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When intake temperature sensor fails to work, ECU will make fault record.

04

Circuit Diagram

Refer to this chapter "2-3-3 Intake Pressure Sensor—Circuit Diagram"

Parts that may cause faults

1. **Circuit of intake pressure temperature sensor (shorted or opened).**
2. **Intake pressure temperature sensor (damaged).**
3. **ECU (damaged).**

Diagnosis Steps

1. **Connect the diagnostic apparatus**

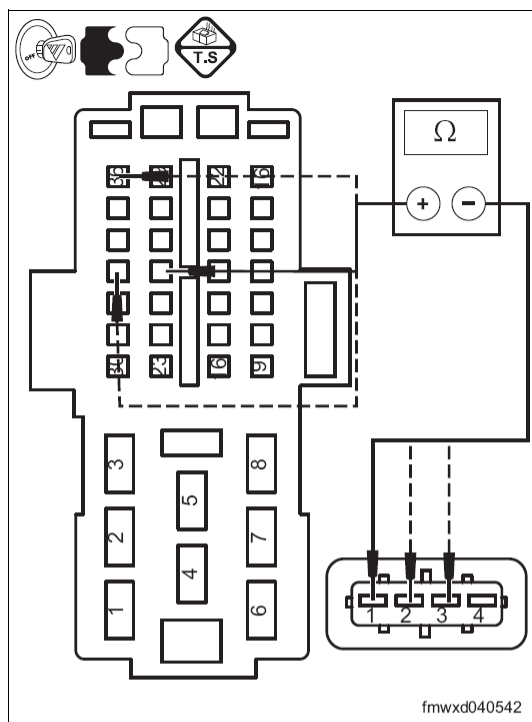
- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

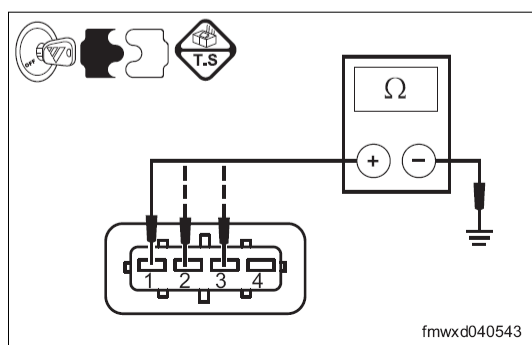
No > see Step 2

2. **Inspect the circuit from intake pressure temperature sensor to ECU**



- Turn off the ignition switch.
- Disconnect connector C006 of ECU and harness connector C009 of intake pressure temperature sensor.
- Use multi-meter to measure resistance between pin 33 of connector C006 and pin 3 of connector C009, resistance between pin 25 of connector C006 and pin 1 of connector C009, resistance of pin 36 of connector C006 and pin 2 of connector C009.

Resistance: $\leq 2 \Omega$



- Use multi-meter to measure resistance between pin 3, 2, 1 of harness connector C009 of intake pressure temperature sensor and earth connection.

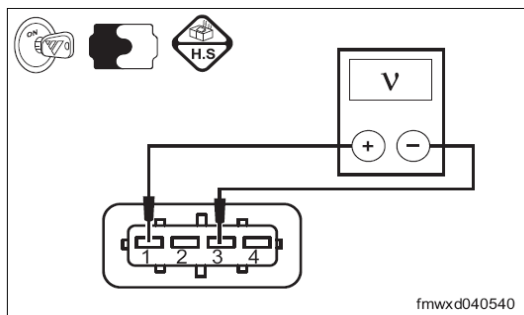
Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes > see Step 3

No > overhaul the circuit fault from intake pressure temperature sensor to ECU

3. Inspect power circuit of intake pressure temperature sensor



- Connect connector C006 of ECU and harness connector C009 of intake pressure temperature sensor.
- Turn on the ignition switch.
- Use multi-meter to measure voltage between pin 3 and pin 1 of connector C009 of intake pressure temperature sensor.

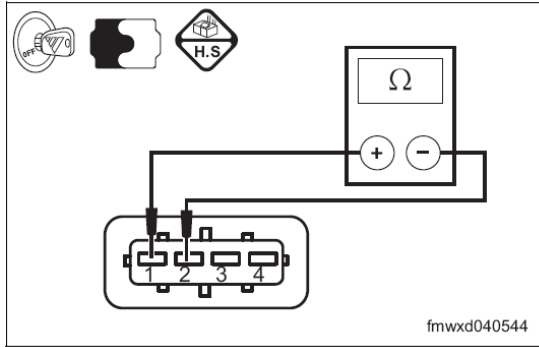
Voltage standard value: 4.9~5.1V

Is the inspection result normal?

Yes > see Step 4

No > replace the ECU

Diagnosis - Cigarette Lighter

4. Inspect the temperature signal circuit of intake pressure temperature sensor

- (a). Turn off the ignition switch.
- (b). Disconnect connector C006 of ECU.
- (c). Use multi-meter to measure resistance between pin 2 and pin 1 of connector C009 of intake pressure temperature sensor.

Resistance:

Temperature	Standard Value
-10 °C	9426 Ω
-5 °C	7419Ω
0 °C	5887Ω
5 °C	4707Ω
10 °C	3791 Ω
15 °C	3075Ω
20°C	2510Ω
25 °C	2063Ω
30°C	1715Ω

Is the inspection result normal?

Yes > see Step 5

No > replace the intake pressure temperature sensor and erase the fault code

Refer to this chapter, "Read and Erase Flash Fault Code".

5. Erase fault code

- (a). Erase fault code, refer to this chapter, "Read and Erase Flash Fault Code".

Can the fault code be erased?

Yes > system is normal

No > replace the ECU

2-4-1 Cooling Water Temperature Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

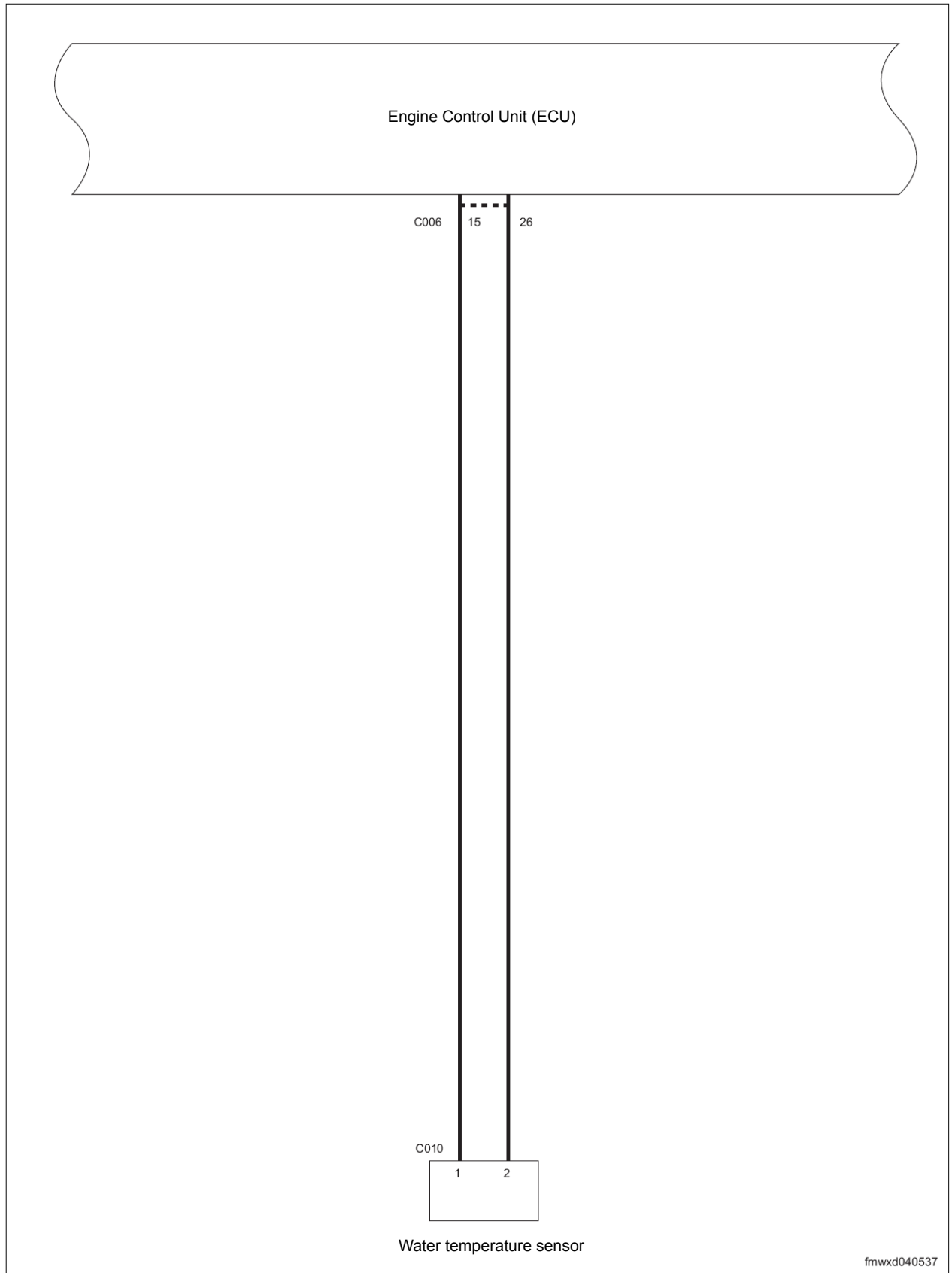
When cooling water temperature sensor fails to work, ECU will make fault record and turn into the mode of "Limp Home", which will lead to abnormal working condition of preheat system.

Parts that may cause faults

1. **Circuit of cooling water temperature sensor (shorted or opened).**
2. **Cooling water temperature sensor (damaged).**
3. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



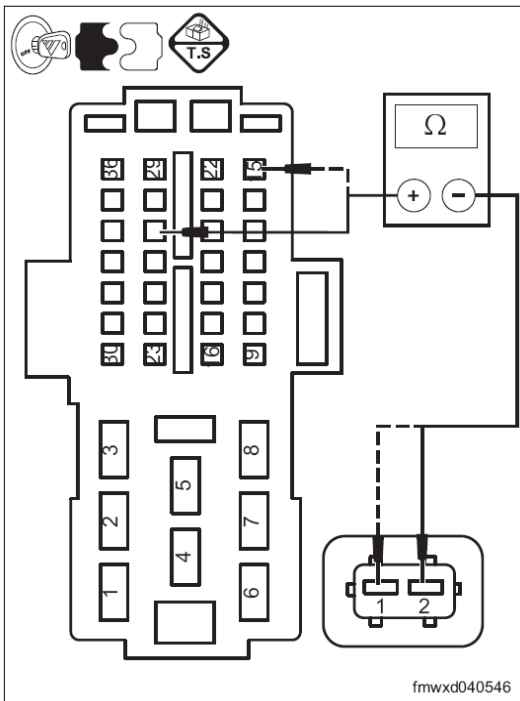
Diagnosis procedure**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

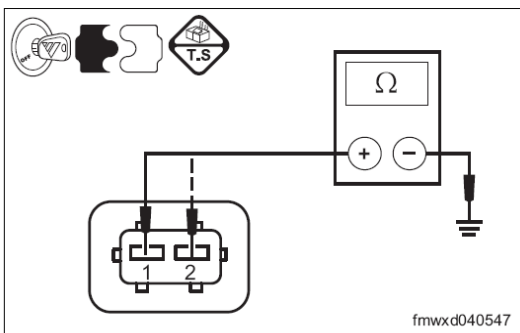
Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

2. Inspect circuit from water temperature sensor to ECU

- (a). Turn off the ignition switch.
- (b). Disconnect connector C006 of ECU and harness connector C010 of water temperature sensor.
- (c). Use multi-meter to measure resistance between pin 15 of connector C006 and pin 2 of connector C009.

Resistance: $\leq 2 \Omega$



- (d). Use multi-meter to measure resistance between pin 1, 2 of harness connector C009 of water temperature sensor and earth connection.

Resistance: $> 10 M\Omega$

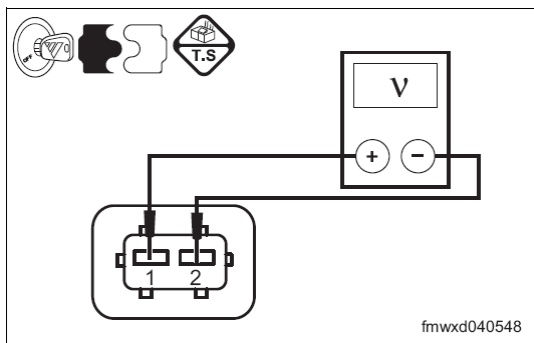
Is the inspection result normal?

Yes > see Step 3

No > overhaul the circuit fault from water temperature sensor to ECU

Diagnosis - Cigarette Lighter

3. Inspect power circuit of water temperature sensor



- (a). Connect connector C006 of ECU.
- (b). Keep the harness connector C010 of water temperature sensor off.
- (c). Turn on the ignition switch.
- (d). Use multi-meter to measure voltage between pin 1 and pin 2 of connector C010 of water temperature sensor.

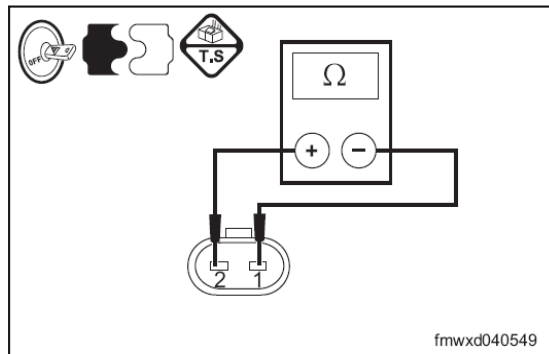
Voltage standard value: 4.9~5.1V

Is the inspection result normal?

Yes > see Step 4

No > replace the ECU

4. Inspect water temperature sensor



- (a). Turn off the ignition switch.
- (b). Use multi-meter to measure resistance between pin 1 and 2 of water temperature sensor.

Resistance:

Temperature	Standard Value
-10°C	8642 Ω
0 °C	5466 Ω
10°C	3542 Ω
20 °C	2351 Ω
25 °C	1941 Ω
30°C	1615 Ω

Is the inspection result normal?

Yes > see Step 5

No > replace the water temperature sensor and erase the fault code

Refer to this chapter "Read and Erase Flash Fault Code".

5. Erase fault code

- (a) Erase fault code, refer to this chapter "Read and Erase Flash Fault Code".

Can the fault code be erased?

Yes > system is normal

No > replace the ECU

2-4-2 Excessive Water Temperature Alarm

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When water temperature is over 105 °C, ECU will make a fault record and limit engine power.

04

Parts that may cause faults

1. **Coolant (deficient, too dirty).**
2. **Cooling Fan (damaged).**
3. **Circuit of cooling water temperature sensor (shorted).**
4. **Cooling System, Temperature Saver, Water Pump etc.(abnormal).**

Diagnosis procedure

1. **Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Do other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. **Inspect the coolant**

- (a). Inspect coolant of engine, which shall not be deficient.
- (b). Inspect coolant of engine, which shall not be too dirty.

Whether the above problems exist?

Yes > add or replace coolant of engine

No > see Step 3

3. **Inspect cooling fan**

- (a). Operate the engine.
- (b). Inspect the working conditions of engine cooling fan in different water temperatures.

Whether the engine cooling fan works normally?

Yes > see Step 4

No > overhaul the engine cooling fan

4. Inspect temperature saver, water pump and other parts of engine cooling system

- (a) Inspect temperature saver, water pump and other parts of engine cooling system, refer to “Chapter 14A Cooling”.

Whether there are problems in the above parts?

Yes > overhaul relevant parts of engine cooling system

No > see Step 5

5. Inspect circuit of cooling water temperature sensor

- (a). Inspect circuit of cooling water temperature sensor, which shall not be short.
(b). Inspect cooling water temperature sensor, which shall not be damaged.

Whether the above problems exist?

Yes > overhaul circuit of cooling water temperature sensor or replace water temperature sensor, refer to this chapter “2-4-1 Cooling Water Temperature Sensor”

No > see Step 6

6. Erase fault code

- (a). Erase fault code, refer to this chapter “Read and Erase Flash Fault Code”.

Can the fault code be erased?

Yes > system is normal

No > replace the ECU

2-4-3 Oil Pressure Sensor Alarm of High Pressure and Low Pressure

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

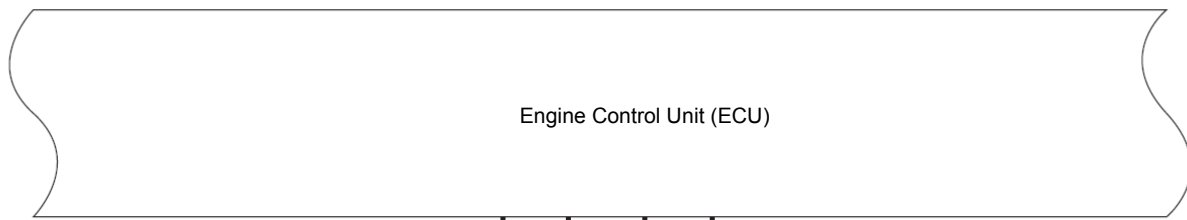
When oil pressure is too high or too low, ECU will make fault record and protect the engine.

04

Parts that may cause faults

1. **Circuit of oil pressure temperature sensor (shorted or opened).**
2. **Oil pressure temperature sensor (blocked, damaged).**
3. **ECU (damaged).**
4. **Engine Lubricating System (abnormal).**

Circuit Diagram



C006 32 27 24 28



Oil Pressure Temperature Sensor

fmwxd040550

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect engine oil

- (a). Inspect engine oil.

Whether engine oil is deficiency, excessive over-dirty and whether it has wrong types?

Yes > Add, discharge or replace right types of oil to the right liquid level , and refer to" Chapter 15A Lubrication" and Chapter 15 B "Lubrication"

No > see Step 3

3. Inspect the appearance of oil pressure temperature sensor

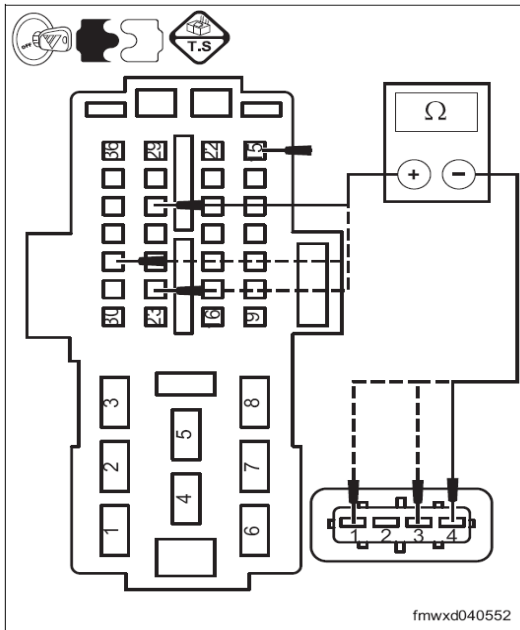
- (a). Turn off the ignition switch.
- (b). Inspect the installation of the sensor. The installation shall be correct and reliable.
- (c). Dismantle the sensor and inspect the Sensor. The sensor shall not be over-dirty and blocked.

Whether the above problems exist?

Yes > overhaul the fault parts.

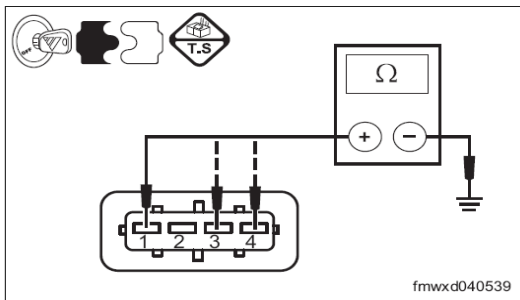
No > see Step 3

4. Inspect oil pressure temperature sensor and ECU circuits.

Diagnosis - Cigarette Lighter

- (a). Turn off the ignition switch.
- (b). Disconnect connector C006 of ECU, harness connector C003 of oil pressure temperature sensor.
- (c). Use multi-meter to measure resistance between Pin 32 of C006 and Pin 3 of C003, Pin 27 of C006 and Pin 4 of C003, Pin 24 of C006 and Pin 1 of C003.

Resistance: $\leq 2 \Omega$



- (d). Use multi-meter to measure resistance between pin 3, 4, 1 of harness connector C003 of oil pressure temperature sensor and earth connection.

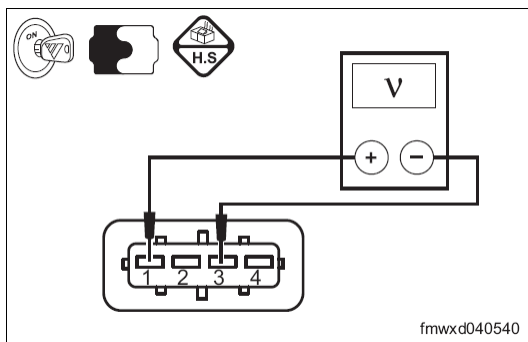
Electronic Resistance: $\leq 10 \Omega$

Is the inspection result normal?

Yes > see Step 5

No > Overhaul line faults from oil pressure temperature sensor to ECU.

5. Inspect power circuits of temperature sensor of oil pressure.



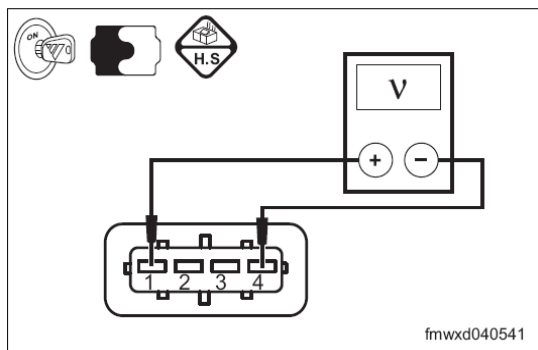
- (a). Connect Connector C006 of ECU, Connector C003 of oil pressure temperature sensor harness.
- (b). Turn on the ignition switch. .
- (c). Use multi-meter to measure voltage between Pin 3 and Pin1 of Connector C003 of oil pressure temperature sensor.

Voltage standard value: 4.9~5.1V

Is the inspection result normal?

Yes > See Step 6

No > Replace ECU

6. Inspect pressure signal circuits of oil pressure temperature sensor.

- (a). The engine is operating.
- (b). Use multi-meter to measure voltage between Pin 4 and Pin1 of Connector C003 of oil pressure temperature sensor.

Hint:

Under the normal circumstances,
variation ranges of voltage signals: 0.2~4.8V

Is the inspection result normal?

Yes>Overhaul mechanical faults of engine lubrication system and refer to “Chapter 15A Lubrication”, “Chapter 15B Lubrication”

No>Replace oil pressure temperature sensor and erase fault code

Refer to this chapter, “read and erase the flash fault code”.

2-4-4 Oil Temperature Sensor Fault and Oil Temperature Excessive Warning

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the oil temperature is too high or low, ECU will record faults and protect engine.

04

Parts that may cause faults:

1. **Circuit of oil pressure temperature sensor (short circuit, open circuit).**
2. **Oil pressure temperature sensor (damaged).**
3. **ECU (damaged).**
4. **Lubrication system of engine (Abnormal).**

Circuit Diagram

Refer to this chapter "2-4-3 Too High or Low Alarming of Oil Pressure Sensor –Circuit Diagram"

Diagnostic Steps

1. **Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. **Inspect engine oil**

- (a). Inspect engine oil.

Whether engine oil is deficiency, excessive over-dirty and whether it has wrong types?

Yes > Add, discharge or replace right types of oil to the right liquid level , and refer to "Chapter 15A Lubrication" and Chapter 15 B "Lubrication"

No > see Step 3

3. **Inspect the appearance of oil pressure temperature sensor**

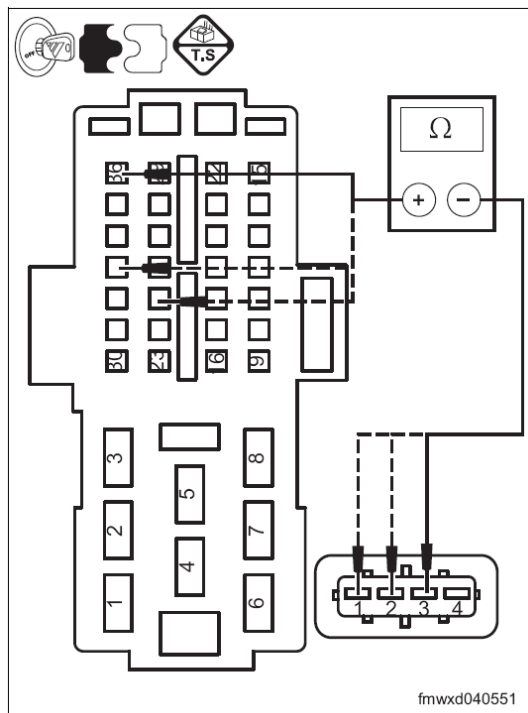
- (a). Turn off the ignition switch.
- (b). Inspect the installation of the sensor. The installation shall be correct and reliable.
- (b). Inspect the installation of the sensor. The installation shall be correct and reliable.
- (c). Dismantle the sensor and inspect the Sensor. The sensor shall not be over-dirty and blocked.

Whether the above problems exist?

Yes > overhaul the fault parts.

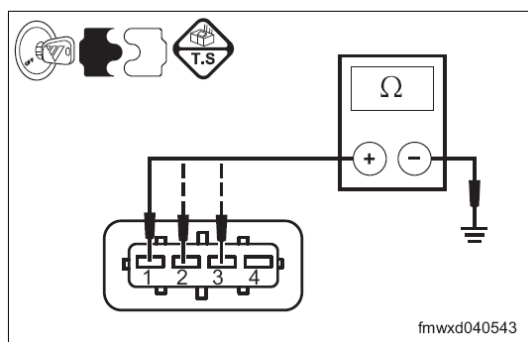
No > see Step

4. Inspect oil pressure temperature sensor and ECU circuits.



- (a). Turn off the ignition switch.
- (b). Disconnect connector C006 of ECU, harness connector C003 of oil pressure temperature sensor.
- (c). Use multi-meter to measure resistance between Pin 33 of C006 and Pin 3 of C003, Pin 25 of C006 and Pin 1 of C003, Pin 36 of C006 and Pin 2 of C003.

Resistance: $\leq 2 \Omega$



- (d). Use multi-meter to measure resistance between pin 3, 2, 1 of harness connector C003 of oil pressure temperature sensor and earth connection.

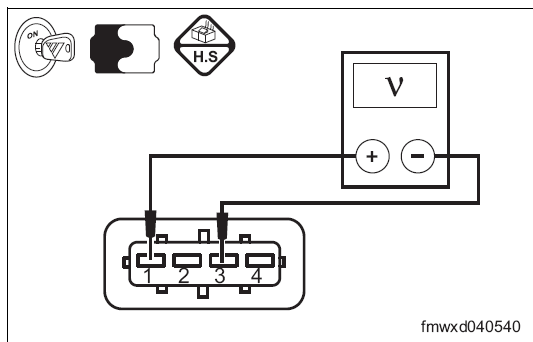
Electronic Resistance: $> 10 \Omega$

Is the inspection result normal?

Yes > see Step 5

No > Overhaul line faults from oil pressure temperature sensor to ECU.

5. Inspect power circuits of oil pressure temperature sensor.

Diagnosis - Cigarette Lighter

- Connect Connector C006 of ECU, Connector C003 of oil pressure temperature sensor harness.
- Turn on the ignition switch. .
- Use multi-meter to measure voltage between Pin 3 and Pin1 of Connector C003 of oil pressure temperature sensor.

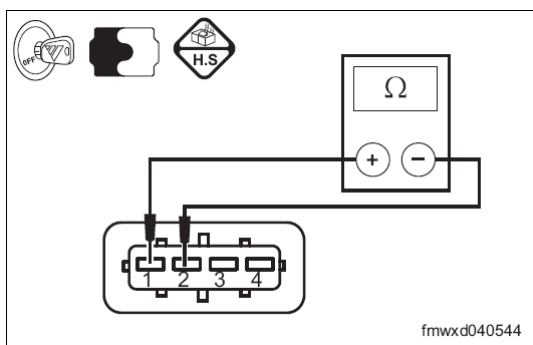
Voltage standard value: 4.9~5.1V

04

Is the inspection result normal?

Yes >See Step

6. Inspect signal circuits of oil pressure temperature sensor.



- Turn on the ignition switch.
- Disconnect Connector C006 of ECU.
- Use multi-meter to measure resistance between Pin 2 and Pin1 of Connector C003 of oil pressure

temperature sensor:

Temperature	Standard Value
0 °C	5895 Ω
10 °C	3791Ω
20 °C	2499Ω
30°C	1706Ω
40°C	1174Ω
50 °C	834 Ω
60 °C	595Ω
70°C	436Ω
80 °C	323Ω
90 °C	243Ω
100 °C	287Ω

Is the inspection result normal?

Yes > Overhaul mechanical faults of engine lubrication system and refer to “Chapter 15A Lubrication”, “Chapter 15B Lubrication”

No > Replace oil pressure temperature sensor and erase fault code

Refer to this chapter, “read and erase the flash fault code”.

2-4-5 Water Temperature Sensor Test

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Functional test of water temperature sensor: when use diagnostic apparatus to test water temperature sensor, ECU will record the faults.

04

Parts that may cause faults

1. ECU (damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

2. Erase fault code

- (a). Erase fault code, see this chapter, "read and erase the flash fault code"

Can the fault code be erased?

Yes > system is normal

No > Replace ECU

2-5-1 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-2 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-3 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-4 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-5 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-6 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

2-5-7 High-pressure Fuel Pipe \Low-pressure Fuel Pipe Problems (Oil Leakage)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When common rail pressure sensor monitor the existing leakage of fuel piping system, or fuel pressure is abnormal, ECU will record faults, and enter into the mode of "limp home", which will cause hard starting.

Parts that may cause faults

1. Inadequate fuel (insufficient fuel in the oil tank, this may cause air entrainment when bumping)
2. The fuel pipe is bent, blocked or leaking (the suction pipe of the fuel tank has foreign matters or the fuel pipe is bent and extruded or has foreign matters).
3. There is air in the fuel pipe system (the interface of the fuel pipe is loosened).
4. Fuel injector (damaged or decompression, leaking).
5. Common-rail pipe and pressure control device (pressure- limiting valve) (damaged or leaking).

Diagnosis Steps

1. Conduct basic inspection for engine diagnosis; refer to this chapter, "Basic Inspection".

Warning:

When the engine is operating, do not disconnect any high-pressure oil pipe; when disconnecting any low-pressure oil pipe, use an appropriate container for the fuel outflow. When the engine rotating, do not open any high-pressure pipeline; when opening any low-pressure pipeline, make sure to use suitable container to collect the excurrent fuel.

Diagnosis - Cigarette Lighter**2. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Whether other fault codes exist?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 3

3. Inspect the fuel

- (a). Open the fuel tank cap to inspect and ensure that the fuel is sufficient and the fuel is clean without too much water and the type is right

04

Whether the fuel has the above problems?

Yes > add or replace the right type of fuel

No > see Step 4

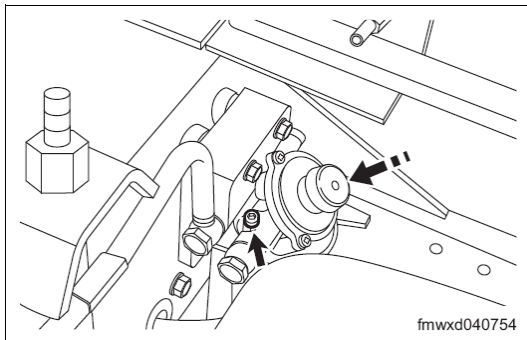
4. Inspect fuel coarse filter and fine filter

- (a). Inspect by dismantling the fuel coarse filter and fine filter and ensure that they are not dirty and blocked; if not, replace them with new ones.

Whether the fuel coarse filter and fine filter have the above problem?

Yes > replace them with new ones

No > See Step 5

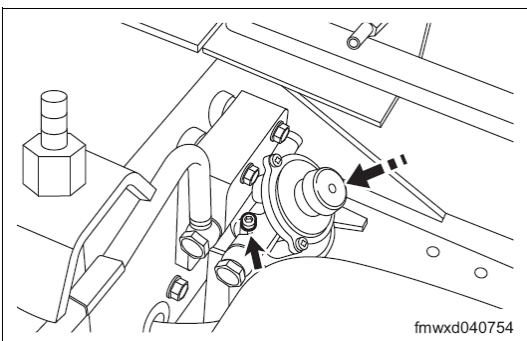
5. Inspect whether air has been taken into the low-pressure fuel pipe

- (a). Loosen the air bleed bolt and repeatedly press the hand pump until outflow of fuel.
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > see Step 6

NO > see Step 7

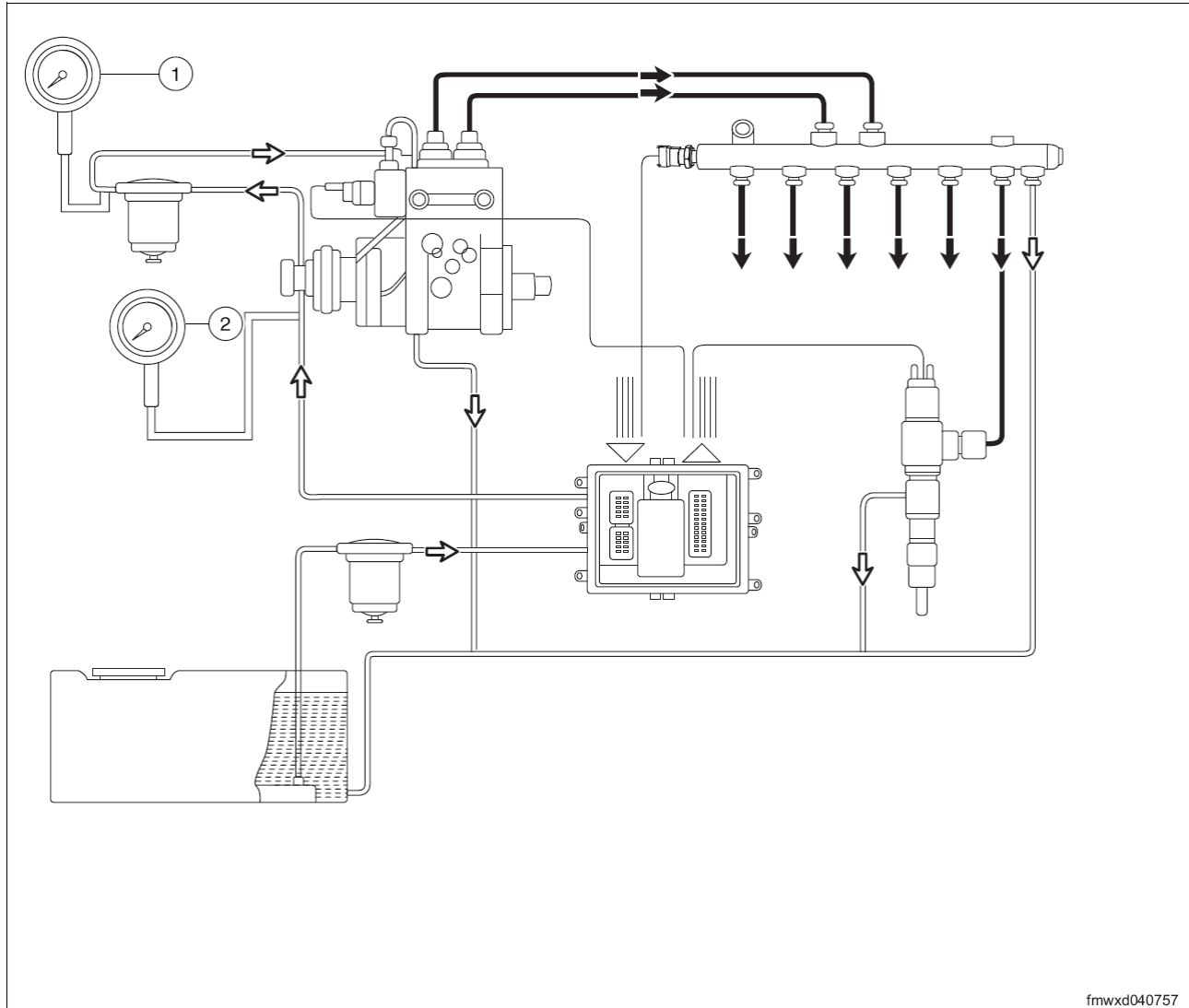
6. Exhaust air in the low-pressure fuel pipe

- (a). Repeatedly press the hand pump until the bubbles in the fuel outflow disappear, tighten the air bleed bolt and then press the hand pump for several times. Refer to "Air Exhausting of Fuel System" in "Chapter 11A Fuel-Detection and Adjustment" and "Air Exhausting of Fuel System" in "Chapter 11B Fuel-Detection and Adjustment".
- (b). Observe the status of fuel outflow from the air bleed bolt.

Whether the fuel outflow from the air bleed bolt has bubbles?

Yes > inspect the air-intake fault of the low-pressure fuel pipe and ensure that the fuel pipe joint is not loosened and has no air taken in; if not, maintain the fault parts and exhaust air again.

NO> See Step7



fmwxd040757

7. Inspect the gear pump of the high-pressure oil pump

- (a). Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:

Exhaust air in the fuel pipe after connecting the pressure gauge.

- (b). Use starter to keep the engine operating and observe the pressure gauge.

Hint:

Under normal circumstances, the press value of pressure gage 1 can reach 900KPa at high rotating speed.

Whether the press value of pressure gage 1 can reach 900KPa?

Yes> See Step13

No> the gear pump of the high-pressure oil pump is damaged and shall be replaced with a new one.

Diagnosis - Cigarette Lighter

8. Inspect whether the low-pressure fuel pipe is blocked

- (a) Connect in parallel the pressure gauge to the low-pressure fuel pipe.

Caution:**Exhaust air in the fuel pipe after connecting the pressure gauge.**

- (b) Inspect pressure gauge when the engine operates at different speeds.

Hint:

Under normal circumstances, the pressure value of pressure gauge 2 shall decrease to no less than -70Kpa.

Whether the pressure value of pressure gauge 2 is less than -70Kpa?

Yes > the low-pressure fuel pipe is blocked, bent or extruded and therefore the block shall be removed and the fault parts maintained

NO> See Step9

9. Inspect the high-pressure common rail fuel pressure of the engine

- (a) Operate the engine.
(b) Conduct "high-pressure test" with a diagnostic apparatus.

Hint:

Under normal circumstances, in the "high-pressure test", the "actual fuel rail pressure" shall reach the high pressure value set in the "high-pressure test".

If the high-pressure value set in the "high-pressure test" can not be reached, it shows that the high-pressure common rail pipe has leakage.

Whether the "actual fuel rail pressure" shown by the diagnostic apparatus can reach the high-pressure value set in the "high-pressure test"?

Yes> See Step10

NO > See Step11

10. Inspect the Fuel Injector

- (a) Operate the engine.
(b) Conduct "cylinder cutout test" with a diagnostic apparatus.

Hint:

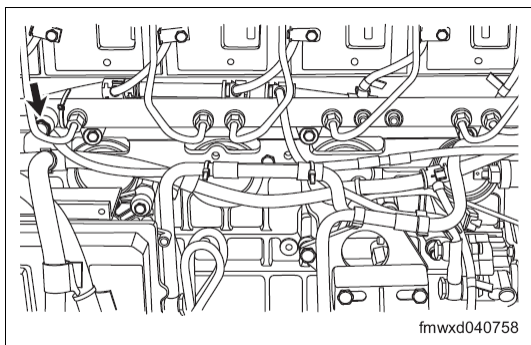
Under normal conditions, in the "cylinder cutout test", when one cylinder stops working, the engine will shake. If the engine does not shake when one cylinder stops working; it shows that the fuel injector of such cylinder is damaged or such cylinder is leaking.

Does the engine shake when one cylinder shakes?

Yes> See Step11

No> replace the fuel injector of the cylinder

11 Inspect the common rail and the pressure limiting valve

Diagnosis - Cigarette Lighter

- (a). Disconnect the return pipe joint of the pressure limiting valve.
- (b). Operate the engine at different rotation speed and use the diagnostic apparatus to read the "actual fuel rail pressure" from the data stream.

Hint:

Under normal circumstances, when the engine is operating and the "actual fuel rail pressure" shown by the diagnostic apparatus is higher than 160MPa, the pressure limiting valve will release pressure, that is, the releasing pressure of pressure limiting valve will be 160Mpa.

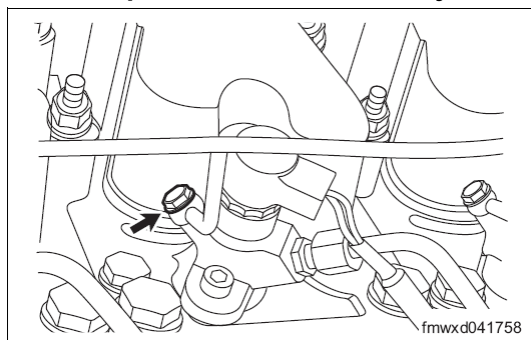
- (c). When the engine functions and the actual fuel rail pressure shown by the diagnostic apparatus is lower than 160MPa, observe whether the oil outlet of the pressure limiting valve has fuel outflow.

Whether the oil outlet of the pressure limiting valve has fuel outflow ?

Yes > the pressure limiting valve is damaged and the common rail pipe and the pressure limiting valve shall be replaced with new ones

NO> See Step12

12. Inspect oil return of fuel injector



- (a). Respectively disconnect the oil return pipe joint at each cylinder fuel injector
- (b). Compare the oil return volume of each cylinder's fuel injector.

Hint:

Under normal circumstances, the oil return volume of each cylinder's fuel injector is nearly the same when the engine functions. If the oil return volume of one cylinder's fuel injector is higher than others, it indicates the fuel injector of this cylinder is damaged.

Whether the oil return volume of one certain cylinder is abnormal?

Yes> replace the fuel injector of the cylinder and erase the fault codes.

NO> See Step13

13. Erase the fault codes

- (a). Erase fault codes, refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes> system is normal

No> replace ECU

2-6-1 ECU System Recovery

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU has inner errors and the fault shall be recorded and it shall enter the mode of "Limp Home".

Parts that may cause faults

1. ECU(damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault codes.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

NO> See Step 2

2. Disconnect and connect ignition switch once again

- (a). Turn off the ignition switch and then turn it on after several seconds.
- (b). Read the fault code.

Do the fault codes exist currently?

Yes> replace ECU

NO> See Step3

3. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes> system is normal

No> replace ECU

2-6-2 Over-speed Detection

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

Functional test of over-speed detection, ECU will record the fault when using the diagnostic apparatus to conduct the "over-speed detection".

Parts that may cause faults

1. ECU(damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault codes.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

NO> See Step2

2. Erase the fault codes

- (a). Erase fault codes, refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes> system is normal

No> replace ECU

2-6-3 ECU Chip CJ940

2-6-4 ECU Chip CJ940 and Watchdog

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

The inner voltage of ECU is over high or over low with communication error which leads to engine flameout; the fault will be recorded.

04

Parts that may cause faults

1. ECU (damaged).

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault codes.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

NO> See Step2

2. Disconnect and connect ignition switch once again

- (a). Turn off the ignition switch and then turn it on after several seconds.
- (b). Read the fault codes.

Do the fault codes exist currently?

Yes> replace ECU

NO> See Step3

3. Erase the fault codes

- (a). Erase fault codes, refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes> system is normal

No> replace ECU

2-6-5 EEPROM (Electronically Erasable Programmable Read-only Memory)

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

ECU cannot record the mileage and other information, and the fault shall be recorded.

Parts that may cause faults

1. **ECU (damaged).**

Diagnostic Steps

1. **Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault codes.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

NO> See Step2

2. **Disconnect and connect ignition switch once again**

- (a). Turn off the ignition switch and then turn it on after several seconds.
- (b). Read the fault codes.

Do the fault codes exist currently?

Yes> replace ECU

NO> See Step3

3. **Erase the fault codes**

- (a). Erase fault codes, refer to this chapter "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes> system is normal

No> replace ECU

3-1-1 Exhaust Brake Solenoid Valve

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel have been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

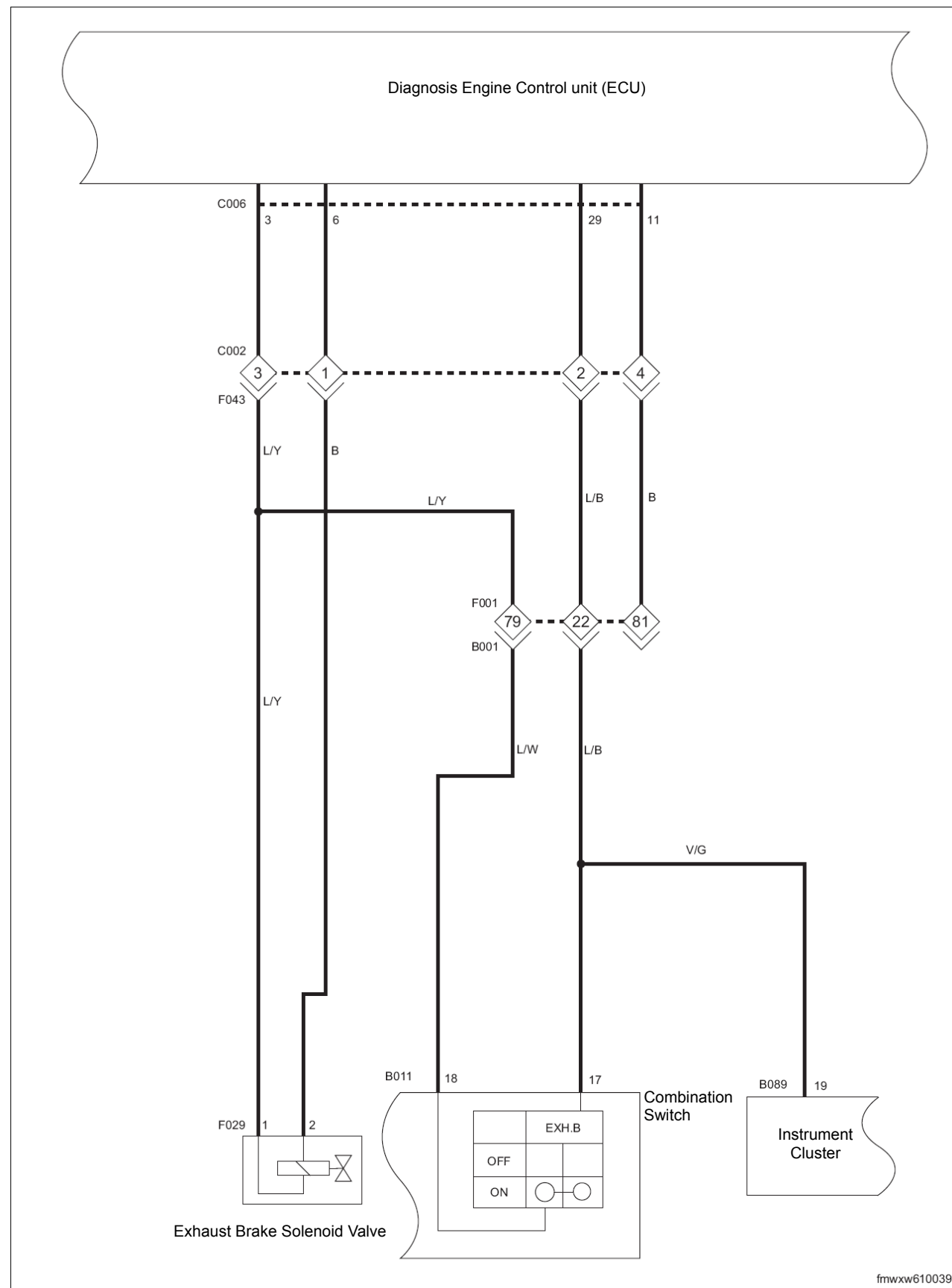
If the fault exists, the exhaust brake will fail to work and ECU will record the fault.

04

Parts that may cause faults

1. Exhaust brake solenoid valve circuit (shorted, opened)
2. Exhaust brake solenoid valve (damaged)
3. ECU (damaged)

Circuit Diagram



Diagnostic Steps**1. Connect the diagnostic apparatus**

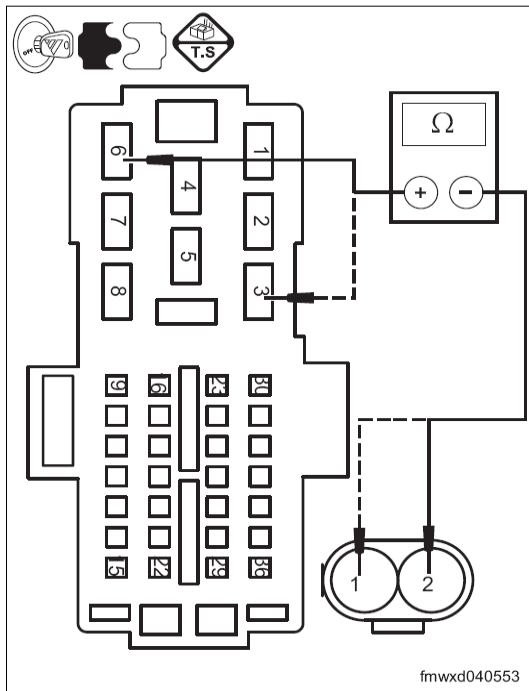
- (a). Connect the Fukuda special diagnostic apparatus KT600 to the vehicle, refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnose apparatus according to the instructions for use.
- (c). Read the fault code.

Whether there are other fault codes?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

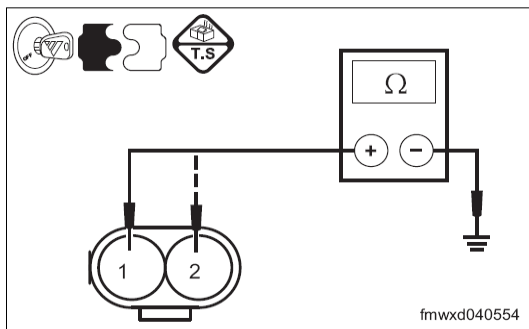
No > see Step 2

04

2. Inspect the circuit from exhaust brake solenoid valve to ECU.

- (a). Turn off ignition switch.
- (b). Disconnect the connector C006 of ECU and the harness connector F029 of exhaust brake solenoid valve.
- (c). Use the multi-meter to measure pin 3 of C006 and pin 1 of F209, pin 6 of C006 and pin 2 of F209.

Resistance: $\leq 2 \Omega$



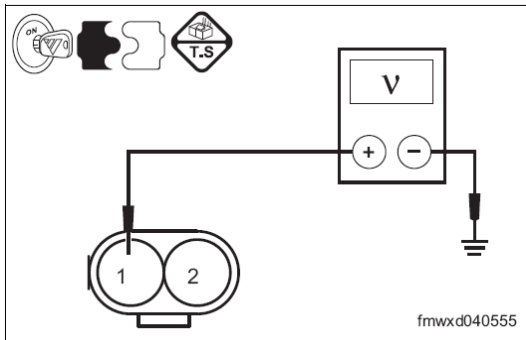
- (d). Use the multi-meter to measure the resistance between pin 1 and pin 2 of the harness connector F029 of exhaust brake solenoid valve and the earth.

Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes>see Step 3

No> overhaul the fault of the circuit from exhaust brake solenoid valve to ECU.

3. Inspect the power circuit of the exhaust brake solenoid valve

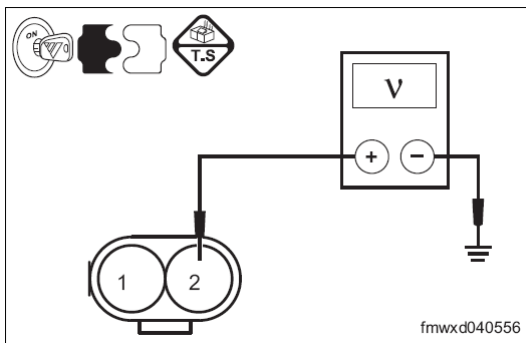
- Connect the connector C006 of ECU and the harness connector F029 of exhaust brake solenoid valve.
- Keep disconnected the harness connector F029 of exhaust brake solenoid valve.
- Turn on ignition switch.
- Use the multi-meter to measure the voltage between pin 3 of the harness connector F029 of exhaust brake solenoid valve and the earth.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes>see Step 4

No>replace the ECU.

4. Inspect the control circuit of the exhaust brake solenoid valve

- Use the multi-meter to measure the voltage between pin 2 of the harness connector F029 of exhaust brake solenoid valve and the earth.
- Standard voltage value: 2.91~3.19V

Is the inspection result normal?

Yes > replace the exhaust brake solenoid valve and erase fault code

No > see Step 5

5. Erase fault code

- Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-1-3 Air Conditioner Compressor Relay

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

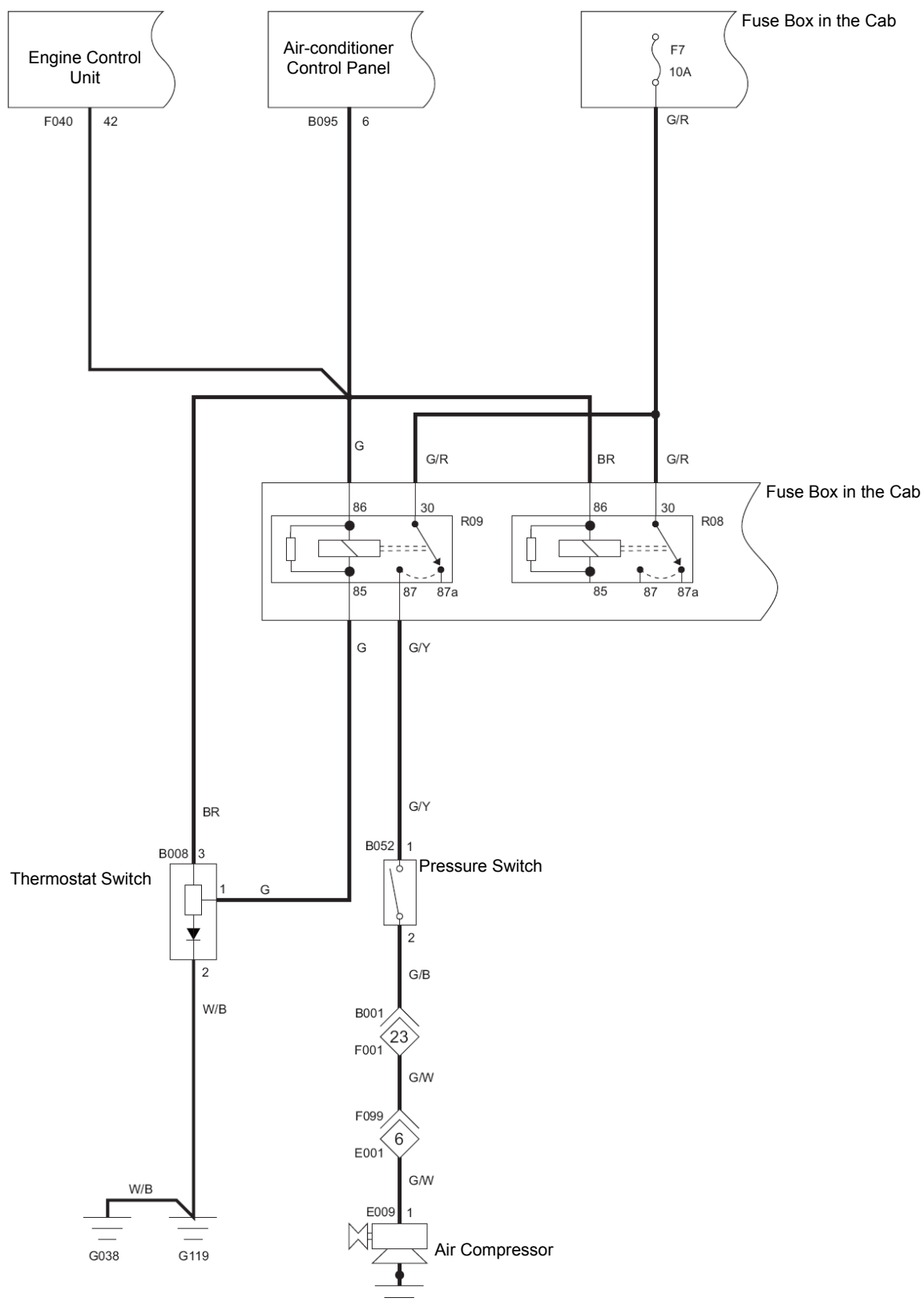
Refer to this chapter, "General Steps for Fault Diagnosis".

The circuit error in the air conditioner relay may cause the air compressor not to work and the ECU will record the fault.

04

Parts that may cause faults

1. **Air conditioner relay circuit (shorted, opened)**
2. **Air conditioner relay (damaged)**
3. **ECU (damaged)**

Diagnosis - Cigarette Lighter**Circuit Diagram**

fmwxd040591

Diagnosis - Cigarette Lighter**Diagnostic Steps****1. Connect the diagnostic apparatus**

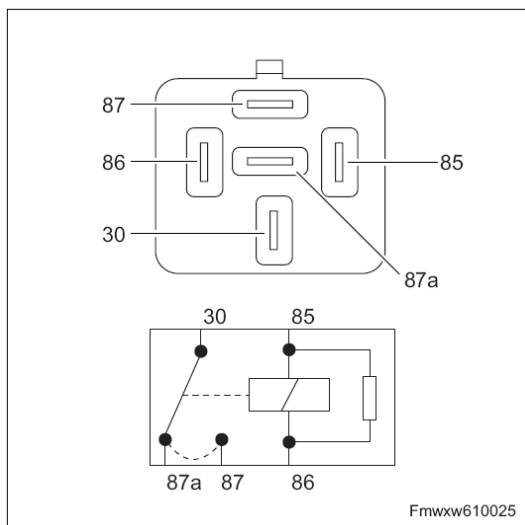
- (a). Connect the Fukuda special diagnostic apparatus KT600 to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnose apparatus according to the instructions for use.
- (c). Read the fault code.

Whether there are other fault codes?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List"

No > see Step 2

04

2. Inspect the air conditioner compressor relay R09

- (a). Turn off ignition switch.
- (b). Dismantle the brake switch relay R19.
- (c). Inspect the brake switch relay R19.

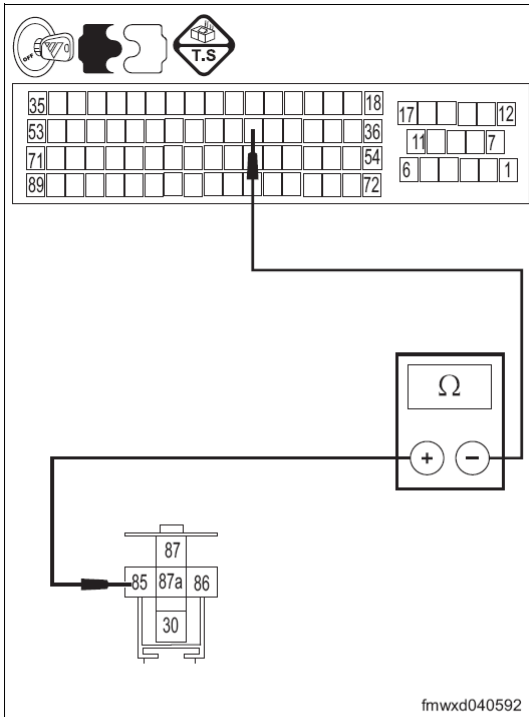
Condition	Measured Pin	Standard Value
Under normal conditions	85 – 86	200~400Ω
	30 – 87	≤ 2 Ω
	30 – 87a	> 10 MΩ
85 and 86 applied with 24V voltage	30 – 87	> 10 MΩ
	30 – 87a	≤ 2 Ω

Is the inspection result normal?

Yes > see Step 5

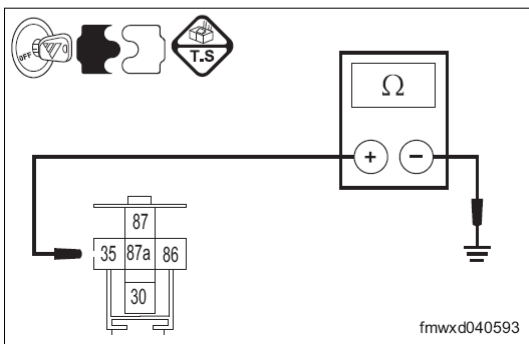
No > replace the air conditioner compressor relay R09

3. Inspect the circuit from pin 86 of air conditioner compressor relay R09 and ECU.



- (a). Turn off ignition switch.
- (b). Disconnect the connector F040 of ECU and dismantle the air conditioner compressor relay R09.
- (c). Use the multi-meter to measure the resistance between pin 42 of F040 and pin 85 of the air conditioner compressor relay R09.

Resistance: $\leq 2 \Omega$



- (d). Use the multi-meter to measure the resistance between pin 85 of the air conditioner compressor relay R09 and the earth.

Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes > see Step 4.

No > overhaul the fault of the circuit from air conditioner compressor relay R09 and ECU.

>To overhaul the circuit of the thermostat switch, refer to “Chapter 4 Diagnosis- Air Conditioner Compressor Fails to Work”.

Hint:

If the temperature is low in the cab, then connect the thermostat switch. Resistance value measured at this time is $> 10 M\Omega$.

4. Erase fault code

- (a). Erase fault code, refer to this chapter, “Reading and Erasing of Flash Fault Codes”.

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-2-1 Intake Heater Relay

3-2-2 Intake Heater Relay

3-2-3 Intake Heater Relay

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

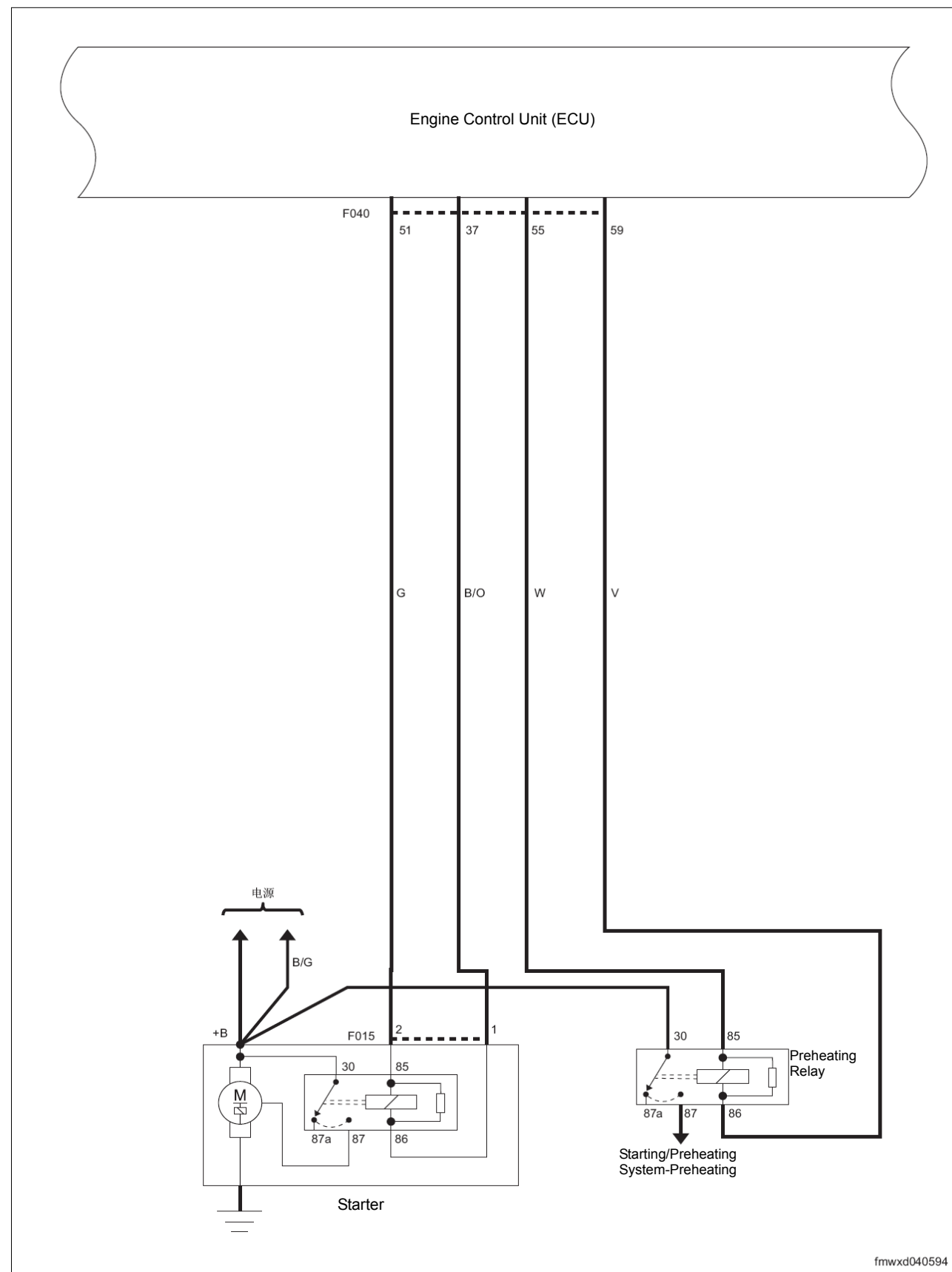
Earthing or short-circuit of intake heater relay control circuit result in fault in the preheating system and ECU will record the fault.

04

Parts that may cause faults

1. Intake heater relay (shorted, opened).
2. Intake heater relay (damaged).
3. ECU (damaged).

Circuit Diagram



Diagnosis - Cigarette Lighter

Diagnostic Steps

1. Connect the diagnostic apparatus

- Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

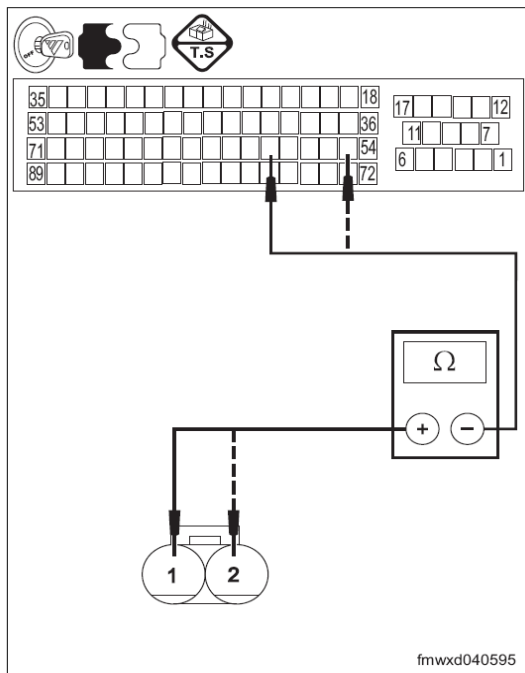
Is there any other fault codes?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect the circuit from intake heater relay to ECU

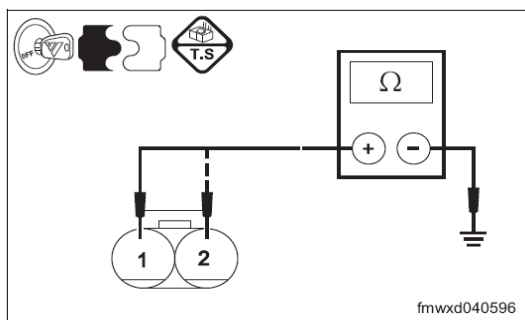


- Turn off the ignition switch.
- Disconnect the ECU connector F040 and the connector F016 of intake heater relay.
- Use the multi-meter to measure the resistance between F040 pin 59 and F016 pin 1 (86), F040 pin 55 and F016 pin 2 (85).

Resistance $\leq 2 \Omega$

- Use the multi-meter to measure the resistance between F016 pin 1 (86), F016 pin 2 (85) and earthing.

Resistance $> 10 M\Omega$

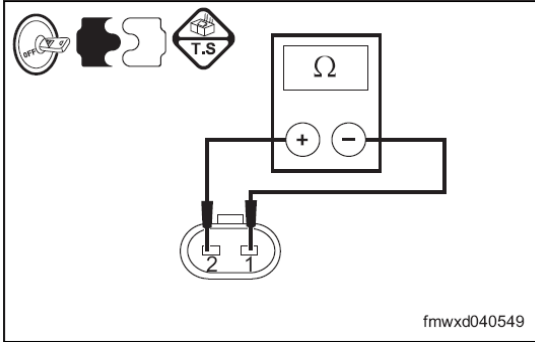


Is the inspection result normal?

Yes > see Step 3.

No > overhaul the circuit fault from intake heater relay to ECU

3. Inspect the intake heater relay coil



- (a). Use the multi-meter to measure the voltage between pin 2 (85) and pin 1 (86) of intake heater relay.

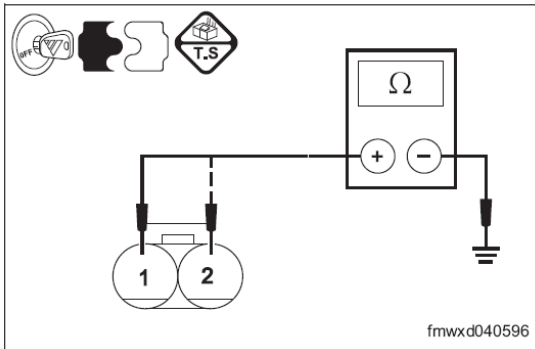
Resistance standard value: 200-400 Ω

Is the inspection result normal?

Yes > see Step 4.

No > replace the intake heater relay.

4. Inspect the power circuit of intake heater relay.



- (a). Connect the ECU connector F040 and the connector F016 of intake heater relay.
- (b). Turn ON ignition switch.
- (c). Use the multi-meter to measure the voltage between F016 pin 2 (85) and pin 1 (86) of intake heater relay.

Voltage standard value: battery voltage

Is the inspection result normal?

Yes > see Step 5.

No > replace ECU

5. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-2-4 Vehicle Speed Sensor

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the speed of vehicle exceeds the maximum speed, or the signal of vehicle speed sensor is not reliable or stable, it will cause cruise control out of work and underslung flameout fault and ECU will record fault.

04

Parts that may cause faults

1. **Circuit of vehicle speed sensor (shorted, opened).**
2. **Vehicle speed sensor (damaged).**
3. **Lock remover (damaged).**
4. **ECU (damaged).**

Circuit Diagram



Diagnosis - Cigarette Lighter

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (d). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect the work conditions of speedometer

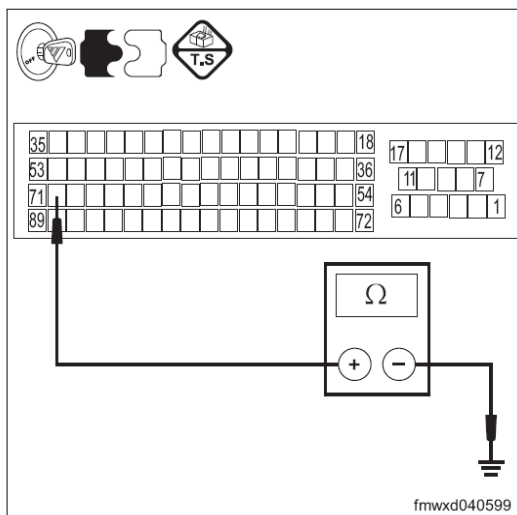
- (a). Have a trial run to confirm whether the speedometer works.

Whether the speedometer works properly?

Yes > see Step 3.

No > overhaul the speedometer work fault, refer to "Chapter 4 Diagnose, Instrument Cluster".

3. Inspect the earthed circuit of ECU vehicle speed sensor



- (a). Turn off ignition switch.
- (b). Disconnect ECU connector F040
- (c). Use the multi-meter to measure the resistance between pin 70 of ECU connector F040 and the earth.

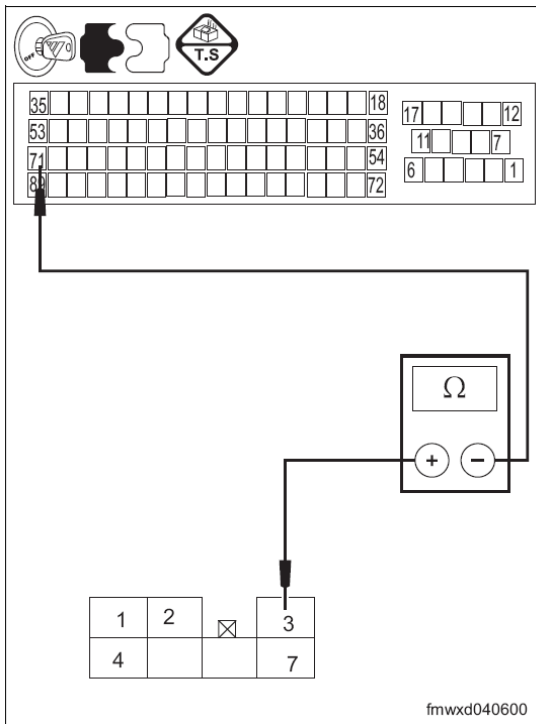
Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes > see Step 4.

No > overhaul the earthed circuit of ECU vehicle speed sensor

4. Inspect the speed signal input circuit of ECU



(a). Disconnect the harness connector B123 of lock remover.

(b). Use the multi-meter to measure the resistance between F040 pin 71 and B123 pin.

Resistance $\leq 2 \Omega$

(c). Use the multi-meter to measure the resistance between F040 pin 71 and the earth.

Resistance $> 10 M\Omega$

Is the inspection result normal?

Yes > see Step 5.

No > overhaul the speed signal input circuit from lock remover to ECU.

5. Erase fault codes

(a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-2-7 Polymorphic Switch

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

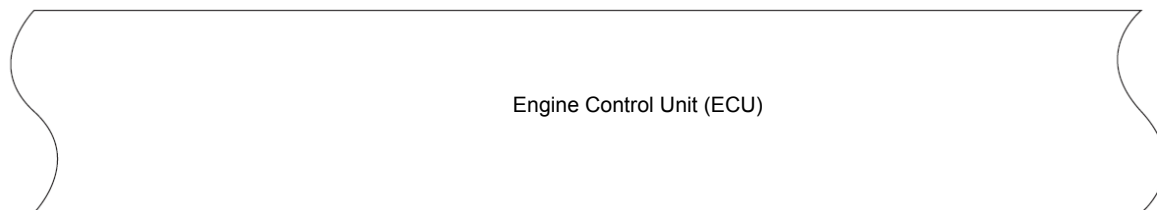
The resistance errors of harness and polymorphic switch will lead to control faults of rotation speed and torque and ECU will record faults.

04

Parts that may cause faults

1. **Polymorphic switch (damaged).**
2. **Harness of polymorphic switch (damaged).**
3. **ECU (damaged).**

Circuit Diagram

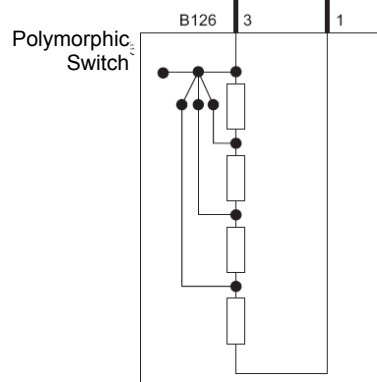


F040 62 65

R/G R/W

F001 84 80
B001

R/G R/W



fmwxd040601

Diagnostic Steps

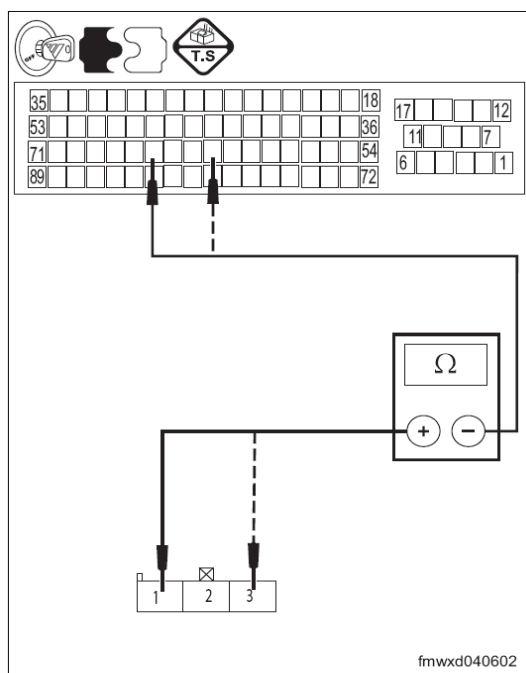
1. Connect the diagnostic apparatus
 - (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, “**KT 600** Diagnostic Apparatus Usage and Fault Test”.
 - (b). Operate the diagnostic apparatus according to the instruction for use.
 - (c). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, “Flash Fault Code List”.

No > see Step 2

04

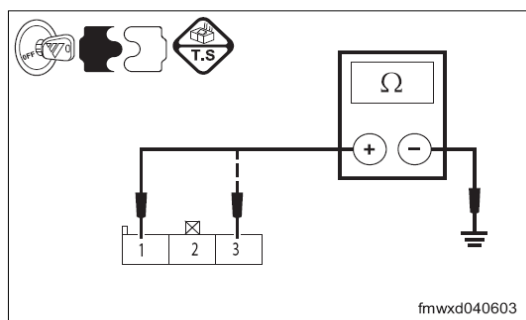
2. Inspect the circuit from polymorphic switch to ECU

- (a). Turn off ignition switch.
- (b). Disconnect ECU connector F040, polymorphic switch connector B126.
- (c). Use the multi-meter to measure the resistance between F040 pin 62 and B126 pin 3, F040 pin 65 and B126 pin 1.

Resistance $\leq 2 \Omega$

- (d). Use the multi-meter to measure the resistance between pin 1, 3 of polymorphic connector B126 and the earth.

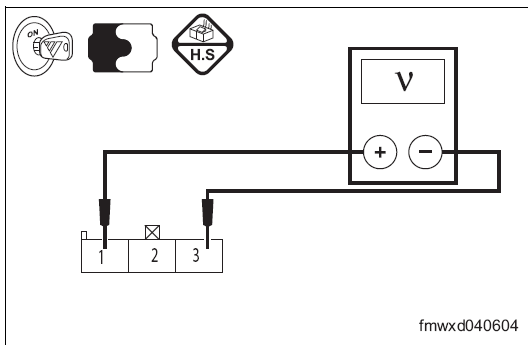
Resistance $>10 \text{ M}\Omega$

**Is the inspection result normal?**

Yes > see Step 3.

No > inspect the fault of circuit from polymorphic switch to ECU.

3. Inspect the power circuit of polymorphic switch



- (a). Connect ECU connector F040, polymorphic switch connector B126.
- (b). Turn on ignition switch.
- (c). Use the multi-meter to measure the resistance between pin 1 and 3 of polymorphic switch connector.

Voltage standard value: 4.9-5.1V

Is the inspection result normal?

Yes > see Step 5.

No > replace ECU

4. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-3-1 System Lamp

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the circuit of engine fault warning lamp and warning lamp bulb are fault, the ECU will record faults.

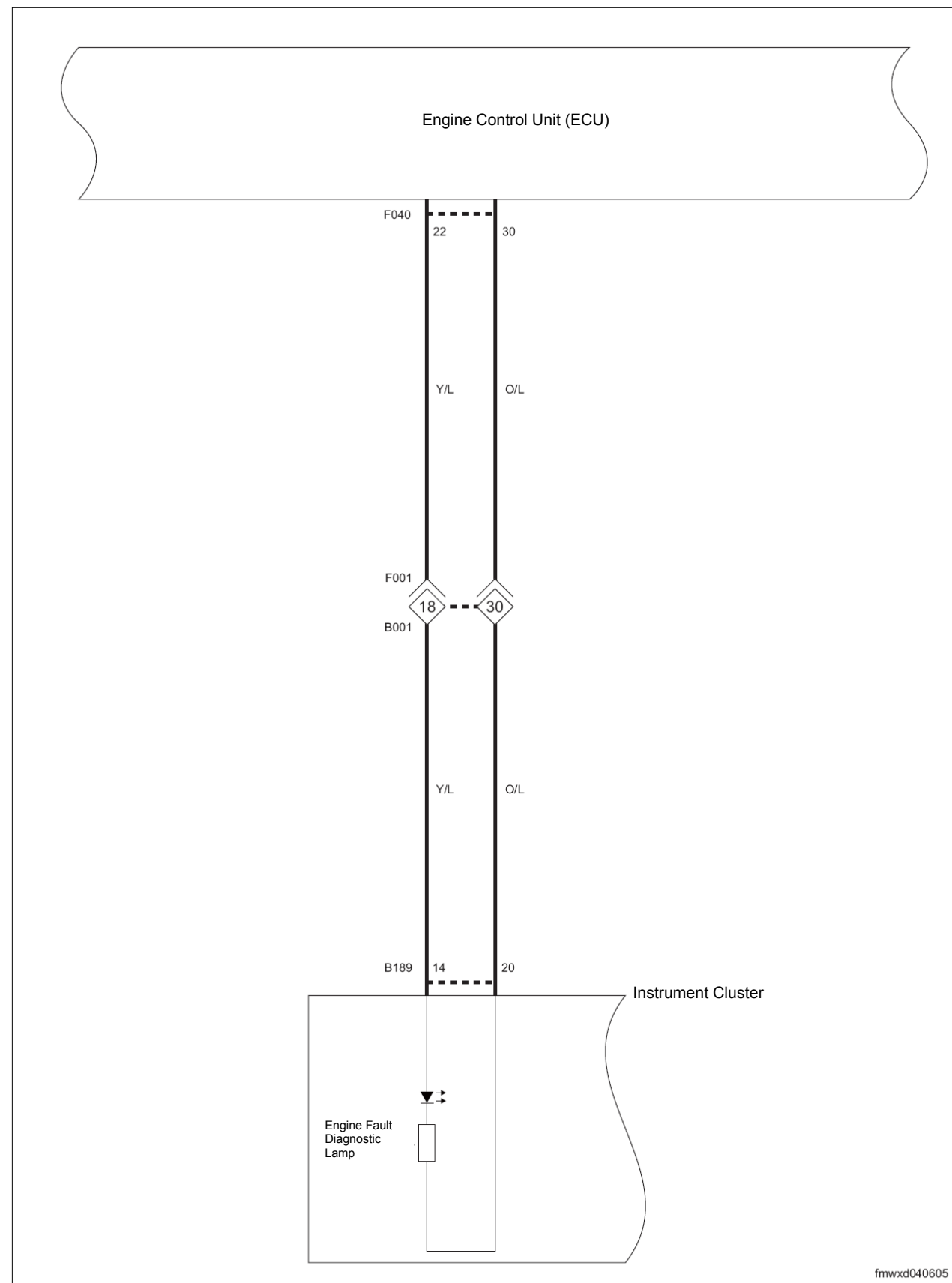
04

Parts that may cause faults

1. **Bulb of the engine fault warning lamp (damaged).**
2. **The circuit of engine fault warning lamp (shorted, opened).**
3. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnosis - Cigarette Lighter

Diagnostic Steps

1. Connect the diagnostic apparatus

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (d). Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect warning lamp bulb

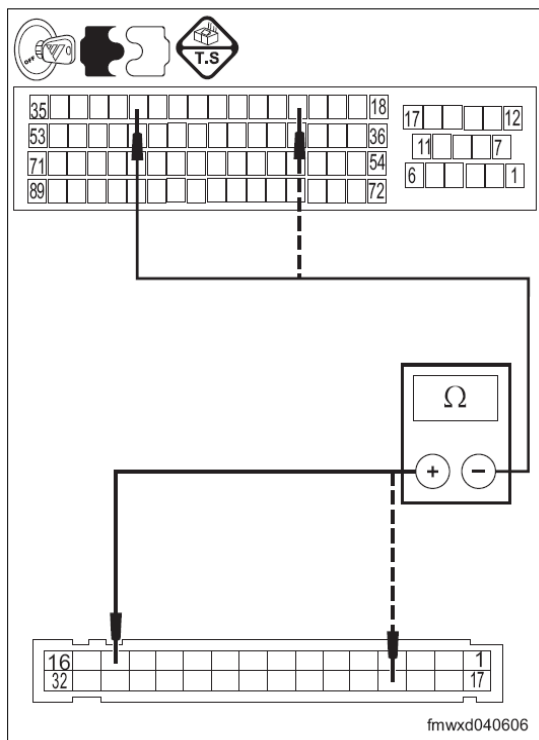
- (a). Turn off ignition switch.
- (b). Dismantle the instrument and inspect warning lamp bulb.

Is the inspection result normal?

Yes > see Step 3.

No > replace the warning lamp

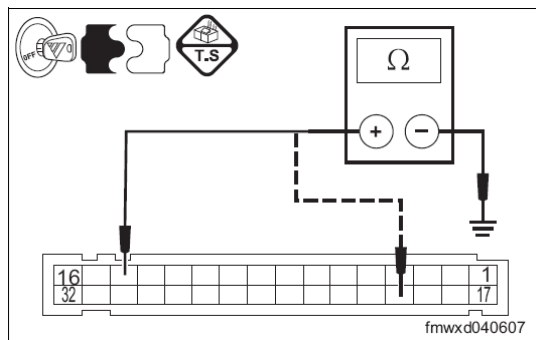
3. Inspect the circuit from Instrument Cluster to ECU



- (a). Turn off ignition switch.
- (b). Disconnect ECU connector F040, instrument cluster connector B089.
- (c). Use the multi-meter to measure the resistance between F040 pin 22 and B089 pin 14, F040 pin 30 and B089 pin 20.

Resistance $\leq 2 \Omega$

Diagnosis - Cigarette Lighter



- (d). Use the multi-meter to measure the resistance between pin 14, 20 of instrument cluster connector B078 and the earth.

Resistance >10 M Ω

04

Is the inspection result normal?

Yes > see Step 4.

No > inspect the circuit from instrument cluster to ECU

4. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-3-2 Cold Start Lamp and Warning Lamp

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the warning lamp circuit and warning lamp bulb are fault, ECU will record the faults.

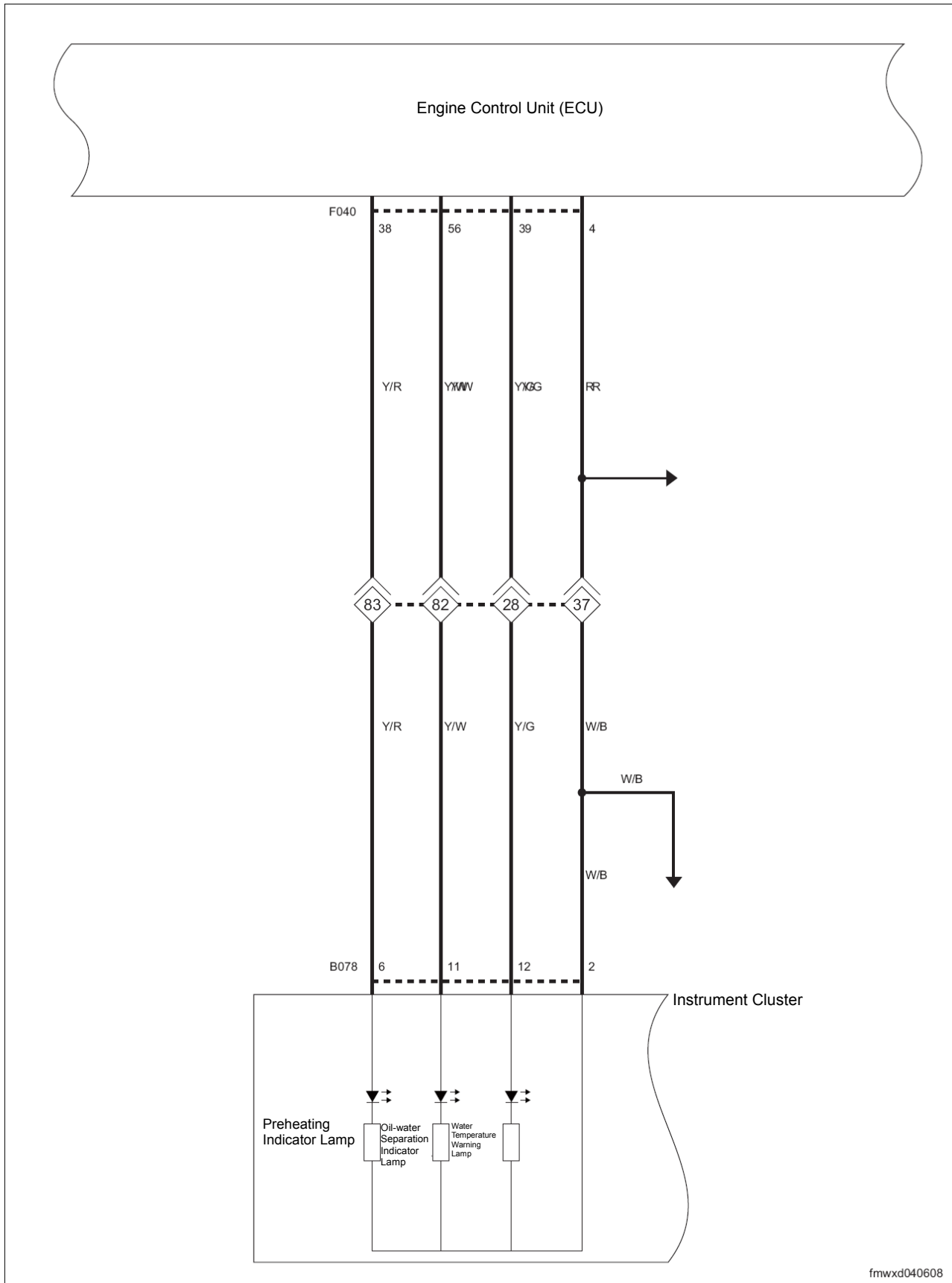
04

Parts that may cause faults

1. **Warning lamp bulb (damaged).**
2. **Warning lamp circuit (shorted or opened).**
3. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnosis - Cigarette Lighter

Diagnostic Steps

1. Connect the diagnostic apparatus

- Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

Is there any other fault code?

Yes > diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > see Step 2

04

2. Inspect the warning lamp bulb

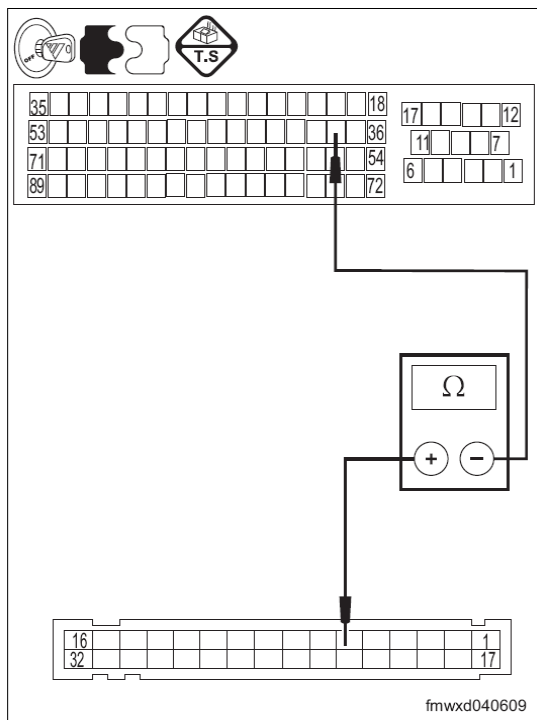
- Turn off the ignition switch.
- Dismantle the instrument and inspect the warning indicator bulb.

Is the inspection result normal?

Yes > see Step 3

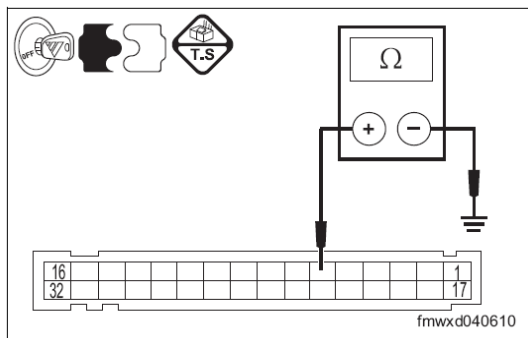
No>replace the warning indicator

3. Inspect the control circuit from instrument cluster to ECU



- Turn off the ignition switch.
- Disconnect connector F040 of ECU and connector B078 of the instrument cluster.
- Use the multi-meter to measure the resistance, pin 38 of connector F040 to pin 6 of connector B078.

Resistance: $\leq 2 \Omega$



- (d). Use the multi-meter to measure the resistance, pin 6 of connector B078 to the earth.

Resistance: >10 M Ω

Is the inspection result normal?

Yes > see Step 4

No > Inspect the control circuit from instrument cluster to ECU

4. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-3-4 Water-in-oil Lamp and Warning Lamp

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the warning lamp circuit and warning lamp bulb are fault, ECU will record the faults.

04

Parts that may cause faults

1. **Warning lamp bulb (damaged).**
2. **Warning lamp circuit (shorted or opened).**
3. **ECU (damaged).**

Circuit Diagram

Refer to this chapter, 3-3-2 Cold Start Lamp and Warning Lamp - Circuit Diagram

Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

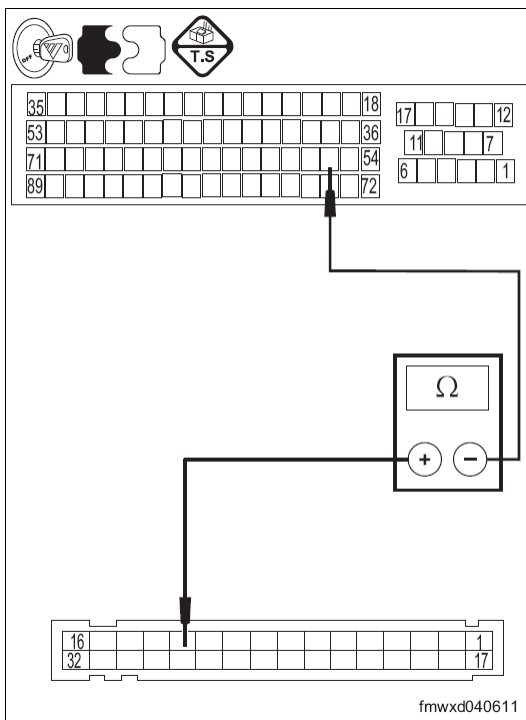
2. Inspect the warning lamp bulb

- (a). Turn off the ignition switch.
- (b). Dismantle the instrument and inspect the warning indicator bulb.

Is the inspection result normal?

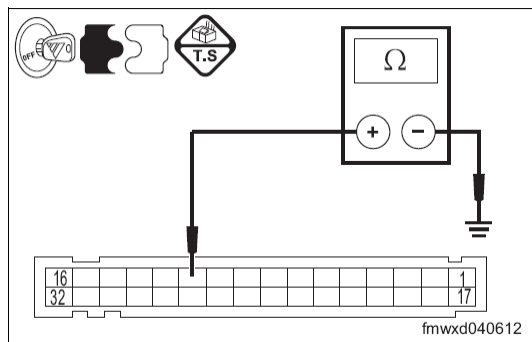
Yes > See Step 3

No>Replace the warning indicator

3. Inspect the control circuit from instrument cluster to ECU

- (a). Turn off the ignition switch.
- (b). Disconnect connector F040 of ECU and connector B078 of the instrument cluster.
- (c). Use the multi-meter to measure the resistance, pin 56 of connector F040 to pin 11 of connector B078.

Resistance: $\leq 2 \Omega$

Diagnosis - Cigarette Lighter

- (d). Use the multi-meter to measure the resistance, pin 11 of connector B078 to the earth.

Resistance: >10 M Ω

Is the inspection result normal?

Yes > See Step 4

No > Inspect the control circuit, instrument cluster to ECU

4. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-4-1 Cruise Switches

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the cruise switches are fault in cluster, ECU will record the faults.

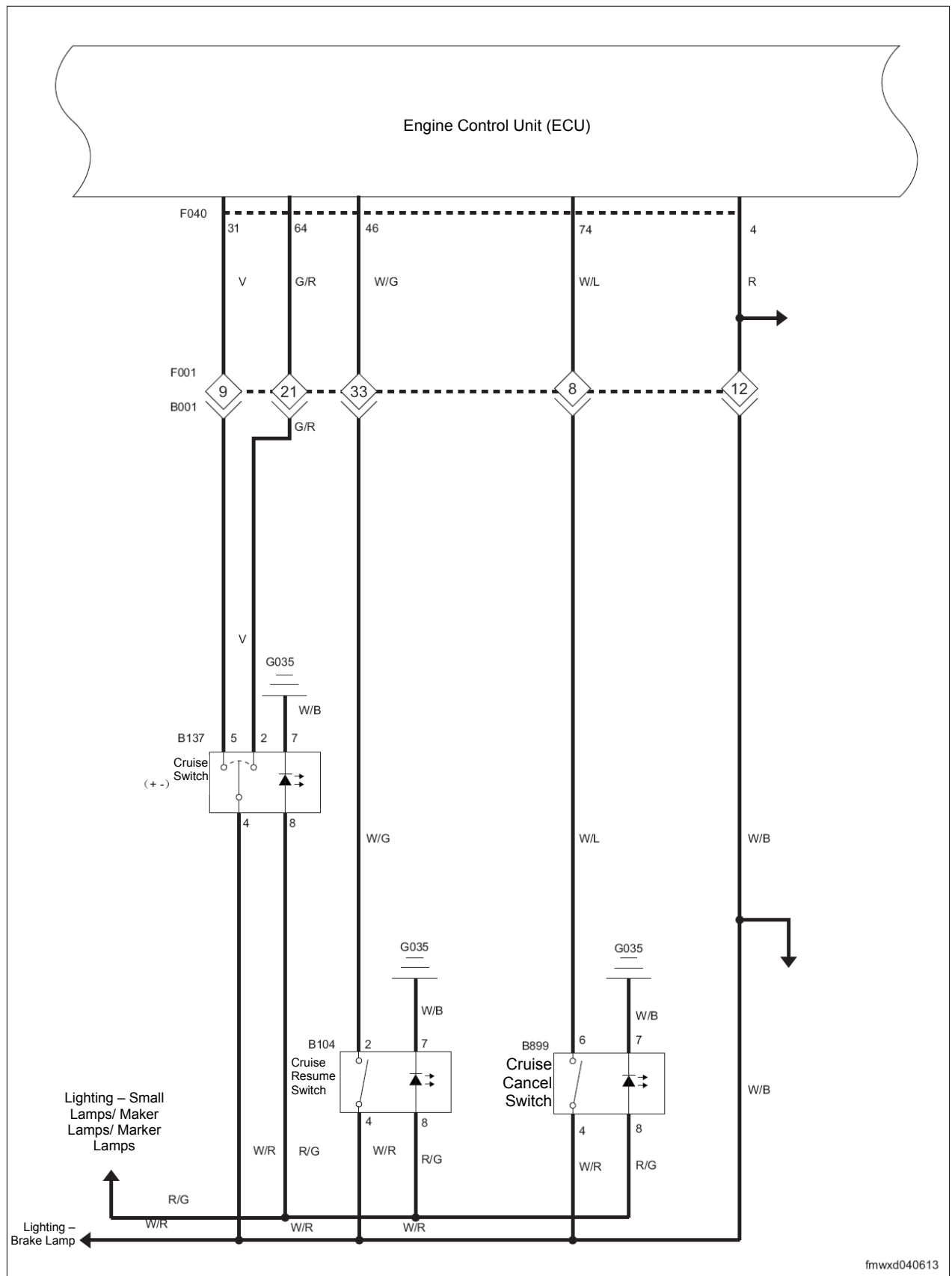
04

Parts that may cause faults

1. **Cruise switch circuits (shorted or opened)**
2. **Cruise switches (damaged)**
3. **ECU (damaged).**

Diagnosis - Cigarette Lighter

Circuit Diagram



Diagnostic Steps

1. Connect the diagnostic apparatus

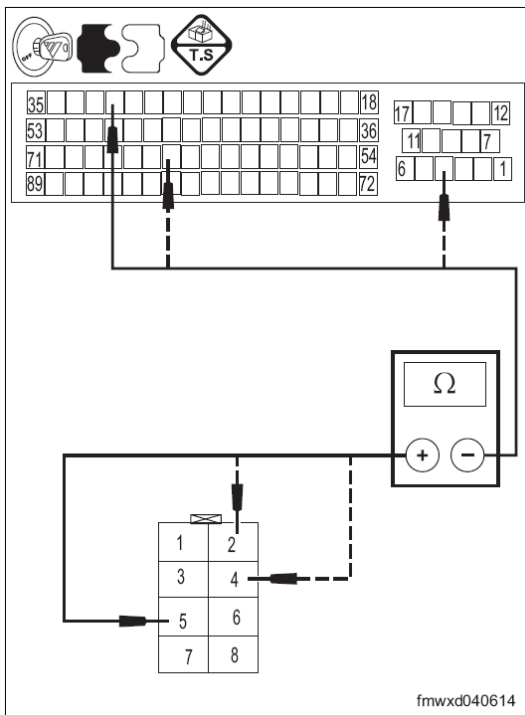
- Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

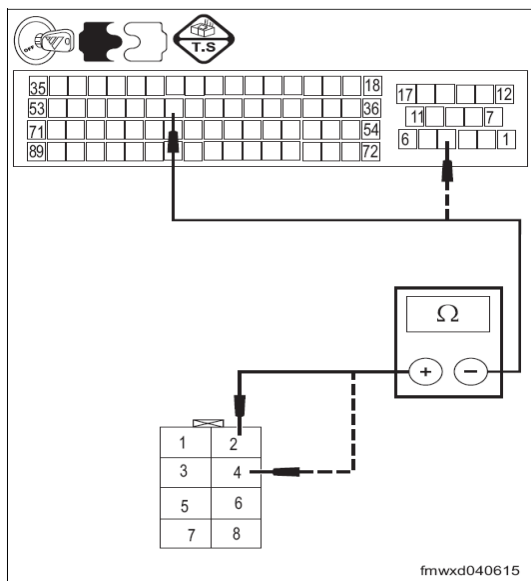
2. Inspect the circuits from cruise (+/-) switches, cruise resume switch and cruise cancel switch to ECU



- Turn off the ignition switch.
- Disconnect connector F040 of ECU, connector B137 of the cruise (+/-) switch harness, connector B104 of the cruise resume switch harness and connector B099 of the cruise cancel switch harness.
- Use the multi-meter to measure the resistance, pin 31 of connector F040 to pin 5 of connector B137, pin 64 of connector F040 to pin 2 of connector B137 and pin 4 of connector F040 to pin 4 of connector B137.

Resistance: $\leq 2 \Omega$

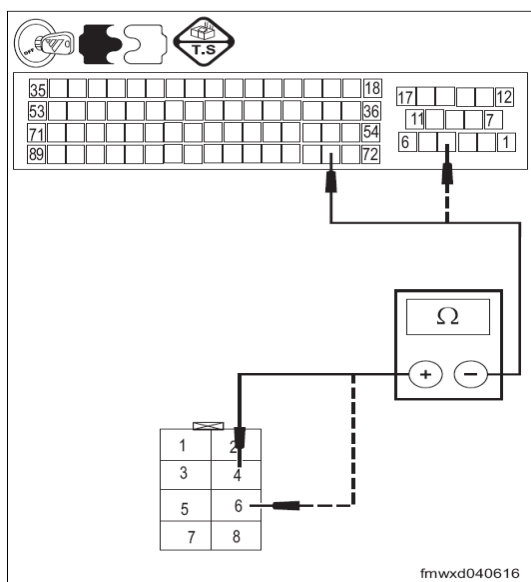
Diagnosis - Cigarette Lighter



- (d). Use the multi-meter to measure the resistance, pin 46 of connector F040 to pin 2 of connector B104 and pin 4 of connector F040 to pin 4 of connector B104.

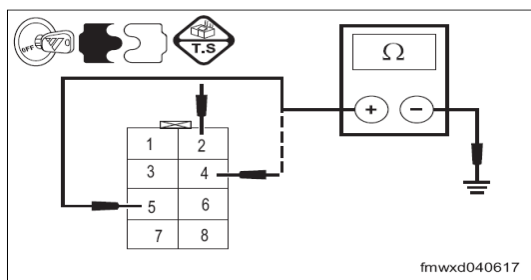
Resistance: $\leq 2 \Omega$

04



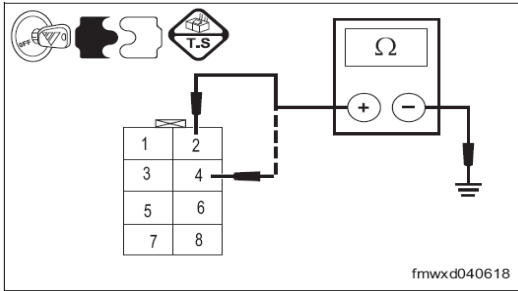
- (e). Use the multi-meter to measure the resistance, pin 74 of connector F040 to pin 6 of connector B099 and pin 4 of connector F040 to pin 4 of connector B099.

Resistance: $\leq 2 \Omega$



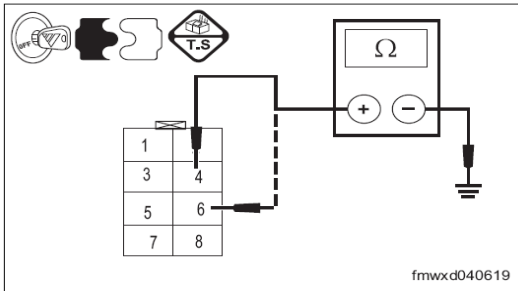
- (f). Use the multi-meter to measure the resistance, pin 2, 4 and 5 of connector B137 of the cruise (+/-) switches harness to the earth.

Resistance: $> 10 M\Omega$



- (g). Use the multi-meter to measure the resistance, pin 2 and 4 of connector B104 of the cruise resume switch to the earth.

Resistance: >10 MΩ



- (h). Use the multi-meter to measure the resistance, pin 4 and 6 of connector B104 of the cruise resume switch to the earth.

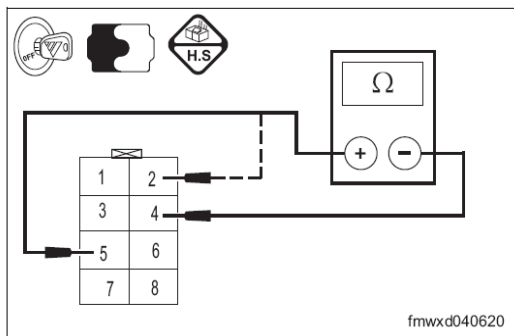
Resistance: >10 MΩ

Is the inspection result normal?

Yes > See Step 3

No>Repair the faults in circuits from cruise (+/-) switches, cruise resume switch and cruise cancel switch to ECU

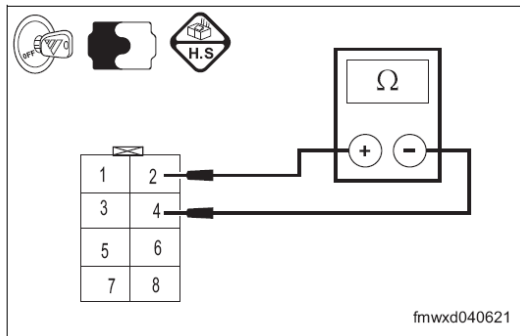
3. Inspect the cruise (+/-) switches, cruise resume switch and cruise cancel switch



- (a). Disconnect connector F040 of ECU, connector B088 of the cruise (+/-) switch harness, the cruise resume switch harness and the cruise cancel switch harnesses.
- (b). Turn off the ignition switch.
- (c). Use the multi-meter to measure the continuity, pin 4 to pin 2 and pin 5 of connector B137 of the cruise (+/-) switches harness.

Resistance:

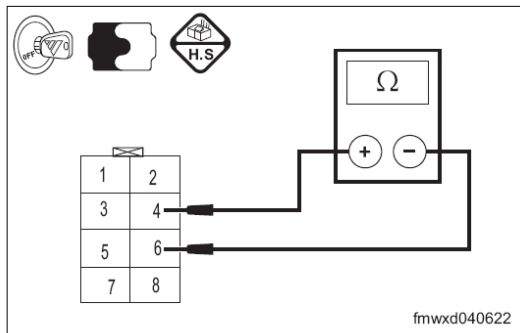
Condition	Measured Pin	Standard Value
Release switch	4—2	> 10 MΩ
	4—5	> 10 MΩ
Press down the switch upward	4—2	≤ 2 Ω
Press down the switch downward	4—5	≤ 2 Ω

Diagnosis - Engine Control-WP

- (d). Use the multi-meter to measure the continuity, pin 4 to pin 2 of connector B104 of the cruise resume switch harness.

Resistance:

Condition	Measured Pin	Standard Value
OFF	2—4	> 10 MΩ
ON	2—4	≤ 2 Ω



- (e). Use the multi-meter to measure the continuity, pin 4 to pin 6 of connector B104 of the cruise cancel switch harness.

Resistance:

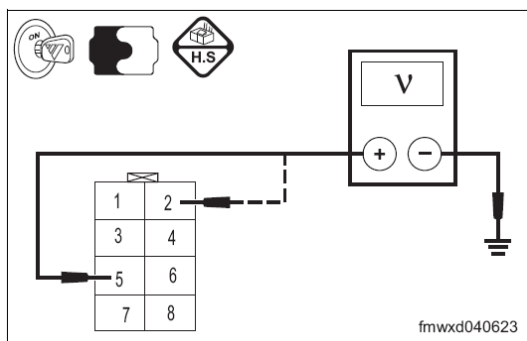
Condition	Measured pin	Standard Value
OFF	6—4	≤ 2 Ω
ON	6—4	> 10 MΩ

Is the inspection result normal?

Yes > See Step 4

No>Replace the cruise (+/-) switches, cruise resume switch and cruise cancel switch

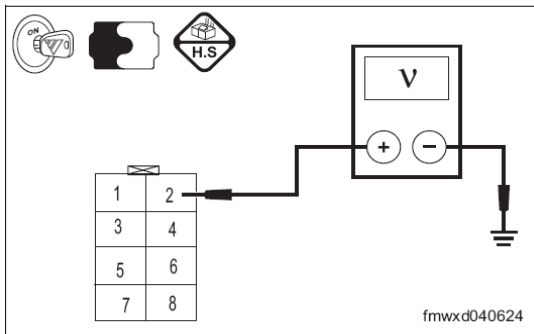
4. Inspect the signals of the cruise (+/-) switches, cruise resume switch and cruise cancel switch



- (a). Turn on the ignition switch.
 (b). Use the multi-meter to measure the voltages between pin 2 and 5 of connector B137 of the cruise (+/-) switches harness and the earth.

Voltage:

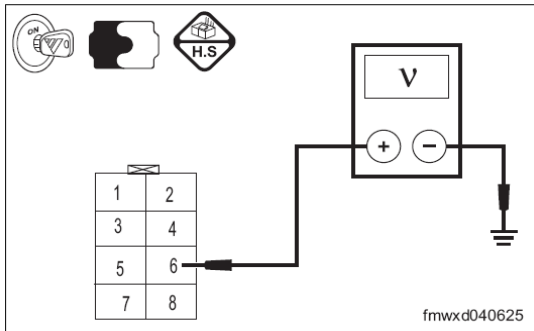
Condition	Measured Pin	Standard Value
Release switch	2 – Vehicle Body	0V
	5 – Vehicle Body	0V
Press down the switch upward	5 – Vehicle Body	24V
Press down the switch downward	2 – Vehicle Body	24V

Diagnosis - Engine Control-WP

- (c). Use the multi-meter to measure the voltage between pin 2 of connector B104 of the cruise resume switch and the earth.

Resistance:

Condition	Measured Pin	Standard Value
OFF	2 – Vehicle Body	0V
ON	2 – Vehicle Body	24V



- (d). Use the multi-meter to measure the voltage, pin 6 of connector B104 of the cruise resume switch to the earth.

Resistance:

Condition	Measured Pin	Standard Value
OFF	6 – Vehicle Body	24V
ON	6 – Vehicle Body	0V

Is the inspection result normal?

Yes > See Step 5

No> Replace ECU

5. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, “Reading and Erasing of Flash Fault Codes”.

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

3-4-2 Exhaust Brake Switch

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

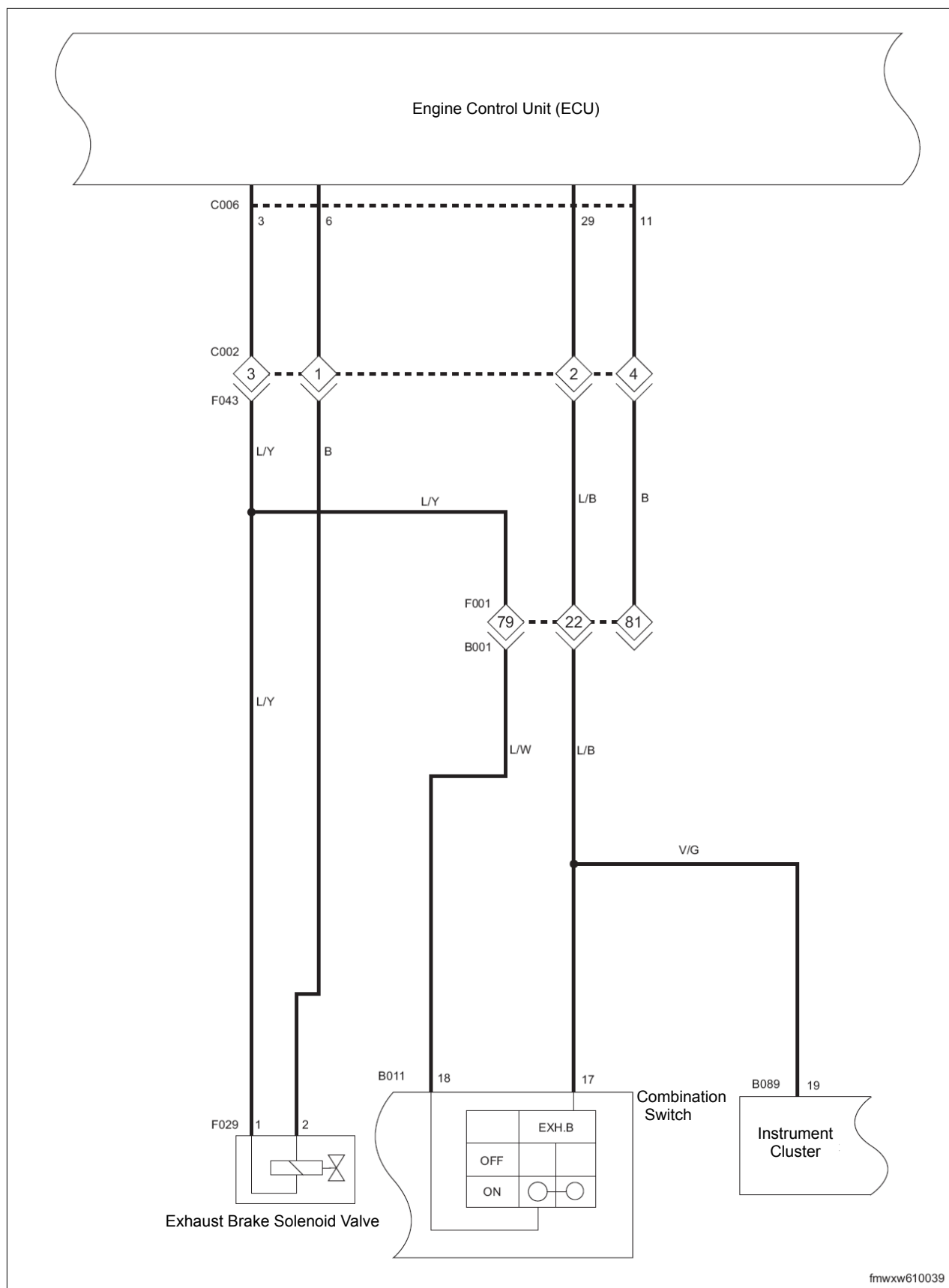
Refer to this chapter, "General Steps for Fault Diagnosis".

If the exhaust brake switch and its circuit fail, the vehicle will fail to cruise.

Parts that may cause faults

1. Exhaust brake switch circuit (shorted or opened).
2. Exhaust brake switch (damaged).
3. ECU (damaged).

Circuit Diagram



Diagnosis - Engine Control-WP

Diagnostic Steps

1. Connect the diagnostic apparatus

- Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- Operate the diagnostic apparatus according to the instruction for use.
- Read the fault code.

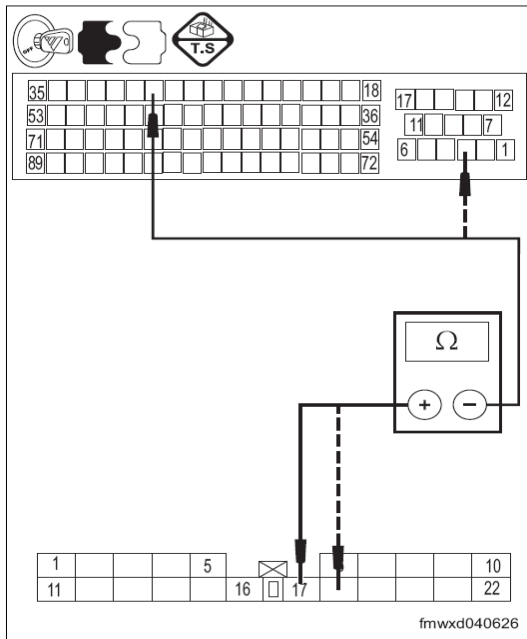
Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

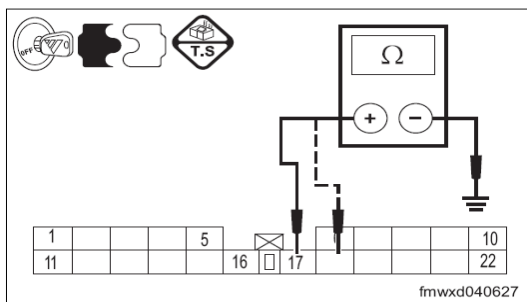
04

2. Inspect the circuit from the exhaust brake switch to ECU



- Turn off the ignition switch.
- Disconnect connector F040 of ECU and connector B011 of the combination switch.
- Use the multi-meter to measure the resistance, pin 3 of connector F040 to pin 18 of connector B011 and pin 29 of connector F040 to pin 17 of connector B011.

Resistance: $\leq 2 \Omega$



- Disconnect connector B099 of the instrument cluster.
- Use the multi-meter to measure the resistance, pin 17 of connector B011 to the earth.

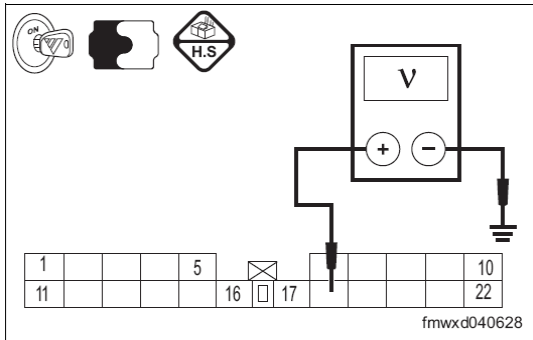
Resistance: $> 10 M\Omega$

Is the inspection result normal?

Yes > See Step 3

No > Repair or replace circuit from ECU to the exhaust brake switch or to the instrument cluster

3. Inspect the power of the exhaust brake switch



- Connect connector F040 of ECU and connector B011 of the exhaust brake switch.
- Turn on the ignition switch.
- Use the multi-meter to measure the voltage, pin 18 of connector B011 of the exhaust brake switch to the earth.

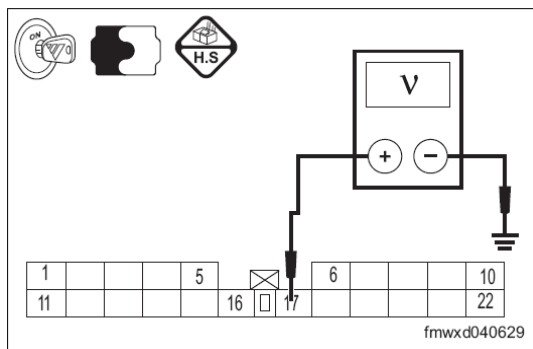
Voltage standard value: battery voltage

Is the inspection result normal?

Yes > See Step 4

No > Replace ECU

4. Inspect the signal of the exhaust brake switch



- Turn on the ignition switch.
- Use the multi-meter to measure the voltage between pin 17 of connector B011 of the exhaust brake switch and the earth.

Resistance:

Condition	Measured Pin	Standard Value
ON	17 – Vehicle Body	> 3.75 V
OFF	17 – Vehicle Body	< 2.18 V

Is the inspection result normal?

Yes > See Step 5

No > Replace the combination switch and erase the fault codes

Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

5. Inspect the instrument cluster

- Connect connector B099 of the instrument cluster.
- Read the fault code.

Does the shown fault code match with the existing fault?

Yes > Overhaul the inner earth fault of the instrument cluster or replace the instrument cluster

No > See Step 6

6. Erase fault codes

- Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

Diagnosis - Engine Control-WP

No > replace ECU.

3-4-3 Underslung Starting Switch

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

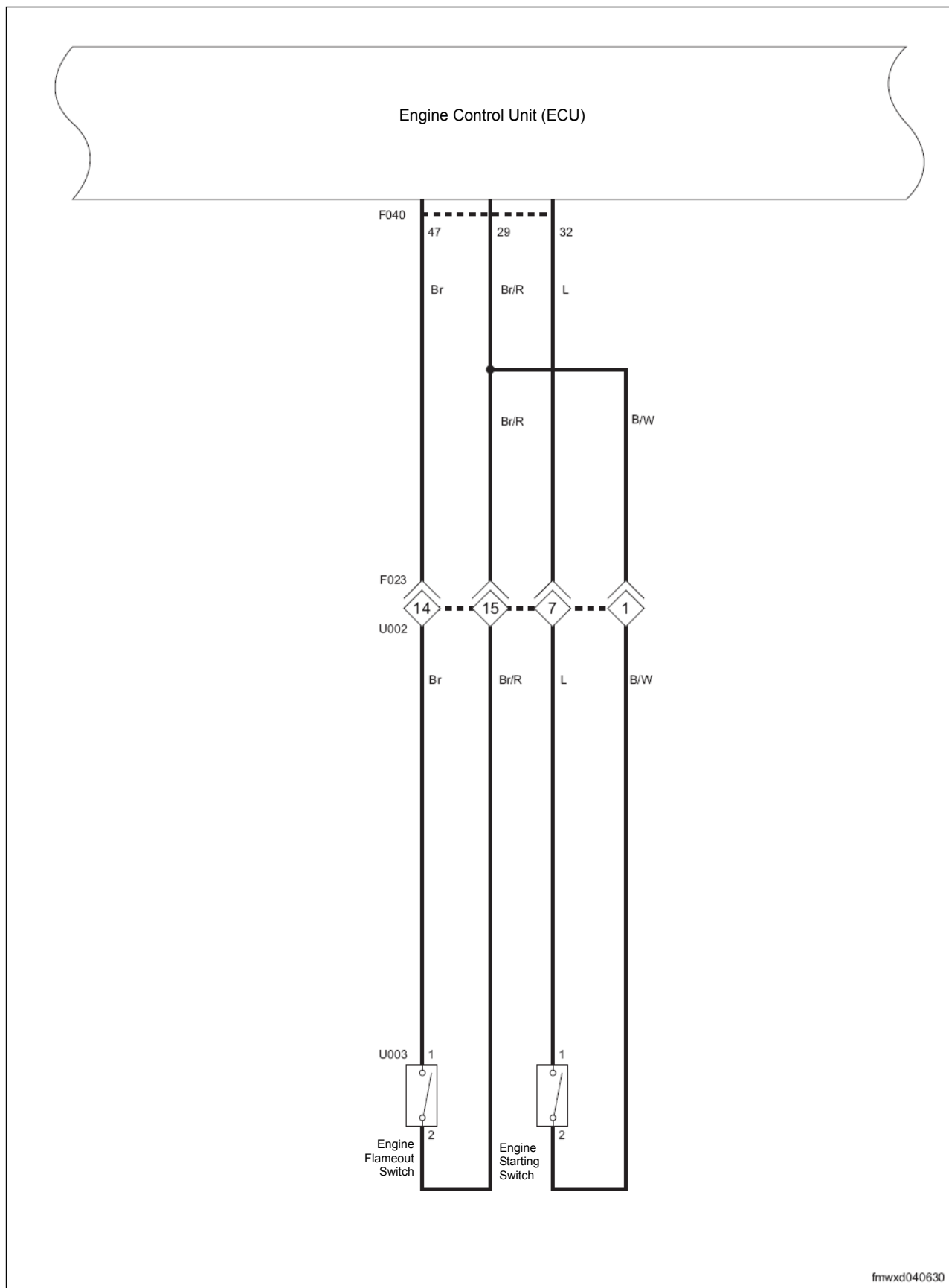
If the underslung starting switches (jammed) and their circuit is fault, the vehicle will fail to achieve the underslung start and ECU will record the fault.

Parts that may cause faults

1. Underslung starting switch circuit (shorted or opened).
2. Underslung starting switch (damaged)
3. ECU (damaged).

Diagnosis - Engine Control-WP

Circuit Diagram



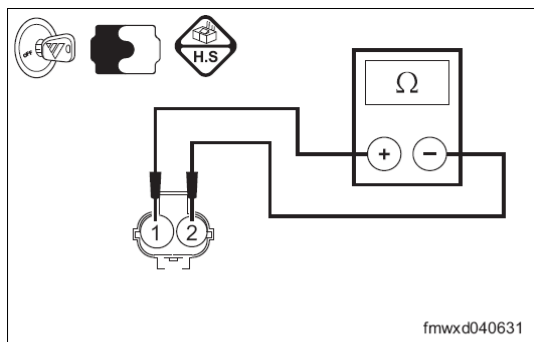
Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, “**KT 600** Diagnostic Apparatus Usage and Fault Test”.
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, “Flash Fault Code List”.

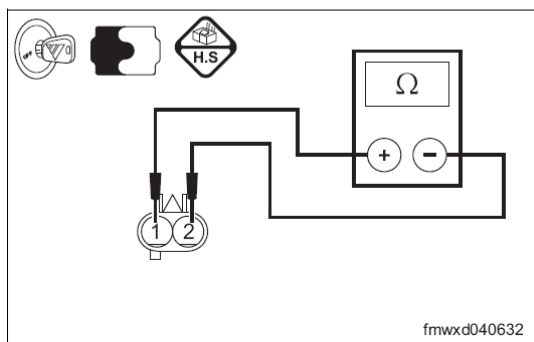
No > See Step 2

2. Inspect the engine flameout switch and starting switch

- (a). Turn off the ignition switch.
- (b). Use the multi-meter to measure the resistance between pin 1 and pin 2 of connector U003 of the engine flameout switch.

Resistance:

Condition	Measured Pin	Standard Value
Press Down	1—2	$\leq 2 \Omega$
Release	1—2	$> 10 \text{ M}\Omega$



- (c). Use the multi-meter to measure the resistance between pin 1 and pin 2 of connector U014 of the engine starting switch.

Resistance:

Condition	Measured Pin	Standard Value
Press Down	1—2	$\leq 2 \Omega$
Release	1—2	$> 10 \text{ M}\Omega$

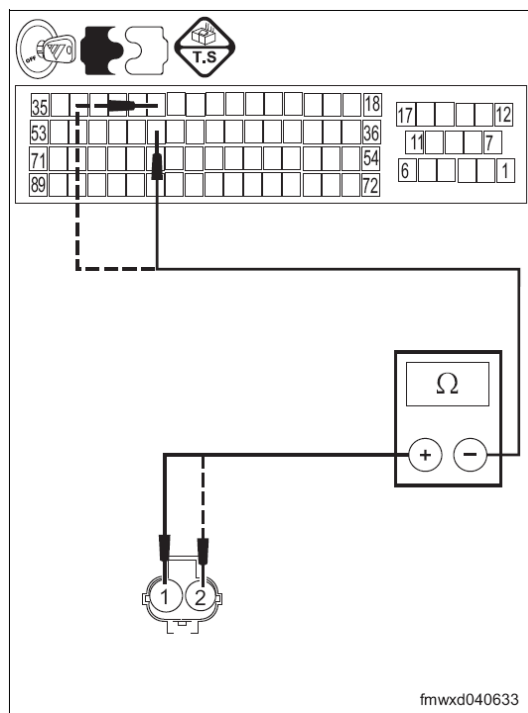
Is the inspection result normal?

Yes > See Step 3

No> Replace the engine flameout switch or starting switch

Diagnosis - Engine Control-WP

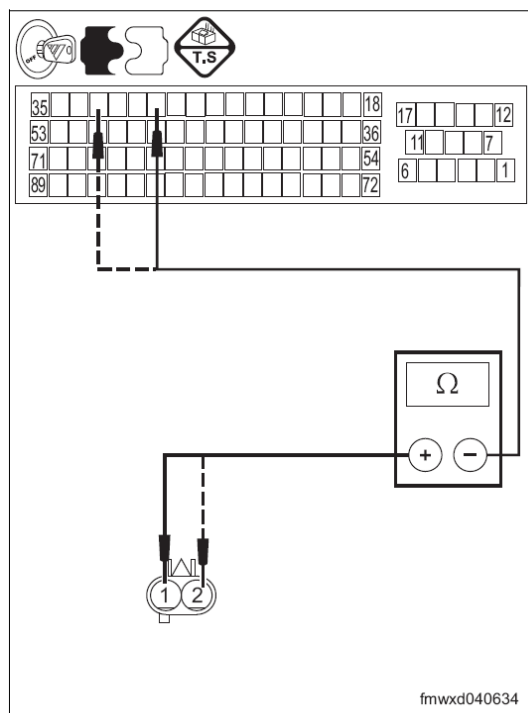
3. Inspect the circuits, the engine flameout switch and starting switch to ECU



- Turn off the ignition switch.
- Disconnect connector F040 of ECU, connector U003 of the engine flameout switch and connector U014 of the engine starting switch.
- Use the multi-meter to measure the resistance, pin 47 of connector F040 to pin 1 of connector U003 and pin 29 of connector F040 to pin 2 of connector U003.

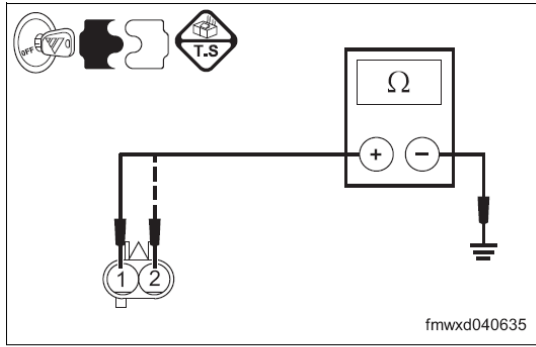
Resistance: $\leq 2 \Omega$

04



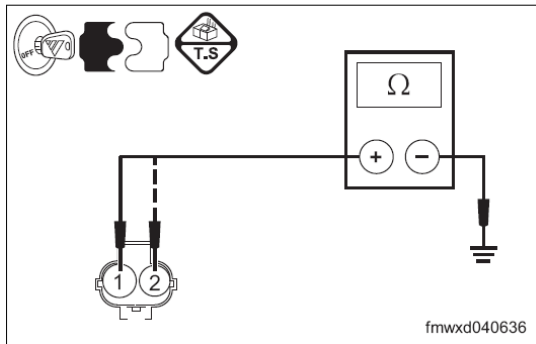
- Use the multi-meter to measure the resistance, pin 32 of connector F040 to pin 2 of connector U014 and pin 29 of connector F040 to pin 1 of connector U014.

Resistance: $\leq 2 \Omega$



- (e). Use the multi-meter to measure the resistance, pin 1 and pin 2 of connector U003 of the engine flameout switch to the earth.

Resistance: >10 MΩ



- (f). Use the multi-meter to measure the resistance, pin 1 and pin 2 of connector U014 of the engine starting switch to the earth.

Resistance: >10 MΩ

Is the inspection result normal?

Yes > See Step 4

**No>Overhaul or replace the circuits, the engine flameout switch and starting switch to ECU
Refer to this chapter, "Reading and Erasing of Flash Fault Codes".**

4. Erase fault codes

- (a) Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

- 5-1-1 Cylinder 1 Misfire Detection
- 5-1-2 Cylinder 2 Misfire Detection
- 5-1-3 Cylinder 3 Misfire Detection
- 5-1-4 Multi-cylinder Misfire Detection
- 5-3-1 Cylinder 4 Misfire Detection
- 5-3-2 Cylinder 5 Misfire Detection
- 5-3-3 Cylinder 6 Misfire Detection

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the fuel injector, cylinder head seal, valve maker, etc. are tested by such functions of the diagnostic apparatus as the "cylinder cutout test" and "compression test" for the functional test of the misfire detection, ECU will record the fault.

Parts that may cause faults

1. ECU (damaged).

Diagnostic Steps**1. Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

2. Erase fault codes

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

5-3-4 External Test

5-2-1 External Test

5-2-2 External Test

5-2-3 External Test

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

When the exhaust throttle valve, fault lamp and cold start lamp of the engine brake are automatically tested by the diagnostic apparatus for the external test on the engine, ECU will record the fault.

Parts that may cause faults

1. **ECU (damaged).**

Diagnostic Steps

1. **Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "**KT 600** Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

2. **Erase fault codes**

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

5-4-1 Problem of Sync Signal

Description

Before the fault inspection, verify the faults put forward by the customers by confirming the vehicle condition as failed or normal.

Ask the customers whether the appropriate engine oil and fuel has been used and whether additional non-manufacturer equipment has been installed.

Refer to this chapter, "General Steps for Fault Diagnosis".

The engine timing is judged by ECU through the reception and comparison of the signals from the crankshaft position sensor and camshaft position sensor as well as the confirmation of the synchronization of the sensor signals. If the sync signal issue caused by the improper processing of the flywheel ring gear is considered, ECU will record the fault.

04

Parts that may cause faults

1. **Flywheel ring gear (unqualified processing, damaged, teeth missing and improper installation).**

Diagnostic Steps

1. **Connect the diagnostic apparatus**

- (a). Connect the diagnostic apparatus **KT 600** dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any other fault code?

Yes > Diagnose according to the flash fault codes, refer to this chapter, "Flash Fault Code List".

No > See Step 2

2. **Inspect the flywheel ring gear**

- (a). Inspect the flywheel ring gear, without such incorrect phenomena as unqualified processing, damaged, teeth missing and improper installation.

Is the inspection result normal?

Yes > See Step 3

No>Replace the flywheel ring gear

3. **Erase fault codes**

- (a). Erase fault codes. Refer to this chapter, "Reading and Erasing of Flash Fault Codes".

Can fault codes be erased?

Yes > system is normal.

No > replace ECU.

Starting/Preheating System

Precautions

1. The operating time of the starter shall not exceed 5 seconds. If the vehicle needs starting many times, there must be an interval of at least 10 seconds between every two operations.
2. The first maintenance for the motor is between 50,000~80,000km. Remove dirt inside, and re-fill lubricating oil.
3. The second maintenance is between 40,000~50,000km. Inspect the wearing degree of the carbon brush; if the carbon brush is worn too much, replace it. If not replaced and cleaned, the contact face between the motor's rotor and carbon brush is easy to damage, and the motor needs to be replaced at that time.
4. The carbon brush is close to its limit between about 100000~150000km. If the vehicle usually runs in a short distance and needs starting frequently, the motor shall be maintained at a mileage below 80,000km; if the vehicle usually runs in a long distance and needs starting infrequently, the motor can be maintained at a mileage above 80,000km.
5. Frequent maintenance and lubrication of the motor will not increase load and current flow, and the motor is not easy to damage.

Diagnosis - Starting/Preheating System

Basic Inspection

Step	Scope of Inspection	Measure	
1	Inspect the voltage of the battery The voltage of the battery shall not be lower than 12V Is the inspection result normal?	Yes	See Step 2
		No	See Fault Symptom Table
2	Inspect the ignition switch Inspect whether the ignition switch is well working. Is the inspection result normal?	Yes	See Step 3
		No	See Fault Symptom Table
3	Inspect the neutral gear switch Inspect whether the neutral gear switch is normal. Is the inspection result normal?	Yes	See Step 4
		No	See Fault Symptom Table
4	Inspect the engine flameout switch Inspect whether the engine flameout switch is normal Is the inspection result normal?	Yes	See Step 5
		No	See Fault Symptom Table
5	Inspect the engine starting switch Inspect whether the engine starting switch is normal Is the inspection result normal?	Yes	See Step 6
		No	See Fault Symptom Table
6	Inspect the starting system circuit/relay/fuse Inspect the starting system circuit/relay/fuse. Is the inspection result normal?	Yes	See Step 7
		No	See Fault Symptom Table
7	Inspect ECU Inspect whether the ECU is normal. Is the inspection result normal?	Yes	See Step 8
		No	See Fault Symptom Table
8	Inspect engine machinery The engine crankshaft shall rotate. Is the inspection result normal?	Yes	Replace the starter
		No	See Fault Symptom Table

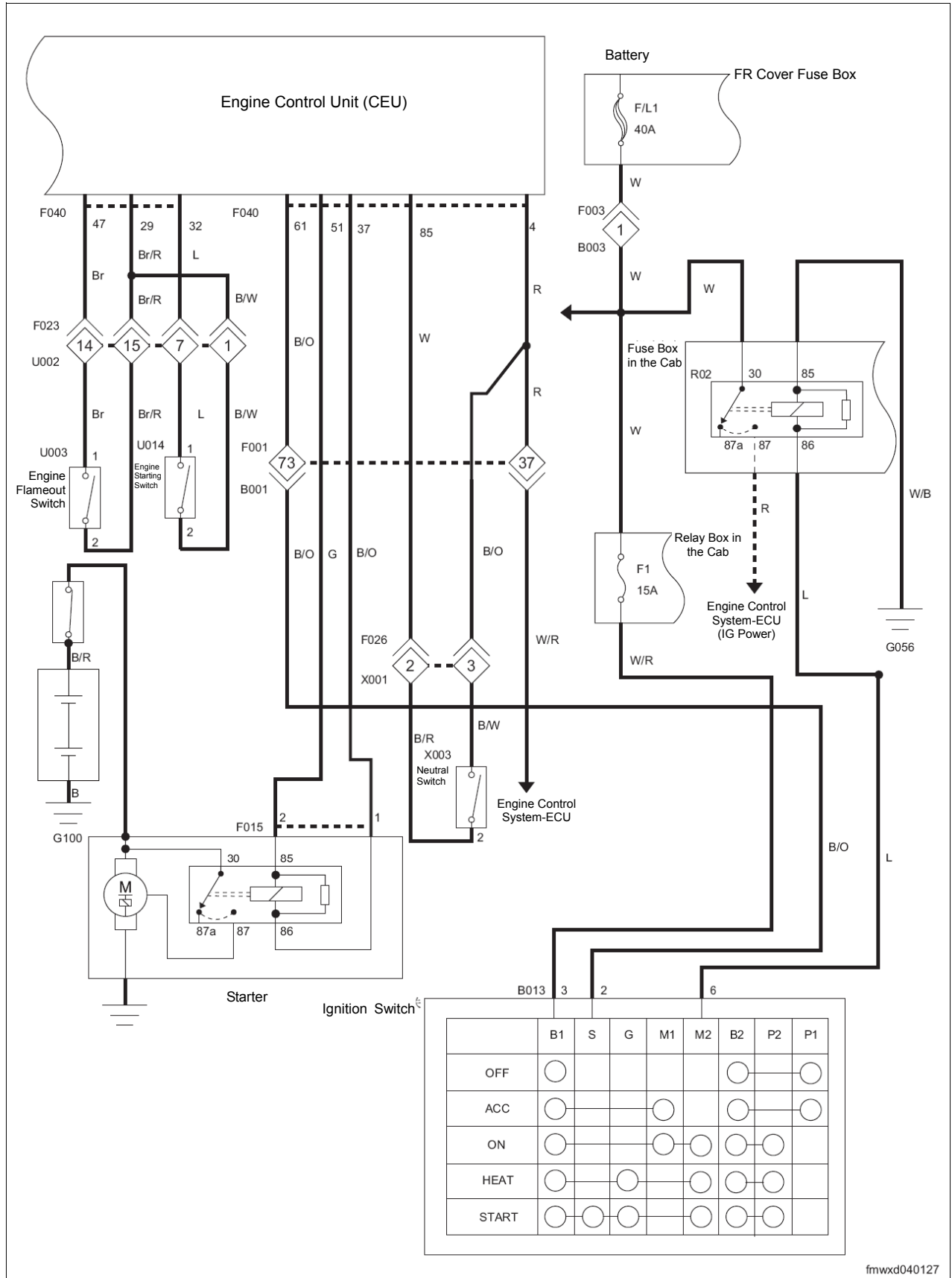
Fault Symptom Table

Fault Symptom	Possible Cause	Reference
The starter fails to stop	1. Ignition switch (damaged)	Chapter18 Starting and Preheating Systems - Ignition Switch, Replacement
	2. Engine ECU (damaged)	Chapter17 Engine Control – ECU, Replacement
	3. Relay (damaged)	Replace the relay
	4. Harness (shorted to power supply)	Repair or replace the harness
The starter fails to start	1. Battery (insufficient voltage)	Chapter53 Battery – Battery, Replacement
	2. Ignition switch (damaged).	Chapter18 Starting and Preheating Systems - Ignition Switch, Replacement
	3. Engine ECU (damaged)	Chapter17 Engine Control – ECU, Replacement
	4. Neutral gear switch (damaged).	Replace the neutral gear switch
	5. Engine flameout switch (not returned)	Replace the engine flameout switch
	6. Fuse (damaged)	Replace the fuse
	7. Harness (open circuit)	Repair or replace the harness
	8. Engine machinery (damaged)	Repair or replace the engine machinery
Starter noise	1. Starter (damaged)	Chapter18 Starting and Preheating Systems - Ignition Switch, Replacement
	2. Flywheel (damaged).	Chapter16 Engine machinery – Flywheel and Flywheel Housing, Replacement

Diagnosis - Starting/Preheating System

The Starter Fails to Stop

Circuit Diagram



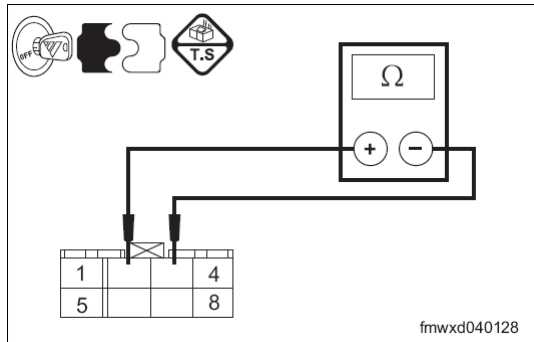
Diagnostic Steps

Hint:

During troubleshooting for starting and preheating system, confirm the transmission on the neutral gear.

1. Inspect the ignition switch

- (a). Switch off general power supply.
- (b). Disconnect ignition switch connector B013.



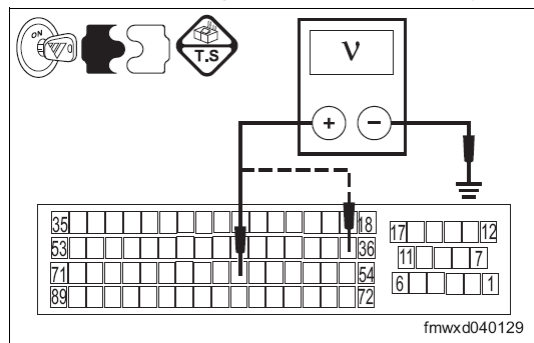
- (c). Inspect the ignition switch.

Standard value:

Condition	Pin Connected to Multi-meter	Standard Value
Turn off the ignition switch	2-3	> 10 MΩ
Start the ignition switch	2-3	≤ 2 Ω

Is the inspection result normal?**Yes>see Step 2****No > replace the ignition switch****2. Inspect wiring harness**

- (a). Disconnect engine ECU connector F040.
- (b). Disconnect starter connector F015.
- (c). Switch on general power supply.



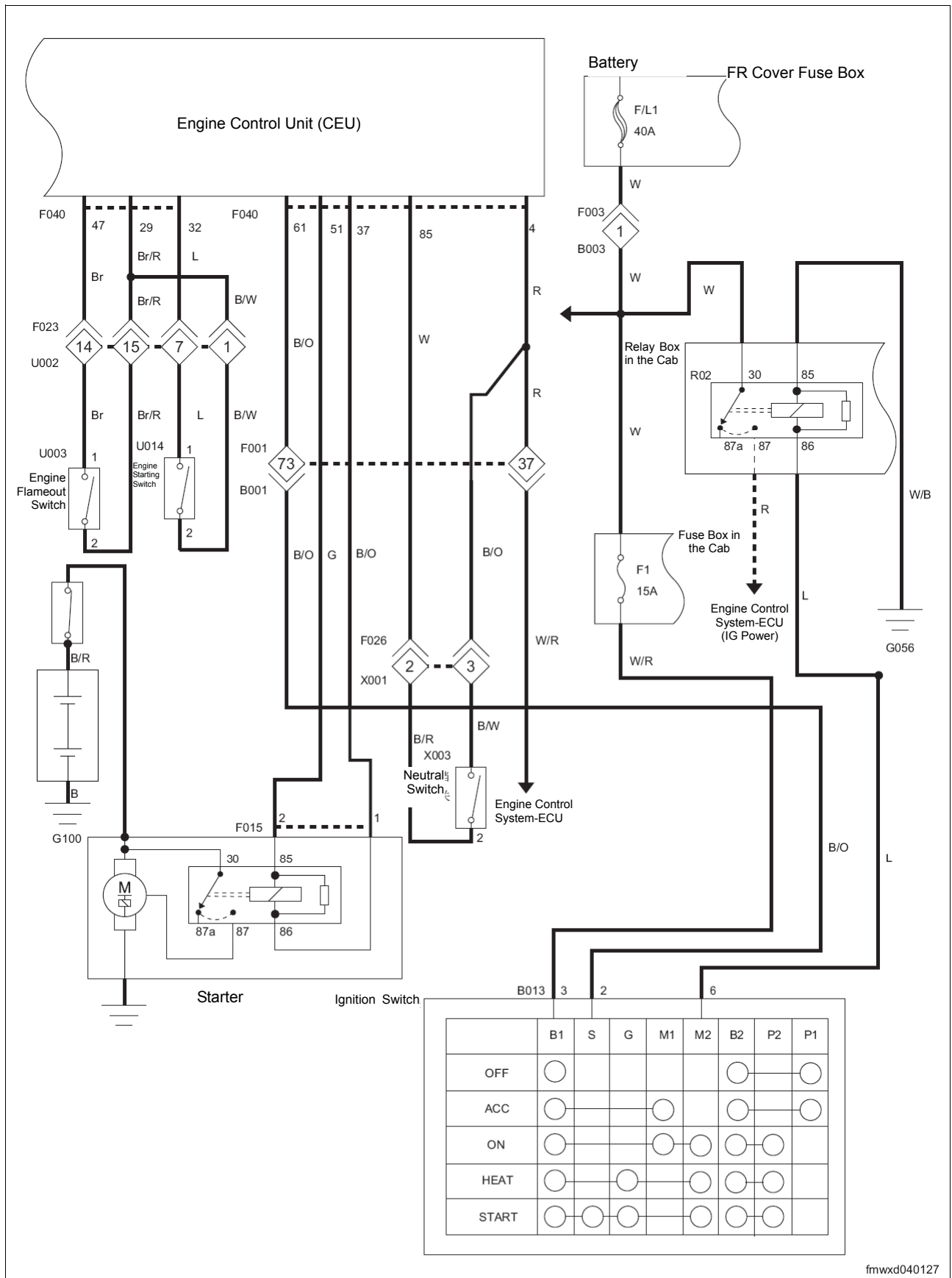
- (d). Use the multi-meter to measure the voltage between pin 61 and pin 37 of engine ECU connector F040 and effective earthing point of vehicle body.

Standard voltage value: 0V.**Is the inspection result normal?****Yes> replace the engine ECU.****No> repair or replace the wiring harness.**

Diagnosis - Starting/Preheating System

The Starter Fails to Start

Circuit Diagram



Diagnostic Steps

Hint:

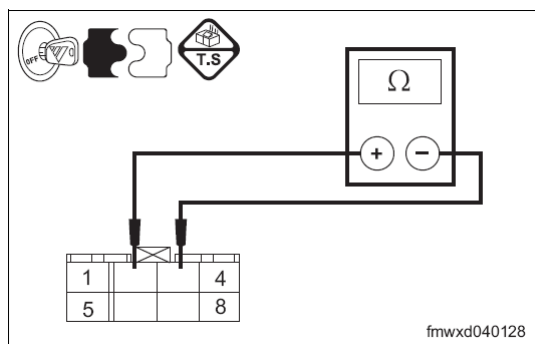
During troubleshooting for starting and preheating system, confirm the transmission on the neutral gear.

1. Inspect the battery

- (a). Inspect the voltage of the battery.

Standard voltage value: $\geq 22V$.**Is the inspection result normal?****Yes>see Step 2****No> replace the battery****2. Inspect the ignition switch**

- (a). Switch off general power supply
- (b). Disconnect ignition switch connector B013.



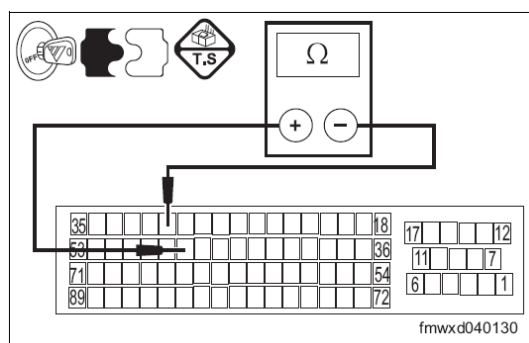
- (c). Inspect the ignition switch.

Standard value:

Condition	Pin Connected to Multi-meter	Standard Value
Turn off the ignition switch	2-3	$> 10 M\Omega$
Start the ignition switch	2-3	$\leq 2 \Omega$

Is the inspection result normal?**Yes>see Step 3****No > replace the ignition switch****3. Inspect the flameout switch and wiring harness of the engine.**

- (a). Disconnect engine ECU connector F040



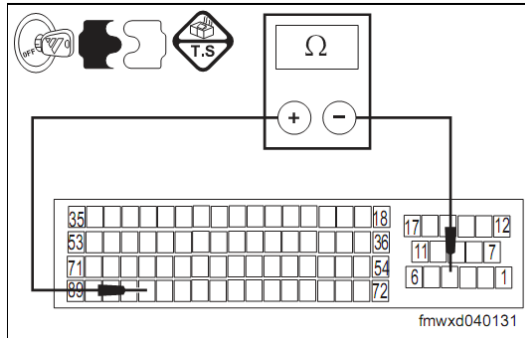
- (b). Inspect the flameout switch and wiring harness of the engine.

Standard value:

Condition	Pin Connected to Multi-meter	Standard Value
Open engine flameout switch	47-29	$\leq 2 \Omega$
Close engine flameout switch	47-29	$> 10 M\Omega$

Diagnosis - Starting/Preheating System

4. Inspect neutral gear switch and circuit of the transmission.



- (a). Inspect neutral gear switch and circuit of the transmission.

Standard value:

Condition	Pin Connected to Multi-meter	Standard Value
Neutral gear of transmission	85-4	> 10 MΩ
Transmission engaged	85-4	≤ 2 Ω

Is the inspection result normal?

Yes>see Step 5

No> repair or replace the neutral gear switch and wiring harness of the transmission.

5. Inspect ECU power of the engine and earthed circuit.

- (a). Inspect the circuit between pins 2, 3, 8 and 9 of the engine ECU connector F040 and fuse F/46.
 (b). Inspect the circuit between pin 40 of the engine ECU connector F040 and fuse F/50.
 (c). Inspect the circuit between pins 5, 6, 10 and 11 of the engine ECU connector F040 .

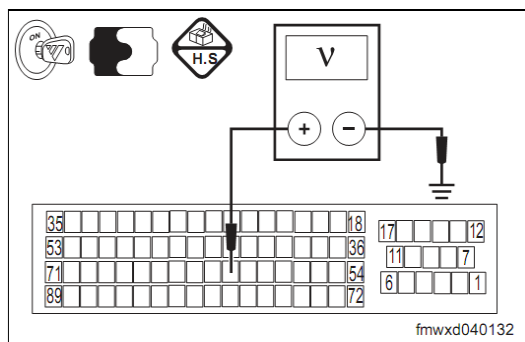
Is the inspection result normal?

Yes>see Step 6

No> repair or replace the wiring harness.

6. Inspect the circuit from the ignition switch to the engine ECU.

- (a). Connect the engine ECU connector F040.
 (b). Switch on general power supply.



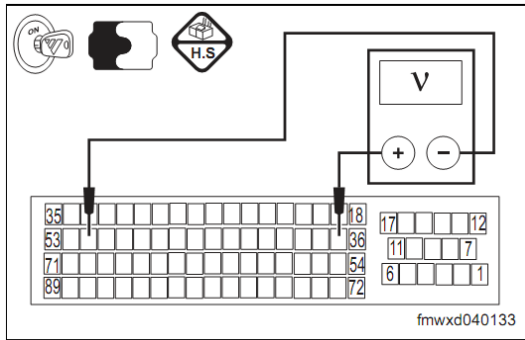
- (c). Keep the ignition switch on START position and use the multi-meter to measure the voltage between pin 61 of the engine ECU connector F040 and effective earthing point of vehicle body.

Standard voltage value: battery voltage.

Is the inspection result normal?

Yes>see Step 7

No> repair or replace the wiring harness.

7. Inspect the engine ECU.

- (a). Keep the ignition switch on START position and use the multi-meter to measure the voltage between pin 37 and 51 of the engine ECU connector F040.

Standard voltage value: battery voltage.

Is the inspection result normal?

Yes>see Step 8

No> replace the engine ECU.

8. Inspect the wiring harness between the engine and battery.

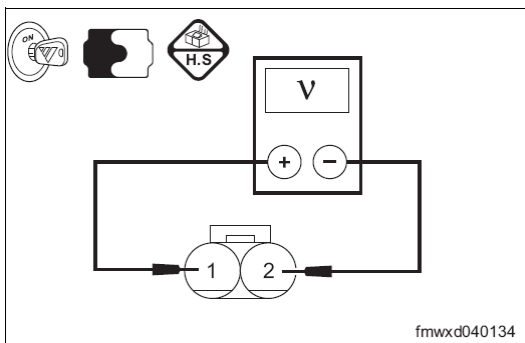
- (a). Use the multi-meter to measure the voltage between the wiring terminal of the starter and effective earthing point of vehicle body.

Standard voltage value: battery voltage.

Is the inspection result normal?

Yes>see Step 9

No> repair or replace the wiring harness.

9. Inspect the starter control circuit

- (a). Keep the ignition switch on START position and use the multi-meter to measure the voltage between pin 1 and pin 2 of the starter connector F015.

Standard voltage value: battery voltage.

Is the inspection result normal?

Yes>see Step 10

No> repair or replace the wiring harness.

10. Inspect the engine machinery.

- (a). Turn the crankshaft and inspect whether the crankshaft can be turned within the effective torque.

Is the inspection result normal?

Diagnosis - Starting/Preheating System

Yes> replace the engine assembly.

No> repair the engine machinery fault.

Starter Noise

Diagnostic Steps

1. Start the engine and listen whether the starter is operating.

- (a). When the starter is still on the joint position after starting the engine, inspect whether there is loud “gasp” (if the speed of engine is furthermore increased when the starter is on the joint position, then the noise may be sound as alarm).

Is the inspection result the same as what mentioned above?

Yes> inspect whether there are following faults in the flywheel ring gear: cracking of wheel teeth, missing of wheel teeth or wear of wheel teeth; whether the flywheel is bent; or the wheel teeth are damaged; replace the flywheel if necessary

No >see Step 2

2. After starting the engine, when the starter is gradually stopped, whether the noise of “rumbling”, “bellow” or “knocking” under certain circumstances can be heard?

Is the inspection result the same as what mentioned above?

Yes>see Step 4

No >see Step 3

3. When starting the engine, after the engine crankshaft rotates and normally starts, whether the high-frequency mobility whining can be heard and whether the inspection result is the same as what mentioned above?

Yes> replace the starter.

No >see Step 4

4. Dismantle and inspect the starter

- (a). Inspect shaft sleeve of starter and clutch gear; whether there is cracking or wear in the clutch gear and whether the shaft sleeve is worn out.

Yes> replace the starter.

No> replace the flywheel.

Charging System

Precautions

The structures of the AC generator and adjustor are simple and convenient for maintenance. Not only the fault is less but also the service life is longer if correctly used. It may be worn out if incorrectly used. Hence, pay attention to the following points for using and maintaining:

1. The battery's pole to be grounded must be negative pole. Do not connect inversely. Or the electronic components of the generator or regulator will be burnt.
2. The connection between the generator and battery shall be secure. If they are disconnected suddenly, over-voltage will be generated to damage the electronic components of the generator or regulator.
3. When the generator is operating, do not use the method of sparking to inspect whether the generator generates power, or the rectifier diodes will be burnt.
4. Once detecting that there is a fault in the AC generator or regulator, overhaul the defective part immediately and eliminate the fault in time. Or the fault will result in more serious faults or the lack of electricity of the battery, and thus the vehicle can not move.
5. When the regulator is matched for the AC generator, the voltage grade of the AC generator must be the same with that of the regulator, the grounding type of the generator must be the same with that of the regulator, and the power of the regulator shall not be lower than that of the generator. Or the system can not operate normally.
6. The line connection must be correct. At present, the installation positions and connection modes of the regulators for various models are different. Pay special attention during connection.
7. The regulator must be under the control of the ignition switch. When the generator stops, turn off the ignition switch. Or the field circuit of the generator will always stay in on-state, which will not only burn the field coil, but also cause the lack of electricity of the battery.
8. When the generator or regulator needs to be dismantled from the vehicle for overhaul because it is defective, turn off the ignition switch and all electrical equipment at first, and dismantle the negative cable of the battery and then the conductor joint on the generator.
9. **Warning:**
The battery shall be put on the places beyond children's reach. There is sulfuric acid in the battery which shall be avoided touching with skin, eyes or clothes. When working near the battery, wear safety goggles to avoid acid solution spraying into the eyes. In case the acid solution spraying into the eyes, use clean water to wash eyes for at least 15 min immediately and seek medical assistance as soon as possible. In case of eating the acid solution, seek medical assistance immediately. The fault to comply with these instructions may cause serious injuries and death.
10. **Warning:**
Generally, the battery will produce explosive gases which cause injuries and death. Hence, do not allow the flame, spark or flammable materials near the battery. When charging the battery or constructing near the battery, wear protective mask to protect the face and eyes. Place it in a well-ventilated position. Nonconformity to these instructions may cause serious injuries and death.
11. **Warning:**
The use of any charging equipment shall comply with the instructions made by all

manufacturers. Nonconformity to these instructions may cause serious injuries and death.

12. Warning:

Before the charger is connected to the battery, do not open the switch. Nonconformity to these instructions may cause serious injuries and death.

Warning:

Before dismantling the charger from the battery, close the switch first. Nonconformity to these instructions may cause serious injuries and death.

13. Caution:

Do not put the battery in the vehicle for charging.

14. Caution:

Do not rely on the generator to charge the discharged battery, since it must travel continuously for 8h under the status of the charging system without load of electric accessory.

Diagnosis - Charging System

Basic Inspection

Step	Scope of Inspection	Measure	
1	Appearance inspection of battery The surface of the battery shall not have leakage trace; Shell is not cracked and damaged; electrode is not corroded; Electrode connection is reliable. Is the inspection result normal?	Yes	See Step 2.
		No	See Fault Symptom Table
2	Conduct inspection with discharging detector. Press the relevant contact on positive pole and negative pole of the battery; when the indicator of the discharging detector is on the green scope for about 2s, it indicates that the accumulator capacity is sufficient for large current starting requirement; when the indicator of the discharging detector is on the red scope without any other abnormal phenomenon, it indicates that the accumulator capacity is insufficient and need charging. Is the inspection result normal?	Yes	See Step 3.
		No	See Fault Symptom Table
3	Use headlamp as the load and voltmeter inspection. Connect the voltmeter onto the battery by method of measuring the battery voltage; Read the voltage value of the battery; Turn on headlamp; if the voltage of the battery does not descend rapidly and keeps above 22V, then the vehicle can be started after the battery has been charged. If the voltage of the battery does not descend rapidly after starting the headlamp, charge the battery to recover its function; for the long idle time of the battery, extend the time for charging; it is best to charge it for several times in order to fully activate the battery. Is the inspection result normal? Caution: For the battery been charged or completely charged, it is inadvisable to use discharging detector to inspect. Because during the charging, a large number of oxyhydrogen will be produced, if using discharging detector or resistance wire to make moderate inspection, it will produce spark and explode the gas which may cause injury or damage.	Yes	See Step 4.
		No	See Fault Symptom Table

Diagnosis - Charging System

04	4	Generator Unload Test 1. Assemble the generator on the fixture of the test-bed; Select socket and rubber transmission joint; adjust fixture position; the tested generator and arm shaft of the adjustment motor on the test-bed shall be in correct alignment. 2. Inspect whether the wiring is correct; if it is correct, start the adjustment motor on the test-bed. 3. The adjustment motor on the test-bed is provided with exciting current by battery (or power on the test-bed). Speed up the motor gradually. When the rotation speed is increased by 500~800 r/min, the generator is no longer provided with exciting current by external power source. The generator shall be able to generate electricity by self-exciting. 4. Increase rotation speed continuously and observe the reading of the voltmeter. • When the voltage reaches rated voltage, record the rotation speed of the generator for the time being. Disconnect the switch of the adjustment motor and complete the unload test. 5. Analyze the data of the unload test. • Compare with the standard value; if the rotation speed is quicker than the unload rotation speed, and then the generator is fault; now dismantle the generator for testing. If it is not sure for the fault of the generator, continue the load test. Is the inspection result normal?	Yes	See Step 5.
			No	See Fault Symptom Table
5	5	Generator Load Test 1. Adjust the rheostat on the maximum resistance position. 2. Start the speed regulation motor to make the voltage of the generator reach the rated value. 3. Keep voltage and improve the rotation speed of the generator and output current to make the rotation speed reach the rated value. Record the output current for the time being. Disconnect the switch of the speed regulation motor and complete the load test. 4. Analyze the data of the load test. • Compare with the standard value, if the output current can reach the rated current, it indicates that the generator is in good condition; otherwise, the AC generator has fault, now dismantle the generator for testing. Is the inspection result normal?	Yes	See Fault Symptom Table
			No	Repair or replace the generator, refer to "Chapter 19, Charging System-Generator and Overhaul".

Diagnosis - Charging System**Fault Symptom Table**

Use the following table to help you find the fault. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

Fault Symptom	Possible Cause	Refer to
Charging indicator is normally on	Generator belt (loose)	Chapter 19, Charging System-Charging System, Detection and Adjustment
	Generator regulator (damaged)	Replace regulator
	Generator (damaged)	Chapter 19, Charging System-Generator, Overhaul
	Instrument cluster (damaged)	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	The wiring harness is damaged or the connection is poor.	Repair or replace the wiring harness and ampere meter.
The battery is undercharged	Generator belt (loose)	Chapter 19, Charging System-Charging System, Detection and Adjustment
	Generator (damaged)	Chapter 19, Charging System-Generator, Overhaul
	Generator fuse (damaged)	Replace the fuse
	Battery (damaged)	Chapter 53, Battery-Battery, Replacement
The battery is overcharged	The wiring harness is damaged or the connection is poor.	Repair or replace the wiring harness and ampere meter.
	Generator regulator (damaged)	Replace regulator
The charging current is unstable	The transmission belt of generator is loosened.	Chapter 19, Charging System-Charging System, Detection and Adjustment
	The stator coil is about to short out or be disconnected.	Chapter 19, Charging System-Generator, Overhaul
	The wiring harness is damaged or the connection is poor.	Repair
	Generator regulator (damaged)	Replace regulator
	The terminal of the regulator has not been connected or has been loosened.	Repair
Generator has abnormal noise	The belt is loosened.	Chapter 19, Charging System-Charging System, Detection and Adjustment
	The bearing is damaged.	Chapter 19, Charging System-Generator, Overhaul
	The rotor core is in contact with the stator core.	Chapter 19, Charging System-Generator, Overhaul
	The diode is damaged.	Repair or replacement
	The stator coil is about to short out or be disconnected.	Chapter 19, Charging System-Generator, Overhaul

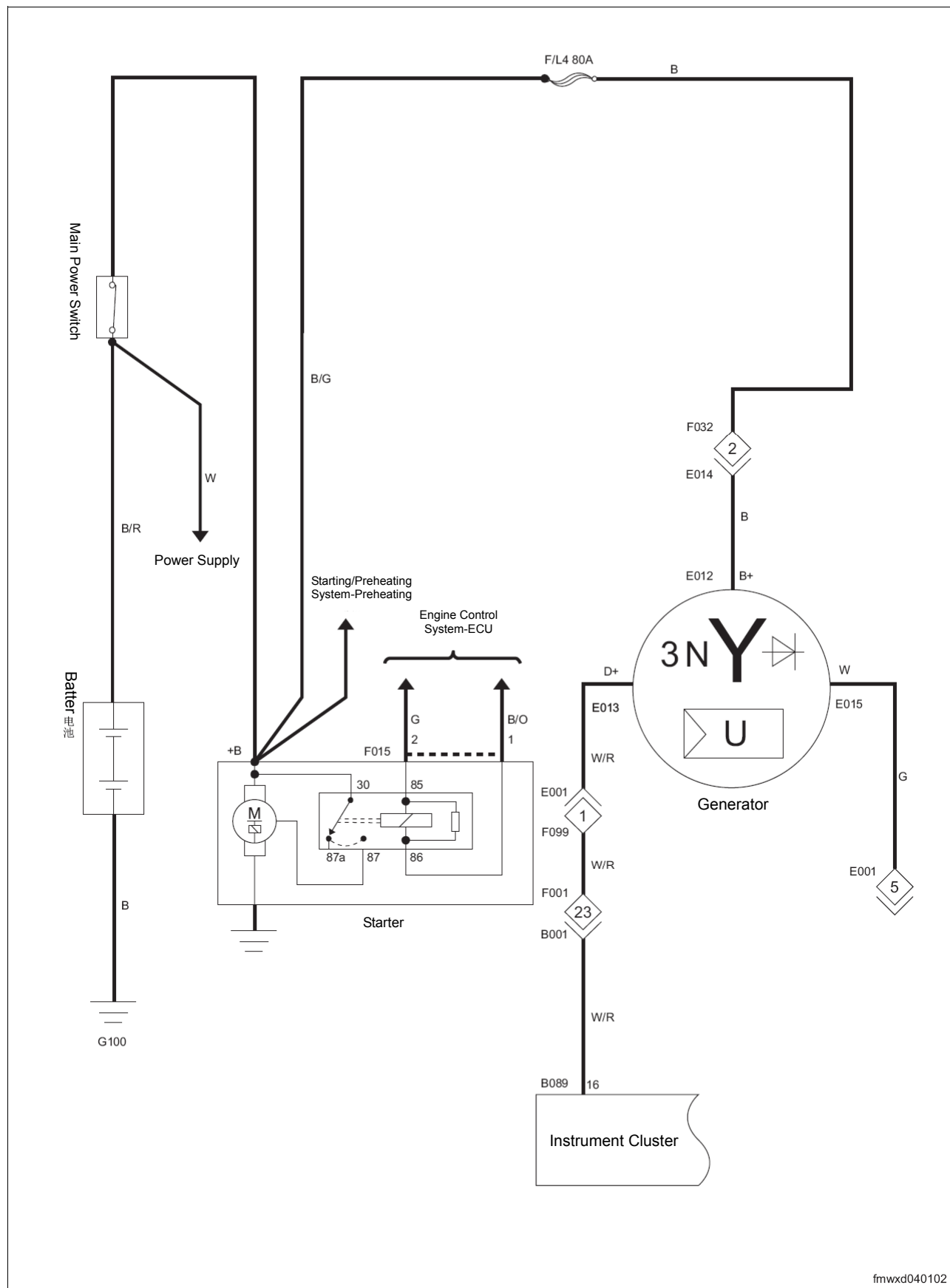
Diagnosis - Charging System

Fault Symptom	Possible Cause	Refer to
Discharge current and parasitic load of the battery	Battery (damaged)	Chapter 53, Battery-Battery, Replacement
	Electrical equipment (discharge)	Repair or replace the electrical equipment.
	Wiring harness (internal friction)	Repair or replace the wiring harness.

Diagnosis - Charging System

Charging Indicator is Normally On

Circuit Diagram



Diagnostic Steps**1. Inspect the output of electricity of the generator.**

- (a). Start the engine.
- (b). Use the multi-meter to measure the voltage between the connector E012 of the generator and effective earthing point of vehicle body.

Standard voltage value: 27~29V.

Is the inspection result normal?

Yes > see Step 2

No> adjust the preload of the belt of the generator or replace the generator.

2. Conduct emergency test for the charging indicator

- (a). Shut down the engine.
- (b). Disconnect the connector E013 of the generator and the generator.
- (c). Start the engine and inspect whether the indicator of the generator of the instrument cluster is normally on.

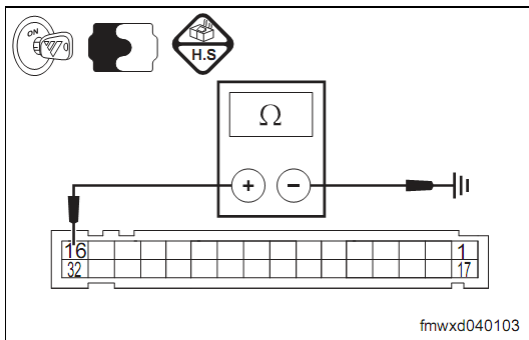
Is the inspection result normal?

Yes> replace the generator.

No > see Step 3

3. Inspect the wiring harness.

- (a). Shut down the engine.
- (b). Disconnect the connector B089 of the instrument cluster.



- (c). Inspect the resistance between the pin 16 of the instrument cluster connector B089 and effective earthing point of vehicle body.

Resistance: $\geq 10\text{ M}\Omega$

Is the inspection result normal?

Yes> replace the instrument cluster.

No> repair or replace the wiring harness.

The Battery Is Undercharged

Circuit Diagram

Refer to this chapter, "Charging Indicator is Normally On - Circuit Diagram".

Diagnostic Steps

1. Inspect the output of electricity of the generator.

- (a). Start the engine.
- (b). Use the multi-meter to measure the voltage between the connector E012 of the generator and effective earthing point of vehicle body.

Standard voltage value: 27~29V.

Is the inspection result normal?

Yes > see Step 2

No> replace the generator

2. Inspect the voltage between the two ends of the battery.

- (a). Use the multi-meter to measure the voltage between the two ends of the battery.

Standard voltage value: 27~29V.

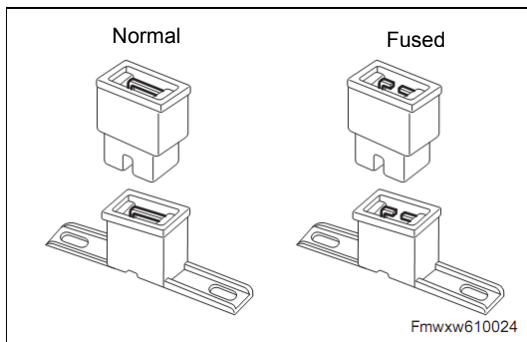
Is the inspection result normal?

Yes> replace the battery.

No > see Step 3

3. Inspect the generator fuse

- (a). Shut down the engine.
- (b). Switch off general power supply.



- (c). Inspect the fuse in the front cover fuse box: F/L4 (80 A).

Standard voltage value: 27~29V.

Is the inspection result normal?

Yes > repair or replace the wiring harness.

No>overhaul the circuit of the charging system and replace it with rated fuse.

The Battery Is Overcharged

Circuit Diagram

Refer to this chapter, "Charging Indicator is Normally On - Circuit Diagram".

Diagnostic Steps

1. Inspect the output of electricity of the generator.

- (a). Start the engine and increase the rotation speed of the engine from idle speed to 2000 rpm.

Standard voltage value: 27~29V.

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Whether the voltage value is larger than 29 V?

Yes> replace the generator

No> system is normal

The Charging Current Is Unstable

Circuit Diagram

Refer to this chapter, "Charging Indicator is Normally On - Circuit Diagram".

Diagnostic Steps

1. Inspect the output of electricity of the generator.

- (a). Start the engine.
- (b). Use the multi-meter to measure the voltage between the connector E012 of the generator and effective earthing point of vehicle body.

04

Standard voltage value: 27~29V.

Is the inspection result normal?

Yes > repair or replace the wiring harness

No> adjust the preload of the belt of the generator or replace the generator

Generator Noise

Diagnostic Steps

1. Inspect the driving belt of the generator.

- (a). Inspect whether the driving belt has teeth missing.

Hint:

When inspecting the driving belt of the generator, do not start the engine.

Is the inspection result normal?

Yes > see Step 2

No> replace the driving belt

2. Inspect the tension of the driving belt of the generator.

- (a). Inspect the tension of the driving belt of the generator.

Hint:

When inspecting the tension of the driving belt of the generator, do not start the engine.

Is the inspection result normal?

Yes > see Step 3

No> adjust the tension of the driving belt of the generator.

3. Inspect the generator

- (a). Dismantle the driving belt.
(b). Manually turn the generator.

Whether the noise of the generator still exists?

Yes> replace the generator.

No> inspect accessory driving mechanism.

Tests of Discharge Current and Parasitic Load of the Battery

Testing Steps

If the battery continues to be short of power, conduct the following testing procedures and inspect whether the battery produces parasitic current.

Caution:

Before conducting the procedure, inspect whether the vehicle has after-sales additional device first, such as DVD, acoustic multi-media amplifiers, mega bass loudspeaker and other non-original accessories. In case of this circumstance, shut down these systems before this testing procedure.

04

1. Tests of discharge current and parasitic load of the battery

- (a). Disconnect the negative cable of the battery.
- (b). The positive electro-probe of the multi-meter is connected with the negative cable of the battery and the negative electro-probe is connected with the negative pole of the battery.
- (c). Make sure that all electrical equipment are shut down and all vehicle doors of the tested vehicle are closed.
- (d). Select the mA gear of the multi-meter for current measurement.
- (e). Measure the parasitic current.

Standard parasitic current: 10~12mA.

Is the inspection result normal?

Yes > system is normal

No>overhaul the faults of the electrical equipment of the vehicle and leakage of electricity of the circuit.

Jumper Starting Steps

Jumper Steps

1. Park properly the vehicles that provide jumper power, under which condition that batteries on two vehicles can be connected by jumper cable.
2. Turn off the ignition switches of two vehicles and turn off headlamps as well as power equipment of all accessories.
3. Press down hazard warning lamp button as to turn it on.
4. Pull the parking brakes of two vehicles.
5. Make sure that transmission is in the neutral gear.

Warning:

Jumper cable shall be intact with no bare wire, which or else may lead to unnecessary body injury or vehicle damage.

6. Connect one end of red cable with positive terminal of a fully charged battery, and make sure no contact with other metal pieces.
7. Connect the other end of red cable with positive terminal of a dead battery. Do not connect red cable with negative terminal of a dead battery.

Warning:

Do not connect jumper cable directly with negative terminal of a dead battery, for this may lead to sparks and battery gas explosion.

8. Connect one end of black cable with negative terminal of a fully charged battery.
9. Finally, connect the other end of black cable with engine firm earthing contact of a dead battery. And the distance between the firm earthing contact and the dead battery shall be at least 500mm.
10. Start the vehicle's engine, which is powered by battery, and keep the engine in medium-speed operation for more than 3min.
11. Start the vehicle's engine whose battery is dead.
12. Dismantle the jumper cable in reverse order.

Caution:

At the disassembly process, if one end of the cable is not completely disconnected, avoid any metal contact with cable clamp.

13. The operation is finished.

ABS System

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.

Hint:

Before disconnecting negative cable of the battery, do not leave car key in the vehicle for fear that the vehicle door is locked.

- (b). Turn off the ignition switch, unless otherwise specified.

Hint:

The odometer will not be reset.

2. Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.

3. Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.

Hint:

Reset the audio system after reconnecting negative cable of the battery (refer to "Audio System Introduction for Use in Chinese and English").

4. Precautions for fault elimination

- (a). If there are faults in terminal contacts or parts installation, dismantling and reinstalling suspicious fault parts may completely or temporarily get the system back to normal condition.
- (b). As to identify fault parts, ensure to inspect the vehicle condition when faults take place. For instance, inspect through fault code (DTC) output and make record before disconnecting all the connectors or dismantle and then install the parts.
- (c). Unless there are particular specifications in the inspection steps, ensure to turn off the ignition switch when dismantling and installing ABS control unit, ABS solenoid valve and every independent sensor.
- (d). After reinstalling the dismantled ABS control unit, ABS solenoid valve and sensors, ensure to inspect whether system is normal. Use dedicated detector to inspect fault code (DTC) or read the fault code by flash code.
- (e). Do not use the multi-meter to measure the ABS control unit terminal directly.

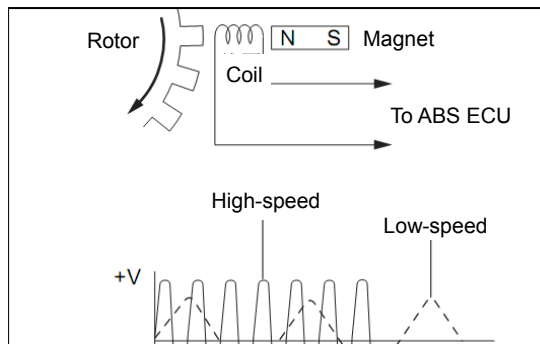
ABS Diagnostic Description

1. If the faults can not be identified through DTC inspection, carry out the fault elimination in all circuits that may possibly lead to the faults.
2. In most cases, faults in the ABS system may not be caused by electric problems or circuit problems. And usually, they are mechanical faults or gas path faults the same as those in the regular brake system. Meanwhile, the ABS fault indicator will not be lit.
3. When the ABS fault indicator is lit, generally it means that there are faults in the ABS system related to electric aspect. Now, send it to Foton Special Service Center for maintenance as fast as possible.

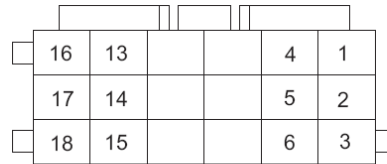
Operation condition of ABS fault indicator:

Condition of Ignition Switch	Condition of ABS Fault Indicator	Description
Ignition Switch: ON	Goes out after lighting for 3 seconds.	ABS system is normal
	Keep lighting	Indicator goes out when the vehicle's speed is more than 7 km/h; ABS system is normal.
		Indicator does not go out when vehicle's speed is more than 7 km/h; there are faults in ABS system or indicator circuit.
	Fail to light up	Faults in indicator circuit or ABS control unit

System Description



1. Speed sensor will detect the wheel speed and then send the signals to ABS control units; ABS control system is controlled by these signals.
2. When the rotor is rotating, there will be alternating voltage produced by magnetic field due to permanent magnet in the speed sensor.
3. Because changing frequencies of alternating voltage are in direct proportion with rotor's rotating speed, ABS control unit uses these frequencies to detect speed of every wheel.

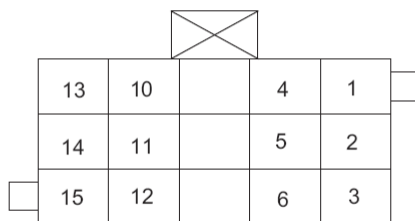
Diagnosis - ABS System**ABS Control Unit Terminal**

fmwxd040502

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Pin No.	Line Color	Function
1	Br	ECU 18-1
2	Br	ECU 18-2
3	Br	ECU 18-3
4	L	ECU 18-4
5	L	ECU 18-5
6	L	ECU 18-6
7	Br	ASR solenoid valve
8	Br	ECU 18-8
9	L	ECU 18-9

Pin No.	Line Color	Function
10	Br	ECU 18-10
11	Br	ECU 18-11
12	Br	ECU 18-12
13	B	ECU 18-13
14	B	ECU 18-14
15	B	ECU 18-15
16	L	ASR solenoid valve
17	Br	ECU 18-17
18	B	ECU 18-18

Diagnosis - ABS System

fmwxd040503

Pin No.	Line Color	Function
1	G	SAE J1939(B)
2		None
3	W	SAE J1939(A)
4	W-B	ABS fuse (5A)
5		None
6	G-L	ECU 14-6
7	Br	ABS ECU(+)
8	B-Y	ABS ECU(UB)

Pin No.	Line Color	Function
9	W-B	ABS ECU(0V)
10	Y	ECU 18-8
11	Y-R	ECU 18-9
12		None
13	G-Y	ASR indicator lamp
14	W-B	ABS ECU(DBR)
15	B-Y	ABS ECU(WL)

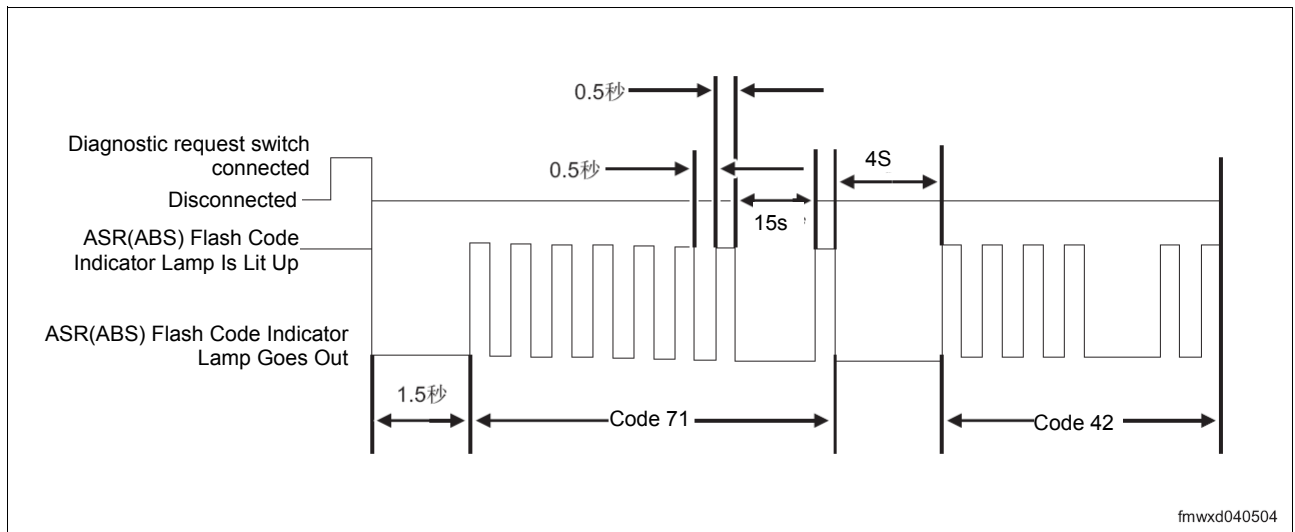
Reading and Erasing of Fault Codes

Read the flash code

Flash fault codes are in two groups: the first group stands for fault parts and properties; the second group stands for positions of faults. The time interval between flash codes of two groups is 1.5 seconds. If ABS fault indicator is lit up and keep shining after turning on the ignition key, press flash fault code button for 1 second, and inspect flash times of the fault indicator.

If there are two or more faults in ABS system, ABS fault indicator will be lit again with the second group flash codes after 4 seconds by the end of the first group flash codes. By this way, all the flash codes will be presented.

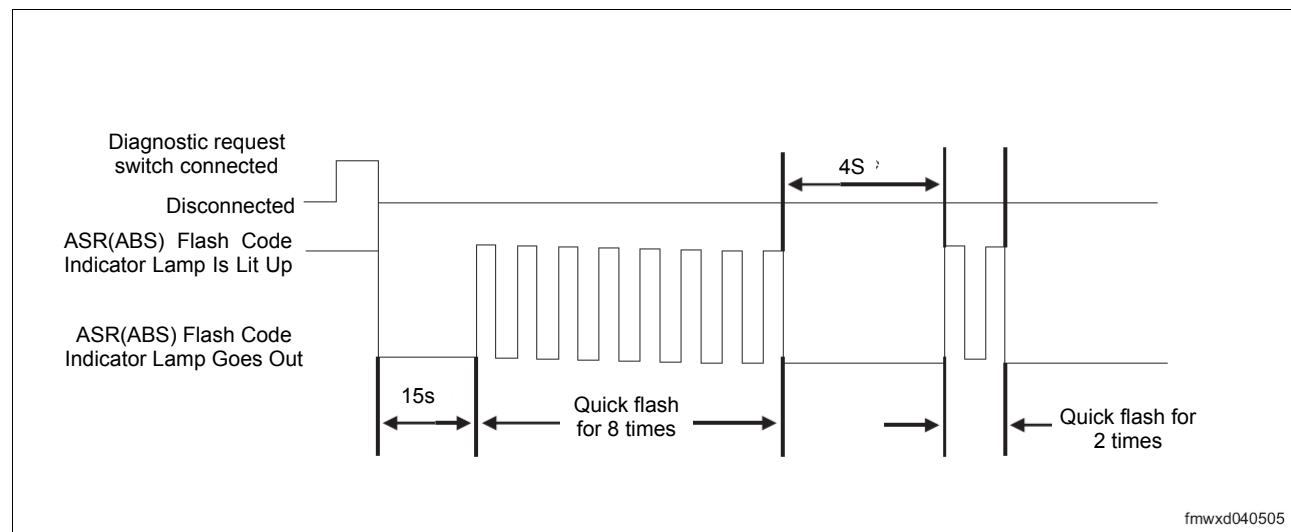
Example: Flash modes of diagnostic fault code 7-1 and 4-2 are presented in below figure



Press flash fault code button (for 1 second), fault code will appear repeatedly (it goes out only when ignition switch is turned off). If this happens, it means that this failed or these faults do exist and need to be solved by maintenance. And this failed or these faults are called “Current Faults”. And there is another flash mode of fault indicator, which is, every flash code will appear for once in turn and then the fault indicator will go out. This is called “Storage Fault”. There are two situations in “Storage Fault”: one stands for past faults that have been fixed but not removed from ECU. Another stands for past faults that do not exist any more. Like bad contact of conducting wire, which has been solved. Therefore, storage fault is just a way of keeping fault record and has no practical sense of maintenance. Therefore, each time after maintenance, the fault memory shall get cleared.

Fault Code Erasing

Press flash fault code switch and keep for 3 seconds before loosening it. If fault indicator quickly flashes for 8 times and then flashes for 2 times, it means that all the fault memory has been cleared and there is no current fault. If fault indicator flashes for 2 times rather than 8 times, it means that there are faults in the ABS system need to be maintained.



Basic Inspection

Park the vehicle and turn on the ignition key. Then ABS fault indicator will be lit up following four sounds from ABS solenoid valve in the order of “right front wheel—left rear wheel—left front wheel—right rear wheel”. After that, one sound from both right front wheel and left rear wheel and then the last sound from both left front wheel and right rear wheel. There are six sounds in total. Sound type: “Dada” sound that occurs when solenoid valve is energized. If ABS fault indicator goes out 3 seconds after that, it means that the system is in normal operation. If ECU is newly installed into ABS system, it can be dismantled from ABS system for overhaul and then reinstalled. Turn on the ignition key, if ABS fault indicator is lit up and only goes out when the vehicle is moving and its speed is over 7km/h, it means that ABS system is normal.

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Turn on the ignition key, if ABS fault indicator is not lit up, it means that ABS circuit has failed or the bulb in indicator is broken. Now inspect the bulb and circuit. If fault indicator never goes out, it means that there is one or more faults in ABS system. Now, use “Flash Code Fault Inspection” method to identify positions and properties of faults.

Besides ABS system fault self-inspection, there is a more precise and detailed inspection method. Drive on a wide and flat hard pavement (asphalt road or cement road), and for the purpose of emergency brake, jam on the brake pedal in the end when vehicle speed is over 40km/h. Then inspect whether there is drag mark on the pavement. If there is no drag mark, it means that ABS system is in normal operation. If there is drag mark left by all or a certain wheel, it means that all or a certain wheel has fault, inspection and maintenance shall be carried out.

Fault Code List

Meanings of Flash Code List

First Group Flash Fault Codes		Second Group Flash Fault Codes	
Times of Flash	Fault Property	Times of Flash	Fault Position
1	No fault	1	No fault
2	ASR solenoid valve fault	1	Right front wheel
3	Large gap of sensor	2	Left front wheel
4	Short circuit or open circuit of sensor	3	Right rear wheel
5	Unstable signal of sensor	4	Left rear wheel
6	Broken ring gear	5	Right wheel of the third axle
		6	Left wheel of the third axle
7	System function fault	1	Data interface fault
		2	ASR differential valve fault
		3	The third auxiliary relay fault
		4	ABS indicator fault
		5	ASR arrangement fault
		6	ASR proportional valve fault
8	ECU fault	1	Low pressure
		2	High pressure
		3	ECU internal fault
		4	System arrangement fault
		5	Earthing fault

Flash Fault Code List

Flash Fault Codes	Fault Position and Reason
2-1	Solenoid valve fault of right front wheel
2-2	Solenoid valve fault of left front wheel
2-3	Solenoid valve fault of right rear wheel
2-4	Solenoid valve fault of left rear wheel
2-5	Solenoid valve fault of the third axle right wheel
2-6	Solenoid valve fault of the third axle left wheel
3-1	Large gap and weak signal of sensor in right front wheel
3-2	Large gap and weak signal of sensor in left front wheel

Diagnosis - ABS System

Flash Fault Codes	Fault Position and Reason
3-3	Large gap and weak signal of sensor in right rear wheel
3-4	Large gap and weak signal of sensor in left rear wheel
3-5	Large gap and weak signal of sensor in right wheel of the third axle
3-6	Large gap and weak signal of sensor in left wheel of the third axle
4-1	Short circuit or open circuit of sensor in right front wheel
4-2	Short circuit or open circuit of sensor in left front wheel
4-3	Short circuit or open circuit of sensor in right rear wheel
4-4	Short circuit or open circuit of sensor in left rear wheel
4-5	Short circuit or open circuit of sensor in right wheel of the third axle
4-6	Short circuit or open circuit of sensor in left wheel of the third axle
5-1	Unstable signal of sensor in right front wheel
5-2	Unstable signal of sensor in left front wheel
5-3	Unstable signal of sensor in right rear wheel
5-4	Unstable signal of sensor in left rear wheel
6-1	Ring gear fault of right front wheel
6-2	Ring gear fault of left front wheel
6-3	Ring gear fault of right rear wheel
6-4	Ring gear fault of left rear wheel
7-1	No signal or wrong signal in C3
7-2	Open circuit or short to earth of differential brake valve, differential brake fault
7-3	Open circuit or short to earth of retarder
7-4	No reaction of ABS warning lamp
7-5	ASR arrangement fault
7-6	Short circuit or open circuit of proportional valve
8-1	Low voltage of ECU diagonal
8-2	Overvoltage of ECU diagonal 1 or diagonal 2 with fault in all valves
8-3	ECU internal fault
8-4	Wrong parameters of EEPROM vehicle wheel
8-5	Power short circuit of ECU diagonal 2, short circuit or open circuit of diagonal earthing, the third axle fault in the positions of left front, right rear and right of ABS

2-1 Solenoid Valve Fault of Right Front Wheel

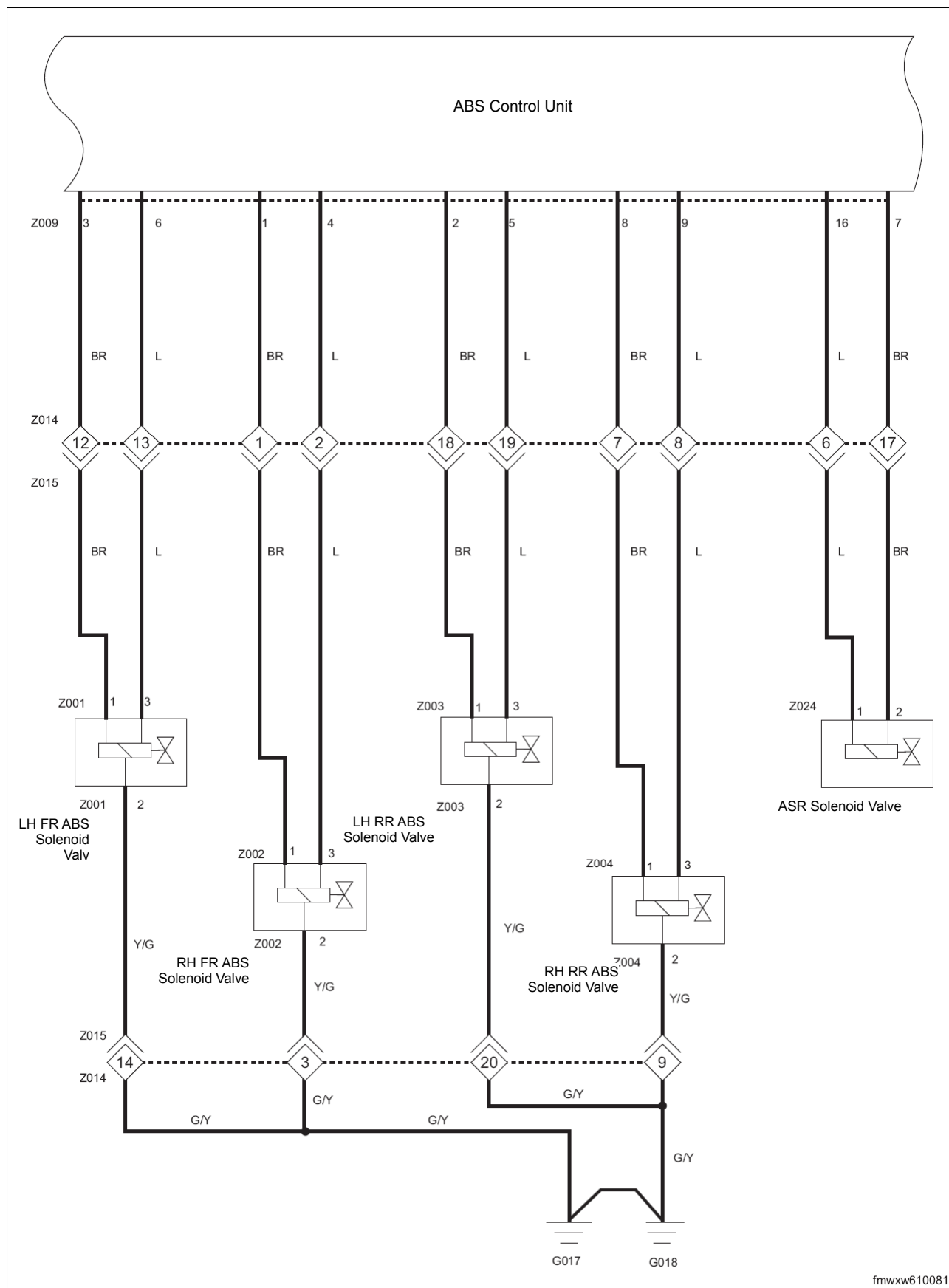
2-2 Solenoid Valve Fault of Left Front Wheel

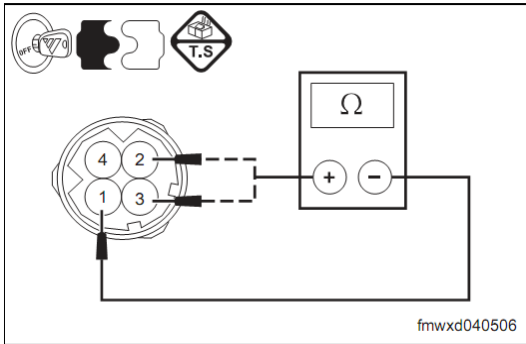
2-3 Solenoid Valve Fault of Right Rear Wheel

2-4 Solenoid Valve Fault of Left Rear Wheel

Diagnosis - ABS System

Circuit Diagram



Diagnostic Steps**1. Inspect solenoid valve of right front wheel**

- (a). Disconnect connector of ABS solenoid valve, and use the multi-meter to measure resistance between pin 3 and pin 1 of connector Z002 of solenoid valve.

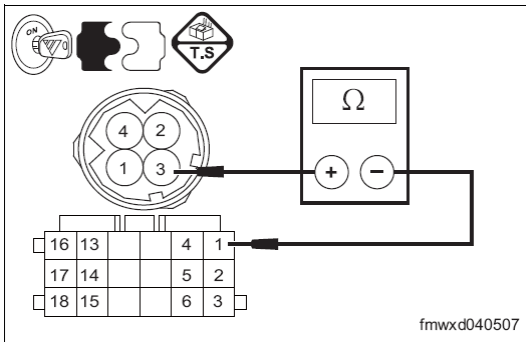
- (b). Use the multi-meter to measure resistance between pin 2 and pin 1 of connector Z002 of solenoid valve.

Resistance: $14.75 \pm 0.75 \Omega$

Is the inspection result normal?

Yes > see Step 2

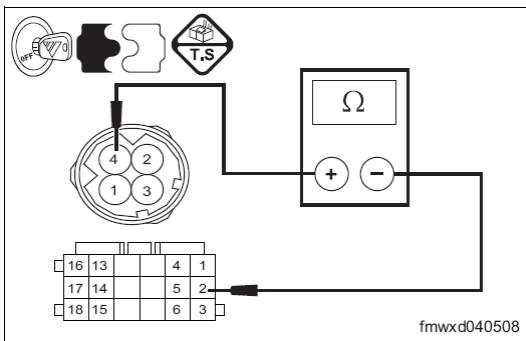
No > replace the solenoid valve of right front wheel

2. Inspect control circuit of solenoid valve of right front wheel

- (a). Disconnect connector Z009 of ABS control unit and connector Z002 of ABS solenoid valve in right front.

- (b). Measure resistance between pin 1 of connector Z009 of ABS control unit and pin 3 of connector Z002 of ABS solenoid valve in right front.

Resistance: $\leq 2 \Omega$



- (c). Measure resistance between pin 4 of connector Z009 of ABS control unit and pin 2 Of connector Z002 of ABS solenoid valve in right front.

Resistance: $\leq 2 \Omega$

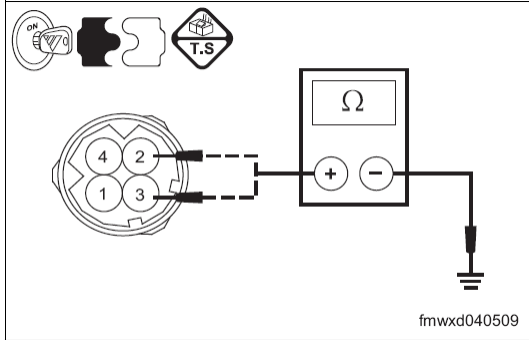
Is the inspection result normal?

Yes > see Step 3

No > repair or replace the harness

Diagnosis - ABS System

3. Inspect control circuit of solenoid valve of right front wheel



- Disconnect connector Z009 of ABS control unit and connector Z002 of ABS solenoid valve in right front.
- Measure resistance between pin 2 and pin 3 of connector Z002 of ABS solenoid valve in right front.

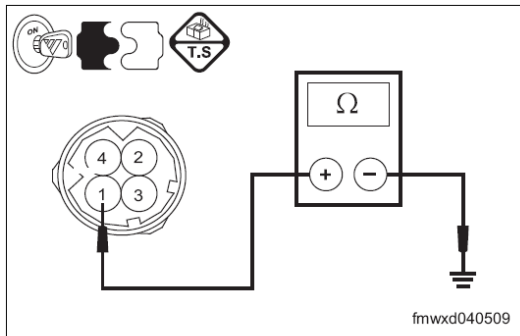
Resistance: $\geq 10\text{ M}\Omega$

Is the inspection result normal?

Yes > see Step 4

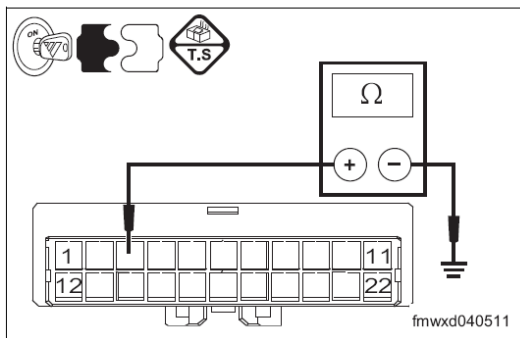
No > repair or replace the harness

4. Inspect earthing harness of solenoid valve of right front wheel



- Disconnect connector Z002 of ABS solenoid valve in right front.
- Measure resistance between pin 1 of connector Z002 of ABS solenoid valve in right front and earth.

Resistance: $\leq 2\text{ }\Omega$



- Disconnect connector Z015 and connector Z014.
- Measure resistance between pin 3 of connector Z014 and earth.

Resistance: $\leq 2\text{ }\Omega$

Is the inspection result normal?

Yes > replace ABS control unit

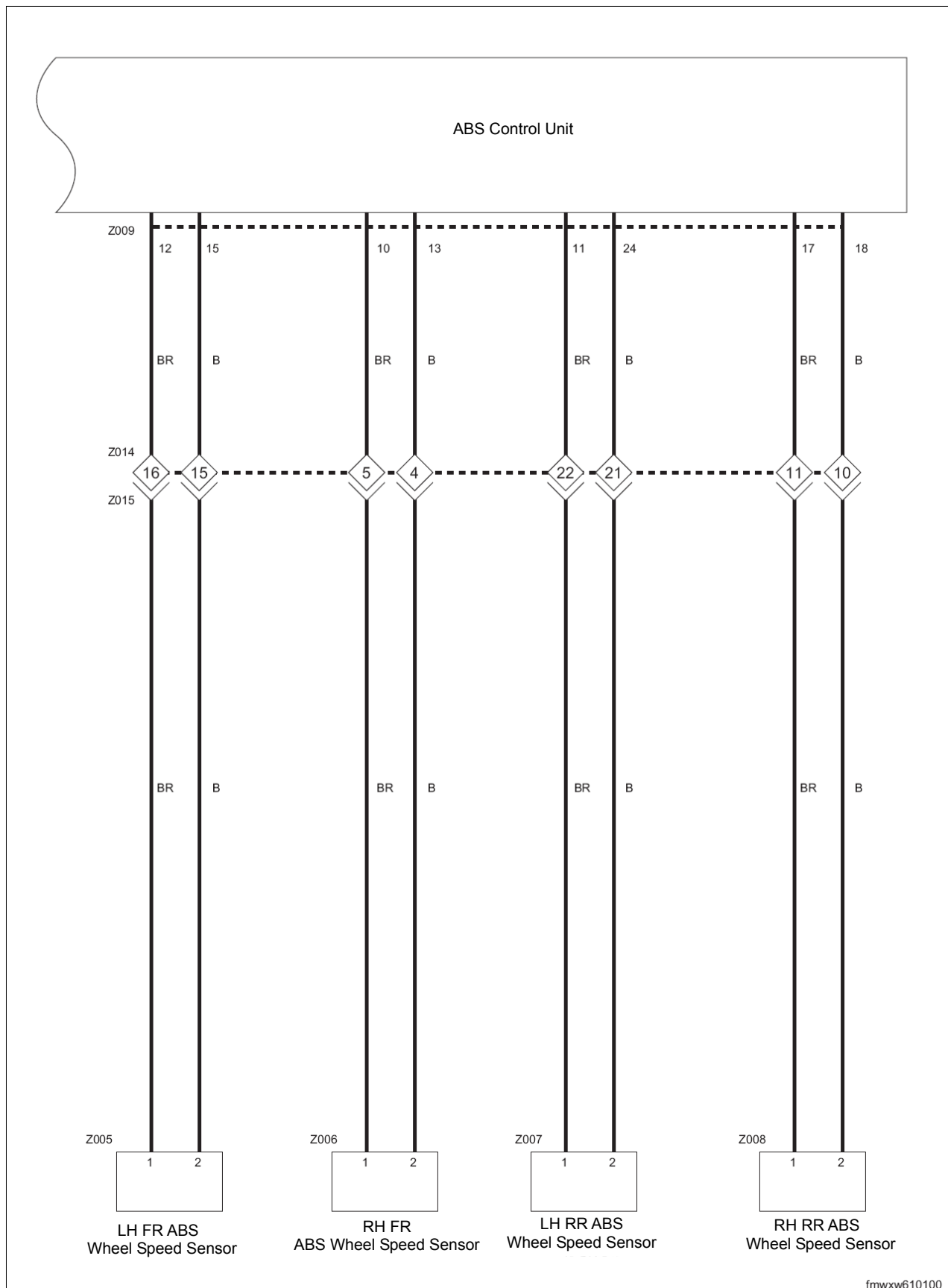
No > repair or replace the harness

3-1 Large Gap and Weak Signal of Sensor in Right Front Wheel

3-2 Large Gap and Weak Signal of Sensor in Left Front Wheel

3-3 Large Gap and Weak Signal of Sensor in Right Rear Wheel

3-4 Large Gap and Weak Signal of Sensor in Left Rear Wheel

Diagnosis - ABS System**Circuit Diagram**

Diagnostic Steps**1. Inspect the installation position of sensor**

- (a). Inspect whether the sensor is installed properly. The axial direction of sensor is perpendicular to radial direction of ring gear with largest angular deviation: $< \pm 2.5^\circ$ and head touching ring gear.
- (b). Inspect whether axial run out of ring gear is beyond range of deviation.

Conjoint rate of locating face: $> 75\%$;

Tick volume of tooth face: $< 0.06 \text{ mm}$

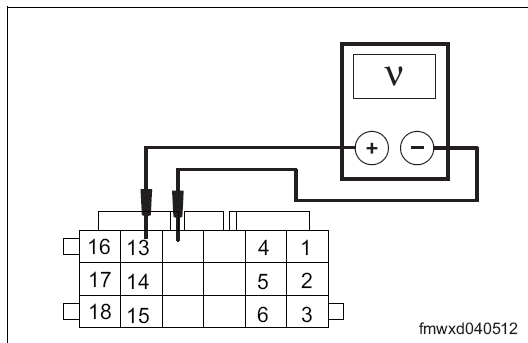
- (c). Inspect wheel hub bearings.

04

Is the inspection result normal?

Yes $>$ see Step 2

No $>$ reinstall or replace sensor of right front wheel, ring gear and wheel hub bearings.

2. Inspect sensor harness of right front wheel

- (a). Turn off the ignition switch.
- (b). Disconnect connector Z009 of ABS control Unit.
- (c). Rotate the car wheels and keep the speed at over 30 r/min.
- (d). Use the multi-meter to measure sensor induced voltage between pin 10 and pin 13 of connector Z009.

Voltage: $> 0.30 \text{ V}$

Is the inspection result normal?

Yes $>$ replace ABS control unit

No $>$ repair or replace the harness

4-1 Short Circuit or Open Circuit of Sensor in Right Front Wheel

4-2 Short Circuit or Open Circuit of Sensor in Left Front Wheel

4-3 Short Circuit or Open Circuit of Sensor in Right Rear Wheel

4-4 Short Circuit or Open Circuit of Sensor in Left Rear Wheel

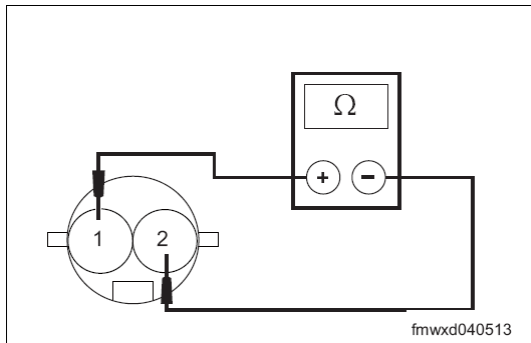
04

Circuit Diagram

Refer to "ABS System - 3-1 Large Gap and Weak Signal of Sensor in Right Front Wheel - Circuit Diagram".

Diagnostic Steps

1. Inspect sensor of right front wheel



- (a). Turn off the ignition switch.
- (b). Disconnect connector Z006 of sensor of right front wheel.
- (c). Measure resistance of sensor in right front wheel.

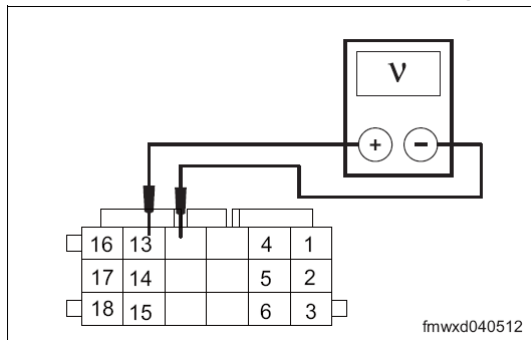
Resistance: $1175 \pm 75 \Omega$

Is the inspection result normal?

Yes > see Step 2

No > replace the sensor

2. Inspect sensor harness of right front wheel



- (a). Turn off the ignition switch.
- (b). Disconnect connector Z009 of ABS control Unit.
- (c). Rotate the car wheels and keep the speed at over 30 r/min.
- (d). Use the multi-meter to measure sensor induced voltage between pin 10 and pin 13 of connector Z009.

Voltage: > 0.30 V

Is the inspection result normal?

Yes > replace ABS control unit

No > repair or replace the harness

5-1 Unstable Signal of Sensor in Right Front Wheel

5-2 Unstable Signal of Sensor in Left Front Wheel

5-3 Unstable Signal of Sensor in Right Rear Wheel

5-4 Unstable Signal of Sensor in Left Rear Wheel

Circuit Diagram

Refer to "ABS System - 3-1 Large Gap and Weak Signal of Sensor in Right Front Wheel - Circuit Diagram".

04

Diagnostic Steps**1. Inspect the ring gear**

- (a). Inspect whether axial runout of ring gear is beyond range of deviation.

Conjoint rate of locating face: > 75%

Tick volume of tooth face: < 0.06 mm

- (b). Inspect whether upper teeth in every part of the ring gear are the same.
(c). Inspect whether the ring gear is broken.

Is the inspection result normal?

Yes > see Step 2

No > reinstall or replace the ring gear

2. Inspect the installation position of sensor

- (a). Inspect whether the sensor is installed properly.

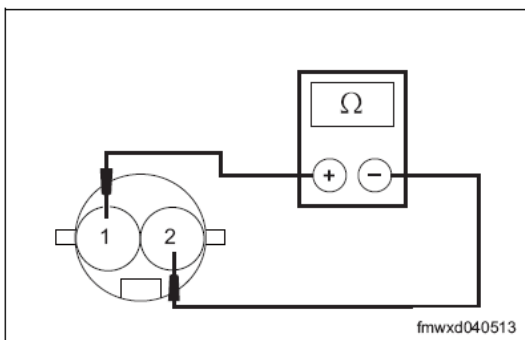
The axial direction of sensor is perpendicular to radial direction of ring gear with largest angular deviation: $< \pm 2.5^\circ$, and head touching ring gear.

- (b). Inspect whether the sensor type is right.
(c). Inspect wheel hub bearings.

Is the inspection result normal?

Yes > see Step 3

No > reinstall or replace sensor of right front wheel, ring gear and wheel hub bearings.

3. Inspect sensor of right front wheel

- (a). Turn off the ignition switch.
(b). Disconnect connector Z006 of sensor of right front wheel.
(c). Measure resistance of sensor of right front wheel.

Resistance: $1175 \pm 75 \Omega$

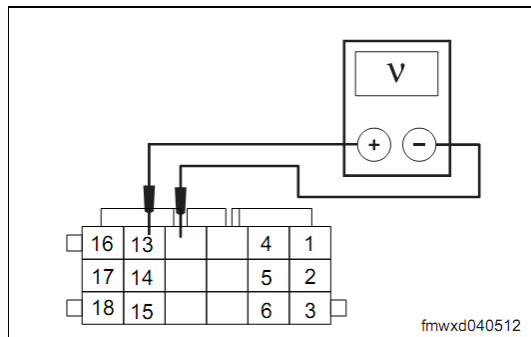
Diagnosis - ABS System

Is the inspection result normal?

Yes > see Step 4

No > replace sensor

4. Inspect sensor harness of right front wheel



- (a). Turn off the ignition switch.
- (b). Disconnect connector Z009 of ABS control Unit.
- (c). Rotate the car wheels and keep the speed at over 30 r/min.
- (d). Use the multi-meter to measure sensor induced voltage between pin 10 and pin 13 of connector Z009. Sensor induced voltage.

Voltage: > 0.30 V

Is the inspection result normal?

Yes > replace ABS control unit

No > repair or replace the harness

6-1 Ring Gear Fault of Right Front Wheel

6-2 Ring Gear Fault of Left Front Wheel

6-3 Ring Gear Fault of Right Rear Wheel

6-4 Ring Gear Fault of Left Rear Wheel

Diagnostic Steps

1. Inspect the ring gear

- (a). Inspect whether axial runout of ring gear is beyond range of deviation.

Conjoint rate of locating face: > 75%

Tick volume of tooth face: < 0.06 mm

- (b). Inspect whether upper teeth in every part of the ring gear are the same.

- (c). Inspect whether the ring gear is broken.

Is the inspection result normal?

Yes > see Step 2

No > reinstall or replace the ring gear

2. Inspect the installation position of sensor

- (a). Inspect whether the sensor is installed properly.

The axial direction of sensor is perpendicular to radial direction of ring gear with largest angular deviation: $< \pm 2.5^\circ$, and head touching ring gear.

- (b). Inspect wheel hub bearings.

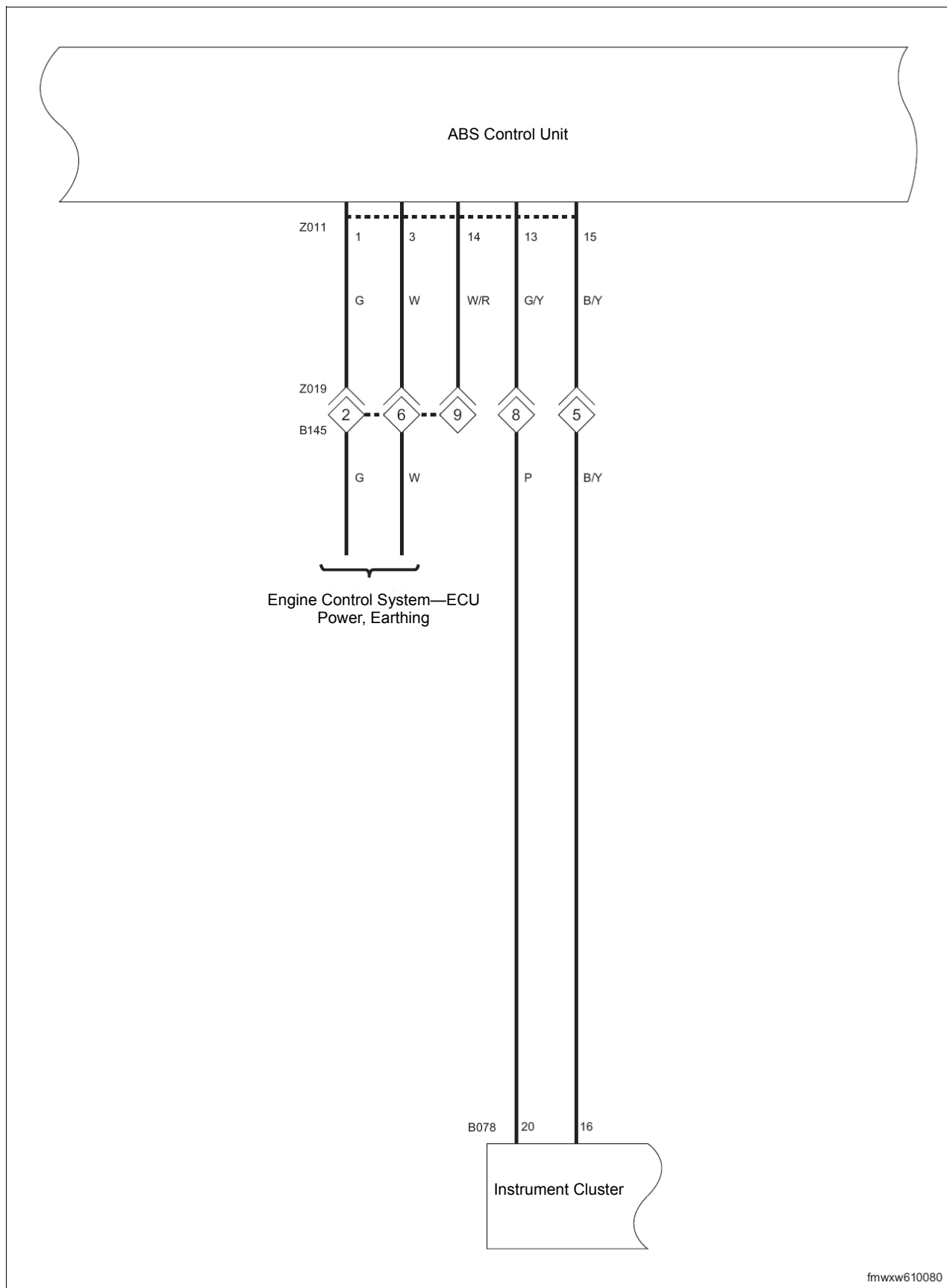
Is the inspection result normal?

Yes > replace ABS control unit

No > reinstall or replace sensor of right front wheel, ring gear and wheel hub bearings.

7-4 No Response of ABS Warning Lamp

Circuit Diagram



Diagnostic Steps**1. Inspect the flash code switch**

- (a). Whether the pressing time of flash code switch is too long.
Time: < 16 s
- (b). Inspect whether flash code switch can return automatically.

Is the inspection result normal?

Yes > see Step 2

No > re-operate flash code switch; repair or replace flash code switch

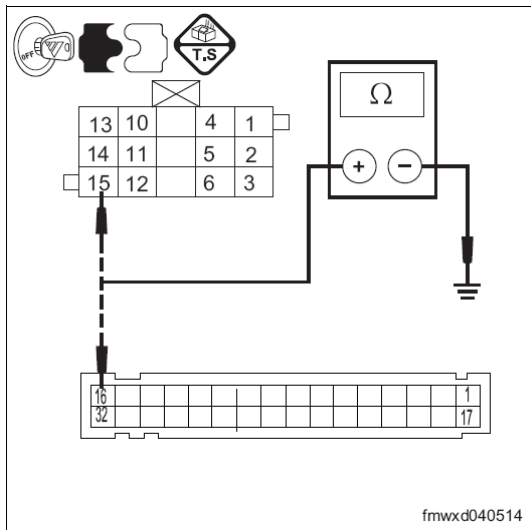
2. Inspect ABS warning lamp

- (a). Turn on the ignition switch.
- (b). Inspect whether ABS warning lamp is lit up (keep lighting or fail to light up).

Inspect whether ABS warning lamp is lit up?

Yes > see Step 3

No > see Step 4

3. Inspect harness short circuit of ABS warning lamp

- (a). Turn off the ignition switch.
- (b). Disconnect instrument cluster connector B078 and connector Z011 of ABS control unit.
- (c). Use the multi-meter to measure resistance between pin 16 of instrument cluster connector B078 and pin 15 of connector Z011 of ABS control unit.

Resistance: > 10 MΩ

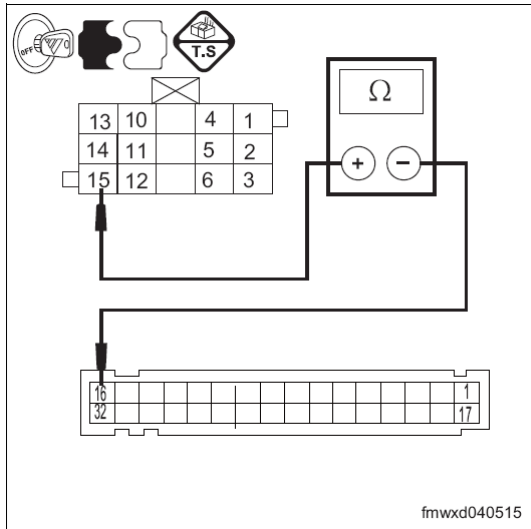
Is the inspection result normal?

Yes > see Step 5

No > repair or replace the harness

4. Inspect harness open circuit of ABS warning lamp

Diagnosis - ABS System



- Turn off the ignition switch.
- Disconnect instrument cluster connector B078 and connector Z011 of ABS control unit.
- Measure resistance between pin 16 of instrument cluster connector B078 and pin 15 of connector Z011 of ABS control unit.

Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > see Step 6

No > repair or replace the harness

5. Inspect the warning lamp bulb

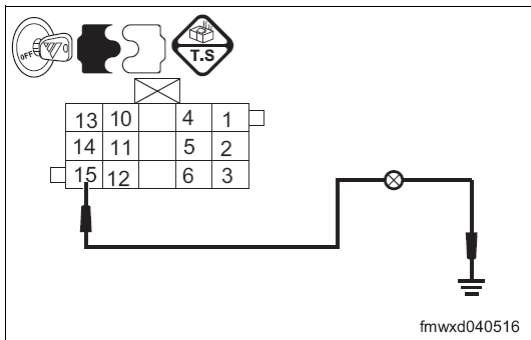
- Disconnect instrument cluster **B078** connector.
- Inspect whether **ABS** warning lamp is lit.

Whether the ABS warning lamp is lit?

Yes > replace the warning lamp bulb

No > replace ABS control unit

6. Inspect the warning lamp bulb



- Turn off the ignition switch.
- Disconnect ABS control unit connector Z011.
- Connect the tested lamp to ABS control unit connector Z011 pin 15.
- Turn on the ignition switch and inspect whether the tested lamp will be lit.

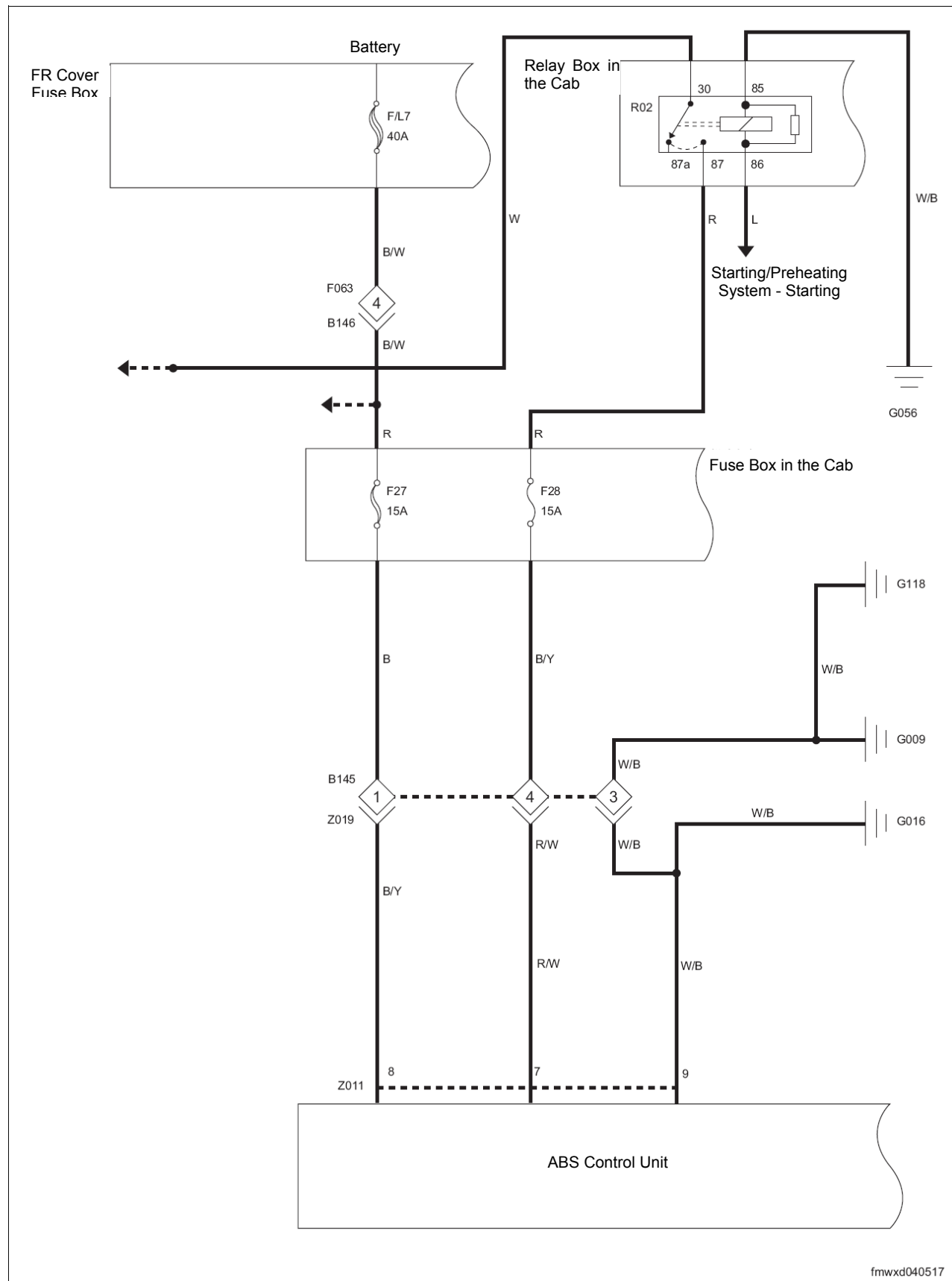
Whether the tested lamp will be lit?

Yes > replace ABS control unit

No > replace the warning lamp bulb

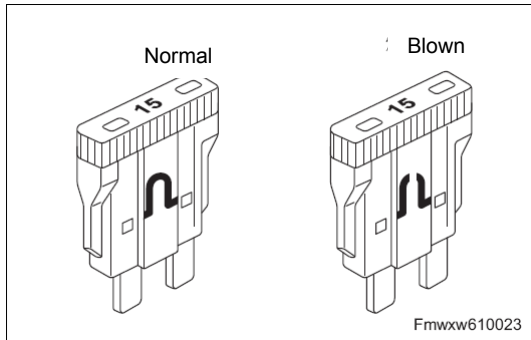
8-1 ECU Diagonal Low Voltage

Circuit Diagram



Diagnosis - ABS System**Diagnostic Steps****1. Inspect fuses F27, F28**

(a). Switch off general power supply.



(b). Inspect the fuses in the fuse box in the cab: F27, F28 (15A)

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Is the inspection result normal?

Yes > see Step 2

No > overhaul the fuse circuit and replace it with the rated fuse

2. Inspect battery voltage

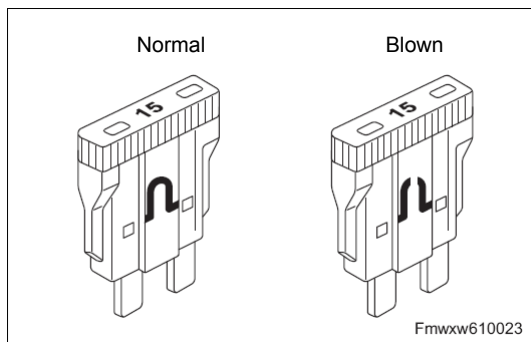
(a). Inspect battery voltage, refer to Chapter 53, Battery – Battery, Detection and Adjustment.

(b). Inspect charging voltage, refer to Chapter 19, Charging System – Charging System, Detection and Adjustment.

Is the inspection result normal?

Yes > see Step 3

No > replace the battery or generator

3. Inspect ABS control unit power circuit

(a). Turn on the ignition switch.

(b). Inspect the pressure between pins 7 and 8 of the connector Z011 of the ABS control unit and the earth.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the ABS control unit

No > overhaul ABS control unit power circuit

8-2 Overpressure of ECU Diagonal 1 or 2, All Valves Fail

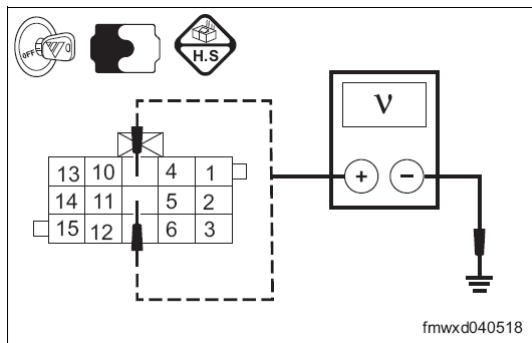
Circuit Diagram

Refer to "ABS System – ECU Diagonal Low Voltage, Circuit Diagram"

Diagnostic Steps

1. Inspect ABS control unit power circuit

(a). Start the engine.



(b). Use multi-meter to measure the resistance between pins 7 and 8 of the connector Z011 of the ABS control unit and the earth.

Voltage standard value: 24V < charging voltage < 30V

Is the inspection result normal?

Yes > replace ABS control unit

No > overhaul the charging system, refer to Chapter 19, Charging System – Charging System, Detection and Adjustment

8-3 ECU Internal Fault

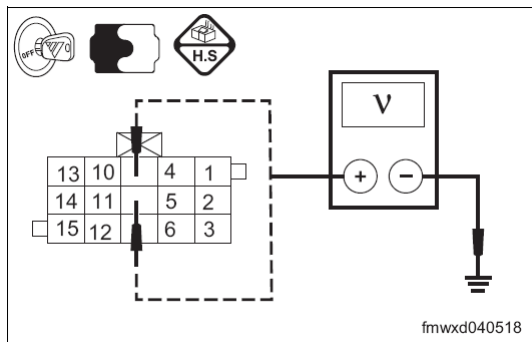
Circuit Diagram

Refer to “ABS System – ECU Diagonal Low Voltage, Circuit Diagram”

Diagnostic Steps

1. Inspect ABS control unit power circuit

(a). Start the engine.



(b). Use multi-meter to measure the resistance between pins 7 and 8 of the connector Z011 of the ABS control unit and the earth.

Voltage standard value: 24V < charging voltage < 30V

Is the inspection result normal?

Yes > see Step 2

No > overhaul the charging system, refer to Chapter 19, Charging System – Charging System, Detection and Adjustment

2. Read the fault code.

(a). Erase the fault code.

(b). Read the fault code.

Whether the fault code will appear repeatedly?

Yes > replace the ABS control unit

No > system is normal

ABS System Fault

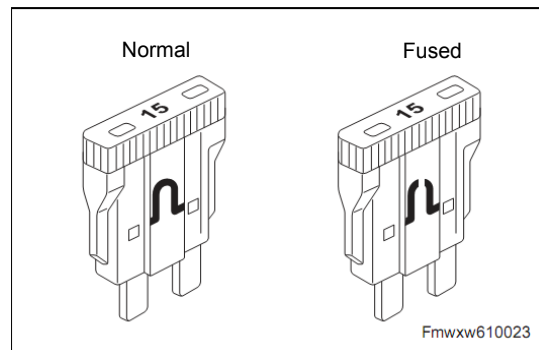
Circuit Diagram

Refer to "ABS System – ECU Diagonal Low Voltage, Circuit Diagram"

Diagnostic Steps

1. Inspect fuses F27, F28

(a). Switch off general power supply.



(b). Inspect the fuses in the fuse box in the cab: F27, F28 (15A).

Standard voltage value: 24V < charging voltage < 30V

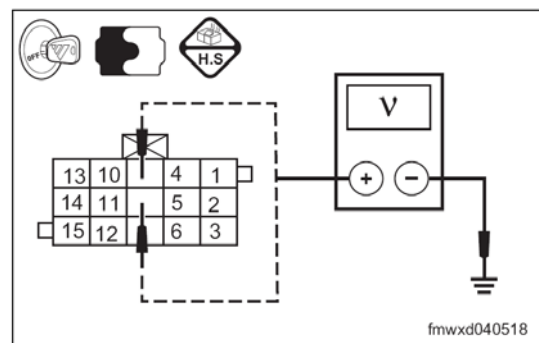
Is the inspection result normal?

Yes > see Step 2.

No > overhaul the fuse circuit and replace it with the rated fuse

2. Inspect ABS control unit power circuit

(a). Start the engine.



(b). Use multi-meter to measure the resistance between pins 7 and 8 of the connector Z011 of the ABS control unit and the earth.

Standard voltage value: 24V < charging voltage < 30V

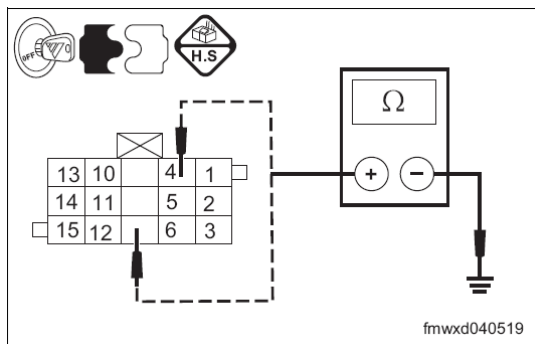
Is the inspection result normal?

Yes > see Step 3

No > repair or replace the harness

3. Inspect ABS control unit earthed circuit

(a). Turn off ignition switch

Diagnosis - ABS System

- (b). Use multi-meter to measure the resistance between pins 4 and 9 of the connector Z011 of the ABS control unit and the earth.

Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace the ABS control unit

No > repair or replace the harness

Heater & Air Conditioner

Precautions

Relevant procedures, regulations and cautions shall be followed in maintenance of air conditioning system.

- Keep the working area clean.
- Protective goggles and gloves shall be worn when operating the cooling system.
- Pay attention to the harm of carbon monoxide generated when starting the engine.
- Pay attention to the discharged coolant in the enclosed or unventilated garage.
- Normally disconnect the negative cables of the battery, discharge and recover the coolant when repairing the air conditioning system.
- When discharging and recovering the coolant, do not discharge too fast for it will take the compressor oil out of the system.
- Discharge the moisture and pollutant out of the system. When disconnecting or dismantling any pipeline or component, immediately cover the joint with a plug or cover.
- The cover or plug shall not be dismantled in reconnection or installation.
- When the pipeline is disconnected or reconnected, two wrenches shall be used to support the pipeline joint to prevent distortion or any other damages.
- New O-ring shall be installed whenever dismantling the joint.
- Use new specified compressor oil to mop the O-ring when connecting any hose or pipeline.
- The compressor (PAG) oil used shall verify according to different compressor models. The specified compressor oil to the model must be mopped.
- When dismantling and replacing the components required to discharge the coolant circuit, the order below shall be followed to conduct specified operations of the chapter:
 1. Coolant recovery/recycle/filling system or similar device shall discharge and recover the coolant completely.
 2. Dismantle and replace damaged components.
 3. After discharging, the air conditioning system shall be filled with coolant and inspected for leakage.

The coolant, a chemical mixture, shall follow special management regulations to prevent harm to any personnel.

- Normally wear protective goggles and gloves.
- Normally work in a ventilated environment. No welding or steam cleaning may be conducted on any vehicle-mounted air condition pipeline or part (or places nearby).
- If anyone has physical contact with R-134a to any part of his body, cooling water must be used to wash the contacted part and seek medical assistance immediately.
- If any R-134a container needs to be transported or moved by vehicle, do not place it inside the carriage.
- If R-134a needs to be filled from bigger container to smaller one, it shall, by no means, be filled. Normally leave a space for expansion above the level.
- R-134a containers shall be stored under 40°C(100°F) condition.

Warning:

- **If your eyes have physical contact with R-134a, seek medical assistance immediately.**
- **Do not wipe the infected eye. Use lots of fresh water to wash the infected part so as to let the coolant temperature rise to its condensation point.**
- **Seek for correct medical treatment as much as possible. If your skin touches R-134a, treatment for cold injury must be used at once to the injured part.**

Diagnosis - Heater & Air Conditioner**Basic Inspection****Test the Cooling System**

Step	Scope of Inspection	Measure	
1	Inspect the outer surface of the radiator and condenser Inspect the outer surface of the radiator and condenser And make sure the air flow is not blocked by dust, leaves or any other objects. Inspect the space between the radiator and condenser and all the outer surface. Is the inspection result normal?	Yes	See Step 2
		No	See Fault Symptom Table
2	Inspect condenser element and hose Inspect whether the condenser element, hose and connecting pipe is blocked or twisted. Is the inspection result normal?	Yes	See Step 3
		No	See Fault Symptom Table
3	Inspect blower volume Inspect whether blower volume is normal. Is the inspection result normal?	Yes	See Step 4
		No	See Fault Symptom Table
4	Inspect all air pipes for leakage or blockage Inspect all air pipes for leakage or blockage. Small air flow volume probably means blockage to evaporator element. Is the inspection result normal?	Yes	See Step 5
		No	See Fault Symptom Table
5	Inspect compressor clutch Inspect whether the compressor clutch slips. Is the inspection result normal?	Yes	See Step 6
		No	See Fault Symptom Table
6	Inspect accessory driving belt Inspect the tension of accessory driving belt. Is the inspection result normal?	Yes	See Fault Symptom Table
		No	Adjust driving belt tension

Fault Symptom Table

Use the following table to help you find the fault. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

The heater does not generate heat

Fault Symptom Table	Possible Cause	Reference
No heat	1. Coolant of the engine (low level)	Add refrigeration
	2. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	3. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	4. Air duct(blocked)	Ventilate the air duct
	5. Blower(damaged)	Chapter 51 Heater & Air Conditioner -Heater, Overhaul
	6. Heater core and/or hose (blocked)	Chapter 51 Heater & Air Conditioner -Heater, Overhaul
	7. Engine(lower water temperature)	Overhaul the engine cooling system
	8. Air duct/hose (unaligned)	Reinstall the air duct/hose
Over heat	1. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	2. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	3. Engine(too hot)	Overhaul the engine cooling system

The air heating system generates too much noise

Fault Symptom	Possible Cause	Reference
Sound of cackles	1. Refrigeration of the engine (low liquid level)	Chapter 51 Heater & Air Conditioner -Coolant, Overhaul
	2. Engine(too hot)	Overhaul the engine cooling system

Diagnosis - Heater & Air Conditioner**Cooling System Fails**

Fault Symptom	Possible Cause	Reference
Not generating cooling or generate insufficient cooling	1. Solenoid clutch (not functioning)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	2. Fin of the solenoid clutch (filthy substance causes slipping)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	3. Driving belt (loosened or ruptured)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	4. compressor (stuck)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	5. Refrigeration oil (leakage)	Chapter 51 Heater & Air Conditioner- Coolant, Overhaul
	6. Coolant (insufficient or excessive)	Chapter 51 Chapter 51 Heater & Air Conditioner- Coolant, Overhaul
	7. Cooling system (leakage)	Chapter 51 Heater & Air Conditioner-Air Conditioner Pipe, Overhaul
	8. Condenser (blocked or insufficient radiation)	Chapter 51 Heater & Air Conditioner- Condenser, Overhaul
	9. Temperature control knob (damaged)	Chapter 51 Heater & Air Conditioner- Air Conditioner Control Switch, Overhaul
	10. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner- -Heater Overhaul
	11. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner- Heater, Overhaul
	12.Expansion valve(blockage)	Chapter 51 Heater & Air Conditioner- Evaporator, Overhaul
Insufficient air flow rate	1. Evaporator(blocked or frosted)	Chapter 51 Heater & Air Conditioner- Evaporator, Overhaul
	2. Air duct(air leakage)	Replace the air duct
	3. Blower(damaged)	Chapter 51 Heater & Air Conditioner- Blower, Overhaul

Interrupted Cooling

Fault Symptom	Possible Cause	Reference
Interrupted air flow	1. Blower(damaged)	Chapter 51 Heater & Air Conditioner-Blower, Overhaul
	2. Air duct(blocked)	Ventilate the air duct
Interrupted operation of the compressor	1. Belt(slipped)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	2. Solenoid clutch(damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	3. Compressor(damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	4. Three-state pressure switch(damaged)	Chapter 51 Heater & Air Conditioner- Fluid Reservoir, Overhaul
Blower and compressor operate normally with interrupted cooling	1. Temperature sensor kit(loosened)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	2. Expansion valve(ice blocked)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	3. Intermittent system foreign substance blockage	Ventilate or change relevant pipes

Diagnosis - Heater & Air Conditioner**Cooling System Generates Too Much Noise**

Fault Symptom	Possible Cause	Reference
System external noise	1. Belt (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	2. Compressor bracket (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	3. Compressor (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	4. Solenoid clutch(slipped)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	5. Refrigeration oil (too little or none)	Chapter 51 Heater & Air Conditioner-Refrigeration oil, Overhaul
	6. Blower (damaged)	Chapter 51 Heater & Air Conditioner-Blower, Overhaul
System internal noise	1. Coolant (insufficient or too much)	Chapter 51 Heater & Air Conditioner-Coolant, Overhaul
	2. Expansion valve (water vapor in the system)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	3. Compressor vibrates (high pressure too high)	Chapter 51 Heater & Air Conditioner-Coolant, Overhaul

Air Conditioner Insufficient Cooling

Diagnostic Steps

1. Inspect the air temperature on the dashboard measured at the air conditioner outlet

- (a). Start the engine at 2,000 rpm rotation speed and measure the air temperature on the dashboard at the air conditioner outlet.

Whether the air temperature on the dashboard measured at the air conditioner outlet is excessive?

Yes > conduct the following maintenance and adjustment and make sure that the system is normal.

- Switch to internal cycling.
- Move the vehicles to cool places.
- Adjust external cycling damper structure and switch to internal & external cycling damper mechanical structure and intake damper adjustment motor if necessary.
- Repair bleed door motor and make replacement if necessary.

No > see Step 2

2. Inspect the air outlet volume on the dashboard measured at the air conditioner outlet

- (a). Inspect the air outlet volume status on the dashboard measured at the air conditioner outlet

Whether the air outlet volume on the dashboard measured at the air conditioner outlet is insufficient?

Yes > conduct the following maintenance and adjustment and make sure that the system is normal.

- Clean and overhaul dashboard air outlet and make replacement if necessary.
- Overhaul the circuit.
- Overhaul air direction control structure and make replacement if necessary.
- Overhaul air inlet damper motor and make replacement if necessary.
- Overhaul blower motor and make replacement if necessary.
- Replace blower speed regulation module.
- Overhaul backup motor and make replacement if necessary.
- Overhaul bleed door motor and make replacement if necessary.
- Overhaul air volume switch and make replacement if necessary.

No > see Step 3

3. Inspect coolant pressure

- (a). Connect air conditioner pressure measure, start the engine, idle the speed and measure the pressures at high and low pressures of the air conditioning system.

Standard system pressure value:

Low pressure: 20~40MPa

High pressure: 160~200Mpa

Whether the coolant pressure conforms to the regulations?

No > conduct the following maintenance and adjustment and make sure that the system is normal.

Diagnosis - Heater & Air Conditioner

- If both the high and low pressures of the air conditioner are excessive , overhaul the pipeline tightness of the cooling system and pay precautions to add coolant; discharge excessive coolant and Refrigeration oil; replace the expansion valve.
- If the high pressure of the air conditioner is excessive and low pressure is insufficient, clean and replace blocked high pressure pipe; replace the expansion valve.
- If the high pressure of the air conditioner is insufficient but low pressure is excessive, supplement Refrigeration oil, overhaul or replace the compressor.
- If both the high and low pressures of the air conditioner are insufficient, overhaul and replace the leaking components of the air conditioning system and add coolant to the regulated standard of the manufacturer.
- If the high pressure of the air conditioner is insufficient and vacuum at low pressure, replace the reservoir drying bottle and the expansion valve, clean or replace the blocked low pressure pipes, extend the time for pumping the vacuum and add air conditioner coolant to the regulated standard of the manufacturer.

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Yes > see Step 4**4. Inspect the working state of the compressor**

- (a). Compressor belt working state.
- (b). Compressor clutch working state.
- (c). Compressor working state.

Whether the system function is normal?**No > conduct the following maintenance and adjustment and make sure that the system is normal.**

- Adjust compressor belt and make replacement if necessary.
- Inspect the volume of coolant and lubrication oil and make supplement if necessary.
- Overhaul compressor clutch circuit.
- Overhaul compressor clutch and make replacement if necessary.
- Overhaul coolant pressure switch and make replacement if necessary.
- Overhaul air conditioner temperature control switch and make replacement if necessary.
- Overhaul the compressor and make replacement if necessary.
- Overhaul air direction control panel and make replacement if necessary.

Yes > see Step 5**5. Inspect condenser temperature**

- (a). Inspect condenser radiating state.

Whether the system function is normal?**No > conduct the following maintenance and adjustment and make sure that the system is normal.**

- Overhaul and clean the condenser and make replacement if necessary.

Yes > see Step 6**6. Inspect the water temperature of the engine**

- (a). Conduct following inspections:
 - Engine operation time with idling speed.
 - Engine operation time in big workload.
 - Adding volume of the coolant.

- Coolant performance.
 - Thermostat performance.
 - Engine working state.
 - Cooling blower working state.
 - Water tank radiating state.
 - Cooling blower cowl working state.
- (b). According to inspection, conduct the following maintenance and adjustment and make sure that the system is normal.
- Reduce engine operation time with idling speed.
 - Reduce engine operation time in big workload.
 - Overhaul coolant leaking status and add coolant to standard amount.
 - Replace with coolant satisfactory to the manufacturer's requirements.
 - Replace the thermostat.
 - Overhaul cooling blower cowl and make replacement if necessary.
 - Overhaul and clean the cooling water tank and make replacement if necessary.
 - Overhaul cooling blower motor and its circuit and make replacement if necessary.
 - Overhaul engine cooling system.
 - Overhaul engine working state.

Air Conditioner Insufficient Heating

Diagnostic Steps

1. Inspect the water temperature of the engine

- (a). Inspect the water temperature of the engine

Whether the water temperature of the engine reaches 82°C?

Yes > see Step 2

No > conduct the following maintenance and adjustment and make sure that the system is normal.

- Extend engine operation time.
- Exhaust the air inside the cooling system.
- Overhaul and replace the thermostat.
- Overhaul and adjust the engine working state.
- Overhaul whether the condenser blower is rotating normally.

2. Inspect temperature damper working state

- (a). Inspect air conditioner temperature damper working state.

Whether the damper working state is normal?

Yes > see Step 3

No > conduct the following maintenance and adjustment and make sure that the system is normal.

- Adjust temperature damper structure and replace the bleed door adjustment motor and mechanical structure if necessary.
- Overhaul air duct, repair and replace the leaking air duct.
- Overhaul air conditioner temperature damper switch and make replacement if necessary.
- Overhaul the circuit between the air conditioner damper switch and bleed door motor and make replacement if necessary.

3. Inspect internal & external cycling damper working state

- (a). Inspect air conditioner internal & external cycling damper working state.

Whether the internal & external cycling damper working state is normal?

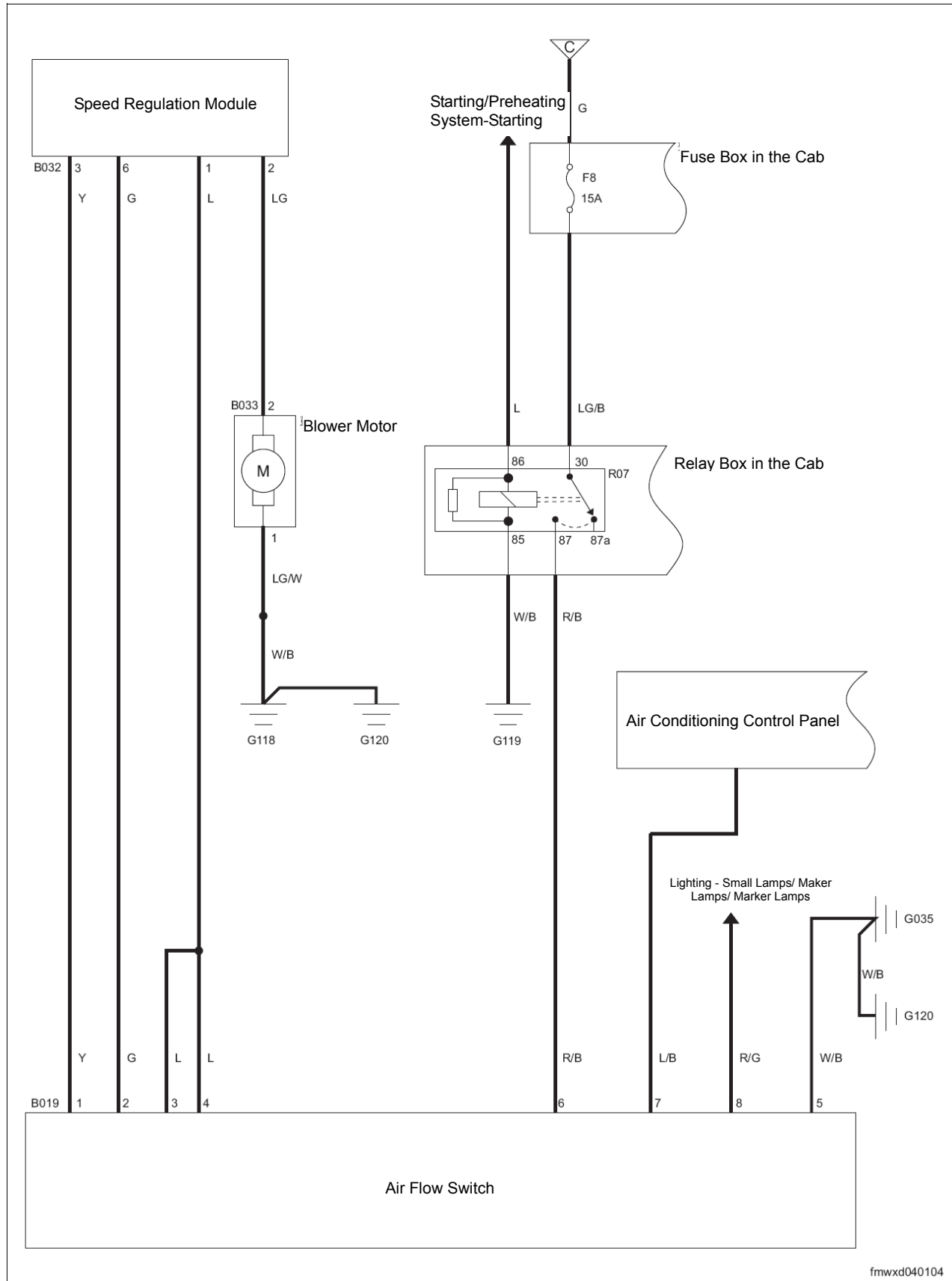
Yes > make sure that the system is normal

No > conduct the following maintenance and adjustment and make sure that the system is normal.

- Switch to internal cycling mode.
- Adjust the internal & external cycling damper structure.
- Overhaul and replace intake damper motor and mechanical structure.
- Overhaul air conditioner control panel and make replacement if necessary.

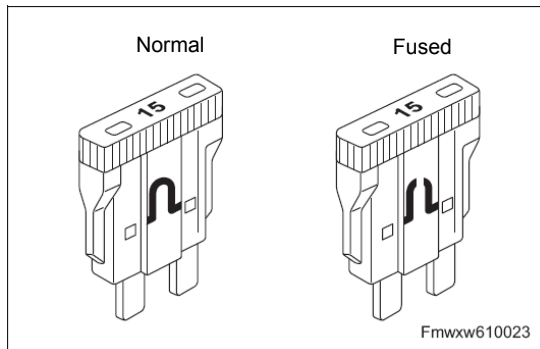
Blower Fails to Work

Circuit Diagram



Diagnosis - Heater & Air Conditioner**Diagnostic Steps****1. Inspect the fuse**

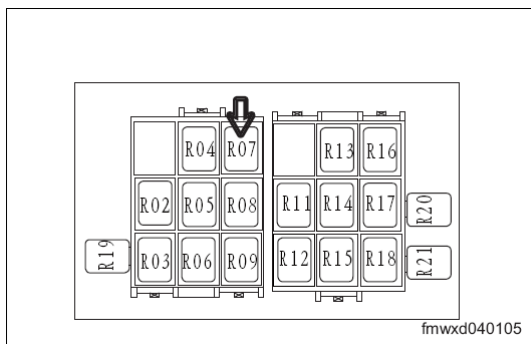
(a). Switch off general power.



(b). Inspect the fuse F8 (15A) in the fuse box in the cab.

Inspect whether the structure is normal?**Yes > see Step 2****No > overhaul the fuse circuit and replace with rated fuse****2. Inspect the blower relay R07**

(a). Switch on general power supply.



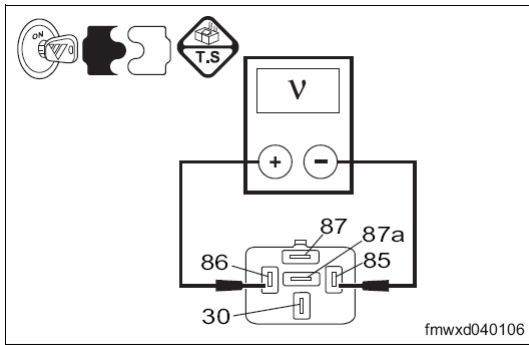
(b). Repeatedly turn on the ignition switch to inspect whether the blower relay R07 in the relay box in the cab is working.

Is the inspection result normal?**Yes > see Step 4****No > see Step 3****3. Inspect the coil control circuit and electric shock circuit of relay R07**

(a). Switch off general power.

(b). Dismantle the relay R07.

(c). Switch on general power supply and the ignition switch.



- (d). Use the multi-meter to measure respectively the voltage between pin 86, 30 and 85 of the blower relay's connector.

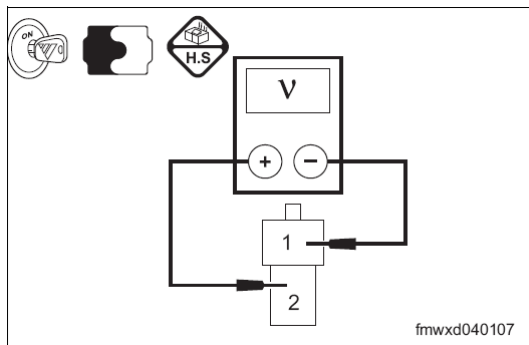
Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the relay

No > repair or replace the wiring harness

4. Inspect the voltage between pin 2 and 1 of the blower motor's connector B033



- (a). Turn the air conditioner's blowing rate switch from position 1 to 4 and use the multi-meter to measure the voltage between pin 2 and 1 of the blower motor's connector B033 .

Standard voltage value: the voltage of position 4 is the battery voltage while the voltage from position 3 to 1 changes correspondingly

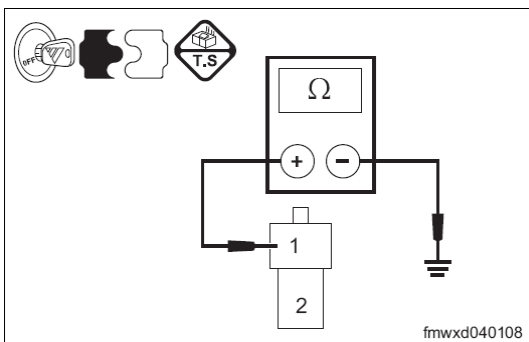
Is the inspection result normal?

Yes > replace the blower motor

No > see Step 5

5. Inspect the blower's earthed circuit

- (a). Disconnect the blower motor's connector B033.
(b). Inspect the blower motor's earthed circuit.



- (c). Use the multi-meter to measure the resistance between pin 1 of the blower motor's connector B033 and the effective earthing point of the vehicle body.

Resistance $\leq 2 \Omega$

Diagnosis - Heater & Air Conditioner

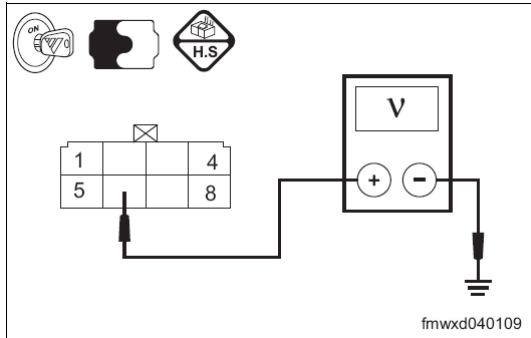
Is the inspection result normal?

Yes > see Step 6

No > repair or replace the wiring harness

6. Inspect the power circuit of the blowing rate switch

(a). Turn on the ignition switch.



(b). Use the multi-meter to measure the voltage between pin 6 of the blower motor's connector B033 and the effective earthing point of the vehicle body

Standard voltage value: battery voltage

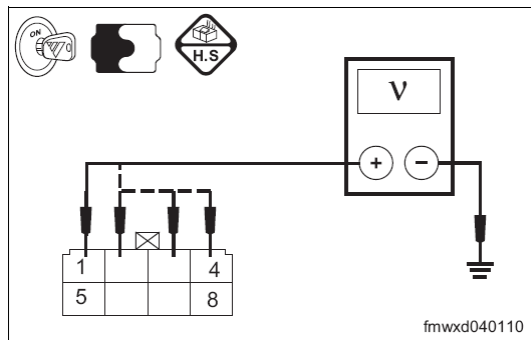
Is the inspection result normal?

Yes > see Step 7

No > repair or replace the wiring harness

7. Inspect the air-conditioner's blowing rate switch

(a). Inspect the air-conditioner's blowing rate switch.



- Turn the air conditioner's blowing rate switch to position 1 and use the multi-meter to measure voltage between pin 1 of the blowing rate switch's connector B019 and the effective earthing point of the vehicle body.
- Turn the air conditioner's blowing rate switch to position 2 and use the multi-meter to measure voltage between pin 2 of the blowing rate switch's connector B019 and the effective earthing point of the vehicle body.
- Turn the air conditioner's blowing rate switch to position 3 and use the multi-meter to measure voltage between pin 3 of the blowing rate switch's connector B019 and the effective earthing point of the vehicle body.
- Turn the air conditioner's blowing rate switch to position 4 and use the multi-meter to measure voltage between pin 4 of the blowing rate switch's connector B019 and the effective earthing point of the vehicle body.

Standard voltage value: the voltage of position 1/2/4 is the batter voltage while the voltage of position 3 is slightly different

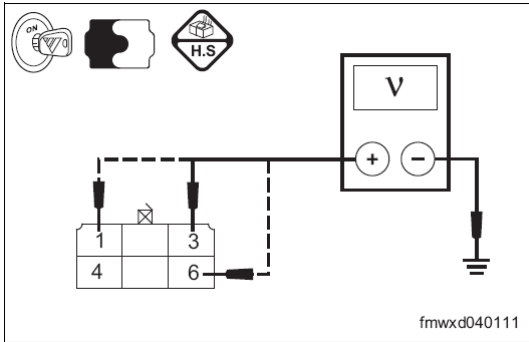
Is the inspection result normal?

Yes > see Step 8

No > replace the air conditioner's blowing rate switch

8. Inspect the circuit between the speed regulation module and the blowing rate switch

(a). Inspect the circuit between the speed regulation module and the blowing rate switch.



- Turn the blowing rate switch to position 1 to measure the voltage between pin 3 of the speed regulation module's connector B032 and the effective earthing point of the vehicle body.
- Turn the blowing rate switch to position 2 to measure the voltage between pin 6 of the speed regulation module's connector B019 and the effective earthing point of the vehicle body.
- Turn the blowing rate switch to position 3/4 to measure the voltage between pin 4 of the speed regulation module's connector B019 and the effective earthing point of the vehicle body.

Standard voltage value: the voltage of position 1/2/4 is the batter voltage while the voltage of position 3 is slightly different

Is the inspection result normal?

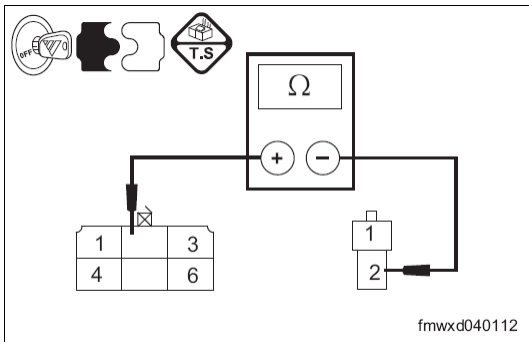
Yes > see Step 9

No > repair or replace the wiring harness

9. Inspect the circuit between the blower motor and the speed regulation module

(a). Disconnect the speed regulation module's connector B033.

(b). Disconnect the blower motor's connector B033.



- (c). Use the multi-meter to measure the resistance between pin 2 of the speed regulation module's connector B032 and the blower motor's connector B033 pin 2.

Resistance $\leq 2 \Omega$

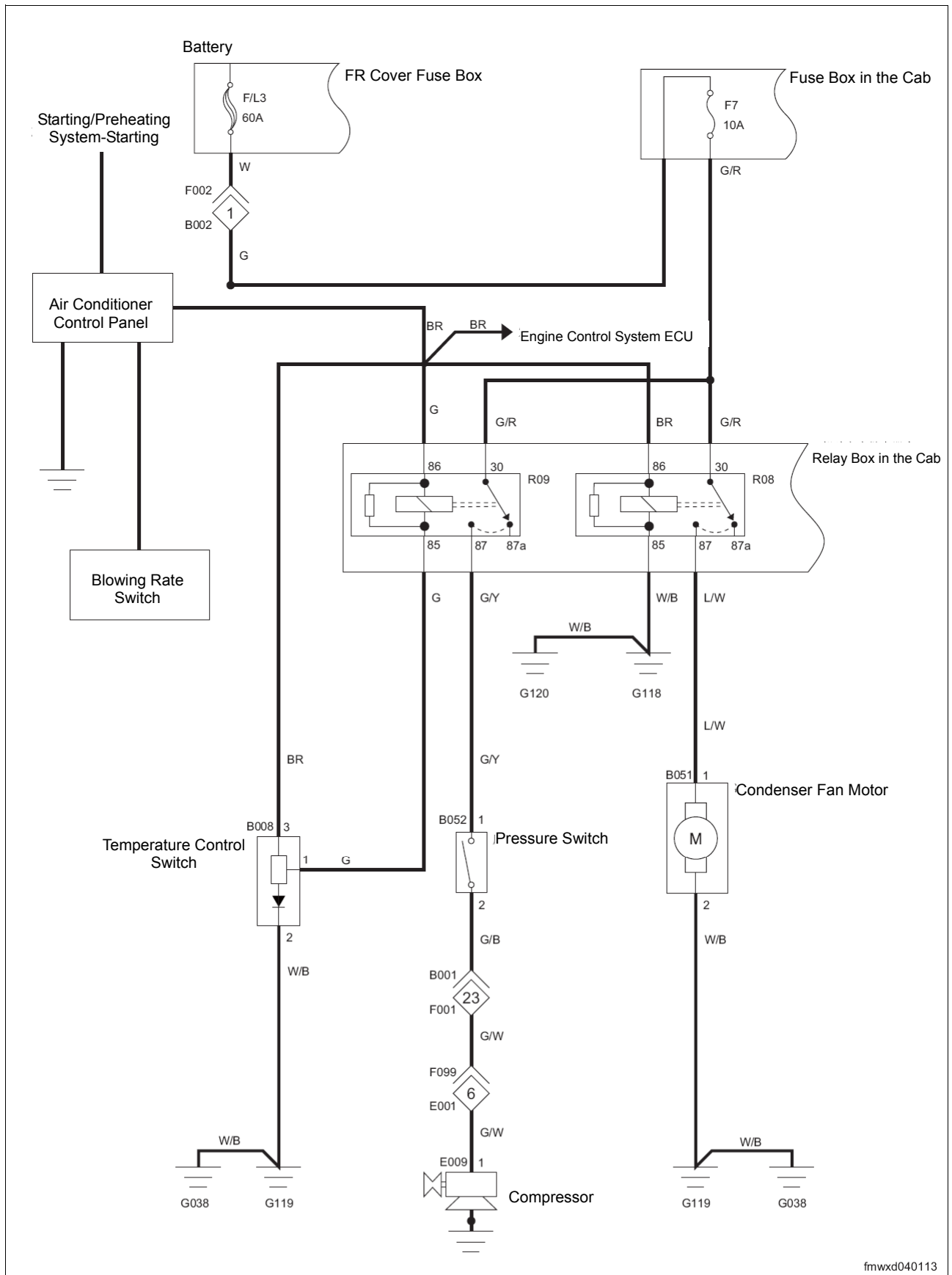
Is the inspection result normal?

Yes > replace the speed regulation module

No > repair or replace the wiring harness

Air Conditioner Compressor's Clutch Fails to Work

Circuit Diagram



fmwxd040113

Diagnostic Steps**1. Inspect the pressure of the air conditioning system**

- (a). Connect the air conditioning pressure gauge to measure the high and low pressure of the air conditioning system.

Standard pressure value of the air conditioning system:

Low pressure: 20~ 40MPa

High pressure: 160~ 200MPa

Whether the refrigerant pressure complies with the standard value?

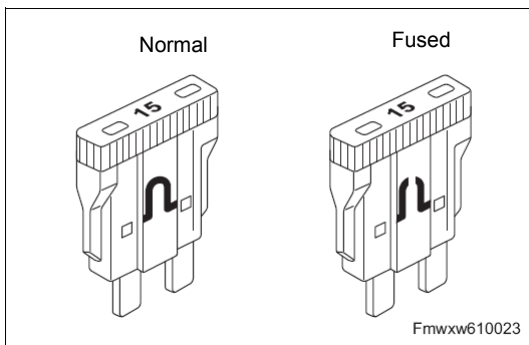
No > conduct the following maintenance and adjustment and make sure that the system is normal

- If the air conditioning high and low pressures are low, overhaul and replace the leaking components of the air conditioning system and add the refrigerant required by the manufacturer.

No > see Step 2

2. Inspect the fuse

- (a). Switch off general power supply.



- (b). Inspect the fuse F8 (15A) in the fuse box in the cab.

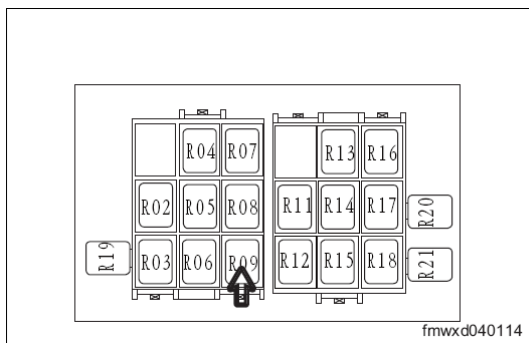
Is the inspection result normal?

No > overhaul the fuse circuit and replace with rated fuse

Yes > see Step 3

3. Inspect the compressor's relay R09

- (a). Switch on general power supply.



- (b). Repeatedly turn on the A/C switch to inspect whether the compressor's relay R09 is working.

Diagnosis - Heater & Air Conditioner

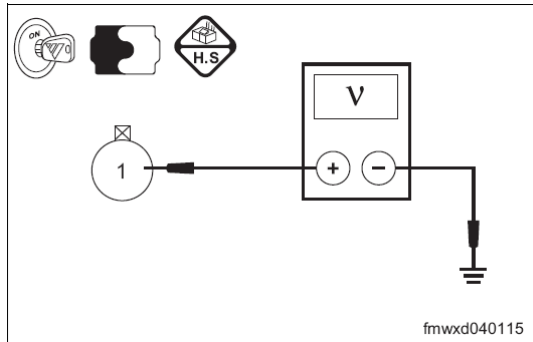
Is the inspection result normal?

Yes > see Step 4

No > see Step 8

4. Inspect compressor

(a). Start the engine and turn on the A/C switch and the blowing rate switch.



(b). Use the multi-meter to measure the voltage between pin 1 of the compressor's connector E009 and the effective earthing point of the vehicle body.

04

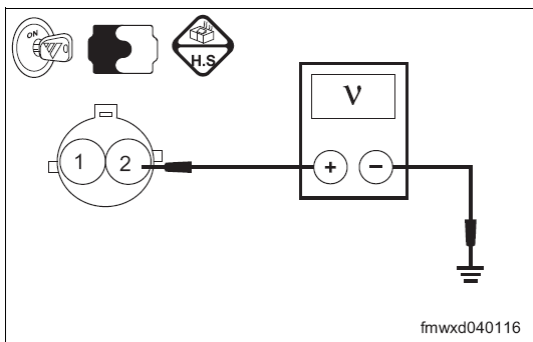
Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the compressor

No > see Step 5

5. Inspect the circuit between the pressure switch and the compressor



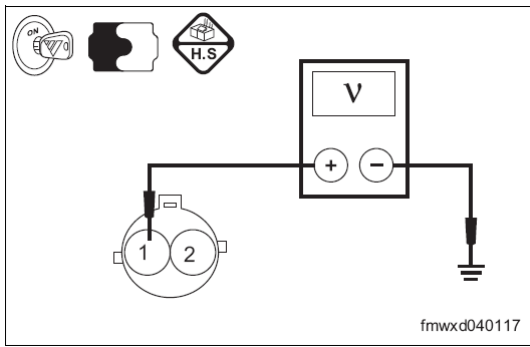
(a). Use the multi-meter to measure the voltage between pin 2 of the pressure switch's connector B052 and the effective earthing point of the vehicle body.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > repair or replace the wiring harness

No > see Step 6

6. Inspect the power circuit of the pressure switch

- (a). Use the multi-meter to measure the voltage between pin 1 of the pressure's connector B052 and the effective earthing point of the vehicle body.

Standard voltage value: battery voltage

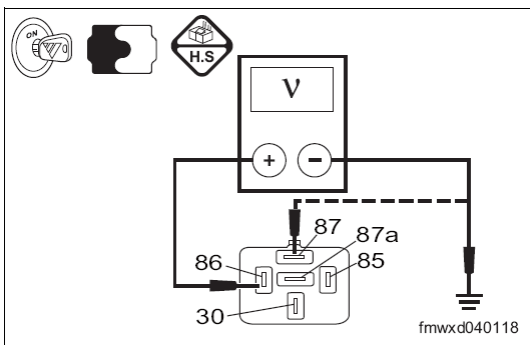
Is the inspection result normal?

Yes > replace the pressure switch

No > see Step 7

7. Inspect the compressor's relay R09

- (a). Switch off general power supply.
 (b). Dismantle the compressor's relay R09.
 (c). Switch on general power supply.



- (d). Use the multi-meter to measure the voltage between pin 30 of the connector of the compressor's relay R09 and the effective earthing point of the vehicle body.
 (e). Use the multi-meter to measure the voltage between pin 30 and 87 of the connector of the compressor's relay R09.

Standard voltage value: battery voltage

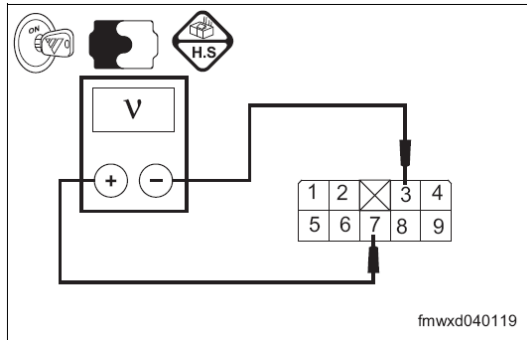
Is the inspection result normal?

Yes > see Step 8

No > repair or replace the wiring harness

8. Inspect the air conditioner panel's power and earthed circuit

- (a). Turn on the ignition switch.

Diagnosis - Heater & Air Conditioner

- (b). Use the multi-meter to measure the voltage between pin 7 and 3 of the connector B095 of the air conditioner's panel.

Standard voltage value: battery voltage

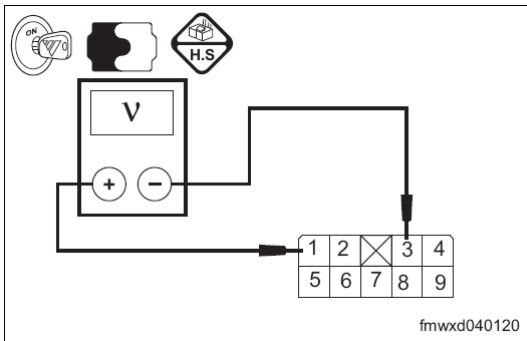
Is the inspection result normal?

Yes > see Step 9

No > repair or replace the wiring harness

9. Inspect the input signal of the blowing rate switch of the air conditioner's panel

- (a) Turn on the blowing rate switch of the blower.



- (b). Use the multi-meter to measure the voltage between pin 1 and 3 of the connector B095 of the air conditioner's panel.

Standard voltage value: battery voltage

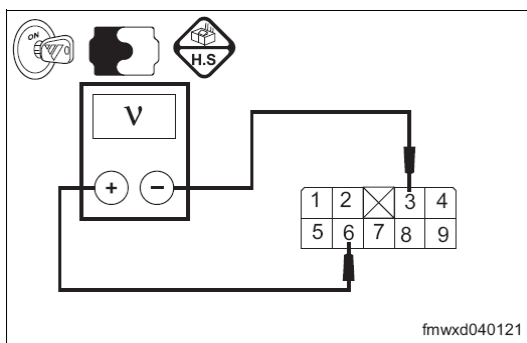
Is the inspection result normal?

Yes > see Step 10

No > repair the signal circuit or replace the blowing rate switch

10. Inspect the output signal of the air conditioner's panel

- (a). Turn on the A/C switch.



- (b). Use the multi-meter to measure the voltage between pin 6 and 3 of the connector B095 of the air conditioner's panel.

Standard voltage value: battery voltage

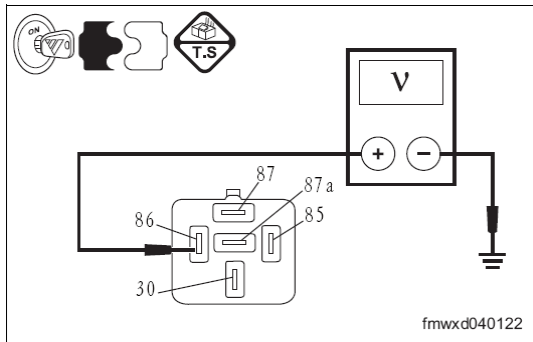
Is the inspection result normal?

Yes > see Step 11

No > replace the air conditioner's panel

11. Inspect the coil power circuit of the compressor's relay R09

- Switch off general power supply.
- Dismantle the compressor's relay R09.
- Switch on general power supply and the ignition switch.
- Turn on the A/C switch and the blowing rate switch and use the multi-meter to measure the voltage between pin 86 of the compressor's relay R09 and the effective earthing point of the vehicle body.



Standard voltage value: battery voltage

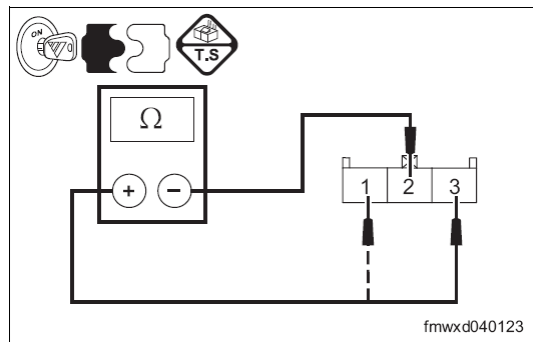
Is the inspection result normal?

Yes > see Step 12

No > repair or replace the wiring harness

12. Inspect the temperature control switch

- Turn off the A/C switch.
- Disconnect the connector B008 of the temperature control switch.
- Use the multi-meter to measure respectively the resistance between pin 3, 1 and 2 of the temperature control switch.



Standard value:

Condition	Pin Connected to Multi-meter	Standard Value
Evaporator temperature above 5 °C	1-2	$\leq 2 \Omega$
Evaporator temperature below 5 °C	1-2	$\geq 10M\Omega$
Evaporator temperature above 5 °C	3-2	$\geq 10M\Omega$
Evaporator temperature below 5 °C	3-2	$\leq 2 \Omega$

Is the inspection result normal?

Yes > see Step 13

No > replace the temperature control switch

13. Inspect the wiring harness

- Inspect whether the circuit between pin 86 of the compressor's relay R09 and pin 3 of the connector B008 of the temperature control switch is a short circuit to earth.
- Inspect whether the circuit between pin 85 of the compressor's relay R09 and pin 1 of the connector B008 of the temperature control switch is an open circuit .

Diagnosis - Heater & Air Conditioner

- (c). Inspect whether the circuit between pin 2 of the connector B008 of the temperature control switch and the earthing point of the vehicle body is a short circuit.

Is the inspection result normal?

Yes > Dismantle the compressor's relay R09.

No > repair or replace the wiring harness

Air Conditioner Cooling Fan Fails to Work

Circuit Diagram

Refer to this chapter, "Air Conditioner Compressor's Clutch Fails to Work-Circuit Diagram"

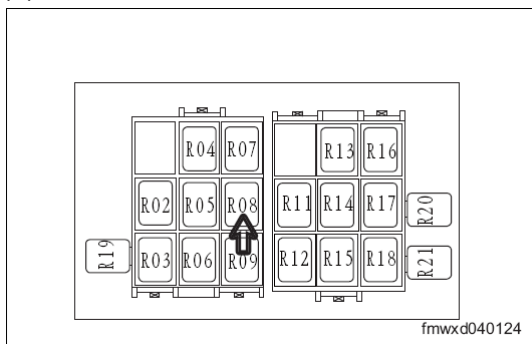
Diagnostic Steps

Hint:

Before inspecting the air conditioner cooling fan, confirm whether the air conditioner compressor's clutch is working. If not, refer to this chapter, "Air Conditioner Compressor's Clutch Fails to Work-Diagnostic Steps"

1. Inspect the condenser's relay R08

- (a). Turn on the ignition switch.
- (b). Turn on the A/C switch and the blowing rate switch.
- (c). Inspect whether the condenser's relay R08 is working.



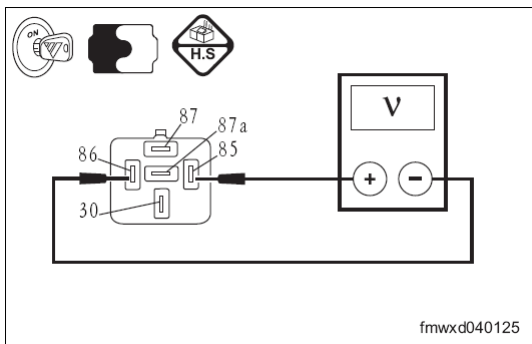
Is the inspection result normal?

Yes > see Step 3

No > see Step 2

2. Inspect the coil circuit of the condenser's relay R08

- (a). Turn off the ignition switch and the main power.
- (b). Dismantle the condenser's relay R08.
- (c). Switch on general power supply and the ignition switch.
- (d). Turn on the A/C switch and the blowing rate switch and use the multi-meter to measure the voltage between pin 85 and 86 of the connector of the condenser's relay R08.



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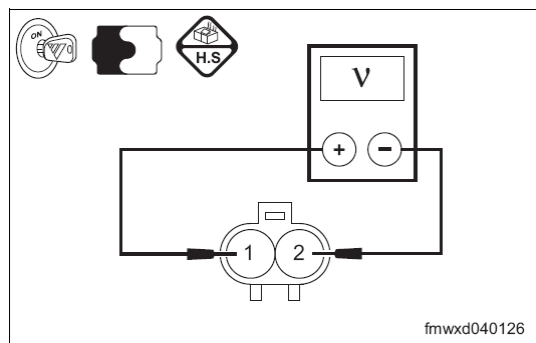
Voltage standard value: battery voltage

Is the inspection result normal?

Yes > replace the condenser's relay R08

No > repair or replace the wiring harness

3. Inspect the voltage at two ends of the condenser fan motor



- (a). Use the multi-meter to measure the voltage between pin 1 and 2 of the connector B051 of the condenser fan motor.

04

Voltage standard value: battery voltage

Is the inspection result normal?

Yes > replace the condenser fan

No > repair or replace the wiring harness

Lighting System

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.

Hint:

Before disconnecting negative cable of the battery, do not leave vehicle key in the vehicle for fear that the vehicle door is locked.

- (b). Turn off the ignition switch, unless otherwise specified.

2. Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.

Hint:

The odometer will not be reset.

3. Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.

Hint:

Reset the audio system after reconnecting negative cable of the battery (refer to "Audio System Introduction for Use in Chinese and English").

4. Replace the bulb carefully

- (a). If there are oil stains on the surface of the halogen bulb, the bulb life circle can be shorted for overheating.
- (b). Handle the halogen bulb as carefully as possible. Because of the internal high pressure, dropping, hitting or damaging the bulb can lead to explosion and burst.
- (c). Wear protective glasses when replacing the halogen bulb.
- (d). Hold nowhere except the lamp holder. Do not touch the glass. (e). Normally prepare a bulb for immediate replacement. During the replacement of bulb, the reflecting mirror will absorb dust and water vapor if the dismantling process last too long.
- (f). Use the bulb of same power for replacement.
- (g). Install the lamp holder firmly after the replacement. The reflecting mirror can become vague for

the absorption water vapor near the lamp holder. **Basic Inspection**

Step	Scope of Inspection	Measure
1	Inspect the battery voltage • The battery voltage shall be no less than 22 V. Is the inspection result normal?	Yes See Step 2
		No Charge or replace the battery. See Chapter 53 Battery-Battery
2	Inspect the small lamp • Use the combination switch to turn on the small lamp. Is the inspection result normal?	Yes See Step 3
		No See Fault Symptom Table
3	Inspect the low beam lamp • Turn on the ignition switch • Use the combination switch to turn on the low beam lamp. Is the inspection result normal?	Yes See Step 4
		No See Fault Symptom Table

Diagnosis - Lighting System

4	Inspect the high beam lamp. Use the combination switch to turn on the high beam lamp. Is the inspection result normal?	Yes	See Step 5
		No	See Fault Symptom Table
5	Inspect the passing lamp Use the combination switch to turn on the passing lamp. Is the inspection result normal?	Yes	See Step 6
		No	See Fault Symptom Table
6	Inspect the turn lamp Use the combination switch to turn on the turn lamp. Is the inspection result normal?	Yes	See Step 7
		No	See Fault Symptom Table
7	Inspect the hazard warning lamp Use the hazard warning lamp to turn on the hazard warning lamp. Is the inspection result normal?	Yes	See Step 8
		No	See Fault Symptom Table
8	Inspect the interior lamp Use the interior lamp to turn on the interior lamp. Is the inspection result normal?	Yes	Inspect the circuit
		No	See Fault Symptom Table
9	Inspect the back-up lamp Engage the reverse gear and inspect the back-up lamp. Is the inspection result normal?	Yes	Inspect the circuit
		No	See Fault Symptom Table
10	Inspect the brake lamp Dismantle the brake paddle and inspect the brake lamp. Is the inspection result normal?	Yes	Inspect the circuit
		No	See Fault Symptom Table

Fault Symptom Table

Use the following table to help you find the causes of faults. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

1. Large lamp

Fault Symptom	Suspected Position	Measure
The low beam lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Fuse (damaged)	Replace the fuse
	3. Harness (opened or shorted to earth)	Repair or replace the wiring harness
The low beam lamp at two side is off	1. Fuse (damaged)	Replace the fuse
	2. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	3. Low beam lamp relay(damaged)	Replace the relay
	4. Harness (opened or shorted)	Repair or replace the harness
	5. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
The low beam lamp at one side is normally on	1. Fuse box	Replace the fuse box
	2. Harness (shorted)	Repair or replace the harness
The low beam lamps at both sides are normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Low beam lamp relay (damaged)	Replace the fuse
	3. Harness (shorted or shorted to the power)	Repair or replace the harness
The high beam lamp at one side is off	1. Fuse (damaged)	Replace the fuse
	2. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	3. Harness (shorted)	Repair or replace the harness
The high beam lamps at both sides are off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Fuse (damaged)	Replace the fuse
	3. High beam lamp relay(damaged)	Replace the high beam lamp relay
	4. Low beam lamp (damaged)	Replace the low beam lamp relay
	5. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	6. Harness (shorted)	Repair or replace the harness

Diagnosis - Lighting System

Fault Symptom	Suspected Position	Measure
The high beam lamp at one side is normally on	1. Harness (shorted to the power)	Repair or replace the harness
	2. Fuse box (damaged)	Replace the fuse
The high beam lamps at both sides are normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. High beam lamp relay (damaged)	Replace the high beam lamp relay
	3. Harness (shorted)	Repair or replace the harness
The passing lamp is off	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
The low beam lamps and high beam lamps at both sides are off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Fuse (damaged)	Replace the fuse
	3. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	4. Harness (shorted or shorted to earth)	Repair or replace the harness
The large lamp is dark	1. Bulb (aged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (poorly connected)	Repair or replace the harness

Diagnosis - Lighting System**2. Fog lamp**

Fault Symptom	Suspected Position	Measure
The front fog lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (shorted)	Repair or replace the harness
The front fog lamps at both sides are off	1. Fuse (damaged)	Replace the fuse
	2. Fog lamp relay(damaged)	Replace the fog lamp relay
	3. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	4. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	5. Harness (shorted)	Repair or replace the harness
The front fog lamp at one side is normally on	1. Harness (shorted to the power)	Repair or replace the harness
The front fog lamp at both sides are normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (shorted to the power)	Repair or replace the harness
The front fog lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (shorted)	Repair or replace the harness
The rear fog lamps at both sides are off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Switch (damaged)	Replace the switch of the rear fog lamp
	3. Combo controller (damaged)	Replace the combo controller
	4. Harness (opened)	Repair or replace the harness
The rear fog lamp at one side is normally on	1. Harness (shorted to the power)	Repair or replace the harness
The rear fog lamps at both sides are normally on	1. Switch (damaged)	Replace the switch of the rear fog lamp
	2. Combo controller (damaged)	Replace the combo controller
	3. Harness	Repair or replace the harness

Diagnosis - Lighting System**3. Turn lamp**

Fault Symptom	Suspected Position	Measure
The turn lamps and warning lamps are off	1. Fuse (damaged)	Replace the fuse
	2. Relay (damaged)	Replace the relay
	3. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	4. Flasher (damaged)	Replace the flasher
	5. Harness (opened)	Repair or replace the harness
	6. Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
The turn lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	3. Flasher (damaged)	Replace the flasher
	4. Harness (opened)	Repair or replace the harness
The warning lamps are off (the turn lamps are normal)	1. Combination switch	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Flasher	Replace the flasher
The turn lamp at one side is normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (shorted to the power)	Repair or replace the harness
	3. Flasher (damaged)	Replace the flasher
The turn lamps at both sides are normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (shorted to the power)	Repair or replace the harness

Diagnosis - Lighting System**4. Brake lamp**

Fault Symptom	Suspected Position	Measure
The brake lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (opened)	Repair or replace the harness
The brake lamps at both sides are off	1. Fuse (damaged)	Replace the fuse
	2. Relay (damaged)	Replace the relay
	3. Brake lamp witch (damaged)	Replace the brake lamp switch
	4. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	5. The alarm controller of the brake lamp (damaged)	Replace the alarm controller of the brake lamp
	6. Harness (opened)	Repair or replace the harness
The brake lamps are normally on	1. Brake lamp witch (damaged)	Replace the brake lamp switch
	2. Harness (shorted)	Repair or replace the harness

5. Back-up lamp

Fault Symptom	Suspected Position	Measure
The back-up lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (opened)	Repair or replace the harness
The back-up lamp is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Fuse (damaged)	Replace the fuse
	3. Reverse gear relay(damaged)	Replace the reverse gear relay
	4. Reverse gear switch (damaged)	Replace the reverse gear switch
	5. Harness (opened)	Repair or replace the harness
The back-up lamp is normally on	1. Back-up lamp switch (damaged)	Replace the back-up lamp switch
	2. Harness (shorted)	Repair or replace the harness
The reversing buzzer is not working	1. Buzzer (damaged)	Replace the buzzer
	2. Harness (opened)	Repair or replace the harness

Diagnosis - Lighting System**6. Small lamp**

Fault Symptom	Suspected Position	Measure
The small lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (opened)	Repair or replace the harness
The maker lamp at one side is off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Harness (opened)	Repair or replace the harness
The front small lamps and maker lamps at both sides are off	1. Bulb (damaged)	Chapter 54 Lighting-Front Combination Lamp Bulb, Replacement
	2. Fuse (damaged)	Replace the fuse
	3. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	4. Relay (damaged)	Replace the relay
	5. Harness (opened)	Repair or replace the harness
The switch lamp of the interior lamp is off	1. Back-up lamp switch (damaged)	Chapter 54 Lighting-Interior lamp, Replacement
	2. Harness (opened)	Repair or replace the harness
The cigarette lighter lamp is off	1. Cigarette lighter (damaged)	Chapter 54 Cigarette Lighter on the Instrument Desk-Cigarette Lighter, Replacement
	2. Harness (opened)	Repair or replace the harness
The lamp for the inter-axial differential switch is off	Lamp for the inter-axial differential switch (damaged)	Replace the inter-axial differential switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the inter-wheel differential switch is off	Lamp for the inter-wheel differential switch (damaged)	Replace the inter-wheel differential switch
	2. Harness (opened)	Repair or replace the harness
The PTO switch lamp is off	1. PTO switch .lamp (damaged)	Replace the inter-wheel differential switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the auxiliary box neutral switch is off	1. Lamp for the auxiliary box neutral switch (damaged)	Replace the auxiliary box neutral switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the electric horn conversion is off	1. Lamp for the electric horn conversion (damaged)	Replace the electric horn conversion
	2. Harness (opened)	Repair or replace the harness
The ABS diagnostic switch lamp is off	1. ABS diagnosis .lamp (damaged)	Replace the ABS diagnostic switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the rearview mirror heating switch is off	1. Lamp for the rearview mirror heating switch (damaged)	Replace the lamp for the rearview mirror heating switch
	2. Harness (opened)	Repair or replace the harness

Diagnosis - Lighting System

Fault Symptom	Suspected Position	Measure
The lamp for the rear lamp switch is off	1. Lamp for the rear lamp switch (damaged)	Replace the rear lamp switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the rear fog lamp switch is off	1. Lamp for the rear fog lamp switch (damaged)	Replace the rear fog lamp switch
	2. Harness (opened)	Repair or replace the harness
The cruise (+ -) switch lamp is off	1. Cruise (+ -)switch lamp (damaged)	Replace the cruise (+ -)switch lamp
	2. Harness (opened)	Repair or replace the harness
The cruise recovery switch lamp is off	1. Cruise recovery switch lamp (damaged)	Replace the cruise recovery switch lamp
	2. Harness (opened)	Repair or replace the harness
The cruise cancellation switch lamp is off	1. Cruise cancellation switch lamp (damaged)	Replace the cruise cancellation switch lamp
	2. Harness (opened)	Repair or replace the harness
The remote throttle lamp is off	1. Remote throttle lamp (damaged)	Replace the remote throttle lamp
	2. Harness (opened)	Repair or replace the harness
The lamp for the engine diagnostic switch is off	1. Lamp for the engine diagnostic switch (damaged)	Replace the engine diagnostic switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the blowing rate switch is off	1. Lamp for the blowing rate switch (damaged)	Replace the blowing rate switch
	2. Harness (opened)	Repair or replace the harness
The lamp for the air conditioner panel is off	1. Lamp for the air conditioner panel (damaged)	Replace the air conditioner panel
	2. Harness (opened)	Repair or replace the harness
The lamp for the instrument cluster is off	1. Lamp for the instrument cluster (damaged)	Replace the instrument cluster
	2. Harness (opened)	Repair or replace the harness
The rear small lamps and marker lamps at both sides are off	1. Bulb (damaged)	Replace the bulb
	2. Fuse (damaged)	Replace the fuse
	3. Relay (damaged)	Replace the relay
	4. Harness (opened)	Repair or replace the harness

Diagnosis - Lighting System

The marker lamps, maker lamps and front and rear small lamps are off	1. Bulb (damaged)	Replace the bulb
	2. Fuse (damaged)	Replace the fuse
	3. Relay (damaged)	Replace the relay
	4. Harness (opened)	Repair or replace the harness
	5. Combination switch	Chapter 55 Wiper and Washer-Combination Switch, Replacement

Diagnosis - Lighting System

Fault Symptom	Suspected Position	Measure
The marker lamps, maker lamps and front and rear small lamps are normally on	1. Combination switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (shorted to the power)	Repair or replace the harness

7. Step lamp

Fault Symptom	Suspected Position	Measure
The step lamp at one side is off	1. Bulb (damaged)	Replace the bulb
	2. Harness (opened)	Repair or replace the harness
The step lamps at both sides are off	1. Fuse (damaged)	Replace the fuse
	2. Door-side switch (damaged)	Replace the door-side switch
	3. Bulb (damaged)	Replace the bulb
	4. Harness (opened)	Repair or replace the harness
The step lamp is normally on	1. Switch (damaged)	Replace the door-side switch
	2. Harness (shorted)	Repair or replace the harness

8. Interior lamp

Fault Symptom	Suspected Position	Measure
The interior lamp is off	1. Fuse (damaged)	Replace the fuse
	2. Bulb (damaged)	Replace the bulb
	3. Switch (damaged)	Chapter 54 Lighting-Interior lamp, Replacement
	4. Harness (opened)	Repair or replace the harness

Low Beam Lamp at One Side is Off.

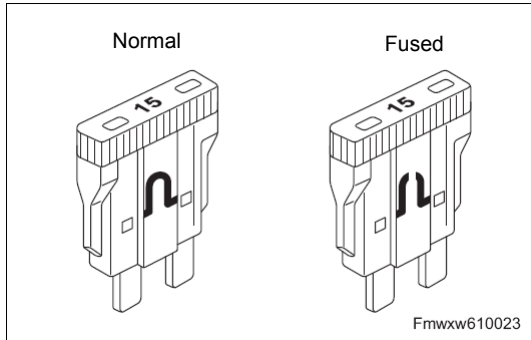
Circuit Diagram

Refer to this chapter "Low Beam Lamps at Both Sides are Off—Circuit Diagram"

Diagnostic Steps

1. Inspect fuse.

(a). Switch off general power supply.



(b). Inspect fuse F22 (5A) or F23 (5A) in cab fuse box.

04

Inspect whether the fuse is normal.

Yes > See Step 2

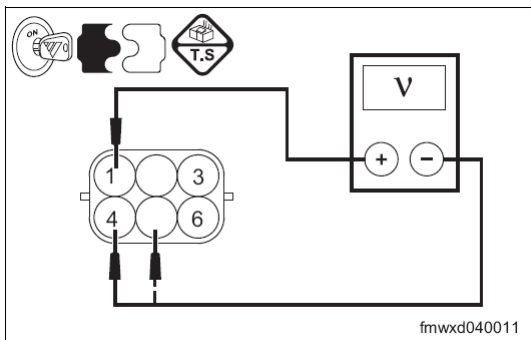
No > Overhaul fuse circuit and replace rated capacity fuse

2. Measure the voltage between Pin 1 and Pin 4 of the left front combination lamp connector B 017, as well as the voltage between Pin 1 and Pin 5 of the right front combination lamp connector B041.

(a). Disconnect the left front combination lamp connector B017 or the right front combination lamp connector B041.

(b). Switch on general power supply.

(c). Switch on the low beam light.



(d). Use the multi-meter to measure the voltage between Pin 1 and Pin 4 of the left front combination lamp connector B 017, as well as the voltage between Pin 1 and Pin 5 of the right front combination lam connector B041.

Standard voltage value: Battery voltage

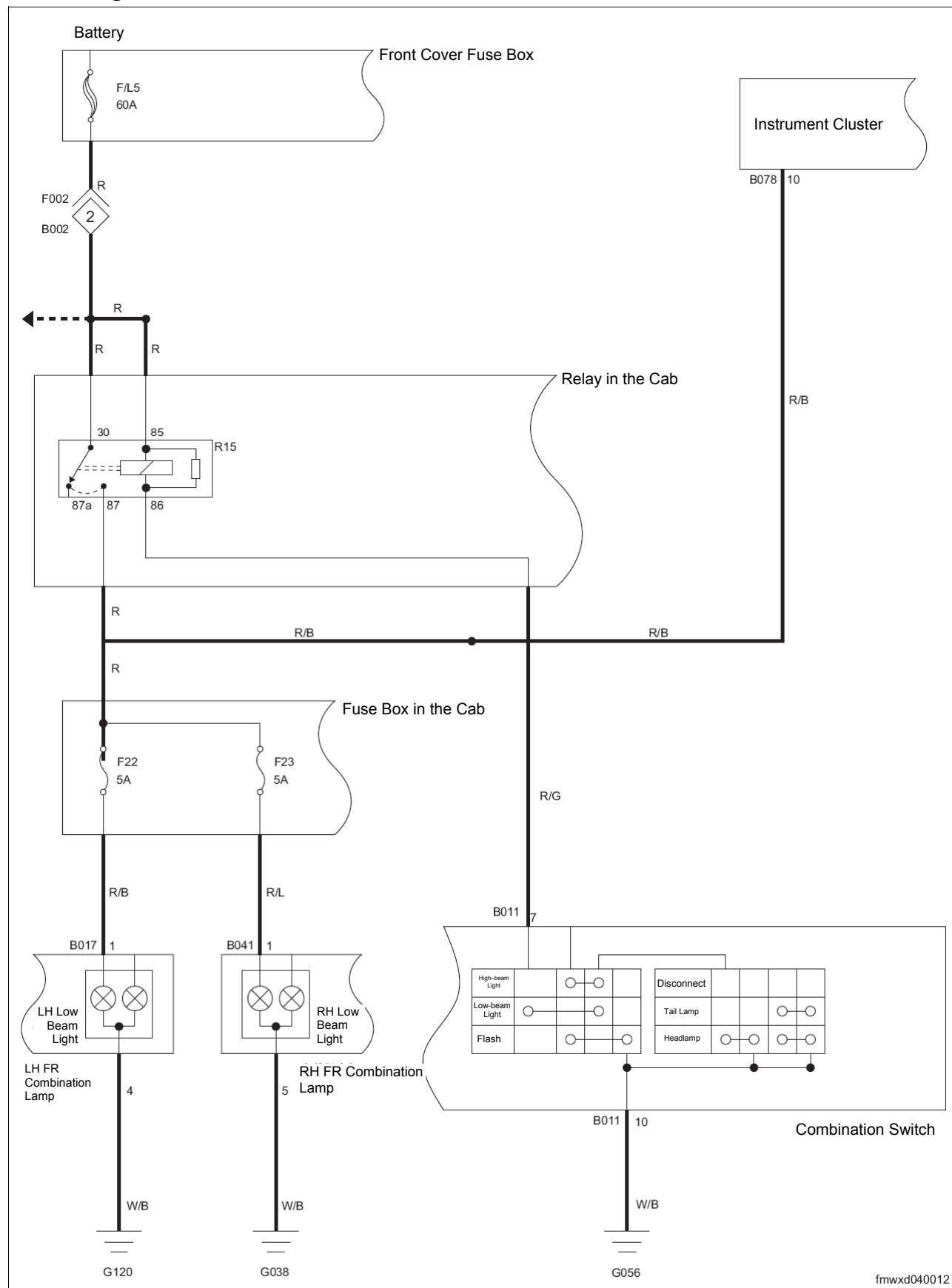
Is the inspection result normal?

Yes > Replace bulb

No > Repair or replace harness

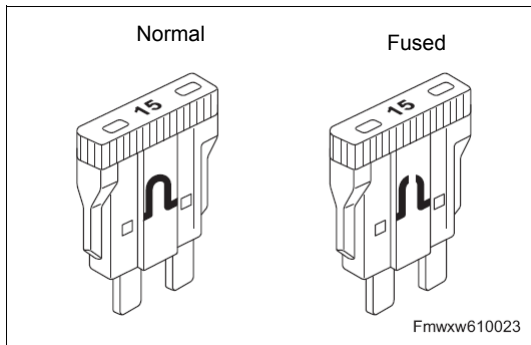
Low Beam Lamps at Both Sides are Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse.**

(a). Switch off general power supply.



(b). Inspect fuse F22 (5A) and F23(5A) inside fuse box in the cab.

(c). Inspect fuse L5 (60A) inside fuse box.

Inspect whether fuse is normal?

Yes > See Step 2

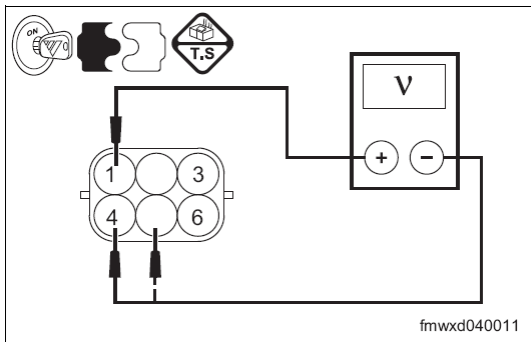
No > Overhaul fuse circuit and replace rated capacity fuse

2. Measure the voltage between Pin 1 and Pin 4 of the left front combination lamp connector B 017, as well as the voltage between Pin 1 and Pin 5 of the right front combination lamp connector B041.

(a). Disconnect the left front combination connector B017 or the right front combination connector B041.

(b). Switch on general power.

(c). Switch on the low beam lamp.



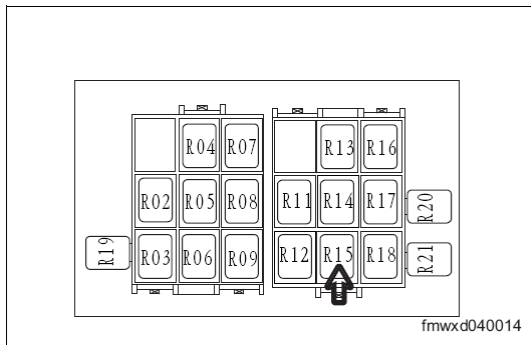
(d). Use the multi-meter to measure the voltage between Pin 1 and Pin 4 of the left front combination lamp connector B 017, as well as the voltage between Pin 1 and Pin 5 of the right front combination lamp connector B041.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > Replace bulb

No > See Step 3

3. Inspect the passing light relay R15

- (e). Switch on the low beam light repeatedly, and meanwhile inspect whether the relay R15 works.

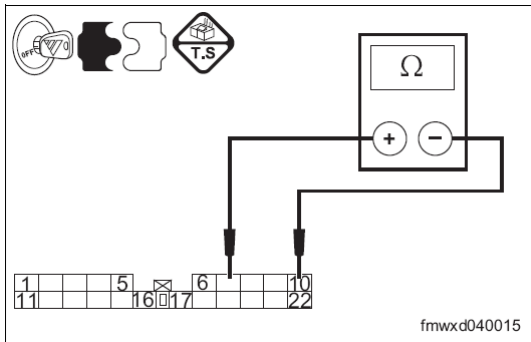
Does the relay work?

Yes > Repair or replace harness

No > See Step 4

4. Inspect the combination switch

- (a). Switch off general power.
 (b). Disconnect the connector B011 of the combination switch.



- (c). Inspect the combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	7-10	> 10 MΩ
Switch on the low beam light	7-10	≤ 2 Ω

Is the inspection result normal?

Yes > Repair or replace harness

No > Replace the combination switch

Low Beam Lamp at One Side is Normally On.

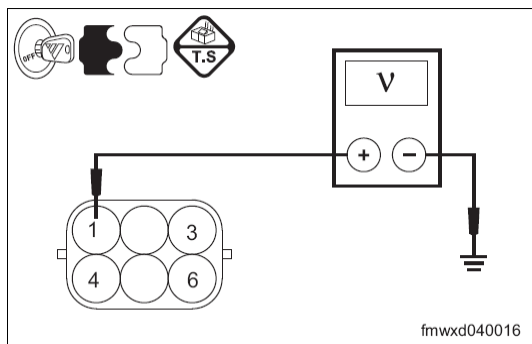
Circuit Diagram

Refer to this chapter "Low Beam lamps at Both Sides are Off—Circuit Diagram"

Diagnostic Steps

1. Inspect the power circuit of the low beam bulb

(a). Switch off general power.



(b). Dismantle fuse F22 or F23 inside fuse box in the cab.

(c). Disconnect the connector B017 of the left front combination lamp or the connector B041 of the right front combination lamp. Use the multi-meter to measure the resistance between Pin 1 of the connector B017 or B041 and the effective earthing point of vehicle body.

04

Resistance: > 10 MΩ

Is the inspection result normal?

Yes > Replace fuse box in the cab

No > Repair or replace harness

Low Beam Lamps at Both Sides are Normally On.

Circuit Diagram

Refer to this chapter "Low Beam lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

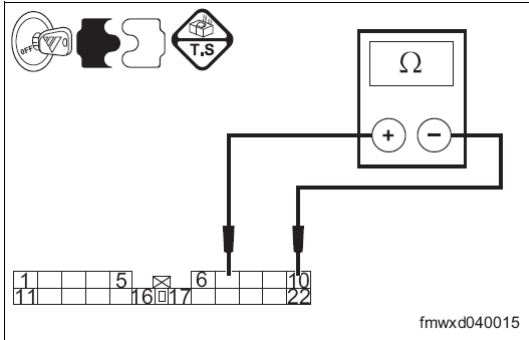
1. Inspect the combination switch

- (a). Switch off general power.
- (b). Disconnect the connector B011 of the combination switch.

- (c). Inspect the combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	7-10	$> 10 \text{ M}\Omega$
Switch on the low beam light	7-10	$\leq 2 \Omega$



Is the inspection result normal?

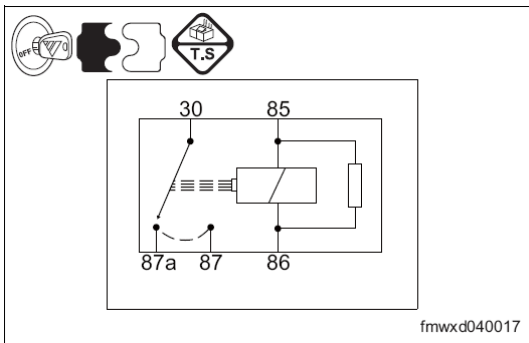
Yes > See Step 2

No > Replace the combination switch

2. Inspect whether the contact of the passing light relay is normally closed.

- (a). Dismantle the relay R15 in the cab.

- (b). Use the multi-meter to measure the resistance between Pin 30 and Pin 87 of the passing light relay.



Resistance: $> 10 \text{ M}\Omega$

Is the inspection result normal?

No > Replace the passing light relay R15

Yes > Repair or replace harness

High Beam Lamps at One Side is Off

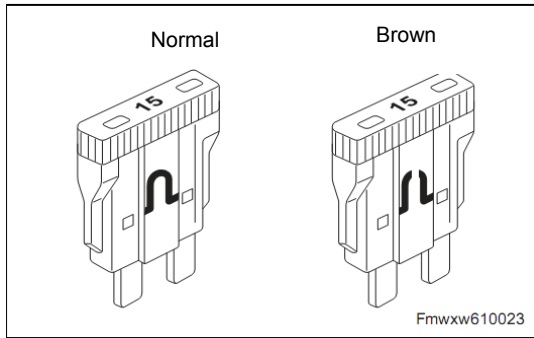
Circuit Diagram

Refer to this chapter "High Beam Lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. Inspect fuse.

(a). Switch off general power.



(b). Inspect fuse F12 (10A) and F13(10A) inside fuse box in the cab.

04

Inspect whether fuse is normal.

Yes > See Step 2

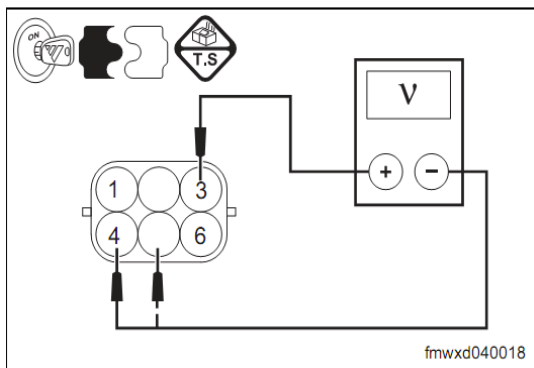
No > Overhaul fuse circuit and replace rated capacity fuse

2. Measure the voltage between Pin 3 and Pin 4 of the left combination lamp connector B 017, as well as the voltage between Pin 3 and Pin 5 of the right combination lamp connector B041.

(a). Disconnect the left combination connector B017 or the right combination connector B041.

(b). Switch on general power.

(c). Switch on the high beam lamp.



(d). Use the multi-meter to measure the voltage between Pin 3 and Pin 4 of the left combination lamp connector B017, as well as the voltage between Pin 3 and Pin 5 of the right combination lamp connector.

Standard voltage value: battery voltage

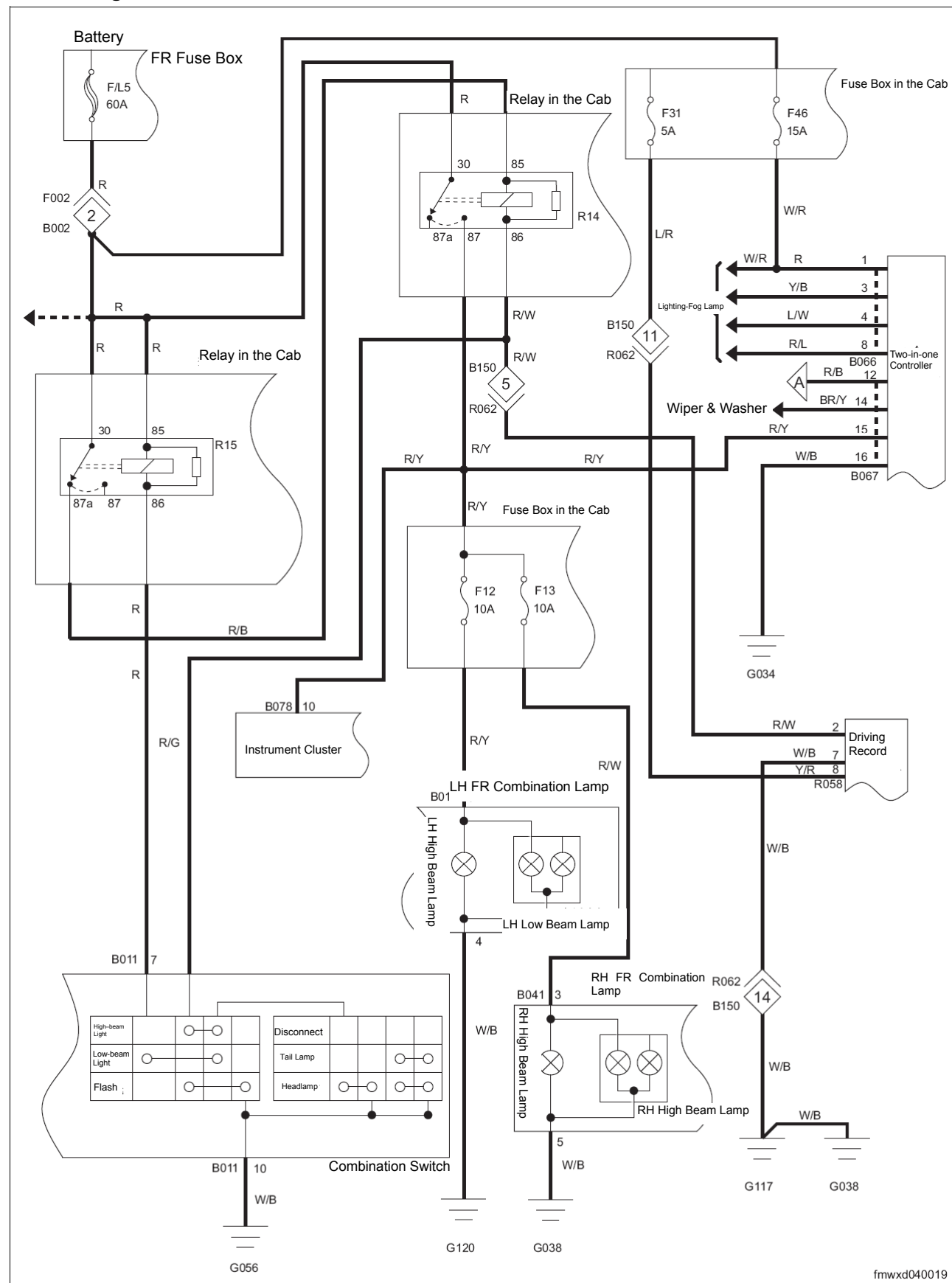
Is the inspection result normal? .

Yes > Replace bulb

No > Repair or replace harness

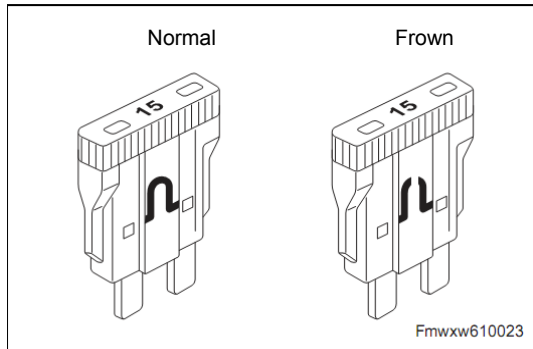
High Beam Lamps at Both Sides are Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse.**

(a). Switch off general power.



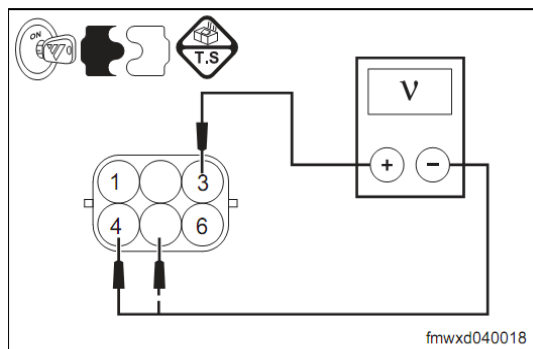
(b). Inspect fuse F12 (10A) and F13 (10A) inside fuse box in the cab.

Inspect whether fuse is normal.**Yes > See Step 2****No > Overhaul fuse circuit and replace rated capacity fuse****2. Measure the voltage between Pin 3 and Pin 4 of the left front combination lamp connector B 017, as well as the voltage between Pin 3 and Pin 5 of the right front combination lamp connector B041.**

(a). Disconnect the left combination connector B017 or the right combination connector B041.

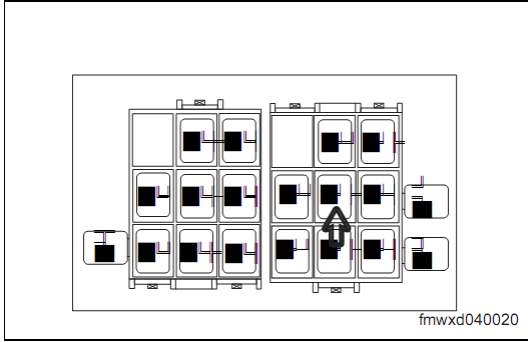
(b). Switch on general power.

(c). Switch on the high beam lamp.



(d). Use the multi-meter to measure the voltage between Pin 3 and Pin 4 of the left combination lamp connector B017, as well as the voltage between Pin 3 and Pin 5 of the right combination lamp connector.

Standard voltage value: battery voltage**Is the inspection result normal?****Yes > Replace bulb****No > See Step 3**

3. Inspect the distance light relay R14 in the cab

- (a). Switch on the high beam lamp repeatedly, and meanwhile inspect whether the relay R14 works

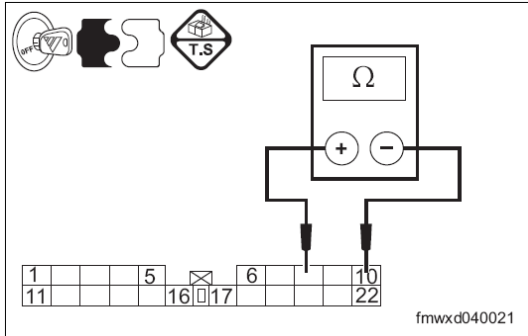
Does the relay work?

No > See Step 4

Yes > Repair or replace harness

4. Inspect the combination switch

- (a). Switch off general power.
(b). Disconnect the connector B011 of the combination switch.



- (c). Inspect the combination switch.

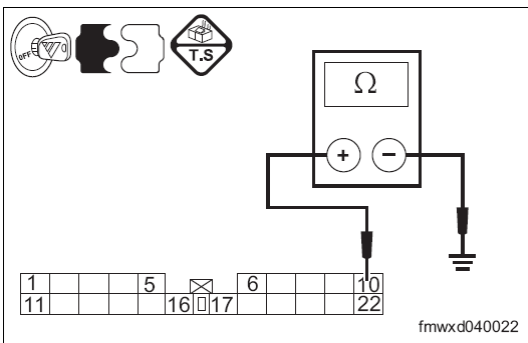
Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	8-10	> 10 MΩ
Switch on the low beam light	8-10	≤ 2 Ω

Is the inspection result normal?

No > Replace the combination switch

Yes > See Step 5

5. Inspect the earth circuit of the combination switch

- (a). Use the multi-meter to measure the resistance between Pin 10 of the combination switch connector B011 and effective earthing point of the vehicle body.

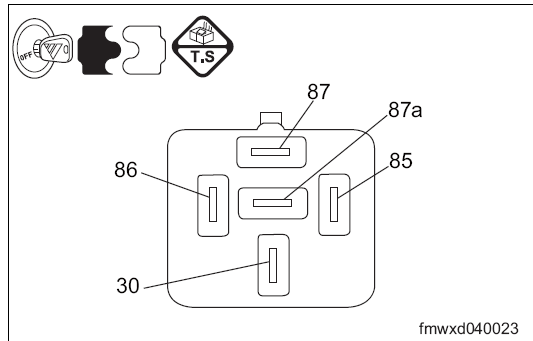
Resistance: ≤ 2 MΩ

Is the inspection result normal?

Diagnosis - Lighting System**No > Repair or replace harness****Yes > See Step 6**

6. Inspect the coil control circuit of the high beam lamp relay R14 inside the relay box in the cab.

(a). Dismantle the high beam relay R14 and the low beam relay R15 inside the relay box in the cab.



(b). Use the multi-meter to measure the wiring harness resistance between Pin 86 of the relay R14 connector and Pin 87a of the relay R15 connector.

(c). Use the multi-meter to measure the wiring harness resistance between Pin 85 of the relay R14 connector and Pin 8 of the combination switch connector B011.

Resistance: $\leq 2\text{ M}\Omega$ **Is the inspection result normal?.****No > Repair or replace harness****Yes > Replace the high beam lamp relay R14**

High Beam Lamp at One Side is Normally On

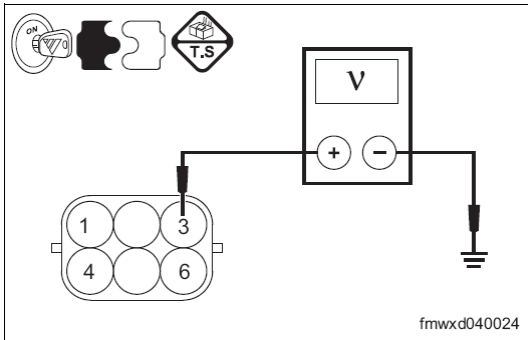
Circuit Diagram

Refer to this chapter "High Beam Lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. Inspect the power circuit of the high beam bulb

- (a). Switch off general power.
- (b). Dismantle fuse F12 or F13 of the high beam lamp inside fuse box in the cab.
- (c). Disconnect the left combination connector B017 or the right combination connector B041.
- (d). Switch on general power.
- (e). Use the multi-meter to measure the effective earthed resistance between Pin 3 of the left combination lamp connector B017 or Pin 3 of the right combination lamp connector B041 and the vehicle body.



Resistance: > 10 MΩ

Is the inspection result normal?.

Yes > Replace fuse box in the cab

No > Repair or replace harness

High Beam Lamps at Both Sides are Normally On

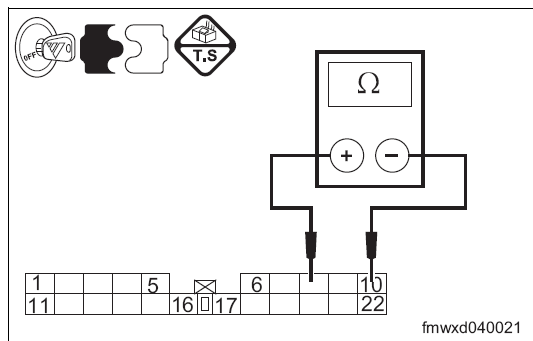
Circuit Diagram

Refer to this chapter "High Beam Lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off general power.
- (b). Disconnect the connector B011 of the combination switch.



- (c). Inspect the combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	8-10	$> 10\text{ M}\Omega$
Switch on the low beam light	8-10	$\leq 2\text{ }\Omega$

Is the inspection result normal?.

Yes > Repair or replace harness

No > Replace the combination switch

The Passing is Off

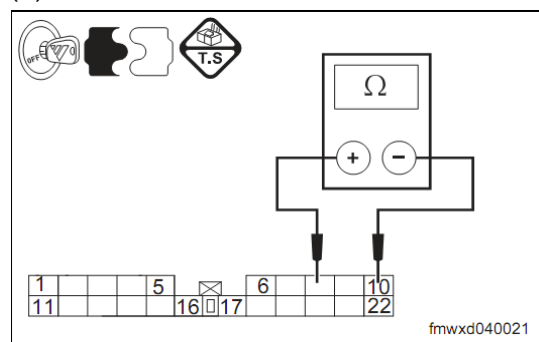
Circuit Diagram

Refer to this chapter "High Beam Lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off general power.
- (b). Disconnect the connector B011 of the combination switch.



- (c). Inspect the combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	8-10	$> 10 \text{ M}\Omega$
Switch on the low beam light	8-10	$\leq 2 \Omega$

Is the inspection result normal?

No > Replace the combination switch

Yes > Refer to this chapter "High Beam Lamps at Both Sides are Off—Diagnostic Steps

Low and High Beam Lamps at Both Sides are Off

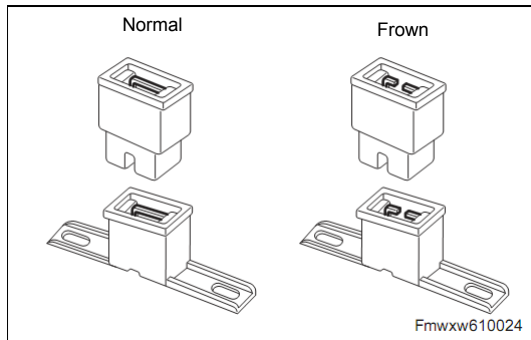
Circuit Diagram

Refer to this chapter, "High Beam Lamps at Both Sides are Off—Circuit Diagram", "Low Beam lamps at Both Sides are Off---Circuit Diagram.

Diagnostic Steps

1. Inspect fuse.

(a). Switch off general power.



(b). Inspect fuse F/L5 (60A) inside the front cover fuse box.

04

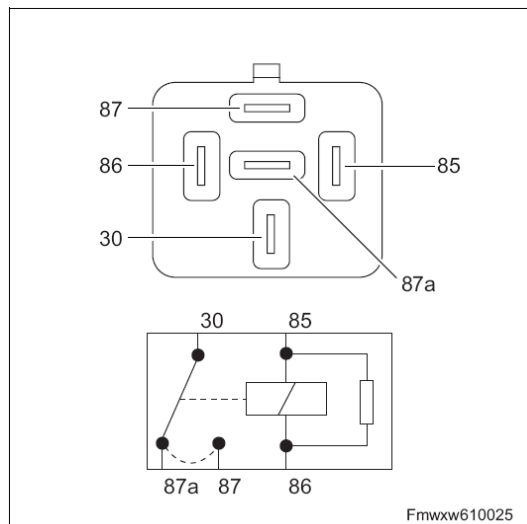
Inspect whether fuse is normal.

Yes > See Step 2

No > Overhaul fuse circuit and replace rated capacity fuse

2. Inspect the circuit

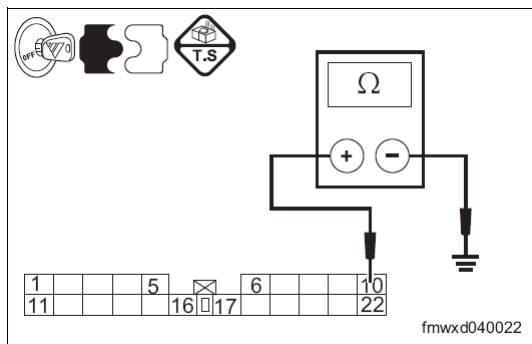
(a) Dismantle the relay R15 inside the relay box in the cab.



(b). Use the multi-meter to measure the wiring harness resistance between fuse F/L5 and Pin 30 of the relay R15 connector.

(c). Disconnect the connector B011 of the combination switch.

Diagnosis - Lighting System



- (d). Use the multi-meter to measure the resistance between Pin 10 of the combination switch connector B011 and the effective earthing point of vehicle body.

04

Resistance: $\leq 2 \text{ M}\Omega$

Is the inspection result normal?

Yes > Replace the combination switch

No > Repair or replace harness

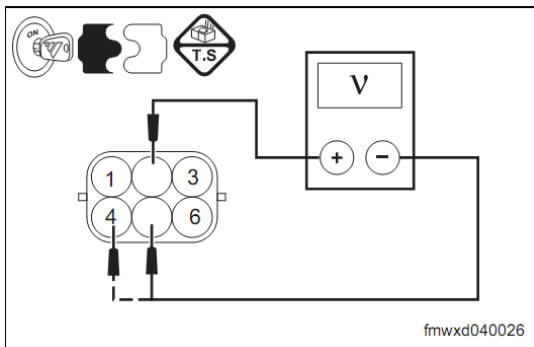
Front Fog Lamp at One Side is Off

Circuit Diagram

Refer to this chapter "Front Fog lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. **Measure the voltage between Pin 2 and Pin 5 of the left front combination lamp connector B 017, as well as the voltage between Pin 2 and Pin 4 of the right front combination lamp connector B041.**
 - (a). Disconnect the left front combination connector B017 or the right front combination connector B041.
 - (b). Switch on the front fog lamp.



- (c). Use the multi-meter to measure the voltage between Pin 2 and Pin 5 of the left front combination lamp connector B 017, as well as the voltage between Pin 2 and Pin 4 of the right front combination lamp connector B041.

Standard voltage value: battery voltage

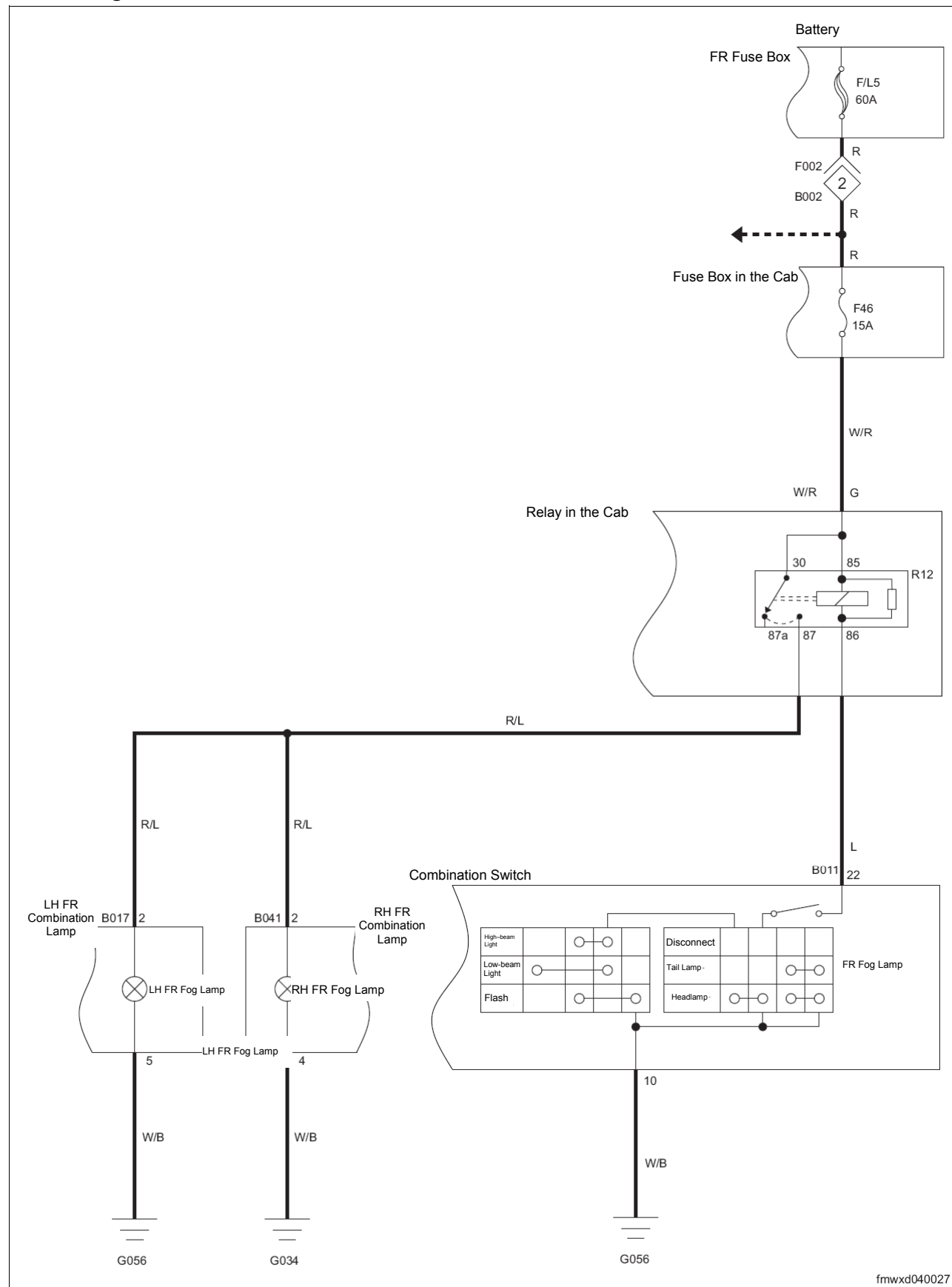
Is the inspection result normal?.

Yes > Replace bulb

No > Repair or replace harness

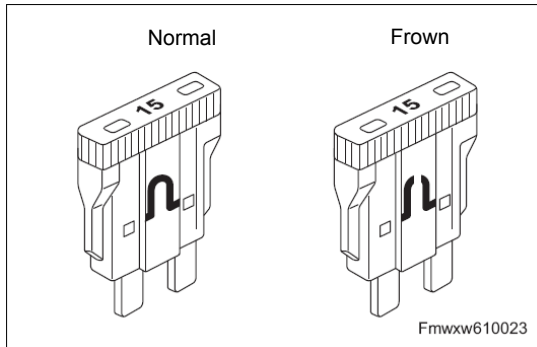
Front Fog Lamps at Both Sides are Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse F46.**

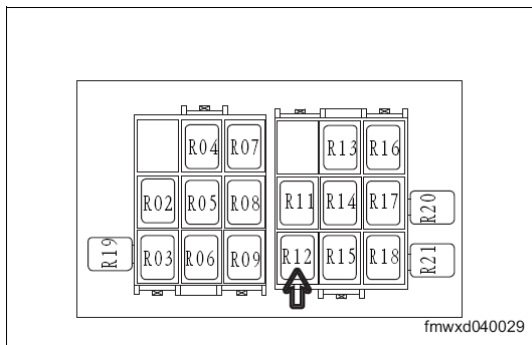
(a). Switch off general power.



(b). Inspect fuse F46(15A) inside fuse box in the cab.

Is the inspection result normal?**Yes > See Step 2****No > Overhaul fuse circuit and replace rated capacity fuse****2. Inspect whether the relay R12 of the front fog lamp in the cab works.**

(a). Switch on general power.

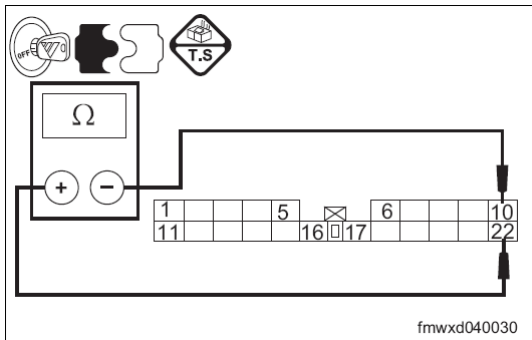


(b). Switch on the front fog lamp repeatedly, and inspect whether the relay R12 works.

Does the relay R12 work ?**Yes > See Step 5****No > See Step 3****3. Inspect the front fog lamp switch**

(a). Switch off general power.

(b). Disconnect the connector B011 of the combination switch.



(c). Inspect the combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off the low beam light	22-10	> 10 MΩ
Switch on the low beam light	22-10	≤ 2 Ω

Is the inspection result normal?.

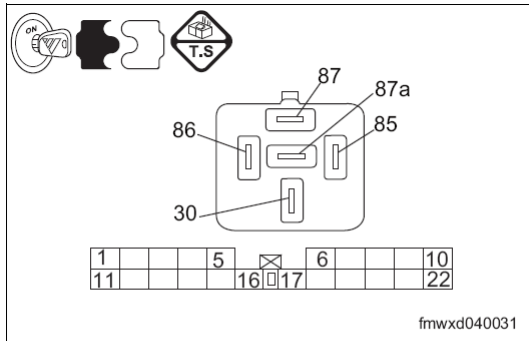
Yes > See Step 4

No > Replace the combination switch

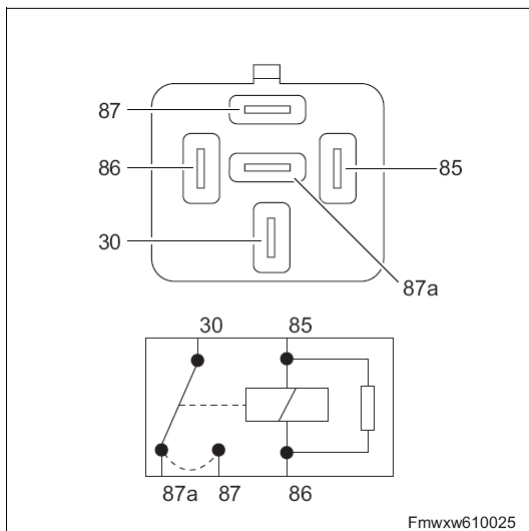
4. Inspect the circuit

(a). Disconnect the connector B011 of the combination switch.

(b). Dismantle the relay R12 in the cab.



(c). Use the multi-meter to inspect the wiring harness resistance between Pin 22 of the combination switch connector B011 and Pin 85 of cab fog lamp relay R12 connector.



(d). Use the multi-meter to measure the wiring harness resistance between the output end of cab fuse F46 and Pin 86 of the relay R12 connector.

Resistance: $\leq 2 \text{ M}\Omega$

Is the inspection result normal?.

Yes > Replace the front fog lamp relay R12

No > Repair or replace harness

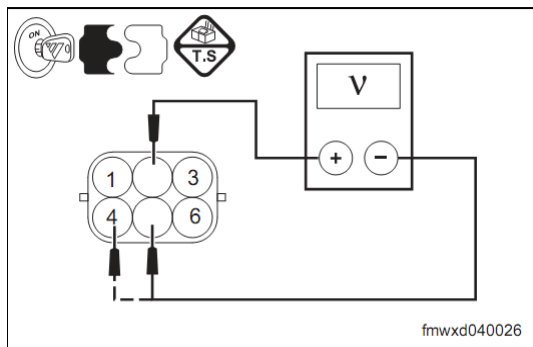
5. Measure the voltage between Pin 2 and Pin 5 of the left front combination lamp connector B 017, as well as the voltage between Pin 2 and Pin 4 of the right front combination lamp connector B041.

(a). Disconnect the connector B017 or B041 of the combination switch.

(b). Switch on general power.

(c). Switch on the front fog lamp.

Diagnosis - Lighting System



- (d). Use the multi-meter to measure the voltage between Pin 2 and Pin 5 of the left front combination lamp connector B017, as well as the voltage between Pin 2 and Pin 4 of the right front combination lamp connector B041.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > Replace bulb

No > Repair or replace harness

Front Fog Lamp at One Side is Normally On

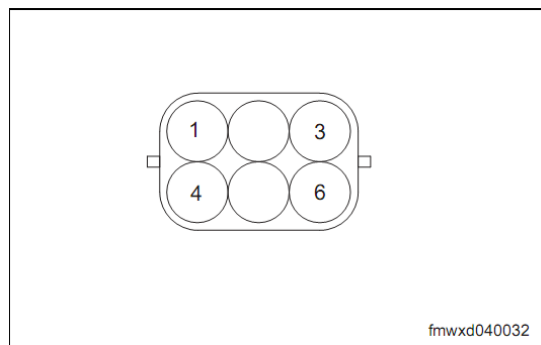
Circuit Diagram

Refer to this chapter "Front Fog lamps at Both Sides are Off—Circuit Diagram

Diagnostic Steps

1. Overhaul whether Pin 2 of the front combination lamp is short-circuited to power.

- (a). Switch off general power.
- (b). Disconnect the connector B011 of the left front combination switch.
- (c). Use the multi-meter to inspect whether Pin 2 of the left front combination lamp connector B 017 or Pin 2 of the right front combination lamp connector B041 is short-circuited to power supply.



- (d). Repair or replace the wiring harness.

Front fog lamps at both sides are normally on.

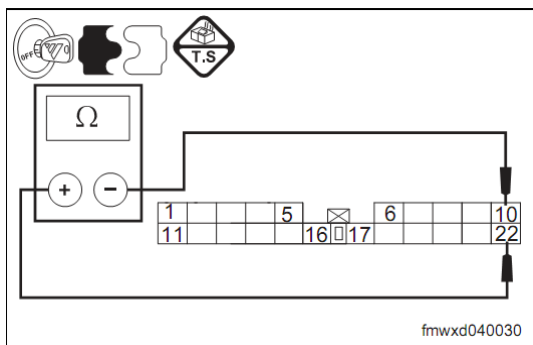
Circuit Diagram

Refer to this chapter, "Front Fog Lamps at Both Sides are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off general power
- (b). Disconnect connector B011 of combination switch.



- (c). Inspect the combination switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch off fog lamp	22-10	> 10 MΩ
Switch on fog lamp	22-10	≤ 2 Ω

Is the inspection result normal?

Yes. Repair or replace harness.

No. Replace combination switch.

Rear Fog Lamp at One Side is Off

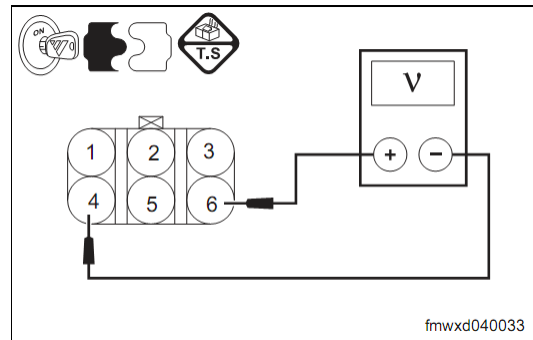
Circuit Diagram

Refer to this chapter, "Rear Fog Lamps at Both Sides are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect the voltage between power of rear fog lamps and the earth

- (a). Disconnect connector T013 of left rear combination lamp or connector T012 of right rear combination lamp
- (b). Switch on rear fog lamp



- (c). Use the multi-meter to measure the voltage between pin 6 and pin 4 of connector T013 of left rear combination lamp, or the voltage between pin 6 and pin 4 of connector T012 of right rear combination lamp

Voltage standard value: battery voltage

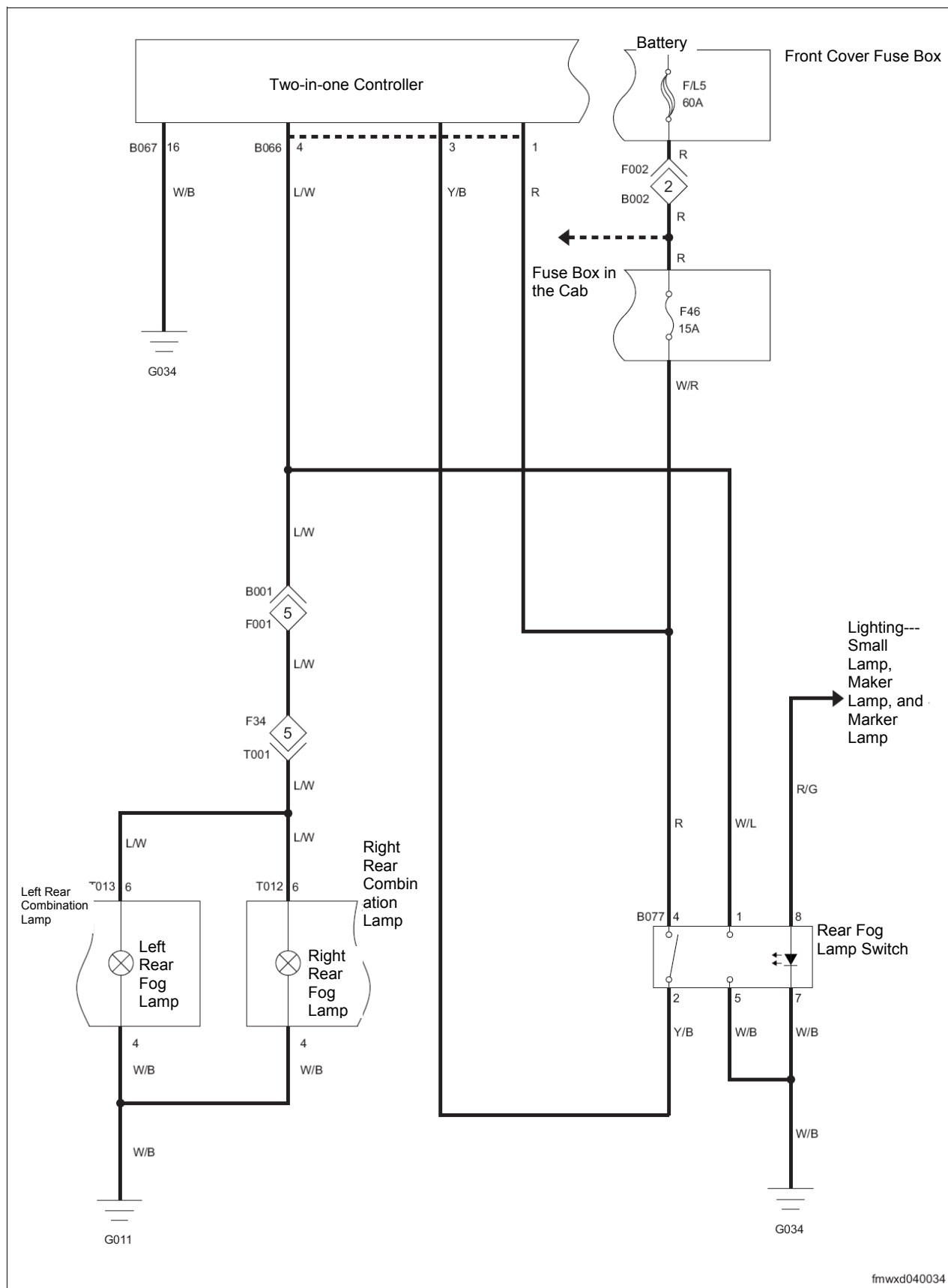
Is the inspection result normal?

Yes. Replace right fog lamp.

No. Repair or replace harness.

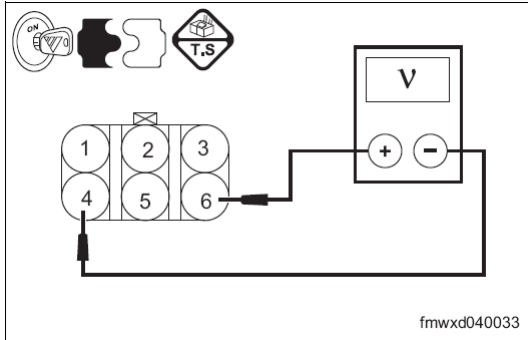
Rear Fog Lamps at Both Sides are Off

Circuit Diagram



Diagnostic Steps**1. Inspect the voltage between power of rear fog lamps and the earth**

- (a). Disconnect connector T013 of left rear combination lamp or connector T012 of right rear combination lamp
- (b). Switch on rear fog lamp



- (c). Use the multi-meter to measure the voltage between pin 6 and pin 4 of connector T013 of left rear combination lamp, or the voltage between pin 6 and pin 4 of connector T012 of right rear combination lamp

Voltage standard value: battery voltage

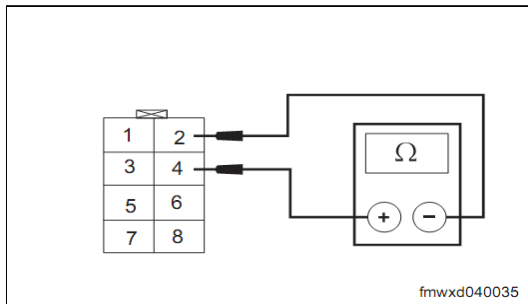
Is the inspection result normal?

Yes. Replace right fog bulb.

No. See Step 2.

2. Inspect rear fog lamp switch

- (a). Switch off general power
- (b). Disconnect connector B077 of rear fog lamp switch.



- (c). Inspect rear fog lamp switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on rear fog lamp	4-2	$\leq 2 \Omega$
Switch off rear fog lamp	4-2	$> 10 M\Omega$

Resistance: $\leq 2 \Omega$

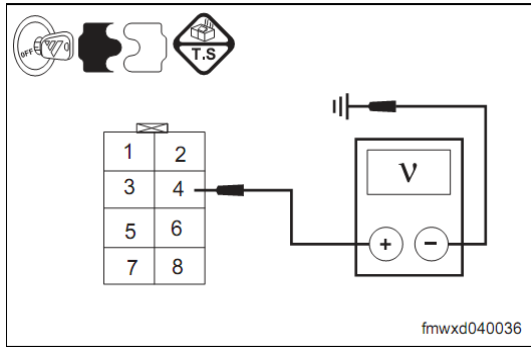
Is the inspection result normal?

Yes. See Step 3.

No. replace rear fog lamp switch.

3. Inspect the voltage between pin4 of connector B077 of rear fog lamp switch and effective earthing point of vehicle body.

- (a). Switch on general power

Diagnosis - Lighting System

- (b). Use the multi-meter to measure the voltage between pin4 of connector B077 of rear fog lamp switch and effective earthing point of vehicle body.

Voltage standard value: battery voltage

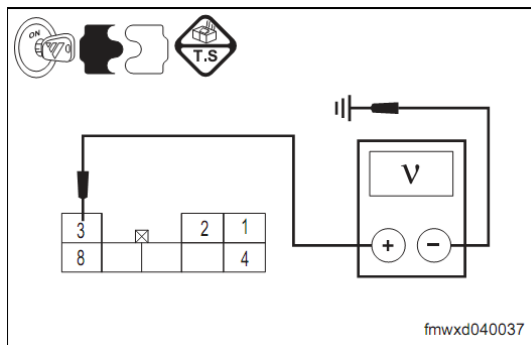
Is the inspection result normal?

Yes. See Step 4.

No. Repair or replace harness.

4. Inspect the voltage between pin3 of connector B066 of two-in-one controller and effective earthing point of vehicle body

- (a). Switch off general power
(b). Disconnect connector B066 of two-in-one controller.
(c). Switch on general power and rear fog lamp



- (d). Use the multi-meter to measure the voltage between pin3 of connector B066 of two-in-one controller and effective earthing point of vehicle body

Resistance: $\leq 2 \Omega$

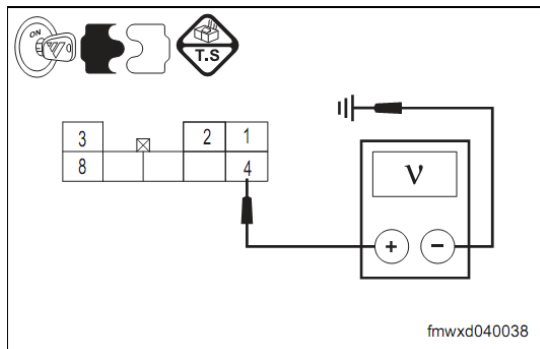
Is the inspection result normal?

Yes. Replace relay R12 of front fog lamp.

No. Repair or replace harness.

5. Inspect the voltage between pin4 of connector B066 of two-in-one controller and effective earthing point of vehicle body

- (a). Switch off general power
(b). Connect connector B066 of two-in-one controller.
(c). Switch on general power and rear fog lamp



- (d). Use the multi-meter to measure the voltage between pin4 of connector BO66 of two-in-one controller and effective earthing point of vehicle body

Voltage Standard value: battery voltage

Is the inspection result normal?

Yes. Repair or replace the harness.

No. Replace two-in-one controller.

Rear Fog Lamp at One Side is Normally On

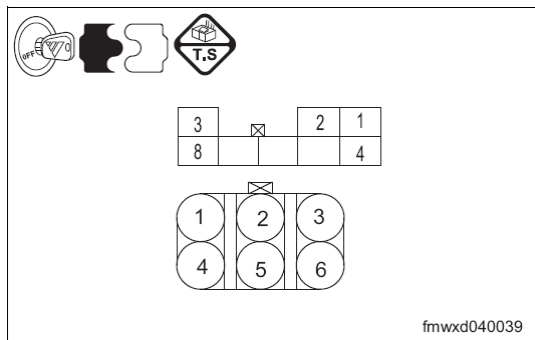
Circuit Diagram

Refer to this chapter, "Rear Fog Lamps at Both Sides are Off--- Circuit Diagram"

Diagnostic Steps

1. **Overhaul whether connector T013 of left rear combination lamp or pin 6 of connector T012 of right rear combination lamp is short-circuited to power**

- (a). Switch off general power



- (b) Use the multi-meter to disconnect connector T013 and connector T012 of rear combination lamps at both sides and connector BO66 of two-in-one controller.
- (c). Use the multi-meter to measure the power supply short-circuited point between pin6 of connector T013 and connector T012 of rear combination lamp and pin4 of connector B066 of two-in-one controller.

- (d). Repair or replace harness.

Rear Fog Lamps at Both Sides are Normally On

Circuit Diagram

Refer to this chapter, "Rear Fog Lamps at Both Sides are Off--- Circuit Diagram"

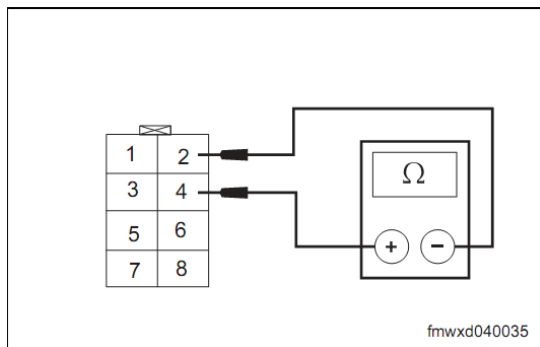
Diagnostic Steps

1. Inspect rear fog lamp switch

- (a). Switch off general power
- (b). Disconnect connector B077 of rear fog lamp switch
- (c). Inspect rear fog lamp switch

Standard Value

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on rear fog lamp	4-2	$\leq 2 \Omega$
Switch off rear fog lamp	4-2	$> 10 \text{ M}\Omega$



Resistance $\leq 2 \Omega$

Is the inspection result normal?

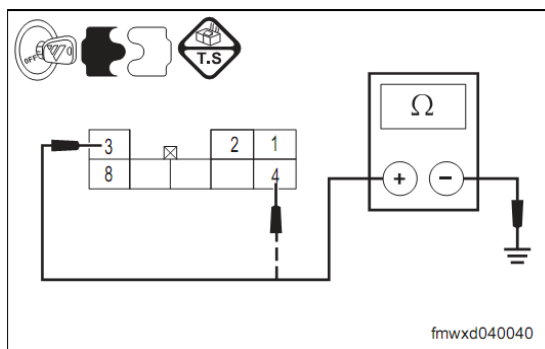
Yes. See Step 2.

No. Replace rear fog lamp switch.

2. Inspect circuit

- (a). Disconnect connector B066 of two-in-one controller.
- (b). Disconnect connector T103 and connector T012 of rear combination lamp.

- (c). Use the multi-meter to measure the resistance between pin3 and pin4 of connector BO66 of two-in-one controller and effective earthing point of vehicle body



Resistance $> 10 \text{ M}\Omega$

Is the inspection result normal?

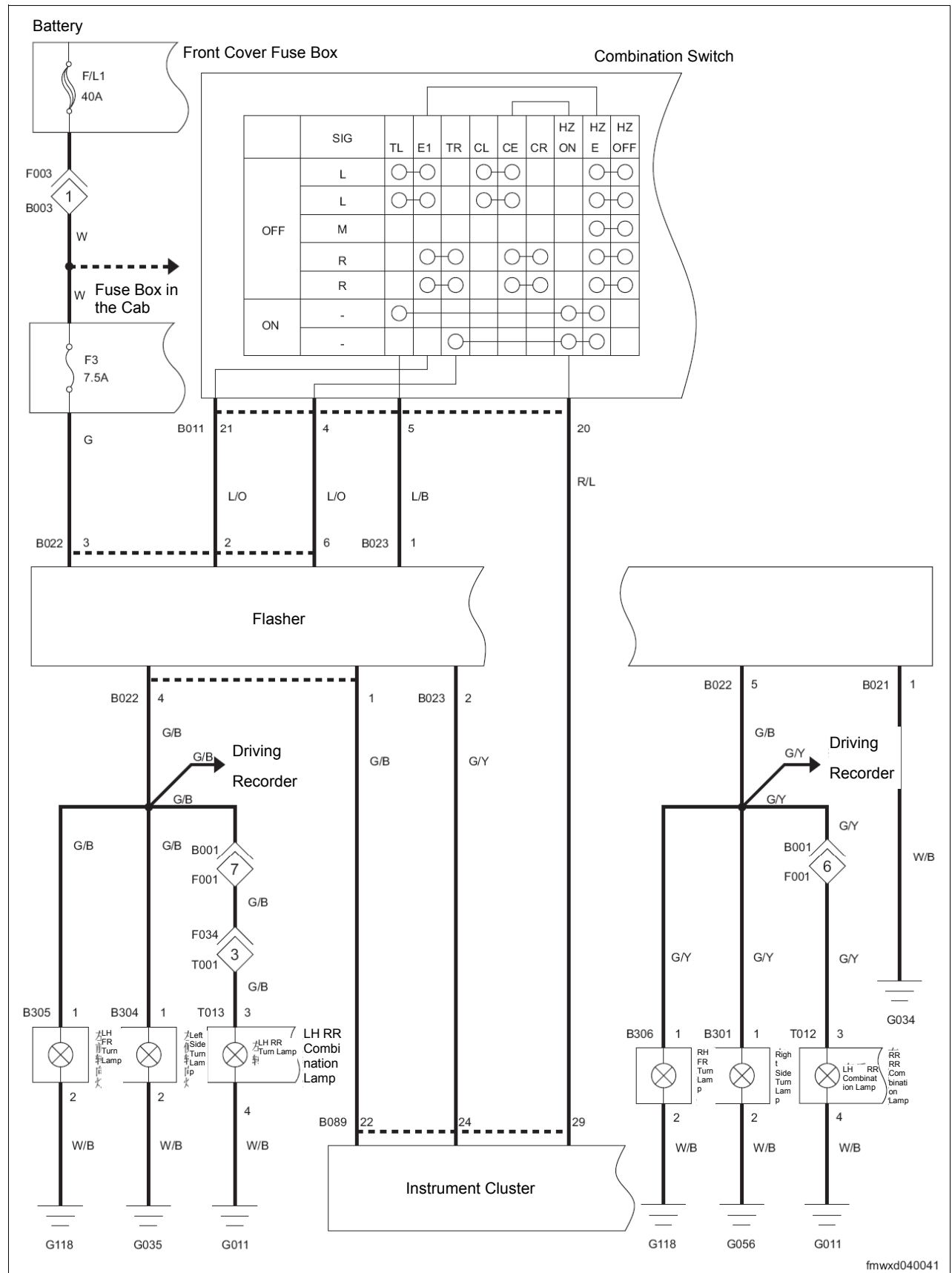
Yes. Replace two-in-one controller.

No. Repair or replace harness.

Diagnosis - Lighting System

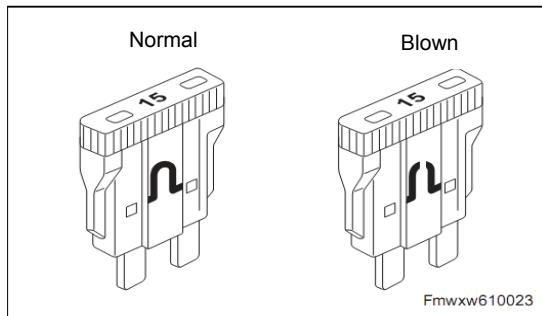
Turn Lamp and Warning Lamp are Off

Circuit Diagram



Diagnostic Steps**1. Inspect fuse**

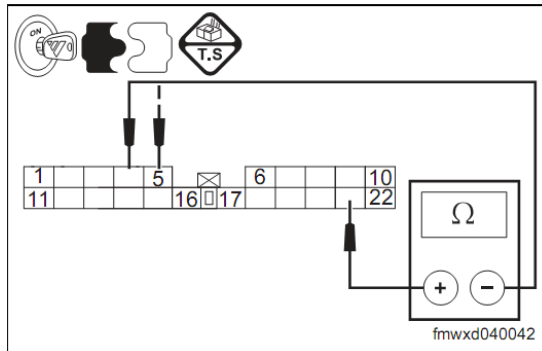
(a). Switch off general power



(b). Inspect fuse F3 (7.5A) in cab fuse box

Inspect whether the fuse is normal?**Yes. See Step 2.****No. Overhaul fuse circuit and replace rated capacity fuse.****2. Inspect combination switch**

(a). Disconnect connector B101 of combination switch.



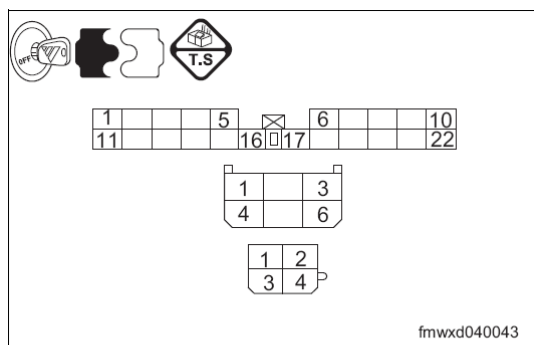
(b). Inspect combination switch

Standard Value

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on left turn lamp	5-21	$\leq 2 \Omega$
Switch on right turn lamp	4-21	$\leq 2 \Omega$
Switch off turn lamp	5-21 4-21	$> 10 \text{ M}\Omega$
Switch on warning lamp	5-21 4-21	$\leq 2 \Omega$
Switch off warning lamp	5-21 4-21 21-22	$> 10 \text{ M}\Omega$

Is the inspection result normal?**Yes. See Step three.****No. Replace combination switch.**

3. Inspect circuit



- (a). Disconnect flasher connector B022 and use the multi-meter to measure the resistance between output end of fuse F3 and pin3 of flasher connector B022.
- (b). Use the multi-meter to measure the resistance between pin21 of connector B011 of combination switch and pin2 of flasher connector B022
- (c). Use the multi-meter to measure the resistance between pin4 of connector B011 of combination switch and pin6 of flasher connector B022.
- (d). Use the multi-meter to measure the resistance between pin5 of connector B011 of combination switch and pin1 of flasher connector B023.

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Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes. Replace lamp or flasher.

No. Repair or replace harness.

Turn Lamp at One Side is Off

Circuit Diagram

Refer to this chapter, "Turn Lamp and Warning Lamp are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect lamp

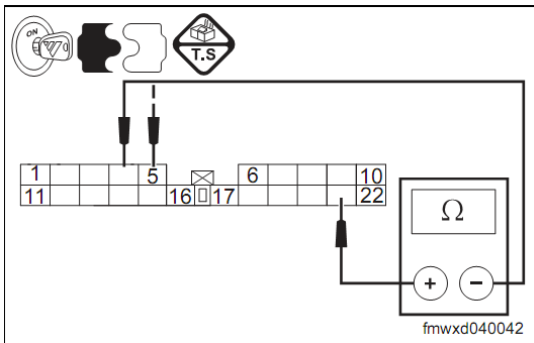
- (a). Inspect whether bulb is damaged.

Yes. Replace bulb.

No. See Step 2.

2. Inspect combination switch

- (a). Switch off general power
(b). Disconnect connector B011 of combination switch.



- (c). Inspect combination switch

Standard Value

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on left turn lamp	5-21	$\leq 2 \Omega$
Switch on right turn lamp	4-21	$\leq 2 \Omega$
Switch off turn lamp	5-21 4-21	$> 10 \text{ M}\Omega$

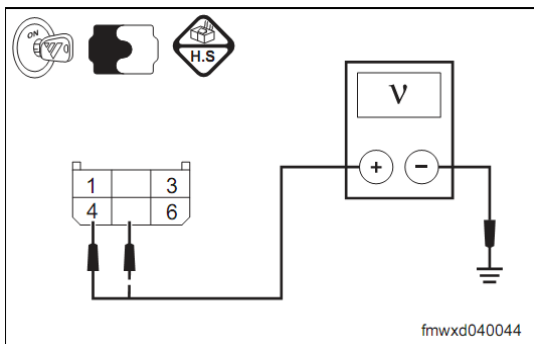
Is the inspection result normal?

Yes. See Step three.

No. Replace combination switch.

3. Inspect circuit

- (a). Switch on general power



- (b). Switch on left turn lamp and use the multi-meter to measure the voltage between pin4 of flasher connector BO22 and effective earthing point of vehicle body
(c). Switch on right turn lamp and use the multi-meter to measure the voltage between pin5 of flasher connector BO22 and effective earthing point of vehicle body

Voltage standard value: battery voltage

Is the inspection result normal?

Yes. Repair or replace harness.

Diagnosis - Lighting System

No. Replace flasher.

Warning Lamp is Off (while turn lamp is normal)

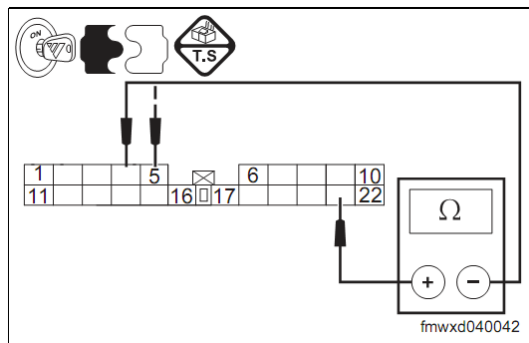
Circuit Diagram

Refer to this chapter, "Turn Lamp and Warning Lamp are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect combination switch

- (a). Switch off general power
- (b). Disconnect connector BO11 of combination switch.



- (c). Inspect combination switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on warning lamp	5-21 4-21	$\leq 2 \Omega$
Switch off warning lamp	5-21 4-21 21-22	$> 10 M\Omega$

Is the inspection result normal?

Yes. Replace flasher.

No. Replace combination switch.

Turn Lamp at One Side is Normally On

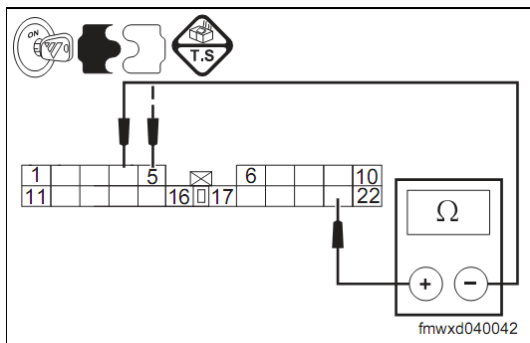
Circuit Diagram

Refer to this chapter, "Turn Lamp and Warning Lamp are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect combination switch

- (a). Switch off general power
- (b). Disconnect connector B101 of combination switch.



- (c). Inspect combination switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on left turn lamp	5-21	$\leq 2 \Omega$
Switch on right turn lamp	4-21	$\leq 2 \Omega$
Switch off turn lamp	5-21 4-21	$> 10 M\Omega$

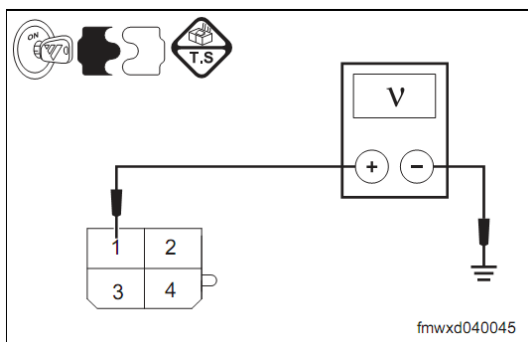
Is the inspection result normal?

Yes. See Step 2.

No. Replace combination switch.

2. Inspect circuit

- Left side turn lamp is normally on.
- (a). Disconnect flasher connector B022 and connector B023, connector B305 of left front turn lamp, connector B304 of left side turn lamp and connector T013 of left rear combination lamp.
 - (b). Switch on general power.



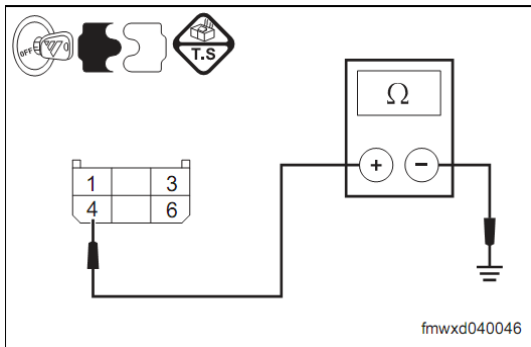
- (c). Use the multi-meter to measure the voltage between pin1 of flasher connector B023 and effective earthing point of vehicle body.

Voltage Standard value: 0 V

Is the inspection result normal?

No. Repair or replace harness.

Yes. See Step (d).

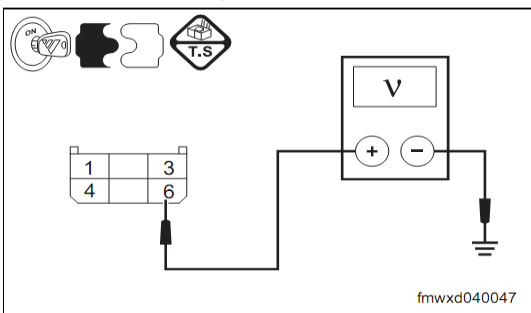


- (d). Use the multi-meter to measure the resistance between pin4 of flasher connector B022 and effective earthing point of vehicle body.

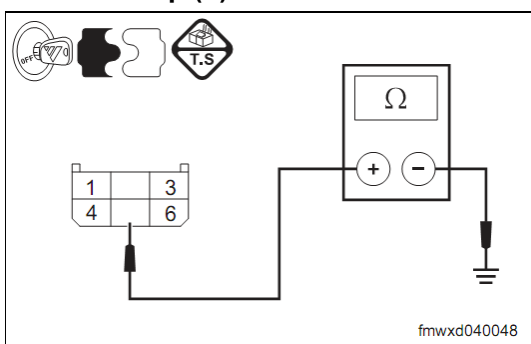
04

Resistance > 10 MΩ**Is the inspection result normal?****No. Repair or replace harness.****Yes. Replace flasher.**

- Right side turn lamp is normally on.
- (a). Disconnect flasher connector B022 and connector B023, connector B306 of right front turn lamp, connector B301 of right side turn lamp and connector T012 of right rear combination lamp.
- (b). Switch on general power



- (c). Use the multi-meter to measure the voltage between pin6 of flasher connector B022 and effective earthing point of vehicle body.

Voltage standard value: 0 V**Is the inspection result normal?****No. Repair or replace harness.****Yes. See Step (d).**

- (d). Use the multi-meter to measure the resistance between pin5 of connector B022 of flash lamp relay and effective earthing point of vehicle body.

Resistance > 10 MΩ**Is the inspection result normal?**

Diagnosis - Lighting System

Yes. Replace flasher.

No. Repair or replace harness.

Turn Lamps at Both Sides are Normally On

Circuit diagram

Refer to this chapter, "Turn Lamp and Warning Lamp are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect combination switch

- (a). Switch off general power
- (b). Disconnect connector B011 of combination switch.

- (c). Inspect combination switch

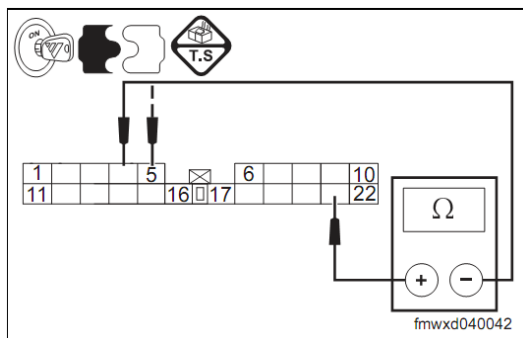
Standard Value

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on left turn lamp	5-21	$\leq 2 \Omega$
Switch on right turn lamp	4-21	$\leq 2 \Omega$
Switch off turn lamp	5-21 4-21	$> 10 \text{ M}\Omega$
Switch on warning lamp	5-21 4-21	$\leq 2 \Omega$
Switch off warning lamp	5-21 4-21 21-22	$> 10 \text{ M}\Omega$

Is the inspection result normal?

Yes. Repair or replace harness.

No. Replace combination switch.



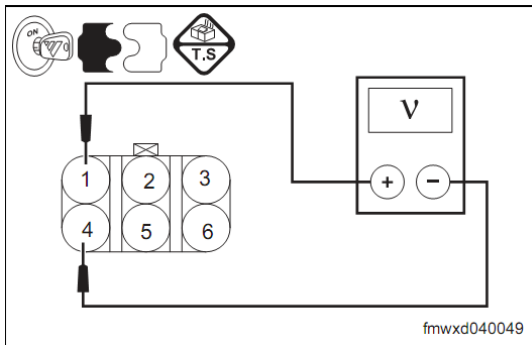
Brake Lamp at One Side is Off

Circuit Diagram

Refer to this chapter, "Brake Lamps at Both Sides are Off--- Circuit Diagram"

Diagnostic Steps

1. **Inspect the voltage between pin1 and pin4 of connector T013 of left rear combination lamp, or the voltage between pin1 and pin4 of connector T012 of right rear combination lamp**
 - (a). Disconnect connector T013 of left rear combination lamp or connector T012 of right rear combination lamp.
 - (b). Turn on ignition switch.



- (c). Stamp on brake pedal and use the multi-meter to measure the voltage between pin1 and pin4 of connector T013 of left rear combination lamp, or the voltage between pin1 and pin4 of connector T012 of right rear combination lamp

Voltage Standard value: battery voltage

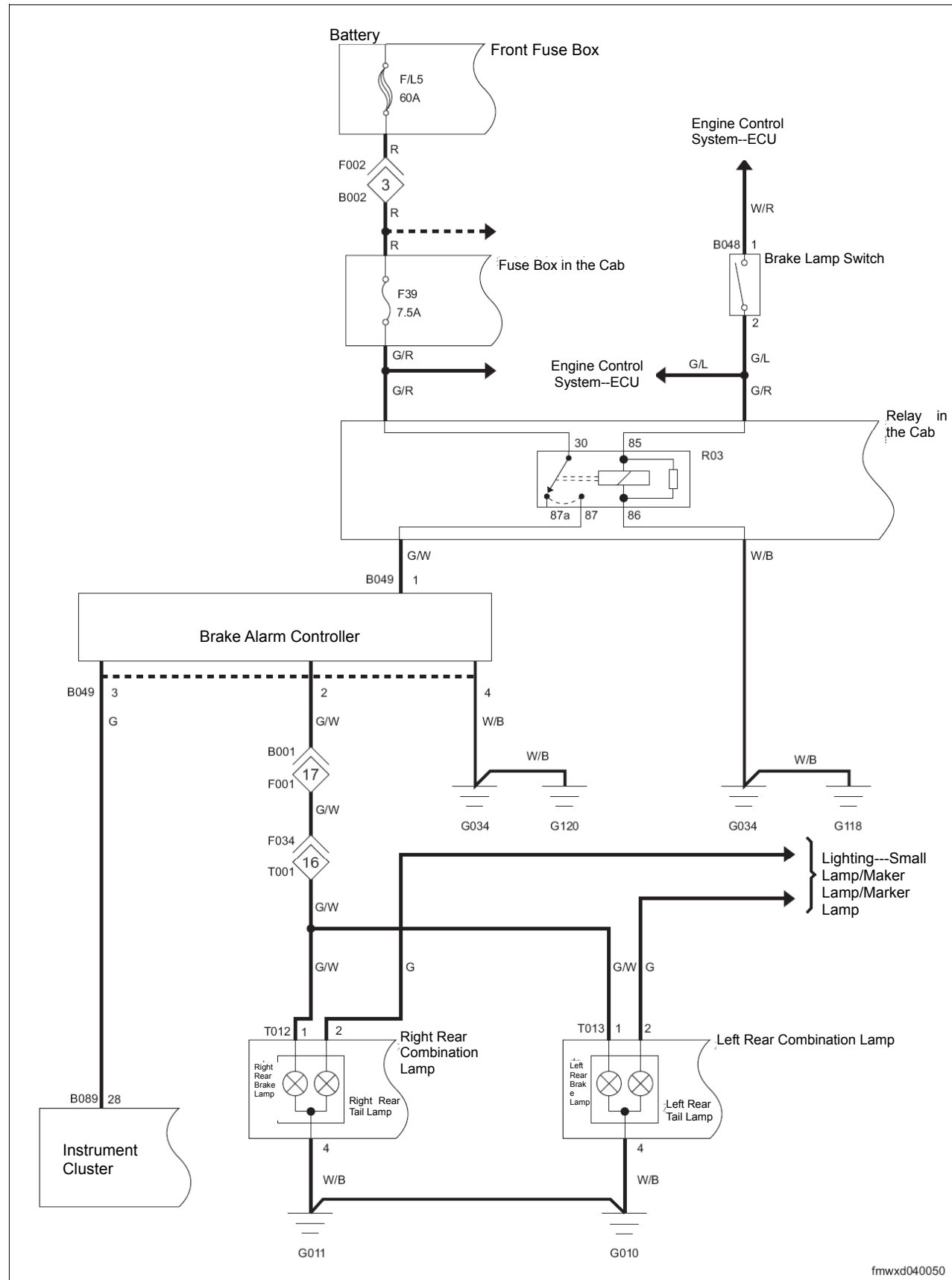
Is the inspection result normal?

Yes. Replace lamp.

No. Repair or replace harness.

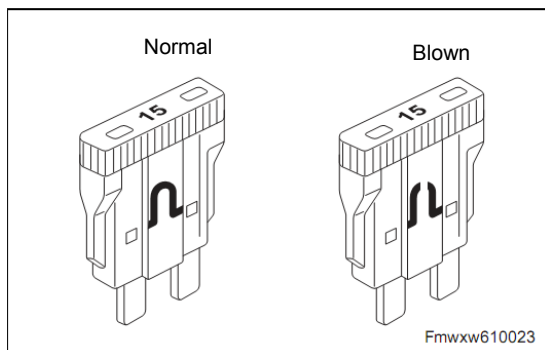
Brake Lamps at Both Sides are Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse**

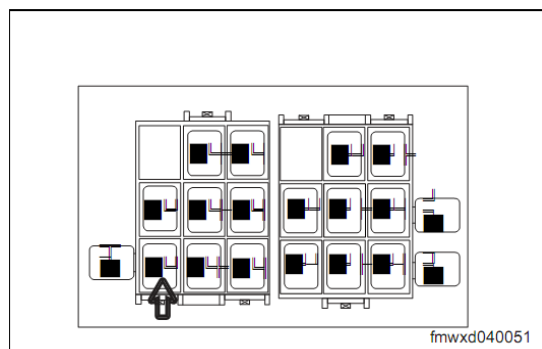
(a). Switch off general power



(b). Inspect fuse F39 (7.5A) in cab fuse box

Inspect whether the fuse is normal?**Yes. See Step two.****No. Overhaul fuse circuit and replace rated capacity fuse.****2. Inspect relay R03 of brake lamp**

(a). Switch on general power.

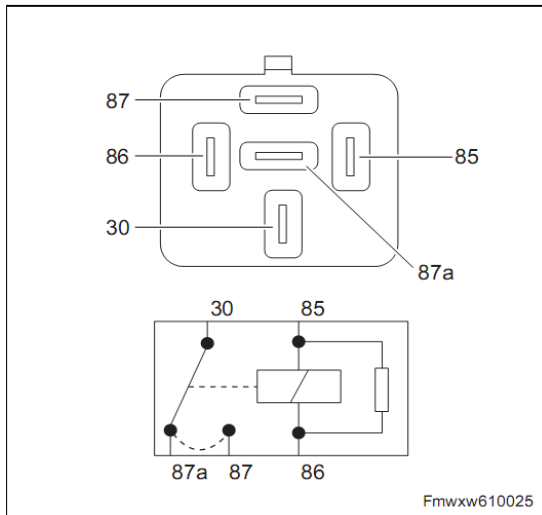


(b). Repeatedly stamp on brake pedal and inspect whether brake lamp relay R03 in cab relay box works.

Whether brake lamp relay works?**Yes. See Step six.****No. See Step three.****3. Inspect the power circuit of brake lamp relay R03 coil**

(a). Switch off general power and dismantle brake lamp relay R03

(b). Switch on general power and turn on ignition switch



- (c). Stamp on brake pedal and use the multi-meter to measure the voltage between pin 86 of relay R03 connector of brake lamp and effective earthing point of vehicle body

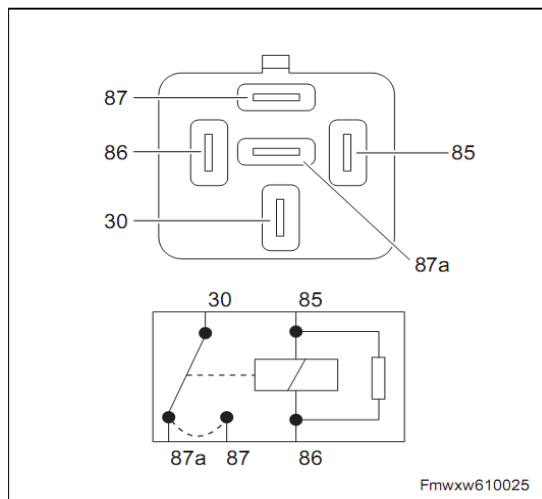
Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes. Replace lamp or flasher.

No. Repair or replace harness.

4. Inspect earth circuit of brake lamp relay R03 coil



- (d). Use the multi-meter to measure the resistance between pin 85 of relay R03 connector of brake lamp and effective earthing point of vehicle body.

Resistance $\leq 2 \Omega$

Is the inspection result normal?

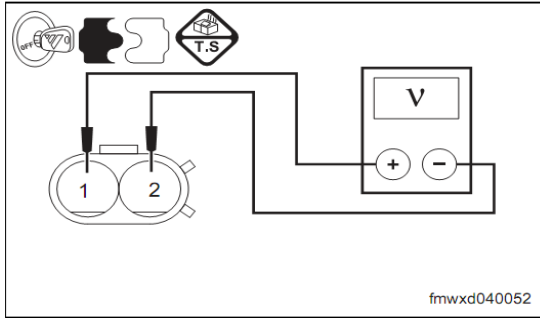
Yes. Replace relay R03 of brake lamp.

No. See Step 5.

5. Inspect brake lamp switch

- (a). Turn off ignition switch
(b). Switch off connector B048 of brake lamp switch

Diagnosis - Lighting System



(c). Inspect brake lamp switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Stamp on brake pedal	1-2	.
Loosen brake pedal	1-2	.

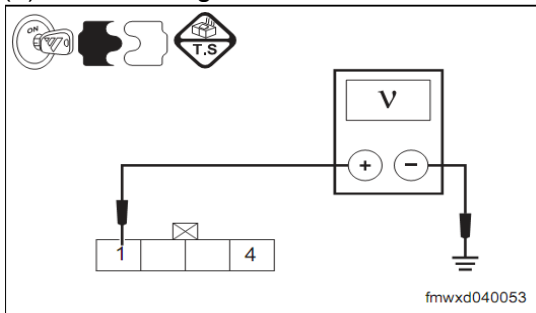
Is the inspection result normal?

No. replace brake lamp switch.

Yes. See Step 6.

6. Inspect the voltage between pin 1 of connector B049 of brake alarm controller and vehicle body

- (a). Connect connector B048 of brake lamp switch and install relay.
 (b). Turn on ignition switch



(c). Stamp on brake pedal and use the multi-meter to measure the voltage between pin 1 of brake alarm controller and effective earthing point of vehicle body

Voltage standard value: battery voltage

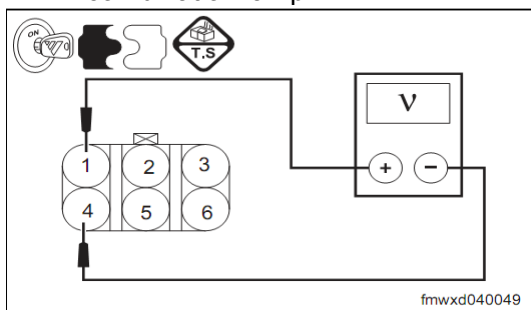
Is the inspection result normal?

No. Repair or replace harness.

Yes. See Step 7

7. Inspect the voltage between pin 1 and pin 4 of connector T013 of left rear combination lamp, or the voltage between pin1 and pin4 of connector T012 of right rear combination lamp

- (a). Disconnect connector T013 of left rear combination lamp or connector T012 of right rear combination lamp.



(b). Stamp on brake pedal and use the multi-meter to measure the voltage between pin 1 and pin 4 of connector T013 of left rear combination lamp, or the voltage between pin 1 and pin 4 of connector T012 of right rear combination lamp

Voltage standard value: battery voltage

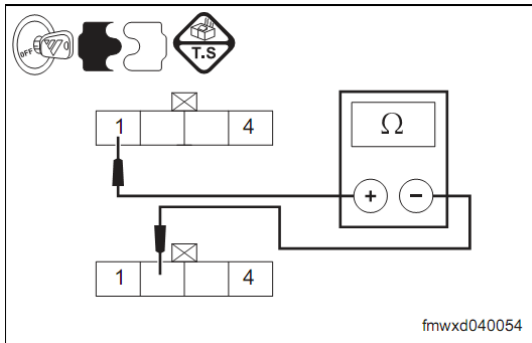
Is the inspection result normal?

No. See Step 8.

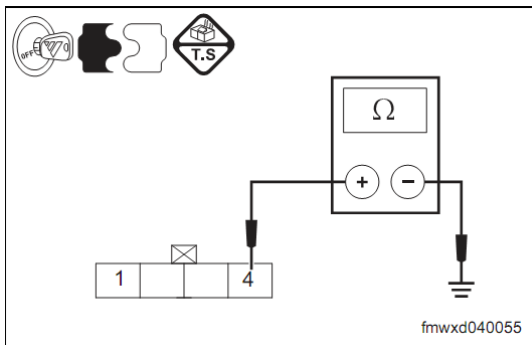
Yes. Replace bulb.

8. Inspect power and earth circuit between both ends of rear brake lamp

(a). Disconnect connector B049 of brake alarm controller.



(b). Use the multi-meter to measure the resistance between pin 1 of connector T013 or of connector T012 of rear combination lamp and pin2 of connector B049 of brake alarm controller.



(c). Use the multi-meter to measure the resistance between pin 4 of rear combination lamp connector and effective earthing point of vehicle body

Resistance $\leq 2 \Omega$

Is the inspection result normal?

No. Repair or replace harness.

Yes. Replace brake alarm controller.

Brake Lamp is Normally On

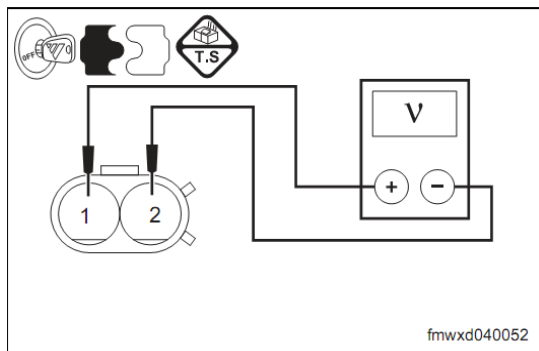
Circuit Diagram

Refer to this chapter, "Brake Lamps at Both Sides are Off--- Circuit Diagram"

Diagnostic Steps

1. Inspect brake lamp switch

- (a). Turn off ignition switch
- (b). Disconnect connector B048 of brake lamp switch



- (c). Inspect brake lamp switch

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Stamp on brake pedal	1-2	$> 10 \text{ M}\Omega$
Loosen brake pedal	1-2	$\leq 2 \Omega$

Is the inspection result normal?

Yes. Repair or replace harness.

No. replace brake lamp switch.

Back-up Lamp at One Side is Off

Circuit Diagram

Refer to this chapter, "Back-up lamp is Off--- Circuit Diagram"

Diagnostic Steps

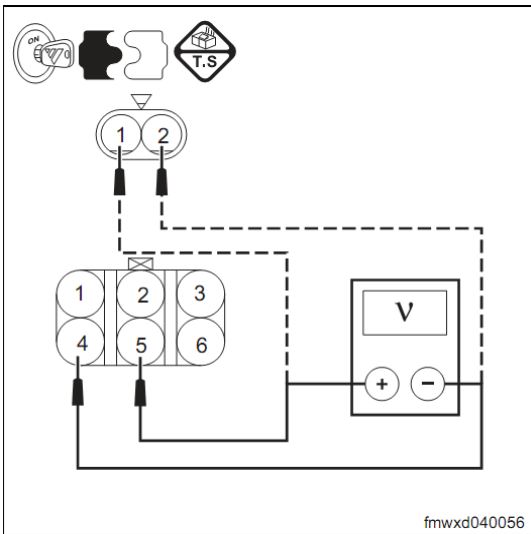
Warning:

Stop operating engine when inspecting back-up lamp.

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1. Inspect circuit

- (a). Disconnect connector T013 of left rear combination lamp, connector T012 of right rear combination lamp, or connector T006 of back-up lamp.
- (b). Turn on ignition switch
- (c). Choose reverse gear and use the multi-meter to measure the voltage between pin 5 and pin 4 of connector T013 of left rear combination lamp, and the voltage between pin 5 and pin 4 of connector T012 of right rear combination lamp, or the voltage between pin 1 and pin 2 of connector T006 of back-up lamp.



Voltage standard value: battery voltage

Is the inspection result normal?

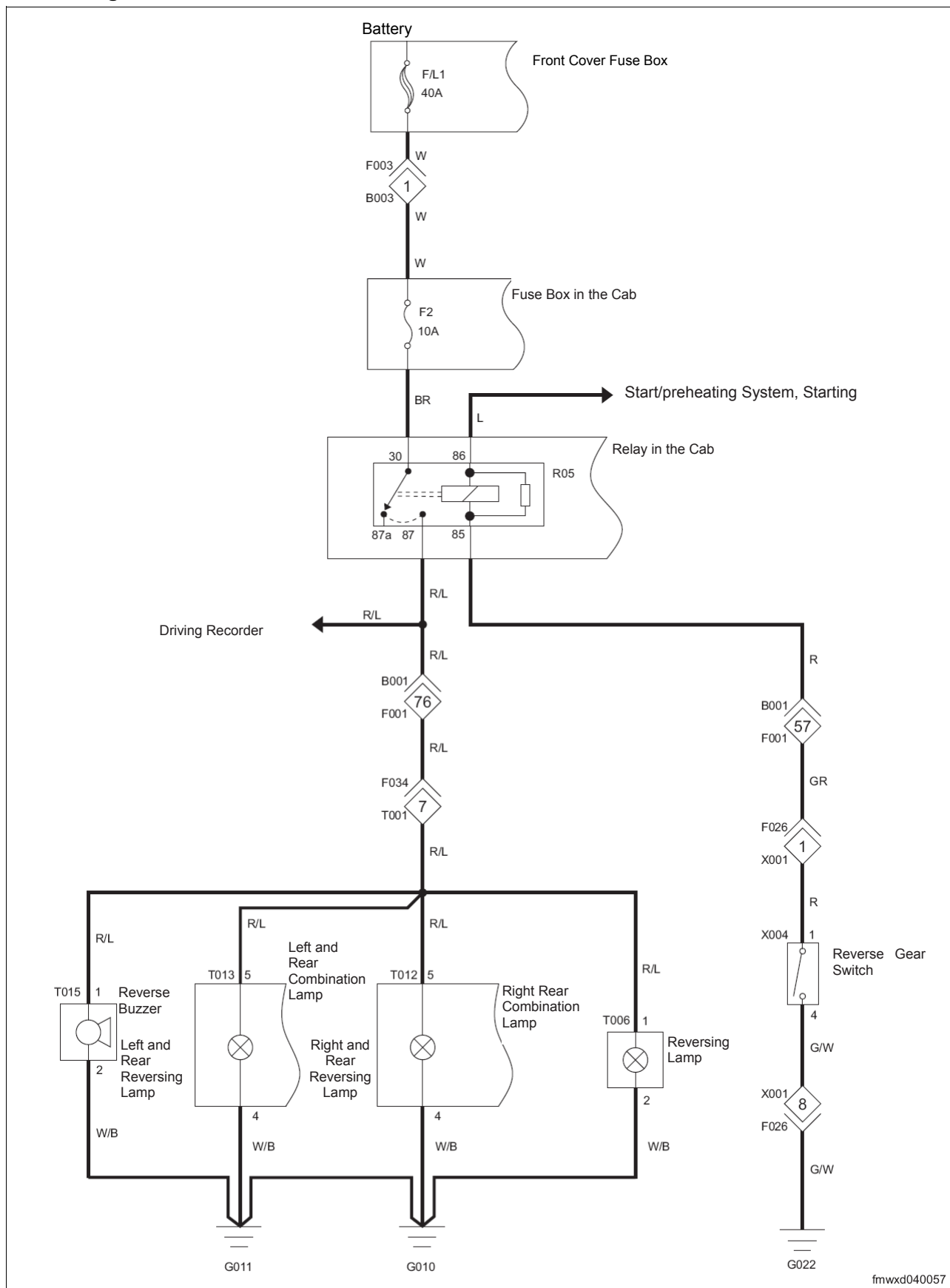
Yes. Replace lamp.

No. Repair or replace harness.

Diagnosis - Lighting System

Back-up Lamp is Off

Circuit Diagram

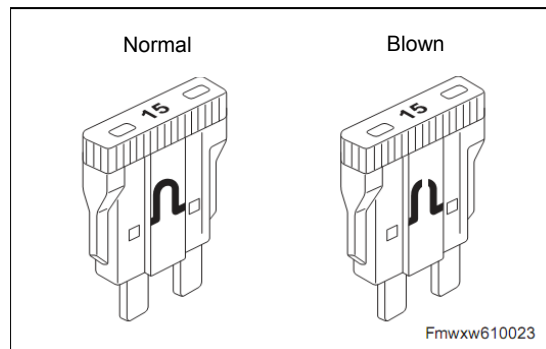


Diagnostic Steps**Warning:**

Stop operating engine when inspecting back-up lamp.

1. Inspect fuse

(a). Switch off general power



(b). Inspect fuse F2 (10A) in cab fuse box

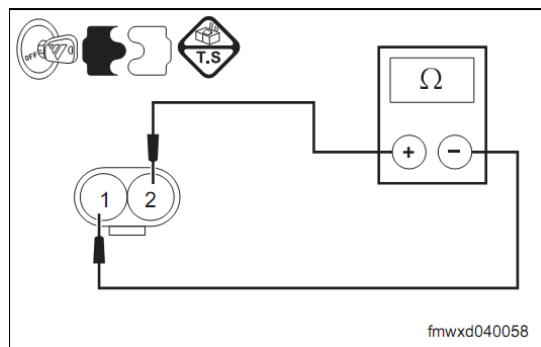
Inspect whether the fuse is normal?

Yes. See Step 2.

No. Normal fuse circuit and replace rated capacity fuse.

2. Inspect reverse gear switch

(a). Disconnect connector X004 of reverse gear switch.



(b). Inspect reverse gear switch.

Standard Value:

Gear	Contact Resistance
Reverse gear	$\leq 1\Omega$
Other gears	$> 10\text{ M}\Omega$

Is the inspection result normal?

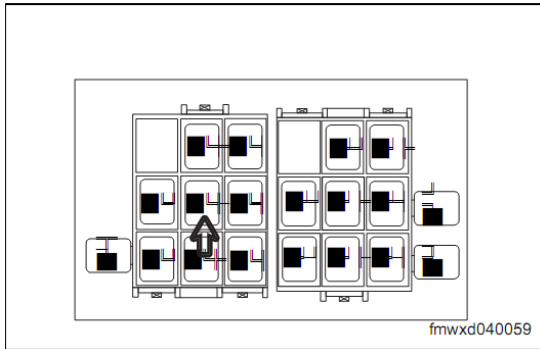
Yes. See Step 3.

No. Replace reverse gear switch.

3. Inspect relay R05 of reverse gear in cab relay box.

(a). Switch on general power and turn on ignition switch

Diagnosis - Lighting System



- (b). Repeatedly choose reverse gear and inspect whether relay R05 of back-up lamp relay works.

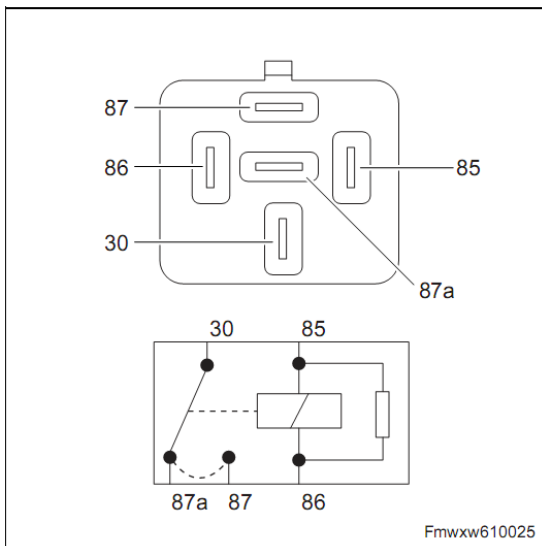
Whether relay R05 of back-up lamp relay works?

Yes. See Step 5.

No. See Step 4.

4. Inspect control circuit of relay R05 coil of cab back-up lamp relay

- (a). Switch off general power
- (b). Dismantle relay R05 of back-up lamp.
- (c). Switch on general power and turn on ignition switch.



- (d). Choose reverse gear and use the multi-meter to measure the voltage between pin86 and pin85 of relay R05 of back-up lamp relay

Voltage standard value: battery voltage

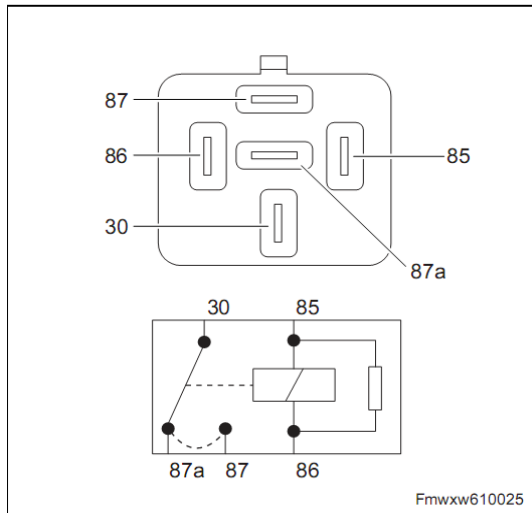
Is the inspection result normal?

Yes. Replace relay R05 of back-up lamp.

No. Repair or replace harness.

5. Inspect circuit between fuse F2 and relay R05

- (a). Switch off general power
- (b). Dismantle relay R05 of back-up lamp in cab relay box
- (c). Switch on general power



- (d). Use the multi-meter to measure the voltage between pin 30 of relay R05 of back-up lamp and effective earthing point of vehicle body.

Voltage standard value: battery voltage

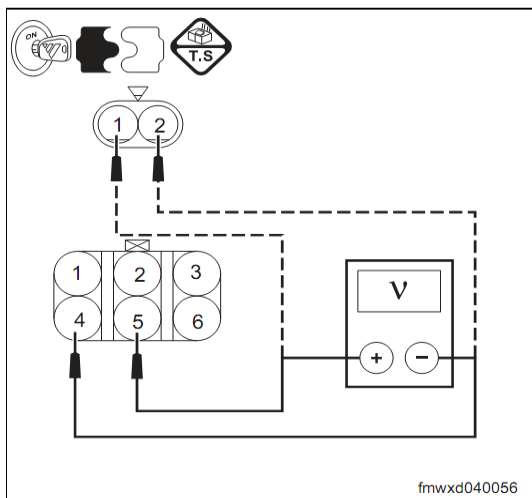
Is the inspection result normal?

Yes. See Step 6.

No. Repair or replace harness.

6. Inspect the voltage of both ends of back-up bulb

- (a). Disconnect connector T013 of left rear combination lamp, connector T012 of right rear combination lamp, or connector T006 of back-up lamp.
- (b). Turn on ignition switch.



- (c). Choose reverse gear and use the multi-meter to measure the voltage between pin 5 and pin 4 of connector T013 of left rear combination lamp, and the voltage between pin 5 and pin 4 of right rear combination lamp, or the voltage between pin 1 and pin 2 of connector T006 of back-up lamp.

Voltage standard value: battery voltage

Is the inspection result normal?

Yes. Replace bulb.

No. Repair or replace harness.

Back-up Lamp is Normally On

Circuit Diagram

Refer to this chapter, "Back-up lamp is Off--- Circuit Diagram"

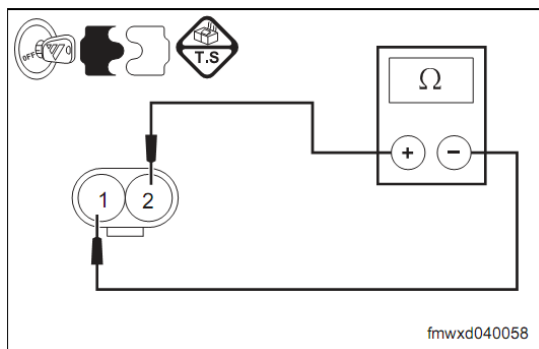
Diagnostic Steps

Warning:

Stop operating engine when inspecting back-up lamp.

1. Inspect reverse gear switch

- (a). Turn off ignition switch
- (b). Disconnect connector X004 of reverse gear switch.



- (c). Inspect reverse gear switch.

Standard Value:

Gear	Contact resistance
Reverse gear	$\leq 1\Omega$
Other gears	$> 10\text{ M}\Omega$

Is the inspection result normal?

Yes. Repair or replace harness.

No. Replace reverse gear switch.

The Reverse Buzzer Fails to Work

Circuit Diagram

Refer to this chapter, "Back-up Lamp is Off- Circuit Diagram"

Diagnostic Steps

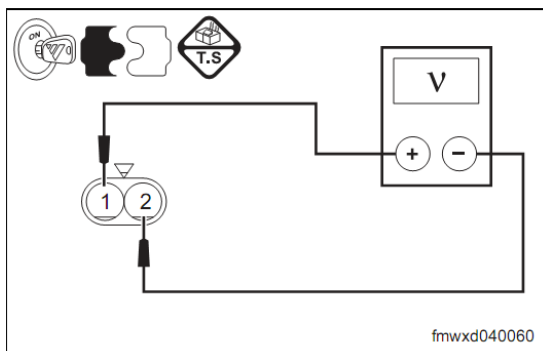
Warning:

Stop operating engine when inspecting the reverse buzzer.

04

1. Inspect circuit

- (a). Disconnect the reverse buzzer connector T015
- (b). Switch on the ignition switch
- (c). Choose reverse gear



- (d). Use the multi-meter to measure the voltage between pin 1 and pin 2 of the reverse buzzer connector T015.

Voltage standard value: battery voltage.

Is the inspection result normal?

Yes>Replace the reverse buzzer

No> Repair or replace harness

Front Small Lamp at One Side is Off

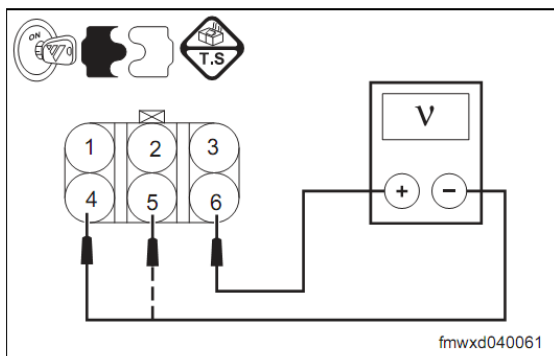
Circuit Diagram

Refer to this chapter, "Front Small Lamp and the Front Marker Lamp at Both Sides are Off- Circuit diagram".

Diagnostic Steps

1. Inspect power of the small lamp and the earth circuit.

- (a). Disconnect the front combination lamp connector B017 or B041.
- (b). Switch on the small lamp.



- (c). Use the multi-meter to measure the voltage between pin 6 and pin 4 of the left front combination lamp connector B107 or the voltage between pin 6 and pin 5 of the right front combination lamp connector B041.

Voltage standard value: battery voltage.

Is the inspection result normal?

Yes>Replace bulb

No> Repair or replace harness

Front Maker Lamp at One Side is Off

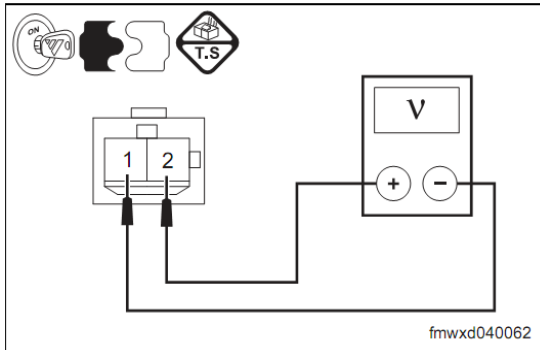
Circuit Diagram

Refer to this chapter, "Front Small Lamp and the Front Maker Lamp at Both Sides are Off- Circuit Diagram".

Diagnostic Steps

1. Inspect power of the front maker lamp and the earthed circuit.

- (a). Disconnect the maker lamp connector R008 or R002.
- (b). Switch on the small lamp.



- (c). Use the multi-meter to measure the voltage between pin 1 and pin 2 of the right maker lamp connector R008 or the voltage between pin 1 and pin 2 of the left maker lamp connector R002.

Voltage standard value: battery voltage.

Is the inspection result normal?

Yes>Replace bulb

No> Repair or replace harness

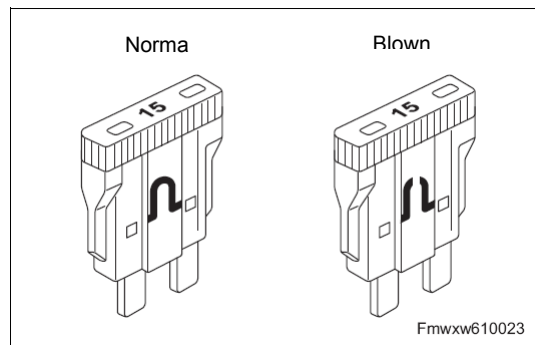
Front Small Lamp and the Front Maker Lamp at Both Sides
are Off

04



Diagnostic Steps**1. Inspect fuse.**

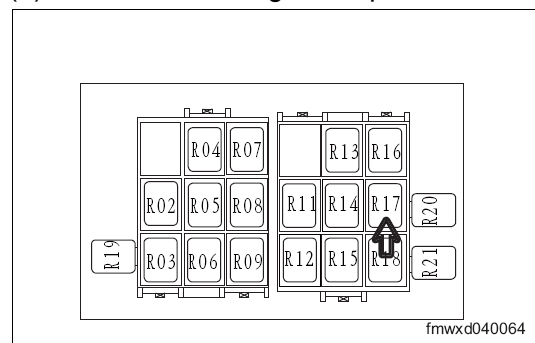
(a). Switch off general power.



(b). Inspect fuse F6 (10A) in the fuse box of the cab.

Inspect whether fuse is normal?**Yes>See Step 2****No>Overhaul fuse circuit and replace rated capacity fuse.****2. Inspect whether the small lamp relay R17 works**

(a). Switch on the general power.

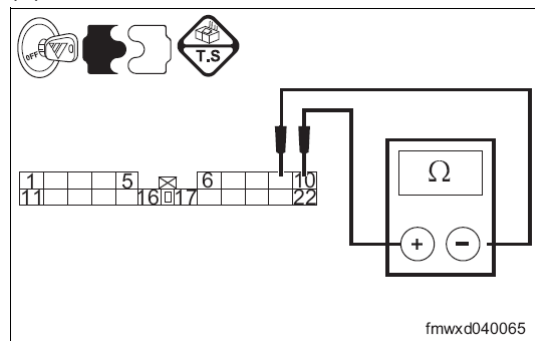


(b). Switch on the small lamp repeatedly to inspect whether the small lamp relay R17 works.

Whether the relay R17 works?**Yes>See Step 5****No> See Step 3****3. Inspect the combination switch**

(a). Switch off the general power.

(b). Disconnect the combination switch connector B011.



(c). Use the multi-meter to measure the resistance between pin 9 and pin 10 of the combination switch.

Standard Values:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp	9-10	$\leq 2 \Omega$
Switch off the small lamp	9-10	$> 10 M\Omega$

Diagnosis - Lighting System

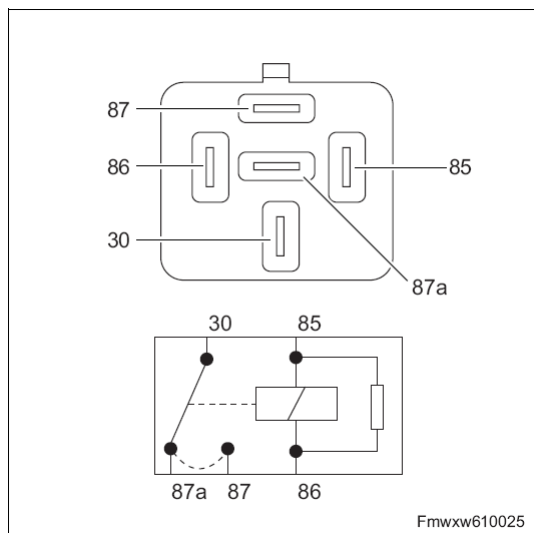
Is the inspection result normal?

Yes see Step 4

No replace combination switch

4. Inspect the R17 circuit control circuit of the small vehicle in the cab of the vehicle body.

- (a). Switch on the general power.
- (b). Dismantle relay R17.
- (c). Switch on the small lamp.



- (d). Measure the voltage between pin 86 and pin 85 of the relay R17 connector.

04

Voltage standard value: battery voltage.

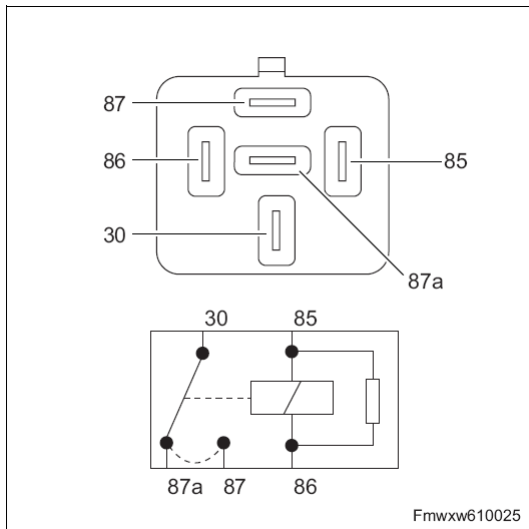
Is the inspection result normal?

Yes>Replace the relay R17 in the cab

No> Repair or replace harness

5. Inspect control circuit contact of relay R17

- (a). Switch off general power.
- (b). Dismantle the relay R17.
- (c). Switch on general power.



- (d). Measure the voltage between pin 30 of relay connector R17 and the effective earthing point of the vehicle body.

Voltage standard value: battery voltage.

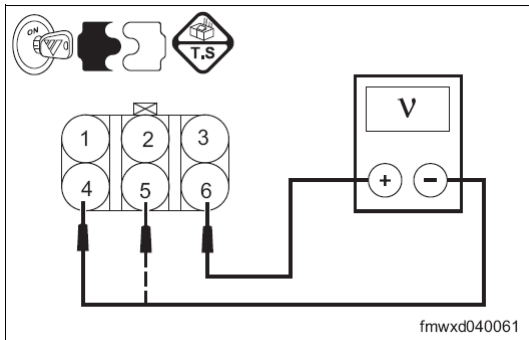
Is the inspection result normal?

Yes>See Step 6

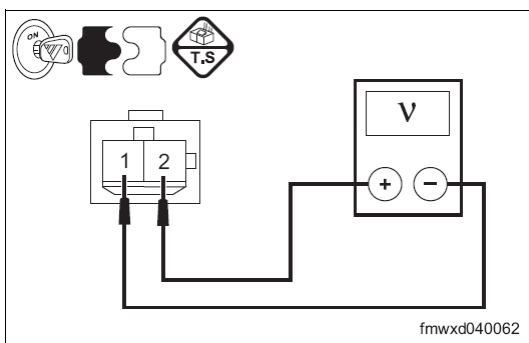
No> Repair or replace the relay box in the cab

6. Inspect power of the small lamp and the earthed circuit.

- (a). Disconnect the front combination lamp connector B017, B041 or maker lamp connector R008 and R002.
- (b). Switch on the small lamp



- Measure the voltage between pin 6 and pin 4 of the left front combination lamp connector B017 or the voltage between pin 6 and pin 5 of the right front combination lamp connector B041.



- Measure the voltage between pin 1 and pin 2 of the left front maker lamp connector R008 or the voltage between pin 1 and pin 2 of the right front maker lamp connector R002.

Voltage standard value: battery voltage.

Is the inspection result normal?

Yes>Replace the bulb

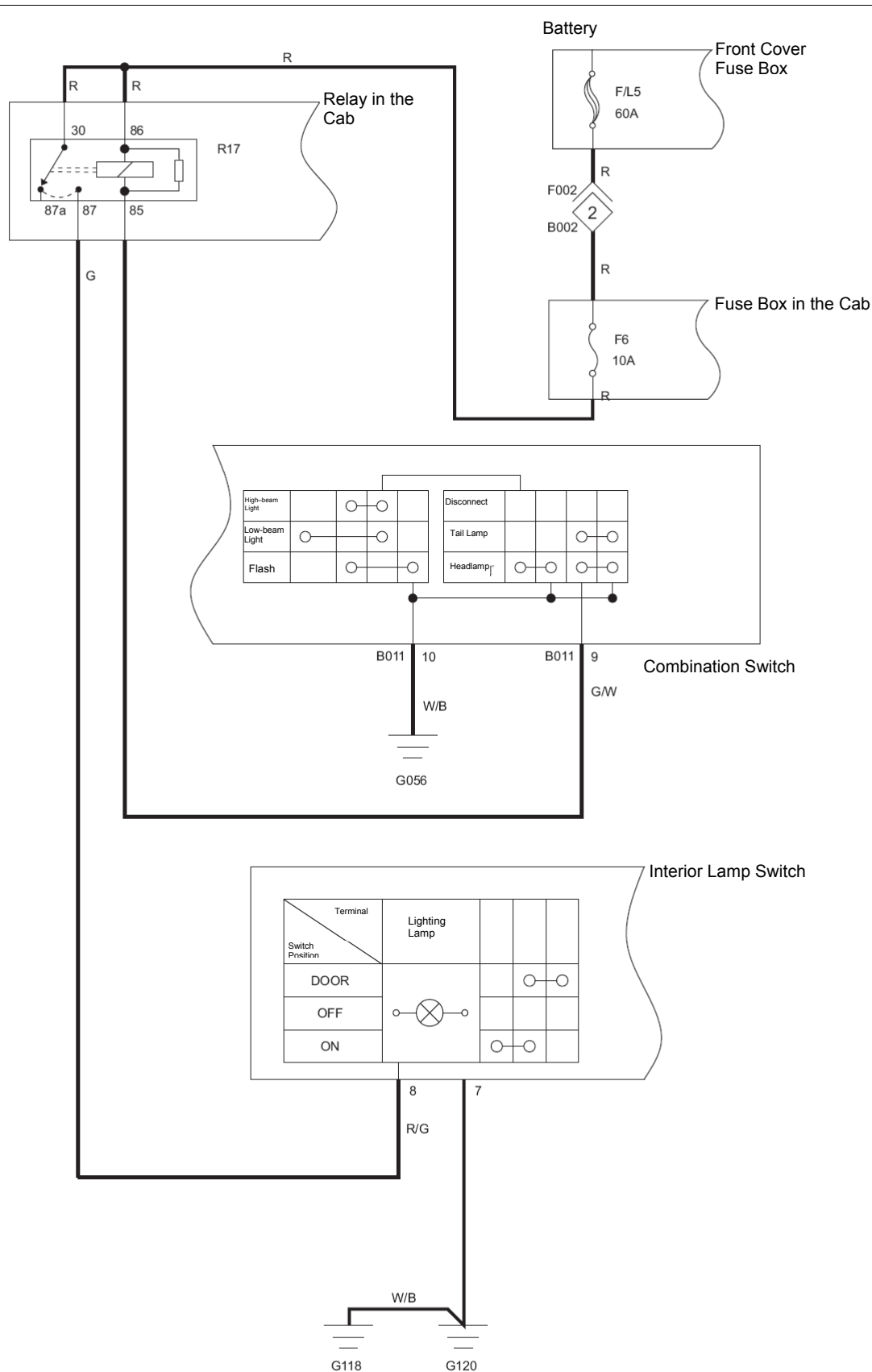
Diagnosis - Lighting System

No> Repair or replace harness

Lighting Lamp of the Interior Lamp Switch is Off

Circuit Diagram

04

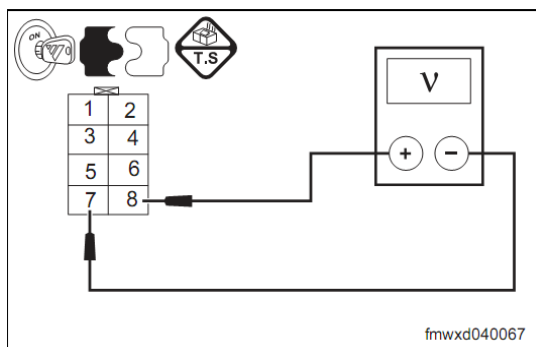


fmwx040066

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect power of lighting bulb of the interior lamp switch and the earthed circuit.**

(a). Disconnect the interior lamp switch connector B202.

(b). Switch on the small lamp.



(c). Measure the voltage between pin 8 and pin 7 of lighting bulb of the interior lamp switch connector B202.

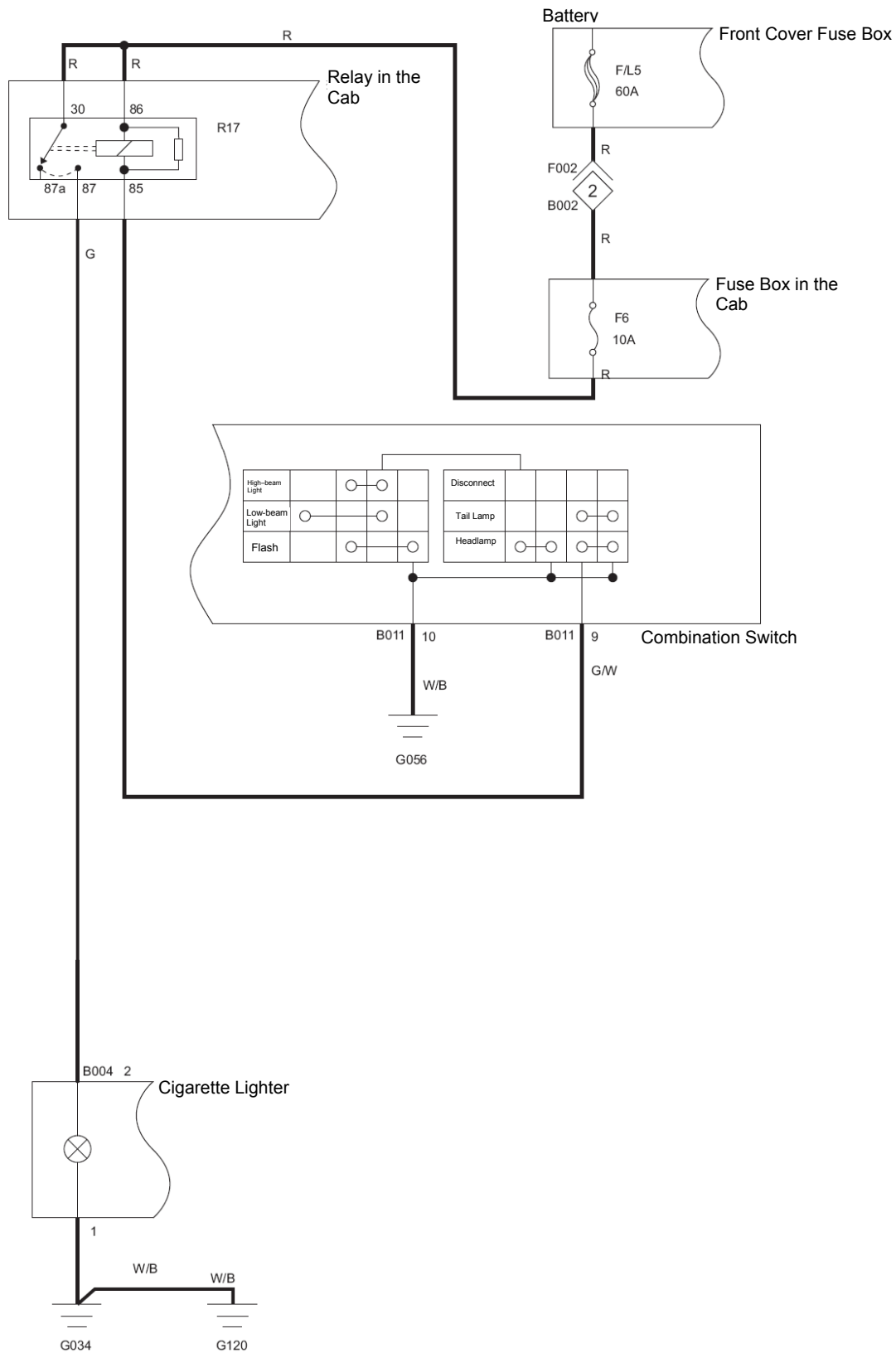
Voltage standard value: battery voltage.

Is the inspection result normal?

Yes>Replace the switch of the interior lamp

Cigarette Lighter Lighting Lamp is Off

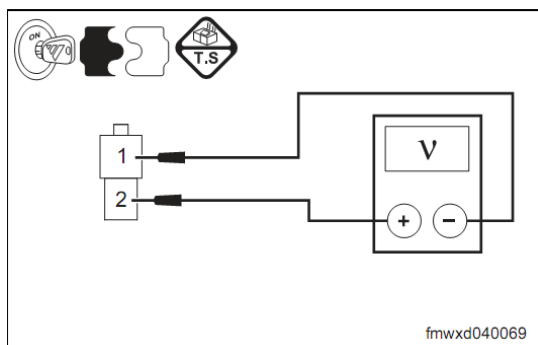
Circuit Diagram



fmwxd040068

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect power of the cigarette lighter lighting bulb and the earthed circuit.**

- (a). Disconnect the cigarette lighter connector B004.
- (b). Switch on the small lamp.



- (c). Measure the voltage between pin 2 and pin 1 of the cigarette lighter lighting bulb connector B004.

Voltage standard value: battery voltage.

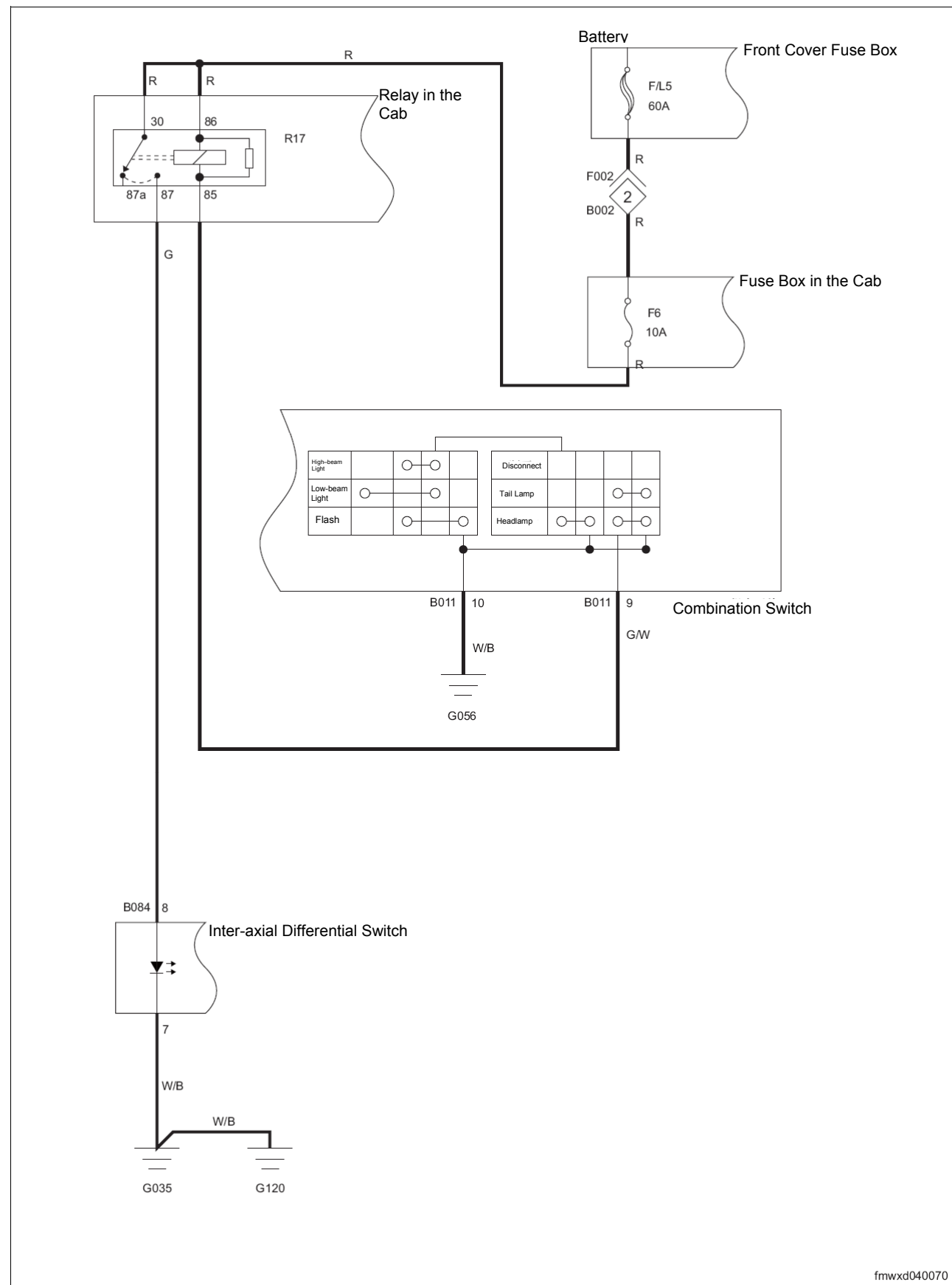
Is the inspection result normal?

Yes > Replace the lighting bulb of the cigarette lighter seat

No > Repair or replace harness

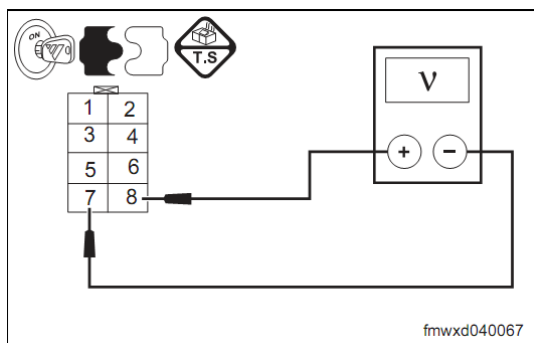
Inter-axial Differential Switch Lighting Lamp is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect power of the inter-axial differential switch lighting lamp and the earthed circuit.**

- (a). Disconnect inter-axial differential switch connector B084.
(b). Switch on the small lamp.



- (c). Measure the voltage between pin 8 and pin 7 of the inter-axial differential switch connector B084.

Voltage standard value: battery voltage.

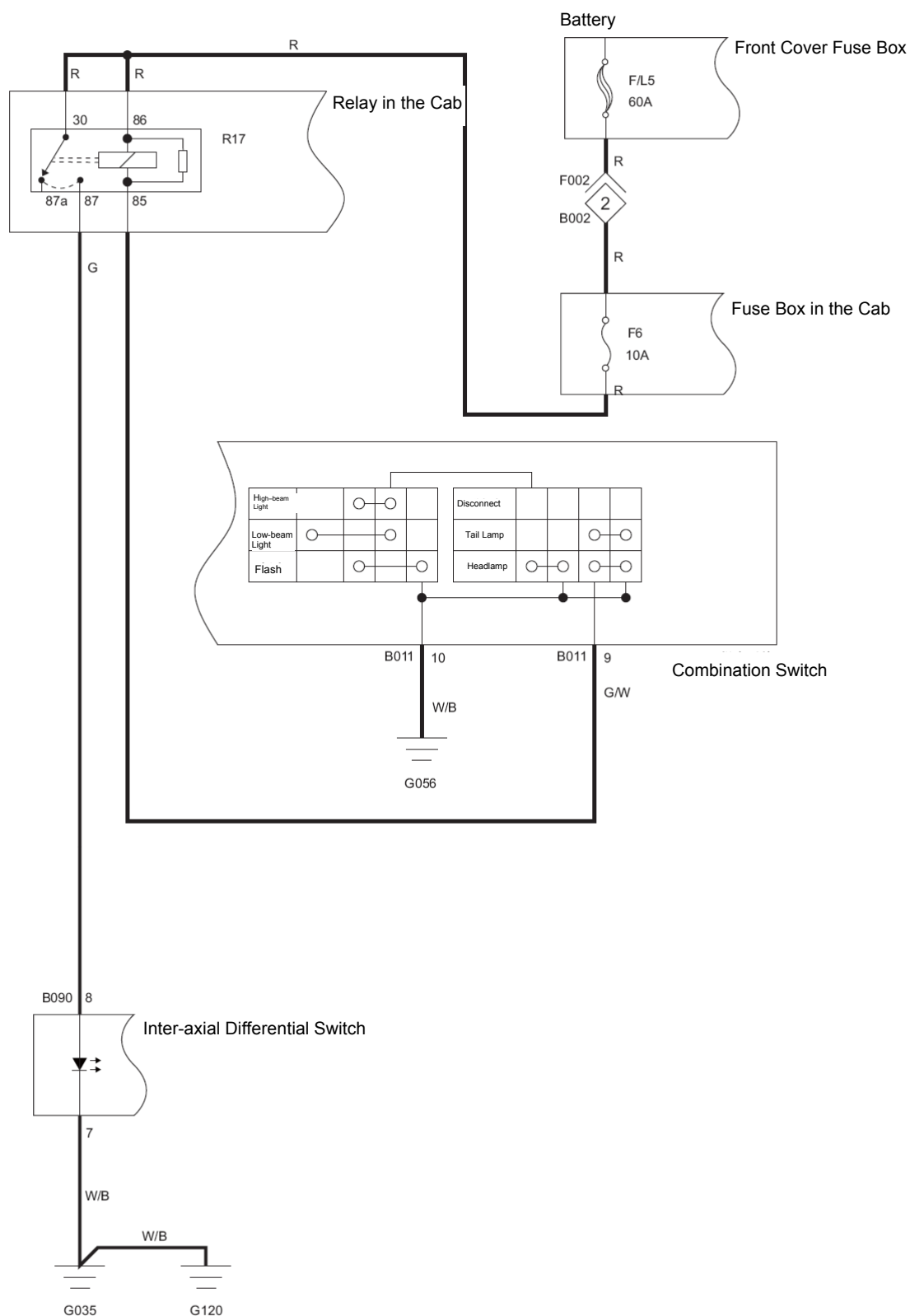
Is the inspection result normal?

Yes > Replace the inter-axial differential switch

No > Repair or replace harness

Inter-wheel Differential Switch Lighting Lamp is Off

Circuit Diagram

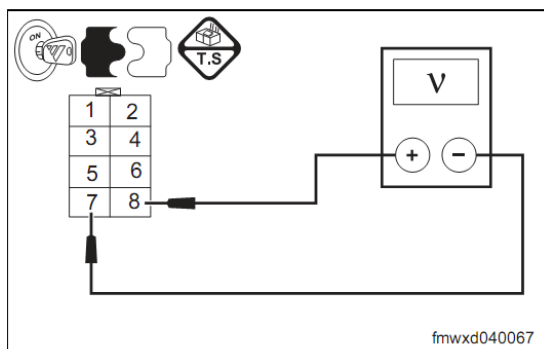


fmwxd040072

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect power of the inter-wheel differential switch lighting bulb and the earthed circuit.**

(a). Disconnect inter-wheel differential switch connector B083.

(b). Switch on the small lamp.

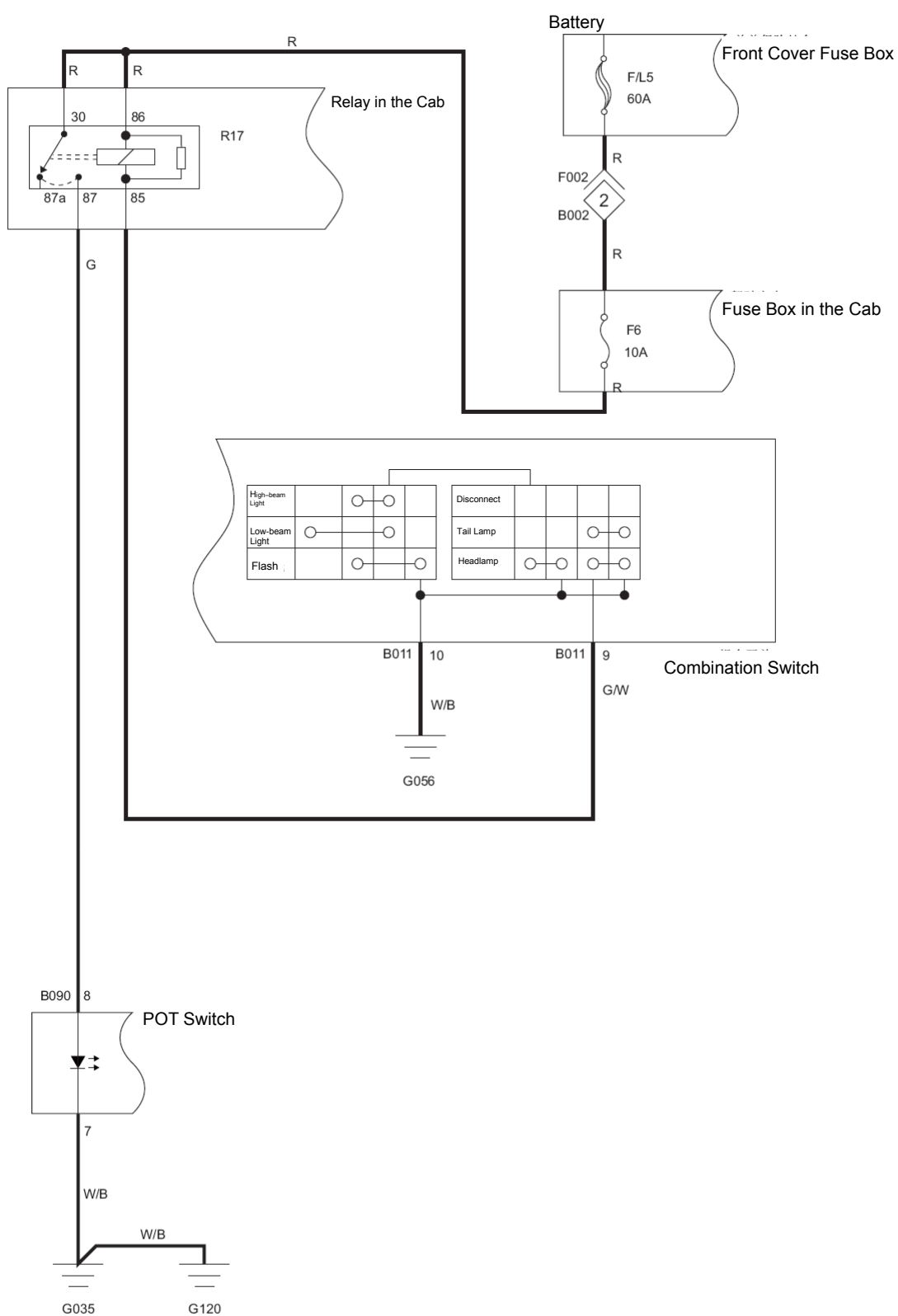


(c). Measure the voltage between pin 8 and pin 7 of the inter-wheel differential switch connector B083.

Voltage standard value: battery voltage.**Is the inspection result normal?****Yes > Replace the inter-wheel differential switch****No > Repair or replace harness**

PTO Switch Lamp is off

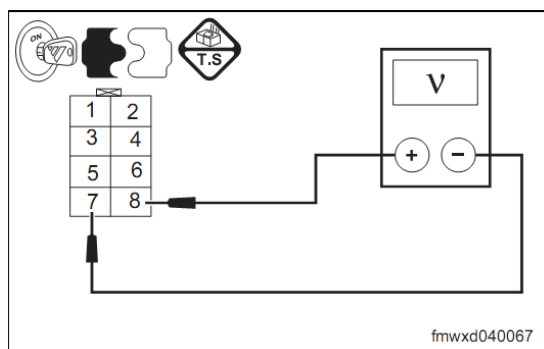
Circuit Diagram



fmwxd040072

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect POT switch lamp power and earth circuit.**

- (a). Disconnect PTO switch connector B090
- (b). Switch on the small light.



- (c). Measure the voltage between PTO switch connector B090 pin 8 and pin 7.

Voltage standard value: battery voltage

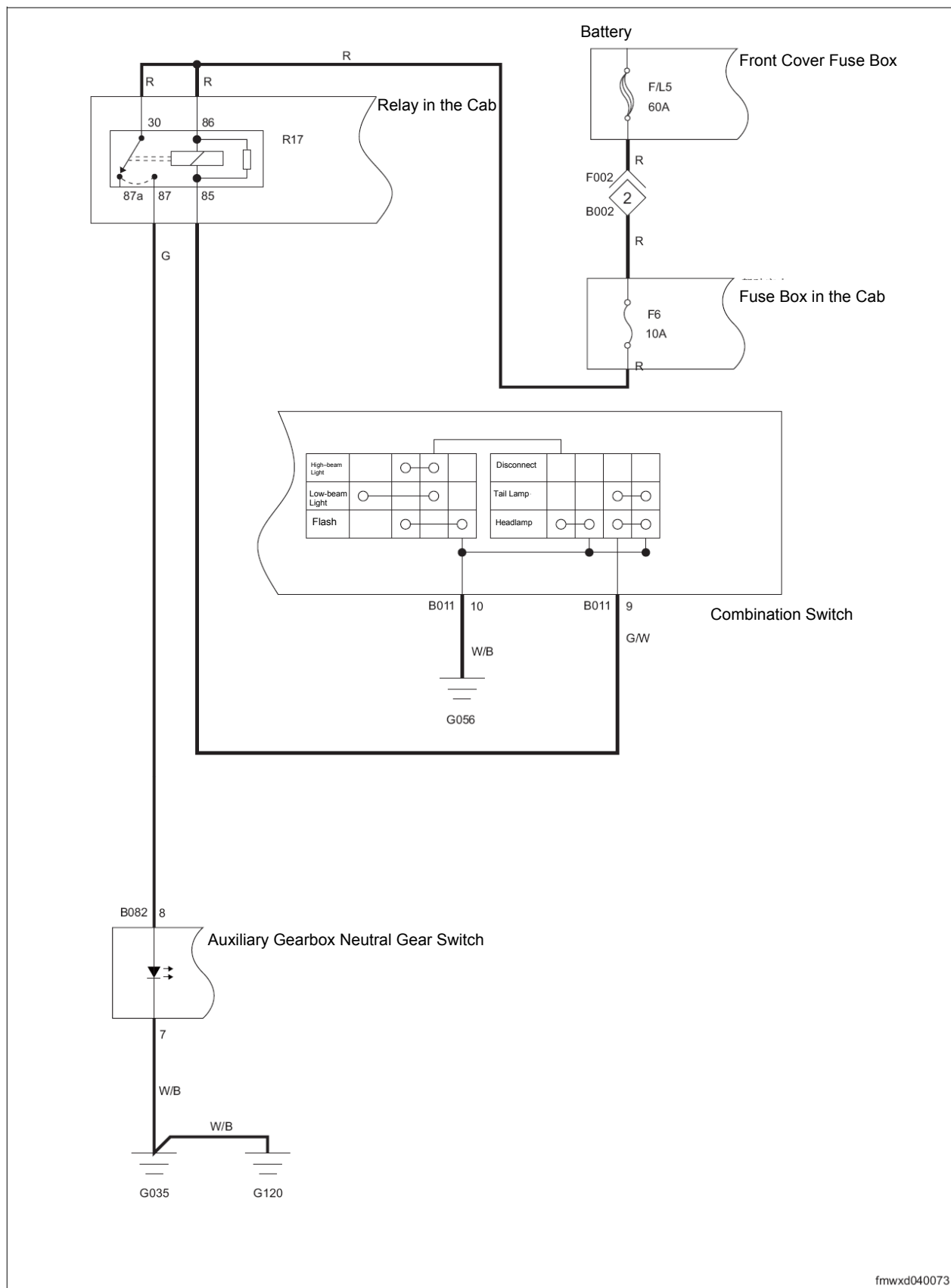
Is the inspection result normal?

Yes > replace the PTO switch

No > repair or replace harness

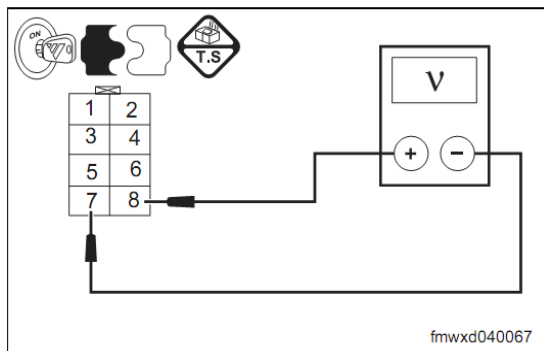
Auxiliary Gearbox Neutral Gear Switch Lamp is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect auxiliary gearbox neutral gear switch lamp power and earth circuit.**

- (a). Disconnect auxiliary gearbox neutral gear switch connector B082.
(b). Switch on the small light.



- (c). Measure the voltage between auxiliary gearbox neutral gear switch connector B082 pin 8 and pin 7.

Voltage standard value: battery voltage

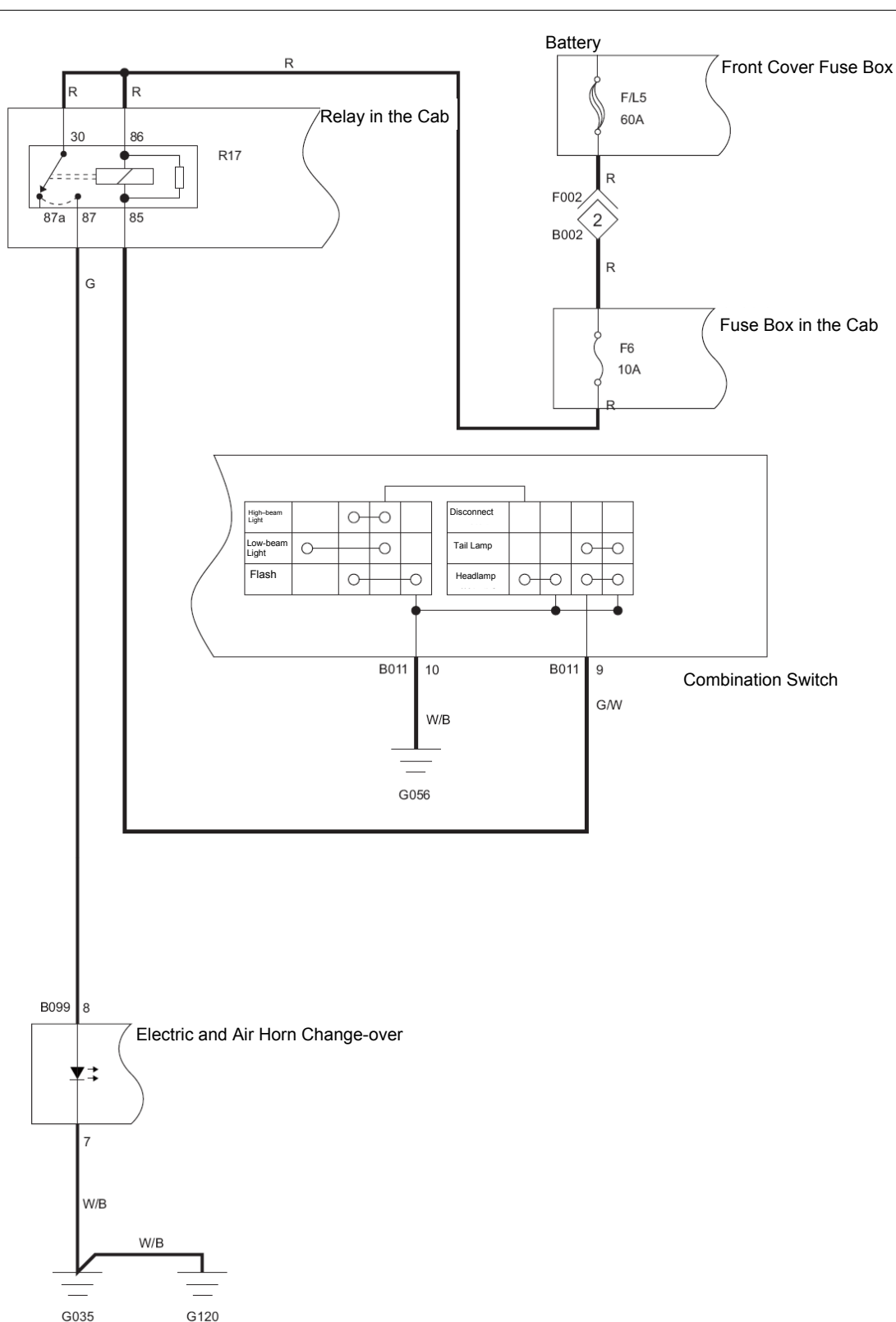
Is the inspection result normal?

Yes > replace the auxiliary gearbox neutral

No > repair or replace harness.

Electric and Air Horn Change-over Lamp is Off.

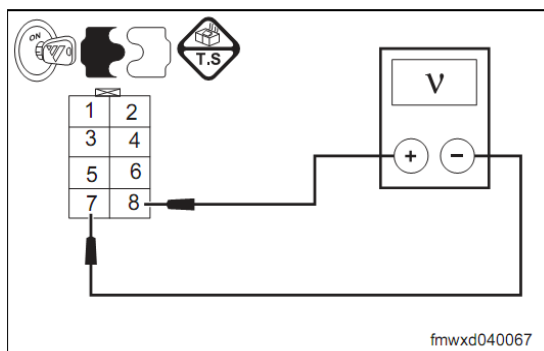
Circuit Diagram



fmwxd040074

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect electric and air horn change-over lamp power and earth circuit.**

- (a). Disconnect electric and air horn change-over connector B099.
 (b). Switch on the small light.



- (c). Measure the voltage between electric and air horn change-over connector B099 pin 8 and pin 7.

Voltage standard value: battery voltage

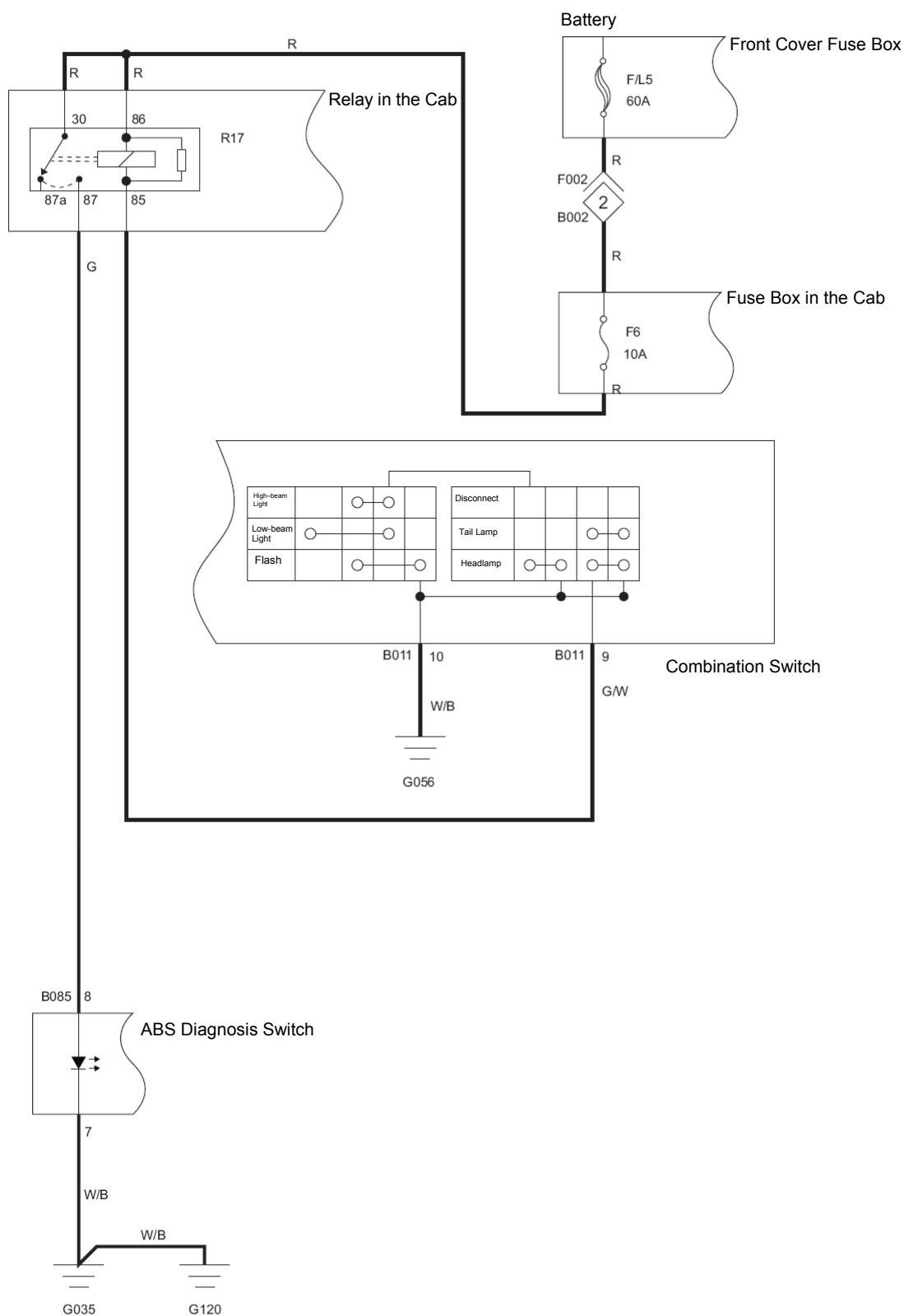
Is the inspection result normal?

Yes > replace the electric and air horn change-over .

No > repair or replace harness.

ABS Diagnostic Switch Lamp is off

Circuit Diagram

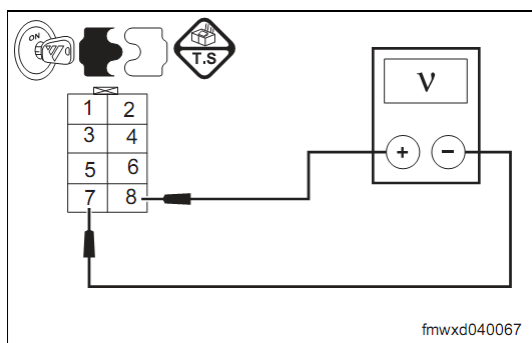


fmwxd040075

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect ABS diagnostic switch lamp power and earth circuit.**

(a) . Disconnect ABS diagnostic switch connector B085.

(b) . Switch on the small light.



(c). Measure the voltage between ABS diagnostic switch connector B085 pin 8 and pin 7

Voltage standard value: battery voltage

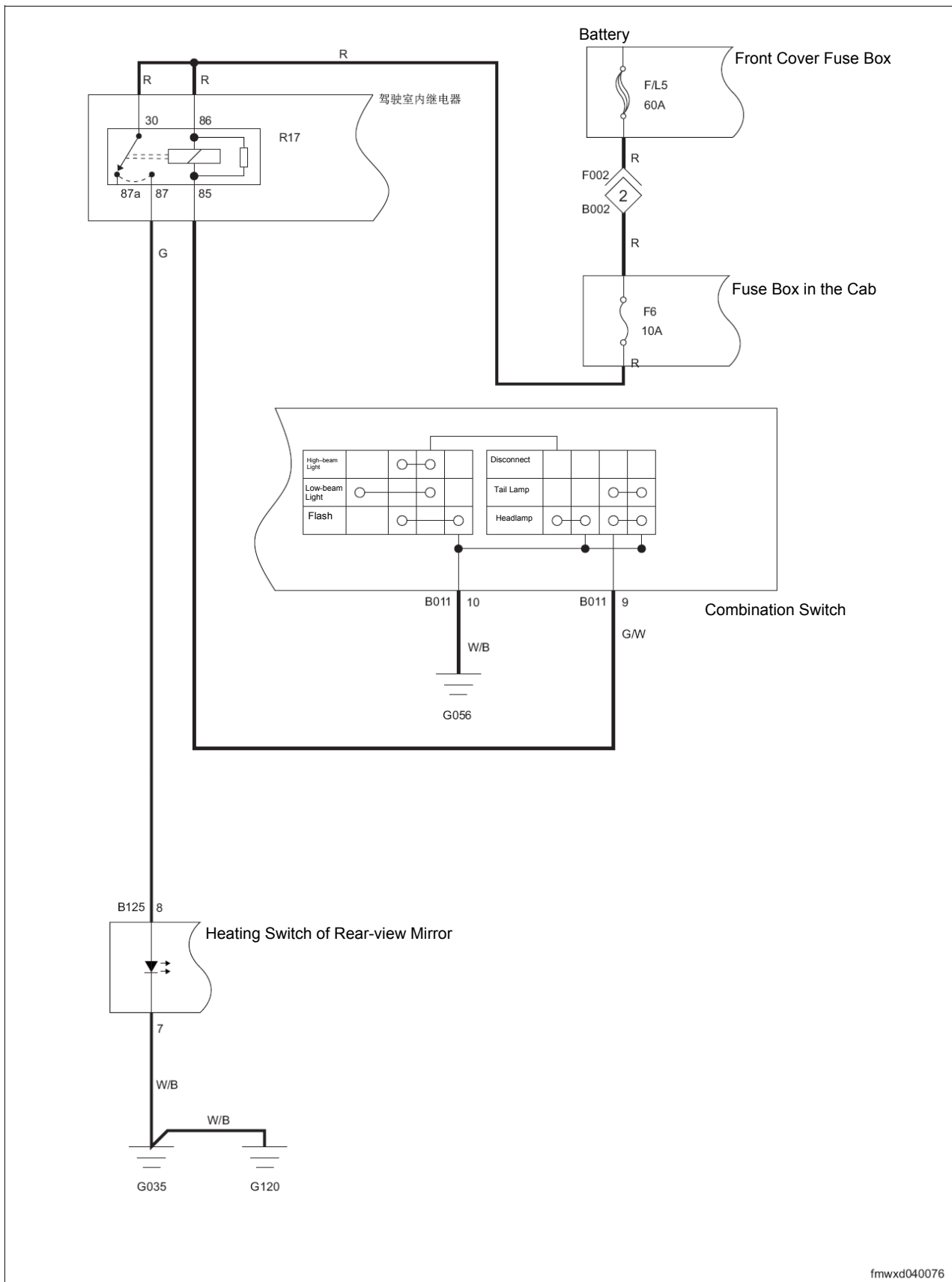
Is the inspection result normal?

Yes > replace the ABS diagnostic switch.

No > repair or replace harness.

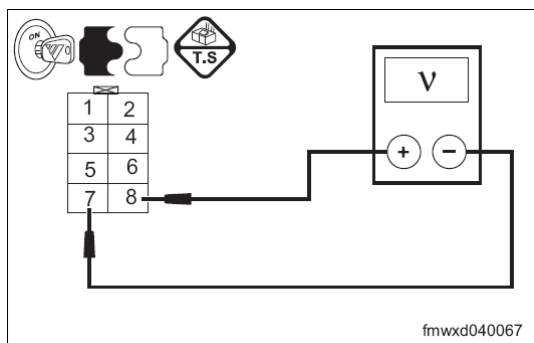
Rear View Mirror Heating Switch Lamp is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect rear view mirror heating switch power and earth circuit.**

- (a). Disconnect rear view mirror heating switch connector B125.
(b). Switch on the small light.



- (c). Measure the voltage between rear view mirror heating switch connector B125 pin 8 and pin 7.

Voltage standard value: battery voltage

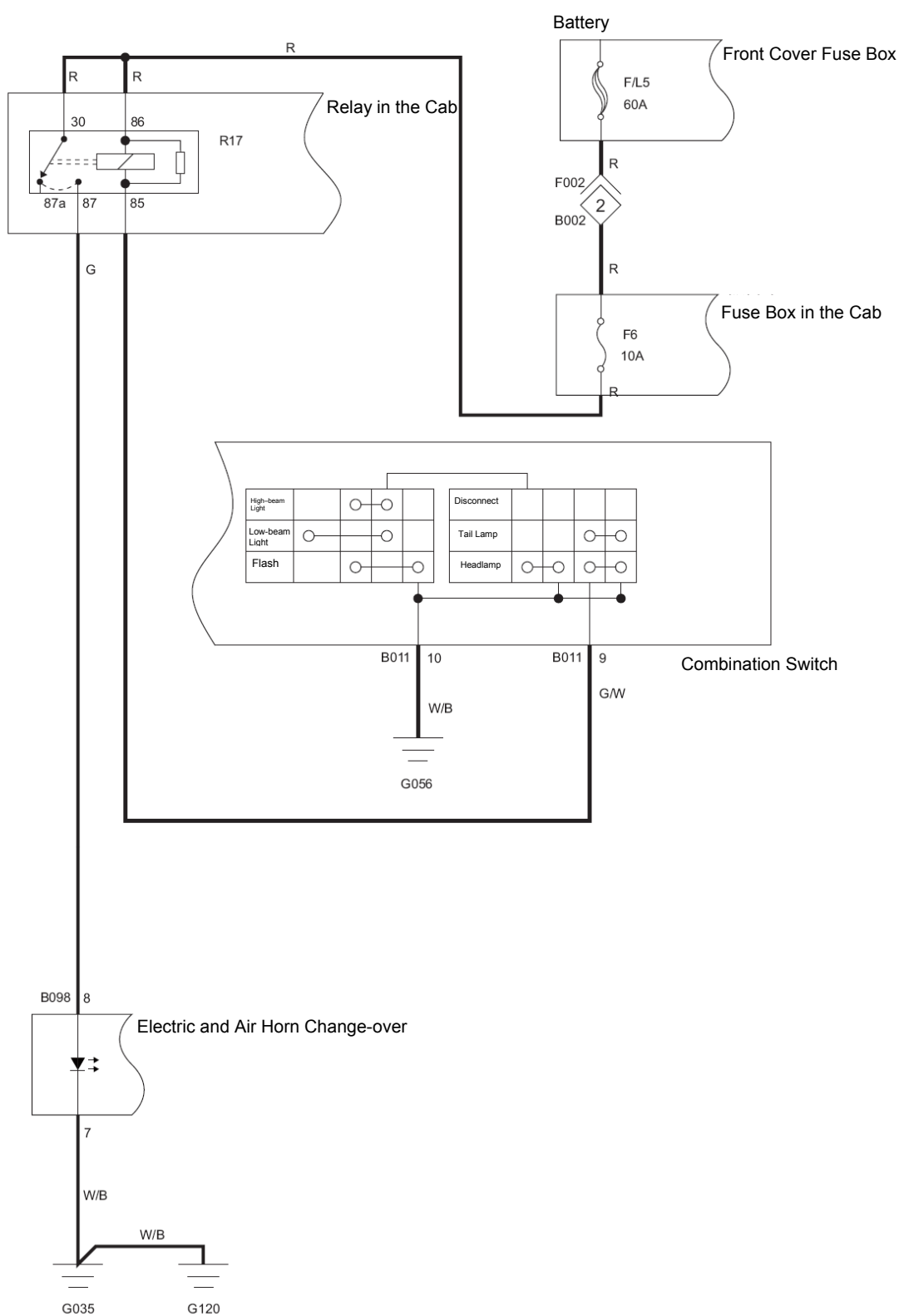
Is the inspection result normal?

Yes > replace rear view mirror heating switch.

No > repair or replace harness.

Reversing Light Switch Lamp is Off

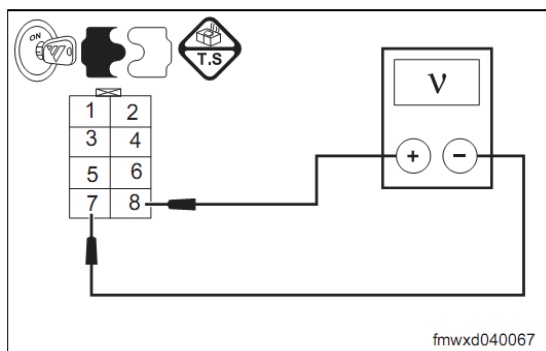
Circuit Diagram



fmwxd040077

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect reversing light switch lamp power and earth circuit.**

- (a). Disconnect reversing light switch connector B098.
- (b). Switch on the small lamp.



- (c). Measure the voltage between reversing light switch connector B098 pin 8 and pin 7

Voltage standard value: battery voltage

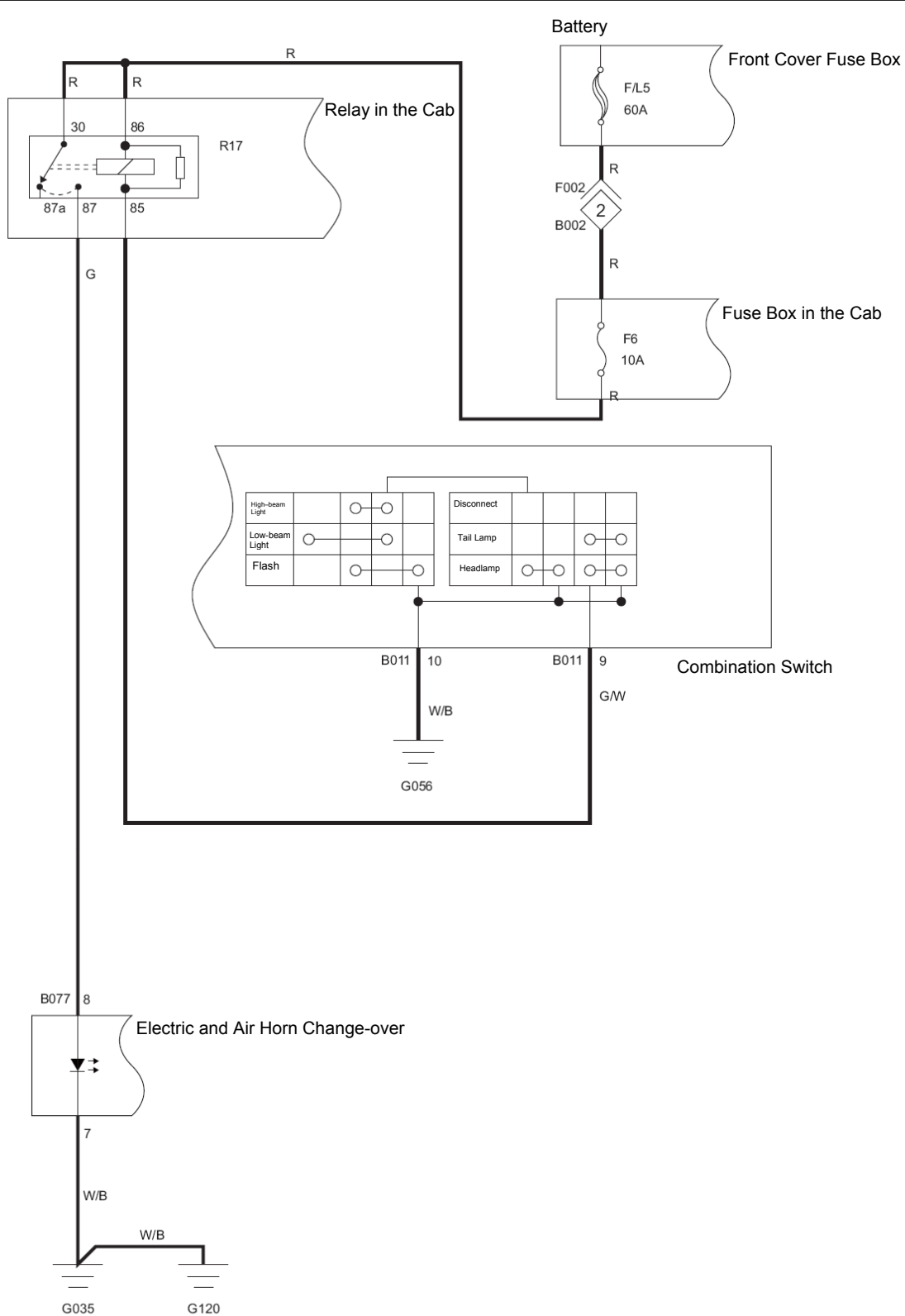
Is the inspection result normal?

Yes > replace the reversing light switch.

No > repair or replace harness.

Rear Fog Lamp switch Lamp is Off

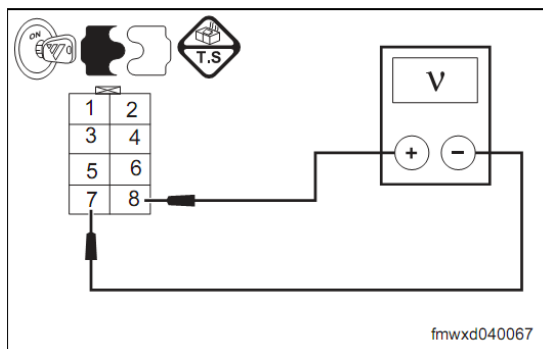
Circuit Diagram



fmwxd040078

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect rear fog lamp switch lamp power and earth circuit.**

- (a). Measure the voltage between reversing light switch connector B098 pin 8 and pin 7
Disconnect rear fog lamp switch connector B077.
- (b). Measure the voltage between reversing light switch connector B098 pin 8 and pin 7
Switch on the small lamp.



- (c). Measure the voltage between rear fog lamp switch connector B077 pin 8 and pin 7.

Voltage standard value: battery voltage

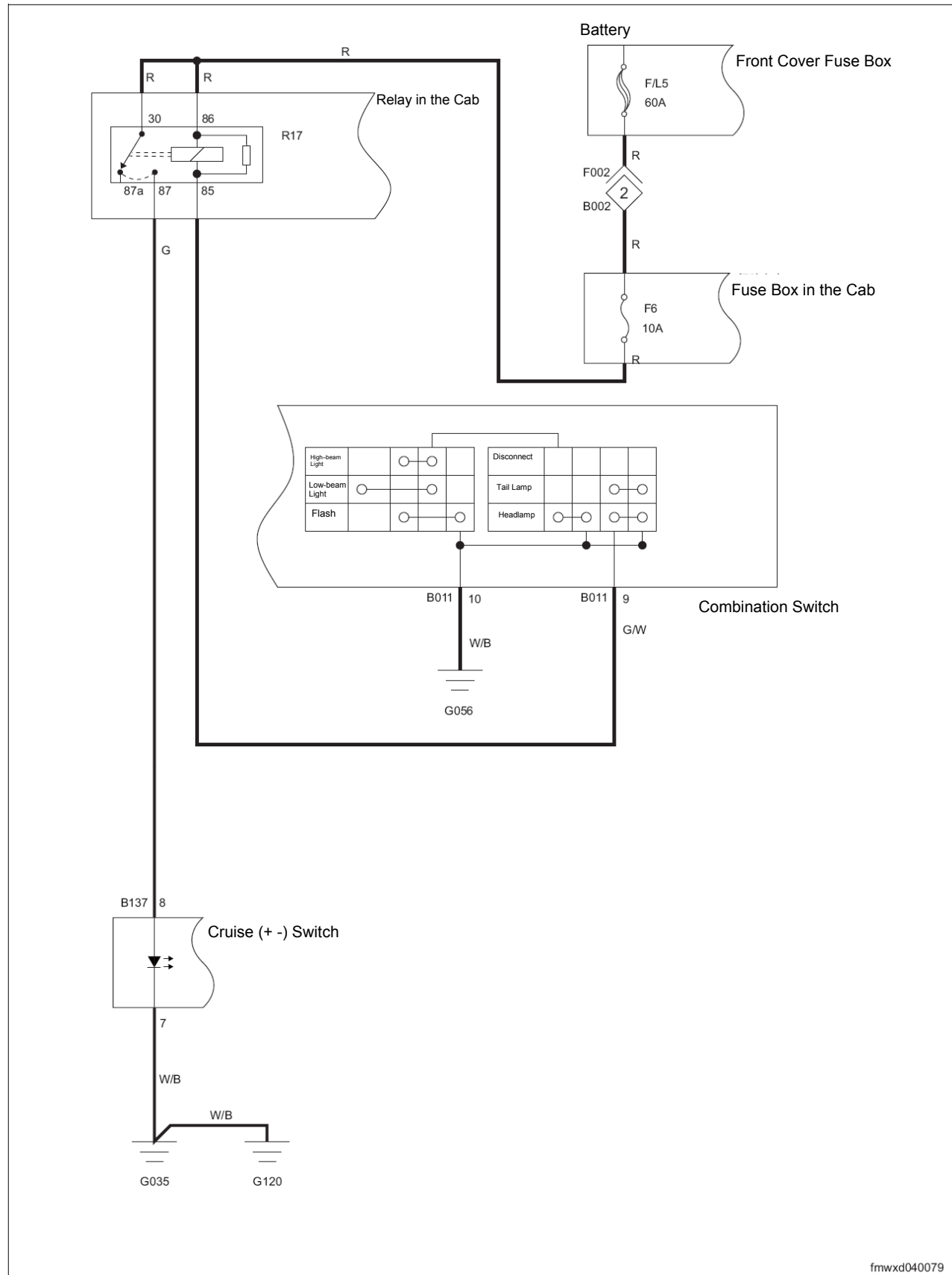
Is the inspection result normal?

Yes > replace the rear fog lamp switch.

No > repair or replace harness.

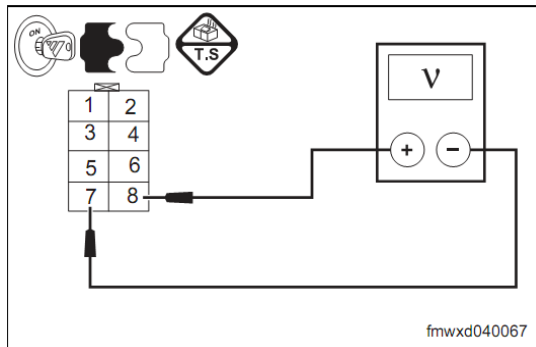
Cruise (+ -) Switch Lamp is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect cruise (+ -) switch lamp power and earth circuit.**

- (a). Disconnect cruise (+ -) switch connector B137.
- (b). Switch on the small lamp.



- (b). Measure the voltage between cruises (+ -) switch connector B137 pin 8 and pin 7

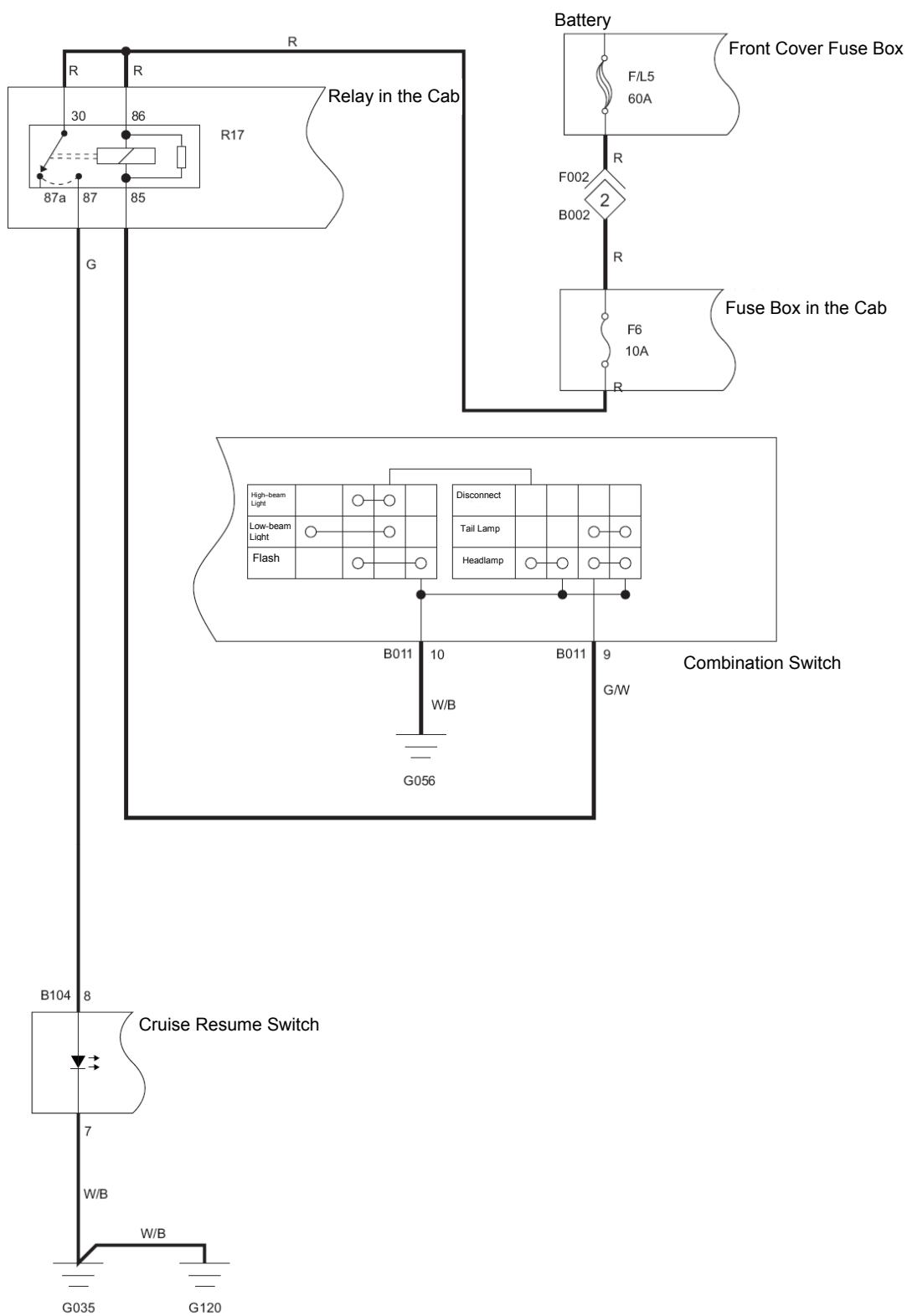
Voltage standard value: battery voltage

Is the inspection result normal?

Yes > replace the cruise (+ -) switch.No > repair or replace harness.

Cruise (+ -) Resume Switch Lamp is Off

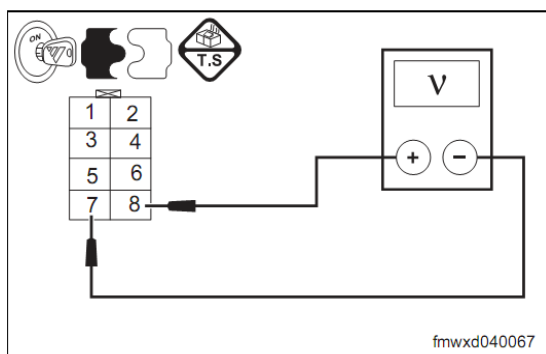
Circuit Diagram



fmwxd040080

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect cruise (+ -) resume switch lamp power and earth circuit.**

- (a). Disconnect cruise (+ -) resume switch connector B104.
- (b). Switch on the small lamp.



- (b). Measure the voltage between cruise (+ -) resume switch connector B104 pin 8 and pin 7.

Voltage standard value: battery voltage

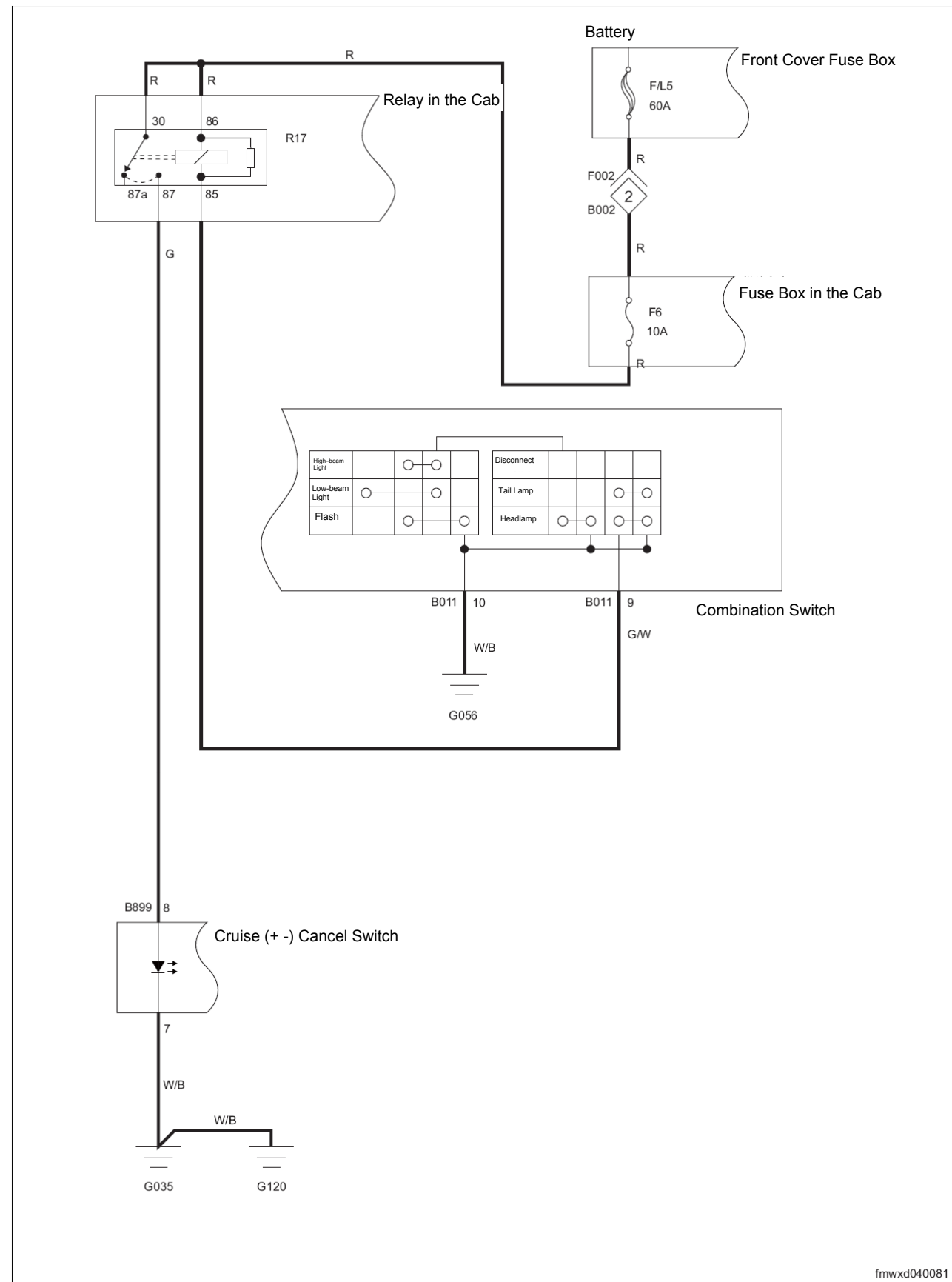
Is the inspection result normal?

Yes > replace the cruise (+ -) resume switch.

No > repair or replace harness.

Cruise (+ -) Cancel Switch Lamp is Off

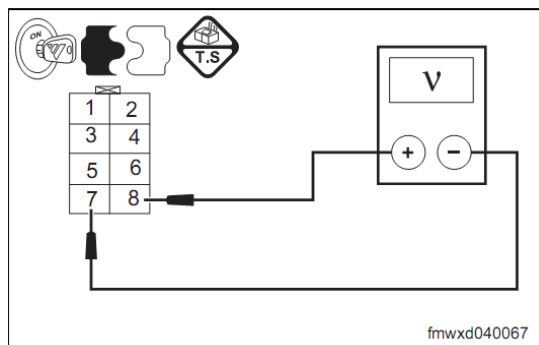
Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect cruise (+ -) cancel switch lamp power and earth circuit.**

(a). Disconnect cruise (+ -) cancel switch connector B099.

(b). Switch on the small lamp.



(c). Measure the voltage between cruise (+ -) cancel switch connector B099 pin 8 and pin 7.

Voltage standard value: battery voltage

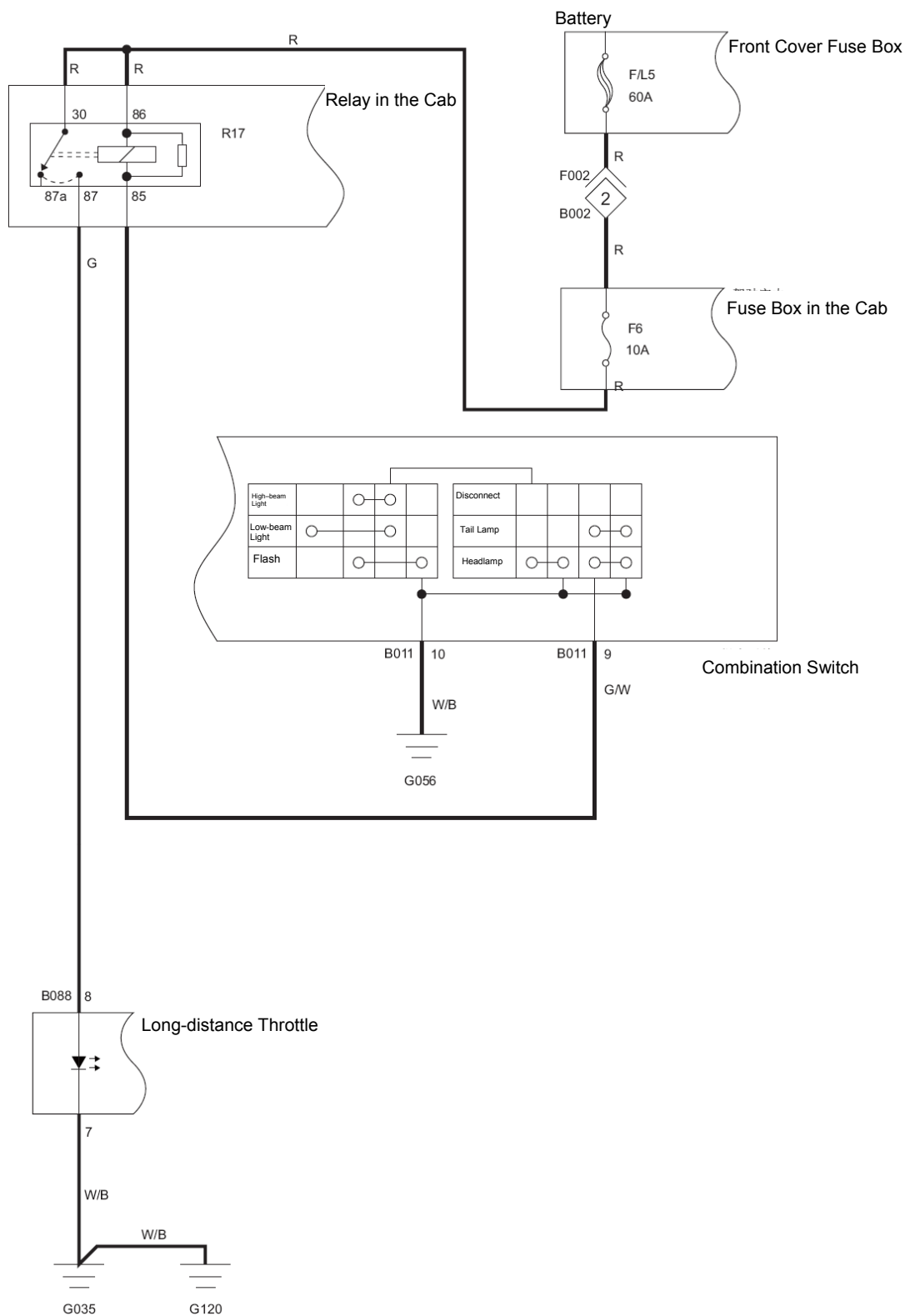
Is the inspection result normal?

Yes > replace the cruise (+ -) cancel switch.

No > repair or replace harness.

Long-distance Throttle Lamp is Off

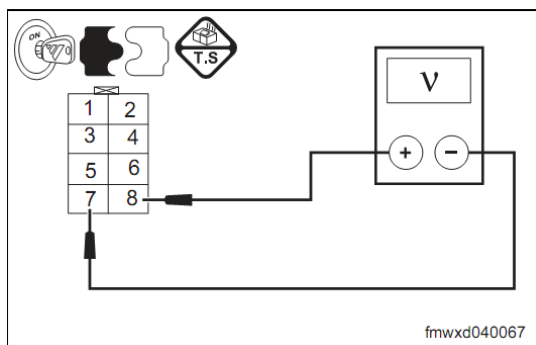
Circuit Diagram



fmwxd040082

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect long-distance throttle lamp power and earth circuit.**

- (a). Disconnect long-distance throttle connector B088.
- (b). Switch on the small lamp.



- (c). Measure the voltage between long-distance throttle connector B088 pin 8 and pin 7.

Voltage standard value: battery voltage

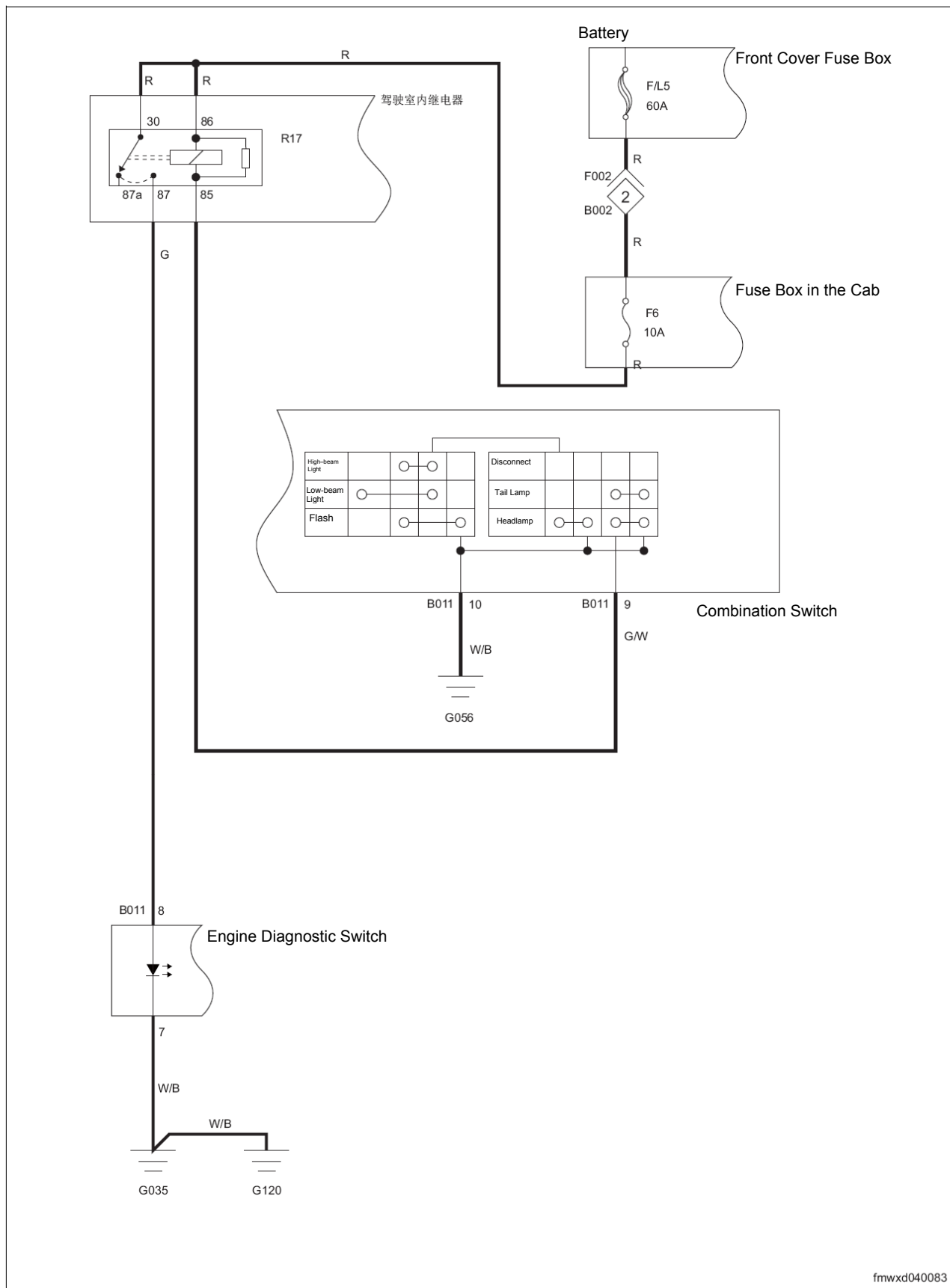
Is the inspection result normal?

Yes > replace long-distance throttle.

No > repair or replace harness.

Engine Diagnostic Switch Lamp is Off

Circuit Diagram

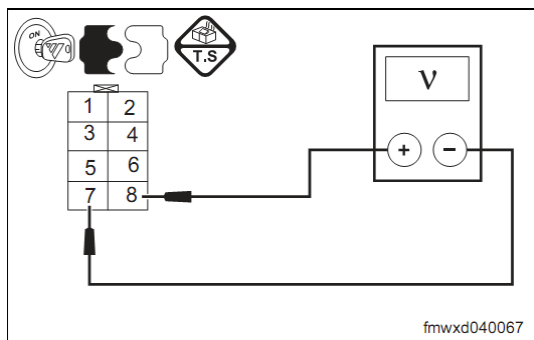


fmwxd040083

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect engine diagnostic switch lamp power and earth circuit.**

(a). Disconnect engine Diagnostic switch connector B085.

(b). Switch on the small lamp.



(c). Measure the voltage between engine Diagnostic switch connector B011 pin 8 and pin 7.

Voltage standard value: battery voltage

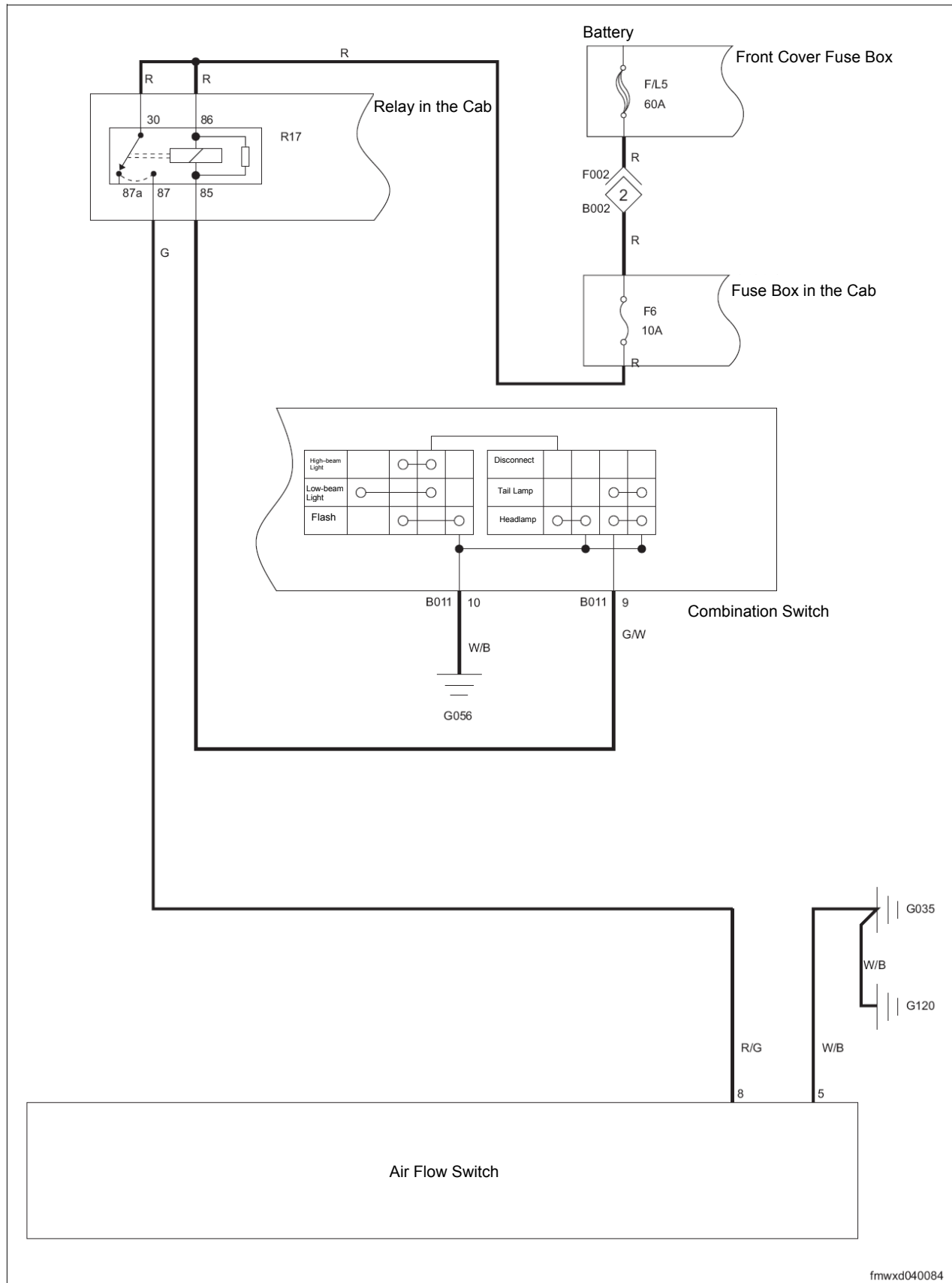
Is the inspection result normal?

Yes > replace the engine diagnostic switch.

No > repair or replace harness.

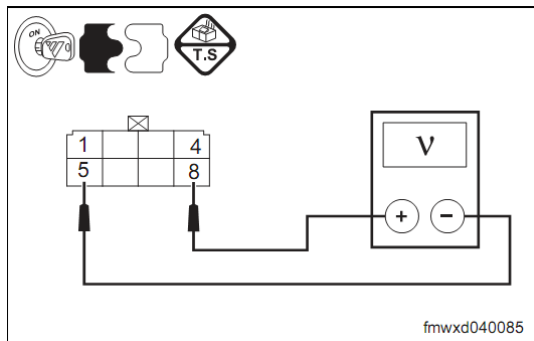
Air Switch Lighting Lamp is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect air switch lighting lamp power and earth circuit.**

- (a). Turn off the ignition switch.
- (b). Disconnect air switch connector B019.
- (c). Switch on the small lamp.



- (c). Measure the voltage between air switch connector B019 pin 8 and pin 5.

Voltage standard value: battery voltage

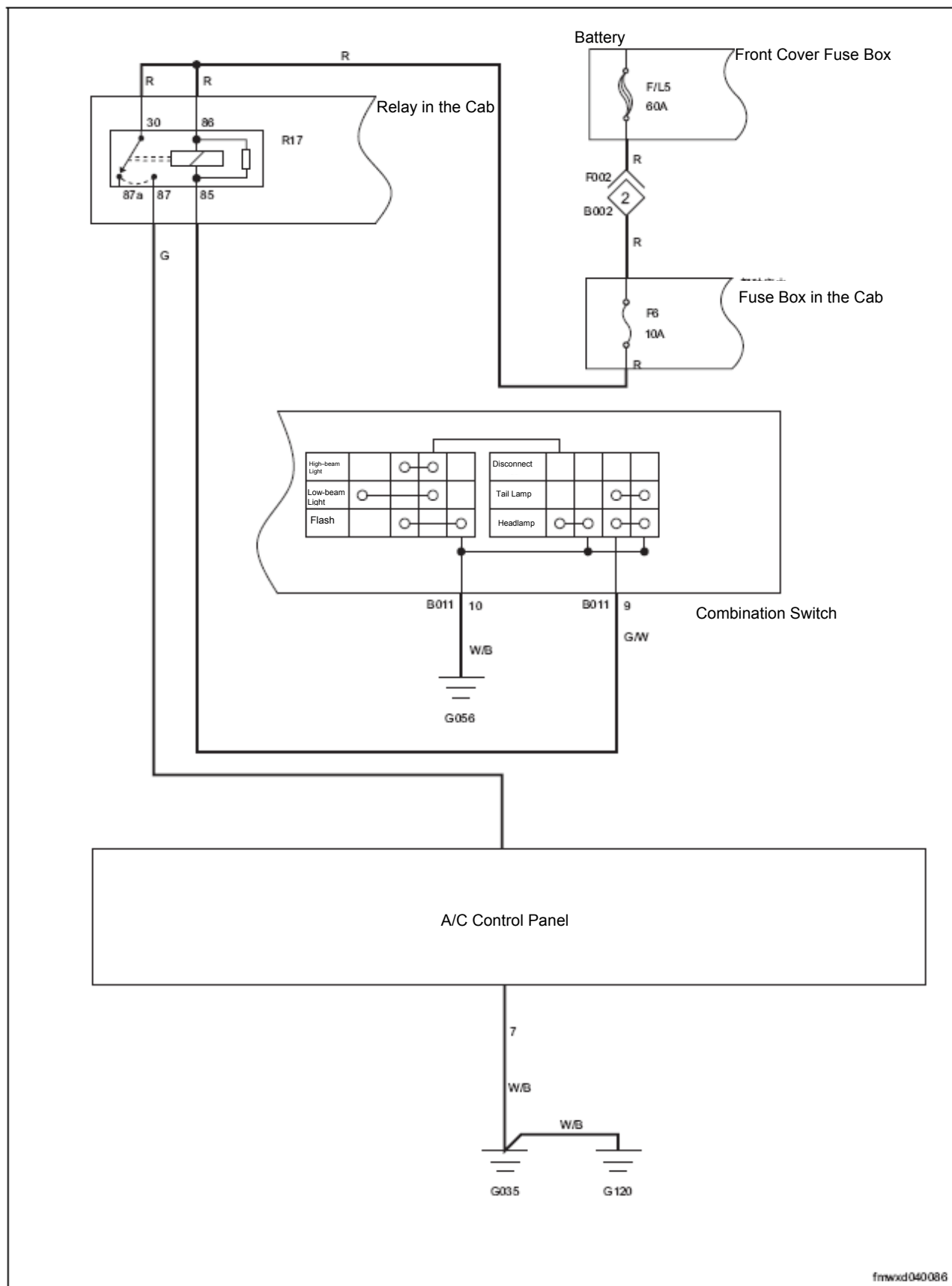
Is the inspection result normal?

Yes > replace the air switch

No > repair or replace harness.

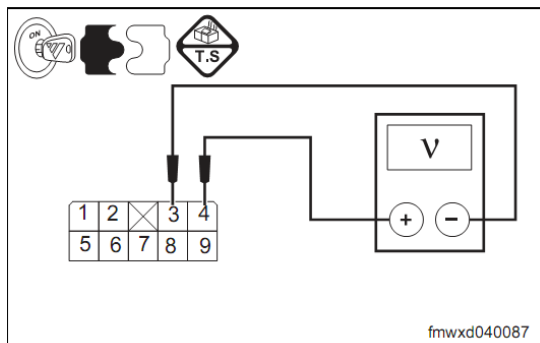
Lighting Lamp of A/C Control Panel is Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect the power and earth circuit of lighting lamp of A/C control panel**

- (a). Turn off ignition switch.
- (b). Disconnect the connector B095 of A/C control panel.
- (c). Switch on the small lamp.
- (d). Measure the voltage between pin 4 and pin 3 of the connector B095 of A/C control panel.



Voltage standard value: battery voltage

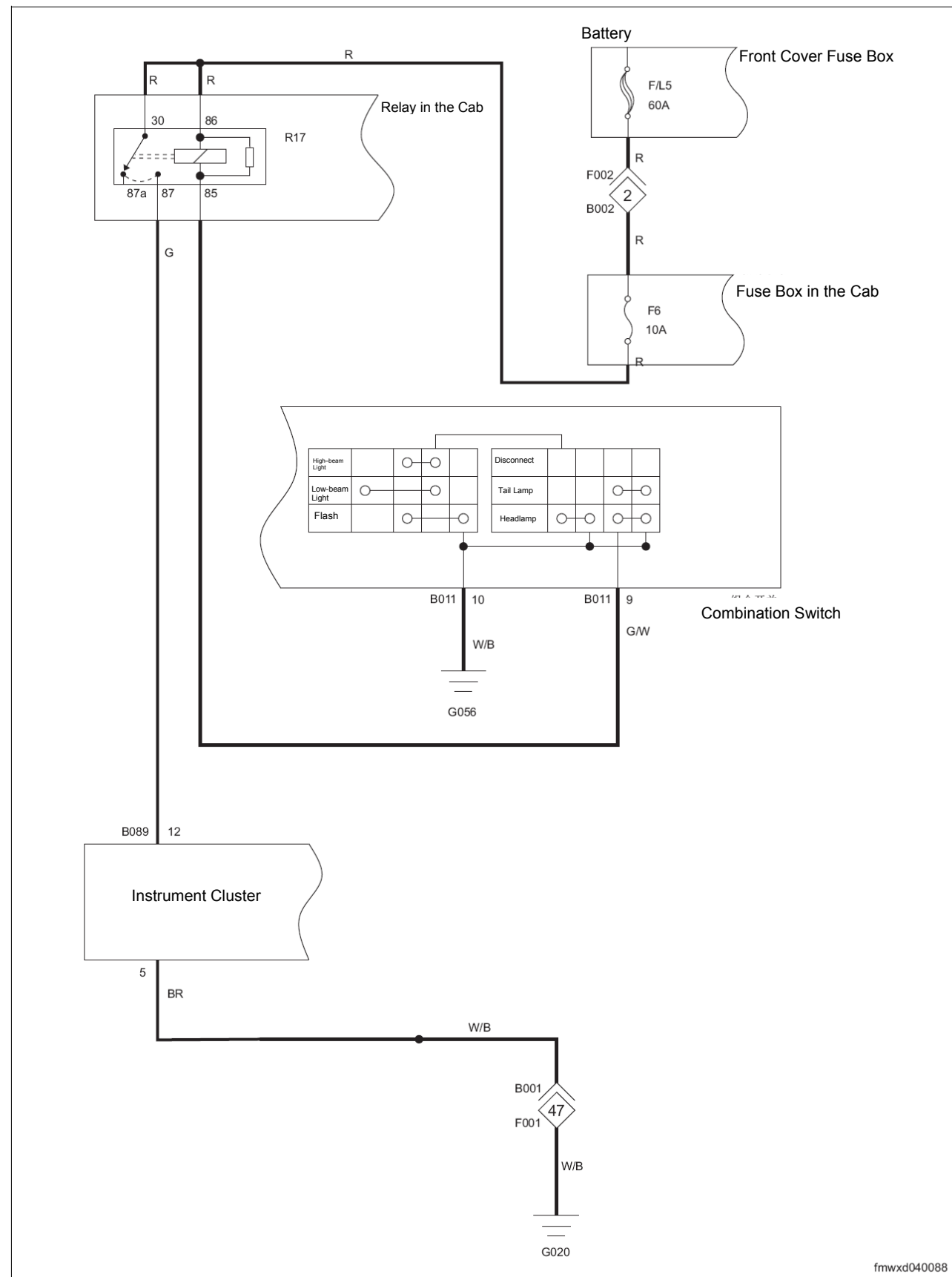
Is the inspection result normal?

Yes> replace the A/C control panel

No> repair or replace the harness

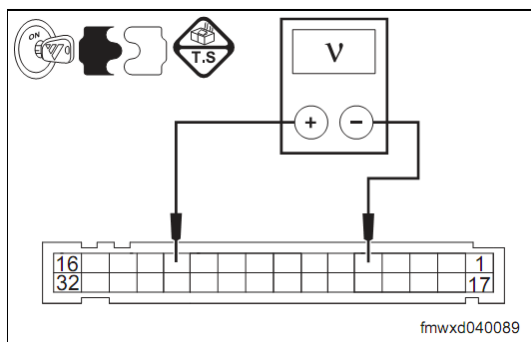
Instrument Cluster Lighting Lamps are Off

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect the power and earth circuit of instrument cluster.**

- (a). Turn off ignition switch.
- (b). Disconnect the connector B089 of instrument cluster.
- (c). Switch on the small lamp.



- (d). Measure the voltage between pin 4 and pin 3 of the connector B089 of instrument cluster.

Voltage standard value: battery voltage

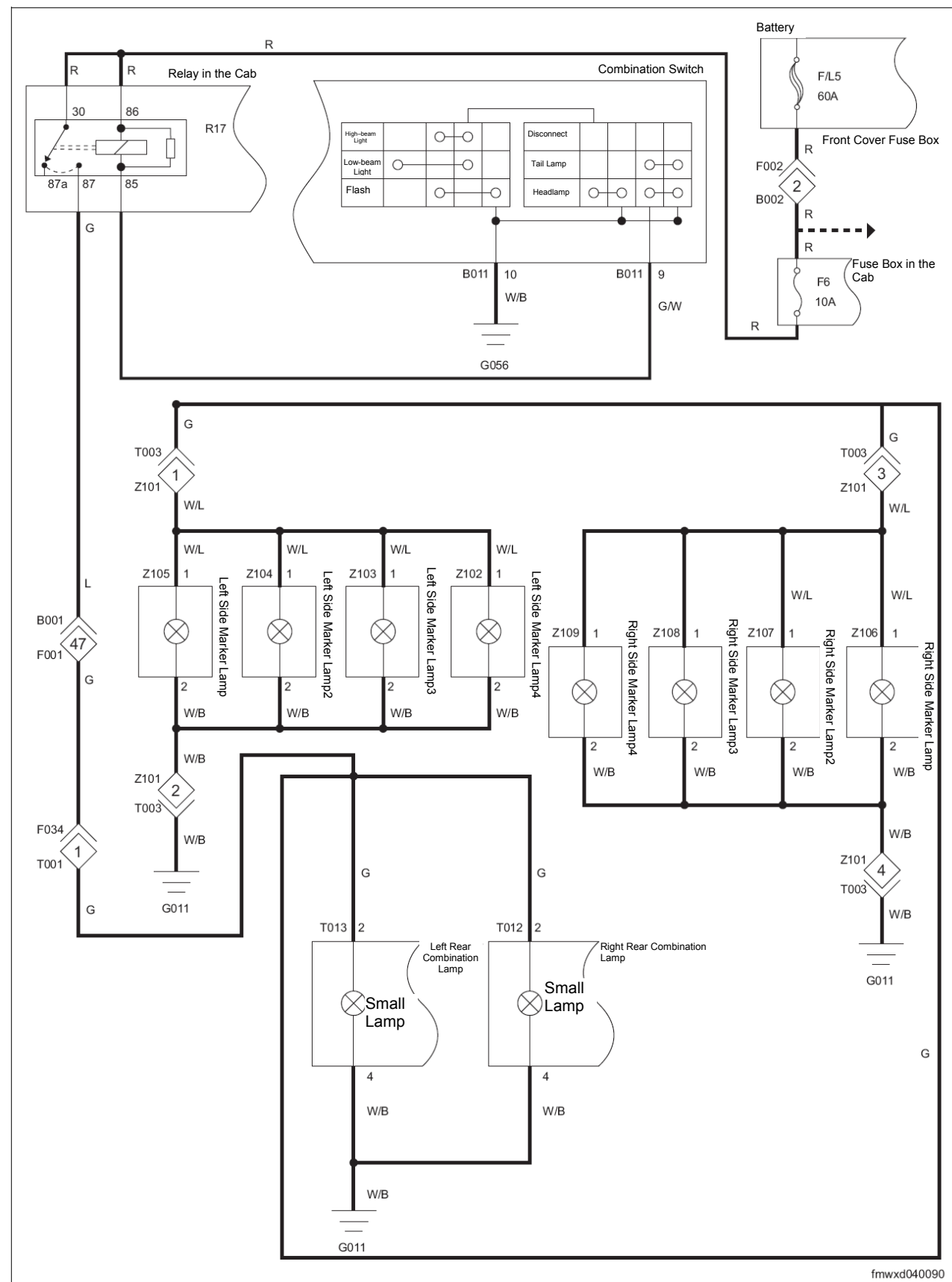
Is the inspection result normal?

Yes> replace the instrument cluster.

No> repair or replace the harness

Rear Small Lamps and the Marker Lamp at Both Sides are Off

Circuit Diagram

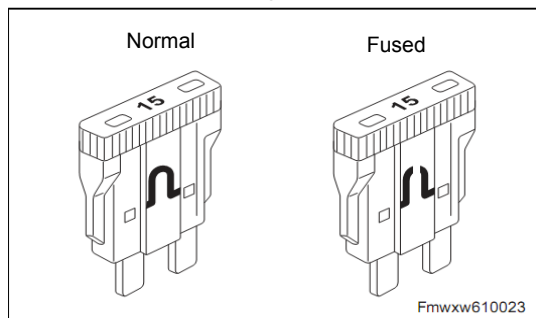


Diagnosis - Lighting System

Diagnostic Steps

1. Inspect fuse

- (a). Switch off the general power.



- (b). Inspect the fuse 18(10A) in the fuse box of the cab.

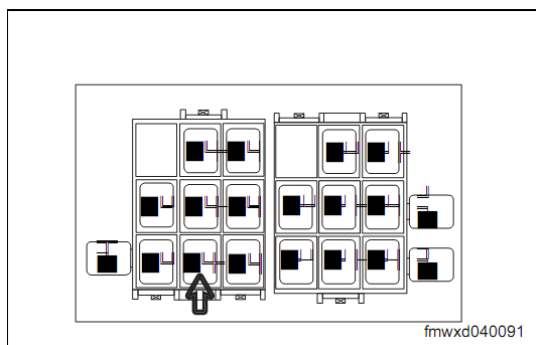
Inspect whether the fuse is normal.

Yes > See Step 2

No > Overhaul fuse circuit and replace rated capacity fuse

2. Inspect whether the relay R06 of frame small lamp works

- (a). Switch on the general power.



- (b). Open the small lamp repeatedly to inspect whether the relay R06 of frame small lamp works.

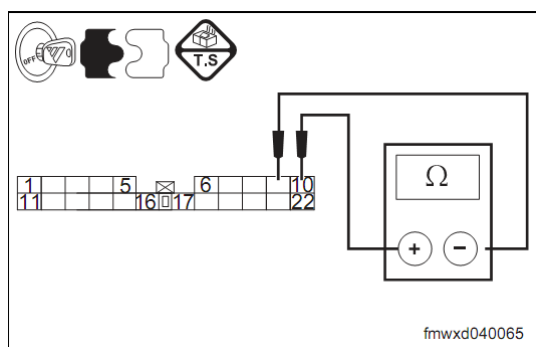
Whether the relay R06 of frame small lamp works?

Yes > see Step 5

No > see Step 3

3. Inspect the combination switch

- (a). Switch off the general power.
(b). Disconnect the connector B011 of combination switch.



- (c). Measure the voltage between pin 9 and pin 10 of combination switch. **Standard Value:**

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp.	9-10	$\leq 2 \Omega$
Switch off the small lamp	9-10	$> 10 M\Omega$

Is the inspection result normal?

Yes > see Step 4

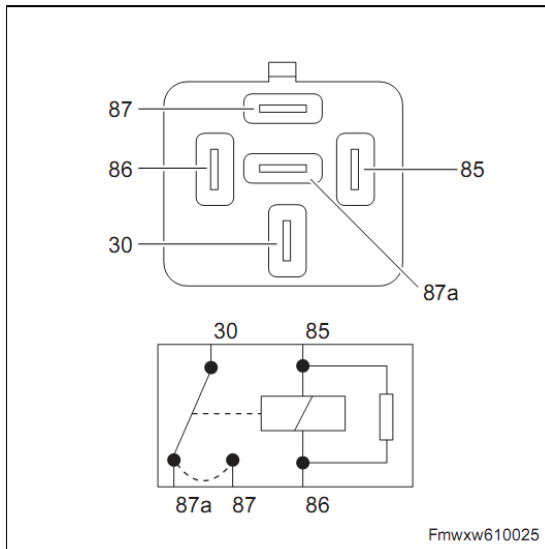
No > replace the combination switch

4. Inspect the pin control circuit of interior relay R06

- (a). Dismantle the relay R06 of frame small lamp.
- (b). Switch on the general power.
- (c). Switch

the small lamp.

- (d). Measure the voltage between pin 86 and pin85 of the relay connector.



Voltage standard value: battery voltage

Is the inspection result normal?

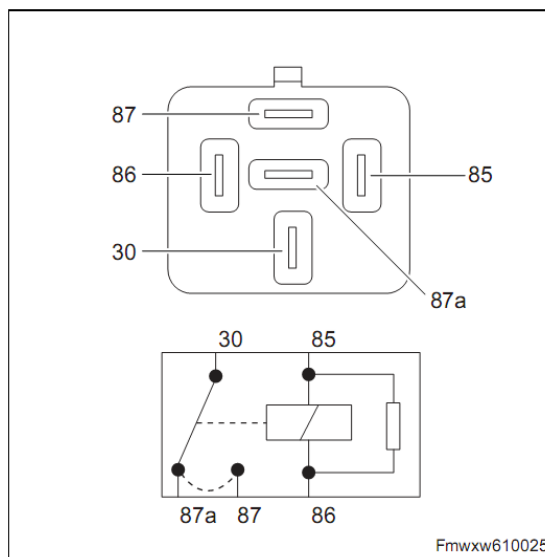
Yes> replace the relay R06 of frame small lamp

No> repair or replace the harness

5. Inspect the contact control loop of relay R06 of frame small lamp

- (a). Switch off the general power.
- (b). Dismantle the relay R06 of frame small lamp.

- (c). Measure the voltage between the pin 30 of relay R06 connector and the effective earthing point of vehicle body.



Voltage standard value: battery voltage

Diagnosis - Lighting System

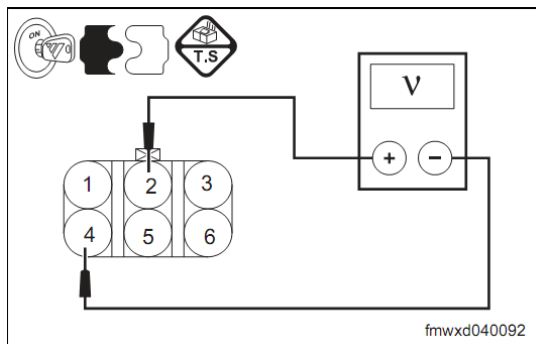
Is the inspection result normal?

Yes > see Step 6

No> repair or replace the interior relay box

6. Inspect the power and earth circuit of the rear small lamp

- (a). Disconnect the rear combination lamp or the marker lamp connector
- (b). Switch on the general power.
- (c). Switch on the small lamp,



- (d). Measure the voltage between pin 2 and pin 4 of the connector T013 and T012 of the rear combination lamp or the voltage between pin 1 and pin 2 of the marker lamp

04

Voltage standard value: battery voltage

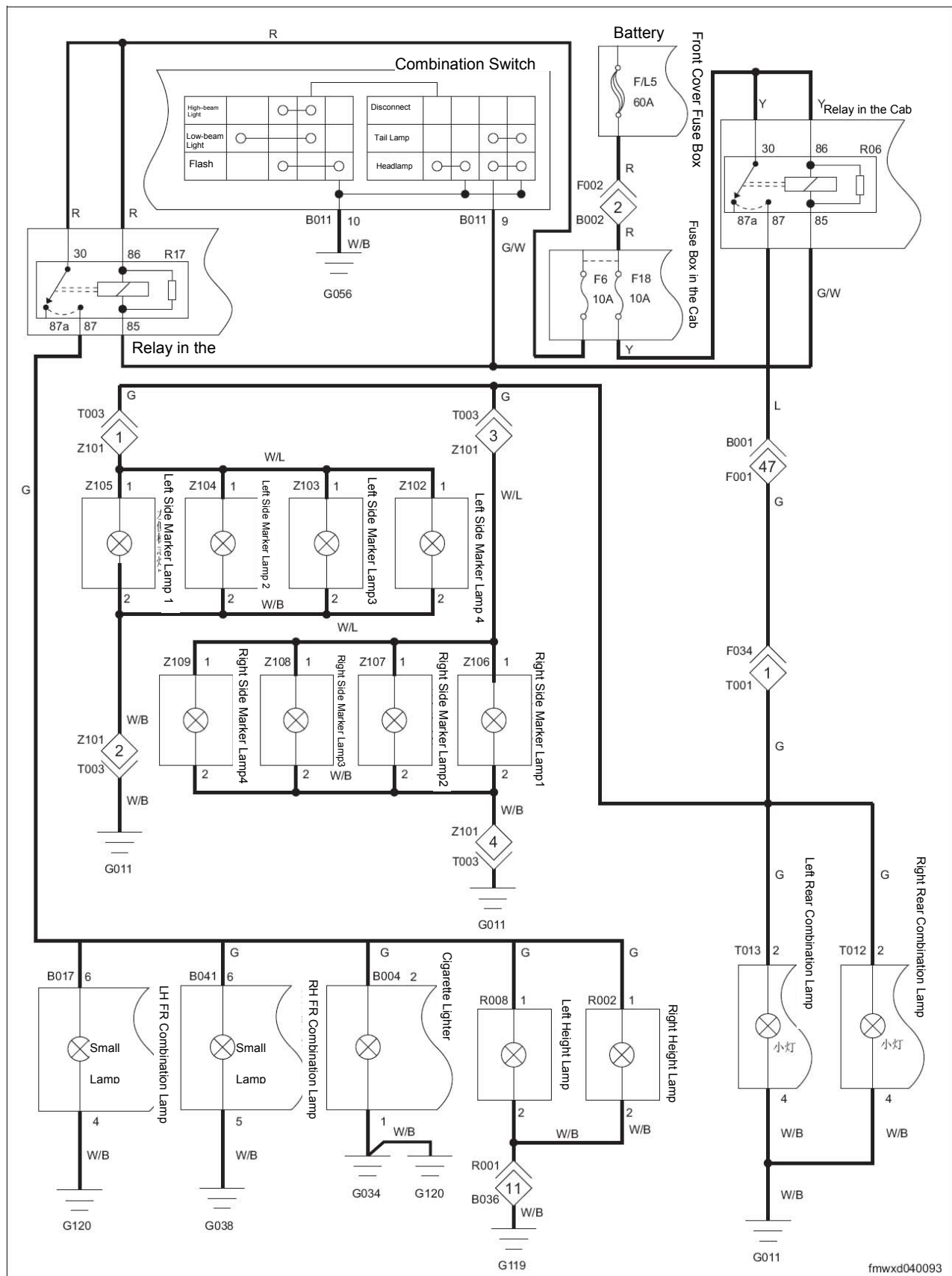
Is the inspection result normal?

Yes> replace the bulb

No> repair or replace the harness

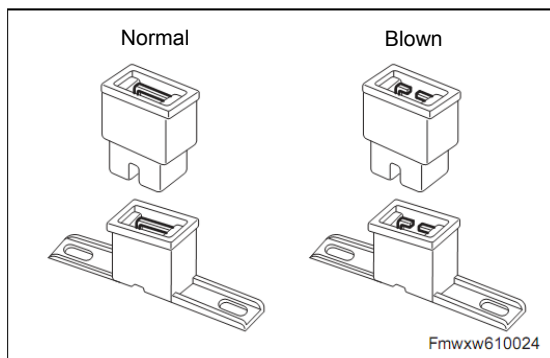
Marker Lamp, Marker Lamp and Front Rear Small Lamp are Off.

Circuit Diagram



Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse**

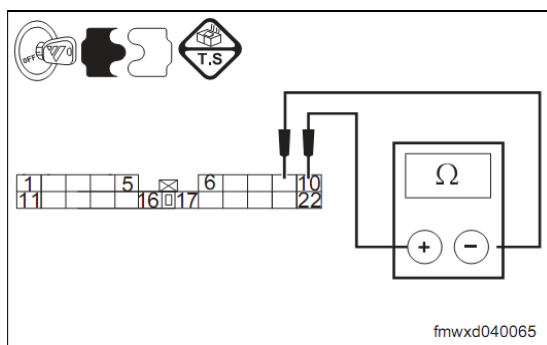
(a). Switch off the general power.



(b). Inspect the fuse F/L5 (60A) in the front cover fuse box.

Inspect whether the fuse is normal.**Yes > see Step 2****No > Overhaul fuse circuit and replace rated capacity fuse****2. Inspect the combination switch**

(a) Disconnect the connector B011 of combination switch.



(b). Measure the resistance between pin 9 and pin 10 of combination switch.

Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp.	9-10	$\leq 2 \Omega$
Switch off the small lamp	9-10	$> 10 M\Omega$

Is the inspection result normal?**Yes > repair or replace the harness****No > replace the combination switch**

Marker Lamp, Marker Lamp and Front Rear Small Lamp are Normally on

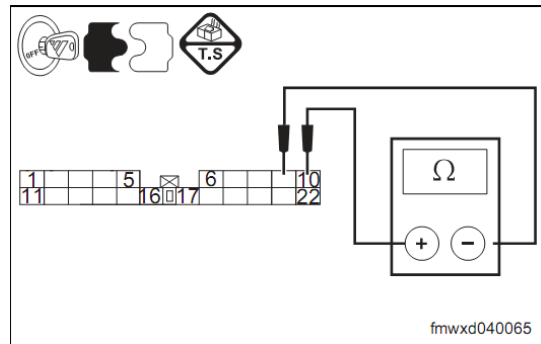
Circuit Diagram

Refer to this chapter, "Marker Lamp, Marker Lamp and Front Rear Small Lamp are Off-Circuit Diagram"

Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off the general power.
- (b). Disconnect the connector B011 of combination switch.
- (c). Measure the resistance between pin 9 and pin 10 of combination switch.



Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp.	9-10	$\leq 2 \Omega$
Switch off the small lamp	9-10	$> 10 \text{ M}\Omega$

Is the inspection result normal?

Yes > repair or replace the harness

No > replace the combination switch

Step Lamp is OFF

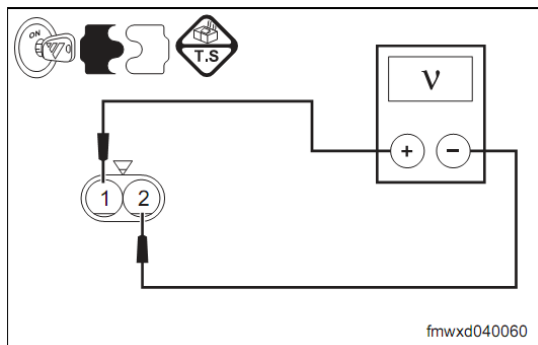
Circuit Diagram

Refer to this chapter, "Step Lights at Both Sides are Off- Circuit Diagram"

Diagnostic Steps

1. Inspect circuit

- (a). Switch off the general power.
- (b). Disconnect the connector B302 or B303 of step lamp.
- (c). Measure the voltage between pin 1 and pin 2 of the connector B302 and B303 of step lamp.



Voltage standard value: battery voltage

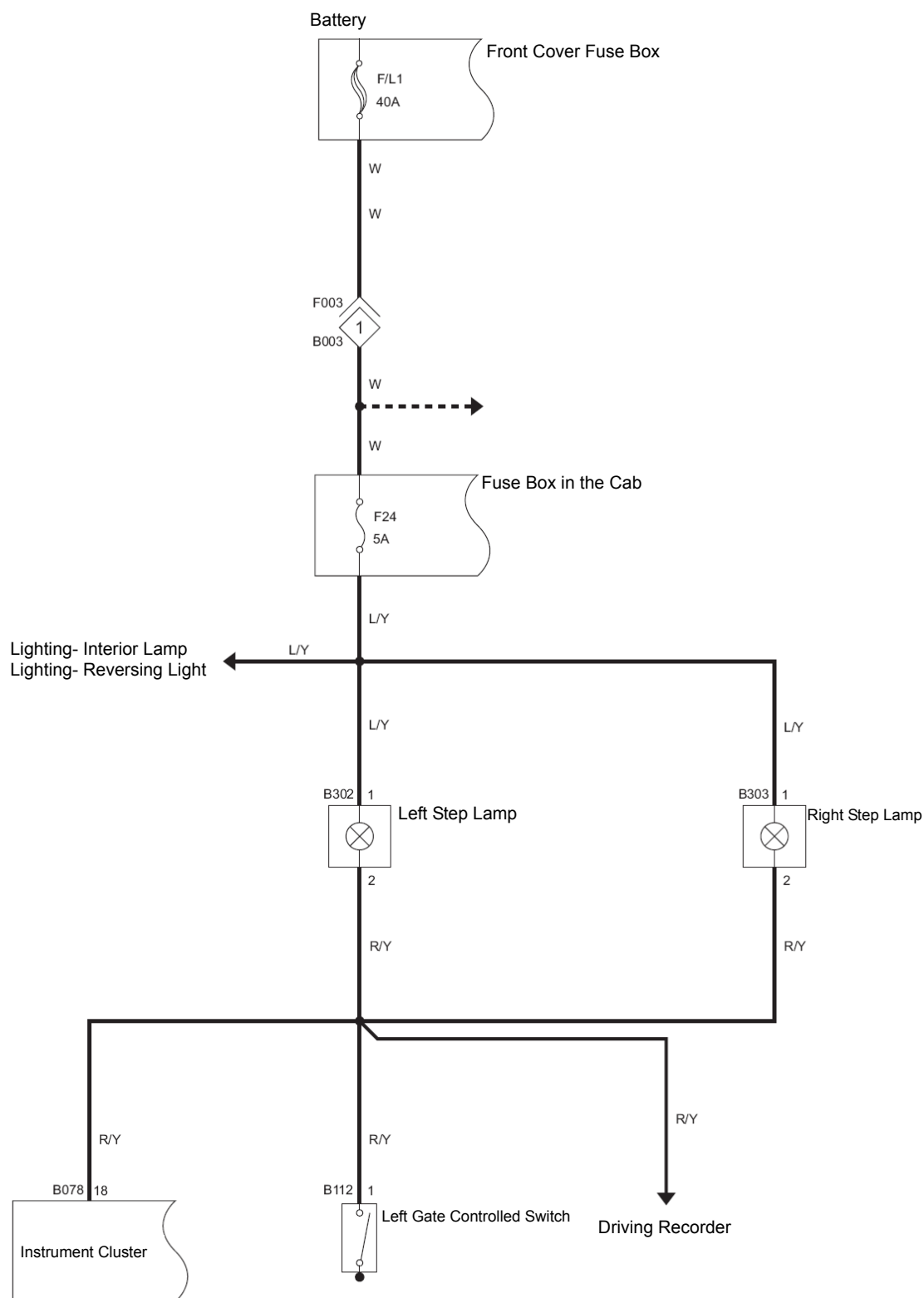
Is the inspection result normal?

Yes> replace the step lamp bulb

No> repair or replace the harness

Step Lamps at Both Sides are OFF

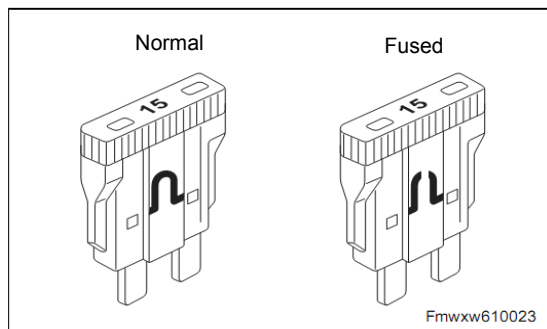
Circuit Diagram



fmwxd040094

Diagnosis - Lighting System**Diagnostic Steps****1. Inspect fuse**

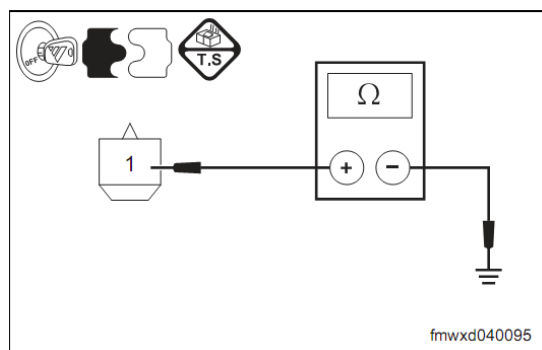
(a). Switch off the general power.



(b). Inspect the fuse F24 (5A) in the fuse box of the cab.

Inspect whether the fuse is normal.**Yes > See Step 2****No > Overhaul fuse circuit and replace rated capacity fuse****2. Inspect left gate controlled switch**

(a). Disconnect the connector B112 of left gate controlled switch.



(b). Measure the resistance of left gate controlled switch

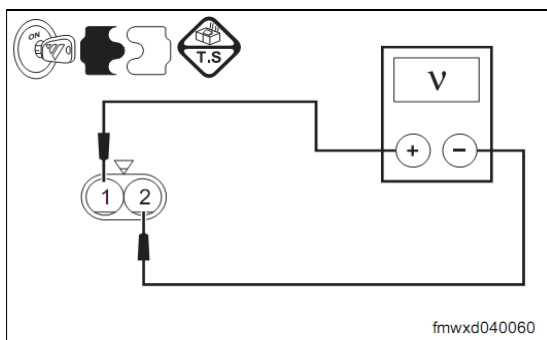
Standard Value:

Conditions	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp.	1- earth connection	$\leq 2 \Omega$
Switch off the small lamp	1- earth connection	$> 10 M\Omega$

Is the inspection result normal?**Yes > see Step 3****No> replace the left gate controlled switch****3. Inspect circuit**

(a). Switch on the general power.

(b). Open the left vehicle door.



(c). Measure the voltage between pin 1 and pin 2 of the step lamp connector.

Diagnosis - Lighting System

Voltage standard value: battery voltage

Is the inspection result normal?

Yes> replace the step lamp bulb

No> repair or replace the harness

The Step Lamp is Normally On

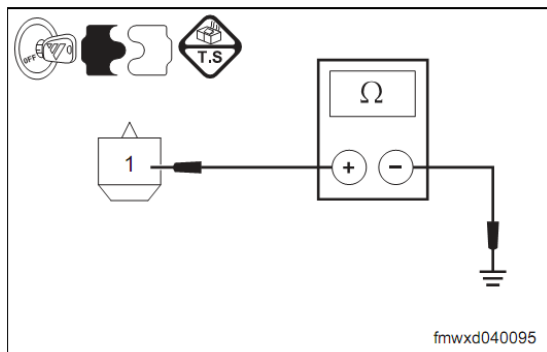
Circuit Diagram

Refer to this chapter, "Step Lights at Both Sides are Off- Circuit Diagram"

Diagnostic Steps

1. Inspect left gate controlled switch

- (a). Switch off the general power.
- (b). Disconnect the connector B112 of left gate controlled switch.



- (c). Measure the resistance of left gate controlled switch.

Standard Value:

Condition	Pin Connected to Multi-meter	Standard Value
Switch on the small lamp.	1- earth connection	$\leq 2 \Omega$
Switch off the small lamp	1- earth connection	$> 10 M\Omega$

Is the inspection result normal?

Yes > repair or replace the harness

No > replace the left gate controlled switch

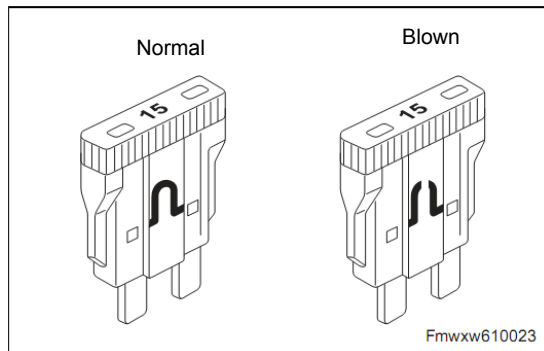
The Interior Lamp is OFF (Switch on the Right Side Interior Switch)

Diagnosis - Lighting System

Diagnostic Steps

1. Inspect fuse

- (a). Switch off the general power.



- (b). Inspect the fuse F24 (5A) in the fuse box of the cab.

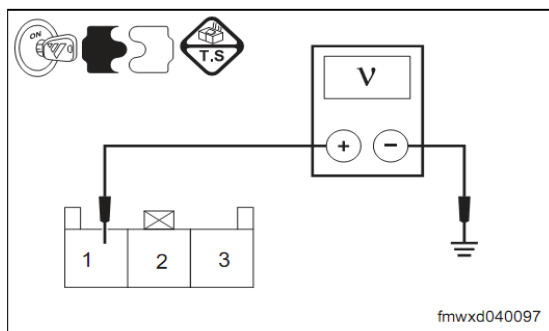
Inspect whether the fuse is normal?

Yes > see Step 2

No > Overhaul fuse circuit and replace rated capacity fuse

2. Inspect the power circuit of interior lamp

- (a). Disconnect the connector R007 of interior lamp.
(b). Switch on the general power.



- (c). Measure the voltage between the pin 1 of interior lamp connector R007 and the effective earthing point of vehicle body.

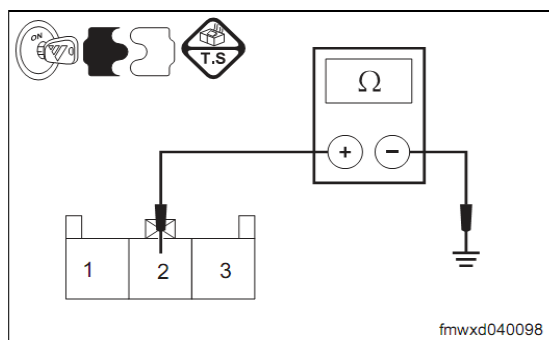
Voltage standard value: battery voltage

Is the inspection result normal?

Yes > see Step 3

No > repair or replace the harness

3. Inspect the earthed circuit of interior lamp



- (a). Measure the resistance between the pin 2 of interior lamp connector R007 and the effective earthing point of frame.

Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace the interior lamp assembly

No > repair or replace the harness

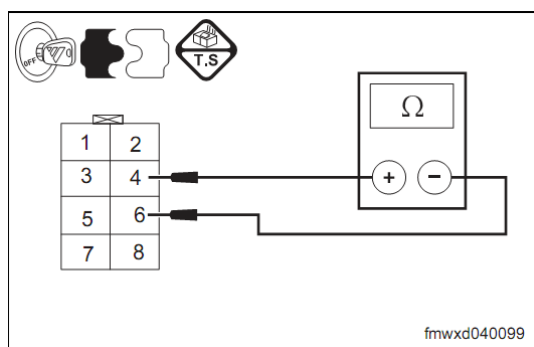
The Interior Lamp Is Off (Switch on the Left Side Interior Switch)

Circuit Diagram

Refer to this chapter, "Interior Lamp is Off (Switch on the Right Side Interior Switch)-Circuit Diagram"

Diagnostic Steps

1. **Make sure that the right side interior lamp switch is on and the interior lamp is in proper working**
2. **Inspect the left side interior lamp switch**
 - (a). Switch off the general power.
 - (b) Disconnect the connector B202 of interior lamp switch.
 - (c). Switch on the left side interior lamp switch.



- (d). Measure the resistance between pin 4 and pin 6 of interior lamp connector B202.

Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > repair or replace the harness

No > replace the interior lamp switch

The Interior Lamp Switch is Off (Open the left vehicle door)

Circuit Diagram

Refer to this chapter, "Interior Lamp is Off (Switch on the Right Side Cubicle Switch)-Circuit Diagram"

Diagnostic Steps

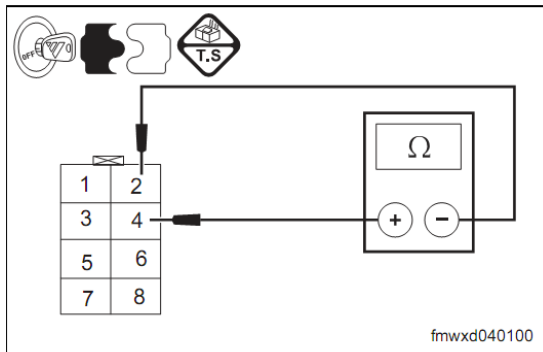
1. **Make sure that the step lamp in left vehicle door is in proper working**
2. **Inspect the left side interior lamp switch**

(a). Switch off the general power.

(b) Disconnect the connector B202 of interior lamp switch.

(c). Move the interior lamp switch to the position of DOOR

(d). Measure the resistance between pin 4 and pin 2 of interior lamp connector B202.



Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > repair or replace the harness

No > replace the interior lamp switch

The Interior Lamp is Normally On

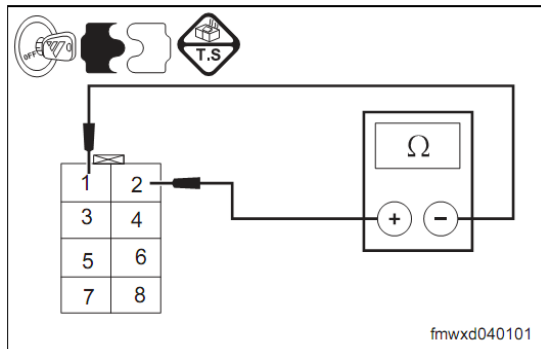
Circuit Diagram

Refer to this chapter, "Interior Lamp is Off (Switch on the Right Side Cubicle Switch)-Circuit Diagram"

Diagnostic Steps

1. Inspect the right side switch of interior lamp

- (a). Switch off the general power.
- (b) Disconnect the connector R007 of interior lamp switch
- (c). Switch off the right side interior lamp switch.



- (d). Measure the voltage between pin 1 and pin 2 of interior lamp connector R007.

Resistance: > 10MΩ

Is the inspection result normal?

Yes > see Step 2

No> replace the right side switch of interior lamp

2. Inspect circuit

- (a). Disconnect the harness connector R007 and B202 of interior lamp.
- (b). Measure the resistance between the pin 3 of R007 and the effective earthing point of frame.

Resistance: > 10MΩ

Is the inspection result normal?

No> replace the left side switch of interior lamp

No> repair or replace the harness

Wiper & Washer

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
- (b). Turn off the ignition switch, unless otherwise specified.

2. **Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.**

Hint:

The odometer will not be reset.

3. **Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.**

Hint:

Reset the audio system after reconnecting negative cable of the battery (refer to “Audio System Introduction for Use in Chinese and English”).

4. **Precautions for the nozzle adjustment of spraying cleaner**

- (a). Do not use safety pin to clean or adjust the nozzle of spraying cleaner, because the top of the nozzle of spraying cleaner is made of resin which may be damaged.
- (b). If the nozzle of spraying cleaner is blocked by objects made of wax, dismantle and clean the nozzle by the soft resin brush or other cleaning tools.

Diagnosis - Wiper & Washer**Basic Inspection**

Step	Inspection contents		Measures
1	Inspect the battery voltage • The battery voltage shall not be less than 22 V. Is the inspection result normal?	Yes	See Step 2
		No	Charge for the battery or replace it. Refer to "Chapter 53 Battery-Battery"
2	Inspect the gap gear of wiper • Open the intermittent gear of wiper by combination switch. Is the inspection result normal?	Yes	See Step 3
		No	See the Fault Symptom Table
3	Inspect the low gear of wiper • Turn on the ignition switch. • Open the low gear of wiper by combination switch. Is the inspection result normal?	Yes	See Step 4
		No	See the Fault Symptom Table
4	Inspect the high gear of wiper • Open the high gear of wiper by combination switch. Is the inspection result normal?	Yes	See Step 5
		No	See the Fault Symptom Table
5	Inspect the washer • Open the washer by combination switch. Is the inspection result normal?	Yes	See Step 6
		No	See the Fault Symptom Table
6	Inspect the washing liquid Is the inspection result normal?	Yes	See the Fault Symptom Table
		No	Add the washing liquid

Fault Symptom Table

Use the following table to help you find the fault. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

Fault Symptom	Possible Position	Reference
Wiper fails to work in any speed gear.	1. Fuse (damaged)	Replace Fuse
	2. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	3. Two-in-one Controller (damaged)	Replace Two-in-one Controller
	4. Wiper Motor (damaged)	Chapter 55 Wiper and Washer- Wiper Motor, Replacement
	5. Harness (shorted or shorted to earth)	Replace Harness
Motor rotates but the wiper arm fails to rotate.	1. Wiper Arm (loosened)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	2. Worm (loosened)	Chapter 55 Wiper and Washer- Wiper Motor, Replacement
	3. Connecting Rod Mechanism (loosened)	Chapter 55 Wiper and Washer- Connecting Rod Mechanism, Replacement
Wiper rotates very slowly.	1. Battery (brown-out voltage)	Chapter 53 Battery- Battery, Replacement
	2. Harness (loose contact)	Repair Harness
	3. Motor Bearing and Reducer Gear (insufficient lubrication)	Chapter 55 Wiper and Washer-Wiper Motor, Replacement
	4. Wiper Motor (damaged)	Chapter 55 Wiper and Washer- Wiper Motor Assembly, Replacement
	5. Two-in-one Controller (damaged)	Replace Two-in-one Controller
Abnormal Sound	1. Worm Gear (unlubricated)	Chapter 55 Wiper and Washer- Wiper Motor Assembly, Replacement
	2. Connecting Rod Mechanism (distorted)	Chapter 55 Wiper and Washer- Connecting Rod Mechanism, Replacement
	3. Connecting Joint (worn)	Chapter 55 Wiper and Washer- Connecting Rod Mechanism, Replacement

Diagnosis - Wiper & Washer

Fault Symptom	Possible Position	Reference
Wiper has no sound effect.	1. Glass (oil stained, vehicle wax)	Clean Glass
	2. Wiper Arm and Wiper Blade (error type)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	3. Wiper Arm and Wiper Blade (damaged rubber)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	4. Wiper Arm (damaged)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	5. Wiper Arm (spring force is reduced)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
Wiper fails to stop working.	1. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
Wiper fails to work in intermittent speed gear.	1. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (opened or shorted to earth)	Repair or Replace Harness
	3. Two-in-one Controller (damaged)	Replace Two-in-one Controller
Wiper fails to work in low speed gear.	1. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (opened or line-to-earth short circuit)	Repair or Replace Harness
	3. Two-in-one Controller (damaged)	Replace Two-in-one Controller
	4. Wiper Motor (damaged)	Chapter 55 Wiper and Washer-Wiper Motor Assembly, Replacement
Wiper fails to work in high speed gear.	1. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	2. Harness (opened or shorted to earth)	Repair or Replace Harness
	3. Two-in-one Controller (damaged)	Replace Two-in-one Controller
	4. Wiper Motor (damaged)	Chapter 55 Wiper and Washer-Wiper Motor Assembly, Replacement
When the switch is turned off, the wiper fails to return to normal position.	1. Harness (opened or line-to-earth short circuit)	Repair or Replace Harness
	2. Cam Switch Connection (loose contact)	Chapter 55 Wiper and Washer- Wiper Motor Assembly, Replacement

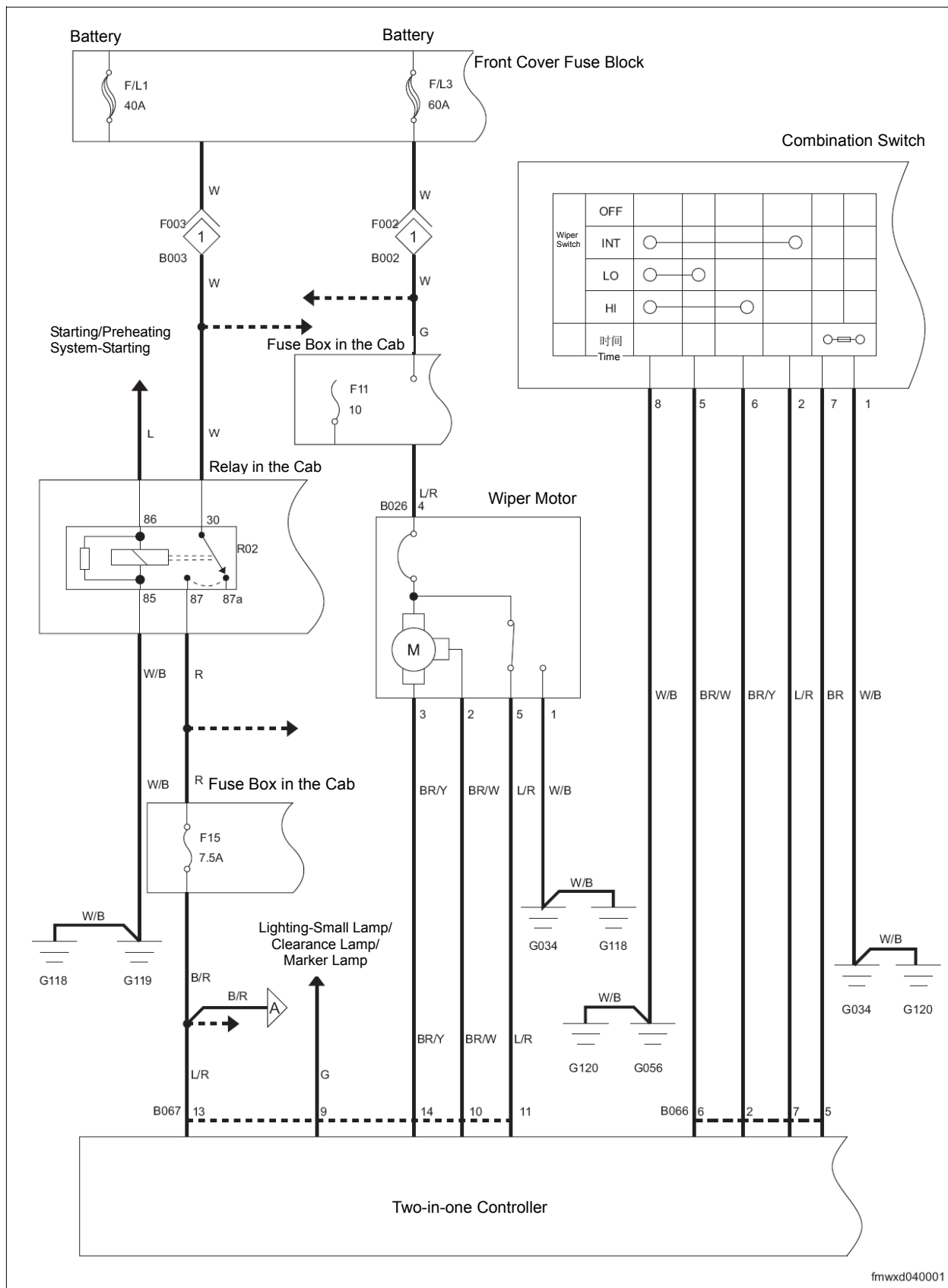
Diagnosis - Wiper & Washer

Fault Symptom	Possible Position	Reference
Washer fails to work and the wiper is normal.	1. Washing Liquid (insufficient)	Add Washing Liquid
	2. Nozzle (blocked)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	3. Hose (damaged)	Replace Hose
	4. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	5. Washer Motor (damaged)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	6. Harness	Repair or Replace Harness
Washing liquid can not be spout out.	1. Nozzle (damaged)	Chapter 55 Wiper and Washer- Wiper Arm Assembly, Replacement
	2. Hose (damaged)	Replace Hose
	3. Washer Motor (damaged)	Chapter 55 Wiper and Washer- Washer, Replacement
	4. Combination Switch (damaged)	Chapter 55 Wiper and Washer-Combination Switch, Replacement
	5. Harness (opened or shorted to earth)	Repair or Replace Harness

Diagnosis - Wiper & Washer

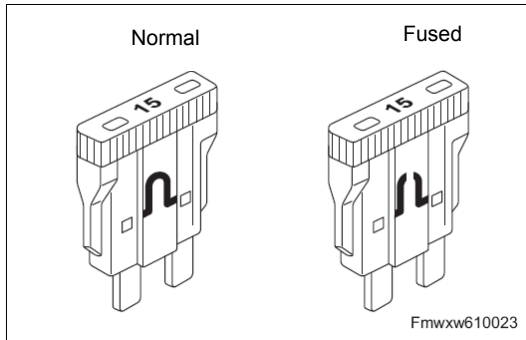
Wiper Fails to Work in Any Gear

Circuit Diagram



Diagnostic Steps**1. Inspect the fuse F11**

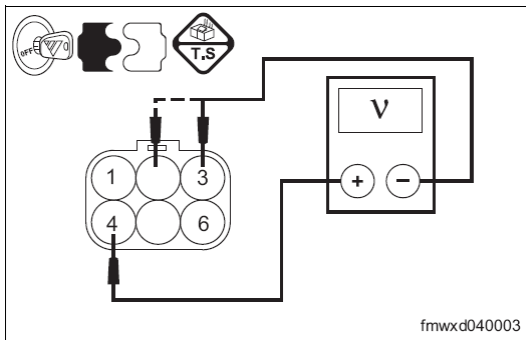
(a). Switch off the general power .



(b). Inspect the fuse F11 (10 A) inside fuse box in cab.

Is the inspection result normal?**Yes > see Step 2****Overhaul fuse circuit and replace rated capacity fuse****2. Inspect the both-end voltage of wiper motor**

(a). Disconnect the wiper motor connector B026 and switch on the general power .



(b). Inspect the low-gear circuit of wiper.

- Get the wiper switch to low gear "LO" and use multi-meter to measure the voltage between pin 4 and pin 3 of wiper motor connector B026.

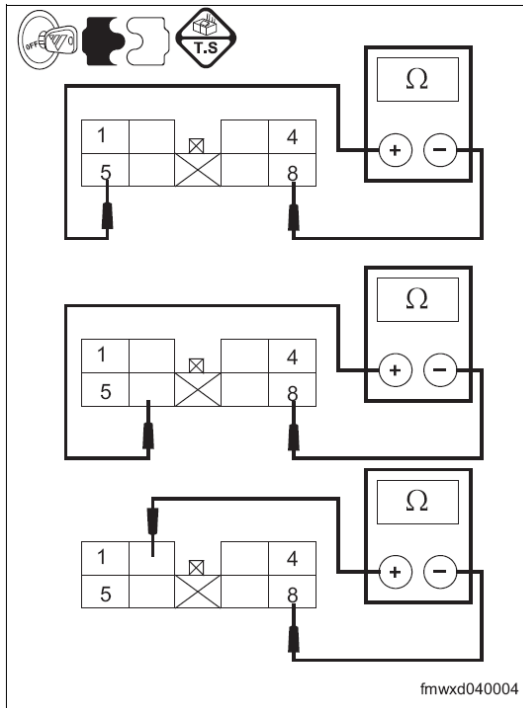
(c). Inspect the high-gear circuit of wiper.

- Get the wiper switch to high gear "HI" and use multi-meter to measure the voltage between pin 4 and pin 2 of wiper motor connector B026

Voltage standard value: battery voltage**Is the inspection result normal?****Yes > replace the wiper motor****No > see Step 3**

Diagnosis - Wiper & Washer**3. Inspect the combination switch**

(a). Switch off the general power .



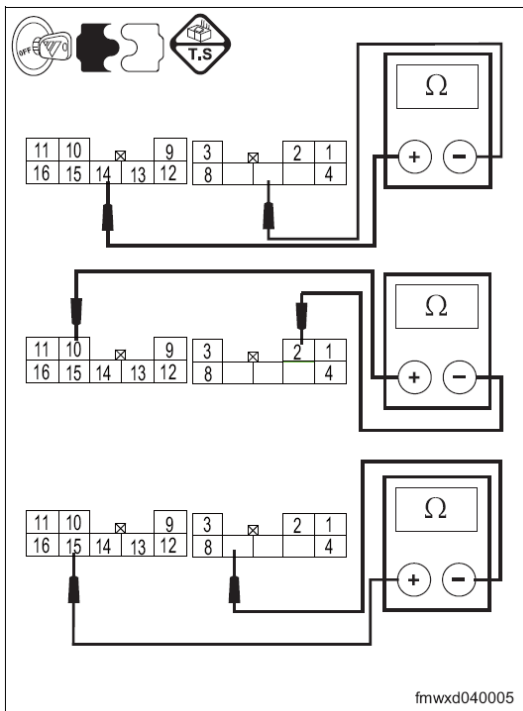
(b). Disconnect the combination switch connector B010.

Standard Value:

Switch Position	Pin Connected to Multi-meter	Standard Value
LO	5-8	$\leq 2 \Omega$
HI	6-8	$\leq 2 \Omega$
INT	8-2	$\leq 2 \Omega$

Is the inspection result normal?**No > replace the combination switch****Yes > see Step 4****4. Inspect the two-in-one controller**

(a). Disconnect two-in-one controller connector B067, B066.



(b). Inspect the two-in-one controller

Standard Value:

Pin Connected to Multi-meter	Standard Value
14-6	$\leq 2 \Omega$
10-2	$\leq 2 \Omega$
14-7	$\leq 2 \Omega$

Is the inspection result normal?

No > replace the two-in-one controller

Yes > repair or replace the harness

Wiper Rotates Very Slowly

Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear - Circuit Diagram"

Diagnostic Steps

1. Inspect the battery voltage

- (a). Use multi-meter to measure the battery voltage.

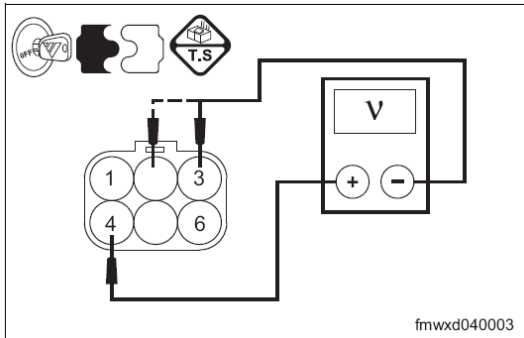
Is the inspection result normal?

Yes > see Step 2

No > charge or replace battery

2. Inspect the wiper motor

- (a). Switch off the general power .
- (b). Disconnect wiper motor connector B026.



- (c). Inspect the low-gear function.

- Connect the battery positive (+) to the wiper motor pin 4, and battery negative (-) to wiper motor pin 3. Inspect whether the motor is running in low speed gear.

- (d). Inspect the high-gear function.

- Connect the battery positive (+) to the wiper motor pin 4, and battery negative (-) to wiper motor pin 2. Inspect whether the motor is running in high speed gear.

Is the inspection result normal?

No > replace the wiper motor

Yes > see Step 3

3. Inspect the motor bearing and reducer gear

- (a). Dismantle the wiper motor and refer to Chapter 55 "Wiper and Washer - Wiper Motor Assembly, Replacement".
- (b). Inspect the lubricating situation of motor bearing and reducer gear.

Is the inspection result normal?

Yes > repair or replace the harness

No > charge lubricating oil

Wiper Fails to Stop Working

Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear, Circuit Diagram"

Diagnostic Steps

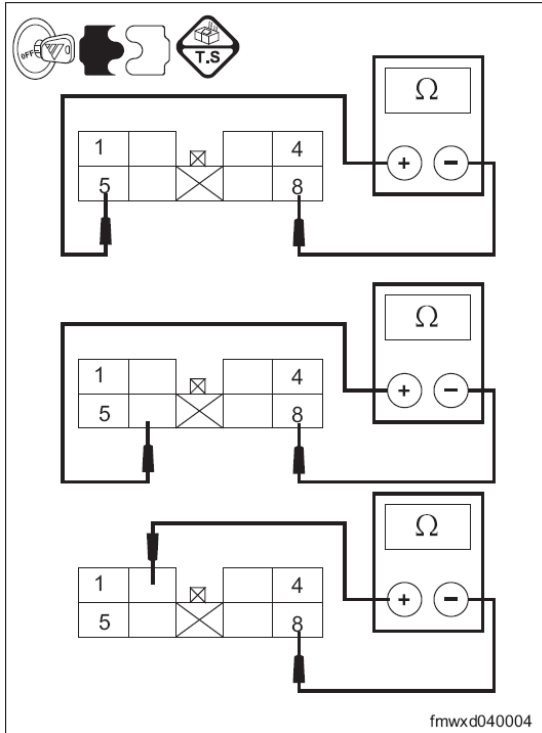
1. Inspect the combination switch

- (a). Switch off the general power .
- (b). Disconnect the combination switch connector B010.

- (c). Inspect the combination switch.

Standard Value:

Switch Position	Pin Connected to Multi-meter	Standard Value
LO	5-8	$\leq 2 \Omega$
HI	6-8	$\leq 2 \Omega$
INT	2-8	$\leq 2 \Omega$



Is the inspection result normal?

No > replace the combination switch

Yes > repair or replace the harness

Wiper Fails to Work in Intermittent Gear

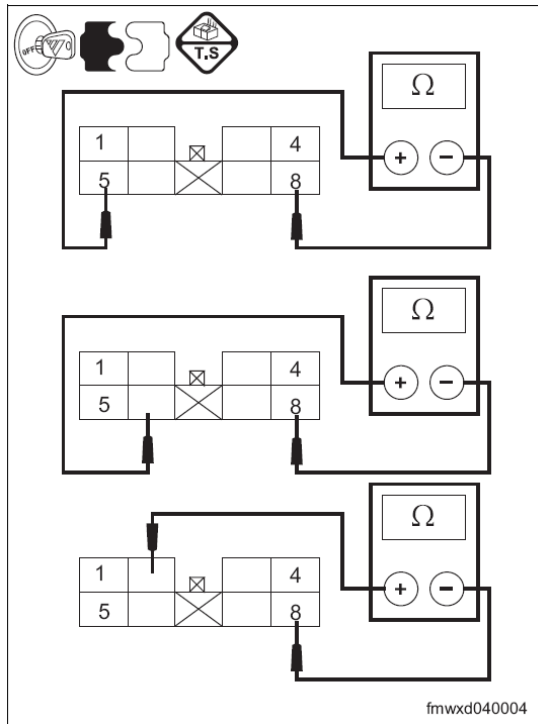
Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear, Circuit Diagram"

Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off the general power .
- (b). Disconnect the combination switch connector B010.



- (c).. Inspect the combination switch.

Standard Value:

Switch Position	Pin Connected to Multi-meter	Standard Value
LO	5-8	$\leq 2 \Omega$
HI	6-8	$\leq 2 \Omega$
INT	2-8	$\leq 2 \Omega$

Is the inspection result normal?

No > replace the combination switch

Yes > see Step 2

2. Inspect the harness

- (a). Disconnect the two-in-one controller connector B066, B067 and combination switch connector B010.
- (b). Use multi-meter to measure the harness resistance between pin 7 of two-in-one controller connector B066 and pin 2 of combination switch connector B010 .
- (c). Use the multi-meter to measure the harness resistance between pin 11 of two-in-one controller connector B067 and pin 5 of wiper motor connector B026.

Resistance: $\leq 2 \Omega$.

Is the inspection result normal?

Yes > replace the two-in-one controller

No > repair or replace the harness

Wiper Fails to Work in Low Speed Gear

Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear, Circuit Diagram"

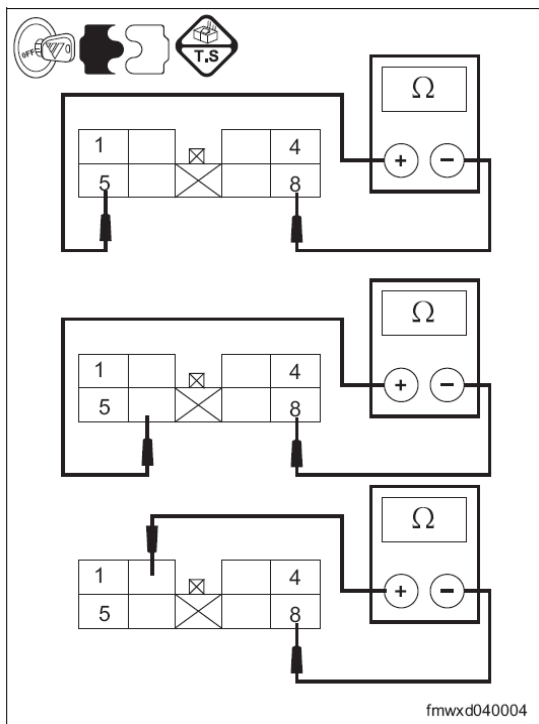
Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off the general power.
- (b). Disconnect the combination switch connector B010.
- (c). Inspect the combination switch.

Standard Value:

Switch Position	Pin Connected to Multi-meter	Standard Value
LO	5-8	$\leq 2 \Omega$
HI	6-8	$\leq 2 \Omega$
INT	2-8	$\leq 2 \Omega$



Is the inspection result normal?

No > replace the combination switch

Yes > see Step 2

2. Inspect the harness

- (a). Disconnect the two-in-one controller connector B066, B067, combination switch connector B010 and wiper motor connector B026.
- (b). Use multi-meter to measure the harness resistance between pin 6 of two-in-one controller connector B066 and pin 5 of combination switch connector B010. Harness resistance.
- (c). Use multi-meter to measure the harness resistance between pin 14 of two-in-one controller connector B067 and pin 3 of wiper motor connector B026.

Resistance: $\leq 2 \Omega$.

Is the inspection result normal?

Yes > replace the two-in-one controller

Diagnosis - Wiper & Washer

No > repair or replace the wiring harness

Wiper Fails to Work in High Speed Gear

Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear, Circuit Diagram"

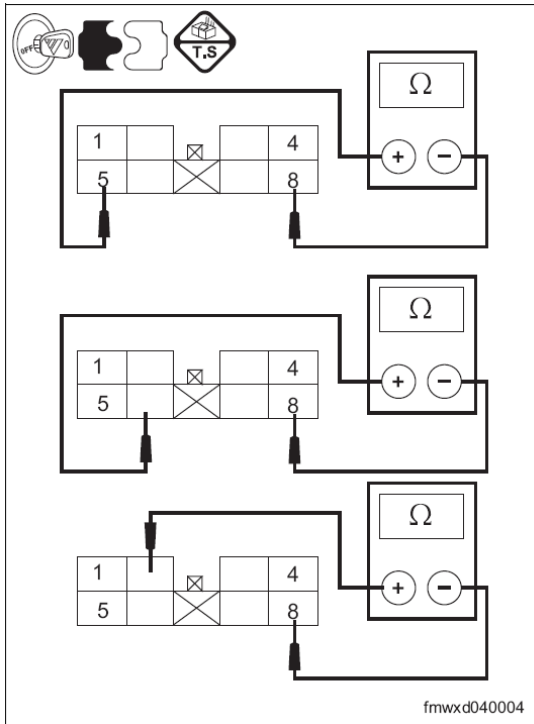
Diagnostic Steps

1. Inspect the combination switch

- (a). Switch off the general power.
- (b). Disconnect the combination switch connector B010.
- (c). Inspect the combination switch.

Standard Value:

Switch Position	Pin Connected to Multi-meter	Standard Value
LO	5-8	$\leq 2 \Omega$
HI	6-8	$\leq 2 \Omega$
INT	2-8	$\leq 2 \Omega$



Is the inspection result normal?

No > replace the combination switch

Yes > see Step 2

2. Inspect the harness

- (a). Disconnect the two-in-one controller connector B066, B067 and wiper motor connector B026.
- (b). Use multi-meter to measure the harness resistance between pin 2 of two-in-one controller connector B066 and pin 6 of combination switch connector B010.
- (c). Use multi-meter to measure the harness resistance between pin 10 of two-in-one controller connector B067 and pin 2 of wiper motor connector B026.

Resistance: $\leq 2 \Omega$.

Is the inspection result normal?

Yes > replace the two-in-one controller

No > repair or replace the wiring harness

Wiper Fails to Return to Normal position (when the switch is turned off)

Circuit Diagram

Refer to this chapter "Wiper Fails to Work in Any Gear, Circuit Diagram"

Diagnostic Steps

1. Inspect the harness

- Switch off the general power.
- Disconnect the two-in-one controller connector B066, B067 and wiper motor connector B026.
- Use multi-meter to measure the harness resistance between pin 11 of two-in-one controller connector B067 and pin 5 of wiper motor connector B026.
- Use multi-meter to measure the resistances of pin 1 of wiper motor connector B026 and effective earthing point of the vehicle body.

Resistance: $\leq 2 \Omega$.

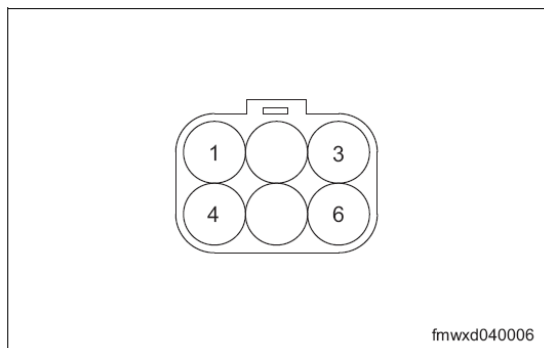
Is the inspection result normal?

No > repair or replace harness

Yes > see Step 2

2. Inspect the wiper motor

- Dismantle the wiper motor assembly and refer to Chapter 55 "Wiper and Washer - Wiper Motor Assembly, Replacement".



- Inspect the auto-stopping function.

- Connect the battery positive (+) to the wiper motor pin 4, and the battery negative (-) to the wiper motor pin 3. When the motor is running in lower speed gear, disconnect the connection of pin 4 and the motor automatically gets stopped at any position.
- Connect the wiper motor pin 3 to pin 1. And connect battery positive (+) to wiper motor pin 4 to restart the motor that it can operate in low speed gear.
- Inspect whether the auto-stopping position is correct.

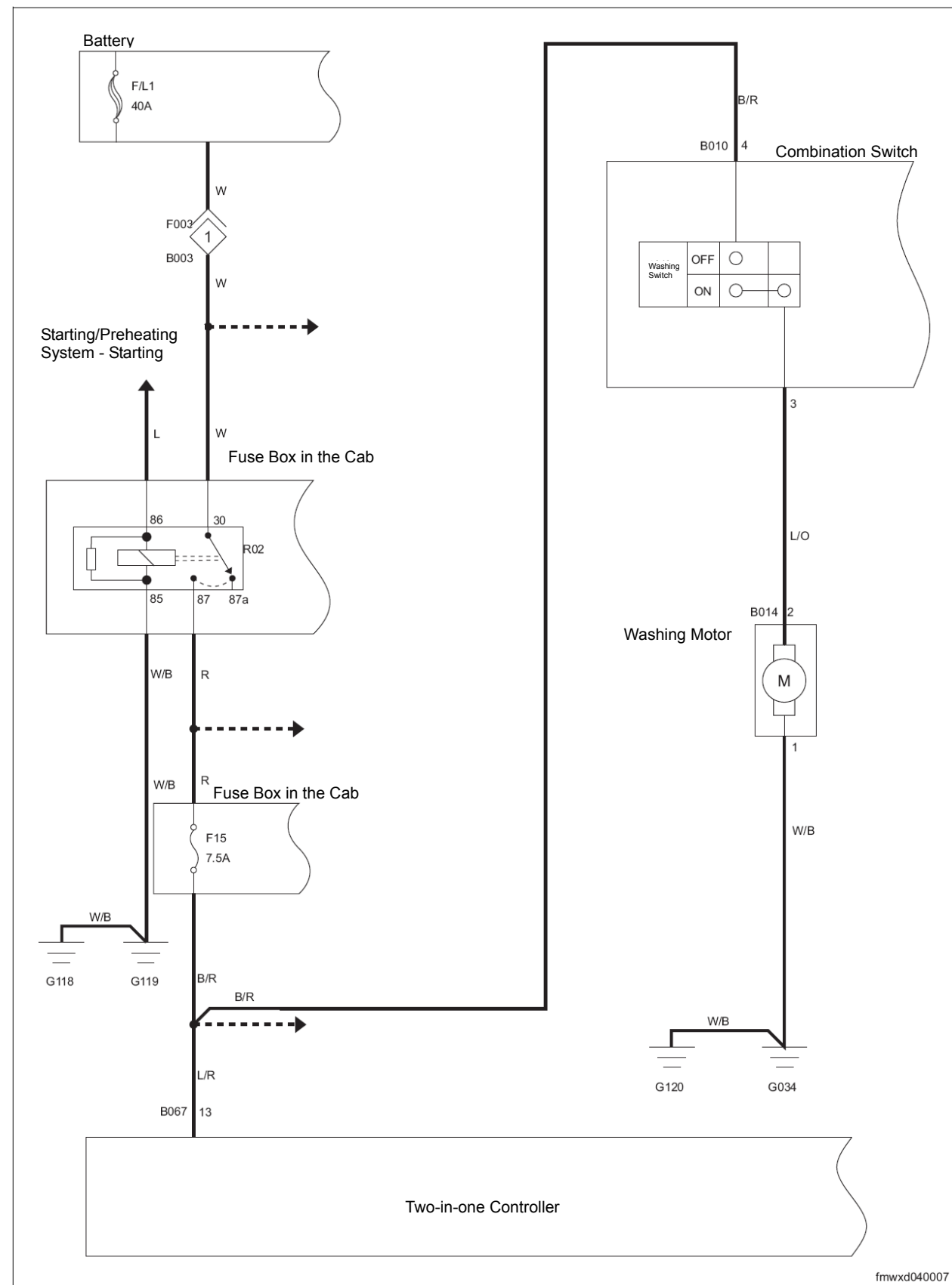
Is the inspection result normal?

Yes > replace the two-in-one controller

No > repair or replace wiring harness

Washer Fails to Work and the Wiper is Normal.

Circuit Diagram



Diagnosis - Wiper & Washer**Diagnostic Steps****1. Inspect the washing liquid**

- (a). Inspect the liquid surface of washing liquid.

Whether the washing liquid is adequate?

No > add the washing liquid

Yes > see Step 2

2. Inspect the nozzle

- (a). Inspect the nozzle.

Whether the nozzle is unblocked?

Yes > see Step 3

No > replace the nozzle

3. Inspect the hose

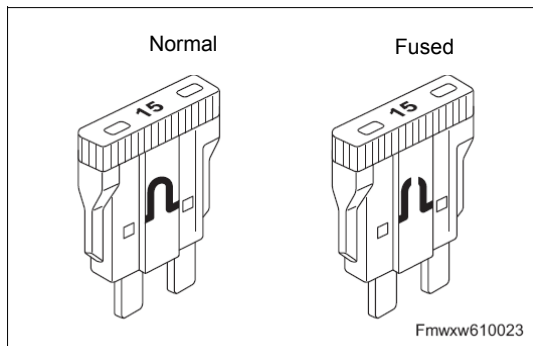
- (a). Inspect the leakage of hose.

Is > replace the hose

No > see Step 4

4. Inspect the fuse

- (a). Turn off the ignition switch.



- (b). Inspect the fuse F15 (7.5 A) inside fuse block in cab.

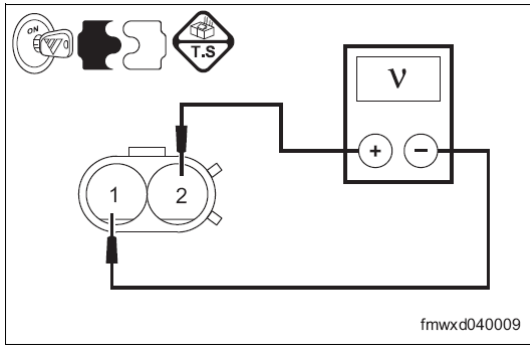
Is the inspection result normal?

Yes > see Step 5

No > overhaul fuse circuit and replace rated capacity fuse

5. Inspect both-end voltage of washer motor

- (a). Disconnect the washer motor connector B014.
(b). Turn on the ignition switch.



- (c). Keep the washing switch in water-injection position and use multi-meter to measure the voltage between the pin 2 and pin 1 of washing motor connector B014 at the same time

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Voltage standard value: battery voltage

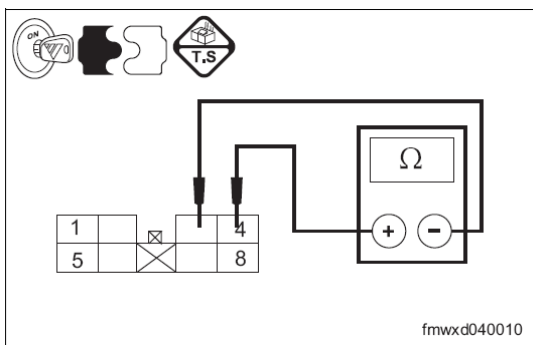
Is the inspection result normal?

Yes > replace washer motor

No > see Step 6

6. Inspect the combination switch

- (a). Switch off the general power.
(b). Disconnect the combination switch connector B010.



- (c). Inspect the combination switch.

Standard Value:

Switch Position	Pin Connect ed to Multi-me ter	Standard Value
OFF	-	-
ON (Wash)	4-3	$\leq 2 \Omega$

Is the inspection result normal?

No > replace combination switch

Yes > repair or replace harness

Audio System

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
- (b). Turn off the ignition switch, unless otherwise specified.

2. Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.

Hint:

The odometer will not be reset.

3. Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.

Hint:

The audio system must be rest after reconnection of the negative cable of the battery.

4. The modification of audio system and other additional audio equipment is strictly prohibited.

5. This audio system uses the following radio waveband.

Radio Waveband	AM	FM
Modulation Approach	Amplitude Modulation	Frequency Modulation
Tuning Range	522-1,620kHz	87.5-1,620kHz

6. Precautions for MP3

- (a). The MP3 audio unit is equipped with a USB interface which can connect extra media sources.
- (b). Only if that the extension of the document is “.mp3”, the document can be identified and played.
- (c). If the non-mp3 documents are saved as files with “.mp3” extension, these documents will be mistaken for MP3 files and be played. But it may occur that they can not be played or there are shrill noises when played, and the loudspeaker may be damaged.

Warning:

Any document in nonstandard format and virus may result in the machine's abnormal play or disability. So before using the USB mobile storage media make sure that the format is correct and there is no virus.

Basic Inspection

Steps	Inspection	Solutions	
1	Inspect the Voltage of Battery The voltage of battery shall not be lower than 22V. Is the inspection result normal?	Yes	See Step 2
		No	Charge or replace the battery refer to "Chapter 53 Battery-Battery"
2	Inspect Antenna - Has the antenna been pulled out to the longest? - Is there foreign object covering the antenna? - Is the antenna bended or out of shape? Is the inspection result normal?	Yes	See Step 3
		No	Repair or replace the antenna. Refer to "Chapter 56 Audio System-Antenna"
3	Inspect Audio Unit Switch on the audio power and inspect whether the liquid crystal display displays. Is the inspection result normal?	Yes	See Step 4
		No	See Fault Symptom Table
4	Inspect Audio Unit Turn the volume to 5 VOL and inspect whether there is any sound. Is the inspection result normal?	Yes	See Step 5
		No	See Fault Symptom Table
5	Inspect Radio Wave - There is much difference between the coverage areas of AM and FM broadcast, and sometimes the AM broadcast can be clearly received while the FM can not. - The coverage area of FM stereo is the smallest and is easy to be interfered by solenoid wave. - Inspect whether there are high buildings or mountains, for which will obstruct part of the signal between transmitter tower and vehicles. - Inspect whether there is large substation or energy relay, the strong solenoid wave of which will result in the fault to pick up broadcast signals. - Some buildings, because of their materials, will reflex the broadcast signal and generate two signals, causing interference. Is the inspection result normal?	Yes	See Fault Symptom Table
		No	Move the vehicle to somewhere with good signal

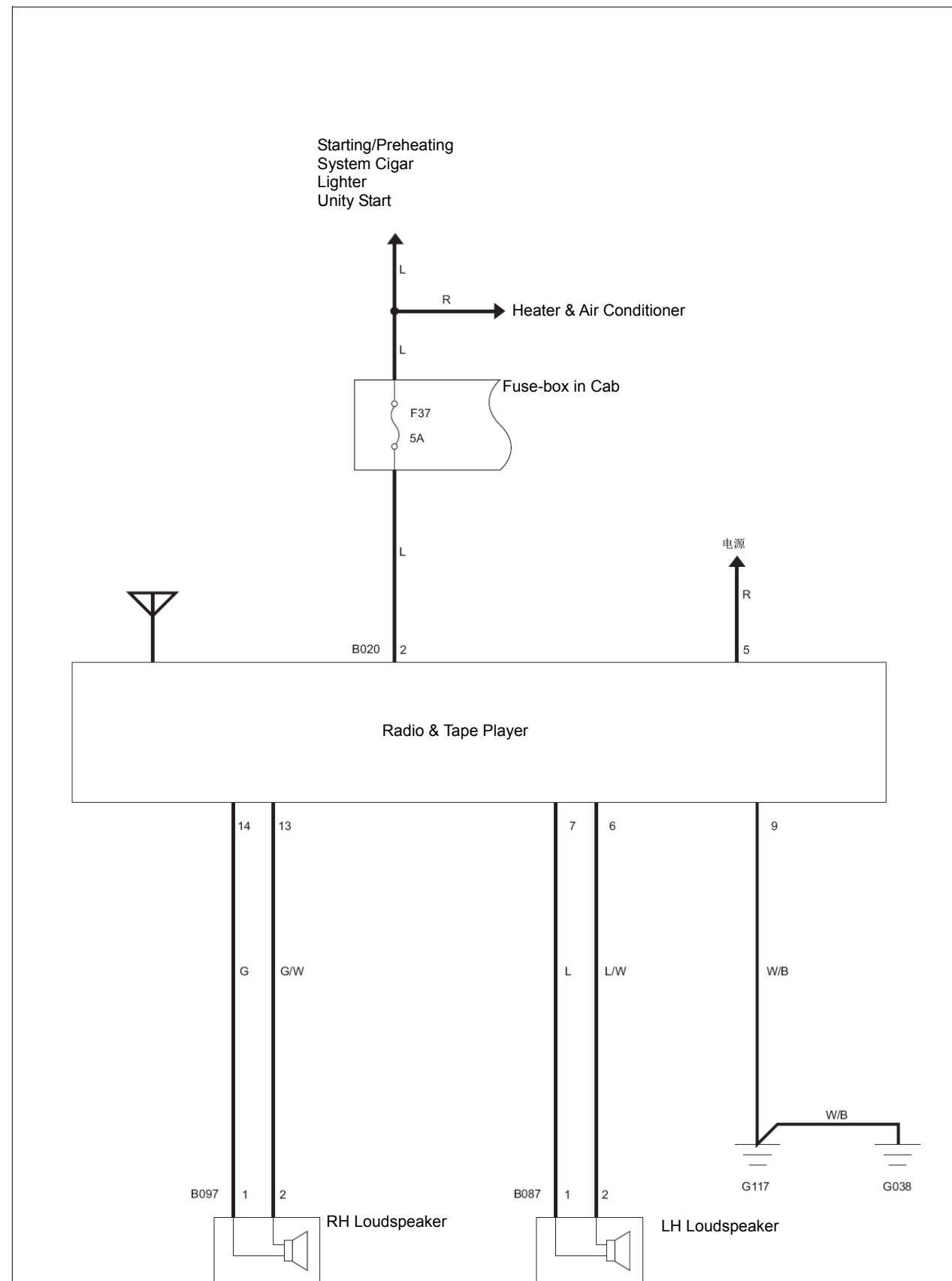
Diagnosis - Audio System**Fault Symptom Table**

The following table will help you find out the causes. The serial number represents the order of possibility of fault cause. Inspect each part according to the order and replace it when necessary.

Fault Symptom	Possible Position	Reference
The audio unit fails to work.	1. Power, earthed circuit	Chapter 04 Audio System-Audio System Fails to Work
	2. The audio unit itself	
Electric loudspeaker has no sound (under any mode)	1. Silent Mode	Chapter 04 Audio System- Electric Loudspeaker Has No Sound (Under Any Mode)
	2. Circuit of loudspeaker	
	3. Loudspeaker	
	4. The audio unit itself	
Acoustics is not good (under any mode).	1. Improper setting of audio unit	Chapter 04 Audio System- Acoustics Is Not Good (Under Any Mode)
	2. Circuit of loudspeaker	
	3. Loudspeaker	
Loudspeaker volume is low (under any mode).	1. Improper setting of audio unit	Set audio unit correctly
	2. Circuit of loudspeaker	Chapter 04 Audio System- Loudspeaker Volume Is Weak (Under Any Mode)
	3. Loudspeaker	
	4. The audio unit itself	
Fail to or barely receive radio broadcast	1. Strong interference of neighbor solenoid wave	Leave far away from interference place of solenoid wave
	2. Antenna	Chapter 04 Audio System- Fail to Receive Radio Broadcast or Bad Effect
	3. The audio unit itself	
MP3 cannot be inserted/played	1. Wrong format of media source document	Chapter 04 Audio System- MP3 Cannot Be Inserted/Played
	2. The audio unit itself	
MP3 staccato	1. Bad acoustics of media source document	Chapter 04 Audio System- MP3 Staccato
	2. The audio unit itself	
No display on liquid crystal display, but audio system works properly	1. The audio unit itself	Chapter 56 Audio System-Radio-Cassette Player, Replace

The Audio Unit Fails to Work

Circuit Diagram

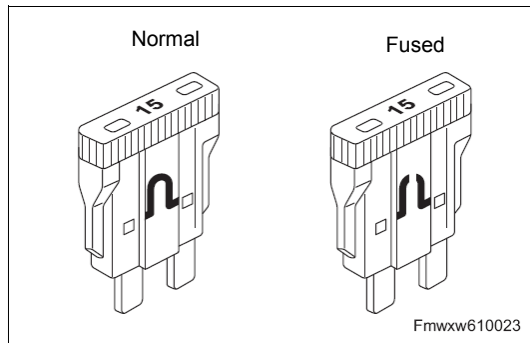


Diagnosis - Audio System

Diagnostic Steps

1. Inspect fuse F37

(a). Turn off the ignition switch.



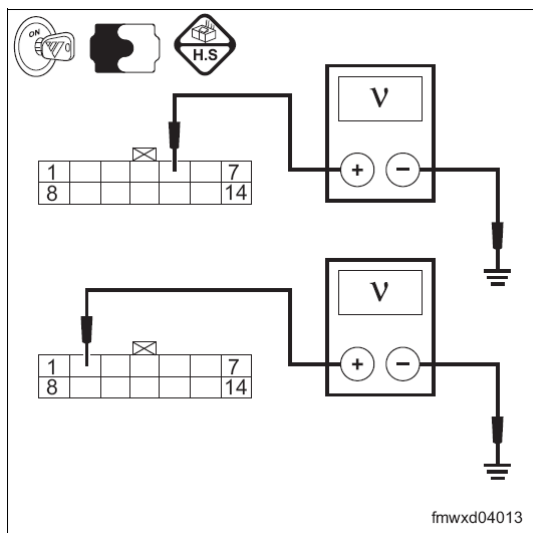
(b). Inspect the fuse F37 (5A) in fuse-box of cab.

Is the inspection result normal?

Yes > see Step 2.

No > overhaul fuse circuit, replace rated capacity fuse

2. Inspect the power circuit of audio unit



(a). Inspect the normal power circuit of audio unit

- Measure the voltage between connector B020 stitch 5 of audio unit and earthing.

(b). Inspect the power circuit of audio unit

- Turn on the ignition switch.
- Measure the voltage between connector B020 stitch 2 of audio unit and earthing.

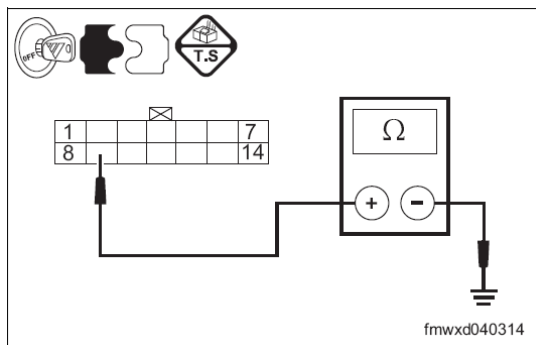
Voltage standard: voltage of battery

Is the inspection result normal?

Yes > see Step 3.

No > repair or replace harness

3. Inspect the earthed circuit of audio unit



- (a). Inspect the earthed circuit of audio unit
- Turn off the ignition switch.
 - Disconnect connector B020 of audio unit.
 - Measure the voltage between connector B020 stitch 9 of audio unit connector and earthing.

Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace audio unit

No > repair or replace harness

Electric Loudspeaker Has No Sound (Under Any Mode)

Circuit Diagram

Refer to this Chapter, "Audio Unit Fails to Work-Circuit Diagram"

Diagnostic Steps

1. Inspect the set of audio unit

- (a). Turn on the ignition switch.
- (b). Switch on the power switch of audio unit.
- (c). Turn the volume of audio unit to 5VOL and above.
- (d). Inspect and confirm the "MUTE" is turned off.

Does the loudspeaker work?

Yes > improper setting of audio unit

No > see Step 2.

2. Inspect loudspeaker

- (a). Turn off the ignition switch.
- (b). Dismantle left and right loudspeaker, refer to "Chapter 56 Audio System – Loudspeaker, Replace".
- (c). Inspect whether the diffuser is broken.
- (d). Install new loudspeaker, turn on ignition switch, open power switch of audio unit and turn to FM mode.

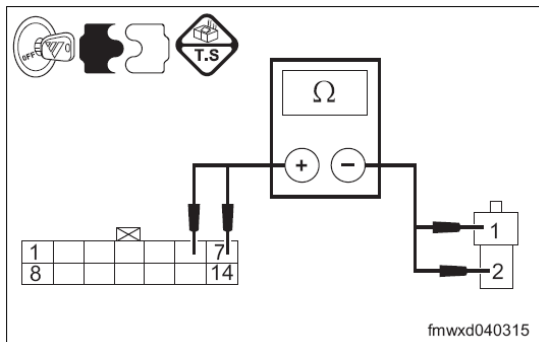
Does the loudspeaker work?

Yes > replace loudspeaker

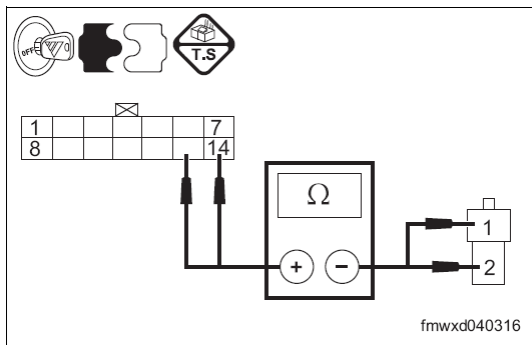
No > see Step 3.

3. Inspect signal circuit of loudspeaker

- (a). Turn off the ignition switch.
- (b). Disconnect connector of audio unit.



- (c). Measure the resistances separately between audio unit B020 stitch 6, stitch 7 and left loudspeaker B087 stitch 2, stitch 1 with multi-meter.



- (d). Measure the resistances separately between audio unit B020 stitch 13, stitch 14 and right loudspeaker B097 stitch 2, stitch 1 with multi-meter.

Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace audio unit

No > repair or replace harness

Acoustics is Not Good (Under Any Mode)

Diagnostic Steps

1. Inspect the set of audio unit

- (a). Turn on the ignition switch.
- (b). Switch on the power switch of audio unit.
- (c). Turn the volume of audio unit to 5VOL and above.
- (d). Set the high-low sound effect and track balance to initial setup.

Is the acoustics of loudspeaker normal?

Yes > improper setting of audio unit

No > see Step 2.

2. Inspect loudspeaker

- (a). Turn off the ignition switch.
- (b). Dismantle left and right loudspeaker, refer to "Chapter 56 Audio System – Loudspeaker, Replace".
- (c). Inspect whether there are foreign bodies absorbing on the left and right loudspeaker.
- (d). Inspect whether there is too much dust in diffuser of left and right loudspeaker.
- (e). Inspect whether the diffuser of left and right loudspeaker is broken.
- (f). Install new loudspeaker, turn on ignition switch, open power switch of audio unit and turn to FM mode.

Is the inspection result normal?

Yes > see Step 3.

No > clear the foreign bodies, dust or replace loudspeaker

3. Compare with similar motorcycle types

- (a). Set the high-low sound effect and track balance of audio unit to a same level.
- (b). Compare with similar motorcycle types

Is the acoustics of loudspeaker the same?

Yes > system is normal

No > replace audio unit

Loudspeaker Volume Is Weak (Under Any Mode)

Circuit Diagram

Refer to this chapter, "Audio Unit Fails to Work-Circuit Diagram"

Diagnostic Steps

1. Inspect the set of audio unit

- (a). Turn on the ignition switch.
- (b). Switch on the power switch of audio unit.
- (c). Turn the volume of audio unit to 5VOL and above.
- (d). Turn the volume balance to 0.

Is the volume of loudspeaker normal?

Yes > improper setting of audio unit

No > see Step 2.

2. Inspect loudspeaker

- (a). Turn off the ignition switch.
- (b). Dismantle the left and right loudspeaker.
- (c). Inspect whether the diffuser is broken.
- (d). Install new loudspeaker, turn on ignition switch, open power switch of audio unit and turn to FM mode.

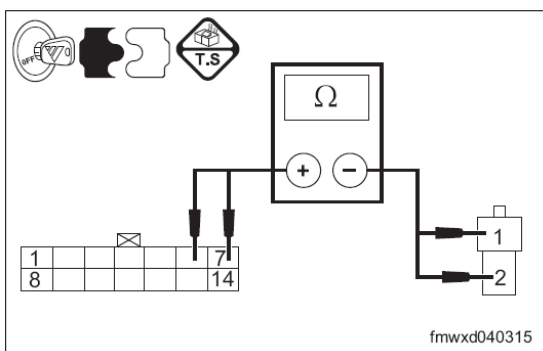
Inspect whether the volume of loudspeaker is normal?

Yes > replace loudspeaker

No > see Step 3.

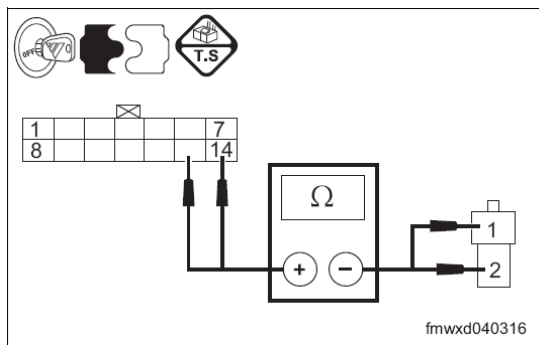
3. Inspect signal circuit of loudspeaker

- (a). Turn off the ignition switch.
- (b). Disconnect connector of audio unit.



- (c). Measure the resistances between audio unit B020 stitch 6, stitch and left loudspeaker B087 stitch 2, stitch 1 with multi-meter.

Diagnosis - Audio System



- (d). Measure the resistances separately between audio unit B020 stitch 13, stitch 14 and right loudspeaker B097 stitch 2, stitch 1 with multi-meter

Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes > see Step 4.

No > repair or replace harness

4. Compare with similar motorcycle types

- (a). Set the high-low sound effect and track balance of audio unit to a same level.
- (b). Compare with similar motorcycle types

Inspect is the volume of loudspeaker is the same?

Yes > system is normal

No > replace audio unit

Fail to Receive Radio Broadcast or Bad Effect

Diagnostic Steps

1. Inspect the set of audio unit

- (a). Turn on the ignition switch.
- (b). Switch on the power switch of audio unit.
- (c). Turn the volume of audio unit to 5VOL and above.
- (d). Conduct auto search of radio station.

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Is the auto search function of audio unit normal?

Yes > see Step 2.

No > replace audio unit

2. Inspect the antenna of audio unit

- (a). Inspect whether the antenna has been pulled up to the longest.
- (b). Whether there are foreign bodies covering the antenna?
- (c). Whether the antenna is bended or out of shape?

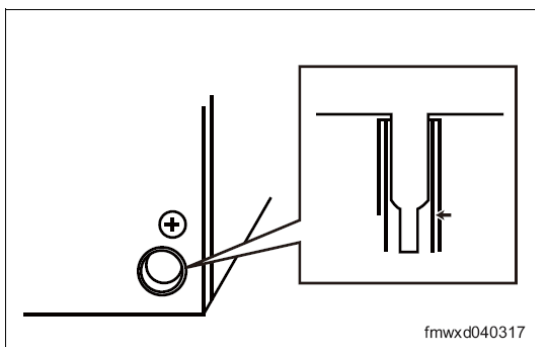
Is the inspection result normal?

Yes > see Step 3.

No > replace the antenna

3. Inspect audio unit

- (a). Turn off the ignition switch.



- (b). Pull out the audio antenna plug.
- (c). Turn on the ignition switch.
- (d). Switch on the power switch of audio unit.
- (e). Turn the volume of audio unit to 5VOL or above.
- (f). Select frequency range "FM1", put a screw driver or a thin wire or other metal, inspect and confirm whether radio broadcast can be heard.

Can the audio unit receive the radio broadcast?

Yes > replace the antenna

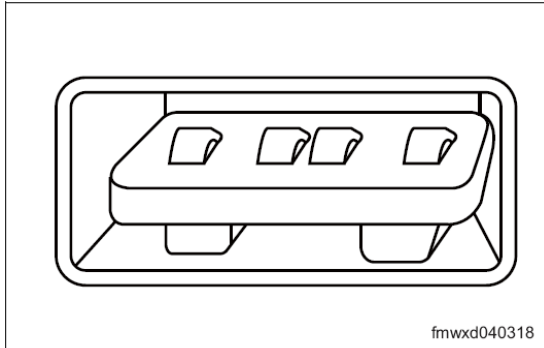
No > replace audio unit

MP3 Cannot Be Inserted/Played

Diagnostic Steps

1. Inspect USB interface

(a). Inspect whether the USB interface of USB flash disc is out of shape, damaged or oxidized.



(b). Inspect whether the USB interface of auto unit is out of shape, damaged or oxidized.

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Whether the inspection result is normal?

Yes > see Step 2.

No > if that's the problem of USB flash disc, replace it. If the USB interface of audio unit out of shape or damaged, replace audio unit.

2. Inspect MP3 media source document

(a). Play the known and ascertained ".mp3" format source document

Inspect whether the audio unit plays normally.

Yes > use source document with correct format

No > see Step 3.

3. Inspect USB flash Disc

(a). Confirm the read function of USB flash disc is not locked.

(b). Replace normal USB flash disc.

Inspect whether the audio unit plays normally.

Yes > replace USB flash disc

No > replace audio unit

MP3 Staccato

Diagnostic Steps

Hint:

When vehicle is on the uneven road, it is normal that the MP3 will break off.

1. **Inspect whether all the “.mp3” format source document occur staccato when playing.**

Whether the inspection result is as stated?

Yes > see Step 2.

No > use legal copy of “.mp3” source document with correct format.

2. **Inspect USB flash Disc**

- (a). Confirm whether the source document in USB flash disc is “.mp3” source document that can be played normally.
- (b). Replace normal USB flash disc.

Inspect whether the audio unit plays normally.

Yes > replace USB flash disc

No > replace audio unit

Horn

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
- (b). Turn off the ignition switch, unless otherwise specified.

2. **Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.**

Hint:

The odometer will not be reset.

3. **Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.**

Hint:

The audio system must be reset after reconnection of the negative cable of the battery.

Basic Inspection

Steps	Inspection		Solutions
1	Inspect the battery voltage • The battery voltage shall not be lower than 22V. Is the inspection result normal?	Yes	See Step 2
		No	Charge or replace the battery. Refer to "Chapter 53, Battery-Battery"
2	Inspect whether the horn frequently sounds • Set the ignition switch in ON position Does the horn frequently sound?	Yes	See the fault symptom table
		No	See Step 3
3	Inspect whether the horn is mute • Press the horn switch. • Release the horn switch. Is the air horn mute?	Yes	See the fault symptom table
		No	See Step 4
4	Inspect the air horn • Turn on the electric/air horn switch • Press the horn switch. Does the air horn sound?	Yes	Confirm system is normal
		No	See the fault symptom table

Diagnosis - Horn

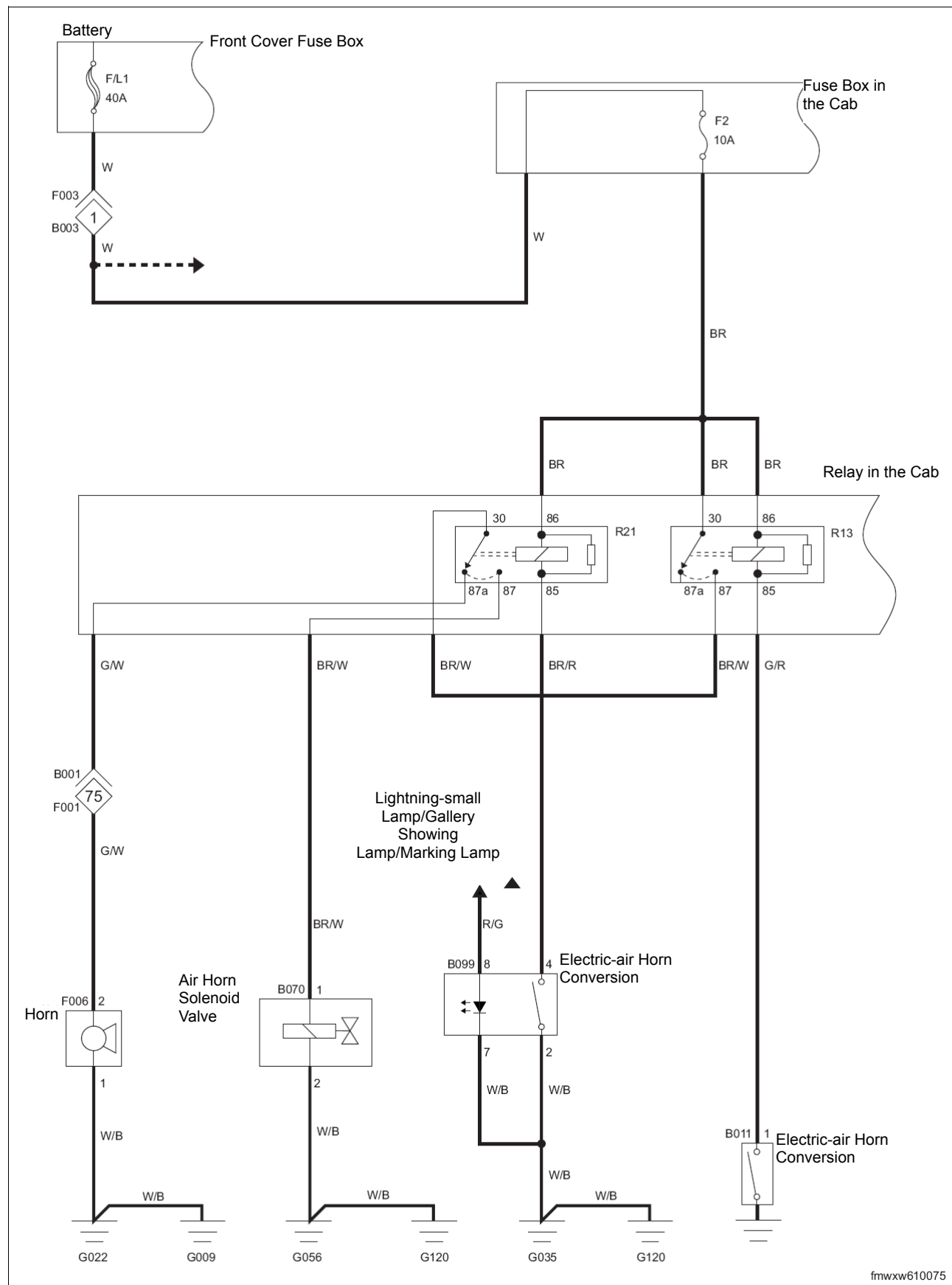
Fault Symptom Table

The following table will help you to find out the fault causes. The sequence number refers to the order of the possibility of the fault cause. Inspect each spare part according to the order and replace it as needed.

Fault Symptoms	Suspected Position	References
The electric horn does not sound.	1. Electric Horn (damaged)	Chapter 57 Horn-Horn, Replacement
	2. Horn Switch (damaged)	Chapter 57 Horn-Horn, Replacement
	3. Wiring Harness	Wiring harness replacement
The electric horn frequently sounds.	1. Horn Switch (damaged)	Chapter 57 Horn-Horn, Replacement
	2. Wiring Harness	Wiring harness replacement
The horn sound is abnormal.	1. Horn	Chapter 57 Horn-Horn, Replacement
The air horn fails to sound.	1. Air Horn (damaged)	Chapter 04, Diagnosis-Horn-Air Horn Fails to Sound
	2. Horn Switch (damaged)	Chapter 57 Horn-Horn, Replacement
	3. Wiring Harness	Wiring harness replacement
	4. Electric Horn Switch	Chapter 04, Diagnosis-Horn-Air Horn not Sound
	5. Air Horn Solenoid Valve	Chapter 04, Diagnosis-Horn-Air Horn Fails to Sound
The air horn frequently sounds.	1. Horn Switch (damaged)	Chapter 57 Horn-Horn, Replacement
	2. Wiring Harness	Wiring harness replacement
	3. Air Horn Solenoid Valve	Chapter 04, Diagnosis-Horn-Air Horn frequently Sound

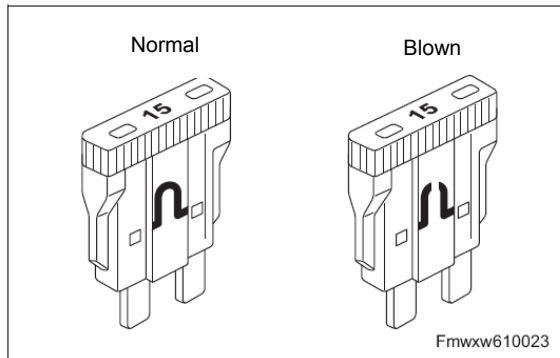
Electric Horn Fails to Sound

Circuit Diagram

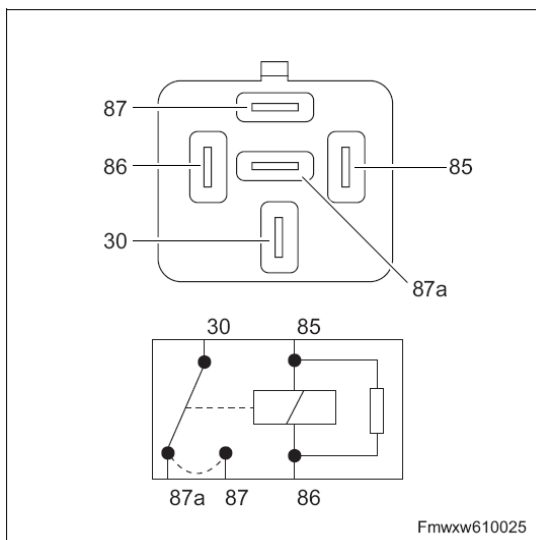


Diagnosis - Horn**Diagnostic Steps****1. Inspect the fuse F2**

(a). Place the ignition switch on OFF.



(b). Inspect the fuse in the fuse box inside the cab: F2 (10A).

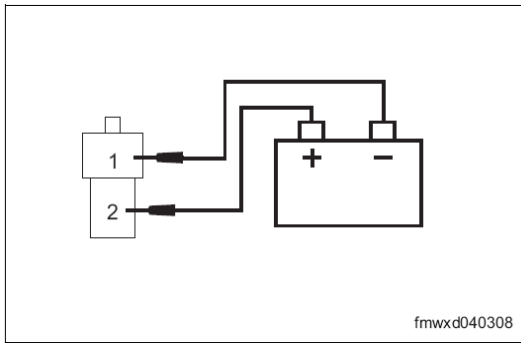
Is the inspection result normal?**Yes > see Step 2****No > overhaul the fuse circuit and replace the rated capacity fuse****2. Inspect the horn relay R13 and the electric/air horn conversion relay R21**

(a). Inspect the relays in the relay box inside the cab: R13 and R21.

Standard Value:

Switch Position	Multi-meter Connected to Pins	Standard Value
Constant	85-86	Breakover
Apply the power supply voltage between Pin 85 and 86	30-87	Breakover
Constant	30-87a	Breakover

Is the inspection result normal?**Yes > see Step 3****No > replace the relay****3. Inspect the electric horn**



- (a). Remove the horn, refer to "Chapter 57 Horn-Horn, Replacement".
- (b). Connect the electric horn to the battery.

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Does the electric horn sound?

Yes > see Step 4

No > replace the electric horn

4. Inspect the wiring harness

- (a). Measure the resistance of the wiring harness between B003 and F2 with a multi-meter.
- (b). Measure the resistance of the wiring harness between F2 and Pin 30 and 86 of the horn relay R13 with a multi-meter.
- (c). Measure the resistance of the wiring harness between Pin 1 of B011 and Pin 85 of the horn relay R13 with a multi-meter.
- (d). Measure the resistance of the internal wiring harness of the horn switch with a multi-meter.
- (e). Measure the resistance of the wiring harness between Pin 87 of the horn relay R13 and Pin 30 of the air horn conversion relay R21 with a multi-meter.
- (f). Measure the resistance of the wiring harness between Pin 87a of the electric / air horn relay R21 and B001 with a multi-meter.
- (g). Measure the resistance of the wiring harness between F001 and Pin 2 of F006 with a multi-meter.
- (h). Measure the resistance of the wiring harness between Pin 1 of F001 and G022 with a multi-meter.

Resistance $\leq 2\Omega$

Is the inspection result normal?

Yes > repair the horn switch or replace the steering wheel

No > repair or replace the wiring harness

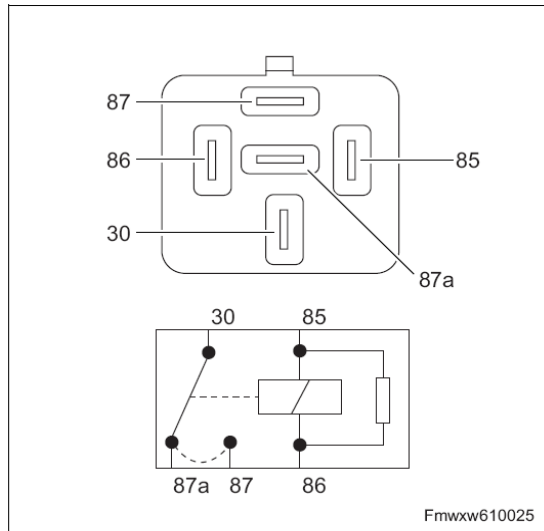
Electric Horn Sounding Frequently

Circuit Diagram

Refer to "this Chapter, Electric Horn Failing to Sound -Circuit Diagram"

Diagnostic Steps

1. Inspect the horn relay R13



- (a) . Inspect the relay in the relay box inside the cab: R13.

Standard Value:

Switch Position	Multi-meter Connected to Pins	Standard Value
Constant	85-86	Breakover
Apply the power supply voltage between Pin 85 and 86	30-87	Breakover
Constant	30-87a	Breakover

04

Is the inspection result normal?

Yes > see Step 2

No > replace the horn relay

2. Inspect the wiring harness

- (a) . Release the horn switch.
 (b) . Measure the resistance of the wiring harness between Pin 1 and the earthing of the horn switch with a multi-meter.

Resistance $\geq 10 \text{ M}\Omega$

Is the inspection result normal?

Yes > repair the horn switch or replace the steering wheel

No > repair or replace the wiring harness

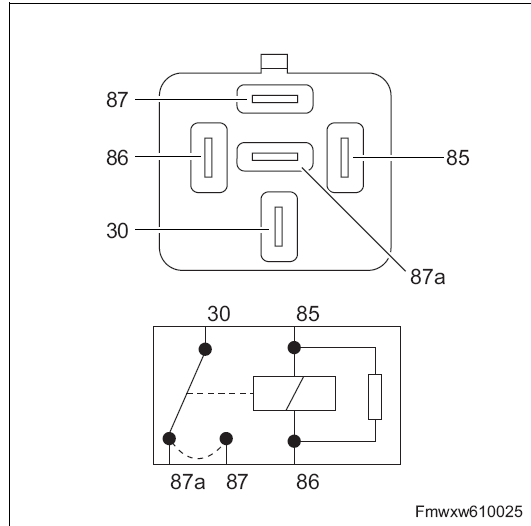
Air Horn Failing to Sound

Circuit Diagram

Refer to "this Chapter, Electric Horn Failing to Sound -Circuit Diagram"

Diagnostic Steps

1. Inspect the electric/air horn conversion relay R21



- (a) . Inspect the relay in the relay box inside the cab: R21.

Standard Value:

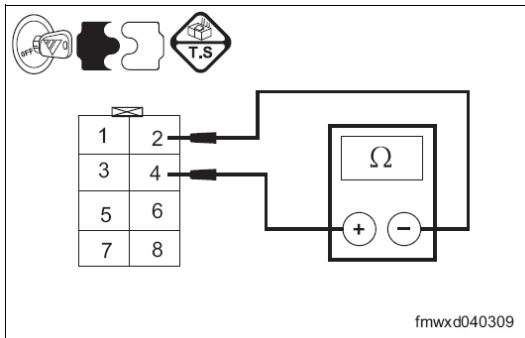
Switch Position	Multi-meter Connected to Pins	Standard Value
Constant	85-86	Breakover
Apply the power supply voltage between Pin 85 and 86	30-87	Breakover
Constant	30-87a	Breakover

Is the inspection result normal?

Yes > see Step 2

No > replace the electric/air horn conversion relay

2. Inspect the electric/air horn conversion switch



- (a) . Cut off the power.
 (b) . Disconnect the connector B099 of the electric/air horn conversion switch.
 (c) . Inspect the electric/air horn conversion switch.

Standard Value

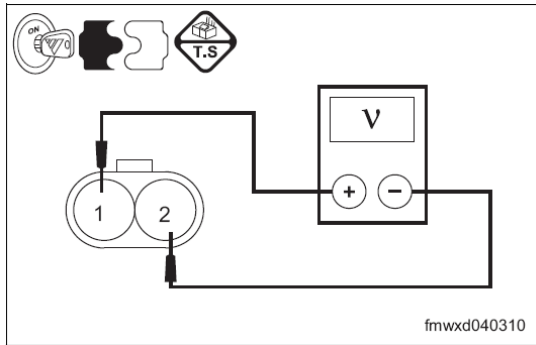
Switch Position	Multi-meter Connected to Pins	Standard Value
ON	2-4	$\leq 2 \Omega$
OFF	2-4	$\geq 10M\Omega$

Is the inspection result normal?

Yes > see Step 3

No > replace the electric/air horn conversion switch

3. Inspect the voltages of both ends of the air horn solenoid valve

Diagnosis - Horn

- (a) . Disconnect the connector B070 of the air horn solenoid valve.
- (b) . Set the ignition switch in ON position.
- (c) . Press the horn switch and measure the voltage between Pin 1 and 2 of the connector B070 of the air horn solenoid valve with a multi-meter at the same time.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the air horn solenoid valve

No > see Step 4

4. Inspect the wiring harness

- (a) Measure the resistance of the wiring harness between Pin 86 of the electric/air horn conversion relay R21 and F2 with a multi-meter.
- (b) Measure the resistance of the wiring harness between Pin 85 of the electric/air horn conversion relay R21 and Pin 4 of the electric/air horn conversion switch with a multi-meter.
- (c) Measure the resistance of the wiring harness between Pin 2 of the electric/air horn conversion switch and G035 with a multi-meter.
- (d) Measure the resistance of the wiring harness between Pin 87 of the electric/air horn conversion relay and Pin 1 of B070 with a multi-meter.
- (e) Measure the resistance of the wiring harness between Pin 2 of B070 and G056 with a multi-meter.

Resistance $\leq 2\Omega$

Yes > repair the air horn and its circuit

No > repair or replace the wiring harness

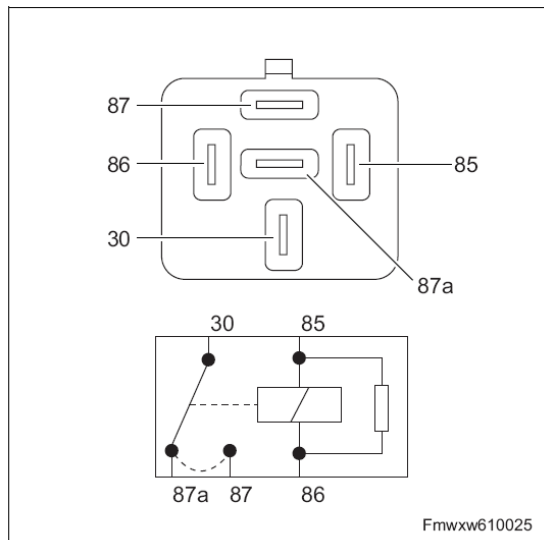
Air Horn Sounding Frequently

Circuit Diagram

Refer to "this Chapter, Electric Horn Failing to -Circuit Diagram"

Diagnostic Steps

1. Inspect the horn relay R13



- (a). Inspect the relay in the relay box inside the cab: R13.

Standard Value

Switch Position	Multi-meter Connected to Pins	Standard Value
Constant	85-86	Breakover
Apply the power supply voltage between Pin 85 and 86	30-87	Breakover
Constant	30-87a	Breakover

Is the inspection result normal?

Yes > see Step 2

No > replace the horn relay

2. Inspect the air horn solenoid valve

- (a). Disconnect the connector of the air horn solenoid valve and inspect the air horn solenoid valve.

Does the air horn sound frequently?

Yes > see Step 3

No > replace the air horn solenoid valve

3. Inspect the wiring harness

- (a). Release the horn switch
 (b). Measure the resistance of the wiring harness between Pin 1 and the earthing of the horn switch with a multi-meter.

Resistance $\geq 10 \text{ M}\Omega$

Is the inspection result normal?

Yes > repair the horn switch or replace the steering wheel

No > repair or replace wiring harness

Instrument cluster

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
- (b). Turn off the ignition switch, unless otherwise specified.

2. **Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.**

Hint:

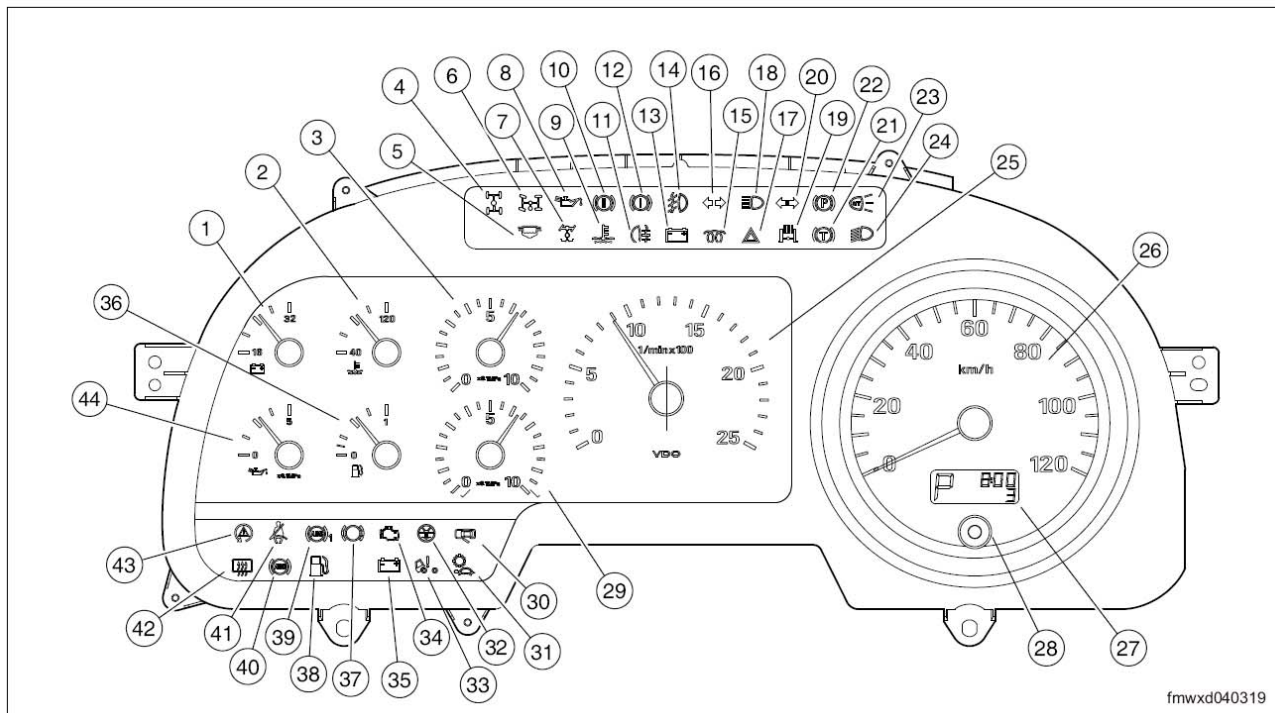
The odometer will not be reset.

3. **Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.**

Hint:

The audio system must be reset after reconnection of the negative cable of the battery.

Instrument Description



No	Item	Description
1	Voltmeter	The voltmeter shows whether the battery is charging or discharging. Inspect the figure on the voltmeter when the engine is operating.
2	Water Temperature Gauge	The water temperature gauge indicates the cooling water temperature of the engine.
3	Front Axle Pressure Gauge	It indicates the air pressure in the front axle brake air storage tube. When driving, the pressure gauge pointer will show at 750~830kpa.
4	Inter-axle Lock Indicator	When the differential gear between axis is carried out the locking, the indicator will be on, which indicates that the rear axle is directly interlocked with the differential system.
5	Oil-water Separation Indicator	When the precipitation water in the oil-water separator is up to a certain amount, break over the precipitation water switch installed in the oil-water separator to turn on the oil-water separation indicator.
6	Power Takeoff Indicator	When the power takeoff switch is working, the indicator will be on, which indicates that the power output device is at work.
7	Locking Indicator Between Wheels	When the differential speed between wheels is locked, the indicator will be on, which indicates that the left and right wheels are directly connected with the differential speed system.
8	Oil Pressure Warning Lamp	When the starter is working while the engine has been started, the warning lamp will be on. The engine shall not be used when the warning lamp is on.
9	Water Temperature Warning Lamp	When the cooling water temperature is too high, the indicator will be on.
10	Middle and Rear Axle Air Pressure Warning Lamp	When the air pressure in the middle and rear axle brake air storage tube is lower than 500Kpa, the warning lamp will be on.
11	Rear Fog Indicator	When turning on the rear fog lamp, the indicator will be on.

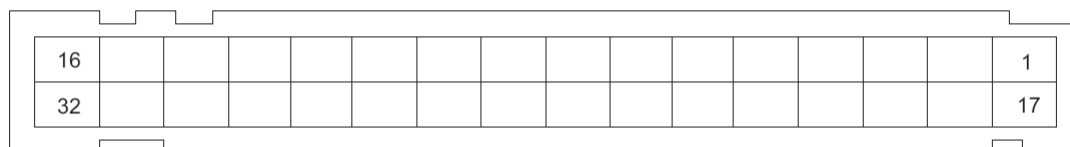
Diagnosis - Instrument cluster

No	Item	Description
12	Front Axle Air Pressure Warning Lamp	When the air pressure in the front axle brake air storage tube is lower than 500Kpa, the warning lamp will be on.
13	Charging Indicator	The fault of the charging system will turn on the charging indicator.
14	Front Fog Indicator	When turning on the front fog lamp, the indicator will be on.
15	Preheating Indicator	When preheating the air intake manifold, the ECU turns on the preheating indicator.
16	Main Vehicle Turning Indicator	When the turning signal switch is connected, the main vehicle turning indicator will flash to show that the external turning signal is working.
17	Hazard Warning Indicator	When the hazard warning switch is connected, the indicator will flash to show that the current vehicle works abnormally.
18	Remote Light Indicator	When the front big lamp turns to the remote light, the remote light indicator will be on.
19	Air Exhaust Brake Indicator	When the air exhaust brake switch is connected, the air exhaust brake indicator will be on, which indicates that the air exhaust brake device is taking effect.
20	Trailer Turning Indicator	When the vehicle is a trailer and is connected to the turning signal switch, the trailer turning indicator will flash to show that the external turning signal is working.
21	Retarder Working Indicator	When equipped with the retarder, turn on the retarder switch. When the retarder starts working, the working indicator will be on.
22	Parking Brake Indicator	When the parking brake switch is connected, turn on the parking brake indicator.
23	Brake Light Broken Wire Warning Lamp	When the wire of the brake light is burnout, the warning lamp will be on.
24	Beam Indicator	When the front big lamp is beam, the indicator will be on.
25	Engine Speed Meter	The signal received from the ECU indicates the engine speed. The speed meter shows the engine speed as per rpm.
26	Speedometer	It indicates the current speed according to the pulse signal received from the speed sensor. The unit of the speedometer is km/h.
27	Clock and Mileage Display	The clock shows the current time. The milemeter records and accumulates the total miles with kilometer.
28	Time Adjusting Rod	Press the time adjusting rod and it may adjust the time.
29	Rear Axle Pressure Gauge	It indicates the air pressure of the rear axle brake air storage tube. When operating, the pressure gauge pointer shall show at 750~830kpa.
30	Vehicle Door Unclosed Indicator	When the vehicle door is not closed and the warning switch is connected, the vehicle door unclosed indicator will be turned on.
31	Low-gear Indicator	When the speed changer is at the low gear, the indicator will be on.
32	Air Filter Clogging Warning Lamp	When the air filter element is clogged, the warning lamp will be on.

Diagnosis - Instrument cluster

No	Item	Description
33	Cab Locked and Forbidden Warning Indicator	When the cab is open, the indicator will be on.
34	Engine Fault Lamp	When the electric control system of the engine has problems, the ECU will light the engine fault indicator.
35	Low-voltage Warning Lamp	When the battery voltage is too low, the warning lamp will be on.
36	Fuel Gauge	The fuel gauge indicates the fuel level in the tank.
37	Brake Pad Wear Warning Lamp	When the brake pad is excessively worn, the indicator will be on.
38	Low Fuel Volume Warning Lamp	When the fuel in the tank is too little, the indicator will be on.
39	Trailer ABS Indicator	It indicates whether the trailer ABS system is normal and can be taken as the flash indicator.
40	ABS Indicator	It indicates whether the ABS system is normal and can be taken as the flash indicator. Turn on the ignition switch, the ABS system will self inspect. If the system has no fault, the indicator will be on.
41	Seat Belt Indicator	When the driver does not tight the seat belt, the indicator will be on and will not be off until the driver tightens the seat belt.
42	Rear View Heating Indicator	When turning on the rear view heating switch, the indicator will be on.
43	ASR Flash Code Indicator	When the ASR system fails, the warning lamp is lit or is taken as the ABS flash fault code.
44	Oil Pressure Gauge	It indicates the oil pressure when the engine is operating.

Instrument Terminal



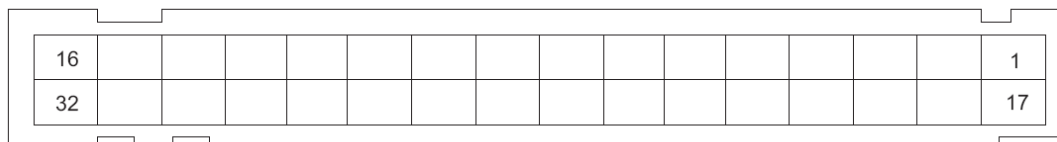
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Pin No.	Line Color	Function
1	-	-
2	Y-L	Instrument coolant level warning
3	BR	Instrument earthed
4	-	-
5	BR	Instrument sensor earthed
6	-	-
7	-	-
8	R-B	R-B oil pressure indicator
9	-	-
10	BR-B	Engine speed indicator A10
11	Y-R	Instrument power (+B)
12	R-G	Instrument lamping input
13	Y-B	Instrument power (IG)
14	Y-L	Engine fault diagnostic lamp (+)
15	-	-
16	W-R	Charging indicator

Pin No.	Line Color	Function
17	-	-
18	L-B	Parking indicator
19	V-G	Exhaust braking indicator
20	O-L	Engine fault diagnostic lamp (-)
21	Y-R	Instrument fuel sensor input
22	G-B	Main frame turn indicator
23	Y-G	Instrument water temperature indication (+)
24	G-Y	Trailer turn indicator
25	R-Y	High beam lamp
26	R-W	Friction plate wear warning A-26
27	GR-W	Instrument GES (single-pole shielding line)
28	G	Warning indicator for broken wire of stop lamp
29	R-L	Hazard warning lamp
30	GR	Instrument 12V output
31	-	-
32	-	-

Diagnosis - Instrument cluster



fmwxd040321

Pin No.	Line Color	Function
1	-	-
2	R-Y	Preheating, oil-water separation, coolant (normal)
3	-	-
4	L-	Rear axle air pressure gauge
5	R	Front axle air pressure gauge
6	Y-R	Preheating indication (-)
7	R-L	Front fog indicator
8	-	-
9	-	-
10	R-B	Low beam indicator
11	V-W	Oil-water separation indication (-)
12	Y-G	Instrument water temperature indication B12
13	B-W	CAB lock warning indicator
14	W	End indicator
15	-	-
16	B-Y	ABS diagnostic lamp

Pin No.	Line Color	Function
17	B-L	Air filter blocking warning instrument lamp
18	R-Y	Door control instrument indicator
19	B-L	Trailer ABS diagnostic lamp
20	P	ASR fault warning lamp
21	G-W	Instrument vehicle speed 20km/h
22	G-R	Instrument vehicle speed 60km/h
23	G-Y	Instrument vehicle speed 40km/h
24	-	-
25	-	-
26	-	-
27	B	Seat belt preload (+)
28	-	-
29	-	-
30	-	-
31	-	-
32	-	-

Basic Inspection

Caution:

In basic inspection, the temperature of the engine must reach operating temperature. The driving test requires two persons.

Step	Scope of Inspection	Measure	
1	Inspect air pressure gauge - When the air pressure gauge indicator shall show between 750 ~ 830kPa. - When the air pressure is below 500kP in the red areas, no vehicles are allowed to drive. Is the inspection result normal?	Yes	See Step 2.
		No	See Fault Symptom Table
2	Inspect tachomete - Connect diagnostic apparatus and choose the rotation speed of the engine. - Respectively observe the indication of engine speed indicator at 700, 1000, 1500, 2000r/min. - The error shall be $\pm 70 \sim 200$ r/min. Is the inspection result normal?	Yes	See Step 3.
		No	See Fault Symptom Table
3	Inspect speedometer - Connect diagnostic apparatus and choose vehicle speed. - Respectively observe the indication of speedometer at 40, 60, 80Km/h - The error shall be ± 5Km/h. - In the constant speed or speedup, the indicator shall have no beating. Is the inspection result normal?	Yes	See Step 4.
		No	See Fault Symptom Table
4	Inspect engine fault diagnostic lamp - Turn on the ignition switch. Engine fault diagnostic lamp shall be lit. - Engine fault diagnostic lamp shall go out when the engine starts. Is the inspection result normal?	Yes	Make sure system is normal
		No	Maintain relative fault point

Fault Symptom Table

Use the following table to help you find the fault. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

Fault Symptom	Possible Cause	Refer to
The whole instrument cluster fails to work	1. Fuse	Replace the fuse
	2. Instrument cluster	Chapter 73 Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	3. Harness	Replace or repair the harness
	4. Relay	Replace the relay
Speedometer fault	1. Instrument cluster	Chapter 73 Dashboard, Instrument, Cigarette Lighter-instrument cluster,
	2. Harness	Repair or replace the harness
	3. Vehicle speed sensor	Replace speed sensor
Speedometer fault	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
Fuel gauge fault	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Fuel sensor	Replace fuel sensor
Oil pressure gauge fault	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Oil pressure sensor	Replace oil pressure sensor
Air pressure gauge fault	1. Instrument cluster	Chapter 73, Dashboard,
	2. Harness	Repair or replace harness
	3. Air pressure sensor	Replace air pressure sensor
Coolant indicator is normally on/off	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Water level warning switch	Replace water level warning switch

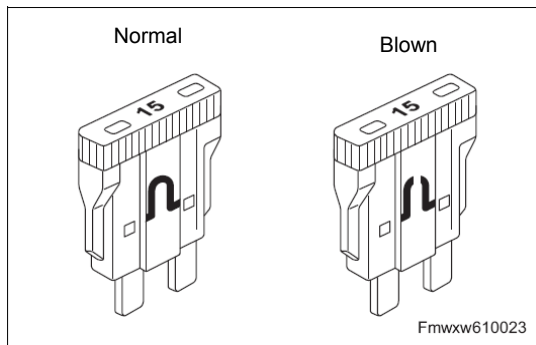
Diagnosis - Instrument cluster

Fault Symptom	Possible Cause	Refer to
Seat belt indicator is normally on/off	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Seat belt preload switch	Replace seat belt preload switch
Exhaust braking indicator is normally on/off	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Combination switch	Replace combination switch
Parking Brake indicator is normally on/off	1. Instrument cluster	Chapter 73, Dashboard, Instrument, Cigarette Lighter-Instrument Cluster, Replacement
	2. Harness	Repair or replace harness
	3. Parking indicator switch	Replace parking indicator switch
Cab lock warning indicator is normally on/off	1. Instrument cluster	Repair or replace harness
	2. Harness	Replace CAB lock switch

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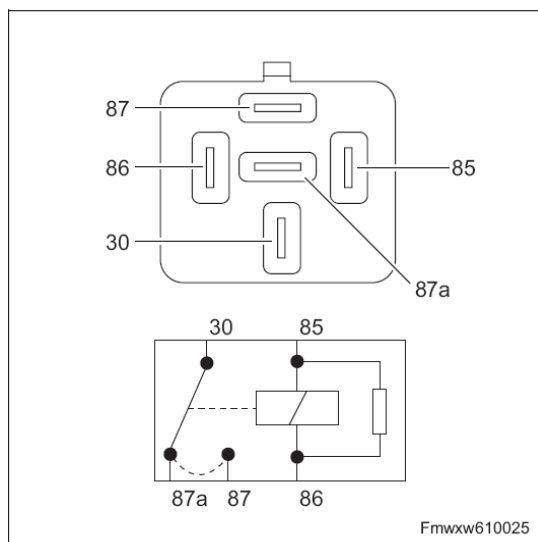
Diagnosis - Instrument cluster**Diagnostic Steps****1. Inspect the fuse**

(a). Switch off general power.



(b). Inspect the fuse in the fuse box in the cab: F40 (7.5A) and F36 (5A).

04

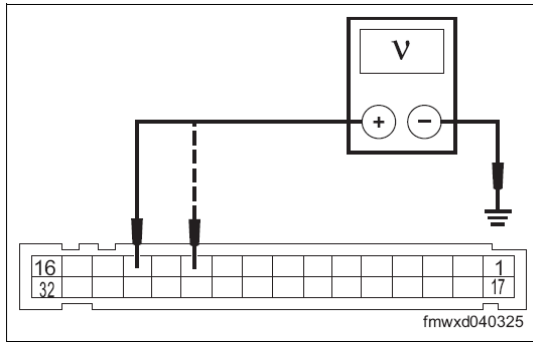
Is the inspection result normal?**Yes > See Step 2****No > overhaul the fuse circuit and replace it with the rated fuse****3. Inspect IG power relay R02**

(a). Inspect relay in the relay box in the cab: R02.

Standard value:

Switch Position	Pin Connected to Multi-meter	Standard Value
Invariable	85-86	Conduction
Apply power supply voltage between pin 85 and pin 86	30-87	Conduction
Invariable	30-87a	Conduction

Is the inspection result normal?**Yes > see Step 3****No > replace the relay****3. Inspect power circuit of instrument cluster**



- (a). Switch off general power supply
- (b). Turn on the ignition switch.
- (c). Use the multi-meter to respectively measure the voltage of instrument cluster connector B089 pin 11, 13 and the earth.

04

Standard voltage value: battery voltage.

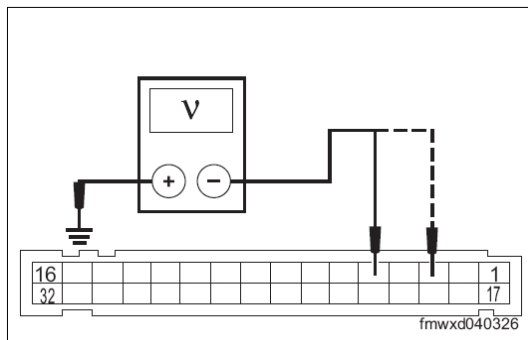
Is the inspection result normal?

Yes > See Step 4

No > repair or replace the harness

4. Inspect earthed circuit of instrument cluster

- (a). Switch off general power



- (b). Disconnect the connector B089 of the instrument cluster.
- (c). Use the multi-meter to measure the resistance between pin 3, 5 of instrument cluster connector B089 and the earth.

Resistance $\leq$

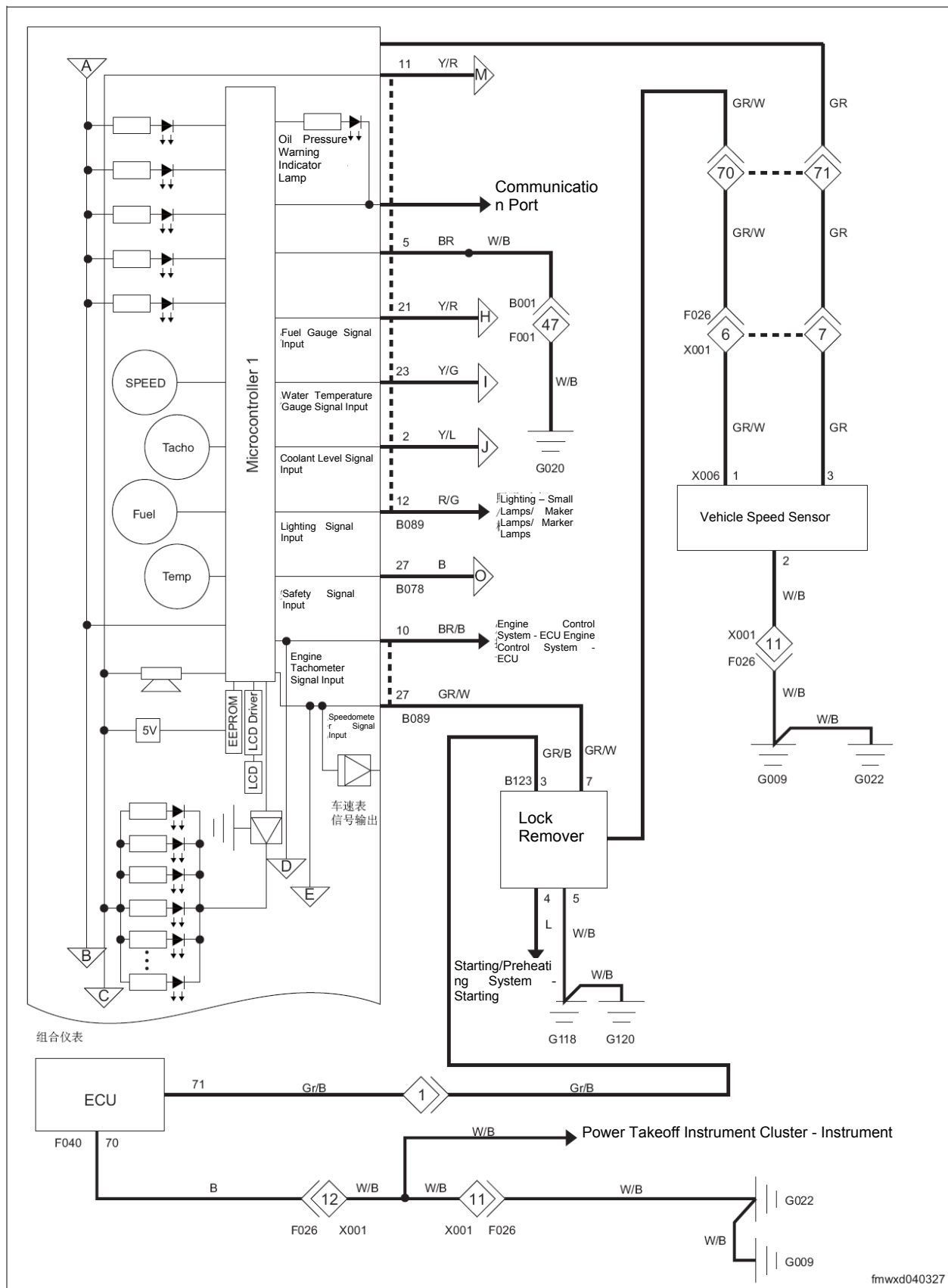
Is the inspection result normal?

Yes> replace the instrument cluster.

No > repair or replace the harness

Speedometer Fault

Circuit Diagram



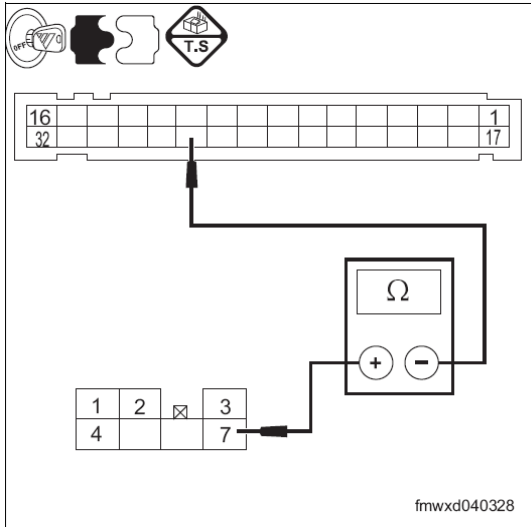
Diagnostic Steps**1. Inspect vehicle speed signal**

- (a). Use diagnostic apparatus to test vehicle speed signal

Whether it has vehicle speed signal?

Yes>see Step 2

No>see Step 3

4. Inspect speedometer signal input circuit

- (a). Turn off the ignition switch.
- (b). Switch off instrument cluster connector B089 and lock remover connector B123.
- (c). Use the multi-meter to respectively measure the voltage of instrument cluster connector B089 pin 27 and lock remover connector B123 pin 7.

Resistance ≤

Is the inspection result normal?

Yes> replace the instrument cluster.

No > repair or replace the harness

3. Read the fault code.

- (a). Connect the diagnostic apparatus KT 600 dedicated for Foton to the vehicle; refer to this chapter, "KT 600 Diagnostic Apparatus Usage and Fault Test".
- (b). Operate the diagnostic apparatus according to the instruction for use.
- (c). Read the fault code.

Is there any fault code?

Yes > maintain respective trouble code

No > see Step4

4. Inspect vehicle speed sensor

- (a). Install a new vehicle speed sensor.
- (b). Sensor pin roll of manual speed vehicle speed (Turn on the ignition switch).

Whether the speedometer has changes?

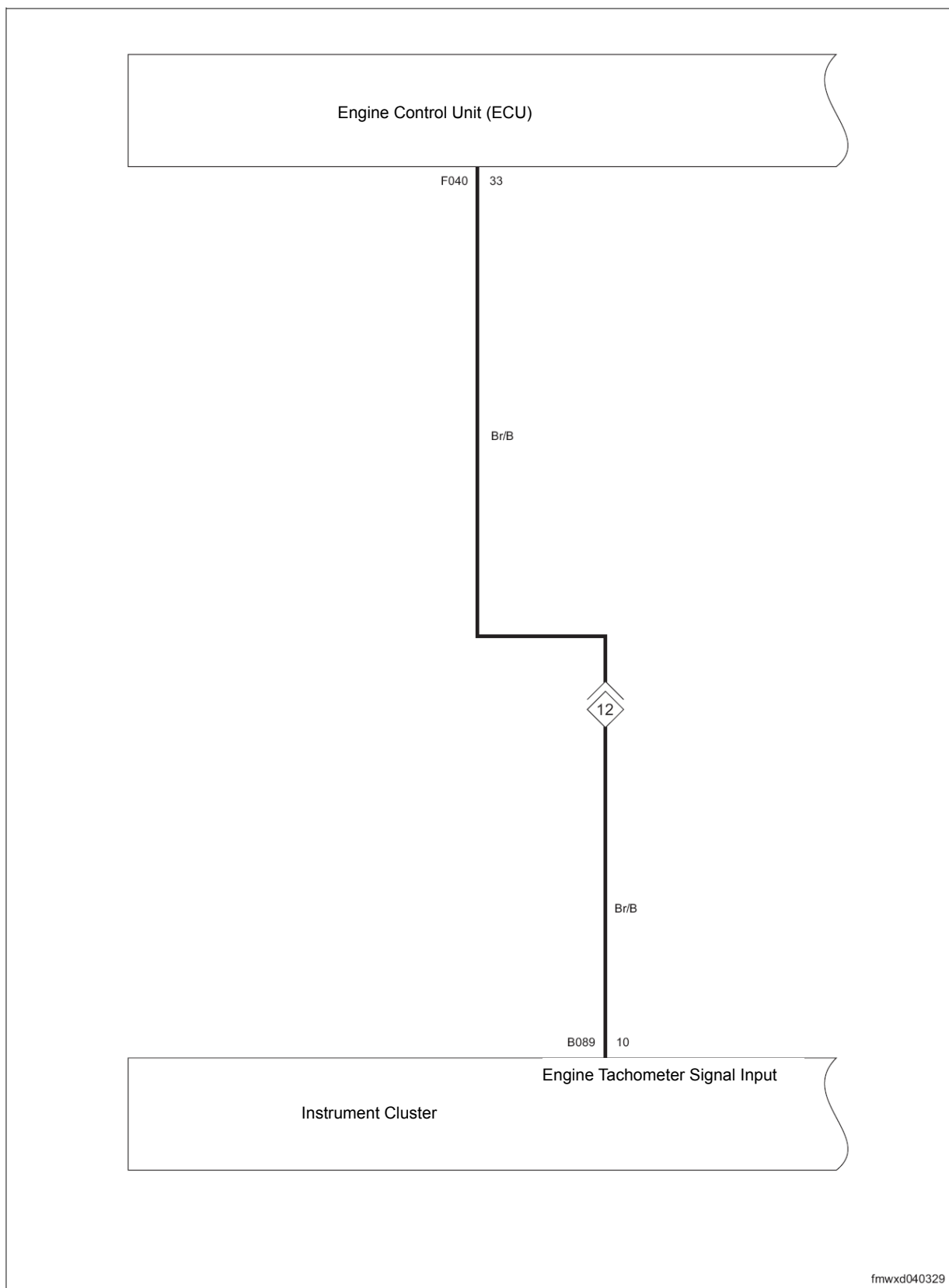
Diagnosis - Instrument cluster

Yes > re-install or change vehicle speed sensor

No > see Step 2

Tachometer Fault

Circuit Diagram



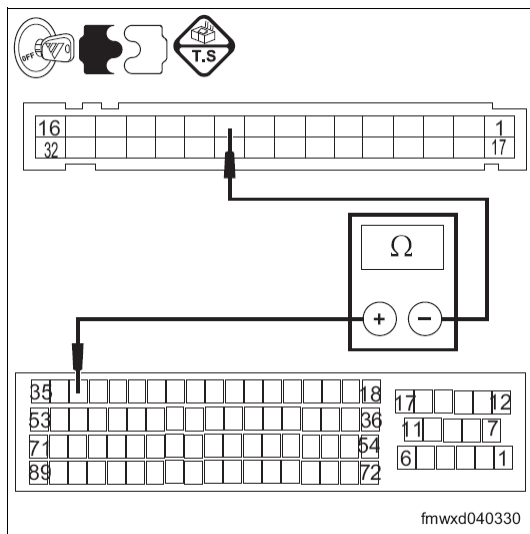
Diagnosis - Instrument cluster**Diagnostic Steps**

Hint:

When the engine speed is not stable, it will cause the beating of speed indicator.

1. Inspect the tachometer signal

- (a). Use diagnostic apparatus to test tachometer signal.

Whether it has speed signal?**Yes > see Step3****No > repair engine fault****2. Inspect input circuit of tachometer signal**

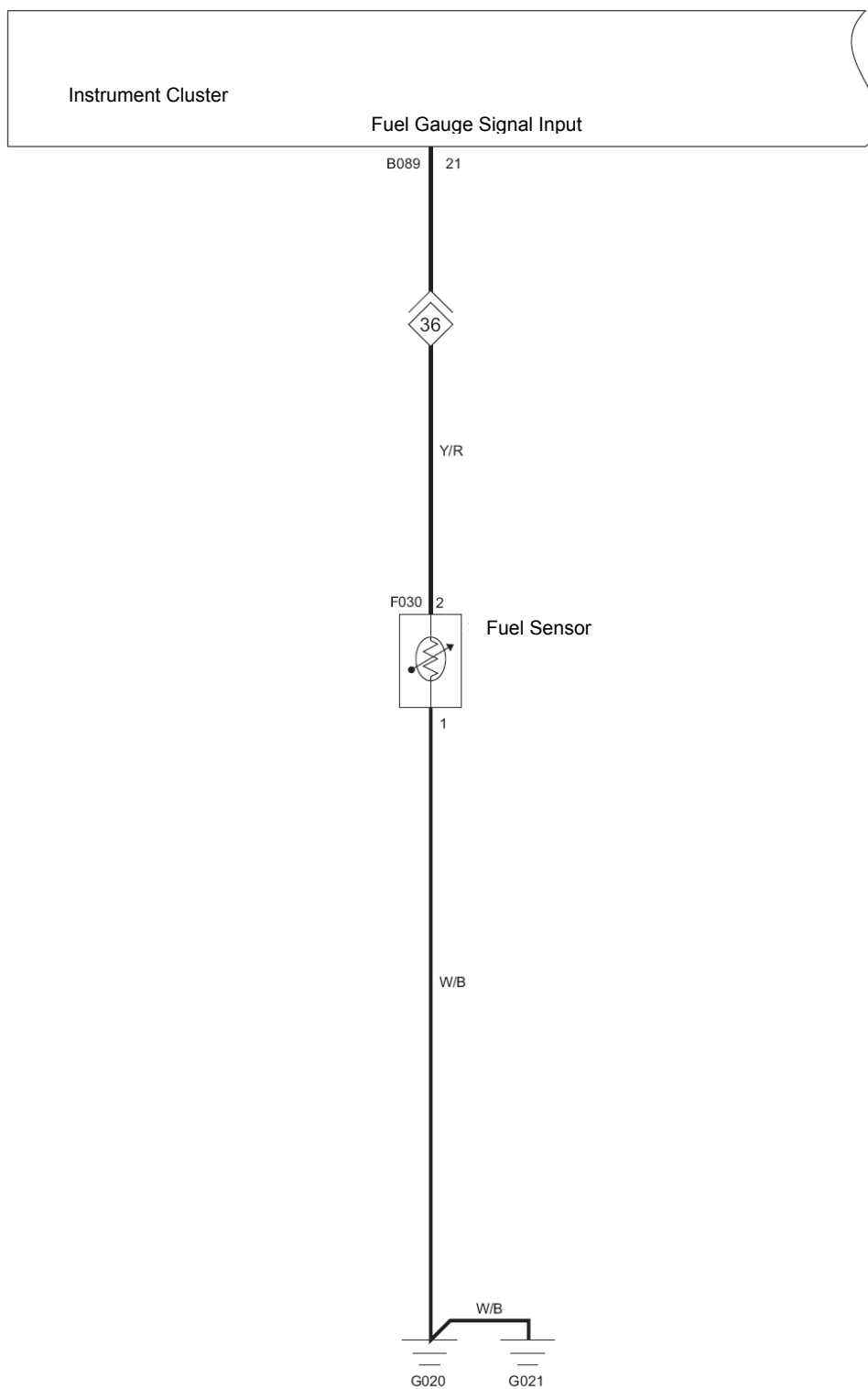
- (a). Switch off general power supply.
 (b). Disconnect ECU connector F040 and instrument cluster connector B089.
 (c). Use the multi-meter to respectively measure the voltage of instrument cluster connector B089 pin 10 and connector F040 pin 33.

Resistance $\leq$ **Is the inspection result normal?****Yes> replace the instrument cluster.****No > repair or replace the harness**

Fuel Gauge Fault

Circuit Diagram

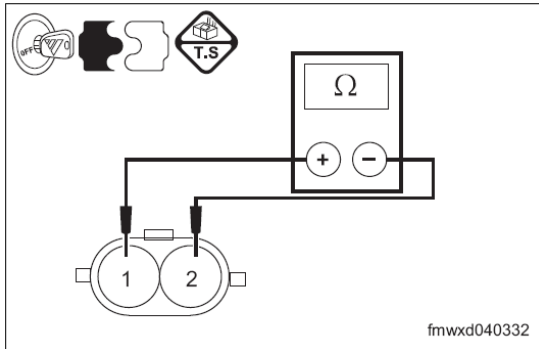
04



fmwxd040331

Diagnosis - Instrument cluster**Diagnostic Steps****1. Inspect fuel sensor**

- (a). Turn off the ignition switch.



- (b). Disconnect fuel sensor connector F030.

Use the multi-meter to measure the resistance between pin 1 and pin 2 of instrument cluster connector F030.

- (d). Dismantle fuel sensor, and respectively analog the condition of empty and full oil on a fuel tank.

Resistance: $10 \pm 3 \Omega$, $180 \pm 10 \Omega$

04

Is the inspection result normal?

Yes > see Step2

No > replace fuel sensor

2. Inspect fuel sensor harness

- (a). Use the multi-meter to measure the resistance of the harness between instrument cluster connector B089 pin 21 and fuel sensor connector F030 pin 2.
- (b). Use the multi-meter to measure the resistance of the harness between fuel sensor connector F030 pin 1 and G020.

Resistance: $\leq 2 \Omega$

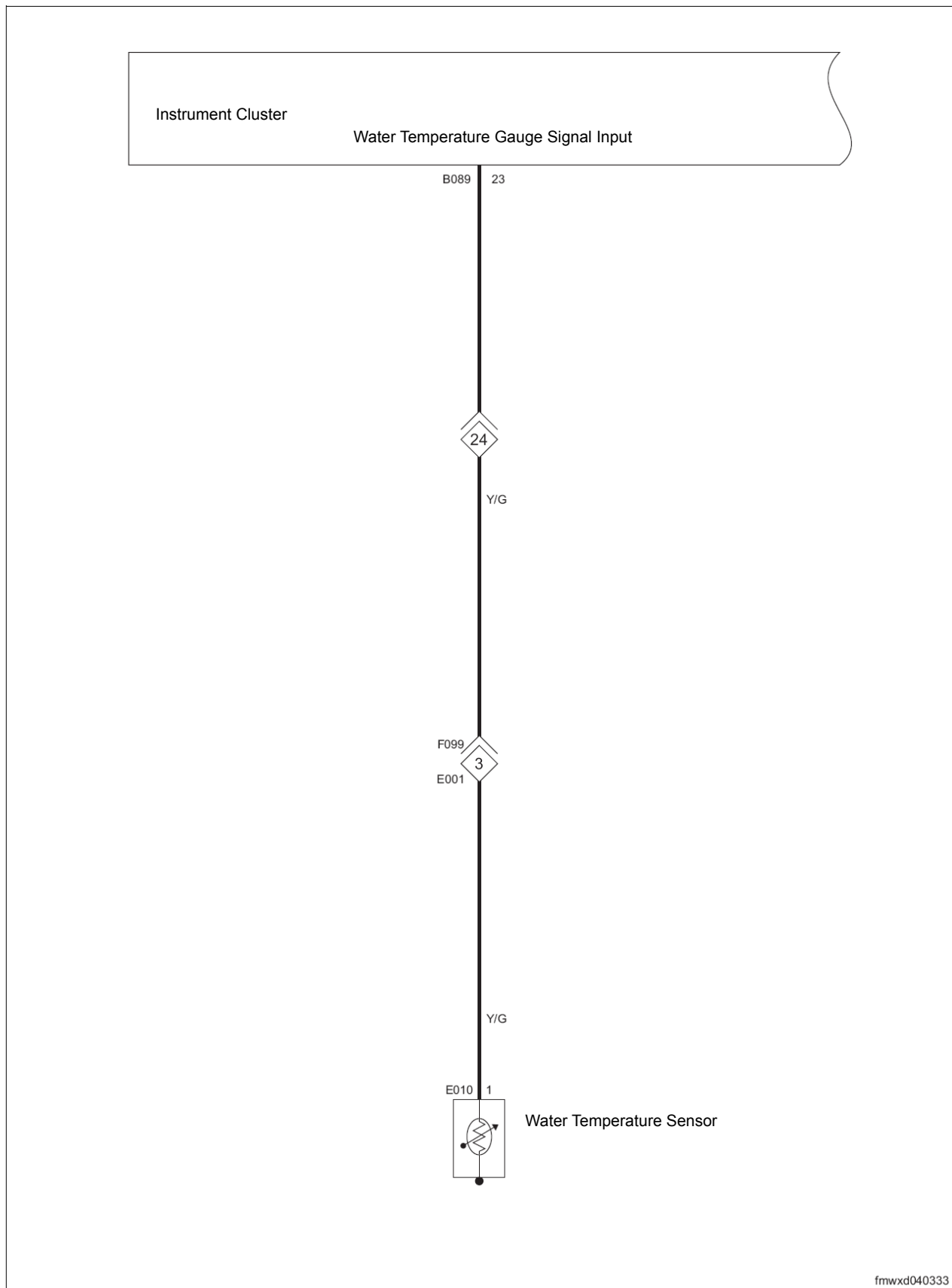
Is the inspection result normal?

Yes > replace instrument cluster

No > repair or replace harness

Water Temperature Gauge Fault

Circuit Diagram

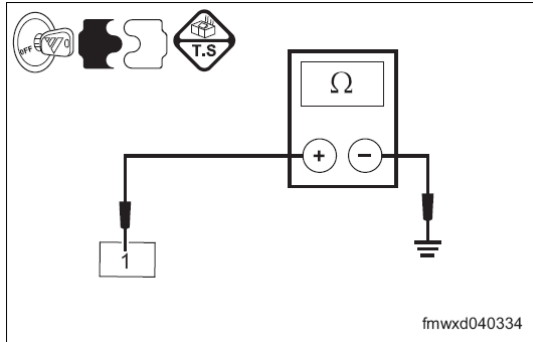


Diagnosis - Instrument cluster**Diagnostic Steps****1. Inspect water temperature sensor**

- (a). Turn off the ignition switch.
- (b). Dismantle water temperature sensor.

Warning:

Dismantle water temperature sensor in the cool engine condition.



Use the multi-meter to measure the resistance between water temperature sensor connector E010 pin 1 and the earth (the resistance varies with water temperature).

Resistance range: $38.5 \pm 4 \sim 287.4 \pm 30 \Omega$

04

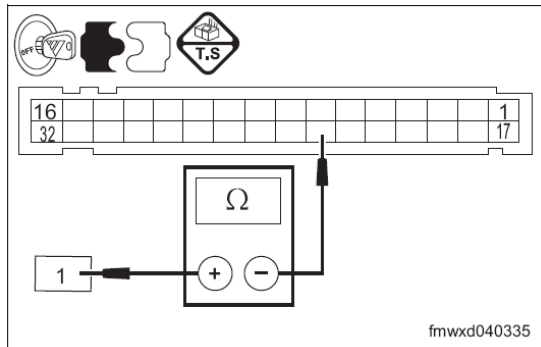
Whether the resistance has changes?

Yes > see Step2

No > replace water temperature sensor

2. Inspect water temperature sensor harness

- (a). Turn off the ignition switch.



- (b). Disconnect instrument cluster connector B089 and water temperature sensor connector E010.
- (c). Use the multi-meter to measure the resistance of the harness between instrument cluster connector B089 pin 23 and water temperature sensor connector E010 pin 1.

Resistance: $\leq 2 \Omega$

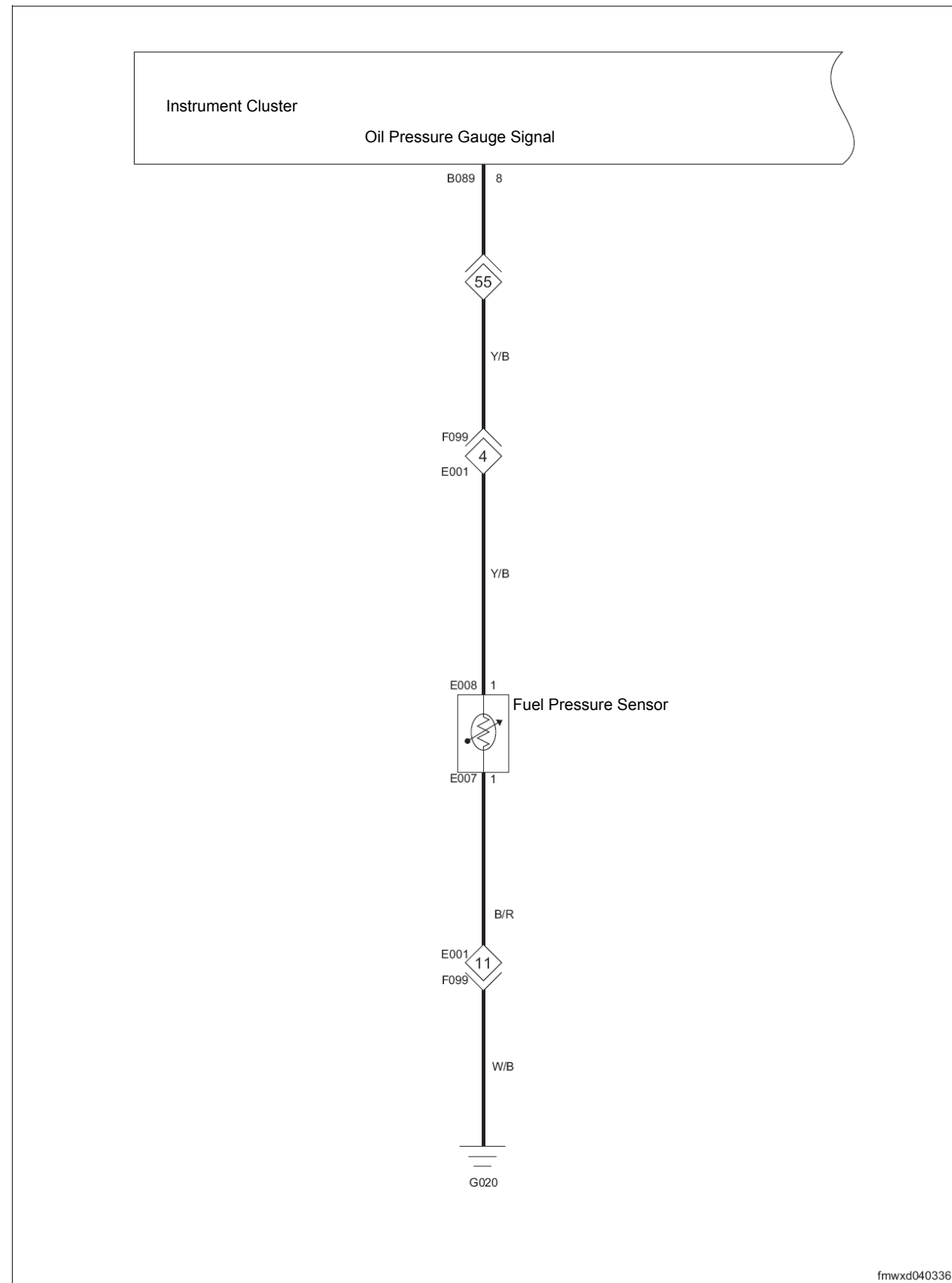
Is the inspection result normal?

Yes > replace instrument cluster

No > repair or replace harness

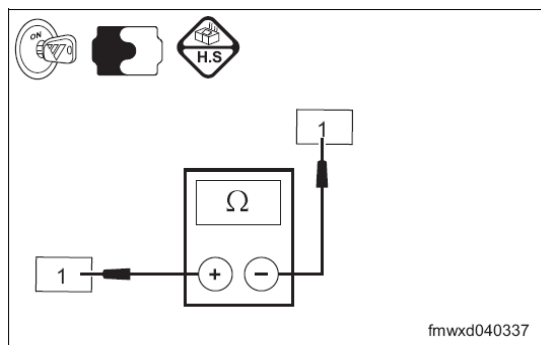
Oil Pressure Gauge Fault

Circuit Diagram



Diagnosis - Instrument cluster**Diagnostic Steps****1. Inspect fuel pressure sensor**

- (a). Start engine and operate engine at idling speed.



- (b). Use the multi-meter to measure the resistance between oil pressure sensor connector E007 pin 1 and E008 pin 1.

Resistance range: $9\pm3 \sim 189\pm15\Omega$

04

Whether the resistance value has changes?

Yes> see Step2

No > replace oil pressure sensor

2. Inspect oil pressure sensor harness

- (a). Use the multi-meter to measure the resistance of the harness between instrument cluster connector B089 pin 8 and oil pressure sensor connector E008 pin 1.
- (b). use the multi-meter to measure the resistance of the harness between oil pressure sensor connector E007 pin 1 and G020.

Resistance: $\leq 2 \Omega$

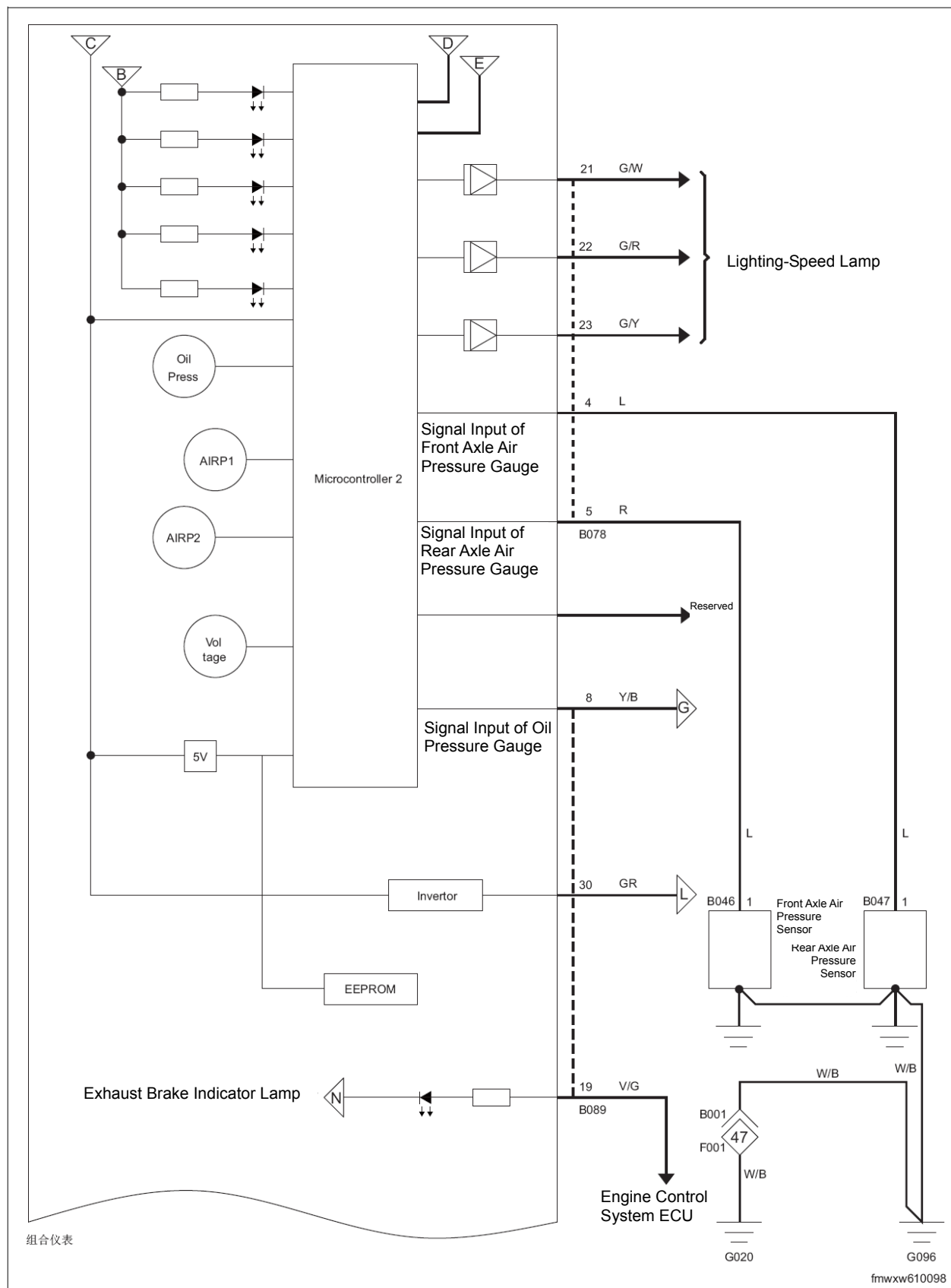
Is the inspection result normal?

Yes > replace instrument cluster

No > repair or replace harness

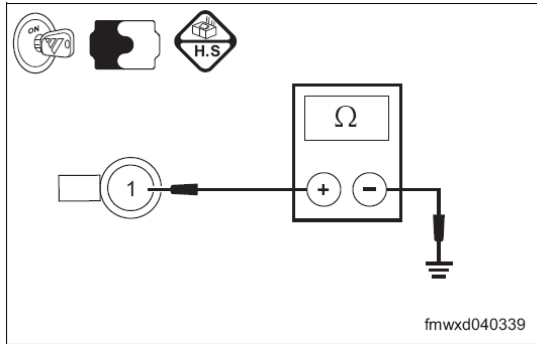
Air Pressure Gauge Fault

Circuit Diagram



Diagnosis - Instrument cluster**Diagnostic Steps****1. Inspect front and rear air pressure sensors**

(a). Start engine and operate the engine at idling speed.



(b). Use the multi-meter to respectively measure the resistance between connector B046 pin 1 of front axle air pressure sensor & connector B047 pin 1 of rear axle air pressure sensor and the earth.

Resistance range: 10 ~ 184Ω

04

Whether the resistance value changes?

Yes> see Step 2

No > replace air pressure sensor

2. Inspect air pressure sensor harness

(a). Use the multi-meter to respectively measure the resistance of the harness between instrument cluster connector B078 pin 4 and air pressure sensor connector B047 pin 1 and between instrument cluster connector B078 pin 5 and air pressure sensor connector B046 pin 1.

(b). Use the multi-meter to measure the resistance of the harness between the air pressure sensor and the earthing points G096 and G020.

Resistance: $\leq 2 \Omega$

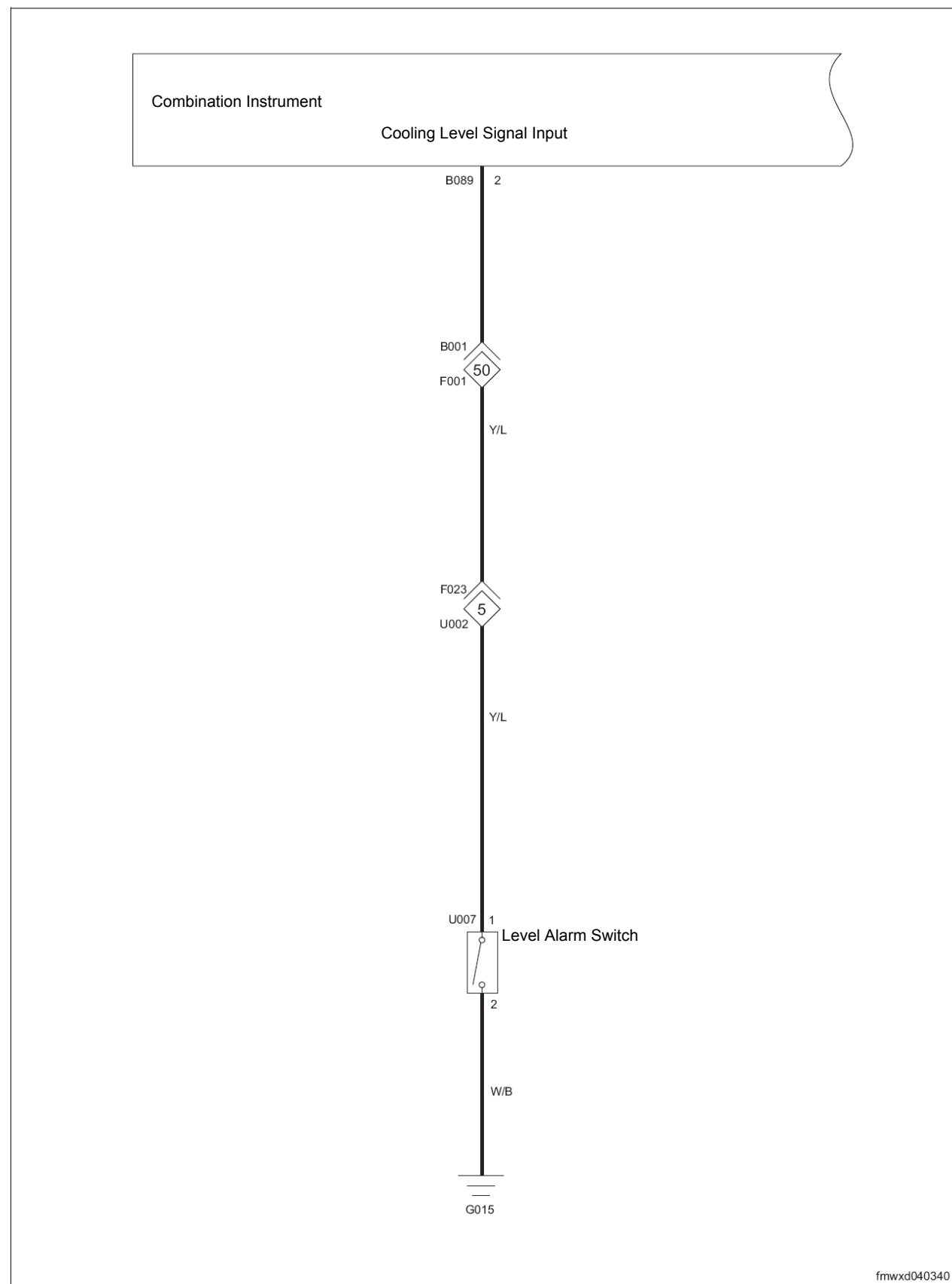
Is the inspection result normal?

Yes > replace instrument cluster

No > repair or replace harness

Cooling Level Indicator ON/OFF

Circuit Diagram



Diagnosis - Instrument cluster**Diagnostic Steps**

- Confirm that the cooling level is within the standard scale.
- Place the ignition switch in "ON" position.

Is the cooling level indicator on?

Yes > (on) see Step 1.

No > (off) see Step 3.

1. Inspect the short circuit of signal circuit in cooling level indicator

- Place the ignition switch in "OFF" position.
- Disconnect the Plug-in U007 in level alarm switch.
- Place the ignition switch in "ON" position.

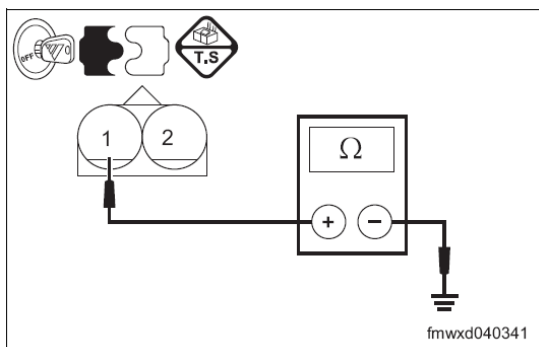
Is the cooling level indicator off?

Yes > replace the level alarm switch

No > see Step 2.

2. Inspect the short circuit of signal circuit in cooling level indicator

- Place the ignition switch in "OFF" position.
- Disconnect the plug-in B089 in instrument cluster.



- Use the multi-meter to measure the resistance between plug-in U007 pin 1 in level alarm switch and earthing.

Resistance: > 10 MΩ

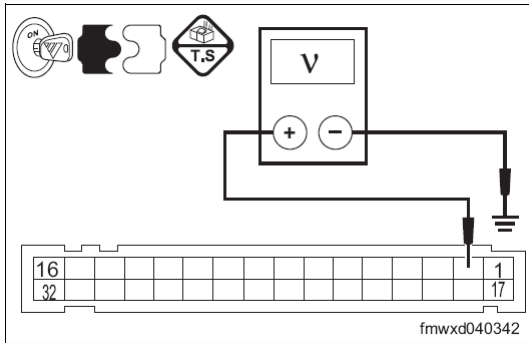
Are the inspection results normal?

Yes > replace the instrument cluster

No > repair or replace the wiring

3. Inspect the signal circuit in cooling level indicator

- Turn off the ignition switch.
- Disconnect the plug-in B089 in instrument cluster.
- Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B089 pin 2 in combination instrument and earthing.

Standard voltage value: battery voltage

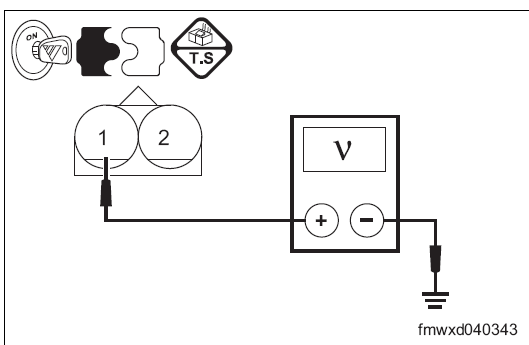
Are the inspection results normal?

Yes > see Step 4.

No > replace the instrument cluster

4. Inspect the open circuit of signal circuit in cooling level indicator

- Turn off the ignition switch.
- Disconnect the Plug-in U007 in level alarm switch.
- Turn on the ignition switch.



- (c). Use the multi-meter to measure the voltage between plug-in U007 pin 1 in level alarm switch and earthing.

Standard voltage value: battery voltage

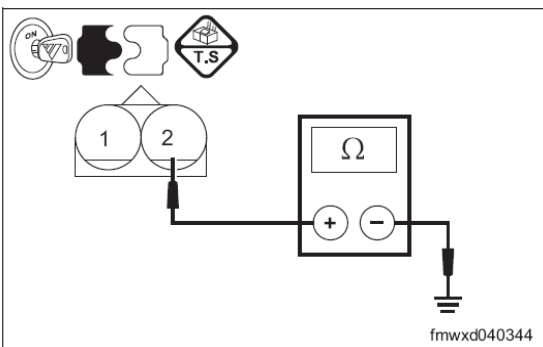
Are the inspection results normal?

Yes > see Step 5.

No > repair or replace the wiring

5. Inspect the earth circuit in cooling level indicator

- Turn off the ignition switch.
- Disconnect the Plug-in U007 in level alarm switch.



- (c). Use the multi-meter to measure the resistance between plug-in U007 pin 2 in level alarm switch and earthing.

Resistance: $\leq 2 \Omega$

Diagnosis - Instrument cluster

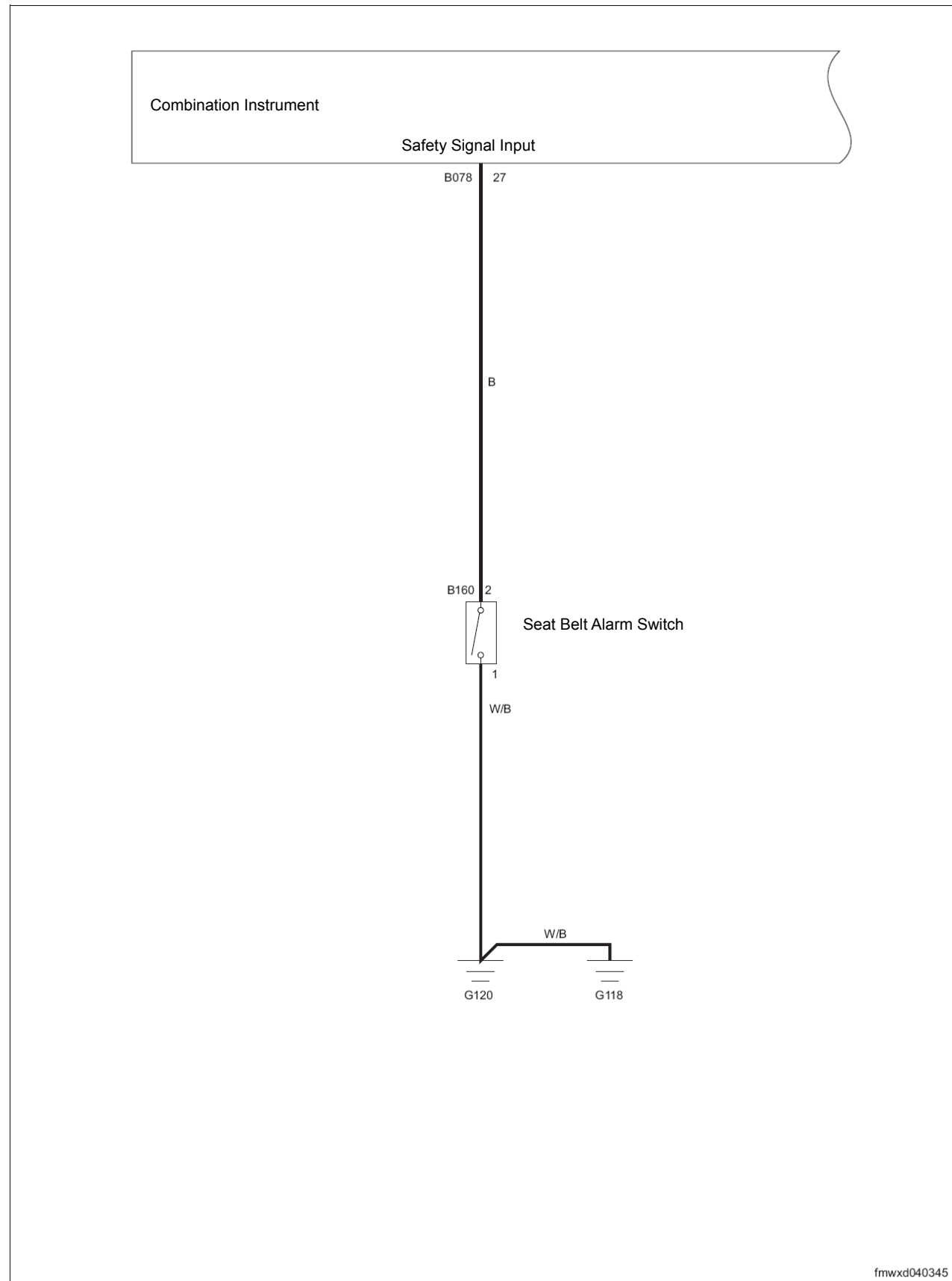
Is the inspection result normal?

Yes > replace the level alarm switch

No > repair or replace the wiring

Seat Belt Indicator ON/OFF

Circuit Diagram



Diagnosis - Instrument cluster**Diagnostic Procedures**

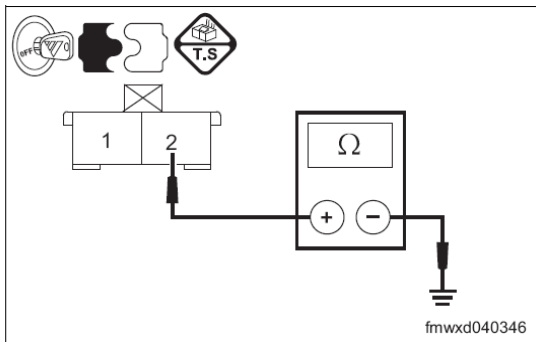
- Turn on the ignition switch. The indicator turns on if driver does not fasten the seat belt.
- Turn off the ignition switch. The indicator turns off if driver fastened the seat belt.

Is the seat belt indicator on?**Yes > (on) see Step 1.****No > (off) see Step 3.****1. Inspect the short circuit of signal circuit in seat belt indicator**

- Turn off the ignition switch.
- Disconnect the plug-in B160 in seat belt alarm switch.
- Turn on the ignition switch.

Is the seat belt indicator off?**Yes > replace the seat belt alarm switch****No > see Step 2.****2. Inspect the short circuit of signal circuit in seat belt indicator**

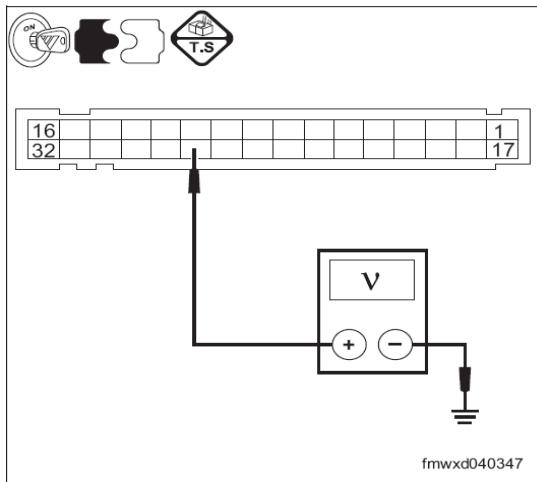
- Turn off the ignition switch.
- Disconnect the plug-in B078 in instrument cluster.



- Use the multi-meter to measure the resistance between plug-in B160 pin 2 in seat belt alarm switch and earthing.

Resistance: > 10 MΩ**Is the inspection result normal?****Yes > replace the instrument cluster****No > repair or replace the wiring****3. Inspect the signal circuit in seat belt indicator**

- Turn off the ignition switch.
- Disconnect the plug-in B078 in instrument cluster.
- Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B078 pin 27 in combination instrument and earthing.

Standard voltage value: battery voltage

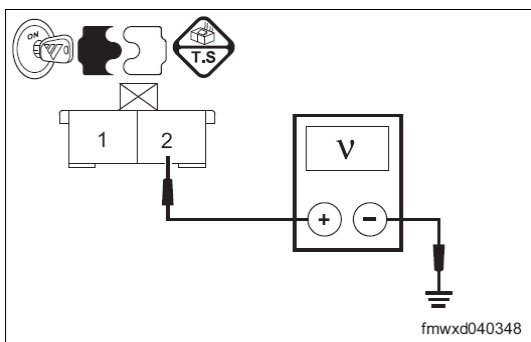
Are the inspection results normal?

Yes > see Step 4.

No > replace the instrument cluster

4. Inspect the open circuit of signal circuit in seat belt indicator

- (a). Turn off the ignition switch.
- (b). Disconnect the plug-in B160 in seat belt alarm switch.
- (c). Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B160 pin 2 in seat belt alarm switch and earthing.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > see Step 5.

No > repair or replace the wiring

Is the inspection result normal?

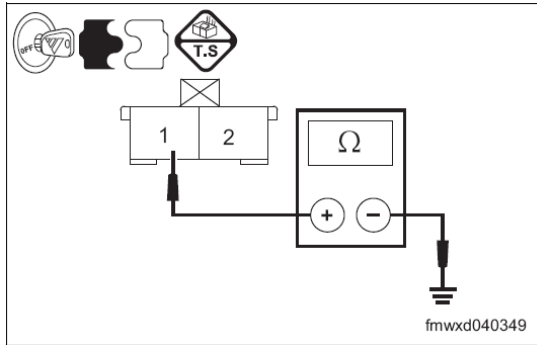
Yes > see Step 5.

No > repair or replace the wiring

5. Inspect the earth circuit in seat belt indicator

- (a). Turn off the ignition switch.
- (b). Disconnect the plug-in B160 in seat belt alarm switch.

Diagnosis - Instrument cluster



- (c). Use the multi-meter to measure the resistance between plug-in B160 pin 1 in seat belt alarm switch and earthing.

Resistance: $\leq 2 \Omega$

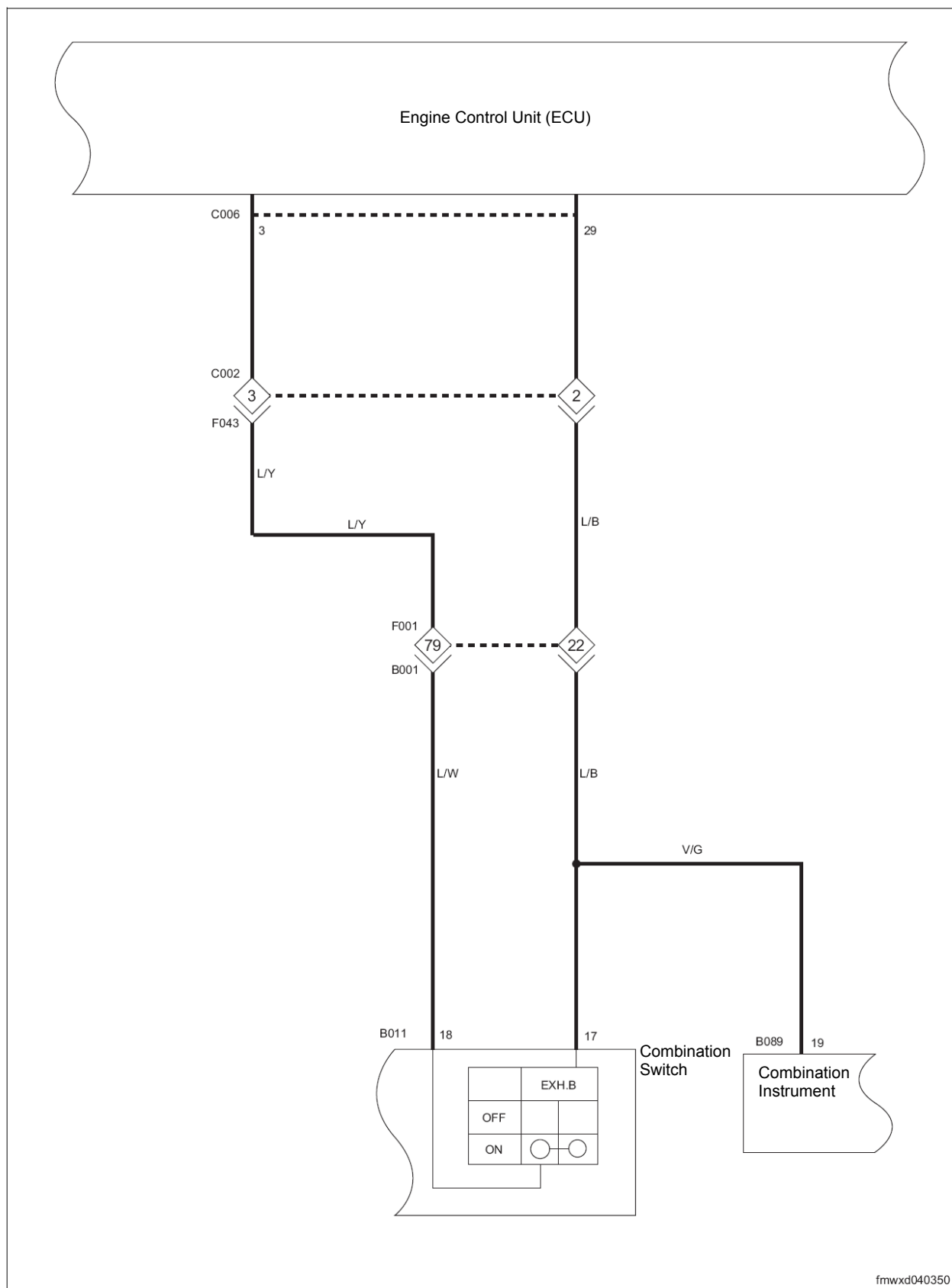
Is the inspection result normal?

Yes > replace the seat belt alarm switch

No > repair or replace the wiring

Exhaust Brake Indicator ON/OFF

Circuit Diagram



Diagnosis - Instrument cluster**Diagnostic Procedures**

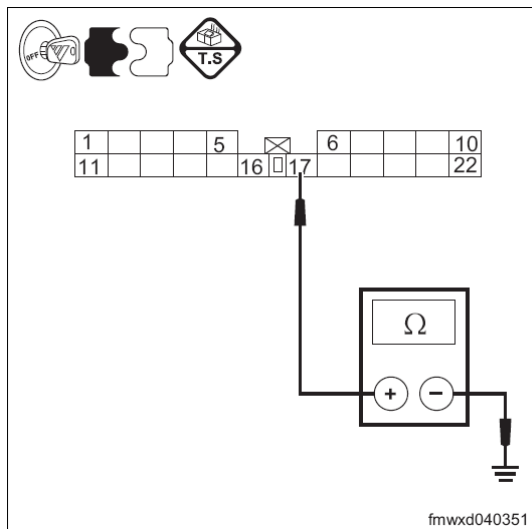
- Start the engine.
- Toggle back and forth the exhaust brake switch.

Is the exhaust brake indicator on?**Yes > (on) see Step 1.****No > (off) see Step 3.****1. Inspect the short circuit of signal circuit in exhaust brake indicator**

- Turn off the ignition switch.
- Disconnect the plug-in B011 in combination switch.
- Turn on the ignition switch.

Is the exhaust brake indicator off?**Yes > replace the combination switch****No > see Step 2.****2. Inspect the short circuit of signal circuit in exhaust brake indicator**

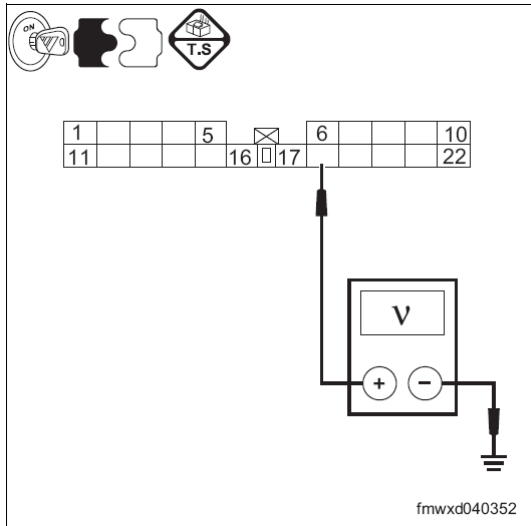
- Turn off the ignition switch.
- Disconnect the plug-in B089 in instrument cluster.



- Use the multi-meter to measure the resistance between plug-in B011 pin 17 in combination switch and earthing.

Resistance: > 10 M Ω **Are the inspection results normal?****Yes > replace the instrument cluster****No > repair or replace the wiring****3. Inspect the signal circuit in exhaust brake indicator**

- Turn off the ignition switch.
- Disconnect the plug-in B011 in combination switch.
- Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B011 pin 18 in combination switch and earthing.

Standard voltage value: battery voltage

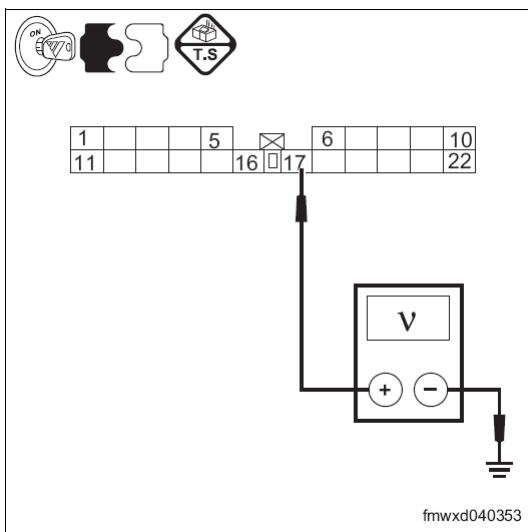
Are the inspection results normal?

Yes > see Step 4.

No > repair or replace the wiring

4. Inspect the open circuit of signal circuit in exhaust brake indicator

- (a). Turn on the exhaust brake switch.



- (b). Use the multi-meter to measure the voltage between plug-in B011 pin 17 in combination switch and earthing.

Standard voltage value: battery voltage

Is the inspection result normal?

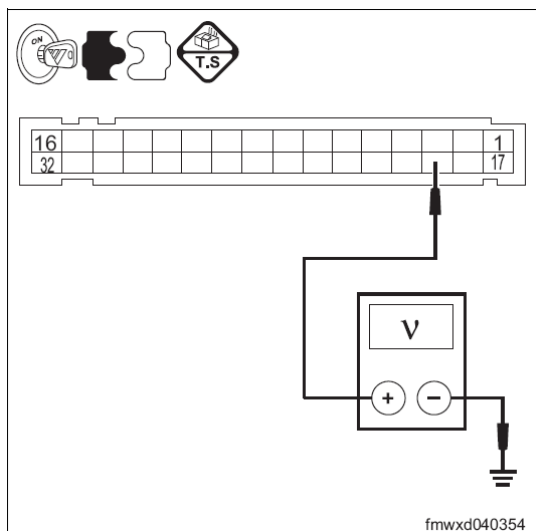
Yes > see Step 5.

No > replace the combination switch

5. Inspect the earth circuit in exhaust brake indicator

- (a). Turn off the ignition switch.
 (b). Disconnect the plug-in B089 in instrument cluster.
 (c). Turn on the ignition switch.

Diagnosis - Instrument cluster



- (d). Use the multi-meter to measure the voltage between plug-in B089 pin 19 in combination instrument and earthing.

Standard voltage value: battery voltage

Is the inspection result normal?

Yes > replace the instrument cluster

No > repair or replace the wiring

Legend:

- 13 B/W
- 14 W
- 16 B/Y
- 19 B/L
- 17 B/L
- 20 P
- 18 L/B
- 13 Y/B
- 16 W/R
- 26 R/W

Indicators and Switches:

- Inter-axle Differential Indicator
- Inter-wheel Differential Indicator
- Wheelhouse Locked Alarm Indicator
- Low Gear Indicator
- ABS Indicator in Main Vehicle
- ABS Indicator in Trailer
- Air filter clogging alarm indicator
- Power Take-off Indicator
- Hand Brake Indicator
- Rearview Mirror Heating Indicator
- Charging Indicator
- Brake Wear Alarm Indicator
- Parking Indicator Switch

Wiring Details:

- Inter-axle Differential Indicator:** Connected to wire 13 (B/W).
- Inter-wheel Differential Indicator:** Connected to wire 14 (W).
- Wheelhouse Locked Alarm Indicator:** Connected to wire 16 (B/Y).
- Low Gear Indicator:** Connected to wire 19 (B/L).
- ABS Indicator in Main Vehicle:** Connected to wire 17 (B/L).
- ABS Indicator in Trailer:** Connected to wire 20 (P).
- Air filter clogging alarm indicator:** Connected to wire 18 (L/B).
- Power Take-off Indicator:** Connected to wire 13 (Y/B).
- Hand Brake Indicator:** Connected to wire 16 (W/R).
- Rearview Mirror Heating Indicator:** Connected to wire 26 (R/W).
- Charging Indicator:** Connected to wire 26 (R/W).
- Brake Wear Alarm Indicator:** Connected to wire 26 (R/W).
- Parking Indicator Switch:** Connected to wire 16 (W/R).

Component Connections:

- Charging System:** Connected to wire 26 (R/W) and wire 13 (Y/B).
- Air Filter:** Connected to wire 18 (L/B) and wire 13 (Y/B).
- ABS System:** Connected to wire 17 (B/L) and wire 20 (P).
- Power Take-off Indicator:** Connected to wire 13 (Y/B).
- Hand Brake Indicator:** Connected to wire 16 (W/R).
- Rearview Mirror Heating Indicator:** Connected to wire 26 (R/W).
- Charging Indicator:** Connected to wire 26 (R/W).
- Brake Wear Alarm Indicator:** Connected to wire 26 (R/W).
- Parking Indicator Switch:** Connected to wire 16 (W/R).

Combination Instrument

fmwxw610095

Diagnostic Procedures

- Turn on the ignition switch. The indicator turns on when the hand brake is pulled.
- Turn on the ignition switch. The indicator turns off when the hand brake is released.

Hint:

Abnormal pressure in braking system will lead to the malfunction of parking brake indicator. In case of abnormal pressure in braking system, fault in brake air circuit shall be dealt first.

Is the parking brake indicator is on?

Yes > (on) see Step 1.

No > (off) see Step 3.

04

1. Inspect the short circuit of signal circuit in parking brake indicator

- Turn off the ignition switch.
- Pull down the hand brake.

Warning:

Four shim blocks shall be placed in way of four wheels before the hand brake is pulled to avoid vehicle slipping.

- Disconnect the plug-in B054 in parking brake indicator.
- Turn on the ignition switch.

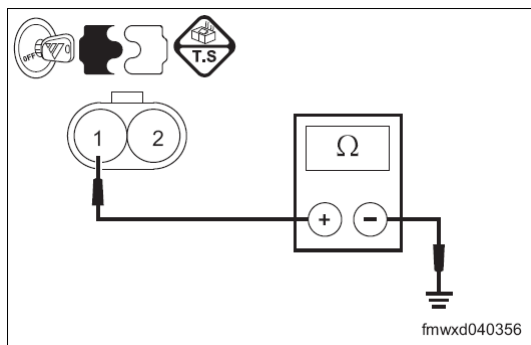
Is the parking brake indicator off?

Yes > replace the parking brake indicator switch.

No > see Step 2.

2. Inspect the short circuit of signal circuit in parking brake indicator

- Turn off the ignition switch.
- Disconnect the plug-in B089 in instrument cluster.



- Use the multi-meter to measure the resistance between plug-in B054 pin 1 in parking brake indicator switch and earthing.

Resistance: > 10 MΩ

Is the inspection result normal?

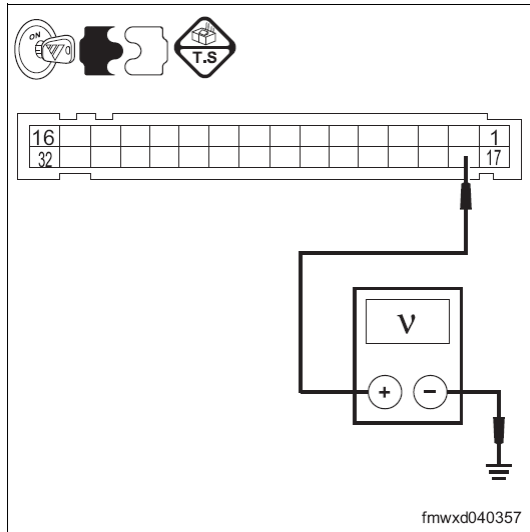
Yes > replace the instrument cluster

No > repair or replace the wiring

3. Inspect the signal circuit in parking brake indicator

- Turn off the ignition switch.

- (b). Disconnect the plug-in B089 in instrument cluster.
 (c). Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B089 pin 18 in combination instrument and earthing.

Standard voltage value: battery voltage

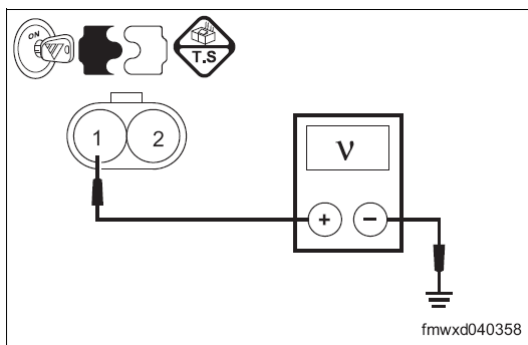
Are the inspection results normal?

Yes > see Step 4.

No > replace the instrument cluster

4. Inspect the open circuit of signal circuit in parking brake indicator

- (a). Turn off the ignition switch.
 (b). Disconnect the plug-in B054 in parking brake indicator.
 (c). Turn on the ignition switch.



- (d). Use the multi-meter to measure the voltage between plug-in B054 pin 1 in parking brake indicator switch and earthing.

Standard voltage value: battery voltage

Is the inspection result normal?

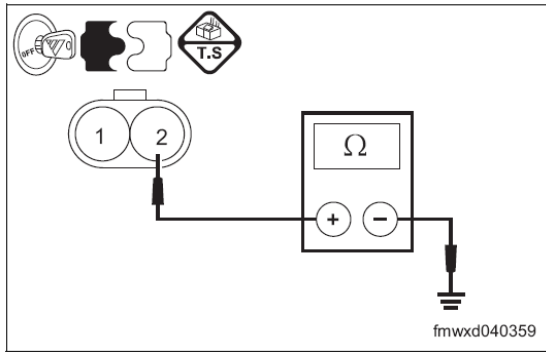
Yes > see Step 5.

No > repair or replace the wiring

5. Inspect the earth circuit in parking brake indicator

- (a). Turn off the ignition switch.
 (b). Disconnect the plug-in B054 in parking brake indicator.

Diagnosis - Instrument cluster



- (c). Use the multi-meter to measure the resistance between plug-in B054 pin 2 in parking brake indicator switch and earthing.

Resistance: $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace the parking brake indicator switch.

No > repair or replace the wiring

Air Filter Clogging Warning lamp is Normally On or Off

Circuit Diagram

Refer to this chapter, "Parking Brake Lamp is Normally On or Off---Circuit Diagram."

Diagnostic Steps

- Inspect whether the air filter is heavily soiled. If it is, replace it with a new one.
- Inspect whether intake resistance of intake system is excessive. If it is, this fault shall be corrected first.
- Start the engine.

Is the air filter clogging warning lamp is Normally on?

Yes > (normally on) see Step 1.

No > (normally off) see Step 3.

1. Inspect whether air filter clogging warning lamp is short-circuited.

- Turn off ignition switch
- Disconnect switch connector U004 and U005 of air filter clogging warning lamp
- Turn on ignition switch

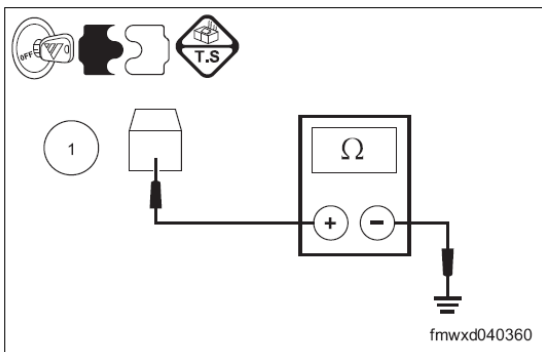
Is the air filter clogging warning lamp off?

Yes > replace air filter clogging warning lamp switch.

No > see Step 2.

2. Inspect whether parking brake lamp is short-circuited.

- Turn off ignition switch
- Disconnect connector B078 of instrument cluster.



- Use multi-meter to measure the resistance between earth and pin1 of switch connector U004 of air filter clogging alarm lamp.

Resistance > 10 MΩ

Is the inspection result normal?

Yes > replace instrument cluster.

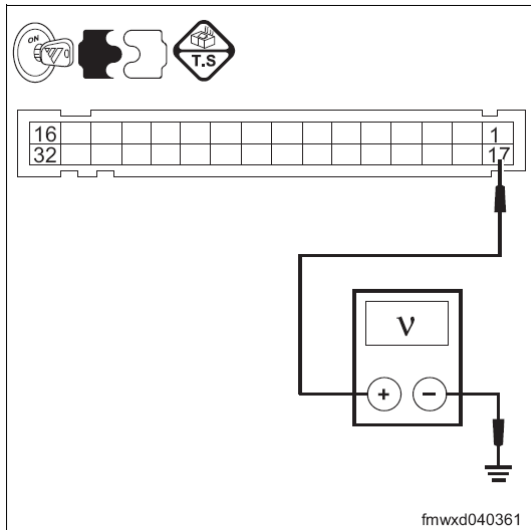
No > overhaul or replace harness.

3. Inspect signal circuit of air filter clogging warning lamp.

- Turn off ignition switch

Diagnosis - Instrument cluster

- (b). Disconnect connector B078 of instrument cluster.
- (c). Turn on ignition switch



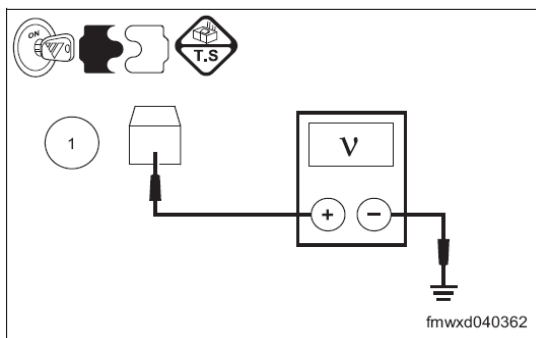
Is the inspection result normal?

Yes > see Step 4.

No > replace instrument cluster.

4. Inspect whether signal circuit of air filter clogging warning lamp is open?

- (a). Turn off ignition switch
- (b). Disconnect switch connector U004 of air filter clogging warning lamp
- (c). Turn on ignition switch



- (d). Use multi-meter to measure the voltage between earth and pin1 of switch connector U004 of air filter clogging alarm lamp.

Standard voltage value: battery voltage

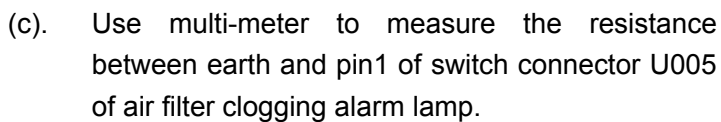
Is the inspection result normal?

Yes > see Step five.

No > overhaul or replace harness.

5. Inspect earth circuit of air filter clogging warning lamp.

- (a). Turn off ignition switch
- (b). Disconnect switch connector U005 of air filter clogging warning lamp



Resistance $\leq 2 \Omega$

Yes > replace air filter clogging warning lamp switch.

No > overhaul or replace harness.

Cab locking warning lamp normally on or off

Circuit diagram

Refer to this chapter, "Parking Brake Lamp Normally on or Off---Circuit Diagram."

Diagnostic Steps

- Turn on ignition switch and prop up cab; this lamp is on.
- Turn on ignition switch and drop cab; this lamp is off.

Is the cab locking warning lamp is normally on?

Yes > (normally on) see Step 1.

No > (normally off) see Step 3.

1. Inspect whether signal circuit of cab locking warning lamp is shorted.

- Turn off ignition switch
- Prop up cab.
- Disconnect connector U006 of CAB locking switch.
- Turn on ignition switch

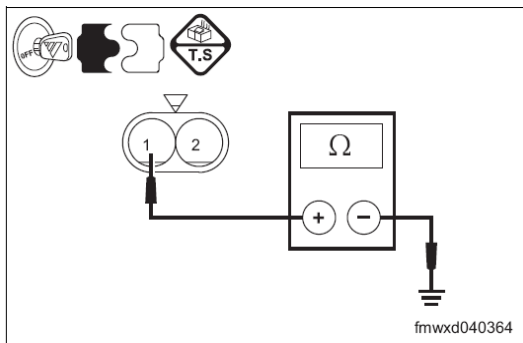
Is the cab locking warning lamp off?

Yes > replace CAB locking switch.

No > see Step 2.

2. Inspect whether signal circuit of cab locking warning lamp is shorted.

- Turn off ignition switch
- Disconnect connector B078 of instrument cluster.



- Use multi-meter to measure the resistance between earth and pin1 of connector U006 of CAB locking switch

Resistance > 10 MΩ

Is the inspection result normal?

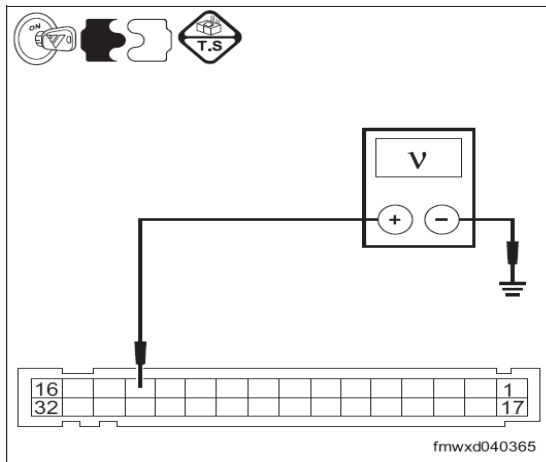
Yes > replace instrument cluster.

No > overhaul or replace harness.

3. Inspect signal circuit of cab locking warning lamp.

- Turn off ignition switch

- (b). Disconnect connector B078 of instrument cluster.
- (c). Turn on ignition switch



- (d). Use multi-meter to measure the voltage between earth and pin13 of connector B078 of combination instrument.

Standard voltage value: battery voltage

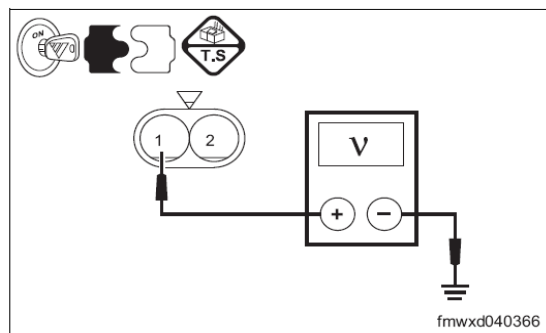
Is the inspection result normal?

Yes > see Step 4.

No > replace instrument cluster.

4. Inspect whether signal circuit of cab locking warning lamp is open.

- (a). Turn off ignition switch
- (b). Disconnect connector U006 of CAB locking switch.
- (c). Turn on ignition switch



- (d). Use multi-meter to measure the voltage between earth and pin1 of connector U006 of CAB locking switch

Standard voltage value: battery voltage

Is the inspection result normal?

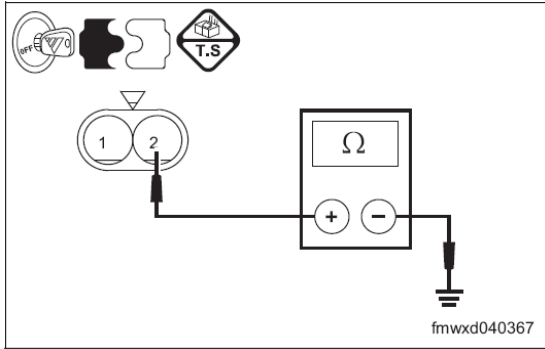
Yes > see Step five.

No > overhaul or replace harness.

5. Inspect earth circuit of cab locking warning lamp.

- (a). Turn off ignition switch
- (b). Disconnect connector U006 of CAB locking switch.

Diagnosis - Instrument cluster



- (c). Use multi-meter to measure the resistance between earth and pin2 of connector U006 of CAB locking switch

Resistance $\leq 2 \Omega$

Is the inspection result normal?

Yes > replace CAB locking switch.

No > overhaul or replace harness.

Cigarette Lighter

Precautions

1. Cut off the power

- (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.

Hint:

Before disconnecting negative cable of the battery, do not leave vehicle key in the vehicle for fear that the vehicle door is locked.

- (b). Turn off the ignition switch, unless otherwise specified.

2. Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, and the clock will be reset.

Hint:

The odometer will not be reset.

3. Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.

Hint:

The audio system must be reset after reconnection of the negative cable of the battery.

4. Inspect after-sale installed devices which may affect cigarette lighter.

5. When using it, press down cigarette lighter and it will get heated within fifteen seconds. When heated well, cigarette lighter will automatically withdraw to its original position.

- (a). When pressing down cigarette lighter, you must not grab it, but press its knob with your finger so as to avoid getting burned.
- (b). If cigarette lighter does not withdraw to its original position after eighteen seconds, there must be some fault and cigarette lighter knob needs pressing down again so as to withdraw.
- (c). When cigarette lighter withdraws, do not leave the vehicle to prevent fire hazard.
- (d). If cigarette lighter can not withdraw due to deformation, please replace it with authentic cigarette lighter part.

Diagnosis - Cigarette Lighter**Basic Inspection**

Steps	Inspection		Solutions
1	Inspect Battery Voltage • Battery voltage shall not be lower than 22 V. Is the result normal?	Yes	See Step 2.
		No.	Charge or replace battery. Refer to Chapter 53, "Battery-battery"
2	Inspect Cigarette Lighter • Turn on ignition switch • Press down cigarette lighter; it will get heated and pop out within fifteen seconds. Is the result normal?	Yes	System functions normally.
		No.	See Fault Symptom Table

Fault Symptom Table

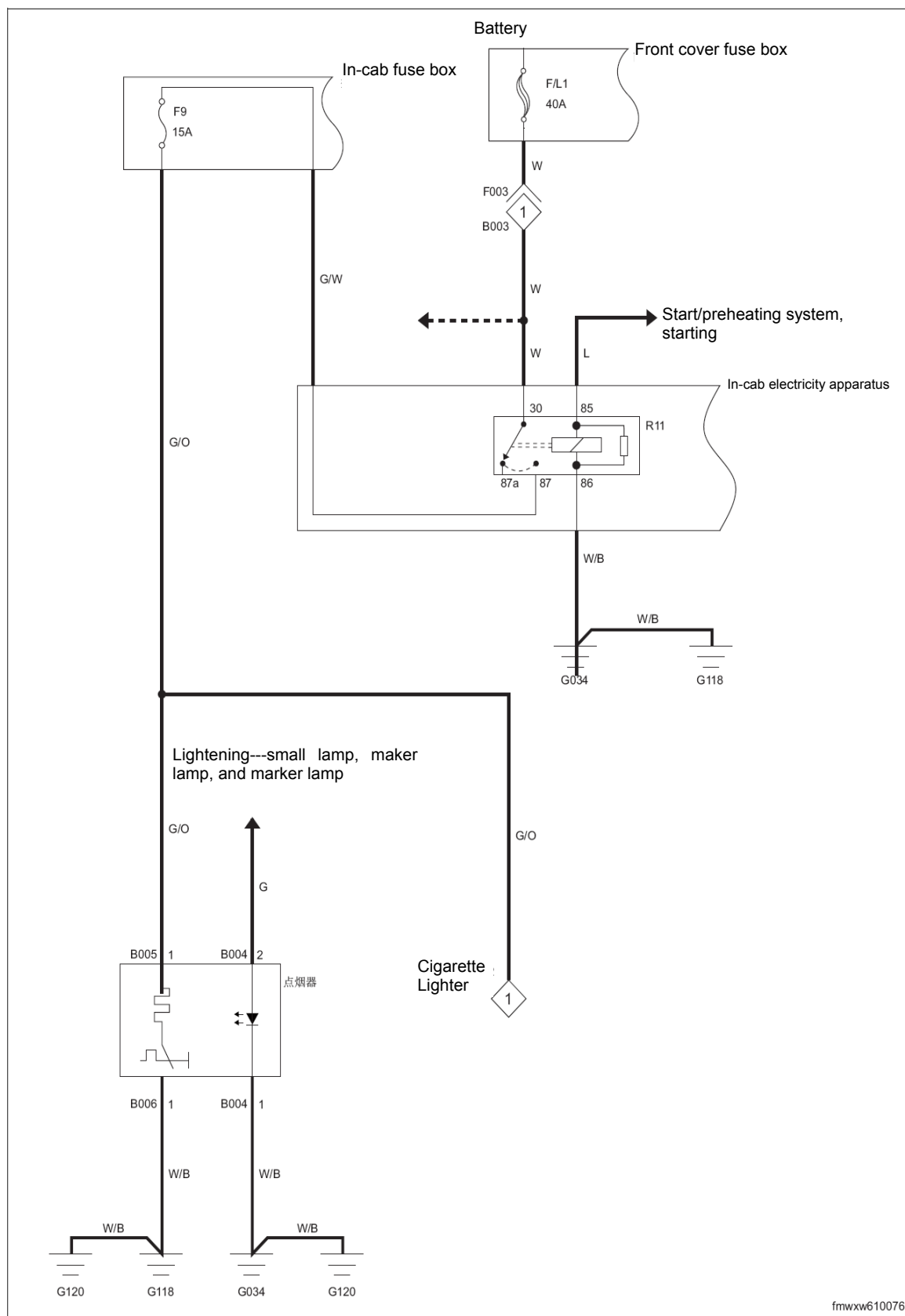
The following table will help you find the cause of faults. Serial number represents the possible sequence of the cause for faults. Inspect every part in accordance with this sequence and replace the part if necessary.

Fault Symptom	Possible Position	Reference
Cigarette lighter does not work.	1. Fuse (damaged)	Replace fuse
	2. Cigarette Lighter (damaged)	Chapter4: Diagnosis of cigarette lighter, cigarette lighter does not work.
	3. Harness(shorted or shorted to earth)	Replace harness
1. Cigarette lighter (deformed)	1. Cigarette Lighter (deformed)	Chapter73: Instrument Panel, Instrument, Cigarette Lighter--- Replacement of Cigarette Lighter
	2. Cigarette Lighter Seat (damaged)	Chapter73: Instrument Panel, Instrument, Cigarette Lighter--- Replacement of Cigarette Lighter
Cigarette lighter lamp is off.	1. Fuse, Harness	Replace fuse and harness
	2. Lamp Combination Switch	Chapter4: Diagnosis---Lighting--- Cigarette lighter lamp is off
	3. Cigarette Lighter Lamp	Chapter4: Diagnosis---Lighting--- Cigarette lighter lamp is off

Diagnosis - Cigarette Lighter

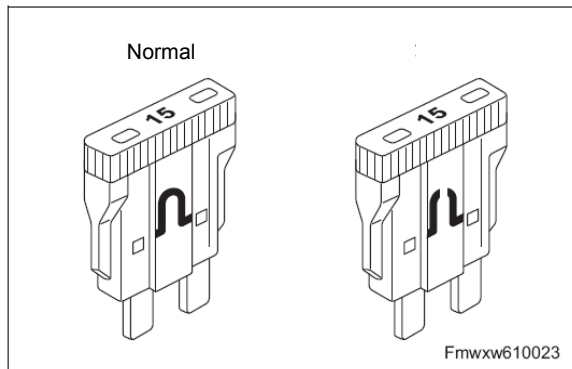
Cigarette Lighter Fails to Work

Circuit diagram

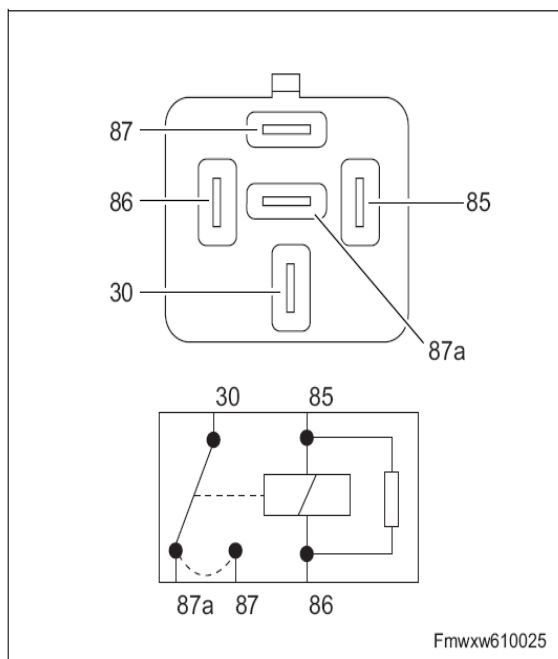


Diagnostic Steps**1. Inspect fuse F9**

(a) Turn off ignition switch



(b). Inspect fuse F9 (15A) in cab fuse box

Is the inspection result normal?**Yes > see Step 2.****No > overhaul fuse circuit and replace rated capacity fuse.****2. Inspect relay R11 of cigarette lighter**

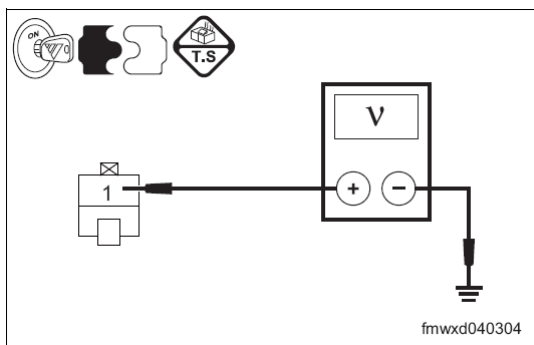
(a). Inspect relay R11 in cab relay box

Nominal Value

Switch Position	Connect Multi-meter to Pins	Nominal Value
Stable	85-86	Breakover
Apply power supply voltage between pin85 and pin86	30-87	Breakover
Stable	.	Breakover

Is the inspection result normal?**Yes > see Step 3.****No > replace cigarette lighter relay.****3. Inspect power circuit of cigarette lighter**

Diagnosis - Cigarette Lighter



- (a). Disconnect connector B005 of cigarette lighter and turn on ignition switch
- (b). Use multi-meter to measure the voltage between earth and pin1 of connector B005 of cigarette lighter.

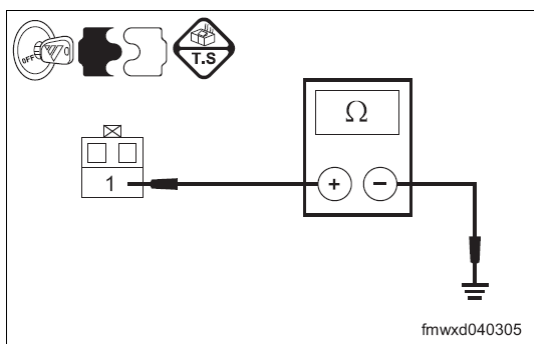
Standard voltage value: battery voltage

Is the inspection result normal?

Yes > see Step 4.

No > overhaul or replace harness.

4. Inspect earth circuit of cigarette lighter



- (a). Disconnect connector B006 of cigarette lighter and turn off ignition switch
- (b). Use multi-meter to measure the resistance between earth G118 and pin1 of connector B006 of cigarette lighter.

Resistance ≤ 2 Ω

Is the inspection result normal?

Yes > replace cigarette lighter.

No > overhaul or replace harness 7.

Fuel (WP10)

- Fuel System 11A-3**
 - General11A-3
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 - Testing & Adjustment.....11A-14
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 - Replacement.....11A-24
- Fuel Injector Sleeve..... 11A-26**
 - Replacement.....11A-26

11A

Fuel System

General

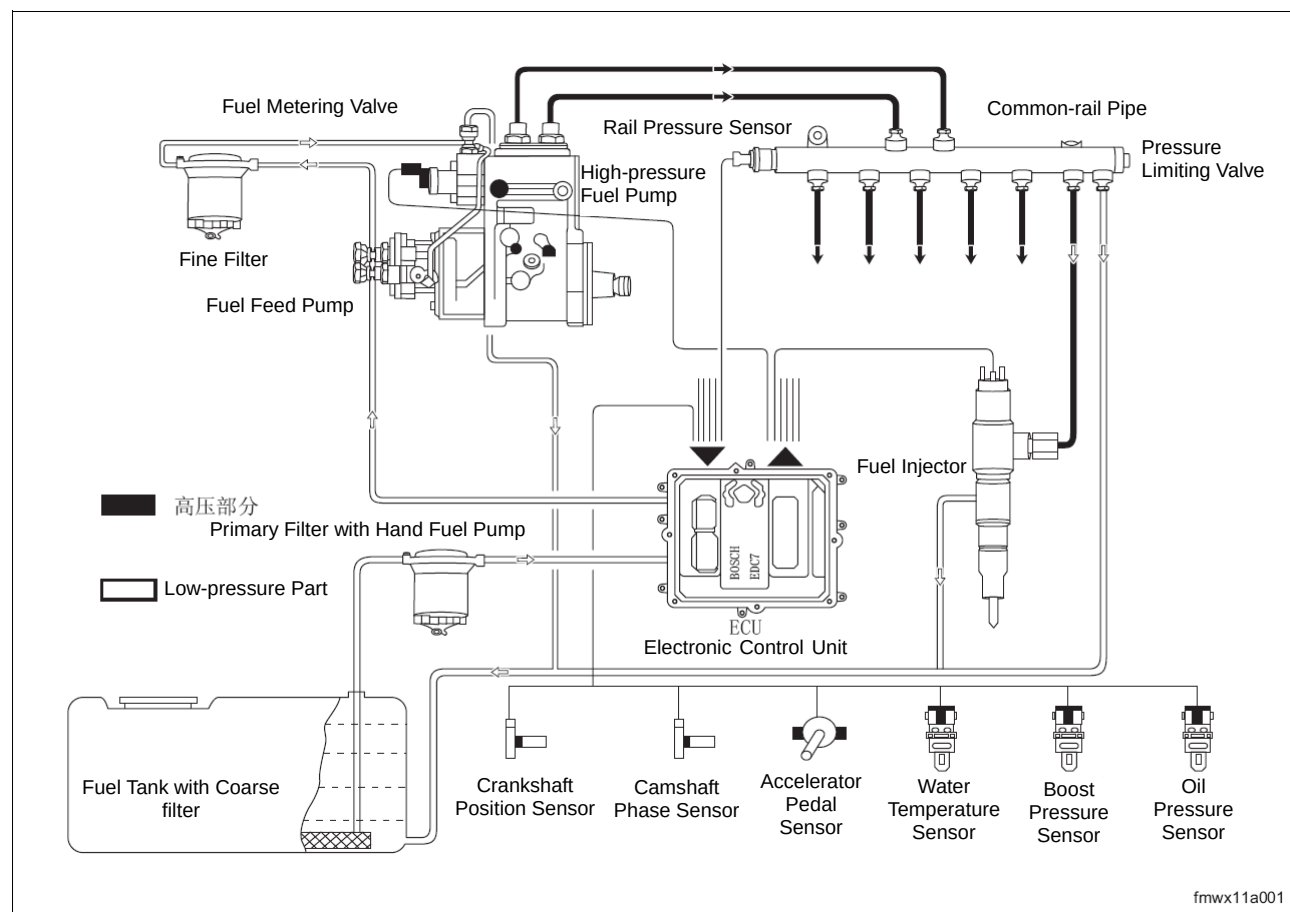
The parameters of the traditional mechanical fuel injection system (injection timing, injection quantity and injection pressure) are controlled by mechanical means. For example, the fuel injection quantity is controlled by a fuel supply gear rack in a fuel injection pump, and the injection timing is controlled by a mechanical timing device, i.e. the fuel injection is controlled by an adjusting device in advance. Therefore, the control range and accuracy are limited. The injection pressure is generated due to the rise of an injection pump plunger, the starting time of the fuel injector is also caused by the rise of the injection pressure, therefore, the control of the fuel injection time is inaccurate, and apparently, according to the needs of a diesel engine, pre-injection and regular repeated injection are even impossible to achieve.

The ECU computer-controlled high-pressure common-rail fuel injection system has the following unique advantages:

1. **Generation of injection pressure is independent of engine speed, and the injection process is relatively independent, which can guarantee the stability of injection pressure.**
2. **Commencement of injection and fuel injection quantity are controlled completely separately, so random accurate control of injection timing can be achieved.**
3. **Multiple injection of pre-injection, main injection and compensation injection can be achieved, which is entirely determined by the performance and emission requirements of the diesel engine. In other words, according to the different requirements of diesel engine performance, the fuel injection process can be accurately controlled.**
4. **The fuel injection system has sensitive response and can achieve injection control of a variety of speed ranges.**
5. **The accuracy of the fuel injection quantity is higher, and the minimum steady injection quantity is $1\text{mm}^3/\text{time}$.**
6. **The injection pressure is increased (from currently 160Mpa to 180Mpa), so the atomization effect is improved, fuel and air are fully mixed, and the emissions and noise are reduced.**
7. **The driving torque peak value of the fuel pump is smaller, which reduces the driving power and noise.**
8. **The high-pressure common-rail system can replace the traditional fuel injection system in case that the major structural of the diesel engine is unchanged, thereby speeding up the upgrading and improvement of the diesel engine.**

In short, the old mechanical pump is controlled by mechanical means, so the control accuracy, response speed and sensitivity are relatively rough. The high-pressure common-rail fuel system is controlled by a computer, so the control accuracy, response speed and sensitivity of controlling changes are very accurate.

Fuel (WP10) – Fuel System



Seen from the drawing, the high-pressure common-rail fuel injection system basically consists of a low-pressure fuel line, a high-pressure fuel line, an information acquisition part and a control and actuating member, wherein the low-pressure fuel line consists of a fuel tank, a primary fuel filter with a hand fuel pump, a low-pressure fuel supply pump and a fuel fine filter; the high-pressure fuel line consists of a high-pressure fuel pump, a common-rail pipe and a fuel injector; the information acquisition part consists of a crankshaft position sensor, a camshaft phase sensor, an accelerator pedal sensor, a water temperature sensor, a boost pressure and temperature sensor, an oil pressure sensor and other sensors; and the control and actuating member consists of a central processing unit (ECU), a fuel metering valve, a fuel injector solenoid valve, etc. The system also provides a fuel return line, and surplus fuel passing through the high-pressure fuel pump and the fuel injector, and the fuel effluent from a pressure limiting valve after the common-rail pressure exceeds the limited pressure flows back to the fuel tank from the fuel return pipe.

Fuel (WP10) – Fuel System

Information Acquisition Content	To	Control Unit	To	Control and Actuating Content
Accelerator Pedal Position Sensor				Fuel Injection Time
Crankshaft Position Sensor				Fuel Injection Pressure
Camshaft Phase Sensor				Number of Times of Fuel Injection
Common-rail Pressure Sensor				Fuel Injection Quantity
Boost Pressure and Temperature Sensor		(ECU)		Common-rail Pressure
Water Temperature Sensor				Cold Start
Oil Pressure and Temperature Sensor				Start Control
Vehicle Speed Sensor				Air Conditioning Acceleration Control
Information Acquisition Content		Control Unit		Control and Actuating Content
Air Conditioning Sensor (Air Conditioning Switch)				
Start Signal Sensor (Neutral Position Switch)				

11A

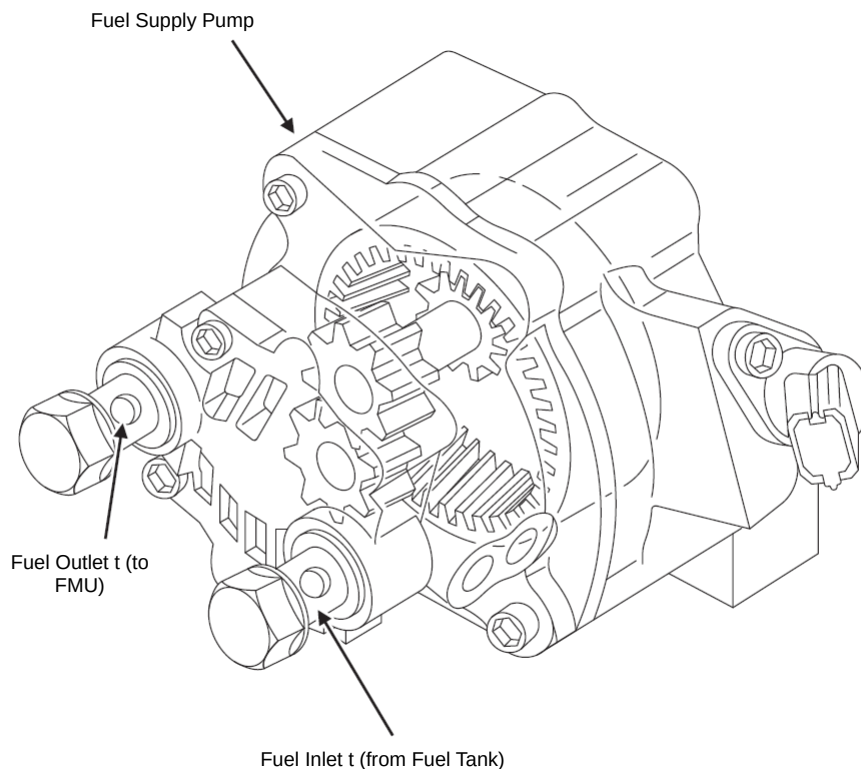
The above is the control process of the Bosch common-rail injection system. The ECU central processing unit collects all instant parameters influencing the dynamic property, economy and emission of diesel fuel, and simultaneously according to the driver's operational command - namely the position of the accelerator pedal, the ECU comprehensively calculates the optimum values of various actuating parameters such as the injection timing, fuel injection pressure, fuel injection quantity, number of times of fuel injection, etc., thereby achieving the optimum operation state of the diesel engine.

Primary Fuel Filter with Hand Fuel Pump

The primary fuel filter with a hand fuel pump is simultaneously provided with an oil-water separator. When the filter filters the fuel, water is gathered in a water collector, and the separated water shall be emptied from a drain screw in time in daily maintenance. The coarse filter is screwed on the filter housing and shall be replaced periodically in maintenance. A hand fuel pump is installed on the filter cover of the coarse filter, and when the filter is assembled for the first time or maintained and replaced, or air exists in the system, the air in the low-pressure loop shall be discharged by the hand fuel pump. An exhaust bolt is arranged on the housing of a filter connecting flange, by unscrewing the exhaust bolt and repeatedly pressing the hand fuel pump, fuel accompanied with air is exhausted from the exhaust bolt until the outflow fuel contains no air, and then the exhaust bolt is screwed.

High-pressure Fuel Pump

The high-pressure fuel pump integrates the low-pressure fuel line and the high-pressure fuel line. The high-pressure pump has two tasks: first, a gear pump connected with the high-pressure fuel pump is the fuel feed pump of the low-pressure fuel line, and the gear pump pumps fuel through the primary fuel filter and the ECU and supplies fuel to the high-pressure pump through the fuel fine filter; and second, two sets of plungers or the high-pressure fuel pump provides high-pressure fuel as high as 160Mpa to the high-pressure common rail.



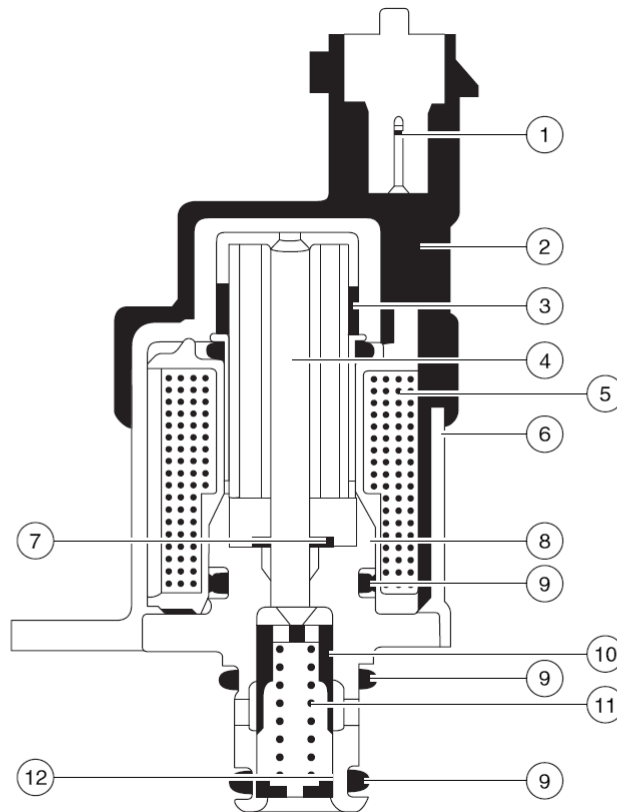
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In a low-pressure oil path, fuel flows through the ECU inner chamber to perform the function of cooling the ECU.

The fuel feed pump is a straight gear type fuel pump which is driven by driving a straight small gear by an inner ring gear integrated with a camshaft of a high-pressure pump. The fuel feed pump feeds the fuel from the fuel tank to the high-pressure fuel pump.

The high-pressure part of the high-pressure fuel pump comprises two cam type camshafts, a roller type tappet rod, plungers, fuel outlet joints and a fuel metering valve. Two rows of cams are alternately arranged on the camshafts on three surfaces, and when the camshafts rotate, two pairs of plunger pistons simultaneously pump the fuel for six times back and forth. Two fuel outlet valves are arranged in two fuel outlet joints of the high-pressure fuel pump and can supply high-pressure fuel of 160MPa to common-rail pipes.

Fuel (WP10) – Fuel System

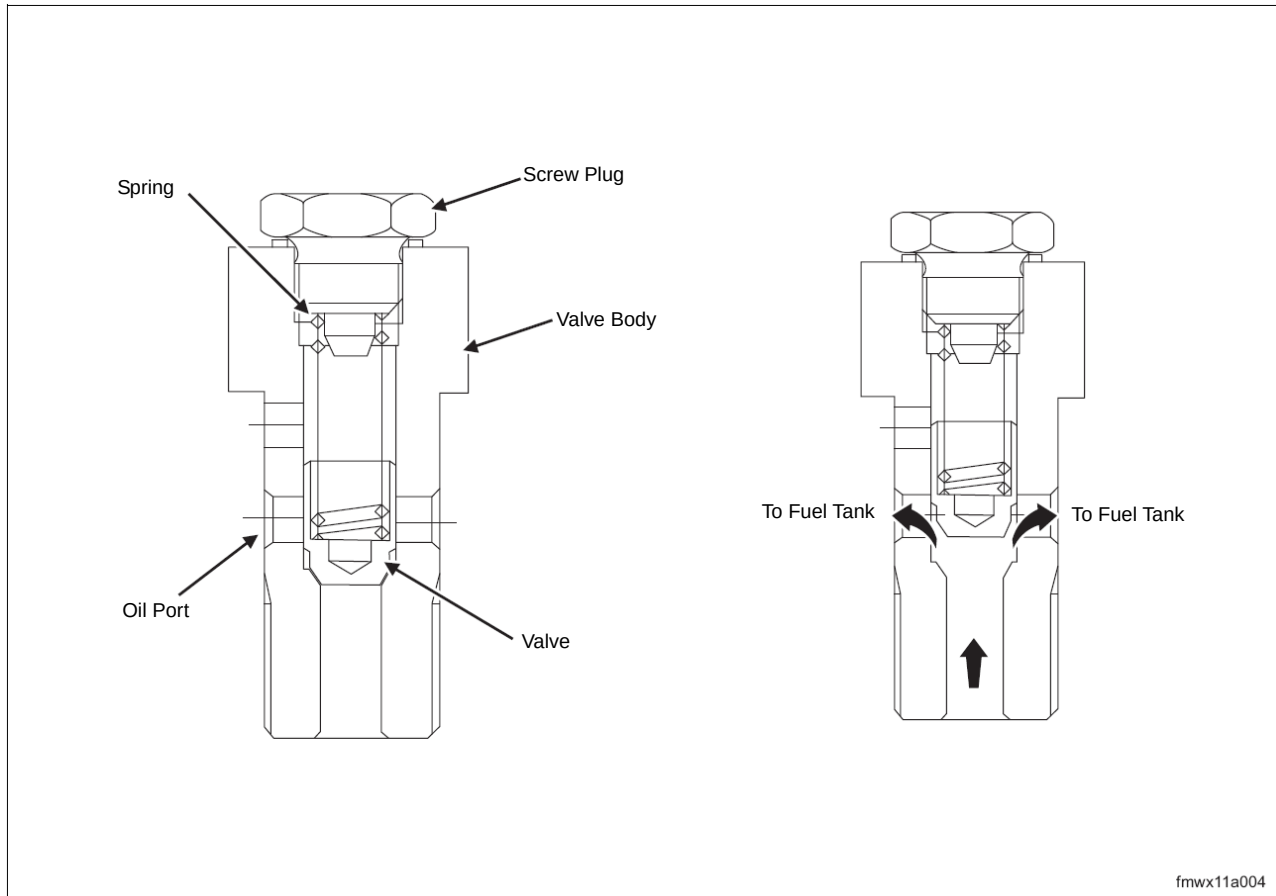


fmwx11a003

1	Plug
2	Solenoid Valve Housing
3	Sleeve
4	Tappet
5	Coil
6	Housing

7	Air Gap Gasket
8	Magnetic Core
9	O-Ring
10	Plunger with Control Gap
11	Spring
12	Snap Ring

A fuel metering valve is arranged on the fuel outlet pipeline of the high-pressure fuel pump and is mainly used for receiving the instruction of the ECU to randomly change the capacity of the fuel entering the high-pressure pump, thereby changing the high-pressure fuel feed pressure of the high-pressure pump, i.e. changing the common-rail pressure. When a fuel metering unit has a fault, the engine operates at the limited rotation speed of 1500r/min, and meantime, the resistance value of the metering valve is 2.6-3.4 ohm. The ECU controls the capacity of the fuel entering the high-pressure pump by the on-off time of pulse signals. It is noteworthy that when the coil of the fuel metering valve is not electrified, the metering valve is all-pass and can supply maximal fuel flow. In other words, maximal common-rail pressure can be formed.



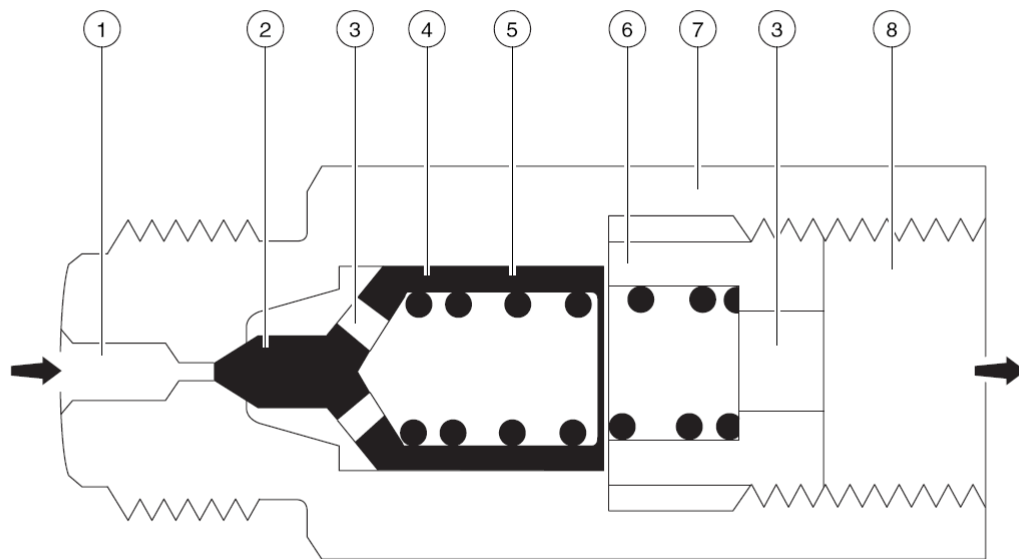
The low-pressure fuel feed side of the high-pressure fuel pump is connected with the fuel inlet of the fuel metering valve in parallel and is provided with a fuel return valve. The valve enables the low-pressure fuel path to keep a constant fuel feed pressure, and the fuel return pipeline of the high-pressure fuel pump is connected out of the fuel return valve.

A camshaft phase sensor is arranged in the position of the shell of the high-pressure fuel pump corresponding to a camshaft fluted disc and transfers the random position of the camshaft to the ECU, so that the ECU can recognize the running position of each cylinder of the diesel engine.

High-pressure Common-rail Pipe

The common-rail pipe is a fuel pressure storing device which distributes the high-pressure fuel provided by the high-pressure fuel pump to each fuel injector and weakens the pulsation of the fuel feed pressure of the high-pressure fuel pump and the pressure oscillation generated by fuel injection of each fuel injector, so that the pressure fluctuation of the high-pressure fuel path is controlled in a certain range. Meanwhile, the fuel pressure in the common-rail pipe is also controlled by the fuel metering valve controlled by the ECU, thereby determining the fuel delivery of each fuel injector according to the working condition of the diesel engine. A common-rail pressure sensor is installed at the left end of the common-rail pipe, and the sensor transfers the fuel pressure in the common-rail pipe to the ECU at any time, so that the ECU can adjust the fuel flow valve as required to change the common-rail inner fuel pressure value. A pressure limiting valve is also arranged on the common-rail pipe, and the pressure limiting valve is opened when the pressure in the common-rail pipe exceeds 160Mpa, so that the maximum pressure in the common-rail pipe can not exceed the set value of 160Mpa.

Fuel (WP10) – Fuel System



fmwx11a005

1	High-pressure Connector (to Common-rail Pipe)
2	Valve Needle
3	Channel
4	Valve Spool

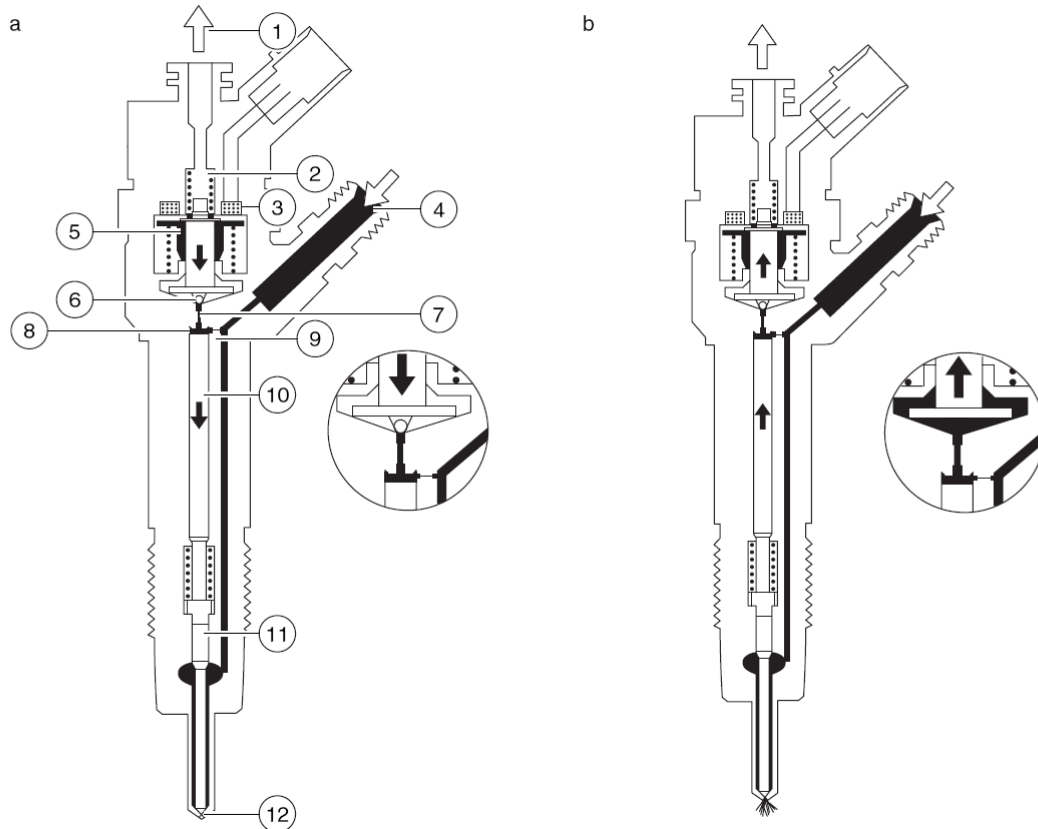
5	Spring
6	Limiting Sleeve
7	Valve Body
8	Fuel Return Channel

Fuel Injector

An electric control fuel injector is a key position of a fuel injection system, and nearly all of the elements of an electric control system finally serve for the fuel injector. The injection of the fuel injector is controlled by the ECU, and the ECU controls the fuel injection quantity, the injection timing, the fuel injection pressure and the number of times of fuel injection of the fuel injector according to the state information input by each sensor of the engine and the instruction of the driver, thereby achieving optimal output of the instant state.

The control of the fuel injection pressure is generated on the common-rail pressure provided by the high-pressure fuel pump, and the injection timing, the fuel injection duration and the number of times of fuel injection are controlled by voltage signals output by the ECU through a solenoid valve at the upper part of the fuel injector. The fuel injection quantity of the fuel injector is obviously determined by the common-rail pressure and the opening time of the needle valve of the fuel injector, wherein the higher the fuel injection pressure is, the longer the opening time of the needle valve is, and the larger the fuel injection quantity is.

At present, a fuel injector with seven holes is used by the national III diesel engine.



fmwx11a006

1	Fuel Return Connector
2	Return Spring
3	Solenoid Valve Coil
4	Fuel Inlet Connector
5	Solenoid Valve Spool
6	Ball Valve

7	Drain Hole
8	Control Chamber
9	Fuel Inlet
10	Plunger
11	Needle Valve
12	Nozzle

The high-pressure fuel from the common-rail pipe enters the fuel injector through the fuel inlet joint and enters the control chamber through fuel inlet holes, the high-pressure fuel generates downward pressure on the upper cross section of the plunger piston, and simultaneously, the high-pressure fuel enters the lower chamber and acts on the lower annular area of the needle valve to generate an acting force for pushing the plunger piston upward. Because the area of the upper cross section of the plunger piston is greater than the lower annular area of the needle valve, the downward force acting on the plunger piston is obviously greater than the upward force acting on the needle valve; meantime, the needle valve is tightly pressed on the injector nozzle under the action of the downward force of the plunger piston and the action of the spring of the needle valve; and meantime, the nozzle is closed, and the fuel injector is in an injection stopping state.

When the ECU switches on the solenoid valve of the fuel injector, the solenoid valve core is attracted upward, the ball valve pressing on the drain hole opens the drain hole, and the fuel pressure acting in the control chamber is unloaded through the throttling fuel feed hole; and meantime, the fuel pressure acting on the lower annular cross section of the needle valve overcomes the spring pressure to quickly push the needle valve upward, thereby opening the orifice of the nozzle for injecting fuel. When the voltage signals of the ECU disappear, the solenoid valve core enables the ball valve to close the drain hole under the action of the return spring, the plunger piston immediately enables the needle valve to return to the original position under the action of the high-pressure fuel of the control chamber, the fuel injection hole is closed, and the fuel injector stops injecting. Because lifting and closing of the needle

Fuel (WP10) – Fuel System

valve are determined by the difference of the hydraulic pressure on the upper cross section of the plunger piston and the lower annular area of the needle valve, the force of the solenoid valve for lifting the valve core does not need to be very large, so that the reaction speed of the fuel injector is high and is 0.1-0.3ms generally, thus accurate and sensitive injection can be realized.

ECU (central processing unit)

The ECU is the nerve center of the electric control fuel injection system, is actually a simple computer, gathers various kinds of state information of running of the diesel engine through the sensor, simultaneously receives the instruction transferred by the driver through the accelerator pedal sensor, and determines the fuel injection quantity, the injection timing and the number of times of fuel injection of the fuel system through simple and quick operation (the ECU can control the fuel injector for injecting fuel for 5 times in each process of circulation, and only a preliminary injection process and a main injection process are used at present), so that the diesel engine can run in the optimal state in any working condition.

Another function of the ECU is to realize reliable self-control operation. For example, in order to ensure the safety in the process of starting the engine, a neutral switch is arranged on the gearbox, and the control circuits of the neutral switch and the starter are controlled by the ECU; and when the engine is started, if the gearbox is shifted in any gear, the starting circuits of the engine are broken, so that the engine can not be started. When the driver opens the air conditioner, the ECU controls the idle speed of the engine to be improved, so that the engine at the idle speed can not flame out; and if the PTO power is output, the ECU controls the engine to adapt to the needs of load change to automatically adjust the output of the torque, etc.

The ECU has self-diagnostic capability of faults, reflects the running faults of the diesel engine caused by the electric control fuel injection system in the form of fault flash codes, and can store the faults, so that the faults can be found visually or by a fault diagnosis instrument, thereby providing the convenience for quickly and accurately processing the faults.

The ECU also has a function of "limp home", i.e. when the diesel engine has a fault which affects the working reliability and safety, before the fault is eliminated, the ECU can output a "default" for each executive component, wherein the "default" means that under the preset condition which can not affect the fault extension, the engine only can maintain general running instructions; meantime, the rotation speed of the engine can not exceed 1500r/min, and the engine can not exert full power, thus the driver only can reluctantly drive the vehicle to the home or the maintenance point; and after the fault is eliminated, the vehicle can restore.

The ECU is provided with three sockets of the connector assembly, wherein one socket has 36 pins and is connected with the wiring harness of the sensors, one socket has 16 pins and is connected with the fuel injector and other executive components, and the maximal socket has 89 pins (only more than 40 pins are used currently) and is connected with the wiring harness of the whole vehicle. The wiring harness of the whole vehicle is not only connected with each sensor of the whole vehicle (such as the neutral switch of the gearbox, the master cylinder switch of the clutch, the gas pressure sensor, etc.) and is also provided with a CAN communication bus (not arranged on the vehicle) and a K line. The CAN bus is a communication bus connected with other computer devices of the whole vehicle, and the K line is a fault finding cable connected with the electric control injection diagnosis instrument.

The ECU is generally installed at the intake pipe side of the diesel engine and simultaneously needs to be cooled by the fuel.

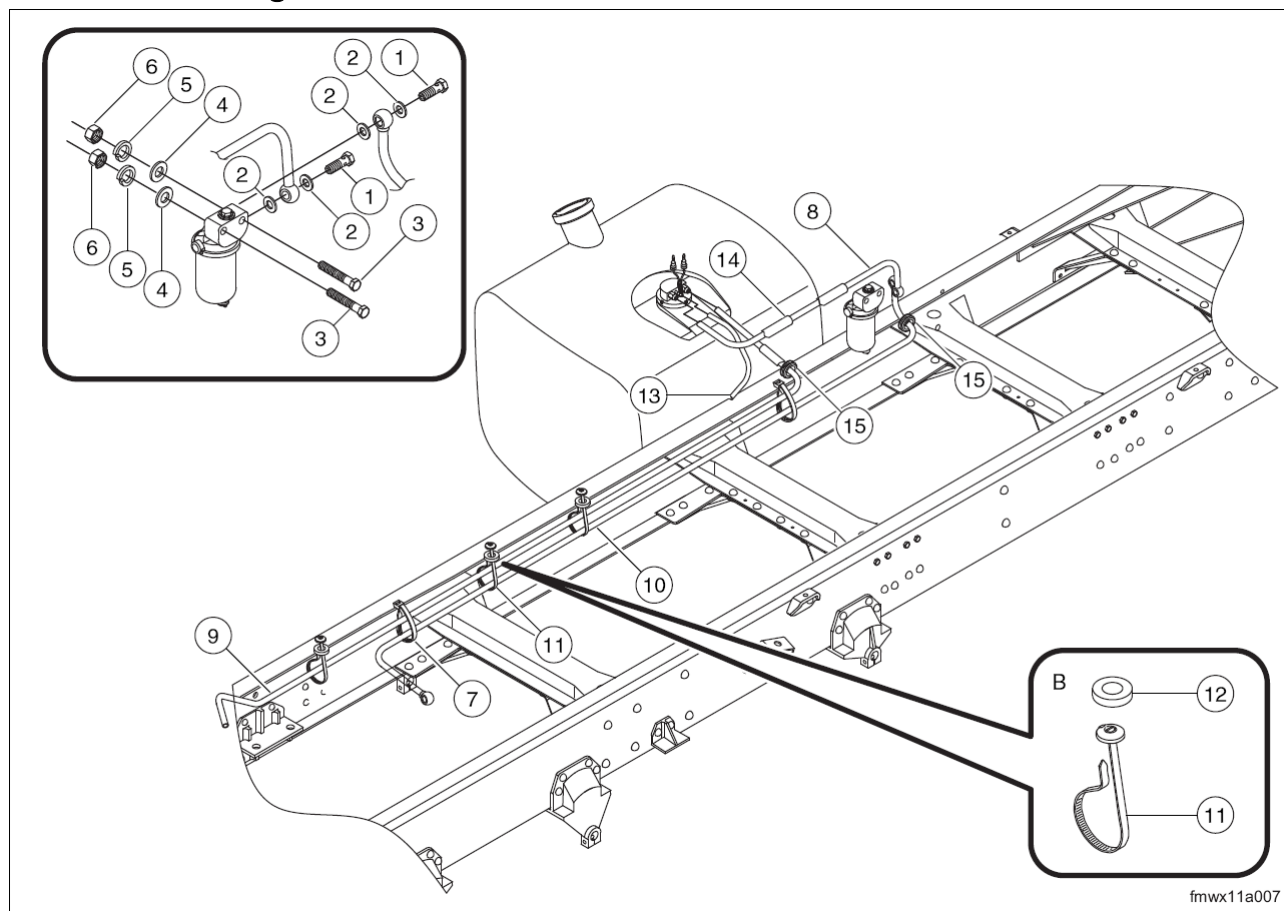
Precautions

1. Before checking and maintaining the fuel system, disconnect the battery negative cable.
2. Because the fuel is an inflammable substance, when the fuel system is operated, enable cigarettes, naked flame, indicating lamps, arc equipment and switches to be far from the working area, and provide ventilating equipment in the working area to avoid occurrence of personal injury or even death.
3. In order to avoid personal injury, never loosen any fuel pipe joint when the engine runs.
4. Keep the fuel away from rubber or leather components.
5. Manufacture the diesel fuel injection equipment according to very accurate tolerance and gaps. Thus, when the fuel system is operated, absolutely clean working environment is very important. Use special plugs to close all openings.
6. Before disconnecting the fuel system pipeline, check and confirm whether dirt or impurity exists around the fuel pipe joint or not, and if the dirt or impurity exists around the fuel pipe joint, clean the dirt or impurity, wherein the dirt or impurity may damage the fuel system or the engine.
7. Do not forcibly bend or twist the fuel system pipeline.
8. Before connecting each pipeline of the fuel system, ensure that each fuel pipe joint is not damaged, and if the fuel pipe joint is damaged or has cracks, replace the fuel pipe assembly and ensure that no dirt exists on the surface of the fuel pipe connecting surface.

11A

Fuel (WP10) – Fuel System

Part Drawing



fmwx11a007

1	Hinged Bolt
2	Flat Washer
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Hex Head Nut-Style 1
7	Tightening Strap
8	Fuel Supply Pipe - Fuel Tank to Coarse filter

9	Fuel Return Pipe
10	Fuel Supply Pipe - Coarse filter to Engine
11	Cable Tie
12	Rubber Cushion Block
13	Air Bleed Pipe
14	Spiral Sleeve
15	Rubber Ring - Through Hole

Testing & Adjustment

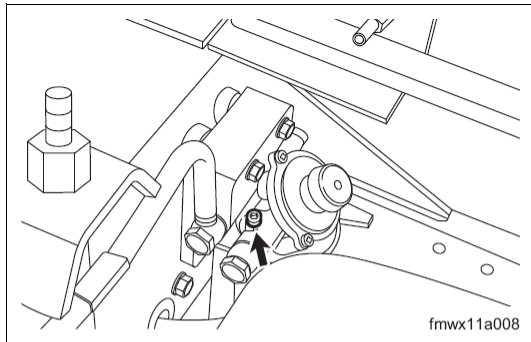
Exhaust of Fuel System

When replacing the coarse filter, reassembling the fuel delivery pipe, or emptying the fuel tank, air will enter the fuel system. If air enters the fuel system, the flow of fuel to the engine will be hindered and can not flow smoothly. To prevent this from happening, the fuel system shall be exhausted.

Hint:

Part Drawing, refer to Chapter 11A, Fuel - Oil-water Separator, Part Drawing

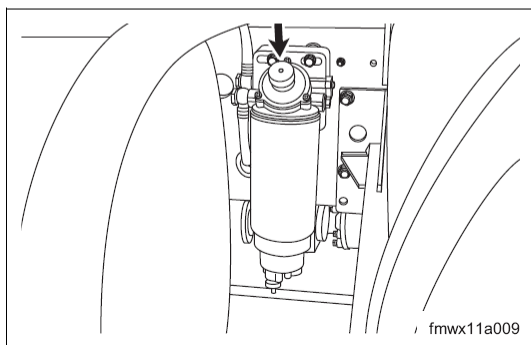
1. Stop the engine.



2. Dismantle air bleed screw

3. Inflate with hand pump

- (a). Inflate with a hand pump until only fuel flows out from the air bleed screw.



4. Install air bleed screw

Fuel (WP10) – Fuel System

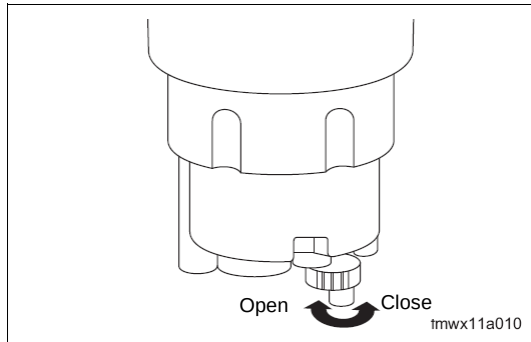
Drain water collector

When the water collector is full, drain the collected water.

Warning:

There is danger of freezing. Drain the water before freezing.

1. Stop the engine.

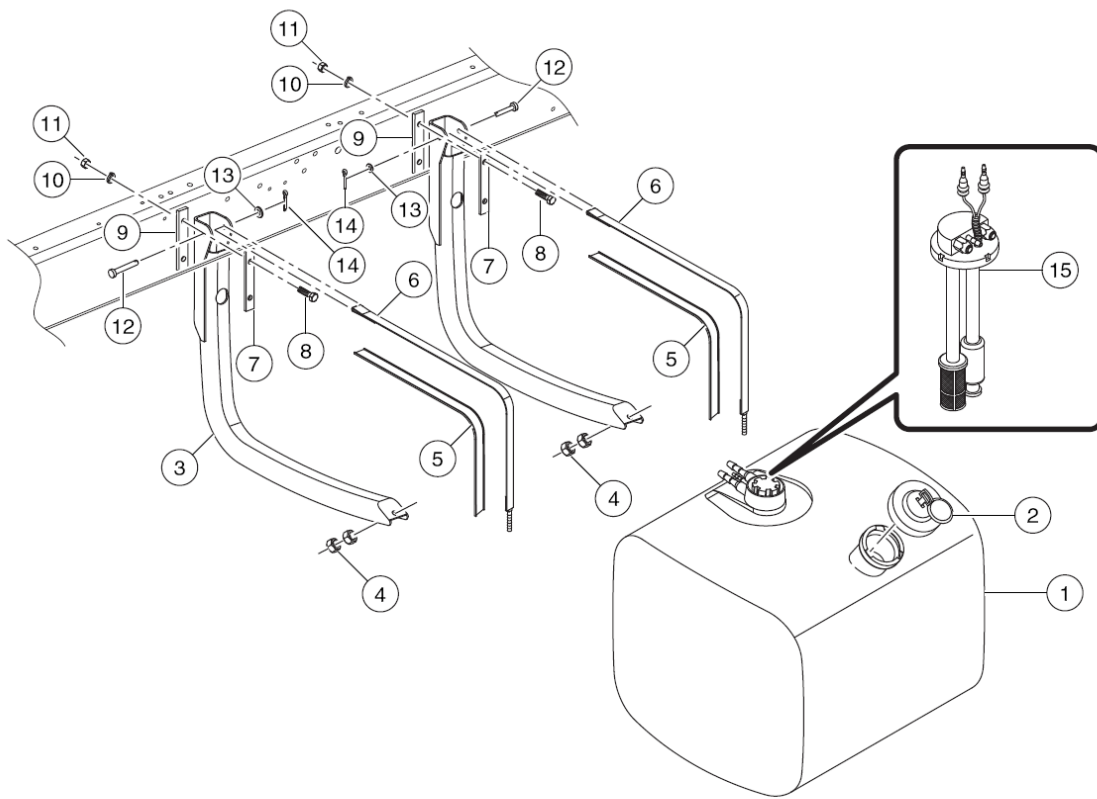


2. Dismantle drain screw

- (a). Open the drain screw at the bottom of the water collector to drain the water.

3. Install drain screw

Fuel Tank Part Drawing



fmwx11a019

1	Fuel Tank Assembly, 260L, Aluminum Alloy
2	Fuel Tank Lock Assembly
3	Bracket Assembly
4	Hex Head Nut - Style 1
5	Rubber Rim Strip
6	Tightening Pull Strap Assembly
7	Base Plate - Fuel Tank
8	Hex Head Bolt - Fine Thread

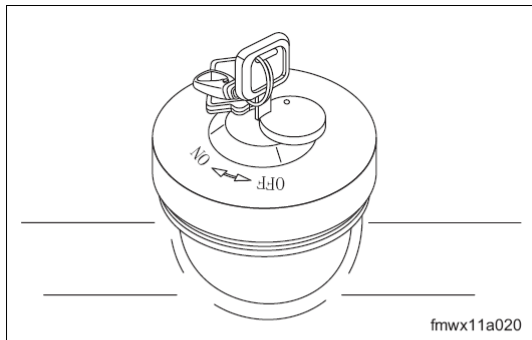
9	Base Plate - Fuel Tank
10	Spring Washer
11	Hex Head Nut, Style 1 - Fine Thread
12	Pin Shaft
13	Flat Washer
14	Cotter Pin
15	Fuel Sensor

Replacement

Hint:

Part Drawing, refer to Chapter 11A, Fuel - Fuel Tank, Part Drawing

1. **Open cargo box**
2. **Disconnect battery negative cable**
3. **Dismantle guardrail assembly of cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**



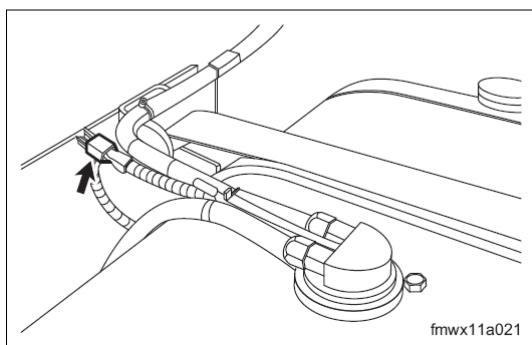
4. **Release fuel pressure**

- (a). Insert the key to open the fuel tank lock.
- (b). Unscrew the fuel tank lock assembly.

Caution:

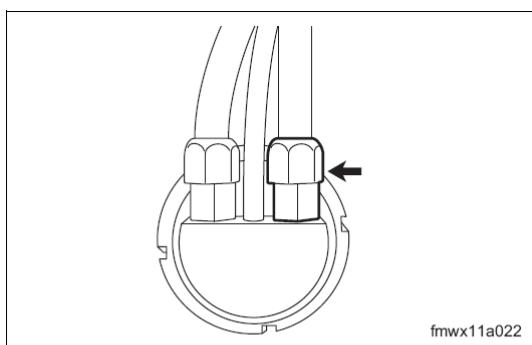
Be sure to use clean, soft cloth to plug the fuel filler.

11A



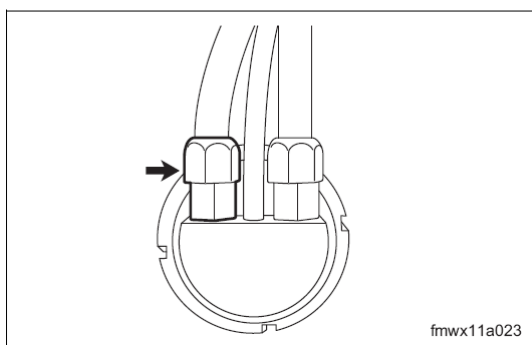
5. **Disconnect connector of fuel sensor**

- (a). Disconnect the connector of the fuel sensor.



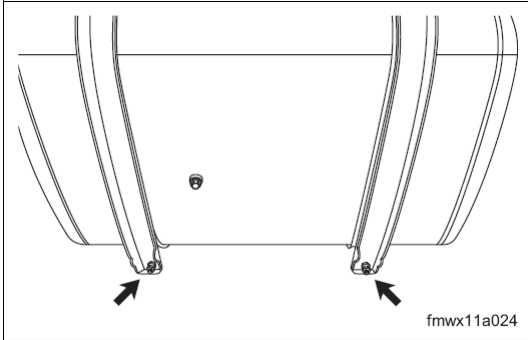
6. **Disconnect outlet pipe of fuel tank**

- (a). Disconnect the connector nut of the outlet pipe of the fuel tank.



7. **Disconnect fuel return pipe of fuel tank**

- (a). Disconnect the connector nut of the fuel return pipe of the fuel tank.

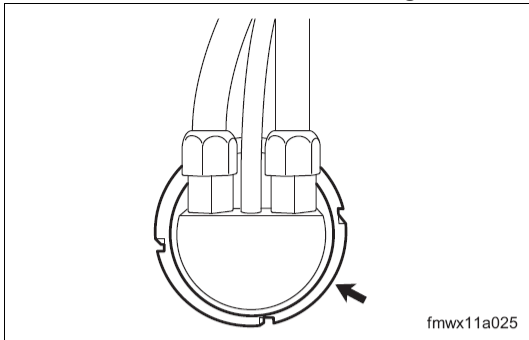


8. Dismantle fuel tank assembly

- (a). Dismantle the fixing nut of the tightening pull strap.
- (b). Take off the tightening pull strap of the fuel tank.
- (c). Dismantle the fuel tank assembly.

Caution:

- Before operation, check and make sure there is no lines, wiring harness or other foreign matters around the fuel tank, and clean up if necessary.
- When lifting the fuel tank, due to large size, use appropriate tools or operate with the help of others if necessary.
- Because the fuel tank is an aluminum alloy workpiece, avoid collision in the process of dismantlement, handling and installation.

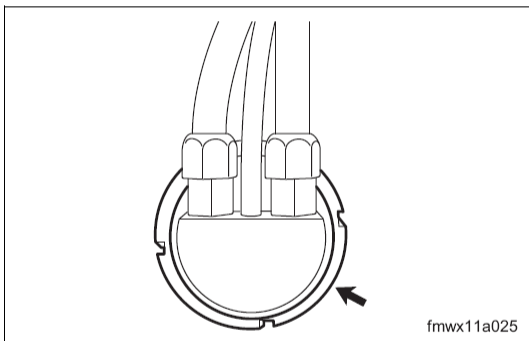


9. Dismantle fuel sensor

- (a). Loosen the sealing cover of the fuel sensor with a special tool.
- (b). Rotate the fuel sensor to a proper angle and take it out lightly.

Caution:

- Before operation, check and make sure there is no dirt or other foreign matters around the fuel sensor, and clean up if necessary.
- There is a rubber seal ring in the sealing cover of the fuel sensor. Do not damage the seal ring while dismantling.

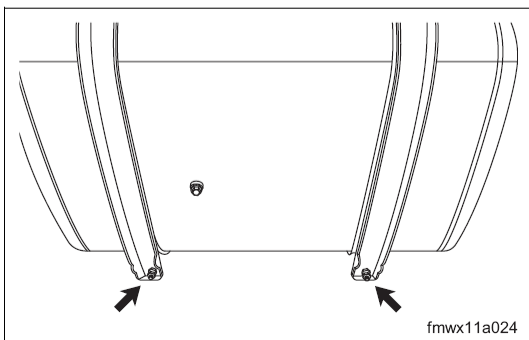


10. Install fuel sensor

- (a). Rotate the fuel sensor to a proper angle and install to the right position of the fuel tank.
- (b). Screw down the sealing cover of the fuel sensor with a special tool.

Caution:

When installing the fuel sensor, insert after rotating to the proper angle, and do not cause warp or deformation.



11. Install fuel tank assembly

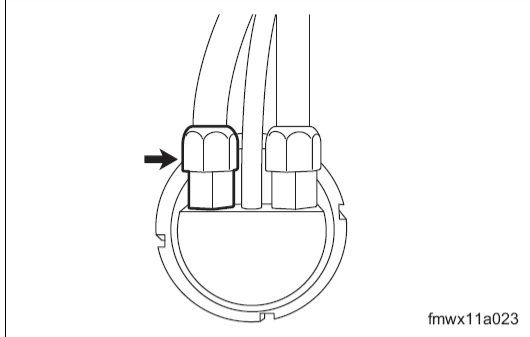
- (a). Install the fuel tank assembly on the fuel tank bracket and fix to the right position.
- (b). Install the fixing nut of the tightening pull strap of the fuel tank.

Torque: 45±5N.m(M10)

Torque: 81±8N.m(M12)

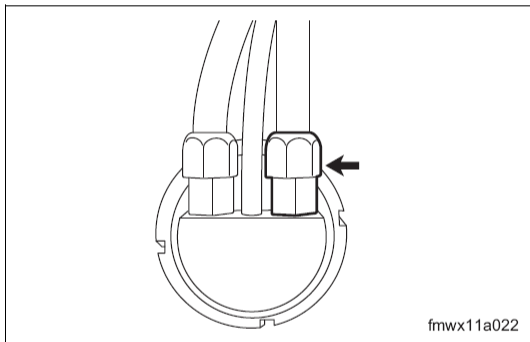
Fuel (WP10) – Fuel Tank**Caution:**

- The tightening pull strap of the fuel tank and the connecting nut of the fuel tank bracket shall be fastened to the specified torque. Excessive torque will cause deformation of the fuel tank.
- The fuel tank shall be connected firmly and reliably without abnormal vibration.
- Each rubber rim strip shall be even and level.

**12. Install fuel return pipe of fuel tank**

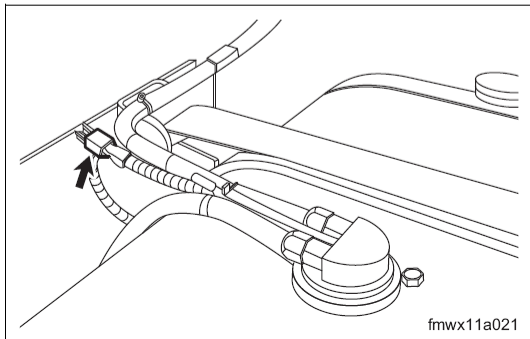
- (a). Install the connector nut of the fuel return pipe of the fuel tank.

Torque: 46±5N.m

**13. Install outlet pipe of fuel tank**

- (a). Install the connector nut of the outlet pipe of the fuel tank.

Torque: 46±5N.m

**14. Install connector of the fuel sensor**

- (a). Install the connector of the fuel sensor.

15. Install fuel tank lock assembly

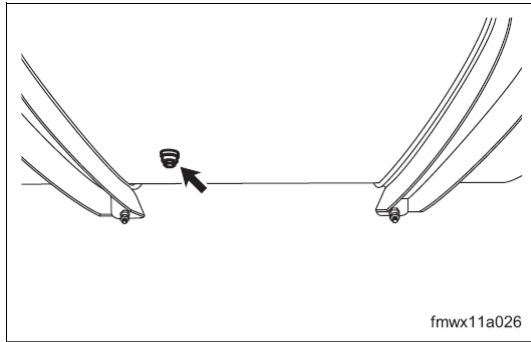
- (a). Check whether the fuel tank lock and gasket are deformed or damaged. Replace the fuel tank lock assembly if necessary.
- (b). Periodically lubricate the rotating part.

16. Exhaust of Fuel System, refer to Chapter 11A, Fuel - Fuel System, Testing & Adjustment**17. Install battery negative cable****18. Inspect**

- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joints of the fuel system.

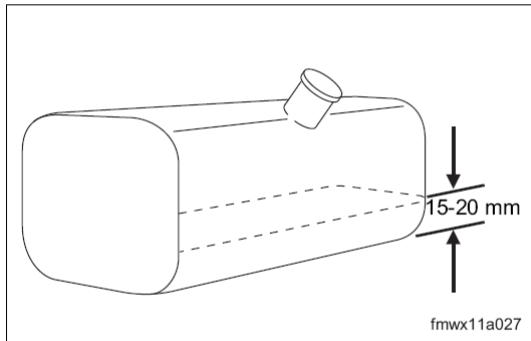
19. Install the guardrail assembly of the cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**20. Put down cargo box**

Cleaning



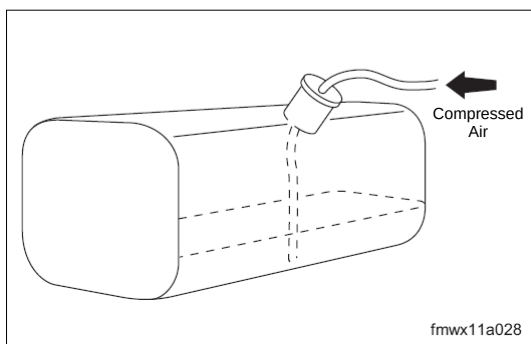
1. Drain fuel

- (a). Open the fuel tank lock assembly, unscrew the drain plug of the fuel tank, after draining the trapped fuel, clean up dirt on the drain plug and then install the drain plug.



2. Fill clean fuel

- (a). Fill up the fuel tank with fuel until the distance from the fuel level to the bottom of the fuel tank is 15-20mm.



3. Clean fuel tank assembly

- (a). Insert a hose with a spraying nozzle into the bottom of the fuel tank.
- (b). Connect the hose with an air duster gun.
- (c). Plug the fuel filler with a clean, soft cloth, and open the switch of the air duster gun for flushing.
 - Change the position of the spraying nozzle while flushing so that precipitate and adherent matters are flipped along with fuel.

4. Clean fuel tank assembly for many times

- (a). After flushing the whole fuel tank with the spraying nozzle, unscrew the drain plug to drain the dirty oil, and repeat twice to thrice to clean completely

5. Check fuel tank assembly

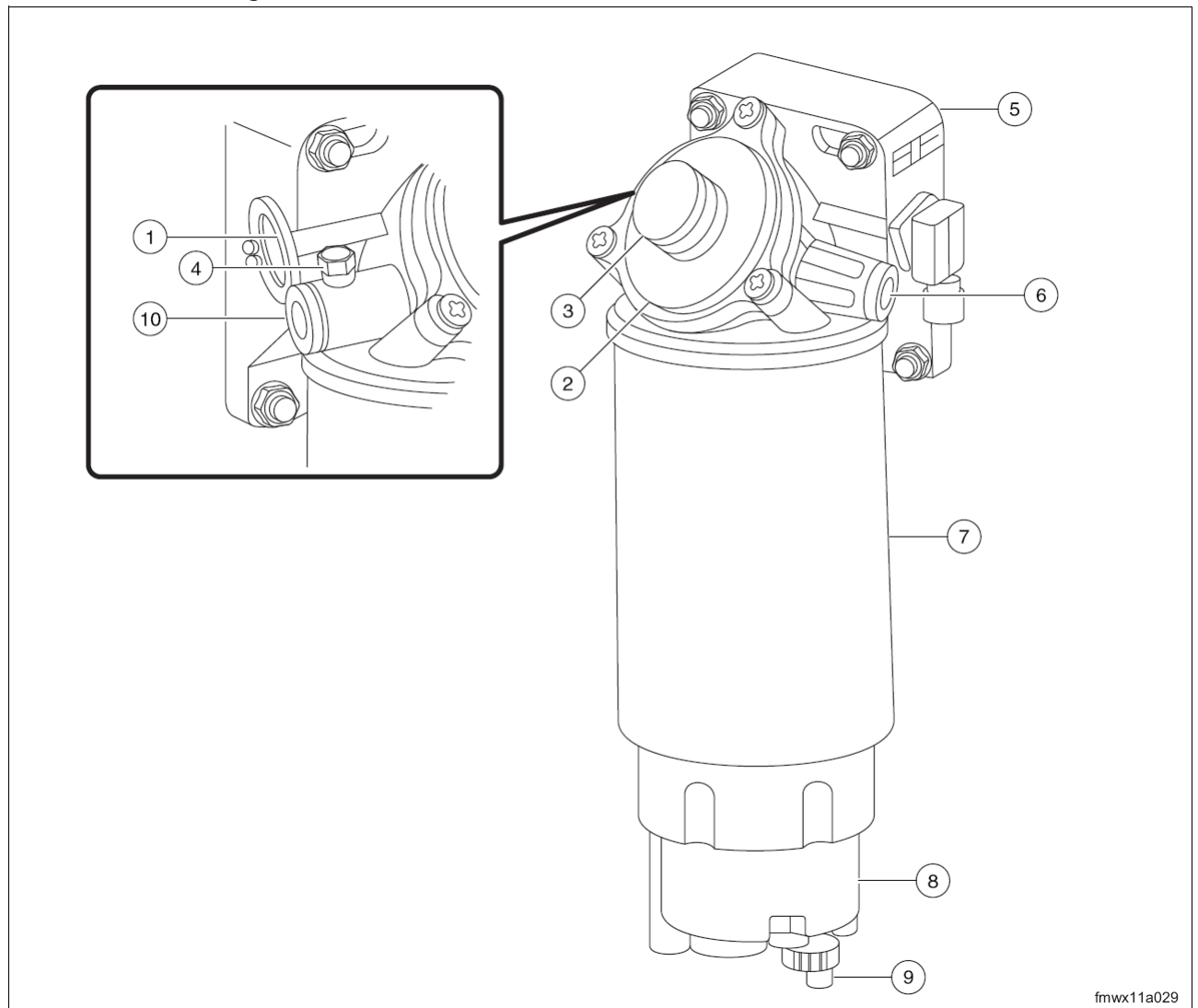
- (a). After cleaning the fuel tank, check whether the fuel tank is damaged, and the damage shall be promptly dealt.

6. Install fuel tank lock assembly

- (a). Check and clean the filter screen of the filler port of the fuel tank.

Oil-water Separator

Part Drawing



fmwx11a029

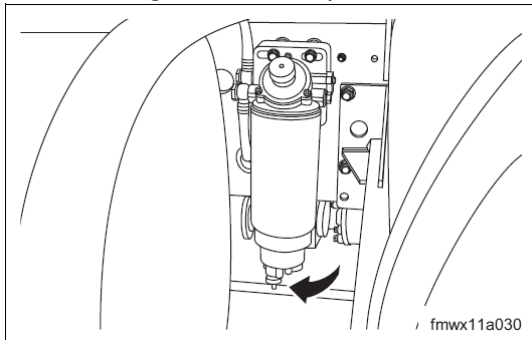
1	Fuel Inlet
2	Filter Cover
3	Hand Pump
4	Air Bleed Screw
5	Mounting Flange

6	Fuel Outlet
7	Spinning Filter
8	Water Collector
9	Drain Screw
10	Fuel Outlet

Replacement

Hint:

Part Drawing, refer to Chapter 11A, Fuel - Oil-water Separator, Part Drawing

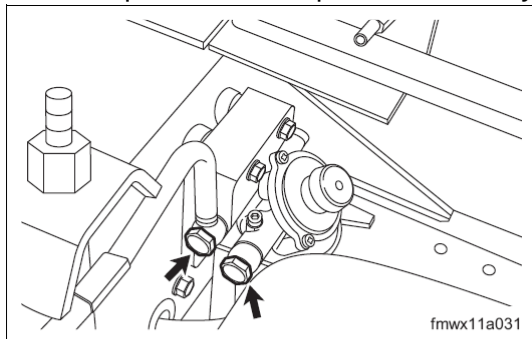


1. Dismantle oil-water separator

- (a). Counterclockwise rotate with a fuel filter wrench to dismantle the oil-water separator.

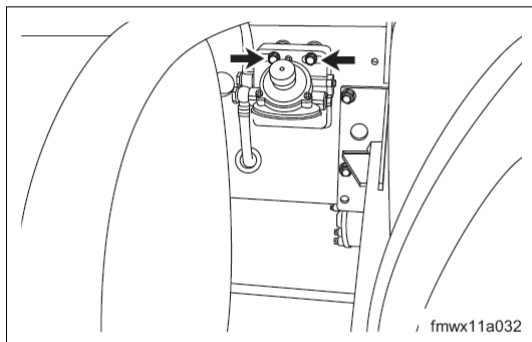
2. Check oil-water separator seat

- (a). Check whether the fuel filter seat has defects such as cracks, scratches, obvious damage, etc. Replace with new parts if necessary.

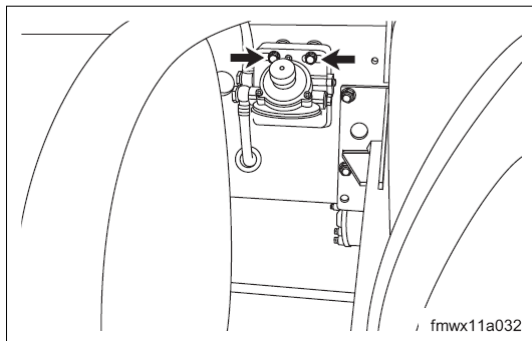


3. Dismantle oil-water separator seat

- (a). Dismantle the hinged bolts of the inlet and outlet pipes.



- (b). Dismantle the fixing bolt of the oil-water separator seat.



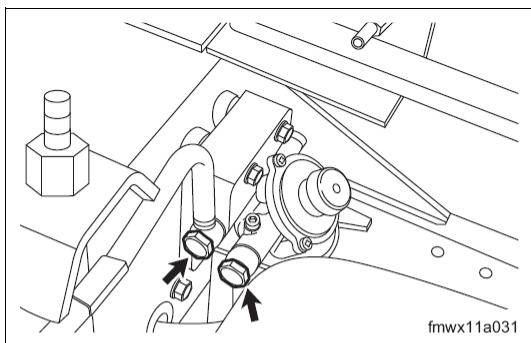
4. Install oil-water separator seat

- (a). Install the fixing bolt of the oil-water separator seat.

Torque: 45±5N.m(M10)

Torque: 81±8N.m(M12)

Fuel (WP10) – Oil-water Separator

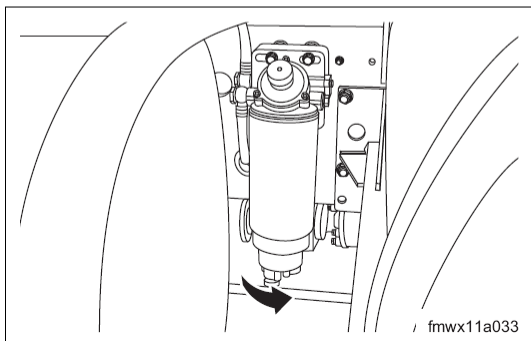


- (b). Install the hinged bolts of the inlet and outlet pipes.

Torque: 45±5N.m

Caution:

Check the washers of the inlet and outlet pipes, and replace with new parts if necessary.



5. Install oil-water separator

- (a). Apply a small amount of lubricating oil on the seal ring of the oil-water separator.
- (b). Screw on the oil-water separator by hand until the seal ring is combined with the interface.
- (c). Clockwise screw down the oil-water separator with the fuel filter wrench (for about 3/4 round).

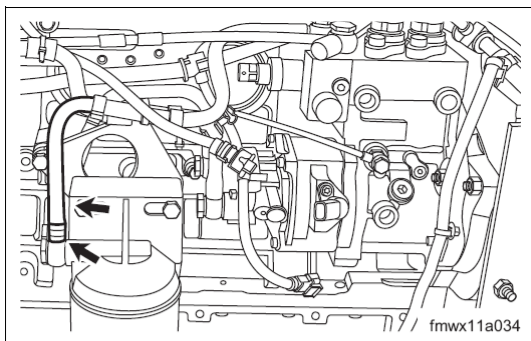
11A

6. Exhaust of Fuel System, refer to Chapter 11A Fuel - Fuel System, Testing & Adjustment

7. Inspect

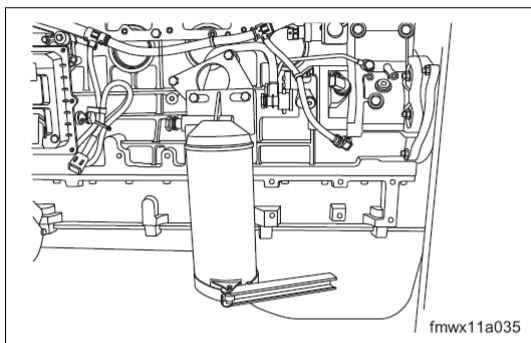
- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joint of the fuel system.

Fuel Fine Filter Replacement

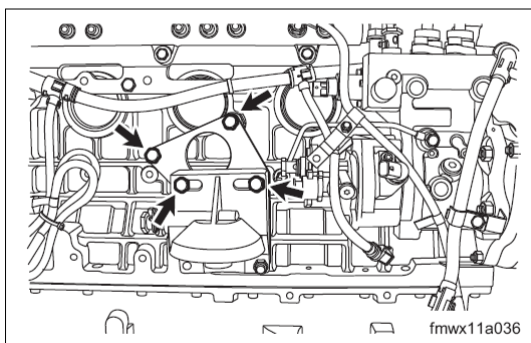


1. Dismantle fuel fine filter

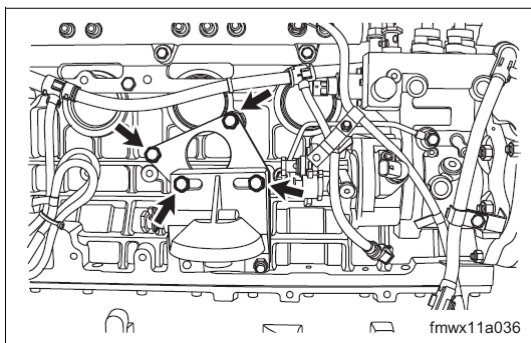
- (a). Dismantle the inlet and outlet pipes of the fuel fine filter.



- (b). Dismantle the fuel fine filter with a fuel filter wrench.



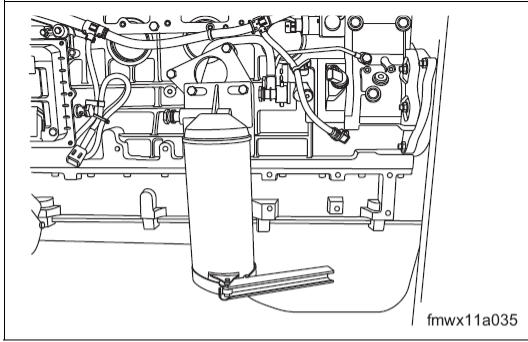
- (c). Dismantle the fuel fine filter seat.



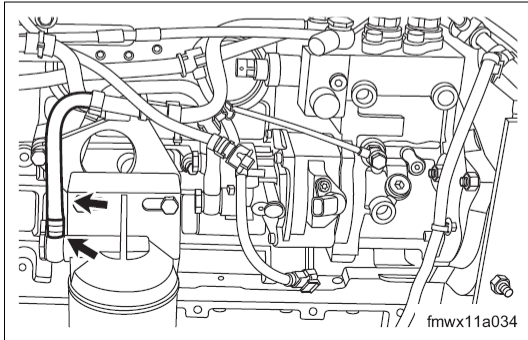
2. Install fuel fine filter

- (a). Install the fuel fine filter seat.

Fuel (WP10) – Fuel Fine Filter



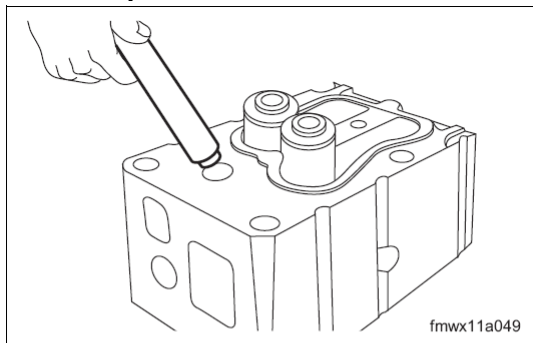
- (b). Install the fuel fine filter with a fuel filter wrench.



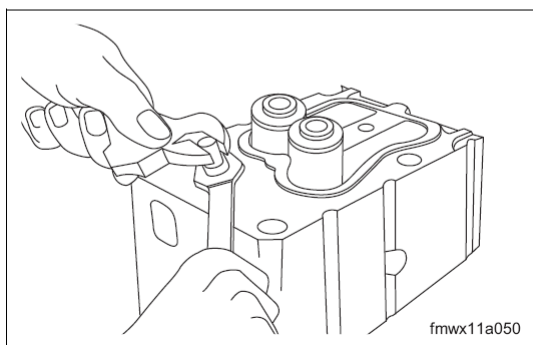
- (c). Install the inlet and outlet pipes of the fuel fine filter.

Fuel Injector Sleeve Replacement

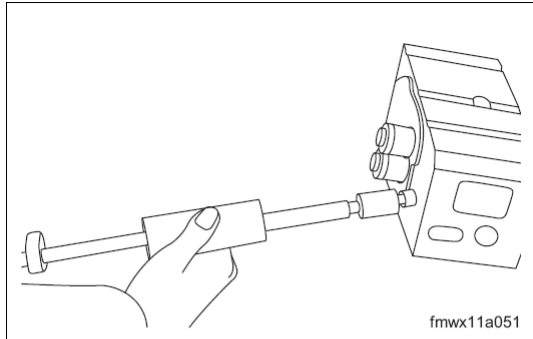
1. Dismantle the fuel injector, refer to Chapter 17, Engine Control - Fuel Injector, Replacement



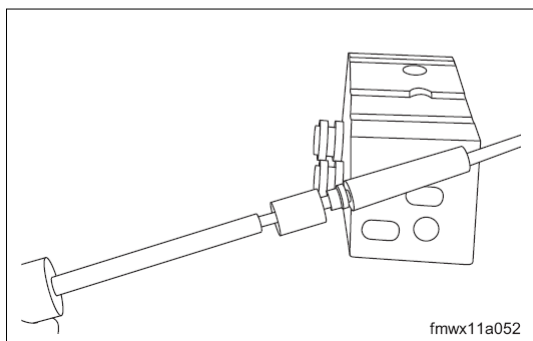
2. Insert shifting block into sleeve



3. Screw down expansion nut of shifting block



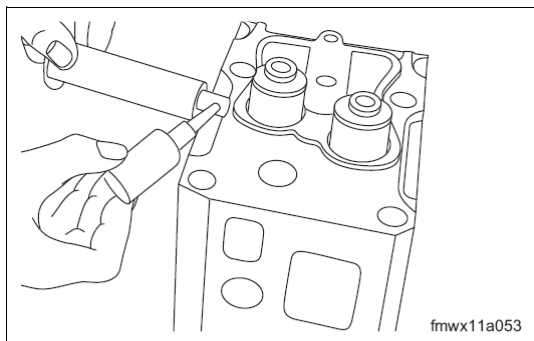
4. Pull old sleeve with puller punch hammer



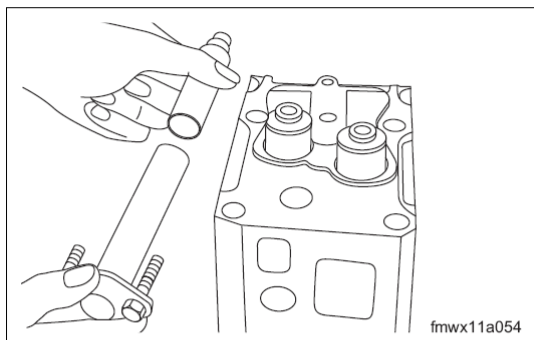
5. Pull out old sleeve

11A

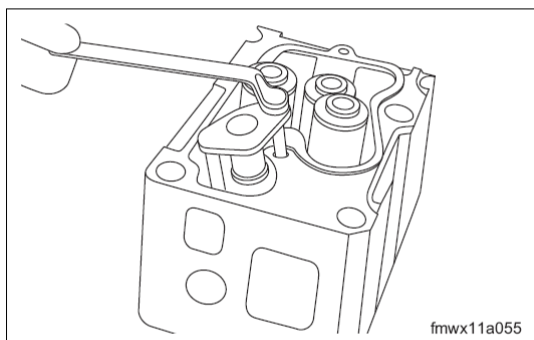
Fuel (WP10) – Fuel Injector Sleeve



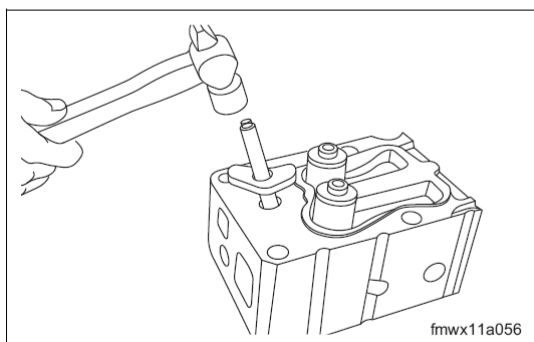
6. Apply 602 sealant at small end of sleeve



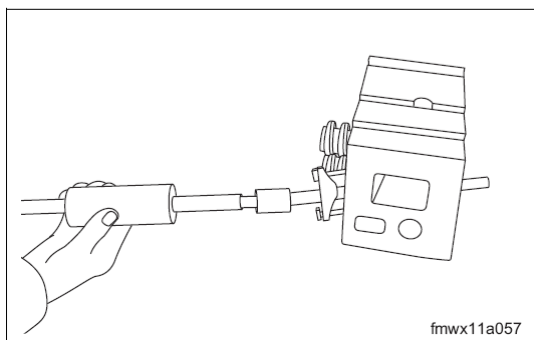
7. Insert new sleeve into pressing sleeve



8. Press pressing sleeve and new sleeve into cylinder head with pressure plate of fuel injector



9. Drive expanding arbor into pressing sleeve



10. Pull out expanding arbor with puller

11A

Fuel (WP12)

- Fuel System11B-3**
 - General..... 11B-3
 - Precautions..... 11B-12
 - Part Drawing..... 11B-13
 - Testing & Adjustment..... 11B-14
- Fuel Tank11B-16**
 - Part Drawing..... 11B-16
 - Replacement 11B-17
 - Cleaning 11B-20
- Oil-water Separator11B-21**
 - Part Drawing..... 11B-21
 - Replacement 11B-22
- Fuel Fine Filter.....11B-24**
 - Replacement 11B-24

11B

Fuel System

General

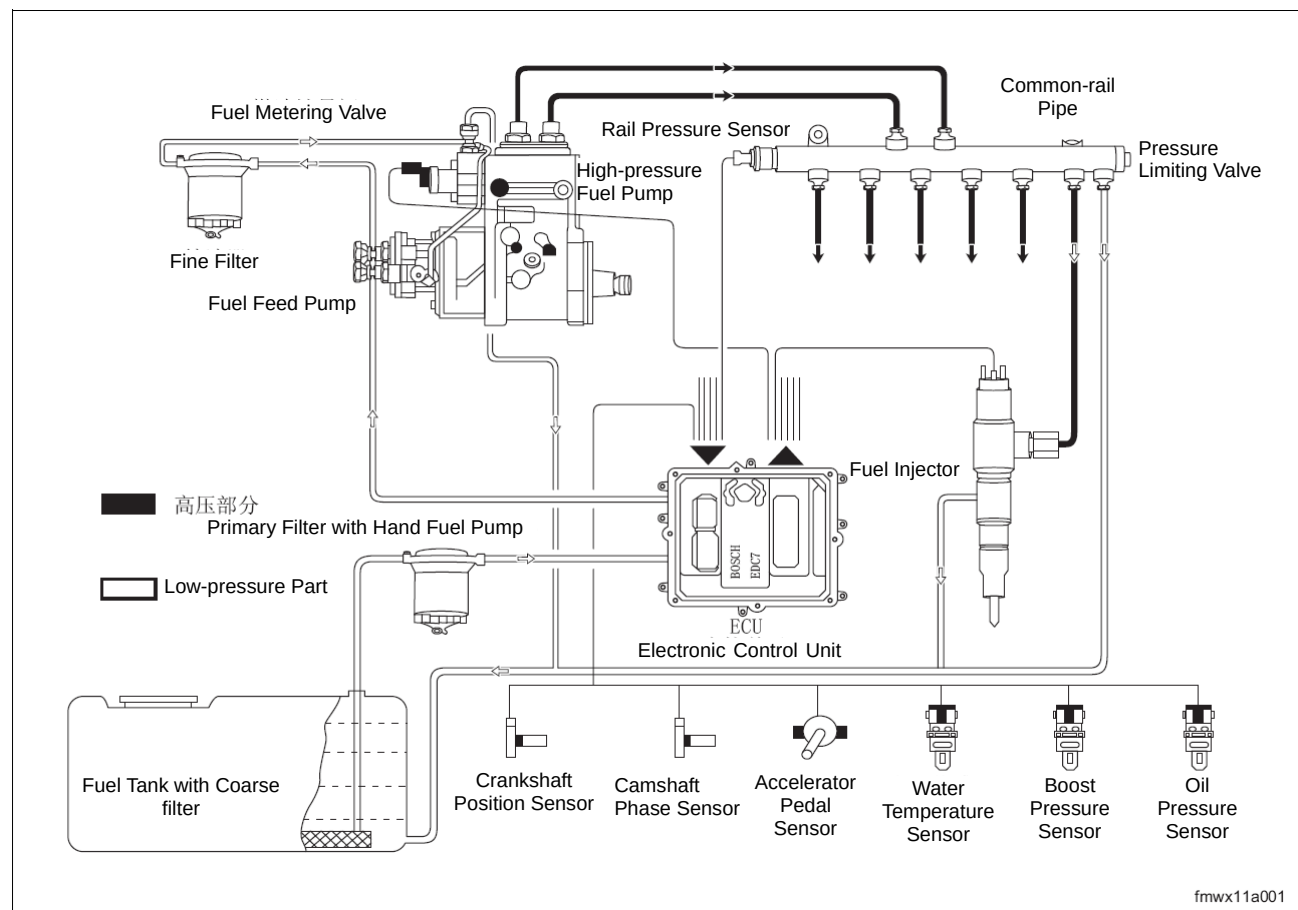
The parameters of the traditional mechanical fuel injection system (injection timing, injection quantity and injection pressure) are controlled by mechanical means. For example, the fuel injection quantity is controlled by a fuel supply gear rack in a fuel injection pump, and the injection timing is controlled by a mechanical timing device, i.e. the fuel injection is controlled by an adjusting device in advance. Therefore, the control range and accuracy are limited. The injection pressure is generated due to the rise of an injection pump plunger, the starting time of the fuel injector is also caused by the rise of the injection pressure, therefore, the control of the fuel injection time is inaccurate, and apparently, according to the needs of a diesel engine, pre-injection and regular repeated injection are even impossible to achieve.

The ECU computer-controlled high-pressure common-rail fuel injection system has the following unique advantages:

1. **Generation of injection pressure is independent of engine speed, and the injection process is relatively independent, which can guarantee the stability of injection pressure.**
2. **Commencement of injection and fuel injection quantity are controlled completely separately, so random accurate control of injection timing can be achieved.**
3. **Multiple injection of pre-injection, main injection and compensation injection can be achieved, which is entirely determined by the performance and emission requirements of the diesel engine.**
In other words, according to the different requirements of diesel engine performance, the fuel injection process can be accurately controlled.
4. **The fuel injection system has sensitive response and can achieve injection control of a variety of speed ranges.**
5. **The accuracy of the fuel injection quantity is higher, and the minimum steady injection quantity is 1mm³ /time.**
6. **The injection pressure is increased (from currently 160Mpa to 180Mpa), so the atomization effect is improved, fuel and air are fully mixed, and the emissions and noise are reduced.**
7. **The driving torque peak value of the fuel pump is smaller, which reduces the driving power and noise.**
8. **The high-pressure common-rail system can replace the traditional fuel injection system in case that the major structural of the diesel engine is unchanged, thereby speeding up the upgrading and improvement of the diesel engine.**

In short, the old mechanical pump is controlled by mechanical means, so the control accuracy, response speed and sensitivity are relatively rough. The high-pressure common-rail fuel system is controlled by a computer, so the control accuracy, response speed and sensitivity of controlling changes are very accurate.

Fuel (WP12) – Fuel System



Seen from the drawing, the high-pressure common-rail fuel injection system basically consists of a low-pressure fuel line, a high-pressure fuel line, an information acquisition part and a control and actuating member, wherein the low-pressure fuel line consists of a fuel tank, a primary fuel filter with a hand fuel pump, a low-pressure fuel supply pump and a fuel fine filter; the high-pressure fuel line consists of a high-pressure fuel pump, a common-rail pipe and a fuel injector; the information acquisition part consists of a crankshaft position sensor, a camshaft phase sensor, an accelerator pedal sensor, a water temperature sensor, a boost pressure and temperature sensor, an oil pressure sensor and other sensors; and the control and actuating member consists of a central processing unit (ECU), a fuel metering valve, a fuel injector solenoid valve, etc. The system also provides a fuel return line, and surplus fuel passing through the high-pressure fuel pump and the fuel injector, and the fuel effluent from a pressure limiting valve after the common-rail pressure exceeds the limited pressure flows back to the fuel tank from the fuel return pipe.

Fuel (WP12) – Fuel System

Information Acquisition Content	To	Control Unit	To	Control and Actuating Content
Accelerator Pedal Position Sensor				Fuel Injection Time
Crankshaft Position Sensor				Fuel Injection Pressure
Camshaft Phase Sensor				Number of Times of Fuel Injection
Common-rail Pressure Sensor				Fuel Injection Quantity
Boost Pressure and Temperature Sensor		(ECU)		Common-rail Pressure
Water Temperature Sensor				Cold Start
Oil Pressure and Temperature Sensor				Start Control
Vehicle Speed Sensor				Air Conditioning Acceleration Control
Air Conditioning Sensor (Air Conditioning Switch)				
Start Signal Sensor (Neutral Position Switch)				

11B

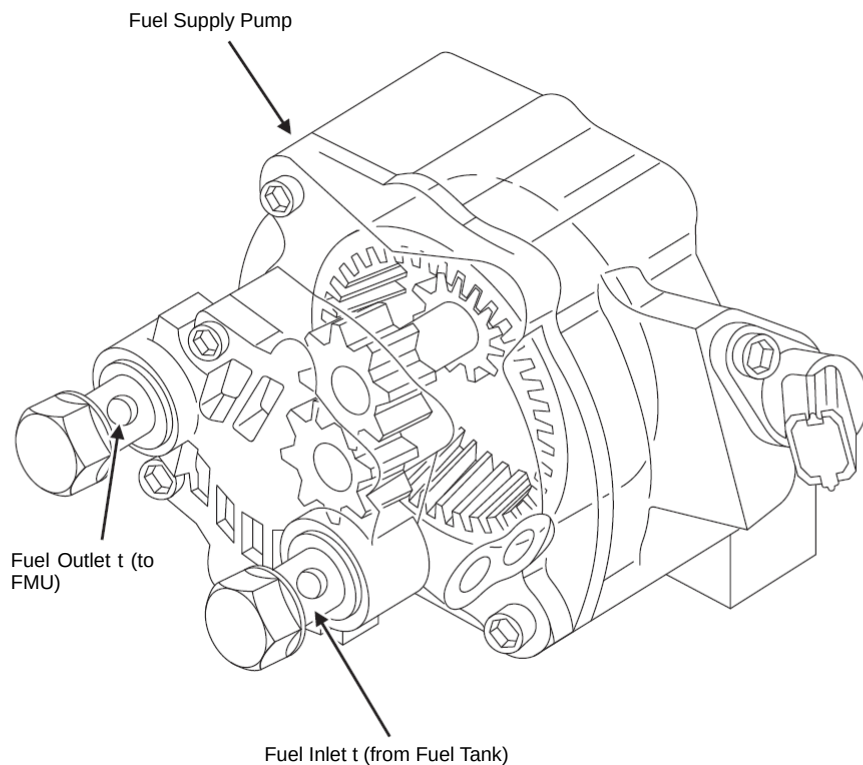
The above is the control process of the Bosch common-rail injection system. The ECU central processing unit collects all instant parameters influencing the dynamic property, economy and emission of diesel fuel, and simultaneously according to the driver's operational command - namely the position of the accelerator pedal, the ECU comprehensively calculates the optimum values of various actuating parameters such as the injection timing, fuel injection pressure, fuel injection quantity, number of times of fuel injection, etc., thereby achieving the optimum operation state of the diesel engine.

Primary Fuel Filter with Hand Fuel Pump

The primary fuel filter with a hand fuel pump is simultaneously provided with an oil-water separator. When the filter filters the fuel, water is gathered in a water collector, and the separated water shall be emptied from a drain screw in time in daily maintenance. The coarse filter is screwed on the filter housing and shall be replaced periodically in maintenance. A hand fuel pump is installed on the filter cover of the coarse filter, and when the filter is assembled for the first time or maintained and replaced, or air exists in the system, the air in the low-pressure loop shall be discharged by the hand fuel pump. An exhaust bolt is arranged on the housing of a filter connecting flange, by unscrewing the exhaust bolt and repeatedly pressing the hand fuel pump, fuel accompanied with air is exhausted from the exhaust bolt until the outflow fuel contains no air, and then the exhaust bolt is screwed.

High-pressure Fuel Pump

The high-pressure fuel pump integrates the low-pressure fuel line and the high-pressure fuel line. The high-pressure pump has two tasks: first, a gear pump connected with the high-pressure fuel pump is the fuel feed pump of the low-pressure fuel line, and the gear pump pumps fuel through the primary fuel filter and the ECU and supplies fuel to the high-pressure pump through the fuel fine filter; and second, two sets of plungers or the high-pressure fuel pump provides high-pressure fuel as high as 160Mpa to the high-pressure common rail.



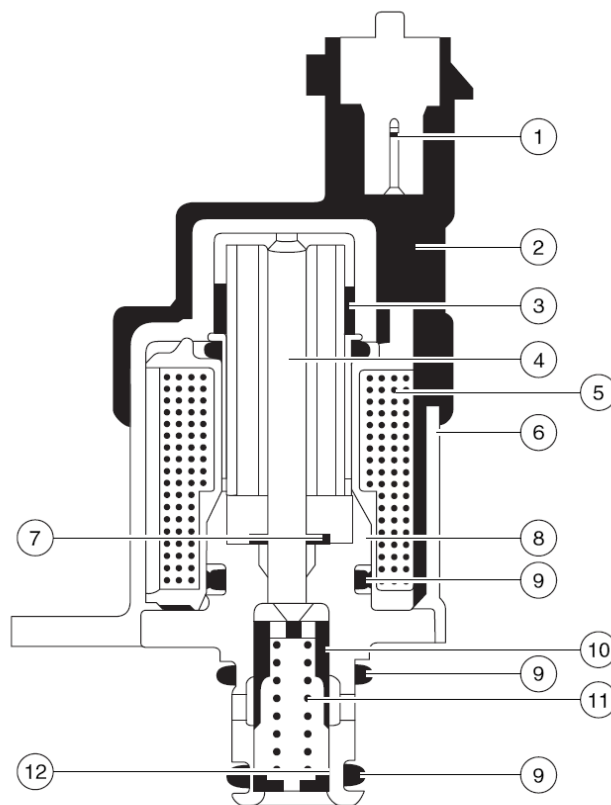
fmwx11a002

In a low-pressure oil path, fuel flows through the ECU inner chamber to perform the function of cooling the ECU.

The fuel feed pump is a straight gear type fuel pump which is driven by driving a straight small gear by an inner ring gear integrated with a camshaft of a high-pressure pump. The fuel feed pump feeds the fuel from the fuel tank to the high-pressure fuel pump.

The high-pressure part of the high-pressure fuel pump comprises two cam type camshafts, a roller type tappet rod, plungers, fuel outlet joints and a fuel metering valve. Two rows of cams are alternately arranged on the camshafts on three surfaces, and when the camshafts rotate, two pairs of plunger pistons simultaneously pump the fuel for six times back and forth. Two fuel outlet valves are arranged in two fuel outlet joints of the high-pressure fuel pump and can supply high-pressure fuel of 160MPa to common-rail pipes.

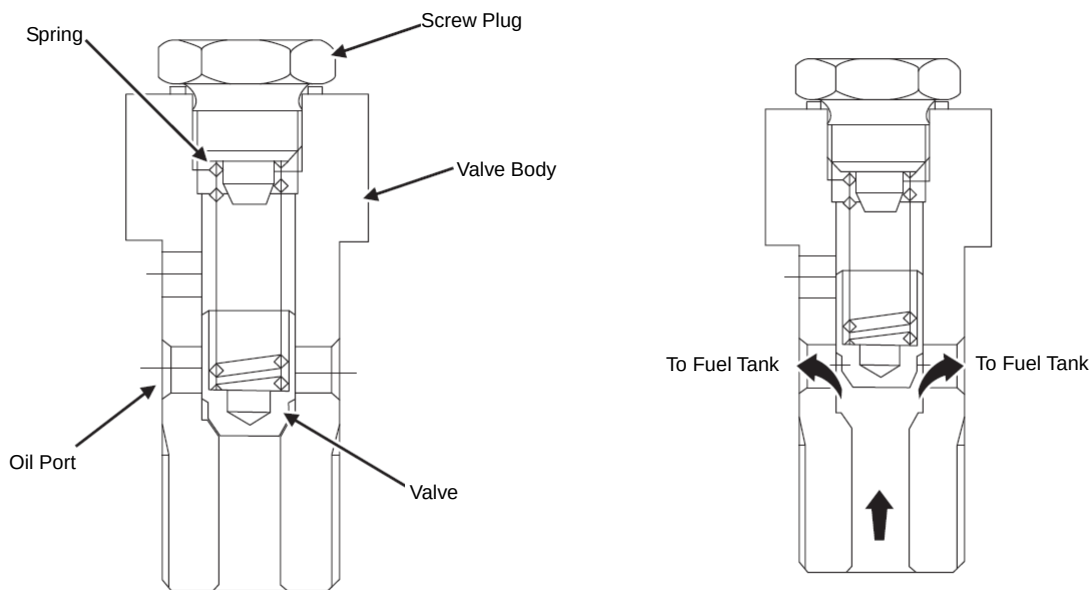
Fuel (WP12) – Fuel System



fmwx11a003

1	Plug	7	Air Gap Gasket
2	Solenoid Valve Housing	8	Magnetic Core
3	Sleeve	9	O-Ring
4	Tappet	10	Plunger with Control Gap
5	Coil	11	Spring
6	Housing	12	Snap Ring

A fuel metering valve is arranged on the fuel outlet pipeline of the high-pressure fuel pump and is mainly used for receiving the instruction of the ECU to randomly change the capacity of the fuel entering the high-pressure pump, thereby changing the high-pressure fuel feed pressure of the high-pressure pump, i.e. changing the common-rail pressure. When a fuel metering unit has a fault, the engine operates at the limited rotation speed of 1500r/min, and meantime, the resistance value of the metering valve is 2.6-3.4 ohm. The ECU controls the capacity of the fuel entering the high-pressure pump by the on-off time of pulse signals. It is noteworthy that when the coil of the fuel metering valve is not electrified, the metering valve is all-pass and can supply maximal fuel flow. In other words, maximal common-rail pressure can be formed.



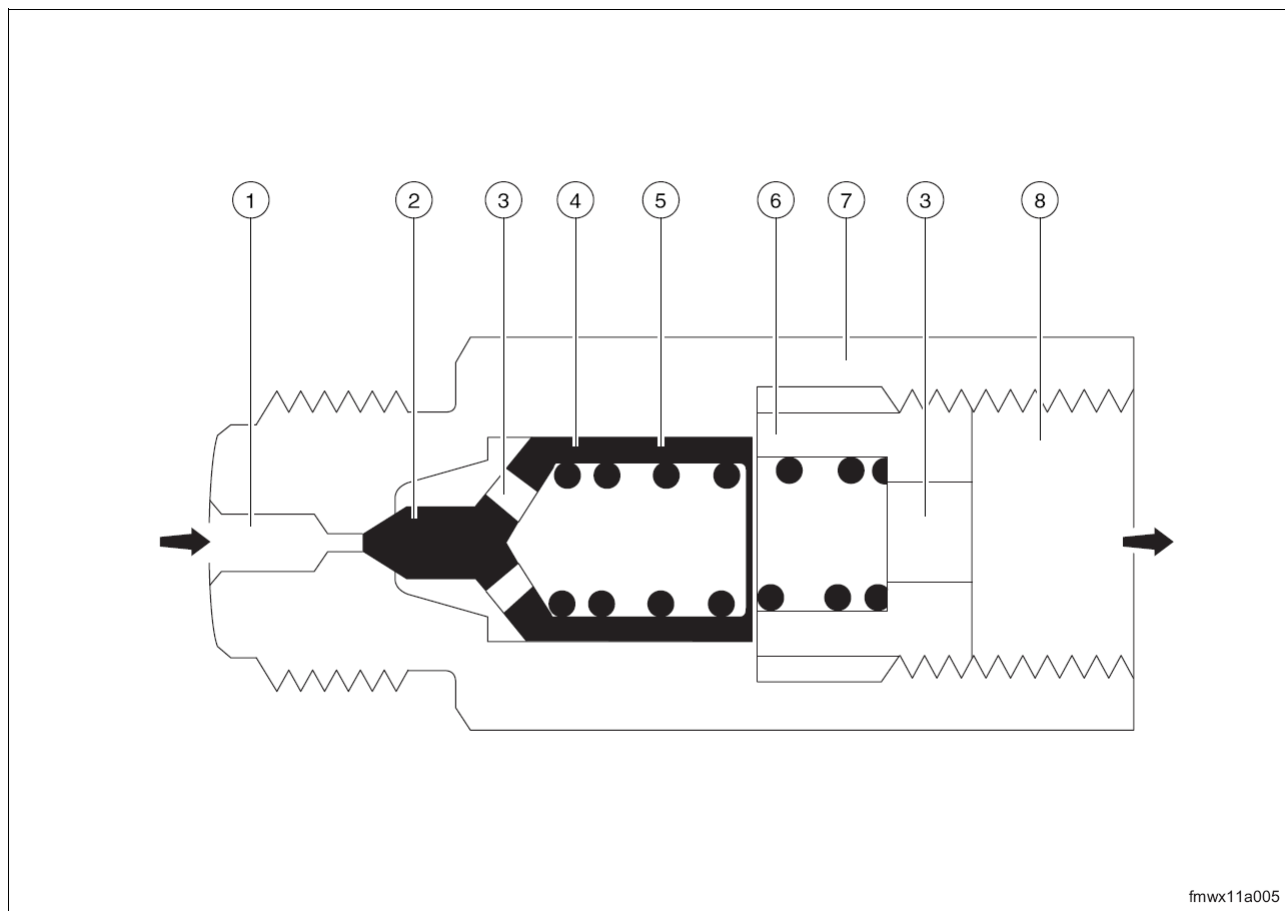
fmwx11a004

The low-pressure fuel feed side of the high-pressure fuel pump is connected with the fuel inlet of the fuel metering valve in parallel and is provided with a fuel return valve. The valve enables the low-pressure fuel path to keep a constant fuel feed pressure, and the fuel return pipeline of the high-pressure fuel pump is connected out of the fuel return valve.

A camshaft phase sensor is arranged in the position of the shell of the high-pressure fuel pump corresponding to a camshaft fluted disc and transfers the random position of the camshaft to the ECU, so that the ECU can recognize the running position of each cylinder of the diesel engine.

High-pressure Common-rail Pipe

The common-rail pipe is a fuel pressure storing device which distributes the high-pressure fuel provided by the high-pressure fuel pump to each fuel injector and weakens the pulsation of the fuel feed pressure of the high-pressure fuel pump and the pressure oscillation generated by fuel injection of each fuel injector, so that the pressure fluctuation of the high-pressure fuel path is controlled in a certain range. Meanwhile, the fuel pressure in the common-rail pipe is also controlled by the fuel metering valve controlled by the ECU, thereby determining the fuel delivery of each fuel injector according to the working condition of the diesel engine. A common-rail pressure sensor is installed at the left end of the common-rail pipe, and the sensor transfers the fuel pressure in the common-rail pipe to the ECU at any time, so that the ECU can adjust the fuel flow valve as required to change the common-rail inner fuel pressure value. A pressure limiting valve is also arranged on the common-rail pipe, and the pressure limiting valve is opened when the pressure in the common-rail pipe exceeds 160Mpa, so that the maximum pressure in the common-rail pipe can not exceed the set value of 160Mpa.



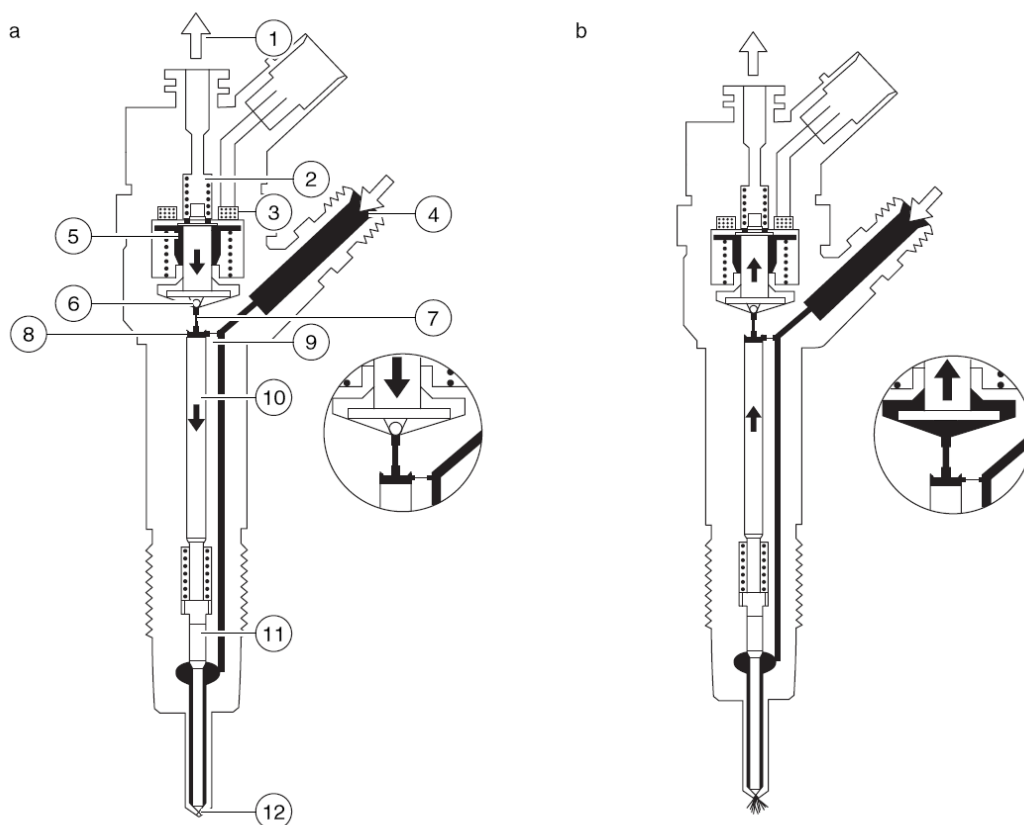
1	High-pressure Connector (to Common-rail Pipe)	5	Spring
2	Valve Needle	6	Limiting Sleeve
3	Channel	7	Valve Body
4	Valve Spool	8	Fuel Return Channel

Fuel Injector

An electric control fuel injector is a key position of a fuel injection system, and nearly all of the elements of an electric control system finally serve for the fuel injector. The injection of the fuel injector is controlled by the ECU, and the ECU controls the fuel injection quantity, the injection timing, the fuel injection pressure and the number of times of fuel injection of the fuel injector according to the state information input by each sensor of the engine and the instruction of the driver, thereby achieving optimal output of the instant state.

The control of the fuel injection pressure is generated on the common-rail pressure provided by the high-pressure fuel pump, and the injection timing, the fuel injection duration and the number of times of fuel injection are controlled by voltage signals output by the ECU through a solenoid valve at the upper part of the fuel injector. The fuel injection quantity of the fuel injector is obviously determined by the common-rail pressure and the opening time of the needle valve of the fuel injector, wherein the higher the fuel injection pressure is, the longer the opening time of the needle valve is, and the larger the fuel injection quantity is.

At present, a fuel injector with seven holes is used by the national III diesel engine.



fmwx11a006

1	Fuel Return Connector
2	Return Spring
3	Solenoid Valve Coil
4	Fuel Inlet Connector
5	Solenoid Valve Spool
6	Ball Valve

7	Drain Hole
8	Control Chamber
9	Fuel Inlet
10	Plunger
11	Needle Valve
12	Nozzle

The high-pressure fuel from the common-rail pipe enters the fuel injector through the fuel inlet joint and enters the control chamber through fuel inlet holes, the high-pressure fuel generates downward pressure on the upper cross section of the plunger piston, and simultaneously, the high-pressure fuel enters the lower chamber and acts on the lower annular area of the needle valve to generate an acting force for pushing the plunger piston upward. Because the area of the upper cross section of the plunger piston is obviously greater than the lower annular area of the needle valve, the downward force acting on the plunger piston is obviously greater than the upward force acting on the needle valve; meantime, the needle valve is tightly pressed on the injector nozzle under the action of the downward force of the plunger piston and the action of the spring of the needle valve; and meantime, the nozzle is closed, and the fuel injector is in an injection stopping state.

When the ECU switches on the solenoid valve of the fuel injector, the solenoid valve core is attracted upward, the ball valve pressing on the drain hole opens the drain hole, and the fuel pressure acting in the control chamber is unloaded through the throttling fuel feed hole; and meantime, the fuel pressure acting on the lower annular cross section of the needle valve overcomes the spring pressure to quickly push the needle valve upward, thereby opening the orifice of the nozzle for injecting fuel. When the voltage signals of the ECU disappear, the solenoid valve core enables the ball valve to close the drain hole under the action of the return spring, the plunger piston immediately enables the needle valve to return to the original position under the action of the high-pressure fuel of the control chamber, the fuel injection hole is closed, and the fuel injector stops injecting. Because lifting and closing of the needle

Fuel (WP12) – Fuel System

valve are determined by the difference of the hydraulic pressure on the upper cross section of the plunger piston and the lower annular area of the needle valve, the force of the solenoid valve for lifting the valve core does not need to be very large, so that the reaction speed of the fuel injector is high and is 0.1-0.3ms generally, thus accurate and sensitive injection can be realized.

ECU (central processing unit)

The ECU is the nerve center of the electric control fuel injection system, is actually a simple computer, gathers various kinds of state information of running of the diesel engine through the sensor, simultaneously receives the instruction transferred by the driver through the accelerator pedal sensor, and determines the fuel injection quantity, the injection timing and the number of times of fuel injection of the fuel system through simple and quick operation (the ECU can control the fuel injector for injecting fuel for 5 times in each process of circulation, and only a preliminary injection process and a main injection process are used at present), so that the diesel engine can run in the optimal state in any working condition.

Another function of the ECU is to realize reliable self-control operation. For example, in order to ensure the safety in the process of starting the engine, a neutral switch is arranged on the gearbox, and the control circuits of the neutral switch and the starter are controlled by the ECU; and when the engine is started, if the gearbox is shifted in any gear, the starting circuits of the engine are broken, so that the engine can not be started. When the driver opens the air conditioner, the ECU controls the idle speed of the engine to be improved, so that the engine at the idle speed can not flame out; and if the PTO power is output, the ECU controls the engine to adapt to the needs of load change to automatically adjust the output of the torque, etc.

The ECU has self-diagnostic capability of faults, reflects the running faults of the diesel engine caused by the electric control fuel injection system in the form of fault flash codes, and can store the faults, so that the faults can be found visually or by a fault diagnosis instrument, thereby providing the convenience for quickly and accurately processing the faults.

The ECU also has a function of "limp home", i.e. when the diesel engine has a fault which affects the working reliability and safety, before the fault is eliminated, the ECU can output a "default" for each executive component, wherein the "default" means that under the preset condition which can not affect the fault extension, the engine only can maintain general running instructions; meantime, the rotation speed of the engine can not exceed 1500r/min, and the engine can not exert full power, thus the driver only can reluctantly drive the vehicle to the home or the maintenance point; and after the fault is eliminated, the vehicle can restore.

The ECU is provided with three sockets of the connector assembly, wherein one socket has 36 pins and is connected with the wiring harness of the sensors, one socket has 16 pins and is connected with the fuel injector and other executive components, and the maximal socket has 89 pins (only more than 40 pins are used currently) and is connected with the wiring harness of the whole vehicle. The wiring harness of the whole vehicle is not only connected with each sensor of the whole vehicle (such as the neutral switch of the gearbox, the master cylinder switch of the clutch, the gas pressure sensor, etc.) and is also provided with a CAN communication bus (not arranged on the vehicle) and a K line. The CAN bus is a communication bus connected with other computer devices of the whole vehicle, and the K line is a fault finding cable connected with the electric control injection diagnosis instrument.

The ECU is generally installed at the intake pipe side of the diesel engine and simultaneously needs to be cooled by the fuel.

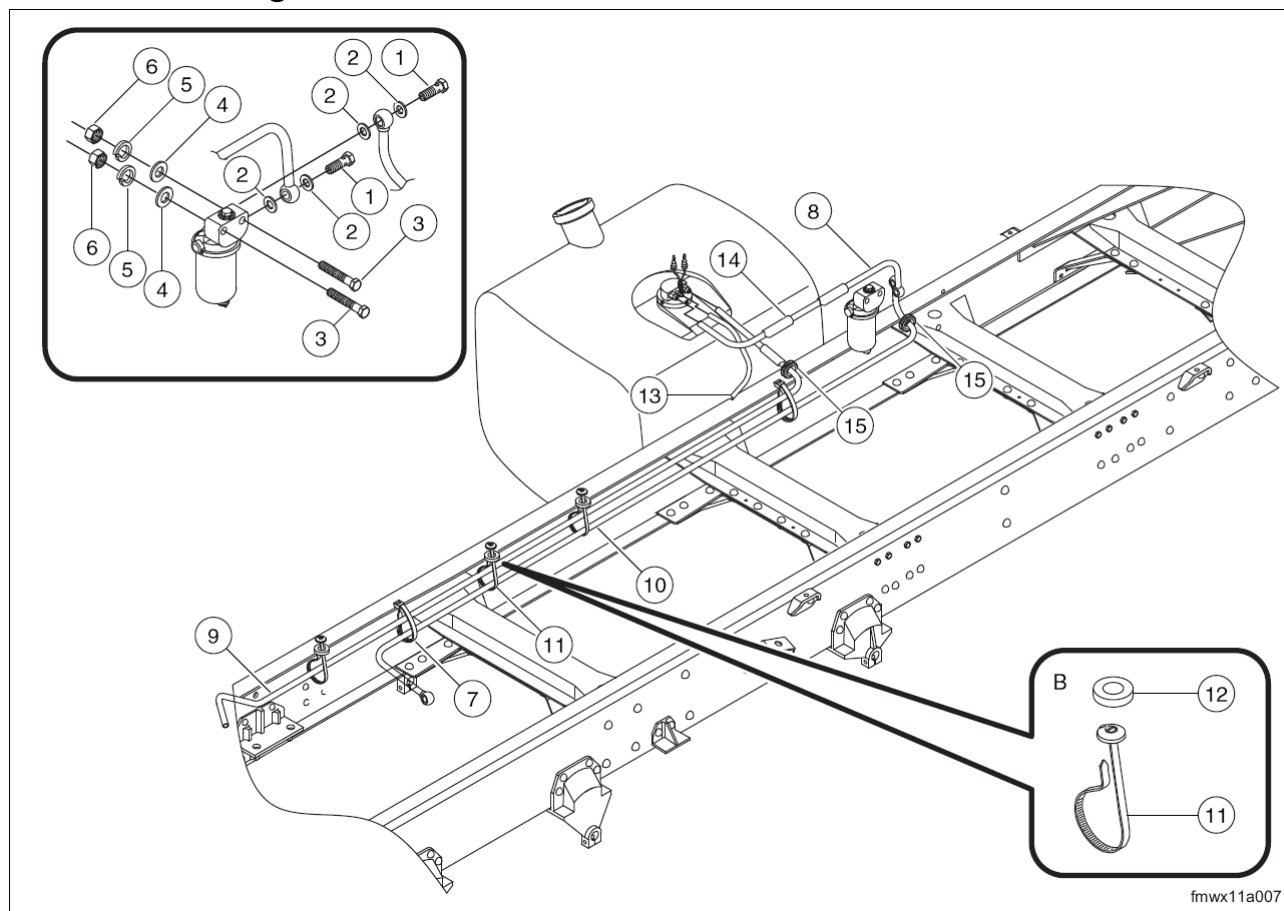
Precautions

1. Before checking and maintaining the fuel system, disconnect the battery negative cable.
2. Because the fuel is an inflammable substance, when the fuel system is operated, enable cigarettes, naked flame, indicating lamps, arc equipment and switches to be far from the working area, and provide ventilating equipment in the working area to avoid occurrence of personal injury or even death.
3. In order to avoid personal injury, never loosen any fuel pipe joint when the engine runs.
4. Keep the fuel away from rubber or leather components.
5. Manufacture the diesel fuel injection equipment according to very accurate tolerance and gaps. Thus, when the fuel system is operated, absolutely clean working environment is very important. Use special plugs to close all openings.
6. Before disconnecting the fuel system pipeline, check and confirm whether dirt or impurity exists around the fuel pipe joint or not, and if the dirt or impurity exists around the fuel pipe joint, clean the dirt or impurity, wherein the dirt or impurity may damage the fuel system or the engine.
7. Do not forcibly bend or twist the fuel system pipeline.
8. Before connecting each pipeline of the fuel system, ensure that each fuel pipe joint is not damaged, and if the fuel pipe joint is damaged or has cracks, replace the fuel pipe assembly and ensure that no dirt exists on the surface of the fuel pipe connecting surface.

11B

Fuel (WP12) – Fuel System

Part Drawing



1	Hinged Bolt
2	Flat Washer
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Hex Head Nut-Style 1
7	Tightening Strap
8	Fuel Supply Pipe - Fuel Tank to Coarse filter

9	Fuel Return Pipe
10	Fuel Supply Pipe - Coarse filter to Engine
11	Cable Tie
12	Rubber Cushion Block
13	Air Bleed Pipe
14	Spiral Sleeve
15	Rubber Ring - Through Hole

Testing & Adjustment

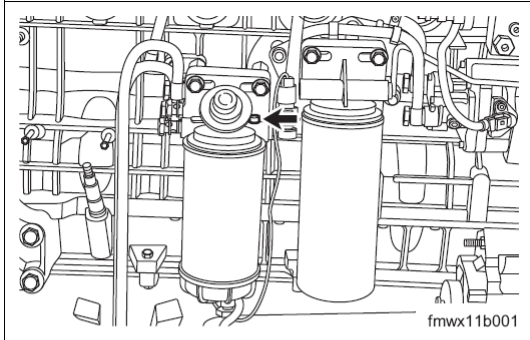
Exhaust of Fuel System

When replacing the coarse filter, reassembling the fuel delivery pipe, or emptying the fuel tank, air will enter the fuel system. If air enters the fuel system, the flow of fuel to the engine will be hindered and can not flow smoothly. To prevent this from happening, the fuel system shall be exhausted.

Hint:

Part Drawing, refer to Chapter 11B, Fuel - Oil-water Separator, Part Drawing

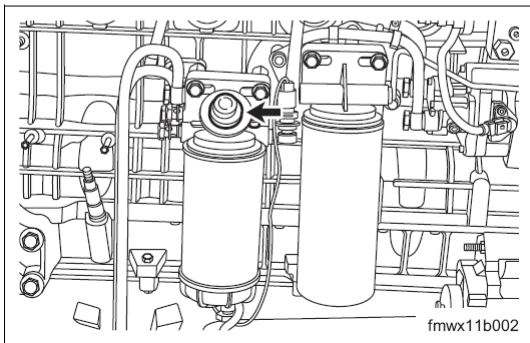
1. Stop the engine.



2. Dismantle air bleed screw

3. Inflate with hand pump

- (a). Inflate with a hand pump until only fuel flows out from the air bleed screw.



4. Install air bleed screw



Fuel (WP12) – Fuel System

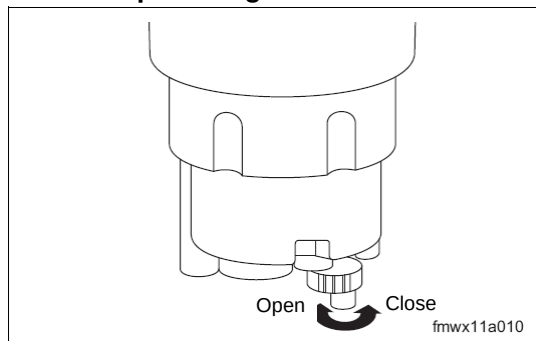
Drain water collector

When the water collector is full, drain the collected water.

Warning:

There is danger of freezing. Drain the water before freezing.

1. Stop the engine.



2. Dismantle drain screw

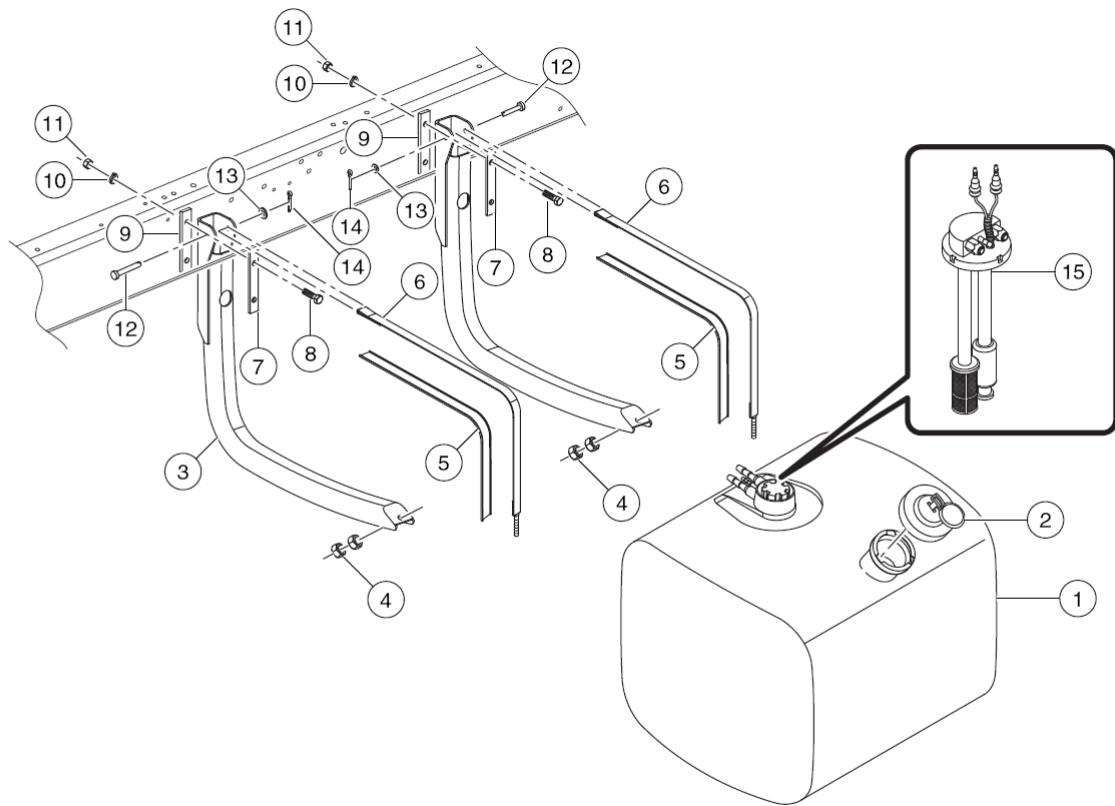
- (a). Open the drain screw at the bottom of the water collector to drain the water.

3. Install drain screw

11B

Fuel Tank

Part Drawing



fmwx11a019

1	Fuel Tank Assembly, 260L, Aluminum Alloy
2	Fuel Tank Lock Assembly
3	Bracket Assembly
4	Hex Head Nut - Style 1
5	Rubber Rim Strip
6	Tightening Pull Strap Assembly
7	Base Plate - Fuel Tank
8	Hex Head Bolt - Fine Thread

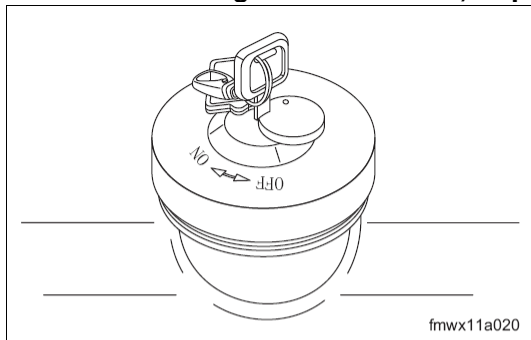
9	Base Plate - Fuel Tank
10	Spring Washer
11	Hex Head Nut, Style 1 - Fine Thread
12	Pin Shaft
13	Flat Washer
14	Cotter Pin
15	Fuel Sensor

Replacement

Hint:

Part Drawing, refer to Chapter 11A, Fuel - Fuel Tank, Part Drawing

1. **Open cargo box**
2. **Disconnect battery negative cable**
3. **Dismantle guardrail assembly of cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**

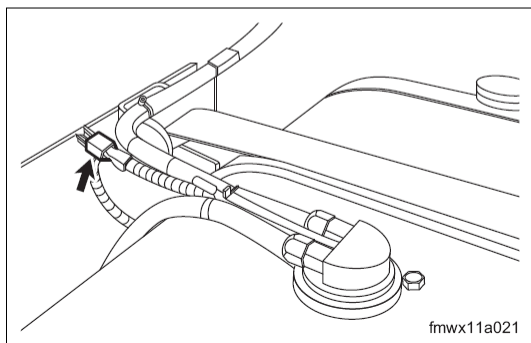


4. **Release fuel pressure**
 - (a). Insert the key to open the fuel tank lock.
 - (b). Unscrew the fuel tank lock assembly.

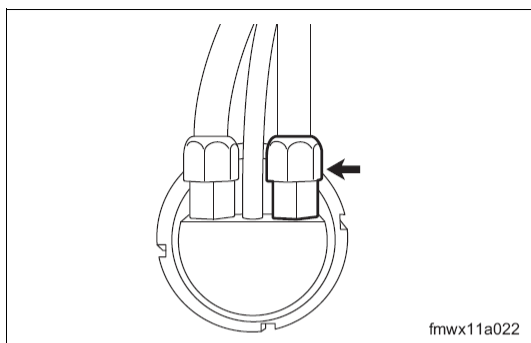
Caution:

Be sure to use clean, soft cloth to plug the fuel filler.

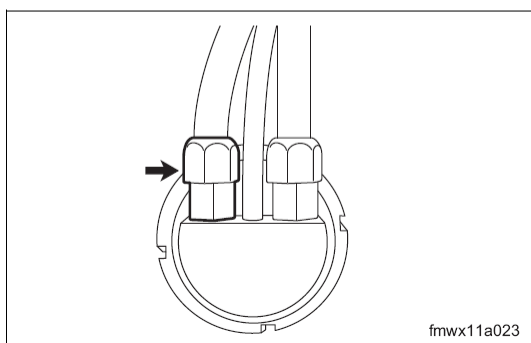
11B



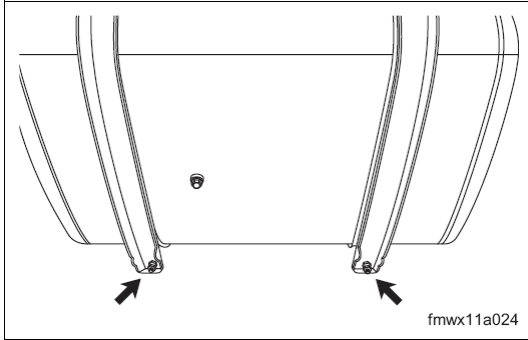
5. **Disconnect connector of fuel sensor**
 - (a). Disconnect the connector of the fuel sensor.



6. **Disconnect outlet pipe of fuel tank**
 - (a). Disconnect the connector nut of the outlet pipe of the fuel tank.



7. **Disconnect fuel return pipe of fuel tank**
 - (a). Disconnect the connector nut of the fuel return pipe of the fuel tank.

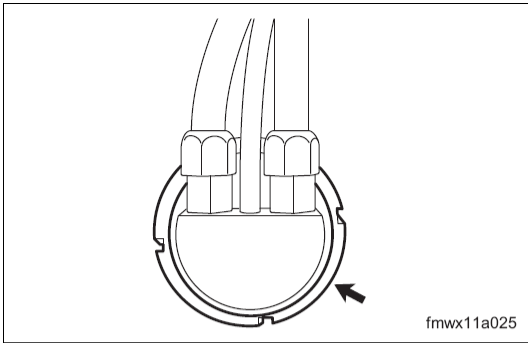


8. Dismantle fuel tank assembly

- (a). Dismantle the fixing nut of the tightening pull strap.
- (b). Take off the tightening pull strap of the fuel tank.
- (c). Dismantle the fuel tank assembly.

Caution:

- Before operation, check and make sure there is no lines, wiring harness or other foreign matters around the fuel tank, and clean up if necessary.
- When lifting the fuel tank, due to large size, use appropriate tools or operate with the help of others if necessary.
- Because the fuel tank is an aluminum alloy workpiece, avoid collision in the process of dismantlement, handling and installation.

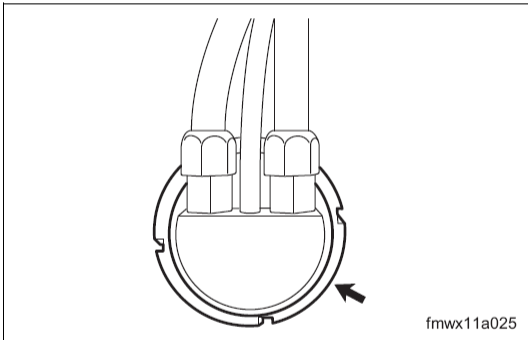


9. Dismantle fuel sensor

- (a). Loosen the sealing cover of the fuel sensor with a special tool.
- (b). Rotate the fuel sensor to a proper angle and take it out lightly.

Caution:

- Before operation, check and make sure there is no dirt or other foreign matters around the fuel sensor, and clean up if necessary.
- There is a rubber seal ring in the sealing cover of the fuel sensor. Do not damage the seal ring while dismantling.

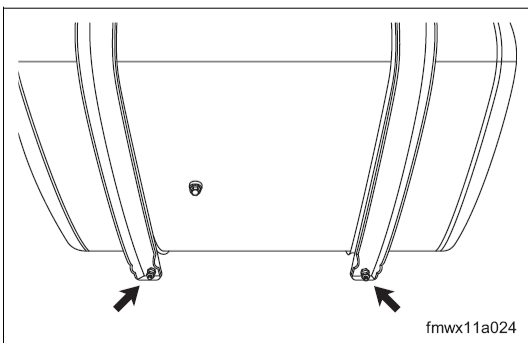


10. Install fuel sensor

- (a). Rotate the fuel sensor to a proper angle and install to the right position of the fuel tank.
- (b). Screw down the sealing cover of the fuel sensor with a special tool.

Caution:

When installing the fuel sensor, insert after rotating to the proper angle, and do not cause warp or deformation.



11. Install fuel tank assembly

- (a). Install the fuel tank assembly on the fuel tank bracket and fix to the right position.
- (b). Install the fixing nut of the tightening pull strap of the fuel tank.

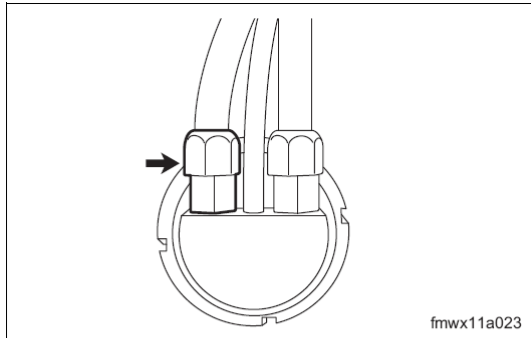
Torque: 45±5N.m(M10)

Torque: 81±8N.m(M12)

Fuel (WP12) – Fuel Tank

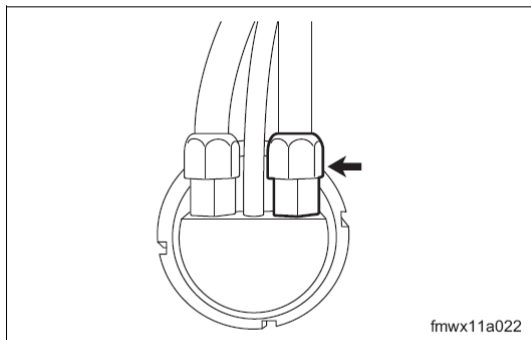
Caution:

- The tightening pull strap of the fuel tank and the connecting nut of the fuel tank bracket shall be fastened to the specified torque. Excessive torque will cause deformation of the fuel tank.
- The fuel tank shall be connected firmly and reliably without abnormal vibration.
- Each rubber rim strip shall be even and level.

**12. Install fuel return pipe of fuel tank**

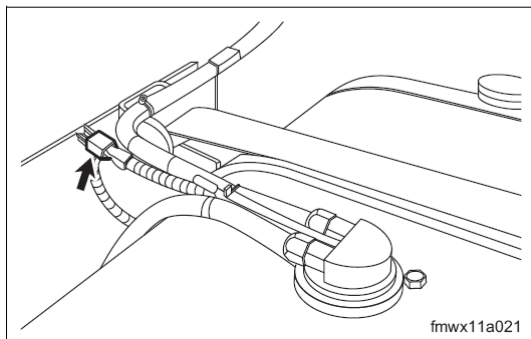
- (a). Install the connector nut of the fuel return pipe of the fuel tank.

Torque: 46±5N.m

**13. Install outlet pipe of fuel tank**

- (a). Install the connector nut of the outlet pipe of the fuel tank.

Torque: 46±5N.m

**14. Install connector of the fuel sensor**

- (a). Install the connector of the fuel sensor.

15. Install fuel tank lock assembly

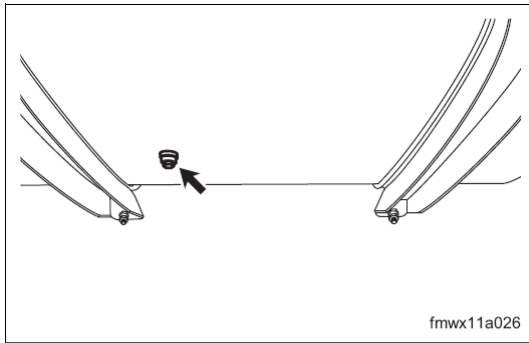
- (a). Check whether the fuel tank lock and gasket are deformed or damaged. Replace the fuel tank lock assembly if necessary.
- (b). Periodically lubricate the rotating part.

16. Exhaust of Fuel System, refer to Chapter 11B, Fuel - Fuel System, Testing & Adjustment**17. Install battery negative cable****18. Inspect**

- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joints of the fuel system.

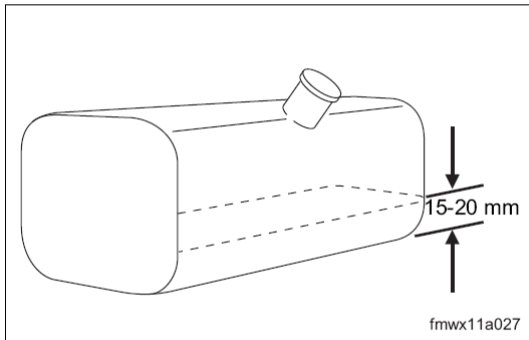
19. Install the guardrail assembly of the cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**20. Put down cargo box**

Cleaning



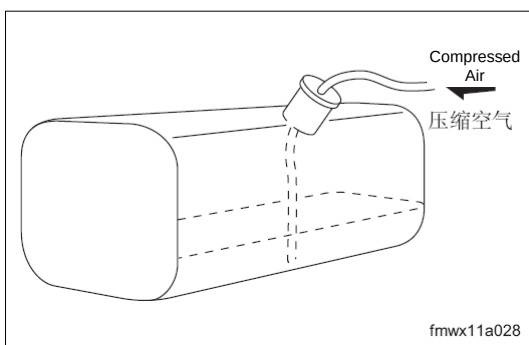
1. Drain fuel

- (a). Open the fuel tank lock assembly, unscrew the drain plug of the fuel tank, after draining the trapped fuel, clean up dirt on the drain plug and then install the drain plug.



2. Fill clean fuel

- (a). Fill up the fuel tank with fuel until the distance from the fuel level to the bottom of the fuel tank is 15-20mm.



3. Clean fuel tank assembly

- (a). Insert a hose with a spraying nozzle into the bottom of the fuel tank.
- (b). Connect the hose with an air duster gun.
- (c). Plug the fuel filler with a clean, soft cloth, and open the switch of the air duster gun for flushing.
 - Change the position of the spraying nozzle while flushing so that precipitate and adherent matters are flipped along with fuel.

4. Clean fuel tank assembly for many times

- (a). After flushing the whole fuel tank with the spraying nozzle, unscrew the drain plug to drain the dirty oil, and repeat twice to thrice to clean completely

5. Check fuel tank assembly

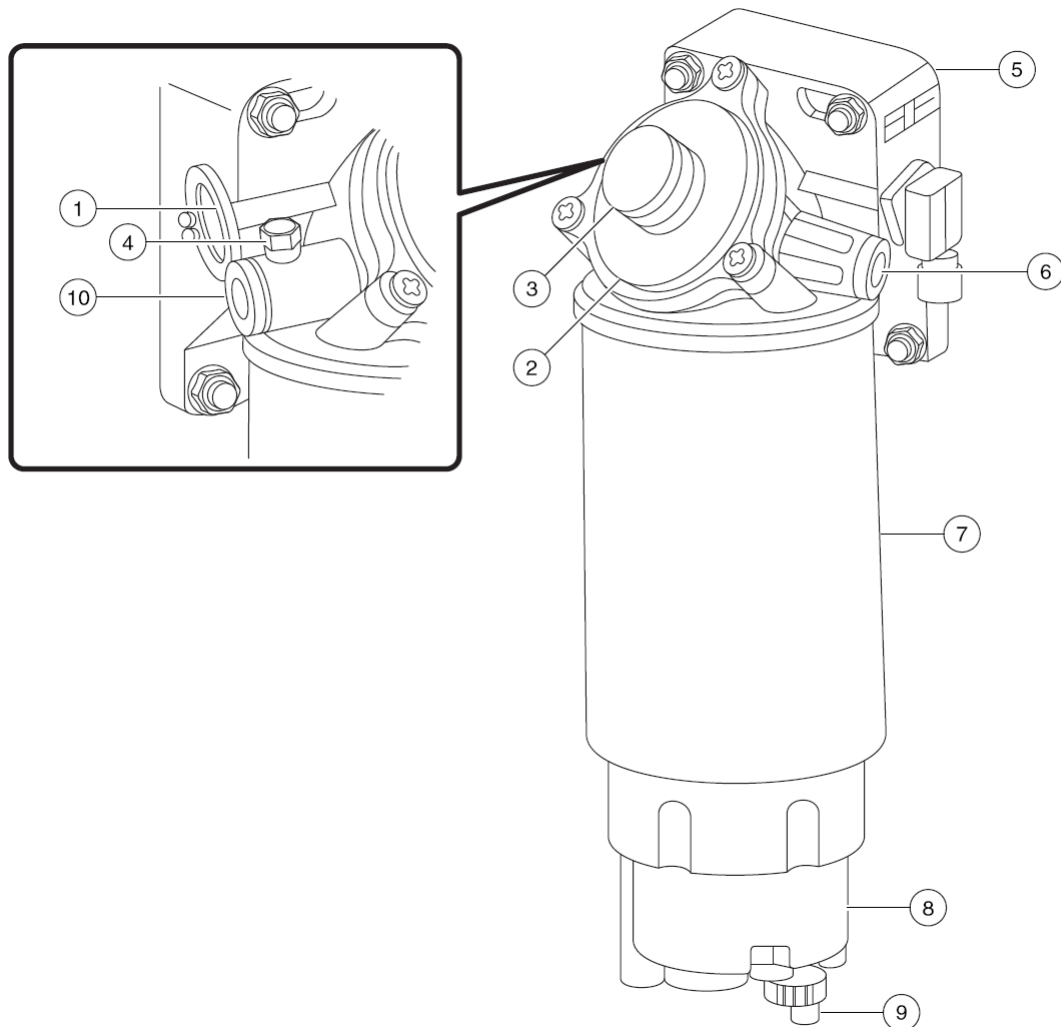
- (a). After cleaning the fuel tank, check whether the fuel tank is damaged, and the damage shall be promptly dealt.

6. Install fuel tank lock assembly

- (a). Check and clean the filter screen of the filler port of the fuel tank.

Oil-water Separator

Part Drawing



fmwx11a029

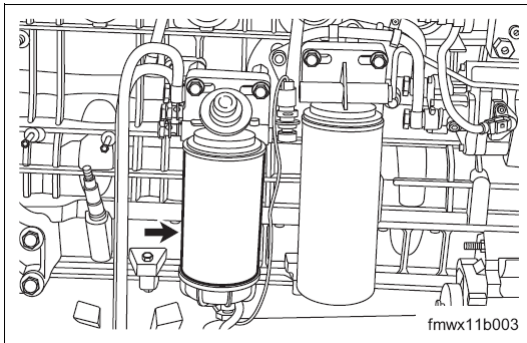
1	Fuel Inlet
2	Filter Cover
3	Hand Pump
4	Air Bleed Screw
5	Mounting Flange

6	Fuel Outlet
7	Spinning Filter
8	Water Collector
9	Drain Screw
10	Fuel Outlet

Replacement

Hint:

Part Drawing, refer to Chapter 11B, Fuel - Oil-water Separator, Part Drawing

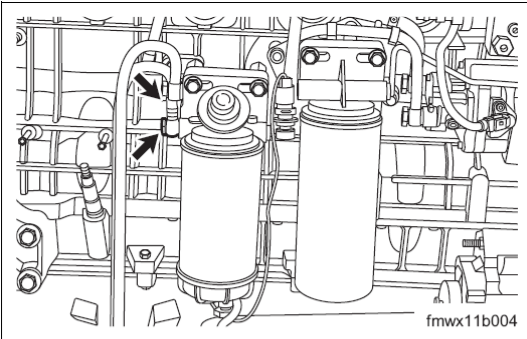


1. Dismantle oil-water separator

- (a). Counterclockwise rotate with a fuel filter wrench to dismantle the oil-water separator.

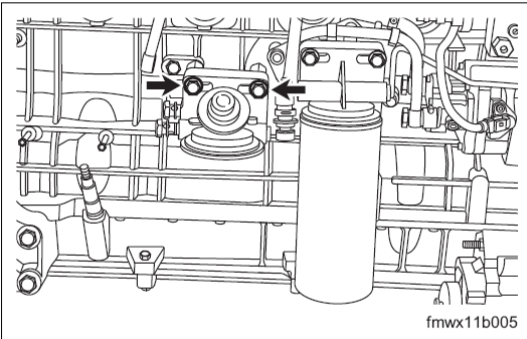
2. Check oil-water separator seat

- (a). Check whether the fuel filter seat has defects such as cracks, scratches, obvious damage, etc. Replace with new parts if necessary.

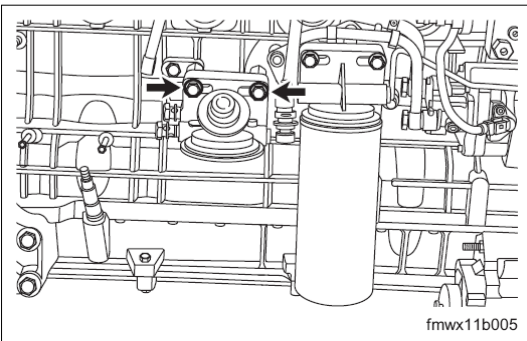


3. Dismantle oil-water separator seat

- (a). Dismantle the hinged bolts of the inlet and outlet pipes.



- (b). Dismantle the fixing bolt of the oil-water separator seat.



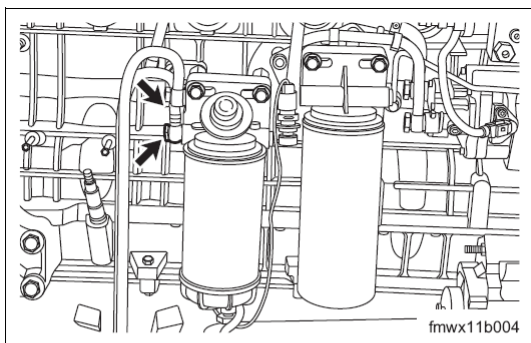
4. Install oil-water separator seat

- (a). Install the fixing bolt of the oil-water separator seat.

Torque: 45±5N.m(M10)

Torque: 81±8N.m(M12)

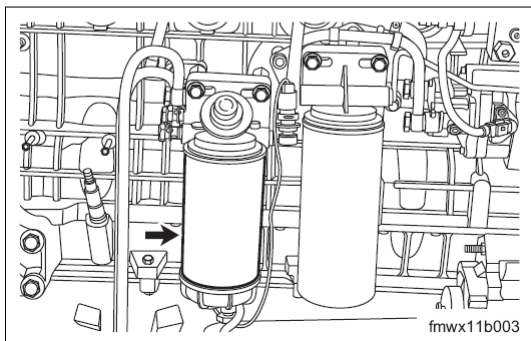
Fuel (WP12) – Oil-water Separator



- (b). Install the hinged bolts of the inlet and outlet pipes.
Torque: 45±5N.m

Caution:

Check the washers of the inlet and outlet pipes, and replace with new parts if necessary.



5. Install oil-water separator

- (a). Apply a small amount of lubricating oil on the seal ring of the oil-water separator.
(b). Screw on the oil-water separator by hand until the seal ring is combined with the interface.
(c). Clockwise screw down the oil-water separator with the fuel filter wrench (for about 3/4 round).

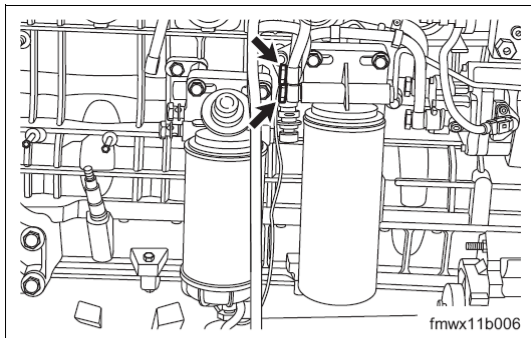
11B

6. Exhaust of Fuel System, refer to Chapter 11A Fuel - Fuel System, Testing & Adjustment

7. Inspect

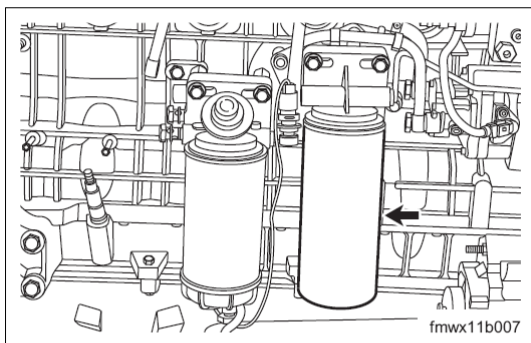
- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joint of the fuel system.

Fuel Fine Filter Replacement

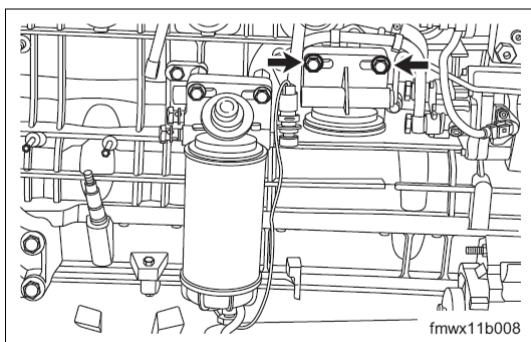


1. Dismantle fuel fine filter

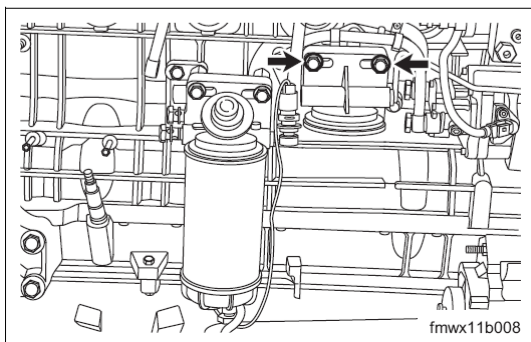
- (a). Dismantle the inlet and outlet pipes of the fuel fine filter.



- (b). Dismantle the fuel fine filter with a fuel filter wrench.



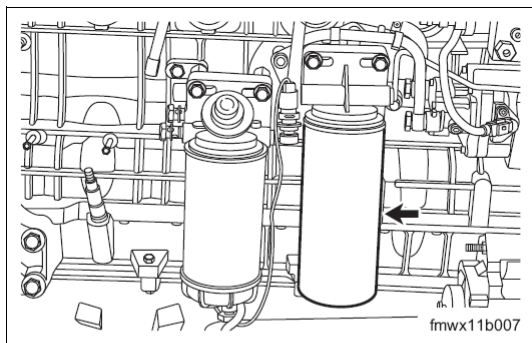
- (c). Dismantle the fuel fine filter seat.



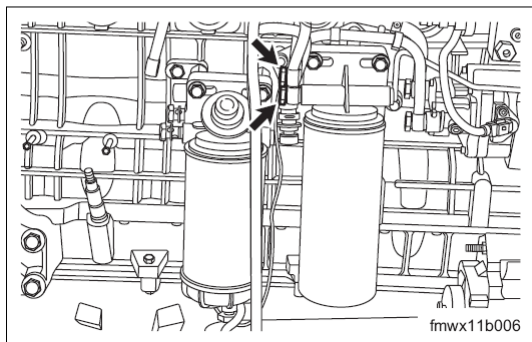
2. Install fuel fine filter

- (a). Install the fuel fine filter seat.
Torque: 45±5N.m (M10)
Torque: 81±8N.m (M12)

Fuel (WP12) – Fuel Fine Filter



- (b). Install the fuel fine filter with a fuel filter wrench.



- (c). Install the inlet and outlet pipes of the fuel fine filter.

Torque: 45±5N.m

Caution:

Check the washers of the inlet and outlet pipes, and replace with new parts if necessary.

11B

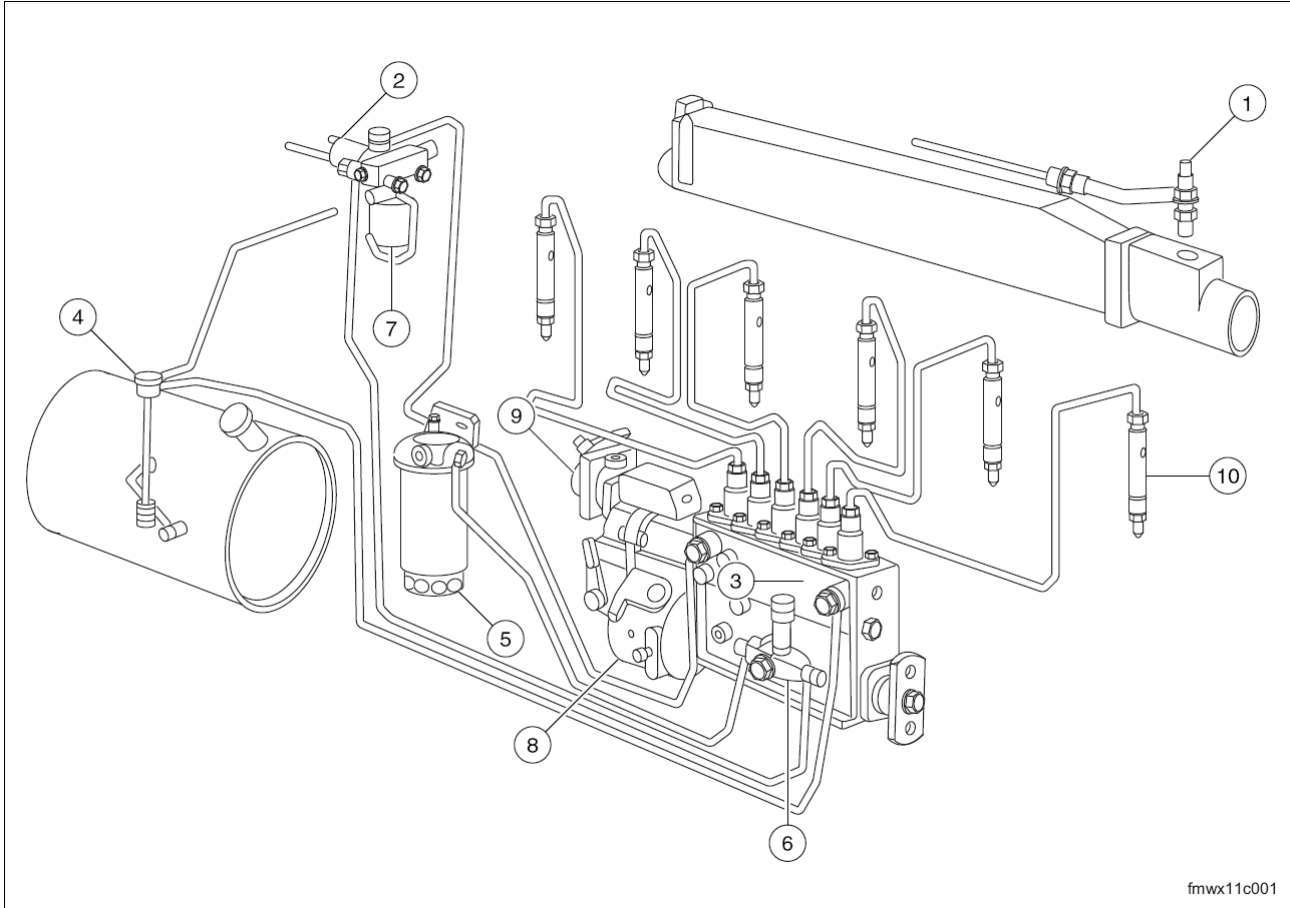
Fuel (WD615)

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Fuel Injection Pump	11C-34
Replacement	11C-34
Fuel Injector	11C-39
Overhaul	11C-39
Fuel Injector Sleeve.....	11C-41
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Fuel System

General

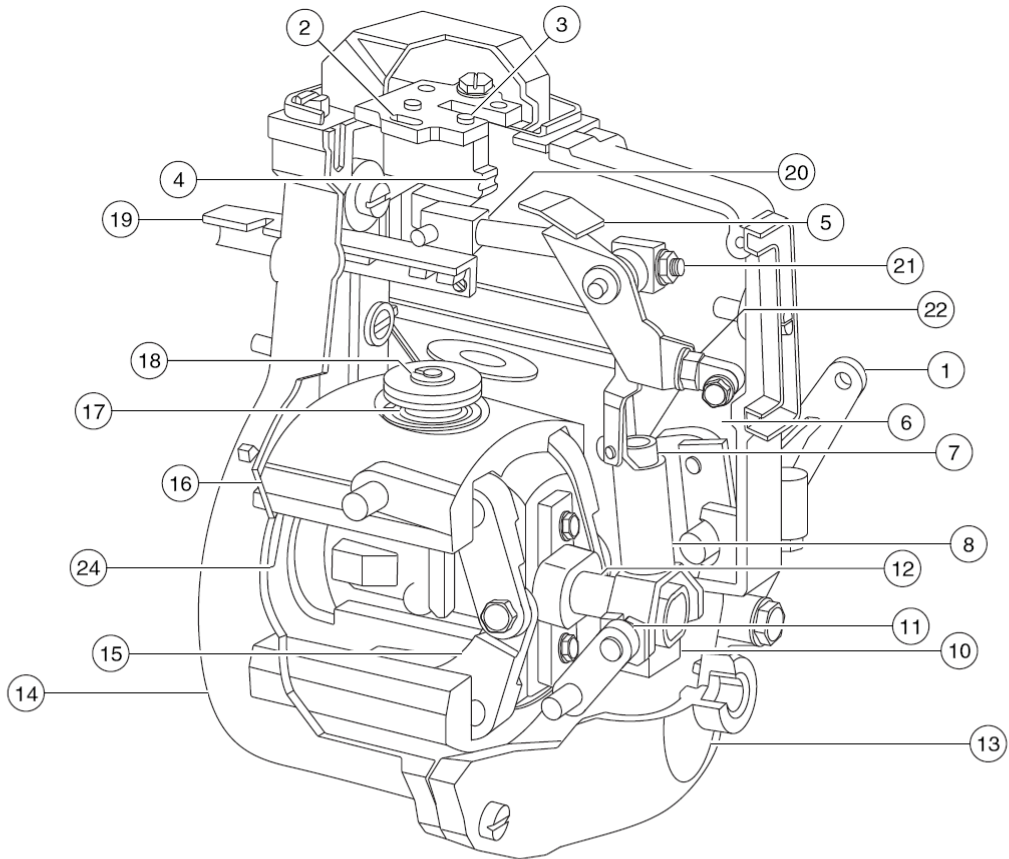
WD615 series diesel engine adopts a typical plunger in-line pump type fuel injection system. The key position of the fuel injection system is a P type intensified fuel injection pump with an RQV or RQV-K type full-range governor and a rear smoke limiter.



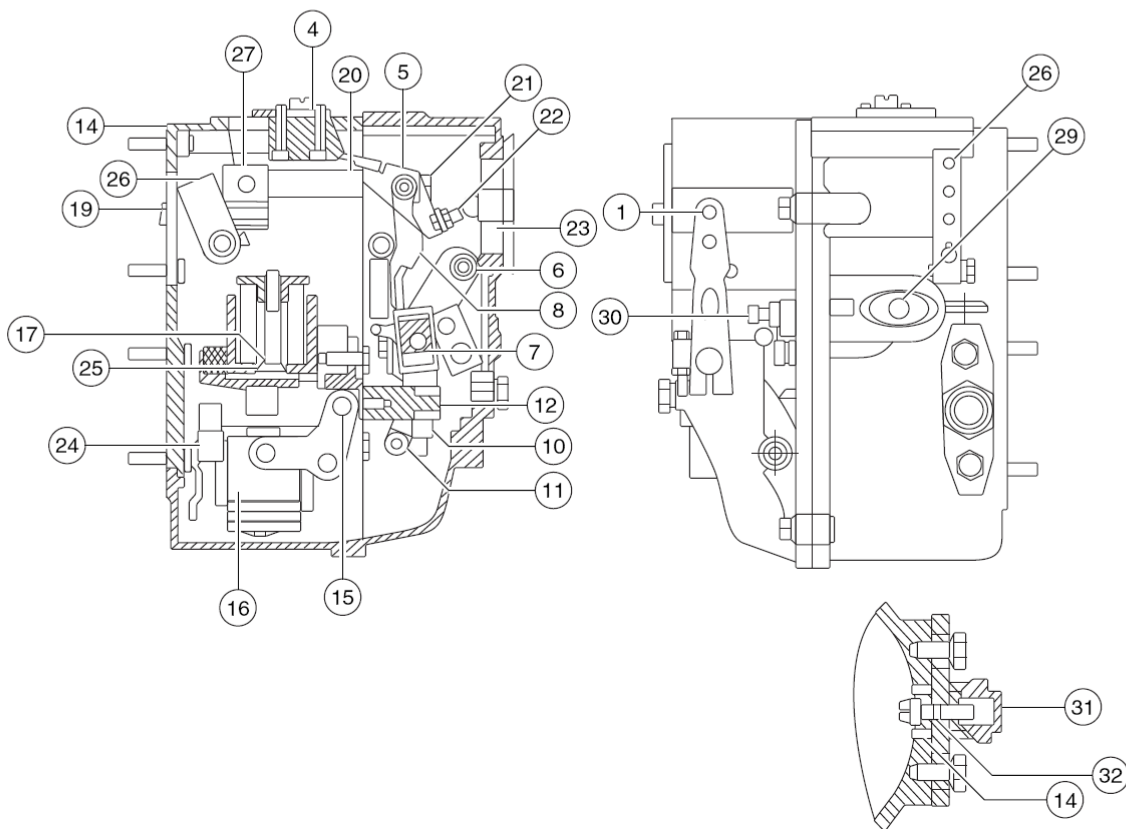
1	Flame Glow Plug	6	Fuel Feed Pump
2	Preheating Solenoid Valve	7	Preheating Filter
3	P-Type Fuel Injection Pump	8	Governor
4	Fuel Tank	9	RR Smoke Limiter
5	Fuel Filter	10	Fuel Injector

Bosch P type pump is a typical intensified pump which is mainly characterized in that the pump body is a tank type fully-enclosed structure. The plunger matching part, outlet valve and valve base are all installed in a flange sleeve, the sleeve is suspended in the pump body, and there is no side window on the pump body, thereby enhancing the rigidity of the pump body. The pump meets the requirement of high-power diesel engine for large fuel injection quantity and high fuel injection pressure, and enables its structure to be particularly compact. For the fine control mode, the pump adopts a link slot, a mechanism meshed with a ball on the fuel quantity control sleeve, to realize reliable fuel quantity control and sensitive speed governing. The pump carries out fuel quantity adjustment by rotating the suspended sleeve, and performs fuel injection timing adjustment by adding or decreasing gaskets to the suspended sleeve, thereby making the adjustment convenient and reliable. The fuel injection pump cam and tappet mechanism is subject to forced lubrication. In the forced lubrication process, oil is supplied through a pipeline connected to the pump body from the secondary oil line of the engine, and then the oil returns to the engine oil pan through the oil return pipe installed at a certain height of the pump body.

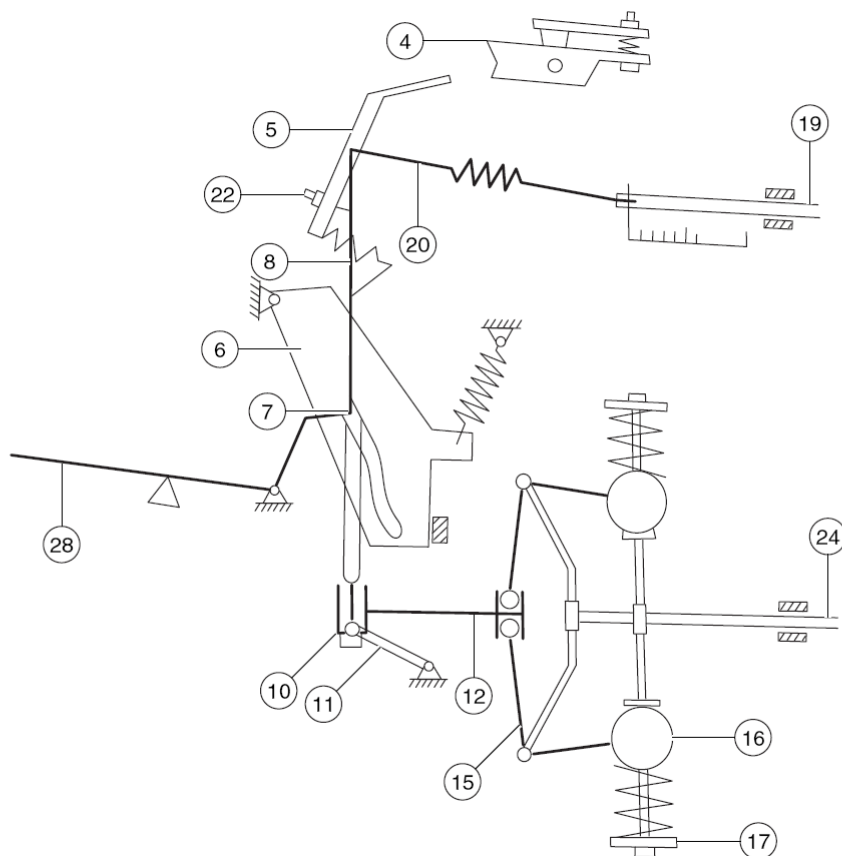
Fuel (WD615) – Fuel System



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fmwx11c003

Fuel (WD615) – Fuel System

fmwx11c004

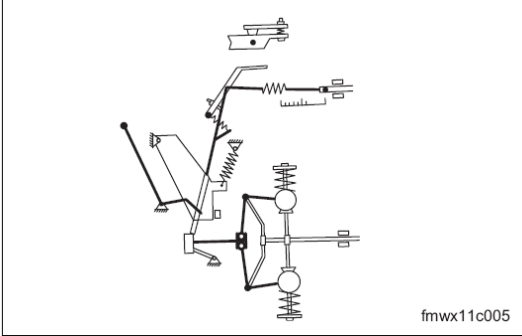
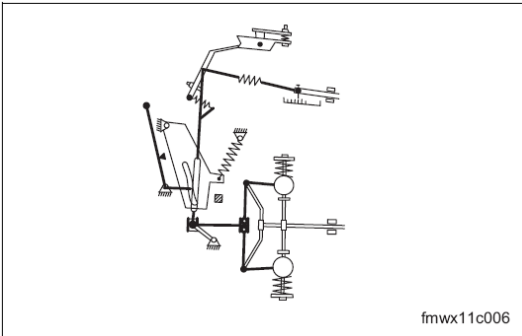
1	Control Lever (Throttle Lever)	17	Speed Governing Spring
2	Fixing Slot Hole of Correction Sliding Block	18	Adjusting Screw of Speed Governing Spring
3	Position Slot of Limiting Block of Smoke Limiter	19	Fuel Supply Gear Rack
4	Correction Sliding Block	20	Connecting Rod
5	Tongue-Shaped Swinging Vane	21	Fuel Quantity Adjusting Screw
6	Curved Guide Plate	22	Tab Adjusting Screw
7	Sliding Block	23	Inspection Window
8	Floating Lever	24	Fuel Injection Pump Camshaft
9	Sliding Block of Shifting Bar	25	Adjusting Gasket
10	Swinging Arm	26	Fuel Cut-Off Lever
11	Shifting Bar	27	Connecting Plate
12	RR Housing of Governor	28	Control Lever (Throttle Lever)
13	FR Cover of Governor	29	Adjusting Window of Speed Governing Spring
14	Angular Lever	30	Rated Speed Limiting Screw
15	Fly Weight	31	Timing Inspection Hole Cover
16	Speed Governing Spring	32	Timing Pin

Fuel (WD615) – Fuel System

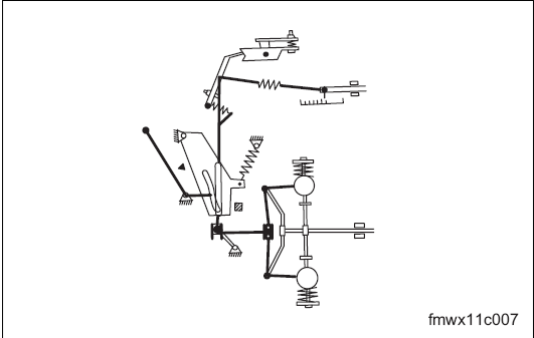
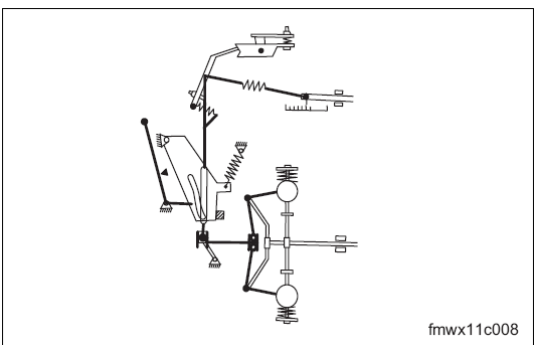
The lower end of floating lever of governor is supported by the upper end of swinging arm, and it can vertically move along the longitudinal groove of shift sliding block. Therefore, the position of the lower end of floating lever is determined by shifting bar. When the engine stops operating, the fly weight goes closed under the action of the speed governing spring, the angular lever pushes the shifting bar to the leftmost position in the drawing, at the same time, the floating lever is in the lowest position, and the correction tongue-shaped swinging vane is also in the lowest position to be separated from the correction sliding block. If the engine is started at this time, the control lever (throttle lever) of governor will be accordingly pushed to the high-speed limiting screw position, and simultaneously, the floating lever pushes the fuel supply gear rack to the maximum fuel supply position to realize the start enrichment effect.

After the engine is started, the fly weight will immediately overcome the idle spring force and go open. The fly weight pulls the shifting bar to the right side in the drawing through the angular lever, thus the swinging arm is simultaneously pulled to swing clockwise to cause the lower end of floating lever to move upwards, the whole floating lever synchronously move upwards to drive the tongue-shaped swinging vane for correcting fuel supply to move upwards with it and initiate a contact with the correction sliding block, and then, the travel of the fuel supply gear rack regularly changes with the rotation speed in accordance with the end-face shape of the correction sliding block, so that the fuel supply also regularly changes, thereby meeting the requirements of the engine for external characteristics.

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 fmwx11c005	Parking and start conditions
 fmwx11c006	Post-start condition

Fuel (WD615) – Fuel System

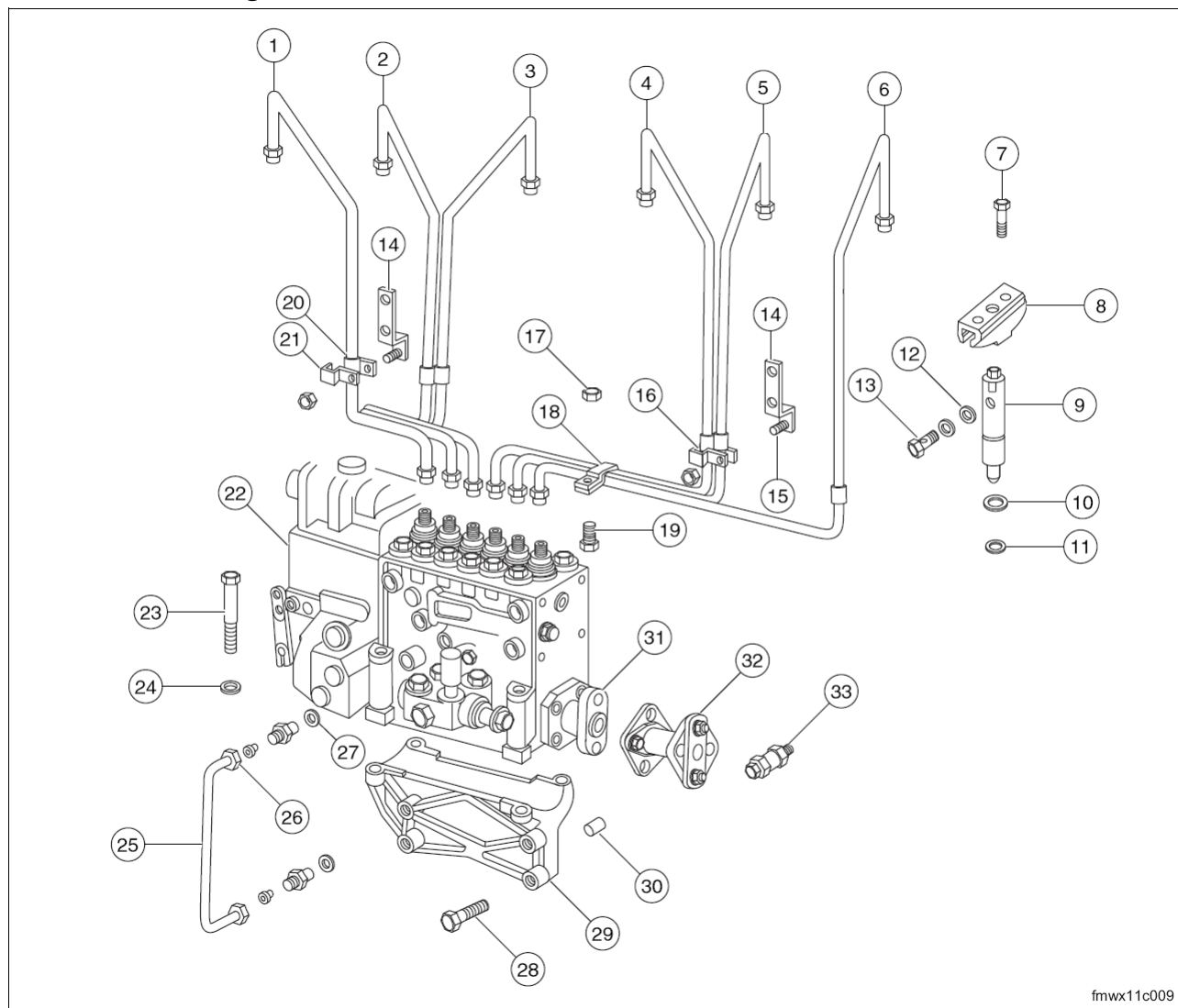
 fmwx11c007	Intermediate rotation speed condition
 fmwx11c008	High speed condition

Precautions

1. Before checking and maintaining the fuel system, disconnect the battery negative cable.
2. Because the fuel is an inflammable substance, when the fuel system is operated, keep cigarettes, naked flame, indicating lamps, arc equipment and switches away from the working area, and provide ventilating equipment in the working area to avoid occurrence of personal injury or even death.
3. In order to avoid personal injury, never loosen any fuel pipe joint when the engine runs.
4. Keep the fuel away from rubber or leather components.
5. Manufacture the diesel fuel injection equipment according to very accurate tolerance and clearance. Thus, when the fuel system is operated, absolutely clean working environment is very important. Use special plugs to close all openings.
6. Before disconnecting the fuel system pipeline, check and confirm whether dirt or impurity exists around the fuel pipe joint or not, and clean the dirt or impurity if any, otherwise the dirt or impurity may damage the fuel system or the engine.
7. Do not forcibly bend or twist the fuel system pipeline.
8. Before connecting each pipeline of the fuel system, ensure that each fuel pipe joint is not damaged, and if the fuel pipe joint is damaged or has cracks, replace the fuel pipe assembly and ensure that no dirt exists on the surface of the fuel pipe connecting surface.

Fuel (WD615) – Fuel System

Part Drawing



fmwx11c009

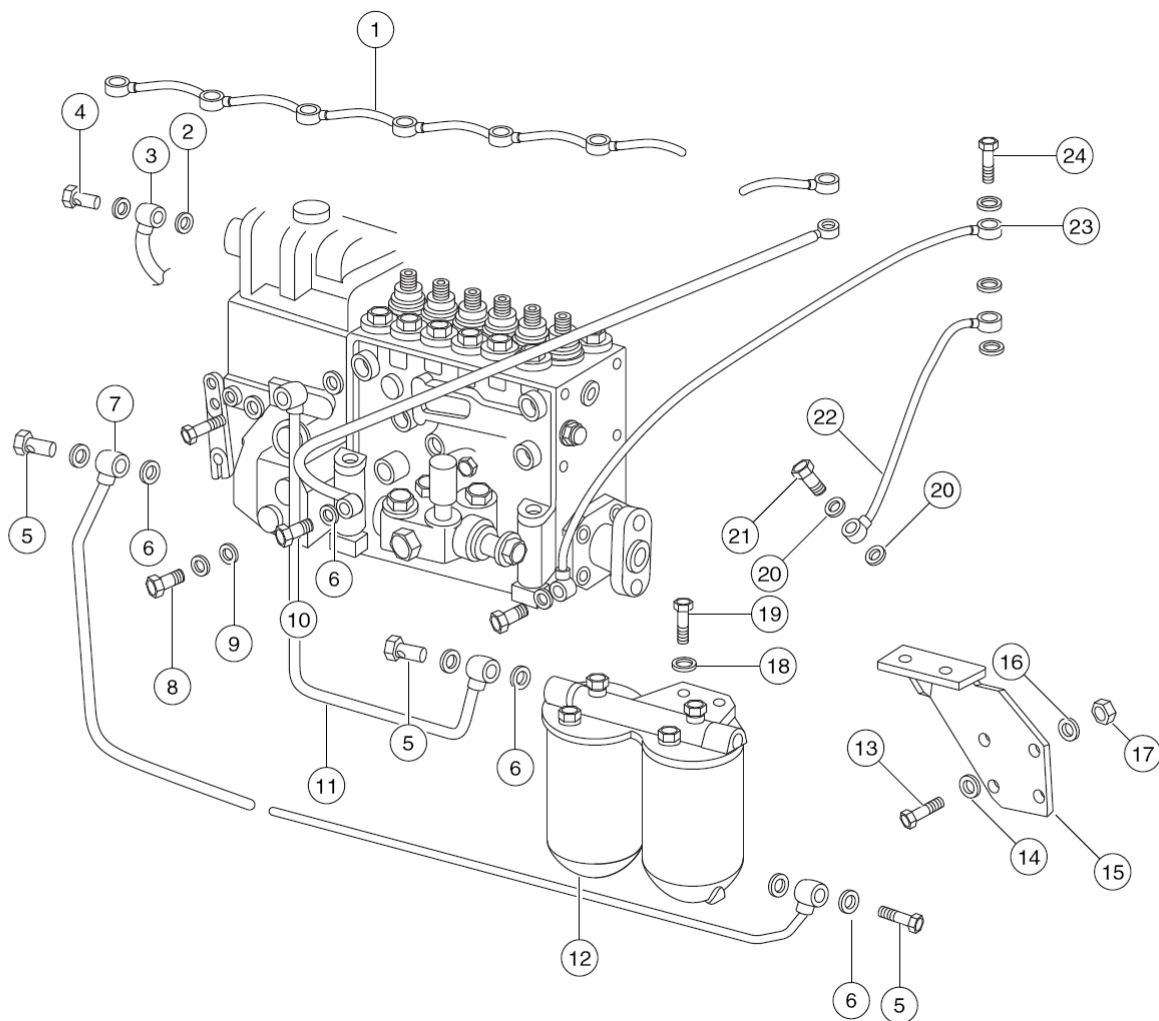
1	6th High-Pressure Oil Pipe Assembly	18	Pipe Clamp
2	5th High-Pressure Oil Pipe Assembly	19	Hex Head Bolt
3	4th High-Pressure Oil Pipe Assembly	20	Lower Plate of Pipe Clamp
4	3rd High-Pressure Oil Pipe Assembly	21	Upper Plate of Pipe Clamp
5	2nd High-Pressure Oil Pipe Assembly	22	Fuel Injection Pump with Full-Range K Type Governor
6	1st High-Pressure Oil Pipe Assembly	23	Hex Socket Cap Head Screw
7	Hex Head Bolt	24	Flat Washer
8	Fastening Pressure Plate	25	Lubricating Oil Return Pipe Assembly
9	Fuel Injector Assembly	26	Lubricating Oil Return Pipe Assembly
10	Sealing Washer	27	Pipe Joint
11	Washer	28	Sealing Washer
12	Sealing Washer	29	Hex Head Bolt

11C-10

Fuel (WD615) – Fuel System

13	Hollow Bolt
14	Support Bracket
15	Hex Head Bolt
16	Pipe Clamp
17	Style 1 Hex Nut

30	Fuel Injection Pump Bracket
31	Cylindrical Pin
32	Flange
33	One-Way Valve



fmwx11c009

1	Oil Return Pipe Assembly
2	Sealing Washer
3	Air Pipe Assembly
4	Hollow Bolt
5	Hollow Bolt
6	Sealing Washer
7	Fuel Pipe
8	Hollow Bolt

18	Hex Head Bolt
19	Wave Elastic Washer
20	Diesel Filter Bracket Assembly
21	Washer
22	Style 2 All-Metal Hex Locking Nut
23	Wave Elastic Washer
24	Hex Head Bolt
25	Sealing Washer

Fuel (WD615) – Fuel System

1	Sealing Washer
2	Hollow Bolt
3	Fuel Pipe
4	Fuel Pipe Filter Assembly

18	Hollow Bolt
19	Lubricating Oil Inlet Pipe Assembly
20	Lubricating Oil Inlet Pipe Assembly
21	Hollow Bolt

Testing & Adjustment

Exhaust of Fuel System

When replacing the coarse filter, reassembling the fuel delivery pipe, or emptying the fuel tank, air will enter the fuel system. If air enters the fuel system, the flow of fuel to the engine will be hindered and can not flow smoothly. To prevent this from happening, the fuel system shall be exhausted.

The oil return pipe on fuel injection pump can do some exhaust work, i.e. when replacing the fuel filter or the low-pressure oil pipe, the small amount of air in the fuel filter or the low-pressure oil pipe will be discharged by themselves if the replacement is carried out in accordance with the requirements. The oil return pipe of fuel injection pump is positioned at the top of the fuel injection pump, and the small amount of oil bubbles can be discharged through the oil return pipe.

For the fuel injection pump without timing reticle

1. Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
2. Install the observation tube on a fuel outlet joint of the cylinder fuel supply branch pump.
3. Control the throttle at the maximum fuel feed position with hand.
4. Rotate the flywheel to the fuel injection lead angle specified for 1st compression BTDC.
5. Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

For the fuel injection pump with timing reticle

1. Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
2. Install the observation tube on a fuel outlet joint of the cylinder fuel supply branch pump.
3. Control the throttle at the maximum fuel feed position with hand.
4. Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

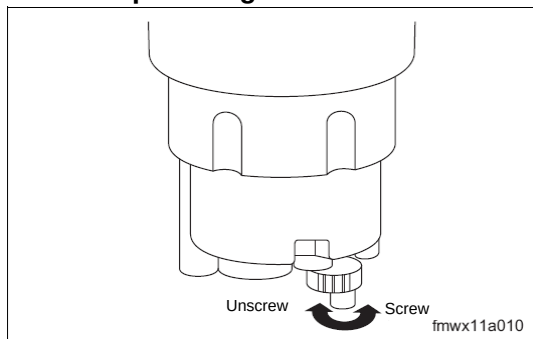
Drain of Water Collector

When the water collector is full, drain the collected water.

Warning:

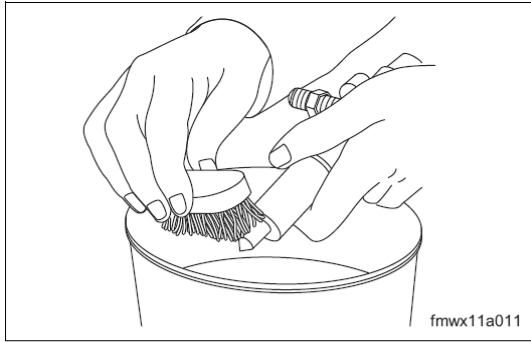
Because of a risk of icing, the water shall be discharged before icing.

1. Stop the engine

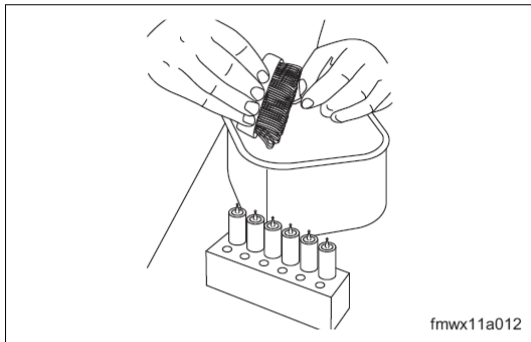


2. Dismantle the drain screw
(a). Unscrew the drain screw at the bottom of the water collector to empty water.

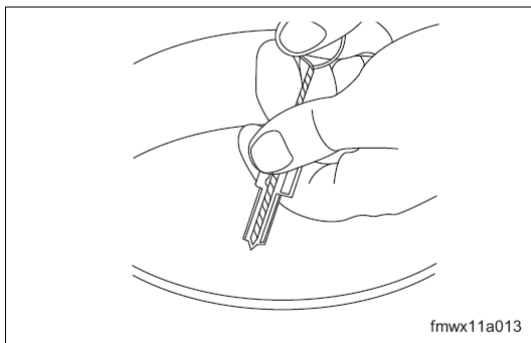
3. Install the drain screw Check and adjustment of fuel injector



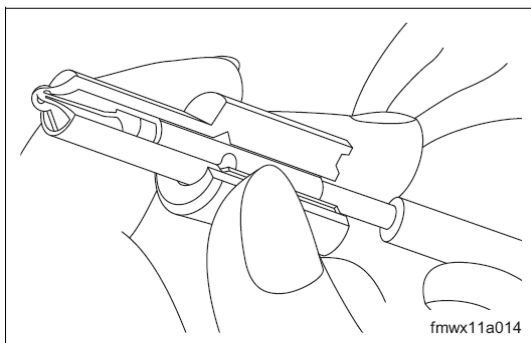
1. Carefully clean the exterior of the fuel injector before disassembling inspection to prevent dirt and impurities from scratching any fine matching surface of the fuel injector in the disassembling and assembling process



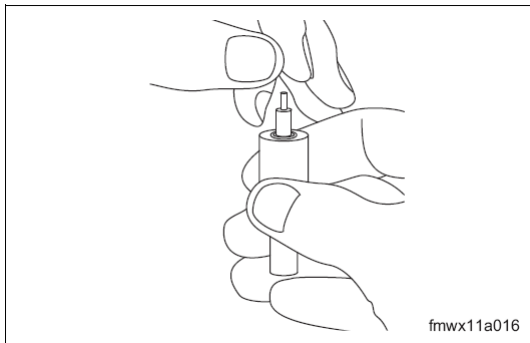
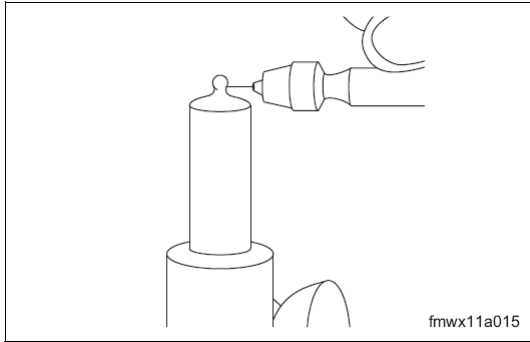
2. Draw the fuel injector needle valve out of the fuel injector, clean the head of the needle valve in kerosene with a brush, and clear carbon deposits at the head of the fuel injector needle valve with a wood piece



3. Clean the needle valve hole in the fuel injector valve base with a special brush



4. Scrape the head of the needle valve hole of the injector valve base with a special scraper to remove carbon deposits, wherein the shank of the special scraper must be in a precision fit with the needle valve hole. Avoid scratching the needle valve hole matching surface in the scraping process.

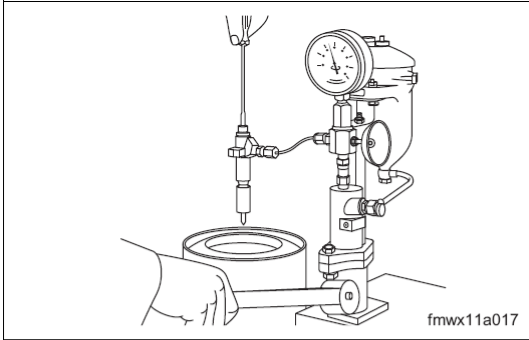
Fuel (WD615) – Fuel System

5. **Clean the injection hole of the fuel injector with a clean special cleaning steel needle**
 - (a). Generally, the diameter of the steel needle is 0.02~0.03 mm smaller than the diameter of the injection hole. In order not to damage the injection hole, firstly clean the injection hole with a thin steel needle, and then gradually increase the diameter of the steel needle.
 - (b). During hole cleaning, the steel needle shall be rolled back and forth after being inserted in the injection hole. After cleaning, further clean it with clean kerosene, and blow off dirt in the needle valve hole with compressed air.
6. **Sliding test of fuel injector matching part**
 - (a). Lubricate the fuel injector in clean light diesel fuel, and roll needle valve to and fro. Erect the fuel injector, pull the needle valve up by 1/3, then release it and check whether the needle valve can smoothly slide into the valve base by the self weight. If the needle valve can not smoothly slide into the valve base, drip a little high-grade low-viscosity lubricating oil in the needle valve and the fuel injector valve hole, then insert the needle valve into the fuel injector hole and roll it to and fro to meet the requirements for slide.
 - (b). Check the sealing condition between the needle valve and the conical surface of fuel injection valve base. If wear is not so serious, spread precise alumina abrasive on the conical surface of needle valve, abrade it with the fuel injection valve base, and clean them with clean kerosene after the abrasion is qualified. In the abrading process, do not spread the abrasive on the guide surface for precision fit between needle valve rod and oil injection.
 - (c). Check whether the contact surface between the fuel injector seat and the fuel injector body is damaged, whether the fuel injector spring rusts and cracks, whether the needle valve and the fuel injector needle valve hole form eccentric wear, and whether the contact surface between the needle valve and the ejector pin as well as the contact surface between the spring and the ejector pin is seriously worn, and replace them in case of serious damage or wear. Check the wearing condition of the fuel injector locating pin.

Caution:

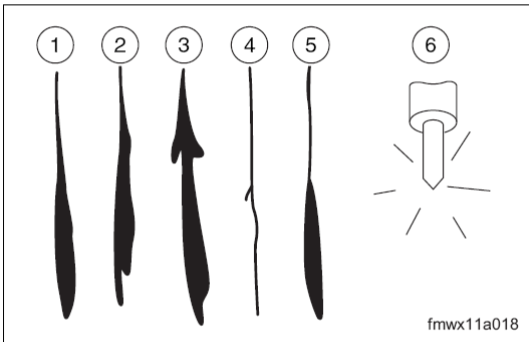
When reassembling the fuel injector assembly, the fuel injection nozzle cap must be tightened in accordance with the specified torque, otherwise bad atomization of fuel injection will be caused.

When replacing with a new fuel injection nozzle matching part, the new fuel injection nozzle matching part shall be cleaned in clean kerosene, and the needle valve shall be rolled to and fro in the needle valve hole of fuel injection nozzle, so that oil enclosed in the fuel injection nozzle can be completely discharged.



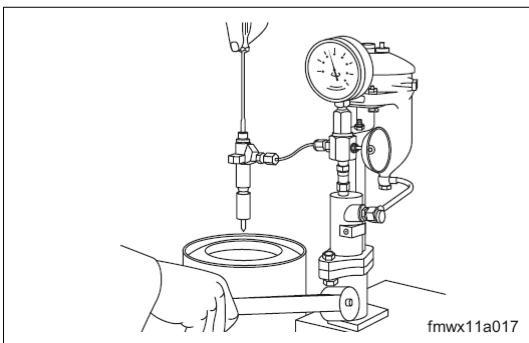
7. Check and adjust fuel injection pressure

- (a). Install **the** fuel injector on the fuel injector testing stand.
- (b). Press the testing stand handle with hand several times to remove air in the fuel pipe and the fuel injector, and rinse the interior of the fuel injector again.
- (c). Then press the testing stand handle with hand, and observe whether the pressure is 30 MPa when oil injection starts.
- (d). Adjust the fuel injection pressure by using spring gaskets of different thicknesses.
- (e). After the fuel injection pressure is adjusted, tighten the fuel injector locking nut. After the nut is tightened, check the oil injection opening pressure again, and readjust the pressure if it does not meet the standard.



8. Check of atomization state

- (a). On the fuel injector testing stand, repeatedly press the testing stand handle with the maximum stroke at a rate of 40~80 times per min, and observe the atomization state of fuel injection.
 - Fuel injection shall be in the form of uniform mist, the fuel mist shall not contain large fuel particles, and mist beams ejected from all the injection holes shall be even and equal in length, but shall not form continuous fuel columns or be uneven in the concentration.
 - The fuel beams shown as ① through ⑤ do not meet the standard.
 - Obvious noises shall be heard when the injection starts or terminates. After injection, the fuel injector head shall not have fuel dripping or fuel drop suspension phenomenon.



9. Check seal of fuel injector

- (a). Press the fuel injector testing stand handle with hand to slowly increase the pressure to 28~29 MPa (1~2 MPa lower than the fuel injection opening pressure), and hold on for some time (generally, 2~3 S). If there is no oil leakage or obvious pressure reduction, it indicates that the seal is satisfactory.

Fuel (WD615) – Fuel System**RQV-K Type Governor**

The RQV-K type governor has the following adjustable positions:

1. Fuel quantity adjusting screw

- There is a fuel quantity adjusting screw between the upper end of the floating lever and the connecting rod. The length of the connecting rod can be changed by adjusting the screw. If the connecting rod is lengthened by adjusting the screw, the fuel feed quantity of the fuel injection pump will be integrally increased, and on the contrary, if the connecting rod is shortened by adjusting the screw, the fuel feed quantity of the fuel injection pump will be integrally decreased. Thus, the fuel feed quantity under each working condition can be integrally increased or decreased by adjusting the fuel quantity adjusting screw.
- For some RQV-K type governors, the correction sliding block is fixed on the governor housing by a slot hole, that is to say, the sliding block can be moved forward or backwards for a certain distance relative to the governor housing by unscrewing the fixing screw of correction sliding block. As a result of the movement of the sliding block, the correction tongue-shaped swinging vane abuts on the correction sliding block, the initial position of the floating lever is changed, and the initial position of the fuel feed gear rack is accordingly changed, thereby also achieving the effect of adjusting the overall fuel feed. However, in such adjustment, the tab adjusting screw must be simultaneously adjusted to enable the position for starting correction to meet the original requirements. Because some experience is required for such adjustment, it is not recommended to change the overall fuel feed by changing the position of the correction sliding block, and it is preferred to keep the position of the correction sliding block before leaving factory unchanged.

2. Tab adjusting screw

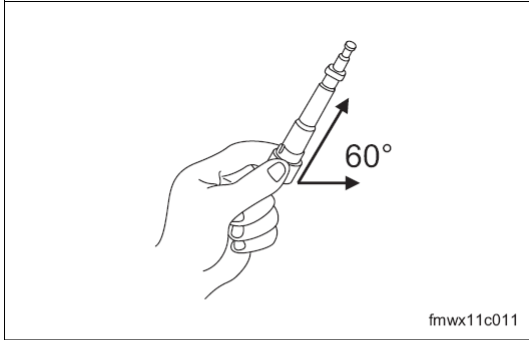
- The tab adjusting screw is used for adjusting the relative position between the tab and the correction sliding block so as to change the whole fuel feed rule, wherein the change of the fuel feed rule means the change of features of engine. Thus, the screw shall be generally kept in the state before leaving factory, and it needs to be checked and adjusted only if the correction sliding block is reassembled.

3. Adjusting screw of speed governing spring

- The adjusting screw of speed governing spring is used for adjusting the pretightening force of the speed governing spring. The idle speed and the rated speed can be changed by adjusting the screw.
- In order to match with the charging features of the exhaust-driven turbo charger, the fuel injection pump is provided with a smoke limiter. Because the charging features of the charger, the charging effect of the charger will be sharply enhanced with the increase of rotation speed when the engine is at a speed higher than the intermediate rotation speed. However, when the engine is at a speed lower than the intermediate rotation speed, the charging effect will not be so apparent. Therefore, if the fuel feed can meet the requirements of the engine for maximum torque and rated power when the engine is at an intermediate-low rotation speed, black smoke will be produced as a result of insufficient fuel burning caused by insufficient air intake.

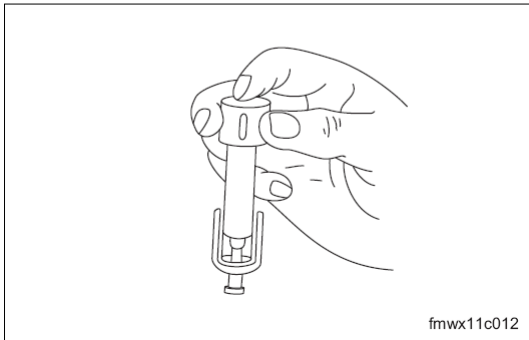
Check and adjustment of fuel injection pump**1. Check of plunger matching part**

- (a). The plunger and the plunger bushing are a pair of precise matching parts, and fit clearance between the both is 0.001~0.003 mm. Wear of the precise matching part will postpone the time for starting fuel injection and terminate fuel feed in advance, at the same time, the fuel feed will be decreased, and some faults of diesel engine will be caused, such as power reduction, difficult starting, unsteady idle speed and easy flameout. Besides, the uneven wear of branch pump plungers will cause uneven fuel quantity of each cylinder, and therefore, the wearing condition of the plunger matching part has a direct influence on the power performance of the diesel engine.
- (b). Visual check.
 - Clean the plunger bushing in clean kerosene or light diesel fuel, and observe the matching positions between the plunger and the plunger bushing, especially the guiding part at the upper part of the plunger. If severe change of color on the surface of plunger (wearing position is white), peeling corrosion of spiral flute, straight flute and flute edge of plunger, cracking and deformation of plunger or cracking of plunger bushing, etc. is detected, the plunger matching parts must be replaced in pairs.



(c). Sliding test of plunger.

- Tilt the plunger matching part that has been immersed in kerosene by 60°, and pull the plunger out of the plunger bushing by 2/3. After the plunger is released, it shall be capable of completely sliding into the plunger bushing by the self weight. Rotate the plunger to different positions to repeatedly perform the above test. If the plunger is blocked in some positions, spread polishing paste on the plunger, and carry out in-pair abrasion by inserting the plunger into the plunger bushing. In the abrading process, the plunger shall be moved to and fro in the vertical direction and be simultaneously rolled.



(d). Leakage test of plunger matching part.

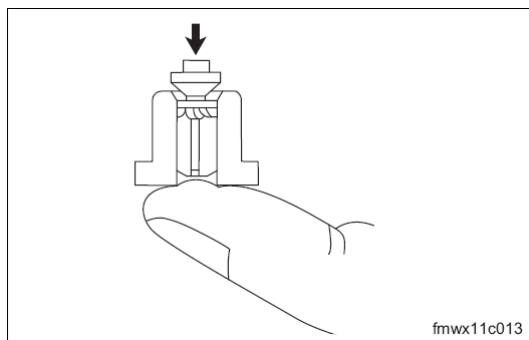
- Cover the upper end of the plunger bushing with forefinger, make the plunger stay at the intermediate or maximum fuel feed position, and pull the plunger down (do not pull the plunger over the fuel inlet hole position of the plunger bushing). At this time, if the forefinger feels a pull of vacuum, and the plunger can still return back to the original position when it is released, it indicates that seal of the plunger is qualified.

2. Check of outlet valve

The outlet valve has two pairs of sealing contact surfaces, namely the precision fit and the seal between the pressure relief ring belt and the valve base hole. When the outlet valve is seriously worn, the pressure relief ring belt or the conical-surface seal will fail, and after burning and fuel dripping phenomena will be accordingly caused, so that burning will be deteriorated to generate white smoke, the power of engine will be reduced, and engine knock will also be caused in serious cases. Thus, check must be carried out on the seal of the outlet valve.

(a). Visual check.

- Clean the outlet valve matching part in clean kerosene or light diesel fuel, and observe the conical surface of outlet valve with naked eyes or a magnifier. If serious wear of pressure relief ring belt (i.e. there are clear wide or deep while wear marks on the conical surface of outlet valve), or obvious longitudinal scratching marks on the pressure relief ring belt are detected, replacement shall be carried out. At the same time, the outlet valve and the valve base shall be observed for crack and corrosion.



(b). Leakage test.

- Slide the outlet valve completely into the valve base, and cover the bottom hole of the outlet valve base with mouth. The lip will be sucked in case of no air leakage, otherwise the outlet valve shall be abraded. When abrading the conical surface of the outlet valve, only spread the abrasive paste on the conical surface of the outlet valve with a thin rod, and do not spread it on the pressure relief ring belt. For the leakage test of the pressure relief ring belt, cover middle finger on the bottom hole of the outlet valve, and press down the outlet valve core. When the outlet valve core is released, the valve core will automatically bounce up, which indicates that the seal of the pressure relief ring belt is qualified, otherwise it shall be replaced with a new one.

Fuel (WD615) – Fuel System

- (c). Leakage test of outlet valve can also be carried out on a fuel injector tester.
- Pull the outlet valve and the valve base into the special joint (the seat of the joint is provided with an ejector valve base of which the diameter is smaller than that of the outlet valve core, but the pressure relief ring belt is still in the sealing position in the valve base hole). Connect the joint to the fuel injector tester, unscrew the adjusting screw to slide the valve core completely into the valve base, operate the tester to raise the pressure to 25 MPa, and observe the time for the pressure to drop to 10 MPa, wherein the time shall not be less than 60 s. Use the adjusting screw to lift the outlet valve core by 0.3~0.5 mm, raise the pressure to 25 MPa in a similar way, and observe the time for the pressure to drop to 10 MPa, wherein the time shall not be less than 2 s. In the leakage test, attention shall be paid to the seal of the tester itself, and check shall be firstly carried out on the seal ring of the tester before test.

3. Check of other parts of fuel injection pump

- (a). Check of plunger flange and control sleeve
- Check the clearance between the plunger flange and the fuel quantity control sleeve groove, wherein the clearance is 0.02~0.08 mm generally. If the clearance is beyond 0.12 mm, replace the control sleeve.
- (b). Check of tappet assembly.
- Observe the tappet and the roller for wearing and corrosion conditions. Measure the total radial clearance between the tappet roller and the roller bush as well as the total radial clearance between the roller bush and the roller shaft. If the clearance is beyond 0.2 mm, replace the tappet assembly. Check the clearance between the tappet and the pump body, replace the tappet or the pump body.
- (c). Check camshaft.
- Observe the cam face for wearing, corrosion, cracking and peeling conditions, and carry out stone abrasion or replacement in accordance with the damage. If the wear of cam exceeds 0.2 mm, bending of camshaft is more than 0.15 mm, or height of cam goes beyond the service limit, replace the camshaft.
- (d). Check the plunger spring for crack, corrosion and surface peeling.
- Check whether the free length of spring meets the standard, wherein the maximum deviation of the center of spring shall not exceed 1.5 mm.
- (e). Check of fuel quantity control mechanism.
- The travel clearance between the fuel quantity control link (or gear rack) and the fuel quantity control sleeve shall not be more than 0.25~0.30 mm, otherwise the replacement shall be carried out.
- (f). Check resistance of fuel quantity control lever (or gear rack).
- Measure the sliding resistance of the fuel quantity control lever (or gear rack) in the total travel on the fuel injection pump testing stand, wherein the sliding resistance shall not be more than the standard value.

Pump Speed (r/min)	Sliding Resistance (N)
0	1.3
600	0.5
1000	0.7

Adjustment of fuel injection pump on testing stand

The fuel injection pump is adjusted on the testing stand to enable the fuel injection pump to meet its technical standard, and such adjustment is the basis for the normal work of the fuel injection system.

The adjustment of the fuel injection pump on the testing stand must be carried out under specified conditions. It is preferred to adjust the fuel injection pump by completely simulating working conditions of a diesel engine. However, it is quite difficult to simulate the actual working conditions of each fuel injection system on the testing stand due to great varieties and different types of diesel engine. In order to realize the standardization of test and adjustment and consistency of test data, factors which will have an influence on the test result in the test and adjustment of fuel injection pump of each type are subject to relevant unified specifications which are the test conditions of the fuel injection pump.

Generally, the test conditions for the adjustment of fuel injection pump testing stand contain the following items:

Type of fuel injection nozzle and fuel injector. Under certain circumstances, type of fuel injection nozzle, size and quantity of injection holes and opening pressure of fuel injector have a direct influence on the fuel injection quantity each. Generally, the bigger the diameter of injection hole is and the more the number of injection holes is, the more the fuel injection quantity is. Similarly, the lower the opening pressure of fuel injector is, the less the fuel injection quantity is. In order to eliminate influences of above factors of the fuel injection nozzle and the fuel injector on the test of the fuel injection pump to be tested, the type of the fuel injection nozzle and the fuel injector must be subject to unified specifications during test and adjustment. In order to ensure the test and adjustment accuracy, it is specified that check and adjustment shall be carried out on the fuel injection pressure of a fuel injector which is used on the testing stand for some time, and it is also specified that the fuel injection nozzle must be replaced with a new one after being used several times.

Fuel injection opening pressure. The fuel injection opening pressure of the fuel injector has a strong influence on the fuel injection quantity of the fuel injection pump. Thus, the fuel injection opening pressure standard must be specified in the test. It is to be noted that the fuel injection pressure specified in test conditions does not always conform to the fuel injection pressure required in the actual work.

Fuel supply pressure. The low fuel supply pressure of the fuel injection pump also has a strong influence on the fuel injection quantity of the fuel injection pump. Generally, the higher the fuel supply pressure is, the more the fuel feed of the fuel injection pump is. Thus, the fuel supply pressure must be specified in the test.

Fuel for test and temperature of fuel. The fuel for test and the temperature of fuel determine the viscosity of the test fuel. The viscosity of the test fuel has an indispensable influence on the fuel feed of the fuel injection pump. Generally, the higher the viscosity of the test fuel is, the more the fuel feed of the fuel injection pump is. Thus, the designation and the temperature of test fuel are strictly specified in the test conditions.

Dimensions of high-pressure fuel pipe. The high-pressure fuel pipe for connecting the fuel injection pump with the fuel injector has a certain length, inner diameter and wall thickness, and will generate fuel pipe effect in the impulse type work, that is to say, the fuel pipe will generate elastic expansion in the fuel feed process, and at the same time, the fuel injection of the fuel injector lags behind the fuel feed start time of the fuel injection pump. Thus, high-pressure fuel pipes of different dimensions will have different influences on the fuel injection quantity, and therefore, the dimensions of the high-pressure fuel pipe must be specified in the test.

In order to ensure the accuracy of the test, the test and adjustment of the fuel injection pump must be carried out in accordance with the standard specified in the test conditions. If specified requirements can not be met or test conditions are not available for some items, the test result must be corrected in the test and adjustment.

1. Preparation before test and adjustment

- (a). Install the fuel injection pump on the testing stand and connect it with the testing stand driving shaft. Because the smoke limiter is arranged on the fuel injection pump in the turbo-charged diesel engine, the fuel injection pump testing stand must be provided with an air supply device which can regulate the air pressure, so that a specified air pressure value can be input to the smoke limiter when the fuel injection pump is adjusted and tested. Fill clean lubricating oil into the fuel injection pump.

2. Check seal and opening pressure of each cylinder

- (a). Raise the pressure of the testing stand pressure regulator valve to 2~3 MPa, and check the outlet valve base of each cylinder for oil leakage. If the leakage is detected, remove the outlet valve and clean it in clean diesel fuel, or replace the outlet valve.
 - Connect the high-pressure fuel pipes of each cylinder of the fuel injection pump, sequentially open each overflow pipe of the fuel injector, and check whether the opening pressure of the outlet valve is in the standard range of 1.4~1.8 MPa. If the outlet valve goes beyond the range, it can be adjusted by adding or subtracting the outlet valve gasket. For one fuel injection pump, the difference between the opening pressures of the outlet valves of the cylinders can not be greater than 0.2 MPa.

3. Check and adjustment of "zero" position of fuel feed gear rack

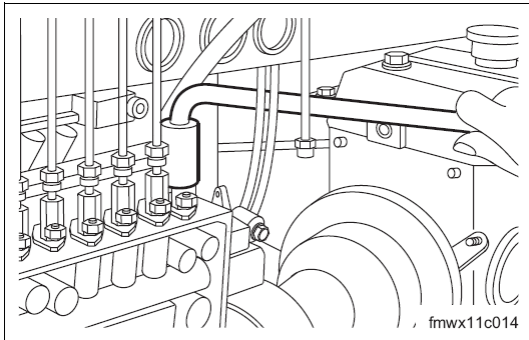
- (a). In order to ensure the consistency between the test and adjustment and the specification, a fuel feed gear rack travel meter (or gear rack travel ruler) is generally installed at the front end of the pump in the test. Before adjusting the pump, the "zero" position of the fuel feed gear rack shall be firstly calibrated.
 - The "zero" position of the gear rack is preferred to be in the maximum torque speed range of the pump speed (about half the rated-power pump speed). Pull the throttle control lever of governor to the highest limiting screw position, pull the fuel cut-off handle to the limit position, adjust the gear rack travel meter to the "zero" position, and tighten the locking nut.

Caution:

Do not forcibly pull the fuel cut-off lever to the fuel cut-off limit position, which easily causes damage to the governor.

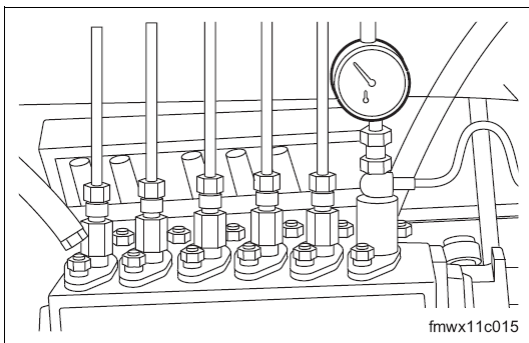
Fuel (WD615) – Fuel System**Adjustment of fuel feed timing**

1. In order to ensure the accuracy of fuel injection range (fuel injection rule) so that the diesel engine works under the optimum condition, the plunger lift travel, when the branch pumps of the fuel injection pump start to feed fuel (the plunger starts to seal the fuel inlet), are constant, the check and adjustment of the fuel feed timing of the fuel injection pump is the check and adjustment of plunger pretravel. In other words, the proper adjustment of the plunger pretravel ensures that the work area of the cam is within the designed shape of the pump, thereby ensuring that the fuel injection rate is within the design range and ensuring that the fuel feed timing of the fuel injection is accurate. As for the injection timing of the complete machine, as introduced above, must be carried out on the complete machine
2. The plunger pretravel must be measured with a special measurer. There are two kinds of measurers for plunger pretravel: measurer for directly measuring the lift travel of plunger; measurer for measuring lift travel of tappet.

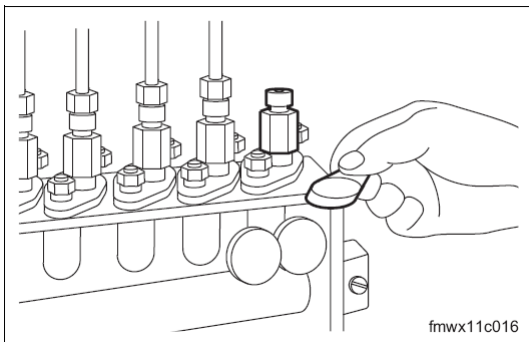


3. **Measure pretravel of plunger by overflow method**

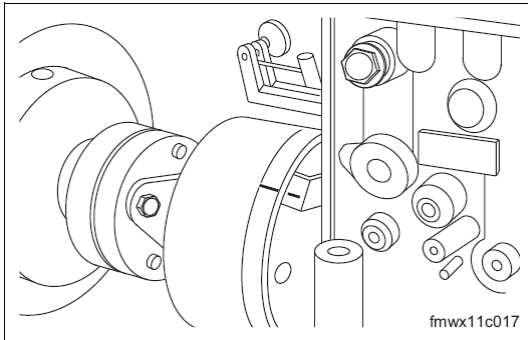
- (a). Dismantle the high-pressure fuel pipe joint of the 1st cylinder branch pump, take out the delivery valve assembly and gasket, and install the measurer on the oil outlet pipe joint of the branch pump. The measurer is composed of a dial indicator and an overflow pipe which are installed on the oil outlet pipe sleeve.



- (b). After installation, make the measuring head of the dial indicator to directly contact the top end of the plunger. Start the low pressure fuel feed duct of the test bed, rotate the camshaft so that the plunger is at the BDC (the BDC position of the plunger can be indicated by the dial indicator), check the pointer of dial indicator to zero, and control the load lever of fuel injection pump so that the fuel injection pump is in the position of maximum fuel feed quantity. At this time, fuel flows out of the overflow pipe. Slowly rotate the camshaft in the working direction of the fuel injection pump. If the measured value does not conform to the standard, adjustment is required.

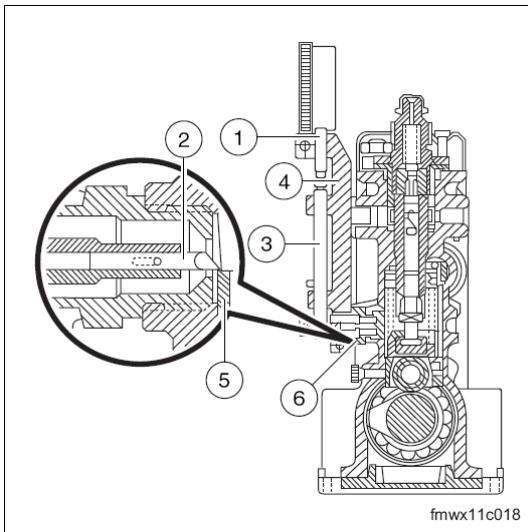


- (c). The adjustment of fuel feed timing is realized by adding or reducing timing gaskets. Remove the branch pump assembly. If the measured value of pretravel of plunger is less than the standard value, it is required to add timing gaskets under the branch pump flange; if the measured value is greater than the standard value, it is required to reduce the timing gaskets. When reinstalling the branch pump, pay special attention to keep the O-ring of the branch pump complete. After the fuel feed timing adjustment of the 1st branch pump, it is required to put the pump in the position where the 1st branch pump starts to feed fuel (i.e. the pretravel position of plunger), and check whether the fuel feed timing reticle of the fuel injection pump is aligned.



- (d). If the timing reticle is marked in wrong position, it is required to reprint the timing reticle for alignment on the timer and fuel injection pump housing for the check of complete machine and the adjustment of injection timing.

Check and adjust fuel feed angular interval of cylinders



1	Dial Gauge
2	Probe
3	Guide Rod

4	Test Stand
5	Tappet
6	Test Body

- By using the same method, check and adjust the fuel feed start points of the branch pumps in the fuel feed sequence of 1-5-3-6-2-4, so that the fuel feed start points are at $60 \pm 0.5^\circ$ cam angle intervals. At this time, the fuel feed timing adjustment of the fuel injection pump is completed.
- The pretravel of plunger can also be measured with tappet lift travel measurer. Install the measurer on a special measuring hole of the fuel injection pump (the measuring hole is generally in the 1st cylinder tappet position), and put the measuring head on the upper edge of the tappet. Dismantle the delivery valve assembly of the 1st cylinder branch pump, start the test bed to feed fuel for the fuel injection pump (otherwise, it is not necessary to dismantle the delivery valve, but make the fuel feed pressure to reach $2.5 \pm 0.2 \text{ MPa}$), set the fuel injection pump in the maximum fuel feed position, and at this time, fuel overflows from the branch pump. Rotate the camshaft so that the plunger tappet is in the BDC position, adjust the dial indicator to zero, slowly rotate the camshaft in the normal rotation direction of the pump, and when the branch pump stops feeding fuel (when the plunger starts to seal the fuel inlet), observe whether the plunger lift travel indicated by the dial indicator conforms to the standard value of pretravel. If not, adjust by adding or reducing timing gaskets. Similarly, after finishing adjustment of pretravel of 1st cylinder plunger, adjust the fuel feed timing of other branch pump in the sequence of fuel feed start points, and the fuel feed start points of the branch pumps are at $60 \pm 0.5^\circ$ cam angle intervals.

Fuel (WD615) – Fuel System**Check and adjustment of fuel feed gear rack travel at control point, maximum torque point and calibration point**

At the control point, the engine speed increases until the smoke limiter no longer operates, and the tongue-shaped swinging vane has already disengaged from the limiting block of the smoke limiter and started to abut against the working molding surface of the correction sliding block. The maximum torque point is the working condition position when the engine is at the maximum torque. The gear rack variation from control point to calibration point via maximum torque point reflects the process of the tongue-shaped swinging vane going on the molding surface of the correction sliding block as the rotating speed rises. In this process, the variation of the gear rack travel (variation of fuel feed quantity) is the variation of the simulating the engine characteristic. Therefore, this adjustment is very important for the engine performance.

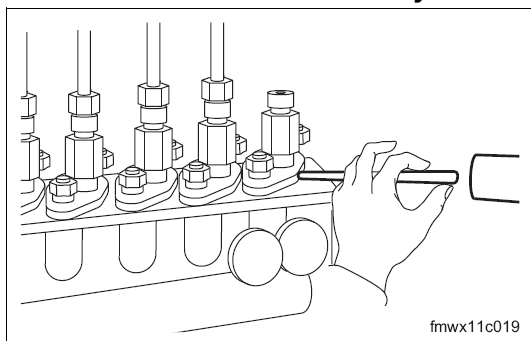
This adjustment is realized by the cooperative adjustment of the fuel quantity adjusting screw and tongue-shaped swinging vane adjusting screw. It aims to realize that the tongue-shaped swinging vane works in the standard molded lines locked by the correction sliding block within the corresponding rotating speed range, so that the actual performance of the engine is more ideal.

1. **Check and adjustment start from the calibration point. Start the test bed, introduce 120kPa air pressure into the smoke limiter (to cancel the operation of the smoke limiter), and push the throttle lever of the governor to the position limited by the high-speed limiting screw. Respectively set the pump speed at calibration point 1100r/min, maximum torque point 750r/min and control point 600r/min, and respectively check whether the gear rack travel is within the standard range of 12.0-12.2mm, 11.8-12.0mm and 11.3-11.5mm.**
2. **4. The adjustment is realized by adjusting the fuel quantity adjusting screw and tongue-shaped swinging vane adjusting screw. The fuel quantity adjusting screw adjusts the total travel of the fuel feed gear rack, i.e. the whole fuel quantity. The tongue-shaped swinging vane adjusting screw adjusts the position of the tongue-shaped swinging vane relative to the correction sliding block, thereby changing the variation rule of the fuel feed gear rack (or fuel feed quantity).**
3. **5. This adjustment is realized by the cooperation of the fuel quantity adjusting screw and the tongue-shaped swinging vane adjusting screw, so that all the gear rack travels at the calibration point, maximum torque point and control point are within the standard range. This adjustment aims to ensure that the engine characteristics conform to the design requirements, so that the engine can exert the maximal efficacy on the premise that the emission is satisfactory.**

Check and adjustment of fuel feed quantity at control point, maximum torque point and calibration point

Once the fuel feed quantity of the fuel feed gear rack is determined under a certain travel, the fuel feed quantities under the other gear rack travels are determined by the working molded lines and precision of the plunger. In the adjustment process, the fuel feed quantity at the maximum torque point or the calibration point of rated power is used as the reference fuel quantity, and the fuel feed quantity standards under other working conditions are only for check during pump correction.

1. **Push the throttle lever of the governor to the position limited by the high-speed limiting screw. Start the test bed, introduce 120kPa air pressure into the smoke limiter, increase the pump speed to 750r/min, and observe whether the fuel quantity is within the range of 37.2-38.4ml when injecting 200 times. If not, it is required to adjust the fuel quantity difference between the cylinders to less than 2.5ml.**



2. **The adjustment of fuel feed quantity is realized by rotating the branch pump plunger sleeve.**
 - (a). Each branch pump plunger sleeve can be rotated by 10° relative to the pump body. This is equivalent to the relative movement travel of 2.5mm of the fuel feed gear rack. When adjusting the fuel feed quantity of the branch pump, firstly loosen the fixing bolt of the branch pump flange, and slightly knock the branch pump flange with screwdriver or any other tool to rotate the branch pump flange. Pay attention to the fuel increase or decrease direction during adjustment.

Due to the mismachining tolerance of the plunger, the fuel feed quantity of the fuel injection pump may be satisfactory under the reference working condition, and the difference between the cylinders is also

Fuel (WD615) – Fuel System

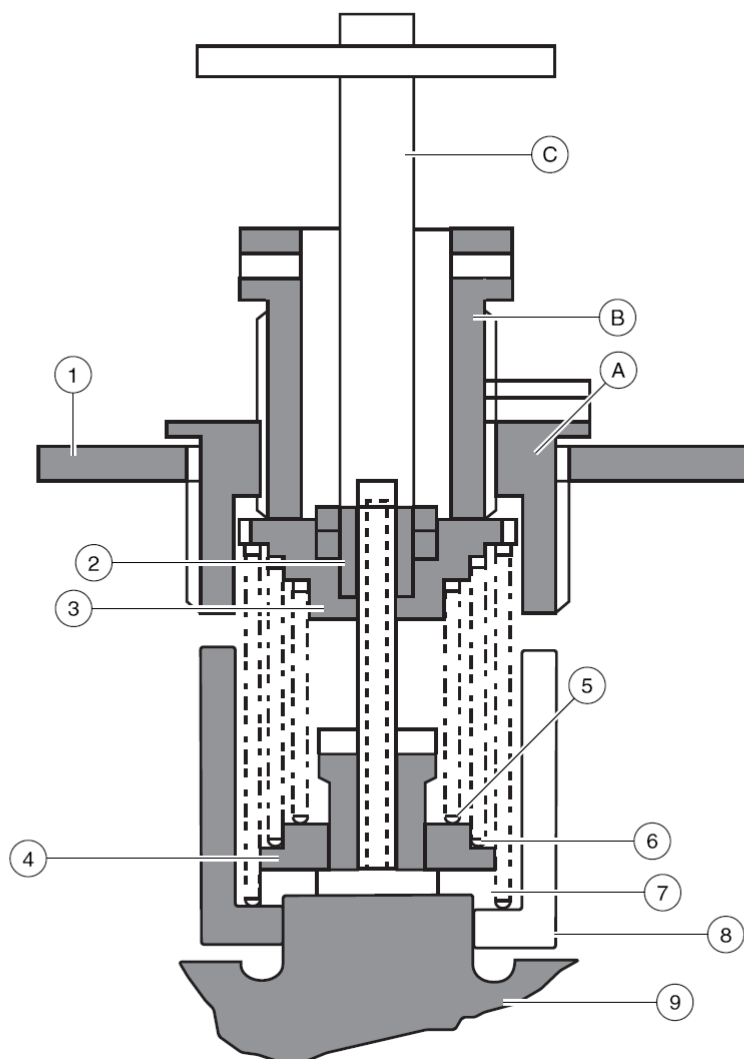
within the allowable range; however, under other working conditions, the fuel feed quantities and fuel feed unevenness between the cylinders may differ a lot. After finishing the adjustment of the fuel feed quantity under the reference working condition, it is also required to check the fuel feed quantity and difference between the fuel feed quantities of branch pumps under other working conditions. If the difference between the fuel feed quantity of a certain branch pump and the fuel feed quantity of any other branch pump is within the limit under the reference working condition, but is great under any other working condition, replace the coupler of the branch pump plunger, to ensure that the fuel feed quantity and difference between cylinders under every working condition are within the limit, thereby ensuring stable operation of diesel engine under various working conditions.

The fuel feed quantity is directly proportional to the gear rack travel, i.e. the greater the gear rack travel is, the greater the fuel feed quantity is. Due to the speed characteristic of constant pressure delivery valve (under the condition of identical gear rack travel, the fuel feed quantity of the delivery valve varies as the speed varies), the fuel feed quantity of the fuel injection pump does not necessarily increase as the gear rack travel increases. Therefore, interchanging the delivery valves may adjust the fuel feed quantity and the uniformity of fuel feed quantities of the cylinders in some cases.

Check of starting fuel quantity

1. After checking and adjusting the fuel feed quantity under normal working condition, adjust the pump speed to 100r/min, push the governor control lever to the position of full load high-speed limiting screw (push the throttle push rod to the position of maximum fuel feed quantity), and check whether the starting fuel quantity is greater than 16ml per 100 times.
2. After finishing all adjustment, check the fuel feed quantity under reference working condition again.
3. If the vehicle runs on highland, the fuel feed quantity shall be corrected according to the absolute altitude.

Fuel (WD615) – Fuel System

Adjustment of high-speed start action of governor and cut-off rotating speed

fmwx11c020

1	Governor housing
2	Adjusting Nut
3	Upper seat
4	Lower seat
5	Correction spring
6	High speed spring

7	Idle speed spring
8	Fly weight
9	Fly weight body
A	-
B	Pressing sleeve
C	Socket wrench

1. Increase the pump speed to 1100r/min, and the governor throttle controls the lever to the limit position limited by the high speed limiting screw.
 2. Increase the pump speed to 1120-1140r/min, and make sure that the gear rack keeps still. Continue to increase the pump speed, and the gear rack shall start to move towards the fuel reduction direction. When the pump speed is increased to 1350r/min, the gear rack shall retreat to the travel 0- 1.0mm cut-off position.
 3. Press down the adjusting spring outer seat with a special tool tooth socket, and adjust the speed governing nut with a socket wrench.
- (a). If the special rotation speed for the start action is lower than the standard value, it is required to tighten the nut, else, it is required to loosen the nut.

Caution:

In the adjustment process, the adjusting nuts of the two fly weights shall be adjusted identically, i.e. the spring adjusting nuts of the two fly weights shall be screwed outwards or inwards by the same number of turns. Else, it will accelerate the wear of the governor due to the internal stress generated between the fly weights.

- (b). If the high speed comes into action, the rotation speed is satisfactory, but the adjustment rate is not satisfactory (when the pump speed reaches 1350r/min, the travel of the gear rack is greater than 1.0mm), it is required to replace the high speed spring of the governor.

Adjustment of idle speed control

1. Move the load control lever to the idle speed direction. When the pump speed reaches 300r/min, enable the gear rack to be at the travel 2.8-6.0mm position, and fix the load control lever to this position.
2. Increase the pump speed. Make sure that the travel of the gear rack is less than 2.0mm when the pump speed is 405-445r/min. Make sure that the travel of the gear rack is greater than 7.5mm when the pump completely stops. If the test data does not conform to the standard, the idle speed spring gaskets can be reduced or increased, or the idle speed spring can be replaced.
3. After the idle adjustment, adjust the idle stop screw to just contact the current load control lever limiting block.

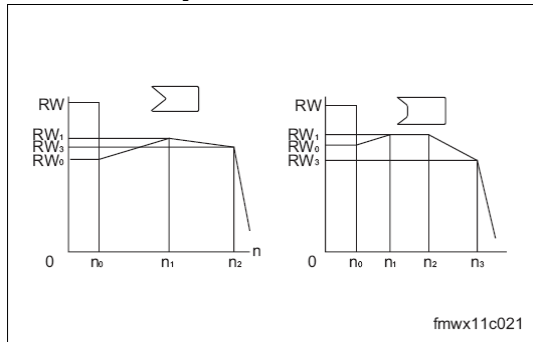
Check and adjustment of smoke limiter

1. **Check the gear rack travel and fuel feed quantity at the point of zero supercharging torque**
 - (a). Start the test bed, compressed air is not introduced into the smoke limiter, and set the pump speed at 500r/min.
 - (b). Adjust the zero supercharging limiting adjusting screw of the smoke limiter, so that the travel of the gear rack is within the range of 9.4-9.6mm.
 - (c). Check that the fuel feed quantity shall be 29.6-31.0ml when injecting 200 times.
2. **Check the start action air pressure and ending action air pressure.**
 - (a). When the pump speed is 750r/min, the start action air pressure of the smoke limiter is 70-65kpa, and the ending action air pressure is 25-15kpa.
 - (b). Start the test bed, set the pump speed at 750r/min, and introduce 100kpa air pressure to the smoke limiter. Gradually decrease the air pressure, and observe whether the whether is within the range of 70-65kpa when the gear rack starts to move towards the oil reduction direction.
 - (c). If not conforming to the standard, remove the screw plug at the check hole of the smoke limiter, shift the groove teeth on the adjusting sleeve with a screwdriver, inwardly tighten the adjusting sleeve to reduce the start action air pressure, and outwardly loosen the regulating sleeve to increase the start action air pressure.
 - (d). Continue to reduce the air pressure value, and observe whether the air pressure is within the range of 25-15kpa when the gear rack stops action. If not conforming to the standard, replace the smoke limiter spring.

Check of low-speed torque control

This aims to check whether the smoke limiter is operating smoothly.

1. **Start the test bed, introduce 30kPa air pressure into the smoke limiter until the governor throttle lever reaches the limit position of full-load high-speed limiting screws.**
2. **Check whether the fuel feed gear rack is within the range of 10.2-10.4mm when the pump speed is set at 500r/min. Check whether the fuel feed quantity is within the range of 31.0-32.4ml when injecting 200 times.**

Fuel (WD615) – Fuel System**Check and adjustment of smoke limiter (no parameter)**

1. Introduce 120-150kPa air pressure into the smoke limiter, and push the throttle control lever of the governor to the limit position limited by the full load high-speed limiting screw.
2. Start the test bed. At this time, the pump speed starts to increase from 100r/min. Record the travel value of the fuel feed gear rack every increase of 100r/min.
3. Reduce the input air pressure of the smoke limiter to "0", and push the throttle control lever of the governor to the position limited by the idle stop screw.
4. Start the test bed. At this time, the pump speed starts to increase from 100r/min. Record the travel value of the fuel feed gear rack every increase of 100r/min.
5. Mark the pump speeds under the working conditions with full load and idle speed and the corresponding gear rack travels on the coordinate graph. The horizontal coordinate is pump speed, and the vertical coordinate is gear rack travel. Connect the points into a full-load speed regulation characteristic curve and an idle speed regulation characteristic curve. Use the inflection points of the curves as the calibration points for pump correction.

Fuel Tank Replacement

Hint:

Part Drawing, refer to Chapter 11C, Fuel - Fuel Tank, Part Drawing

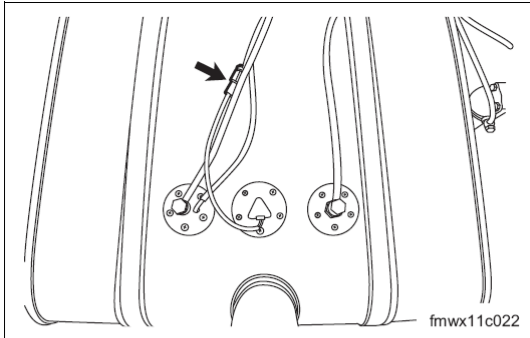
1. **Open cargo box**
2. **Disconnect battery negative cable**
3. **Dismantle guardrail assembly of cargo box, refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement**
4. **Release fuel pressure**
 - (a). Insert the key to open the fuel tank lock.
 - (b). Unscrew the fuel tank lock assembly.

Caution:

Be sure to use clean, soft cloth to plug the fuel filler.

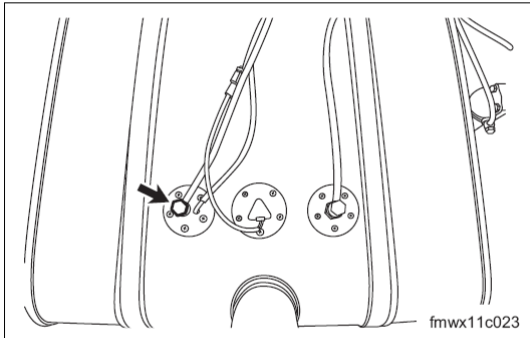
5. **Disconnect connector of fuel sensor**

- (a). Disconnect the connector of the fuel sensor.



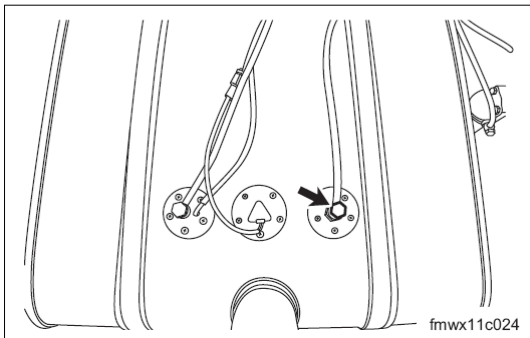
6. **Disconnect outlet pipe of fuel tank**

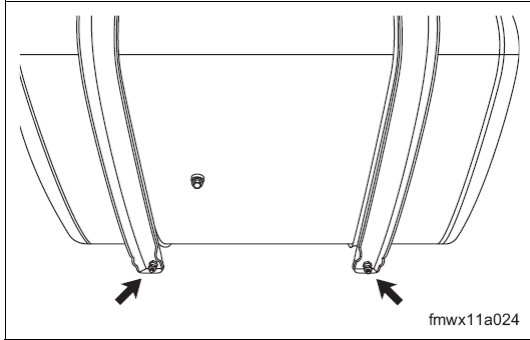
- (a). Disconnect the connector nut of the outlet pipe of the fuel tank.



7. **Disconnect fuel return pipe of fuel tank**

- (a). Disconnect the connector nut of the fuel return pipe of the fuel tank.

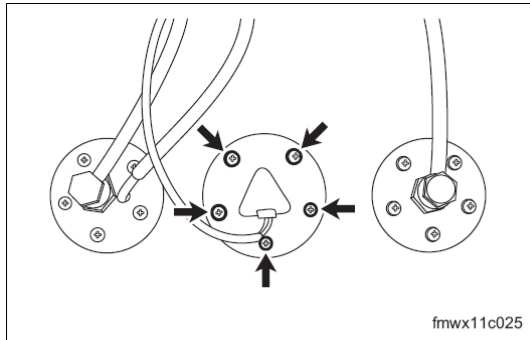


Fuel (WD615) – Fuel Tank**8. Dismantle fuel tank assembly**

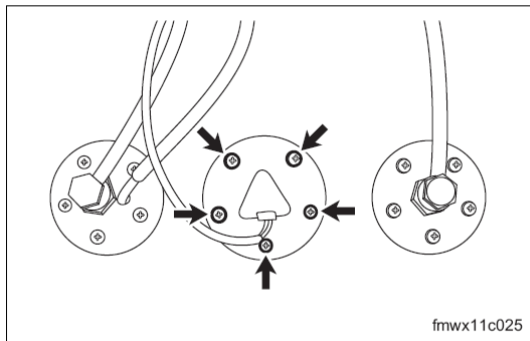
- (a). Dismantle the fixing nut of the tightening pull strap.
- (b). Take off the tightening pull strap of the fuel tank.
- (c). Dismantle the fuel tank assembly.

Caution:

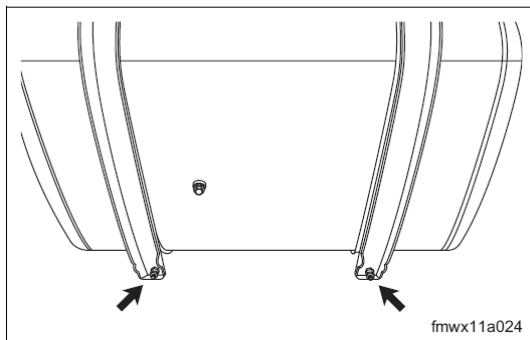
- Before operation, check and make sure there is no lines, wiring harness or other foreign matters around the fuel tank, and clean up if necessary.
- When lifting the fuel tank, due to large size, use appropriate tools or operate with the help of others if necessary.
- Because the fuel tank is an aluminum alloy workpiece, avoid collision in the process of dismantlement, handling and installation.

**9. Dismantle fuel sensor****Caution:**

- Before operation, check and make sure there is no dirt or other foreign matters around the fuel sensor, and clean up if necessary.
- There is a rubber seal ring in the sealing cover of the fuel sensor. Do not damage the seal ring while dismantling.

**10. Install fuel sensor****Caution:**

When installing the fuel sensor, insert after rotating to the proper angle, and do not cause warp or deformation.

**11. Install fuel tank assembly**

- (a). Install the fuel tank assembly on the fuel tank bracket and fix to the right position.
- (b). Install the fixing nut of the tightening pull strap of the fuel tank.

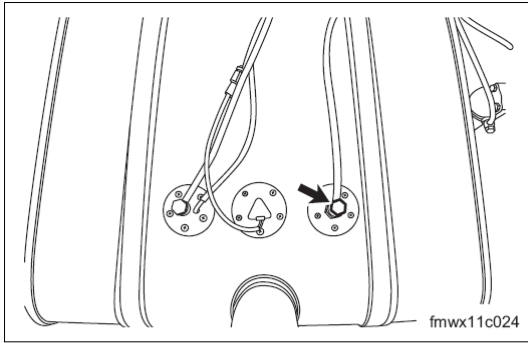
Torque: 45±5 N.m(M10)

Torque: 81±8 N.m(M12)

Caution:

- The tightening pull strap of the fuel tank and the connecting nut of the fuel tank bracket shall be fastened to the specified torque. Excessive torque will cause deformation of the fuel tank.

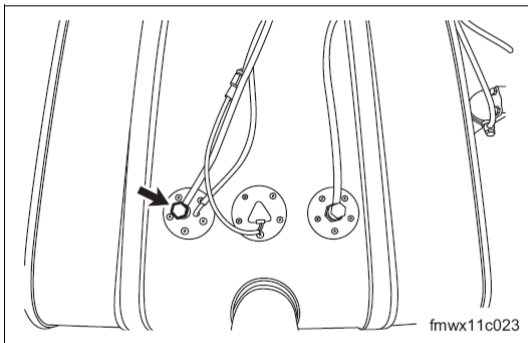
- The fuel tank shall be connected firmly and reliably without abnormal vibration.
- Each rubber rim strip shall be even and level.



12. Install fuel return pipe of fuel tank

- (a). Install the connector nut of the fuel return pipe of the fuel tank.

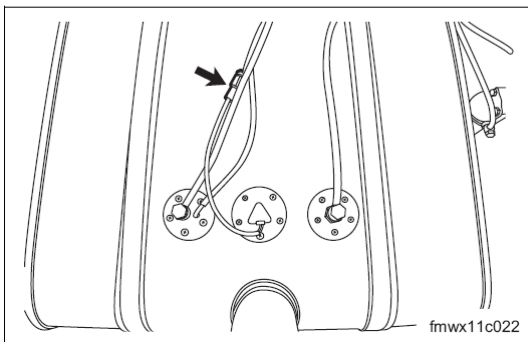
Torque: 46±5N.m



13. Install outlet pipe of fuel tank

- (a). Install the connector nut of the outlet pipe of the fuel tank.

Torque: 46±5N.m



14. Install connector of the fuel sensor

- (a). Install the connector of the fuel sensor.

15. Install fuel tank lock assembly

- (a). Check whether the fuel tank lock and gasket are deformed or damaged. Replace the fuel tank lock assembly if necessary.
- (b). Periodically lubricate the rotating part.

16. Exhaust the fuel system. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment

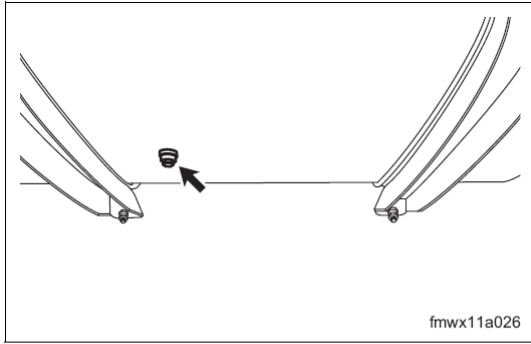
17. Install battery negative cable

18. Inspect

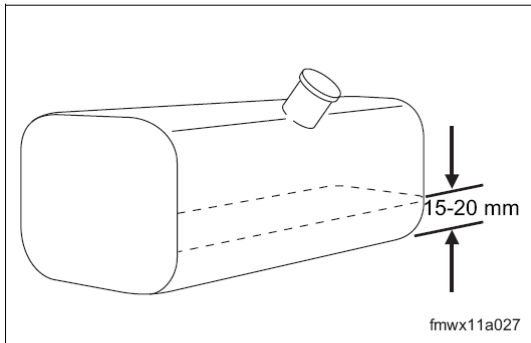
- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joints of the fuel system.

19. Install the guardrail assembly of the cargo box. Refer to Chapter 77, Interior & Exterior Trim Parts - Cargo Box Guardrail, Replacement

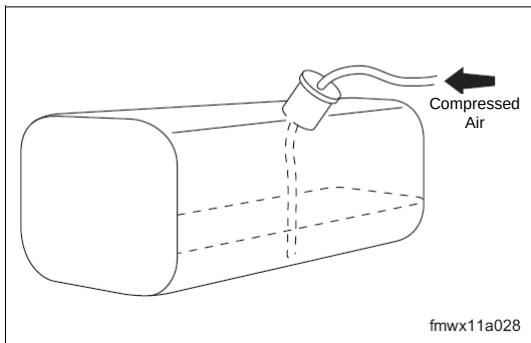
20. Put down cargo box

Fuel (WD615) – Fuel Tank**Clean****1. Drain fuel**

- (a). Open the fuel tank lock assembly, unscrew the drain plug of the fuel tank, after draining the trapped fuel, clean up dirt on the drain plug and then install the drain plug.

**2. Fill clean fuel**

- (a). Fill up the fuel tank with fuel until the distance from the fuel level to the bottom of the fuel tank is 15-20mm.

**3. Clean fuel tank assembly**

- (a). Insert a hose with a spraying nozzle into the bottom of the fuel tank.
 (b). Connect the hose with an air duster gun.
 (c). Plug the fuel filler with a clean, soft cloth, and open the switch of the air duster gun for flushing.
 • Change the position of the spraying nozzle while flushing so that precipitate and adherent matters are flipped along with fuel.

4. Clean fuel tank assembly for many times

- (a). After flushing the whole fuel tank with the spraying nozzle, unscrew the drain plug to drain the dirty oil, and repeat twice to thrice to clean completely

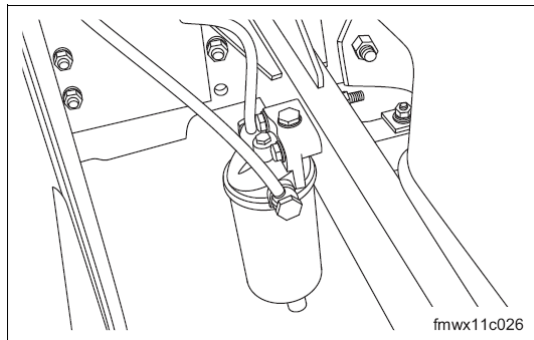
5. Check fuel tank assembly

- (a). After cleaning the fuel tank, check whether the fuel tank is damaged, and the damage shall be promptly dealt.

6. Install fuel tank lock assembly

- (a). Check and clean the filter screen of the filler port of the fuel tank.

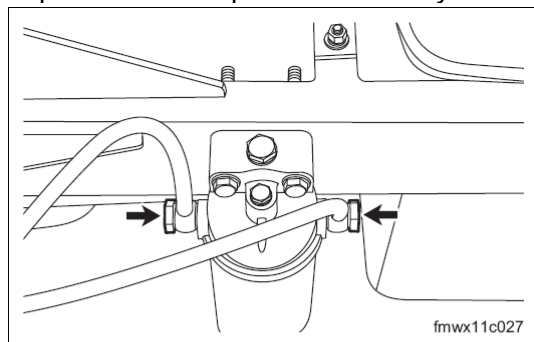
Oil-water Separator Replacement



1. Dismantle oil-water separator

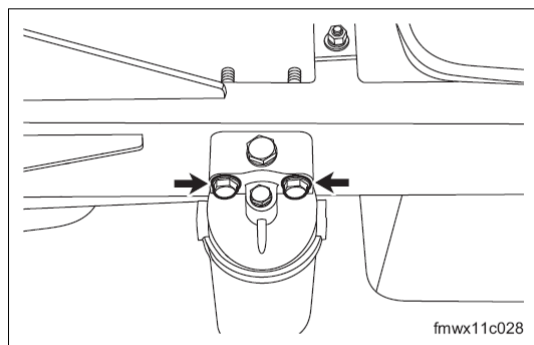
2. Check oil-water separator seat

- (a). Check whether the fuel filter seat has defects such as cracks, scratches, obvious damage, etc. Replace with new parts if necessary.

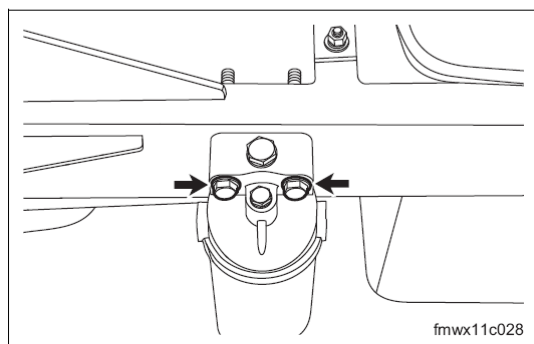


3. Dismantle oil-water separator seat

- (a). Dismantle the hinged bolts of the inlet and outlet pipes.



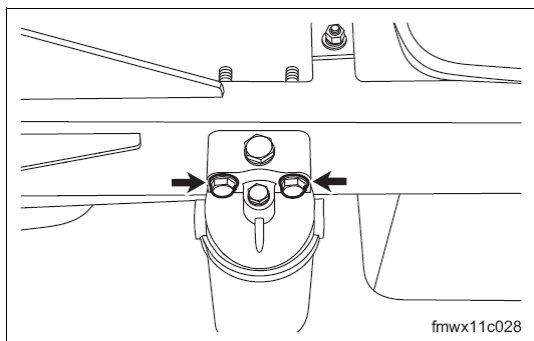
- (b). Dismantle the fixing bolt of the oil-water separator seat.



4. Install oil-water separator seat

- (a). Install the fixing bolt of the oil-water separator seat.
Torque: 45±5N.m(M10)
Torque: 81±8N.m(M12)

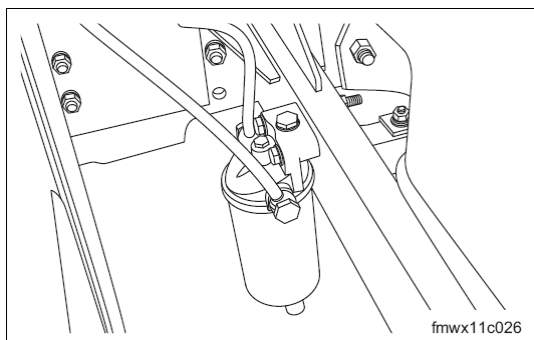
Fuel (WD615) – Oil-water Separator



(b). Install the hinged bolts of the inlet and outlet pipes.

Caution:

Check the washers of the inlet and outlet pipes, and replace with new parts if necessary.



5. Install oil-water separator

- (a). Apply a small amount of lubricating oil on the seal ring of the oil-water separator.
- (b). Screw on the oil-water separator by hand until the seal ring is combined with the interface.
- (c). Clockwise screw down the oil-water separator with the fuel filter wrench (for about 3/4 turns).

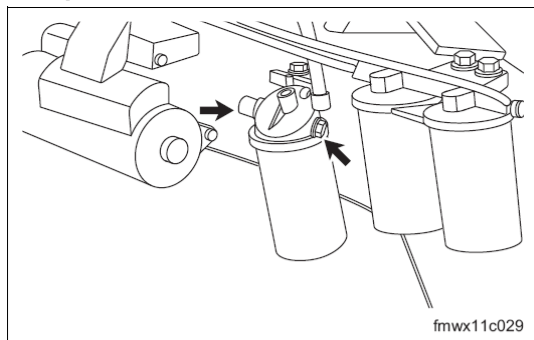
11C

6. Exhaust the fuel system. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment

7. Inspect

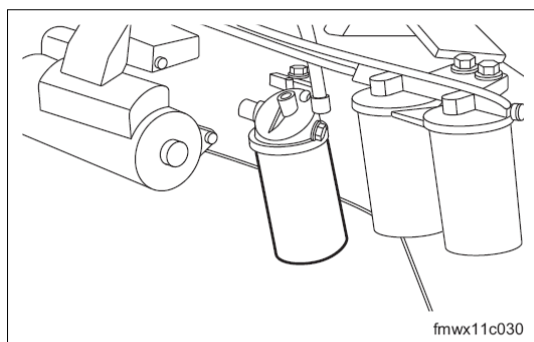
- (a). After ensuring that the connector assemblies are connected well, open the ignition switch, check whether the fuel gauge of the meter shows normal, start the engine, and check whether there is oil leakage at the fuel pipe joint of the fuel system.

Fuel Fine Filter Replacement

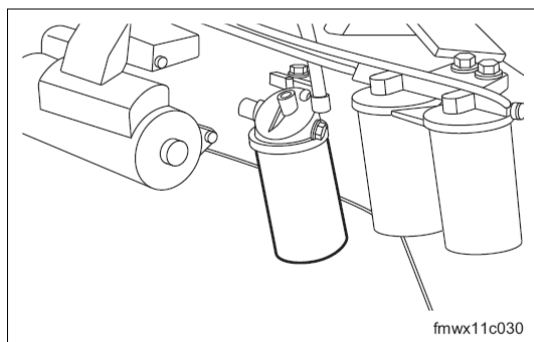


1. Dismantle fuel fine filter

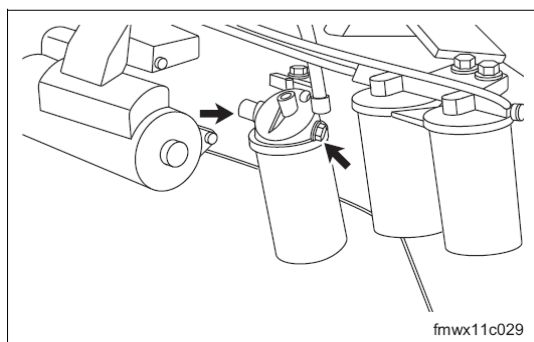
- (a). Dismantle the inlet and outlet pipes of the fuel fine filter.



- (b). Dismantle the fuel fine filter with a fuel filter wrench.



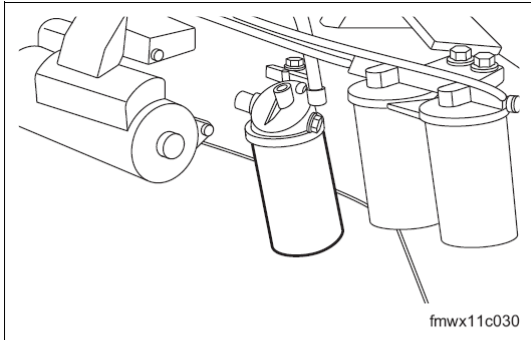
- (c). Dismantle the fuel fine filter seat.



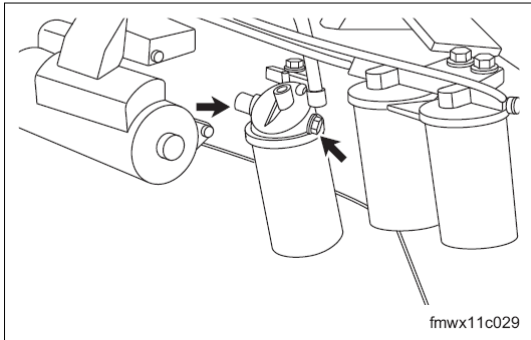
2. Install fuel fine filter

- (a). Install the fuel fine filter seat.

Fuel (WD615) – Fuel Fine Filter



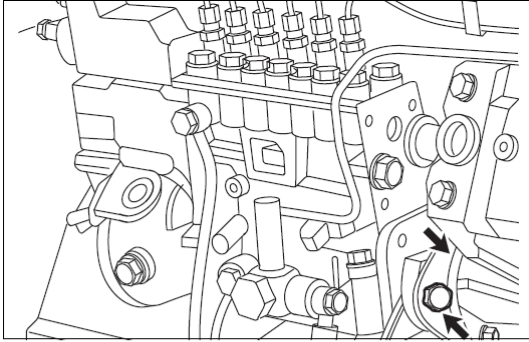
- (b). Install the fuel fine filter with a fuel filter wrench.



- (c). Install the inlet and outlet pipes of the fuel fine filter.

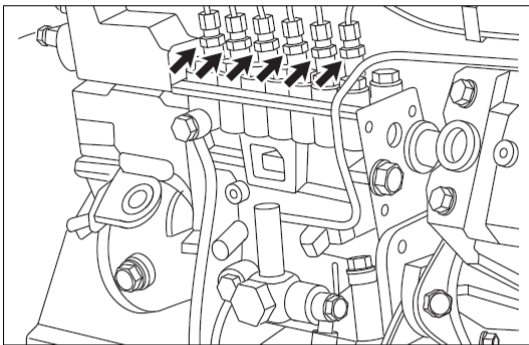
Fuel Injection Pump Replacement

1. Release the fuel pressure



2. Dismantle the fuel injection pump

(a). Dismantle the fuel injection pump driving flange.



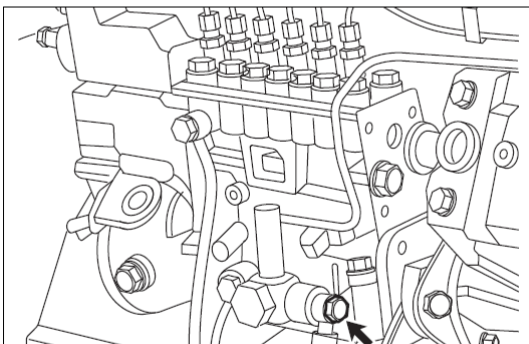
(b). Dismantle the high-pressure fuel pipe of the fuel injection pump.

Caution:

When loosening the nut of the high-pressure fuel pipe, the fuel inlet joint of the fuel injection pump must be fixed with another wrench. If the fuel inlet joint is loosened by accident, it can only be repeatedly tightened once, and the fuel inlet joint box gasket must be replaced.

Caution:

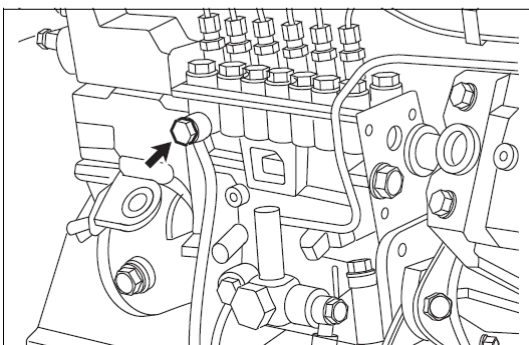
Cover the joint caps to prevent pollution.



(c). Dismantle the low-pressure fuel pipe of the fuel injection pump.

Caution:

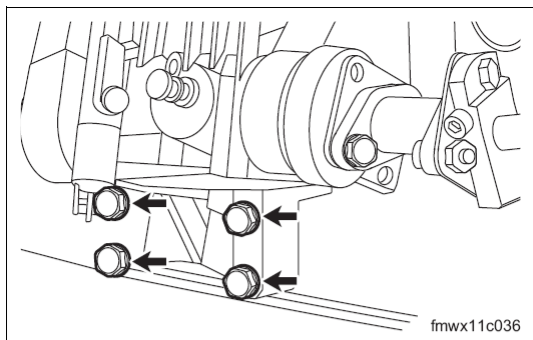
Cover the joint caps to prevent pollution.



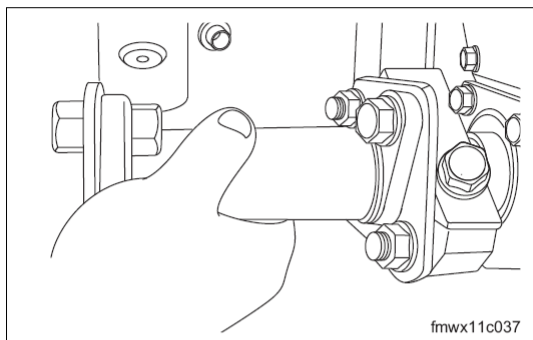
(d). Dismantle the oil pipe of the fuel injection pump.

Caution:

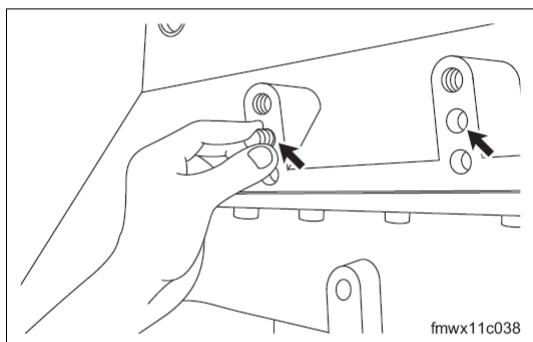
Cover the joint caps to prevent pollution.

Fuel (WD615) – Fuel Injection Pump

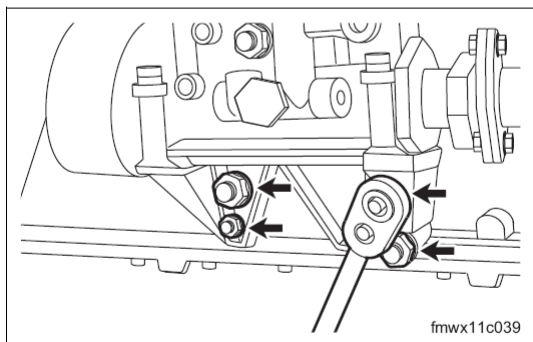
- (e). Dismantle the fuel injection pump.
Caution:
 Cover the joint caps to prevent pollution.



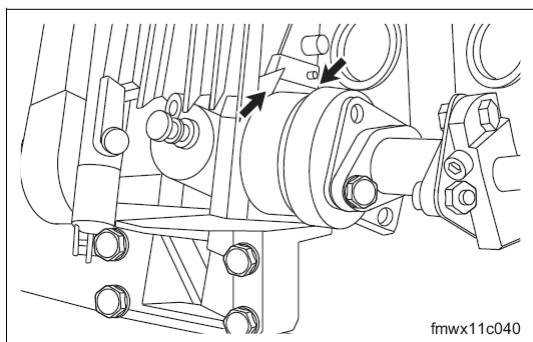
- 3. Install the fuel injection pump**
 (a). Install the driving flange and driving sleeve of the fuel injection pump.
Caution:
 Do not tighten the flange fastening bolt.



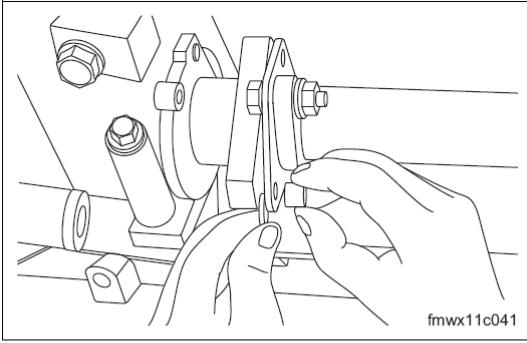
- (b). Install the locating pin of the fuel injection pump bracket.
Caution:
 Cover the joint caps to prevent pollution.



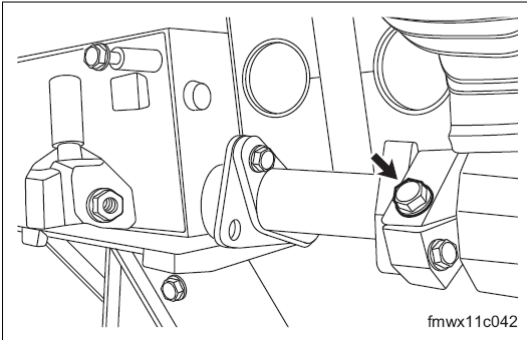
- (c). Install the fuel injection pump onto the fuel injection pump bracket.
Torque: 32 N.m
 (d). Install the fuel injection pump bracket.
Torque: 80 N.m



- (e). Align the timing reticle of the fuel injection pump with the timing reticle on the fuel injection pump driving flange.



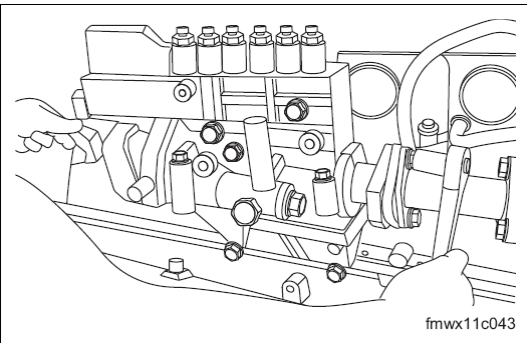
- (f). Make sure that the driving sleeve and fuel injection pump are connected and fastened by connecting bolts.



- (g). Rotate the engine flywheel to the fuel injection lead angle specified at the 1st cylinder compression BTDC, and tighten the driving flange fastening bolt.

Torque: 110N.m

For the fuel injection pump without timing reticle

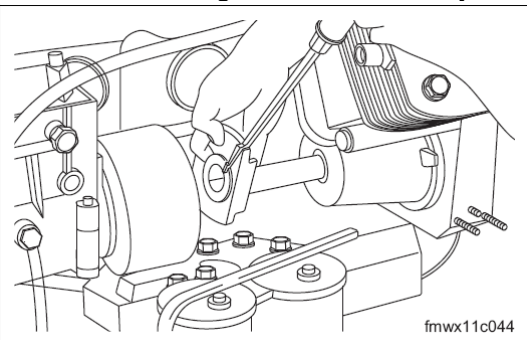


- (a). Drive the diesel fuel into the fuel injection pump body with a manual fuel pump, and discharge air in the pump body.
(b). Install the observation tube on an fuel outlet joint of the cylinder fuel supply branch pump.
(c). Control the throttle at the maximum fuel feed position with hand.
(d). Rotate the flywheel to the fuel injection lead angle specified for 1st compression BTDC.
(e). Rotate the driving shaft of the fuel injection pump slowly and intermittently in the normal rotation direction of the fuel injection pump, and tighten the driving flange fastening bolt after the diesel in the observation tube starts to rise.

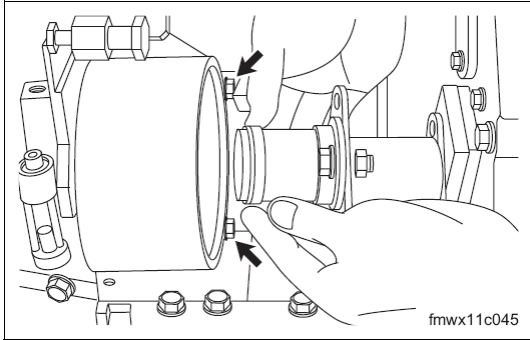
Torque: 110 N.m

Fuel injection pump with timer

When installing the double-cylinder air compressor, the driving shaft of the fuel injection pump and the crankshaft of the air compressor are integrated. When assembling, fix the air compressor onto the timing housing, put the fuel injection pump to the position where the 1st cylinder starts to inject fuel, put the air compressor to the piston TDC position, and finally, install the driving gear of the fuel injection pump and connect the driving shaft of the fuel injection pump with the driving flange.



- (a). Sheathe the driving flange on the drive shaft of the fuel injection pump.

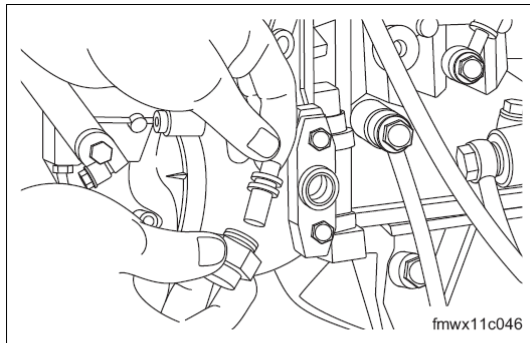
Fuel (WD615) – Fuel Injection Pump

- (b). Connect the drive sleeve with the timer.

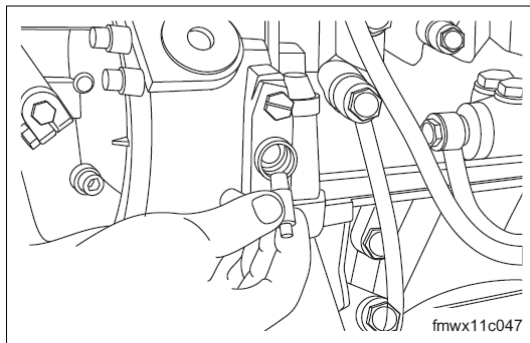
- (c). After connecting the flange and sleeve, rotate the flywheel to the fuel injection lead angle of the 1st cylinder compression BTDC.

PS7100 and PS8500 series fuel injection pumps

This series fuel injection pumps has an injection timing tester on the lateral side of the governor.



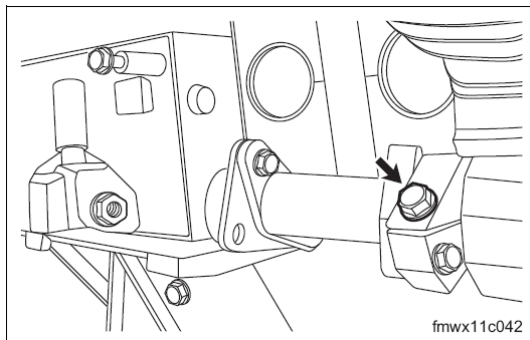
- (a). After installing the fuel injection pump, dismantle the injection timing pin lock cap.



- (b). Take the timing pin out of the inspection hole, invertedly insert the timing pin into the inspection, and rotate the flange connector of the pump. When the timing pin groove is inserted into the locating lug boss, it indicates that the 1st cylinder starts to inject fuel at this moment. At this time, connect the flange connector of the fuel injection pump with the driving shaft flange of the fuel injection pump through connecting steel sheets. Tighten the flange locking nut.

Caution:

After the installation, make sure to pull out the timing pin, invert it, put it in the inspection hole, and finally tighten the lock cap.



- (c). Put the fuel injection pump to a cylinder start fuel injection position.
(d). Tighten the flange fixing bolt.

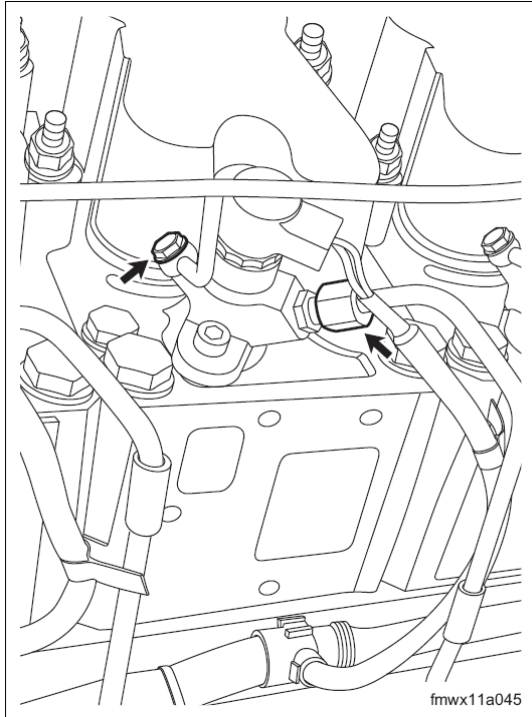
Torque: 110 N.m

4. **Exhaust the low-pressure oil way. Refer to Chapter 11C, Fuel - Fuel System, Testing and Adjustment**
5. **Exhaust the high-pressure oil way**
 - (a). Loosen the first cylinder fuel injector and high-pressure fuel pipe joint, drag the diesel engine to rotate with a starting motor until the joint discharges continuous diesel without bubbles, and tighten the joint nut.

Fuel injector

Overhaul

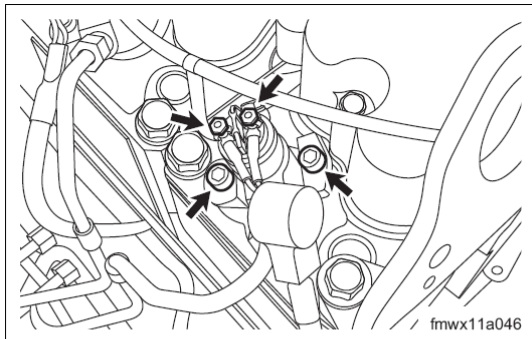
1. Release the fuel pressure
2. Dismantle the intake manifold. Refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement



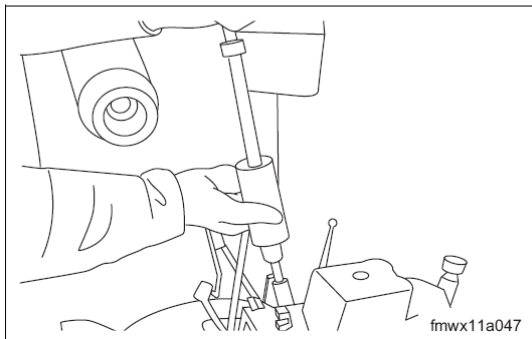
3. Dismantle the fuel injector
 - (a). Dismantle the fuel injector oil inlet pipe.
 - (b). Dismantle the fuel injector oil return pipe.

Caution:

Cover the joint caps to prevent pollution.



- (c). Dismantle the fuel injector wiring harness.
 - (d). Dismantle the fuel injector fixing bolts.

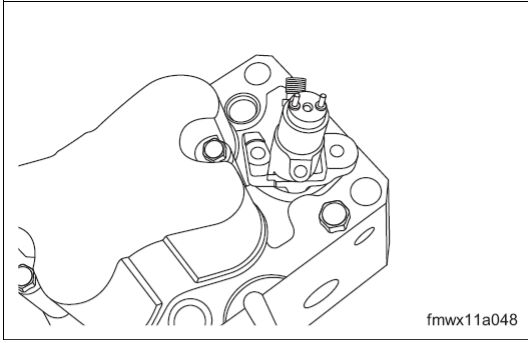


- (e). Dismantle the fuel injector pressure plate.
 - (f). Draw out the fuel injector.

Caution:

A special tool is required to dismantle the fuel injector. It is not allowed to apply force on the solenoid valve to pull out the fuel injector.

4. Test the fuel injector. Refer to Chapter 11C, Fuel - Fuel System, Testing & Adjustment



5. Install the fuel injector

- (a). Insert the fuel injector.
- (b). Install the fuel injector pressure plate.

Caution:

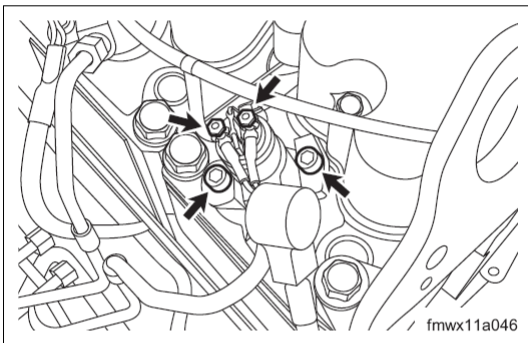
The inner packaging of the fuel injector shall only be opened before installation.

Caution:

Keep the fuel injector body, O-ring and sealing washer clean and complete in the installation process of the fuel injector.

Caution:

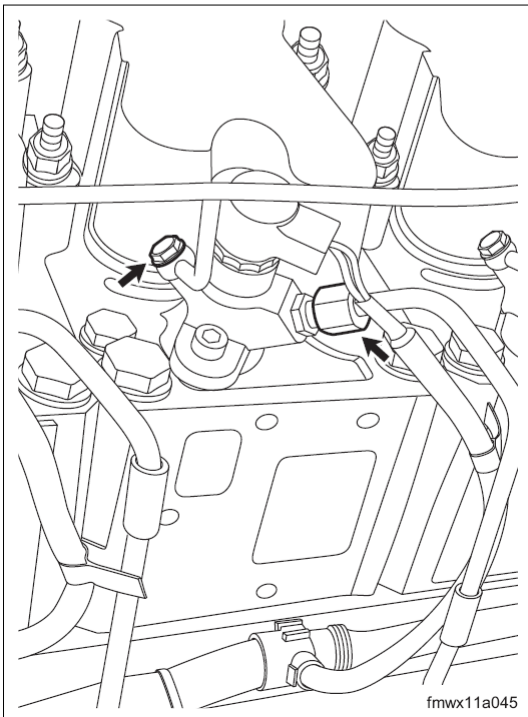
The high pressure joint, O-ring and sealing washer are disposable.



- (c). Install the fuel injector fixing bolts.

Torque: 11 ± 1 N.m. Tighten the bolts symmetrically and make sure that the side clearances are identical.

- (d). Install the fuel injector wiring harness.



- (e). Install the fuel injector oil inlet pipe.

- (f). Install the fuel injector oil return pipe.

Caution:

The protective cap shall only be dismantled before installing the oil pipe.

6. Install the intake manifold. Refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement

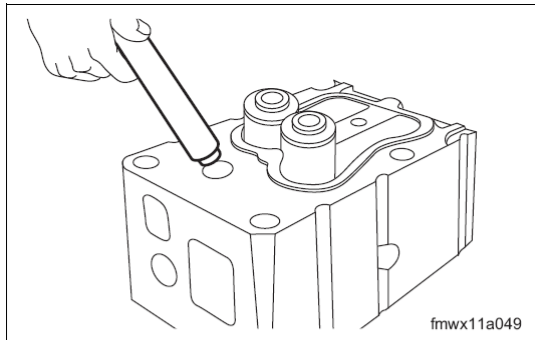
7. Exhaust the low-pressure oil way. Refer to Chapter 11A, Fuel - Fuel System, Testing and Adjustment

8. Exhaust the high-pressure oil way

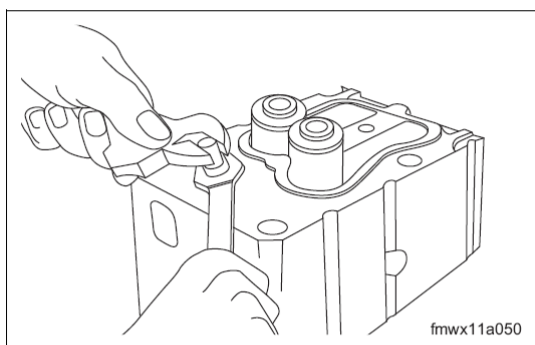
- (a). Loosen the first cylinder fuel injector and high-pressure fuel pipe joint, drag the diesel engine to rotate with a starting motor until the joint discharges continuous diesel without bubbles, and tighten the joint nut.

Fuel Injector Sleeve Replacement

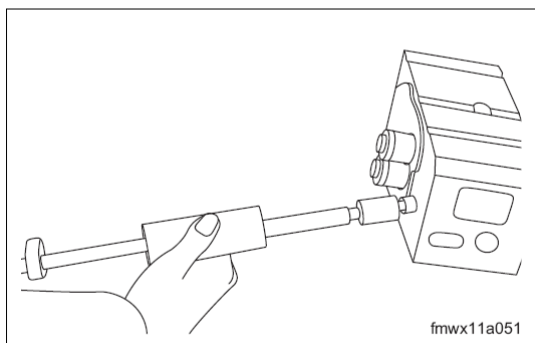
1. Dismantle the fuel injector, refer to Chapter 11C, Fuel - Fuel Injector, Overhaul
2. Insert shifting block into sleeve



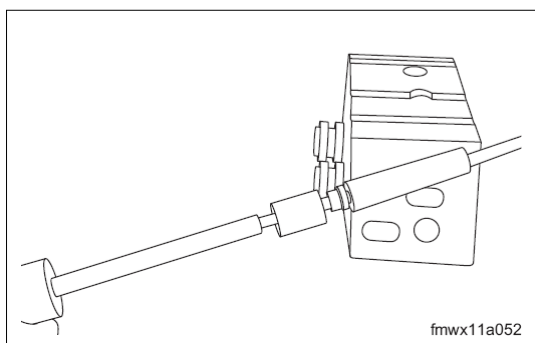
3. Screw down expansion nut of shifting block

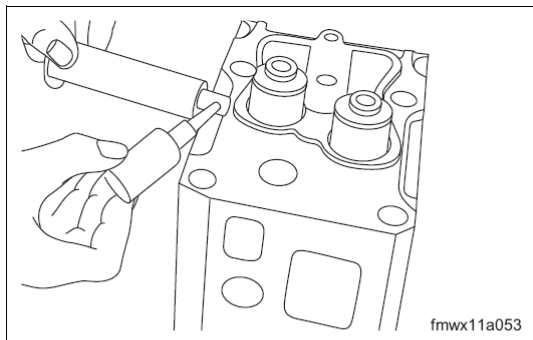


4. Pull old sleeve with puller punch hammer

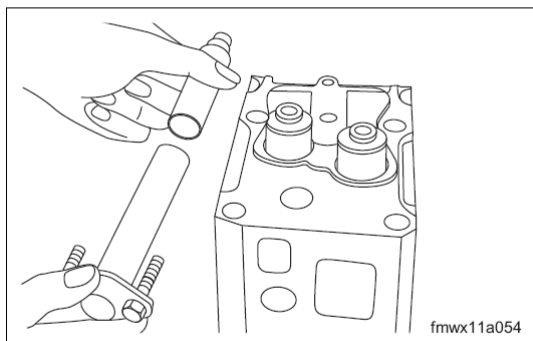


5. Pull out old sleeve

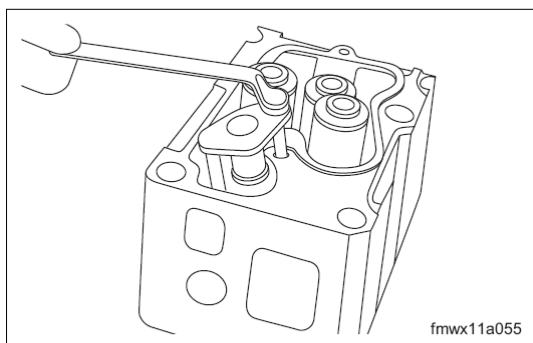




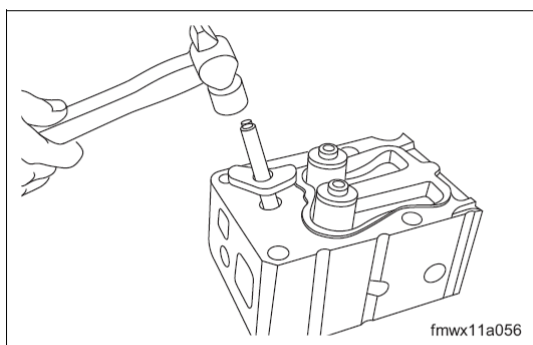
6. Apply 602 sealant at small end of sleeve



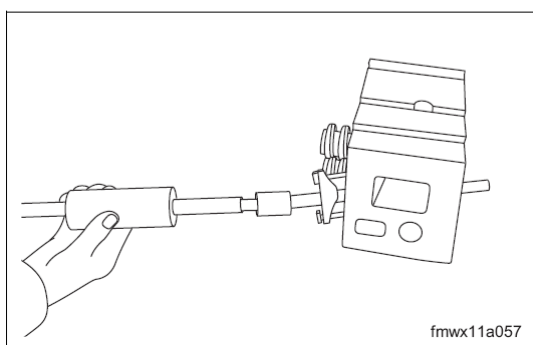
7. Insert new sleeve into pressing sleeve



8. Press pressing sleeve and new sleeve into cylinder head with pressure plate of fuel injector



9. Drive expanding arbor into pressing sleeve



10. Pull out expanding arbor with puller

Fuel (WD615) – Fuel Injector Sleeve

Air Intake

Intake System	12-3
Overall	12-3
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High-position Intake Pipe	12-4
Part Drawing	12-4
Replacement	12-5
Air Filter Assembly.....	12-7
Part Drawing	12-7
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Intake System

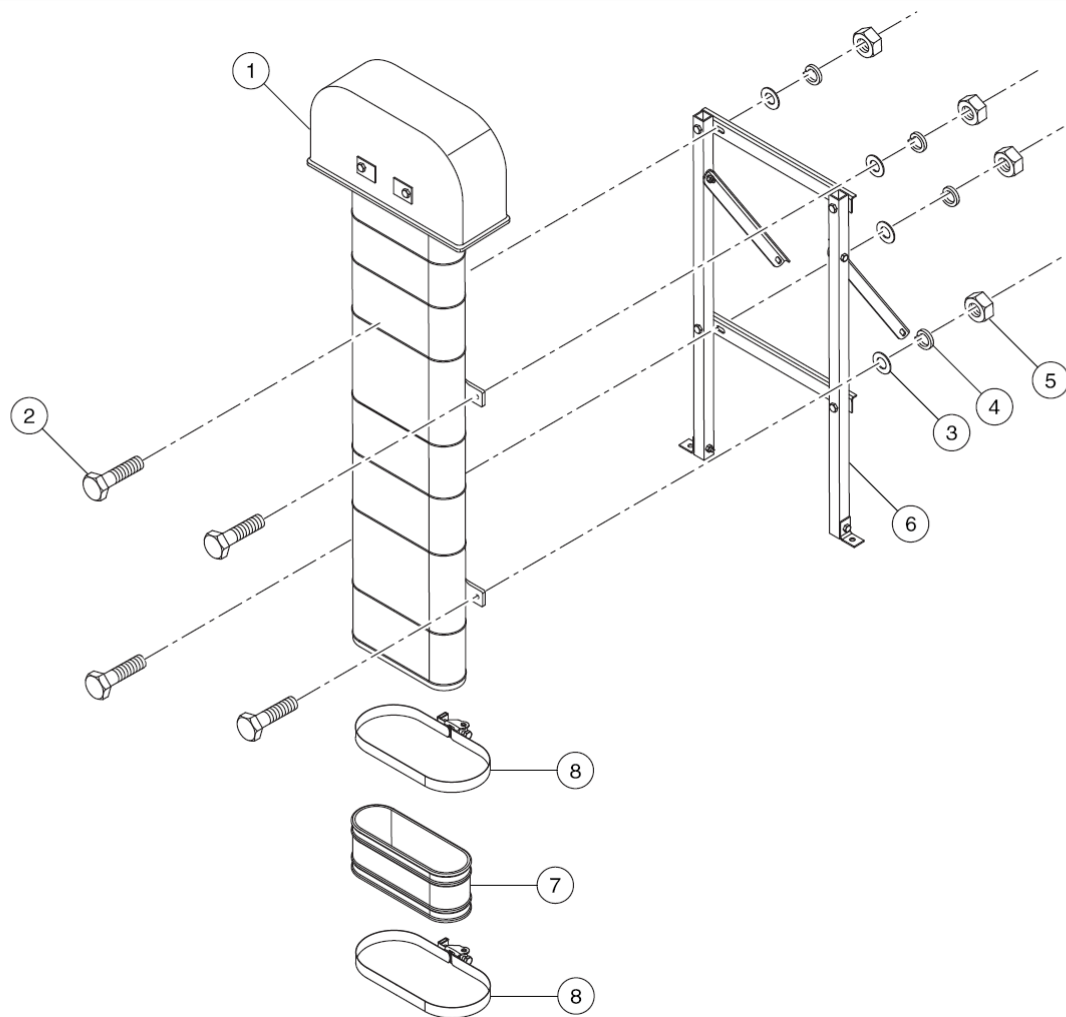
General

The vehicle adopts a tornadotron type desert two-stage air filter which comprises a housing, a tornadotron primary filter, a paper main filter element, a safety filter element, etc. The air filter has double filtration functions: the tornadotron primary filter can carry out first-stage filtration on most dust, the paper main filter element completes fine filtration, and the function of the safety filter element is to ensure the safety of the engine when the main filter element has accident damage. The filter is mainly suitable for air filtration of vehicles used in areas with serious dust.

Precautions

1. **Engine intake must be filtered to prevent dirt and debris entering the engine. If the intake pipe is damaged or loosened, unfiltered air will enter the engine, and cause premature wear of the engine.**
2. **The joint of the air intake hose and the high-position intake pipe shall be firm, reliable without light leak, loose, etc.**
3. **The high-position intake pipe and the bracket shall be connected firmly and reliably without external cracks, and the joint of the air intake hose shall have no air leaks.**
4. **The maintenance cycle shall be properly shortened in areas with serious sand storm and dust.**
5. **In the process of maintenance, pay special attention to that the air exhaust part of the filter element shall not have secondary pollution.**
6. **If a non-original assorted filter element is used or the filter element is not maintained by maintenance methods, the filtration indices of the air filter can not be guaranteed.**
7. **Squeeze a dust exhaust bag to exhaust the dust deposit after travelling for one week and check whether the dust exhaust bag is in a good condition.**
8. **Clean periodically or when a plugging indicator light of the air filter is on; replace the outer filter element every year, or after repeatedly cleaning for six times, or when damage is found.**
9. **Inspect the tornadotron primary filter once every time after travelling for 500 hours (about two months).**

High-position Intake Pipe Part Drawing



fmwx120001

1	High-position Intake Pipe Assembly
2	Hex Head Bolt
3	Flat Washer
4	Spring Washer

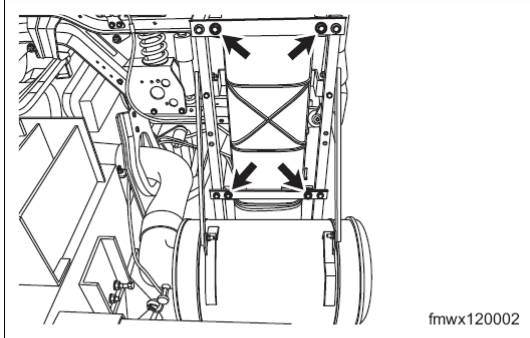
5	Hex Head Nut - Style 1
6	High-position Intake Pipe Bracket Assy.
7	Connecting Hose
8	Worm Drive Type Hose Hoop - Style A

High-position Intake Pipe

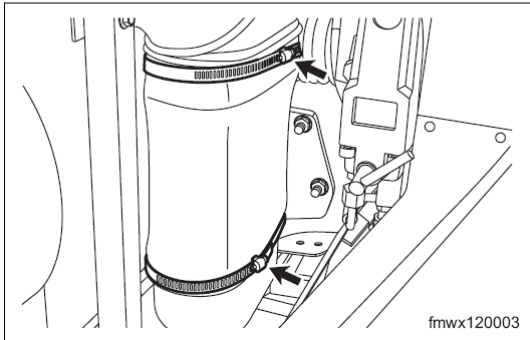
Replacement

Hint:

Part Drawing, refer to Chapter 12, Intake - High-position Intake Pipe, Part Drawing.



1. **Dismantle high-position intake pipe assembly**
 - (a). Dismantle the fixing bolt and nut of the high-position intake pipe assembly.



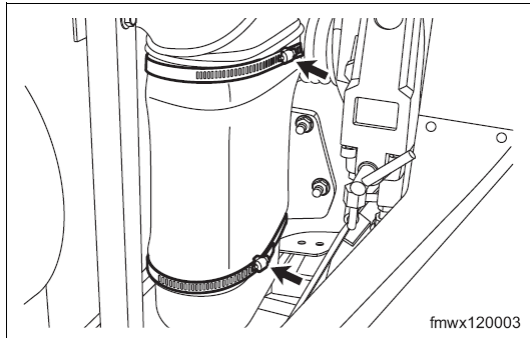
2. **Dismantle connecting hose**
 - (a). Loosen the hose hoop.

3. **Inspect high-position intake pipe**

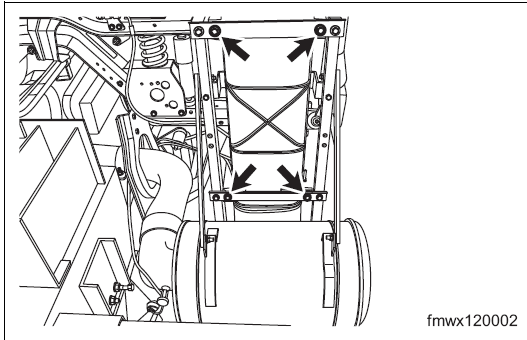
- (a). Clean the high-position intake pipe and check for cracks, air leakage , etc.
 - (b). Check for aging, cracks, air leakage, etc. of the connecting hose.

Caution:

If there is any abnormal condition, replace the high-position intake pipe and the connecting hose assembly with a new one.



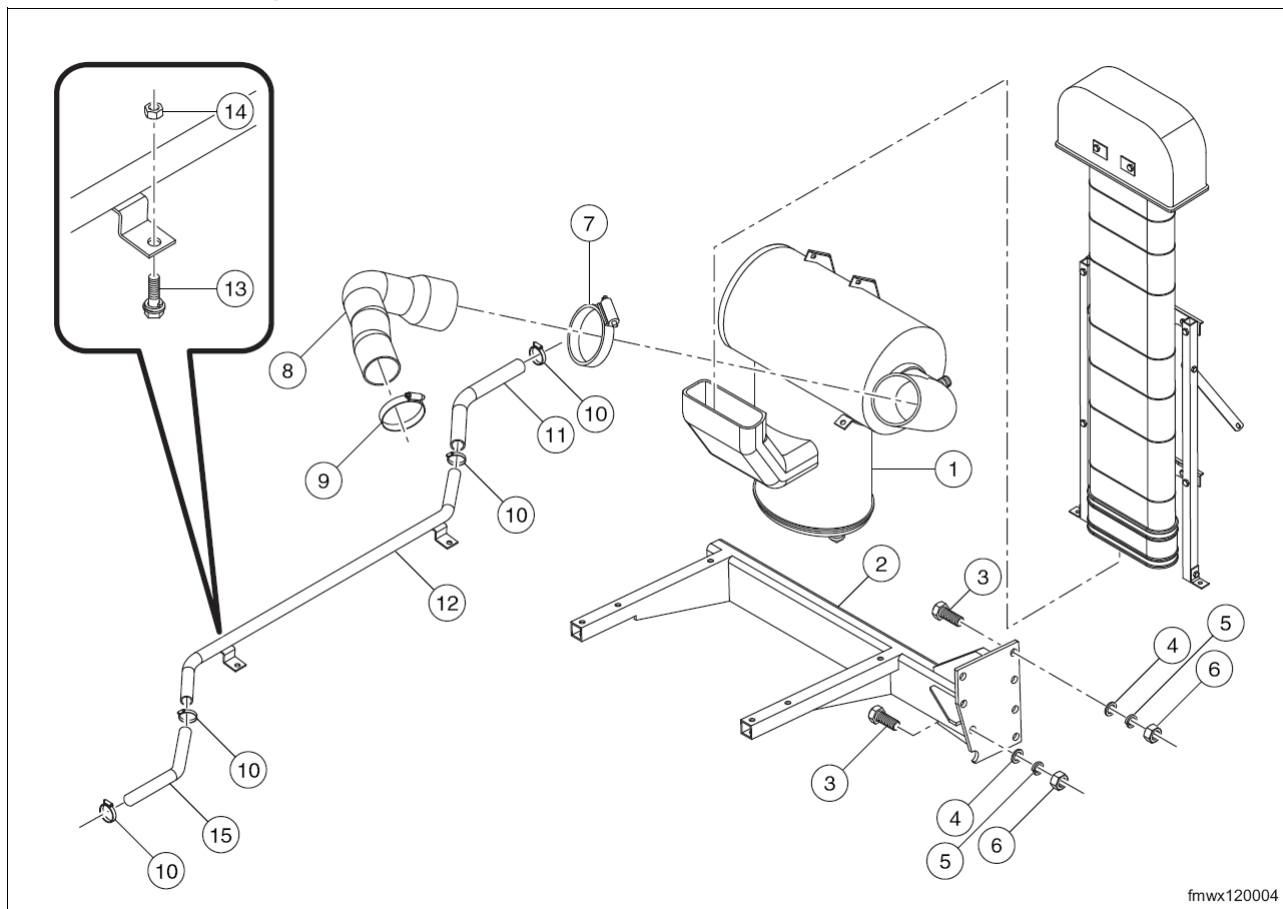
4. **Install connecting hose**
 - (a). Tighten the hose hoop.



- 5. Install high-position intake pipe assembly**
(a). Install the fixing bolt and nut of the high-position intake pipe assembly.
Torque: 21~25N.m

Air Filter Assembly

Part Drawing



1	Desert Air Filter Assembly
2	Desert Air Filter Bracket Assembly
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Hex Nut - Style 1
7	Worm Drive Type Hose Hoop - Type A
8	Exhaust hose - Air Filter

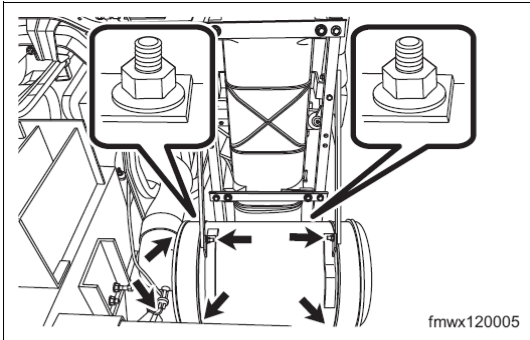
9	Worm Drive Type Hose Hoop - Style A
10	Worm Drive Type Hose Hoop - Style A
11	Intake Hose - Air Compressor
12	Intake Steel Pipe - Air Compressor
13	Hex Head Bolt, Spring Washer and Plain Washer Assy.
14	Hex Flange Face Nut
15	Intake Hose 1 - Air Compressor

Replacement

Hint:

Part Drawing, refer to Chapter 12, Intake - Air Filter Assembly, Part Drawing.

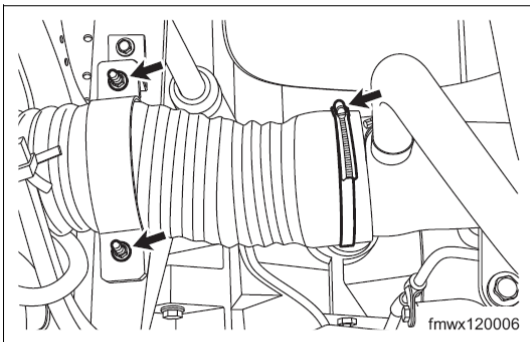
1. Turn off main power



2. Dismantle air filter assembly

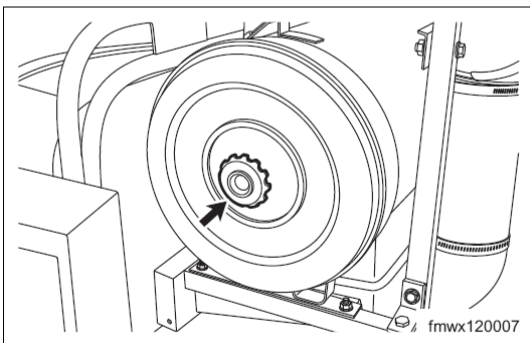
(a). Dismantle the fixing bolt and nut of the air filter assembly.

- Disconnect the connector assembly of the plugging alarm indicator light switch of the air filter.
- Loosen the exhaust hose hoop of the air filter.



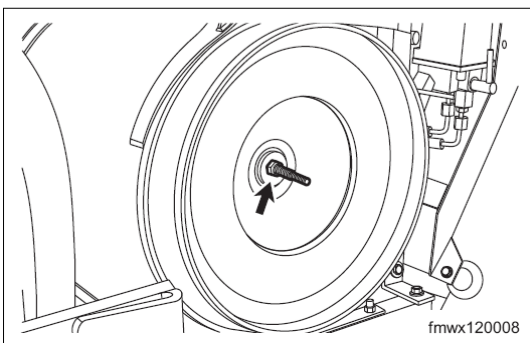
(b). Dismantle exhaust hose of the air filter.

- Loosen the exhaust hose hoop of the air filter.
- Dismantle the fixing nut of the exhaust hose bracket of the air filter.



3. Dismantle air filter assembly

(a). Dismantle the sealing dome handle of the air filter assembly.



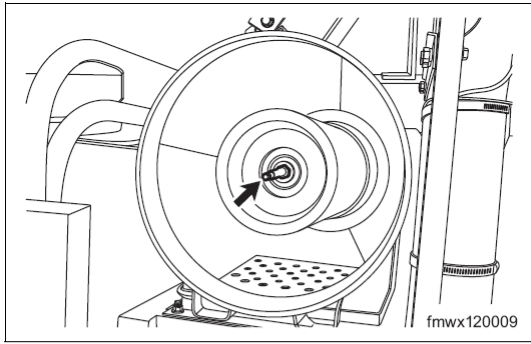
(b). Dismantle the fixing nut of the main filter element.

- Clean the main filter element with compressed air, and replace the main filter element if necessary.

Caution:

Do not drop dust on the safety filter element. Put on appropriate goggles and a face shield when using compressed air. Flying chipping and dirt may cause physical injury.

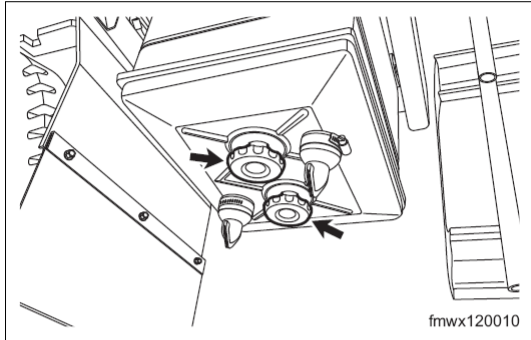
Intake – High-position Intake Pipe



- (c). Dismantle the fixing nut of the safety filter element.

Caution:

Check whether the safety filter element has pollution or damage, and if there is any abnormal conditions, replace the safety filter element with a new one.



- (d). Dismantle the sealing square cover handle below the air filter assembly.

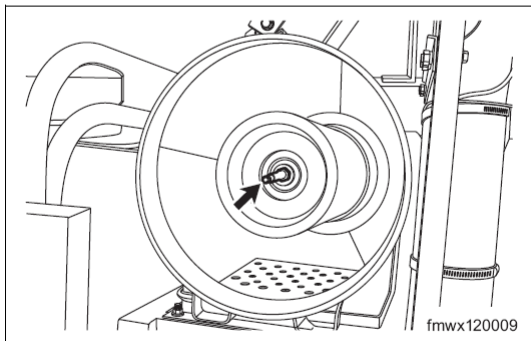
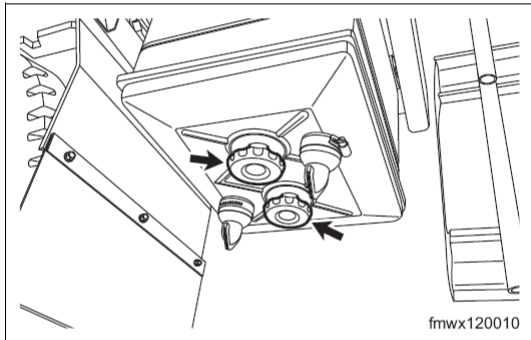
- Squeeze the dust exhaust bag to exhaust the dust deposit, and check whether the dust exhaust bag is in a good condition.
- Clean dust deposit of each position with compressed air.

Caution:

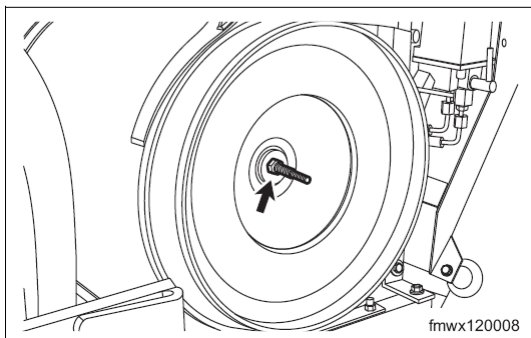
Plug the air outlet with a clean object. Put on appropriate goggles and a face shield when using compressed air. Flying chipping and dirt may cause physical injury.

4. Assemble air filter assembly

- (a). Install the sealing square cover handle below the air filter assembly.



- (b). Install the fixing nut of the safety filter element.
Torque: 41~51N.m



- (c). Install the fixing nut of the main filter element.
Torque: 41~51N.m

Air Intake – Air Filter Assembly

- (d). Install the sealing dome handle of the air filter assembly.

Caution:

After assembling the air filter assembly, check whether the sealing is good without lose and air leakage.

5. Install air filter assembly

- (a). Install the exhaust hose of the air filter.
- Screw down the exhaust hose hoop of the air filter.
 - Install the fixing nut of the exhaust hose bracket of the air filter.

- (b). Install the fixing bolt and nut of the air filter assembly.
- Screw down the exhaust hose hoop of the air filter.
 - Connect the connector assembly of the plugging alarm indicator light switch of the air filter.

6. Turn on the main power

Exhaust & Turbocharger (WP10)

Exhaust System.....	13A-3
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Part Drawing.....	13A-5
Testing & Adjustment.....	13A-8
Exhaust Pipe.....	13A-10
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Overhaul	13A-12

13A

Exhaust System

General

Supercharger:

All WP10 Series diesel engines are of a turbocharged intercooled model, and the supercharger marched for the engine is an exhaust gas turbocharger. The engine generates power as a result of the combustion of fuel in the cylinder, and the input amount of fuel is limited by the intake amount of air into the cylinder, so the power generated is also limited. If the running performance of the engine has been in optimum state, in order to increase the output power, only more air is compressed into the cylinder to increase the amount of fuel and further improve the capacity to do work through combustion. Under current technical condition, the turbocharger is the only machine which can increase output power with the engine's working efficiency unchanged.

The greatest advantage of the turbocharger lies in significantly boosting the engine's power and torque without increasing the engine's displacement. Generally speaking, the power and torque of the engine which is equipped with the turbocharger will increase by 20 % ~30 %. The disadvantage of the turbocharger lies in lagging; in other words, the engine delays to increase or decrease output power because the impeller has a slow response to the sudden change of the throttle due to inertia effect. A vehicle which accelerates suddenly or overtakes another vehicle will have insufficient power at that moment.

The exhaust gas turbocharger is mainly composed of an impeller and a turbine, and also includes some other control elements. The impeller and turbine are connected by a shaft, which is known as rotor, the exhaust gas from the engine drives the impeller, which in turn draws the turbine to rotate, so as to turbocharge the intake system. As the turbocharger is installed at the engine's exhaust side, the working temperature of the turbocharger is high, and the speed of the turbocharger's rotor is very high, which can reach several hundred thousand rpm. Such high speed and temperature disable common mechanical needle or ball bearings to work for the rotor, so non-locating bearings must be used for the turbocharger, which is lubricated by engine oil and cooled by coolant.

Intercooler:

High temperature not only affects charging efficiency, but also is easy to result in explosion. Accordingly, a device is needed to lower the intake temperature, which is an intercooler. It is installed between the turbocharger outlet and intake pipe and used for cooling air into the cylinder. The intercooler, as a radiator, uses air or water for cooling, and the heat of air escapes to the atmosphere through cooling. According to the test, the intercooler with good performance can not only keep the engine's compression ratio at a certain value without explosion, but also lower temperature to increase intake pressure and further boost the effective power of the engine. This vehicle is air-air cooled, and the resistance of the intercooler shall be lower than 5 kPa (in rated condition).

Precautions

As the turbocharger usually operates at high speed and high temperature, the temperature of the turbocharger's exhaust gas end is about 600 °C, and the turbocharger's rotor rotates by 7,000~100,000 r/min, the following points shall be noted in order to ensure that the turbocharger operates normally:

1. DO NOT drive immediately after the engine starts

- After the engine starts, especially in winter, run it at idle speed for a while, which allows lubricating oil to sufficiently lubricate bearings before the turbocharger's rotor operates at high speed. Therefore, never step on the accelerator sharply just after the engine starts, to avoid damaging the oil seal of the turbocharger. The engine shall be idled appropriately (about 5min, which can be shortened for a short stop) after starting, and then loaded.

2. DO NOT shut down the engine immediately

- DO NOT shut down immediately the engine which has operated at high speed for a long time. When the engine is running, some oil is supplied to the bearings of the turbocharger's rotor for lubrication and cooling. If the operating engine is shut down suddenly, the oil pressure goes down to 0 rapidly, the high temperature of the turbocharger's turbine part is transferred to the middle, and the heat in the bearing support housing can not be taken away quickly while the rotor of the turbocharger is still rotating under inertia effect. Thus, if the engine in hot state is shut down suddenly, the oil remaining in the turbocharger will get overheated to damage the bearings and shaft. As a result, the engine, which has operated with large load for a long time, shall be run at idle speed for 3~5min, and then shut down after the rotor rotates at low speed. It is specially prohibited to shut down the engine suddenly after stepping on the accelerator strongly.

3. Keep clean

- Keep clean while dismantling the turbocharger. Block each pipe joint with clean cloth to prevent foreign matters from falling into the turbocharger and damaging the rotor. Be careful not to hit or damage the impeller during repair. Remove the obstructions after reassembly.

4. Wash the turbocharger

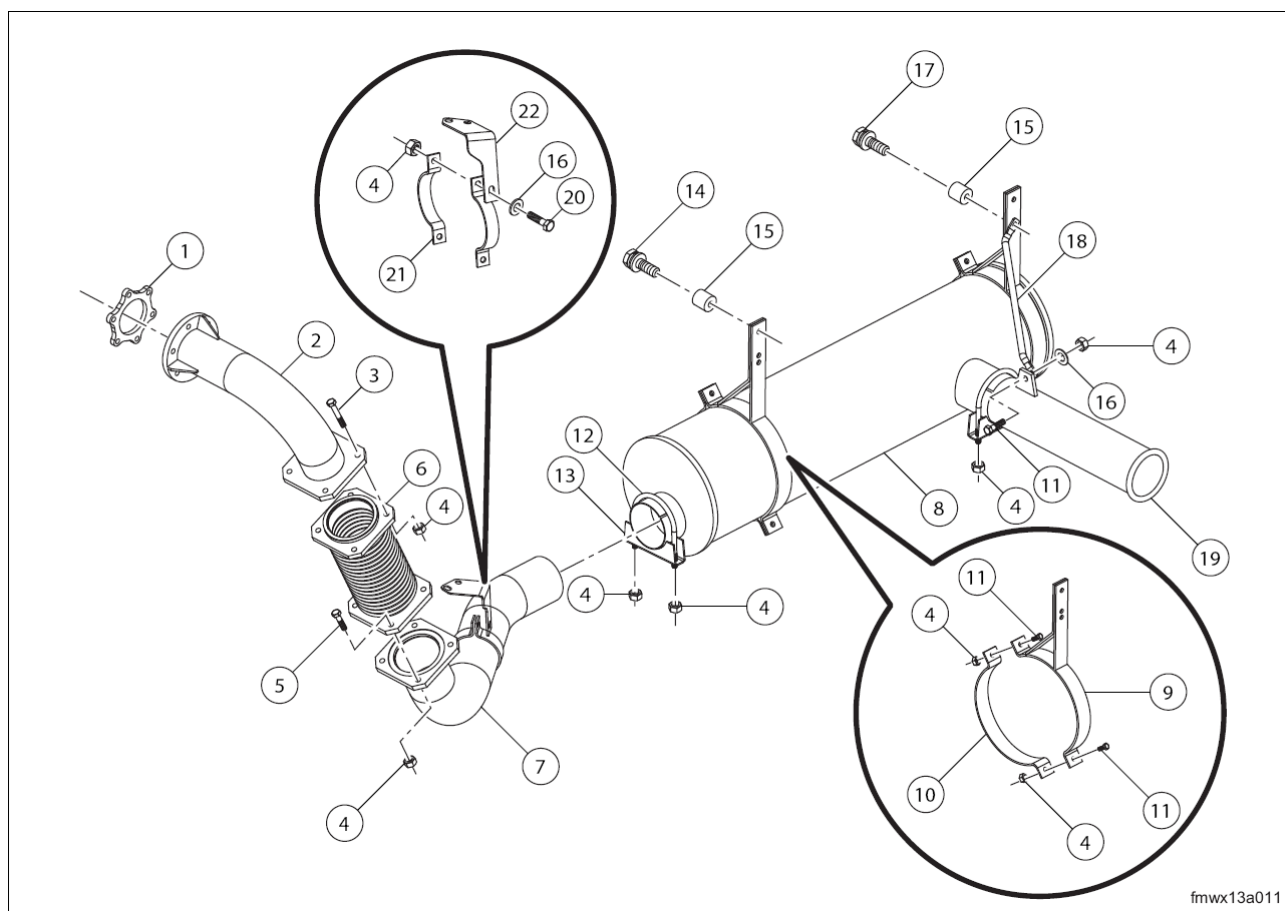
- As the turbocharger usually operates at high temperature, the partial coking of engine oil in the lubricating oil pipeline easy occurs due to the effect of high temperature, which will cause and damage to on bearings as a result of insufficient lubrication. Therefore, the lubricating oil pipeline shall be washed after the turbocharger has operated for a period of time.

5. Inspect the operating condition of the turbocharger usually

- Inspect the connection of various air pipes before driving and after stopping, and prevent the turbocharger from failing due to looseness and falling and air from going into the cylinder due to short circuit. Make sure the tightness of the turbocharger's pipeline system and parts, and the heat dispersion of the intercooler.

Exhaust & Turbocharger (WP10) –Exhaust System

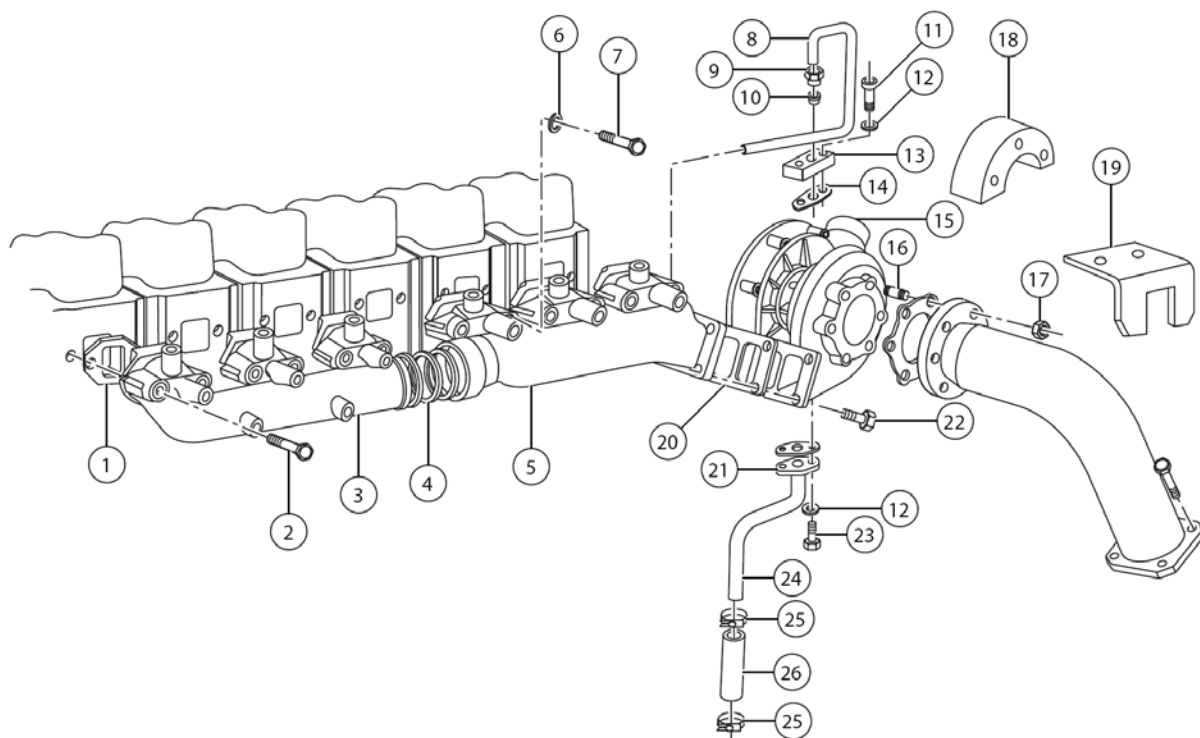
Part Drawing



fmwx13a011

1	Sealing Gasket	12	U-bolt
2	Exhaust Pipe Welding Assembly 1	13	Support
3	Hex Head Bolt	14	Hex Head Bolt, Spring Washer and Flat Washer Assembly
4	Prevailing Torque Type All-metal Hex Nut, Style 2	15	Rubber and Metal Pad
5	Exhaust Pipe Gasket	16	Flat Washer
6	Hose Assembly	17	Hex Head Bolt, Spring Washer and Flat Washer Assembly
7	Exhaust Pipe Welding Assembly 2	18	Tailpipe Hanger
8	Exhaust Muffler Assembly	19	Tailpipe
9	Muffler Clamp 1	20	Hex Head Bolt
10	Muffler Clamp 2	21	Clamp
11	Hex Head Bolt	22	Bracket, Exhaust Pipe

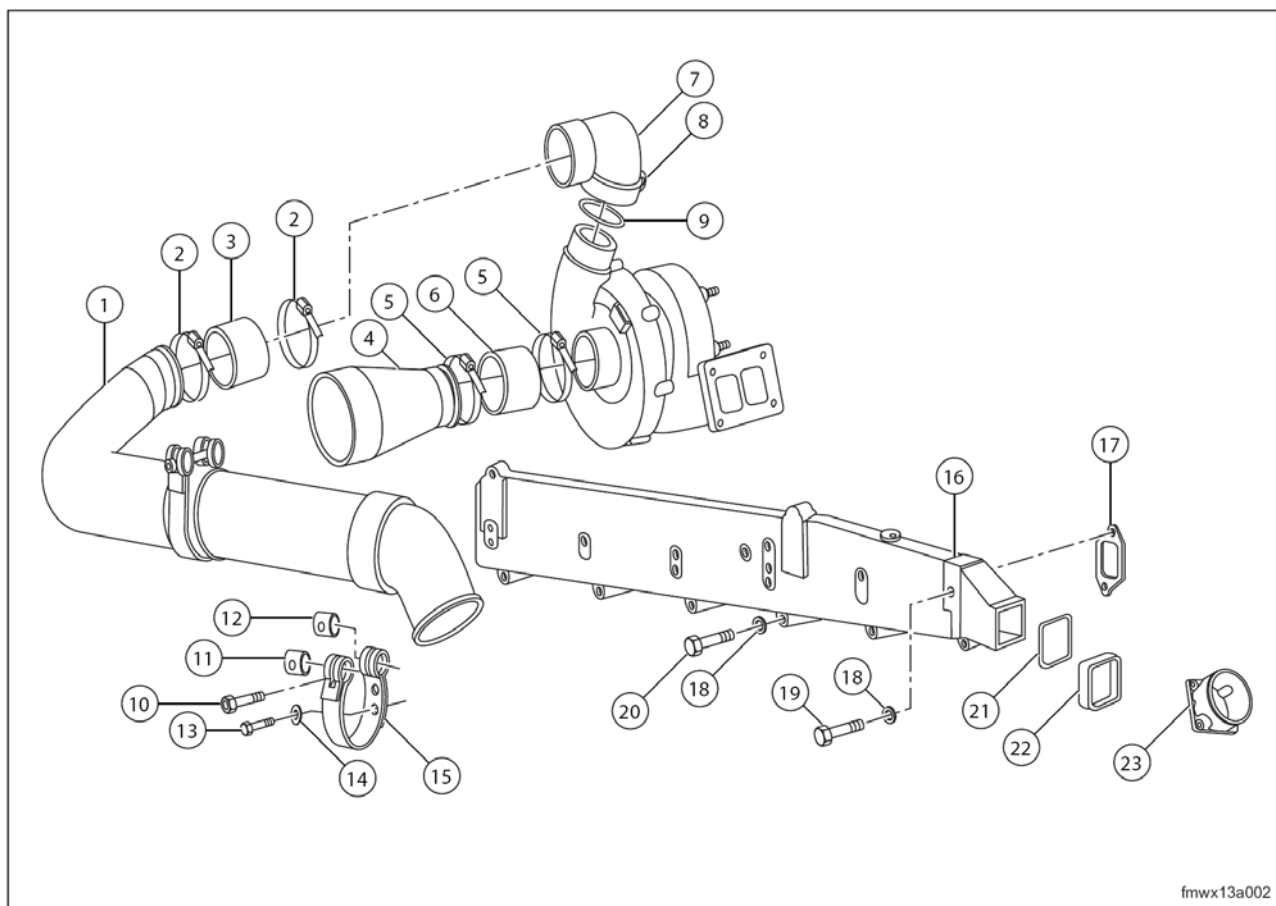
Exhaust & Turbocharger (WP10) –Exhaust System



fmwx13a001

1	Exhaust Pipe Gasket
2	Fastening Bolt, Exhaust Pipe
3	Front Exhaust Manifold
4	Sealing Ring, Exhaust Pipe
5	Rear Exhaust Manifold
6	Thrust Washer
7	Fastening Bolt, Exhaust Pipe
8	Oil Inlet Pipe
9	Nut, Pipe Joint
10	Clamp Sleeve
11	Hex Socket Cap Head Screw
12	Self-locking Washer
13	Flange, Oil Inlet Pipe

14	Gasket, Oil Inlet Pipe
15	Turbocharger, with exhaust valve
16	Stud Bolt
17	Prevailing Torque Type All-metal Hex Nut, Style 2
18	Heat Shield
19	Bracket
20	Turbocharger Gasket
21	Gasket, Oil Return Pipe Flange
22	Hex Head Bolt
23	Oil Return Pipe
24	Exhaust Pipe Bracket
25	Hose Clamp
26	Hose for Turbocharger Oil Return

Exhaust & Turbocharger (WP10) –Exhaust System

fmwx13a002

1	Pipe Assembly
2	Hose Clamp
3	Rubber Hose with Fibre
4	Intake Pipe, Air Compressor
5	Hose Clamp
6	Rubber Hose
7	Connecting Elbow
8	Clamp
9	Sealing Ring
10	Hex Socket Cap Head Screw
11	Clamping Pin
12	Tension Pin

13	Hex Head Bolt
14	Adjusting Washer
15	Tension Strap
16	Intake Pipe Assembly
17	Intake Pipe Gasket
18	Wave Spring Washer
19	Fastening Bolt, Intake Pipe
20	Hex Head Bolt
21	Gasket
22	Heater
23	Intake Connecting Pipe

Testing & Adjustment

The turbocharger is a key mechanical part which is used for boosting the engine's power and decreasing exhaust gas emission. Improper use, maintenance and care may cause the turbocharger to be defective and disable the turbocharger to work. This text introduces some common faults and solutions of the turbocharger as follows:

The turbocharger leaks oil.

Symptom 1: Excessive oil is consumed, but the color of exhaust smoke is normal and the power does not decrease.

Cause: This condition is generally caused by oil leakage.

Solution:

1. **First of all, inspect whether the external oil pipes (including oil inlet and return pipes of the turbocharger) of the engine lubrication system leak oil.**
2. **Inspect whether there is oil at the exhaust gas outlet of the turbocharger. If any, you can decide that the sealing ring at one end of the turbine is damaged, and replace it.**

Symptom 2: Excessive oil is consumed, the color of exhaust smoke is blue, but the power does not decrease.

Cause: It is caused by that the oil leaked from the compressor end of the turbocharger leaks oil goes into the combustion chamber through the intake pipe of the engine. The possible causes are as follows:

1. **The oil return pipe of the turbocharger is obstructed, and excessive oil accumulates at the middle support of the rotor assembly and flows into the compressor impeller along the rotor shaft.**
2. **After the sealing ring or oil slinger at the compressor impeller end is damaged, oil will go into the impeller chamber through the damaged sealing ring or oil slinger, and then into the combustion chamber through the intake pipe along with turbocharged air in the impeller chamber.**

Solution:

1. **Open the outlet of the air compressor or the straight intake pipe (rubber hose) of the engine, observe whether oil is attached to the pipe orifice or wall. If any, inspect whether the oil return pipe of the turbocharger is unobstructed. If obstructed, it may caused by the accumulation of excessive oil at the middle support. Unblock the oil return pipe and then reassemble.**
2. **If unobstructed, it is caused by that the sealing ring or oil slinger at the impeller end is damaged. Disassemble the turbocharger and repair the damaged part.**

Symptom 3: Excessive oil is consumed, the color of exhaust smoke is blue or black, and the power decreases.

Cause:

1. **The wearing of the clearance between the piston and cylinder is too big, and the oil goes into the combustion chamber and is combusted.**
2. **In process of sucking air into the turbocharger, air flow encounters great resistance (such as clogging of the air filter element, deformation or flattening of the intake rubber hose due to suction, etc.). The low pressure at the inlet of the air compressor will cause oil leakage, and the oil leaked will go into the air compressor, then get into the combustion chamber along with compressed air and be combusted.**

Solution:

Exhaust & Turbocharger (WP10) –Exhaust System

1. **Inspect whether there is oil on the wall of the straight intake hose, the hose is flattened, air flow is obstructed, or the air filter element is clogged.**
 2. **If there is oil at the pipe orifice and on the pipe wall, wash or replace the air filter element.**
- There is metallic grating noise.**

Symptom: The color of exhaust smoke is black, the power decreases, and there is abnormal noise from the turbocharger.

Cause:

1. **If there is metallic grating noise, it is caused by the friction between the impeller and turbocharger housing due to the excessive wearing of the turbocharger's rotor bearings or thrust bearings.**
2. **If it is air flow noise rather than metallic grating noise, it is the rotation noise generated by the rotation of the turbocharger's rotor at high speed, or the air leakage noise due to poor connection of the intake or exhaust joint.**

Solution:

1. **For the former, replace the damaged part or repair according to the wearing condition.**
2. **For the latter, distinguish carefully, and solve according to the specific condition.**

The turbocharger's bearing is damaged.

Symptom: The turbocharger's bearing is damaged, the engine's power decreases, excessive oil is consumed, the color of smoke is black, and the turbocharger fails to work when the fault is serious.

Cause:

1. **The pressure and flow of lubricating oil is insufficient.**
 - Lubricating oil supplied for the turbocharger's journal and thrust bearing is insufficient.
 - Lubricating oil which keeps floating between rotor journal and bearing is insufficient.
 - The turbocharger has operated at high speed, but lubricating oil is not supplied in time.
2. **Foreign matters or silt goes into the lubrication system.**
3. **Engine oil deteriorates due to oxidization.**
 - The diesel engine overheats, and gas going between the piston and cylinder wall is excessive;
 - Cooling water is leaked into engine oil;
 - Improper engine oil is selected, and engine oil is not replaced periodically according to specified requirement.

Solution:

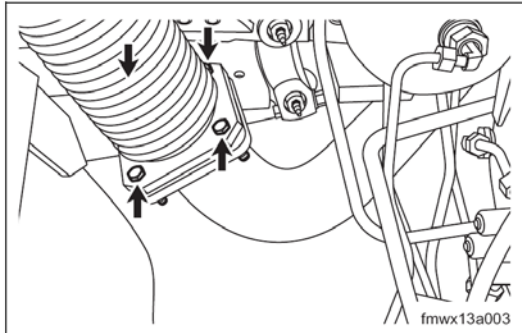
1. **Inspect whether the pressure of lubricating oil is normal, and the oil amount meets the requirement.**
2. **Replace lubricating oil periodically according to the specified requirement, and ensure the cleanliness of lubricating oil.**
3. **Use lubricating oil strictly according to the specified requirement. Mixing of lubricating oils is not allowed.**
4. **Prevent the engine from operating at high temperature, and keep the engine at normal operating temperature.**

Exhaust Pipe

Overhaul

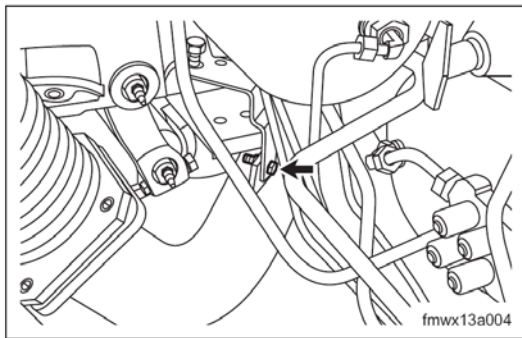
Hint:

Part Drawing, refer to Chapter 13A, Exhaust & Turbocharger – Exhaust System, Part Drawing

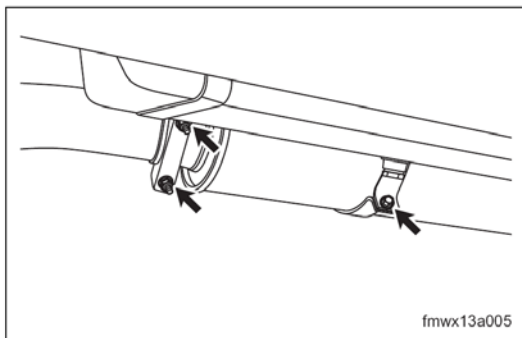


1. Dismantle the exhaust pipe

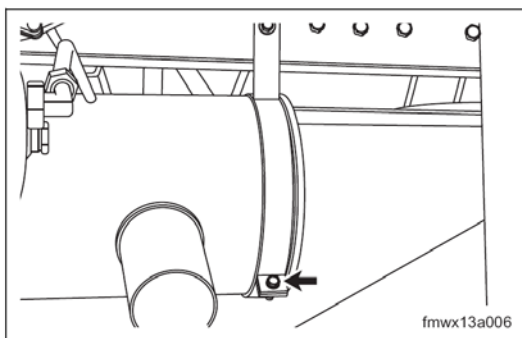
- (a). Dismantle the fixing bolts of the exhaust pipe.



- (b). Dismantle the bolts of the exhaust pipe fixing bracket.



- (c). Dismantle the fixing nuts of the muffler bracket.
(d). Dismantle the fixing bolts of the muffler clamp.



- (e). Dismantle the fixing bolts of the muffler clamp.
(f). Draw out the exhaust pipe.

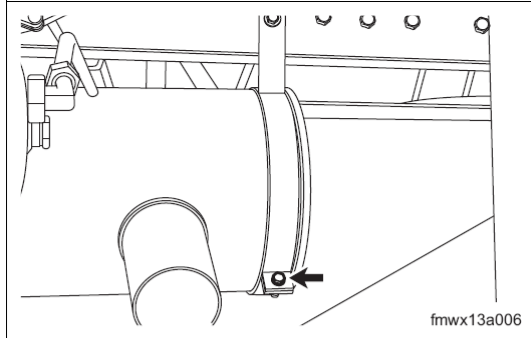
13A

Exhaust & Turbocharger (WP10) – Exhaust Pipe**2. Inspect the exhaust pipe**

- (a). Inspect whether there is excessive corrosion, cracking or air leakage of the exhaust pipe and muffler.
- (b). Inspect the exhaust pipe and muffler.

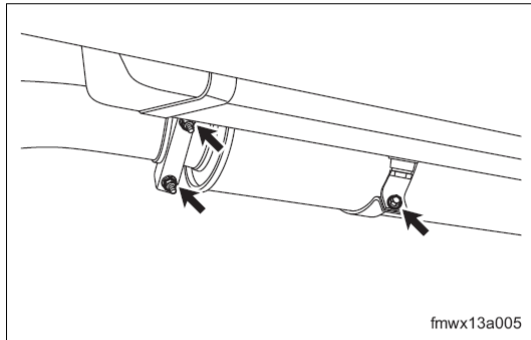
Caution:

If any performance of the exhaust pipe and muffler fails to meet the requirements, replace with a new exhaust pipe and muffler assembly.

**3. Install the exhaust pipe**

- (a). Install the exhaust pipe.
- (b). Install the fixing bolts of the muffler clamp.

Torque: 80±10N.m

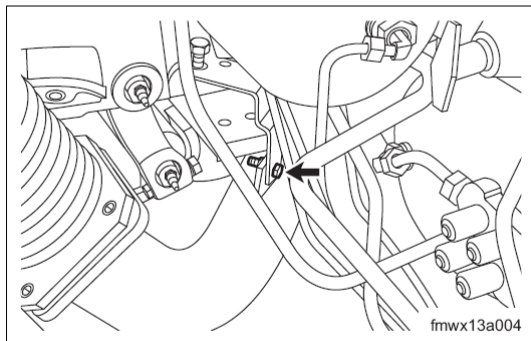


- (c). Install the fixing nuts of the muffler bracket.

Torque: 80±10N.m

- (d). Install the fixing bolts of the muffler clamp.

Torque: 80±10N.m

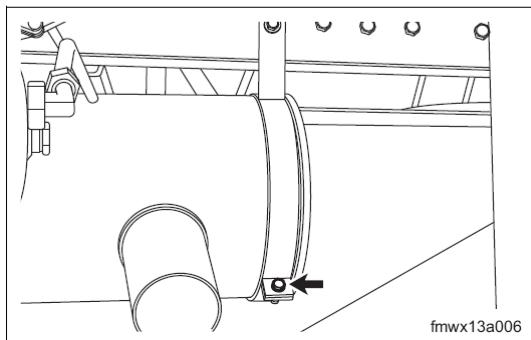


- (e). Install the bolts of the exhaust pipe fixing bracket.

Torque: 45±5N.m

- (f). Install the fixing bolts of the exhaust pipe.

Torque: 45±5N.m

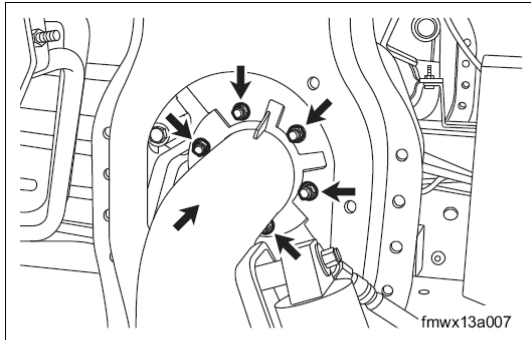


Turbocharger

Overhaul

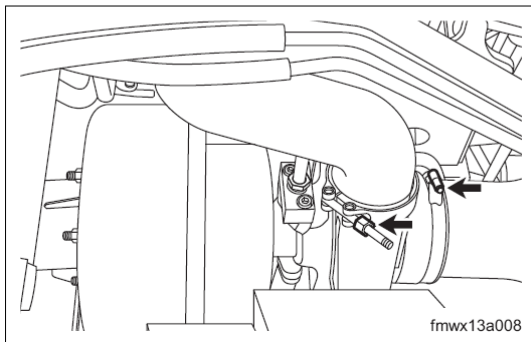
Hint:

Part Drawing, refer to Chapter 13A, Exhaust & Turbocharger – Exhaust System, Part Drawing

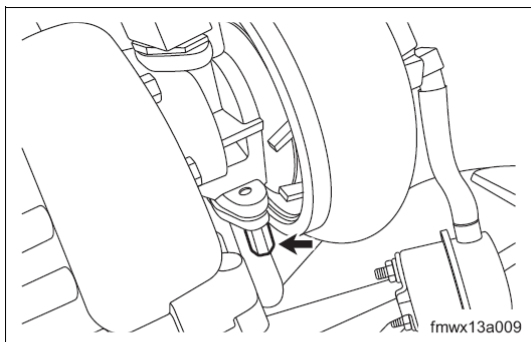


1. Dismantle the turbocharger

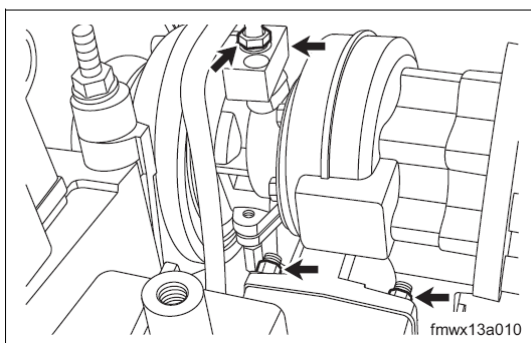
- (a). Dismantle the heat shield and exhaust pipe.



- (b). Dismantle the intercooler intake pipe and connecting elbow.



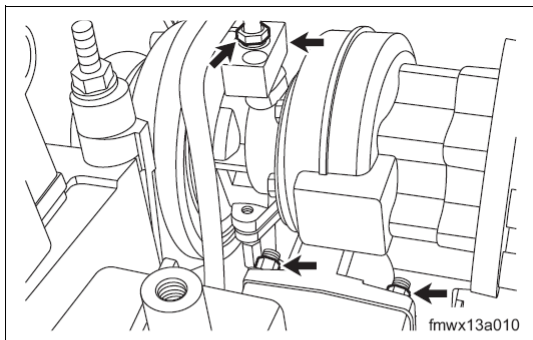
- (c). Dismantle the oil return pipe.
 - Dismantle the bolts of the oil return pipe.



- (d). Dismantle the oil inlet pipe.
 - Dismantle the hex socket bolts of the oil inlet pipe.

2. Inspect the turbocharger. Refer to Chapter 13A, Exhaust & Turbocharger – Exhaust System, Testing & Adjustment.

Exhaust & Turbocharger (WP10) – Turbocharger

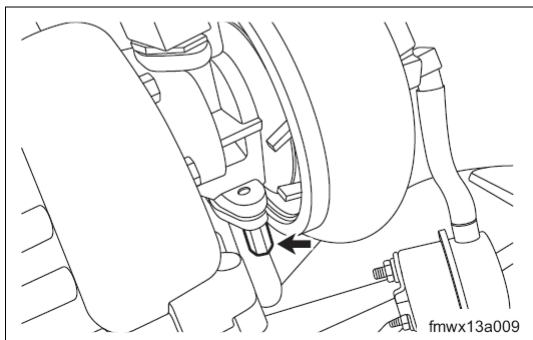


3. Install the turbocharger

- (a). Install the fixing bolts of the turbine.

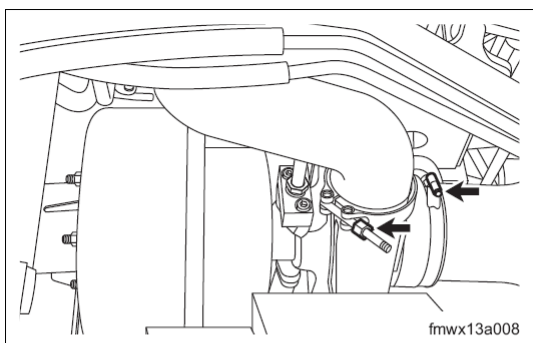
Torque: 45±5N.m

- (b). Install the oil inlet pipe.
- Install the hex socket bolts of the oil inlet pipe.

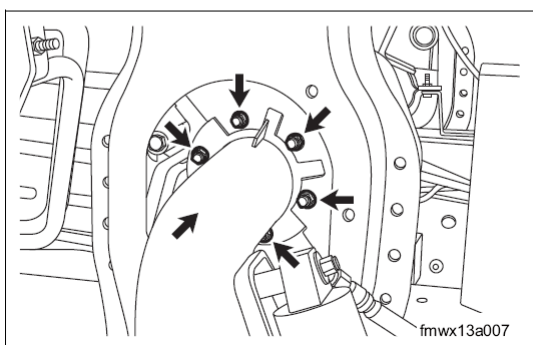


- (c). Install the oil return pipe.

- Install the bolts of the oil return pipe.



- (d). Install the intercooler intake pipe and connecting elbow.



- (e). Install the heat shield and exhaust pipe.

Torque: 25±5N.m

Exhaust & Turbocharger (WP12)

Exhaust System.....	13B-3
General	13B-3
Precautions	13B-4
Part Drawing	13B-5
Testing & Adjustment	13B-6
Turbocharger	13B-8
Overhaul	13B-8

13B

Exhaust System

General

Supercharger:

All WP12 Series diesel engines are of a turbocharged intercooled model, and the supercharger marched for the engine is an exhaust gas turbocharger. The engine generates power as a result of the combustion of fuel in the cylinder, and the input amount of fuel is limited by the intake amount of air into the cylinder, so the power generated is also limited. If the running performance of the engine has been in optimum state, in order to increase the output power, only more air is compressed into the cylinder to increase the amount of fuel and further improve the capacity to do work through combustion. Under current technical condition, the turbocharger is the only machine which can increase output power with the engine's working efficiency unchanged.

The greatest advantage of the turbocharger lies in significantly boosting the engine's power and torque without increasing the engine's displacement. Generally speaking, the power and torque of the engine which is equipped with the turbocharger will increase by 20 % ~30 %. The disadvantage of the turbocharger lies in lagging; in other words, the engine delays to increase or decrease output power because the impeller has a slow response to the sudden change of the throttle due to inertia effect. A vehicle which accelerates suddenly or overtakes another vehicle will have insufficient power at that moment.

The exhaust gas turbocharger is mainly composed of an impeller and a turbine, and also includes some other control elements. The impeller and turbine are connected by a shaft, which is known as rotor, the exhaust gas from the engine drives the impeller, which in turn draws the turbine to rotate, so as to turbocharge the intake system. As the turbocharger is installed at the engine's exhaust side, the working temperature of the turbocharger is high, and the speed of the turbocharger's rotor is very high, which can reach several hundred thousand rpm. Such high speed and temperature disable common mechanical needle or ball bearings to work for the rotor, so non-locating bearings must be used for the turbocharger, which is lubricated by engine oil and cooled by coolant.

Intercooler:

High temperature not only affects charging efficiency, but also is easy to result in explosion. Accordingly, a device is needed to lower the intake temperature, which is an intercooler. It is installed between the turbocharger outlet and intake pipe and used for cooling air into the cylinder. The intercooler, as a radiator, uses air or water for cooling, and the heat of air escapes to the atmosphere through cooling. According to the test, the intercooler with good performance can not only keep the engine's compression ratio at a certain value without explosion, but also lower temperature to increase intake pressure and further boost the effective power of the engine. This vehicle is air-air cooled, and the resistance of the intercooler shall be lower than 5 kPa (in rated condition).

Precautions

As the turbocharger usually operates at high speed and high temperature, the temperature of the turbocharger's exhaust gas end is about 600°C, and the turbocharger's rotor rotates by 7,000~100,000 r/min, the following points shall be noted in order to ensure that the turbocharger operates normally:

1. DO NOT drive immediately after the engine starts

- After the engine starts, especially in winter, run it at idle speed for a while, which allows lubricating oil to sufficiently lubricate bearings before the turbocharger's rotor operates at high speed. Therefore, never step on the accelerator sharply just after the engine starts, to avoid damaging the oil seal of the turbocharger. The engine shall be idled appropriately (about 5min, which can be shortened for a short stop) after starting, and then loaded.

2. DO NOT shut down the engine immediately

- DO NOT shut down immediately the engine which has operated at high speed for a long time. When the engine is running, some oil is supplied to the bearings of the turbocharger's rotor for lubrication and cooling. If the operating engine is shut down suddenly, the oil pressure goes down to 0 rapidly, the high temperature of the turbocharger's turbine part is transferred to the middle, and the heat in the bearing support housing can not be taken away quickly while the rotor of the turbocharger is still rotating under inertia effect. Thus, if the engine in hot state is shut down suddenly, the oil remaining in the turbocharger will get overheated to damage the bearings and shaft. As a result, the engine, which has operated with large load for a long time, shall be run at idle speed for 3~5min, and then shut down after the rotor rotates at low speed. It is specially prohibited to shut down the engine suddenly after stepping on the accelerator strongly.

3. Keep clean

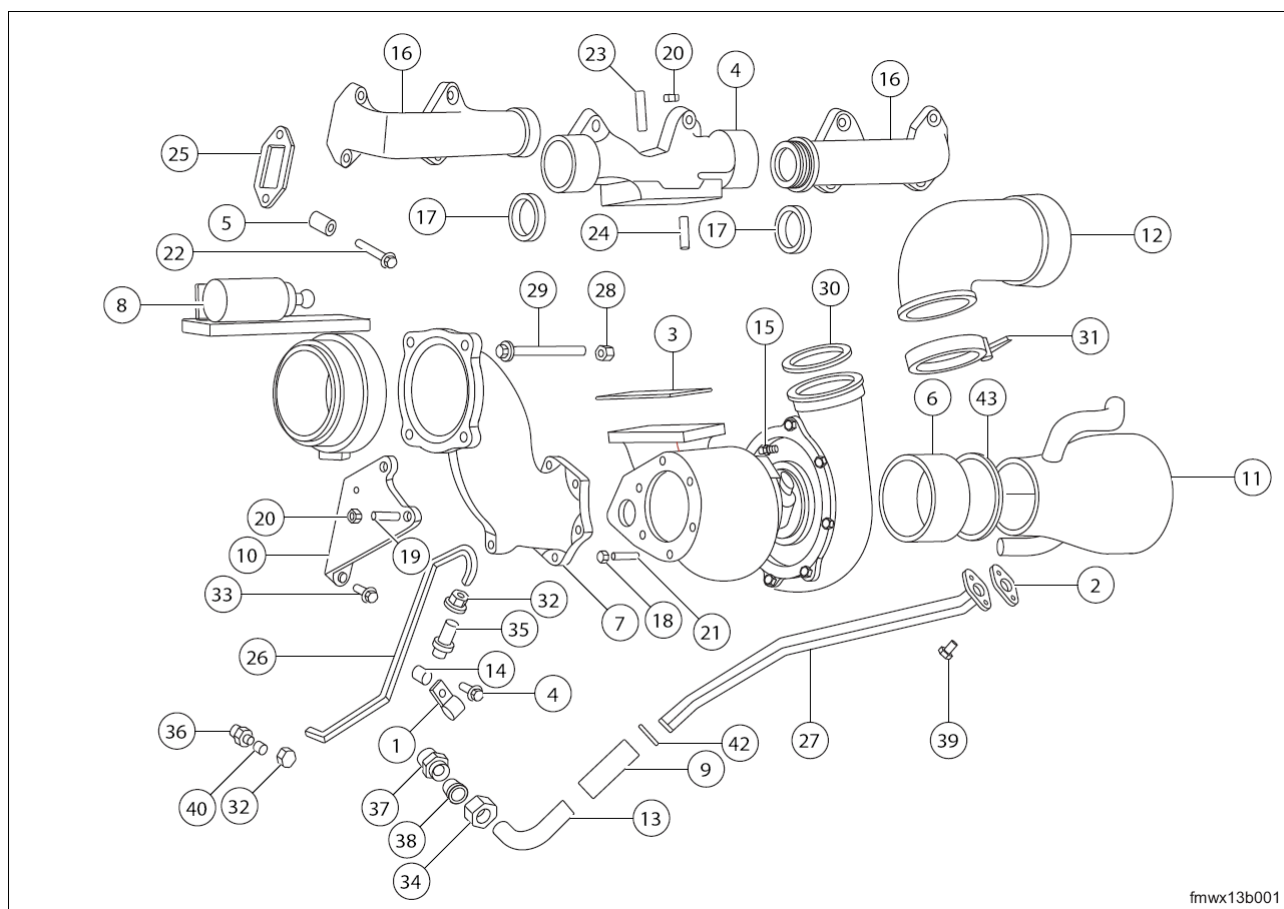
- Keep clean while dismantling the turbocharger. Block each pipe joint with clean cloth to prevent foreign matters from falling into the turbocharger and damaging the rotor. Be careful not to hit or damage the impeller during repair. Remove the obstructions after reassembly.

4. Wash the turbocharger

- As the turbocharger usually operates at high temperature, the partial coking of engine oil in the lubricating oil pipeline easy occurs due to the effect of high temperature, which will cause and damage to on bearings as a result of insufficient lubrication. Therefore, the lubricating oil pipeline shall be washed after the turbocharger has operated for a period of time.

5. Inspect the operating condition of the turbocharger usually

- Inspect the connection of various air pipes before driving and after stopping, and prevent the turbocharger from failing due to looseness and falling and air from going into the cylinder due to short circuit. Make sure the tightness of the turbocharger's pipeline system and parts, and the heat dispersion of the intercooler.

Exhaust & Turbocharger (WP12) – Exhaust System**Part Drawing**

fmwx13b001

1	Single Pipe Clamp Assembly	22	Hex Head Bolt
2	Gasket, Oil Return Pipe Flange	23	Stud Bolt
3	Gasket, Turbocharger Flange	24	Stud Bolt
4	Middle Exhaust Manifold	25	Exhaust Pipe Gasket
5	Exhaust Flange Sleeve	26	Oil Return Pipe Assembly, Turbocharger
6	Connecting Hose	27	Pressure Oil Pipe, Turbocharger
7	Rear Exhaust Pipe, Turbocharger	28	Hex Nut
8	Bracket, Exhaust Pipe	29	Hex Head Bolt with Flange
9	Oil Return Connecting Hose, Turbocharger	30	Rubber Ring
10	Bracket, Turbocharger	31	Clamp
11	Intake Pipe Assembly, Air Compressor	32	Connecting Nut
12	Connecting Pipe, Intercooler	33	Hex Head Bolt
13	Elbow	34	Union Nut
14	Sleeve	35	Double Pipe Joint
15	Turbocharger	36	Double Pipe Joint

Exhaust & Turbocharger (WP12) –Exhaust System

16	Front and Rear Exhaust Manifold	37	Double Pipe Joint
17	Sealing Ring	38	Clamp Sleeve
18	Hex Nut	39	Oil Return Pipe Bolt
19	Stud Bolt	40	Clamp Sleeve
20	Hex Nut	41	Hex Head Bolt
21	Stud Bolt	42	Hose Clamp

Testing & Adjustment

The turbocharger is a key mechanical part which is used for boosting the engine's power and decreasing exhaust gas emission. Improper use, maintenance and care may cause the turbocharger to be defective and disable the turbocharger to work. This text introduces some common faults and solutions of the turbocharger as follows:

The turbocharger leaks oil.

Symptom 1: Excessive oil is consumed, but the color of exhaust smoke is normal and the power does not decrease.

Cause: This condition is generally caused by oil leakage.

Solution:

- First of all, inspect whether the external oil pipes (including oil inlet and return pipes of the turbocharger) of the engine lubrication system leak oil.**
- Inspect whether there is oil at the exhaust gas outlet of the turbocharger. If any, you can decide that the sealing ring at one end of the turbine is damaged, and replace it.**

Symptom 2: Excessive oil is consumed, the color of exhaust smoke is blue, but the power does not decrease.

Cause: It is caused by that the oil leaked from the compressor end of the turbocharger leaks oil goes into the combustion chamber through the intake pipe of the engine. The possible causes are as follows:

- The oil return pipe of the turbocharger is obstructed, and excessive oil accumulates at the middle support of the rotor assembly and flows into the compressor impeller along the rotor shaft.**
- After the sealing ring or oil slinger at the compressor impeller end is damaged, oil will go into the impeller chamber through the damaged sealing ring or oil slinger, and then into the combustion chamber through the intake pipe along with turbocharged air in the impeller chamber.**

Solution:

- Open the outlet of the air compressor or the straight intake pipe (rubber hose) of the engine, observe whether oil is attached to the pipe orifice or wall. If any, inspect whether the oil return pipe of the turbocharger is unobstructed. If obstructed, it may caused by the accumulation of excessive oil at the middle support. Unblock the oil return pipe and then reassemble.**
- If unobstructed, it is caused by that the sealing ring or oil slinger at the impeller end is damaged. Disassemble the turbocharger and repair the damaged part.**

Symptom 3: Excessive oil is consumed, the color of exhaust smoke is blue or black, and the power decreases.

Cause:

- The wearing of the clearance between the piston and cylinder is too big, and the oil goes**

Exhaust & Turbocharger (WP12) – Exhaust System

into the combustion chamber and is combusted.

2. In process of sucking air into the turbocharger, air flow encounters great resistance (such as clogging of the air filter element, deformation or flattening of the intake rubber hose due to suction, etc.). The low pressure at the inlet of the air compressor will cause oil leakage, and the oil leaked will go into the air compressor, then get into the combustion chamber along with compressed air and be combusted.

Solution:

1. Inspect whether there is oil on the wall of the straight intake hose, the hose is flattened, air flow is obstructed, or the air filter element is clogged.
 2. If there is oil at the pipe orifice and on the pipe wall, wash or replace the air filter element.
- There is metallic grating noise.**

Symptom: The color of exhaust smoke is black, the power decreases, and there is abnormal noise from the turbocharger.

Cause:

1. If there is metallic grating noise, it is caused by the friction between the impeller and turbocharger housing due to the excessive wearing of the turbocharger's rotor bearings or thrust bearings.
2. If it is air flow noise rather than metallic grating noise, it is the rotation noise generated by the rotation of the turbocharger's rotor at high speed, or the air leakage noise due to poor connection of the intake or exhaust joint.

Solution:

1. For the former, replace the damaged part or repair according to the wearing condition.
2. For the latter, distinguish carefully, and solve according to the specific condition.

The turbocharger's bearing is damaged.

Symptom: The turbocharger's bearing is damaged, the engine's power decreases, excessive oil is consumed, the color of smoke is black, and the turbocharger fails to work when the fault is serious.

Cause:

1. **The pressure and flow of lubricating oil is insufficient.**
 - Lubricating oil supplied for the turbocharger's journal and thrust bearing is insufficient.
 - Lubricating oil which keeps floating between rotor journal and bearing is insufficient.
 - The turbocharger has operated at high speed, but lubricating oil is not supplied in time.
2. **Foreign matters or silt goes into the lubrication system.**
3. **Engine oil deteriorates due to oxidization.**
 - The diesel engine overheats, and gas going between the piston and cylinder wall is excessive;
 - Cooling water is leaked into engine oil;
 - Improper engine oil is selected, and engine oil is not replaced periodically according to specified requirement.

Solution:

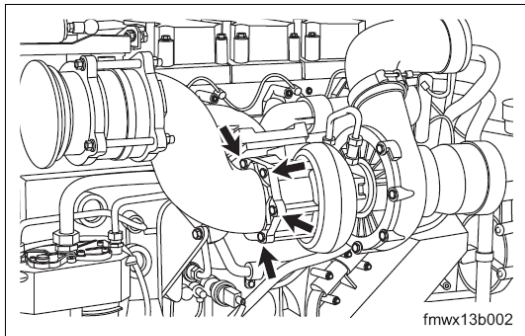
1. Inspect whether the pressure of lubricating oil is normal, and the oil amount meets the requirement.
2. Replace lubricating oil periodically according to the specified requirement, and ensure the cleanliness of lubricating oil.
3. Use lubricating oil strictly according to the specified requirement. Mixing of lubricating oils is not allowed.
4. Prevent the engine from operating at high temperature, and keep the engine at normal operating temperature.

Turbocharger

Overhaul

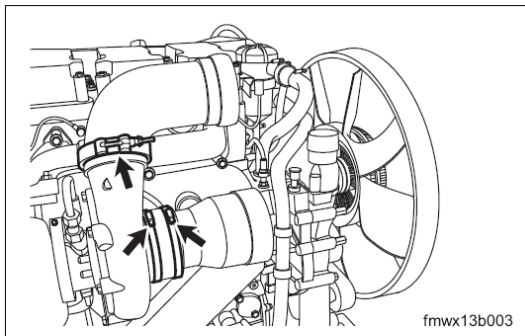
Hint:

Part Drawing, refer to Chapter 13B, Exhaust & Turbocharger – Exhaust System, Part Drawing

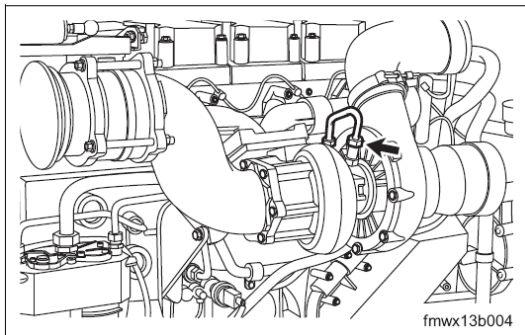


1. Dismantle the turbocharger

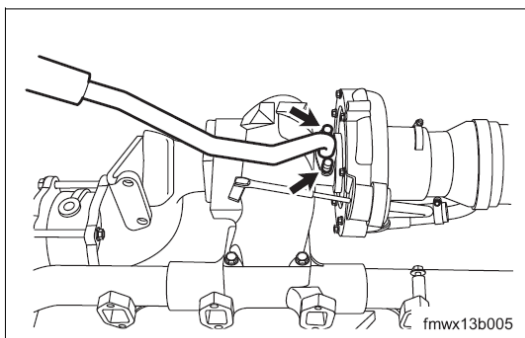
(a). Dismantle the exhaust pipe.



(b). Dismantle the intercooler intake pipe and connecting elbow.

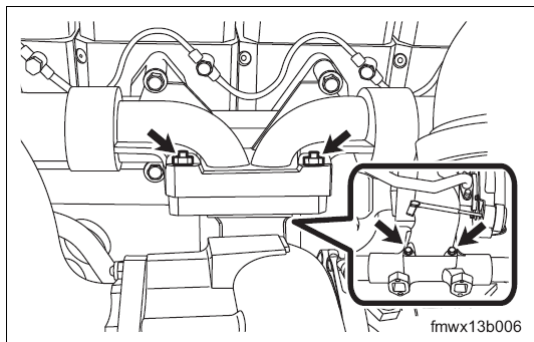


(c). Dismantle the oil inlet pipe.



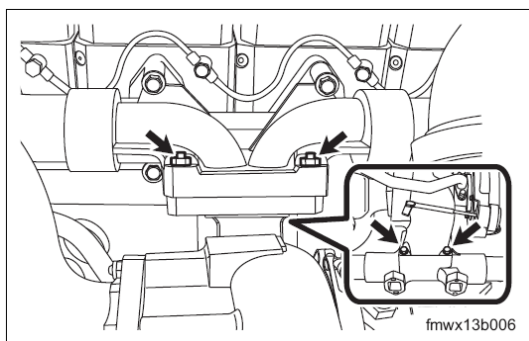
(d). Dismantle the oil return pipe.

Exhaust & Turbocharger (WP12) – Turbocharger

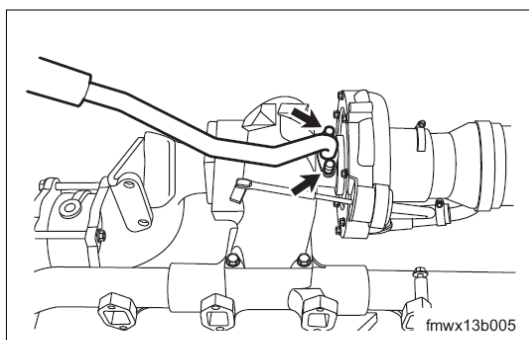


- (e). Dismantle the fixing bolts of the turbine.

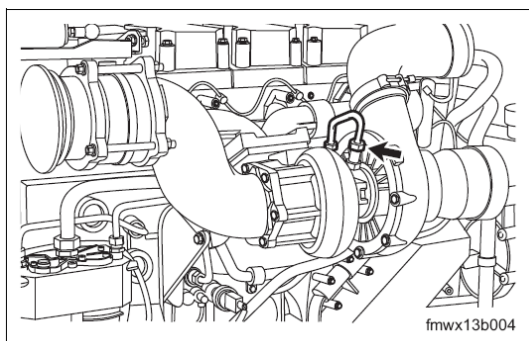
2. Inspect the turbocharger. Refer to Chapter 13B, Exhaust & Turbocharger – Exhaust System, Testing & Adjustment.



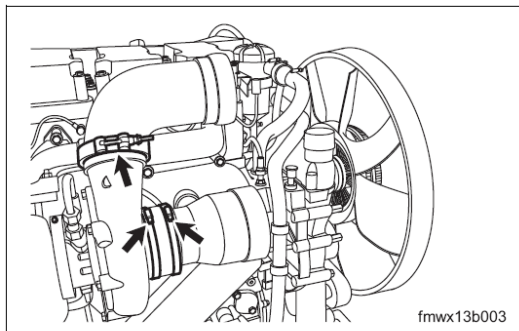
- (a). Install the fixing bolts of the turbine.
Torque: $45 \pm 5 \text{ N.m}$



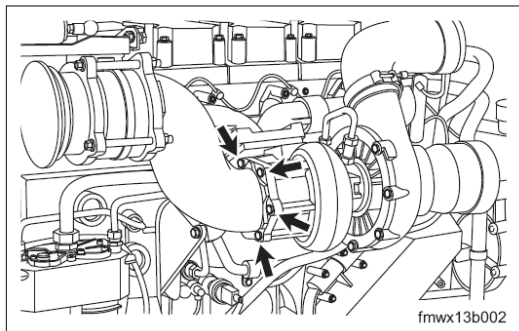
- (b). Install the oil return pipe.



- (c). Install the oil inlet pipe.



- (d). Install the intercooler intake pipe and connecting elbow.



- (e). Install the exhaust pipe.
Torque: $60 \pm 10 \text{ N.m}$

Exhaust & Turbocharger (WD615)

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13C

Exhaust System

General

Supercharger:

All WD615 Series diesel engines are of a turbocharged intercooled model, and the supercharger marched for the engine is an exhaust gas turbocharger. The engine generates power as a result of the combustion of fuel in the cylinder, and the input amount of fuel is limited by the intake amount of air into the cylinder, so the power generated is also limited. If the running performance of the engine has been in optimum state, in order to increase the output power, only more air is compressed into the cylinder to increase the amount of fuel and further improve the capacity to do work through combustion. Under current technical condition, the turbocharger is the only machine which can increase output power with the engine's working efficiency unchanged.

The greatest advantage of the turbocharger lies in significantly boosting the engine's power and torque without increasing the engine's displacement. Generally speaking, the power and torque of the engine which is equipped with the turbocharger will increase by 20 % ~30 %. The disadvantage of the turbocharger lies in lagging; in other words, the engine delays to increase or decrease output power because the impeller has a slow response to the sudden change of the throttle due to inertia effect. A vehicle which accelerates suddenly or overtakes another vehicle will have insufficient power at that moment.

The exhaust gas turbocharger is mainly composed of an impeller and a turbine, and also includes some other control elements. The impeller and turbine are connected by a shaft, which is known as rotor, the exhaust gas from the engine drives the impeller, which in turn draws the turbine to rotate, so as to turbocharge the intake system. As the turbocharger is installed at the engine's exhaust side, the working temperature of the turbocharger is high, and the speed of the turbocharger's rotor is very high, which can reach several hundred thousand rpm. Such high speed and temperature disable common mechanical needle or ball bearings to work for the rotor, so non-locating bearings must be used for the turbocharger, which is lubricated by engine oil and cooled by coolant.

Intercooler:

High temperature not only affects charging efficiency, but also is easy to result in explosion. Accordingly, a device is needed to lower the intake temperature, which is an intercooler. It is installed between the turbocharger outlet and intake pipe and used for cooling air into the cylinder. The intercooler, as a radiator, uses air or water for cooling, and the heat of air escapes to the atmosphere through cooling. According to the test, the intercooler with good performance can not only keep the engine's compression ratio at a certain value without explosion, but also lower temperature to increase intake pressure and further boost the effective power of the engine. This vehicle is air-air cooled, and the resistance of the intercooler shall be lower than 5 kPa (in rated condition).

Precautions

As the turbocharger usually operates at high speed and high temperature, the temperature of the turbocharger's exhaust gas end is about 600 °C, and the turbocharger's rotor rotates by 7,000~100,000 r/min, the following points shall be noted in order to ensure that the turbocharger operates normally:

1. DO NOT drive immediately after the engine starts

- After the engine starts, especially in winter, run it at idle speed for a while, which allows lubricating oil to sufficiently lubricate bearings before the turbocharger's rotor operates at high speed. Therefore, never step on the accelerator sharply just after the engine starts, to avoid damaging the oil seal of the turbocharger. The engine shall be idled appropriately (about 5min, which can be shortened for a short stop) after starting, and then loaded.

2. DO NOT shut down the engine immediately

- DO NOT shut down immediately the engine which has operated at high speed for a long time. When the engine is running, some oil is supplied to the bearings of the turbocharger's rotor for lubrication and cooling. If the operating engine is shut down suddenly, the oil pressure goes down to 0 rapidly, the high temperature of the turbocharger's turbine part is transferred to the middle, and the heat in the bearing support housing can not be taken away quickly while the rotor of the turbocharger is still rotating under inertia effect. Thus, if the engine in hot state is shut down suddenly, the oil remaining in the turbocharger will get overheated to damage the bearings and shaft. As a result, the engine, which has operated with large load for a long time, shall be run at idle speed for 3~5min, and then shut down after the rotor rotates at low speed. It is specially prohibited to shut down the engine suddenly after stepping on the accelerator strongly.

3. Keep clean

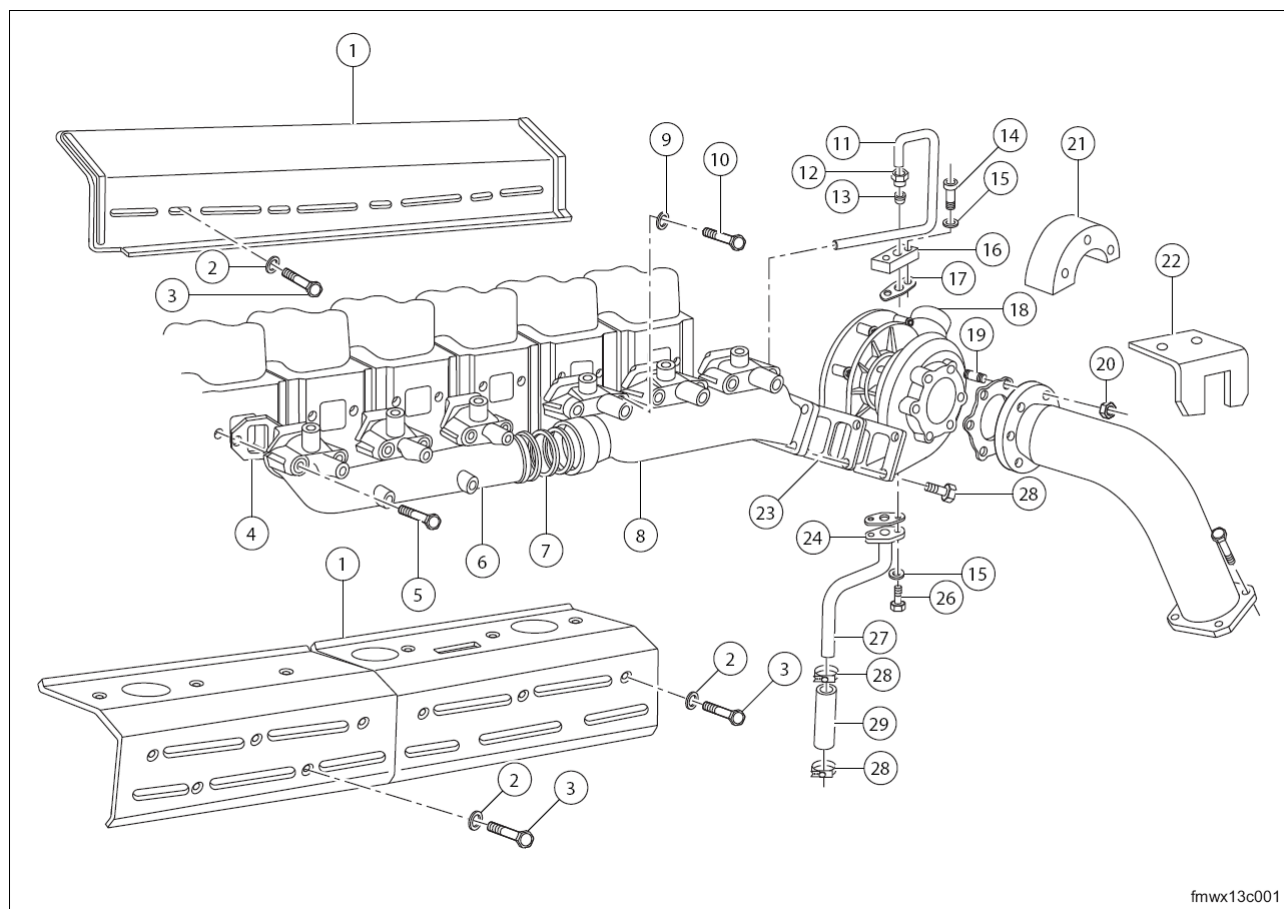
- Keep clean while dismantling the turbocharger. Block each pipe joint with clean cloth to prevent foreign matters from falling into the turbocharger and damaging the rotor. Be careful not to hit or damage the impeller during repair. Remove the obstructions after reassembly.

4. Wash the turbocharger

- As the turbocharger usually operates at high temperature, the partial coking of engine oil in the lubricating oil pipeline easy occurs due to the effect of high temperature, which will cause and damage to on bearings as a result of insufficient lubrication. Therefore, the lubricating oil pipeline shall be washed after the turbocharger has operated for a period of time.

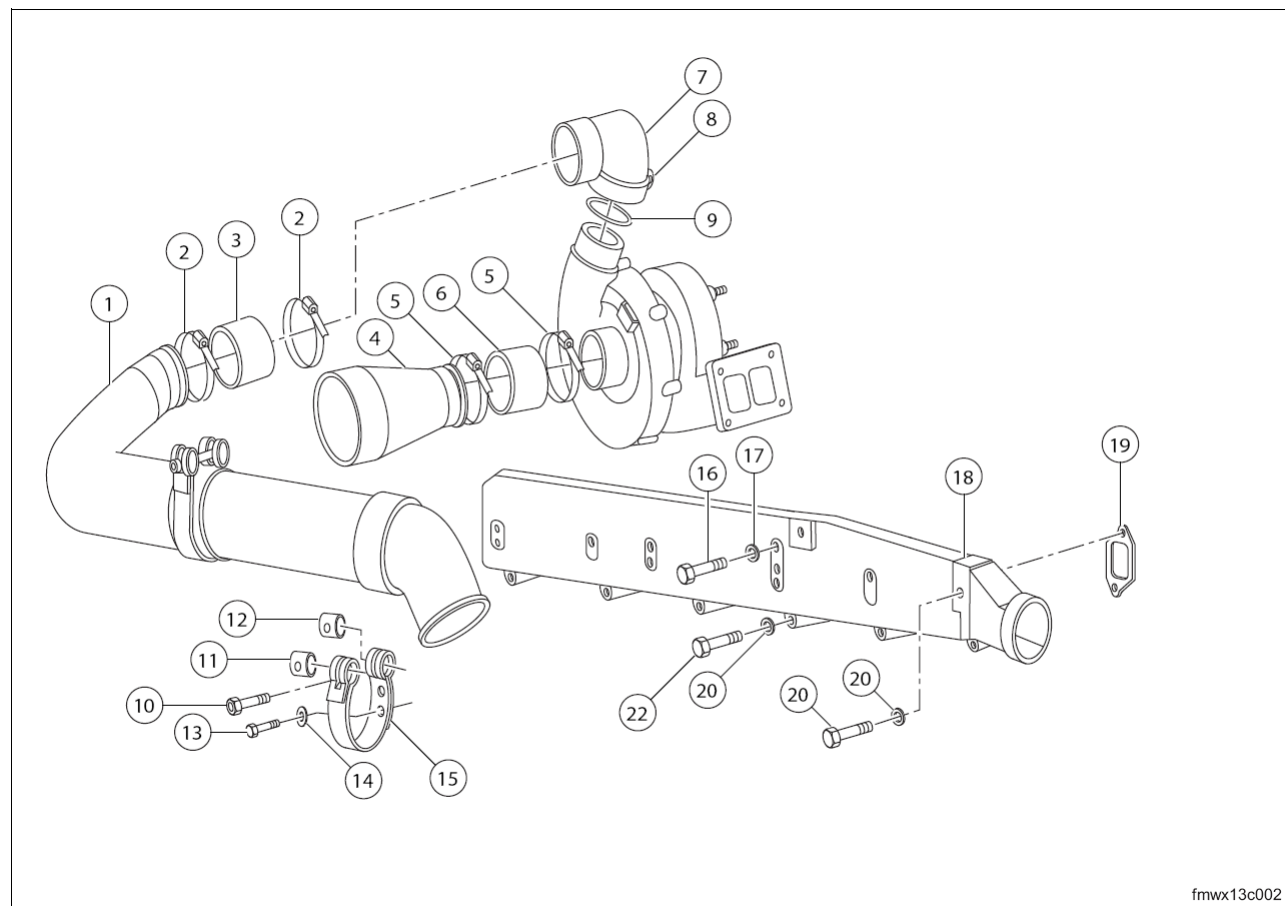
5. Inspect the operating condition of the turbocharger usually

- Inspect the connection of various air pipes before driving and after stopping, and prevent the turbocharger from failing due to looseness and falling and air from going into the cylinder due to short circuit. Make sure the tightness of the turbocharger's pipeline system and parts, and the heat dispersion of the intercooler.

Exhaust & Turbocharger (WD615) –Exhaust System**Part Drawing****13C**

1	Front Heat Shield
2	Rear Heat Shield
3	Small Washer
4	Bolt
5	Exhaust Pipe Gasket
6	Front Exhaust Manifold
7	Sealing Ring, Exhaust Pipe
8	Rear Exhaust manifold
9	Thrust Washer
10	Fastening Bolt, Exhaust Pipe
11	Oil Inlet Pipe
12	Pipe Joint Nut
13	Clamp Sleeve
14	Hex Socket Cap Head Screw
15	Self-locking Washer

16	Flange, Oil Inlet Pipe
17	Gasket, Oil Inlet Pipe
18	Exhaust Gas Turbocharger
19	Stud Bolt
20	Prevailing Torque Type All-metal Hex Nut, Style 2
21	Heat Shield
22	Bracket
23	Turbocharger Gasket
24	Gasket, Oil Return Pipe Flange
25	Hex Head Bolt
26	Oil Return Pipe Bolt
27	Oil Return Pipe
28	Hose Clamp
29	Hose for Turbocharger Oil Return



fmwx13c002

1	Pipe Assembly	12	Clamping Pin
2	Hose Clamp	13	Hex Head Bolt
3	Rubber Hose with Fibre	14	Adjusting Washer
4	Intake Pipe, Air Compressor	15	Tension Strap
5	Hose Clamp	16	Hex Head Screw Plug
6	Rubber Hose	17	Sealing Washer
7	Connecting Elbow	18	Intake Pipe Assembly
8	Clamp	19	Intake Pipe Gasket
9	Sealing Ring	20	Wave Spring Washer
10	Hex Socket Cap Head Screw	21	Fastening Bolt, Intake Pipe
11	Clamping Pin	22	Hex Head Bolt

Testing & Adjustment

The turbocharger is a key mechanical part which is used for boosting the engine's power and decreasing exhaust gas emission. Improper use, maintenance and care may cause the turbocharger to be defective and disable the turbocharger to work. This text introduces some common faults and solutions of the turbocharger as follows:

The turbocharger leaks oil.

Symptom 1: Excessive oil is consumed, but the color of exhaust smoke is normal and the power does not decrease.

Cause: This condition is generally caused by oil leakage.

Solution:

1. **First of all, inspect whether the external oil pipes (including oil inlet and return pipes of the turbocharger) of the engine lubrication system leak oil.**
2. **Inspect whether there is oil at the exhaust gas outlet of the turbocharger. If any, you can decide that the sealing ring at one end of the turbine is damaged, and replace it.**

Symptom 2: Excessive oil is consumed, the color of exhaust smoke is blue, but the power does not decrease.

Cause: It is caused by that the oil leaked from the compressor end of the turbocharger leaks oil goes into the combustion chamber through the intake pipe of the engine. The possible causes are as follows:

1. **The oil return pipe of the turbocharger is obstructed, and excessive oil accumulates at the middle support of the rotor assembly and flows into the compressor impeller along the rotor shaft.**
2. **After the sealing ring or oil slinger at the compressor impeller end is damaged, oil will go into the impeller chamber through the damaged sealing ring or oil slinger, and then into the combustion chamber through the intake pipe along with turbocharged air in the impeller chamber.**

Solution:

1. **Open the outlet of the air compressor or the straight intake pipe (rubber hose) of the engine, observe whether oil is attached to the pipe orifice or wall. If any, inspect whether the oil return pipe of the turbocharger is unobstructed. If obstructed, it may caused by the accumulation of excessive oil at the middle support. Unblock the oil return pipe and then reassemble.**
2. **If unobstructed, it is caused by that the sealing ring or oil slinger at the impeller end is damaged. Disassemble the turbocharger and repair the damaged part.**

Symptom 3: Excessive oil is consumed, the color of exhaust smoke is blue or black, and the power decreases.

Cause:

1. **The wearing of the clearance between the piston and cylinder is too big, and the oil goes into the combustion chamber and is combusted.**
2. **In process of sucking air into the turbocharger, air flow encounters great resistance (such as clogging of the air filter element, deformation or flattening of the intake rubber hose due to suction, etc.). The low pressure at the inlet of the air compressor will cause oil leakage, and the oil leaked will go into the air compressor, then get into the combustion chamber along with compressed air and be combusted.**

Solution:

1. **Inspect whether there is oil on the wall of the straight intake hose, the hose is flattened, air**

flow is obstructed, or the air filter element is clogged.

2. If there is oil at the pipe orifice and on the pipe wall, wash or replace the air filter element.

There is metallic grating noise.

Symptom: The color of exhaust smoke is black, the power decreases, and there is abnormal noise from the turbocharger.

Cause:

1. If there is metallic grating noise, it is caused by the friction between the impeller and turbocharger housing due to the excessive wearing of the turbocharger's rotor bearings or thrust bearings.
2. If it is air flow noise rather than metallic grating noise, it is the rotation noise generated by the rotation of the turbocharger's rotor at high speed, or the air leakage noise due to poor connection of the intake or exhaust joint.

Solution:

1. For the former, replace the damaged part or repair according to the wearing condition.
2. For the latter, distinguish carefully, and solve according to the specific condition.

The turbocharger's bearing is damaged.

Symptom: The turbocharger's bearing is damaged, the engine's power decreases, excessive oil is consumed, the color of smoke is black, and the turbocharger fails to work when the fault is serious.

Cause:

1. **The pressure and flow of lubricating oil is insufficient.**
 - Lubricating oil supplied for the turbocharger's journal and thrust bearing is insufficient.
 - Lubricating oil which keeps floating between rotor journal and bearing is insufficient.
 - The turbocharger has operated at high speed, but lubricating oil is not supplied in time.
2. **Foreign matters or silt goes into the lubrication system.**
3. **Engine oil deteriorates due to oxidization.**
 - The diesel engine overheats, and gas going between the piston and cylinder wall is excessive;
 - Cooling water is leaked into engine oil;
 - Improper engine oil is selected, and engine oil is not replaced periodically according to specified requirement.

Solution:

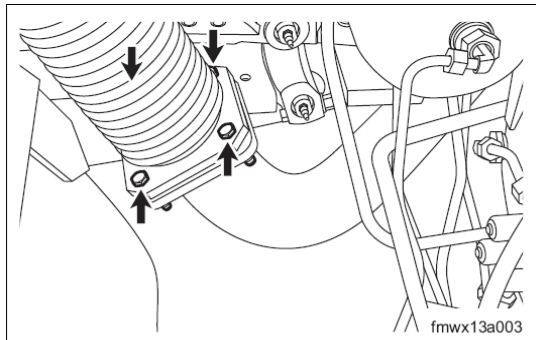
1. Inspect whether the pressure of lubricating oil is normal, and the oil amount meets the requirement.
2. Replace lubricating oil periodically according to the specified requirement, and ensure the cleanliness of lubricating oil.
3. Use lubricating oil strictly according to the specified requirement. Mixing of lubricating oils is not allowed.
4. Prevent the engine from operating at high temperature, and keep the engine at normal operating temperature.

Exhaust Pipe

Overhaul

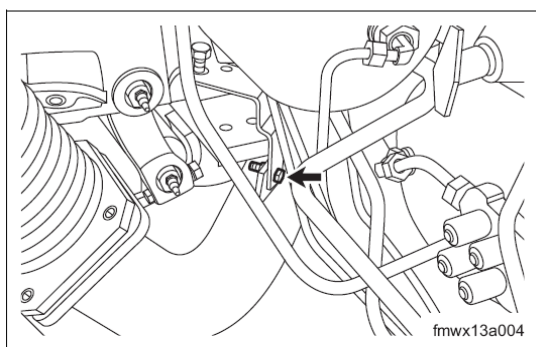
Hint:

Part Drawing, refer to Chapter 13C, Exhaust & Turbocharger – Exhaust System, Part Drawing

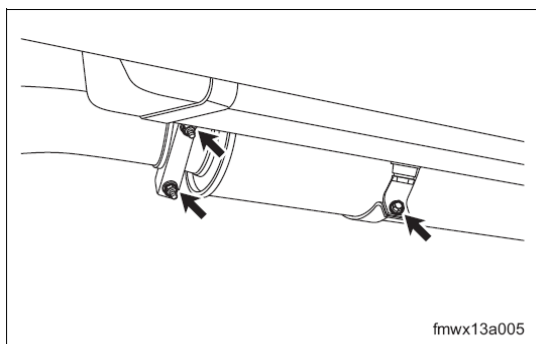


1. Dismantle the exhaust pipe

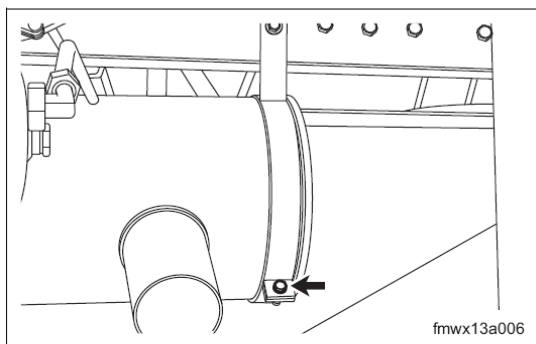
- (a). Dismantle the fixing bolts of the exhaust pipe.



- (b). Dismantle the bolts of the exhaust pipe fixing bracket.



- (c). Dismantle the fixing nuts of the muffler bracket.
(d). Dismantle the fixing bolts of the muffler clamp.



- (e). Dismantle the fixing bolts of the muffler clamp.
(f). Draw out the exhaust pipe.

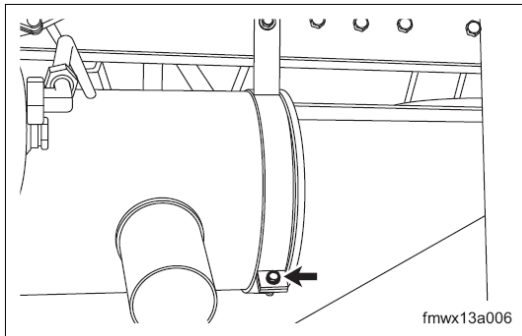
2. Inspect the exhaust pipe

- (a). Inspect whether there is excessive corrosion, cracking or air leakage of the exhaust pipe and muffler.

(b). Inspect the exhaust pipe and muffler.

Caution:

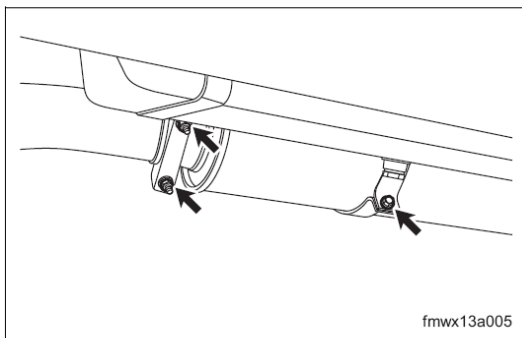
If any performance of the exhaust pipe and muffler fails to meet the requirements, replace with a new exhaust pipe and muffler assembly.



3. Install the exhaust pipe

- (a). Install the exhaust pipe.
- (b). Install the fixing bolts of the muffler clamp.

Torque: 80±10N.m

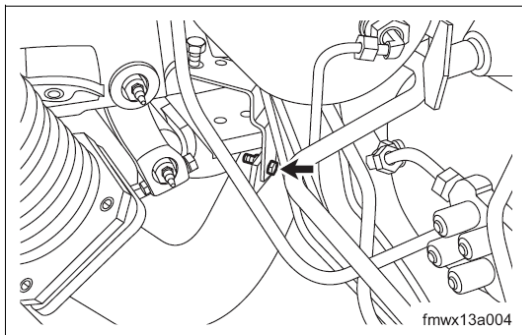


- (c). Install the fixing nuts of the muffler bracket.

Torque: 80±10N.m

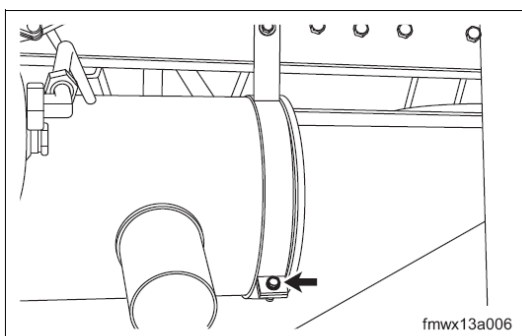
- (d). Install the fixing bolts of the muffler clamp.

Torque: 80±10N.m



- (e). Install the bolts of the exhaust pipe fixing bracket.

Torque: 45±5N.m



- (f). Install the fixing bolts of the exhaust pipe.

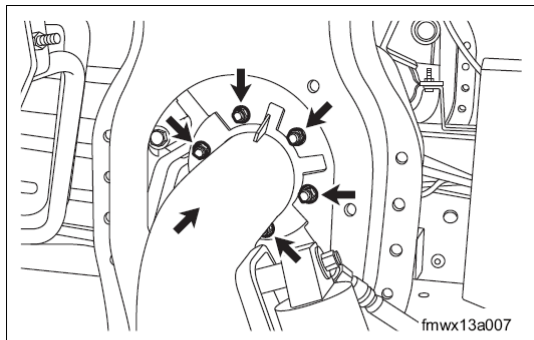
Torque: 45±5N.m

Turbocharger

Overhaul

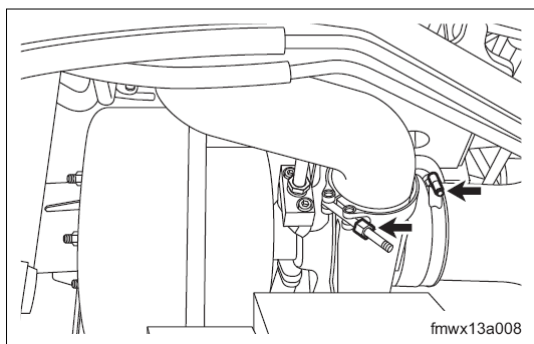
Hint:

Part Drawing, refer to Chapter 13C, Exhaust & Turbocharger – Exhaust System, Part Drawing

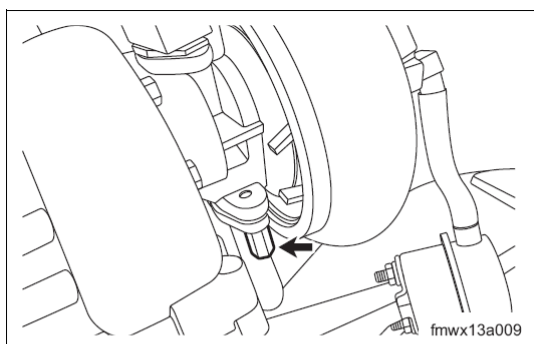


1. Dismantle the turbocharger

- (a). Dismantle the heat shield and exhaust pipe.

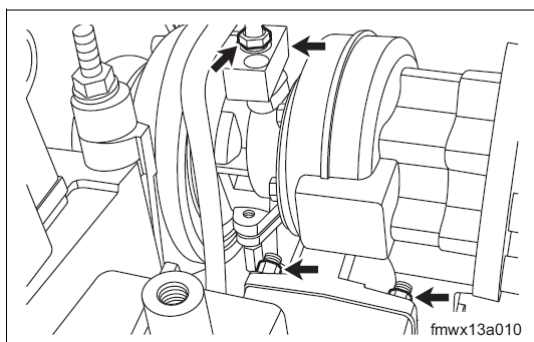


- (b). Dismantle the intercooler intake pipe and connecting elbow.



- (c). Dismantle the oil return pipe.

- Dismantle the bolts of the oil return pipe.

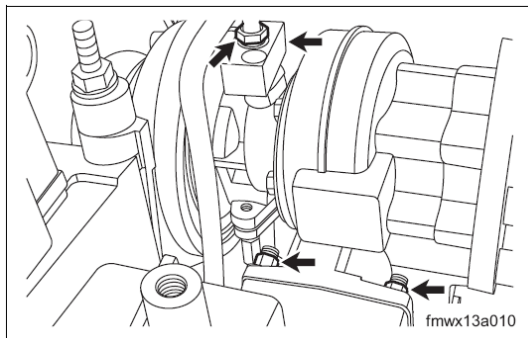


- (d). Dismantle the oil inlet pipe.

- Dismantle the hex socket bolts of the oil inlet pipe.

- (e). Dismantle the fixing bolts of the turbine.

2. Inspect the turbocharger. Refer to Chapter 13C, Exhaust & Turbocharger – Exhaust System, Testing & Adjustment.



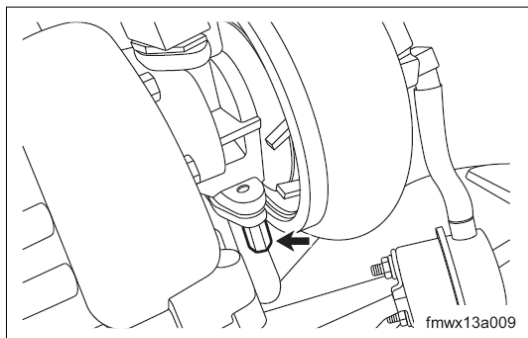
3. Install the turbocharger

- (a). Install the fixing bolts of the turbine.

Torque: 45±5N.m

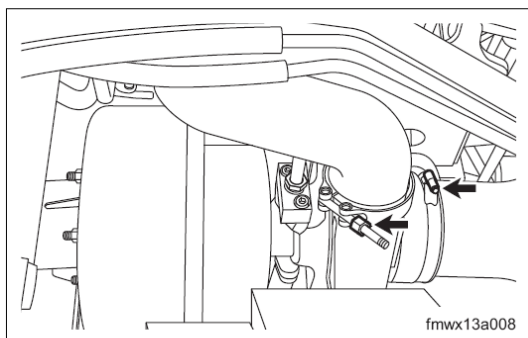
- (b). Install the oil inlet pipe.

- Install the hex socket bolts of the oil inlet pipe.

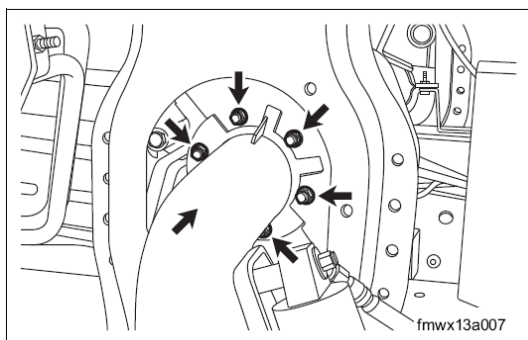


- (c). Install the oil return pipe.

- Install the bolts of the oil return pipe.



- (d). Install the intercooler intake pipe and connecting elbow.



- (e). Install the heat shield and exhaust pipe.

Torque: 25±5N.m

Cooling (WP10)

Cooling System	14A-3
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14A

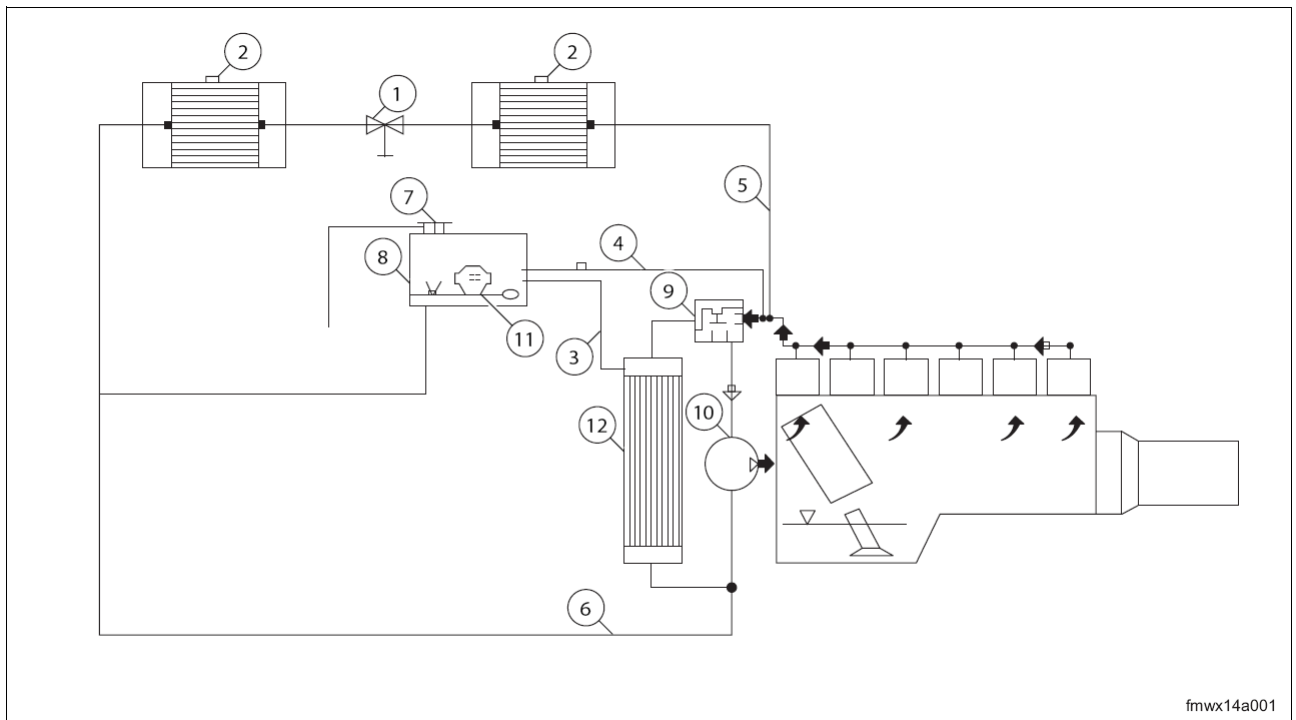
Cooling System

General

The function of the diesel engine's cooling system is to transfer outside the heat absorbed by the heated parts of the diesel engine through cooling medium – coolant, and ensure that the heated parts operate normally under allowable temperature condition. The cooling for the diesel engine shall be appropriate, not excessive. Excessive cooling will bring about the following adverse effects for the diesel engine's operation: 1. the temperature of the cylinder is too low, the ignition delay period of fuel extends, the combustion rate lowers, and heat loss due to radiation rises; 2. the diesel engine runs roughly, and its fuel consumption increases; 3. the viscosity of lubricating oil increases, which results in increase in moving parts' friction power loss, and in decrease in the diesel engine's power. Therefore, only appropriate cooling can ensure that the diesel engine operates normally and has good economy.

Do not use common water as coolant, because the thermal conductivity of the scale deposit generated by heating water is 40 times lower than that of cast iron. The scale deposit on the water jacket will lower the performance of the engine cooling system. After the scale deposit blocks the orifice on the cylinder gasket in particular, it will disturb smooth water flow and bring about various faults and damages.

The engine cooling system consists of a water pump, a radiator, a fan, a thermostat, an auxiliary water tank, cooling pipes, the water channel of the cylinder body, and the cooling water chamber of the crankcase.



1	Switch
2	Heater
3	Exhaust Pipe, Water Tank
4	Water Inlet Pipe, Auxiliary Water Tank
5	Water Inlet Pipe, Heater
6	Water Pipe

7	Pressure Limiting Valve Cover
8	Auxiliary Water Tank
9	Thermostat
10	Water Pump
11	Water Filler Cap
12	Water Tank

Water Pump

The water pump is a power unit in the forced-circulation type water cooling system. Its main function is to generate a certain pressure for coolant and force the coolant into various cooled parts of the diesel engine, in order to ensure the continuous circulation of coolant in the process of the engine's operation. For the WD615 Series diesel engine, the water pump is installed at its front end. The water coming out from the water pump goes into the right water chamber of the engine body; cooling water goes across the oil cooler, flows into the water jacket of the cylinder barrel through the right lower channel hole of the engine body, goes into the water chamber of the cylinder head through the upper water hole after cooling the cylinder barrel, and drains into the water outlet pipe from the water outlet of the cylinder head after cooling the cylinder head; the thermostat is installed at the end of the water outlet pipe. The thermostat has two outlets, one leading to the radiator and the other leading to the water pump inlet, which is small circulation. When the temperature of coolant is at $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat starts to open and fully opens at $95\text{ }^{\circ}\text{C}$, and at the moment, coolant is pumped into the engine body by water pump after being cooled by the radiator. When the temperature of coolant is lower than $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat cuts off the above channel, and coolant directly flows into the water pump inlet, which can help the diesel engine's temperature rise as soon as possible and help the diesel engine reach hot state required for operation, avoid cold scuffing, and prolong the service life of the diesel engine.

The oil chamber of the water pump is filled with 120cm^3 of general purpose lithium base grease from automobile, which needs regular filling or makeup.

Radiator

The function of the radiator is to transfer the heat absorbed by coolant from the heated parts into air and then emit the heat into the atmosphere so as to lower the temperature of coolant.

Fan

The silicon oil fan clutch, adopting silicon oil as medium, transfers torque by using the high viscosity of silicon oil. The release and engagement of the fan clutch can be automatically control by the temperature sensor which detects the temperature of air behind the radiator. When the temperature is low, silicon oil does not flow, the fan clutch releases, and the fan's speed descends and basically idles. When the temperature is high, the viscosity of silicon oil engages the fan clutch, and then the fan rotates together with the water pump shaft, which plays a role in adjusting the engine's temperature.

The temperature sensing element of the silicon oil fan clutch is a bimetallic coil spring temperature sensor. Its working process is as follows:

1. When the temperature or air passing through the radiator rises, the bimetallic temperature sensor deforms as a result of heating to force the valve disc shaft to rotate and open the oil inlet on the driven plate. The silicon oil stored between the driven plate and front cover flows into the working chamber between the driving plate and driven plate, the clutch engages, and the fan's speed increases.

The higher the air temperature, the larger the oil inlet opens, and the faster the fan rotates.

2. When the temperature of air passing through the radiator falls, the bimetallic temperature sensor recovers to its original shape, the valve disc closes the oil inlet, the silicon oil returns to the oil storage chamber from the working chamber through the oil inlet under the action of centrifugal force, the clutch releases, and the fan's speed gets very low.

Thermostat

The function of the thermostat is to keep the coolant's temperature appropriate, which ensures reliable cooling for the diesel engine, and avoids lowering the power and economy of the diesel engine in use due to too low water temperature. When the temperature of coolant is low, the big circulation valve of the thermostat closes, the small circulation valve opens, the coolant in the water return pipe of the diesel engine is directly supplied to the water pump inlet through the small circulation valve, the water pump

Cooling (WP10) – Cooling System

pumps coolant into the cooling system of the diesel engine again, and the radiation water tank does not work. When the water temperature of the diesel engine rises to a certain value, the big circulation valve of the thermostat opens while the small circulation valve closes, and the coolant flows into the radiation water tank through the big circulation valve and the water return pipe of the water tank, is sucked into the water pump from the radiation water tank after being cooled, and then is pumped into the cooling circulation system of the diesel engine.

This vehicle adopts a wax and core combined thermostat. When the temperature of coolant is lower than the specified value, the refined wax in the temperature sensing element of the thermostat is solid, the thermostat valve closes the channel between the engine and radiator under the spring action, and the coolant returns to the engine through the water pump and flows within the small circulation. When the temperature of coolant rises to the specified value, the wax starts to melt and gradually changes into liquid, and it presses the rubber hose with its volume increasing and forces the hose to shrink. The rubber hose applies an upward thrust to the push rod while shrinking, and the push rod exerts a downward reverse thrust on the valve to open the valve. At the moment, the coolant passes through the radiator, thermostat valve and water pump, then returns to the engine, and flows within the big circulation. This is the principle of operation of the thermostat. Mostly, the thermostat is arranged in the water outlet pipe of the cylinder head, which has the advantages that the structure is simple and bubbles in the cooling system is easy to eliminate, but has the disadvantages that vibration is usually generated along with the frequent opening and closing of the thermostat.

Auxiliary Water Tank

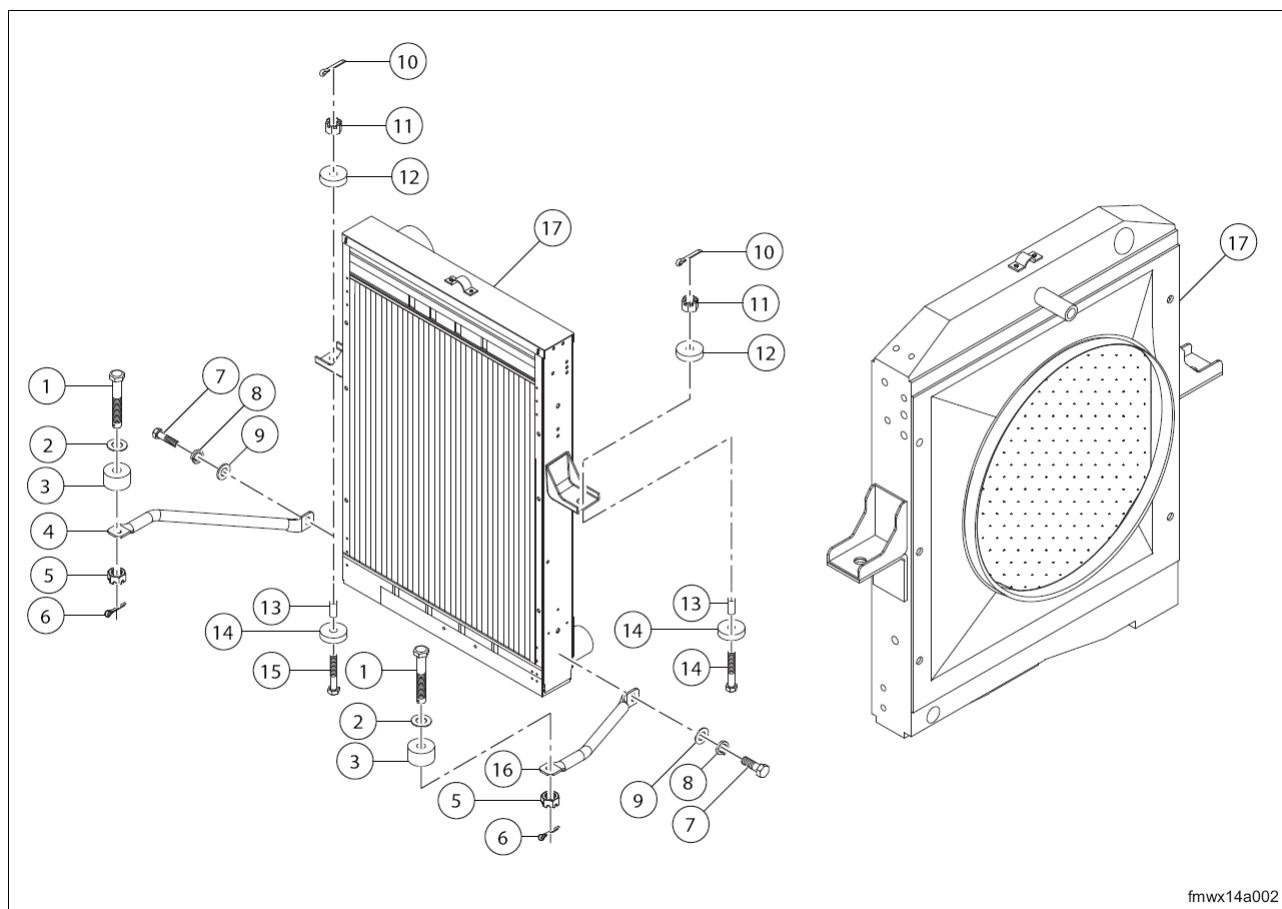
The function of the auxiliary water tank is to eliminate vapor in the low pressure part of the cooling system, which may cause air resistance, and to make up coolant. The pressure of the auxiliary water tank shall be kept at 50kPa, and its position must be 400mm higher than the diesel engine and radiator. Various water tank caps in the cooling system shall be kept good, and it is prohibited to open them. Keeping an internal pressure in the cooling system will enhance the cooling efficiency of the cooling system, and boiling can be avoided.

Precautions

1. Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.
2. When disconnecting the pipeline of the cooling system, collect the residual coolant with a special container. If the coolant is disused, follow the waste disposal as specified.
3. When disconnecting the pipeline of the cooling system, never allow debris to go into the pipeline of the cooling system, which may damage the cooling system and engine.
4. When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.
5. Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.
6. Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.
7. The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.
8. The antifreeze must be replaced regularly, generally once every two years or every 40,000km.
9. Drain the old antifreeze during replacement, clean the cooling system, and then fill new antifreeze.
10. Avoid mixing antifreeze with water. The traditional inorganic antifreeze can not be mixed with water, or sediment will be generated, which will seriously affect the normal function of the antifreeze. The organic antifreeze can be mixed with water, but not too much.
11. When the air temperature is below 0 °C, inspect the concentration of antifreeze regularly.
12. Vehicles, which usually run in the regions above 0 °C, can use water after anti-rust and scale prevention treatment as coolant. They are prohibited to use untreated water as coolant.
13. When using the silicon oil clutch fan, be careful not to place the fan horizontally after dismantling it, or silicon oil will be leaked from the fit clearance of the sensor shaft, which will cause failure of the fan.

Cooling (WP10) – Cooling System

Part Drawing

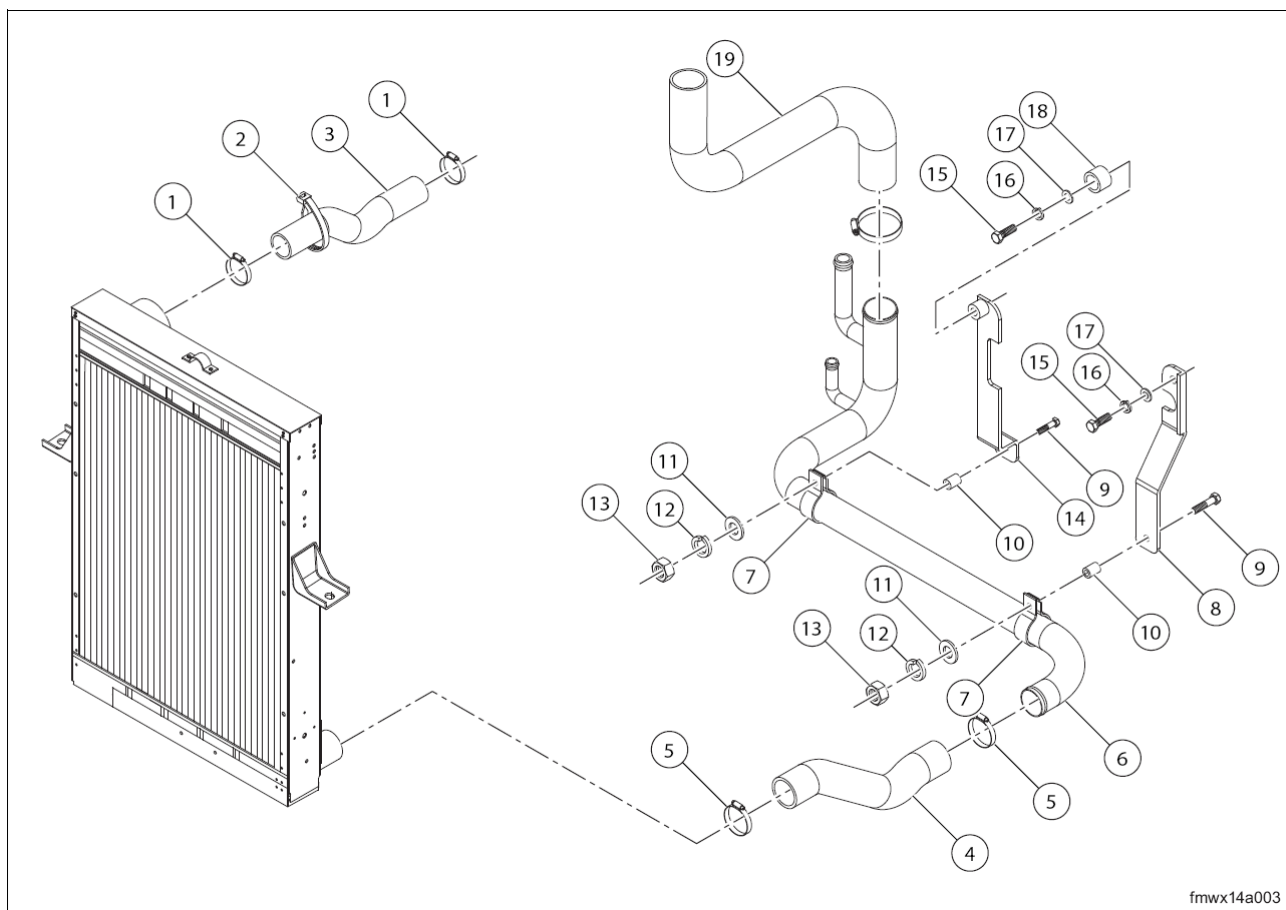


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14A

1	Hex Bolt with Split Pin Hole on Shank
2	Big Washer
3	Cushion, Radiator Tie Rod
4	Right Tie Rod, Radiator (symmetrical with the left part)
5	Hex Thin Slotted Nut
6	Cotter Pin
7	Hex Head Bolt
8	Spring Washer
9	Flat Washer

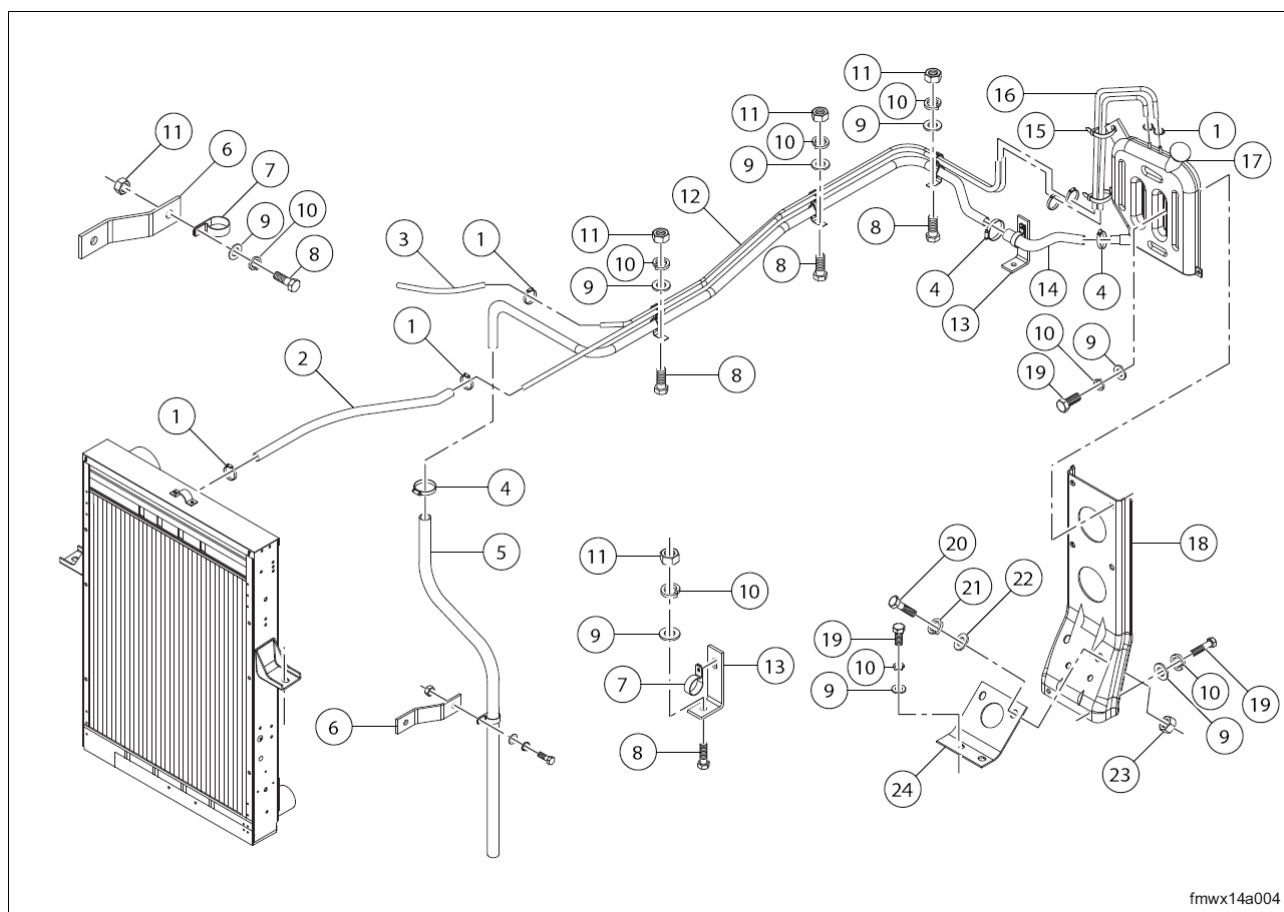
10	Cotter Pin
11	Hex Slotted Nut, Style 1 – Fine Pitch Thread
12	Upper Cushion, Radiator
13	Sleeve
14	Cushion, Radiator
15	Hex Bolt with Split Pin Hole on Shank
16	Left Tie Rod, Radiator
17	Radiator with Cowl Assembly



14A

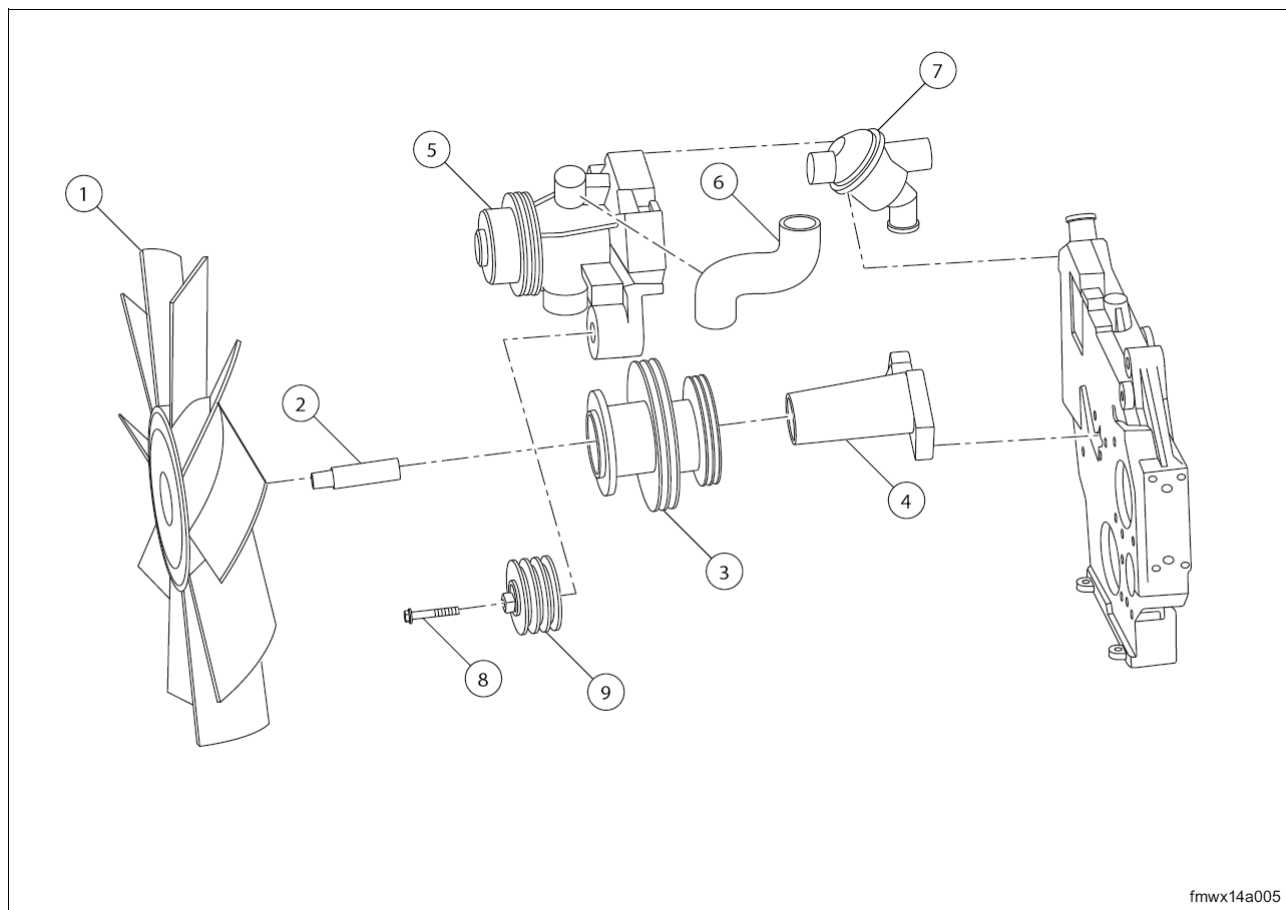
1	Worm Drive Type Hose Hoop, Type A
2	Plastic Strap
3	Water Inlet Hose, Radiator
4	Water Outlet Hose, Radiator
5	Worm Drive Type Hose Hoop, Type A
6	Engine Water Inlet Pipe Welding Assembly
7	Clamp
8	Fixing Bracket, Water Pipe
9	Hex Head Bolt
10	Limiting Sleeve, Water Pipe

11	Flat Washer
12	Spring Washer
13	Hex Nut, Style 1
14	Bracket, Water Pipe Welding Assembly
15	Hex Head Bolt
16	Spring Washer
17	Flat Washer
18	Cushion block
19	Water Inlet Hose, Engine

Cooling (WP10) – Cooling System

1	Worm Drive Type Hose Hoop, Type A
2	Exhaust Hose, Radiator
3	Exhaust Hose, Engine
4	Worm Drive Type Hose Hoop, Type A
5	Water Outlet Pipe, Auxiliary Water Tank
6	Bracket, Engine Water Make-up Pipe
7	Single Pipe Clamp
8	Hex Head Bolt
9	Flat Washer
10	Spring Washer
11	Hex Nut, Style 1
12	Combined Cooling Water Pipe

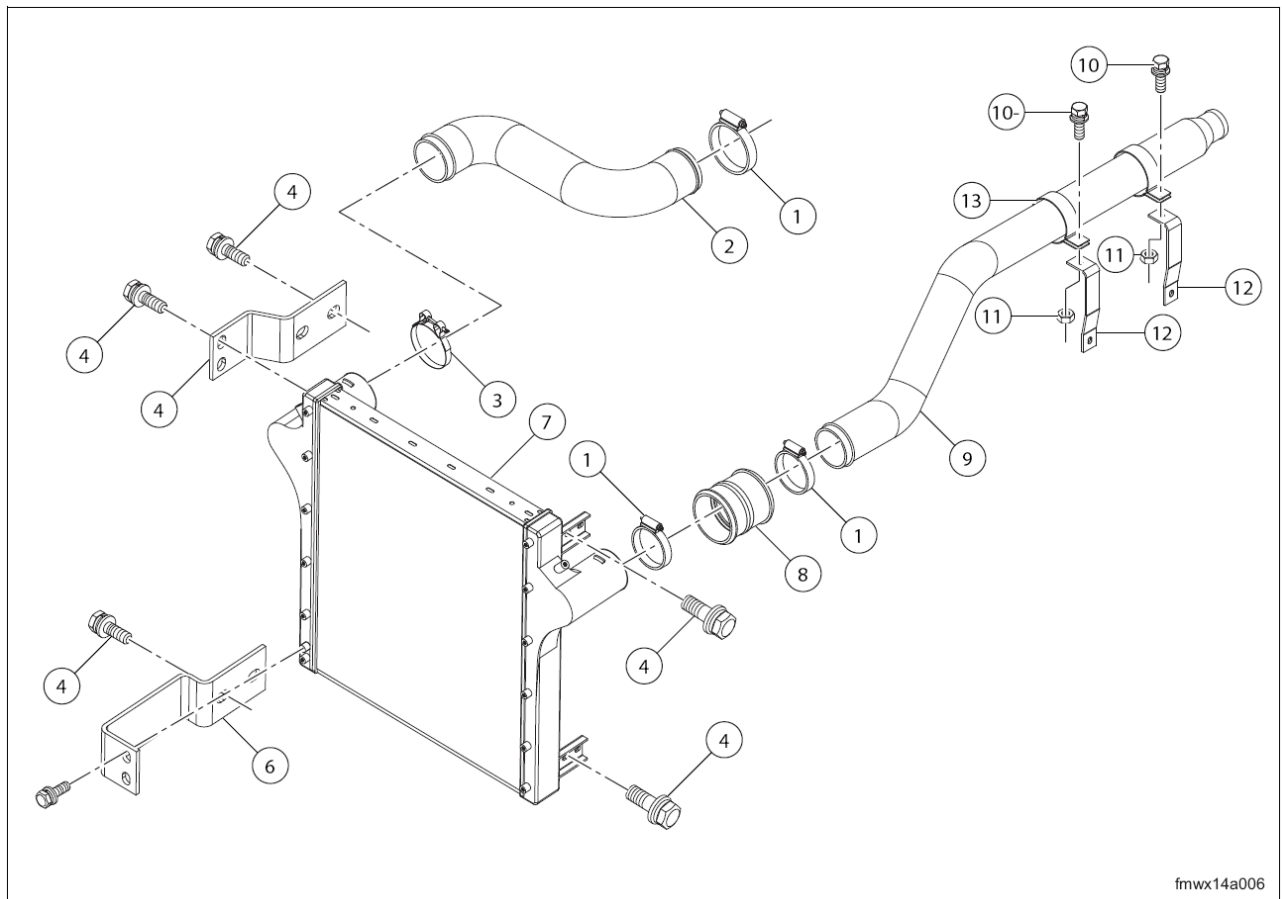
13	Bracket, Cooling Water Hose
14	Water Outlet Pipe, Auxiliary Water Tank
15	Plastic Strap
16	Exhaust Hose
17	Plastic Auxiliary Water Tank
18	Bracket, Auxiliary Water Tank
19	Hex Head Bolt
20	Hex Head Bolt
21	Spring Washer
22	Flat Washer
23	Hex Nut, Style 1
24	Support Plate, Auxiliary Water Tank



14A

1	Silicon Oil Clutch Fan
2	Shaft
3	Pulley
4	Fan Bracket
5	Wave Pump Assembly

6	Shaped Hose
7	Thermostat Assembly
8	Hex Flange Bolt
9	Tension Pulley Assembly

Cooling (WP10) – Cooling System

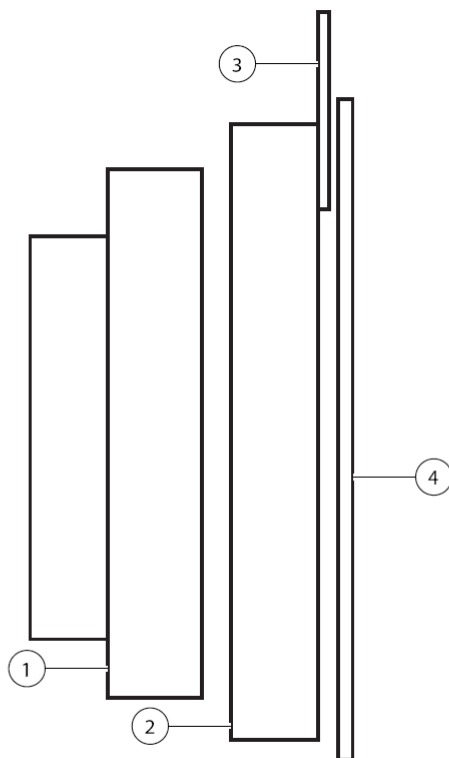
1	Clamp
2	Exhaust Pipe, Intercooler
3	T-clamp
4	Hex Head Bolt, Spring Washer and Flat Washer Assembly
5	Fixing Bracket, Intercooler
6	Fixing Bracket, Intercooler
7	Intercooler assembly

8	Connecting hose
9	Intake Pipe, Intercooler
10	Hex Head Bolt, Spring Washer and Flat Washer Assembly
11	Hex Flange Nut
12	Bracket, Intercooler Pipe
13	Clamp, Intercooler Pipe

Testing & Adjustment

Fan

Manual test method: Start the engine, run it for several minutes and then shut down; pull the fan by hand. If the clutch is released and the fan can rotate, it shows that the silicon oil fan is good. There are, however, exceptions that the fan can not rotate at low temperature because silicon oil can not return at once, which does not always show that the silicon fan is damaged. Start the engine to continue the test, run it at middle speed and low temperature for 1~2 minutes and then shut down; pull the fan by hand. If the fan can rotate and operate flexibly, it shows that the silicon fan is good. When the temperature rises to 88 °C, shut the engine down, and pull the fan by hand. If the fan does not move, it shows that the silicon fan is normal; if not, it shows that the silicon fan is defective.



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1	Fan
2	Radiator

3	Thermometer
4	Baffle Plate

Dynamic test: Place the thermometer with a range of -18~105 °C ahead of the radiator. Put a fixed plastic plate ahead of the radiator to prevent air from passing through the radiator, and ensure that it can prevent air passage. If an air conditioner is equipped, the A/C switch must be turned off. Use a timing lamp to point to the fan blades, start the engine and run it at a speed of 2400r/min. The air temperature showed by dial thermometer shall reach 88 °C within 10 minutes. The ideal engagement of the fan clutch shall be before 88 °C. Observe the increase in the fan's speed. When the air temperature rises to 88 °C, take away the plastic plate, and the air temperature starts to fall. The ideal silicon oil fan clutch can lower the air temperature by 11 °C or more, and at the same time, you can hear that the air flow sound of the fan reduces. If the fan clutch fails to meet the above requirement, replace the silicon oil fan clutch assembly.

Cooling (WP10) – Cooling System**Water Pump**

In case that the cooling system leaks, you can smell hot antifreeze. But you have to do inspection, and find out whether the cooling water is leaked from the shaft seal of the water pump. You can use a small mirror and a lamp to inspect whether the air bleed hole of the water pump leaks water.

Conduct the regular maintenance, and pay attention to inspecting the consumption of coolant in the water tank.

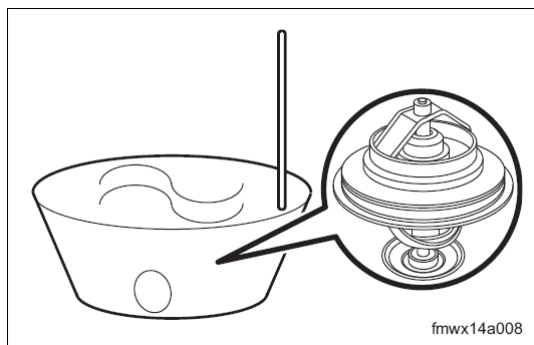
Do not underestimate the problem of leakage in the cooling system, which will cause air sucked in to destroy the preset coolant flow mode and result in generation of hotspots, and greatly aggravate corrosion to the water pump.

If the amount of coolant is insufficient for a long time, it will cause the engine to overheat, and steam corrosion may occur, which may damage the radiator and cause other problems of the water pump.

When the color of coolant is rusty, it may be the problem of impeller corrosion. At the moment, it is necessary to inspect the circulation condition of the water pump coolant. Discharge part of the coolant in the radiator and keep the lever right above the pipe, and warm up the engine to let the thermostat stay in full opening position. When the engine's speed is 3,000r/min, you shall see a good water circulation.

Thermostat

The safe life of the wax thermostat is generally for a range of 50,000km, and the wax thermostat shall be replaced regularly according to its safe life.

**1. Inspect the thermostat**

- (a). The thermostat and thermometer can be put in hot water.
- (b). Inspect the opening temperature of the main valve of the thermostat.
- (c). Inspect the sealing ring of the thermostat.
- (d). Replace the thermostat if either of the items fails to meet the specified value.

14A

Opening Temperature	Full-opening Temperature
80 ± 2 °C	95 °C

Water Pipe

Inspect whether the clogging, bulging, aging or cracking of water pipes occurs, and whether the connection of water pipe joints is secure.

Auxiliary Water Tank

Inspect whether there are cracks on the auxiliary water tank, whether the bulging, aging or cracking of the auxiliary water tank occurs, and whether the auxiliary water tank cap is in perfect condition.

Coolant

When the engine idles and warms up to the normal operating temperature, the level of coolant in the bottle shall be between the lowest graduation line and highest graduation line, as shown on the bottle. Test the concentration of coolant by a freezing point tester.

Radiator

Fill water into the radiator, and observe whether water flow is smooth. If not smooth, it shows that the radiator inside is clogged. Rinse the radiator outside, and wash the radiator inside with hot water. If the scale deposit can not be eliminated still after the radiator is washed, use a soft metal cleaning rod to remove the scale deposit, and then wash with the above method. Remove the radiating fin of the

Cooling (WP10) – Cooling System

damaged radiating pipe by needle nose pliers, then cut off the damaged radiating pipe, insert the cleaning rod from the end of the core, pass it through the upper orifice and lower orifice of the cut part and straighten, cut the same usable radiating pipe from a waste radiator, and solder the upper and lower joints. Insert the resistance heater into the radiating pipe to be replaced, and supply 24V power. After resistance wires are hot, the radiating pipe releases as its soldering tin melts. Cut off the power, take out the radiating pipe and resistance heater together, and change with the new radiating pipe and solder securely. Install the radiator tester on the radiator cap opening, and inspect the cooling system for leakage. Pressurize the radiator to 176kPa, inspect the leakage of coolant at normal operating temperature, and repair if any.

Intercooler

This vehicle is of a turbocharged intercooled type. The intercooler is installed on the front of the diesel engine, i.e. the front end of the water tank, and it sucks the air from the fan and the headwind of the vehicle during driving for cooling. Foreign matters such as oil sludge and colloid, which are usually attached to the internal pipe of the intercooler, not only narrow the air channel to reduce the heat exchange capacity, but also lower air intake because dirt clogs the air channel, which cause the problems that the diesel engine's power falls, the exhaust gas is white, and even the vehicle can not run normally.

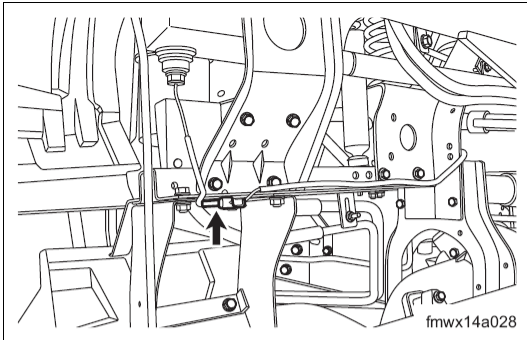
Fill water into the intercooler, and observe whether water flow is smooth. If not smooth, it shows that the intercooler is clogged. Wash the intercooler with hot water. If the scale deposit can not be eliminated after washing, replace the intercooler.

Auxiliary Water Tank

Overhaul

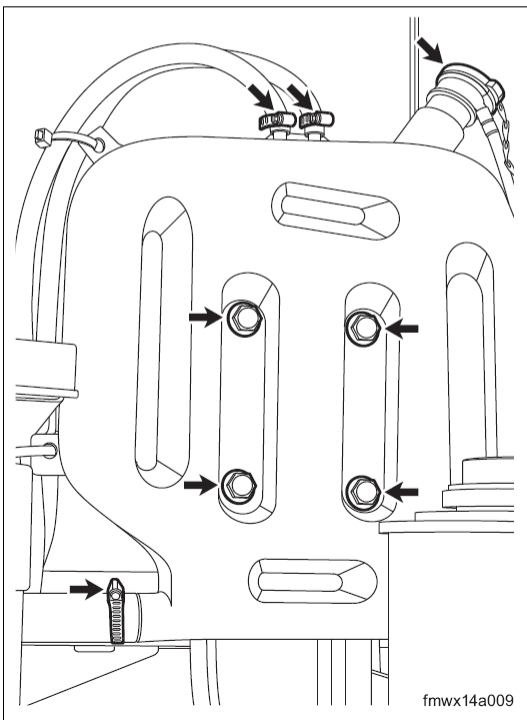
Hint:

Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing



1. Dismantle the auxiliary water tank

- (a). Disconnect the wiring harness of the auxiliary water tank.



- (b). Open the auxiliary water tank cap.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

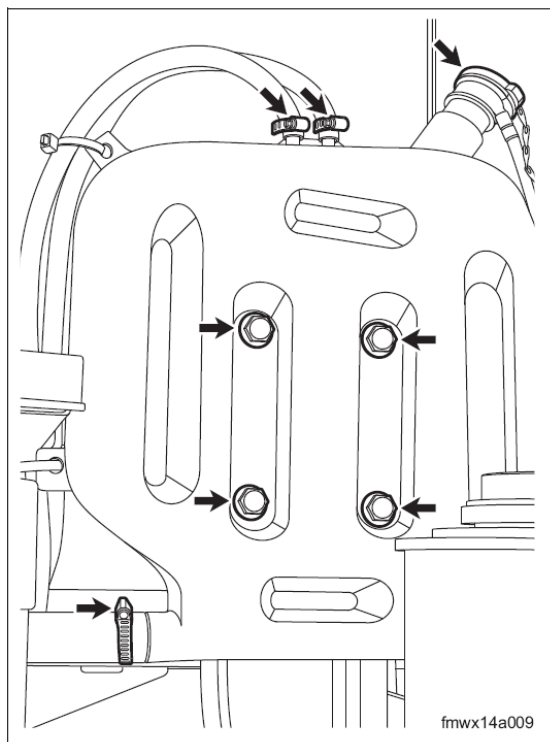
- (c). Disconnect the pipe of the auxiliary water tank.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

- (d). Dismantle the fixing bolts of the auxiliary water tank.

2. Inspect the auxiliary water tank. Refer to Chapter 14A Cooling – Cooling System, Testing & Adjustment.

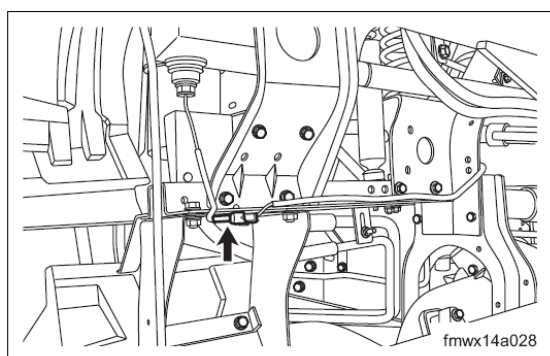


3. Install the auxiliary water tank

- (a). Install the fixing bolts of the auxiliary water tank.

Torque: 20N.m

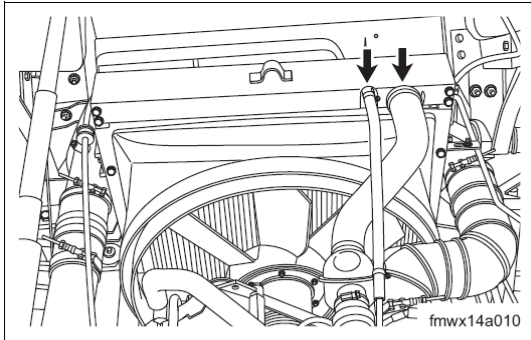
- (b). Connect the pipe of the auxiliary water tank.
(c). Fill coolant.
(d). Close the auxiliary water tank cap.



- (e). Disconnect the wiring harness of the auxiliary water tank.

Coolant

Replacement



1. Drain coolant

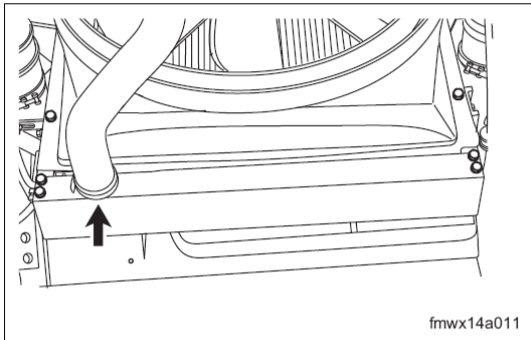
- (a). Disconnect the water inlet hose and exhaust pipe of the radiator.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.



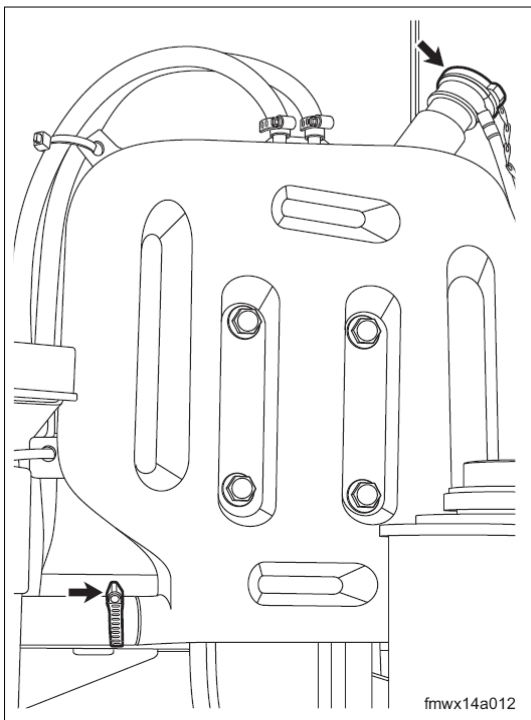
- (b). Disconnect the water outlet hose of the radiator.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

Caution:

Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.



- (c). Unscrew the auxiliary water tank cap.

- (d). Disconnect the water pipe of the auxiliary water tank.

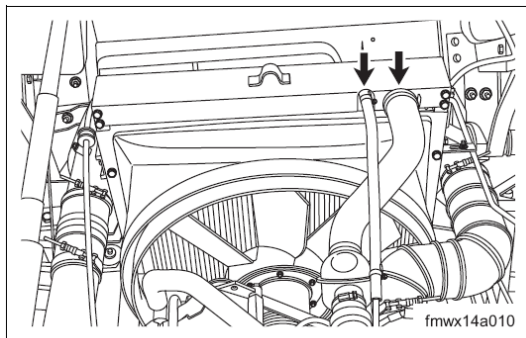
Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

Caution:

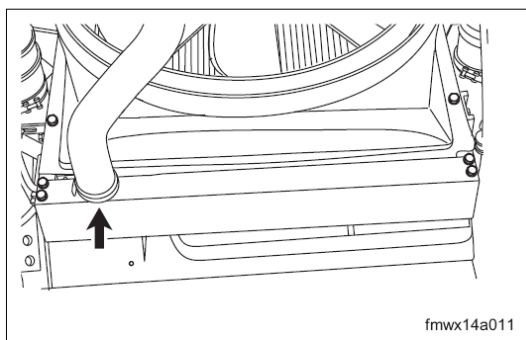
Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.

Cooling (WP10) – Coolant

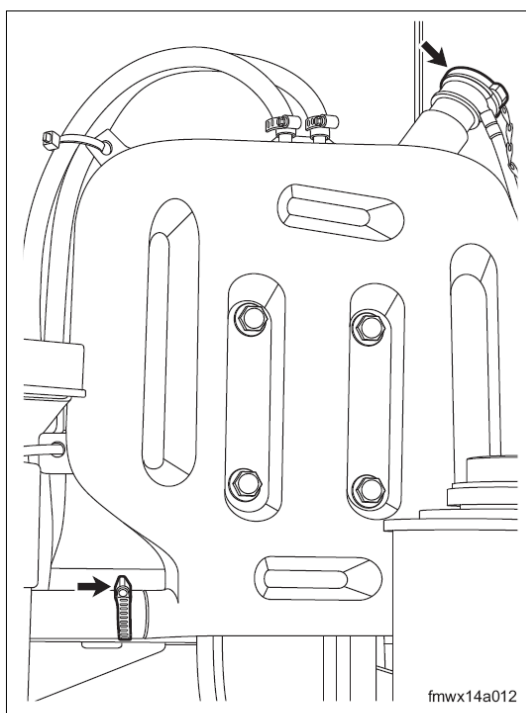


2. Fill coolant

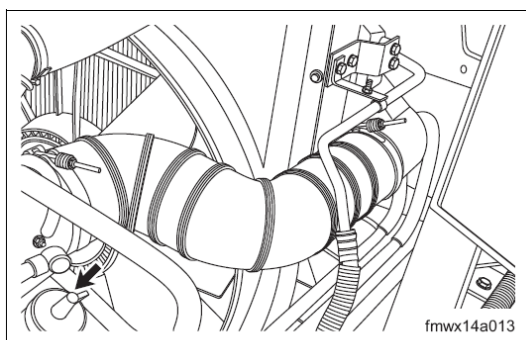
- (a). Connect the water inlet hose and exhaust pipe of the radiator.



- (b). Connect the water outlet hose of the radiator.



- (c). Connect the water pipe of the auxiliary water tank.
(d). Fill coolant.
(e). Tighten the auxiliary water tank cap.



- (f). Fill coolant from the engine water filler.

Caution:

Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.

Caution:

The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.

Cooling (WP10) – Coolant

3. Inspect the coolant level

- (a). Run the engine, and inspect the engine coolant level.
- (b). If the level is too low, continue to fill coolant.

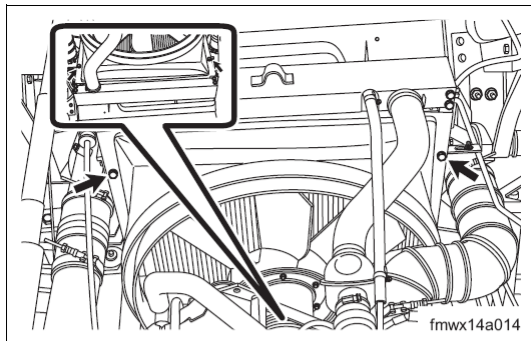
Radiator

Overhaul

Hint:

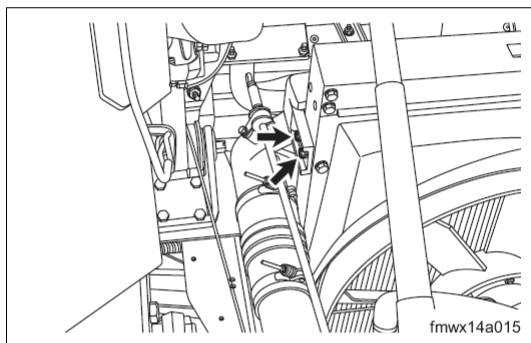
Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.

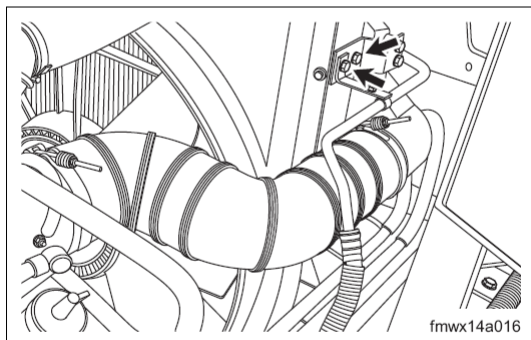


2. Dismantle the radiator

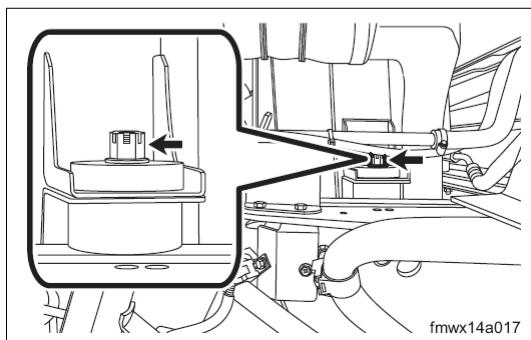
(a). Loosen the shroud.



(b). Loosen the intercooler.



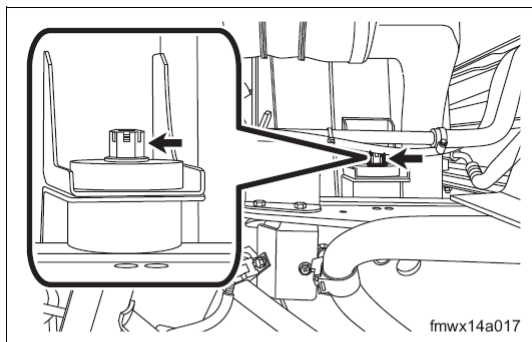
(c). Dismantle the fixing bracket of the A/C pipe.



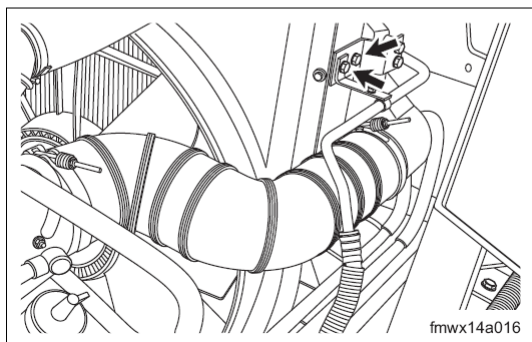
(d). Dismantle the radiator.

- Dismantle the cotter pin.
- Dismantle the slotted nuts of the radiator.
- Take out the radiator upward.

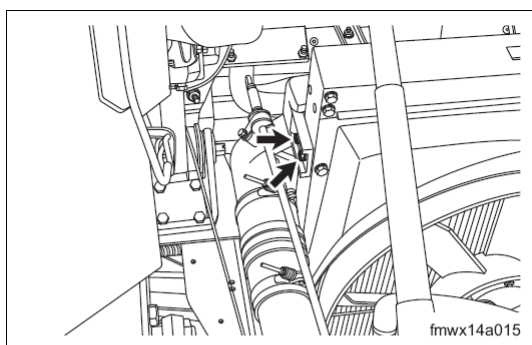
3. Inspect the radiator. Refer to Chapter 14A Cooling – Cooling System, Testing & Adjustment.

Cooling (WP10) – Radiator**4. Install the radiator**

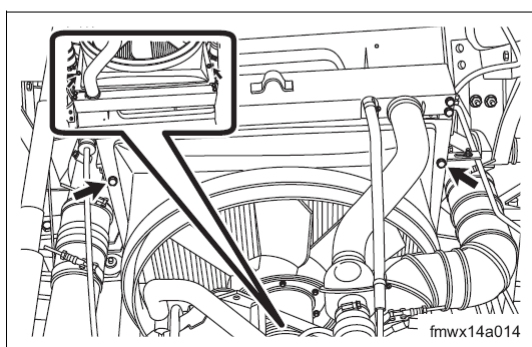
- (a). Install the radiator.
- Put radiator downward.
 - Install the slotted nuts of the radiator.
Torque: 70N.m
 - Install the cotter pin.



- (b). Install the fixing bracket of the A/C pipe.



- (c). Tighten the intercooler.
Torque: 23±2N.m



- (d). Tighten the shroud.
Torque: 20N.m

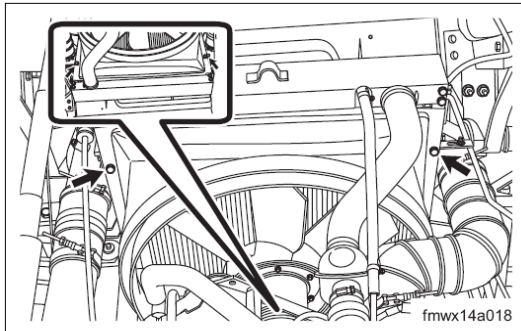
5. Fill coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.

Cooling Fan

Overhaul

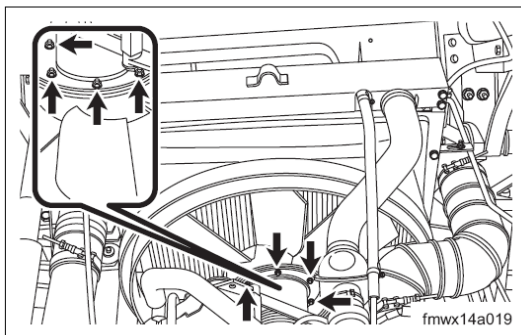
Hint:

Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing



1. Dismantle the cooling fan

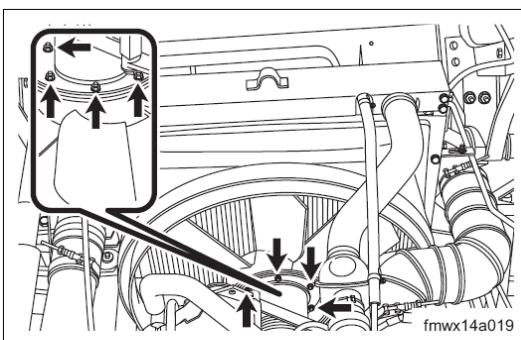
(a). Loosen the shroud.



(b). Disconnect the silicon oil temperature sensor of the cooling fan.

(c). Dismantle the cooling fan.

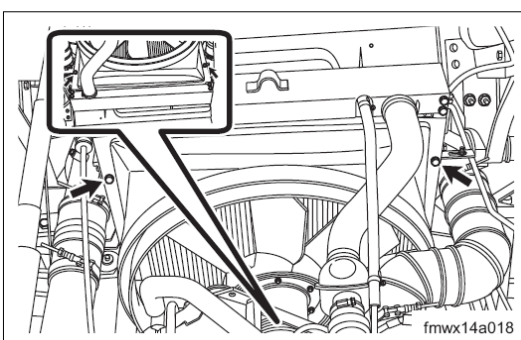
2. Inspect the cooling fan. Refer to Chapter 14A Cooling – Cooling System, Testing & Adjustment.



3. Install the cooling fan

(a). Install the cooling fan.

Torque: 20N.m



(b). Tighten the shroud.

Torque: 20N.m

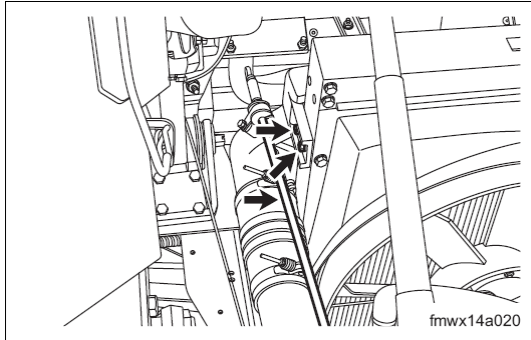
(c). Connect the silicon oil temperature sensor of the cooling fan.

Intercooler

Overhaul

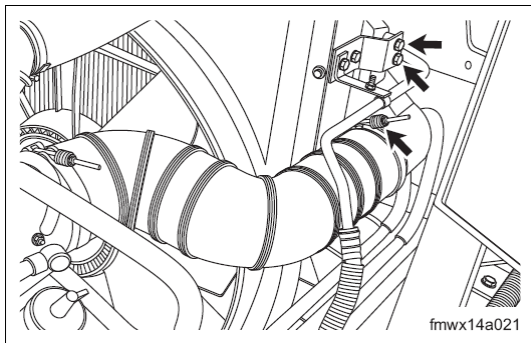
Hint:

Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing

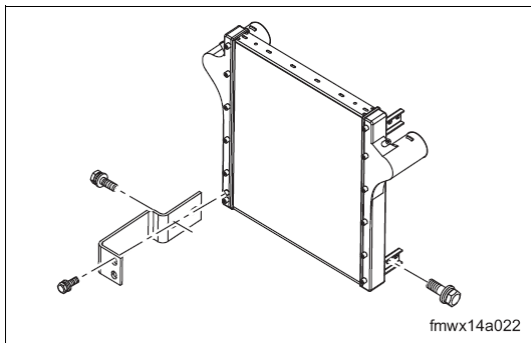


1. Dismantle the intercooler

- (a). Dismantle the intake pipe of the intercooler.
- (b). Dismantle the fixing bolts of the intercooler.

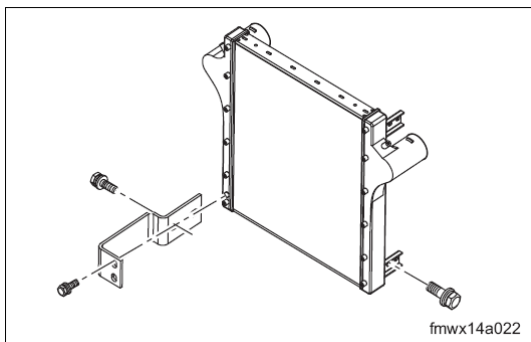


- (c). Dismantle the exhaust pipe of the intercooler.
- (d). Dismantle the fixing bracket of the intercooler.



- (e). Dismantle the fixing bolts of the intercooler.
- (f). Dismantle the fixing bolts of the intercooler.

2. Inspect the intercooler. Refer to Chapter 14A Cooling – Cooling System, Testing & Adjustment.

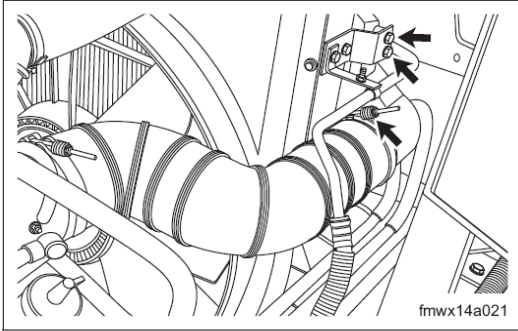


3. Install the intercooler

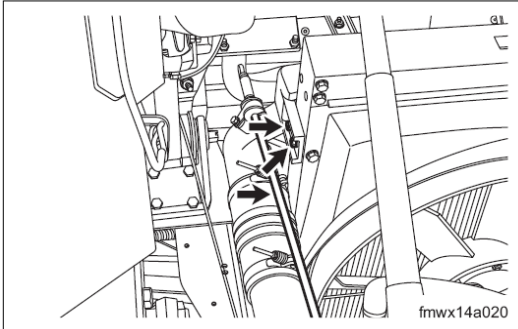
- (a). Install the fixing bolts of the intercooler.
- (b). Install the fixing bolts of the intercooler.

Torque: 23±3N.m

Cooling (WP10) – Intercooler



- (c). Install the exhaust pipe of the intercooler.
 - (d). Install the fixing bracket of the intercooler.
- Torque: 23±3N.m**



- (e). Install the intake pipe of the intercooler.
- (f). Install the fixing bolts of the intercooler.

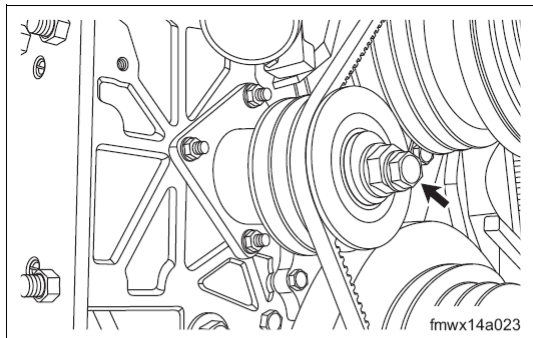
Water Pump

Overhaul

Hint:

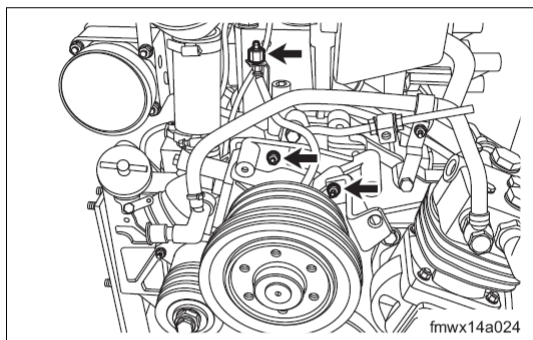
Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.



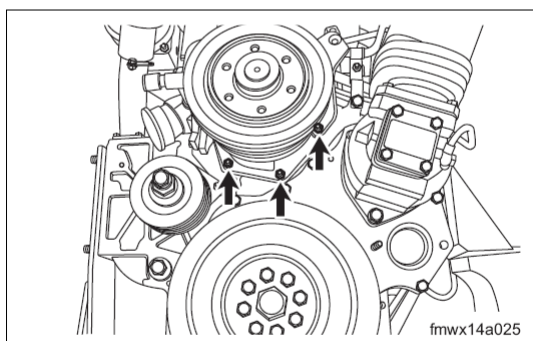
2. Dismantle the belt

- (a). Loosen the tension pulley.
- (b). Remove the belt.

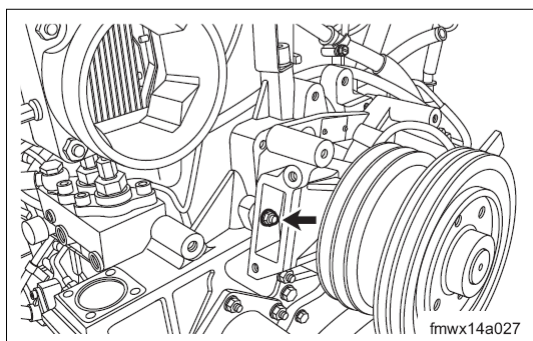


3. Dismantle the water pump

- (a). Dismantle the grease nipple and fixing nuts of the water pump.



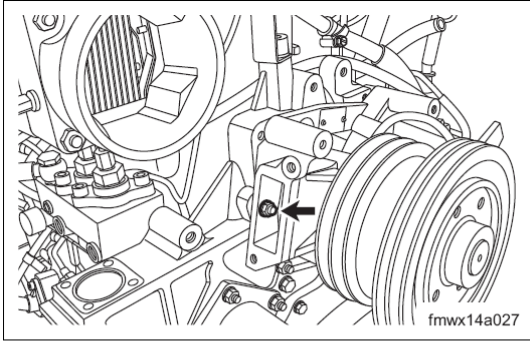
- (b). Dismantle the fixing nuts of the water pump.



- (c). Dismantle the fixing nuts of the water pump.
 - Dismantle the thermostat and water filler.

Cooling (WP10) – Water Pump

4. Inspect the water pump. Refer to Chapter 14A Cooling – Cooling System, Part Drawing.

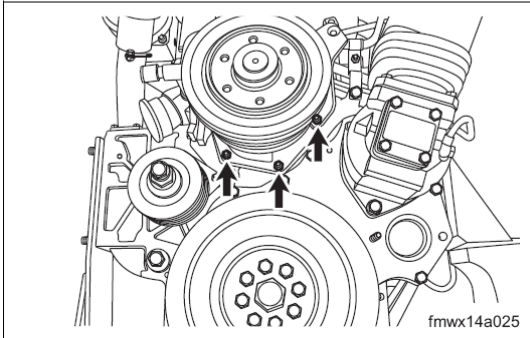


5. Install the water pump

- (a). Install the fixing nuts of the water pump.

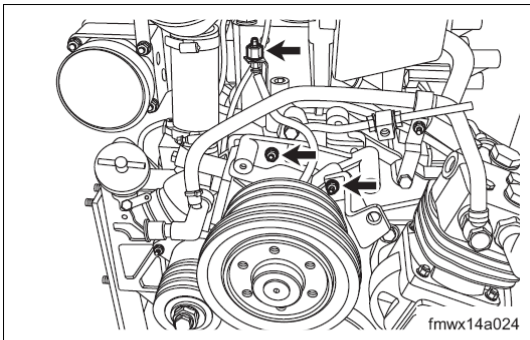
Torque: 63N.m

- (b). Install the thermostat and water filler.



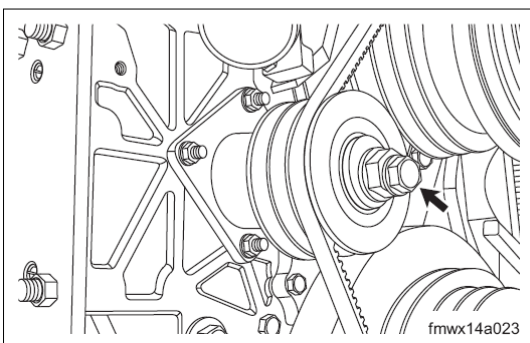
- (c). Install the fixing nuts of the water pump.

Torque: 63N.m



- (d). Install the grease nipple and fixing nuts of the water pump.

Torque: 63N.m



6. Install the belt

- (a). Put the belt on the tension pulley.

- (b). Tighten the tension pulley.

7. Fill coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.

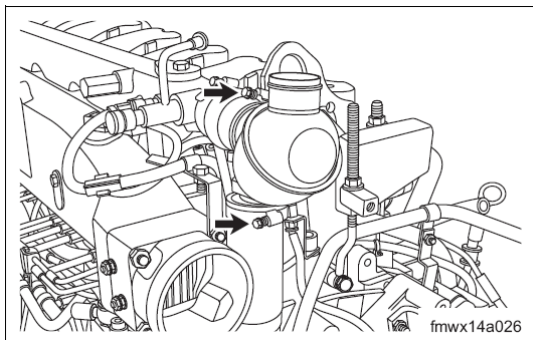
Thermostat

Overhaul

Hint:

Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing

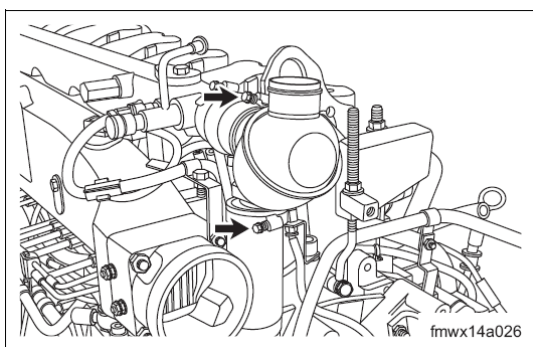
1. Drain coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.



2. Dismantle the thermostat

- (a). Dismantle the cooling water pipe.
- (b). Dismantle the thermostat.

3. Inspect the thermostat. Refer to Chapter 14A Cooling – Cooling System, Testing & Adjustment.



4. Install the thermostat

- (a). Install the thermostat.
- (b). Install the cooling water pipe.

5. Fill coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.

Cooling (WP12)

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14B

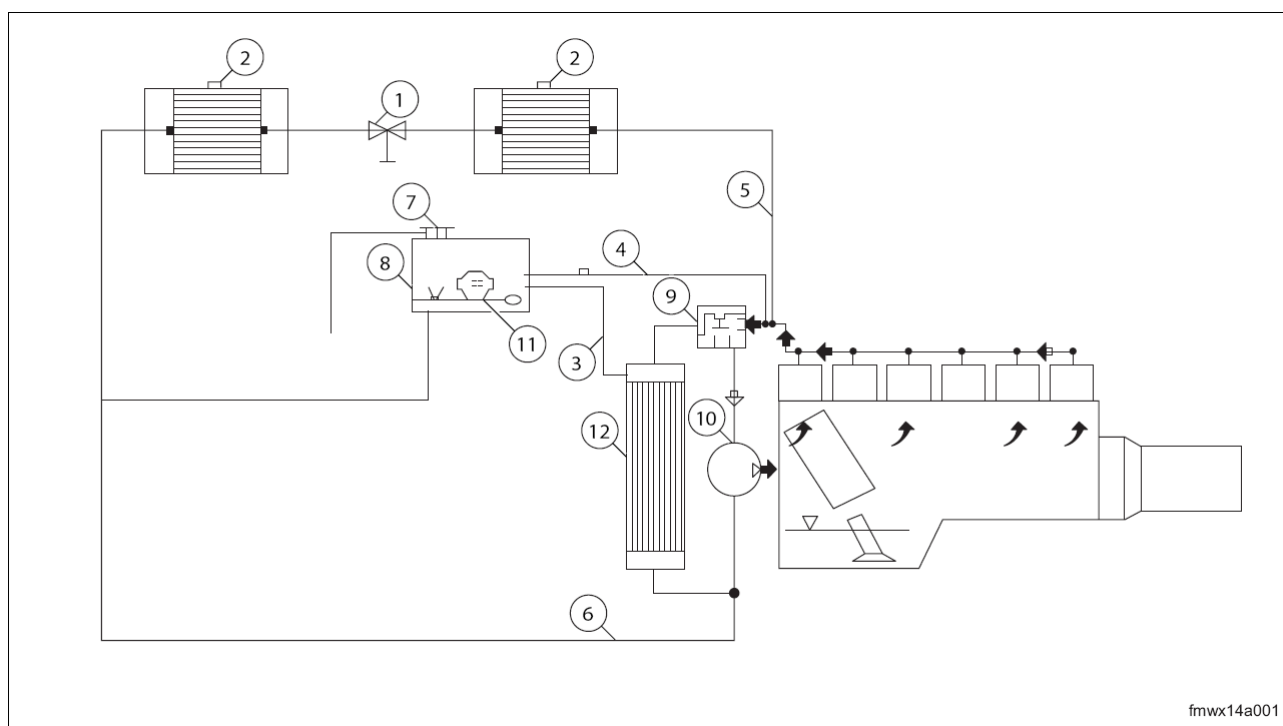
Cooling System

General

The function of the diesel engine's cooling system is to transfer outside the heat absorbed by the heated parts of the diesel engine through cooling medium – coolant, and ensure that the heated parts operate normally under allowable temperature condition. The cooling for the diesel engine shall be appropriate, not excessive. Excessive cooling will bring about the following adverse effects for the diesel engine's operation: 1. the temperature of the cylinder is too low, the ignition delay period of fuel extends, the combustion rate lowers, and heat loss due to radiation rises; 2. the diesel engine runs roughly, and its fuel consumption increases; 3. the viscosity of lubricating oil increases, which results in increase in moving parts' friction power loss, and in decrease in the diesel engine's power. Therefore, only appropriate cooling can ensure that the diesel engine operates normally and has good economy.

Do not use common water as coolant, because the thermal conductivity of the scale deposit generated by heating water is 40 times lower than that of cast iron. The scale deposit on the water jacket will lower the performance of the engine cooling system. After the scale deposit blocks the orifice on the cylinder gasket in particular, it will disturb smooth water flow and bring about various faults and damages.

The engine cooling system consists of a water pump, a radiator, a fan, a thermostat, an auxiliary water tank, cooling pipes, the water channel of the cylinder body, and the cooling water chamber of the crankcase.



1	Switch
2	Heater
3	Exhaust Pipe, Water Tank
4	Water Inlet Pipe, Auxiliary Water Tank
5	Water Inlet Pipe, Heater
6	Water Pipe

7	Pressure Limiting Valve Cover
8	Auxiliary Water Tank
9	Thermostat
10	Water Pump
11	Water Filler Cap
12	Water Tank

Water Pump

The water pump is a power unit in the forced-circulation type water cooling system. Its main function is to generate a certain pressure for coolant and force the coolant into various cooled parts of the diesel engine, in order to ensure the continuous circulation of coolant in the process of the engine's operation. For the WD615 Series diesel engine, the water pump is installed at its front end. The water coming out from the water pump goes into the right water chamber of the engine body; cooling water goes across the oil cooler, flows into the water jacket of the cylinder barrel through the right lower channel hole of the engine body, goes into the water chamber of the cylinder head through the upper water hole after cooling the cylinder barrel, and drains into the water outlet pipe from the water outlet of the cylinder head after cooling the cylinder head; the thermostat is installed at the end of the water outlet pipe. The thermostat has two outlets, one leading to the radiator and the other leading to the water pump inlet, which is small circulation. When the temperature of coolant is at $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat starts to open and fully opens at $95\text{ }^{\circ}\text{C}$, and at the moment, coolant is pumped into the engine body by water pump after being cooled by the radiator. When the temperature of coolant is lower than $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat cuts off the above channel, and coolant directly flows into the water pump inlet, which can help the diesel engine's temperature rise as soon as possible and help the diesel engine reach hot state required for operation, avoid cold scuffing, and prolong the service life of the diesel engine.

The oil chamber of the water pump is filled with 120cm^3 of general purpose lithium base grease from automobile, which needs regular filling or makeup.

Radiator

The function of the radiator is to transfer the heat absorbed by coolant from the heated parts into air and then emit the heat into the atmosphere so as to lower the temperature of coolant.

Fan

The silicon oil fan clutch, adopting silicon oil as medium, transfers torque by using the high viscosity of silicon oil. The release and engagement of the fan clutch can be automatically control by the temperature sensor which detects the temperature of air behind the radiator. When the temperature is low, silicon oil does not flow, the fan clutch releases, and the fan's speed descends and basically idles. When the temperature is high, the viscosity of silicon oil engages the fan clutch, and then the fan rotates together with the water pump shaft, which plays a role in adjusting the engine's temperature.

The temperature sensing element of the silicon oil fan clutch is a bimetallic coil spring temperature sensor. Its working process is as follows:

1. When the temperature or air passing through the radiator rises, the bimetallic temperature sensor deforms as a result of heating to force the valve disc shaft to rotate and open the oil inlet on the driven plate. The silicon oil stored between the driven plate and front cover flows into the working chamber between the driving plate and driven plate, the clutch engages, and the fan's speed increases.

The higher the air temperature, the larger the oil inlet opens, and the faster the fan rotates.

2. When the temperature of air passing through the radiator falls, the bimetallic temperature sensor recovers to its original shape, the valve disc closes the oil inlet, the silicon oil returns to the oil storage chamber from the working chamber through the oil inlet under the action of centrifugal force, the clutch releases, and the fan's speed gets very low.

Thermostat

The function of the thermostat is to keep the coolant's temperature appropriate, which ensures reliable cooling for the diesel engine, and avoids lowering the power and economy of the diesel engine in use due to too low water temperature. When the temperature of coolant is low, the big circulation valve of the thermostat closes, the small circulation valve opens, the coolant in the water return pipe of the diesel engine is directly supplied to the water pump inlet through the small circulation valve, the water pump

Cooling (WP12) – Cooling System

pumps coolant into the cooling system of the diesel engine again, and the radiation water tank does not work. When the water temperature of the diesel engine rises to a certain value, the big circulation valve of the thermostat opens while the small circulation valve closes, and the coolant flows into the radiation water tank through the big circulation valve and the water return pipe of the water tank, is sucked into the water pump from the radiation water tank after being cooled, and then is pumped into the cooling circulation system of the diesel engine.

This vehicle adopts a wax and core combined thermostat. When the temperature of coolant is lower than the specified value, the refined wax in the temperature sensing element of the thermostat is solid, the thermostat valve closes the channel between the engine and radiator under the spring action, and the coolant returns to the engine through the water pump and flows within the small circulation. When the temperature of coolant rises to the specified value, the wax starts to melt and gradually changes into liquid, and it presses the rubber hose with its volume increasing and forces the hose to shrink. The rubber hose applies an upward thrust to the push rod while shrinking, and the push rod exerts a downward reverse thrust on the valve to open the valve. At the moment, the coolant passes through the radiator, thermostat valve and water pump, then returns to the engine, and flows within the big circulation. This is the principle of operation of the thermostat. Mostly, the thermostat is arranged in the water outlet pipe of the cylinder head, which has the advantages that the structure is simple and bubbles in the cooling system is easy to eliminate, but has the disadvantages that vibration is usually generated along with the frequent opening and closing of the thermostat.

Auxiliary Water Tank

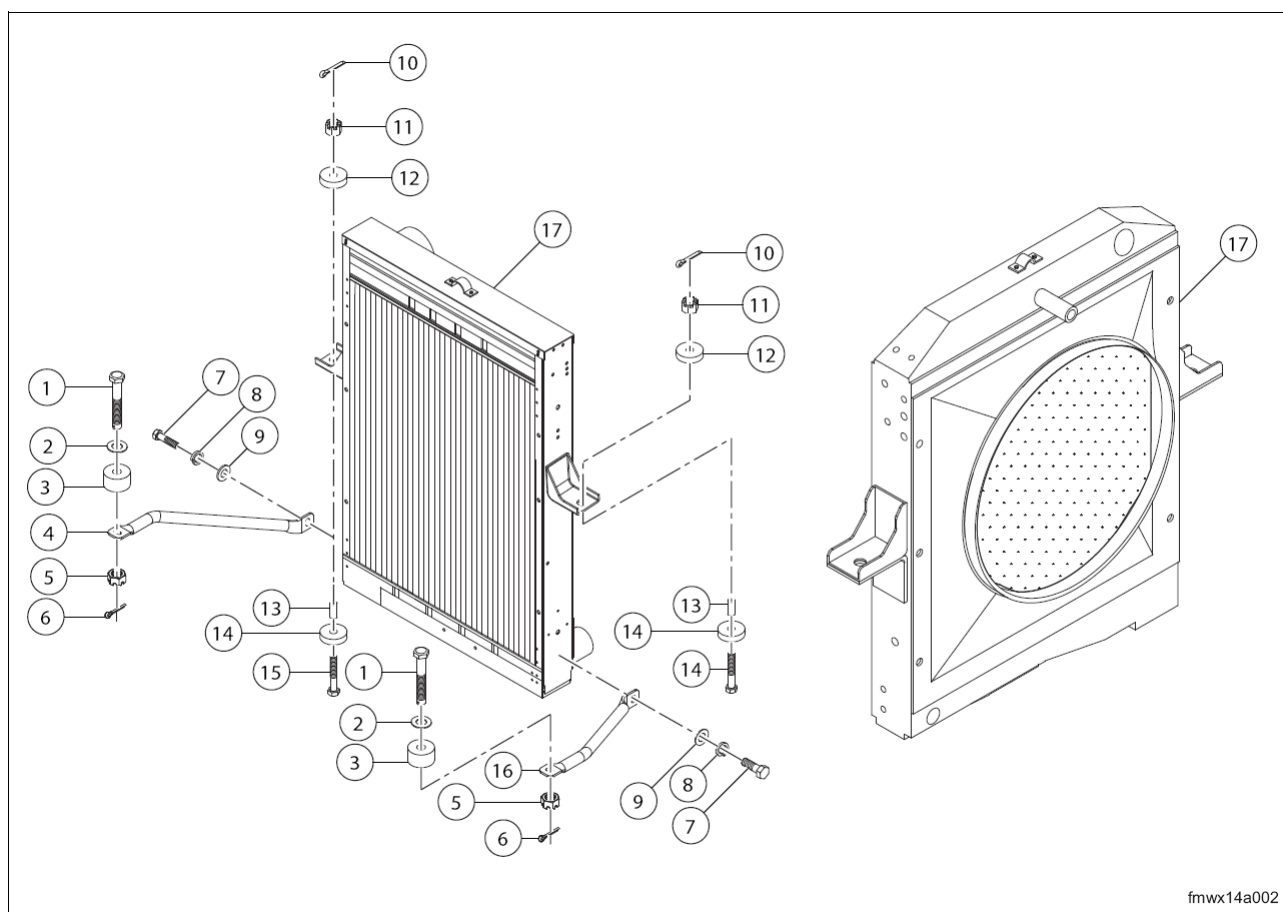
The function of the auxiliary water tank is to eliminate vapor in the low pressure part of the cooling system, which may cause air resistance, and to make up coolant. The pressure of the auxiliary water tank shall be kept at 50kPa, and its position must be 400mm higher than the diesel engine and radiator. Various water tank caps in the cooling system shall be kept good, and it is prohibited to open them. Keeping an internal pressure in the cooling system will enhance the cooling efficiency of the cooling system, and boiling can be avoided.

Precautions

1. Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.
2. When disconnecting the pipeline of the cooling system, collect the residual coolant with a special container. If the coolant is disused, follow the waste disposal as specified.
3. When disconnecting the pipeline of the cooling system, never allow debris to go into the pipeline of the cooling system, which may damage the cooling system and engine.
4. When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.
5. Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.
6. Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.
7. The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.
8. The antifreeze must be replaced regularly, generally once every two years or every 40,000km.
9. Drain the old antifreeze during replacement, clean the cooling system, and then fill new antifreeze.
10. Avoid mixing antifreeze with water. The traditional inorganic antifreeze can not be mixed with water, or sediment will be generated, which will seriously affect the normal function of the antifreeze. The organic antifreeze can be mixed with water, but not too much.
11. When the air temperature is below 0 °C, inspect the concentration of antifreeze regularly.
12. Vehicles, which usually run in the regions above 0 °C, can use water after anti-rust and scale prevention treatment as coolant. They are prohibited to use untreated water as coolant.
13. When using the silicon oil clutch fan, be careful not to place the fan horizontally after dismantling it, or silicon oil will be leaked from the fit clearance of the sensor shaft, which will cause failure of the fan.

Cooling (WP12) – Cooling System

Part Drawing



fmwx14a002

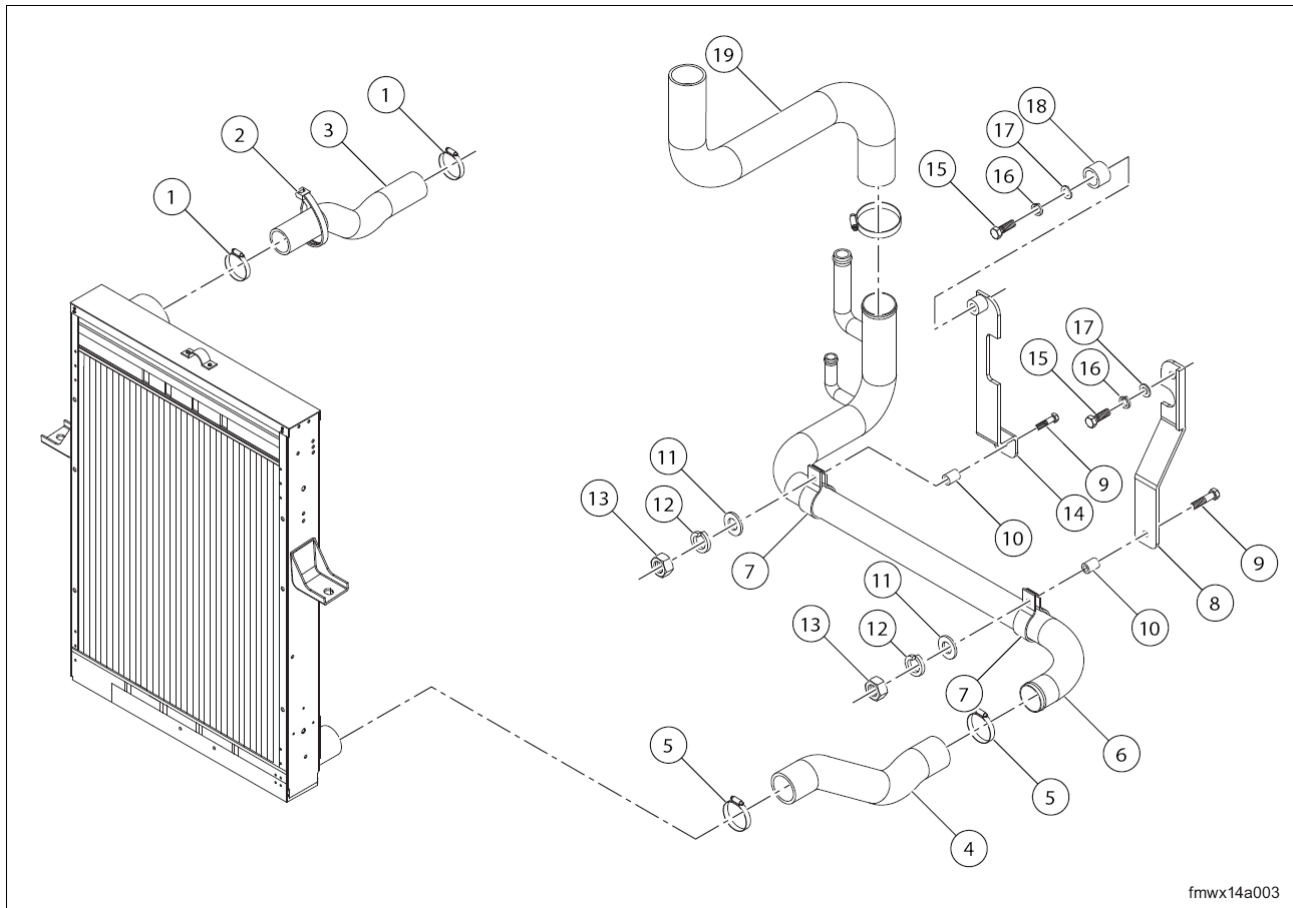
1	Hex Bolt with Split Pin Hole on Shank
2	Big Washer
3	Cushion, Radiator Tie Rod
4	Right Tie Rod, Radiator (symmetrical with the left part)
5	Hex Thin Slotted Nut
6	Cotter Pin
7	Hex Head Bolt
8	Spring Washer
9	Flat Washer

10	Cotter Pin
11	Hex Slotted Nut, Style 1 – Fine Pitch Thread
12	Upper Cushion, Radiator
13	Sleeve
14	Cushion, Radiator
15	Hex Bolt with Split Pin Hole on Shank
16	Left Tie Rod, Radiator
17	Radiator with Cowl Assembly

14B

14B-8

Cooling (WP12) – Cooling System

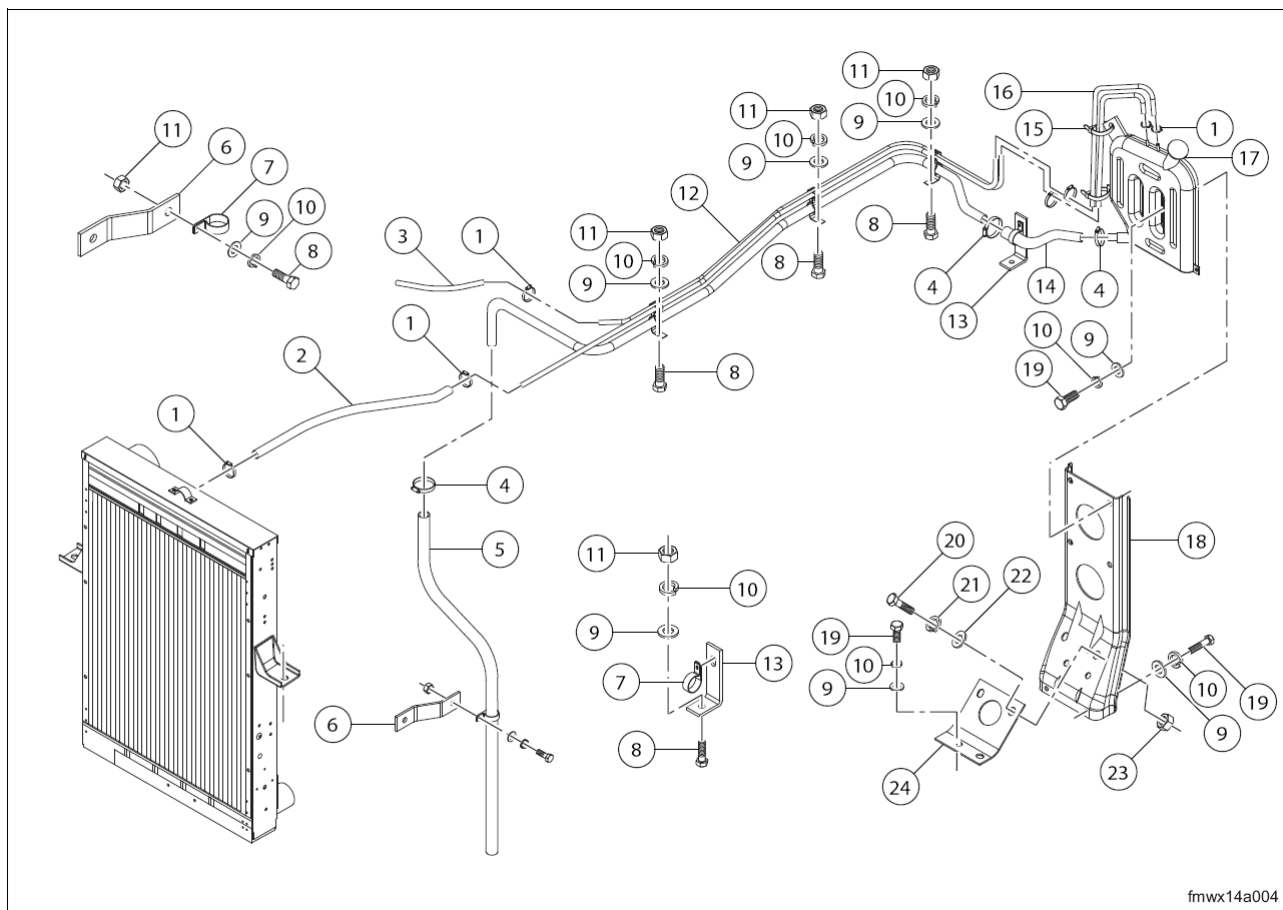


fmwx14a003

14B

1	Worm Drive Type Hose Hoop, Type A
2	Plastic Strap
3	Water Inlet Hose, Radiator
4	Water Outlet Hose, Radiator
5	Worm Drive Type Hose Hoop, Type A
6	Engine Water Inlet Pipe Welding Assembly
7	Clamp
8	Fixing Bracket, Water Pipe
9	Hex Head Bolt
10	Limiting Sleeve, Water Pipe

11	Flat Washer
12	Spring Washer
13	Hex Nut, Style 1
14	Bracket, Water Pipe Welding Assembly
15	Hex Head Bolt
16	Spring Washer
17	Flat Washer
18	Cushion block
19	Water Inlet Hose, Engine

Cooling (WP12) – Cooling System

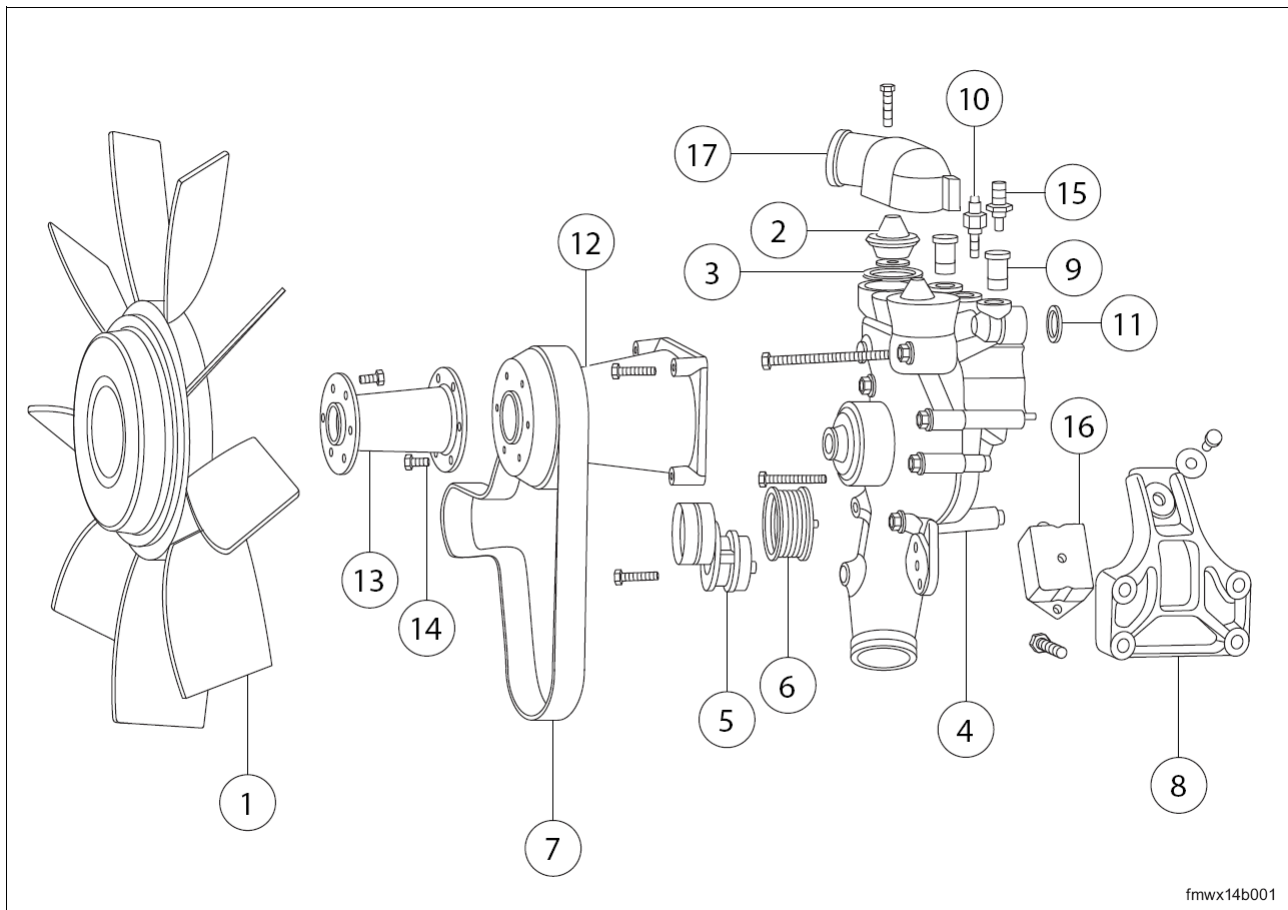
1	Worm Drive Type Hose Hoop, Type A
2	Exhaust Hose, Radiator
3	Exhaust Hose, Engine
4	Worm Drive Type Hose Hoop, Type A
5	Water Outlet Pipe, Auxiliary Water Tank
6	Bracket, Engine Water Make-up Pipe
7	Single Pipe Clamp
8	Hex Head Bolt
9	Flat Washer
10	Spring Washer
11	Hex Nut, Style 1
12	Combined Cooling Water Pipe

13	Bracket, Cooling Water Hose
14	Water Outlet Pipe, Auxiliary Water Tank
15	Plastic Strap
16	Exhaust Hose
17	Plastic Auxiliary Water Tank
18	Bracket, Auxiliary Water Tank
19	Hex Head Bolt
20	Hex Head Bolt
21	Spring Washer
22	Flat Washer
23	Hex Nut, Style 1
24	Support Plate, Auxiliary Water Tank

14B

14B-10

Cooling (WP12) – Cooling System



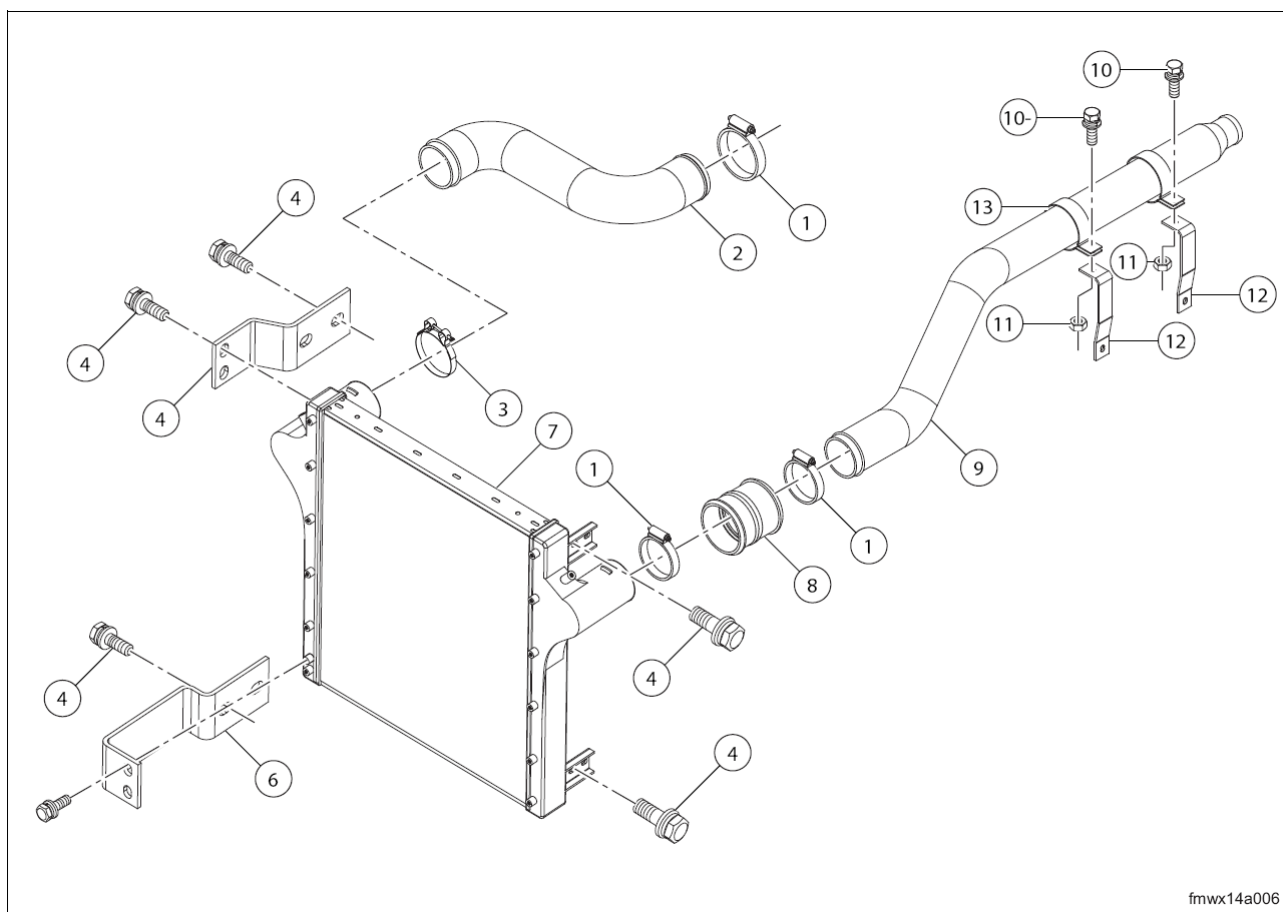
fmwx14b001

14B

1	Silicon Oil Clutch Fan
2	Thermostat
3	Sealing Ring
4	Water Pump
5	Tension Pulley
6	Idle Pulley (10-groove)
7	Belt (10-groove)
8	Engine Bracket
9	Water Pipe Joint

10	Water Temperature Sensor
11	Sealing Ring
12	Fan Bracket
13	Fan Driving Shaft
14	Hex Head Bolt
15	Water Temperature Gauge Sensor
16	Engine Front Support
17	Thermostat Cap

Cooling (WP12) – Cooling System



fmwx14a006

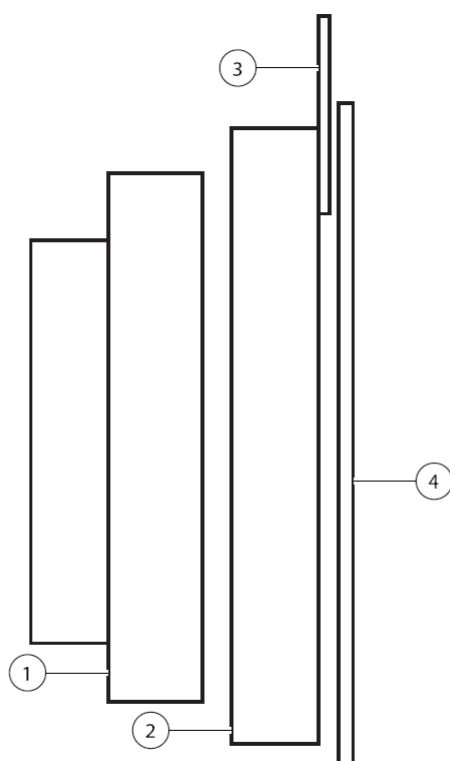
1	Clamp
2	Exhaust Pipe, Intercooler
3	T-clamp
4	Hex Head Bolt, Spring Washer and Flat Washer Assembly
5	Fixing Bracket, Intercooler
6	Fixing Bracket, Intercooler
7	Intercooler assembly

8	Connecting hose
9	Intake Pipe, Intercooler
10	Hex Head Bolt, Spring Washer and Flat Washer Assembly
11	Hex Flange Nut
12	Bracket, Intercooler Pipe
13	Clamp, Intercooler Pipe

Testing & Adjustment

Fan

Manual test method: Start the engine, run it for several minutes and then shut down; pull the fan by hand. If the clutch is released and the fan can rotate, it shows that the silicon oil fan is good. There are, however, exceptions that the fan can not rotate at low temperature because silicon oil can not return at once, which does not always show that the silicon fan is damaged. Start the engine to continue the test, run it at middle speed and low temperature for 1~2 minutes and then shut down; pull the fan by hand. If the fan can rotate and operate flexibly, it shows that the silicon fan is good. When the temperature rises to 88 °C, shut the engine down, and pull the fan by hand. If the fan does not move, it shows that the silicon fan is normal; if not, it shows that the silicon fan is defective.



fmwx14a007

1	Fan	3	Thermometer
2	Radiator	4	Baffle Plate

Dynamic test: Place the thermometer with a range of -18~105 °C ahead of the radiator. Put a fixed plastic plate ahead of the radiator to prevent air from passing through the radiator, and ensure that it can prevent air passage. If an air conditioner is equipped, the A/C switch must be turned off. Use a timing lamp to point to the fan blades, start the engine and run it at a speed of 2400r/min. The air temperature showed by dial thermometer shall reach 88 °C within 10 minutes. The ideal engagement of the fan clutch shall be before 88 °C. Observe the increase in the fan's speed. When the air temperature rises to 88 °C, take away the plastic plate, and the air temperature starts to fall. The ideal silicon oil fan clutch can lower the air temperature by 11 °C or more, and at the same time, you can hear that the air flow sound of the

Cooling (WP12) – Cooling System

fan reduces. If the fan clutch fails to meet the above requirement, replace the silicon oil fan clutch assembly.

Water Pump

In case that the cooling system leaks, you can smell hot antifreeze. But you have to do inspection, and find out whether the cooling water is leaked from the shaft seal of the water pump. You can use a small mirror and a lamp to inspect whether the air bleed hole of the water pump leaks water.

Conduct the regular maintenance, and pay attention to inspecting the consumption of coolant in the water tank.

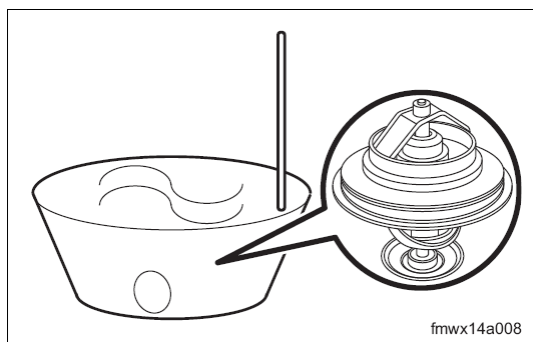
Do not underestimate the problem of leakage in the cooling system, which will cause air sucked in to destroy the preset coolant flow mode and result in generation of hotspots, and greatly aggravate corrosion to the water pump.

If the amount of coolant is insufficient for a long time, it will cause the engine to overheat, and steam corrosion may occur, which may damage the radiator and cause other problems of the water pump.

When the color of coolant is rusty, it may be the problem of impeller corrosion. At the moment, it is necessary to inspect the circulation condition of the water pump coolant. Discharge part of the coolant in the radiator and keep the lever right above the pipe, and warm up the engine to let the thermostat stay in full opening position. When the engine's speed is 3,000r/min, you shall see a good water circulation.

Thermostat

The safe life of the wax thermostat is generally for a range of 50,000km, and the wax thermostat shall be replaced regularly according to its safe life.



1. **Inspect the thermostat**
 - (a). **The thermostat and thermometer can be put in hot water.**
 - (b). **Inspect the opening temperature of the main valve of the thermostat.**
 - (c). **Inspect the sealing ring of the thermostat.**
 - (d). **Replace the thermostat if either of the items fails to meet the specified value.**

14B

Opening Temperature	Full-opening Temperature
$80 \pm 2\text{ }^{\circ}\text{C}$	$95\text{ }^{\circ}\text{C}$

Water Pipe

Inspect whether the clogging, bulging, aging or cracking of water pipes occurs, and whether the connection of water pipe joints is secure.

Auxiliary Water Tank

Inspect whether there are cracks on the auxiliary water tank, whether the bulging, aging or cracking of the auxiliary water tank occurs, and whether the auxiliary water tank cap is in perfect condition.

Coolant

When the engine idles and warms up to the normal operating temperature, the level of coolant in the bottle shall be between the lowest graduation line and highest graduation line, as shown on the bottle.

Test the concentration of coolant by a freezing point tester.

Radiator

Cooling (WP12) – Cooling System

Fill water into the radiator, and observe whether water flow is smooth. If not smooth, it shows that the radiator inside is clogged. Rinse the radiator outside, and wash the radiator inside with hot water. If the scale deposit can not be eliminated still after the radiator is washed, use a soft metal cleaning rod to remove the scale deposit, and then wash with the above method. Remove the radiating fin of the damaged radiating pipe by needle nose pliers, then cut off the damaged radiating pipe, insert the cleaning rod from the end of the core, pass it through the upper orifice and lower orifice of the cut part and straighten, cut the same usable radiating pipe from a waste radiator, and solder the upper and lower joints. Insert the resistance heater into the radiating pipe to be replaced, and supply 24V power. After resistance wires are hot, the radiating pipe releases as its soldering tin melts. Cut off the power, take out the radiating pipe and resistance heater together, and change with the new radiating pipe and solder securely. Install the radiator tester on the radiator cap opening, and inspect the cooling system for leakage. Pressurize the radiator to 176kPa, inspect the leakage of coolant at normal operating temperature, and repair if any.

Intercooler

This vehicle is of a turbocharged intercooled type. The intercooler is installed on the front of the diesel engine, i.e. the front end of the water tank, and it sucks the air from the fan and the headwind of the vehicle during driving for cooling. Foreign matters such as oil sludge and colloid, which are usually attached to the internal pipe of the intercooler, not only narrow the air channel to reduce the heat exchange capacity, but also lower air intake because dirt clogs the air channel, which cause the problems that the diesel engine's power falls, the exhaust gas is white, and even the vehicle can not run normally.

Fill water into the intercooler, and observe whether water flow is smooth. If not smooth, it shows that the intercooler is clogged. Wash the intercooler with hot water. If the scale deposit can not be eliminated after washing, replace the intercooler.

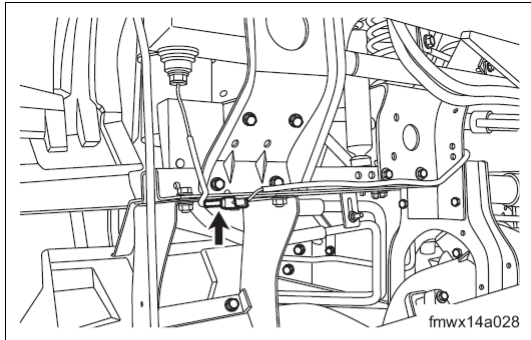
14B

Auxiliary Water Tank

Overhaul

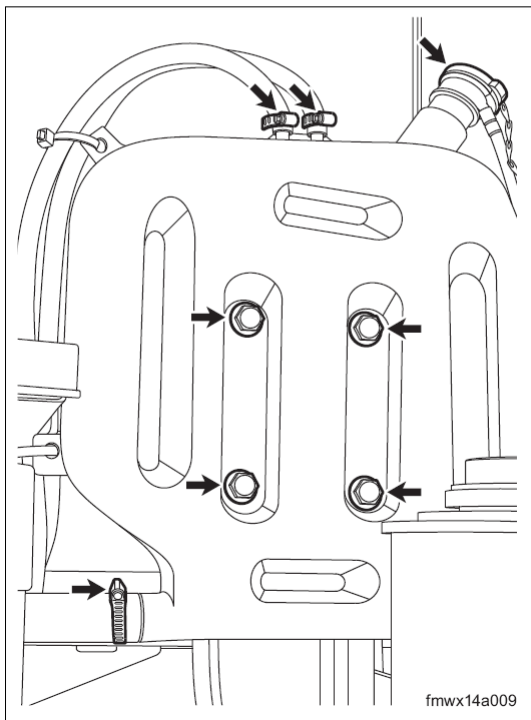
Hint:

Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing



1. Dismantle the auxiliary water tank

- (a). Disconnect the wiring harness of the auxiliary water tank.



- (b). Open the auxiliary water tank cap.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

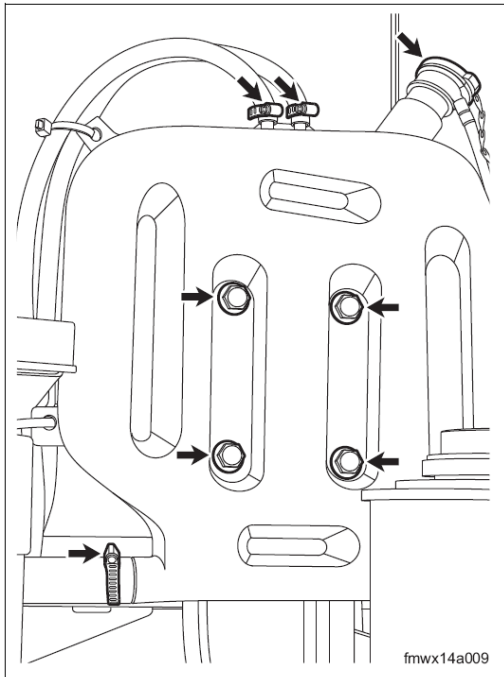
- (c). Disconnect the pipe of the auxiliary water tank.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

- (d). Dismantle the fixing bolts of the auxiliary water tank.

2. Inspect the auxiliary water tank. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.

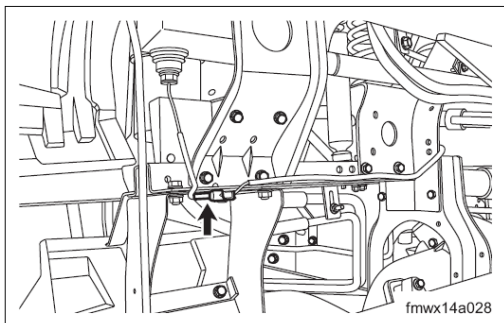


3. Install the auxiliary water tank

- (a). Install the fixing bolts of the auxiliary water tank.

Torque: 20N.m

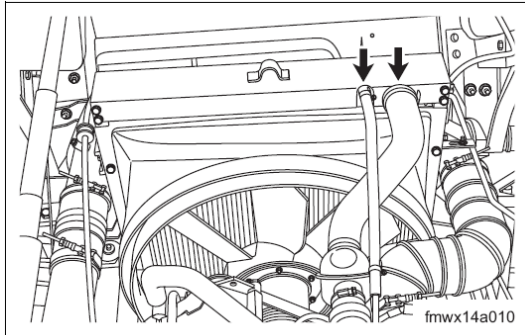
- (b). Connect the pipe of the auxiliary water tank.
(c). Fill coolant.
(d). Close the auxiliary water tank cap.



- (e). Disconnect the wiring harness of the auxiliary water tank.

Coolant

Replacement



1. Drain coolant

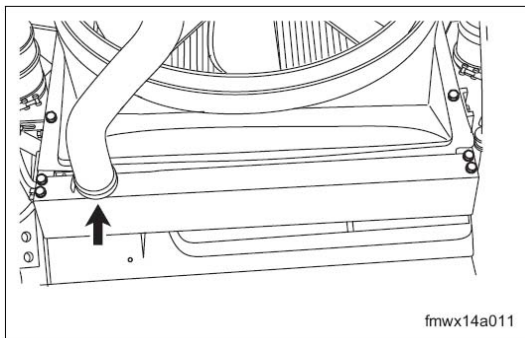
- (a). Disconnect the water inlet hose and exhaust pipe of the radiator.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.



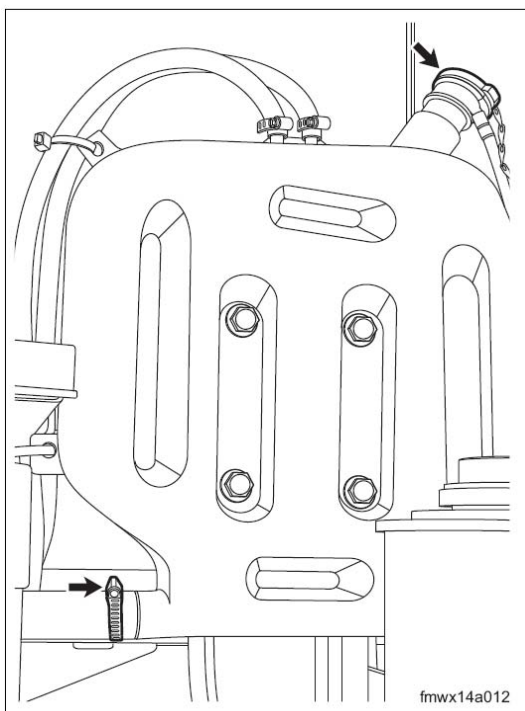
- (b). Disconnect the water outlet hose of the radiator.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

Caution:

Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.



- (c). Unscrew the auxiliary water tank cap.

- (d). Disconnect the water pipe of the auxiliary water tank.

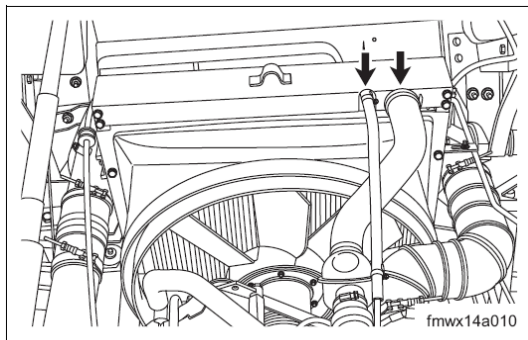
Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

Caution:

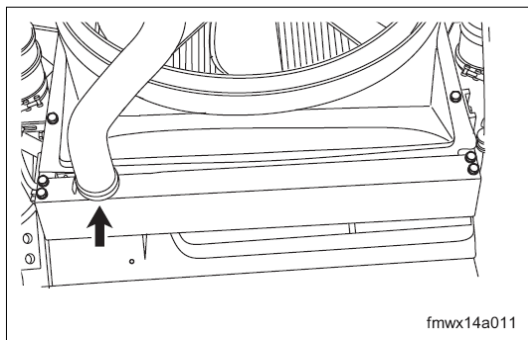
Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.

Cooling (WP12) – Coolant

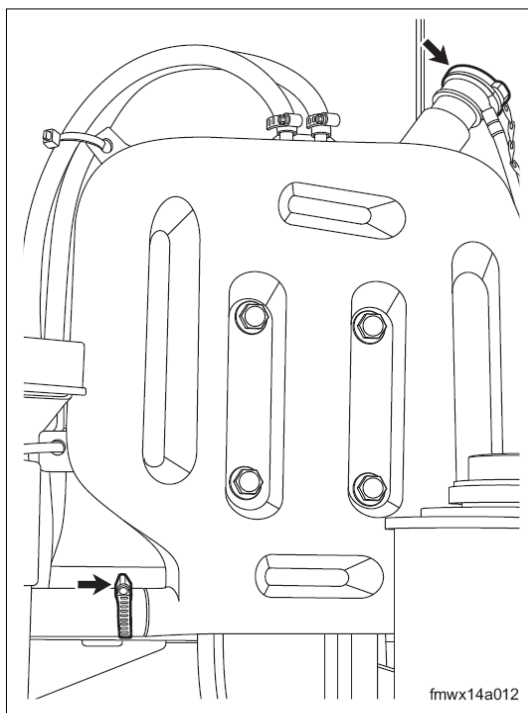


2. Fill coolant

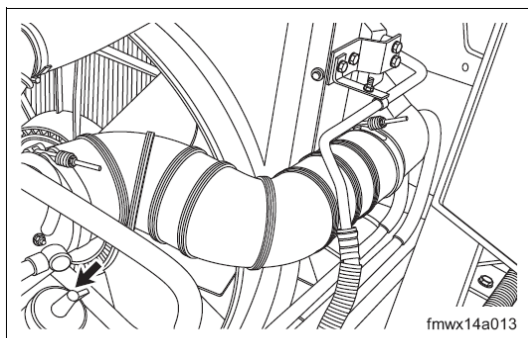
- (a). Connect the water inlet hose and exhaust pipe of the radiator.



- (b). Connect the water outlet hose of the radiator.



- (c). Connect the water pipe of the auxiliary water tank.
(d). Fill coolant.
(e). Tighten the auxiliary water tank cap.



- (f). Fill coolant from the engine water filler.

Caution:

Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.

Caution:

The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.

Cooling (WP12) – Coolant

3. Inspect the coolant level

- (a). Run the engine, and inspect the engine coolant level.
- (b). If the level is too low, continue to fill coolant.

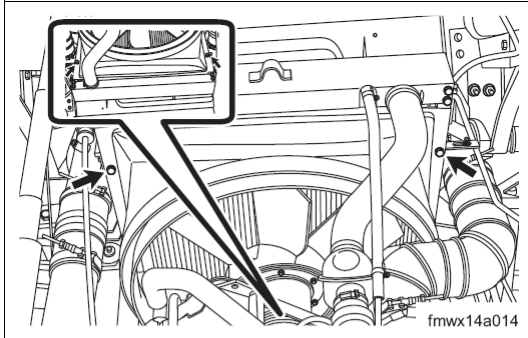
Radiator

Overhaul

Hint:

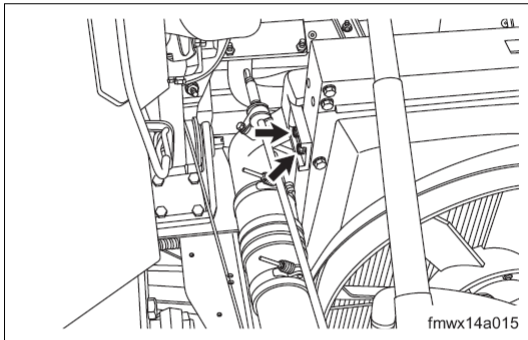
Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.

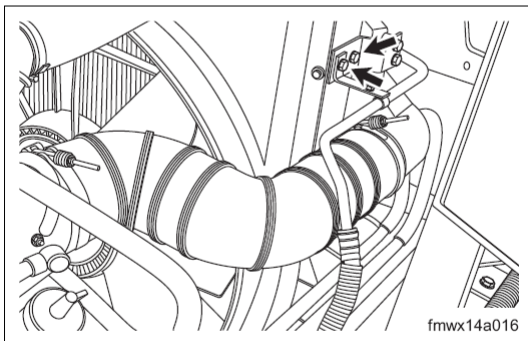


2. Dismantle the radiator

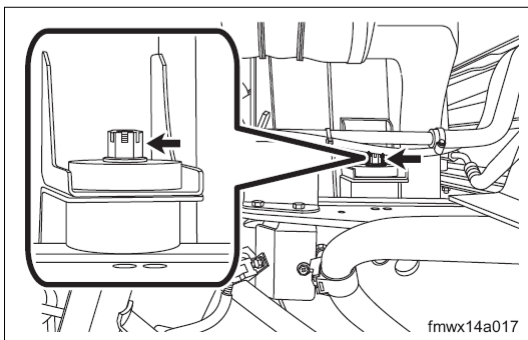
(a). Loosen the shroud.



(b). Loosen the intercooler.



(c). Dismantle the fixing bracket of the A/C pipe.

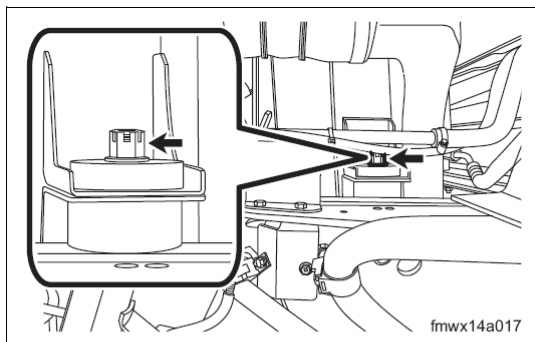


(d). Dismantle the radiator.

- Dismantle the cotter pin.
- Dismantle the slotted nuts of the radiator.
- Take out the radiator upward.

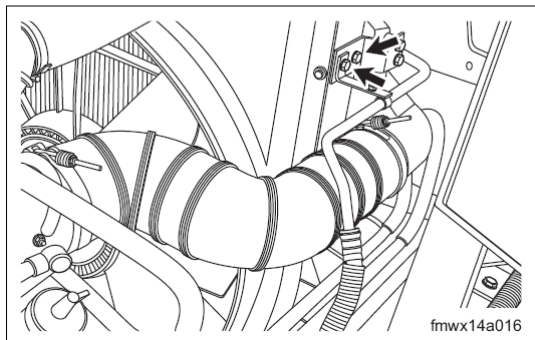
3. Inspect the radiator. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.

Cooling (WP12) – Radiator

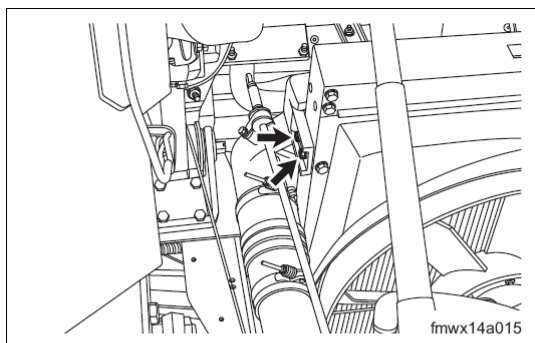


4. Install the radiator

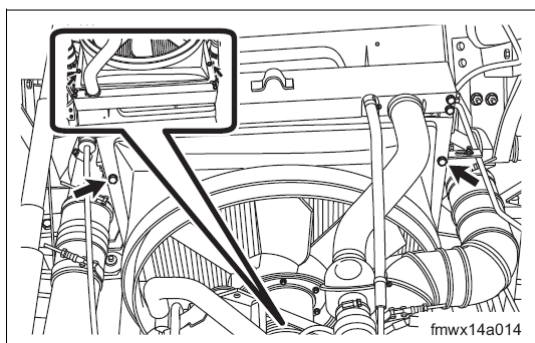
- (a). Install the radiator.
- Put radiator downward.
 - Install the slotted nuts of the radiator.
Torque: 70N.m
 - Install the cotter pin.



- (b). Install the fixing bracket of the A/C pipe.



- (c). Tighten the intercooler.
Torque: 20N.m



- (d). Tighten the shroud.
Torque: 20N.m

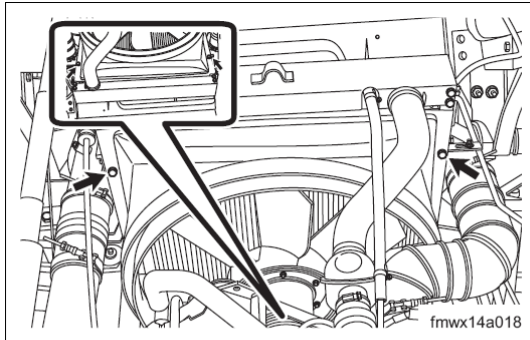
5. Fill coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.

Cooling Fan

Overhaul

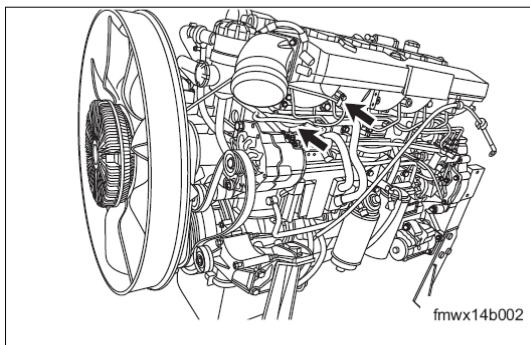
Hint:

Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing



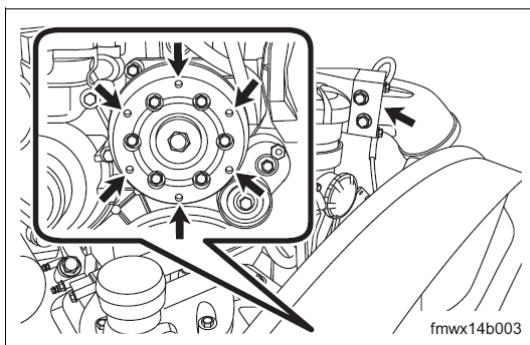
1. Dismantle the cooling fan

(a). Loosen the shroud.



(b). Disconnect the silicon oil temperature sensor of the cooling fan.

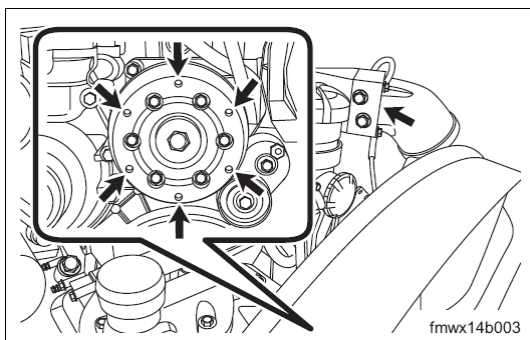
(c). Dismantle the fixing clamp of the cooling fan silicon oil temperature sensor.



(d). Dismantle the fixing clamp of the cooling fan silicon oil temperature sensor.

(e). Dismantle the cooling fan.

2. Inspect the cooling fan. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.



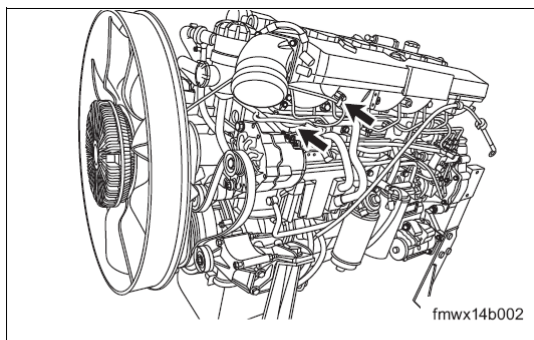
3. Install the cooling fan

(a). Install the cooling fan.

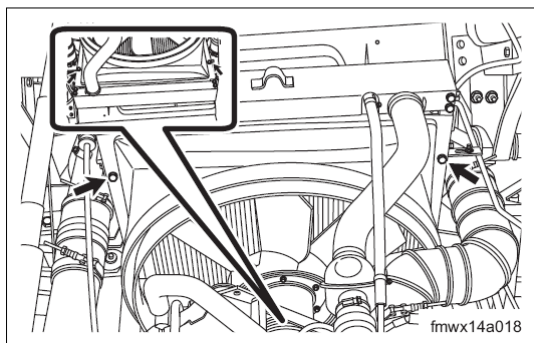
Torque: 20N.m

(b). Install the fixing clamp of the cooling fan silicon oil temperature sensor.

Cooling (WP12) – Cooling Fan



- (c). Install the fixing clamp of the cooling fan silicon oil temperature sensor.
- (d). Connect the silicon oil temperature sensor of the cooling fan.



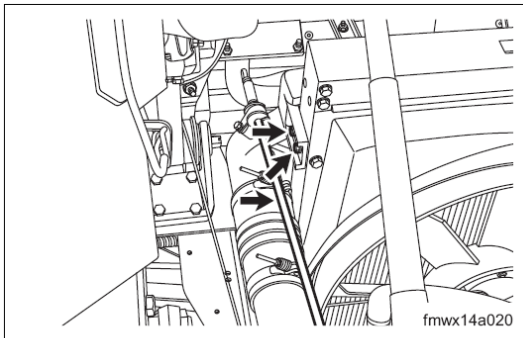
- (e). Tighten the shroud.
Torque: 20N.m

Intercooler

Overhaul

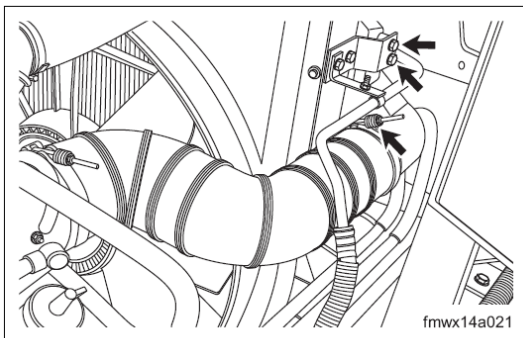
Hint:

Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing

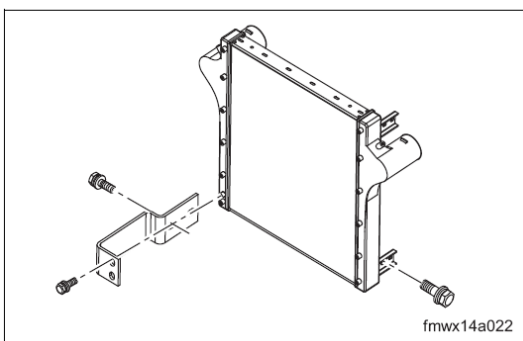


1. Dismantle the intercooler

- (a). Dismantle the intake pipe of the intercooler.
- (b). Dismantle the fixing bolts of the intercooler.

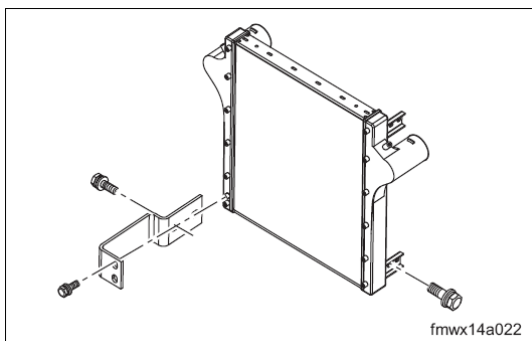


- (c). Dismantle the exhaust pipe of the intercooler.
- (d). Dismantle the fixing bracket of the intercooler.



- (e). Dismantle the fixing bolts of the intercooler.
- (f). Dismantle the fixing bolts of the intercooler.

2. Inspect the intercooler. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.

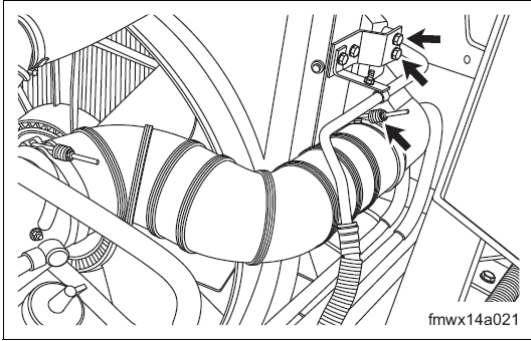


3. Install the intercooler

- (a). Install the fixing bolts of the intercooler.
- (b). Install the fixing bolts of the intercooler.

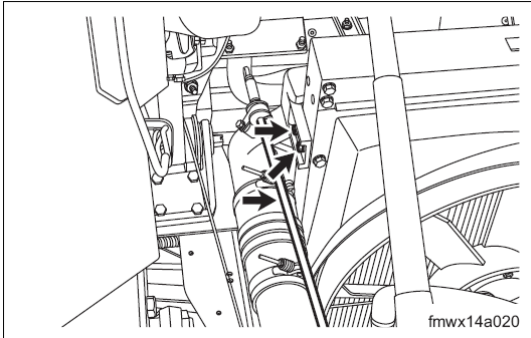
Torque: 23±2N.m

Cooling (WP12) – Intercooler



- (c). Install the exhaust pipe of the intercooler.
- (d). Install the fixing bracket of the intercooler.

Torque: $23\pm 2\text{N.m}$



- (e). Install the intake pipe of the intercooler.
- (f). Install the fixing bolts of the intercooler.

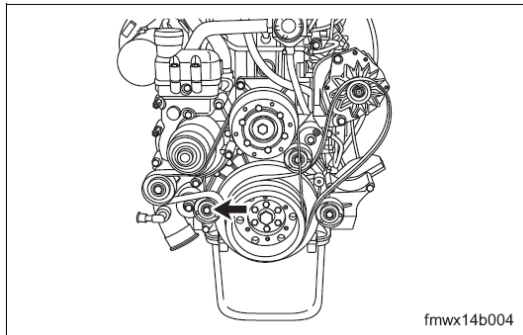
Water Pump

Overhaul

Hint:

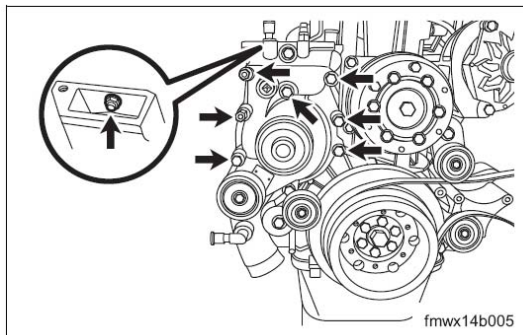
Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.



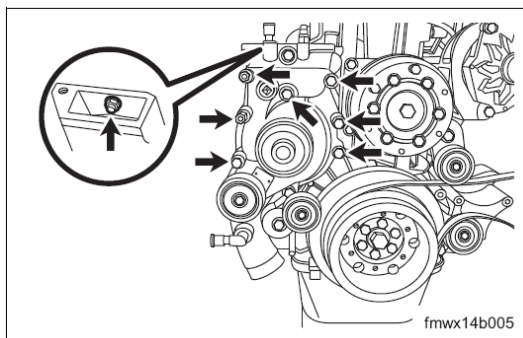
2. Dismantle the belt

3. Dismantle the thermostat. Refer to Chapter 14B Cooling – Thermostat, Overhaul.



4. Dismantle the water pump

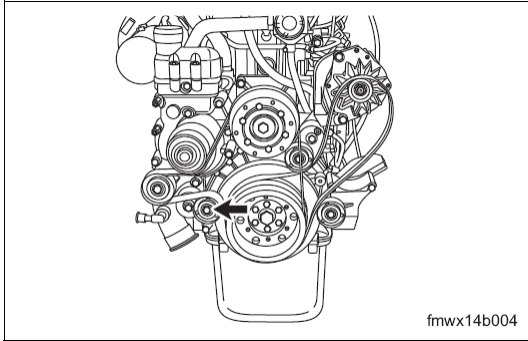
5. Inspect the water pump. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.



6. Install the water pump
Torque: 63N.m

7. Install the thermostat. Refer to Chapter 14B Cooling – Thermostat, Overhaul.

Cooling (WP12) – Water Pump



8. Install the belt

9. Fill coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.

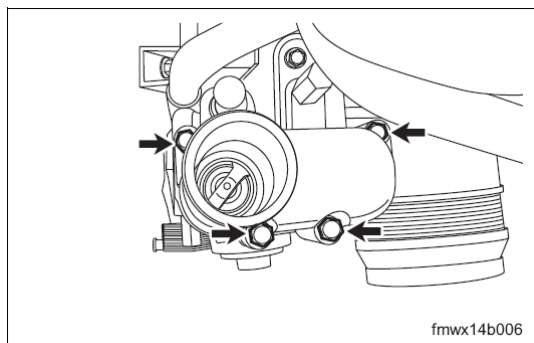
Thermostat

Overhaul

Hint:

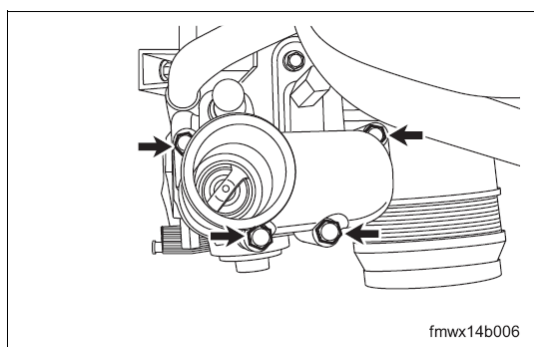
Part Drawing, refer to Chapter 14B Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.



2. Dismantle the thermostat

3. Inspect the thermostat. Refer to Chapter 14B Cooling – Cooling System, Testing & Adjustment.



4. Install the thermostat

5. Fill coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.

Cooling (WD615)

Cooling System	14C-3
General	14C-3
Precautions	14C-6
Part Drawing	14C-7
Testing & Adjustment	14C-12
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Overhaul.....	14C-15
Coolant.....	14C-17
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Radiator.....	14C-20
Overhaul.....	14C-20
Cooling Fan	14C-22
Overhaul.....	14C-23
Intercooler.....	14C-23
Overhaul.....	14C-25
Water Pump	14C-25
Overhaul.....	14C-25
Thermostat.....	14C-27
Overhaul.....	14C-27

14C

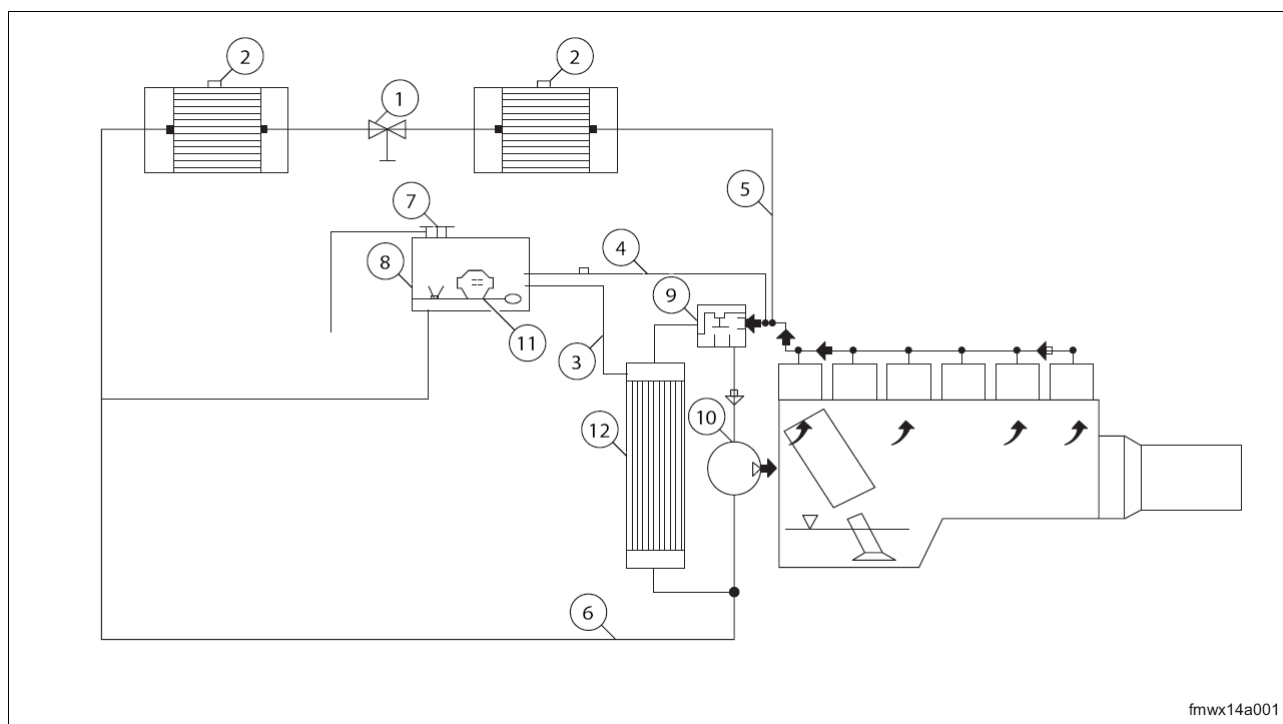
Cooling System

General

The function of the diesel engine's cooling system is to transfer outside the heat absorbed by the heated parts of the diesel engine through cooling medium – coolant, and ensure that the heated parts operate normally under allowable temperature condition. The cooling for the diesel engine shall be appropriate, not excessive. Excessive cooling will bring about the following adverse effects for the diesel engine's operation: 1. the temperature of the cylinder is too low, the ignition delay period of fuel extends, the combustion rate lowers, and heat loss due to radiation rises; 2. the diesel engine runs roughly, and its fuel consumption increases; 3. the viscosity of lubricating oil increases, which results in increase in moving parts' friction power loss, and in decrease in the diesel engine's power. Therefore, only appropriate cooling can ensure that the diesel engine operates normally and has good economy.

Do not use common water as coolant, because the thermal conductivity of the scale deposit generated by heating water is 40 times lower than that of cast iron. The scale deposit on the water jacket will lower the performance of the engine cooling system. After the scale deposit blocks the orifice on the cylinder gasket in particular, it will disturb smooth water flow and bring about various faults and damages.

The engine cooling system consists of a water pump, a radiator, a fan, a thermostat, an auxiliary water tank, cooling pipes, the water channel of the cylinder body, and the cooling water chamber of the crankcase.



fmwx14a001

1	Switch
2	Heater
3	Exhaust Pipe, Water Tank
4	Water Inlet Pipe, Auxiliary Water Tank
5	Water Inlet Pipe, Heater
6	Water Pipe

7	Pressure Limiting Valve Cover
8	Auxiliary Water Tank
9	Thermostat
10	Water Pump
11	Water Filler Cap
12	Water Tank

Water Pump

The water pump is a power unit in the forced-circulation type water cooling system. Its main function is to generate a certain pressure for coolant and force the coolant into various cooled parts of the diesel engine, in order to ensure the continuous circulation of coolant in the process of the engine's operation. For the WD615 Series diesel engine, the water pump is installed at its front end. The water coming out from the water pump goes into the right water chamber of the engine body; cooling water goes across the oil cooler, flows into the water jacket of the cylinder barrel through the right lower channel hole of the engine body, goes into the water chamber of the cylinder head through the upper water hole after cooling the cylinder barrel, and drains into the water outlet pipe from the water outlet of the cylinder head after cooling the cylinder head; the thermostat is installed at the end of the water outlet pipe. The thermostat has two outlets, one leading to the radiator and the other leading to the water pump inlet, which is small circulation. When the temperature of coolant is at $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat starts to open and fully opens at $95\text{ }^{\circ}\text{C}$, and at the moment, coolant is pumped into the engine body by water pump after being cooled by the radiator. When the temperature of coolant is lower than $80\pm 2\text{ }^{\circ}\text{C}$, the thermostat cuts off the above channel, and coolant directly flows into the water pump inlet, which can help the diesel engine's temperature rise as soon as possible and help the diesel engine reach hot state required for operation, avoid cold scuffing, and prolong the service life of the diesel engine.

The oil chamber of the water pump is filled with 120cm^3 of general purpose lithium base grease from automobile, which needs regular filling or makeup.

Radiator

The function of the radiator is to transfer the heat absorbed by coolant from the heated parts into air and then emit the heat into the atmosphere so as to lower the temperature of coolant.

Fan

The silicon oil fan clutch, adopting silicon oil as medium, transfers torque by using the high viscosity of silicon oil. The release and engagement of the fan clutch can be automatically control by the temperature sensor which detects the temperature of air behind the radiator. When the temperature is low, silicon oil does not flow, the fan clutch releases, and the fan's speed descends and basically idles. When the temperature is high, the viscosity of silicon oil engages the fan clutch, and then the fan rotates together with the water pump shaft, which plays a role in adjusting the engine's temperature.

The temperature sensing element of the silicon oil fan clutch is a bimetallic coil spring temperature sensor. Its working process is as follows:

1. When the temperature or air passing through the radiator rises, the bimetallic temperature sensor deforms as a result of heating to force the valve disc shaft to rotate and open the oil inlet on the driven plate. The silicon oil stored between the driven plate and front cover flows into the working chamber between the driving plate and driven plate, the clutch engages, and the fan's speed increases.

The higher the air temperature, the larger the oil inlet opens, and the faster the fan rotates.

2. When the temperature of air passing through the radiator falls, the bimetallic temperature sensor recovers to its original shape, the valve disc closes the oil inlet, the silicon oil returns to the oil storage chamber from the working chamber through the oil inlet under the action of centrifugal force, the clutch releases, and the fan's speed gets very low.

Thermostat

The function of the thermostat is to keep the coolant's temperature appropriate, which ensures reliable cooling for the diesel engine, and avoids lowering the power and economy of the diesel engine in use due to too low water temperature. When the temperature of coolant is low, the big circulation valve of the thermostat closes, the small circulation valve opens, the coolant in the water return pipe of the diesel engine is directly supplied to the water pump inlet through the small circulation valve, the water pump

Cooling (WD615) – Cooling System

pumps coolant into the cooling system of the diesel engine again, and the radiation water tank does not work. When the water temperature of the diesel engine rises to a certain value, the big circulation valve of the thermostat opens while the small circulation valve closes, and the coolant flows into the radiation water tank through the big circulation valve and the water return pipe of the water tank, is sucked into the water pump from the radiation water tank after being cooled, and then is pumped into the cooling circulation system of the diesel engine.

This vehicle adopts a wax and core combined thermostat. When the temperature of coolant is lower than the specified value, the refined wax in the temperature sensing element of the thermostat is solid, the thermostat valve closes the channel between the engine and radiator under the spring action, and the coolant returns to the engine through the water pump and flows within the small circulation. When the temperature of coolant rises to the specified value, the wax starts to melt and gradually changes into liquid, and it presses the rubber hose with its volume increasing and forces the hose to shrink. The rubber hose applies an upward thrust to the push rod while shrinking, and the push rod exerts a downward reverse thrust on the valve to open the valve. At the moment, the coolant passes through the radiator, thermostat valve and water pump, then returns to the engine, and flows within the big circulation. This is the principle of operation of the thermostat. Mostly, the thermostat is arranged in the water outlet pipe of the cylinder head, which has the advantages that the structure is simple and bubbles in the cooling system is easy to eliminate, but has the disadvantages that vibration is usually generated along with the frequent opening and closing of the thermostat.

Auxiliary Water Tank

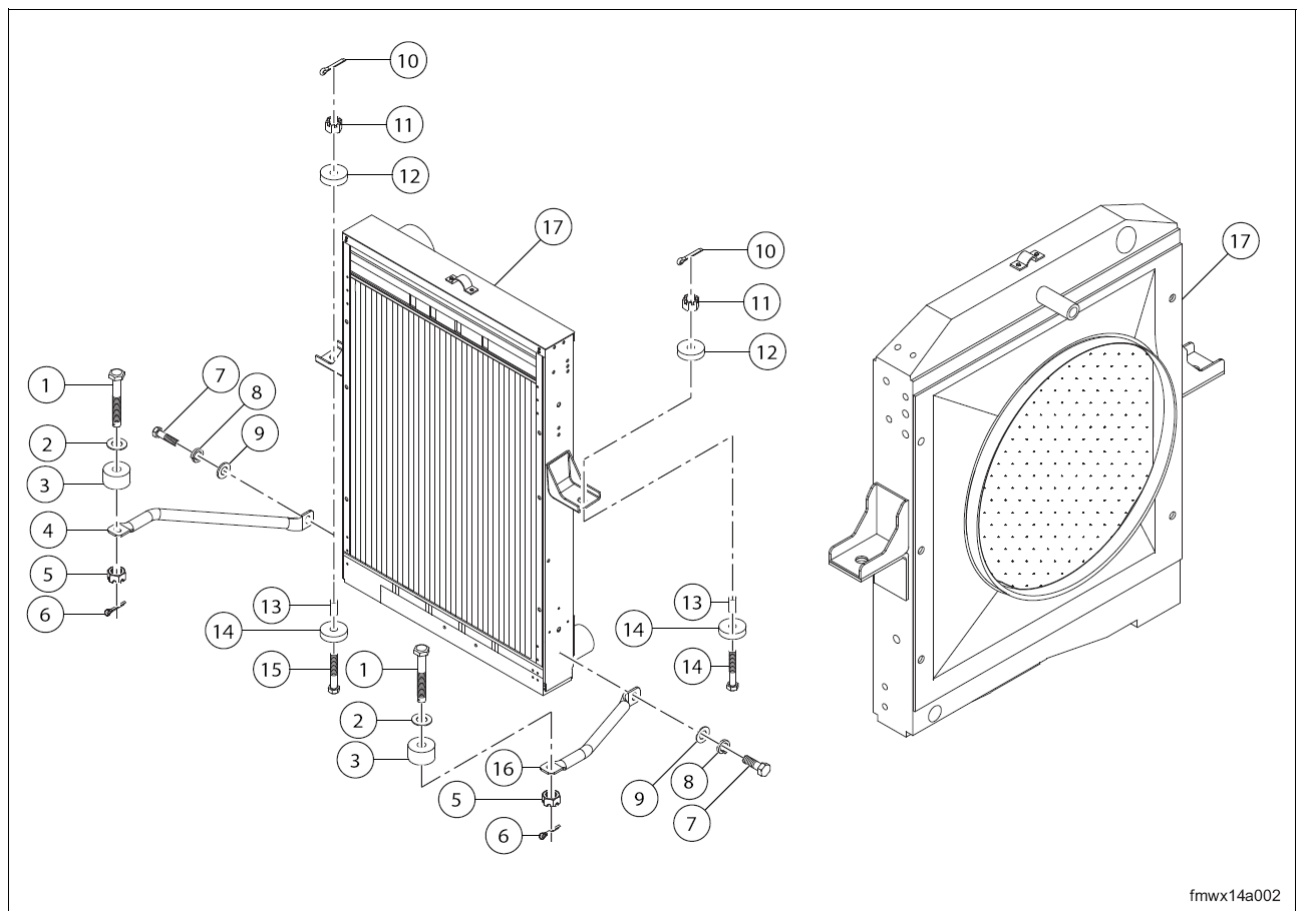
The function of the auxiliary water tank is to eliminate vapor in the low pressure part of the cooling system, which may cause air resistance, and to make up coolant. The pressure of the auxiliary water tank shall be kept at 50kPa, and its position must be 400mm higher than the diesel engine and radiator. Various water tank caps in the cooling system shall be kept good, and it is prohibited to open them. Keeping an internal pressure in the cooling system will enhance the cooling efficiency of the cooling system, and boiling can be avoided.

Precautions

1. Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.
2. When disconnecting the pipeline of the cooling system, collect the residual coolant with a special container. If the coolant is disused, follow the waste disposal as specified.
3. When disconnecting the pipeline of the cooling system, never allow debris to go into the pipeline of the cooling system, which may damage the cooling system and engine.
4. When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.
5. Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.
6. Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.
7. The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.
8. The antifreeze must be replaced regularly, generally once every two years or every 40,000km.
9. Drain the old antifreeze during replacement, clean the cooling system, and then fill new antifreeze.
10. Avoid mixing antifreeze with water. The traditional inorganic antifreeze can not be mixed with water, or sediment will be generated, which will seriously affect the normal function of the antifreeze. The organic antifreeze can be mixed with water, but not too much.
11. When the air temperature is below 0 °C, inspect the concentration of antifreeze regularly.
12. Vehicles, which usually run in the regions above 0 °C, can use water after anti-rust and scale prevention treatment as coolant. They are prohibited to use untreated water as coolant.
13. When using the silicon oil clutch fan, be careful not to place the fan horizontally after dismantling it, or silicon oil will be leaked from the fit clearance of the sensor shaft, which will cause failure of the fan.

Cooling (WD615) – Cooling System

Part Drawing

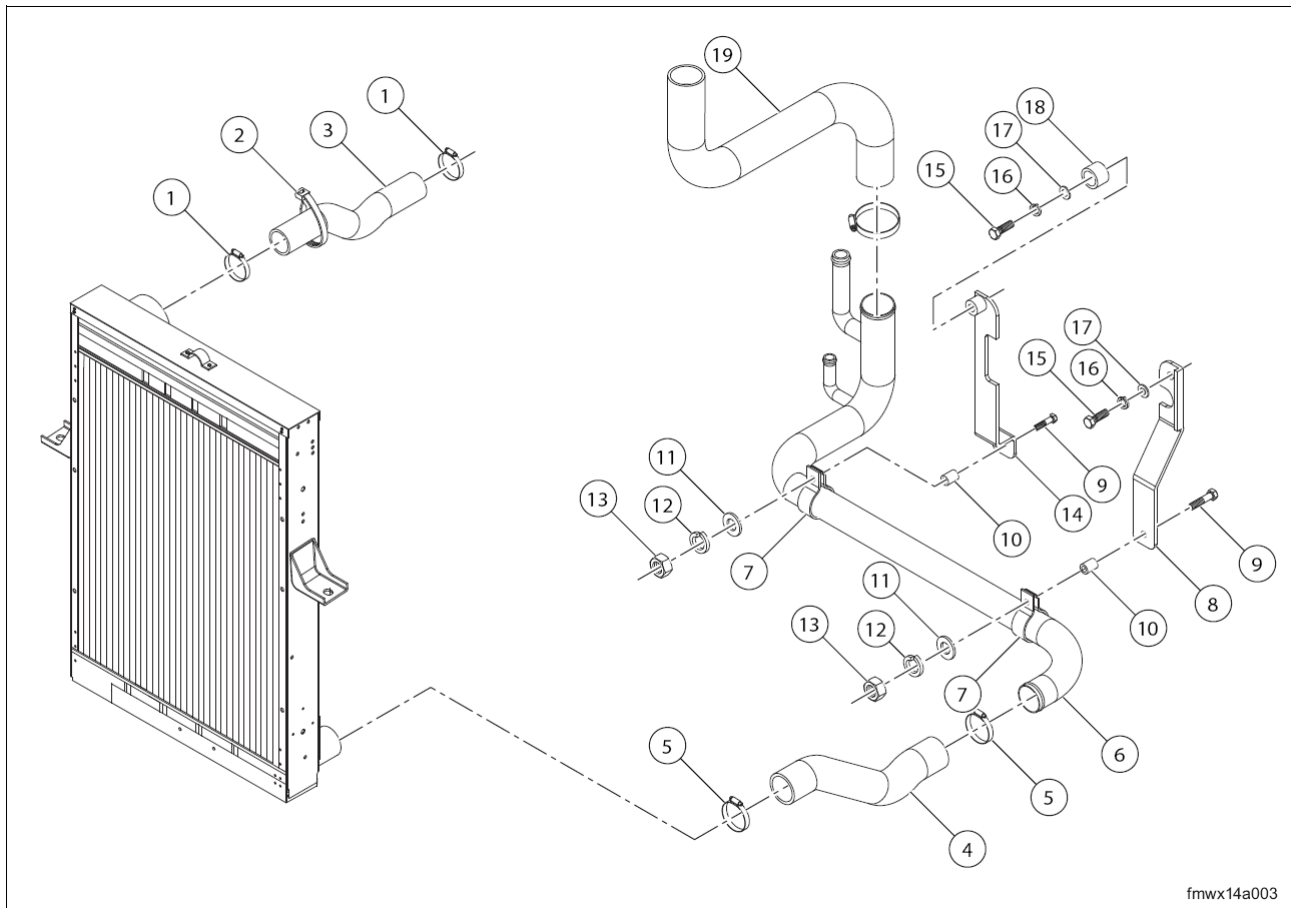


1	Hex Bolt with Split Pin Hole on Shank
2	Big Washer
3	Cushion, Radiator Tie Rod
4	Right Tie Rod, Radiator (symmetrical with the left part)
5	Hex Thin Slotted Nut
6	Cotter Pin
7	Hex Head Bolt
8	Spring Washer
9	Flat Washer

10	Cotter Pin
11	Hex Slotted Nut, Style 1 – Fine Pitch Thread
12	Upper Cushion, Radiator
13	Sleeve
14	Cushion, Radiator
15	Hex Bolt with Split Pin Hole on Shank
16	Left Tie Rod, Radiator
17	Radiator with Cowl Assembly

14C

Cooling (WD615) – Cooling System

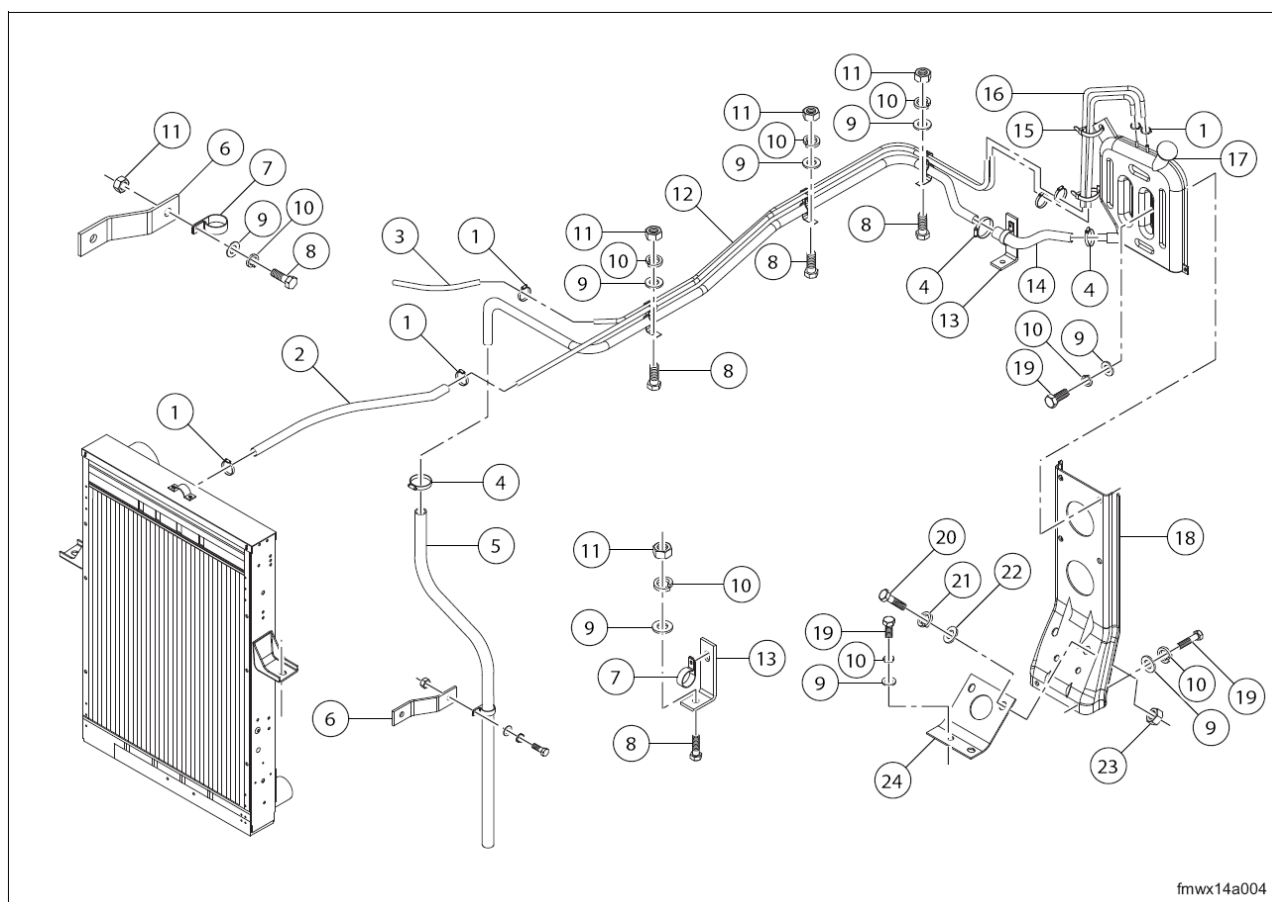


fmwx14a003

1	Worm Drive Type Hose Hoop, Type A
2	Plastic Strap
3	Water Inlet Hose, Radiator
4	Water Outlet Hose, Radiator
5	Worm Drive Type Hose Hoop, Type A
6	Engine Water Inlet Pipe Welding Assembly
7	Clamp
8	Fixing Bracket, Water Pipe
9	Hex Head Bolt
10	Limiting Sleeve, Water Pipe

11	Flat Washer
12	Spring Washer
13	Hex Nut, Style 1
14	Bracket, Water Pipe Welding Assembly
15	Hex Head Bolt
16	Spring Washer
17	Flat Washer
18	Cushion block
19	Water Inlet Hose, Engine

Cooling (WD615) – Cooling System

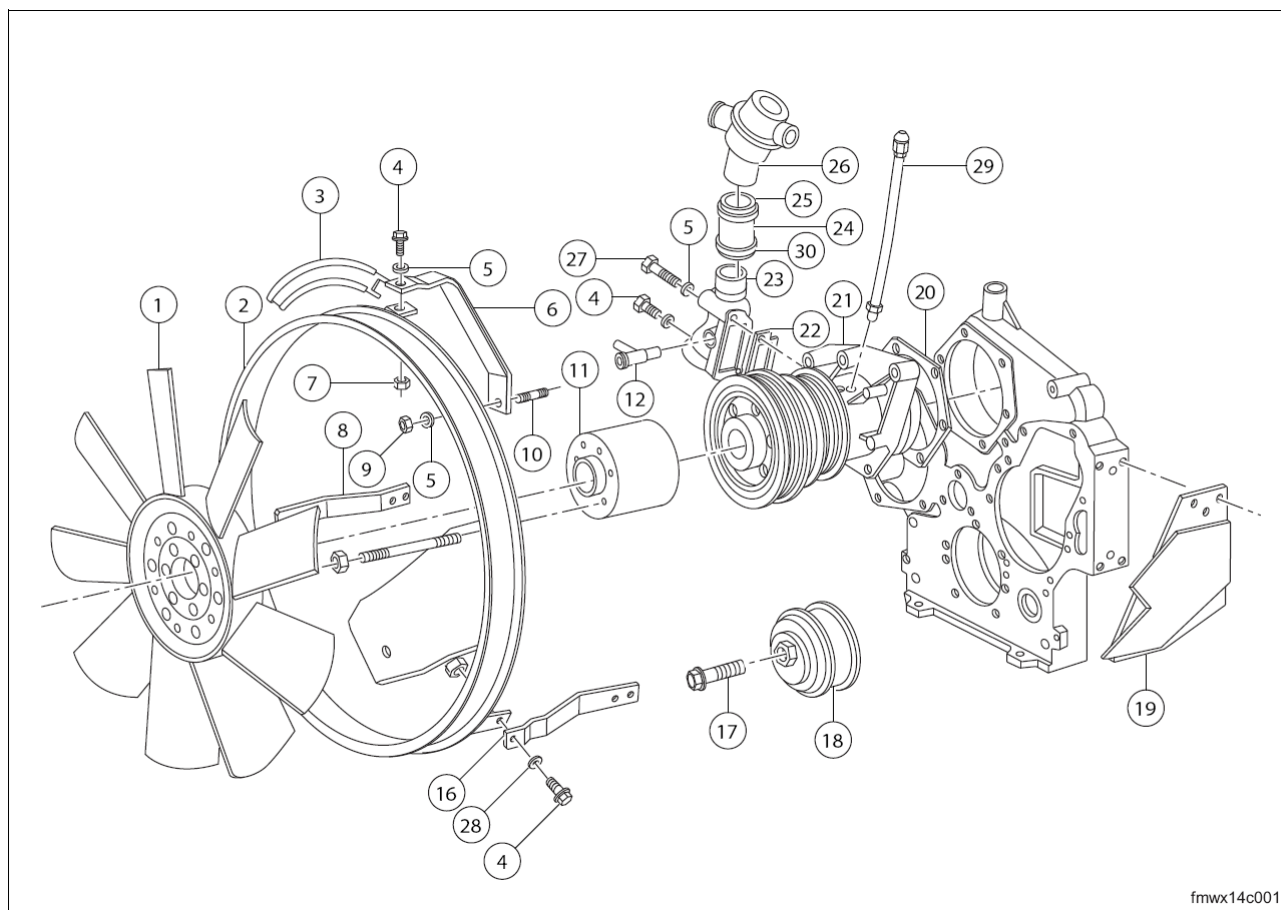


fmwx14a004

1	Worm Drive Type Hose Hoop, Type A
2	Exhaust Hose, Radiator
3	Exhaust Hose, Engine
4	Worm Drive Type Hose Hoop, Type A
5	Water Outlet Pipe, Auxiliary Water Tank
6	Bracket, Engine Water Make-up Pipe
7	Single Pipe Clamp
8	Hex Head Bolt
9	Flat Washer
10	Spring Washer
11	Hex Nut, Style 1
12	Combined Cooling Water Pipe

13	Bracket, Cooling Water Hose
14	Water Outlet Pipe, Auxiliary Water Tank
15	Plastic Strap
16	Exhaust Hose
17	Plastic Auxiliary Water Tank
18	Bracket, Auxiliary Water Tank
19	Hex Head Bolt
20	Hex Head Bolt
21	Spring Washer
22	Flat Washer
23	Hex Nut, Style 1
24	Support Plate, Auxiliary Water Tank

Cooling (WD615) – Cooling System

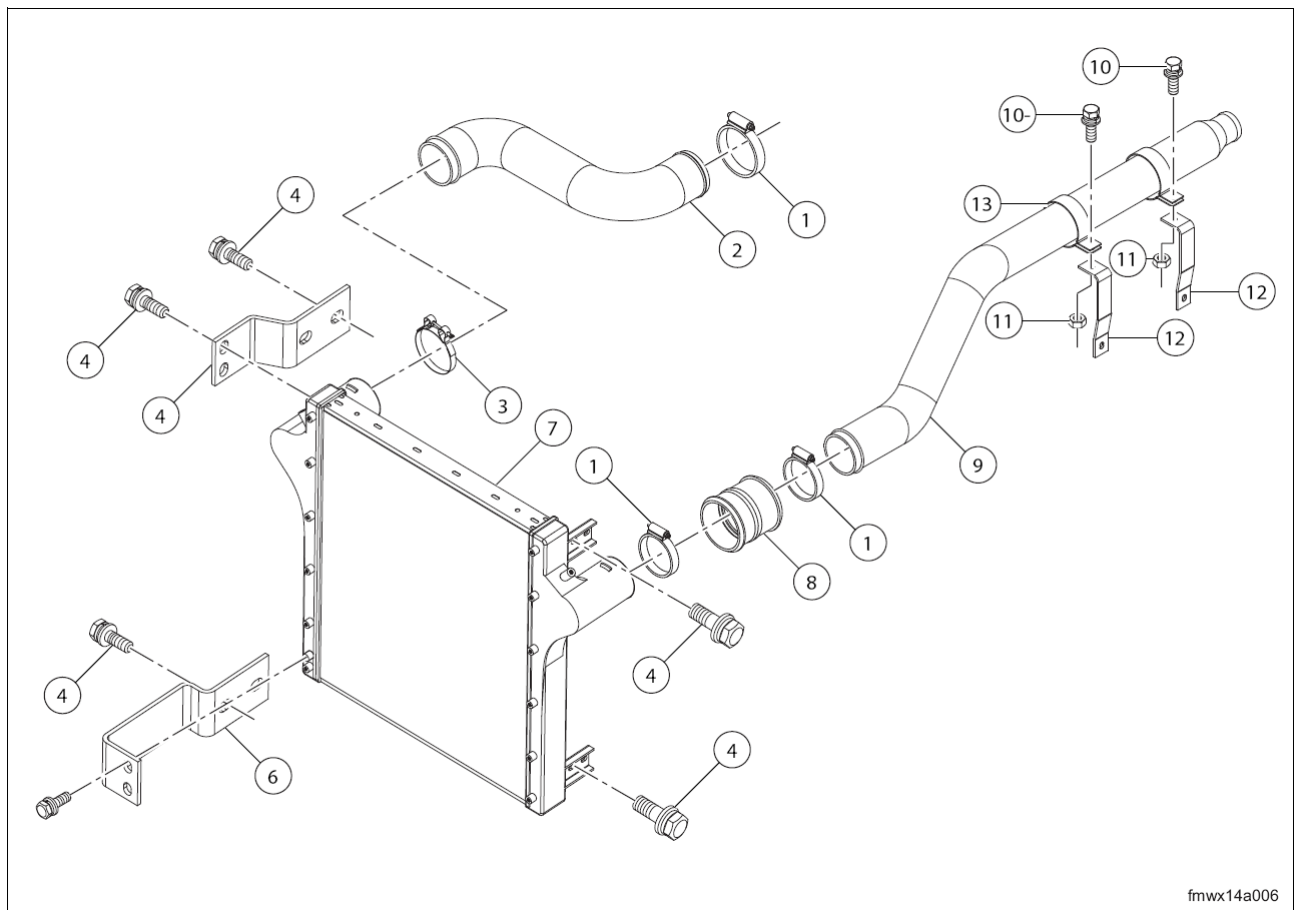


fmwx14c001

1	Silicon Oil Clutch Fan
2	Cowl Assembly
3	Protection Band Assembly
4	Hex Head Bolt
5	Wave Circlip
6	Bracket
7	Prevailing Torque Type All-metal Hex Nut, Style 2
8	Bracket
9	Hex Nut, Style 1
10	Stud Bolt
11	Middle Flange
12	Pipe Joint Assembly
13	Prevailing Torque Type All-metal Hex Nut, Style 2
14	Stud Bolt
15	Left Bracket

16	Bracket
17	Hex Flange Bolt
18	Tension Pulley Assembly
19	Right Bracket
20	Sealing Gasket, Water Pump
21	Water Pump Assembly
22	Gasket, Water Pipe Joint
23	Water Pipe Joint
24	Cooling Water Hose
25	Hose Clamp
26	Thermostat Assembly
27	Hex Head Bolt
28	Washer
29	Grease Filling Device for Water Pump
30	Rubber Hose (with Fibre)

Cooling (WD615) – Cooling System



fmwx14a006

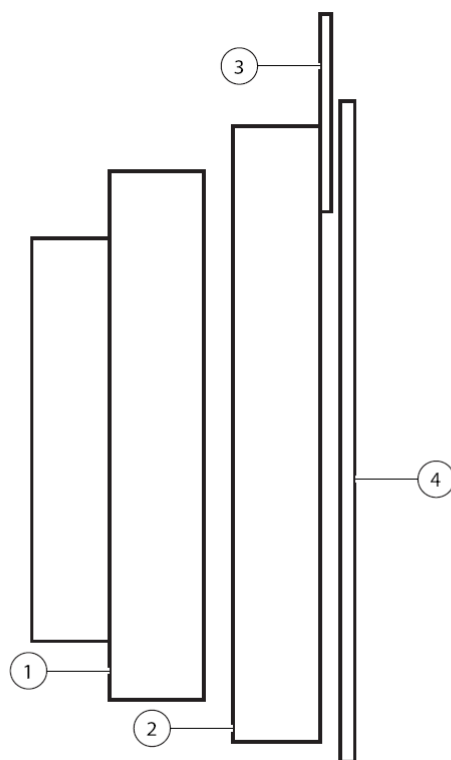
1	Clamp
2	Exhaust Pipe, Intercooler
3	T-clamp
4	Hex Head Bolt, Spring Washer and Flat Washer Assembly
5	Fixing Bracket, Intercooler
6	Fixing Bracket, Intercooler
7	Intercooler assembly

8	Connecting hose
9	Intake Pipe, Intercooler
10	Hex Head Bolt, Spring Washer and Flat Washer Assembly
11	Hex Flange Nut
12	Bracket, Intercooler Pipe
13	Clamp, Intercooler Pipe

Testing & Adjustment

Fan

Manual test method: Start the engine, run it for several minutes and then shut down; pull the fan by hand. If the clutch is released and the fan can rotate, it shows that the silicon oil fan is good. There are, however, exceptions that the fan can not rotate at low temperature because silicon oil can not return at once, which does not always show that the silicon fan is damaged. Start the engine to continue the test, run it at middle speed and low temperature for 1~2 minutes and then shut down; pull the fan by hand. If the fan can rotate and operate flexibly, it shows that the silicon fan is good. When the temperature rises to 88 °C, shut the engine down, and pull the fan by hand. If the fan does not move, it shows that the silicon fan is normal; if not, it shows that the silicon fan is defective.



1	Fan
2	Radiator

3	Thermometer
4	Baffle Plate

Dynamic test: Place the thermometer with a range of -18~105 °C ahead of the radiator. Put a fixed plastic plate ahead of the radiator to prevent air from passing through the radiator, and ensure that it can prevent air passage. If an air conditioner is equipped, the A/C switch must be turned off. Use a timing lamp to point to the fan blades, start the engine and run it at a speed of 2400r/min. The air temperature showed by dial thermometer shall reach 88 °C within 10 minutes. The ideal engagement of the fan clutch shall be before 88 °C. Observe the increase in the fan's speed. When the air temperature rises to 88 °C, take away the plastic plate, and the air temperature starts to fall. The ideal silicon oil fan clutch can lower the air temperature by 11 °C or more, and at the same time, you can hear that the air flow sound of the

Cooling (WD615) – Cooling System

fan reduces. If the fan clutch fails to meet the above requirement, replace the silicon oil fan clutch assembly.

Water Pump

In case that the cooling system leaks, you can smell hot antifreeze. But you have to do inspection, and find out whether the cooling water is leaked from the shaft seal of the water pump. You can use a small mirror and a lamp to inspect whether the air bleed hole of the water pump leaks water.

Conduct the regular maintenance, and pay attention to inspecting the consumption of coolant in the water tank.

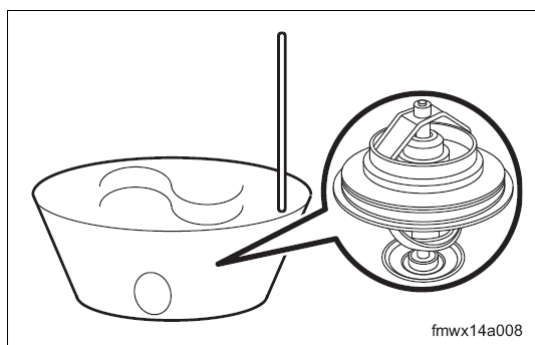
Do not underestimate the problem of leakage in the cooling system, which will cause air sucked in to destroy the preset coolant flow mode and result in generation of hotspots, and greatly aggravate corrosion to the water pump.

If the amount of coolant is insufficient for a long time, it will cause the engine to overheat, and steam corrosion may occur, which may damage the radiator and cause other problems of the water pump.

When the color of coolant is rusty, it may be the problem of impeller corrosion. At the moment, it is necessary to inspect the circulation condition of the water pump coolant. Discharge part of the coolant in the radiator and keep the lever right above the pipe, and warm up the engine to let the thermostat stay in full opening position. When the engine's speed is 3,000r/min, you shall see a good water circulation.

Thermostat

The safe life of the wax thermostat is generally for a range of 50,000km, and the wax thermostat shall be replaced regularly according to its safe life.

**1. Inspect the thermostat**

- (a). The thermostat and thermometer can be put in hot water.
- (b). Inspect the opening temperature of the main valve of the thermostat.
- (c). Inspect the sealing ring of the thermostat.
- (d). Replace the thermostat if either of the items fails to meet the specified value.

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Opening Temperature	Full-opening Temperature
$80 \pm 2\text{ }^{\circ}\text{C}$	$95\text{ }^{\circ}\text{C}$

Water Pipe

Inspect whether the clogging, bulging, aging or cracking of water pipes occurs, and whether the connection of water pipe joints is secure.

Auxiliary Water Tank

Inspect whether there are cracks on the auxiliary water tank, whether the bulging, aging or cracking of the auxiliary water tank occurs, and whether the auxiliary water tank cap is in perfect condition.

Coolant

When the engine idles and warms up to the normal operating temperature, the level of coolant in the bottle shall be between the lowest graduation line and highest graduation line, as shown on the bottle. Test the concentration of coolant by a freezing point tester.

Radiator

Fill water into the radiator, and observe whether water flow is smooth. If not smooth, it shows that the radiator inside is clogged. Rinse the radiator outside, and wash the radiator inside with hot water. If the

Cooling (WD615) – Cooling System

scale deposit can not be eliminated still after the radiator is washed, use a soft metal cleaning rod to remove the scale deposit, and then wash with the above method. Remove the radiating fin of the damaged radiating pipe by needle nose pliers, then cut off the damaged radiating pipe, insert the cleaning rod from the end of the core, pass it through the upper orifice and lower orifice of the cut part and straighten, cut the same usable radiating pipe from a waste radiator, and solder the upper and lower joints. Insert the resistance heater into the radiating pipe to be replaced, and supply 24V power. After resistance wires are hot, the radiating pipe releases as its soldering tin melts. Cut off the power, take out the radiating pipe and resistance heater together, and change with the new radiating pipe and solder securely. Install the radiator tester on the radiator cap opening, and inspect the cooling system for leakage. Pressurize the radiator to 176kPa, inspect the leakage of coolant at normal operating temperature, and repair if any.

Intercooler

This vehicle is of a turbocharged intercooled type. The intercooler is installed on the front of the diesel engine, i.e. the front end of the water tank, and it sucks the air from the fan and the headwind of the vehicle during driving for cooling. Foreign matters such as oil sludge and colloid, which are usually attached to the internal pipe of the intercooler, not only narrow the air channel to reduce the heat exchange capacity, but also lower air intake because dirt clogs the air channel, which cause the problems that the diesel engine's power falls, the exhaust gas is white, and even the vehicle can not run normally.

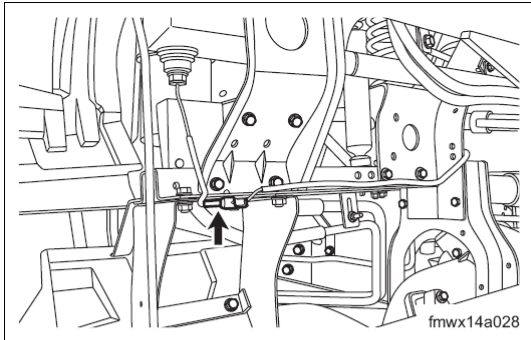
Fill water into the intercooler, and observe whether water flow is smooth. If not smooth, it shows that the intercooler is clogged. Wash the intercooler with hot water. If the scale deposit can not be eliminated after washing, replace the intercooler.

Auxiliary Water Tank

Overhaul

Hint:

Part Drawing, refer to Chapter 14C Cooling – Cooling System, Part Drawing



1. Dismantle the auxiliary water tank

- (a). Disconnect the wiring harness of the auxiliary water tank.

- (b). Open the auxiliary water tank cap.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

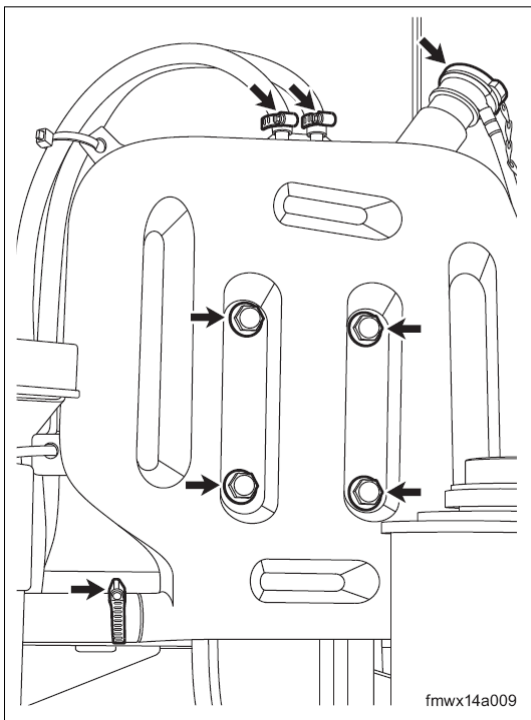
- (c). Disconnect the pipe of the auxiliary water tank.

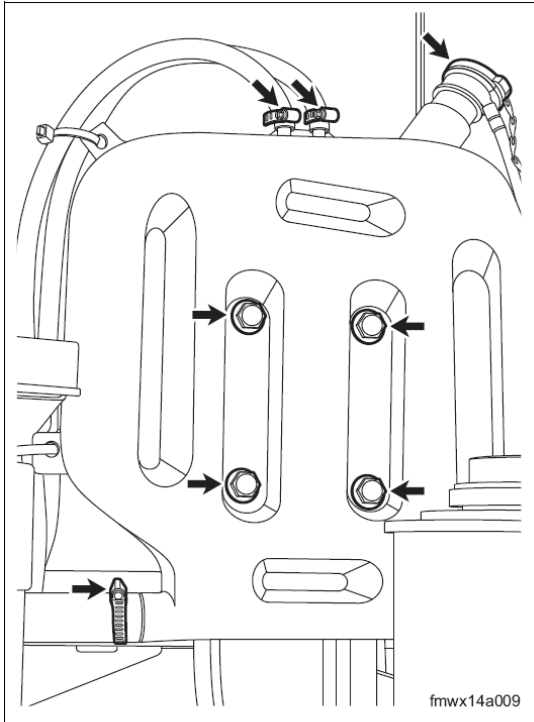
Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

- (d). Dismantle the fixing bolts of the auxiliary water tank.

2. Inspect the auxiliary water tank. Refer to Chapter 14C Cooling – Cooling System, Testing & Adjustment.



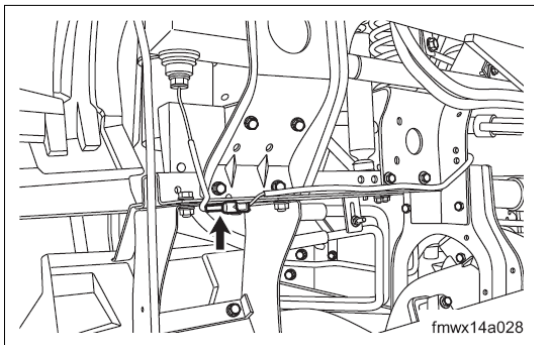


3. Install the auxiliary water tank

- (a). Install the fixing bolts of the auxiliary water tank.

Torque: 20N.m

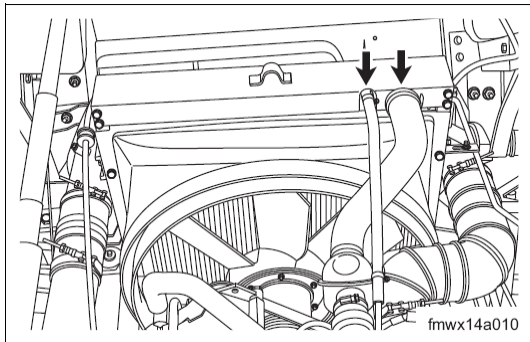
- (b). Connect the pipe of the auxiliary water tank.
(c). Fill coolant.
(d). Close the auxiliary water tank cap.



- (e). Disconnect the wiring harness of the auxiliary water tank.

Coolant

Replacement



1. Drain coolant

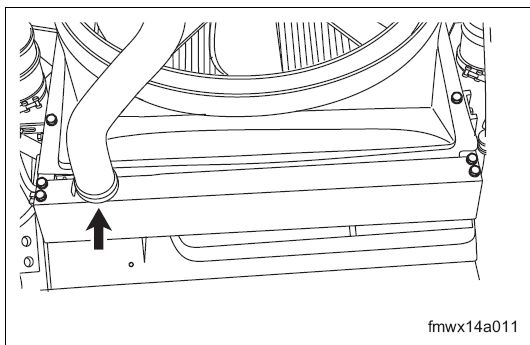
- (a). Disconnect the water inlet hose and exhaust pipe of the radiator.

Caution:

Never open the pressure cap when the engine is in hot state. The pressure cap can be opened when the temperature of coolant falls below 50°C, or hot coolant or vapor emitted may cause personal injury.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.



- (b). Disconnect the water outlet hose of the radiator.

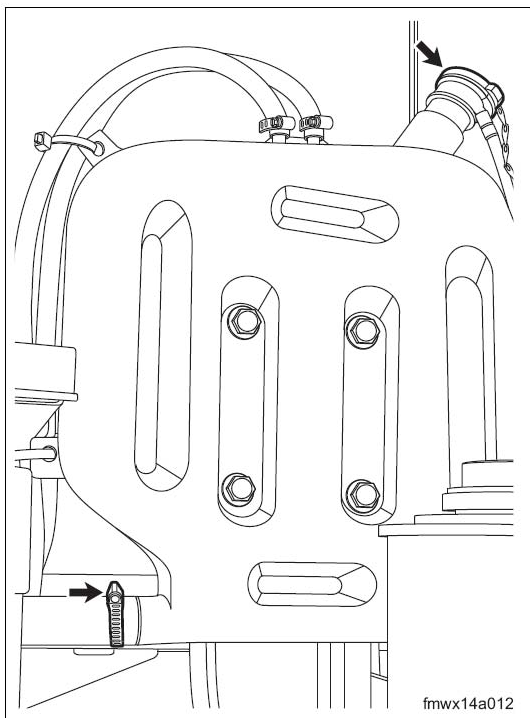
Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

Caution:

Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.

14C



- (c). Unscrew the auxiliary water tank cap.

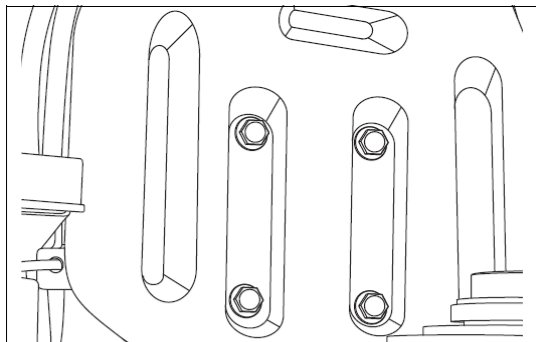
- (d). Disconnect the water pipe of the auxiliary water tank.

Caution:

When disconnecting the pipe joint of the cooling system, in order to prevent dirt or impurities from going into the pipe, make sure to use special plug to seal the pipe orifice.

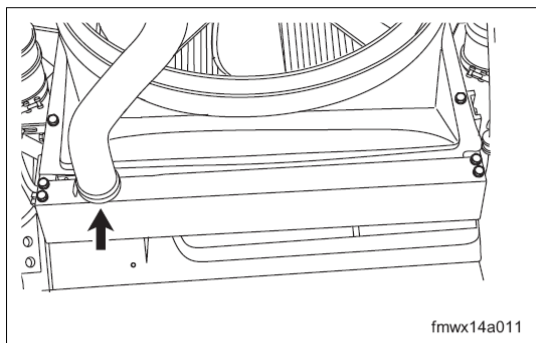
Caution:

Coolant is toxic. If disused, keep it far away from children and pets, and follow the waste disposal as specified.

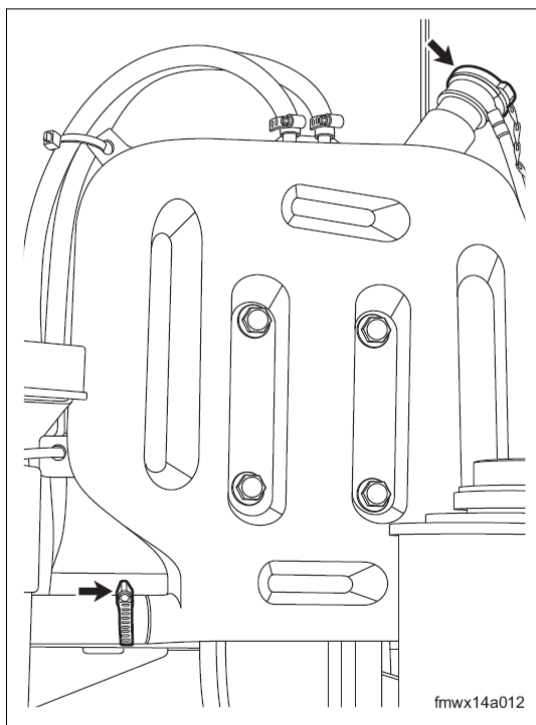


2. Fill coolant

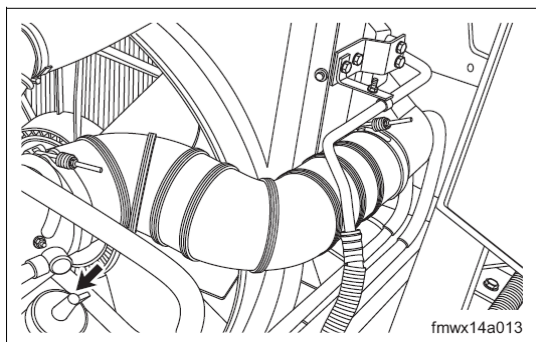
- (a). Connect the water inlet hose and exhaust pipe of the radiator.



- (b). Connect the water outlet hose of the radiator.



- (c). Connect the water pipe of the auxiliary water tank.
(d). Fill coolant.
(e). Tighten the auxiliary water tank cap.



- (f). Fill coolant from the engine water filler.

Caution:

Different brands of antifreezes are based on different production formulas. If they are mixed, various additives are likely to react with each other, which will result in failure of the additives.

Caution:

The shelf life of the antifreeze is two years. Confirm whether the antifreeze is within the shelf life when filling.

Cooling (WD615) – Coolant

3. Inspect the coolant level

- (a). Run the engine, and inspect the engine coolant level.
- (b). If the level is too low, continue to fill coolant.

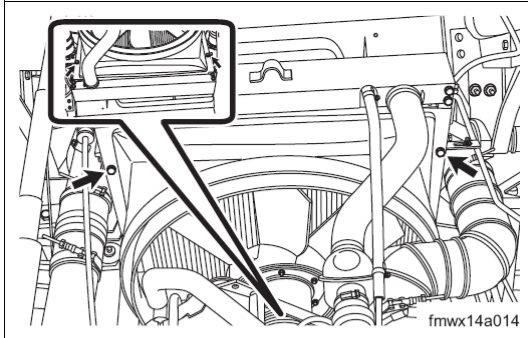
Radiator

Overhaul

Hint:

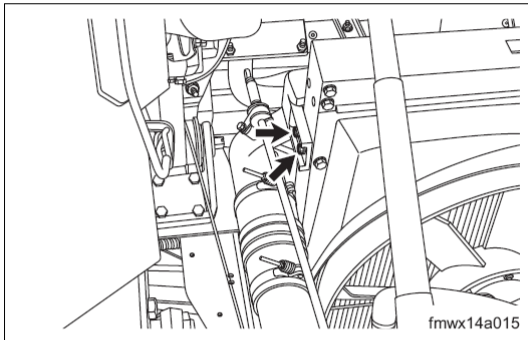
Part Drawing, refer to Chapter 14C Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.

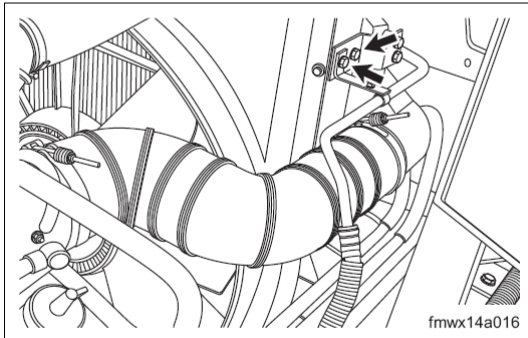


2. Dismantle the radiator

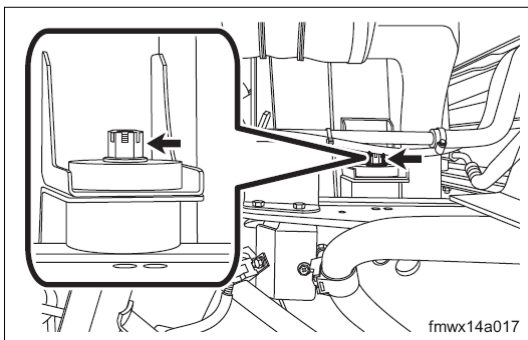
(a). Loosen the shroud.



(b). Loosen the intercooler.



(c). Dismantle the fixing bracket of the A/C pipe.

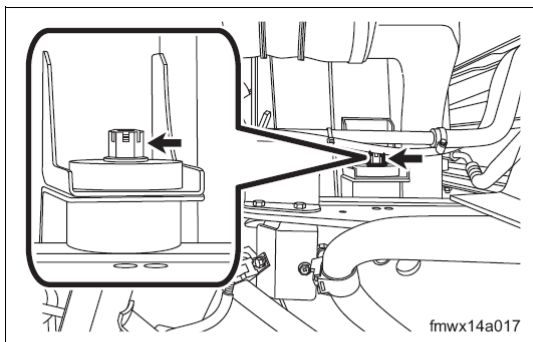


(d). Dismantle the radiator.

- Dismantle the cotter pin.
- Dismantle the slotted nuts of the radiator.
- Take out the radiator upward.

3. Inspect the radiator. Refer to Chapter 14C Cooling – Cooling System, Testing & Adjustment.

Cooling (WD615) – Radiator

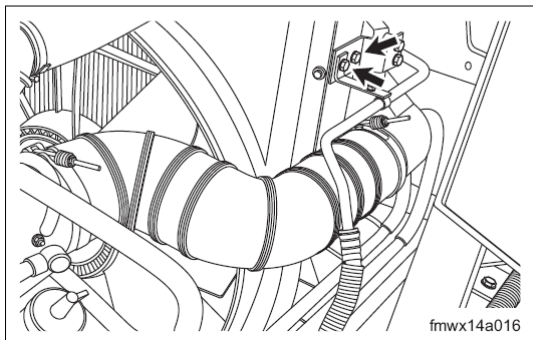


4. Install the radiator

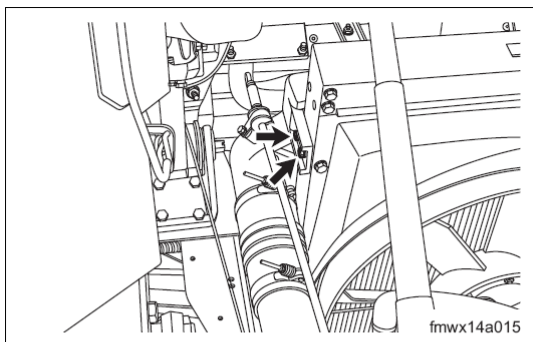
- (a). Install the radiator.
- Put radiator downward.
 - Install the slotted nuts of the radiator.

Torque: 70N.m

- Install the cotter pin.

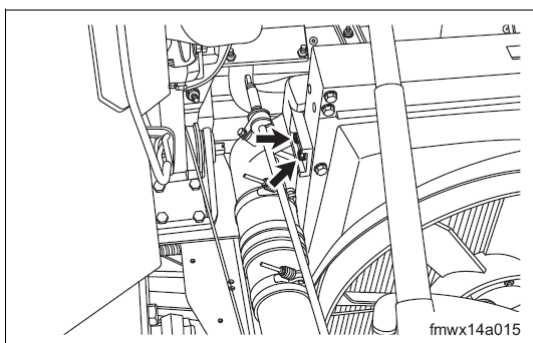


- (b). Install the fixing bracket of the A/C pipe.



- (c). Tighten the intercooler.

Torque: 23±2N.m



- (d). Tighten the shroud.

Torque: 20N.m

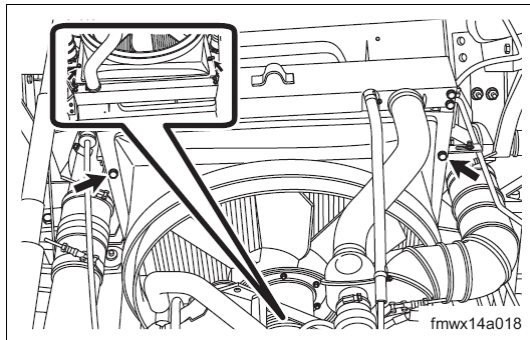
5. Fill coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.

Cooling Fan

Overhaul

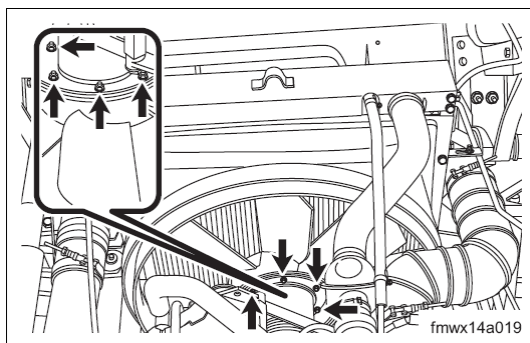
Hint:

Part Drawing, refer to Chapter 14C Cooling – Cooling System, Part Drawing



1. Dismantle the cooling fan

(a). Loosen the shroud.

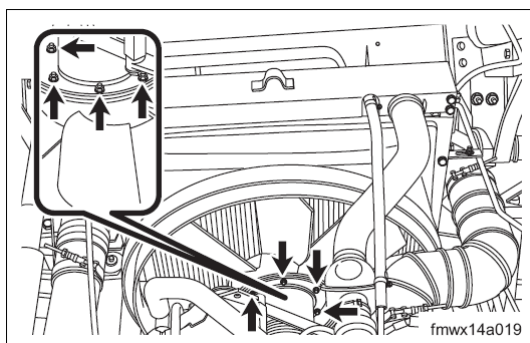


(b). Disconnect the silicon oil temperature sensor of the cooling fan.

(c). Dismantle the cooling fan.

14C

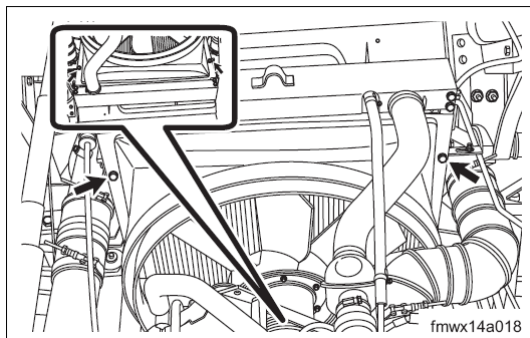
2. Inspect the cooling fan. Refer to Chapter 14C Cooling – Cooling System, Testing & Adjustment.



3. Install the cooling fan

(a). Install the cooling fan.

Torque: 20N.m



(b). Tighten the shroud.

Torque: 20N.m

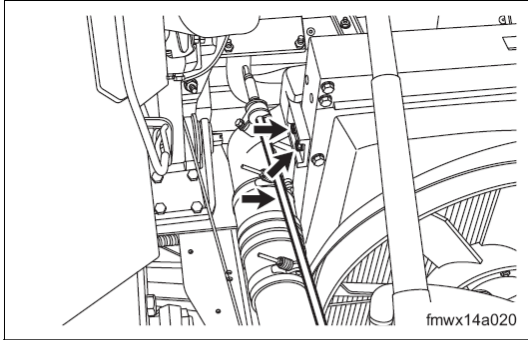
(c). Connect the silicon oil temperature sensor of the cooling fan.

Intercooler

Overhaul

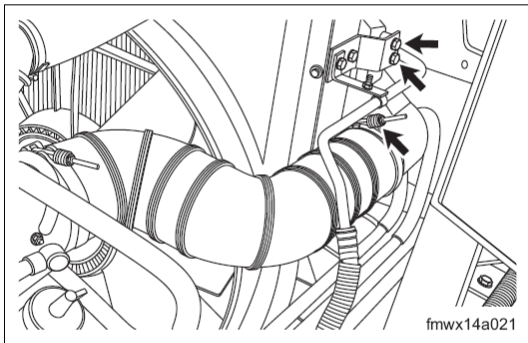
Hint:

Part Drawing, refer to Chapter 14C Cooling – Cooling System, Part Drawing

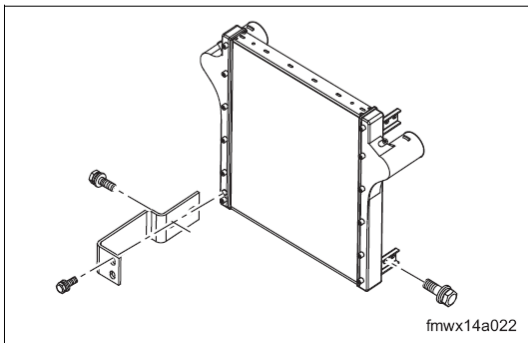


1. Dismantle the intercooler

- (a). Dismantle the intake pipe of the intercooler.
- (b). Dismantle the fixing bolts of the intercooler.



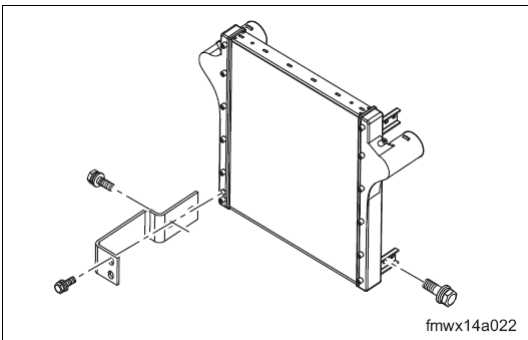
- (c). Dismantle the exhaust pipe of the intercooler.
- (d). Dismantle the fixing bracket of the intercooler.



- (e). Dismantle the fixing bolts of the intercooler.
- (f). Dismantle the fixing bolts of the intercooler.

14C

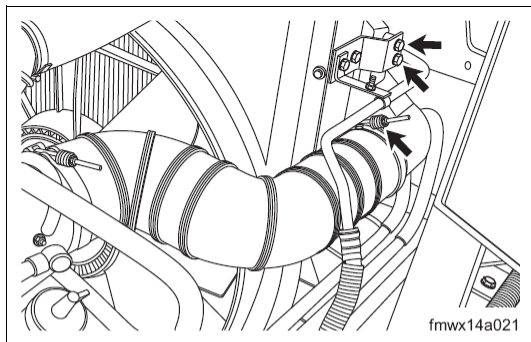
2. Inspect the intercooler. Refer to Chapter 14C Cooling – Cooling System, Testing & Adjustment.



3. Install the intercooler

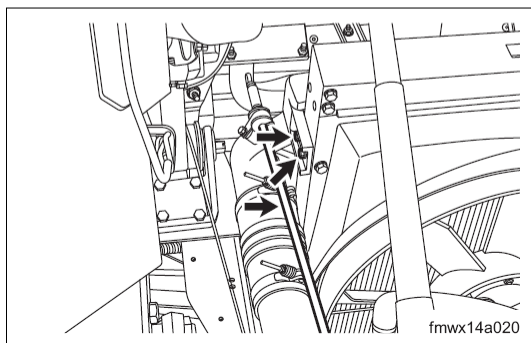
- (a). Install the fixing bolts of the intercooler.
- (b). Install the fixing bolts of the intercooler.

Torque: 23±2N.m



- (c). Install the exhaust pipe of the intercooler.
- (d). Install the fixing bracket of the intercooler.

Torque: 23±2N.m



- (e). Install the intake pipe of the intercooler.
- (f). Install the fixing bolts of the intercooler.

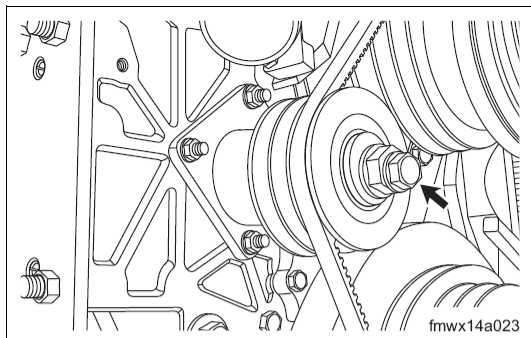
Water Pump

Overhaul

Hint:

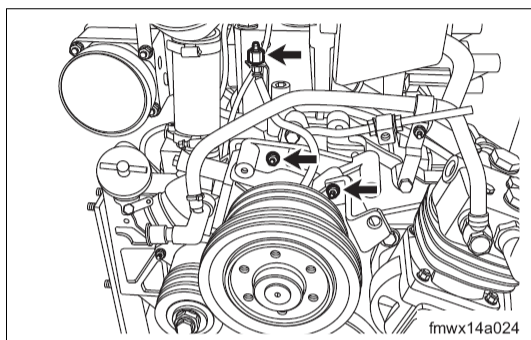
Part Drawing, refer to Chapter 14A Cooling – Cooling System, Part Drawing

1. Drain coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.



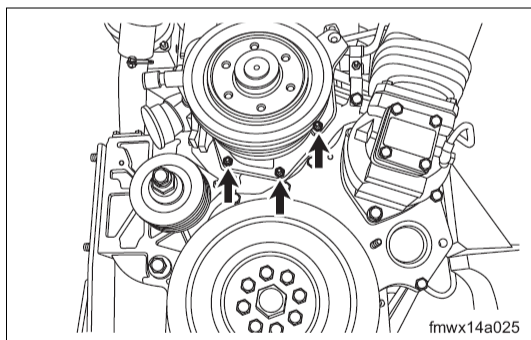
2. Dismantle the belt

- (a). Loosen the tension pulley.
- (b). Remove the belt.

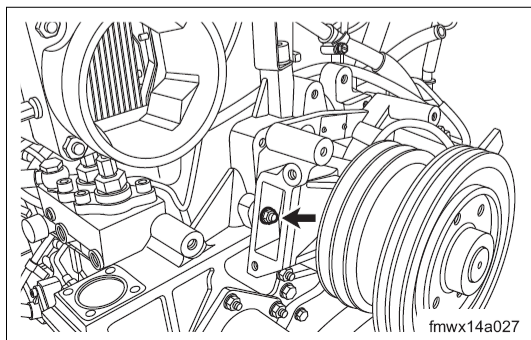


3. Dismantle the water pump

- (a). Dismantle the grease nipple and fixing nuts of the water pump.



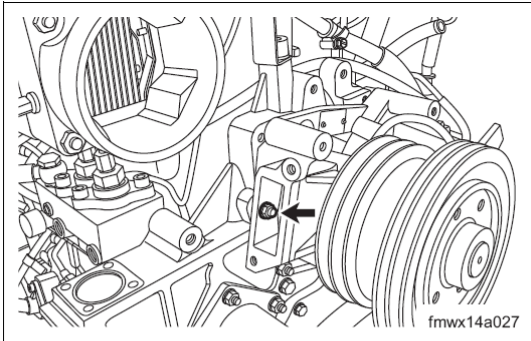
- (b). Dismantle the fixing nuts of the water pump.



- (c). Dismantle the fixing nuts of the water pump.
 - Dismantle the thermostat and water filler.

Cooling (WD615) – Water Pump

4. Inspect the water pump. Refer to Chapter 14A Cooling – Cooling System, Part Drawing.

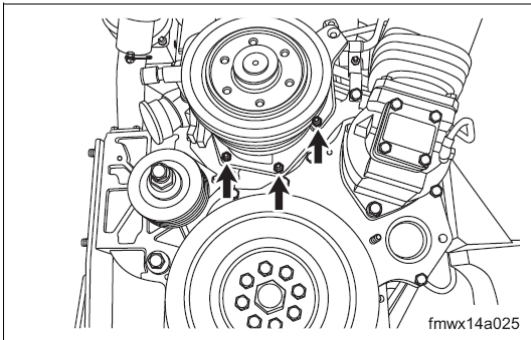


5. Install the water pump

- (a). Install the fixing nuts of the water pump.

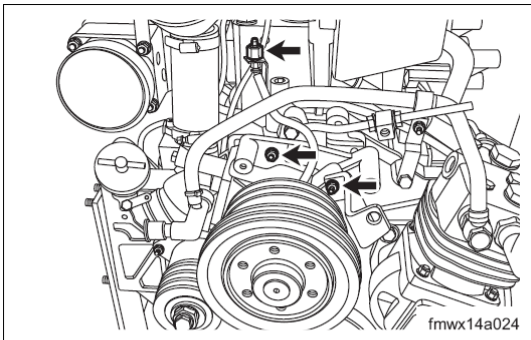
Torque: 63N.m

- (b). Install the thermostat and water filler.



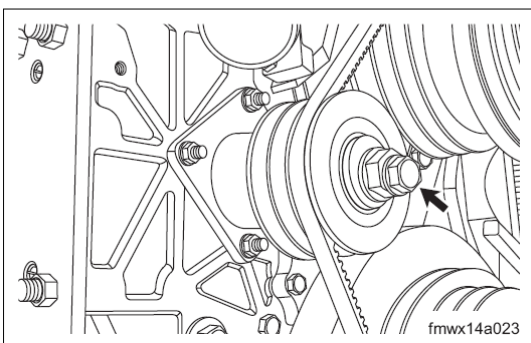
- (c). Install the fixing nuts of the water pump.

Torque: 63N.m



- (d). Install the grease nipple and fixing nuts of the water pump.

Torque: 63N.m



6. Install the belt

- (a). Put the belt on the tension pulley.

- (b). Tighten the tension pulley.

7. Fill coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.

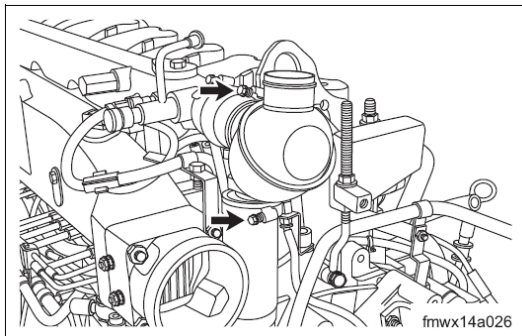
Thermostat

Overhaul

Hint:

Part Drawing, refer to Chapter 14C Cooling – Cooling System, Part Drawing

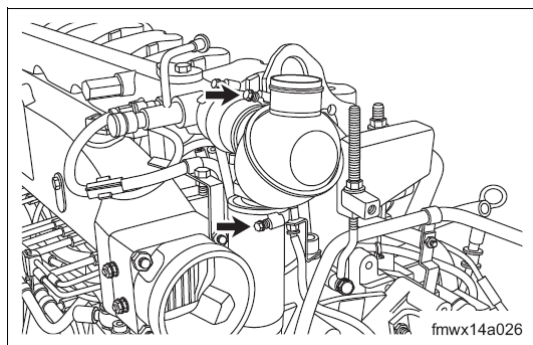
1. Drain coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.



2. Dismantle the thermostat

- (a). Dismantle the cooling water pipe.
- (b). Dismantle the thermostat.

3. Inspect the thermostat. Refer to Chapter 14C Cooling – Cooling System, Testing & Adjustment.



4. Install the thermostat

- (a). Install the thermostat.
- (b). Install the cooling water pipe.

5. Fill coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.

Lubrication (WP10)

Lubrication System	15A-3
General.....	15A-3
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15A

Lubrication System

General

Functions of Lubrication System

Lubricating function: it can lubricate the surface of the moving part, decrease the frictional drag, abrasion and watt consumption of the engine.

Cleaning function: the oil circulates continually in the lubrication system to clean the friction surface and to take away the abrasive dusts and other foreign matters.

Cooling function: the circulation of the oil in the lubrication system can also take away the heat resulting from the burning and friction to play the role of cooling.

Sealing function: the oil film is formed between the moving parts in order to improve their tightness, which can avoid air or oil leakage.

Antirust function: the oil film is formed on the surface of the part to protect the surface and to avoid corrosion.

Hydraumatic function: the oil can also be used as hydraulic oil, take hydraulic pressure staying up for example, to play the role of hydraulic.

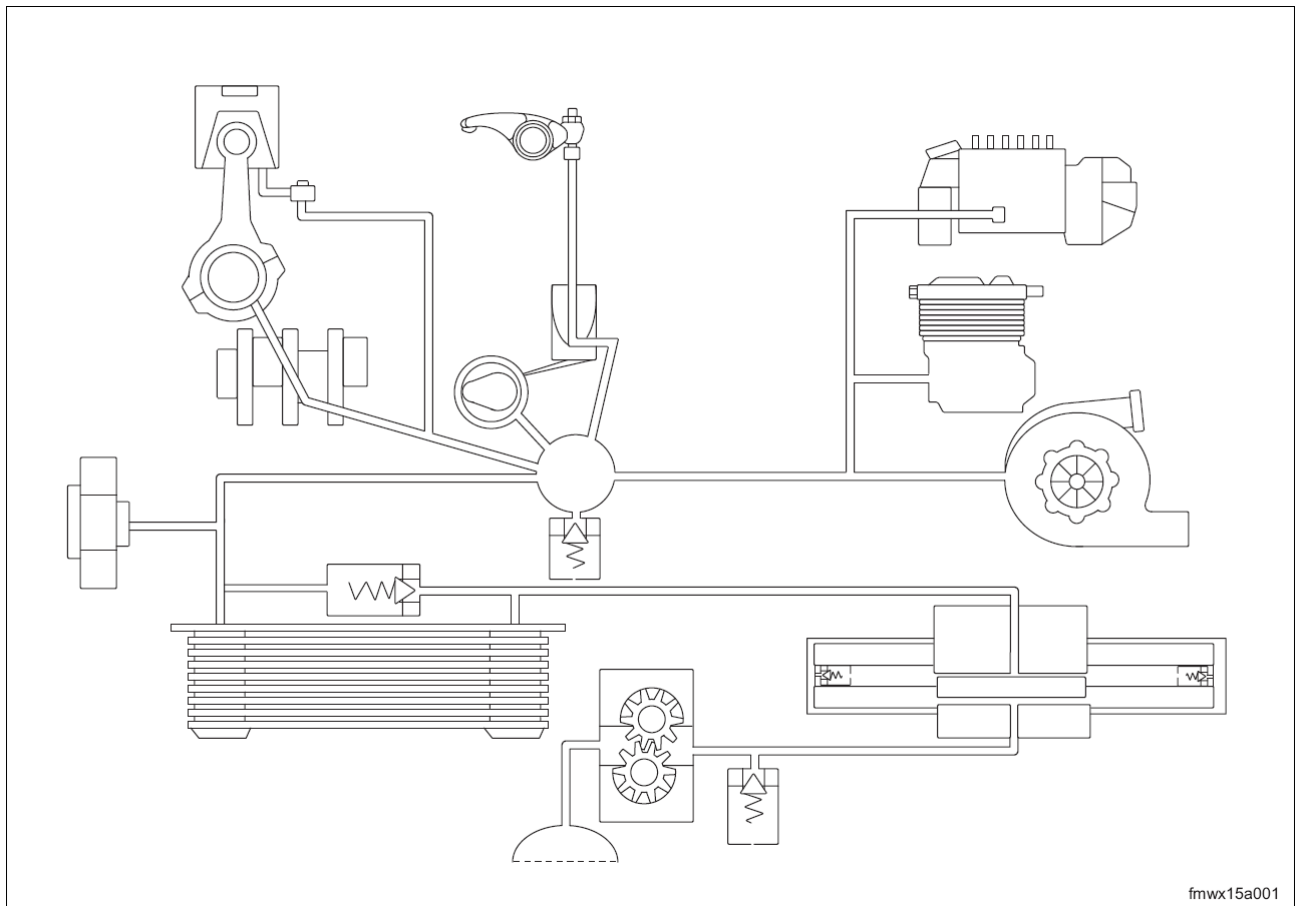
Shock absorption function: the oil film is formed on the surface of the moving part to absorb the shock and decrease the vibration, and consequently to play the role of shock absorption.

Oil

The application of the oil should be determined according to the standards of the company. Multistage oil is preferred because it is better for cold start. Multistage oil for yearly use such as 5W30, 10W40, 15W40 and so on can be only used within the specified temperature range. As for the occasional low temperature cases, take reasonable measures to preheat the oil, or replace it with another kind of oil which is fit for the ambient temperature.

The replacing time of the oil should be determined according to the need of maintaining.

Pressure Lubrication



Lubrication (WP10) – Lubrication System

The oil pump sucks the oil from the bottom of the oil pan via the suction filter and presses it into the oil filter and oil cooler, and then the oil reaches the lubrication location via the oil system. Most of the oil reaches the main bearing and gets to the connecting rod bearing through the oil hole on the crankshaft. The cylinder liner surface and the position pin are lubricated by the injecting fuel from the nozzle. The pressure lubrication of the valve control system, turbocharger, high-pressure oil pump, air compressor and the intermediate gear bearing is also realized by the oil pipe and tanks. The bottom of the piston is cooled by the injecting fuel from the nozzle and the oil is cooled by the coolant through the oil cooler. The oil pressure of the oil circulation system is adjusted via a relief valve. When the oil engine starts the oil pressure will be on the high level because of the low temperature and the large viscosity of the oil. But with the increase of the water temperature of the engine, the oil temperature increases, the oil pressure decreases, and when the full load water temperature of the oil engine is between 80~95°C, the normal oil pressure is between 350~550kPa.

Oil Pan

The oil pan is made with the method of punch forming by applying sheet steel, its faying face with the crankcase has a very deep turnup which leads to its large stiffness. Press the low fraying face via 12 oil pan support blocks and M8 bolts attaching a concave oil pan gasket. The tightness is so good that there will not be oil leakage.

Oil Cooler

In order to prevent the blocking of the oil cooler and the low temperature, large viscosity and high resistance at the beginning of the start in winter from leading oil starvation damage to the engine, an oil cooler safety valve (bypass valve) is set in the engine oil way and the starting pressure of the valve is 600±36kPa

Main Oil Gallery Relief Valve

The main oil gallery relief valve is at the lower right part of the crankcase, and the starting pressure of the main oil gallery relief valve which bulges in the inner chamber of the oil pan is 500kPa.

Oil Filter

Two multiple pinning filter element structures are applied, and when carrying out the maintaining and replacement, one can only unscrew the old filter element and install a new one.

Oil Pump

A gear pump is used for the oil pump. Two stage pumps are applied to full-wheel drive road vehicles and single pumps are used on other vehicle types.

Suction Pump

A suction filter is a filter with a mental net, it is installed on the inlet pipe of the oil pump and is used for preventing major mechanical impurities from getting into the pump.

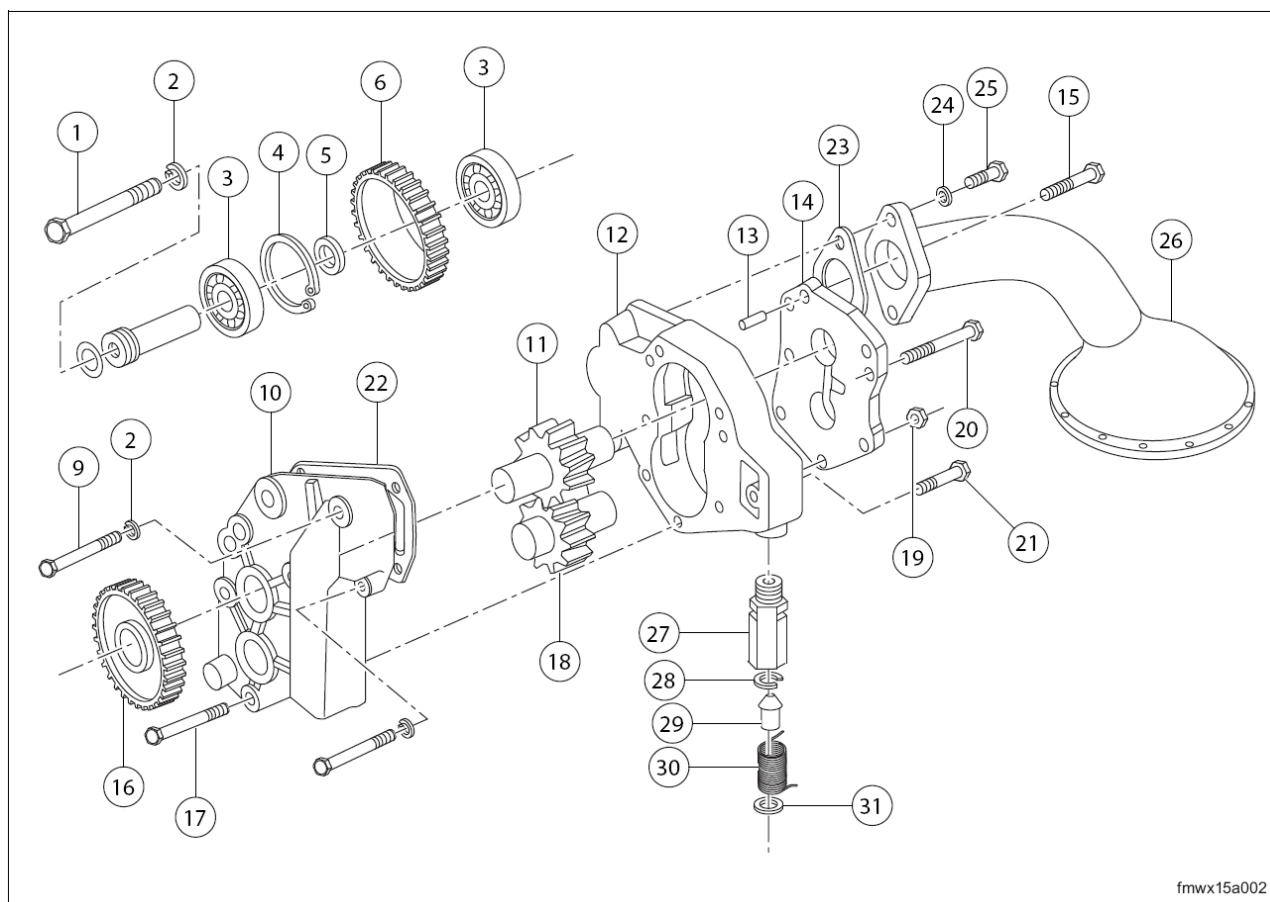
Oil Coarse Filter

The coarse filter is used to filter impurities of major particle size out of the oil, since the flow resistance of the oil is small, it is often installed in series between the oil pump and the main oil gallery, and it is fully-flow filter. The coarse filter is a filterable one the working principle of which is that when the oil passes through fine holes or gaps, the impurities of big holes or gaps are kept out of the filter element. There are structures with different types according to different filter elements.

Precautions

1. **During the dismounting, prevent impurities from entering and keep clean.**
2. **Check the oil level regularly, a higher level will increase the running resistance of the engine which will result in unnecessary power loss and oil leakage; a lower level will lead damage to the engine owing to the poor lubrication.**
3. **Use the oil with proper viscosity, if the viscosity is too low, the oil film will be damaged, and part lock phenomenon will occur; if the viscosity is too high, additional resistance will be produced from the moving parts, which makes the engine start difficult, and the power loss will increase.**
 - Choose the oil according to the climate. When the temperature is low, choose the oil with low viscosity in order to make it convenient for engine start. When the temperature is high, choose the oil with high viscosity to keep the oil film during the move.
 - Choose the oil according to the vehicle conditions. Vehicles with good condition have small fit clearance, so choose the oil with low viscosity, and vehicles with poor condition have big fit clearance, so choose the oil with high viscosity.
 - Since the oil engine has high firing pressure, and the oil containing sulfur will produce sulfurous acid which can dilute the oil after burning, choose the dedicated oil for the engine which can neutralize the sulfurous acid.
4. **Replace the engine oil regularly, it would be best not to add oil, adding oil chronically will accumulate more and more oil contamination and carbon deposit which will block the oil suction filter, so the moving parts of the engine can not be lubricated, which will damage the parts seriously.**

Part Drawing

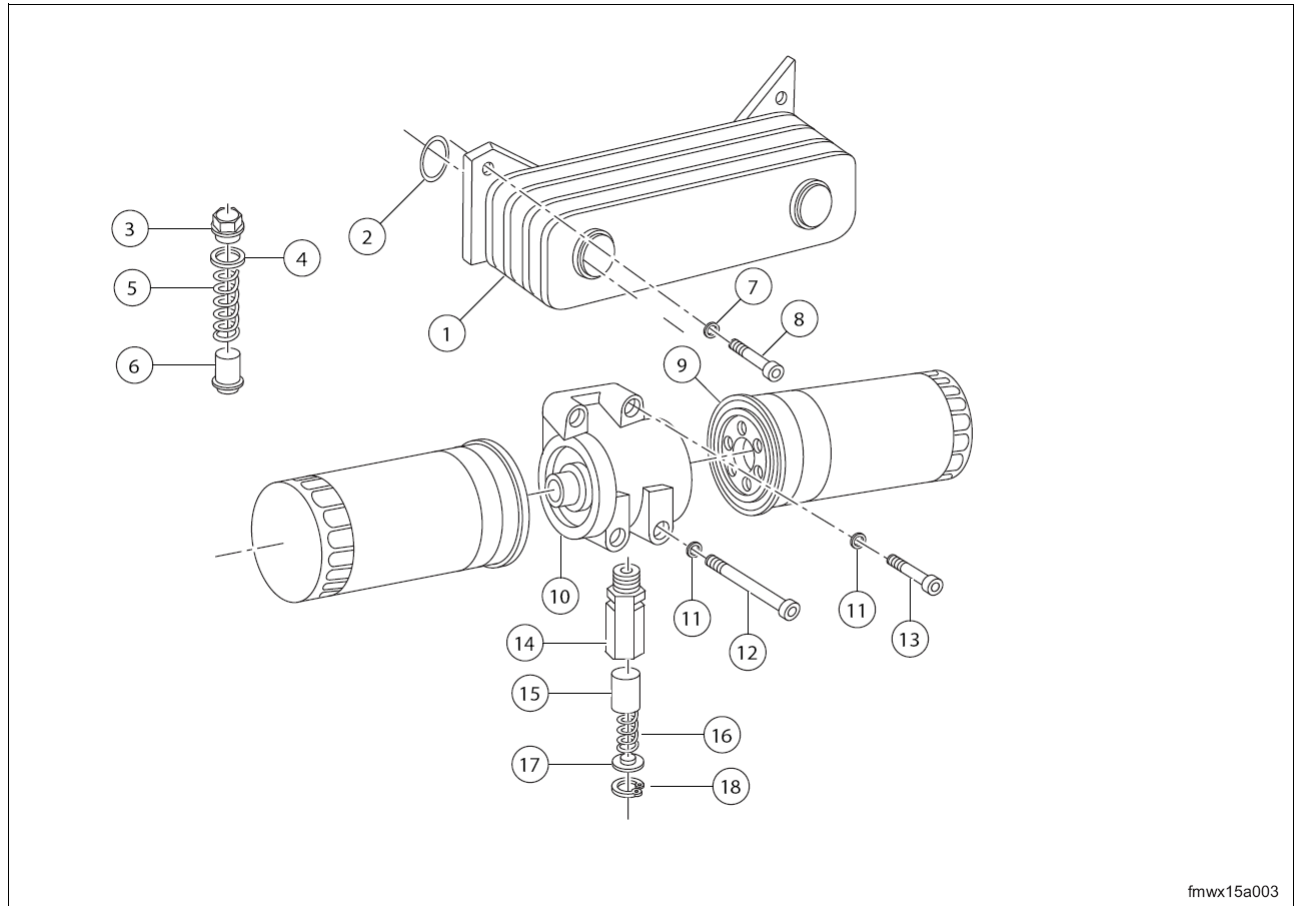


1	Hex Head Bolt
2	Spring Washer
3	Radial Ball Bearing
4	Circlip For Hole with Convex Teeth
5	Intermediate Set Collar
6	Intermediate Gear-Oil Pump
7	Sealing Ring
8	Intermediate Gear Shaft
9	Hex Head Bolt
10	8mm Widened Oil Pump
11	Front Cover-Oil Pump
12	Gear Assembly-Oil Pump
13	Housing-Oil Pump
14	Cylindrical Pin
15	Rear Cover-Oil Pump

18	Hex Head Bolt
19	Gear Assembly-Oil pump
20	Hex Nut, Style I
21	Hex Head Bolt
22	Hex Head Bolt
23	Gasket-Oil Pump
24	Gasket
25	Flat Washer
26	Hex Head Bolt
27	Suction Filter Assembly
28	Hex Head Bolt
29	Relief Valve Assembly-Oil Pump
30	Relief Valve Body
31	Circlip For Hole
32	Relief Valve

16	Hex Socket Cap Head Screw
17	Driving Gear-Oil Pump

33	Spring
34	Gasket

Lubrication (WP10) – Lubrication System

1	Oil Cooler Core Assembly
2	Sealing Ring
3	Hex Head Plug
4	Composite Gasket
5	Safety Valve Spring
6	Safety Valve
7	Wave Shape Circlip
8	Hex Socket Cap Head Screw
9	Rotary Oil Filter Element Assembly
10	Filter Seat Assembly

11	Wave Shape Circlip
12	Hex Socket Cap Head Screw
13	Hex Socket Cap Head Screw
14	Main Oil Gallery Assembly
15	Valve Body
16	Valve
17	Spring Seat-Main Oil Gallery Pressure Valve
18	Spring-Main Oil Gallery Pressure Valve
19	Circlip For Hole

Testing & Adjustment

Detection of Pump Oil

As for the engine under normal technical condition within common speed range, the oil pressure should be between 350~550kPa. If the oil pressure of medium speed is below 300kPa and of idling is below 100kPa, stop the running of the engine and check the lubrication system.

Effect factors of oil pressure:

1. **Property of the oil pump, adjustment of the relief valve, resistance of the oil gallery and oil filter**
2. **Quality, temperature and viscosity of the oil**
 - If the viscosity of the oil is low and the temperature is high, the oil pressure will decrease; otherwise it will increase.
3. **Gaps of the crankshaft main bearing, connecting rod bearing and camshaft bearing**
 - The gearing gap will become larger after wear, the oil leakage amount at the gearing gap place will increase, but the oil pressure will decrease. As a result, oil pressure is often used as an important parameter to determine the related gearing gap.
 - If the oil pump is under normal technical condition, the decrease of the oil pressure is mainly caused by the large wear of the crankshaft main journal and connecting rod journal. When the crankshaft main bearing gap increases by 0.01mm, the oil pressure will decrease by 0.01MPa.
4. **Oil pressure gauge and oil pressure sensor**
 - The oil pressure value can be showed on the instrument panel, but during the regular detection a dedicated oil pressure gauge should be used, because the oil pressure gauge and oil pressure sensor can not guarantee a necessary measurement accuracy.
 - When detecting, dismantle the oil pressure sensor first and install the oil pressure gauge. Then start the engine and make it run within specified speed, and now the indicated value on the oil pressure gauge is the oil pressure of the lubrication.

15A

Detection of Oil Consumption

Effect factors of oil consumption:

1. **Lubrication leakage**
2. **Abnormal working of air compressor**
3. **Improper selection of oil standards**
4. **Cylinder-piston assembly wear**
 - The oil consumption can both reflect the technical condition of the engine lubrication system and help determine the wear condition of the cylinder-piston assembly
 - The main reasons of the large oil consumption are large wear of cylinder-piston assembly, gap increase and the burning of the oil into the burning chamber on condition that the mark of the oil is correct and the technical conditions of other mechanisms is normal.

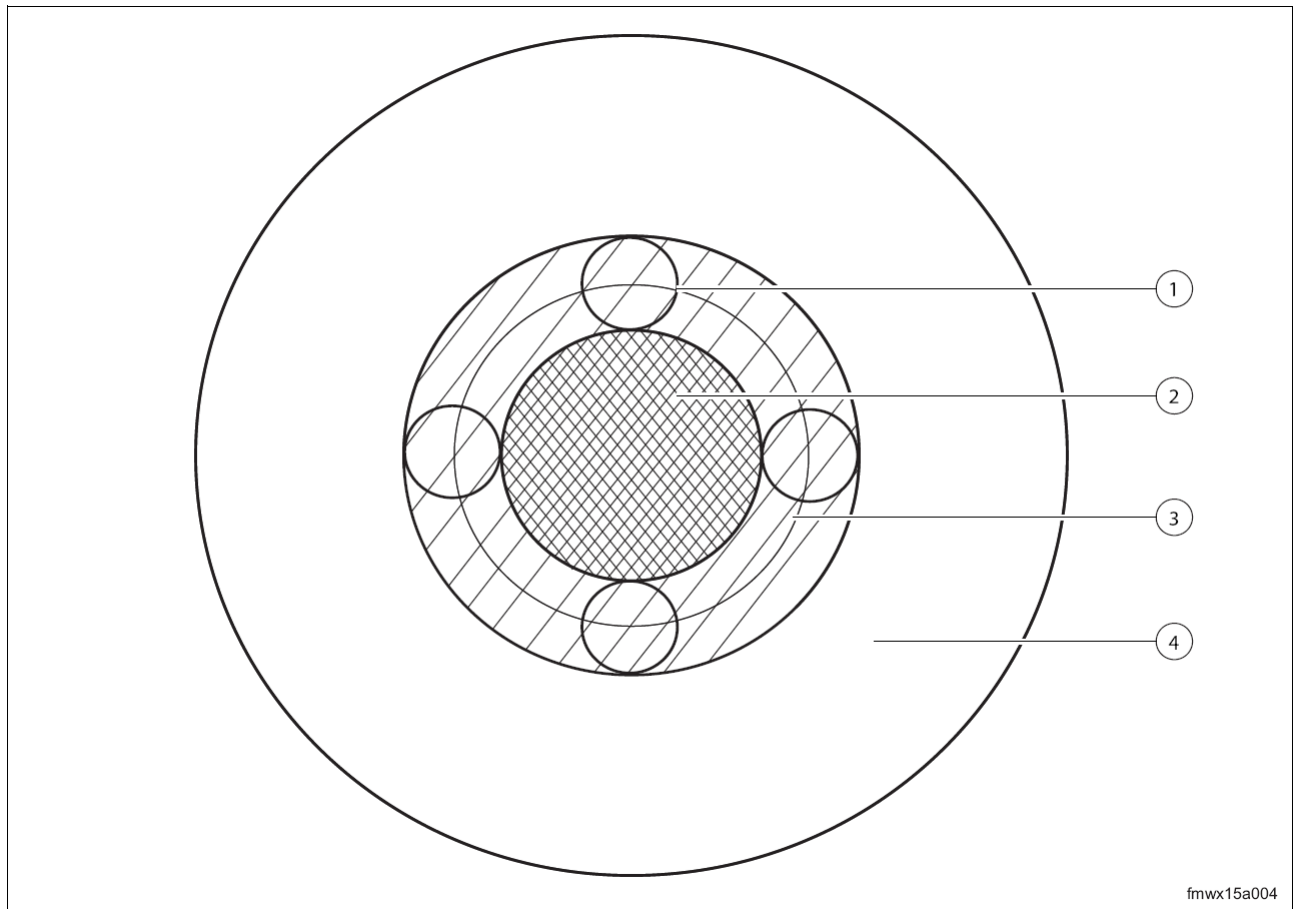
The oil consumption is about 0.1~0.5L/100km; when the engine wear is serious, it can reach 1L/100km or more. As for the measurement of oil consumption, all that is needed is to make a conversion of the real oil consumption (L) of the vehicle after running for some mileages (1000~1500 km) into the average oil consumption (L/100km) per hundred kilometers of the vehicle.

Testing and Analysis of Oil Quality

During the use of the oil, its quality will go bad gradually because of the impurity contamination, oil dilution, high-temperature oxidation, additive consumption or its performance loss. Visually, the color will go black and the viscosity will increase or decrease.

Lubrication (WP10) – Lubrication System

The impurities leading to the oil contamination are mainly from the wear particles on the friction surface, the outside dust and carbon deposition; the abnormal working, imperfect burning or misfiring of the engine will make the oil that does not burn flow into the oil pan to dilute the oil; the high temperature resulting from the engine working, especially when the cylinder-piston assembly wear is serious, the gap becomes larger, and there is high temperature and pressure gas in the combustion stroke whisking into the crankcase, it will aggravate the oil oxidation and produce oxide and oxidative polymer. The detergent dispersant in the oil is an important kind of additive for the oil, and it has the abilities of scattering and taking away the particles and carbon deposition on the friction surface. The detergent dispersant consumption and property decrease will also make it lose the function of cleaning and dispersing.

Filter Paper Oil Patch Testing Method**1. Testing Principle**

1	Black Circle
2	Centre Region

3	Diffusion Region
4	Translucence Region

- Drop the engaged oil on specified filter, the oil drop will soak and disperse around gradually, finally multi-ring ringlike oil patches with different color shades will be formed and there are deep color nuclear in the centre of the patches. If the concentration and particle size of the impurities in the oil are different and their abilities of cleaning and dispersing differ from each other, the color shades of each ring region of the oil patches will also be different.
- If the particle size of the impurities in the oil is small and their cleaning and dispersing abilities are perfect, the impurity particle will disperse father, the impurity concentrations and the color shade extents of the centre region and diffusion region have no significant differences; if the particle size of the impurities in the oil is large and they lose the abilities of cleaning and dispersing, the impurities in the oil will centralize into the centre region gradually, and the

impurity concentrations and the color shade extents of the centre region and diffusion region will have significant differences. As a result, the impurity concentration of the centre region on the oil patch can reflect the total contamination extent, and the subtraction of the impurity concentration of per unit centre region and the impurity concentration of per unit diffusion region can reflect the cleaning and dispersing abilities of the detergent dispersant in the oil.

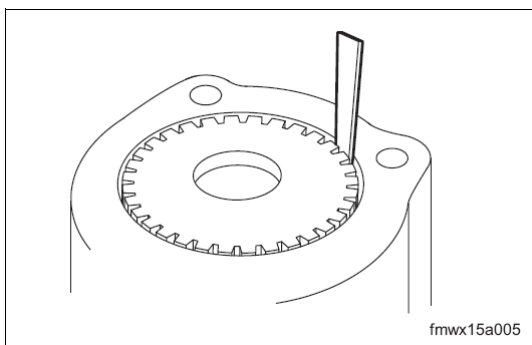
2. Testing Method

- Make two pieces of the same type by using organic glass (cardboard, plastic plate or board can also be used) with the length and width 12cm×7cm, scrap out a circular hole with the diameter 5cm, and bond one side with adhesive plaster to make the rear of the filter not touch the table-board, which can affect the diffusion of the oil patches.
- Take the oil sample out of the engine under thermal condition and put it into the test tube, poke into the tube oil level to certain depth by using a drop rod with specified size (a metal rod with a smooth tip, the diameter is 2mm and the length is 150mm), then take out of the drop rod and drip the third oil drop onto the filter paper to form the oil patch.
- Lay the filter paper with oil drops together with the frame at a place with no blown dust, let it stand for 2~4h, observe the diffusion formation of the patch, and make a judgment through comparative analysis with the standard atlas (National Standard GB/T7607-2002 *Filter Paper Oil Patch Testing Method For Combustion Engine Oil*)

3. Evaluation Standards

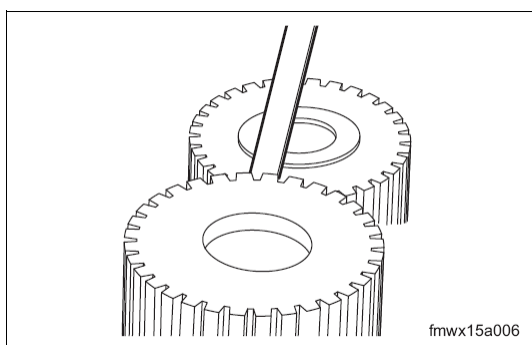
- 1 level: The core region and the diffusion ring in the filter paper patch picture are bright and colorless or the color is light, and there are no obvious deposition rings. This indicates that the oil is new or its service time is very short, there is no contamination, and it can be used sequentially.
- 2 level: There is a clear bound between the deposition ring and the diffusion ring in the filter paper patch picture, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is not long and the contamination extent is slight, the detergent dispersant properties are good and it can be used sequentially.
- 3 level: The deposition ring in the filter paper patch picture is dull black, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is long and the contamination extent is great, but the detergent dispersant properties are good and it can be used sequentially.
- 4 level: The deposition ring in the filter paper patch picture is jet black, the diffusion ring begins to lessen and the oil ring is light yellow. This indicates that the service time of the oil is very long and the amount of the depositing sediments increases, the detergent dispersant properties get worse, but it can be used sequentially.
- 5 level: The deposition ring in the filter paper patch picture is jet black and even presents a fault state, it is not easy to be dried, the diffusion ring is narrow, and the oil ring is large with a yellow color. This indicates that the contamination of the oil is already quite serious and detergent dispersant abilities are poor, the detergent dispersant will be used up and it can't be used anymore, then new oil should be used as the replacement.
- 6 level: There is only very black deposition ring and brown orange oil ring in the filter paper patch picture, and the diffusion ring has disappeared completely. This indicates that the contamination of the oil is already quite serious, the contamination impurities completely gather in the deposition ring, and the detergent dispersant is used up, the detergent dispersant abilities are lost, and it has already been long since the oil replacement time.

Oil Pump



1. Check the inwall gap of the driving/driven gears and pump cavity

- Measure with a plug guage to insert the gap between the two, and when it is beyond 0.3mm, replace with a new one.



2. Check the rear gap of the driving/driven gears

Insert the rear gap by using a plug gauge to measure the 120° three-point, the standard is 0.05mm, and the use limit is 0.20mm.

Oil Cooler

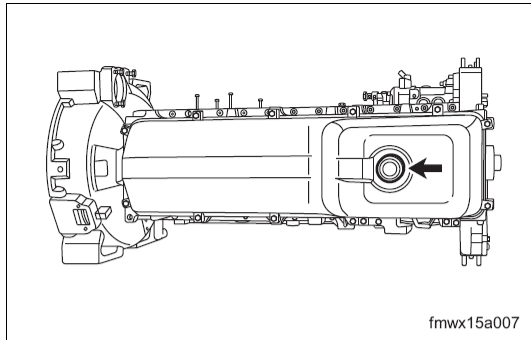
Dip the oil cooler into water, block the exit, blow compressed air into the oil cooler entrance and observe if there are bubbles in the water.

Oil Pan

Replacement

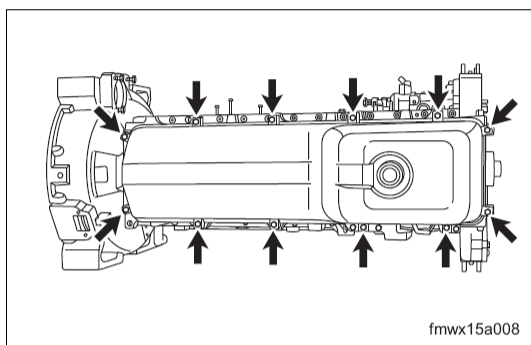
Hint:

Part Drawing, refer to Chapter 15A, Lubrication–Lubrication System, Part Drawing.



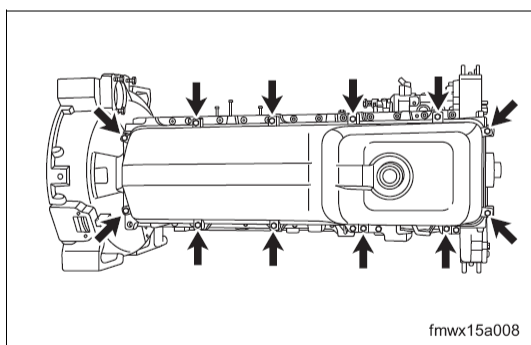
1. Drain the lubricating oil

- (a). Dismantle the oil drain bolt.



2. Dismantle the oil pan

- (a). Dismantle the 12 oil pan support block fixing bolts.
- (b). Receive the oil from the oil pan with a clean container.



3. Install the oil pan

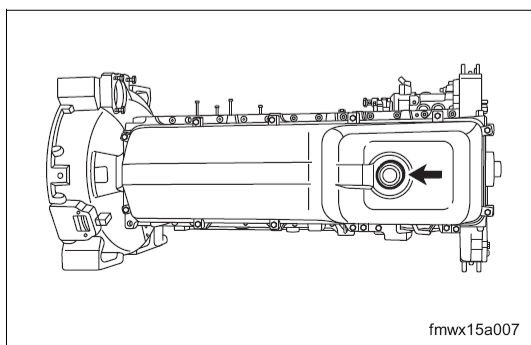
- (a). Install the 12 oil pan support block fixing bolts.

Torque: 25N•m

- (b). Install the oil drain bolt.

Torque: 25N•m

- (c). Fill lubricating oil.

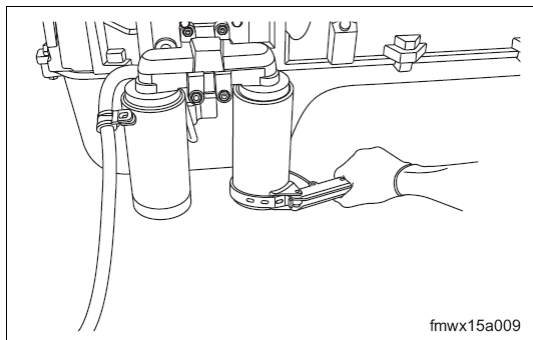


Oil Filter

Replacement

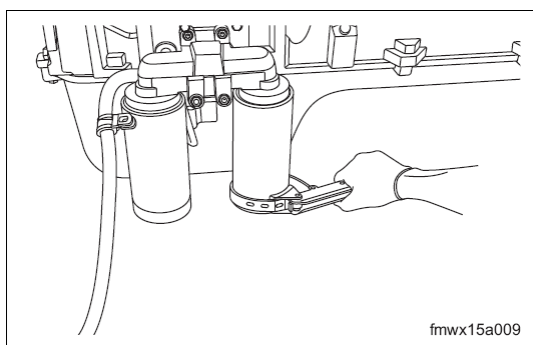
Hint:

Part Drawing, refer to Chapter 15A, Lubrication–Lubrication System, Part Drawing.



1. Dismantle the oil filter

- (a). Unscrew the oil filter.
- (b). Receive the oil from the oil pan with a clean container.



2. Install the oil filter

- (a). Screw down the oil filter.
 - Apply clean oil to the sealing ring before screwing.

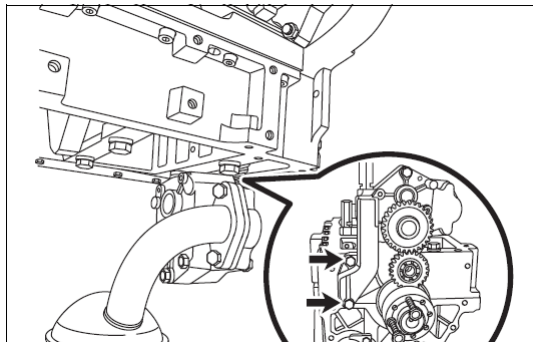
Oil Pump

Overhaul

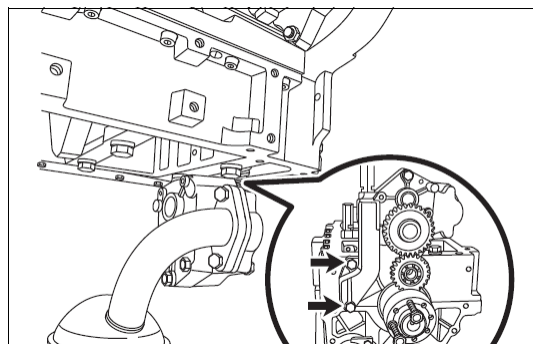
Hint:

Part Drawing, refer to Chapter 15A, Lubrication – Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15A, Lubrication – Oil Pan, Replacement**
2. **Dismantle the oil pump**



3. **Check the oil pump, refer to Chapter 15A, Lubrication – Lubrication System, Testing & Adjustment**



4. **Install the oil pump**
Torque: $62.5 \pm 2.5 \text{ N} \cdot \text{m}$

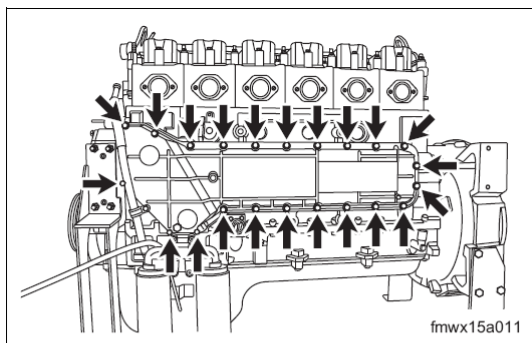
Oil Cooler

Overhaul

Hint:

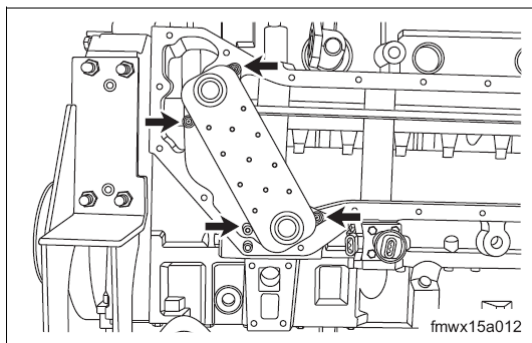
Part Drawing, refer to Chapter 15A, Lubrication–Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15A, Lubrication–Oil Pan, Replacement**
2. **Drain the coolant, refer to Chapter 14A, Cooling–Coolant, Replacement**



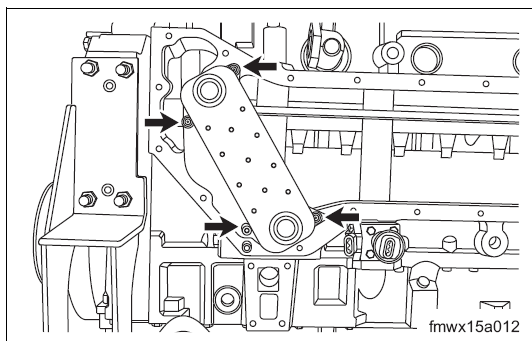
3. Dismantle the oil cooler

- (a). Dismantle the air pipe support of the crankcase.
- (b). Dismantle the water gallery cover of the engine.



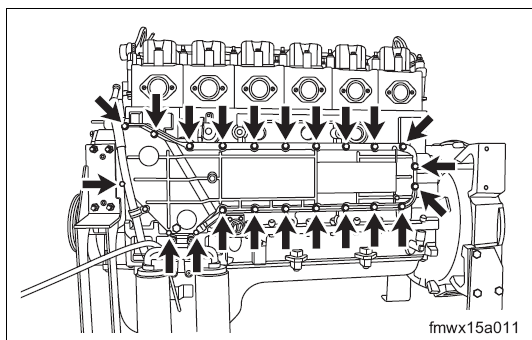
- (c). Dismantle the oil cooler.

4. **Check the oil cooler, refer to Chapter 15A, Lubrication–Lubrication System, Testing & Adjustment**



5. Install the oil cooler

- (a). Install the oil cooler
Torque: 25N•m



- (b). Install the water gallery cover of the engine.
Torque: 25N•m

Caution:

Check the sealing ring to find if there are damages, if there are, replace it with a new one.

Lubrication (WP10) –Oil Cooler

6. Fill the coolant, refer to Chapter 14A, Cooling–Coolant, Replacement
7. Fill the oil, refer to Chapter 15A, Lubrication–Oil Pan, Replacement

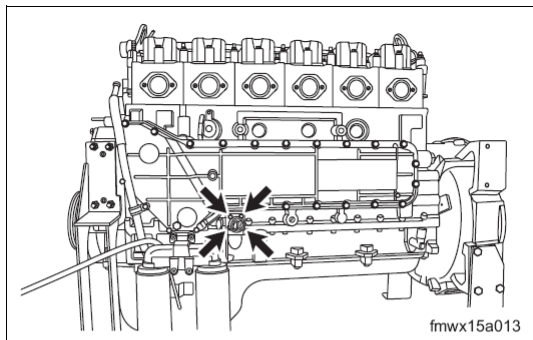
Oil Pressure Sensor

Replacement

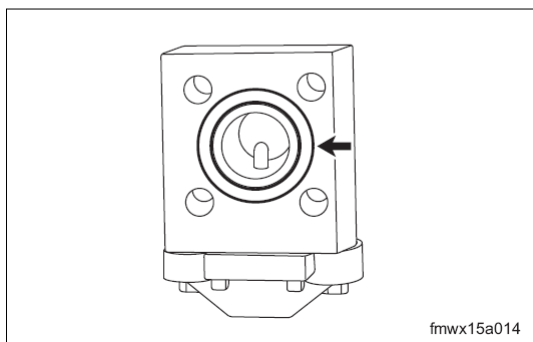
Hint:

Part Drawing, refer to Chapter 15A, Lubrication – Lubrication System, Part Drawing.

1. Drain the oil, refer to Chapter 15A, Lubrication – Oil Pan, Replacement



2. Dismantle the oil pressure sensor



3. Install the oil pressure sensor

Caution:

Check the sealing ring to find if there are damages, if there are, replace it with a new one.

Lubrication (WP12)

Lubrication System	15B-3
General	15B-3
Precautions.....	15B-5
Part Drawing	15B-6
Testing & Adjustment	15B-8
Oil Pan.....	15B-12
Replacement.....	15B-12
Oil Filter.....	15B-13
Replacement.....	15B-13
Oil Pump	15B-14
Overhaul	15B-14
Oil Cooler	15B-15
Overhaul	15B-15

15B

Lubrication System

General

Functions of Lubrication System

Lubricating function: it can lubricate the surface of the moving part, decrease the frictional drag, abrasion and watt consumption of the engine.

Cleaning function: the oil circulates continually in the lubrication system to clean the friction surface and to take away the abrasive dusts and other foreign matters.

Cooling function: the circulation of the oil in the lubrication system can also take away the heat resulting from the burning and friction to play the role of cooling.

Sealing function: the oil film is formed between the moving parts in order to improve their tightness, which can avoid air or oil leakage.

Antirust function: the oil film is formed on the surface of the part to protect the surface and to avoid corrosion.

Hydraumatic function: the oil can also be used as hydraulic oil, take hydraulic pressure staying up for example, to play the role of hydraulic.

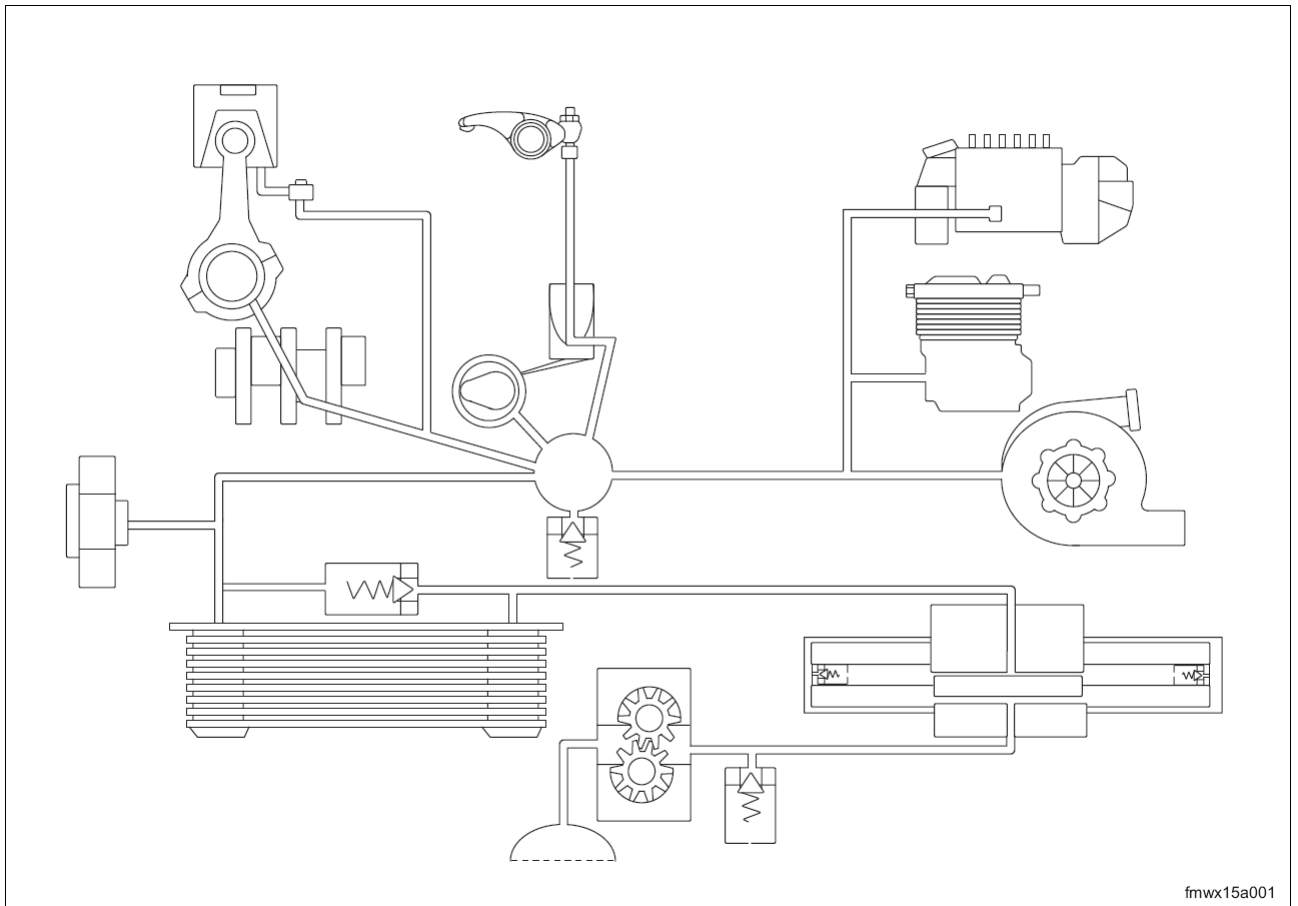
Shock absorption function: the oil film is formed on the surface of the moving part to absorb the shock and decrease the vibration, and consequently to play the role of shock absorption.

Oil

The application of the oil should be determined according to the standards of the company. Multistage oil is preferred because it is better for cold start. Multistage oil for yearly use such as 5W30, 10W40, 15W40 and so on can be only used within the specified temperature range. As for the occasional low temperature cases, take reasonable measures to preheat the oil, or replace it with another kind of oil which is fit for the ambient temperature.

The replacing time of the oil should be determined according to the need of maintaining.

Pressure Lubrication



The oil pump sucks the oil from the bottom of the oil pan via the suction filter and presses it into the oil filter and oil cooler, and then the oil reaches the lubrication location via the oil system. Most of the oil reaches the main bearing and gets to the connecting rod bearing through the oil hole on the crankshaft. The cylinder liner surface and the position pin are lubricated by the injecting fuel from the nozzle. The pressure lubrication of the valve control system, turbocharger, high-pressure oil pump, air compressor and the intermediate gear bearing is also realized by the oil pipe and tanks. The bottom of the piston is cooled by the injecting fuel from the nozzle and the oil is cooled by the coolant through the oil cooler. The oil pressure of the oil circulation system is adjusted via a relief valve. When the oil engine starts the oil pressure will be on the high level because of the low temperature and the large viscosity of the oil. But with the increase of the water temperature of the engine, the oil temperature increases, the oil pressure decreases, and when the full load water temperature of the oil engine is between 80~95°C, the normal oil pressure is between 350~550kPa.

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The oil pan is made with the method of punch forming by applying sheet steel, its faying face with the crankcase has a very deep turnup which leads to its large stiffness. Press the low fraying face via 12 oil pan support blocks and M8 bolts attaching a concave oil pan gasket. The tightness is so good that there will not be oil leakage.

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The main oil gallery relief valve is at the lower right part of the crankcase, and the starting pressure of the main oil gallery relief valve which bulges in the inner chamber of the oil pan is 500kPa.

Oil Filter

Two multiple pinning filter element structures are applied, and when carrying out the maintaining and replacement, one can only unscrew the old filter element and install a new one.

Oil Pump

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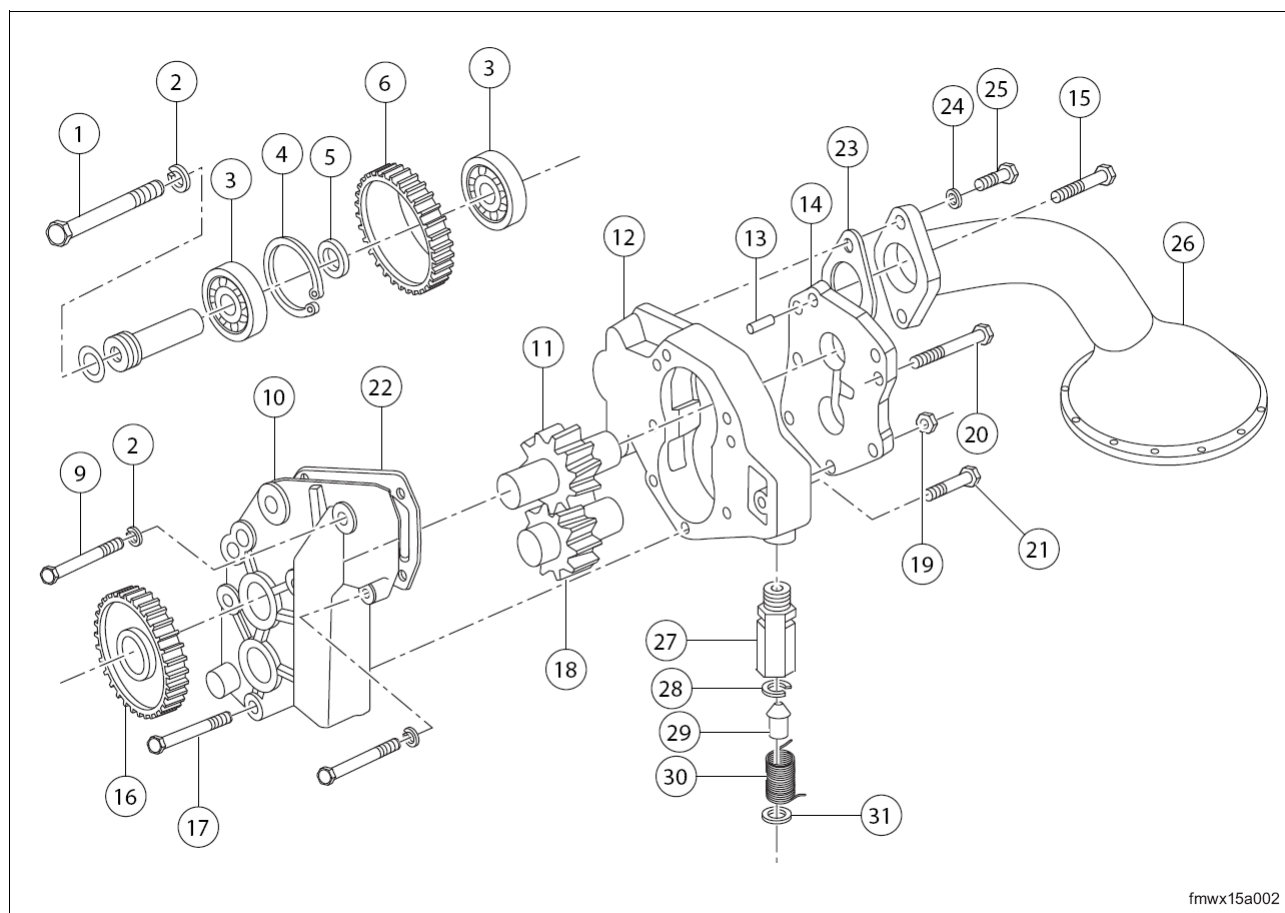
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Precautions

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4. **Replace the engine oil regularly, it would be best not to add oil, adding oil chronically will accumulate more and more oil contamination and carbon deposit which will block the oil suction filter, so the moving parts of the engine can not be lubricated, which will damage the parts seriously.**

Part Drawing



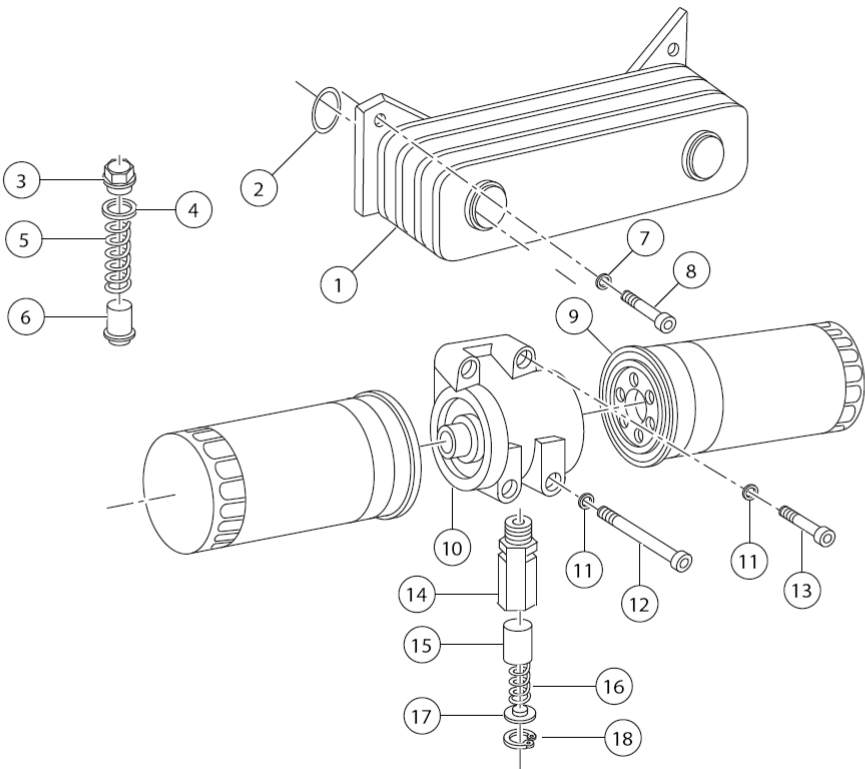
fmwx15a002

1	Hex Head Bolt
2	Spring Washer
3	Radial Ball Bearing
4	Circlip For Hole with Convex Teeth
5	Intermediate Set Collar
6	Intermediate Gear-Oil Pump
7	Sealing Ring
8	Intermediate Gear Shaft
9	Hex Head Bolt
10	8mm Widened Oil Pump
11	Front Cover-Oil Pump
12	Gear Assembly-Oil Pump
13	Housing-Oil Pump
14	Cylindrical Pin
15	Rear Cover-Oil Pump

18	Hex Head Bolt
19	Gear Assembly-Oil pump
20	Hex Nut, Style I
21	Hex Head Bolt
22	Hex Head Bolt
23	Gasket-Oil Pump
24	Gasket
25	Flat Washer
26	Hex Head Bolt
27	Suction Filter Assembly
28	Hex Head Bolt
29	Relief Valve Assembly-Oil Pump
30	Relief Valve Body
31	Circlip For Hole
32	Relief Valve

Lubrication (WP12) - Lubrication System

16	Hex Socket Cap Head Screw	33	Spring
17	Driving Gear-Oil Pump	34	Gasket



fmwx15a003

1	Oil Cooler Core Assembly	11	Wave Shape Circlip
2	Sealing Ring	12	Hex Socket Cap Head Screw
3	Hex Head Plug	13	Hex Socket Cap Head Screw
4	Composite Gasket	14	Main Oil Gallery Assembly
5	Safety Valve Spring	15	Valve Body
6	Safety Valve	16	Valve
7	Wave Shape Circlip	17	Spring Seat-Main Oil Gallery Pressure Valve
8	Hex Socket Cap Head Screw	18	Spring-Main Oil Gallery Pressure Valve
9	Rotary Oil Filter Element Assembly	19	Circlip For Hole
10	Filter Seat Assembly		

15B

Testing & Adjustment

Detection of Pump Oil

As for the engine under normal technical condition within common speed range, the oil pressure should be between 350~550kPa. If the oil pressure of medium speed is below 300kPa and of idling is below 100kPa, stop the running of the engine and check the lubrication system.

Effect factors of oil pressure:

1. **Property of the oil pump, adjustment of the relief valve, resistance of the oil gallery and oil filter**
2. **Quality, temperature and viscosity of the oil**
 - If the viscosity of the oil is low and the temperature is high, the oil pressure will decrease; otherwise it will increase.
3. **Gaps of the crankshaft main bearing, connecting rod bearing and camshaft bearing**
 - The gearing gap will become larger after wear, the oil leakage amount at the gearing gap place will increase, but the oil pressure will decrease. As a result, oil pressure is often used as an important parameter to determine the related gearing gap.
 - If the oil pump is under normal technical condition, the decrease of the oil pressure is mainly caused by the large wear of the crankshaft main journal and connecting rod journal. When the crankshaft main bearing gap increases by 0.01mm, the oil pressure will decrease by 0.01MPa.
4. **Oil pressure gauge and oil pressure sensor**
 - The oil pressure value can be showed on the instrument panel, but during the regular detection a dedicated oil pressure gauge should be used, because the oil pressure gauge and oil pressure sensor can not guarantee a necessary measurement accuracy.
 - When detecting, dismantle the oil pressure sensor first and install the oil pressure gauge. Then start the engine and make it run within specified speed, and now the indicated value on the oil pressure gauge is the oil pressure of the lubrication.

Detection of Oil Consumption

Effect factors of oil consumption:

1. **Lubrication leakage**
2. **Abnormal working of air compressor**
3. **Improper selection of oil standards**
4. **Cylinder-piston assembly wear**
 - The oil consumption can both reflect the technical condition of the engine lubrication system and help determine the wear condition of the cylinder-piston assembly
 - The main reasons of the large oil consumption are large wear of cylinder-piston assembly, gap increase and the burning of the oil into the burning chamber on condition that the mark of the oil is correct and the technical conditions of other mechanisms is normal.

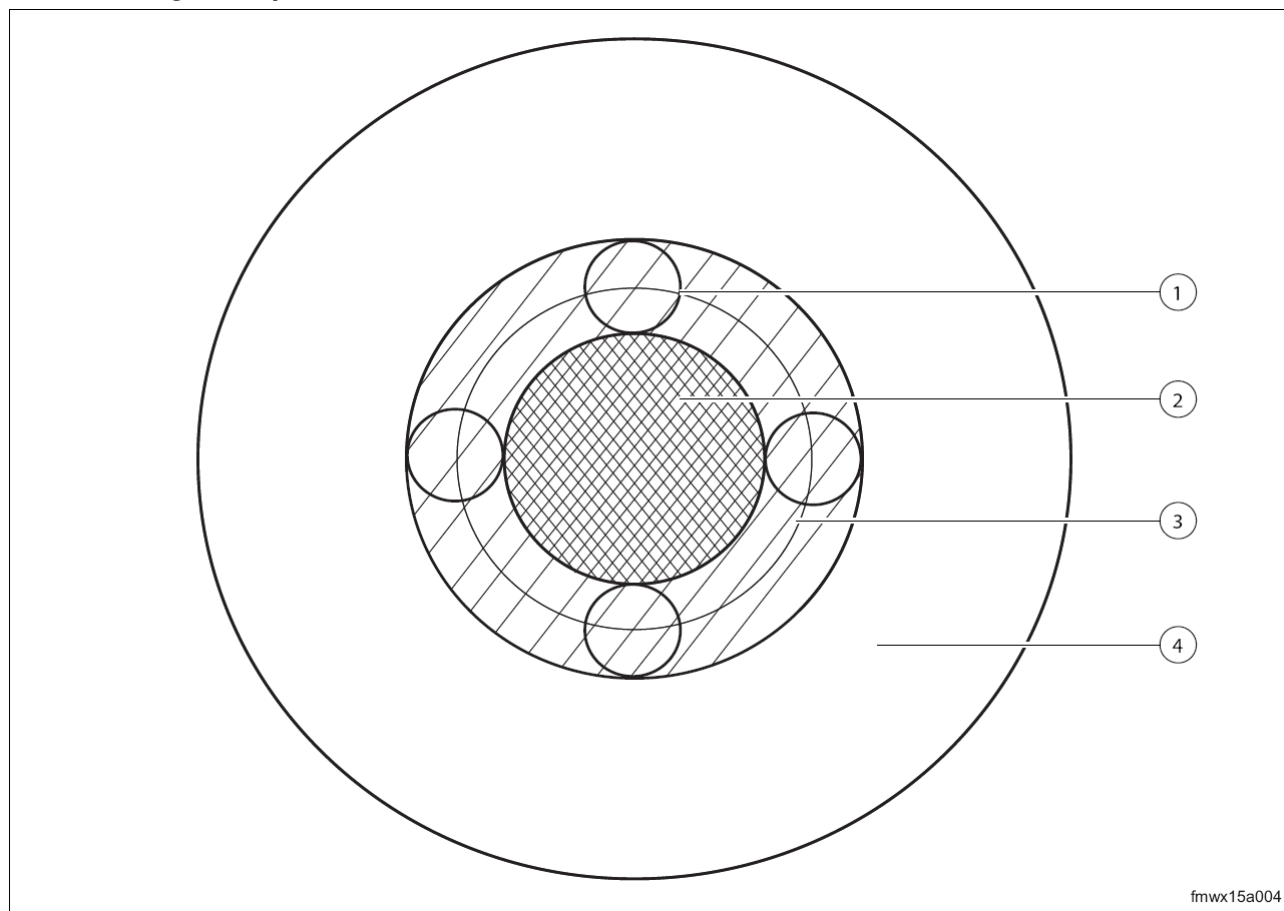
The oil consumption is about 0.1~0.5L/100km; when the engine wear is serious, it can reach 1L/100km or more. As for the measurement of oil consumption, all that is needed is to make a conversion of the real oil consumption (L) of the vehicle after running for some mileages (1000~1500 km) into the average oil consumption (L/100km) per hundred kilometers of the vehicle.

Testing and Analysis of Oil Quality

During the use of the oil, its quality will go bad gradually because of the impurity contamination, oil dilution, high-temperature oxidation, additive consumption or its performance loss. Visually, the color will go black and the viscosity will increase or decrease.

Lubrication (WP12) - Lubrication System

The impurities leading to the oil contamination are mainly from the wear particles on the friction surface, the outside dust and carbon deposition; the abnormal working, imperfect burning or misfiring of the engine will make the oil that does not burn flow into the oil pan to dilute the oil; the high temperature resulting from the engine working, especially when the cylinder-piston assembly wear is serious, the gap becomes larger, and there is high temperature and pressure gas in the combustion stroke whisking into the crankcase, it will aggravate the oil oxidation and produce oxide and oxidative polymer. The detergent dispersant in the oil is an important kind of additive for the oil, and it has the abilities of scattering and taking away the particles and carbon deposition on the friction surface. The detergent dispersant consumption and property decrease will also make it lose the function of cleaning and dispersing.

Filter Paper Oil Patch Testing Method**1. Testing Principle**

fmwx15a004

1	Black Circle
2	Centre Region

3	Diffusion Region
4	Translucence Region

- Drop the engaged oil on specified filter, the oil drop will soak and disperse around gradually, finally multi-ring ringlike oil patches with different color shades will be formed and there are deep color nuclear in the centre of the patches. If the concentration and particle size of the impurities in the oil are different and their abilities of cleaning and dispersing differ from each other, the color shades of each ring region of the oil patches will also be different.
- If the particle size of the impurities in the oil is small and their cleaning and dispersing abilities are perfect, the impurity particle will disperse farther, the impurity concentrations and the color shade extents of the centre region and diffusion region have no significant differences; if the particle size of the impurities in the oil is large and they lose the abilities of cleaning and dispersing, the impurities in the oil will centralize into the centre region gradually, and the impurity concentrations and the color shade extents of the centre region and diffusion region

will have significant differences. As a result, the impurity concentration of the centre region on the oil patch can reflect the total contamination extent, and the subtraction of the impurity concentration of per unit centre region and the impurity concentration of per unit diffusion region can reflect the cleaning and dispersing abilities of the detergent dispersant in the oil.

2. Testing Method

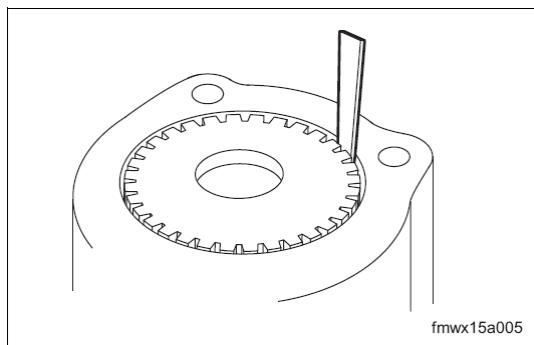
- Make two pieces of the same type by using organic glass (cardboard, plastic plate or board can also be used) with the length and width 12cm×7cm, scrap out a circular hole with the diameter 5cm, and bond one side with adhesive plaster to make the rear of the filter not touch the table-board, which can affect the diffusion of the oil patches.
- Take the oil sample out of the engine under thermal condition and put it into the test tube, poke into the tube oil level to certain depth by using a drop rod with specified size (a metal rod with a smooth tip, the diameter is 2mm and the length is 150mm), then take out of the drop rod and drip the third oil drop onto the filter paper to form the oil patch.
- Lay the filter paper with oil drops together with the frame at a place with no blown dust, let it stand for 2~4h, observe the diffusion formation of the patch, and make a judgment through comparative analysis with the standard atlas (National Standard GB/T7607-2002 *Filter Paper Oil Patch Testing Method For Combustion Engine Oil*)

3. Evaluation Standards

- 1 level: The core region and the diffusion ring in the filter paper patch picture are bright and colorless or the color is light, and there are no obvious deposition rings. This indicates that the oil is new or its service time is very short, there is no contamination, and it can be used sequentially.
- 2 level: There is a clear bound between the deposition ring and the diffusion ring in the filter paper patch picture, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is not long and the contamination extent is slight, the detergent dispersant properties are good and it can be used sequentially.
- 3 level: The deposition ring in the filter paper patch picture is dull black, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is long and the contamination extent is great, but the detergent dispersant properties are good and it can be used sequentially.
- 4 level: The deposition ring in the filter paper patch picture is jet black, the diffusion ring begins to lessen and the oil ring is light yellow. This indicates that the service time of the oil is very long and the amount of the depositing sediments increases, the detergent dispersant properties get worse, but it can be used sequentially.
- 5 level: The deposition ring in the filter paper patch picture is jet black and even presents a fault state, it is not easy to be dried, the diffusion ring is narrow, and the oil ring is large with a yellow color. This indicates that the contamination of the oil is already quite serious and detergent dispersant abilities are poor, the detergent dispersant will be used up and it can't be used anymore, then new oil should be used as the replacement.
- 6 level: There is only very black deposition ring and brown orange oil ring in the filter paper patch picture, and the diffusion ring has disappeared completely. This indicates that the contamination of the oil is already quite serious, the contamination impurities completely gather in the deposition ring, and the detergent dispersant is used up, the detergent dispersant abilities are lost, and it has already been long since the oil replacement time.

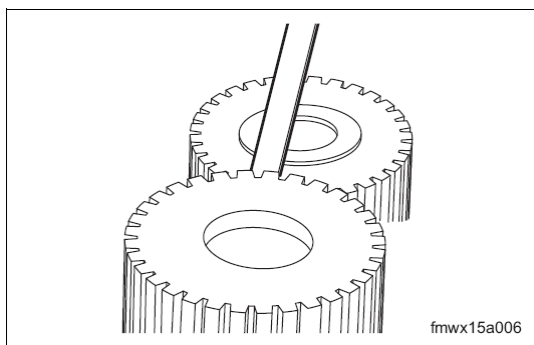
Lubrication (WP12) - Lubrication System

Oil Pump



1. Check the inwall gap of the driving/driven gears and pump cavity

- Measure with a plug gauge to insert the gap between the two, and when it is beyond 0.3mm, replace with a new one.



2. Check the rear gap of the driving/driven gears

- Insert the rear gap by using a plug gauge to measure the 120° three-point, the standard is 0.05mm, and the use limit is 0.20mm.

Oil Cooler

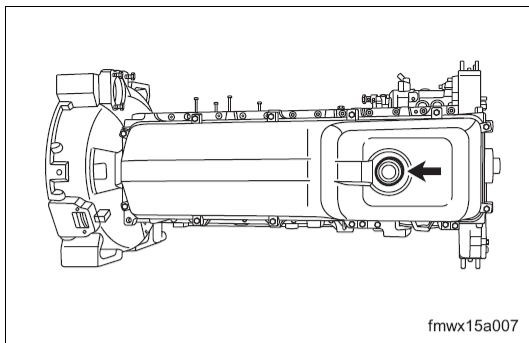
Dip the oil cooler into water, block the exit, blow compressed air into the oil cooler entrance and observe if there are bubbles in the water.

Oil Pan

Replacement

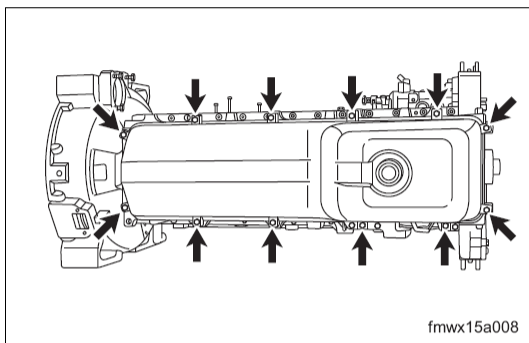
Hint:

Part Drawing, refer to Chapter 15B, Lubrication–Lubrication System, Part Drawing.



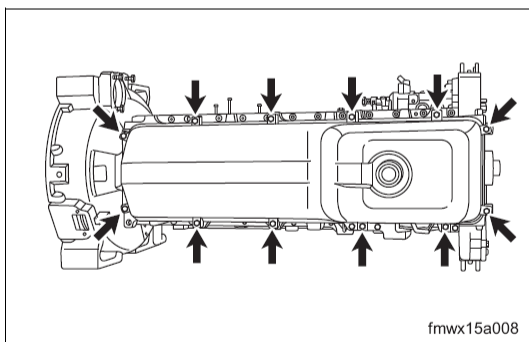
1. Drain the lubricating oil

- (a). Dismantle the oil drain bolt.



2. Dismantle the oil pan

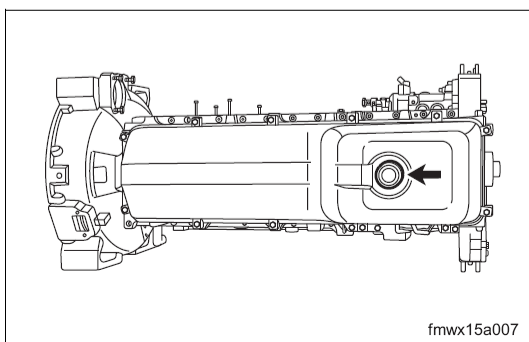
- (a). Dismantle the 12 oil pan support block fixing bolts.
(b). Receive the oil from the oil pan with a clean container.



3. Install the oil pan

- (a). Install the 12 oil pan support block fixing bolts.

Torque: 25N•m



- (b). Install the oil drain bolt.

Torque: 25N•m

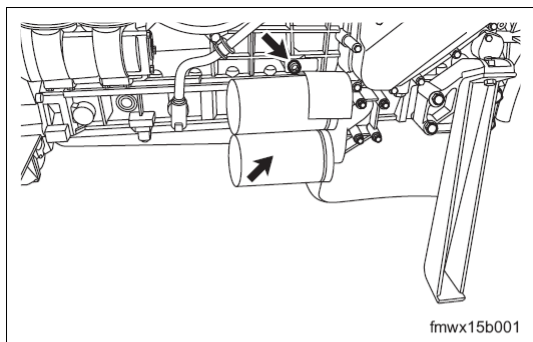
- (c). Fill lubricating oil.

Oil Filter

Replacement

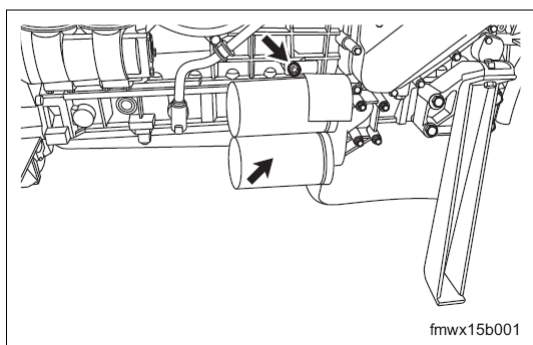
Hint:

Part Drawing, refer to Chapter 15B, Lubrication–Lubrication System, Part Drawing.



1. Dismantle the oil filter

- (a). Unscrew the oil filter.
- (b). Receive the oil from the oil pan with a clean container.



2. Install the oil filter

- (a). Screw down the oil filter.
 - Apply clean oil to the sealing ring before screwing.

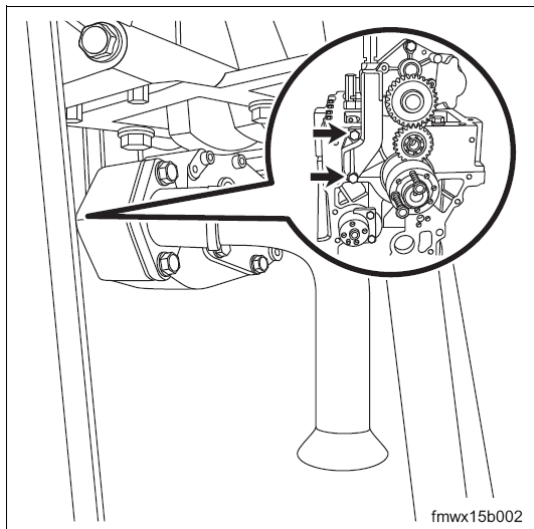
Oil Pump

Overhaul

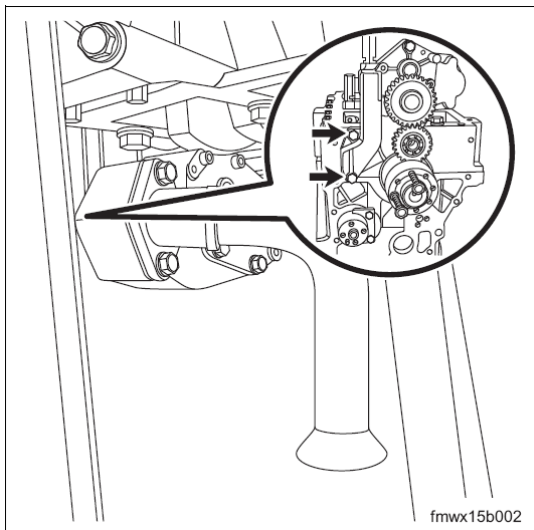
Hint:

Part Drawing, refer to Chapter 15B, Lubrication – Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15A, Lubrication – Oil Pan, Replacement**
2. **Dismantle the oil pump**



3. **Check the oil pump, refer to Chapter 15B, Lubrication – Lubrication System, Testing & Adjustment**
4. **Install the oil pump**
Torque: $62.5 \pm 2.5 \text{ N} \cdot \text{m}$



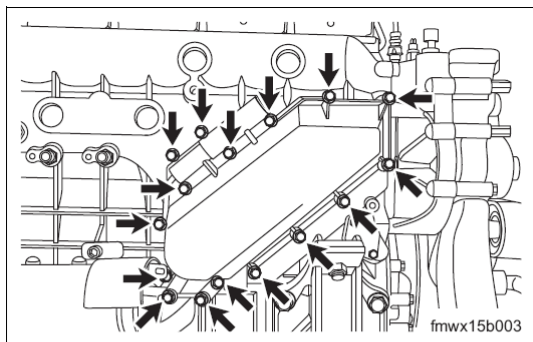
Oil Cooler

Overhaul

Hint:

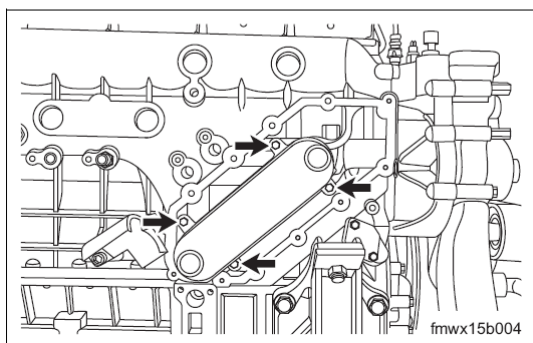
Part Drawing, refer to Chapter 15B, Lubrication–Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15B, Lubrication–Oil Pan, Replacement**
2. **Drain the coolant, refer to Chapter 14B, Cooling–Coolant, Replacement**



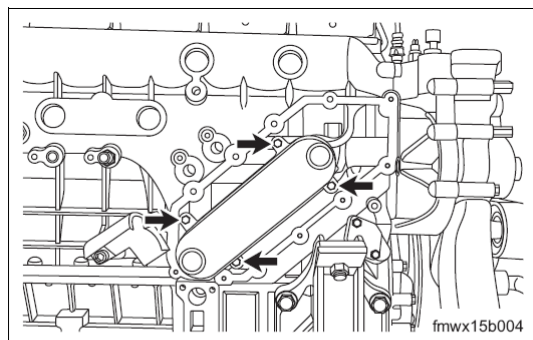
3. Dismantle the oil cooler

- (a). Dismantle the air pipe support of the crankcase.
- (b). Dismantle the water gallery cover of the engine.



- (c). Dismantle the oil cooler.

4. **Check the oil cooler, refer to Chapter 15B, Lubrication–Lubrication System, Testing & Adjustment**



5. Install the oil cooler

- (a). Install the oil cooler

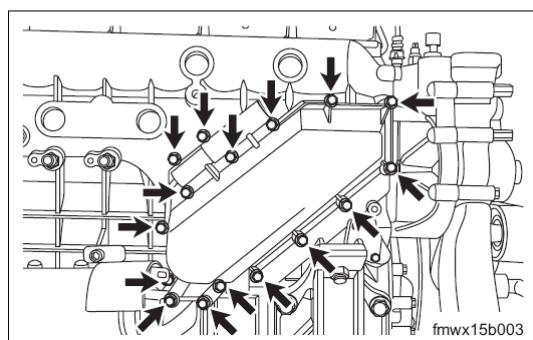
Torque: 25N•m

- (b). Install the water gallery cover of the engine.

Torque: 25N•m

Caution:

Check the sealing ring to find if there are damages, if there are, replace it with a new one.



Lubrication (WP12) - Oil Cooler

6. Fill the coolant, refer to Chapter 14B, Cooling–Coolant, Replacement
7. Fill the oil, refer to Chapter 15B, Lubrication–Oil Pan, Replacement

Lubrication (WD615)

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Replacement	15C-12
Oil Filter	15C-13
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Oil Cooler.....	15C-15
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15C

Lubrication System

General

Functions of Lubrication System

Lubricating function: it can lubricate the surface of the moving part, decrease the frictional drag, abrasion and watt consumption of the engine.

Cleaning function: the oil circulates continually in the lubrication system to clean the friction surface and to take away the abrasive dusts and other foreign matters.

Cooling function: the circulation of the oil in the lubrication system can also take away the heat resulting from the burning and friction to play the role of cooling.

Sealing function: the oil film is formed between the moving parts in order to improve their tightness, which can avoid air or oil leakage.

Antirust function: the oil film is formed on the surface of the part to protect the surface and to avoid corrosion.

Hydraumatic function: the oil can also be used as hydraulic oil, take hydraulic pressure staying up for example, to play the role of hydraulic.

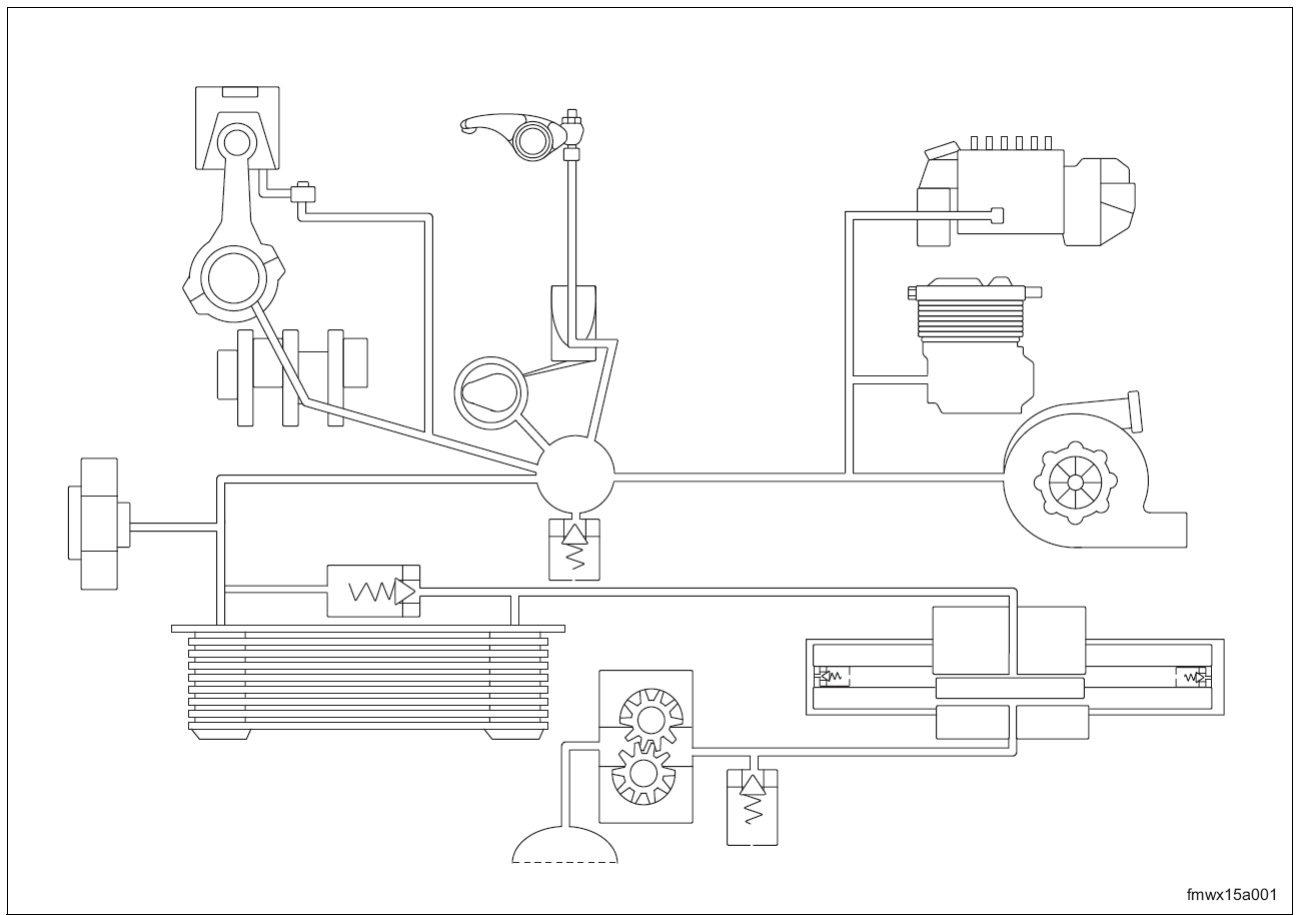
Shock absorption function: the oil film is formed on the surface of the moving part to absorb the shock and decrease the vibration, and consequently to play the role of shock absorption.

Oil

The application of the oil should be determined according to the standards of the company. Multistage oil is preferred because it is better for cold start. Multistage oil for yearly use such as 5W30, 10W40, 15W40 and so on can be only used within the specified temperature range. As for the occasional low temperature cases, take reasonable measures to preheat the oil, or replace it with another kind of oil which is fit for the ambient temperature.

The replacing time of the oil should be determined according to the need of maintaining.

Pressure Lubrication



The oil pump sucks the oil from the bottom of the oil pan via the suction filter and presses it into the oil filter and oil cooler, and then the oil reaches the lubrication location via the oil system. Most of the oil reaches the main bearing and gets to the connecting rod bearing through the oil hole on the crankshaft. The cylinder liner surface and the position pin are lubricated by the injecting fuel from the nozzle. The pressure lubrication of the valve control system, turbocharger, high-pressure oil pump, air compressor and the intermediate gear bearing is also realized by the oil pipe and tanks. The bottom of the piston is cooled by the injecting fuel from the nozzle and the oil is cooled by the coolant through the oil cooler. The oil pressure of the oil circulation system is adjusted via a relief valve. When the oil engine starts the oil pressure will be on the high level because of the low temperature and the large viscosity of the oil. But with the increase of the water temperature of the engine, the oil temperature increases, the oil pressure decreases, and when the full load water temperature of the oil engine is between 80~95°C, the normal oil pressure is between 350~550kPa.

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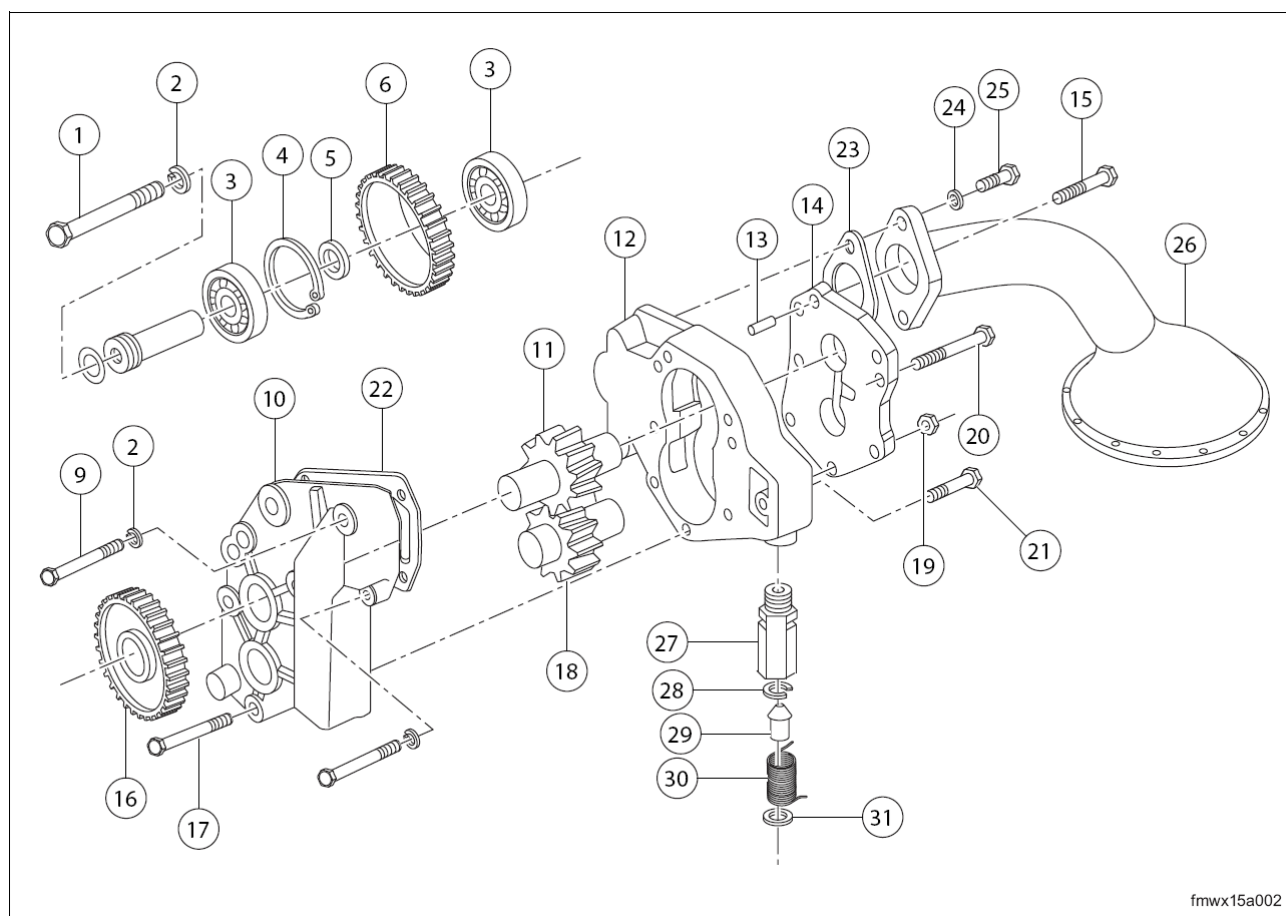
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Part Drawing



fmwx15a002

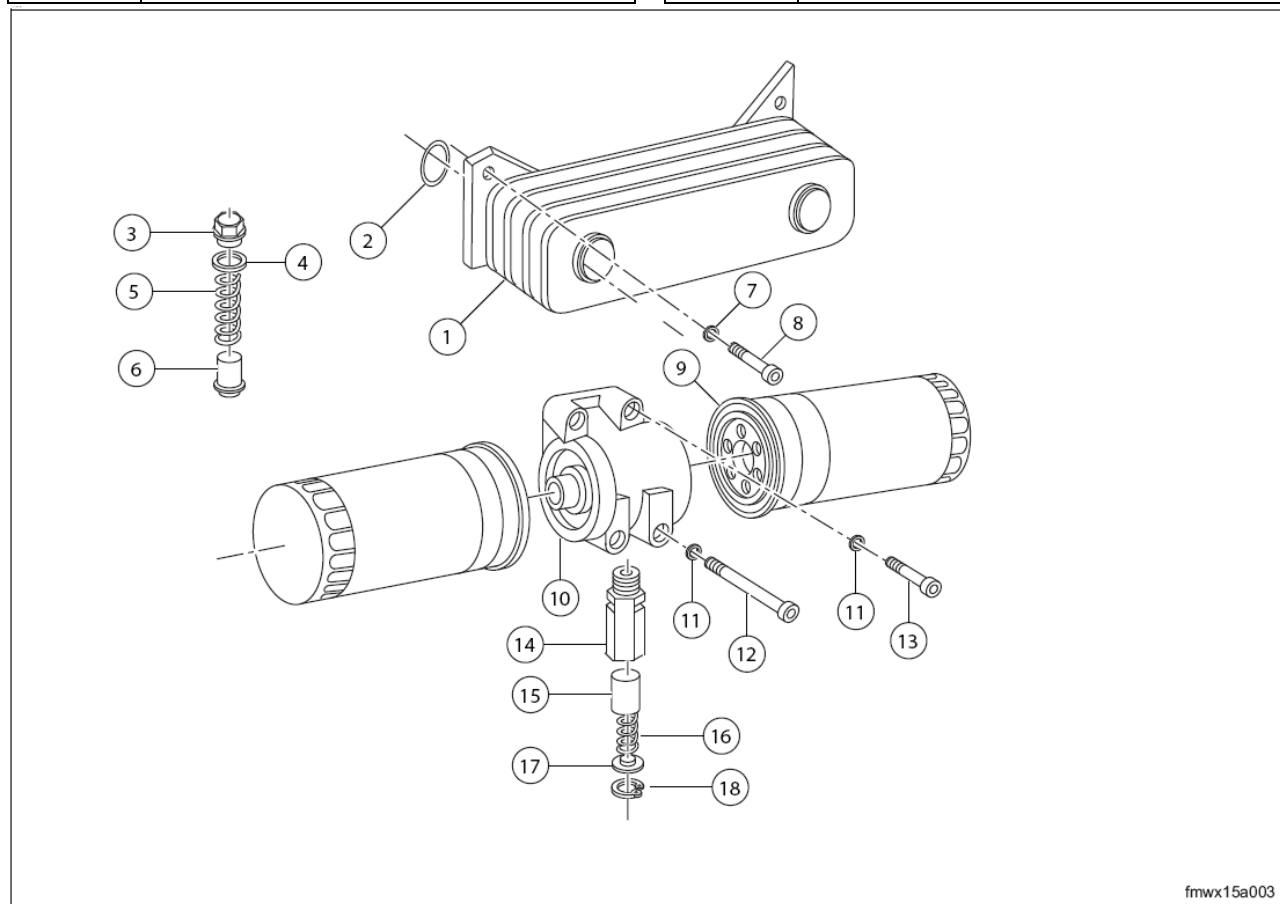
1	Hex Head Bolt
2	Spring Washer
3	Radial Ball Bearing
4	Circlip For Hole with Convex Teeth
5	Intermediate Set Collar
6	Intermediate Gear-Oil Pump
7	Sealing Ring
8	Intermediate Gear Shaft
9	Hex Head Bolt
10	8mm Widened Oil Pump
11	Front Cover-Oil Pump
12	Gear Assembly-Oil Pump
13	Housing-Oil Pump
14	Cylindrical Pin
15	Rear Cover-Oil Pump

18	Hex Head Bolt
19	Gear Assembly-Oil pump
20	Hex Nut, Style I
21	Hex Head Bolt
22	Hex Head Bolt
23	Gasket-Oil Pump
24	Gasket
25	Flat Washer
26	Hex Head Bolt
27	Suction Filter Assembly
28	Hex Head Bolt
29	Relief Valve Assembly-Oil Pump
30	Relief Valve Body
31	Circlip For Hole
32	Relief Valve

Lubrication (WD615) – Lubrication System

16	Hex Socket Cap Head Screw
17	Driving Gear-Oil Pump

33	Spring
34	Gasket



fmwx15a003

1	Oil Cooler Core Assembly
2	Sealing Ring
3	Hex Head Plug
4	Composite Gasket
5	Safety Valve Spring
6	Safety Valve
7	Wave Shape Circlip
8	Hex Socket Cap Head Screw
9	Rotary Oil Filter Element Assembly
10	Filter Seat Assembly

11	Wave Shape Circlip
12	Hex Socket Cap Head Screw
13	Hex Socket Cap Head Screw
14	Main Oil Gallery Assembly
15	Valve Body
16	Valve
17	Spring Seat-Main Oil Gallery Pressure Valve
18	Spring-Main Oil Gallery Pressure Valve
19	Circlip For Hole

Testing & Adjustment

Detection of Pump Oil

As for the engine under normal technical condition within common speed range, the oil pressure should be between 350~550kPa. If the oil pressure of medium speed is below 300kPa and of idling is below 100kPa, stop the running of the engine and check the lubrication system.

Effect factors of oil pressure:

1. **Property of the oil pump, adjustment of the relief valve, resistance of the oil gallery and oil filter**
2. **Quality, temperature and viscosity of the oil**
 - If the viscosity of the oil is low and the temperature is high, the oil pressure will decrease; otherwise it will increase.
3. **Gaps of the crankshaft main bearing, connecting rod bearing and camshaft bearing**
 - The gearing gap will become larger after wear, the oil leakage amount at the gearing gap place will increase, but the oil pressure will decrease. As a result, oil pressure is often used as an important parameter to determine the related gearing gap.
 - If the oil pump is under normal technical condition, the decrease of the oil pressure is mainly caused by the large wear of the crankshaft main journal and connecting rod journal. When the crankshaft main bearing gap increases by 0.01mm, the oil pressure will decrease by 0.01MPa.
4. **Oil pressure gauge and oil pressure sensor**
 - The oil pressure value can be showed on the instrument panel, but during the regular detection a dedicated oil pressure gauge should be used, because the oil pressure gauge and oil pressure sensor can not guarantee a necessary measurement accuracy.
 - When detecting, dismantle the oil pressure sensor first and install the oil pressure gauge. Then start the engine and make it run within specified speed, and now the indicated value on the oil pressure gauge is the oil pressure of the lubrication.

Detection of Oil Consumption

Effect factors of oil consumption:

1. **Lubrication leakage**
2. **Abnormal working of air compressor**
3. **Improper selection of oil standards**
4. **Cylinder-piston assembly wear**
 - The oil consumption can both reflect the technical condition of the engine lubrication system and help determine the wear condition of the cylinder-piston assembly
 - The main reasons of the large oil consumption are large wear of cylinder-piston assembly, gap increase and the burning of the oil into the burning chamber on condition that the mark of the oil is correct and the technical conditions of other mechanisms is normal.

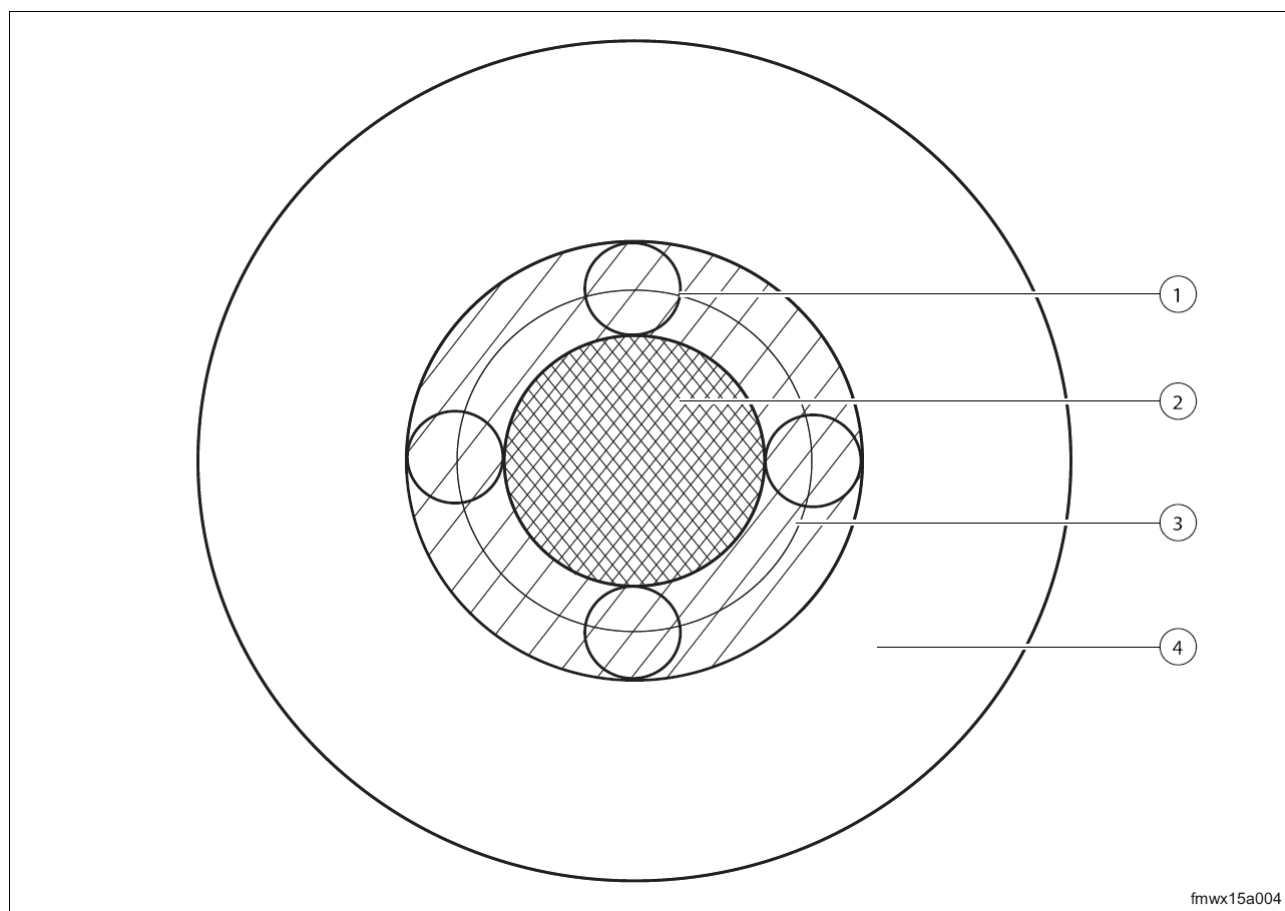
The oil consumption is about 0.1~0.5L/100km; when the engine wear is serious, it can reach 1L/100km or more. As for the measurement of oil consumption, all that is needed is to make a conversion of the real oil consumption (L) of the vehicle after running for some mileages (1000~1500 km) into the average oil consumption (L/100km) per hundred kilometers of the vehicle.

Testing and Analysis of Oil Quality

During the use of the oil, its quality will go bad gradually because of the impurity contamination, oil dilution, high-temperature oxidation, additive consumption or its performance loss. Visually, the color will go black and the viscosity will increase or decrease.

Lubrication (WD615) – Lubrication System

The impurities leading to the oil contamination are mainly from the wear particles on the friction surface, the outside dust and carbon deposition; the abnormal working, imperfect burning or misfiring of the engine will make the oil that does not burn flow into the oil pan to dilute the oil; the high temperature resulting from the engine working, especially when the cylinder-piston assembly wear is serious, the gap becomes larger, and there is high temperature and pressure gas in the combustion stroke whisking into the crankcase, it will aggravate the oil oxidation and produce oxide and oxidative polymer. The detergent dispersant in the oil is an important kind of additive for the oil, and it has the abilities of scattering and taking away the particles and carbon deposition on the friction surface. The detergent dispersant consumption and property decrease will also make it lose the function of cleaning and dispersing.

Filter Paper Oil Patch Testing Method**1. Testing Principle**

fmwx15a004

1	Black Circle
2	Centre Region

3	Diffusion Region
4	Translucence Region

- Drop the engaged oil on specified filter, the oil drop will soak and disperse around gradually, finally multi-ring ringlike oil patches with different color shades will be formed and there are deep color nuclear in the centre of the patches. If the concentration and particle size of the impurities in the oil are different and their abilities of cleaning and dispersing differ from each other, the color shades of each ring region of the oil patches will also be different.
- If the particle size of the impurities in the oil is small and their cleaning and dispersing abilities are perfect, the impurity particle will disperse father, the impurity concentrations and the color shade extents of the centre region and diffusion region have no significant differences; if the particle size of the impurities in the oil is large and they lose the abilities of cleaning and dispersing, the impurities in the oil will centralize into the centre region gradually, and the impurity concentrations and the color shade extents of the centre region and diffusion region will have significant differences. As a result, the impurity concentration of the centre region on the oil patch can reflect the total contamination extent, and the subtraction of the impurity concentration of per unit centre region and the impurity concentration of per unit diffusion region can reflect the cleaning and dispersing abilities of the detergent dispersant in the oil.

2. Testing Method

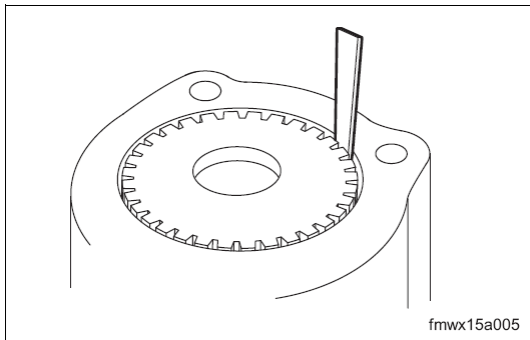
- Make two pieces of the same type by using organic glass (cardboard, plastic plate or board can also be used) with the length and width 12cm×7cm, scrap out a circular hole with the diameter 5cm, and bond one side with adhesive plaster to make the rear of the filter not touch the table-board , which can affect the diffusion of the oil patches.
- Take the oil sample out of the engine under thermal condition and put it into the test tube, poke into the tube oil level to certain depth by using a drop rod with specified size (a mental rod with a smooth tip, the diameter is 2mm and the length is 150mm), then take out of the drop rod and drip the third oil drop onto the filter paper to form the oil patch.
- Lay the filter paper with oil drops together with the frame at a place with no blown dust, let it stand for 2~4h, observe the diffusion formation of the patch, and make a judgment through comparative analysis with the standard atlas (National Standard GB/T7607-2002 *Filter Paper Oil Patch Testing Method For Combustion Engine Oil*)

3. Evaluation Standards

- 1 level: The core region and the diffusion ring in the filter paper patch picture are bright and colorless or the color is light, and there are no obvious deposition rings. This indicates that the oil is new or its service time is very short, there is no contamination, and it can be used sequentially.
- 2 level: There is a clear bound between the deposition ring and the diffusion ring in the filter paper patch picture, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is not long and the contamination extent is slight, the detergent dispersant properties are good and it can be used sequentially.
- 3 level: The deposition ring in the filter paper patch picture is dull black, the diffusion ring is wide and the oil ring is bright. This indicates that the service time of the oil is long and the contamination extent is great, but the detergent dispersant properties are good and it can be used sequentially.
- 4 level: The deposition ring in the filter paper patch picture is jet black, the diffusion ring begins to lessen and the oil ring is light yellow. This indicates that the service time of the oil is very long and the amount of the depositing sediments increases, the detergent dispersant properties get worse, but it can be used sequentially.

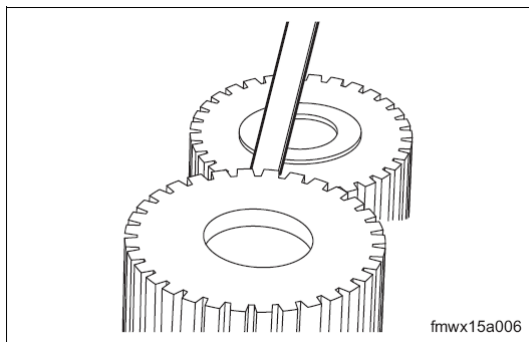
Lubrication (WD615) – Lubrication System

- 5 level: The deposition ring in the filter paper patch picture is jet black and even presents a fault state, it is not easy to be dried, the diffusion ring is narrow, and the oil ring is large with a yellow color. This indicates that the contamination of the oil is already quite serious and detergent dispersant abilities are poor, the detergent dispersant will be used up and it can't be used anymore, then new oil should be used as the replacement.
- 6 level: There is only very black deposition ring and brown orange oil ring in the filter paper patch picture, and the diffusion ring has disappeared completely. This indicates that the contamination of the oil is already quite serious, the contamination impurities completely gather in the deposition ring, and the detergent dispersant is used up, the detergent dispersant abilities are lost, and it has already been long since the oil replacement time.

Oil Pump

1. Check the inwall gap of the driving/driven gears and pump cavity

- Measure with a plug gauge to insert the gap between the two, and when it is beyond 0.3mm, replace with a new one.



2. Check the rear gap of the driving/driven gears

- Insert the rear gap by using a plug gauge to measure the 120° three-point, the standard is 0.05mm, and the use limit is 0.20mm.

Oil Cooler

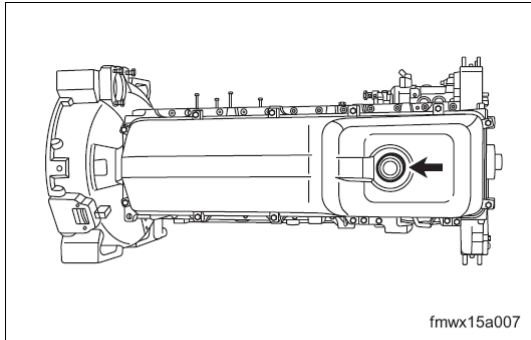
Dip the oil cooler into water, block the exit, blow compressed air into the oil cooler entrance and observe if there are bubbles in the water.

Oil Pan

Replacement

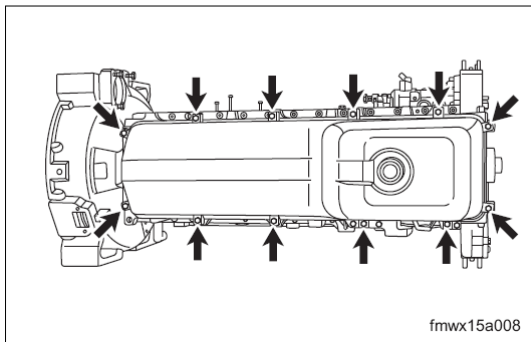
Hint:

Part Drawing, refer to Chapter 15C, Lubrication–Lubrication System, Part Drawing.



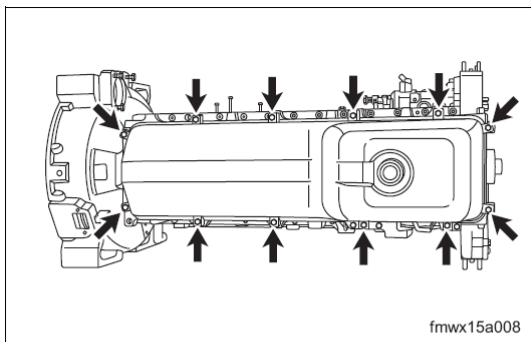
1. Drain the lubricating oil

- (a). Dismantle the oil drain bolt.
- (b). Receive the oil from the oil pan with a clean container.



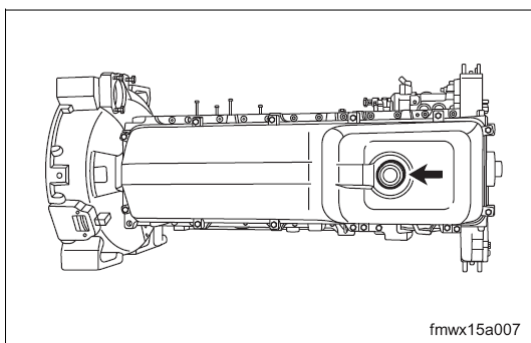
2. Dismantle the oil pan

- (a). Dismantle the 12 oil pan support block fixing bolts.



3. Install the oil pan

- (a). Install the 12 oil pan support block fixing bolts.
Torque: 25N•m



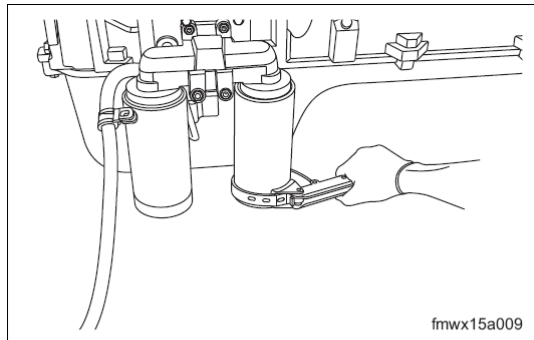
- (b). Install the oil drain bolt.
Torque: 25N•m
- (c). Fill lubricating oil.

Oil Filter

Replacement

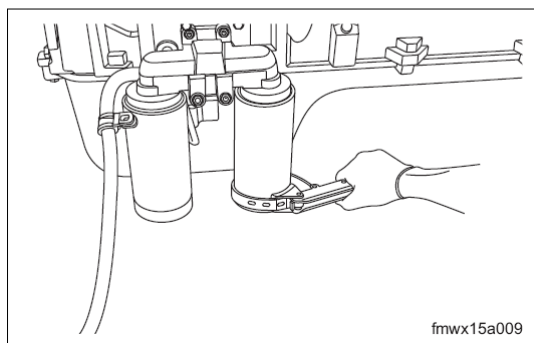
Hint:

Part Drawing, refer to Chapter 15C, Lubrication–Lubrication System, Part Drawing.



1. Dismantle the oil filter

- (a). Unscrew the oil filter.
- (b). Receive the oil from the oil pan with a clean container.



2. Install the oil filter

- (a). Screw down the oil filter.
 - Apply clean oil to the sealing ring before screwing.

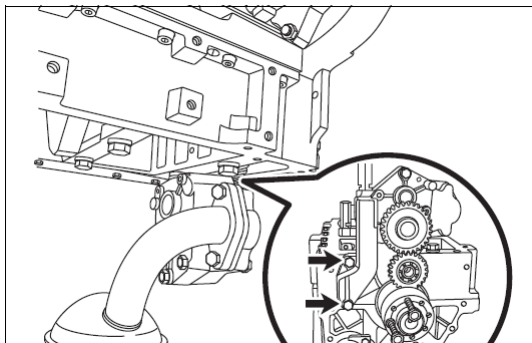
Oil Pump

Overhaul

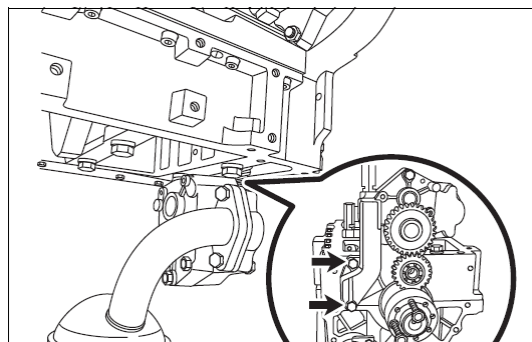
Hint:

Part Drawing, refer to Chapter 15C, Lubrication – Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15C, Lubrication – Oil Pan, Replacement**
2. **Dismantle the oil pump**



3. **Check the oil pump, refer to Chapter 15C, Lubrication – Lubrication System, Testing & Adjustment**



4. **Install the oil pump**
Torque: $62.5 \pm 2.5 \text{ N} \cdot \text{m}$

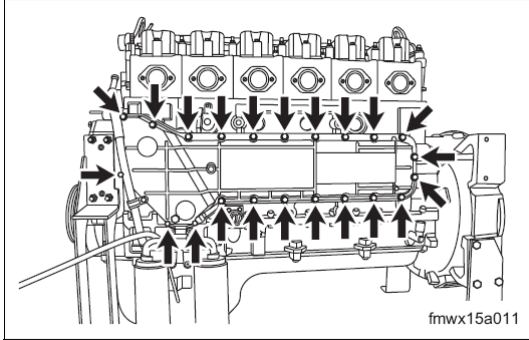
Oil Cooler

Overhaul

Hint:

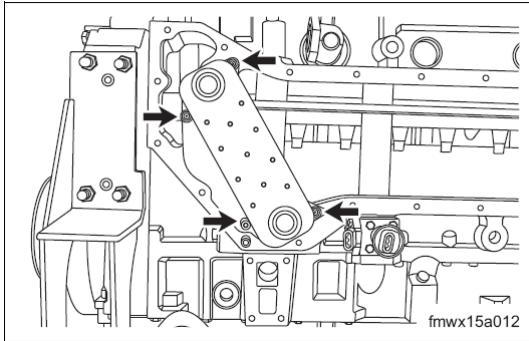
Part Drawing, refer to Chapter 15C, Lubrication–Lubrication System, Part Drawing.

1. **Drain the oil, refer to Chapter 15C, Lubrication–Oil Pan, Replacement**
2. **Drain the coolant, refer to Chapter 14C, Cooling–Coolant, Replacement**



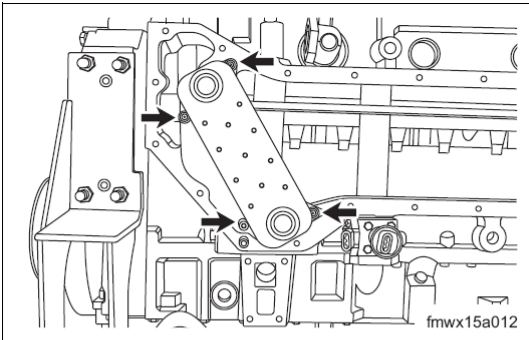
3. Dismantle the oil cooler

- (a). Dismantle the air pipe support of the crankcase.
- (b). Dismantle the water gallery cover of the engine.



- (c). Dismantle the oil cooler.

4. **Check the oil cooler, refer to Chapter 15A, Lubrication–Lubrication System, Testing & Adjustment**

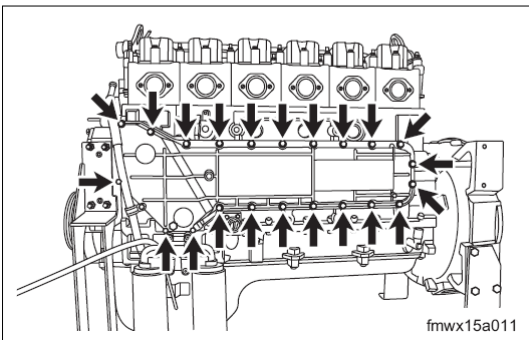


5. Install the oil cooler

- (a). Install the oil cooler

Torque: 25N•m

15C



- (b). Install the water gallery cover of the engine.

Torque: 25N•m

Caution:

Check the sealing ring to find if there are damages, if there are, replace it with a new one.

6. Fill the coolant, refer to Chapter 14C, Cooling–Coolant, Replacement
7. Fill the oil, refer to Chapter 15C, Lubrication–Oil Pan, Replacement

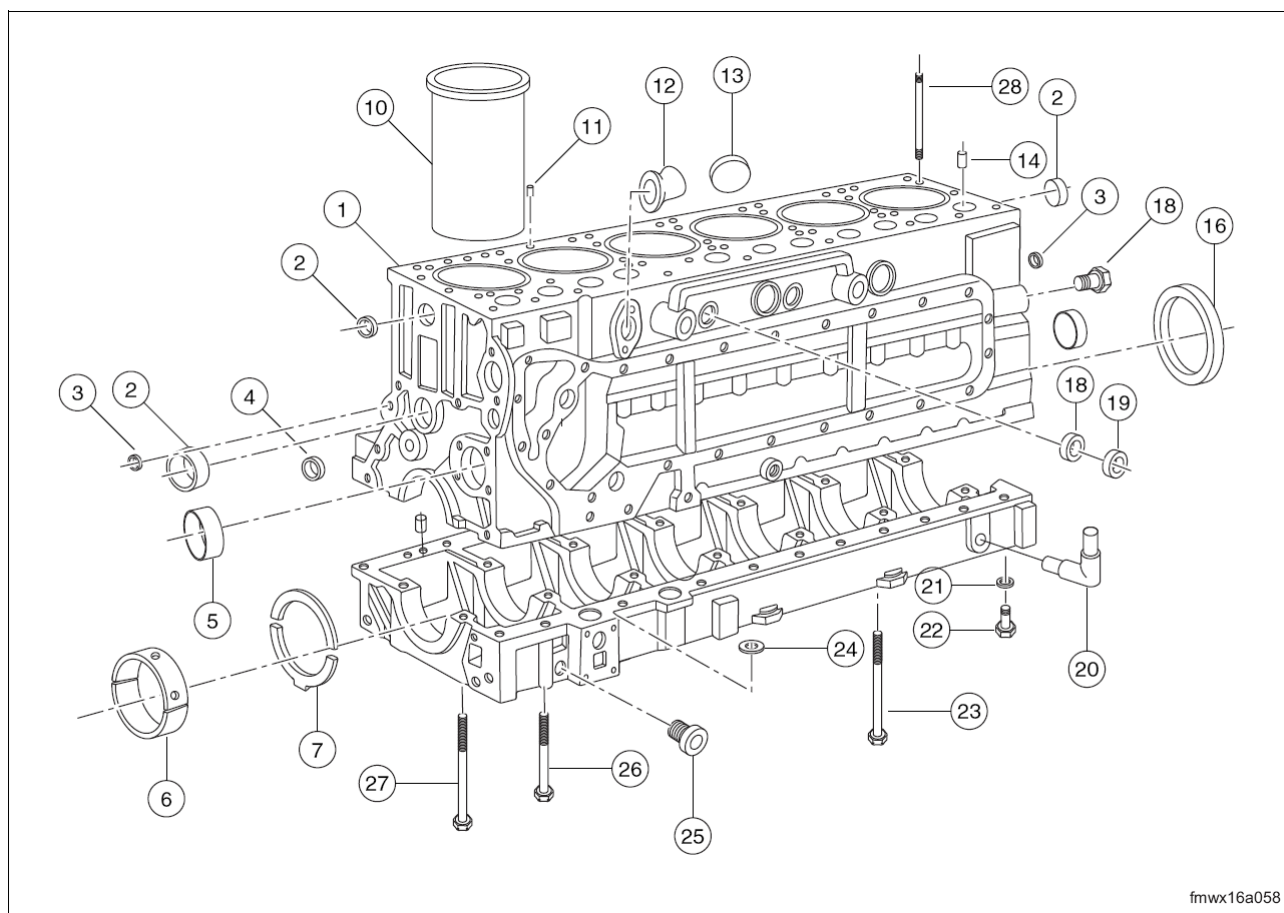
Engine Mechanical (WP10)

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Replacement	16A-35
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Replacement	16A-38

16A

Engine Mechanical

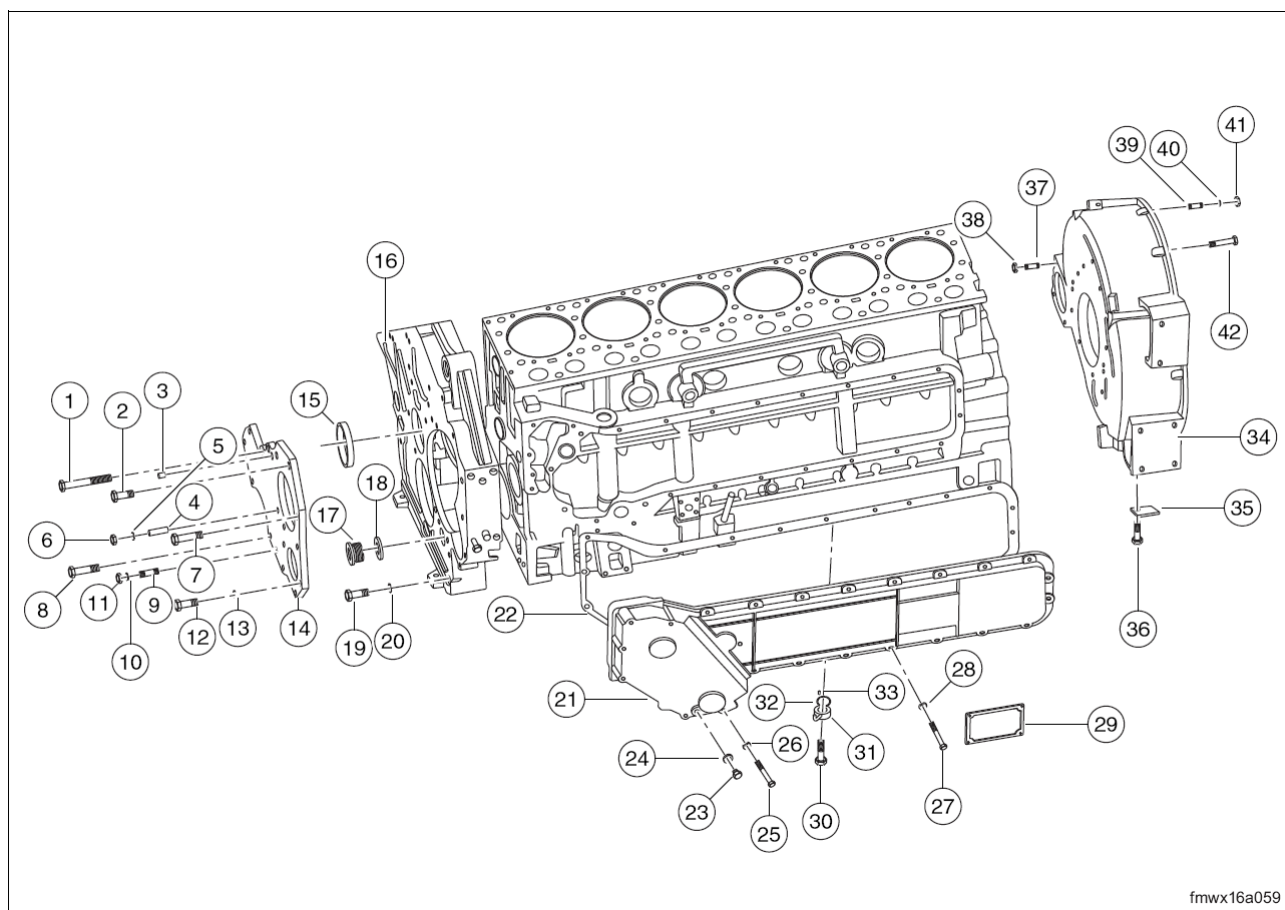
Part Drawing



fmwx16a058

1	Cylinder Body	15	Rear Screw Plug, Main Oil Gallery
2	Core Plug	16	Rear Oil Seal
3	Core Plug	17	Core Plug
4	Core Plug	18	Core Plug
5	Camshaft Bushing	19	Core Plug
6	Main Bearing	20	Oil Return Elbow
7	Thrust Gasket	21	Self-locking Washer
8	Crankcase	22	Hex Socket Cap Head Screw
9	Cylindrical Pin	23	Main Bearing Bolt
10	Cylinder Liner	24	Sealing Ring
11	Elastic Cylindrical Pin	25	Hexagonal Socket Head Plug
12	Breathing Elbow	26	Hex Head Bolt
13	Core Plug	27	Main Bearing Bolt
14	Cylindrical Pin	28	Cylinder Head Bolt

16A



fmwx16a059

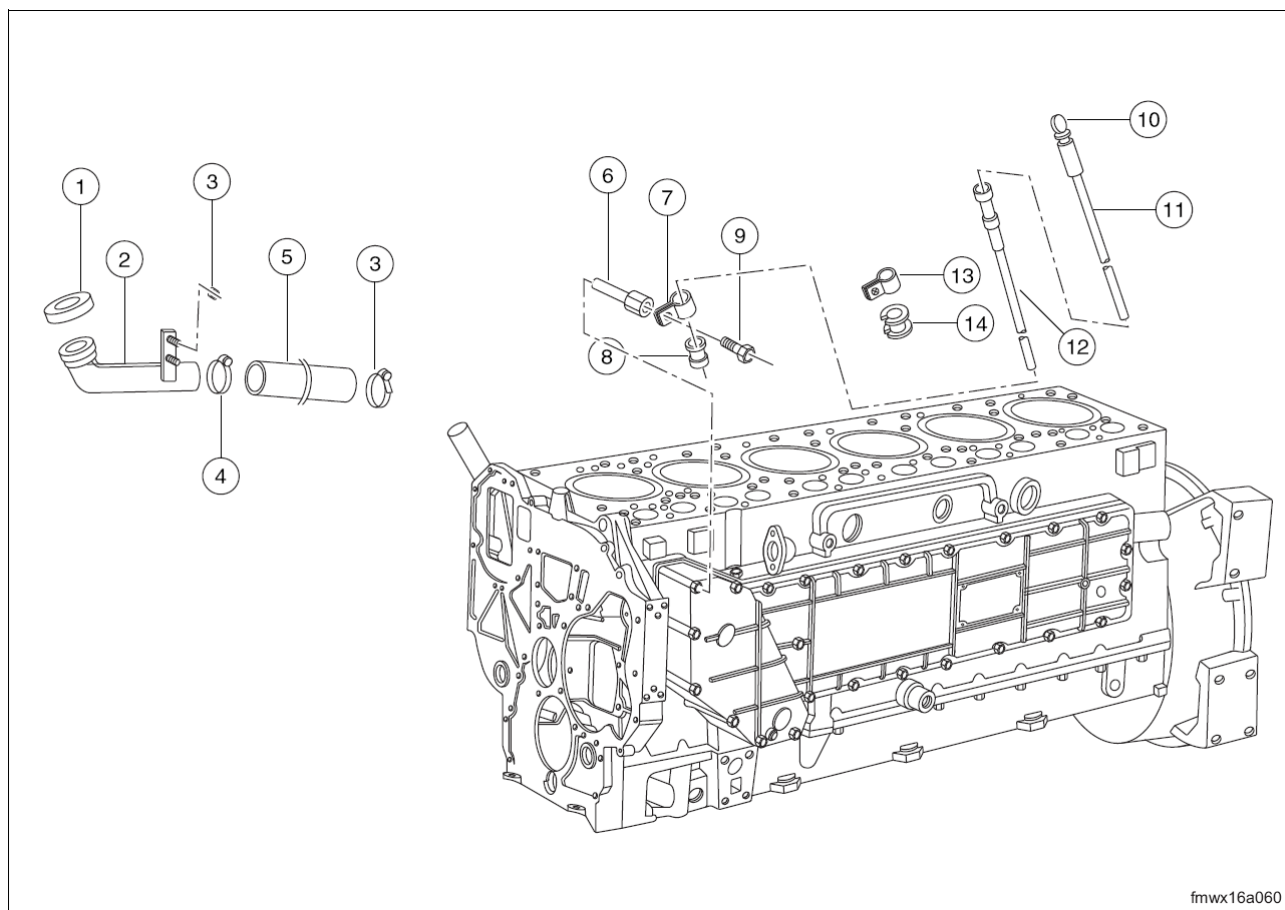
1	Hex Head Bolt
2	Hex Head Bolt
3	Cylindrical Pin
4	Cylindrical Pin
5	Wave Cylindrical Washer
6	Hex Nut, Style 1
7	Hex Head Bolt
8	Hex Head Bolt
9	Stud Bolt
10	Curved Spring Washer
11	Hex Nut, Style 1
12	Hex Head Bolt
13	Curved Spring Washer
14	End Cover
15	Sealing Ring
16	Timing Gear Chamber
17	Hex Head Screw Plug

22	Gasket, Oil Cooler Cover
23	Hex Head Screw Plug
24	Sealing Washer
25	Hex Head Bolt
26	Wave Spring Washer
27	Hex Head Bolt
28	Wave Spring Washer
29	Nameplate
30	Hollow Bolt
31	Nozzle Assembly
32	Sealing Washer
33	Elastic Cylindrical Pin
34	Flywheel Housing
35	Observation Hole Cover
36	Hex Head Bolt
37	Stud Bolt
38	Prevailing Torque Type All-metal Hex Nut, Style 2

Engine Mechanical (WP10) – Engine Mechanical

18	Sealing Washer
19	Hex Socket Cap Head Screw
20	Curved Spring Washer
21	Oil Cooler Cover

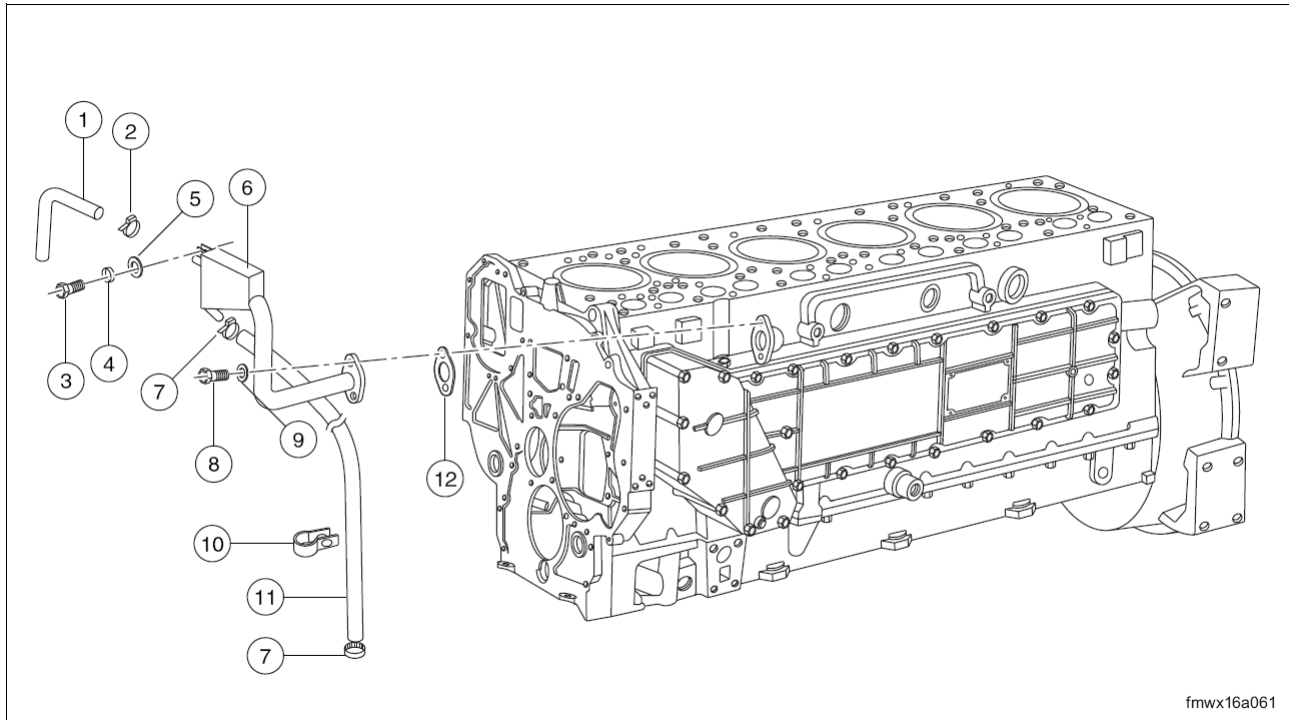
39	Stud Bolt
40	Spring Washer
41	Hex Nut, Style 1
42	Flywheel Housing Bolt



fmwx16a060

1	Oil Filler Pipe Cap Assembly
2	Oil Filler Pipe Assembly
3	Prevailing Torque Type All-metal Hex Nut, Style 2
4	Hose Clamp
5	Rubber Hose with Fibre
6	Support Block
7	Single Pipe Clamp

8	Rubber Hose Clamp
9	Hex Head Bolt
10	Oil Dipstick
11	Upper Assembly, Oil Dipstick Pipe
12	Lower Assembly, Oil Dipstick Pipe
13	Single Pipe Clamp
14	Oil Dipstick Rubber Hose

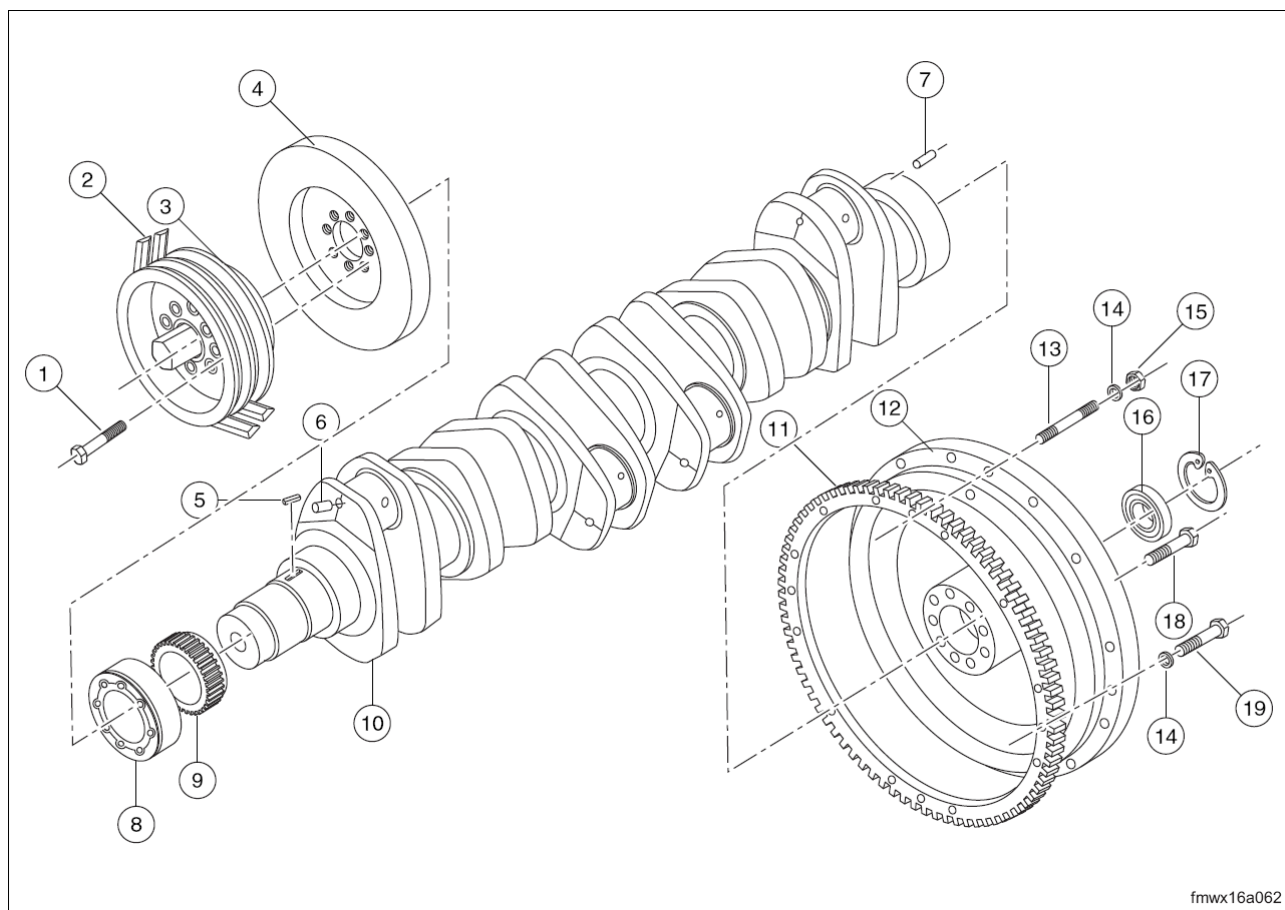


fmwx16a061

1	Rubber Hose with Fibre
2	Hose Clamp
3	Hex Head Bolt
4	Spring Washer
5	Big Washer
6	Oil-Gas Separator assembly

7	Hose Clamp
8	Hex Socket Cap Head Screw
9	Wave Spring Washer
10	Fixing Plate
11	Rubber Hose without Fibre
12	Gasket

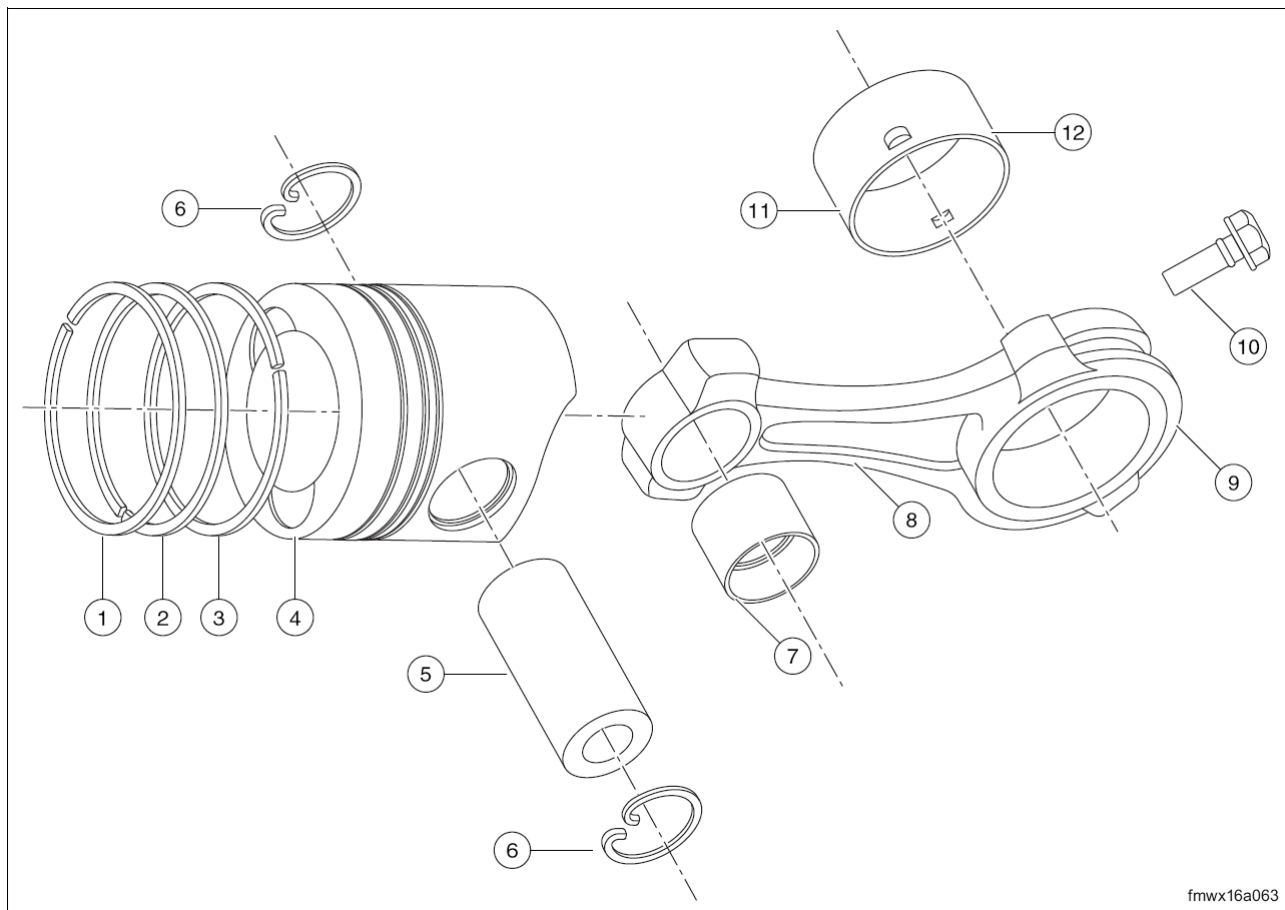
Engine Mechanical (WP10) – Engine Mechanical



fmwx16a062

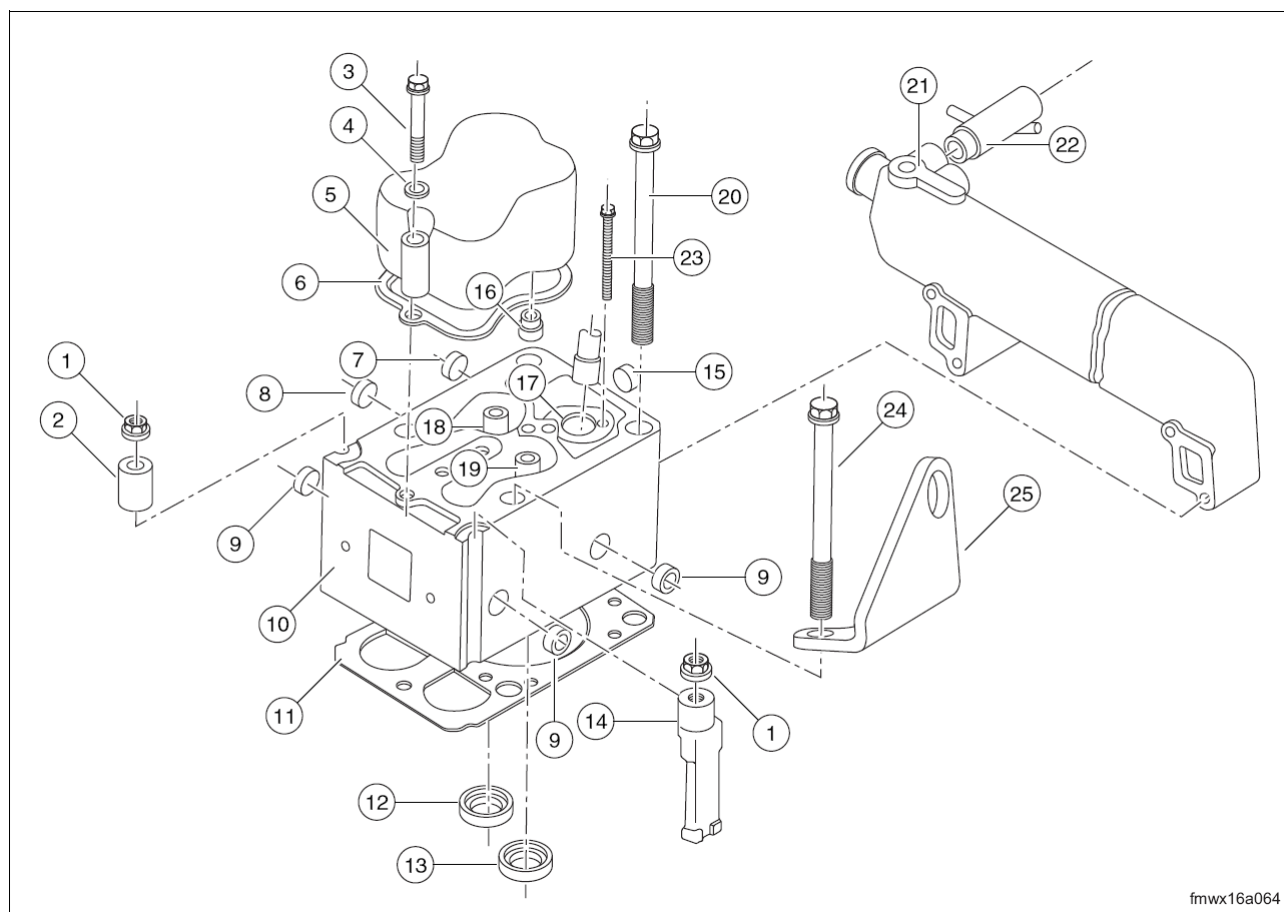
1	Hex Head Bolt
2	V-belt
3	Pulley
4	Damper
5	Parallel Key
6	Cylindrical Pin
7	Cylindrical Pin
8	Flange
9	Crankshaft Gear
10	Crankshaft Assembly

11	Flywheel Ring Gear
12	Flywheel
13	Stud Bolt
14	Wave Spring Washer
15	Hex Nut, Style 1
16	Radial Ball Bearing
17	Circlip for Hole
18	Hex Head Bolt
19	Hex Head Bolt



1	Keystone Ring
2	Torsional Taper-face Ring
3	Coil Spring Ring
4	Piston
5	Piston Pin
6	Piston Pin Circlip
7	Connecting Rod Assembly

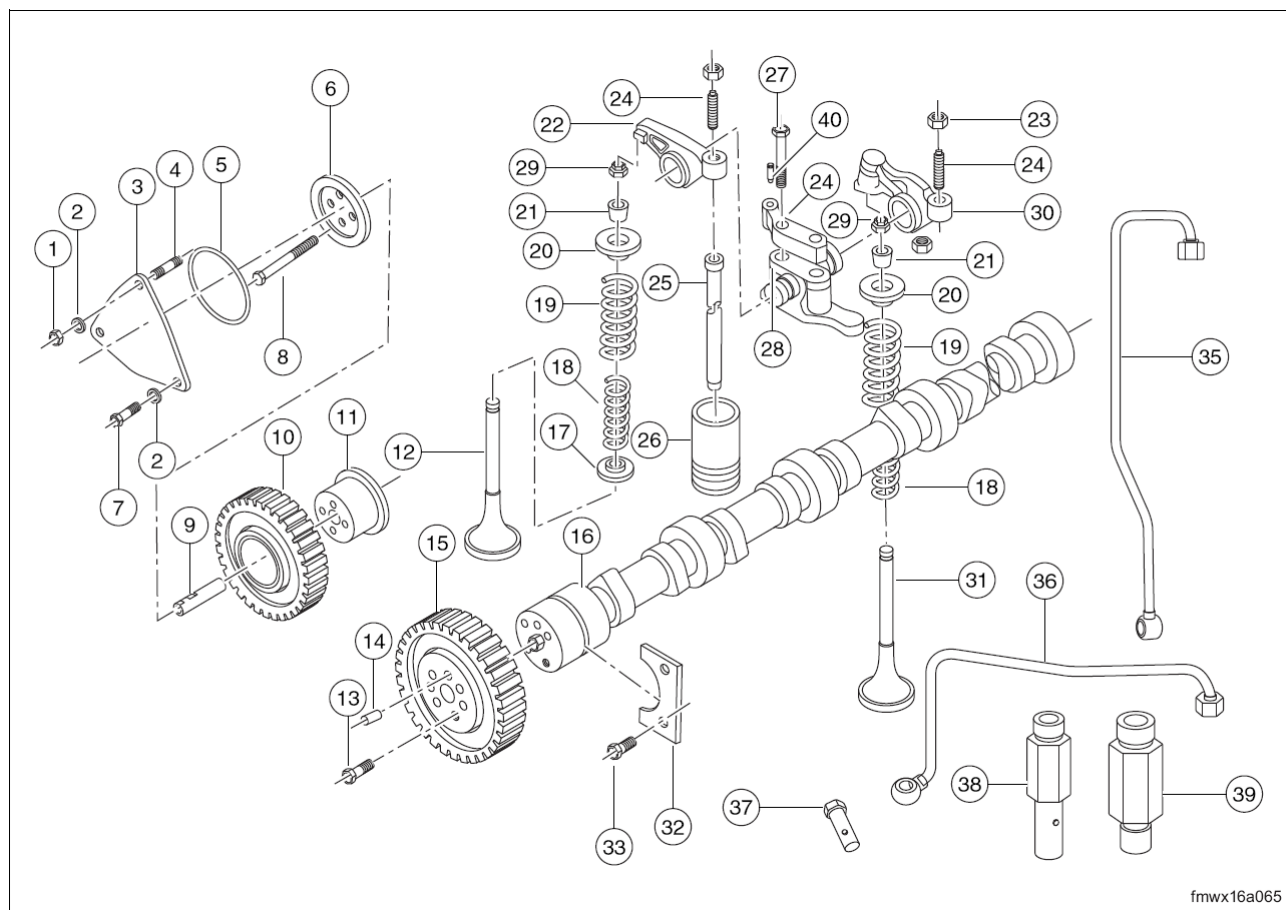
8	Connecting Rod Bushing
9	Connecting Rod Body
10	Connecting Rod Cap
11	Connecting Rod Bolt
12	Connecting Rod Upper Bearing
13	Connecting Rod Lower Bearing

Engine Mechanical (WP10) – Engine Mechanical

fmwx16a064

1	Nut with Shoulder
2	Clamping Block
3	Hex Head Bolt
4	Wave Spring Washer
5	Cylinder Head Cover
6	Cylinder Head Cover Washer
7	Core Plug
8	Core Plug
9	Core Plug
10	Cylinder Head
11	Cylinder Head Gasket
12	Intake Valve Seat
13	Exhaust Valve Seat

14	Clamping Block
15	Core Plug
16	Valve Stem Gland
17	Fuel Injector Bushing
18	Valve Guide
19	Lower Seat, Exhaust Valve Spring
20	Main Bolt, Cylinder Head
21	Water Outlet Pipe
22	Pipe Joint Assembly
23	Hex Head Bolt
24	Main Bolt, Cylinder Head
25	Hanging Plate



fmwx16a065

1	Hex Nut, Style 1
2	Wave Spring Washer
3	Cover Plate
4	Stud Bolt
5	Sealing Ring
6	Gasket
7	Hex Socket Cap Head Bolt
8	Hex Head Bolt
9	Shaft
10	Intermediate Gear Assembly
11	Intermediate Gear Shaft
12	Intake Valve
13	Hex Head Bolt
14	Cylindrical Pin
15	Camshaft Timing Gear
16	Camshaft
17	Lower Seat, Intake Valve Spring

21	Valve Lock Clamp
22	Intake Valve Rocker Arm
23	Valve Clearance Adjusting Nut
24	Valve Clearance Adjusting Screw
25	Valve Push Rod Assembly
26	Valve Tappet
27	Hex Head Bolt
28	Valve Rocker Arm Seat Assembly
29	Valve Cap
30	Exhaust Valve Rocker Arm
31	Exhaust valve
32	Camshaft Thrust Gasket
33	Hex Head Bolt
34	Support Arm
35	EVB Oil Inlet Pipe Assembly
36	Short Oil inlet pipe assembly
37	Hollow Bolt

Engine Mechanical (WP10) – Engine Mechanical

18	Inner Valve Spring
19	Outer Valve Spring
20	Upper Seat, Valve Spring

38	Hollow Bolt Joint
39	Threaded Joint
40	Adjusting Bolt Assembly

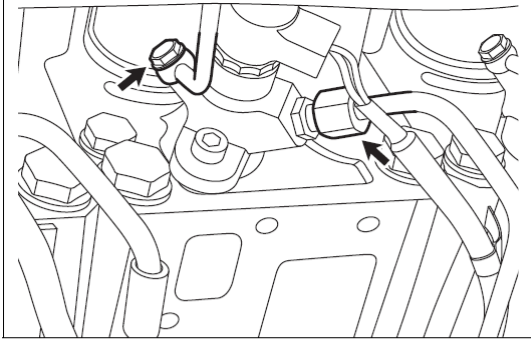
Precautions

1. When lifting or supporting the engine, **DO NOT** allow the jack to come into contact with the oil pan. When putting down the engine, support the engine outside the engine mount and flywheel housing by the engine supporting plate, wood frame or other similar tools.
2. When dismantling the intake system, cover the air inlet to prevent foreign matters from going into the cylinder. If foreign matters go into the cylinder, the cylinder and other parts may be damaged seriously when the engine is operating.
3. Make sure to disconnect the grounding cable of the battery when conducting maintenance on the engine body. When it is necessary to supply power to the engine in the course of inspection or other similar work, pay special attention because short circuit may occur.
4. In order to protect and lubricate the sliding surface in the course of initial operation, apply a large amount of engine oil to the sliding surface.
5. When disassembling the valve parts, piston, piston ring, connecting rod, connecting rod bearing and crankshaft journal bearing, place them in order and store.
6. When re-installing parts, install them in their original positions, as shown before disassembly.
7. When dismantling gaskets, oil seals and other similar parts, make sure to replace them with new parts.
8. If liquid gaskets are used on parts, dismantle all old gaskets, clean the parts and remove any oil, grease, water and contaminants, then apply the specified liquid gasket and install those parts.
9. After applying sealant on a part, install the part within 7 minutes. If not, remove the sealant from the part and re-apply sealant.
10. In the process of assembly and installation, fasten the part to the specified fastening torque, and make sure to install the parts correctly.

Testing & Adjustment

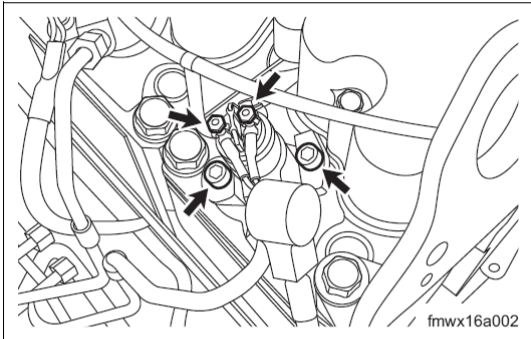
Compression Pressure

Measure the compression pressure using the battery and starter motor under no fault state when the engine cools (the water temperature is 20°C).

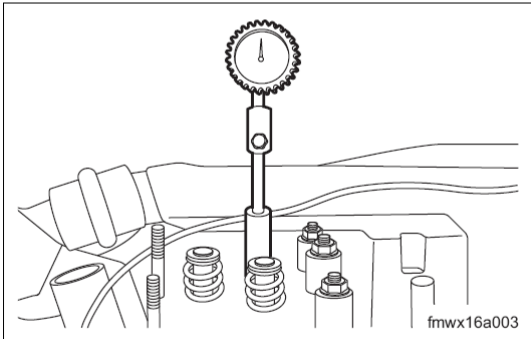


1. Dismantle the fuel injector

- (a). Dismantle the oil inlet pipe of the fuel injector.
- (b). Dismantle the oil return pipe of the fuel injector.

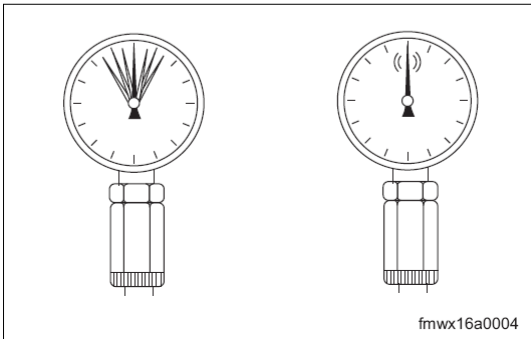


- (c). Disconnect the wiring harness of the fuel injector.
- (d). Dismantle the fixing bolts of the fuel injector.



2. Install a pressure gauge

- (a). Install the pressure gauge into the fuel injector hole.



3. Measure the compression pressure

- (a). Run the starter motor, and read the compression pressure when the pressure gauge pointer is stable.

Caution:

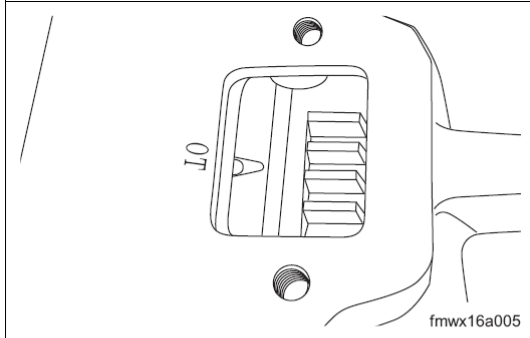
- Remember that air will be suddenly emitted from the fuel injector hole when the motor is running.
 - Measure the pressure of all cylinders.
 - When disconnecting the wiring harness joint, ECM will identify it as a fault and record the fault code. After finishing measurement, make sure to eliminate the ECM memory.
- (b). Drop engine oil into the cylinder, and then measure the compression pressure again.

- If the compression pressure rises, it shows that the clearance between the piston ring and cylinder liner is too big.

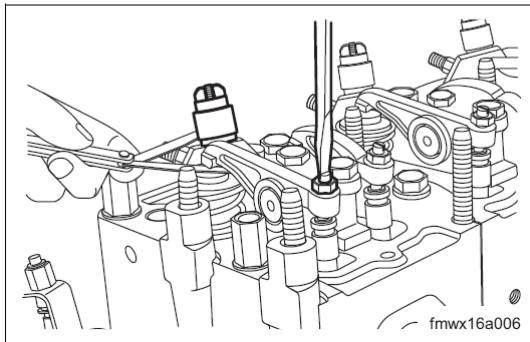
Item	Compression Pressure	Pressure Difference between Cylinders
Standard Value	2.6~2.8MPa	200kPa

Adjust the valve clearance

Adjust the valve clearance in two steps: set the No.1 cylinder at the top dead center on the compression stroke, and then set the No.6 cylinder at the top dead center on the compression stroke.



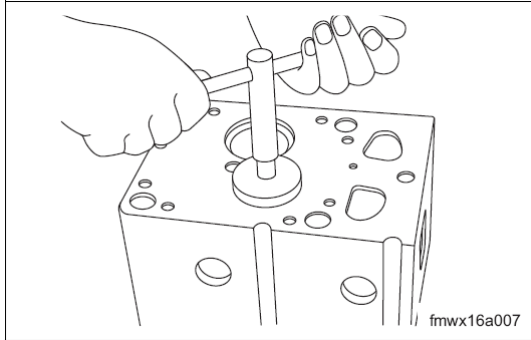
- Set the No.1 (or No.6) cylinder at the top dead center on the compression stroke**
 - Rotate the crankshaft forward, and align the OT rule line of the flywheel with the pointer. Inspect whether there is a clearance between the cam and rocker arm of the No.1 (or No.6) cylinder (top dead center on the compression stroke) at this point.



- Adjust the valve clearance**
 - Fully loosen the adjusting screws of the rocker arm.
 - Insert a thickness gauge between the rocker arm and cam, adjust with the adjusting screws of the rocker arm, and then fix with the lock nuts.
 - When inserting the thickness gauge, fastening the adjusting screws of the rocker arm, until the thickness gauge stops moving.
 - Loosen the adjusting screws of the rocker arm gradually and re-adjust to such a degree that the thickness gauge can be inserted and dismantled flexibly, and then fix the lock nuts of the rocker arm.

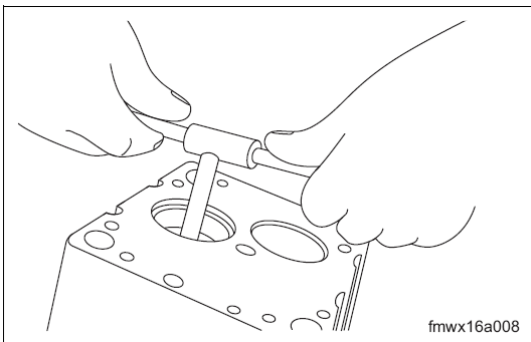
Item	Standard Value
Intake Valve Clearance	0.3mm
Exhaust Valve Clearance	0.4mm
Exhaust Valve Brake Clearance	0.25mm

	Cylinder No.	1		2		3		4		5		6	
Condition	Valve Arrangement	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN
Valve to be adjusted	Top Dead Center of No.1 Cylinder	○	○		○	○			○	○			
	Top Dead Center of No.6 Cylinder			○			○	○			○	○	○

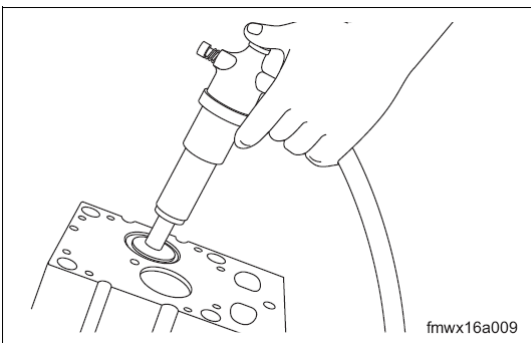
Engine Mechanical (WP10) – Engine Mechanical**Ream the valve seat****1. Ream the valve seat**

- (a). Install the locating bar on the reamer.
- (b). Insert the locating bar into the valve guide for location.
- (c). Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

Item	Standard Value
Width of Working Cone Face	1.5~1.8mm

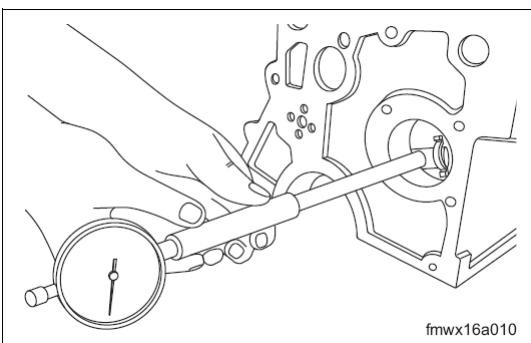
Ream the valve guide**1. Ream the valve guide**

- (a). Use the tap wrench to rotate the reamer downwards clockwise.
- (b). Insert the locating bar into the valve guide for location.
- (c). Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

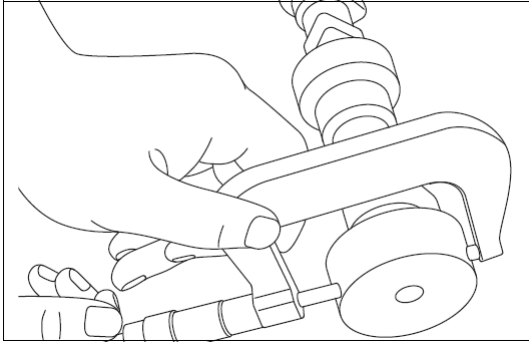
Grind the valve**1. Grind the valve seat**

- (a). Grind the valve by a grinding machine.
 - The rotating and beating frequency of the grinding machine can be adjusted.
- (b). After grinding and cleaning, inspect the sealing condition of the valve by kerosene.

16A

Inspect and adjust the radial clearance of the camshaft**1. Measure the inside diameter of the bushing**

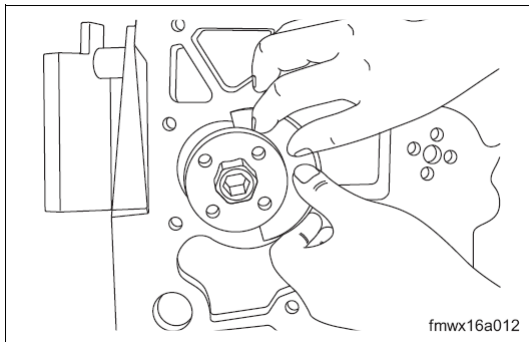
- (a). Inspect whether each shaft hole bushing is installed securely.
- (b). Inspect whether the oil gallery and oil hole are through.
- (c). Measure the inside diameter of each bushing by an inside micrometer.



- (d). Measure the outside diameter of each camshaft bearing by an outside micrometer.

Item	Standard Value
Radial Clearance of Camshaft	0.04~0.12mm

Inspect and adjust the axial clearance of the camshaft

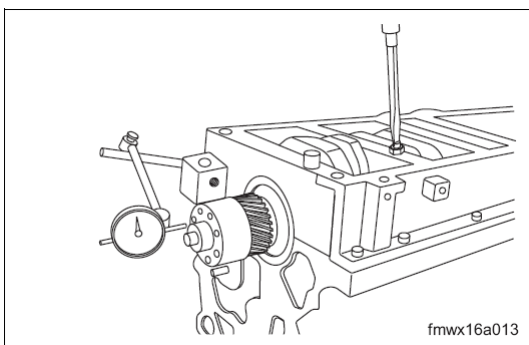


1. Measure the axial clearance of the camshaft

- Inspect whether there are damages and burrs on the camshaft thrust groove, thrust baffle plate and cylinder body joint face.
- Insert the thrust baffle plate into the thrust ring groove, and fix the baffle plate by two screws.
- Inspect the axial clearance of the camshaft by a dial indicator.

Item	Standard Value
Axial Clearance of Camshaft	0.1~0.4mm

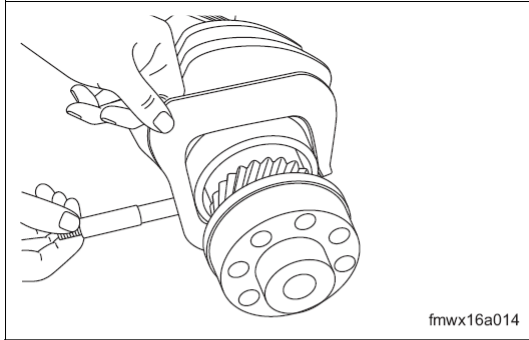
Inspect and adjust the axial clearance of the crankshaft



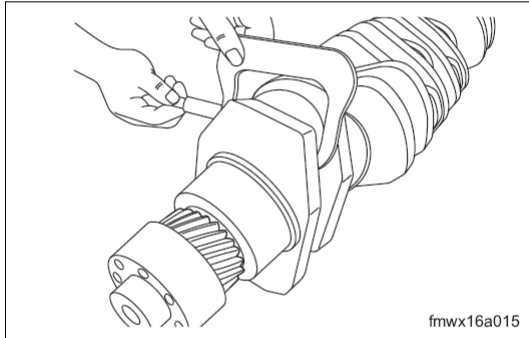
1. Measure the axial clearance of the crankshaft

- Fix the dial indicator at the crankshaft end by a magnetic dial indicator seat.
- Prize the crankshaft up and down.
 - The crankshaft shall go flexibly when rotating it, free from various jamming phenomenon.
- If the clearance exceeds the range, replace the crankshaft gasket.

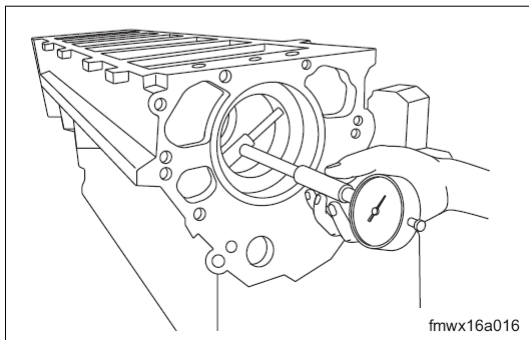
Item	Standard Value
Axial Clearance of Crankshaft	0.052~0.255mm

Engine Mechanical (WP10) – Engine Mechanical**Inspect and adjust the radial clearance of the crankshaft**

- 1. Measure the radial clearance of the crankshaft**
 - (a). Measure each main journal of the crankshaft by an outside micrometer.



- (b). Measure each connecting rod journal of the crankshaft by an outside micrometer.

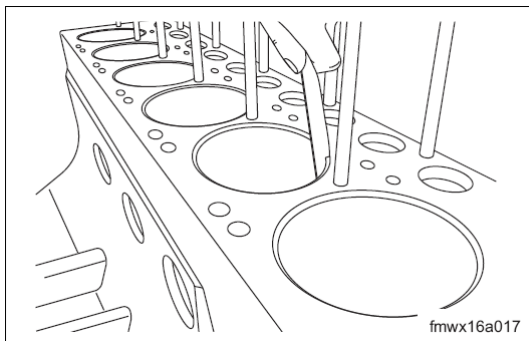


- (c). Install the main bearings of the crankshaft in the cylinder body and crankcase seat holes, and tighten with a torque of 250N.m. Measure the inside diameter of each bearing by an inside micrometer.

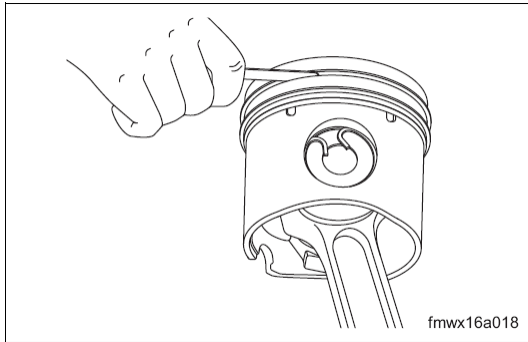
Caution:

The main bearing with oil groove is the upper half, and the bearing without oil groove is the lower half.

Item	Standard Value
Radial Clearance of Crankshaft	0.095~0.163mm

Inspect and adjust the piston ring clearance

- 1. Measure the piston ring gap clearance**
 - (a). Measure the piston ring gap clearance.
 - (b). If the clearance exceeds the range, replace the piston ring.

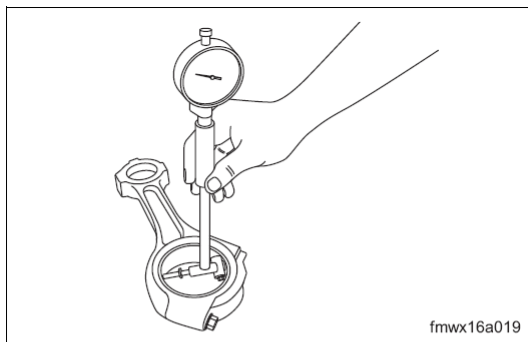


2. Measure the piston ring side clearance

- (a). Measure the piston ring side clearance by a thickness gauge.
- (b). If the clearance exceeds the range, replace the piston ring.

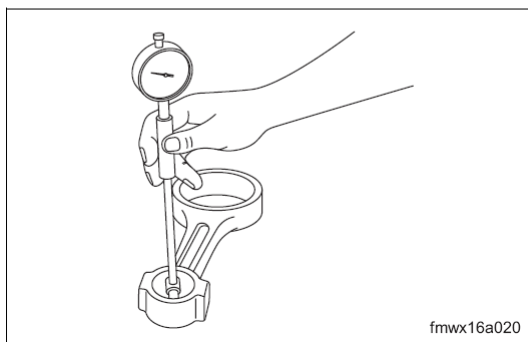
Item		Standard Value
Top Compression Ring	Gap Clearance	0.4~0.6mm
	Side Clearance	-
Second Compression Ring	Gap Clearance	0.25~0.4mm
	Side Clearance	0.07~0.102mm
Third Oil Ring	Gap Clearance	0.35~0.55mm
	Side Clearance	0.05~0.085mm

Inspect the fit clearance of the connecting rod



1. Measure the connecting rod big end

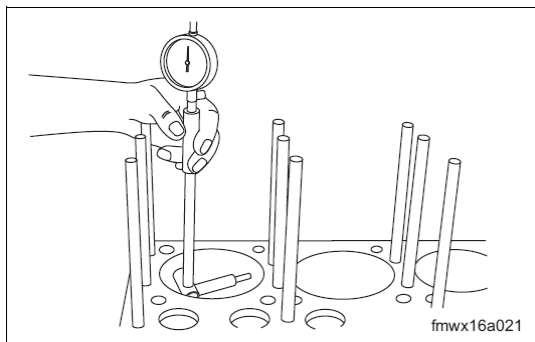
- (a). Install the connecting rod into the connecting rod big end, and tighten the connecting rod bolts.
- (b). Measure the hole diameter of the connecting rod bearing.



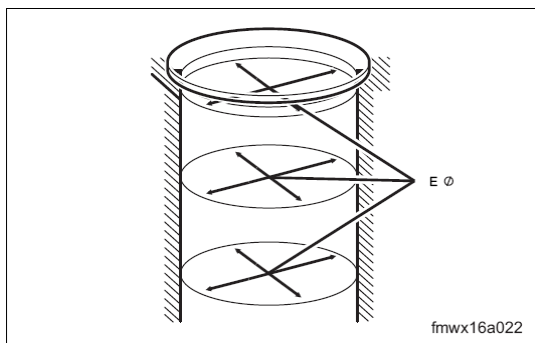
2. Measure the connecting rod small end

- (a). Press the connecting rod small end bushing into the shaft hole.
- (b). Measure the inside diameter of the bushing.
- (c). Measure the inside diameter of the piston pin hole and the outside diameter of the piston pin.

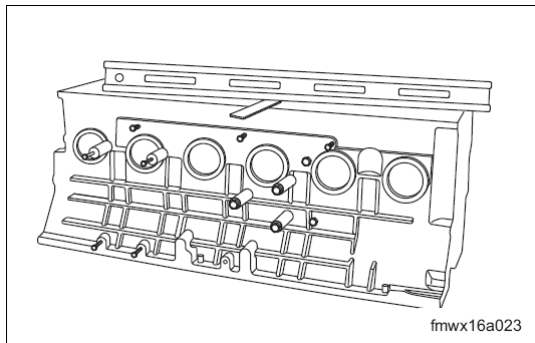
Item	Standard Value
Fit Clearance between Bearing and Crankshaft Connecting Rod Journal	0.059~0.127mm
Fit Clearance between Connecting Rod Bushing and Piston Pin	0.025~0.046mm
Fit Clearance between Piston Pin Hole and Piston Pin	0.003~0.014mm

Engine Mechanical (WP10) – Engine Mechanical**Inspect the roundness of the cylinder liner**

- 1. Measure the roundness of the cylinder liner**
 - (a). Inspect whether the cylinder bores and spigots are clean, corroded and damaged.
 - (b). Clean the cylinder bores and spigots with trichloroethylene cleaning agent.
 - (c). Measure the inside diameter of the cylinder liner by an inside micrometer.
 - (d). Measure two times respectively at the top, middle and bottom.



Item	Standard Value
Out of Roundness	Lower than 0.04mm

Inspect the flatness of the cylinder body

- 1. Measure the flatness of the cylinder body**
 - (a). Place a level ruler on the upper surface of the cylinder body.
 - (b). Measure the clearance between the level ruler and the upper surface of the cylinder body by a thickness gauge.

Caution:

Three sections respectively in the front, middle and rear of the upper surface need to be measured, and the parts of the diagonal shall also be measured.

Engine Assembly

Replacement

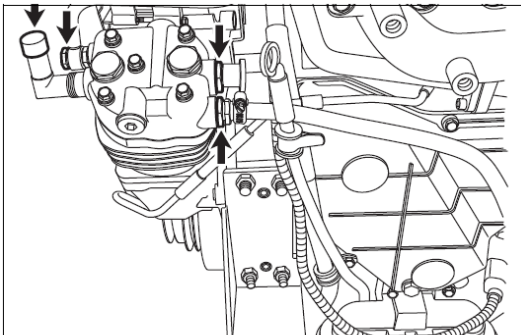
1. Turn off the battery switch, and then disconnect the battery negative cable.
2. Dismantle the oil inlet pipe of the engine. Refer to Chapter 11 Fuel – Oil-Water Separator, Replacement.
3. Dismantle the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
4. Dismantle the exhaust pipe. Refer to Chapter 13A Exhaust & Turbocharger – Exhaust Pipe, Replacement.
5. Dismantle the transmission assembly. Refer to Chapter 31A Transmission – Transmission Assembly, Replacement.
6. Drain coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.
7. Dismantle the intercooler hose. Refer to Chapter 14A Cooling – Intercooler, Overhaul.
8. Dismantle the radiator hose. Refer to Chapter 14A Cooling – Radiator, Overhaul.
9. Dismantle the auxiliary water tank hose. Refer to Chapter 14A Cooling – Auxiliary Water Tank, Replacement.
10. Dismantle the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
11. Dismantle the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
12. Dismantle the pipeline of the air compressor. Refer to Chapter 18A Engine Mechanical – Engine Accessories, Overhaul.
13. Disconnect the wiring harness of the Engine ECU.
14. Dismantle the fixing bolts of the engine.
15. Install the fixing bolts of the engine.
16. Connect the wiring harness of the engine ECU.
17. Install the pipeline of the air compressor. Refer to Chapter 18A Engine Mechanical – Engine Accessories, Overhaul.
18. Install the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
19. Install the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
20. Install the auxiliary water tank hose. Refer to Chapter 14A Cooling – Auxiliary Water Tank, Replacement.
21. Install the radiator hose. Refer to Chapter 14A Cooling – Radiator, Overhaul.
22. Install the intercooler hose. Refer to Chapter 14A Cooling – Intercooler, Overhaul.
23. Fill coolant. Refer to Chapter 14A Cooling – Coolant, Replacement.
24. Install the transmission assembly. Refer to Chapter 31A Transmission – Transmission Assembly, Replacement.
25. Install the exhaust pipe. Refer to Chapter 13A Exhaust & Turbocharger – Exhaust Pipe, Replacement.
26. Install the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
27. Install the oil inlet pipe of the engine. Refer to Chapter 11 Fuel – Oil-Water Separator, Replacement.
28. Connect the battery negative cable.

16A

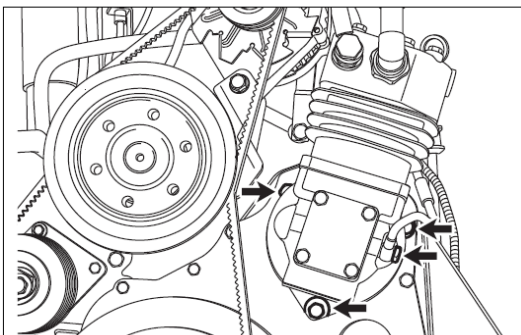
Engine Accessories

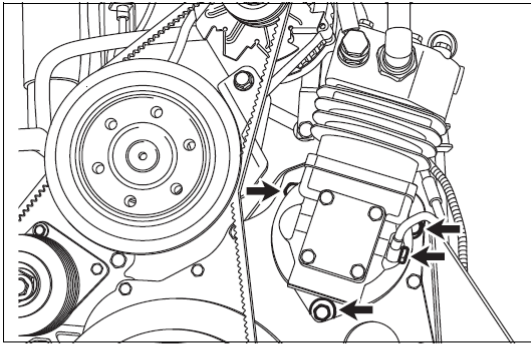
Replacement

1. Turn off the main power
2. Dismantle the generator. Refer to Chapter 19A Charging System – Generator, Overhaul.
3. Dismantle the starter. Refer to Chapter 18A Starting & Preheating System – Starter, Overhaul.
4. Dismantle the heater. Refer to Chapter 18A Starting & Preheating System – Heater, Overhaul.
5. Dismantle the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
6. Dismantle the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
7. Dismantle the water pump. Refer to Chapter 14A Cooling – Water Pump, Replacement.
8. Dismantle the cooling fan. Refer to Chapter 14A Cooling – Cooling Fan, Overhaul.
9. Dismantle the high-pressure pump. Refer to Chapter 11A Fuel – High-pressure Pump, Replacement.
10. Dismantle the common-rail pipe. Refer to Chapter 11A Fuel – Common-rail Pipe, Replacement.
11. Dismantle the fuel fine filter. Refer to Chapter 11A Fuel – Fuel Fine Filter, Replacement.
12. Dismantle the oil pan. Refer to Chapter 15A Lubrication – Oil Pan, Replacement.
13. Dismantle ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.



14. Dismantle the air compressor.
 - (a). Disconnect the cooling water pipe of the air compressor.
 - (b). Disconnect intake and exhaust pipes of the air compressor.
 - (c). Dismantle the lubricating oil pipe of the air compressor.
 - (d). Dismantle the fixing bolts of the air compressor.





15. Install the air compressor

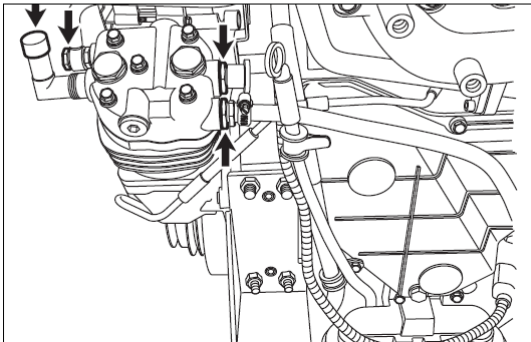
- (a). Install the fixing bolts of the air compressor.

Torque: 97N.m

Caution:

Pay attention to the gasket of the air compressor during installation.

- (b). Install the lubricating oil pipe of the air compressor.



- (c). Connect intake and exhaust pipes of the air compressor.

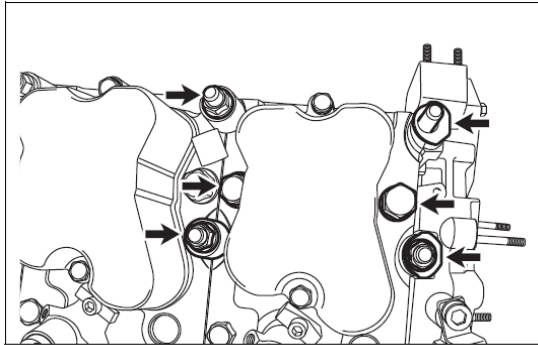
- (d). Connect the cooling water pipe of the air compressor.

16. Install ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.
17. Install the oil pan. Refer to Chapter 15A Lubrication – Oil Pan, Replacement.
18. Install the fuel fine filter. Refer to Chapter 11A Fuel – Fuel Fine Filter, Replacement.
19. Install the common-rail pipe. Refer to Chapter 11A Fuel – Common-rail Pipe, Replacement.
20. Install the high-pressure pump. Refer to Chapter 11A Fuel – High-pressure Pump, Replacement.
21. Install the cooling fan. Refer to Chapter 14A Cooling – Cooling Fan, Overhaul.
22. Install the water pump. Refer to Chapter 14A Cooling – Water Pump, Replacement.
23. Install the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
24. Install the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
25. Install the heater. Refer to Chapter 18A Stating & Preheating System – Heater, Overhaul.
26. Install the starter. Refer to Chapter 18A Stating & Preheating System – Starter, Overhaul.
27. Install the generator. Refer to Chapter 19A Charging System – Generator, Overhaul.

Cylinder Head

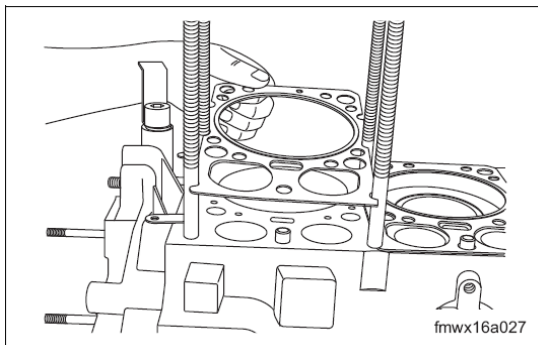
Replacement

1. Disconnect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
2. Disconnect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
3. Disconnect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.

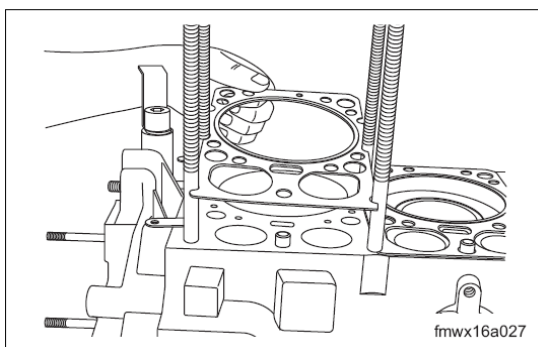


4. Dismantle the cylinder head

- (a). Dismantle the lock block of the cylinder head.
- (b). Dismantle the fixing bolts and nuts of the cylinder head.



- (c). Remove the cylinder gasket.
- (d). Remove the valve tappet.



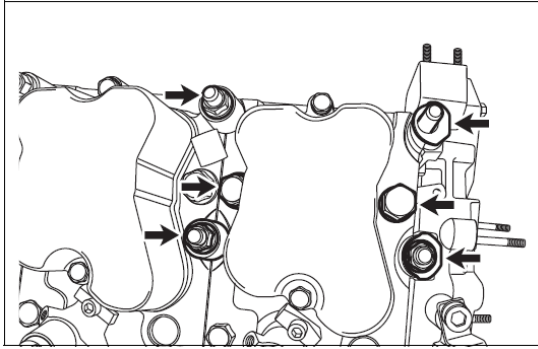
5. Install the cylinder head

- (a). Install the valve tappet.
- (b). Install the cylinder gasket.

Caution:

DO NOT install reversely.

Engine Mechanical (WP10) – Cylinder Head



- (c). Install the lock block of the cylinder head.
- (d). Install the fixing bolts and nuts of the cylinder head.

Torque: First, tighten the main and auxiliary bolts with $40 \pm 10 \text{ N.m}$;

Second, tighten the auxiliary bolts with 100 N.m ;

Third, tighten the main bolts with 200 N.m ;

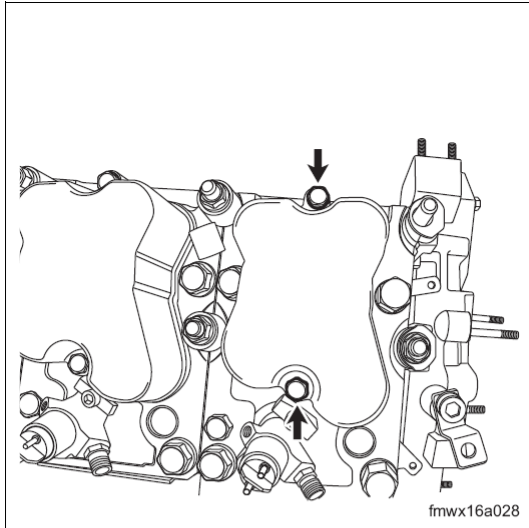
Fourth, tighten the auxiliary bolt nuts by 90° ;

Fifth, tighten the main bolts by 90° .

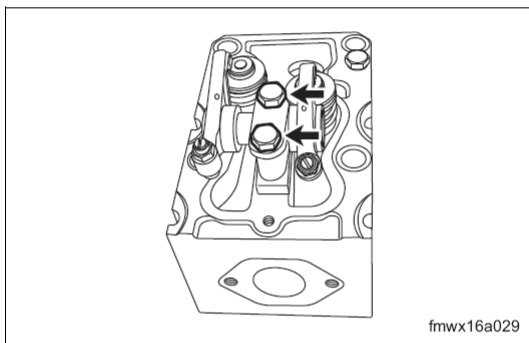
- 6. Connect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
- 7. Connect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
- 8. Connect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.

Rocker Arm and Valve Replacement

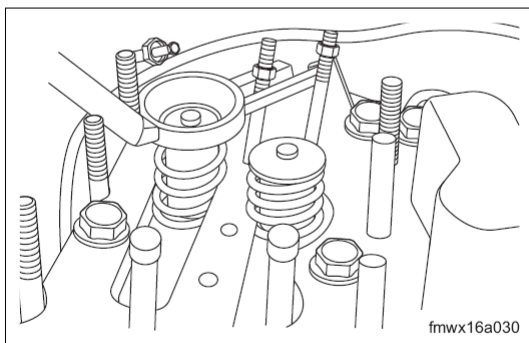
1. **Dismantle the cylinder head. Refer to Chapter 16A Engine Mechanical – Cylinder Head, Replacement.**



2. **Dismantle the valve chamber cover**
 - (a). Dismantle the fixing bolts of the valve chamber cover.

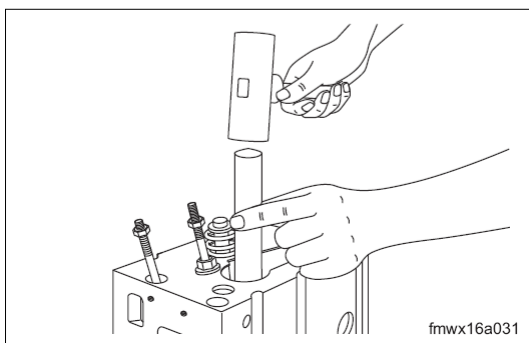


3. **Dismantle the rocker arm**
 - (a). Dismantle the intake and exhaust valve rocker arms.
 - (b). Dismantle the rocker arm support.

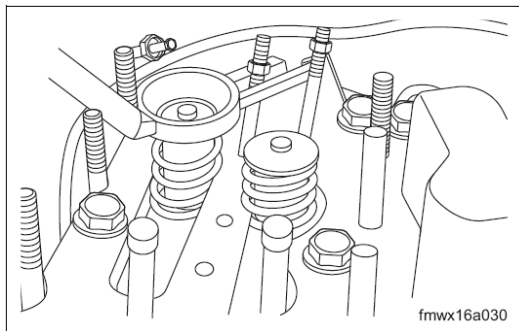


4. **Dismantle the valve**
 - (a). Dismantle the valve lock by a valve dismantling/installing tool.
 - (b). Take out the valve spring and valve.
 - (c). Dismantle the valve guide.

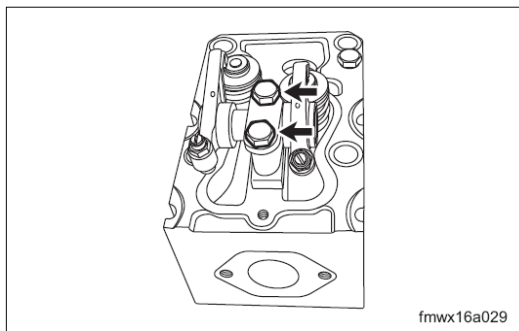
16A



5. **Install the valve**
 - (a). Install the valve guide by a valve guide bar.
 - (b). Install the valve spring.

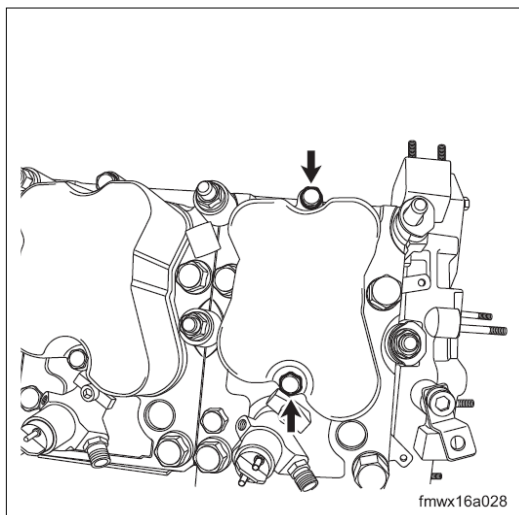


- (c). Install the valve lock by the valve dismantling/ installing tool.



6. Install the rocker arm

- (a). Install the rocker arm support.
Torque: 105±5N.m
- (b). Install the intake and exhaust valve rocker arms.



7. Install the valve chamber cover

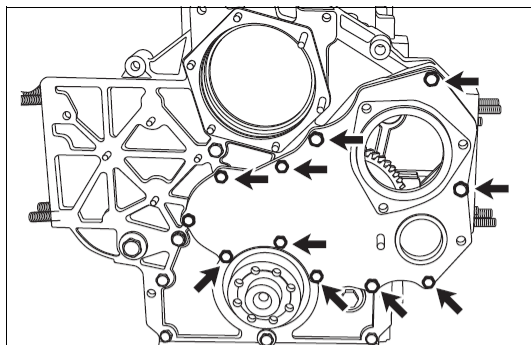
- (a). Install the fixing bolts of the valve chamber cover.
Torque: 25N.m

- 8. Install the cylinder head. Refer to Chapter 16A Engine Mechanical – Cylinder Head, Replacement.**

Timing Gear

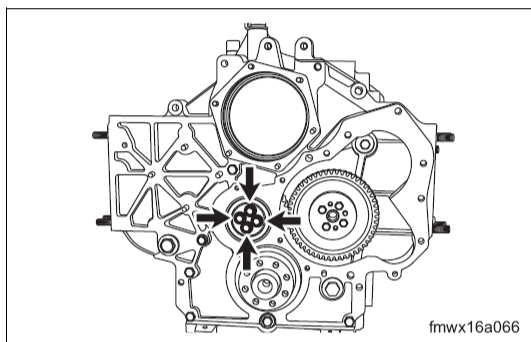
Replacement

1. Dismantle the engine accessories. Refer to Chapter 16A Engine Mechanical – Engine Accessories, Replacement.



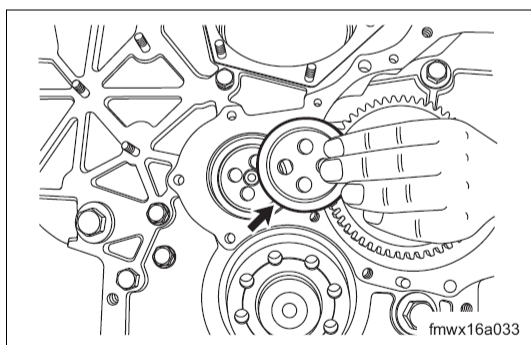
2. Dismantle the timing gear chamber

- (a). Dismantle the cover plate of the timing gear chamber.

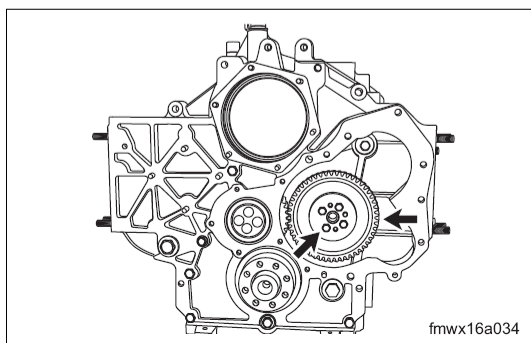


- (b). Dismantle the cover plate of the intermediate timing gear.

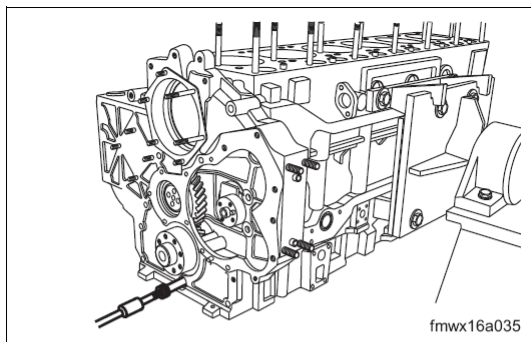
- Dismantle the fixing bolts of the intermediate timing gear cover plate.



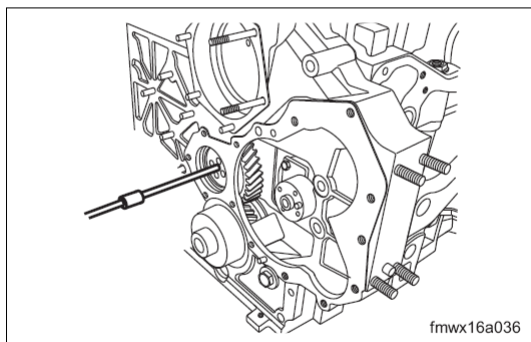
- Dismantle the cover plate of the intermediate timing gear.



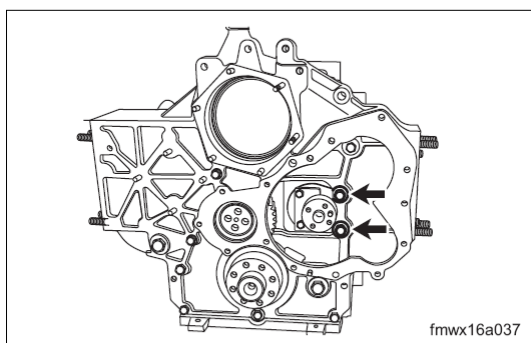
- (c). Dismantle the fixing bolts of the camshaft gear.



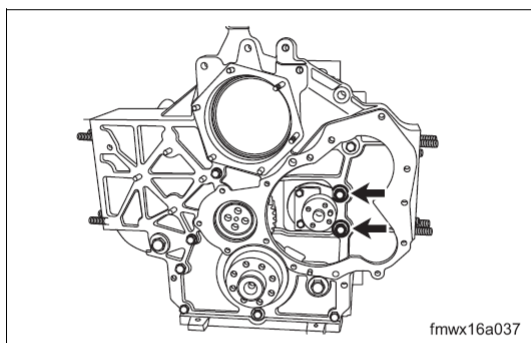
- (d). Pull out the intermediate gear shaft of the oil pump by a puller.



- (e). Pull out the intermediate timing gear shaft by the puller.

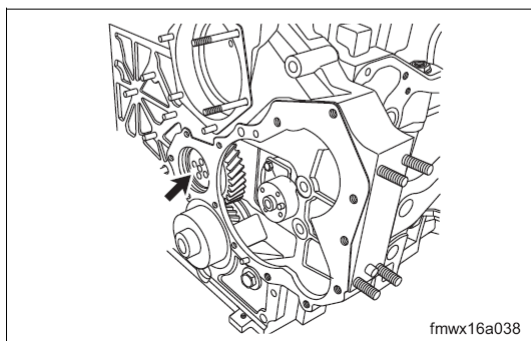


- (f). Dismantle the fixing bolts of the timing gear chamber.
(g). Put down the timing gear chamber.
(h). Take out the intermediate timing gear.



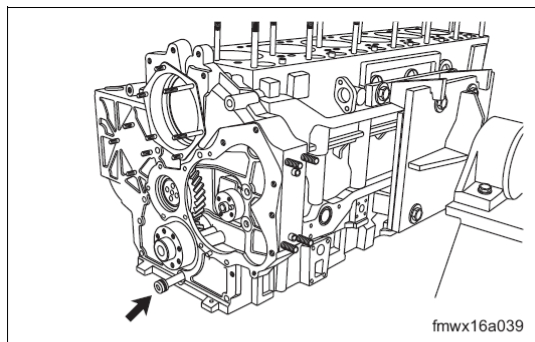
3. Install the timing gear chamber

- (a). Install the intermediate timing gear.
(b). Install the timing gear chamber.
(c). Install the intermediate timing gear shaft.

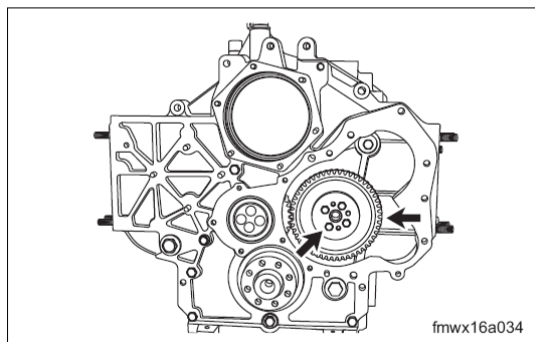


- (d). Install the intermediate gear shaft of the oil pump.

Engine Mechanical (WP10) – Timing Gear

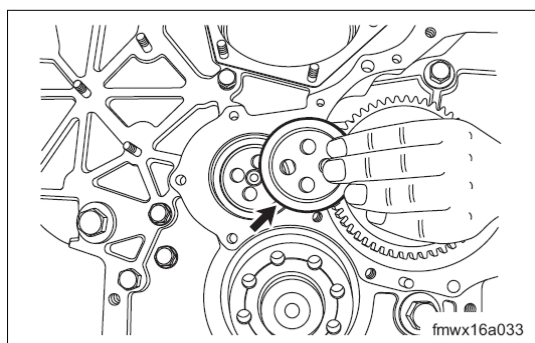


(e). Install the intermediate gear shaft of the oil pump.



- (f). Install the camshaft gear.
- Rotate the engine to the position of the top dead center on the compression stroke of the No.1 cylinder.
 - Align the camshaft gear with the timing mark of the intermediate timing gear.

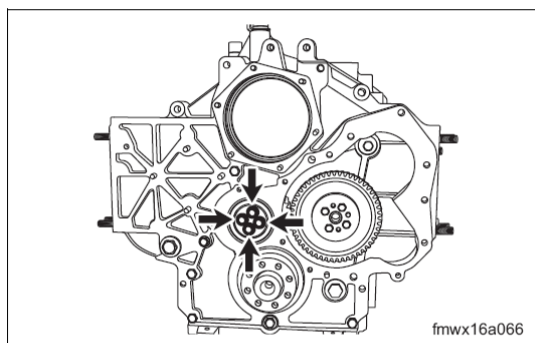
Torque: Tighten with $34\pm 2\text{N.m}$ symmetrically.



- (g). Install the cover plate of the intermediate timing gear.
- Install the cover plate of the intermediate timing gear.

Caution:

Align with the timing mark.



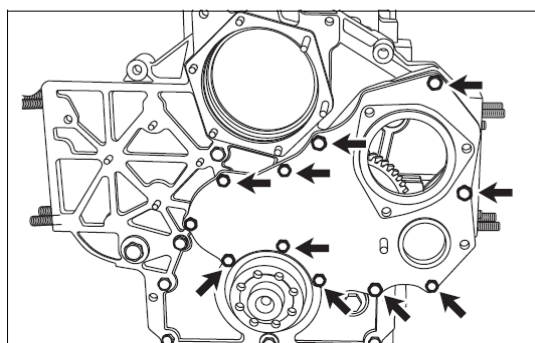
- Tighten the bolts of the intermediate timing gear cover plate.

Torque: Pre-tighten with $60\pm 5\text{N.m}$;

Then tighten by $90^\circ\pm 5^\circ$;

Inspection whether the torque reaches 112.5N.m .

16A



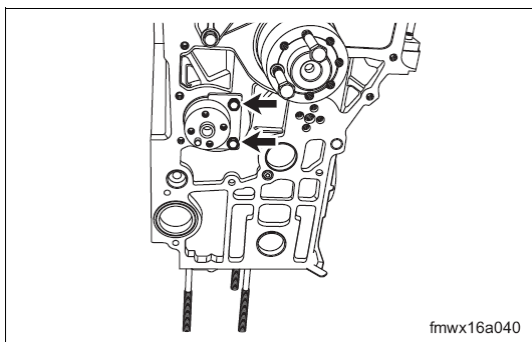
- (h). Install the cover plate of the timing gear chamber.
- Torque: 75N.m**

4. **Install the engine accessories. Refer to Chapter 16A Engine Mechanical – Engine Accessories, Replacement.**

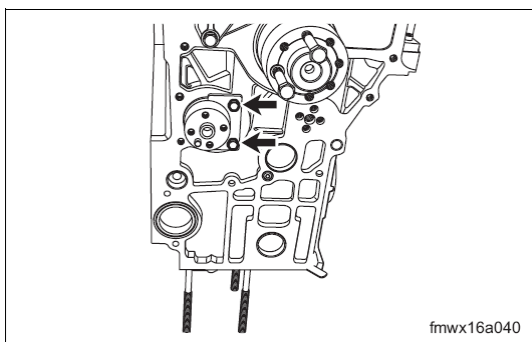
Camshaft

Replacement

1. Dismantle the timing gear chamber. Refer to Chapter 16A Engine Mechanical – Timing Gear Chamber, Replacement.



2. Dismantle the camshaft



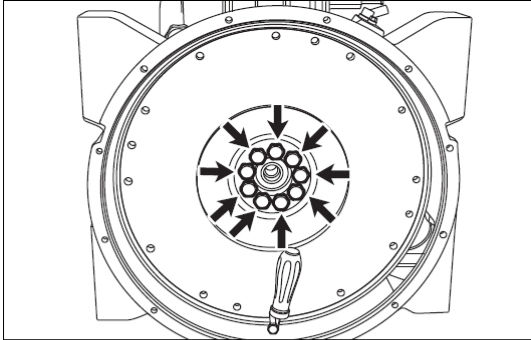
3. Install the camshaft
 - (a). Install the camshaft.
 - (b). Install the fixing bolts of the camshaft.**Torque: 60N.m**

4. Install the timing gear chamber. Refer to Chapter 16A Engine Mechanical – Timing Gear Chamber, Replacement.

Flywheel and Flywheel Housing

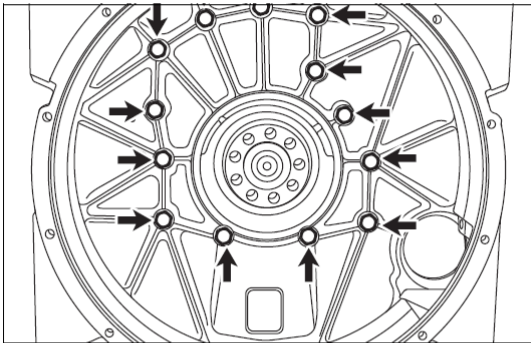
Replacement

1. Dismantle the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.



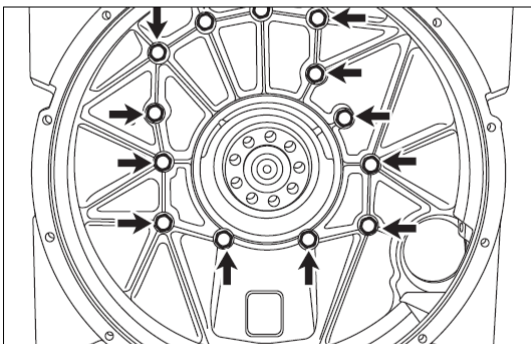
2. Dismantle the flywheel

(a). Dismantle the fixing bolts of the flywheel.



3. Dismantle the flywheel housing

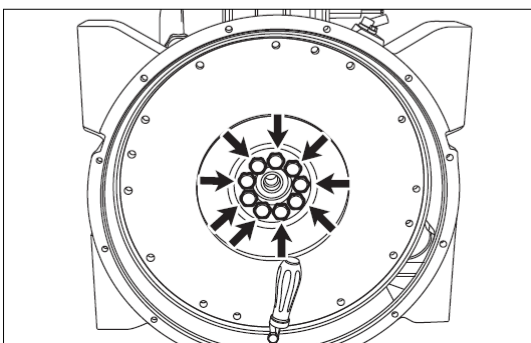
(a). Dismantle the fixing bolts of the flywheel housing.



4. Install the flywheel housing

(a). Install the fixing bolts of the flywheel housing.

**Torque: First, tighten with $50 \pm 10 \text{ N.m}$ symmetrically;
Second, tighten by $120^\circ \pm 5^\circ$;
Inspection whether the torque reaches 255 N.m .**



5. Install the flywheel

(a). Install the fixing bolts of the flywheel.

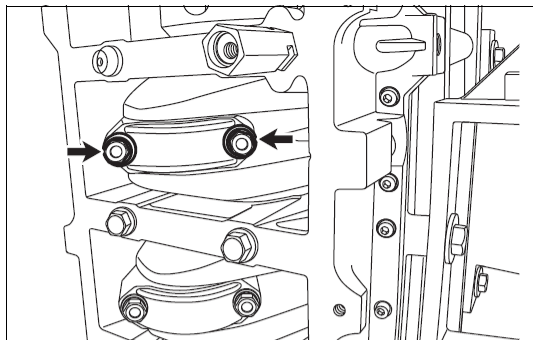
**Torque: First, tighten symmetrically;
Second, tighten with $70 \pm 10 \text{ N.m}$;
Then tighten by 90° two times.**

6. Install the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.

Piston and Connecting Rod

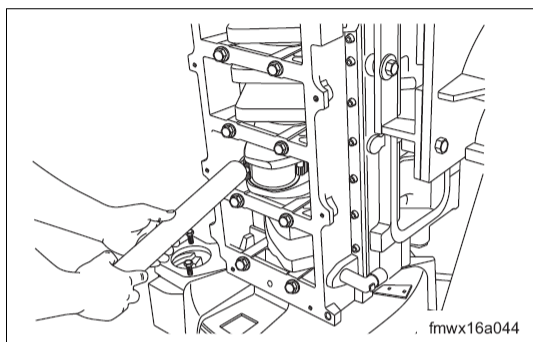
Replacement

1. Dismantle the cylinder head. Refer to Chapter 16A Engine Mechanical – Cylinder Head, Replacement.
2. Dismantle the oil pan. Refer to Chapter 15A Lubrication – Oil Pan, Replacement.

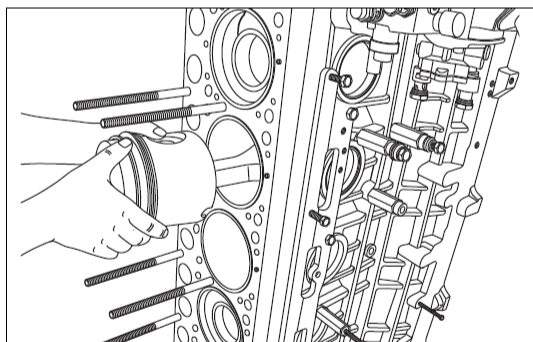


3. Dismantle the piston and connecting rod mechanism

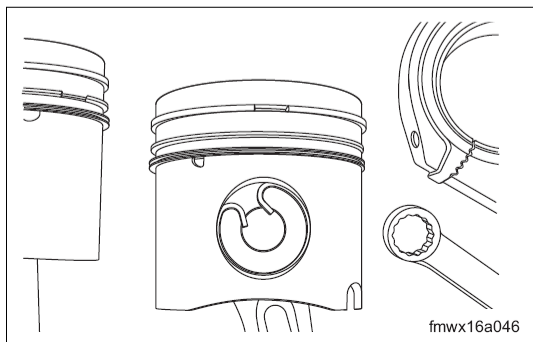
- (a). Dismantle the fixing bolts of the connecting rod big end.



- (b). Beat the connecting rod by a nylon rod to loosen it.

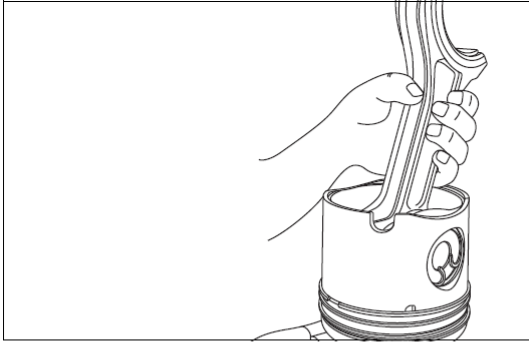


- (c). Take out the connecting rod and piston assembly.



4. Dismantle the piston

- (a). Dismantle the piston ring.
- (b). Dismantle the piston pin clamping spring.
- (c). Beat out the piston pin, and remove the piston.

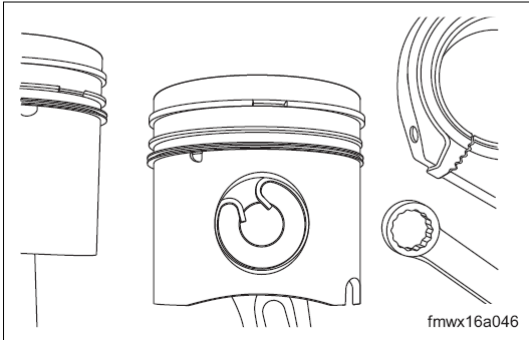


5. Install the piston

- (a). Put the piston components in a thermostat at 80 °C for 10 minutes, and then install the piston pin and connecting rod immediately after taking them out.

Caution:

The 45° cutting face of the connecting rod big end shall back on to the gap of the piston oil nozzle.

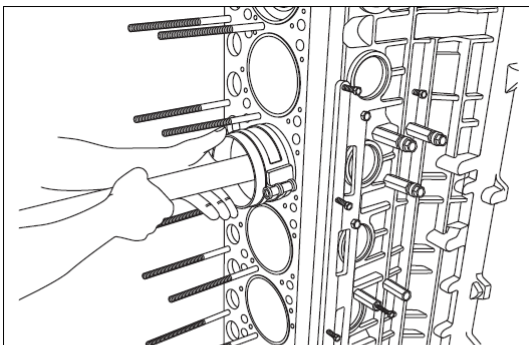


- (b). Install the locating clamping springs the locating grooves at both sides of the piston pin hole.

- (c). Install the piston ring.

Caution:

The face of the compression ring with “TOP” or upward mark must be face up. The oil ring has no difference in both faces.



6. Install the piston and connecting rod mechanism

- (a). Install the piston into the cylinder liner by piston pliers.

Caution:

Stagger the piston ring gaps by 120°, and keep the gaps off at least 30° from the piston pin axis. Apply oil on the outer surface of the piston and the inner surface of the cylinder liner.

- (b). Install the fixing bolts of the connecting rod big end.

- Tighten the connecting rod bolts symmetrically.

Torque: First tighten with 120N.m;

Then tighten in order by 90°±5°;

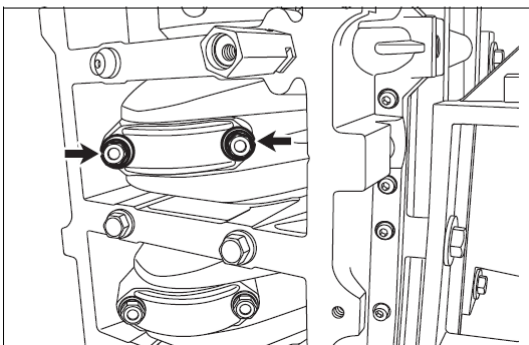
Inspect whether the torque reaches 210N.m.

Caution:

The connecting rod bolts can be used only once repeatedly.

7. Install the oil pan. Refer to Chapter 15A Lubrication – Oil Pan, Replacement.

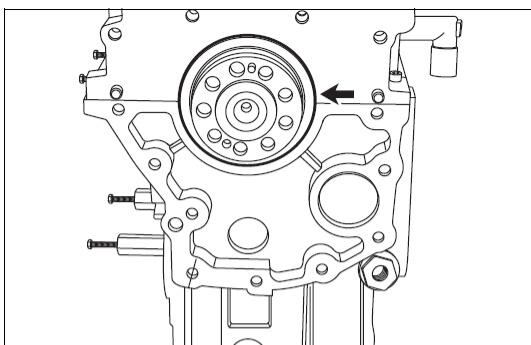
8. Install the cylinder head. Refer to Chapter 16A Engine Mechanical – Cylinder Head, Replacement.



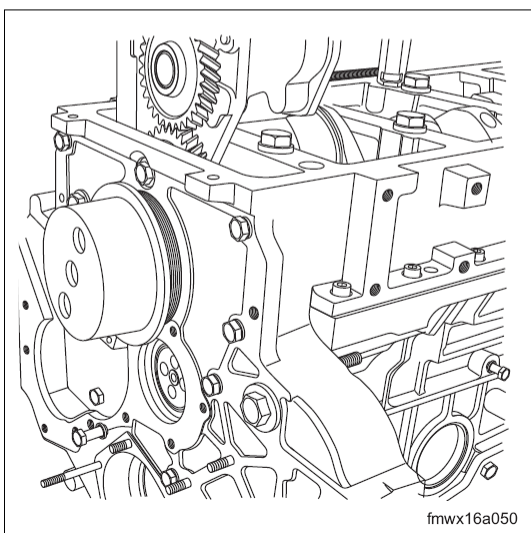
Crankshaft

Replacement

1. Dismantle the piston and connecting rod. Refer to Chapter 16A Engine Mechanical – Piston and Connecting Rod, Replacement.
2. Dismantle the flywheel and flywheel housing. Refer to Chapter 16A Engine Mechanical – Flywheel and Flywheel Housing, Replacement.

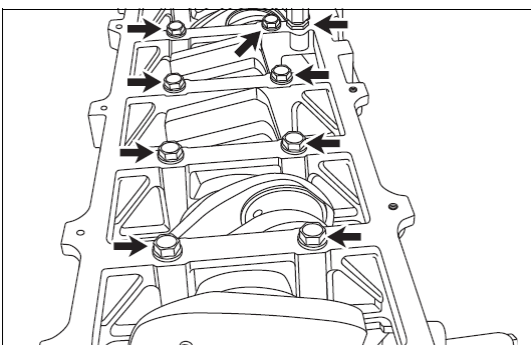


3. Dismantle the oil seal of the crankshaft
 - (a). Dismantle the front oil seal of the crankshaft.

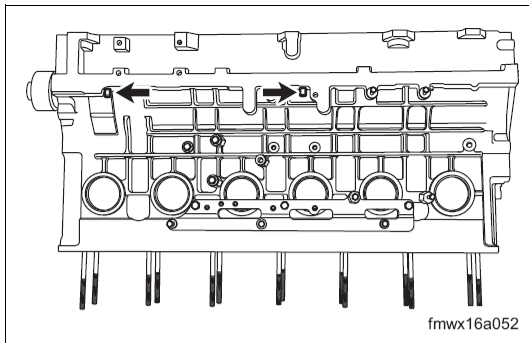


- (b). Dismantle the rear oil seal of the crankshaft.

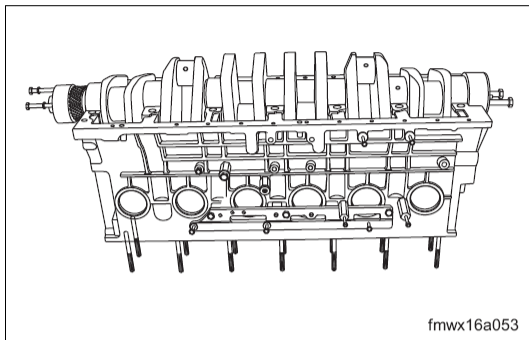
4. Dismantle the timing gear chamber. Refer to Chapter 16A Engine Mechanical – Timing Gear Chamber, Replacement.



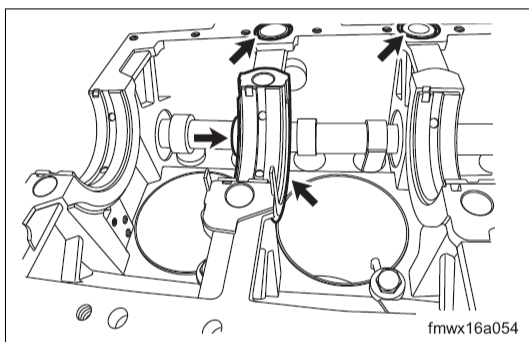
5. Dismantle the crankshaft
 - (a). Dismantle the crankcase.
 - Dismantle the oil pressure regulator valve.
 - Dismantle the fixing bolts of the crankcase.



- Beat out the locating pin of the crankcase.
- Put down the crankcase.

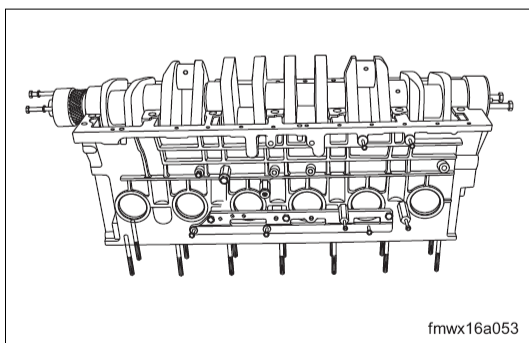


- (b). Put down the crankshaft.

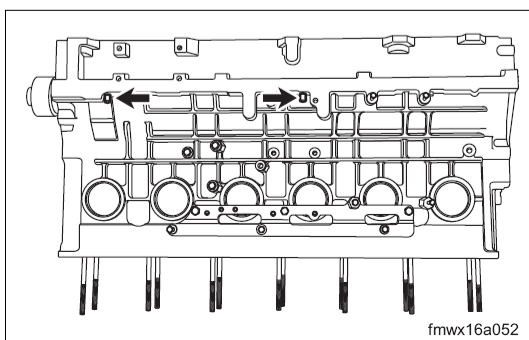


6. Install the crankshaft

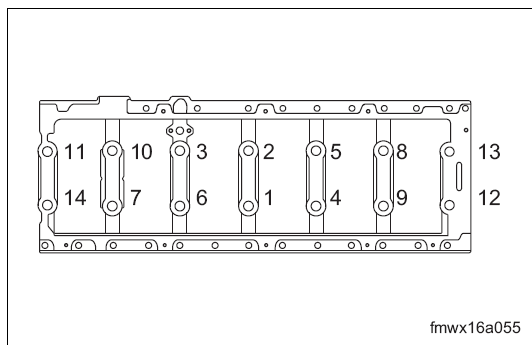
- (a). Install the bearing.
- (b). Adjust the radial clearance of the crankshaft. Refer to Chapter 16A Engine Mechanical – Engine Mechanical, Testing & Adjustment.
- (c). Install the thrust gasket.
- (d). Install the sealing ring.



- (e). Install the crankshaft.
- (f). Adjust the axial clearance of the crankshaft. Refer to Chapter 16A Engine Mechanical – Engine Mechanical, Testing & Adjustment.

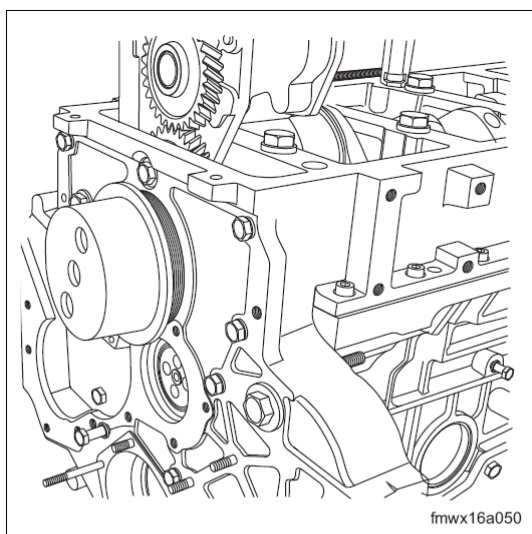


- (g). Install the crankcase.
- Clean the contact face between the cylinder and crankcase, and apply 510 flange sealant.
 - Put on the crankcase.
 - Beat in the locating pin of the crankcase.

Engine Mechanical (WP10) – Crankshaft

- Install the fixing bolts of the crankcase.
**Torque: First, 30 N.m;
Second, 80 N.m;
Third, 250 ±25 N.m.**
- Install the oil pressure regulator valve.

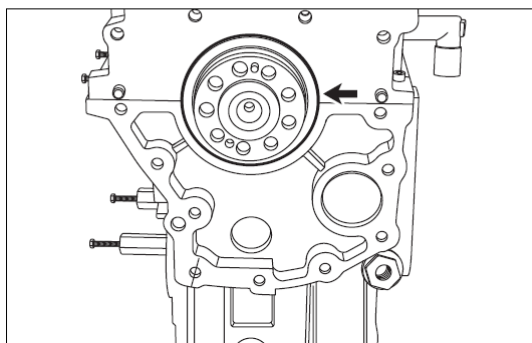
7. Install the timing gear chamber. Refer to Chapter 16A Engine Mechanical – Timing Gear Chamber, Replacement.



8. Install the oil seal of the crankshaft

- (a). Install the rear oil seal of the crankshaft.

- (b). Install the front oil seal of the crankshaft.

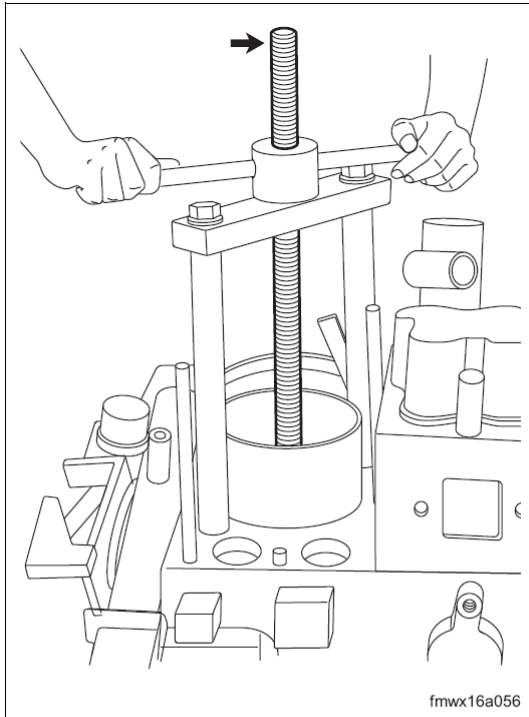


- 9. Install the flywheel and flywheel housing. Refer to Chapter 16A Engine Mechanical – Flywheel and Flywheel Housing, Replacement.**
- 10. Install the piston and connecting rod. Refer to Chapter 16A Engine Mechanical – Piston and Connecting Rod, Replacement.**

Cylinder Body

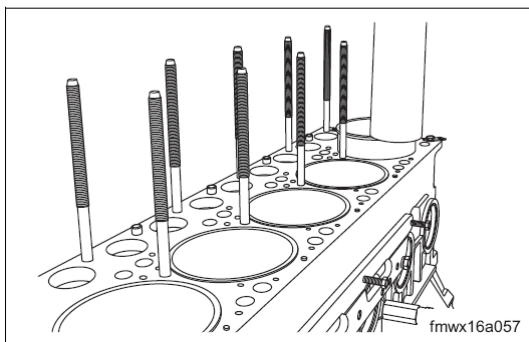
Replacement

1. Dismantle the engine accessories. Refer to Chapter 16A Engine Mechanical – Engine Accessories, Replacement.
2. Dismantle the crankshaft. Refer to Chapter 16A Engine Mechanical – Crankshaft, Replacement.



3. Dismantle the cylinder liner

- (a). Pull out the cylinder liner by a cylinder liner puller.



4. Install the cylinder liner

- (a). Apply a layer of molybdenum disulfide powder on the outer surface of the cylinder liner.

Caution:

DO NOT apply oil.

- (b). Slightly press into the cylinder liner.

Caution:

The part of the cylinder liner, which is higher than the top plane of the cylinder body, shall be within the range of 0.05~0.10mm.

5. Install the crankshaft. Refer to Chapter 16A Engine Mechanical – Crankshaft, Replacement.
6. Install the engine accessories. Refer to Chapter 16A Engine Mechanical – Engine Accessories, Replacement.

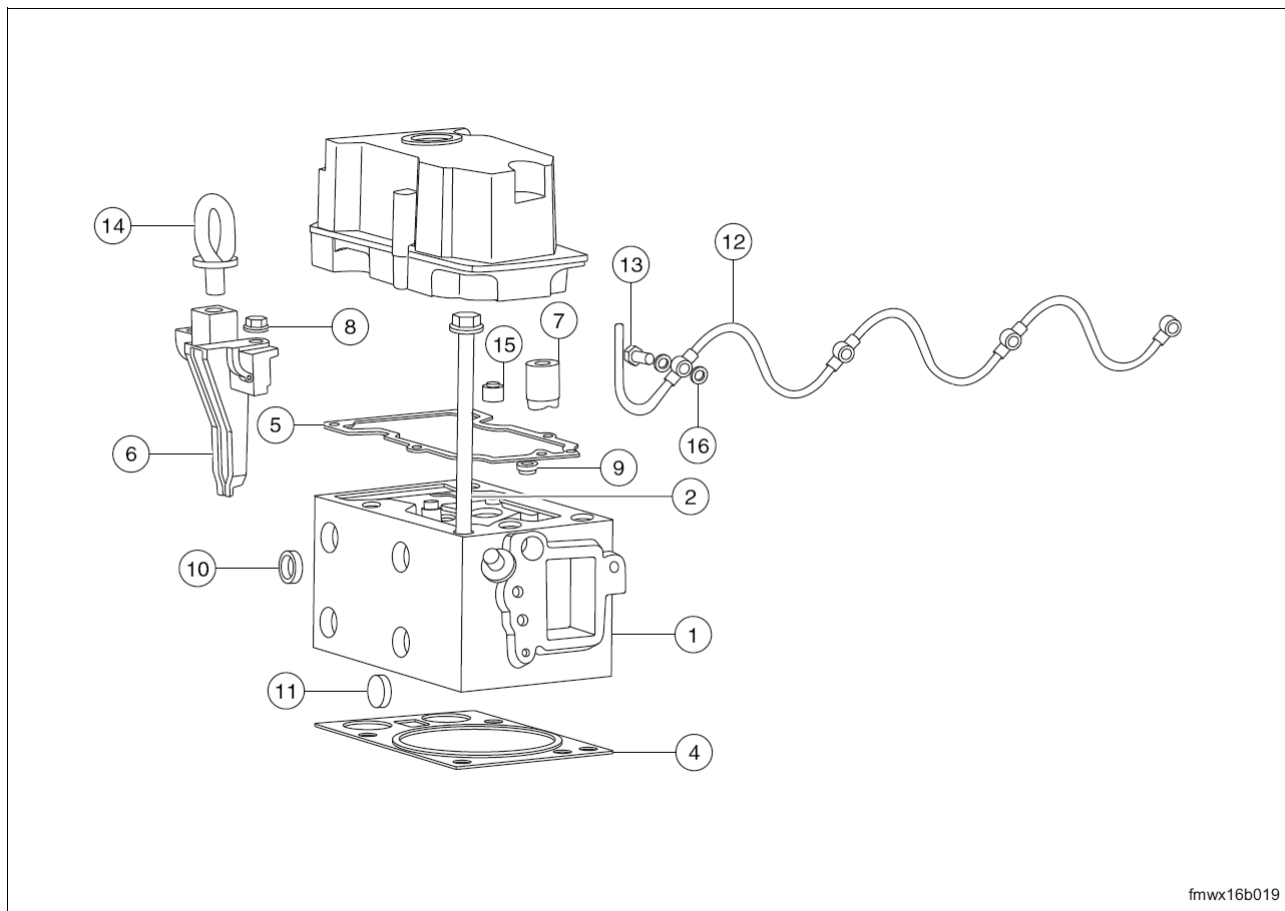
Engine Mechanical (WP12)

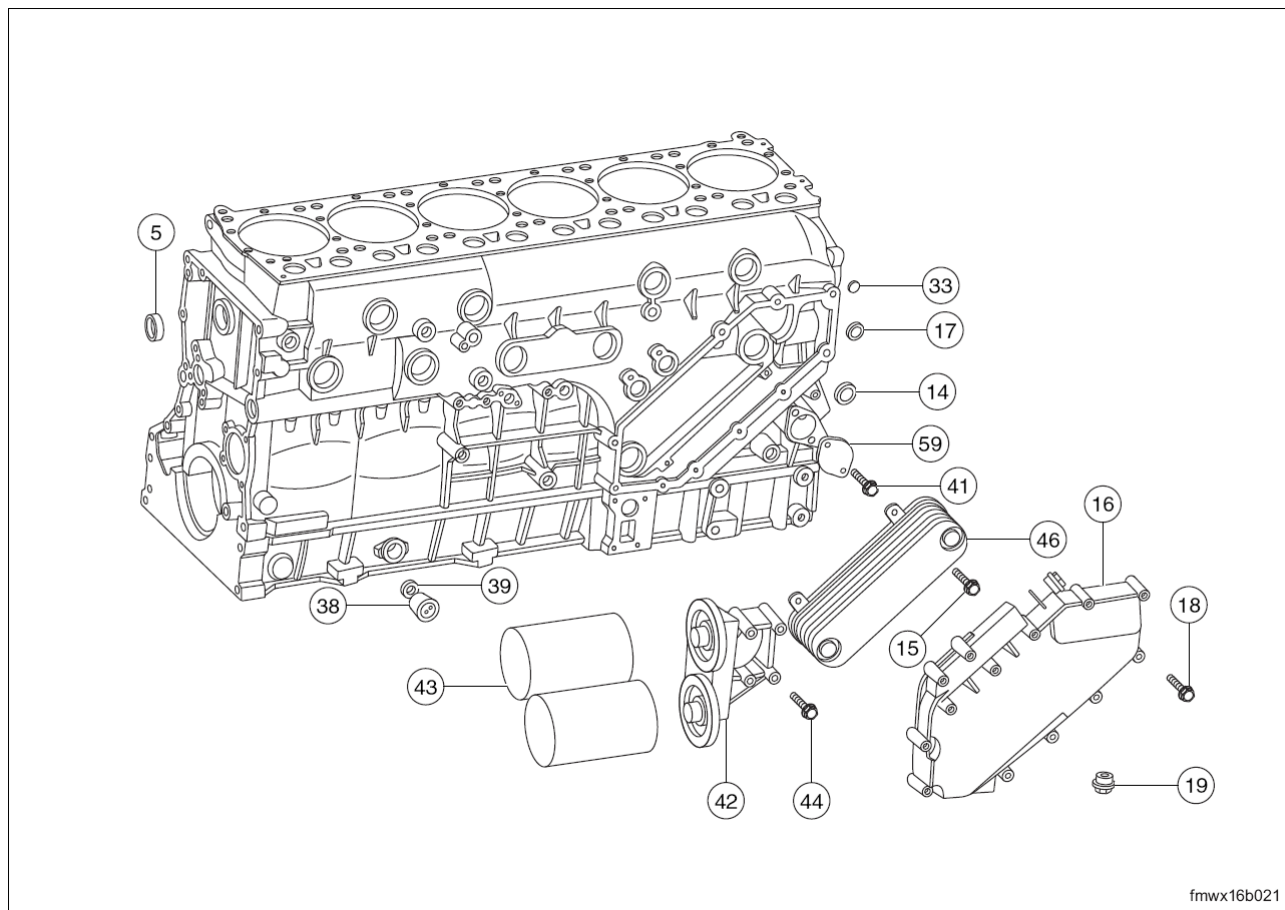
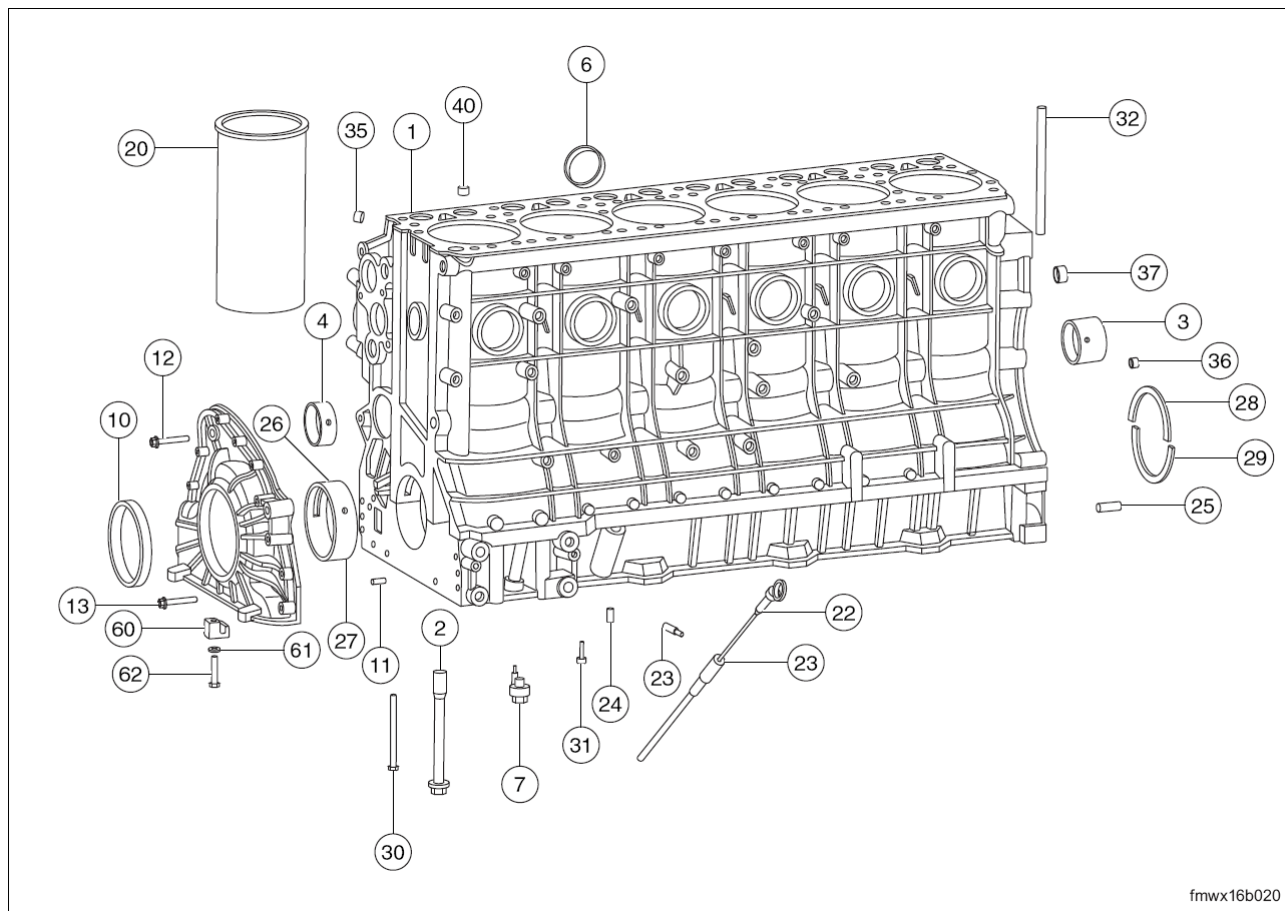
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Replacement.....	16B-20
Rocker Arm and Valve	16B-22
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Replacement.....	16B-25
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Replacement.....	16B-28
Crankshaft	16B-30
Replacement.....	16B-30
Cylinder Body.....	16B-33
Replacement.....	16B-33

16B

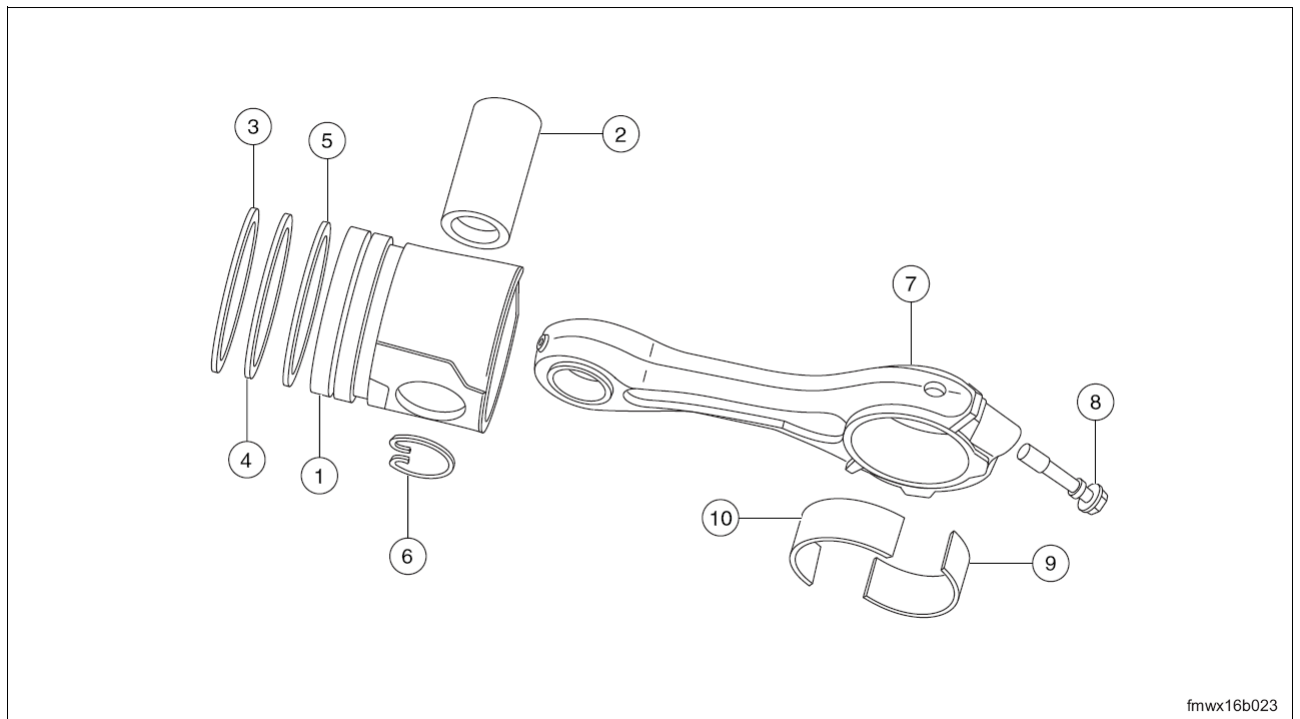
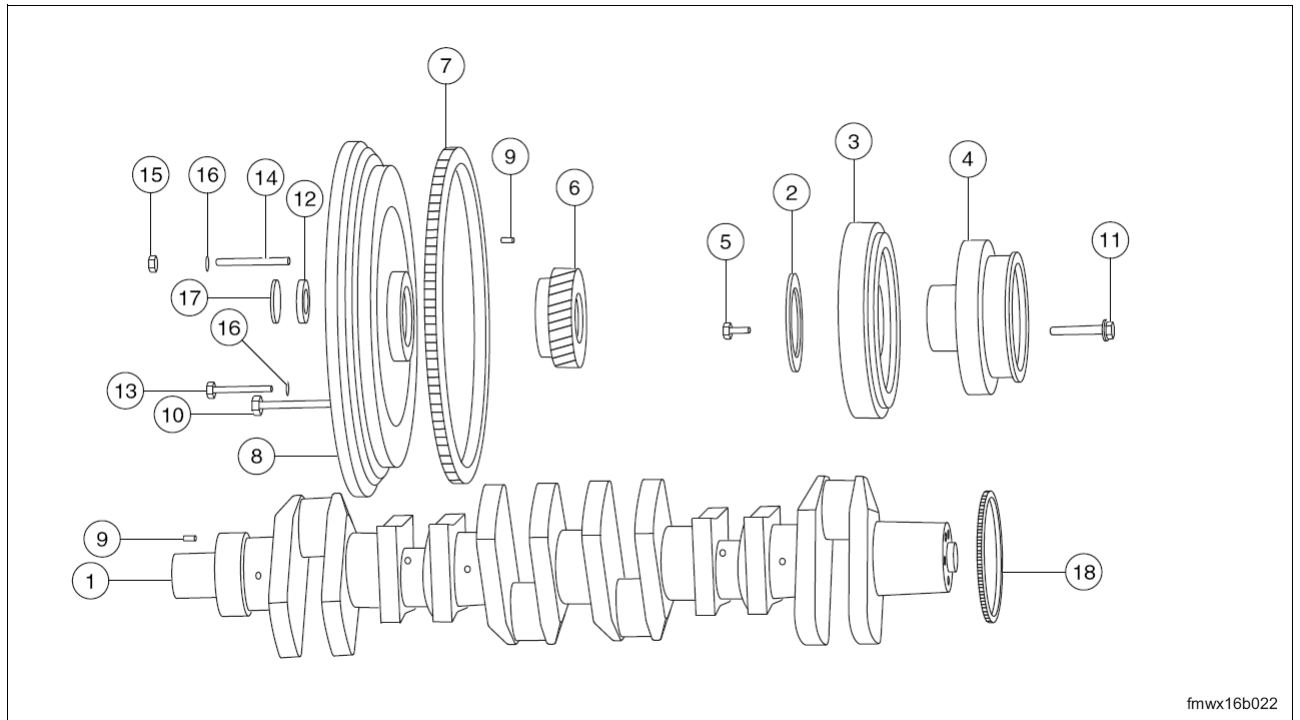
Engine Mechanical

Part Drawing





Engine Mechanical (WP12) – Engine Mechanical



16B

1	Cylinder Body
2	Main Bearing Bolt
3	Rear Camshaft Bushing
4	Camshaft Bushing
5	Core Plug
6	Core Plug
7	Nozzle Assembly

32	Cylinder Head Bolt
33	O-ring
34	Hex Head Bolt
35	Core Plug
36	Core Plug
37	Core Plug
38	Pressure Sensor

8	Gasket
9	Front End Cover
10	Front Oil Seal, Crankshaft
11	Cylindrical Pin
12	Hex Head Bolt with Flange
13	Hex Head Bolt with Flange
14	O-ring
15	Hex Head Bolt
16	Oil Cooler Cover Assembly
17	O-ring
18	Hex Head Bolt
19	Screw Plug
20	Cylinder Liner
21	Oil Dipstick Pipe Assembly
22	Oil Dipstick
23	Stud Bolt
24	Locating Pin
25	Locating Pin
26	Upper Half, Main Bearing
27	Lower Half, Main Bearing
28	Upper Thrust Gasket
29	Lower Thrust Gasket
30	Hex Head Bolt
31	Hex Socket Cap Head Screw

39	Sealing Washer
40	Cylindrical Pin
41	Hex Head Bolt
42	Oil Filter Seat
43	Oil Filter
44	Hex Head Bolt
45	Oil Pump
46	Oil Cooler
47	Oil Pipe Assembly
48	Strainer assembly
49	Gasket
50	Wave Spring Washer
51	Hex Head Bolt
52	Pressure Limiting Valve
53	Cylindrical Pin
54	O-ring
55	Oil Pump Driving Gear
56	Magnetic Screw Plug Assembly
57	Sealing Washer
58	Oil Pan Assembly
59	Cover Plate
60	Oil Pan Support Block
61	Flat Washer
62	Hex Head Bolt

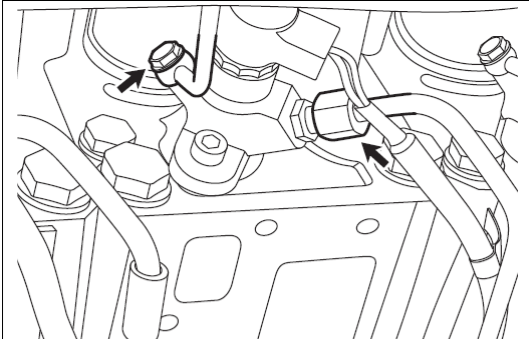
Precautions

1. When lifting or supporting the engine, **DO NOT** allow the jack to come into contact with the oil pan. When putting down the engine, support the engine outside the engine mount and flywheel housing by the engine supporting plate, wood frame or other similar tools.
2. When dismantling the intake system, cover the air inlet to prevent foreign matters from going into the cylinder. If foreign matters go into the cylinder, the cylinder and other parts may be damaged seriously when the engine is operating.
3. Make sure to disconnect the grounding cable of the battery when conducting maintenance on the engine body. When it is necessary to supply power to the engine in the course of inspection or other similar work, pay special attention because short circuit may occur.
4. In order to protect and lubricate the sliding surface in the course of initial operation, apply a large amount of engine oil to the sliding surface.
5. When disassembling the valve parts, piston, piston ring, connecting rod, connecting rod bearing and crankshaft journal bearing, place them in order and store.
6. When re-installing parts, install them in their original positions, as shown before disassembly.
7. When dismantling gaskets, oil seals and other similar parts, make sure to replace them with new parts.
8. If liquid gaskets are used on parts, dismantle all old gaskets, clean the parts and remove any oil, grease, water and contaminants, then apply the specified liquid gasket and install those parts.
9. After applying sealant on a part, install the part within 7 minutes. If not, remove the sealant from the part and re-apply sealant.
10. In the process of assembly and installation, fasten the part to the specified fastening torque, and make sure to install the parts correctly.

Testing & Adjustment

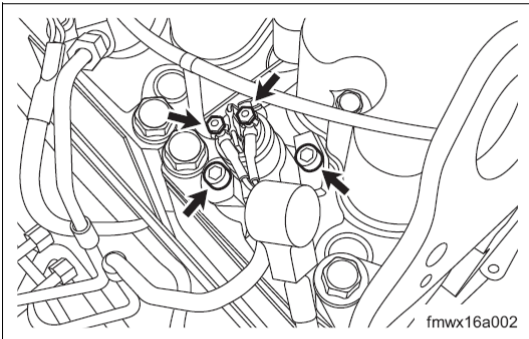
Compression Pressure

Measure the compression pressure using the battery and starter motor under no fault state when the engine cools (the water temperature is 20°C).

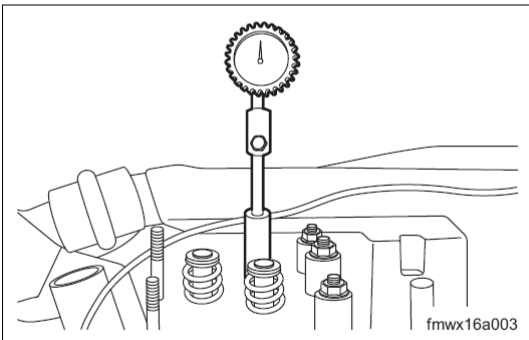


1. Dismantle the fuel injector

- (a). Dismantle the oil inlet pipe of the fuel injector.
- (b). Dismantle the oil return pipe of the fuel injector.

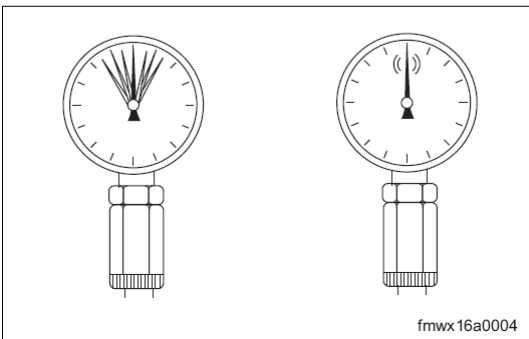


- (c). Disconnect the wiring harness of the fuel injector.
- (d). Dismantle the fixing bolts of the fuel injector.



2. Install a pressure gauge

- (a). Install the pressure gauge into the fuel injector hole.



3. Measure the compression pressure

- (a). Run the starter motor, and read the compression pressure when the pressure gauge pointer is stable.

Caution:

- Remember that air will be suddenly emitted from the fuel injector hole when the motor is running.
- Measure the pressure of all cylinders.
- When disconnecting the wiring harness joint, ECM will identify it as a fault and record the fault code. After finishing measurement, make sure to eliminate the ECM memory.
- (b). Drop engine oil into the cylinder, and then measure the compression pressure again.

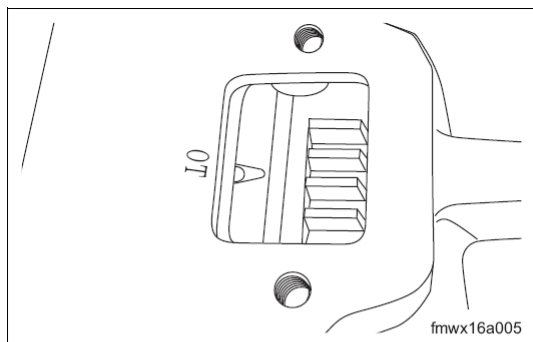
Engine Mechanical (WP12) – Engine Mechanical

- If the compression pressure rises, it shows that the clearance between the piston ring and cylinder liner is too big.

Item	Compression Pressure	Pressure Difference between Cylinders
Standard Value	2.6~2.8MPa	200kPa

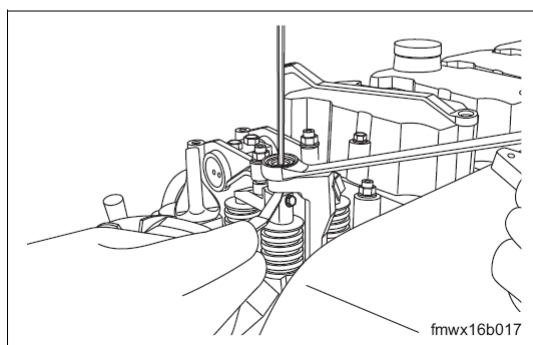
Adjust the valve clearance

Adjust the valve clearance in two steps: set the No.1 cylinder at the top dead center on the compression stroke, and then set the No.6 cylinder at the top dead center on the compression stroke.



1. Set the No.1 (or No.6) cylinder at the top dead center on the compression stroke

- (a). Rotate the crankshaft forward, and align the OT rule line of the flywheel with the pointer. Inspect whether there is a clearance between the cam and rocker arm of the No.1 (or No.6) cylinder (top dead center on the compression stroke) at this point.



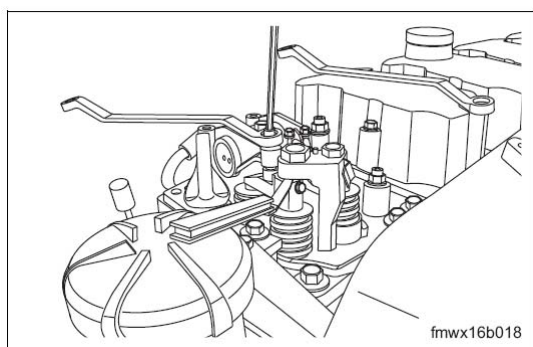
2. Adjust the valve clearance

- (a). Adjust the clearance between the fixing seat and rocker arm.

- Fully loosen the adjusting screws of the rocker arm.
- Insert a thickness gauge, adjust with the adjusting screws of the fixing seat, and then fix with the lock nuts.
- Loosen the adjusting screws of the fixing seat gradually and re-adjust to such a degree that the thickness gauge can be inserted and dismantled flexibly, and then fix the lock nuts of the fixing seat.

- (b). Adjust the clearance between the valve and rocker arm.

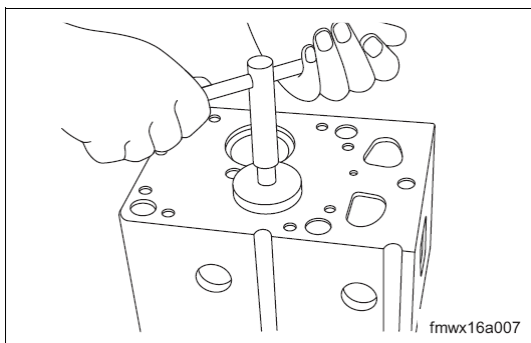
- Fully loosen the adjusting screws of the rocker arm.
- Insert a thickness gauge between the rocker arm and cam, adjust with the adjusting screws of the rocker arm, and then fix with the lock nuts.
- When inserting the thickness gauge, fastening the adjusting screws of the rocker arm, until the thickness gauge stops moving.
- Loosen the adjusting screws of the rocker arm gradually and re-adjust to such a degree that the thickness gauge can be inserted and dismantled flexibly, and then fix the lock nuts of the rocker arm.



Item	Standard Value
Intake Valve Clearance	0.3mm
Exhaust Valve Clearance	0.4mm
Exhaust Valve Brake Clearance	0.25mm

	Cylinder No.	1		2		3		4		5		6	
Condition	Valve Arrangement	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN
Valve to be adjusted	Top Dead Center of No.1 Cylinder	○	○		○	○			○	○			
	Top Dead Center of No.6 Cylinder			○			○	○			○	○	○

Ream the valve seat

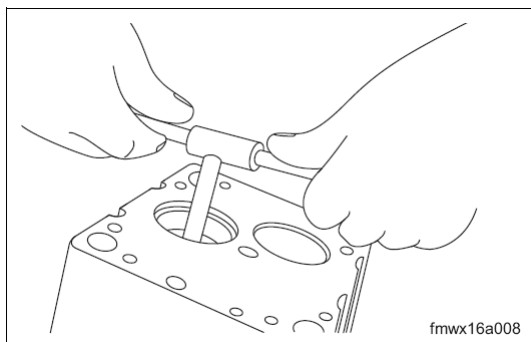


1. Ream the valve seat

- Install the locating bar on the reamer.
- Insert the locating bar into the valve guide for location.
- Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

Item	Standard Value
Width of Working Cone Face	1.5~1.8mm

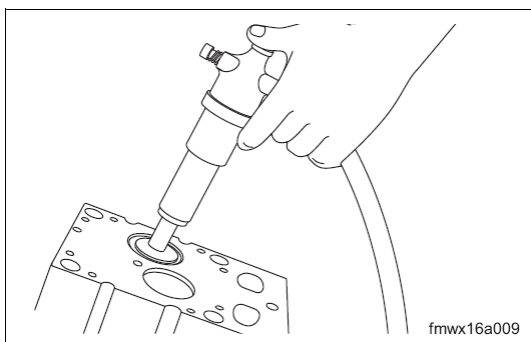
Ream the valve guide



1. Ream the valve guide

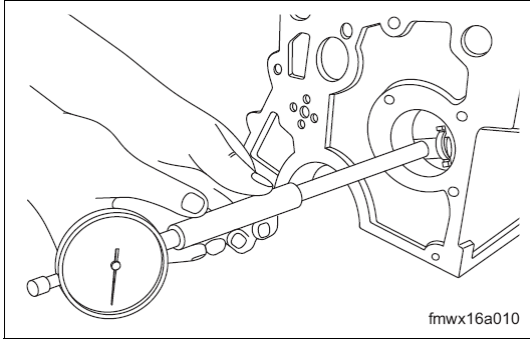
- Use the tap wrench to rotate the reamer downwards clockwise.
- Insert the locating bar into the valve guide for location.
- Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

Grind the valve

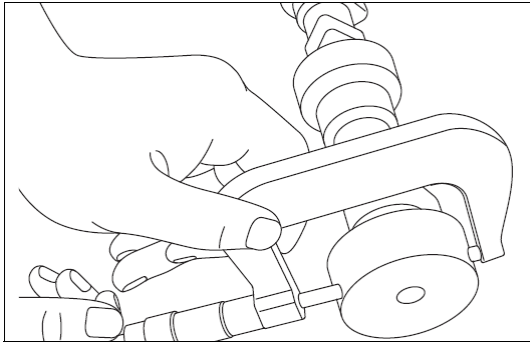


1. Grind the valve seat

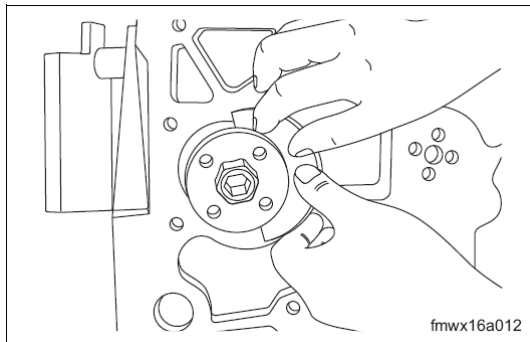
- Grind the valve by a grinding machine.
 - The rotating and beating frequency of the grinding machine can be adjusted.
- After grinding and cleaning, inspect the sealing condition of the valve by kerosene.

Engine Mechanical (WP12) – Engine Mechanical**Inspect and adjust the radial clearance of the camshaft**

- 1. Measure the inside diameter of the bushing**
 - (a). Inspect whether each shaft hole bushing is installed securely.
 - (b). Inspect whether the oil gallery and oil hole are through.
 - (c). Measure the inside diameter of each bushing by an inside micrometer.
 - (d). Measure the outside diameter of each camshaft bearing by an outside micrometer.

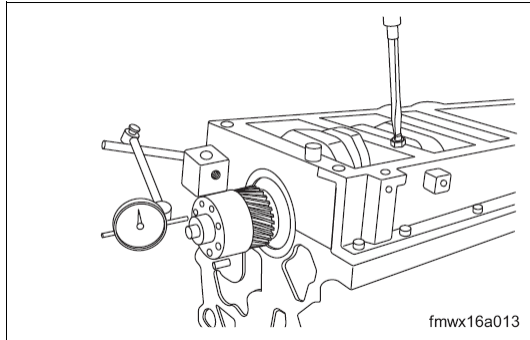


Item	Standard Value
Radial Clearance of Camshaft	0.04~0.12mm

Inspect and adjust the axial clearance of the camshaft

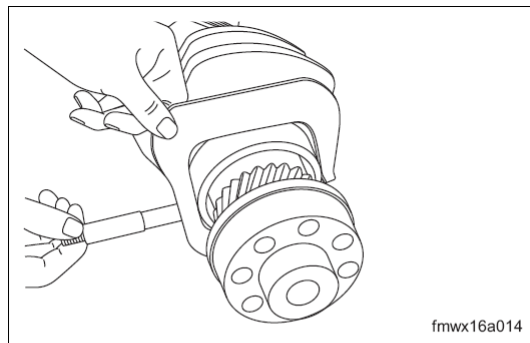
- 1. Measure the axial clearance of the camshaft**
 - (a). Inspect whether there are damages and burrs on the camshaft thrust groove, thrust baffle plate and cylinder body joint face.
 - (b). Insert the thrust baffle plate into the thrust ring groove, and fix the baffle plate by two screws.
 - (c). Inspect the axial clearance of the camshaft by a dial indicator.

Item	Standard Value
Axial Clearance of Camshaft	0.1~0.4mm

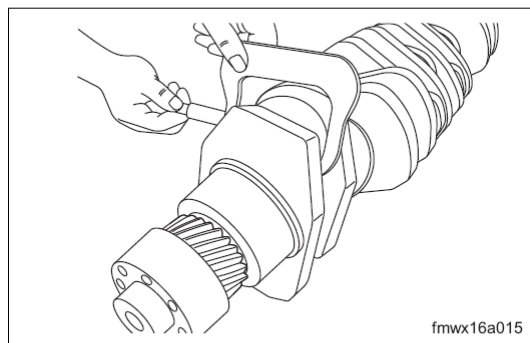
Inspect and adjust the axial clearance of the crankshaft

- 1. Measure the axial clearance of the crankshaft**
 - (a). Fix the dial indicator at the crankshaft end by a magnetic dial indicator seat.
 - (b). Prize the crankshaft up and down.
 - The crankshaft shall go flexibly when rotating it, free from various jamming phenomenon.
 - (c). If the clearance exceeds the range, replace the crankshaft gasket.

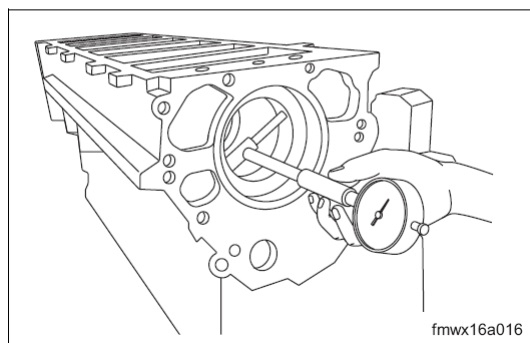
Item	Standard Value
Axial Clearance of Crankshaft	0.052~0.255mm

Inspect and adjust the radial clearance of the crankshaft

- 1. Measure the radial clearance of the crankshaft**
 - (a). Measure each main journal of the crankshaft by an outside micrometer.



- (b). Measure each connecting rod journal of the crankshaft by an outside micrometer.

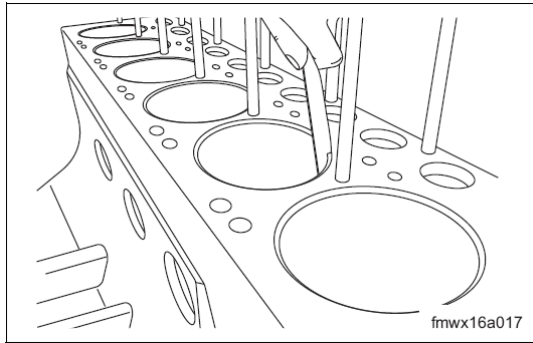


- (c). Install the main bearings of the crankshaft in the cylinder body and crankcase seat holes, and tighten with a torque of 250N.m. Measure the inside diameter of each bearing by an inside micrometer.

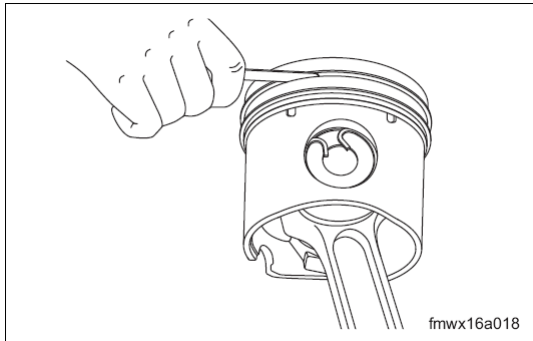
Caution:

The main bearing with oil groove is the upper half, and the bearing without oil groove is the lower half.

Item	Standard Value
Radial Clearance of Crankshaft	0.095~0.163mm

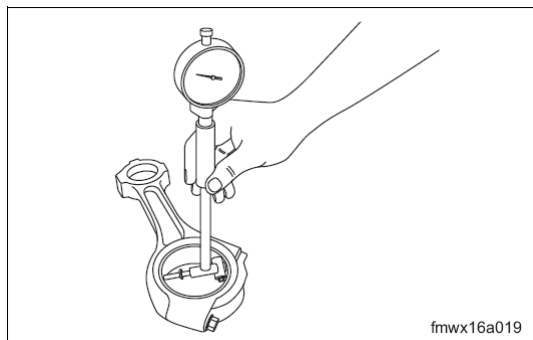
Engine Mechanical (WP12) – Engine Mechanical**Inspect and adjust the piston ring clearance**

- 1. Measure the piston ring gap clearance**
 - (a). Measure the piston ring gap clearance.
 - (b). If the clearance exceeds the range, replace the piston ring.

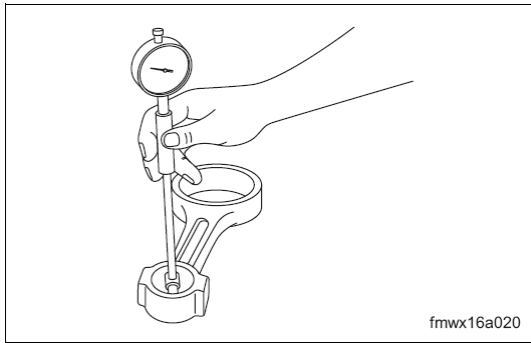


- 2. Measure the piston ring side clearance**
 - (a). Measure the piston ring side clearance by a thickness gauge.
 - (b). If the clearance exceeds the range, replace the piston ring.

Item		Standard Value
Top Compression Ring	Gap Clearance	0.4~0.6mm
	Side Clearance	-
Second Compression Ring	Gap Clearance	0.25~0.4mm
	Side Clearance	0.07~0.102mm
Third Oil Ring	Gap Clearance	0.35~0.55mm
	Side Clearance	0.05~0.085mm

Inspect the fit clearance of the connecting rod

- 1. Measure the connecting rod big end**
 - (a). Install the connecting rod into the connecting rod big end, and tighten the connecting rod bolts.
 - (b). Measure the hole diameter of the connecting rod bearing.

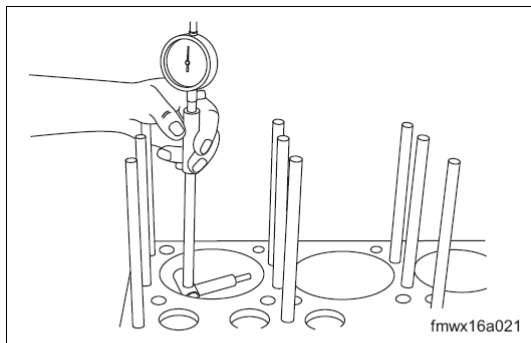


2. Measure the connecting rod small end

- (a). Press the connecting rod small end bushing into the shaft hole.
- (b). Measure the inside diameter of the bushing.
- (c). Measure the inside diameter of the piston pin hole and the outside diameter of the piston pin.

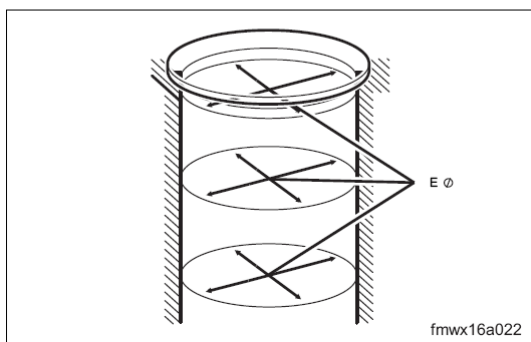
Item	Standard Value
Fit Clearance between Bearing and Crankshaft Connecting Rod Journal	0.059~0.127mm
Fit Clearance between Connecting Rod Bushing and Piston Pin	0.025~0.046mm
Fit Clearance between Piston Pin Hole and Piston Pin	0.003~0.014mm

Inspect the roundness of the cylinder liner



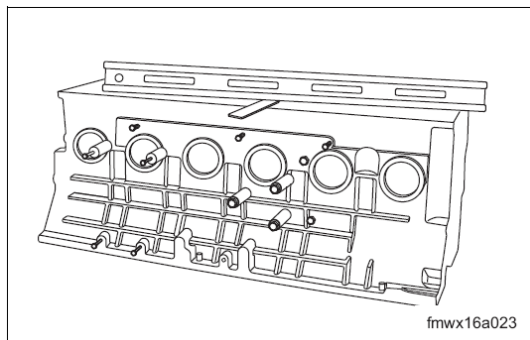
1. Measure the roundness of the cylinder liner

- (a). Inspect whether the cylinder bores and spigots are clean, corroded and damaged.
- (b). Clean the cylinder bores and spigots with trichloroethylene cleaning agent.
- (c). Measure the inside diameter of the cylinder liner by an inside micrometer.
- (d). Measure two times respectively at the top, middle and bottom.



Item	Standard Value
Out of Roundness	Lower than 0.04mm

Inspect the flatness of the cylinder body



1. Measure the flatness of the cylinder body

- (a). Place a level ruler on the upper surface of the cylinder body.
- (b). Measure the clearance between the level ruler and the upper surface of the cylinder body by a thickness gauge.

Caution:

Three sections respectively in the front, middle and rear of the upper surface need to be measured, and the parts of the diagonal shall also be measured.

Engine Assembly

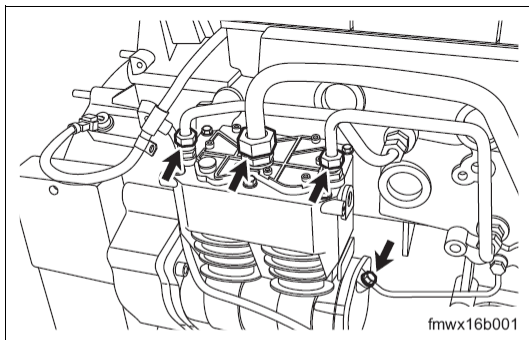
Replacement

1. Turn off the battery switch, and then disconnect the battery negative cable.
2. Dismantle the oil inlet pipe of the engine. Refer to Chapter 11 Fuel – Oil-Water Separator, Replacement.
3. Dismantle the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
4. Dismantle the exhaust pipe. Refer to Chapter 13B Exhaust & Turbocharger – Exhaust Pipe, Replacement.
5. Dismantle the transmission assembly. Refer to Chapter 31B Transmission – Transmission Assembly, Replacement.
6. Drain coolant. Refer to Chapter 14 B Cooling – Coolant, Replacement.
7. Dismantle the intercooler hose. Refer to Chapter 14 B Cooling – Intercooler, Overhaul.
8. Dismantle the radiator hose. Refer to Chapter 14 B Cooling – Radiator, Overhaul.
9. Dismantle the auxiliary water tank hose. Refer to Chapter 14 B Cooling – Auxiliary Water Tank, Replacement.
10. Dismantle the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
11. Dismantle the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
12. Dismantle the pipeline of the air compressor. Refer to Chapter 18B Engine Mechanical – Engine Accessories, Overhaul.
13. Disconnect the wiring harness of the Engine ECU.
14. Dismantle the fixing bolts of the engine.
15. Install the fixing bolts of the engine.
16. Connect the wiring harness of the engine ECU.
17. Install the pipeline of the air compressor. Refer to Chapter 18B Engine Mechanical – Engine Accessories, Overhaul.
18. Install the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
19. Install the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
20. Install the auxiliary water tank hose. Refer to Chapter 14B Cooling – Auxiliary Water Tank, Replacement.
21. Install the radiator hose. Refer to Chapter 14B Cooling – Radiator, Overhaul.
22. Install the intercooler hose. Refer to Chapter 14B Cooling – Intercooler, Overhaul.
23. Fill coolant. Refer to Chapter 14B Cooling – Coolant, Replacement.
24. Install the transmission assembly. Refer to Chapter 31B Transmission – Transmission Assembly, Replacement.
25. Install the exhaust pipe. Refer to Chapter 13B Exhaust & Turbocharger – Exhaust Pipe, Replacement.
26. Install the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
27. Install the oil inlet pipe of the engine. Refer to Chapter 11B Fuel – Oil-Water Separator, Replacement.

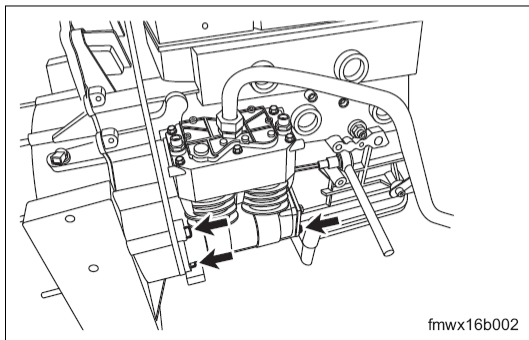
Engine Accessories

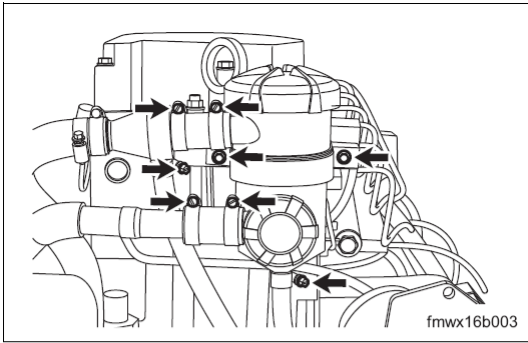
Replacement

1. Turn off the main power
2. Dismantle the generator. Refer to Chapter 19B Charging System – Generator, Overhaul.
3. Dismantle the starter. Refer to Chapter 18B Starting & Preheating System – Starter, Overhaul.
4. Dismantle the heater. Refer to Chapter 18B Starting & Preheating System – Heater, Overhaul.
5. Dismantle the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
6. Dismantle the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
7. Dismantle the water pump. Refer to Chapter 14B Cooling – Water Pump, Replacement.
8. Dismantle the cooling fan. Refer to Chapter 14B Cooling – Cooling Fan, Overhaul.
9. Dismantle the high-pressure pump. Refer to Chapter 11B Fuel – High-pressure Pump, Replacement.
10. Dismantle the common-rail pipe. Refer to Chapter 11B Fuel – Common-rail Pipe, Replacement.
11. Dismantle the fuel fine filter. Refer to Chapter 11B Fuel – Fuel Fine Filter, Replacement.
12. Dismantle the oil pan. Refer to Chapter 15B Lubrication – Oil Pan, Replacement.
13. Dismantle ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.



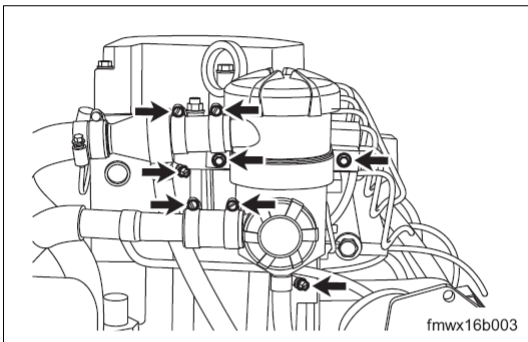
14. Dismantle the air compressor.
 - (a). Disconnect the cooling water pipe of the air compressor.
 - (b). Disconnect the intake and exhaust pipes of the air compressor.
 - (c). Dismantle the lubricating oil pipe of the air compressor.
 - (d). Dismantle the fixing bolts of the air compressor.





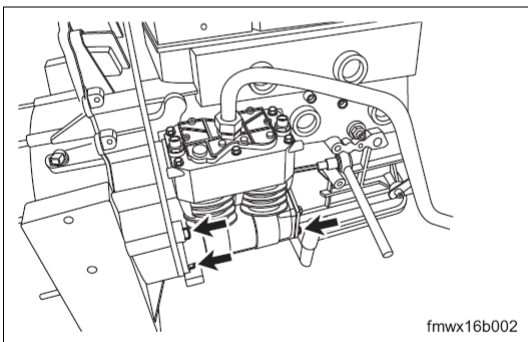
15. Dismantle the oil-gas separator

- (a). Dismantle the pipeline of the oil-gas separator.
- (b). Dismantle the fixing bolts of the oil-gas separator.



16. Install the oil-gas separator

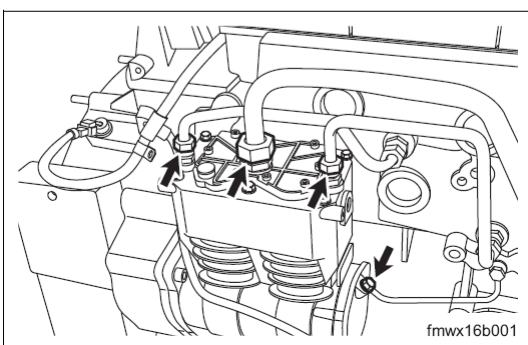
- (a). Install the fixing bolts of the oil-gas separator.
- (b). Install the pipeline of the oil-gas separator.



17. Install the air compressor

- (a). Install the fixing bolts of the air compressor.

Torque: 63N.m



- (b). Install the lubricating oil pipe of the air compressor.
- (c). Connect the intake and exhaust pipes of the air compressor.
- (d). Connect the cooling water pipe of the air compressor.

18. Install ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.

19. Install the oil pan. Refer to Chapter 15B Lubrication – Oil Pan, Replacement.

20. Install the fuel fine filter. Refer to Chapter 11B Fuel – Fuel Fine Filter, Replacement.

21. Install the common-rail pipe. Refer to Chapter 11B Fuel – Common-rail Pipe, Replacement.

22. Install the high-pressure pump. Refer to Chapter 11B Fuel – High-pressure Pump, Replacement.

23. Install the cooling fan. Refer to Chapter 14B Cooling – Cooling Fan, Overhaul.

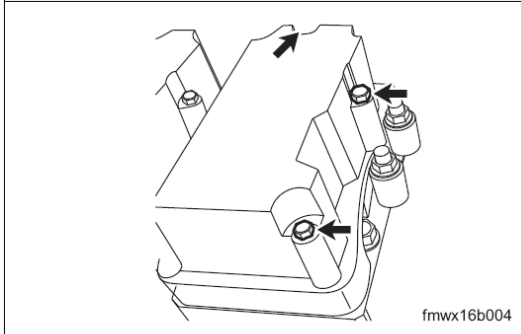
Engine Mechanical (WP12) – Engine Accessories

- 24. Install the water pump. Refer to Chapter 14B Cooling – Water Pump, Replacement.
- 25. Install the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
- 26. Install the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
- 27. Install the heater. Refer to Chapter 18B Stating & Preheating System – Heater, Overhaul.
- 28. Install the starter. Refer to Chapter 18B Stating & Preheating System – Starter, Overhaul.
- 29. Install the generator. Refer to Chapter 19B Charging System – Generator, Overhaul.

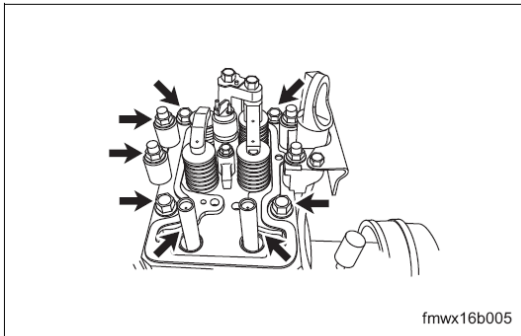
Cylinder Head

Replacement

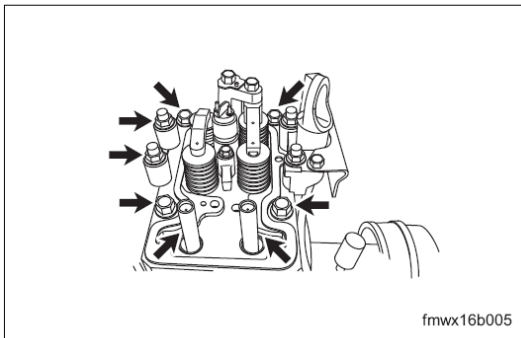
1. Disconnect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.
2. Disconnect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.
3. Disconnect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.



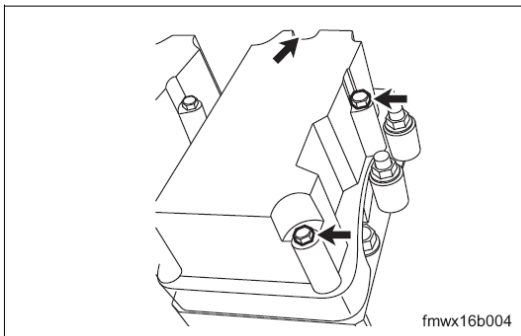
4. Dismantle the cylinder head
 - (a). Dismantle the valve chamber cover.
 - (b). Remove the cylinder gasket.



- (c). Remove the valve tappet.
- (d). Dismantle the clamping block of the cylinder head.
- (e). Dismantle the fixing bolts of the cylinder head.



5. Install the cylinder head
 - (a). Install the fixing bolts of the cylinder head.
Torque: 200 N.m
 - (b). Install the clamping block of the cylinder head.
Torque: 100 N.m
 - (c). Install the valve tappet.



- (d). Install the lock block of the cylinder head.
Torque: 25N.m
 - (e). Install the fixing bolts and nuts of the cylinder head.
Torque: 25N.m
 - (f). Install the cylinder gasket.
- Caution:**
Do not install reversely.

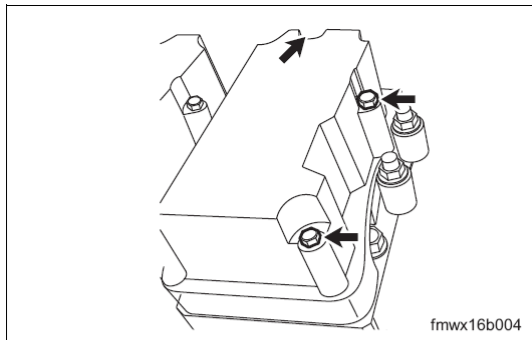
Engine Mechanical (WP12) – Cylinder Head

6. Connect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.
7. Connect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.
8. Connect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP12), Overhaul.

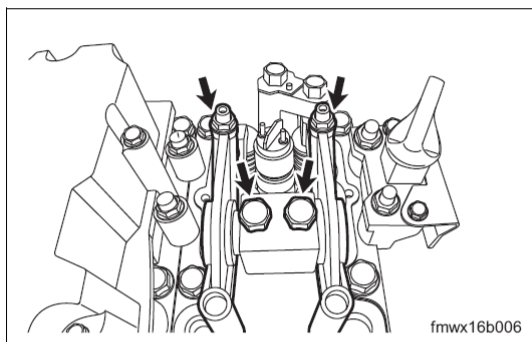
Rocker Arm and Valve

Replacement

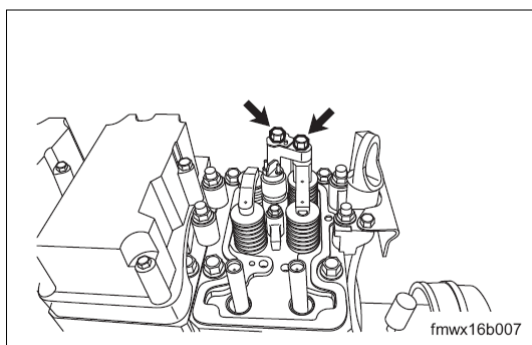
1. Dismantle the cylinder head. Refer to Chapter 16B Engine Mechanical – Cylinder Head, Replacement.



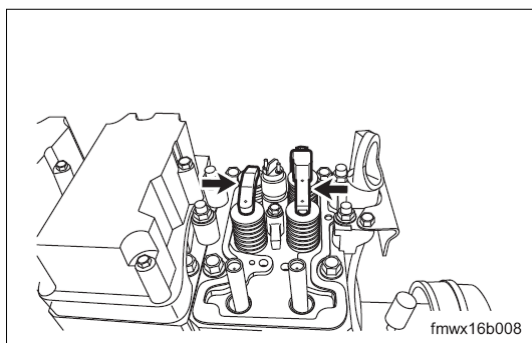
2. Dismantle the valve chamber cover
 - (a). Dismantle the fixing bolts of the valve chamber cover.



3. Dismantle the rocker arm
 - (a). Dismantle the intake and exhaust valve rocker arms.
 - (b). Dismantle the rocker arm support.

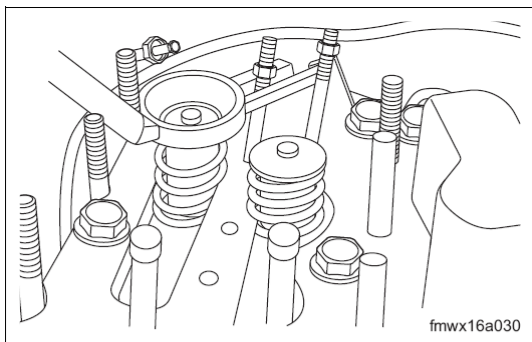


- (c). Dismantle the rocker arm fixing seat.



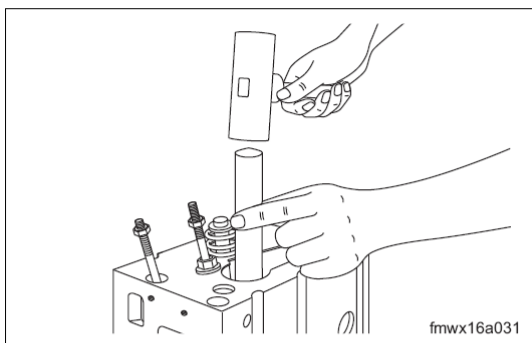
- (d). Remove the intake and exhaust valve rocker arms.

Engine Mechanical (WP12) – Rocker Arm and Valve



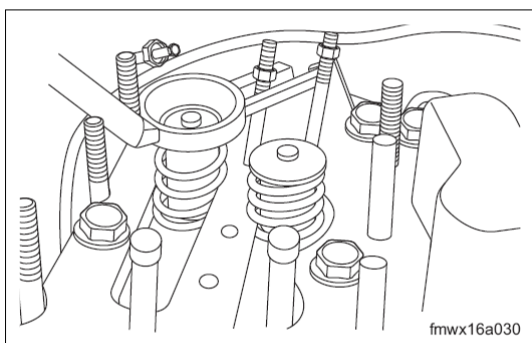
4. Dismantle the valve

- (a). Dismantle the valve lock by a valve dismantling/installing tool.
- (b). Take out the valve spring and valve.
- (c). Dismantle the valve guide.

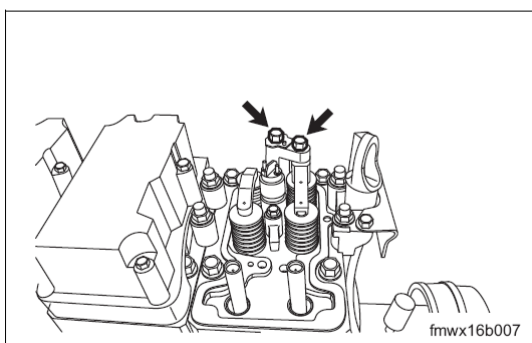


5. Install the valve

- (a). Install the valve guide by a valve guide bar.
- (b). Install the valve spring.

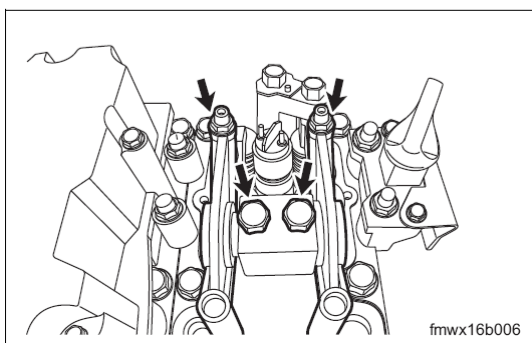


- (c). Install the valve lock by the valve dismantling/installing tool.



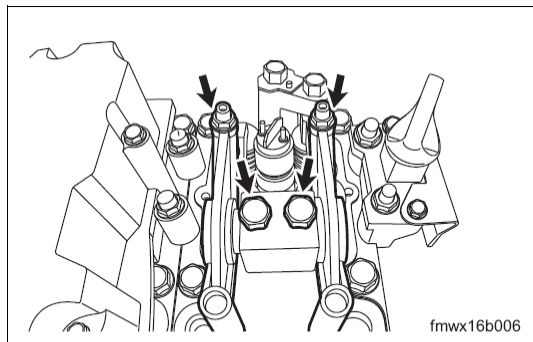
6. Install the rocker arm

- (a). Install the intake and exhaust valve rocker arms.

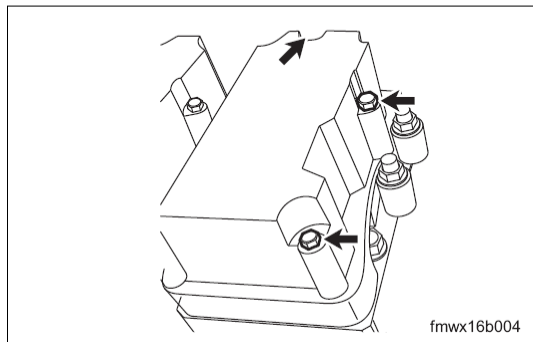


- (b). Install the rocker arm fixing seat.

Torque: 105±5N.m



- (c). Install the rocker arm support.
- (d). Install the intake and exhaust valve rocker arms.



7. Install the valve chamber cover

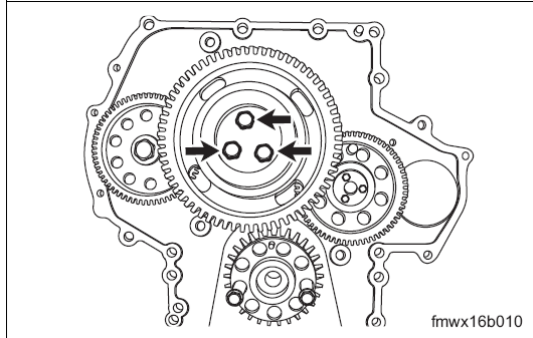
- (a). Install the fixing bolts of the valve chamber cover.

8. Install the cylinder head. Refer to Chapter 16B Engine Mechanical – Cylinder Head, Replacement.

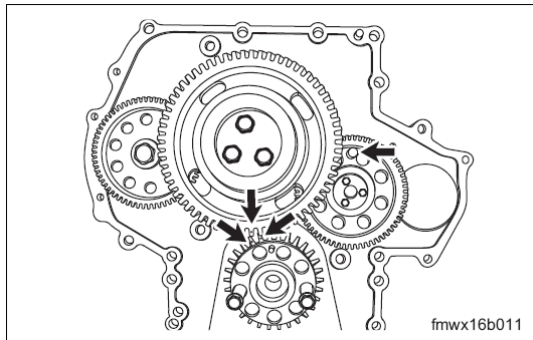
Timing Gear

Replacement

1. Dismantle the engine accessories. Refer to Chapter 16B Engine Mechanical – Engine Accessories, Replacement.
2. Dismantle the flywheel housing. Refer to Chapter 16B Engine Mechanical – Flywheel and Flywheel Housing, Replacement.



3. Dismantle the timing gear
 - (a). Dismantle the intermediate idler.



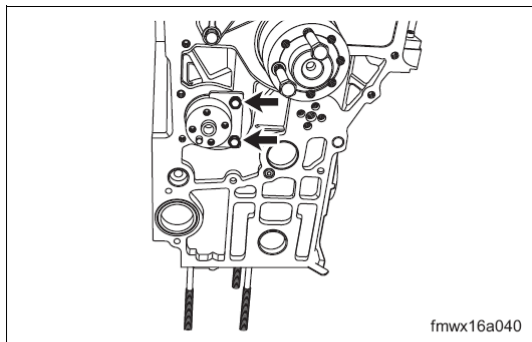
4. Install the timing gear
 - (a). Install the intermediate idler.
 - Align the air compressor driving gear with the locating hole, and fix.
 - Align the locating marks of the intermediate idler and crankshaft gear.

5. Install the flywheel housing. Refer to Chapter 16B Engine Mechanical – Flywheel and Flywheel Housing, Replacement.
6. Install the engine accessories. Refer to Chapter 16B Engine Mechanical – Engine Accessories, Replacement.

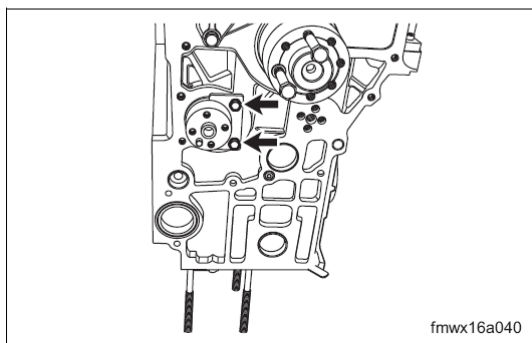
Camshaft

Replacement

1. Dismantle the timing gear chamber. Refer to Chapter 16B Engine Mechanical – Timing Gear Chamber, Replacement.



2. Dismantle the camshaft



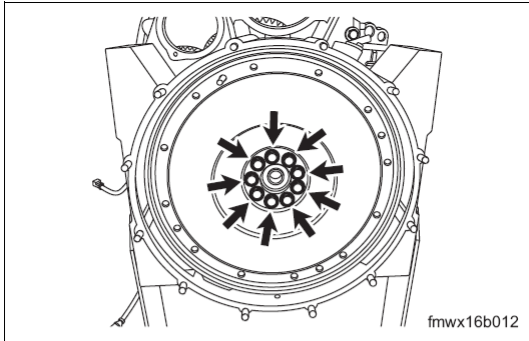
3. Install the camshaft
 - (a). Install the camshaft.
 - (b). Install the fixing bolts of the camshaft.

4. Install the timing gear chamber. Refer to Chapter 16B Engine Mechanical – Timing Gear Chamber, Replacement.

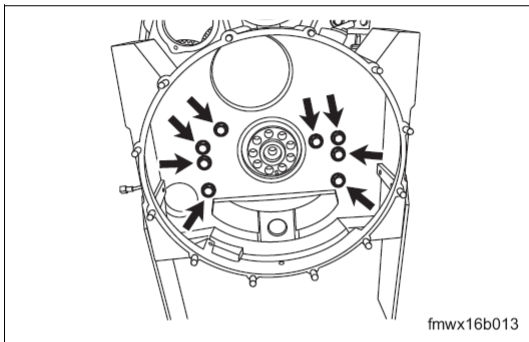
Flywheel and Flywheel Housing

Replacement

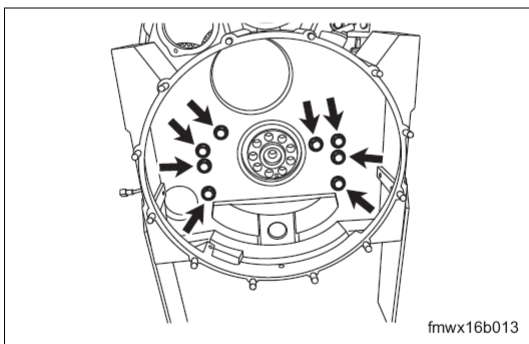
1. Dismantle the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.



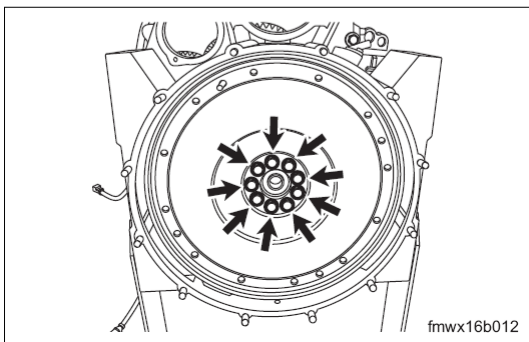
2. Dismantle the flywheel
 - (a). Dismantle the fixing bolts of the flywheel.



3. Dismantle the flywheel housing
 - (a). Dismantle the fixing bolts of the flywheel housing.



4. Install the flywheel housing
 - (a). Install the fixing bolts of the flywheel housing.
Torque: First, tighten with $50 \pm 10 \text{ N.m}$ symmetrically;
Second, tighten by $120^\circ \pm 5^\circ$;
Inspection whether the torque reaches 255 N.m .



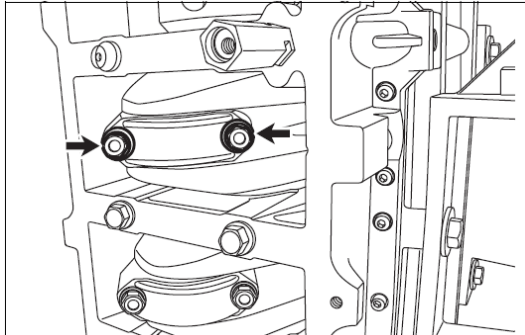
5. Install the flywheel
 - (a). Install the fixing bolts of the flywheel.
Torque: First, tighten symmetrically;
Second, tighten with $70 \pm 10 \text{ N.m}$;
Then tighten by 90° two times.

6. Install the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.

Piston and Connecting Rod

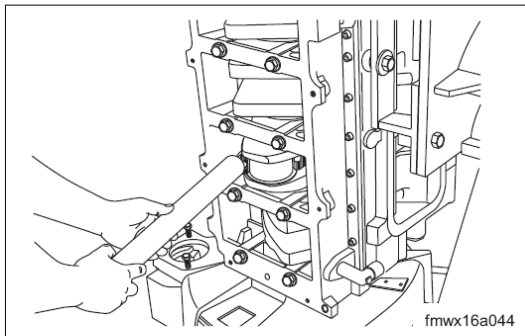
Replacement

1. Dismantle the cylinder head. Refer to Chapter 16B Engine Mechanical – Cylinder Head, Replacement.
2. Dismantle the oil pan. Refer to Chapter 15B Lubrication – Oil Pan, Replacement.

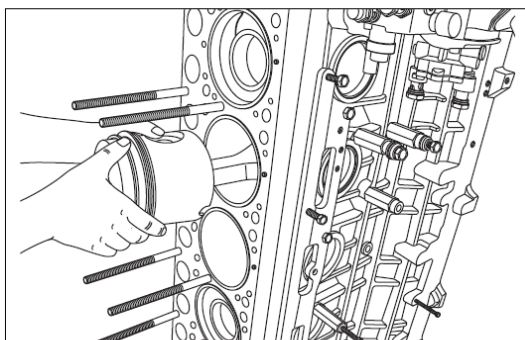


3. Dismantle the piston and connecting rod mechanism

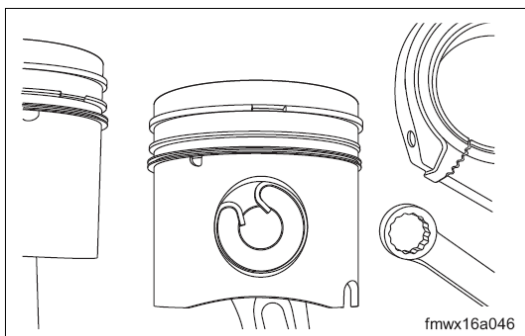
- (a). Dismantle the fixing bolts of the connecting rod big end.



- (b). Beat the connecting rod by a nylon rod to loosen it.

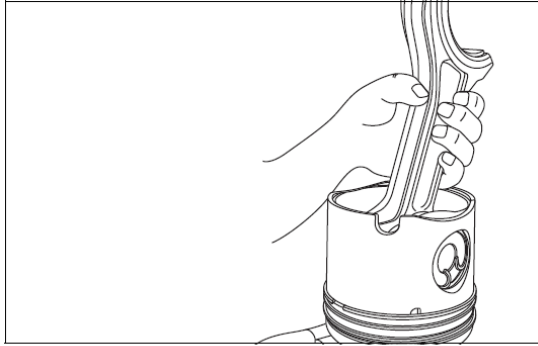


- (c). Take out the connecting rod and piston assembly.



4. Dismantle the piston

- (a). Dismantle the piston ring.
 - (b). Dismantle the piston pin clamping spring.
 - (c). Beat out the piston pin, and remove the piston.

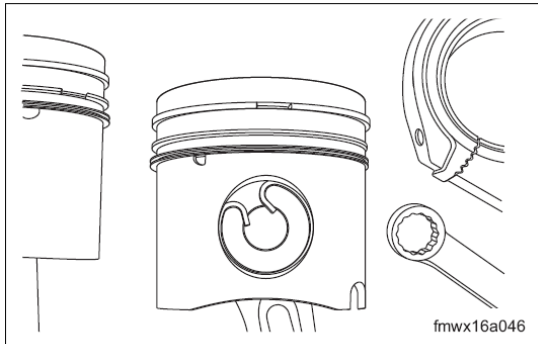


5. Install the piston

- (a). Put the piston components in a thermostat at 80 °C for 10 minutes, and then install the piston pin and connecting rod immediately after taking them out.

Caution:

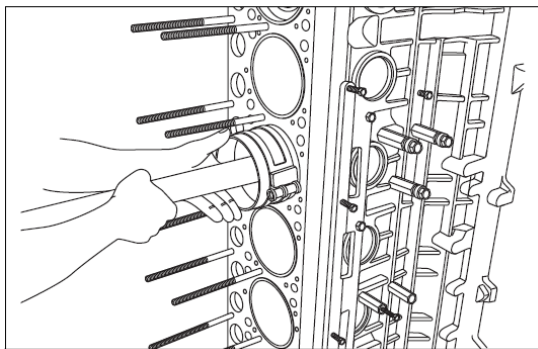
The 45° cutting face of the connecting rod big end shall back on to the gap of the piston oil nozzle.



- (b). Install the locating clamping springs the locating grooves at both sides of the piston pin hole.
- (c). Install the piston ring.

Caution:

The face of the compression ring with “TOP” or upward mark must be face up. The oil ring has no difference in both faces.

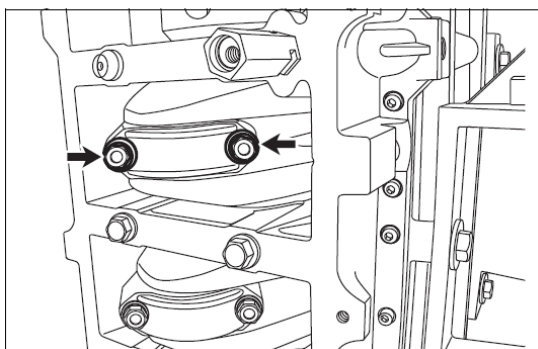


6. Install the piston and connecting rod mechanism

- (a). Install the piston into the cylinder liner by piston pliers.

Caution:

Stagger the piston ring gaps by 120°, and keep the gaps off at least 30° from the piston pin axis. Apply oil on the outer surface of the piston and the inner surface of the cylinder liner.



- (b). Install the fixing bolts of the connecting rod big end.

- Tighten the connecting rod bolts symmetrically.

Torque: First tighten with 120N.m;

Then tighten in order by 90°±5°;

Inspect whether the torque reaches 210N.m.

Caution:

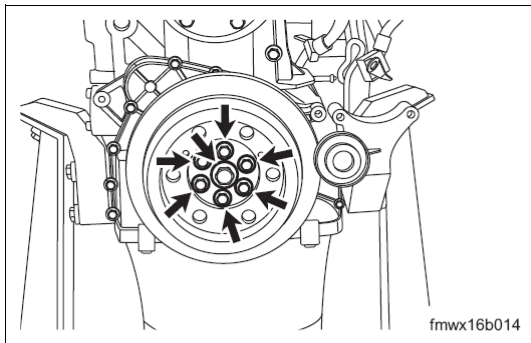
The connecting rod bolts can be used only once repeatedly.

7. Install the oil pan. Refer to Chapter 15A Lubrication – Oil Pan, Replacement.
8. Install the cylinder head. Refer to Chapter 16A Engine Mechanical – Cylinder Head, Replacement.

Crankshaft

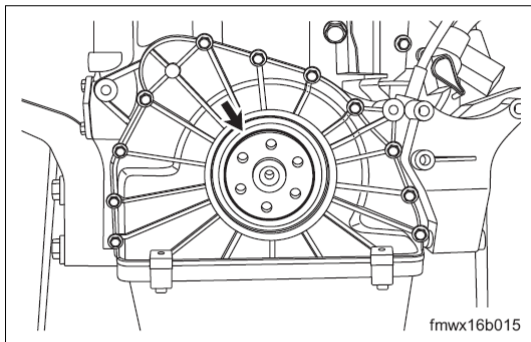
Replacement

1. Dismantle the piston and connecting rod. Refer to Chapter 16B Engine Mechanical – Piston and Connecting Rod, Replacement.
2. Dismantle the flywheel and flywheel housing. Refer to Chapter 16B Engine Mechanical – Flywheel and Flywheel Housing, Replacement.

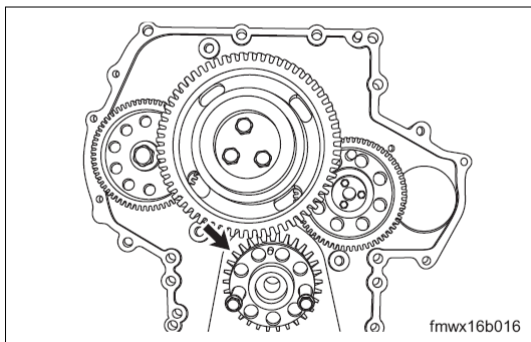


3. Dismantle the oil seal of the crankshaft

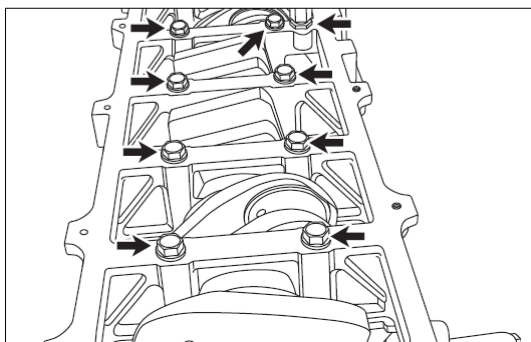
- (a). Dismantle the crankshaft pulley.



- (b). Dismantle the front oil seal of the crankshaft.

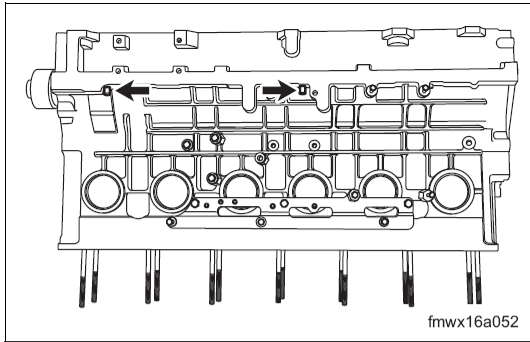


- (b). Dismantle the rear oil seal of the crankshaft.

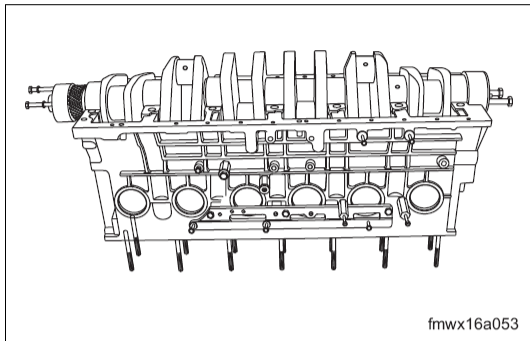


4. Dismantle the crankshaft

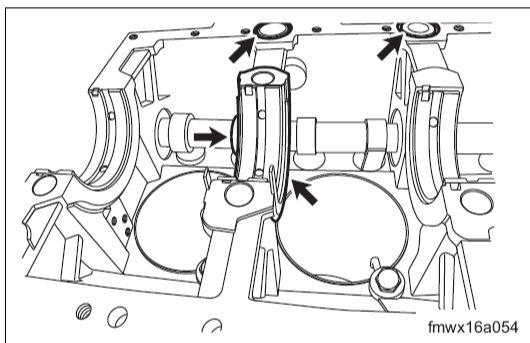
- (a). Dismantle the crankcase.
 - Dismantle the oil pressure regulator valve.
 - Dismantle the fixing bolts of the crankcase.

Engine Mechanical (WP12) – Crankshaft

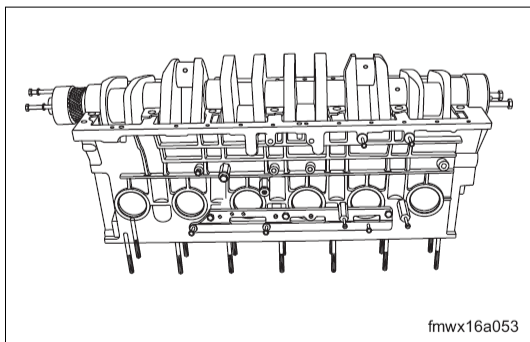
- Beat out the locating pin of the crankcase.
- Put down the crankcase.



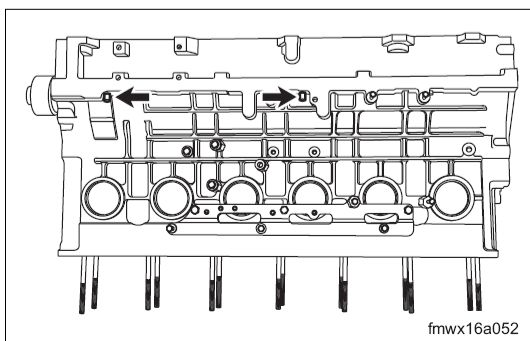
- (b). Put down the crankshaft.

**5. Install the crankshaft**

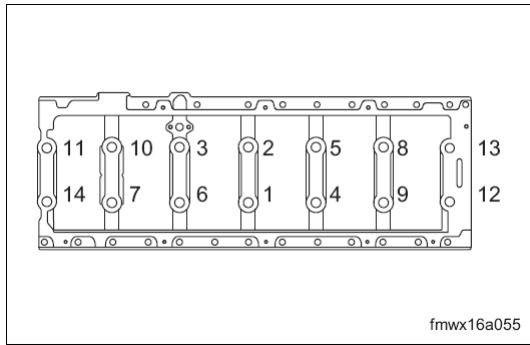
- Install the bearing.
- Adjust the radial clearance of the crankshaft. Refer to Chapter 16B Engine Mechanical – Engine Mechanical, Testing & Adjustment.
- Install the thrust gasket.
- Install the sealing ring.



- Install the crankshaft.
- Adjust the axial clearance of the crankshaft. Refer to Chapter 16B Engine Mechanical – Engine Mechanical, Testing & Adjustment.

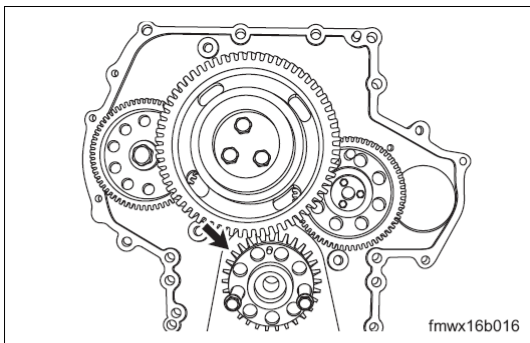


- Install the crankcase.
 - Clean the contact face between the cylinder and crankcase, and apply 510 flange sealant.
 - Put on the crankcase.
 - Beat in the locating pin of the crankcase.



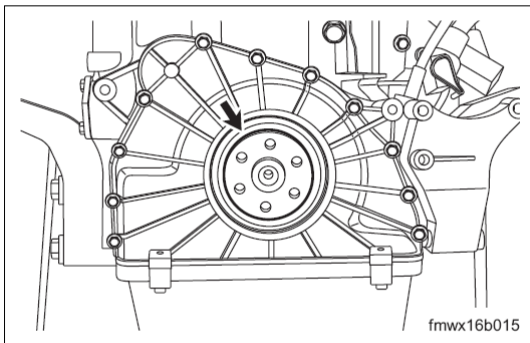
- Install the fixing bolts of the crankcase.
**Torque: First, 30 N.m;
Second, 80 N.m;
Third, 250 ±25 N.m.**
- Install the oil pressure regulator valve.

6. Install the timing gear chamber. Refer to Chapter 16B Engine Mechanical – Timing Gear Chamber, Replacement.

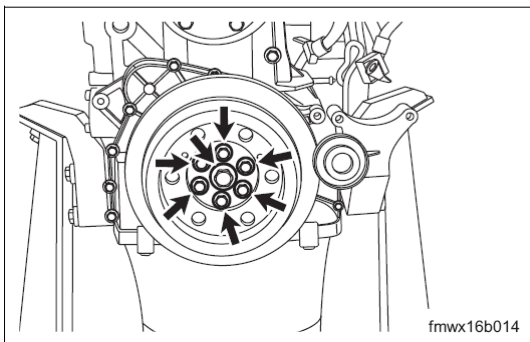


7. Install the oil seal of the crankshaft

- (a). Install the rear oil seal of the crankshaft.



- (b). Install the front oil seal of the crankshaft.



- (b). Install the crankshaft pulley.

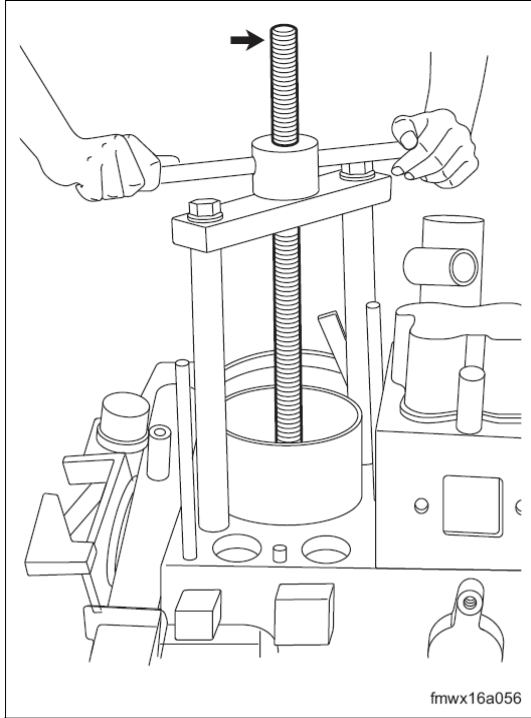
8. Install the flywheel and flywheel housing. Refer to Chapter 16B Engine Mechanical – Flywheel and Flywheel Housing, Replacement.

9. Install the piston and connecting rod. Refer to Chapter 16B Engine Mechanical – Piston and Connecting Rod, Replacement.

Cylinder Body

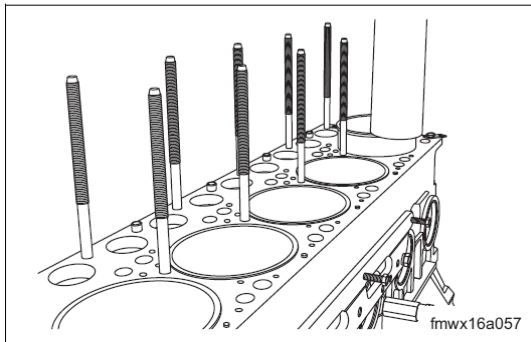
Replacement

1. Dismantle the engine accessories. Refer to Chapter 16B Engine Mechanical – Engine Accessories, Replacement.
2. Dismantle the crankshaft. Refer to Chapter 16B Engine Mechanical – Crankshaft, Replacement.



3. Dismantle the cylinder liner

- (a). Pull out the cylinder liner by a cylinder liner puller.



4. Install the cylinder liner

- (a). Apply a layer of molybdenum disulfide powder on the outer surface of the cylinder liner.

Caution:

DO NOT apply oil.

- (b). Slightly press into the cylinder liner.

Caution:

The part of the cylinder liner, which is higher than the top plane of the cylinder body, shall be within the range of 0.05~0.10mm.

5. Install the crankshaft. Refer to Chapter 16B Engine Mechanical – Crankshaft, Replacement.
6. Install the engine accessories. Refer to Chapter 16B Engine Mechanical – Engine Accessories, Replacement.

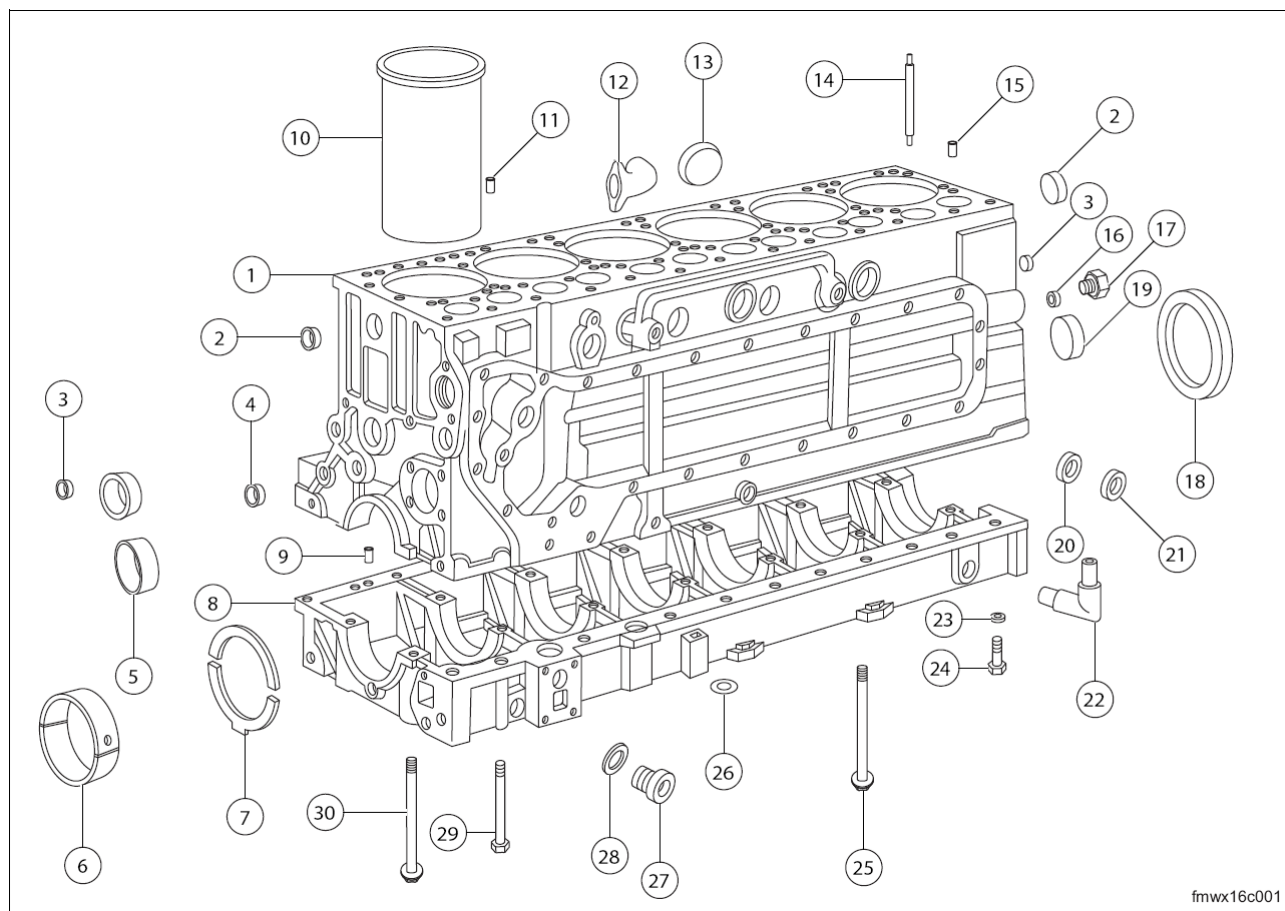
Engine Mechanical (WD615)

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16C

Engine Mechanical

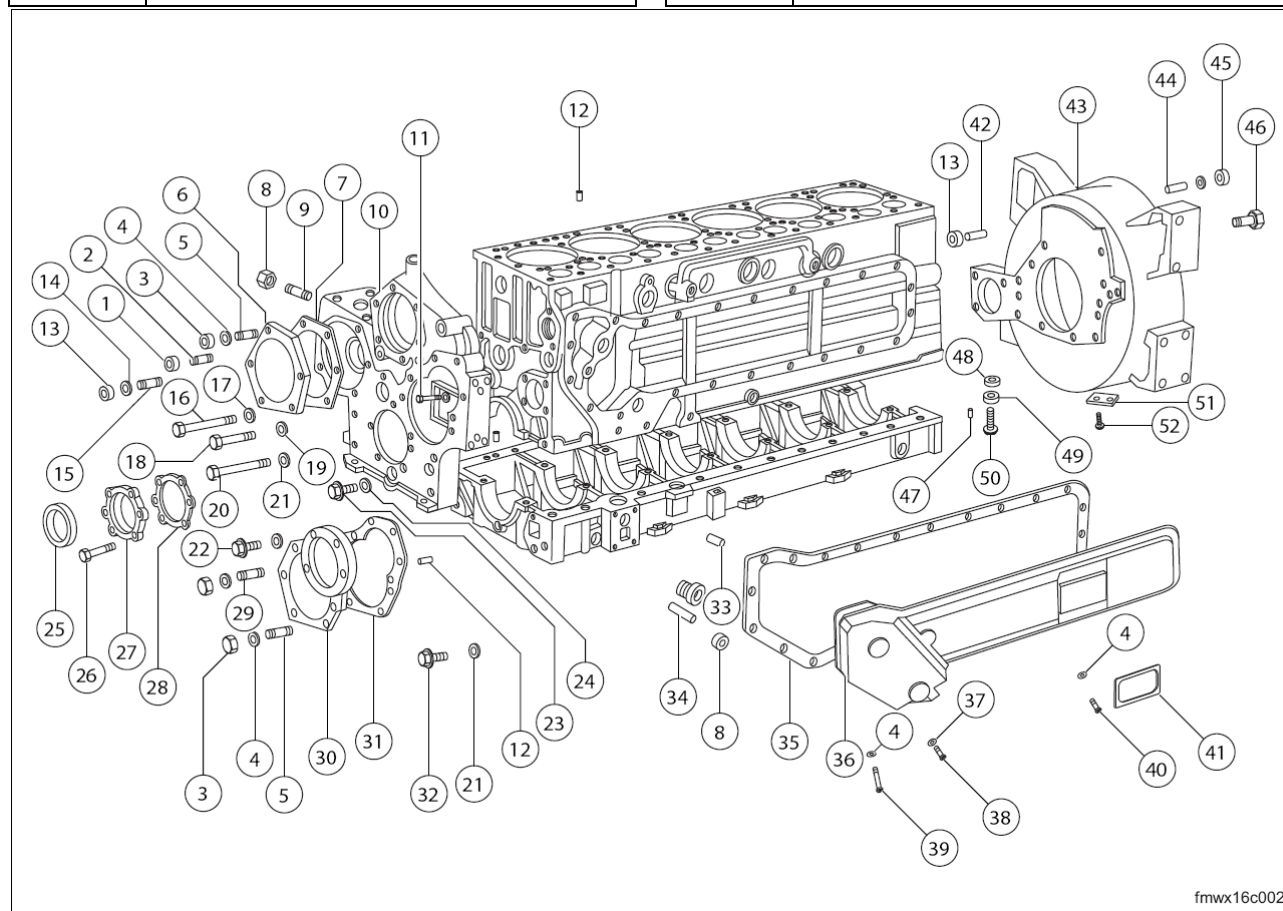
Part Drawing



fmwx16c001

1	Cylinder Body	16	Sealing Washer
2	Core Plug	17	Rear Screw Plug, Main Oil Gallery
3	Core Plug	18	Rear Oil Seal
4	Core Plug	19	Core Plug
5	Camshaft Bushing	20	Core Plug
6	Main Bearing	21	Core Plug
7	Thrust Gasket	22	Oil Return Elbow
8	Crankcase	23	Self-locking Washer
9	Cylindrical Pin	24	Hex Socket Cap Head Screw
10	Cylinder Liner	25	Main Bearing Bolt
11	Elastic Cylindrical Pin	26	Sealing Ring
12	Breathing Elbow	27	Hexagonal Socket Head Plug
13	Core Plug	28	Sealing Washer
14	Cylinder Head Bolt	29	Hex Head Bolt

15	Cylindrical Pin	30	Main Bearing Bolt
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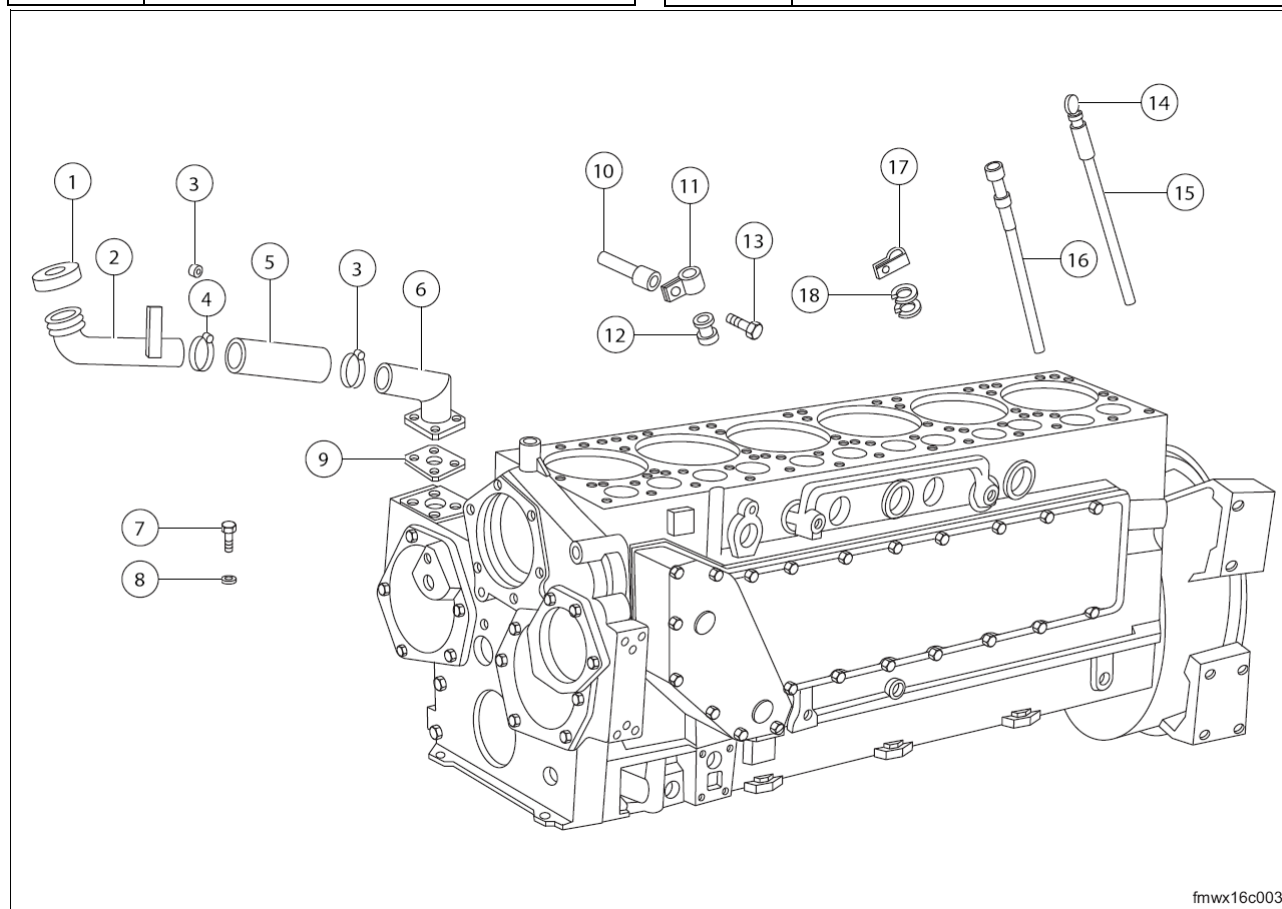
fmwx16c002

1	Prevailing Torque Type All-metal Hex Nut, Style 2	27	Front Oil Seal Seat
2	Stud Bolt	28	Front Oil Seal Gasket
3	Hex Nut, Style 1	29	Stud Bolt
4	Wave Spring Washer	30	Camshaft Gear Cover Assembly
5	Stud Bolt	31	Gasket, Camshaft Gear Cover
6	Gear Cover, Air Compressor	32	Hex Socket Cap Head Screw
7	Gasket, Air Compressor Gear Cover	33	Elastic Cylindrical Pin
8	Prevailing Torque Type All-metal Hex Nut, Style 2	34	Stud Bolt
9	Stud Bolt	35	Gasket, Oil Cooler Cover
10	Timing Gear Chamber	36	Oil Cooler Cover
11	Hex Head Bolt	37	Sealing Washer
12	Cylindrical Pin	38	Hex Head Bolt

Engine Mechanical (WD615) – Engine Mechanical

13	Prevailing Torque Type All-metal Hex Nut, Style 2
14	Washer
15	Stud Bolt
16	Hex Head Bolt
17	Wave Spring Washer
18	Hex Head Bolt
19	Hex Head Bolt
20	Hex Head Bolt
21	Curved Spring Washer
22	Hex Socket Cap Head Screw
23	Hex Head Bolt
24	Spring Washer
25	Receiving Ring, Front Oil Seal
26	Hex Socket Cap Head Screw

39	Hex Head Bolt
40	Hex Head Bolt
41	Nameplate
42	Stud Bolt
43	SAE1 Flywheel Housing
44	Stud Bolt
45	Hex Nut, Style 1
46	Flywheel Housing Bolt
47	Elastic Cylindrical Pin
48	Sealing Washer
49	Nozzle Assembly
50	Hollow Bolt
51	Observation Hole Cover
52	Hex Head Bolt



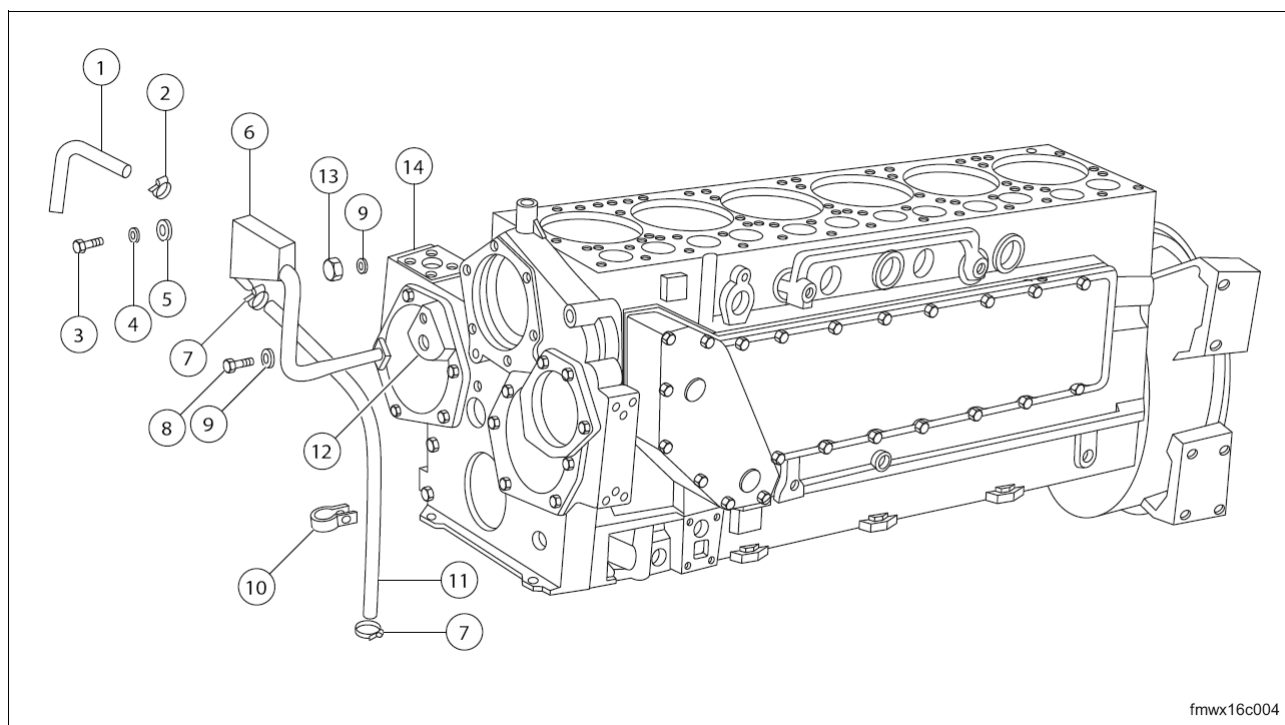
fmwx16c003

16C-6

Engine Mechanical (WD615) – Engine Mechanical

1	Oil Filler Pipe Cap Assembly
2	Oil Filler Pipe Assembly
3	Prevailing Torque Type All-metal Hex Nut, Style 2
4	Hose Clamp
5	Rubber Hose with Fibre
6	Short Oil Filler Pipe Assembly
7	Hex Head Bolt
8	Spring Washer
9	Gasket, Short Oil Filler Pipe

10	Support Block
11	Single Pipe Clamp
12	Oil Dipstick
13	Hex Head Bolt
14	Oil Dipstick
15	Upper Assembly, Oil Dipstick Pipe
16	Lower Assembly, Oil Dipstick Pipe
17	Single Pipe Clamp
18	Oil Dipstick Rubber Hose



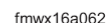
fmwx16c004

16C

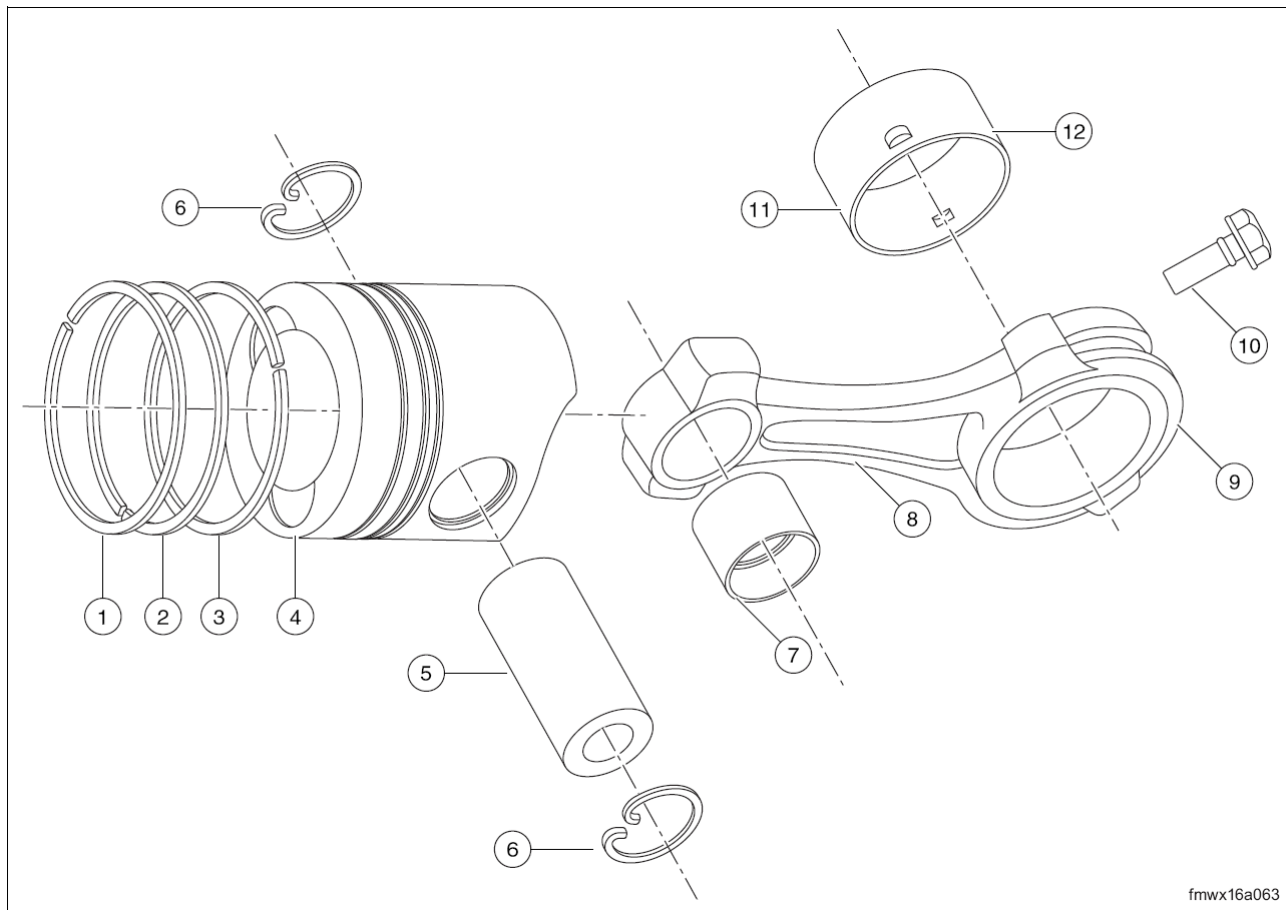
1	Rubber Hose with Fibre
2	Hose Clamp
3	Hex Head Bolt
4	Spring Washer
5	Big Washer
6	Oil-Gas Separator assembly
7	Hose Clamp

8	Hex Socket Cap Head Screw
9	Wave Spring Washer
10	Fixing Plate
11	Rubber Hose without Fibre
12	Gasket
13	Hex Nut, Style 1
14	Stud Bolt

Engine Mechanical (WD615) – Engine Mechanical



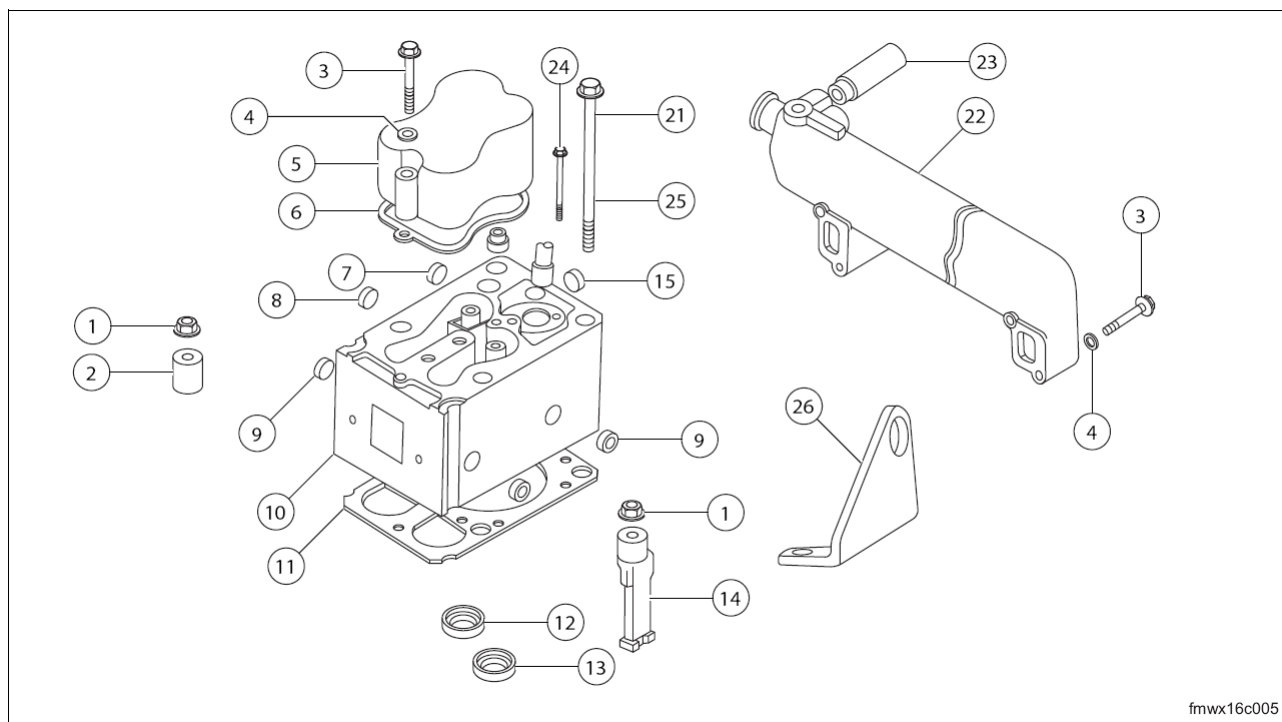
11	Flywheel Ring Gear
12	Flywheel
13	Stud Bolt
14	Wave Spring Washer
15	Hex Nut, Style 1
16	Radial Ball Bearing
17	Circlip for Hole
18	Hex Head Bolt
19	Hex Head Bolt



1	Keystone Ring
2	Torsional Taper-face Ring
3	Coil Spring Ring
4	Piston
5	Piston Pin
6	Piston Pin Circlip
7	Connecting Rod Assembly

8	Connecting Rod Bushing
9	Connecting Rod Body
10	Connecting Rod Cap
11	Connecting Rod Bolt
12	Connecting Rod Upper Bearing
13	Connecting Rod Lower Bearing

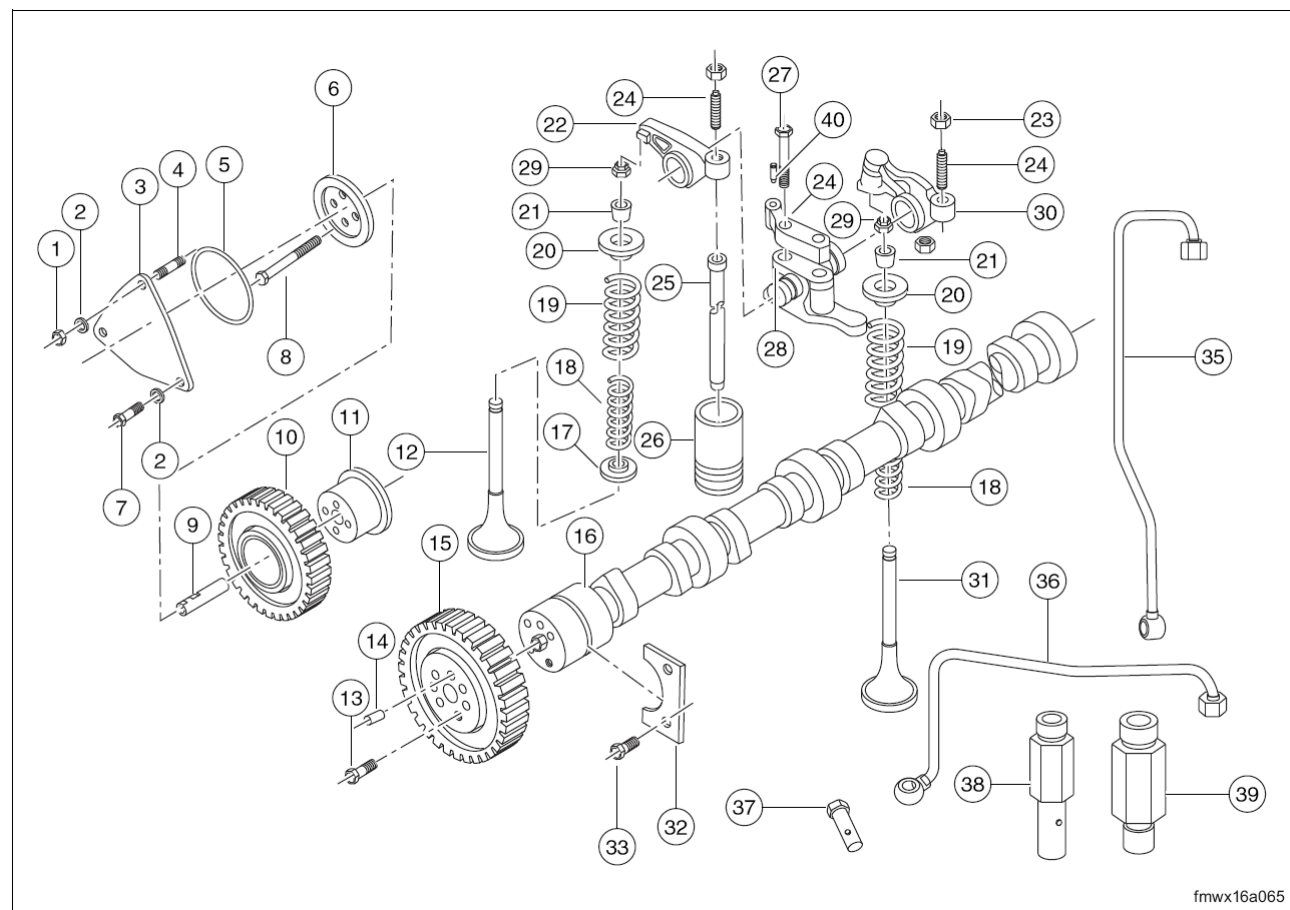
Engine Mechanical (WD615) – Engine Mechanical



fmwx16c005

1	Nut with Shoulder
2	Clamping Block
3	Hex Head Bolt
4	Wave Spring Washer
5	Cylinder Head Cover
6	Cylinder Head Cover Washer
7	Core Plug
8	Core Plug
9	Core Plug
10	Cylinder Head
11	Cylinder Head Gasket
12	Intake Valve Seat
13	Exhaust Valve Seat

14	Clamping Block
15	Core Plug
16	Valve Stem Gland
17	O-ring
18	Fuel Injector Bushing
19	Valve Guide
20	Lower Seat, Exhaust Valve Spring
21	Main Bolt, Cylinder Head
22	Water Outlet Pipe
23	Pipe Joint Assembly
24	Hex Head Bolt
25	Main Bolt, Cylinder Head
26	Hanging Plate



fmwx16a065

1	Hex Nut, Style 1
2	Wave Spring Washer
3	Cover Plate
4	Stud Bolt
5	Sealing Ring
6	Gasket
7	Hex Socket Cap Head Bolt
8	Hex Head Bolt
9	Shaft
10	Intermediate Gear Assembly
11	Intermediate Gear Shaft
12	Intake Valve
13	Hex Head Bolt
14	Cylindrical Pin
15	Camshaft Timing Gear
16	Camshaft
17	Lower Seat, Intake Valve Spring

21	Valve Lock Clamp
22	Intake Valve Rocker Arm
23	Valve Clearance Adjusting Nut
24	Valve Clearance Adjusting Screw
25	Valve Push Rod Assembly
26	Valve Tappet
27	Hex Head Bolt
28	Valve Rocker Arm Seat Assembly
29	Valve Cap
30	Exhaust Valve Rocker Arm
31	Exhaust valve
32	Camshaft Thrust Gasket
33	Hex Head Bolt
34	Support Arm
35	EVb Oil Inlet Pipe Assembly
36	Short Oil inlet pipe assembly
37	Hollow Bolt

Engine Mechanical (WD615) – Engine Mechanical

18	Inner Valve Spring	38	Hollow Bolt Joint
19	Outer Valve Spring	39	Threaded Joint
20	Upper Seat, Valve Spring	40	Adjusting Bolt Assembly

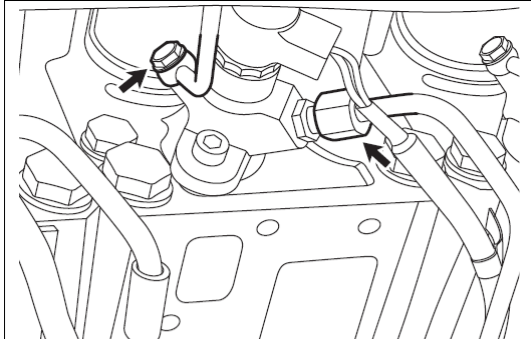
Precautions

1. When lifting or supporting the engine, DO NOT allow the jack to come into contact with the oil pan. When putting down the engine, support the engine outside the engine mount and flywheel housing by the engine supporting plate, wood frame or other similar tools.
2. When dismantling the intake system, cover the air inlet to prevent foreign matters from going into the cylinder. If foreign matters go into the cylinder, the cylinder and other parts may be damaged seriously when the engine is operating.
3. Make sure to disconnect the grounding cable of the battery when conducting maintenance on the engine body. When it is necessary to supply power to the engine in the course of inspection or other similar work, pay special attention because short circuit may occur.
4. In order to protect and lubricate the sliding surface in the course of initial operation, apply a large amount of engine oil to the sliding surface.
5. When disassembling the valve parts, piston, piston ring, connecting rod, connecting rod bearing and crankshaft journal bearing, place them in order and store.
6. When re-installing parts, install them in their original positions, as shown before disassembly.
7. When dismantling gaskets, oil seals and other similar parts, make sure to replace them with new parts.
8. If liquid gaskets are used on parts, dismantle all old gaskets, clean the parts and remove any oil, grease, water and contaminants, then apply the specified liquid gasket and install those parts.
9. After applying sealant on a part, install the part within 7 minutes. If not, remove the sealant from the part and re-apply sealant.
10. In the process of assembly and installation, fasten the part to the specified fastening torque, and make sure to install the parts correctly.

Testing & Adjustment

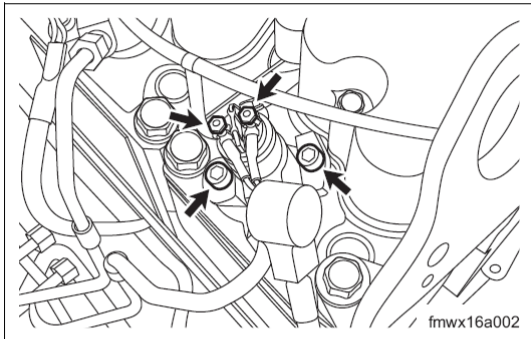
Compression Pressure

Measure the compression pressure using the battery and starter motor under no fault state when the engine cools (the water temperature is 20°C).

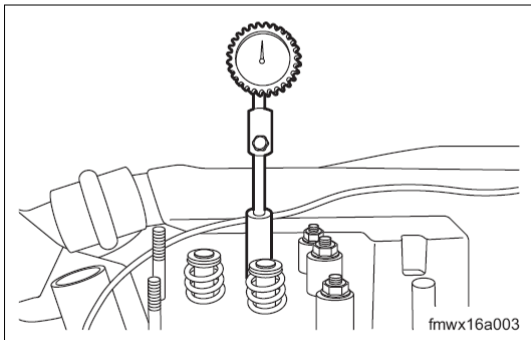


1. Dismantle the fuel injector

- (a). Dismantle the oil inlet pipe of the fuel injector.
- (b). Dismantle the oil return pipe of the fuel injector.

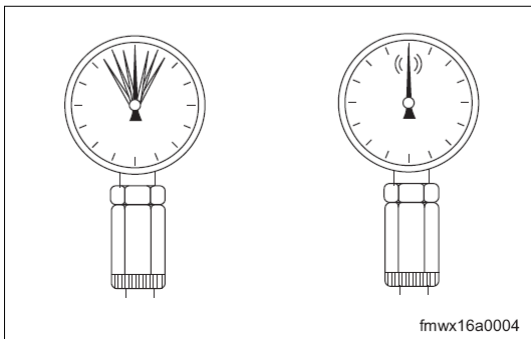


- (c). Disconnect the wiring harness of the fuel injector.
- (d). Dismantle the fixing bolts of the fuel injector.



2. Install a pressure gauge

- (a). Install the pressure gauge into the fuel injector hole.



3. Measure the compression pressure

- (a). Run the starter motor, and read the compression pressure when the pressure gauge pointer is stable.

Caution:

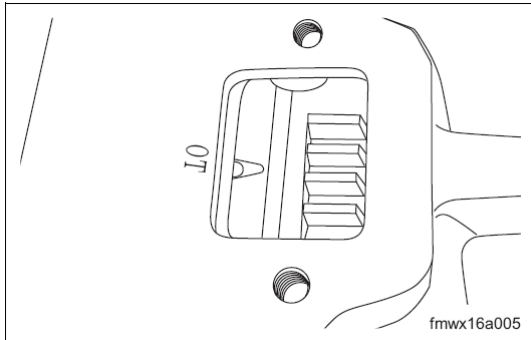
- Remember that air will be suddenly emitted from the fuel injector hole when the motor is running.
 - Measure the pressure of all cylinders.
 - When disconnecting the wiring harness joint, ECM will identify it as a fault and record the fault code. After finishing measurement, make sure to eliminate the ECM memory.
- (b). Drop engine oil into the cylinder, and then measure the compression pressure again.

- If the compression pressure rises, it shows that the clearance between the piston ring and cylinder liner is too big.

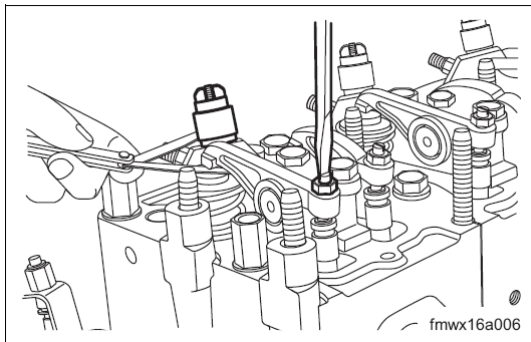
Item	Compression Pressure	Pressure Difference between Cylinders
Standard Value	2.6~2.8MPa	200kPa

Adjust the valve clearance

Adjust the valve clearance in two steps: set the No.1 cylinder at the top dead center on the compression stroke, and then set the No.6 cylinder at the top dead center on the compression stroke.



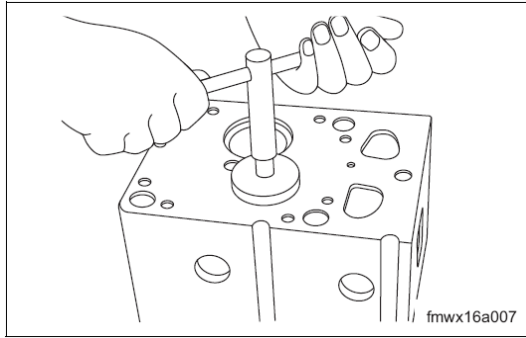
1. **Set the No.1 (or No.6) cylinder at the top dead center on the compression stroke**
 - (a). Rotate the crankshaft forward, and align the OT rule line of the flywheel with the pointer. Inspect whether there is a clearance between the cam and rocker arm of the No.1 (or No.6) cylinder (top dead center on the compression stroke) at this point.



2. **Adjust the valve clearance**
 - (a). Fully loosen the adjusting screws of the rocker arm.
 - (b). Insert a thickness gauge between the rocker arm and cam, adjust with the adjusting screws of the rocker arm, and then fix with the lock nuts.
 - (c). When inserting the thickness gauge, fastening the adjusting screws of the rocker arm, until the thickness gauge stops moving.
 - (d). Loosen the adjusting screws of the rocker arm gradually and re-adjust to such a degree that the thickness gauge can be inserted and dismantled flexibly, and then fix the lock nuts of the rocker arm.

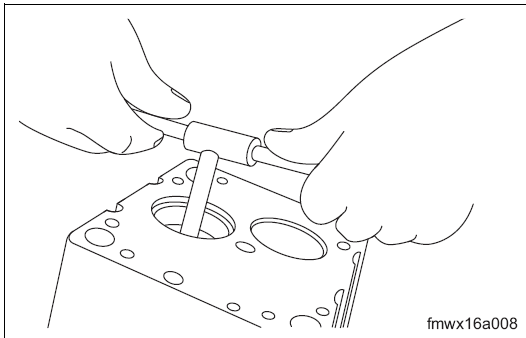
Item	Standard Value
Intake Valve Clearance	0.3mm
Exhaust Valve Clearance	0.4mm
Exhaust Valve Brake Clearance	0.25mm

	Cylinder No.	1		2		3		4		5		6	
Condition	Valve Arrangement	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN	EXH	IN
Valve to be adjusted	Top Dead Center of No.1 Cylinder	○	○		○	○			○	○			
	Top Dead Center of No.6 Cylinder			○			○	○			○	○	○

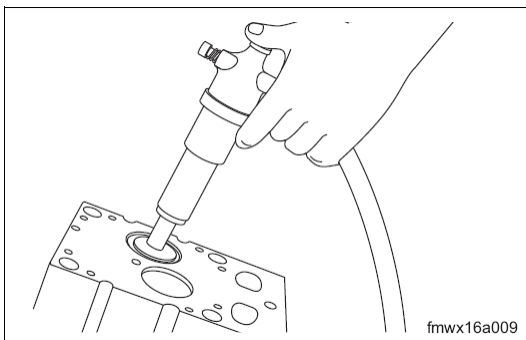
Engine Mechanical (WD615) – Engine Mechanical**Ream the valve seat****1. Ream the valve seat**

- (a). Install the locating bar on the reamer.
- (b). Insert the locating bar into the valve guide for location.
- (c). Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

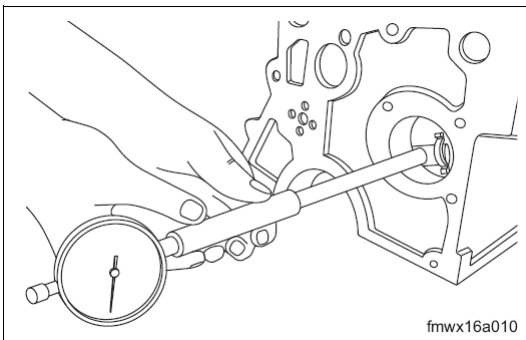
Item	Standard Value
Width of Working Cone Face	1.5~1.8mm

Ream the valve guide**1. Ream the valve guide**

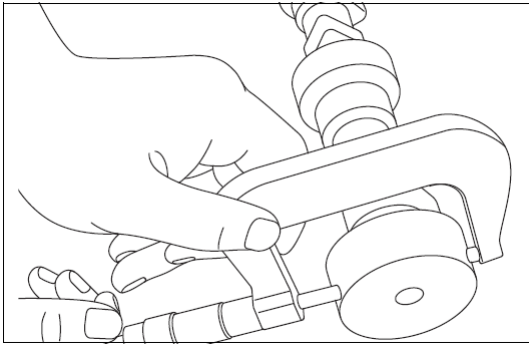
- (a). Use the tap wrench to rotate the reamer downwards clockwise.
- (b). Insert the locating bar into the valve guide for location.
- (c). Slight press the locating bar, and rotate clockwise.
 - Ream the inner and outer cone faces, and then ream the working cone face.

Grind the valve**1. Grind the valve seat**

- (a). Grind the valve by a grinding machine.
 - The rotating and beating frequency of the grinding machine can be adjusted.
- (b). After grinding and cleaning, inspect the sealing condition of the valve by kerosene.

Inspect and adjust the radial clearance of the camshaft**1. Measure the inside diameter of the bushing**

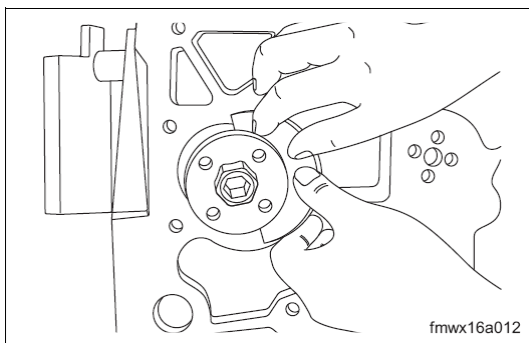
- (a). Inspect whether each shaft hole bushing is installed securely.
- (b). Inspect whether the oil gallery and oil hole are through.
- (c). Measure the inside diameter of each bushing by an inside micrometer.



- (d). Measure the outside diameter of each camshaft bearing by an outside micrometer.

Item	Standard Value
Radial Clearance of Camshaft	0.04~0.12mm

Inspect and adjust the axial clearance of the camshaft

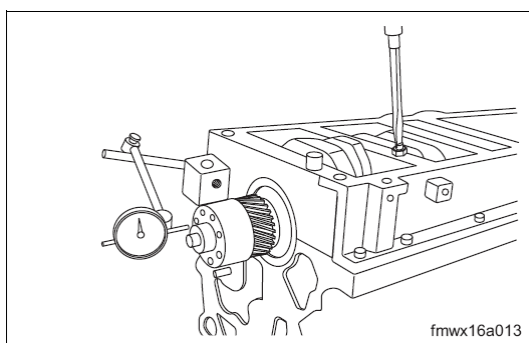


1. Measure the axial clearance of the camshaft

- Inspect whether there are damages and burrs on the camshaft thrust groove, thrust baffle plate and cylinder body joint face.
- Insert the thrust baffle plate into the thrust ring groove, and fix the baffle plate by two screws.
- Inspect the axial clearance of the camshaft by a dial indicator.

Item	Standard Value
Axial Clearance of Camshaft	0.1~0.4mm

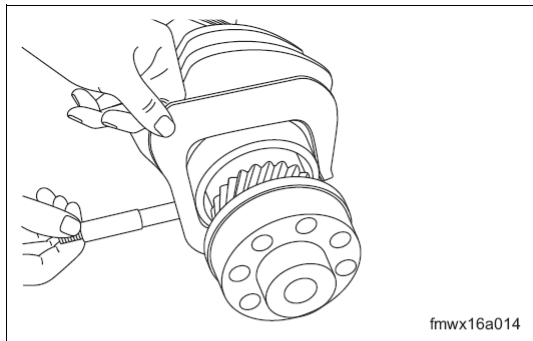
Inspect and adjust the axial clearance of the crankshaft



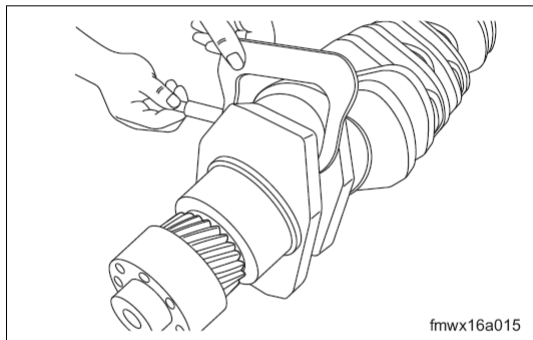
1. Measure the axial clearance of the crankshaft

- Fix the dial indicator at the crankshaft end by a magnetic dial indicator seat.
- Prize the crankshaft up and down.
 - The crankshaft shall go flexibly when rotating it, free from various jamming phenomenon.
- If the clearance exceeds the range, replace the crankshaft gasket.

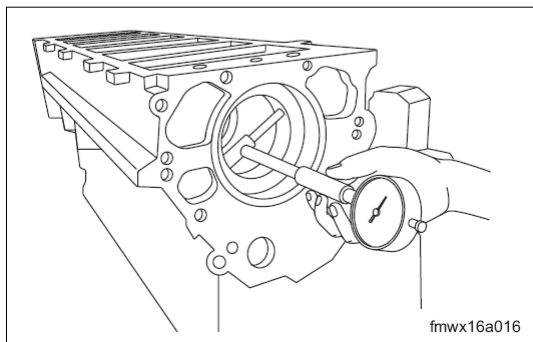
Item	Standard Value
Axial Clearance of Crankshaft	0.052~0.255mm

Engine Mechanical (WD615) – Engine Mechanical**Inspect and adjust the radial clearance of the crankshaft****1. Measure the radial clearance of the crankshaft**

- (a). Measure each main journal of the crankshaft by an outside micrometer.



- (b). Measure each connecting rod journal of the crankshaft by an outside micrometer.

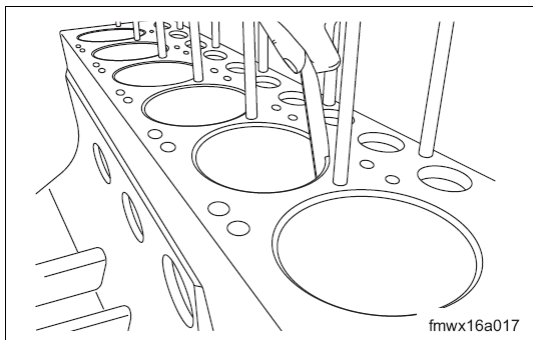


- (c). Install the main bearings of the crankshaft in the cylinder body and crankcase seat holes, and tighten with a torque of 250N.m. Measure the inside diameter of each bearing by an inside micrometer.

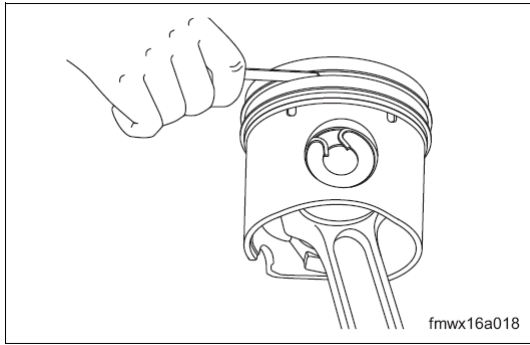
Caution:

The main bearing with oil groove is the upper half, and the bearing without oil groove is the lower half.

Item	Standard Value
Radial Clearance of Crankshaft	0.095~0.163mm

Inspect and adjust the piston ring clearance**1. Measure the piston ring gap clearance**

- (a). Measure the piston ring gap clearance.
- (b). If the clearance exceeds the range, replace the piston ring.

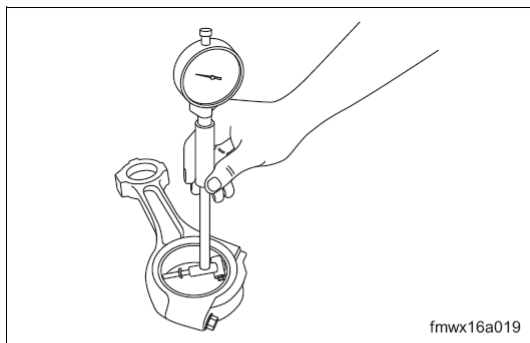


2. Measure the piston ring side clearance

- (a). Measure the piston ring side clearance by a thickness gauge.
- (b). If the clearance exceeds the range, replace the piston ring.

Item		Standard Value
Top Compression Ring	Gap Clearance	0.4~0.6mm
	Side Clearance	-
Second Compression Ring	Gap Clearance	0.25~0.4mm
	Side Clearance	0.07~0.102mm
Third Oil Ring	Gap Clearance	0.35~0.55mm
	Side Clearance	0.05~0.085mm

Inspect the fit clearance of the connecting rod

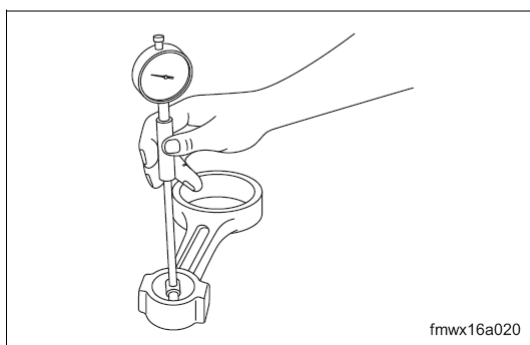


1. Measure the connecting rod big end

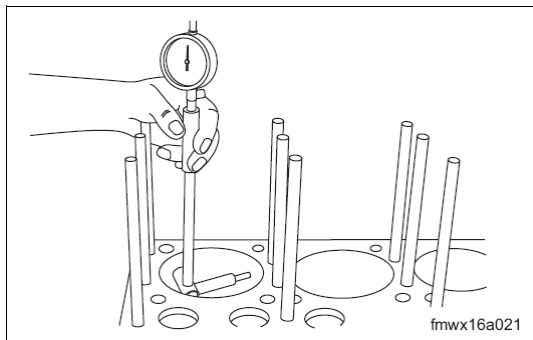
- (a). Install the connecting rod into the connecting rod big end, and tighten the connecting rod bolts.
- (b). Measure the hole diameter of the connecting rod bearing.

2. Measure the connecting rod small end

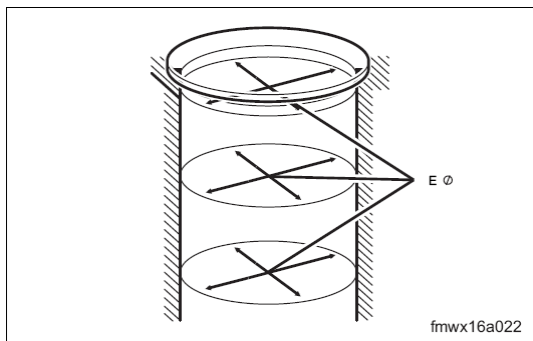
- (a). Press the connecting rod small end bushing into the shaft hole.
- (b). Measure the inside diameter of the bushing.
- (c). Measure the inside diameter of the piston pin hole and the outside diameter of the piston pin.



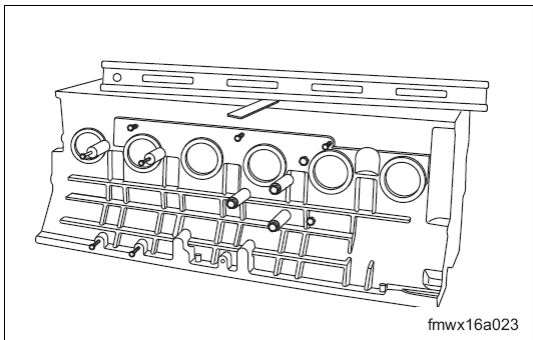
Item	Standard Value
Fit Clearance between Bearing and Crankshaft Connecting Rod Journal	0.059~0.127mm
Fit Clearance between Connecting Rod Bushing and Piston Pin	0.025~0.046mm
Fit Clearance between Piston Pin Hole and Piston Pin	0.003~0.014mm

Engine Mechanical (WD615) – Engine Mechanical**Inspect the roundness of the cylinder liner**

- 1. Measure the roundness of the cylinder liner**
 - (a). Inspect whether the cylinder bores and spigots are clean, corroded and damaged.
 - (b). Clean the cylinder bores and spigots with trichloroethylene cleaning agent.
 - (c). Measure the inside diameter of the cylinder liner by an inside micrometer.
 - (d). Measure two times respectively at the top, middle and bottom.



Item	Standard Value
Out of Roundness	Lower than 0.04mm

Inspect the flatness of the cylinder body

- 1. Measure the flatness of the cylinder body**
 - (a). Place a level ruler on the upper surface of the cylinder body.
 - (b). Measure the clearance between the level ruler and the upper surface of the cylinder body by a thickness gauge.

Caution:

Three sections respectively in the front, middle and rear of the upper surface need to be measured, and the parts of the diagonal shall also be measured.

Engine Assembly

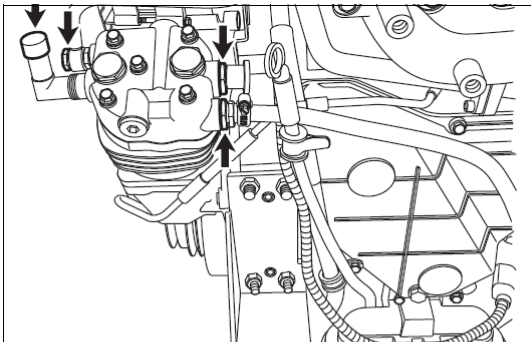
Replacement

1. Turn off the main power
2. Dismantle the oil inlet pipe of the engine. Refer to Chapter 11 Fuel – Oil-Water Separator, Replacement.
3. Dismantle the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
4. Dismantle the exhaust pipe. Refer to Chapter 13C Exhaust & Turbocharger – Exhaust Pipe, Replacement.
5. Dismantle the transmission assembly. Refer to Chapter 31C Transmission – Transmission Assembly, Replacement.
6. Drain coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.
7. Dismantle the intercooler hose. Refer to Chapter 14C Cooling – Intercooler, Overhaul.
8. Dismantle the radiator hose. Refer to Chapter 14C Cooling – Radiator, Overhaul.
9. Dismantle the auxiliary water tank hose. Refer to Chapter 14C Cooling – Auxiliary Water Tank, Replacement.
10. Dismantle the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
11. Dismantle the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
12. Dismantle the pipeline of the air compressor. Refer to Chapter 18C Engine Mechanical – Engine Accessories, Overhaul.
13. Disconnect the wiring harness of the Engine ECU.
14. Dismantle the fixing bolts of the engine.
15. Install the fixing bolts of the engine.
16. Connect the wiring harness of the engine ECU.
17. Install the pipeline of the air compressor. Refer to Chapter 18C Engine Mechanical – Engine Accessories, Overhaul.
18. Install the pipeline of the air conditioner compressor. Refer to Chapter 51 Heater & Air Conditioner -- Refrigeration Pipe, Overhaul.
19. Install the heater hose. Refer to Chapter 51 Heater & Air Conditioner – Heater Water Pipe, Overhaul.
20. Install the auxiliary water tank hose. Refer to Chapter 14C Cooling – Auxiliary Water Tank, Replacement.
21. Install the radiator hose. Refer to Chapter 14C Cooling – Radiator, Overhaul.
22. Install the intercooler hose. Refer to Chapter 14C Cooling – Intercooler, Overhaul.
23. Fill coolant. Refer to Chapter 14C Cooling – Coolant, Replacement.
24. Install the transmission assembly. Refer to Chapter 31C Transmission – Transmission Assembly, Replacement.
25. Install the exhaust pipe. Refer to Chapter 13C Exhaust & Turbocharger – Exhaust Pipe, Replacement.
26. Install the intake pipe. Refer to Chapter 12 Intake – High-mounted Intake Pipe, Replacement.
27. Install the oil inlet pipe of the engine. Refer to Chapter 11 Fuel – Oil-Water Separator, Replacement.

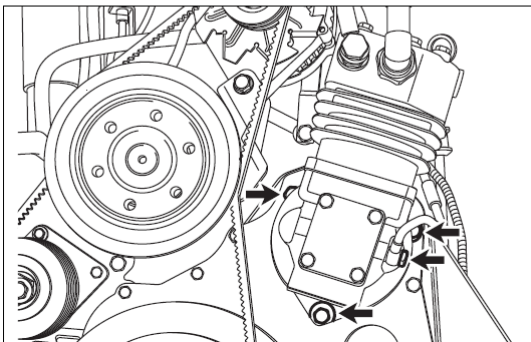
Engine Accessories

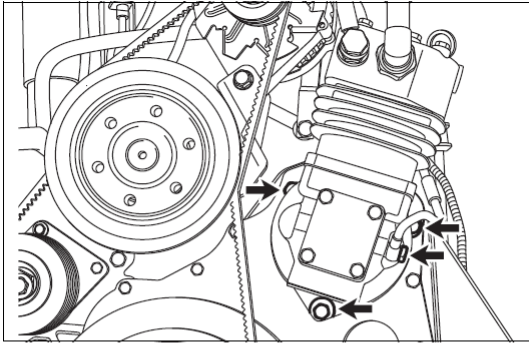
Replacement

1. Turn off the main power
2. Dismantle the generator. Refer to Chapter 19C Charging System – Generator, Overhaul.
3. Dismantle the starter. Refer to Chapter 18C Starting & Preheating System – Starter, Overhaul.
4. Dismantle the heater. Refer to Chapter 18C Starting & Preheating System – Heater, Overhaul.
5. Dismantle the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
6. Dismantle the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
7. Dismantle the water pump. Refer to Chapter 14C Cooling – Water Pump, Replacement.
8. Dismantle the cooling fan. Refer to Chapter 14C Cooling – Cooling Fan, Overhaul.
9. Dismantle the high-pressure pump. Refer to Chapter 11C Fuel – High-pressure Pump, Replacement.
10. Dismantle the common-rail pipe. Refer to Chapter 11C Fuel – Common-rail Pipe, Replacement.
11. Dismantle the fuel fine filter. Refer to Chapter 11C Fuel – Fuel Fine Filter, Replacement.
12. Dismantle the oil pan. Refer to Chapter 15C Lubrication – Oil Pan, Replacement.
13. Dismantle ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.



14. Dismantle the air compressor.
 - (a). Disconnect the cooling water pipe of the air compressor.
 - (b). Disconnect intake and exhaust pipes of the air compressor.
 - (c). Dismantle the lubricating oil pipe of the air compressor.
 - (d). Dismantle the fixing bolts of the air compressor.





15. Install the air compressor

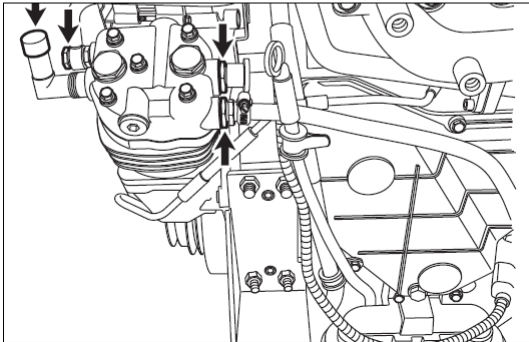
- (a). Install the fixing bolts of the air compressor.

Torque: 60N.m

Caution:

Pay attention to the gasket of the air compressor during installation.

- (b). Install the lubricating oil pipe of the air compressor.
- (c). Connect intake and exhaust pipes of the air compressor.
- (d). Connect the cooling water pipe of the air compressor.

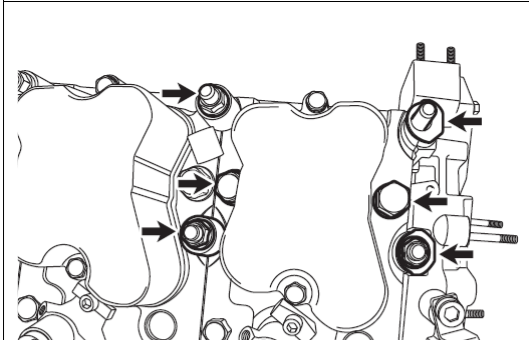


16. Install ECU. Refer to Chapter 17 Engine Control – ECU, Replacement.
17. Install the oil pan. Refer to Chapter 15C Lubrication – Oil Pan, Replacement.
18. Install the fuel fine filter. Refer to Chapter 11C Fuel – Fuel Fine Filter, Replacement.
19. Install the common-rail pipe. Refer to Chapter 11C Fuel – Common-rail Pipe, Replacement.
20. Install the high-pressure pump. Refer to Chapter 11C Fuel – High-pressure Pump, Replacement.
21. Install the cooling fan. Refer to Chapter 14C Cooling – Cooling Fan, Overhaul.
22. Install the water pump. Refer to Chapter 14C Cooling – Water Pump, Replacement.
23. Install the air compressor. Refer to Chapter 51 Heater & Air Conditioner – Air Compressor, Overhaul.
24. Install the steering pump. Refer to Chapter 42 Power Steering Mechanism – Steering Pump Assembly, Replacement.
25. Install the heater. Refer to Chapter 18C Stating & Preheating System – Heater, Overhaul.
26. Install the starter. Refer to Chapter 18C Stating & Preheating System – Starter, Overhaul.
27. Install the generator. Refer to Chapter 19C Charging System – Generator, Overhaul.

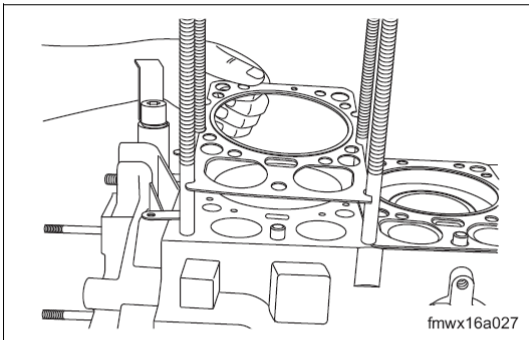
Cylinder Head

Replacement

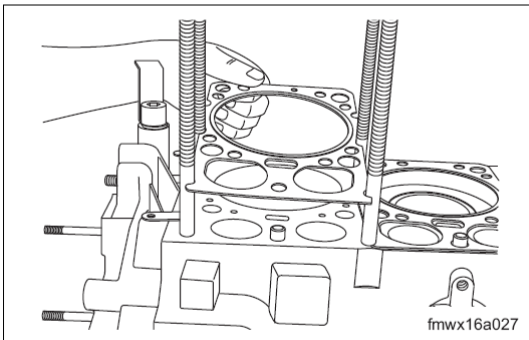
1. Disconnect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
2. Disconnect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.
3. Disconnect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.



4. Dismantle the cylinder head
 - (a). Dismantle the lock block of the cylinder head.
 - (b). Dismantle the fixing bolts and nuts of the cylinder head.



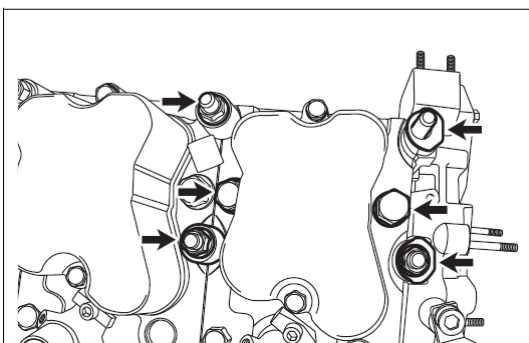
- (c). Remove the cylinder gasket.
 - (d). Remove the valve tappet.



5. Install the cylinder head
 - (a). Install the valve tappet.
 - (b). Install the cylinder gasket.

Caution:

DO NOT install reversely.



- (c). Install the lock block of the cylinder head.
 - (d). Install the fixing bolts and nuts of the cylinder head.

Torque: First, tighten the main and auxiliary bolts with 40±10N.m;
 Second, tighten the auxiliary bolts with 100N.m;
 Third, tighten the main bolts with

200N.m;

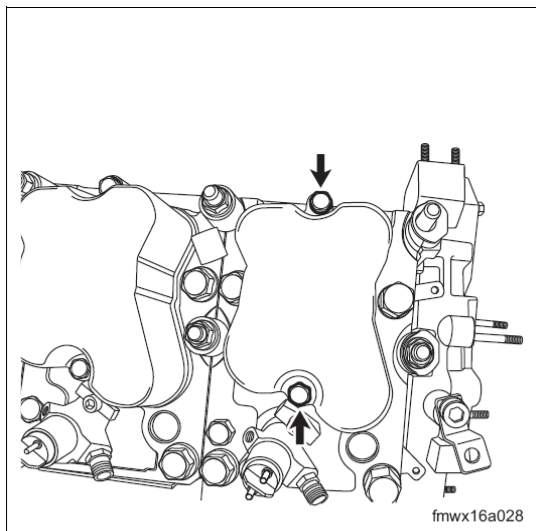
Fourth, tighten the auxiliary bolt nuts by 90°;

Fifth, tighten the main bolts by 90°.

- 6. Connect the oil return pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.**
- 7. Connect the oil inlet pipe of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.**
- 8. Connect the wiring harness of the fuel injector. Refer to Chapter 17 Engine Control – Fuel Injector (WP10), Overhaul.**

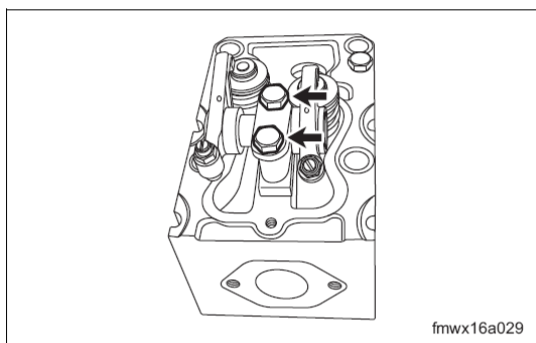
Rocker Arm and Valve Replacement

1. Dismantle the cylinder head. Refer to Chapter 16C Engine Mechanical – Cylinder Head, Replacement.



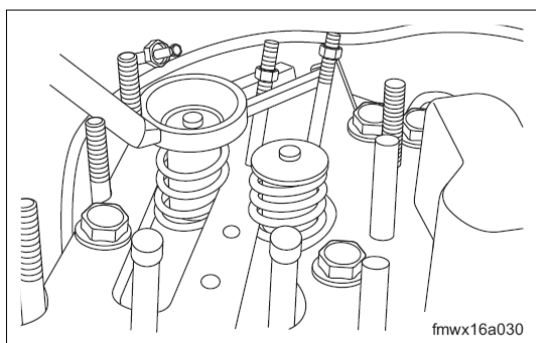
2. Dismantle the valve chamber cover

- (a). Dismantle the fixing bolts of the valve chamber cover.



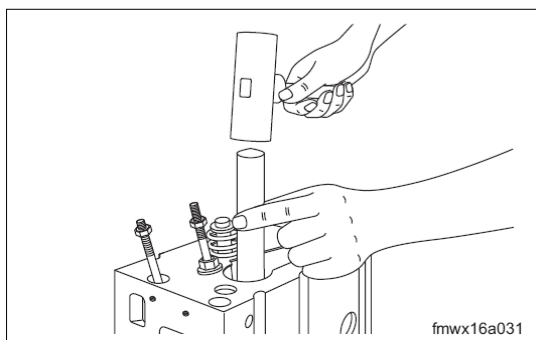
3. Dismantle the rocker arm

- (a). Remove the intake and exhaust valve rocker arms.
- (b). Dismantle the rocker arm support.



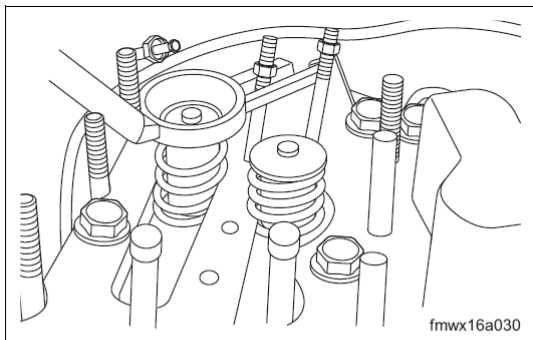
4. Dismantle the valve

- (a). Dismantle the valve lock by a valve dismantling/installing tool.
- (b). Take out the valve spring and valve.
- (c). Dismantle the valve guide.

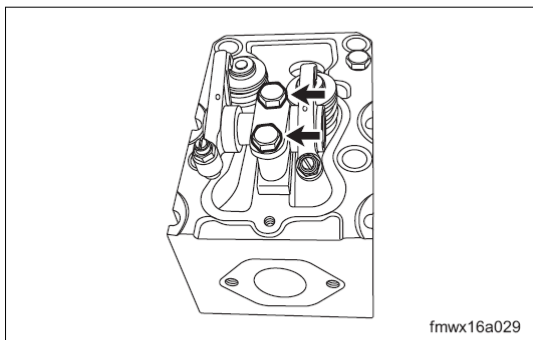


5. Install the valve

- (a). Install the valve guide by a valve guide bar.
- (b). Install the valve spring.



- (c). Install the valve lock by the valve dismantling/ installing tool.

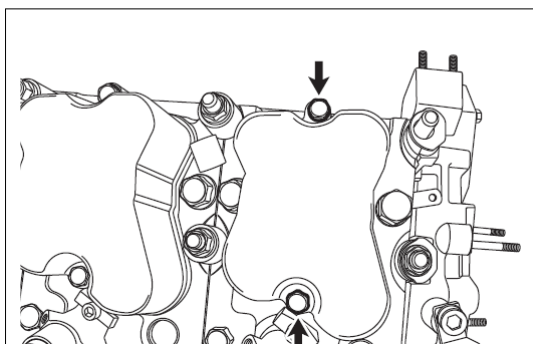


6. Install the rocker arm

- (a). Install the rocker arm support.

Torque: 105±5N.m

- (b). Install the intake and exhaust valve rocker arms.



7. Install the valve chamber cover

- (a). Install the fixing bolts of the valve chamber cover.

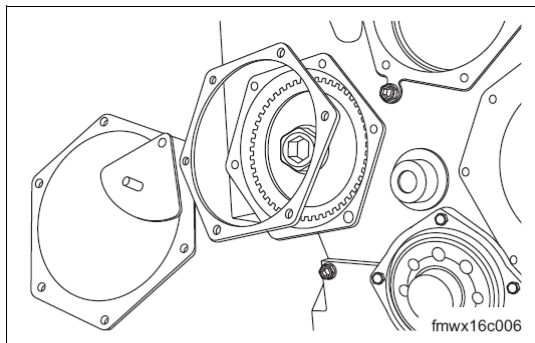
Torque: 25N.m

- 8. Install the cylinder head. Refer to Chapter 16C Engine Mechanical – Cylinder Head, Replacement.**

Timing Gear

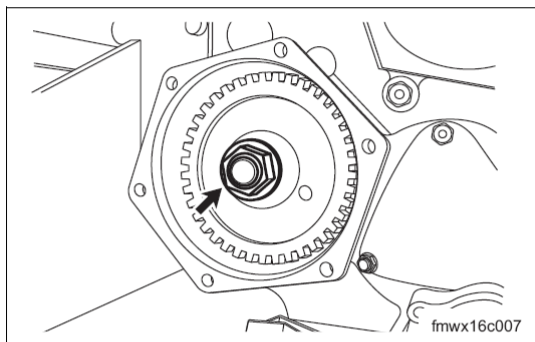
Replacement

1. Dismantle the engine accessories. Refer to Chapter 16C Engine Mechanical – Engine Accessories, Replacement.

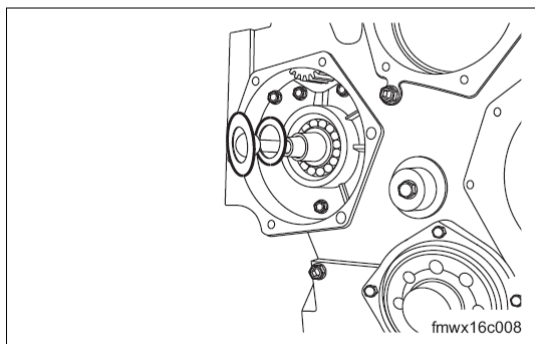


2. Dismantle the timing gear chamber

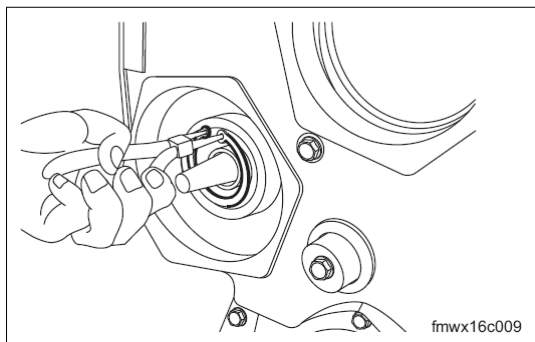
- (a). Dismantle the gasket and cover plate of the driving gear chamber.



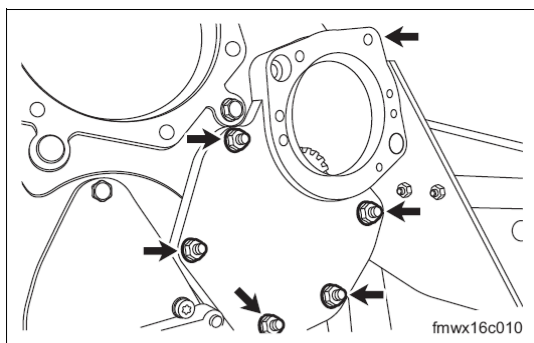
- (b). Dismantle the driving gear.



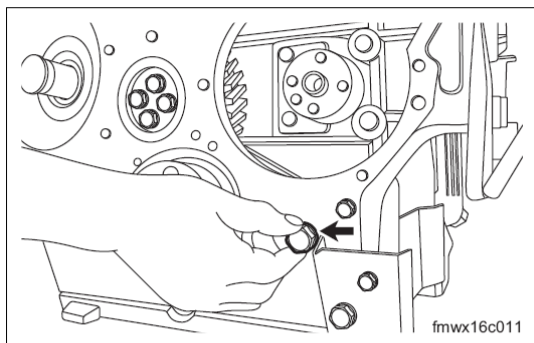
- (c). Dismantle the locating washer and butterfly spring washer of the driving bearing inner ring.



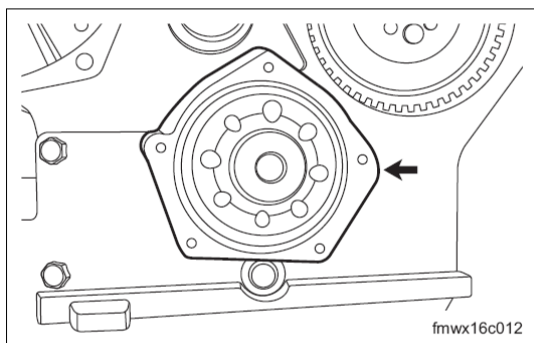
- (d). Dismantle the locating clamping spring of the bearing outer ring.



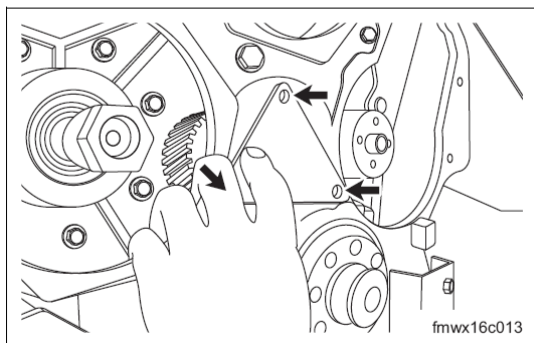
- (e). Dismantle the gasket and cover plate of the camshaft gear.



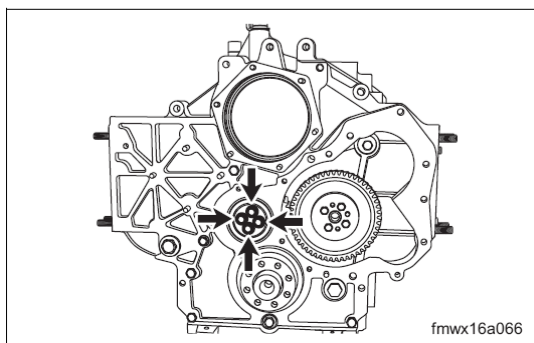
- (f). Dismantle the screw plug of the timing gear chamber.



- (g). Dismantle the gasket of the crankshaft oil seal seat.

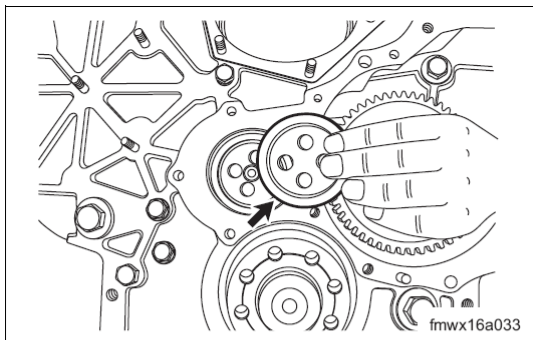


- (h). Dismantle the triangle cover plate.

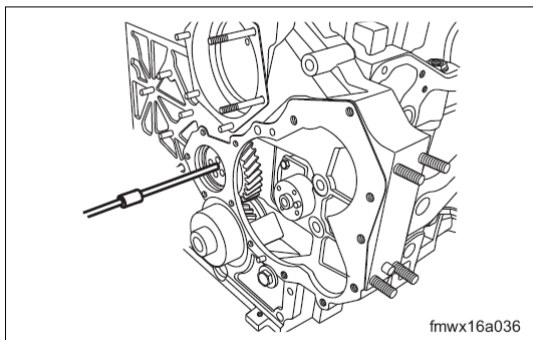


- (i). Dismantle the fixing bolts of the intermediate timing gear shaft cover plate.

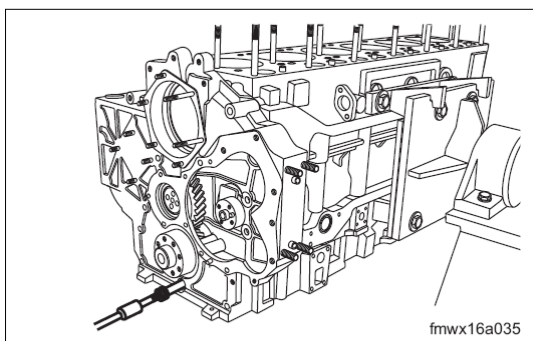
Engine Mechanical (WD615) – Timing Gear



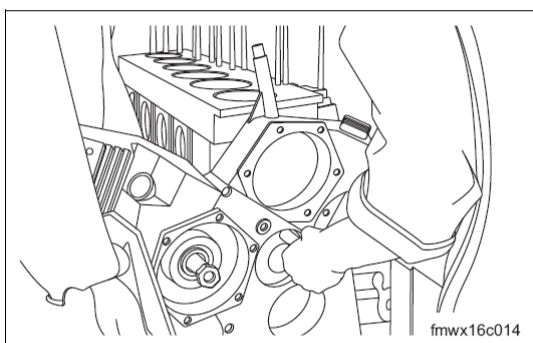
- (j). Dismantle the cover plate of the intermediate timing gear shaft.



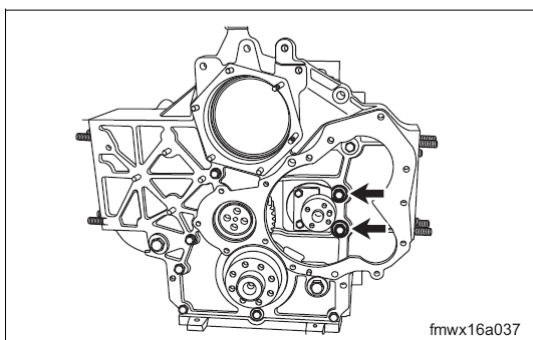
- (k). Dismantle the intermediate timing gear shaft.



- (l). Dismantle the intermediate gear shaft of the oil pump.

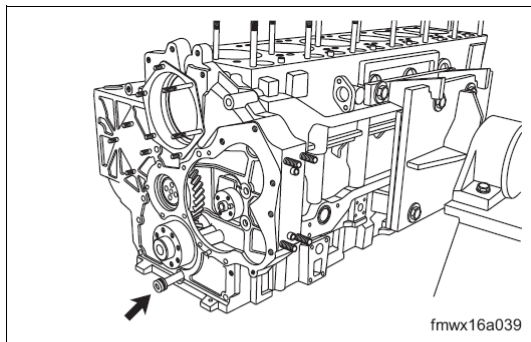


- (m). Dismantle the timing gear chamber.

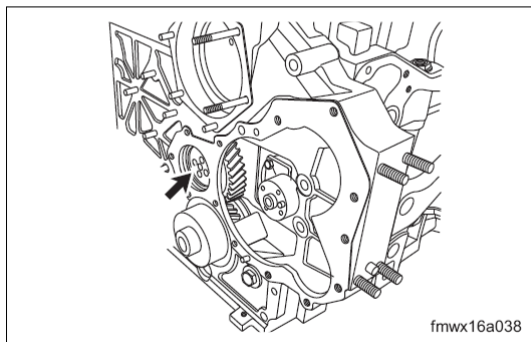


3. Install the timing gear

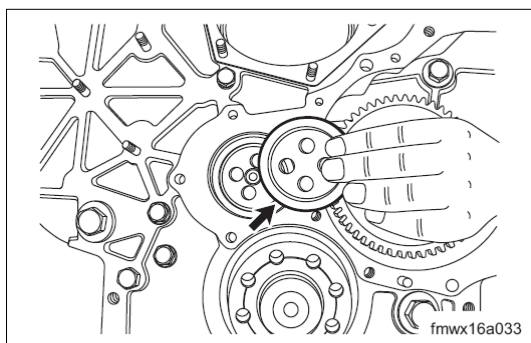
- (a). Install the timing gear chamber.



(b). Install the intermediate gear shaft of the oil pump.



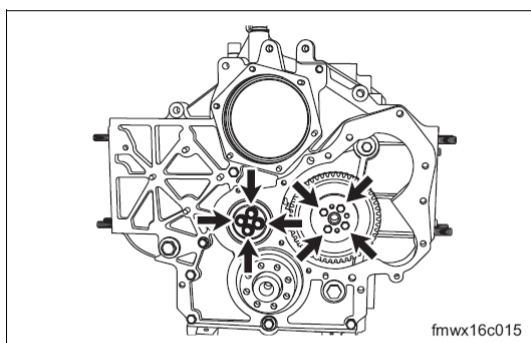
(c). Install the intermediate timing gear shaft.



(d). Install the cover plate of the intermediate timing gear.

Caution:

Align with the timing mark.



(e). Install the camshaft gear.

Torque: Tighten with $334 \pm 3 \text{ N.m}$ symmetrically.

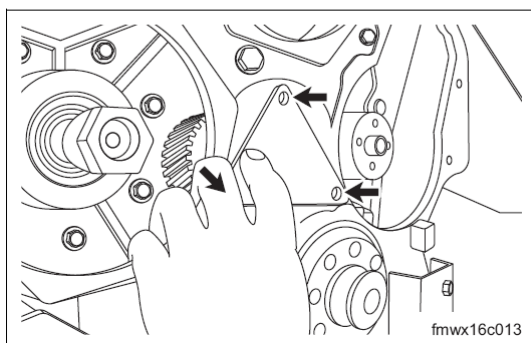
(f). Install the fixing bolts of the intermediate timing gear shaft cover plate.

Caution:

There is one bolt that has different length from that of the other three.

Torque: Pre-tighten with $60 \pm 5 \text{ N.m}$;

Then tighten by $90^\circ \pm 5^\circ$, and inspect whether the torque reaches 112.5 N.m .

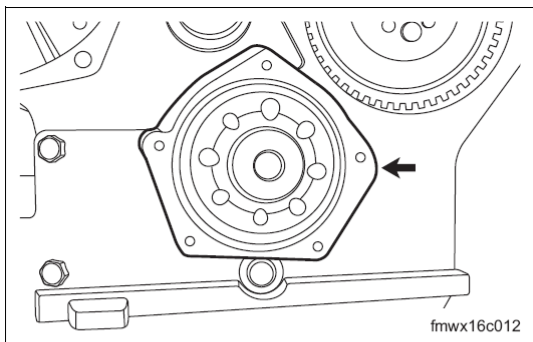


(g). Install the triangle cover plate.

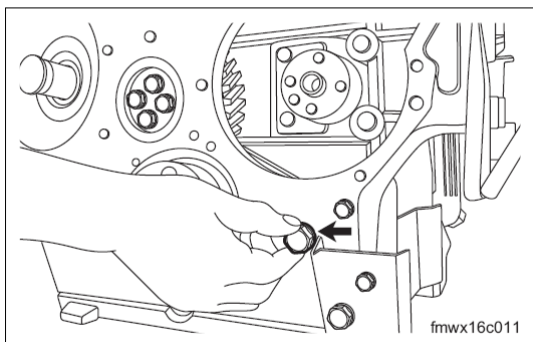
Caution:

Apply flange sealant.

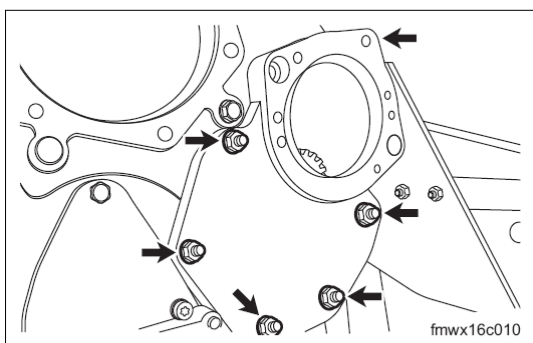
Engine Mechanical (WD615) – Timing Gear



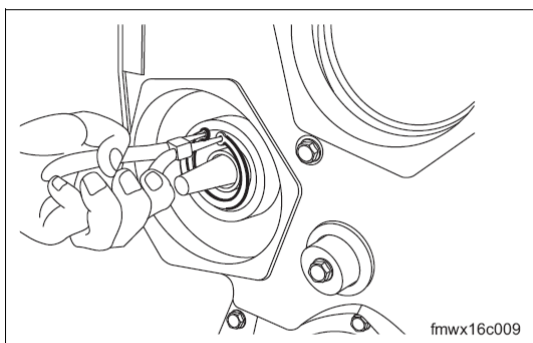
(h). Install the gasket of the crankshaft oil seal seat.



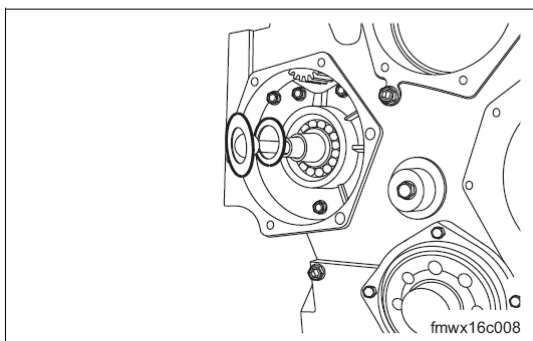
(i). Install the screw plug of the timing gear chamber.



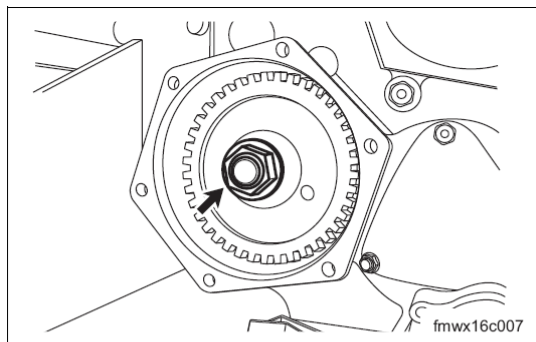
(j). Install the gasket and cover plate of the camshaft gear.



(k). Install the locating clamping spring of the bearing outer ring.



(l). Install the locating washer and butterfly spring washer of the driving bearing inner ring.

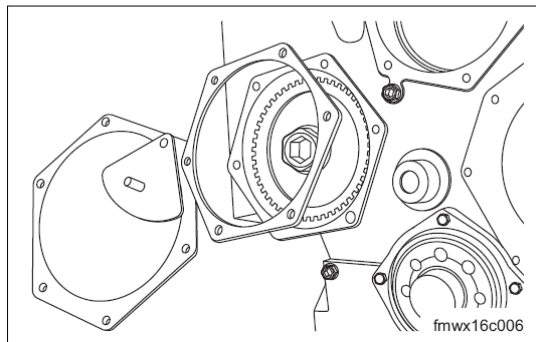


(m). Install the driving gear.

Torque: 200 N.m

Caution:

Apply 242 thread locker to the thread part.



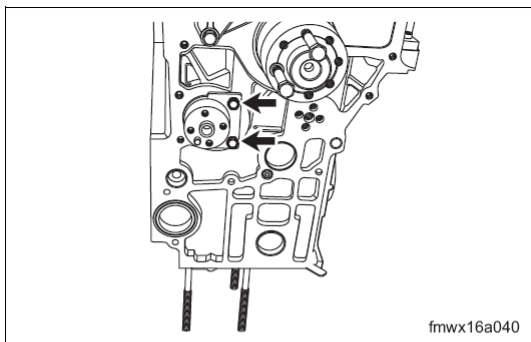
(n). Install the gasket and cover plate of the driving gear chamber.

4. Install the engine accessories. Refer to Chapter 16C Engine Mechanical – Engine Accessories, Replacement.

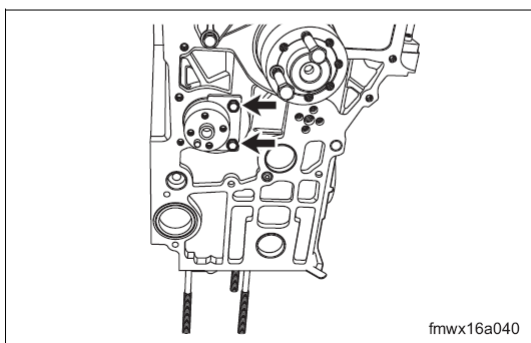
Camshaft

Replacement

1. Dismantle the timing gear chamber. Refer to Chapter 16C Engine Mechanical – Timing Gear Chamber, Replacement.



2. Dismantle the camshaft



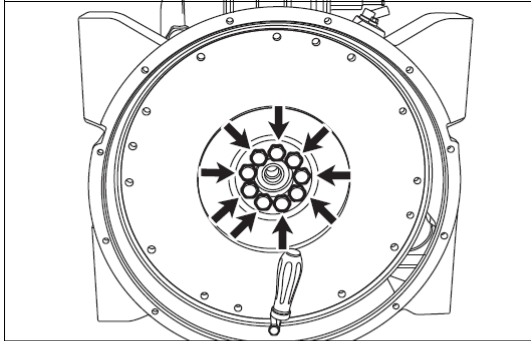
3. Install the camshaft
 - (a). Install the camshaft.
 - (b). Install the fixing bolts of the camshaft.**Torque: 60N.m**

4. Install the timing gear chamber. Refer to Chapter 16C Engine Mechanical – Timing Gear Chamber, Replacement.

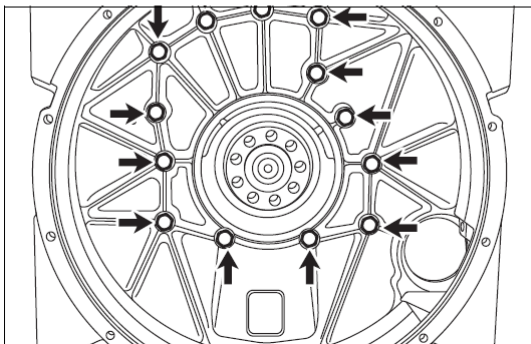
Flywheel and Flywheel Housing

Replacement

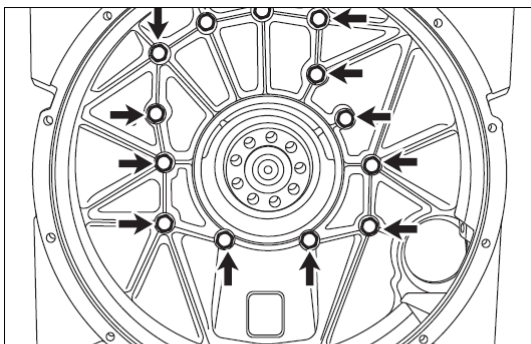
1. Dismantle the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.



2. Dismantle the flywheel
 - (a). Dismantle the fixing bolts of the flywheel.



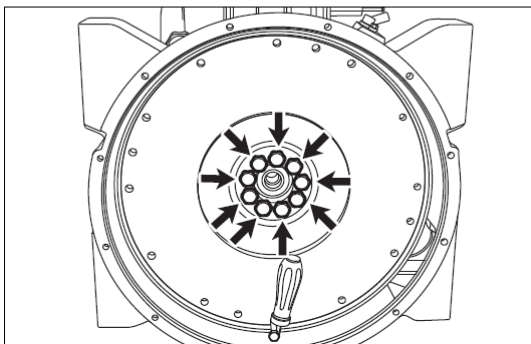
3. Dismantle the flywheel housing
 - (a). Dismantle the fixing bolts of the flywheel housing.



4. Install the flywheel housing
 - (a). Install the fixing bolts of the flywheel housing.

Torque: First, tighten with $50\pm 10\text{N.m}$ symmetrically;
Second, tighten by $120^\circ\pm 5^\circ$;
Inspection whether the torque reaches 255N.m .

16C



5. Install the flywheel
 - (a). Install the fixing bolts of the flywheel.

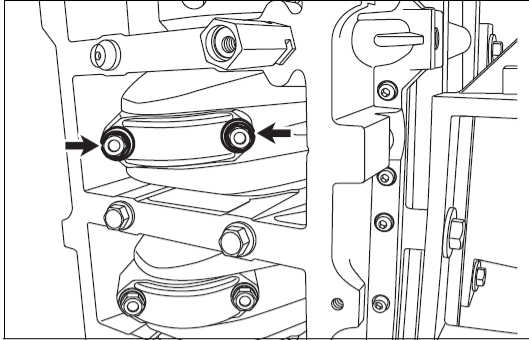
Torque: First, tighten symmetrically;
Second, tighten with $70\pm 10\text{N.m}$;
Then tighten by 90° two times.

6. Install the transmission. Refer to Chapter 31 Transmission – Transmission Assembly, Replacement.

Piston and Connecting Rod

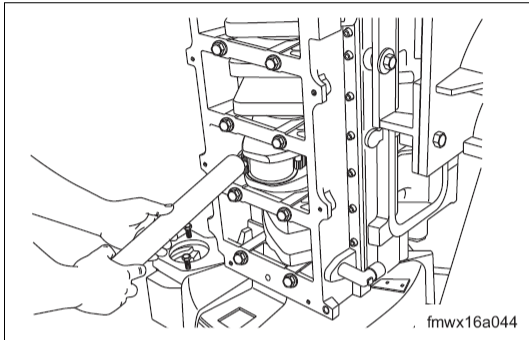
Replacement

1. Dismantle the cylinder head. Refer to Chapter 16C Engine Mechanical – Cylinder Head, Replacement.
2. Dismantle the oil pan. Refer to Chapter 15C Lubrication – Oil Pan, Replacement.

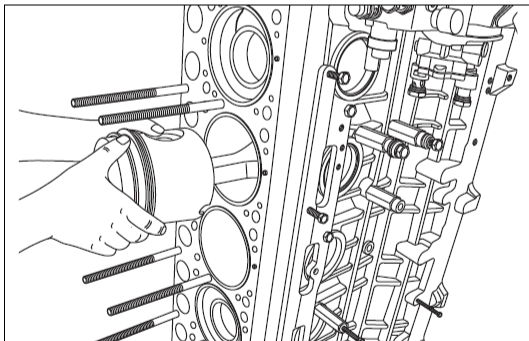


3. Dismantle the piston and connecting rod mechanism

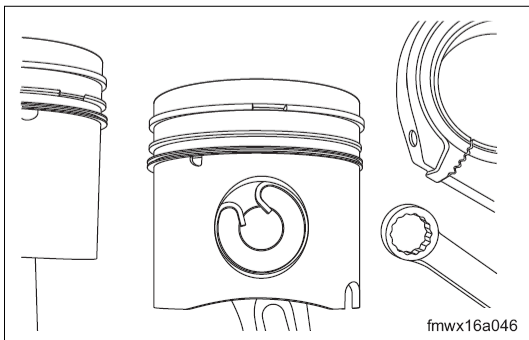
- (a). Dismantle the fixing bolts of the connecting rod big end.



- (b). Beat the connecting rod by a nylon rod to loosen it.

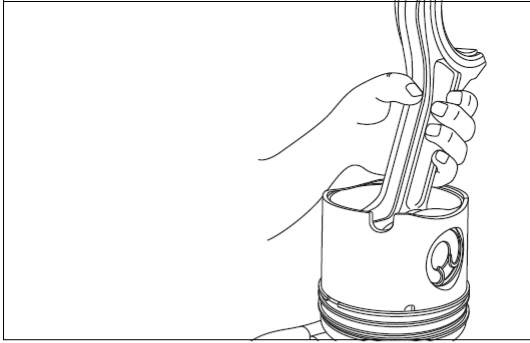


- (c). Take out the connecting rod and piston assembly.



4. Dismantle the piston

- (a). Dismantle the piston ring.
- (b). Dismantle the piston pin clamping spring.
- (c). Beat out the piston pin, and remove the piston.

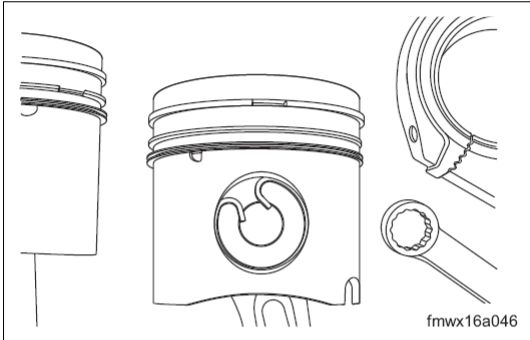


5. Install the piston

- (a). Put the piston components in a thermostat at 80°C for 10 minutes, and then install the piston pin and connecting rod immediately after taking them out.

Caution:

The 45° cutting face of the connecting rod big end shall back on to the gap of the piston oil nozzle.

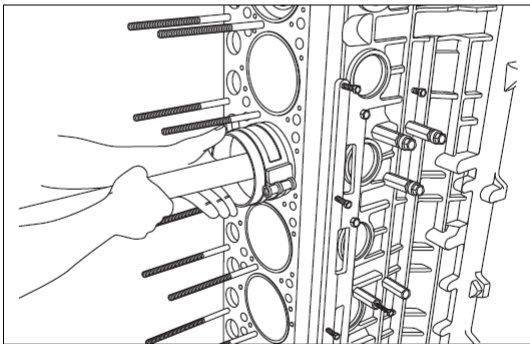


- (b). Install the locating clamping springs the locating grooves at both sides of the piston pin hole.

- (c). Install the piston ring.

Caution:

The face of the compression ring with “TOP” or upward mark must be face up. The oil ring has no difference in both faces.

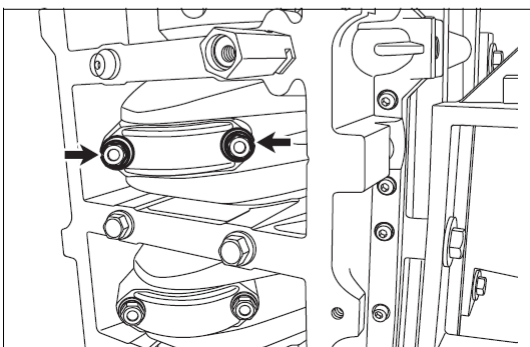


6. Install the piston and connecting rod mechanism

- (a). Install the piston into the cylinder liner by piston pliers.

Caution:

Stagger the piston ring gaps by 120°, and keep the gaps off at least 30° from the piston pin axis. Apply oil on the outer surface of the piston and the inner surface of the cylinder liner.



- (b). Install the fixing bolts of the connecting rod big end.

- Tighten the connecting rod bolts symmetrically.

Torque: First tighten with 120N.m;

Then tighten in order by 90°±5°;

Inspect whether the torque reaches 210N.m.

Caution:

The connecting rod bolts can be used only once repeatedly.

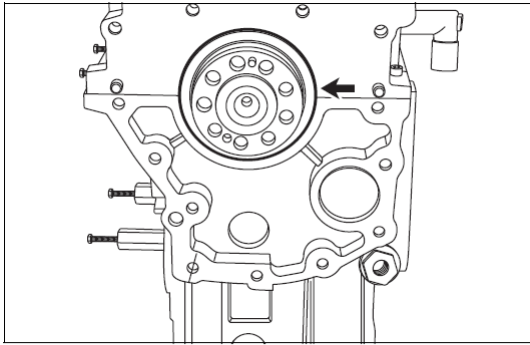
7. Install the oil pan. Refer to Chapter 15C Lubrication – Oil Pan, Replacement.

8. Install the cylinder head. Refer to Chapter 16C Engine Mechanical – Cylinder Head, Replacement.

Crankshaft

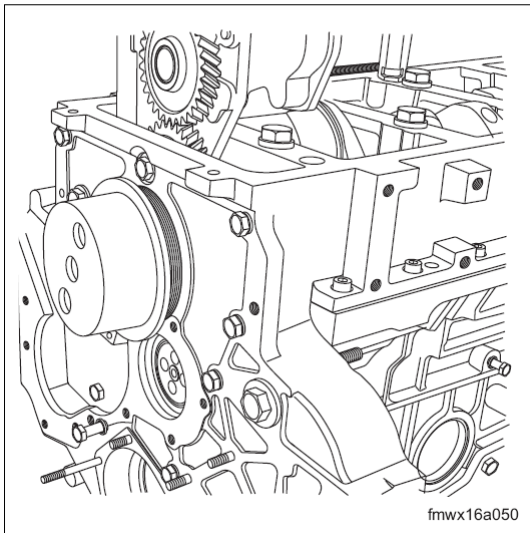
Replacement

1. Dismantle the piston and connecting rod. Refer to Chapter 16C Engine Mechanical – Piston and Connecting Rod, Replacement.
2. Dismantle the flywheel and flywheel housing. Refer to Chapter 16C Engine Mechanical – Flywheel and Flywheel Housing, Replacement.



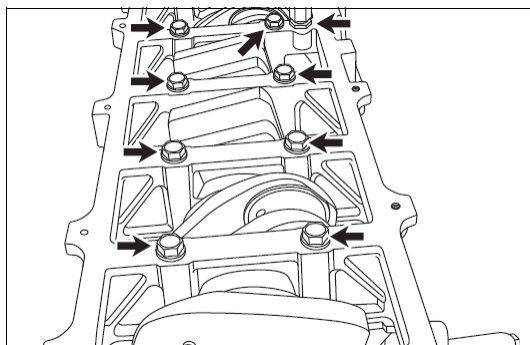
3. Dismantle the oil seal of the crankshaft

(a). Dismantle the front oil seal of the crankshaft.



(b). Dismantle the rear oil seal of the crankshaft.

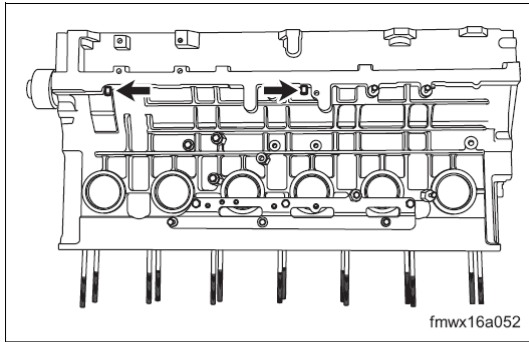
4. Dismantle the timing gear chamber. Refer to Chapter 16C Engine Mechanical – Timing Gear Chamber, Replacement.



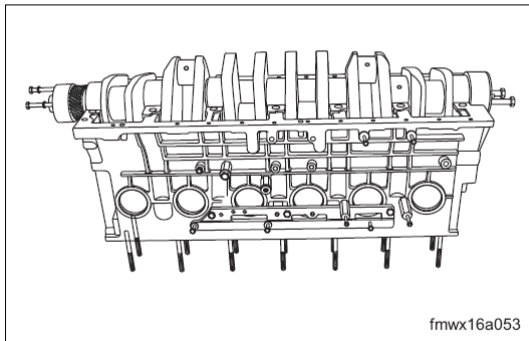
5. Dismantle the crankshaft

(a). Dismantle the crankcase.

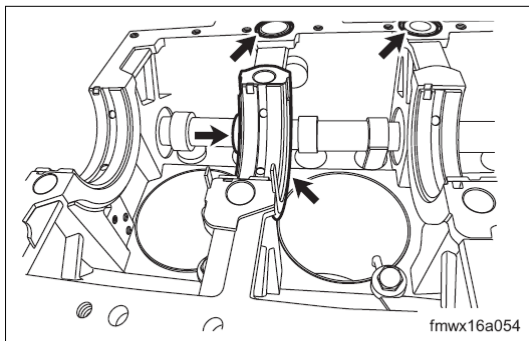
- Dismantle the oil pressure regulator valve.
- Dismantle the fixing bolts of the crankcase.



- Beat out the locating pin of the crankcase.
- Put down the crankcase.

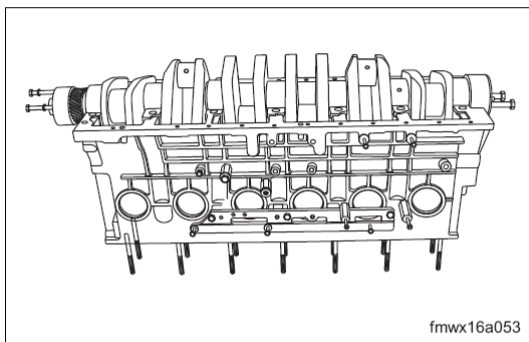


- (b). Put down the crankshaft.

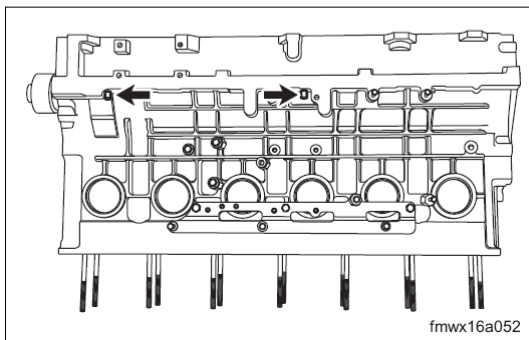


6. Install the crankshaft

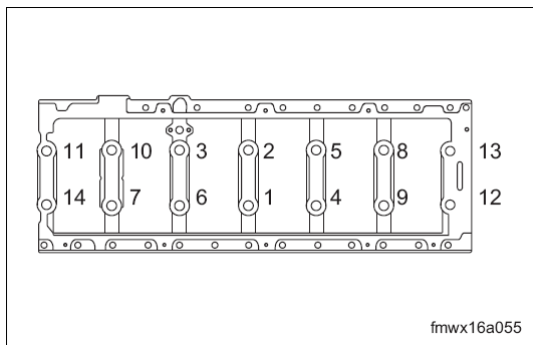
- Install the bearing.
- Adjust the radial clearance of the crankshaft. Refer to Chapter 16A Engine Mechanical – Engine Mechanical, Testing & Adjustment.
- Install the thrust gasket.
- Install the sealing ring.



- Install the crankshaft.
- Adjust the axial clearance of the crankshaft. Refer to Chapter 16A Engine Mechanical – Engine Mechanical, Testing & Adjustment.

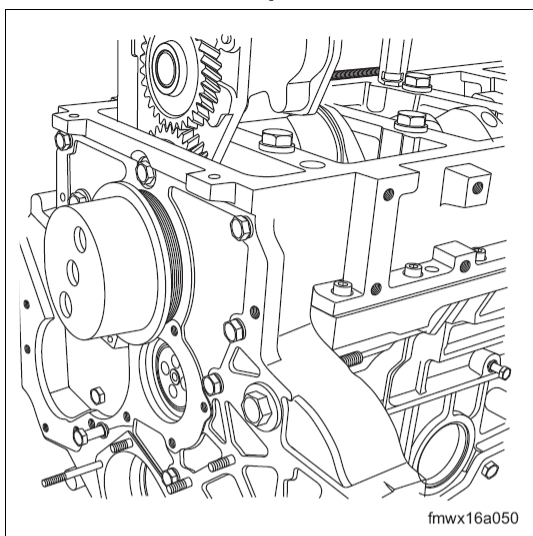


- Install the crankcase.
 - Clean the contact face between the cylinder and crankcase, and apply 510 flange sealant.
 - Put on the crankcase.
 - Beat in the locating pin of the crankcase.

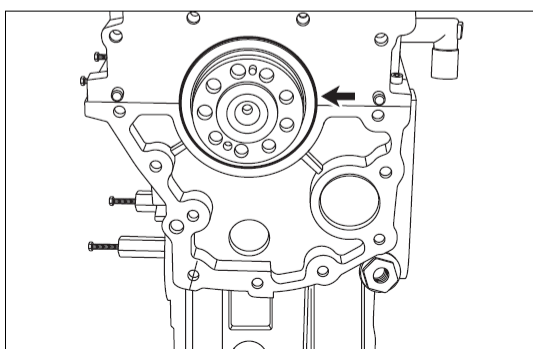
Engine Mechanical (WD615) – Crankshaft

- Install the fixing bolts of the crankcase.
**Torque: First, 30 N.m;
Second, 80 N.m;
Third, 250 ±25 N.m.**
- Install the oil pressure regulator valve.

7. Install the timing gear chamber. Refer to Chapter 16A Engine Mechanical – Timing Gear Chamber, Replacement.



- 8. Install the oil seal of the crankshaft**
- (a). Install the rear oil seal of the crankshaft.



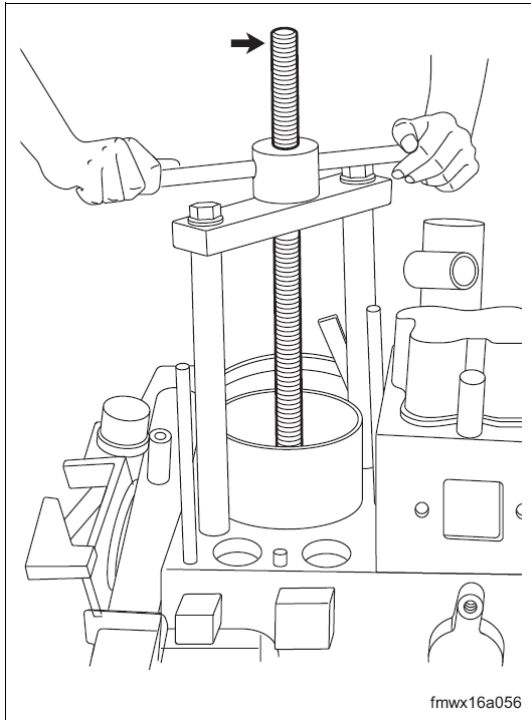
- (b). Install the front oil seal of the crankshaft.

- 9. Install the flywheel and flywheel housing. Refer to Chapter 16C Engine Mechanical – Flywheel and Flywheel Housing, Replacement.**
- 10. Install the piston and connecting rod. Refer to Chapter 16C Engine Mechanical – Piston and Connecting Rod, Replacement.**

Cylinder Body

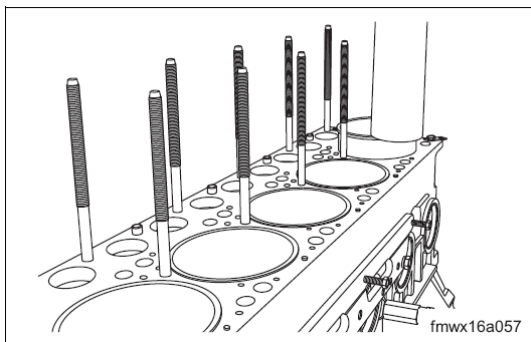
Replacement

1. Dismantle the engine accessories. Refer to Chapter 16C Engine Mechanical – Engine Accessories, Replacement.
2. Dismantle the crankshaft. Refer to Chapter 16C Engine Mechanical – Crankshaft, Replacement.



3. Dismantle the cylinder liner

- (a). Pull out the cylinder liner by a cylinder liner puller.



4. Install the cylinder liner

- (a). Apply a layer of molybdenum disulfide powder on the outer surface of the cylinder liner.

Caution:

DO NOT apply oil.

- (b). Slightly press into the cylinder liner.

Caution:

The part of the cylinder liner, which is higher than the top plane of the cylinder body, shall be within the range of 0.05~0.10mm.

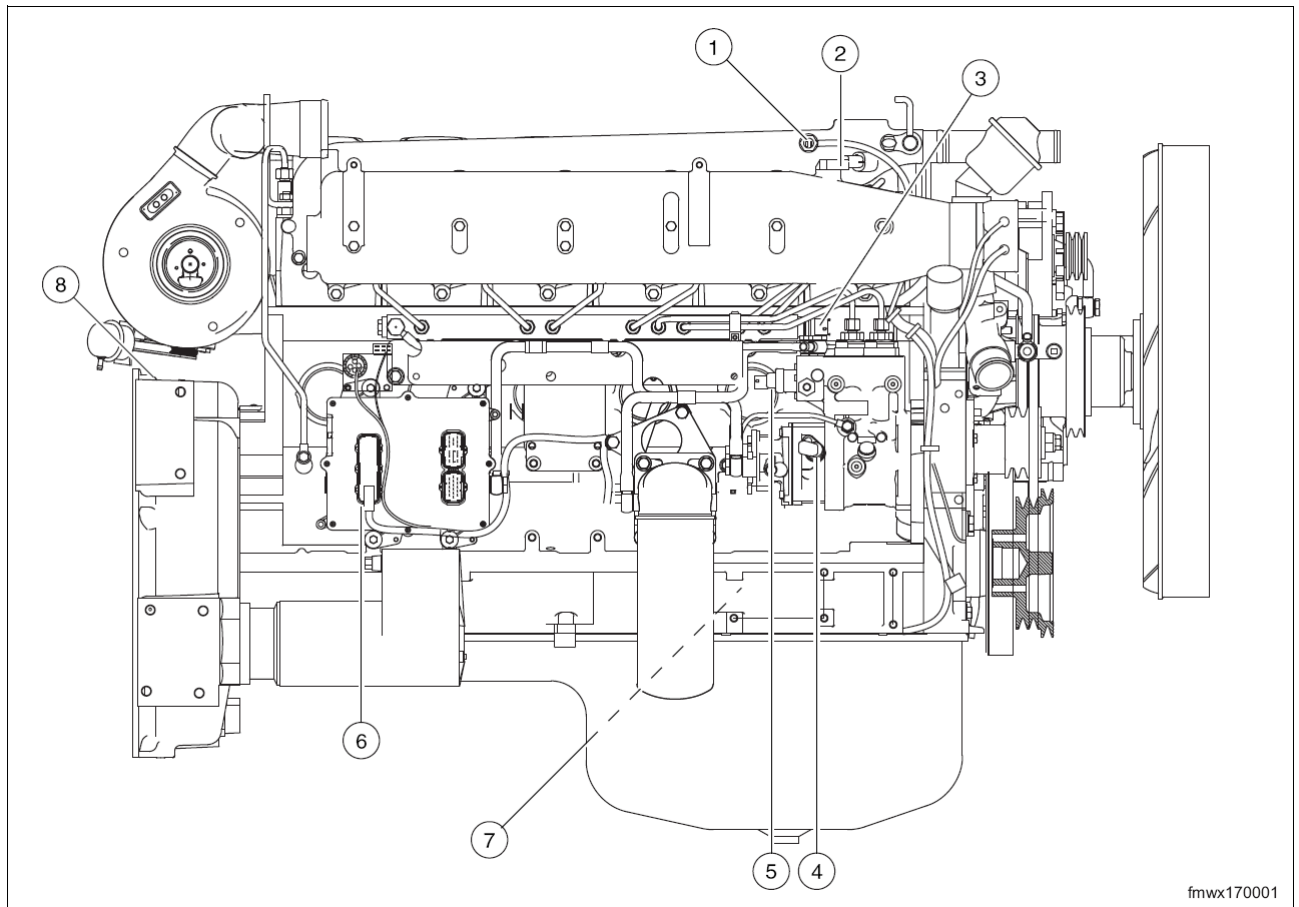
5. Install the crankshaft. Refer to Chapter 16C Engine Mechanical – Crankshaft, Replacement.
6. Install the engine accessories. Refer to Chapter 16C Engine Mechanical – Engine Accessories, Replacement.

Engine Control

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Replacement	17-22
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Replacement	17-23
Intake Pressure Sensor	17-24
Replacement	17-24
Intake Pressure Sensor –	
Intercooler	17-25
Replacement	17-25

Engine Control

Part Drawing

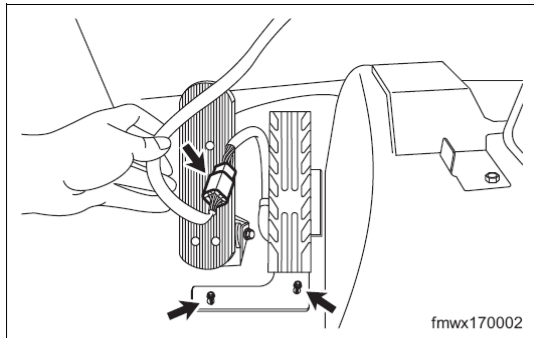


1	Water Temperature Sensor
2	Intake Pressure and Temperature Sensor
3	Common-rail Pressure Sensor
4	Camshaft Position Sensor

5	Fuel Flowmeter Valve
6	ECU
7	Oil Pressure Sensor
8	Crankshaft Position Sensor

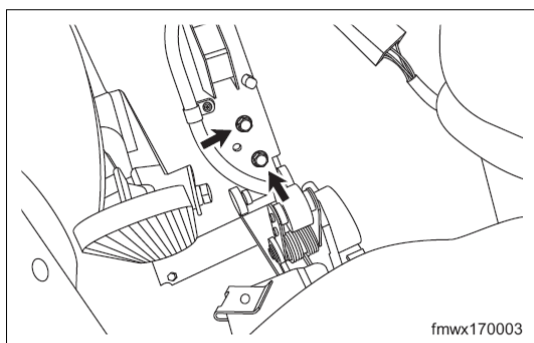
Accelerator Pedal Replacement

1. Turn off main power

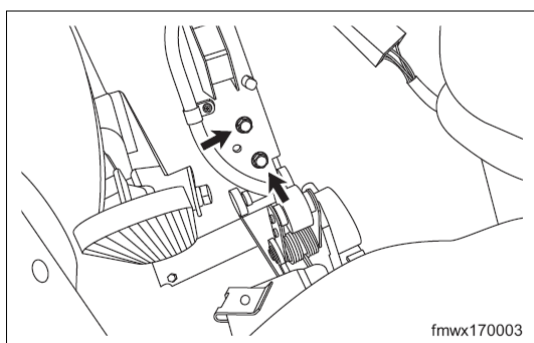


2. Dismantle accelerator pedal

- (a). Disconnect the connector of the wiring harness of the accelerator pedal.
- (b). Dismantle the fixing bolts of the accelerator pedal.

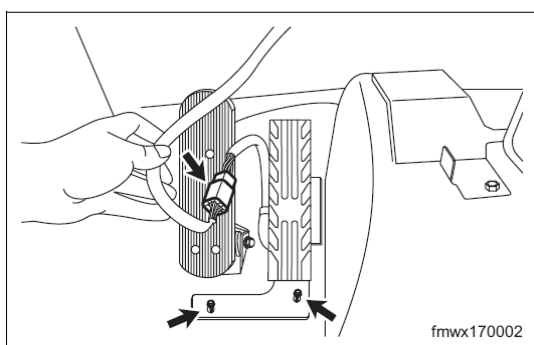


- (c). Dismantle the fixing nuts of the accelerator pedal.



3. Install accelerator pedal

- (a). Install the fixing nuts of the accelerator pedal.
Torque: 25N.m



- (b). Install the fixing bolts of the accelerator pedal.
Torque: 25N.m
- (c). Connect the connector of the wiring harness of the accelerator pedal.

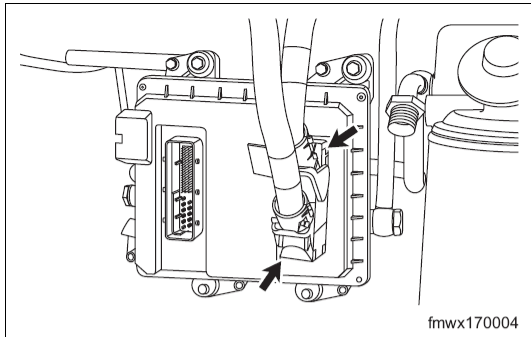
ECU

Replacement

Hint:

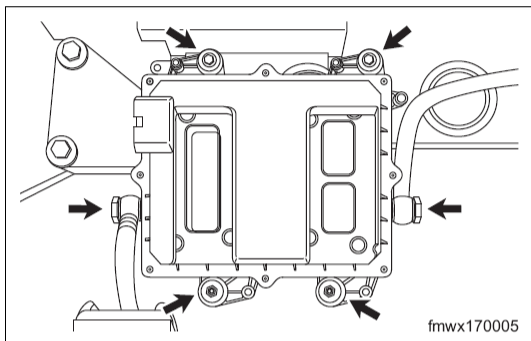
Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

1. Turn off main power

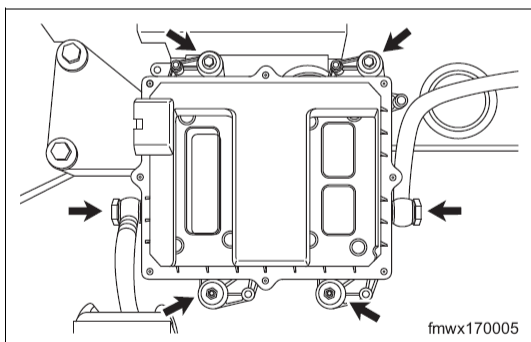


2. Dismantle ECU

- (a). Disconnect the connector of the wiring harness of the ECU.

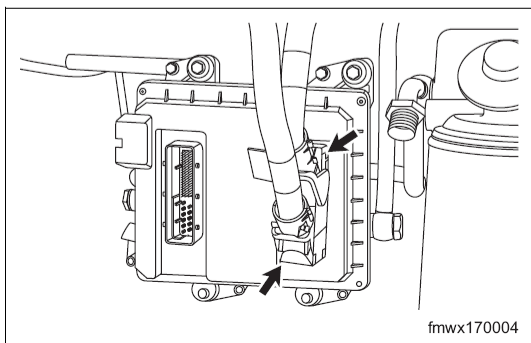


- (b). Disconnect the fuel pipe of the ECU.
(c). Dismantle the fixing bolts of the ECU.



3. Install ECU

- (a). Install the fixing bolts of the ECU.
Torque: 11±1N.m
(b). Connect the fuel pipe of the ECU.



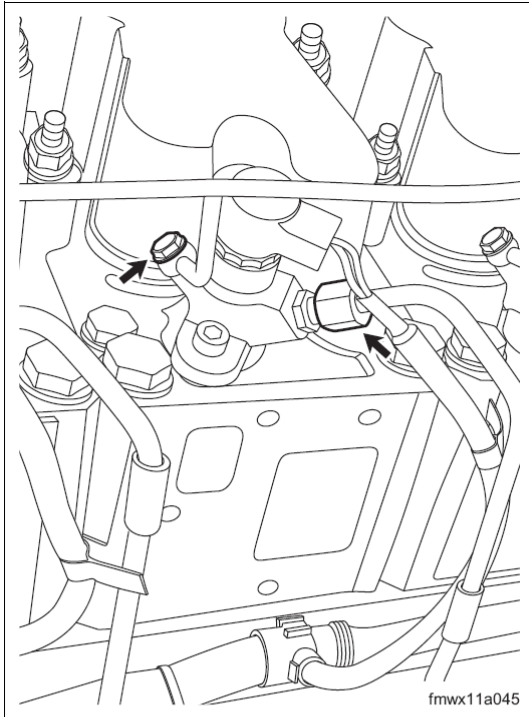
- (c). Connect the connector of the wiring harness of the ECU.

Fuel Injector (WP10)

Replacement

1. Turn off main power
2. Release fuel pressure
3. Dismantle intake manifold, refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement

17

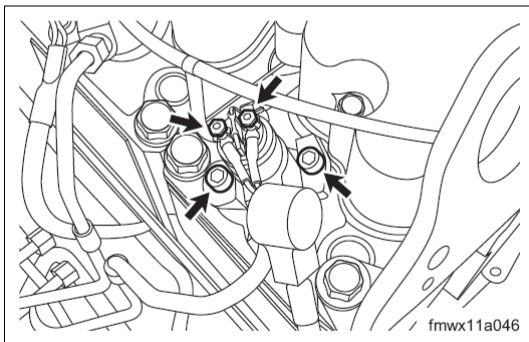


4. Dismantle fuel injector

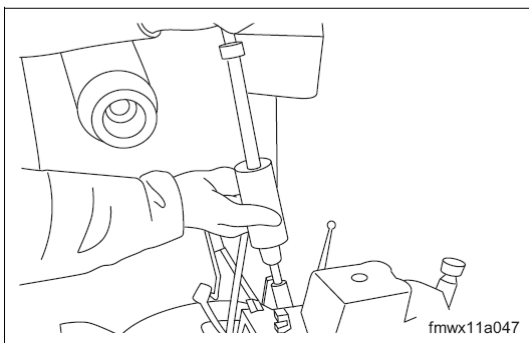
- (a). Dismantle the fuel inlet pipe of the fuel injector.
- (b). Dismantle the fuel return pipe of the fuel injector.

Caution:

Cover the protective cap of the joint to prevent pollution.



- (c). Dismantle the wiring harness of the fuel injector.
- (d). Dismantle the fixing bolts of the fuel injector.

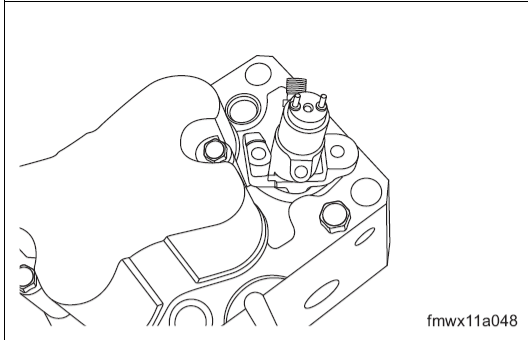


- (e). Dismantle the pressure plate of the fuel injector.
- (f). Pull out the fuel injector.

Caution:

Use special tools for dismantling the fuel injector, and it is not allowed to apply force on the solenoid valve to pull the fuel injector.

Engine Control – Fuel Injector (WP10)

**5. Install fuel injector**

- (a). Insert the fuel injector.
- (b). Install the pressure plate of the fuel injector.

Caution:

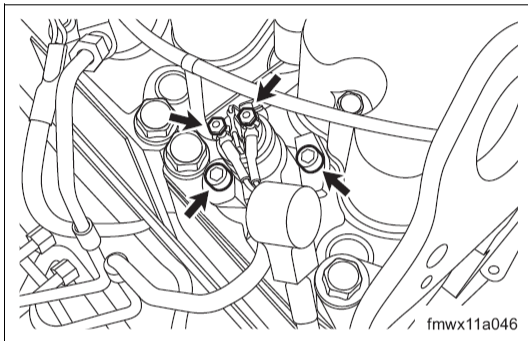
Dismantle the internal packing of the fuel injector only before installation.

Caution:

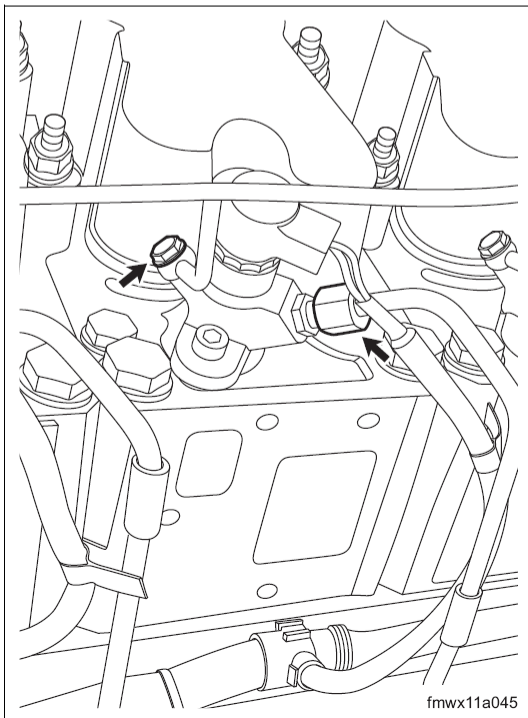
Keep the fuel injector body, O-ring and seal washer clean and in good condition in the installation process of the fuel injector.

Caution:

The high-pressure joint, O-ring and seal washer can be used only once.



- (c). Install the fixing bolts of the fuel injector.
Torque: 11±1N.m, symmetrically tighten and keep the side clearance consistent
- (d). Install the wiring harness of the fuel injector.



- (e). Install the fuel inlet pipe of the fuel injector.
Torque: 22.5±2.5N.m
- (f). Install the fuel return pipe of the fuel injector.
Torque: 22.5±2.5N.m

Caution:

Dismantle the protective cap only before installing the fuel pipe.

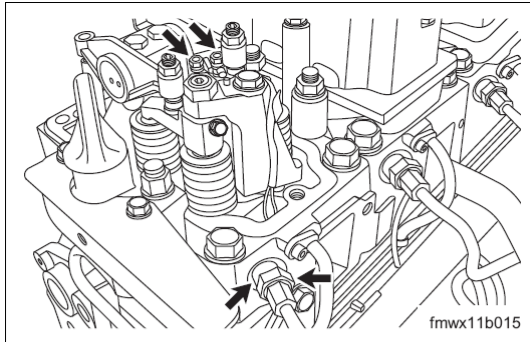
- 6. Install intake manifold, refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement
- 7. Exhaust low-pressure fuel line, refer to Chapter 11A, Fuel - Fuel System, Testing & Adjustment
- 8. Exhaust high-pressure fuel line
 - (a). Unscrew the fuel injector and the high-pressure fuel pipe joint of the first cylinder, drive the diesel engine to rotate by a starter motor, and tighten the joint nut when continuous diesel fuel free of bubbles is discharged from the joint.

Fuel Injector (WP12)

Overhaul

1. Turn off main power
2. Release fuel pressure
3. Dismantle intake manifold, refer to Chapter 16B, Engine Mechanical - Engine Accessories, Replacement
4. Dismantle valve-chamber cover, refer to Chapter 16B, Engine Mechanical - Cylinder Head, Replacement

17

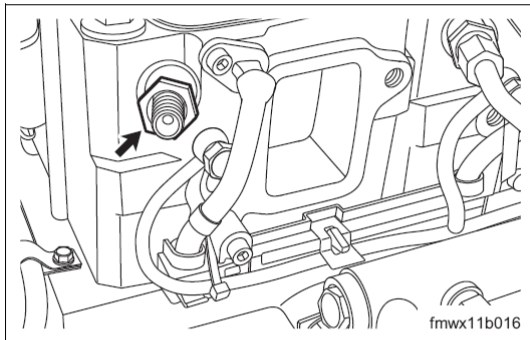


5. Dismantle fuel injector

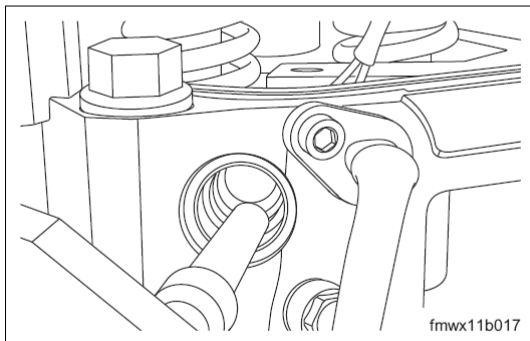
- (a). Dismantle the fuel inlet pipe of the fuel injector.
- (b). Dismantle the fuel return pipe of the fuel injector.
- (c). Dismantle the wiring harness of the fuel injector.

Caution:

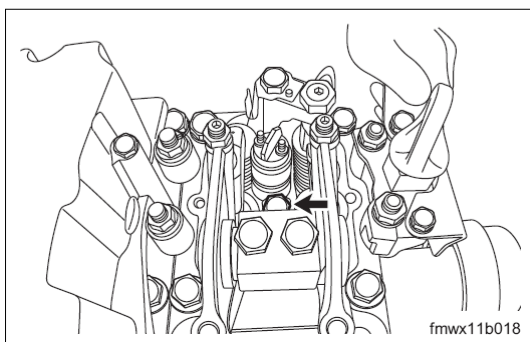
Cover the protective cap of the joint to prevent pollution.



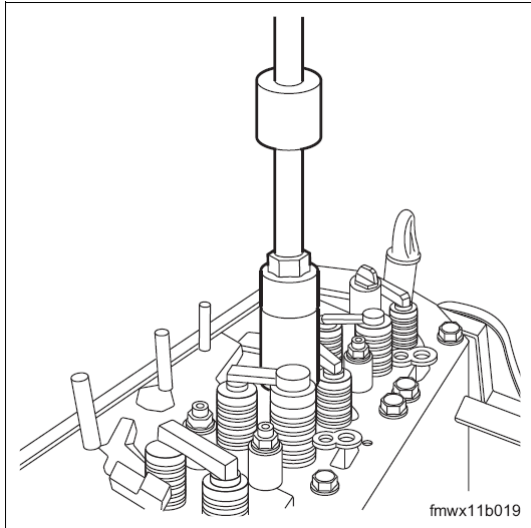
- (d). Dismantle the pressure cap of the high-pressure joint.



- (e). Dismantle the high-pressure fuel pipe joint of the fuel injector.



- (f). Dismantle the bolts of the pressure plate of the fuel injector.

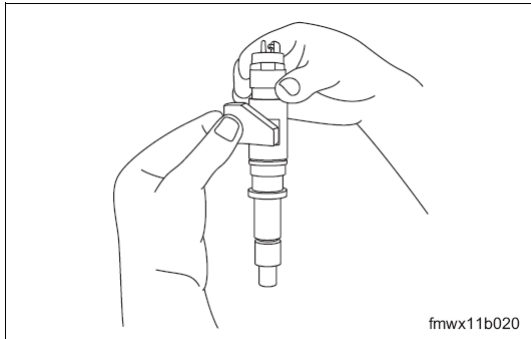
Engine Control – Fuel Injector (WP12)

(g). Pull out the fuel injector.

Caution:

Use special tools for dismantling the fuel injector, and it is not allowed to apply force on the solenoid valve to pull the fuel injector.

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6. Inspect the fuel injector, refer to Chapter 11B, Fuel - Fuel System, Testing & Adjustment**7. Install fuel injector**

(a). Install the pressure plate of the fuel injector.

(b). Insert the fuel injector.

Caution:

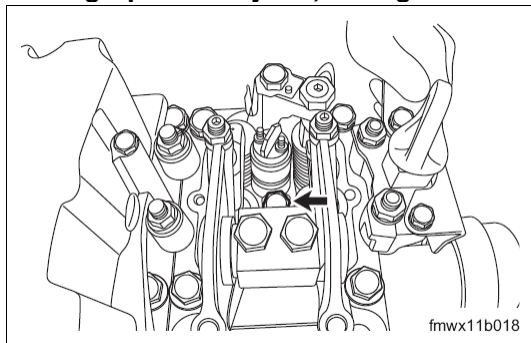
Dismantle the internal packing of the fuel injector only before installation.

Caution:

Keep the fuel injector body, O-ring and seal washer clean and in good condition in the installation process of the fuel injector.

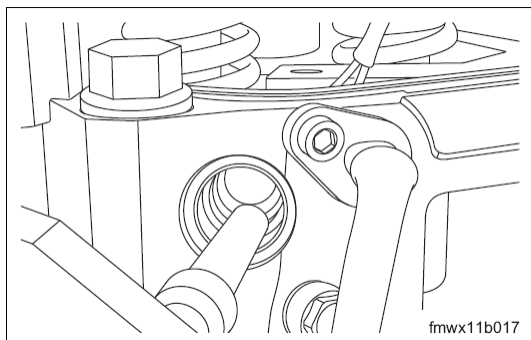
Caution:

The high-pressure joint, O-ring and seal washer can be used once only.



(c). Install the bolts of the pressure plate of the fuel injector.

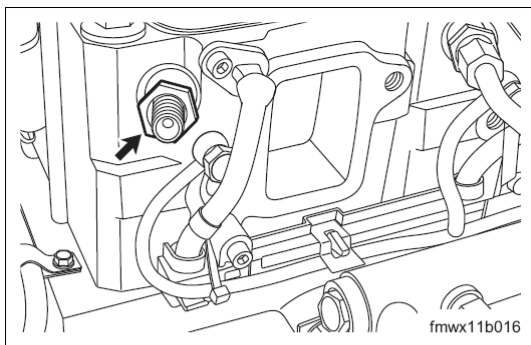
Torque: 3 N.m



(d). Loosen the bolts of the pressure plate to completely loosen the fuel injector in the cylinder head hole.

(e). Install the high-pressure fuel pipe joint of the fuel injector.

Torque: 22.5±2.5N.m

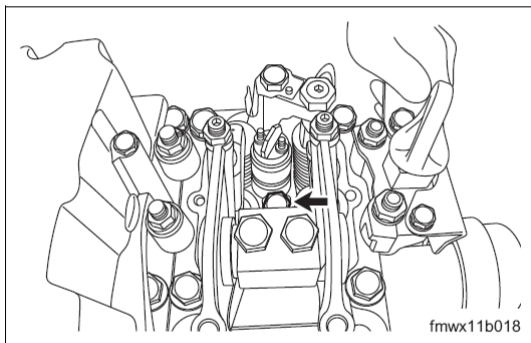


- (f). Install the wiring harness of the fuel injector.
- (g). Install the fuel return pipe of the fuel injector.
- (h). Install the pressure cap of the high-pressure joint of the fuel injector.

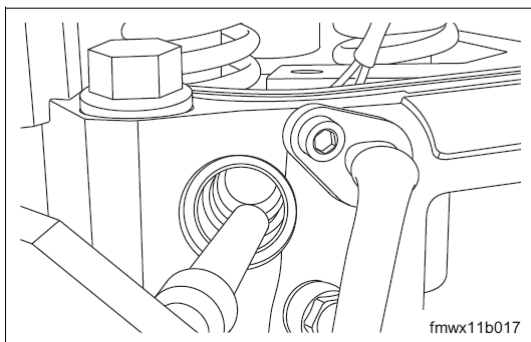
Torque: 17.5±2.5 N.m

Caution:

Dismantle the protective cap only before installing the fuel pipe.



- (i). Tighten the bolts of the pressure plate.
- Torque: 8 N.m + 90°**



- (j). Tighten the pressure cap of the high-pressure joint of the fuel injector.
- Torque: 52.5±2.5 N.m**

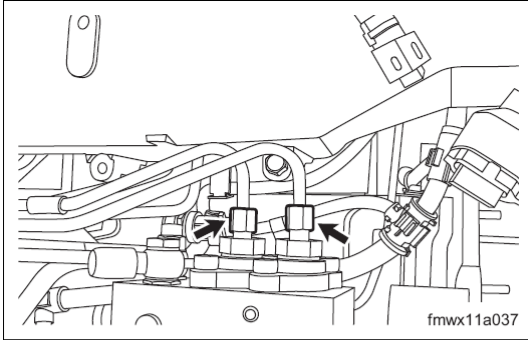
Engine Control – Fuel Injector (WP12)

8. Install valve-chamber cover, refer to Chapter 16B, Engine Mechanical - Cylinder Head, Replacement
9. Install intake manifold, refer to Chapter 16B, Engine Mechanical - Engine Accessories, Replacement
10. Exhaust fuel system, refer to Chapter 11B, Fuel - Fuel System, Testing & Adjustment

High-pressure Pump (WP10)

Replacement

1. Release fuel pressure



2. Dismantle high-pressure pump

- (a). Dismantle the high-pressure fuel pipe of the high-pressure pump.

Caution:

When loosening the nuts of the high-pressure fuel pipe, fix the fuel inlet joint of the high-pressure pump with another wrench; if the fuel inlet joint is loosened carelessly, tighten again at most once only, and replace the gasket of the fuel inlet joint box.

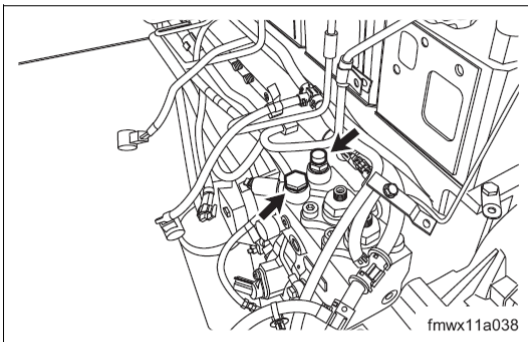
Caution:

Cover the protective cap of the joint to prevent pollution.

- (b). Dismantle the low-pressure fuel pipe of the high-pressure pump.

Caution:

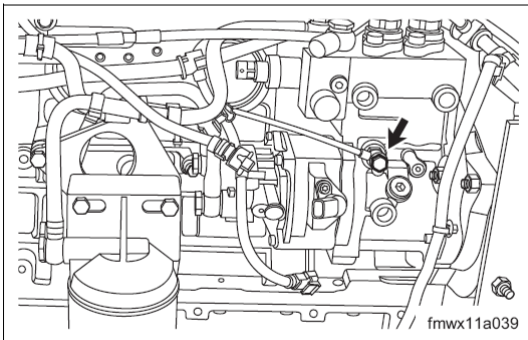
Cover the protective cap of the joint to prevent pollution.



- (c). Dismantle the oil pipe of the high-pressure pump.

Caution:

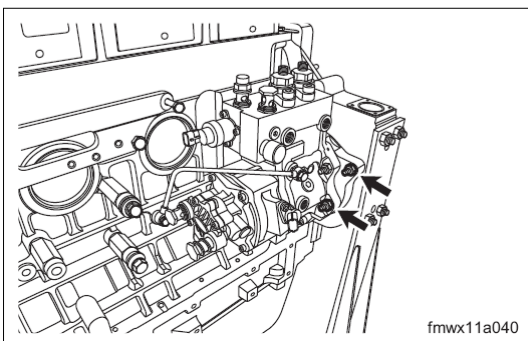
Cover the protective cap of the joint to prevent pollution.

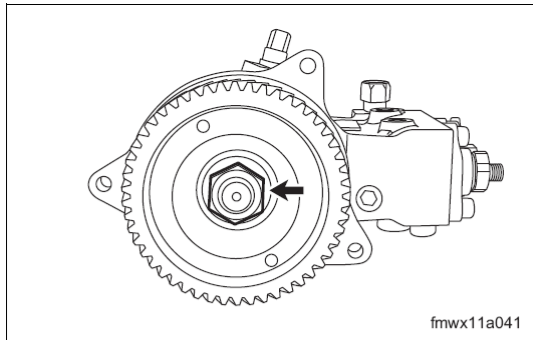


- (d). Dismantle the high-pressure pump.

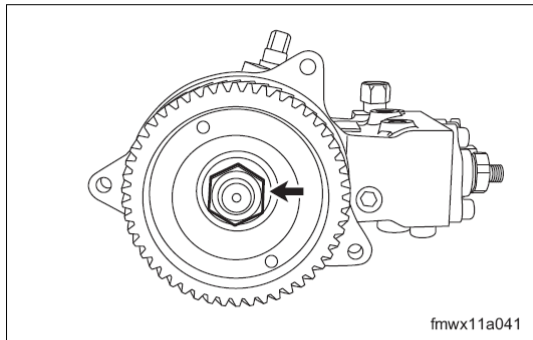
Caution:

Cover the protective cap of the joint to prevent pollution.

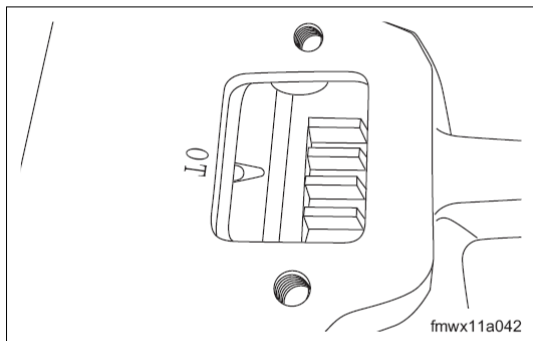


Engine Control – High-pressure Pump (WP10)**3. Dismantle drive gear of high-pressure pump**

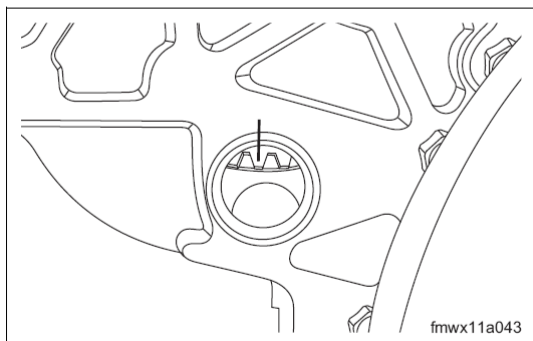
- (a). Dismantle the gland nut of the drive gear.
- (b). Dismantle the drive gear of the high-pressure pump.

**4. Install drive gear of high-pressure pump**

- (a). Clean the grease on the surface of the shaft with gasoline, alcohol, 755 cleaning agent, glycol, propane or other cleaning agents.
- (b). Tighten the gland nut of the drive gear.

**5. Adjustment high-pressure pump timing**

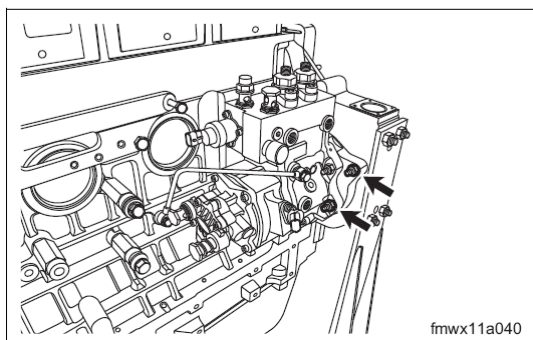
- (a). Adjust the engine to a cylinder top center position.



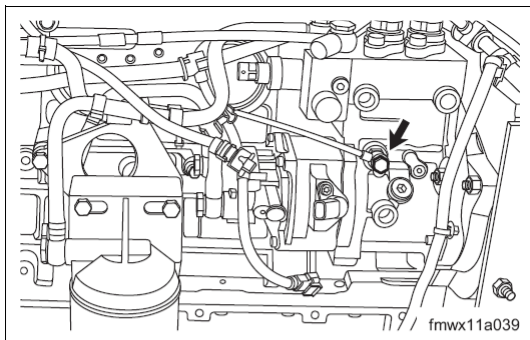
- (b). Adjust the driving gear of the high-pressure pump and align the timing mark.

Caution:

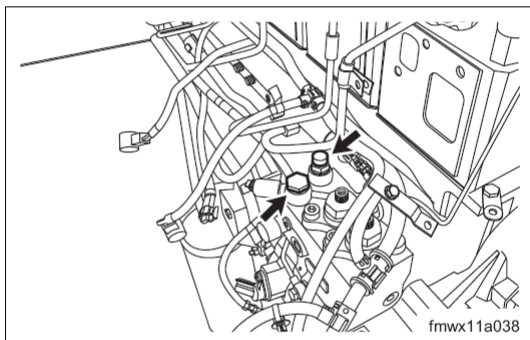
When handling and assembling the high-pressure pump, do not let easily worn parts to bear weight, comprising the high-pressure joints, low-pressure joints, the fuel control unit, the gear pump and the camshaft phase sensor.

**6. Install high-pressure pump**

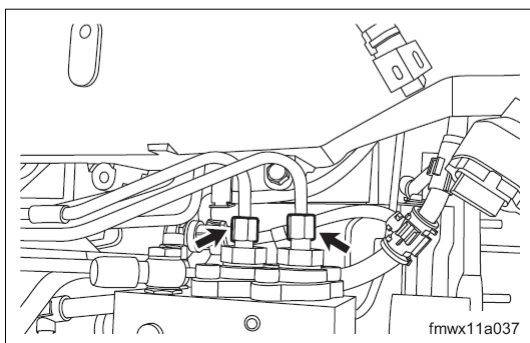
- (a). Tighten the fixing nuts of the high-pressure pump.
Torque: 63N.m



- (b). Install the oil pipe of the high-pressure pump.
Torque: $30\pm5\text{N.m}$



- (c). Install the low-pressure fuel pipe of the high-pressure pump.
Torque: $30\pm5\text{N.m}$

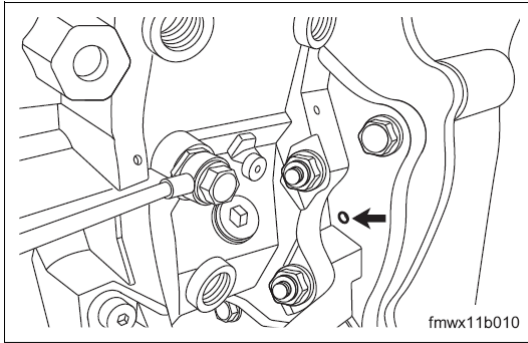


- (d). Install the high-pressure fuel pipe of the high-pressure pump.
Torque: $30\pm5\text{N.m}$

7. Exhaust fuel system, refer to Chapter 11A Fuel - Fuel System, Testing & Adjustment

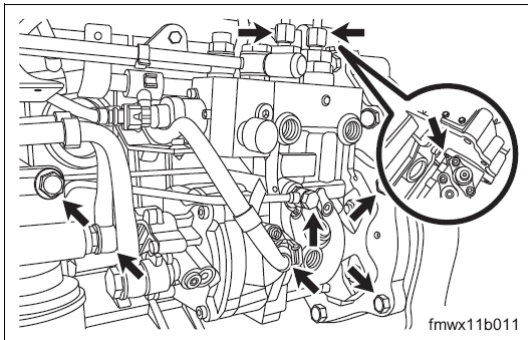
Replacement

1. Release fuel pressure



2. Adjustment high-pressure pump timing

- (a). Turn the engine.
- (b). Penetrate the spacer bar through a timing hole and fix the timing gear of the high-pressure pump.



3. Dismantle high-pressure pump

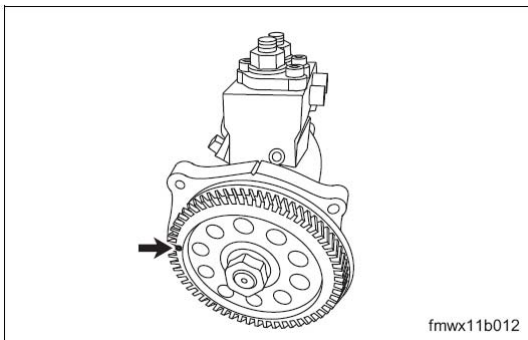
- (a). Dismantle the high-pressure fuel pipe of the high-pressure pump.
- (b). Dismantle the low-pressure fuel pipe of the high-pressure pump.
- (c). Dismantle the oil pipe of the high-pressure pump.
- (d). Disconnect the camshaft phase sensor.
- (e). Dismantle the fixing nuts of the high-pressure pump.

Caution:

When loosening the nuts of the high-pressure fuel pipe, fix the fuel inlet joint of the high-pressure pump with another wrench; if the fuel inlet joint is loosened carelessly, tighten again at most once only, and replace the gasket of the fuel inlet joint box.

Caution:

Cover the protective cap of the joint to prevent pollution.

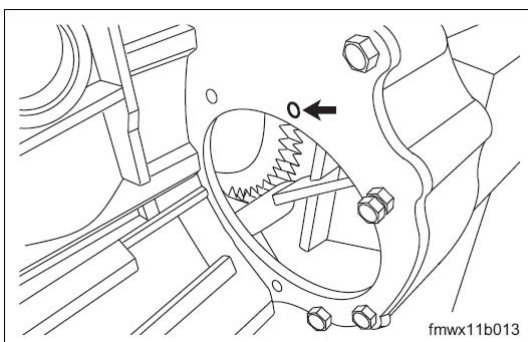


4. Install high-pressure pump

- (a). Adjust the driving gear of the high-pressure pump and align the timing mark.

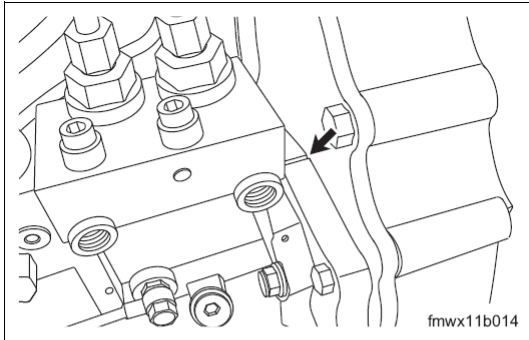
Caution:

When handling and assembling the high-pressure pump, do not let easily worn parts to bear weight, comprising the high-pressure joints, low-pressure joints, the fuel control unit, the gear pump and the camshaft phase sensor.

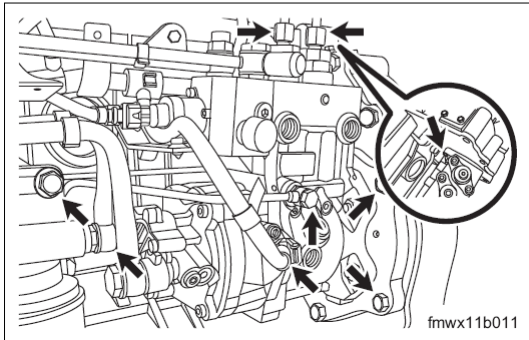


- (b). Align the assembly mark of the connecting plate of the high-pressure pump.

Engine Control – High-pressure Pump (WP12)



- (c). Align the assembly notch mark of the flange of the high-pressure pump.



- (d). Tighten the fixing nuts of the high-pressure pump.
Torque: 63N.m
(e). Install the camshaft phase sensor.
(f). Install the oil pipe of the high-pressure pump.
(g). Install the low-pressure fuel pipe of the high-pressure pump.
(h). Install the high-pressure fuel pipe of the high-pressure pump.

5. **Exhaust low-pressure fuel line, refer to Chapter 11B Fuel - Fuel System, Testing & Adjustment**

6. **Exhaust high-pressure fuel line**

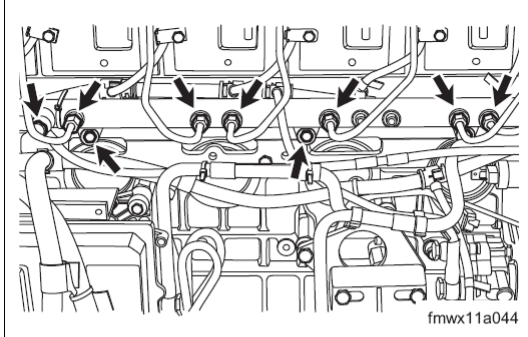
- (a). Unscrew the fuel injector and the high-pressure fuel pipe joint of the first cylinder, drive the diesel engine to rotate by a starter motor, and tighten the joint nut when continuous diesel fuel free of bubbles is discharged from the joint.

Common-rail Pipe

Replacement

1. Release fuel pressure
2. Dismantle intake manifold, refer to Chapter 16A, Engine Mechanical - Engine Accessories, Replacement

17



3. Dismantle common-rail pipe

- (a). Dismantle the fuel inlet pipe of the common-rail pipe.

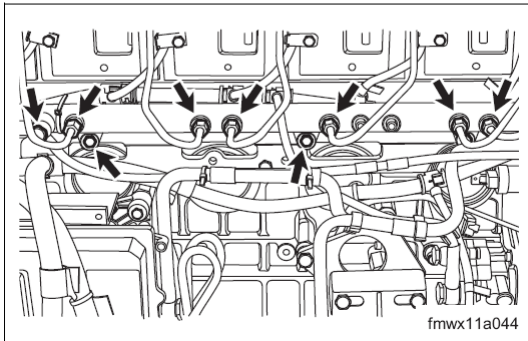
Caution:

Cover the protective cap of the joint to prevent pollution.

- (b). Dismantle the common-rail pipe

Caution:

After dismantling the common-rail component, cover the protective caps of the fuel injector, the high-pressure oil pipe, the high-pressure pump and the common-rail pipe.



4. Install common-rail pipe

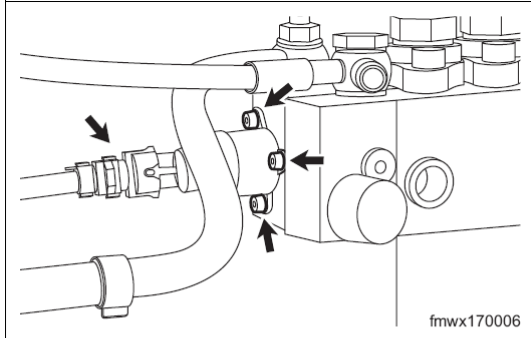
- (a). Install the common-rail pipe
Torque: 63N.m
- (b). Install the fuel inlet pipe of the common-rail pipe.
Torque: 30±5N.m

5. Exhaust low-pressure fuel line, refer to Chapter 11A Fuel - Fuel System, Testing & Adjustment
6. Exhaust high-pressure fuel line
 - (a). Unscrew the fuel injector and the high-pressure fuel pipe joint of the first cylinder, drive the diesel engine to rotate by an electric starter, and tighten the joint nut when continuous diesel fuel free of bubbles is discharged from the joint.

Fuel Pressure Sensor

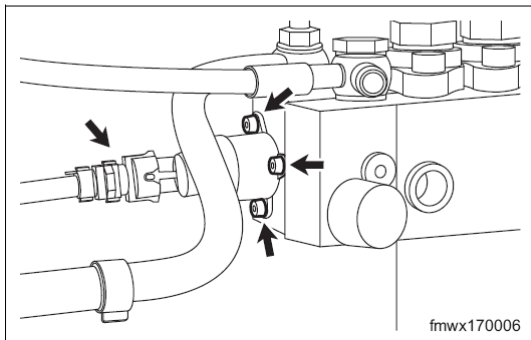
Replacement

1. Turn off main power
2. Release fuel pressure



3. Dismantle fuel pressure sensor
 - (a). Disconnect the connector of the fuel pressure sensor.
 - (b). Dismantle the fixing bolts of the fuel pressure sensor.

Caution:
Cover the protective cap of the joint to prevent pollution.



4. Dismantle fuel pressure sensor
 - (a). Install the fixing bolts of the fuel pressure sensor.
 - (b). Connect the connector of the fuel pressure sensor.

5. Exhaust low-pressure fuel line, refer to Chapter 11A Fuel - Fuel System, Testing & Adjustment
6. Exhaust high-pressure fuel line
 - (a). Unscrew the fuel injector and the high-pressure fuel pipe joint of the first cylinder, drive the diesel engine to rotate by an electric starter, and tighten the joint nut when continuous diesel fuel free of bubbles is discharged from the joint.
7. Turn on main power

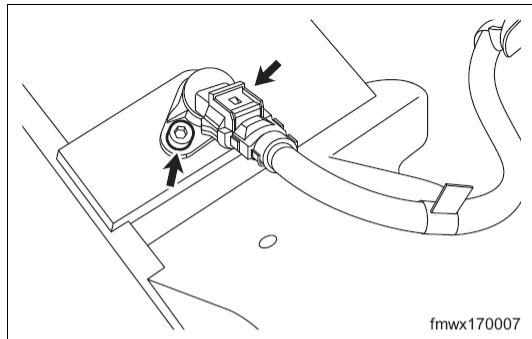
Crankshaft Position Sensor

Replacement

Hint:

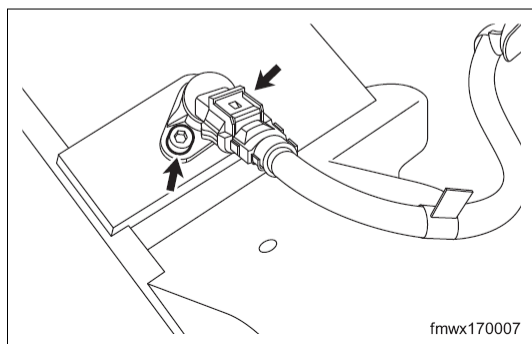
Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

1. Turn off main power



2. Dismantle crankshaft position sensor

- (a). Disconnect the connector of the crankshaft position sensor.
- (b). Dismantle the crankshaft position sensor.



3. Install crankshaft position sensor

- (a). Install the crankshaft position sensor.
- (b). Connect the connector of the crankshaft position sensor.

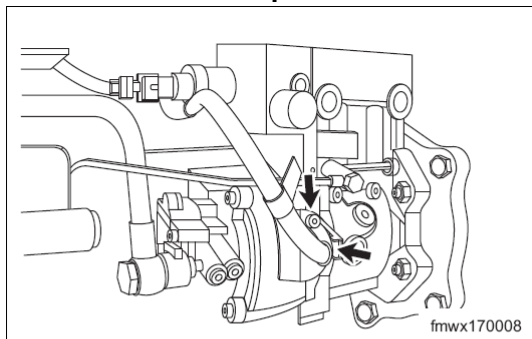
Camshaft Position Sensor

Replacement

Hint:

Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

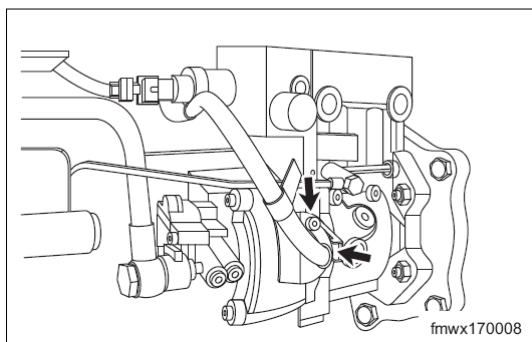
1. Turn off main power



2. Dismantle camshaft position sensor

- (a). Disconnect the connector of the camshaft position sensor.
- (b). Dismantle the camshaft position sensor.

17



3. Install camshaft position sensor

- (a). Install the camshaft position sensor.
- (b). Connect the connector of the camshaft position sensor.

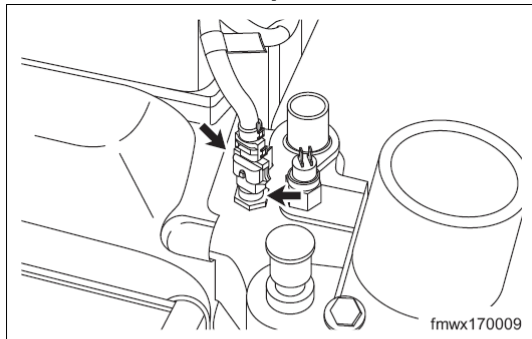
Water Temperature Sensor

Replacement

Hint:

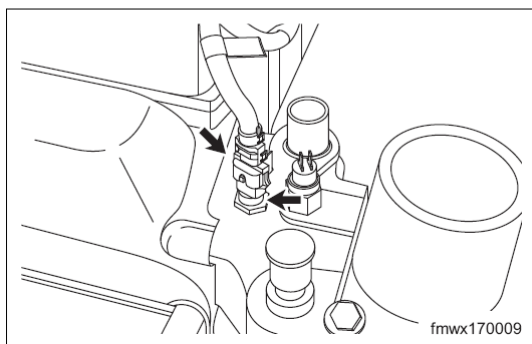
Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

1. Turn off main power



2. Dismantle water temperature sensor

- (a). Disconnect the connector of the water temperature sensor.
- (b). Dismantle the water temperature sensor.



3. Install water temperature sensor

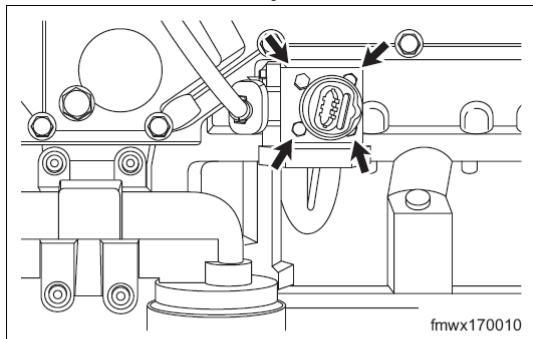
- (a). Install the water temperature sensor.
- (b). Connect the connector of the water temperature sensor.

Oil Pressure Sensor Replacement

Hint:

Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

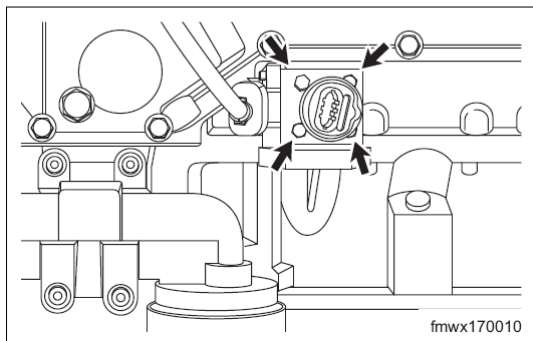
1. Turn off main power



2. Dismantle oil pressure sensor

- (a). Disconnect the connector of the oil pressure sensor.
- (b). Dismantle the fixing bolts of the oil pressure sensor.

17



3. Install oil pressure sensor

- (a). Install the fixing bolts of the oil pressure sensor.
- (b). Connect the connector of the oil pressure sensor.

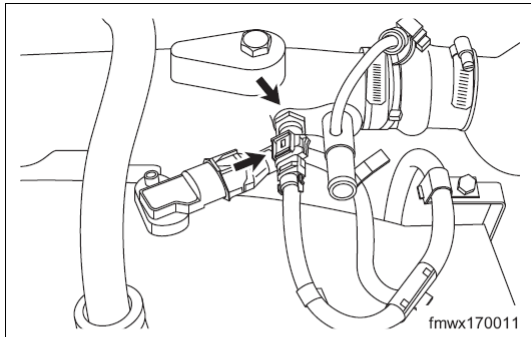
Intake Pressure Sensor

Replacement

Hint:

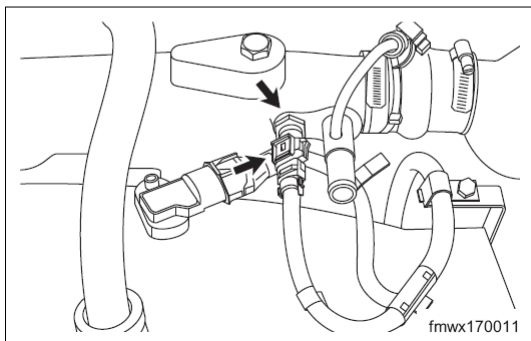
Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

1. Turn off main power



2. Dismantle intake pressure sensor

- (a). Disconnect the connector of the intake pressure sensor.
- (b). Dismantle the intake pressure sensor.



3. Install intake pressure sensor

- (a). Install the intake pressure sensor.
- (b). Connect the connector of the intake pressure sensor.

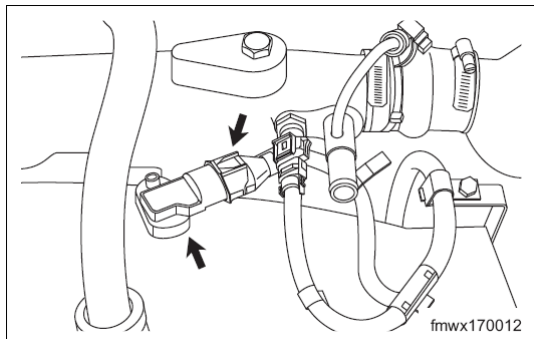
Intake Pressure Sensor - Intercooler

Replacement

Hint:

Part Drawing, refer to Chapter 17, Engine Control - Engine Control, Part Drawing.

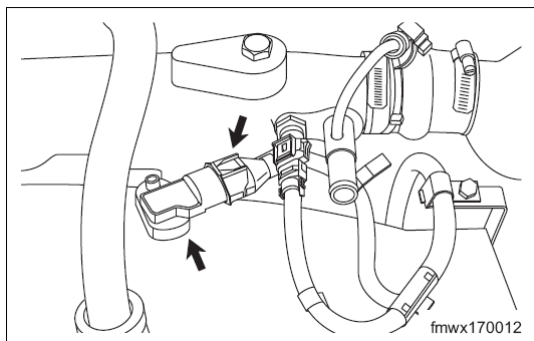
1. Turn off main power



2. Dismantle intake pressure sensor - intercooler

- (a). Disconnect the connector of the intake pressure sensor of the intercooler.
- (b). Dismantle the intake pressure sensor of the intercooler.

17



3. Install intake pressure sensor - intercooler

- (a). Install the intake pressure sensor of the intercooler.
- (b). Connect the connector of the intake pressure sensor of the intercooler.

Starting & Preheating System (WP10)

Starting & Preheating System.....	18A-3
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Precautions.....	18A-4
Testing & Adjustment.....	18A-5
Ignition Switch.....	18A-6
Replacement	18A-6
Auxiliary Starting Switch	18A-7
Replacement	18A-7
Preheating Relay	18A-8
Replacement	18A-8
Starter.....	18A-9
Replacement	18A-9
Heater	18A-10
Replacement	18A-10

18A

Starting & Preheating System

General

Starter

The starting torque is the moment necessary to overcome the resistance from air compression in the cylinder and the resistance from friction between the relatively moving parts of the engine itself and its accessories when the engine is started.

The starting speed is the crankshaft speed necessary to start the engine successfully. For the starting of the diesel engine for automobile, in order to prevent the cylinder from leaking air and too much heat from dispersing, ensure that there is enough pressure and temperature in the cylinder at the end of the compression, and also ensure that the fuel injection pump can establish sufficient fuel injection pressure to form sufficiently strong air eddy in the cylinder, it requires very high starting speed, which can reach 150~300r/min. Or diesel spray is poor, the quality of gas mixture is bad, the engine is difficult to start. In addition, the compression ratio of the diesel engine is larger than that of the gasoline engine, so the starting torque for the diesel engine is greater, and the power of the starter necessary to start the diesel engine is bigger than that necessary to start the gasoline engine.

The DC starter consists of a DC series motor, a control mechanism and an engaging/disengaging mechanism. It is special for engine starting and needs powerful torque, so a large amount of current will pass through it, which is up to several hundred amperes.

The DC motor is suitable for the starter as its torque is big at low speed, and gets smaller gradually with the speed increasing.

The starter adopts the DC series motor, and its rotor and stator parts are made of thick copper wires with rectangular cross section by winding; the driving mechanism is of a reduction gear structure; and the control mechanism is based on a manner of electromagnetic attraction.

The driving gear of the reduction gear mechanism is linked with the engine flywheel to start the engine in a manner of one-way driving. When the speed of the pinion on the motor is higher than that of the ring gear of the engine flywheel, the motor drives the engine to rotate; when the engine's speed is higher than the motor's, the power transmission relation between them automatically disappears.

The gear-reduction starter is mainly composed of electromagnetically engaged switch, reduction gear, motor, starting gear (pinion) and overrunning clutch.

Intake Preheater

In order to improve the engine's starting performance, an intake preheater is installed on the intake duct of the engine. It is energized when the intake temperature or the temperature of cooling water is lower than a certain value, and heats air in the air pipe, which is favorable for starting of the engine and combustion of gas mixture. Generally, the intake preheater is composed of an electric gas mixture preheater, an intake preheating temperature control switch, an intake preheating relay, etc.

Middle and low-power diesel engines are usually equipped with intake preheaters for cold start. When the engine is started, after the preheater switch is turned on, heating wires are energized, get hot and heat the valve body. The valve body extends when heated and forces the valve core to move down, and its tapered end goes away from the fuel feed hole. Fuel flows into the inner chamber of the valve body and is vaporized due to heating, the fuel vapor is injected from the inner chamber of the valve body and ignited by the hot heating wires, and the flame is injected into the intake pipe to preheat intake air. When the preheater switch is turned off, the power of heating wires are cut off, the valve body gets cold and shrinks, the valve core moves up to force the tapered end to block the fuel feed hole, the flame goes out, and preheating is stopped.

Precautions

1. The operating time of the starter shall not exceed 5 seconds. If the vehicle needs starting many times, there must be an interval of at least 10 seconds between every two operations.
2. The first maintenance for the motor is between 50,000~80,000km. Remove dirt inside, and re-fill lubricating oil.
3. The second maintenance is between 40,000~50,000km. Inspect the wearing degree of the carbon brush; if the carbon brush is worn too much, replace it. If not replaced and cleaned, the contact face between the motor's rotor and carbon brush is easy to damage, and the motor needs to be replaced at that time.
4. The carbon brush is close to its limit between about 100,000~150,000km. If the vehicle usually runs in a short distance and needs starting frequently, the motor shall be maintained at a mileage below 80,000km; if the vehicle usually runs in a long distance and needs starting infrequently, the motor can be maintained at a mileage above 80,000km.
5. Frequent maintenance and lubrication of the motor will not increase load and electric current, and the motor is not easy to damage.

Testing & Adjustment

Ignition Switch

Inspect the continuity of various stages of the ignition switch by a multimeter.

Auxiliary Starting Switch

Inspect the continuity of various stages of the auxiliary starting switch by a multimeter.

Starter

Test the starting current, and measure the resistance of the starter cable.

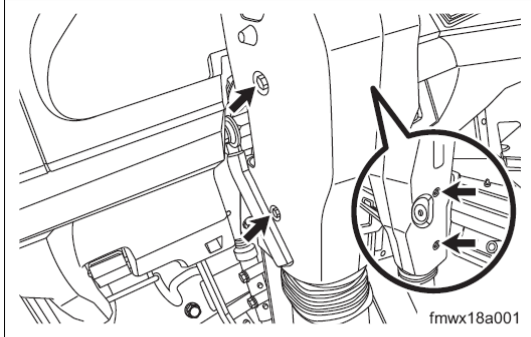
Heater

Test the conduction between the intake preheater and power supply, and between the intake preheater and grounding cable. Measure the resistance of the intake preheater.

Ignition Switch

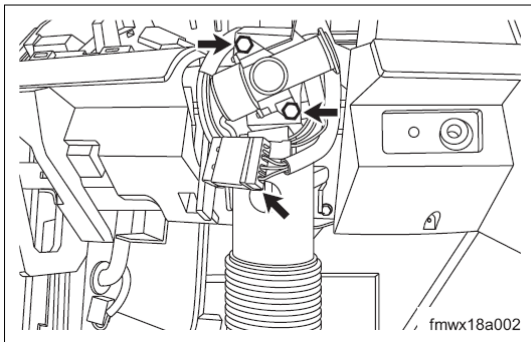
Replacement

1. Turn off the main power



2. Dismantle the ignition switch

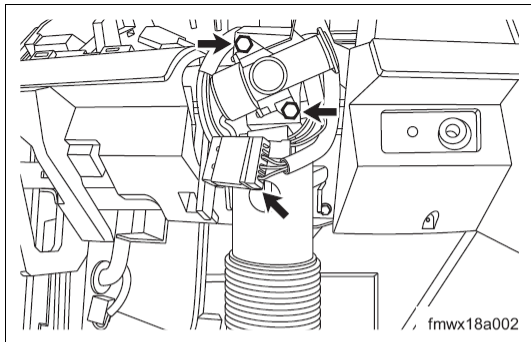
(a). Dismantle the trim panel of the steering column.



(b). Dismantle the ignition switch

- Disconnect the wiring harness of the ignition switch.
- Dismantle the fixing bolts of the ignition switch.

3. Inspect the ignition switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



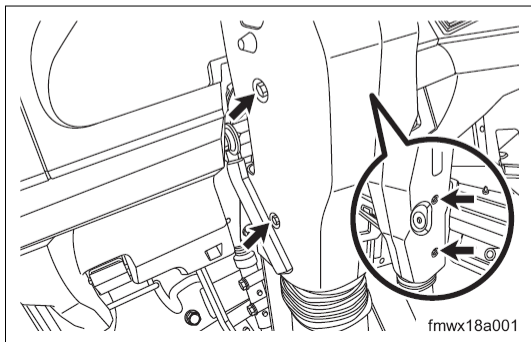
4. Install the ignition switch

- Install the fixing bolts of the ignition switch.

Torque: 25N.m

- Connect the wiring harness of the ignition switch.

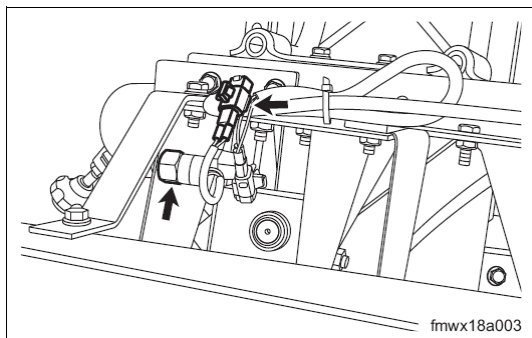
(a). Install the trim panel of the steering column.



Auxiliary Starting Switch

Replacement

1. Turn off the main power

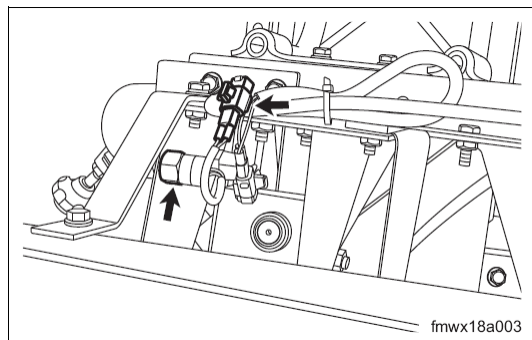


2. Dismantle the auxiliary starting switch

- (a). Disconnect the wiring harness of the auxiliary starting switch.
- (b). Dismantle the auxiliary starting switch

18A

3. Inspect the auxiliary starting switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



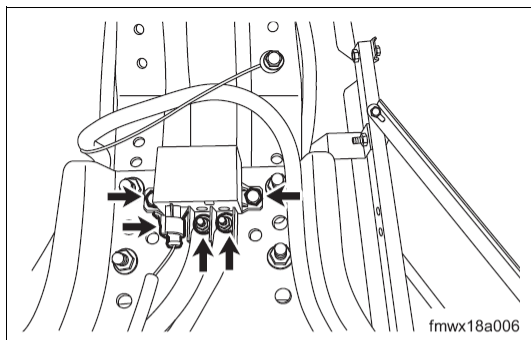
4. Install the auxiliary starting switch

- (a). Install the auxiliary starting switch.
- (b). Connect the wiring harness of the auxiliary starting switch.

Preheating Relay

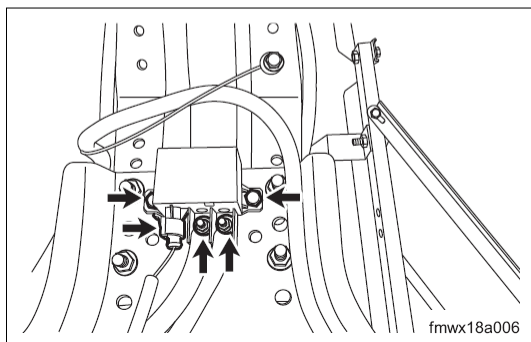
Replacement

1. Turn off the main power



2. Dismantle the preheating relay

- (a). Disconnect the wiring harness of the preheating relay.
- (b). Dismantle the fixing bolts of the preheating relay.



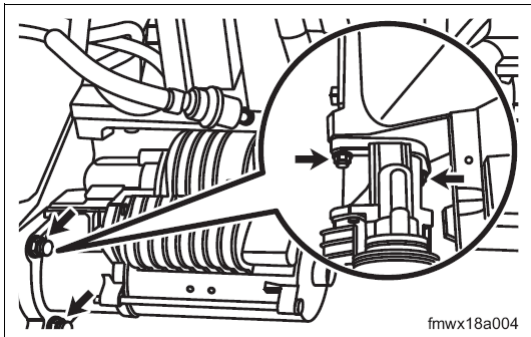
3. Install the preheating relay

- (a). Install the fixing bolts of the preheating relay.
- (b). Connect the wiring harness of the preheating relay.

Starter

Replacement

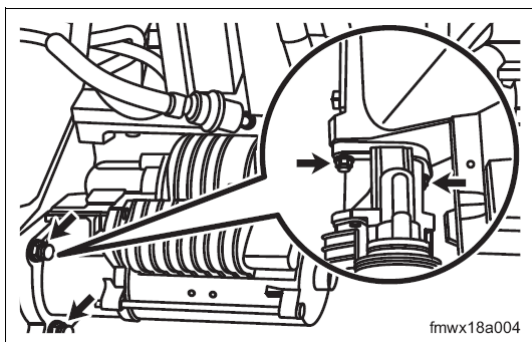
1. Turn off the main power



2. Dismantle the starter

- (a). Disconnect the wiring harness of the starter.
- (b). Dismantle the starter.

3. Inspect the starter. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



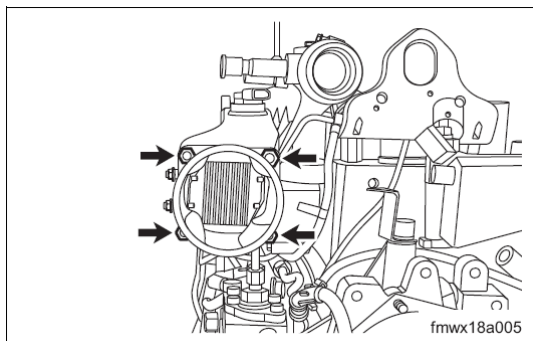
4. Install the starter

- (a). Install the starter.
- Torque: 60N.m**
- (b). Connect the wiring harness of the starter.

Heater

Replacement

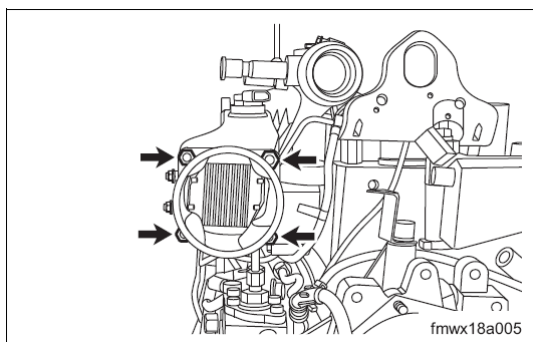
1. Turn off the main power



2. Dismantle the heater

- (a). Disconnect the wiring harness of the heater.
- (b). Dismantle the heater.

3. Inspect the heater. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



4. Install the heater

- (a). Install the heater.

Torque: 25N.m

- (b). Connect the wiring harness of the heater.

Starting & Preheating System (WP12)

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Testing & Adjustment.....	18B-5
Ignition Switch.....	18B-6
Replacement	18B-6
Auxiliary Starting Switch	18B-7
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Preheating Relay	18B-8
Replacement	18B-8
Starter.....	18B-9
Replacement	18B-9
Heater	18B-10
Replacement	18B-10

18B

18B

Starting & Preheating System

General

Starter

The starting torque is the moment necessary to overcome the resistance from air compression in the cylinder and the resistance from friction between the relatively moving parts of the engine itself and its accessories when the engine is started.

The starting speed is the crankshaft speed necessary to start the engine successfully. For the starting of the diesel engine for automobile, in order to prevent the cylinder from leaking air and too much heat from dispersing, ensure that there is enough pressure and temperature in the cylinder at the end of the compression, and also ensure that the fuel injection pump can establish sufficient fuel injection pressure to form sufficiently strong air eddy in the cylinder, it requires very high starting speed, which can reach 150~300r/min. Or diesel spray is poor, the quality of gas mixture is bad, the engine is difficult to start. In addition, the compression ratio of the diesel engine is larger than that of the gasoline engine, so the starting torque for the diesel engine is greater, and the power of the starter necessary to start the diesel engine is bigger than that necessary to start the gasoline engine.

The DC starter consists of a DC series motor, a control mechanism and an engaging/disengaging mechanism. It is special for engine starting and needs powerful torque, so a large amount of current will pass through it, which is up to several hundred amperes.

The DC motor is suitable for the starter as its torque is big at low speed, and gets smaller gradually with the speed increasing.

The starter adopts the DC series motor, and its rotor and stator parts are made of thick copper wires with rectangular cross section by winding; the driving mechanism is of a reduction gear structure; and the control mechanism is based on a manner of electromagnetic attraction.

The driving gear of the reduction gear mechanism is linked with the engine flywheel to start the engine in a manner of one-way driving. When the speed of the pinion on the motor is higher than that of the ring gear of the engine flywheel, the motor drives the engine to rotate; when the engine's speed is higher than the motor's, the power transmission relation between them automatically disappears.

The gear-reduction starter is mainly composed of electromagnetically engaged switch, reduction gear, motor, starting gear (pinion) and overrunning clutch.

Intake Preheater

In order to improve the engine's starting performance, an intake preheater is installed on the intake duct of the engine. It is energized when the intake temperature or the temperature of cooling water is lower than a certain value, and heats air in the air pipe, which is favorable for starting of the engine and combustion of gas mixture. Generally, the intake preheater is composed of an electric gas mixture preheater, an intake preheating temperature control switch, an intake preheating relay, etc.

Middle and low-power diesel engines are usually equipped with intake preheaters for cold start. When the engine is started, after the preheater switch is turned on, heating wires are energized, get hot and heat the valve body. The valve body extends when heated and forces the valve core to move down, and its tapered end goes away from the fuel feed hole. Fuel flows into the inner chamber of the valve body and is vaporized due to heating, the fuel vapor is injected from the inner chamber of the valve body and ignited by the hot heating wires, and the flame is injected into the intake pipe to preheat intake air. When the preheater switch is turned off, the power of heating wires are cut off, the valve body gets cold and shrinks, the valve core moves up to force the tapered end to block the fuel feed hole, the flame goes out, and preheating is stopped.

Precautions

1. The operating time of the starter shall not exceed 5 seconds. If the vehicle needs starting many times, there must be an interval of at least 10 seconds between every two operations.
2. The first maintenance for the motor is between 50,000~80,000km. Remove dirt inside, and re-fill lubricating oil.
3. The second maintenance is between 40,000~50,000km. Inspect the wearing degree of the carbon brush; if the carbon brush is worn too much, replace it. If not replaced and cleaned, the contact face between the motor's rotor and carbon brush is easy to damage, and the motor needs to be replaced at that time.
4. The carbon brush is close to its limit between about 100,000~150,000km. If the vehicle usually runs in a short distance and needs starting frequently, the motor shall be maintained at a mileage below 80,000km; if the vehicle usually runs in a long distance and needs starting infrequently, the motor can be maintained at a mileage above 80,000km.
5. Frequent maintenance and lubrication of the motor will not increase load and electric current, and the motor is not easy to damage.

18B

Testing & Adjustment

Ignition Switch

Inspect the continuity of various stages of the ignition switch by a multimeter.

Auxiliary Starting Switch

Inspect the continuity of various stages of the auxiliary starting switch by a multimeter.

Starter

Test the starting current, and measure the resistance of the starter cable.

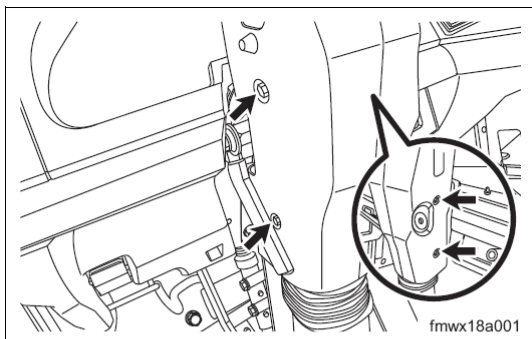
Heater

Test the conduction between the intake preheater and power supply, and between the intake preheater and grounding cable. Measure the resistance of the intake preheater.

Ignition Switch

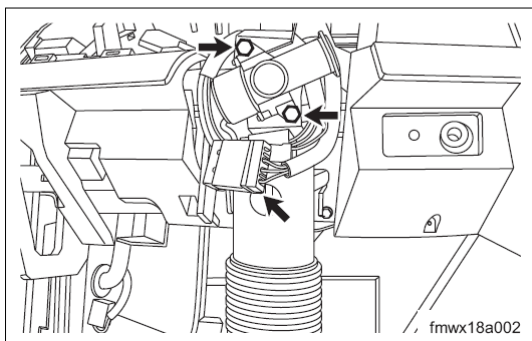
Replacement

1. Turn off the main power



2. Dismantle the ignition switch

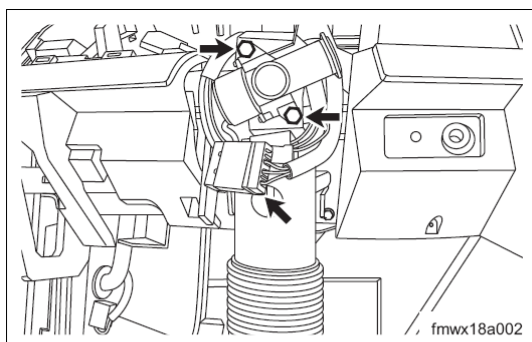
(a). Dismantle the trim panel of the steering column.



(b). Dismantle the ignition switch

- Disconnect the wiring harness of the ignition switch.
- Dismantle the fixing bolts of the ignition switch.

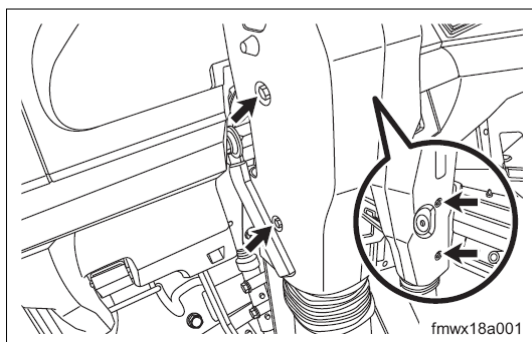
3. Inspect the ignition switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



4. Install the ignition switch

- Install the fixing bolts of the ignition switch.
- Torque: 25N.m**
- Connect the wiring harness of the ignition switch.

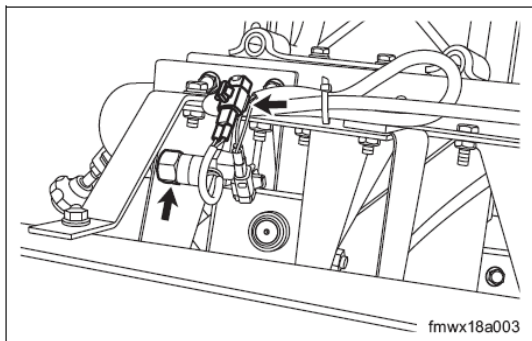
(a). Install the trim panel of the steering column.



Auxiliary Starting Switch

Replacement

1. Turn off the main power

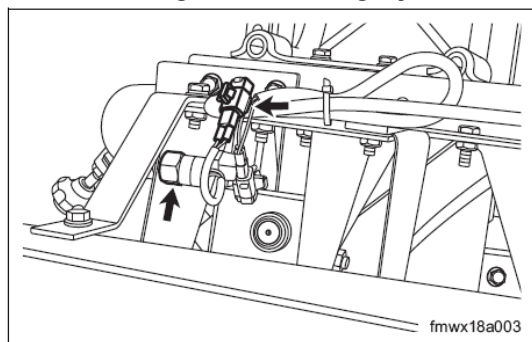


2. Dismantle the auxiliary starting switch

- (a). Disconnect the wiring harness of the auxiliary starting switch.
- (b). Dismantle the auxiliary starting switch

18B

3. Inspect the auxiliary starting switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



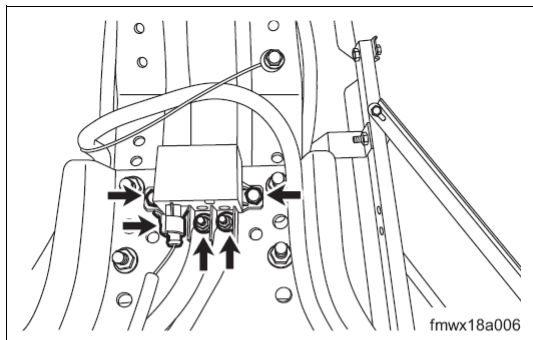
4. Install the auxiliary starting switch

- (a). Install the auxiliary starting switch.
- (b). Connect the wiring harness of the auxiliary starting switch.

Preheating Relay

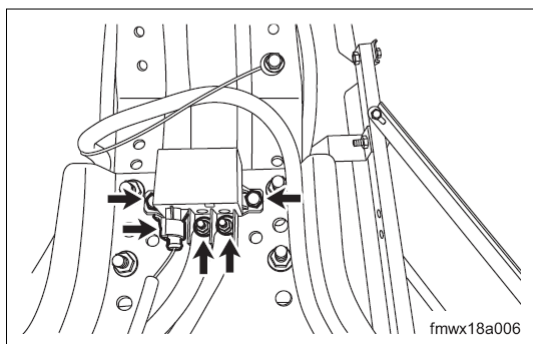
Replacement

1. Turn off the main power



2. Dismantle the preheating relay

- (a). Disconnect the wiring harness of the preheating relay.
- (b). Dismantle the fixing bolts of the preheating relay.



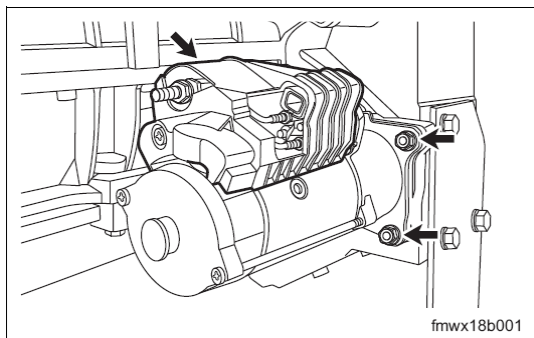
3. Install the preheating relay

- (a). Install the fixing bolts of the preheating relay.
- (b). Connect the wiring harness of the preheating relay.

Starter

Replacement

1. Turn off the main power

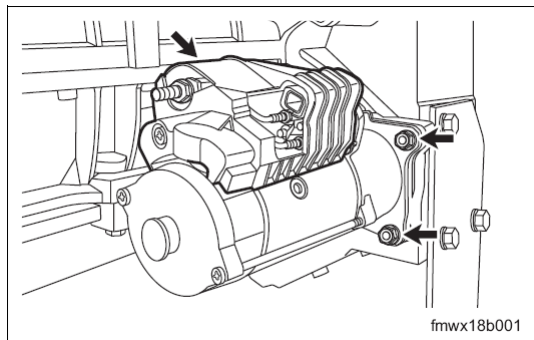


2. Dismantle the starter

- (a). Disconnect the wiring harness of the starter.
- (b). Dismantle the starter.

18B

3. Inspect the starter. Refer to Chapter 18B, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



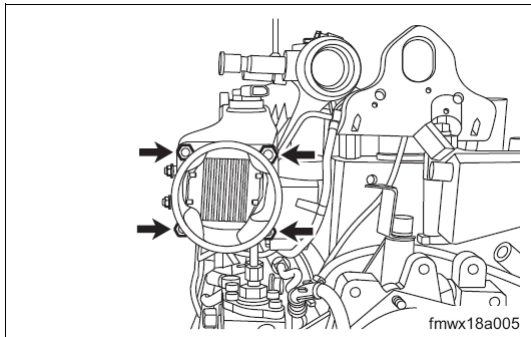
4. Install the starter

- (a). Install the starter.
Torque: 60N.m
- (b). Connect the wiring harness of the starter.

Heater

Replacement

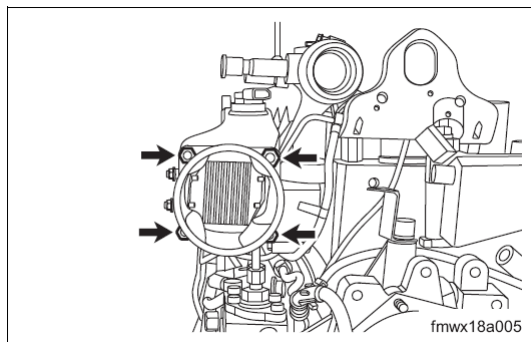
1. Turn off the main power



2. Dismantle the heater

- (a). Disconnect the wiring harness of the heater.
- (b). Dismantle the heater.

3. Inspect the heater. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



4. Install the heater

- (a). Install the heater.
Torque: 25N.m
- (b). Connect the wiring harness of the heater.

Starting & Preheating System (WD615)

Starting & Preheating System	
(WD615)	18C-3
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Testing & Adjustment.....	18C-5
Ignition Switch	18C-6
Replacement	18C-6
Auxiliary Starting Switch	18C-7
Replacement	18C-7
Preheating Relay	18C-8
Replacement	18C-8
Starter	18C-9
Replacement	18C-9
Heater	18C-10
Replacement	18C-10

18C

18C

Starting & Preheating System

General

Starter

The starting torque is the moment necessary to overcome the resistance from air compression in the cylinder and the resistance from friction between the relatively moving parts of the engine itself and its accessories when the engine is started.

The starting speed is the crankshaft speed necessary to start the engine successfully. For the starting of the diesel engine for automobile, in order to prevent the cylinder from leaking air and too much heat from dispersing, ensure that there is enough pressure and temperature in the cylinder at the end of the compression, and also ensure that the fuel injection pump can establish sufficient fuel injection pressure to form sufficiently strong air eddy in the cylinder, it requires very high starting speed, which can reach 150~300r/min. Or diesel spray is poor, the quality of gas mixture is bad, the engine is difficult to start. In addition, the compression ratio of the diesel engine is larger than that of the gasoline engine, so the starting torque for the diesel engine is greater, and the power of the starter necessary to start the diesel engine is bigger than that necessary to start the gasoline engine.

The DC starter consists of a DC series motor, a control mechanism and an engaging/disengaging mechanism. It is special for engine starting and needs powerful torque, so a large amount of current will pass through it, which is up to several hundred amperes.

The DC motor is suitable for the starter as its torque is big at low speed, and gets smaller gradually with the speed increasing.

The starter adopts the DC series motor, and its rotor and stator parts are made of thick copper wires with rectangular cross section by winding; the driving mechanism is of a reduction gear structure; and the control mechanism is based on a manner of electromagnetic attraction.

The driving gear of the reduction gear mechanism is linked with the engine flywheel to start the engine in a manner of one-way driving. When the speed of the pinion on the motor is higher than that of the ring gear of the engine flywheel, the motor drives the engine to rotate; when the engine's speed is higher than the motor's, the power transmission relation between them automatically disappears.

The gear-reduction starter is mainly composed of electromagnetically engaged switch, reduction gear, motor, starting gear (pinion) and overrunning clutch.

Intake Preheater

In order to improve the engine's starting performance, an intake preheater is installed on the intake duct of the engine. It is energized when the intake temperature or the temperature of cooling water is lower than a certain value, and heats air in the air pipe, which is favorable for starting of the engine and combustion of gas mixture. Generally, the intake preheater is composed of an electric gas mixture preheater, an intake preheating temperature control switch, an intake preheating relay, etc.

Middle and low-power diesel engines are usually equipped with intake preheaters for cold start. When the engine is started, after the preheater switch is turned on, heating wires are energized, get hot and heat the valve body. The valve body extends when heated and forces the valve core to move down, and its tapered end goes away from the fuel feed hole. Fuel flows into the inner chamber of the valve body and is vaporized due to heating, the fuel vapor is injected from the inner chamber of the valve body and ignited by the hot heating wires, and the flame is injected into the intake pipe to preheat intake air. When the preheater switch is turned off, the power of heating wires are cut off, the valve body gets cold and shrinks, the valve core moves up to force the tapered end to block the fuel feed hole, the flame goes out, and preheating is stopped.

Precautions

1. The operating time of the starter shall not exceed 5 seconds. If the vehicle needs starting many times, there must be an interval of at least 10 seconds between every two operations.
2. The first maintenance for the motor is between 50,000~80,000km. Remove dirt inside, and re-fill lubricating oil.
3. The second maintenance is between 40,000~50,000km. Inspect the wearing degree of the carbon brush; if the carbon brush is worn too much, replace it. If not replaced and cleaned, the contact face between the motor's rotor and carbon brush is easy to damage, and the motor needs to be replaced at that time.
4. The carbon brush is close to its limit between about 100,000~150,000km. If the vehicle usually runs in a short distance and needs starting frequently, the motor shall be maintained at a mileage below 80,000km; if the vehicle usually runs in a long distance and needs starting infrequently, the motor can be maintained at a mileage above 80,000km.
5. Frequent maintenance and lubrication of the motor will not increase load and electric current, and the motor is not easy to damage.

18C

Testing & Adjustment

Ignition Switch

Inspect the continuity of various stages of the ignition switch by a multimeter.

Auxiliary Starting Switch

Inspect the continuity of various stages of the auxiliary starting switch by a multimeter.

Starter

Test the starting current, and measure the resistance of the starter cable.

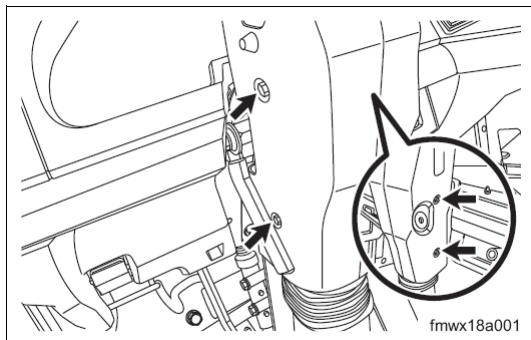
Heater

Test the conduction between the intake preheater and power supply, and between the intake preheater and grounding cable. Measure the resistance of the intake preheater.

Ignition Switch

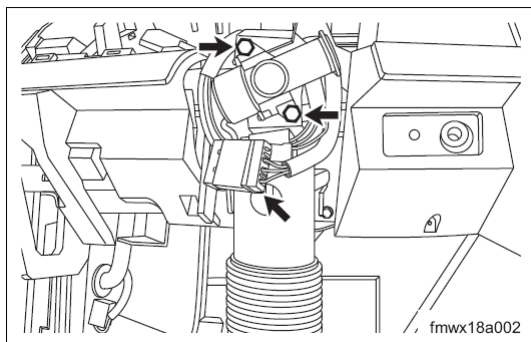
Replacement

1. Turn off the main power



2. Dismantle the ignition switch

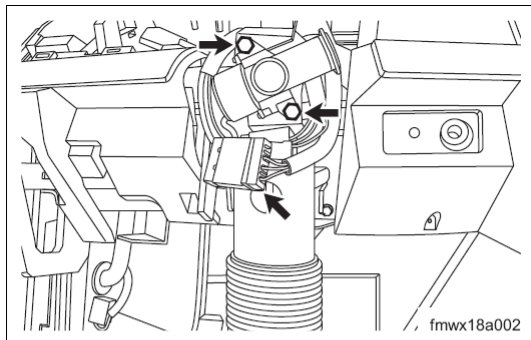
(a). Dismantle the trim panel of the steering column.



(b). Dismantle the ignition switch

- Disconnect the wiring harness of the ignition switch.
- Dismantle the fixing bolts of the ignition switch.

3. Inspect the ignition switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



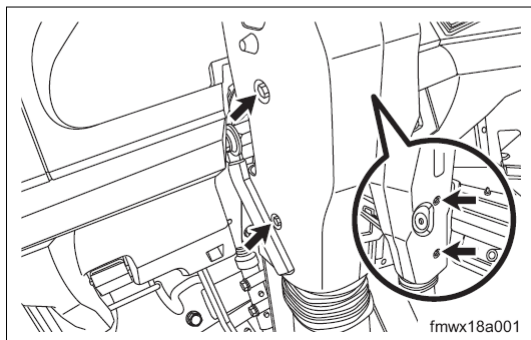
4. Install the ignition switch

- Install the fixing bolts of the ignition switch.

Torque: 25N.m

- Connect the wiring harness of the ignition switch.

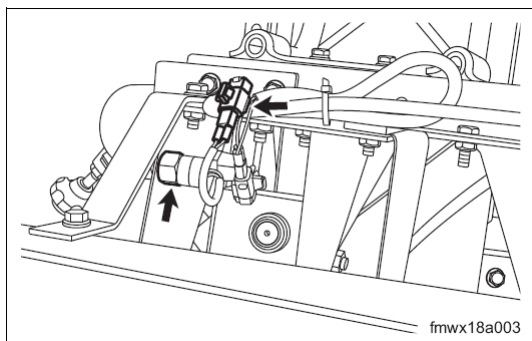
(a). Install the trim panel of the steering column.



Auxiliary Starting Switch

Replacement

1. Turn off the main power

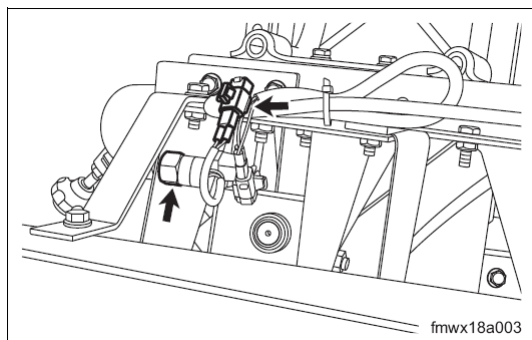


2. Dismantle the auxiliary starting switch

- (a). Disconnect the wiring harness of the auxiliary starting switch.
- (b). Dismantle the auxiliary starting switch

18C

3. Inspect the auxiliary starting switch. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



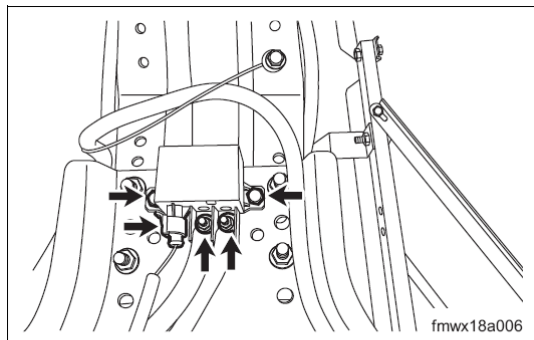
4. Install the auxiliary starting switch

- (a). Install the auxiliary starting switch.
- (b). Connect the wiring harness of the auxiliary starting switch.

Preheating Relay

Replacement

1. Turn off the main power

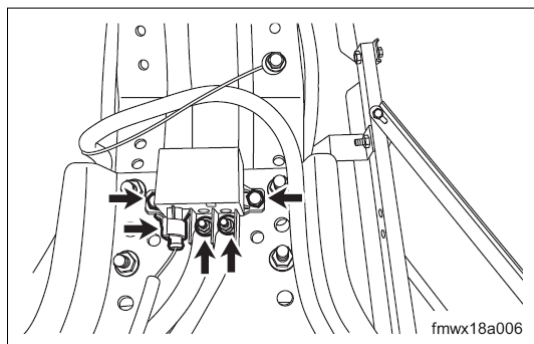


2. Dismantle the preheating relay

- (a). Disconnect the wiring harness of the preheating relay.
- (b). Dismantle the fixing bolts of the preheating relay.

3. Install the preheating relay

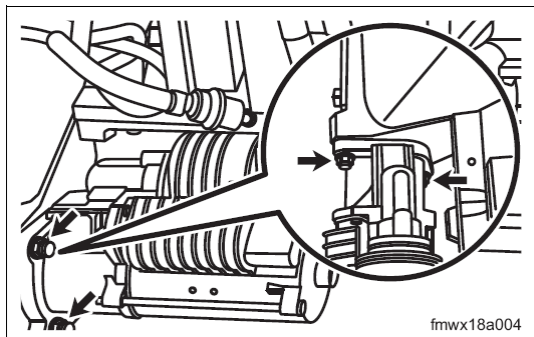
- (a). Install the fixing bolts of the preheating relay.
- (b). Connect the wiring harness of the preheating relay.



Starter

Replacement

1. Turn off the main power

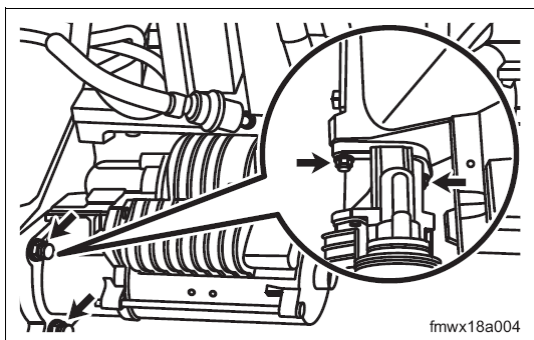


2. Dismantle the starter

- (a). Disconnect the wiring harness of the starter.
- (b). Dismantle the starter.

18C

3. Inspect the starter. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



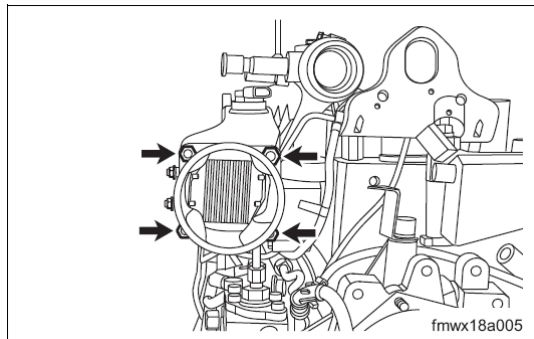
4. Install the starter

- (a). Install the starter.
Torque: 60N.m
- (b). Connect the wiring harness of the starter.

Heater

Replacement

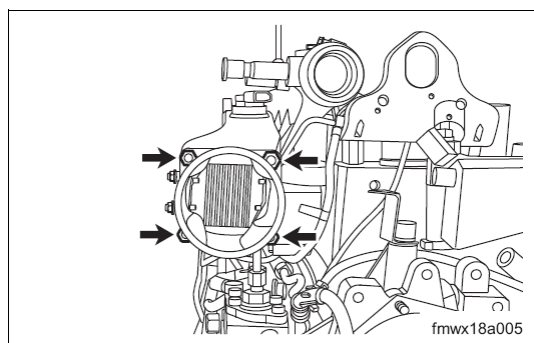
1. Turn off the main power



2. Dismantle the heater

- (a). Disconnect the wiring harness of the heater.
- (b). Dismantle the heater.

3. Inspect the heater. Refer to Chapter 18A, Starting & Preheating System – Starting & Preheating System, Testing & Adjustment.



4. Install the heater

- (a). Install the heater.
Torque: 25N.m
- (b). Connect the wiring harness of the heater.

18C

Charging System (WP10)

Charging System.....	19A-3
General	19A-3
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Principle of Operation.....	19A-6
Testing & Adjustment	19A-8
Generator	19A-10
Overhaul.....	19A-10

19A

Charging System

General

The generator is the main power supply of a vehicle. Its function lies in that it supplies power to all electrical equipment (starter not included), and charges the battery at the same time when the engine is operating normally.

Currently, all the vehicles adopt a three-phase AC generator, and its inside is provided with a diode rectifier circuit which can rectify alternating current into direct current. Therefore, the direct current can be output from the AC generator of a vehicle. The AC generator must be equipped with a voltage regulator, which can control the output voltage of the generator and keep it basically constant to meet the demands of the vehicle's electrical equipment.

Rotor

The function of a rotor is to generate magnetic field.

The rotor consists of claw poles, a yoke, a field winding, slip rings, a rotor shaft, etc.

Two claw poles, which are processed into a beak shape, are press-installed on the rotor shaft, and the field winding and yoke are installed in the cavities of the claw poles.

The slip rings, made of copper rings which are insulated with each other, are press-installed on and insulated with the rotor shaft, and they are respectively connected with both ends of the field winding.

When the slip rings are supplied with direct current, current passes through the field winding, and axial flux is generated accordingly to magnetize one claw pole into N pole and the other one into S pole, so that six pairs (or eight pairs) of staggered magnetic poles are formed.

Stator

The function of a stator is to generate alternating current.

The stator is installed outside the stator, and fixed with the front and rear end covers of the generator. When the rotor rotates inside, the flux in the stator winding changes, and alternate induced electromotive force is generated in the stator winding.

The stator consists of a stator core and a stator winding (coil).

The stator core is formed by stacking silicon steel sheets which have grooves in the inner ring and are insulated with each other.

The stator winding includes three groups of coils, which are symmetrically embedded in the grooves of the stator core. The three-phase winding can be connected with two methods (star connection and delta connection), both of which can generate three-phase alternating current.

Rectifier

The function of a rectifier is to convert the three-phase alternating current of the stator winding into direct current.

The rectifier consists of current plates and rectifier diodes. The rectifier of the six-diode AC generator is formed by that six diodes are respectively press-installed (or welded) on two mutually insulated plates. The two plates includes one positive plate (with output end bolts) and one negative plate, the latter is directly connected (grounded) with the generator housing, and the rear cover of the generator can be directly used as the negative plate.

The six rectifier diodes fall into positive diodes and negative diodes. The diodes leading out the positive pole are called positive diodes, and three positive diodes are installed on the same plate which is called positive plate; the diodes leading out the negative pole are called negative diodes, and three negative diodes are installed on the negative plate or directly on the rear cover.

End Cover and Brush Assembly

Generally, the end cover is divided into two parts (front end cover and rear end cover), used for supporting the rotor, stator, rectifier and brush assembly. The end cover is usually cast by aluminum alloy which can effectively prevent magnetic leakage and has good heat dispersion. The brush assembly is installed on the rear end cover.

The brush assembly consists of brushes, brush carriers and brush springs.

The function of the brush is to introduce power into the field winding through slip rings. Two brushes are respectively installed in the holes of the brush carriers, and they keep in contact with the slip rings through the pressure from springs.

The contact between the brushes and slip rings shall be in good condition, or the power generated by the generator will be insufficient due to too small field current.

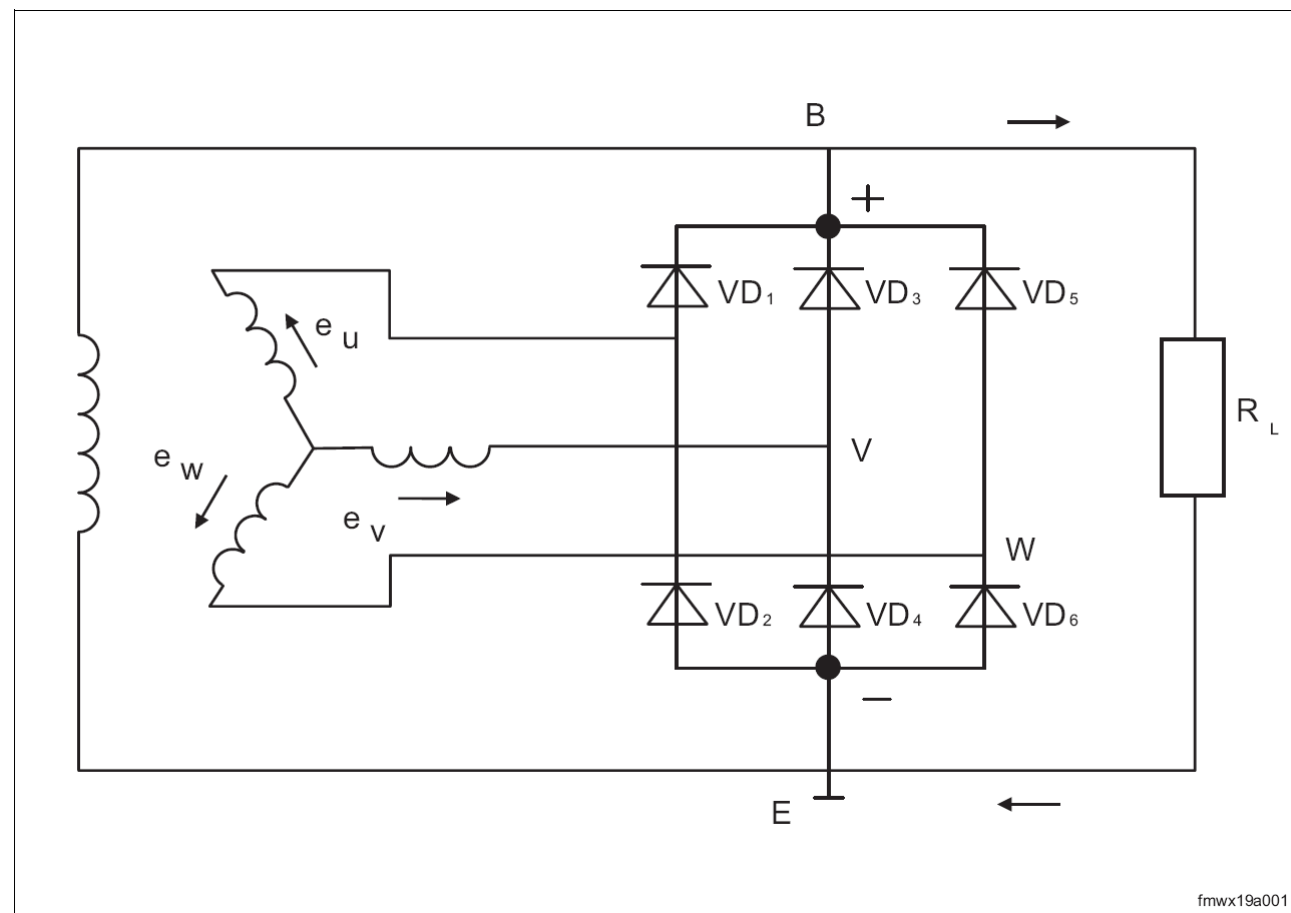
Precautions

The AC generator and regulator have a simple structure and are easy to maintain. If they are used correctly, there will be little faults and their service life will be long; if used incorrectly, they will be damaged soon. Therefore, the following points shall be noted in use and maintenance:

1. **The battery's pole to be grounded must be negative pole. Do not connect inversely. Or the electronic components of the generator or regulator will be burnt.**
2. **The connection between the generator and battery shall be secure. If they are disconnected suddenly, over-voltage will be generated to damage the electronic components of the generator or regulator.**
3. **When the generator is operating, do not use the method of sparking to inspect whether the generator generates power, or the rectifier diodes will be burnt.**
4. **Once detecting that there is a fault in the AC generator or regulator, overhaul the defective part immediately and eliminate the fault in time. Or the fault will result in more serious faults or the lack of electricity of the battery, and thus the vehicle can not move.**
5. **When the regulator is matched for the AC generator, the voltage grade of the AC generator must be the same with that of the regulator, the grounding type of the generator must be the same with that of the regulator, and the power of the regulator shall not be lower than that of the generator. Or the system can not operate normally.**
6. **The line connection must be correct. At present, the installation positions and connection modes of the regulators for various models are different. Pay special attention during connection.**
7. **The regulator must be under the control of the ignition switch. When the generator stops, turn off the ignition switch. Or the field circuit of the generator will always stay in on-state, which will not only burn the field coil, but also cause the lack of electricity of the battery.**
8. **When the generator or regulator needs to be dismantled from the vehicle for overhaul because it is defective, turn off the ignition switch and all electrical equipment at first, and dismantle the negative cable of the battery and then the conductor joint on the generator.**

19A

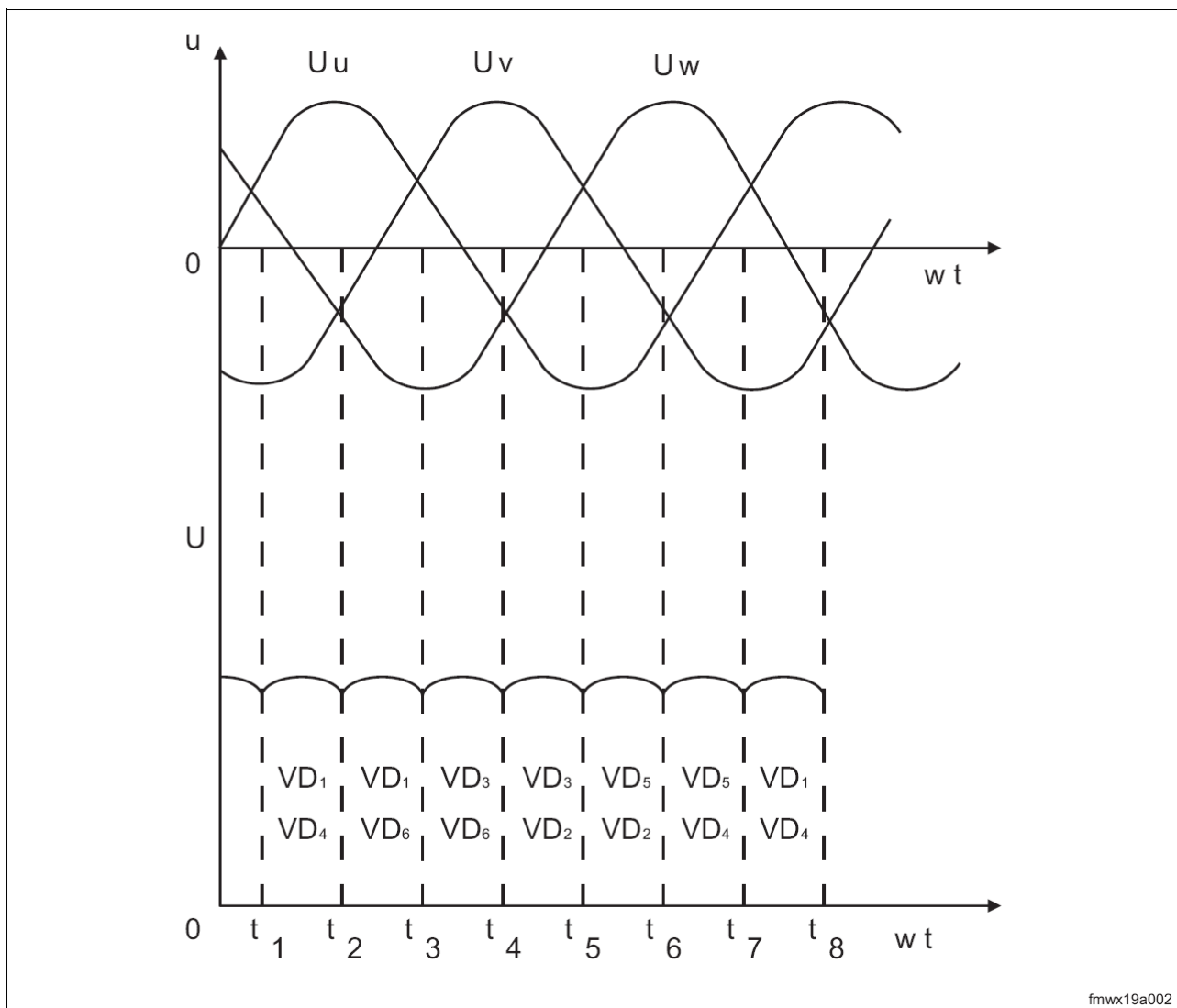
Principle of Operation



Alternating current, which is generated by induction in the three-phase winding of the AC generator's stator, rectified into direct current by the three-phase bridge rectifier circuit, as shown in the diagram.

The diode has one-way continuity. When forward voltage is applied to the diode, the diode conducts; when backward voltage is applied to the diode, the diode picks off.

Charging System (WP10) – Charging System



When the stator's three-phase winding and six rectifier diodes are connected according to the circuit diagram, the output ends B and E of the generator will output a ripple DC voltage, as shown in the diagram. This is the rectification principle.

Testing & Adjustment

Maintenance

1. Inspect the driving belt of the generator.
2. Inspect the connection of conductors.
3. Inspect whether there is noise during operation.
4. Inspect whether the generator generates power normally.
5. Inspect whether there is over-charger for the battery.

Overhaul

1. External Cleaning

- (a) After external cleaning, rotate the rotor of the generator by hand and inspect whether it rotates flexibly and there is noise during rotation so as to judge whether the bearing is defective.

2. Measurement of Whole Machine

- (a) Measure the forward resistance and back resistance (ground end) between the output terminal B and housing of the generator, and compare them with the standard values. If the measured values fail to meet the standard values, it shows that the rectifier is defective.
- (b) Measure the resistance between the positive brush terminal and negative brush of the generator, and compare it with the standard value. If the measured value fails to meet the standard value, it shows that the brush and field winding are defective.

No-load Test

1. Install the generator on the fixture of the test bed, select the sleeve and rubber drive joint, adjust the fixture in a position where the test generator is concentric with the spindle of the adjustable speed motor.
2. Inspect whether the connection is correct, and if there is no problem. The adjustable speed motor on the test bed can be started only after making sure that there is no problem in connection.
3. Start the adjustable speed motor on the test bed, and use the battery (or power supply on the test bed) to supply field current to the generator. Increase the speed of the generator step by step. When the speed is up to 500 ~ 800 r/min, cut off the external power supply which supplies field current to the generator. The generator shall be able to start self-exciting power generation.
4. Increase the speed continuously, and observe the reading of the voltmeter at the same time.
 - When the voltage is up to the rated voltage, record the speed of the generator. Turn off the adjustable speed motor switch, and the no-load test ends.
5. Analyze the no-load test data.
 - Compare it with the standard value. If the speed is higher than the no-load speed, it shows that the generator is defective, and the generator shall be disassembled and tested. If it is unsure that the generator is defective, continue to do the load test.

Load Test

1. Adjust the rheostat to the maximum resistance position.
2. Start the adjustable speed motor, and increase the generator's voltage up to the rated value.
3. Keep the voltage unchanged, and meanwhile increase the generator's speed and output current to increase the speed up to the rated value. Record the output current value at the moment. Turn off the adjustable speed motor switch, and the no-load test ends.

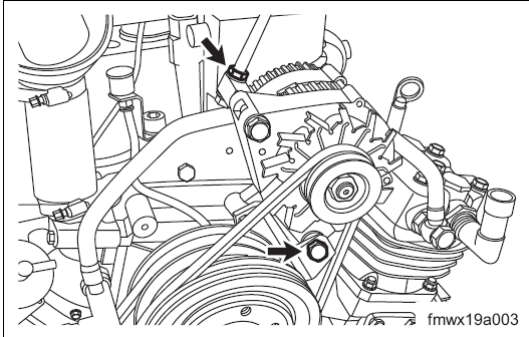
Charging System (WP10) – Charging System

4. **Analyze the load test data.**
 - Compare it with the standard value. If the output current reaches the rated current, it shows that the generator is in good condition; if not, it shows that the generator is defective, and the generator shall be disassembled and tested.

Generator

Overhaul

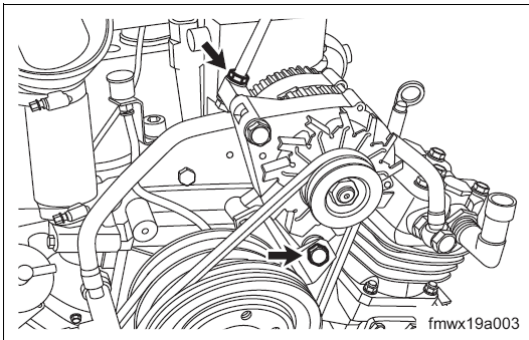
1. Turn off the main power



2. Dismantle the generator

- (a) Disconnect the wiring harness of the generator.
- (b) Loosen the tension nuts of the generator, and dismantle the belt.
- (c) Dismantle the fixing bolts of the generator.

3. Inspect the generator. Refer to Chapter 19A, Charging System – Charging System, Testing & Adjustment.



4. Install the generator

- (a) Install the fixing bolts of the generator.
- Torque: 60 N.m**
- (b) Install the tension nuts of the generator, and install the belt.
 - (c) Connect the wiring harness of the generator.

Charging System (WP12)

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19B

Charging System

General

The generator is the main power supply of a vehicle. Its function lies in that it supplies power to all electrical equipment (starter not included), and charges the battery at the same time when the engine is operating normally.

Currently, all the vehicles adopt a three-phase AC generator, and its inside is provided with a diode rectifier circuit which can rectify alternating current into direct current. Therefore, the direct current can be output from the AC generator of a vehicle. The AC generator must be equipped with a voltage regulator, which can control the output voltage of the generator and keep it basically constant to meet the demands of the vehicle's electrical equipment.

Rotor

The function of a rotor is to generate magnetic field.

The rotor consists of claw poles, a yoke, a field winding, slip rings, a rotor shaft, etc.

Two claw poles, which are processed into a beak shape, are press-installed on the rotor shaft, and the field winding and yoke are installed in the cavities of the claw poles.

The slip rings, made of copper rings which are insulated with each other, are press-installed on and insulated with the rotor shaft, and they are respectively connected with both ends of the field winding.

When the slip rings are supplied with direct current, current passes through the field winding, and axial flux is generated accordingly to magnetize one claw pole into N pole and the other one into S pole, so that six pairs (or eight pairs) of staggered magnetic poles are formed.

Stator

The function of a stator is to generate alternating current.

The stator is installed outside the stator, and fixed with the front and rear end covers of the generator. When the rotor rotates inside, the flux in the stator winding changes, and alternate induced electromotive force is generated in the stator winding.

The stator consists of a stator core and a stator winding (coil).

The stator core is formed by stacking silicon steel sheets which have grooves in the inner ring and are insulated with each other.

The stator winding includes three groups of coils, which are symmetrically embedded in the grooves of the stator core. The three-phase winding can be connected with two methods (star connection and delta connection), both of which can generate three-phase alternating current.

Rectifier

The function of a rectifier is to convert the three-phase alternating current of the stator winding into direct current.

The rectifier consists of current plates and rectifier diodes. The rectifier of the six-diode AC generator is formed by that six diodes are respectively press-installed (or welded) on two mutually insulated plates. The two plates includes one positive plate (with output end bolts) and one negative plate, the latter is directly connected (grounded) with the generator housing, and the rear cover of the generator can be directly used as the negative plate.

The six rectifier diodes fall into positive diodes and negative diodes. The diodes leading out the positive pole are called positive diodes, and three positive diodes are installed on the same plate which is called positive plate; the diodes leading out the negative pole are called negative diodes, and three negative diodes are installed on the negative plate or directly on the rear cover.

End Cover and Brush Assembly

Generally, the end cover is divided into two parts (front end cover and rear end cover), used for supporting the rotor, stator, rectifier and brush assembly. The end cover is usually cast by aluminum alloy which can effectively prevent magnetic leakage and has good heat dispersion. The brush assembly is installed on the rear end cover.

The brush assembly consists of brushes, brush carriers and brush springs.

The function of the brush is to introduce power into the field winding through slip rings. Two brushes are respectively installed in the holes of the brush carriers, and they keep in contact with the slip rings through the pressure from springs.

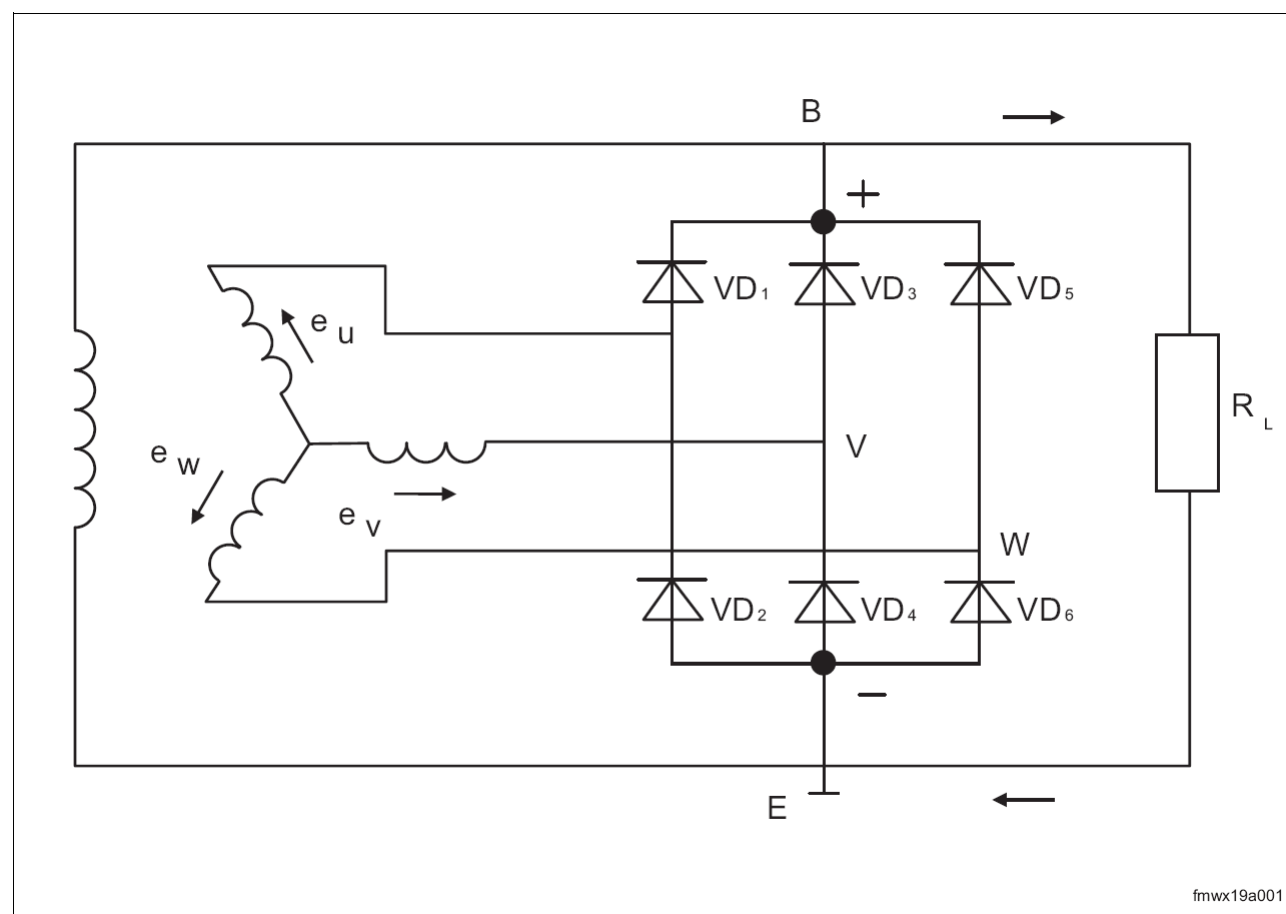
The contact between the brushes and slip rings shall be in good condition, or the power generated by the generator will be insufficient due to too small field current.

Precautions

The AC generator and regulator have a simple structure and are easy to maintain. If they are used correctly, there will be little faults and their service life will be long; if used incorrectly, they will be damaged soon. Therefore, the following points shall be noted in use and maintenance:

1. **The battery's pole to be grounded must be negative pole. Do not connect inversely. Or the electronic components of the generator or regulator will be burnt.**
2. **The connection between the generator and battery shall be secure. If they are disconnected suddenly, over-voltage will be generated to damage the electronic components of the generator or regulator.**
3. **When the generator is operating, do not use the method of sparking to inspect whether the generator generates power, or the rectifier diodes will be burnt.**
4. **Once detecting that there is a fault in the AC generator or regulator, overhaul the defective part immediately and eliminate the fault in time. Or the fault will result in more serious faults or the lack of electricity of the battery, and thus the vehicle can not move.**
5. **When the regulator is matched for the AC generator, the voltage grade of the AC generator must be the same with that of the regulator, the grounding type of the generator must be the same with that of the regulator, and the power of the regulator shall not be lower than that of the generator. Or the system can not operate normally.**
6. **The line connection must be correct. At present, the installation positions and connection modes of the regulators for various models are different. Pay special attention during connection.**
7. **The regulator must be under the control of the ignition switch. When the generator stops, turn off the ignition switch. Or the field circuit of the generator will always stay in on-state, which will not only burn the field coil, but also cause the lack of electricity of the battery.**
8. **When the generator or regulator needs to be dismantled from the vehicle for overhaul because it is defective, turn off the ignition switch and all electrical equipment at first, and dismantle the negative cable of the battery and then the conductor joint on the generator.**

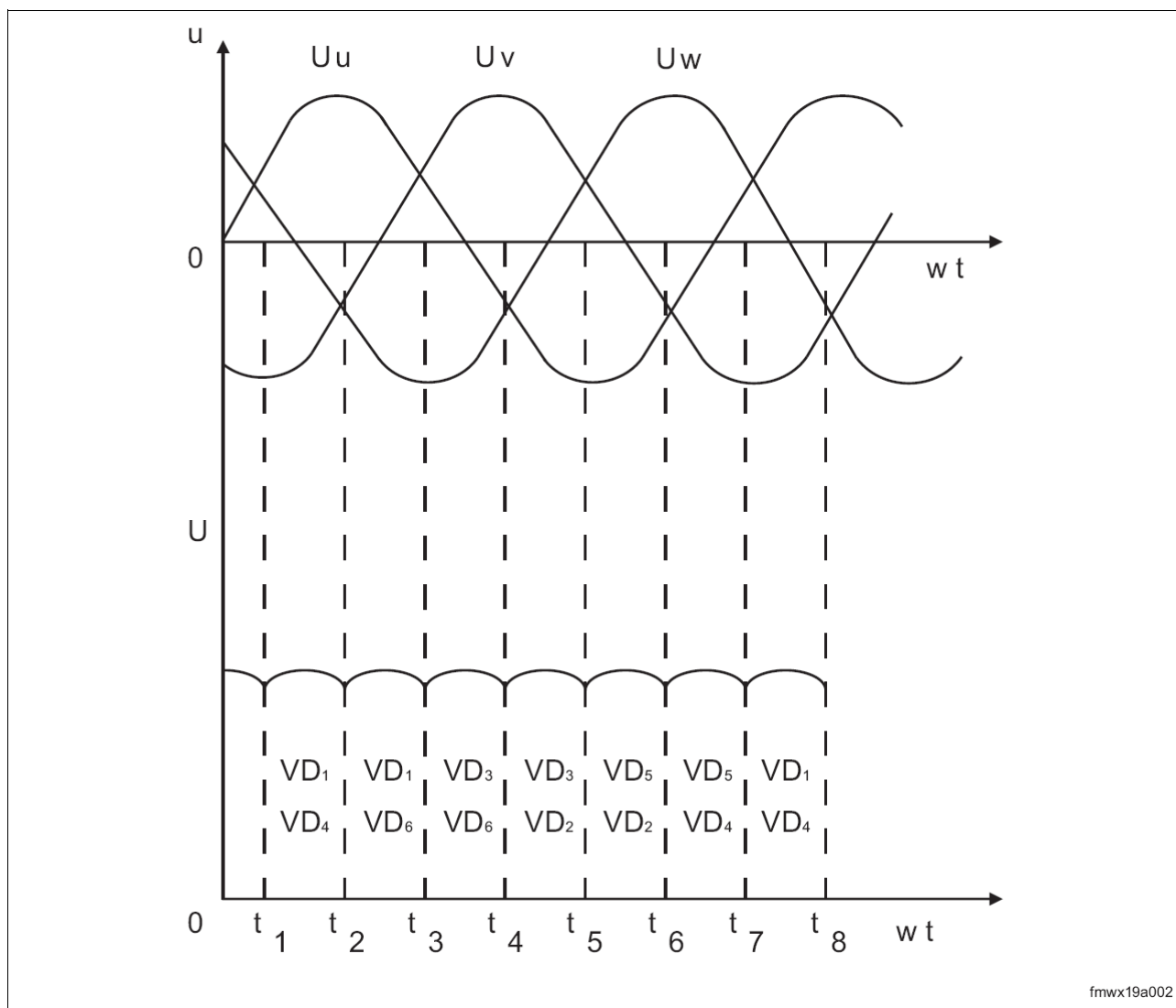
Principle of Operation



Alternating current, which is generated by induction in the three-phase winding of the AC generator's stator, rectified into direct current by the three-phase bridge rectifier circuit, as shown in the diagram.

The diode has one-way continuity. When forward voltage is applied to the diode, the diode conducts; when backward voltage is applied to the diode, the diode picks off.

Charging System (WP12) – Charging System



19B

When the stator's three-phase winding and six rectifier diodes are connected according to the circuit diagram, the output ends B and E of the generator will output a ripple DC voltage, as shown in the diagram. This is the rectification principle.

Testing & Adjustment

Maintenance

1. Inspect the driving belt of the generator.
2. Inspect the connection of conductors.
3. Inspect whether there is noise during operation.
4. Inspect whether the generator generates power normally.
5. Inspect whether there is over-charger for the battery.

Overhaul

1. External Cleaning

- (a) After external cleaning, rotate the rotor of the generator by hand and inspect whether it rotates flexibly and there is noise during rotation so as to judge whether the bearing is defective.

2. Measurement of Whole Machine

- (a) Measure the forward resistance and back resistance (ground end) between the output terminal B and housing of the generator, and compare them with the standard values. If the measured values fail to meet the standard values, it shows that the rectifier is defective.
- (b) Measure the resistance between the positive brush terminal and negative brush of the generator, and compare it with the standard value. If the measured value fails to meet the standard value, it shows that the brush and field winding are defective.

No-load Test

1. Install the generator on the fixture of the test bed, select the sleeve and rubber drive joint, adjust the fixture in a position where the test generator is concentric with the spindle of the adjustable speed motor.
2. Inspect whether the connection is correct, and if there is no problem. The adjustable speed motor on the test bed can be started only after making sure that there is no problem in connection.
3. Start the adjustable speed motor on the test bed, and use the battery (or power supply on the test bed) to supply field current to the generator. Increase the speed of the generator step by step. When the speed is up to 500 ~ 800 r/min, cut off the external power supply which supplies field current to the generator. The generator shall be able to start self-exciting power generation.
4. Increase the speed continuously, and observe the reading of the voltmeter at the same time.
 - When the voltage is up to the rated voltage, record the speed of the generator. Turn off the adjustable speed motor switch, and the no-load test ends.
5. Analyze the no-load test data.
 - Compare it with the standard value. If the speed is higher than the no-load speed, it shows that the generator is defective, and the generator shall be disassembled and tested. If it is unsure that the generator is defective, continue to do the load test.

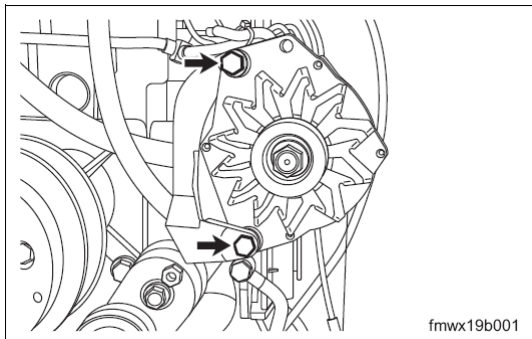
Load Test

1. Adjust the rheostat to the maximum resistance position.
2. Start the adjustable speed motor, and increase the generator's voltage up to the rated value.
3. Keep the voltage unchanged, and meanwhile increase the generator's speed and output current to increase the speed up to the rated value. Record the output current value at the moment. Turn off the adjustable speed motor switch, and the no-load test ends.
4. Analyze the load test data.
 - Compare it with the standard value. If the output current reaches the rated current, it shows that the generator is in good condition; if not, it shows that the generator is defective, and the generator shall be disassembled and tested.

Generator

Overhaul

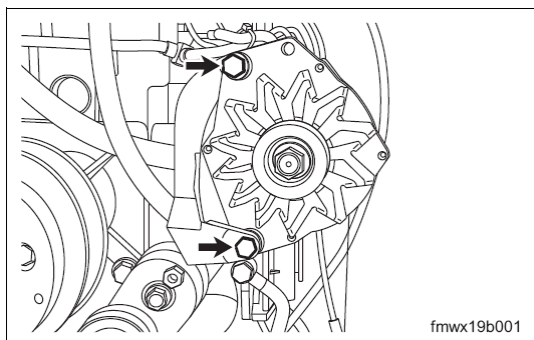
1. Turn off the main power



2. Dismantle the generator

- (a) Dismantle the belt.
- (b) Disconnect the wiring harness of the generator.
- (c) Dismantle the fixing bolts of the generator.

3. Inspect the generator. Refer to Chapter 19A, Charging System – Charging System, Testing & Adjustment.



4. Install the generator

- (a) Install the fixing bolts of the generator.
Torque: 60 N.m
- (b) Install the tension nuts of the generator, and install the belt.
- (c) Connect the wiring harness of the generator.

Charging System (WD615)

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19C

Charging System

General

The generator is the main power supply of a vehicle. Its function lies in that it supplies power to all electrical equipment (starter not included), and charges the battery at the same time when the engine is operating normally.

Currently, all the vehicles adopt a three-phase AC generator, and its inside is provided with a diode rectifier circuit which can rectify alternating current into direct current. Therefore, the direct current can be output from the AC generator of a vehicle. The AC generator must be equipped with a voltage regulator, which can control the output voltage of the generator and keep it basically constant to meet the demands of the vehicle's electrical equipment.

Rotor

The function of a rotor is to generate magnetic field.

The rotor consists of claw poles, a yoke, a field winding, slip rings, a rotor shaft, etc.

Two claw poles, which are processed into a beak shape, are press-installed on the rotor shaft, and the field winding and yoke are installed in the cavities of the claw poles.

The slip rings, made of copper rings which are insulated with each other, are press-installed on and insulated with the rotor shaft, and they are respectively connected with both ends of the field winding.

When the slip rings are supplied with direct current, current passes through the field winding, and axial flux is generated accordingly to magnetize one claw pole into N pole and the other one into S pole, so that six pairs (or eight pairs) of staggered magnetic poles are formed.

Stator

The function of a stator is to generate alternating current.

The stator is installed outside the stator, and fixed with the front and rear end covers of the generator. When the rotor rotates inside, the flux in the stator winding changes, and alternate induced electromotive force is generated in the stator winding.

The stator consists of a stator core and a stator winding (coil).

The stator core is formed by stacking silicon steel sheets which have grooves in the inner ring and are insulated with each other.

The stator winding includes three groups of coils, which are symmetrically embedded in the grooves of the stator core. The three-phase winding can be connected with two methods (star connection and delta connection), both of which can generate three-phase alternating current.

Rectifier

The function of a rectifier is to convert the three-phase alternating current of the stator winding into direct current.

The rectifier consists of current plates and rectifier diodes. The rectifier of the six-diode AC generator is formed by that six diodes are respectively press-installed (or welded) on two mutually insulated plates. The two plates includes one positive plate (with output end bolts) and one negative plate, the latter is directly connected (grounded) with the generator housing, and the rear cover of the generator can be directly used as the negative plate.

The six rectifier diodes fall into positive diodes and negative diodes. The diodes leading out the positive pole are called positive diodes, and three positive diodes are installed on the same plate which is called positive plate; the diodes leading out the negative pole are called negative diodes, and three negative diodes are installed on the negative plate or directly on the rear cover.

End Cover and Brush Assembly

Generally, the end cover is divided into two parts (front end cover and rear end cover), used for supporting the rotor, stator, rectifier and brush assembly. The end cover is usually cast by aluminum alloy which can effectively prevent magnetic leakage and has good heat dispersion. The brush assembly is installed on the rear end cover.

The brush assembly consists of brushes, brush carriers and brush springs.

The function of the brush is to introduce power into the field winding through slip rings. Two brushes are respectively installed in the holes of the brush carriers, and they keep in contact with the slip rings through the pressure from springs.

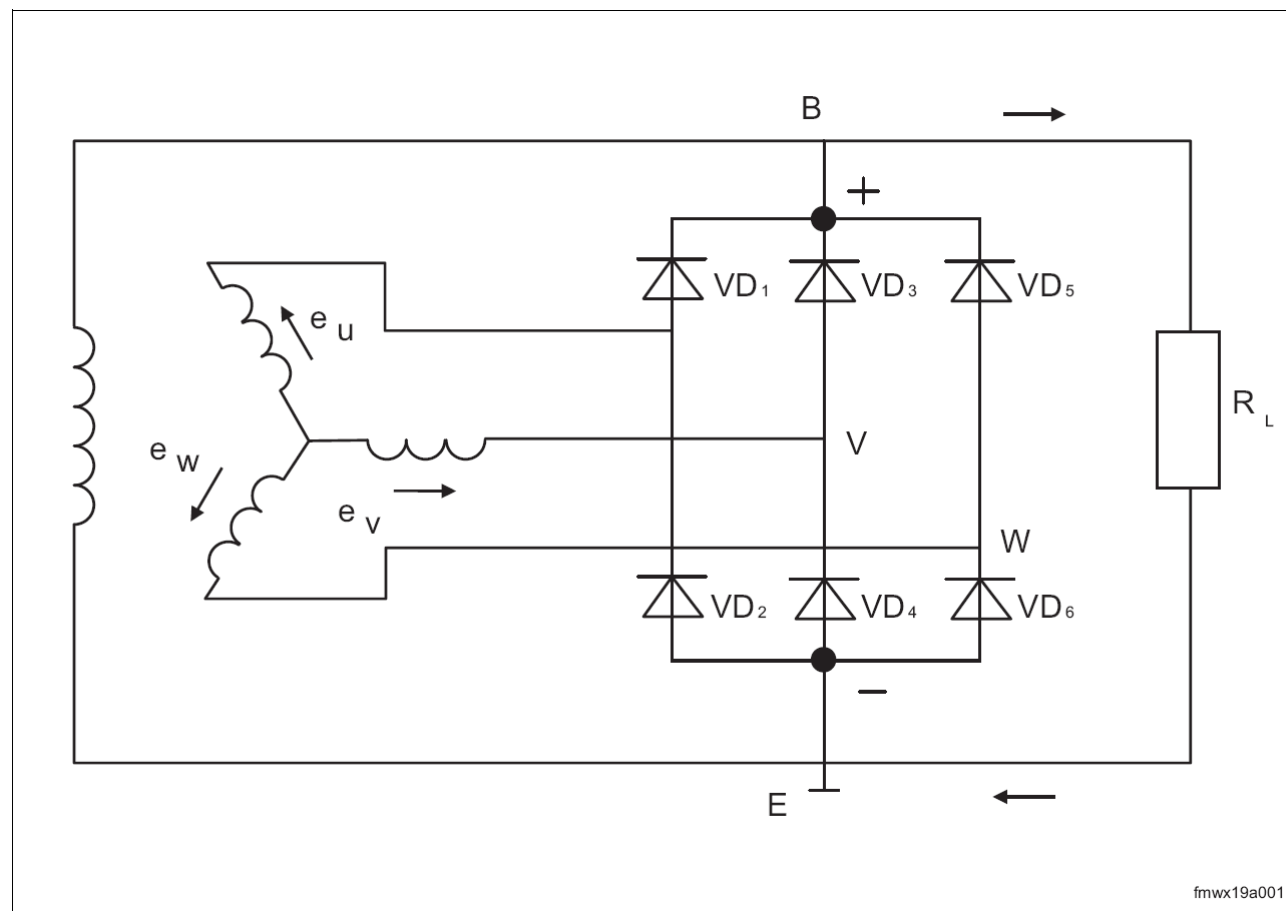
The contact between the brushes and slip rings shall be in good condition, or the power generated by the generator will be insufficient due to too small field current.

Precautions

The AC generator and regulator have a simple structure and are easy to maintain. If they are used correctly, there will be little faults and their service life will be long; if used incorrectly, they will be damaged soon. Therefore, the following points shall be noted in use and maintenance:

1. **The battery's pole to be grounded must be negative pole. Do not connect inversely. Or the electronic components of the generator or regulator will be burnt.**
2. **The connection between the generator and battery shall be secure. If they are disconnected suddenly, over-voltage will be generated to damage the electronic components of the generator or regulator.**
3. **When the generator is operating, do not use the method of sparking to inspect whether the generator generates power, or the rectifier diodes will be burnt.**
4. **Once detecting that there is a fault in the AC generator or regulator, overhaul the defective part immediately and eliminate the fault in time. Or the fault will result in more serious faults or the lack of electricity of the battery, and thus the vehicle can not move.**
5. **When the regulator is matched for the AC generator, the voltage grade of the AC generator must be the same with that of the regulator, the grounding type of the generator must be the same with that of the regulator, and the power of the regulator shall not be lower than that of the generator. Or the system can not operate normally.**
6. **The line connection must be correct. At present, the installation positions and connection modes of the regulators for various models are different. Pay special attention during connection.**
7. **The regulator must be under the control of the ignition switch. When the generator stops, turn off the ignition switch. Or the field circuit of the generator will always stay in on-state, which will not only burn the field coil, but also cause the lack of electricity of the battery.**
8. **When the generator or regulator needs to be dismantled from the vehicle for overhaul because it is defective, turn off the ignition switch and all electrical equipment at first, and dismantle the negative cable of the battery and then the conductor joint on the generator.**

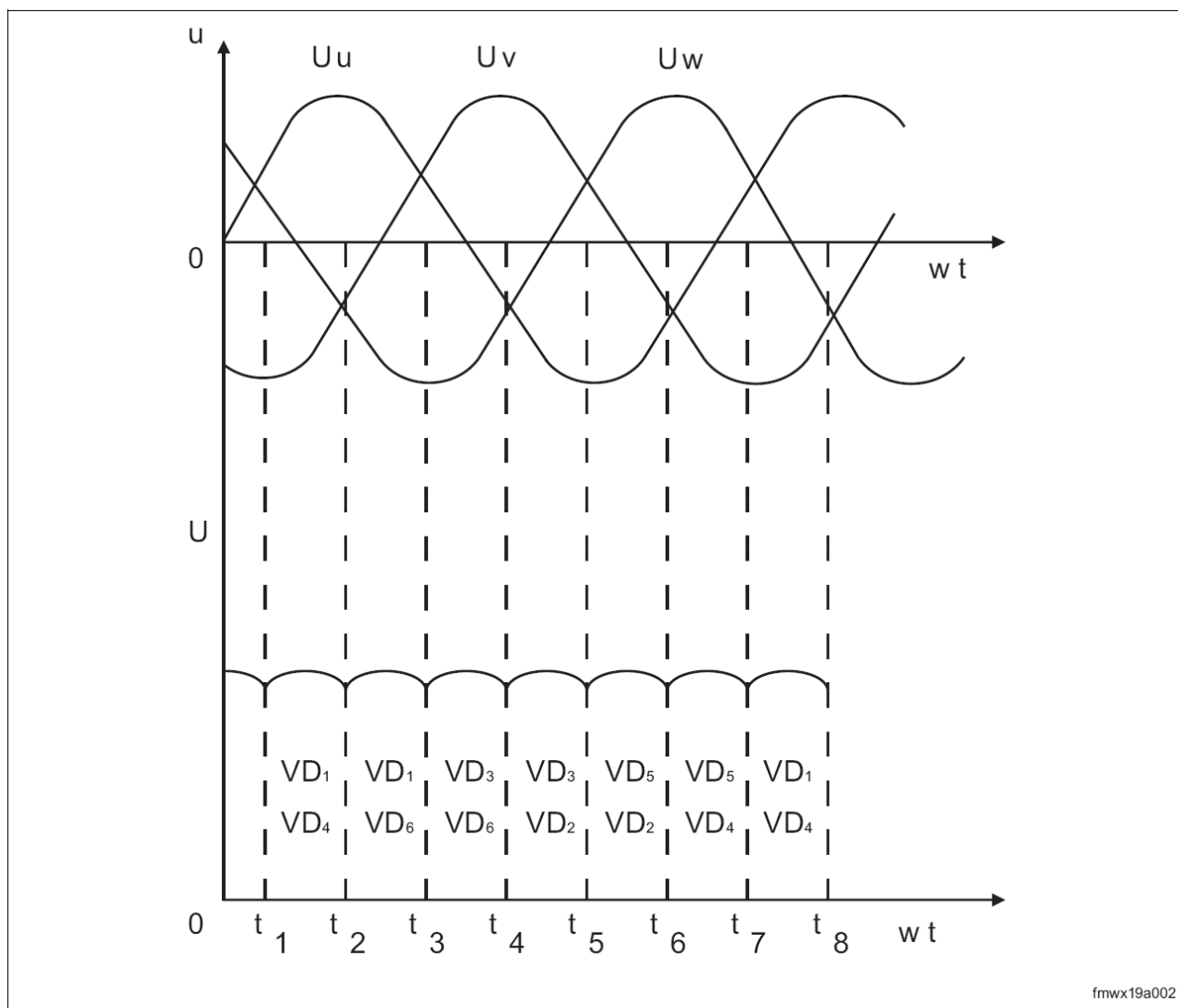
Principle of Operation



Alternating current, which is generated by induction in the three-phase winding of the AC generator's stator, rectified into direct current by the three-phase bridge rectifier circuit, as shown in the diagram.

The diode has one-way continuity. When forward voltage is applied to the diode, the diode conducts; when backward voltage is applied to the diode, the diode picks off.

Charging System (WD615) – Charging System



19C

When the stator's three-phase winding and six rectifier diodes are connected according to the circuit diagram, the output ends B and E of the generator will output a ripple DC voltage, as shown in the diagram. This is the rectification principle.

Testing & Adjustment

Maintenance

1. **Inspect the driving belt of the generator.**
2. **Inspect the connection of conductors.**
3. **Inspect whether there is noise during operation.**
4. **Inspect whether the generator generates power normally.**
5. **Inspect whether there is over-charger for the battery.**

Overhaul

1. **External Cleaning**
 - (a) After external cleaning, rotate the rotor of the generator by hand and inspect whether it rotates flexibly and there is noise during rotation so as to judge whether the bearing is defective.
2. **Measurement of Whole Machine**
 - (a) Measure the forward resistance and back resistance (ground end) between the output terminal B and housing of the generator, and compare them with the standard values. If the measured values fail to meet the standard values, it shows that the rectifier is defective.
 - (b) Measure the resistance between the positive brush terminal and negative brush of the generator, and compare it with the standard value. If the measured value fails to meet the standard value, it shows that the brush and field winding are defective.

No-load Test

1. **Install the generator on the fixture of the test bed, select the sleeve and rubber drive joint, adjust the fixture in a position where the test generator is concentric with the spindle of the adjustable speed motor.**
2. **Inspect whether the connection is correct, and if there is no problem. The adjustable speed motor on the test bed can be started only after making sure that there is no problem in connection.**
3. **Start the adjustable speed motor on the test bed, and use the battery (or power supply on the test bed) to supply field current to the generator. Increase the speed of the generator step by step. When the speed is up to 500 ~ 800 r/min, cut off the external power supply which supplies field current to the generator. The generator shall be able to start self-exciting power generation.**
4. **Increase the speed continuously, and observe the reading of the voltmeter at the same time.**
 - When the voltage is up to the rated voltage, record the speed of the generator. Turn off the adjustable speed motor switch, and the no-load test ends.
5. **Analyze the no-load test data.**
 - Compare it with the standard value. If the speed is higher than the no-load speed, it shows that the generator is defective, and the generator shall be disassembled and tested. If it is unsure that the generator is defective, continue to do the load test.

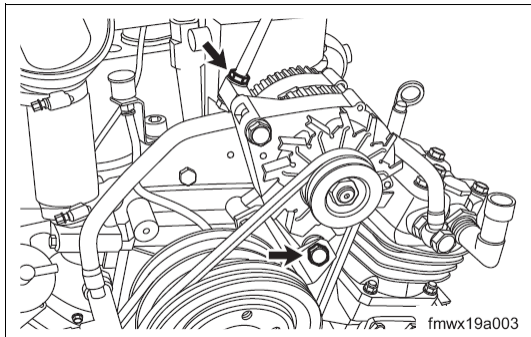
Load Test

1. **Adjust the rheostat to the maximum resistance position.**
2. **Start the adjustable speed motor, and increase the generator's voltage up to the rated value.**
3. **Keep the voltage unchanged, and meanwhile increase the generator's speed and output current to increase the speed up to the rated value. Record the output current value at the moment. Turn off the adjustable speed motor switch, and the no-load test ends.**
4. **Analyze the load test data.**
 - Compare it with the standard value. If the output current reaches the rated current, it shows that the generator is in good condition; if not, it shows that the generator is defective, and the generator shall be disassembled and tested.

Generator

Overhaul

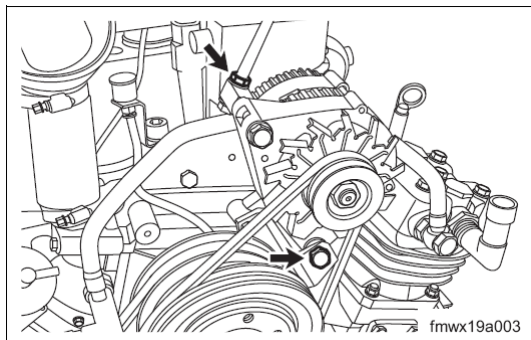
1. Turn off the main power



2. Dismantle the generator

- (a) Disconnect the wiring harness of the generator.
- (b) Loosen the tension nuts of the generator, and dismantle the belt.
- (c) Dismantle the fixing bolts of the generator.

3. Inspect the generator. Refer to Chapter 19A, Charging System – Charging System, Testing & Adjustment.



4. Install the generator

- (a) Install the fixing bolts of the generator.
Torque: 60 N.m
- (b) Install the tension nuts of the generator, and install the belt.
- (c) Connect the wiring harness of the generator.

Front Suspension

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Front Suspension Assembly

General

The vehicle front suspension system is used for farthest increasing the friction between the tire and the pavement, can provide good steering maneuverability and stability, can ensure the comfort of passengers, and can absorb the energy of vertical acceleration wheels to ensure that the wheels pitch along the pavement, and simultaneously, the frame and the body can not be disturbed. The front suspension comprises leaf springs, a shared connecting shaft, a bumper, cushion rubber and a stabilizer bar, wherein the number of the leaf springs is nine, the front ends of the leaf springs are directly connected to a spring bracket through spring pins, and the rear ends of the leaf springs pass through a shackle through shackle pins. The shackle is used for buffering the distance change generated by bending of the leaf springs. The leaf springs are connected to the front shaft through a clamp plate (middle upper part) and a bracket (middle lower part). The bumper and the stabilizer bar are installed between the front shaft and the chassis frame to ensure the driving process to be more comfortable and smooth.

Precautions

1. Precautions of Mounting System in Operation

- (a). When replacing parts, be sure to observe the specifications of the manual and be careful.
- (b). Incorrect operation may affect the performance of the steering system and even endanger the personal safety.
- (c). Strictly operate according to the specifications for the places with special requirements.

System Working Principle

1. Bumper

The bumper controls the undesired spring motion through a damping process. The bumper slows down and weakens the magnitude of the vibratory motion by converting the kinetic energy of mounting motion into the heat energy capable of being dissipated through hydraulic oil. The upper support of the bumper is connected to the frame (namely sprung mass), and the lower support of the bumper is connected to the shaft near the wheels (namely unsprung mass). In double-cylinder design, one of the most common type of the bumper is that the upper support is connected to a piston rod, the piston rod is connected to a piston, and the piston is positioned in a cylinder filled with hydraulic oil. An inner cylinder is named as a pressure cylinder, and an outer cylinder is named as an oil storage cylinder. The oil storage cylinder is used for storing redundant hydraulic oil. When the wheels encounter the bumpy pavement and the springs are compacted and stretched, the energy of the springs is transferred to the bumper through the upper support and is transferred downward to the piston through the piston rod. Holes are perforated on the piston, and when the piston moves up and down in the pressure cylinder, the hydraulic oil can leak through the holes. Because the holes are very small, only a small amount of hydraulic oil can pass through the holes under very large pressure. Thus, the motion speed of the piston is slowed down, thereby slowing down the motion of the springs. The work of the bumper comprises a compression cycle and a stretching cycle. The compression cycle means that when the piston moves downward, the hydraulic oil below the piston is compressed; and the stretching cycle means that when the piston moves upward to the top of the pressure cylinder, the hydraulic oil above the piston is compressed. For a typical vehicle, the resistance of the stretching cycle is larger than the resistance of the compression cycle. In addition, the compression cycle controls the motion of the unsprung mass of the vehicle, but the stretching cycle controls the motion of relatively heavier sprung mass. All modern bumpers have a speed sensing function, wherein the higher the motion speed of the mounting is, the larger the resistance provided by the bumper is. Thus, the bumper can be adjusted according to the road condition and can control all undesired motions which may appear in the driving vehicles, such as bouncing, side-tipping, brake subduction, accelerated crouch, etc.

2. Stabilizer Bar

The stabilizer bar is matched with the bumper to provide additional stability for the driving vehicle. The stabilizer bar is a metal bar which passes across the whole axle and effectively connects the two sides of the mounting together. When the mounting on one wheel moves up and down, the stabilizer bar can transfer the motion to other wheels, thus the driving process is smoother, and the gradient of the vehicle is reduced. The stabilizer bar can especially eliminate the side-tipping trend of the vehicle on the mounting in the steering process.

3. Leaf Springs

The middle parts of the leaf springs are fixed on the axle through U-bolts, and spring eyes at two ends are articulated on the bracket of the frame through pins. Thus, the axle is connected with the body through the leaf springs to perform the functions of buffering, damping and force transmission. All steel plates of multiple leaf springs are superposed into a triangular shape, the steel plate at the uppermost end is longest, the steel plate at the undermost end is shortest, and the number of the steel plates is related to the weight of supporting the vehicle and the damping effect, wherein the more, the thicker and the shorter the steel plates are, the larger the rigidity of the springs is.

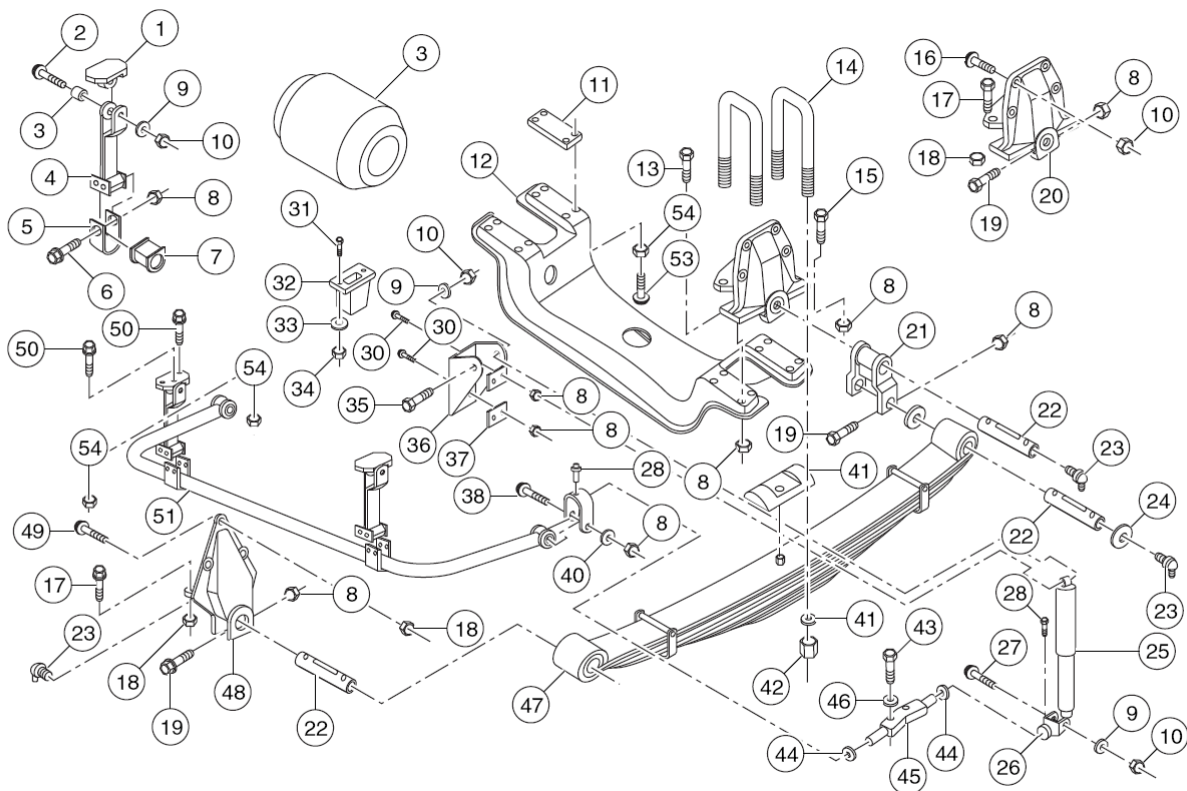
Front Suspension - Front Suspension Assembly

Fault Symptom Table

Use the table below to help you find the malfunction. The serial numbers represent the precedence order of the likelihood of the faults. Check every part in this order, and replace if necessary.

Symptom	Possible Cause	Reference
Sinking of Body	1. Vehicle (over loaded)	Load the vehicle in accordance with carrying capacity
	2. Leaf Spring (weak)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul
	3. Damper (worn)	Chapter 21, Front Suspension - Front Damper, Overhaul
Swing/Inclination	1. Tire (worn or improperly inflated)	Chapter 23, Wheel & Tire - Front Wheel & Tire Assembly, Overhaul Chapter 23, Wheel & Tire - Rear Wheel & Tire Assembly, Overhaul
	2. Wheel (unbalanced)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	3. Damper (worn)	Chapter 21, Front Suspension - Front Damper, Overhaul
	4. Leaf Spring Pin , Sleeve, Lifting Eye (excessively worn)	Chapter 21, Front Suspension - Front Leaf Spring Assembly, Overhaul
	5. U-bolt (loose)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul
	6. Leaf Spring (drop or inconsistent rigidity of elastic force)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul
Oil Leakage o Damper	1. Lubricating Oil (excessive)	Adjust lubricating oil
	2. Sealing Member (failed or damaged)	Replace sealing member
	3. Damper (failed)	Chapter 21, Front Suspension - Front Damper, Overhaul
Noise of Mounting Part	1. Damper (failed)	Chapter 21, Front Suspension - Front Damper, Overhaul
	2. Leaf spring (worn or damaged)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul
	3. Sleeve (worn or damaged)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul
	4. Fastening bolts and nuts, damper and leaf spring assembly (loose or damaged)	Chapter 21, Front Suspension - Front Damper, Overhaul
	5. Wear of stabilizer bar sleeve	Chapter 21, Front Suspension - Front Stabilizer Bar, Overhaul

Part Drawing



fmwx210001

1	Hanger - Front Stabilizer Bar
2	Upper Connecting Bolt
3	Sleeve - Front Stabilizer Bar
4	Hanger - Front Stabilizer Bar
5	U-connecting Plate
6	Hex Bolt - Fine Thread
7	Cushion - Front Stabilizer Bar
8	Self-locking Nut
9	Flat Washer
10	Self-locking Nut
11	Reinforcement Plate
12	Cross Member
13	Hex Bolt - Fine Thread
14	Front U-bolt
15	Hex Bolt - Fine Thread

28	Straight Grease Nipple
29	Pressure Plate - Front Spring
30	Hex Bolt - Fine Thread
31	Hex Bolt
32	Bumper Block Assembly
33	Flat Washer
34	All-metal Hex Lock Nut - Type 2
35	Bolt
36	Damper Bracket
37	Reinforcement Plate
38	Head Connecting Bolt
39	Head Connecting Piece - Stabilizer Bar
40	Flat Washer
41	Spherical Washer
42	Self-locking Nut

Front Suspension - Front Suspension Assembly

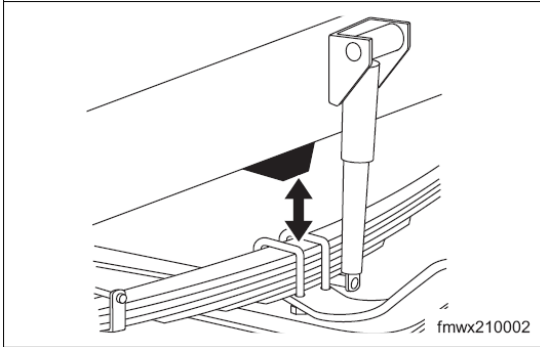
16	Hex Bolt - Fine Thread
1	Hex Bolt - Fine Thread
18	Self-locking Nut
19	Hex Bolt - Fine Thread
20	Rear Bracket - Front Spring
21	Lifting Eye - Front Leaf Spring
22	Pin Shaft - Leaf Spring
23	Bent Grease Nipple
24	Adjusting Gasket
25	Front Damper Assy.
26	Damper Fork
27	Bolt

43	Hex Bolt - Fine Thread
44	Circlip for Shaft
45	Common Connecting Shaft
46	Spring Washer
47	Front Leaf Spring Assy.
48	Front Bracket - Front Spring
49	Hex Bolt - Fine Thread
50	Hex Bolt - Fine Thread
51	Front Stabilizer Bar Assembly
52	Hex Bolt - Fine Thread
53	Spring Washer
54	Hex Nut, Type 1 - Fine Thread

Inspection and Adjustment

1. Vehicle inspection

- (a). Visually check for oil leakage of the damper and cracks of the sleeve.
- (b). Check whether the U-bolt has deformation and cracks and whether threads are damaged, and replace with new parts if necessary.
- (c). The U-bolt shall be fastened by a uniform cross screw-down method, and gradually increase the tightening torque to the specified value. When the vehicle is fully loaded, because the leaf spring is fitted tightly, by this time, screw down the nut of the U-bolt once again. When fastening the nut, prevent the condition that the bolt and nut are rusted and can not compress the leaf spring tightly, and cause the false impression that the torque is large. If necessary, tap again with a screw tap to enable the bolt and nut to be well fitted.



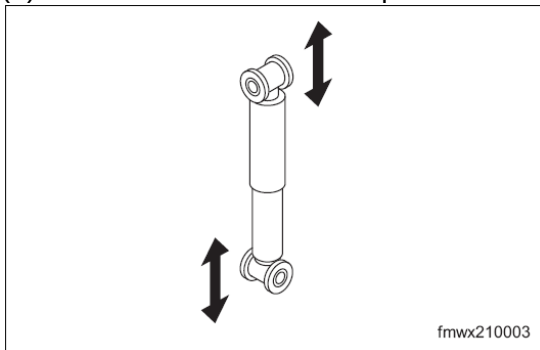
- (d). Measure buffer gap
Standard value: 124 mm
Limit value: 118-130 mm

Caution:

Make the measurement at no load. If the buffer gap is significantly reduced, the leaf spring and the buffer block may be damaged (crack or poor elasticity).

2. Check damper

- (a). Check whether the damper leaks oil.



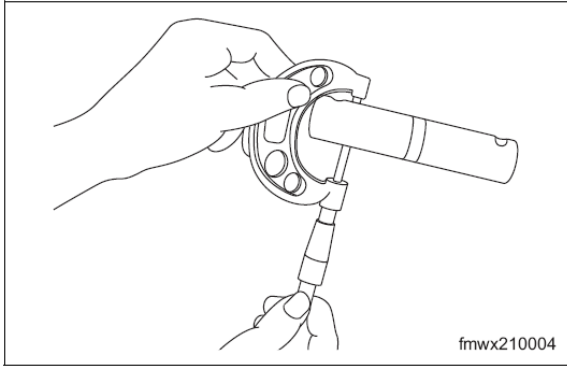
- (b). Check whether the connecting pieces of the damper, such as the connecting rod, the rubber bushing, etc. are damaged, and replace with new parts if damaged.
- (c). Press and pull the damper twice or thrice to and fro, if the stroke in the whole reciprocating process is normal and uniform, there is no obvious idle stroke, jam and suddenly light and heavy phenomena.
- (d). After loading, stop after running for about 10Km on a poor road surface; touch the surfaces of the dampers by hand; if the two dampers have large temperature difference, it is shown that the resistance also has large difference; the damper with low temperature has small resistance; and if the surface temperature is not higher than the air temperature, it is shown that the dampers does not have resistance and is out of action.

Hint:

To replace the damper for any symptoms, refer to Chapter 21, Front Suspension - Front Damper, Overhaul

Front Suspension - Front Suspension Assembly

3. Check pin shaft of leaf spring



- (a). Measure the outer diameter of the pin shaft of the leaf spring with a micrometer.

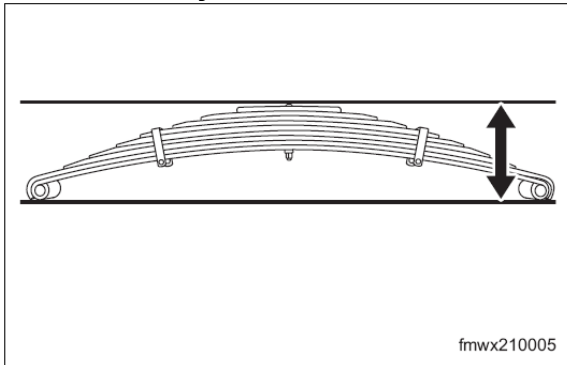
Standard value: $\phi 30\text{mm}$

Limit value: $\phi 29.93\text{-}29.97\text{mm}$

Caution:

Replace the pin shaft of the leaf spring if exceeding the limit value.

4. Check camber of leaf spring assembly in free state



- (a). Measure the camber of the leaf spring with a tape.

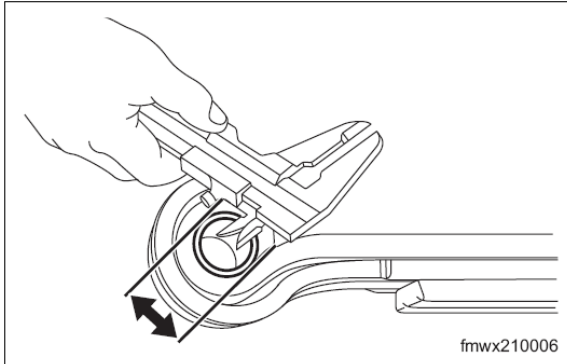
Standard value: left 135 mm; right 120mm

Limit value: left 129-141mm; right 114-126mm

Caution:

The camber deviation of the two front leaf springs shall not be greater than 4mm, otherwise vehicle inclination may be caused.

5. Measure inner diameter of sleeve of front leaf spring pin



- (a). Measure the inner diameter of the sleeve of the pin shaft of the leaf spring with a vernier caliper.

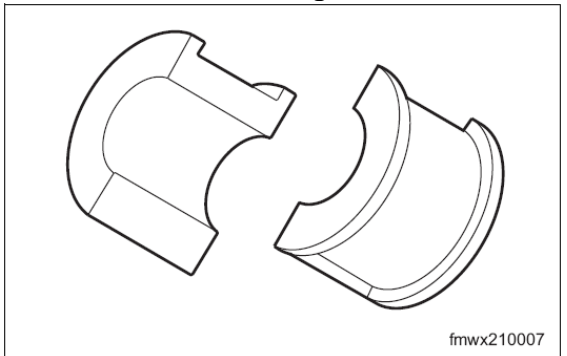
Standard value: $\phi 30\text{mm}$

Limit value: $\phi 30.11\text{-}30.194\text{mm}$

Caution:

Take three positions for measurement

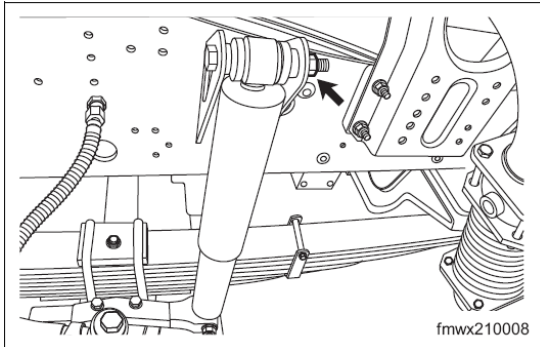
6. Check inner lining of stabilizer bar



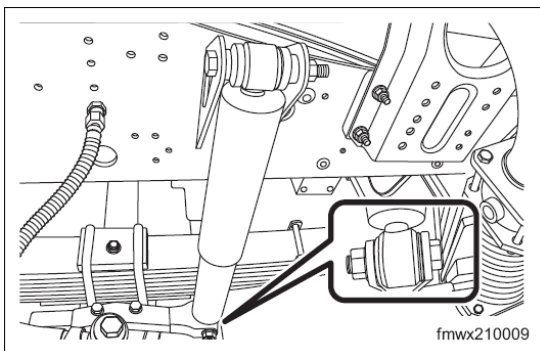
- (a). Check whether the sleeve has excessive wear, crack, etc.

Front Damper Overhaul

1. Dismantle left front damper assembly

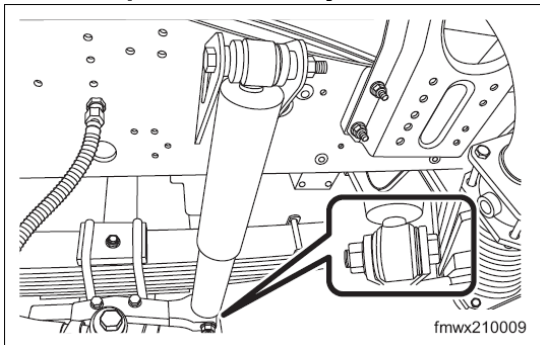


(a). Loosen the top fastening nuts.



(b). Loosen the bottom fastening nuts and dismantle the front damper.

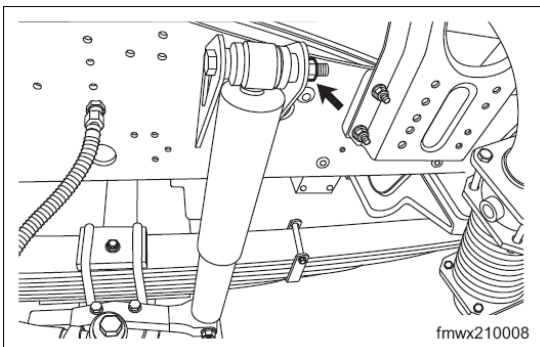
2. To check damper, refer to Chapter 21, Front Suspension - Front Suspension Assembly, Inspection and Adjustment



3. Install left front damper assembly

(a). Screw down the bottom fastening nuts.

Torque: 221± 22N.m



(b). Screw down the top fastening nuts.

Torque: 221± 22N.m

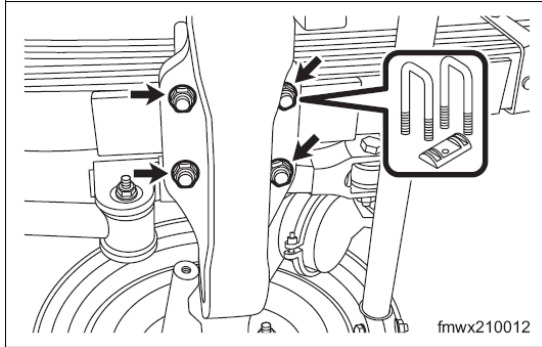
Hint:

For overhaul of the right front damper, refer to overhaul of the left front damper.

Front Leaf Spring

Overhaul

1. To dismantle tires, refer to Chapter 23, Wheel & Tire - Front Wheel & Tire Assembly, Overhaul
2. To disconnect the air pipe of the left front brake air chamber, refer to Chapter 26, Service Brake - Front Brake Air Chamber, Overhaul
3. Disconnect connector assembly of left front ABS wiring harness
4. To dismantle left front damper, refer to Chapter 21, Front Suspension - Front Damper, Overhaul

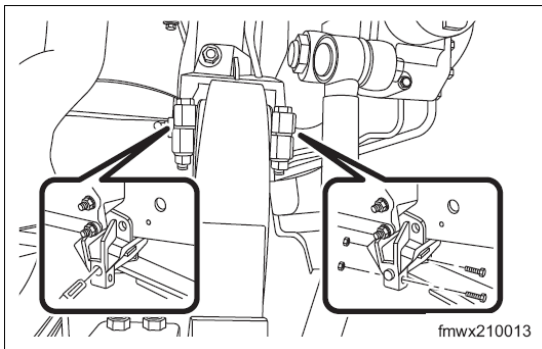


5. Dismantle left front leaf spring assembly

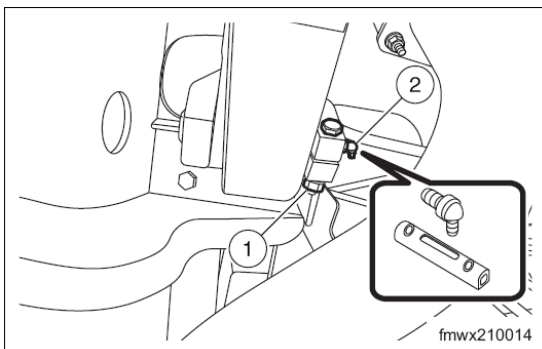
- (a). Jack up the front axle, dismantle the U-connecting nuts of the left front leaf spring and four connecting nuts of the front axle.
- (b). Sequentially take down the U-bolts and the pressure plate of the front spring.
- (c). Slowly release the jack so that the front axle stably is lowered.

Caution:

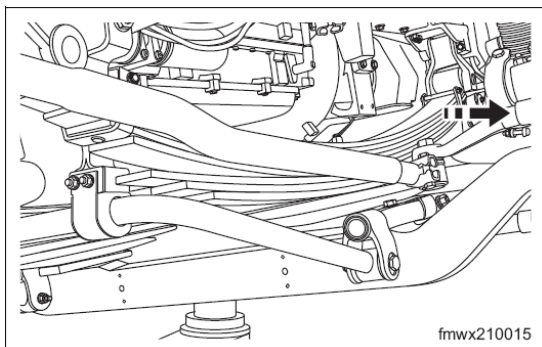
When releasing the jack of the front axle, make sure that the front part of the vehicle is jacked.



- (d). Dismantle the fixing bolt 1 of the pin shaft of the front leaf spring.
- (e). Pull out the pin shaft of the front leaf spring with a puller.



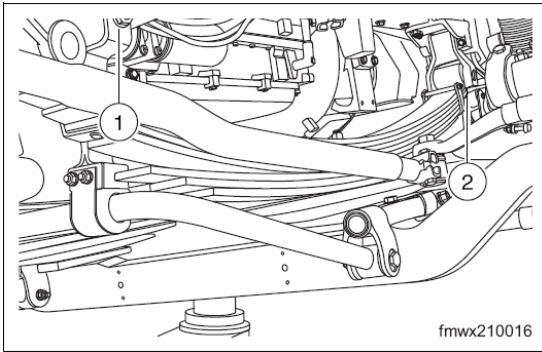
- (f). Dismantle the fastening bolt 1 of the pin shaft of the rear leaf spring.
- (g). Pull out the pin shaft 2 of the rear leaf spring with a puller.



- (h). Take down the left front leaf spring.

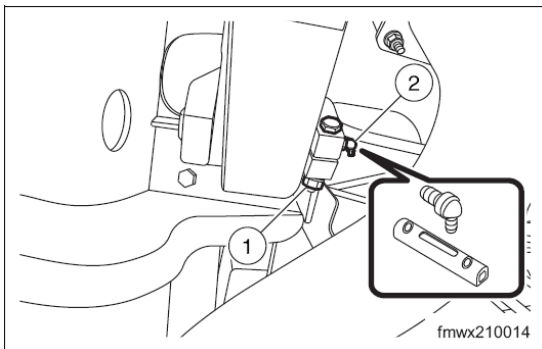
Front Suspension - Front Leaf Spring

6. To check front leaf spring assembly, refer to Chapter 21, Front Suspension - Front Suspension Assembly, Inspection and Adjustment



7. Install left front leaf spring assembly

- (a). Install the left front leaf spring into the front bracket 1 of the front spring and the left lifting eye 2 of the front leaf spring.

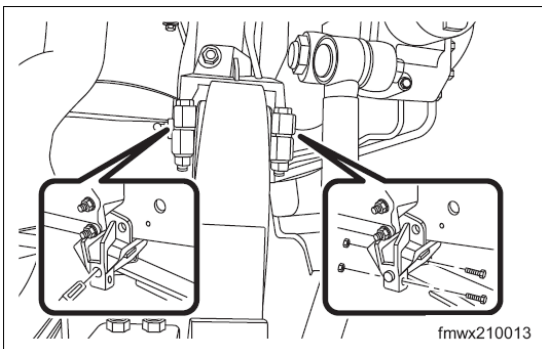


- (b). Install the pin shaft 2 of the rear leaf spring.
(c). Install the fastening bolt 1 of the pin shaft of the rear leaf spring.

Torque: 84±8 N.m

Hint:

Apply lubricating grease on the pin shaft of the leaf spring. The lubricating grease is No.2 lithium lubricating grease.



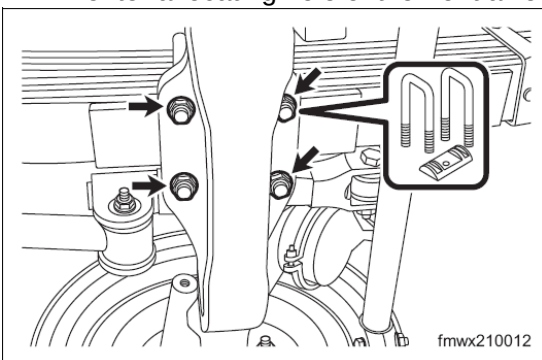
- (d). Install the pin shaft 2 of the front leaf spring.
(e). Install 2 fastening bolts of the pin shaft of the front leaf spring.

Torque: 84±8 N.m

Hint:

Apply lubricating grease on the pin shaft of the leaf spring. The lubricating grease is No.2 lithium lubricating grease.

- (f). Slowly jack up the front axle with the jack, and enable the head of the leaf spring center bolt to enter a locating hole of the front axle.



- (g). Sequentially install the pressure plate of the front spring, the U-bolt and nuts.

- Screw down four fastening nuts.

Torque: 280±20 N.m

8. To install left front damper assembly, refer to Chapter 21, Front Suspension - Front Damper, Overhaul
9. To install air pipe of the left front brake air chamber, refer to Chapter 26, Service Brake - Front Brake Air Chamber, Overhaul
10. Disconnect connector assembly of left front ABS wiring harness
11. To install tires, refer to Chapter 23, Wheel & Tire - Front Wheel & Tire Assembly, Overhaul

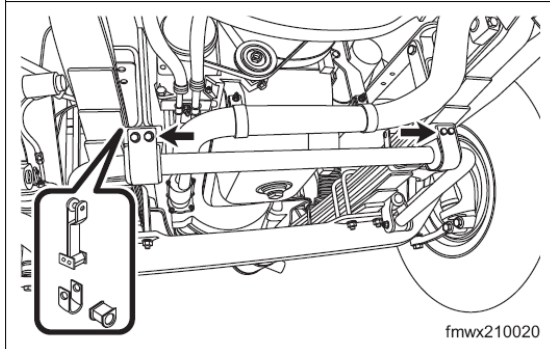
Front Suspension - Front Leaf Spring

Hint:

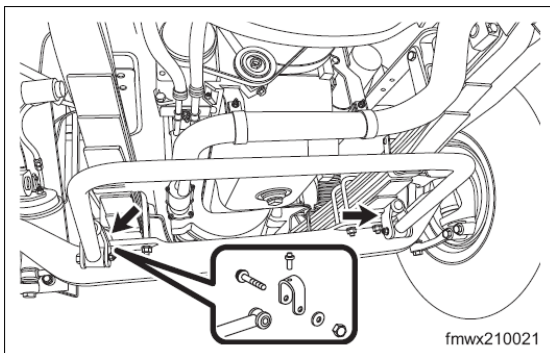
For overhaul of the right front leaf spring assembly, refer to the steps of overhaul of the left front leaf spring.

Front Stabilizer Bar Overhaul

1. Dismantle front stabilizer assembly



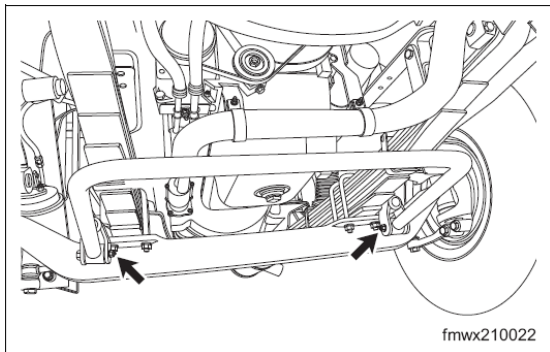
- (a). Dismantle the U-connecting plates at two sides.
 - Loosen the fastening nuts at two sides.
- (b). Sequentially take down the U-connecting plate and the rubber gasket of the front stabilizer bar.



- (c). Disconnect the stabilizer bar from the head connecting piece of the stabilized bar.
 - Loosen the fastening nuts.
- (d). Take down the stabilizer bar assembly.

2. Check stabilizer bar assembly

- (a). Check whether the stabilizer bar is deformed or worn
- (b). Check whether the rubber gasket of the stabilizer bar is worn, cracked, etc.
- (c). Check whether the U-connecting plate and the front stabilizer bar are deformed, etc.

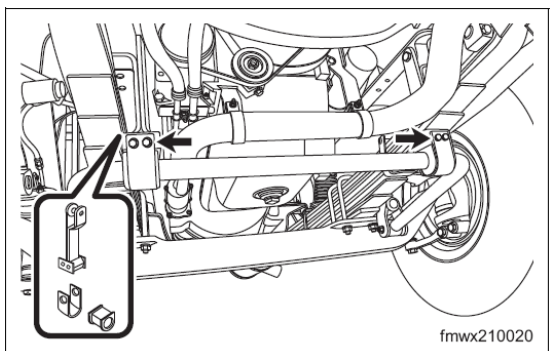


3. Install stabilizer bar assembly

- (a). Connect the stabilizer bar with the connecting piece of the stabilizer bar and install the bolts.
Torque: 140±14 N.m

Caution:

The bolts shall be screwed down after the U-connecting plates of the stabilizer bar are fully installed in place.



- (b). Install the rubber gasket and the U-connecting plate of the stabilizer bar sequentially into the stabilizer bar assembly.
- (c). Screw down the bolts.
Torque: 84±8 N.m

Rear Suspension

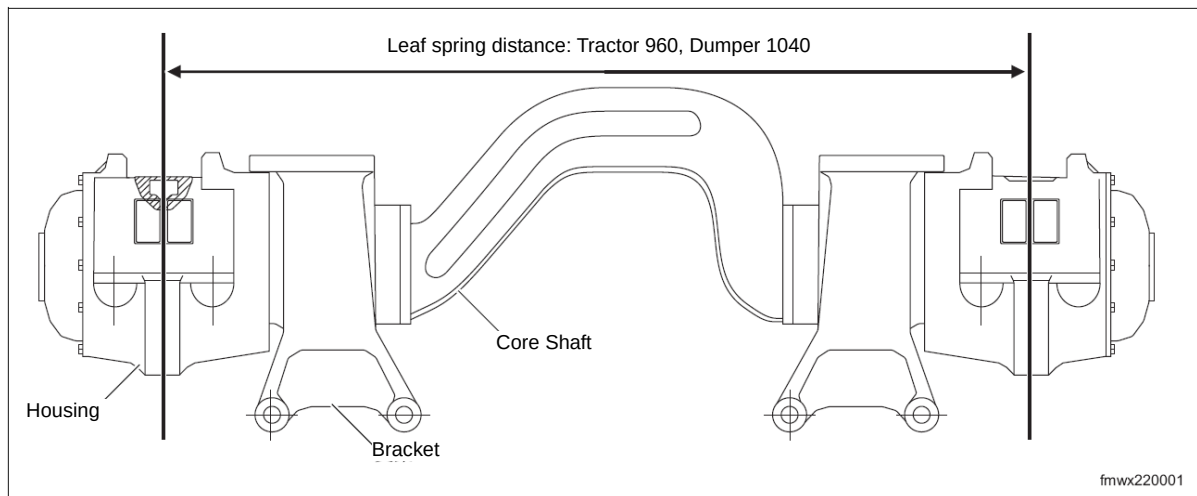
Rear Suspension Assembly	22-3
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Overhaul	22-10
Rear Balance Shaft Assembly.....	22-12
Overhaul	22-12
Rear Stabilizer Bar	22-14
Overhaul	22-14

Rear Suspension Assembly

General

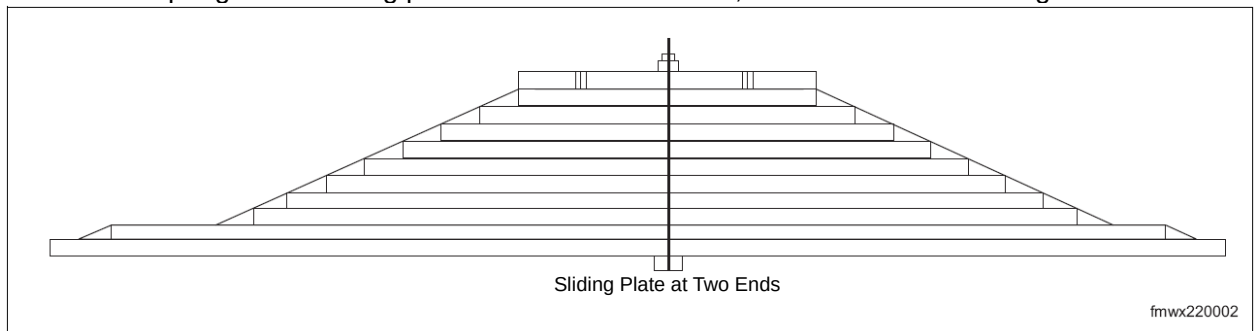
The rear suspension comprises a leaf spring, a balance shaft, a rubber bumper, a stabilizer bar, an upper thrust bar, a lower thrust bar, etc.; Bearings are assembled in the housings at two ends of the balance shaft, and a king bolt is screwed down at the ends; the king nut adopts a screw locking structure, and the two ends can be freely rotated, thereby reducing the impact of the road surface to the frame and increasing the handling of the vehicle; the stabilizer bar is installed between the rear axle and the chassis frame to ensure the comfortableness and stability of driving.

Because two ends of the leaf springs are only supported by the rear axle housing, when the wheels move, the leaf springs can slide. When the vehicle runs on the rugged pavement, the spring seat can reciprocate along the balance shaft, and the thrust rods are also linked, so that each rear axle can independently move up and down, thereby ensuring that the vehicle has higher running performance. The structure of the balance shaft is shown in the drawing below:



22

The rear leaf spring is in a sliding plate structure at two ends, as shown in the drawing below:



Precautions

1. Precautions of Rear Suspension in Operation

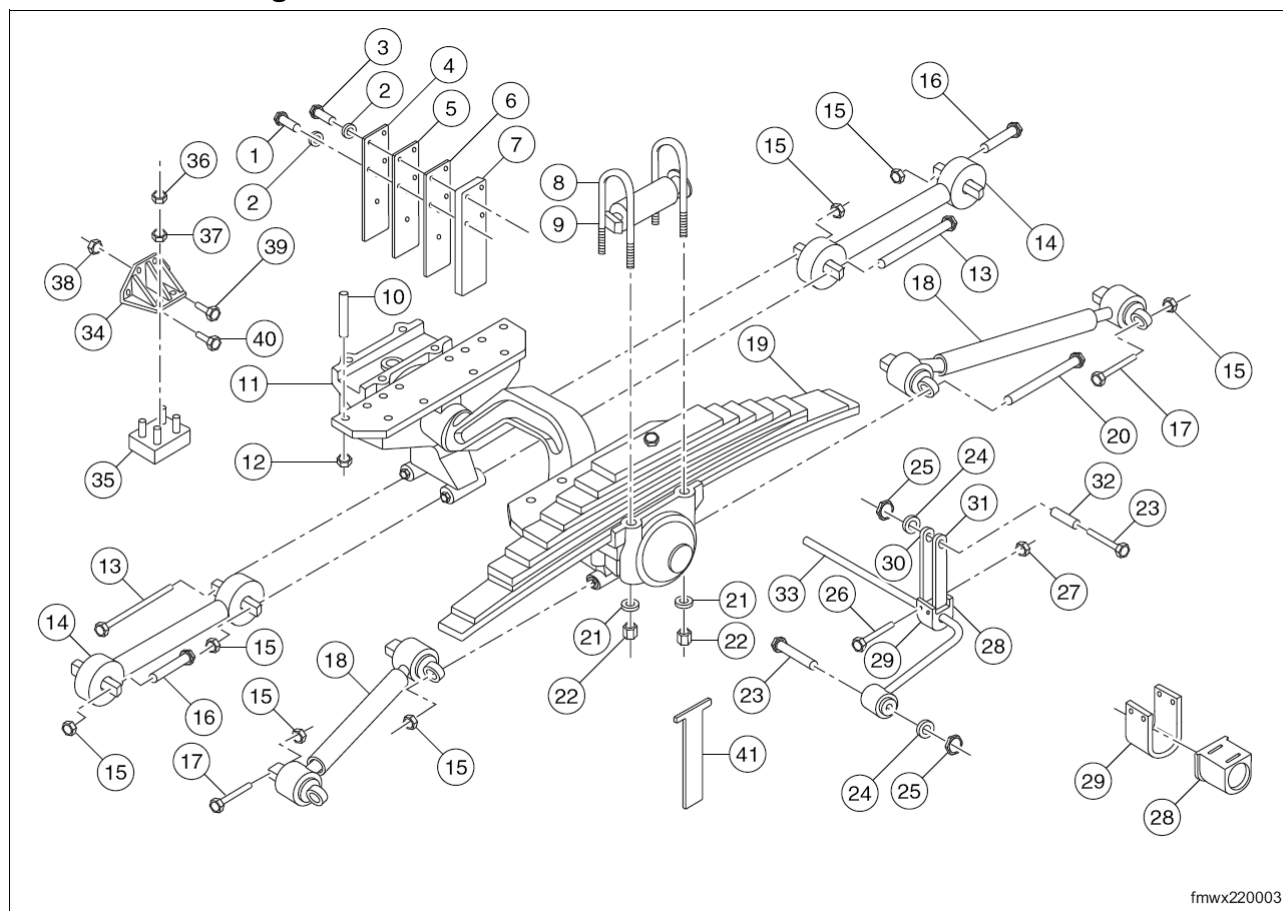
- (a). When replacing parts, be sure to observe the specifications of the manual and be careful.
- (b). Incorrect operation may affect the performance of the steering system and even endanger the personal safety.
- (c). Strictly maintain according to the maintenance specifications.
- (d). Fill lubricating oil in the shaft housings at two ends of the balance shaft, and if the phenomenon of oil leakage occurs, please pay attention to and replenish the lubricating oil 85W/90 to the standard position in time to prevent the balance shaft assembly from being damaged.
- (e). Record the mark (left side/right side) on the spring when the spring is disassembled to ensure that the spring can be assembled in the normal position again. This is very important, because the specification and the feature of the spring may be changed with the vehicle side.

Rear Suspension - Rear Suspension Assembly**Fault Symptom Table**

Use the table below to help you find the cause of the malfunction. Use the table below to help you find the cause of the malfunction. The serial numbers represent the precedence order of the likelihood of the faults. Check every part in this order, and replace if necessary.

Symptom	Possible Cause	Reference
Noise of Mounting Part	1. Leaf Spring (worn or damaged)	Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul
	2. Rubber Sleeve of Stabilizer Bar (worn)	Chapter 22, Rear Suspension - Rear Stabilizer Bar, Overhaul
	3. Leaf spring (loose)	Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul
	4. Balance Shaft (worn)	Chapter 22, Rear Suspension - Rear Balance Shaft Assembly, Overhaul
Inclination of body in service or parking	1. Leaf Spring (worn or damaged)	Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul
	2. Tire Pressure (inconsistent)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	3. Balance Shaft (worn or damaged)	Chapter 22, Rear Suspension - Rear Balance Shaft Assembly, Overhaul

Part Drawing



1	Hex Bolt - Fine Thread
2	Spring Washer
3	Hex Bolt - Fine Thread
4	Adjusting Plate (III)
5	Adjusting Plate (I)
6	Adjusting Plate (II)
7	Guide Plate
8	Rear U-bolt
9	Pressure Plate - Leaf Spring
10	Stud Bolt
11	Balance Shaft Assy.
12	Hex Nut, Type 1 - Fine Thread
13	Connecting Bolt - Thrust Bar
14	Upper Thrust Bar Assy.
15	Self-locking Nut

22	Self-locking Nut
23	Bolt
24	Flat Washer
25	Self-locking Nut
26	Hex Bolt - Fine Thread
27	Self-locking Nut
28	Rubber Sleeve - Rear Stabilizer Bar
29	U-connecting Plate
30	Hanger - Rear Stabilizer Bar
31	Sleeve - Rear Stabilizer Bar
32	Sleeve
33	Rear Stabilizer bar Assy.
34	Limiting Block Bracket
35	Limiting Block
36	Hex Nut, Type 1 - Fine Thread

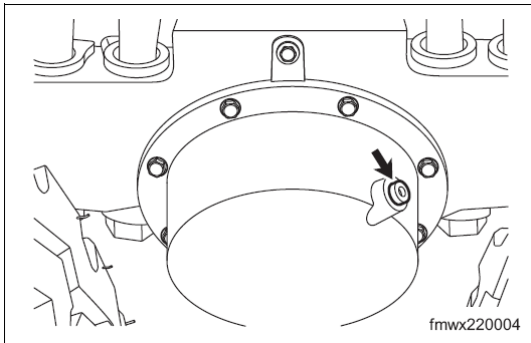
Rear Suspension - Rear Suspension Assembly

16	Connecting Bolt - Thrust Bar	37	Spring Washer
17	Connecting Bolt - Thrust Bar	38	Self-locking Nut
18	Lower Thrust Bar Assy.	39	Hex Bolt - Fine Thread
19	Rear Leaf Spring	40	Hex Bolt - Fine Thread
20	Connecting Bolt - Thrust Bar	41	T-adjusting Plate
21	Washer		

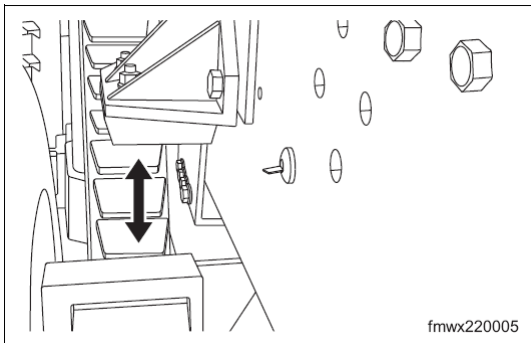
Inspection and Adjustment

1. Vehicle inspection

- (a). Check whether the U-bolt has deformation and cracks and whether threads are damaged, and replace with new parts if necessary.
- (b). The U-bolt shall be fastened by a uniform cross screw-down method, and gradually increase the tightening torque to the specified value. When the vehicle is fully loaded, because the leaf spring is fitted tightly, by this time, screw down the nut of the U-bolt once again. When tightening the nut, prevent the condition that the bolt and nut are rusted and can not compress the leaf spring tightly, and cause the false impression that the torque is large. If necessary, tap again with a screw tap to enable the bolt and nut to be well fitted.
- (c). Check whether the sleeve of the thrust bar is damaged and the bolt are loose.
- (d). Check whether the fastening nuts of the balance shaft are loose.



- (e). Frequently check the liquid level of two ends of the balance shaft, and replenish the lubricating oil 85W/90 to the standard position in time if the liquid level is insufficient.

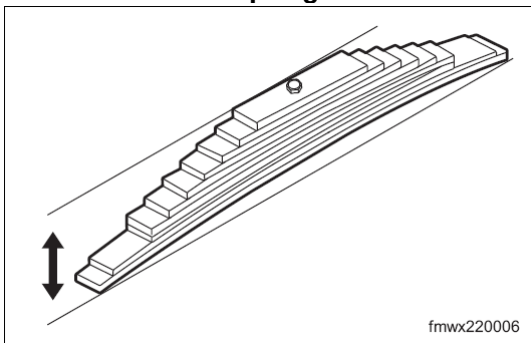


- (f). Measure buffer gap
 - Measure the gap with a tape.**Standard value: 145mm**
Limit value: 139-151 mm

Hint:

The vehicle must be in a no-load condition for this measurement. Replace the limiting block or the rear leaf spring assembly if exceeding the limit value.

2. Check leaf spring

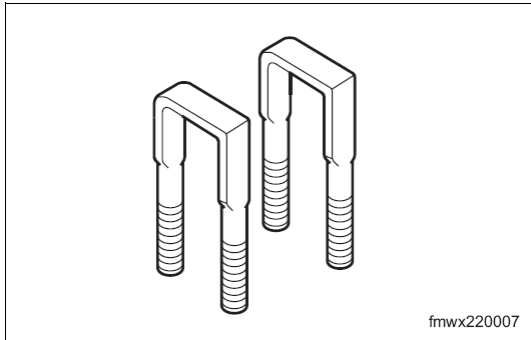


- (a). Measure the camber of the leaf spring in a free state with a tape.
Standard value: 54-66 mm

Hint:

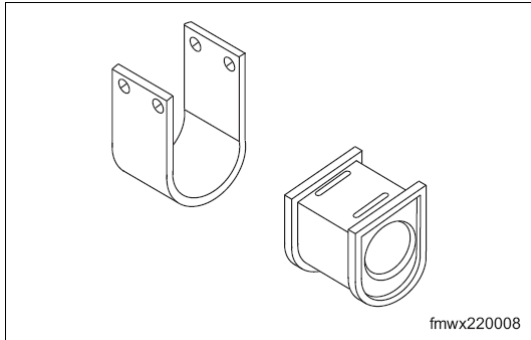
The left right camber difference shall not be greater than 4mm, otherwise deflection of the body may be caused.

Rear Suspension - Rear Suspension Assembly



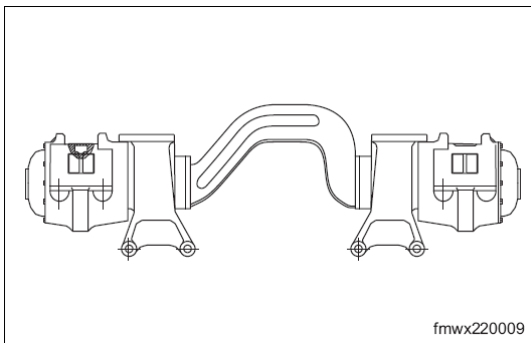
3. U-bolt

- (a). Check whether the bolts have deformation and other damage. Pay special attention to the threaded portion.
- (b). Remove any dust at the threaded portion with a rethreading die.



4. Check stabilizer bar assembly

- (a). Check whether the U-connecting plate has warp, excessive wear and other damage conditions.
- (b). Check whether the rubber sleeve of the stabilizer bar has excessive wear, crack and other damage conditions.



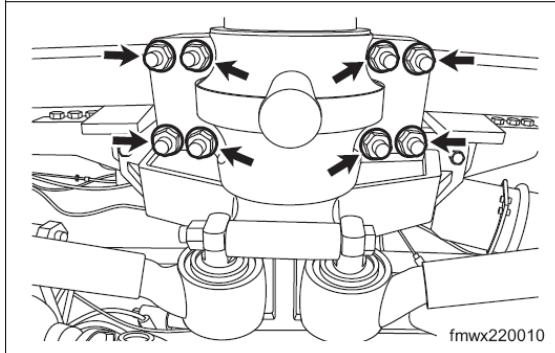
5. Check balance shaft assembly

- (a). Check the rotation at two sides of the balance shaft has drag and abnormal sound.
- (b). Measure the length of the balance shaft with a tape and check for torsional deformation, etc.

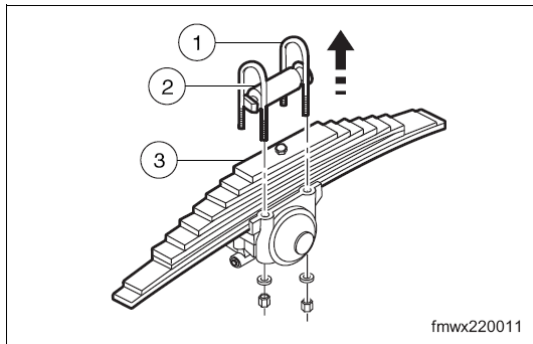
Standard value: 1040 mm

Rear Leaf Spring Overhaul

1. Lift vehicle
2. Dismantle rear tire



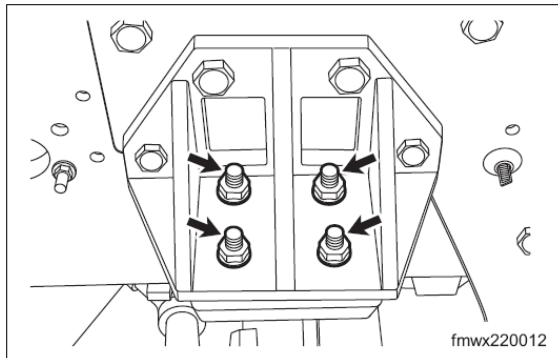
3. **Dismantle the left rear leaf spring assembly.**
 - (a). Dismantle the U-bolts and eight connecting nuts of the stabilizing shaft.



- (b). Sequentially take down four U-connecting bolts 1 and the pressure plate 2 of the leaf spring.
- (c). Loosen the connecting nut 3 of the steel plate.
- (d). Sequentially take down 12 leaf springs.

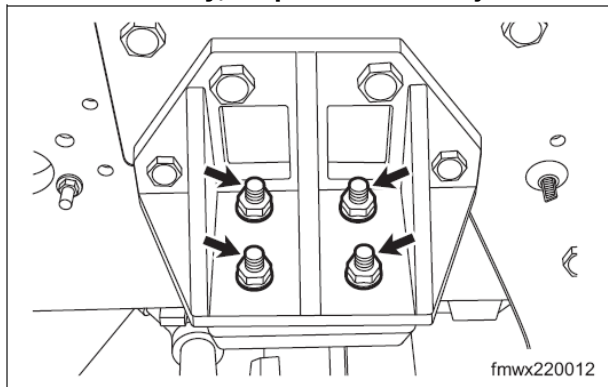
Hint:

To recover the primary characteristics after assembly, make forward marks on the steel plate.



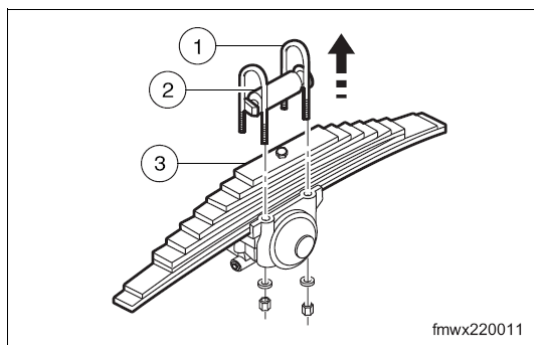
4. **Dismantle limiting block**
 - (a). Dismantle four connecting nuts of the limiting block and take down the limiting block.

5. **Check leaf spring assembly; refer to Chapter 22, Rear Suspension - Rear Suspension Assembly, Inspection and Adjustment**



6. **Install limiting block**
 - (a). Install the limiting block and screw down four connecting nuts.
Torque: 45±5N.m

Rear Suspension - Rear Leaf Spring



7. Install leaf spring assembly

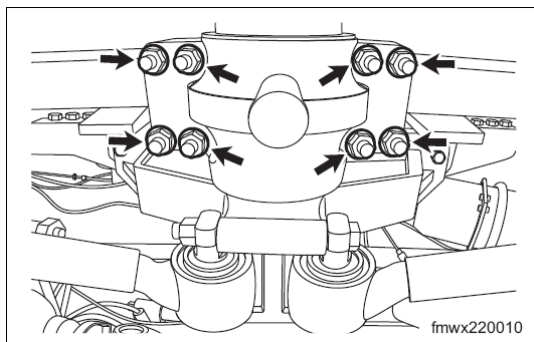
- (a). Sequentially install 12 steel plates into through bolts, and screw down the connecting nuts of the steel plates.

Torque: $100 \pm 20 \text{ N.m}$

Caution:

Be sure to install according to the assembling marks.

- (b). Install the pressure plate and U-bolts of the leaf spring into the steel plate.



- (c). Screw down the U-bolts and 8 connecting nuts of the balance shaft.

Torque: $510 \pm 20 \text{ N.m}$

Hint:

For overhaul of the right rear leaf spring, refer to the overhaul procedure of the left rear leaf spring. Record the mark (left side/right side) on the spring when the spring is disassembled to ensure that the spring can be assembled in the normal position again. This is very important, because the specification and the feature of the spring may be changed with the vehicle side.

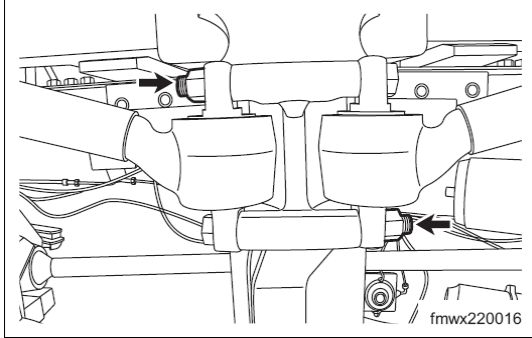
8. Install rear tire

9. Lower vehicle

Rear Balance Shaft Assembly

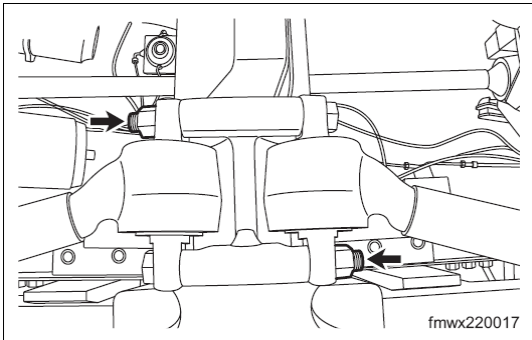
Overhaul

1. Dismantle two rear leaf springs; refer to Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul
2. Dismantle inter-axle drive shaft; refer to Chapter 33, Drive Shaft - Inter-axle Drive Shaft, Overhaul

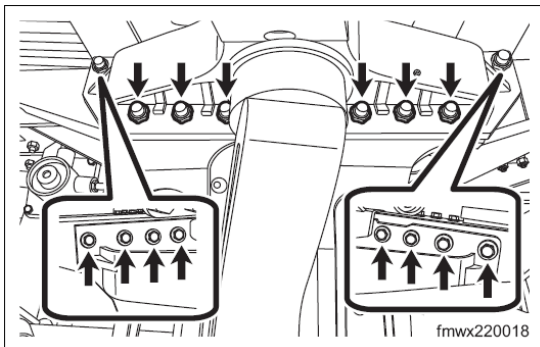


3. Dismantle lower thrust bar assembly

- (a). Dismantle the bolts of the lower thrust bar at the left side and take down the left thrust bar assembly.

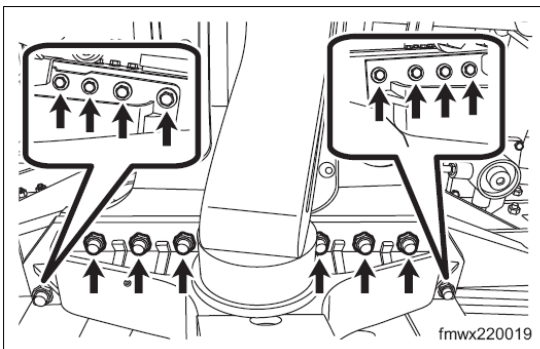


- (b). Dismantle the bolts of the lower thrust bar at the right side and take down the right thrust bar assembly.



4. Dismantle rear balance shaft assembly

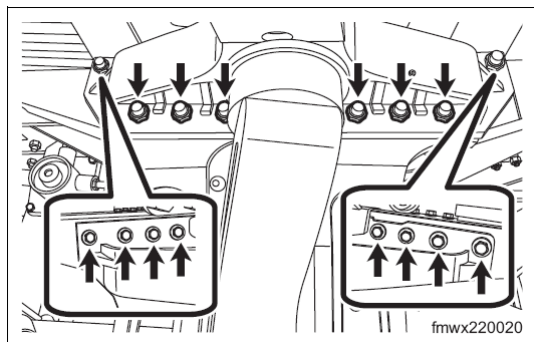
- (a). Dismantle 14 connecting nuts at the left side.



- (b). Dismantle 14 connecting nuts at the right side.
- (c). Support the balance shaft with a hydraulic trolley and dismantle the balance shaft assembly.

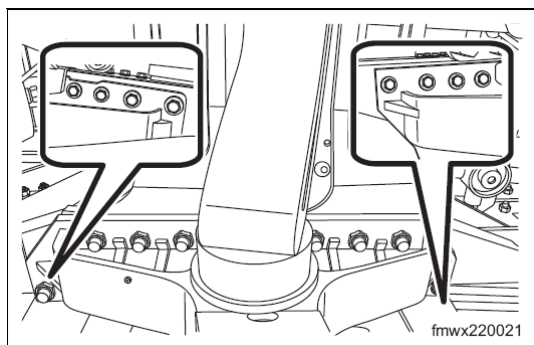
Rear Suspension - Rear Balance Shaft Assembly

5. To check the balance shaft assembly, refer to Chapter 22, Rear Suspension - Rear Suspension Assembly, Inspection and Adjustment

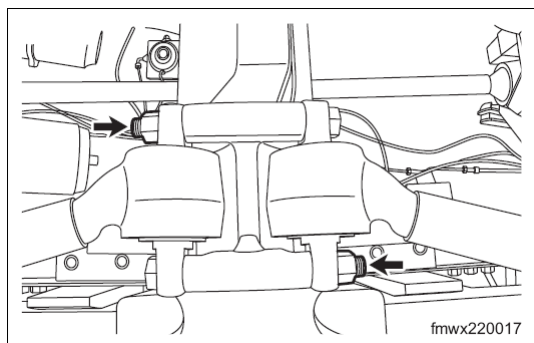


6. Install rear balance shaft assembly

- (a). Support the rear balance shaft assembly with the hydraulic trolley and align to the stud bolt.
 (b). Screw down 14 fastening nuts at the left side.
Torque: $311.5 \pm 24.5 \text{ N.m}$

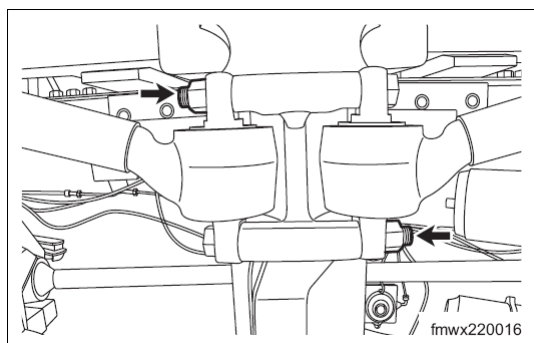


- (c). Screw down 14 fastening nuts at the right side
Torque: $311.5 \pm 24.5 \text{ N.m}$



7. Install lower thrust bar assembly

- (a). Install the lower thrust bar at the right side and screw down the bolts.
Torque: $525 \pm 25 \text{ N.m}$

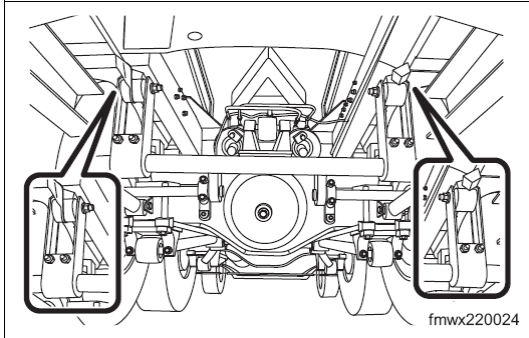


- (b). Install the lower thrust bar at the left side and screw down the bolts.
Torque: $525 \pm 25 \text{ N.m}$

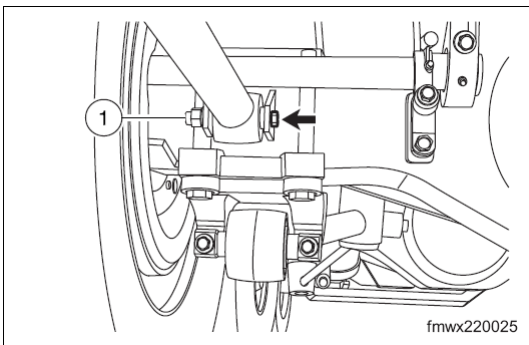
8. Install inter-axle drive shaft; refer to Chapter 33, Drive Shaft - Inter-axle Drive Shaft, Overhaul
 9. Install two rear leaf springs; refer to Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul

Rear Stabilizer Bar Overhaul

1. Dismantle rear stabilizer bar assembly



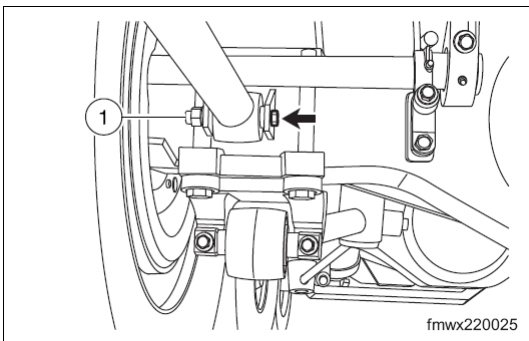
- (a). Dismantle the U-connecting plates at two ends of the stabilizer bar and the connecting bolts of the hanger of the rear stabilizer bar.
- (b). Sequentially take down the U-connecting plates at two ends and the rubber sleeve of the stabilized bar.



- (c). Dismantle the connecting bolts 1 at two ends of the rear stabilizer bar and the rear axle housing.
- (d). Take down the rear stabilizer bar assembly.

2 Check rear stabilizer bar assembly

- (a). Check whether the stabilizer bar has deformation and distortion.
- (b). Check whether the rubber sleeve of the stabilizer bar has excessive wear, crack, etc.
- (c). Check whether the stabilizer bar hanger has deformation and the sleeve of the stabilizer bar is worn.



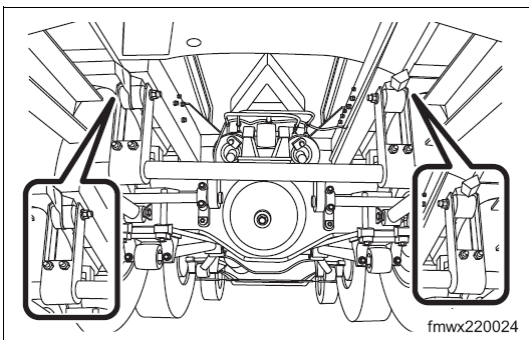
3. Install the rear stabilizer bar assembly.

- (a). Connect two ends of the stabilizer bar with the rear axle housing, and screw down bolts 1.

Torque: 221±22N.m

Caution:

The connecting bolt shall be screwed down after the U-connecting plates of the stabilizer bar are fully installed in place.



- (b). Install the rubber sleeves at two ends of the stabilizer bar and the U-connecting plate and screw down bolts.

Torque: 84±8 N.m

Tire & Wheel

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Tire & Wheel Assembly

General

The driving style of the vehicle is 6×4 with 10 road tires and one spare tire. The tire assembly comprises tires, wheels, tire nuts, nut covers, air nozzle extension pipes, protective caps, etc. The part of the tire in contact with the road surface enables the vehicle to have driving, braking and other performance through friction, and shall have good abrasion resistance, puncture resistance, impact resistance, heat radiation and other performance. The cord ply in the tire is the main stressed component in the tire and shall have shock resistance and good flex resistance in travelling. The wirecord fabric between the tire tread and the tire case protects the tire case, inhibits deformation of the tire tread, maintain the ground plane of the tire tread and improves the wear resistance and the riding stability. The special cord ply above the belt ply inhibits the belt ply from moving in the travelling process, prevents the belt ply from disengaging in high-speed running, and keeps the dimensional stability of the tire under a high-speed condition. Rubberized steel wires are entwined according to a certain shape (square or hexagonal shape), playing effects of installing the tires on the tire rims and fixing the tires. Materials are filled on the wire loops in the tire to prevent the tire bead from dispersing, alleviate the impact to the tire bead, protect the tire bead and prevent air from entering when forming.

Precautions

1. Use special tools for dismantling the tire, and it is not allowed to use a sledgehammer or other sharp tool for dismantling.
2. On the same shaft, it is not allowed to use mixed tires with different specifications, different levels, different patterns, different air pressure and different loads.
3. When installing directed rib tires, pay attention to the rolling direction markers.
4. When installing twin tires, pay attention to align the ventilation holes of two wheels, the two valves shall be separated from each other by 180°, and form a clearance view hole with the angle of 90° with the shoe hub on the brake hub.
5. After travelling 5000-6000 Km, interchange the tires once so that the tire wear is uniform.
6. After interchanging of tires, readjust the air pressure according to the requirement of the changed tire position.
7. Periodically check and adjust the toe-in of the front wheel to avoid unnecessary increase of running resistance and oil consumption and even the acceleration of tire wear.

8. Precautions for inflation of tire pressure:

- (a). Tire pressure has definitive effects on wear, oil consumption and fault damage of the tire, so for the safety of traffic, keep standard pressure and regularly check the air pressure.
- (b). The load bearing capacity of the tire is corresponding to its inflation pressure, and you must determine reasonable air pressure for the tire according to the load condition of the vehicle. Climate and seasonal change shall not become the reasons for adjusting the tire pressure.
- (c). At the early stage of using a new tire, the external dimensions of the tire may be changed due to heating of flex movement and the tire pressure may be reduced, so check and adjust the air pressure after using the new tire for 24 hours or travelling 2000-3000km.
- (d). Increase the tire pressure 10%-15% for long time high-speed travelling.
- (e). Tire inflation shall be actuated according to the standard pressure specified on the specification of the vehicle, and measure with an air pressure gauge under a cold condition. Check whether the valve core and the inflating valve are matched levelly before inflation, and the inflated air shall contain no water and oil mist. Check for air leakage after inflation and screw down the valve cap.

9. Air pressure shall not be insufficient for a long time

If the air pressure is insufficient for a long time, the deformation of the sidewall of the tire will be more serious, heat generation will be increased, thereby greatly reducing the tire life and bringing on the following problems and potential safety hazard:

- (a). Excessive wear of the tire shoulder position.
- (b). Increased possibility of impact and bulge of tire.
- (c). Decrease of binding force and delamination among components of the tire.
- (d). Rolling damage of the sidewall of tire caused by serious insufficiency of air pressure.
- (e). Abnormal wear between the tire bead part and the rim and damage of rim caused by large tire jump.
- (f). Increase of rolling resistance and oil consumption.

10. Air pressure shall not be excessive for a long time

Excessive air pressure will result in decrease of ground contact area of the tire tread, increase of tire case rigidity and reduction of impact absorption, and bring on the following problems and potential safety hazard:

- (a). Excessive wear of central position of tire tread.
- (b). Increase of danger of rupture even burst when the tire is impacted by external force.
- (c). Decrease of the ground contact area results in decrease of controllability and danger of whipping, sliding, etc.
- (d). Drop of riding comfortableness.
- (e). Poor ride comfort and damage of the vehicle chassis due to riding with excessive air pressure for a long time.

Tire & Wheel - Tire & Wheel Assembly**Fault Symptom Table**

Use the table below to help you find the cause of the malfunction. The serial numbers represent the precedence order of the likelihood of the faults. Check every part in this order, and replace these parts if necessary.

Symptom	Possible Cause	Reference
Abnormal wear of tire	1. Toe-in (does not meet the requirements)	Chapter 24, Front Axle - Front Axle Assembly, Inspection and Adjustment
	2. Tire (air pressure does not meet the requirements)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	3. Wheel (unbalanced)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	4. Front shaft (deformation)	Chapter 24, Front Axle - Front Shaft, Overhaul
	5. Knuckle (deformation) (wear)	Chapter 24, Front Axle - Knuckle, Overhaul
Swing or shake of front wheel	1. Front wheel (air pressure is different)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	2. Wheel (unbalanced)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	3. Damper (failed)	Chapter 21, Front Suspension - Front Damper, Overhaul
	4. Steering mechanism (serious wear)	Chapter 42, Power Steering Mechanism - Steering Gear Assembly, Overhaul Chapter 42, Power Steering Mechanism - Straight Steering Pull Rod, Replacement
Lateral sliding of front wheel	1. Tire toe-in (does not meet the requirements)	Chapter 24, Front Axle - Front Axle Assembly, Inspection and Adjustment
	2. Tire (air pressure does not meet the requirements)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
Poor riding comfortableness	1. Tire (excessive air pressure)	Chapter 23, Wheel & Tire - Wheel & Tire Assembly, Inspection and Adjustment
	2. Damper (failed)	Chapter 21, Front Suspension - Front Damper, Overhaul
	3. Leaf spring (failed)	Chapter 21, Front Suspension - Front Leaf Spring, Overhaul Chapter 22, Rear Suspension - Rear Leaf Spring, Overhaul

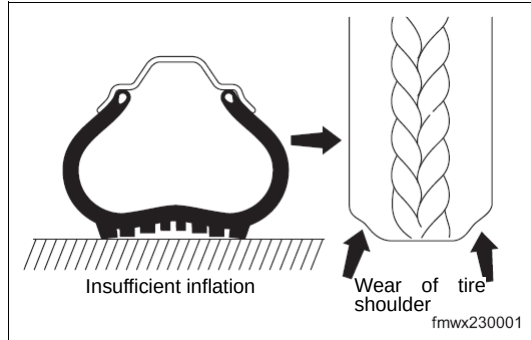
Inspection and Adjustment

1. Check depth of tread pattern

Depth: $\geq 2\text{mm}$

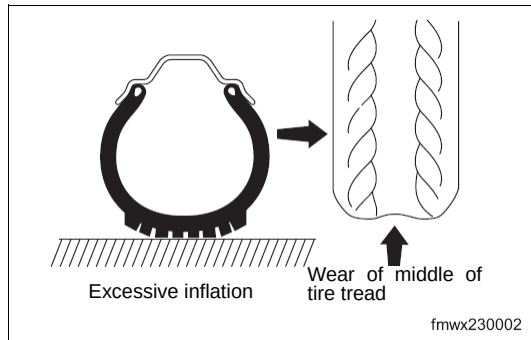
Hint:

If the depth of the tread pattern exceeds the limit range, replace with new tires; and be sure to replace in pair of the left and right sides.

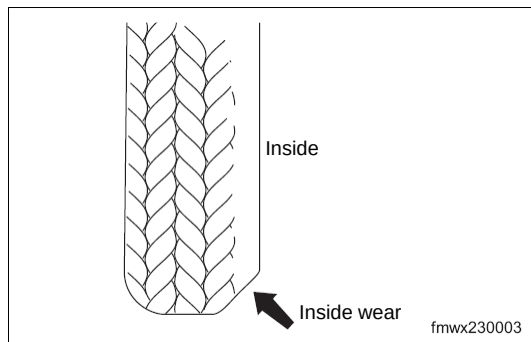


2. Check for abnormal wear of tire

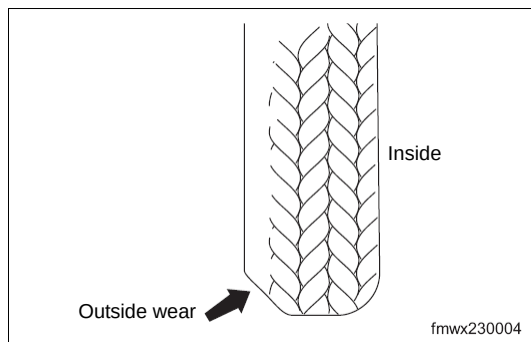
- (a). Check whether the tire shoulder is worn, if so, check whether the tire inflation pressure is insufficient and whether over loading is frequent, and adjust the air pressure and then interchange the tires.



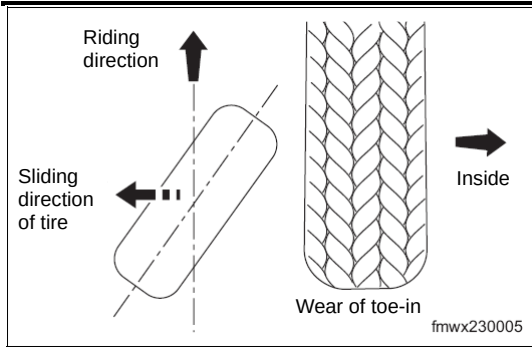
- (b). Check whether the middle of the tire tread is worn, if so, check whether the tire inflation pressure is insufficient, and adjust the air pressure and then interchange the tires.



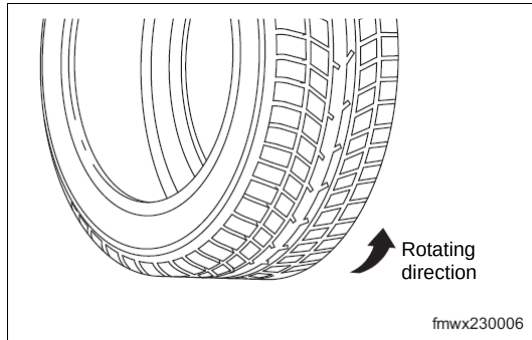
- (c). Check whether the inside of the tire is worn, if so, pay attention to try to avoid high-speed turning; check whether the mounting components are loosen and whether the camber angle is normal, and interchange the tires after adjustment.



- (d). Check whether the outside of the tire is worn, if so, pay attention to try to avoid high-speed turning; check whether the mounting components are loosen and whether the camber angle is normal, and interchange the tires after adjustment.

Tire & Wheel - Tire & Wheel Assembly

- (e). Check whether the tire has feather wear, if so, check and adjust the toe-in, and interchange the tires after adjustment.



- (f). Check whether the tire has corrugated wear, if so, check whether the tire inflation pressure is standard, whether the camber angle and toe-in are correct, and whether the wheel bearing is loosen or worn, adjust and then interchange the tires.

3. Detect tire inflation pressure in cold condition

Tire Specification	Inflation Pressure
12.00R20	830 kpa

23

Hint: If the tire specification or the inflation pressure does not conform to the standard, adjust or replace as required.

4. Check tire crown, tire shoulder and sidewall of tire

Hint: If the tire crown, tire shoulder and sidewall of tire have internal injury, delamination, bulge, deformation and other defects, be sure to replace with a new tire.

5. Check inflating valve

Hint: If the valve core has air leakage, replace it in time.

6. Check rim and circlip

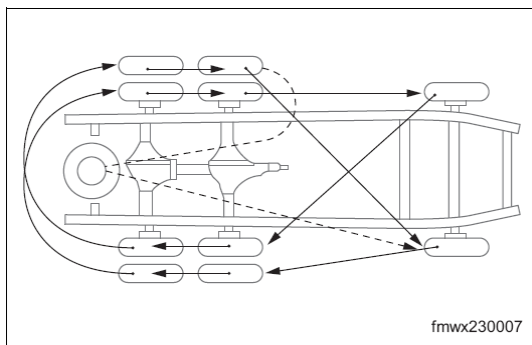
Hint: If deformation, rust and damage are found, replace in time.

7. Check tire bolts

Hint: If the bolts are not fastened, tighten the bolts one by one again by standard.

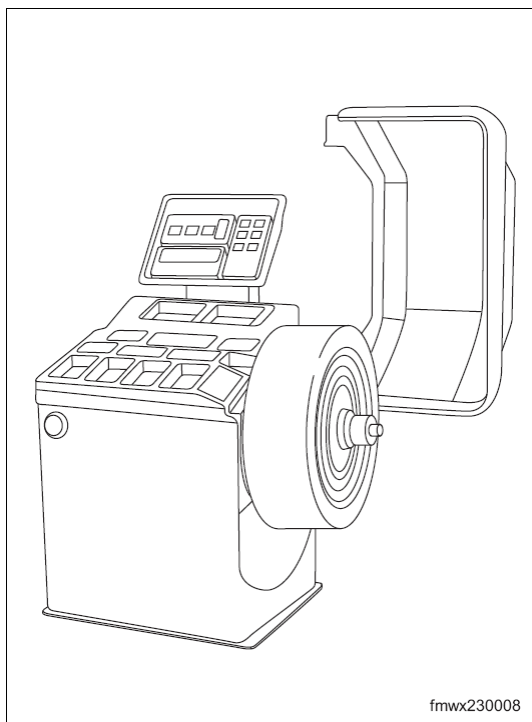
Torque of front wheel: 575±25 N.m

Torque of rear wheel: 575±25 N.m



8. Interchange tires

- (a). Cyclic interchanging



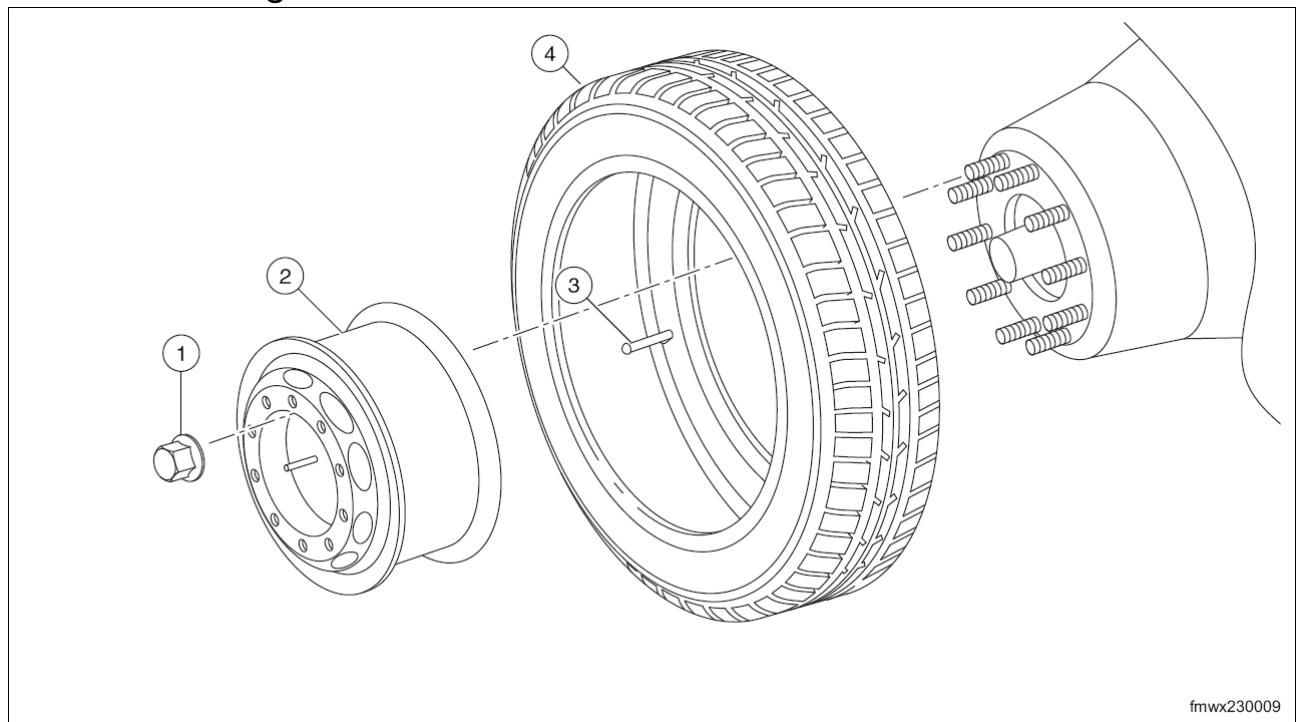
9. Dynamic balance of tires

- (a). Clean dust, gravel and old balance weight on the tested wheel.
- (b). Check the tire pressure to be consistent with the original specification.
- (c). Select a cone according to the size of the center hole of the rim and install the wheel carefully.
- (d). Screw down with a quick nut.
- (e). Turn on the power of a dynamic balance detector.
- (f). Measure the rim width.
- (g). Measure the rim diameter.
- (h). Measure the distance from the edge of rim to the dynamic balance detector.
- (i). Lower the wheel cover and start detecting.
- (j). After detection, according to the unbalanced position and unbalanced amount indicated by the machine,
- (k). Firmly install the balance weight.
- (l). Detect again and adjust until the dynamic balance value meets the requirement.
- (m). Dismantle the tire.

Tire & Wheel - Front Tire & Wheel

Front Tire & Wheel

Part Drawing



fmwx230009

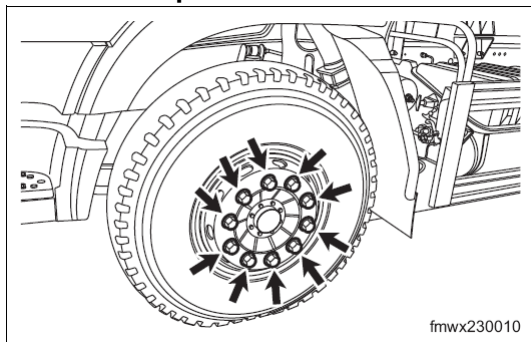
1	Nut Cover
2	Wheel Assy.

3	Extension Pipe - Air Nozzle and Protective Cap
4	Tire Assy.

23

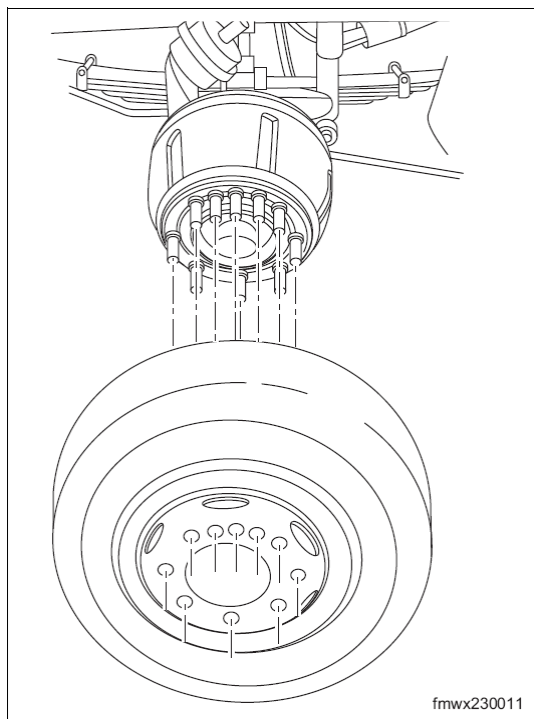
Overhaul

1. Pull up hand brake and wedge rear wheel with wedge blocks
2. Jack up front end of vehicle

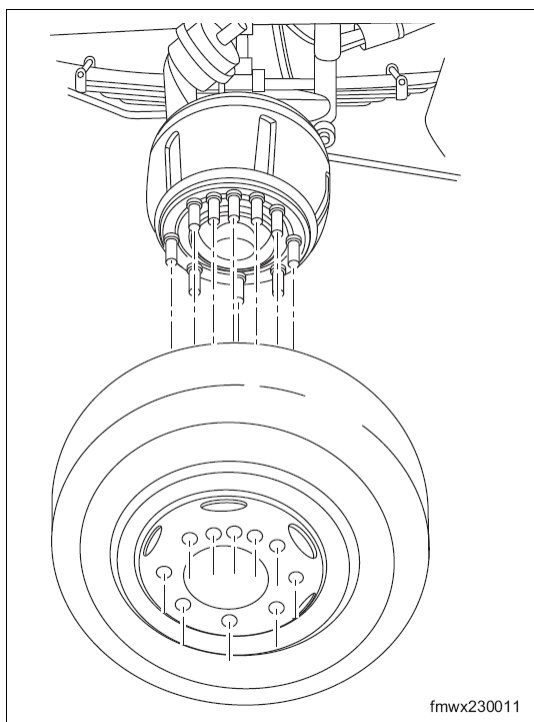


fmwx230010

3. Dismantle front tire
 - (a). Dismantle the left front tire nut cover.
 - (b). Dismantle the left front tire nut.

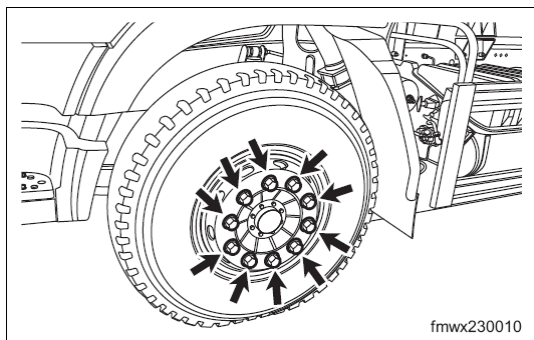


- (c). Dismantle the left front tire.



4. Install front tire

- (a). Install the left front tire.



- (b). Screw down the left front tire nut.

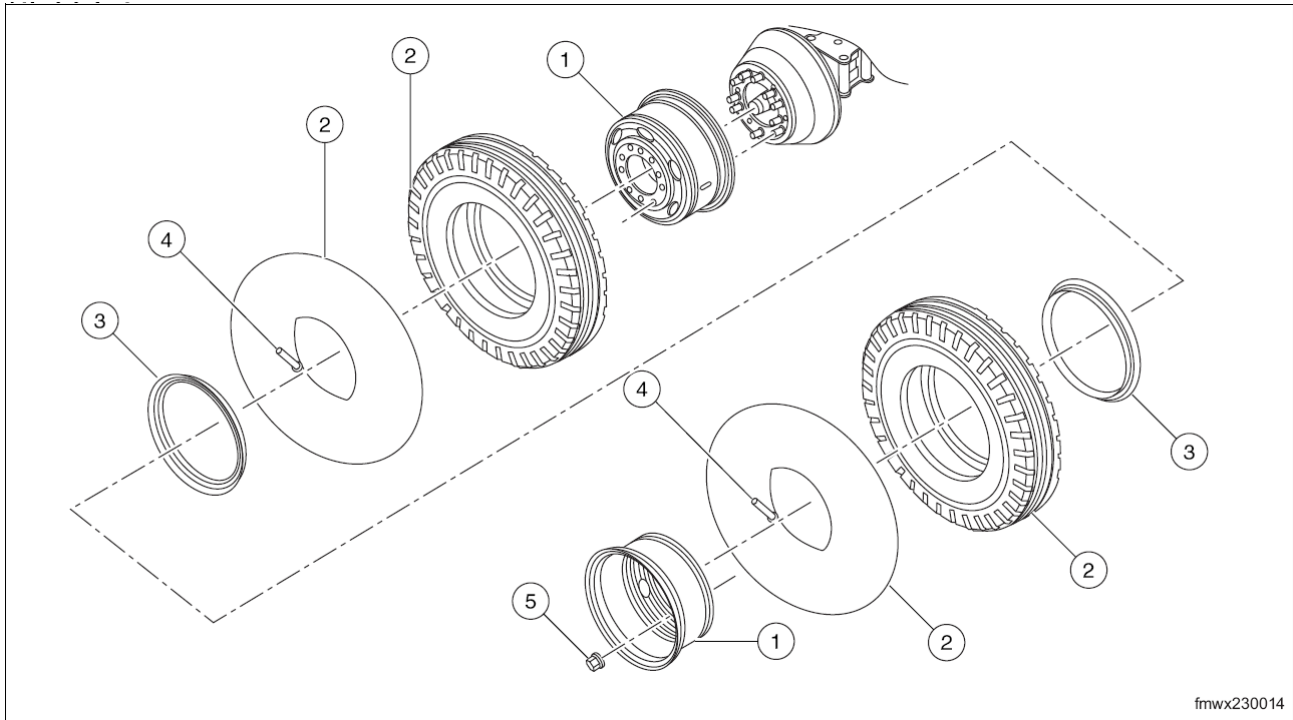
Torque: 575±25 N.m

- (c). Install the left front tire nut cover.

Tire & Wheel - Front Tire & Wheel

5. Dismantle right front tire; refer to dismantlement of left front tire
6. Remove wedge blocks
7. Lower vehicle

Rear Tire & Wheel Part Drawing



fmwx230014

1 Rim Assy.

2 Tire

3 Circlip

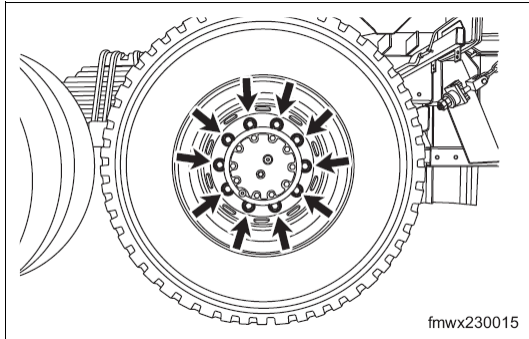
4 Extension Pipe - Air Nozzle and Protective Cap

5 Tire Nut

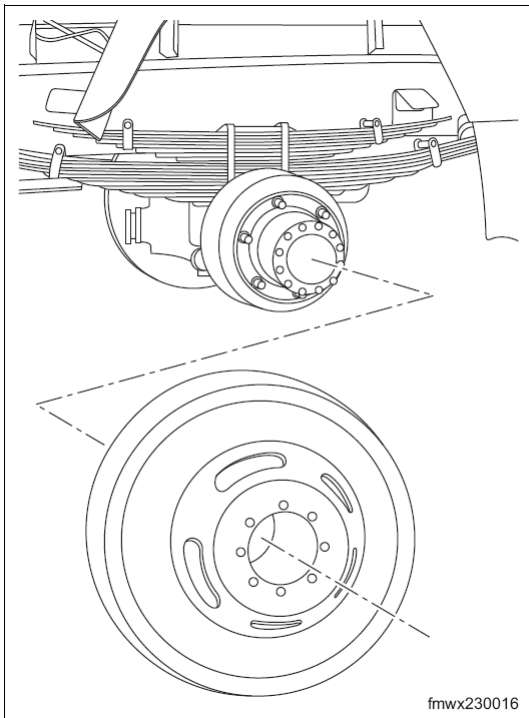
Tire & Wheel - Rear Tire & Wheel

Overhaul

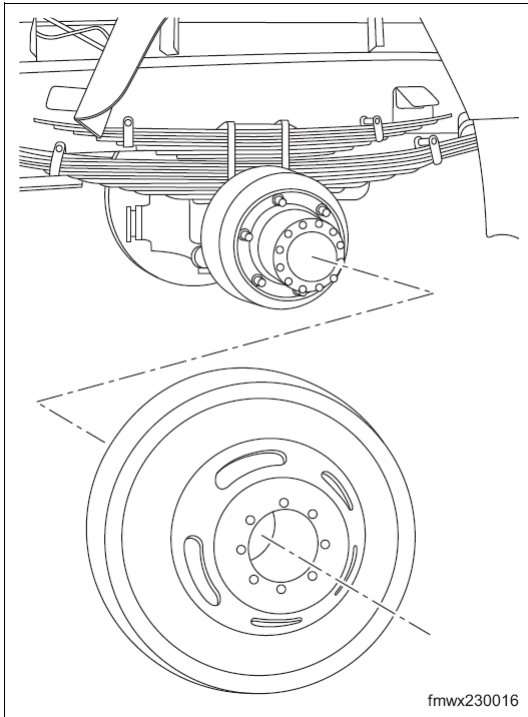
1. Pull up hand brake and wedge front wheel with wedge blocks
2. Jack rear end of vehicle



3. **Dismantle rear tire**
 - (a). Loosen the left rear outer tire nuts and dismantle the left rear outer wheel.

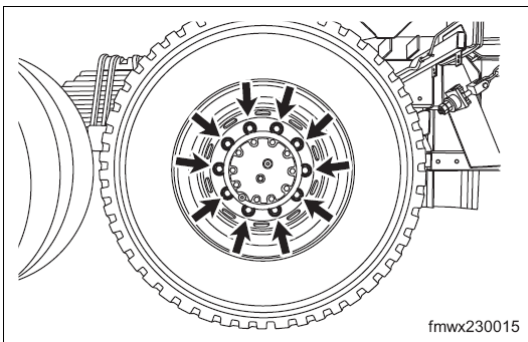


- (b). Dismantle the left rear inner wheel.



4. Install left rear tire

- (a). Install the left rear inner wheel.



- (b). Install the left rear outer wheel, and screw down the nuts of the left rear outer tire.

Torque: 575±25 N.m

5. Dismantle the right rear tire, refer to dismantlement of the left rear tire.
6. Remove wedge blocks
7. Lower vehicle

Front Axle (Ankai)

- Front Axle Assembly24A-3**
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 - Precautions 24A-4
 - Fault Symptom Table 24A-5
 - Part Drawing 24A-7
 - Testing & Adjustment 24A-9
- Front Wheel Hub24A-10**
 - Overhaul..... 24A-10
- Knuckle.....24A-12**
 - Overhaul..... 24A-12
- Front Shaft.....24A-17**
 - Overhaul..... 24A-17

24A

Front Axle Assembly

General

Since front axle is one important assembly component in vehicle running system, modern transport vehicles are stricter with its performance. Front axle of a 6.5T level not only meets performance requirements of Auman heavy transport vehicles, but also enhances the bearing capacity of auman heavy transport vehicles by virtue of its excellent advantage of large axle load. Front axle of a 6.5T level has a rated load of 6.5T and can carry a load of 8T on a road in good condition

Precautions

1. Care shall be taken not to overload front axle in operation, and effect of shock load shall be avoided.
2. Inspection and maintenance shall be carried out on front axle in accordance with specified mileage. During maintenance, dismantle the hub to check hub bearing and fill lubricating grease, and check the matching of knuckle king pin and sleeve at the same time, if sintering or excessive clearance is detected, replace them. Attention must be paid to the concentricity while reaming the knuckle king pin and sleeve.
3. Front shaft is connected with the carriage by parabolic leaf spring. Attention shall be paid to the Testing & Adjustment of front wheel alignment dimensions while installing front shaft.
4. The initial tension of knuckle is 10~50 N·m (the difference between two sides is no more than 10 N·m), and the rotation of knuckle shall be flexible without obvious blocking phenomena. Both clearance between bracket and gasket and surface bearing clearance shall be no more than 0.15 mm.
5. The involute direction of camshaft agrees with the bracket direction, namely "S" for the left, and inverse "S" for the right. The direction of adjusting arm agrees with the bracket direction, and hexagonal head of worm faces upward.
6. Prior to the use of a new axle, fill sufficient Lithium Grease No.2 into each butter nozzle, so that each member can be well lubricated.
7. After the axle is installed for use, forced maintenance and bearing pretightening force inspection shall be simultaneously carried out on it together with engine and gearbox after a complete-vehicle driving for 2000-4000 Km, at the same time, brake clearance must be adjusted and fastening of fasteners in every position must be rechecked before being formally put into use.
8. Regular inspection must be carried out on the air plug of axle housing, and the dirt and dust on it shall be cleaned to prevent oil leakage caused by the increase of oil pressure inside the axle as a result of blockage.
 - For every 2000 Km, fill Lithium Grease No.2 into each butter nozzle and clean air plug.
 - For every 5000 Km, check brake clearance.
 - For every 8000-10000 Km, check the fastening of brake base plate; check the loosening of hub bearing.
9. Parts may be stained with greasy dirt and mud. Cleaning of parts is an essential process. Some damaged parts may be detected in the cleaning process. Thus, care must be taken in the cleaning process. After cleaning of parts, use a specially prepared survey meter or tool to carry out inspection. Judge whether parts are suitable for use in accordance with the specified maintenance standard. Damaged parts shall be repaired or replaced as required. If one of mating parts is seriously worn and its fit-up gap is beyond the specified value, the parts or mating parts can be replaced as required.
10. In view of preventive maintenance, some parts within the repair or wear limit range shall be replaced before they go beyond the limit range.
11. For rubber parts, such as O-rings, oil seals, sealing washers, etc., when they are dismantled, judge whether to disuse them according to circumstances.

Charging System (WD615) – Charging System

Fault Symptom Table

Use the table below to help you find the cause of the fault. If necessary, replace these parts.

Symptom	Possible Cause	Reference
Heating of bearing	1. Hub bearing (Pretightening force is too big)	Chapter 24, Front Axle - Front Axle assembly - Front Wheel Bearing, Overhaul
	2. Hub bearing (Oil leakage)	Chapter 24, Front Axle - Front Axle assembly - Front Wheel Bearing, Overhaul
Heating of brake drum-	1. Brake chamber (Failing to return or slowly returns when brake process is finished)	Chapter 26, Service Brake - Front Brake Chamber, Overhaul
	2. Brake shoe and brake drum (No clearance therebetween)	Chapter 26, Service Brake System - Testing & Adjustment, Brake Clearance Adjustment
	3. Brake shoe return spring (Broken)	Chapter 26, Service Brake - Front Brake Shoe, Overhaul
Waddle or whipping of front wheels	1. Front wheels (Different pressures)	Chapter 23, Wheel & Tire - Wheels and Tire Assembly, Testing & Adjustment
	2. Wheels (Unbalanced)	Chapter 23, Wheel & Tire - Wheels and Tire Assembly, Testing & Adjustment
	3. Shock absorber (Failed)	Chapter 21, Front Mounting - Front Shock Absorber, Overhaul
	4. Steering mechanical (Severely worn)	Chapter 42, Power Steering Mechanism - Steering Gear Assembly, Overhaul Chapter 42, Power Steering Mechanism - Steering Drag Link, Replacement
Brake deviation	1. Friction plate (Worn out at one side)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	2. Friction plate (Used incorrectly)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	3. Brake clearance (Abnormal)	Chapter 26, Service Brake - Service Brake System, Testing & Adjustment
	4. Brake chamber (Different pressures)	Chapter 26, Service Brake - Front Brake Chamber, Replacement Chapter 26, Service Brake - Rear Brake Chamber, Replacement

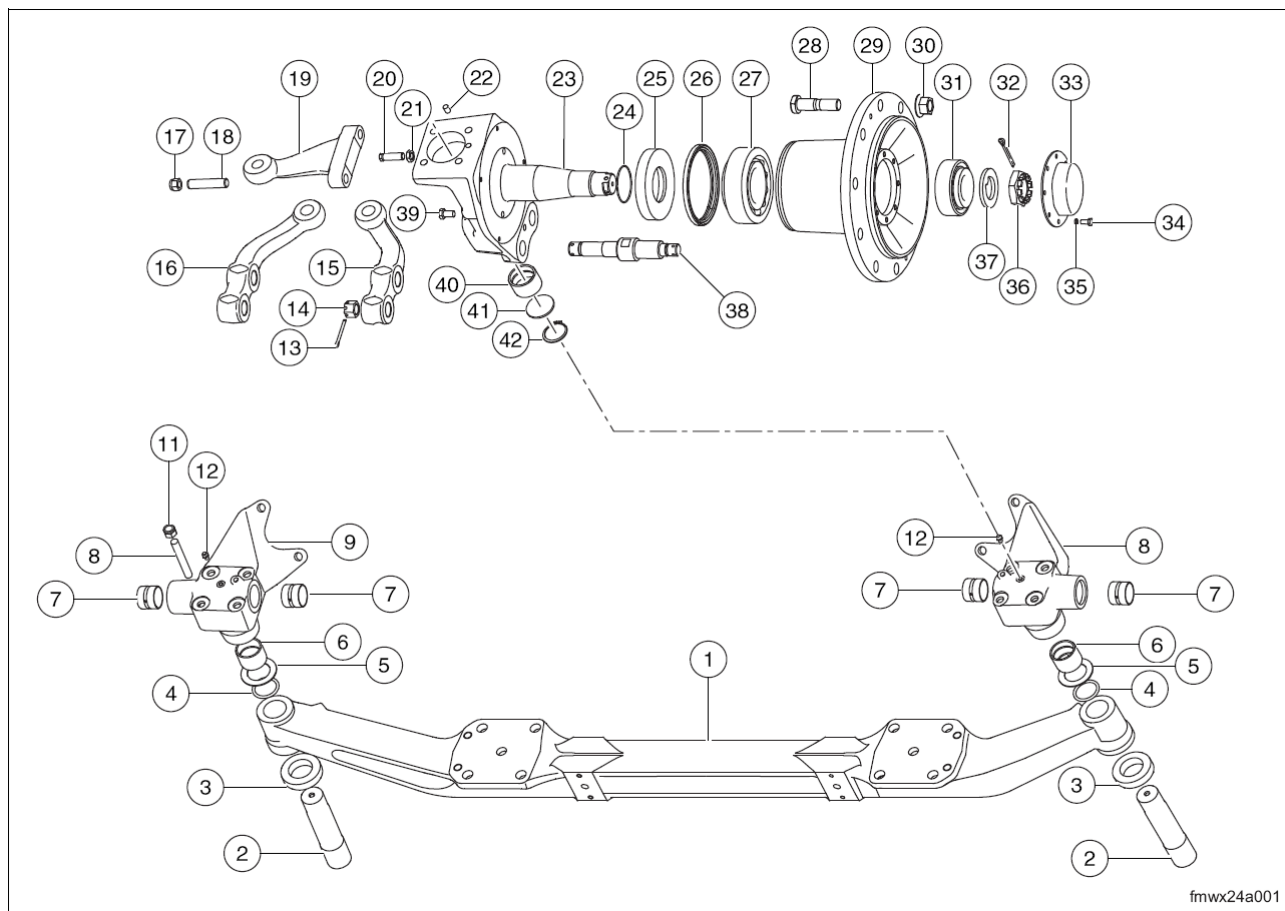
24A-6

Front Axle (Ankai) – Front Axle Assembly

Lack of braking force	1. Air compressor (Failing to work)	Chapter 16, Engine Machinery - Engine Accessories, Replacement
	2. Relay Valve (Damaged)	Chapter 26, Service Brake - Relay Valve, Replacement
	3. Brake friction plate (Hardened)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	4. Brake drum or brake friction plate (Oil stain)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	5. Brake chamber push rod (Distorted)	Chapter 26, Service Brake - Front Brake Chamber, Replacement Chapter 26, Service Brake - Rear Brake Chamber, Replacement

Charging System (WD615) – Charging System

Part Drawing



24A

1	FR Shaft
2	Knuckle Pin
3	Thrust Roller Bearing
4	O-Ring
5	Additional Washer
6	Sleeve
7	Sleeve
8	Bracket (LH)
9	Bracket (RH)
10	Stud Bolt
11	Full Metal Self-Locking Nut
12	Straight-Through Grease Nipple
13	Cotter Pin
14	Hex Slotted Flat Nut
15	Steering Tie Rod Arm (LH)

22	Cylindrical Pin
23	Knuckle
24	O-Ring
25	Spacer Ring
26	Shaft O-Ring
27	Tapered Roller Bearing
28	Wheel Bolt
29	FR Wheel Hub
30	Wheel Nut
31	Tapered Roller Bearing
32	Cotter Pin
33	Cover
34	Hex Head Bolt
35	Spring Washer
36	Hex Slotted Nut

24A-8

Front Axle (Ankai) – Front Axle Assembly

16	Steering Tie Rod Arm (RH)
17	Full Metal Self-Locking Nut
18	Stud Bolt
19	Steering Drag Link Arm
20	Adjusting Screw
21	Hex Thin Nut

37	Washer
38	Backing Pin
39	Hex Bolt
40	Sleeve
41	Cover
42	Circlip for Hole

24A



FOTON
福田汽车

Testing & Adjustment

Front Wheel Bearing

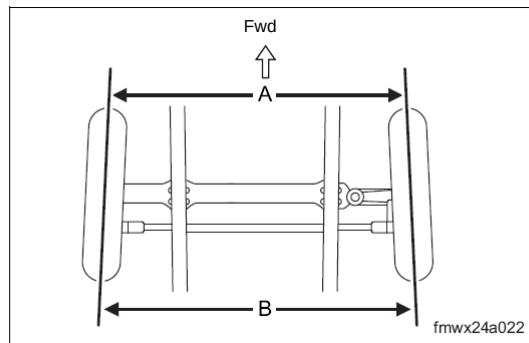
Having a regular structure, the hub is held on the knuckle spindle by two tapered roller bearings and is fixed on the knuckle spindle by slotted nut and baffle plate. After the installation of the hub, screw up the slotted nut in accordance with a torque of 250 N•m, then make a 1/6 - 1/3 back turn to ensure that the pretightening torque of bearing measured by dynamometer is 60-90 N•m and the difference between the two sides is no more than 10 N•m, align cotter pin hole of the shaft to any rabbet of the slotted nut, and lock up the cotter pin. During the installation, care must be taken of axle end oil seal, and the oil seal shall be aligned to oil seal seat so that edges of oil seal can not be damaged.

Toe-In of Front Wheel

Adjusting method for toe-in of front wheel is as follows:

1. Jack up the front axle to raise two wheels of this axle off the ground for 30 mm and enable the wheels at both sides to freely rotate and keep straight ahead.
2. Respectively make a mark in the tread center of the wheel at each side. Marking points shall be clear but not too big or too thick.
3. Rotate the marking points of the two wheels to positions in front of the wheel centers (the forward running direction of the vehicle), keep them in one horizontal plane, measure the distance between them with a measuring tape and record a data A. Respectively rotate the two wheels at both sides by 180° to keep the two marking points in one horizontal plane (which is the same with the plane for the first measurement), measure the distance between the two marking points with a measuring tape and record a data B.

Toe-in = data B - data A



4. If the result of the previous step is beyond the specified range (0~2 mm), adjust the length of the steering axle tie rod to meet the requirements.

Front Wheel Hub

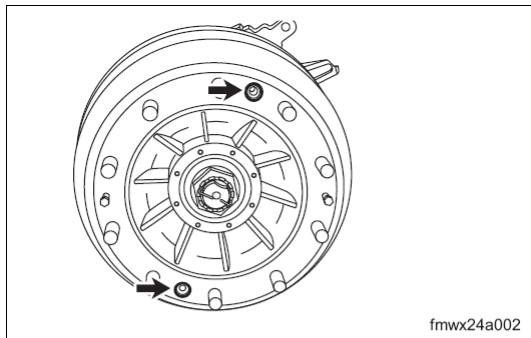
Overhaul

Hint:

Part Drawing, refer to Chapter 24, Front Axle - Front Axle Assembly, Part Drawing.

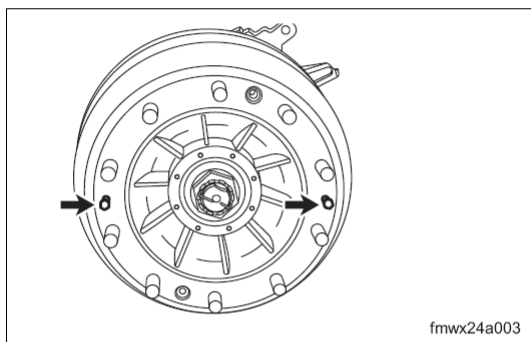
1. **Jack up head of vehicle**

2. **Dismantle front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul**

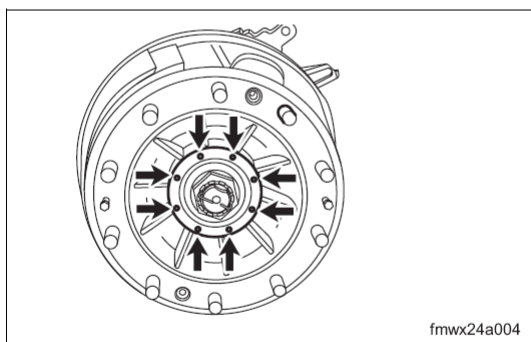


3. **Dismantle front brake drum**

(a). Dismantle two fixing screws of the brake drum with a cross screwdriver.

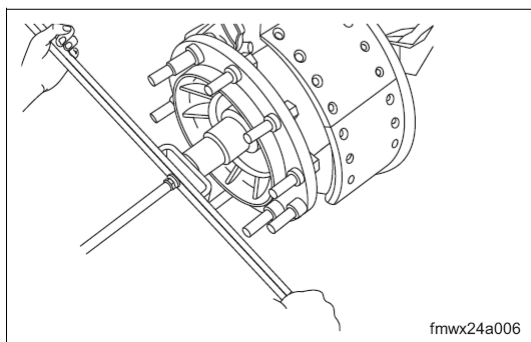


(b). Drive the brake drum out with two M10 bolts.



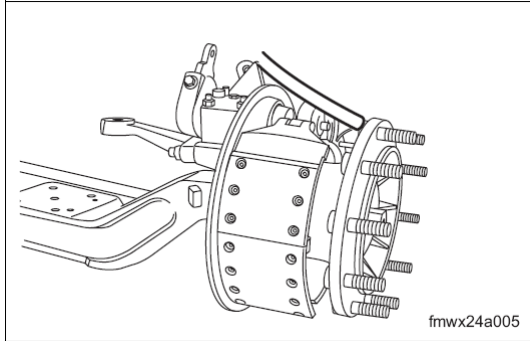
4. **Dismantle front wheel hub**

(a). Dismantle the axle end cover bolt.



(b). Remove the slotted nut cotter pin with a jaw vice, and dismantle the slotted nut.

Front Axle (Ankai) – Front Wheel Hub



- (c). Knock the hub with a copper rod until the hub is loosened, and remove the hub.

Caution:

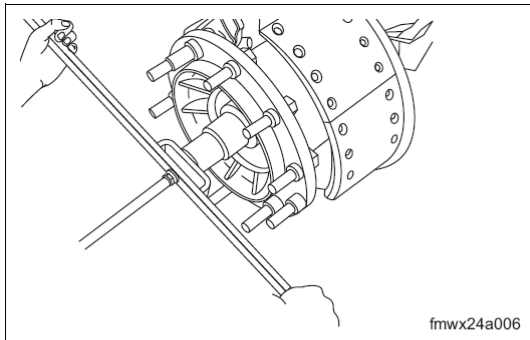
Do not use a hammer.

5. Check front wheel hub

- (a). Inspect whether the hub is cracked or worn, the oil seal is in good condition, the hub bearing is sintered or worn and the wheel bolt is broken. Replace them with new ones in case of the above-mentioned defects.

Caution:

Replace with new parts in case of any defect.

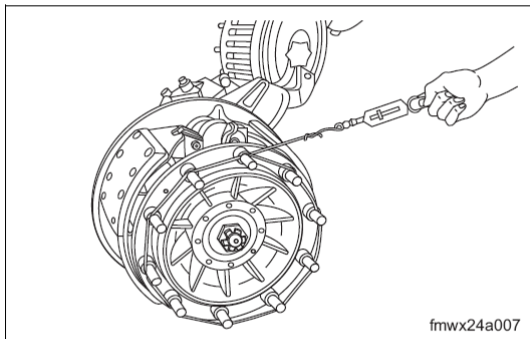
**6. Install front wheel hub**

- (a). Install the hub onto the axle end, screw down the slotted nut and then make a 1/6 - 1/3 back turn.

Torque: 250 N•m

Caution:

Fill the bearing chamber with lubricating grease.



- (b). Measure the pretightening torque of the bearing with a tension spring balance. Install the cotter pin.

Pretightening torque: 60~90 N•m

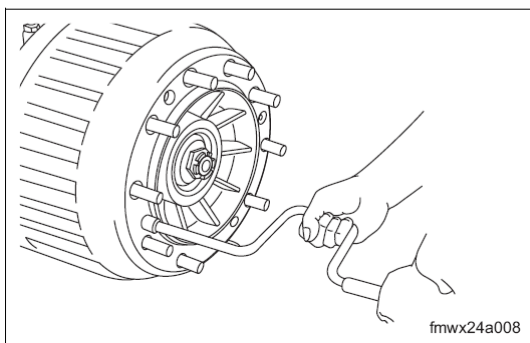
Caution:

The difference between both sides shall not be more than 10 N•m.

- (c). Install the axle end cover bolt.

Caution:

Sealant shall be applied to the surface of the axle end cover.

**7. Install front brake drum**

- (a). Install two fixing screws of the brake drum with a cross screwdriver.

Caution:

During installation, the screw holes shall be aligned to. Attention shall be paid to the protection of the tire bolt.

8. Install front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul**9. Lay down head of vehicle**

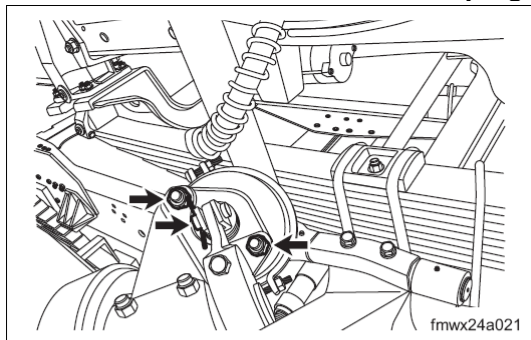
Knuckle

Overhaul

Hint:

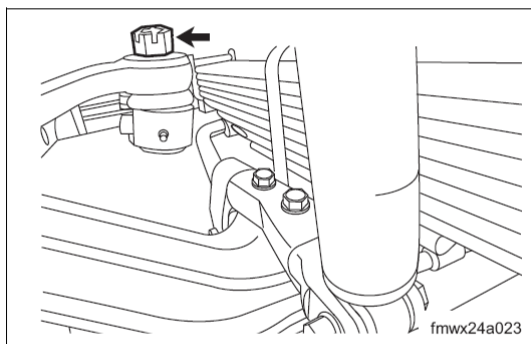
Part Drawing, refer to Chapter 24, Front Axle - Front Axle Assembly, Part Drawing.

1. **Jack up head of vehicle**
2. **Open cab**
3. **Dismantle front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul**
4. **Dismantle front ABS sensor plug**



5. Dismantle front brake chamber

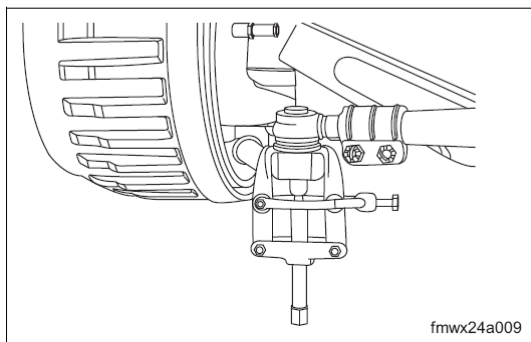
- (a). Dismantle connecting pin of the brake chamber and adjusting arm.
- (b). Dismantle fixing bolt of the brake chamber.



6. Dismantle ball locking nut of steering linkage and steering crank

Caution:
Special tools shall be used.

24A

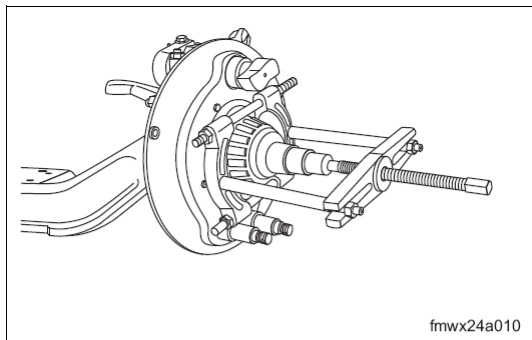


7. Dismantle ball locking nut of tie rod and drag link

Caution:
Special tools shall be used.

Front Axle (Ankai) – Knuckle

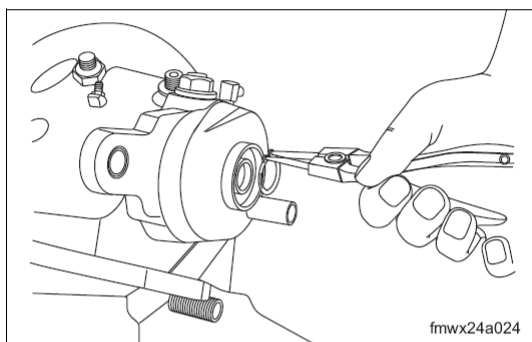
8. Dismantle front brake drum, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul
9. Dismantle front wheel hub, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul
10. Dismantle front brake shoe, refer to Chapter 26, Service Brake - Front Brake Shoe, Overhaul



11. Dismantle bearing in front wheel hub

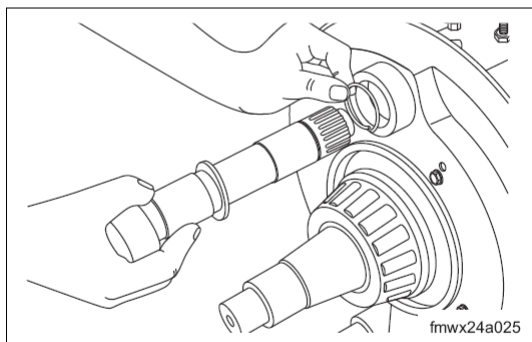
Caution:

Special tools shall be used.



12. Dismantle brake adjusting arm

- (a). Remove circlip and adjusting washer on the brake adjusting arm with circlip pliers.

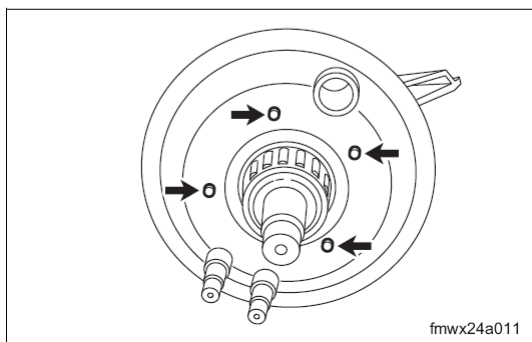


13. Dismantle brake camshaft

- (a). Draw out the brake camshaft from cam end, and remove O-ring and washer.

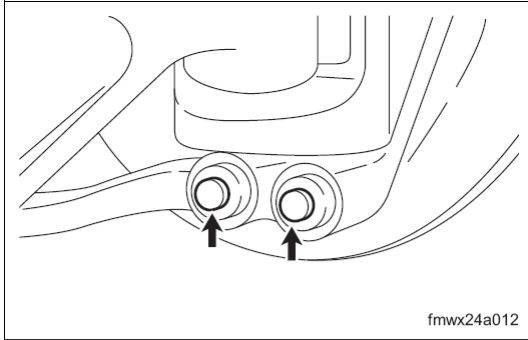
Caution:

Check the O-ring, and replace it if damaged.

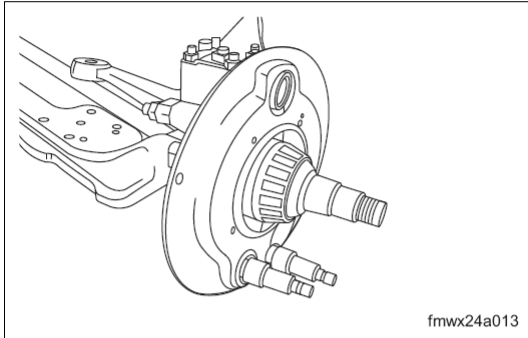


14. Dismantle brake dust cover

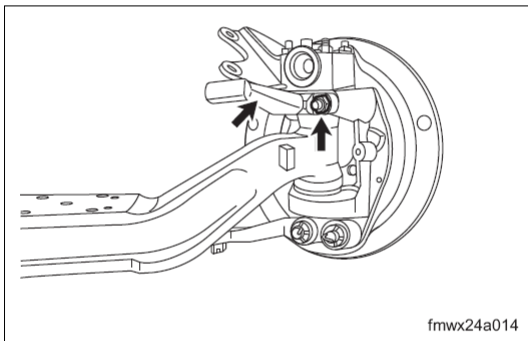
- (a). Dismantle fixing bolt of the brake dust cover.



- (b). Dismantle fixing nut of the tie rod crank.

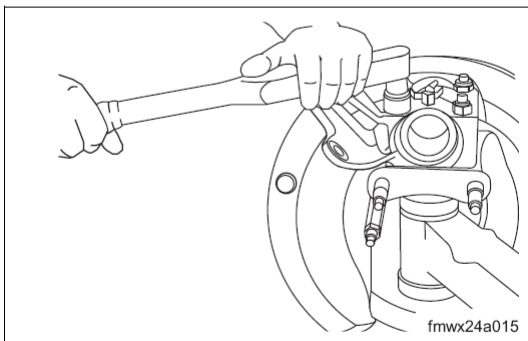


- (c). Knock the support pin shaft with a copper rod, and remove the support pin shaft and brake dust cover.



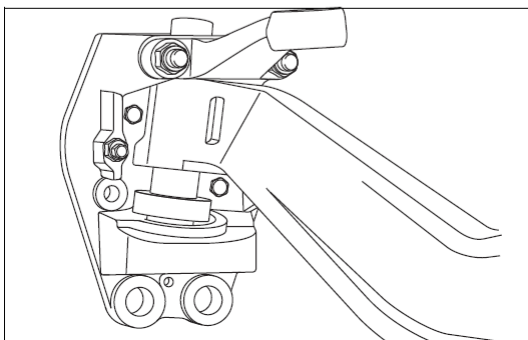
15. Dismantle steering drag link crank

- (a). Dismantle fixing bolt of the steering drag link crank.



16. Dismantle camshaft bracket

- (a). Dismantle fixing nut of the camshaft bracket.
(b). Remove the camshaft bracket together with upper sleeve of the king pin.



17. Dismantle knuckle

- (a). Hold up the lower end of the knuckle by hand, and draw it out to disconnect the lower end of the knuckle from the knuckle pin. Hold up the knuckle by hand to disconnect it from the knuckle pin, and remove the knuckle and thrust bearing.

Front Axle (Ankai) – Knuckle

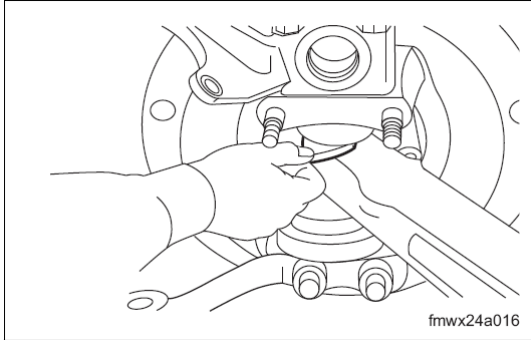
18. Check knuckle for crack, wear, sintering, etc., and replace it if any.

19. Install knuckle

- (a). Sheath thrust roller bearing of the knuckle on the lower axle end of the king pin, and then push the knuckle upwards into the king pin. Install adjusting washer of the camshaft seat, and install the camshaft support in the upper end of the king pin.

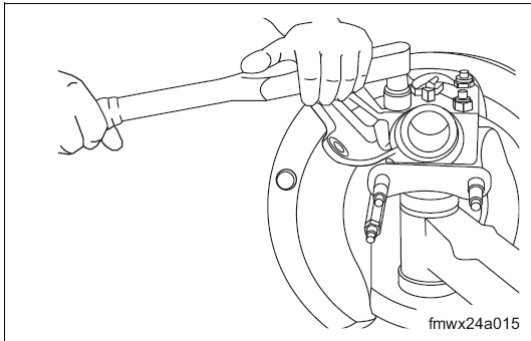
Caution:

The side of the thrust roller bearing having smaller hole size faces upward.



- (b). After installing fixing nut of the camshaft bracket, measure the axial clearance of the upper end of the king pin with a thickness gauge.

Clearance: 0.05~0.1 mm



- (c). Tighten fixing nut of the camshaft bracket in accordance with the torque.

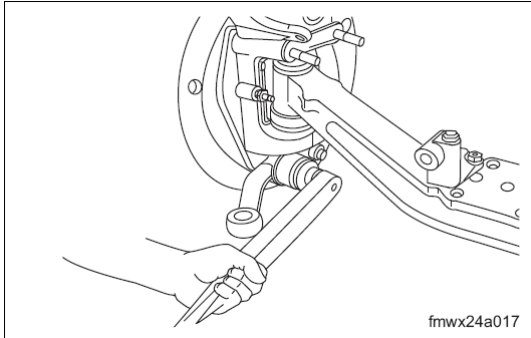
Torque: 140 N·m

Caution:

If the replacement of stud bolt is required, thread at the end from which the knuckle is put into needs to be spread with thread fastening glue.

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20. Install brake dust cover and support pin shaft



21. Install tie rod crank

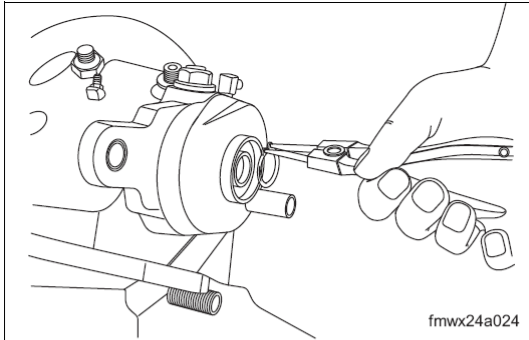
Torque: 300 N·m

22. Install brake camshaft

- (a). Check the diameter of the camshaft and the size of the sleeve. Replacement shall be carried out if they do not meet the standard. The sleeves can be reamed with a reamer, and attention shall be paid to the concentricity of the two sleeves.

Caution:

The interchange of the left and right parts of the camshaft is not permitted, and lubricating grease shall be applied between two slide shaft diameters of the camshaft.

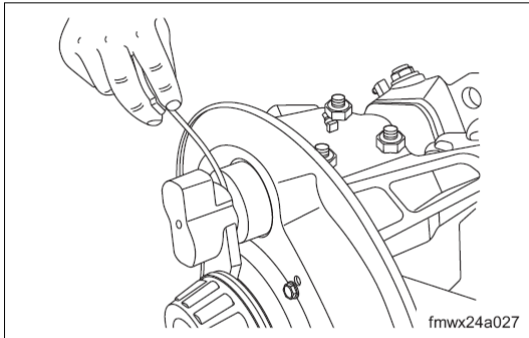


23. Install front brake adjusting arm

- (a). Install the axial adjusting gasket on the shaft, and then lock it up with a locating circlip.

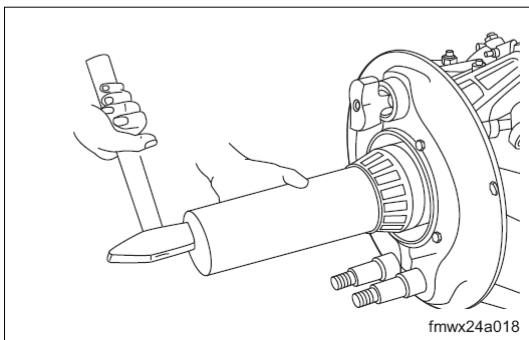
Caution:

Spline teeth at the end part of the camshaft shall be wholly put into the adjusting arm.



- (b). Measure the axial clearance of the camshaft with a thickness gauge. The thickness of the adjusting gasket shall be adjusted if it does not meet the standard.

Clearance: 0.1 mm



24. Install bearing in front wheel hub

- (a). Knock in the bearing inner ring with special tools.

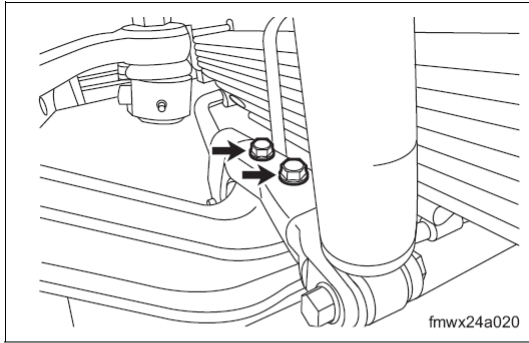
25. Install front brake shoe, refer to Chapter 26, Service Brake - Front Brake Shoe, Overhaul
26. Install front wheel hub, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul
27. Install front brake drum, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul
28. Adjust brake shoe clearance, refer to Chapter 26, Service Brake - Service Brake System, Testing & Adjustment
29. Install tie rod and drag link, and adjust toe-in. Refer to Chapter 24, Front Axle - Front Axle Assembly, Testing & Adjustment
30. Install ball locking nut of steering linkage and steering crank
Torque: 275~335 N•m
31. Install front brake chamber
32. Install ABS sensor
33. Install front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul
34. Close cab
35. Lay down head of vehicle

Front Axle Overhaul

Hint:

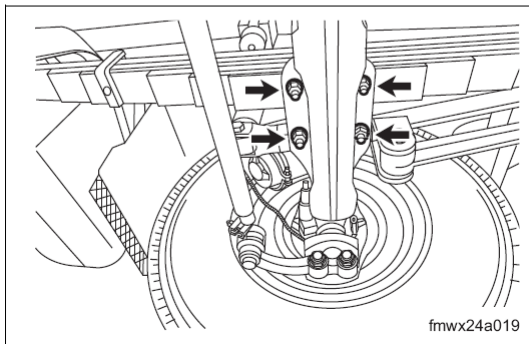
Part Drawing, refer to Chapter 24, Front Axle A - Front Axle Assembly, Part Drawing.

1. **Jack up head of vehicle**
2. **Open cab**
3. **Dismantle front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul**
4. **Dismantle front wheel hub, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul**
5. **Dismantle knuckle, refer to Chapter 24, Front Axle - Knuckle, Overhaul**



6. **Dismantle front fixing bolt of front shock absorber support**

- (a). Jack the front axle with a pneumatic hydraulic jack.
- (b). Dismantle fixing bolt of the front shock absorber support.



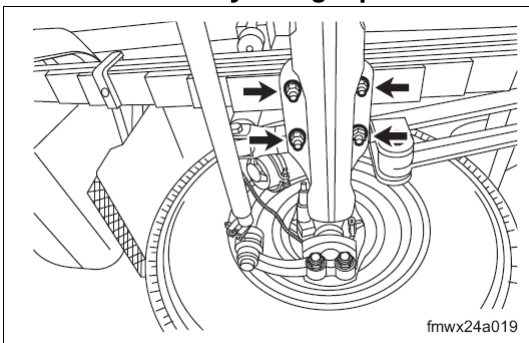
7. **Dismantle U-bolt of front leaf spring**

- (a). Dismantle U-bolt of the front leaf spring.
- (b). Lay down the pneumatic hydraulic jack, and draw out the front axle.

8. **Check front axle for crack, wear, bending, etc., and replace it if any.**

Caution:

Since the king pin and H-beam hole of front axle form a tight fit, the king pin needs to be pressed downwards out by using a press.

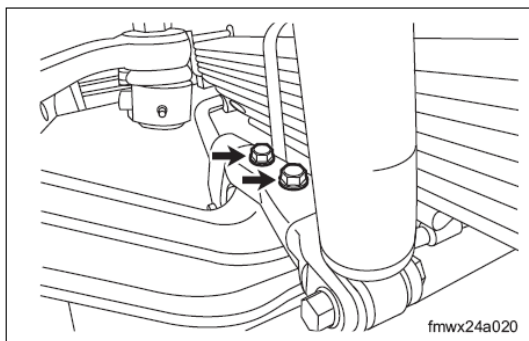


9. **Install U-bolt of front leaf spring**

- (a). Place the front axle under the head of vehicle, and jack the front axle by using a pneumatic hydraulic jack.

- (b). Install U-bolt of the front leaf spring.

Torque: 260~300 N•m



10. Install fixing bolt of front shock absorber support
Torque: 268 N•m

11. Install knuckle, refer to Chapter 24, Front Axle - Knuckle, Overhaul
12. Install front wheel hub, refer to Chapter 24, Front Axle - Front Wheel Hub, Overhaul
13. Install front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul
14. Close cab
15. Lay down head of vehicle

Front Axle (Triring)

Front Axle Assembly.....	24B-3
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Fault Symptom Table.....	24B-4
Testing & Adjustment.....	24B-5
Front Wheel Hub.....	24B-6
Part Drawing.....	24B-6
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Knuckle	24B-11
Part Drawing.....	24B-11
Overhaul.....	24B-12
Front Axle	24B-16
Replacement	24B-16

24B

Front Axle Assembly

Precautions

1. Care shall be taken not to overload front axle in operation, and effect of shock load shall be avoided.
2. Inspection and maintenance shall be carried out on front axle in accordance with specified road haul. During maintenance, dismantle the hub to check hub bearing and fill lubricating grease, and check the matching of knuckle king pin and sleeve at the same time, if sintering or excessive clearance is detected, replace them. Attention must be paid to the concentricity while reaming the knuckle king pin and sleeve.
3. Front shaft is connected with the carriage by parabolic leaf spring. Attention shall be paid to the Testing & Adjustment of front wheel alignment dimensions while installing front shaft.
4. The initial tension of knuckle is 10~50 N·m (the difference between two sides is no more than 10 N·m), and the rotation of knuckle shall be flexible without obvious blocking phenomena. Both clearance between bracket and gasket and surface bearing clearance shall be no more than 0.15 mm.
5. The involute direction of camshaft agrees with the bracket direction, namely "S" for the left, and inverse "S" for the right. The direction of adjusting arm agrees with the bracket direction, and hexagonal head of worm faces upward.
6. Prior to the use of a new axle, fill sufficient Lithium Grease No.2 into each butter nozzle, so that each member can be well lubricated.
7. After the axle is installed for use, forced maintenance and bearing pretightening force inspection shall be simultaneously carried out on it together with engine and gearbox after a complete-vehicle driving for 2000-4000 Km, at the same time, brake clearance must be adjusted and fastening of fasteners in every position must be rechecked before being formally put into use.
8. Regular inspection must be carried out on the air plug of axle housing, and the dirt and dust on it shall be cleaned to prevent oil leakage caused by the increase of oil pressure inside the axle as a result of blockage.
 - For every 2,000 Km, fill Lithium Grease No.2 into each butter nozzle and clean air plug.
 - For every 5,000 Km, check brake clearance.
 - For every 8,000-10,000 Km, check the fastening of brake base plate; check the loosening of hub bearing.
9. Parts may be stained with greasy dirt and mud. Cleaning of parts is an essential process. Some damaged parts may be detected in the cleaning process. Thus, care must be taken in the cleaning process. After cleaning of parts, use a specially prepared survey meter or tool to carry out inspection. Judge whether parts are suitable for use in accordance with the specified maintenance standard. Damaged parts shall be repaired or replaced as required. If one of mating parts is seriously worn and its fit-up gap is beyond the specified value, the parts or mating parts can be replaced as required.
10. In view of preventive maintenance, some parts within the repair or wear limit range shall be replaced before they go beyond the limit range.
11. For rubber parts, such as O-rings, oil seals, sealing washers, etc., when they are dismantled, judge whether to disuse them according to circumstances.

Fault Symptom Table

Use the table below to help you find the cause of the malfunction. If necessary, replace these parts.

Symptom	Possible Cause	Reference
Heating of bearing	1. Hub bearing (Pretightening force is too big)	Chapter 24, Front Axle - Front Axle assembly - Front Wheel Bearing, Overhaul
	2. Hub bearing (Oil leakage)	Chapter 24, Front Axle - Front Axle assembly - Front Wheel Bearing, Overhaul
Heating of brake drum-	1. Brake chamber (Failing to return or slowly returns when brake process is finished)	Chapter 26, Service Brake - Front Brake Chamber, Overhaul
	2. Brake shoe and brake drum (No clearance therebetween)	Chapter 26, Service Brake System - Testing & Adjustment, Brake Clearance Adjustment
	3. Brake shoe return spring (Broken)	Chapter 26, Service Brake - Front Brake Shoe, Overhaul
Waddle or whipping of front wheels	1. Front wheels (Different pressures)	Chapter 23, Wheel & Tire - Wheels and Tire Assembly, Testing & Adjustment
	2. Wheels (Unbalanced)	Chapter 23, Wheel & Tire - Wheels and Tire Assembly, Testing & Adjustment
	3. Shock absorber (Failed)	Chapter 21, Front Mounting - Front Shock Absorber, Overhaul
	4. Steering mechanical (Severely worn)	Chapter 42, Power Steering Mechanism - Steering Gear Assembly, Overhaul Chapter 42, Power Steering Mechanism - Steering Drag Link, Replacement
Brake deviation	1. Friction plate (Worn out at one side)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	2. Friction plate (Used incorrectly)	Chapter 26, Service Brake - Front Brake Shoe, Replacement Chapter 26, Service Brake - Rear Brake Shoe, Replacement
	3. Brake clearance (Abnormal)	Chapter 26, Service Brake - Service Brake System, Testing & Adjustment
	4. Brake chamber (Different pressures)	Chapter 26, Service Brake - Front Brake Chamber, Replacement Chapter 26, Service Brake - Rear Brake Chamber, Replacement

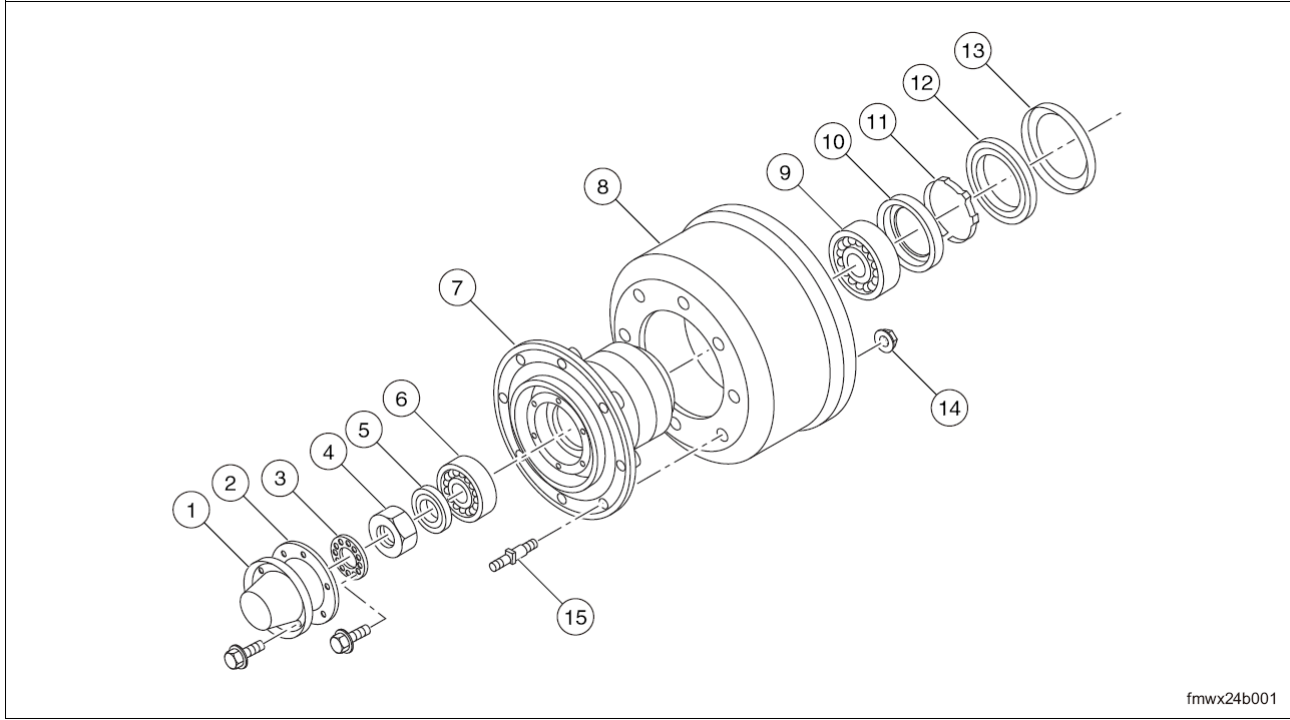
Front Axle (Triring) – Front Axle Assembly

Testing & Adjustment

Refer to Chapter 24, Front Axle A - Front Axle Assembly, Testing & Adjustment

Front Wheel Hub

Part Drawing



1	Hub Cover
2	Gasket
3	Washer
4	Hub Nut
5	Locking Washer
6	Outer Bearing
7	Hub
8	Brake Drum

9	Inner Bearing
10	Cover
11	Fixing Ring
12	Oil Seal
13	Exciter Ring
14	Drum Nut
15	Wheel Pin

Front Axle (Triring) – Front Wheel Hub

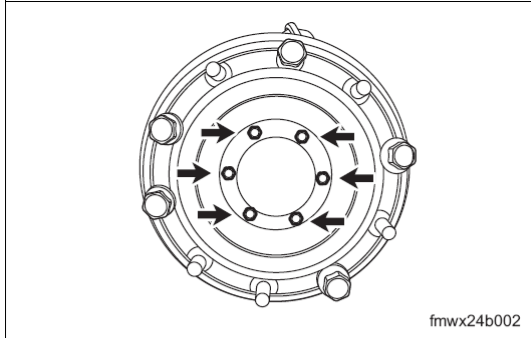
Overhaul

Hint:

Part Drawing, refer to Chapter 24, Front Axle B - Front Wheel Hub, Part Drawing.

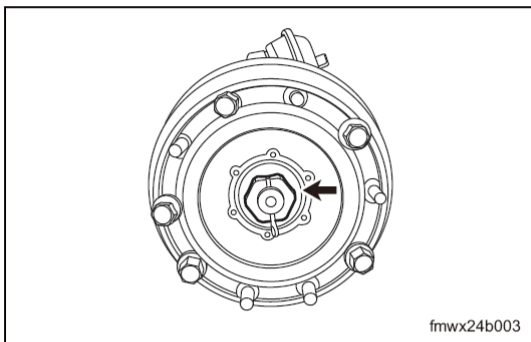
1. Jack up head of vehicle

2. Dismantle front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul



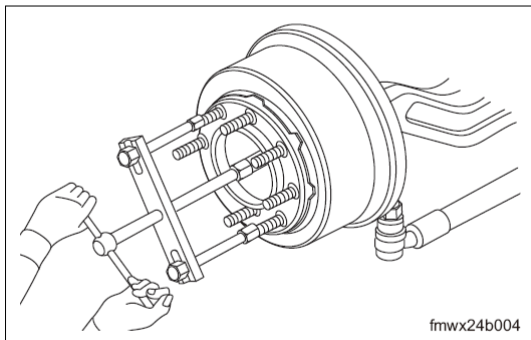
3. Dismantle front wheel hub assembly

(a). Dismantle fixing bolt of the front wheel hub cover.

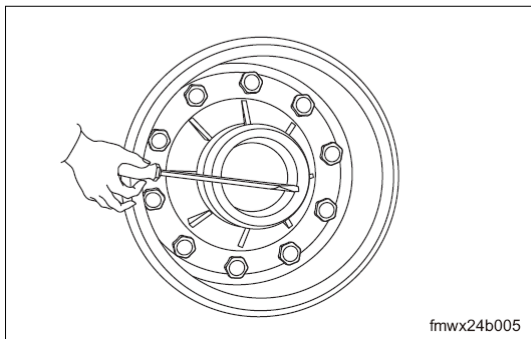


(b). Remove the cotter pin, and dismantle the hub nut and locking washer.

(c). Remove the outer bearing.

Caution:**Ensure that dirt, dust, etc. are not let in the hub or bearing.**

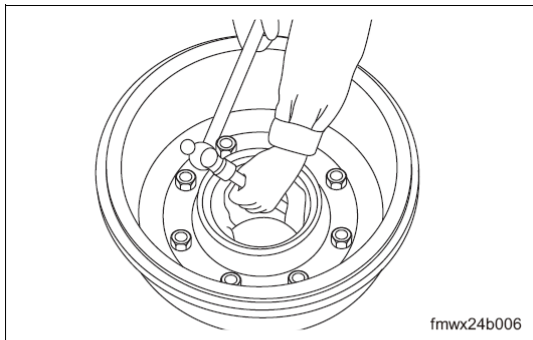
(d). Dismantle the front wheel hub assembly with a hub puller.

Caution:**During the dismantlement of the hub, do not operate the brake or parking brake. Make sure not to hurt yourself or others, because these parts are particularly heavy.**

4. Dismantle hub oil seal

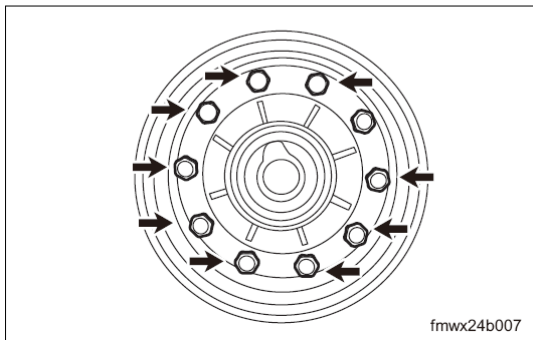
(a). Dismantle the hub oil seal with a screwdriver or similar tool.

Caution:**The oil seal removed can not be used for a second time, and it must be replaced with a new one.**



5. Dismantle bearing outer ring

- (a). With the help of either of two spiral grooves at the inner side of the hub, knock out the outer bearing outer ring and inner bearing outer ring with a copper rod.

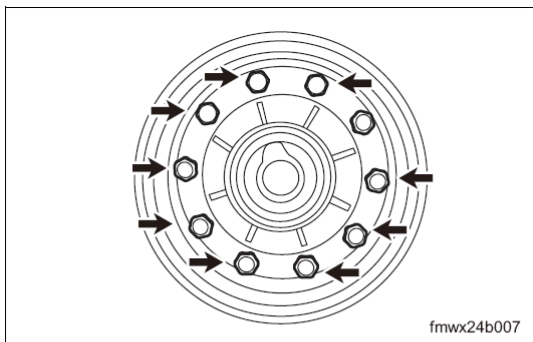


6. Dismantle wheel pin and nut

Caution:

Ensure that the inner side of the brake drum is not damaged.

7. Check brake drum for out-of-round, crack, ablation, etc., and replace it if any.



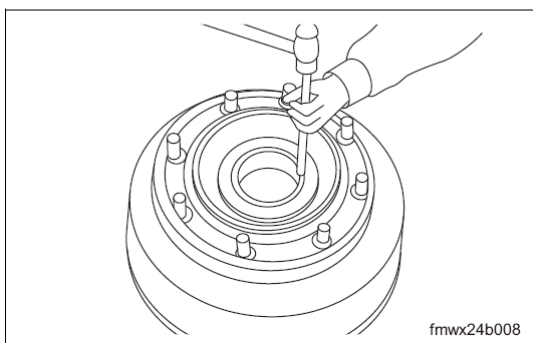
8. Install wheel pin and nut

- (a). Apply the thread fastening glue, and install the wheel pin and nut.

Torque: 600 N•m

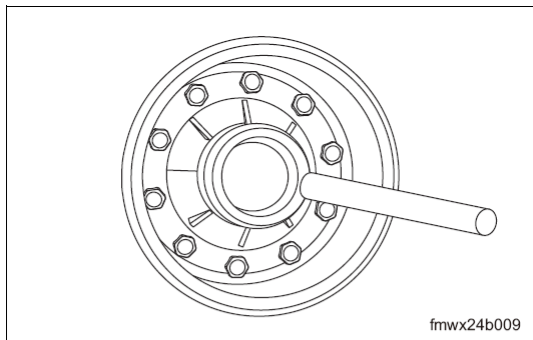
Caution:

If the thread is damaged, the wheel pin must be replaced with a new one.



9. Install bearing outer ring.

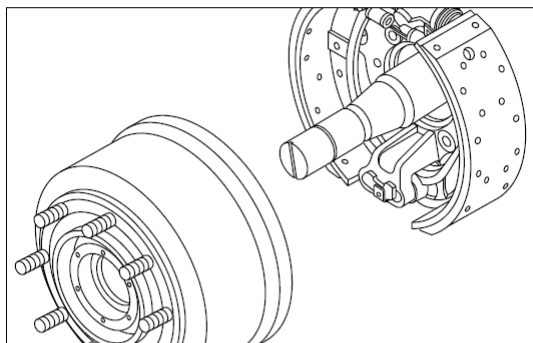
- (a). Knock the inner and outer bearing outer rings into the hub with a copper rod.

Front Axle (Triring) – Front Wheel Hub**10. Install hub oil seal**

- (a). Knock the oil seal into the hub with a copper rod.

Caution:

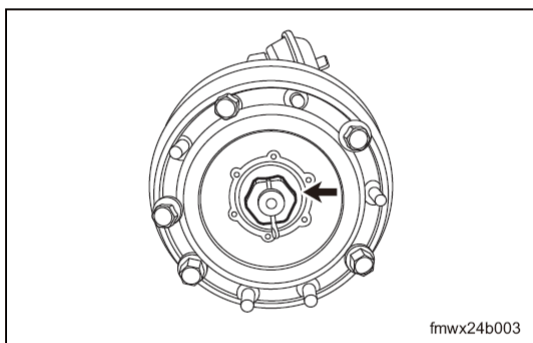
New oil seal must be used.

**11. Install front wheel hub**

- (a). Fill the hub bearing with new lubricating grease.

Caution:

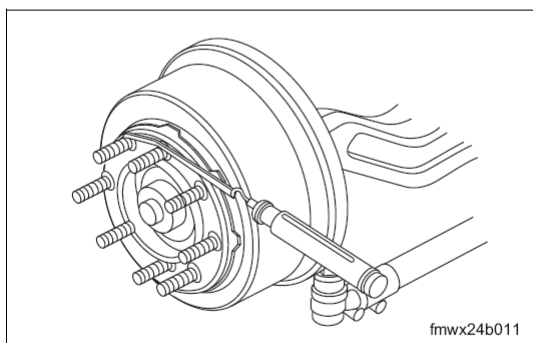
Ensure that dirt, dust, etc. are not let in the hub or bearing. Make sure not to hurt yourself or others, because these parts are particularly heavy.



- (b). Install the outer bearing.

- (c). Install the locking washer, screw up the hub nut and then make a 1/6 - 1/3 back turn.

Torque: 300 N•m

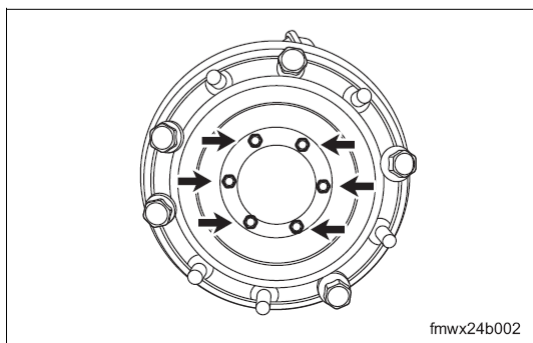


- (d). Measure the pretightening torque of the bearing with a tension spring balance. Adjust the pretightening torque to a designated value by tightening the hub nut. Install the cotter pin.

Pretightening torque: 6~10 N•m

Caution:

The difference between both sides shall not be more than 10 N•m.



- (e). Install fixing bolt of the front wheel hub cover.

Torque: 20~25 N•m

Caution:

The hub cover shall be fully filled with lubricating grease.

24B-10

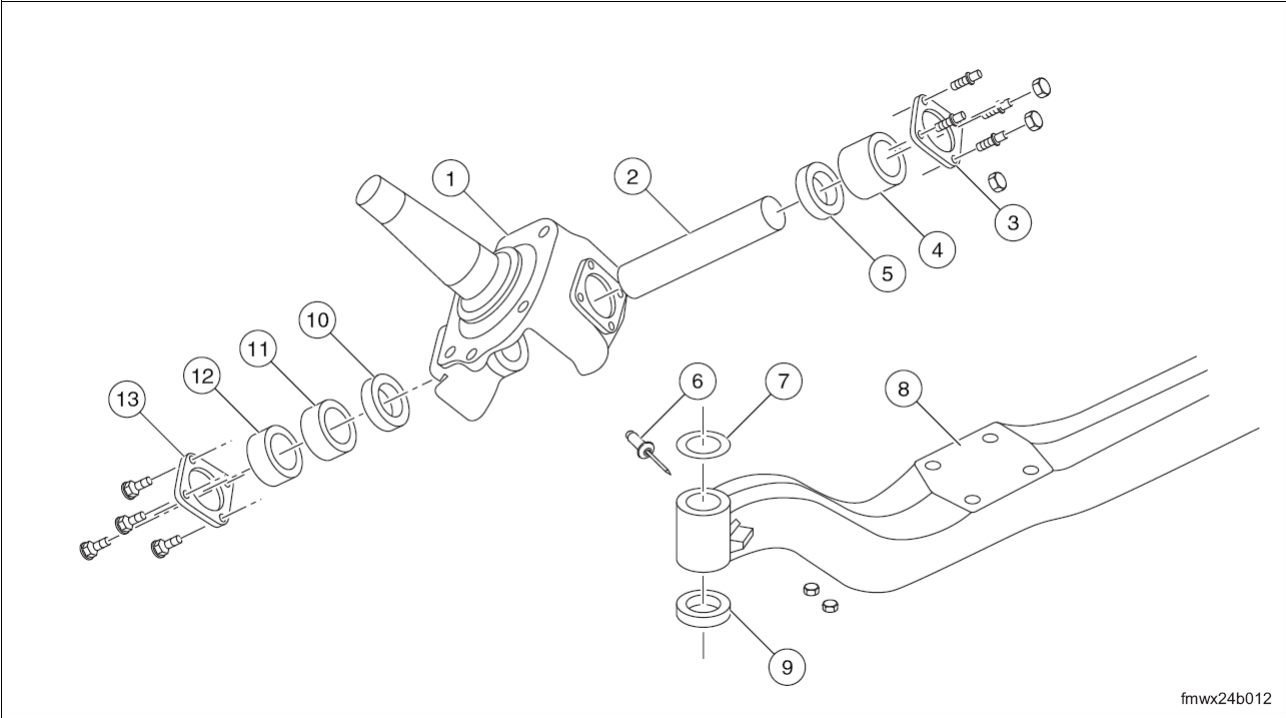
Front Axle (Triring) – Front Wheel Hub

12. Install front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul
13. Lay down head of vehicle

24B

Front Axle (Triring) – Knuckle

Knuckle
Part Drawing



1	Knuckle
2	Knuckle king pin
3	Upper Cover
4	Needle Bearing
5	Seal
6	Key Pin Bolt
7	Thrust Washer

8	Front Axle
9	Thrust Bearing
10	Bearing
11	Needle Bearing
12	Needle Bearing
13	Lower Cover Plate

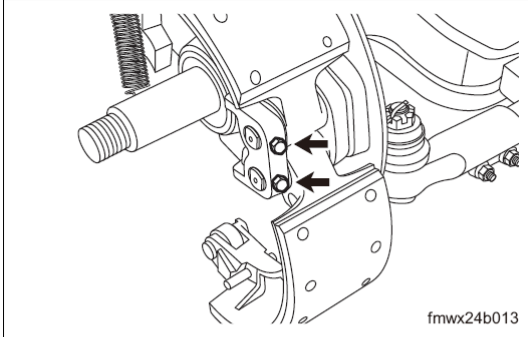
24A

Replacement

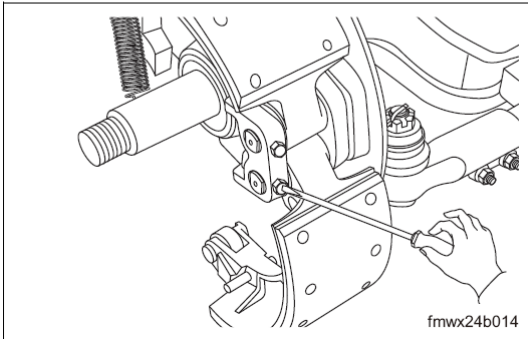
Hint:

Part Drawing, refer to Chapter 24, Front Axle B - Knuckle, Part Drawing.

1. **Jack up head of vehicle**
2. **Dismantle front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul**
3. **Dismantle front wheel hub, refer to Chapter 24, Front Axle B - Front Wheel Hub, Overhaul**

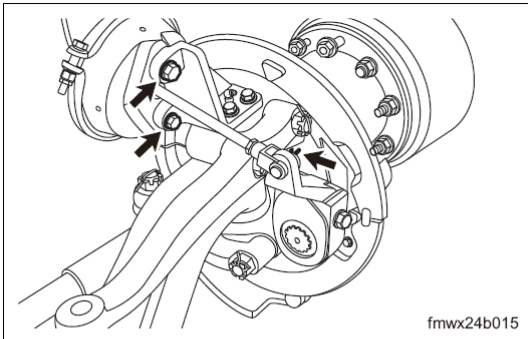


4. **Dismantle front brake shoe**
 - (a). Dismantle return spring of the front brake shoe.
 - (b). Dismantle fixing bolt of the brake shoe pin shaft.

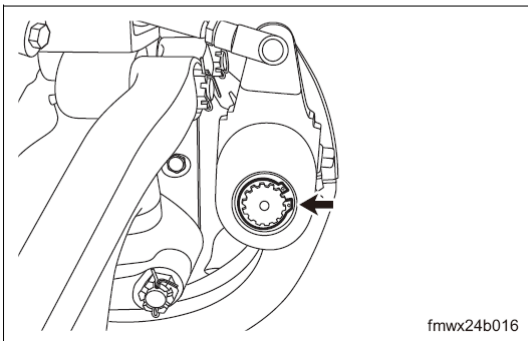


- (c). Dismantle the brake shoe pin shaft with a screwdriver, and remove the brake shoe.

24B

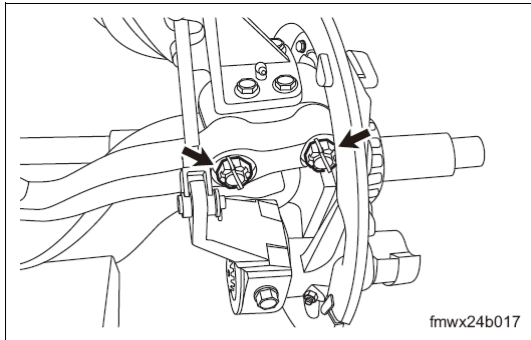


5. **Dismantle front brake chamber**
 - (a). Dismantle cotter pin of the front brake chamber pin shaft, and remove the pin shaft.
 - (b). Dismantle fixing bolt of the front brake chamber, and remove the brake chamber.

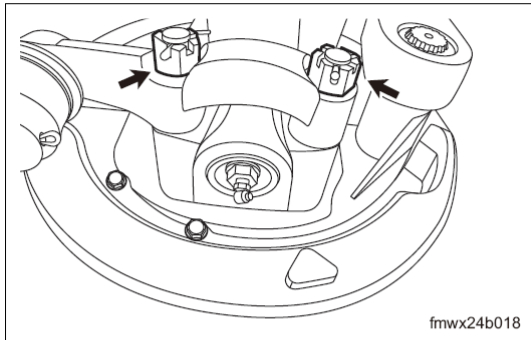


6. **Dismantle front brake camshaft**
 - (a). Dismantle fixing circlip of the brake adjusting arm, and remove the brake adjusting arm.
 - (b). Remove the brake camshaft.

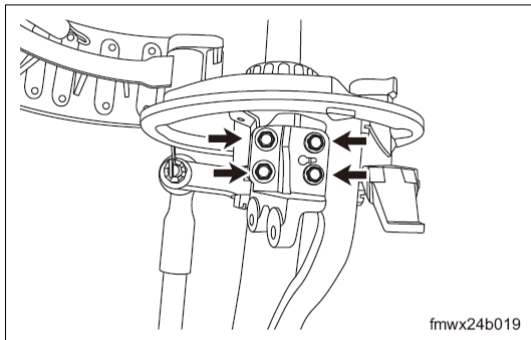
Front Axle (Triring) – Knuckle



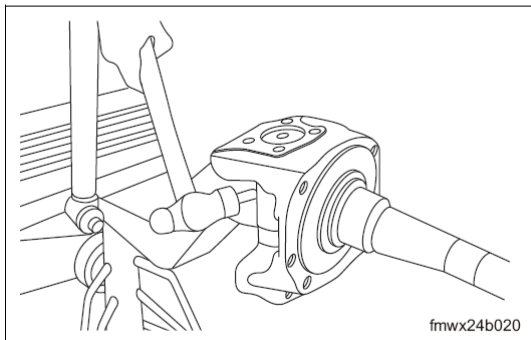
- 7. Dismantle steering drag link crank**
(a). Dismantle fixing nut of the steering drag link crank.



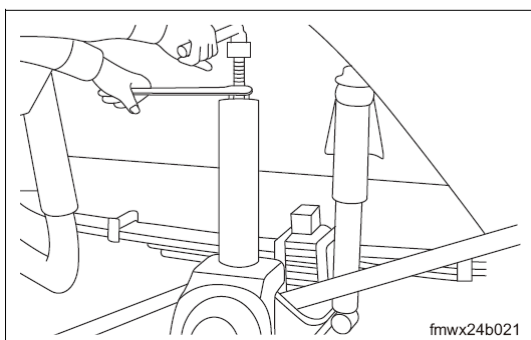
- 8. Dismantle tie rod crank**
(a). Dismantle the tie rod ball.
(b). Dismantle fixing nut of the tie rod crank.



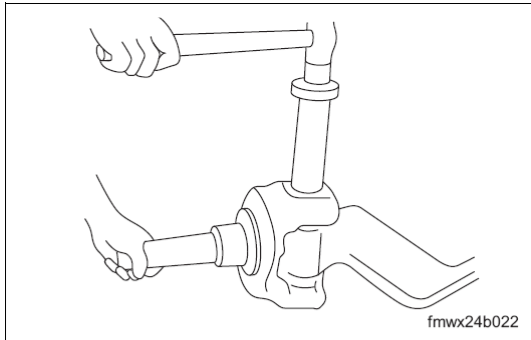
- 9. Dismantle knuckle upper cover**
(a). Dismantle fixing bolt of the knuckle upper cover.



- 10. Dismantle key pin bolt**
(a). Loosen the nut, align the surface to tip of the key pin bolt, and then knock down the key pin bolt with a copper rod.

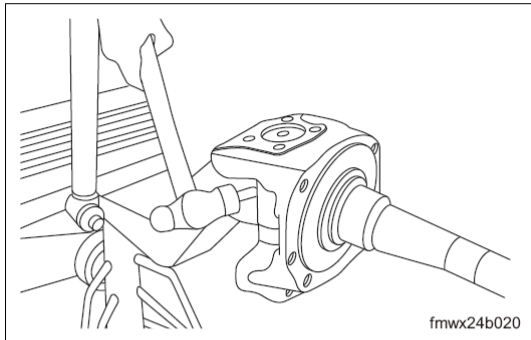


- 11. Dismantle knuckle assembly**
(a). Dismantle the knuckle king pin with a puller.
(b). Remove the knuckle, thrust bearing and thrust washer.
(c). Check the parts removed, and replace them with new ones if any defect is detected.



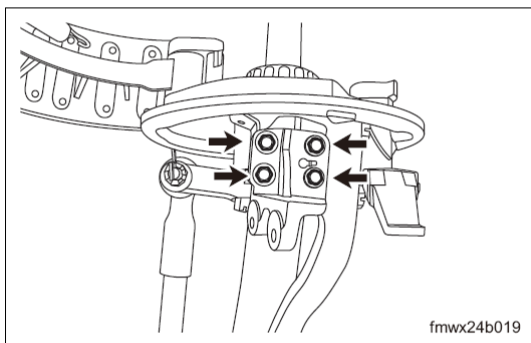
12. Install knuckle assembly

- (a). Install the knuckle, thrust bearing and thrust washer.
- (b). Knock in the knuckle king pin.



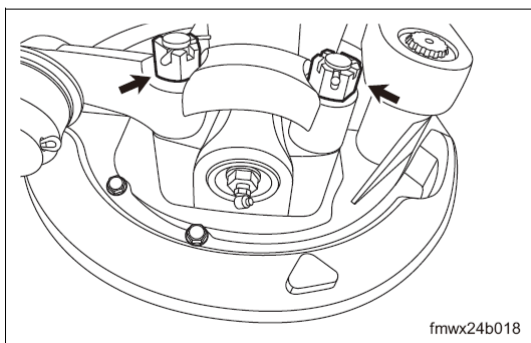
13. Install key pin bolt

- (a). Knock in the key pin bolt.
Torque: 250~300 N•m



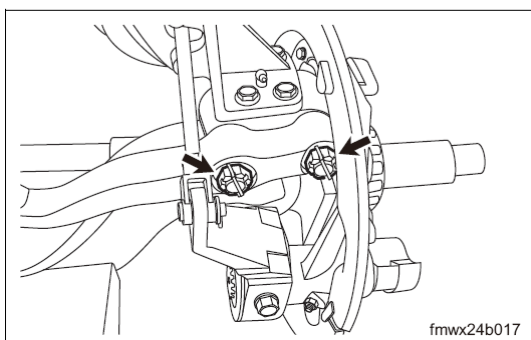
14. Install knuckle upper cover

- (a). Install fixing bolt of the knuckle upper cover.
Torque: 160 N•m



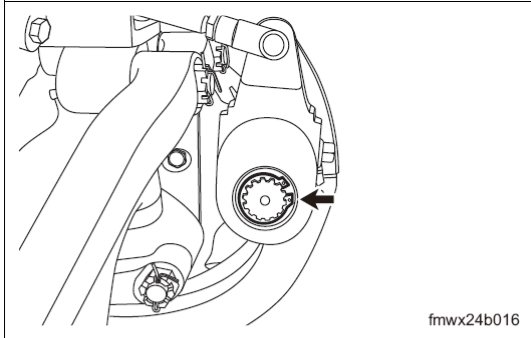
15. Install tie rod crank

- (a). Install fixing nut of the tie rod crank.
- (b). Install the tie rod ball.
Torque: 250~340 N•m

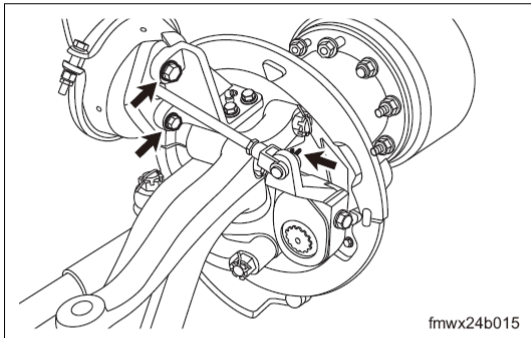


16. Install steering drag link crank

- (a). Install fixing nut of the steering drag link crank.
Torque: 290~340 N•m

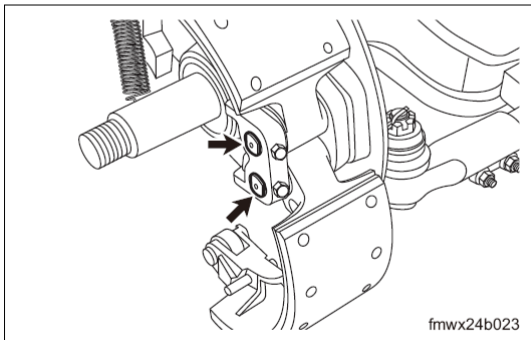
Front Axle (Triring) – Knuckle**17. Install front brake camshaft**

- (a). Install the brake camshaft.
- (b). Install fixing circlip of the brake adjusting arm.

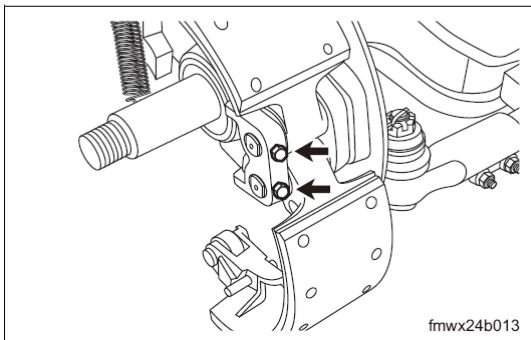
**18. Install front brake chamber**

- (a). Install fixing bolt of the front brake chamber.
- (b). Install the front brake chamber pin shaft, and install the cotter pin.

Torque: 160 N•m

**19. Install front brake shoe**

- (a). Install the brake shoe, and install the brake shoe pin shaft.



- (b). Install fixing bolt of the brake shoe pin shaft.
- (c). Install return spring of the front brake shoe.

Torque: 240~300 N•m

- 20. Install front wheel hub, refer to Chapter 24, Front Axle B - Front Wheel Hub, Overhaul
- 21. Install front wheels, refer to Chapter 23, Tire & Wheel - Front Tire & Wheel, Overhaul
- 22. Adjust toe-in, refer to Chapter 24, Front Axle B - Front Axle Assembly, Testing & Adjustment
- 23. Lay down head of vehicle

Front Axle Replacement

Hint:

Refer to Chapter 24, Front Axle A - Front Axle, Overhaul.

Rear Axle

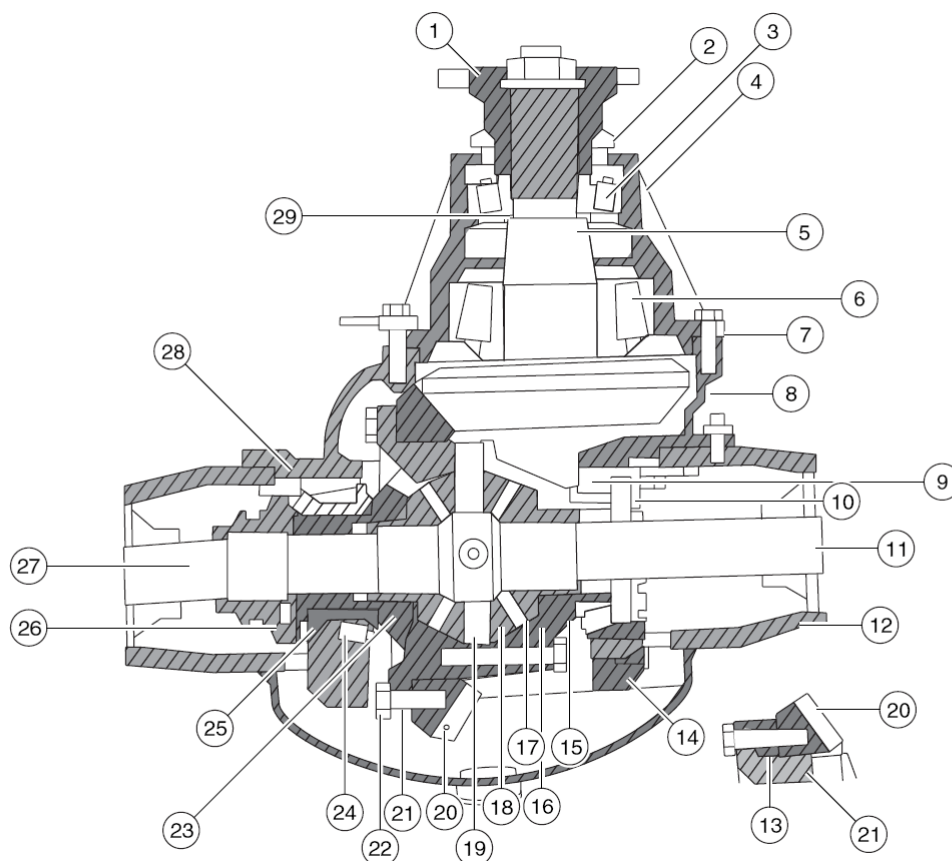
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& Planet Gear Assembly.....	25-33
Overhaul	25-33

Rear Axle Assembly

General

The Kunlun heavy truck model adopts driving types of 4×2, 6×4 or 6×6. The driving rear axle is a common one with central single reduction plus wheel planet gear reduction. According to different service conditions, it is classified into a common version and an enhanced version which are the same in their structure and all other parts but different in the thickness of the axle housing. The thickness of the axle housing of the common type is 16 mm, while the thickness of the axle housing of the enhanced type is 20 mm. Generally, the axle housing of the enhanced type is used for an engineering truck for off-highway use.

The differential lock device is installed on the left axle shaft of the driving rear axle and the differential housing. The differential lock mesh sleeve is fixed on the differential housing with slotted nuts. The differential lock closing mesh sleeve is erected on the spline shaft of the left axle shaft. When the vehicle runs on a muddy road and wheels on one side slip, the control on the differential lock switch will introduce compressed air to the differential lock working cylinder through the electromagnetic valve, the piston push rod of the working cylinder will enable the mesh sleeves to be meshed with each other through the shift fork, so that the axle shafts and the differential housing are connected into a whole, in other words, the left and right axle shafts are integrated so as to smoothly drive the vehicle out of the muddy road. The driving rear axle adopts the wheel planet reduction mechanism to increase the speed ratio and reduce the size of the central main reducer, so that the ground clearance of the chassis is increased and the universality of the vehicle is improved. Power is sequentially transmitted to the driving flange 1 and driving gear shaft 5 through the drive shaft, and is then transmitted to the differential through the driven gear 20. The differential comprises the cross shaft 19, four planet gears 18, two axle shaft gears 17,23 and two half differential housings 15,21. The two half differential housings 15,21 are connected into a whole by the connection bolt, and therefore, the cross shaft rotates simultaneously when the differential housing rotates, the planet gears revolve to simultaneously drive the left and right axle shaft gears 17,23 to rotate, so that the left and right axle shafts transmit power to the left and right wheels at equal torque. When the vehicle makes a turn, the number of rotation turns of the steering inner wheels shall be less than that of the outer wheels, the planet gears revolve and rotate around the cross shaft as a result of the torque balance, so that the differential between the two axle shaft gears is generated, that is, the less turns the steering inner wheel rotate, the more turns the steering outer wheels synchronously rotate, thus realizing the differential effect to ensure the smoothness of the vehicle in the turning process. The driving rear axle is shown in the figure below.

Rear Axle – Rear Axle Assembly

fmwx250001

1	Flange Assembly	16	Thrust Gasket of RH Axle Shaft Gear
2	Oil Seal	17	RH Axle Shaft Gear
3	Driving Gear Outer Bearing	18	Planet Gear & Spherical Washer
4	Driving Gear Bearing Seat	19	Cross Shaft
5	Driving Gear Shaft	20	Driven Gear
6	Driving Gear Inner Bearing	21	Differential LH Housing
7	Adjusting Gasket	22	Thrust Gasket of LH Axle Shaft Gear
8	Main Reducer Housing	23	LH Axle Shaft
9	Differential RH Bearing	24	Differential LH Bearing
10	Adjusting Nut of Differential RH Bearing	25	Differential Mesh Sleeve
11	RH Axle Shaft	26	Differential Mesh Sleeve
12	Axle Housing	27	LH Axle Shaft
13	Driven Gear Washer	28	Adjusting Nut of Differential LH Bearing
14	Differential Bearing Cap	29	Adjusting Washer
15	Differential RH Housing		

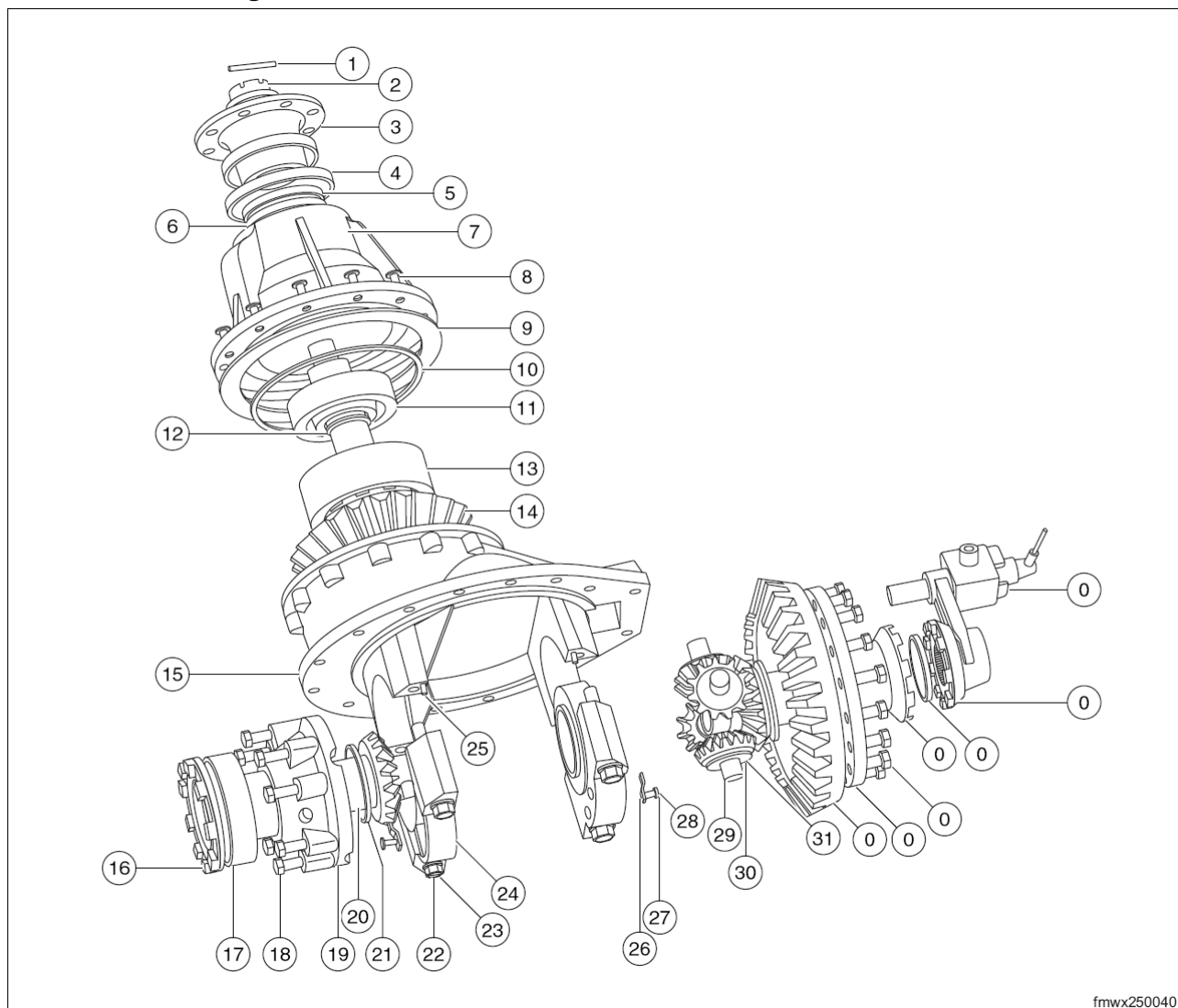
Precautions

1. Prior to maintenance, be familiar with the system structure principle as well as the overhaul process specification on system maintenance to improve maintenance efficiency and accuracy of fault judgment; during lifting of the vehicle, pay attention to the support position of the vehicle, and avoid damage of vehicle parts and occurrence of safety accidents; inspect, dismantle and install the parts with special requirements by using special tools provided by the manufacturer.
2. During the disassembly and assembly of the differential, it shall be noted that: the differential bearing cap and bearing seat are machined in a mating way, so if there are no mating marks on the bearing cap and bearing seat, mating marks shall be printed prior to the dismantlement so as to avoid making mistakes in the reassembling process, (although the bearing cap and bearing seat are provided with pins, attention shall still be paid to the printing of mating marks). Generally, in order to ensure the well-adjusted bearing fit clearance, it is better to make mating marks on the planet gear and cross shaft in the disassembling process of the planet cross shaft, so that they can keep the original well-adjusted fit during the reassembly.
3. The rear axle main reducer and wheel reducers use gear oil of AP1GL-5 grade and SAE85W/90 viscosity; generally, the oil capacity of the main reducer is 6 L, and the oil capacity of each wheel reductor is 2 L or so; the drain interval of the driving rear axle gear oil is 40000 Km, and the gear oil shall be replaced during the forced maintenance for the first 2000~4000 Km. The oil level of wheel reductor preferably reaches such as a normal position that it can be touched by extending fingers straight into the threaded hole after opening the oil filler bolt when the filler hole is in the highest position.
4. Prior to the use of a new axle, the rear axle fills sulfur-phosphorous type, AP1 GL-5 grade, 85W/90 viscosity heavy-load gear oil of about 12 L into the main reducer from the rear cover oil filler hole; the intermediate axle fills gear oil of about 4 L into the intermediate axle main reducer from the gap bridge box cover oil filler hole, and then fills gear oil of 12 L into the main reducer from the rear cover oil filler hole; each wheel reductor is filled with gear oil of 3.5 L from each wheel oil filler hole. Caution: pipe thread sealant shall be spread prior to tightening of the oil filler/drain plug. Oil shall be so filled that the oil level can overflow; sufficient Lithium Grease No.2 shall be filled into each butter nozzle, so that each member can be well lubricated.
5. Regular inspection shall be carried out on the oil filler and oil drain plug of the intermediate axle and rear axle, the sealing gasket shall be tightened or replaced in time if oil leakage is detected, and the copper gasket for the oil filler and oil drain plug must be replaced after oil changing/filling twice, otherwise oil leakage may occur due to its deformation; dirt and dust on the air plug of axle housing shall be regularly inspected and cleaned to prevent oil leakage caused by the increase of oil pressure inside the axle as a result of blockage.
6. For every 2000 Km, fill Lithium Grease No.2 into each butter nozzle and clean air plug; check the axle housing inner gear for oil level (by opening the oil level plug).
7. During the maintenance of axle assembly with differential lock, the axle shaft with differential lock must be removed with the differential lock closed when it needs to be removed, otherwise the mesh sleeve will fall off accordingly, and the main reducer assembly has to be dismantled.
8. Use of differential lock: the vehicle must be at a speed of 10~15 km/h, the differential lock can not be closed until the clutch is released, then the indicator lamp is on, and meanwhile, the vehicle can run straight only. When the differential lock is used, it is forbidden to turn the vehicle by using the steering wheel, otherwise the differential gear will be broken; after the use of vehicle differential lock, the differential lock shall be removed immediately after the vehicle goes out of the fault road surface, otherwise serious accidents of severe tire wear and differential breaking will be resulted in.

Fault Symptom Table

Use the table below to help you find the cause of the fault. Sequence number indicates the priority of possible causes of the fault. Check each part in order. If necessary, replace these parts.

Symptom	Possible Position	Reference
Oil leakage	1. Input shaft of central reducer	Chapter 25, Rear Axle - Driving Gear and Bearing, Overhaul
	2. O-ring between Hub and Planet Carrier Axle End	Chapter 25, Rear Axle - Axle Shaft, Overhaul
	3. O-ring between Hub Oil Seal Seat and Axle Housing Shaft Pipe	Chapter 25, Rear Axle - Hub Bearing and Oil Seal, Overhaul
	4. Hub Oil Seal	Chapter 25, Rear Axle - Hub Bearing and Oil Seal, Overhaul
Heating of Hub	1. Hub Bearing (Pretightening force is too strong)	Chapter 25, Rear Axle - Hub Bearing and Oil Seal, Overhaul
Overheating of Brake Drum	1. Brake Mechanical	Chapter 25, Rear Axle - Hub Bearing and Oil Seal, Overhaul
	2. Brake Control Air Circuit System	Chapter 26, Service Brake - Rear Brake Chamber, Overhaul
Abnormal Noises of Central Drive	1. Driving Shaft Bearing	Chapter 25, Rear Axle - Driving Gear and Bearing, Overhaul
	2. Differential Bearing	Chapter 25, Rear Axle - Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul
	3. Drive Gear	Chapter 25, Rear Axle - Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul
	4. Axle Housing (Deformed)	Chapter 25, Rear Axle - Rear Axle Assembly and Rear Axle Housing, Overhaul
Tires are worn by rear wheels	1. Tire Rim (Deformed)	Chapter 23, Tire & Wheel - Rear tires and Wheels, Overhaul
	2. Hub Bearing (Loosened)	Chapter 25, Rear Axle - Hub Bearing and Oil Seal, Overhaul
	3. Rear Axle (Displaced)	Chapter 25, Rear Axle - Rear Axle Assembly and Axle Housing, Overhaul

Rear Axle – Rear Axle Assembly**Part Drawing**

fmwx250040

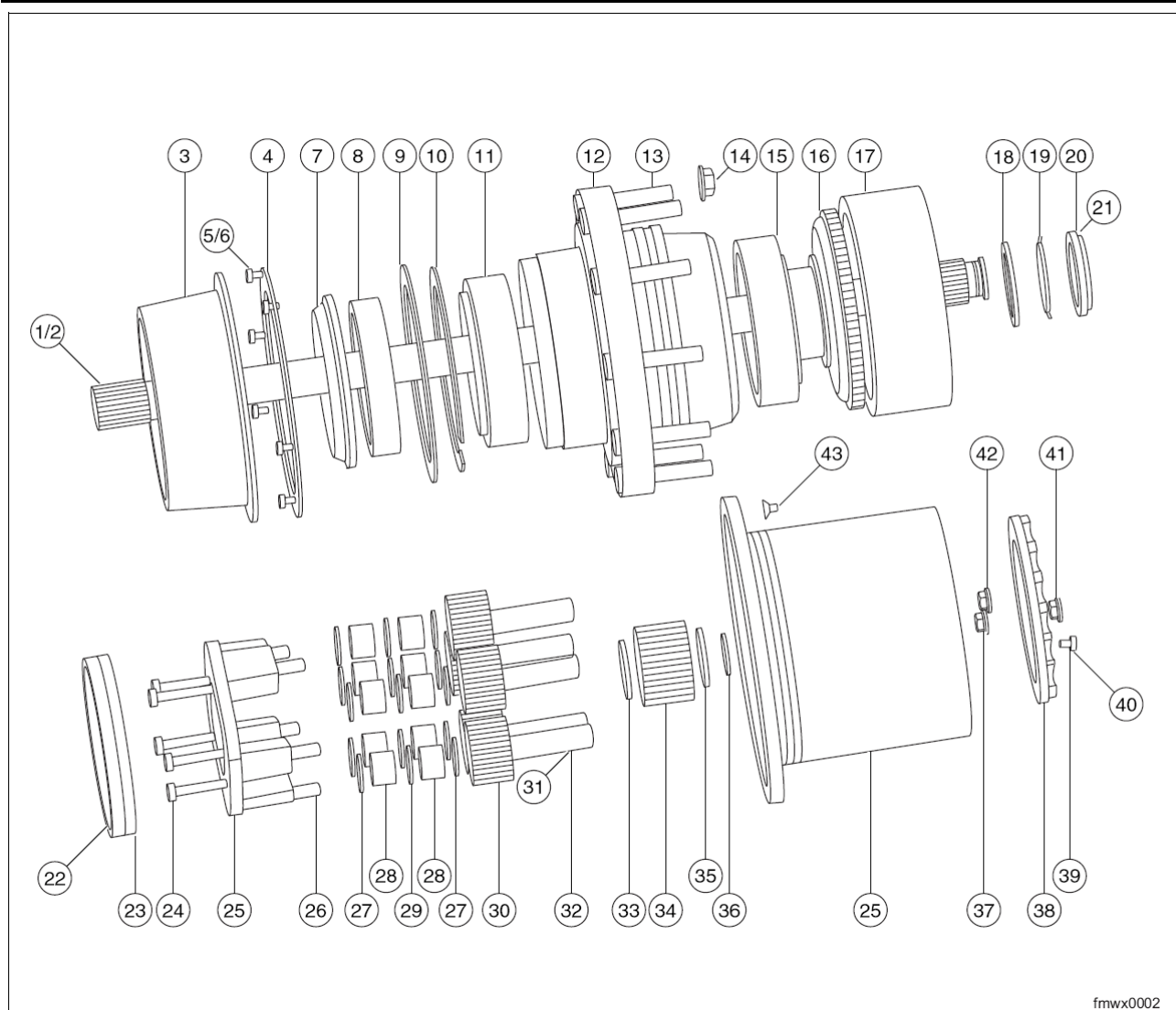
1	Cotter Pin	21	Axle Shaft Gear Gasket
2	Flange Nut	22	Stud Bolt
3	Flange Assembly	23	Hex nut
4	Oil Seal Plug	24	Bearing Cap
5	Shaft O-Ring	25	Cylindrical Pin
6	Shaft O-Ring	26	Locking Plate
7	Main Reducer Bearing Seat	27	Hex Head Bolt
8	Hex Head Bolt	28	Spring Washer
9	Adjusting Gasket	29	Cross Shaft
10	Adjusting Gasket	30	Planet Gear
11	Tapered Needle Bearing	31	Planet Gear Gasket
12	Adjusting Gasket	32	Driven Bevel Gear

Rear Axle – Rear Axle Assembly

13	Tapered Needle Bearing
14	Driving Bevel Gear
15	Main Reducer Housing
16	Adjusting Nut
17	Tapered Roller Bearing
18	Hex Head Bolt
19	Differential Housing
20	Axle Shaft Gear

33	Differential Housing
34	Hex Head Bolt
35	Spring Gasket
36	Fixing Mesh Sleeve
37	Locking Gasket
38	Round Nut
39	Differential Lock Assembly

Rear Axle – Rear Axle Assembly



fmwx0002

1	Axle Shaft (LH)
2	Axle Shaft (RH)
3	Oil Baffle Cover
4	Sealing Gasket
5	Hex Head Bolt
6	Spring Washer
7	Spacer Ring
8	Shaft O-Ring
9	Sealing Gasket
10	Circlip
11	Tapered Roller Bearing
12	RR Wheel Hub
13	Wheel Bolt

23	Planet Carrier Oil Baffle Disc
24	Hex Head Bolt
25	Planet Carrier Assembly
26	Cylindrical Pin
27	Washer
28	Needle Bearing
29	Washer
30	Planet Gear (Z-16)
31	Planet Gear Shaft
32	Steel Ball-8.0-GB308
33	Sun Gear Washer
34	Sun Gear
35	Washer

Rear Axle – Rear Axle Assembly

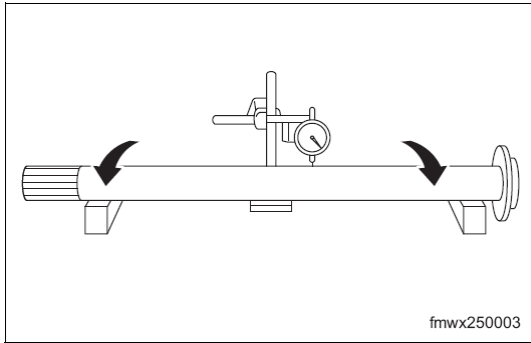
14	Wheel Nut
15	Tapered Roller Bearing
16	Ring Gear Bracket
17	Inner Ring Gear (Z-57)
18	Locking Nut
19	Axle End Locking Plate
20	Locking Nut
21	Adjusting Gasket
22	Oil Seal

36	Circlip for Shaft
37	End Cap Lifting Pin
38	End Cap
39	Hex Head Bolt (Full Thread)
40	Spring Washer
41	Oil Drain/Filler Plug
42	Oil Drain/Filler Plug
43	Cross Recessed Pan Head Screw



Testing & Adjustment

1. Check axle shaft



- (a). Measure radial runout in the middle of the axle shaft as well as runout of the inner end face of the flange with V-stage and dial indicator.

Radial runout: ≤ 1.0 mm

End-face runout: ≤ 0.15 mm

Caution:

If the radial runout and end-face runout exceed the limit values, correction shall be carried out, and the axle shaft may be replaced with a new one as required.

- (b). Check the axle shaft for crack by magnaflux.
(c). Check the spline at the axle shaft end for severe wear and obvious distortion and crack.

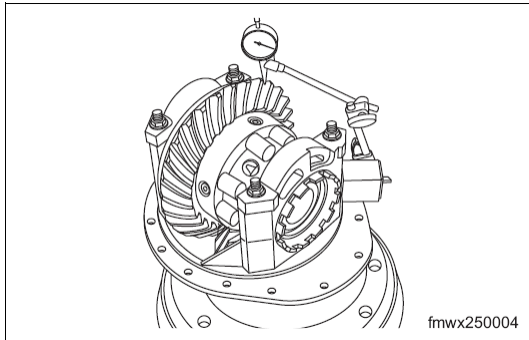
Wear of tooth thickness: ≤ 0.2 mm

Skew of tooth form: ≤ 1 mm

Caution:

If the tooth thickness wear of spline and the skew of tooth form exceed the limit values, the axle shaft shall be replaced with a new one.

2. Adjust clearance between mesh surfaces of driving gear and driven gear



- (a). Make the pointer of dial indicator perpendicular to the tooth face of the driven gear, fix the driving gear to disable its rotation, and gently rotate the driven gear. The swing range of the pointer is the flank clearance between the driving and driven gears.

Clearance: 0.2~0.4 mm

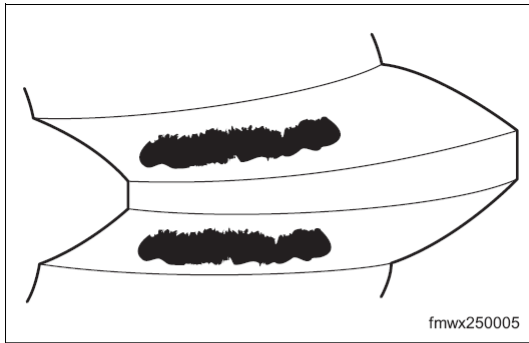
- (b). If the clearance is larger than the standard value, adjust the adjusting nuts to move the driven gear closer to the driving gear; if the clearance is smaller than the standard value, adjust the adjusting nuts to move the driven gear away from the driving gear. During the adjustment, the adjusting nuts at both ends shall be equally screwed in or out to keep the bearing pretightening force unchanged, at the same time, the slots of the adjusting nuts shall be aligned to M8 thread holes in the bearing cap to enable the locking plate to lock up the adjusting nuts.

Caution:

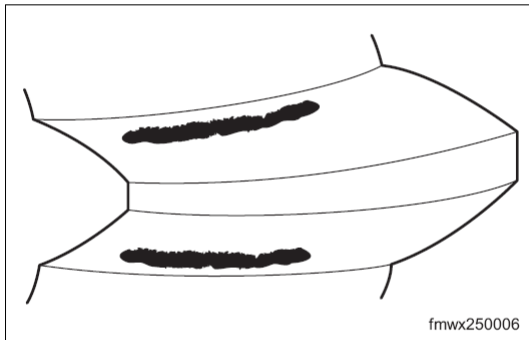
Three positions shall be selected for measurement, and three points shall be measured for each position.

3. Adjust meshing marks of driving and driven gears

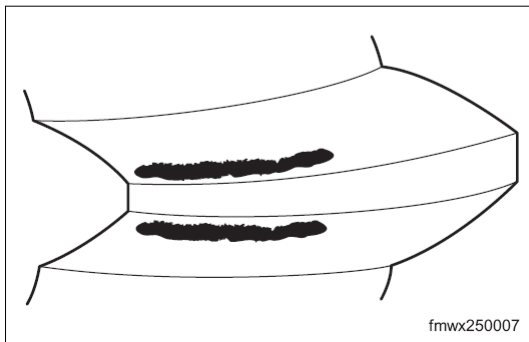
Evenly coat the driven gear with red lead powder in 2~3 positions with front and back sides of 2~3 teeth coated for each position, rotate the flange forward and backwards until contact marks are shown, and observe the contact marks of the driving and driven gears. The meshing marks of the driving and driven gears shall meet the following requirements: marks at front and back sides shall be more than 60% in both tooth length and tooth height directions, and the tooth length direction is positioned at the smaller end in the middle, while the tooth height direction is positioned in the middle. If the contact marks do not meet the requirements, adjust the adjusting gasket to satisfy its requirements. Increase the thickness of the bearing seat adjusting gasket if the marks are closer to the tooth bottom; decrease the thickness of the bearing seat adjusting gasket if the marks are closer to the small tooth top.



- (a). Correct the meshing marks.

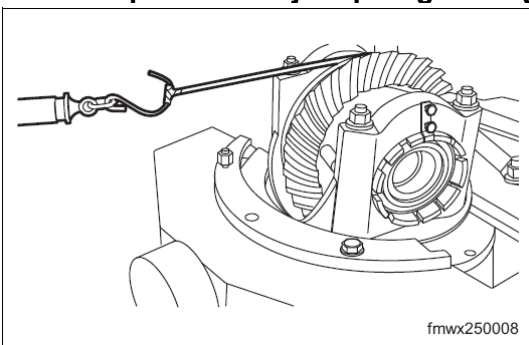


- (b). If the meshing marks are closer to the tooth top, the thickness X of adjusting gasket between the driving gear housing and the main reducer housing needs to be decreased.



- (c). If the meshing marks are closer to the tooth root, the thickness X of adjusting gasket between the driving gear housing and the main reducer housing needs to be increased.

4. Inspect and adjust pretightening force of differential bearing



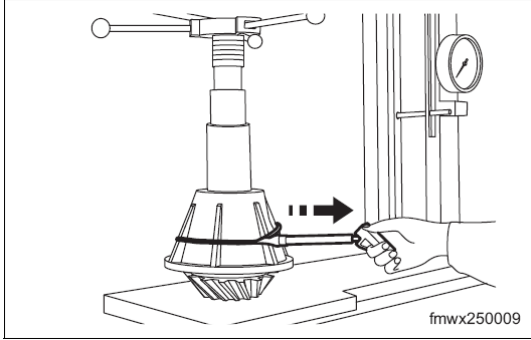
- (a). Install the differential assembly into the differential housing, sheathe the bearing cap on the bearing bolt in accordance with mating marks, and screw up connecting nuts. Torque: $235 \pm 20 \text{ N}\cdot\text{m}$.
- (b). Screw in the adjusting nuts into thread holes at both ends of the main reducer housing. Tie one end of a rope to the driven gear bolt, wind the rope around the differential for 1~2 turns, and measure the pretightening force of the differential bearing by hooking a dynamometer at the other end of the rope.

Pretightening force: $29 \pm 13 \text{ N}$.

- (c). If the measured value goes beyond the specified range, the adjusting nuts at both ends need to be adjusted to meeting the requirements. If the pretightening force is too big, the adjusting nuts at both ends shall be screwed out properly; if the pretightening force is too small, the adjusting nuts at both ends shall be screwed in properly.



Rear Axle – Rear Axle Assembly

5. Inspect and adjust pretightening force of driving gear bearing

- (a). Install the bearing sleeve with the bearing outer ring on the driving gear, put in the adjusting gasket and the tapered roller bearing, and knock the tapered roller bearing in place. Apply a pressure of 10~20 Mpa to the bearing.
- (b). Fix one end of a rope to the bearing seat by using the bolt, wind the rope around the outermost circle of the bearing seat for a turn, and measure the pretightening force of the main gear bearing by hooking a dynamometer at the other end of the rope.

Pretightening force: 15 ± 5 N

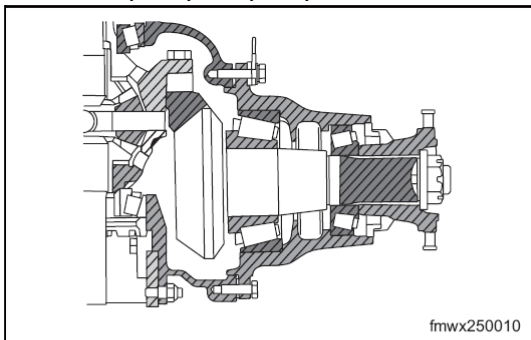
- (c). If the measured value goes beyond the specified range, the adjusting gasket shall be replaced to meet the requirements. If the pretightening force is too big, the thickness of the adjusting gasket shall be increased; if the pretightening force is too small, the thickness of the adjusting gasket shall be decreased. The standard thickness of the washer is 2.0, 2.05, 2.1, 2.15, 2.3, 2.35, 2.45, 2.5, 2.55, 3.0, 3.1, 3.3 and 3.4 mm.

6. Inspect and adjust gasket between driving gear bearing seat and main reducer housing

Hint:

The thickness X of the adjusting gasket between the driving gear housing and the main reducer can be calculated by the formula below:

$$X = (A \pm Z) + B - (L \pm Y)$$



Wherein, A -- theoretical value (mm) of distance from tooth-top end face of the driving gear to axis of the driven gear.

B -- measured value (mm) of distance from end face of the driving gear to connecting face of the driving gear housing (measured with the adjusting gasket not installed).

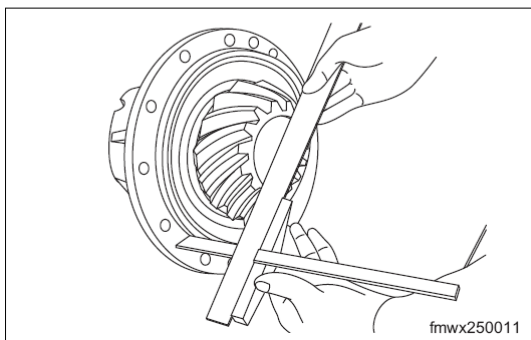
L -- theoretical value of distance from connecting end face of the main reducer housing to central line of the driven gear.

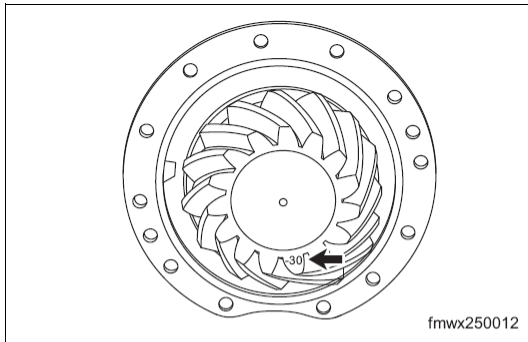
Z -- actual deviation value (mm) of value A (printed on end face of the driving gear).

Y -- actual deviation value (mm) of value L (printed on connecting end face of the main reducer housing). For current Steyr series auman heavy trucks, the overall gear ratio $i = 4.38$

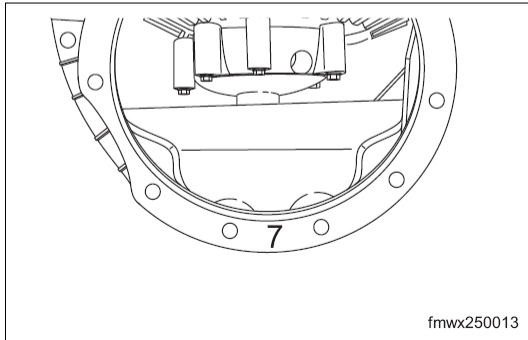
Wherein, A = 102 mm, L = 170 mm

- (a). With the adjusting gasket X not installed, actually measured B = 70.2 mm.





- (b). Observe value Z (1/100 mm) printed on end face of the driving gear. For example, if the print value on the end face is -30, Z = -0.3 mm.



- (c). Observe value Y (1/100 mm) printed on connecting end face of the main reducer housing. For example, if the print value on the end face is -7, Y = -0.07 mm.

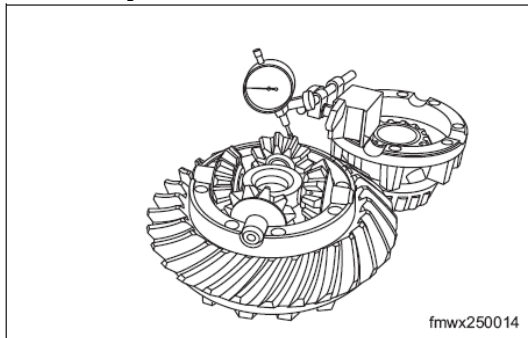
In accordance with the formula, the actual value of the gasket thickness:

$$X=(A\pm Z)+B-(L\pm Y)=(102-0.3)+70.2-(170-0.07)=1.97 \text{ mm}$$

Hint:

The standard thickness of the adjusting gasket is 0.1, 0.15, 0.4 and 1.0 mm. Here, one 1.0 mm gasket, two 0.4 mm gaskets and one 0.15 mm gasket are selected for combination. During the dismantlement of an old main reducer, the original adjusting gasket shall be well kept for reassembly use.

7. Adjust clearance between differential sun gear and planet gear:

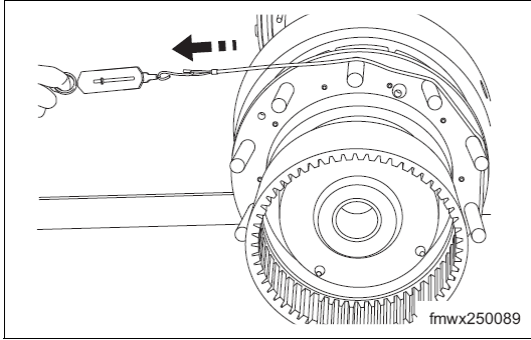


- (a). Respectively place cross shaft assemblies on left and right differential housings, and measure the clearance between the axle shaft gear and the planet gear. Clearance: 0.18~0.5 mm.
- (b). If the clearance is too big, replace with a thicker axle shaft gear gasket; if the clearance is too small, replace with a thinner axle shaft gear gasket. The adjustment shall not be finished until the clearance measured meets the requirements.

Hint:

The standard thickness of thrust gasket of the axle shaft gear is 4.9, 5.0, 5.1, 5.2 and 5.3 mm for selection, and clearance measurement shall be carried out on three points.

8. Adjust pretightening force of wheel bearing

Rear Axle – Rear Axle Assembly

- (a). Wind a rope around the hub bolt for several turns, connect a dynamometer to one end of the rope, and pull the dynamometer in the tangential direction of the wheel bolt circle to smoothly rotate the hub. Then, reading of dynamometer reflects pretightening conditions of the bearing.

Pretightening force: 4~5 kg

- (b). Adjust the axle end nut in accordance with the pretightening force. Unscrew the nut if the pretightening force is too big; screw up the nut to the standard value if the pretightening force is too small.

9. Clean and check parts

- (a). Parts may be stained with greasy dirt and mud. Cleaning of parts is an essential process. There are some common cleaning methods, such as steam cleaning, petrol cleaning, acid or alkali solution cleaning, neutral agent cleaning, trichloroethylene cleaning and magnetic cleaning. Some damaged parts may be detected in the cleaning process. Thus, care must be taken in the cleaning process.
- (b). After cleaning of parts, use a specially prepared survey meter or tool to carry out inspection. Judge whether parts are suitable for use in accordance with the specified maintenance standard. Damaged parts shall be repaired or replaced as required. If one of mating parts is seriously worn and its fit-up gap is beyond the specified value, the parts or mating parts can be replaced as required.
- (c). In view of preventive maintenance, some parts within the repair or wear limit range shall be replaced before they go beyond the limit range.
- (d). All the parts shall be carefully checked by visual observation or infra-red inspection. If any defect below is detected by visual observation, the part can be repaired or replaced as required.
- (e). For rubber parts, such as O-rings, oil seals, sealing washers, etc., when they are dismantled, judge whether to disuse them according to circumstances.

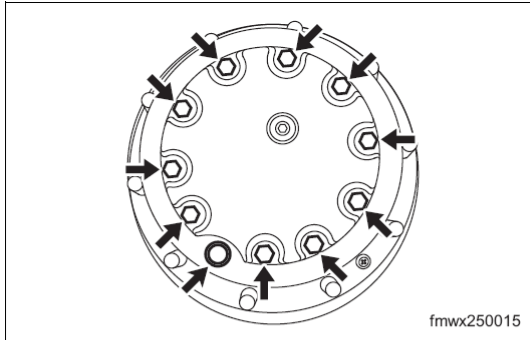
Axle shaft

Overhaul

Hint:

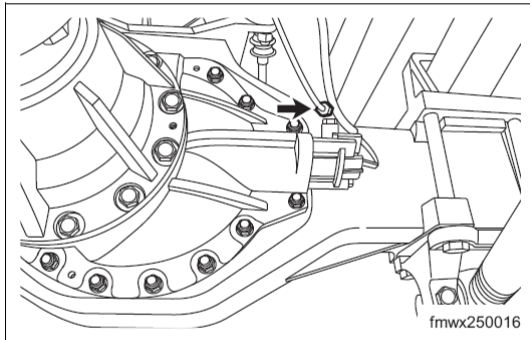
Part Drawing, refer to Chapter 25, Rear Axle - Rear Axle Assembly, Part Drawing.

1. **Lift vehicle, refer to Chapter 01, Introduction - Maintenance Guide, Vehicle Support Position**
2. **Dismantle tires, refer to Chapter 23, Tire & Wheel - Rear Tire & Wheel, Overhaul**

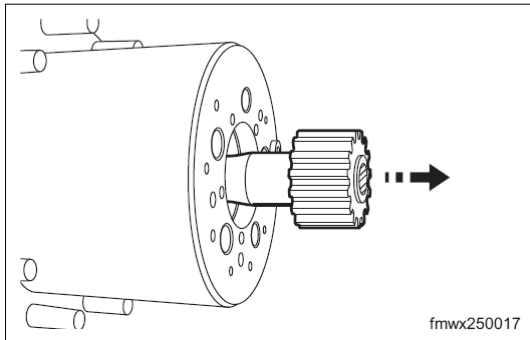


3. Dismantle axle shaft assembly

- (a). Loosen the wheel oil drain bolts at both sides.
 - Drain wheel gear oil to a container.
- (b). Loosen connecting bolt of the wheel reductor end cover.
 - Remove the wheel reductor end cover.



- (c). Enable the differential lock.
 - Ensure that the differential lock has already been closed.



- (d). Draw out the axle shaft assembly without differential lock.
- (e). Draw out the axle shaft assembly with differential lock.

Caution:

Prior to drawing out of the axle shaft with differential lock, the differential lock must be closed in advance, otherwise the differential lock mesh sleeve will fall into the differential housing, and the main reducer will fail to be disassembled in serious conditions.

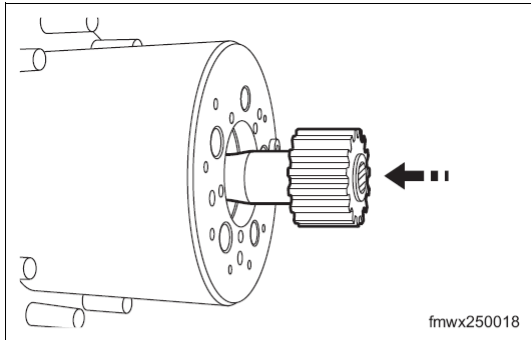
4. Check axle shaft assembly

- Check the axle shaft for deformation.
- Check the spline tooth for breaking.
- Check the sun gear for wear and breaking.

Caution:

If any defect is detected, replace them with new ones.

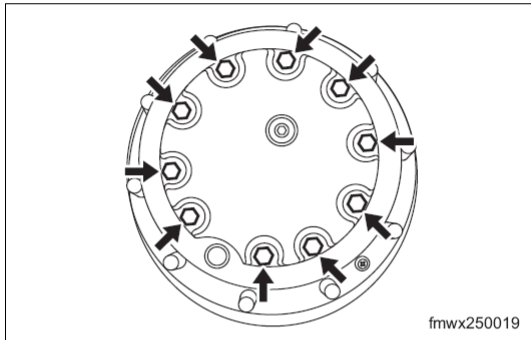
Rear Axle – Axle shaft

**5. Install axle shaft assembly**

- (a). Put the axle shaft into the axle housing.

Caution:

When the axle shaft is put in, take care not to damage the axle shaft oil seal, insert the left and right axle shafts into axle shaft gear spline holes in a rotating mode, and pay attention to the normal meshing of the sun gear and the planet gear.



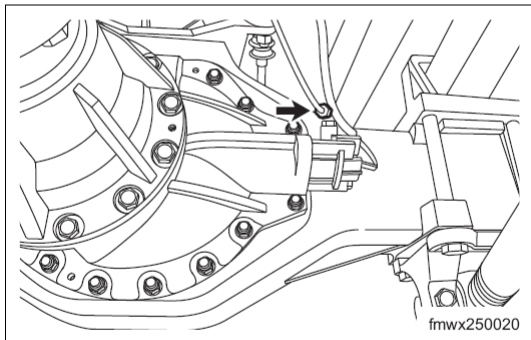
- (b). Fix the wheel reductor end cover onto the wheel reductor end cover.

- Screw up the connecting bolt.

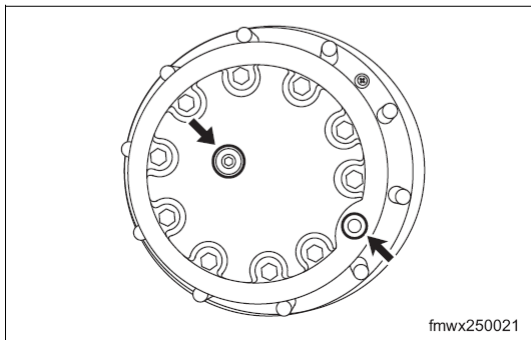
Torque: $60 \pm 15 \text{ N}\cdot\text{m}$

Caution:

Prior to sealant spreading, clean contact surface of the wheel reductor end cover and contact surface of the wheel reductor; the flange sealant must be continuous and uniform.



- (c). Cancel the work of the differential lock.



- (d). Fill the gear oil.

- Tighten the oil drain bolt.
- Tighten the oil filler bolt.

Torque: $100 \pm 20 \text{ N}\cdot\text{m}$

Caution:

The normal position for oil capacity of wheel reductor shall be the highest position of the oil filler plug, and the oil filler plug is preferably in such a position that the oil level can be touched by extending fingers straight into the threaded hole; the wheel reducers use gear oil of AP1GL-5 grade and SAE85W/90 viscosity, and the oil capacity of each wheel reductor is 2 L or so.

6. Install tires, refer to Chapter 23, Tire & Wheel - Rear Tire & Wheel, Overhaul
7. Let down vehicle, refer to Chapter 01, Introduction - Maintenance Guide, Vehicle Support Position

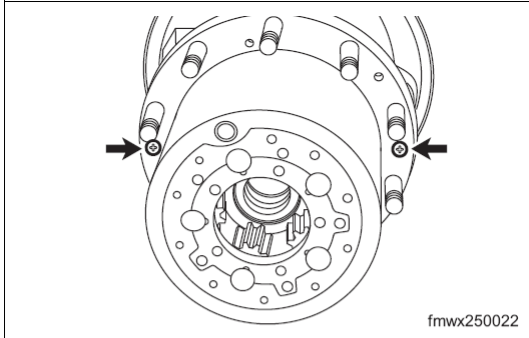
Wheel Hub Bearing and Oil Seal

Overhaul

Hint:

Part Drawing, refer to Chapter 25, Rear Axle - Rear Axle Assembly, Part Drawing.

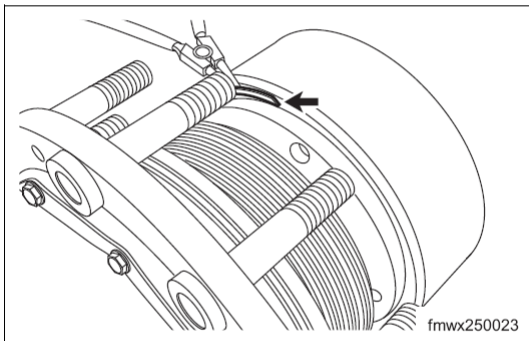
1. **Lift the vehicle**
2. **Dismantle the tires**
3. **Dismantle the axle shaft assembly. Refer to Chapter 25, Rear Axle - Axle Shaft, Overhaul**
4. **Dismantle the brake drum and brake shoe. Refer to Chapter 26, Service Brake - Rear Brake Shoe, Overhaul**



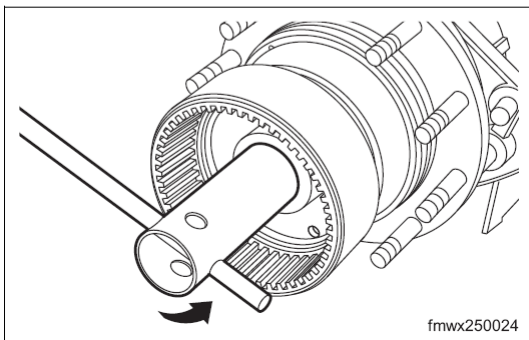
5. **Dismantle the wheel reductor assembly**
 - (a). Dismantle the wheel reductor locating bolts.
 - (b). Diagonally push the wheel reductor assembly out with two M10 stay bolts.

Caution:

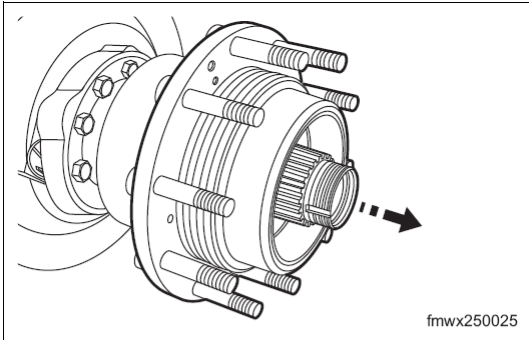
Tighten the two bolts by turns, so that the two wheel parts are stressed evenly and symmetrically.



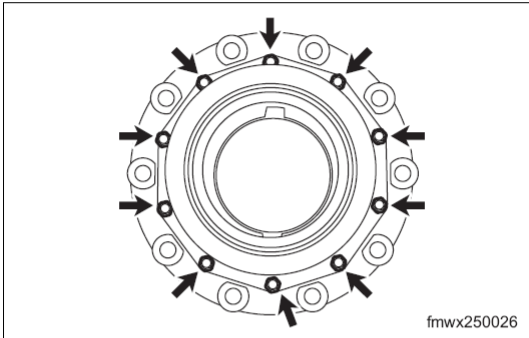
6. **Dismantle the hub assembly**
 - (a). Dismantle the snap ring on the ring gear.



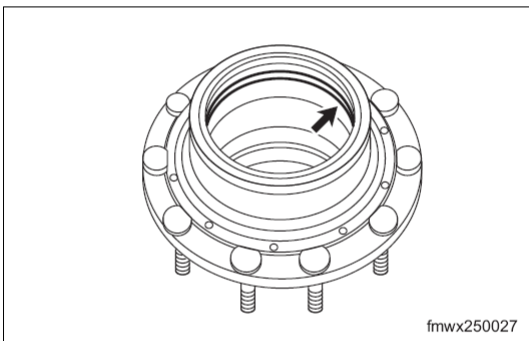
- (b). Flatten the locking plate, and dismantle the axle end slotted nuts with an xle end slotted nut wrench.
 - (c). Remove the ring gear and ring gear shaft sleeve from the axle pipe.

Rear Axle – Wheel Hub Bearing and Oil Seal

- (d). Take down the hub assembly together with the axle pipe shaft.

**7. Dismantle the hub oil seal**

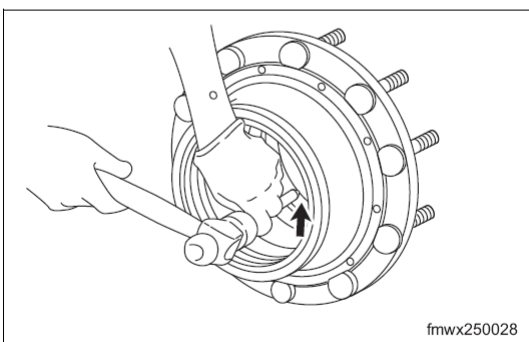
- (a). Dismantle the connecting bolts of the hub oil baffle cover.
- Take down the oil baffle cover.



- (b). Take out the hub oil seal.

Caution:

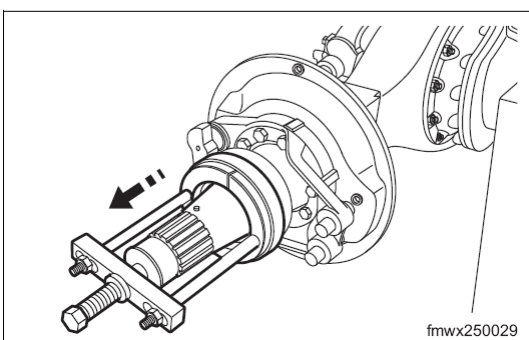
The oil seal, which is a wearing part, shall be replaced after dismantling, otherwise, that may result in oil leakage. Do not damage the hub inner ring while dismantling the oil seal.



- (c). Knock out the bearing outer ring with a thin copper rod.

Caution:

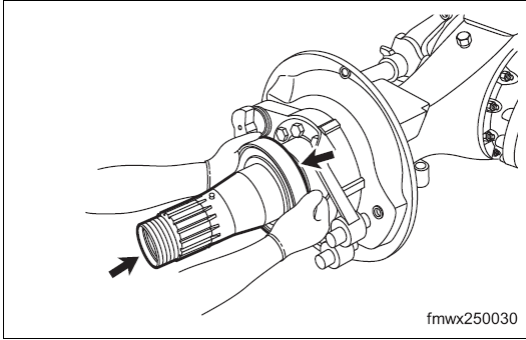
Do not damage the hub inner ring while knocking the bearing outer ring.

**8. Dismantle the hub bearing**

- (a). Pull the hub inner bearing out of the axle pipe with a bearing puller.

Caution:

The bearing forms an interference fit. It is suggested to pull out the inner bearing with the puller after heating to 80-100°C.



- (b). Take the axle shaft oil seal out of the axle pipe.
- (c). Take down the spacer ring.

Caution:

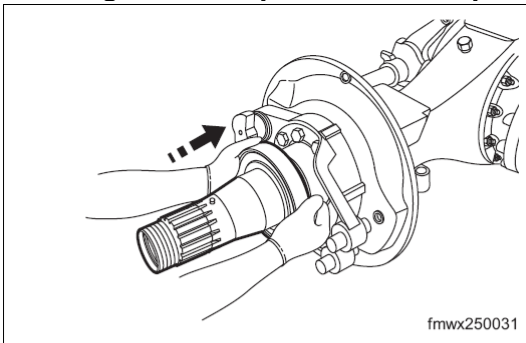
Do not scratch the outer side and inner side of the shaft pipe while dismantling the spacer ring and axle shaft oil seal.

9. Overhaul the hub assembly and wheel reductor assembly parts

- Check the snap ring for deformation;
- Check the hub seal ring for damage and aging;
- Check the wheel reductor for blister/crack;
- Check the planet carrier for damage; check the inner ring gear for rupture/wear;
- Check the sun gear and planet gear for rupture/wear, and check the planet gear shaft and needle bearing for damage.

Caution:

If damaged, a new part must be replaced.

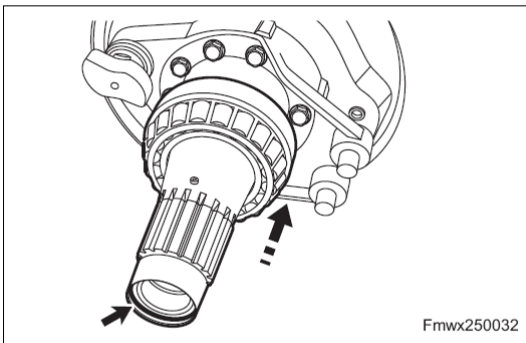


10. Install the hub bearing

- (a). Install the spacer ring on the axle pipe shaft.

Caution:

Make sure that the spacer ring closely abuts against the axle housing axle end.

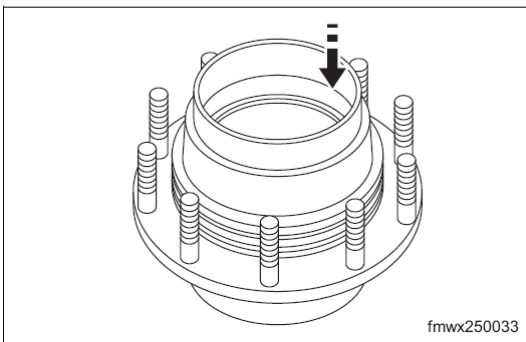


- (b). Heat the bearing inner race to 80-100°C, and install the inner bearing to proper position with a press mold.

- (c). Install the axle shaft oil seal into the axle pipe.

Caution:

Make sure that there is no axial clearance to the oil seal spacer ring.



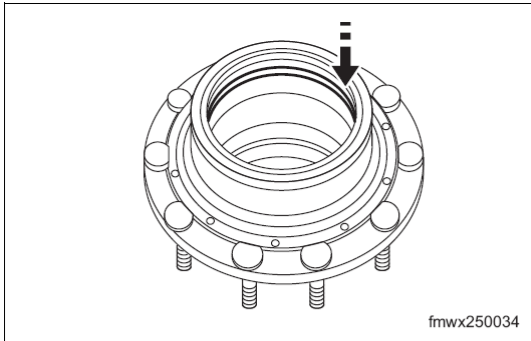
- (d). Install the bearing outer ring.

- Smoothly press the bearing outer ring into the hub with a press mold.

Caution:

It is prohibited to knock the surface of the bearing outer ring. If replacing the hub bearing, smoothly press the across corners of the new bearing outer ring into the two ends of the hub with a dedicated presser.

Rear Axle – Wheel Hub Bearing and Oil Seal

**11. Install the hub oil seal**

- (a). Press in the hub oil seal.

Caution:

Smoothly press the oil seal into the hub with a dedicated presser. It is not allowed to knock the surface of the oil seal. If replacing the hub bearing, press the new bearing outer ring into the two ends of the hub with a special presser, and orderly press the hub oil seals into the hub. If replacing the ABS ring gear, check the run-out quantity of the end face of ring gear shall not be greater than 0.15mm after pressing it into the ring gear.

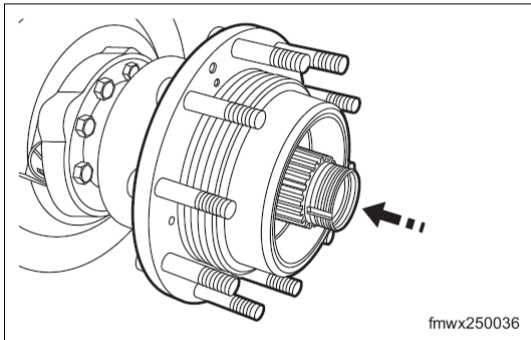
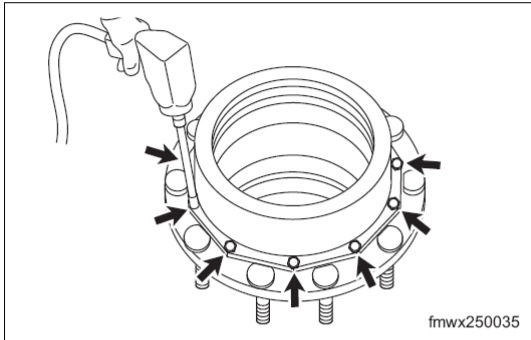
- (b). Install the oil baffle cover.

- Tighten the bolts.

Torque: 25 N•m

Caution:

The bolts shall be tightened diagonally. Do not use an impact wrench.

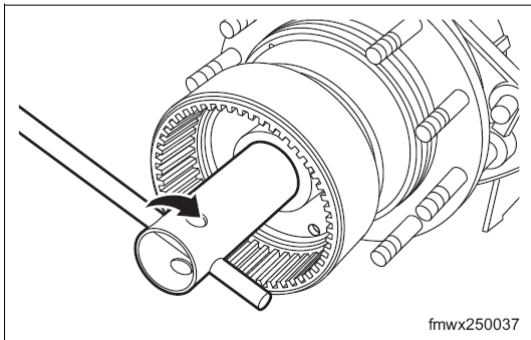
**12. Install the hub assembly**

- (a). Push the hub assembly into the axle end.

- Install the new seal ring in the hub.

Caution:

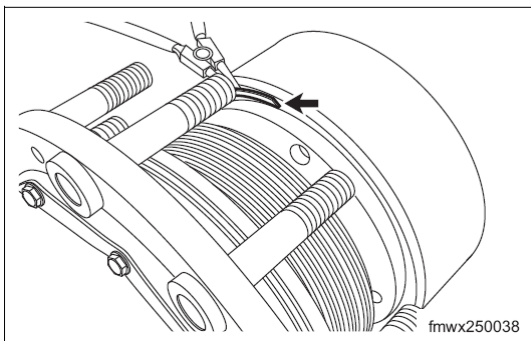
Take care not to damage the hub oil seal when pushing the hub in.



- (b). Install the ring gear assembly.

Caution:

Take care not to damage the bearing when installing the ring gear.

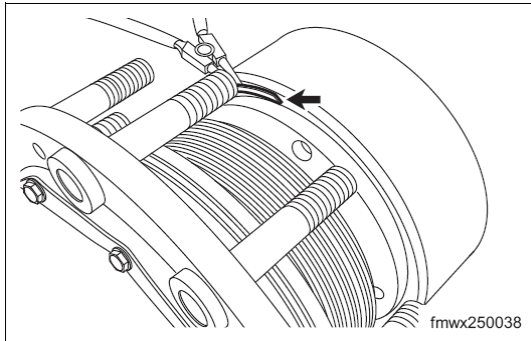


- (c). Orderly install the slotted nut, locking plate and slotted nut.

- Tighten the slotted nuts with an axle end slotted nut wrench.

Torque: 350±50 N•m

- 13. Inspect the pretightening force of the hub bearing. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.**



- 14. Install the wheel reductor assembly**
(a). Install the wheel reductor to the ring gear.
• Tighten the bolts.

- 15. Install the hub and brake shoe. Refer to Chapter 26, Service Brake - Rear Brake Shoe, Overhaul**

- 16. Install the axle shaft assembly. Refer to Chapter 25, Rear Axle - Axle Shaft, Overhaul**
Caution:

When filling the wheel lubricating oil, check whether the lubricating oil level in the rear axle main reducer is normal. Refer to Chapter 25, Rear Axle - Main Reducer, Overhaul

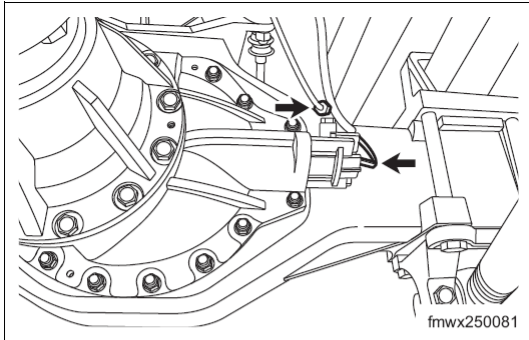
- 17. Install the tires.**
18. Put down the vehicle

Rear Axle Assembly and Rear Axle Housing Overhaul

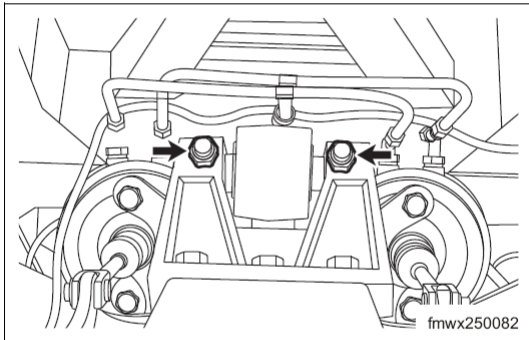
Hint:

Part Drawing, refer to Chapter 25, Rear Axle - Rear Axle Assembly, Part Drawing.

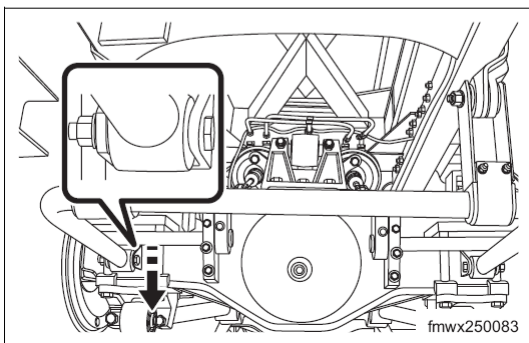
1. **Lift the self-unloading container**
2. **Disconnect the battery negative cable. Refer to Chapter 53, Battery - Battery Assembly, Replacement**
3. **Lift the vehicle**
4. **Dismantle the rear brake chamber assembly. Refer to Chapter 26, Service Brake - Rear Brake Chamber, Overhaul**
5. **Dismantle the drive shaft. Refer to Chapter 33, Drive Shaft - Drive Shaft Assembly, Overhaul**



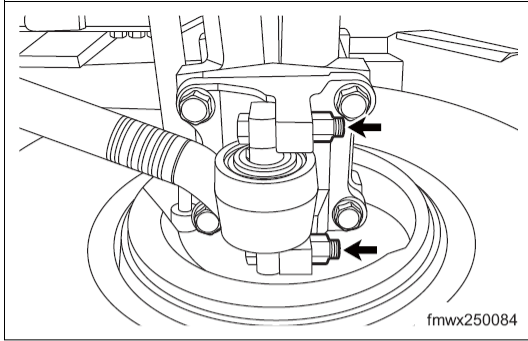
6. **Dismantle the rear axle assembly**
 - (a). Disconnect the differential lock air pipe.
 - (b). Disconnect the differential lock switching wiring harness connector.



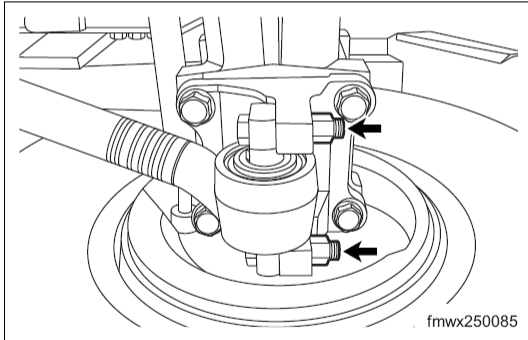
- (c). **Dismantle the upper thrust rod.**
 - Dismantle the upper thrust rod and the rear axle housing upper bracket connecting bolts.



- (d). **Dismantle the stabilizer bar.**
 - Dismantle the stabilizer bar connecting bolts on the two sides.
 - Rotate the stabilizer bar downwards.



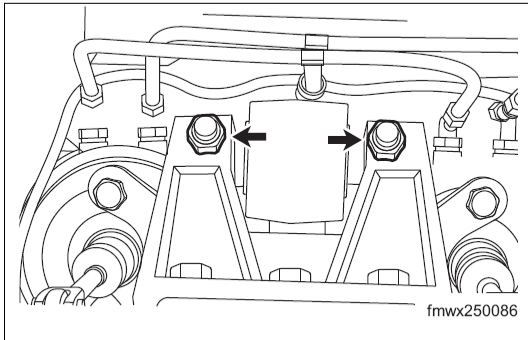
- (e). Lift the middle part of the rear axle with a hydraulic pusher.
- (f). Take down the lower thrust rod.
 - Dismantle the lower thrust rod and rear axle connecting bolts.
- (g). Disconnect the wheel speed sensor.
- (h). Push the rear axle assembly back until it is out.



7. Install the rear axle assembly

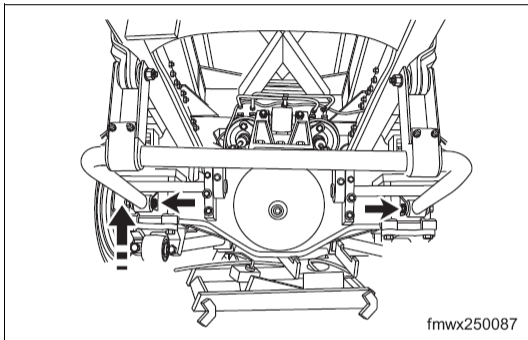
- (a). Push the rear axle to below the frame, and ensure that the leaf spring is installed in the rear axle bracket.
- (b). Install the lower thrust rod.
 - Tighten the lower thrust rod and rear axle connecting bolts.

Torque: 525±25 N•m



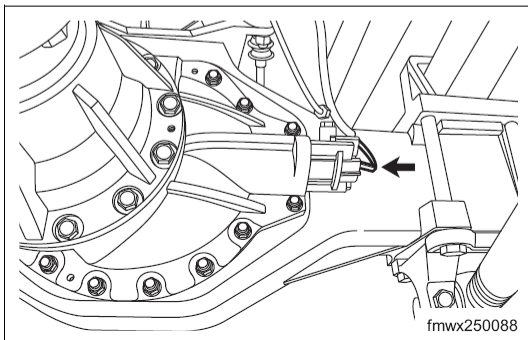
- (c). Install the upper thrust rod.
 - Fasten the upper thrust rod connecting bolts.

Torque: 525±25 N•m



- (d). Install the stabilizer bar.
 - Rotate the stabilizer bar up into the stabilizer bar fixing bracket.
 - Tighten the stabilizer bar connecting bolts on the two sides.

Torque: 221±22 N•m

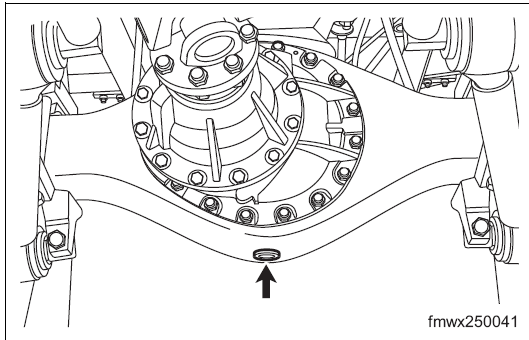


- (e). Connect the differential lock switching wiring harness connector.
- (f). Connect the differential lock air pipe.
- (g). Connect the ABS wiring harness connector.

Rear Axle – Rear Axle Assembly and Rear Axle Housing

8. Install the drive shaft. Refer to Chapter 33, Drive Shaft - Drive Shaft Assembly, Overhaul
9. Install the rear brake chamber assembly. Refer to Chapter 26, Service Brake - Rear Brake Chamber, Overhaul
10. Install the tires. Refer to Chapter 23, Tire & Wheel -Rear Tire and Wheel, Overhaul
11. Put down the vehicle. Refer to Chapter 01, Introduction - Maintenance Guide, Vehicle Support Position
12. Install the battery negative cable. Refer to Chapter 53, Battery - Battery Assembly, Replacement
13. Put down the self-unloading container

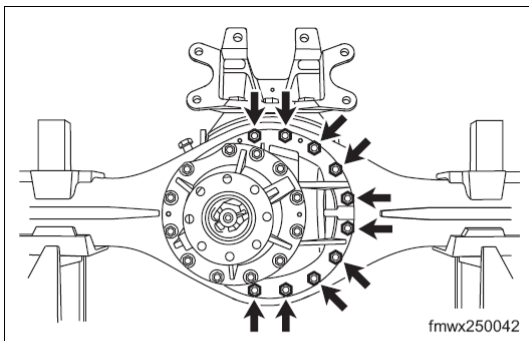
Main reducer Overhaul



1. Drain oil

- (a). Dismantle the oil drain bolt.

2. Dismantle the axle shaft. Refer to Chapter 25, Rear Axle - Axle Shaft, Overhaul
3. Dismantle the drive shaft. Refer to Chapter 33, Drive Shaft - Drive Shaft Assembly, Overhaul

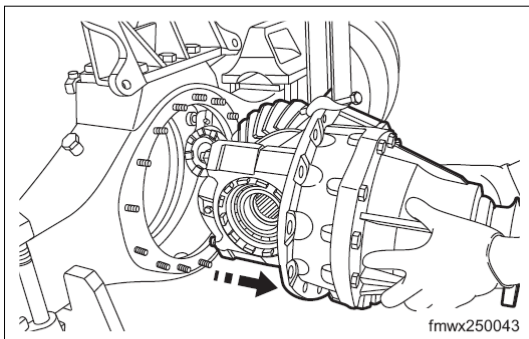


4. Dismantle the main reducer assembly

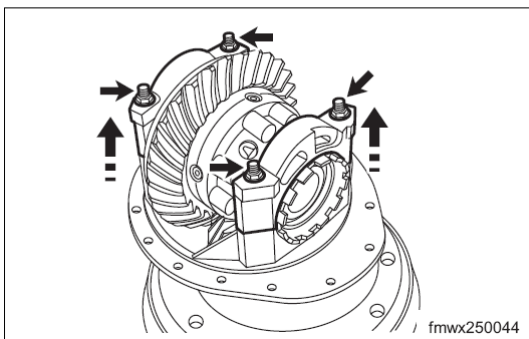
- (a). Loosen the connecting nuts of the main reducer and axle housing.
- (b). Push the main reducer out with two M10 long bolts.

Caution:

The two bolts shall be tightened diagonally.



- (c). Lift the main reducer assembly out with a hanger.

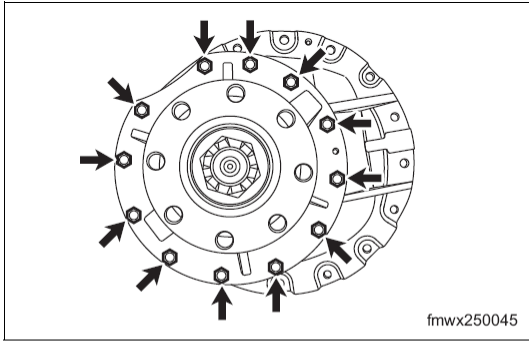


- (d). Dismantle the bearing cap fixing bolts of the main reducer.
- (e). Take down the bearing cap.

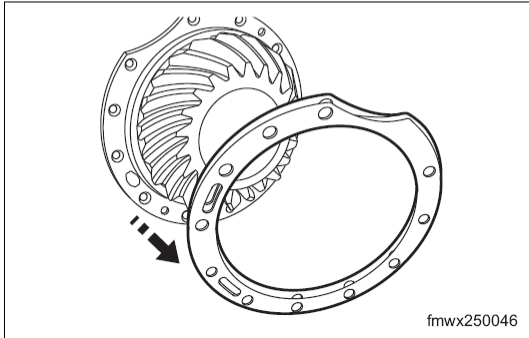
Caution:

Before dismantling the bearing cap, the mating assembly marks shall be printed on the seat and the cap to avoid mistaken installation when reassembling.

- (f). Take down the differential assembly.
- (g). Dismantle the driven gear. Refer to Chapter 25, Rear Axle - Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul.

Rear Axle – Main reducer

- (h). Dismantle the connecting bolts of the driving gear bearing seat and main reducer housing.
- (i). Disconnect the driving gear bearing seat and main reducer housing.



- (j). Take down the gasket between the bearing seat and main reducer housing.

Caution:

If no part is replaced during reassembly, the original gasket shall be installed back. If any of the driving and driven gears, driving gear bearing or bearing seat housing is replaced, the thickness of the adjusting gasket must be remeasured and recalculated before reassembly.

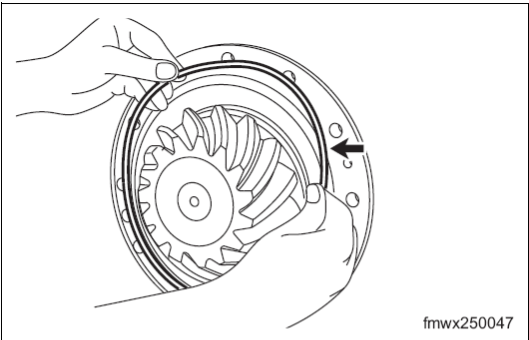
5. Dismantle the driving gear. Refer to Chapter 25, Rear Axle - Driving Gear and Bearing, Overhaul

6. Overhaul the main reducer parts

- Check the main reducer housing for rupture; check the gasket for damage.
- Check the driving and driven gears for rupture; check the bearings for wear and pitting.

Caution:

If damaged, replace them with new parts; and the driving and driven gears shall be replaced in pairs.

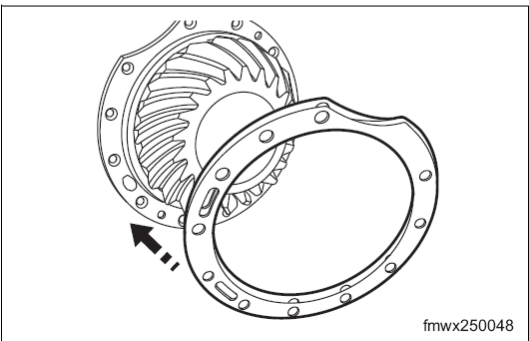


7. Install the main reducer assembly

- (a). Sheathe the O-ring on the driving gear shaft housing.

Caution:

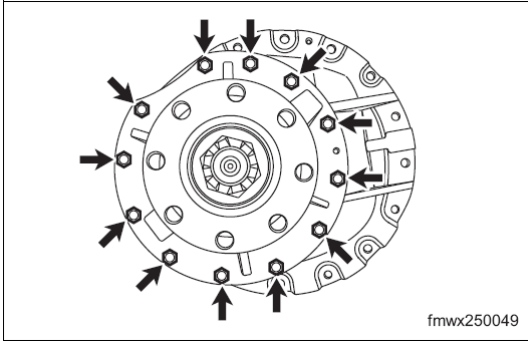
Clean the gear and contact surface before installation.



- (b). Install the adjusting gasket.
 - Select the adjusting gasket. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.

Caution:

Spread flange sealant on the connecting surface of the driving gear bearing seat and main reducer housing before installing the gasket.



- (c). Install the driving gear bearing seat assembly in the main reducer housing.

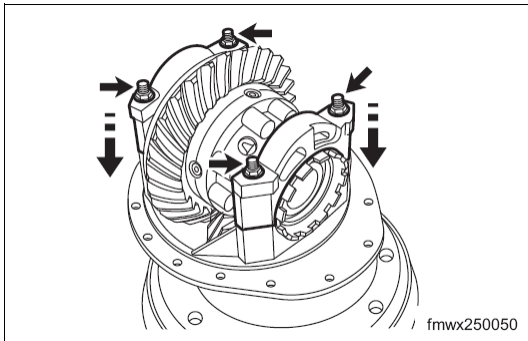
- Tighten the connecting bolts.

Torque: 110 N•m

Caution:

Tighten the bolts diagonally. Do not use an impact wrench.

- (d). Install the driven gear. Refer to Chapter 25, Rear Axle - Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul.



- (e). Install the differential assembly in the main reducer housing.

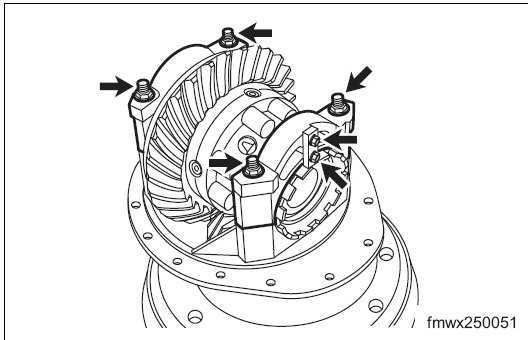
- (f). Install the bearing cap.

- Pretighten the bolts.

- (g). Adjust the mesh clearance of the driving and driven gears. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.

- (h). Check and adjust the mesh traces of the driving and driven checks. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.

- (i). Inspect the pretightening force of the differential bearing. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.

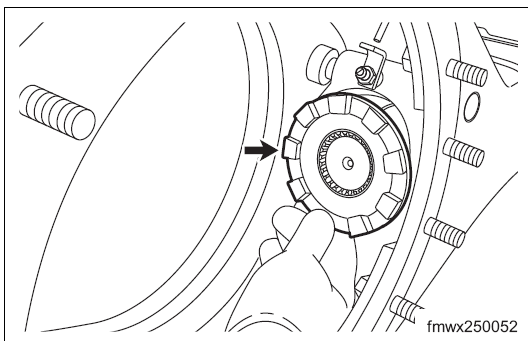


- (j). Tighten the nuts.

Torque: 235±20 N•m

- Install the locking plate and tighten the bolts.

Torque: 25 N•m

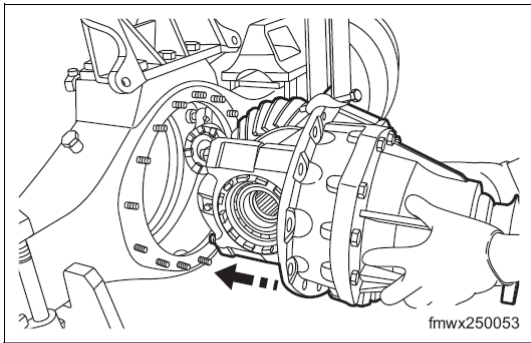


- (k). Slightly push the axle shaft in on one side of the axle differential lock. In the axle housing, firstly put the differential lock shift fork and the mesh sleeve on the axle shaft, and then push the axle shaft until it is aligned with the mesh sleeve.

Caution:

Do not damage the axle shaft oil seal while pushing the axle shaft.

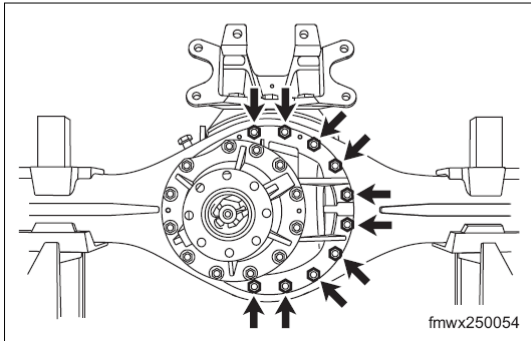
Rear Axle – Main reducer



- (l). Install the central reducer assembly in the axle housing.

Caution:

Before installing the main reducer, clean the contact surface of the axle housing and main reducer housing, and uninterruptedly spread 598 flange sealant.

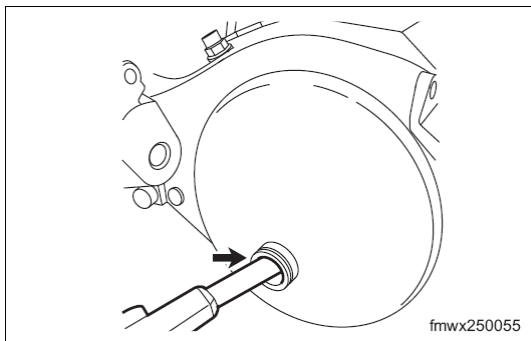


- (m). Tighten the connecting bolts of the axle housing and main reducer.

Torque: 210 N•m

8. Install the axle shaft. Refer to Chapter 25, Rear Axle - Axle Shaft, Overhaul

9. Install the drive shaft. Refer to Chapter 33 Drive Shaft - Drive Shaft Assembly, Overhaul



10. Refill oil

- (a). Refill lubricating oil, and tighten the bolts.

Torque: 200-270 N•m

Caution: There is an oil filling hole in the middle of the rear part of the axle housing, and the normal liquid level shall be kept at the height of the oil filling hole all the time.

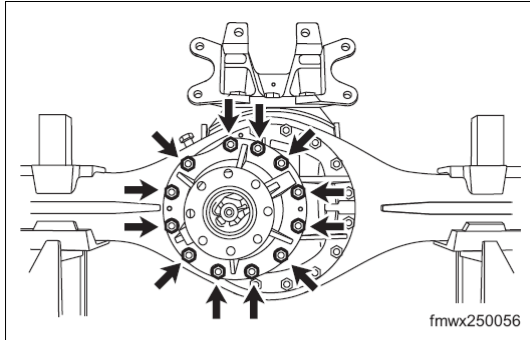
Driving Gear and Bearing

Overhaul

Hint:

Part Drawing, refer to Chapter 25, Rear Axle - Main Reducer, Part Drawing.

1. **Drain oil**
2. **Disconnect the drive shaft and the main reducer flange. Refer to Chapter 33, Drive Shaft - Drive Shaft Assembly, Overhaul**

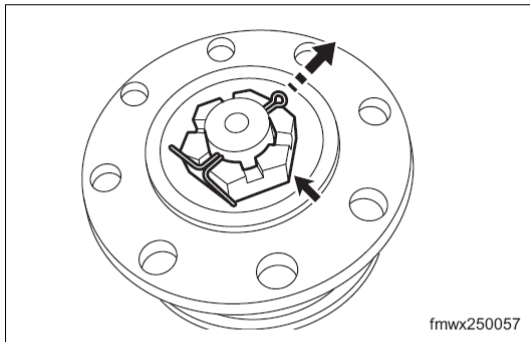


3. **Dismantle the driving gear bearing seat.**

- (a). Dismantle the connecting bolts of the driving gear bearing seat and main reducer housing.
- (b). Disconnect the driving gear bearing seat and main reducer housing with two M10 long bolts.

Caution:

The two M10 long bolts shall be loosened diagonally.

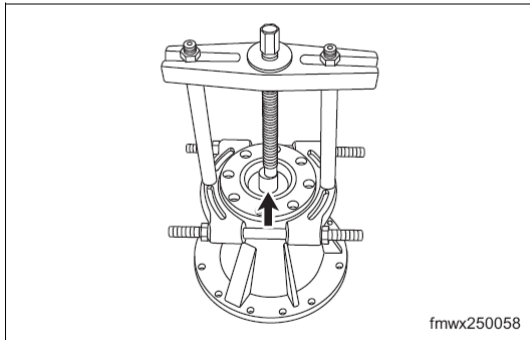


4. **Dismantle the driving gear and bearing**

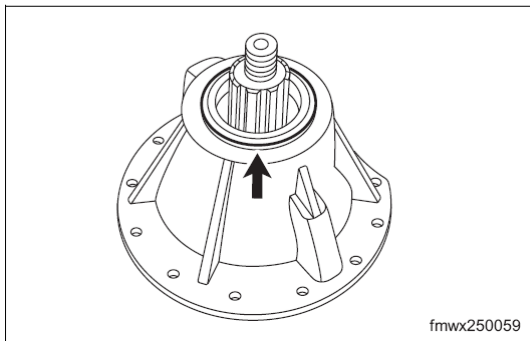
- (a). Dismantle the flange nuts.
 - Dismantle the cotter pin and flange nuts.

Caution:

The cotter pin is a worn part, and not suitable for repeated use.



- (b). Pull the flange out with a puller.



- (c). Take out the oil seal.

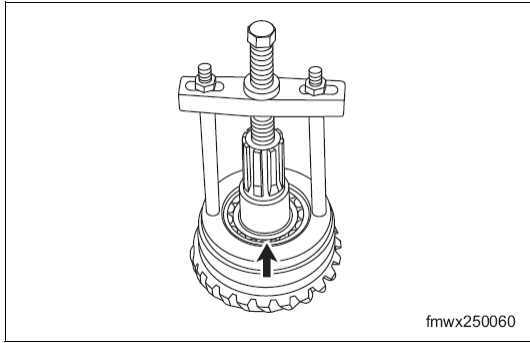
Caution:

Do not scratch the oil seal seat ring while taking out the oil seal.

- (a). Press the driving gear out of the driving gear bearing seat with a presser.

Caution:

Do not damage the threads while maintaining the driving gear.

Rear Axle – Main reducer

- (b). Pull out the bearing on the driving gear with a puller.

Caution:

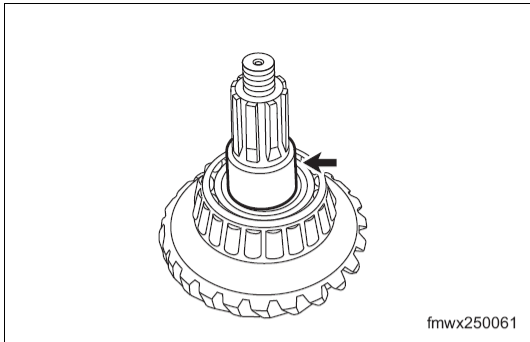
The bearing inner race and driving gear shaft form an interference fit. It is suggested to pull it out after heating to 80-100°C.

5. Check the driving gear assembly

- Check the driving gear bearing for wear and pitting.
- Check the driving gear for wear, rupture and distortion.
- Check the driving gear seat for cracking.

Caution:

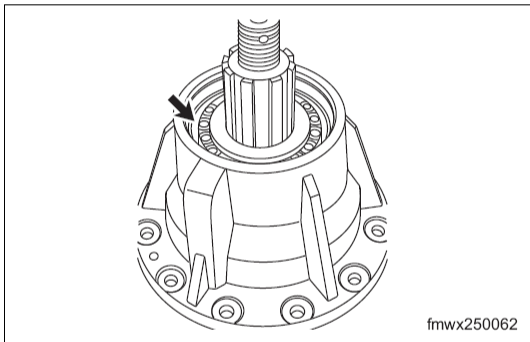
If any defect is detected, replace with new parts.

**6. Install the driving gear and bearing**

- (a). Press the bearing into the driving gear shaft.

Caution:

The bearing inner race and driving gear shaft form an interference fit. It is required to sheathe the tapered roller bearing on the driving gear after heating to 80-100°C.



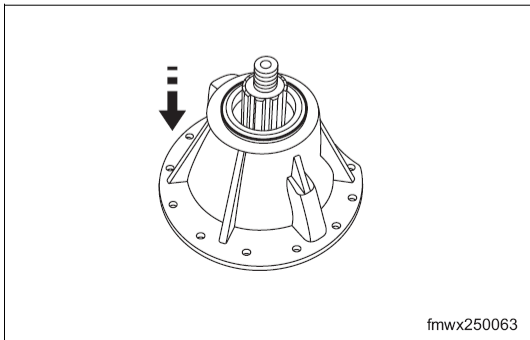
- (b). Sheathe the driving gear bearing seat of the bearing outer ring on the driving gear.
- Press the driving gear to proper position with a press machine.

Caution:

It is required to put the proper gasket on the inner side of the bearing before pressing the bearing.

- (c). Measure the pretightening force of the driving gear bearing. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.

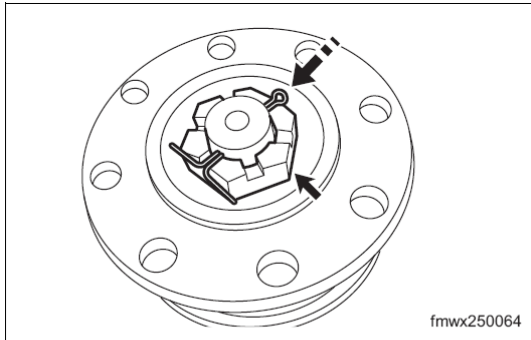
Pretightening force: 15±5N



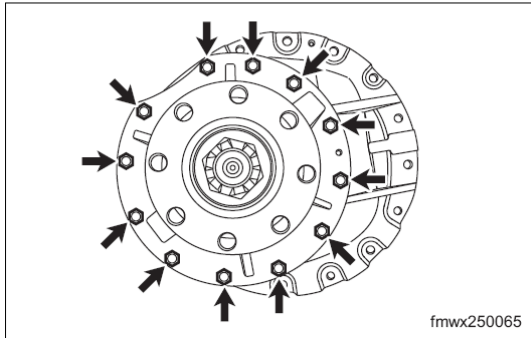
- (d). Install the oil seal in the oil seal seat.

Caution:

Spread 262 thread lock on the outer ring of the oil seal seat.



- (e). Press the flange into the driving gear shaft.
 - (f). Tighten the nuts, and install the cotter pin.
- Torque: 800±50 N•m**



- 7. Install the driving gear bearing seat assembly in the main reducer housing.**
- (a). Spread 598 flange sealant on the disk holes of the main reducer housing.
 - (b). Spread 262 thread lock on the connecting bolts.
 - (c). Tighten the bolts.
- Torque: 135±15 N•m**

- 8. Install the drive shaft. Refer to Chapter 33, Drive Shaft - Drive Shaft Assembly, Overhaul.
- 9. Fill oil. Refer to Chapter 25, Rear Axle - Main Reducer, Overhaul.

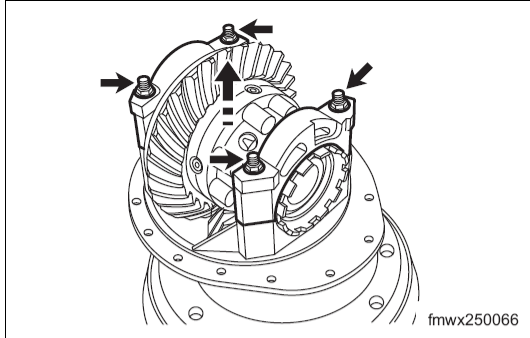
Differential Housing, Driven Gear and Planet Gear Assembly

Overhaul

Hint:

Part Drawing, refer to Chapter 25, Rear Axle - Main Reducer, Part Drawing.

1. Dismantle the main reducer assembly. Refer to Chapter 25, Rear Axle - Main Reducer, Overhaul

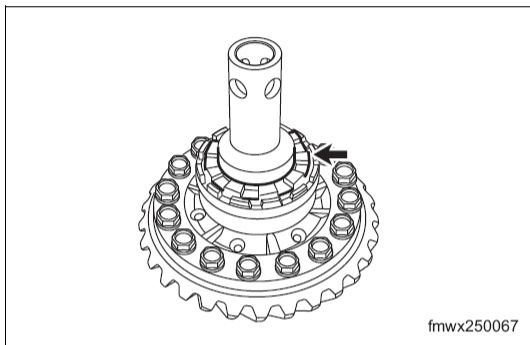


2. Dismantle the differential assembly

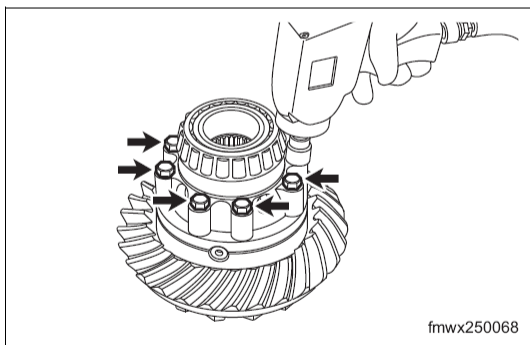
- Dismantle the slotted nut locking plate of the differential bearing.
- Dismantle the differential bearing cap.
 - Loosen the differential bearing cap nuts.
- Take out the differential assembly.

Caution:

Before dismantling the cap, the cap and bearing seat shall be printed with mating marks to avoid mistaken installation when reassembling.



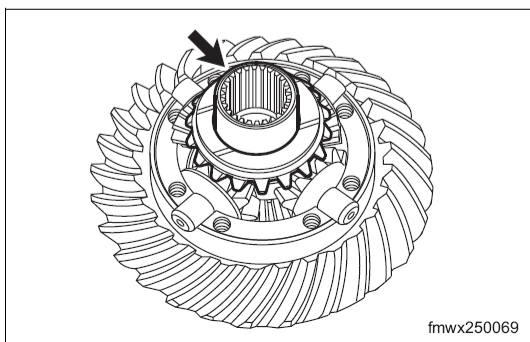
- Dismantle the differential lock mesh sleeve.



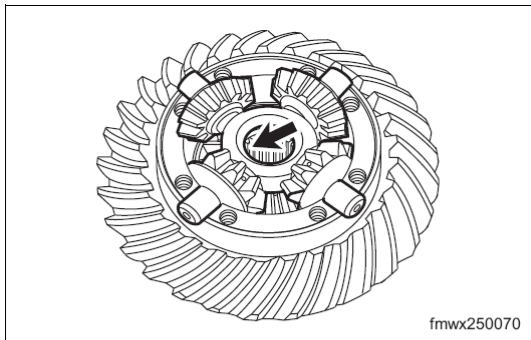
- Dismantle the differential housing coupling bolts, and take down the differential housing.

Caution:

Before dismantling, observe whether there are assembly marks on the two differential housing halves. If there are no assembly marks, corresponding assembly marks shall be printed to avoid mistaken installation when reassembling.



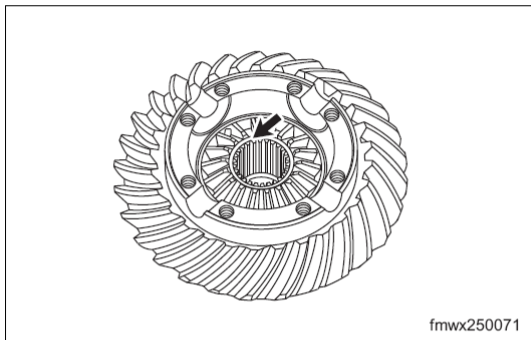
- Take out the axle shaft gear.



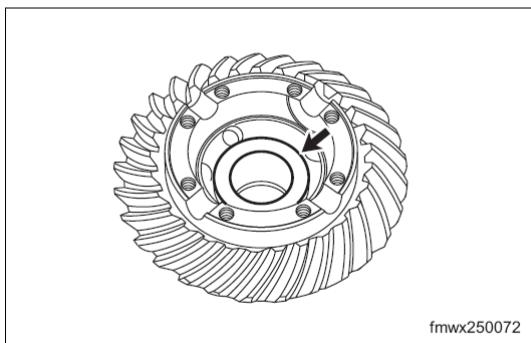
(g). Take out the planet gear and cross shaft.

Caution:

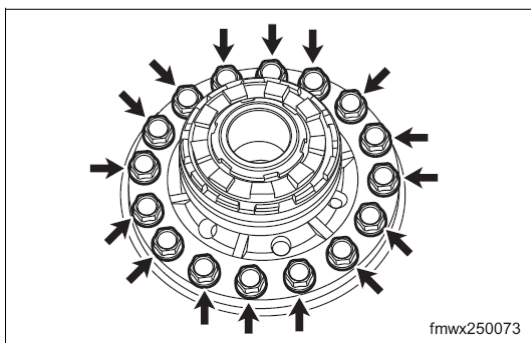
Do not lose planet gear spherical gasket.



(h). Take out the axle shaft gear.



(i). Take out the axle shaft thrust gasket



3. Dismantle the driven gear

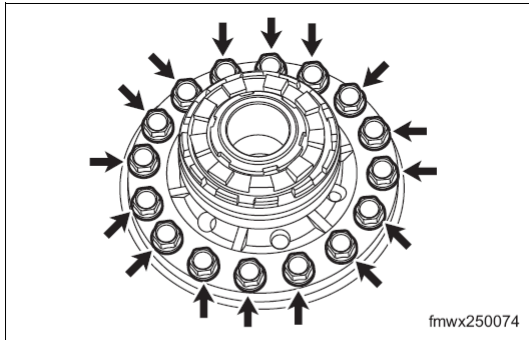
- (a). Dismantle the coupling bolts of the driven gear and differential housing.
- (b). Disconnect the driven gear, backing ring and differential.

4. Check the gear, bearing, gasket, cross shaft and axle shaft gear for wear or damage

Caution:

If any defect is detected, replace with new spares.

Rear Axle – Differential Housing, Driven Gear and Planet Gear Assembly



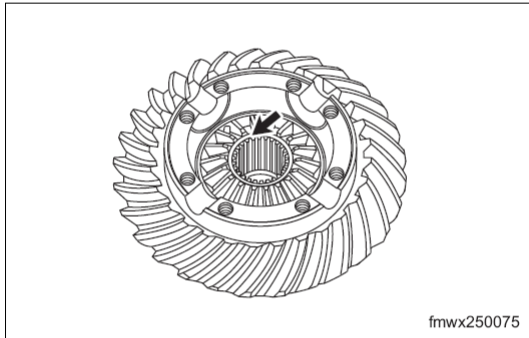
5. Install the driven gear

- (a). Connect the driven gear, backing ring and differential.
- (b). Tighten the coupling bolts of the driven gear and differential housing.

Torque: 325 N•m

Caution:

The bolts must be spread with Lotite 262 thread lock.

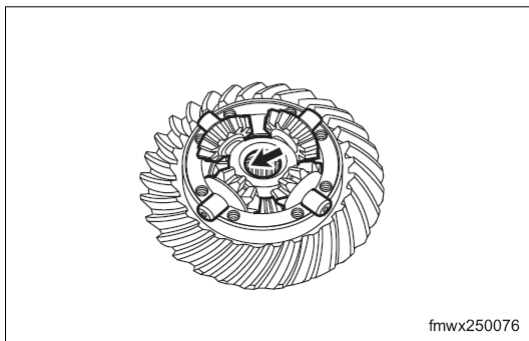


6. Install the differential lock assembly

- (a). Install the axle shaft thrust gasket and axle shaft gear. Standard thickness of axle shaft thrust gasket: 4.9mm, 5.0mm, 5.1mm, 5.2mm, 5.3mm

Caution:

The surface with the oil groove shall be faced with the axle shaft gear.

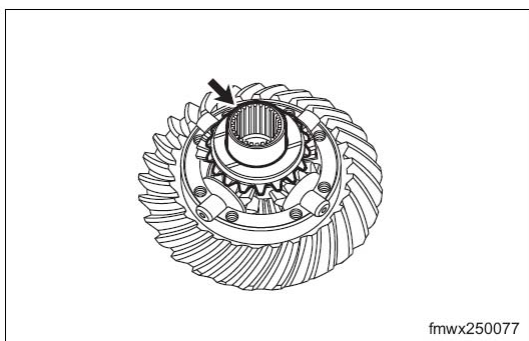


- (b). Install the planet gear and cross shaft.

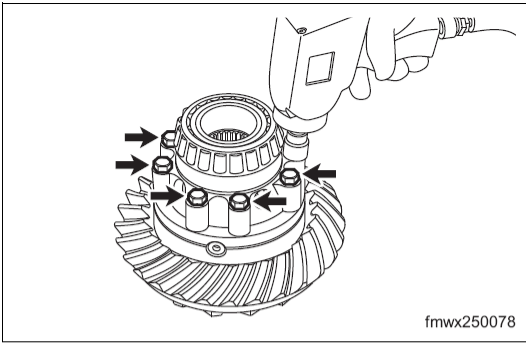
Caution:

Slightly knock the cross shaft to eliminate false clearance.

- (c). **Measure and adjust the tooth side clearance. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.**



- (d). Install the axle shaft gear.

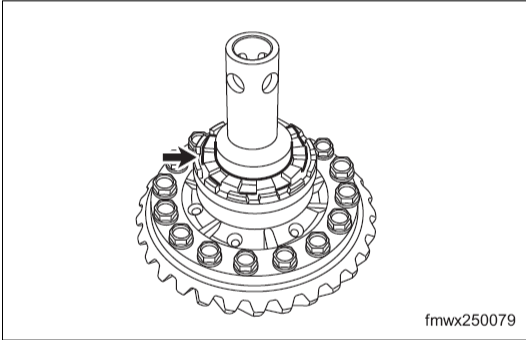


- (e). Install the differential housing, and tighten the coupling bolts of the differential housing.

Torque: 195 N•m

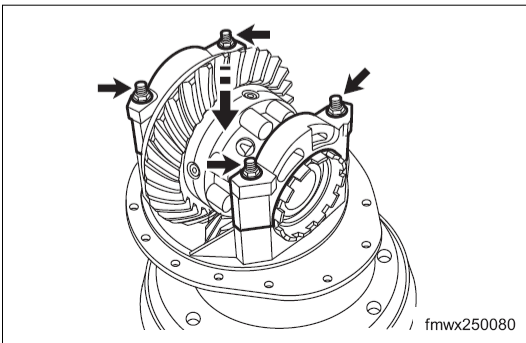
Caution:

Align the installation marks. The bolts must be spread with Lotite 262 thread lock.



- (f). Install the differential slotted nuts, differential lock mesh sleeve and slotted nut locking plate on the differential shaft sleeve, and tighten the differential slotted nuts.

Torque: 200 N•m



- (g). Install the differential assembly.
(h). Pretighten the differential bearing cap, and adjust the mesh clearance, mesh traces of driving and driven gears, and pretightening force of bearing. Refer to Chapter 25, Rear Axle - Rear Axle Assembly, Testing & Adjustment.
(i). Tighten the differential bearing cap.
Torque: 210 N•m
(j). Install the slotted nut locking plate of the differential bearing.

7. Install the main reducer assembly. Refer to Chapter 25, Rear Axle - Main Reducer, Overhaul

Service Brake

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Service Brake System

General

The brake system of the Auman heavy-duty vehicle adopts a typical design at international advanced level. It employs the main brake system of double-circuit air brake, parking brake system with spring energy storage air bleed brake and auxiliary braking system with engine exhaust brake.

1. The heavy-duty vehicle must have three kinds of braking devices including main brake (service brake), emergency brake and parking brake. It also can be equipped with auxiliary brake device. The first two must be adjustable, while the parking brake may be nonadjustable. The emergency brake device refers to the spare brake device used for replacing the main brake under the circumstance of the failure of main brake control system, and it has the same performance with the main brake.

The main brake of the Auman heavy-duty truck adopts a double-circuit air brake system, the parking brake and emergency brake uses spring energy storage air bleed brake, and the auxiliary brake adopts exhaust brake. However, the exhaust brake shares a set of device together with engine flameout device.

2. The main brake, emergency brake and parking brake may share a set of brake control mechanism. But the control system of the main brake must be separated from that of the parking brake. The emergency brake control system and parking brake control system of this vehicle share a set of device.
3. When both the control systems of the service brake and the emergency brake fail, the parking brake must have 50% brake effect of the service brake.
4. When the brake medium fails or the pressure can not reach the required value, warning signal must be emitted. This vehicle has two warning indicator lamps. When the pressure in the service brake air pipe of the whole vehicle can not reach 4.5 bar, the low-pressure warning lamp comes on, and meanwhile, the buzzer sounds. When the pressure in the parking brake air pipe or auxiliary air pipe is less than 4.5 bar, the parking brake indicator lamp comes on, which indicates the vehicle can not start.
5. The parking brake must guarantee that, even no driver drives the vehicle, the working parts can be locked to realize brake fully by the mechanical device, and thereby the reliable parking on the slope can be ensured.
6. The response time from opening the main brake valve to the pressure of the farthest brake sub-chamber reaching the corresponding value shall not exceed 0.6 second.
7. In addition to the above mentioned requirements, in general, the vehicle brake device must ensure driving stability and maneuverability, and with this prerequisite, it must acquire the shortest possible braking distance.

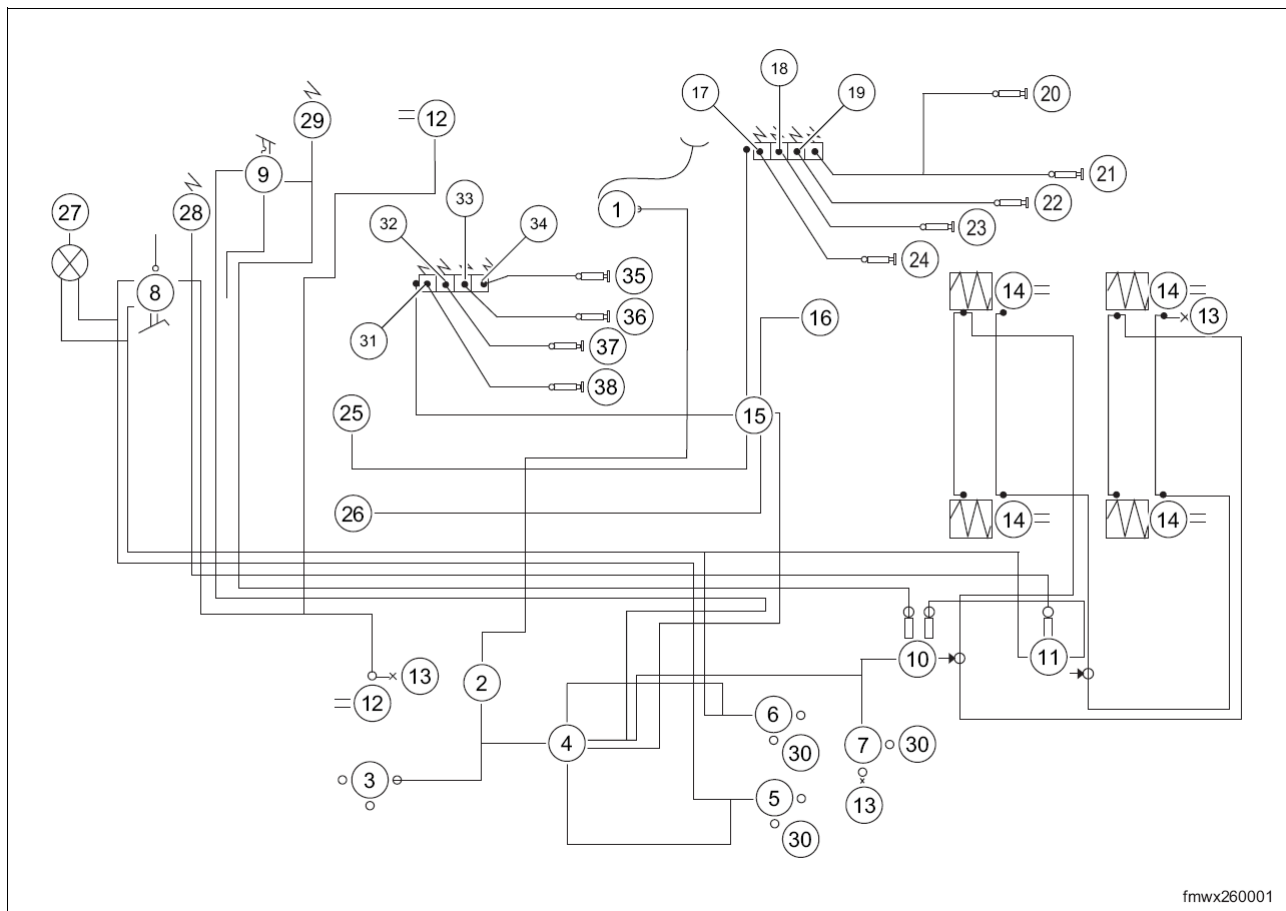
Color Comparison Table of Shaped Air Pipe Nylon Pipe

Differential Relay Valve	Port 1			Red
	Port 2 rear			Red Blue
	Port 2			Rubber Hose
	Port 41			Blue
	Port 42			Apple Green
RR Axle Relay Valve	Port 1			Pink
	Port 2 rear	Φ8		Apple Green
		Φ12		Red Green
	Port 4			Dark Green
	Port 2			Rubber Pipe
Intermediate Axle Relay Valve	Port 1			White
	Port 2 rear			Light Yellow
	Port 2 front			Light Yellow
	Port 4		Φ8 Nylon Pipe	Light Yellow
Solenoid Valve	Connect Inter-axial Differential			Purple
	Connect Inter-axial Differential	Intermediate Axle	To Tee/ Orange Red	Orange Blue
		Rear Axle		Orange Green
	Exhaust Brake Butterfly Valve			Yellow
	Operating Cylinder			Orange
	Lift			Red
	Lower			Blue
	Neutral Position			Red Purple
	Power Take-off			Pink
	Load Sensing Valve	Port 1		
Port 2			Steel Pipe	
Port 3			Rubber Pipe	
Port 4			Dark Green	
Master Brake Cylinder	Port 12			Apple Green
	Port 11			Pink
	Port 21			Dark Green
	Port 22			Light Yellow

Service Brake - Service Brake System

Manual Brake Master Cylinder	Port 11	White
	Port 21	Blue
	Port 22	Apple Green
Seven-way	Clutch Booster	Purple
	Fuel Cut-off Tee	Orange
	Fuel Cut-off Tee to Operating Cylinder	Orange
	Gearbox	Purple
	Port 1	Red
	LH Longitudinal Beam Solenoid Valve Port 1	Yellow Pink
	RH Longitudinal Beam Solenoid Valve Port 1	Yellow Red
	Seat	White Orange
Trailer control valve	Port 2	Yellow
	Port 41	Dark Green
	Port 43	Apple Green
	Port 42	Light Yellow
	Port 1	White
Pneumatic Switch	Port 2 - Operating Cylinder	No Color
	Orange	
Cab Tee to Solenoid Valve		Yellow
Cab Tee to LH Bulkhead Elbow 950		Blue
Cab Tee to RH Bulkhead Elbow 3100		White
Bulkhead elbow to Air Horn Joint Root		Orange
Connecting Pipe between Chambers		Orange
Quick Release Valve	FR Brake Elbow LH	Light Yellow
	FR Brake Elbow RH	Light Yellow
FR ABS Valve	FR Axle Bulkhead Elbow or Tee to ABS Valve 1 Way	Yellow
ASP Valve	Multi-way to ASR Valve	Red Yellow
	ASR Valve to Differential Valve 41	Red Green

System Installation Diagram



fmwx260001

1	Air Compressor
2	Air Dryer
3	Renewable Air Reservoir
4	Four-circuit Protective Valve
5	FR Axle Brake Air Reservoir
6	RR Axle Brake Air Reservoir
7	Parking Brake Air Reservoir
8	Brake Master Valve
9	Hand Brake Valve
10	Double-chamber Relay Valve
11	Relay Valve
12	Diaphragm Brake Chamber
13	Testing Joint
14	Spring Brake Chamber
15	Multi-way Joint Body
16	Transmission Air Inlet

20	Operating Cylinder
21	RR Axle Inter-wheel Differential Lock Cylinder
22	Inter-axial Differential Cylinder
23	Operating Cylinder
24	Exhaust Brake Butterfly Valve
25	Pneumatic Seat Assembly Air Inlet
26	Clutch Booster
27	Electronic Air Pressure Gauge
28	Service Brake Indicator Sensor
29	Parking Indicator Sensor
30	Water Drain Valve
31	Power Take-off Solenoid Valve
32	Neutral Position Solenoid Valve
33	Lift Cylinder Descending Solenoid Valve
34	Lift Cylinder Lifting Solenoid Valve
35	Lift Cylinder

Service Brake - Service Brake System

17	Exhaust Brake Solenoid Valve
18	Operating Cylinder Solenoid Valve
19	Inter-axial Differential Lock Cylinder

36	Lift Cylinder Lower Cylinder
37	Transmission Power Take-off Neutral Position Cylinder
38	Power Take-off Cylinder

Air Supply Part

Compressed air is supplied to the four-circuit protection valve by an air pump through the dryer. A pressure regulator valve is installed in the dryer, which limits the maximum pressure of the whole vehicle within 7.5~8.0 bar. The dryer is provided with desiccant. When the compressed air from the air compressor passes through the dryer, the moisture in the air will be absorbed by the desiccant, and then relatively pure air is supplied to the four-circuit protection valve. At the same time, the backflush air reservoir charges air. When the pressure of the whole vehicle reaches the rated value, the pressure regulator valve in the dryer opens; at the moment, the air compressor unloads to keep the pressure of the whole vehicle not increased, and meanwhile, the backflush channel of the backflush air reservoir to the dryer is opened. The compressed air in the backflush air reservoir flows through the dryer reversely after passing through the orifice in dryer, and then pushes the moisture absorbed by the dryer out of the dryer quickly to regenerate the desiccant. When the pressure of the whole vehicle falls to the degree at which the pressure regulator valve is to close, the pressure regulator valve closes, and the compressed air from the air compressor is dried by the dryer, and then supplied to the circuits of the whole vehicle after passing through the four-circuit protection valve. When the vehicle is running, the dryer will repeat the above process and provide relatively pure air for the circuits.

The air dried by the dryer passes through the four-circuit protection valve to divide the air channel of the whole vehicle into four circuits which are related but independent. The function of the four-circuit protection valve is to close the defective circuit when there are faults in the circuit (such as disconnection or leakage), which has no influence on normal operation and air charging of other circuits.

Front Axle Brake Circuit

Air is charged to the front brake air reservoir through the outlet 21 of the four-circuit protection valve, and then the air is supplied to the lower chamber connecting port 12 of the main brake valve from the air reservoir. When the brake pedal is pressed, the main brake valve opens, and air flows to the brake sub-chamber of the front axle from the port 22. During braking, the pressure in the brake sub-chamber is in direct proportion to the pedal travel of the main brake valve.

(Intermediate) Rear Axle Brake Circuit

Air is charged to the rear (intermediate) brake air reservoir through the outlet 22 of the four-circuit protection valve, and then the air is supplied to the upper chamber connecting port 12 of the main brake valve from the air reservoir, and to the main brake relay valve from the outlet 21 of the main brake valve. Air is supplied to the relay valve directly by the air reservoir. When the main brake valve actuates, the relay valve opens and supplies the brake pressure respectively to the main brake sub-chambers of the intermediate axle and rear axle. The pressure in the brake sub-chamber is in direct proportion to the pedal travel of the main brake valve. The function of the relay valve is to shorten the brake response time, and it plays a role of "quick charging" and "quick release".

Parking Brake Circuit

Air is supplied for the parking brake from the four-circuit protection valve. The parking brake valve controls the relay valve. When the parking brake is applied, the control pressure of the relay valve is emptied through the parking brake valve, and the air in the parking brake chamber of the rear (intermediate) axle is vented through the relay valve, the chamber spring forces the piston and ejector pin to extend out and produce braking function, and the braking strength depends on tension of the energy storage spring. When the parking brake valve is at the "driving" position, the parking brake valve provides a control pressure to the dual-chamber relay valve and open it, the compressed air provided directly by the air reservoir goes into the parking brake chamber of the rear (intermediate) axle quickly, and the compressed air with a pressure of above 550kPa can overcome the spring force and push back the piston and ejector pin, so as to release the brake. The dual-chamber relay valve refers to a valve which is controlled respectively by the parking brake valve and main brake valve. In other words, if the vehicle is in parking brake state, pressing the brake pedal can release the parking brake because the main brake valve supplies a brake pressure to the main brake sub-chamber and a brake pressure to the spring energy storage sub-chamber of the dual-chamber relay valve, so as to achieve the purpose that the ejector pin of the brake sub-chamber is not overloaded.

Auxiliary Air Circuit

All the air systems irrelative with brake can be connected to auxiliary air circuit.

When stepping on clutch pedal, the clutch booster cylinder will be supplied with air and produce boost.

The pressure reducing valve lowers the pressure to 4.5 bar, then the air is supplied to the gear shift valve.

When the valve is in high gear, the low gear cylinder returns air, and the high gear cylinder breathes.

When the valve is in low gear, the high gear cylinder returns air, and the low gear cylinder breathes.

Meanwhile, switching on the inter-wheel differential lock solenoid valve and inter-axial differential lock solenoid valve can realize the engagement of the differential lock.

Brake Clearance

There must be a standard clearance between the brake friction plate and brake drum when they are in a free state. If the clearance value is too small, it will cause brake jamming and the brake drum will heat. If the clearance value is too big, then it will cause long brake reaction time and slow brake.

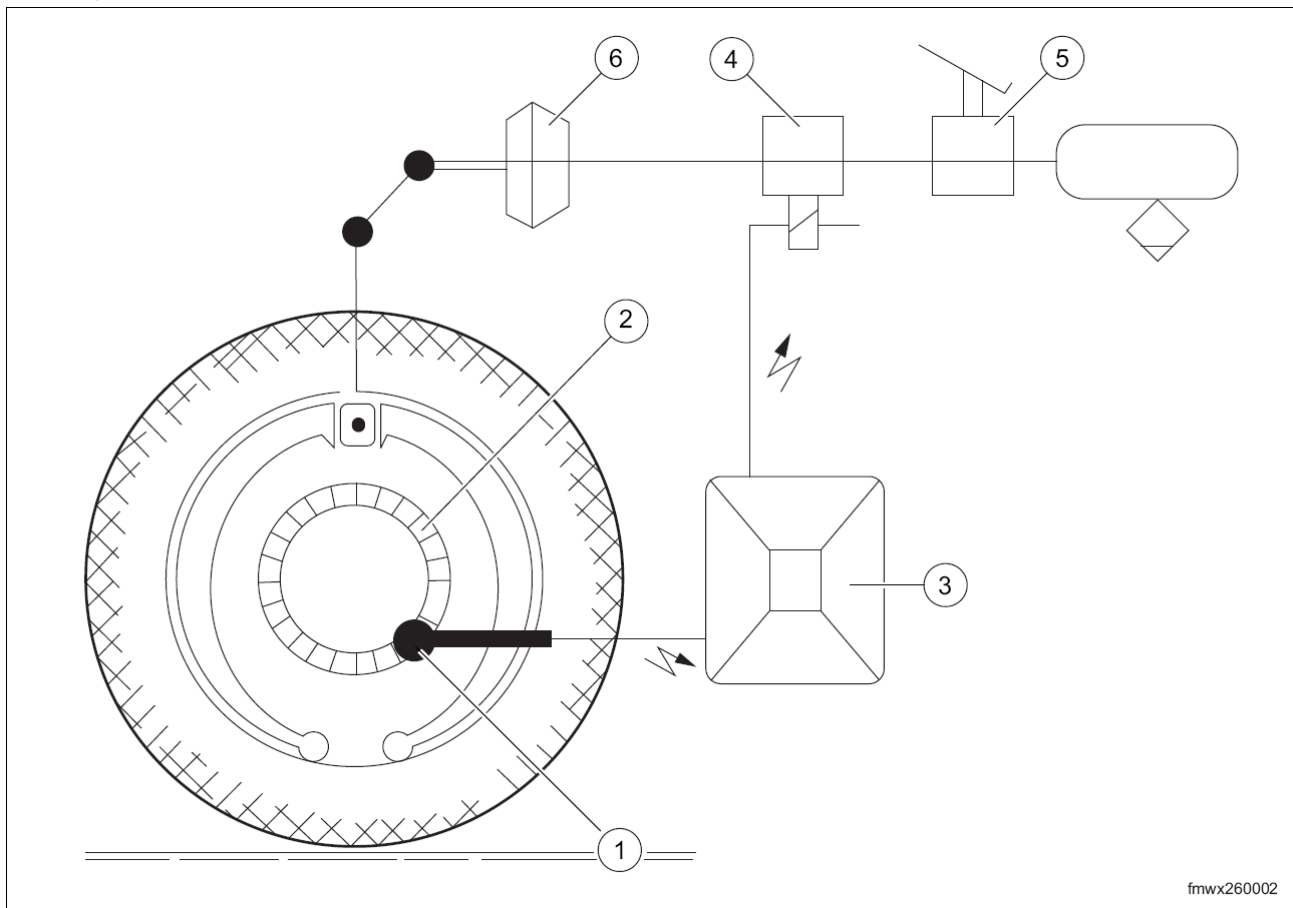
With vehicle driving, the brake friction plate will wear out, and the clearance value will increase constantly. Thereby, the brake clearance needs to be adjusted frequently during maintenance.

ABS System

Advantages of ABS system:

1. **Keeping the steerability of vehicle direction at the moment of brake.**
2. **Shortening and optimizing the brake distance and easing the mental burden of the driver.**
3. **Reducing the abrasion of tire, and saving maintenance cost.**

Working Principle:



fmwx260002

1	Sensor
2	Ring Gear
3	Central Processing Unit ECU

4	ABS Solenoid Valve
5	Main Brake Valve
6	Brake Chamber

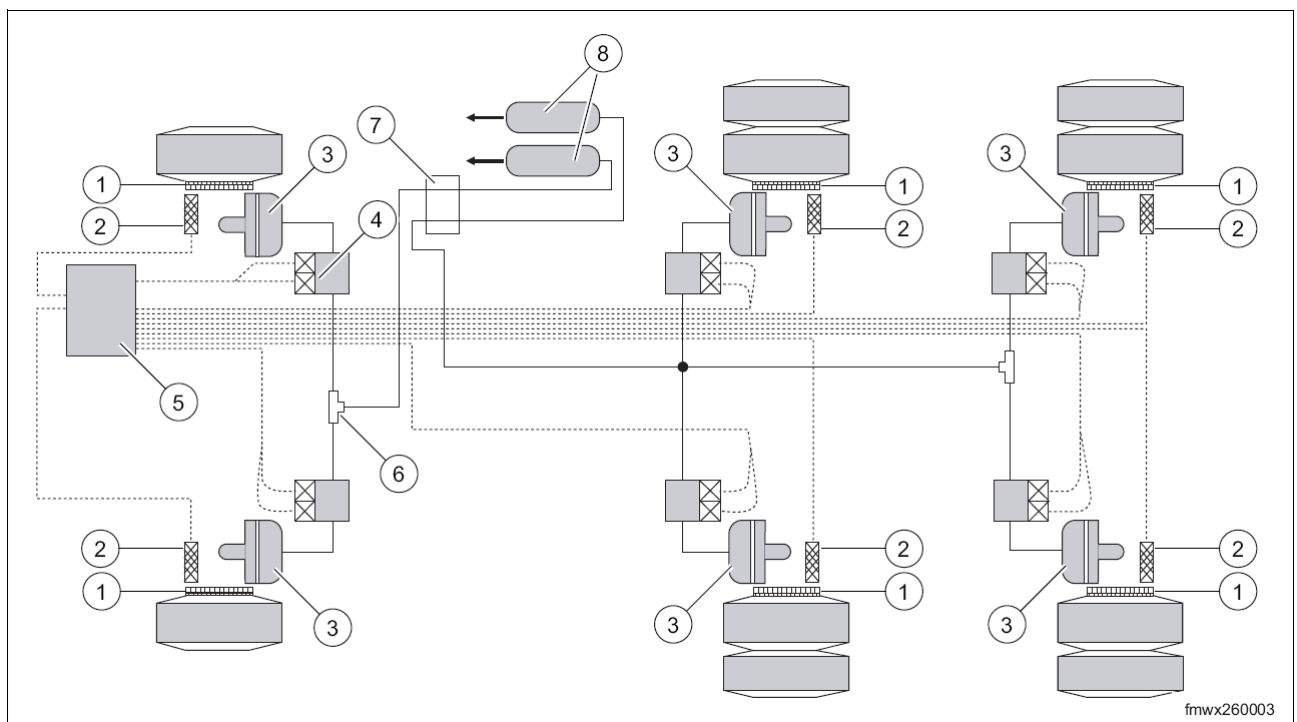
Service Brake - Service Brake System

The signal sensor system consists of the ring gear fixed on the wheel hub, a sensor and wires, wherein the sensor is fixed on the wheel bracket and it forms a group of signal transmission system together with the ring gear. When the wheel rotates, the sensor will transmit the pulse signal that is synchronous with the rotation speed to the central processing unit.

The central processing unit processes the input rotation speed signal, when the vehicle brakes, it can control the ABS solenoid valve (mechanism) at any time, and constantly adjust the pressure value in brake branch chamber by ABS solenoid valve. When the brake pressure is too high, the wheel begins to be locked, and the central processing unit immediately releases air through the solenoid valve and lowers the pressure in the brake branch chamber so as to keep the wheel in the optimal brake status, namely at the sliding edge.

The warning indication system consists of a central processing unit and an ABS warning lamp. It can not only indicate whether the ABS system is normal, but also show the fault position in ABS though different twinkle way of indicator.

The ABS system has many layout manners. The vehicle adopts the basic configuration as follows:



1	Ring Gear
2	Sensor
3	Brake Chamber
4	ABS Solenoid Valve

5	ECU
6	Three-way Joint
7	Master Brake Valve
8	Air Reservoir

Precautions:

1. Precautions for operation of brake system

- (a) Replace each part correctly and carefully, otherwise it will affect the performance of brake system, and even cause personal safety.
- (b) Be sure to use original parts.
- (c) Keep the parts and maintenance area clean.
- (d) Brake pipe is an important safety part, if it leaks, it must be repaired or replaced as needed.
- (e) In the operation of the brake pipe, use the plug to seal the nozzle to prevent dust, dirt and other foreign matter from falling into the pipe.
- (f) When dismantling or installing the brake pipe, do not bend or deform the brake pipe.
- (g) Removed buckle or tie can not be used again.

2. Precautions for maintenance of brake system

- (a) Inspect the brake system regularly, and it is required to inspect the system every 5000km.
 - Inspect the clearance between brake shoe friction plate and brake drum.
 - Inspect the abrasion condition of the brake shoe friction plate.
 - Inspect the brake pedal travel and free travel.
 - Inspect the damage condition of the brake pipe.
 - Inspect whether all connection positions are loose.
 - Inspect whether the function of the brake system is normal.

Service Brake - Service Brake System**Fault Symptom Table**

The following table will help you find the fault. The sequence represents the possibility of fault. Inspect each part in accordance with such sequence, and replace as needed.

Fault Symptom	Possible Cause	Reference
Braking Drag	1. Brake Pedal Free Routine (too small)	Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
	2. Brake Clearance (too small)	Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
	3. Master Brake Valve (failed)	Chapter 26 Service Brake – Master Brake Valve, Replacement
	4. Brake Pedal (deformed)	Chapter 26 Service Brake – Brake Pedal, Replacement
	5. Brake Chamber Pull Rod (damaged)	Chapter 26 Service Brake – Front Brake Chamber, Replacement Chapter 26 Service Brake – Rear Brake Chamber, Replacement
	6. Wheel Hub Bearing (loose)	Chapter 24 Front Axle – Front Wheel Hub, Overhaul Chapter 25 Rear Axle – Wheel Hub Bearing, Oil Seal, Overhaul
	7. Brake Shoe Return Spring (too soft or broken)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	8. Brake Chamber Film (ageing)	Chapter 26 Service Brake – Front Brake Chamber, Replacement Chapter 26 Service Brake – Rear Brake Chamber, Replacement

Service Brake - Service Brake System

Brake Abnormal Noise	1. Brake Shoe Friction Plate (exposure of rivet)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	2. Brake Shoe Friction Plate (hardened)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	3. Brake Drum (abnormal abrasion)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	4. Brake Drum (deformed)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	5. Wheel Hub Bearing (worn excessively)	Chapter 24 Front Axle – Front Wheel Hub, Overhaul Chapter 25 Rear Axle – Wheel Hub Bearing, Oil Seal, Overhaul
Brake Failure	1. Air Compressor (damaged)	Chapter 16 Engine Mechanical – Engine Accessory, Replacement
	2. Brake Pedal (loose)	Chapter 26 Service System – Brake Pedal, Replacement.
	3. Brake Chamber (failed)	Chapter 26 Service Brake – Front Brake Chamber, Replacement Chapter 26 Service Brake – Rear Brake Chamber, Replacement

Service Brake - Service Brake System

Unstable Brake	1. Tire Pressure (uneven)	Chapter 23 Tire and Wheel – Front Tire and Wheel, Overhaul Chapter 23 Tire and Wheel – Rear Tire and Wheel, Overhaul
	2. LH and RH Brake (improper adjusting)	Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
	3. Return Spring(damaged)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	4. Brake Friction Plate (hardened)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	5. Brake Base Plate (damaged)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	6. Steel Palte Spring U-Bolt (loose)	Chapter 21 Front Mounting – Front Steel Plate Spring, Overhaul Chapter 22 Rear Mounting – Rear Steel Plate Spring, Overhaul
Braking deviation	1. Friction Plate (one side polished)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	2. Friction Plate (used wrongly)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	3. Brake Clearance (abnormal)	Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
	4. Brake Chamber (inconsistent pressure)	Chapter 26 Service Brake – Front Brake Chamber, Replacement Chapter 26 Service Brake – Rear Brake Chamber, Replacement

Service Brake - Service Brake System

Lack of Brake Power	1. Air Compressor (out of work)	Chapter 16 Engine Mechanical – Engine Accessories, Replacement
	2. Relay Valve (damaged)	Chapter 26 Service Brake – Relay Valve, Replacement
	3. Brake Friction Plate (hardened)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	4. Brake Drum or Brake Friction Plate (oil stain)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement
	5. Brake Chamber Pull Rod (deformed)	Chapter 26 Service Brake – Front Brake Chamber, Replacement Chapter 26 Service Brake – Rear Brake Chamber, Replacement
Brake Smoking	1. Axle Shaft Oil Seal (damaged)	Chapter 25 Rear Axle – Axle Shaft, Overhaul
	2. Brake Clearance (too small)	Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
	3. Oil of Axle Housing (too much)	Release excessive oil
	4. Brake Friction Plate (used wrongly)	Chapter 26 Service Brake – Front Brake Shoe, Replacement Chapter 26 Service Brake – Rear Brake Shoe, Replacement

Testing & Adjustment

Overhaul of brake valve

1. Inspect air leakage

- (a). Supply compressed air to the air supply end.
- (b). Inspect whether the air supply end leak air.

2. Measure the pedal angle when it starts

- (a). Supply compressed air to the air supply end.
- (b). Put a protractor and pressure gauge near the air supply end, then measure the pedal angle when the reading of the pressure gauge rises to 34.3kPa.
 - Pedal angle: $4^{\circ} \pm 0.5^{\circ}$

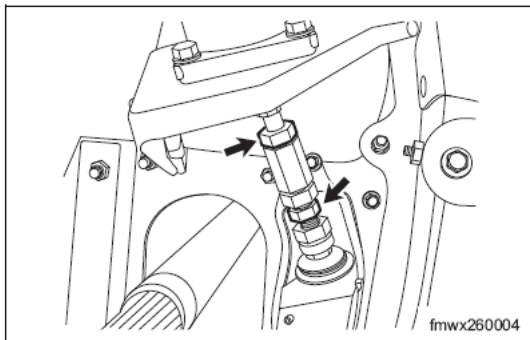
3. Measure the pressure at the air supply end when the pedal is stepped to the floor

- (a). When the pedal is stepped to the floor, read the pressure of the air supply end.
 - Standard Value: 368 = kPa

4. When the pedal is stepped to the floor, measure the pedal force at the position 150mm away from the pedal supporting point.

- (a). When the pedal is stepped to the floor, measure the pedal force at the position 150mm away from the pedal supporting point.
 - Pedal Force: 130N

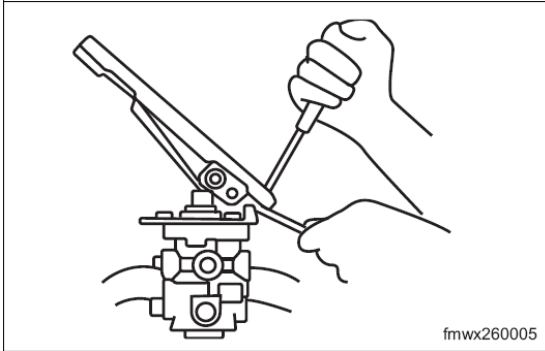
Brake pedal clearance



1. Adjust the brake pedal clearance

- (a). Unscrew the fastening nut.
- (b). Unscrew the adjusting nut.
- (c). Fix the fastening nut.

Brake Pedal Clearance (Right Rudder)



1. Adjust the brake pedal clearance

- (a). Adjust the pedal free travel.
- (b). Adjust the free travel by the adjusting screw at the lower end of the pedal.
- (c). Lock by the locking nut.

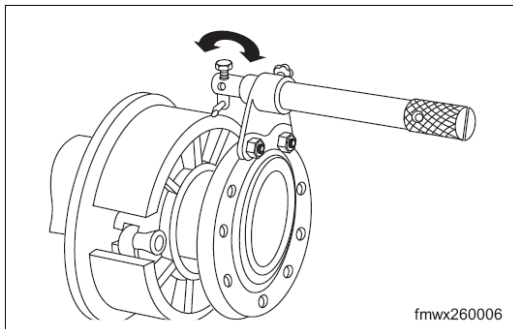
Grind the brake shoe

Caution:

The engagement of grinding every time shall not exceed 1 mm.

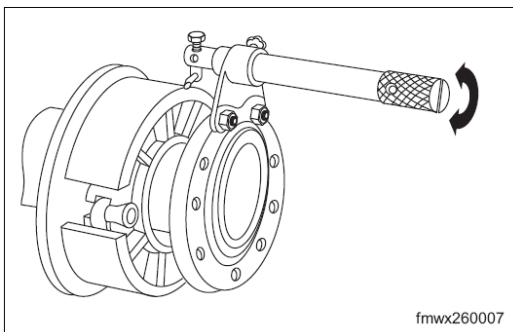
Caution:

If the brake friction plate is too close to the brake base plate, once the grinding is finished, it is necessary to release the handle immediately. At this point, the grinding machine will continue to rotate with the wheel hub, but the handle will not rotate relative to the spindle of the grinding machine any more, so that the cutter bar stops feeding, so as to prevent the cutter bar of the grinding machine from impacting the brake base plate.



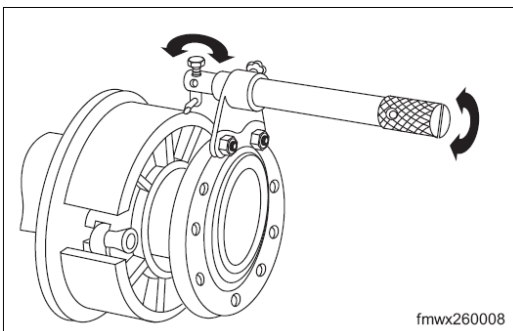
1. Install the grinding machine

- (a). Tighten the adjusting nut of the brake adjusting arm tightly so as to make the friction plate of the brake shoe cling to the brake drum completely.
- (b). Loosen the adjusting nut by one turn.
- (c). Dismantle the brake drum.
- (d). Screw up the adjusting nut by a turn for the purpose of making the friction plate cling to brake drum once more.
- (e). Fix the grinding machine on the wheel hub.



2. Locate the main cutter bar

- (a). Loosen the fixing hand wheel of main shaft.
- (b). Adjust the location of main shaft, put the cutter bit on the edge of friction plate.
- (c). Screw up the hand wheel, and fix the main shaft.

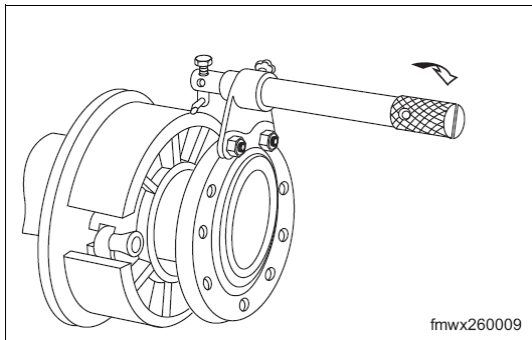


3. Align the cutter

- (a). Turn out the fast feed crank on the main shaft handle.
- (b). Put the cutter bit into friction plate by swinging the cutter bar through fast feed crank.
- (c). Screw off the cutter bar, and make the cutter fit face to the friction surface.
- (d). Rotate by 1/5 to 1/4 turn in the unscrewing direction, so as to ensure the outside diameter of the friction plate is 0.20 to 0.25 mm greater than the inside diameter of the brake drum.

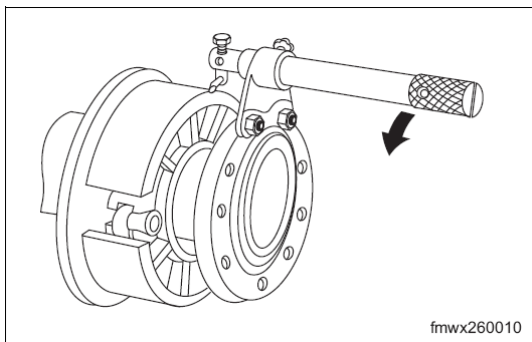
Service Brake - Service Brake System

- (e). Fasten the screw on the cutter bar.
- (f). By using quick tool crank, withdraw the cutter bar to the edge of the friction plate.



4. Grind the friction plate of front wheel brake shoe

- (a). Adjust the brake adjustment arm, make the diameter of brake shoe friction plate increases 1~2mm.
- (b). Hold the handle of the main axle, make the wheel hub in the clockwise rotation.
 - Along with the rotation of wheel hub, the cutter bit of the grinding machine come in automatically.

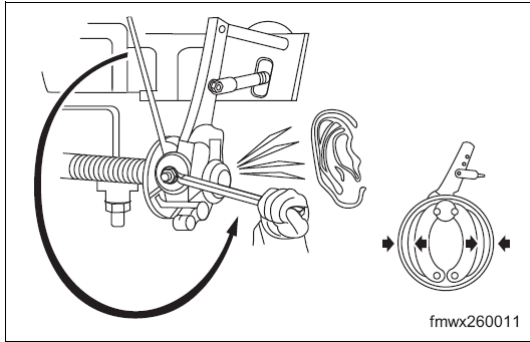


5. Grind the friction plate of rear wheel brake shoe

- (a). Grind the friction plate of the left rear wheel brake shoe.
 - Put the transmission into reverse gear, and then start the engine.
 - Use the clutch to control the rotation of the rear wheel hub.
- (b). Grind the friction plate of the right rear wheel brake shoe.
 - Put the transmission into the 3rd gear, and start engine.

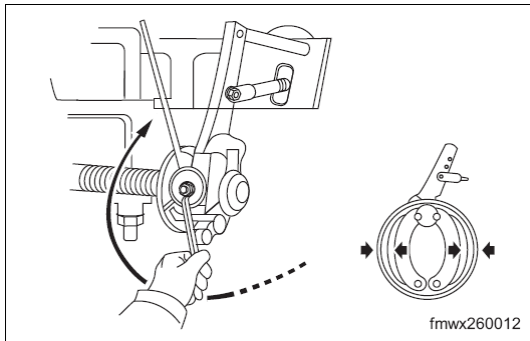
- 6. Dismantle the grinding machine
- 7. Adjust the brake adjusting arm to reduce the diameter of the shoe, and then install the brake drum.
- 8. Adjust the brake shoe clearance.

Adjust the brake clearance



1. Partial adjustment

- (a). Remove the dirt and oil stain on the adjusting arm.
 - When the locking sleeve can not be pressed, it is allowed to use a hammer to beat the wrench lightly.
- (b). Rotate the adjusting nut on the adjusting arm clockwise.
 - Until it can not rotate anymore.
 - The clearance is zero at this moment.



- (c). Rotate the adjusting nut by 3/4 turn anticlockwise (270°).
 - You can hear a click sound.
- (d). Apply the brake several times.

2. Overall adjustment

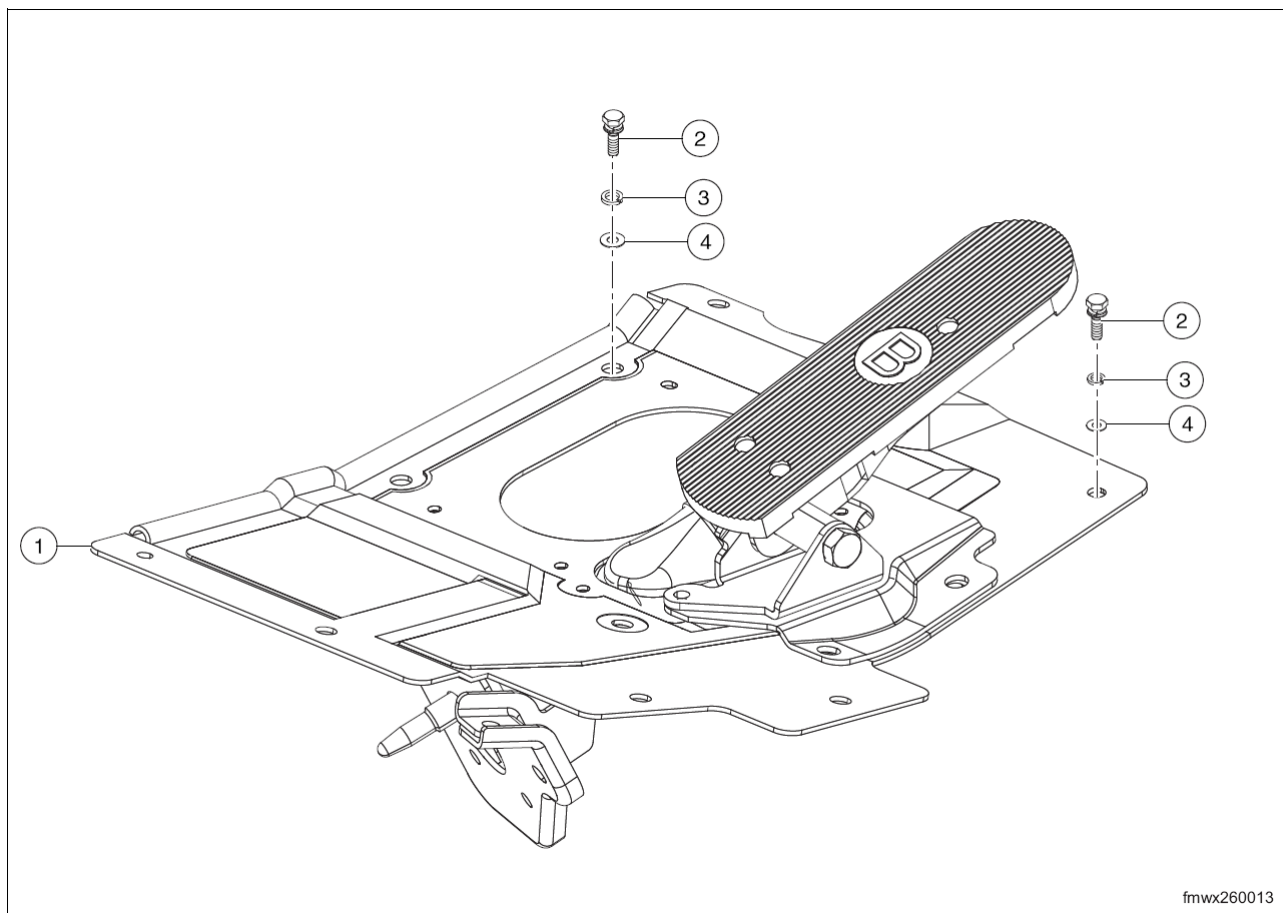
- (a). Prop up the vehicle axle in order to make the wheel leave the ground.
- (b). Loosen the connecting fork cotter pin of the push rod of brake chamber, remove the pin shaft.
- (c). Adjust the adjusting arm for adjusting the nut of three quarters cycle so that the brake drum can rotate freely and do not rub the friction plate.
- (d). Inspect brake clearance.
- (e). Adjust the route of pull rod in brake chamber.
 - Loosen the connecting fork of pull rod and lock the nut, adjust the route of pull rod.
 - Connect the cotter pin of pull rod connecting fork in brake chamber, lock the cotter pin.

Adjust the brake chamber

1. When installing the brake chamber, determine the initial length of the pull rod, and the included angle between the adjustment arm and pull rod in air chamber shall not be greater than the level of 100 ° ~ 105 °, otherwise the initial force of brake chamber will lower.
2. Fill the diaphragm cavity of brake chamber with compressed air, then use height gauge to measure the routine of pull rod.
3. The adjusting routine of brake chamber can not exceed values in the following table, otherwise, the effective brake can not be ensured.

Brake Pedal

Part Drawing



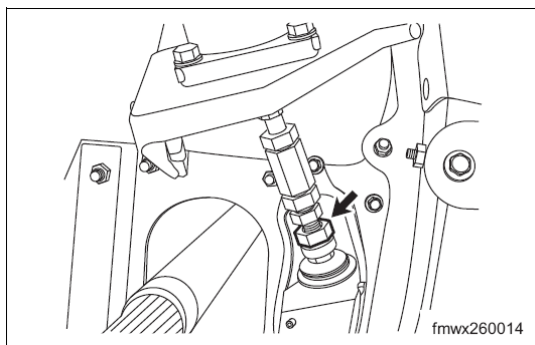
1	Brake Pedal Assembly
2	Hex Head Bolt, Spring Washer and Flat Washer Assembly

3	Spring Washer
4	Flat Washer

Replacement

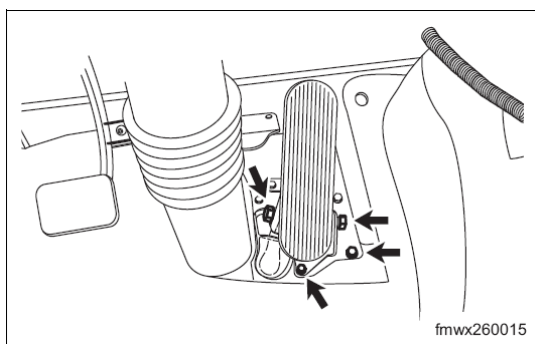
Hint:

Part Drawing, refer to Chapter 26, Service Brake - Brake Pedal, Part Drawing.



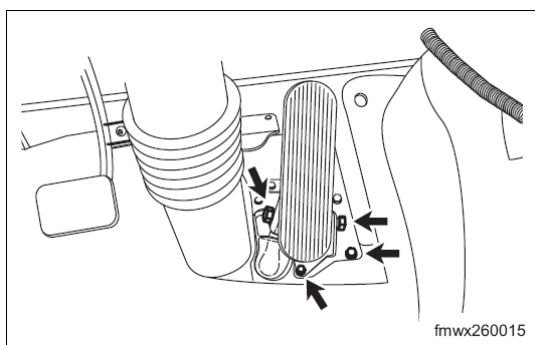
1. Dismantle the brake pedal assembly

- (a). Dismantle the shift lever of master brake valve.



- (b). Roll the carpet.

- (c). Dismantle the fixing bolt of brake pedal.

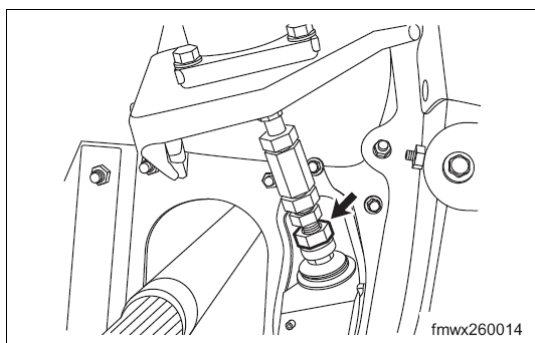


2. Install the brake pedal assembly

- (a). Install the fixing bolt of brake pedal.

Torque: 25N.m

- (b). Roll the carpet.

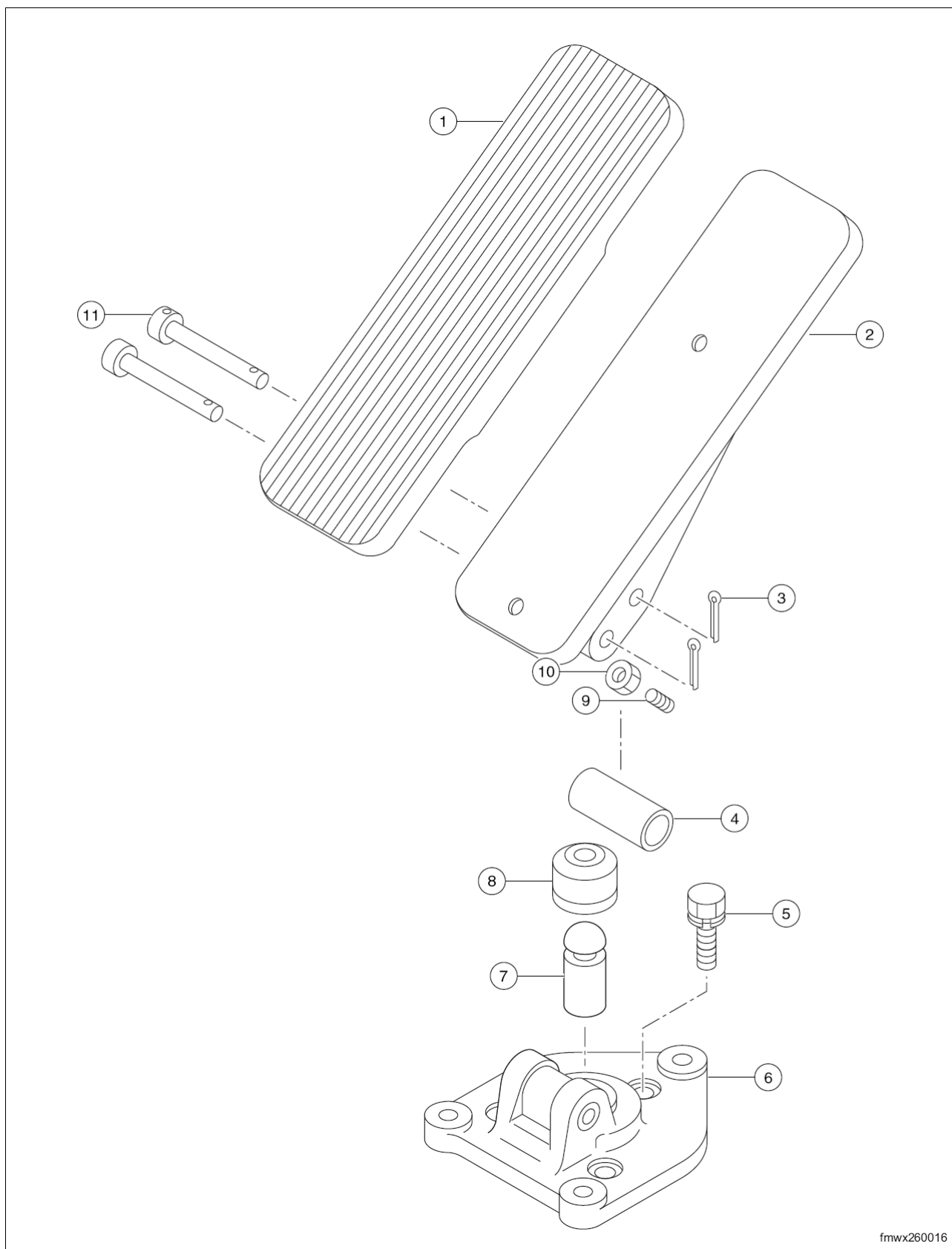


- (c). Install the shift lever of master brake valve.

- (d). Adjust the space of the brake pedal, refer to Chapter 26, Service Brake- Service Brake System, Testing & Adjustment.

Brake Pedal (Right Rudder)

Part Drawing



fmwx260016

1	Pedal Cover	7	Solenoid Core
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Service Brake - Brake Pedal (Right Rudder)

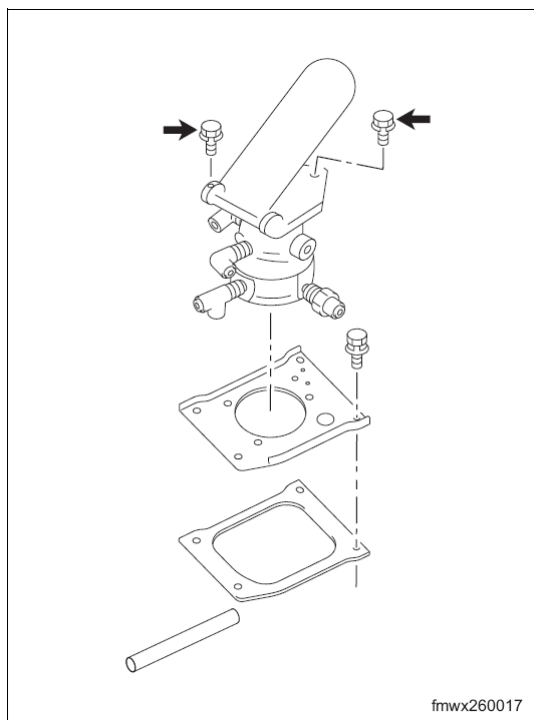
2	Brake Pedal
3	Cotter Pin
4	Roller
5	Bolt
6	Fixing Plate

8	Solenoid Core Protective Guard
9	Adjusting Bolt
10	Nut
11	Straight Pin

Replacement

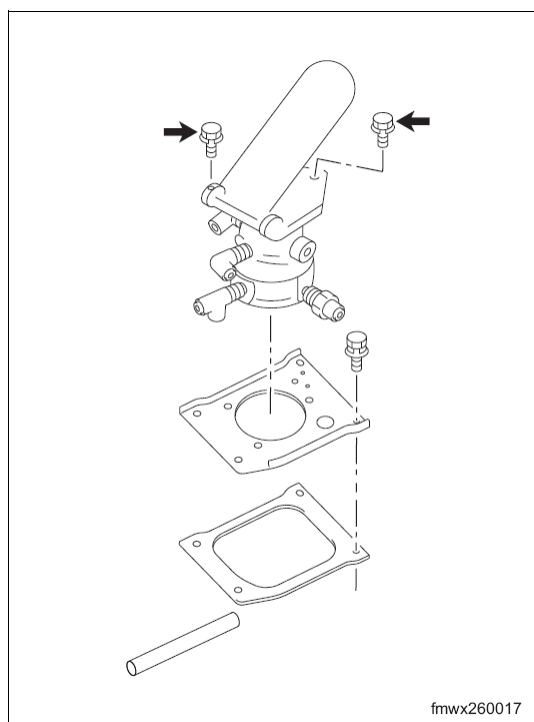
Hint:

Part Drawing, refer to Chapter 26, Service Brake- Brake Pedal (Right Rudder), Part Drawing.



1. Dismantle the brake pedal assembly

- Roll carpet.
- Dismantle the fixing bolt of brake pedal.



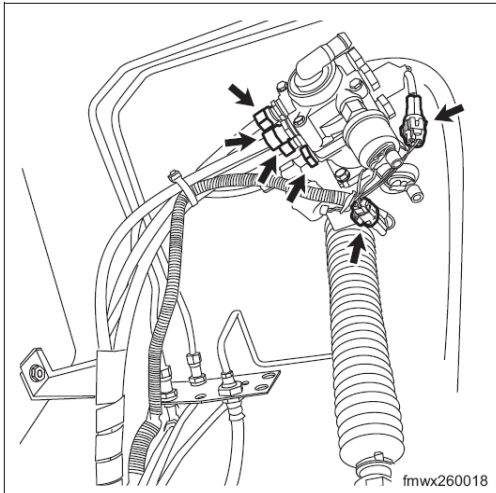
2. Install the brake pedal assembly

- Install the fixing bolt of brake pedal.
Torque: 25N.m
- Roll the carpet.
- Adjust the brake pedal clearance, refer to Chapter 26, Service Brake - Service Brake System, Testing & Adjustment.

Master Brake Valve

Overhaul

1. Release the pressure of brake system
2. Open the vehicle head



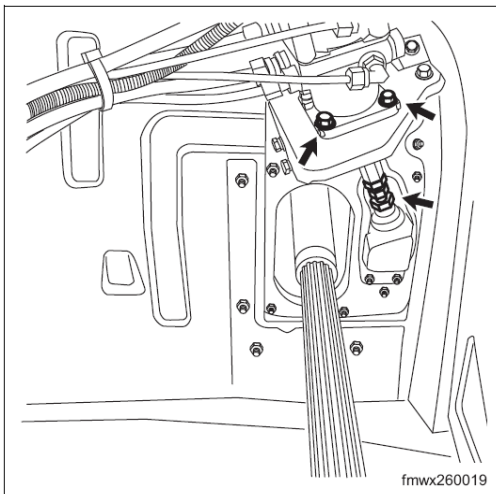
3. Dismantle the master brake valve

- (a). Disconnect the pipe of the master brake valve.

Caution:

Mark the pipe to avoid installing mistake.

- (b). Disconnect the connector of the master brake valve.



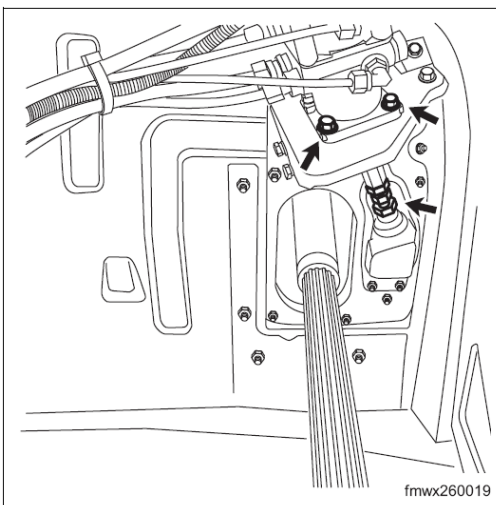
- (c). Dismantle the connecting bolt that connects the master brake valve and brake pedal.
- (d). Dismantle the fixing bolt of master brake valve.

4. Install the master brake valve

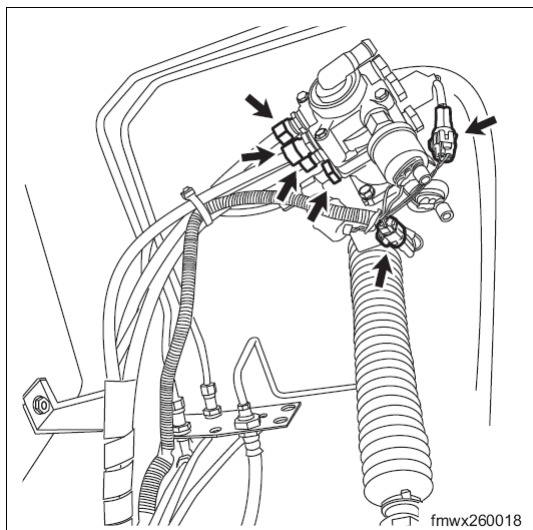
- (a). Install the fixing bolt of master brake valve.

Torque: 25N.m

- (b). Install the bolt which connects the master brake valve and brake pedal.



Service Brake - Master Brake Valve

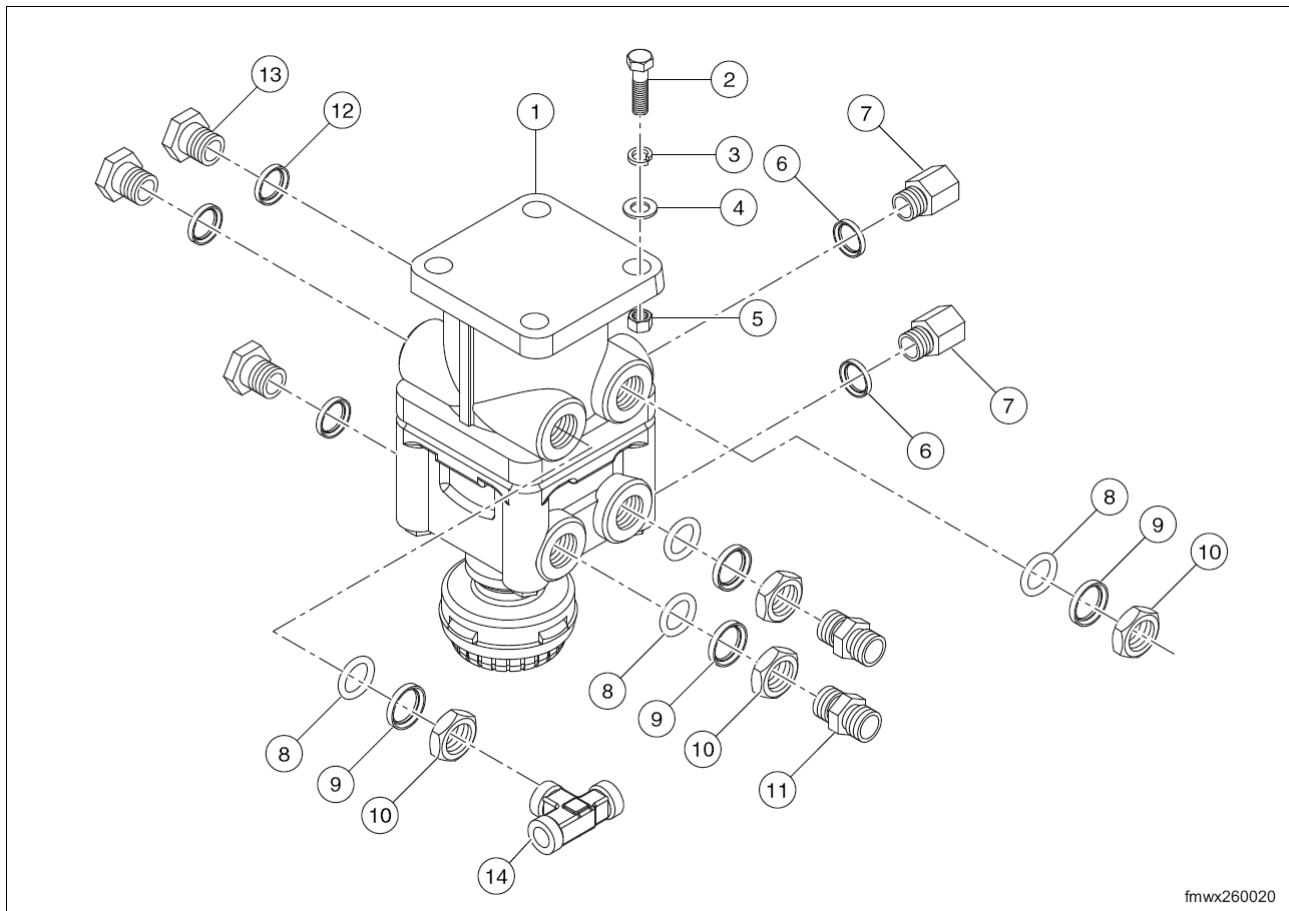


- (c). Connect the connector of master brake valve.
- (d). Connect the pipe of master brake valve.
- (e). Adjust the brake pedal clearance, refer to Chapter 26, Service Brake-Service Brake System, Testing & Adjustment.

5. Close the vehicle head

Master Brake Valve (Right Rudder)

Part Drawing



fmwx260020

26

1	Brake Valve Assembly (with muffler)
2	Hex Head Bolt
3	Spring Washer
4	Flat Washer
5	Hex Head Nut, Style 1
6	Sealing Gasket
7	Transition Joint

8	O-ring Rubber Sealing
9	Sealing Gasket
10	Hex Thin Nut-Fine Thread
11	Bulkhead Union Different Diameter Joint Body
12	Sealing Gasket
13	Hex Head Plug
14	Transition Three-way Joint

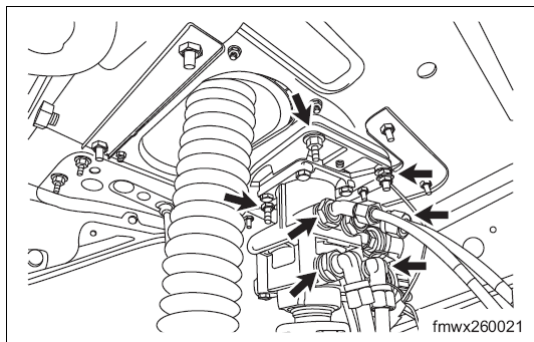
Service Brake - Master Brake Valve (Right Rudder)

Overhaul

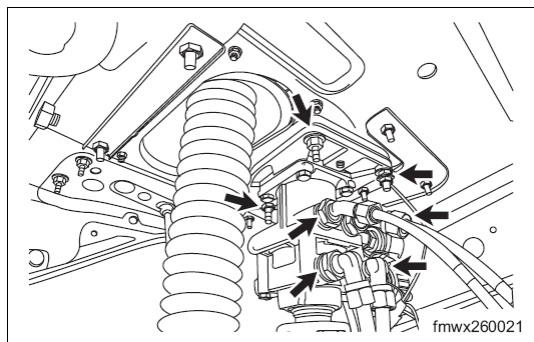
Hint:

Part Drawing, refer to Chapter 26, Service Brake-Master Brake Valve, Part Drawing.

1. **Release the pressure of brake system**
2. **Open the vehicle head**



3. **Dismantle the master brake valve**
 - (a). Disconnect the pipe of mater brake valve.
 - (b). Dismantle the fixing bolt of master brake valve.

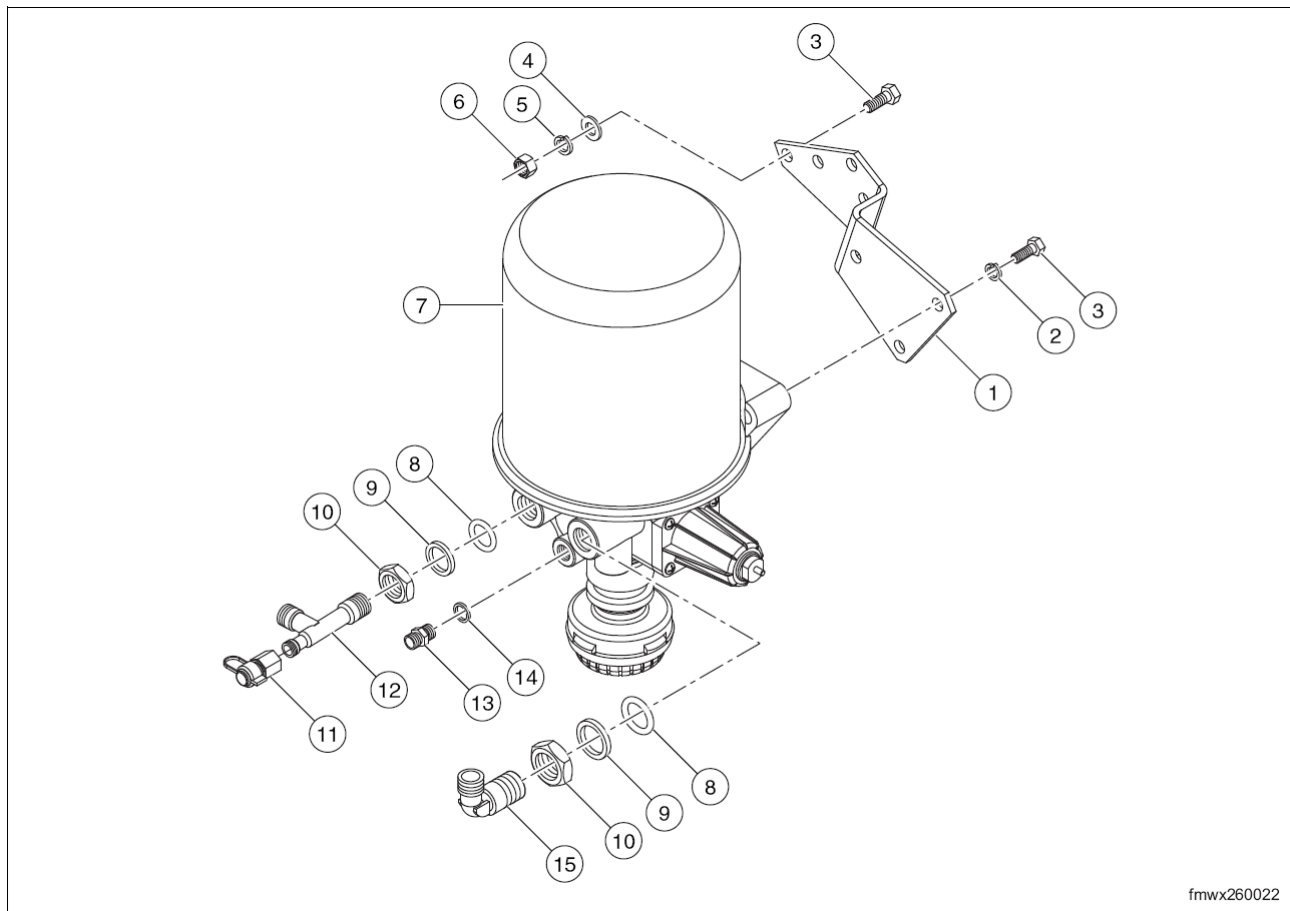


4. **Install the master brake valve**
 - (a). Install the fixing bolt of master brake valve.
Torque: 25N.m
 - (b). Connect the pipe of master brake valve.
 - (c). Adjust the brake pedal clearance, refer to Chapter 26, Service Brake-Service Brake System, Testing & Adjustment.

5. **Close the vehicle head**

Dryer

Part Drawing



fmwx260022

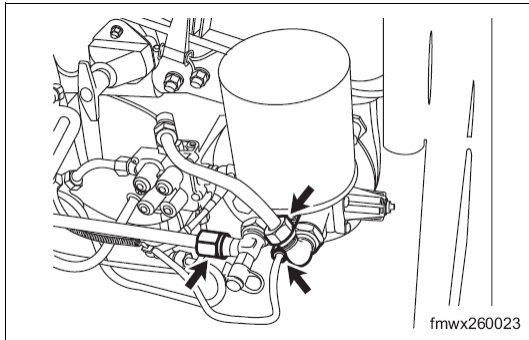
26

1	Dryer Angular Bracket
2	Spring Washer
3	Hex Thin Nut- Fine Thread
4	Flat Washer
5	Heavy Spring Washer
6	Hex Head Nut, Style 1
7	Combined Air Dryer Assembly
8	O-ring Rubber Sealing

9	Sealing Gasket
10	Hex Thin Nut- Fine Thread
11	Test Joint
12	Three-way Joint Body
13	Bulkhead Union Joint Body
14	Sealing Gasket
15	Bulkhead Union Elbow Body

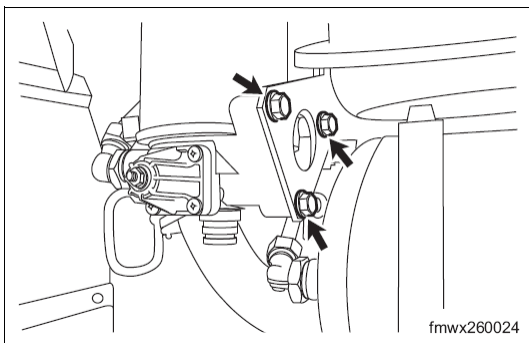
Overhaul

1. Release the pressure of brake system



2. Dismantle the dryer

(a). Dismantle the pipe of the dryer.



(b). Dismantle the fixing bolt of dryer.

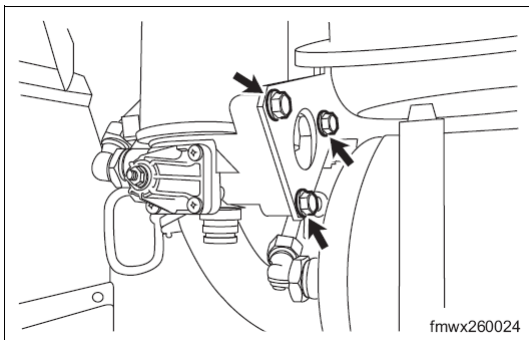
3. Inspect the dryer

(a). Inspect the pressure regulator valve.

- Inspect whether the one-way valve on the air outlet is damaged or not.
- Inspect whether there is material between the one-way valve on the air outlet and valve seat.
- Inspect whether the air vent of upper cover of the pressure regulator valve is blocked.
- Inspect whether the sealing part of the air outlet of the pressure regulator valve is damaged.

(b). Inspect the exhaust valve.

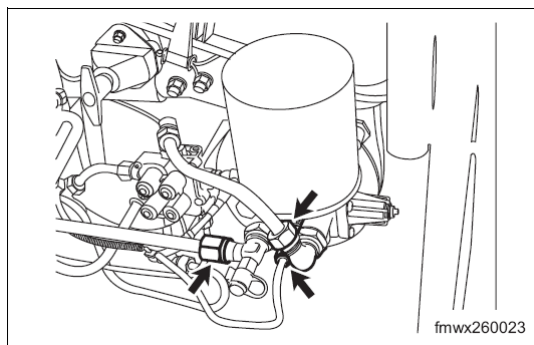
- Inspect whether the sealing part of the exhaust valve is damaged.
- Inspect whether there is material between exhaust valve body and valve seat.



4. Install dryer

(a). Install the fixing bolt of dryer

Torque: 60N.m

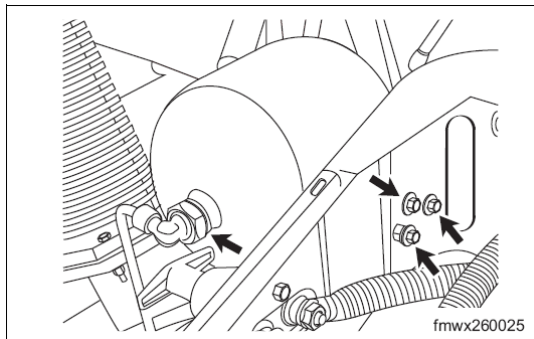


(b). Install the pipe of dryer.

Air Reservoir

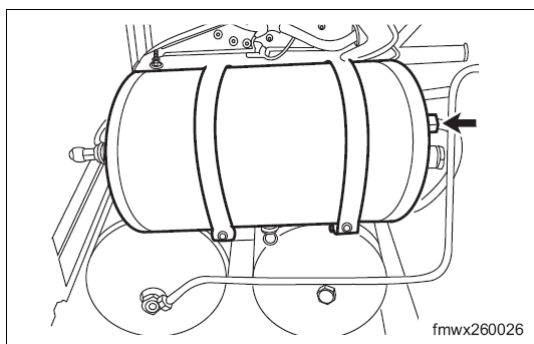
Overhaul

1. Release the pressure of brake system



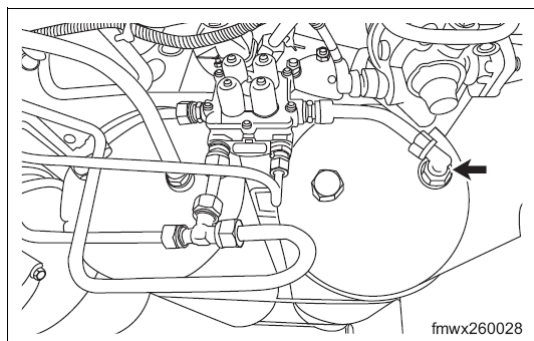
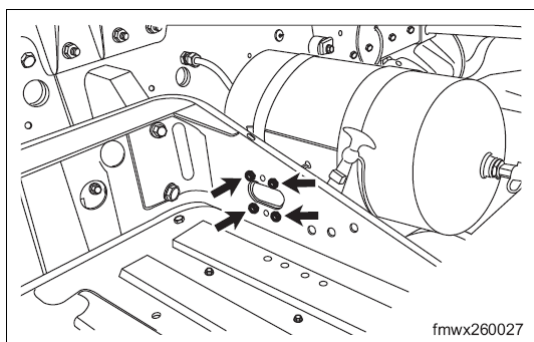
2. Dismantle the renewable air reservoir

- (a). Dismantle the battery, refer to Chapter 53, Battery-Battery Assembly, Replacement.
- (b). Disconnect the air pipe of renewable air reservoir.
- (c). Dismantle the fixing bolt of renewable air reservoir.



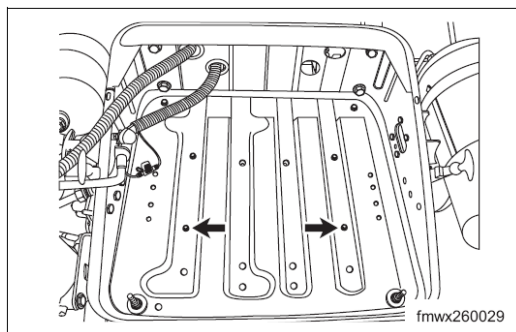
3. Dismantle the air reservoir of parking brake

- (a). Disconnect the air pipe of the air reservoir of parking brake.
- (b). Dismantle the fixing bolt of the air reservoir of parking brake.

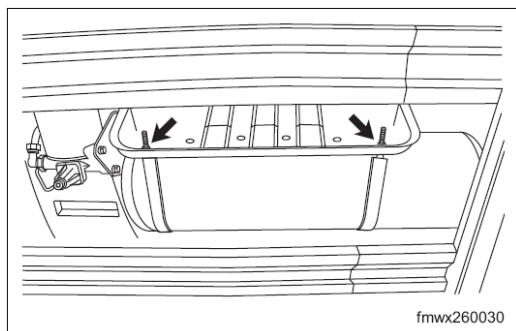


4. Dismantle the air reservoir of front axle brake

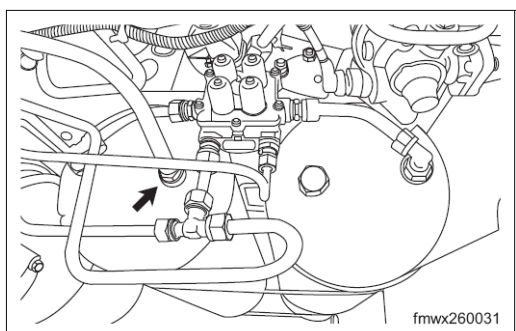
- (a). Disconnect the air pipe of the air reservoir of front axle brake.



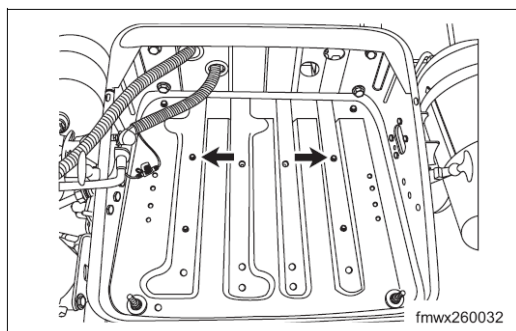
- (b). Dismantle the fixing bolt of the air reservoir of front axle brake.



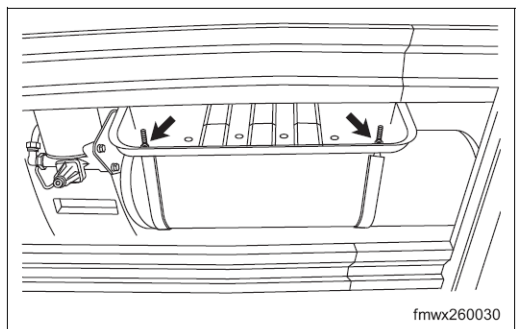
- (c). Dismantle the fixing cable tie of the air reservoir of front and rear axle brake.



- 5. Dismantle the air reservoir of rear axle brake**
(a). Disconnect the air pipe of the air reservoir of rear axle brake.



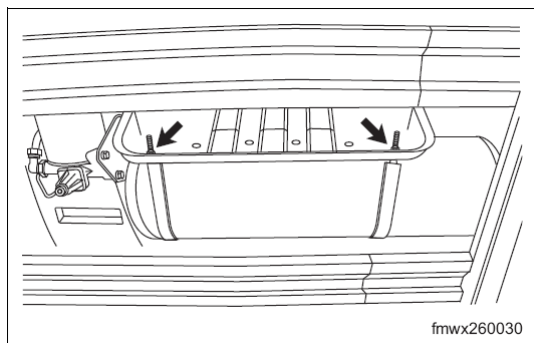
- (b). Dismantle the fixing bolt of the air reservoir of rear axle brake.



- (c). Dismantle the fixing cable tie of the air reservoir of front and rear axle brake.

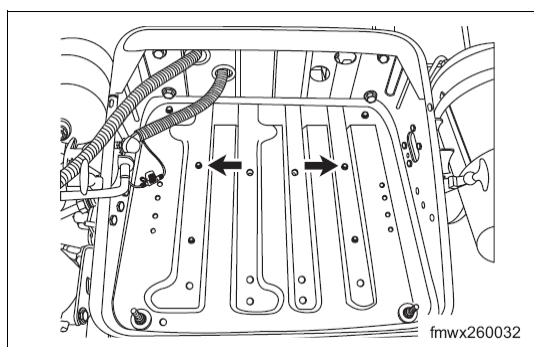
Service Brake - Air Reservoir**6. Inspect the air reservoir**

- (a). Inspect the sealing performance of air reservoir.
- (b). Inspect the sealing performance of drain valve.

**7. Install the air reservoir of rear axle brake**

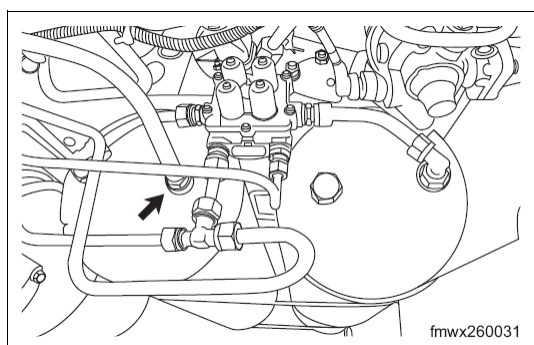
- (a). Install the cable tie of the air reservoir of front and rear axle brake.

Torque: 60N.m

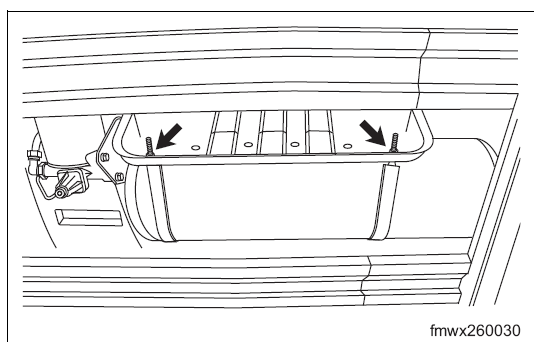


- (b). Install the fixing bolt of the air reservoir of rear axle brake.

Torque: 60N.m

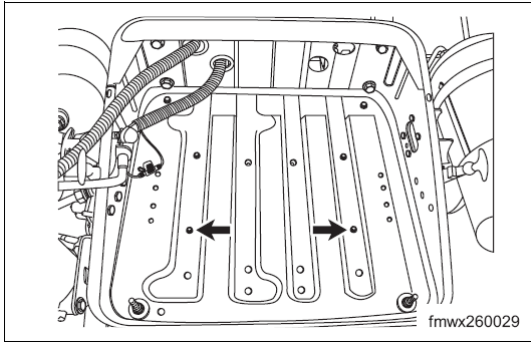


- (c). Install the air pipe of the air reservoir of rear axle brake.

**8. Install the air reservoir of front axle brake**

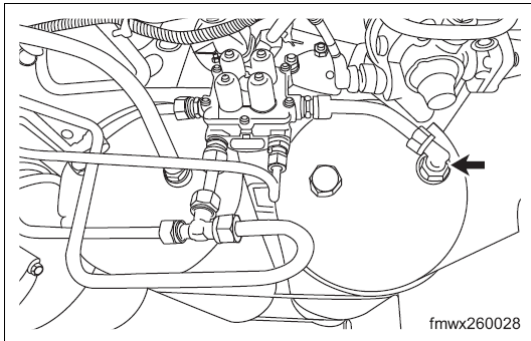
- (a). Install the fixing cable tie of the air reservoir of front and rear axle brake.

Torque: 60N.m



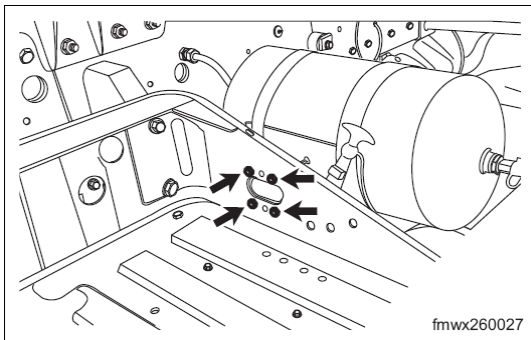
- (b). Install the fixing bolt of front axle brake air reservoir.

Torque: 60N.m



- (c). Install the air pipe of front axle brake air reservoir.

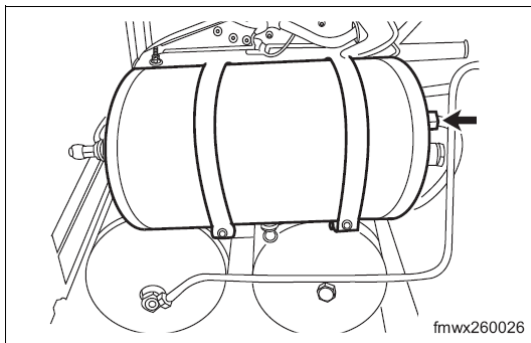
Torque: 60N.m



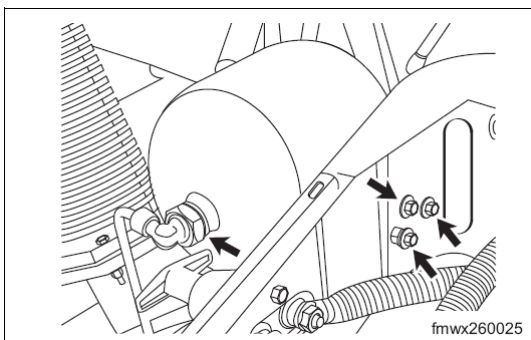
9. Install the air reservoir of parking brake

- (a). Install the fixing bolt of parking brake air reservoir.

Torque: 60N.m



- (b). Connect the air pipe of parking brake air reservoir.



10. Install the renewable air reservoir

- (a). Install the fixing bolt of renewable air reservoir.

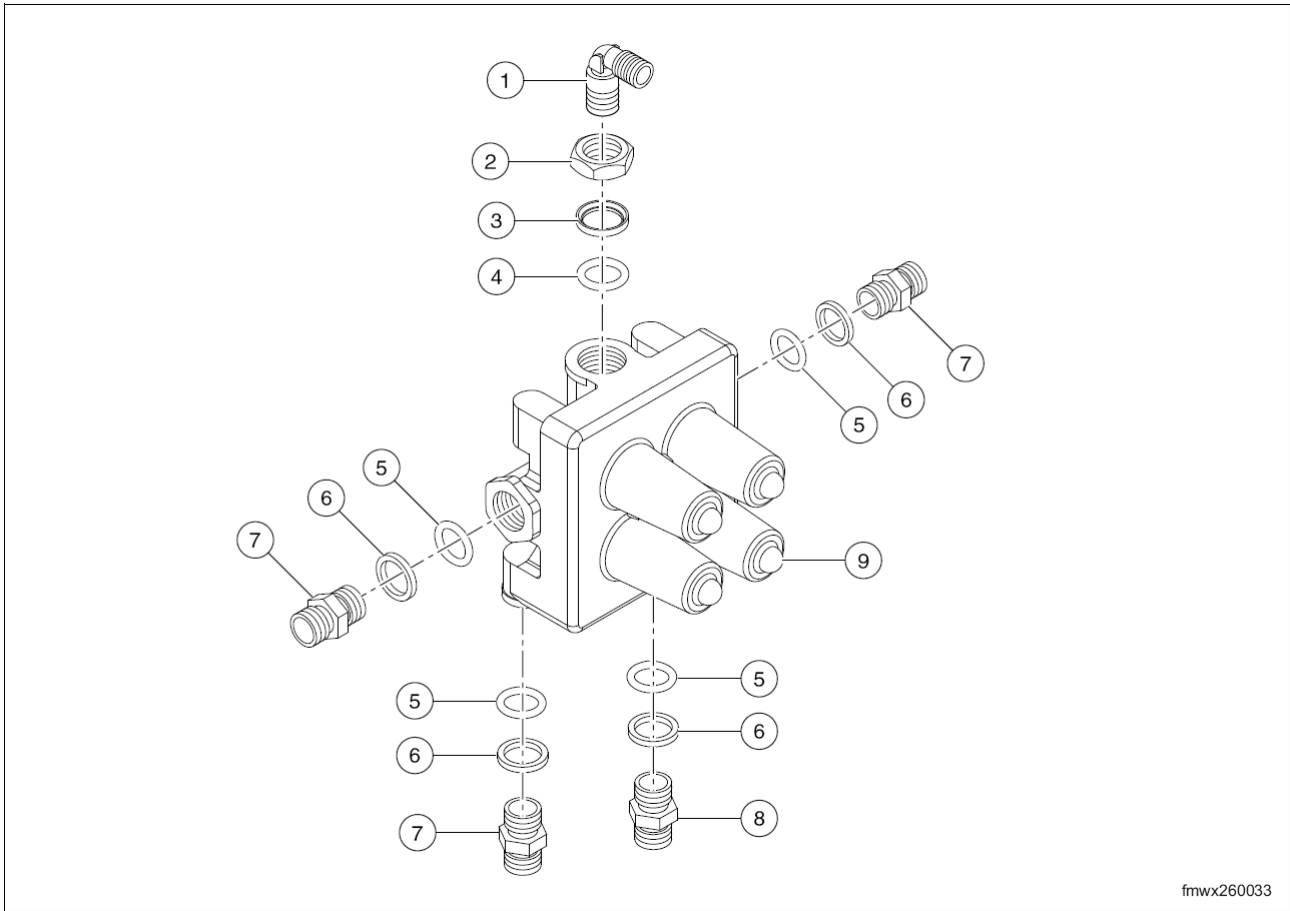
Torque: 60N.m

- (b). Connect the air pipe of renewable air reservoir.

- (c). Install battery, refer to Chapter 53, Battery- Battery Assembly, Replacement.

Four-circuit Protection Valve

Part Drawing

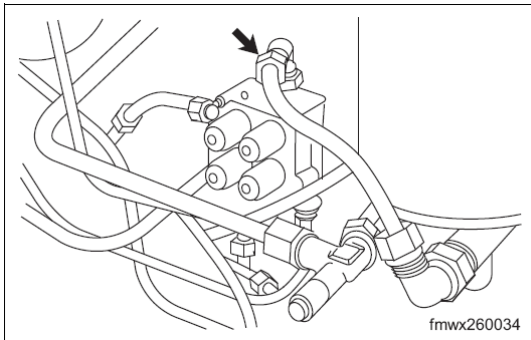


1	Bulkhead Union Elbow Body
2	Hex Thin Nut-Fine Thread
3	Sealing Gasket
4	O-ring Rubber Sealing
5	O-ring Rubber Sealing

6	Sealing Gasket
7	Bulkhead Union Different Diameter Joint Body
8	Bulkhead Union Different Diameter Joint Body
9	Four-circuit Protection Valve

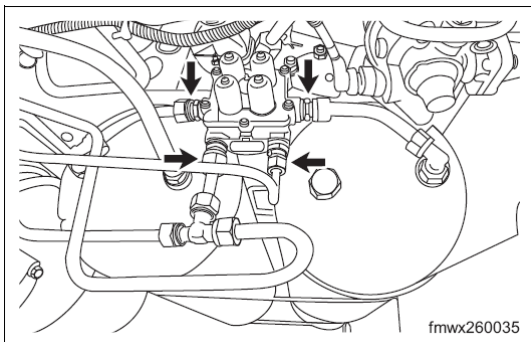
Overhaul

1. Release the pressure of brake system



2. Dismantle the four-circuit protection valve

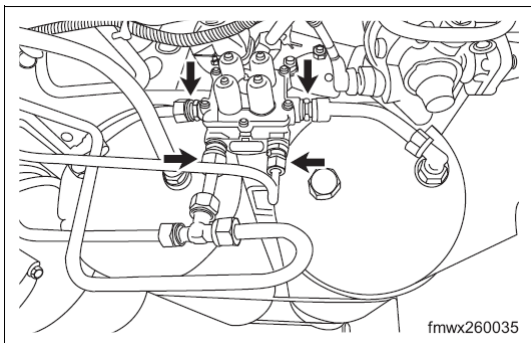
- (a). Disconnect the air pipe of four-circuit protection valve.



- (b). Disconnect the air pipe of four-circuit protection valve.

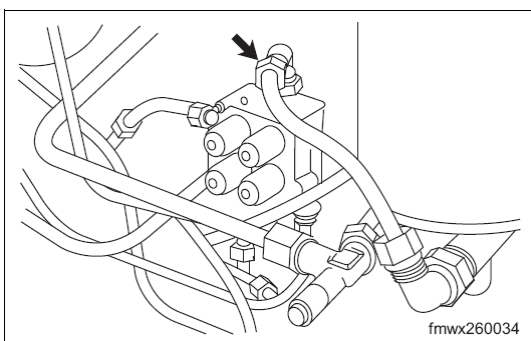
3. Inspect the four-circuit protection valve

- (a). Inspect whether the spool of circuit valve is stuck.
(b). Inspect whether the spool of circuit valve is frozen.
(c). Inspect whether the circuit leaks air.



4. Install the four-circuit protection valve

- (a). Connect the air pipe of four-circuit protection valve.

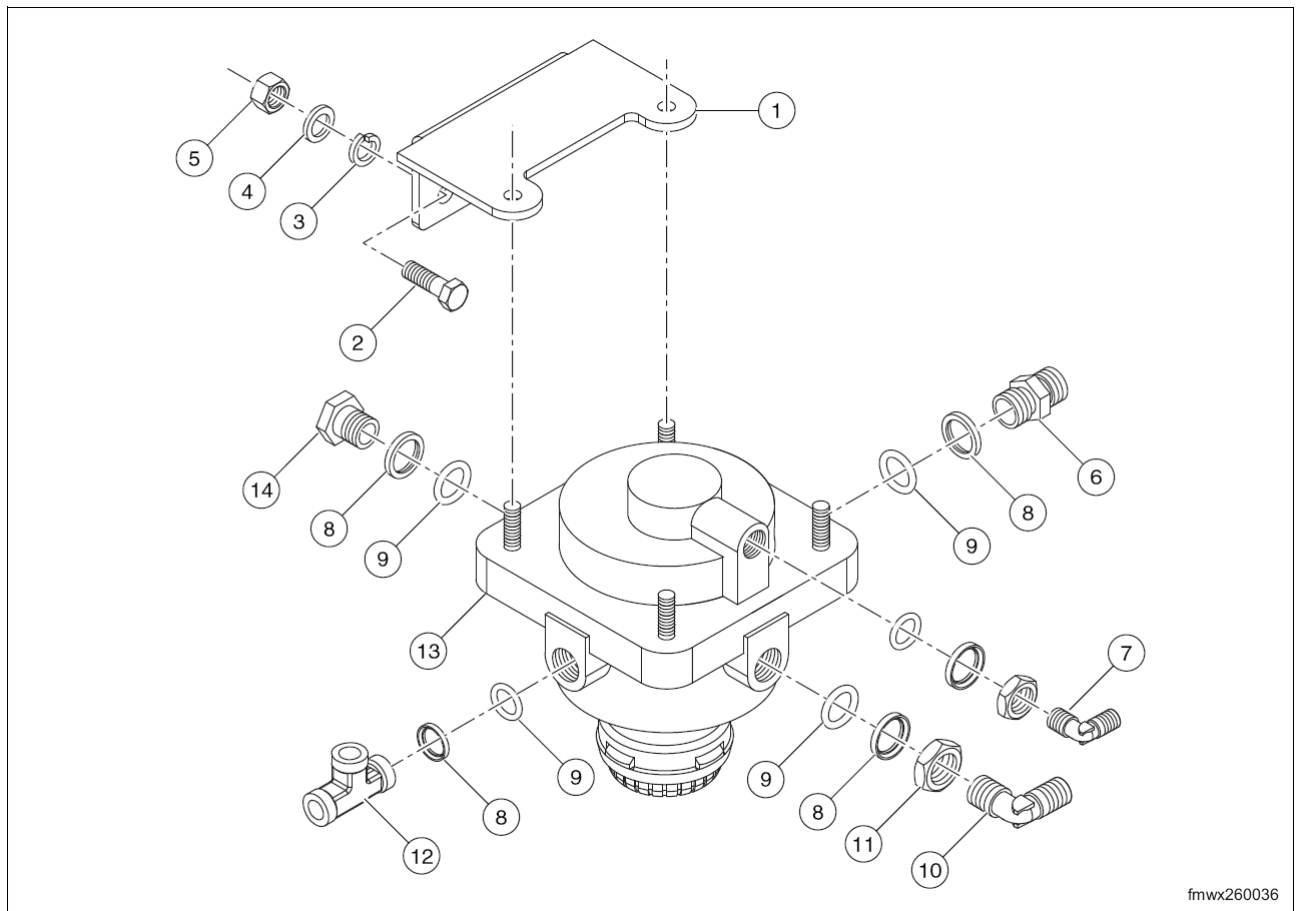


- (b). Connect the air pipe of four-circuit protection valve.

Service Brake - Relay Valve

Relay Valve

Part Drawing



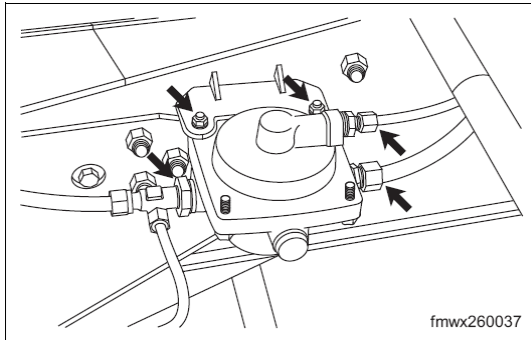
fmwx260036

1	Relay Valve Bracket
2	Hex Head Bolt
3	Spring Washer
4	Flat Washer
5	Hex Head Nut Style 1
6	Bulkhead Union Different Diameter Joint Body
7	Bulkhead Union Joint

8	Sealing Gasket
9	O-ring Rubber Sealing
10	Bulkhead Union Joint Body
11	Hex Thin Nut- Fine Thread
12	Bulkhead Tee joint
13	Relay Valve
14	Hex Head Plug

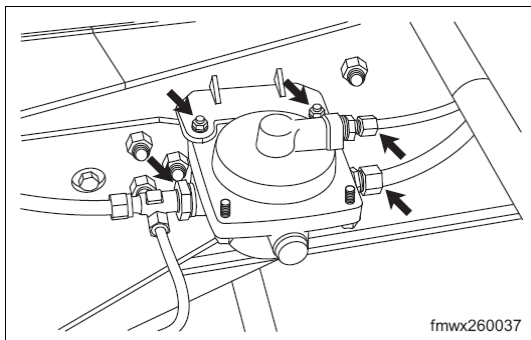
Overhaul

1. Release the pressure of brake system
2. Lift container



3. Dismantle relay valve
 - (a). Disconnect the air pipe of relay valve.
 - (b). Dismantle the fixing nut of relay valve.

4. Inspect relay valve
 - (a). Inspect whether the relay valve piston clip on the upper limiting position.
 - (b). Inspect whether the relay valve piston clip on the lower limiting position.
 - (c). Inspect whether the air outlet of relay valve leak air.
 - (d). Inspect whether the air inlet of relay valve leak air.
 - (e). Inspect whether the elasticity of air inlet and outlet spring of relay valve is too strong or too weak.

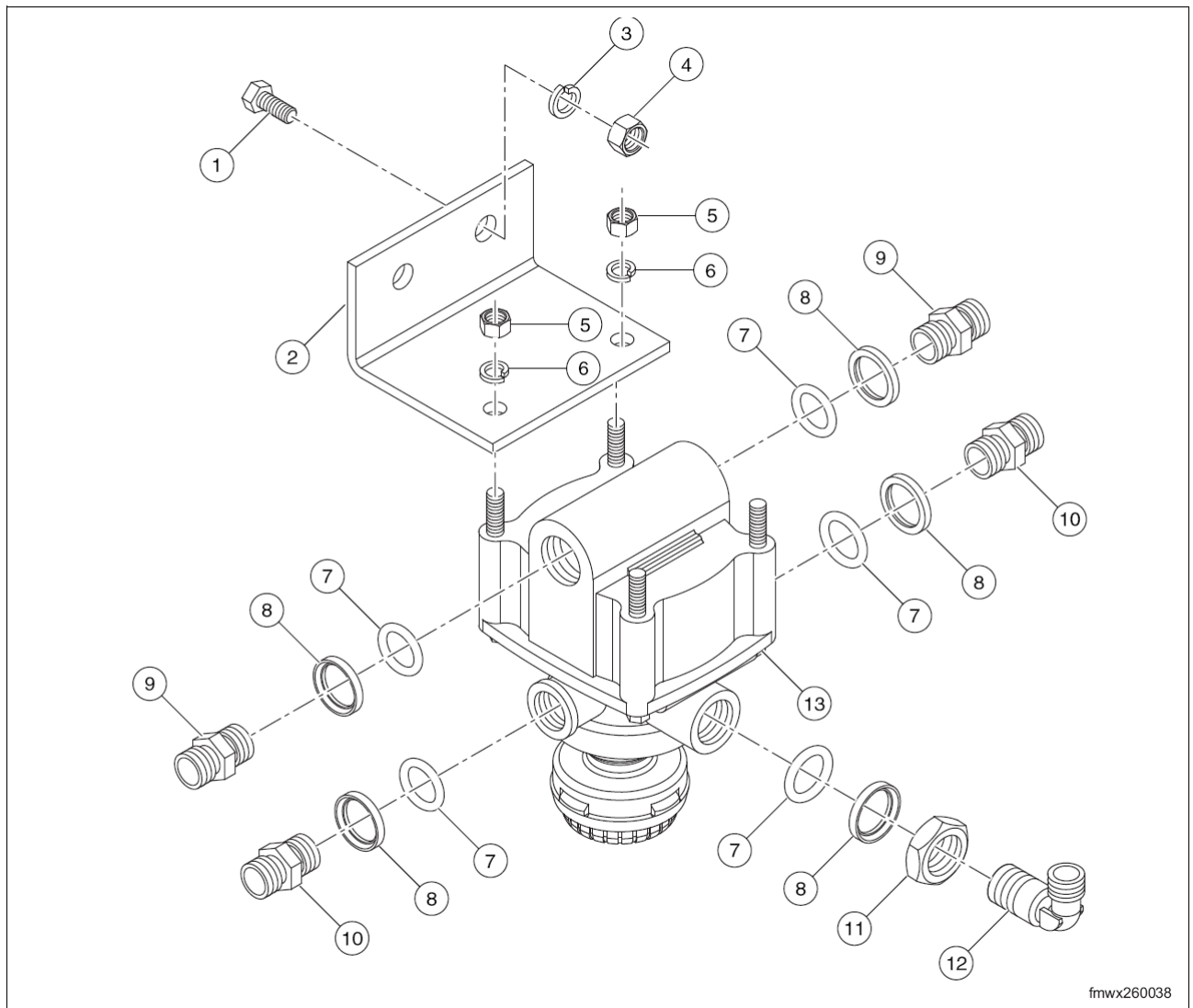


5. Install relay valve
 - (a). Install the fixing nut of relay valve.
Torque: 25N.m
 - (b). Connect the air pipe of relay valve.

6. Lower the container

Differential Valve

Part Drawing

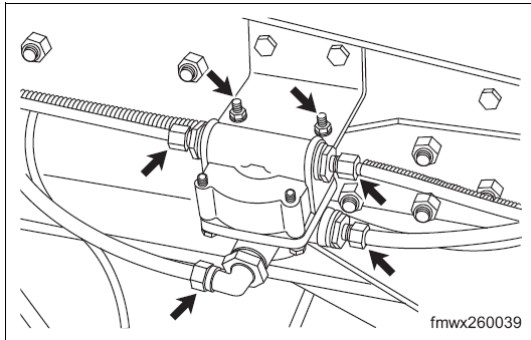


1	Hex Head Bolt
2	Differential Valve Bracket
3	Spring Washer
4	Flat Washer Hex Head Nut Style 1
5	Hex Head Nut Style 1
6	Spring Washer
7	O-ring Rubber Sealing

8	Sealing Gasket
9	Bulkhead Union Body
10	Bulkhead Union Different Diameter Body
11	Hex Thin Nut
12	Bulkhead Union Different Diameter Body
13	Two-way Relay Valve

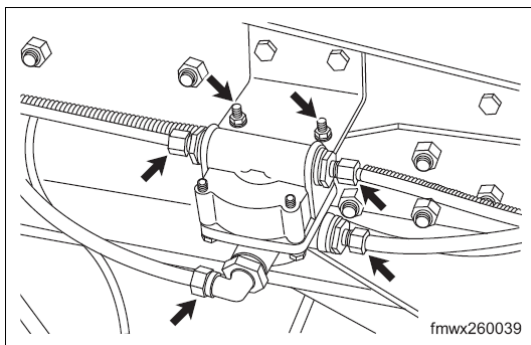
Overhaul

1. Release the pressure of brake system
2. Lift container



3. Dismantle differential valve
 - (a). Disconnect the air pipe of differential valve.
 - (b). Dismantle the fixing nut of differential valve.

4. Inspect differential valve
 - (a). Inspect the sealing between the diaphragm of differential valve and the valve body.
 - (b). Inspect the sealing among valve assembly, valve body and the tappet.
 - (c). Inspect whether the air outlet exists leakage.



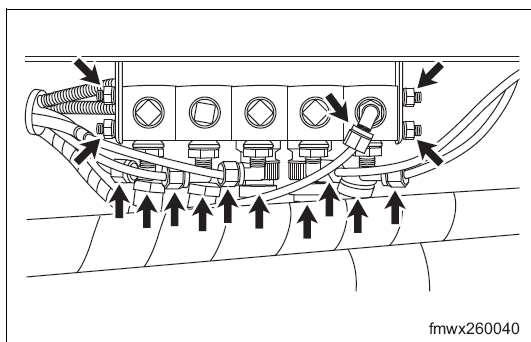
5. Install differential valve
 - (a). Install the fixing nut of differential valve
Torque: 25N.m
 - (b). Connect the air pipe of differential valve

6. Lower the container

Multi-way Joint Body

Replacement

1. Release the pressure of brake system
2. Lift container

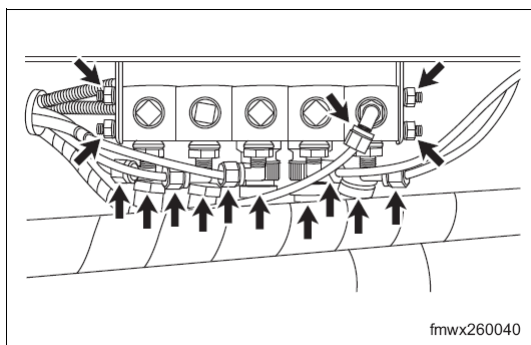


3. Dismantle multi-way joint body
 - (a). Disconnect the pipe of multi-way joint body.

Caution:

Mark the pipe to avoid the installing mistake.

- (b). Disconnect the connector of multi-way joint body.
- (c). Dismantle the fixing nut of multi-way joint body.



4. Install multi-way joint body
 - (a). Install the fixing nut of multi-way joint body.

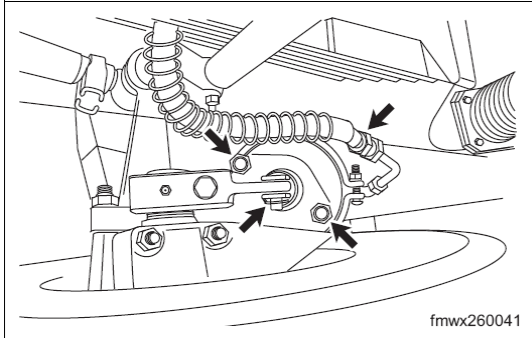
Torque: 25N.m
 - (b). Connect the connector of multi-way joint body.
 - (c). Connect the pipe of multi-way joint body.

5. Lower the container

Front Brake Chamber

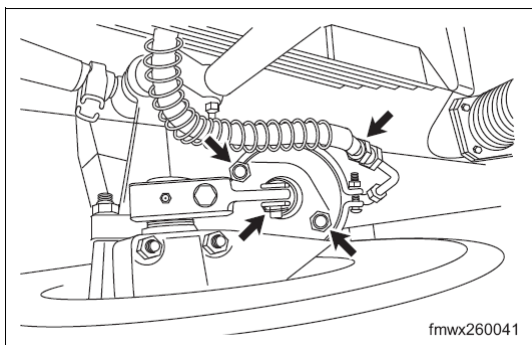
Overhaul

1. Release the pressure of brake system
2. Lift container



3. Dismantle front brake chamber
 - (a). Disconnect the pipe of front brake chamber.
Torque: 97N.m
 - (b). Dismantle the connecting pin between front brake chamber and brake adjusting arm.
 - (c). Dismantle the fixing nut of front brake chamber.

4. Inspect the front brake chamber
 - (a). Inspect the sealing performance of front brake chamber.



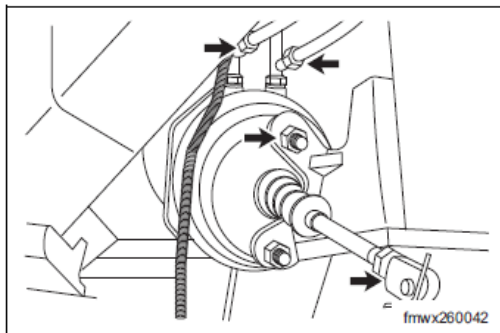
5. Install the front brake chamber
 - (a). Install the fixing nut of front brake chamber.
Torque: 97N.m
 - (b). Connect the connecting pin between front brake chamber and brake adjusting arm.
 - (c). Connect the pipe of front brake chamber.

6. Adjust Front Brake Chamber, refer to Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
7. Lower container

Rear Brake Chamber

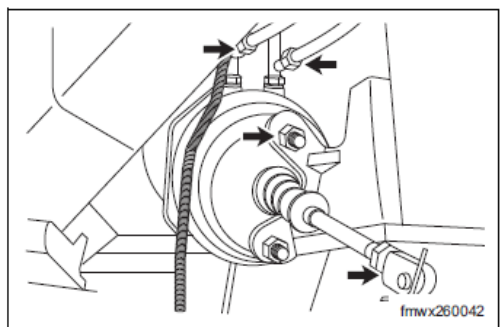
Overhaul

1. Release the pressure of brake system
2. Lift container



3. Dismantle rear brake chamber
 - (a). Disconnect the pipe of rear brake chamber.
 - (b). Dismantle the connecting pin between rear brake chamber and brake adjusting arm.
 - (c). Dismantle the fixing nut of rear brake chamber.

4. Inspect rear brake chamber
 - (a). Inspect the sealing performance of rear brake chamber.

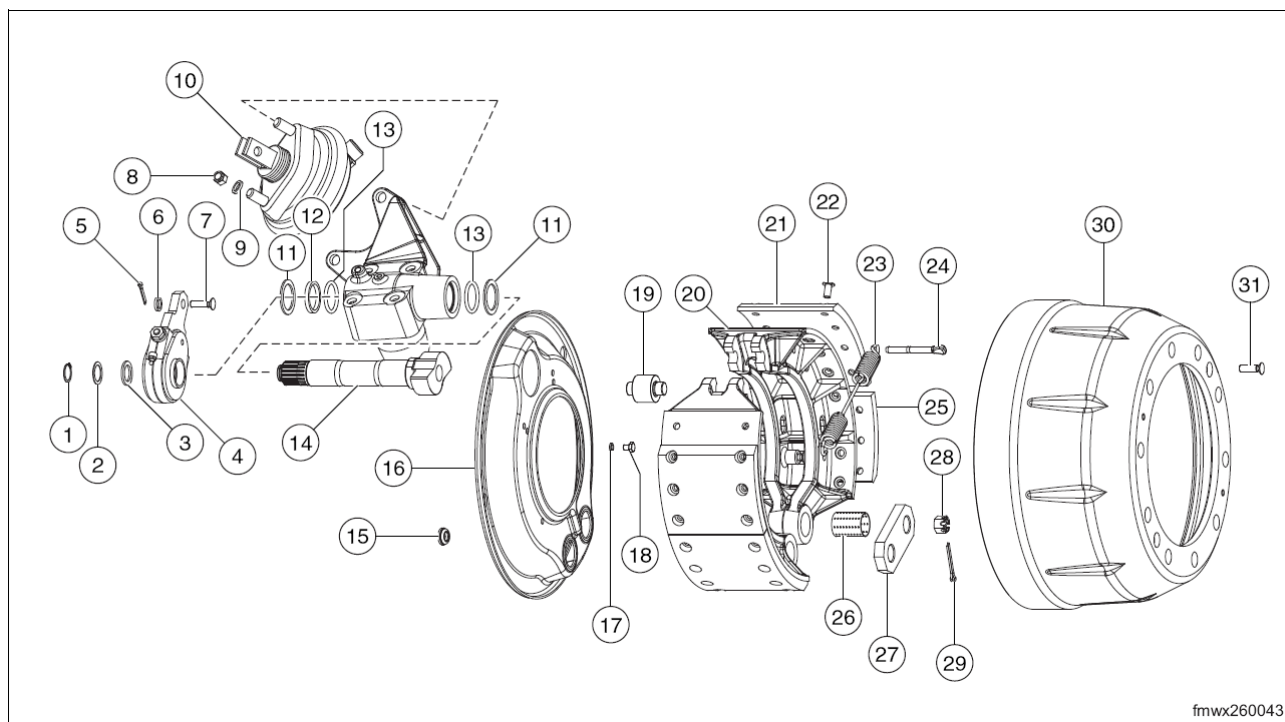


5. Install rear brake chamber
 - (a). Install the fixing nut of rear brake chamber.
 - (b). Connect the connecting pin between rear brake chamber and brake adjusting arm.
 - (c). Connect the pipe of rear brake chamber.

6. Adjust rear brake chamber, refer to Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
7. Lower container

Front Brake Shoe

Part Drawing



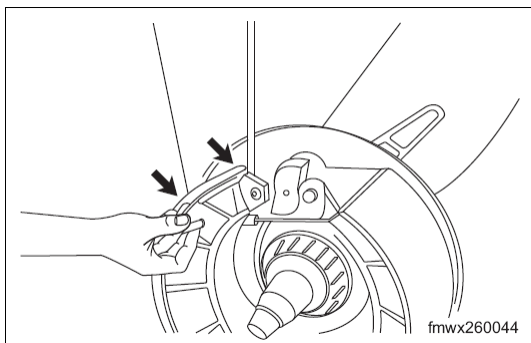
fmwx260043

1	Circlip for Shaft
2	Adjusting Washer
3	Washer
4	Brake Adjusting Arm
5	Cotter Pin
6	Flat Washer
7	Pin Shaft
8	Hex Head Nut
9	External Teeth Serrated Lock Nut
10	Diaphragm-type Brake Chamber
11	Additional Gasket
12	Spacer
13	Sealing O-ring
14	Brake Camshaft
15	Sealing Piston
16	Brake Dust Cover

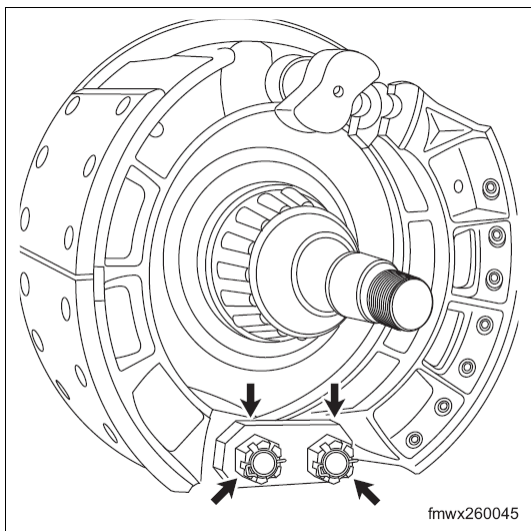
17	Spring Washer
18	Hex Head Bolt
19	Roller
20	Brake Shoe
21	Brake Friction Plate
22	Rivet
23	Return Spring
24	Return Spring Pin
25	Brake Friction Plate
26	Sleeve
27	Limiting Plate
28	Hex Slotted Flat Nut
29	Cotter Pin
30	Brake Drum
31	Countersunk Head Screw

Overhaul

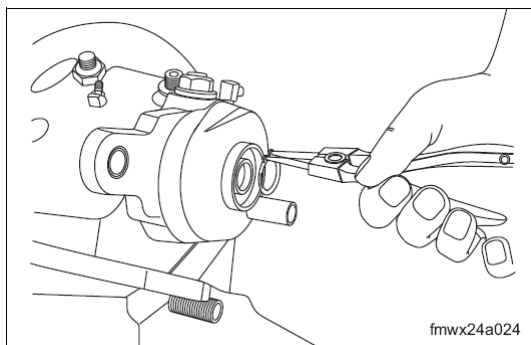
1. Release the pressure of brake system
2. Lift container
3. Dismantle Front Brake Drum, refer to Chapter 24 Front Axle – Front Wheel Hub, Overhaul
4. Dismantle Wheel Hub, refer to Chapter 24 Front Axle – Front Wheel Hub, Overhaul



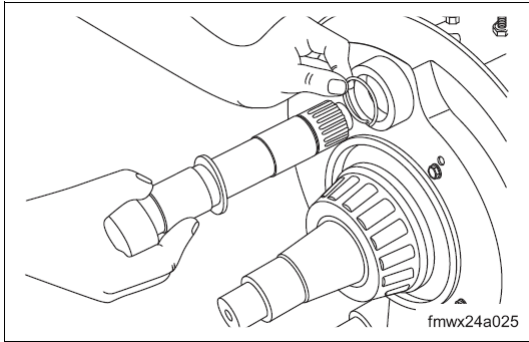
5. Dismantle front brake shoe
 - (a). Tension the return spring with a long lever, remove the roller.
 - (b). Extract the spring fixing pin, and then remove the return spring.



- (c). Remove the cotter pin on the brake shoe support.
- (d). Dismantle the fixing nut of brake shoe support.



6. Dismantle front brake adjusting arm
 - (a). Use the circlip pliers to remove the snap ring and adjusting washer on the brake adjusting arm.
 - (b). Remove the front brake adjusting arm.

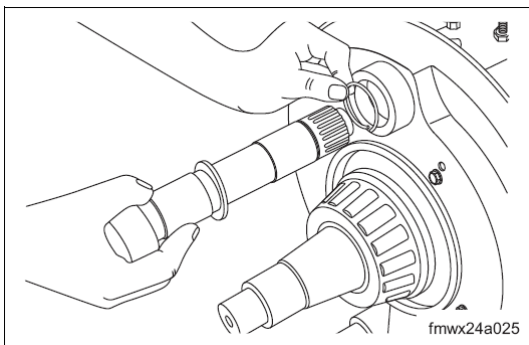


7. Dismantle brake camshaft

- (a). Extract the brake camshaft from camshaft end.
- (b). Remove sealing O-ring and washer.

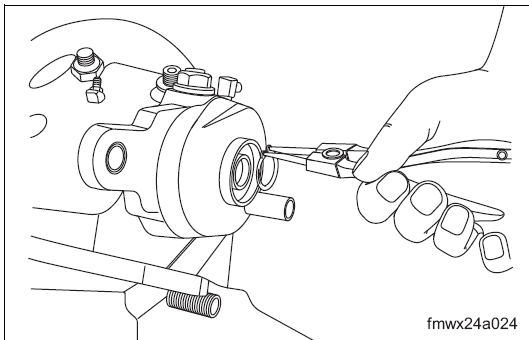
8. Inspect brake shoe

- (a). Inspect whether the brake shoe is abrasion away, crack, burn through or rock.



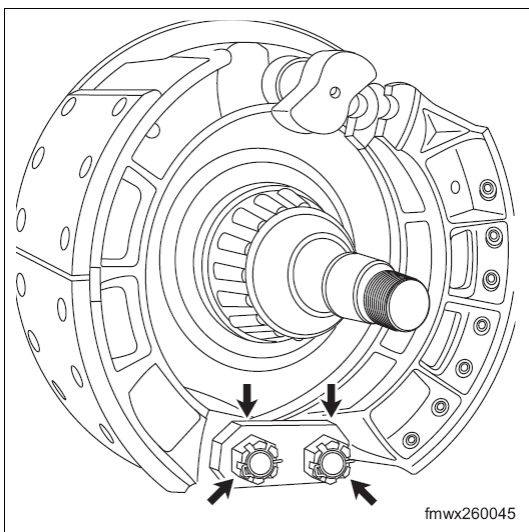
9. Install brake camshaft

- (a). Insert the brake camshaft in camshaft end.
- (b). Install sealing O-ring and washer.



10. Install front brake adjusting arm

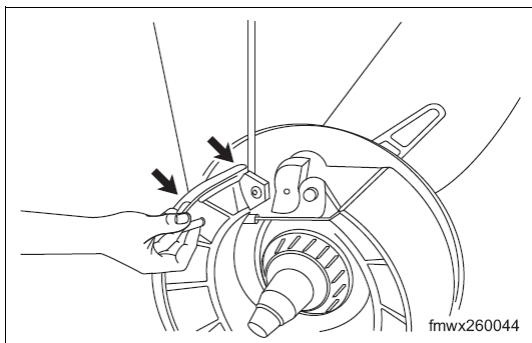
- (a). Install front brake adjusting arm
- (b). Use the circlip pliers to install the snap ring and adjusting gasket on the brake adjusting arm.



11. Install front brake shoe

- (a). Install the fixing nut of brake shoe support.
Torque: 250N.m
- (b). Install the cotter pin on the brake shoe support.

Service Brake - Front Brake Shoe

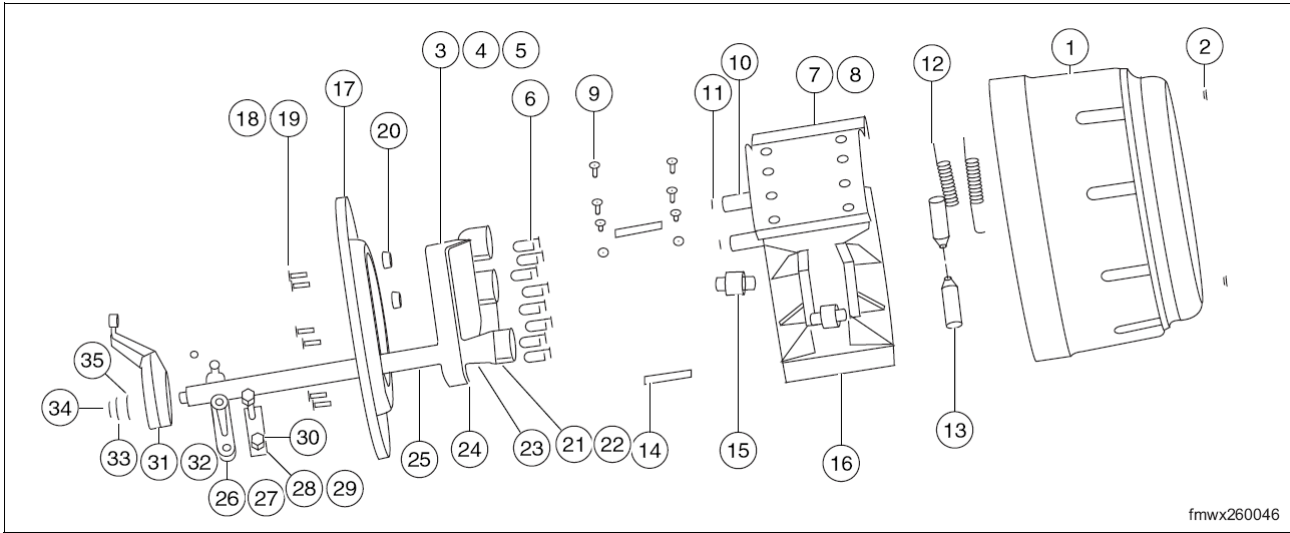


- (c). Install return spring, and spring fixing pin.
- (d). Tension return spring with a long lever, then install roller.

12. Install wheel hub, refer to Chapter 24 Front Axle – Front Wheel Hub, Overhaul
13. Install front brake drum, refer to Chapter 24 Front Axle – Front Wheel Hub, Overhaul
14. Adjust brake clearance, refer to Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
15. Lower container

Rear Brake Shoe

Part Drawing

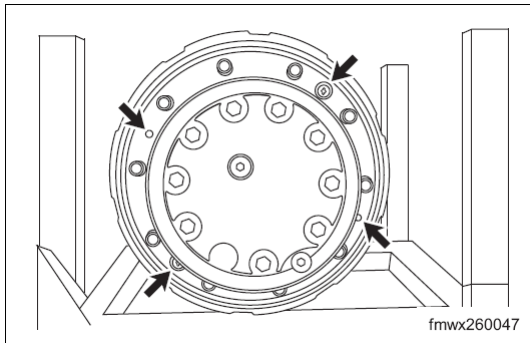


1	Brake Drum
2	Flat Head Bolt
3	Brake Base Plate
4	Brake Base Plate
5	Brake Base Plate
6	Pin Shaft
7	Brake Shoe
8	Brake Shoe
9	Rivet
10	Locating Pin Shaft
11	Gasket
12	Return Spring
13	Return Spring
14	Pin Shaft
15	Roller
16	Brake Shoe Liner
17	Brake Base Plate
18	Pin Shaft

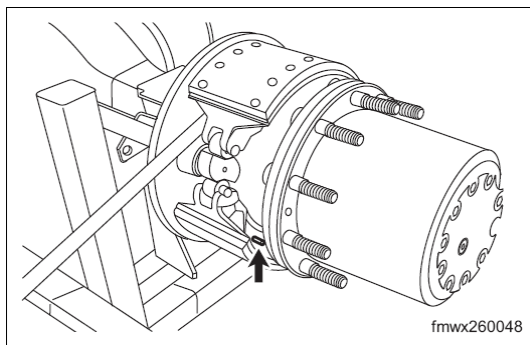
19	Pin Shaft
20	Cap
21	Camshaft
22	Camshaft
23	Gasket
24	O Sealing Ring
25	Gasket
26	Fixing Bracket
27	Fixing Bracket
28	Bracket Upper Cover
29	Bolt
30	Bolt
31	Adjusting Arm
32	Adjusting Arm
33	Sealing Gasket
34	Gasket
35	Snap Ring

Overhaul

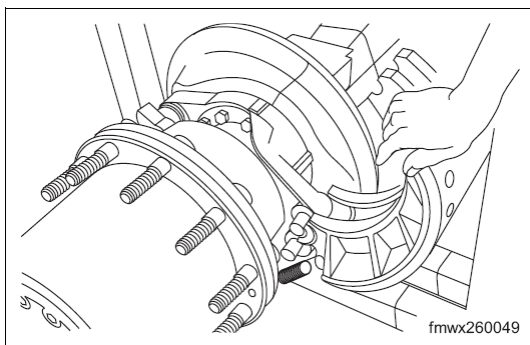
1. Release pressure of brake system
2. Lift container
3. Dismantle the Tire of Rear Wheel, refer to Chapter 23 Wheel and Tire – Rear Tire and Wheel, Overhaul



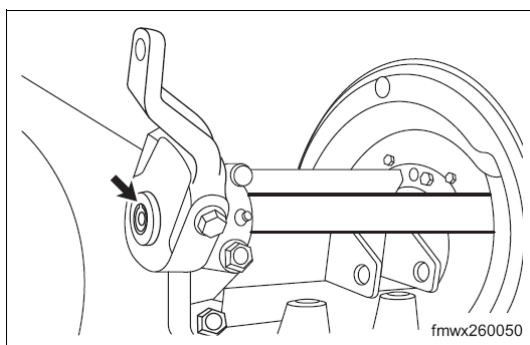
4. Dismantle rear brake drum
 - (a). Dismantle cross fixing bolt.
 - (b). Pack out the rear brake drum by the bolt.



5. Dismantle rear brake shoe
 - (a). Tension the return spring with a long lever, remove the roller.
 - (b). Pull out spring fixing pin, then remove the return spring.

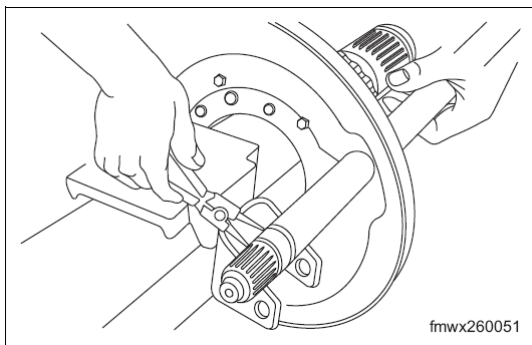


- (c). Dismantle brake shoe supporter.



6. Dismantle rear brake adjusting arm
 - (a). Use the circlip pliers to remove the snap ring and adjusting washer on the brake adjusting arm.
 - (b). Remove rear brake adjusting arm.

Service Brake - Rear Brake Shoe

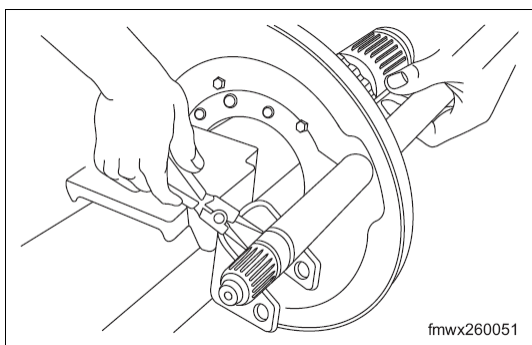


7. Dismantle brake camshaft

- (a). Pull out the camshaft from the camshaft end.
- (b). Remove O-ring and washer.

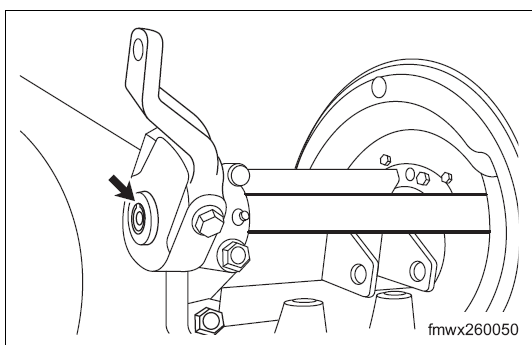
8. Inspect the brake shoe

- (a). Inspect whether the brake shoe abrasions away, crack, burn through or rock.



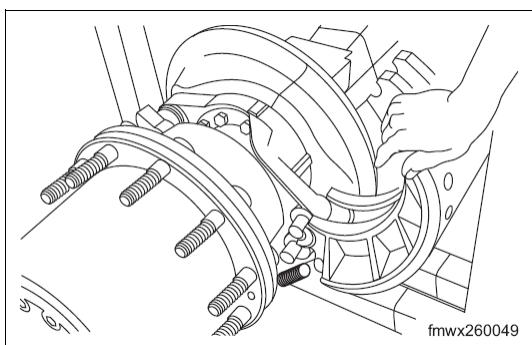
9. Install brake camshaft

- (a). Insert the brake camshaft in camshaft end.
- (b). Install O-ring and washer.



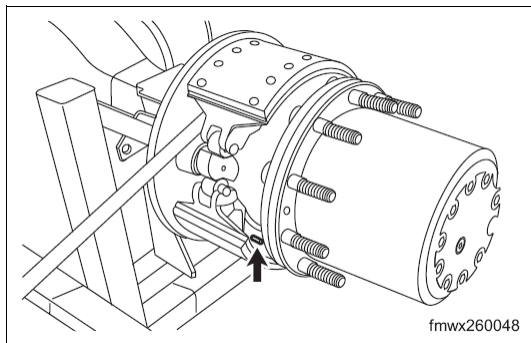
10. Install rear brake adjusting arm

- (a). Install rear brake adjusting arm
- (b). Use the circlip pliers to install the snap ring and adjusting washer on the brake adjusting arm.

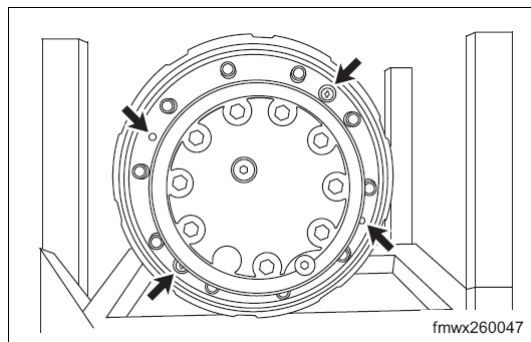


11. Install rear brake shoe

- (a). Install brake shoe support.



- (b). Install return spring and spring fixing pin.
- (c). Tension the return spring with a long lever, install roller.



12. Install rear brake drum

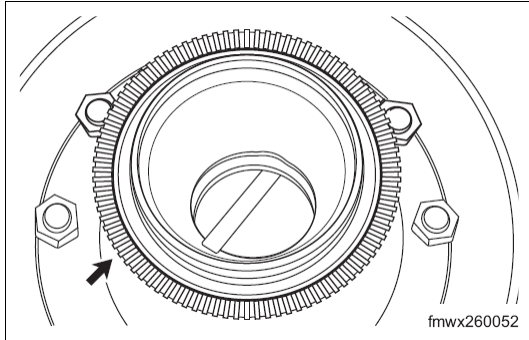
- (a). Install rear brake drum
- (b). Install cross fixing bolt.

- 13. Install tire of rear wheel, refer to Chapter 23 Wheel and Tire – Rear Tire and Wheel, Overhaul
- 14. Adjust brake clearance, refer to Chapter 26 Service Brake – Service Brake System, Testing & Adjustment
- 15. Lower container

ABS Ring Gear

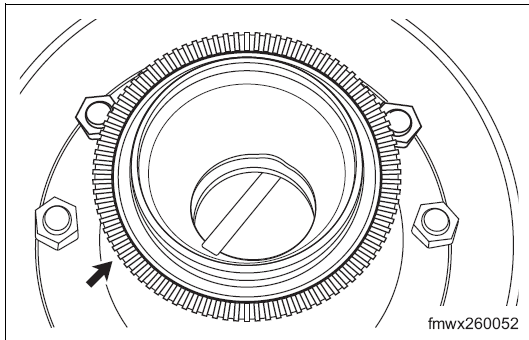
Replacement

1. Dismantle wheel hub, refer to Chapter 24 Front Axle – Front Wheel Hub, Overhaul
2. Dismantle wheel hub, refer to Chapter 25 Rear Axle – Wheel Hub Bearing, Oil Seal, Overhaul



3. Dismantle ABS ring gear

- (a). Dismantle ABS ring gear.



4. Install ABS ring gear

- (a). Install ABS ring gear.
 - Heat ring gear to 150℃ to 200 ℃, and then hold for 5 to 10 minutes.
 - Press the ring gear in wheel hub.

Caution:

The installation can be undertaken one time, prohibit installing repeatedly.

5. Test after installation

- (a). Inspect the jump of tooth flank .
 - Test the tooth flank jump by micrometer.
 - Tooth flank jump: less than 0.2 mm, deviation of adjacent height of tooth: less than 0.04 mm.

Inspect after loading

- (a). Use the sensor hand-held tester to measure signals.
 - When the wheel hub is rotating at 30r/min, the signal lamp must flicker uniformly, it must not appear interrupted phenomenon.
- (b). Use a multimeter to measure the output voltage of sensor.
 - When the rotation speed is more than 30r/min, the output voltage is more than 0.30V.

Caution:

Before installing the ring gear, clean the axial location surface of wheel hub to prevent the ingress of debris which will cause the deviated swing of ring gear.

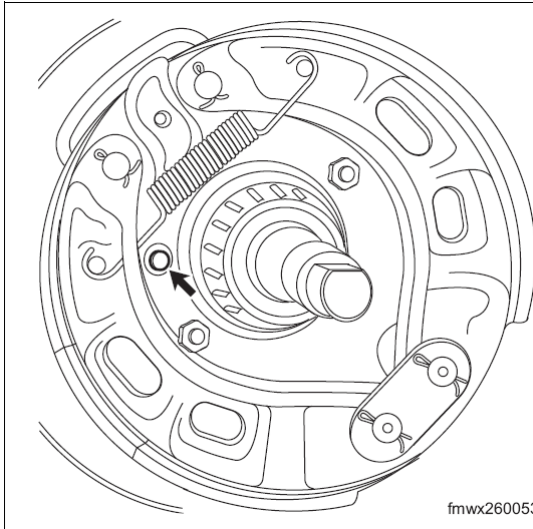
Guarantee during installation, the fitting rate of location surface is more than 75%.

The jumping size of tooth surface of ring gear measured by dial indicator shall be less than 0.06mm.

6. Install wheel hub, refer to Chapter 25, Rear Axle-Wheel Hub, Oil Seal,Overhaul
7. Install wheel hub, refer to Chapter 24, Fount Axle-Front Wheel Hub,Overhaul

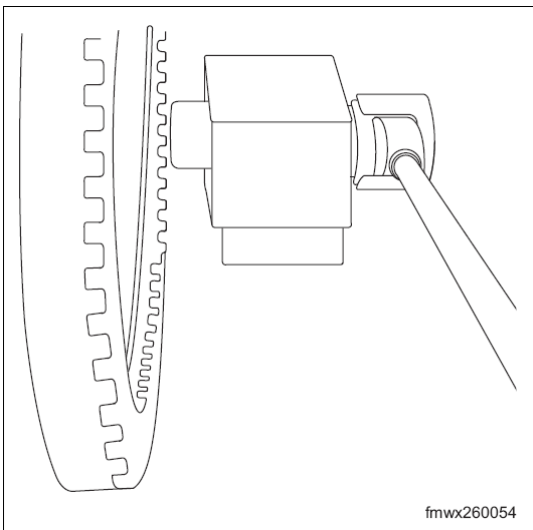
Wheel Speed Sensor

Replacement



1. Install wheel speed sensor

- (a). Install the elastic sleeve and sensor into steel sleeve.
- (b). After adjusting direction of lead wire, the wire shall be tied firmly.
- (c). It can be pulled in by hand or knocked by hammer.

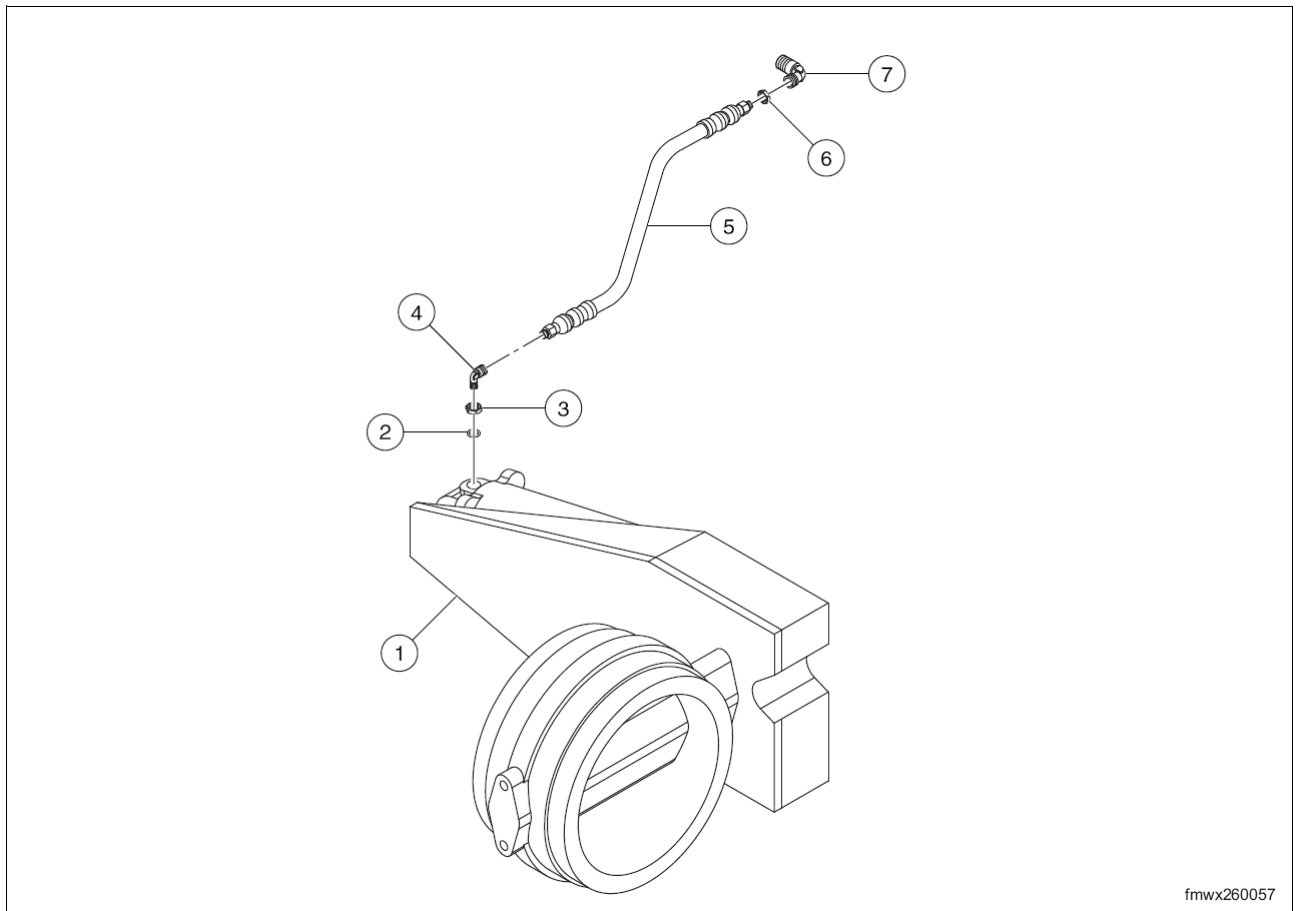


- (d). Guarantee that the front center of sensor is facing the ring gear tooth flank, otherwise, the position of bracket needs to be adjusted, and then the sensor need to be pushed to the bottom.
- (e). Insert the sensor into bracket or holes on the sleeve, and the insertion and extraction force is more than 50N.

2. Install wheel hub, refer to Chapter 25, Rear Axle- Wheel Hub Bearing, Oil Seal, Overhaul
3. Install wheel hub, refer to Chapter 24, Front Axle-Front Wheel Hub, Overhaul

Auxiliary Brake

Part Drawing



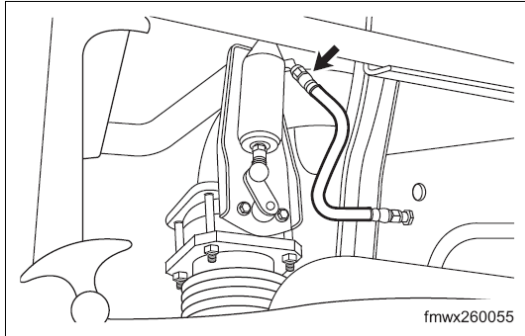
1	Exhaust Brake Butterfly Valve
2	Sealing Ring (O-ring)
3	Compressing Nut
4	Union Elbow Body

5	Butterfly Valve Rubber Pipe Assembly
6	Hex Thin Nut
7	Bulkhead Union Elbow Body

Overhaul

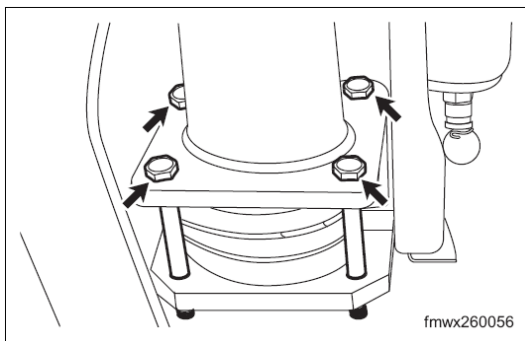
Hint:

Part Drawing, refer to Chapter 26, Service Brake-Auxiliary Brake, Part Drawing.



1. Dismantle the exhaust brake butterfly valve

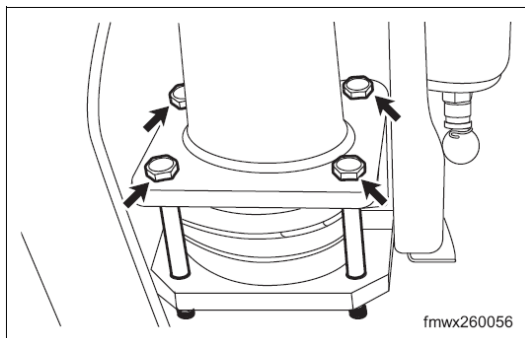
- (a). Dismantle the air pipe of the exhaust brake butterfly valve.



- (b). Dismantle the fixing bolt of exhaust brake butterfly valve.

2. Inspect the exhaust brake butterfly valve

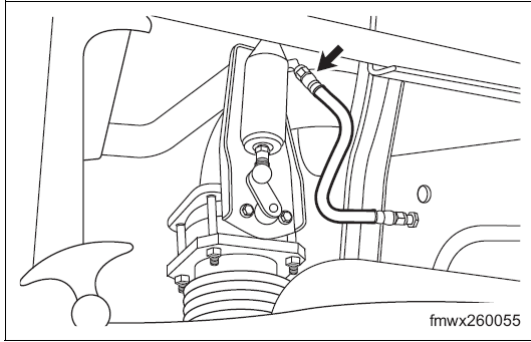
- (a). Inspect the lubricating circumstance of the push rod of butterfly valve.
- (b). Inspect if the butterfly valve is dirty.
- (c). Inspect the leakage of the working cylinder of the butterfly valve.
- (d). Inspect the normal position of the linkage of the butterfly valve.



3. Install exhaust brake butterfly valve

- (a). Install the fixing bolt of exhaust brake butterfly valve.

Service Brake - Overhaul



- (b). Install the air pipe of exhaust brake butterfly valve.

Parking Brake

Parking Brake System	27-3
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Function Check.....	27-3
Hand Brake Valve.....	27-4
Part Drawing	27-4
Replacement	27-5

Parking Brake System

Precautions:

1. Precautions for Parking Brake System

- (a). Take care for replacing each component, otherwise the performance of parking brake system will be influenced, and personal injuries may be caused.
- (b). Only original accessories can be used.
- (c). Keep the components and maintenance area clean.
- (d). Regular inspection must be carried out, after each 10,000 Km check must be carried out for whether the parking brake system is normal.

Fault Symptom Table

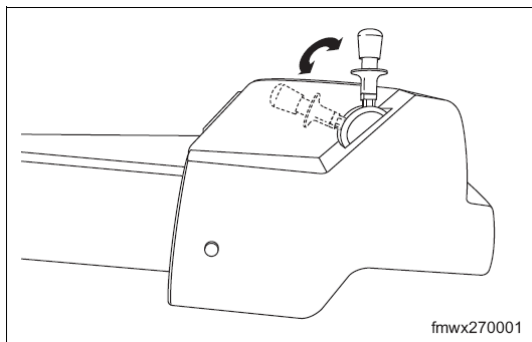
This table will help you find faults. Serial number indicates the chronological order of fault possibility. Check each part in accordance with this sequence, and replace it as necessary.

Fault Symptom	Suspected Reason	Reference
Jamming of rear axle wheel during operation	1. Hand brake valve	Article 27 Parking Brake-Hand Brake Valve, Replacement
	2. Differential valve	Article 26 Service Brake- Differential Valve, Replacement
	3. Brake chamber	Article 26 Service Brake- Rear Brake Chamber, Check and Maintenance

Function Inspection

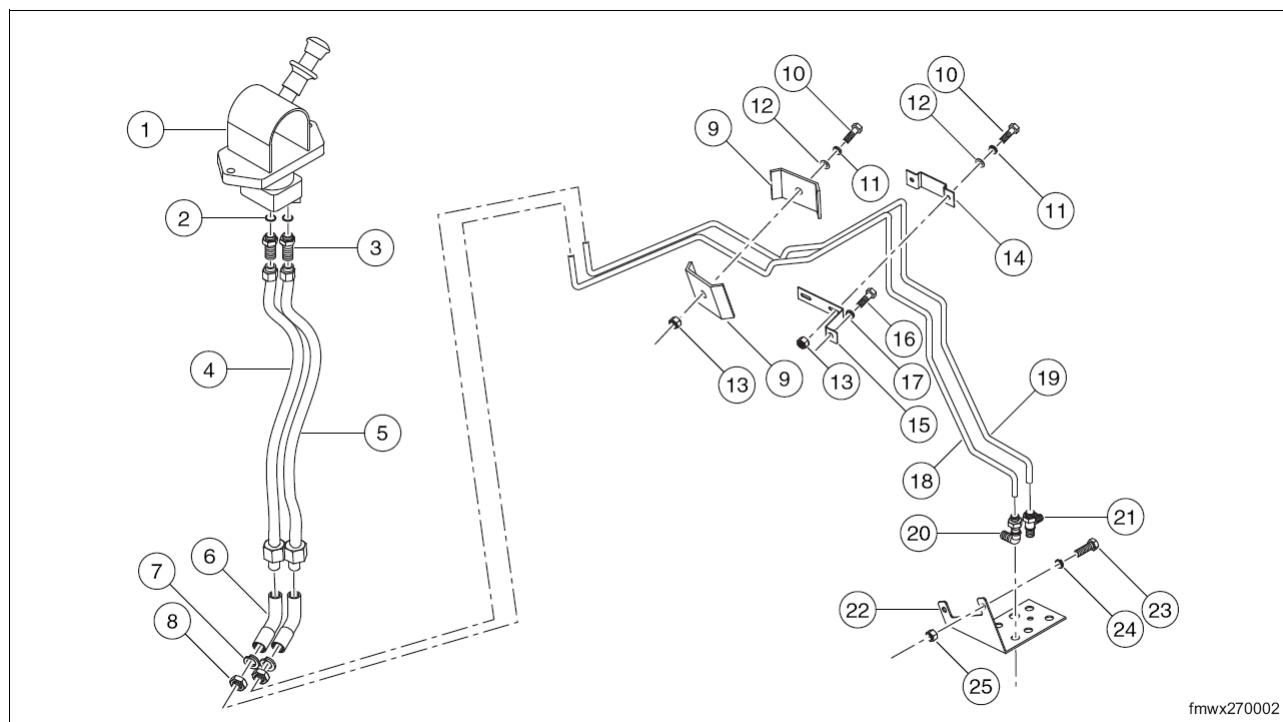
1. Parking Brake Inspection:

- (a). Operation Inspection
 - Park the vehicle on a dry slope. Gear the parking brake, and it must guarantee the vehicle be static.
 - Pull up the brake rod. Check if there has exhaust sound when the spring chambers come into effect (brake force was added to rear tire).
 - Push the release lever to the hand shank on the top of brake rod, and then put down the brake rod.
 - Check the operation status of the warning light.



Hand Brake Valve

Part Drawing



1	Hand Brake Valve Assembly
2	Sealing Gasket
3	Ferrule-type Straight Thread Reducer Union
4	Nylon Hose Assembly- Bulkhead Union Elbow to Hand Valve 1
5	Nylon Hose Assembly- Bulkhead Union Elbow to Hand Valve 21
4	Nylon Hose Assembly- Bulkhead Union Elbow to Hand Valve 1
5	Nylon Hose Assembly- Bulkhead Union Elbow to Hand Valve 21
6	Bulkhead Union Elbow Body
7	Spring Washer
8	Hex Thin Nut- Fine Thread
9	Two-Pipe Clamp
10	Hex Head Bolt
11	Spring Washer
12	Flat Washer
13	Hex Nut, Style 1

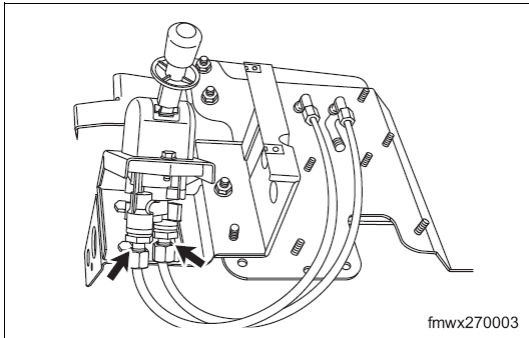
14	Bracket Plate
15	Bracket Plate
16	Hex Head Bolt
17	Spring Washer
18	Steel Pipe Assembly- Hand Brake Valve 21 to Bracket
19	Steel Pipe Assembly-Hose Bracket to Hand Brake Valve 1
20	Bulkhead Union Elbow Body
21	Bulkhead Union Tee Joint Body
22	Bracket
23	Hex Head Bolt
24	Spring Washer
25	Hex Nut, Style 1

Replacement

Hint:

Part Drawing, refer to Chapter 27, Parking Brake – Hand Brake Valve, Part Drawing

1. **Release the pressure of braking system**
2. **Dismantle the middle platform rear assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter- Cigarette Lighter, Replacement**



3. Dismantle hand brake valve assembly

- (a). Dismantle the air pipe joint nut of hand brake valve, and separate the air pipe of hand brake valve.

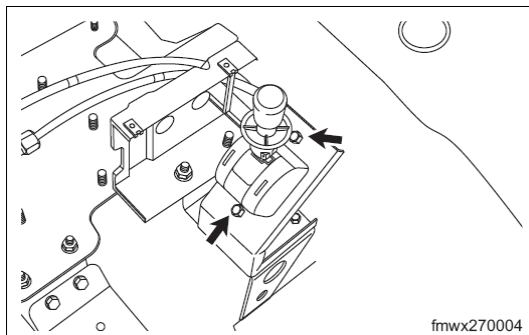
Caution:

The oil pipe wrench shall be applied for dismantlement.

Hint:

Before disconnection, the air pipe shall be labeled and processed so that it can be recognized easily during installation.

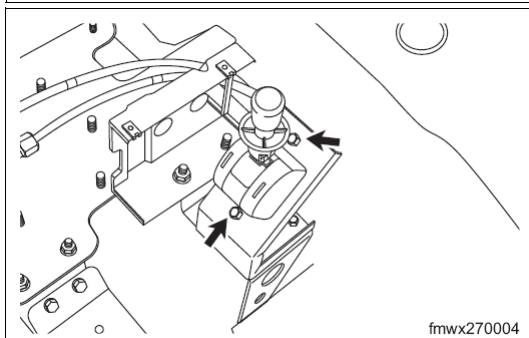
- (b). Dismantle the fixing bolt of hand brake valve, then remove the hand brake valve assembly.



4. Install the hand brake valve assembly

- (a). Install the fixing bolt of hand brake valve.

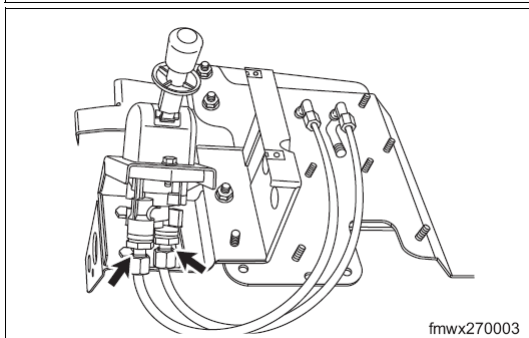
Torque: 23 N.m



- (b). Connect the air pipe of hand brake valve, and install the joint nut of hand brake valve air pipe.

Caution:

The oil pipe wrench shall be applied for dismantlement.



5. **Install the middle platform rear assembly; refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter- Cigarette Lighter, Replacement.**

Frame

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Tilting Control Mechanism Assembly	28-7
Precautions.....	28-7
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Rear Mounting Assembly	28-16
Part Drawing	28-16
Replacement	28-17

Frame Assembly

Precautions:

1. Vehicle overhaul shall be reduced as much as possible

Generally, vehicle overhaul can be reduced by means of decreasing the cohesion of stress on part of the frame.

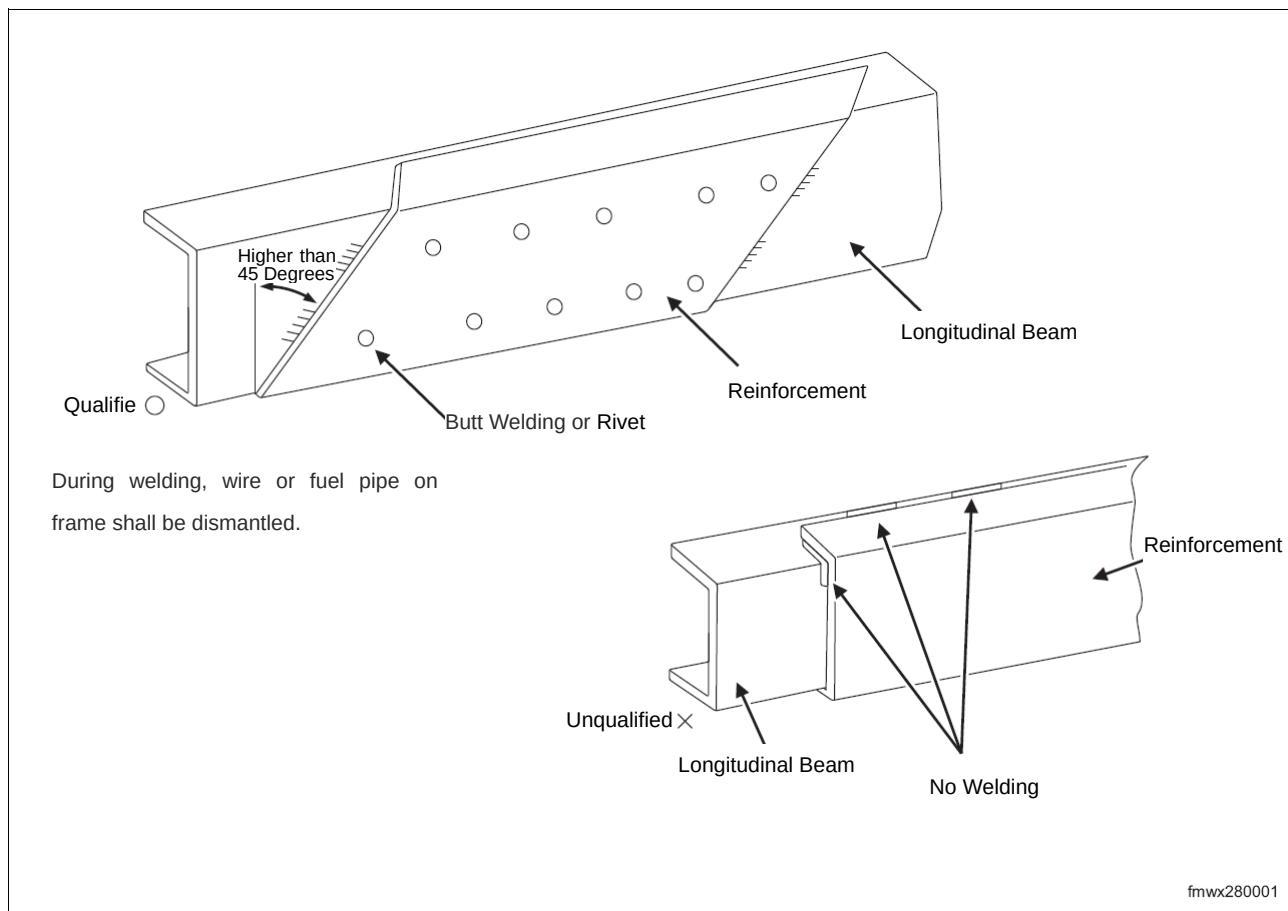
(a). Vehicles can be only applied to design use.

- Overload is not allowed.
- Load bearing shall be uniform, and partial overload shall be avoided.
- Dump truck must not distribute load bearing.
- The baffle plate of van truck shall be used.
- The vehicle can not be driven on the very rough terrain.
- For the usage of the frame of new vehicle, gravity that the frame needs to bear at runtime shall be taken into account, or the frame shall be strengthened.

(b). When repairing frame or fixing vehicle body or equipment to frame, the related operation shall be undertaken on the basis of proposed methods.

- The sudden change of each part shall be avoided.
- Do not drill holes on the flange of the frame track.
- Holes in the track web must be apart at least 40 mm from each other.
- Make full use of existing holes
- Do not use welding torch cut holes.
- Do not cut notches in the track
- Do not make the frame track overheat.
- Welding to the flange shall be avoided.
- Holes in the same vertical line of web shall not exceed four.
- Distance from holes in the reinforced rib to the margin of reinforced rib must be two times of the thickness of its materials.

Frame - Frame Assembly



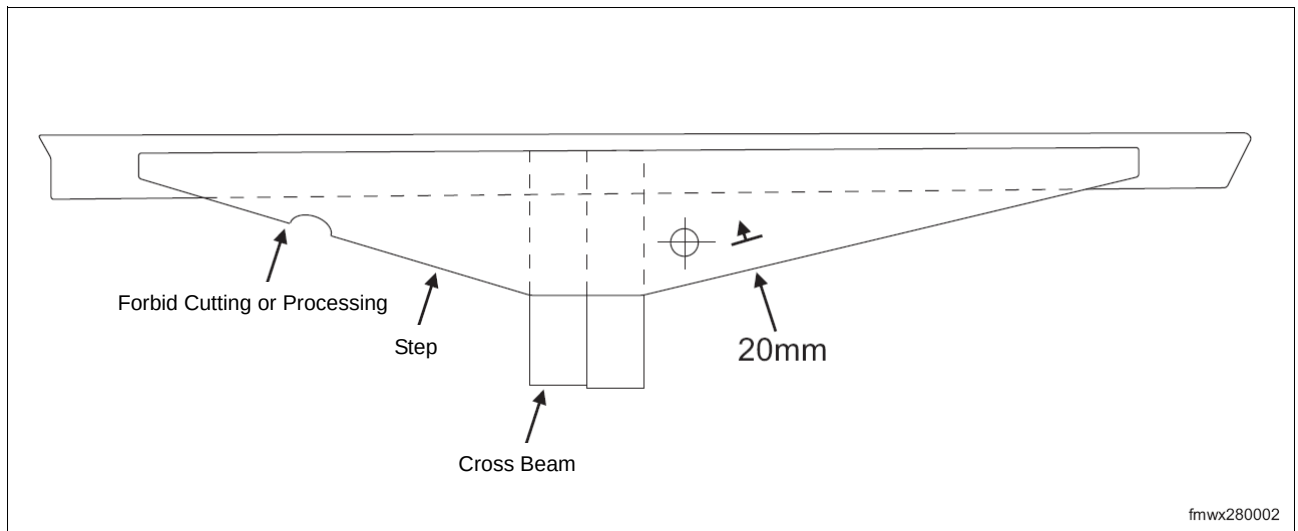
Frame - Frame Assembly**2. Reinforcement**

When fixing the reinforced materials to the chassis frame, Pay special attention to the following.

- (a). When installing reinforced materials, the big changes of model of each part shall be prevented, and partial excessive stress shall be avoided during welding.
- (b). Main frame component shall use reinforced steel plate with high tensile strength, and the steel plate is made of steels with high tensile strength.

3. Drilling Holes

- (a). Do not use gas open fire for drilling holes, the drilling tools shall be used instead.
- (b). The hole edge shall be rubbed down after drilling holes.
- (c). If fixing by rivet, the cold rivet shall be used.
- (d). It is prohibited to cut the flange of chassis frame.
- (e). If fixing the subframe to the chassis frame, the bolt shall be used for fixing.
- (f). On the cross shaft rear mounting bracket of double real axel vehicle model, cutting or processing angle brace angle is strictly prohibited.

**4. Welding**

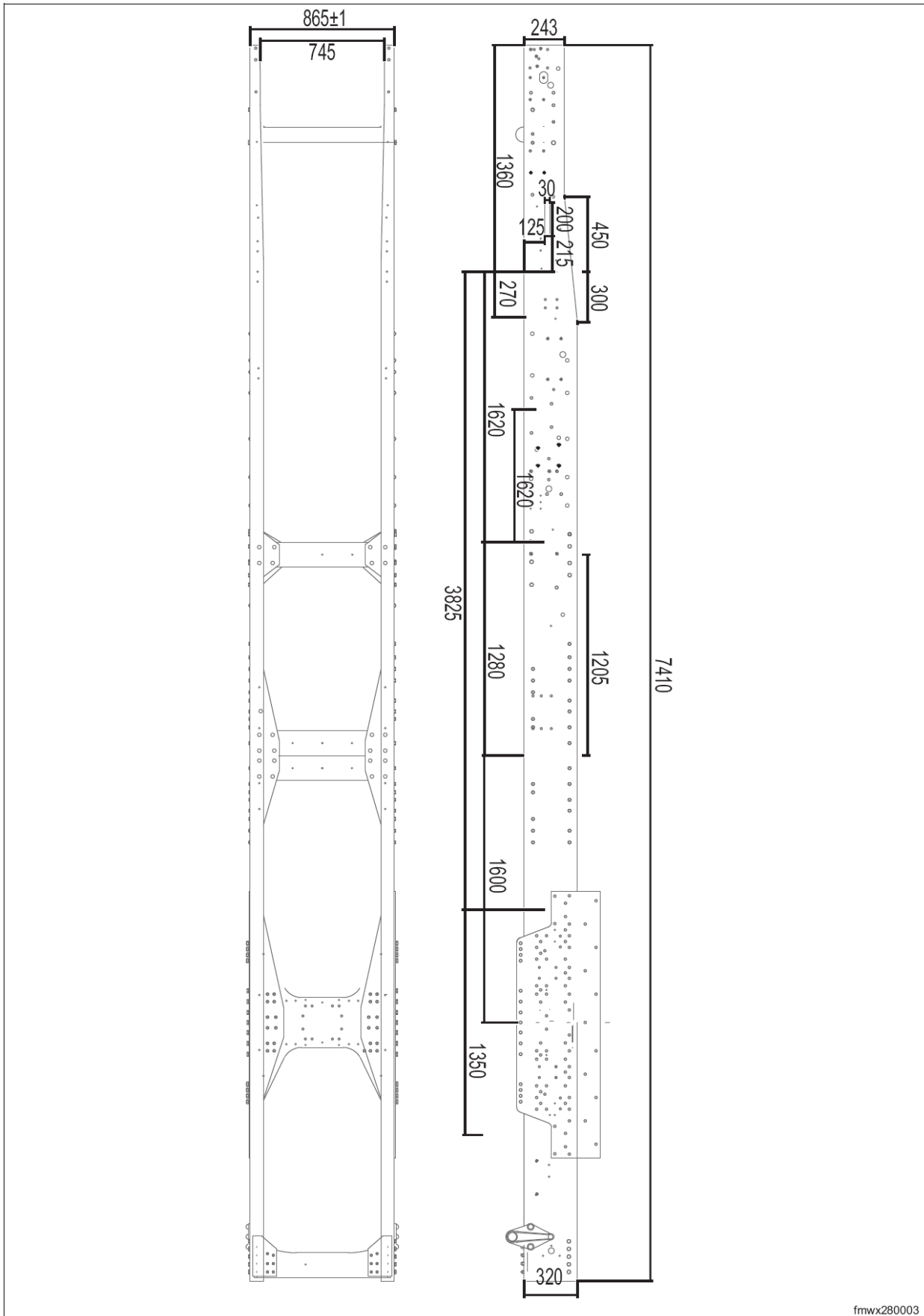
- (a). Common Precautions:

- Before welding, the battery negative cable shall be disconnected.
- Connect the welding ground cable, and make it as close as possible to the work area.
- Keep the reinforced steel and chassis frame components dry.
- Water cooling shall be avoided after welding.
- Pipelines, cables, rubber parts, springs shall be protected in proper methods for the purpose of preventing them from heat and being influenced by the spilled spark.
- When welding near the fuel tank, fuel tank assembly shall be dismantled.
- When welding painted parts, the paint layer should be completely removed.

- (b). When welding chassis frame component made from high strength steel, the following points shall be noted carefully:

- Welding should be especially careful to prevent cracking.
- Keep the materials' hardness which shall not exceed the limits (no more than 350 Vickers hardness.)
- The weld bead surface should be smooth, because the notch effect of high tensile strength steel is higher than the common neutral one.

Frame Dimensional Drawing



Tilting Control Mechanism Assembly

Precautions:

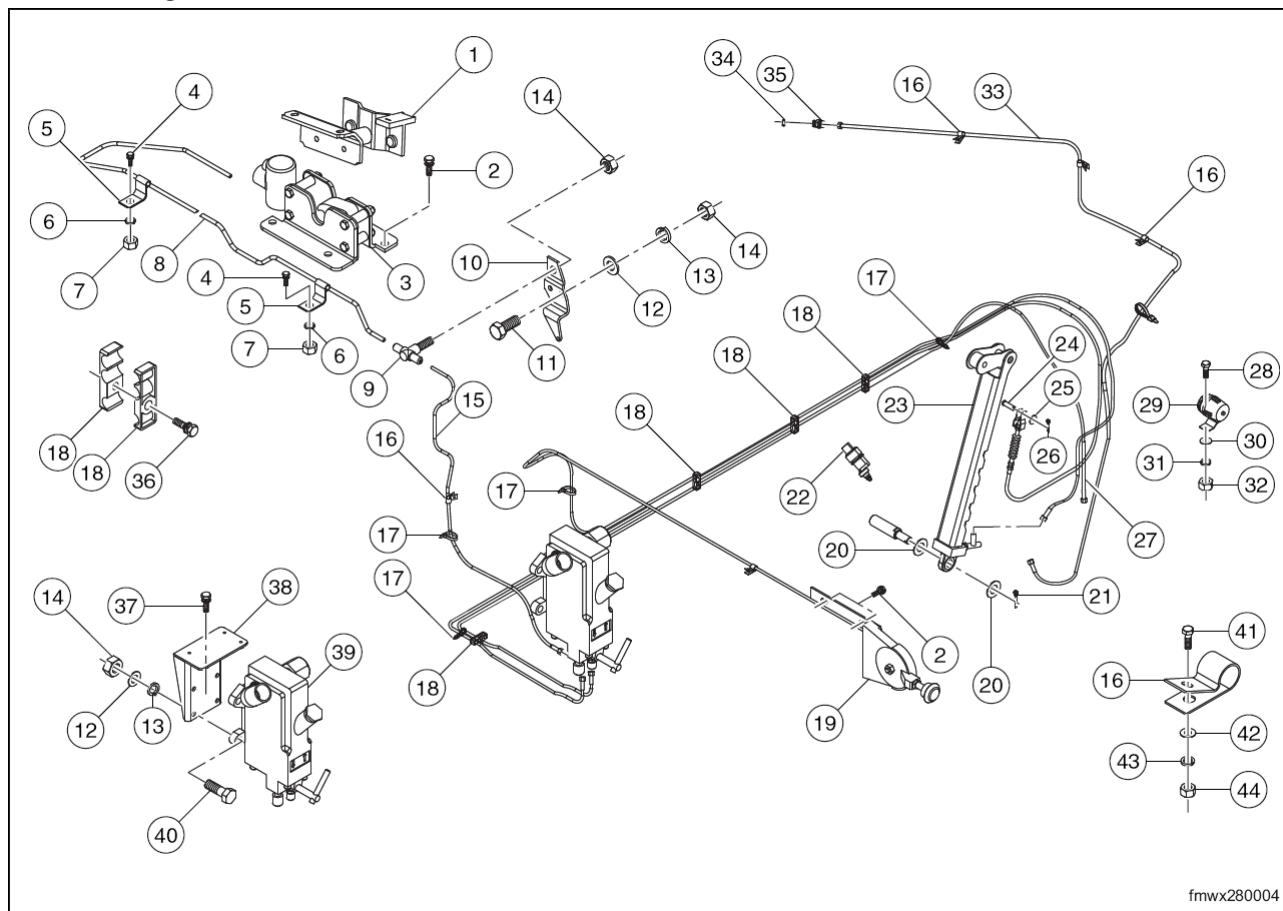
1. When lifting cab, the vehicle shall be parked on the smooth road, the front cover must be opened, and engine shall be shut down.
2. Before starting the engine by auxiliary starting switch, check and confirm that the transmission is in neutral position status.
3. When lowering the cab, pull the cable to a lower position, lower the cab to the bottom, make sure the lock body is locked, then continue to operate the oil pump, and ensure the reposition of cylinder, the buzzer does not ring, and at this moment, pull the cable to the top.
4. Working oil for pump: low temperature antiwear hydraulic oil L-HV32 GB11118.1
5. After system alignment, after filling up the oil pump at the first time, the cab shall be lifted 2 to 3 times in order to fill up the system with oil, as well as exhaust air from the system, and after the completion of final debugging, the oil level shall be under the oil nipple 15-20 mm. Under the circumstance of cylinder's upper part filling with oil, fill the tank with 280 ± 20 ml.
6. It is normal if the air bleeder of oil pump's upper part spills oil.

Warning: Guarantee the rear lock body is locked reliably.

Lock Standard: the left locking piston of lock body is in the bottom, lifting warning lights in the cab goes out.

Frame - Tilting Control Mechanism Assembly

Part Drawing



1	Rear Mounting Upper Lock Body Assembly
2	Hex Head Bolt, Spring Washer, Flat Washer
3	Rear Mounting Lower Lock Body Assembly
4	Hex Head Bolt Assembly
5	Oil Pipe Clip
6	Spring Washer
7	Hex Nut, Style 1
8	Hard Pipe
9	Two-way Joint
10	Two-way Joint Fixing Plate
11	Hex Head Bolt
12	Flat Washer
13	Spring Washer
14	Hex Nut, Style 1

23	Tilting oil cylinder Assembly H3 Series
24	Pin Shaft
25	Flat Washer
26	Cotter Pin
27	Cylinder Oil Inlet and Outlet Pipe
28	Hex Head Bolt
29	Tilting Buzzer
30	Flat Washer
31	Spring Washer
32	Hex Nut, Style 1
33	Decoupling Cylinder
34	Sealing Washer
35	Decoupling Cylinder
36	Hex Head Bolt, Spring Washer, Flat Washer

Frame - Tilting Control Mechanism Assembly

15	Connecting Hose
16	Lift Oil Pipe Fixing Clamp
17	Plastic Fastening Belt
18	Oil Pipe Clamp
19	Cylinder Cable Assembly
20	Flat Washer
21	Cotter Pin
22	Bottom Dead Center

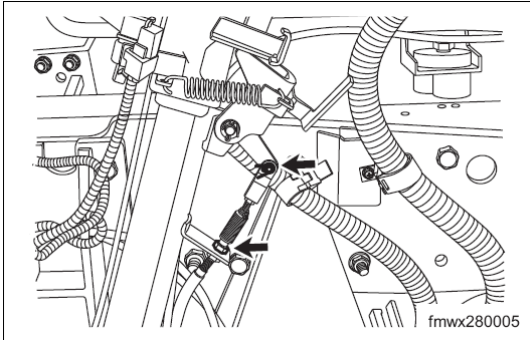
37	Hex Head Bolt, Spring Washer, Flat Washer
38	Manual Oil Pump Bracket
39	Hand pump Assembly
40	Hex Head Bolt
41	Hex Head Bolt
42	Flat Washer
43	Spring Washer
44	Hex Nut, Style 1

Replacement

Hint:

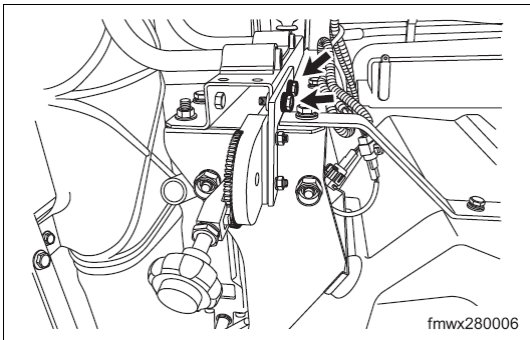
Part Drawing, refer to Chapter 28, Frame - Tilting Control Mechanism Assembly, Part Drawing.

1. **Open the cab**
2. **Roll down the glass of left and right front windows, and put the sling of cab a little after the middle cab. Then lift the sling slowly until it holds the cab.**

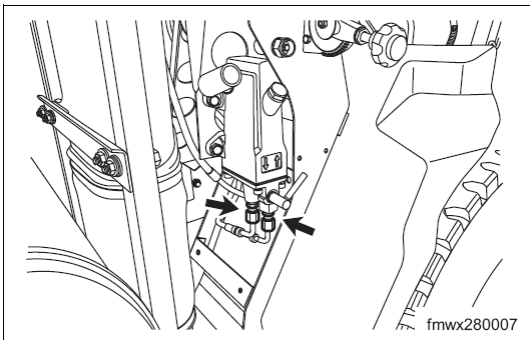


3. Dismantle oil cylinder cable assembly

- (a). Dismantle the cotter pin, and remove the cable pin shaft.
- (b). Loosen the oil cylinder cable, and fasten the nut.



- (c). Dismantle the oil cylinder cable assembly, fix the nut, and remove the oil cylinder cable assembly.

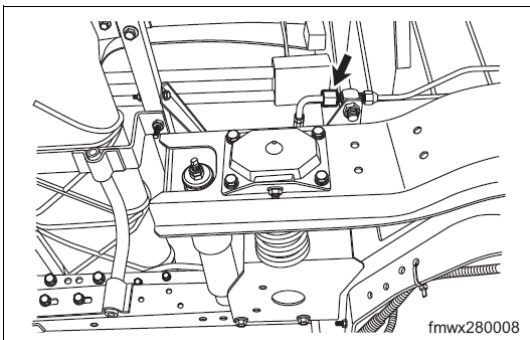


4. Dismantle hand pump assembly

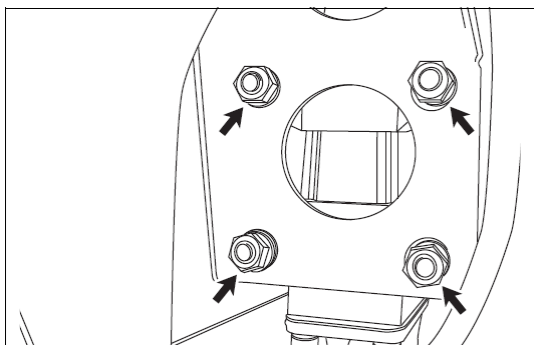
- (a). Dismantle the oil inlet and outlet pipes of hand pump, and drain hydraulic oil.

Caution:

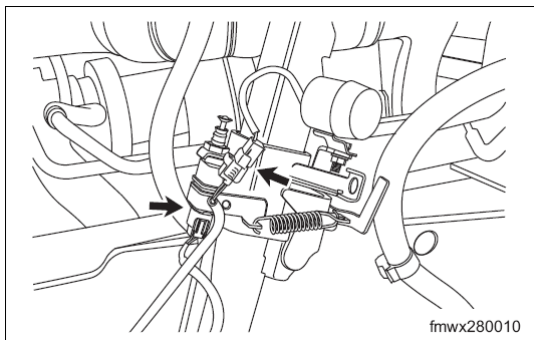
The oil pipe wrench shall be applied for oil pipe dismantlement.



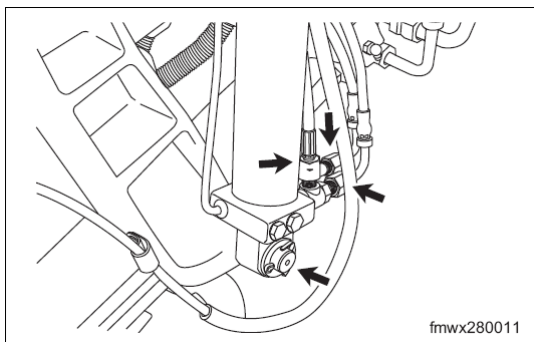
- (b). Dismantle the joint which connects the two-way joint of hose.

Frame - Tilting Control Mechanism Assembly

- (c). Dismantle the fixing nut of hand pump assembly, and remove the hand pump assembly.

**5. Dismantle the tilting oil cylinder assembly**

- (a). Disconnect the connector clip of the reverse buzzer and bottom dead center switch.

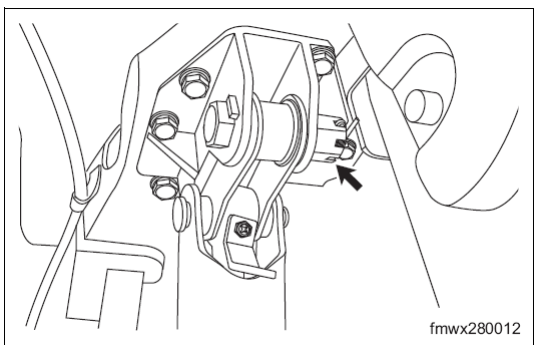


- (b). Dismantle the oil inlet and outlet pipe of the tilting oil cylinder and connect oil pipe of the decoupling cylinder.

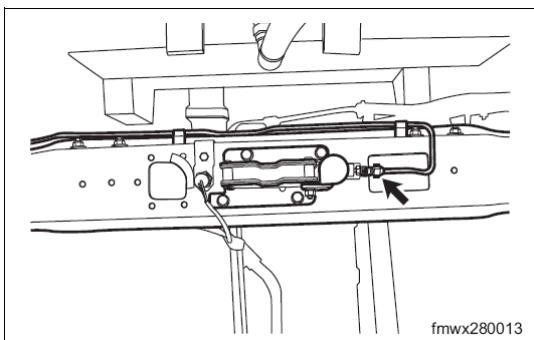
- (c). Dismantle the pin shaft of tilting oil cylinder.

Caution:

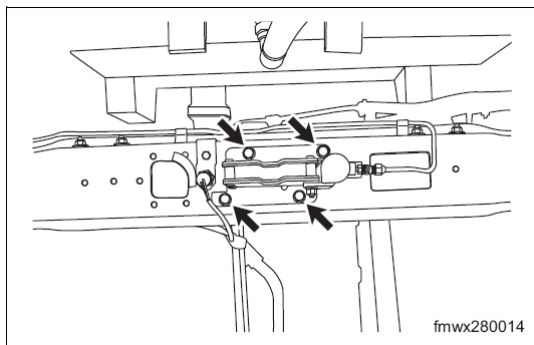
The oil pipe wrench shall be applied for oil pipe dismantlement.



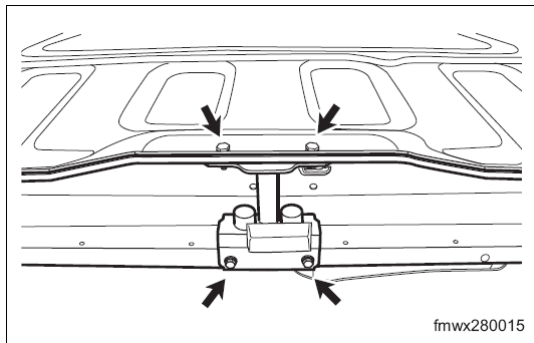
- (d). Dismantle the fixing bolt of tilting oil cylinder, and remove the tilting oil cylinder assembly.

**6. Dismantle rear mounting lower lock body assembly**

- (a). Dismantle the oil pipe joint of rear mounting lower lock body.

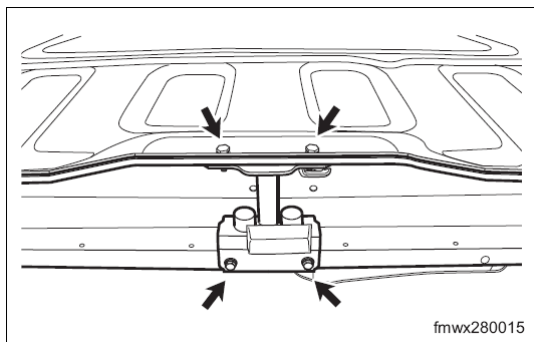


- (b). Dismantle the fixing bolt of rear mounting lower lock body, and remove the rear mounting lower lock body assembly.



7. Dismantle the rear mounting upper lock body assembly

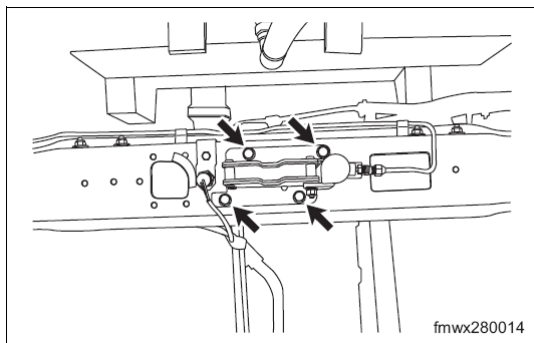
- (a). Dismantle the fixing bolt of rear mounting upper lock body.



8. Install the rear mounting upper lock body assembly

- (a). Install the fixing bolt of rear mounting upper lock body.

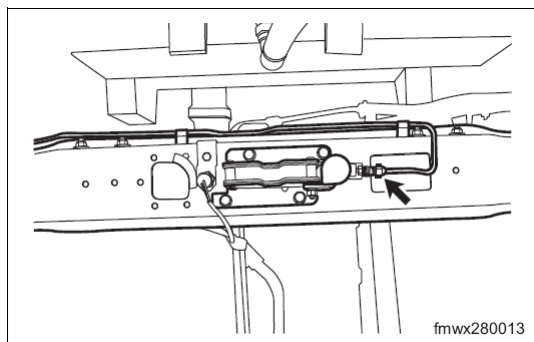
Torque: 63N.m



9. Install the rear mounting lower lock body assembly

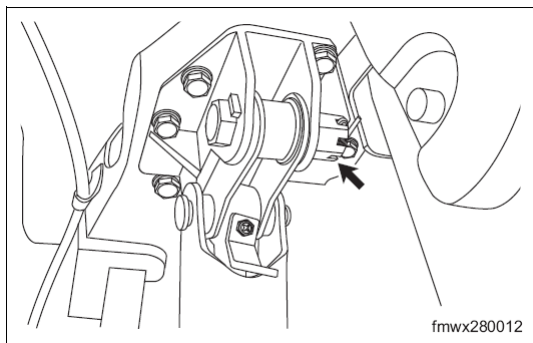
- (a). Install the fixing bolt of rear mounting lower lock body.

Torque: 63N.m



- (b). Install the oil pipe joint of rear mounting lower lock body.

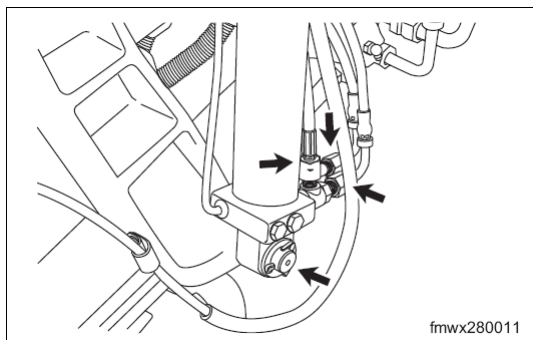
Frame - Tilting Control Mechanism Assembly



10. Install the tilting oil cylinder assembly

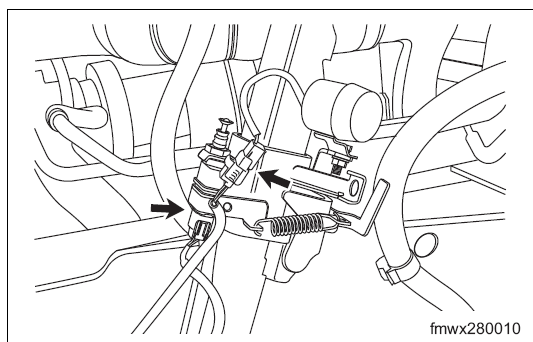
- (a). Install the fixing bolt of tilting oil cylinder.

Torque: 160N.m

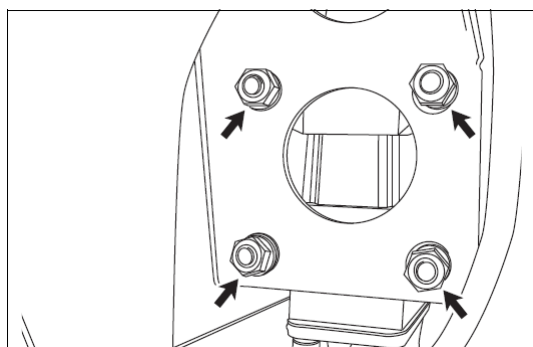


- (b). Install the pin shaft of tilting oil cylinder.

- (c). Install oil inlet and outlet pipes of the tilting oil cylinder and the connect oil pipe of decoupling cylinder.



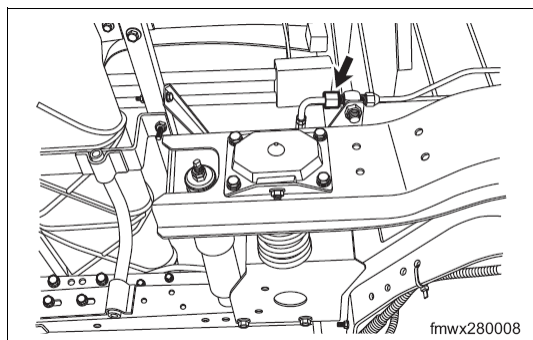
- (d). Install the connector clip of reverse buzzer and bottom dead center switch.



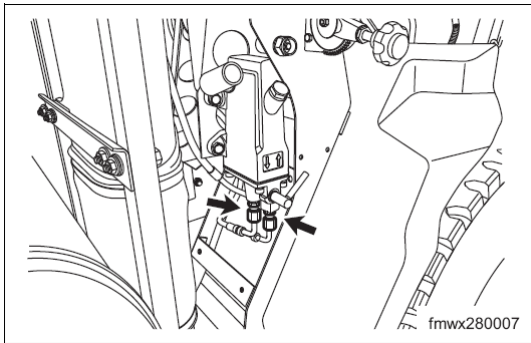
11. Install the hand pump assembly

- (a). Dismantle the fixing nut of hand pump assembly.

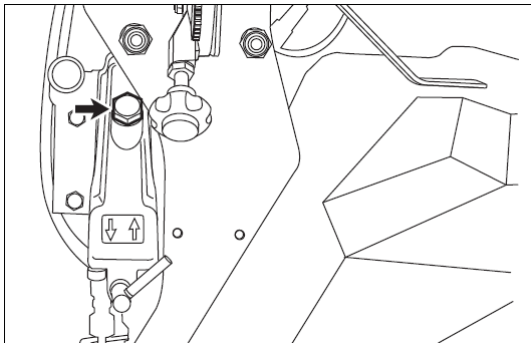
Torque: 97N.m



- (b). Install the joint which connects two-way joint of the hose.



- (c). Install the oil inlet and outlet pipes of the hand pump.

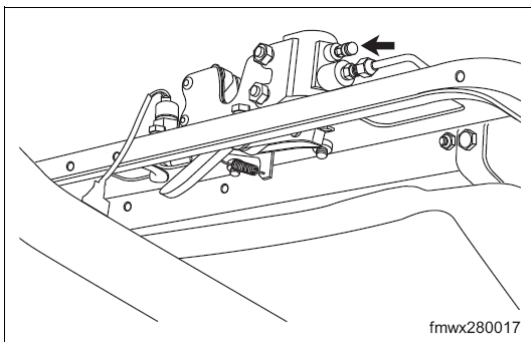


12. Add hydraulic oil to hand pump

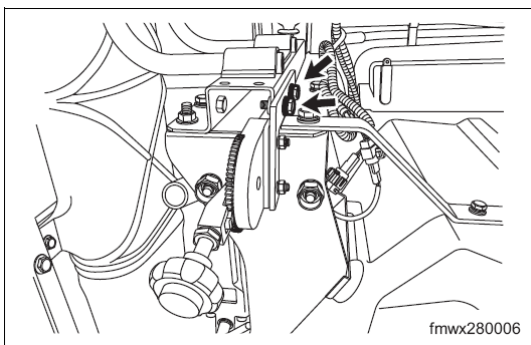
- (a). Open the bolt of oil filler, then add hydraulic oil.

Hint:

After filling up the oil pump at the first time, the cab shall be lifted 2 to 3 times in order to make the system full with oil.

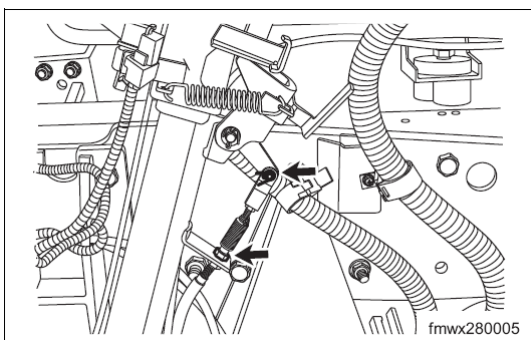


- (b). Loosen the screw of system air outlet, exhaust air in the system, the oil level shall below the oil nipple 15-20 mm after the final debugging. Under the circumstance of upper part of cylinder filling with oil, fill oil 280 ± 20 ml.
- (c). Fasten the exhaust screw, install the oil filler bolt, check if the system has oil leakage.



13. Install oil cylinder cable assembly

- (a). Install the fixing nut of oil cylinder cable assembly.



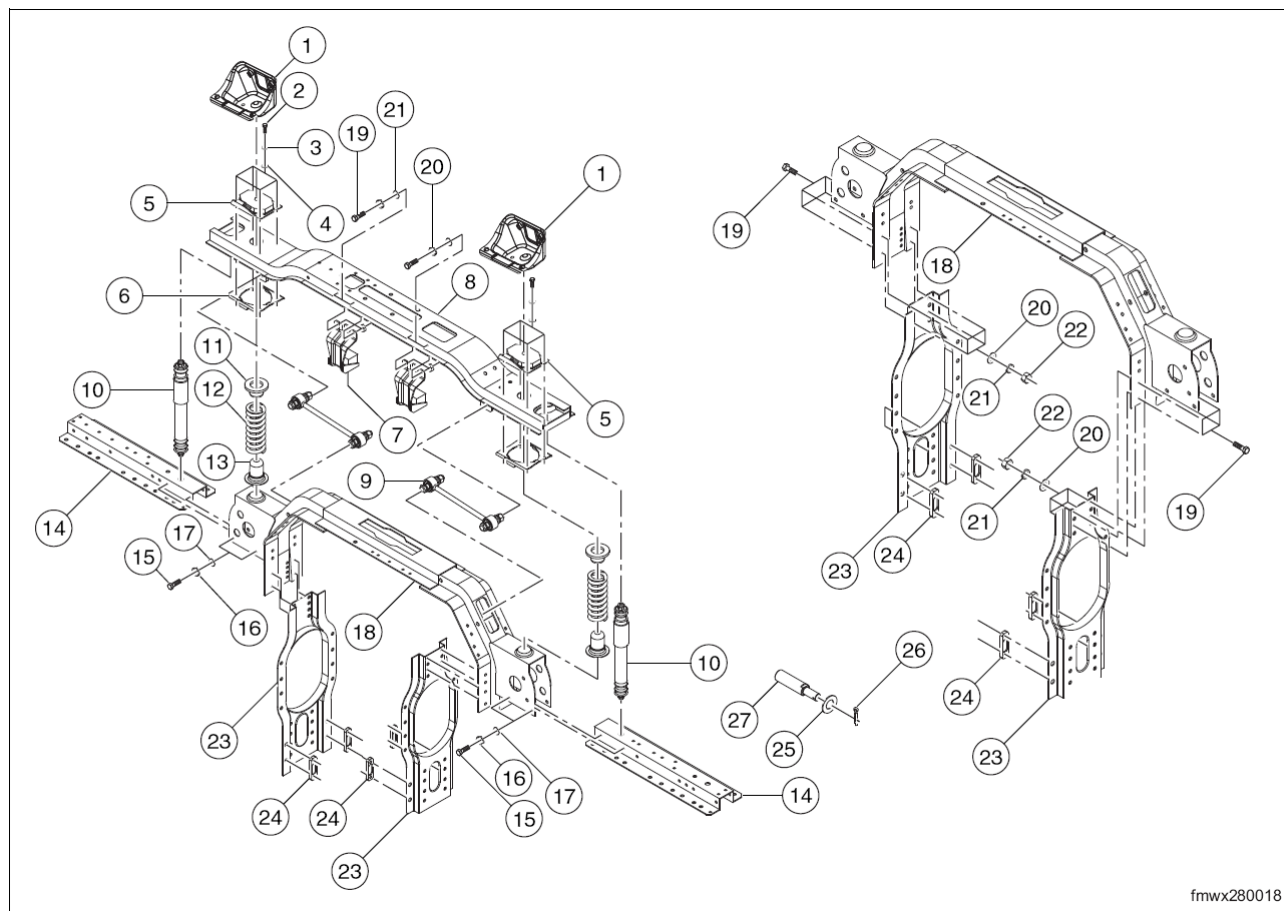
- (b). Fasten the oil cylinder cable and nut.
- (c). Install the cable pin shaft and cotter pin.

Frame - Tilting Control Mechanism Assembly

14. Put down the sling of cab
15. Close the cab.

Rear Mounting Assembly

Part Drawing



fmwx280018

1	Rear Support Seat Assembly
2	Hex Head Bolt
3	Spring Washer
4	Flat Washer
5	Damping Gasket
6	Buffer Block Fixing Seat Assembly
7	Rear Mounting Limiting Rubber Block
8	Rear Mounting Upper Frame Welding
9	Rocker Arm Assembly
10	Rear Damper Assembly
11	Upper Buffer Block Assembly
12	Rear Spiral Spring
13	Lower Buffer Block Assembly
14	Extended beam Assembly

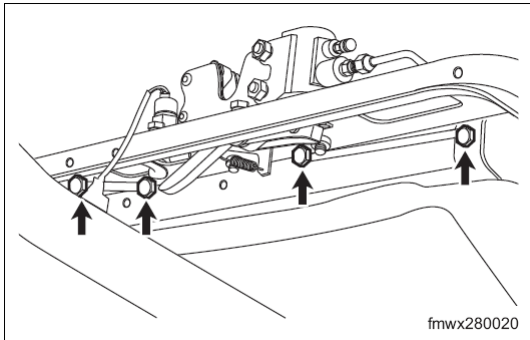
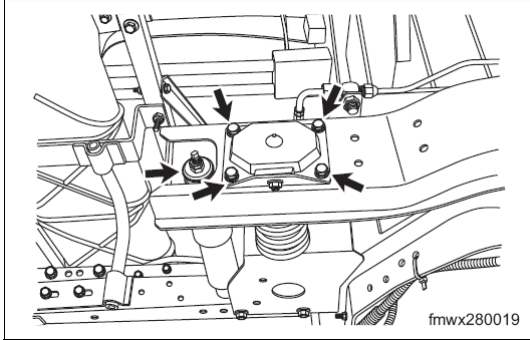
15	Hex Head Bolt
16	Spring Washer
17	Flat Washer
18	Rear Mounting Lower Frame Welding
19	Hex Head Bolt
20	Spring Washer
21	Flat Washer
22	Hex Head Nut, Style 1
23	Rear Mounting Connecting Plate
24	Rear Mounting Transition Bracket
25	Flat Washer
26	Lock Pin
27	Pin Shaft

Replacement

Hint:

Part Drawing, refer to Chapter 28, Frame – (Rear Mounting Assembly, Part Drawing.

1. **Open the cab**
2. **Dismantle the rear mounting lower lock body assembly and joints of all pipes**



3. **Dismantle the rear mounting upper frame welding assembly**

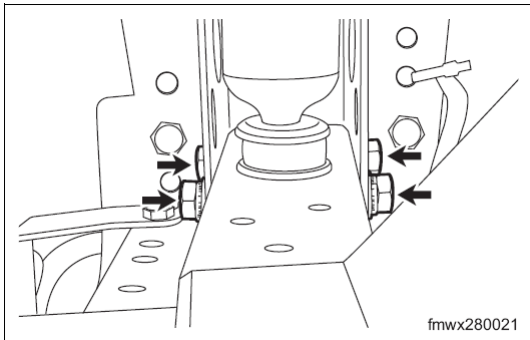
- (a). Dismantle the fixing bolt of right damping gasket assembly, and remove upper and lower buffer block, and the rear spiral spring.
- (b). Dismantle the fixing seat nut on the right rear damper.

Hint:

The steps for dismantling parts on the left side are the same with those for the parts on the right.

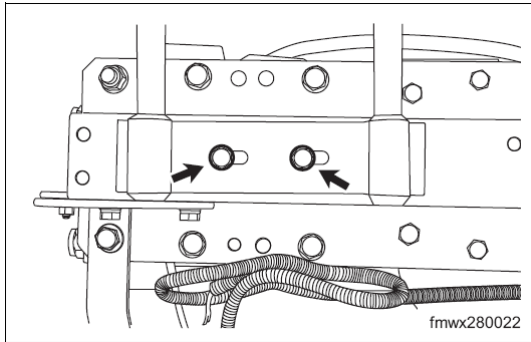
- (c). Dismantle the fixing bolt of rocker arm assembly, and remove the rocker arm assembly.
- (d). Dismantle the welding assembly of rear mounting upper frame.

4. **Dismantle the steering oil reservoir assembly, refer to Chapter 42, Power Steering Mechanism- Steering Oil Reservoir Assembly, Replacement**
5. **Dismantle auxiliary water tank, refer to Chapter 14, Cooling-Auxiliary Tank, Overhaul**
6. **Dismantle the left mudguard bracket and tie and bracket of all wiring harnesses.**



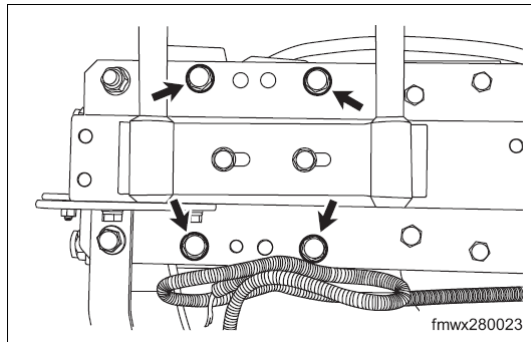
7. **Dismantle the left extended beam assembly**
- (a). Dismantle the fixing bolt of the extended beam, and then remove the extended beam assembly.

8. **Dismantle right mudguard bracket and tie and bracket of all wiring harnesses.**
9. **Dismantle the fixing nut of oil cylinder cable assembly, refer to Chapter 28, Frame - Tilting Control Mechanism Assembly, Replacement**



10. Dismantle the bracket of the high-position intake pipe

- (a). Dismantle the fixing bolt of the high-position intake pipe bracket.



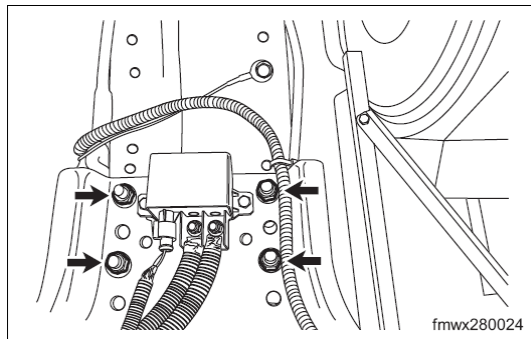
11. Dismantle the hand pump bracket

- (a). Dismantle the fixing bolt of the hand pump bracket

12. Dismantle right extended beam assembly

Hint:

The steps for dismantling right extended beam assembly are the same with the those for the left extended beam.



13. Dismantle the welding assembly of rear mounting lower frame

- (a). Dismantle the fixing nut of welding assembly of right rear mounting lower frame.

Hint:

Steps for installing fixing nut of welding assembly of left rear mounting lower frame are the same with steps of the right.

- (b). Dismantle the welding assembly of rear mounting lower frame.

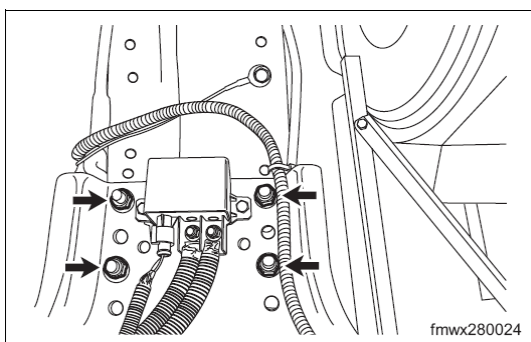
14. Install the welding assembly of rear mounting lower frame

- (a). Install the fixing nut of welding assembly of right rear mounting lower frame.

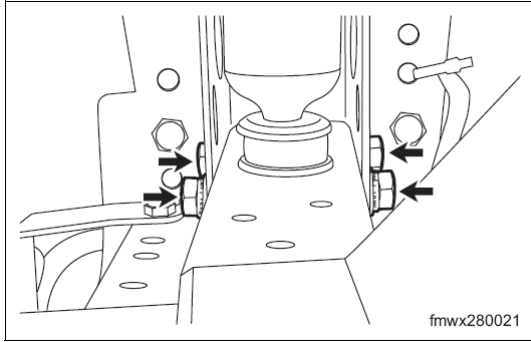
Torque: 97N.m

Hint:

Steps for installing fixing nut of welding assembly of left rear mounting lower frame are the same with steps of the right.



Frame - Rear Mounting Assembly



15. Install left extended beam assembly

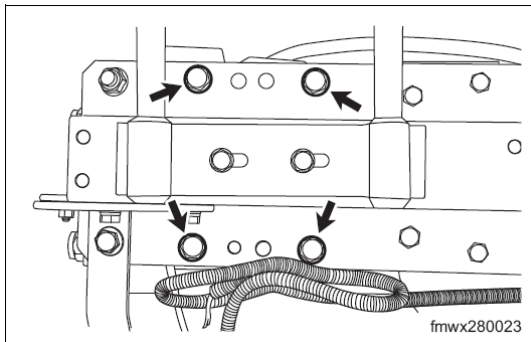
- (a). Install the fixing bolt of left extended beam.

Torque: 63 N.m

16. Install left mudguard bracket, cable ties and brackets for all wiring harnesses.
17. Install auxiliary water tank assembly, refer to Chapter 14, Cooling - Auxiliary Tank, Overhaul.
18. Install steering oil reservoir assembly, refer to Chapter 42, Power Steering Mechanism - Steering Oil Reservoir Assembly, Replacement
19. Install right extended beam assembly

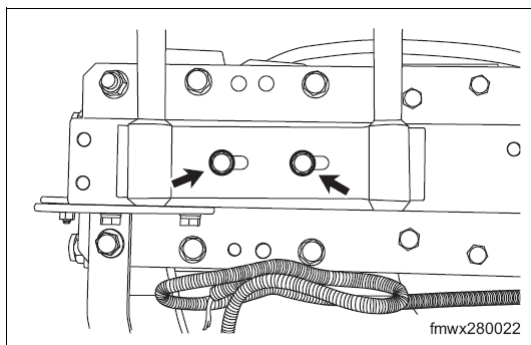
Hint:

The steps for dismantling right extended beam assembly are the same with the left extended beam.



20. Install Hand pump Bracket

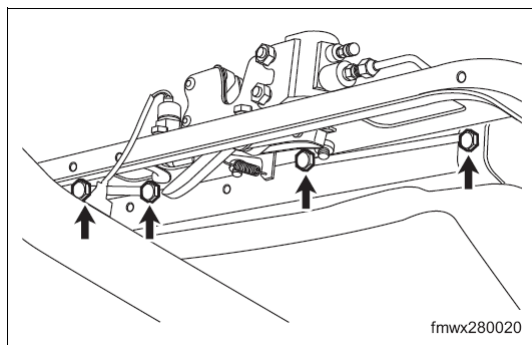
- (a). Install the fixing bolt of hand pump bracket.



21. Install high-position intake pipe bracket

- (a). Install the fixing bolt of high-position intake pipe bracket.

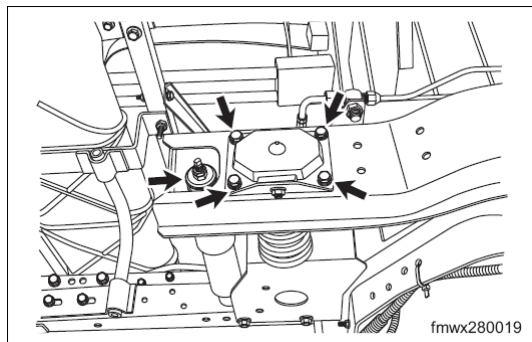
22. Install the fixing bolt of oil cylinder cable assembly, refer to Chapter 28, Frame- Tilting Control Mechanism Assembly, Replacement
23. Install right mudguard bracket, dismantle each type of wiring harness cable tie and bracket.



24. Install welding assembly of rear mounting upper frame

- (a). Install the fixing bolt of rocker arm assembly.

Torque: 97N.m



- (b). Install the upper and lower buffer blocks and rear spiral spring, and install the fixing bolt of right damping gasket assembly.

Torque: 63 N.m

- (c). Install the fixing seat nut on right rear bumper.

Hint:

The steps for installing parts on the left side are the same with parts on the right.

25. Install rear mounting lower lock body assembly and joints of all pipes

26. Close the cab

Intermediate Axle (Steyr)

Intermediate Axle Assembly	29A-3
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Main Reducer.....	29A-31
Overhaul	29A-31
Driving Gear and Bearing	29A-32
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29A

Intermediate Axle Assembly

General

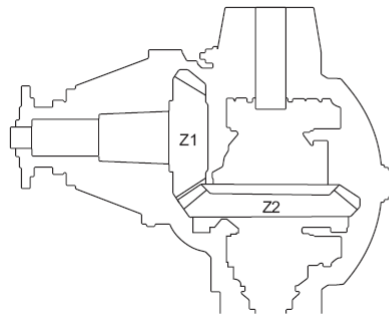
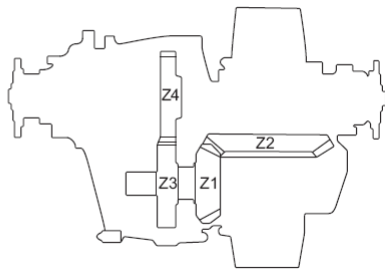
Power is transferred to the input driving flange by the drive shaft, and the spline shaft drives the input shaft to rotate. The input shaft is actually the front housing of the inter-axial differential, and is integrated with the rear housing of the differential through coupling bolts. Identical cross shaft planet gears in the inter-axial differential mesh with two axle shaft gears to drive the two axle shaft gears to rotate. The front axle shaft gear is connected with the through shaft of the driving rear axle through splines, so as to transfer power to the rear driving axle. The rear axle shaft gear is linked with the intermediate axle driving sleeve through splines. The shaft sleeve is linked with a driving cylindrical gear through splines, so that power is transferred to the driving bevel gear shaft via the driven cylindrical gear, and transferred to the left and right axle shafts of the intermediate axle via the inter-wheel differential through the driving and driven bevel gears.

There are two differentials in the driving intermediate axle. One is an inter-wheel differential, and it performs the function of automatic differential of the left and right wheels when the car is turning around. The other is a inter-axial differential, and it performs the function of automatic differential between the intermediate axle and rear axle when the vehicle is running on an uneven road. When the vehicle is running on an uneven road, it usually requires different instantaneous speeds between the intermediate axle and rear axle (at a certain moment, the intermediate axle rotates a little more than the rear axle wheel, while at another moment, the intermediate axle rotates a little less than the rear axle wheel) to meet the requirements of road for wheel rotation. If the intermediate axle and the rear axle form a completely positive drive, the wheels of the intermediate axle and rear axle rotate at the same speed at any moment so as to generate the phenomenon of incoordination. This consumes power, and may result in failure of wheel abrasion in less serious cases or even part damage in serious cases. The inter-axial differential can automatically adjust the speed of the intermediate and rear axles to completely adapt to the road surface.

Similar to the driving rear axle, the inter-wheel differential is provided with a differential lock. When the left and right wheels of the intermediate wheels skid on one side, causing failure to run, the inter-wheel differential lock can be closed. At this time, the mesh sleeve linked with the right axle shaft shall mesh with mesh teeth on the differential, so that the differential housing is locked with the right axle shaft into an integral body. The differential no longer performs the differential function, the left and right axle shafts shall become a positive driving shaft, and the vehicle shall smoothly run out of the fault road surface.

If the inter-wheel differential lock is closed, both the left and right wheels of the intermediate axle skid while the wheels of the rear axle keep still, or both the wheels of the rear axle skid while the wheels of the intermediate axle keep still (which indicates that the inter-axial differential is working), but the vehicle still can not run, then it is necessary to close the inter-axial differential lock. After pressing the inter-axial differential lock button, the electromagnetic valve is opened, and compressed air enters the operating cylinder of the inter-axial differential lock to drive the piston push rod, so that the shift fork of the differential lock drives the differential lock pin into the pinhole of the gear at the front axle shaft. Thus, the differential housing is locked with the axle shaft gear, the differential no longer performs the differential function, and the through shaft and drive gear sleeve completely form a positive linkage. At this time, the intermediate axle, rear axle, left axle shaft and right axle shaft completely form an integrated connection, and the vehicle smoothly runs out of the fault road surface. After the vehicle runs out of the fault road surface, the center and inter-wheel differential locks shall be immediately disengaged and removed.

Precautions



fmwx29a001

Total Speed Ratio i		4.38	4.8	5.73	6.72	7.49	8.4	9.49
Rear axle	Driving cylindrical bevel gear Z1	23	21	17	15	13	12	21
	Driven cylindrical bevel gear Z2	29	29	28	29	28	29	30
Intermediate axle	Driving cylindrical bevel gear Z1	17	17	17	15	13	12	11
	Driven cylindrical bevel gear Z2	28	28	28	29	28	29	30
	Driving cylindrical bevel gear Z3	34	31	35	35	35	35	35
	Driven cylindrical bevel gear Z4	26	26	35	35	35	35	35

As for the dual axle of which the speed ratio $i=6.72$, the intermediate axles and rear axles of the driving and driven bevel gears are identical. As for the dual axle of which the speed ratio $i=5.73$, the intermediate axles and rear axles of the driving and driven bevel gears are also identical. The driving and driven cylindrical drive gears in the gap bridge boxes of the intermediate axles $i=5.73$ and $i=6.72$ are identical. In other words, in the dual axles $i=5.73$ and $i=6.72$, only the numbers of teeth of the driving and driven bevel gears are different, and other parts are basically identical. Therefore, when it is necessary to replace the driving and driven bevel gears in maintenance, pay special attention to the speed ratio of the original vehicle. Otherwise, replacement of a wrong gear shall lead to different speed ratios of the intermediate axle and rear axle, resulting in the fault of burning loss of inter-axial differential. It should be worth noting that the driving and driven bevel gears of the intermediate axle $i=4.8$ are identical to those of the intermediate axle $i=5.73$, but the numbers of teeth of the driving and driven cylindrical gears in the gap bridge boxes. Therefore, the appearances of the gap bridge boxes of the intermediate axles look are identical, and can be interchangeably connected with the axle housing. Thus, do pay special attention to whether the speed ratio of the intermediate axle interruption assembly to be replaced is identical to that of the original vehicle speed ratio. Otherwise, different speed ratios shall result in different speed ratios of the intermediate axle and rear axle, resulting in burning loss of the inter-axial differential. Special attention shall also be paid to this in maintenance, when mounting the intermediate axle $i=4.38$.

The gap bridge transmission case of the intermediate axle and the main reducer adopt splash lubrication. There is a refill plug above the gap bridge box inter-axial differential, and the bottom of the gap bridge box is provided with an oil drain plug. A refill plug and an oil drain plug are also arranged on the intermediate axle tooth pit.

An oil baffle plate is arranged above the intermediate axle gap bridge box housing, so that the splashing lubricating oil flows into the lubrication differential of the inter-axial differential. The position of the inter-axial differential is higher, and its lubrication conditions are severe, so pay special attention to the amount of lubricating oil in the intermediate axle.

Intermediate Axle (Steyr) – Intermediate Axle Assembly

In use and maintenance of the dual axle, pay attention to:

1. Operation of differential lock

The dual axle is provided with an inter-wheel differential lock and an inter-axial differential lock. So that the vehicle can smoothly pull out of the fault road surface by using the differential locks when it runs into the muddy and smooth road surface and fails to pull out.

The cab dashboard is provided with two differential lock buttons, an inter-wheel differential lock button and a inter-axial differential lock button. When the vehicle runs into a muddy road and the wheel of a certain axle skid on one side, it is required to step on the clutch and press down the inter-wheel differential lock button. When the indicator lamp is on, the inter-wheel differential locks of the intermediate and rear axles are closed at the same time. When releasing the clutch pedal, the left and right wheels of a certain axle skid and idle at the same time, and the wheels of the other axle keep still, but the vehicle still can not pull out. At this time, step on the clutch and press down the inter-axial differential lock button; and after the indicator lamp is on, engage a gear, and release the clutch, so the vehicle must pull out of the fault road surface. After the vehicle pulls out of the fault road surface, immediately remove the differential locks.

2. In repair and maintenance, when it is necessary to draw the axle shaft, it should be noted that: the axle shaft on the side without a differential lock can be drawn freely. As for the axle shaft on the side with a differential lock, the differential shall be closed before drawing the axle shaft. In order to ensure the mesh sleeve of the differential lock not to disengage, the operating cylinder push rod of the differential lock shall also be fixed with an iron wire to avoid mesh sleeve disengagement caused by air leakage at the operating cylinder.

3. A new vehicle shall be provided with forced maintenance after running 2,000-4,000km. At this time, gear grease at the center transmission and the wheel reductor shall be replaced. When refilling lubricating oil into the intermediate axle interruption, the lubricating oil shall be refilled from the refilling plug on the inter-axial differential housing. The center transmission and wheel reductor of the dual axle shall be filled with gear oil, AP1GL-5, Viscosity SAE85W/90.

Fault Symptom Table

Use the table below to help you find the cause of the malfunction. Sequence number indicates the probability of the cause of the malfunction. Inspect each part in order. If necessary, replace these parts.

Symptom	Possible Position	Reference
Burn-out of inter-axial differential	1. Lack of oil	Add proper lubricating oil
	2. Different speed ratios of intermediate axle and rear axle	Select intermediate axle and rear axle at proper speed ratio
Abnormal sound of axle	1. Fixing bolt of driven cylindrical bevel gear (falling off or loosening)	Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Main Reducer, Overhaul
	2. Gear (damaged, the gap is too big or small)	Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly, Test and Adjustment
	3. Tooth back (strain or pitting)	Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Main Reducer, Overhaul
	4. Bearing (falling apart, pitting)	Chapter 29A, Intermediate Axle (Steyr) – Gap Bridge Box Assembly, Overhaul Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Main Reducer, Overhaul
	5. Differential lock mesh sleeve (shift)	Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Main Reducer, Overhaul
	6. Differential gear (burn-out)	Chapter 29A, Intermediate Axle (Steyr) – Gap Bridge Box Assembly, Overhaul
	7. Cylindrical bevel gear (deviation of contact site of tooth surface)	Chapter 29A, Intermediate Axle – Intermediate Axle Main Reducer, Overhaul
	8. Spline shaft, hole (loosening)	Chapter 29A, Intermediate Axle (Steyr) – Gap Bridge Box Assembly, Overhaul
Heating of axle	1. Lack of oil	Add proper lubricating oil
	2. Too much lubricating oil	Discharge excessive lubricating oil
	3. Excessive pretightening of bearing	Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly, Test and Adjustment
Oil leakage	1. Oil seal (damaged)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	2. Oil seal outer ring (loosening)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	3. Vent hole (blocked)	Dredge the vent hole

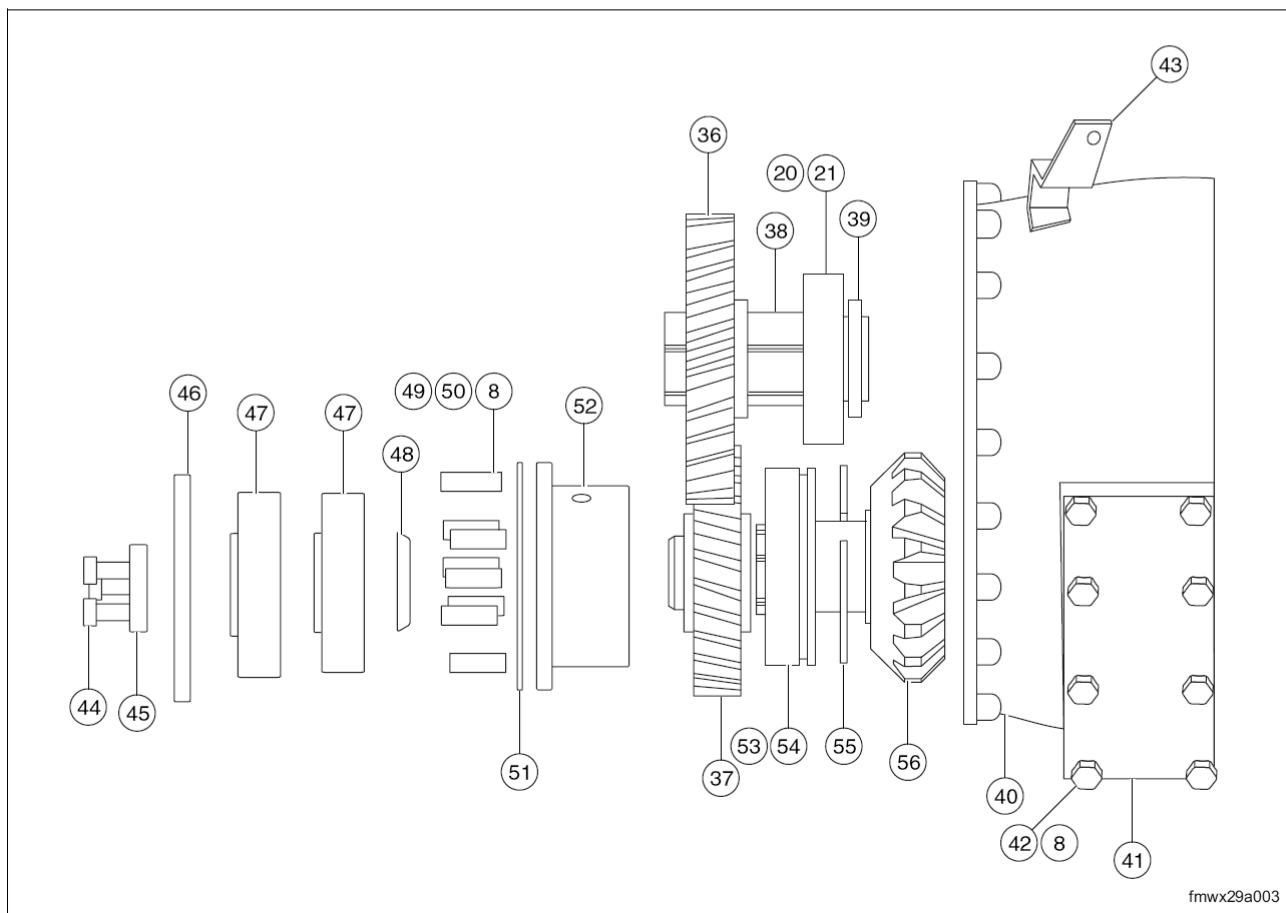
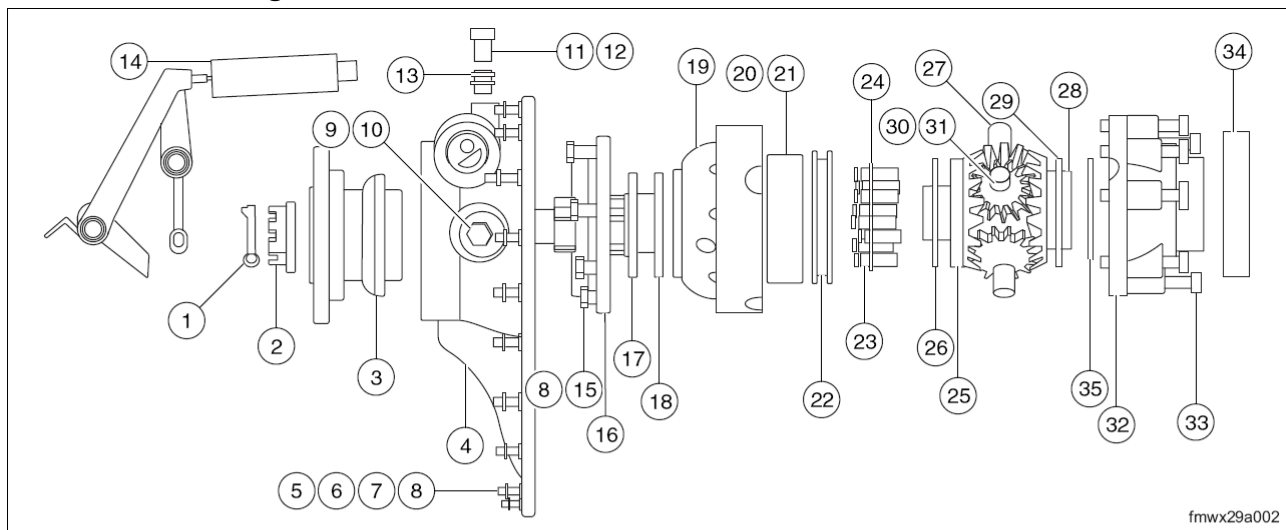
Intermediate Axle (Steyr) – Intermediate Axle Assembly

Symptom	Possible Position	Reference
Wear of tire	1. Steel ring (deformed)	Chapter 23A, Tire and Wheel –Rear Tire and Wheel, Overhaul
	2. Axle end bearing (loosening)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	3. Gas pressures of double rows of tires (too much difference)	Check the tire pressure, and inflate or deflate
	4. Balance shaft sleeve (wear, loosening)	Replace the balance shaft sleeve
	5. Rubber support of balance suspension push rod (damaged)	Chapter 25A, Rear Axle – Rear Axle Assembly and Rear Axle Housing, Overhaul
	6. Balance shaft push rod bracket and axle housing (snap of welding)	Replace the connection of balance shaft push rod bracket and axle housing

29A-8

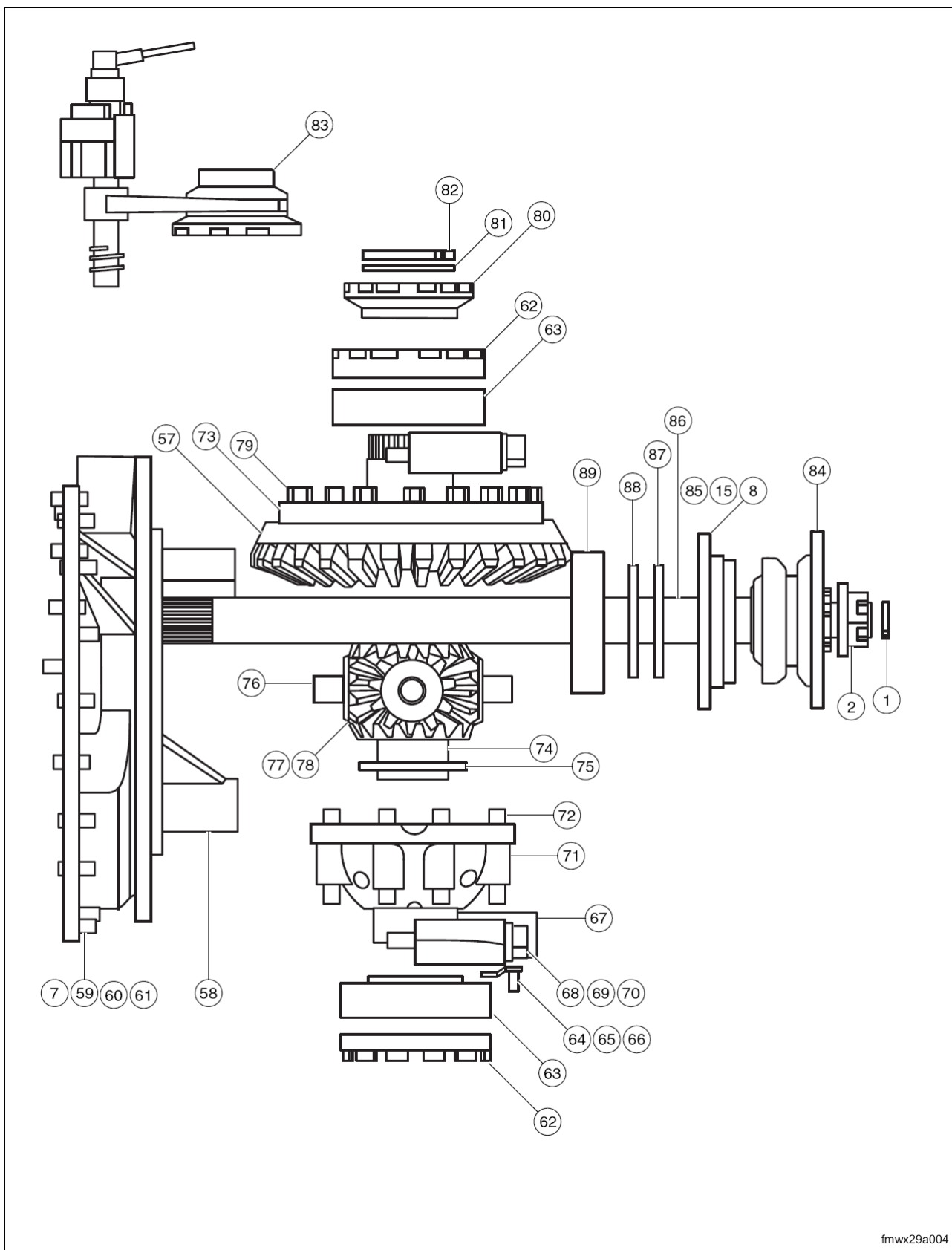
Intermediate Axle (Steyr) – Intermediate Axle Assembly

Part Drawing



29A

Intermediate Axle (Steyr) – Intermediate Axle Assembly



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Intermediate Axle (Steyr) – Intermediate Axle Assembly

1	Cotter Pin
2	Flange Nut
3	Middle Front Flange Assy.
4	Gap Bridge Box Cover
5	Stud Bolt
6	Hex Nut, Style I
7	Cylindrical Pin
8	Spring Washer
9	Oil Filler Plug
10	Sealing Washer
11	Hex Head Bolt
12	Hex Nut, Style II
13	Pressure Switch
14	Differential Lock Assy.
15	Hex Head Bolt
16	End Cover, Bearing Cover
17	Shaft O-ring
18	Shaft O-ring
19	Front Differential Housing
20	Radial Ball Bearing
21	Steel Wire Circlip
22	Inter-axial Differential Gasket
23	Differential Lock Pin
24	Differential Lock Ring
25	Front Axle Shaft Gear
26	Front Gasket, Axle Shaft Gear
27	Differential Cross Shaft
28	Rear Axle Shaft Gear
29	Rear Gasket, Axle Shaft Gear
30	Planet Gear
31	Planet Gear Gasket
32	Rear Differential Housing
33	Hex Head Bolt

46	Pressure Plate, Bearing Outer Ring
47	Tapered Roller Bearing
48	Spacer
49	Stud Bolt
50	Hex Nut
51	Adjusting Gasket
52	Bearing Seat
53	Roller Bearing
54	Round Wire Snap Ring
55	Oil Retainer
56	Driving Bevel Gear
57	Driven Bevel Gear
58	Main Reducer Housing
59	Stud Bolt
60	Hex Nut, Style II
61	Spring Washer
62	Adjusting Nut
63	Single-row Tapered Roller Bearing
64	Locking Plate
65	Hex Head Bolt
66	Spring Washer
67	Differential Bearing Cover
68	Stud Bolt
69	Hex Nut, Style I
70	Cylindrical Pin
71	RH Differential Housing
72	Hex Head Bolt
73	LH Differential Housing
74	Axle Shaft Gear
75	Washer, axle shaft gear
76	Cross Shaft
77	Planet Gear
78	Planet Gear Gasket

29A

Intermediate Axle (Steyr) – Intermediate Axle Assembly

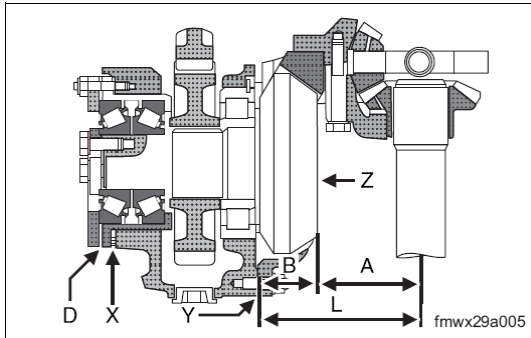
34	Radial Ball Bearing
35	Round Wire Snap Ring for Shaft
36	Driving Cylindrical Gear
37	Driven Cylindrical Gear
38	Hollow Shaft
39	Slotted Nut
40	Gap Bridge Box
41	Oil Baffle Plate Assy.
42	Hex Head Bolt
43	Bracket Assy.
44	Hex Head Bolt
45	Bearing Pressure Plate

79	Hex Head Bolt
80	Fixing Mesh Sleeve
81	Locking Gasket
82	Round Nut
83	Differential Lock Assy.
84	Middle Rear Flange Assy.
85	Oil Seal Seat
86	Through Shaft
87	Sealing Ring
88	Sealing Ring
89	Deep Groove Ball Bearing

Test and Adjustment

Adjustment of pretightening degree of driving gear bearing

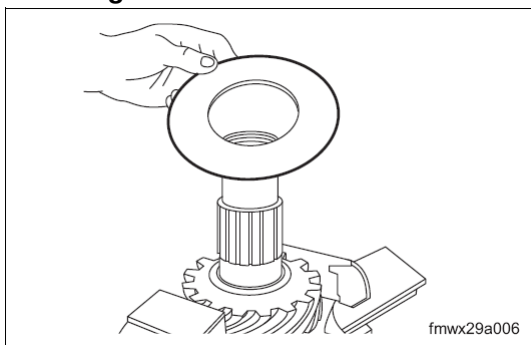
When reassembling, check and adjust the pretightening degree of the driving gear bearing, the mounting distance adjusting washer of the driving gear bearing housing, the differential gear clearance, the driving and driven gear clearances, and the pretightening degree of the inter-wheel differential bearing.



A	Theoretical value of distance between end face of driving gear and axis of driven gear (mm)
B	Measured value of distance between end face of driving gear and connecting surface of transition box (mm) (before adjusting gasket is mounted)
L	Theoretical value of distance between connecting surface of main reducer housing and axis of driven gear (mm)
Z	Actual deviation of A (printed on the end face of driving gear)
Y	Deviation of L (printed on connecting surface of main reducer housing)

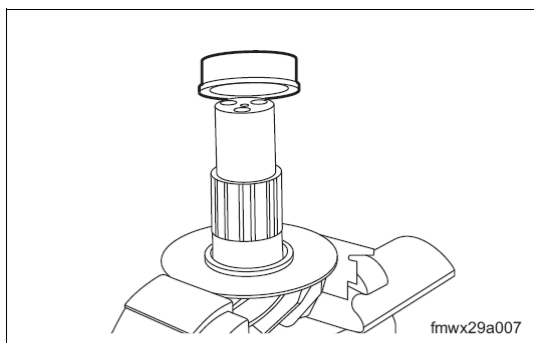
When installing the two tapered roller bearings of the driving gear shaft, select the gasket D with proper thickness. After tightening the pressure cover, the rotational resistance torque of the driving shaft is 0.5-2.5 N.m. This can be measured by pulling the string around the bearing housing with a spring balance. In normal cases, the reading on the spring balance shall be 0.6-2.9kg. If the tensile force is too large, it is required to thicken the gasket; if the tensile force is too small, it is required to thin the gasket. As for the intermediate axles, whose total speed ratio $i=4.38, 4.8, 5.79$ and 6.72 , $A=102\text{mm}$, $L=160\text{mm}$.

Caution: When dismantling and checking the old gap bridge box of intermediate axle, take care to keep the gaskets D and X for reassembling. Take care not to confuse the gaskets D and X, for the two gaskets are identical.

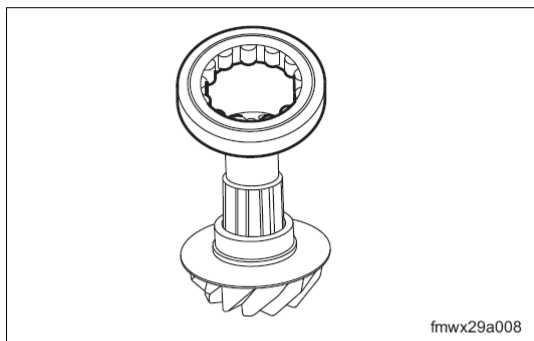


1. Put the oil baffle disc in the driving gear

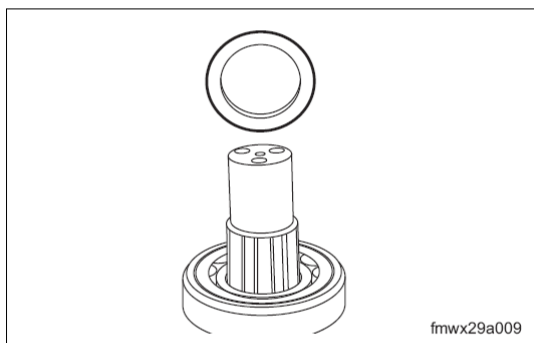
Intermediate Axle (Steyr) – Intermediate Axle Assembly



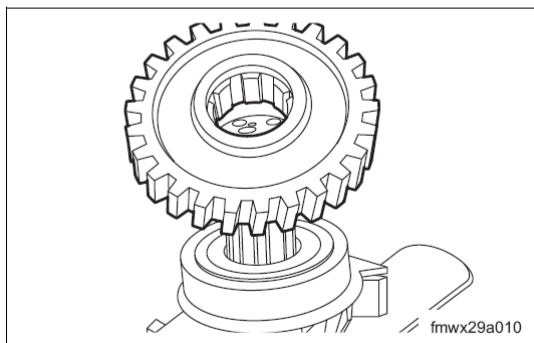
2. Heat the bearing inner ring to 80-100°C, and press it into the driving gear shaft



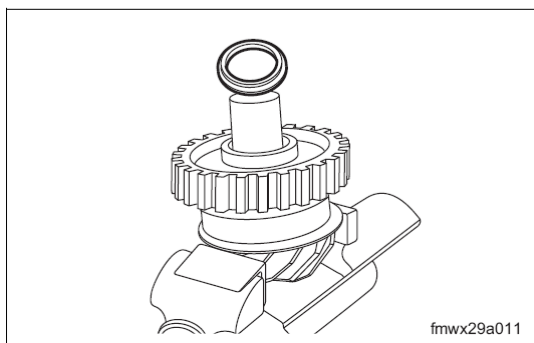
3. After cooling the bearing inner ring, put the outer ring and rollers in



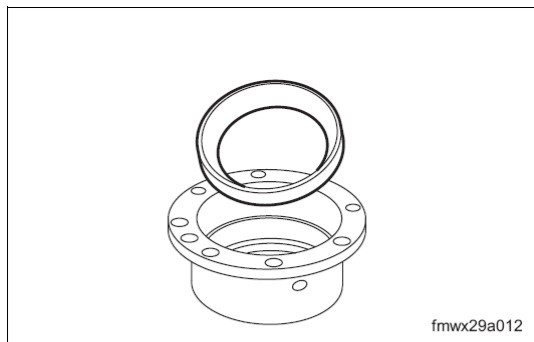
4. Put the gasket into the driving bevel gear shaft



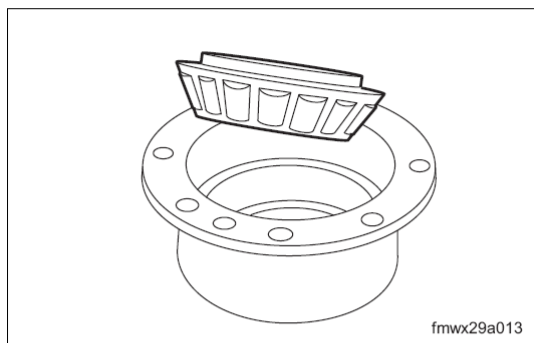
5. Preinstall the driving bevel gear shaft into the driven cylindrical drive gear



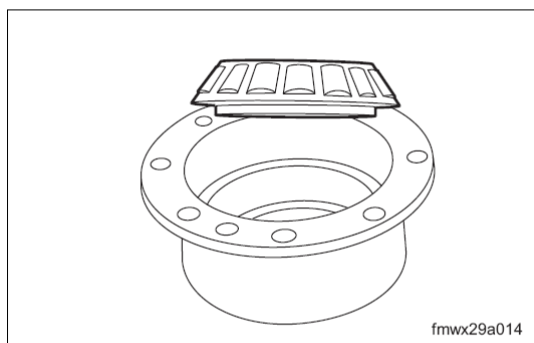
6. Put the spacer ring in the driving gear shaft



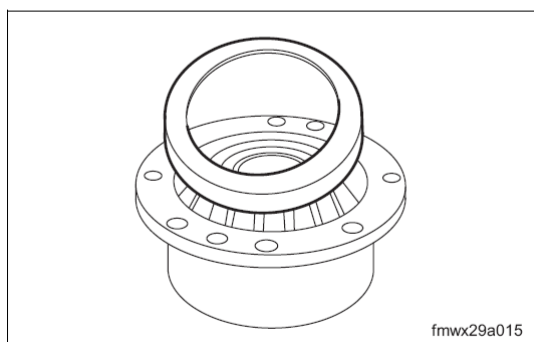
7. Press the bearing outer ring of the driving shaft in the bearing housing



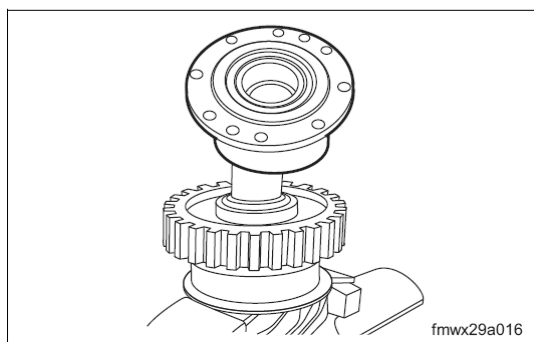
8. Install the inner bearing inner ring of the driving bevel gear



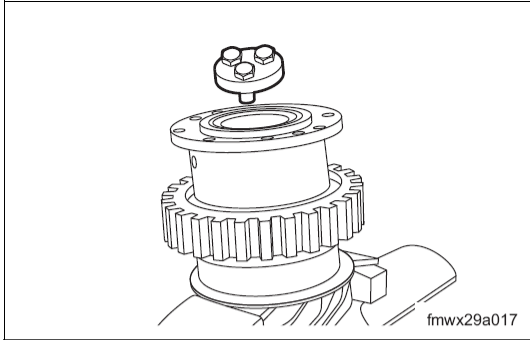
9. Install the outer bearing inner ring of the driving bevel gear



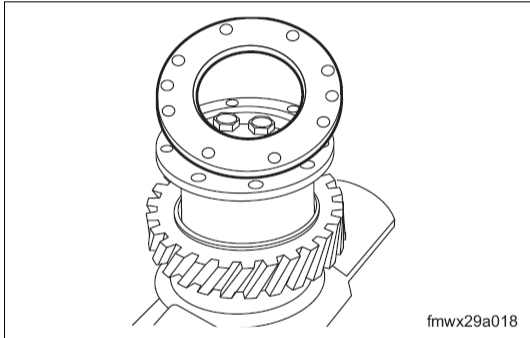
10. Press the outer bearing outer ring into the bearing seat



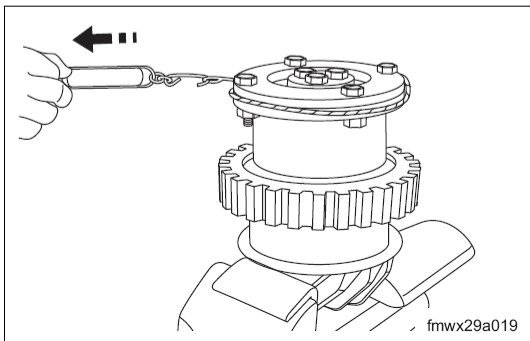
11. Install the bearing seat in the driving bevel gear shaft

Intermediate Axle (Steyr) – Intermediate Axle Assembly

- 12. Install the driving gear shaft baffle plate, and pretighten 3 fixing bolts**
Torque: 195N.m



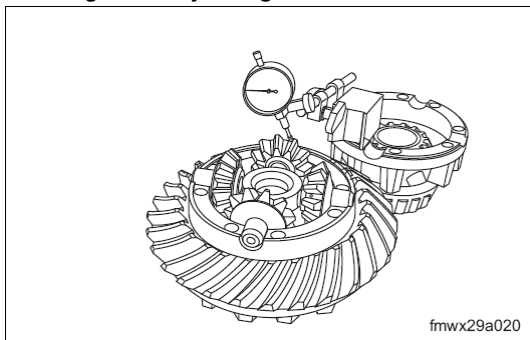
- 13. Preinstall the cover plate on the bearing seat**



- 14. Measure the rotational resistance torque with spring balance**
(a). The resistance torque shall be 0.5-2.5N.m, the reading of tensile force of the spring balance is 0.6-2.9kg. If not conforming to the standard, it is required to readjust the thickness of the gasket. If the resistance torque is too large, the gasket shall be thickened, and vice versa.

Adjustment tooth side clearance between planet gear and axle shaft gear of inter-axial differential and inter-wheel differential

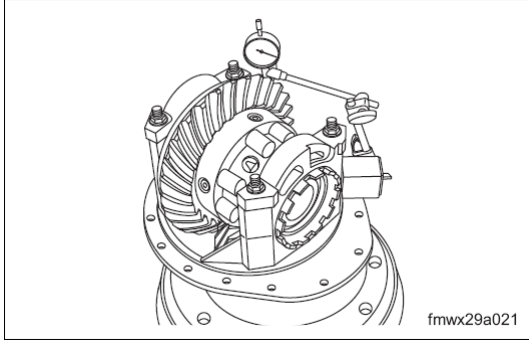
It can be measured by measuring the left and right flexible clearance of big tapered surface tooth top of the planet gear by using a dial indicator. The clearance is realized by measuring the each differential housing and adjusting the thickness of the axle shaft gear thrust gasket.



The tooth side clearance between the inter-axial differential planet gear and the axle shaft gear shall be 0.18-0.5mm.

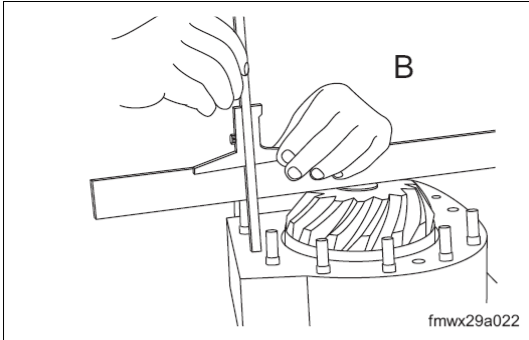
The tooth side clearance between the inter-wheel differential planet gear and the axle shaft gear shall be 0.1-0.5mm.

Adjustment of installation pretightening degree of inter-wheel differential

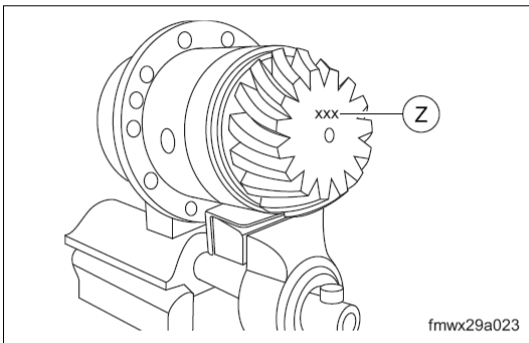


The installation pretightening of the inter-wheel differential bearing in the housing shall be realized by adjusting the torque of the slotted nut. Proper pretightening degree shall make the rotational resistance torque of the inter-wheel differential range 0.5-4.0N.m. This can be measured by pulling the string around the differential housing with a spring balance and observing the tensile force of the spring. This tensile force shall be 1.2-3.2kg.

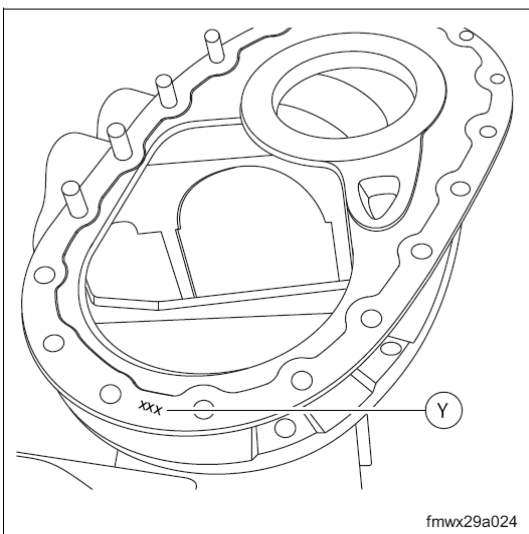
Adjustment of driving gear adjusting gasket



1. Actually measure the distance between the driving gear end face and the connecting plane with a depth indicator. For example, B=60mm



2. Observe that the driving gear end face is printed with Z=+0.2mm



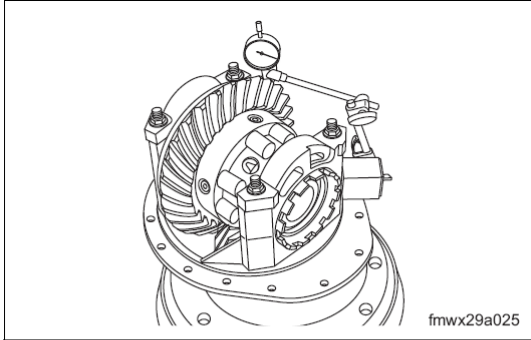
3. The connecting end face of the main reducer is printed with Y=-0.07mm

4. Work out the gasket thickness $X=(A\pm Z)+B-(L\pm Y)=102+0.2+60-(160-0.07)=2.27\text{mm}$

Intermediate Axle (Steyr) – Intermediate Axle Assembly

Adjustment of installation distance of driving gear and driven gear

The actual installation distance of the driving gear and the driven gear is realized by adjusting the connecting surface adjusting gasket between the bearing housing and the gap bridge box.

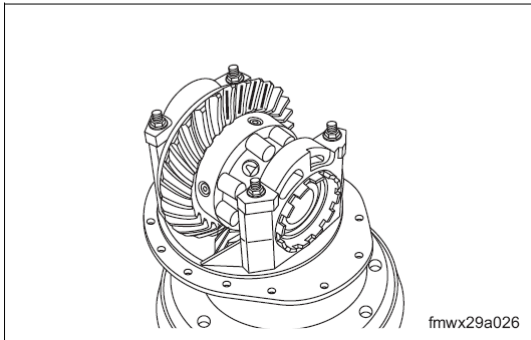


1. Measure the clearance of between the driving bevel gear and the driven bevel gear

Nominal value: 0.3-0.4mm

2. Adjust the bearing slotted nuts

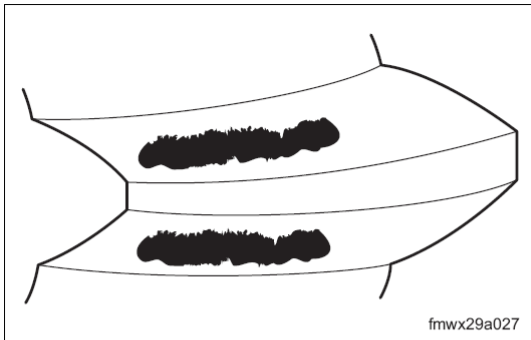
Caution: In order to ensure the pretightening degree of the adjusted bearing, take care that the left and right adjusting slotted nuts shall be adjusted synchronously and equally, i.e. the left slotted nut and the right slotted nut shall be loosened by the same angle (or number of turns). Thus, the left and right slotted nuts shall be marked before adjustment.



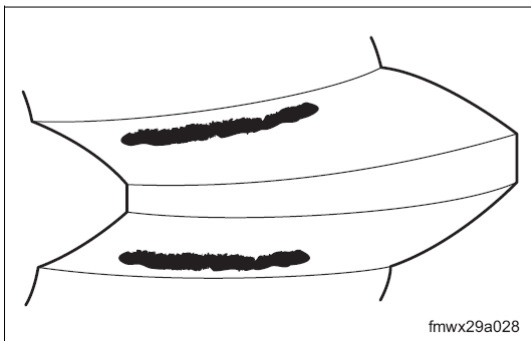
3. Check the tooth surface contact traces

- (a). Coat red lead oil or pigment on the tooth surface. Repeatedly rotate the driving and driven gears, and observe the tooth surface traces.

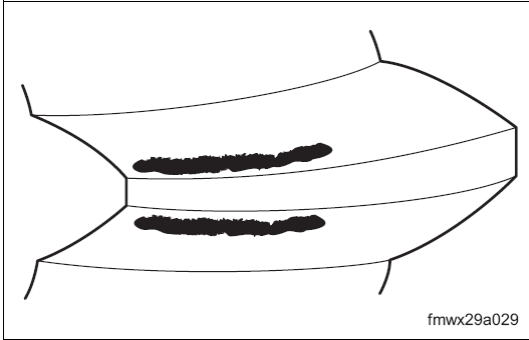
Caution: The test shall be carried out at 3 sites.



- The tooth surface contact traces are correct.



- If the tooth top contacts, the adjusting gasket X shall be thinned.



- If the tooth root contacts, the adjusting gasket X shall be thickened.

Axle Shaft

Overhaul

Hint:

Part Drawing, refer to Chapter 25, Rear Axle – Rear Axle Assembly, Part Drawing.

Refer to Chapter 25, Rear Axle – Axle Shaft, Overhaul

Hub Bearing Overhaul

Hint:

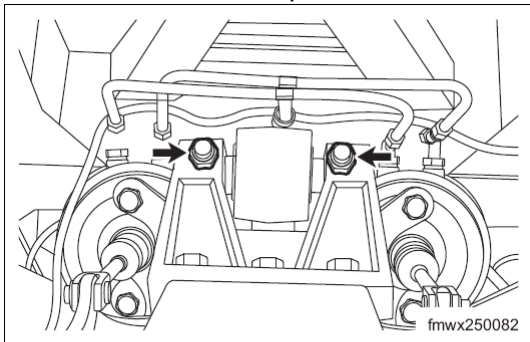
Part Drawing, refer to Chapter 25, Rear Axle – Rear Axle Assembly, Part Drawing.
Refer to Chapter 25, Rear Axle – Hub Bearing and Oil Seal, Overhaul

Intermediate Axle Assembly and Intermediate Axle Housing Overhaul

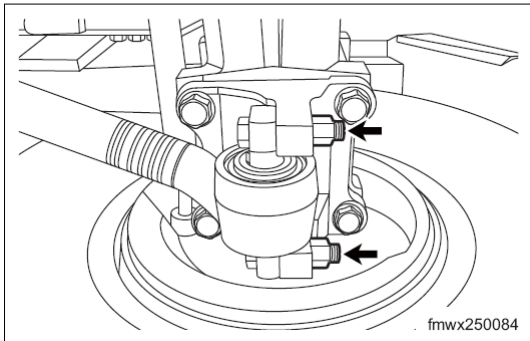
Hint:

Part Drawing, refer to Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly, Part Drawing.

1. **Lift the vehicle. Refer to Chapter 01, Introduction - Maintenance Guide, Vehicle Support Position**
2. **Disconnect the intermediate drive shaft. Refer to Chapter 33, Drive Shaft - Intermediate Drive Shaft, Overhaul**
3. **Disconnect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul**
4. **Dismantle tires. Refer to Chapter 23 Wheel & Tire - Rear Wheel and Tire, Overhaul**
5. **Dismantle the rear brake chamber assembly. Refer to Chapter 26, Service Brake - Rear Brake Chamber, Overhaul**

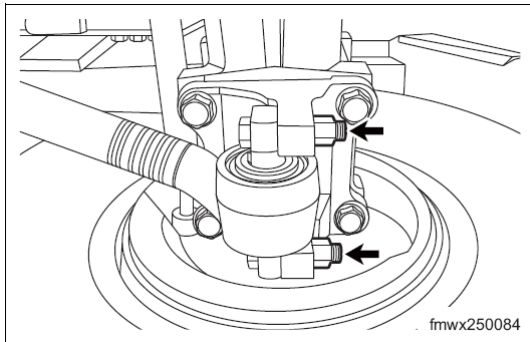


6. **Dismantle the intermediate axle assembly**
 - (a). Disconnect the differential lock air pipe.
 - (b). Disconnect the differential lock switching wiring harness connector.
 - (c). Dismantle the upper thrust rod.

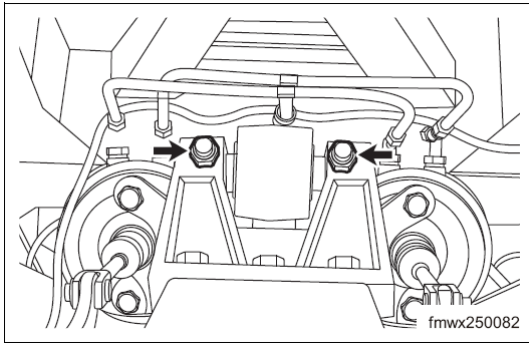


- (d). Dismantle the lower thrust rod.
 - (e). Dismantle the leaf spring U-bolt.
 - (f). Put down the intermediate axle assembly with a jack, and draw it out.

7. **Check the intermediate axle housing for crack, wear and corrosion**



8. **Install the intermediate axle assembly**
 - (a). Put the intermediate axle assembly below the vehicle and lift it with a jack.
 - (b). Install the leaf spring U-bolt.
 - (c). Install the lower thrust rod.



- (d). Install the upper thrust rod.
- (e). Connect the differential lock switching wiring harness connector.
- (f). Connect the differential lock air pipe.

- 9. **Install the rear brake chamber assembly. Refer to Chapter 26, Service Brake - Rear Brake Chamber, Overhaul**
- 10. **Install the tires. Refer to Chapter 23 Wheel & Tire - Rear Wheel and Tire, Overhaul**
- 11. **Connect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul**
- 12. **Connect the intermediate drive shaft. Refer to Chapter 33, Drive Shaft - Intermediate Drive Shaft, Overhaul**

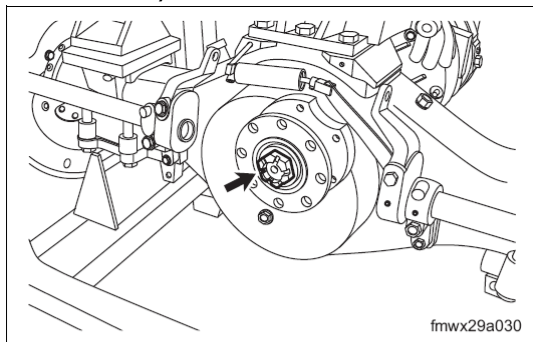
Through Shaft

Overhaul

Hint:

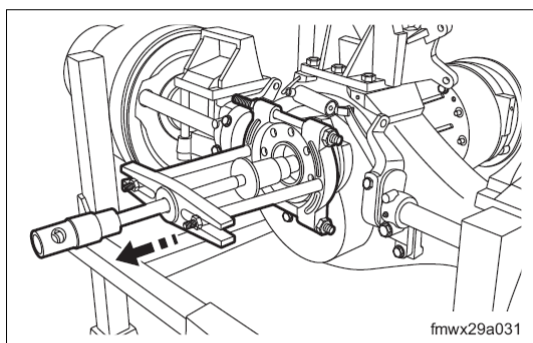
Part Drawing, refer to Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly, Part Drawing.

1. **Disconnect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul**

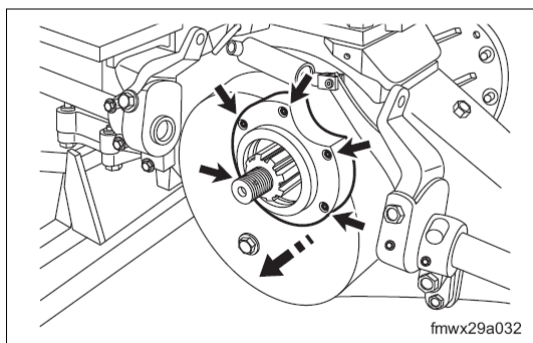


2. **Dismantle the through shaft**

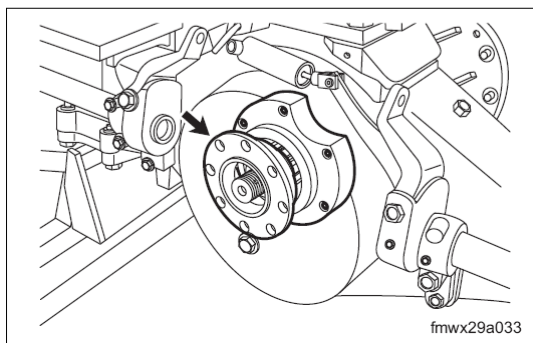
- (a). Dismantle the through shaft output flange.
 - Dismantle the flange nut.



- (b). Pull out the driving flange with a puller.

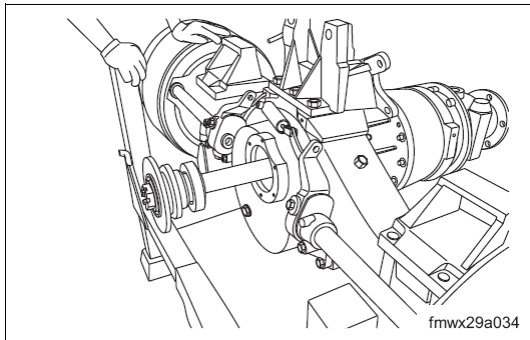


- (c). Dismantle the through shaft bearing end cover.



- (d). Install the through shaft output flange.

Intermediate Axle (Steyr) – Through Shaft



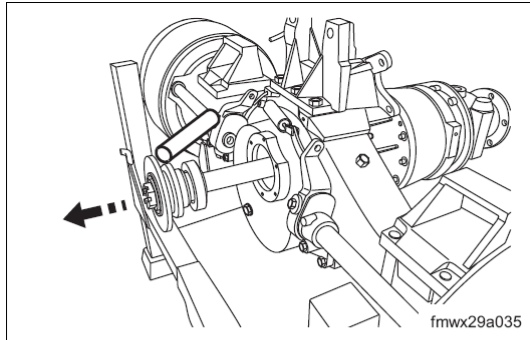
- (e). Knock the through shaft and block bearing out of the axle housing with a copper rod.
- Draw the through shaft out.

3. Check the through shaft

- Check the spline for damage.
- Check the bearing for damage.

Caution:

If damaged, replace with a new axle shaft or bearing.

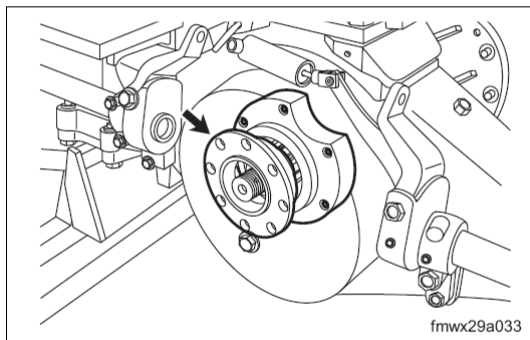


4. Install the through shaft

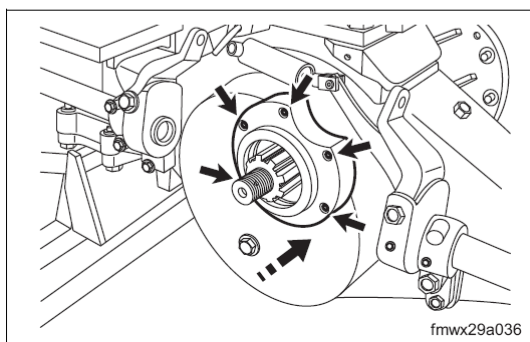
- (a). Knock the through shaft and block bearing into the axle housing with a copper rod.
- Insert the through shaft.

Caution:

Do not use a hammer.



- (b). Dismantle the through shaft output flange.



- (c). Install the through shaft bearing end cover.

Caution:

Before installation, clean the contact surface, and spread 598 flange sealant.

- Install the flange nut.

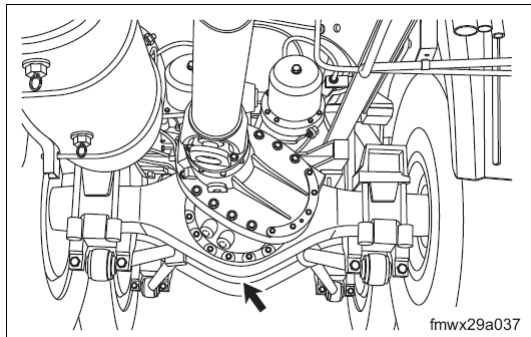
Torque: 210N.m

5. Connect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul

Inter-axial Differential Overhaul

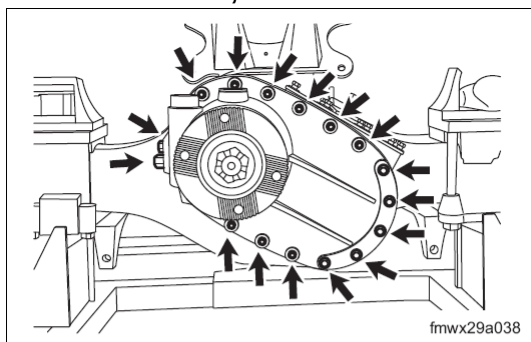
Hint:

Part Drawing, refer to Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly, Part Drawing.

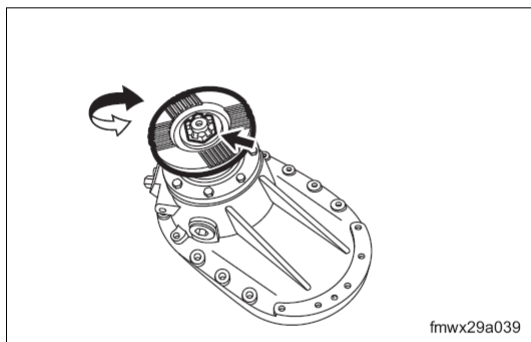


1. **Drain the gear oil**
 - (a). Loosen the bottom oil drain bolt.

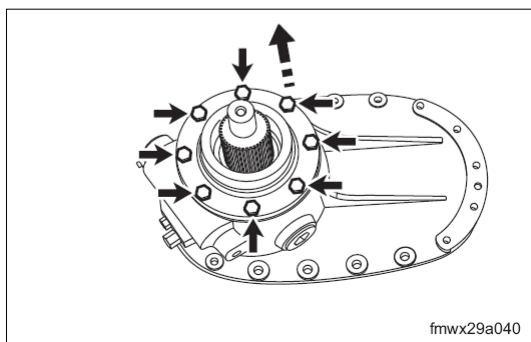
2. **Disconnect the intermediate drive shaft. Refer to Chapter 33, Drive Shaft - Intermediate Drive Shaft, Overhaul**



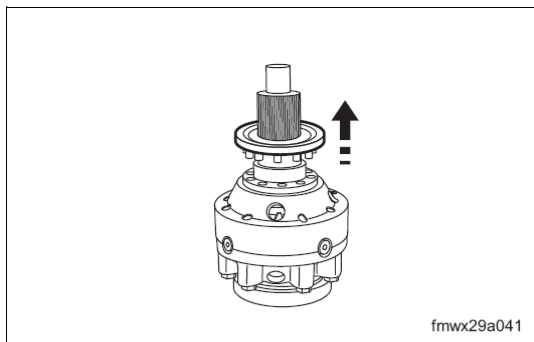
3. **Dismantle the input shaft housing**
 - (a). Dismantle the input shaft housing fixing nut.
 - (b). Dismantle the input shaft housing.



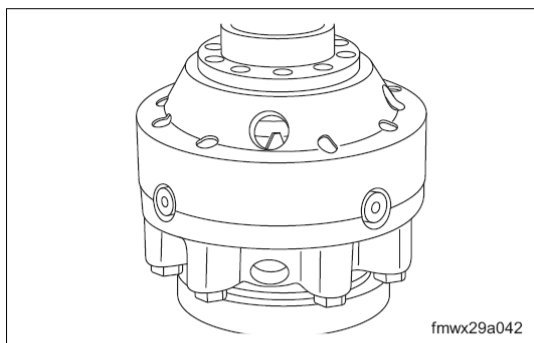
4. **Dismantle the flange**
 - (a). Dismantle the flange nut cotter pin.
 - (b). Loosen the flange nut.



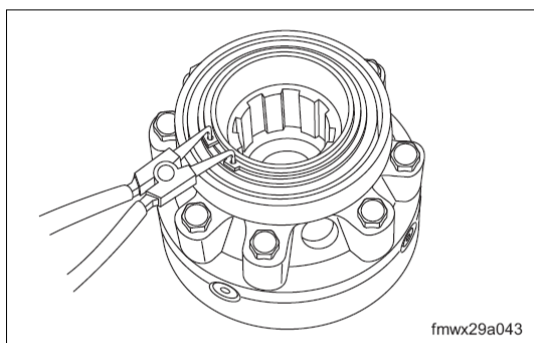
5. **Dismantle the inter-axial differential**
 - Dismantle the bearing end cover



6. Dismantle the differential lock pin slide sleeve

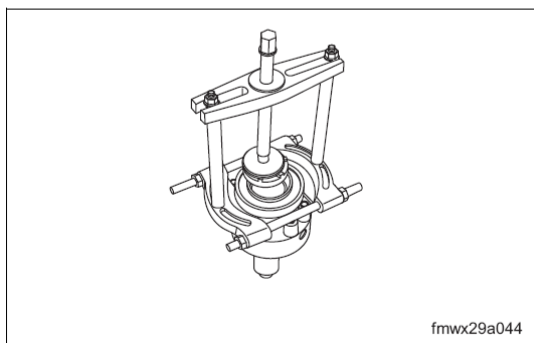


7. Check the differential housing for assembling mark. If there is no assembling mark, reprint the assembling mark on the two differential housing halves.

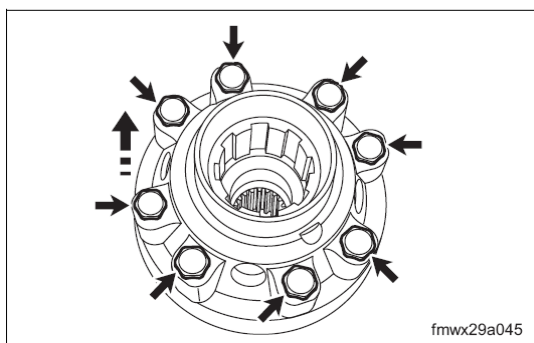


8. Dismantle the bearing

(a). Dismantle the rear bearing locating snap ring of the inter-axial differential.



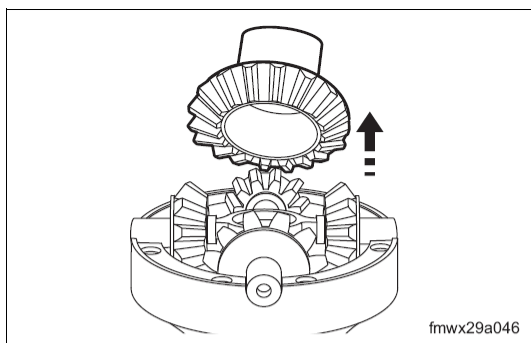
(b). Dismantle the rear bearing of the inter-axial differential with a puller.



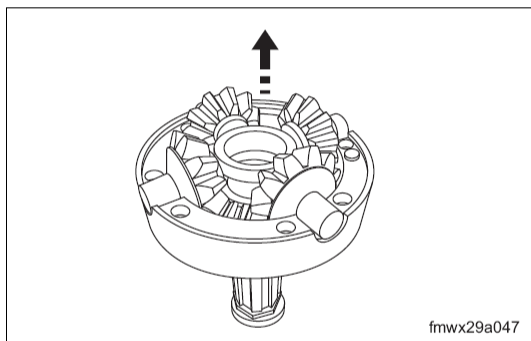
9. Dismantle the differential housing

(a). Dismantle the differential housing connecting bolts.

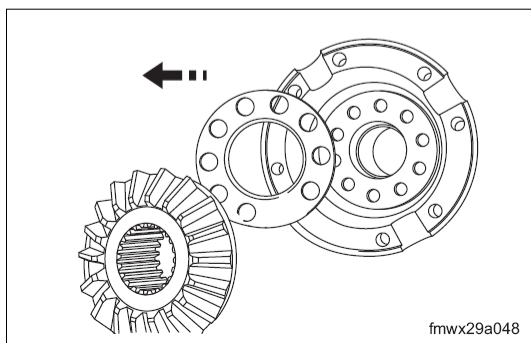
Intermediate Axle (Steyr) – Inter-axial Differential



10. Take out the axle shaft gear



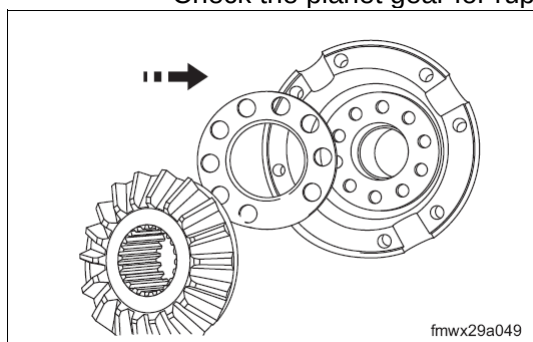
11. Take out the planet gear



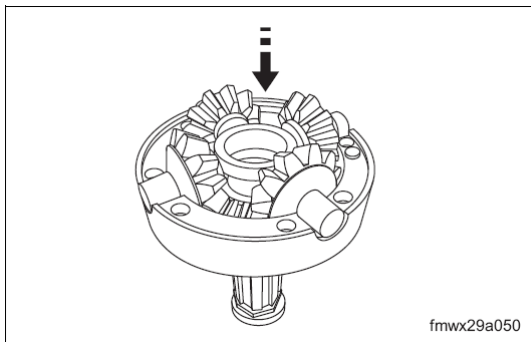
12. Dismantle the axle shaft gear and adjusting gasket

13. Check the differential housing, axle shaft gear and planet gear

- Check the differential housing for crack.
- Check the axle shaft gear for rupture, wear, pitting, gluing and plastic deformation.
- Check the planet gear for rupture, wear, pitting, gluing and plastic deformation.



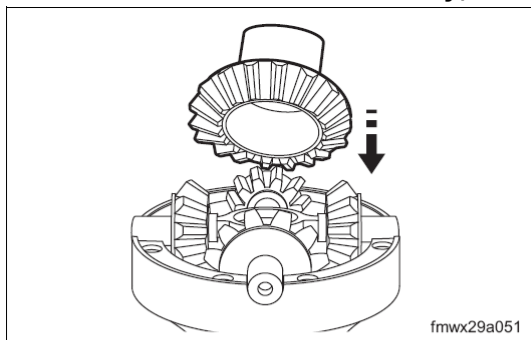
14. Install the axle shaft gear and adjusting gasket



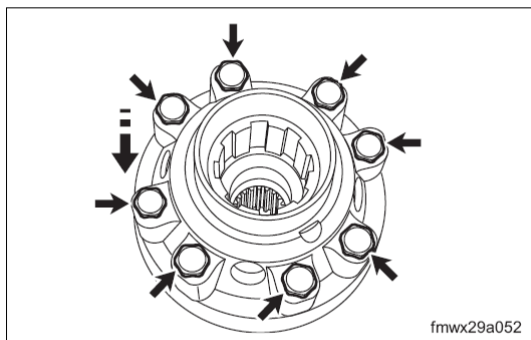
15. Install the planet gear

Caution: slightly knock the cross shaft with a copper rod to eliminate false clearance.

16. Measure the tooth side clearance. Refer to Chapter 29A, Intermediate Axle (Steyr) - Intermediate Axle Assembly, Test and Adjustment

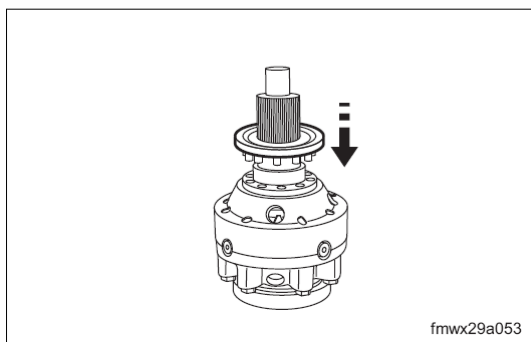


17. Install the axle shaft gear



18. Install the differential housing connecting bolts

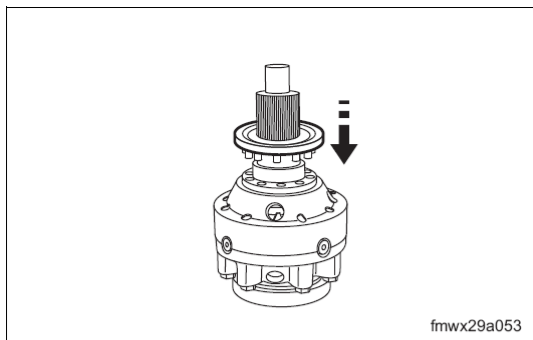
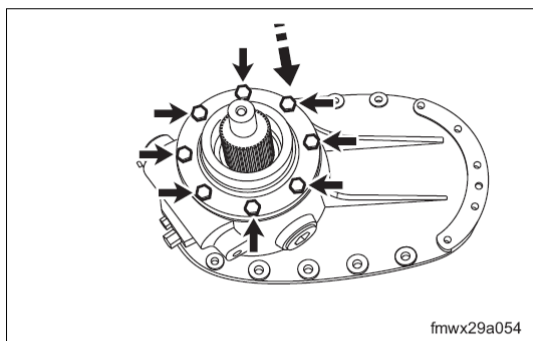
Caution: Before tightening the bolts, apply 262 thread lock on the bolts, and the bolts shall be tightened diagonally.



19. Install the bearing

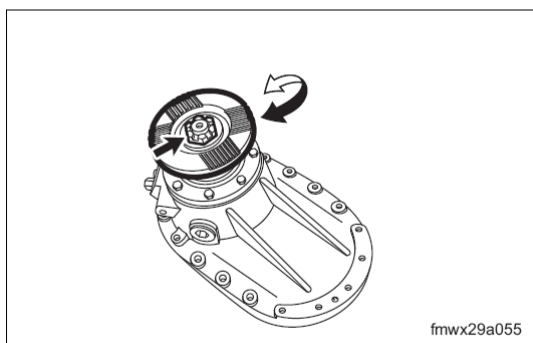
- (a). Install the inter-axial differential rear bearing.
- (b). Install the rear bearing locating snap ring of the inter-axial differential.

Intermediate Axle (Steyr) – Inter-axial Differential

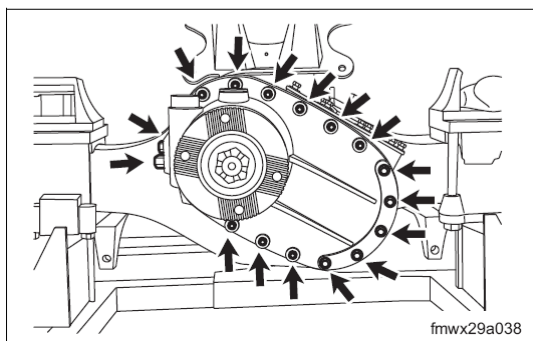
**20. Install the differential lock pin slide sleeve****21. Install the inter-axial differential**

- Install the bearing end cover

Caution: Apply 598 flange sealant on the end face of the bearing cap.

**22. Install the flange**

- Install the flange nut.
Torque: 775±25N.m
- Install the flange nut cotter pin.

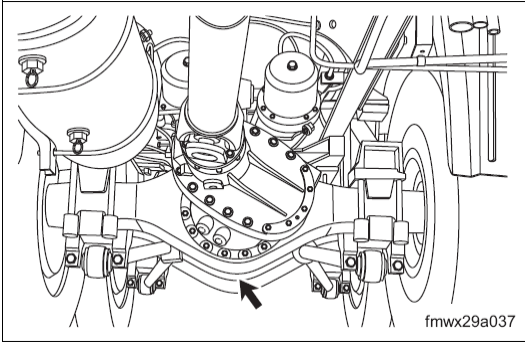
**23. Install the input shaft housing**

- Install the input shaft housing.
- Install the input shaft housing fixing nut.

Caution:

Apply 598 flange sealant on the connecting plane of the gap bridge box.

24. Connect the intermediate drive shaft. Refer to Chapter 33, Drive Shaft - Intermediate Drive Shaft, Overhaul



- 25. Add gear oil**
(a). Tighten the bottom oil drain bolt.

Main Reducer

Overhaul

Hint:

Part Drawing, refer to Chapter 29A, Intermediate Axle (Steyr) – Front Mounting Assembly, Part Drawing.

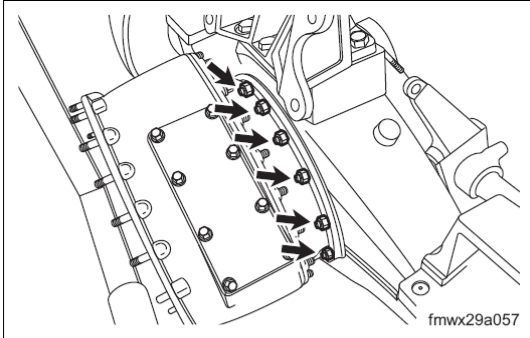
1. **Dismantle the inter-axial differential. Refer to Chapter 29A, Intermediate Axle (Steyr) - Inter-axial Differential, Overhaul**
2. **Dismantle the gap bridge box assembly. Refer to Chapter 29A, Intermediate Axle (Steyr) - Driving Gear and Bearing, Overhaul**
3. **Dismantle the driving gear. Refer to Chapter 29A, Intermediate Axle (Steyr) - Driving Gear and Bearing, Overhaul**
4. **Dismantle the driven gear. Refer to Chapter 29A Intermediate Axle (Steyr) - Inter-wheel Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul**
5. **Check the main reducer**
 - Check the driving gear for rupture, wear, pitting, gluing and plastic deformation.
 - Check the driven gear for rupture, wear, pitting, gluing and plastic deformation.
6. **Install the driven gear. Refer to Chapter 29A Intermediate Axle (Steyr) - Inter-wheel Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul**
7. **Install the driving gear. Refer to Chapter 29A, Intermediate Axle (Steyr) - Driving Gear and Bearing, Overhaul**
8. **Install the gap bridge box assembly. Refer to Chapter 29A, Intermediate Axle (Steyr) - Driving Gear and Bearing, Overhaul**
9. **Install the inter-axial differential. Refer to Chapter 29A, Intermediate Axle (Steyr) - Inter-axial Differential, Overhaul**

Driving Gear and Bearing Overhaul

Hint:

Part Drawing, refer to Chapter 29A, Intermediate Axle (Steyr) - Intermediate Axle Assembly, Part Drawing.

1. Dismantle the inter-axle differential. Refer to Chapter 29A, Intermediate Axle (Steyr) - Inter-axle Differential, Overhaul



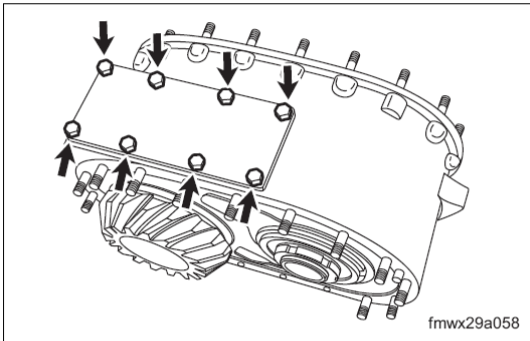
2. Dismantle the gap bridge box assembly

- (a). Draw out the axle shaft. Refer to Chapter 25 Rear Axle - Axle Shaft, Overhaul

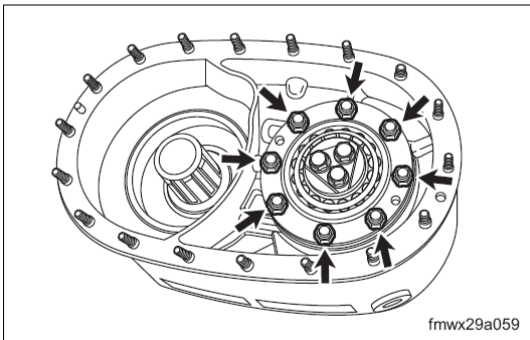
Caution: Before dismantling the intermediate axle gap bridge box, do not draw out the whole axle shaft on the end provided with the differential lock, otherwise, the falling mesh sleeve may check the differential, so that the intermediate axle gap bridge box can not be drawn out of the axle housing.

- (b). Loosen the connecting bolts of the gap bridge box assembly and axle housing.

3. Dismantle the oil baffle plate

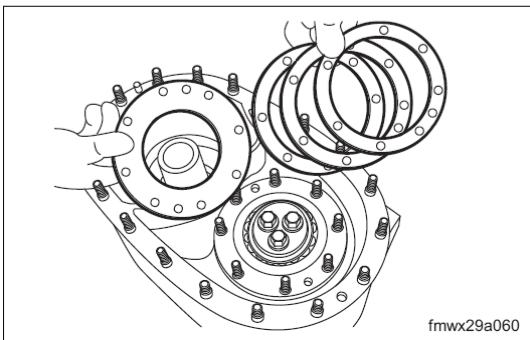


4. Dismantle the fixing bolts and nuts of the gap bridge box driving gear bearing seat

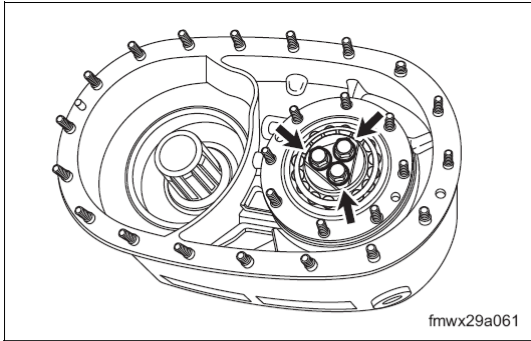


5. Take out the bearing seat end cover and end cover adjusting gasket

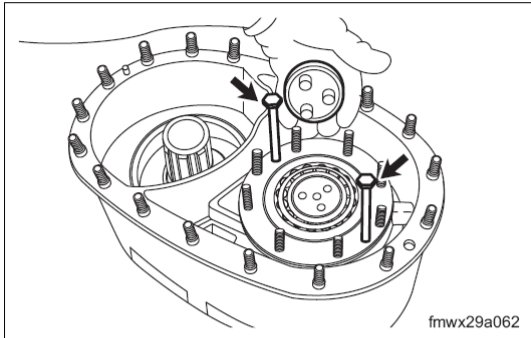
Caution: Keep the adjusting gasket. The adjusting gasket is installed on the connecting surface between the end cover and the bearing seat, and can adjust the pretightening degree of the driving gear bearing. Before reassembling, if there is no part for replacement, the original gasket can be installed. The thickest gasket shall be put at the bottom.



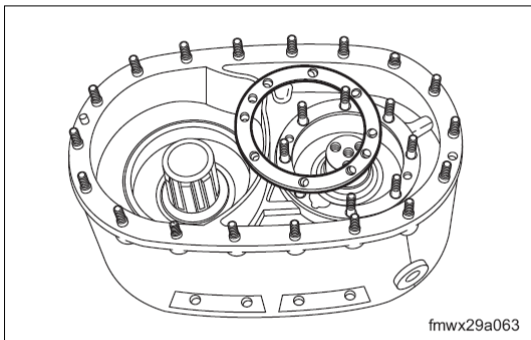
Intermediate Axle (Steyr) – Driving Gear and Bearing



6. **Dismantle the baffle plate of the driving bevel gear bearing**
 - (a). Loosen the baffle plate locking plate of the driving bevel gear bearing.



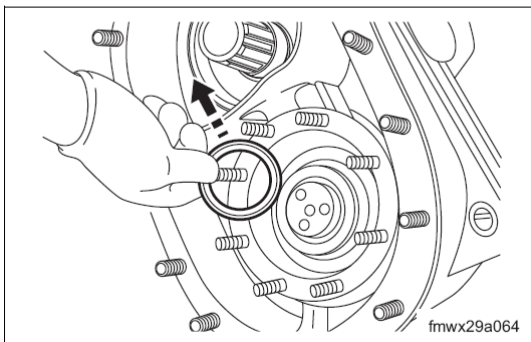
7. **Push out the bearing seat with two bolts, and take out the bearing seat.**



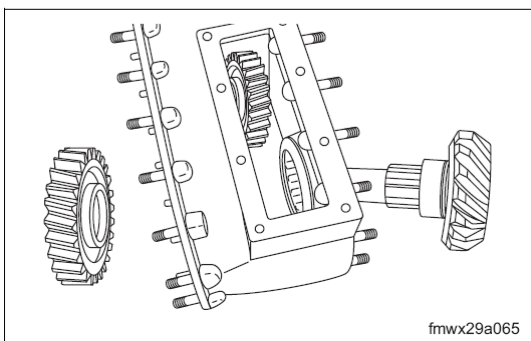
8. **Take out the adjusting gasket of the driving gear**

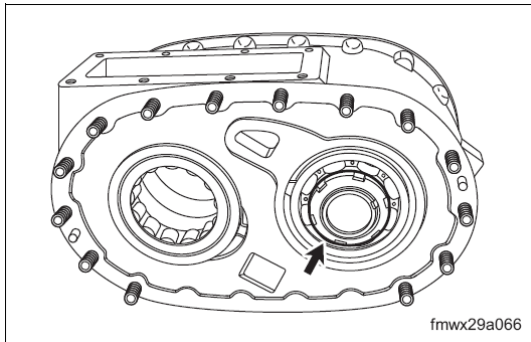
Caution: The gasket is installed on the connecting surface of the bearing seat and the gap bridge box, and can adjust the installation distance of the driving gear. If no part is replaced during reinstallation, the old adjusting gasket is still available. If any of the driving gear shaft, bearing, bearing seat or gap bridge box housing is replaced during reassembly, the thickness of the gasket must be recalculated and readjusted to determine the correct installation distance of the driving gear, thereby ensuring the mesh quality of the driving and driven bevel gears.

9. **Dismantle the spacer**



10. **Dismantle the driving bevel gear shaft, and take out the driven cylindrical gear and spacer**



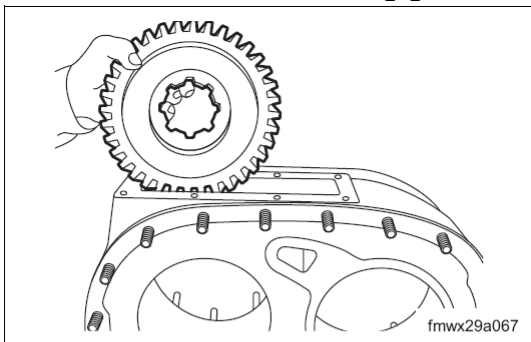


- 11. Take out the hollow shaft and gear**
- (a). Dismantle the hollow shaft locking plate.
 - (b). Dismantle the slotted nut.

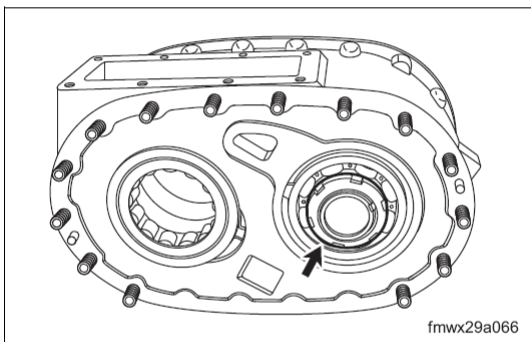
12. Check the driving gear and bearing

- Check the driving gear for rupture, wear, pitting, gluing and plastic deformation.
- Check the bearing for wear, deformation and ablation.

13. Redismantle the driving gear shaft

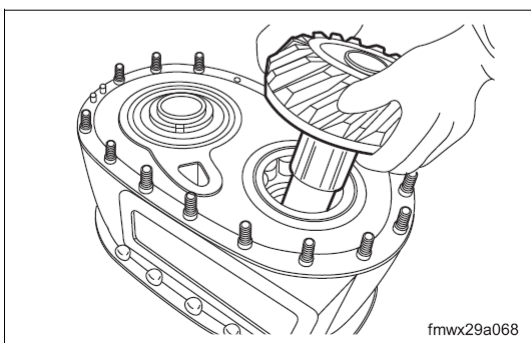


- 14. Put the driving cylindrical gear in the gap bridge box, and insert the hollow shaft**



15. Put the driven cylindrical gear in the gap bridge box

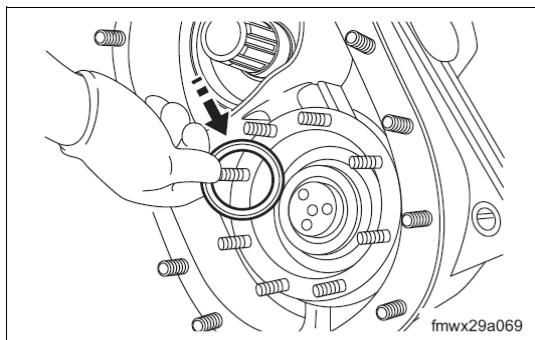
- (a). Tighten the slotted nut of the driving cylindrical gear.
 - (b). Lock the slotted nut with a locking gasket.
- Torque: 300N.m**



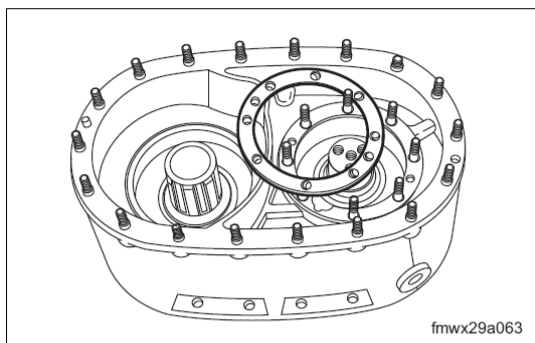
16. Clamp the snap ring with hand tongs, and slightly knock the driving bevel gear assembly into the gap bridge box.

- (a). Put the bearing locating snap ring into the bearing groove.

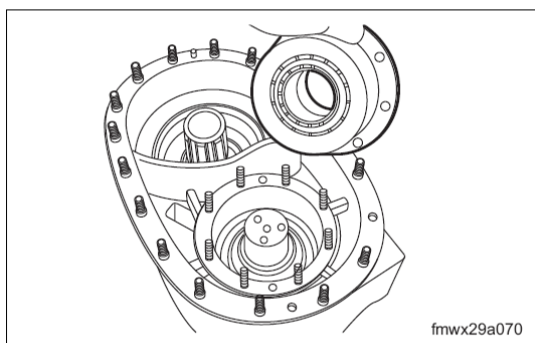
Intermediate Axle (Steyr) – Driving Gear and Bearing



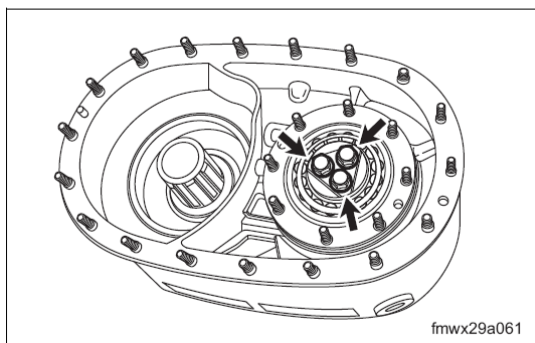
17. Install the spacer



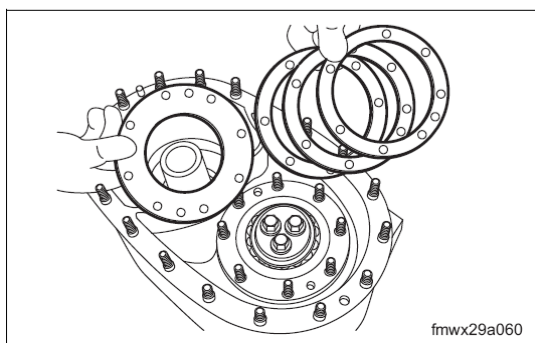
18. Install the adjusting gasket



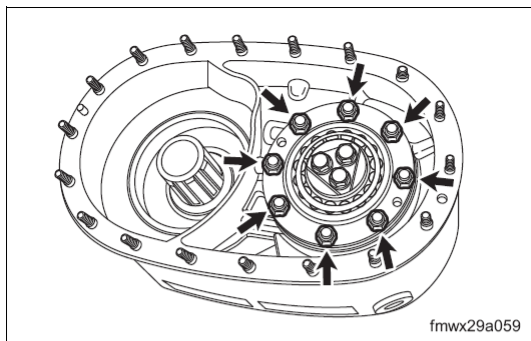
19. Install the driving bevel gear bearing seat



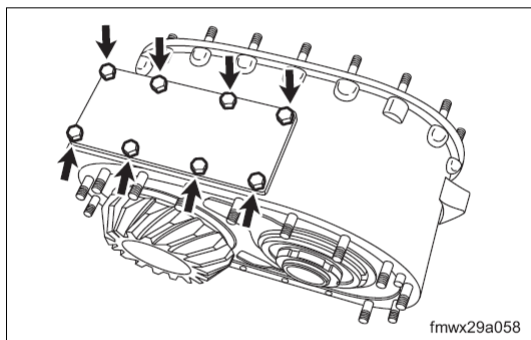
20. Install the baffle plate of the driving bevel gear shaft to lock the locking plate
Torque: 180N.m



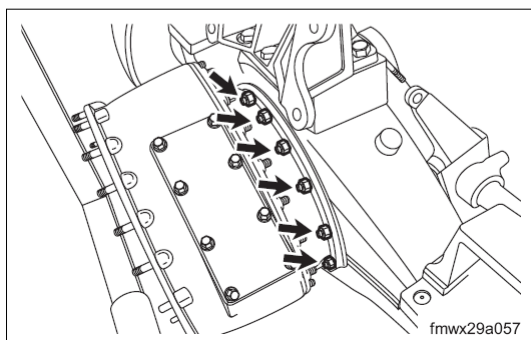
21. Install the adjusted bearing cover plate adjusting gasket



22. Install the bearing cover plate, and tighten the fixing bolts.



23. Install the oil baffle plate



24. Install the gap bridge box assembly

25. Install the inter-axial differential. Refer to Chapter 29A, Intermediate Axle (Steyr) - Inter-axial Differential, Overhaul

Intermediate Axle (Benz)

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29B

Intermediate Axle Assembly

General

Refer to Chapter 29, Intermediate Axle (Benz) - Intermediate Axle Assembly, General

Precautions

1. **Replacement of brake friction plate:** The friction plates on one axle must have the same specification, and be made of the same material and produced from one manufacturer. The brake friction plates at the two ends shall be replaced at the same time.
2. **During maintenance of the axle assembly with differential lock,** the axle shaft on the side with the differential lock can be taken out only after closing the differential lock, otherwise, the mesh sleeve will fall off, and the main reducer assembly must be taken down.
3. **Use of differential lock:** The differential lock shall only be closed after cutting off the clutch when the vehicle is at the speed of 10-15km/h. At this time, the indicator lamp is on, and the vehicle can only run straightly. It is forbidden to make a turn, for this will break the differential gear.

Fault Symptom Table

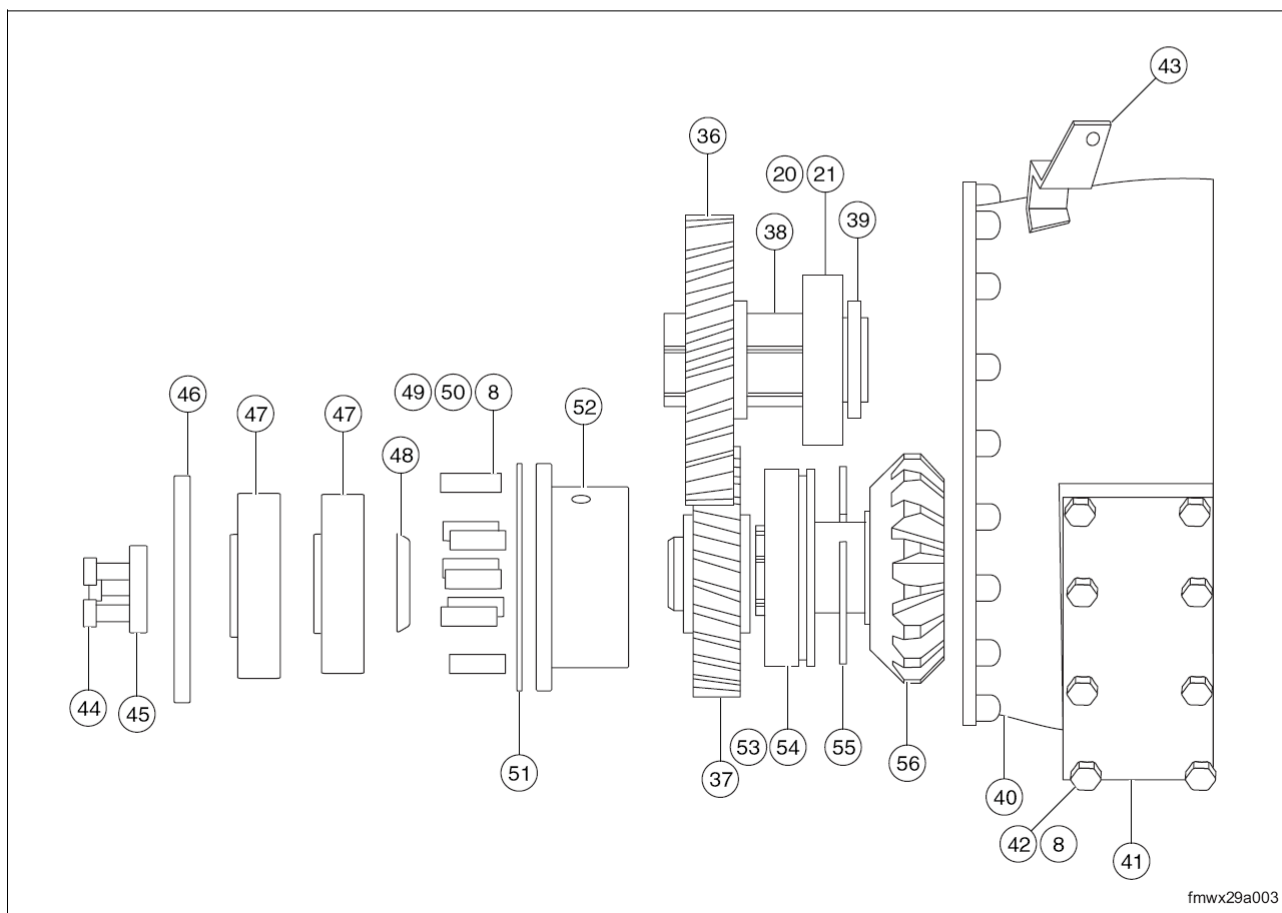
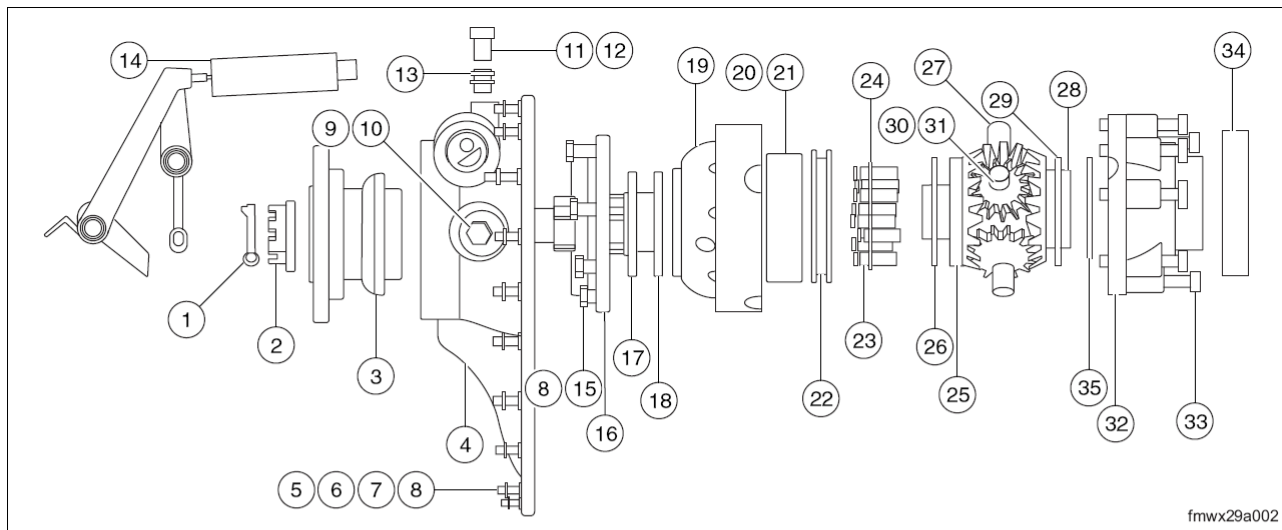
Use the table below to help you find the cause of the malfunction. Sequence number indicates the probability of the cause of the malfunction. Inspect each part in order. If necessary, replace these parts.

Symptom	Possible Position	Reference
Burn-out of inter-axial differential	1. Lack of oil	Add proper lubricating oil
	2. Different speed ratios of intermediate axle and rear axle	Select intermediate axle and rear axle at proper speed ratio
Abnormal sound of axle	1. Fixing bolt of driven cylindrical bevel gear (falling off or loosening)	Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Main Reducer, Overhaul
	2. Gear (damaged, the gap is too big or small)	Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Assembly, Test and Adjustment
	3. Tooth back (strain or pitting)	Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Main Reducer, Overhaul
	4. Bearing (falling apart, pitting)	Chapter 29A, Intermediate Axle (Benz) – Gap Bridge Box Assembly, Overhaul Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Main Reducer, Overhaul
	5. Differential lock mesh sleeve (shift)	Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Main Reducer, Overhaul
	6. Differential gear (burn-out)	Chapter 29A, Intermediate Axle (Benz) – Gap Bridge Box Assembly, Overhaul
	7. Cylindrical bevel gear (deviation of contact site of tooth surface)	Chapter 29A, Intermediate Axle – Intermediate Axle Main Reducer, Overhaul
	8. Spline shaft, hole (loosening)	Chapter 29A, Intermediate Axle (Benz) – Gap Bridge Box Assembly, Overhaul
Heating of axle	1. Lack of oil	Add proper lubricating oil
	2. Too much lubricating oil	Discharge excessive lubricating oil
	3. Excessive pretightening of bearing	Chapter 29A, Intermediate Axle (Benz) – Intermediate Axle Assembly, Test and Adjustment
Oil leakage	1. Oil seal (damaged)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	2. Oil seal outer ring (loosening)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	3. Vent hole (blocked)	Dredge the vent hole

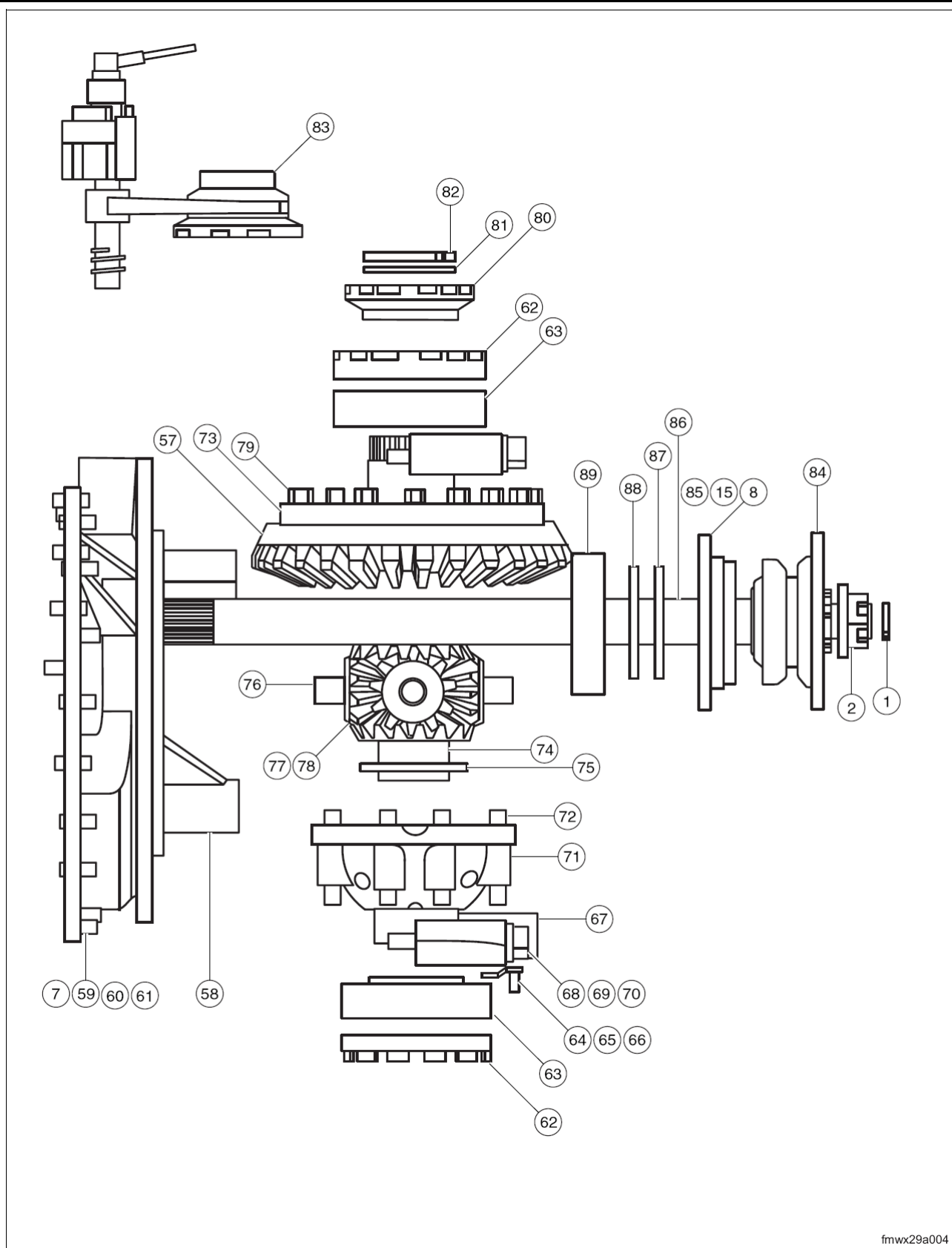
Intermediate Axle (Benz) – Intermediate Axle Assembly

Symptom	Possible Position	Reference
Wear of tire	1. Steel ring (deformed)	Chapter 23A, Tire & Wheel – Rear Tire and Wheel, Overhaul
	2. Axle end bearing (loosening)	Chapter 25A, Rear Axle – Hub Bearing and Oil Seal, Overhaul
	3. Gas pressures of double rows of tires (too much difference)	Check the tire pressure, and inflate or deflate
	4. Balance shaft sleeve (wear, loosening)	Replace the balance shaft sleeve
	5. Rubber support of balance suspension push rod (damaged)	Chapter 25A, Rear Axle – Rear Axle Assembly and Rear Axle Housing, Overhaul
	6. Balance shaft push rod bracket and axle housing (snap of welding)	Replace the connection of balance shaft push rod bracket and axle housing

Part Drawing



Intermediate Axle (Benz) – Intermediate Axle Assembly



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Intermediate Axle (Benz) – Intermediate Axle Assembly

1	Cotter Pin
2	Flange Nut
3	Middle Front Flange Assy.
4	Gap Bridge Box Cover
5	Stud Bolt
6	Hex Nut, Style I
7	Cylindrical Pin
8	Spring Washer
9	Oil Filler Plug
10	Sealing Washer
11	Hex Head Bolt
12	Hex Nut, Style II
13	Pressure Switch
14	Differential Lock Assy.
15	Hex Head Bolt
16	End Cover, Bearing Cover
17	Shaft O-ring
18	Shaft O-ring
19	Front Differential Housing
20	Radial Ball Bearing
21	Steel Wire Circlip
22	Inter-axial Differential Gasket
23	Differential Lock Pin
24	Differential Lock Ring
25	Front Axle Shaft Gear
26	Front Gasket, Axle Shaft Gear
27	Differential Cross Shaft
28	Rear Axle Shaft Gear
29	Rear Gasket, Axle Shaft Gear
30	Planet Gear
31	Planet Gear Gasket
32	Rear Differential Housing
33	Hex Head Bolt

46	Pressure Plate, Bearing Outer Ring
47	Tapered Roller Bearing
48	Spacer
49	Stud Bolt
50	Hex Nut
51	Adjusting Gasket
52	Bearing Seat
53	Roller Bearing
54	Round Wire Snap Ring
55	Oil Retainer
56	Driving Bevel Gear
57	Driven Bevel Gear
58	Main Reducer Housing
59	Stud Bolt
60	Hex Nut, Style II
61	Spring Washer
62	Adjusting Nut
63	Single-row Tapered Roller Bearing
64	Locking Plate
65	Hex Head Bolt
66	Spring Washer
67	Differential Bearing Cover
68	Stud Bolt
69	Hex Nut, Style I
70	Cylindrical Pin
71	RH Differential Housing
72	Hex Head Bolt
73	LH Differential Housing
74	Axle Shaft Gear
75	Washer, axle shaft gear
76	Cross Shaft
77	Planet Gear
78	Planet Gear Gasket

Intermediate Axle (Benz) – Intermediate Axle Assembly

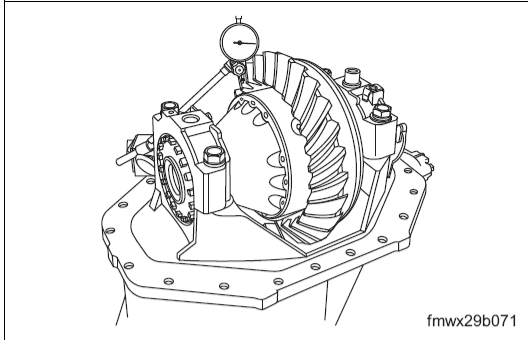
34	Radial Ball Bearing
35	Round Wire Snap Ring for Shaft
36	Driving Cylindrical Gear
37	Driven Cylindrical Gear
38	Hollow Shaft
39	Slotted Nut
40	Gap Bridge Box
41	Oil Baffle Plate Assy.
42	Hex Head Bolt
43	Bracket Assy.
44	Hex Head Bolt
45	Bearing Pressure Plate

79	Hex Head Bolt
80	Fixing Mesh Sleeve
81	Locking Gasket
82	Round Nut
83	Differential Lock Assy.
84	Middle Rear Flange Assy.
85	Oil Seal Seat
86	Through Shaft
87	Sealing Ring
88	Sealing Ring
89	Deep Groove Ball Bearing

Test and Adjustment

Adjustment of installation distance of driving gear and driven gear

The actual installation distance of the driving gear and the driven gear is realized by adjusting the connecting surface adjusting gasket between the bearing housing and the gap bridge box.

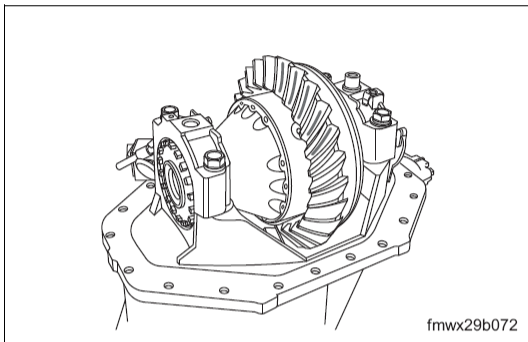


1. Measure the clearance of between the driving bevel gear and the driven bevel gear

Nominal value: 0.3-0.4mm

2. Adjust the bearing slotted nuts

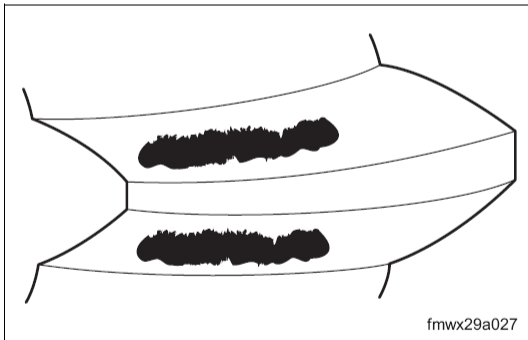
Caution: In order to ensure the pretightening degree of the adjusted bearing, take care that the left and right adjusting slotted nuts shall be adjusted synchronously and equally, i.e. the left slotted nut and the right slotted nut shall be loosened by the same angle (or number of turns). Thus, the left and right slotted nuts shall be marked before adjustment.



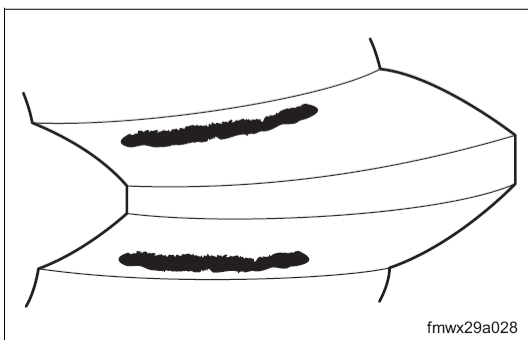
3. Check the tooth surface contact traces

- (a). Coat red lead oil or pigment on the tooth surface. Repeatedly rotate the driving and driven gears, and observe the tooth surface traces.

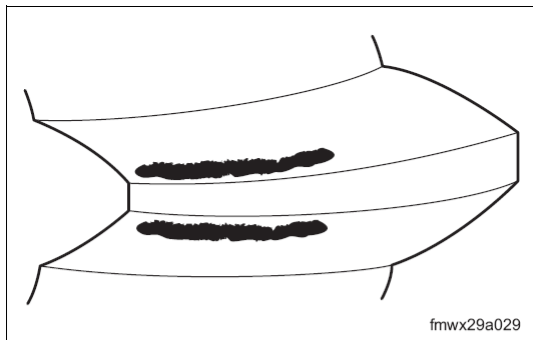
Caution: The test shall be carried out at 3 sites.



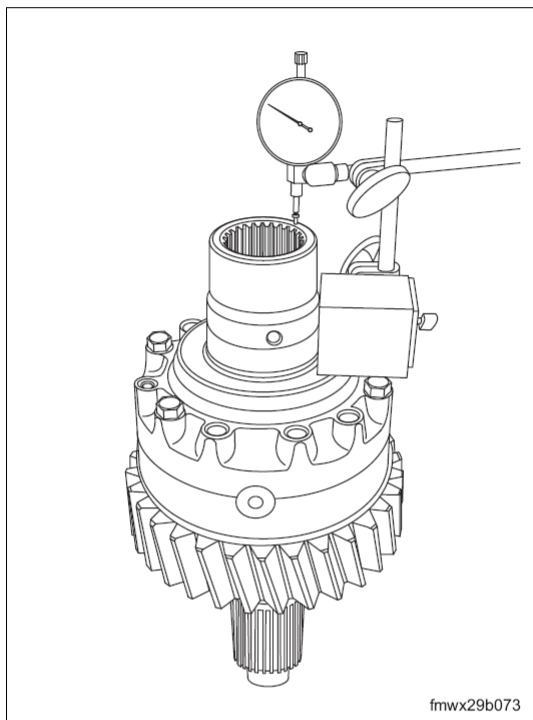
- The tooth surface contact traces are correct.



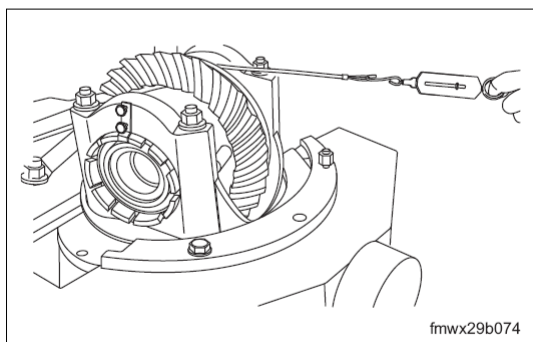
- If the tooth top contacts, the adjusting gasket X shall be thinned.

Intermediate Axle (Benz) – Intermediate Axle Assembly

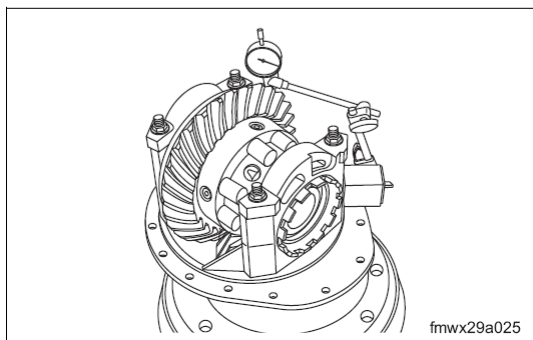
- If the tooth root contacts, the adjusting gasket X shall be thickened.



4. Measure the mesh clearance between the planet gear and the axle shaft gear with a dial indicator

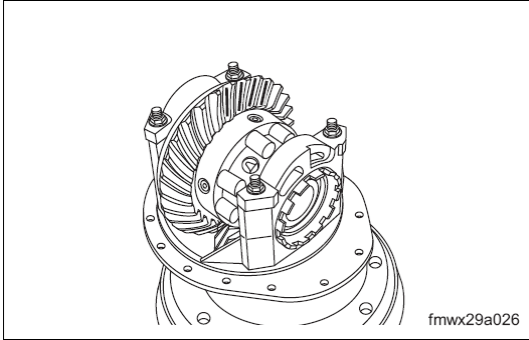


5. Measure the rotational tensile force with a spring balance
Rotational tensile force: 1.6-4.2kg



6. Measure the mesh clearance of the driving and driven bevel gears with a dial indicator
Clearance: 0.2-0.4mm

Caution: In order to ensure the pretightening force of the adjusted bearing, the number of turns (angle) of the left and right slotted nuts, which are tightened or loosened, shall be identical



7. Apply red lead pigment on the tooth surface, rotate the gear back and forth to check the tooth surface contact traces
- Caution:** The test shall be carried out at 3 sites.

Axle Shaft

Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Intermediate Axle Assembly, Part Drawing.

Refer to Chapter 25, Rear Axle – Axle Shaft, Overhaul

Hub Bearing Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Intermediate Axle Assembly, Part Drawing.

Refer to Chapter 25, Rear Axle – Hub Bearing and Oil Seal, Overhaul

Intermediate Axle Assembly and Intermediate Axle Housing Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Intermediate Axle Assembly, Part Drawing.

Refer to Chapter 29A, Intermediate Axle (Steyr) – Intermediate Axle Assembly and Intermediate Axle Housing, Overhaul

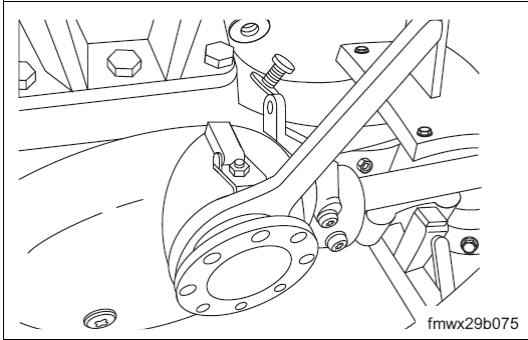
Through Shaft

Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Intermediate Axle Assembly, Part Drawing.

1. **Disconnect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul**



2. **Dismantle the through shaft**

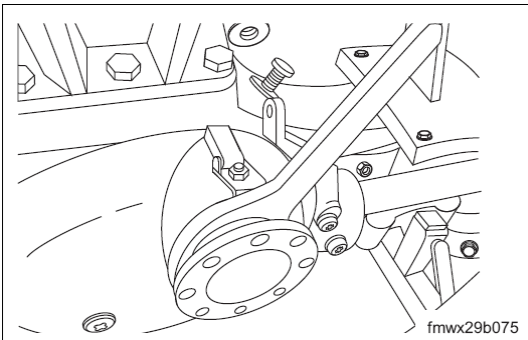
- (a). Dismantle the adjusting nuts with a through shaft adjusting nut hook wrench.
- (b). Pull out the through shaft.

3. **Check the through shaft**

- Check the spline for damage.
- Check the bearing for damage.

Caution:

If damaged, replace with a new axle shaft or bearing.



4. **Install the through shaft**

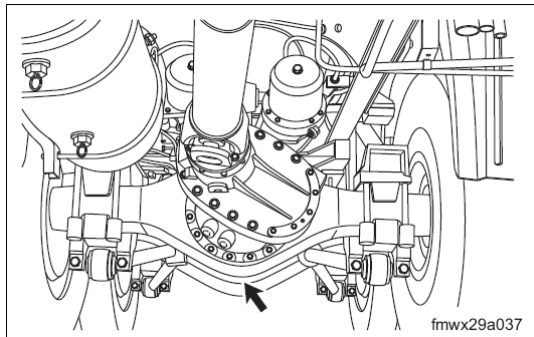
- (a). Insert the through shaft.
- (b). Tighten the adjusting nuts with a through shaft adjusting nut hook wrench.

5. **Disconnect the inter-axial drive shaft. Refer to Chapter 33, Drive Shaft - Inter-axial Drive Shaft, Overhaul**

Inter-axial Differential Overhaul

Hint:

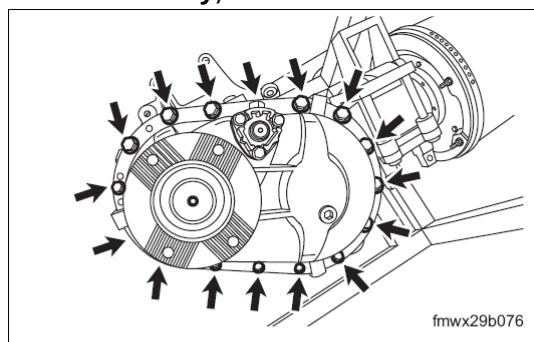
Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Intermediate Axle Assembly, Part Drawing.



1. Drain the gear oil

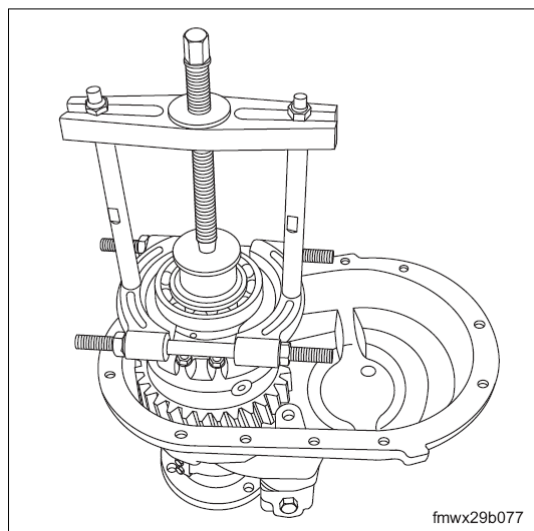
- (a). Loosen the bottom oil drain bolt.

2. Disconnect the intermediate drive shaft. Refer to Chapter 23, Drive Shaft - Drive Shaft Assembly, Overhaul

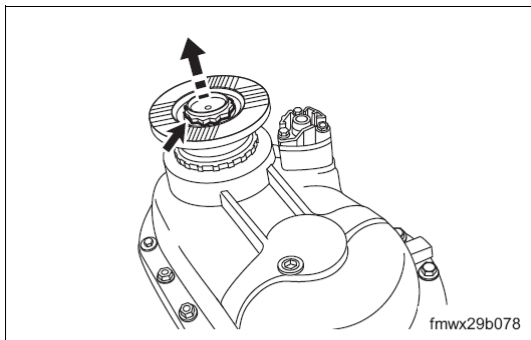


3. Dismantle the input shaft housing

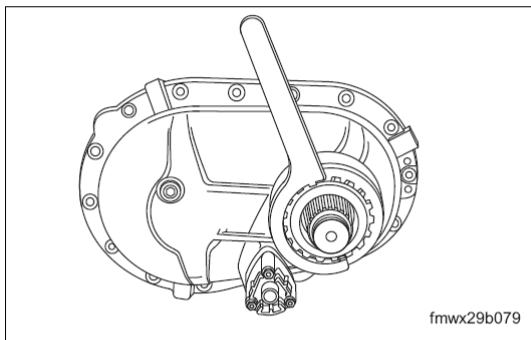
- (a). Loosen the input shaft flange housing fixing nuts.
(b). Loosen the input shaft housing fixing nuts, and dismantle the input shaft housing.



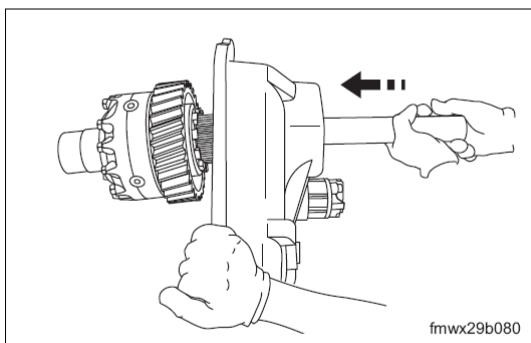
4. Dismantle the gear bearing with a puller



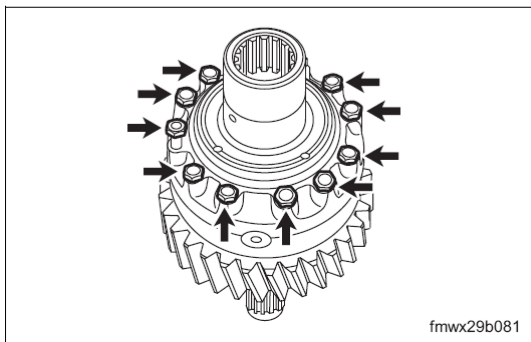
5. Dismantle the input shaft flange



6. Dismantle the input shaft adjusting nuts
Caution: Before dismantling the adjusting nuts, loosen the locking plate.



7. Knock out the inter-axial differential assembly with a copper rod

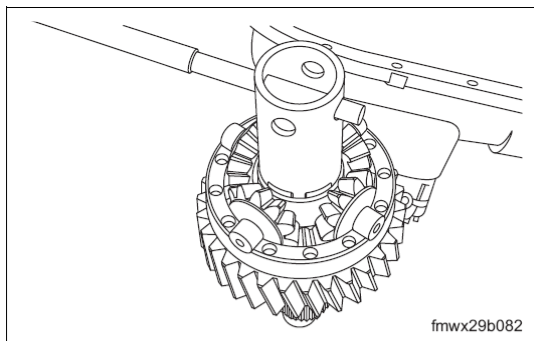


8. Dismantle the axle shaft gear

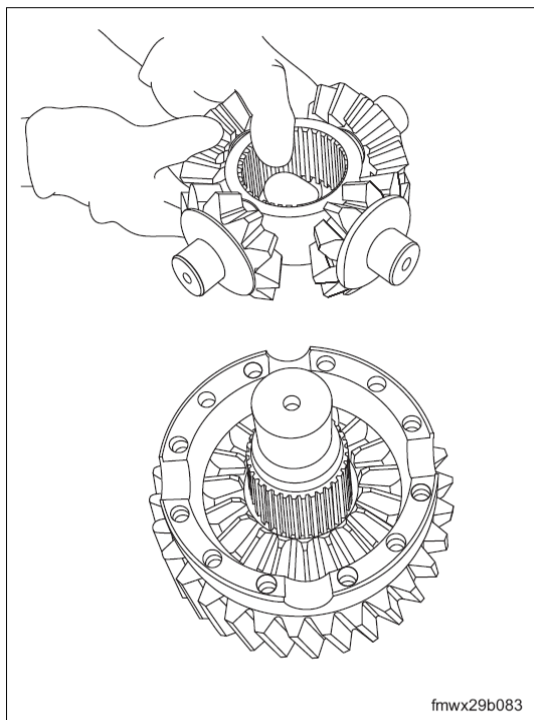
- (a). Dismantle the differential housing connecting bolts.
- (b). Take down the axle shaft gear.

9. Check the differential housing for assembling mark. If there is no assembling mark, reprint the assembling mark on the two differential housing halves.

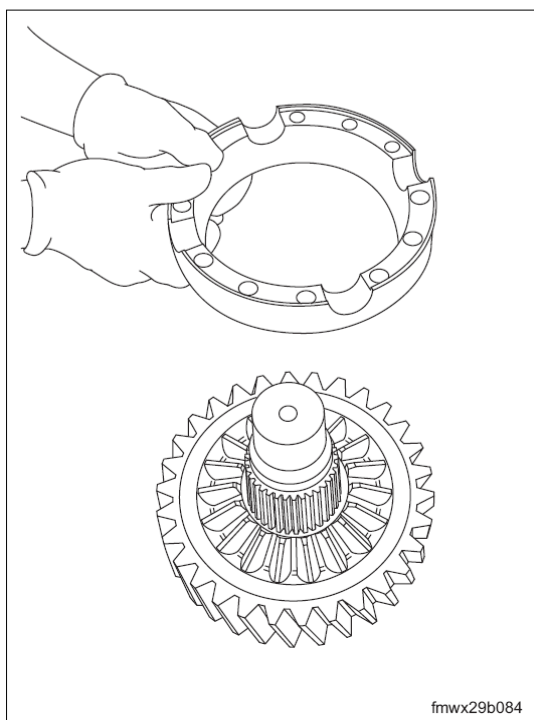
Intermediate Axle (Benz) – Inter-axial Differential



10. Dismantle the planet gear locking nuts



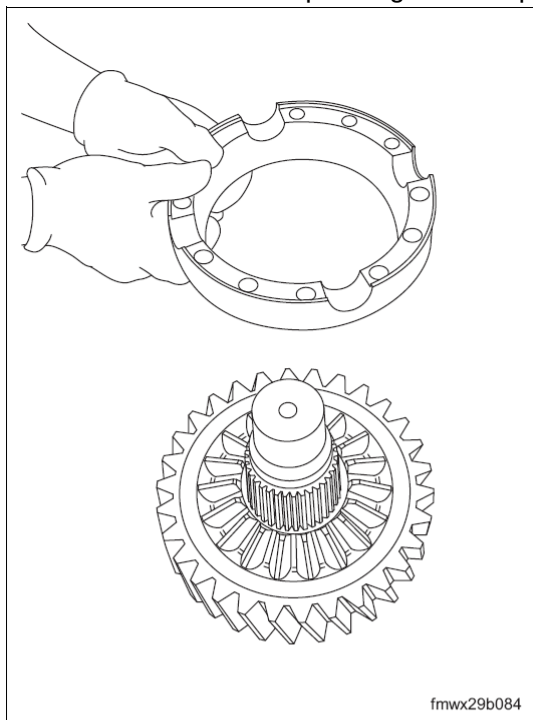
11. Dismantle the planet gear



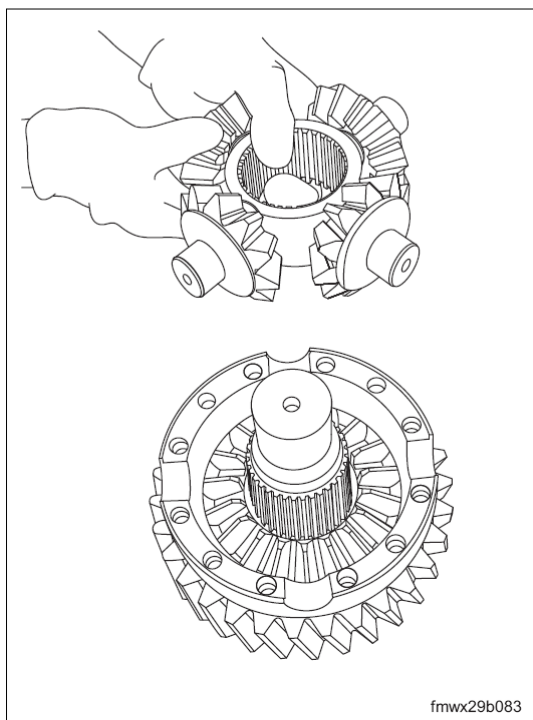
12. Dismantle the inter-axial differential rear housing

13. Clean and check the parts, measure the their dimensions, and replace with the parts which have reached the wear limit

- Check the differential housing for crack.
- Check the axle shaft gear for rupture, wear, pitting, gluing and plastic deformation.
- Check the planet gear for rupture, wear, pitting, gluing and plastic deformation.

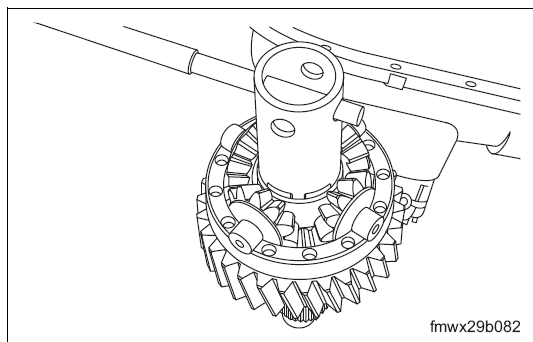


14. Install the inter-axial differential rear housing

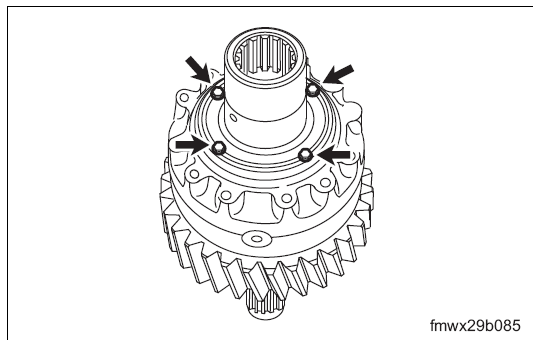


15. Install the planet gear

Intermediate Axle (Benz) – Inter-axial Differential

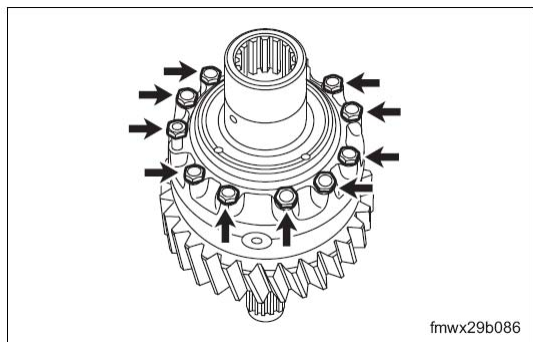


16. Install the planet gear locking nuts



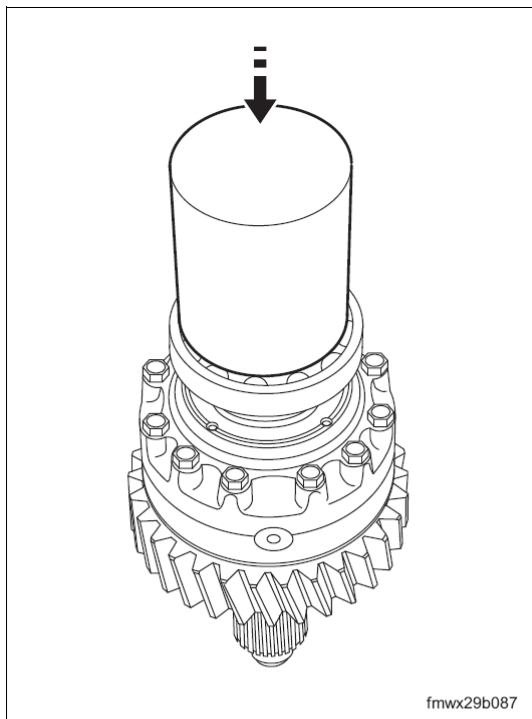
17. Install 4 differential housing connecting bolts

18. Measure the tooth side clearance. Refer to Chapter 29B Intermediate Axle (Benz) - Intermediate Axle Assembly, Test and Adjustment

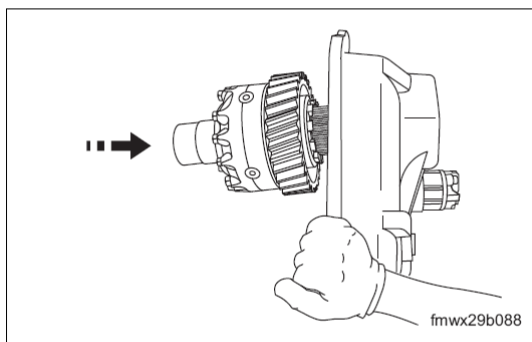


19. Install the differential housing connecting bolts

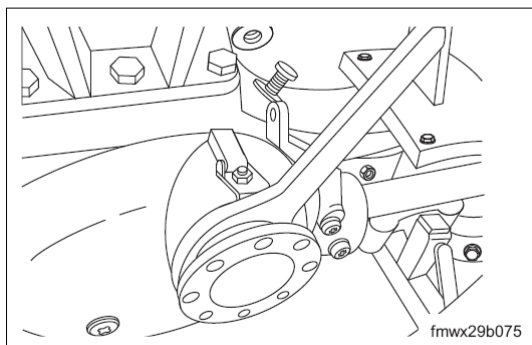
Caution: Before tightening the bolts, apply 262 thread lock on the bolts, and the bolt shall be tightened diagonally.



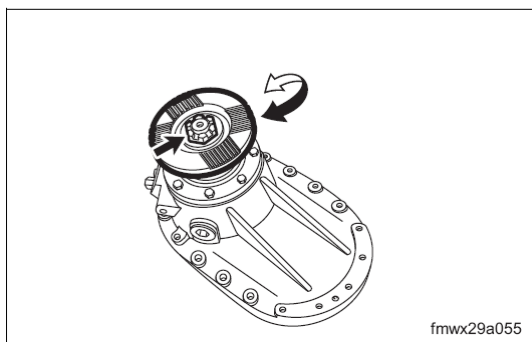
20. Press the bearing into the axle shaft gear



21. Install the inter-axial differential into the inter-axial differential housing assembly



22. Install the driving bevel gear locking plate



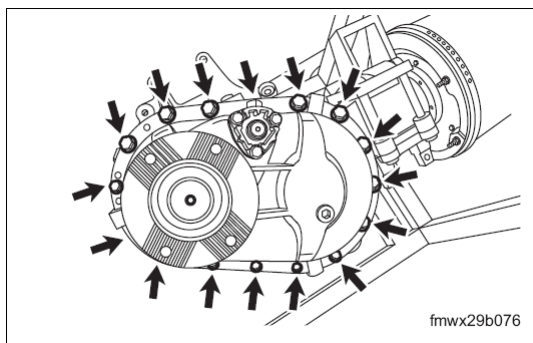
23. Install the flange

(a). Install the flange nut.

Torque: 775±25N.m

(b). Install the flange nut cotter pin.

Intermediate Axle (Benz) – Inter-axial Differential



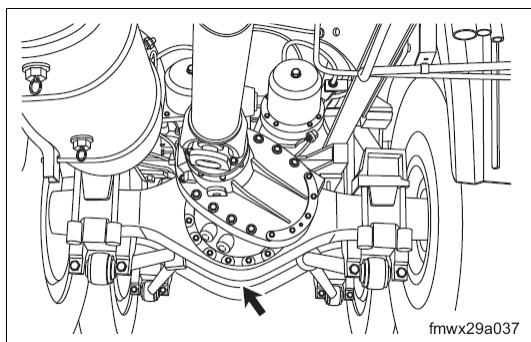
24. Install the input shaft housing

- (a). Install the input shaft housing.
- (b). Install the input shaft housing fixing nut.

Caution:

Apply 598 flange sealant on the connecting plane of the gap bridge box.

25. Connect the drive shaft. Refer to Chapter 23, Drive Shaft - Drive Shaft Assembly, Overhaul



26. Add gear oil

- (a). Tighten the bottom oil drain bolt.

Main Reducer

Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) – Front Mounting Assembly, Part Drawing.

1. **Dismantle the inter-axial differential. Refer to Chapter 29B, Intermediate Axle (Benz) - Inter-axial Differential, Overhaul**
2. **Dismantle the gap bridge box assembly. Refer to Chapter 29B, Intermediate Axle (Benz) - Driving Gear and Bearing, Overhaul**
3. **Dismantle the driving gear. Refer to Chapter 29B, Intermediate Axle (Benz) - Driving Gear and Bearing, Overhaul**
4. **Dismantle the driven gear. Refer to Chapter 29B Intermediate Axle (Benz) - Inter-wheel Differential Housing, Driven Gear and Planet Gear Assembly, Overhaul**
5. **Clean and check the parts, measure the their dimensions, and replace with the parts which have reached the wear limit**
 - Check the driving gear for rupture, wear, pitting, gluing and plastic deformation.
 - Check the driven gear for rupture, wear, pitting, gluing and plastic deformation.
6. **Install the inter-axial differential. Refer to Chapter 29B, Intermediate Axle (Benz) - Inter-axial Differential, Overhaul**

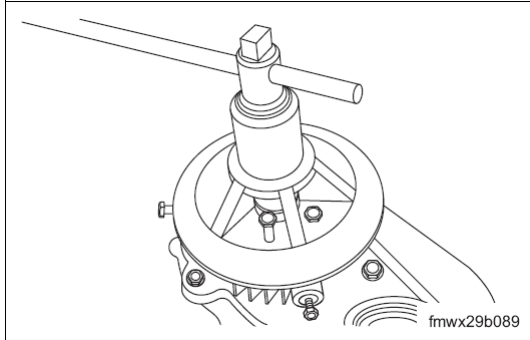
Driving Gear and Bearing

Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) - Intermediate Axle Assembly, Part Drawing.

1. **Dismantle the input shaft cover. Refer to Chapter 29B, Intermediate Axle (Benz) - Inter-axial Differential, Overhaul**



2. **Dismantle the driving gear**

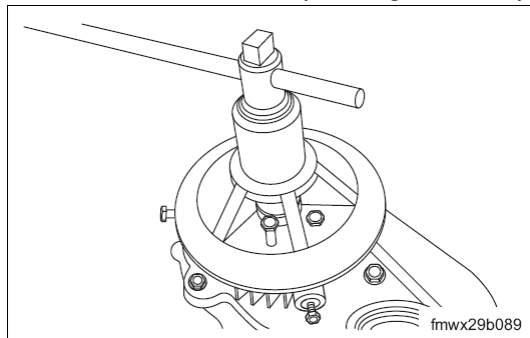
- (a). Draw out the axle shaft. Refer to Chapter 25 Rear Axle - Axle Shaft, Overhaul

Caution: Before dismantling the intermediate axle gap bridge box, do not draw out the whole axle shaft on the end provided with the differential lock, otherwise, the falling mesh sleeve may check the differential, so that the intermediate axle gap bridge box can not be drawn out of the axle housing.

- (b). Dismantle the driving gear locking nuts.

3. **Clean and check the parts, measure the their dimensions, and replace with the parts which have reached the wear limit**

- Check the differential housing for crack.
- Check the axle shaft gear for rupture, wear, pitting, gluing and plastic deformation.
- Check the planet gear for rupture, wear, pitting, gluing and plastic deformation.



4. **Install the driving gear**

- (a). Install the driving gear locking nuts.
- (b). Install the axle shaft. Refer to Chapter 25 Rear Axle - Axle Shaft, Overhaul.

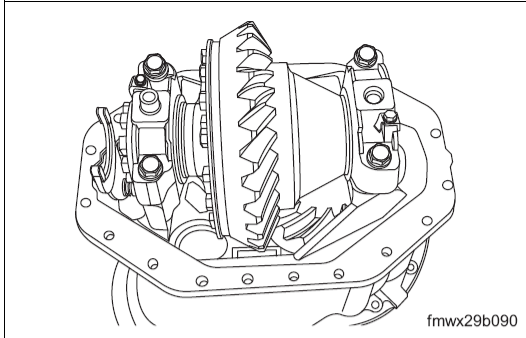
Inter-wheel Differential

Overhaul

Hint:

Part Drawing, refer to Chapter 29B, Intermediate Axle (Benz) - Intermediate Axle Assembly, Part Drawing.

1. **Dismantle the input shaft cover. Refer to Chapter 29B, Intermediate Axle (Benz) - Inter-axial Differential, Overhaul**

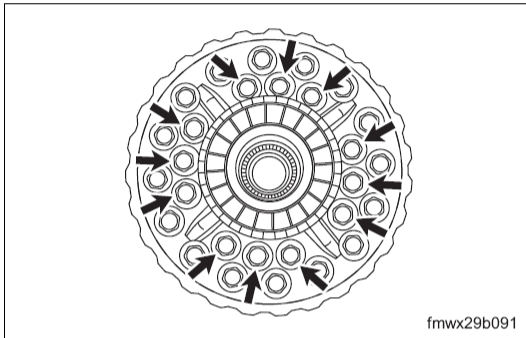


2. **Dismantle the differential assembly**

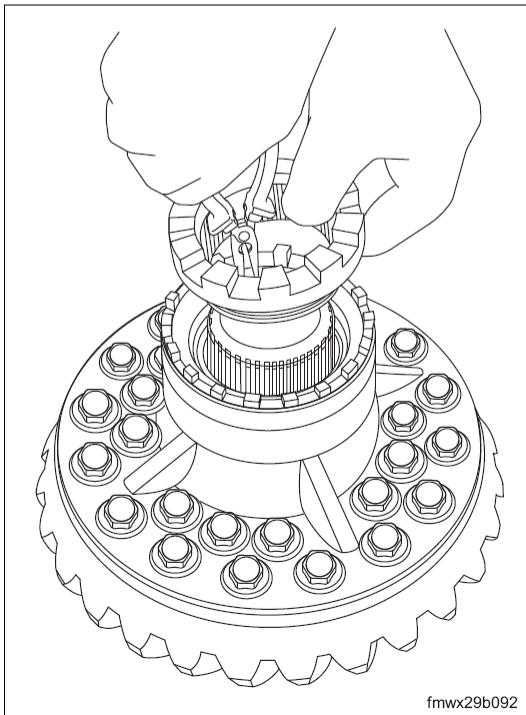
(a). Dismantle the slotted nut locking plate of the differential bearing.

(b). Dismantle the differential bearing cap.

Caution: Before dismantling the cap, the cap and bearing seat shall be printed with suited marks to avoid mistaken installation when reassembling.

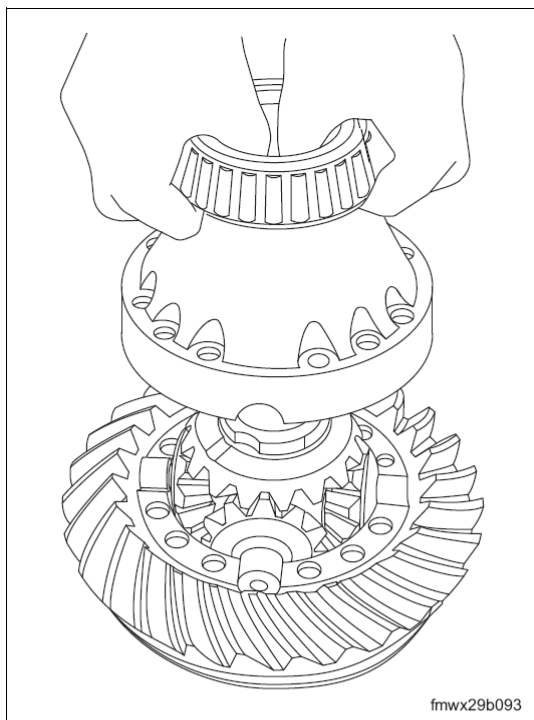


3. **Dismantle the differential housing coupling bolts**



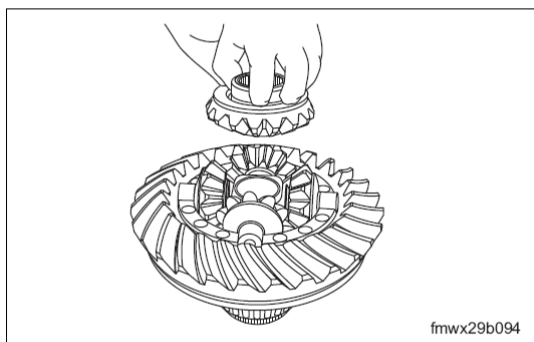
4. **Loosen the snap ring, and take out the differential lock mesh sleeve**

Intermediate Axle (Benz) – Inter-wheel Differential

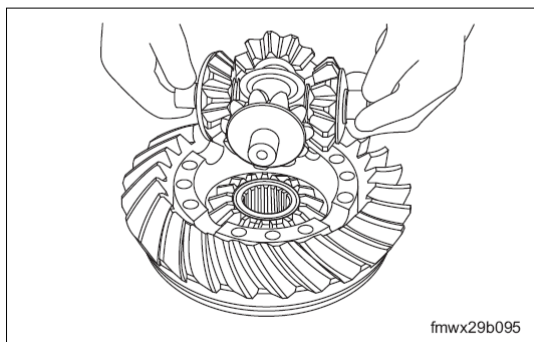


5. Take down the differential housing

Caution: Before dismantling, observe whether there are assembly marks on the two differential housing halves. If there are no assembly marks, corresponding assembly marks shall be printed to avoid mistaken installation when reassembling.

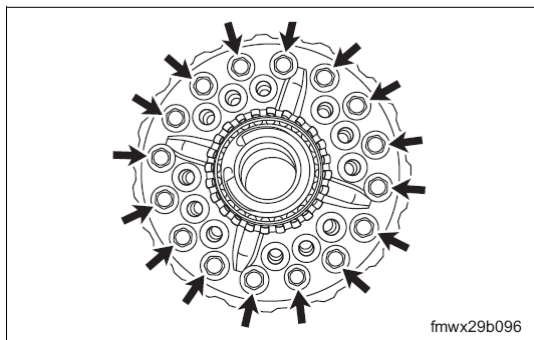


6. Take out the axle shaft gear

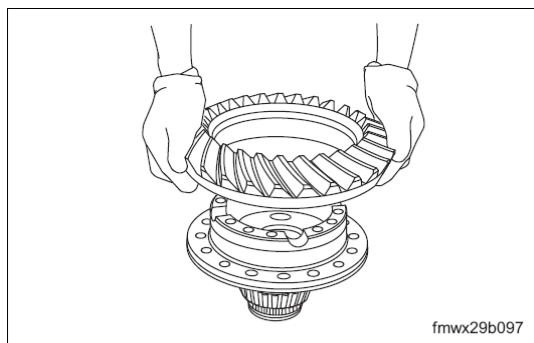


7. Take out the planet gear and cross shaft

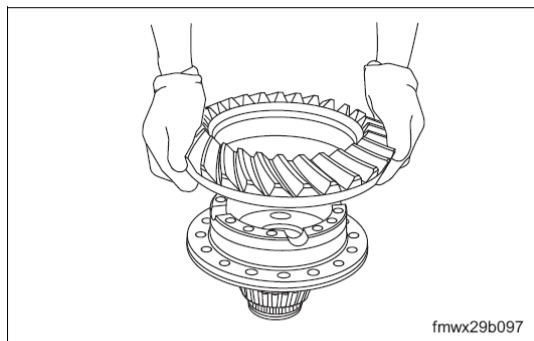
Caution: Do not lose the planet gear spherical gasket.



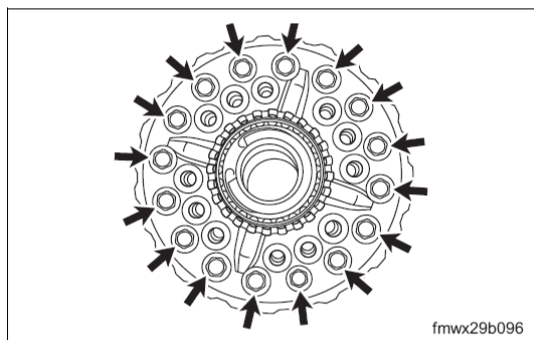
8. Dismantle the driven gear and differential housing coupling bolts



9. Take down the driven gear

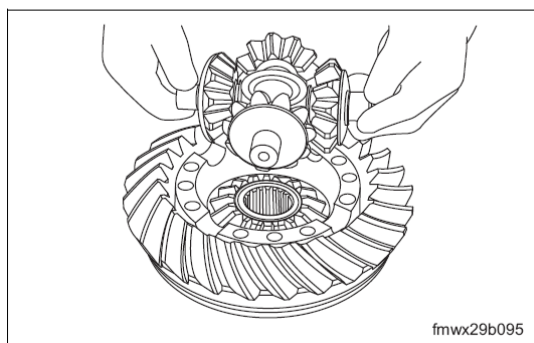


10. Install the driven gear

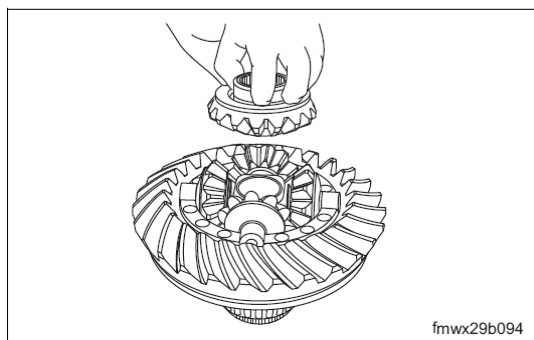


11. Install the driven gear and differential housing coupling bolts, and connect the driven gear, backing ring and differential
Torque: 195N.m

Caution: the bolts must be coated with 262 thread lock.

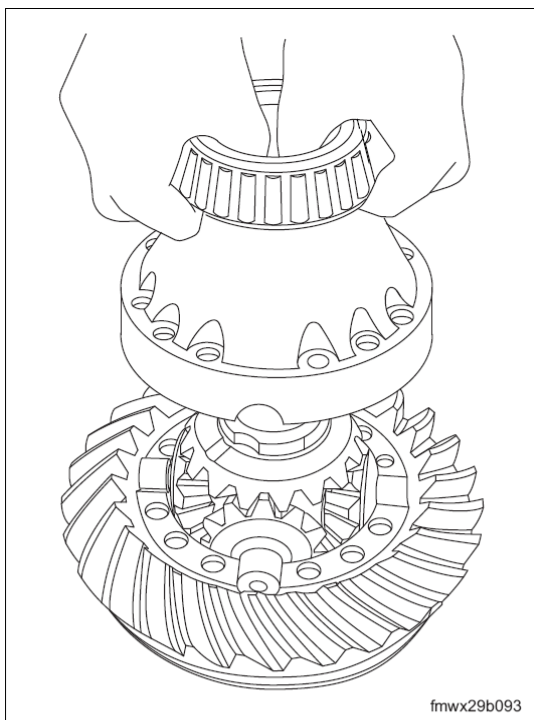


12. Install the planet gear and cross shaft

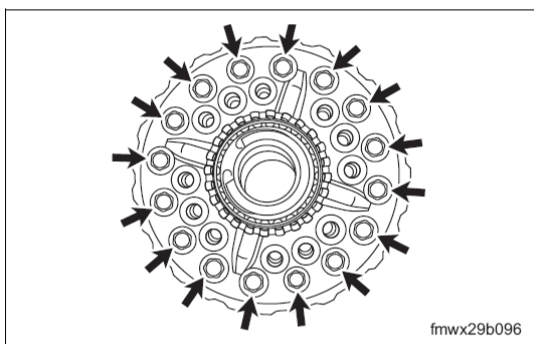


13. Install the axle shaft gear

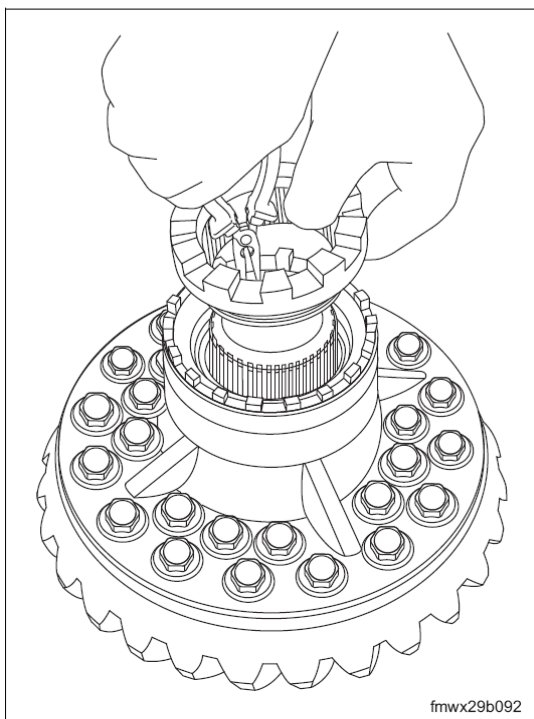
Intermediate Axle (Benz) – Inter-wheel Differential



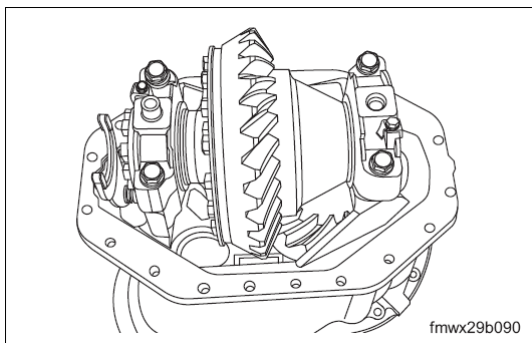
- 14. Install the differential housing**
Caution: Align the installation marks.



- 15. Tighten the differential housing coupling bolts diagonally**



- 16. Loosen the snap ring, and take out the differential lock mesh sleeve**



17. Install the differential assembly

- (a). Install the differential bearing cap.
- (b). Install the slotted nut locking plate of the differential bearing.

Caution: Align the suited marks.

- 18. Install the input shaft cover. Refer to Chapter 29B, Intermediate Axle (Benz) - Inter-axial Differential, Overhaul**

Transmission (RT-11509C)

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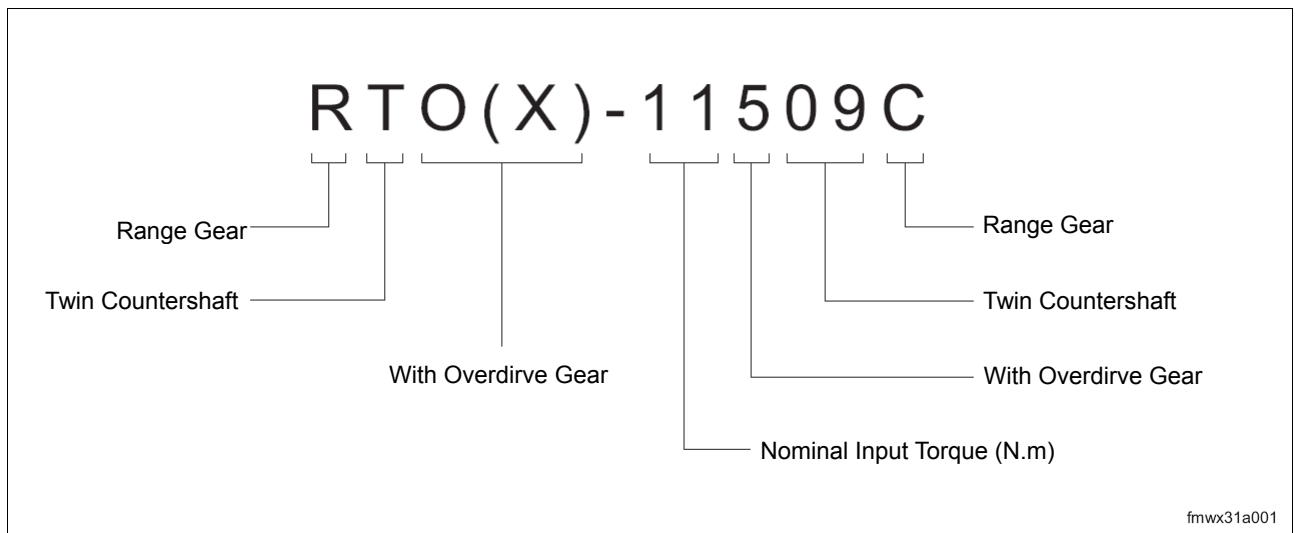
Transmission (RT-11509C) - Transmission

Transmission

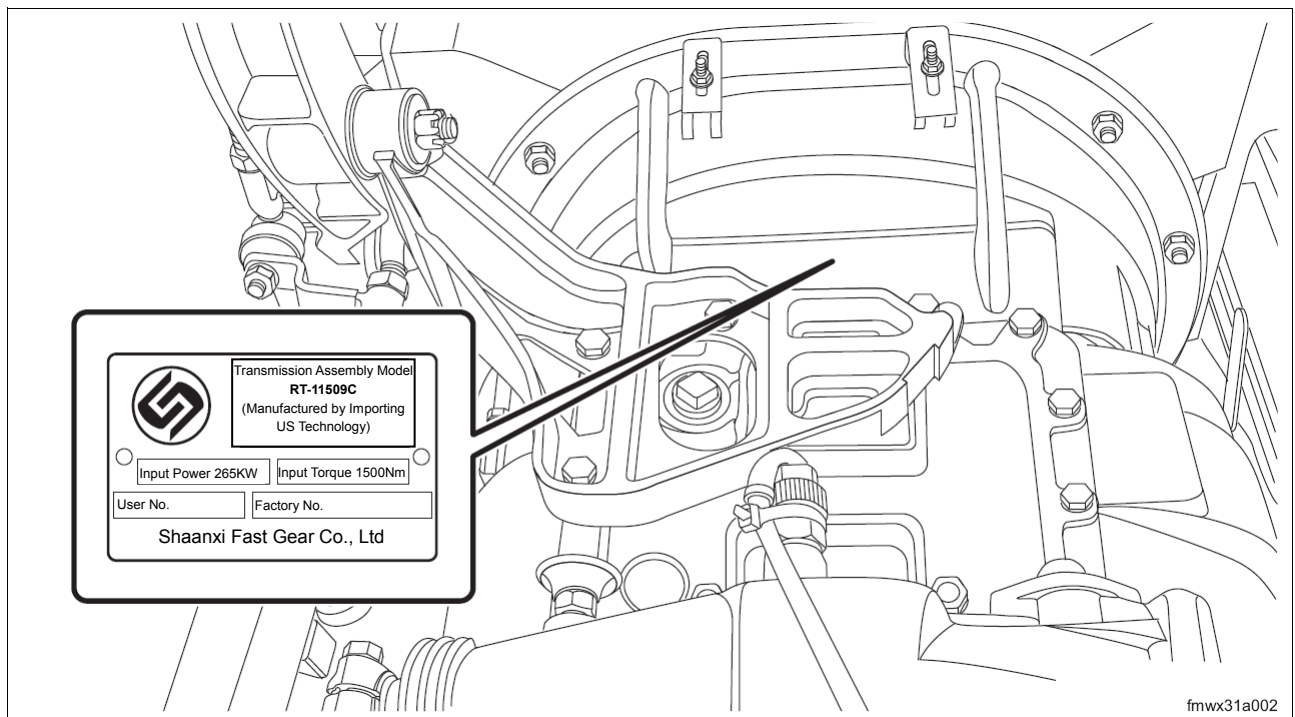
General

The Fast twin countershaft transmission is mainly characterized in that a countershaft is added on the symmetrical axis of the countershaft of the common transmission, and becomes a transmission which has two countershafts. Power can be transmitted symmetrically due to one additional countershaft, so as to gain the advantages of stable transmission and low noise.

Meaning of Transmission Model:



Transmission Nameplate



Precautions

I. Precaution for Use of Transmission

It is very important to correctly and reasonably operate and use the transmission, and do regular maintenance on the transmission for ensuring that the vehicle runs safely and reliably and prolonging the service life of the transmission.

1. **Release the parking brake before the vehicle takes off. For the vehicle with air cut-off brake, after switching on the brake valve, put into gear and take off until the air pressure rises to the pressure required for releasing the brake.**
2. **Take off at the 1st or 2nd gear according to the road condition.**
3. **During gear shift, the clutch must be released fully, and the gear shift lever shall put into gear in position.**
4. **The gear shift lever has two neutral positions, i.e. the 3rd/4th gear in low gears and 5th/6th gear in high gears. When stopping the vehicle, the gear shift lever shall be in the low gear area.**
5. **When putting into reverse gear or climbing gear, stop the vehicle and then put into gear to avoid the inside parts of the transmission. When putting into reverse gear, apply strong hand force to overcome the resistance from the reverse gear lock.**
6. **When shifting between the high and low gears (4th and 5th gears), be aware of stopping for a while, which is good for the auxiliary transmission to finish shifting between the high gear area and low gear area.**

Warning:

1. **The gear jumping operation is prohibited when the transmission is shifted to a high gear from a low gear or to a low gear from a high gear.**
2. **When shifting gears during driving, it is prohibited to use the countershaft brake.**
3. **It is prohibited to shift gears when the vehicle is running down on a slope.**
4. **The vehicle is prohibited to slide at neutral gear.**
5. **The driving wheels are prohibited to touch the road when the vehicle is towed.**
6. **Once detecting the abnormal phenomena that there is abnormal noise in the transmission, the operation gets obviously heavy, etc. in use, stop the vehicle immediately for inspection, and continue to drive after eliminating the fault.**

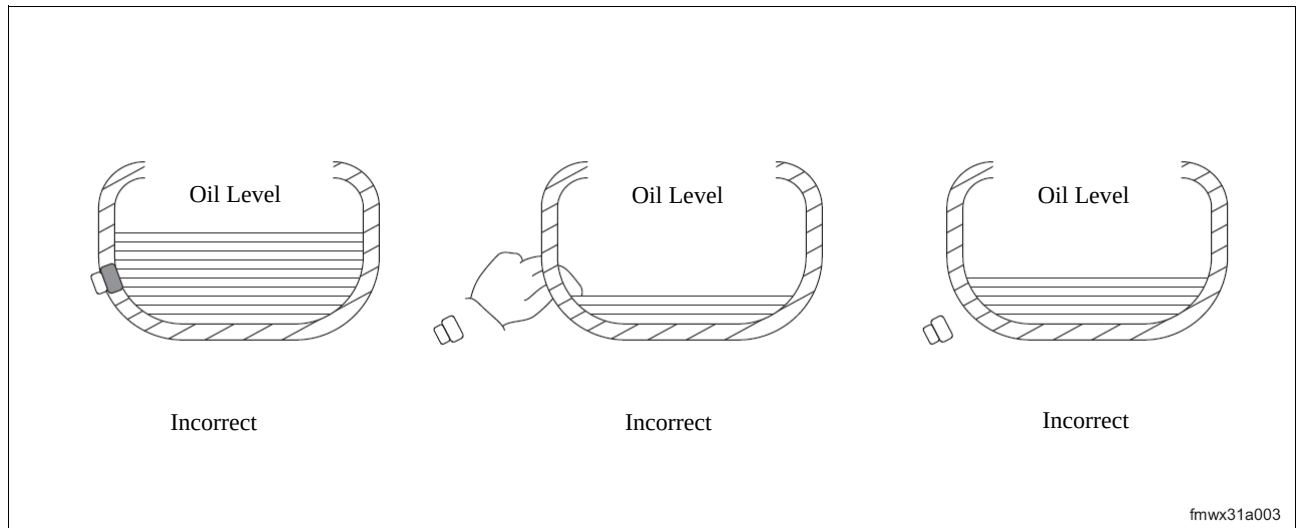
II. Precautions for Maintenance of Transmission

When it reaches the specified maintenance interval, conduct all previous maintenance and inspection items specified in the maintenance regulations.

1. Daily Inspection

1-1 Inspection on lubricating oil level

Inspect the lubricating oil level and leakage of the transmission every day, and fill lubricating oil in time, and repair the leaks if any immediately to prevent the transmission fault caused by loss of lubricating oil.

Transmission (RT-11509C) - Transmission**1-2 Pneumatic System**

- 1) Discharge the water in the pneumatic system of the vehicle every day.
- 2) Hear whether there is air leakage every day, and repair if necessary.
- 3) Confirm whether the air dryer operates normally, and repair if necessary. Overhaul the air compressor of the vehicle according to the requirement to prevent lubricating oil from going into the pneumatic system.

2. 2,000-5,000 km for New Transmission

- 2-1 Replace lubricating oil;
- 2-2 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 2-3 Lubricate the release bearing;
- 2-4 Lubricate the clutch fork shaft;
- 2-5 Clean the air filter element;
- 2-6 Inspect and clean the transmission breather holes;
- 2-7 Inspect whether the transmission control mechanism operates normally.

3. Every 10,000km or 2 months

- 3-1 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 3-2 Lubricate the release bearing;
- 3-3 Lubricate the clutch fork shaft;
- 3-4 Clean the air filter element;
- 3-5 Inspect and clean the transmission breather holes;
- 3-6 Inspect whether the transmission control mechanism operates normally.

4. Oil Replacement

- 4-1 It is very important for the maintenance of the transmission to choose correct lubricating oil, and you must comply with the specified maintenance procedures as follows:
 - 1) Purchase lubricating oil from recognized suppliers;

- 2) Use the correct type and grade of lubricating oil. Brand of lubricating oil: 85W-90 GL5;
- 3) Replace lubricating oil according to the appropriate oil replacement interval;
- 4) Keep the lubricating oil level correct.
- 4-2 The replacement period of lubricating oil shall not exceed the intervals listed in the following table.

Road Service Condition	Off-road Service Condition	Severe Service Condition
One year (at most) or 50,000 km	Every 1,000h	Every 500h

Caution:

The severe service condition refers to the conditions that require parts to operate continuously under high load condition, in heavily polluted environment or on a steep slope. Under those service conditions, apply the oil replacement period specified by the severe service condition.

III. Precaution for Disassembly of Transmission

1. Do repair in a clean place to prevent dust or other foreign matters from going into the transmission. Carefully clean the inside and outside of the transmission before dismantlement.
2. When dismantling various assemblies, place all parts on a clean workbench in the dismantling order, which is convenient for the steps of re-installation and reduces the possibility of part loss.
3. Dismantle the countershaft, main shaft and primary shaft gear, and it is unnecessary to dismantle the primary shaft.
4. Bearing – When dismantling it, use special tools. Clean carefully, and inspect whether there is pitting on its raceway, and whether its rolling element is good.

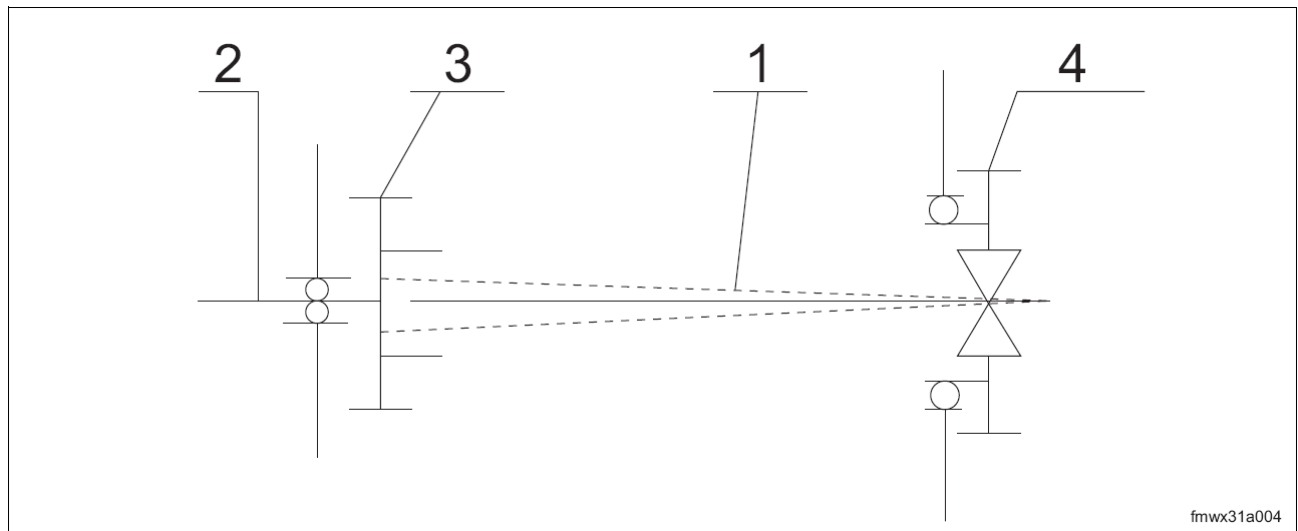
IV. Precautions for Assembly of Transmission:

Before assembly, make sure to fully clean the parts to be assembled so as to prevent dust and foreign matters from going into the transmission, or unnecessary damages will be caused.

1. Gasket – When re-assembling the transmission, use new gaskets.
2. Bolt – In order to prevent leaking oil, apply screw sealant to all bolts, and tighten according to the standard torque.
3. O-ring – Lubricate all O-rings with silicone grease lubricant.
4. Initial lubrication – During assembly, coat all thrust washers with lubricating grease for initial lubrication, which can prevent scratching or wear.
5. Axial Clearance – Ensure an axial clearance of 0.13~0.30mm for the main shaft forward gear, and an axial clearance of 0.30~0.90mm for the reverse gear.
6. Tighten the output shaft flange nuts, and tighten the output nuts with a torque of 610~680N.m, or it will cause serious consequences.

Transmission Structure and Principle

I. Twin Countershaft Floating Structure



1	Main Shaft	3	Input Shaft Gear
2	Input Shaft	4	Auxiliary Box Driving Gear

Both the main and auxiliary transmissions of the Fast twin countershaft transmission adopt two countershafts which have the same structure and are spaced by 180°. Power is input from the input shaft, split on the two countershafts, then gathered on the main shaft and then output. The auxiliary transmission is the same.

Each countershaft only transmits 1/2 of the torque in theory, so by using the twin countershafts, the center distance of the transmission decreases, the gear thins, the axial size shortens, and the quality lightens. After using twin countershafts, the gears on the main shaft must be meshed with two countershaft gears simultaneously.

In order to meet correct meshing and distribute the load equally as much as possible, the main shaft gears are in floating state on the main shaft, and the main shaft is of an articulated floating structure. The main shaft journal is inserted into the hole of the input shaft, the oil-containing guide bushing is pressed into the hole, and the enough radial clearance is left between the main shaft journal and oil-contain guide bushing. The rear end of the main shaft is inserted into the driving gear hole of the auxiliary transmission through the involute spline, and the driving gear journal of the auxiliary transmission is supported on the ball bearing.

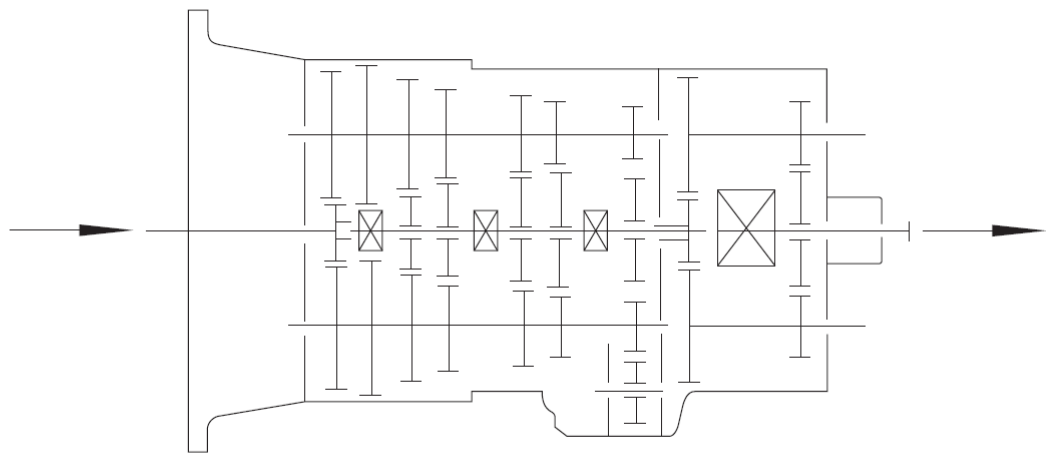
As the gears on the main shaft float on the main shaft, the traditional needle beatings are cancelled, which makes the structure of the main shaft assembly simpler. During operation, the radial forces applied to the main shaft gears by the two countershaft gears are equal but opposite in direction, and they are offset mutually, which makes the main shaft only bear torque without bending moment, improves the stress condition of the main shaft and bearing, and greatly enhances the reliability and durability of the transmission.

II. Power Transmitting Line

Knowing the engine power transmitting line of the specific gears of the transmission is helpful for the technical personnel to overhaul and maintain the transmission. It is usually considered that the Fast transmission is an integral device composed of two separate transmissions. The first transmission (or called transmission front box) consists of six gear pairs which are controlled by the gear shift lever. The second transmission is called auxiliary box, which realizes the shifting of the range gears through two gear pairs which are controlled by air pressure.

Hint:

This transmission is a constant mesh transmission. Although only part of gears transmits power during operation, all gears rotate.

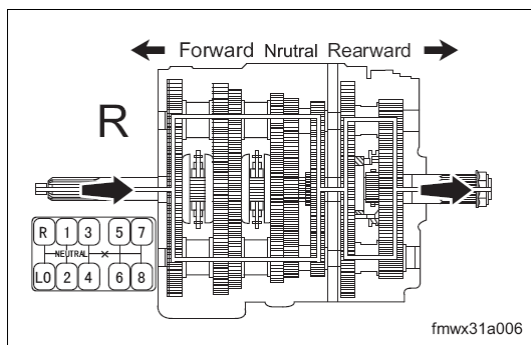
Transmission (RT-11509C) - Transmission

Gear			
RT11509C	9JS135		
Low (L)	Low (L)		
1	1		
2	2		
4	3		
3	4		
5	5		
6	6		
7	7		
8	8		
Reverse (R)	Reverse (R)		

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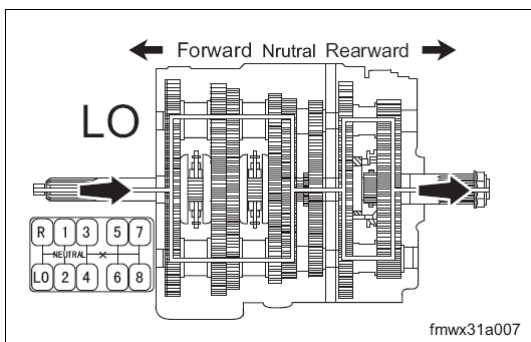
1. Power Transmitting Line of Main Box

(a). Reverse Gear transmitting line.



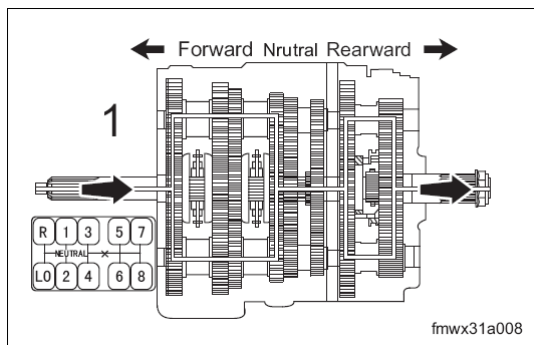
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(b). Climbing Gear transmitting line.

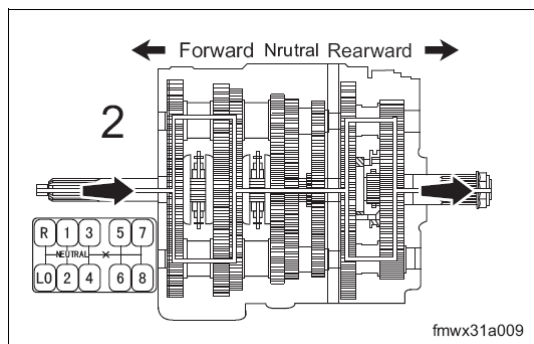


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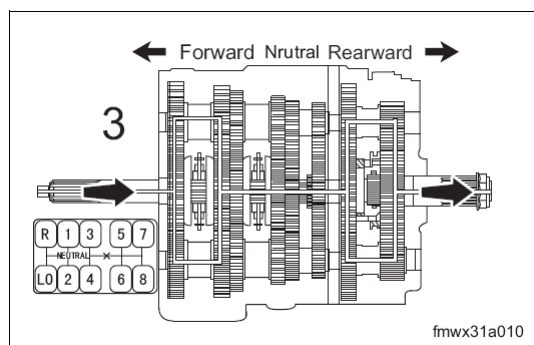
Transmission (RT-11509C) - Transmission



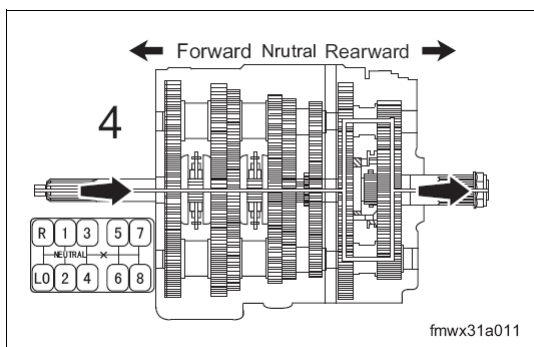
(c). Gear 1 transmitting line.



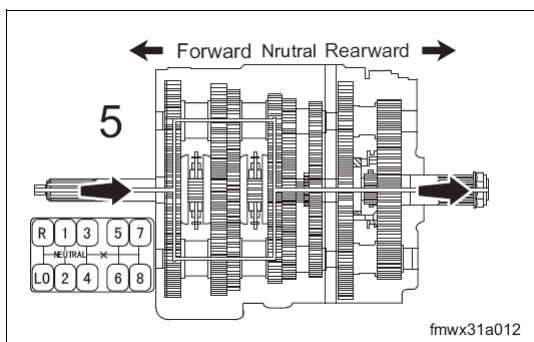
(d). Gear 2 transmitting line.



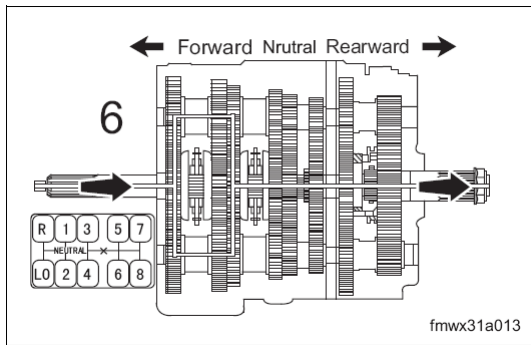
(e). Gear 3 transmitting line.



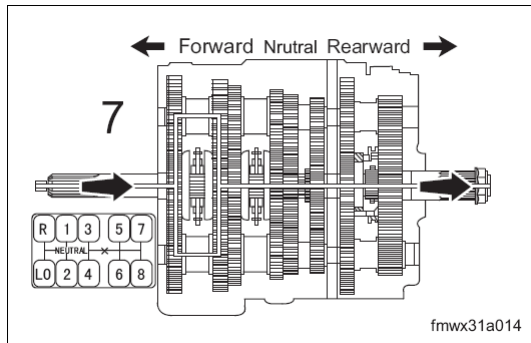
(f). Gear 4 transmitting line.



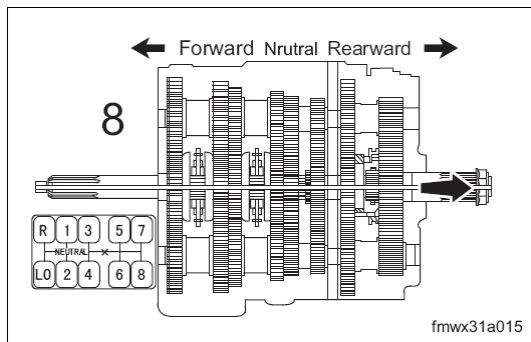
(g). Gear 5 transmitting line.



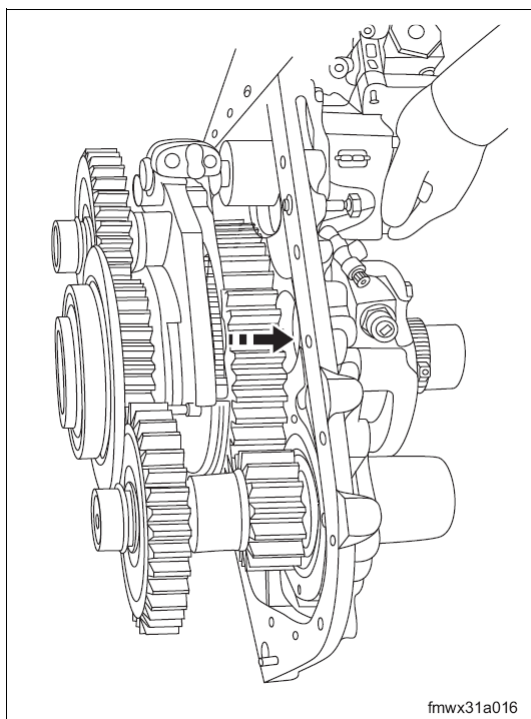
(h). Gear 6 transmitting line.



(i). Gear 7 transmitting line.

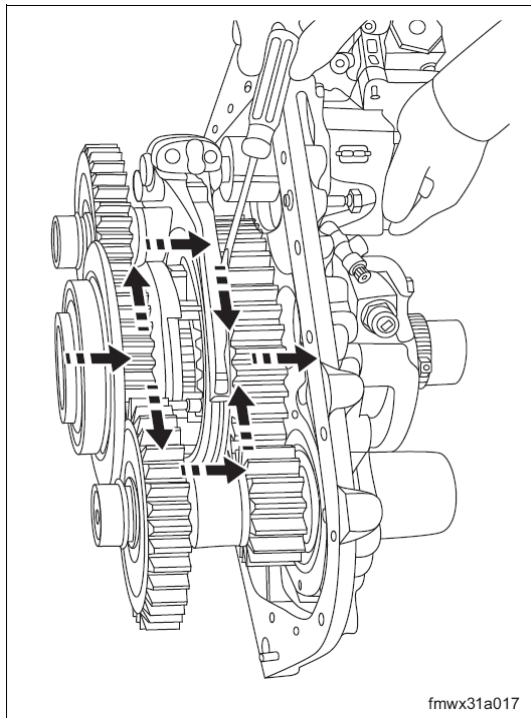


(j). Gear 8 transmitting line.



2. Power Transmitting Line of Auxiliary Box

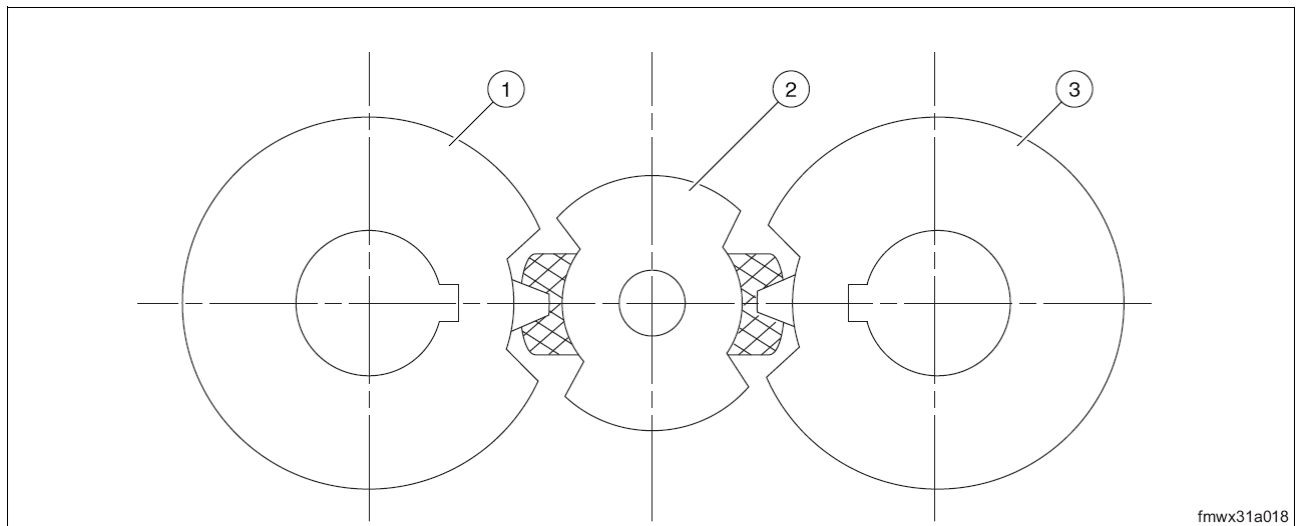
(a). High gears.

Transmission (RT-11509C) - Transmission

(b). Low gears.

III. Teeth Alignment and Tooth Alignment Process

In order to ensure the correct meshing between the countershaft gears and main shaft gear, and the same rotating angle of the two countershafts, the installation of both the main box and auxiliary box must be based on “teeth alignment”. Generally, when installing the main box, choose the primary shaft gear and countershaft constant mesh gears for teeth alignment; when installing the auxiliary box, choose the auxiliary box reduction gear and auxiliary box countershaft gears for teeth alignment.

Tooth Alignment Process:

1	LH Countershaft Gear
2	Primary Shaft Gear

3	RH Countershaft Gear
---	----------------------

Teeth Alignment for Main Box

- First, coat mark paint on any two adjacent teeth of the primary shaft gear, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.

Transmission (RT-11509C) - Transmission

- Respectively coat mark paint on the toplands of the external teeth over against the inner bore keyway of two constant mesh gears of the countershaft, and this mark is unique.
- When installing, respectively insert the marked gear teeth of the two constant mesh gears of the countershaft into the marked tooth grooves of the primary shaft gear. If installed correctly, the primary shaft rotates flexibly, and inspect whether the teeth aligning marks are correct if the primary shaft cannot be rotated or can be rotated heavily.

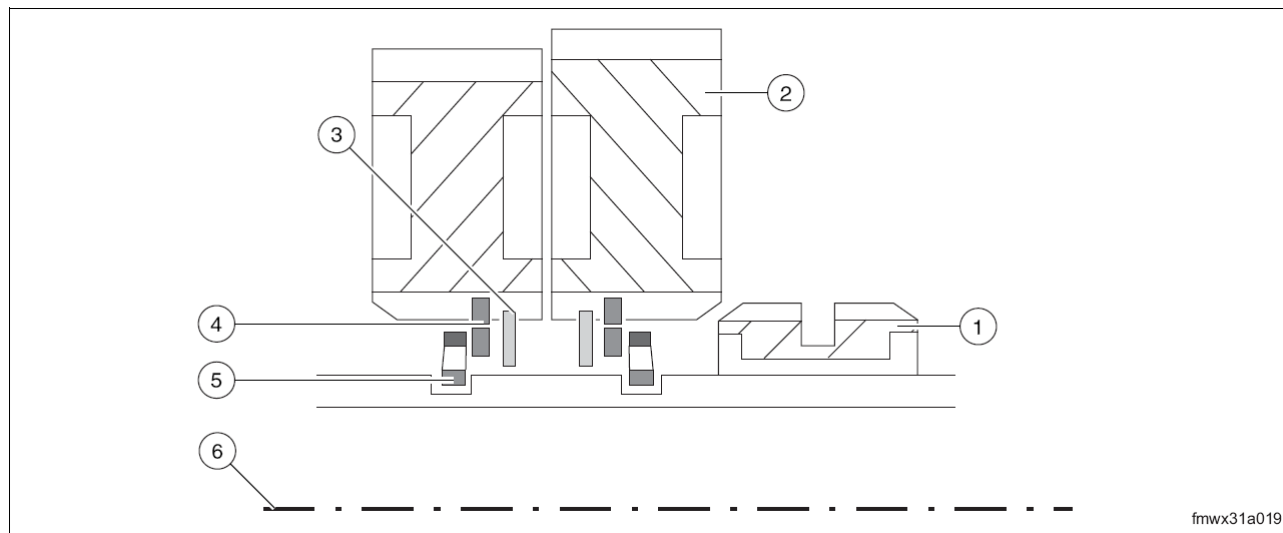
Teeth Alignment for Auxiliary Box

- First, coat mark paint on any two adjacent teeth of the reduction gear of the auxiliary box, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.
- Coat mark paint on the topland with an O mark on the gear shaft of the countershaft of the auxiliary box, and this mark is unique.
- When installing, respectively insert the marked teeth of two auxiliary box countershaft gears into the marked tooth grooves of the auxiliary box reduction gear. When installing the auxiliary transmission assembly in the main box, inspect the teeth aligning marks carefully and assemble after confirmation.

VI. Gear Shift Mechanism

There is no synchronizer in the main box of the RT11509C twin countershaft transmission, and the main shaft sliding sleeve is nested on the main shaft through the involute spline, the moving sliding sleeve makes the engaging teeth meshed with the inner engaging gear of the main shaft gear so as to transmits power, and the sliding sleeve and the inner engaging teeth end have the same cone angle $\alpha=35^\circ$. As the main shaft and main shaft gear are in floating state, those two cone faces can play a role of automatic centering and synchronization when putting into gear.

The RT11509C twin countershaft transmission has many gears, and the speed ratio difference between every two adjacent gears is small, so the speed difference between every two adjacent gears is also small when the transmission is operating, and the gear shift of the transmission is stable.

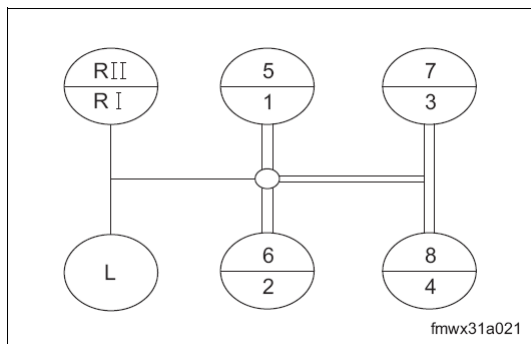
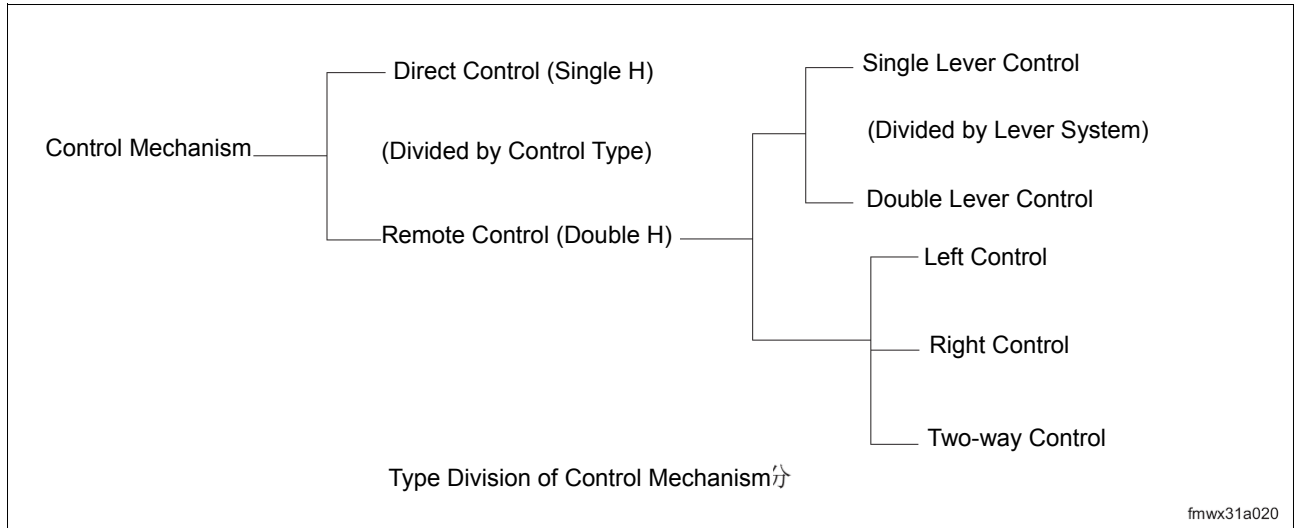
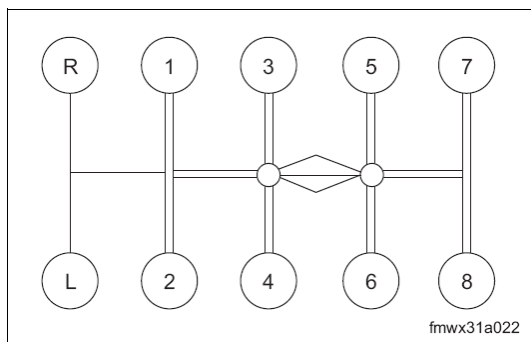


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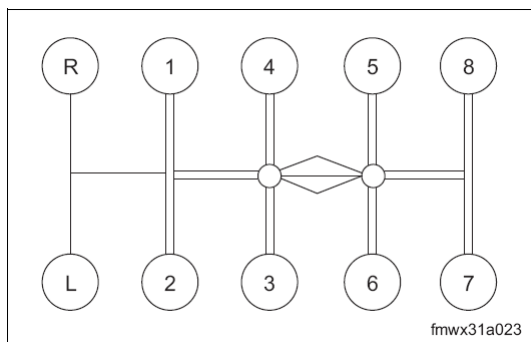
1	Sliding Sleeve	4	Spline Gasket
2	Main Shaft Gear	5	Adjusting Gasket
3	Snap Ring	6	Main Shaft

V. Control Mechanism

The control mechanism of the RT11509C twin countershaft transmission falls into the direct control type (single H) and a remote control type (double H). Most of vehicles adopt the remote control mechanism.

Transmission (RT-11509C) - Transmission**1. Direct control mechanism (Single H)****2. Remote control mechanism (Double H) (New)**

The double H gear shift mechanism has two neutral positions, respectively at the 3rd/4th gear in low gear area and at 5th/6th gear in high gear area.



(Old)

Hint:

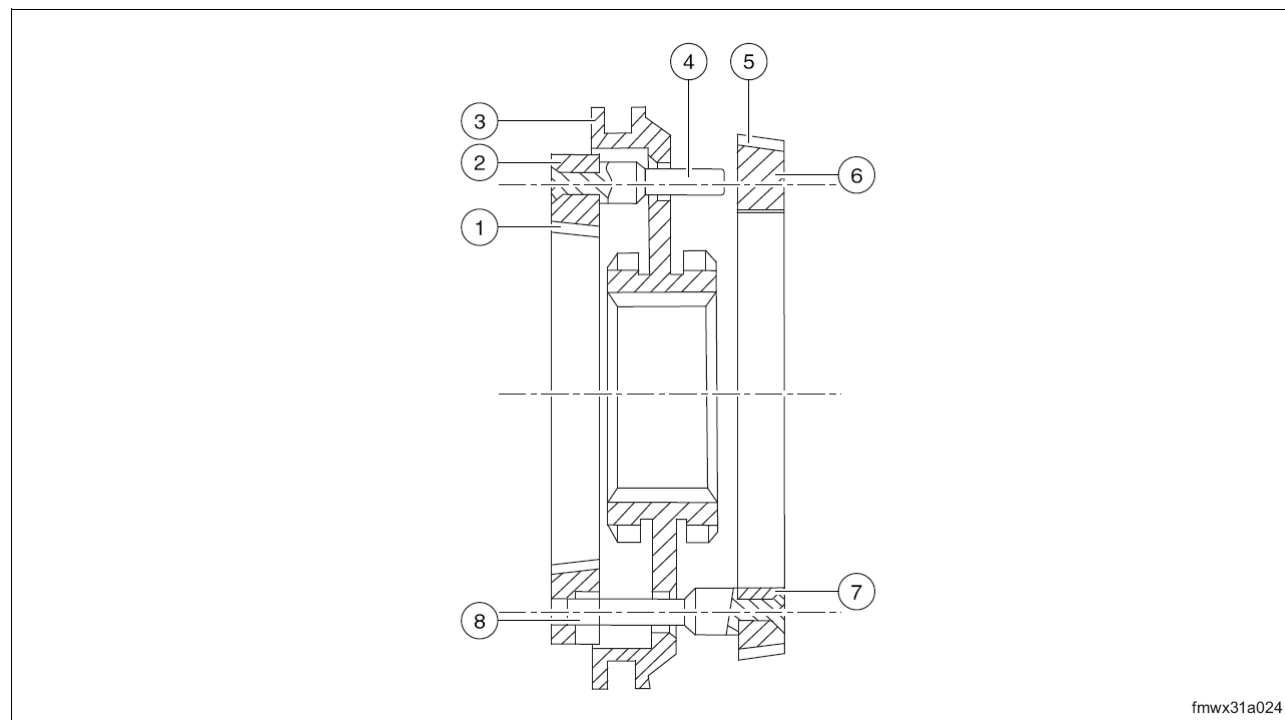
The direct gear and overdrive gear of the old transmission are different on the lever. However, after improvement, the direct gear and overdrive gear of the new transmission are the same on the lever, and a set of reversing mechanism is added on the upper cover, which facilitates the driver's operation largely.

VI. Structure and Operating Principle of Synchronizer

A lock pin inertia synchronizer is installed in the auxiliary transmission of the twin countershaft transmission. The lock pin inertia synchronizer is controlled by the gear shift cylinder of the auxiliary box and only operates during high-low gear shift. The action of the lock pin inertia synchronizer is controlled by the transverse gear shift lever and the single H air valve.

Transmission (RT-11509C) - Transmission

Three lock pins 4 and 7 are respectively riveted on the high-gear synchro ring 2 and the low-gear conical ring 6. The sliding gear sleeve 3 is combined with the output shaft of the auxiliary transmission through a spline. The substrates of the high-gear synchro ring and the low-gear conical ring are made by iron base powder metallurgical sintering, non-metal materials with high frictional property are respectively stuck to the inner cone of the high-gear synchro ring and the outer cone of the low-gear synchro ring, and the corresponding outer cone and inner cone the are respectively arranged on the driving gear and the reduction gear of the auxiliary transmission. See the drawing below:



1	High Gear Friction Belt
2	High Gear Synchro Ring
3	Sliding Gear Sleeve
4	High Gear Lock Pin

5	Low Gear Friction Belt
6	Low Gear Cone Ring
7	Low Gear Lock Pin
8	Spring

VII. Operating Principle of Air Circuit

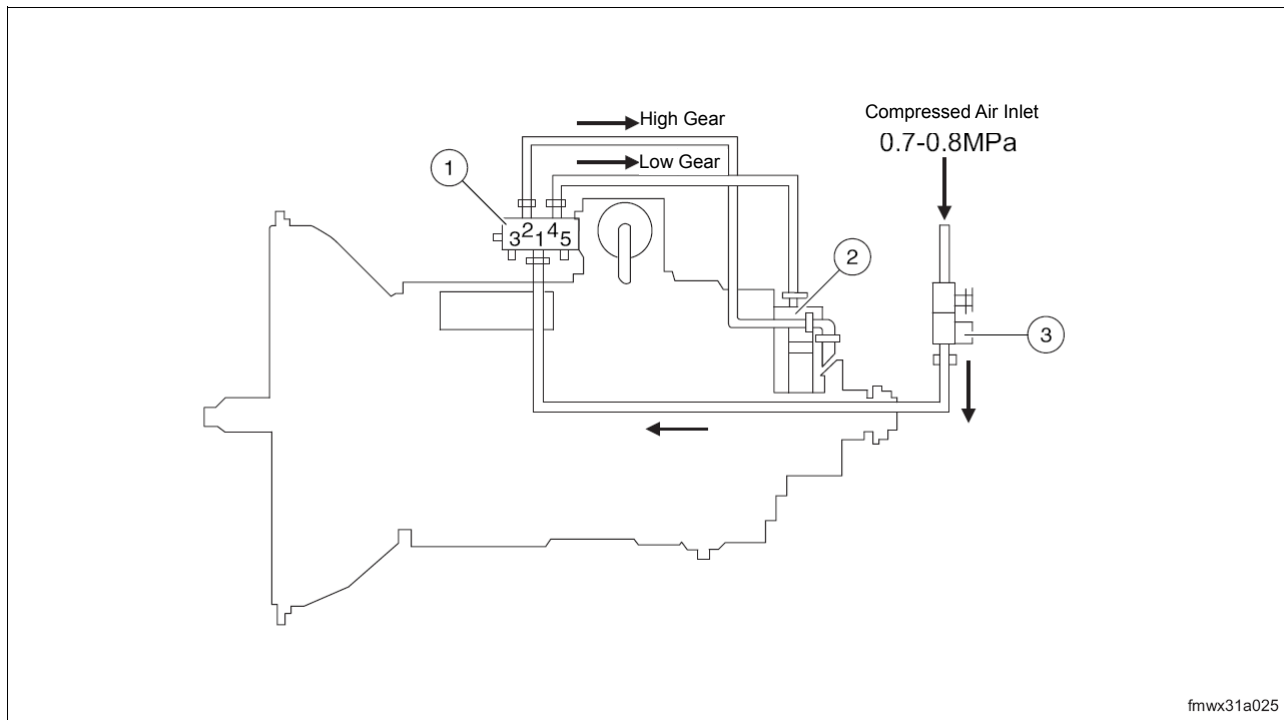
- The gear shift of the auxiliary transmission of the twin countershaft transmission is under the control of the pressure regulating air circuit system.
- The air circuit system includes the air filter regulator, double H air valve, auxiliary box gear shift cylinder and connecting pipe.
- The faults in the air circuit system may cause failure or lagging of the gear shift or damage to the transmission parts. If mastering the operating principle of the air circuit system and doing simple inspection, you can find out the problem and eliminate it by repair in time.

Operating Principle:

Compressed air of 0.7-0.8Mpa from the air reservoir of the whole vehicle, after its pressure is adjusted to 0.41-0.44Mpa by passing through air filter regulator, enters the inlet of the double H air valve through the air pipe. When putting into a low gear, the contact of the double H air valve is ejected to connect the low gear air circuit, the compressed air goes into the low gear inlet of the gear shift cylinder through the low gear air pipe of the double H air valve and then pushes the piston of the gear shift cylinder to move backward, the shift fork shaft of the gear shift cylinder drives the sliding sleeve of the synchronizer to be meshed with the inner engaging teeth of the auxiliary box reduction gear, and both the transmissions are

Transmission (RT-11509C) - Transmission

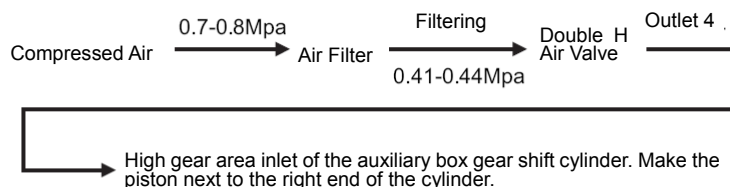
in low gear. When putting into a high gear, the contact of the double H air valve is compressed to connect the high gear air circuit, the compressed air goes into the high gear inlet of the gear shift cylinder through the high gear air pipe of the double H air valve and then pushes the piston of the gear shift cylinder to move forward, the shift fork shaft of the gear shift cylinder drives the sliding sleeve of the synchronizer to be meshed with the inner engaging teeth of the auxiliary box driving gear, and both the transmissions are in high gear. When the gear shift lever shifts gear from the low gear area to the high gear area or from the high gear area to the low gear area, the remaining air in the cylinder is discharged from the air vent of the double H air valve through the connecting air pipe.



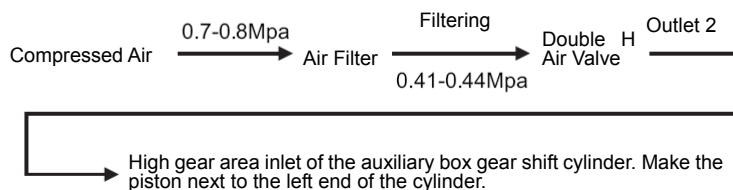
1	Double H Gear Shift Air Valve
2	Cylinder, Range Gear

3	Air Filter Regulator
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When the gear shift lever is operated in the low gear area, the working line of compressed air is:



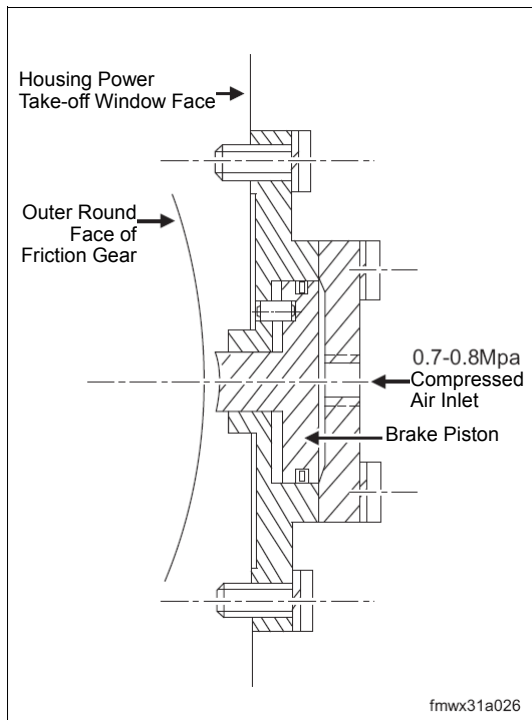
When the gear shift lever is operated in the high gear area, the working line of compressed air is:



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VIII. Countershaft Brake

The countershaft brake is also called clutch brake, which is installed on the right of the main transmission housing. The countershaft brake is a control brake device, and the control air valve is installed below the clutch pedal. Pressing the pedal to the floor is to connect the air circuit of the countershaft brake, compressed air will push the brake piston to the topline of the countershaft power take-off gear to quickly reduce the speed of the countershaft and main shaft gears, and the driven part of the clutch.



The countershaft brake is used in the transmission system equipped with the push type clutch. Before the vehicle takes off, the transmission is in the neutral position, the engine drives the clutch, input shaft and gears in the transmission main box to rotate, but the main shaft does not rotate. When the vehicle is put into gear and takes off, release the clutch first, press the clutch pedal to the floor to connect the air circuit of the countershaft brake so as to quickly reduce the speed of the driven part of the clutch, and the input shaft, countershaft gear and main shaft gear, then put into gear to take off the vehicle stably. The abnormal noise will be generated when putting into gear for the vehicle not equipped with the countershaft brake. The vehicle can take off stably by the method of stopping for additional 3~5s and then putting into gear after pressing the clutch pedal.

Hint:

The countershaft brake is used for take-off only.

Transmission (RT-11509C) - Transmission**Fault Symptom Table**

The following table can help you find out the fault. The serial number shows the order of the fault possibility. Inspect every part according this order, and replace if necessary.

Fault Symptom	Possible Cause	Reference
Abnormal sound or noise	1. The quality of lubricating oil is poor.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	2. The lubricating level is insufficient.	Fill lubricating oil.
	3. The tooth surface of the gear is damaged or worn excessively to generate large tooth gap.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	4. The bearing is damaged or has cracks.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	5. The combining position of the gear shift fork and gear is improper.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	6. The synchronizer is worn or damaged.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	7. The gear is damaged.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
The gear shifting of the main transmission is difficult or fails.	1. The bearing is worn or damaged.	Chapter 31A Transmission RT-11509C – Main Box, Disassembly and Assembly
	2. The shift fork and shaft bend or have burrs.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
	3. The check screws of the shift fork are loose.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
	4. The release of the clutch is abnormal.	Chapter 32 Clutch – Clutch Assembly, Testing & Adjustment
	5. The viscosity of lubricating oil is too high.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	6. The main shaft is distorted.	Chapter 31A Transmission RT-11509C – Main Shaft Assembly, Disassembly and Assembly

Transmission (RT-11509C) - Transmission

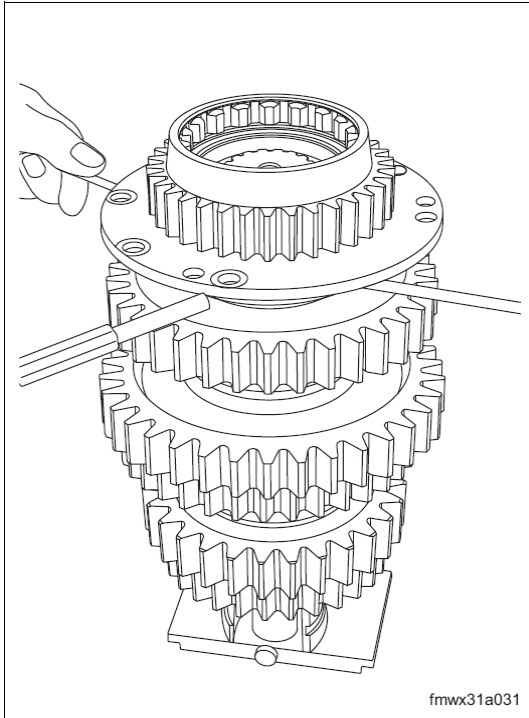
Fault Symptom	Possible Cause	Reference
The shifting of the high and low gear sections of the auxiliary box delays or fails.	1. The pressure regulator valve is defective.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	2. The air pipe or joint is defective.	Chapter 31A Transmission RT-11509C – Double H Control Mechanism, Dismantlement and Installation
	3. The plunger of the double H air valve is seized.	Chapter 31A Transmission RT-11509C – Double H Control Mechanism, Dismantlement and Installation
	4. The O-ring of the gear shift cylinder is lubricated poorly or damaged.	Chapter 31A Transmission RT-11509C – Auxiliary Box, Disassembly and Assembly
	5. The nuts of the cylinder piston are loose.	Chapter 31A Transmission RT-11509C – Auxiliary Box, Disassembly and Assembly
	6. The cylinder piston is damaged.	Chapter 31A Transmission RT-11509C – Auxiliary Box, Disassembly and Assembly
	7. The synchronizer or spring is damaged.	Chapter 31A Transmission RT-11509C – Auxiliary Box, Disassembly and Assembly
Off-gear or gear jumping of the main transmission	1. The gear shift fork deforms or is worn.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
	2. The locking ball or the ball groove on the gear shift fork shaft is worn.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
	3. The locking spring is broken or fatigued.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
	4. The gear clearance is too large.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	5. The engaging teeth or gear sleeve back taper fails.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	6. The sliding part or end face of the sliding bearing bushing is worn.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	7. The bearing is worn to cause axial displacement.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	8. The flange lock nuts are loose.	Chapter 31A Transmission RT-11509C – Auxiliary Box, Disassembly and Assembly
Off-gear of the high and low gear sections of the auxiliary transmission	1. The pressure regulator valve is defective.	Replace the pressure regulator valve.
	2. The air pipe or joint is defective.	Chapter 31A Transmission RT-11509C – Single H Control Mechanism, Dismantlement and Installation
	3. The shaft is distorted, and the gear leaves the teeth alignment position.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	4. The engaging teeth or gear sleeve back taper fails.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment

Transmission (RT-11509C) - Transmission

Fault Symptom	Possible Cause	Reference
The gears are in disorder.	1. The interlock steel ball or interlock pin is not installed or worn.	Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly
Oil or air leakage	1. Lubricating oil is excessive.	Adjust lubricating oil to the standard value.
	2. The seals are damaged or fail.	Chapter 31A Transmission RT-11509C – Transmission, Testing & Adjustment
	3. The fasteners are loose.	Tighten the loose parts.
	4. The breather plug is clogged.	Clean or replace the breather plug.
	5. The bolt is not coated with sealant.	Coat with sealant, and re-install the bolt.

Testing & Adjustment

1. Test the axial clearance of the main shaft gears

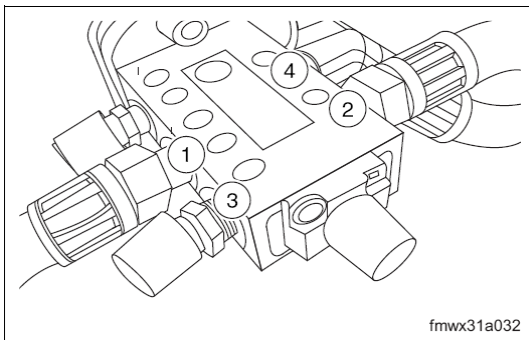


- (a). Place the main shaft vertically, put the reverse gear snap ring in, and install the auxiliary box driving gear and snap ring.
- (b). Inspect the clearance between the reverse gear and driving gear by a feeler gauge.

Standard Clearance Value: 0.3~0.9 mm

- (c). Inspect the axial clearance between the low and reverse gears and between the 2nd and 3rd gears of the main shaft.

Standard Clearance Value: 0.13~0.3 mm

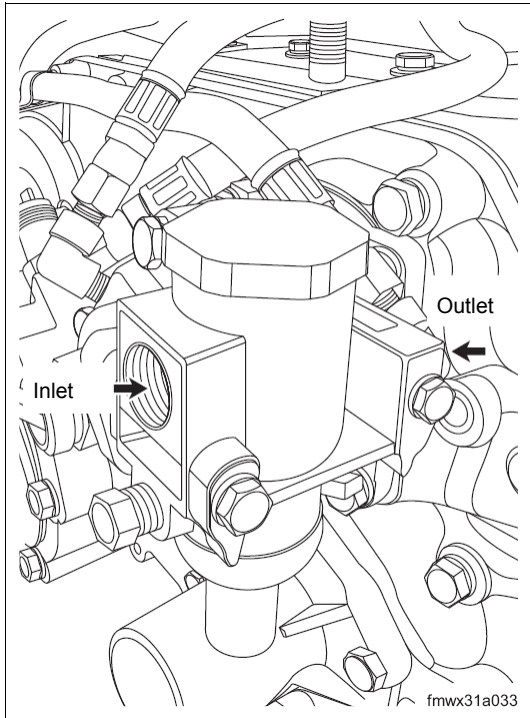


2. Test the dual-H air valve

- (a). Appearance test: The housing shall be free from defects, and the plunger shall move flexibly and have no heavy wear.
- (b). Channel testing: When the pin is in the original position, the compressed air introduced in shall flow out from the outlet 4 only; when the pin backs to the lowest position due to force carrying, the compressed air introduced in shall flow out from the outlet 2 only.

Hint:

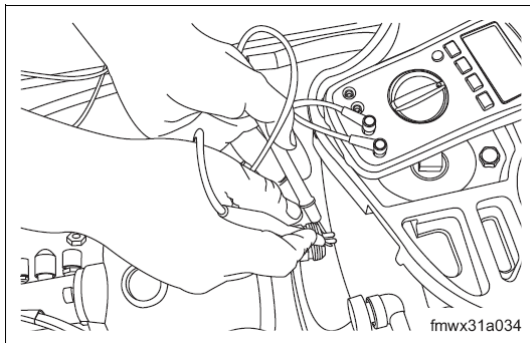
Replace the air valve if any of the fault phenomena appears.

Transmission (RT-11509C) - Transmission**3. Test the air filter regulator**

- (a). Appearance test: The part shall be free from defects and leakage.
- (b). Pressure testing: When the air pressure of the vehicle reaches 0.7~0.8Mpa, an air pressure gauge is installed at the outlet, and the pressure valve displayed by the air pressure gauge shall be 0.41~0.44Mpa.

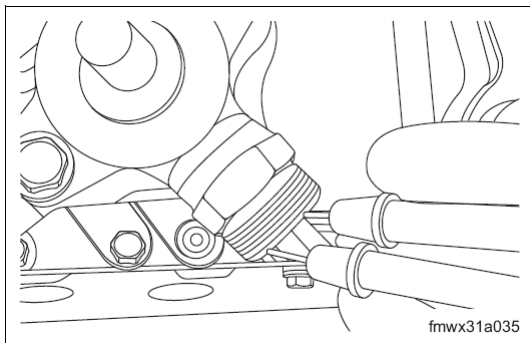
Hint:

Replace the air filter regulator if the reading fails to meet the requirement.

**4. Test the neutral position switch**

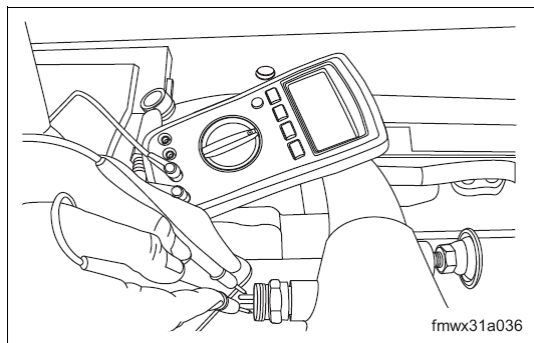
- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Neutral Gear	<1
Other Gears	∞

**5. Test the range gear switch**

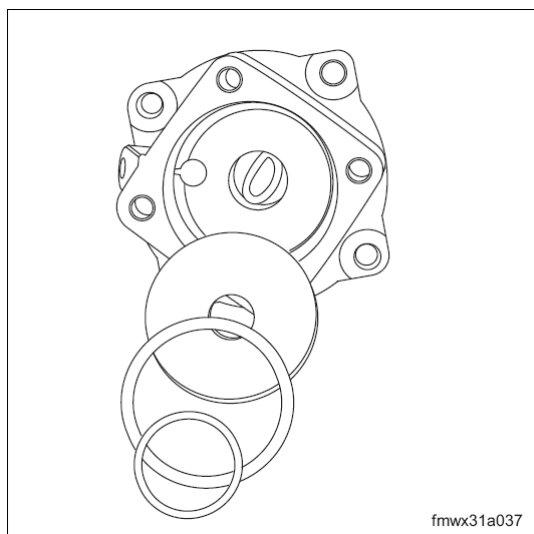
- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Low Gear	<1
High Gear	∞

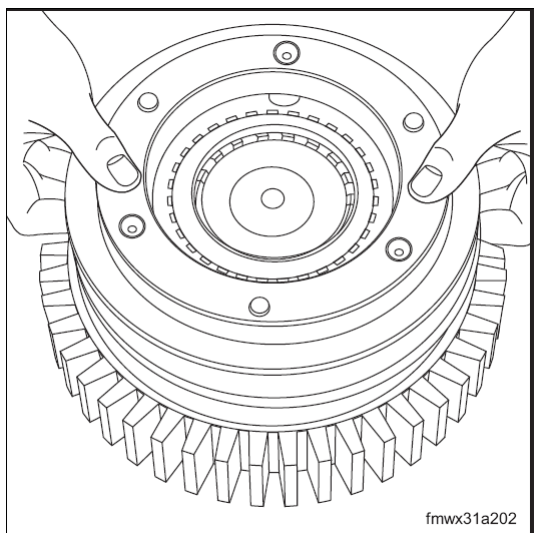
**6. Test the reverse switch**

- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

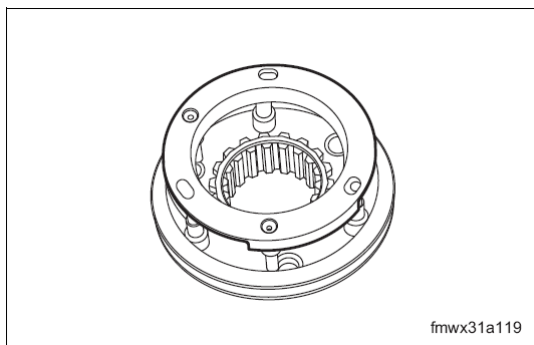
Gear	Contact Resistance (Ω)
Reverse Gear	<1
Other Gears	∞

**7. Test the gear shift cylinder of the auxiliary box**

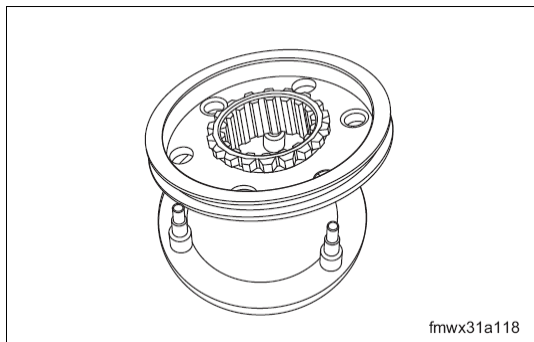
- (a). Test whether the O-ring or other seals are damaged, deformed, lubricated poorly or installed not in position.

**8. Inspect the high/low gear synchronizer**

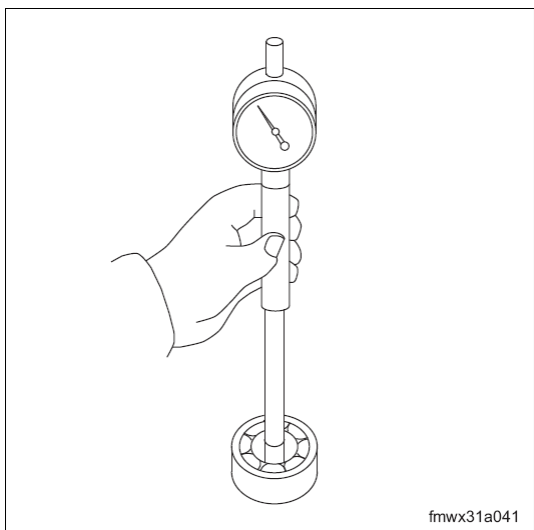
- (a). Inspect the fit state between the synchronizer and auxiliary box output shaft.

Transmission (RT-11509C) - Transmission

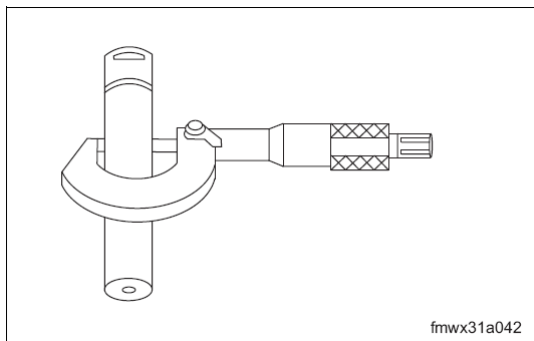
- (b). Inspect whether the synchronizer keyway and lock pin are worn.



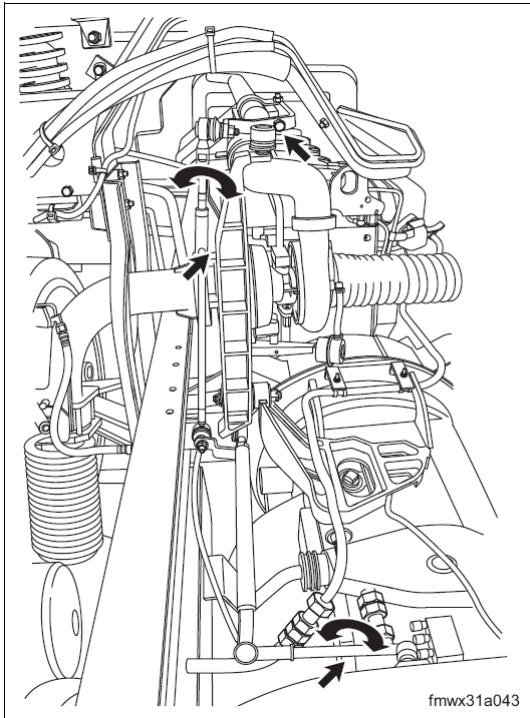
- (c). Inspect whether there are cracks, deformation, etc. on the synchronizer ring gear.

**9. Inspect bearings**

- (a). Place all bearings in clean solution and wash them. Inspect whether the steel balls, rollers and bearing raceway have pits or fall off.
- (b). Measure the inside diameter of the bearing.
- (c). Replace the bearing if the measured value exceeds the limit value.

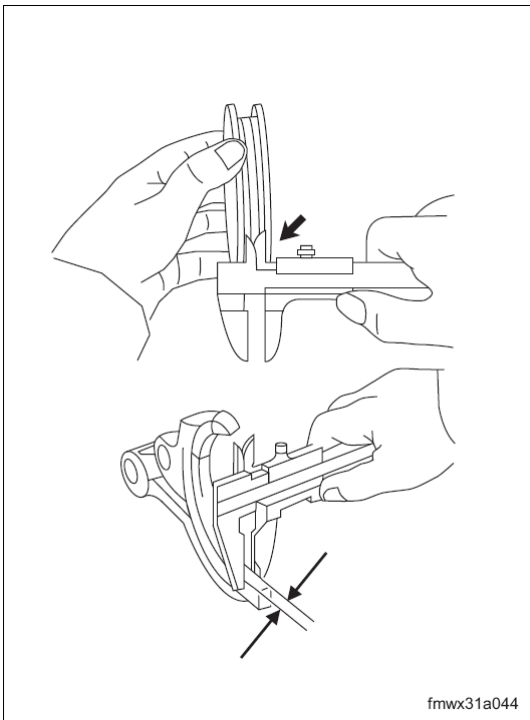
**10. Test the diameter of the reverse gear shaft**

- (a). Measure the diameter of the reverse gear shaft by a micrometer.
- (b). Replace the reverse gear shaft if the measured value exceeds the limit value.



11. Adjust the gear shift control mechanism of the transmission

- (a). The technician A in the cab holds the gear shift lever in the center.
- (b). The technician B releases the adjusting screws of the expansion link assembly or gear shift lever assembly, and adjusts the gears to the best position.
- (c). Tighten the nuts.



12. Measure the fit clearance between the ring gear and shift fork.

- (a). Measure the size of the ring gear by a micrometer.
- (b). Measure the size of the shift fork by a micrometer.

Hint:

Replace the corresponding ring gear and shift fork if the fit clearance exceeds the limit value.

13. Inspect gears

- (a) Inspect whether there is pitting on the tooth surface of the gears, and replace the gears if any.
- (b) Inspect all mesh gears, replace the gears which are worn into a cone have a decreased mesh length due to impact.
- (c) Inspect the axial clearance, and inspect whether the gear split ring, washer, adjusting gasket and gear flange are worn if detecting the part with excessive clearance. The forward gears of the main shaft shall be kept an axial clearance of 0.13~0.30mm. The reverse gear shall be kept an axial clearance of 0.30~0.90mm.

Transmission (RT-11509C) - Transmission

14. Inspect splines

Inspect the wear degree of splines on all shafts, and replace if the sliding gear sleeve and output flange incline to one side of the spline due to wear.

15. Inspect thrust washers

- (a). Inspect the surface condition of all thrust washers. Replace the washers with scratches or thinned depth.

16. Inspect gray cast iron parts

- (a). Inspect whether there are cracks or damages on all gray cast iron parts. Fusion welding or braze welding can be conducted for large castings, but the heat generated shall not extend to the bearing hole or bolt connecting surface.

17. Inspect bearing caps

- (a). Inspect the wear condition of the rabbet.
- (b). Inspect the oil seal in the primary shaft bearing cap and the oil seal in the odometer housing, replace if the sealing function of the lip fails.

18. Inspect sliding sleeves

- (a). Inspect whether all shift forks and shift fork grooves on the sliding sleeves are worn excessively or discolor due to overheating.
- (b). Inspect whether the contact area of the engaging teeth of the sliding sleeve deflects.

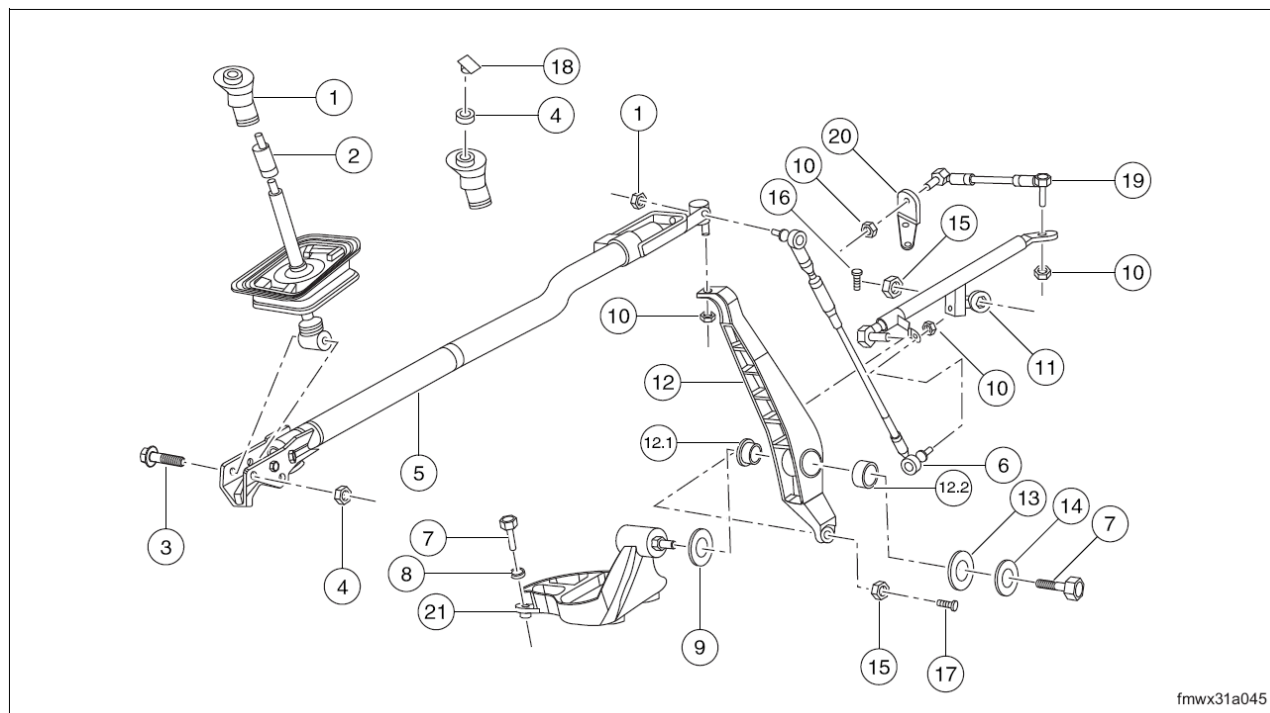
19. Inspect O-ring

- (a). Inspect the cracking and deformation conditions of all O-rings. Replace the O-rings which are worn and aged.

Transmission Control Mechanism

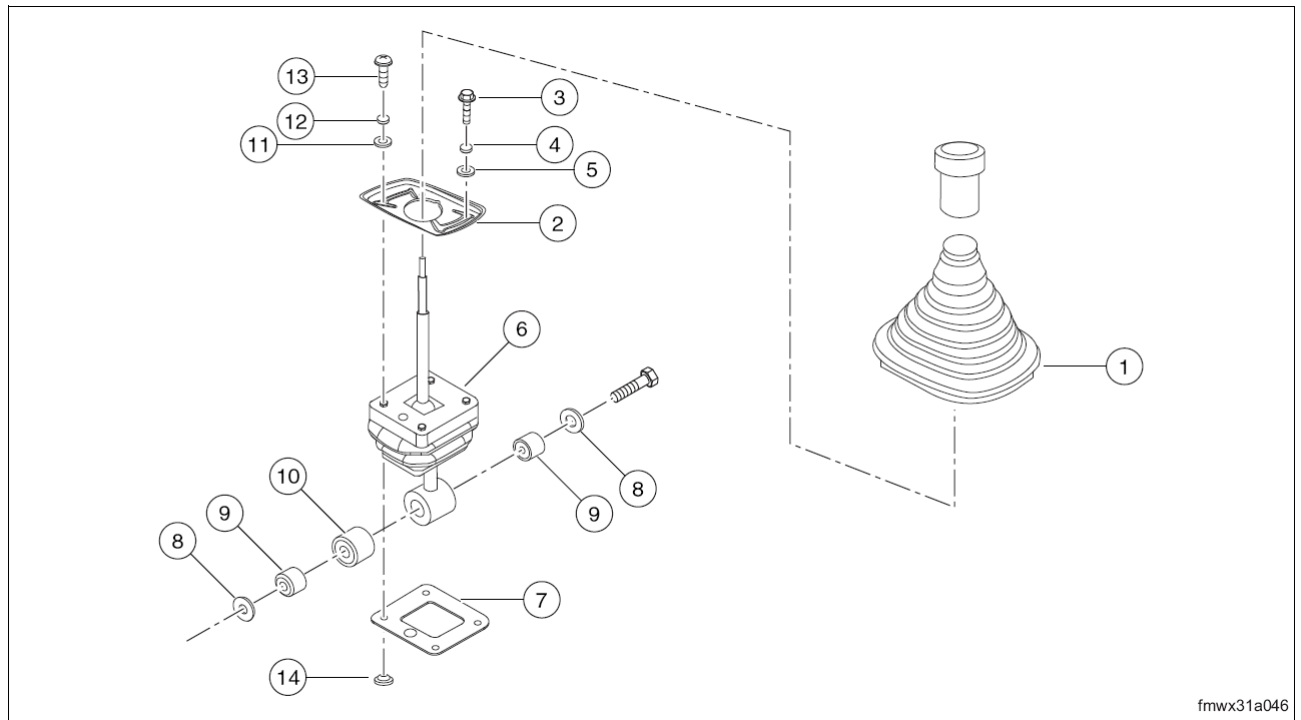
Part

Drawing



1	Knob Assembly
2	Primary Shaft Gear
3	Hex Flange Bolt
4	Prevailing Torque Type All-metal Hex Nut with Flange
5	Expansion Link Assembly
6	Gear Selecting Link
7	Hex Head Bolt
8	Spring Washer
9	Noise Reduction Washer
10	Prevailing Torque Type All-metal Hex Nut, Style 1
11	Gear Shift Link Assembly
12	Gear Shift Rocker Arm Assembly

12.1	Straight Bushing
12.2	L-bushing
13	Sealing Gasket
14	Thick Washer
15	Hex Thin Slotted Nut
16	Cotter Pin
17	Cotter Pin
18	Gear Plate
19	Rear Support Bar Assembly for Gear Selection
20	Gear Selecting Bracket
21	Four-corner Bracket Assembly

Transmission (RT-11509C) - Transmission Control Mechanism

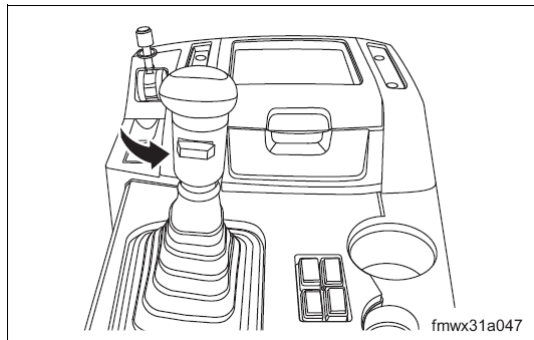
fmwx31a046

1	Upper Dust Cover
2	Upper Pressure Plate
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Operator Assembly
7	Lower Pressure Plate

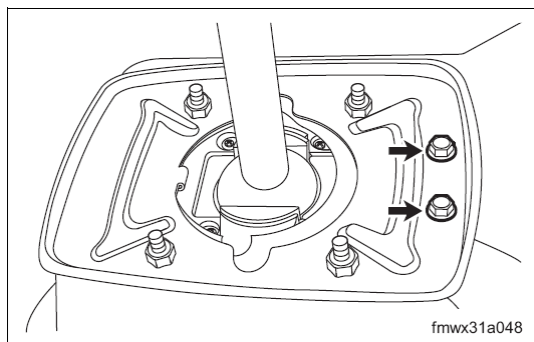
8	Sealing Gasket
9	Composite Bushing
10	Middle Spacer
11	Spring Washer
12	Flat Washer
13	Hex Head Bolt and External Teeth Serrated Lock Washer Assembly
14	Prevailing Torque Type All-metal Hex Nut with Flange

Dismantlement and Installation

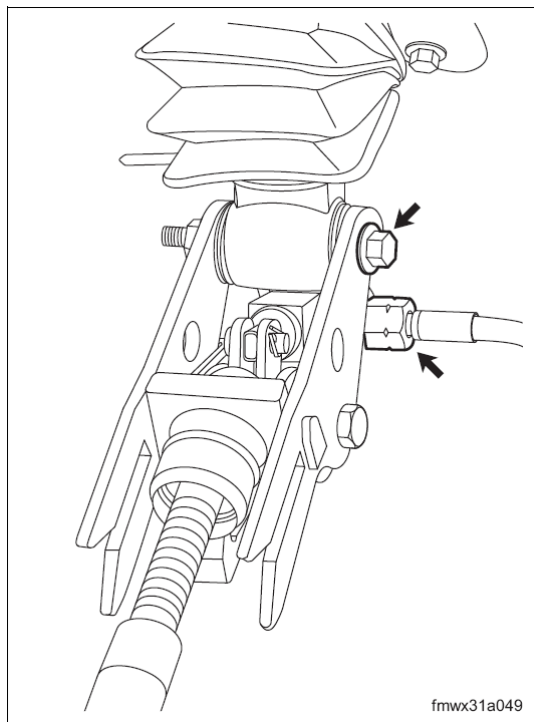
1. Dismantle the gear shift control mechanism



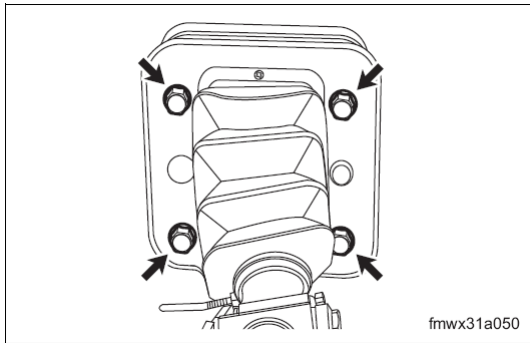
- (a). Dismantle the gear plate, and loose the lock nuts.
- (b). Dismantle the upper dust cover.



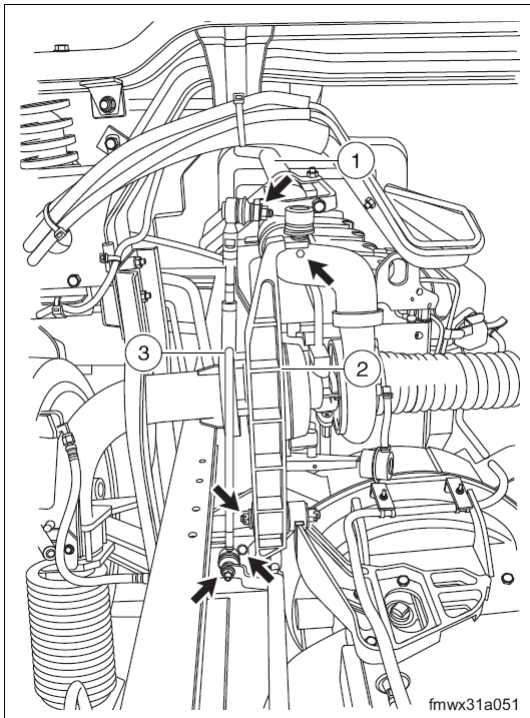
- (c). Dismantle the fastening bolts of the upper pressure plate.



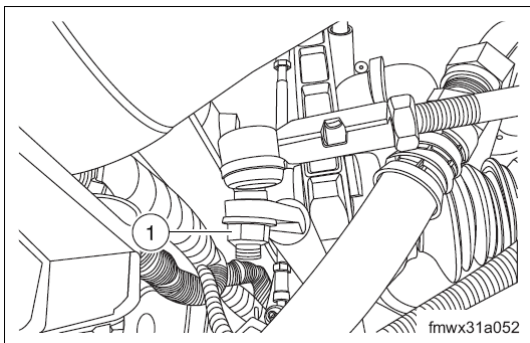
- (d). Disconnect the lubricating oil pipe.
- (e). Disconnect the connecting bolt of the operator and expansion link.

Transmission (RT-11509C) - Transmission Control Mechanism

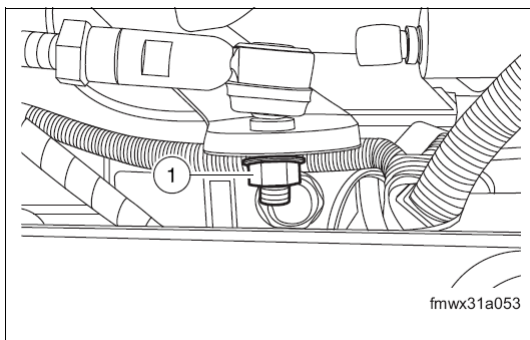
- (f). Dismantle the four fastening bolts of the lower pressure plate.
- (g). Remove the lower pressure plate and lower dust cover in order.
- (h). Remove the gear shift operator assembly.



- (i). Dismantle the gear shift expansion link 1.
 - Dismantle the connecting nut, and take out the expansion link.
- (j). Dismantle the gear selecting link assembly 3.
 - Dismantle the connecting nut, and remove the gear selecting link assembly.
- (k). Dismantle the gear shift rocker arm assembly 2.
 - Dismantle the cotter pin and connecting nut, and remove the gear shift rocker arm assembly.

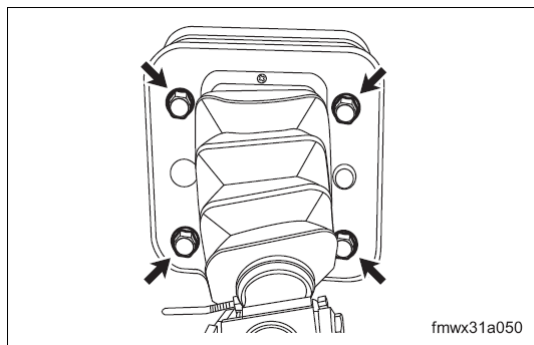


- (l). Dismantle the gear shift link assembly.
 - Dismantle the connecting nut 1 of the gear shift link assembly, and remove the gear shift link assembly.



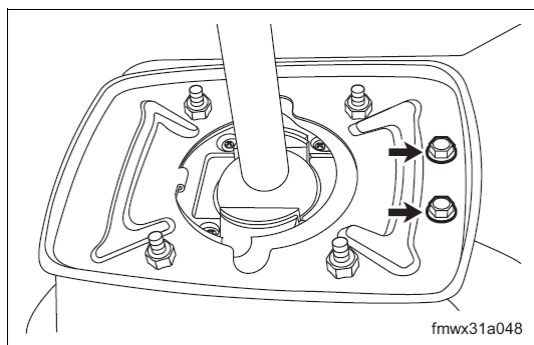
- (m). Dismantle the rear support bar assembly for gear selection.
 - Dismantle the connecting nut 1 of the rear support bar assembly for gear selection, and remove the rear support bar assembly.

2. Install the gear shift control mechanism



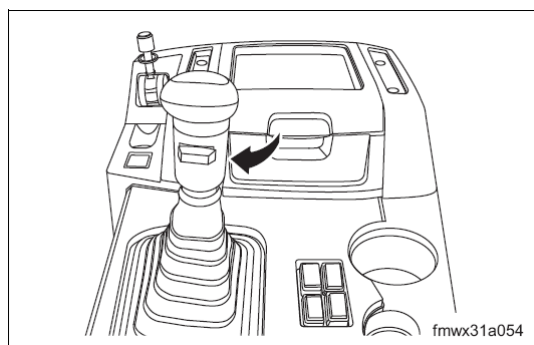
- (a). Install the gear shift operator assembly.
- Install the dust cover and upper and lower pressure plates, and tighten the four bolts.

Torque: 21±5N.m

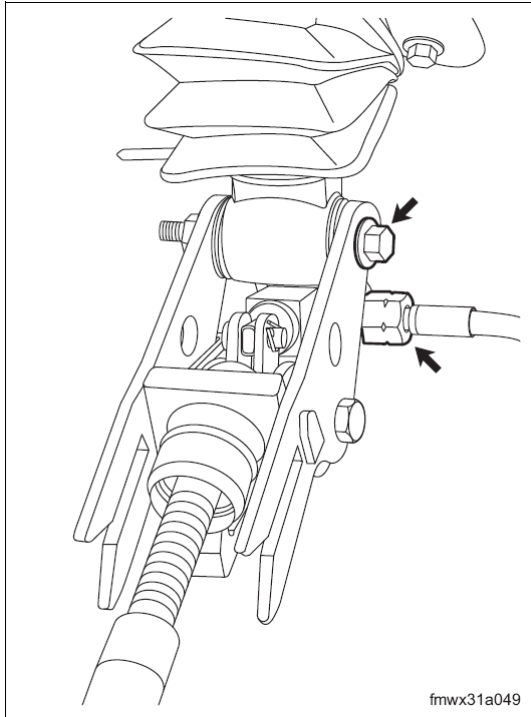


- (b). Dismantle the two fastening bolts of the upper pressure plate.

Torque: 9±3N.m



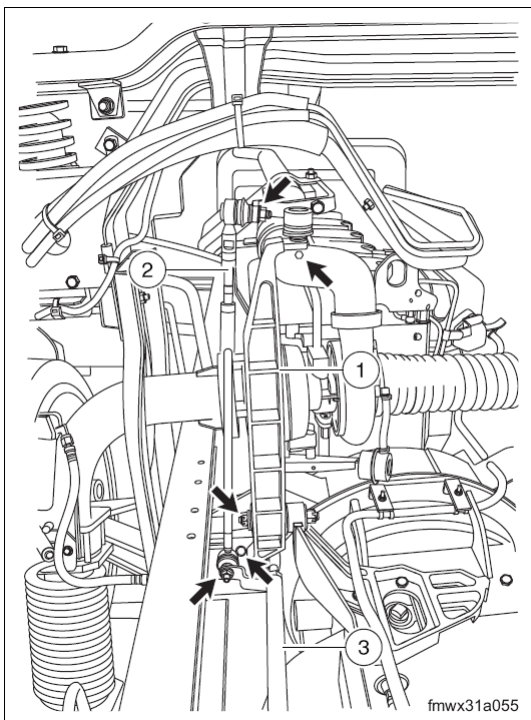
- (c). Install the dust and knob in order, tighten the nuts, and then install the gear plate.

Transmission (RT-11509C) - Transmission Control Mechanism

- (d). Install the expansion link assembly.
- Connect the expansion link and gear shift operator, and tighten the connecting bolt.

Torque: 64N.m

- (e). Connect the lubricating oil pipe.



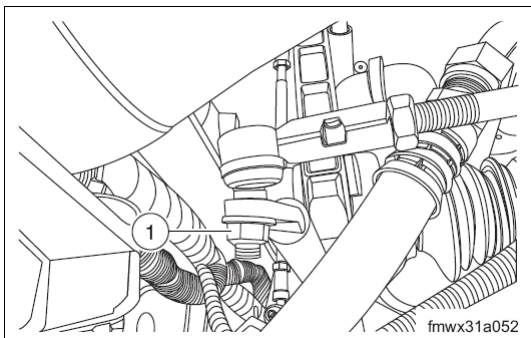
- (f). Install the gear shift rocker arm assembly 1.
- Fix the gear shift rocker arm to the four-corner bracket assembly, tighten the nuts, and insert the cotter pin.
 - Connect the expansion link and gear shift rocker arm, and tighten the connecting nut.

Torque: 95N.m

- (g). Install the gear selecting link assembly 2.
- Connect the gear selecting link assembly 2 and expansion link, and tighten the connecting nut.

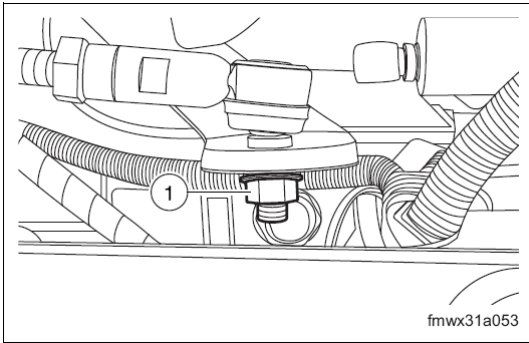
Torque: 95N.m

- (h). Install the gear shift link assembly 3.
- Connect the gear shift selecting link assembly 2 and gear shift link, and tighten the connecting nut.
 - Connect the gear shift link assembly 3 and gear shift rocker arm assembly 1, tighten the connecting nut, and insert the cotter pin.



- (i). Install the rear support bar assembly for gear selection.
- Connect the rear support bar assembly for gear selection and gear shift link, and tighten the connecting nut.

Torque: 95N.m



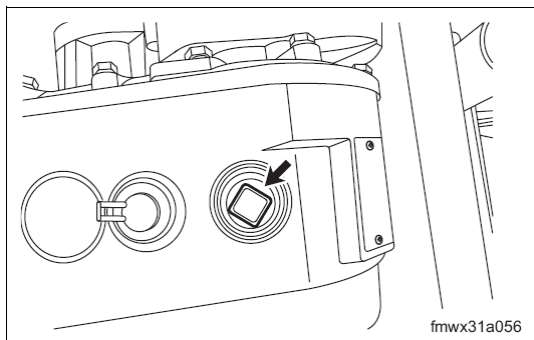
- (j). Install the gear selecting link to the gear selecting bracket, and tighten the connecting nut.

Torque: 95N.m

Transmission Assembly

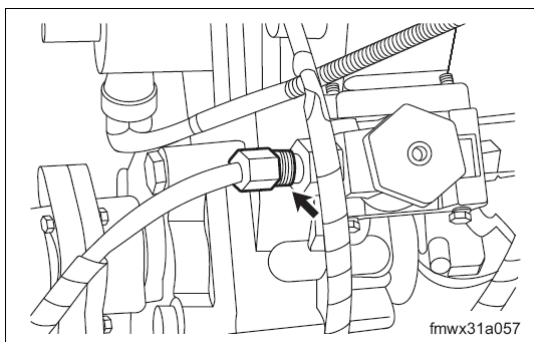
Replacement

1. Lift the rear box
2. Disconnect the battery negative cable

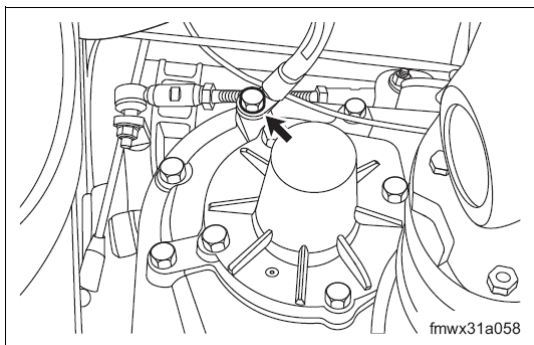


3. Unscrew the oil drain plug at the bottom of the transmission, drain transmission oil, and tighten the oil drain bolt
Torque: $68 \pm 7 \text{ N.m}$

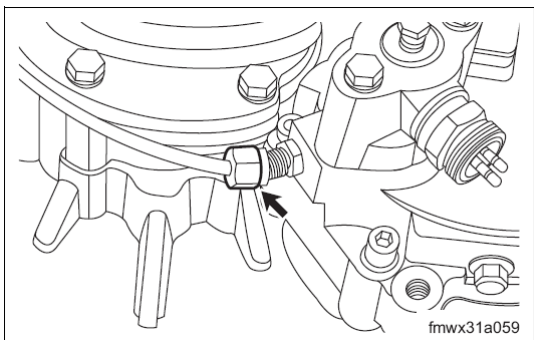
4. Dismantle the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.
5. Dismantle the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.



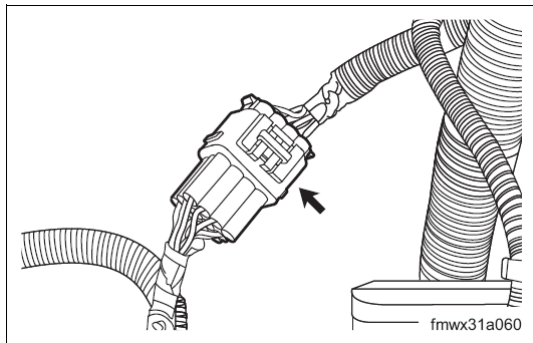
6. Dismantle the transmission accessories
 - (a). Dismantle the air pipe assembly of the air filter regulator.



- (b). Dismantle the grounding cable of the transmission.

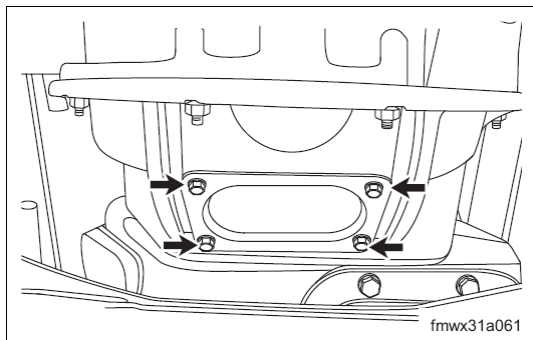


- (c). Dismantle the intake pipe of the power take-off.



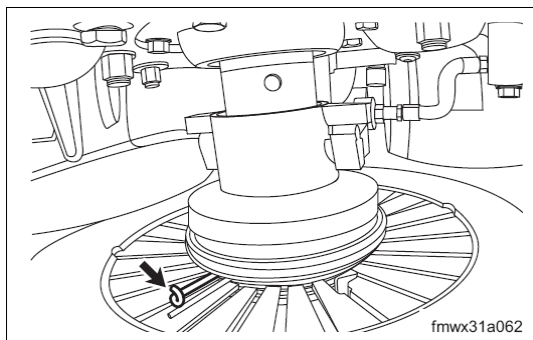
- (d). Disconnect the combined connector of the transmission.

7. **Dismantle the gear shift control mechanism assembly of the transmission. Refer to Chapter 31A Transmission RT-11509C – Transmission Control Mechanism, Disassembly and Assembly.**



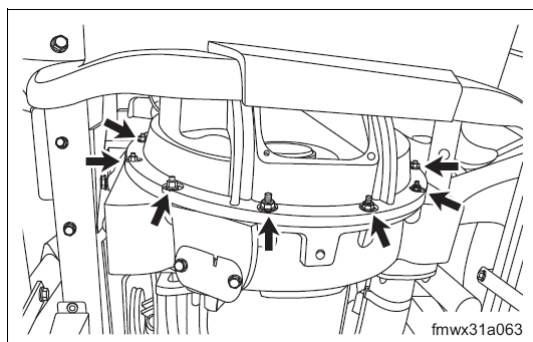
8. **Dismantle the cover plate of the clutch observation hole.**

- (a). Dismantle the four bolts, remove the cover plate.



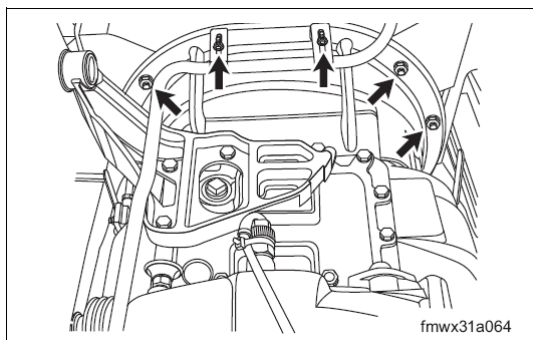
9. **Pick off the hook of the spring clamping wire of the clutch release bearing**

10. **Dismantle the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.**

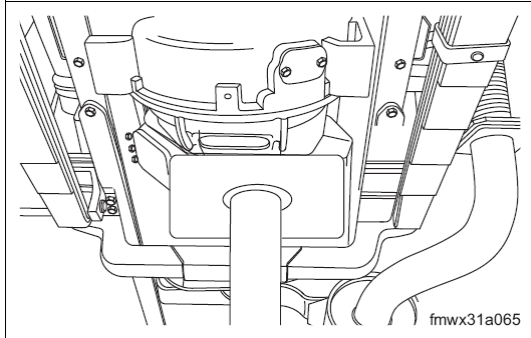


11. **Disconnect the transmission and engine**

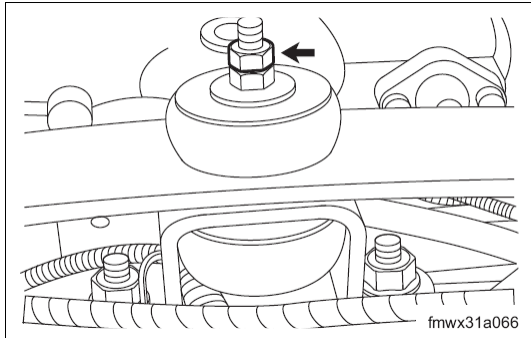
- (a). Dismantle the lower connecting bolts of the transmission and engine.



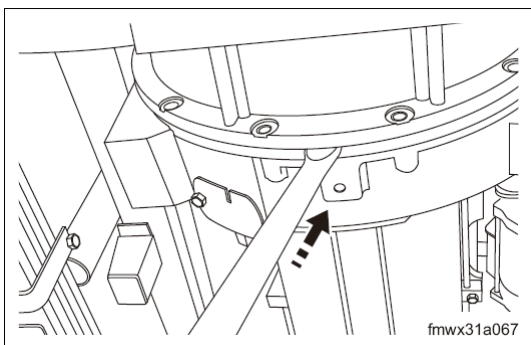
- (b). Dismantle the upper connecting bolts of the transmission and engine.

Transmission (RT-11509C) - Transmission Assembly**12. Dismantle the sub-frame****13. Remove the transmission assembly**

- (a). Jack up the transmission assembly by a transmission hydraulic jack.

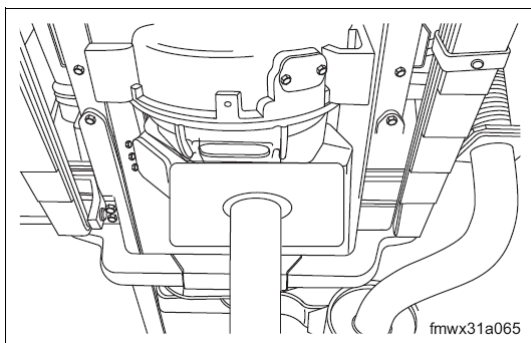


- (b). Dismantle the connecting nut of the transmission mounting, and remove the lower spring beam.



- (c). Separate the transmission from the engine by a flat crowbar.

- (d). Put down the transmission assembly

**14. Install the transmission assembly**

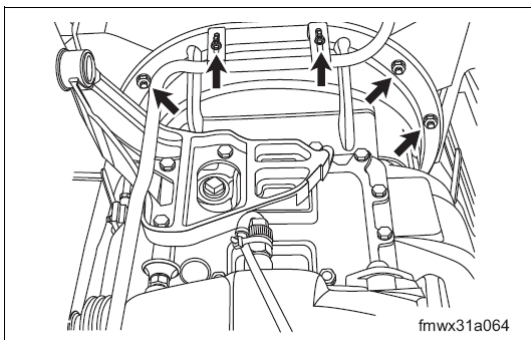
- (a). Connect the transmission assembly with the engine assembly.

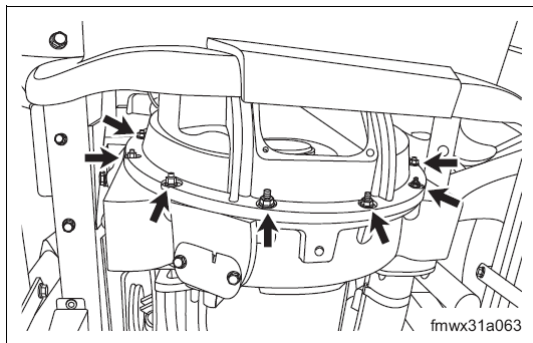
Hint:

Make sure to put on the hook of the clutch spring clamping wire before installing the transmission assembly. Inspect whether the spring clamping wire is loose and flexible on the release ring by moving it. If not flexible, re-install it, or the release bearing may not be installed.

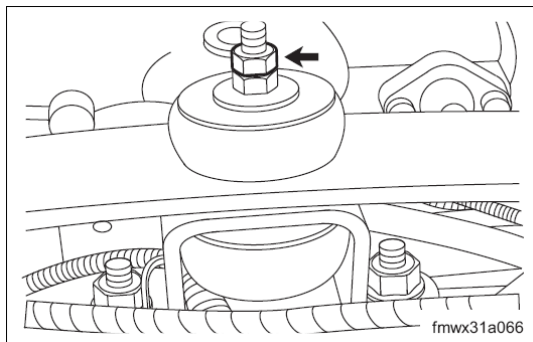
15. Tighten the connecting bolts of the transmission and engine.

- (a). Tighten the upper connecting bolts of the transmission.





- (b). Tighten the lower connecting bolts of the transmission.



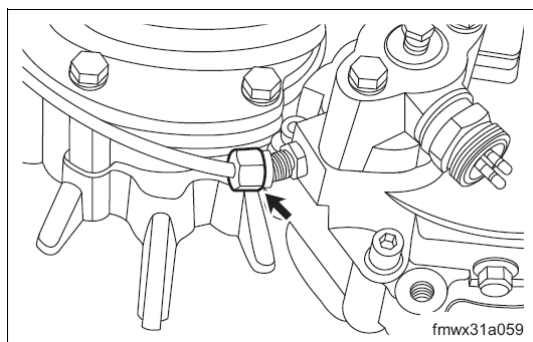
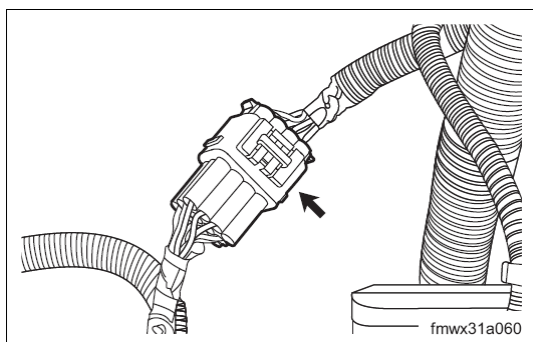
16. Install the spring beam of the transmission, and tighten the connecting nut of the mounting.

Torque: 240N.m

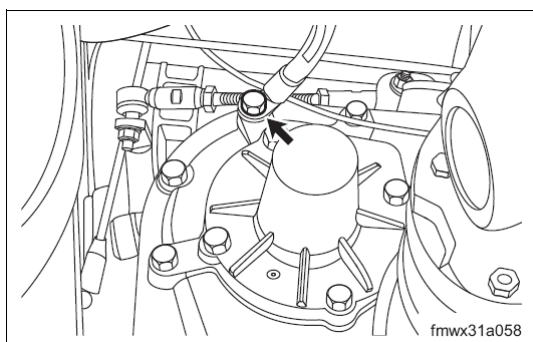
17. Install the gear shift control mechanism assembly of the transmission. Refer to Chapter 31A Transmission RT11509C – Transmission Control Mechanism, Disassembly and Assembly.

18. Install the transmission accessories

- (a). Connect the combined connector of the transmission.

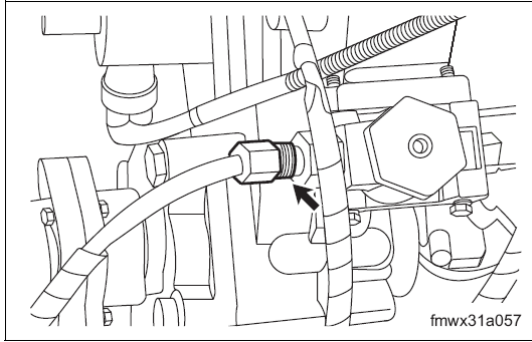


- (b). Install the intake pipe of the power take-off.



- (c). Install the grounding cable of the transmission, and tighten the bolts.

Torque: 54.5±7N.m

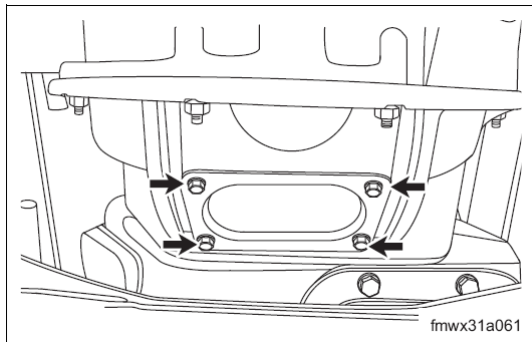
Transmission (RT-11509C) - Transmission Assembly

- (d). Install the air pipe assembly of the air filter regulator.

19. Install the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.

Hint:

Before installing the clutch slave cylinder, tie the end of the release bearing crank by a rope through the window of the clutch slave cylinder, and strongly pull the crank outward to force the release bearing to push the release ring in and make it jammed, which shows that the release bearing is installed in position.



20. Install the cover plate of the clutch observation hole.

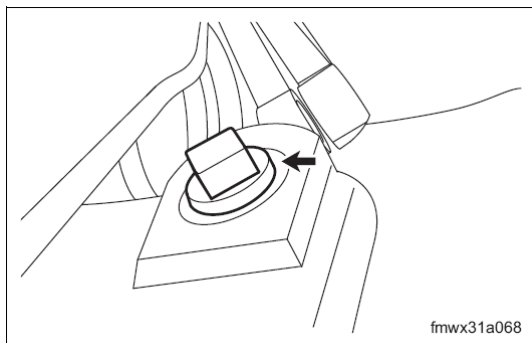
- (a). Install the cover plate of the clutch observation hole, and tighten the four bolts.

Torque: 23.5±3.5N.m

21. Install the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.

22. Install the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.

23. Install the battery negative cable.



24. Unscrew the oil filter plug in the middle of the transmission, fill transmission oil 85W/90GL-5, and tighten the oil filter bolt.

Filling amount of transmission oil: 13L.

Caution:

Run the transmission for several minutes after filling oil, and then inspect the transmission oil level again.

25. Put down the rear box

26. Clutch running-in specification and test

- (a). The environment is that the speed is about 1500 r/min; the oil temperature is not lower than 15 °C;

Transmission (RT-11509C) - Transmission Assembly

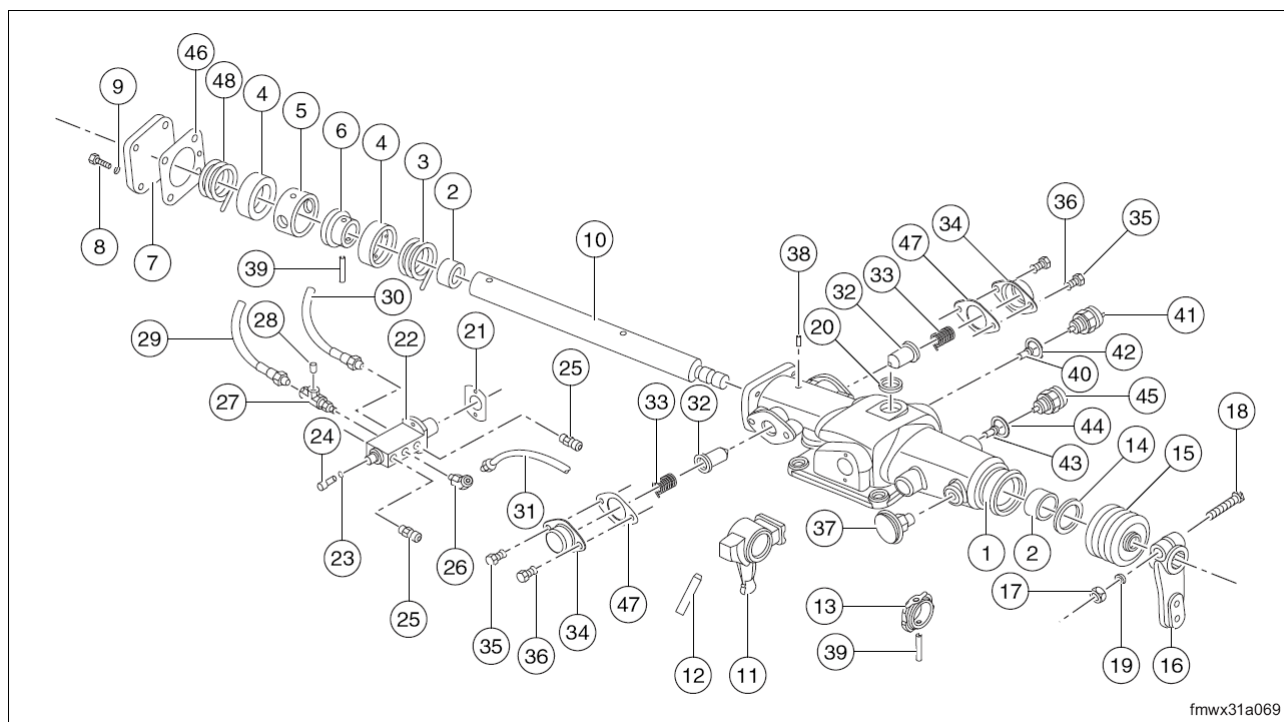
no load is exerted; the transmission is running at neutral gear for not less than 15 min, and at other gear for not less than 20 min.

- (b). Inspect whether the gear shift is flexible, the gears are meshed fully, and there is a gear impact sound during gear shift.
- (c). The gear shift lever of the transmission shall be free from obvious vibration.
- (d). There shall be no abnormal friction sound or impact sound during testing of the transmission.
- (e). The transmission shall not leak oil.
- (f). After running-in, drain transmission oil for running-in, clean the transmission inside completely, and fill transmission oil as specified.

Transmission (RT-11509C) - Double H Control Mechanism

Double H Control Mechanism

Part Drawing



fmwx31a069

1	Double H Control Device Housing
2	Sleeve, Transverse Gear Shift Lever
3	Compression Spring
4	Spring Seat
5	Spring Spacer
6	Locating Ring
7	Side Panel
8	Small Hex Head Bolt M8*22
9	Spring Washer
10	Transverse Gear Shift Lever
11	Guide Block
12	Cylindrical Pin
13	Control Block, Low/Reverse Gear
14	Oil Seal
15	Sleeve
16	LRC Outer Gear Shift Arm
17	Small Hex Nut

25	Breather Plug
26	45° Elbow Joint
27	Tee Pipe Joint
28	Hex Head Tapered Screw Plug
29	Air Pipe Assembly
30	Air Pipe Assembly
31	Air Pipe Assembly
32	Locating Pin
33	Compression Spring
34	Spring Pressure Cover
35	Small Hex Head Bolt M8*12
36	Spring Washer
37	Breather Plug
38	Check Screw
39	Pin 6*36.5
40	Neutral Position Switch Pin
41	Pressure Switch

31A-40

Transmission (RT-11509C) - Double H Control Mechanism

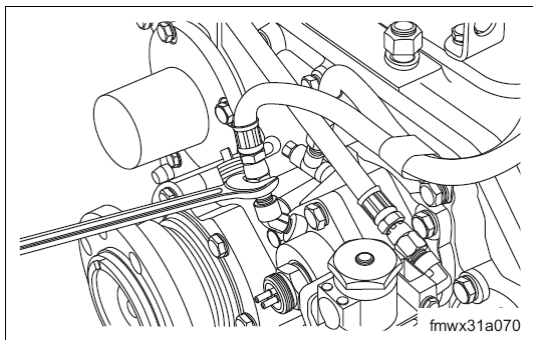
18	Small Hex Head Bolt M10*50
19	Washer
20	Core plug
21	Gasket, Double H Air Valve
22	Double H Air Valve
23	Spring Washer
24	Socket Head Screw

42	Gasket
43	Switch Starting Pin
44	Gasket
45	Pressure Switch
46	End Gasket
47	Gasket
48	Compression Spring

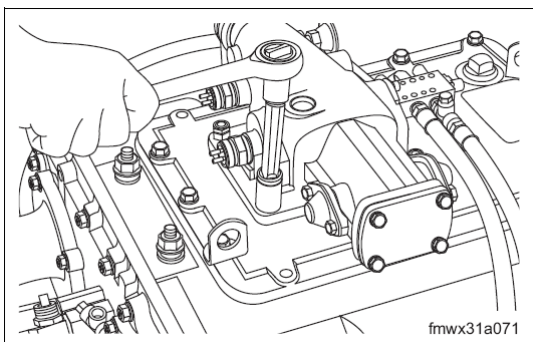
31A

Dismantlement and Installation

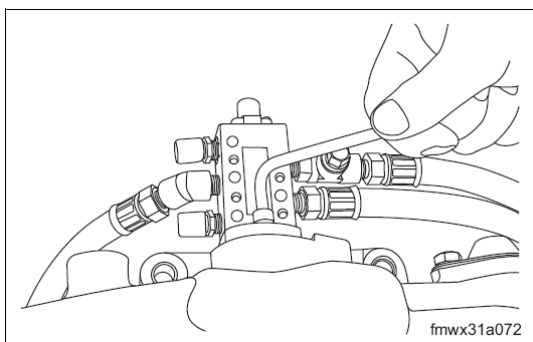
1. Dismantle the double H control mechanism



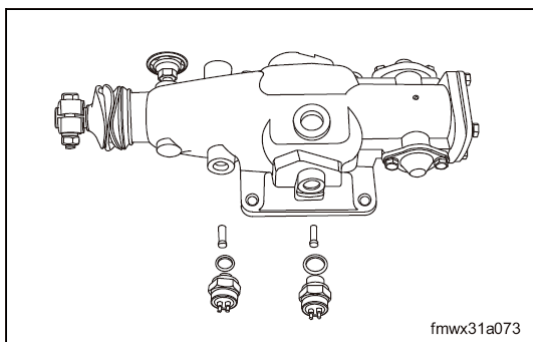
- (a). Dismantle the three air pipes and two air filter bolts.



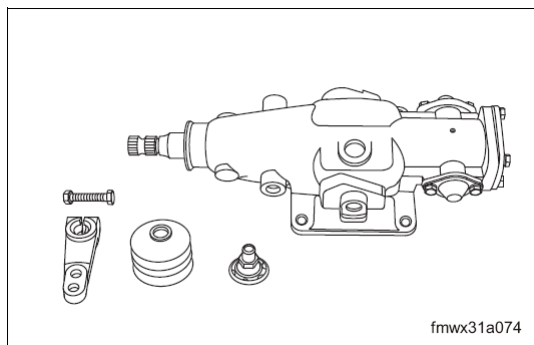
- (b). Dismantle the four nuts on the double H assembly.
(c). Beat the double H assembly housing by a copper rod to make it loose.



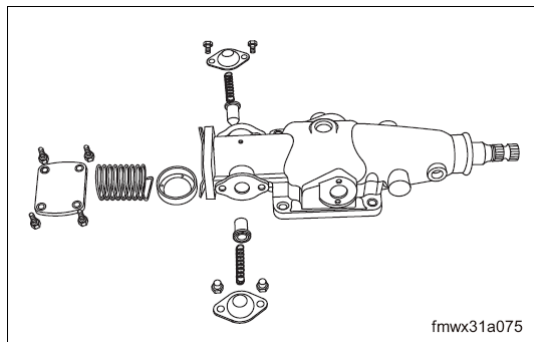
- (d). Remove the double H control assembly from the transmission, and dismantle the double H air valve and air pipe by an Allen wrench.



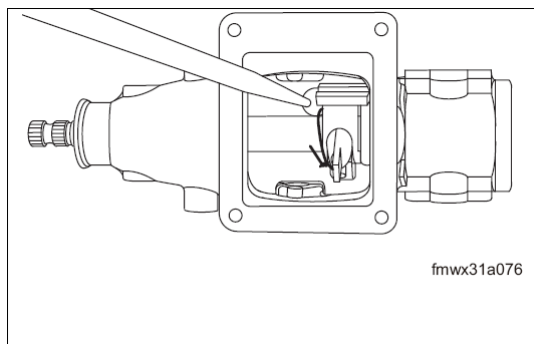
- (e). Dismantle the reverse and neutral position switches and pins.



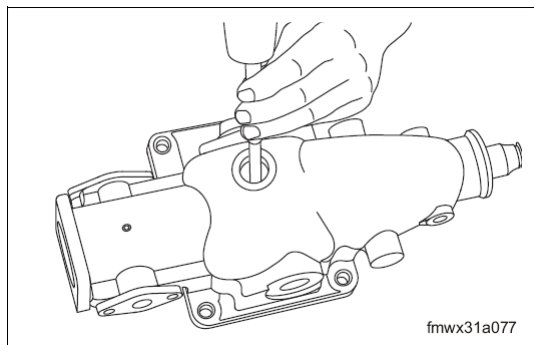
- (f). Dismantle the gear shift rocker arm, dust cover and breather plug in order.



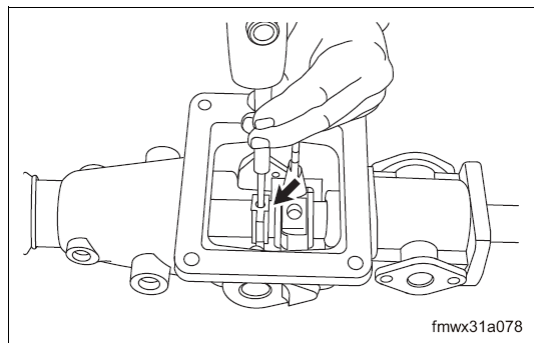
- (g). Dismantle the side panel and spring seats at both sides, and take out the spring, locating plunger and other parts in order.



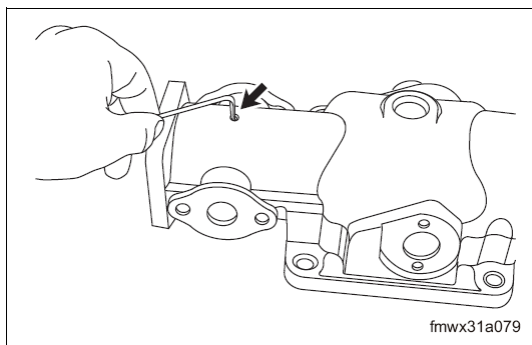
- (h). Dismantle the core plug and locking wire on the guide block.



- (i). Use tools to beat and dismantle the cylindrical pin.



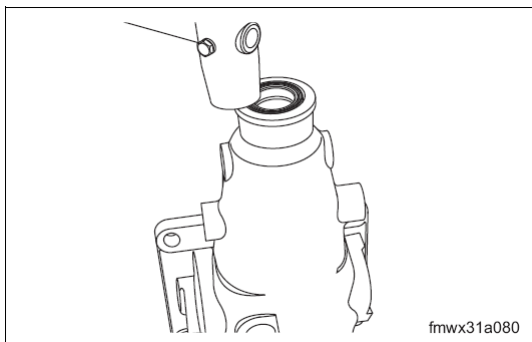
- (j). Dismantle the elastic pin on the transverse gear shift lever.

Transmission (RT-11509C) - Double H Control Mechanism

- (k). Dismantle the check screw, and take out the other group of springs and spring seats the double H housing in order.

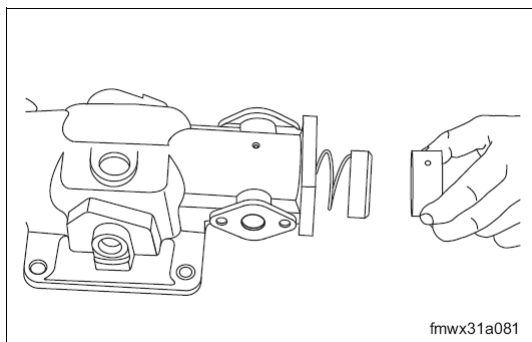
Hint:

There are two springs, and the one close to the housing inside is shorter.

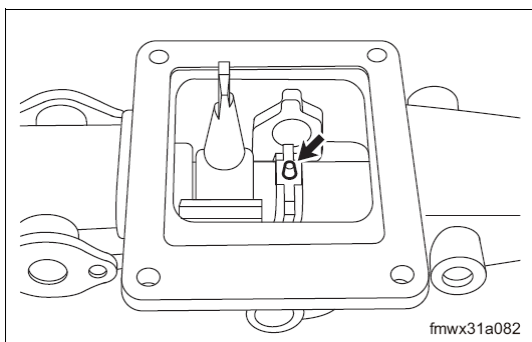


2. Install the double H control mechanism

- (a). Install the oil seal, and apply lubricating grease on the cutting edge.



- (b). Install the springs, spring seats and spacer in the double H housing, and lock with the check screw.

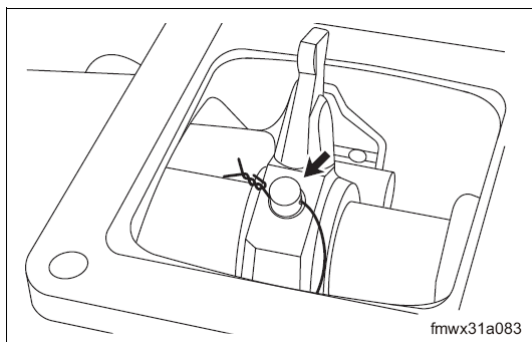


- (c). Install the elastic pin on the locating pin.

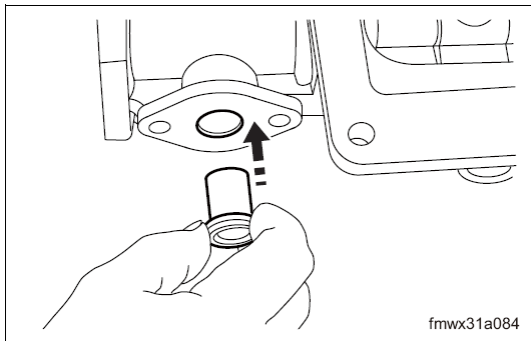
Hint:

Pay attention to the direction of the locating ring.

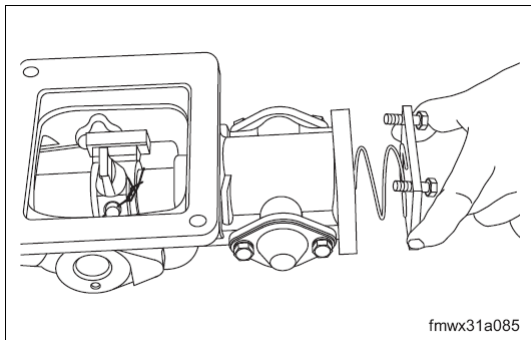
- (d). Install the transverse gear shift lever in the housing, and install the elastic pin on the reverse gear control block.



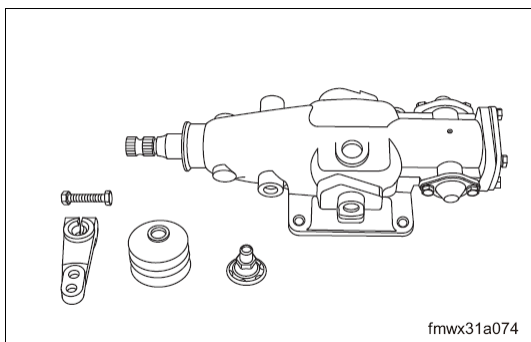
- (e). Install the cylindrical pin on the guide block, and lock with wire.



- (f). Install the plungers, springs and spring seats at both side, and conduct initial lubrication for the plungers.



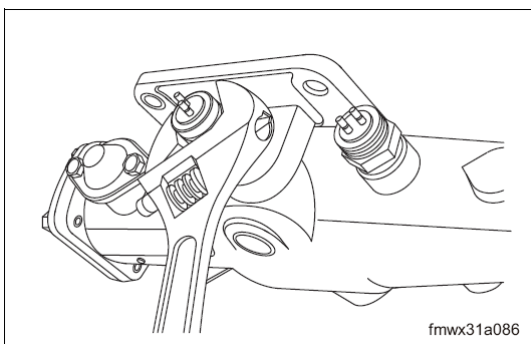
- (g). Install the spring seats and springs, and install the side panel.



- (h). Install the dust cover and gear shift rocker arm.

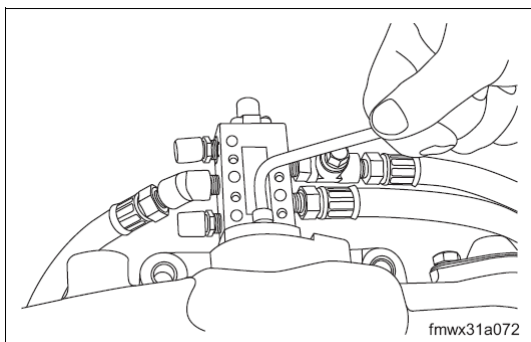
Caution:

Ensure that the rocker arm and guide block are in a straight line.



- (i). Install the reverse and neutral position switches and pins.

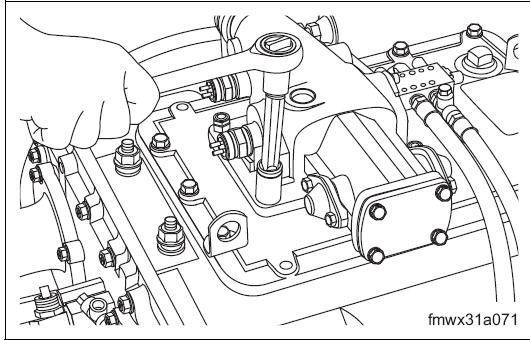
Torque: 23±3N.m



- (j). Install the two locating bolt of the double H valve by a Allen wrench.

Torque: 17±3Nm

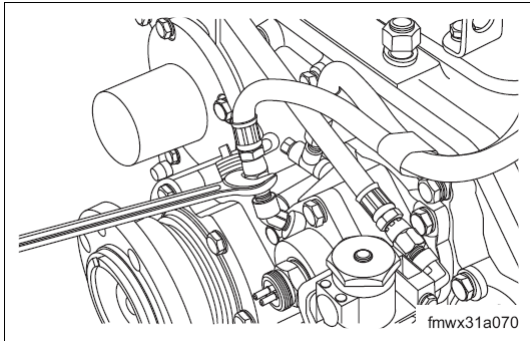
Transmission (RT-11509C) - Double H Control Mechanism



(k). Install the four nuts on the double H assembly.

Caution:

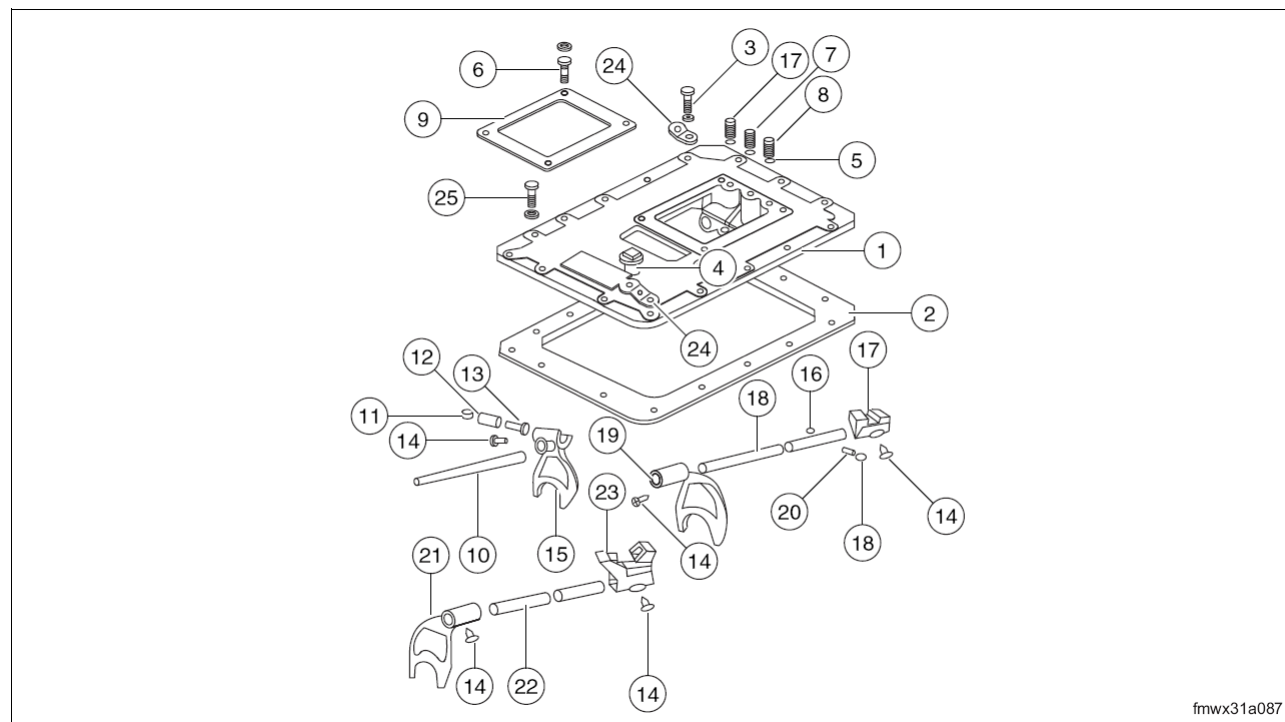
The junction surface must be coated with sealant evenly.



(l). Install the three air pipes and two air filter bolts.

Transmission Upper Cover

Part Drawing



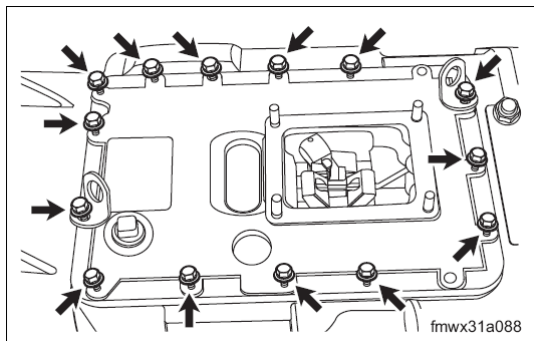
fmwx31a087

1	Upper Cover
2	Upper Cover Gasket
3	Small Hex Head Bolt (M10×38)
4	Square Head Tapered Screw Plug
5	Steel Ball (12.7000G1000b)
6	Stud Bolt
7	Compression Spring
8	Compression Spring
9	Control Window Gasket
10	Low/Reverse Gear Shift Fork Shaft
11	Reverse Gear Lock Screw Plug
12	Reverse Gear Lock Spring
13	Reverse Gear Lock Pin

14	Set Screw, Gear Shift Fork
15	Low/Reverse Gear Shift Fork
16	Steel Ball (19.0500G1000b)
17	1 st /2 nd and 5 th /6 th Gear Guide Block
18	1 st /2 nd Gear Shift Fork Shaft
19	1 st /2 nd Gear Shift Fork
20	Interlock Pin, Shift Fork Shaft
21	3 rd /4 th Gear Shift Fork
22	3 rd /4 th Gear Shift Fork Shaft
23	3 rd /4 th and 7 th /8 th Gear Guide Block
24	Lifting Bent Plate
25	Small Hex Head Bolt (M10×32)

Disassembly and Assembly

1. Dismantle the double H control mechanism assembly of the transmission. Refer to Chapter 31A Transmission RT-11509C – Double H Control Mechanism, Disassembly and Assembly.

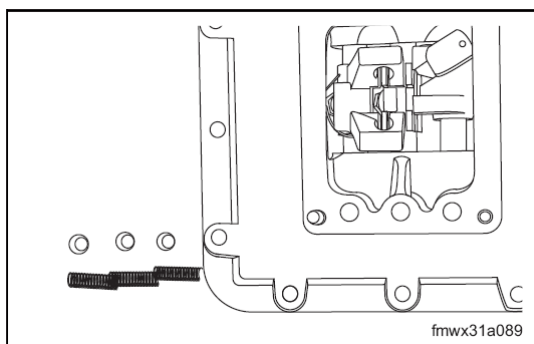


2. Dismantle the upper cover assembly

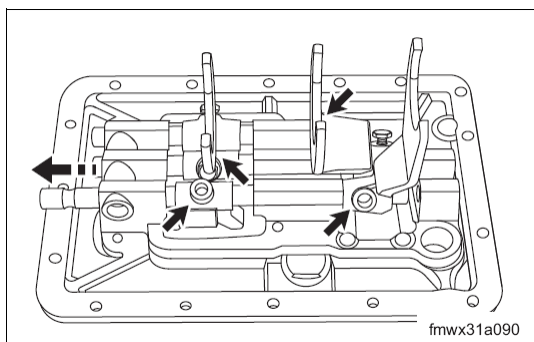
- (a). Dismantle the fastening bolts of the upper cover.
- (b). Beat the upper cover by a copper rod to separate it from the gasket.

Caution:

Do not apply too strong force when bearing the upper cover, and make sure to beat evenly in all directions.

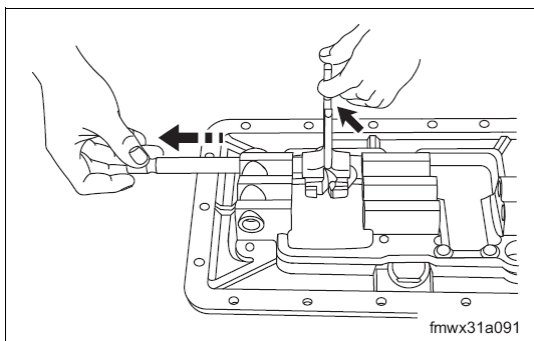


- (c). Remove the upper cover assembly from the transmission, and take out the gear shift self-locking steel balls and the springs.
- (d). Dismantle the four stud bolts.

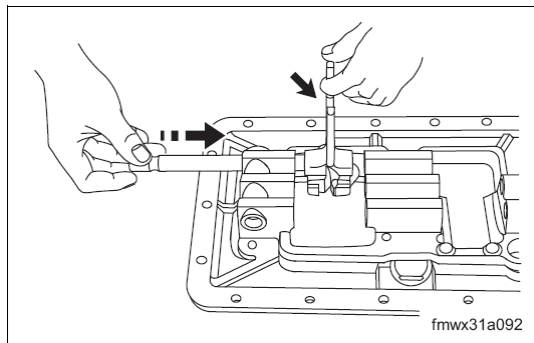


- (e). Turn the upper cover assembly, dismantle the 3rd/4th gear shift fork shaft, guide block and 3rd/4th gear shift fork.

- (f). Dismantle the 1st/2nd gear shift fork shaft, guide block, 1st/2nd gear shift fork and interlock pin.

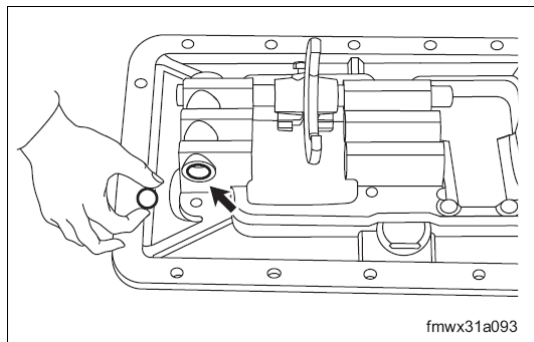


- (g). Dismantle the low/reverse gear shift fork shaft and low/reverse gear shift fork.

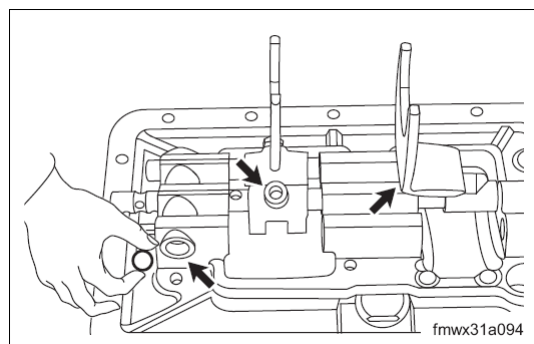


3. Assemble the upper cover assembly

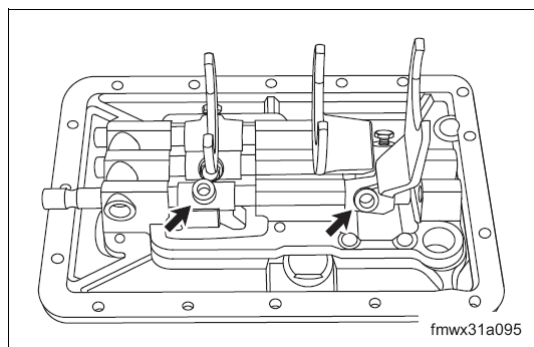
- (a). Install the low/reverse gear shift fork and low/reverse gear shift fork shaft.



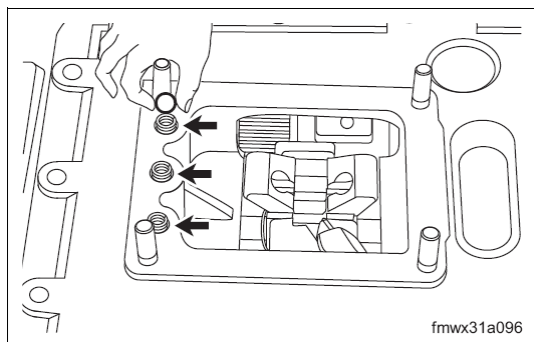
- (b). Put one interlock steel ball in.



- (c). Install the 1st/2nd gear shift fork shaft, guide block, 1st/2nd gear shift fork, interlock pin and interlock steel ball.



- (d). Install the 3rd/4th gear shift fork shaft, guide block and shift fork, fasten the bolts, bind with wires.

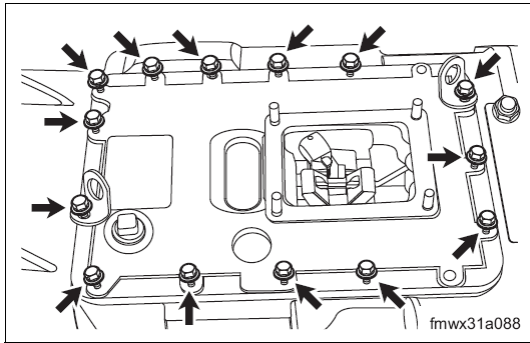


- (e). Install the four stud bolts, self-locking steel balls and springs.

Caution:

The spring in the hole of the 3rd/4th gear shift fork shaft is thicker.

Transmission (RT-11509C) - Transmission Upper Cover

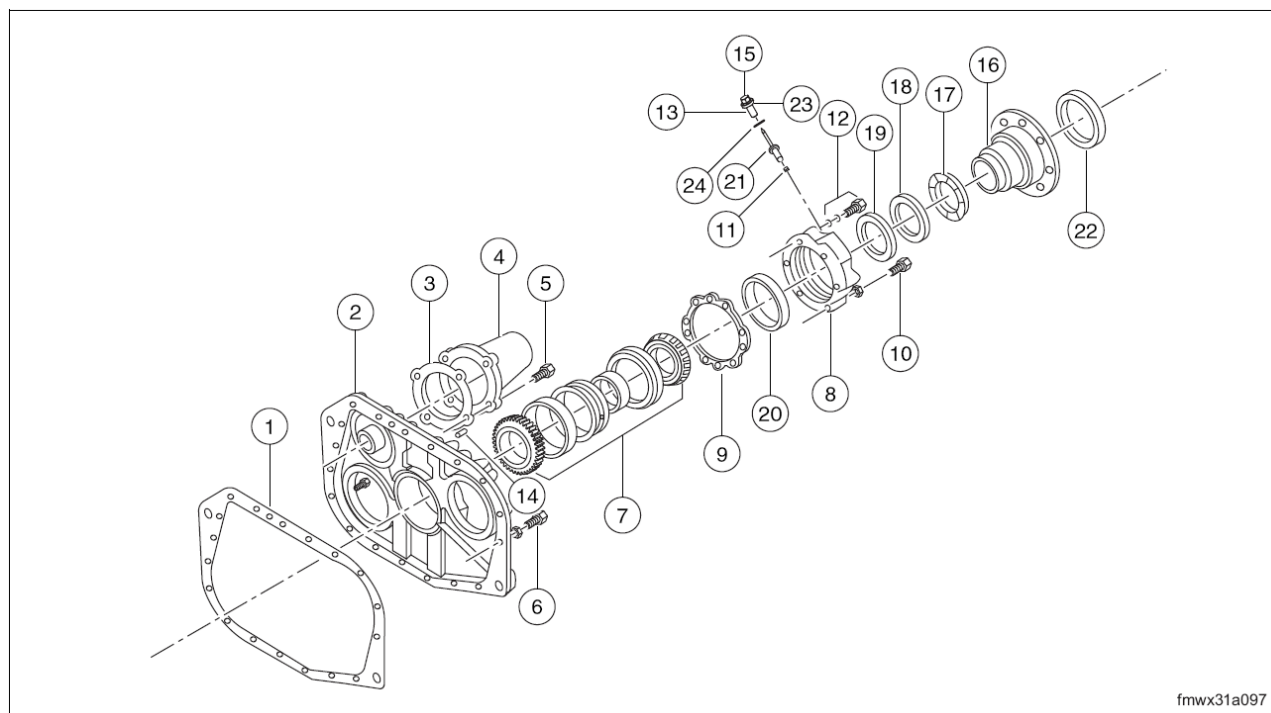


- (f). Tighten the upper cover bolts.
Torque: $54.5 \pm 7 \text{ N.m}$

4. Double H control mechanism assembly of the transmission. Refer to Chapter 31A Transmission RT-11509C – Double H Control Mechanism, Disassembly and Assembly.

Transmission Auxiliary Box

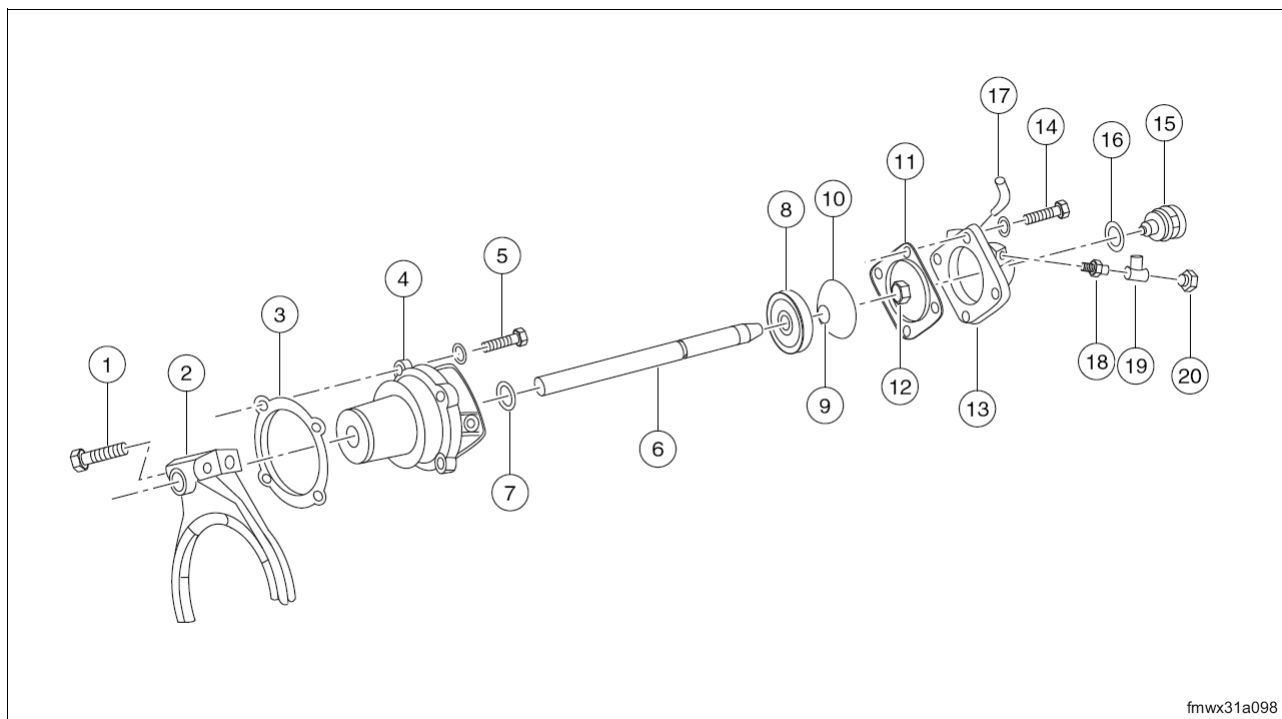
Part Drawing



fmwx31a097

1	Rear Cover Gasket
2	Rear Cover Housing
3	Gasket, Auxiliary Box Countershaft Bearing Cap
4	Lengthened Countershaft Cap
5	Bolt Assembly
6	Hex Head Bolt M10
7	Cylindrical Roller Bearing
8	Output Shaft Rear Bearing Cap
9	Gasket, Auxiliary Box Main Shaft Rear Bearing Cap
10	Hex Head Bolt (M10×75)
11	Sleeve, Odometer Driven Gear
12	Bolt Assembly

13	Odometer Joint
14	Rear Cover Locating Pin
15	Odometer Protective Sleeve
16	Output Flange
17	Dust Cover
18	Oil Seal
19	Oil Seal, Main Shaft Rear Bearing Cap
20	Odometer Driving Gear
21	Odometer Driven Gear
22	Locating Ring
23	O-Ring (φ12×1.9)
24	Gasket

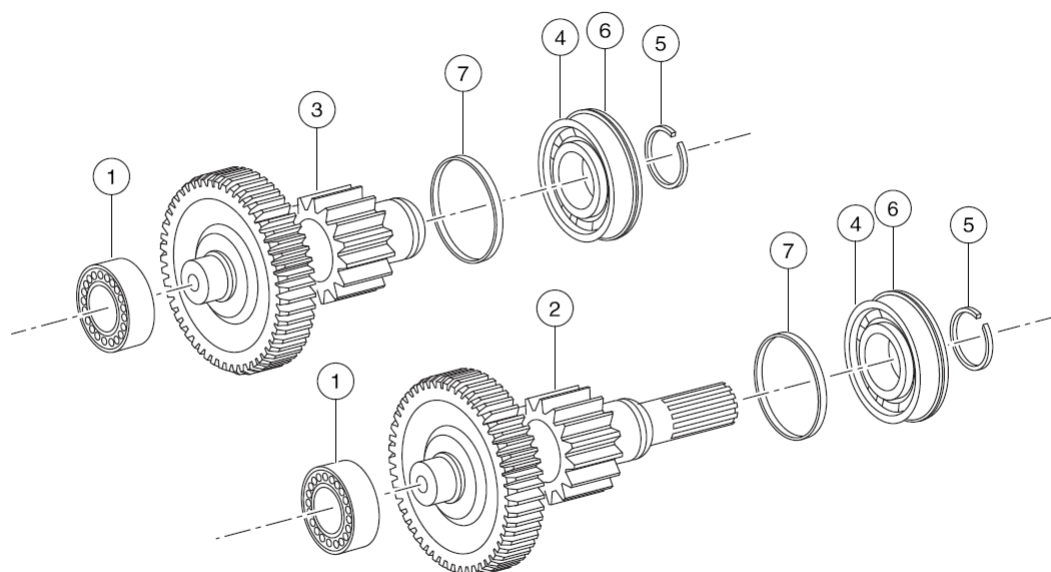
Transmission (RT-11509C) - Transmission Auxiliary Box

fmwx31a098

1	Hex Bolt with Wire Hole on Head
2	Auxiliary Box Shift Fork
3	Sealing Gasket
4	Cylinder, Range Gear
5	Hex Head Bolt
6	Shift Fork Shaft, Range Gear
7	O-ring
8	Cylinder Piston, Range Gear
9	O-ring
10	O-ring

11	Sealing Gasket, Cylinder Head
12	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert (M16×1.5)
13	Gear Shift Cylinder Head, Auxiliary Box
14	Hex Head Bolt (M10×32)
15	Pressure Switch
16	Wrinkled Copper Washer
17	45° Elbow Joint
18	Tee Pipe Joint
19	Tee Pipe Joint
20	Hex Tapered Screw Plug

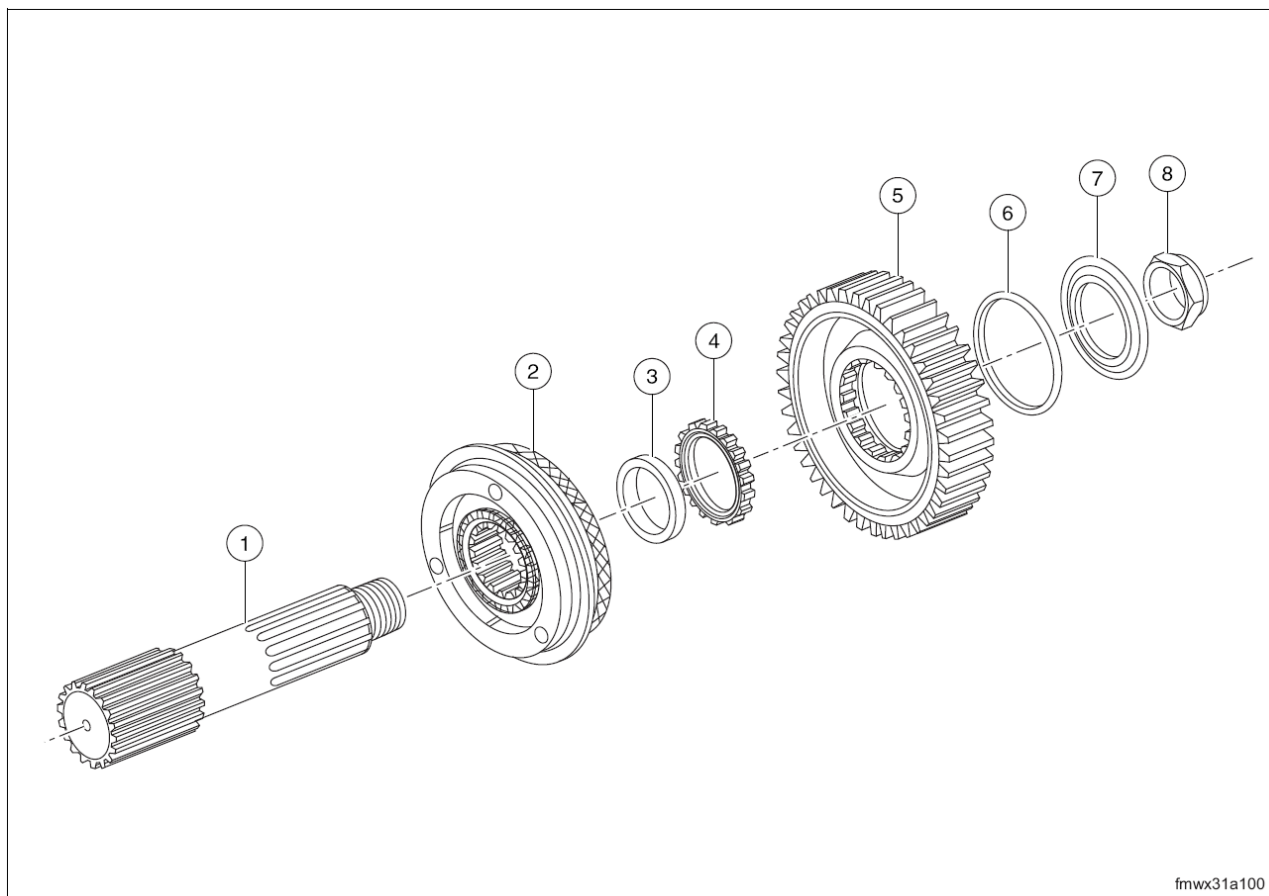
Transmission (RT-11509C) - Transmission Auxiliary Box



fmwx31a099

1	Short Cylindrical Roller Bearing
2	Lengthened Countershaft Welding Assembly, Auxiliary Box
3	Countershaft Welding Assembly, Auxiliary Box
4	Short Cylindrical Roller Bearing

5	Snap Ring
6	(Bearing) Snap Ring
7	Bearing Washer

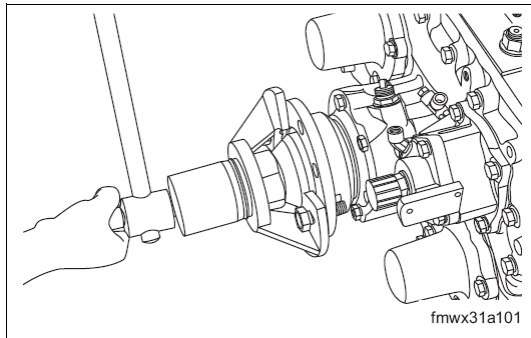
Transmission (RT-11509C) - Transmission Auxiliary Box

1	Auxiliary Box Main Shaft
2	High/Low Gear Synchronizer Assembly
3	Gasket, Auxiliary Box Main Shaft
4	Gasket, Auxiliary Box Main Shaft Gear

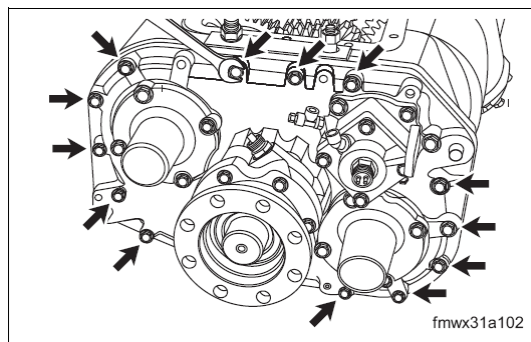
5	Reduction Gear, Auxiliary Box Main Shaft
6	Snap Ring
7	Gasket, Auxiliary Box Reduction Gear
8	Nut with Collar

Disassembly and Assembly

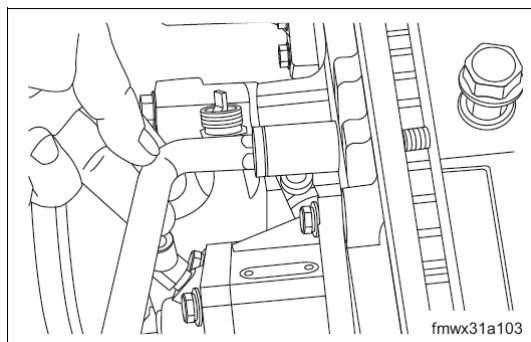
1. Disassemble the auxiliary box assembly



- (a). Mesh the two pairs of sliding sleeves with the main box gears.
- (b). Dismantle the nut with collar by a special wrench.



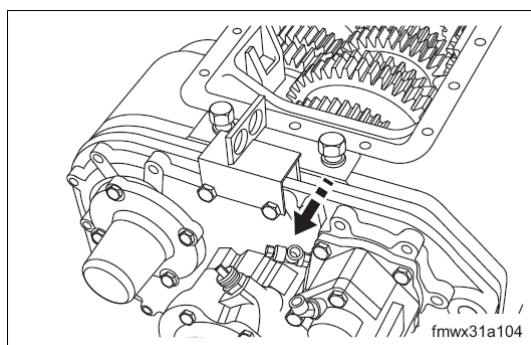
- (c). Dismantle the bolts on the rear cover housing.



- (d). Push against the auxiliary box by about 10mm by three bolts.

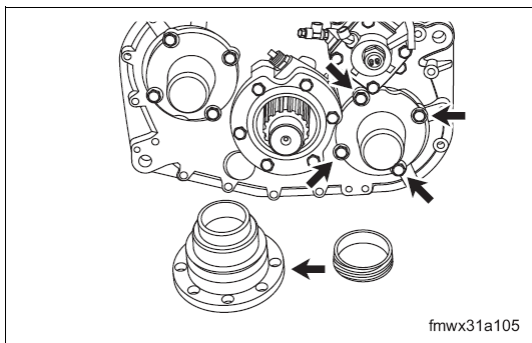
Caution:

Screw in the three bolts evenly.

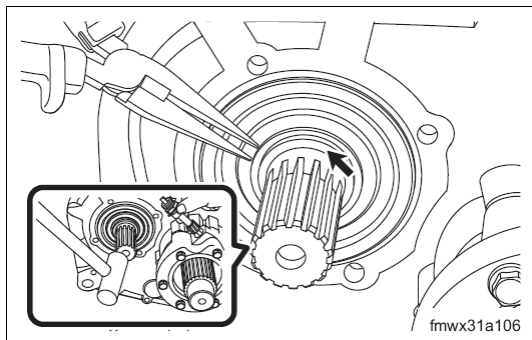


- (e). Lift the auxiliary box assembly by special tools and move backward to separate it from the main box.

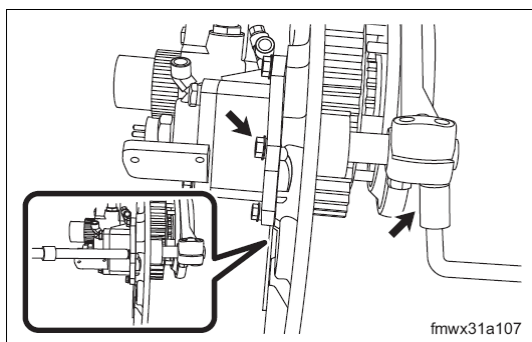
Transmission (RT-11509C) - Transmission Auxiliary Box



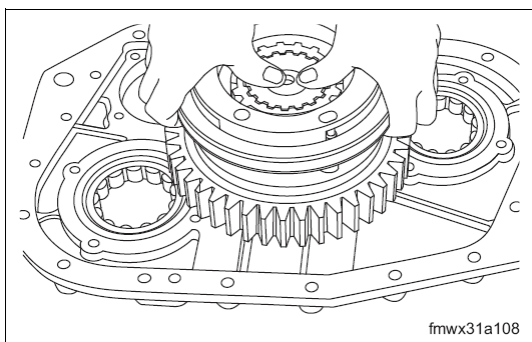
- (f). Dismantle the output flange and odometer driving gear.
- (g). Dismantle the lengthened countershaft cap.



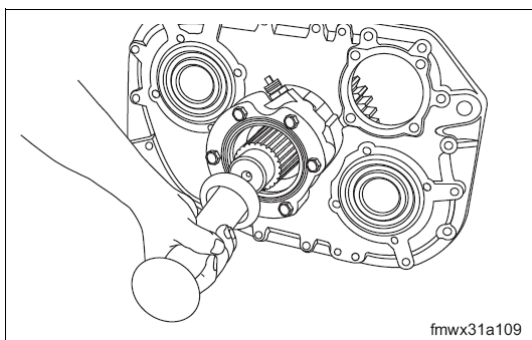
- (h). Remove the snap ring on the lengthened countershaft.
- (i). Beat the lengthened countershaft by a copper rod to separate it from the bearing.



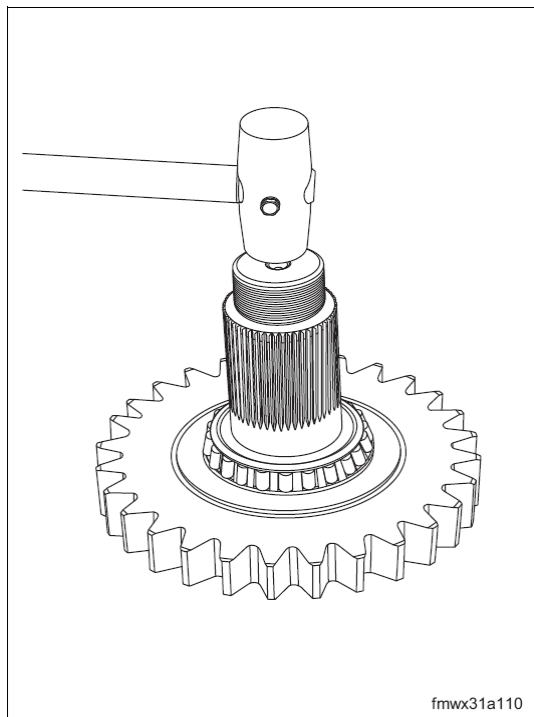
- (j). Cut off the wire, and dismantle the bolt on the auxiliary box shift fork.
- (k). Dismantle the connecting bolt of the gear shift cylinder and rear cover.



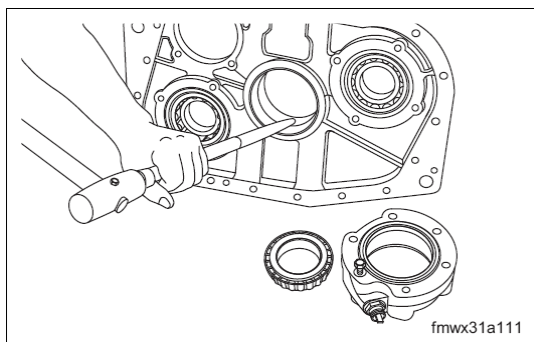
- (l). Remove the auxiliary box synchronizer.



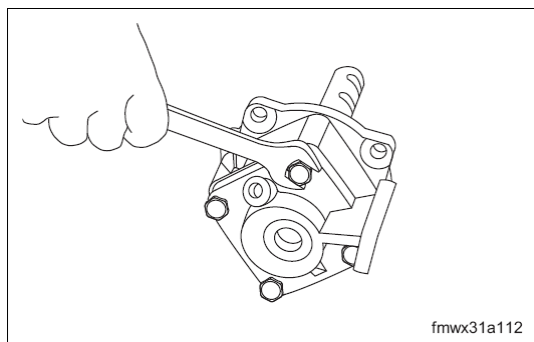
- (m). Take out the output shaft to separate it from the auxiliary box.



- (n). Take out the output shaft to separate it from the bearing.

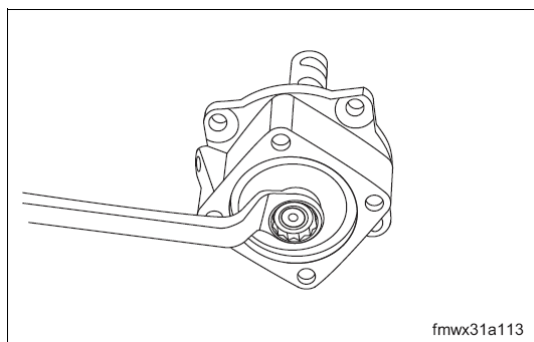


- (o). Dismantle the output shaft bearing cap, beat with a soft rod and take out the bearing outer ring in the rear cover housing.



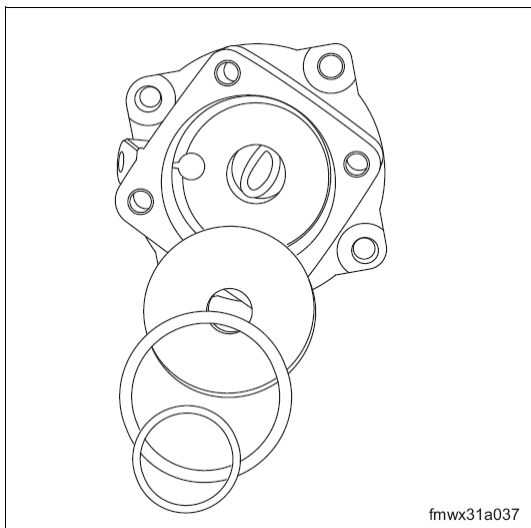
2. Disassemble the gear shift cylinder of the auxiliary box

- (a). Dismantle the four bolts on the cylinder head, and remove the cylinder head.

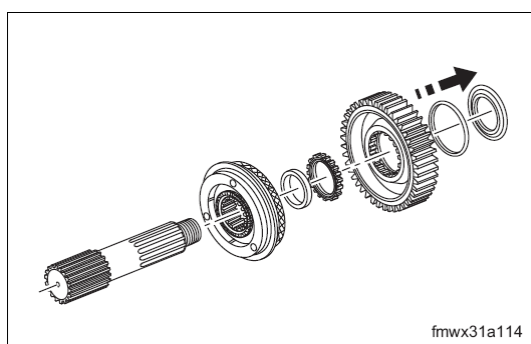


- (b). Dismantle the self-locking nut on the piston.

Transmission (RT-11509C) - Transmission Auxiliary Box

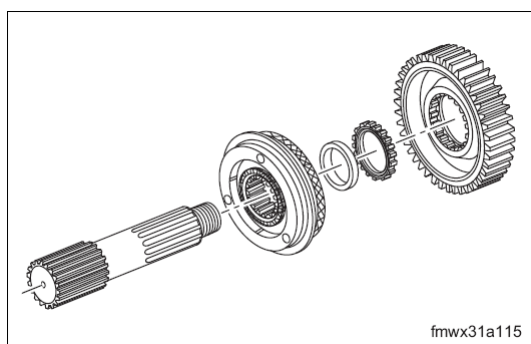


- (c). Remove the piston and three O-rings of the gear shift cylinder in order.



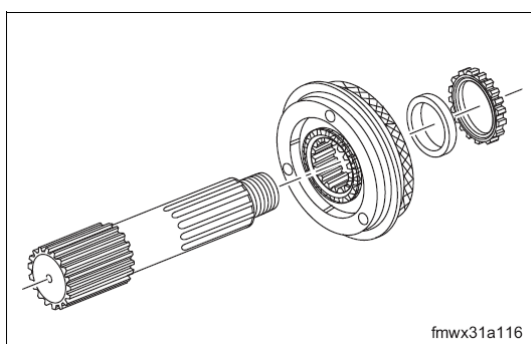
3. Disassemble the auxiliary box main shaft assembly

- (a). Remove the gasket and snap ring in order.



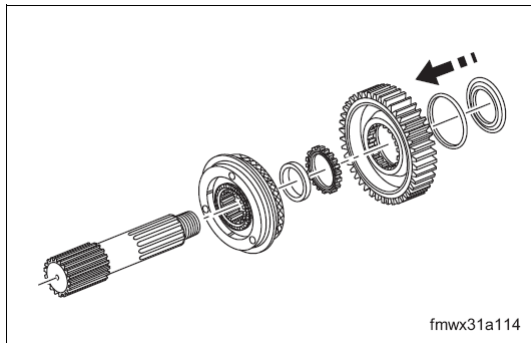
- (b). Remove the reduction gear of the auxiliary box main shaft.

- (c). Remove the auxiliary box main shaft gear gasket, auxiliary main shaft ring gear, high/low gear synchronizer assembly in order.

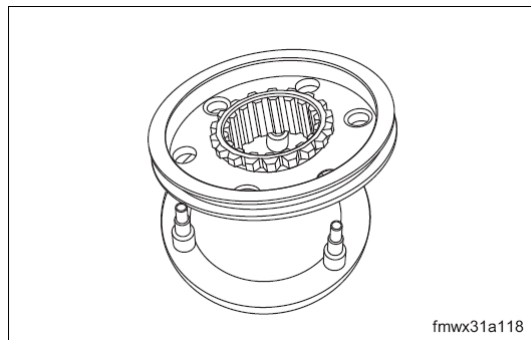


4. Assemble the auxiliary box main shaft assembly

- (a). Install the high/low gear synchronizer assembly, auxiliary main shaft ring gear and auxiliary box main shaft gear gasket in order.

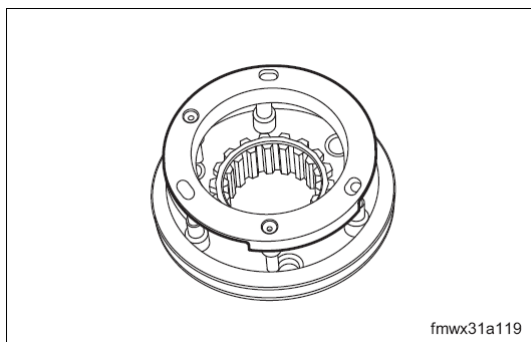


- (b). Install the reduction gear of the auxiliary box main shaft.
- (c). Install the gasket and snap ring in order.

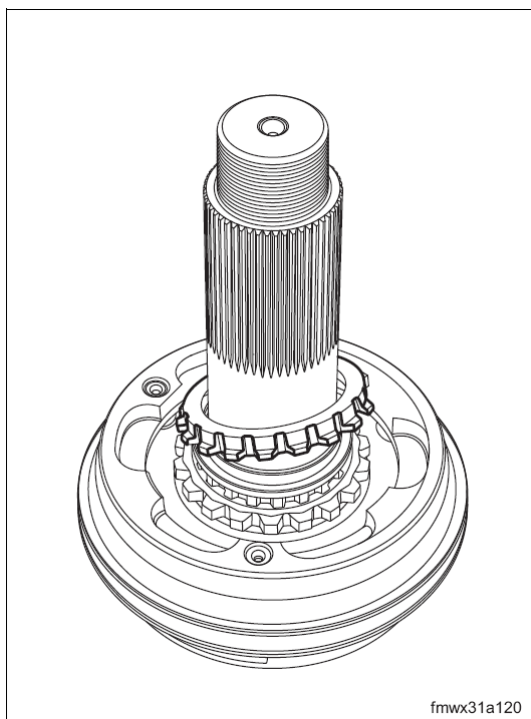


5. Assemble the auxiliary box

- (a). Clean the auxiliary box synchronizer and its components.
- (b). Put the low gear ring of the auxiliary box synchronizer flat, and put it into the synchronizer sliding sleeve.

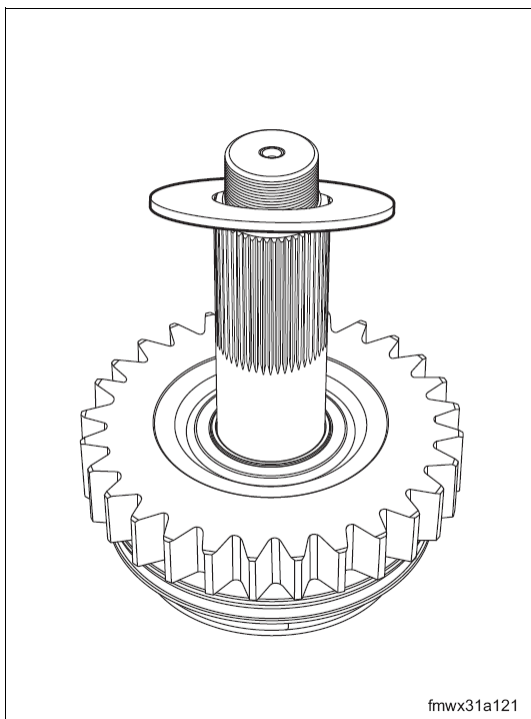


- (c). Put the three springs into the high gear ring hole, and apply a rotary force to make them matched with other parts of the synchronizer.



- (d). Put the low gear ring of the synchronizer on a wood block which is 50mm high, and insert the output shaft.
- (e). Install the auxiliary box main shaft gear gasket and auxiliary box main shaft washer.

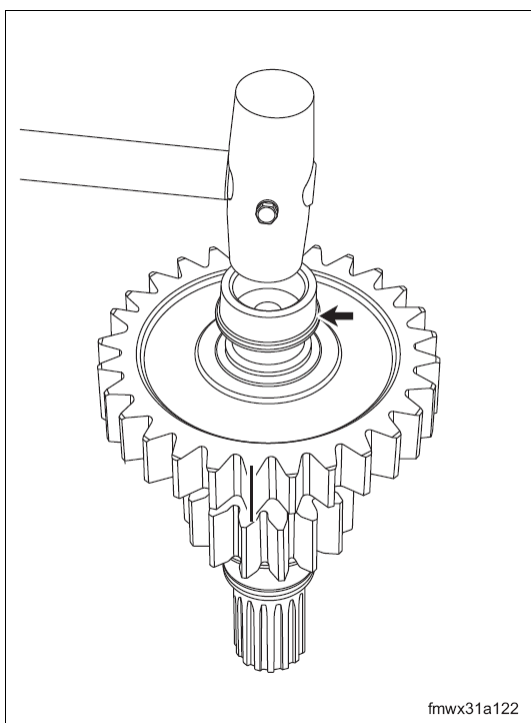
Transmission (RT-11509C) - Transmission Auxiliary Box



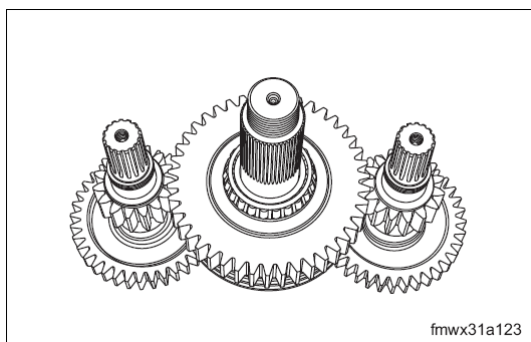
- (f). Nest the gear and gasket in the output shaft, with the convex side facing down.

Caution:

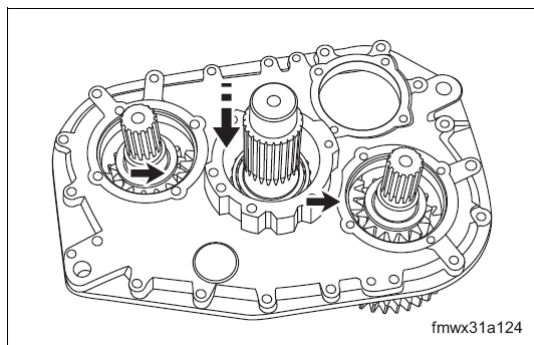
Conduct initial lubrication for the gasket.



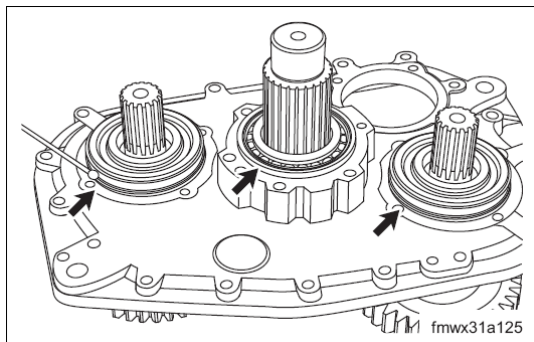
- (g). Install the bearing inner ring in the lengthened countershaft of the auxiliary box.
- (h). Make the teeth aligning marks on the lengthened countershaft of the auxiliary box.



- (i). Make teeth aligning marks which are 180° adjacent on the reduction gear of the auxiliary box, as placed in the drawing.



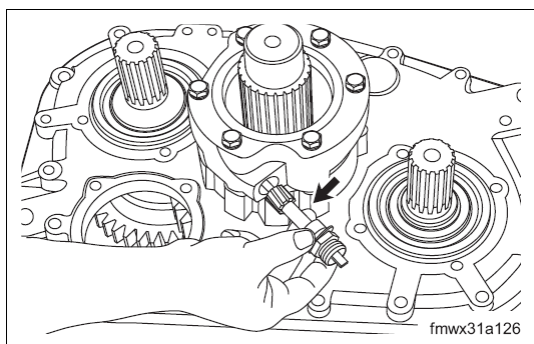
- (j). Put the rear cover housing in.



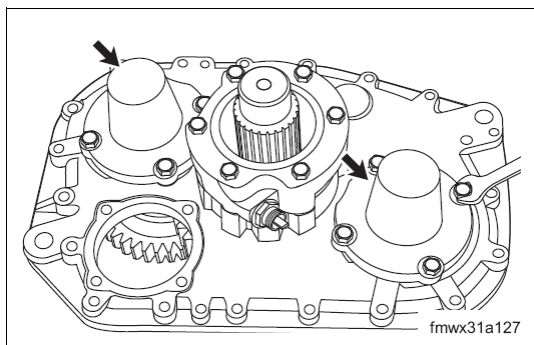
- (k). Install the combination bear and the roller bearings on the two lengthened countershafts.

Caution:

There is a snap ring and a liner ring on the bearing.



- (l). Install the snap rings on the two lengthened countershafts.
(m). Install the output shaft bearing cap, odometer driven gear and odometer joint.

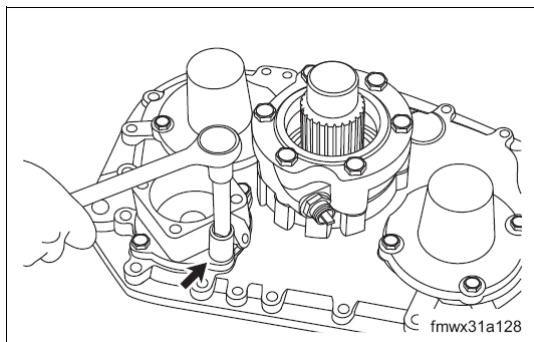


- (n). Install the two lengthened countershaft caps.

Torque: 54.5±7N.m

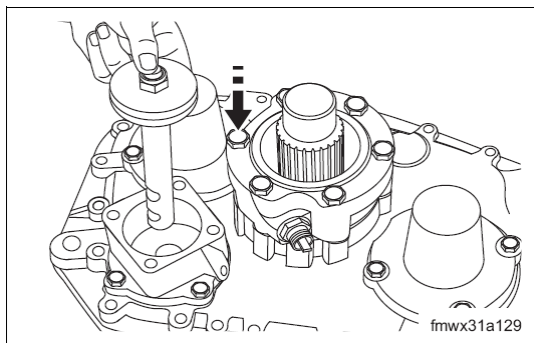
Hint:

Install the power take-off if the power take-off is provided.



- (o). Install the cylinder housing.

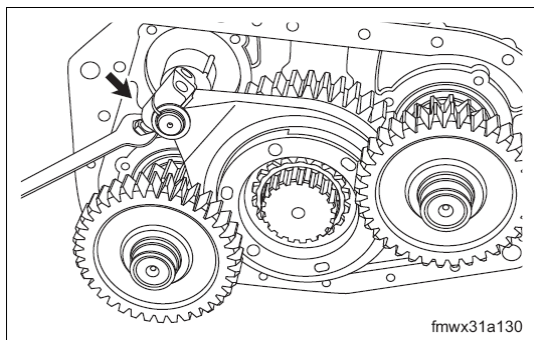
Torque: 54.5±7N.m

Transmission (RT-11509C) - Transmission Auxiliary Box

(p). Install the sealing ring and cylinder piston in order.

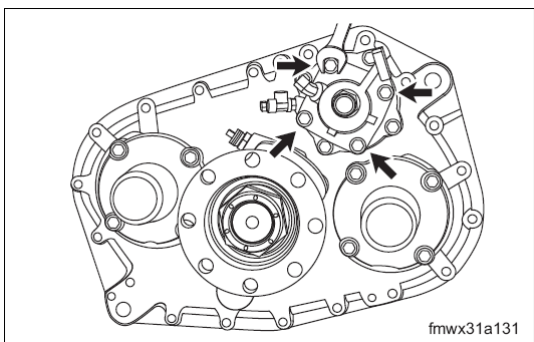
Caution:

The piston plane faces up



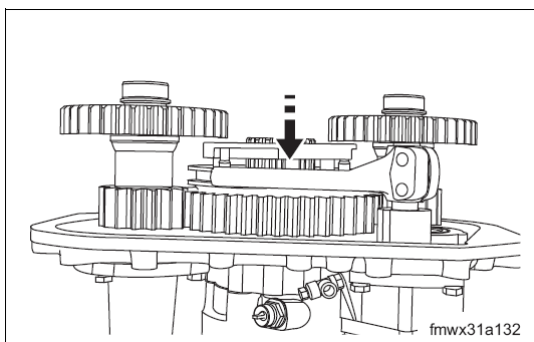
(q). Insert the auxiliary box gear shift fork into the synchronizer sliding sleeve, and install the bolt on the shift shaft, and lock with wires.

Torque: $78 \pm 10 \text{ N.m}$



(r). Install the gear shift cylinder head and flange

Tightening torque for cylinder head: $54.5 \pm 7 \text{ N.m}$

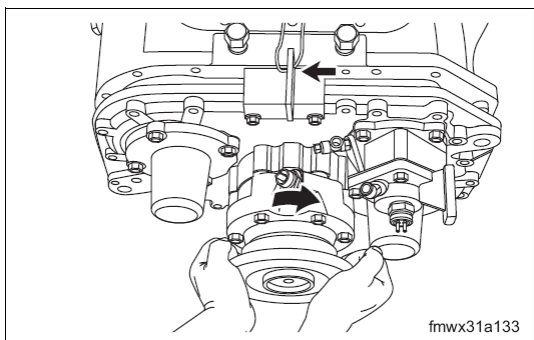


(s). Place the auxiliary box synchronizer in the low gear area.

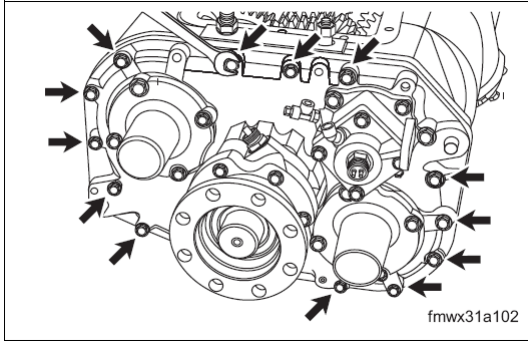
(t). Apply lubricating grease in the two bearing holes of the main box.

Hint:

It is very important to install the auxiliary box.



(u). Lift the auxiliary box assembly by special tools, and meanwhile, push the auxiliary box forward and rotate the flange by hand.



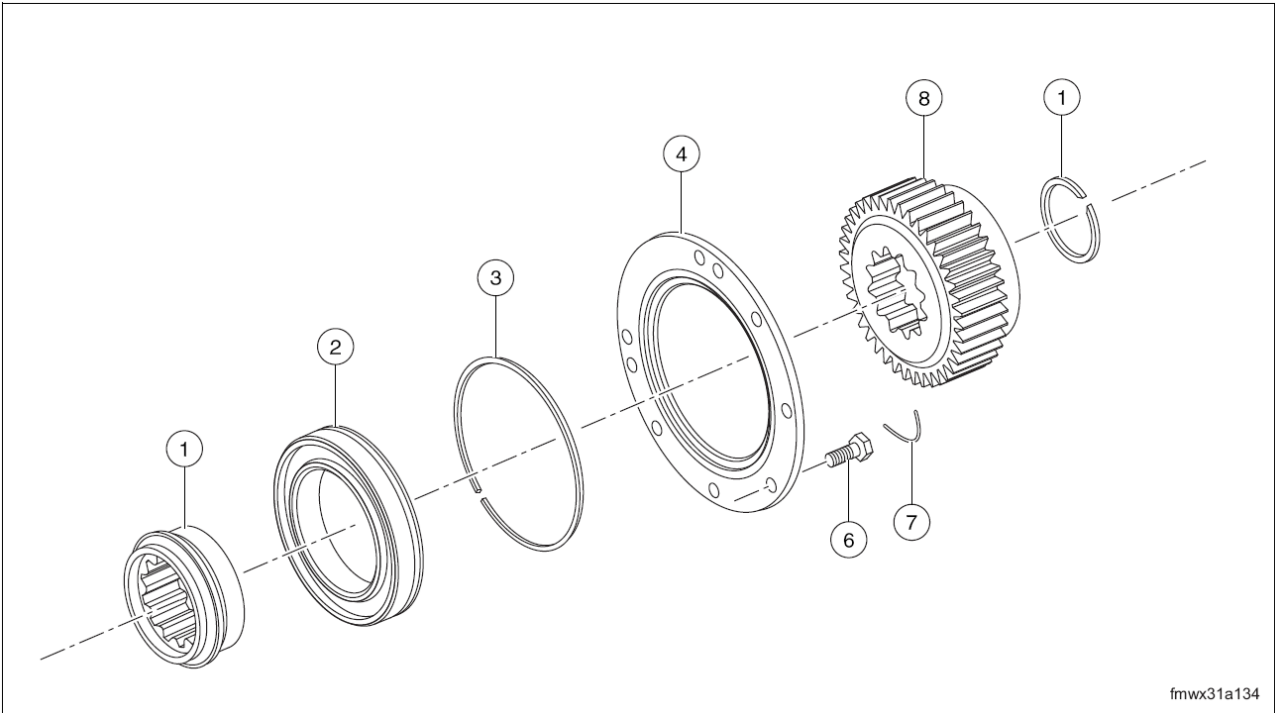
- (v). Install the auxiliary box in position, and tighten the rear cover bolts and flange nuts.

Torque: $54.5 \pm 7 \text{ N.m}$

Tightening torque for flange nut: $654 \pm 45 \text{ N.m}$

Transmission Main Box

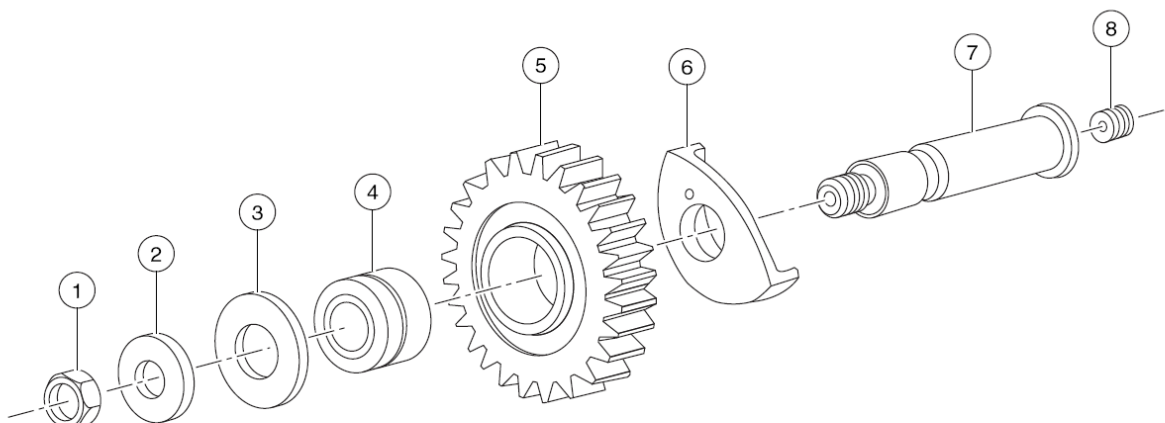
Part Drawing



1	Snap Ring
2	Snap Ring
3	Bearing
4	(Bearing) Snap Ring

5	Locating Disc, Auxiliary Box Bearing
6	Small Hex Bolt with Wire Hole on Head (M10x22)
7	Wire
8	Auxiliary Box Driving Gear

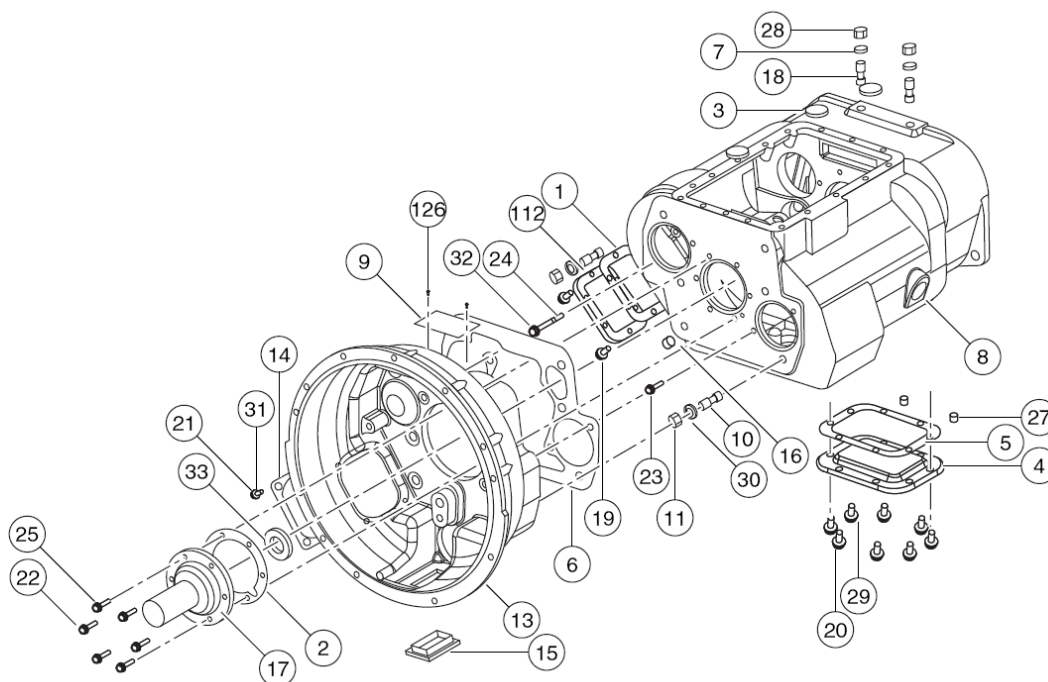
Transmission (RT-11509C) - Transmission Main Box



fmwx31a135

1	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert (M16×1.5)
2	Washer, Reverse Gear Countershaft
3	Reverse Gear Thrust Washer
4	Needle Bearing

5	Reverse Intermediate Gear
6	Reverse Gear Cup Washer
7	Reverse Gear Countershaft
8	Set Bolt with Flat Point (M12×12)



fmwx31a136

1	Gasket, Side Power Take-off Window
2	Gasket, Primary Shaft Bearing Cap

18	Stud Bolt
19	Hex Head Bolt and Spring Washer Assembly

31A

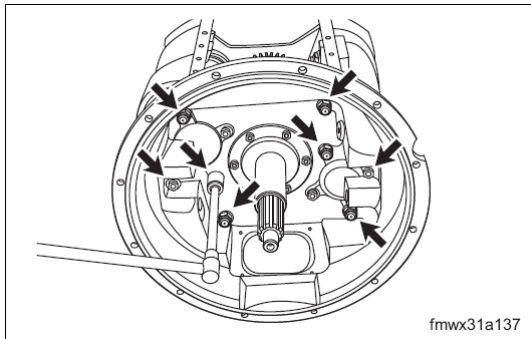
Transmission (RT-11509C) - Transmission Main Box

3	Round Magnet
4	Cover, Bottom Power Take-off Window
5	Gasket, Bottom Power Take-off Window
6	Gasket, Clutch Housing
7	Spring Washer
8	Transmission Housing
9	Rating Plate
10	Stud Bolt
11	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert
12	Cover, Side Power Take-off Window
13	Clutch Housing
14	Hand Hole Cover
15	Hand Hole Cover
16	Slotted Tapered Nut
17	Primary Shaft Bearing Cover

20	Hex Head Bolt
21	Hex Head Bolt
22	Hex Head Bolt
23	Hex Head Bolt
24	Hex Head Bolt
25	Hex Bolt with Wire Hole on Head
26	Cross Recessed Pan Head Tapping Screw
27	Slotted Set Screw with Flat Point
28	Hex Nut, Style 1
29	Flat Washer
30	Flat Washer
31	Spring Washer
32	Spring Washer
33	Framework Oil Seal

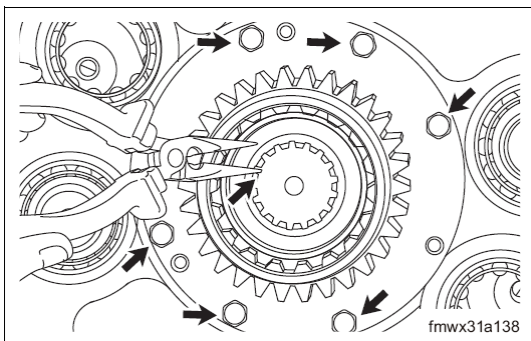
Disassembly and Assembly

1. **Dismantle the upper cover assembly. Refer to Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly**



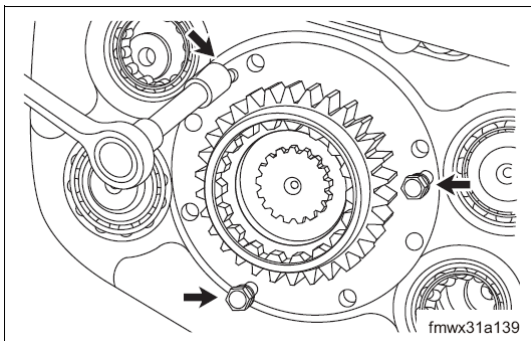
2. **Dismantle the clutch cover assembly**

- (a). Loosen the connecting bolt, and remove the clutch housing.

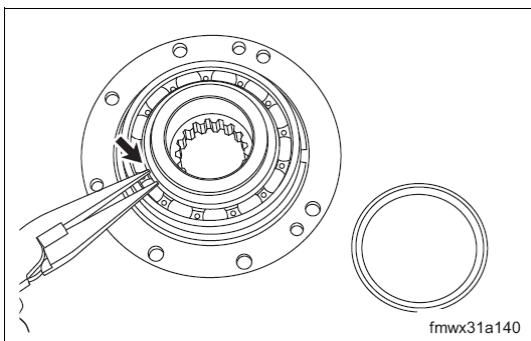


3. **Disassemble the auxiliary box driving gear**

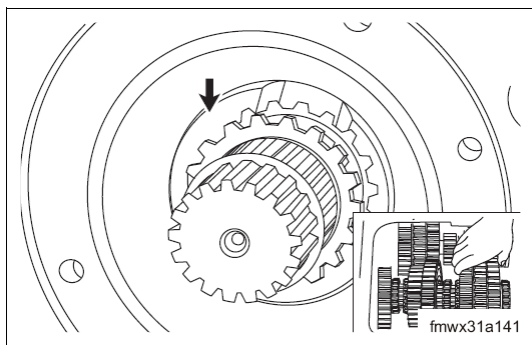
- (a). Dismantle the snap ring at the rear end of the auxiliary box driving gear and the six bolts on the locating disc.
- (b). Dismantle the snap ring.



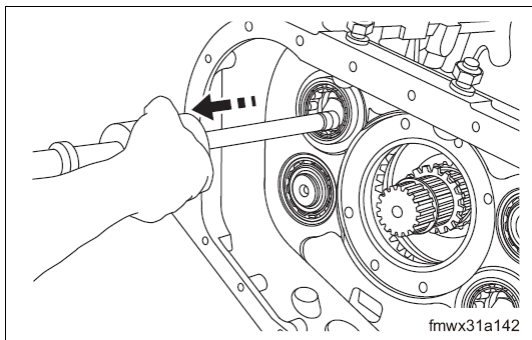
- (c). Push out the driving gear assembly by three bolts.



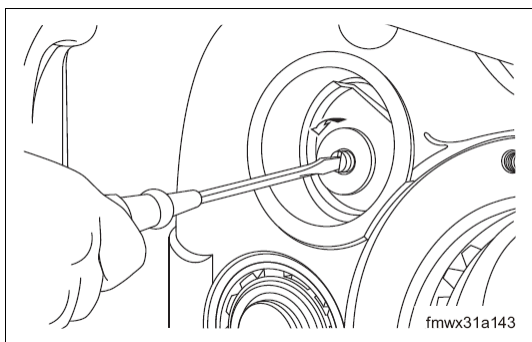
- (d). Dismantle the circlip fixing ring and split ring on the auxiliary box driving gear.

Transmission (RT-11509C) - Transmission Main Box**4. Dismantle the driving gear**

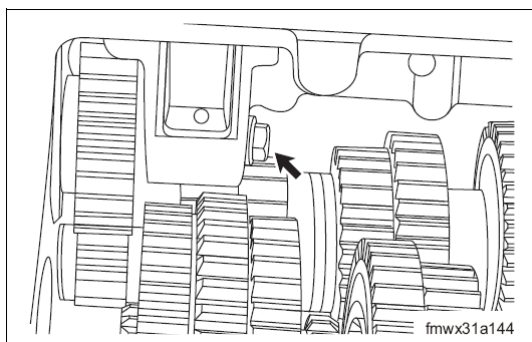
- (a). Dismantle the snap ring in the main shaft reverse gear.
- (b). Move the reverse gear forward until it pushes against the main shaft low gear.



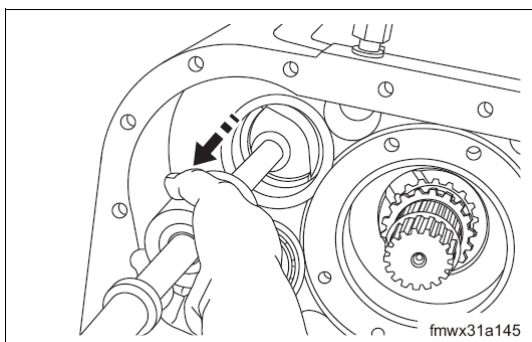
- (c). Pull out the bearing at the rear end of the reverse intermediate gear shaft by a special tool.



- (d). Dismantle the screw plug in the reverse intermediate gear shaft.



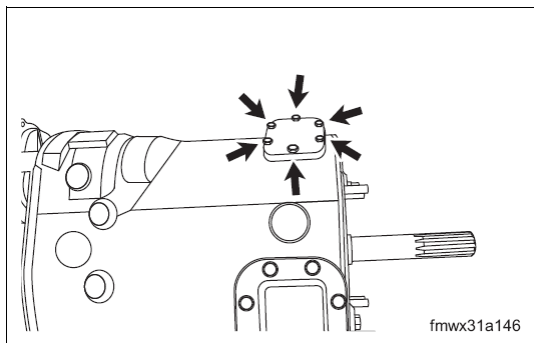
- (e). Dismantle the self-locking nut on the reverse intermediate gear shaft.



- (f). Pull out the reverse intermediate gear shaft by a special tool.

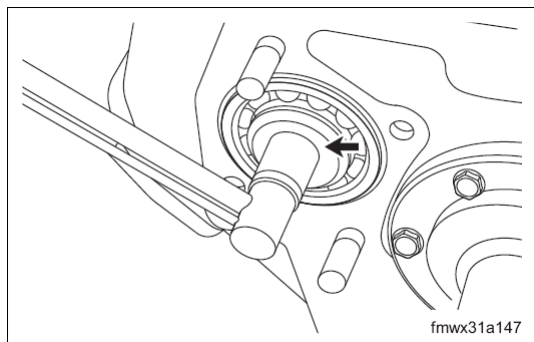
Caution:

Prevent the reverse idler from damage by falling.

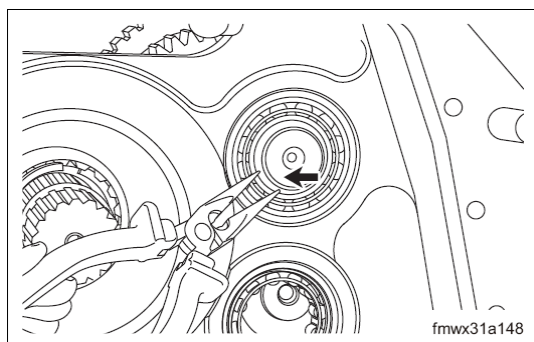


5. Dismantle the main shaft assembly

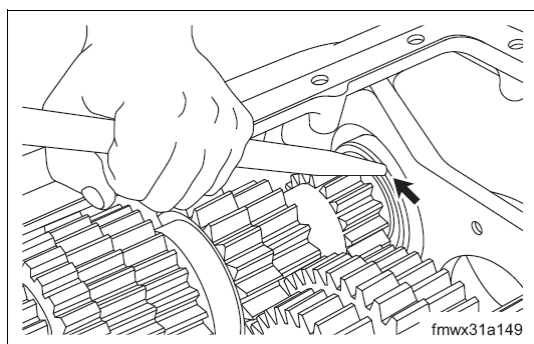
(a). Dismantle the countershaft brake assembly.



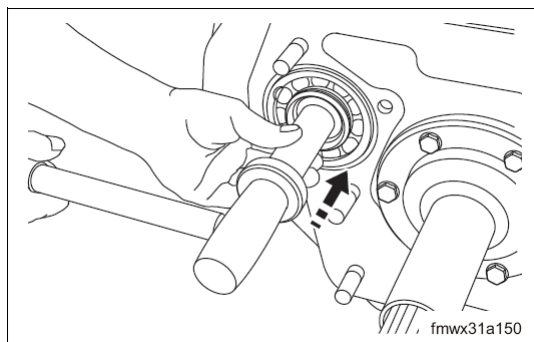
(b). Dismantle the bearing baffle plate at the front end of the main box countershaft.



(c). Dismantle the snap ring on the bearing at the rear end of the main box countershaft.

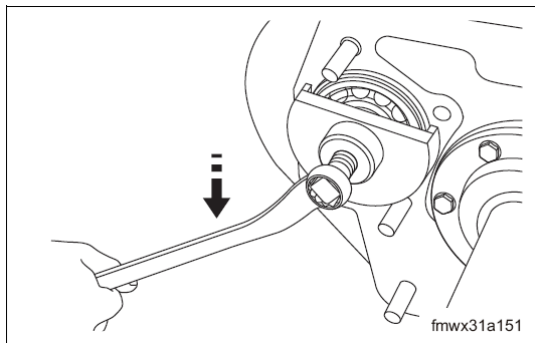


(d). Dismantle the rear bearing of the countershaft by a soft rod.

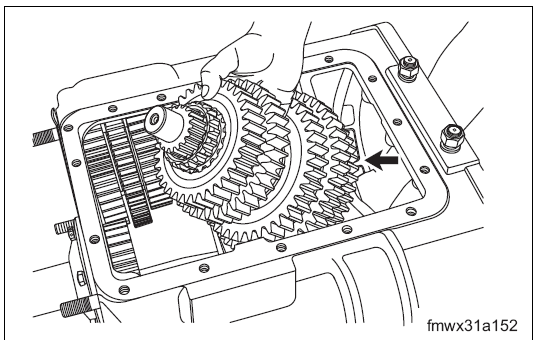


(e). Beat the countershaft by a copper rod to move it backward by about 10mm.

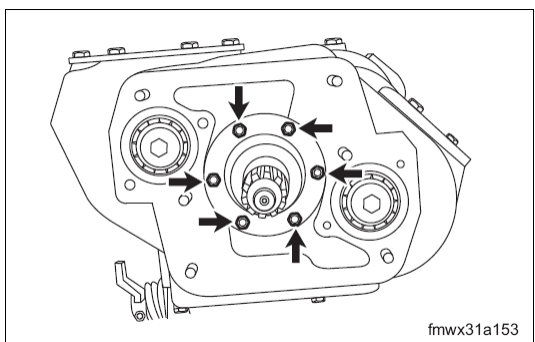
Transmission (RT-11509C) - Transmission Main Box



- (f). Dismantle the countershaft front bearing by a special tool.

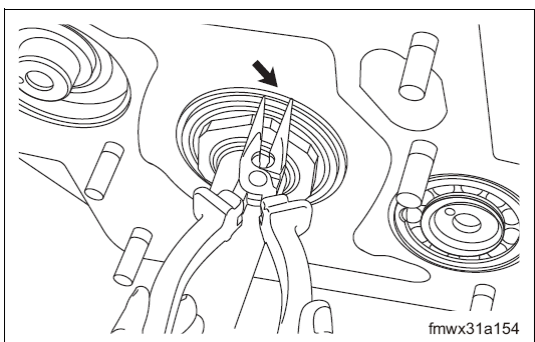


- (g). Take out the main shaft assembly from the main box housing.

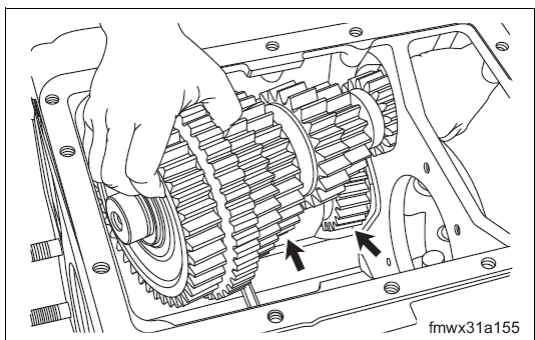


6. Dismantle the primary shaft assembly

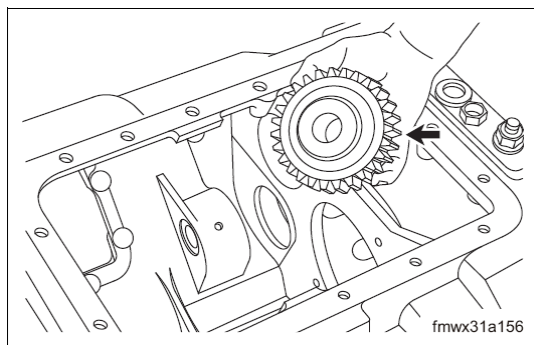
- (a). Loosen the six bolts on the primary shaft bearing cap, and remove the primary shaft bearing cap.



- (b). Dismantle the snap ring on the primary shaft bearing, impact the shaft end, and remove the primary shaft assembly.

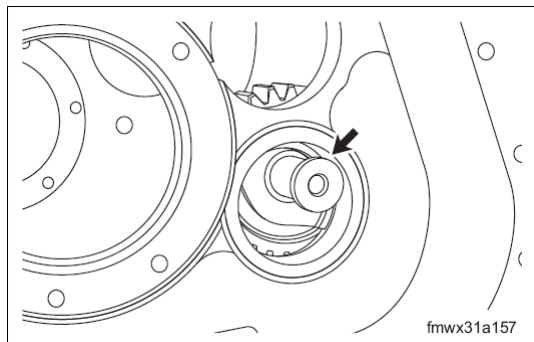


7. Take out the countershaft assembly and reverse intermediate gear from the main box housing.

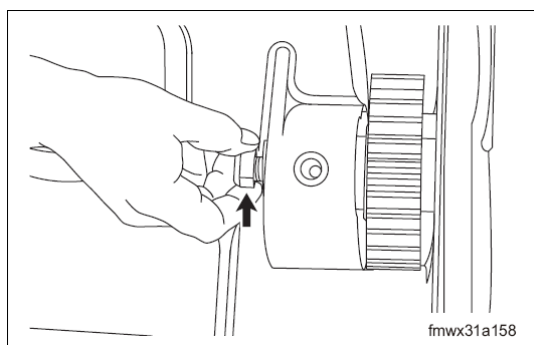


8. Install the reverse intermediate gear

- (a). Put the reverse intermediate gear into the housing, with the convex side facing forward.

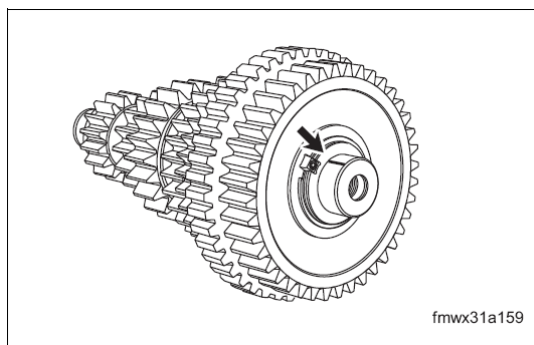


- (b). Install the reverse intermediate gear shaft.



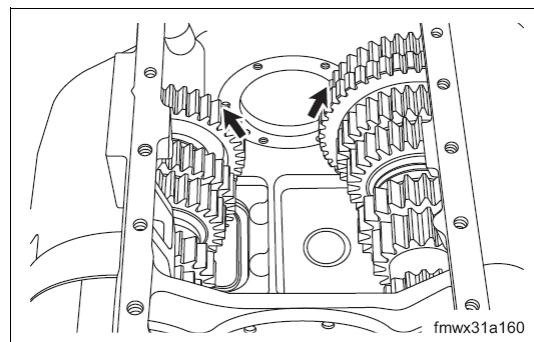
- (c). Tighten the self-locking nut at the front end of the right reverse intermediate gear shaft.

Torque: 74.5±6.5 N.m

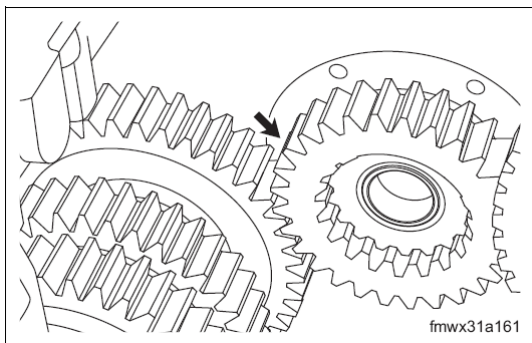


9. Install the countershaft

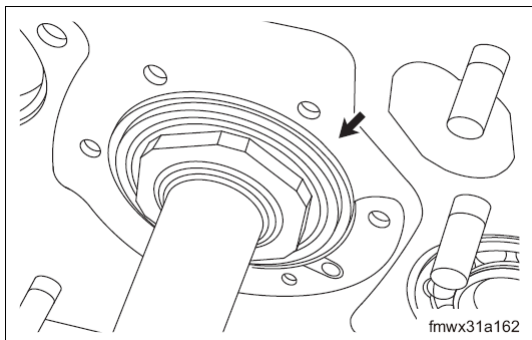
- (a). Make the teeth aligning mark on the tooth of the constant mesh gear of the countershaft assembly, which faces the keyway.



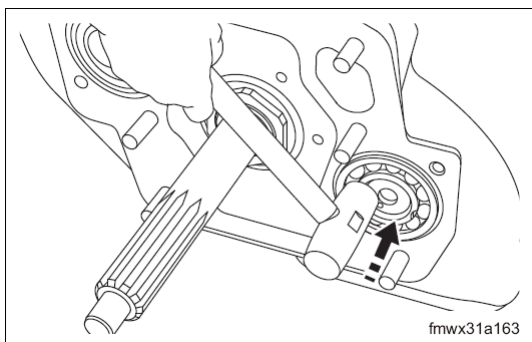
- (b). Put the two countershaft assemblies into the main box housing.

Transmission (RT-11509C) - Transmission Main Box**10. Install the primary shaft assembly**

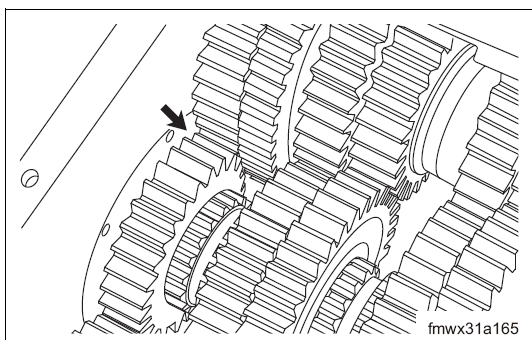
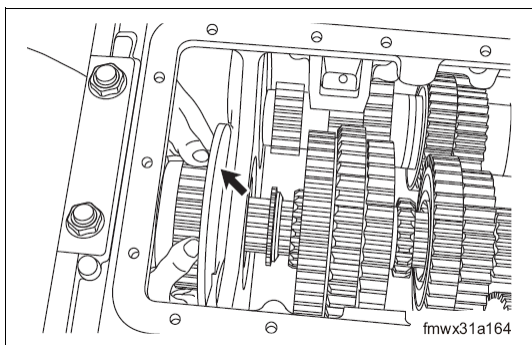
- (a). Make the teeth aligning marks on two groups of teeth which are selected freely and are 180° adjacent on the primary shaft gear.
- (b). Put the primary shaft assembly into the main box housing, insert the marked tooth of the left countershaft into the marked groove of the primary shaft gear, install the countershaft rear bearing, and locate with the snap ring.
- (c). Install the snap ring on the primary shaft bearing.

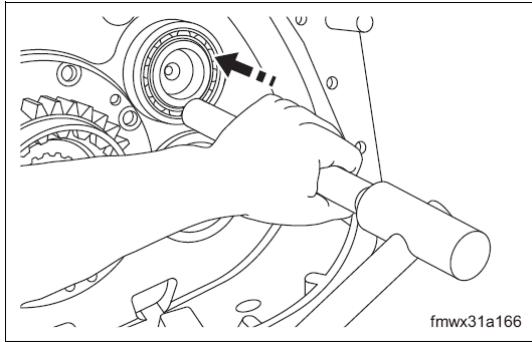
**11. Install the countershaft front bearing**

- (a). Install the countershaft front bearing.

**12. Install the main shaft assembly**

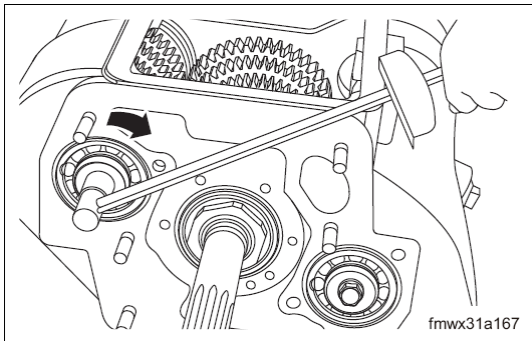
- (a). Apply lubricating grease in the inner hole of the primary shaft.
- (b). Put the main shaft assembly into the main box, and locate its rear end by the driving gear.
- (c). Insert the marked tooth of the right countershaft into the marked groove of the primary shaft gear.





13. Install the bearing at the rear end of the countershaft

- (a). Install the bearing at the rear end of the countershaft, and locate by the snap ring.



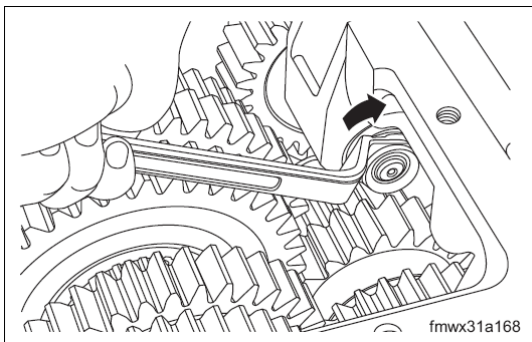
14. Install the bearing at the front end of the countershaft

- (a). Install the bearing at the front end of the countershaft, and assemble the countershaft pressure plate.

Torque: 142±20Nm

Caution:

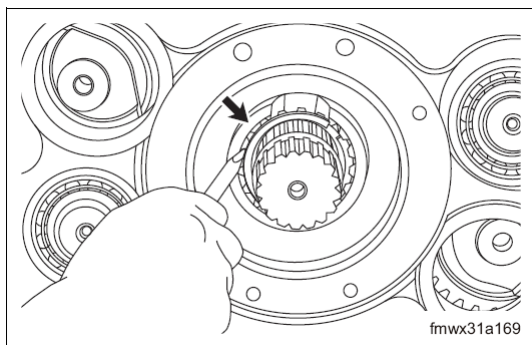
The pressure plate bolt shall be coated with anaerobic adhesive.



15. Install the left reverse intermediate gear assembly

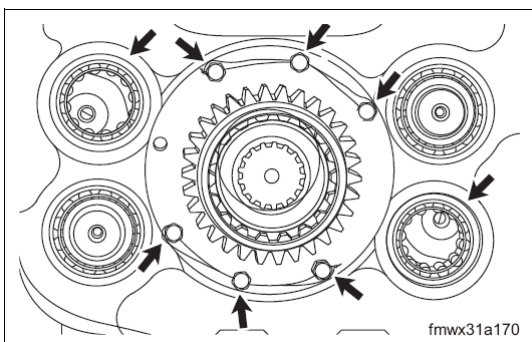
- (a). Install the left reverse intermediate gear assembly, and fasten the self-locking nut.

Torque: 74.5±6.5N.m



16. Install the reverse gear snap ring

- (a). Mesh the reverse gear of the main shaft with the reverse intermediate gear, and install the reverse gear snap ring.

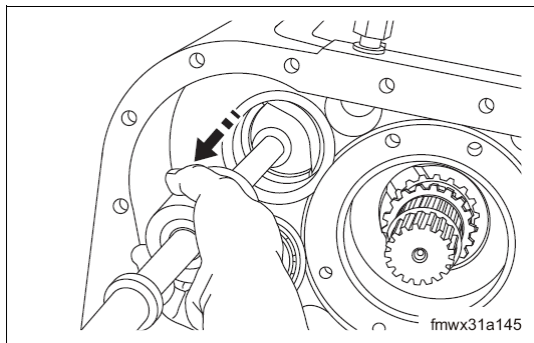


17. Install the driving gear assembly and bearings

- (a). Install the driving gear assembly and two bolts.
(b). Tighten the six bolts.

Torque: 54±7N.m

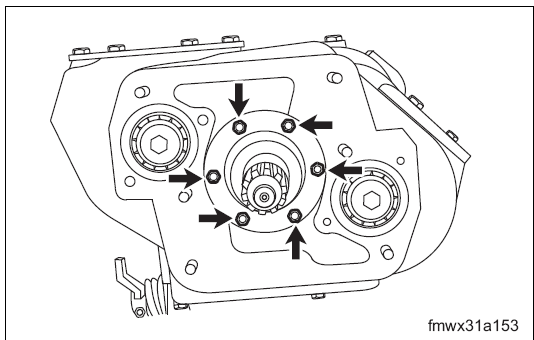
Transmission (RT-11509C) - Transmission Main Box



18. Install the countershaft brake assembly

- (a). Install the countershaft brake assembly.

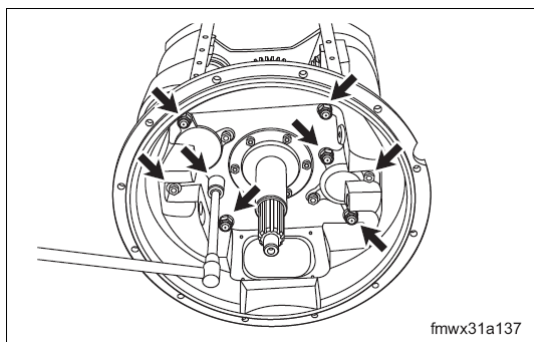
Torque: $54 \pm 7 \text{ N.m}$



19. Install the primary shaft bearing cap

- (a). Install the primary shaft bearing cap, and tighten the bolts.

Torque: $54 \pm 7 \text{ N.m}$



20. Install the clutch housing assembly

- (a). Install the clutch housing assembly, and tighten the bolts.

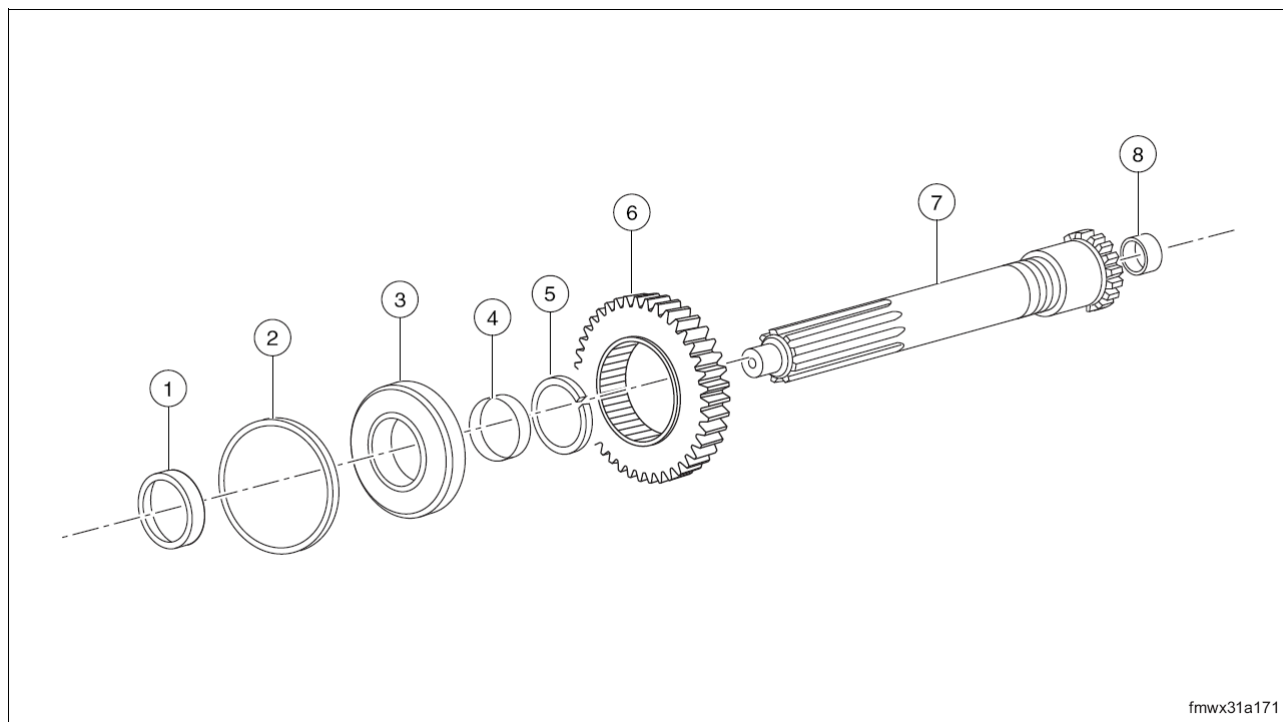
Torque: $257.5 \pm 13.5 \text{ N.m}$

Torque: $121.5 \pm 13.5 \text{ N.m}$

- 21. Install the transmission upper cover. Refer to Chapter 31A Transmission RT-11509C – Transmission Upper Cover, Disassembly and Assembly.**

Primary Shaft Assembly

Part Drawing



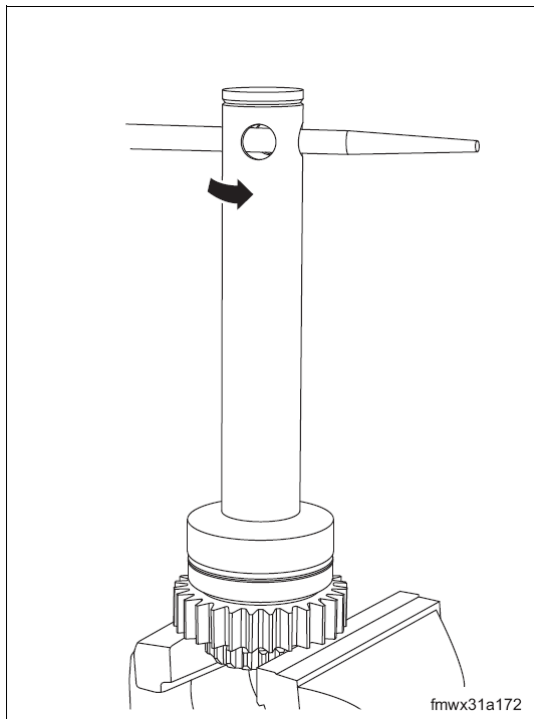
fmwx31a171

1	Primary Shaft Nut
2	(Bearing) Snap Ring
3	Single-row Centripetal Bearing with Snap Ring Groove and Dust Cover on One Side (φ60*φ110*22)
4	Gear Spacer

5	Snap Ring
6	Primary Shaft Gear
7	Primary Shaft
8	Main Shaft Guide Sleeve

Disassembly and Assembly

1. Disassemble the primary shaft

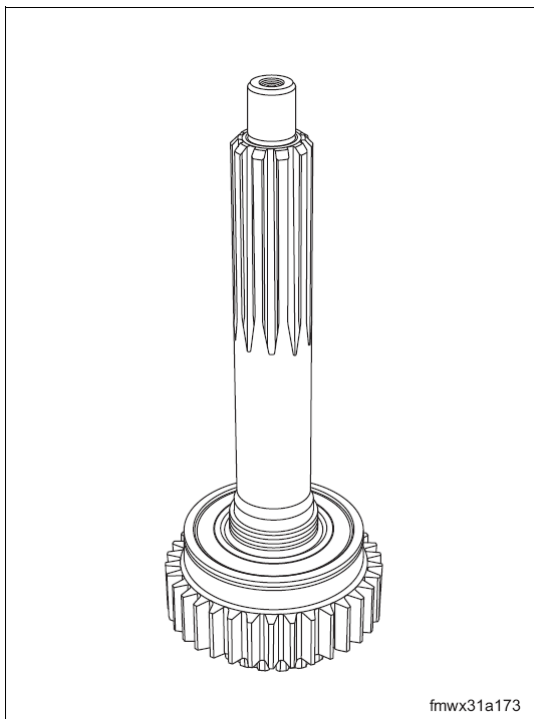


(a). Clamp the primary shaft by a bench vice.

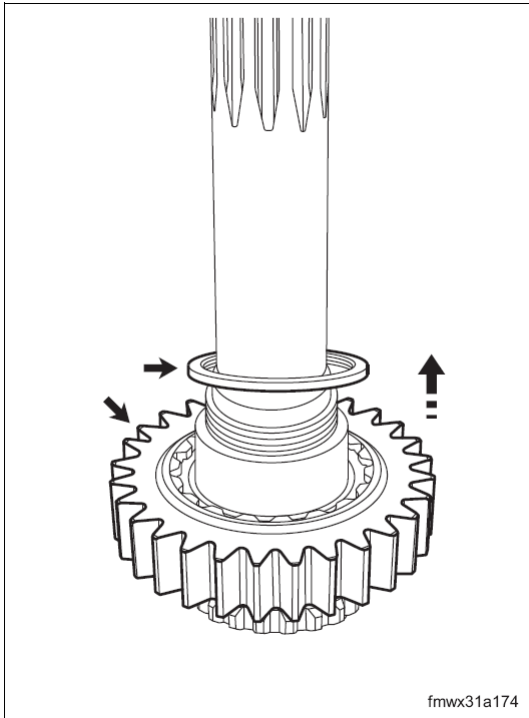
Caution:

Wrap the primary shaft with rags well, and be careful to damage the primary shaft by clamping.

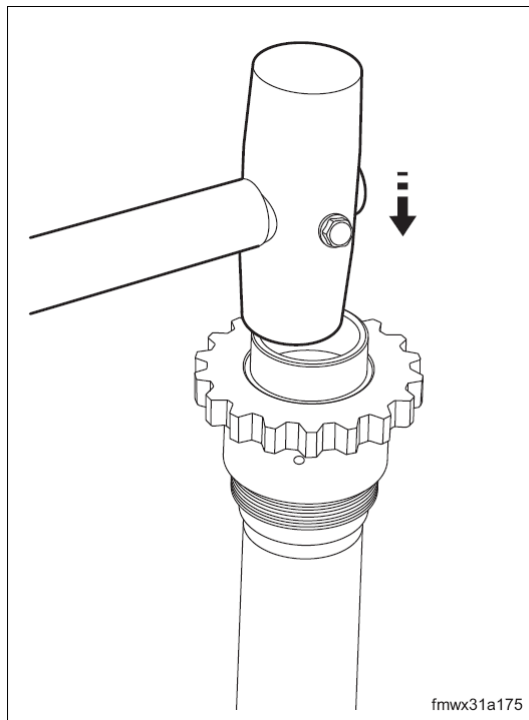
(b). Dismantle the primary shaft nut by a special tool.



(c). Dismantle the primary shaft bearing by a puller.

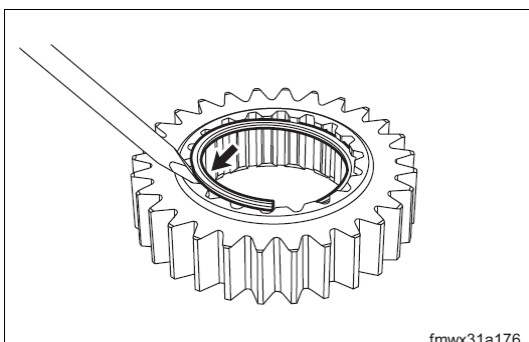


- (d). Take out the primary shaft gear spacer and primary shaft gear in order.



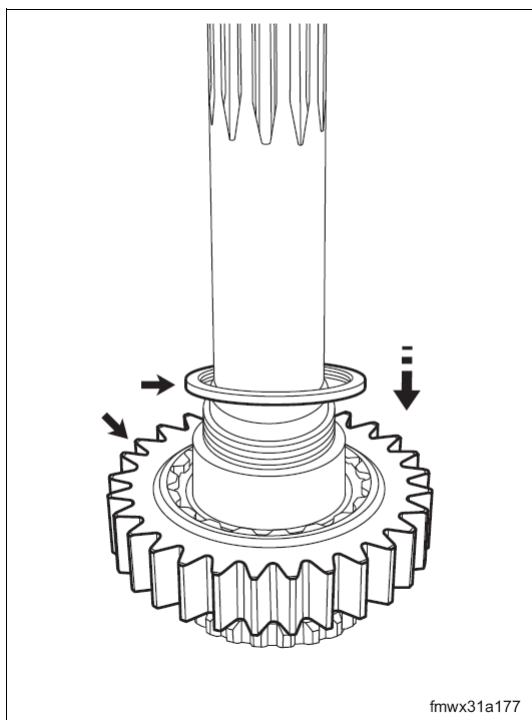
2. Install the primary shaft assembly

- (a). Install the main shaft guide sleeve into the inner hole of the primary shaft.

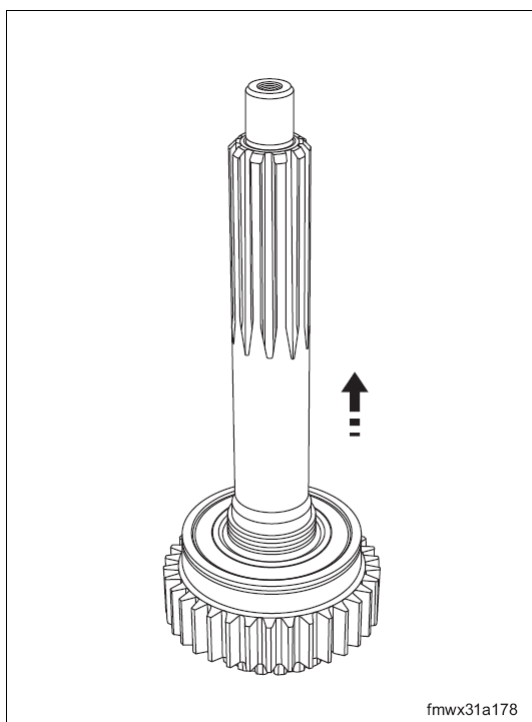


- (b). Put the snap ring in.

Transmission (RT-11509C) - Primary Shaft Assembly



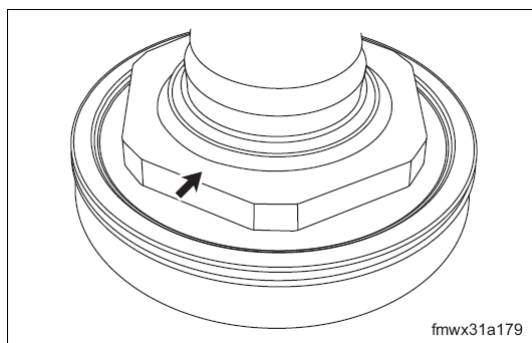
- (c). Install the primary shaft gear and primary shaft gear spacer on the primary shaft by turning in order.



- (d). Install the primary shaft bearing.

Caution:

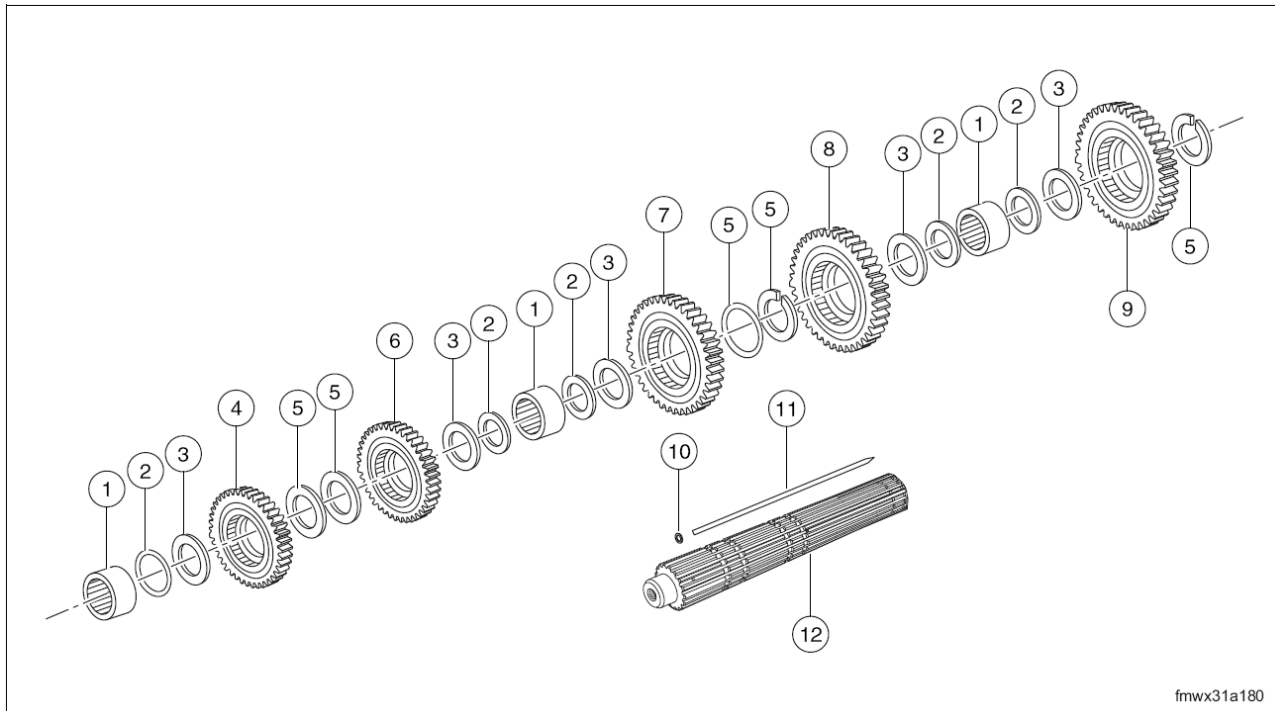
The oil baffle disc side faces up.



- (e). Tighten the primary shaft nut, and rivet,
Torque: 372±34N.m

Main Shaft Assembly

Part Drawing



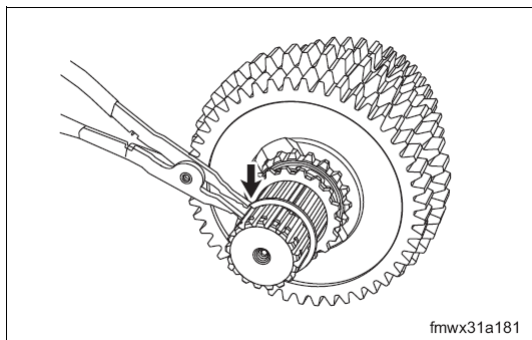
fmwx31a180

1	Main Shaft Sliding Sleeve
2	Adjusting Gasket, Main Shaft Gear
3	Gasket, Main Shaft Gear Spline
4	Main Shaft 3 rd Gear
5	Snap Ring
6	Main Shaft 2 nd Gear

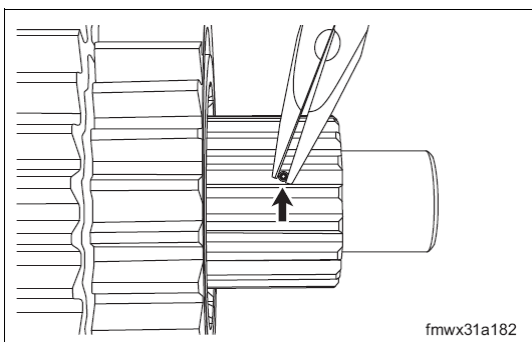
7	Main shaft 1 st gear
8	Main Shaft Low Gear
9	Main Shaft Reverse Gear
10	Elastic Cylindrical Pin (Pin 3×10)
11	Main Shaft Hex Key
12	Main Shaft

Disassembly and Assembly

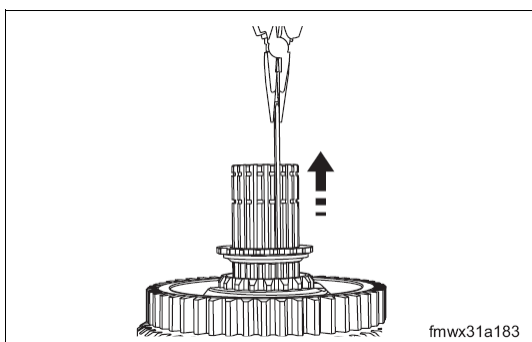
1. Disassemble the main shaft assembly



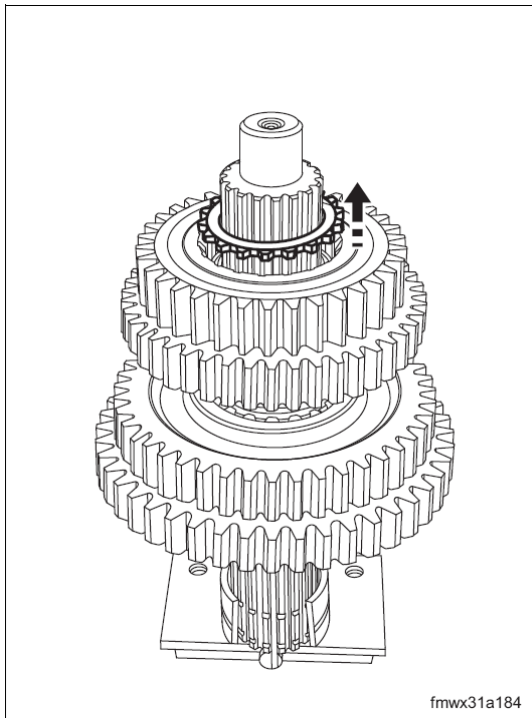
- (a). Dismantle the snap ring at the rear end of the main shaft, and remove the spline gasket and main shaft reverse gear in order.



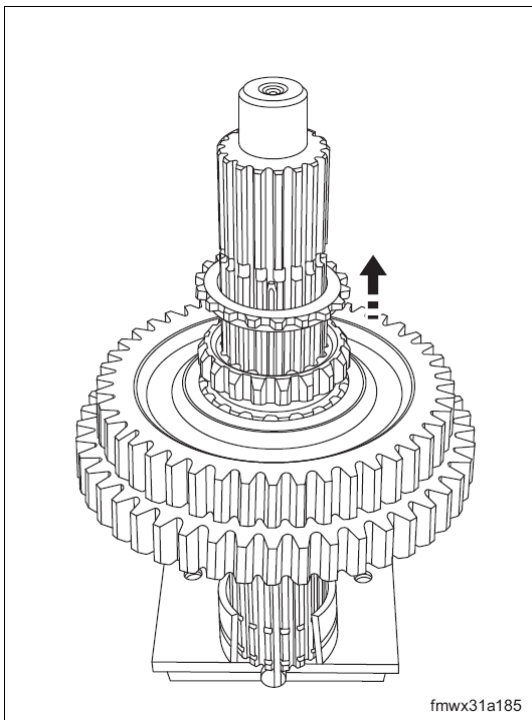
- (b). Pull out the elastic pin on the main shaft.



- (c). Extract out the long key.

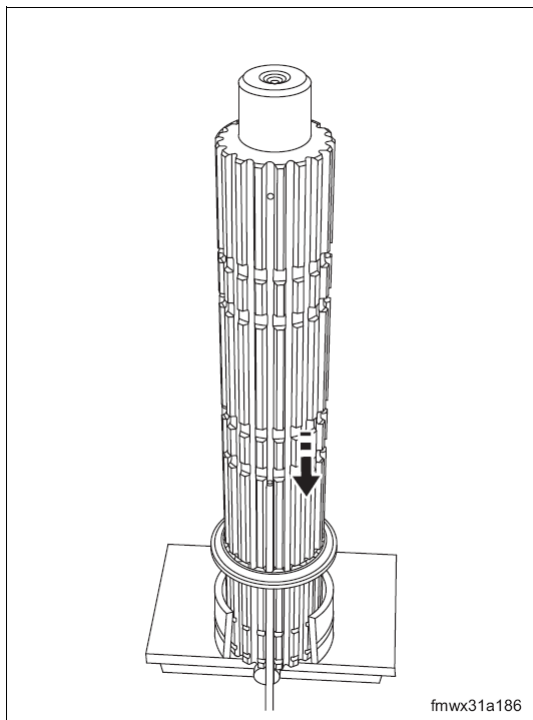


- (d) Dismantle the main shaft sliding sleeve, adjusting gasket, spline gasket and main shaft 3rd gear.
- (e) Dismantle the main shaft 2nd gear.



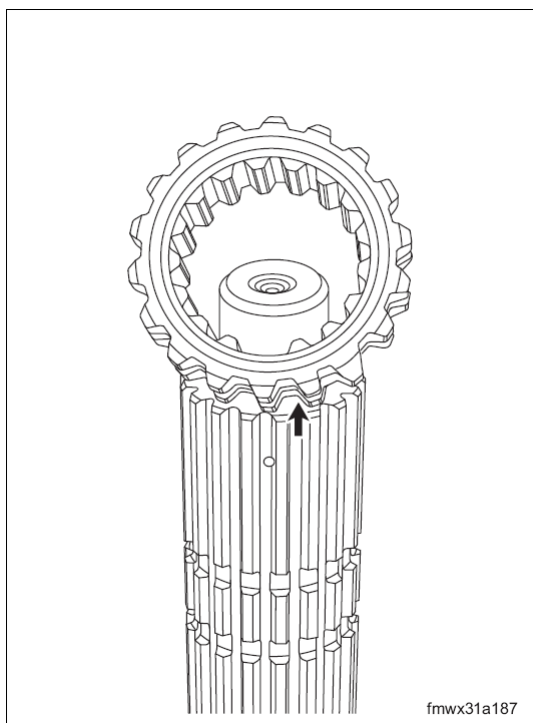
- (f) Dismantle the spline gasket, gear adjusting gasket, sliding sleeve and main shaft 1st gear.
- (g) Dismantle the main shaft gear in low gear .

Transmission (RT-11509C) - Main Shaft Assembly



2. Assemble the main shaft assembly

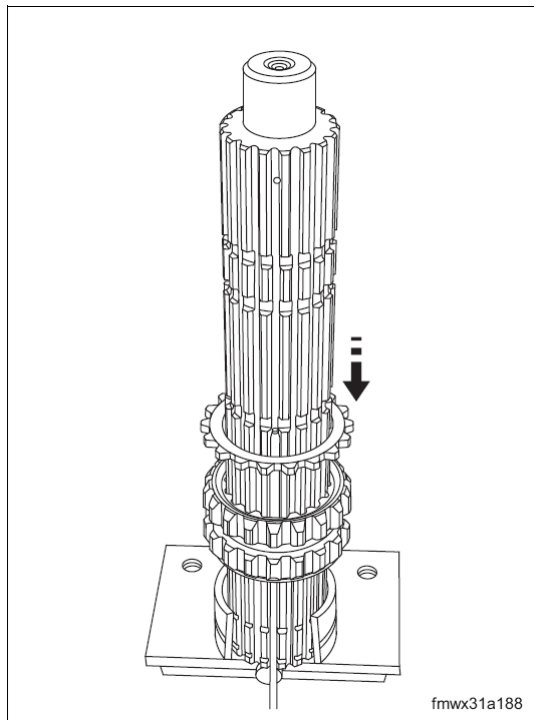
- (a). Place the main shaft vertically in the installation tool, install the adjusting gasket on the main shaft with the convex side facing up, and insert the long key after turning a tooth pitch.



- (b). Install the low/reverse gear sliding sleeve.

Hint:

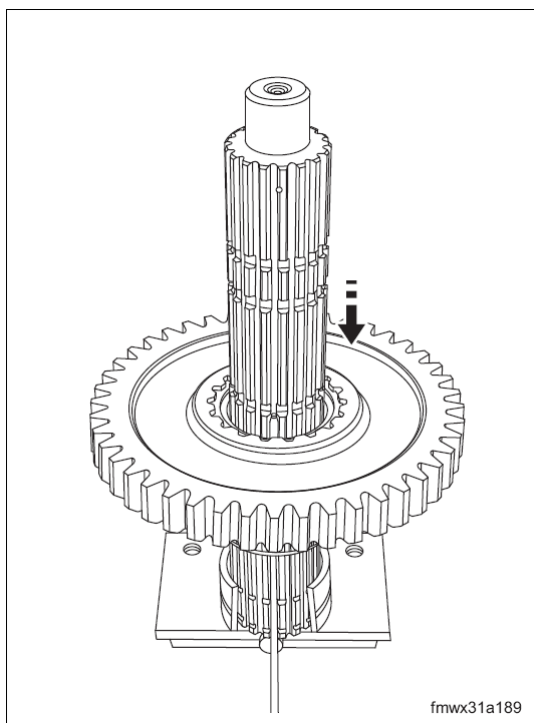
The three sliding sleeves on the main shaft can be interchangeable, and the part without teeth faces the groove with hole on the main shaft.



- (c). Install one adjusting gasket with the convex side facing down, push the long key after turning one tooth pitch, and put one spline gasket in.

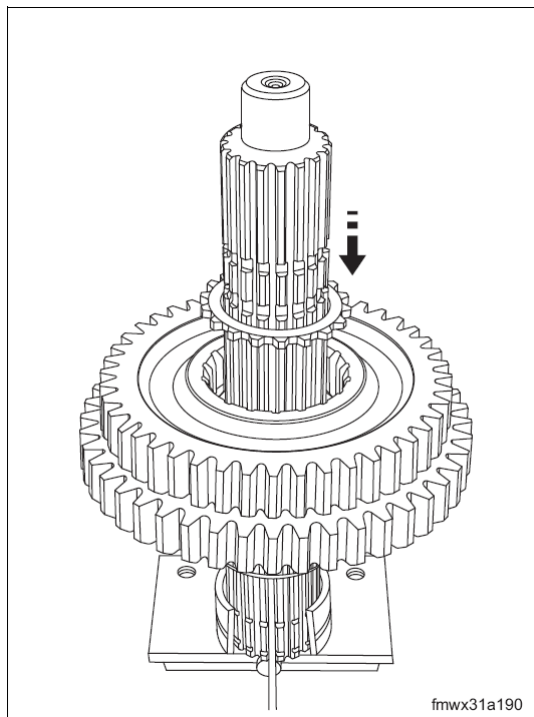
Caution:

The spline gaskets are interchangeable because they have the same thickness, while the adjusting gaskets have various thicknesses. The adjusting gaskets need to be selected.

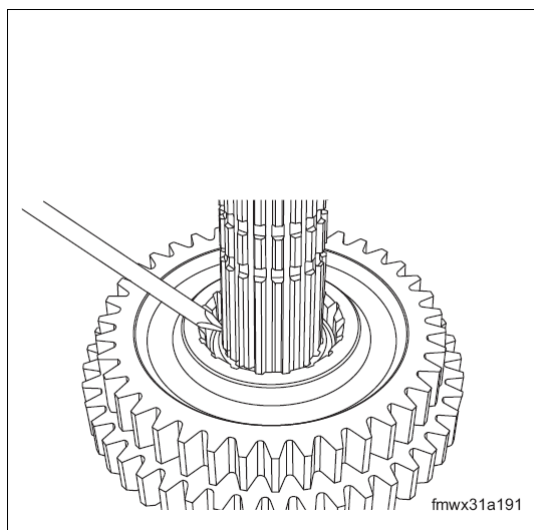


- (d). Install the engaging ring gear of the main shaft low gear downward on the main shaft.

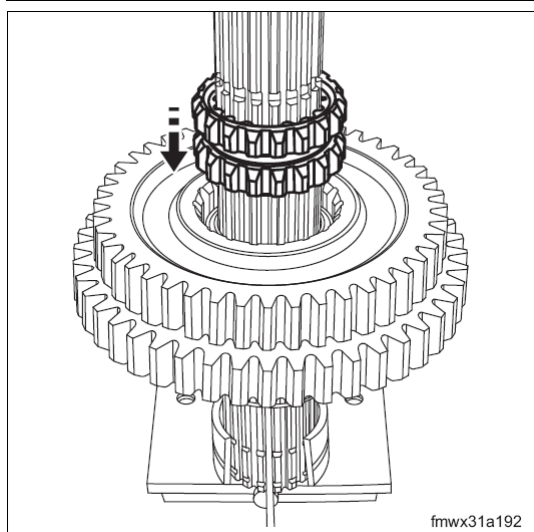
Transmission (RT-11509C) - Main Shaft Assembly



- (e). Install the engaging ring gear of the main shaft 1st gear upward on the main shaft, and install one spline gasket.



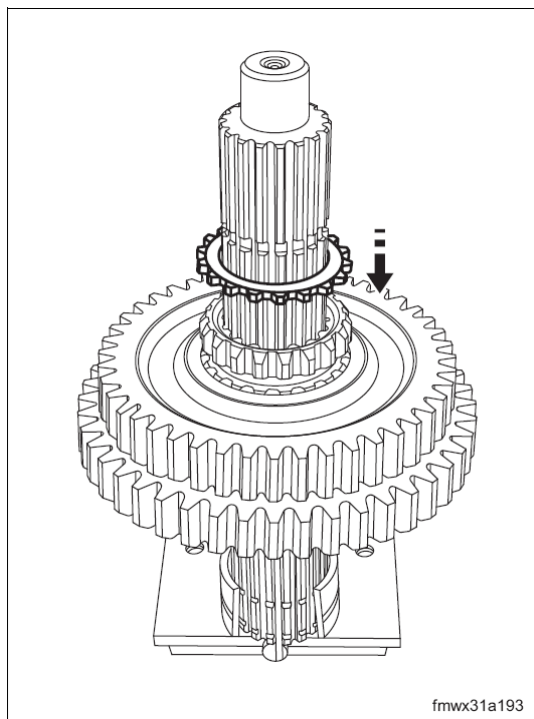
- (f). Install one adjusting gasket with the convex side facing up, and push the long key after turning one angle.



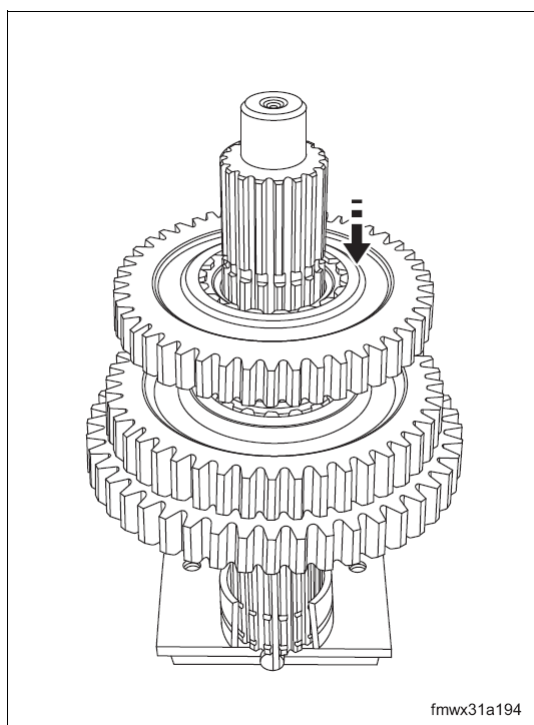
- (g). Install the 1st/2nd gear sliding sleeve.

Caution:

The part without teeth faces the groove with hole on the main shaft.

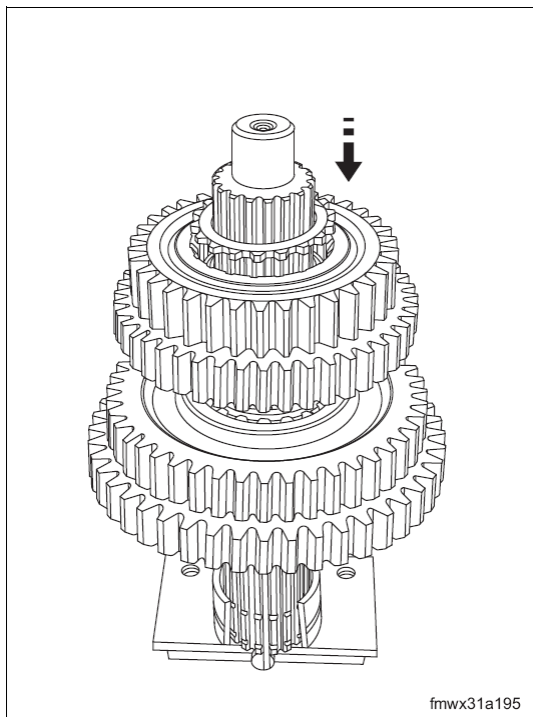


- (h). Install one adjusting gasket with the convex side facing down, push the long key after turning one tooth pitch, and put one spline gasket in.

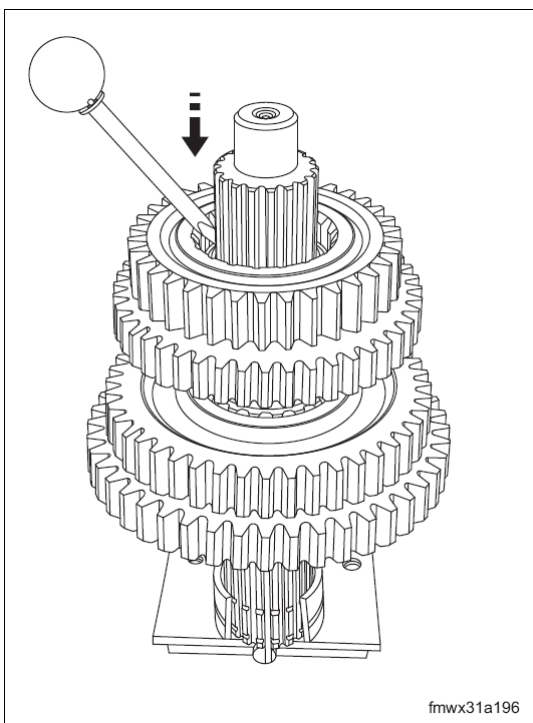


- (i). Install the engaging ring gear of the main shaft 2nd gear downward on the main shaft.

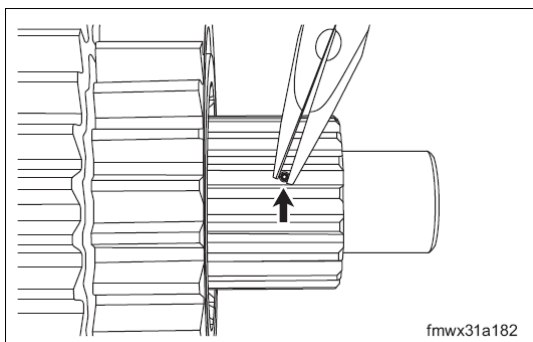
Transmission (RT-11509C) - Main Shaft Assembly



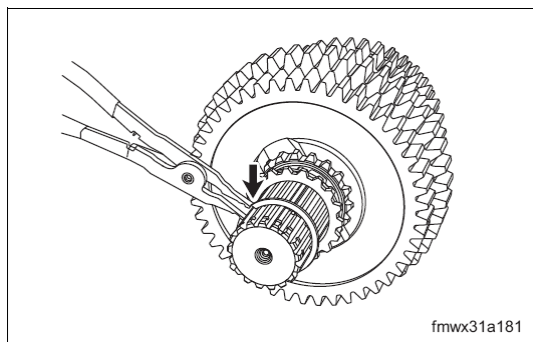
- (j). Install the engaging ring gear of the main shaft 3rd gear upward on the main shaft, and install one spline gasket.



- (k). Install one adjusting gasket with the convex side facing up, and push the long key after turning one angle.



- (l). Beat the elastic pin in the small hole on the main shaft, and install the 3rd/4th gear sliding sleeve.



- (m). Beat the elastic pin in the small hole on the main shaft, and install the 3rd/4th gear sliding sleeve. Place the main shaft flat, install the main shaft reverse gear and spline gasket, and install one snap ring at the rear end of the main shaft.

Caution:

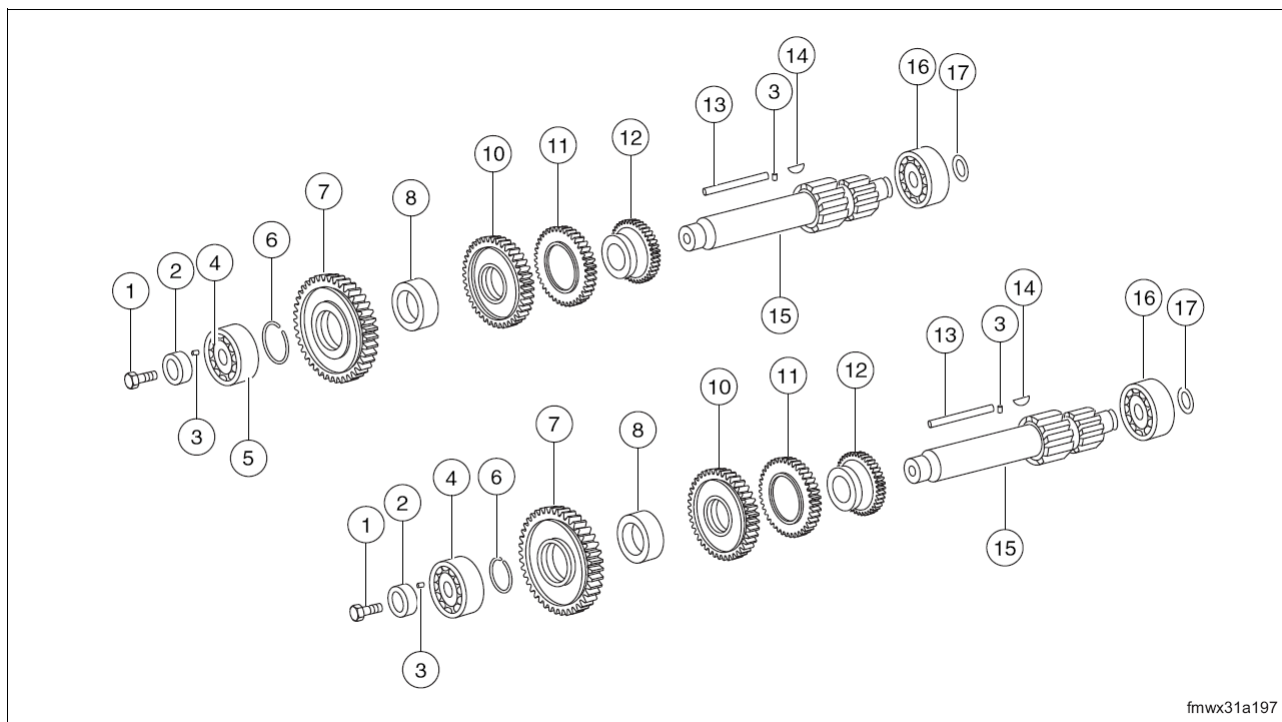
When assembling the shaft, it is necessary to choose the gaskets of different thicknesses to adjust the gear clearance. The thickness and color of the gasket are shown in the following table:

Thickness Range (mm)	Color
6.30~6.35	White
6.45~6.48	Green
6.55~6.60	Orange
6.68~6.73	Purplish Red
6.80~6.86	Yellow
6.93~6.99	Black

Transmission (RT-11509C) - Countershaft Assembly

Countershaft Assembly

Part Drawing



fmwx31a197

1	Small Hex Head Bolt (M16×1.5×45)
2	Countershaft Bearing Baffle Plate
3	Elastic Cylindrical Pin (Pin 5×14)
4	Single-row Centripetal Ball Bearing
5	Snap Ring
6	Countershaft Snap Ring
7	Countershaft Snap Ring
8	Spacer (LH Countershaft Assembly)
9	Friction Gear (RH Countershaft Assembly)

10	Countershaft 3 rd Gear
11	Countershaft 2 nd gear
12	Countershaft 1 st Gear
13	Countershaft Square Key
14	Woodruff Key
15	Countershaft
16	Bearing
17	Snap Ring

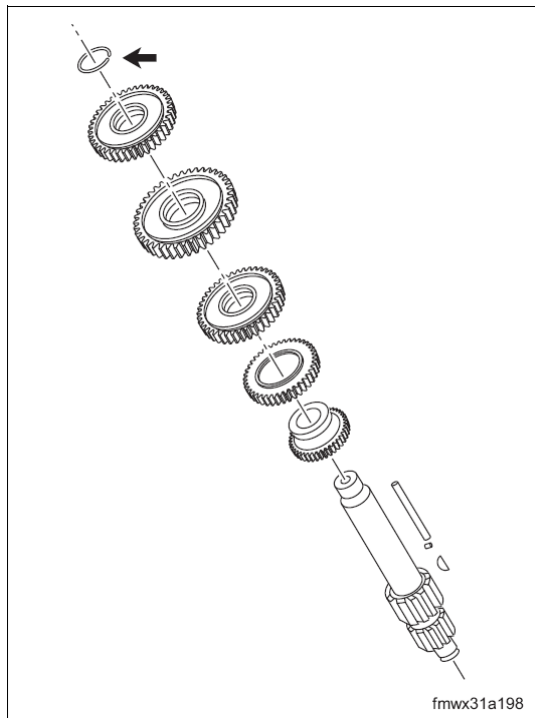
Disassembly and Assembly

Hint:

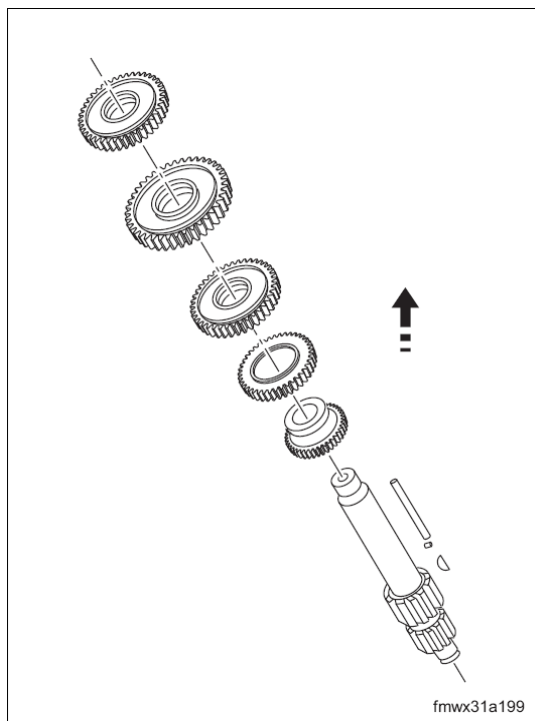
The countershaft shall not be dismantled under general conditions except serious wear, tooth hit, etc.

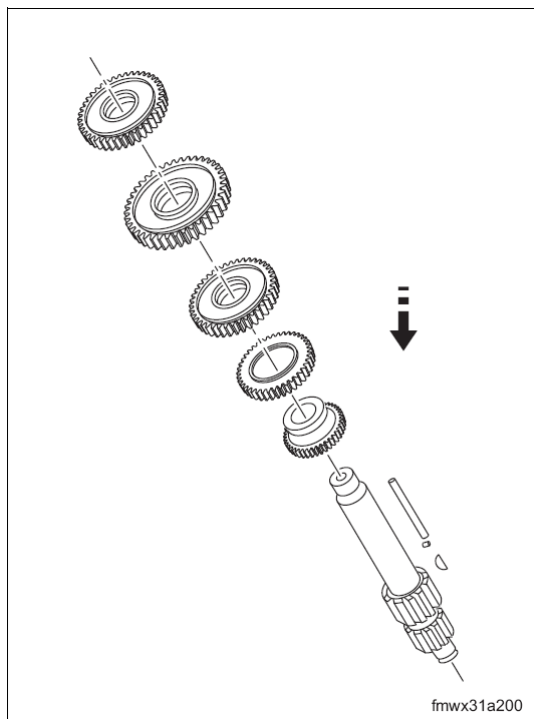
1. Disassemble the right countershaft

- (a). Dismantle the countershaft snap ring.

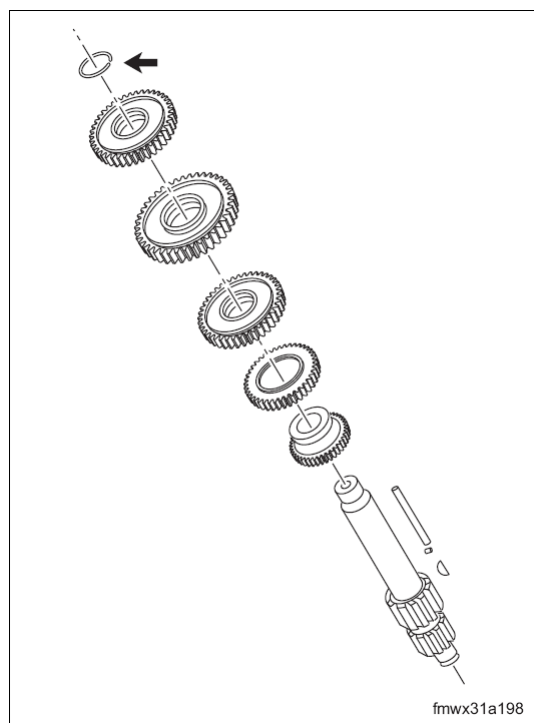


- (b). Dismantle the countershaft drive gear, friction gear, countershaft 3rd gear, countershaft 2nd gear, countershaft 1st gear, countershaft square key and woodruff key in order.



Transmission (RT-11509C) - Countershaft Assembly**2. Assemble the right countershaft**

- (a). Install the woodruff key, countershaft square key, countershaft 1st gear, countershaft 2nd gear, countershaft 3rd gear, friction gear, countershaft drive gear on the countershaft in order.



- (b). Install the countershaft snap ring.

Hint:

Refer to the disassembly and assembly of the right countershaft for the disassembly and assembly of the left countershaft. The difference of the two countershafts lies in that: at the position where the friction gear is arranged on the right countershaft, a spacer is installed on the left countershaft. Except this, their other positions are basically the same.

Transmission (9JS135)

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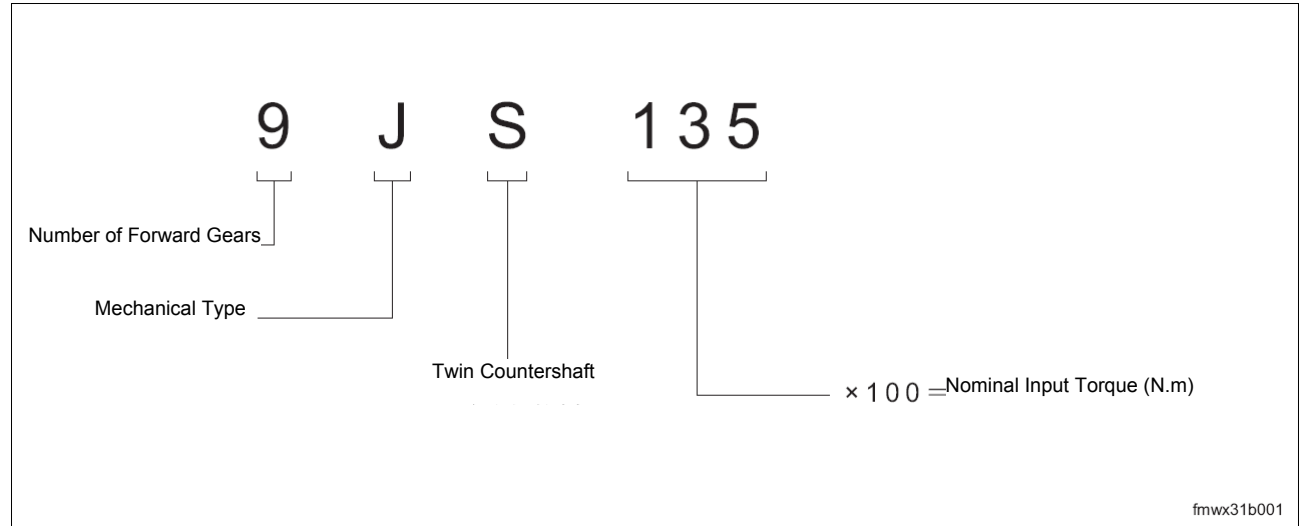
31B

Transmission

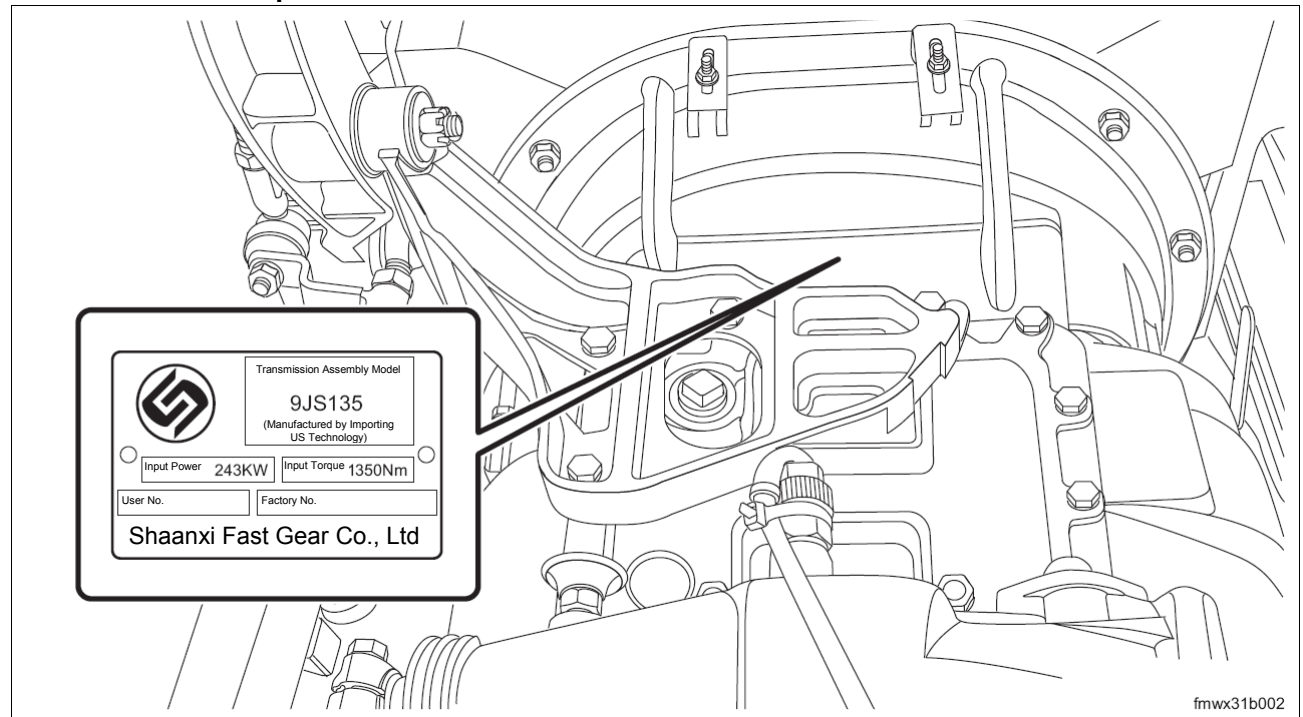
General

The Fast twin countershaft transmission is mainly characterized in that a countershaft is added on the symmetrical axis of the countershaft of the common transmission, and becomes a transmission which has two countershafts. Power can be transmitted symmetrically due to one additional countershaft, so as to gain the advantages of stable transmission and low noise.

Meaning of Transmission Model:



Transmission Nameplate



Precautions

I. Precaution for Use of Transmission

It is very important to correctly and reasonably operate and use the transmission, and do regular maintenance on the transmission for ensuring that the vehicle runs safely and reliably and prolonging the service life of the transmission.

1. Release the parking brake before the vehicle takes off. For the vehicle with air cut-off brake, after switching on the brake valve, put into gear and take off until the air pressure rises to the pressure required for releasing the brake.
2. Take off at the 1st or 2nd gear according to the road condition.
3. During gear shift, the clutch must be released fully, and the gear shift lever shall put into gear in position.
4. The gear shift lever has two neutral positions, i.e. the 3rd/4th gear in low gears and 5th/6th gear in high gears. When stopping the vehicle, the gear shift lever shall be in the low gear area.
5. When putting into reverse gear or climbing gear, stop the vehicle and then put into gear to avoid the inside parts of the transmission. When putting into reverse gear, apply strong hand force to overcome the resistance from the reverse gear lock.
6. When shifting between the high and low gears (4th and 5th gears), be aware of stopping for a while, which is good for the auxiliary transmission to finish shifting between the high gear area and low gear area.
7. The temperature of the transmission which is operating continuously shall be kept within the range of -40 °C to 120 °C. If the operating temperature exceeds 120 °C, the lubricating oil will decompose and the service life of the transmission will shorten.

Warning:

1. The gear jumping operation is prohibited when the transmission is shifted to a high gear from a low gear or to a low gear from a high gear.
2. When shifting gears during driving, it is prohibited to use the countershaft brake.
3. It is prohibited to shift gears when the vehicle is running down on a slope.
4. The vehicle is prohibited to slide at neutral gear.
5. The driving wheels are prohibited to touch the road when the vehicle is towed.
6. Once detecting the abnormal phenomena that there is abnormal noise in the transmission, the operation gets obviously heavy, etc. in use, stop the vehicle immediately for inspection, and continue to drive after eliminating the fault.

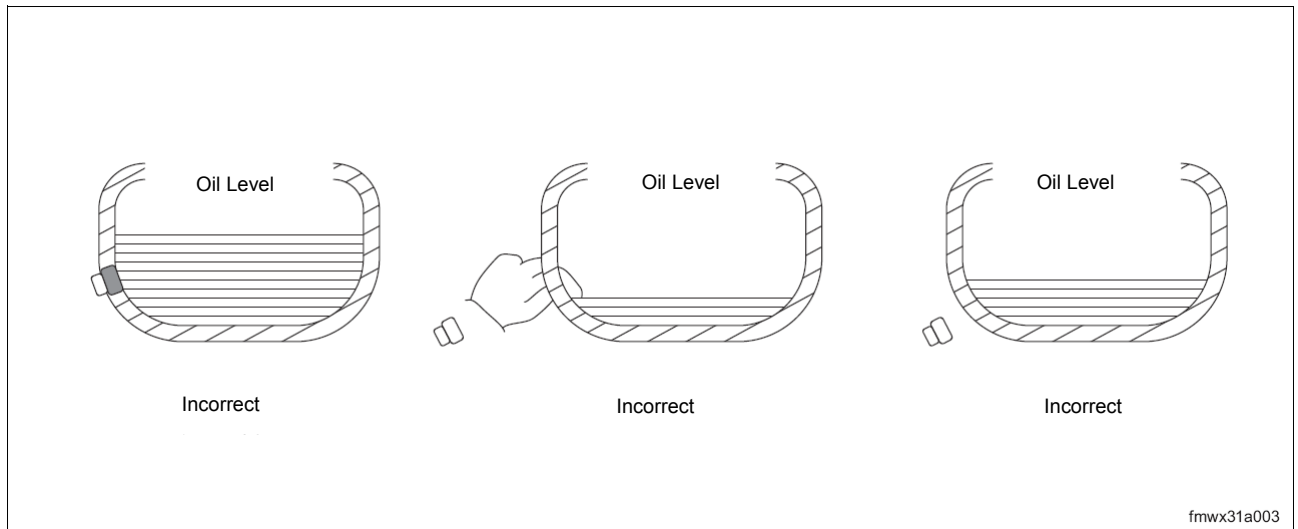
II. Precautions for Maintenance of Transmission

When it reaches the specified maintenance interval, conduct all previous maintenance and inspection items specified in the maintenance regulations.

1. Daily Inspection

1-1 Inspection on lubricating oil level

Inspect the lubricating oil level and leakage of the transmission every day, and fill lubricating oil in time, and repair the leaks if any immediately to prevent the transmission fault caused by loss of lubricating oil.



1-2 Pneumatic System

- 1) Discharge the water in the pneumatic system of the vehicle every day.
- 2) Hear whether there is air leakage every day, and repair if necessary.
- 3) Confirm whether the air dryer operates normally, and repair if necessary. Overhaul the air compressor of the vehicle according to the requirement to prevent lubricating oil from going into the pneumatic system.

2. 2,000-5,000 km for New Transmission

- 2-1 Replace lubricating oil;
- 2-2 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 2-3 Lubricate the release bearing;
- 2-4 Lubricate the clutch fork shaft;
- 2-5 Clean the air filter element;
- 2-6 Inspect and clean the transmission breather holes;
- 2-7 Inspect whether the transmission control mechanism operates normally.

3. Every 10,000km or 2 months

- 3-1 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 3-2 Lubricate the release bearing;
- 3-3 Lubricate the clutch fork shaft;
- 3-4 Clean the air filter element;
- 3-5 Inspect and clean the transmission breather holes;
- 3-6 Inspect whether the transmission control mechanism operates normally.

4. Oil Replacement

- 4-1 It is very important for the maintenance of the transmission to choose correct lubricating oil, and you must comply with the specified maintenance procedures as follows:
 - 1) Purchase lubricating oil from recognized suppliers;

Transmission (9JS135) - Transmission

- 2) Use the correct type and grade of lubricating oil. Brand of lubricating oil: 85W-90 GL5;
- 3) Replace lubricating oil according to the appropriate oil replacement interval;
- 4) Keep the lubricating oil level correct.
- 4-2 The replacement period of lubricating oil shall not exceed the intervals listed in the following table.

Road Service Condition	Off-road Service Condition	Severe Service Condition
One year (at most) or 50,000 km	Every 1,000h	Every 500h

Caution:

The severe service condition refers to the conditions that require parts to operate continuously under high load condition, in heavily polluted environment or on a steep slope. Under those service conditions, apply the oil replacement period specified by the severe service condition.

III. Precautions for Disassembly of Transmission

1. Do repair in a clean place to prevent dust or other foreign matters from going into the transmission. Carefully clean the inside and outside of the transmission before dismantlement.
2. When dismantling various assemblies, place all parts on a clean workbench in the dismantling order, which is convenient for the steps of re-installation and reduces the possibility of part loss.
3. Dismantle the countershaft, main shaft and primary shaft gear, and it is unnecessary to dismantle the primary shaft.
4. Bearing – When dismantling it, use special tools. Clean carefully, and inspect whether there is pitting on its raceway, and whether its rolling element is good.

Transmission (9JS135) - Transmission

IV. Precautions for Assembly of Transmission:

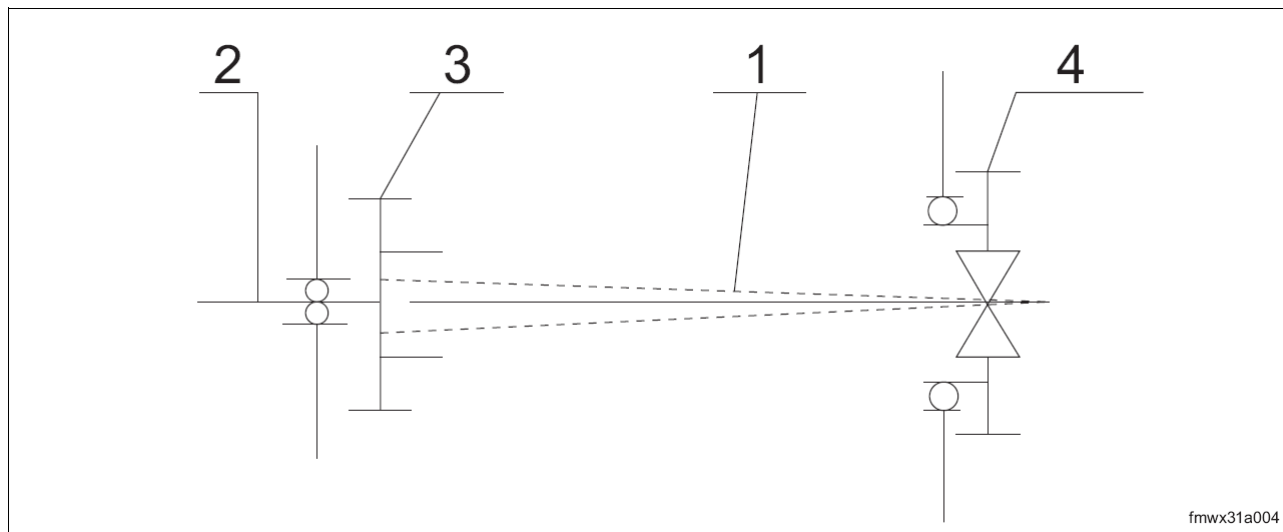
Before assembly, make sure to fully clean the parts to be assembled so as to prevent dust and foreign matters from going into the transmission, or unnecessary damages will be caused.

1. **Gasket** – When re-assembling the transmission, use new gaskets.
2. **Bolt** – In order to prevent leaking oil, apply screw sealant to all bolts, and tighten according to the standard torque.
3. **O-ring** – Lubricate all O-rings with silicone grease lubricant.
4. **Initial lubrication** – During assembly, coat all thrust washers with lubricating grease for initial lubrication, which can prevent scratching or wear.
5. **Axial Clearance** – Ensure an axial clearance of 0.13~0.30mm for the man shaft forward gear, and an axial clearance of 0.30~0.90mm for the reverse gear.
6. **Tighten the output shaft flange nuts**, and tighten the output nuts with a torque of 610~680N.m, or it will cause serious consequences.

31B

Transmission Structure and Principle

I. Twin Countershaft Floating Structure



1	Main Shaft
2	Input Shaft

3	Input Shaft Gear
4	Auxiliary Box Driving Gear

Both the main and auxiliary transmissions of the Fast twin countershaft transmission adopt two countershafts which have the same structure and are spaced by 180°. Power is input from the input shaft, split on the two countershafts, then gathered on the main shaft and then output. The auxiliary transmission is the same.

Each countershaft only transmits 1/2 of the torque in theory, so by using the twin countershafts, the center distance of the transmission decreases, the gear thins, the axial size shortens, and the quality lightens. After using twin countershafts, the gears on the main shaft must be meshed with two countershaft gears simultaneously.

In order to meet correct meshing and distribute the load equally as much as possible, the main shaft gears are in floating state on the main shaft, and the main shaft is of an articulated floating structure. The main shaft journal is inserted into the hole of the input shaft, the oil-containing guide bushing is pressed into the hole, and the enough radial clearance is left between the main shaft journal and oil-contain guide bushing. The rear end of the main shaft is inserted into the driving gear hole of the auxiliary transmission through the involute spline, and the driving gear journal of the auxiliary transmission is supported on the ball bearing.

As the gears on the main shaft float on the main shaft, the traditional needle beatings are cancelled, which makes the structure of the main shaft assembly simpler. During operation, the radial forces applied to the main shaft gears by the two countershaft gears are equal but opposite in direction, and they are offset mutually, which makes the main shaft only bear torque without bending moment, improves the stress condition of the main shaft and bearing, and greatly enhances the reliability and durability of the transmission.

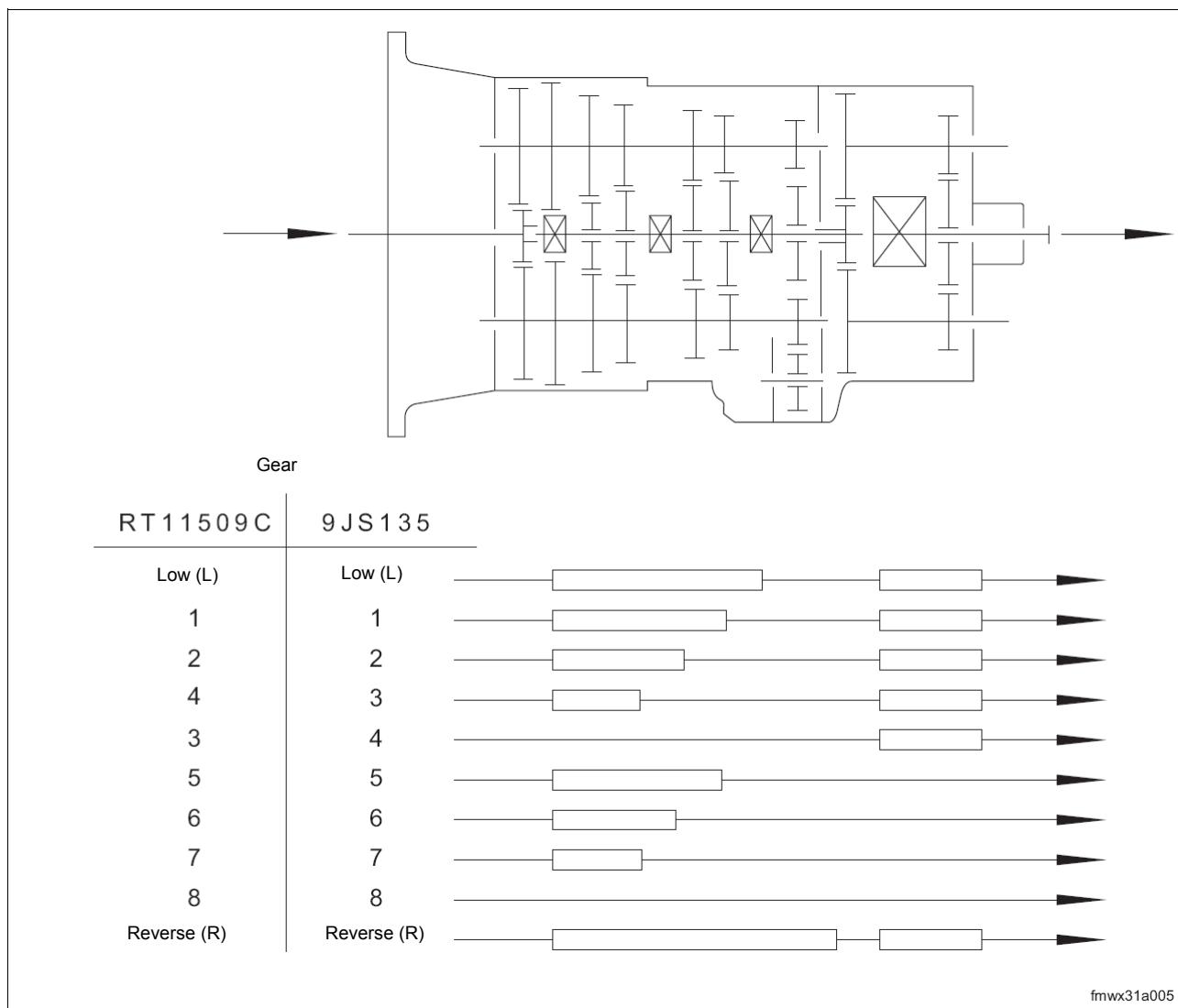
II. Power Transmitting Line

Knowing the engine power transmitting line of the specific gears of the transmission is helpful for the technical personnel to overhaul and maintain the transmission. It is usually considered that the Fast transmission is an integral device composed of two separate transmissions. The first transmission (or called transmission front box) consists of six gear pairs which are controlled by the gear shift lever. The second transmission is called auxiliary box, which realizes the shifting of the range gears through two gear pairs which are controlled by air pressure.

Hint:

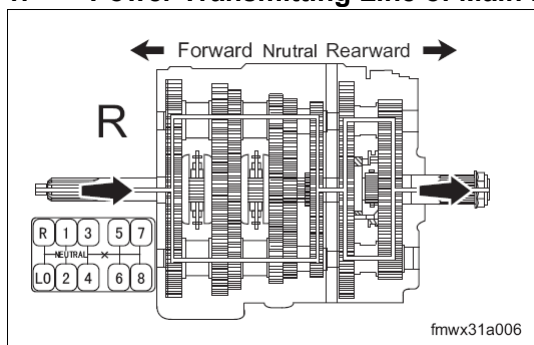
This transmission is a constant mesh transmission. Although only part of gears transmits power during operation, all gears rotate.

Transmission (9JS135) - Transmission

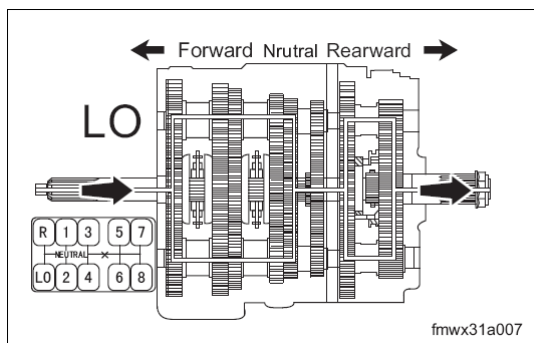


31B

1. Power Transmitting Line of Main Bo

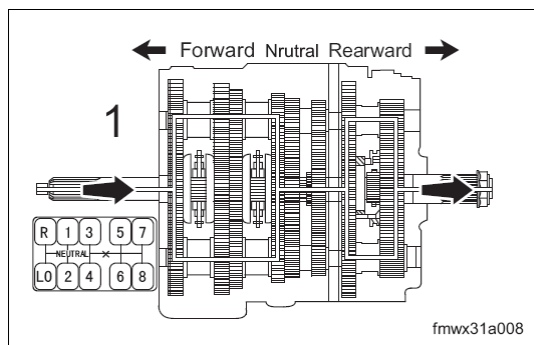


(a). Reverse Gear transmitting line.

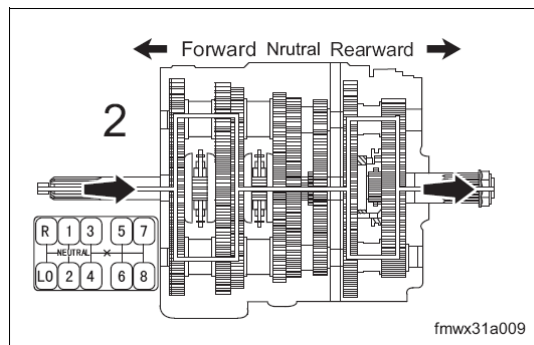


(b). Climbing Gear transmitting line.

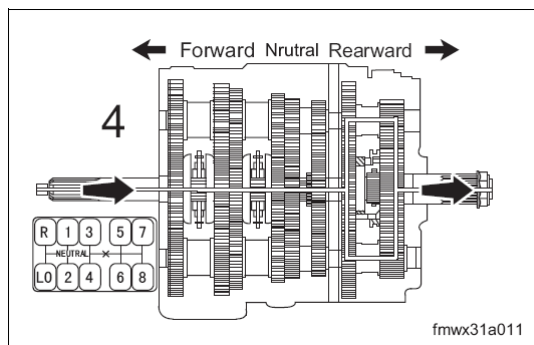
31B



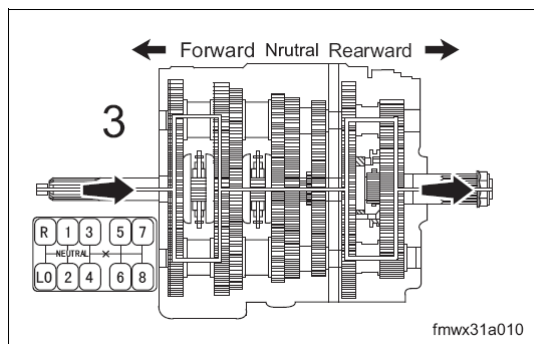
(c). Gear 1 transmitting line.



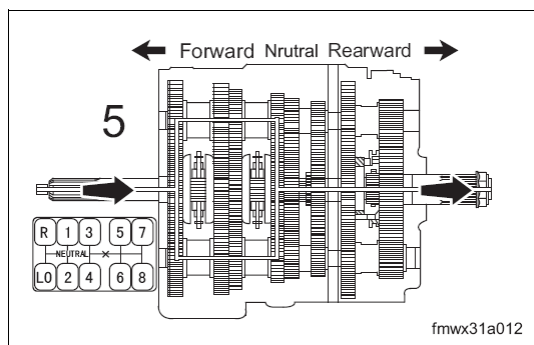
(d). Gear 2 transmitting line.



(e). Gear 3 transmitting line.

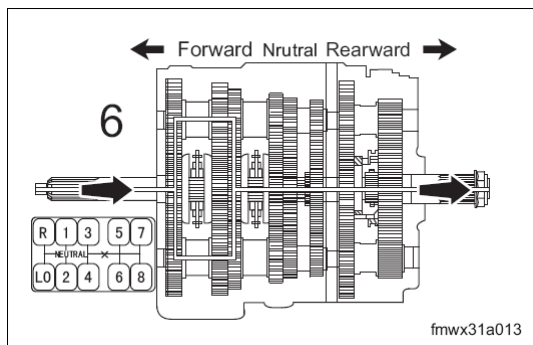


(f). Gear 4 transmitting line.

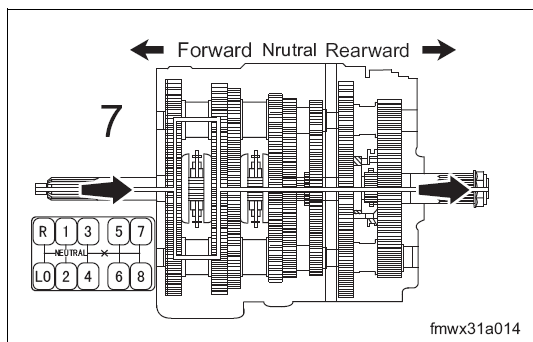


(g). Gear 5 transmitting line.

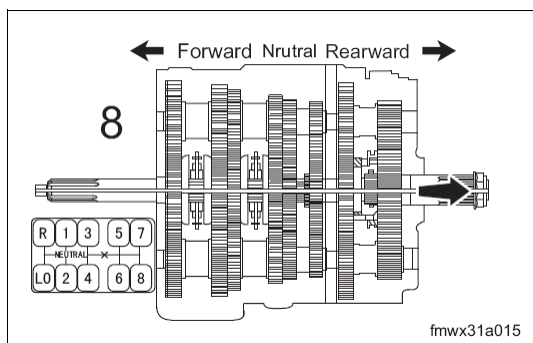
Transmission (9JS135) - Transmission



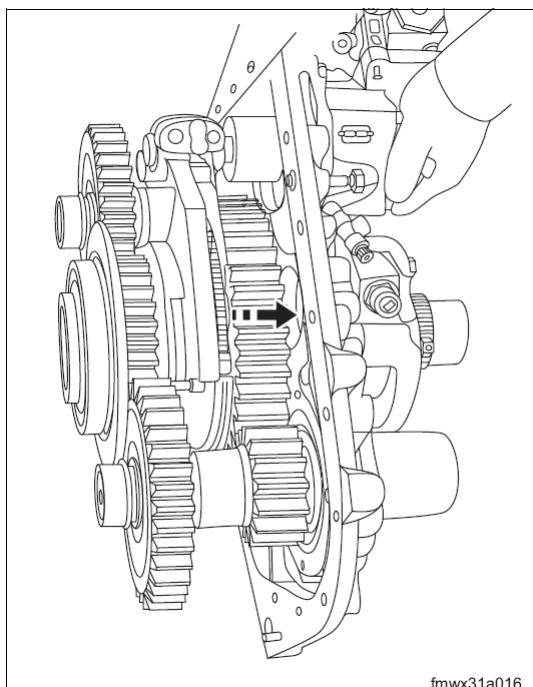
(h). Gear 6 transmitting line.



(i). Gear 7 transmitting line.



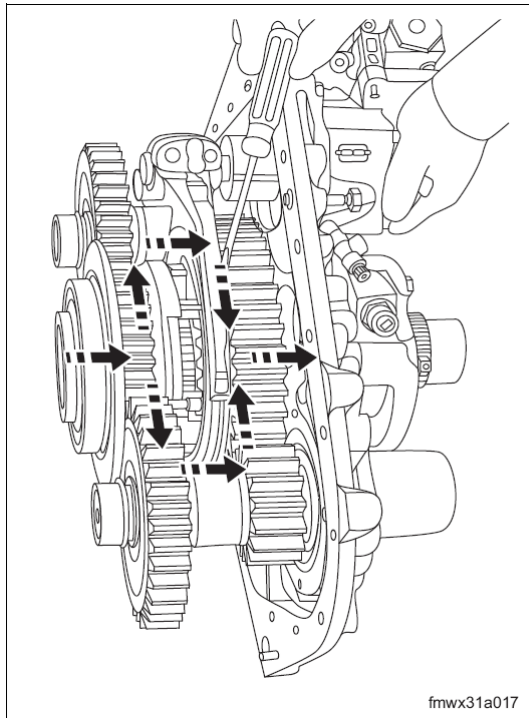
(j). Gear 8 transmitting line.



2. Power Transmitting Line of Auxiliary Box

(a). High gears.

31B

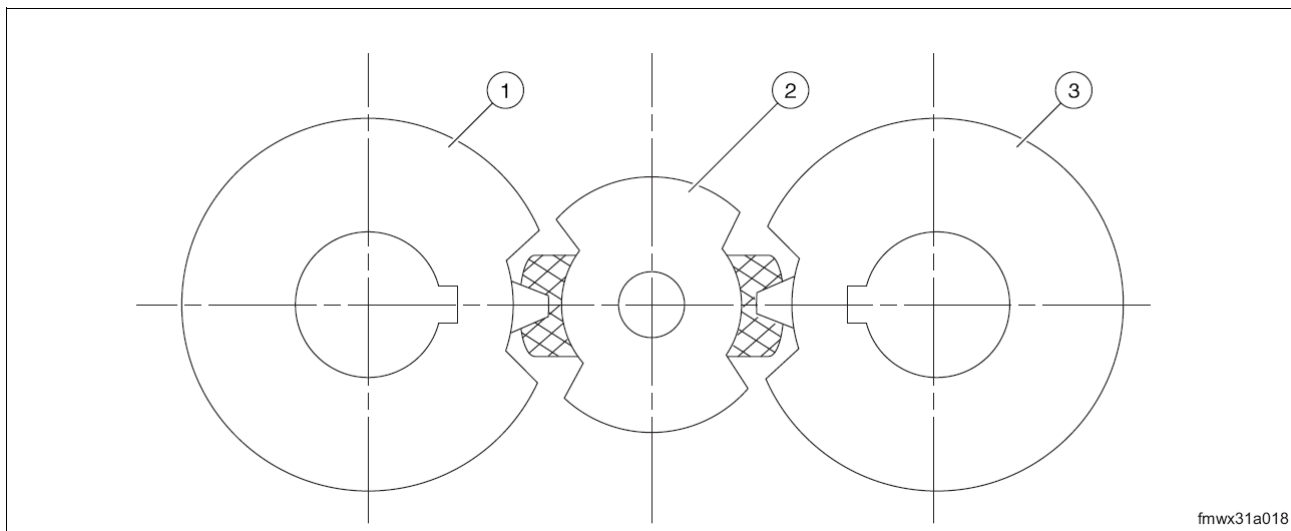


(b). Low gears.

III. Teeth Alignment and Tooth Alignment Process

In order to ensure the correct meshing between the countershaft gears and main shaft gear, and the same rotating angle of the two countershafts, the installation of both the main box and auxiliary box must be based on "teeth alignment". Generally, when installing the main box, choose the primary shaft gear and countershaft constant mesh gears for teeth alignment; when installing the auxiliary box, choose the auxiliary box reduction gear and auxiliary box countershaft gears for teeth alignment.

Teeth Alignment Process:



1	LH Countershaft Gear
2	Primary Shaft Gear

3	RH Countershaft Gear
---	----------------------

Teeth Alignment for Main Box

Transmission (9JS135) - Transmission

- First, coat mark paint on any two adjacent teeth of the primary shaft gear, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.
- Respectively coat mark paint on the toplands of the external teeth over against the inner bore keyway of two constant mesh gears of the countershaft, and this mark is unique.
- When installing, respectively insert the marked gear teeth of the two constant mesh gears of the countershaft into the marked tooth grooves of the primary shaft gear. If installed correctly, the primary shaft rotates flexibly, and inspect whether the teeth aligning marks are correct if the primary shaft can not be rotated or can be rotated heavily.

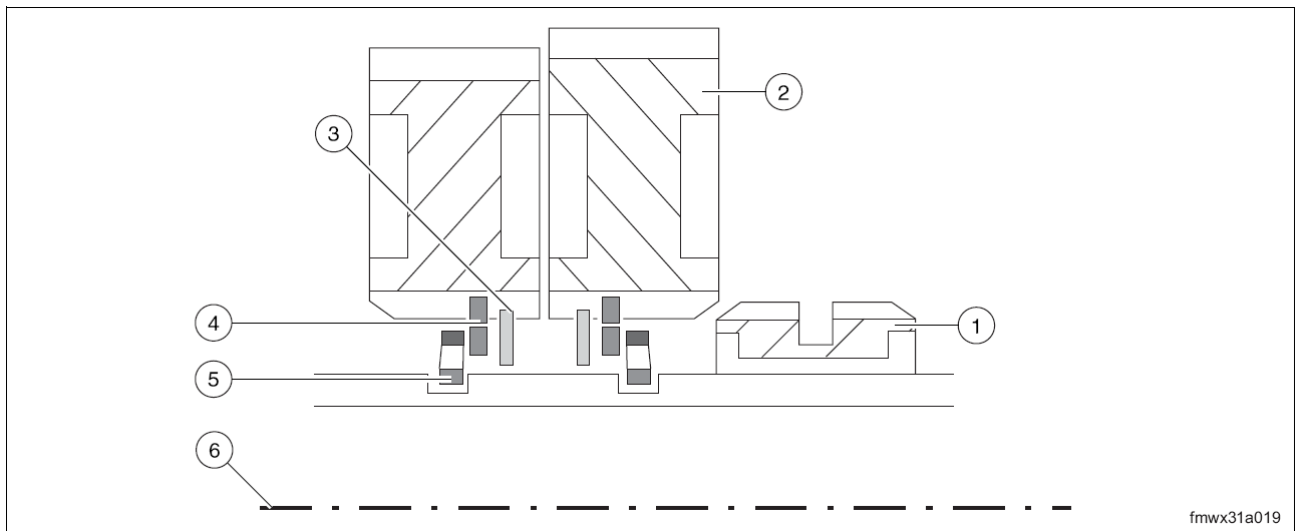
Teeth Alignment for Auxiliary Box

- First, coat mark paint on any two adjacent teeth of the reduction gear of the auxiliary box, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.
- Coat mark paint on the topland with an O mark on the gear shaft of the countershaft of the auxiliary box, and this mark is unique.
- When installing, respectively insert the marked teeth of two auxiliary box countershaft gears into the marked tooth grooves of the auxiliary box reduction gear. When installing the auxiliary transmission assembly in the main box, inspect the teeth aligning marks carefully and assemble after confirmation.

VI. Gear Shift Mechanism

There is no synchronizer in the main box of the 9JS135 twin countershaft transmission, and the main shaft sliding sleeve is nested on the main shaft through the involute spline, the moving sliding sleeve makes the engaging teeth meshed with the inner engaging gear of the main shaft gear so as to transmit power, and the sliding sleeve and the inner engaging teeth end have the same cone angle $\alpha = 35^\circ$. As the main shaft and main shaft gear are in floating state, those two cone faces can play a role of automatic centering and synchronization when putting into gear.

The 9JS135 twin countershaft transmission has many gears, and the speed ratio difference between every two adjacent gears is small, so the speed difference between every two adjacent gears is also small when the transmission is operating, and the gear shift of the transmission is stable.



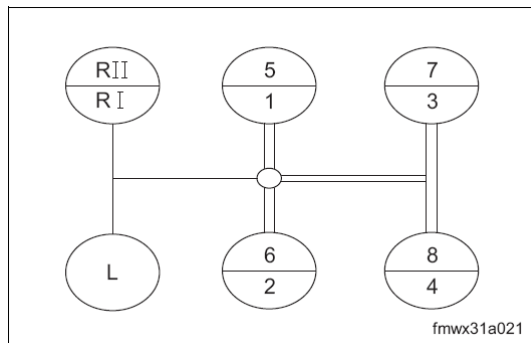
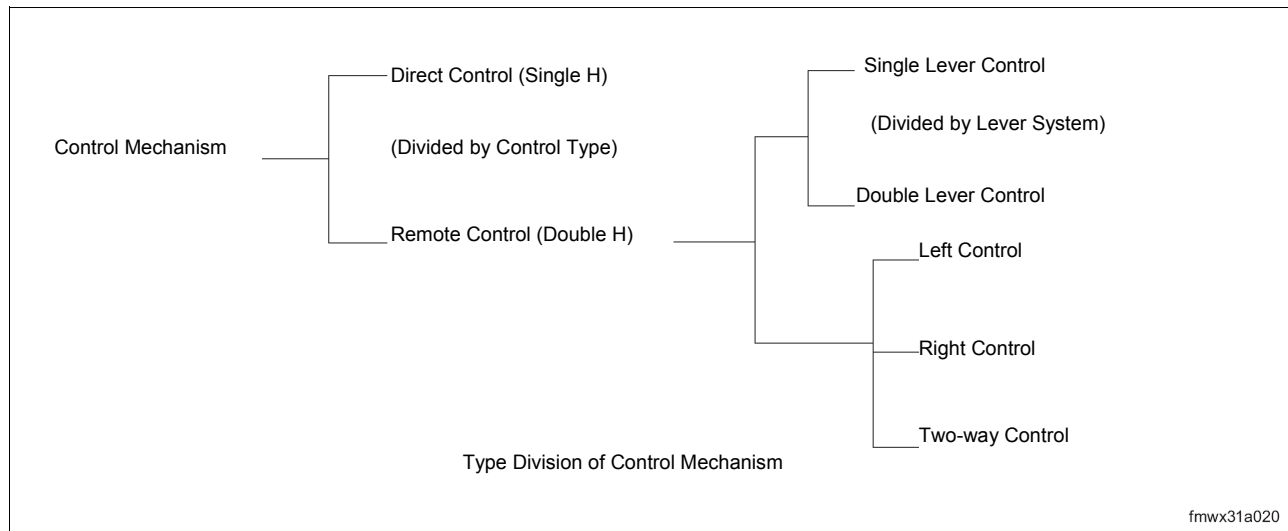
1	Sliding Sleeve
2	Main Shaft Gear
3	Snap Ring

4	Spline Gasket
5	Adjusting Gasket
6	Main Shaft

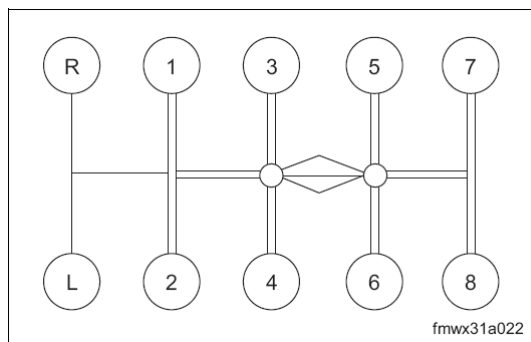
V. Control Mechanism

The control mechanism of the 9JS135 twin countershaft transmission falls into the direct control type (single H) and a remote control type (double H). Most of vehicles adopt the remote control mechanism.

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1. Position Diagram of Single H Gear Shift Mechanism Knob



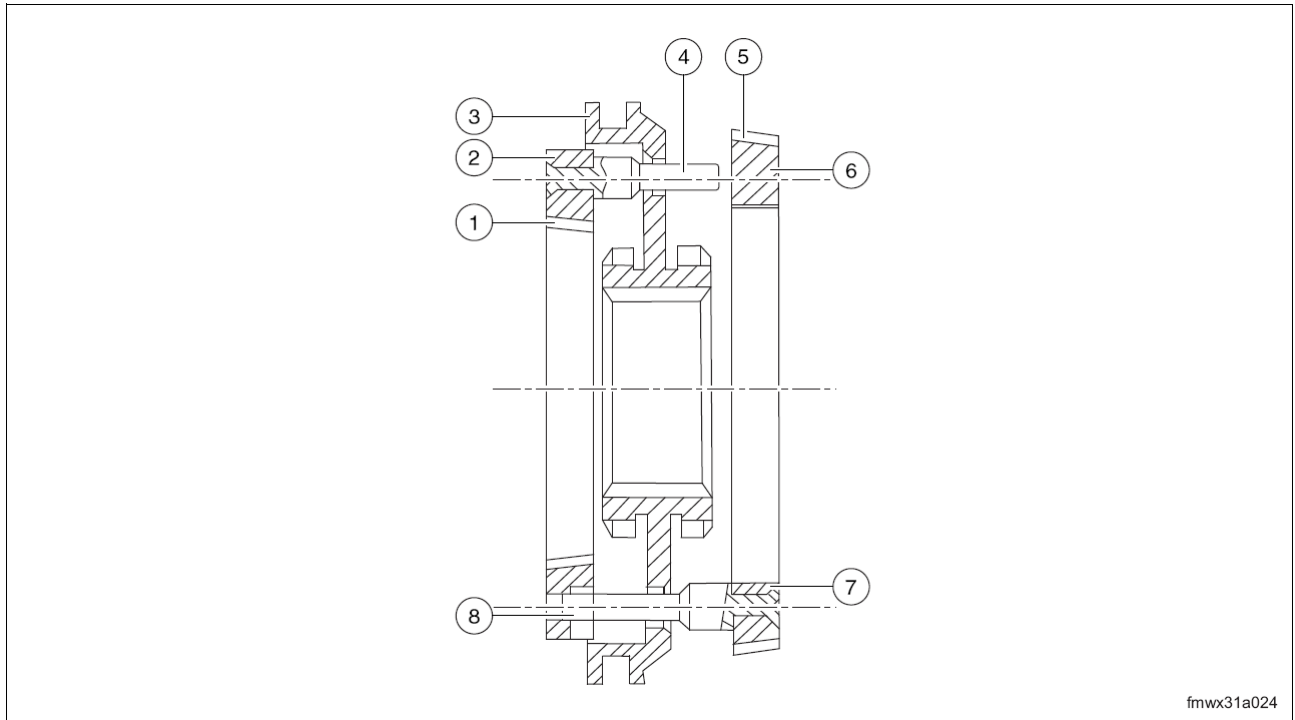
2. Position Diagram of Double H Remote Control Mechanism

In the double H control mechanism, Gears 1, 2, 3, 4, R and L are in the low gear area, and Gear 5, 6, 7 and 8 are in the high gear area. The double H has two neutral positions, respectively at the 3rd/4th gear in low gear area and at 5th/6th gear in high gear area.

VI. Structure and Operating Principle of Synchronizer

A lock pin inertia synchronizer is installed in the auxiliary transmission of the 9JS135 twin countershaft transmission. The lock pin inertia synchronizer is controlled by the gear shift cylinder of the auxiliary box and only operates during high-low gear shift. The action of the lock pin inertia synchronizer is controlled by the transverse gear shift lever and the single H air valve.

Three lock pins 4 and 7 are respectively riveted on the 9JS135 high-gear synchro ring 2 and the low-gear conical ring 6. The sliding gear sleeve 3 is combined with the output shaft of the auxiliary transmission through a spline. The substrates of the high-gear synchro ring and the low-gear conical ring are made by iron base powder metallurgical sintering, non-metal materials with high frictional property are respectively stuck to the inner cone of the high-gear synchro ring and the outer cone of the low-gear synchro ring, and the corresponding outer cone and inner cone the are respectively arranged on the driving gear and the reduction gear of the auxiliary transmission. See the drawing below:



1	High Gear Friction Belt
2	High Gear Synchro Ring
3	Sliding Gear Sleeve
4	High Gear Lock Pin

5	Low Gear Friction Belt
6	Low Gear Cone Ring
7	Lower Gear Lock Pin
8	Spring

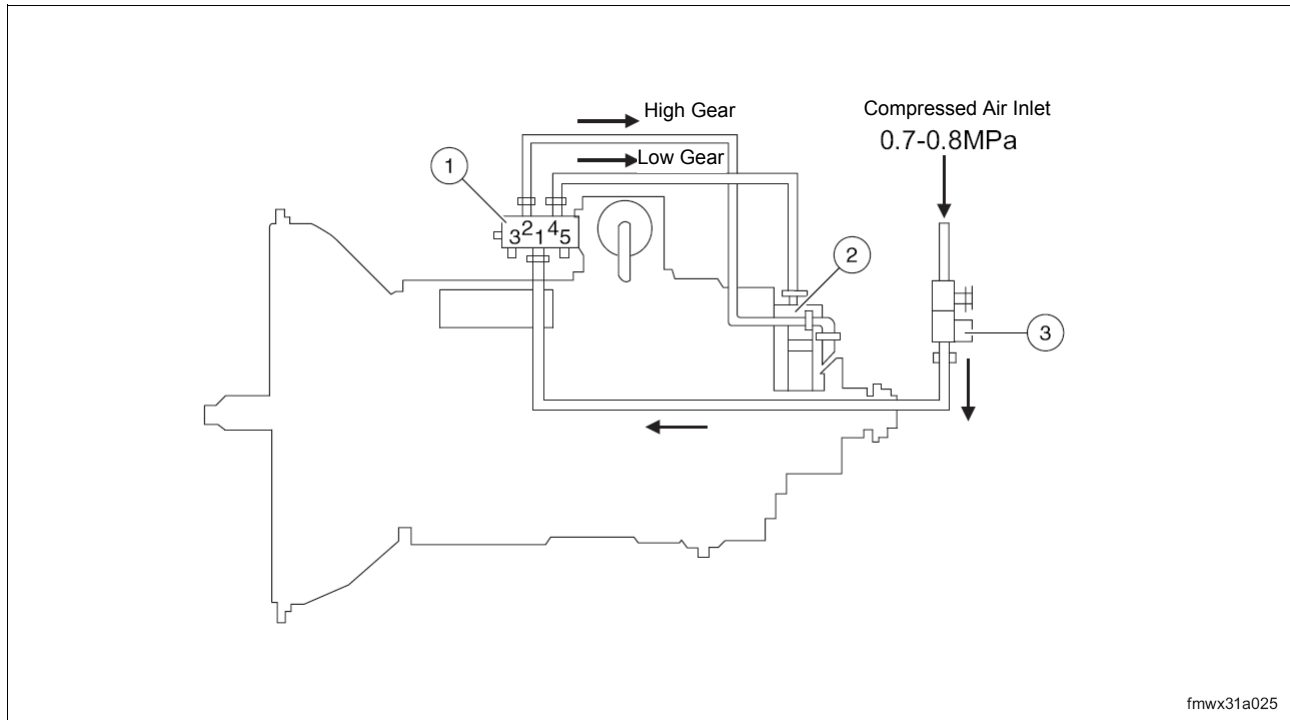
VII. Working Principle of Air Circuit

- The gear shift of the auxiliary transmission of the twin countershaft transmission is under the control of the pressure regulating air circuit system.
- The air circuit system includes the air filter regulator, double H air valve, auxiliary box gear shift cylinder and connecting pipe.
- The faults in the air circuit system may cause failure or lagging of the gear shift or damage to the transmission parts. If mastering the operating principle of the air circuit system and doing simple inspection, you can find out the problem and eliminate it by repair in time.

Working Principle:

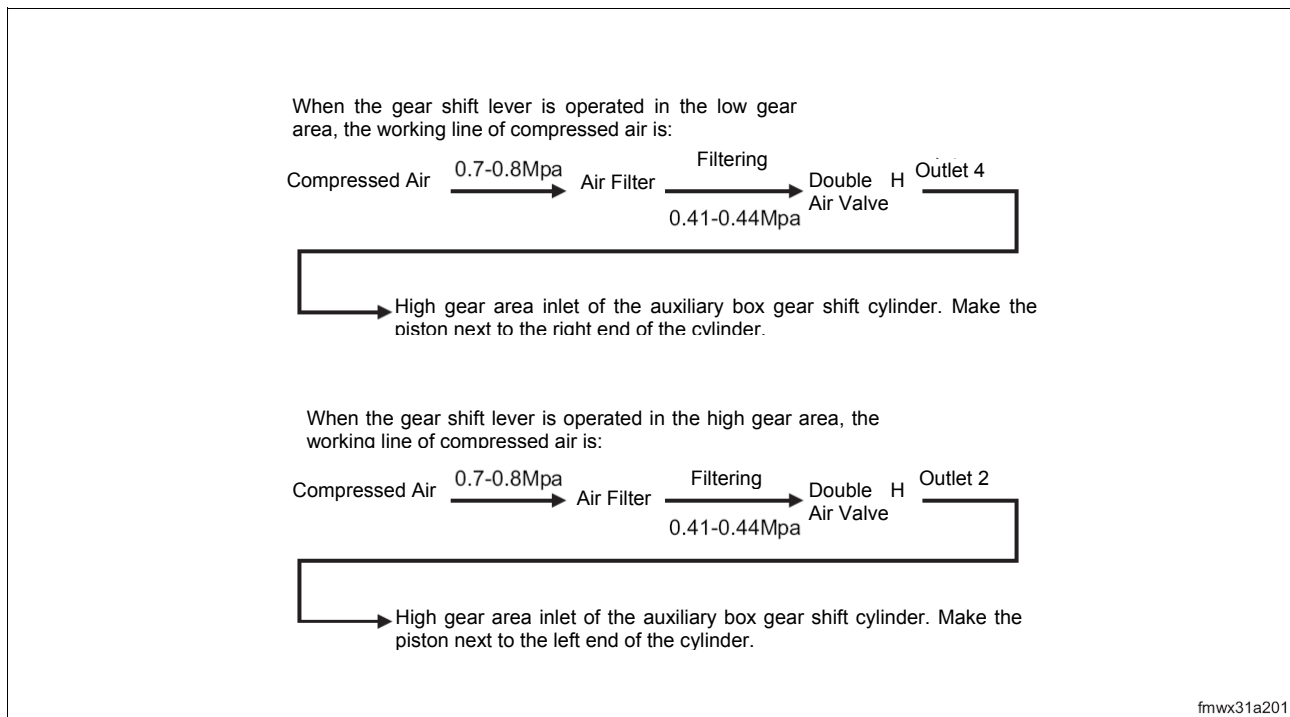
Compressed air of 0.7-0.8Mpa from the air reservoir of the whole vehicle, after its pressure is adjusted to 0.41-0.44Mpa by passing through air filter regulator, enters the inlet of the double H air valve through the air pipe. When putting into a low gear, the contact of the double H air valve is ejected to connect the low gear air circuit, the compressed air goes into the low gear inlet of the gear shift cylinder through the low gear air pipe of the double H air valve and then pushes the piston of the gear shift cylinder to move backward, the shift fork shaft of the gear shift cylinder drives the sliding sleeve of the synchronizer to be meshed with the inner engaging teeth of the auxiliary box reduction gear, and both the transmissions are in low gear. When putting into a high gear, the contact of the double H air valve is compressed to connect the high gear air circuit, the compressed air goes into the high gear inlet of the gear shift cylinder through the high gear air pipe of the double H air valve and then pushes the piston of the gear shift cylinder to move forward, the shift fork shaft of the gear shift cylinder drives the sliding sleeve of the synchronizer to be meshed with the inner engaging teeth of the auxiliary box driving gear, and both the transmissions are in high gear. When the gear shift lever shifts gear from the low gear area to the high gear area or from the high gear area to the low gear area, the remaining air in the cylinder is discharged from the air vent of the double H air valve through the connecting air pipe.

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1	Double H Gear Shift Air Valve
2	Cylinder, Range Gear

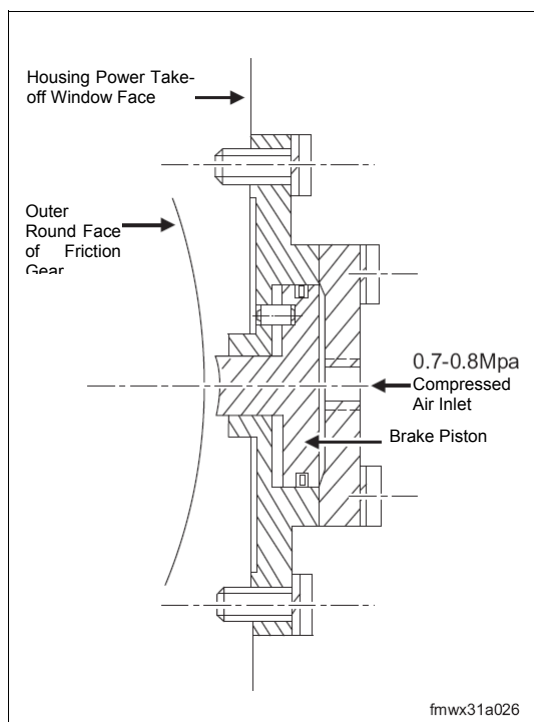
3	Air Filter Regulator
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VIII. Countershaft Brake

The countershaft brake is also called clutch brake, which is installed on the right of the main transmission housing. The countershaft brake is a control brake device, and the control air valve is installed below the clutch pedal. Pressing the pedal to the floor is to connect the air circuit of the countershaft brake, compressed air will push the brake piston to the topline of the countershaft power take-off gear to quickly reduce the speed of the countershaft and main shaft gears, and the driven part of the clutch.

Transmission (9JS135) - Transmission



The countershaft brake is used in the transmission system equipped with the push type clutch. Before the vehicle takes off, the transmission is in the neutral position, the engine drives the clutch, input shaft and gears in the transmission main box to rotate, but the main shaft does not rotate. When the vehicle is put into gear and takes off, release the clutch first, press the clutch pedal to the floor to connect the air circuit of the countershaft brake so as to quickly reduce the speed of the driven part of the clutch, and the input shaft, countershaft gear and main shaft gear, then put into gear to take off the vehicle stably. The abnormal noise will be generated when putting into gear for the vehicle not equipped with the countershaft brake. The vehicle can take off stably by the method of stopping for additional 3~5s and then putting into gear after pressing the clutch pedal.

Hint:

The countershaft brake is used for take-off only.

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Fault Symptom Table

The following table can help you find out the fault. The serial number shows the order of the fault possibility. Inspect every part according this order, and replace if necessary.

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Fault Symptom	Possible Cause	Reference
Abnormal sound or noise	1. The quality of lubricating oil is poor.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	2. The lubricating level is insufficient.	Fill lubricating oil.
	3. The tooth surface of the gear is damaged or worn excessively to generate large tooth gap.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	4. The bearing is damaged or has cracks.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	5. The combining position of the gear shift fork and gear is improper.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	6. The synchronizer is worn or damaged.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	7. The gear is damaged.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
The gear shifting of the main transmission is difficult or fails.	1. The bearing is worn or damaged.	Chapter 31B Transmission 9JS135 – Main Box, Disassembly and Assembly
	2. The shift fork and shaft bend or have burrs.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
	3. The check screws of the shift fork are loose.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
	4. The release of the clutch is abnormal.	Chapter 32 Clutch – Clutch Assembly, Testing & Adjustment
	5. The viscosity of lubricating oil is too high.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	6. The main shaft is distorted.	Chapter 31B Transmission 9JS135 – Main Shaft Assembly, Disassembly and Assembly

Transmission (9JS135) - Transmission

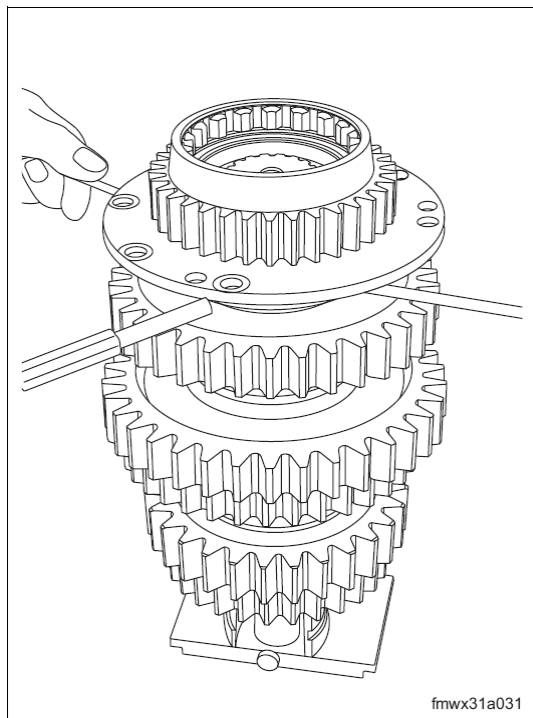
Fault Symptom	Possible Cause	Reference
The shifting of the high and low gear sections of the auxiliary box delays or fails.	1. The pressure regulator valve is defective.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	2. The air pipe or joint is defective.	Chapter 31B Transmission 9JS135 – Double H Control Mechanism, Dismantlement and Installation
	3. The plunger of the double H air valve is seized.	Chapter 31B Transmission 9JS135 – Double H Control Mechanism, Dismantlement and Installation
	4. The O-ring of the gear shift cylinder is lubricated poorly or damaged.	Chapter 31B Transmission 9JS135 – Auxiliary Box, Disassembly and Assembly
	5. The nuts of the cylinder piston are loose.	Chapter 31B Transmission 9JS135 – Auxiliary Box, Disassembly and Assembly
	6. The cylinder piston is damaged.	Chapter 31B Transmission 9JS135 – Auxiliary Box, Disassembly and Assembly
	7. The synchronizer or spring is damaged.	Chapter 31B Transmission 9JS135 – Auxiliary Box, Disassembly and Assembly
Off-gear or gear jumping of the main transmission	1. The gear shift fork deforms or is worn.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
	2. The locking ball or the ball groove on the gear shift fork shaft is worn.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
	3. The locking spring is broken or fatigued.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
	4. The gear clearance is too large.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	5. The engaging teeth or gear sleeve back taper fails.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	6. The sliding part or end face of the sliding bearing bushing is worn.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	7. The bearing is worn to cause axial displacement.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	8. The flange lock nuts are loose.	Chapter 31B Transmission 9JS135 – Auxiliary Box, Disassembly and Assembly
Off-gear of the high and low gear sections of the auxiliary transmission	1. The pressure regulator valve is defective.	Replace the pressure regulator valve.
	2. The air pipe or joint is defective.	Chapter 31B Transmission 9JS135 – Single H Control Mechanism, Dismantlement and Installation
	3. The shaft is distorted, and the gear leaves the teeth alignment position.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	4. The engaging teeth or gear sleeve back taper fails.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment

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Fault Symptom	Possible Cause	Reference
The gears are in disorder.	1. The interlock steel ball or interlock pin is not installed or worn.	Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly
Oil or air leakage	1. Lubricating oil is excessive.	Adjust lubricating oil to the standard value.
	2. The seals are damaged or fail.	Chapter 31B Transmission 9JS135 – Transmission, Testing & Adjustment
	3. The fasteners are loose.	Tighten the loose parts.
	4. The breather plug is clogged.	Clean or replace the breather plug.
	5. The bolt is not coated with sealant.	Coat with sealant, and re-install the bolt.

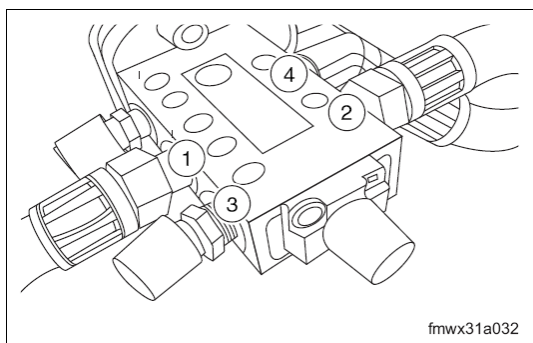
Testing & Adjustment

1. Test the axial clearance of the main shaft gears



- (a). Place the main shaft vertically, put the reverse gear snap ring in, and install the auxiliary box driving gear and snap ring.
- (b). Inspect the clearance between the reverse gear and driving gear by a feeler gauge.
Standard Clearance Value: 0.3~0.9 mm
- (c). Inspect the axial clearance between the low and reverse gears and between the 2nd and 3rd gears of the main shaft.
Standard Clearance Value: 0.13~0.3 mm

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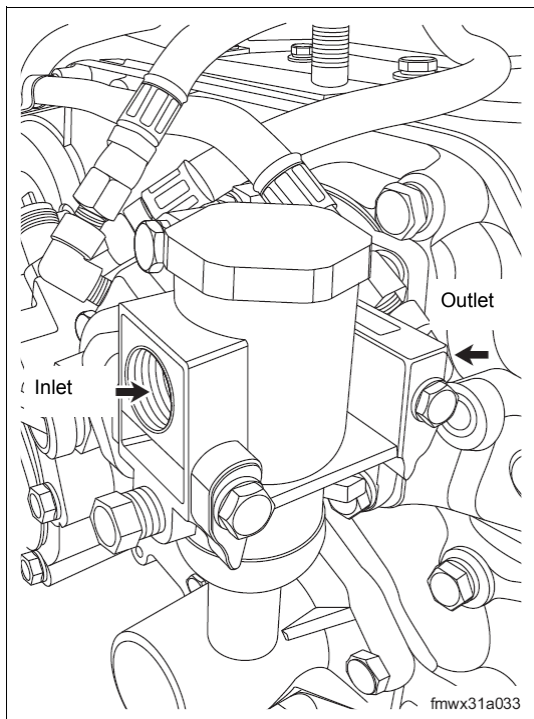
2. Test the double H air valve

- (a). Appearance test: The housing shall be free from defects, and the plunger shall move flexibly and have no heavy wear.
- (b). Channel testing: When the pin is in the original position, the compressed air introduced in shall flow out from the outlet 4 only; when the pin backs to the lowest position due to force carrying, the compressed air introduced in shall flow out from the outlet 2 only.

Hint:

Replace the air valve if any of the fault phenomena appears.

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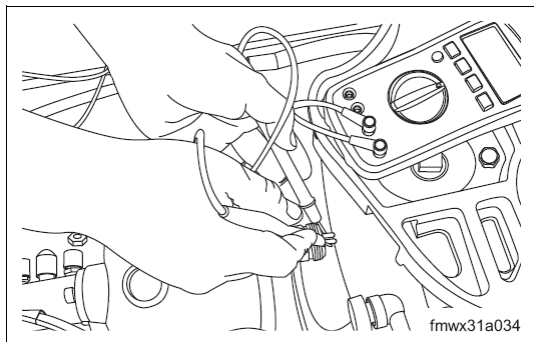


3. Test the air filter regulator

- Appearance test: The part shall be free from defects and leakage.
- Pressure testing: When the air pressure of the vehicle reaches 0.7~0.8Mpa, an air pressure gauge is installed at the outlet, and the pressure valve displayed by the air pressure gauge shall be 0.41~0.44Mpa.

Hint:

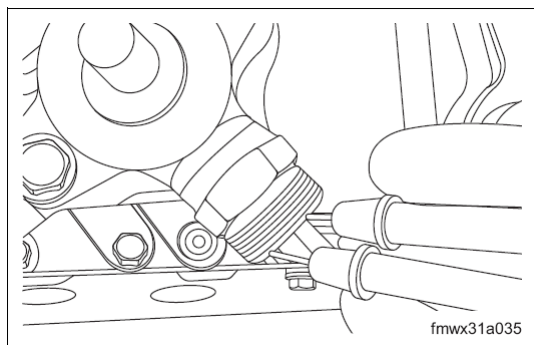
Replace the air filter regulator if the reading fails to meet the requirement.



4. Test the neutral position switch

- Appearance test: Free from defects such as deformation, damage or contact looseness.
- Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Neutral Gear	<1
Other Gears	∞

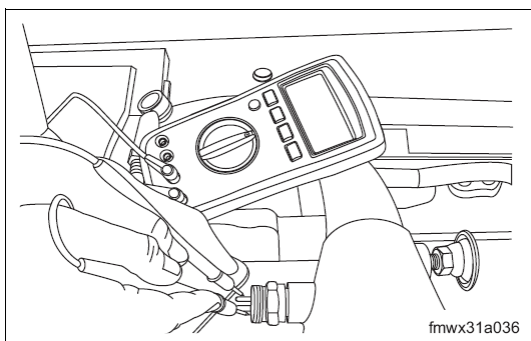


5. Test the range gear switch

- Appearance test: Free from defects such as deformation, damage or contact looseness.
- Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Low Gear	<1
High Gear	∞

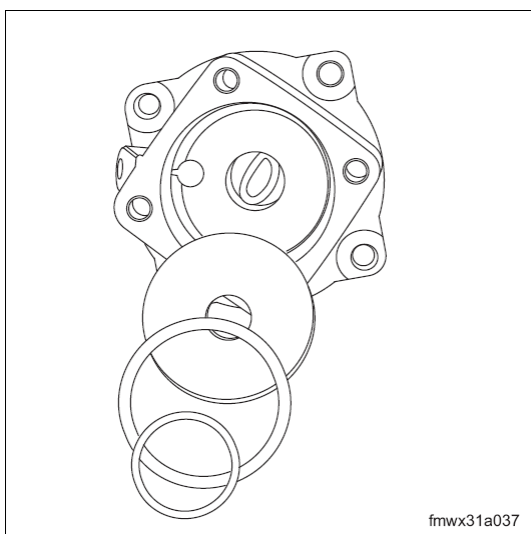


Transmission (9JS135) - Transmission**6. Test the reverse switch**

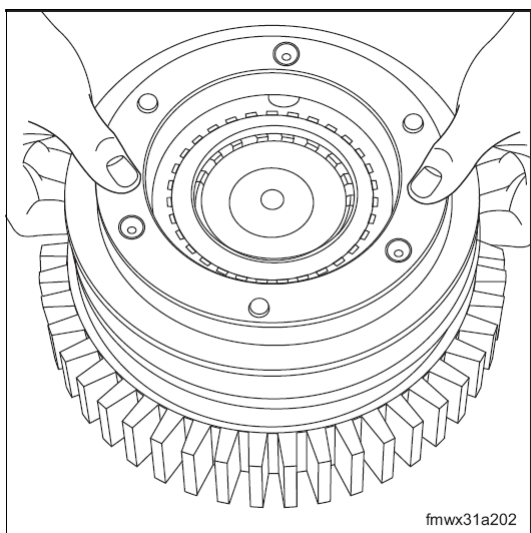
- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Reverse Gear	<1
Other Gears	∞

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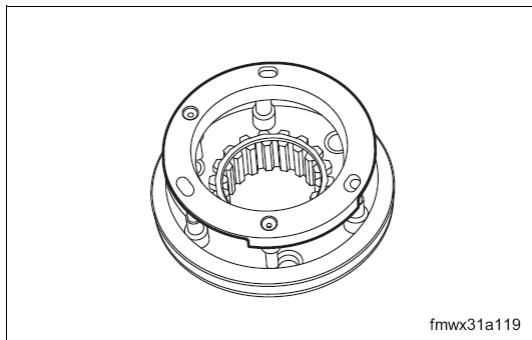
**7. Test the gear shift cylinder of the auxiliary box**

- (a). Test whether the O-ring or other seals are damaged, deformed, lubricated poorly or installed not in position.

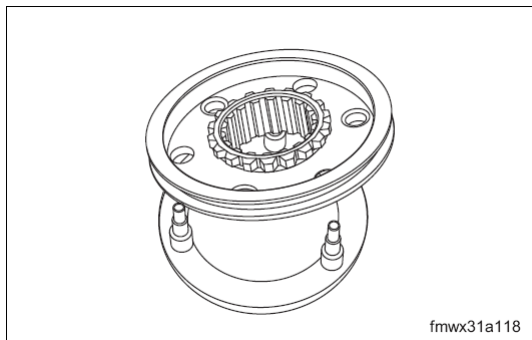
**8. Inspect the high/low gear synchronizer**

- (a). Inspect the fit state between the synchronizer and auxiliary box output shaft.

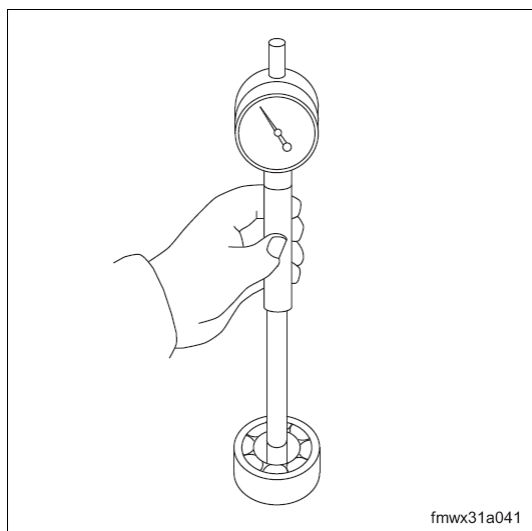
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- (b). Inspect whether the synchronizer keyway and lock pin are worn.

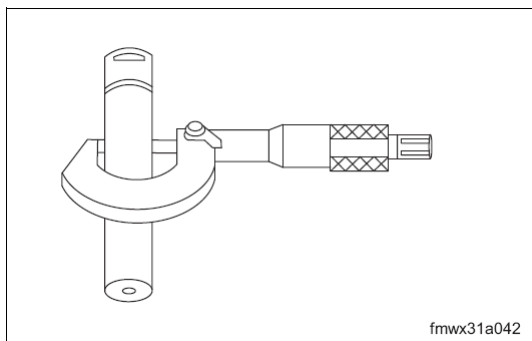


- (c). Inspect whether there are cracks, deformation, etc. on the synchronizer ring gear.



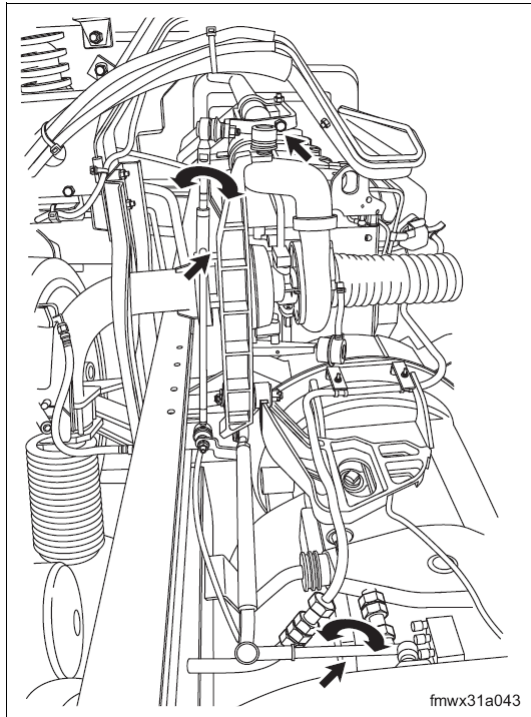
9. Inspect bearings

- (a). Place all bearings in clean solution and wash them. Inspect whether the steel balls, rollers and bearing raceway have pits or fall off.
- (b). Measure the inside diameter of the bearing.
- (c). Replace the bearing if the measured value exceeds the limit value.



10. Test the diameter of the reverse gear shaft

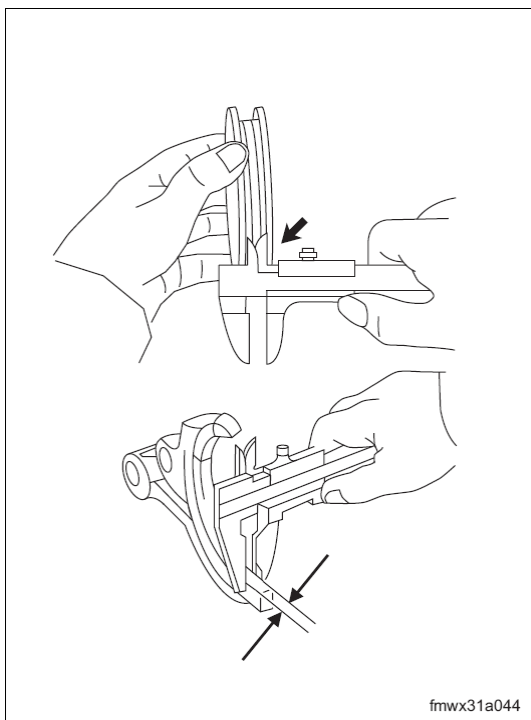
- (a). Measure the diameter of the reverse gear shaft by a micrometer.
- (b). Replace the reverse gear shaft if the measured value exceeds the limit value.



11. Adjust the gear shift control mechanism of the transmission

- (a). The technician A in the cab holds the gear shift lever in the center.
- (b). The technician B releases the adjusting screws of the expansion link assembly or gear shift lever assembly, and adjusts the gears to the best position.
- (c). Tighten the nuts.

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12. Measure the fit clearance between the ring gear and shift fork.

- (a). Measure the size of the ring gear by a micrometer.
- (b). Measure the size of the shift fork by a micrometer.

Hint:

Replace the corresponding ring gear and shift fork if the fit clearance exceeds the limit value.

13. Inspect gears

- (a). Inspect whether there is pitting on the tooth surface of the gears, and replace the gears if any.
- (b). Inspect all mesh gears, replace the gears which are worn into a cone have a decreased mesh length due to impact.
- (c). Inspect the axial clearance, and inspect whether the gear split ring, washer, adjusting gasket and gear flange are worn if detecting the part with excessive clearance. The forward gears of the main shaft shall be kept an axial clearance of 0.13~0.30mm. The reverse gear shall be kept an axial clearance of 0.30~0.90mm.

14. Inspect splines

- (a). Inspect the wear degree of splines on all shafts, and replace if the sliding gear sleeve and output flange incline to one side of the spline due to wear.

15. Inspect thrust washers

- (a). Inspect the surface condition of all thrust washers. Replace the washers with scratches or thinned depth.

16. Inspect gray cast iron parts

- (a). Inspect whether there are cracks or damages on all gray cast iron parts. Fusion welding or braze welding can be conducted for large castings, but the heat generated shall not extend to the bearing hole or bolt connecting surface.

17. Inspect bearing caps

- (a). Inspect the wear condition of the tang.
- (b). Inspect the oil seal in the primary shaft bearing cap and the oil seal in the odometer housing, replace if the sealing function of the lip fails.

18. Inspect sliding sleeves

- (a). Inspect whether all shift forks and shift fork grooves on the sliding sleeves are worn excessively or discolor due to overheating.
- (b). Inspect whether the contact area of the engaging teeth of the sliding sleeve deflects.

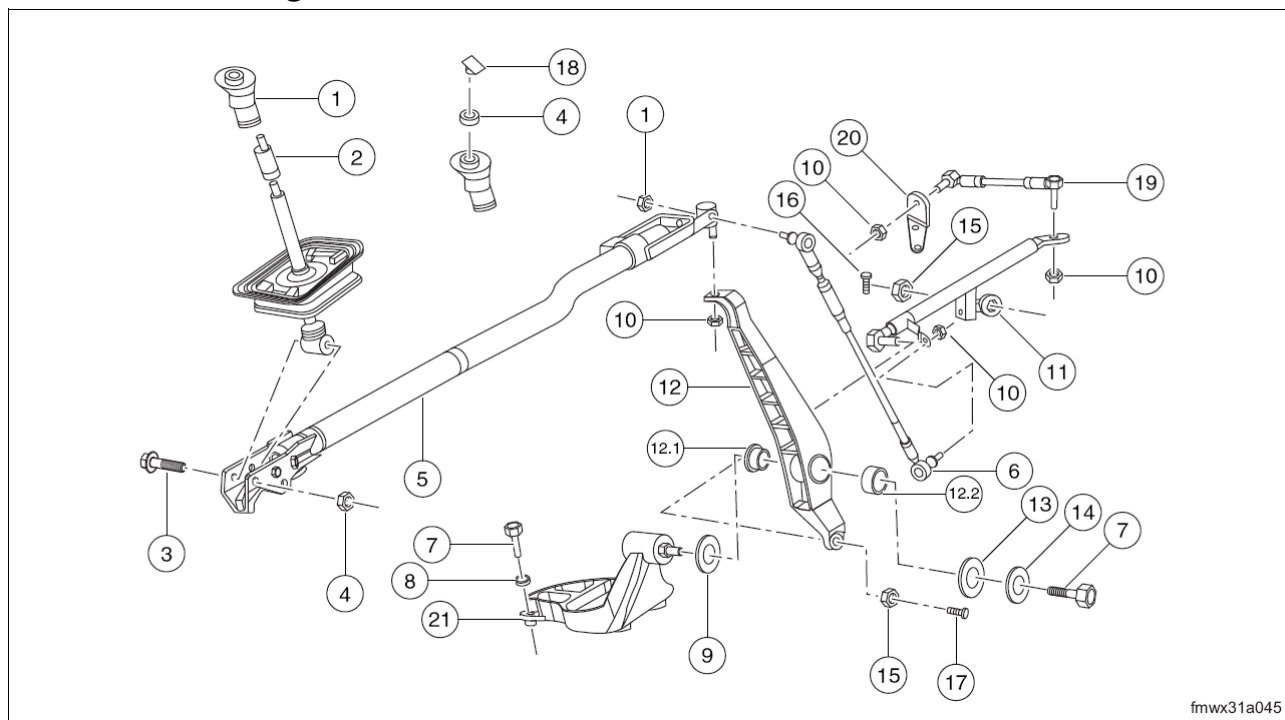
19. Inspect O-ring

- (a). Inspect the cracking and deformation conditions of all O-rings. Replace the O-rings which are worn and aged.

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Transmission Control Mechanism

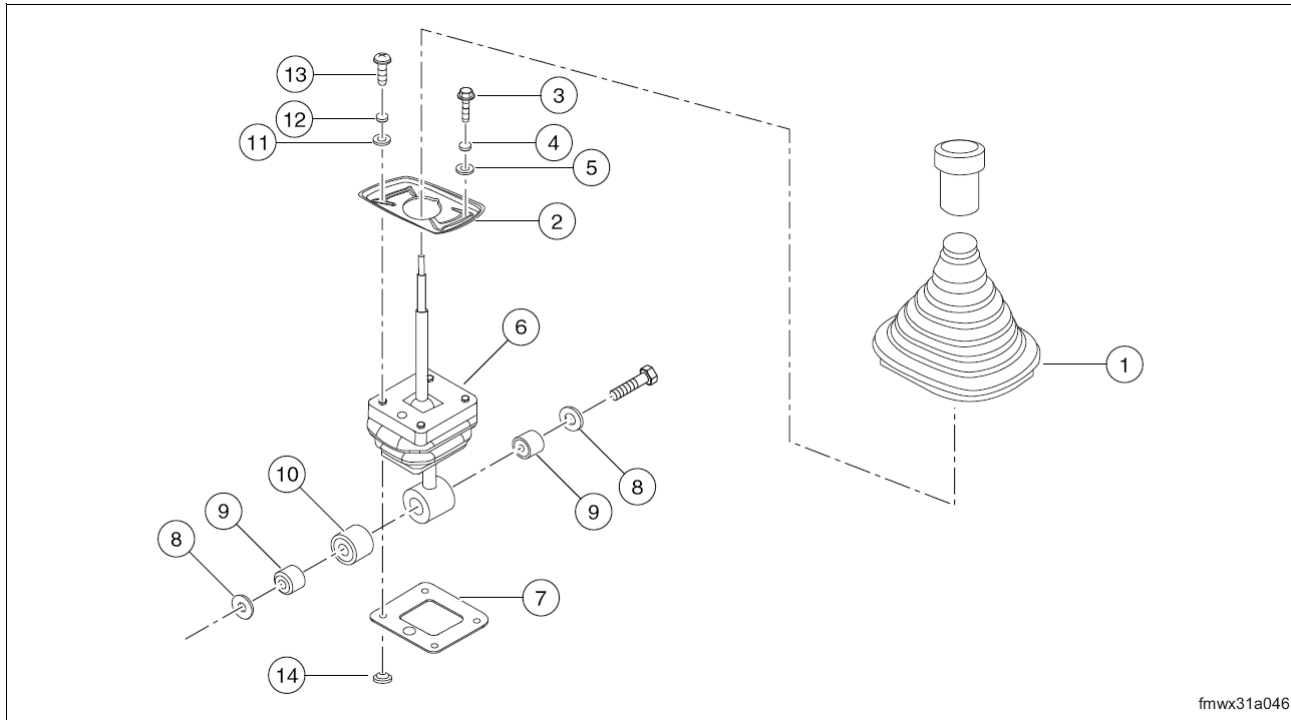
Part Drawing



1	Knob Assembly
2	Primary Shaft Gear
3	Hex Flange Bolt
4	Prevailing Torque Type All-metal Hex Nut with Flange
5	Expansion Link Assembly
6	Gear Selecting Link
7	Hex Head Bolt
8	Spring Washer
9	Noise Reduction Washer
10	Prevailing Torque Type All-metal Hex Nut, Style 1
11	Gear Shift Link Assembly
12	Gear Shift Rocker Arm Assembly

12.1	Straight Bushing
12.2	L-bushing
13	Sealing Gasket
14	Thick Washer
15	Hex Thin Slotted Nut
16	Cotter Pin
17	Cotter Pin
18	Gear Plate
19	Rear Support Bar Assembly for Gear Selection
20	Gear Selecting Bracket
21	Four-corner Bracket Assembly

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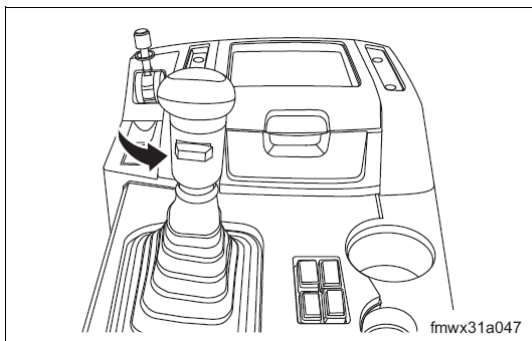


1	Upper Dust Cover
2	Upper Pressure Plate
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Operator Assembly
7	Lower Pressure Plate

8	Sealing Gasket
9	Composite Bushing
10	Middle Spacer
11	Spring Washer
12	Flat Washer
13	Hex Head Bolt and External Teeth Serrated Lock Washer Assembly
14	Prevailing Torque Type All-metal Hex Nut with Flange

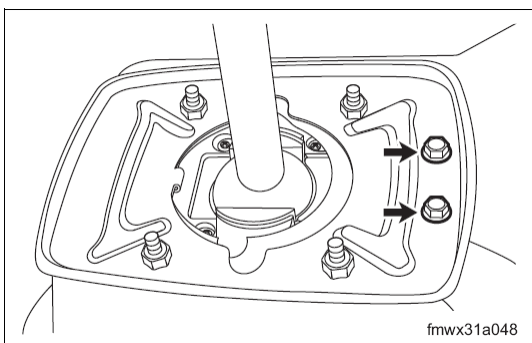
Dismantlement and Installation

1. Dismantle the gear shift control mechanism

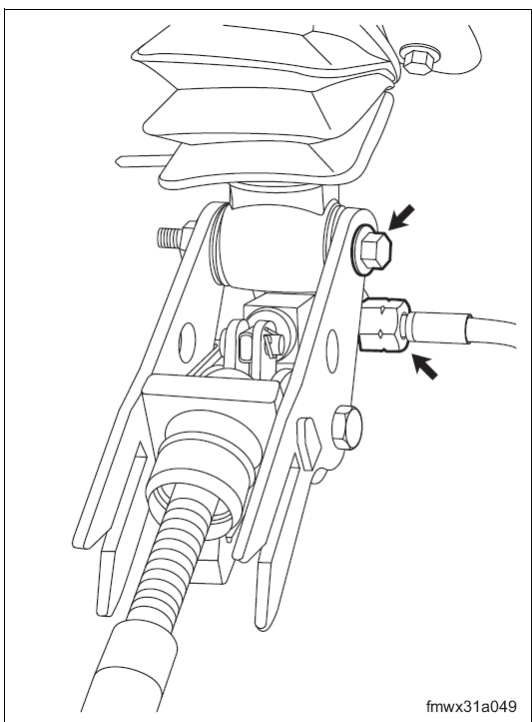


- (a). Dismantle the gear plate, and loose the lock nuts.
- (b). Dismantle the upper dust cover.

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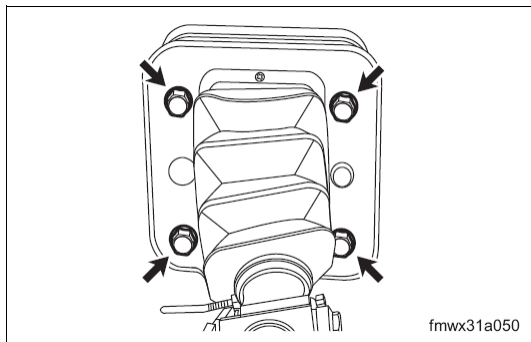


- (c). Dismantle the fastening bolts of the upper pressure plate.

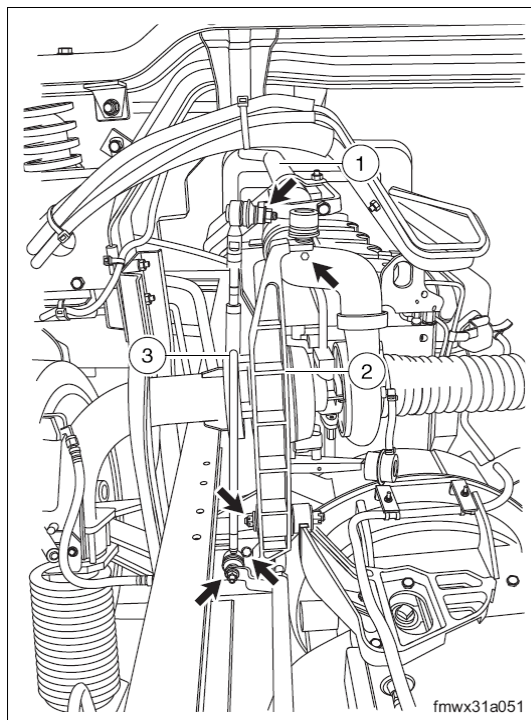


- (d). Disconnect the lubricating oil pipe.
- (e). Disconnect the connecting bolt of the operator and expansion link.

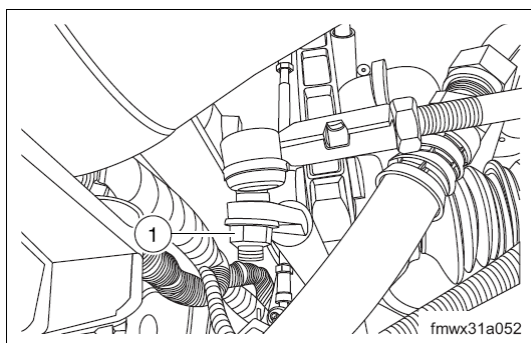
31B



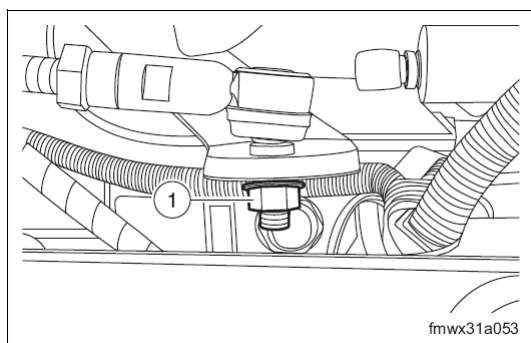
- (f). Dismantle the four fastening bolts of the lower pressure plate.
- (g). Remove the lower pressure plate and lower dust cover in order.
- (h). Remove the gear shift operator assembly.



- (i). Dismantle the gear shift expansion link 1.
 - Dismantle the connecting nut, and take out the expansion link.
- (j). Dismantle the gear selecting link assembly 3.
 - Dismantle the connecting nut, and remove the gear selecting link assembly.
- (k). Dismantle the gear shift rocker arm assembly 2.
 - Dismantle the cotter pin and connecting nut, and remove the gear shift rocker arm assembly.



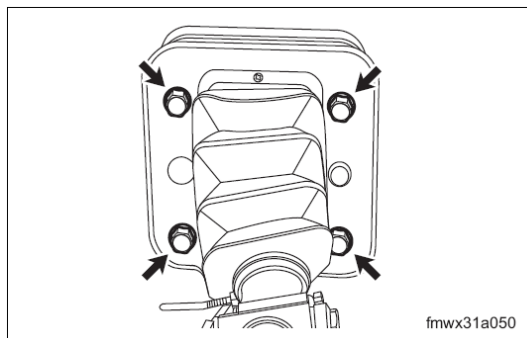
- (l). Dismantle the gear shift link assembly.
 - Dismantle the connecting nut 1 of the gear shift link assembly, and remove the gear shift link assembly.



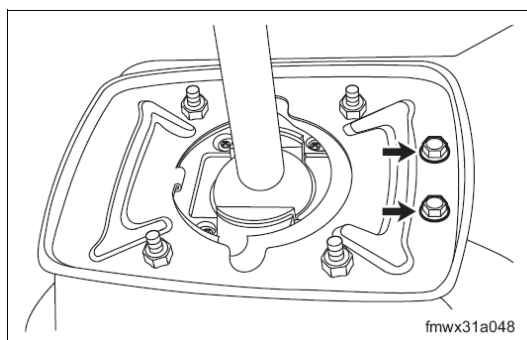
- (m). Dismantle the rear support bar assembly for gear selection.
 - Dismantle the connecting nut 1 of the rear support bar assembly for gear selection, and remove the rear support bar assembly.

Transmission (9JS135) - Transmission Control Mechanism

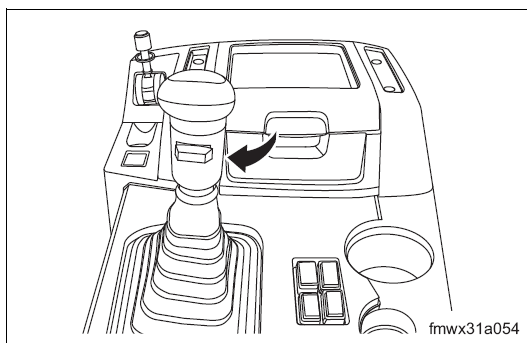
2. Install the gear shift control mechanism



- (a). Install the gear shift operator assembly.
- Install the dust cover and upper and lower pressure plates, and tighten the four bolts.
- Torque: **21±5N.m**

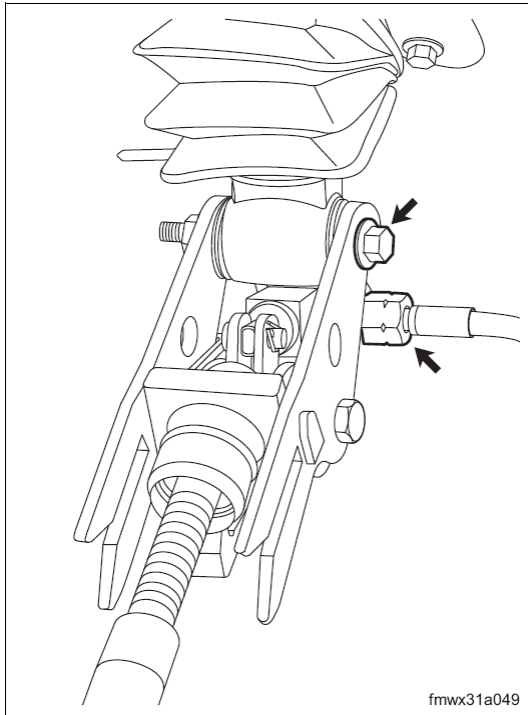


- (b). Dismantle the two fastening bolts of the upper pressure plate.
- Torque: **9±3N.m**

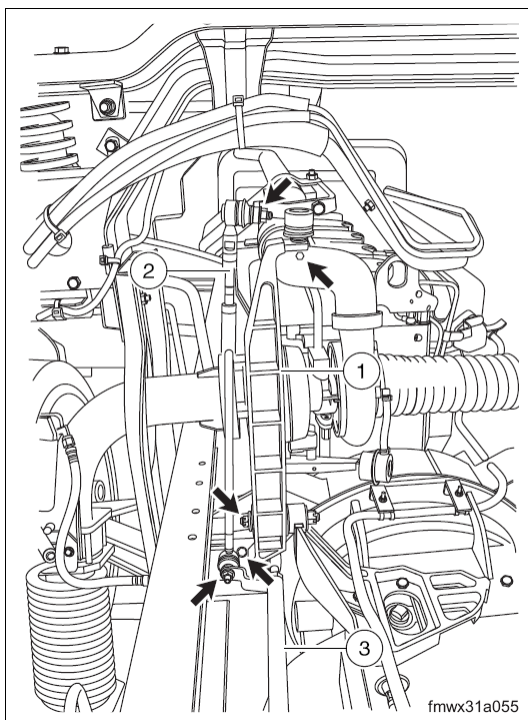


- (c). Install the dust and knob in order, tighten the nuts, and then install the gear plate.

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- (d). Install the expansion link assembly.
- Connect the expansion link and gear shift operator, and tighten the connecting bolt.
Torque: **64N.m**
- (e). Connect the lubricating oil pipe.



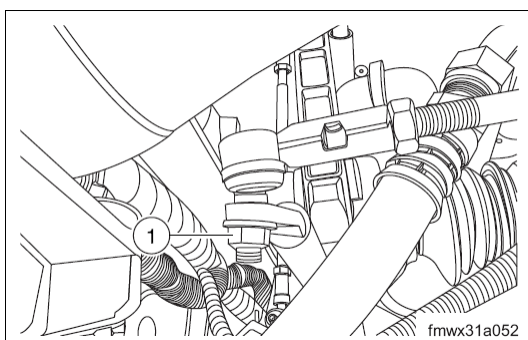
- (f). Install the gear shift rocker arm assembly 1.
- Fix the gear shift rocker arm to the four-corner bracket assembly, tighten the nuts, and insert the cotter pin.
 - Connect the expansion link and gear shift rocker arm, and tighten the connecting nut.

Torque: **95N.m**

- (g). Install the gear selecting link assembly 2.
- Connect the gear selecting link assembly 2 and expansion link, and tighten the connecting nut.

Torque: **95N.m**

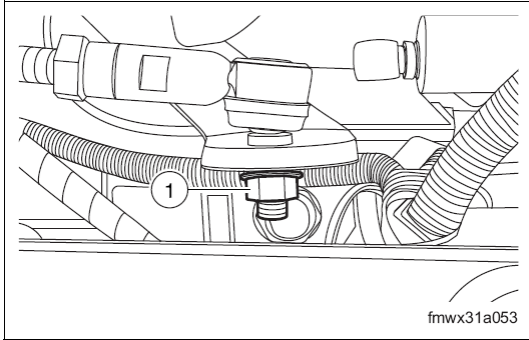
- (h). Install the gear shift link assembly 3.
- Connect the gear shift selecting link assembly 2 and gear shift link, and tighten the connecting nut.
 - Connect the gear shift link assembly 3 and gear shift rocker arm assembly 1, tighten the connecting nut, and insert the cotter pin.



- (i). Install the rear support bar assembly for gear selection.
- Connect the rear support bar assembly for gear selection and gear shift link, and tighten the connecting nut.

Torque: **95N.m**

Transmission (9JS135) - Transmission Control Mechanism



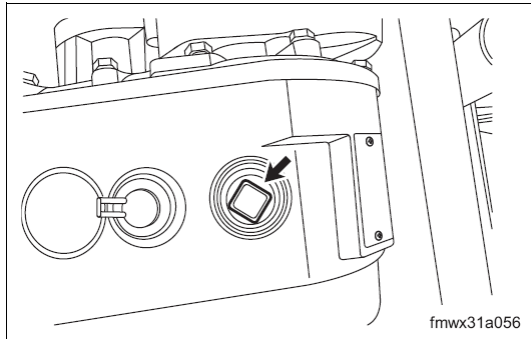
- (j). Install the gear selecting link to the gear selecting bracket, and tighten the connecting nut.
Torque: **95N.m**

Transmission Assembly

Replacement

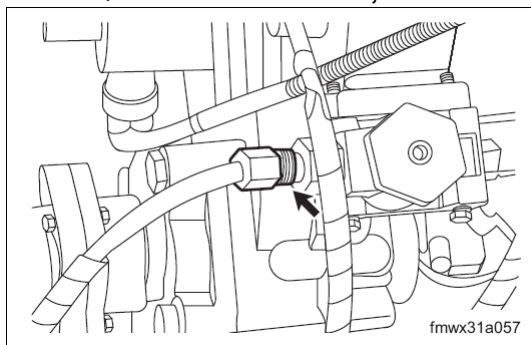
1. Lift the rear box
2. Disconnect the battery negative cable

31B

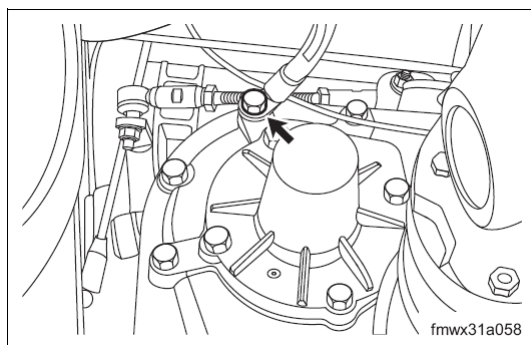


3. Unscrew the oil drain plug at the bottom of the transmission, drain transmission oil, and tighten the oil drain bolt
Torque: $68 \pm 7 \text{N.m}$

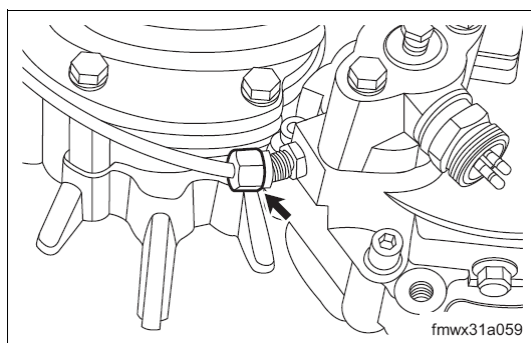
4. Dismantle the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.
5. Dismantle the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.



6. Dismantle the transmission accessories
 - (a). Dismantle the air pipe assembly of the air filter regulator.

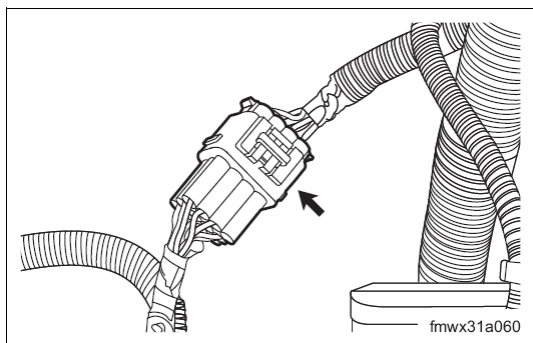


- (b). Dismantle the grounding cable of the transmission.



- (c). Dismantle the intake pipe of the power take-off.

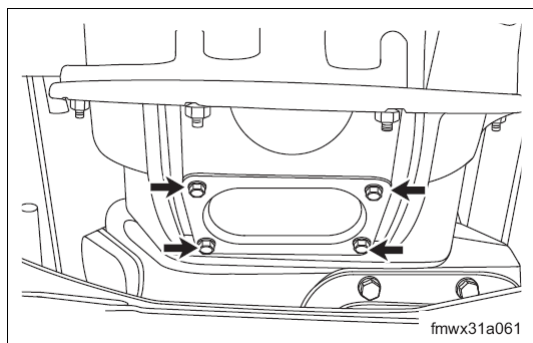
Transmission (9JS135) - Transmission Assembly



(d). Disconnect the combined connector of the transmission.

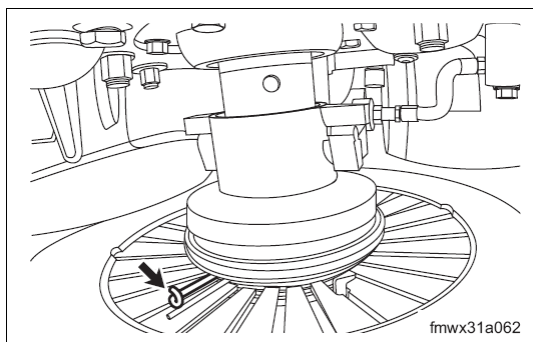
7. **Dismantle the gear shift control mechanism assembly of the transmission. Refer to Chapter 31B Transmission 9JS135 – Transmission Control Mechanism, Disassembly and Assembly.**

31B



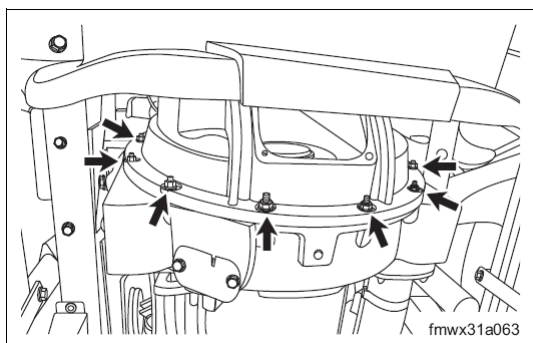
8. **Dismantle the cover plate of the clutch observation hole.**

(a). Dismantle the four bolts, remove the cover plate.



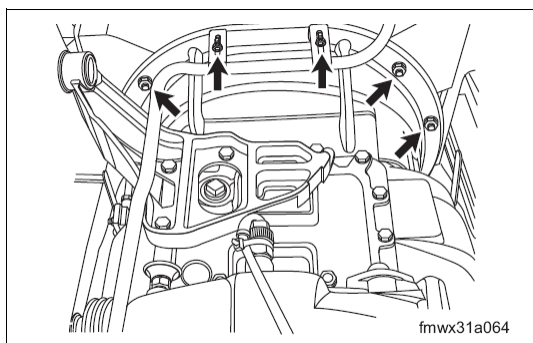
9. **Pick off the hook of the spring clamping wire of the clutch release bearing**

10. **Dismantle the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.**



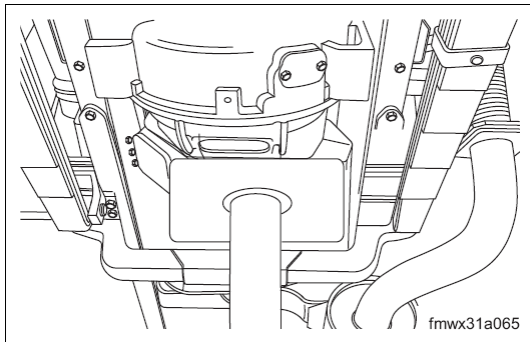
11. **Disconnect the transmission and engine**

(a). Dismantle the lower connecting bolts of the transmission and engine.



(b). Dismantle the upper connecting bolts of the transmission and engine.

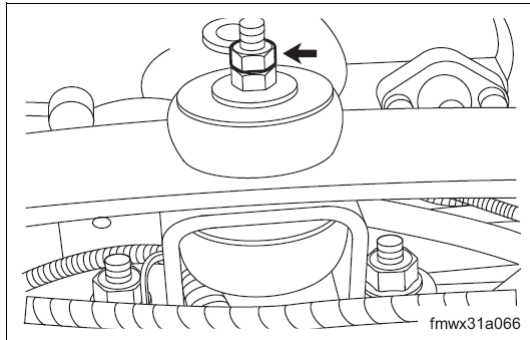
31B



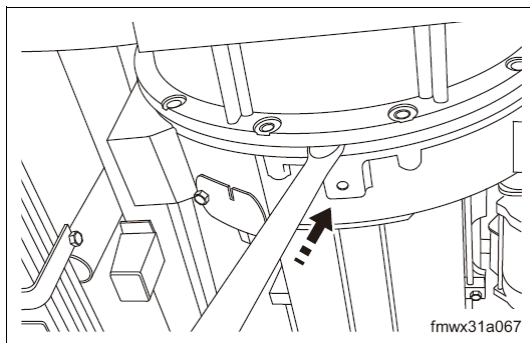
12. Dismantle the sub-frame

13. Remove the transmission assembly

- (a). Jack up the transmission assembly by a transmission hydraulic jack.

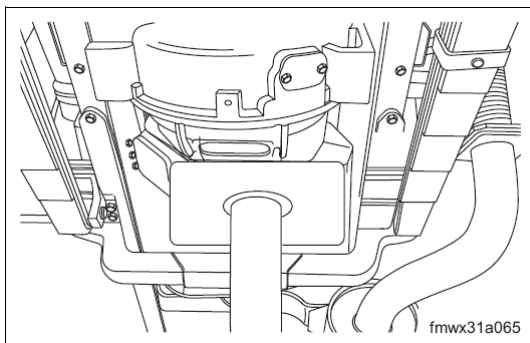


- (b). Dismantle the connecting nut of the transmission mounting, and remove the lower spring beam.



- (c). Separate the transmission from the engine by a flat crowbar.

- (d). Put down the transmission assembly

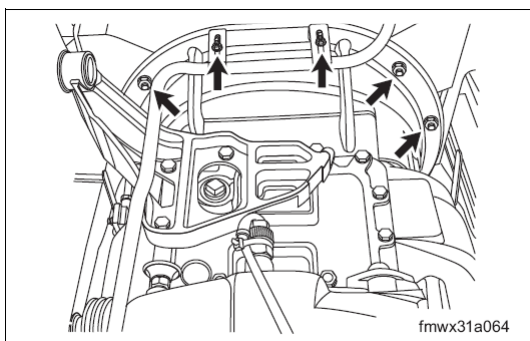


14. Install the transmission assembly

- (a). Connect the transmission assembly with the engine assembly.

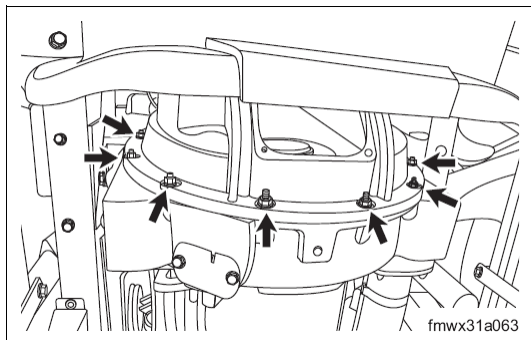
Hint:

Make sure to put on the hook of the clutch spring clamping wire before installing the transmission assembly. Inspect whether the spring clamping wire is loose and flexible on the release ring by moving it. If not flexible, re-install it, or the release bearing may not be installed.

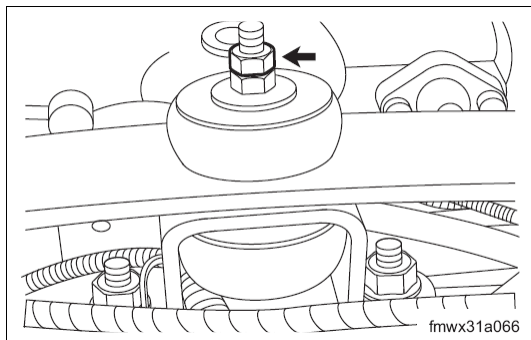


15. Tighten the connecting bolts of the transmission and engine.

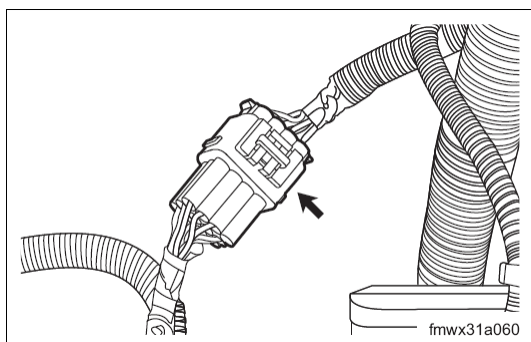
- (a). Tighten the upper connecting bolts of the transmission.

Transmission (9JS135) - Transmission Assembly**31B**

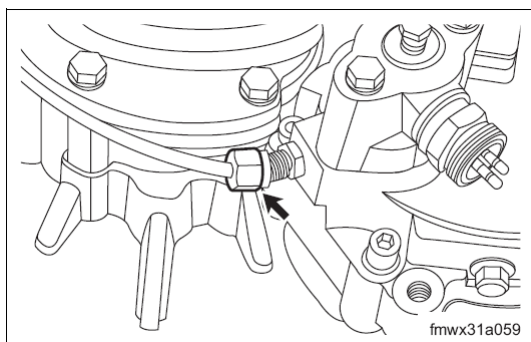
- (b). Tighten the lower connecting bolts of the transmission.



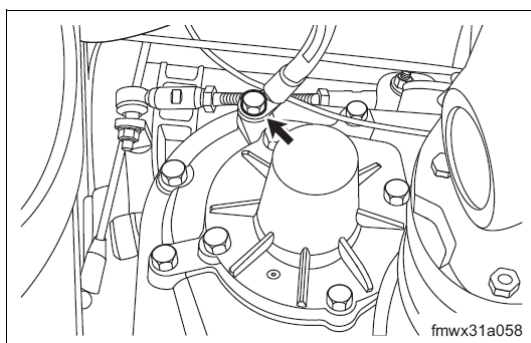
16. Install the spring beam of the transmission, and tighten the connecting nut of the mounting.
Torque: 240N.m
17. Install the gear shift control mechanism assembly of the transmission. Refer to Chapter 31B Transmission 9JS135 – Transmission Control Mechanism, Disassembly and Assembly.



18. Install the transmission accessories
- (a). Connect the combined connector of the transmission.

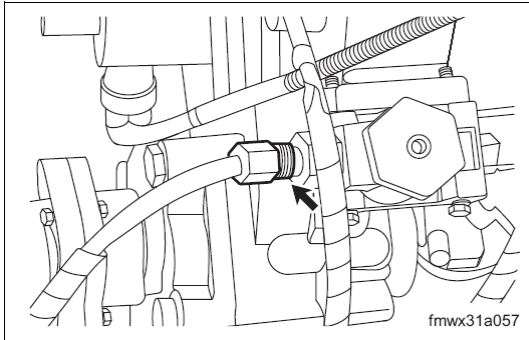


- (b). Install the intake pipe of the power take-off.



- (c). Install the grounding cable of the transmission, and tighten the bolts.
Torque: 47.5~61N.m

31B

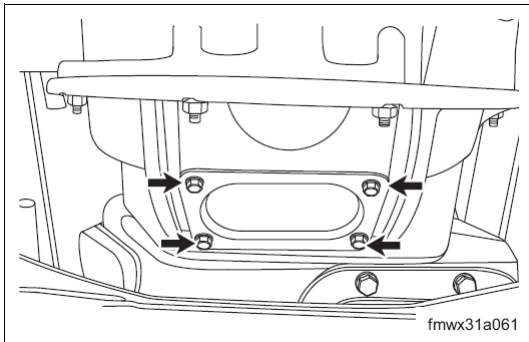


- (d). Install the air pipe assembly of the air filter regulator.

19. Install the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.

Hint:

Before installing the clutch slave cylinder, tie the end of the release bearing crank by a rope through the window of the clutch slave cylinder, and strongly pull the crank outward to force the release bearing to push the release ring in and make it jammed, which shows that the release bearing is installed in position.



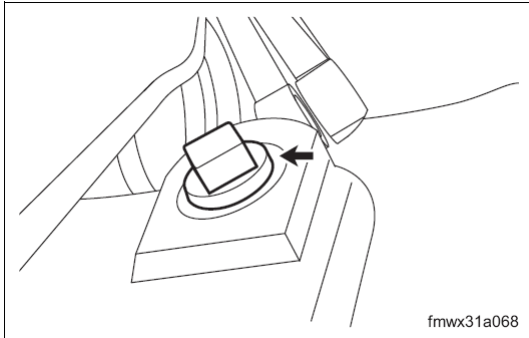
20. Install the cover plate of the clutch observation hole.

- (a). Install the cover plate of the clutch observation hole, and tighten the four bolts.
Torque: **23.5±3.5N.m**

21. Install the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.

22. Install the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.

23. Install the battery negative cable.



24. Unscrew the oil filter plug in the middle of the transmission, fill transmission oil 85W/90GL-5, and tighten the oil filter bolt.

Filling amount of transmission oil: 13L.

Caution:

Run the transmission for several minutes after filling oil, and then inspect the transmission oil level again.

25. Put down the rear box

26. Clutch running-in specification and test

- (a). The environment is that the speed is about 1500 r/min; the oil temperature is not lower than 15 °C; no load is exerted; the transmission is running at neutral gear for not less than 15 min, and at other gear for not less than 20 min.
- (b). Inspect whether the gear shift is flexible, the gears are meshed fully, and there is a gear impact sound during gear shift.
- (c). The gear shift lever of the transmission shall be free from obvious vibration.
- (d). There shall be no abnormal friction sound or impact sound during testing of the transmission.
- (e). The transmission shall not leak oil.

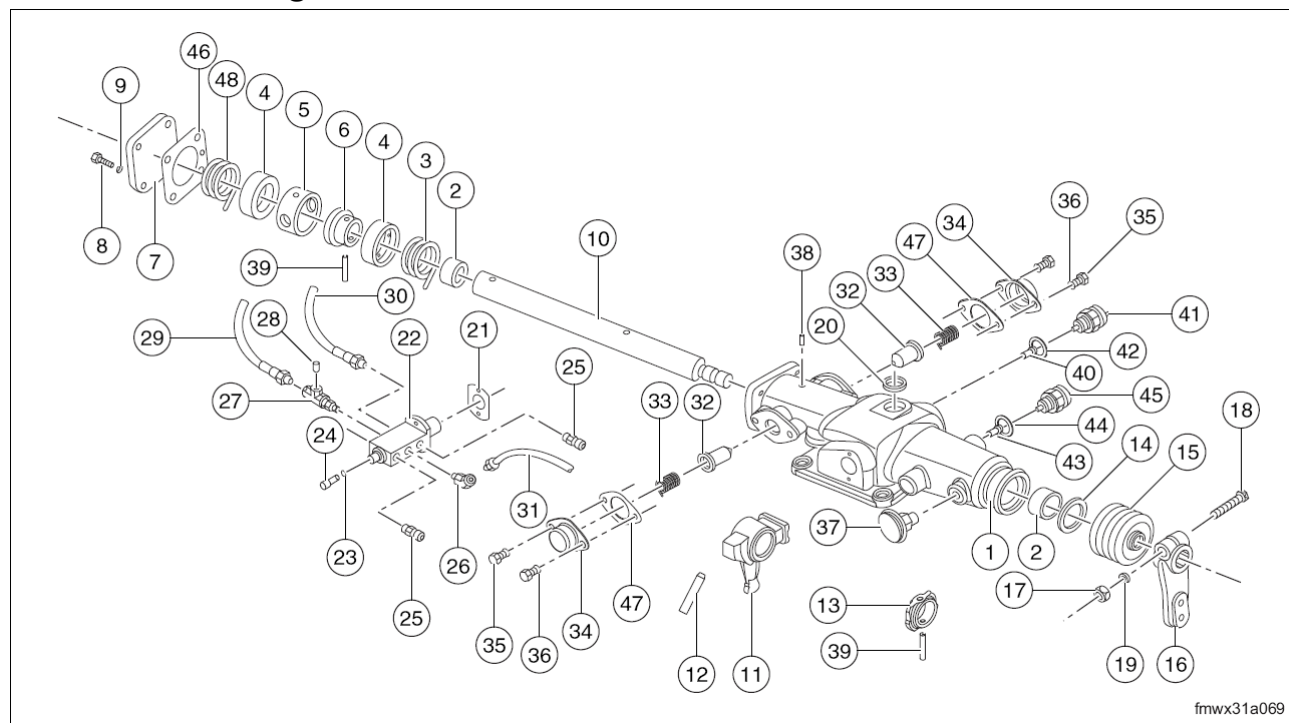
Transmission (9JS135) - Transmission Assembly

- (f). After running-in, drain transmission oil for running-in, clean the transmission inside completely, and fill transmission oil as specified.

Double H Control Mechanism

Part Drawing

31B



1	Double H Control Device Housing
2	Sleeve, Transverse Gear Shift Lever
3	Compression Spring
4	Spring Seat
5	Spring Spacer
6	Locating Ring
7	Side Panel
8	Small Hex Head Bolt M8*22
9	Spring Washer
10	Transverse Gear Shift Lever
11	Guide Block
12	Cylindrical Pin
13	Control Block, Low/Reverse Gear
14	Oil Seal
15	Sleeve
16	LRC Outer Gear Shift Arm
17	Small Hex Nut

25	Breather Plug
26	45° Elbow Joint
27	Tee Pipe Joint
28	Hex Head Tapered Screw Plug
29	Air Pipe Assembly
30	Air Pipe Assembly
31	Air Pipe Assembly
32	Locating Pin
33	Compression Spring
34	Spring Pressure Cover
35	Small Hex Head Bolt M8*12
36	Spring Washer
37	Breather Plug
38	Check Screw
39	Pin 6*36.5
40	Neutral Position Switch Pin
41	Pressure Switch



Transmission (9JS135) - Double H Control Mechanism

18	Small Hex Head Bolt M10*50
19	Washer
20	Core plug
21	Gasket, Double H Air Valve
22	Double H Air Valve
23	Spring Washer
24	Socket Head Screw

42	Gasket
43	Switch Starting Pin
44	Gasket
45	Pressure Switch
46	End Gasket
47	Gasket
48	Compression Spring

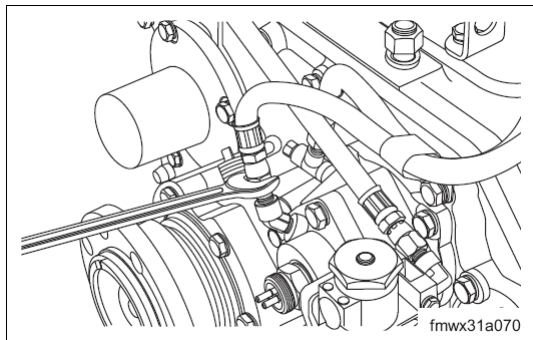
31B



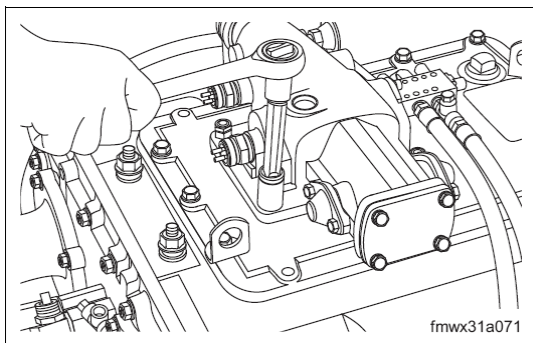
Dismantlement and Installation

1. Dismantle the double H control mechanism

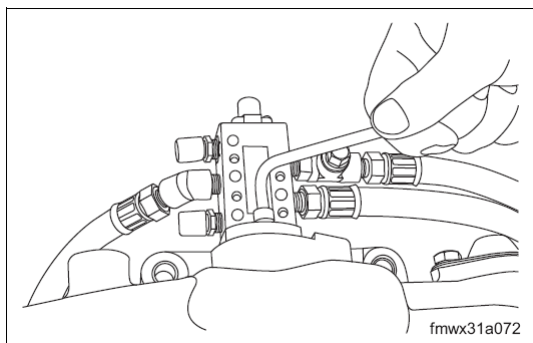
31B



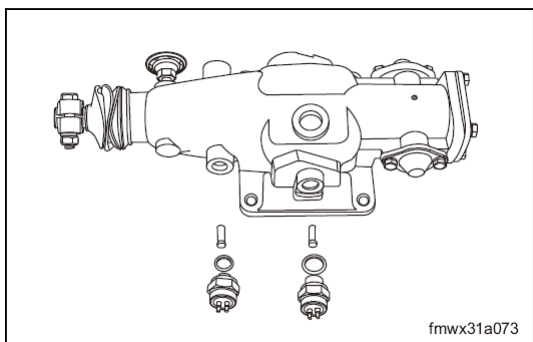
- (a). Dismantle the three air pipes and two air filter bolts.



- (b). Dismantle the four nuts on the double H assembly.
(c). Beat the double H assembly housing by a copper rod to make it loose.



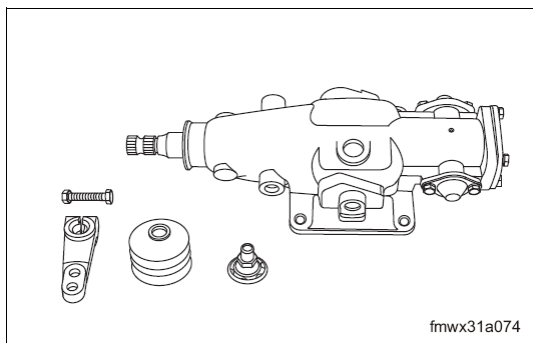
- (d). Remove the double H control assembly from the transmission, and dismantle the double H air valve and air pipe by an Allen wrench.



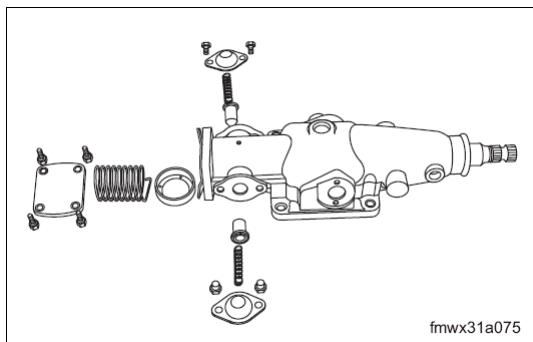
- (e). Dismantle the reverse and neutral position switches and pins.

Transmission (9JS135) - Double H Control Mechanism

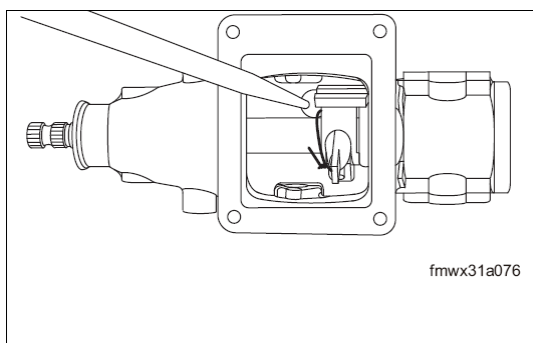
31B



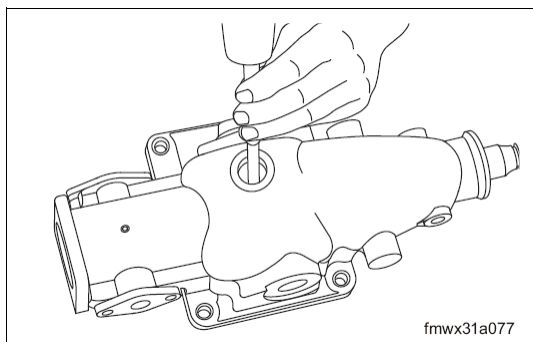
- (f). Dismantle the gear shift rocker arm, dust cover and breather plug in order.



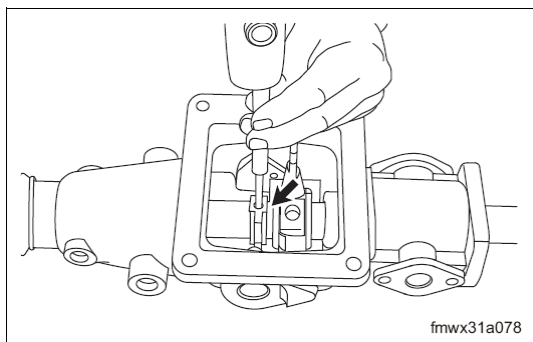
- (g). Dismantle the side panel and spring seats at both sides, and take out the spring, locating plunger and other parts in order.



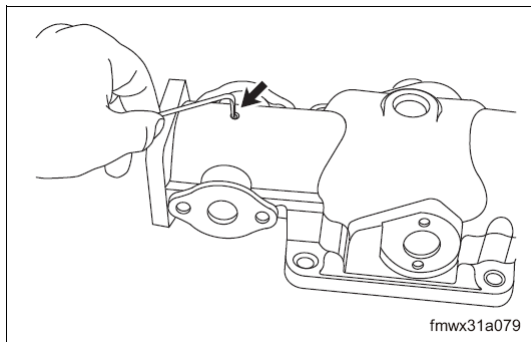
- (h). Dismantle the core plug and locking wire on the guide block.



- (i). Use tools to beat and dismantle the cylindrical pin.



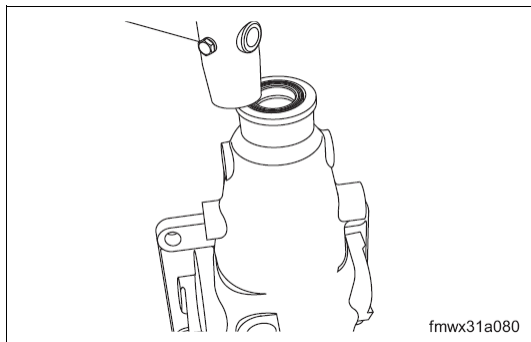
- (j). Dismantle the elastic pin on the transverse gear shift lever.



- (k). Dismantle the check screw, and take out the other group of springs and spring seats the double H housing in order.

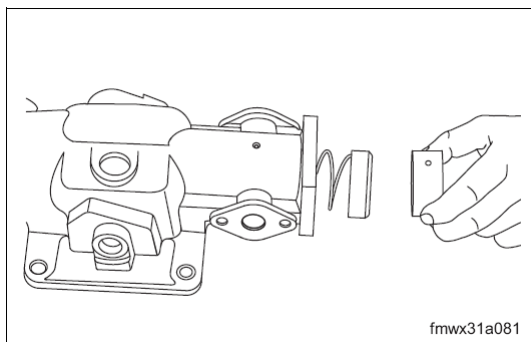
Hint:

There are two springs, and the one close to the housing inside is shorter.

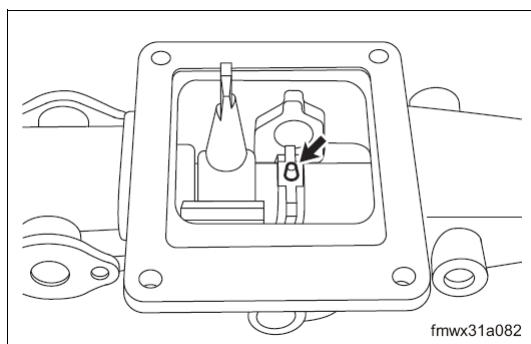


2. Install the double H control mechanism

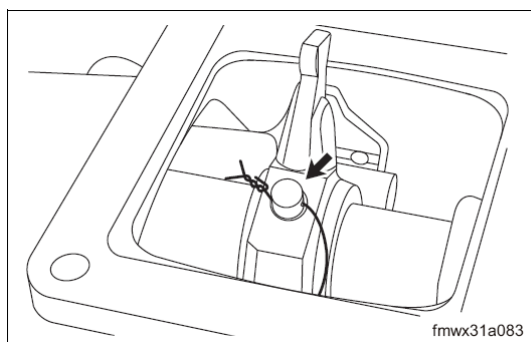
- (a). Install the oil seal, and apply lubricating grease on the cutting edge.



- (b). Install the springs, spring seats and spacer in the double H housing, and lock with the check screw.
(c). Install the elastic pin on the locating pin. And pay attention to the direction of the locating ring.



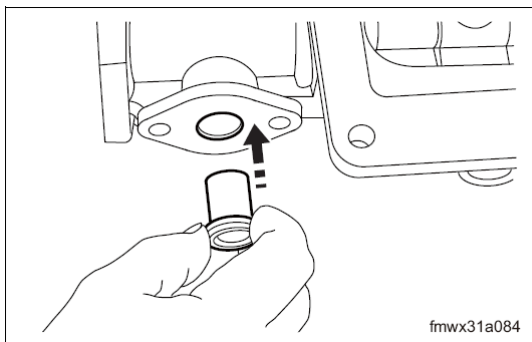
- (d). Install the transverse gear shift lever in the housing, and install the elastic pin on the reverse gear control block.



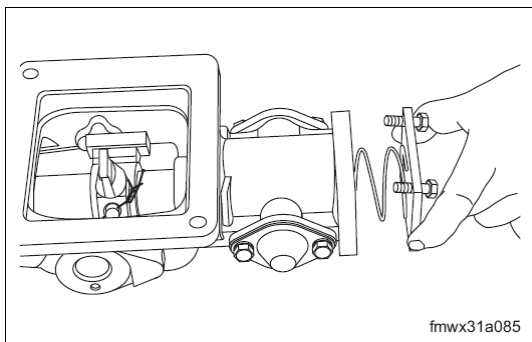
- (e). Install the cylindrical pin on the guide block, and lock with wire.

Transmission (9JS135) - Double H Control Mechanism

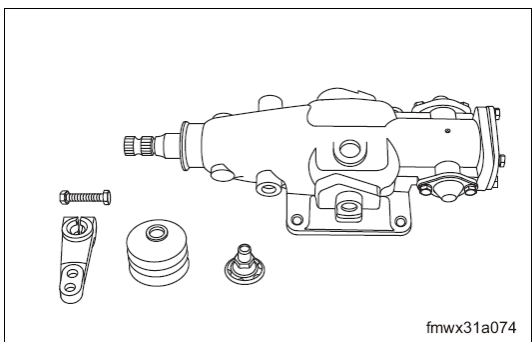
31B



- (f). Install the plungers, springs and spring seats at both side, and conduct initial lubrication for the plungers.



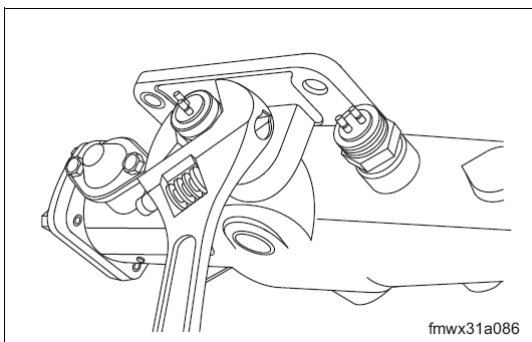
- (g). Install the spring seats and springs, and install the side panel.



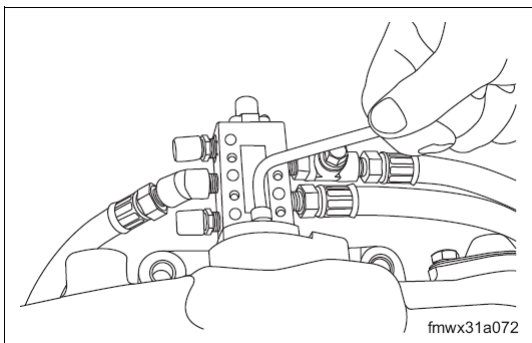
- (h). Install the dust cover and gear shift rocker arm.

Caution:

Ensure that the rocker arm and guide block are in a straight line.



- (i). Install the reverse and neutral position switches and pins.
Torque: **23±3N.m**

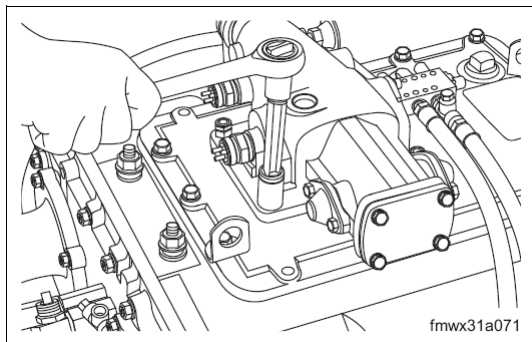


- (j). Install the two locating bolt of the double H valve by a Allen wrench.
Torque: 17±3Nm

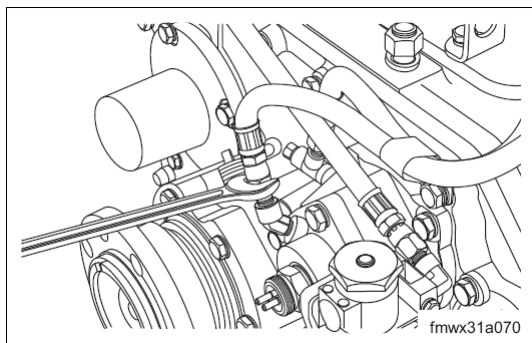
Caution:

The junction surface must be coated with sealant evenly.

31B



- (k). Install the four nuts on the double H assembly.

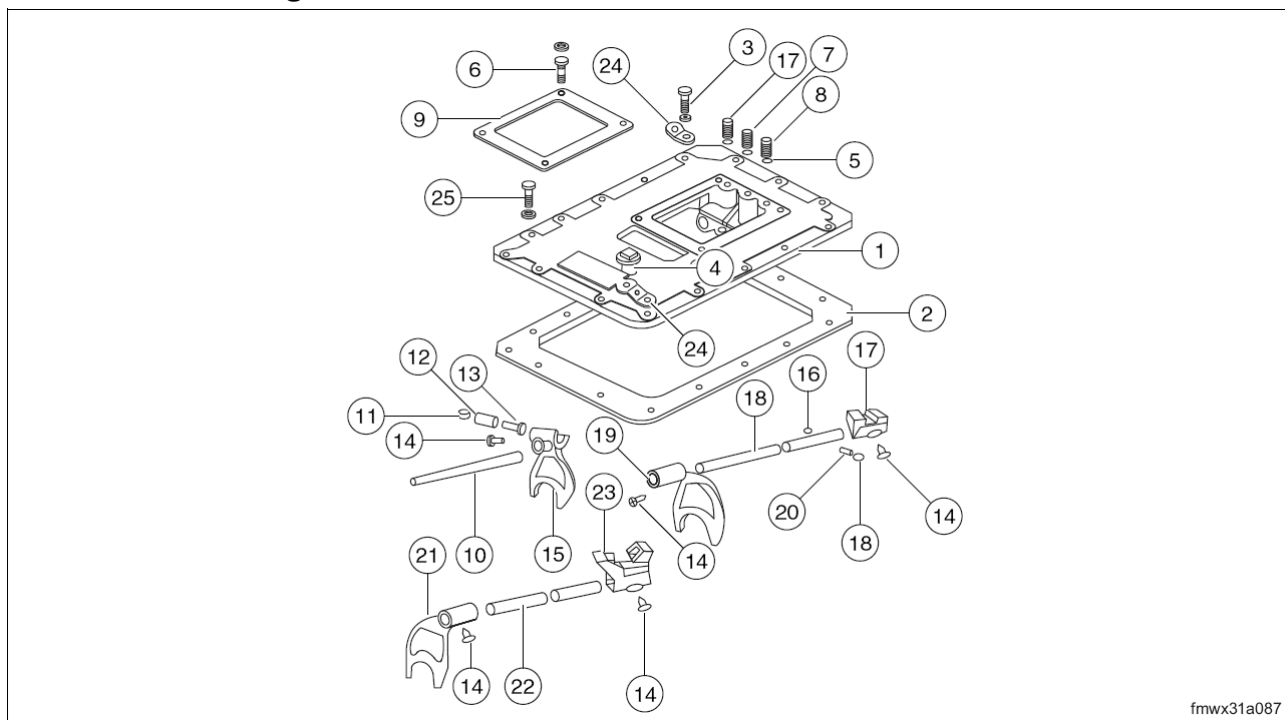


- (l). Install the three air pipes and two air filter bolts.

Transmission (9JS135) - Transmission Upper Cover

Transmission Upper Cover

Part Drawing



31B

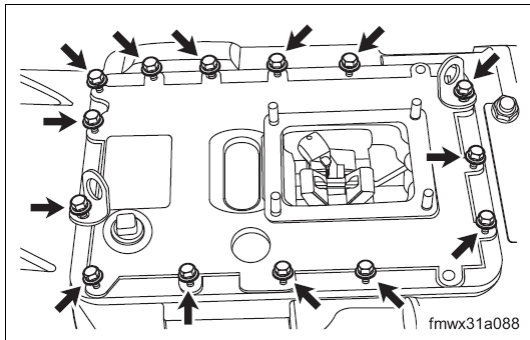
1	Upper Cover
2	Upper Cover Gasket
3	Small Hex Head Bolt (M10*38)
4	Square Head Tapered Screw Plug
5	Steel Ball (12.7000G1000b)
6	Stud Bolt
7	Compression Spring
8	Compression Spring
9	Control Window Gasket
10	Low/Reverse Gear Shift Fork Shaft
11	Reverse Gear Lock Screw Plug
12	Reverse Gear Lock Spring
13	Reverse Gear Lock Pin

14	Set Screw, Gear Shift Fork
15	Low/Reverse Gear Shift Fork
16	Steel Ball (19.0500G1000b)
17	1 st /2 nd and 5 th /6 th Gear Guide Block
18	1 st /2 nd Gear Shift Fork Shaft
19	1 st /2 nd Gear Shift Fork
20	Interlock Pin, Shift Fork Shaft
21	3 rd /4 th Gear Shift Fork
22	3 rd /4 th Gear Shift Fork Shaft
23	3 rd /4 th and 7 th /8 th Gear Guide Block
24	Lifting Bent Plate
25	Small Hex Head Bolt (M10*32)

Disassembly and Assembly

1. Dismantle the double H control mechanism assembly of the transmission. Refer to Chapter 31B Transmission 9JS135 – Double H Control Mechanism, Disassembly and Assembly.

31B

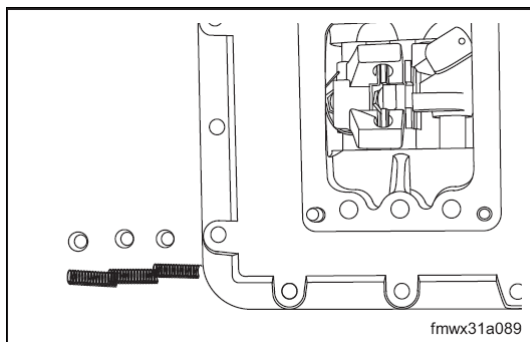


2. Dismantle the upper cover assembly

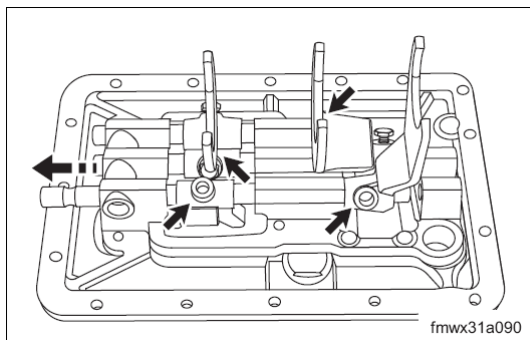
- (a). Dismantle the fastening bolts of the upper cover.
- (b). Beat the upper cover by a copper rod to separate it from the gasket.

Caution:

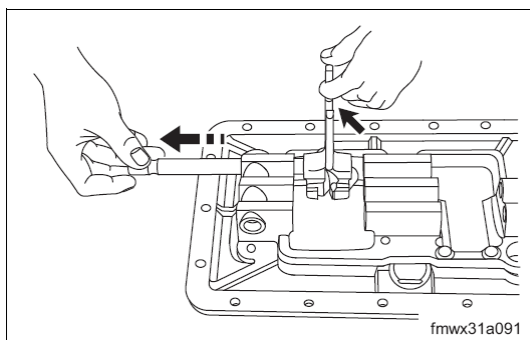
Do not apply too strong force when bearing the upper cover, and make sure to beat evenly in all directions.



- (c). Remove the upper cover assembly from the transmission, and take out the gear shift self-locking steel balls and the springs.
- (d). Dismantle the four stud bolts.

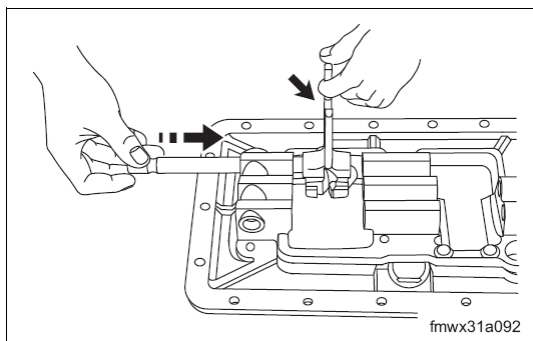


- (e). Turn the upper cover assembly, dismantle the 3rd/4th gear shift fork shaft, guide block and 3rd/4th gear shift fork.
- (f). Dismantle the 1st/2nd gear shift fork shaft, guide block, 1st/2nd gear shift fork and interlock pin.



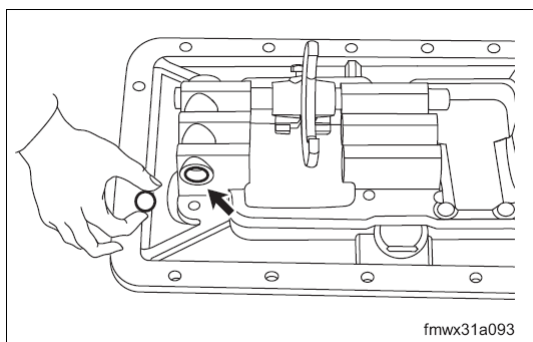
- (g). Dismantle the low/reverse gear shift fork shaft and low/reverse gear shift fork.

Transmission (9JS135) - Transmission Upper Cover

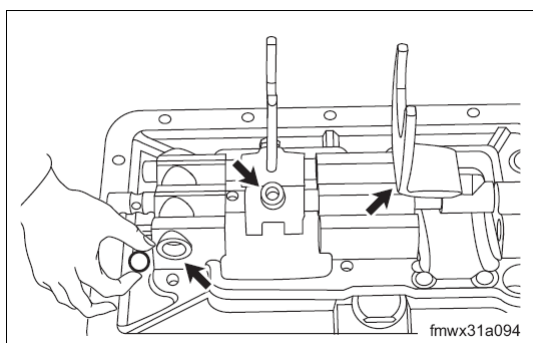


3. Assemble the upper cover assembly
 - (a). Install the low/reverse gear shift fork and low/reverse gear shift fork shaft.

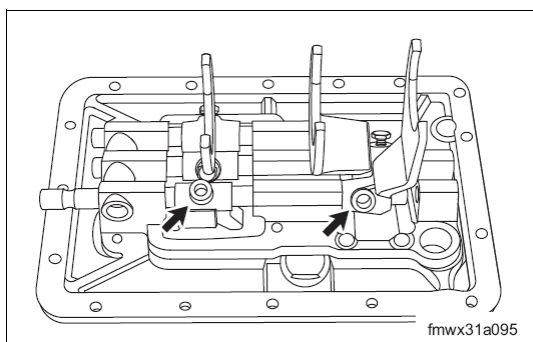
31B



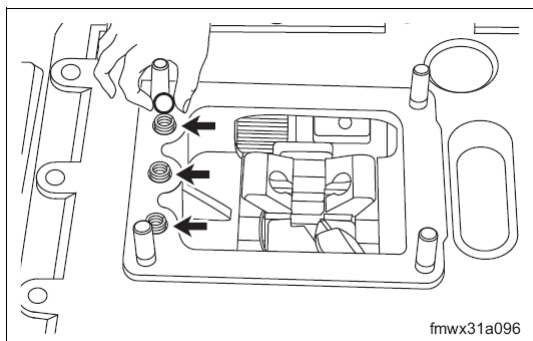
- (b). Put one interlock steel ball in.



- (c). Install the 1st/2nd gear shift fork shaft, guide block, 1st/2nd gear shift fork, interlock pin and interlock steel ball.



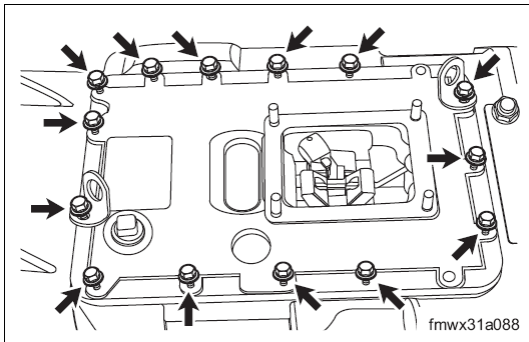
- (d). Install the 3rd/4th gear shift fork shaft, guide block and shift fork, fasten the bolts, bind with wires.



- (e). Install the four stud bolts, self-locking steel balls and springs.

Caution:

The spring in the hole of the 3rd/4th gear shift fork shaft is thicker.

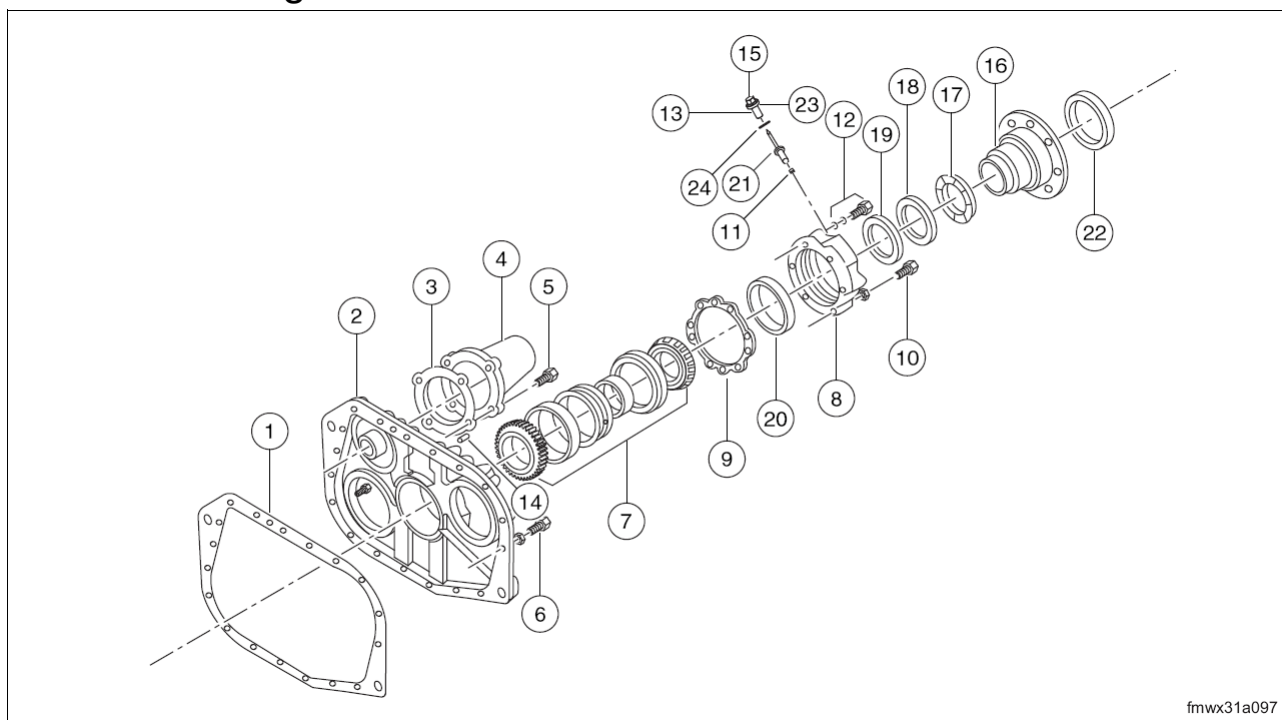


- (f). Tighten the upper cover bolts.
Torque: **54.5±7N.m**

4. **Double H control mechanism assembly of the transmission. Refer to Chapter 31B Transmission 9JS135 – Double H Control Mechanism, Disassembly and Assembly.**

Transmission Auxiliary Box

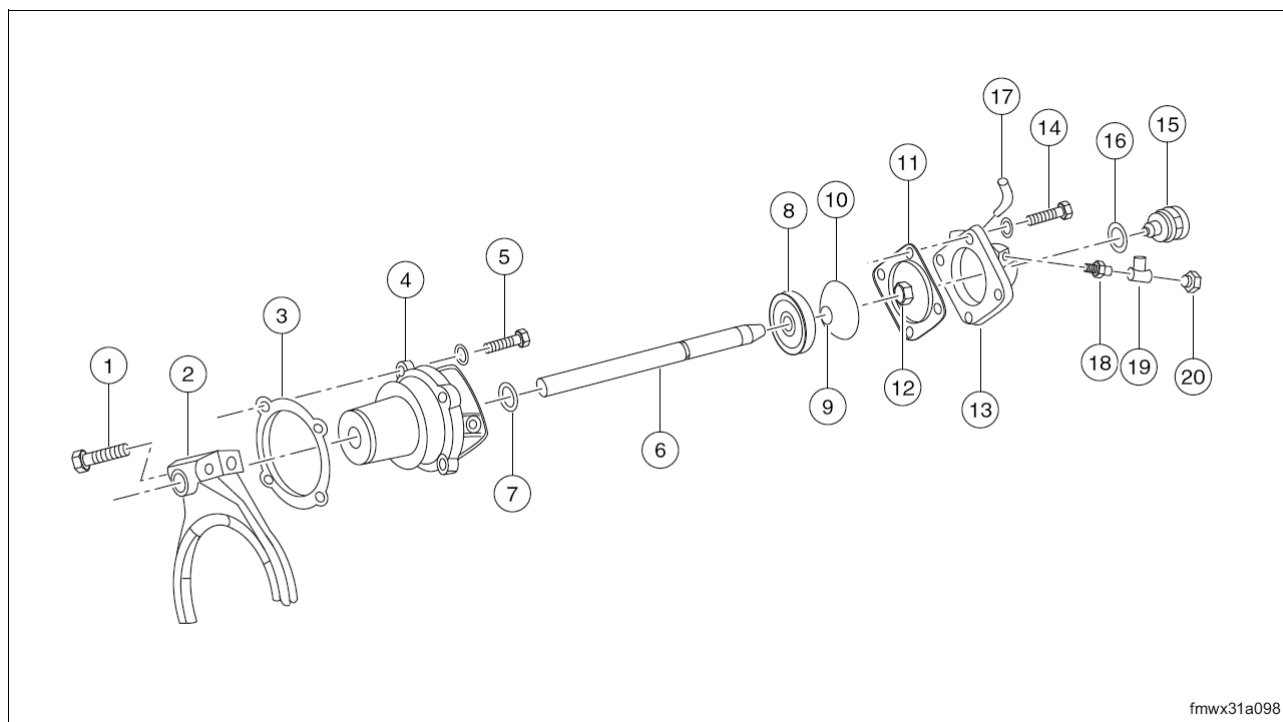
Part Drawing



fmwx31a097

1	Rear Cover Gasket
2	Rear Cover Housing
3	Gasket, Auxiliary Box Countershaft Bearing Cap
4	Lengthened Countershaft Cap
5	Bolt Assembly
6	Hex Head Bolt M10
7	Cylindrical Roller Bearing
8	Output Shaft Rear Bearing Cap
9	Gasket, Auxiliary Box Main Shaft Rear Bearing Cap
10	Hex Head Bolt (M10*75)
11	Sleeve, Odometer Driven Gear
12	Bolt Assembly

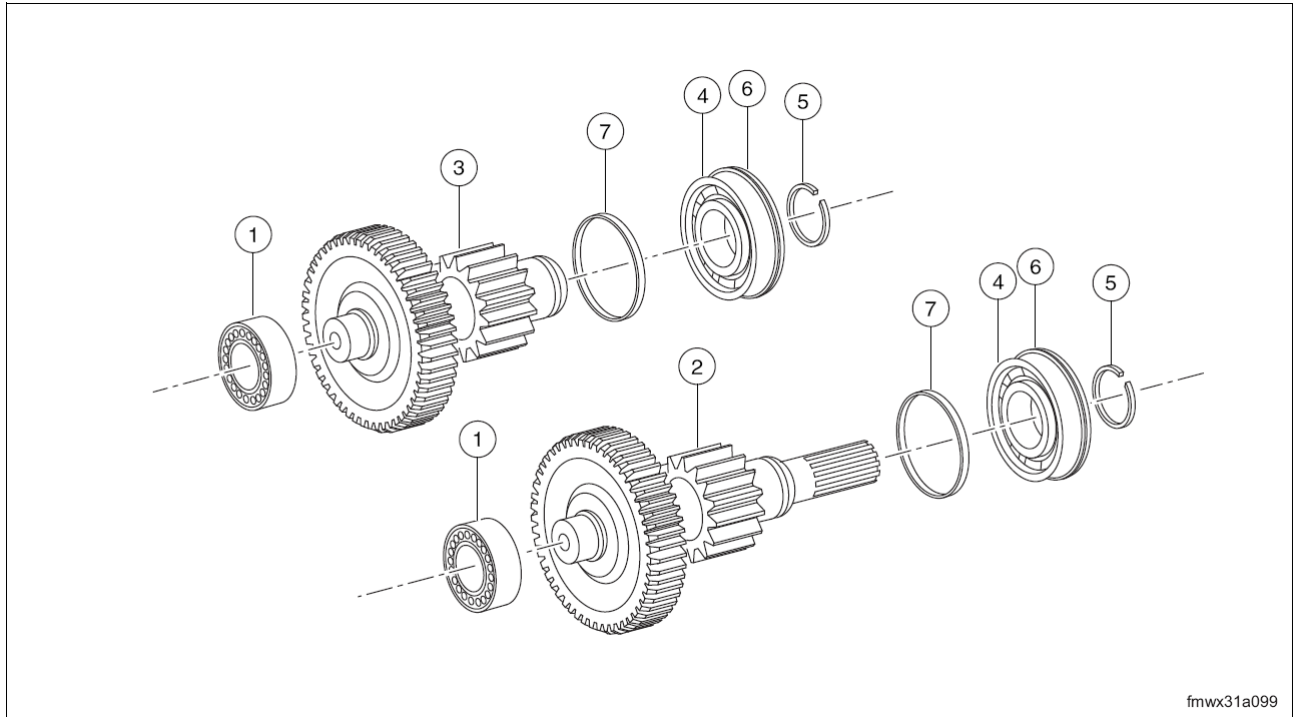
13	Odometer Joint
14	Rear Cover Locating Pin
15	Odometer Protective Sleeve
16	Output Flange
17	Dust Cover
18	Oil Seal
19	Oil Seal, Main Shaft Rear Bearing Cap
20	Odometer Driving Gear
21	Odometer Driven Gear
22	Locating Ring
23	O-Ring (φ12×1.9)
24	Gasket



fmwx31a098

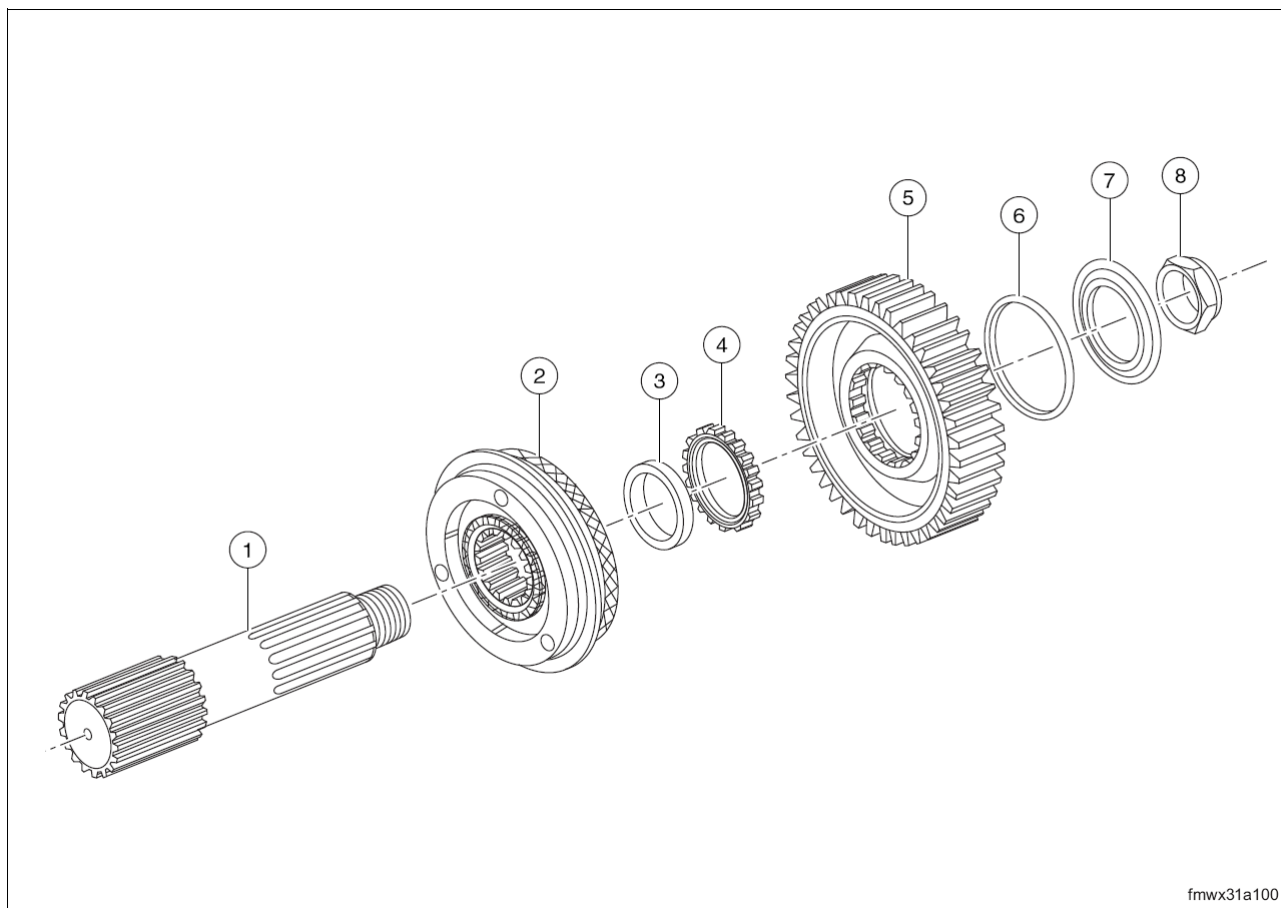
1	Hex Bolt with Wire Hole on Head
2	Auxiliary Box Shift Fork
3	Sealing Gasket
4	Cylinder, Range Gear
5	Hex Head Bolt
6	Shift Fork Shaft, Range Gear
7	O-ring
8	Cylinder Piston, Range Gear
9	O-ring
10	O-ring

11	Sealing Gasket, Cylinder Head
12	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert (M16*1.5)
13	Gear Shift Cylinder Head, Auxiliary Box
14	Hex Head Bolt (M10*32)
15	Pressure Switch
16	Wrinkled Copper Washer
17	45° Elbow Joint
18	Tee Pipe Joint
19	Tee Pipe Joint
20	Hex Tapered Screw Plug

Transmission (9JS135) - Transmission Auxiliary Box

1	Short Cylindrical Roller Bearing
2	Lengthened Countershaft Welding Assembly, Auxiliary Box
3	Countershaft Welding Assembly, Auxiliary Box
4	Short Cylindrical Roller Bearing

5	Snap Ring
6	(Bearing) Snap Ring
7	Bearing Washer



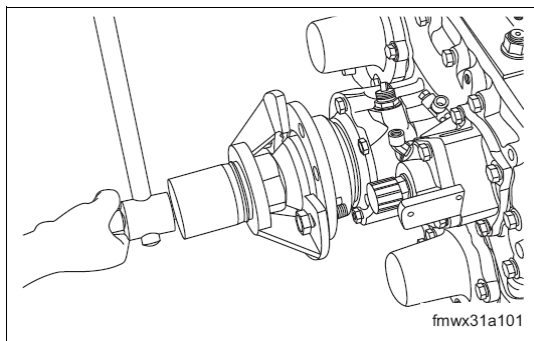
fmwx31a100

1	Auxiliary Box Main Shaft
2	High/Low Gear Synchronizer Assembly
3	Gasket, Auxiliary Box Main Shaft
4	Gasket, Auxiliary Box Main Shaft Gear

5	Reduction Gear, Auxiliary Box Main Shaft
6	Snap Ring
7	Gasket, Auxiliary Box Reduction Gear
8	Nut with Collar

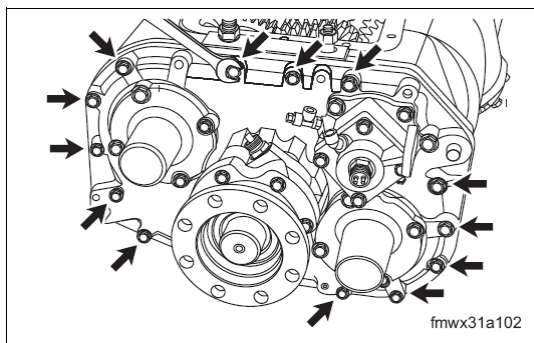
Disassembly and Assembly

1. Disassemble the auxiliary box assembly

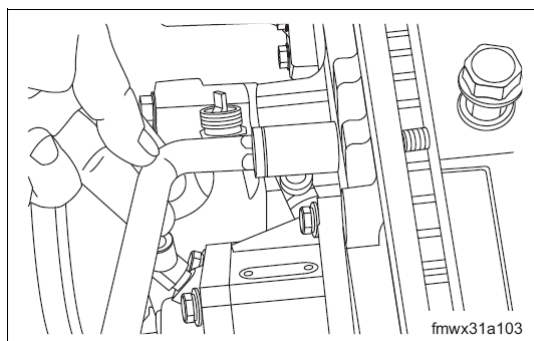


- (a). Mesh the two pairs of sliding sleeves with the main box gears.
- (b). Dismantle the nut with collar by a special wrench.

31B



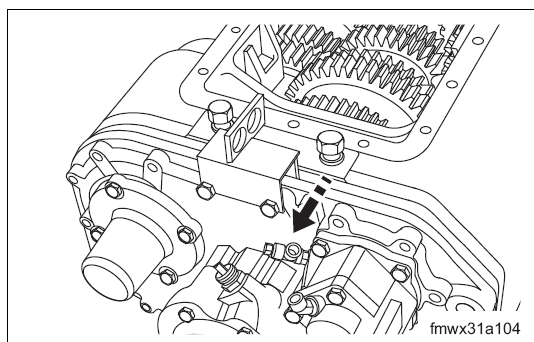
- (c). Dismantle the bolts on the rear cover housing.



- (d). Push against the auxiliary box by about 10mm by three bolts.

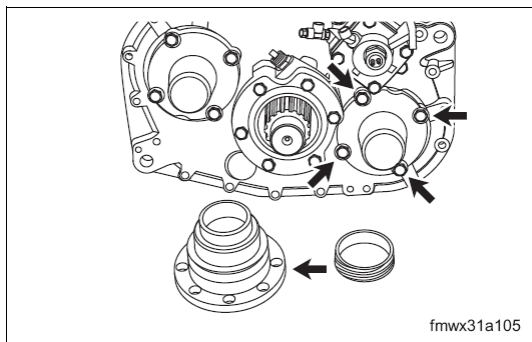
Caution:

Screw in the three bolts evenly.

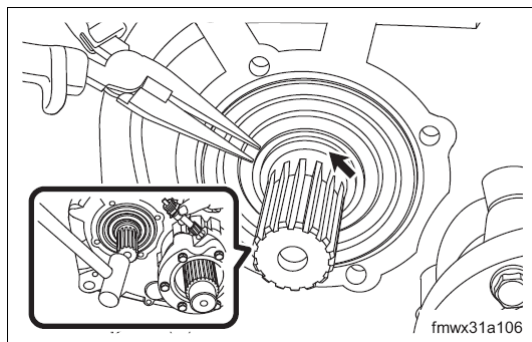


- (e). Lift the auxiliary box assembly by special tools and move backward to separate it from the main box.

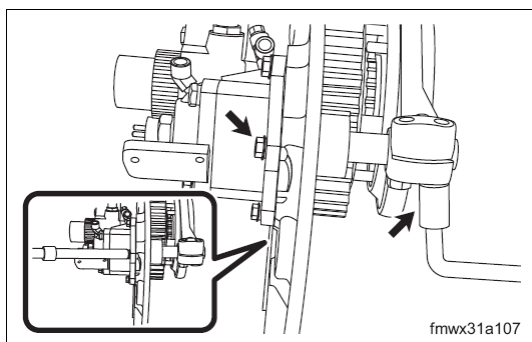
31B



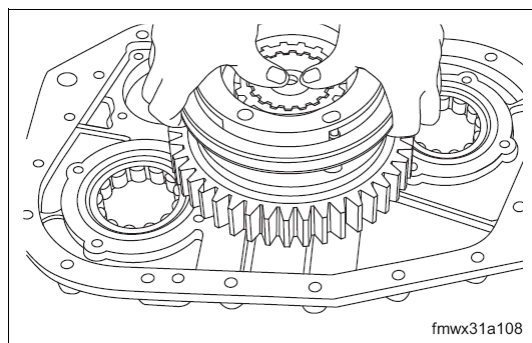
- (f). Dismantle the output flange and odometer driving gear.
- (g). Dismantle the lengthened countershaft cap.



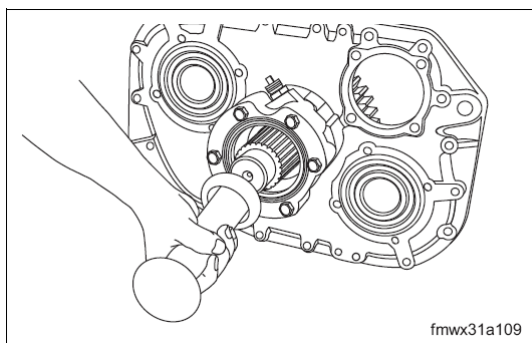
- (h). Remove the snap ring on the lengthened countershaft.
- (i). Beat the lengthened countershaft by a copper rod to separate it from the bearing.



- (j). Cut off the wire, and dismantle the bolt on the auxiliary box shift fork.
- (k). Dismantle the connecting bolt of the gear shift cylinder and rear cover.



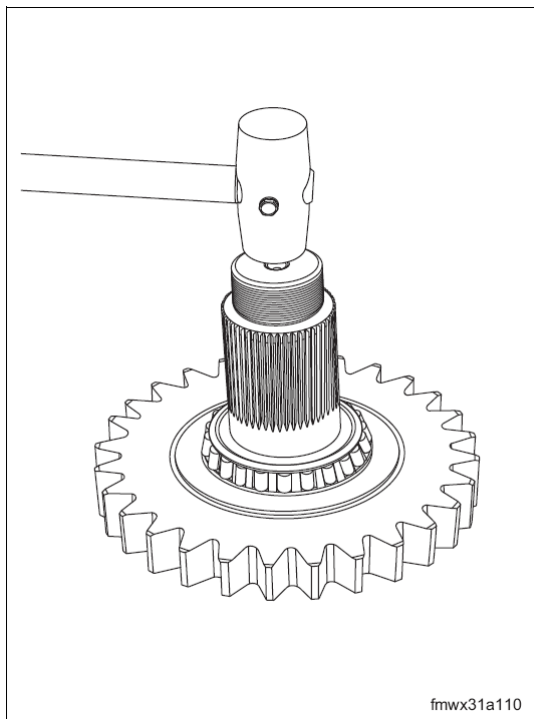
- (l). Remove the auxiliary box synchronizer.



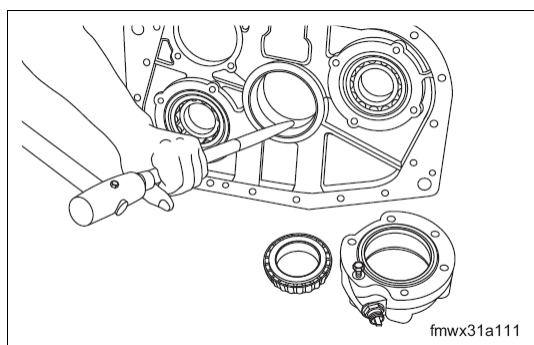
- (m). Take out the output shaft to separate it from the auxiliary box.

Transmission (9JS135) - Transmission Auxiliary Box

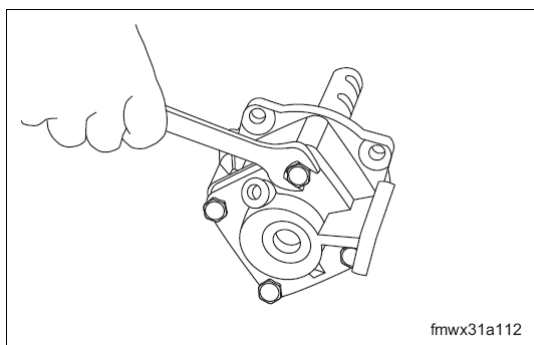
31B



- (n). Take out the output shaft to separate it from the bearing.

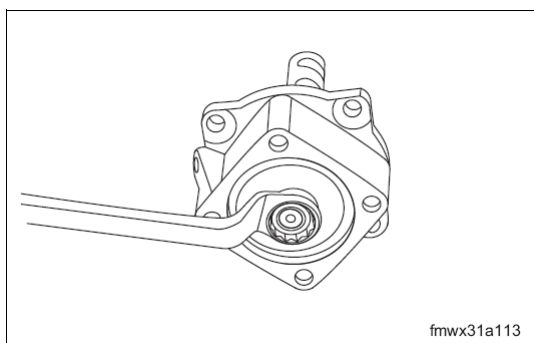


- (o). Dismantle the output shaft bearing cap, beat with a soft rod and take out the bearing outer ring in the rear cover housing.



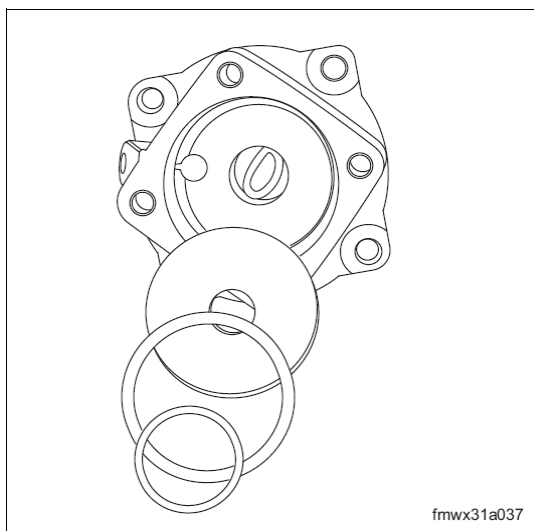
2. Dismantle the gear shift cylinder of the auxiliary box

- (a). Dismantle the four bolts on the cylinder head, and remove the cylinder head.

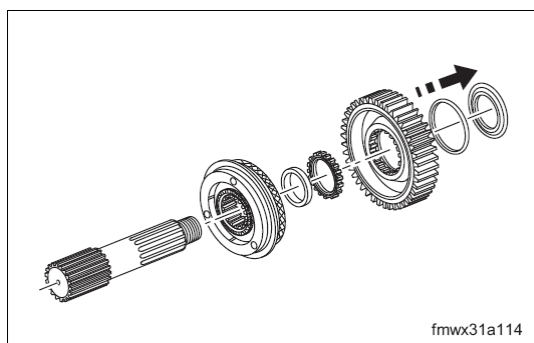


- (b). Dismantle the self-locking nut on the piston.

31B

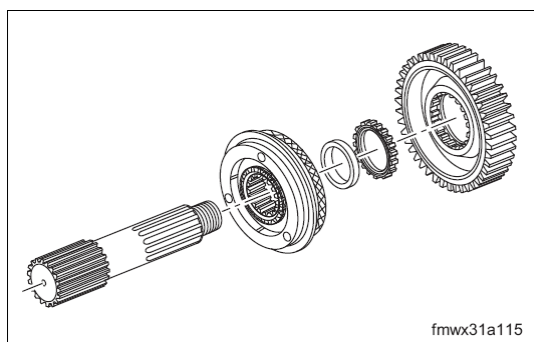


- (c). Remove the piston and three O-rings of the gear shift cylinder in order.

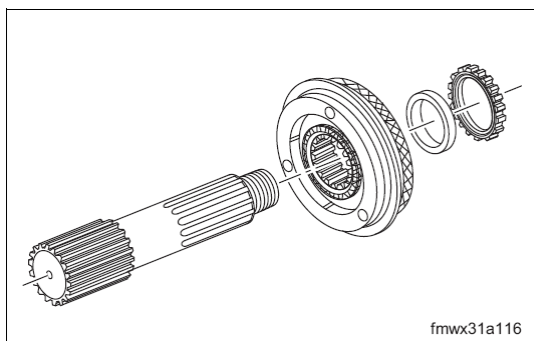


3. Disassemble the auxiliary box main shaft assembly

- (a). Remove the gasket and snap ring in order.



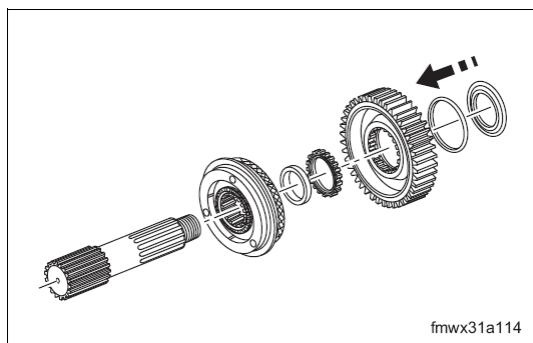
- (b). Remove the reduction gear of the auxiliary box main shaft.
(c). Remove the auxiliary box main shaft gear gasket, auxiliary main shaft ring gear, high/low gear synchronizer assembly in order.



4. Assemble the auxiliary box main shaft assembly

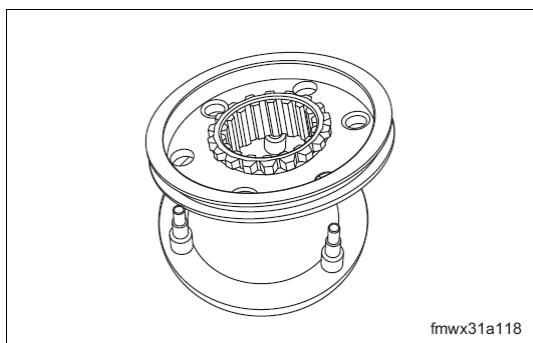
- (a). Install the high/low gear synchronizer assembly, auxiliary main shaft ring gear and auxiliary box main shaft gear gasket in order.

Transmission (9JS135) - Transmission Auxiliary Box



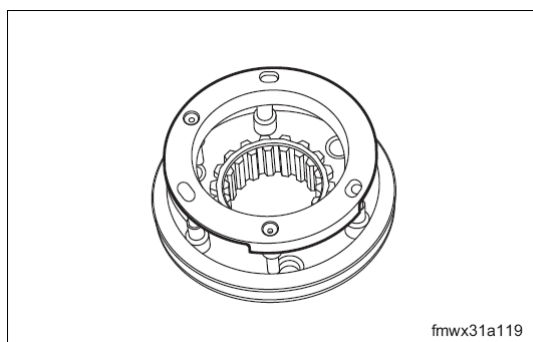
- (b). Install the reduction gear of the auxiliary box main shaft.
- (c). Install the gasket and snap ring in order.

31B

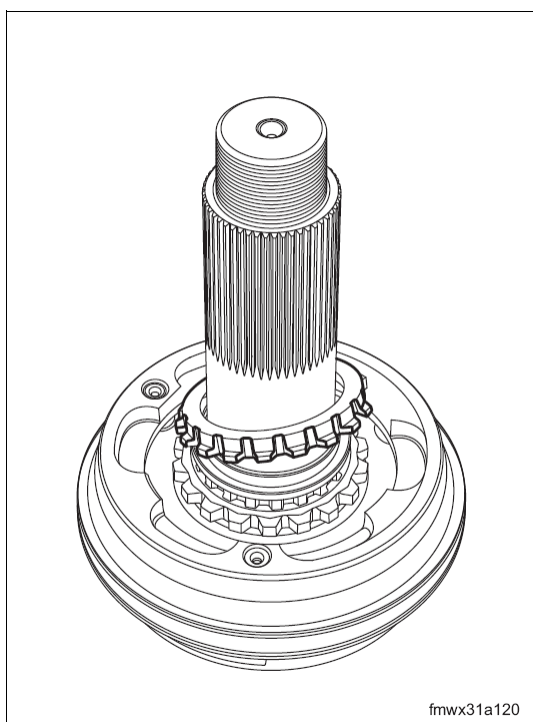


5. Assemble the auxiliary box

- (a). Clean the auxiliary box synchronizer and its components.
- (b). Put the low gear ring of the auxiliary box synchronizer flat, and put it into the synchronizer sliding sleeve.

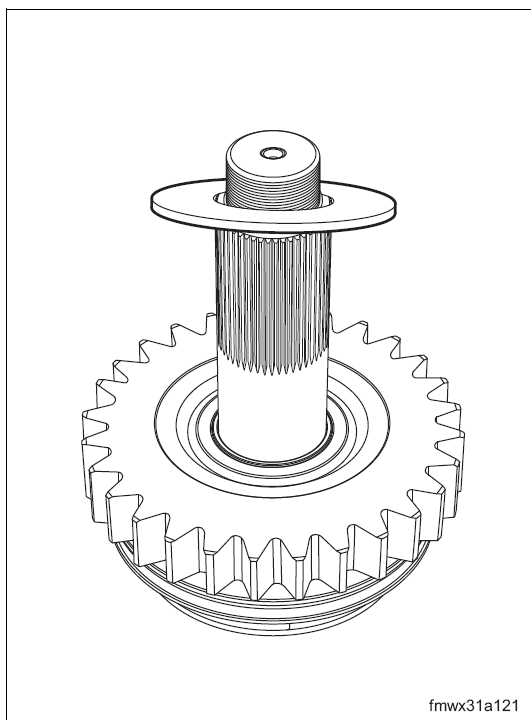


- (c). Put the three springs into the high gear ring hole, and apply a rotary force to make them matched with other parts of the synchronizer.



- (d). Put the low gear ring of the synchronizer on a wood block which is 50mm high, and insert the output shaft.
- (e). Install the auxiliary box main shaft gear gasket and auxiliary box main shaft washer.

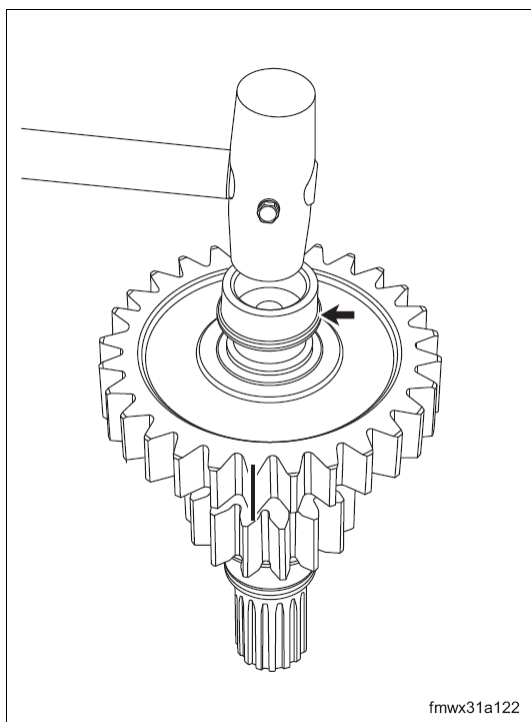
31B



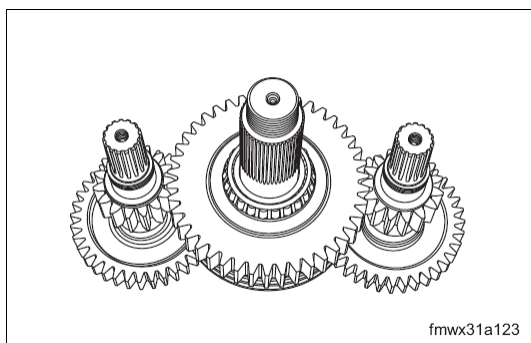
- (f). Nest the gear and gasket in the output shaft, with the convex side facing down.

Caution:

Conduct initial lubrication for the gasket.



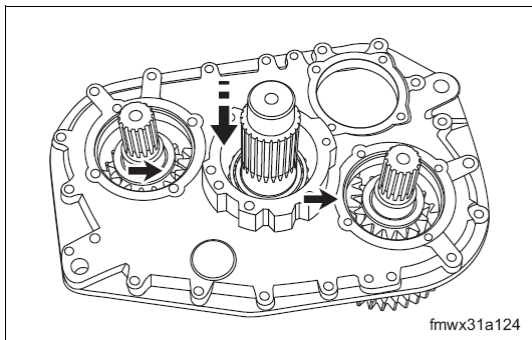
- g). Install the bearing inner ring in the lengthened countershaft of the auxiliary box.
h). Make the teeth aligning marks on the lengthened countershaft of the auxiliary box.



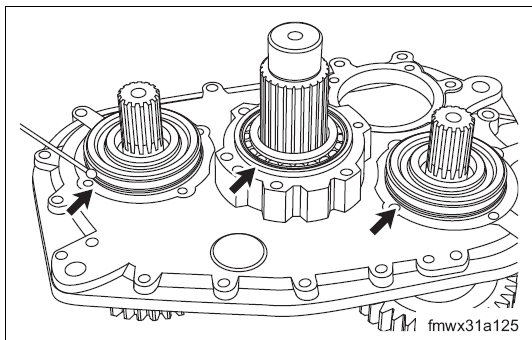
- (i). Make teeth aligning marks which are 180° adjacent on the reduction gear of the auxiliary box, as placed in the drawing.

Transmission (9JS135) - Transmission Auxiliary Box

31B



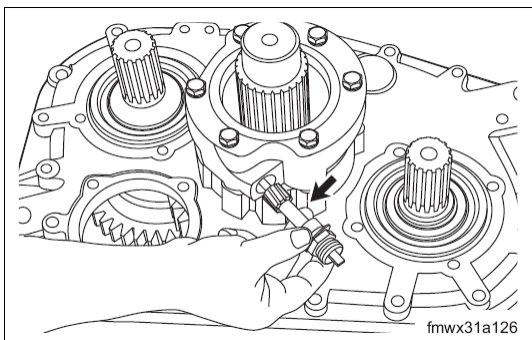
- (j). Put the rear cover housing in.



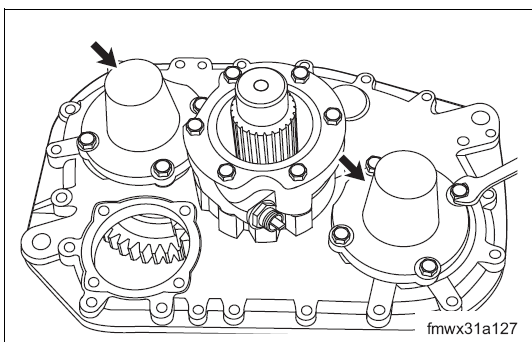
- (k). Install the combination bear and the roller bearings on the two lengthened countershafts.

Caution:

There is a snap ring and a liner ring on the bearing.



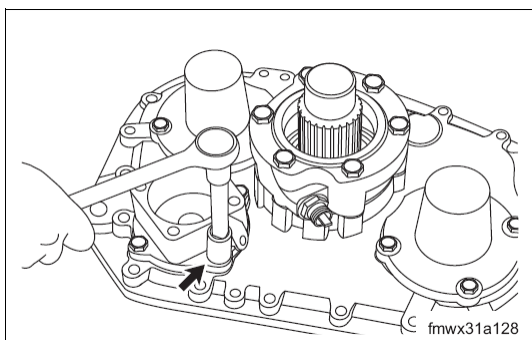
- (l). Install the snap rings on the two lengthened countershafts.
(m). Install the output shaft bearing cap, odometer driven gear and odometer joint.



- (n). Install the two lengthened countershaft caps.
Torque: **54.5±7N.m**

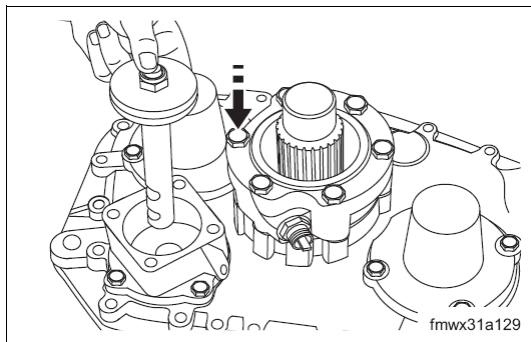
Hint:

Install the power take-off if the power take-off is provided.



- (o). Install the cylinder housing.
Torque: **54.5±7N.m**

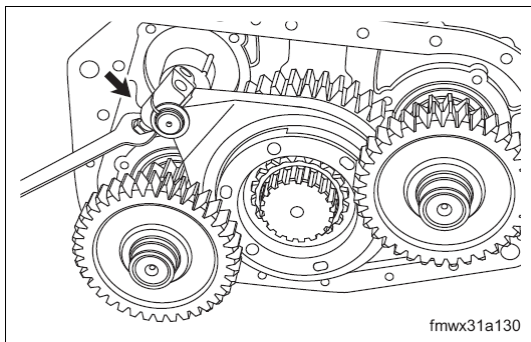
31B



(p). Install the sealing ring and cylinder piston in order.

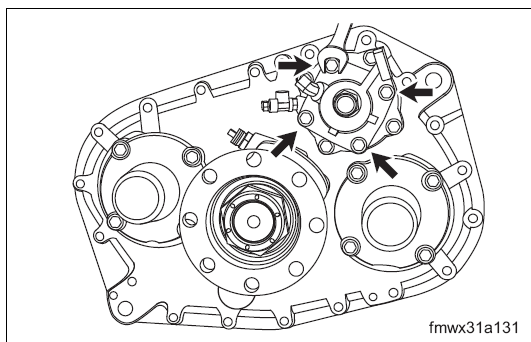
Caution:

The piston plane faces up

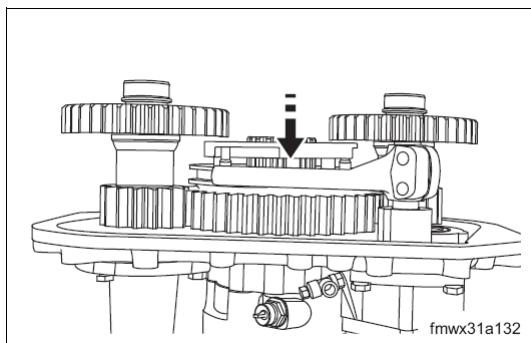


(q). Insert the auxiliary box gear shift fork into the synchronizer sliding sleeve, and install the bolt on the shift shaft, and lock with wires.

Torque: $78 \pm 10 \text{ N.m}$



(r). Install the gear shift cylinder head and flange
Tightening torque for cylinder head: **$54.5 \pm 7 \text{ N.m}$**

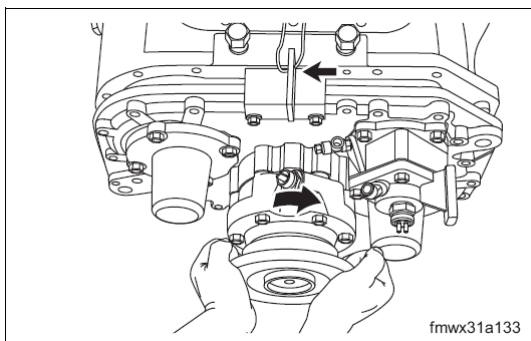


(s). Place the auxiliary box synchronizer in the low gear area.

(t). Apply lubricating grease in the two bearing holes of the main box.

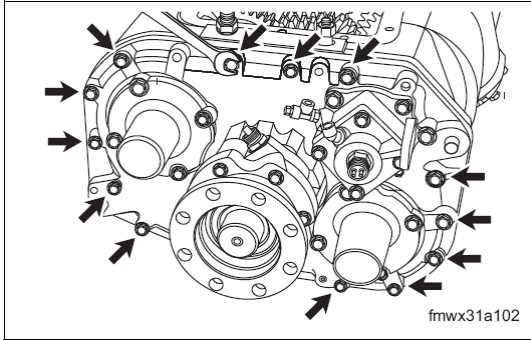
Hint:

It is very important to install the auxiliary box.



(u). Lift the auxiliary box assembly by special tools, and meanwhile, push the auxiliary box forward and rotate the flange by hand.

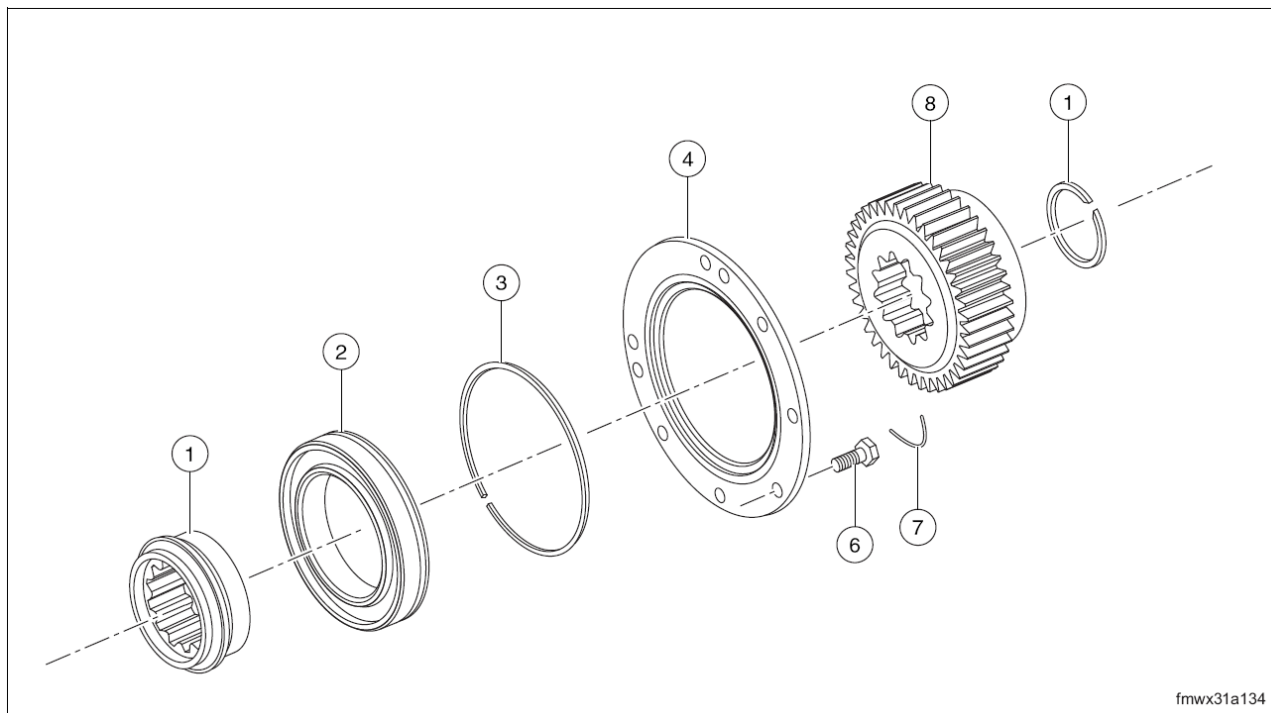
Transmission (9JS135) - Transmission Auxiliary Box



- (v). **Install the auxiliary box in position, and tighten the rear cover bolts and flange nuts.**
Torque: **54.5±7N.m**
Tightening torque for flange nut: **654±45N.m**

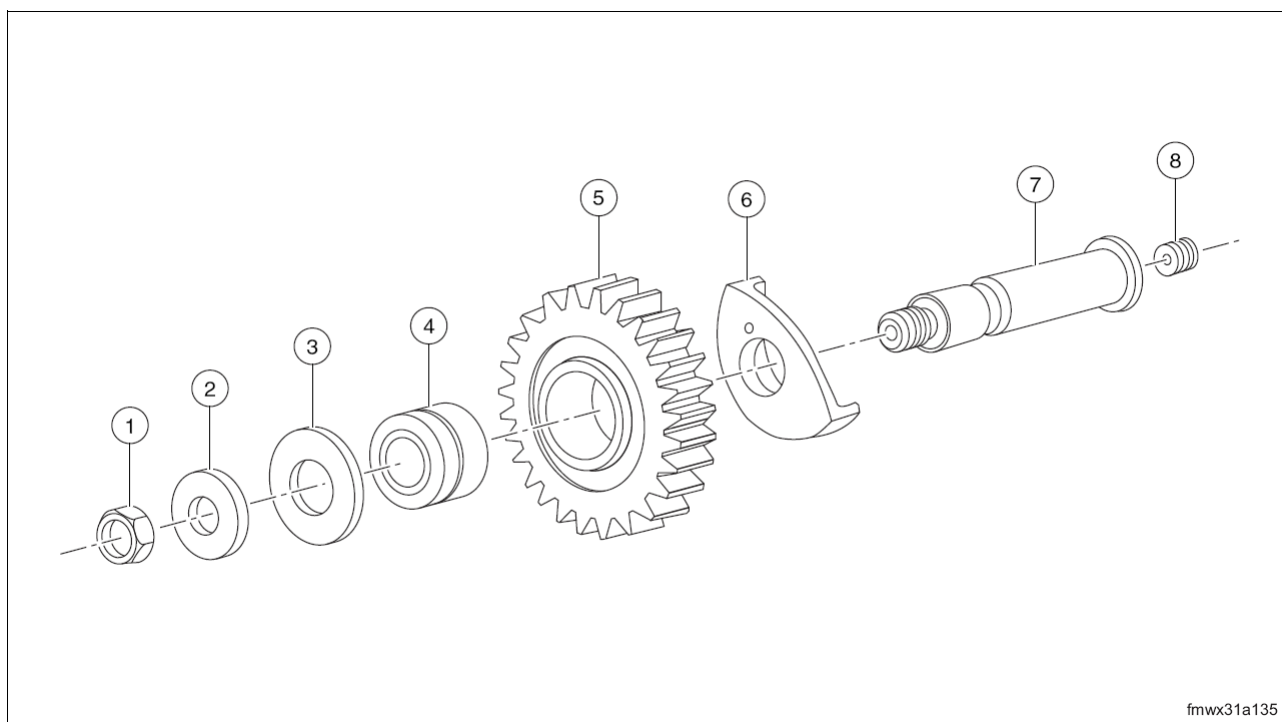
Transmission Main Box Part Drawing

31B



1	Snap Ring
2	Snap Ring
3	Bearing
4	(Bearing) Snap Ring

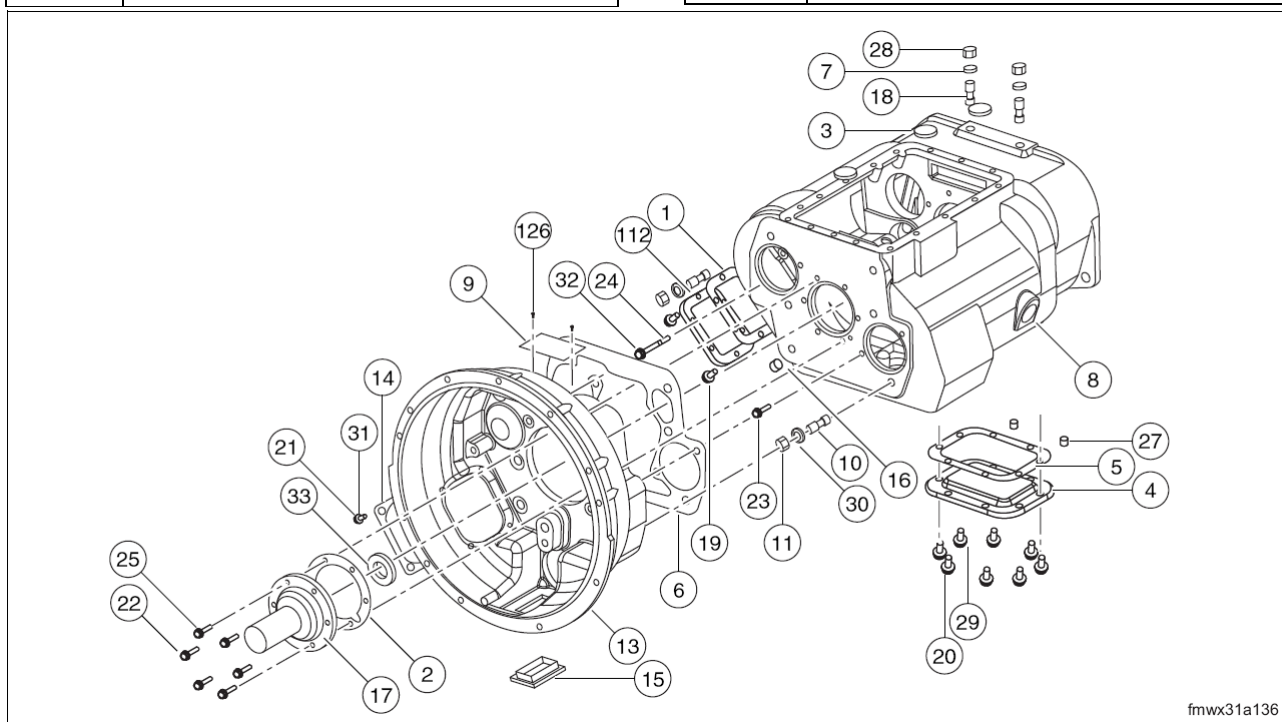
5	Locating Disc, Auxiliary Box Bearing
6	Small Hex Bolt with Wire Hole on Head (M10*22)
7	Wire
8	Auxiliary Box Driving Gear

Transmission (9JS135) - Transmission Main Box

fmwx31a135

1	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert (M16*1.5)
2	Washer, Reverse Gear Countershaft
3	Reverse Gear Thrust Washer
4	Needle Bearing

5	Reverse Intermediate Gear
6	Reverse Gear Cup Washer
7	Reverse Gear Countershaft
8	Set Bolt with Flat Point (M12*12)



fmwx31a136

1	Gasket, Side Power Take-off Window
2	Gasket, Primary Shaft Bearing Cap

18	Stud Bolt
19	Hex Head Bolt and Spring Washer Assembly

31B

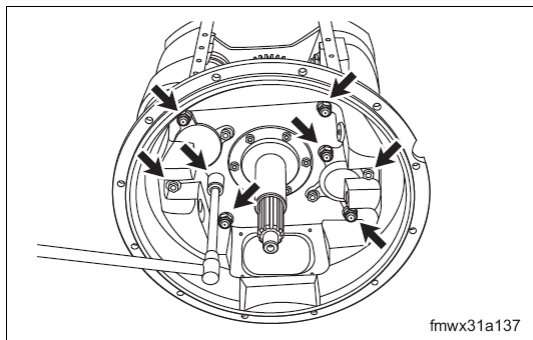
3	Round Magnet
4	Cover, Bottom Power Take-off Window
5	Gasket, Bottom Power Take-off Window
6	Gasket, Clutch Housing
7	Spring Washer
8	Transmission Housing
9	Rating Plate
10	Stud Bolt
11	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert
12	Cover, Side Power Take-off Window
13	Clutch Housing
14	Hand Hole Cover
15	Hand Hole Cover
16	Slotted Tapered Nut
17	Primary Shaft Bearing Cover

20	Hex Head Bolt
21	Hex Head Bolt
22	Hex Head Bolt
23	Hex Head Bolt
24	Hex Head Bolt
25	Hex Bolt with Wire Hole on Head
26	Cross Recessed Pan Head Tapping Screw
27	Slotted Set Screw with Flat Point
28	Hex Nut, Style 1
29	Flat Washer
30	Flat Washer
31	Spring Washer
32	Spring Washer
33	Framework Oil Seal



Disassembly and Assembly

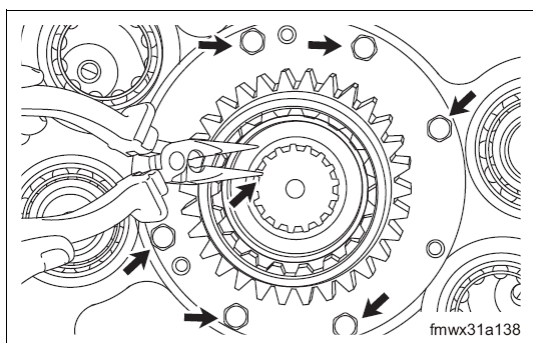
1. Dismantle the upper cover assembly. Refer to Chapter 31B Transmission 9JS135 – Transmission Upper Cover, Disassembly and Assembly



2. Dismantle the clutch cover assembly

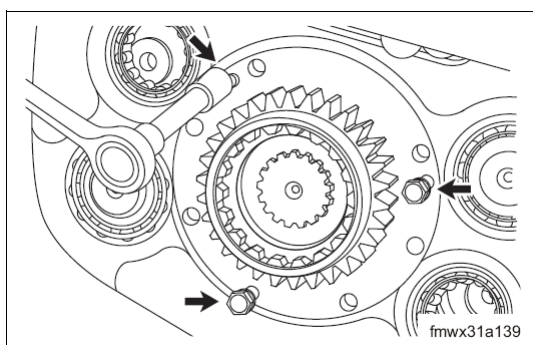
- (a). Loosen the connecting bolt, and remove the clutch housing.

31B

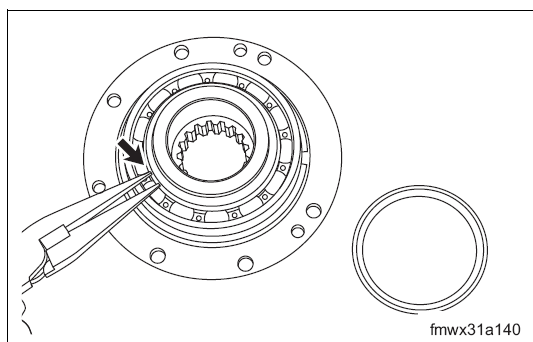


3. Dismantle the auxiliary box driving gear

- (a). Dismantle the snap ring at the rear end of the auxiliary box driving gear and the six bolts on the locating disc.
- (b). Dismantle the snap ring.

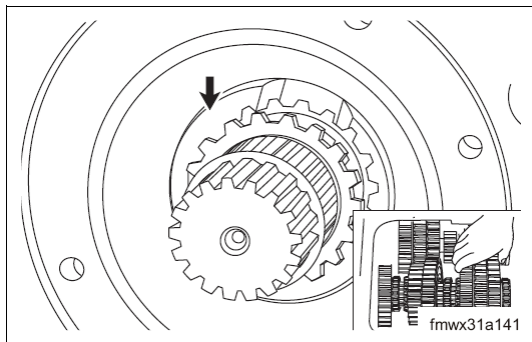


- (c). Push out the driving gear assembly by three bolts.



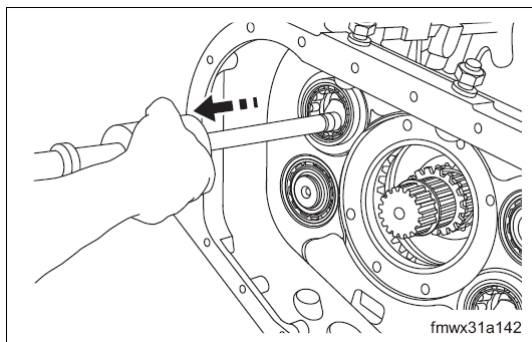
- (d). Dismantle the circlip fixing ring and split ring on the auxiliary box driving gear.

31B

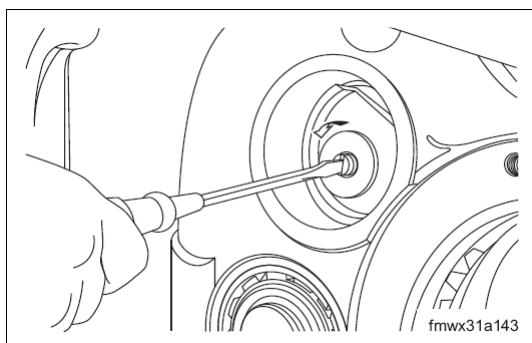


4. Dismantle the driving gear

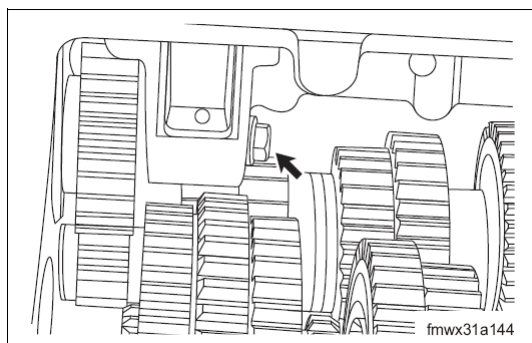
- (a). Dismantle the snap ring in the main shaft reverse gear.
- (b). Move the reverse gear forward until it pushes against the main shaft low gear.



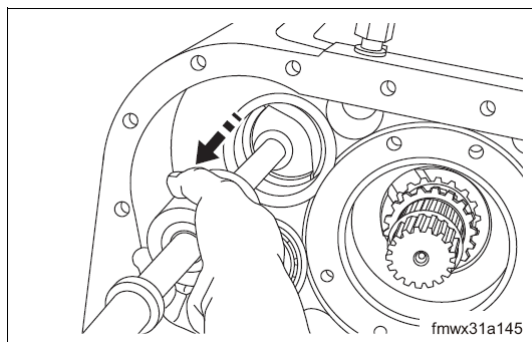
- (c). Pull out the bearing at the rear end of the reverse intermediate gear shaft by a special tool.



- (d). Dismantle the screw plug in the reverse intermediate gear shaft.



- (e). Dismantle the self-locking nut on the reverse intermediate gear shaft.

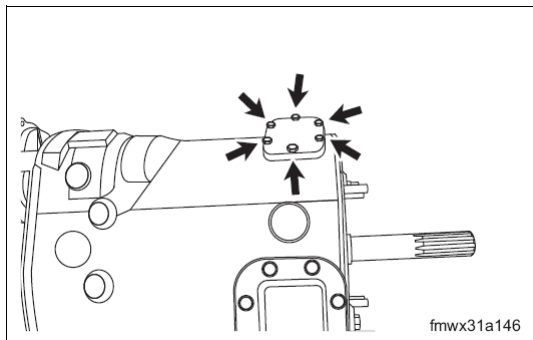


- (f). Pull out the reverse intermediate gear shaft by a special tool.

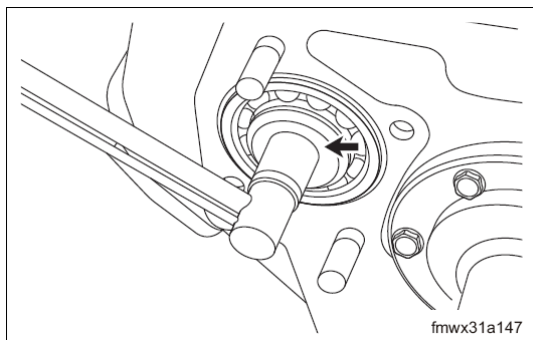
Caution:
Prevent the reverse idler from damage by falling.

Transmission (9JS135) - Transmission Main Box

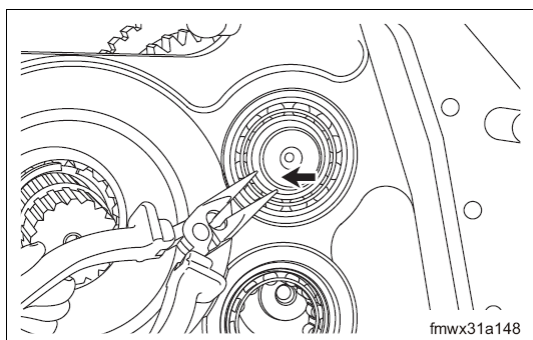
31B



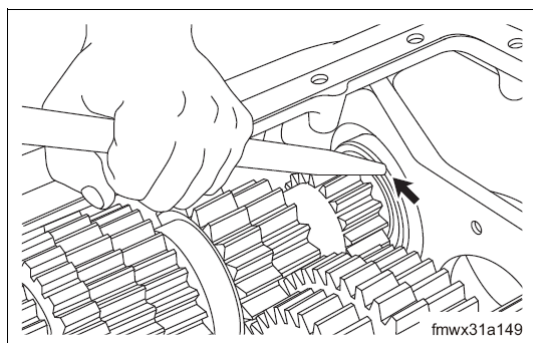
- 5. Dismantle the main shaft assembly**
(a). Dismantle the countershaft brake assembly.



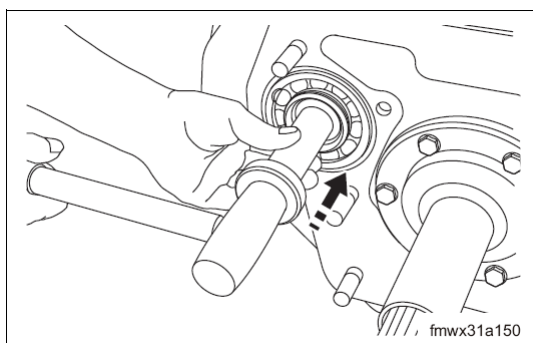
- (b). Dismantle the bearing baffle plate at the front end of the main box countershaft.



- (c). Dismantle the snap ring on the bearing at the rear end of the main box countershaft.

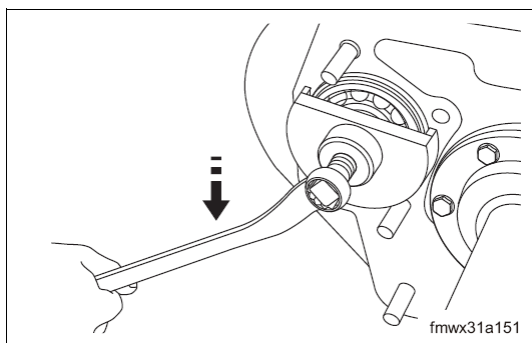


- (d). Dismantle the rear bearing of the countershaft by a soft rod.

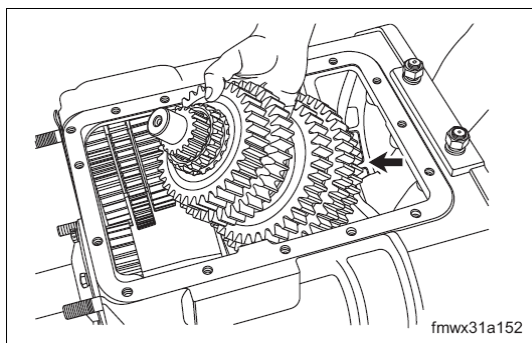


- (e). Beat the countershaft by a copper rod to move it backward by about 10mm.

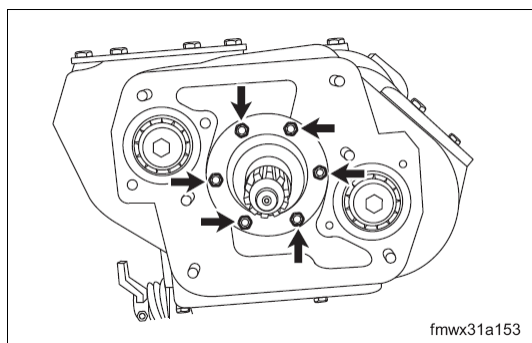
31B



- (f). Dismantle the countershaft front bearing by a special tool.

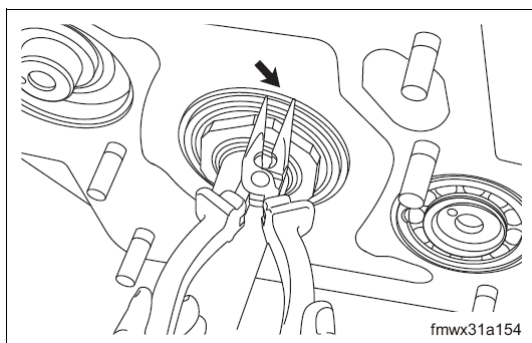


- (g). Take out the main shaft assembly from the main box housing.

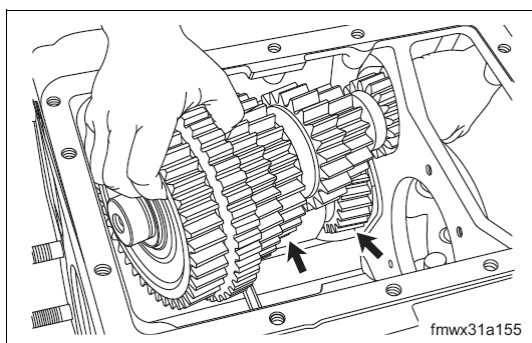


6. Dismantle the primary shaft assembly

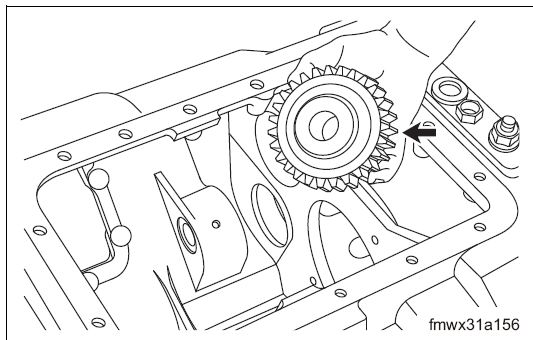
- (a). Loosen the six bolts on the primary shaft bearing cap, and remove the primary shaft bearing cap.



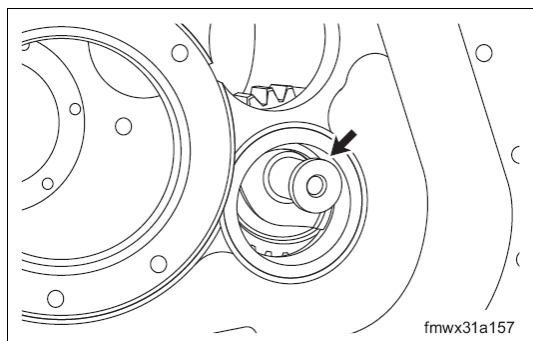
- (b). Dismantle the snap ring on the primary shaft bearing, impact the shaft end, and remove the primary shaft assembly.



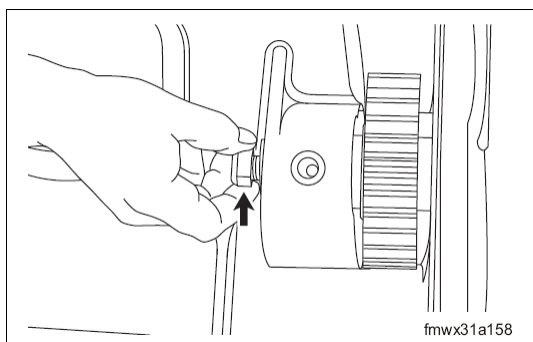
- 7. Take out the countershaft assembly and reverse intermediate gear from the main box housing.**

Transmission (9JS135) - Transmission Main Box**8. Install the reverse intermediate gear**

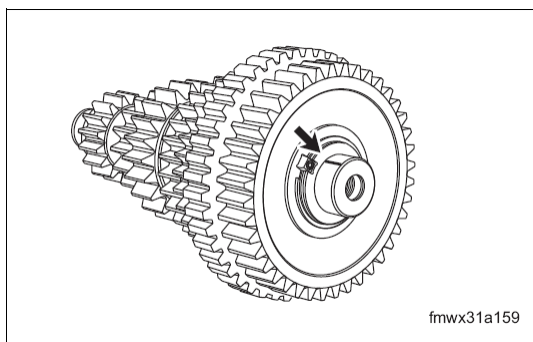
- (a). Put the reverse intermediate gear into the housing, with the convex side facing forward.



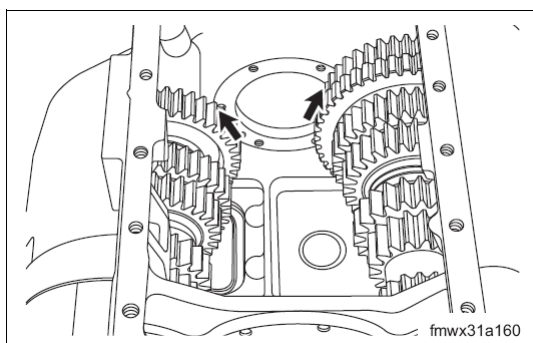
- (b). Install the reverse intermediate gear shaft.



- (c). Tighten the self-locking nut at the front end of the right reverse intermediate gear shaft.
Torque: **74.5±6.5 N.m**

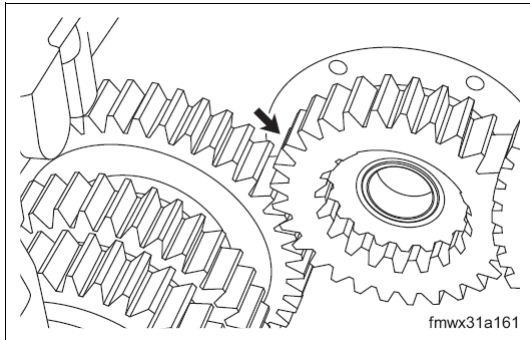
**9. Install the countershaft**

- (a). Make the teeth aligning mark on the tooth of the constant mesh gear of the countershaft assembly, which faces the keyway.



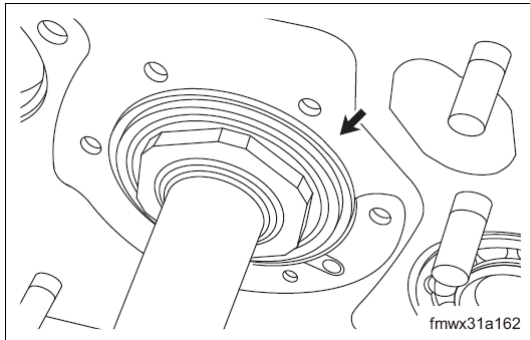
- (b). Put the two countershaft assemblies into the main box housing.

31B

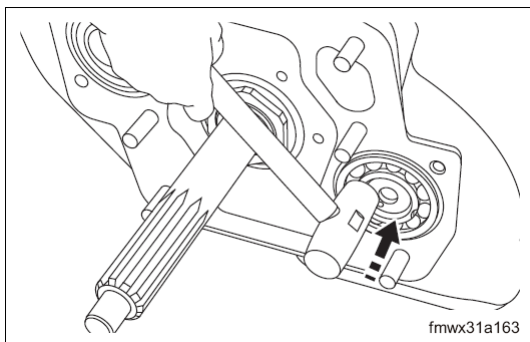


10. Install the primary shaft assembly

- (a). Make the teeth aligning marks on two groups of teeth which are selected freely and are 180° adjacent on the primary shaft gear.
- (b). Put the primary shaft assembly into the main box housing, insert the marked tooth of the left countershaft into the marked groove of the primary shaft gear, install the countershaft rear bearing, and locate with the snap ring.

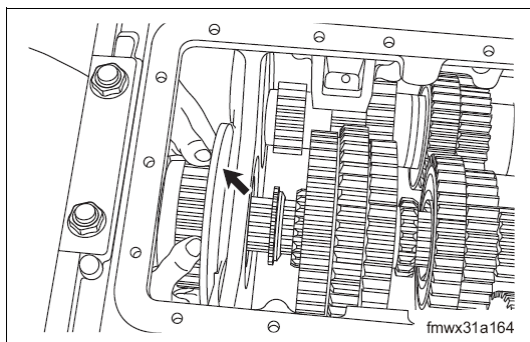


- (c). Install the snap ring on the primary shaft bearing.



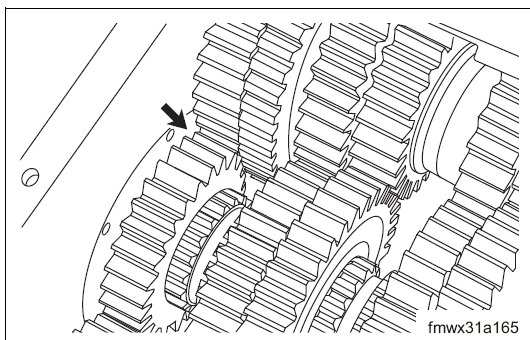
11. Install the countershaft front bearing

- (a). Install the countershaft front bearing.



12. Install the main shaft assembly

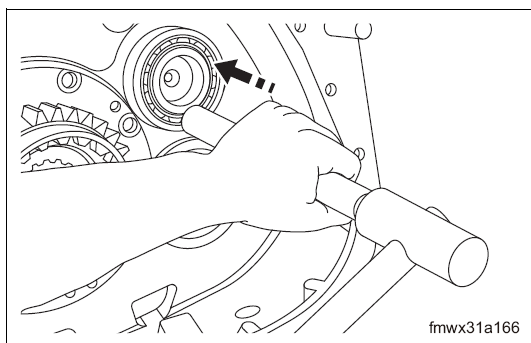
- (a). Apply lubricating grease in the inner hole of the primary shaft.
- (b). Put the main shaft assembly into the main box, and locate its rear end by the driving gear.



- (c). Insert the marked tooth of the right countershaft into the marked groove of the primary shaft gear.

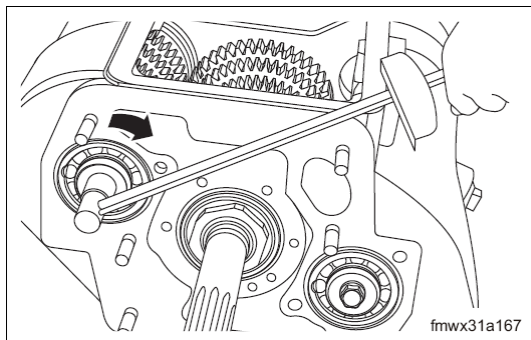
Transmission (9JS135) - Transmission Main Box

31B



13. Install the bearing at the rear end of the countershaft

- (a). Install the bearing at the rear end of the countershaft, and locate by the snap ring.



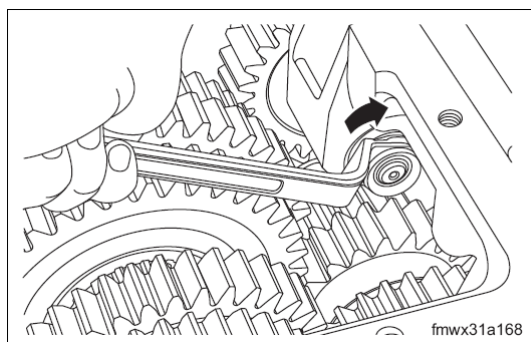
14. Install the bearing at the front end of the countershaft

- (a). Install the bearing at the front end of the countershaft, and assemble the countershaft pressure plate.

Torque: **142±20Nm**

Caution:

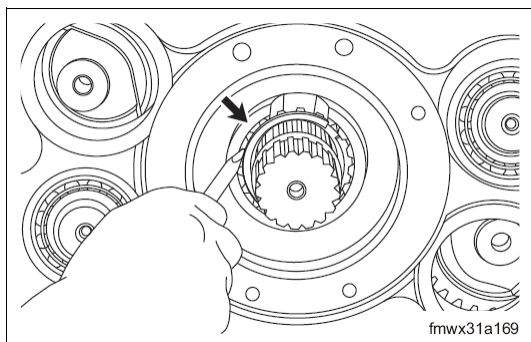
The pressure plate bolt shall be coated with anaerobic adhesive.



15. Install the left reverse intermediate gear assembly

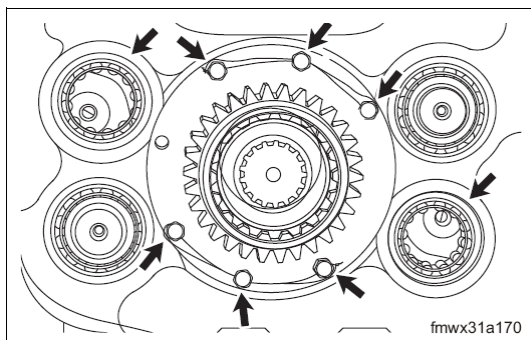
- (a). Install the left reverse intermediate gear assembly, and fasten the self-locking nut.

Torque: **74.5±6.5N.m**



16. Install the reverse gear snap ring

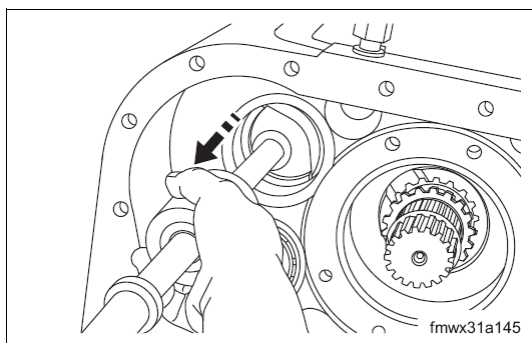
- (a). Mesh the reverse gear of the main shaft with the reverse intermediate gear, and install the reverse gear snap ring.



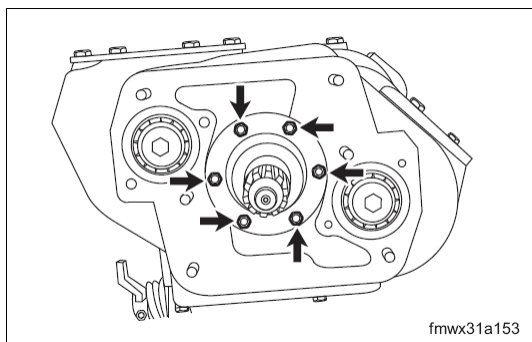
17. Install the driving gear assembly and bearings

- (a). Install the driving gear assembly and two bolts.
(b). Tighten the six bolts.

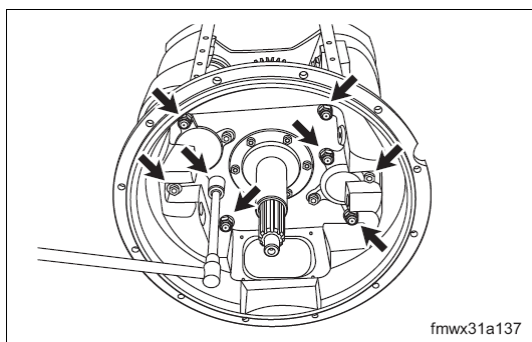
Torque: **54±7N.m**



18. Install the countershaft brake assembly
(a). Install the countershaft brake assembly.
Torque: **54±7N.m**



19. **Install the primary shaft bearing cap**
(a). Install the primary shaft bearing cap, and tighten the bolts.
Torque: **54±7N.m**

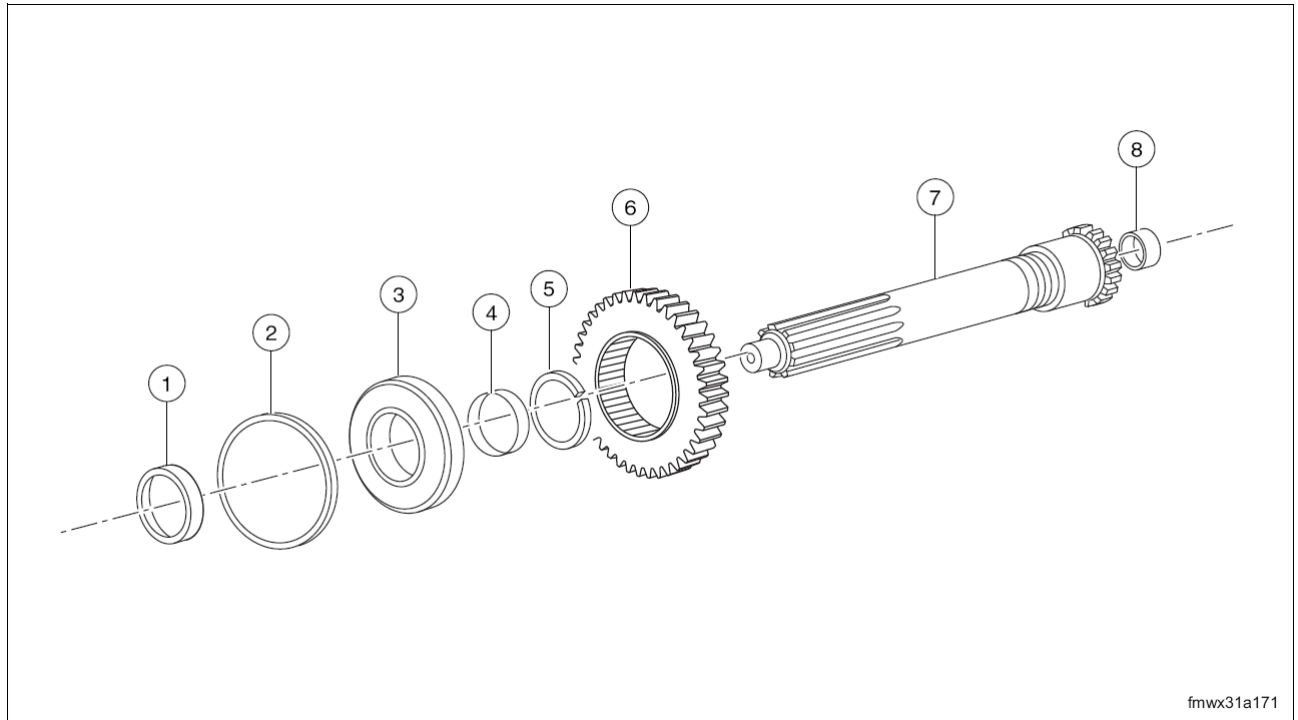


20. **Install the clutch housing assembly**
(a). Install the clutch housing assembly, and tighten the bolts.
M16 Torque: **257.5±13.5N.m**
M12 Torque: **121.5±13.5N.m**

21. **Install the transmission upper cover. Refer to Chapter 31B Transmission 9JS135–Transmission Upper Cover, Disassembly and Assembly.**

Primary Shaft Assembly

Part Drawing



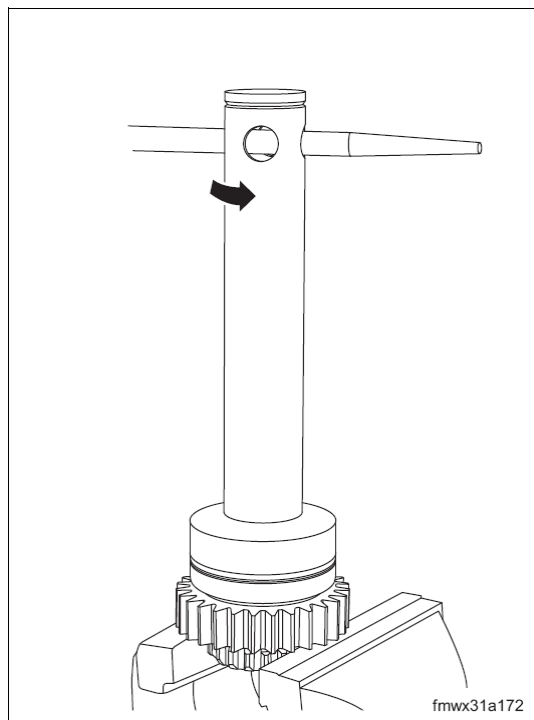
1	Primary Shaft Nut
2	(Bearing) Snap Ring
3	Single-row Centripetal Bearing with Snap Ring Groove and Dust Cover on One Side (φ60*φ110*22)
4	Gear Spacer

5	Snap Ring
6	Primary Shaft Gear
7	Primary Shaft
8	Main Shaft Guide Sleeve

Disassembly and Assembly

1. Disassemble the primary shaft

31B

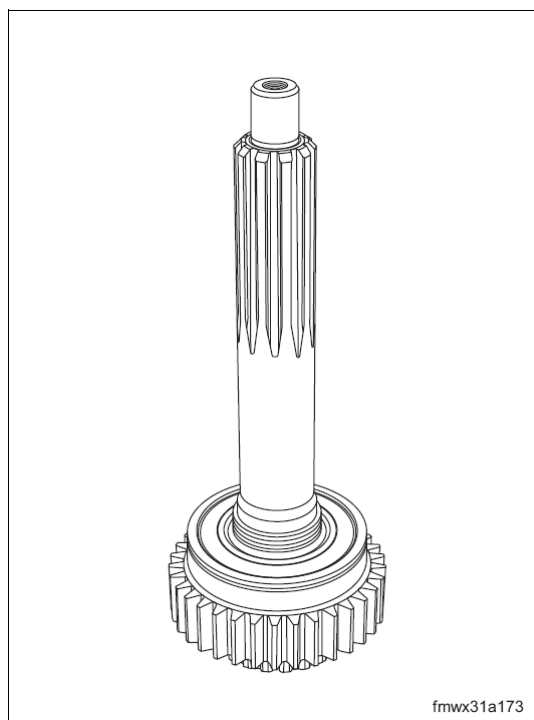


(a). Clamp the primary shaft by a bench vice.

Caution:

Wrap the primary shaft with rags well, and be careful to damage the primary shaft by clamping.

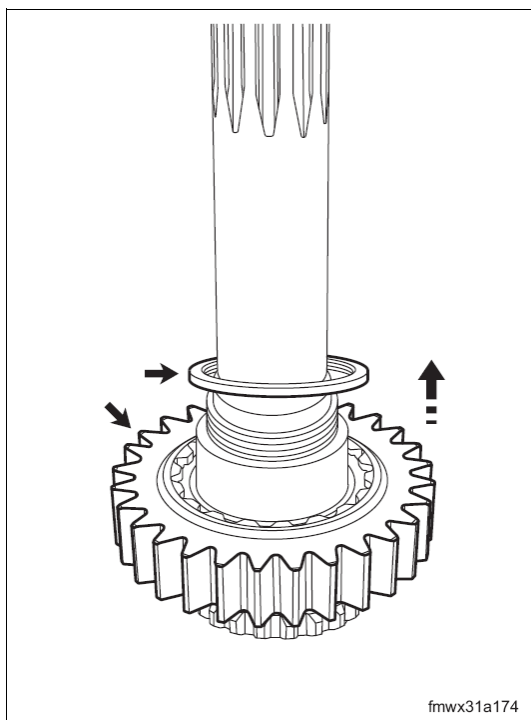
(b). Dismantle the primary shaft nut by a special tool.



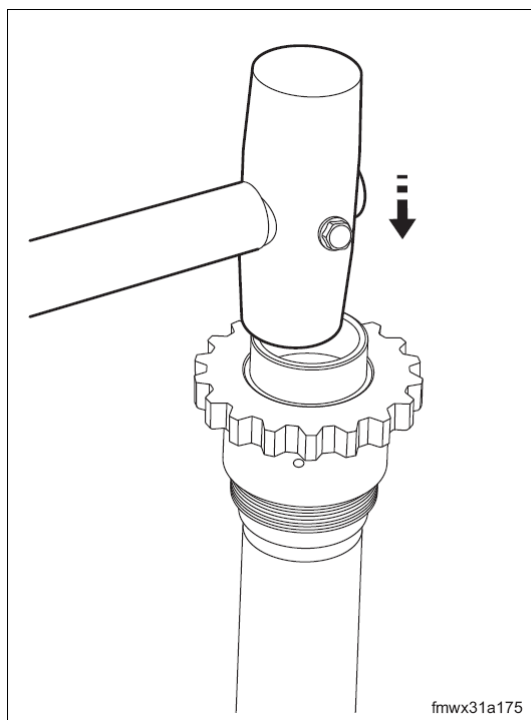
(c). Dismantle the primary shaft bearing by a puller.

Transmission (9JS135) - Primary Shaft Assembly

31B

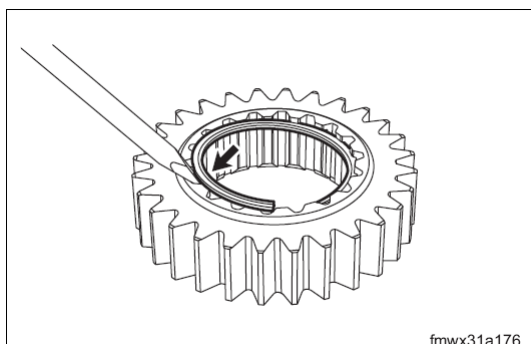


- (d). Take out the primary shaft gear spacer and primary shaft gear in order.



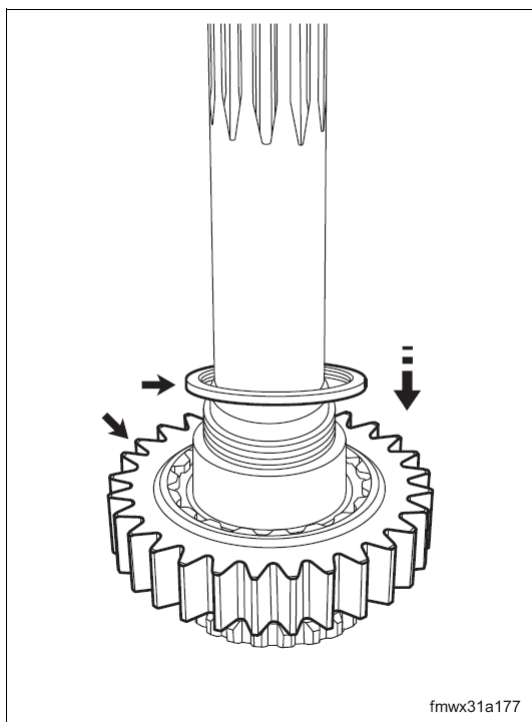
2. Install the primary shaft assembly

- (a). Install the main shaft guide sleeve into the inner hole of the primary shaft.

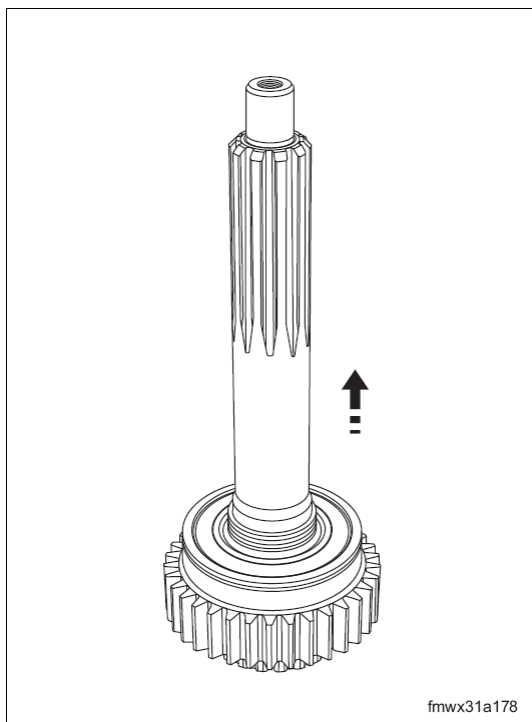


- (b). Put the snap ring in.

31B



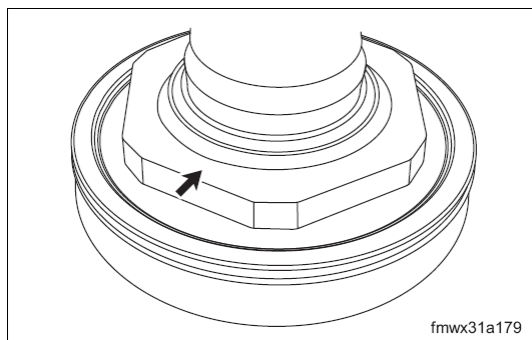
- (c). Install the primary shaft gear and primary shaft gear spacer on the primary shaft by turning in order.



- (d). Install the primary shaft bearing.

Caution:

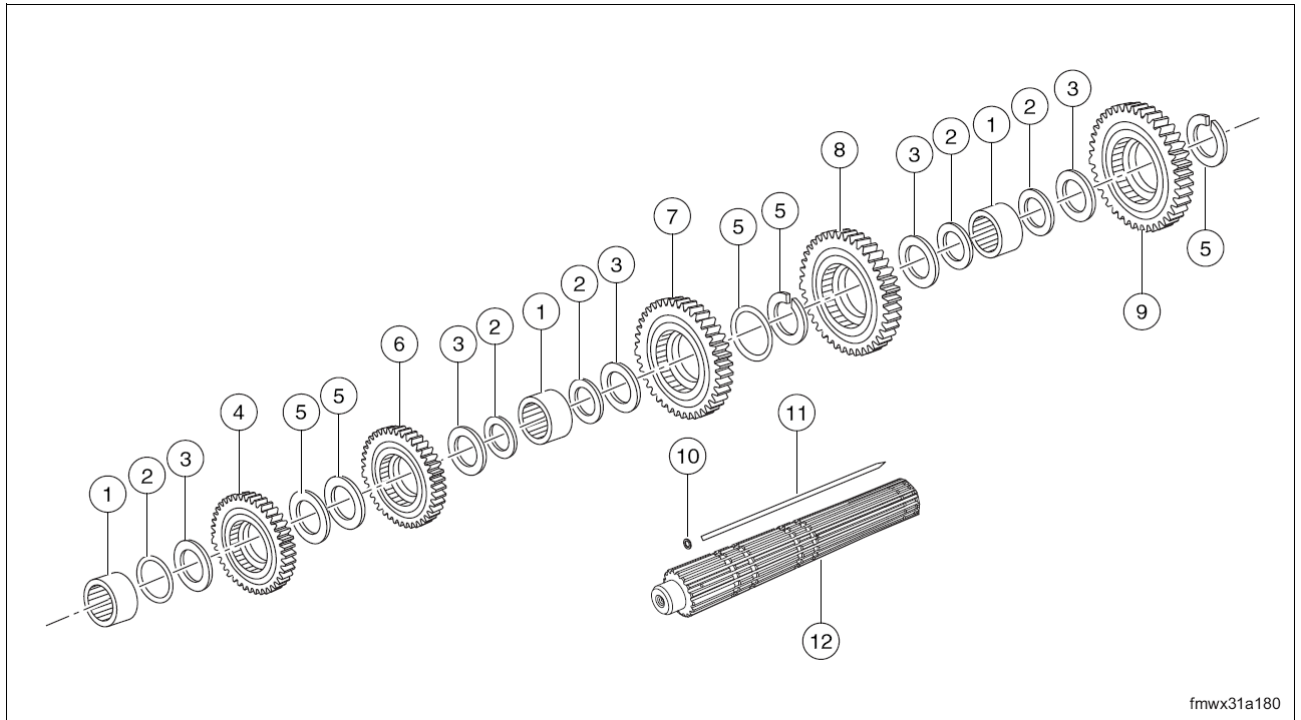
The oil baffle disc side faces up.



- (e). Tighten the primary shaft nut, and rivet,
Torque: **372±34N.m**

Main Shaft Assembly

Part Drawing



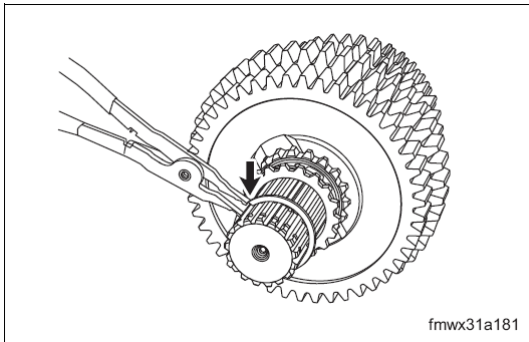
1	Main Shaft Sliding Sleeve
2	Adjusting Gasket, Main Shaft Gear
3	Gasket, Main Shaft Gear Spline
4	Main Shaft 3 rd Gear
5	Snap Ring
6	Main Shaft 2 nd Gear

7	Main shaft 1 st gear
8	Main Shaft Low Gear
9	Main Shaft Reverse Gear
10	Elastic Cylindrical Pin (Pin 3*10)
11	Main Shaft Hex Key
12	Main Shaft

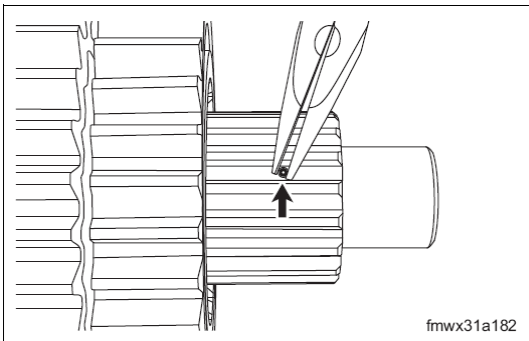
Disassembly and Assembly

1. Disassemble the main shaft assembly

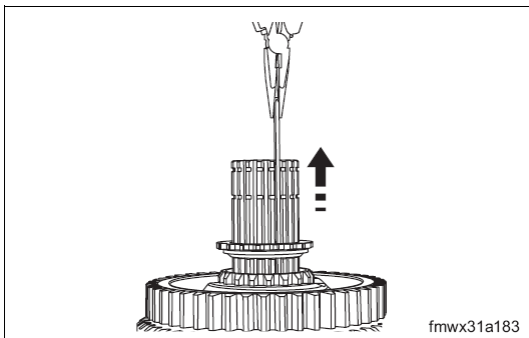
31B



- (a). Dismantle the snap ring at the rear end of the main shaft, and remove the spline gasket and main shaft reverse gear in order.

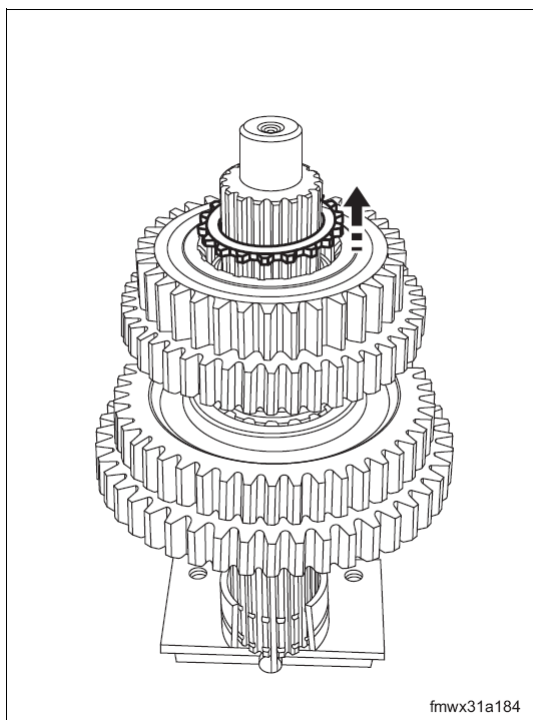


- (b). Pull out the elastic pin on the main shaft.



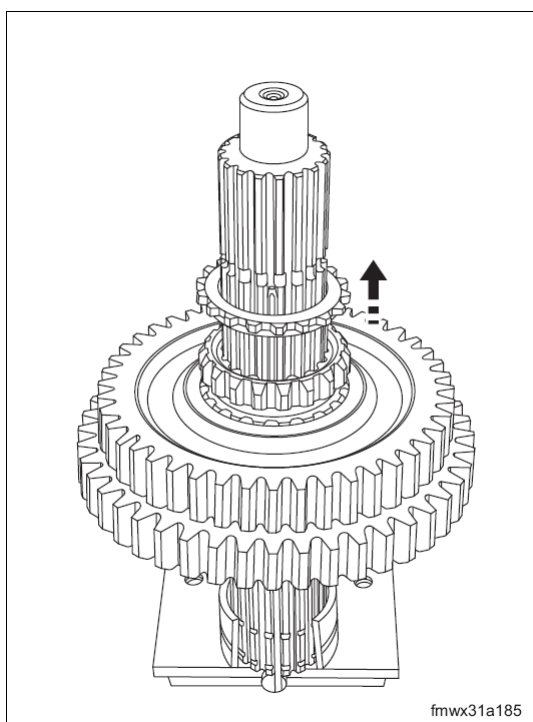
- (c). Extract out the long key.

Transmission (9JS135) - Main Shaft Assembly



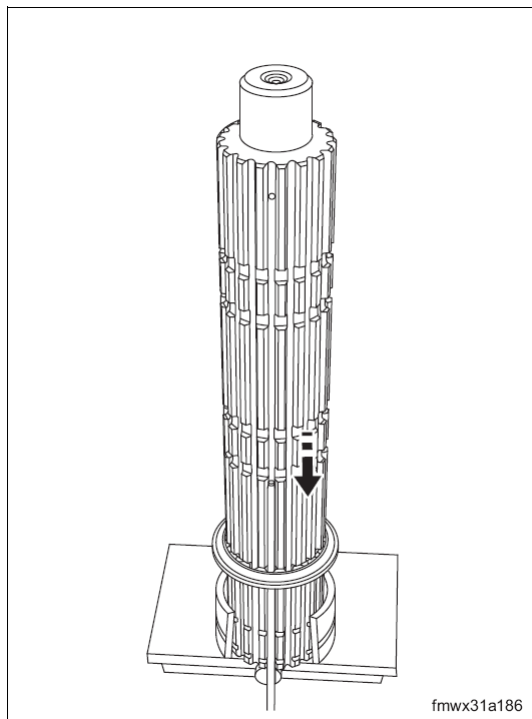
- (d). Dismantle the main shaft sliding sleeve, adjusting gasket, spline gasket and main shaft 3rd gear.
- (e). Dismantle the main shaft 2nd gear.

31B



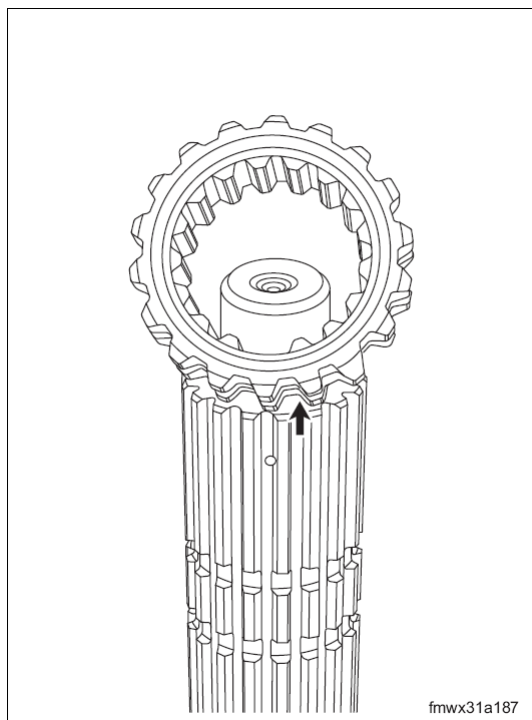
- (f). Dismantle the spline gasket, gear adjusting gasket, sliding sleeve and main shaft 1st gear.
- (g). Dismantle the main shaft low gear.

31B



2. Assemble the main shaft assembly

- (a). Place the main shaft vertically in the installation tool, install the adjusting gasket on the main shaft with the convex side facing up, and insert the long key after turning a tooth pitch.

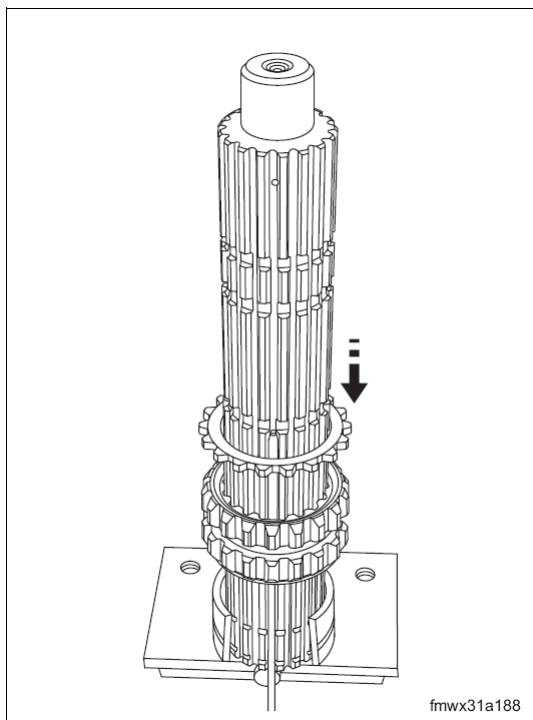


- (b). Install the low/reverse gear sliding sleeve.

Hint:

The three sliding sleeves on the main shaft can be interchangeable, and the part without teeth faces the groove with hole on the main shaft.

Transmission (9JS135) - Main Shaft Assembly

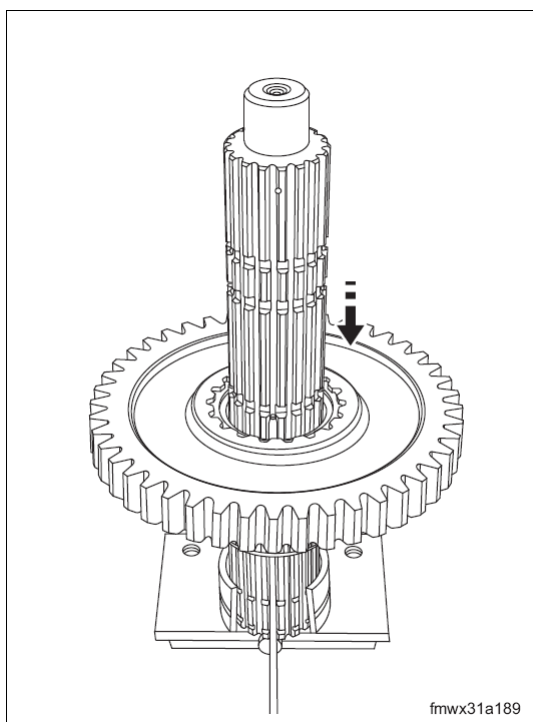


- (c). Install one adjusting gasket with the convex side facing down, push the long key after turning one tooth pitch, and put one spline gasket in.

Caution:

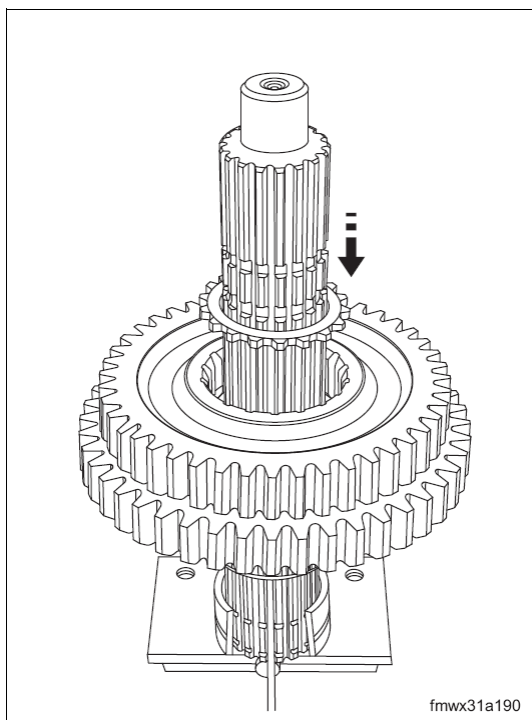
The spline gaskets are interchangeable because they have the same thickness, while the adjusting gaskets have various thicknesses. The adjusting gaskets need to be selected.

31B

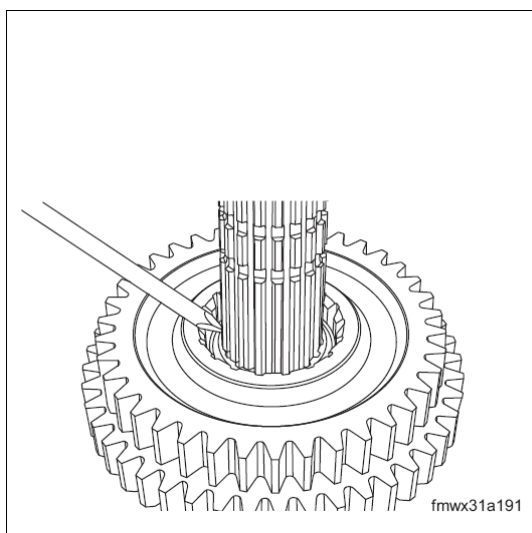


- (d). Install the engaging ring gear of the main shaft low gear downward on the main shaft.

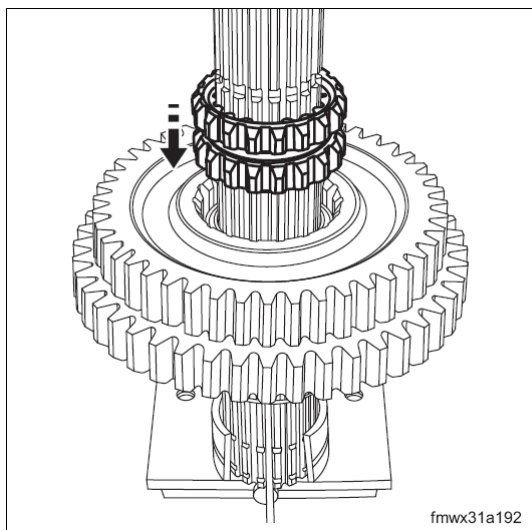
31B



- (e). Install the engaging ring gear of the main shaft 1st gear upward on the main shaft, and install one spline gasket.



- (f). Install one adjusting gasket with the convex side facing up, and push the long key after turning one angle.

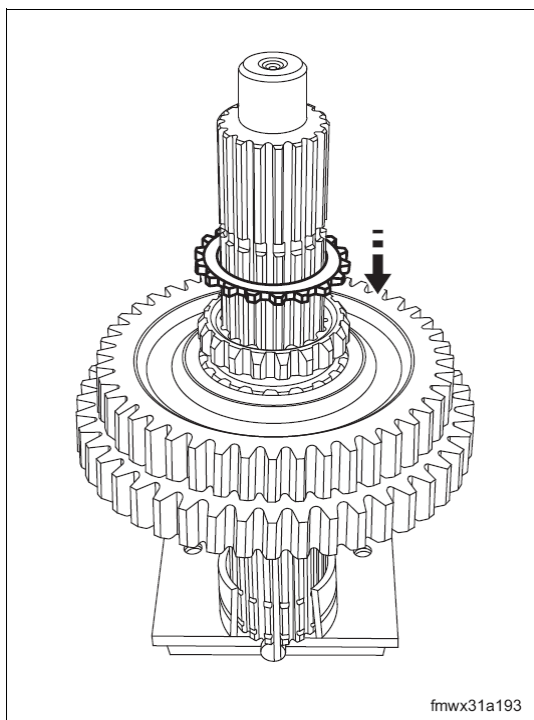


- (g). Install the 1st/2nd gear sliding sleeve.

Caution:

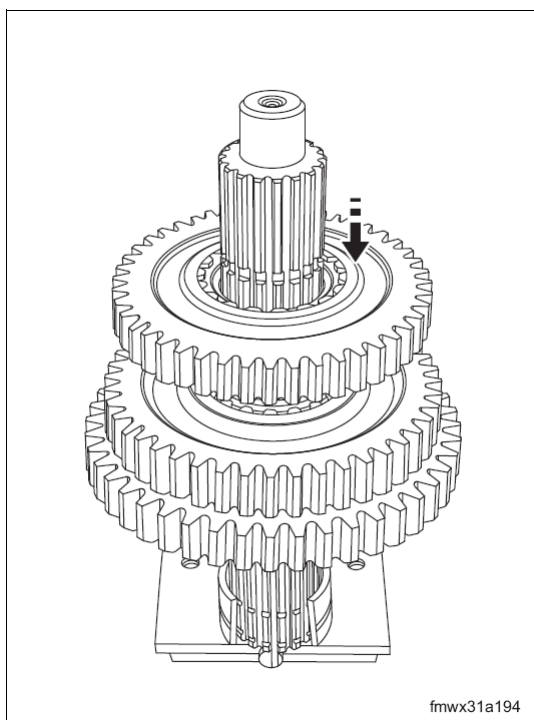
The part without teeth faces the groove with hole on the main shaft.

Transmission (9JS135) - Main Shaft Assembly



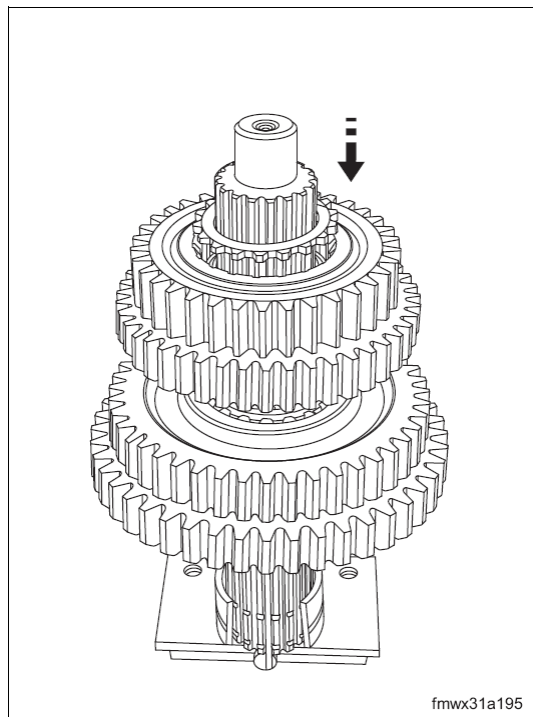
- (h). Install one adjusting gasket with the convex side facing down, push the long key after turning one tooth pitch, and put one spline gasket in.

31B

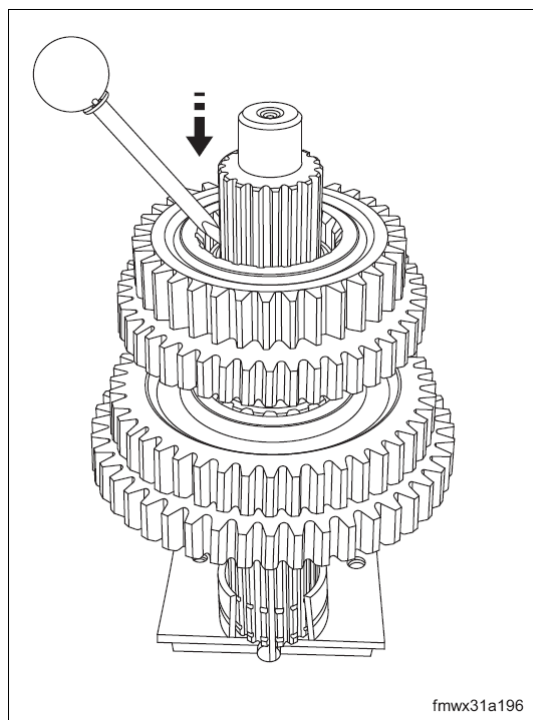


- (i). Install the engaging ring gear of the main shaft 2nd gear downward on the main shaft.

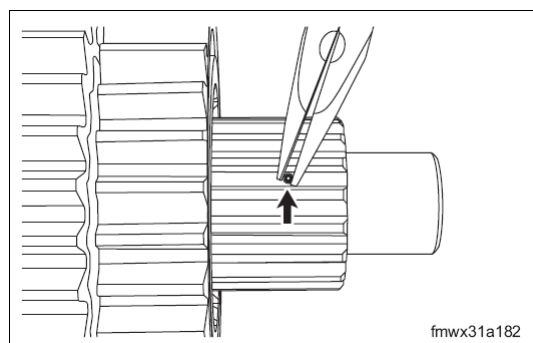
31B



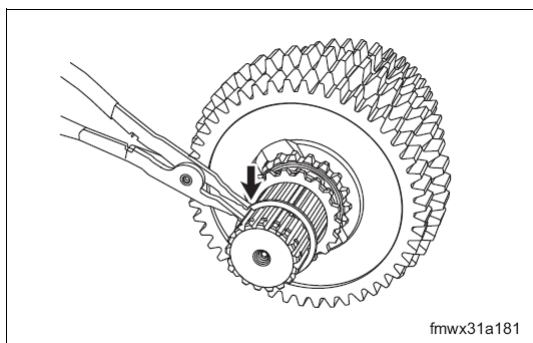
- (j). Install the engaging ring gear of the main shaft 3rd gear upward on the main shaft, and install one spline gasket.



- (k). Install one adjusting gasket with the convex side facing up, and push the long key after turning one angle.



- (l). Beat the elastic pin in the small hole on the main shaft, and install the 3rd/4th gear sliding sleeve.

Transmission (9JS135) - Main Shaft Assembly

- (m). Beat the elastic pin in the small hole on the main shaft, and install the 3rd/4th gear sliding sleeve. Place the main shaft flat, install the main shaft reverse gear and spline gasket, and install one snap ring at the rear end of the main shaft.

Caution:

When assembling the shaft, it is necessary to choose the gaskets of different thicknesses to adjust the gear clearance. The thickness and color of the gasket are shown in the following table:

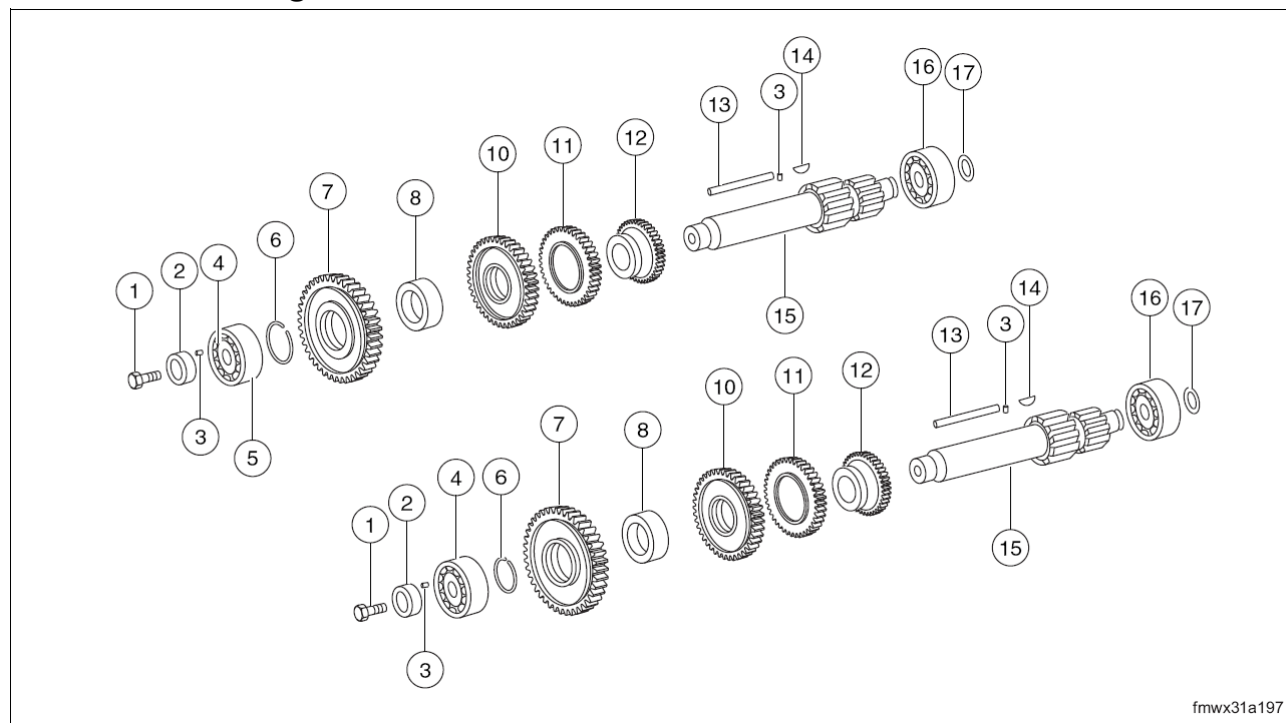
Thickness Range (mm)	Color
6.30~6.35	White
6.45~6.48	Green
6.55~6.60	Orange
6.68~6.73	Purplish Red
6.80~6.86	Yellow
6.93~6.99	Black

31B

Countershaft Assembly

Part Drawing

31B



fmwx31a197

1	Small Hex Head Bolt (M16*1.5*45)
2	Countershaft Bearing Baffle Plate
3	Elastic Cylindrical Pin (Pin 5*14)
4	Single-row Centripetal Ball Bearing
5	Snap Ring
6	Countershaft Snap Ring
7	Countershaft Snap Ring
8	Spacer (LH Countershaft Assembly)
9	Friction Gear (RH Countershaft Assembly)

10	Countershaft 3 rd Gear
11	Countershaft 2 nd gear
12	Countershaft 1 st Gear
13	Countershaft Square Key
14	Woodruff Key
15	Countershaft
16	Bearing
17	Snap Ring

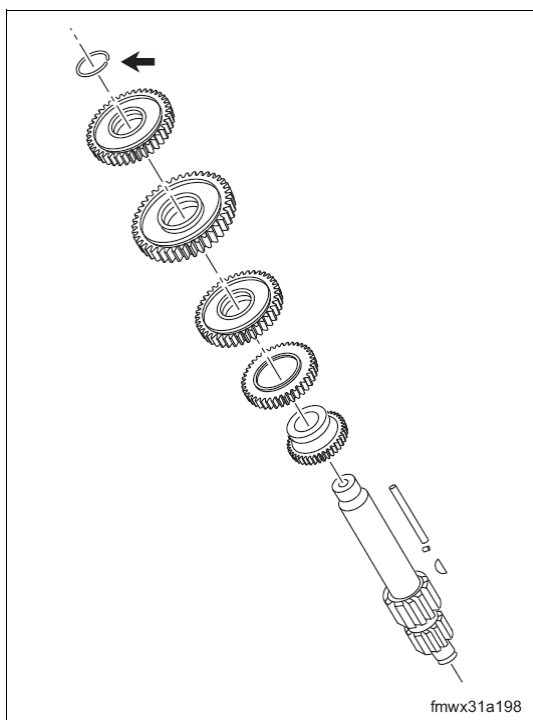
Transmission (9JS135) - Countershaft Assembly

Disassembly and Assembly

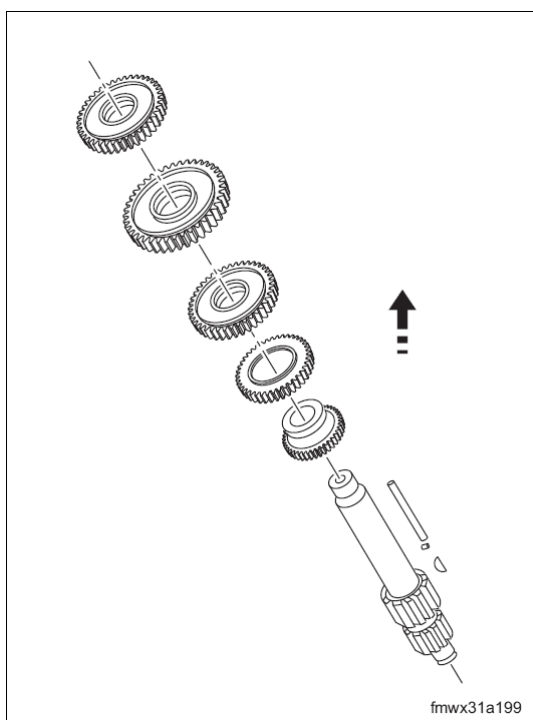
Hint:

The countershaft shall not be dismantled under general conditions except serious wear, tooth hit, etc.

1. Disassemble the right countershaft

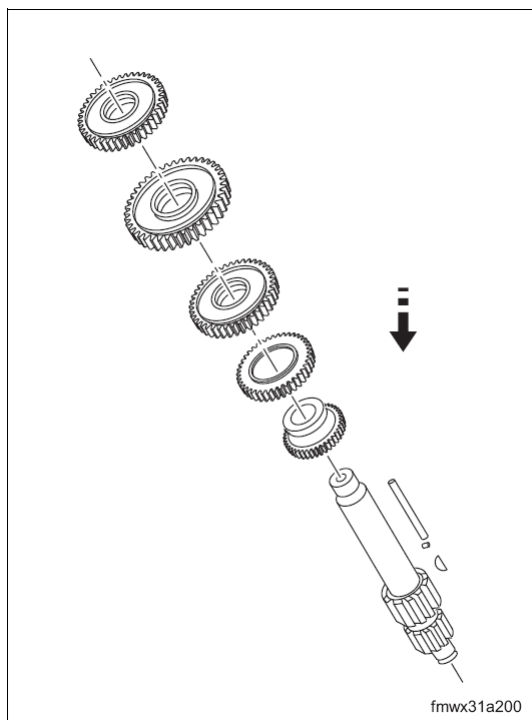


(a). Dismantle the countershaft snap ring.

31B

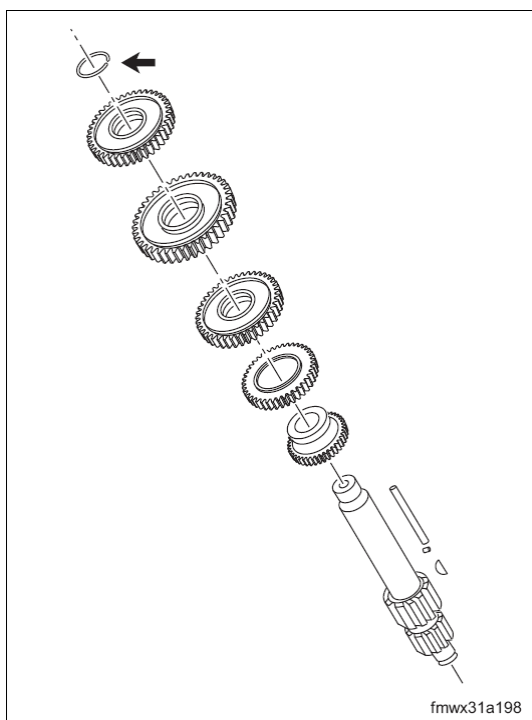
(b). Dismantle the countershaft drive gear, friction gear, countershaft 3rd gear, countershaft 2nd gear, countershaft 1st gear, countershaft square key and woodruff key in order.

31B



2. Assemble the right countershaft

- (a). Install the woodruff key, countershaft square key, countershaft 1st gear, countershaft 2nd gear, countershaft 3rd gear, friction gear, countershaft drive gear on the countershaft in order.



- (b). Install the countershaft snap ring.

Hint:

Refer to the disassembly and assembly of the right countershaft for the disassembly and assembly of the left countershaft. The difference of the two countershafts lies in that: at the position where the friction gear is arranged on the right countershaft, a spacer is installed on the left countershaft. Except this, their other positions are basically the same.

Transmission (12JSD160)

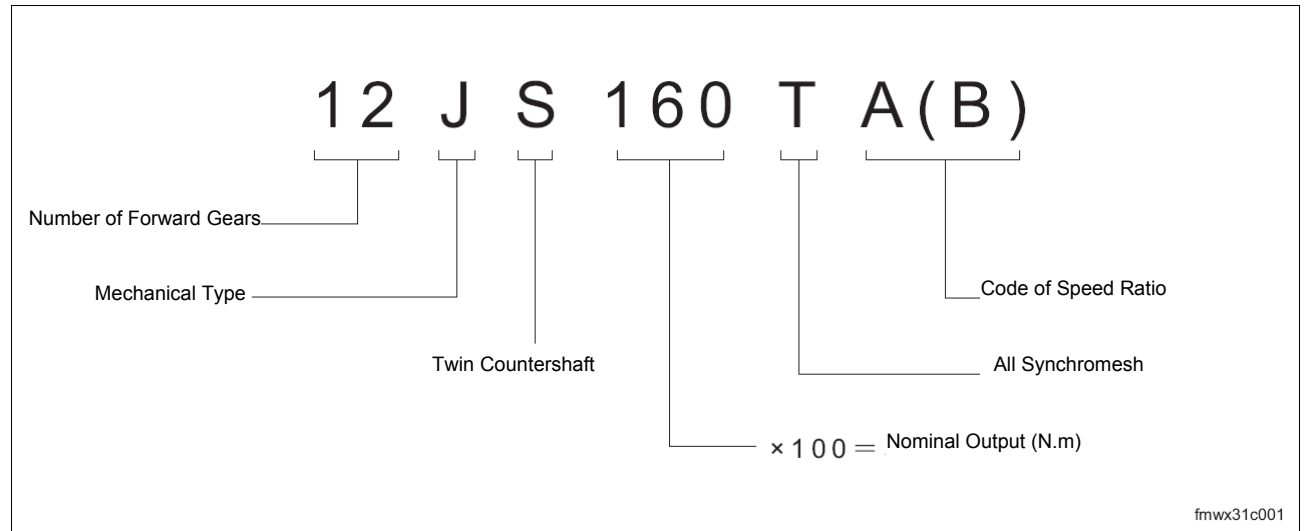
Transmission	31C-3
General	31C-3
Precautions	31C-4
Transmission Structure and Principle	31C-8
Fault Symptom Table	31C-21
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Disassembly and Assembly	31C-57
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Part Drawing	31C-78
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Disassembly and Assembly	31C-92

Transmission

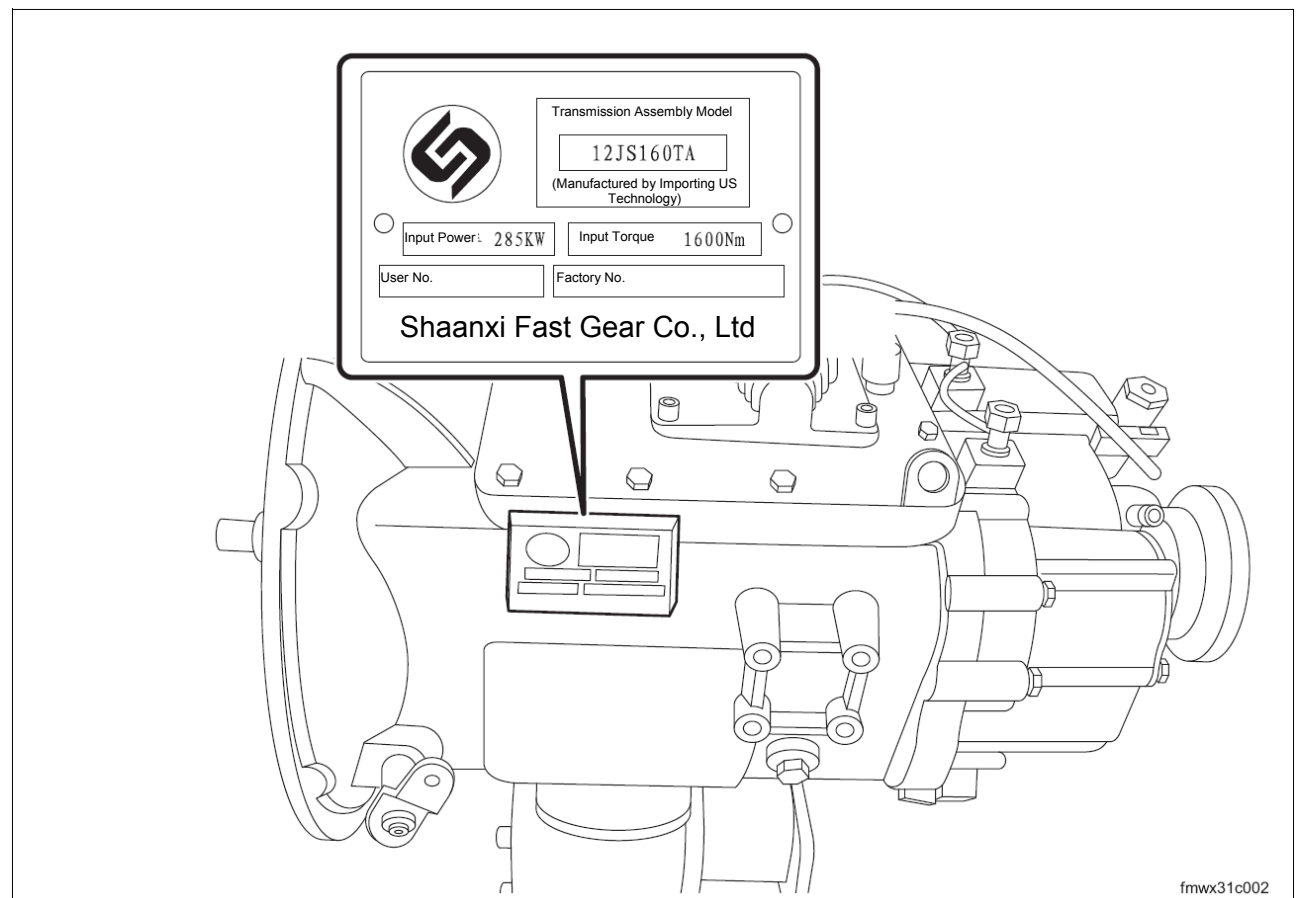
General

The Fast twin countershaft transmission is mainly characterized in that a countershaft is added on the symmetrical axis of the countershaft of the common transmission, and becomes a transmission which has two countershafts. Power can be transmitted symmetrically due to one additional countershaft, so as to gain the advantages of stable transmission and low noise.

Meaning of Transmission Model:



Transmission Nameplate



Precautions

I. Precaution for Use of Transmission

It is very important to correctly and reasonably operate and use the transmission, and do regular maintenance on the transmission for ensuring that the vehicle runs safely and reliably and prolonging the service life of the transmission.

1. **Release the parking brake before the vehicle takes off. For the vehicle with air cut-off brake, after switching on the brake valve, put into gear and take off until the air pressure rises to the pressure required for releasing the brake.**
2. **Take off at the 3rd or 4th gear according to the road condition.**
3. **When the gear shift lever is in the high gear area, the neutral position is between the 9th and 10th gears; when the gear shift lever is in the low gear area, the neutral position is between the 3rd and 4th gears. When the vehicle is stopped, the transmission shall be shifted in the neutral position of the low gear area; in other words, the change-over switch on the control lever is in the low position.**
4. **During gear shift, the clutch must be released fully, or the service life of the main box synchronizer will be affected, and the gear shift lever shall put into gear in position.**
5. **When putting the vehicle into reverse gear, stop the vehicle and then put into gear to avoid the inside parts of the transmission. When putting into reverse gear, apply strong gear selecting force to overcome the resistance from the reverse gear lock.**
6. **When shifting into the 7th gear from the 6th gear (or vice versa), be aware of stopping for a while, which is good for the auxiliary transmission to finish shifting between the high gear area and low gear area. Before leaving the vehicle in gear, push the control lever into the target range first, and then shift between gear areas.**
7. **Do not jump gears when shifting the transmission to the high gear area from the low gear area (or vice versa), or the service life of the auxiliary box synchronizer will be affected.**
8. **Inspect the breather plug usually, and clean away immediately if there is dirt clogging the plug.**
9. **Inspect the air filter screen every 20,000km, wash the screen and the inner wall of the filter with soap water, and dry with compressed air.**
10. **When the vehicle is running down on a slope, shifting between the high gear area and low gear area shall be avoided as much as possible.**
11. **Once detecting the abnormal phenomena that there is abnormal noise in the transmission, the operation gets obviously heavy, etc. in use, stop the vehicle immediately for inspection, and continue to drive after eliminating the fault.**
12. **When operating the power take-off, make sure to comply with the operation regulation strictly, or the auxiliary box synchronizer may be damaged quickly.**
13. **Dismantlement and installation of the transmission within the "three guarantees" period are not allowed without authorization.**

Warning:

1. **The gear jumping operation is prohibited when the transmission is shifted to a high gear from a low gear or to a low gear from a high gear.**
2. **It is prohibited to shift gears when the vehicle is running down on a slope.**
3. **The vehicle is prohibited to slide at neutral gear.**
4. **The driving wheels are prohibited to touch the road when the vehicle is towed.**
5. **Once detecting the abnormal phenomena that there is abnormal noise in the transmission, the operation gets obviously heavy, etc. in use, stop the vehicle immediately for inspection, and continue to drive after eliminating the fault.**

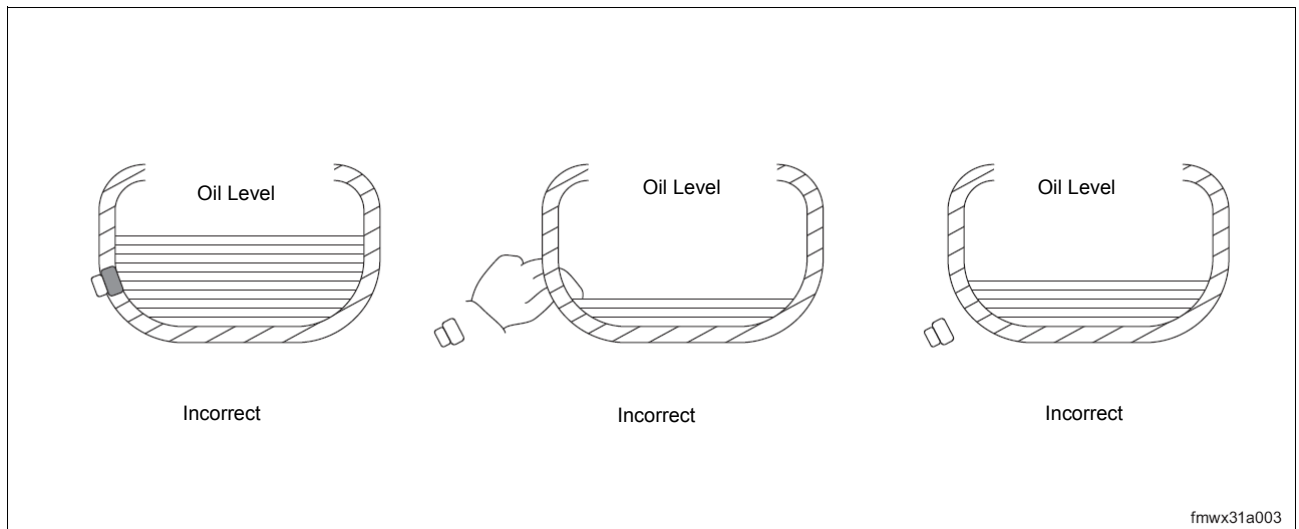
II. Precautions for Maintenance of Transmission

When it reaches the specified maintenance interval, conduct all previous maintenance and inspection items specified in the maintenance regulations.

1. Daily Inspection

1-1 Inspection on lubricating oil level

Inspect the lubricating oil level and leakage of the transmission every day, and fill lubricating oil in time, and repair the leaks if any immediately to prevent the transmission fault caused by loss of lubricating oil.

Transmission (12JSD160) - Transmission

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1-2 Pneumatic System

- 1) Discharge the water in the pneumatic system of the vehicle every day.
- 2) Hear whether there is air leakage every day, and repair if necessary.
- 3) Confirm whether the air dryer operates normally, and repair if necessary. Overhaul the air compressor of the vehicle according to the requirement to prevent lubricating oil from going into the pneumatic system.

2. 2,000-5,000 km for New Transmission

- 2-1 Replace lubricating oil;
- 2-2 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 2-3 Lubricate the release bearing;
- 2-4 Lubricate the clutch fork shaft;
- 2-5 Clean the air filter element;
- 2-6 Inspect and clean the transmission breather holes;
- 2-7 Inspect whether the transmission control mechanism operates normally.

3. Every 10,000km or 2 months

- 3-1 Inspect whether the fixing bolts and fasteners of the transmission are loose or lost, particularly the bolts fixing the transmission to the engine;
- 3-2 Lubricate the release bearing;
- 3-3 Lubricate the clutch fork shaft;
- 3-4 Clean the air filter element;
- 3-5 Inspect and clean the transmission breather holes;
- 3-6 Inspect whether the transmission control mechanism operates normally.

4. Oil Replacement

- 4-1 It is very important for the maintenance of the transmission to choose correct lubricating oil, and you must comply with the specified maintenance procedures as follows:
 - 1) Purchase lubricating oil from recognized suppliers;

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Transmission (12JSD160) - Transmission

- 2) Use the correct type and grade of lubricating oil. Brand of lubricating oil: 85W-90 GL5;
- 3) Replace lubricating oil according to the appropriate oil replacement interval;
- 4) Keep the lubricating oil level correct.
- 4-2 The replacement period of lubricating oil shall not exceed the intervals listed in the following table.

Road Service Condition	Off-road Service Condition	Severe Service Condition
One year (at most) or 50,000 km	Every 1,000h	Every 500h

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Transmission (12JSD160) - Transmission

Caution:

The severe service condition refers to the conditions that require parts to operate continuously under high load condition, in heavily polluted environment or on a steep slope. Under those service conditions, apply the oil replacement period specified by the severe service condition.

III. Precaution for Disassembly of Transmission

1. **Do repair in a clean place to prevent dust or other foreign matters from going into the transmission. Carefully clean the inside and outside of the transmission before dismantlement.**
2. **When dismantling various assemblies, place all parts on a clean workbench in the dismantling order, which is convenient for the steps of re-installation and reduces the possibility of part loss.**
3. **Dismantle the countershaft, main shaft and primary shaft gear, and it is unnecessary to dismantle the primary shaft.**
4. **Bearing – When dismantling it, use special tools. Clean carefully, and inspect whether there is pitting on its raceway, and whether its rolling element is good.**

IV. Precautions for Assembly of Transmission:

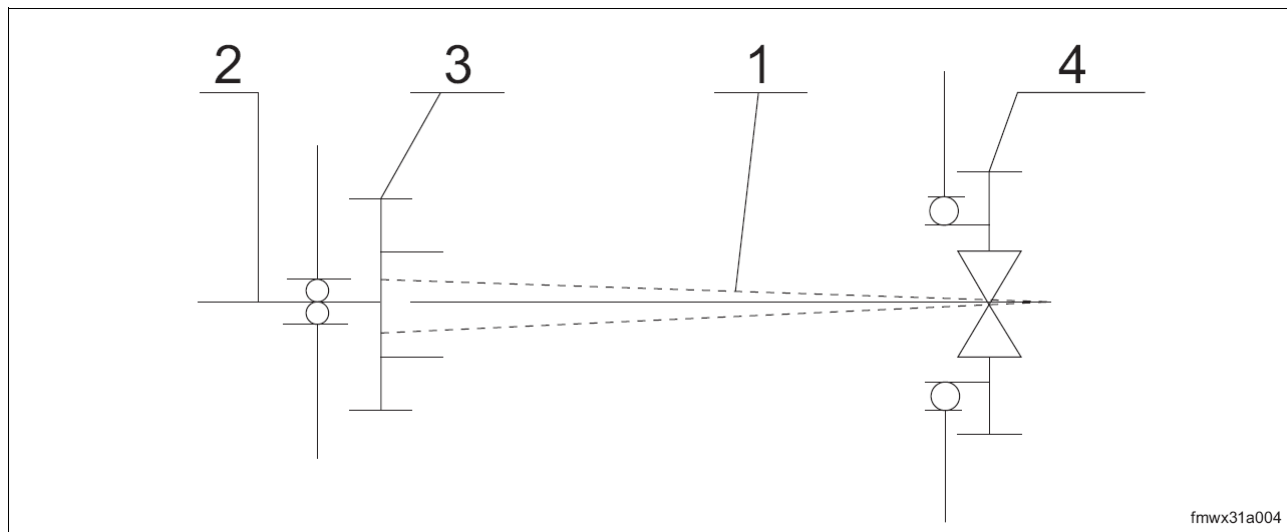
Before assembly, make sure to fully clean the parts to be assembled so as to prevent dust and foreign matters from going into the transmission, or unnecessary damages will be caused.

1. **Gasket – When re-assembling the transmission, use new gaskets.**
2. **Bolt – In order to prevent leaking oil, apply screw sealant to all bolts, and tighten according to the standard torque.**
3. **O-ring – Lubricate all O-rings with silicone grease lubricant.**
4. **Initial lubrication – During assembly, coat all thrust washers with lubricating grease for initial lubrication, which can prevent scratching or wear.**
5. **Tighten the output shaft flange nuts, and tighten the output nuts with a torque of 610~680N.m, or it will cause serious consequences.**

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Transmission Structure and Principle

I. Twin Countershaft Floating Structure



1	Main Shaft
2	Input Shaft

3	Input Shaft Gear
4	Auxiliary Box Driving Gear

Both the main and auxiliary transmissions of the 12-gear all synchromesh transmission adopt two countershafts which have the same structure and are spaced by 180°. Power is input from the input shaft, split on the two countershafts, then gathered on the main shaft and then output. The auxiliary transmission is the same.

Each countershaft only transmits 1/2 of the torque in theory, so by using the twin countershafts, the center distance of the transmission decreases, the gear thins, the axial size shortens, and the quality lightens. After using twin countershafts, the gears on the main shaft must be meshed with two countershaft gears simultaneously.

In order to meet correct meshing and distribute the load equally as much as possible, the main shaft gears are in floating state on the main shaft, and the main shaft is of an articulated floating structure. The main shaft journal is inserted into the hole of the input shaft, the oil-containing guide bushing is pressed into the hole, and the enough radial clearance is left between the main shaft journal and oil-contain guide bushing. The rear end of the main shaft is inserted into the driving gear hole of the auxiliary transmission through the involute spline, and the driving gear journal of the auxiliary transmission is supported on the ball bearing.

As the gears on the main shaft float on the main shaft, the traditional needle beatings are cancelled, which makes the structure of the main shaft assembly simpler. During operation, the radial forces applied to the main shaft gears by the two countershaft gears are equal but opposite in direction, and they are offset mutually, which makes the main shaft only bear torque without bending moment, improves the stress condition of the main shaft and bearing, and greatly enhances the reliability and durability of the transmission.

II. Power Transmitting Line

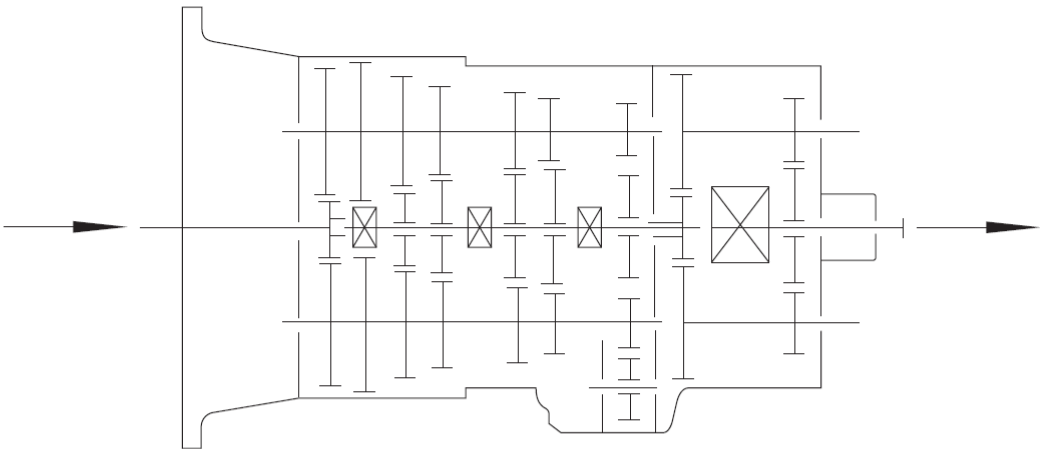
Knowing the engine power transmitting line of the specific gears of the transmission is helpful for the technical personnel to overhaul and maintain the transmission. It is usually considered that the Fast transmission is an integral device composed of two separate transmissions. The first transmission (or called transmission front box) consists of six gear pairs which are controlled by the gear shift lever. The second transmission is called auxiliary box, which realizes the shifting of the range gears through two gear pairs which are controlled by air pressure.

Hint:

This transmission is a constant mesh transmission. Although only part of gears transmits power during operation, all gears rotate.

Transmission (12JSD160) - Transmission

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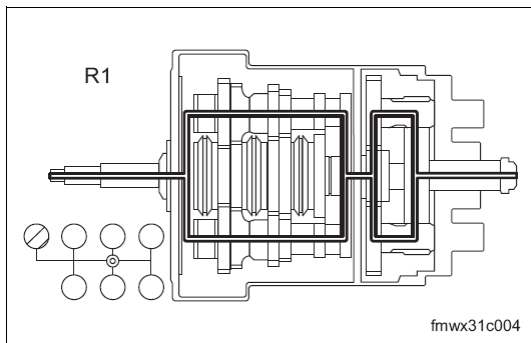


Gear			
12JS160TA	12JS160T		
12JS180TA	12JS180T		
12JS200TA	12JS200T		
1	1		
2	2		
3	3		
4	4		
6	5		
5	6		
7	7		
8	8		
9	9		
10	10		
12	11		
11	12		
Reverse 1 (R)	Reverse 1 (R)		
Reverse 2 (R)	Reverse 2 (R)		

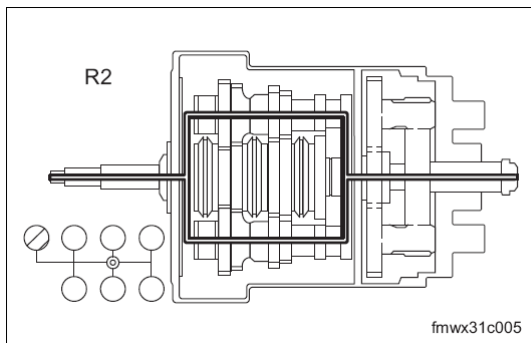
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1. Power Transmitting Line of Main Box

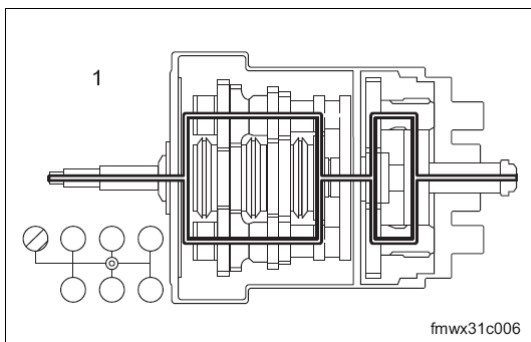
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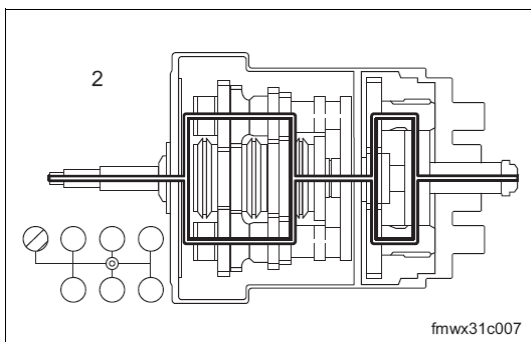
(a). Reverse 1 transmitting line.



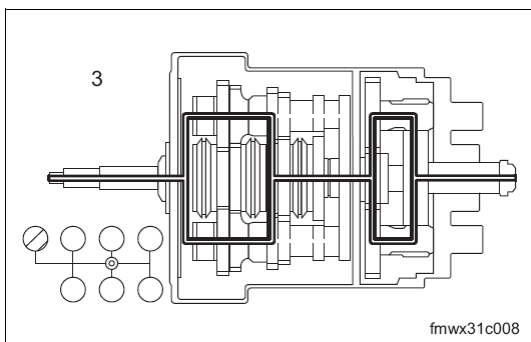
(b). Reverse 2 transmitting line.



(c). Gear 1 transmitting line.

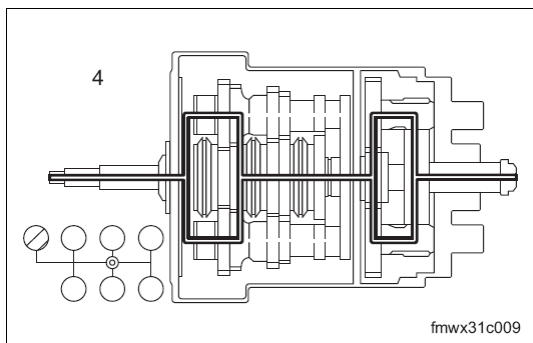


(d). Gear 2 transmitting line.

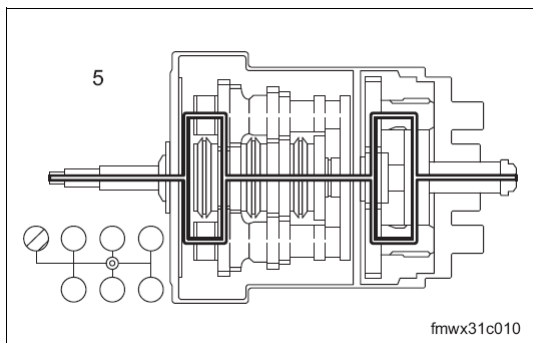


(e). Gear 3 transmitting line.

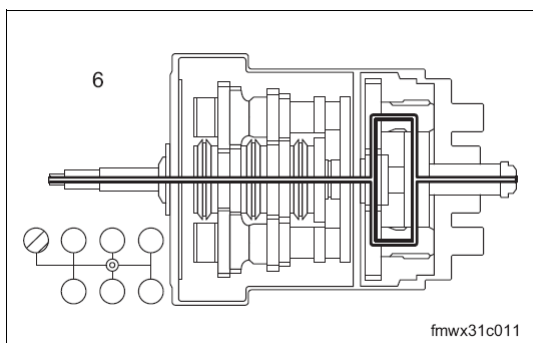
Transmission (12JSD160) - Transmission



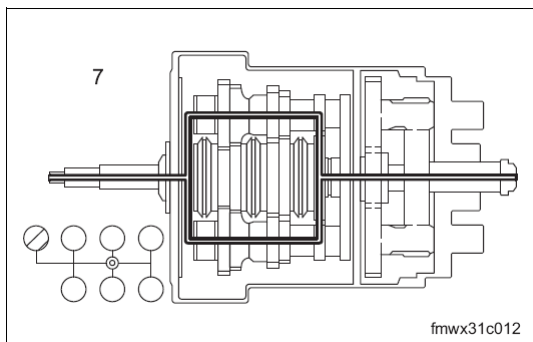
(f). Gear 4 transmitting line.



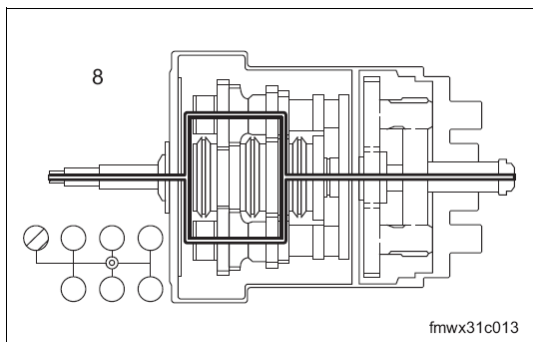
(g). Gear 5 transmitting line.



(h). Gear 6 transmitting line.

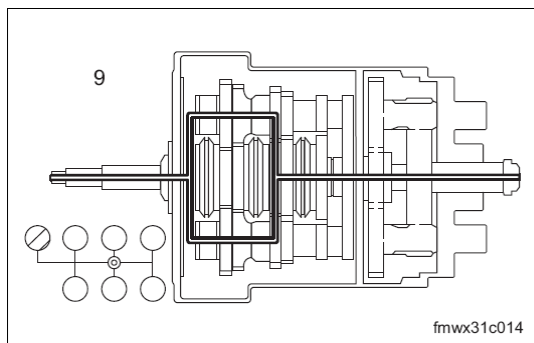


(i). Gear 7 transmitting line.

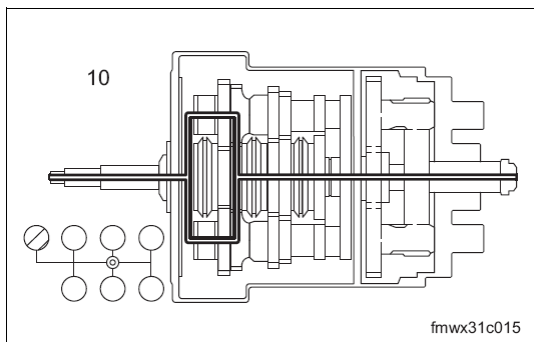


(j). Gear 8 transmitting line.

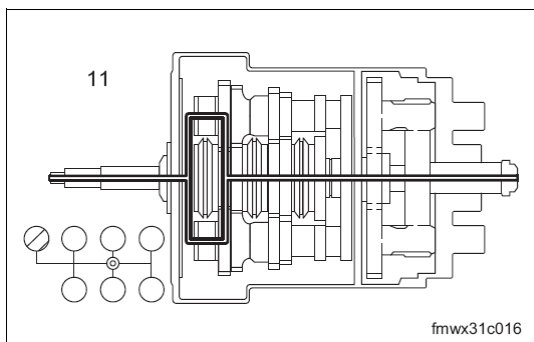
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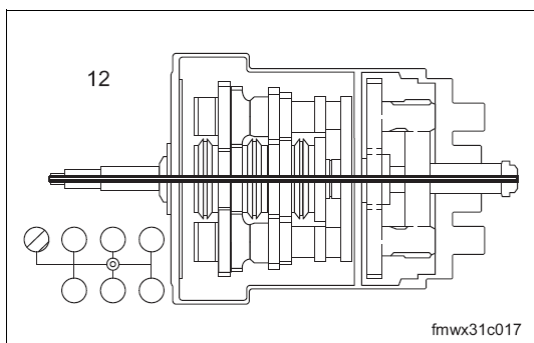
(k). Gear 9 transmitting line.



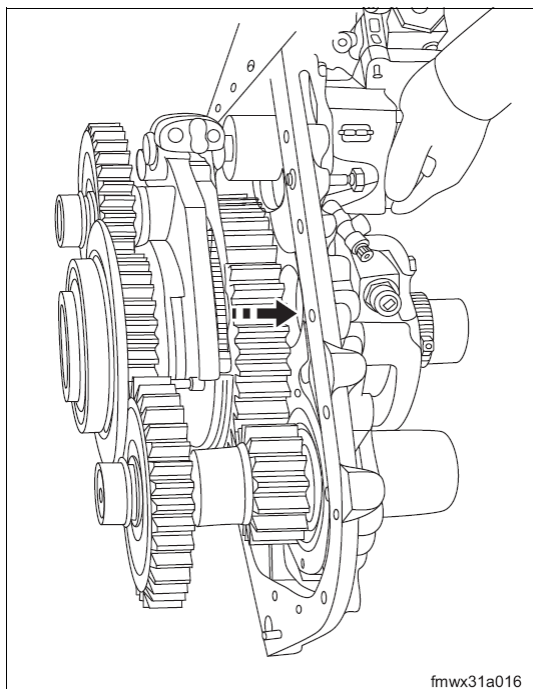
(l). Gear 10 transmitting line.



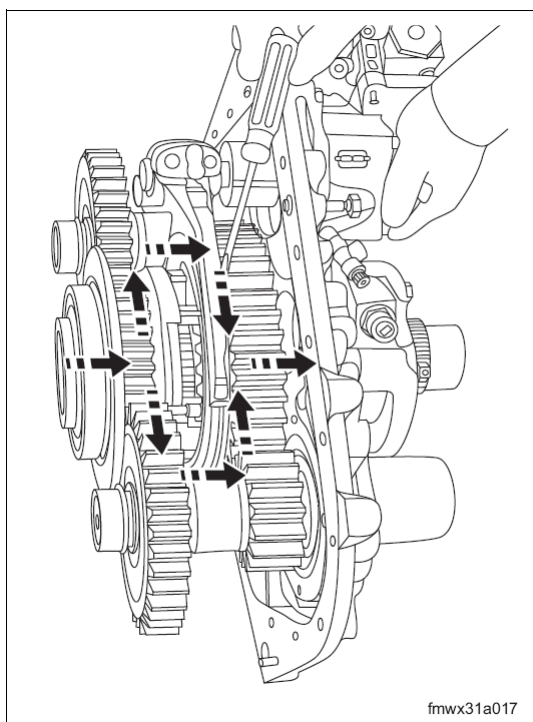
(m). Gear 11 transmitting line.



(n). Gear 12 transmitting line.

Transmission (12JSD160) - Transmission

2. Power Transmitting Line of Auxiliary Box
(a). High gears.



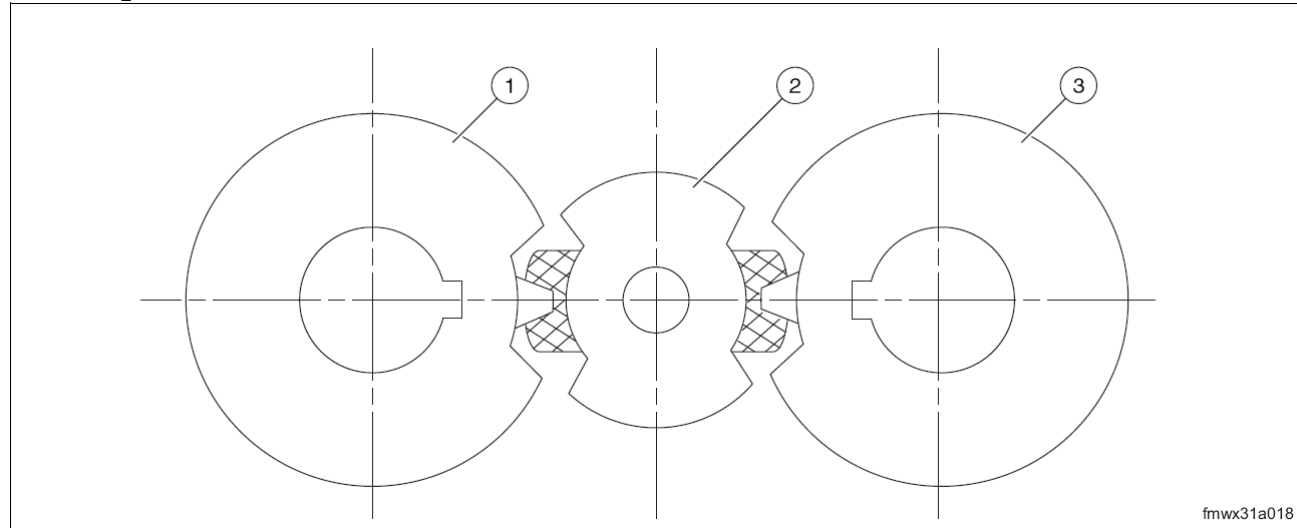
- (b). Low gears.

III. Teeth Alignment and Tooth Alignment Process

To ensure correct mesh of the countershaft gear and the main shaft gear, you must align tooth.

- (1) First, mark any two adjacent teeth of the input shaft gear, and then mark the other side symmetrical to the gear. (The numbers of teeth between two groups of marks shall be equal.)
- (2) Mark a tooth over against a gear keyway on each countershaft driver gear.
- (3) When installing, respectively mesh the marked teeth on two countershaft drive gears into two teeth marked at the left and right sides of the input shaft gear.
- (4) When installing the auxiliary transmission, align the teeth of the reduction gear and the countershaft pinion of the auxiliary box.

Tooth Alignment Process:



1	LH Countershaft Gear
2	Primary Shaft Gear

3	RH Countershaft Gear
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Teeth Alignment for Main Box

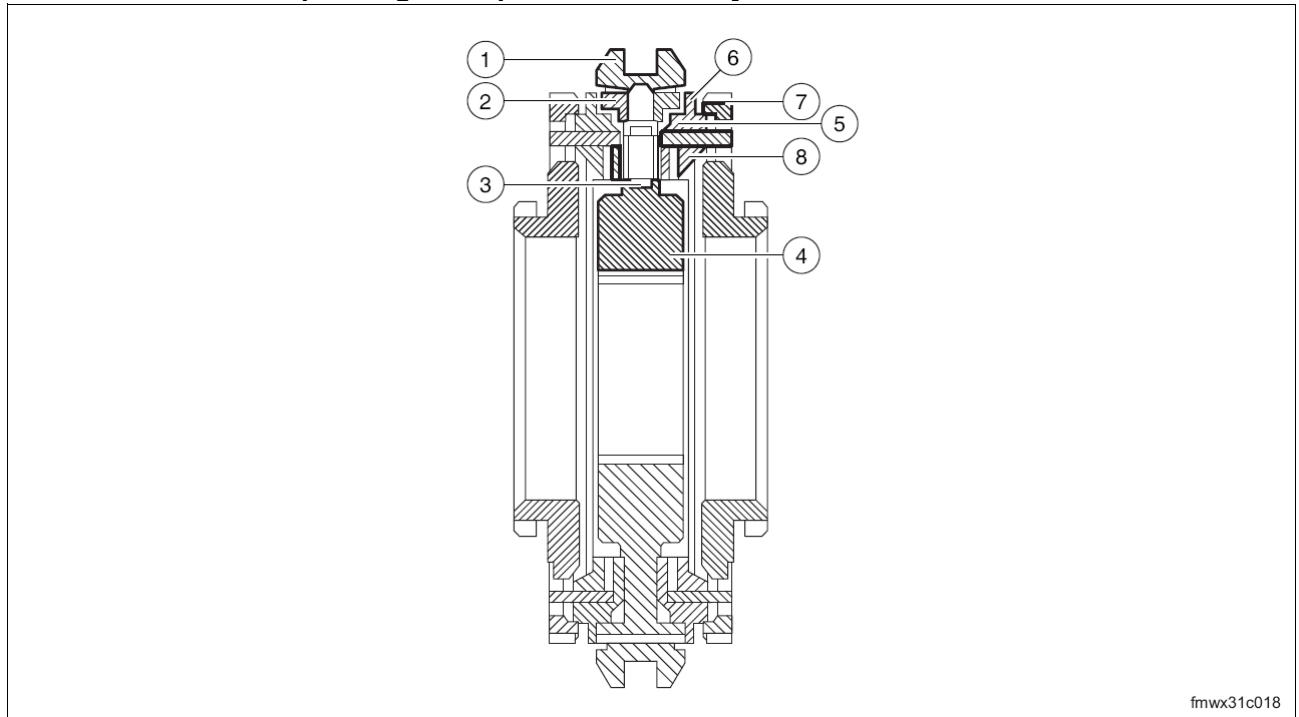
- First, coat mark paint on any two adjacent teeth of the primary shaft gear, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.
- Respectively coat mark paint on the toplands of the external teeth over against the inner bore keyway of two constant mesh gears of the countershaft, and this mark is unique.
- When installing, respectively insert the marked gear teeth of the two constant mesh gears of the countershaft into the marked tooth grooves of the primary shaft gear. If installed correctly, the primary shaft rotates flexibly, and inspect whether the teeth aligning marks are correct if the primary shaft can not be rotated or can be rotated heavily.

Teeth Alignment for Auxiliary Box

- First, coat mark paint on any two adjacent teeth of the reduction gear of the auxiliary box, and then make the same marks on two adjacent teeth at the other side in an opposite direction of 180°. The numbers of teeth between two groups of marks shall be equal.
- Coat mark paint on the topland with an O mark on the gear shaft of the countershaft of the auxiliary box, and this mark is unique.
- When installing, respectively insert the marked teeth of two auxiliary box countershaft gears into the marked tooth grooves of the auxiliary box reduction gear. When installing the auxiliary transmission assembly in the main box, inspect through the teeth aligning marks and assemble after confirmation.
- When installing the main box, inspect the teeth aligning marks and assemble after confirmation.

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IV. Structure and Operating Principle of Main Box Synchronizer



fmwx31c018

1	Synchronizer Gear Sleeve
2	Limiting Block
3	Spring
4	Synchronizer Gear Hub

5	Synchronizer Outer Cone
6	Synchronizer Double Cone
7	Synchronizer Conjunction Gear
8	Synchronizer Inner Cone

The synchronizer in the transmission of the vehicle enables the gear shift of the transmission to be simple and quick without impact and noise, and can prolong the service life of the gear, increase the acceleration performance of the vehicle and save fuel, so the synchronizer is installed on most of the gear positions except the reverse gear of the transmission. It is required that the synchronizer has large torque capacity, stable performance and duration, and the inertia synchronizer can ensure mesh gear shift of the synchronizer and has stable and reliable performance. The inertia synchronizer is divided into an inertia locking type and an inertia reinforcement type, and the most widely used is the synchronizer of the inertia locking types such as lock ring type, lock pin type, etc.

The lock ring synchronizer is widely used at present due to its compact structure, high performance, reliable operation and low cost. The deficiency of the lock ring synchronizer is that the friction torque of the synchronizer is a little small. The double-cone lock ring synchronizer is a new synchronizer device developed and designed on a basis that the working principle and the structural arrangement are basically similar to that of the lock ring synchronizer. It inherits the advantages of the lock ring synchronizer and repairs the defects of the lock ring synchronizer in increasing the friction torque of the synchronizer.

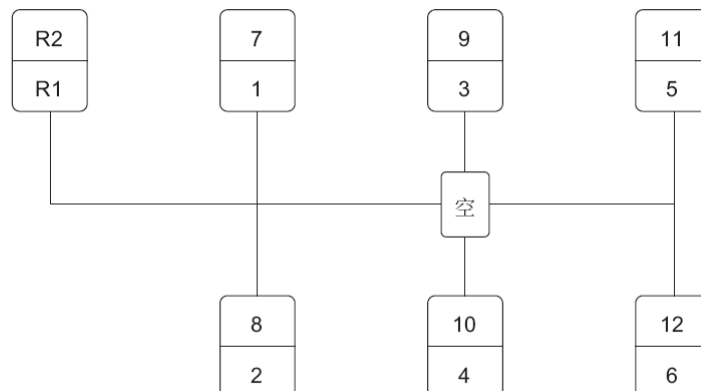
The drawing above is the 5th-6th gear synchronizers, the 5th and 6th gear synchronizers are all double-cone synchronizers, the gear sleeve, gear hub, sliding block, spring, etc. of the synchronizer are shared by the 5th and the 6th gears, and each gear has three (5, 6, 8) conical parts. 6 single keys arranged on the combining outer cone (5) of the synchronizer are connected with 6 keyways on the inner cone (8) of the synchronizer, so the outer cone (5) and the inner cone (8) rotate together with the main shaft of the transmission. While 6 lugs on the synchro cone (6) are in joint with 6 holes on the combining rings (7), so the cone (6) rotates together with the 5th gear. Thus, when the transmission rises from the 4th gear to the 5th gear or decreases from the 6th gear to the 5th gear, relative angle speed difference is generated between the 5th gear and the main shaft. At this time, two pairs of sliding friction cones in the cone structure of the 5th gear synchronizer start up. So under the condition of same overall sizes, the synchronous friction torque generated on the cone of friction by the axial thrust applied to the gear sleeve of the synchronizer is equal to the sum of friction torque applied between the two pairs of cones,

i.e. the synchronous friction torque generated when changing to the 5th gear is about twice of that of the single-cone synchronizer, thereby decreasing the gear shift force by about 50%.

The working process is as follows: when engaging a gear, a sliding sleeve drives the sliding block to push the outer cone to move; because the synchronizer has a clearance after installation, the stressed outer cone pushes the cone; the cone pushes the conjunction gear ring to keep the conjunction gear ring close to the gear; the friction torque generated by the speed difference enables the outer cone to rotate an angle relative to the sliding sleeve and the sliding block and be positioned by the sliding block; at this time, the gear sleeve moves under the gear shift force; the locking edged surface of the gear sleeve is fit with the locking edged surface of the external spline of the outer cone; the gear shift force further compresses the outer cone through the locking inclined plane; at this time, the cone starts friction, and the shift ring torque which is generated on the locking inclined plane under the action of the gear shift force and compels the outer cone to return is less than the friction torque between the cones, thereby preventing the synchronous front gear engagement. After the friction torque of the cone overcomes the inertial torque of the jointed part, the speed difference and the friction torque disappear. The shift ring torque compels the outer cone to return, the locking inclined plane disconnects, and the sliding sleeve overcomes the spring force of the sliding block and crosses the locking ring to be in synchronous joint with the gear engaging tooth to ensure gear shift without impact.

V. Control Mechanism

The basic control mechanism of a 12-gear full synchronizer series transmission is a single remote control mechanism with compact structure, clear gear position and good hand feeling, wherein R1, 2nd, 3rd, 4th, 5th and 6th gears are in the low gear area, R2, 7th, 8th, 9th, 10th, 11th and 12th gears are in the high gear area, the neutral position of the low gear area is between the 3rd and 4th gears, and the neutral position of the high gear area is between the 9th and 10th gears.



fmwx31c019

The single remote control mechanism mainly comprises a control device housing, an outer gear shift arm, a transverse gear shift lever, a reverse gear on-off control block, a gear shift shifting block, a compression spring, a breather plug, an indicator light switch, a starting pin, etc. Its functions are to complete gear selection and gear engaging and disengaging of the transmission. The outer gear shift arm, the reverse gear on-off control block, the gear shift shifting block, the spring seat, the spring and the snap ring are installed on the transverse gear shift lever, and by controlling the outer gear shift arm, the transverse gear shift lever makes transverse movement and rotation to carry out gear selection and gear engaging and disengaging. A sector boss is arranged at each of two sides of the gear shift shifting block, a groove is arranged on the boss for controlling the neutral indicator light switch and the air circuit control valve, and the reverse gear indicator light switch is controlled by the movement and rotation of the reverse gear on-off control block.

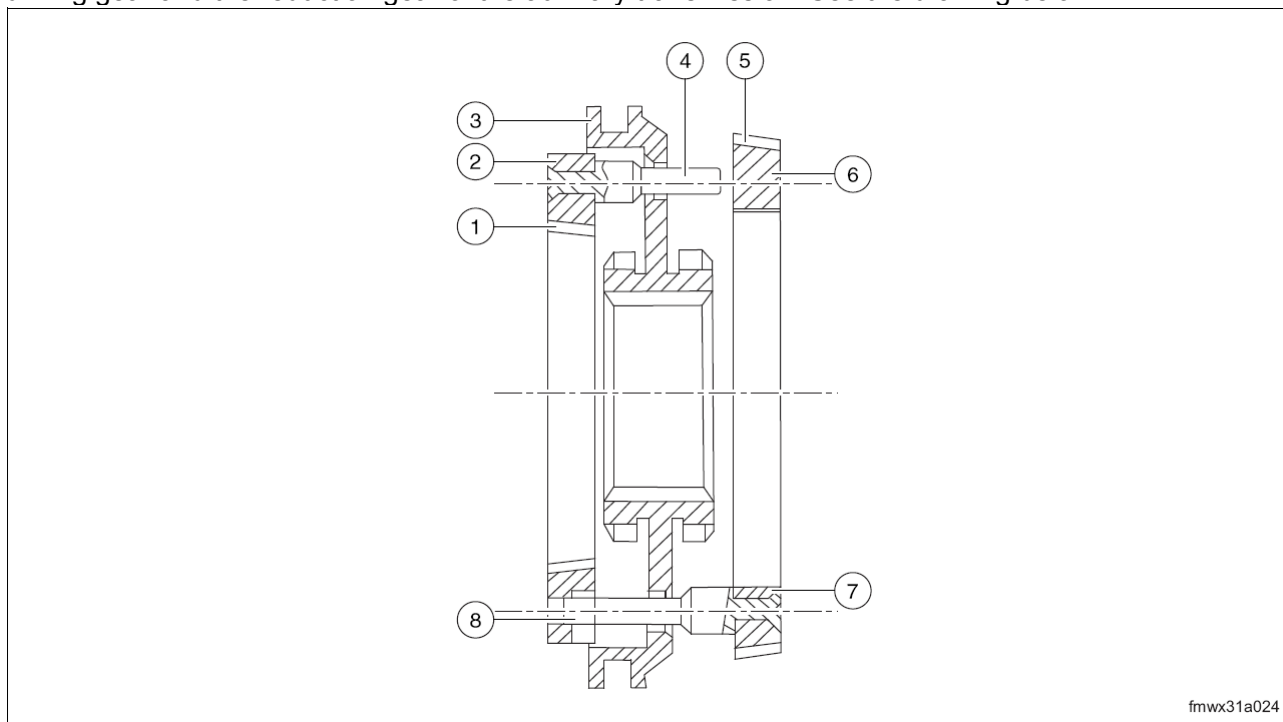
VI. Structure and Operating Principle of Auxiliary Box Synchronizer

A lock pin inertia synchronizer is installed in the auxiliary transmission of the 12JS160TA twin countershaft transmission. The lock pin inertia synchronizer is controlled by the gear shift cylinder of the auxiliary box and only operates during high-low gear shift. The action of the lock pin inertia synchronizer is controlled by the transverse gear shift lever and the single H air valve.

Three lock pins 4 and 7 are respectively riveted on the high-gear synchro ring 2 and the low-gear conical ring 6. The sliding gear sleeve 3 is combined with the output shaft of the auxiliary transmission through a spline. The substrates of the high-gear synchro ring and the low-gear conical ring are made by iron base powder metallurgical sintering, non-metal materials with high frictional property are

Transmission (12JSD160) - Transmission

respectively stuck to the inner cone of the high-gear synchro ring and the outer cone of the low-gear synchro ring, and the corresponding outer cone and inner cone the are respectively arranged on the driving gear and the reduction gear of the auxiliary transmission. See the drawing below:



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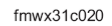
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1	High Gear Friction Belt
2	High Gear Synchro Ring
3	Sliding Gear Sleeve
4	High Gear Lock Pin

5	Low Gear Friction Belt
6	Low Gear Cone Ring
7	Low Gear Lock Pin
8	Spring

VII. Operating Principle of 12-Gear Transmission Air Circuit

Compressed air of 0.7-0.8Mpa from the whole vehicle, after the pressure is adjusted to 0.57-0.6Mpa by an air filter regulator, enters the main air pipe and the control air pipe. When the main box is in the neutral position, the air circuit control valve is open, and then the compressed air enters the air circuit reversing valve. The preselection switch handle selects the low gear, the shifting block of the handle is in a low position, and the air outlet pipe is controlled to be aired to push the air circuit reversing valve to open the low-gear air circuit. The compressed air enters the low-gear air inlet of the gear shift cylinder through the low-gear air pipe; the gear shift cylinder piston drives the sliding sleeve of the synchronizer of the auxiliary box to be combined with the conjunction gear of the reduction gear of the auxiliary box; at this time, all transmissions have low gears, respectively the R1, 2nd, 3rd, 4th, 5th and 6th gears; the preselection switch handle selects the high gear; the position of the handle is in the high position; the air outlet pipe is controlled to be air-free, so the compressed air enters the high-gear air inlet from the high-gear air pipe to the gear shift cylinder of the auxiliary box through the high-gear air outlet of the air circuit reversing valve; the gear shift cylinder piston drives the sliding sleeve of the synchronizer of the auxiliary box to be combined with the conjunction gear of the driving gear of the auxiliary box; and at this time, all transmissions have high gears, respectively R2, 7th, 8th, 9th, 10th, 11th and 12th gears, the neutral position of the low gear area is between the 3rd and 4th gears, and the neutral position of the high gear area is between the 9th and 10th gears.



6	Control Exhaust Pipe
7	High Gear Air pipe
8	Low Gear Air Pipe
9	Air Circuit Control Valve
10	Air Circuit Reversing Valve

1. The air circuit control valve is open only in the neutral position, and when engaging a gear, the air circuit is cut off at the air circuit control valve. That is, high-low gear conversion can be carried out only in the neutral position.
2. Control the air outlet pipe of the air circuit (preselector valve) to be aired at low gear, and control the air outlet pipe of the air circuit (preselector valve) to be air-free at high gear.

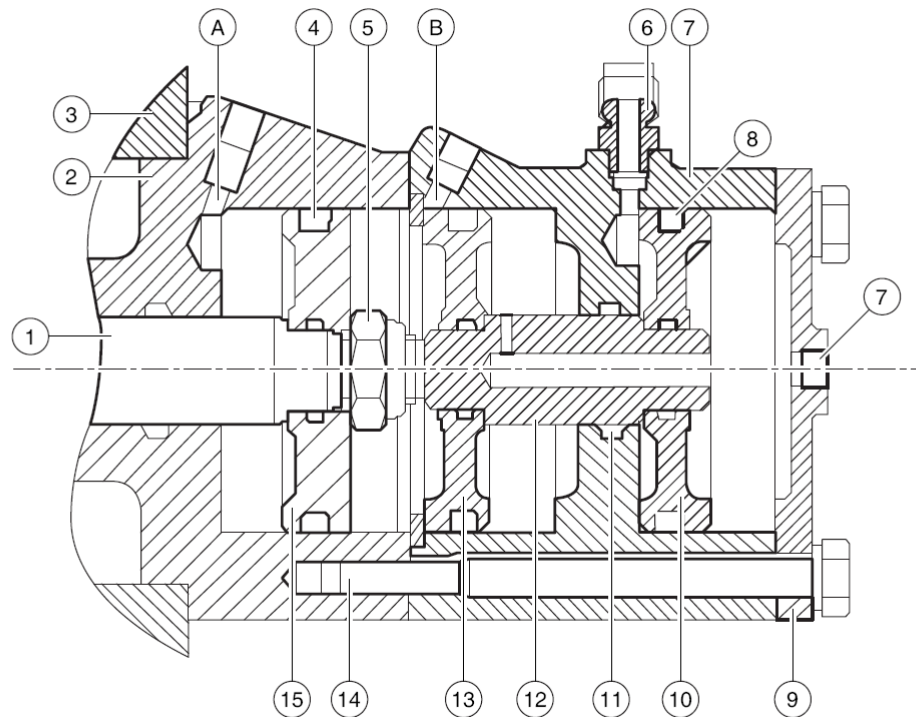
Transmission (12JSD160) - Transmission

VIII. Operating Principle of Power Take-off on Stopping

To adapt to the requirements of some special vehicles, power take-offs can be installed below the rear of the transmission and between the clutch housing body and the transmission. The power take-off at the lengthened countershaft of the auxiliary box at the right lower corner of the rear end of the transmission is called "rear power take-off", which is the most widely used power take-off mode at present. Power take-off between the clutch housing body and the transmission is called "front power take-off" or "full power take-off".

When "rear power take-off" is adopted, to realize power take-off on stopping, you must hang the synchronizer of the rear auxiliary box on the neutral position. To solve the problem, remove the cylinder head of the range gear of the transmission and install a neutral position cylinder.

The orifices A and B are respectively connected with the low-gear air pipe and the high-gear air pipe of the transmission, and also connected with the single H air valve of the transmission, and the air pressure is 0.57-0.6Mpa. The orifice C is the compressed air inlet when the transmission is in the neutral (middle) position, and the air pressure is 0.7-0.8Mpa. When stopping for power take-off, firstly cut off the clutch, put the control lever of the transmission in the neutral position of the low gear area, so that the cylinder piston 15 of the range gear compresses on a locating ring; and then control the cylinder control valve of the neutral position, so that the compressed air with the pressure of 0.7-0.8Mpa is introduced from the orifice C to the neutral position cylinder 7. Because the cylinder has a turbocharging effect, the neutral position cylinder pistons 10 and 13 move left and stop until pushing the locating ring. Thus the range gear cylinder piston 15 of the transmission is in the neutral position. By now, hang the main transmission on an appropriate gear position, switch on the air circuit of the power take-off, connect the clutch, and then the power take-off can realize power take-off on stopping.



fmwx31c021

1	Shift Fork Shaft, Range Gear
2	Cylinder, Range Gear
3	Rear Cover Housing
4	O-ring

9	Cylinder Head
10	Cylinder Piston, Neutral Position
11	O-ring
12	Hollow Shaft

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5	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert
6	Breather Plug
7	Cylinder, Neutral Position
8	Circlip for Shaft

13	Cylinder Piston, Neutral Position
14	Bolt
15	Cylinder Piston, Range Gear

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Transmission (12JSD160) - Transmission**Fault Symptom Table**

The following table can help you find out the fault. The serial number shows the order of the fault possibility. Inspect every part according this order, and replace if necessary.

Fault Symptom	Possible Cause	Reference
Abnormal sound or noise	1. The quality of lubricating oil is poor.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	2. The lubricating level is insufficient.	Fill lubricating oil.
	3. The tooth surface of the gear is damaged or worn excessively to generate large tooth gap.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	4. The bearing is damaged or has cracks.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	5. The combining position of the gear shift fork and gear is improper.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	6. The synchronizer is worn or damaged.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	7. The gear is damaged.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
The gear shifting of the main transmission is difficult or fails.	1. The bearing is worn or damaged.	Chapter 31C Transmission 12JS160TA – Main Box, Disassembly and Assembly
	2. The shift fork and shaft bend or have burrs.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
	3. The check screws of the shift fork are loose.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
	4. The release of the clutch is abnormal.	Chapter 32C Clutch – Clutch Assembly, Testing & Adjustment
	5. The viscosity of lubricating oil is too high.	Replace with the lubricating oil 85W-90 GL5 specified by the manufacturer.
	6. The main shaft is distorted.	Chapter 31C Transmission 12JS160TA – Main Shaft Assembly, Disassembly and Assembly

Transmission (12JSD160) - Transmission

Fault Symptom	Possible Cause	Reference
The shifting of the high and low gear sections of the auxiliary box delays or fails.	1. The pressure regulator valve is defective.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	2. The air pipe or joint is defective.	Chapter 31C Transmission 12JS160TA – Single H Control Mechanism, Dismantlement and Installation
	3. The plunger of the double H air valve is seized.	Chapter 31C Transmission 12JS160TA – Single H Control Mechanism, Dismantlement and Installation
	4. The O-ring of the gear shift cylinder is lubricated poorly or damaged.	Chapter 31C Transmission 12JS160TA – Auxiliary Box, Disassembly and Assembly
	5. The nuts of the cylinder piston are loose.	Chapter 31C Transmission 12JS160TA – Auxiliary Box, Disassembly and Assembly
	6. The cylinder piston is damaged.	Chapter 31C Transmission 12JS160TA – Auxiliary Box, Disassembly and Assembly
	7. The synchronizer or spring is damaged.	Chapter 31C Transmission 12JS160TA – Auxiliary Box, Disassembly and Assembly
Off-gear or gear jumping of the main transmission	1. The gear shift fork deforms or is worn.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
	2. The locking ball or the ball groove on the gear shift fork shaft is worn.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
	3. The locking spring is broken or fatigued.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
	4. The gear clearance is too large.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	5. The engaging teeth or gear sleeve back taper fails.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	6. The sliding part or end face of the sliding bearing bushing is worn.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	7. The bearing is worn to cause axial displacement.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	8. The flange lock nuts are loose.	Chapter 31C Transmission 12JS160TA – Auxiliary Box, Disassembly and Assembly
Off-gear of the high and low gear sections of the auxiliary transmission	1. The pressure regulator valve is defective.	Replace the pressure regulator valve.
	2. The air pipe or joint is defective.	Chapter 31C Transmission 12JS160TA – Single H Control Mechanism, Dismantlement and Installation
	3. The shaft is distorted, and the gear leaves the teeth alignment position.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	4. The engaging teeth or gear sleeve back taper fails.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment

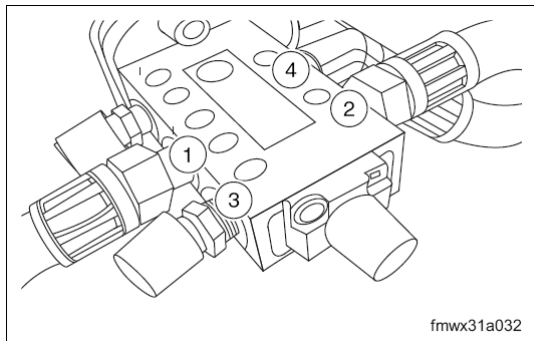
Transmission (12JSD160) - Transmission

Fault Symptom	Possible Cause	Reference
The gears are in disorder.	1. The interlock steel ball or interlock pin is not installed or worn.	Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly
Oil or air leakage	1. Lubricating oil is excessive.	Adjust lubricating oil to the standard value.
	2. The seals are damaged or fail.	Chapter 31C Transmission 12JS160TA – Transmission, Testing & Adjustment
	3. The fasteners are loose.	Tighten the loose parts.
	4. The breather plug is clogged.	Clean or replace the breather plug.
	5. The bolt is not coated with sealant.	Coat with sealant, and re-install the bolt.

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Testing & Adjustment

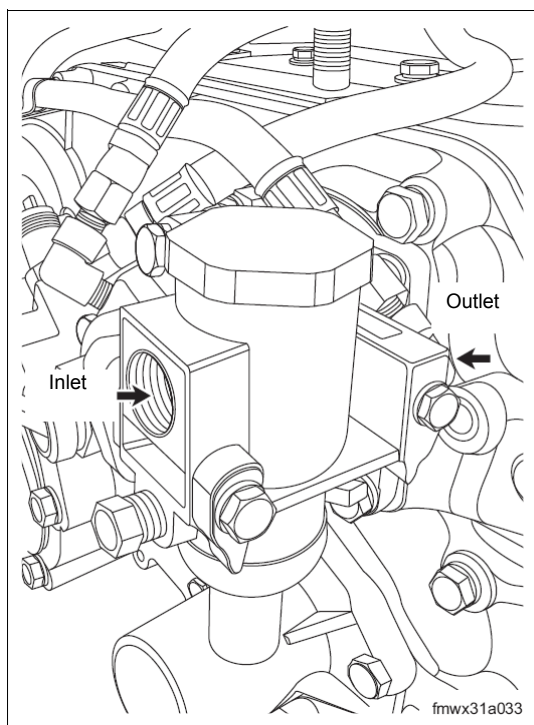
1. Test the single H air valve



- (a). Appearance test: The housing shall be free from defects, and the plunger shall move flexibly and have no heavy wear.
- (b). Channel testing: When the pin is in the original position, the compressed air introduced in shall flow out from the outlet 4 only; when the pin backs to the lowest position due to force carrying, the compressed air introduced in shall flow out from the outlet 2 only.

Hint:

Replace the air valve if any of the fault phenomena appears.

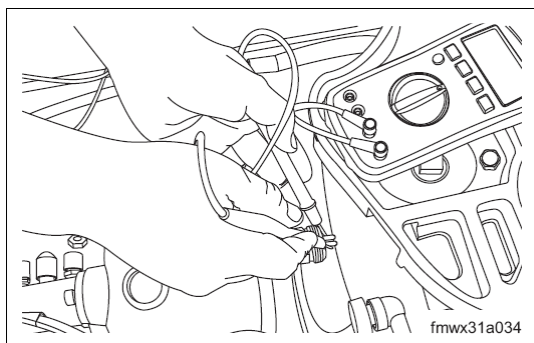


2. Test the air filter regulator

- (a). Appearance test: The part shall be free from defects and leakage.
- (b). Pressure testing: When the air pressure of the vehicle reaches 0.7~0.8Mpa, an air pressure gauge is installed at the outlet, and the pressure valve displayed by the air pressure gauge shall be 0.41~0.44Mpa.

Hint:

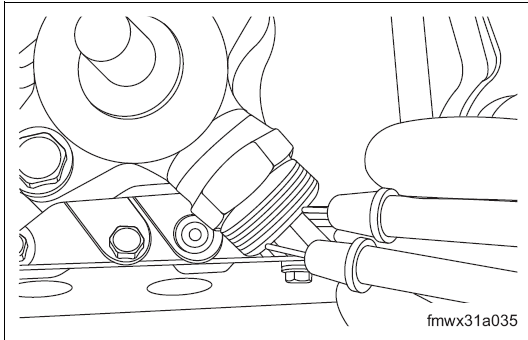
Replace the air filter regulator if the reading fails to meet the requirement.



3. Test the neutral position switch

- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

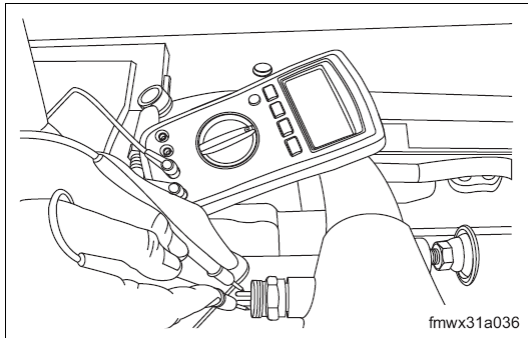
Gear	Contact Resistance (Ω)
Neutral Gear	<1
Other Gears	∞

Transmission (12JSD160) - Transmission**4. Test the range gear switch**

- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

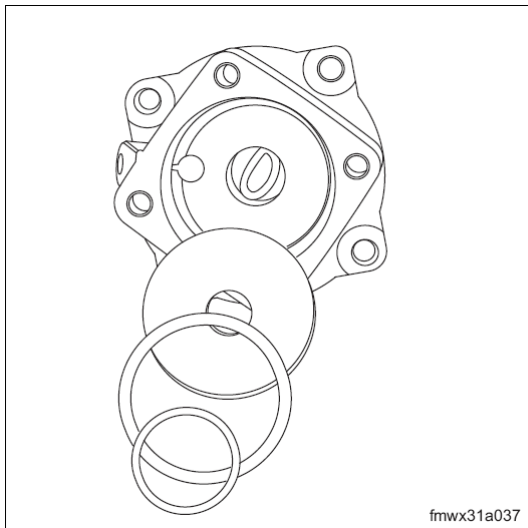
Gear	Contact Resistance (Ω)
Neutral Gear	<1
Other Gears	∞

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**5. Test the reverse switch**

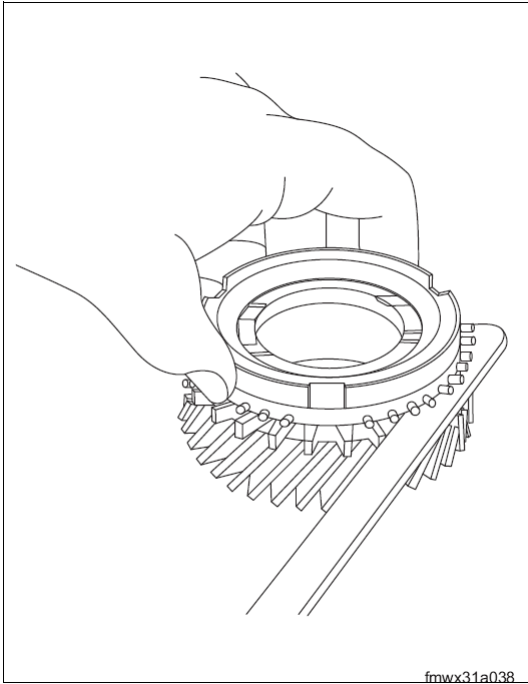
- (a). Appearance test: Free from defects such as deformation, damage or contact looseness.
- (b). Resistance testing: Measure the resistance between the two wiring terminals of the switch by a multimeter.

Gear	Contact Resistance (Ω)
Reverse Gear	<1
Other Gears	∞

**6. Test the gear shift cylinder of the auxiliary box**

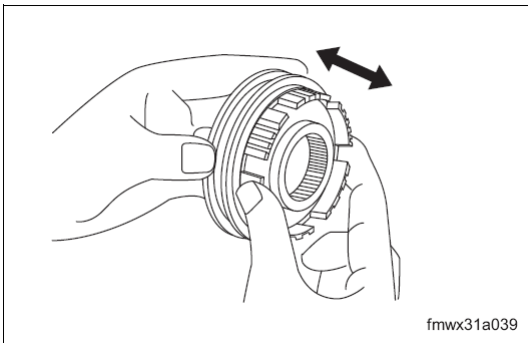
- (a). Test whether the O-ring or other seals are damaged, deformed, lubricated poorly or installed not in position.

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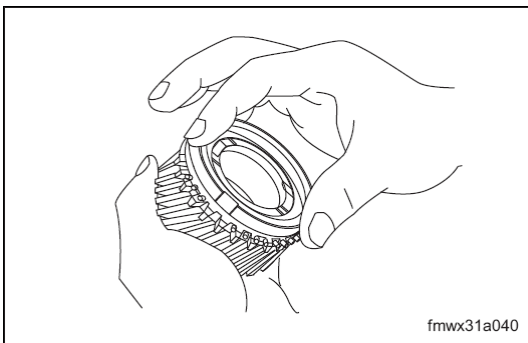


7. Test the high/low gear synchronizer

- (a). Measure the clearance between the gear and synchro ring by a thickness gauge.
- (b). Replace the synchro ring or synchronizer if the measured result exceeds the specified value.



- (c). Inspect the synchronizer ring gear and gear seat.
 - Inspect the sliding condition of the ring gear and gear seat.



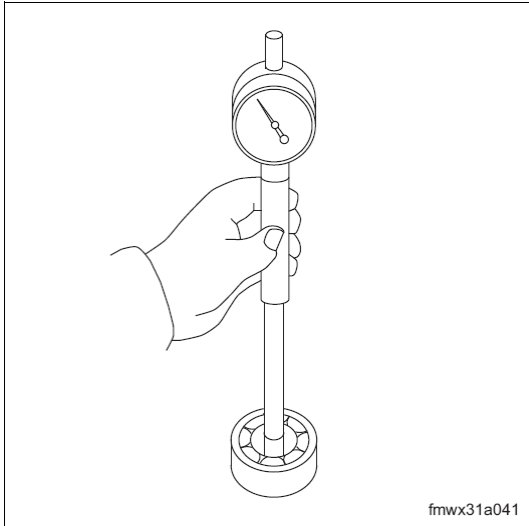
- (d). Inspect the synchro ring.
 - Press the synchro ring toward the gear and rotate in one direction, and inspect the locking effect of the synchro ring. If the locking effect is insufficient, apply a layer of high-quality grinding paster on the contact face between synchro ring and gear, and grind slightly.

Caution:

Make sure to clean away grinding paster after grinding.

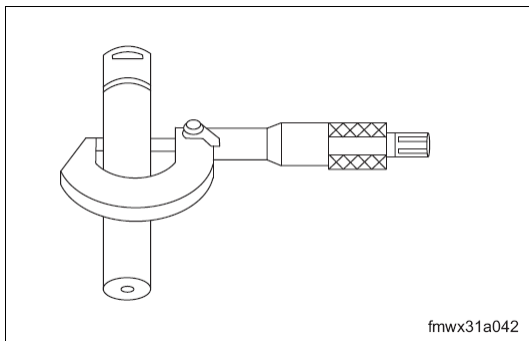
- Inspect the locking effect of the synchro ring.
- If the locking effect is still unideal, test the clearance between the ring gear and synchro ring.

Transmission (12JSD160) - Transmission

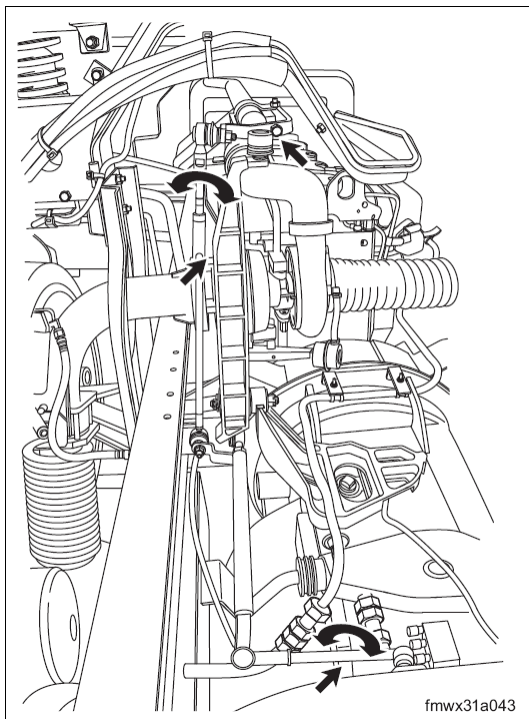
**8. Inspect bearings**

- (a). Place all bearings in clean solution and wash them. Inspect whether the steel balls, rollers and bearing raceway have pits or fall off.
- (b). Measure the inside diameter of the bearing.
- (c). The wear of the bearing seat hole, and the wear of the bearing seat hole on the housing will destroy their installation relation with the bearing, and directly affect the relative position of the transmission input and output shafts. The fit clearance between the bearing and seat hole shall be 0~0.03mm, and the maximum use limit is 0.10mm. Or replace the housing, or line and repair the bearing seat hole.

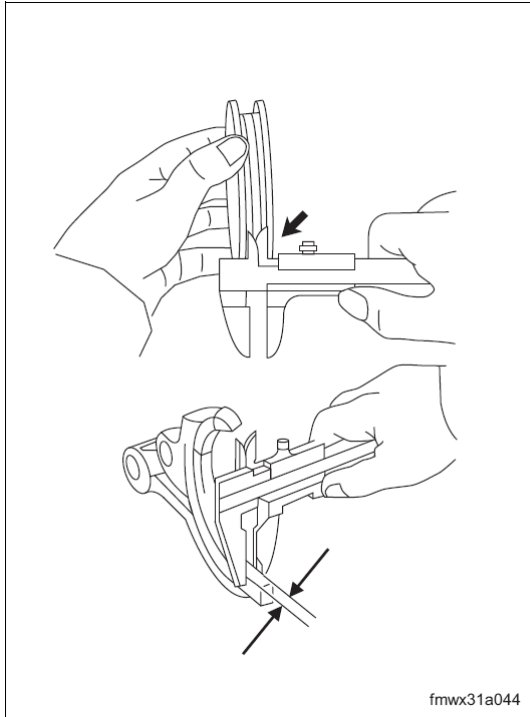
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**9. Test the diameter of the reverse gear shaft**

- (a). Measure the diameter of the reverse gear shaft by a micrometer.
- (b). Replace the reverse gear shaft if the measured value exceeds the limit value.

**10. Adjust the gear shift control mechanism of the transmission**

- (a). The technician A in the cab holds the gear shift lever in the center.
- (b). The technician B releases the adjusting screws of the expansion link assembly or gear shift lever assembly, and adjusts the gears to the best position.
- (c). Tighten the nuts.



11. Measure the fit clearance between the ring gear and shift fork.

- (a). Measure the size of the ring gear by a micrometer.
- (b). Measure the size of the shift fork by a micrometer.

Hint:

Replace the corresponding ring gear and shift fork if the fit clearance exceeds the limit value.

12. Inspect gears

- (a) Inspect whether there is pitting on the tooth surface of the gears, and replace the gears if any.
- (b) Under normal operating conditions, even wear appears on the tooth surface of the transmission gears. It is required that the wear in the tooth length shall not exceed 30% of the original tooth length; the wear in the tooth depth shall not exceed 0.40; the meshing area of the gear shall not be lower than 2/3 of the area of the tooth surface; generally, the meshing clearance of the operating gear shall be 0.1~0.26mm, and the use limit shall be 0.80mm; and the meshing clearance of the engaging gear shall be 0.10~0.15mm, and the use limit shall be 0.60mm. Those values can be measured with a dial indicator or by a soft metal rolling method. Replace the gears in pair if the measured value exceeds the specified clearance.
- (c) Gear breaking is mainly caused by the reasons that the meshing clearance of the gear does not meet the requirement, the meshing position of the gear is incorrect or the gear encounters large impact load. If there are little breaks not greater than 2mm on the gear edge, the gear can be used after being ground with whetstone; replace the gears in pair if the breaks are greater than 2mm or the number of breaks is three or above.
- (d) The end face of the constant mesh gear is worn, and the axial clearance on the end face of the constant mesh bevel gear shall be 1.0~0.30mm to ensure the gear operates well. If grooves are formed on the end face due to wear, repair by grinding, but the grinding amount shall not exceed 0.50mm.

13. Inspect splines

- (a) Inspect the wear degree of splines on all shafts, and replace if the sliding gear sleeve and output flange incline to one side of the spline due to wear. The wear of the spline tooth wear is more serious at the force-carrying side, and it can be inspected along with the spline housing. When the wear of the spline tooth exceeds 0.25mm, or the fit clearance between the spline tooth and original keyway exceeds 0.40mm, the fit clearance among the engaging ring gear, coupling sleeve and spline shaft of the gear exceeds 0.30mm, or the clearance between the woodruff key and journal keyway exceeds 0.08mm, repair or replace the spline shaft or shaft with keyway.

14. Inspect thrust washers

- (a). Inspect the surface condition of all thrust washers. Replace the washers with scratches or thinned depth.

15. Overhaul the transmission shaft

- (a). Use the ejector pin to be against the center holes at both ends of the transmission shaft, and inspect the radial run-out of the shaft by a dial indicator. The deviation shall be smaller than 0.10mm, if not, conduct pressure correction, repair or replacement.

Transmission (12JSD160) - Transmission

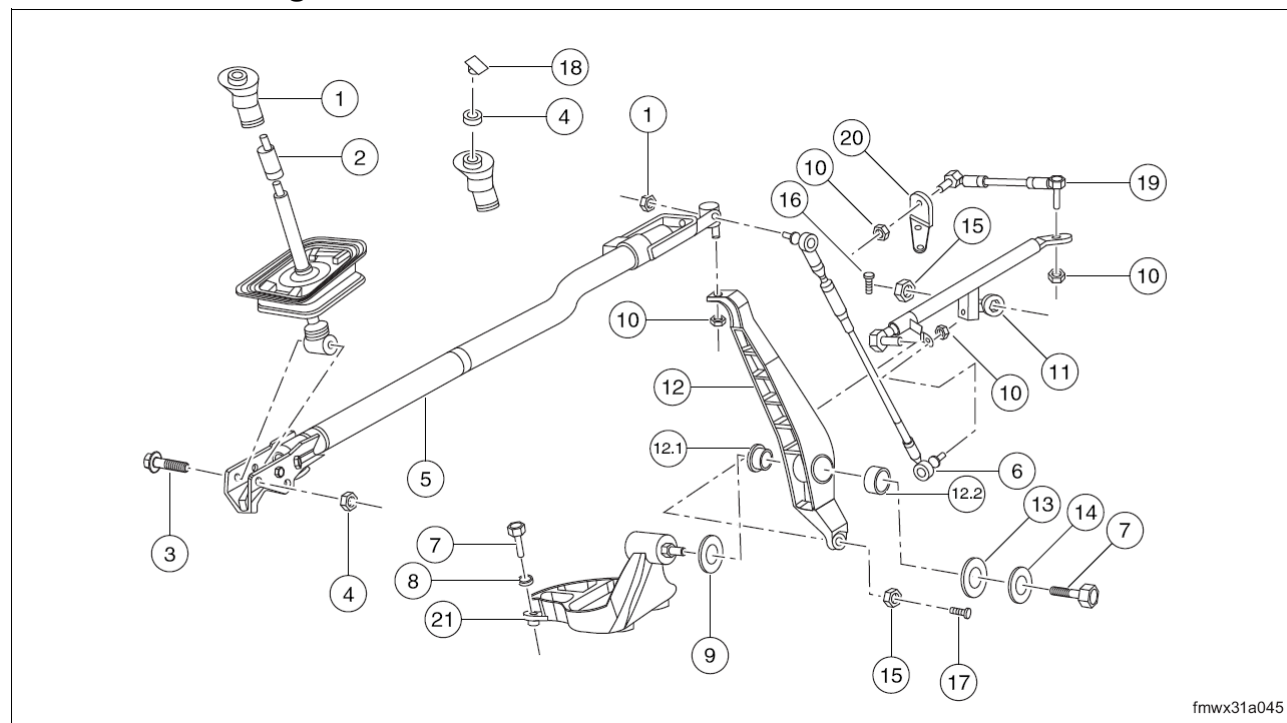
- (b). The journal, needle bearing and seat hole of the constant mesh gear are worn. The fit clearance among them shall be 0.01~0.08, if not, replace it.
- 16. Inspect gray cast iron parts**
 - (a). Inspect whether there are cracks or damages on all gray cast iron parts. Fusion welding or braze welding can be conducted for large castings, but the heat generated shall not extend to the bearing hole or bolt connecting surface.
- 17. Inspect bearing caps**
 - (a). Inspect the wear condition of the tang.
 - (b). Inspect the oil seal in the primary shaft bearing cap and the oil seal in the odometer housing, replace if the sealing function of the lip fails.
- 18. Inspect sliding sleeves**
 - (a). Inspect whether all shift forks and shift fork grooves on the sliding sleeves are worn excessively or discolor due to overheating.
 - (b). Inspect whether the contact area of the engaging teeth of the sliding sleeve deflects.
- 19. Inspect O-ring**
 - (a). Inspect the cracking and deformation conditions of all O-rings. Replace the O-rings which are worn and aged.
- 20. Inspect journal wear**
 - (a). Too large wear in the journal will deflect the gear axis, change the gear meshing clearance, and cause noise generation during drive; at the same time, it will destroy the fit relationship between the journal and bearing, and cause ablation during operation. Therefore, the wear in the journal of the roller bearing at the interference fit shall not be greater than 0.02mm, and the wear in the journal of the needle bearing at the interference fit shall not be greater than 0.07mm. If not, replace or repair by chromium plating.

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Transmission Control Mechanism

Part Drawing

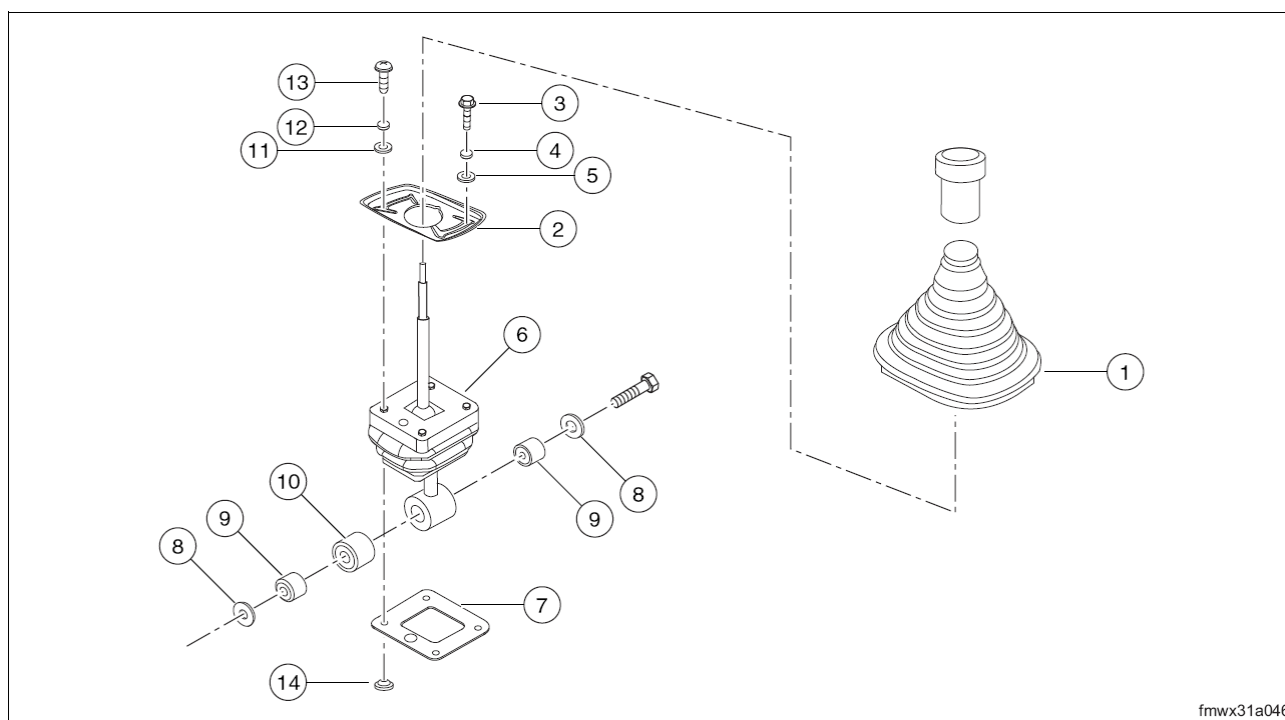
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fmwx31a045

1	Knob Assembly
2	Primary Shaft Gear
3	Hex Flange Bolt
4	Prevailing Torque Type All-metal Hex Nut with Flange
5	Expansion Link Assembly
6	Gear Selecting Link
7	Hex Head Bolt
8	Spring Washer
9	Noise Reduction Washer
10	Prevailing Torque Type All-metal Hex Nut, Style 1
11	Gear Shift Link Assembly
12	Gear Shift Rocker Arm Assembly

12.1	Straight Bushing
12.2	L-bushing
13	Sealing Gasket
14	Thick Washer
15	Hex Thin Slotted Nut
16	Cotter Pin
17	Cotter Pin
18	Gear Plate
19	Rear Support Bar Assembly for Gear Selection
20	Gear Selecting Bracket
21	Four-corner Bracket Assembly

Transmission (12JSD160) - Transmission Control Mechanism

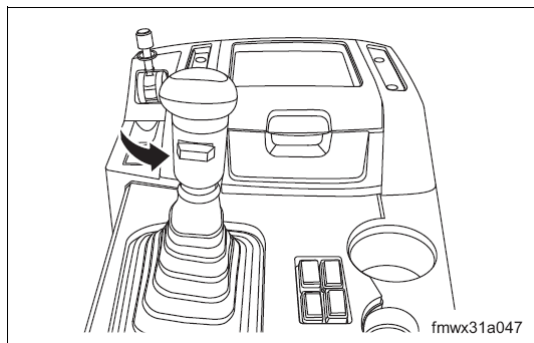
1	Upper Dust Cover
2	Upper Pressure Plate
3	Hex Head Bolt
4	Flat Washer
5	Spring Washer
6	Operator Assembly
7	Lower Pressure Plate

8	Sealing Gasket
9	Composite Bushing
10	Middle Spacer
11	Spring Washer
12	Flat Washer
13	Hex Head Bolt and External Teeth Serrated Lock Washer Assembly
14	Prevailing Torque Type All-metal Hex Nut with Flange

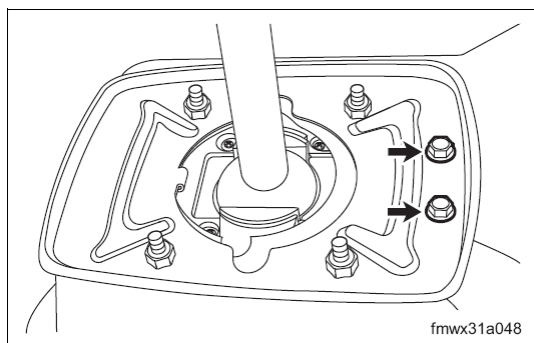
Dismantlement and Installation

1. Dismantle the gear shift control mechanism

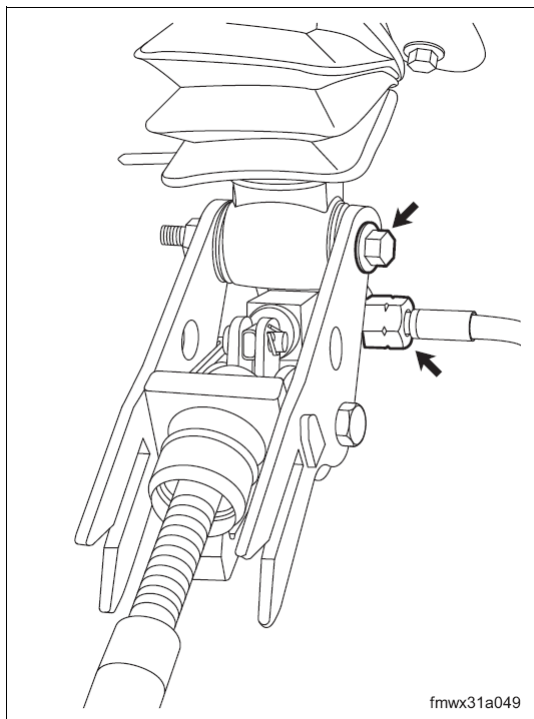
- (a). Dismantle the gear plate, and loose the lock nuts.
- (b). Dismantle the upper dust cover.

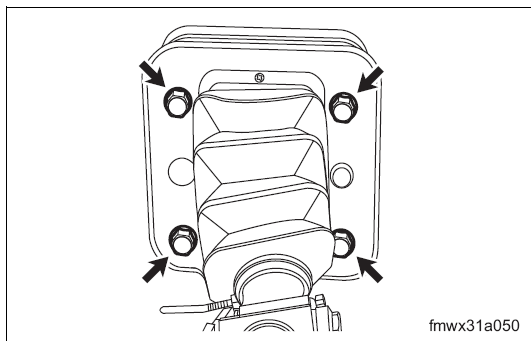


- (c). Dismantle the fastening bolts of the upper pressure plate.

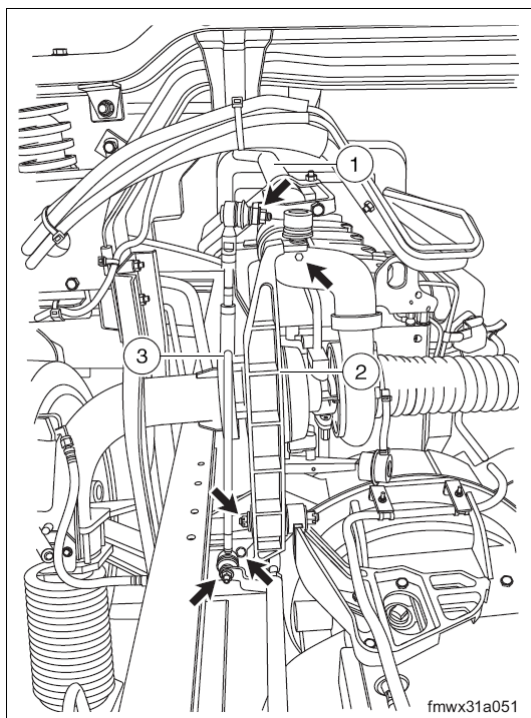


- (d). Disconnect the lubricating oil pipe.
- (e). Disconnect the connecting bolt of the operator and expansion link.

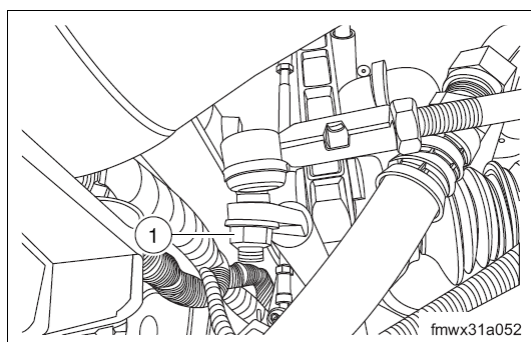


Transmission (12JSD160) - Transmission Control Mechanism

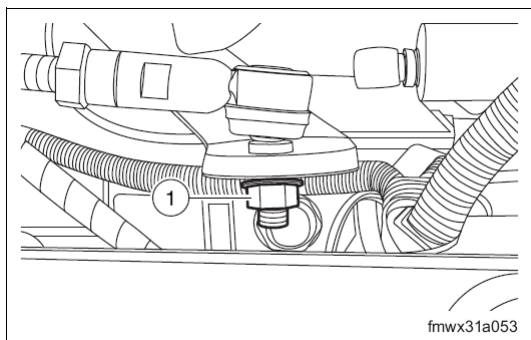
- (f). Dismantle the four fastening bolts of the lower pressure plate.
- (g). Remove the lower pressure plate and lower dust cover in order.
- (h). Remove the gear shift operator assembly.



- (i). Dismantle the gear shift expansion link 1.
 - Dismantle the connecting nut, and take out the expansion link.
- (j). Dismantle the gear selecting link assembly 3.
 - Dismantle the connecting nut, and remove the gear selecting link assembly.
- (k). Dismantle the gear shift rocker arm assembly 2.
 - Dismantle the cotter pin and connecting nut, and remove the gear shift rocker arm assembly.

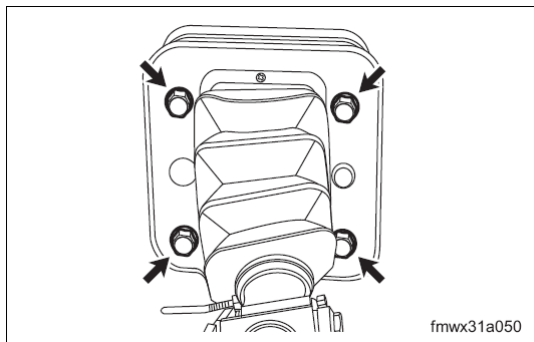


- (l). Dismantle the gear shift link assembly.
 - Dismantle the connecting nut 1 of the gear shift link assembly, and remove the gear shift link assembly.

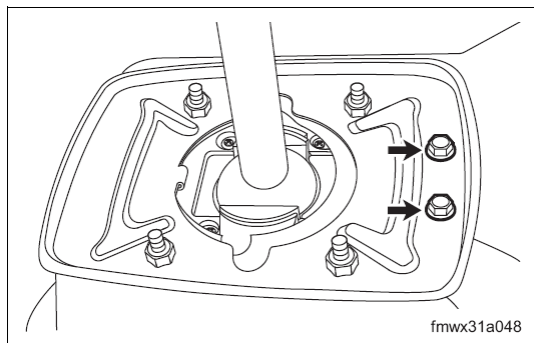


- (m). Dismantle the rear support bar assembly for gear selection.
 - Dismantle the connecting nut 1 of the rear support bar assembly for gear selection, and remove the rear support bar assembly.

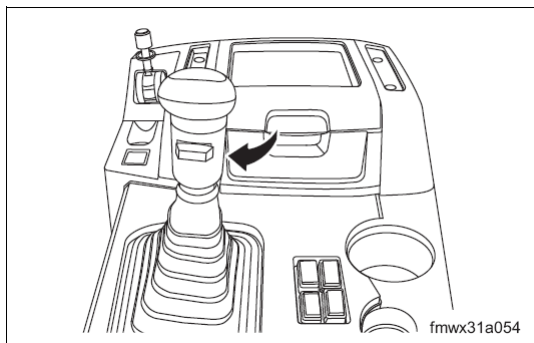
2. Install the gear shift control mechanism



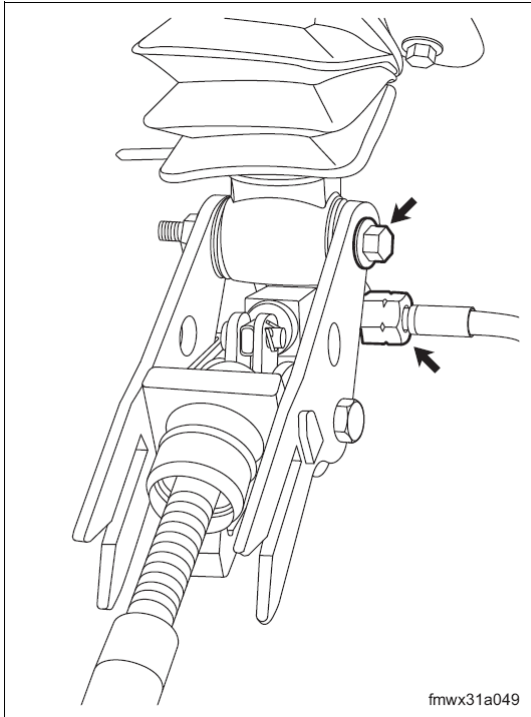
- (a). Install the gear shift operator assembly.
- Install the dust cover and upper and lower pressure plates, and tighten the four bolts.
- Torque: **21±5N.m**



- (b). Dismantle the two fastening bolts of the upper pressure plate.
- Torque: **9±3N.m**

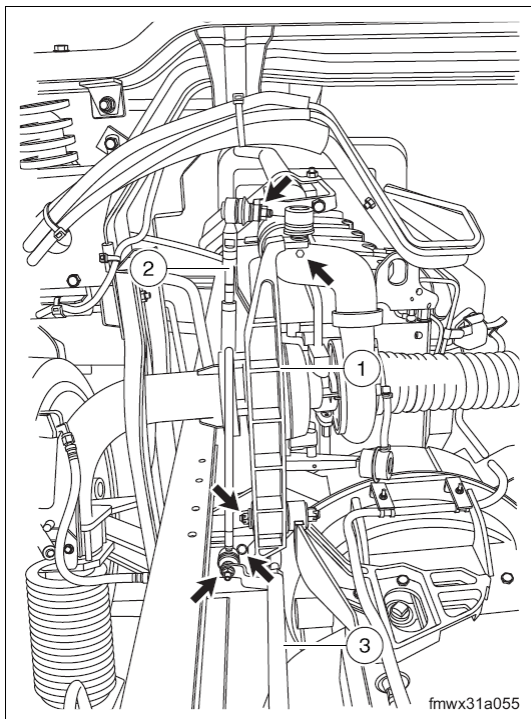


- (c). Install the dust and knob in order, tighten the nuts, and then install the gear plate.

Transmission (12JSD160) - Transmission Control Mechanism

- (d). Install the expansion link assembly.
- Connect the expansion link and gear shift operator, and tighten the connecting bolt.
- Torque: **64N.m**
- (e). Connect the lubricating oil pipe.

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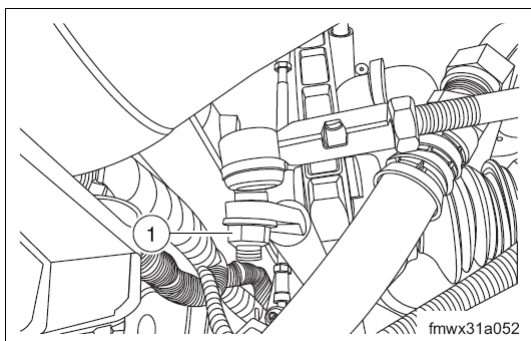
- (f). Install the gear shift rocker arm assembly 1.
- Fix the gear shift rocker arm to the four-corner bracket assembly, tighten the nuts, and insert the cotter pin.
 - Connect the expansion link and gear shift rocker arm, and tighten the connecting nut.

Torque: **95N.m**

- (g). Install the gear selecting link assembly 2.
- Connect the gear selecting link assembly 2 and expansion link, and tighten the connecting nut.

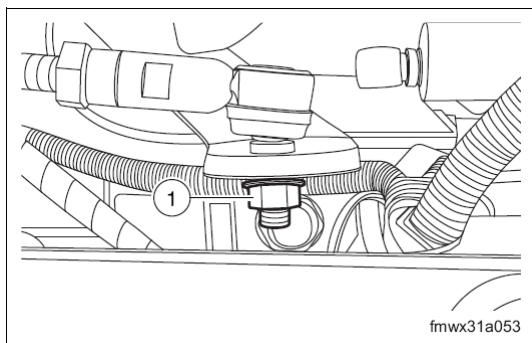
Torque: **95N.m**

- (h). Install the gear shift link assembly 3.
- Connect the gear shift selecting link assembly 2 and gear shift link, and tighten the connecting nut.
 - Connect the gear shift link assembly 3 and gear shift rocker arm assembly 1, tighten the connecting nut, and insert the cotter pin.



- (i). Install the rear support bar assembly for gear selection.
- Connect the rear support bar assembly for gear selection and gear shift link, and tighten the connecting nut.

Torque: **95N.m**



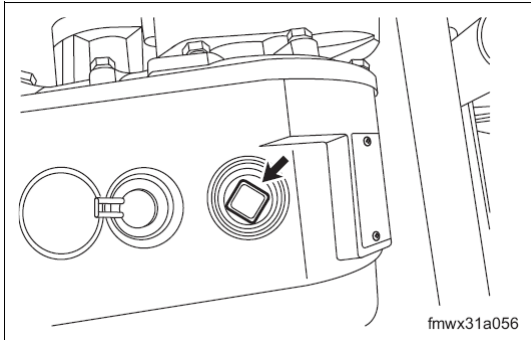
- (j). Install the gear selecting link to the gear selecting bracket, and tighten the connecting nut.
Torque: **95N.m**

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Transmission Assembly

Replacement

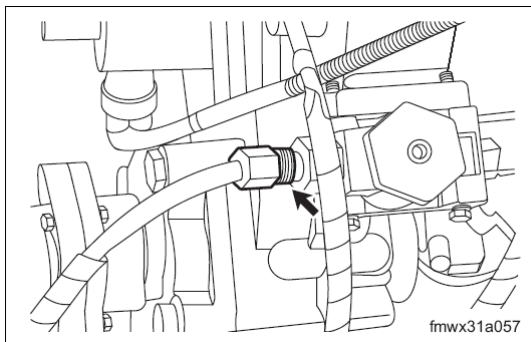
1. Lift the rear box
2. Disconnect the battery negative cable



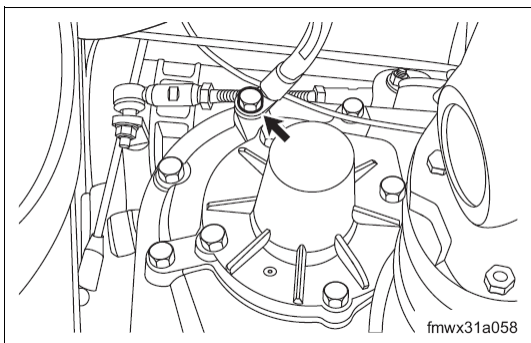
3. Unscrew the oil drain plug at the bottom of the transmission, drain transmission oil, and tighten the oil drain bolt
Torque: $54.5 \pm 7 \text{ N.m}$

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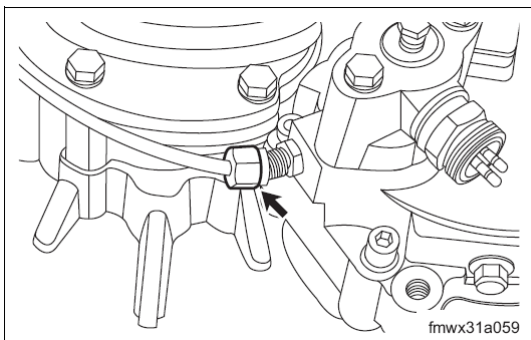
4. Dismantle the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.
5. Dismantle the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.



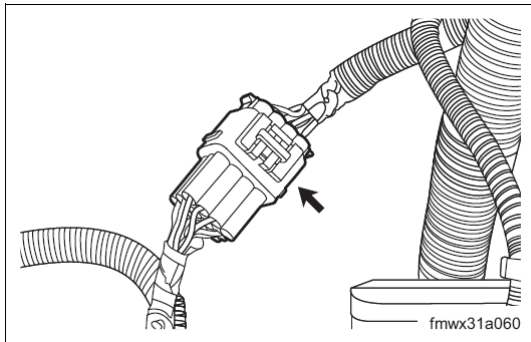
6. Dismantle the transmission accessories
(a). Dismantle the air pipe assembly of the air filter regulator.



- (b). Dismantle the grounding cable of the transmission.

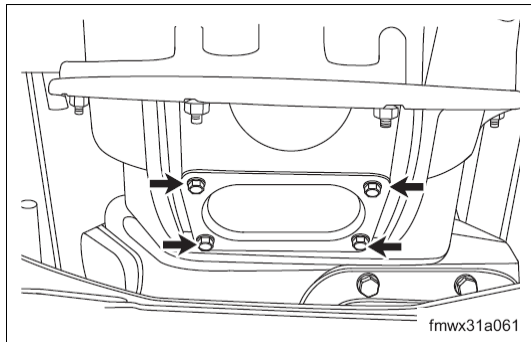


- (c). Dismantle the intake pipe of the power take-off.



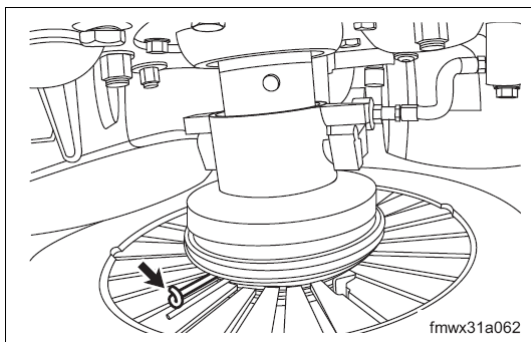
(d). Disconnect the combined connector of the transmission.

7. **Dismantle the gear shift control mechanism assembly of the transmission. Refer to Chapter 31C Transmission 12JS160TA – Transmission Control Mechanism, Disassembly and Assembly.**



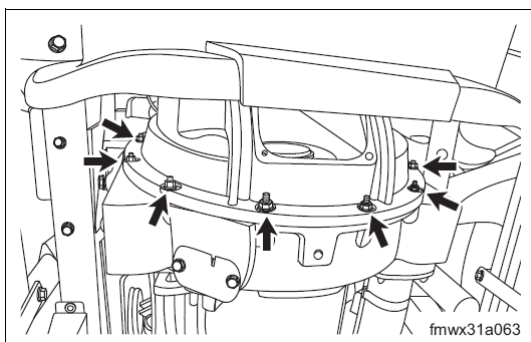
8. **Dismantle the cover plate of the clutch observation hole.**

(a). Dismantle the four bolts, remove the cover plate.



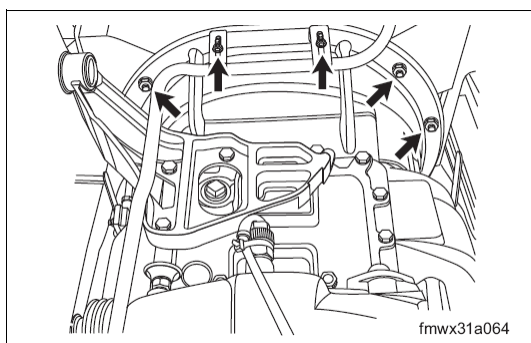
9. **Pick off the hook of the spring clamping wire of the clutch release bearing**

10. **Dismantle the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.**

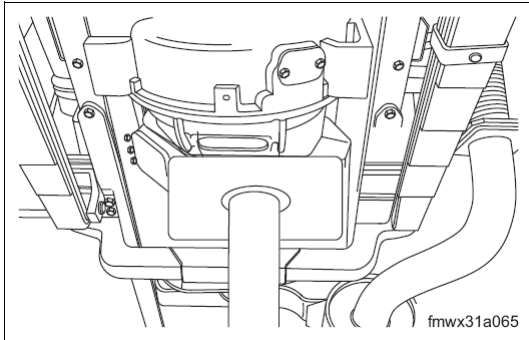


11. **Disconnect the transmission and engine**

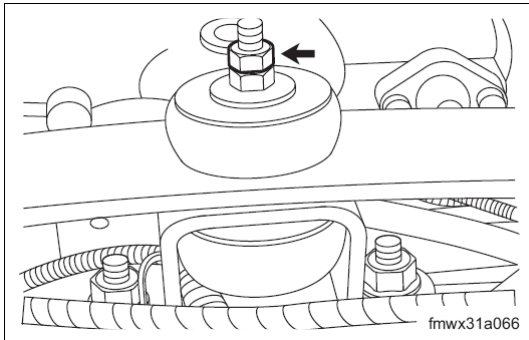
(a). Dismantle the lower connecting bolts of the transmission and engine.



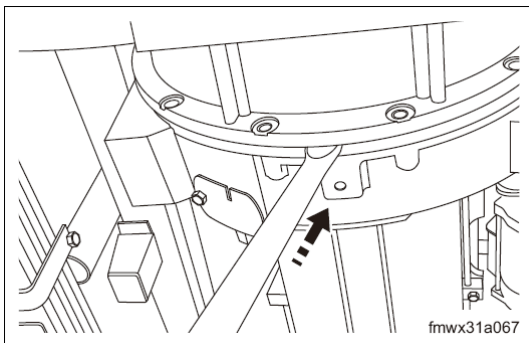
(b). Dismantle the upper connecting bolts of the transmission and engine.

Transmission (12JSD160) - Transmission Assembly**12. Dismantle the sub-frame****13. Remove the transmission assembly**

- (a). Jack up the transmission assembly by a transmission hydraulic jack.

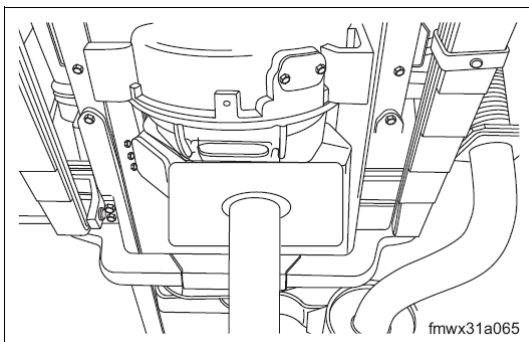


- (b). Dismantle the connecting nut of the transmission mounting, and remove the lower spring beam.



- (c). Separate the transmission from the engine by a flat crowbar.

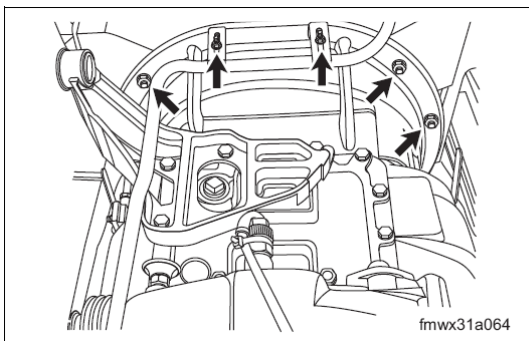
- (d). Put down the transmission assembly

**14. Install the transmission assembly**

- (a). Connect the transmission assembly with the engine assembly.

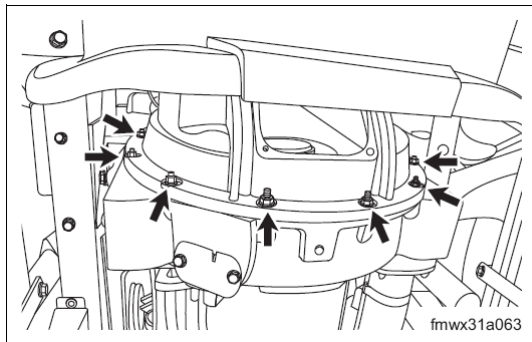
Hint:

Make sure to put on the hook of the clutch spring clamping wire before installing the transmission assembly. Inspect whether the spring clamping wire is loose and flexible on the release ring by moving it. If not flexible, re-install it, or the release bearing may not be installed.

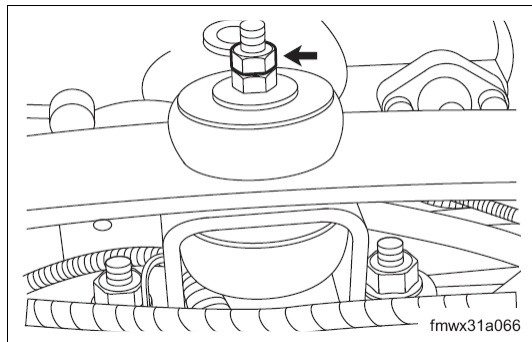
**15. Tighten the connecting bolts of the transmission and engine.**

- (a). Tighten the upper connecting bolts of the transmission.

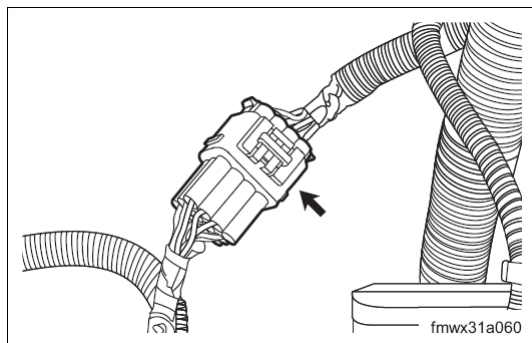
31C



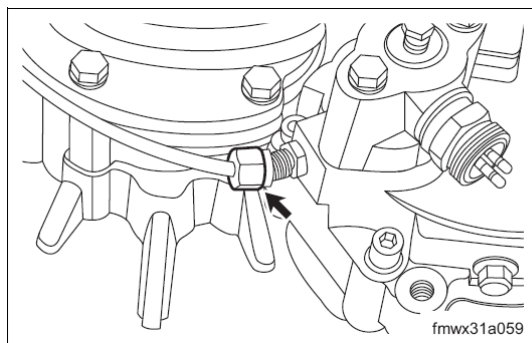
- (b). Tighten the lower connecting bolts of the transmission.



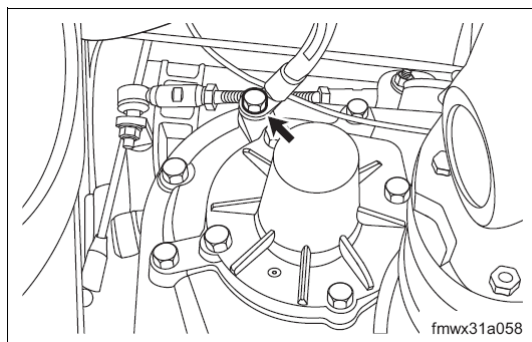
16. Install the spring beam of the transmission, and tighten the connecting nut of the mounting.
Torque: 240N.m
17. Install the gear shift control mechanism assembly of the transmission. Refer to Chapter 31C Transmission 12JSD160 – Transmission Control Mechanism, Disassembly and Assembly.



18. Install the transmission accessories
- (a). Connect the combined connector of the transmission.

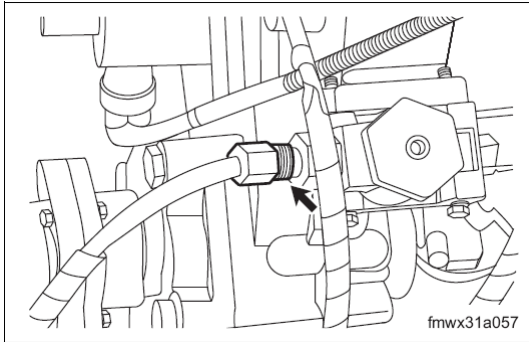


- (b). Install the intake pipe of the power take-off.



- (c). Install the grounding cable of the transmission, and tighten the bolts.
Torque: 54.5±7N.m

Transmission (12JSD160) - Transmission Assembly



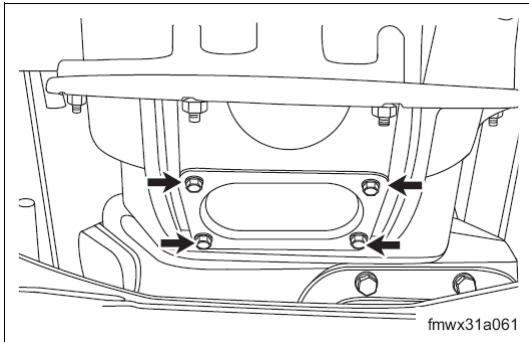
- (d). Install the air pipe assembly of the air filter regulator.

31C

19. Install the clutch slave cylinder. Refer to Chapter 32 Clutch – Clutch Slave Cylinder, Overhaul.

Hint:

Before installing the clutch slave cylinder, tie the end of the release bearing crank by a rope through the window of the clutch slave cylinder, and strongly pull the crank outward to force the release bearing to push the release ring in and make it jammed, which shows that the release bearing is installed in position.



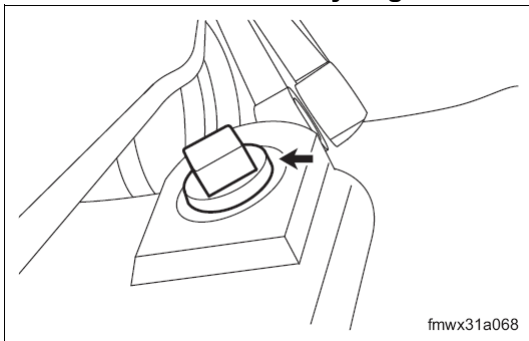
20. Install the cover plate of the clutch observation hole.

- (a). Install the cover plate of the clutch observation hole, and tighten the four bolts.
Torque: **23.5±3.5N.m**

21. Install the drive shaft of the power take-off. Refer to Chapter 34 Power Take-off – QH50 Power Take-off, Dismantlement and Installation.

22. Install the intermediate drive shaft. Refer to Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul.

23. Install the battery negative cable.



- 24. Unscrew the oil filter plug in the middle of the transmission, fill transmission oil 85W/90GL-5, and tighten the oil filter bolt.**
Filling amount of transmission oil : 17L.

Caution:

Run the transmission for several minutes after filling oil, and then inspect the transmission oil level again.

25. Put down the rear box

26. Clutch running-in specification and test

- The environment is that the speed is about 1500 r/min; the oil temperature is not lower than 15 °C; no load is exerted; the transmission is running at neutral gear for not less than 15 min, and at other gear for not less than 20 min.
- Inspect whether the gear shift is flexible, the gears are meshed fully, and there is a gear impact sound during gear shift.
- The gear shift lever of the transmission shall be free from obvious vibration.
- There shall be no abnormal friction sound or impact sound during testing of the transmission.
- The transmission shall not leak oil.

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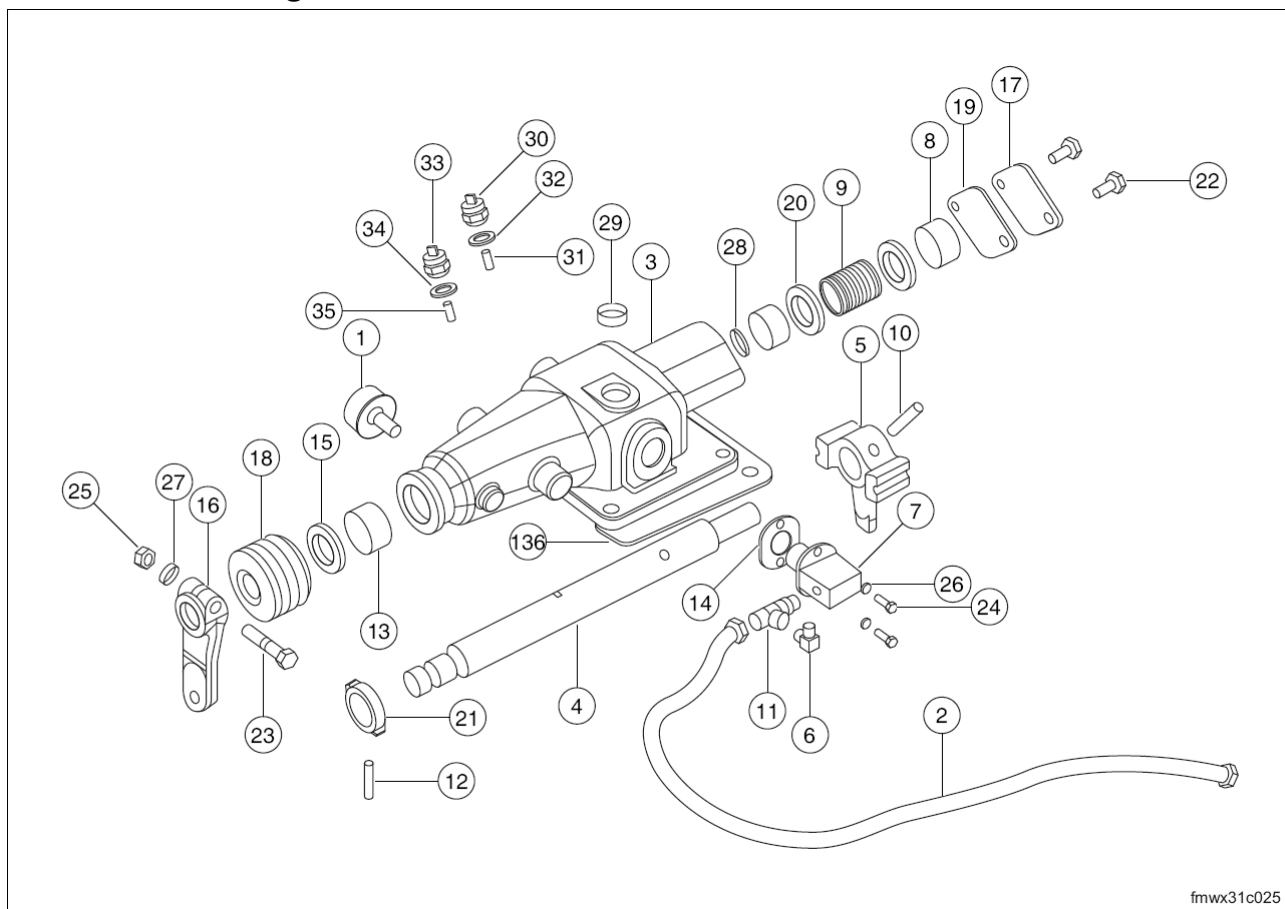
Transmission (12JSD160) - Transmission Assembly

- (f). After running-in, drain transmission oil for running-in, clean the transmission inside completely, and fill transmission oil as specified.

31C

Single H Control Mechanism

Part Drawing



31C

1	Breather Plug
2	Air Pipe Assembly
3	Control Device Housing
4	Transverse Gear Shift Lever
5	Guide Block
6	90° Quick Joint
7	Air Circuit Control Valve
8	Limiting Sleeve
9	Compression Spring
10	Cylindrical Pin
11	Tee Pipe Joint
12	Elastic Cylindrical Pin
13	Sleeve, Transverse Gear Shift Lever
14	Gasket, Single H Air Valve

19	End Gasket
20	Spring Seat
21	Control Valve, Reverse and Low Gear
22	Hex Head Bolt and Spring Washer Assembly
23	Hex Head Bolt – Fine Thread
24	Hex Socket Cap Head Screw
25	Hex Nut, Style 1
26	Spring Washer
27	Spring Washer
28	Circlip for Shaft
29	Core Plug
30	Pressure Switch
31	Switch Starting Pin
32	Sealing Washer

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Transmission (12JSD160) - Single H Control Mechanism

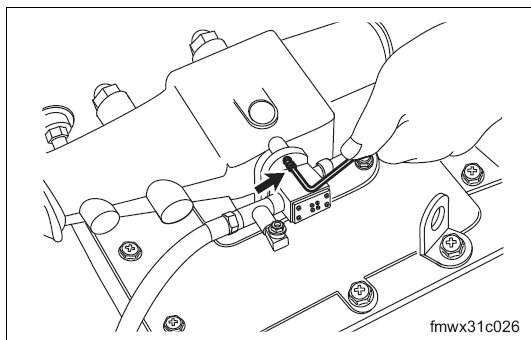
15	Oil Seal
16	LRC Outer Gear Shift Arm
17	Side Panel
18	Sleeve

33	Pressure Switch
34	Sealing Ring
35	Switch Starting Pin
36	Control Window Gasket

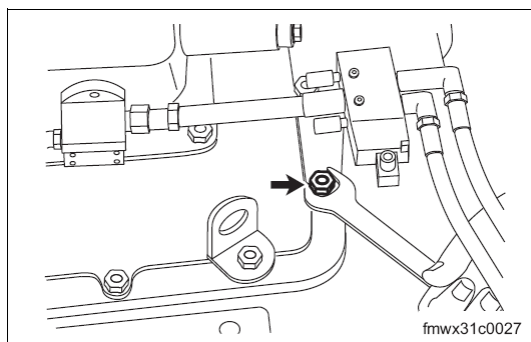
31C

Dismantlement and Installation

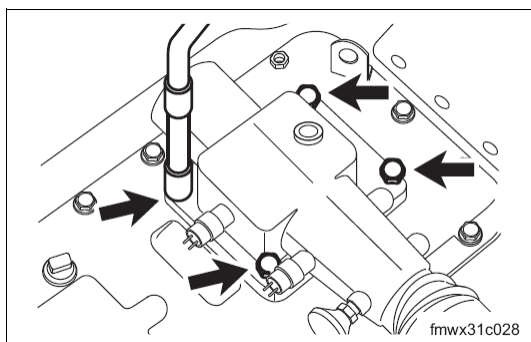
1. Dismantle the single H control mechanism



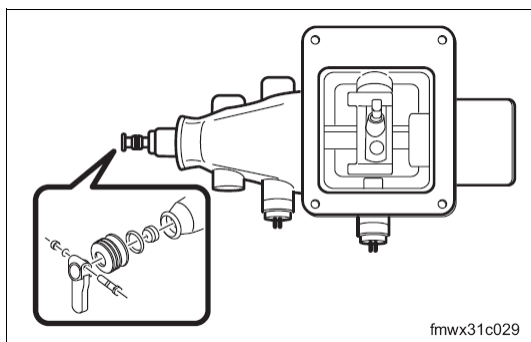
- (a). Dismantle the hex socket bolt of the air circuit cut-off valve on the single H assembly.



- (b). Dismantle the support bolt of the air circuit reversing valve on the right of the upper cover.

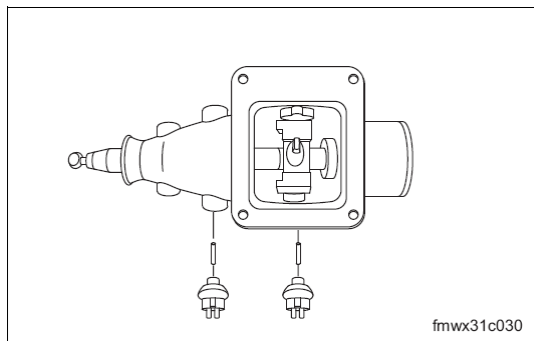


- (c). Dismantle the four locating nuts of the single H assembly.
(d). Slightly beat the single H control mechanism housing by a copper rod, and remove the single H assembly.

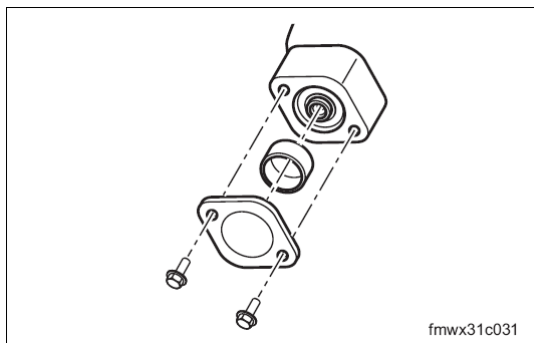


- (e). Dismantle the gear shift rocker arm, dust cover and breather plug in order.

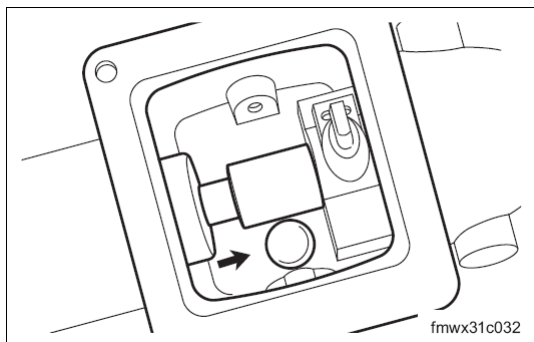
31C



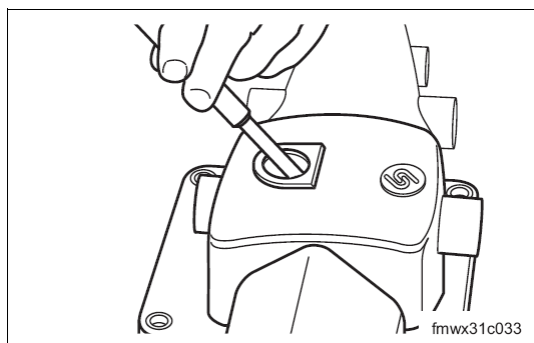
- (f). Dismantle the reverse and neutral position switches and pins.



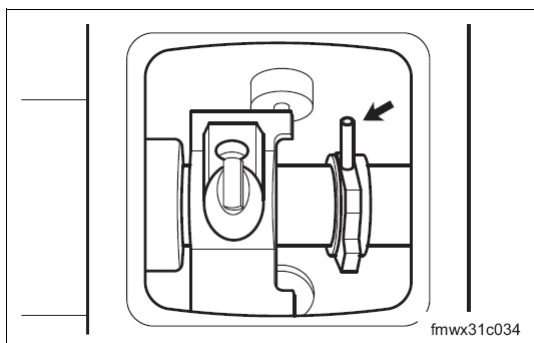
- (g). Dismantle the two bolts, limiting sleeve on the side panel of the single H assembly, and then the clamping spring on the transverse gear shift shaft in order.



- (h). Turn over the single H housing, remove the core plug and wire on the gear shift guide block.

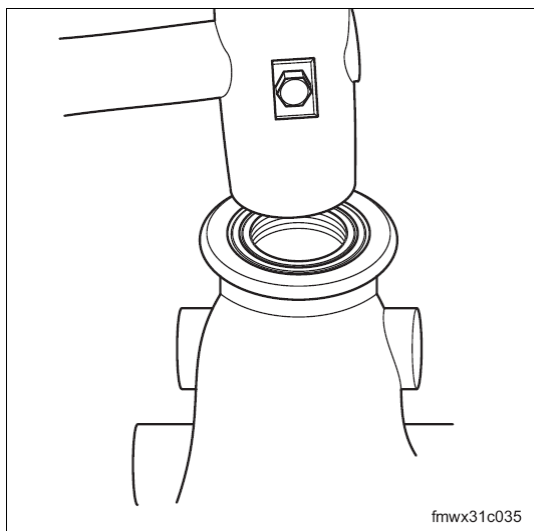


- (i). Dismantle the cylindrical pin on the gear shift guide block.

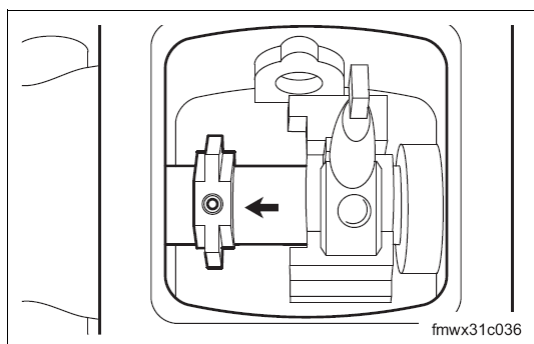


- (j). Dismantle the elastic cylindrical pin on the reverse gear control block, and extract out the transverse gear shift shaft.

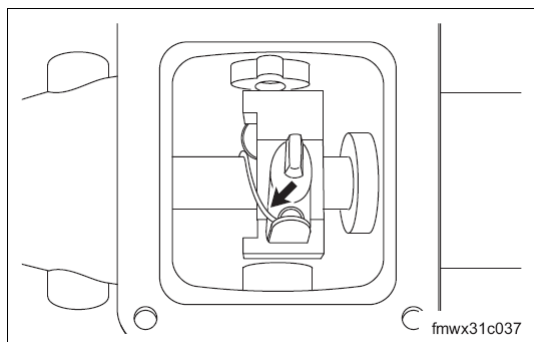
Transmission (12JSD160) - Single H Control Mechanism



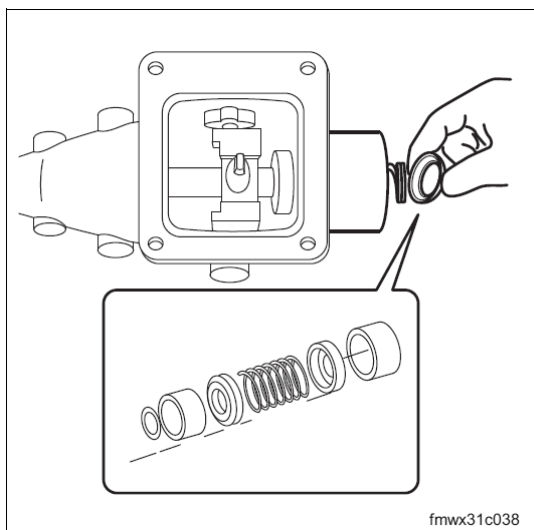
- 2. Install the single H control mechanism**
(a). Erect the single H assembly vertically, and put the oil seal in.



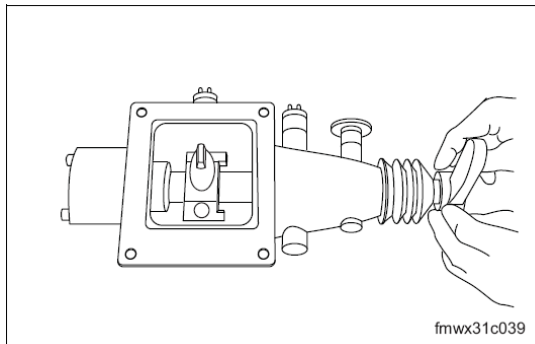
- (b). Put the transverse gear shift shaft in, install the elastic cylindrical pin of the reverse gear control block with the small end facing up.



- (c). Put the cylindrical pin of the gear shift guide block in, and bind with wires.



- (d). Install the spring, spring seat and clamping spring in order.



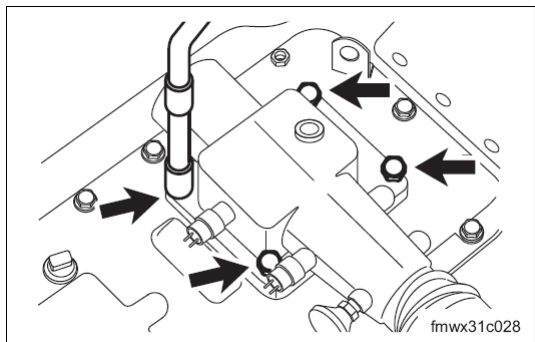
- (e). Put the limiting sleeve in, and install the side panel.
- (f). Install the switch starting pins and reverse and neutral position switches.

Torque: **23±3N.m**

- (g). Install the dust cover and gear shift rocker arm.

Caution:

Ensure that the rocker arm and guide block are in a straight line.

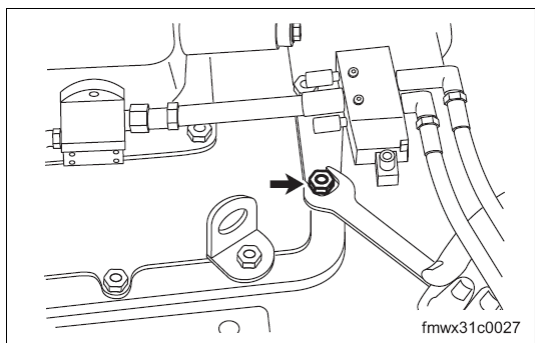


- (h). Install the four locating nuts of the single H assembly.

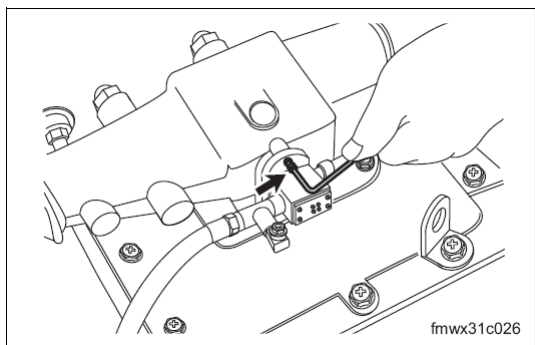
Torque: **17±3Nm**

Caution:

The junction surface must be coated with sealant evenly.



- (i). Install the support bolt of the air circuit reversing valve on the right of the upper cover.



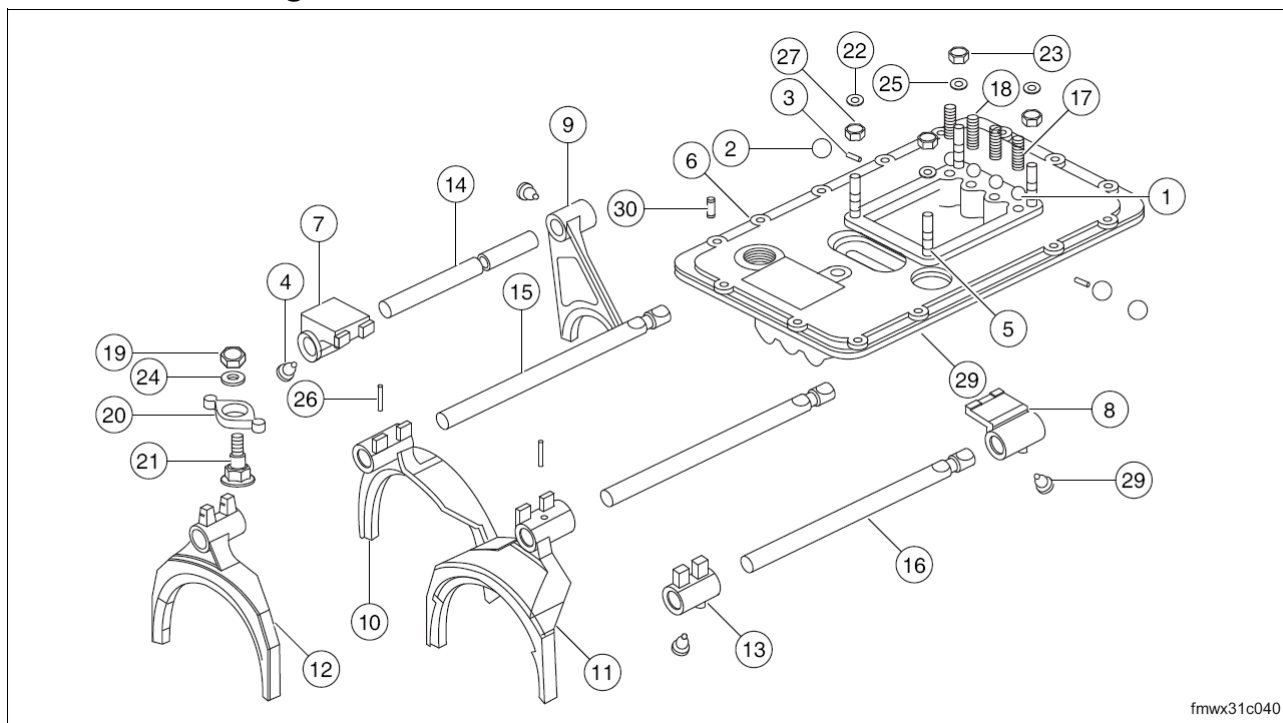
- (j). Install the hex socket bolt of the air circuit cut-off valve on the single H assembly.

Caution:

The junction surface must be coated with sealant evenly.

Transmission Upper Cover

Part Drawing



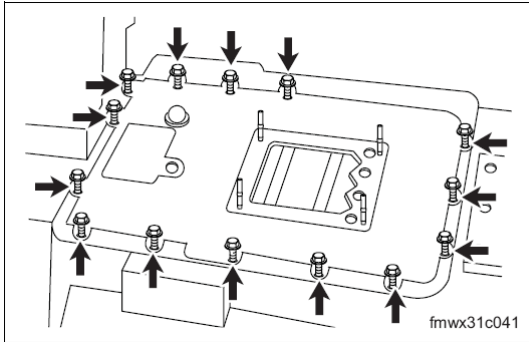
31C

1	Steel Ball
2	Steel Ball
3	Interlock Pin, Shift Fork Shaft
4	Lock Bolt, Gear Shift Fork
5	Stud Bolt
6	Upper Cover
7	Reverse Gear Guide block Assembly
8	5th/6th Gear Guide Block
9	Reverse Gear Shift Fork
10	1st/2nd Gear Shift Fork
11	3rd/4th gear Shift Fork
12	5th/6th Gear Shift Fork
13	5th/6th Gear Shift Guide Block
14	Low/Reverse Gear Shift Fork Shaft
15	1st/ 2nd/3rd/4th Gear Shift Fork Shaft

16	5th/6th Gear Shift Fork
17	Compression Spring
18	Compression Spring
19	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert
20	Swing Guide Block
21	Support Shaft Pin
22	Hex Thin Nut
23	Hex Nut, Style 2
24	Flat Washer
25	Spring Washer
26	Elastic Cylindrical Pin
27	Hex Nut
28	Lock Bolt, Gear Shift Fork
29	Upper Cover Gasket
30	Cylindrical Pin

Disassembly and Assembly

1. Dismantle the single H control mechanism assembly of the transmission. Refer to Chapter 31C Transmission 12JS160TA – Single H Control Mechanism, Disassembly and Assembly.

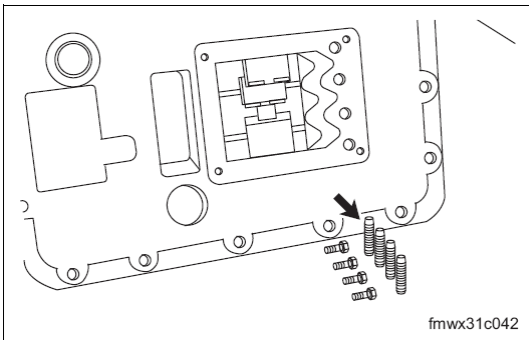


2. Dismantle the upper cover assembly

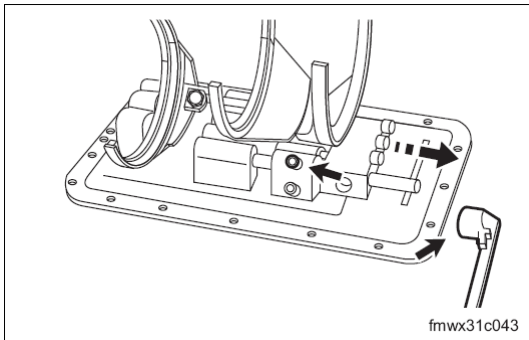
- (a). Dismantle the fastening bolts of the upper cover.
- (b). Dismantle the four stud bolts on the upper cover housing.
- (c). Knock the upper cover by a copper rod to separate it from the gasket.

Caution:

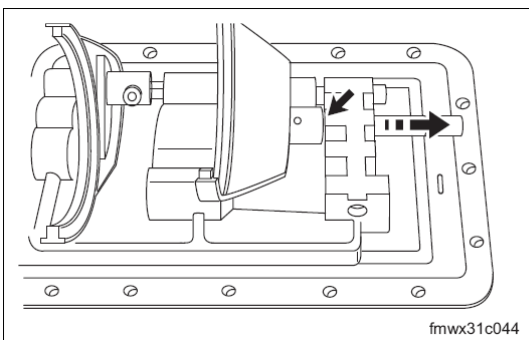
Do not apply too strong force when bearing the upper cover, and make sure to beat evenly in all directions.



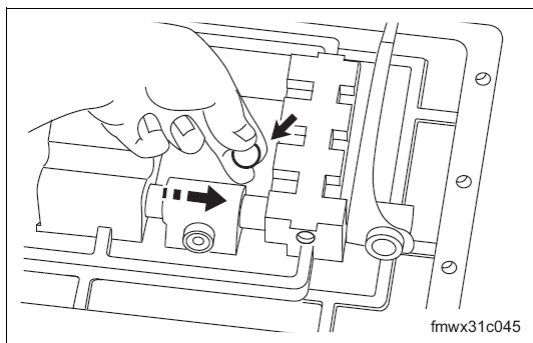
- (d). Remove the upper cover assembly, and take out the springs and steel balls from the upper cover holes.



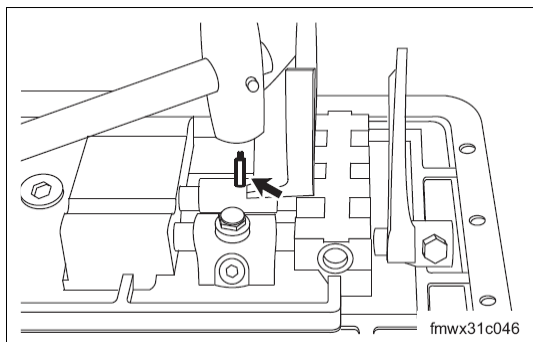
- (e). Turn over the upper cover assembly, dismantle the reverse gear shift fork, reverse gear shift fork shaft and guide block.
- (f). Dismantle the elastic cylindrical pin on the 1st/2nd gear shift fork, and remove the 1st/2nd gear shift fork and shift fork shaft, take out the interlock pin on the shaft and the interlock steel ball from the hole.



- (g). Dismantle the elastic cylindrical pin on the 3rd/4th gear shift fork, and remove the 3rd/4th gear shift fork and shift fork shaft, take out the interlock pin on the shaft and the interlock steel ball from the hole.
- (h). Dismantle the locating bolt on the 5th/6th gear shift fork, extract out the shift fork shaft, and remove the 5th/6th gear shift fork and guide block.

Transmission (12JSD160) - Transmission Upper Cover**3. Assemble the upper cover assembly**

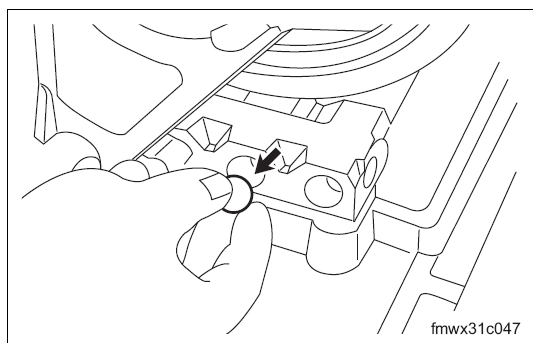
- (a). Insert the reverse gear guide block and shift fork into the reverse gear shift fork shaft in order, fasten with the taper bolt, tighten the locking wire, and put one interlock steel ball in.



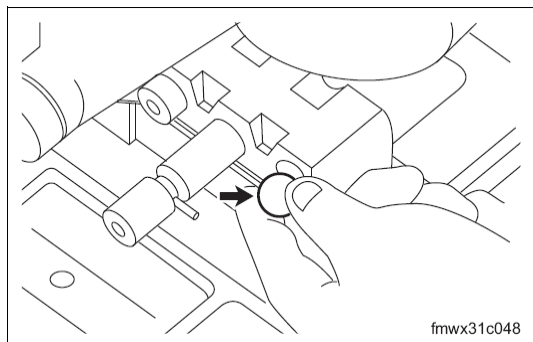
- (b). Install the 1st/2nd gear shift fork shaft, and install the elastic cylindrical pin on the shift fork.

Caution:

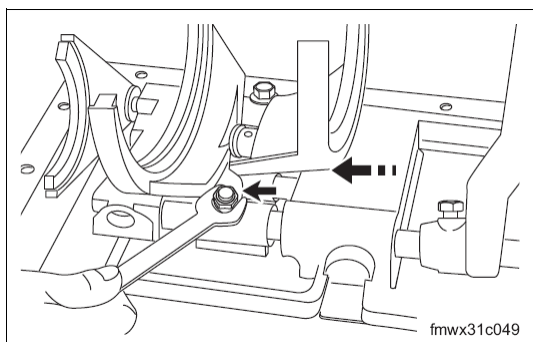
Do not forget the interlock pin on the 1st/2nd gear shift fork shaft.



- (c). Put one interlock steel ball in.

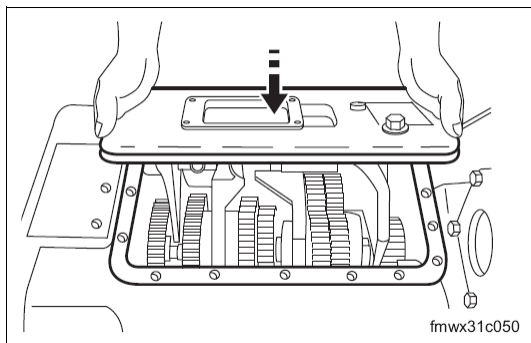


- (d). Install the 3rd/4th gear shift fork shaft, install the elastic cylindrical pin on the shift fork, and install the interlock pin and interlock steel ball.



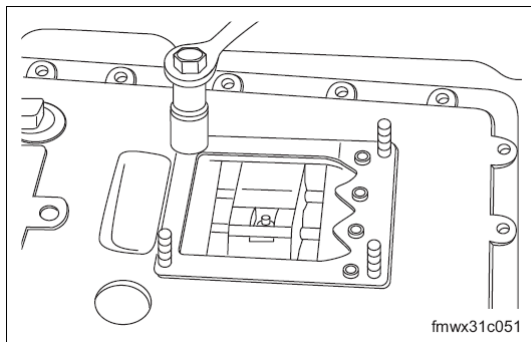
- (e). Install the 5th/6th gear shift fork shaft, and install the 5th/6th gear guide block and shift fork in order, and tighten the locking wire with the bolt.
Torque: **78±10N.m**

31C

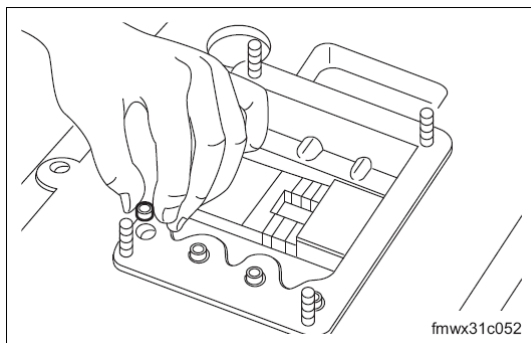


- (f). Put the upper cover assembly into the main box.
Torque: **54.5±7N.m**

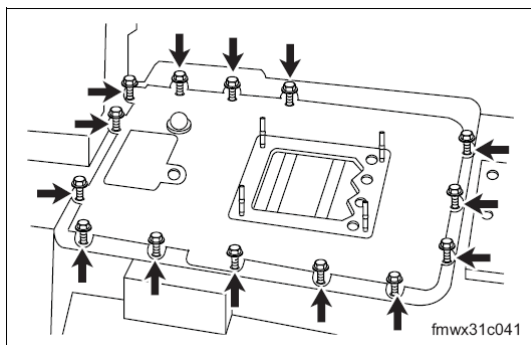
Caution:
The junction surface must be coated with sealant evenly.



- (g). Install the four stud bolts on the upper cover housing.
Torque: **54.5±7N.m**



- (h). Install the four stud bolts, locating springs and steel balls.
Caution:
The spring in the hole of the 5th/6th gear shift fork shaft is thicker.

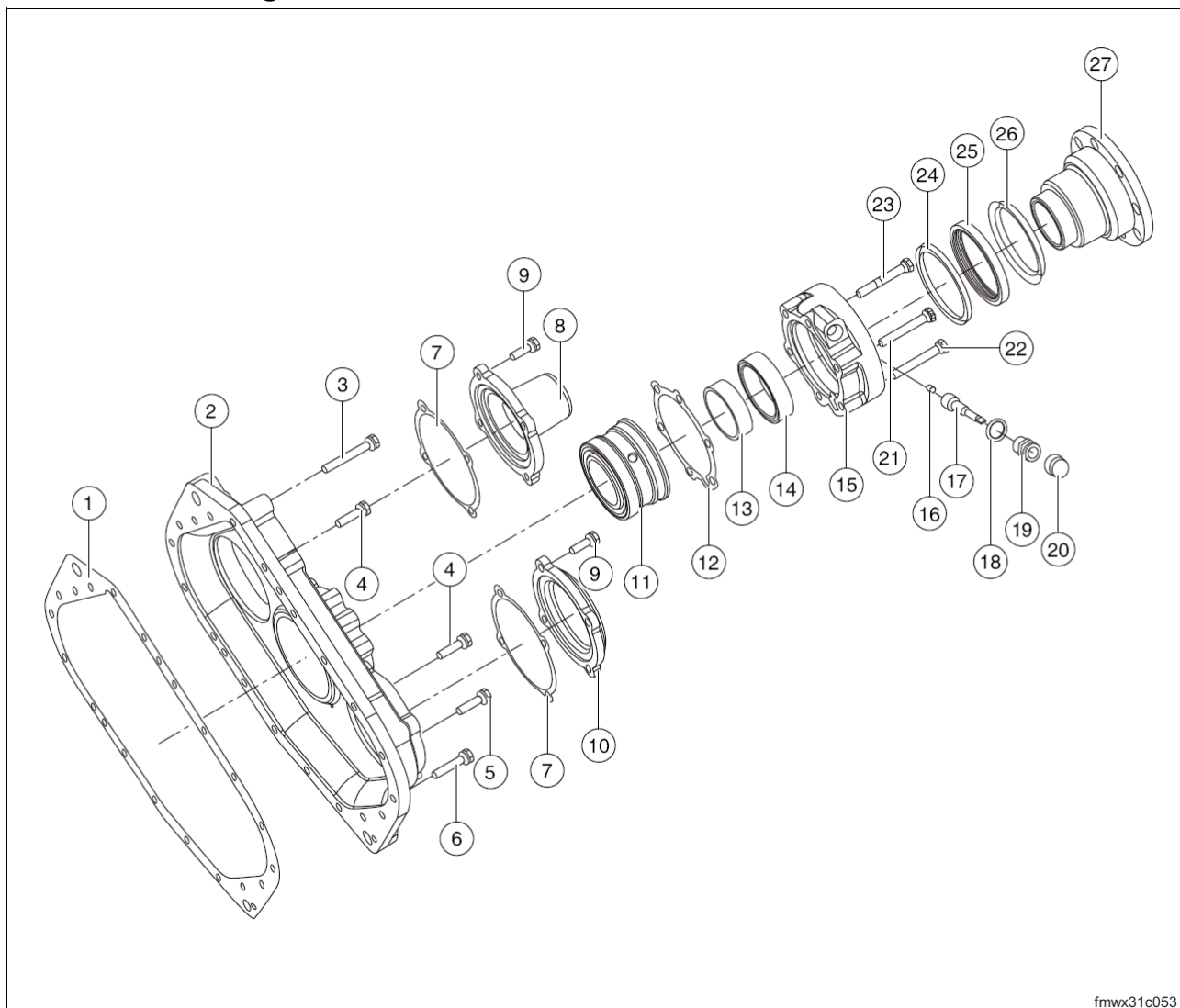


- (i). Install the fastening bolts of the upper cover.
Torque: **54.5±7N.m**

4. Install the single H control mechanism assembly of the transmission. Refer to Chapter 31C Transmission 12JS160TA – Single H Control Mechanism, Disassembly and Assembly.

Transmission Auxiliary Box

Part Drawing



1	Rear Cover Gasket
2	Rear Cover Housing
3	Hex Head Bolt and Spring Washer Assembly
4	Hex Head Bolt, Spring Washer and Flat Washer Assembly
5	Hex Head Bolt and Spring Washer Assembly
6	Hex Head Bolt and Spring Washer Assembly
7	Gasket, Countershaft Bearing Cap
8	Lengthened Countershaft Cap
9	Bolt Assembly
10	Bearing Cap, Auxiliary Box Countershaft

15	Output Shaft Rear Bearing Cap
16	Sleeve, Odometer Driven Gear
17	Odometer Driven Gear
18	Gasket
19	Odometer Joint
20	Odometer Protective Sleeve
21	Hex Head Bolt with Hole and Spring Washer Assembly
22	Hex Head Bolt and Spring Washer Assembly
23	Bolt Assembly
24	Oil Seal, Main Shaft Rear Bearing Cap

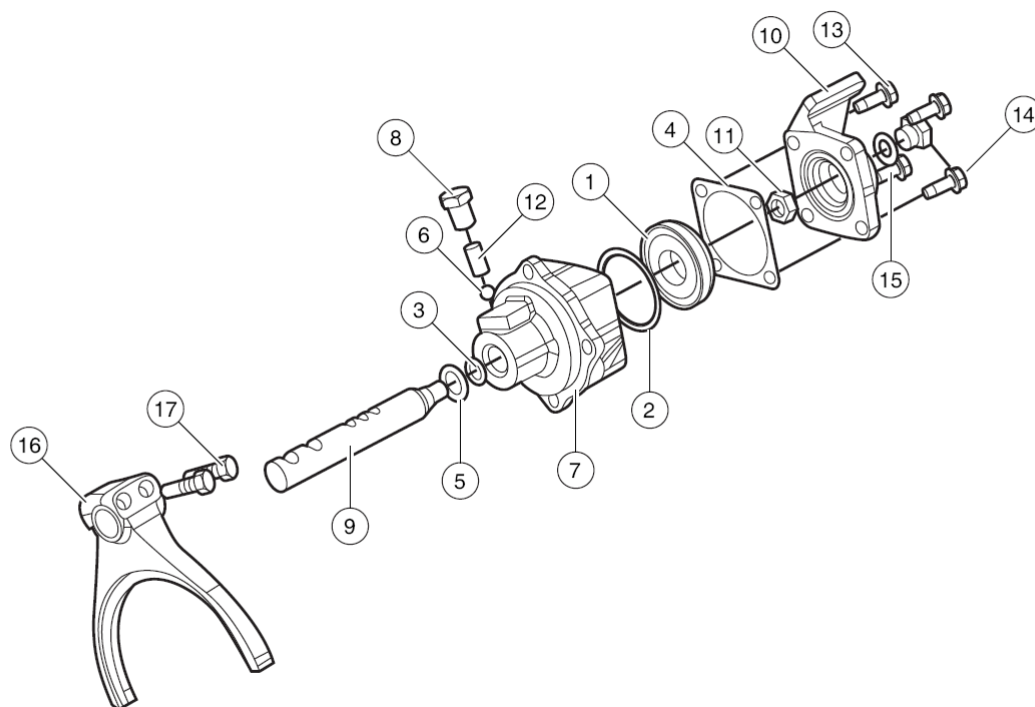
31C-54

Transmission (12JSD160) - Transmission Auxiliary Box

11	Tapered Roller Bearing
12	Gasket, Main Shaft Rear Bearing Cap
13	Sleeve, Odometer Driving Gear
14	Odometer Driving Gear

25	Oil Seal
26	Dust Cover
27	Output Flange

31C

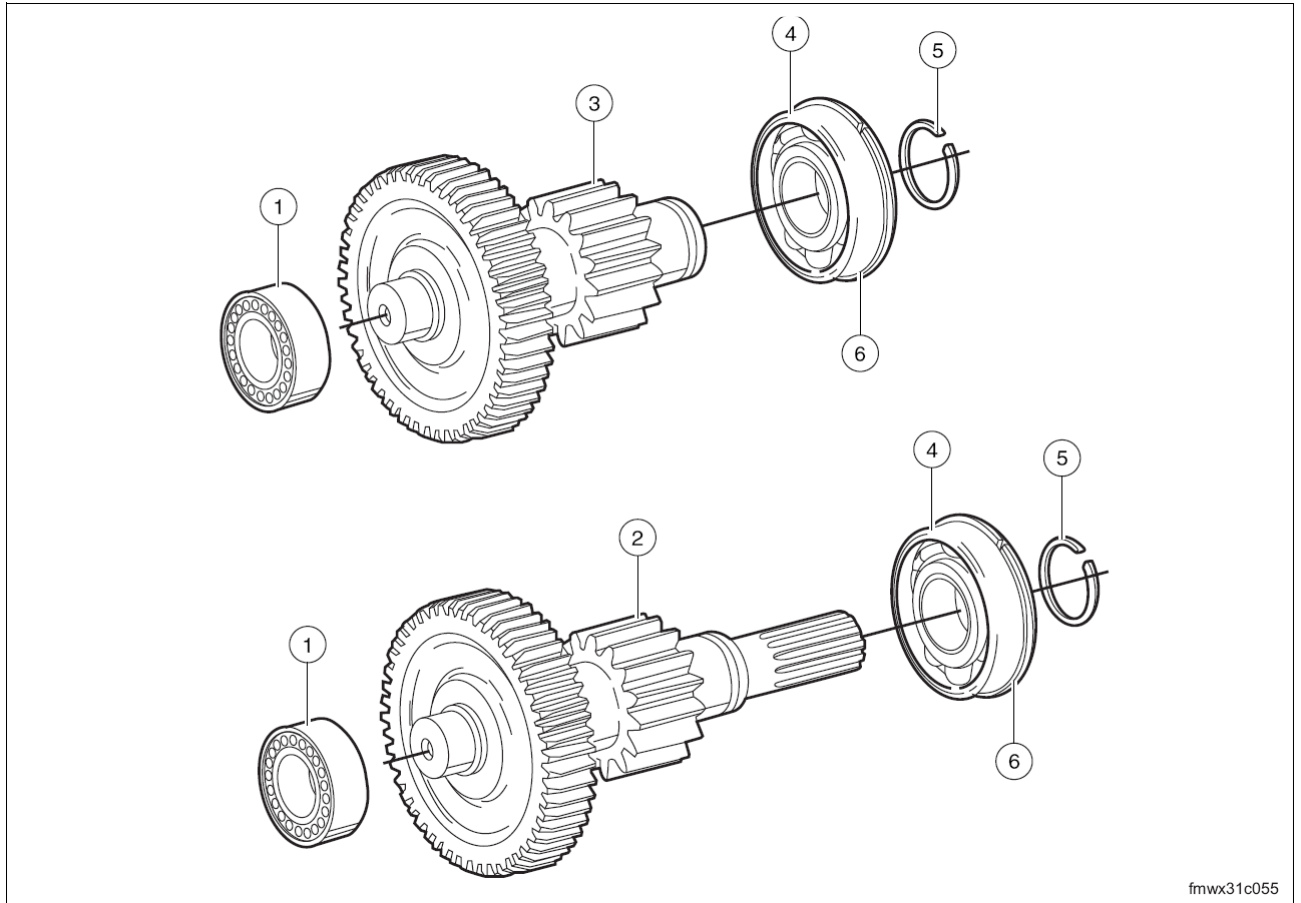


fmwx31c054

1	Cylinder Piston, Range Gear
2	O-ring
3	O-ring
4	Sealing Gasket, Cylinder Head
5	O-ring
6	Steel Ball
7	Cylinder, Range Gear
8	Screw Plug
9	Shift Fork Shaft, Range Gear

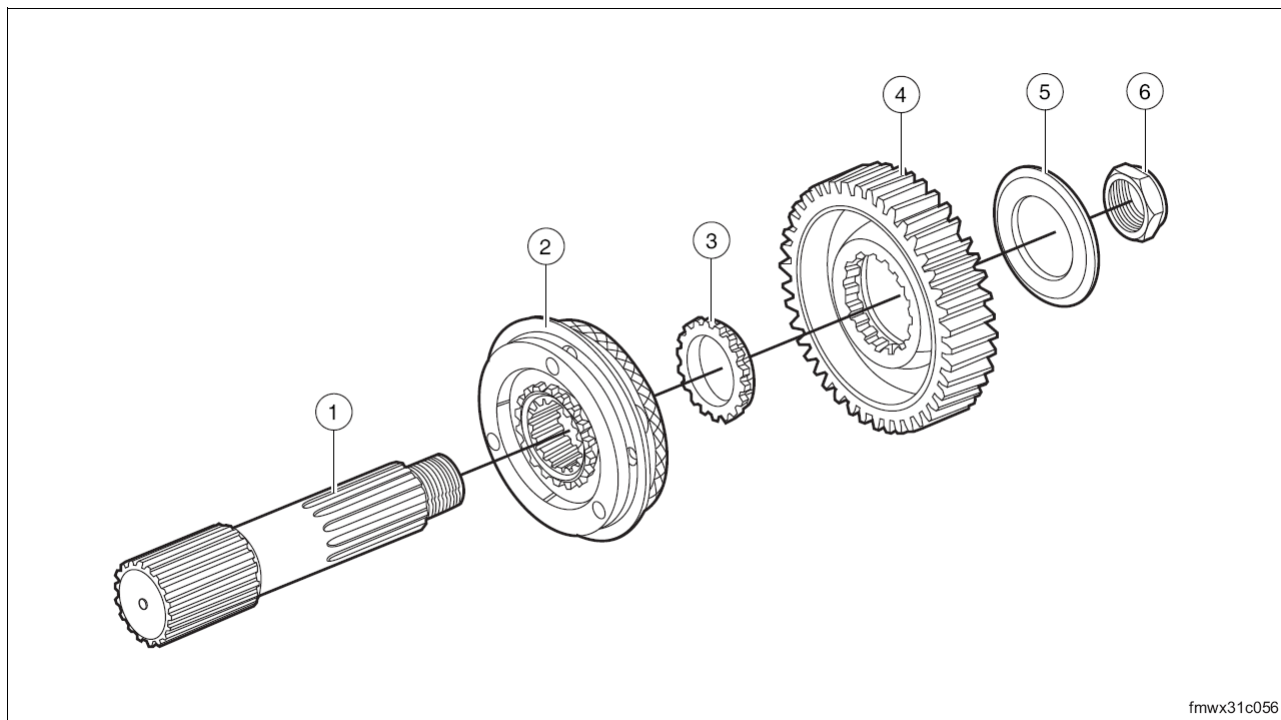
10	Gear Shift Cylinder Head, Auxiliary Box
11	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert
12	Locating Spring
13	Hex Head Bolt
14	Pressure Copper Washer Switch
15	Copper Washer
16	Auxiliary Box Shift Fork
17	Hex Head Bolt with Hole

Transmission (12JSD160) - Transmission Upper Cover



1	Short Cylindrical Roller Bearing
2	Lengthened Countershaft Welding Assembly, Auxiliary Box
3	Countershaft Welding Assembly, Auxiliary Box

4	Short Cylindrical Roller Bearing
5	Snap Ring
6	Snap Ring

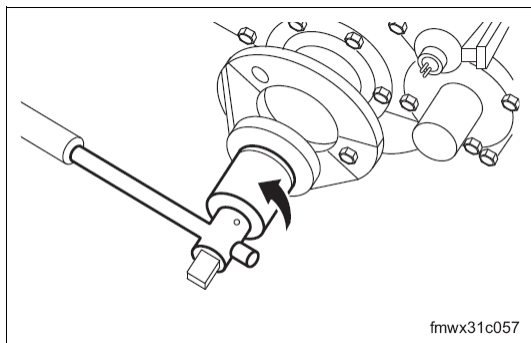


1	Auxiliary Box Main Shaft
2	High/Low Gear Synchronizer Assembly
3	Gasket, Auxiliary Box Main Shaft

4	Reduction Gear, Auxiliary Box Main Shaft
5	Pressure Plate, Auxiliary Box Main Shaft Gear
6	Nut with Collar

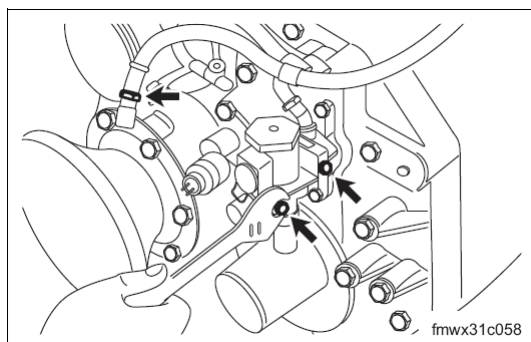
Disassembly and Assembly

1. Disassemble the auxiliary box assembly

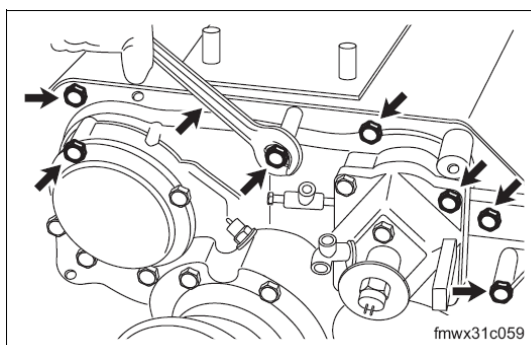


- (a). Make the two synchronizers of the main box respectively meshed with the gear
- (b). Dismantle the nut with collar by a special wrench.

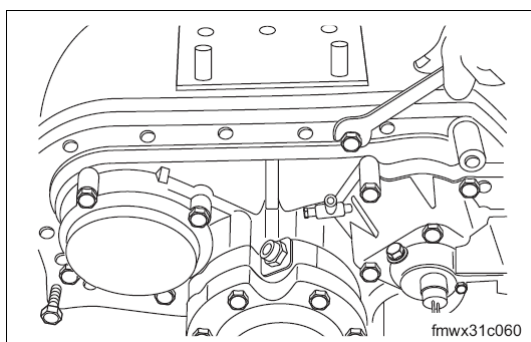
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- (c). Dismantle the three air pipe on the auxiliary box cylinder and two bolts on the air filter.



- (d). Dismantle the connecting bolt of the rear cover housing and main box.

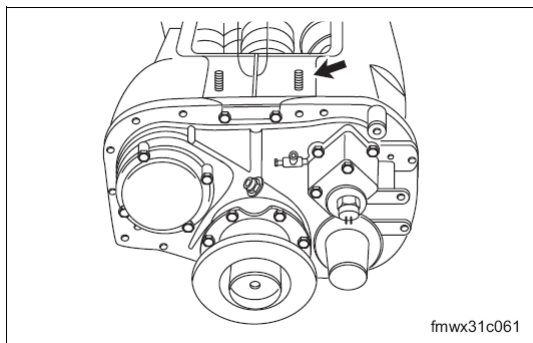


- (e). Push against the auxiliary box by about 10mm by three bolts.

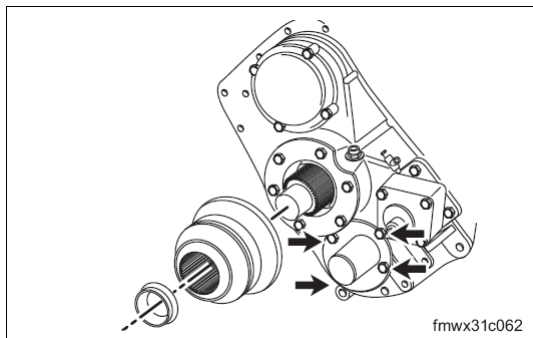
Caution:

Screw in the three bolts evenly.

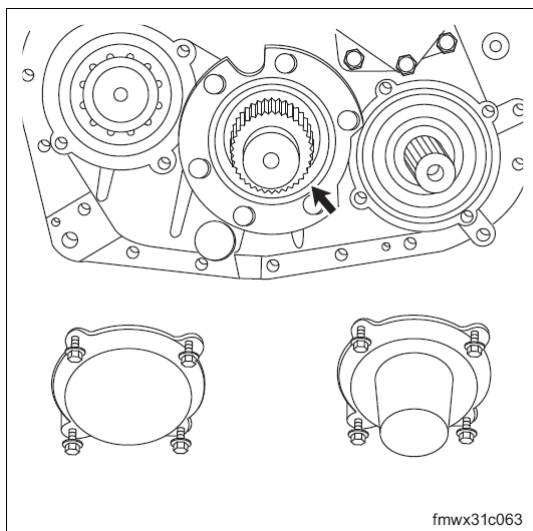
31C



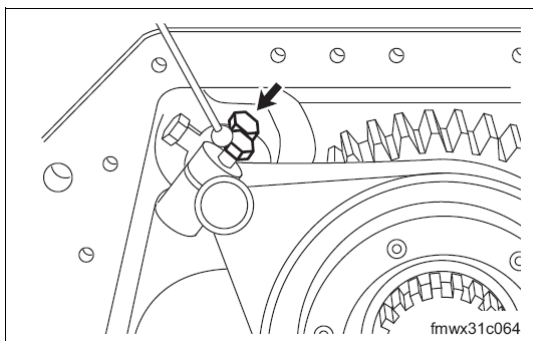
- (f). Put down the auxiliary box assembly by lifting appliance.



- (g). Remove the flange.

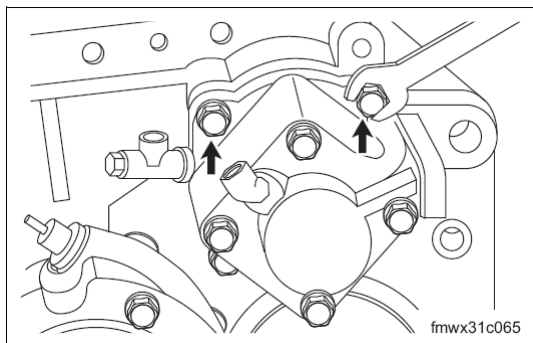


- (h). Dismantle the two output shaft bearing caps, and dismantle the snap ring on the auxiliary box countershaft by snap ring pliers.
(i). Beat out the output backward to separate it from the release bearing, and remove the countershaft bearing.

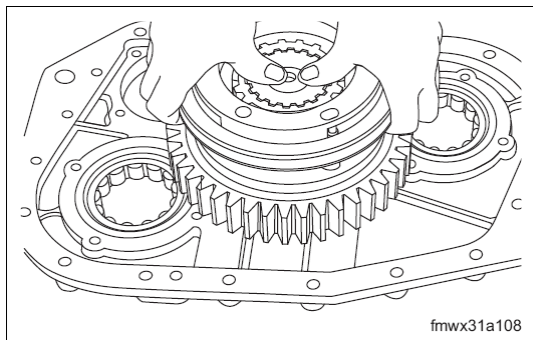


- (j). Dismantle the connecting bolt of the gear shift cylinder and gear shift fork of the auxiliary box.

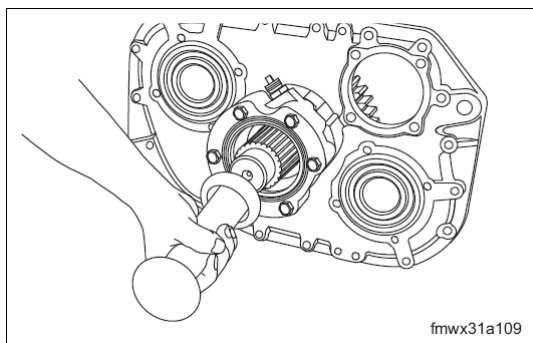
Transmission (12JSD160) - Transmission Upper Cover



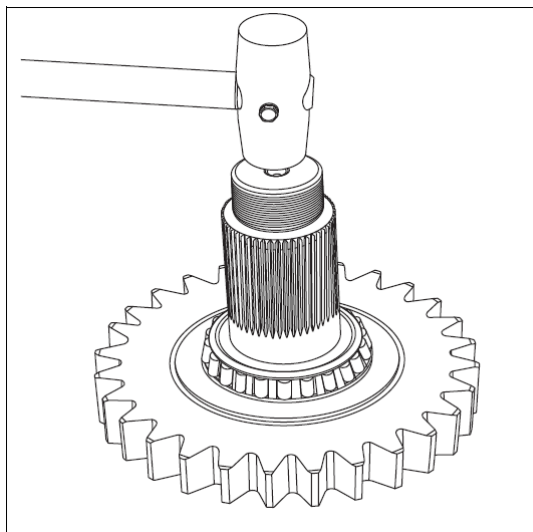
- (k). Dismantle the four bolts of the auxiliary box gear shift cylinder, and remove the cylinder assembly.



- (l). Remove the synchronizer assembly from the output shaft.



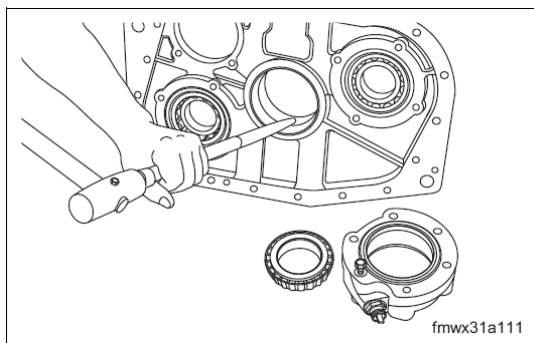
- (m). Take out the output shaft to separate it from the auxiliary box.



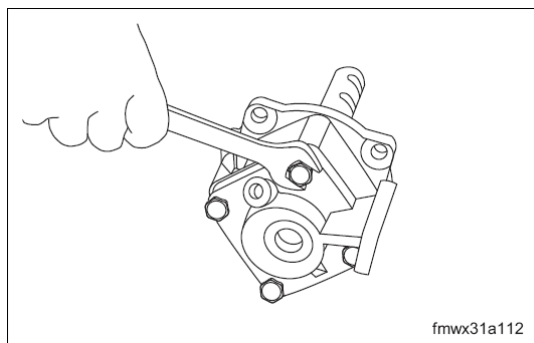
- (n). Take out the output shaft to separate it from the bearing.

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31C

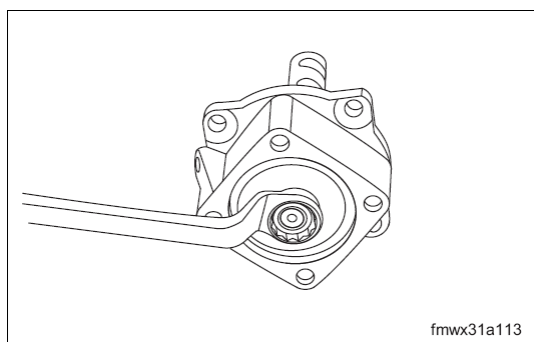


- (o). Dismantle the output shaft bearing cap, beat with a soft rod and take out the bearing outer ring in the rear cover housing.

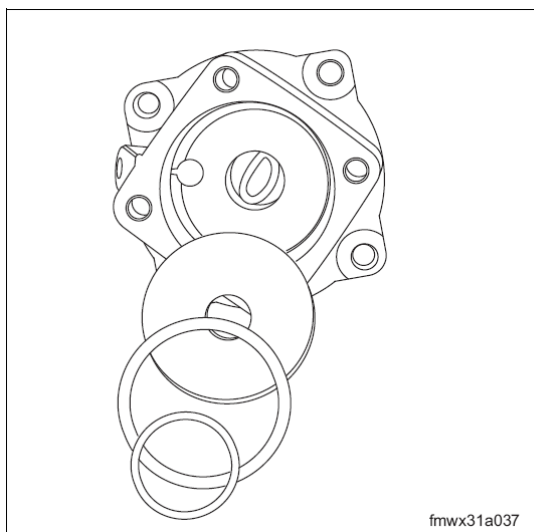


2. Disassemble the gear shift cylinder of the auxiliary box

- (a). Dismantle the four bolts on the cylinder head, and remove the cylinder head.

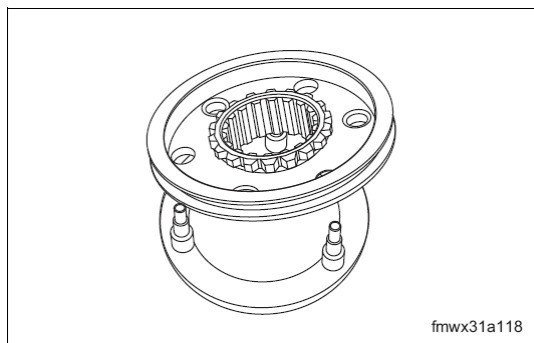


- (b). Dismantle the self-locking nut on the piston.



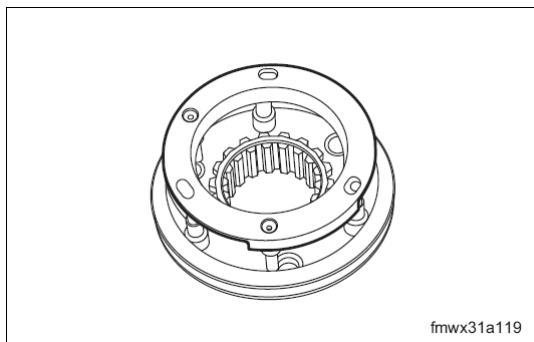
- (c). Remove the piston and three O-rings of the gear shift cylinder in order.

Transmission (12JSD160) - Transmission Upper Cover

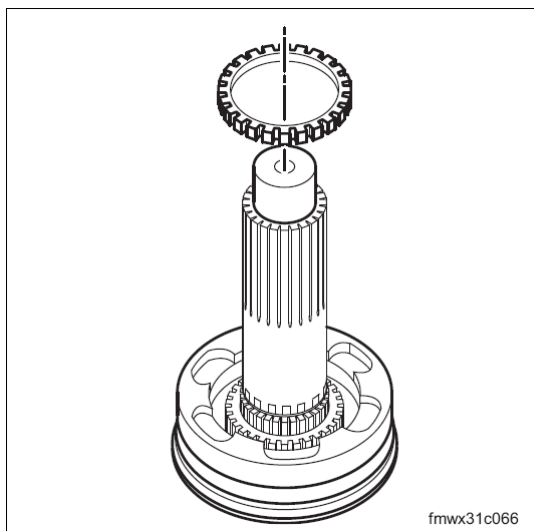


3. Assemble the auxiliary box

- (a). Clean the auxiliary box synchronizer and its components.
- (b). Put the low gear ring of the auxiliary box synchronizer flat, and put it into the synchronizer sliding sleeve.

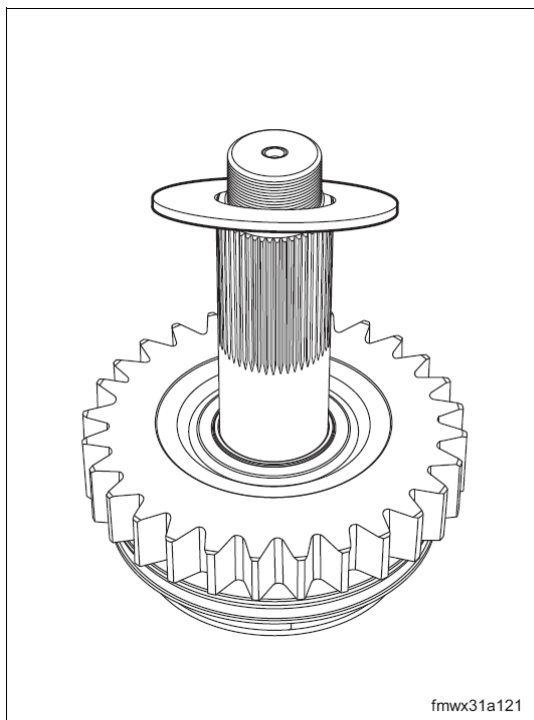


- (c). Put the three springs into the high gear ring hole, and apply a rotary force to make them matched with other parts of the synchronizer.



- (d). Put the low gear ring of the synchronizer on a wood block which is 50mm high, and insert the output shaft.
- (e). Put the washer of the auxiliary main shaft in, with the tang side facing down.

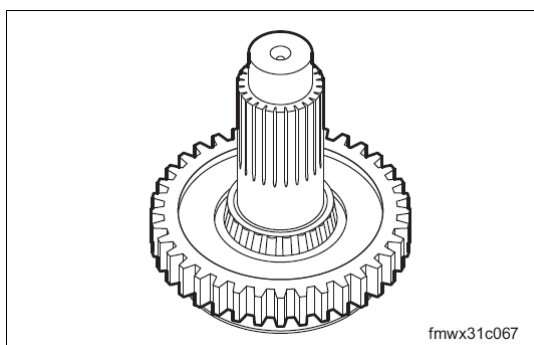
31C



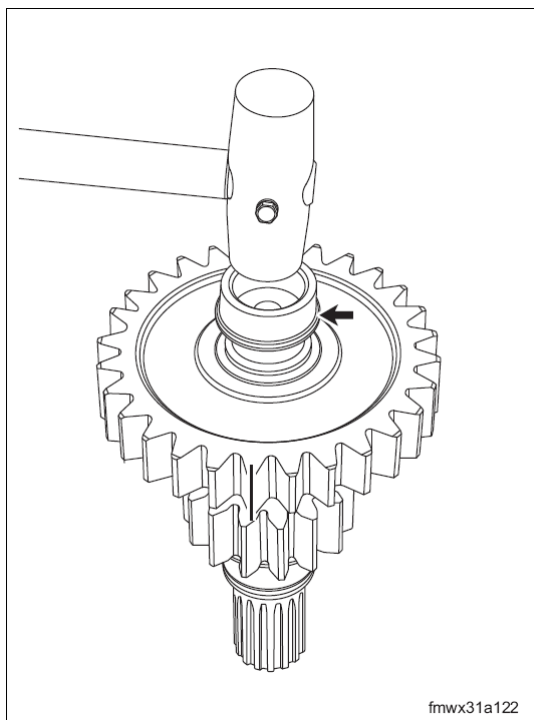
- (f). Nest the auxiliary box reduction gear into the output shaft with the plane facing up, and put the pressure plate of the auxiliary box main shaft gear in.

Caution:

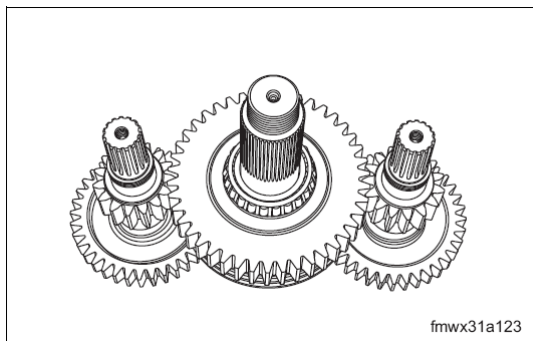
Conduct initial lubrication for the pressure plate.



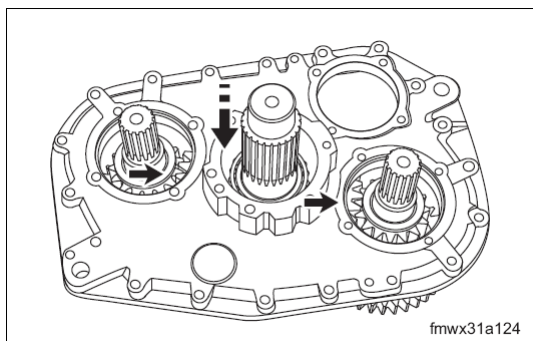
- (g). Put the one side of the combination bearing into the output shaft, and make the teeth aligning mark in the 180° direction of the auxiliary box reduction gear.



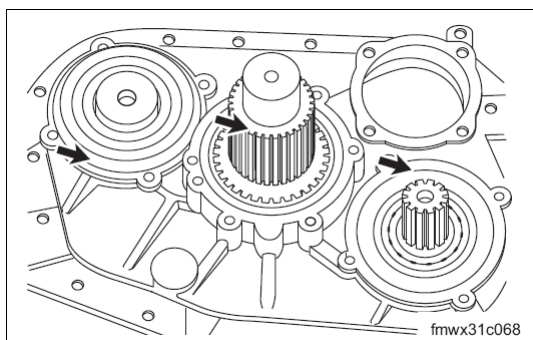
- (h). If the bearing inner ring of the auxiliary box countershaft is dismantled, install the bearing inner ring.

Transmission (12JSD160) - Transmission Upper Cover

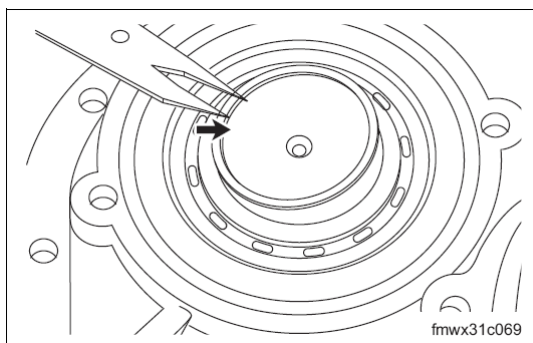
- (i). Put the marked teeth of the two countershafts into the marked grooves of the reduction gear.



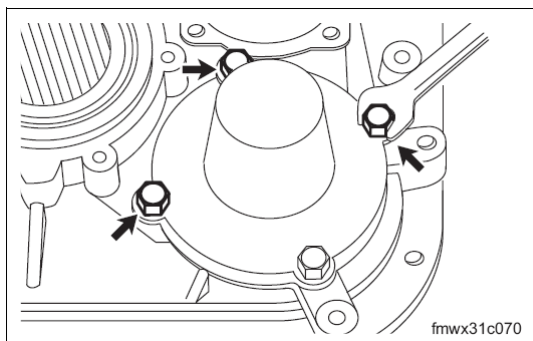
- (j). Put the rear cover housing in.



- (k). Install the combination bear and the roller bearings on the two lengthened countershafts.



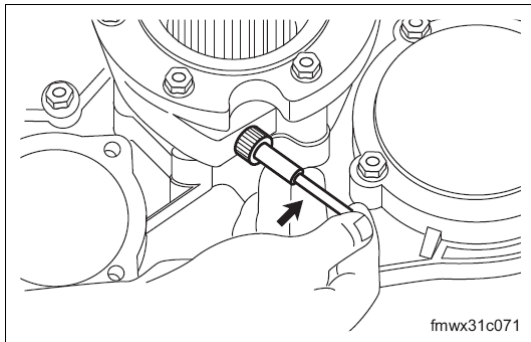
- (l). Install the snap rings on the two lengthened countershafts.



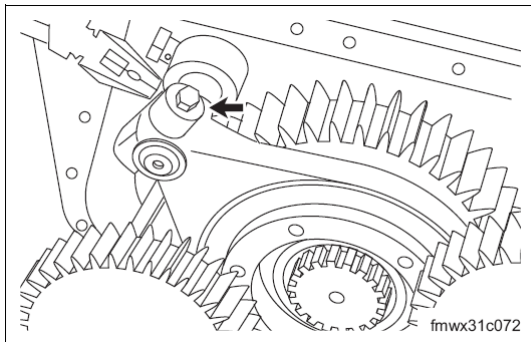
- (m). Install the two countershaft caps.
Torque: **54.5±7N.m**

Hint:
Install the power take-off if the power take-off is provided.

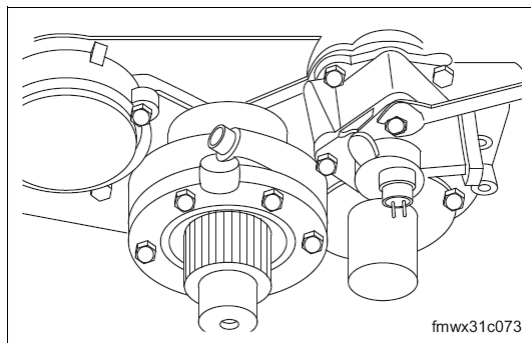
31C



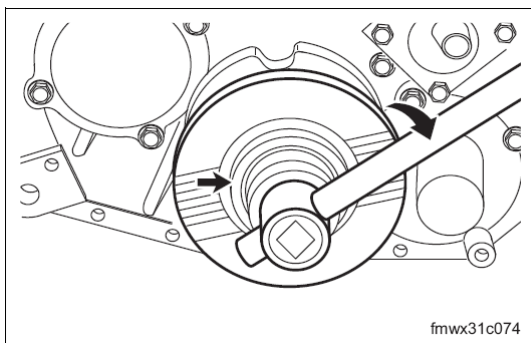
- (n). Install the output shaft bearing cap, and put the odometer driving and driven gears and joint in.



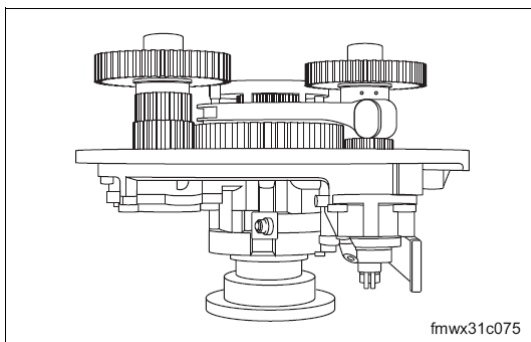
- (o). Insert the gear shift fork of the auxiliary box into the synchronizer sliding sleeve, with the plane facing outward, install the connecting bolt of the shift fork and gear shift cylinder, and lock with wires.



- (p). Install the gear shift cylinder of the auxiliary box, and tighten the four bolts.
Torque: **54.5±7N.m**

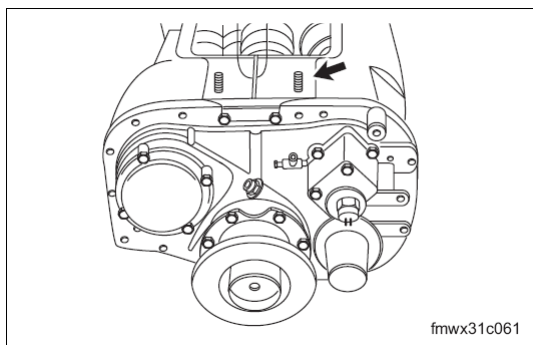


- (q). Tighten the nut with collar by a special socket.
Torque: **654±45N.m**



- (r). Place the auxiliary box synchronizer in the low gear area.

Transmission (12JSD160) - Transmission Upper Cover



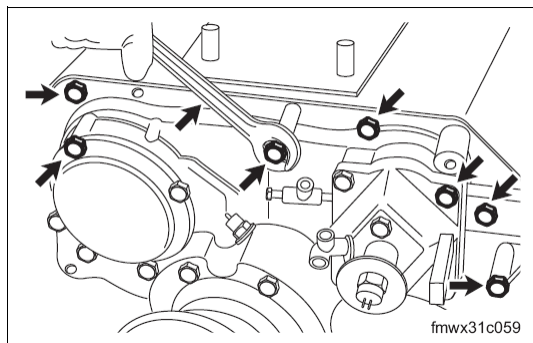
- (s). Apply lubricating grease in the two bearing holes of the main box.

Hint:

It is very important to install the auxiliary box.

- (t). Lift the auxiliary box assembly by special tools, and meanwhile, push the auxiliary box forward and rotate the flange by hand.

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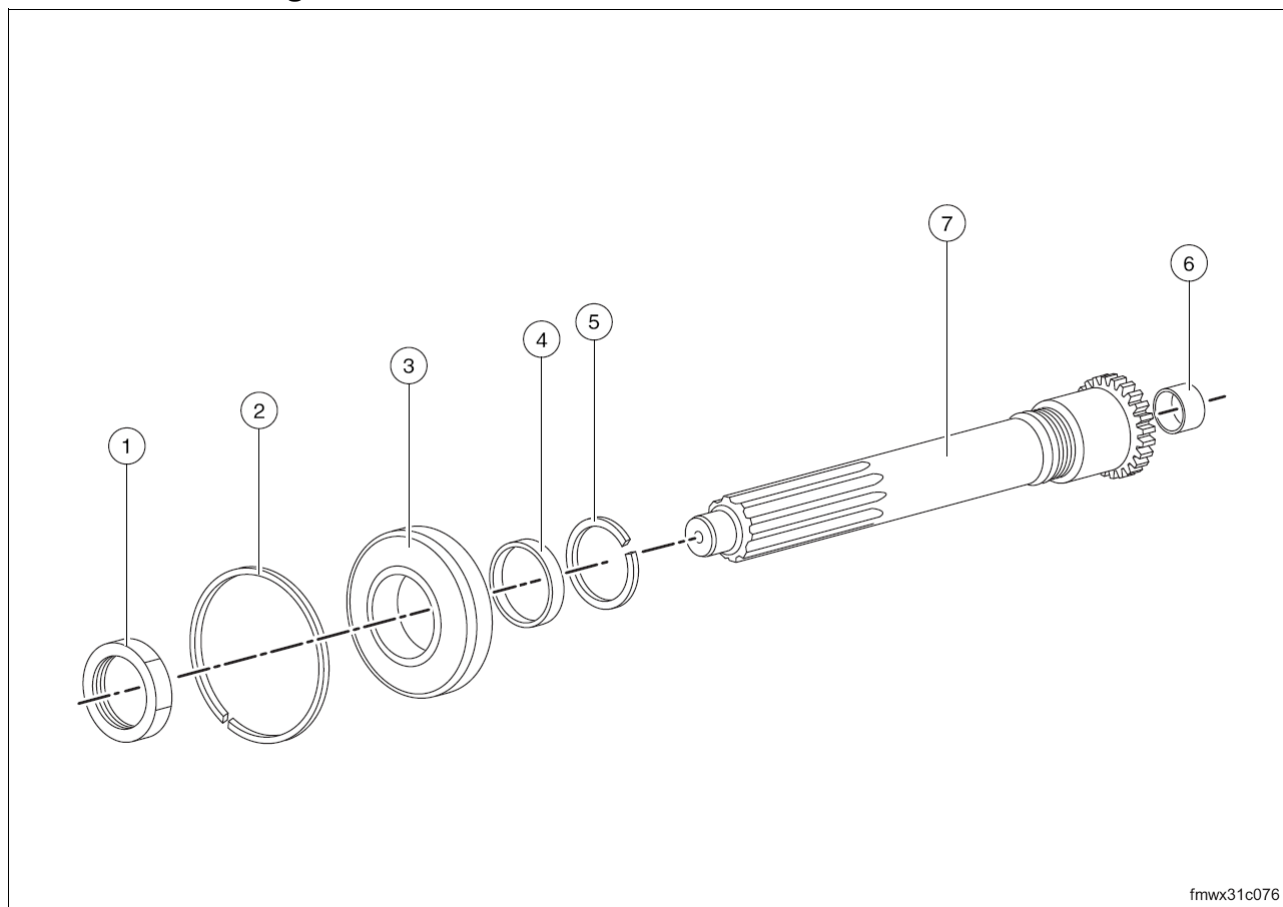
- (u). Install the auxiliary box in position, and tighten the rear cover bolts.

Torque: **54.5±7N.m**

Transmission Main Box

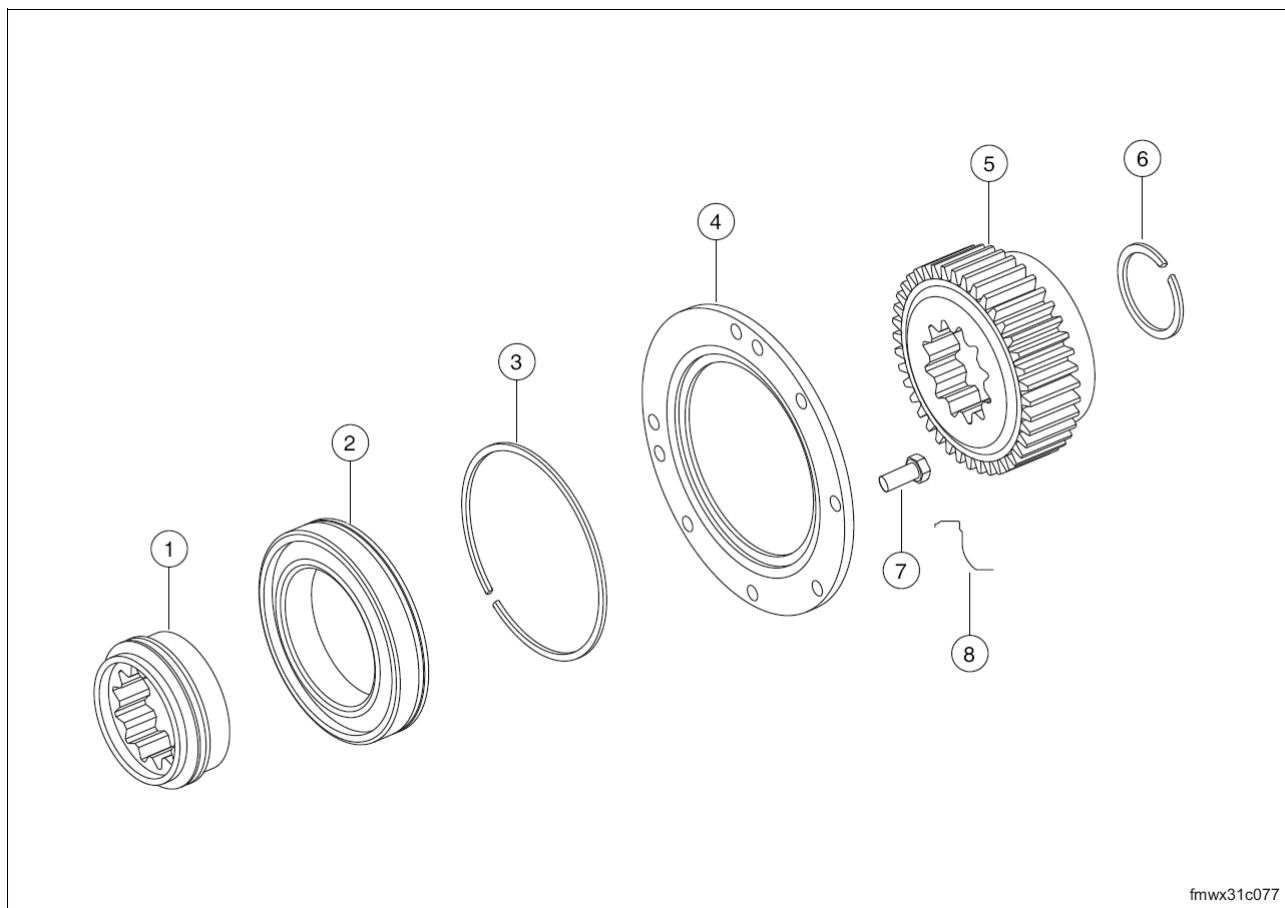
Part Drawing

31C



1	Primary Shaft Nut
2	Snap Ring
3	Single-row Centripetal Bearing
4	Gear Spacer

5	Snap Ring
6	Main Shaft Guide Sleeve
7	Primary Shaft

Transmission (12JSD160) - Transmission Main Box


1	Bearing Support
2	Single-row Centripetal Bearing with Snap Ring Groove
3	Snap Ring
4	Locating Disc, Auxiliary Box Bearing

5	Auxiliary Box Driving Gear
6	Snap Ring
7	Hex Bolt with Wire Hole on Head
8	Wire

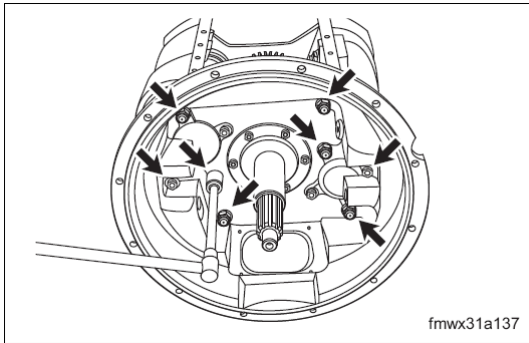
Transmission (12JSD160) - Transmission Main Box

2	Gasket, Primary Shaft Bearing Cap	19	Hex Head Bolt and Spring Washer Assembly
3	Round Magnet	20	Hex Head Bolt
4	Cover, Bottom Power Take-off Window	21	Hex Head Bolt
5	Gasket, Bottom Power Take-off Window	22	Hex Head Bolt
6	Gasket, Clutch Housing	23	Hex Head Bolt
7	Spring Washer	24	Hex Head Bolt
8	Transmission Housing	25	Hex Bolt with Wire Hole on Head
9	Rating Plate	26	Cross Recessed Pan Head Tapping Screw
10	Stud Bolt	27	Slotted Set Screw with Flat Point
11	Prevailing Torque Type Hex Nut, Heavy Type, with Nylon Insert	28	Hex Nut, Style 1
12	Cover, Side Power Take-off Window	29	Flat Washer
13	Clutch Housing	30	Flat Washer
14	Hand Hole Cover	31	Spring Washer
15	Hand Hole Cover	32	Spring Washer
16	Slotted Tapered Nut	33	Framework Oil Seal
17	Primary Shaft Bearing Cover		

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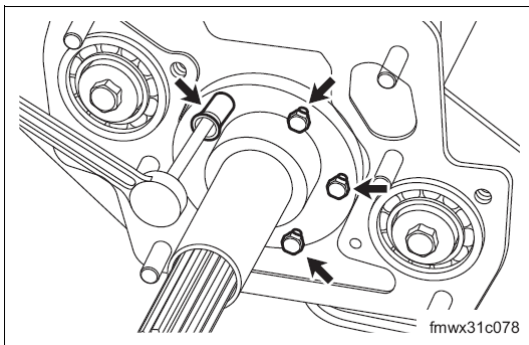
Disassembly and Assembly

1. Dismantle the upper cover assembly. Refer to Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly



2. Dismantle the clutch cover assembly

- (a). Loosen the connecting bolt, and remove the clutch housing.

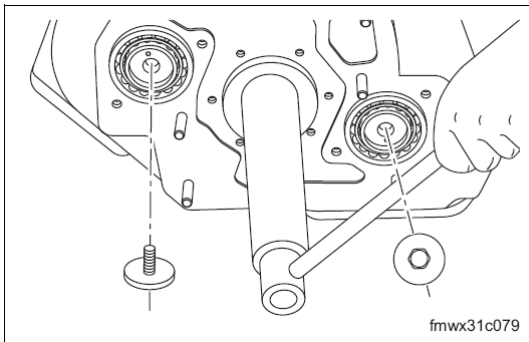


3. Dismantle the primary shaft assembly

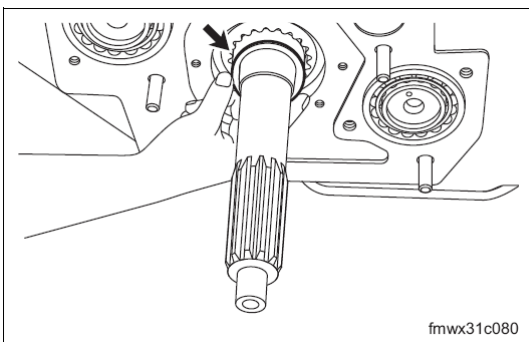
Hint:

This method can be used for replacing the primary shaft without dismantling the main box.

- (a). Dismantle the bolts of the primary, and slightly beat and remove the primary shaft cap.
- (b). Make the main box synchronizers respectively meshed with two groups of gears.

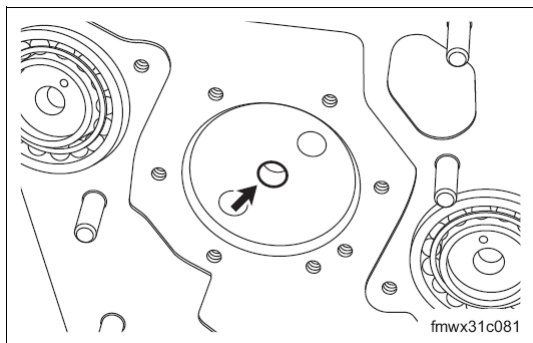


- (c). Dismantle the bearing pressure plate at the front end of the two main box countershafts, and dismantle the primary shaft nuts by a special tool.



- (d). Beat the primary shaft inward by a copper rod.
- (e). Beat the primary shaft left and right to make the bearing come out from the housing hole.
- (f). Remove the spacer of the primary shaft gear.
- (g). Dismantle the snap ring in the primary shaft gear.

Transmission (12JSD160) - Transmission Main Box

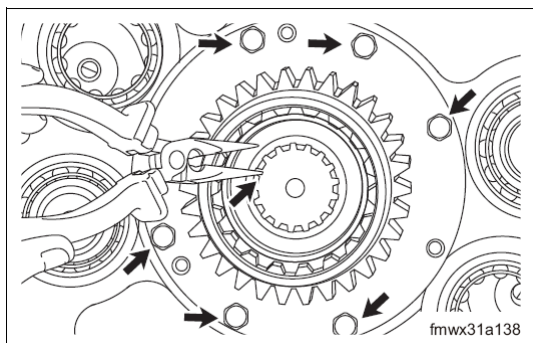


- (h). **Press the primary shaft gear by the pressure plate and one bolt (M10*1).**

Hint:

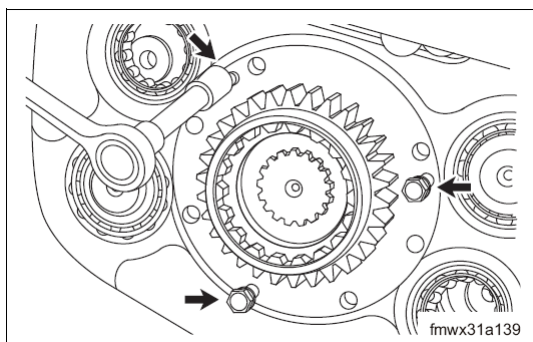
In order to avoid damaging the 5th/6th gear synchronizer during dismantlement and installation, fix the primary shaft gear to the main shaft by the pressure and bolt when dismantling and installing the main shaft.

31C

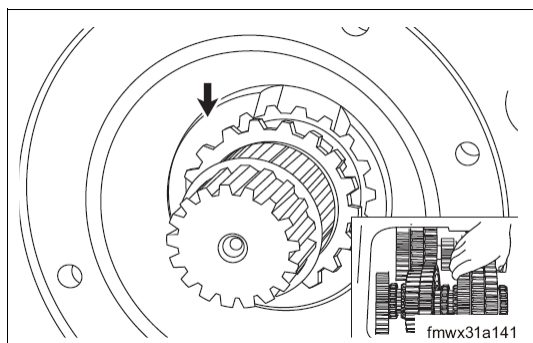


4. Dismantle the driving gear

- (a). Cut off the locking wire of the driving gear assembly, and dismantle the six bolts with hole.
 (b). Dismantle the snap ring.

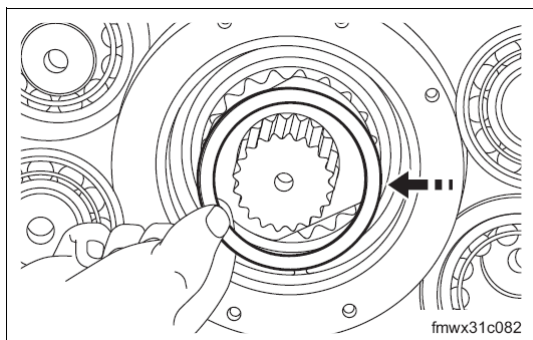


- (c). Push out the driving gear assembly by three bolts.



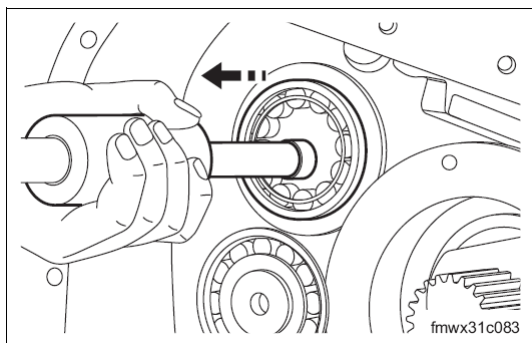
5. Dismantle the reverse intermediate gear assembly

- (a). Dismantle the snap ring in the main shaft reverse gear.

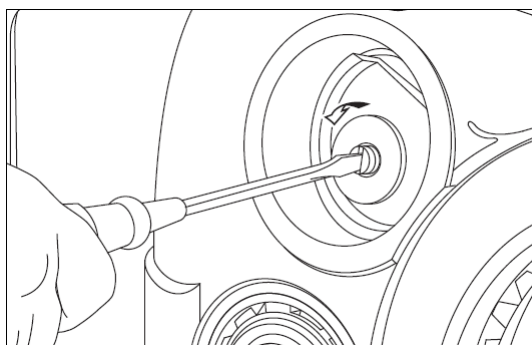


- (b). Take out the main shaft gear washer in the main shaft reverse gear.

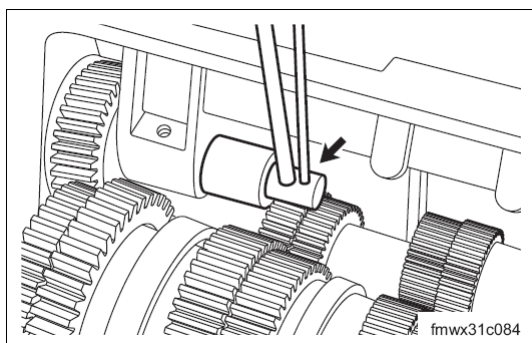
31C



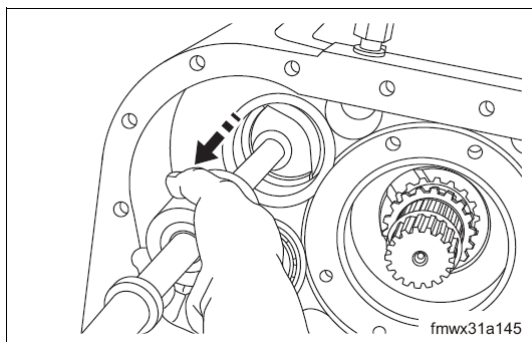
- (c). Pull out the bearing at the rear end of the reverse intermediate gear shaft by a special tool.



- (d). Dismantle the screw plug in the reverse intermediate gear shaft.



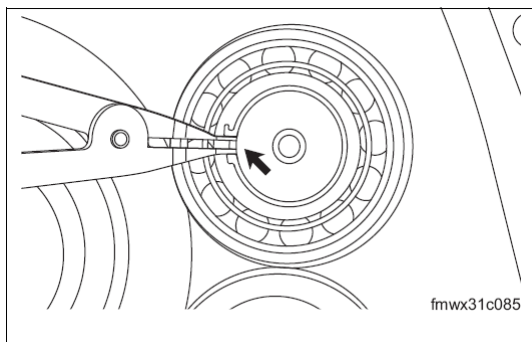
- (e). Dismantle the self-locking nut on the reverse intermediate gear shaft.



- (f). Dismantle the reverse intermediate gear shaft by a special shaft puller.

Caution:

Prevent the reverse idler from damage by falling.

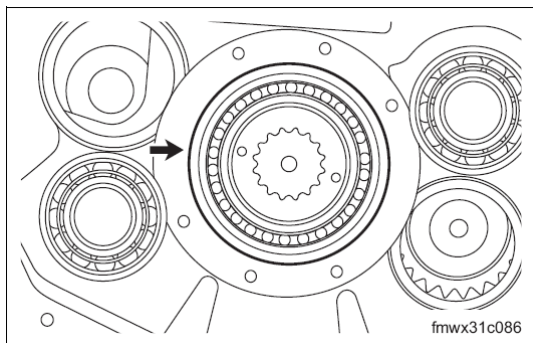


6. Dismantle the main shaft assembly

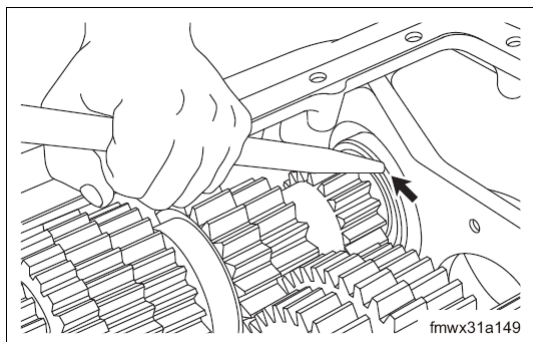
- (a). Dismantle the snap ring at the rear end of the main box countershaft.

Transmission (12JSD160) - Transmission Main Box

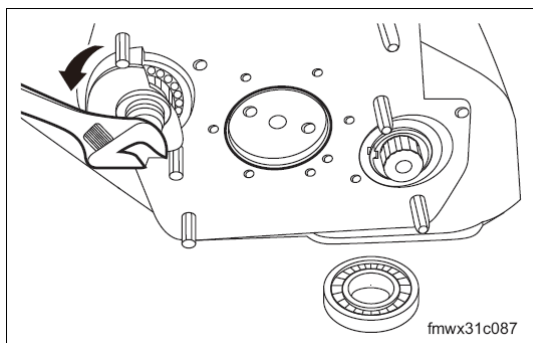
31C



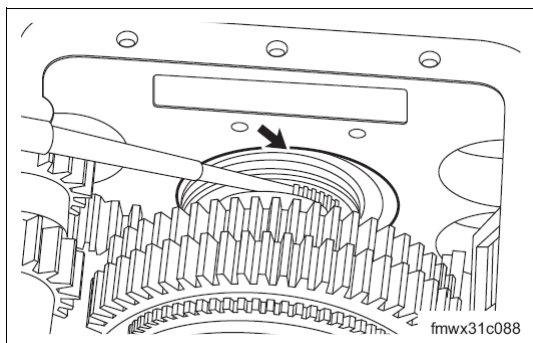
- (b). Install the driving gear shaft to locate the rear end of the main shaft.



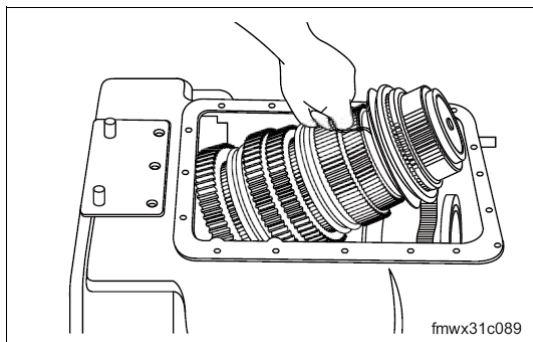
- (c). Dismantle the rear bearing of the countershaft by a soft rod.



- (d). Beat the countershaft backward by about 10mm by a copper rod, and dismantle the front bearings of the two countershafts.

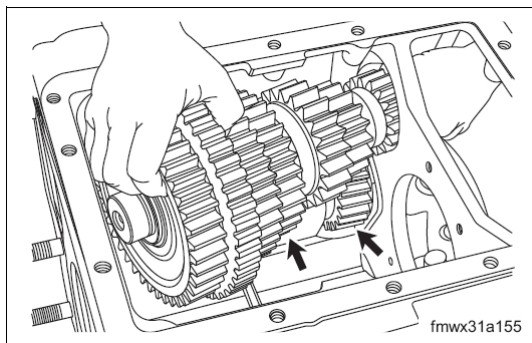


- (e). Re-dismantle the driving gear bearing.

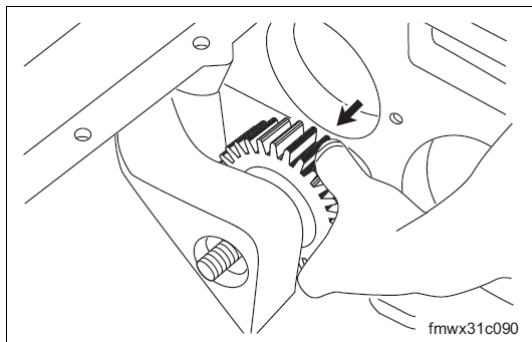


- (f). Take out the main shaft assembly from the main box.

31C

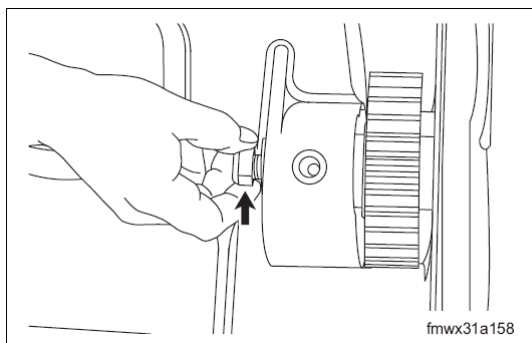


- (g). Take out the countershaft assembly and reverse idler from the main box housing.

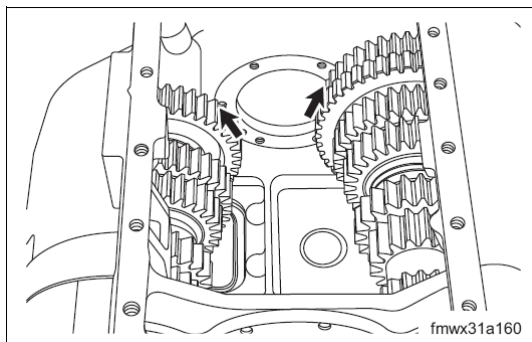


7. Assemble the main box

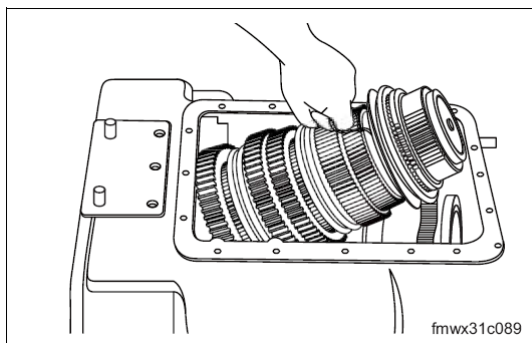
- (a). Put the reverse intermediate gear into the housing, with the convex side facing forward.
(b). Install the reverse intermediate gear shaft.



- (c). Tighten the self-locking nut at the front end of the right reverse intermediate gear shaft.
Torque: **77±10N.m**



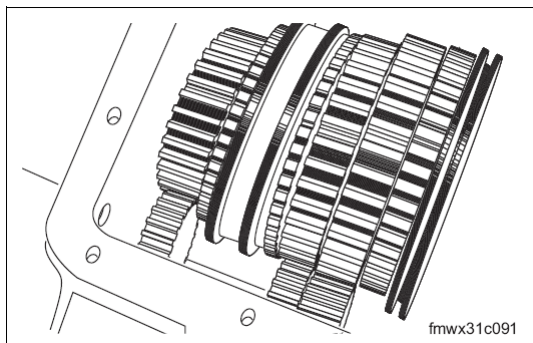
- (d). Make the teeth aligning marks on the teeth facing the keyways of the two countershafts.
(e). Put the two countershaft assemblies into the main box housing.



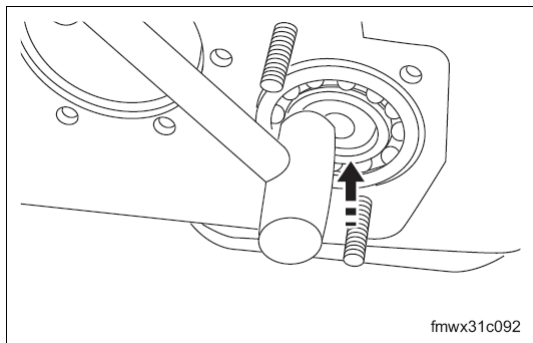
- (f). After making the teeth aligning marks on a pair of teeth which are 180° adjacent on the primary shaft gear, put the main shaft assembly into the main box, and install the driving gear shaft to locate the rear end of the main shaft.

Transmission (12JSD160) - Transmission Main Box

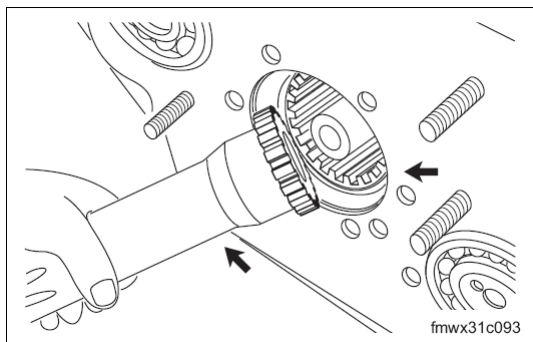
31C



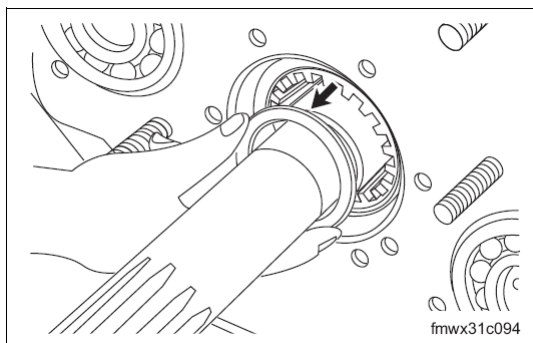
- (g). Insert the marked tooth on the countershaft into the marked groove on the primary shaft gear, and install the rear bearing of the countershaft.



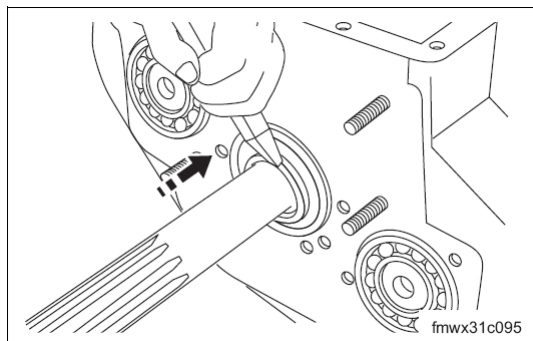
- (h). Install the front bearings of the two countershafts.



- (i). Remove the pressure plate in front of the primary shaft gear, apply lubricating grease in the primary shaft hole, and install the primary shaft gear inner spline into the primary shaft.

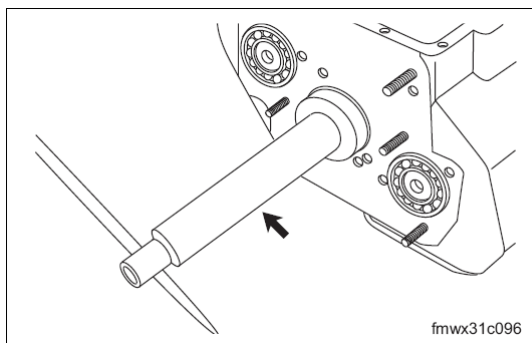


- (j). Install the snap ring of the primary shaft gear.
(k). Install the spacer of the primary shaft gear.



- (l). Install the primary shaft bearing.

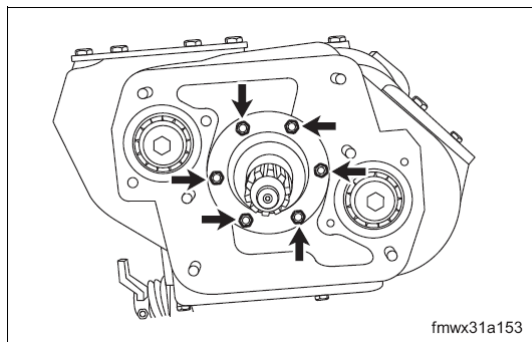
31C



- m). Apply sealant on the primary shaft nut, and install the primary shaft nut by a special tool.

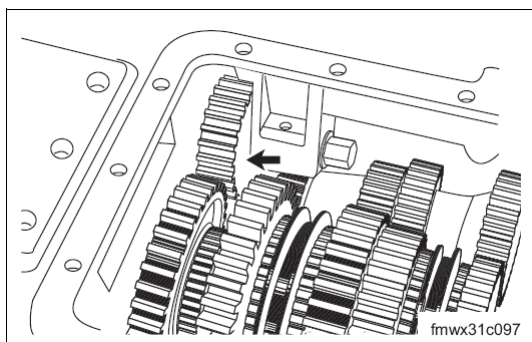
Torque: **372±34N.m**

- (n). Rivet the primary shaft nut at the thread with groove of the primary shaft.

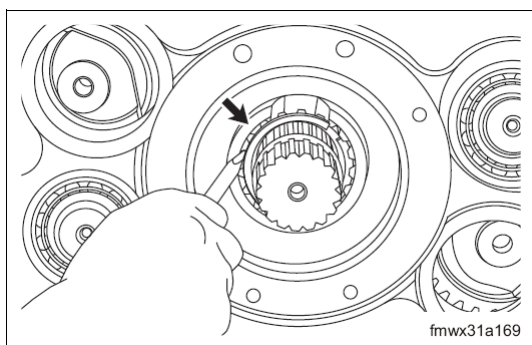


- (o). Install the front baffle plates of the two countershafts, and install the primary shaft cap.

Torque: **54.5±7N.m**

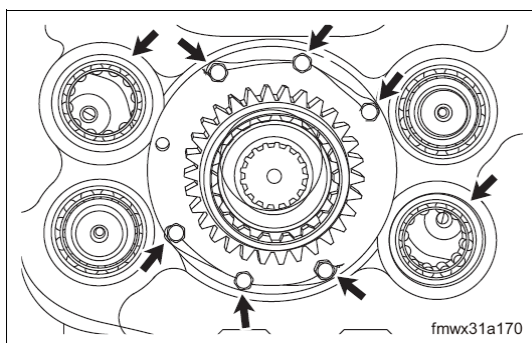


- (p). Install the reverse intermediate gear assembly, remove the driving gear bearing, and pull the main shaft reverse gear backward to mesh with the reverse intermediate gear.



- (q). Install the main shaft gear washer in the main shaft reverse gear.

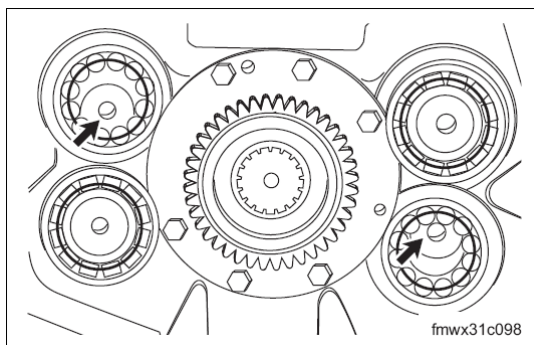
- (r). Install the snap ring in the main shaft reverse gear.



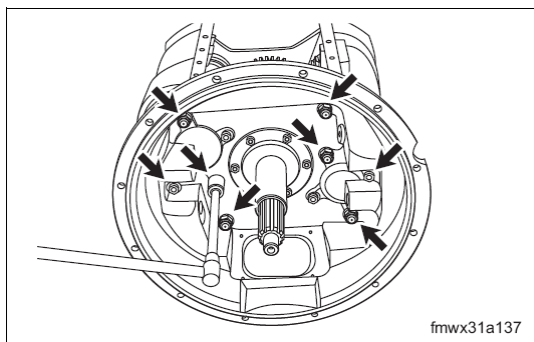
- (s). Install the driving gear bearing, install the locating disc of the driving gear, and fasten the locking wires by the bolts.

Torque: **54.5±7Nm**

Transmission (12JSD160) - Transmission Main Box



- (t). Install the driving gear of the auxiliary box, and install the snap ring at the rear end.
- (u). Install the front bearings of the two lengthened countershafts, install the snap rings at the rear end of the tow main box countershafts.

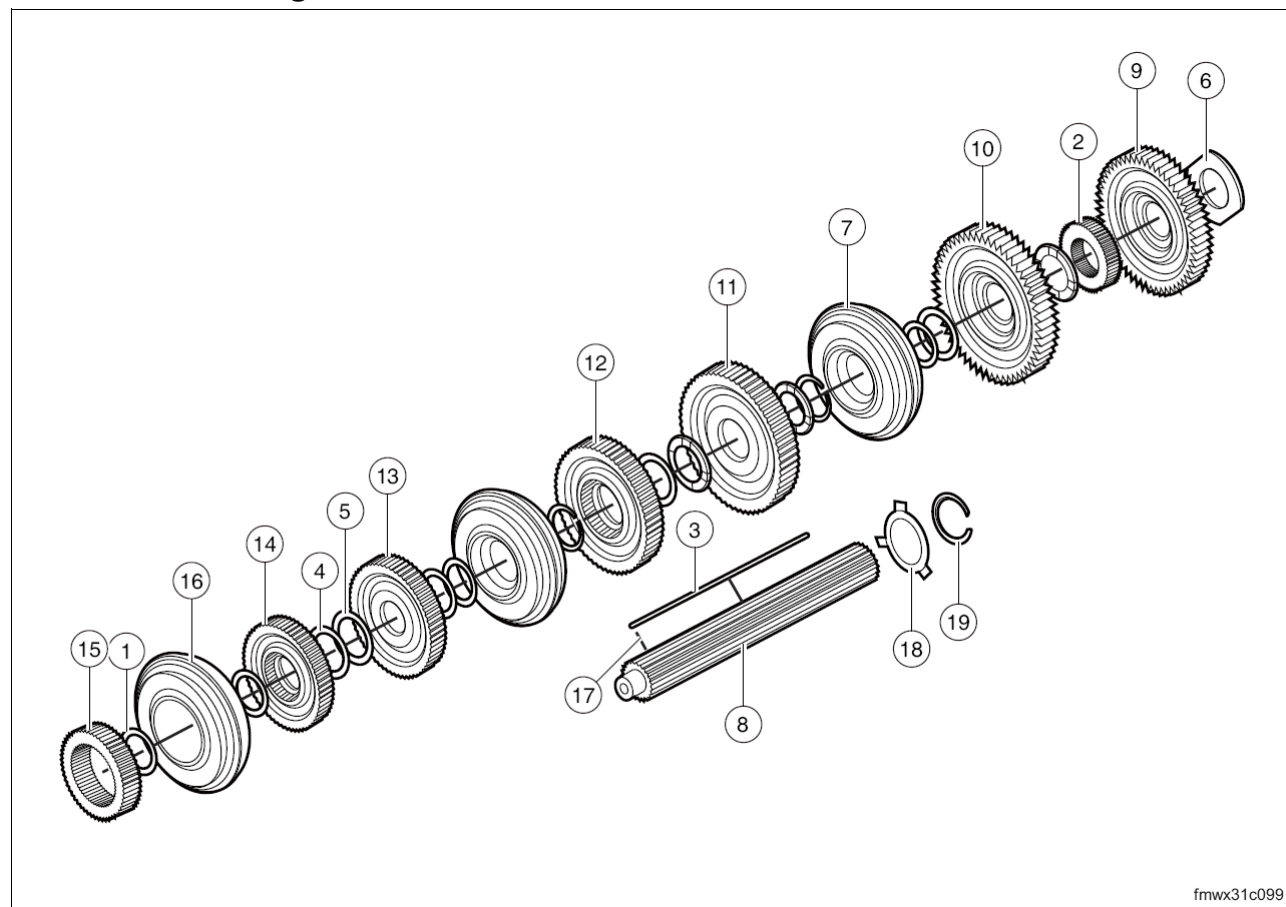


- (v). Install the clutch cover assembly
Torque: **257.5±13.5N.m(M16)**
Torque: **121.5±13.5N.m(M12)**

8. Install the transmission upper cover. Refer to Chapter 31C Transmission 12JS160TA – Transmission Upper Cover, Disassembly and Assembly.

Main Shaft Assembly Part Drawing

31C



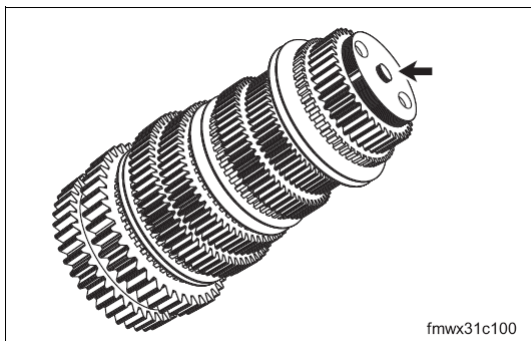
fmwx31c099

1	Snap Ring
2	Sliding Sleeve
3	Main Shaft Hex Key
4	Main Shaft Gear Spline
5	Gear Spacer
6	Gasket, Reverse Gear
7	1st/2nd Gear Synchronizer
8	Main Shaft
9	Main Shaft Reverse Gear
10	1st Gear

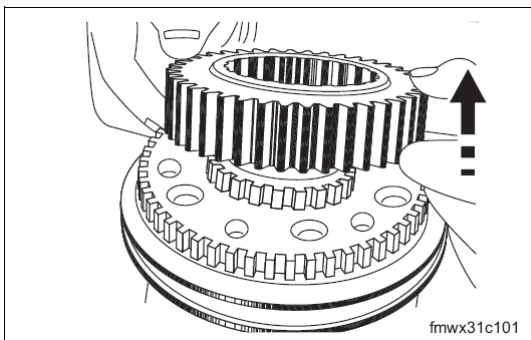
11	2nd Gear
12	3rd Gear
13	4th Gear
14	5th Gear
15	Primary Shaft Gear
16	3rd/4th Gear Synchronizer
17	Elastic Cylindrical Pin
18	Washer, Driving Gear
19	Main Shaft Low Gear

Disassembly and Assembly

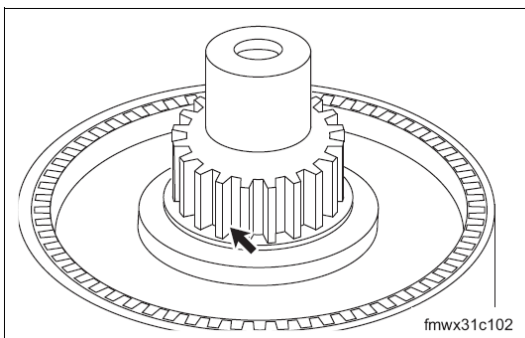
1. Disassemble the main shaft assembly



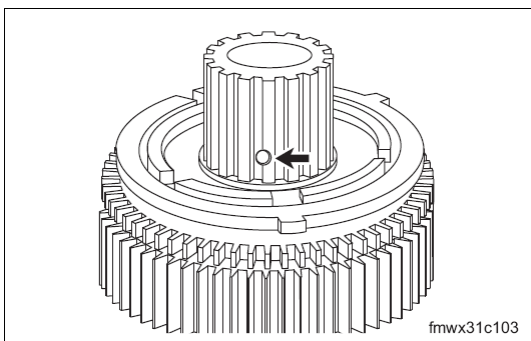
- (a). Dismantle the pressure plate on the main shaft.



- (b). Dismantle the primary shaft gear and 5th/6th gear synchronizer assembly.

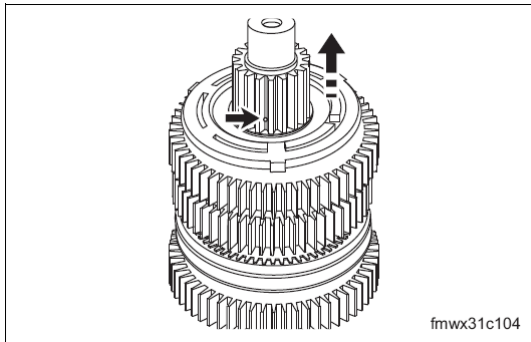


- (c). Dismantle the clamping spring and the gear hub of the 5th/6th gear synchronizer.

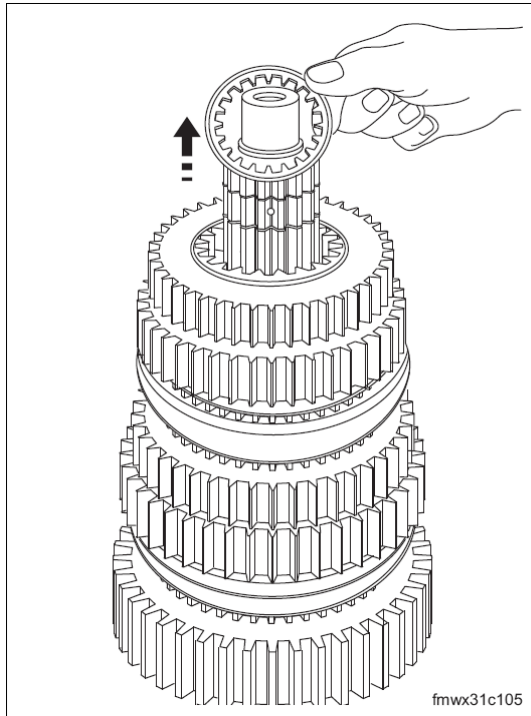


- (d). Pull out the elastic pin on the main shaft, and extract out the long key.

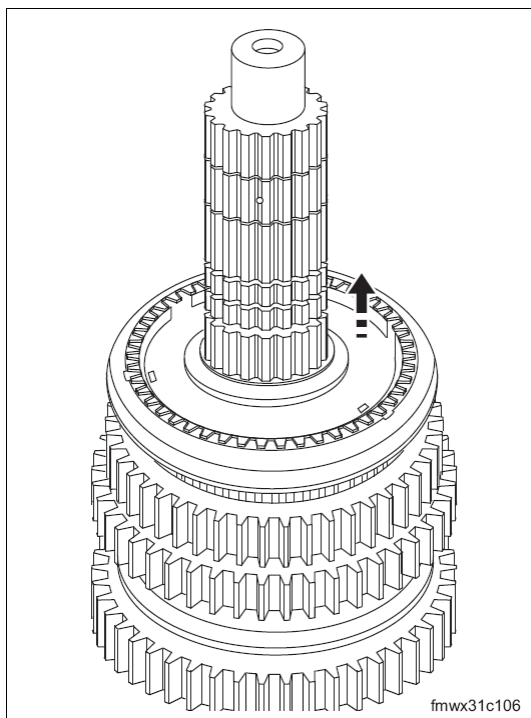
31C



- (e). Dismantle the clamping spring, and take out the components at the other side of the 5th/6th gear synchronizer.

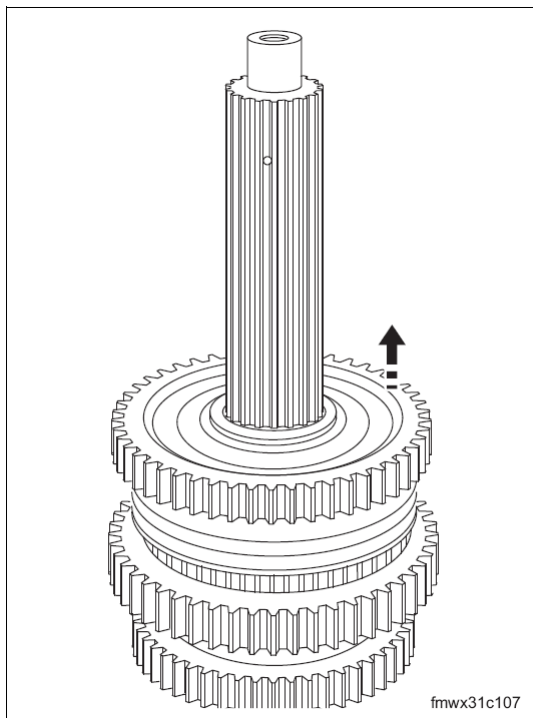


- (f). Take out the spline gasket and 5th gear.
- (g). Take out the gear spacer, and the engaging ring gear of the 4th gear.
- (h). Remove the spline gasket and components at the other side of the 3rd/4th gear synchronizer.



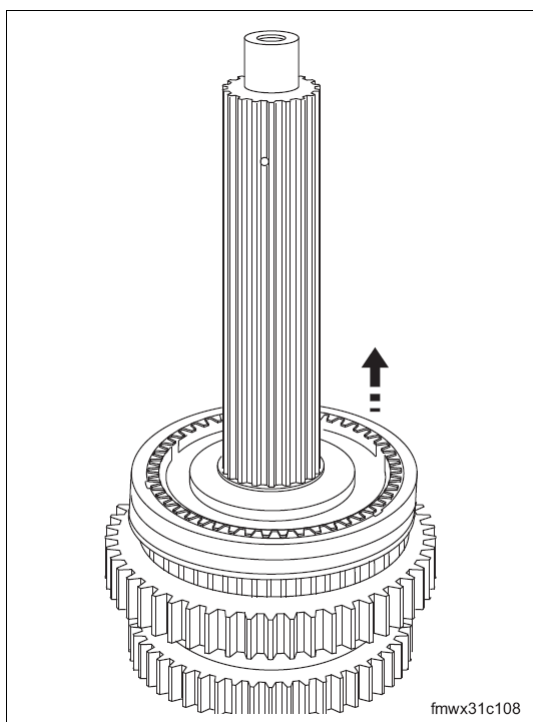
- (i). Dismantle the clamping spring, and remove the gear hub of the 3rd/4th gear synchronizer.
- (j). Dismantle the clamping spring, and remove the components at the other side of the 3rd/4th gear synchronizer.
- (k). Take out the spline gasket, and dismantle the 3rd gear.

Transmission (12JSD160) - Main Shaft Assembly

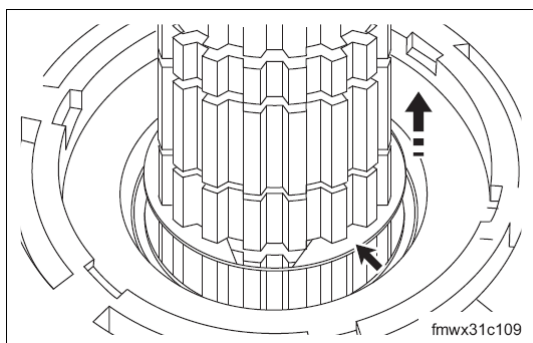


- (l). Take out the gear spacer, and dismantle the 2nd gear.
- (m). Take out the gear spacer, and dismantle the components at the other side of the 3rd/4th gear synchronizer.

31C

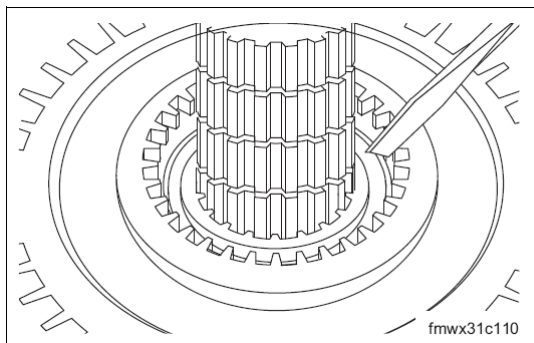


- (n). Dismantle the clamping spring, and take out the gear hub of the 1st/2nd gear synchronizer.

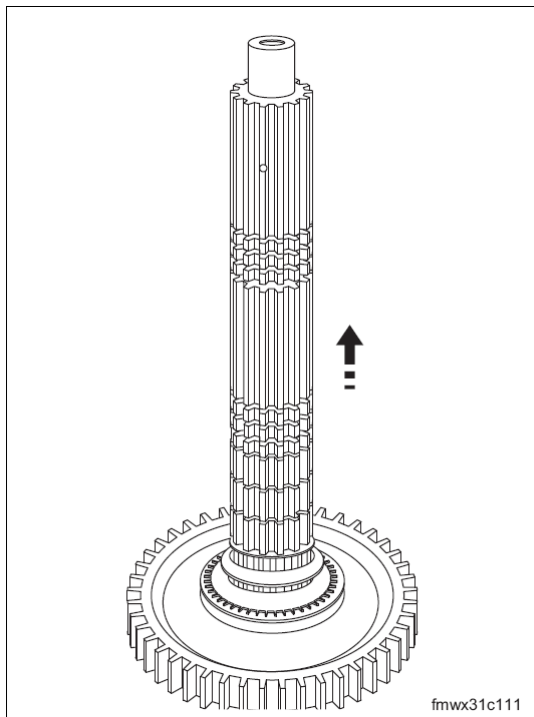


- (o). Dismantle the clamping spring, and remove the components at the other side of the 1st/2nd gear synchronizer.

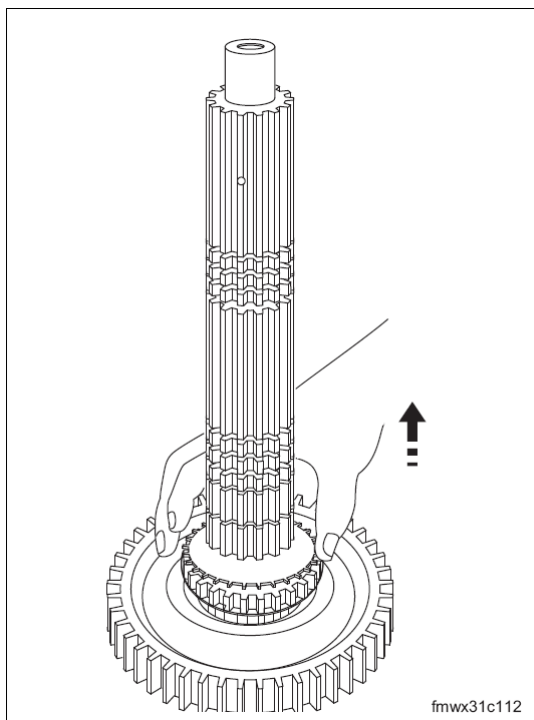
31C



- (p). Take out the spline gasket, and dismantle the 1st gear.

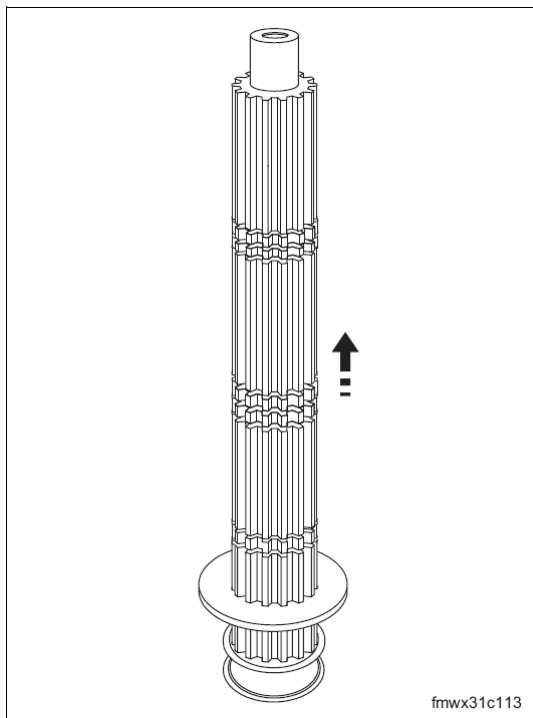


- (q). Take out the spacer.



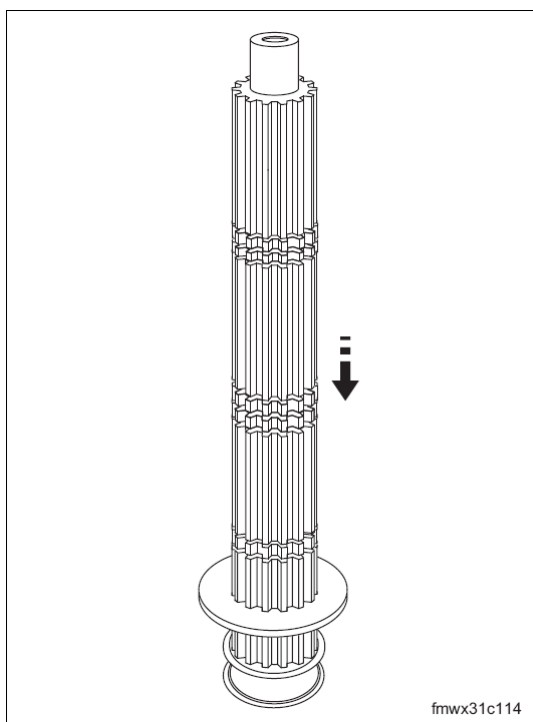
- (r). Take out the sliding sleeve and reverse gear.

Transmission (12JSD160) - Main Shaft Assembly



- (s). Take out the reverse gear gasket.

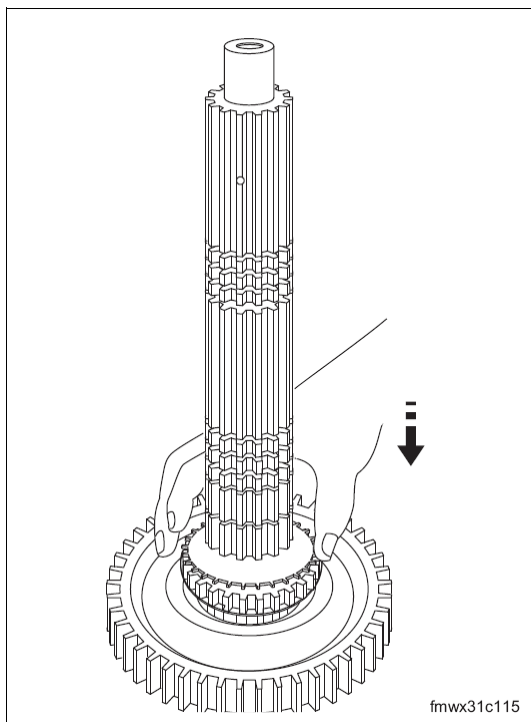
31C



2. Assemble the main shaft

- (a) Put the main shaft vertically on the workbench with the small end facing up, install the main shaft reverse gear gasket, and insert the long key after turning a tooth pitch.

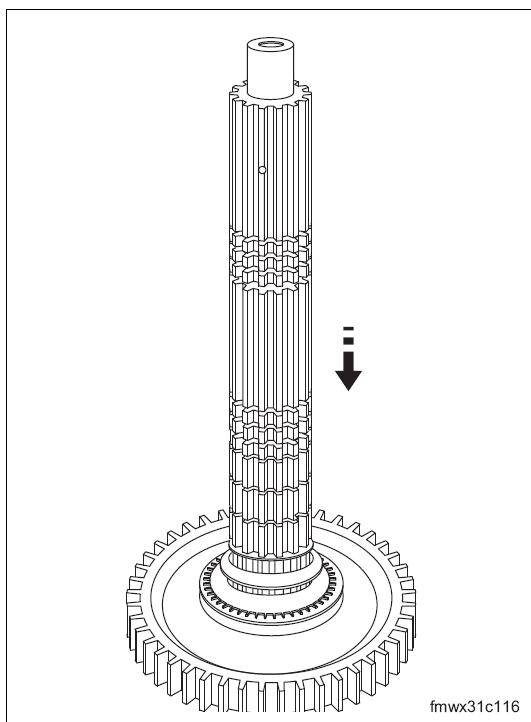
31C



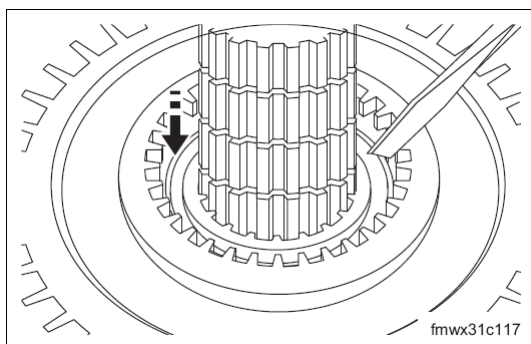
- (b). Install the main shaft reverse gear and reverse gear sliding sleeve.

Caution:

The part without tooth shall be aligned with the groove with hole on the main shaft, with the short-tooth side facing up.

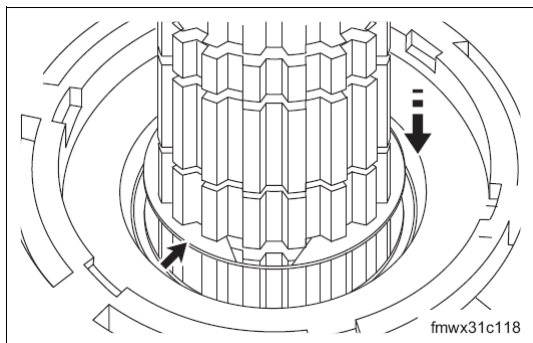


- (c). Install the gear spacer of the main shaft, and insert the long key upward after turning a tooth pitch.



- (d). Install the engaging ring gear of the main shaft 1st gear upward in the main shaft, and put the spline gasket in with the convex side facing up, and insert the long key after turning a tooth pitch.

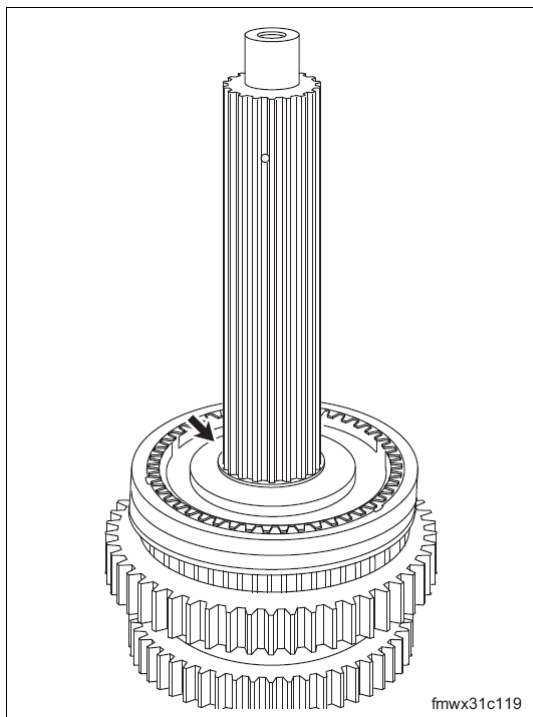
Transmission (12JSD160) - Main Shaft Assembly



- (e). Put in the components at one side of the 1st/2nd gear synchronizer, and install one clamping spring.

Caution:

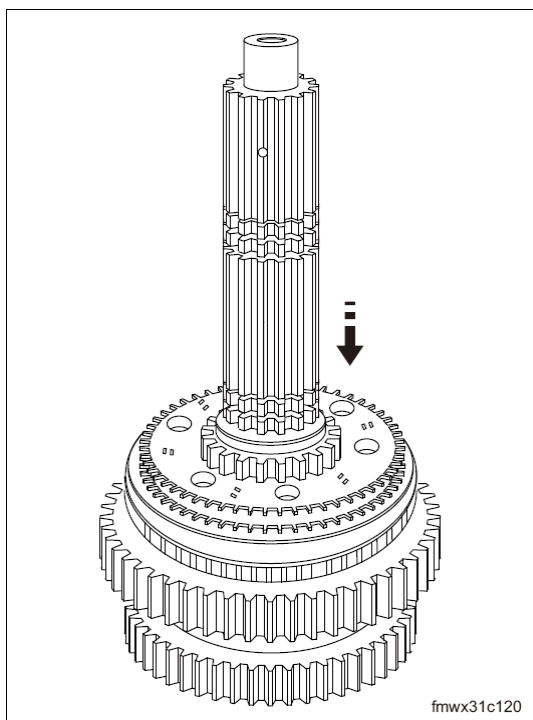
The opening of the clamping ring faces the groove with hole on the main shaft.



- (f). Install the gear hub of the 1st/2nd gear synchronizer, and install one clamping spring.

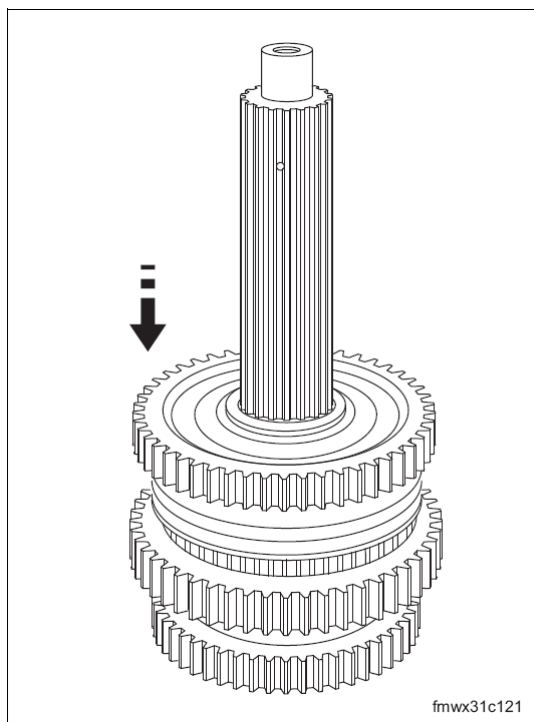
Caution:

The opening of the clamping ring faces the groove with hole on the main shaft.

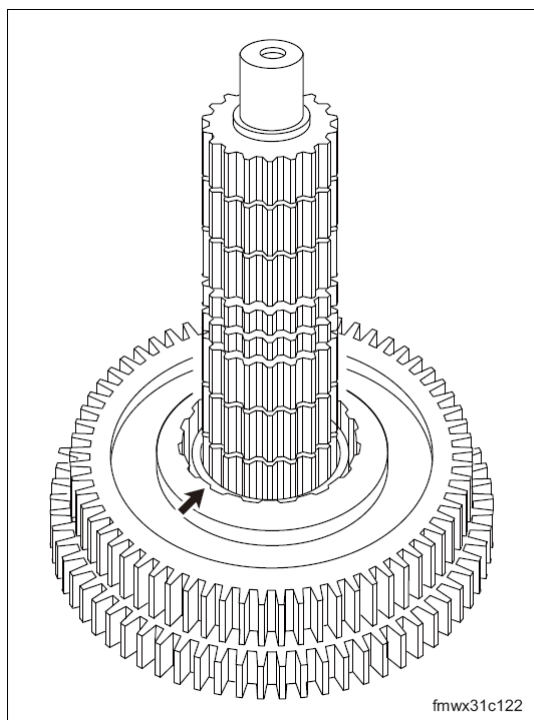


- (g). Put in the components at the other side of the 1st/2nd gear synchronizer, and install the spline gasket of the main shaft with the convex side facing down, and insert the long key after turning a tooth pitch.

31C

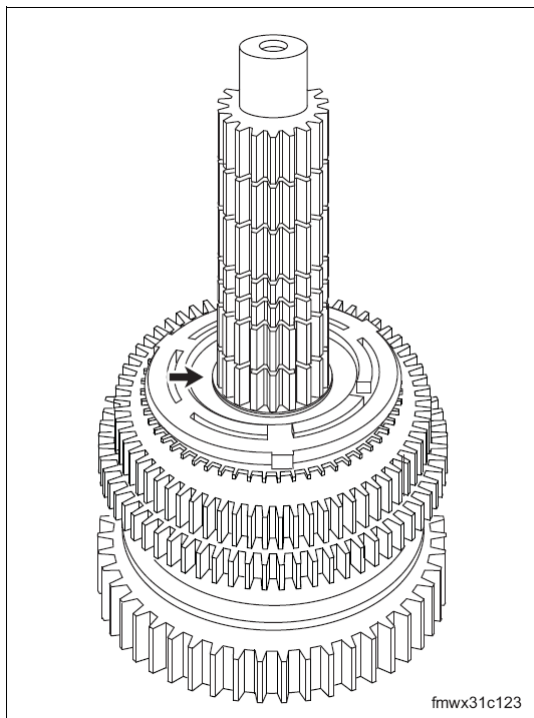


- (h) Install the engaging ring gear of the main shaft 2nd gear downward in the main shaft, put the main shaft gear spacer in, and insert the long key after turning a tooth pitch.



- (i) Install the engaging ring gear of the main shaft 3rd gear upward in the main shaft, and put the spline gasket in with the convex side facing up, and insert the long key after turning a tooth pitch.

Transmission (12JSD160) - Main Shaft Assembly

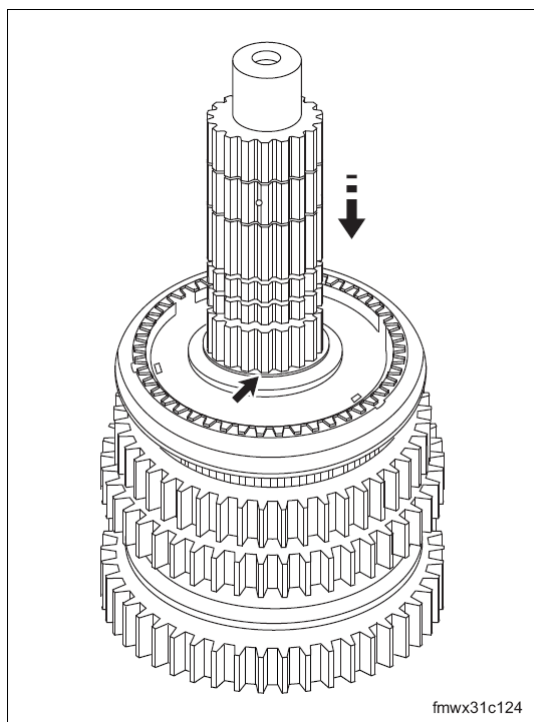


- (j). Install in the components at one side of the 3rd/4th gear synchronizer, and install one clamping spring.

Caution:

The opening of the clamping ring faces the groove with hole on the main shaft.

31C

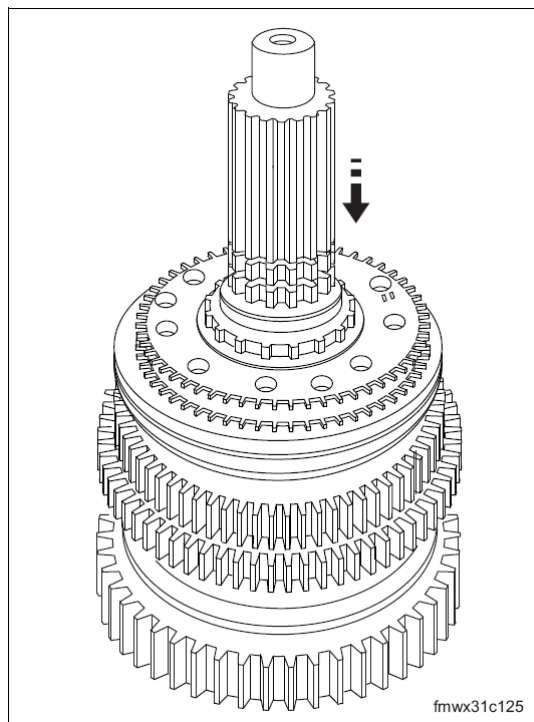


- (k). Install the gear hub of the 3rd/4th gear synchronizer, and install one clamping spring.

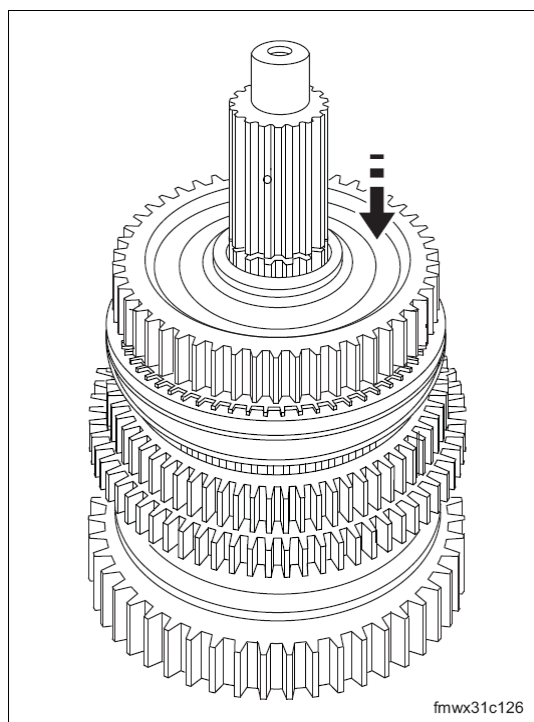
Caution:

The opening of the clamping ring faces the groove with hole on the main shaft.

31C

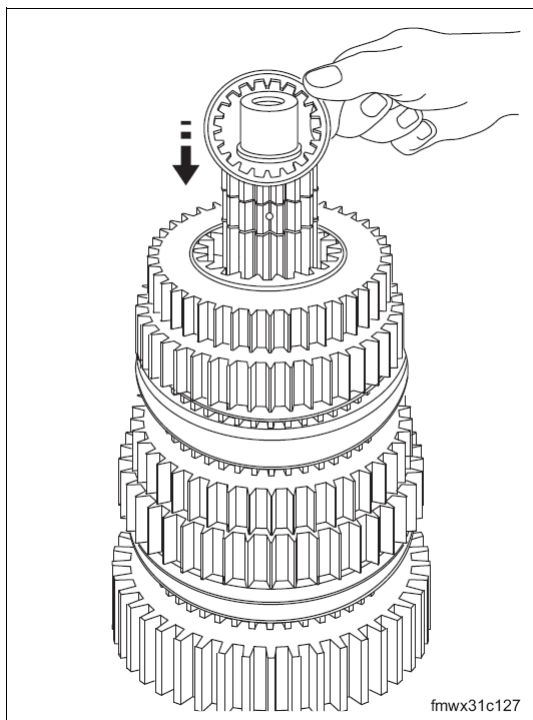


- (l) Put in the components at the other side of the 3rd/4th gear synchronizer, and install the spline gasket of the main shaft with the convex side facing down, and insert the long key after turning a tooth pitch.

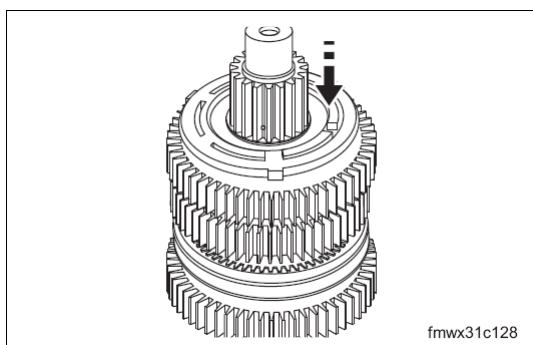


- (m) Install the engaging ring gear of the main shaft 4th gear downward in the main shaft, put the main shaft gear spacer in, and insert the long key after turning a tooth pitch.

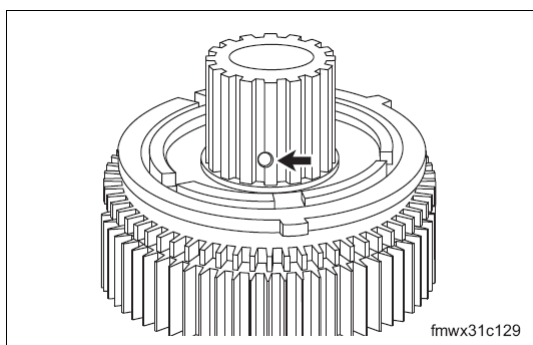
Transmission (12JSD160) - Main Shaft Assembly



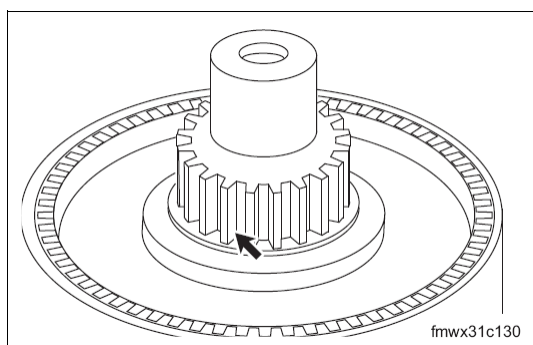
- (n) Install the engaging ring gear of the main shaft 5th gear upward in the main shaft, and put the spline gasket in with the convex side facing up, and insert the long key after turning a tooth pitch.



- (o) Put in the components at one side of the 5th/6th gear synchronizer, and install one clamping spring. The opening of the clamping ring faces the groove with hole on the main shaft.

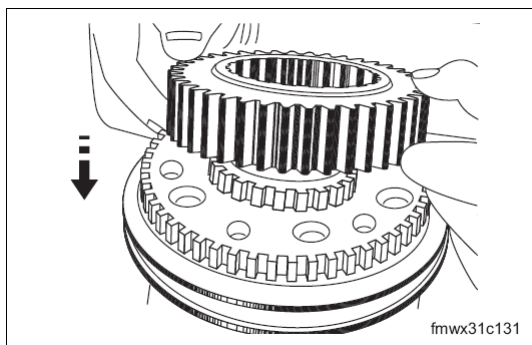


- (p). Install the elastic pin on the main shaft, and push the long key in position.

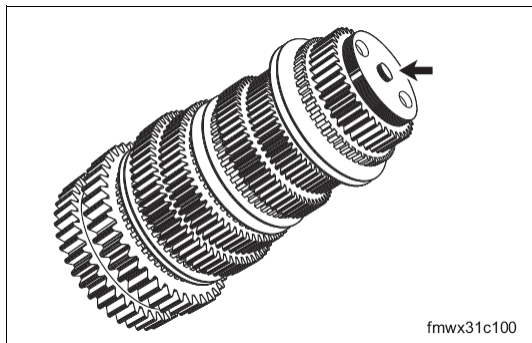


- (q) Install the gear hub of the 5th/6th gear synchronizer, and install one clamping spring. The opening of the clamping ring does not face the groove with hole on the main shaft.

31C

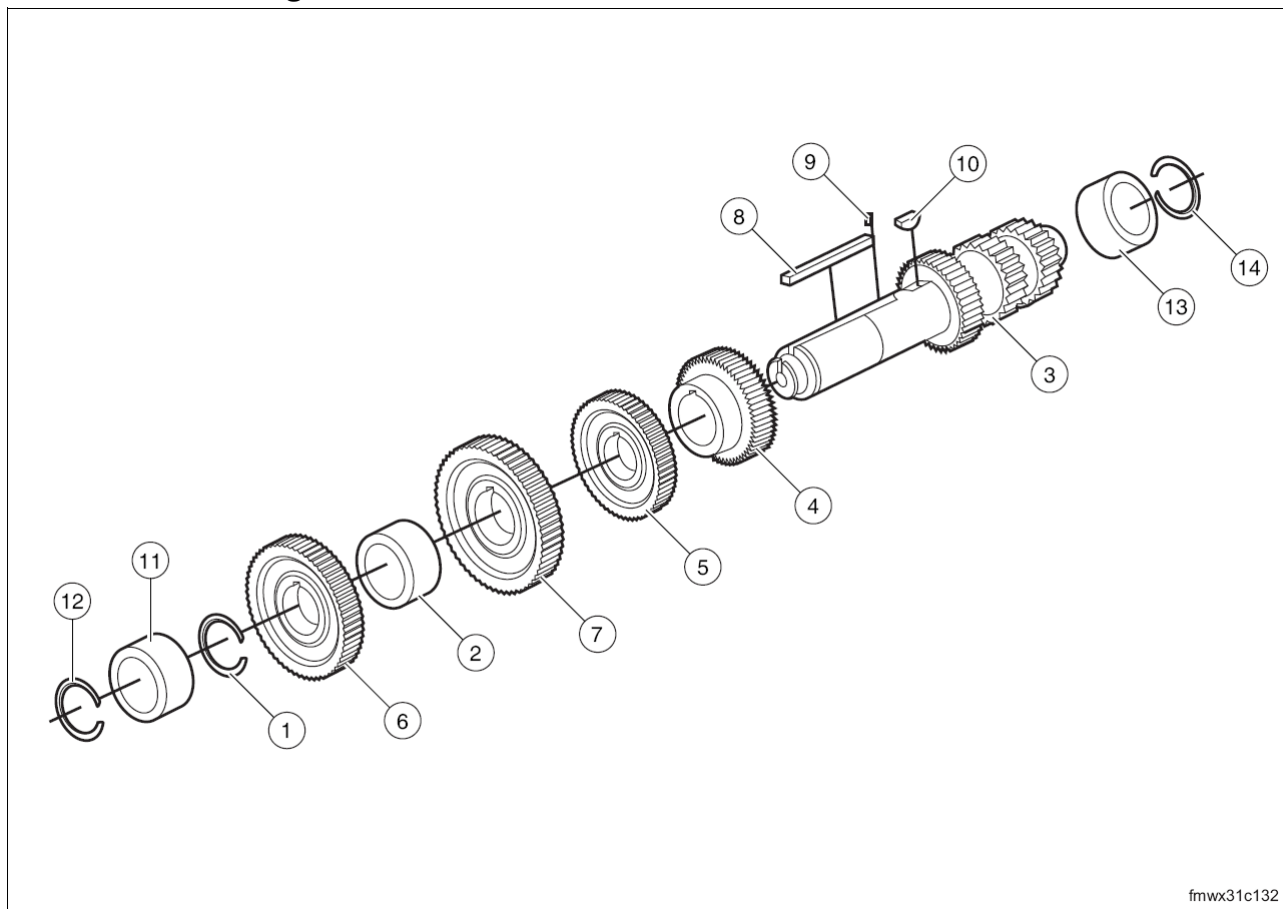


- (r). Put in the components at one side of the 5th/6th gear synchronizer, and install the primary shaft gear.



- (s). Fix the primary shaft gear to the main shaft by the pressure plate.

Main Box Countershaft Part Drawing



1	Countershaft Snap Ring
2	Spacer
3	Countershaft
4	Countershaft 3rd Gear
5	Countershaft 4th Gear
6	Countershaft Drive Gear
7	Countershaft 5th Gear

8	Countershaft Square Key
9	Elastic Cylindrical Pin
10	Woodruff key
11	Short Cylindrical Roller Bearing
12	Snap Ring
13	Short Cylindrical Roller Bearing
14	Circlip for Shaft

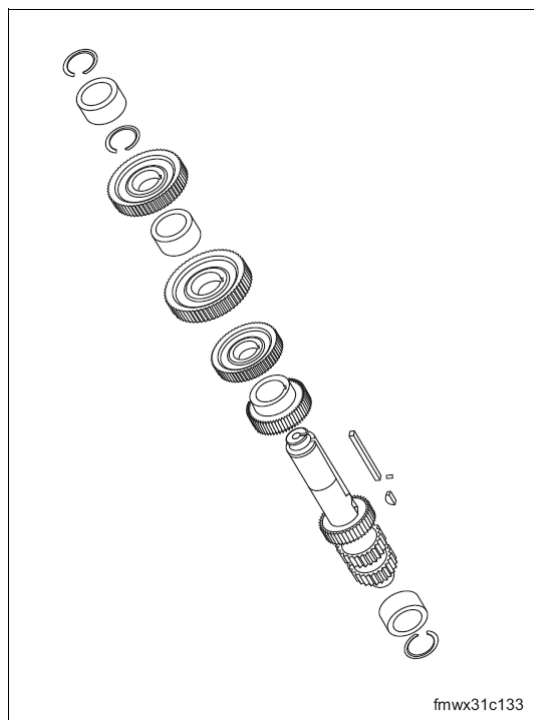
Disassembly and Assembly

Hint:

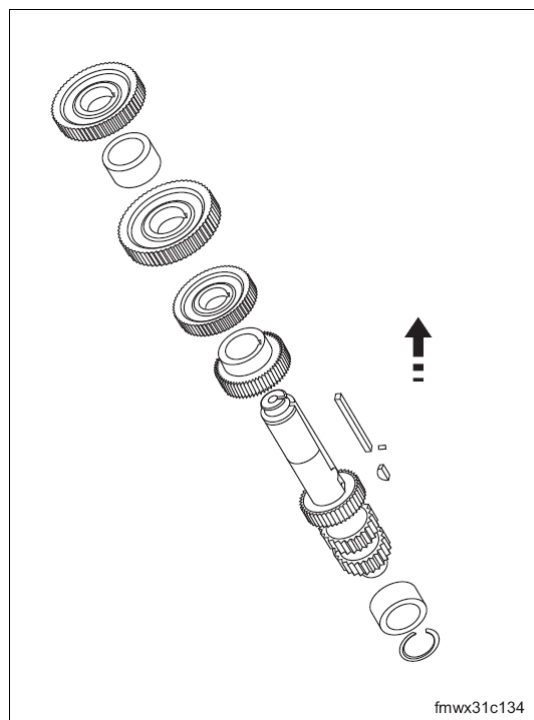
The countershaft shall not be dismantled under general conditions except serious wear, tooth hit, etc.

1. Disassemble the left countershaft

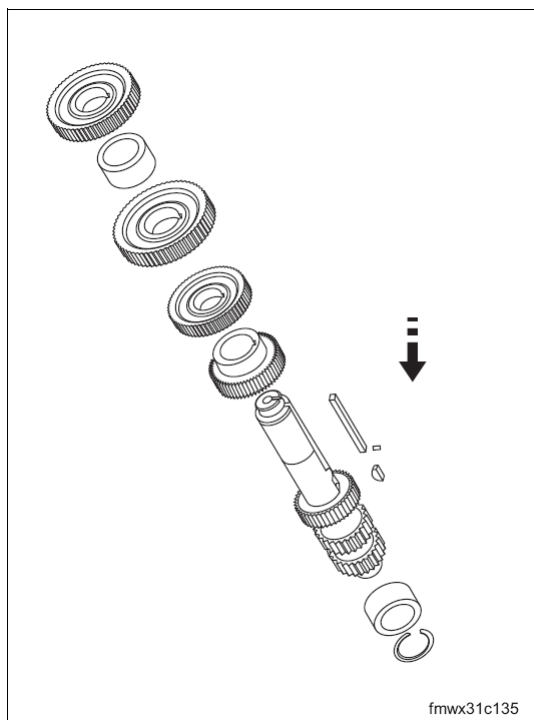
- (a). Dismantle the left countershaft snap ring.



- (b). Dismantle the countershaft drive gear, spacer, countershaft 5th gear, countershaft 4th gear, countershaft 3rd gear, countershaft square key and woodruff key in order



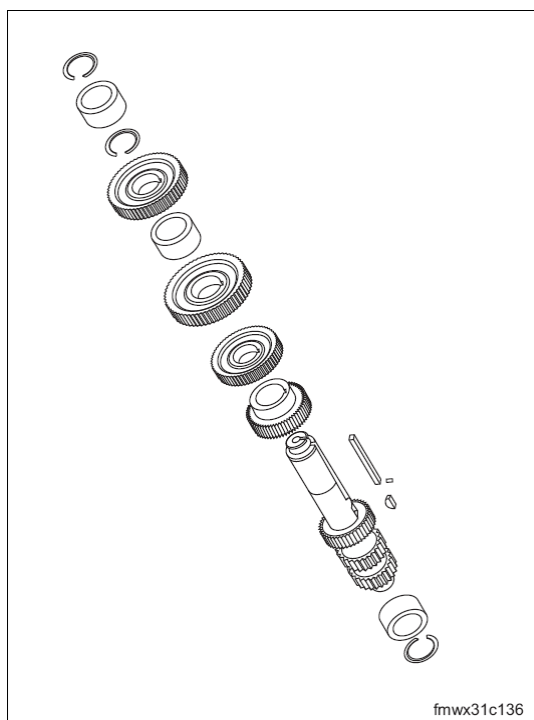
Transmission (12JSD160) - Main Box Countershaft



2. Assemble the left countershaft

- (a). Install the woodruff key, countershaft square key, countershaft 3rd gear, countershaft 4th gear, countershaft 5th gear, spacer, friction gear, countershaft drive gear on the countershaft in order.

31C



- (b). Install the countershaft snap ring.

Hint:

Refer to the disassembly and assembly of the right countershaft for the disassembly and assembly of the left countershaft.

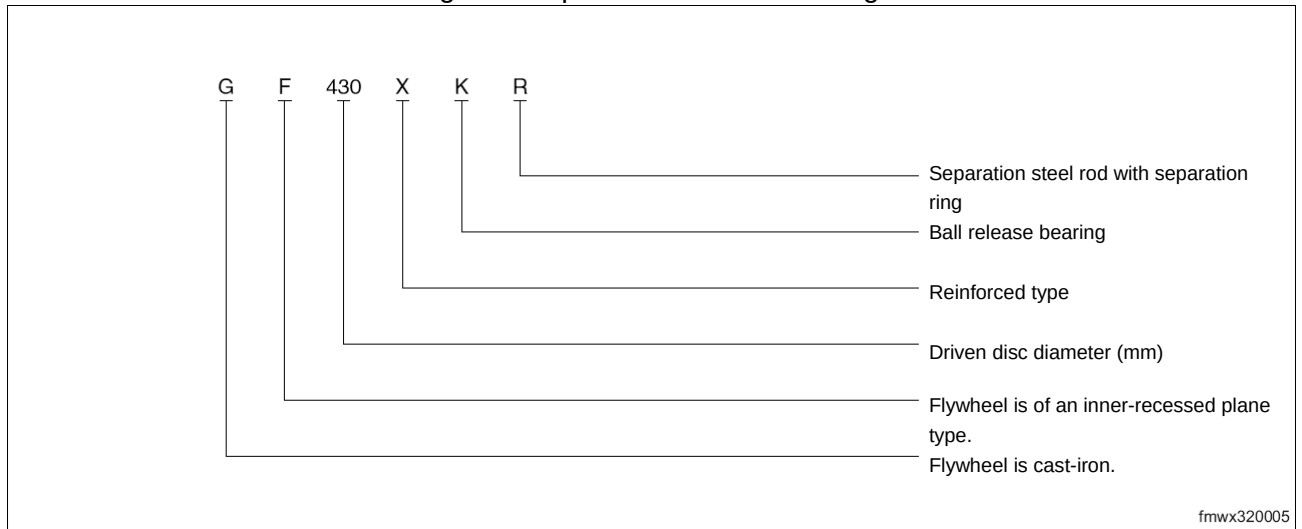
Clutch

Clutch Assembly	32-3
General	32-3
Working Principle	32-5
Precautions	32-6
Fault Symptom Table	32-7
Testing & Adjustment	32-9
Clutch Oil Tank Assembly	32-13
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Part Drawing	32-21
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Clutch Assembly

General

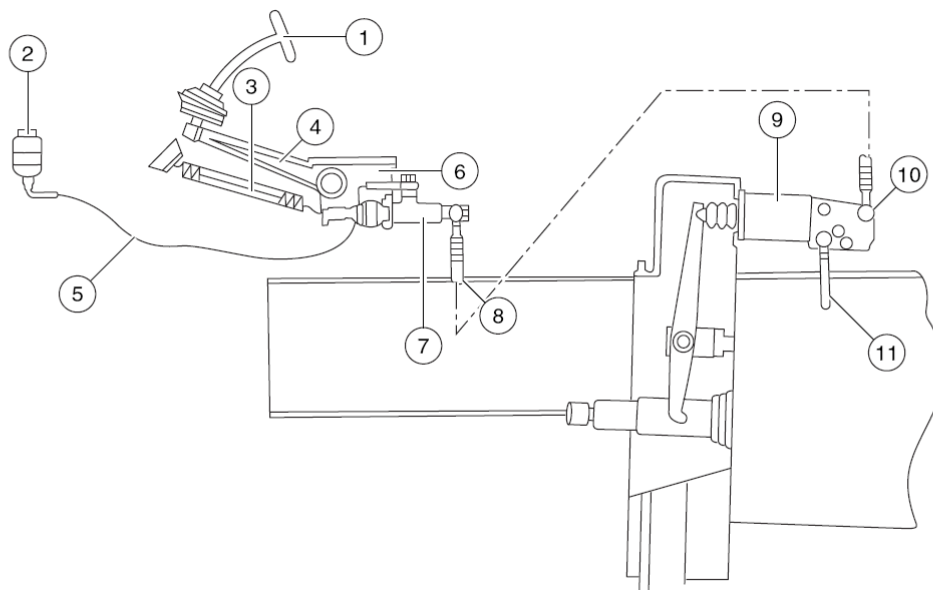
This vehicle adopts a combined use of GF430 single-sheet dry-type film clutch of traditional structure and SAE1 clutch housing. The implications of clutch designation are stated as below:



Clutch assembly is positioned between the engine and gearbox and fixed on the rear plane of flywheel with bolts. The splined hub of clutch and the input shaft of gearbox are rigidly connected. During driving, the driver can press down or release the clutch pedal as required to temporarily separate and gradually joint the engine and gearbox, so as to cut off or transmit the power input from the engine to the gearbox. Clutch system mainly consists of the following clutch disc, driven disc, release bearing, shift fork, clutch housing, etc.

Diaphragm spring clutch is operated in two forms, push type and pull type. Push type clutch works in the way that the release bearing pushes the diaphragm spring forward to disengage the clutch, while pull type clutch works in the way that the release bearing pulls the diaphragm spring backward to disengage the clutch. What this vehicle uses is push clutch. When the driver presses down the clutch pedal, the clutch master cylinder pushes the push rod out via booster slave cylinder and makes the shift fork pull the release bearing backward (transmission direction) to move via the support. As the spring retaining wire fixes the separating grease of diaphragm spring on release bearing, the separating grease of diaphragm spring is also pulled backward (transmission direction). The diaphragm spring releases the pressure plate and the clutch is completely disengaged. When the driver releases the clutch pedal slowly, the release bearing moves forward as the push rod of slave cylinder withdraws. When the separating grease of diaphragm spring moves forward, its pressure against the pressure plate increases gradually and the clutch is steadily engaged. The release bearing of pull type clutch and diaphragm separating grease are always integrated without pause. Therefore, the release bearing is of constant-integrated type. As long as the engine is running, it will operate together with the clutch pressure plate. See the drawing below:

Clutch - Clutch Assembly



fmwx320001

1	Clutch Pedal
2	Oil Tank
3	Pedal Return Spring
4	Pedal Lever
5	Oil Pipe
6	Clutch Bracket

7	Clutch Master Cylinder
8	Connecting Oil Pipe
9	Clutch Booster Slave Cylinder
10	Slave Cylinder Oil Pipe Joint
11	Clutch Slave Cylinder Air Pipe Joint

Working Principle

1. Ensure the vehicle starts smoothly:

The vehicle stays still before starting. If the engine and gearbox are rigidly connected, the vehicle will plunge forward suddenly because of sudden power once it is in gear. This will not only cause damages of parts but also a sharp drop in engine speed and thus flameout as the power is not enough to subdue the big inertia force brought by the vehicle's plunging forward. If the clutch is used to separate the engine and gearbox temporarily when starting, the clutch will be engaged gradually and the torque from the clutch can be gradually increased from zero as wheelspin exists between the driving part and driven part of the clutch. Meanwhile, the driving force of the vehicle also increases gradually so as to make it start smoothly.

2. Facilitate gear shifting:

During the vehicle traveling, different gearbox gears are often used to adapt to the constantly changing traveling conditions. If the clutch does not separate the engine and gearbox temporarily, the engaged force transferring gears in gearbox will be hardly separated because the load is not thrown off and the pressure between the engaged gear faces is very great. Moreover, gears to be engaged will be hardly engaged due to the unequal circumferential velocity of both. Even though they are forcibly engaged, big impact will be produced at the gear end to damage parts easily. If the clutch is used to temporarily separate the engine and gearbox for gear shifting, the previously engaged pair of gears will be easily separated as the load is throw off and the pressure between the engagement faces is greatly reduced. And for the other pair of gears to be engaged, as the rotational inertia is very small after the driving gear and the engine are separated, adopting appropriate gear shifting can make the circumferential velocities of gears to be engaged become equal or approximately equal. Thus the impact between gears is avoided or reduced.

3. Prevent the transmission system from overloading:

In the vehicle emergency braking, the speed of wheels drops suddenly, but the transmission system connected to the engine still remains at the previous rotational speed because of the rotational inertia. This will often produce a moment of inertia far greater than the engine torque in the transmission system and easily damage the parts in it. As the clutch transmits torque by means of friction, the driving and driven parts of the clutch will automatically slip when the internal load of the transmission system exceeds the torque that the friction can transmit. Therefore, it has an effect of preventing the transmission system from overloading.

Precautions

1. Precautions for operation of clutch system

- (a). Do comply with the instructions in this manual when maintaining the clutch system.
- (b). Incorrect operation will affect the performance of the clutch system and the vehicle.
- (c). The special plugs must be used seal all openings when disconnecting the pipeline of the clutch system, and never have the clutch oil stick to paint surface, such as the body.

2. Precautions for maintenance of clutch system

- (a). Only the specified clutch oil can be used, never mix clutch oil of different types and it must be checked and replaced at regular intervals.

Clutch oil: DOT3-type brake fluid

- (b). The clutch oil must be checked once every 5,000 km, replace with new clutch oil after the first 40,000 km and change the clutch oil once every 40,000 km afterwards. The clutch oil must be replaced once every 20,000 km driving after traveling for 80,000 km.
- (c). Make sure to check at regular intervals and check once every 5,000 km.
 - Check the travel and free travel of clutch pedal.
 - Check whether the clutch hydraulic system has leakage.
 - Check whether the clutch pressure system has air leakage.
 - Check the travel and sealing of the booster push rod of clutch slave cylinder.
 - Check whether connections become loose.
 - Check whether the functions of clutch system remain normal.

3. Precautions for clutch disassembly and assembly

- (a). keep the driving strap away from impact load during disassembly and assembly for maintenance. A way shall be thought out to relatively fix the pressure plate and pressure plate cover so as to avoid the damage of driving strap. The deformation of driving strap will greatly affect the clutch performance.
- (b). When installing a new pressure plate assembly, the resilient U-type clip becomes naturally loose after the pressure plate assembly is fixed on the flywheel. At this time, the U-type clip must be dismantled, or serious faults and consequences will be caused if the clip falls into the operating clutch.
- (c). When installing the pressure plate assembly, two jack bolts can be used to locate the pressure plate assembly and the flywheel firstly. Use locating pumps to locate the driven disc on the flywheel center control, pre-tighten the 12 bolts on the pressure plate cover and tighten them with a torque of 50~60 N.m in diagonal order.

Clutch - Clutch Assembly**Fault Symptom Table**

The following table will help you find faults. The serial number represents the fault possibility in sequence. Check every part according to this sequence and replace them as necessary.

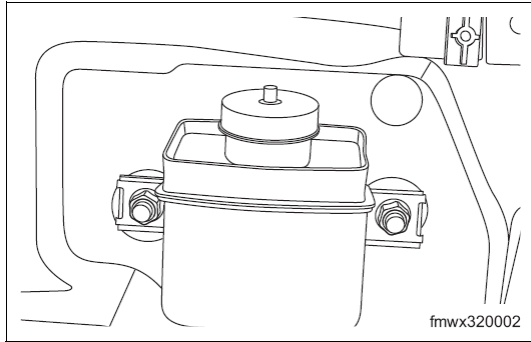
Fault Symptoms	Possible Position	Reference
Clutch slipping	1. Free travel of clutch pedal (too small)	Chapter 32 Clutch – Clutch Pedal, Adjustment
	2. Driven disc (excessive abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	3. Flywheel (warp)	Chapter 16 Engine Mechanical – Flywheel and Flywheel Cover, Replacement
	4. Pressure plate (deformation)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	5. Diaphragm spring of pressure plate (failure)	Chapter 32 Clutch – Clutch Assembly, Overhaul
Incomplete disengagement clutch	1. Free travel of clutch pedal (too big)	Chapter 32 Clutch – Clutch Pedal, Adjustment
	2. Diaphragm spring of pressure plate (failure)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	3. Clutch master cylinder (leakage)	Chapter 32 Clutch – Clutch Master Cylinder, Replacement
	4. Booster of clutch slave cylinder (leakage)	Chapter 32 Clutch – Clutch Slave Cylinder Booster, Replacement
	5. Hydraulic system (the existence of air)	Chapter 32 Clutch – Clutch Assembly, Testing & Adjustment
	6. Driven disc (abnormal abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	7. Pressure plate (abnormal abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	8. Release bearing (excessive abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	9. Clutch throw-put fork (abnormal abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	10. Improper adjustment of the working travel of clutch	Chapter 32 Clutch – Clutch Assembly, Testing & Adjustment
Abnormal sound of clutch	1. Damping spring (break)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	2. Driven disc (excessive abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	3. Release bearing (loose)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	4. Clutch pedal (deformation)	Chapter 32 Clutch – Clutch Pedal, Replacement

Clutch - Clutch Assembly

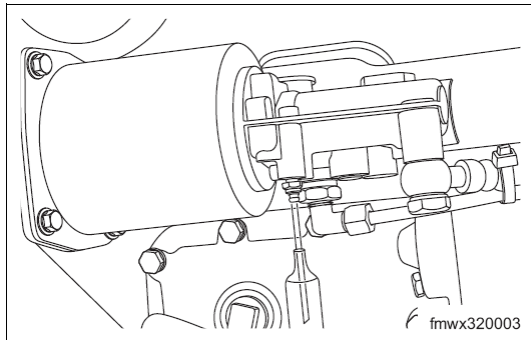
Fault Symptoms	Possible Position	Reference
Clutch tremble	1. Driven disc (deformation or excessive abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	2. Flywheel (excessive abrasion)	Chapter 16 Engine Mechanical – Flywheel and Flywheel Cover, Replacement
	3. Pressure plate (excessive abrasion)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	4. Damping spring (break or fatigue deformation)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	5. Diaphragm spring of pressure plate (deformation)	Chapter 32 Clutch – Clutch Assembly, Overhaul
	6. Engine mounting (looseness or rubber gasket damage)	Tighten, repair or replace rubber gasket
	7. Transmission suspension (looseness or rubber gasket damage)	Tighten, repair or replace rubber gasket

Clutch - Clutch Assembly

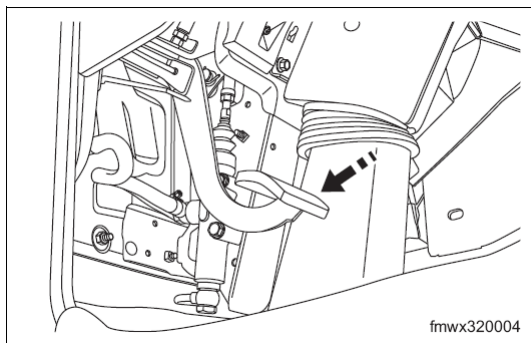
Testing & Adjustment



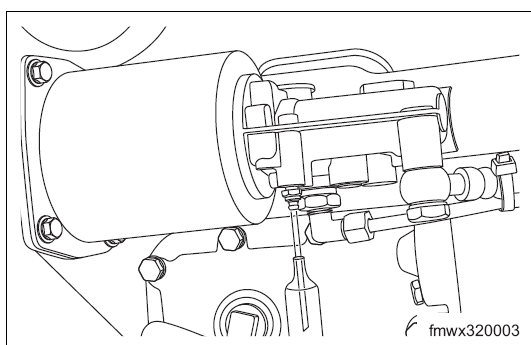
1. **Filling and exhausting of clutch oil**
 - (a). Fill up the oil mug with clutch oil.



- (b). Install a hose in appropriate length on the air bleed valve of clutch slave cylinder booster.
 - (c). Place a suitable container under the hose to hold clutch oil.

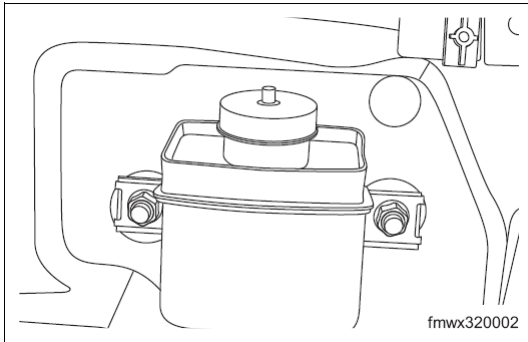


- (d). Step on the clutch pedal quickly for several times and then press it down to the lowest position and hold it still.

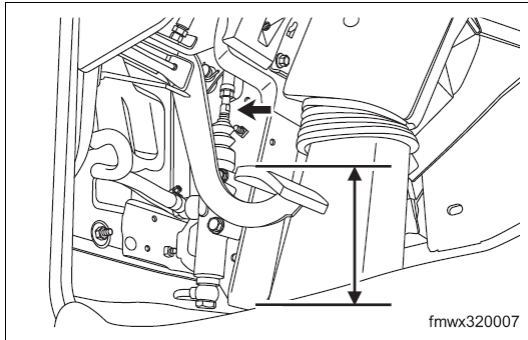


- (e). Loosen the oil drain plug on the air bleed valve to discharge the clutch oil with bubble or turbid clutch oil. When the oil is stopping running out, tighten the oil drain plug.
 - (f). Repeat the above method for several times continuously until there is no bubble appearing in the clutch oil and the oil color becomes normal, and then tighten the oil drain plug.

Torque: 12N.m

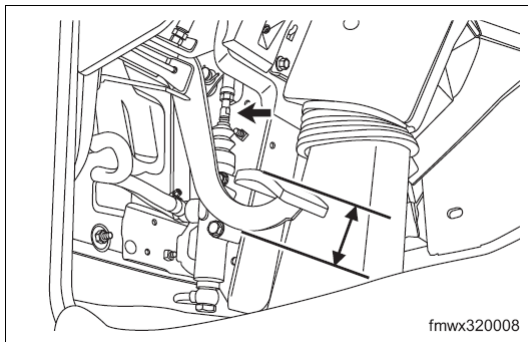


- (g). Check the clutch oil level in the oil mug so that the level is between "MAX" and "MIN". Add if insufficient.

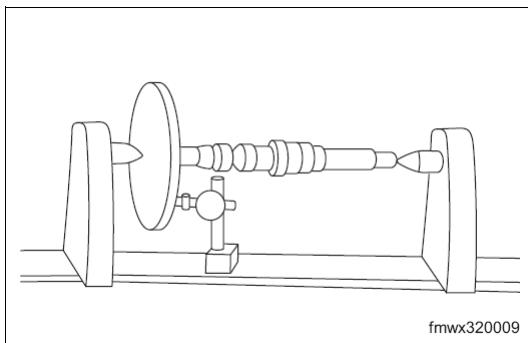


2. Adjust the clutch pedal

- (a). Measure the travel of clutch pedal. Press down the clutch pedal to the lowest point and measure the distance from the start position to the end position.
- (b). Adjust the travel of clutch pedal, loosen the lock nut and rotate the bolt.

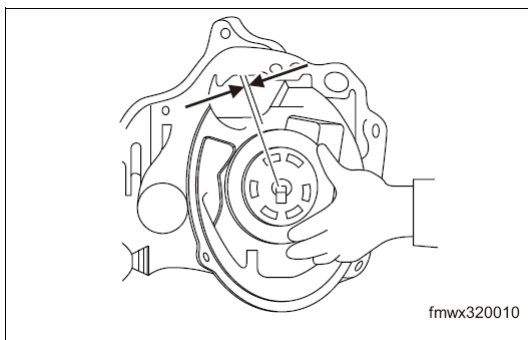


- (c). Determine the free travel of clutch pedal. Press the clutch pedal lightly with a hand and measure the descending distance when feeling resistance.
- (d). Adjust the free travel of clutch pedal. Loosen the lock nut and rotate the push rod. The free travel of clutch pedal should be 35~40 mm. Tighten the lock nut after adjusting.

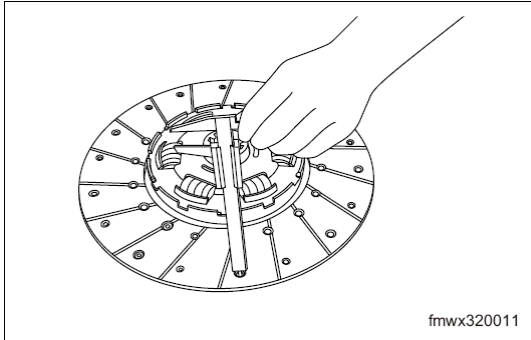


3. Check clutch driven disc

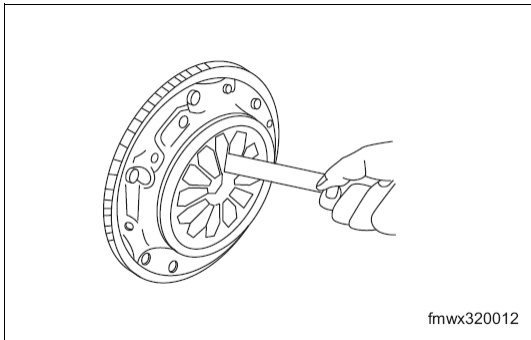
- (a). Check the warp and deformation of clutch driven disc.
- (b). Replace the clutch driven disc if the detected value exceeds the specified value.



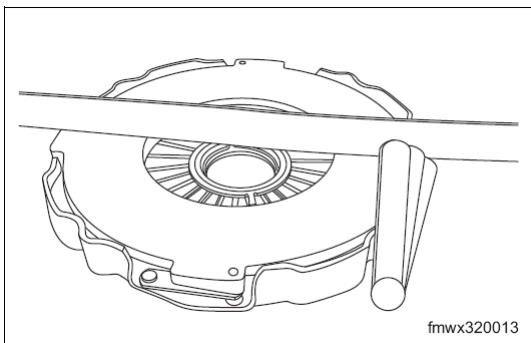
- (c). Check the spline fit side clearance. Rotate the friction plate assembly forward and backward when it is installed on the input shaft of transmission, and check the side clearance. If the side clearance is found to exceed the limit (0.5 mm), the friction plate assembly should be replaced. This side clearance is the windage in circumferential direction when measured with dial gauge.

Clutch - Clutch Assembly

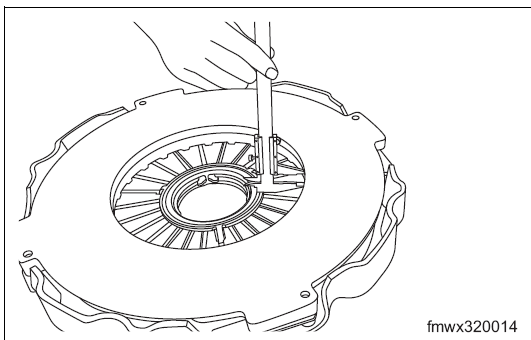
- (d). Check the abrasion of friction plate. Measure the depth of rivet heads, i.e., the distance between the rivet head and the surface of friction plate, and check the abrasion of friction plate. If the distance at any hole is found to have reached the service limit (0.5 mm), the friction plate assembly should be replaced.
- (e). Check the state of friction plate surface. 120~200 sand paper can be used to sand and restore slightly burnt or polished (mirror) friction plates. If they are seriously burnt or the surface can be hardly restored because of cracks on it, the friction plate assembly should be replaced.



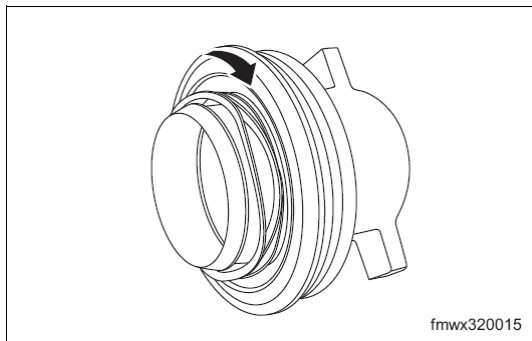
- 4. Check the clutch pressure plate assembly**
 - (a). Check whether the diaphragm spring rivet in the clutch pressure plate assembly becomes loose. If the rivet has become loose or is becoming loose, the pressure plate assembly should be replaced. This is because the pressure plate always clatters when pushing the clutch pedal.
 - (b). Check whether the height at the separation claw of diaphragm spring is identical. The permissible limit is 0.7 mm. If the height difference is too great, adjustment should be performed. The number of adjusted claws should be minimized when adjusting.



- (c). Check the flatness of clutch pressure plate.
- (d). If the measured value exceeds the limit, replace the pressure plate.

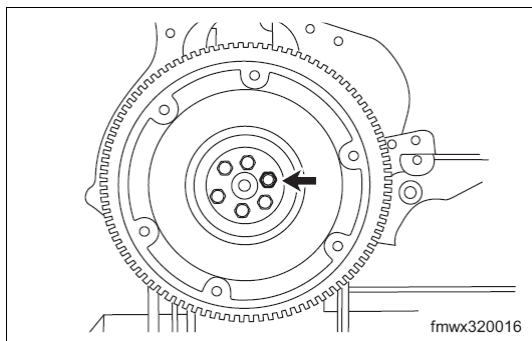


- (e). Check the abrasion of clutch pressure plate.
- (f). If the measured value exceeds the limit, replace the pressure plate.



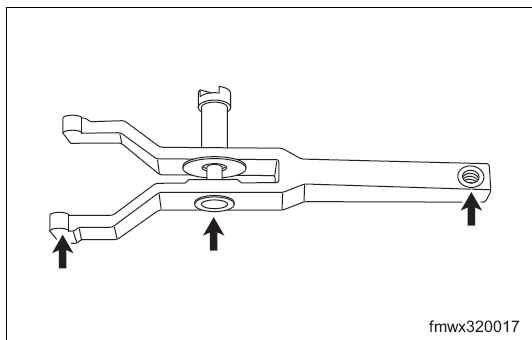
5. Check the release bearing

- (a). Rotate the release bearing with a hand and replace it with a new one if it gets stuck or clatters or has abnormal noise.



6. Check the friction surface of flywheel

- (a). Check whether the flywheel surface contacting the clutch friction plate is worn or damaged.
(b). Check whether the guide bearing is loose.



7. Check the shift fork shaft assembly

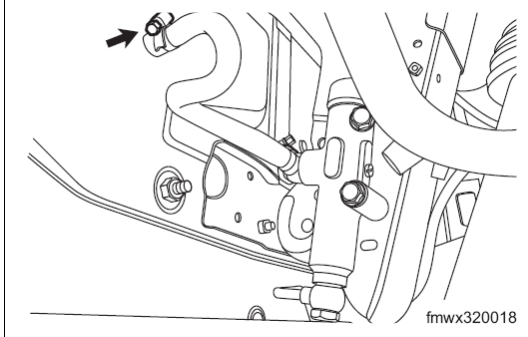
- (a). Check whether the shift fork shaft is deformed and worn, the shaft end spline is seriously damaged and the shift fork is seriously worn. Replace the shift fork shaft assembly if it is damaged.

Clutch Oil Tank Assembly Overhaul

Hint:

Part Drawing, refer to Chapter 32, Clutch – Clutch Master Cylinder, Part Drawing

1. Drain clutch oil

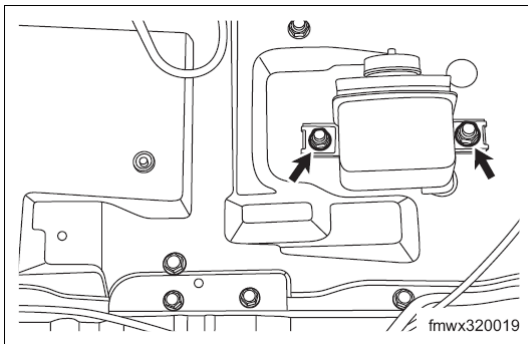


2. Disconnect clutch front hose and clutch oil tank

- (a). Loosen the hoop and disconnect the oil inlet pipe of clutch master cylinder and the oil tank.

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3. Remove the wiper water reservoir; refer to Chapter 55, Wiper & Washer, Overhaul



4. Dismantle the clutch oil tank assembly

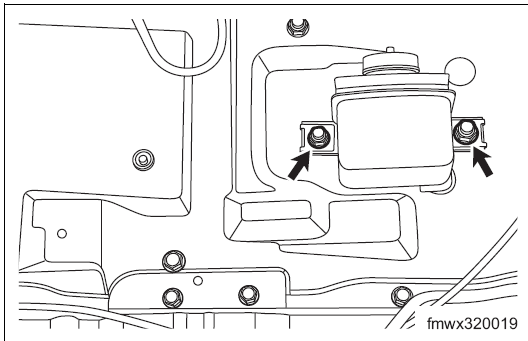
- (a). Dismantle the two fastening nuts of clutch oil tank.
- (b). Remove the clutch oil tank assembly.

5. Check the clutch oil tank assembly

- (a). Check whether the oil tank has cracks, the filter screen is dirty and the oil tank cover is split.

Hint:

Repair or replace according to circumstances.

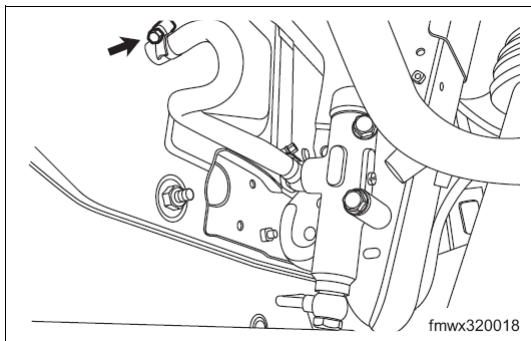


6. Install the clutch oil tank assembly

- (a). Install the clutch oil tank.
- (b). Tighten the fastening nuts.

Torque: 12N.m

Clutch - Clutch Oil Tank Assembly



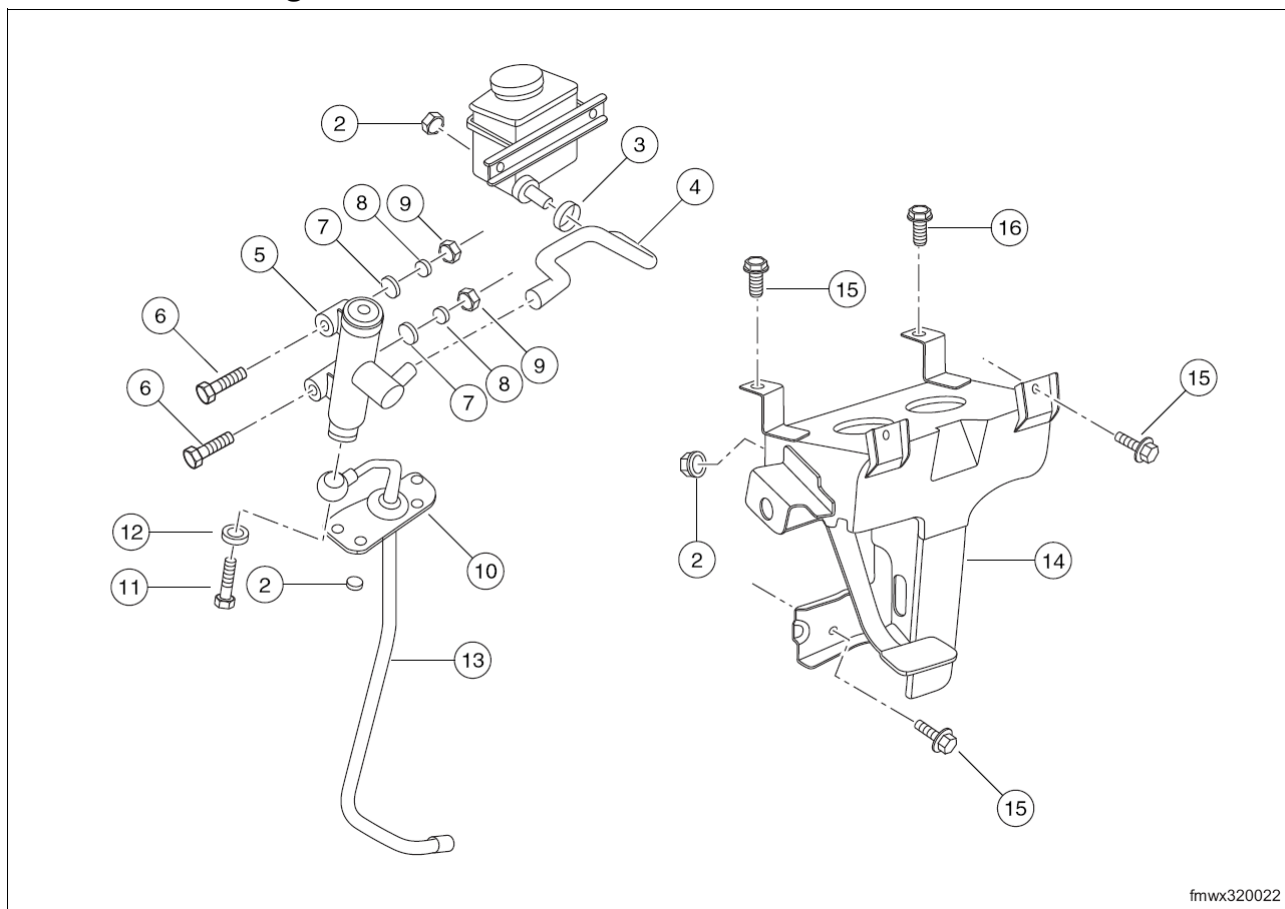
- (c). Connect the oil inlet pipe of clutch master cylinder to the oil tank and tighten the hoop.

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7. Add clutch oil and exhaust; refer to Chapter 32, Clutch – Clutch Assembly, Testing & Adjustment.

Clutch Master Cylinder

Part Drawing

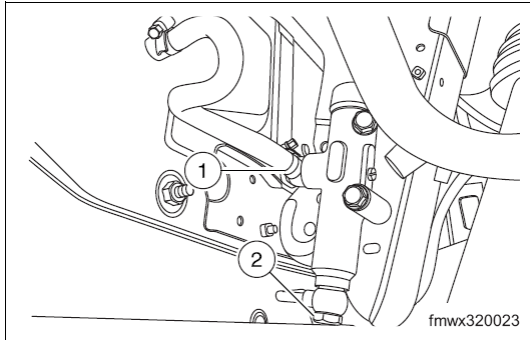


1	Oil Tank Assembly
2	Prevailing Torque Type All-metal Hex Nut with Flange
3	Worm Drive Type Hose Clamp, Type A
4	Oil Inlet Pipe of Clutch Master Cylinder
5	Clutch Master Cylinder Assembly
6	Hex Head Bolt
7	Flat Washer
8	Spring Washer

9	Hex Nut, Style 1
10	Dust Guard
11	Angle Swivel Screw Hex Bolt
12	Sealing Washer
13	Oil Outlet Pipe of Clutch Master Cylinder
14	Clutch Pedal Assembly
15	Hex Head Bolt, Spring Washer and Flat Washer Assembly
16	Hex Head Bolt Assembly

Overhaul

1. Drain clutch oil
2. Open head



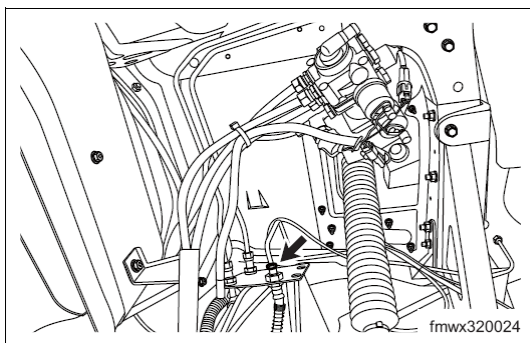
3. Disconnect the oil inlet pipe and outlet pipe of clutch master cylinder

- (a). Loosen the oil inlet pipe hoop 1 of clutch master cylinder and separate the oil inlet pipe of clutch master cylinder.
- (b). Loosen bolt 2 and separate the oil outlet pipe of clutch master cylinder.

Caution:

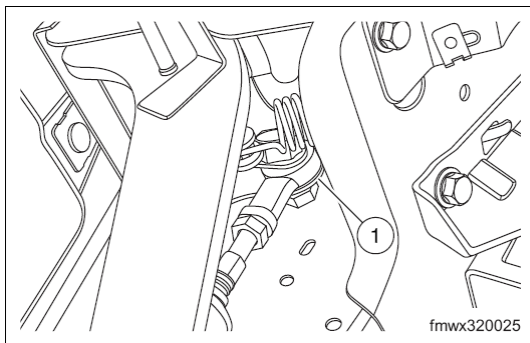
A special container must be used to recover the residual clutches. Never have the clutch oil stick to paint surface. If the clutch oil sticks to skin, wash with a large amount of water.

- (c). Disconnect the oil outlet pipe of clutch master cylinder and the front coupling hose assembly.
- (d). Remove the oil outlet pipe of clutch master cylinder.



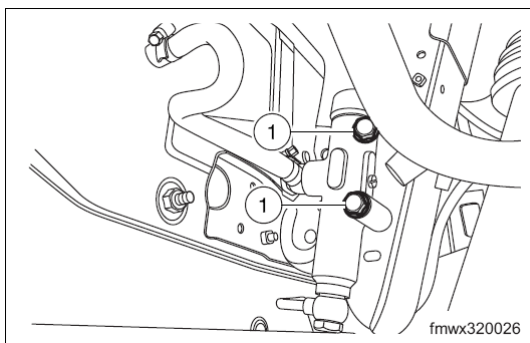
4. Dismantle the push rod of clutch master cylinder

- (a). Remove the pin shaft bolt 1 of clutch master cylinder push rod.



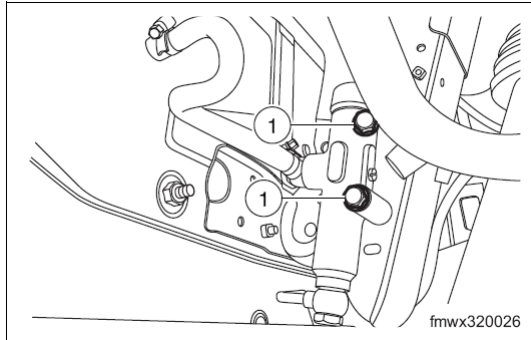
5. Dismantle the clutch master cylinder

- (a). Loosen the two fixing bolts 1 of clutch master cylinder.
- (b). Remove the clutch master cylinder assembly.



Clutch - Clutch Master Cylinder**6. Check the clutch master cylinder**

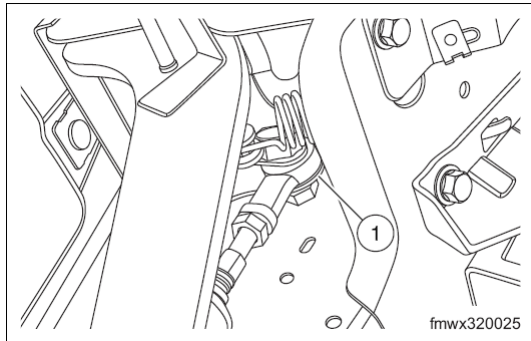
- (a). Check whether the oil inlet pipe connection of master cylinder becomes loose.
- (b). Check the master cylinder dust cover aging and cracking connections.
- (c). Check whether the oil seal of master cylinder push rod has leakage.

**7. Install the clutch master cylinder**

- (a). Install the clutch master cylinder and tighten the two fixing bolts 1.

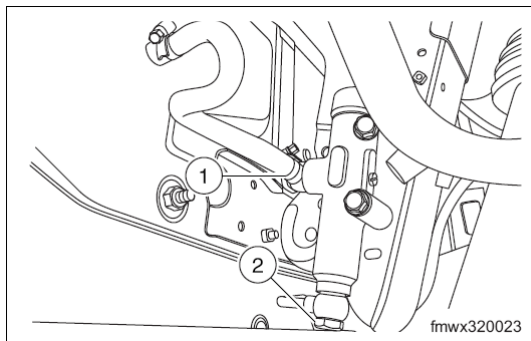
Torque: 64N.m

32

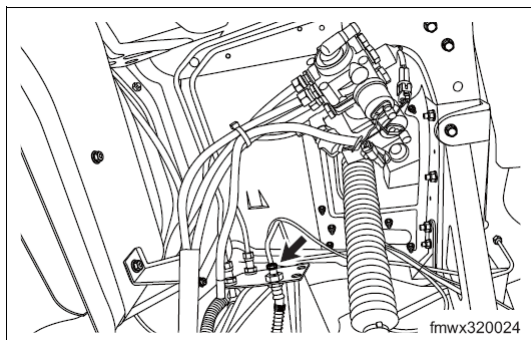
**8. Install the push rod of clutch master cylinder**

- (a). Install the push rod of clutch master cylinder and tighten pin shaft bolt 1.

Torque: 28N.m

**9. Install the oil inlet and outlet pipes of clutch master cylinder**

- (a). Connect the oil inlet pipe of clutch master cylinder and tighten hoop 1.
- (b). Connect the oil outlet pipe of clutch master cylinder and tighten bolt 2.



- (c). Connect the oil outlet pipe of clutch master cylinder and the front coupling hose assembly.

Caution:

Sealing strip should be wound around the pipe connections.

10. Add clutch oil and exhaust; refer to Chapter 32, Clutch – Clutch Assembly, Testing & Adjustment

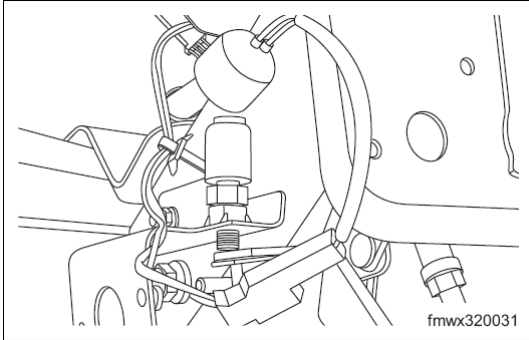
Clutch Pedal Assembly Overhaul

Hint:

Part Drawing, refer to Chapter 32, Clutch – Clutch Master Cylinder, Part Drawing

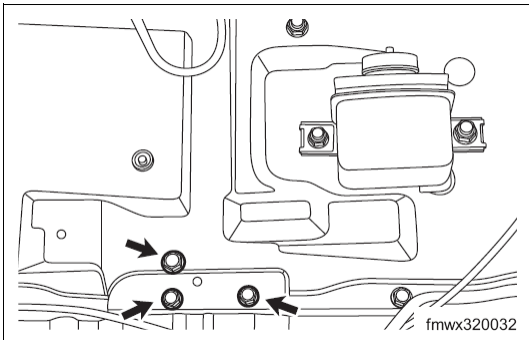
1. **Disconnect the battery negative cable**
2. **Discharge the clutch oil**
3. **Dismantle the steering column; refer to Chapter 41, Steering Wheel and Column – Steering Column, Disassembly and Installation**
4. **Dismantle the dashboard; refer to Chapter 73, Dashboard/Instrument/Cigarette Lighter – Dashboard, Replacement**

32

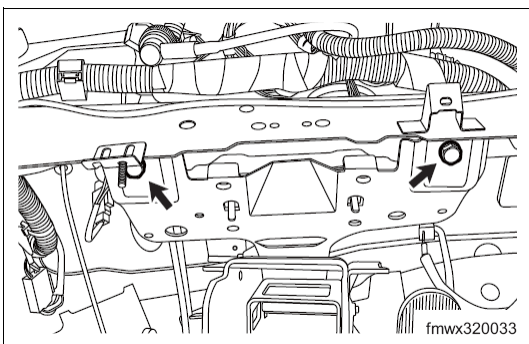


5. **Dismantle the clutch pedal switch**
 - (a). Disconnect the wire harness connector of clutch switch.
 - (b). Loosen the lock nuts of clutch switch and remove the clutch switch assembly.

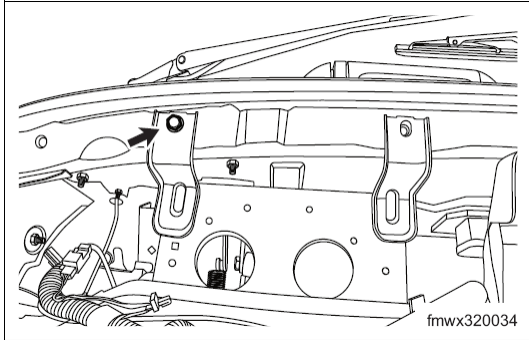
6. **Dismantle and install the clutch master cylinder; refer to Chapter 32, Clutch – Clutch Master Cylinder, Overhaul**
7. **Dismantle and install the wiper water reservoir; refer to Chapter 55, Wiper & Washer – Washer, Replacement**



8. **Dismantle and install the clutch pedal assembly**
 - (a). Dismantle the four fastening bolts of front clutch.



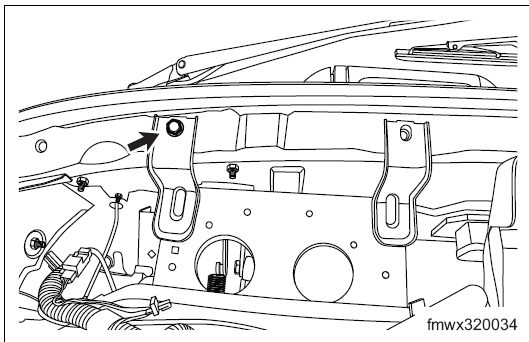
- (b). Dismantle the clutch pedal and the two connecting bolts for the clutch pedal and dashboard beam.

Clutch - Clutch Pedal Assembly

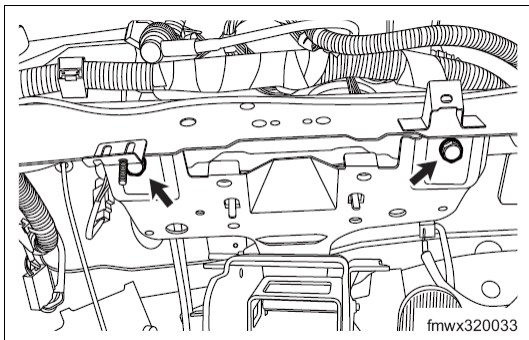
- (c). Dismantle the clutch pedal and carriage connecting bolt.
- (d). Remove the clutch pedal assembly.

9. Check the clutch pedal assembly

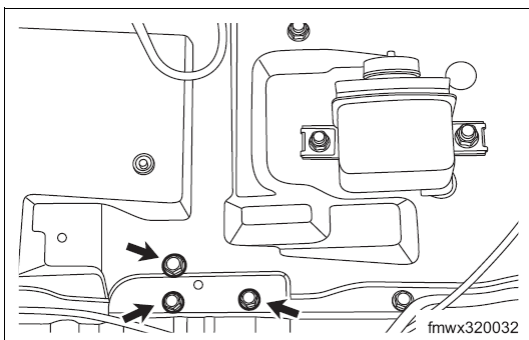
- (a). Whether the clutch pedal assembly is twisted.
- (b). Whether the return spring of pedal is permanently deformed.
- (c). Whether the stepping rubber gasket of pedal is worn.
- (d). Whether the limiting rubber of pedal is worn and aging.

**10. Install the clutch pedal assembly**

- (a). Put the clutch pedal assembly in place and align the threaded holes.
- (b). Install the clutch pedal and carriage connecting bolt and tighten it.

Torque: 28N.m

- (c). Install the two connecting bolts for the clutch pedal and dashboard beam and tighten them.

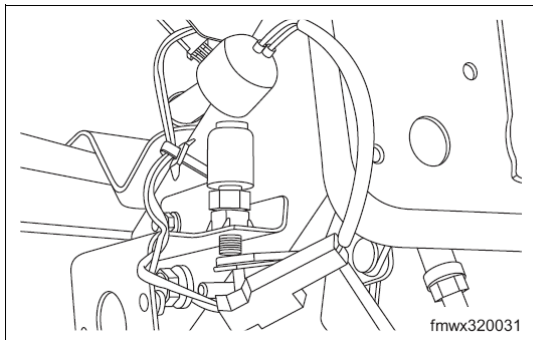
Torque: 12N.m

- (d). Install the four fastening bolts of front clutch and tighten them.

Torque: 12N.m

Clutch - Clutch Pedal Assembly

11. Install the wiper water reservoir assembly; refer to Chapter 55, Wiper & Washer – Washer, Replacement
12. Install the clutch master cylinder; refer to Chapter 32, Clutch - Clutch Master Cylinder, Overhaul



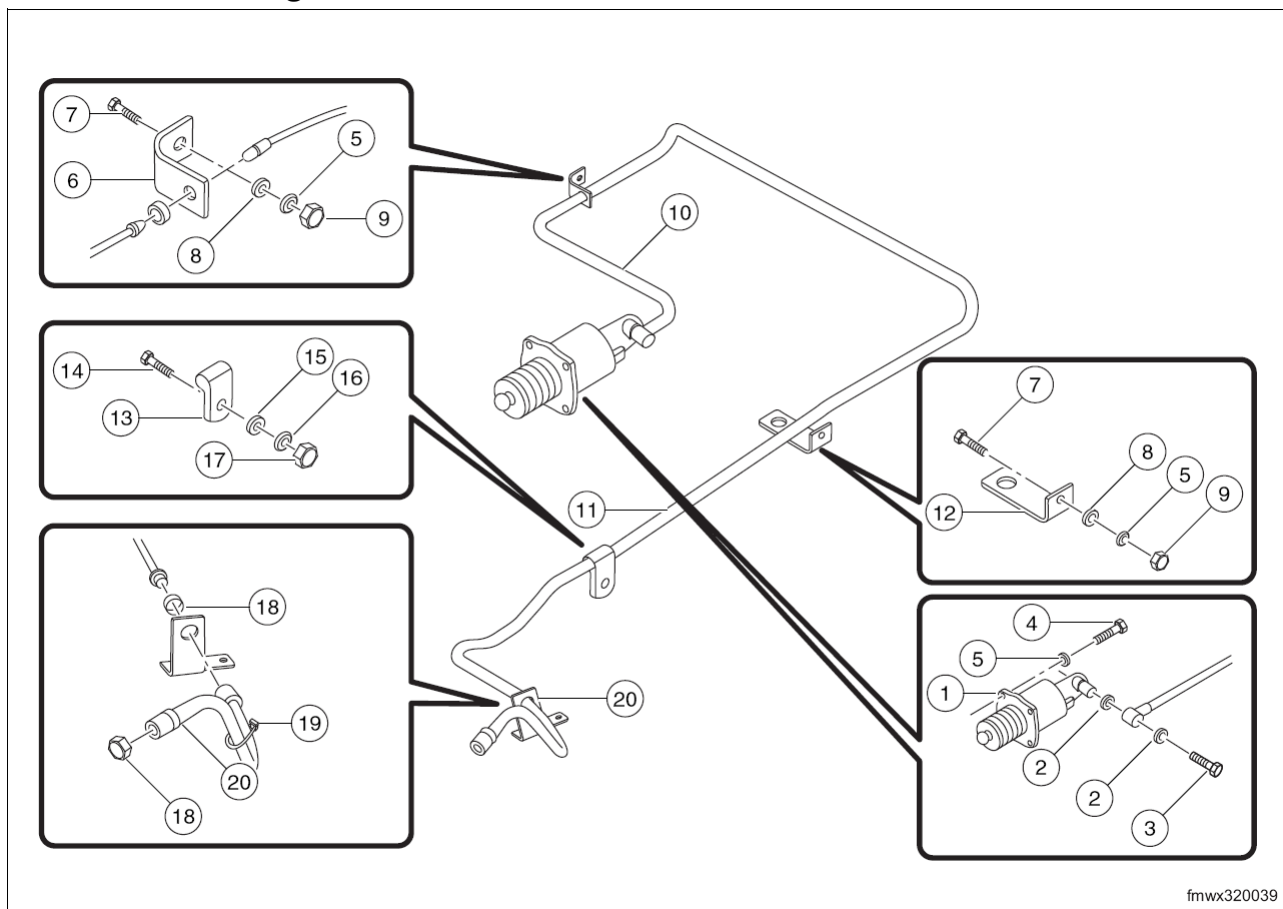
13. Install the clutch pedal switch
 - (a). Install the clutch switch assembly.
 - (b). Adjust the clutch switch to the proper position and tighten the lock nut.
 - (c). Connect the wire harness connector of clutch switch.

14. Install the dashboard; refer to Chapter 73, Dashboard/Instrument/Cigarette Lighter – Dashboard, Replacement
15. Install the steering column; refer to Chapter 41, Steering Wheel and Column – Steering Column, Disassembly and Installation
16. Connect the battery negative cable
17. Add clutch oil and exhaust; refer to Chapter 32, Clutch – Clutch Assembly, Testing & Adjustment

Clutch - Clutch Slave Cylinder

Clutch Slave Cylinder

Part Drawing

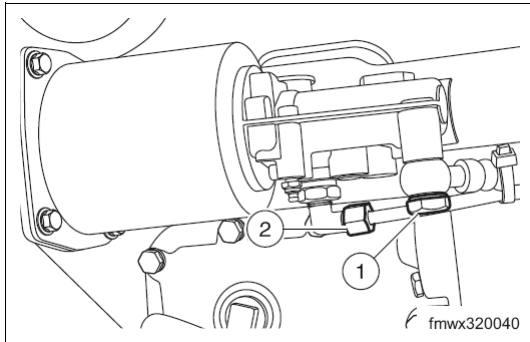


1	Clutch Slave Cylinder Assembly
2	Sealing Washer
3	Angle Swivel Screw Hex Bolt
4	Hex Head Bolt
5	Spring Washer
6	RR Hose Bracket
7	Hex Head Bolt
8	Flat washer
9	Hex Nut, Style 1
10	RR Coupling Hose Assembly

11	Slave Cylinder Oil Pipe Assembly
12	Clutch Bracket
13	Single Pipe Clamp
14	Hex Head Bolt
15	Flat Washer
16	Spring Washer
17	Hex Nut, Style 1
18	Bite Type Tube Fittings – Hex Thin Nut
19	Cable Tie
20	FR Coupling Hose Assembly

Overhaul

1. Drain clutch oil

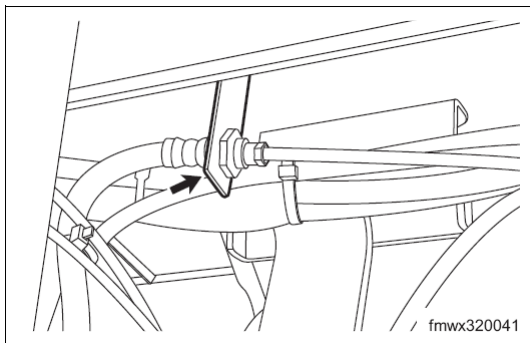


2. Disconnect the oil pipe and air pipe of clutch slave cylinder

- Loosen bolt 1 and separate the connection between clutch slave cylinder and rear coupling hose.
- Loosen bolt 2 and separate the connection between clutch slave cylinder and booster air pipe.

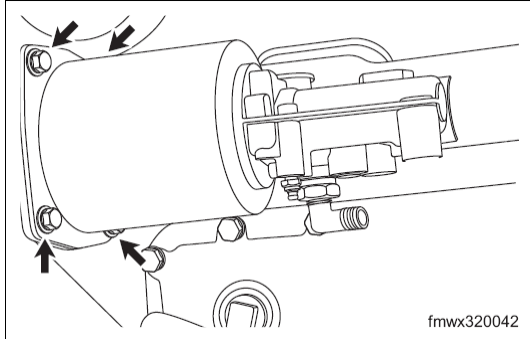
Caution:

A special container must be used to recover the residual clutches. Never have the clutch oil stick to paint surface. If the oil sticks to skin, wash it with a large amount of water.



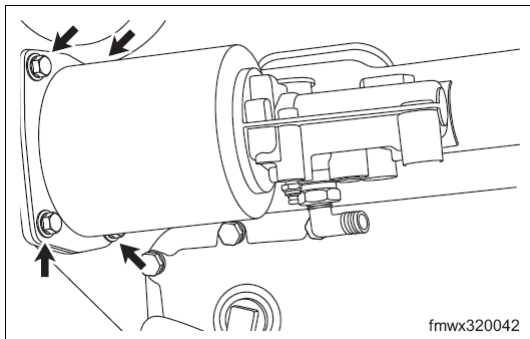
3. Dismantle the rear connecting hose

- Disconnect the connection between rear connecting hose and slave cylinder oil pipe assembly.
- Remove the clutch slave cylinder oil pipe assembly.



4. Remove the clutch slave cylinder assembly

- Loosen the four fixing bolts of clutch slave cylinder.
- Remove the clutch slave cylinder assembly.



5. Install the clutch slave cylinder

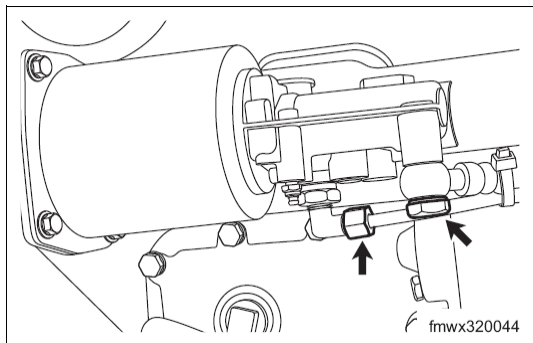
- Install the clutch master cylinder and tighten the fastening bolt.

Torque: 28N.m

Hint:

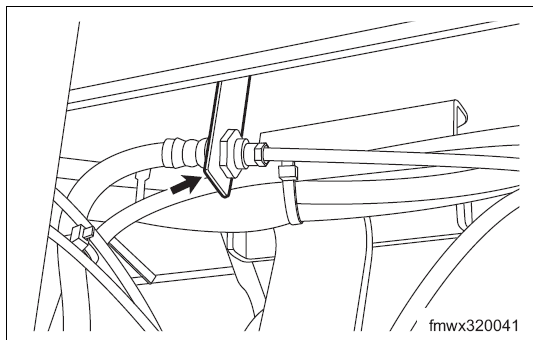
There is an upward arrow mark on the slave cylinder casing. It means upward position.

Clutch - Clutch Slave Cylinder



6. Install the clutch air pipe and oil inlet pipe

- (a). Install the clutch air inlet pipe.
- (b). Install the clutch oil inlet pipe.

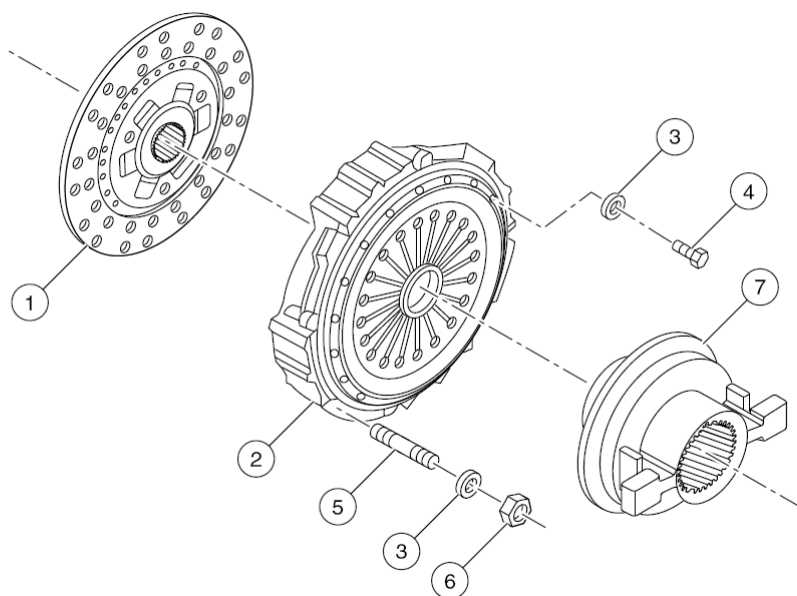


7. Install the rear connecting hose

- 8. Add clutch oil and exhaust; refer to Chapter 32, Clutch – Clutch Assembly, Testing & Adjustment

Clutch Assembly Part Drawing

32



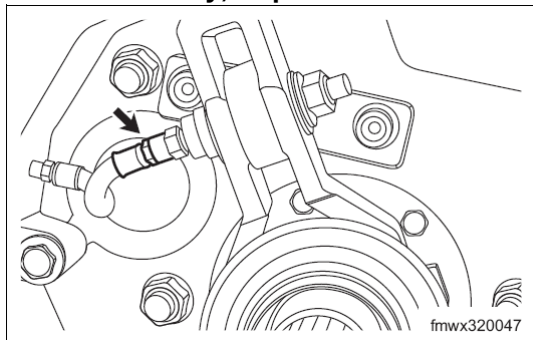
fmwx320046

1	Driven Disc Assembly
2	Clutch Pressure Plate Assembly
3	Spring Washer
4	Hex Flange Bolt

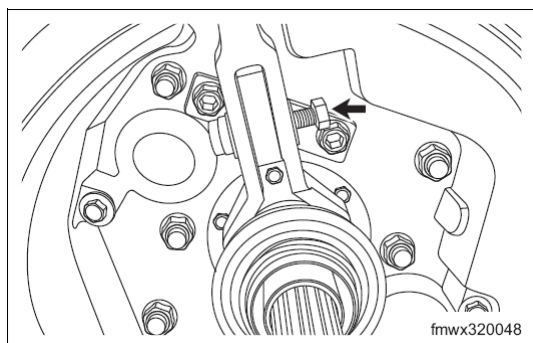
5	Stud Bolt
6	Hex Nut, Style 1
7	Release Bearing

Overhaul

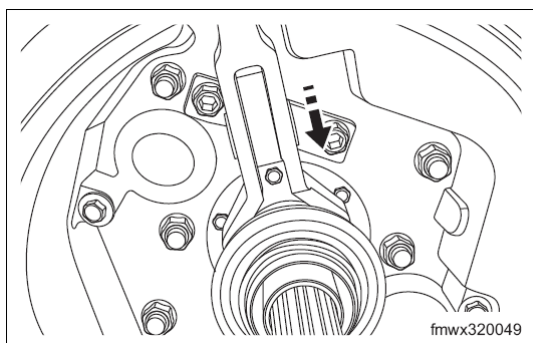
1. **Disconnect the battery negative cable**
2. **Dismantle the transmission assembly; refer to Chapter 31, Transmission – Transmission Assembly, Replacement**



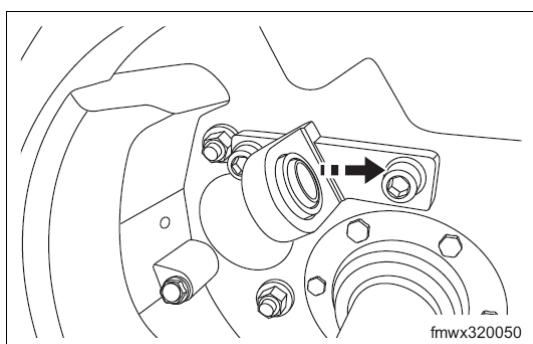
3. **Dismantle the lubricating pipe.**
 - (a). Dismantle the bolts at both ends of the lubricating pipe and remove the pipe.



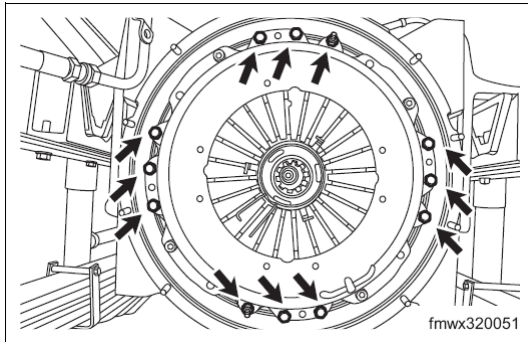
4. **Dismantle the clutch shift fork and release bearing assembly**
 - (a). Dismantle the fastening nut.
 - (b). Remove the support shaft of clutch shift fork.



- (c). Remove the clutch shift fork and release bearing assembly.



- (d). Take out the support shaft sleeve of shift fork.



5. Dismantle pressure plate assembly and driven disc assembly

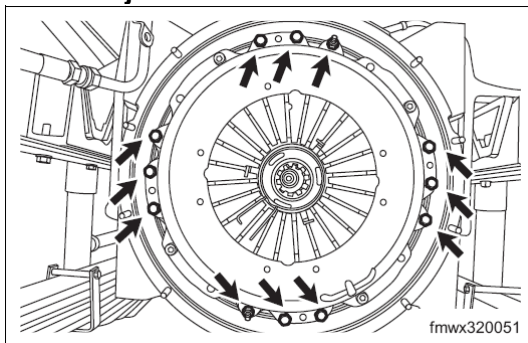
- (a). Remove the 12 fastening bolts for the clutch pressure plate.

Caution:

Diagonal loosening needs to be evenly done when removing the fastening bolts.

- (b). Remove clutch pressure assembly and driven disc assembly in turn.

6. Check clutch assembly; refer to Chapter 32, Clutch – Clutch Assembly, Testing & Adjustment



7. Install clutch pressure plate assembly and driven disc assembly

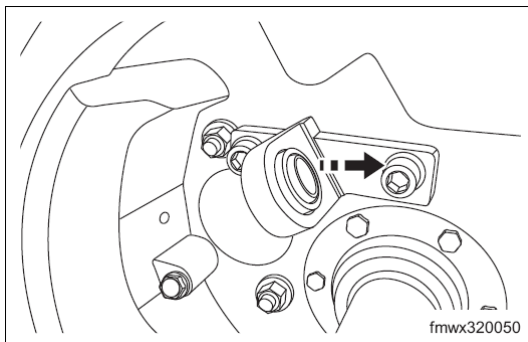
- (a). Install the clutch pressure plate assembly and driven disc to the flywheel with centering pump.

- (b). Tighten the fastening bolts of pressure plate.

Torque: 28N.m

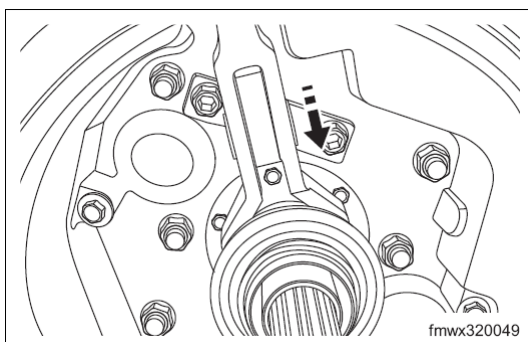
Caution:

Diagonal loosening need be evenly done when removing the fastening bolts.



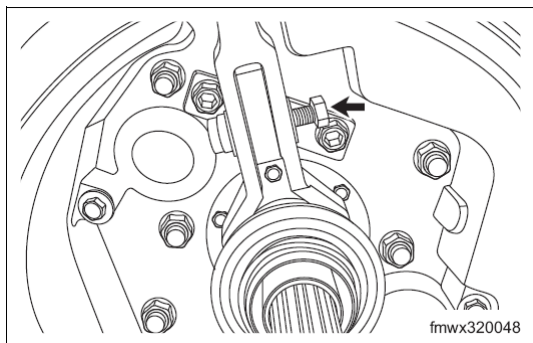
8. Install clutch shift fork and release bearing assembly

- (a). Install the support shaft sleeve of shift fork.

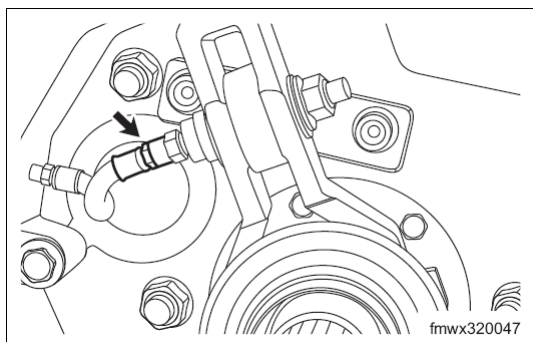


- (b). Install shift fork and release bearing.

Clutch - Clutch Assembly



- (c). Install the support shaft of clutch shift fork.
- (d). Tighten the nut.
Torque: 160N.m



- 9. Install lubricant pipe.**
 - (a). Install the lubricant pipe to the support shaft of clutch shift fork and the filler port of lubricant.
 - (b). Tighten the connection nut.

- 10. Install transmission assembly; refer to Chapter 31, Transmission – Transmission Assembly, Replacement**
- 11. Connect the battery negative cable.**

Drive Shaft

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Drive Shaft

General

This vehicle is equipped with different intermediate drive shafts and inter-axial drive shafts according to drive types of 4×2 , 6×2 , 6×4 and 8×4 . Drive shaft mainly consists of shaft pipe, expansion sleeve and universal joint. Expansion sleeve can automatically adjust the distance changes between gearbox and intermediate axle and between intermediate axle and rear axle; universal joint guarantees the changes of angle between gearbox output shaft and drive axle input shaft and realizes the constant angular velocity drive of the two shafts. Universal joint consists of cross shaft, cross bearing and flange fork. Belleville springs are provided on both end faces of the bearing to compress the roller; a reinforced nylon gasket with spiral flute is added on the end face of cross shaft, which can prevent sintering in transmission of power by big included angle or high torque.

The spline sleeve and drive shaft pipe of drive shaft are welded into a whole and the spline shaft and the flange fork are made into a whole; the spline is big pressure angle involute stub-tooth spline. A layer of nylon is dipped on the whole tooth surface of expansion sleeve and spline shaft. This not only increases wear resistance and self-lubrication but also reduces the damage from impact load to drive shaft and raises buffering capacity. Drive shaft is a revolving solid with high rotational speed and few supports, so its dynamic balance is crucial.

Precautions:

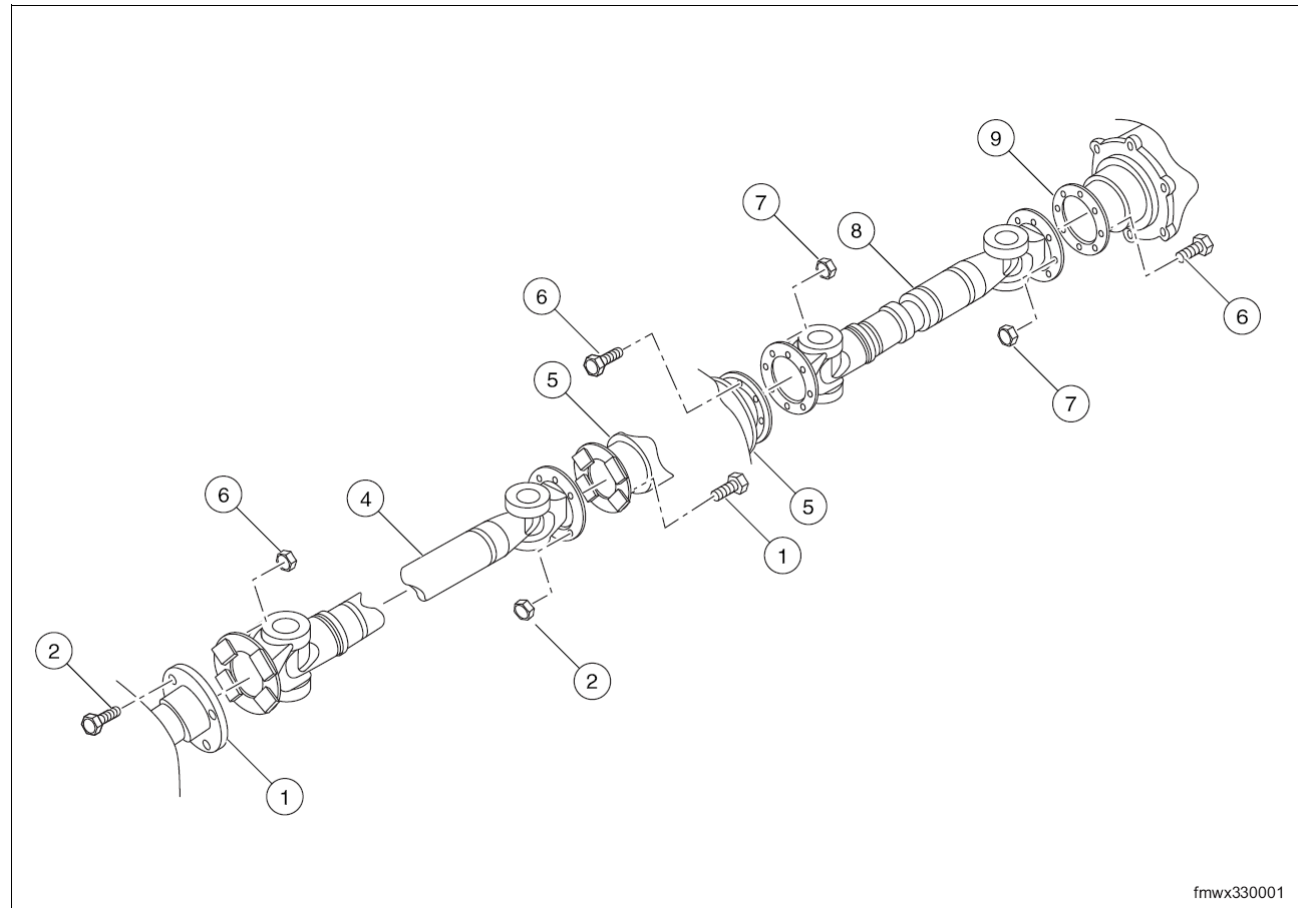
1. To start the vehicle at high gear is prohibited.
2. Releasing the clutch pedal suddenly is prohibited.
3. Front vehicle overloading and speeding are prohibited.
4. The working condition of drive shaft, whether the connections of drive shaft become loose and whether the drive shaft is deformed should be checked regularly.
5. To guarantee the dynamic balance of drive shaft, it should be often noted that whether the balance blocks loose weld and whether the new drive shaft assembly is provided in a complete set. When assembling the drive shaft, the assembly mark of expansion sleeve should be paid attention to and the flange forks be guaranteed in the same plane; when maintaining and removing the drive shaft, assembly marks should be stamped on the expansion sleeve and flange shaft, so as to keep the original assembly relations unchanged when reassembling.
6. Before using the drive shaft and in every 2,000 km, add lubricating grease, lithium lubricating grease 3 in summer and lubricating grease 2 in winter to universal joint cross bearing and spline.
7. When maintaining the drive shaft, disassembly from rear to front and assembly from front to rear should be followed.

Drive Shaft - Drive Shaft**Fault Symptom Table**

The use of the following table will help you find faults. The order numbers represent the fault possibility in sequence. Check every part according to this sequence and replace them as necessary.

Fault Symptoms	Possible Position	Reference
Abnormal sound in drive shaft	1. Drive shaft (loose)	Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul
		Chapter 33 Drive Shaft – Inter-axial Drive Shaft, Overhaul
	2. Lubrication (poor)	Lubricate or replace the drive shaft
	3. Universal joint (worn or damaged)	Chapter 33 Drive Shaft – Universal Joint, Overhaul
	4. Sliding spline (worn)	Chapter 33 Drive Shaft – Drive Shaft Assembly, Testing & Adjustment
Drive shaft vibration	1. Drive shaft (loose)	Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul
		Chapter 33 Drive Shaft – Inter-axial Drive Shaft, Overhaul
	2. Drive shaft (the mark is not aligned)	Chapter 33 Drive Shaft – Intermediate Drive Shaft, Overhaul
		Chapter 33 Drive Shaft – Inter-axial Drive Shaft, Overhaul
	3. Drive shaft (twisted or bent)	Chapter 33 Drive Shaft – Drive Shaft Assembly, Testing & Adjustment
	4. Drive shaft (unbalanced)	Chapter 33 Drive Shaft – Drive Shaft Assembly, Testing & Adjustment

Part Drawing

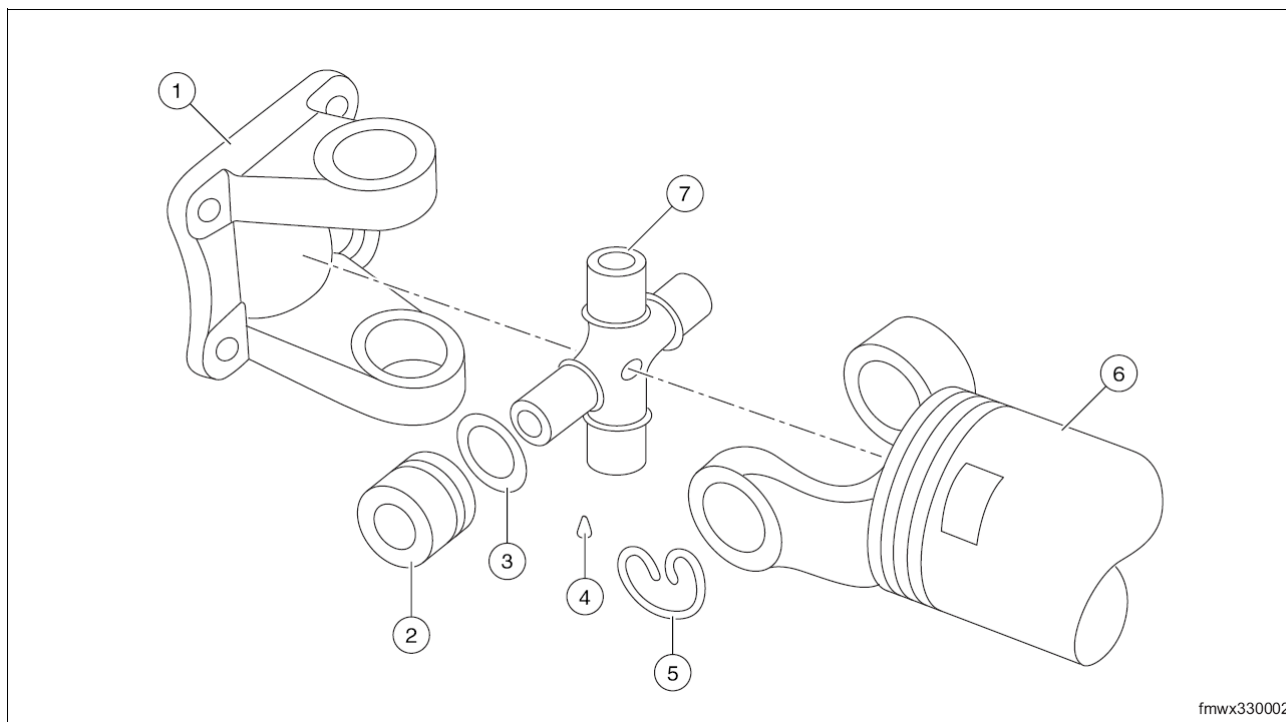


fmwx330001

1	Output Flange of Transmission
2	Bolt
3	Nut
4	Intermediate Drive Shaft
5	Intermediate Axle Flange

6	Bolt
7	Nut
8	Inter-axial Drive Shaft
9	Rear Axle Flange

Drive Shaft - Drive Shaft



1	Flange Fork
2	Needle Bearing
3	Dust Cover
4	Grease Nipple

5	Spring Snap Ring
6	Shaft Fork
7	Cross Bearing

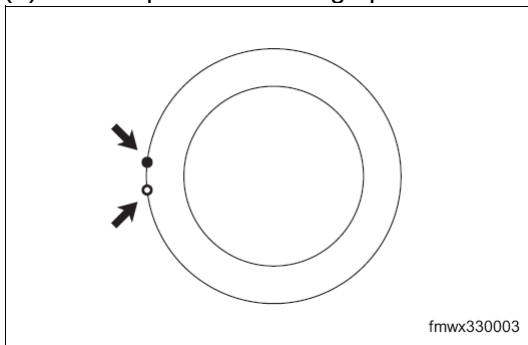
Testing & Adjustment

1. Vibration of transmission (real vehicle inspection)

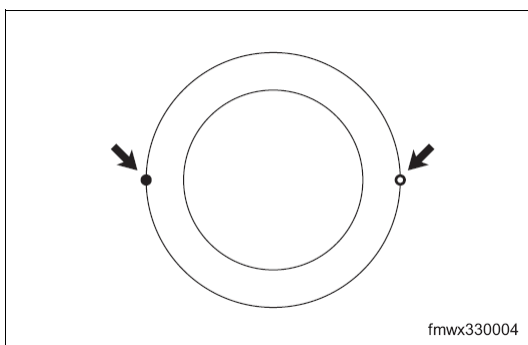
- (a). Check the condition of wheel balance and adjust as necessary; refer to Chapter 23, Wheel and Tire – Tire and Wheel Assembly, Testing & Adjustment
- (b). Have road test and check whether the transmission system vibrates when the vehicle is running.

2. Check transmission and shaft-drive balance (real vehicle inspection)

- (a). Rotate the wheels to make the drive shaft rotate and measure the radial runout at the front end, in the middle and at the rear end of the drive shaft respectively.
 - If the radial runout at the front end and in the middle exceeds the limit, make sure to replace with a new drive shaft.
 - If the radial runout at the front end and in the middle is within the limit but that at the rear end exceeds the limit, mark the runout at the rear end a high point and proceed with the next step.
 - If the radial runout at every point is within the limit, also proceed with the next step.
- (b). Make the drive shaft and the main reducer rotate 1/2 of a circle.
Refer to Chapter 33, Drive Shaft – Intermediate Drive Shaft, Overhaul
Refer to Chapter 33, Drive Shaft – Inter-axial Drive Shaft, Overhaul
 - If they only rotate 1/4 of a circle, inspection and adjustment can be conducted more accurately.
- (c). Check the radial runout of the drive shaft at the rear end.
 - If the radial runout at the rear end still exceeds the limit, mark it a high point and proceed with the next step.
 - If the radial runout at the rear end is within the limit, have road test and check whether the transmission rotates in running.
- (d). Compare the two high points marked in the above steps.



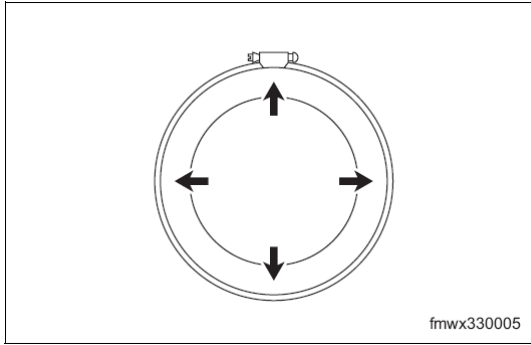
- If the two marked high points are close to each other and within 20 mm away from each other, the drive shaft must be replaced with a new one.



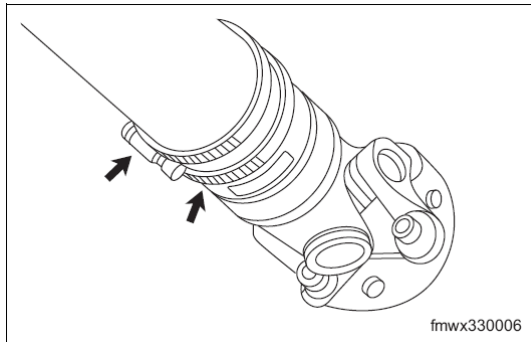
- If the two marked high points are at the opposite sides of the drive shaft, it indicates that the main reducer flange is the main cause for vibration. Refer to Chapter 25, Rear Axle – Driving Gear and Bearing, Overhaul
- Have road test and check whether the transmission vibrates. If the vibration continues, balancing the drive shaft is required.

Drive Shaft - Drive Shaft

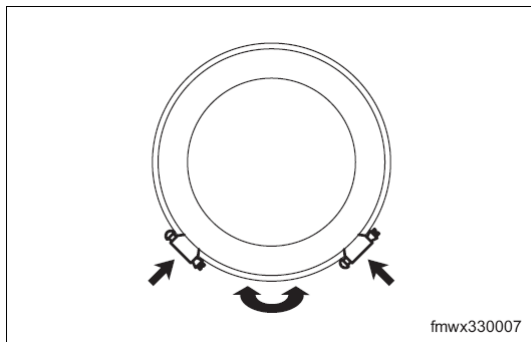
3. Balance the drive shaft (real vehicle inspection)



- (a). Install one or two hoops at the rear end of the drive shaft.
- Divide the circumference face at the rear end of the drive shaft into four parts equally and place the hoop clamp in one of them.
 - Have a road test to check whether there is vibration and change the direction of hoop to determine the position that makes the vibration the minimum. If two close positions have the similar effect on the improvement of the vibration, place the hoop between the two positions.

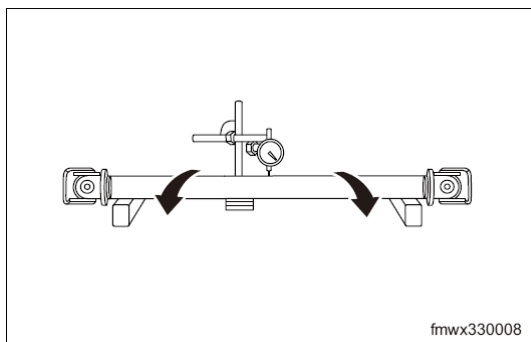


- (b). If the vibration continues, add another hoop in the same position and have road test to check whether vibration exists.



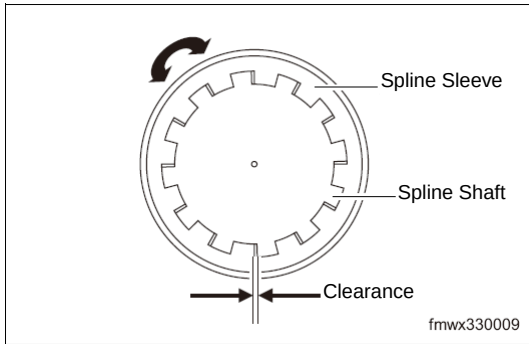
- If the vibration has not been improved, rotate the hoops in reverse to reach the equal distance to the position previously determined to have the minimum vibration. Separate the clamps of the two hoops about 10 cm apart and have road test again to check whether vibration exists.
- Increase the space and repeat the above steps until the optimum position is found or the vibration is reduced to an acceptable level.

4. Check the radial runout of drive shaft



- (a). Use V-shape platform and dial indicator to measure the radial runout of the drive shaft.
- Standard value: 0.6 mm**
Limit value: 1.0 mm

5. Check the backlash of drive shaft sliding spline



- (a). Use a clearance gauge to measure the fit clearance of spline shaft and spline sleeve in the normal rotational direction.

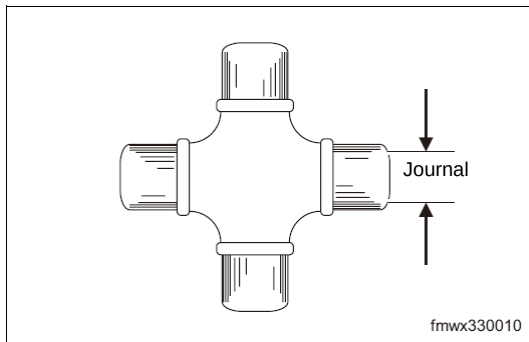
Standard value: 0.02~0.01 mm

Limit value: 0.3 mm

Hint:

If the backlash of sliding spline exceeds the limit value, replace the drive shaft with a new one.

6. Check the cross shaft



- (a). Check the wear on the journal surface of the cross shaft.

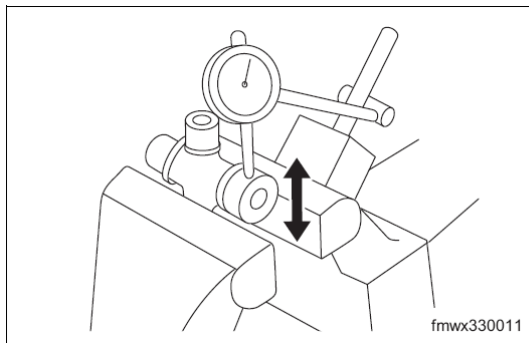
- (b). Use vernier caliper to measure the cross shaft journal.

Standard value: 0.01 mm

Limit value: 0.03 mm

Hint:

If the wear exceeds the limit, replace the cross shaft with a new one.



- (c). Use bench vice and dial indicator to check the clearance between the cross shaft and the needle bearing.

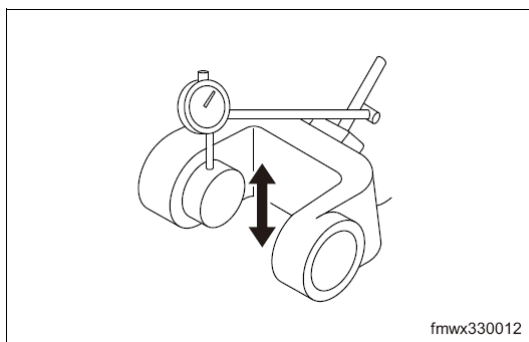
Standard value: 0.02~0.09 mm

Limit value: 0.15 mm

- Never use bench vice to clamp the cross shaft directly. Separate them with a soft cloth at the clamp to avoid cross shaft damage.
- Make sure to use new needle bearing when checking.
- Set the needle bearing on the cross shaft and move the bearing in radial direction to measure the clearance between cross shaft and needle bearing.

Hint:

If the clearance exceeds the limit, replace the cross shaft with a new one.



- (d). Use dial indicator to check the clearance between needle bearing and universal joint fork.

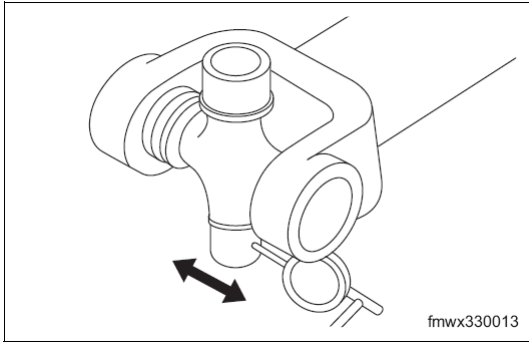
Limit value: 0.50 mm

- Put the needle bearing in the installing hole of the universal joint and move the bearing in radial direction to measure the clearance between needle bearing and universal joint fork.

Hint:

If the clearance exceeds the limit, replace the needle bearing with a new one.

Drive Shaft - Drive Shaft



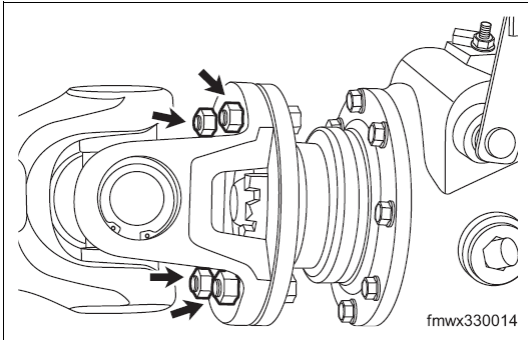
- (e). Use dial indicator to check the axial clearance of the cross shaft.
- Set the needle bearing on the cross shaft and put it in the installing hole of the universal joint. Move the cross shaft in axial direction to measure its axial clearance.

Hint:

If the clearance exceeds the limit, replace the cross shaft and needle bearing with new ones.

Intermediate Drive Shaft Overhaul

1. Use self-discharging function to open the trunk



2. Dismantle intermediate drive shaft assembly

- Lift the drive shaft with hydraulic carrier.
- Disconnect the connection of drive shaft and intermediate axle.
 - Remove the connecting bolt of drive shaft and intermediate axle input flange.

- Disconnect the connection of drive shaft and gear box.
 - Remove the connecting bolt of drive shaft and gearbox output flange.

Hint:

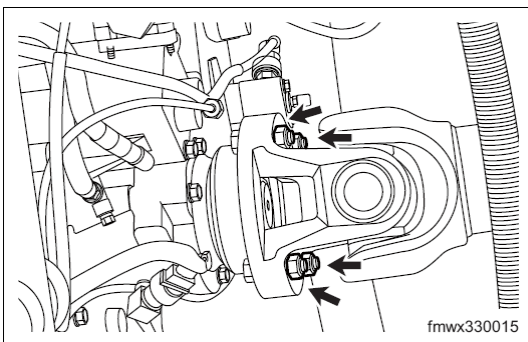
Observe whether there is an installation mark; mark one if there isn't.

- Remove the intermediate drive shaft assembly.

Hint:

Observe whether there is a forward mark; mark one if there isn't.

3. Check the drive shaft; refer to Chapter 33, Drive Shaft – Drive Shaft Assembly, Testing & Adjustment



4. Install the intermediate drive shaft

- Put the drive shaft assembly on the hydraulic carrier to jack up the parallel gearbox output flange and intermediate axle input flange.
- Align the drive shaft and the gearbox output flange and tighten the bolt.

Torque: 178~218 N.m

Caution:

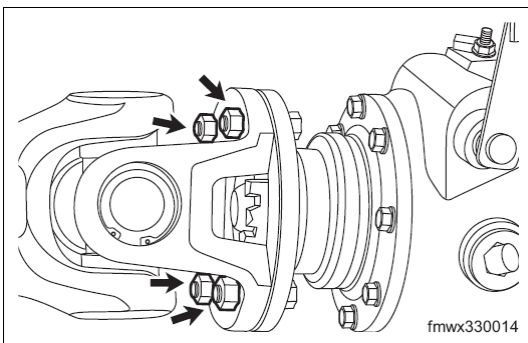
Make sure the forward mark forward and the installation mark aligned.

- Connect the drive shaft and the intermediate axle input flange and tighten the bolt.

Torque: 178~218 N.m

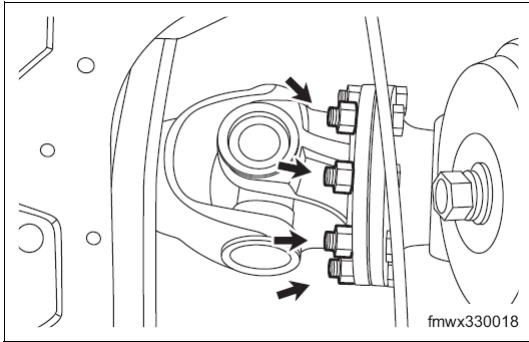
Caution:

Make sure the installation mark aligned.



Inter-axial Drive Shaft Overhaul

1. Use self-discharging function to open the trunk



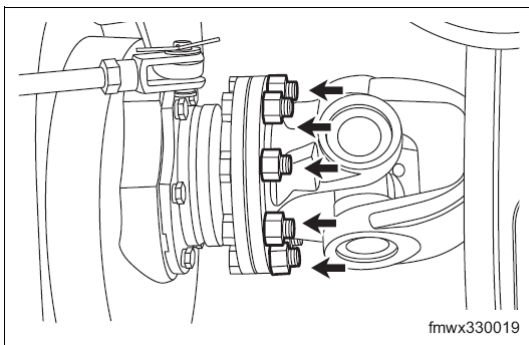
2. Dismantle intermediate drive shaft assembly

- (a). Disconnect the connection of inter-axial drive shaft and rear axle.
- Dismantle the connecting bolt of inter-axial drive shaft and rear axle flange.

Hint:

Observe whether there is an installation mark; mark one if there isn't.

33



- (b). Disconnect the connection of inter-axial drive shaft and intermediate axle.

- Dismantle the connecting bolt of inter-axial drive shaft and intermediate axle output flange.

Hint:

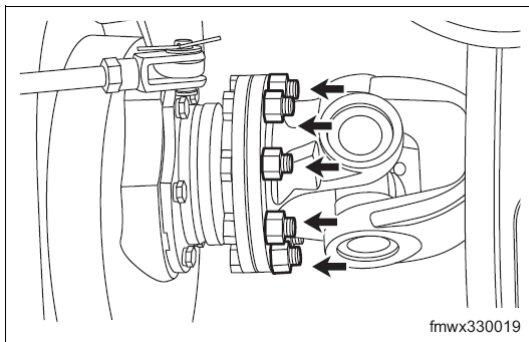
Observe whether there is an installation mark; mark one if there isn't.

- (c). Remove the inter-axial drive shaft assembly.

Hint:

Observe whether there is a forward mark; mark one if there isn't.

3. Check the inter-axial drive shaft; refer to Chapter 33, Drive Shaft – Drive Shaft Assembly, Testing & Adjustment



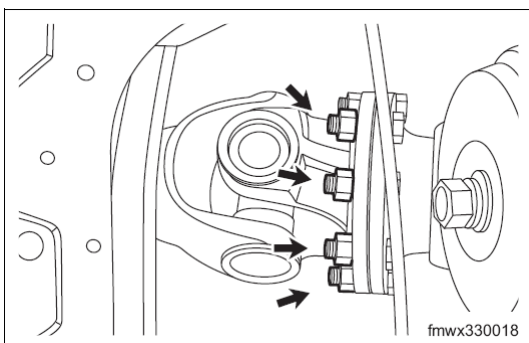
4. Install the inter-axial drive shaft assembly

- (a). Align the inter-axial drive shaft and the intermediate axle output flange and tighten the connecting bolt.

Torque: 178~218 N.m

Note:

Make sure the forward mark forward and the installation mark aligned.



- (b). Align the inter-axial drive shaft and the rear axle flange and tighten the connecting bolt.

Torque: 178~218 N.m

Caution:

Make sure the installation mark aligned.

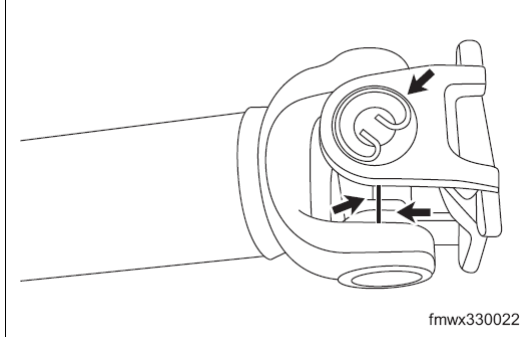
Universal Joint

Overhaul

1. Dismantle the drive shaft

Refer to Chapter 33, Drive Shaft – Intermediate Drive Shaft, Overhaul

Refer to Chapter 33, Drive Shaft – Inter-axial Drive Shaft, Overhaul



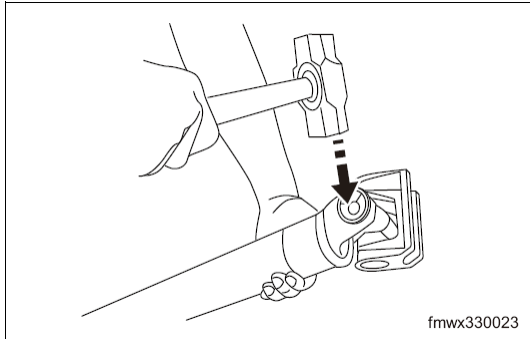
2. Break down sliding fork universal joint

- Make assembly marks on flange fork, cross shaft and sliding fork.
- Dismantle the grease nipple.

Caution:

Be careful when dismantling; do not damage the grease nipple.

- Use spring plier to remove spring snap ring.



- Use a hammer and copper rod to knock the sliding fork lightly to shake out needle bearing and dust cover from the outside of sliding fork and flange fork, so as to remove the cross shaft.

Caution:

Do not use hammer to directly knock or use bench vice to directly clamp the drive shaft.

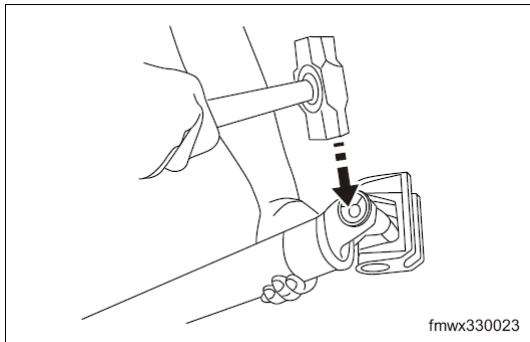
- Separate sliding fork and flange fork.

3. Check the universal joint assembly; refer to Chapter 33, Drive Shaft – Drive Shaft Assembly, Testing & Adjustment

4. Assemble sliding fork universal joint

- Apply an appropriate amount of lithium lubricating grease 2 on the surface of cross shaft and needle bearing.

- Too much lubricating grease may increase difficulty of assembly.



- Use rubber hammer to knock the needle bearing lightly to fit it into the ear hole from the outside of flange fork and sliding fork. Install the cross shaft at the same time.

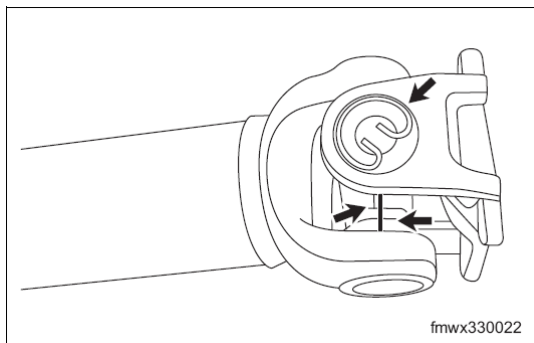
- Be sure to replace the needle bearing with a new one.

- Install the dust cover at the same time.

Caution:

Be sure to install in accordance with the assembly marks. Attention should be paid to the direction of cross shaft grease nipple when installing, which should be the same with the direction of other cross shaft grease nipples, so as to add lubricating grease.

Drive Shaft - Universal Joint



- (c). Use spring plier to install spring snap ring.
 - Be sure to replace the spring snap ring with a new one.
- (d). Install the grease nipple.
 - Be sure to replace the grease nipple with a new one.

5. Install the drive shaft

Refer to Chapter 33, Drive Shaft – Intermediate Drive Shaft, Overhaul

Refer to Chapter 33, Drive Shaft – Inter-axial Drive Shaft, Overhaul

Power Take-off

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Precautions	34-7
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Power Take-off

General

Besides providing variable speed ratio for the vehicle to guarantee it travels normally in various working conditions, the transmission can also be fitted with an additional device to meet the other requirements of complete vehicle. Such device is power take-off. Twin countershaft transmission produced by Fast Company can be equipped with many styles of power take-offs including front (QF60, QQ60 and QQ60A), rear (QH70 and QH50 series), side (QC40, QC40A and QC40B) and bottom (QD60 and QD50) power take-offs according to the special requirements of various special vehicles. It is the ideal transmission for heavy vehicles of the day.

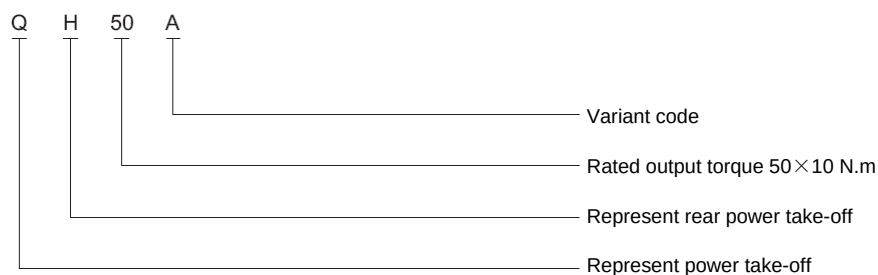
Fast twin countershaft transmission can be fitted with many styles of power take-off, "front power take-off" between the primary shaft at the front of the transmission and the clutch and power take-off to the right side of the main box housing of twin countershaft transmission and at the power take-off window of the bottom. They take off power from the power take-off gear between the countershaft 3rd gear and the countershaft drive gear respectively, called "bottom power take-off" and "side power take-off". Power can also be taken off from the extended countershaft at the rear end of the transmission, called "rear power take-off". This type of power take-off is applied most widely. This article puts emphasis on the explanation of rear power take-off.

Power take-offs of QH50 series take off power from the rear of the sub-box countershaft of twin countershaft transmission, applicable to matching special vehicles above 10T, such as dump truck, truck crane, oil tank truck, sprinkling truck, bulk-cement tanker and so on.

QH50 power take-offs are rear power take-off installed on the extended countershaft at the rear of Fast twin countershaft transmission. The power is taken off by the hollow shaft of power take-off from the transmission extended countershaft, transmitted to the input gear through mesh gear sleeve and output through gear shaft and output flange disc.

This power take-off is one-way air control. The conjunction gears of both input gear and mesh sleeve are inverted cone gears and can take an effect of preventing out-of-gear. Moreover, the hollow shaft is fitted with supporting spring, which can make the shift fork be kept in the middle position of mesh sleeve fork pocket without contacting both sides. This reduces friction and has a boost effect when putting into gear and taking out of gear.

Model implication of power take-off



fmwx340038

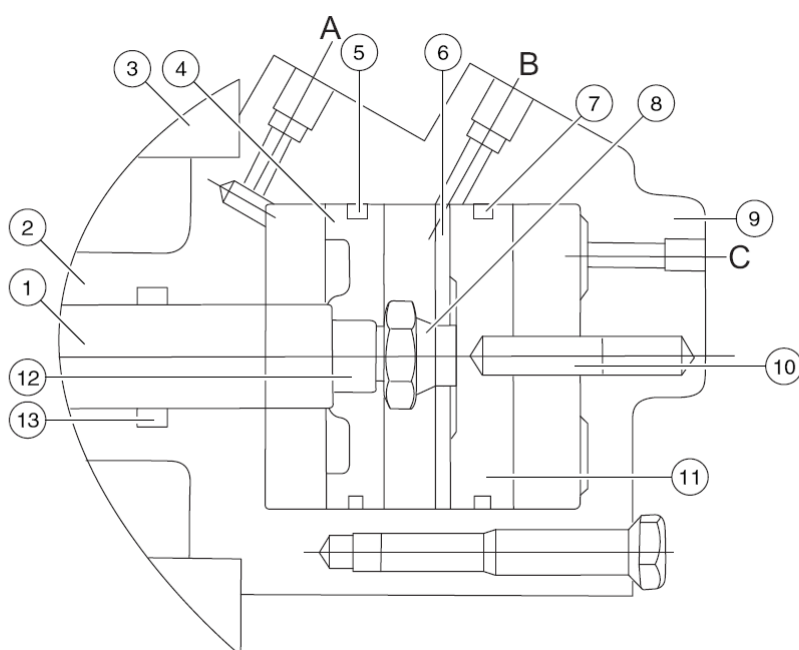
Working Principle of Power Take-off

I. Service power take-off

When using service power take-off, make the vehicle in low gears firstly and drive at a low speed and then place the control lever in low or neutral gears. Turn on the solenoid valve the power take-off to make the power take-off in gear and power take-off state. Put the transmission into the required gear, when the power take-off gets into working state. And the complete vehicle can also run normally.

II. Parking power take-off

When using parking power take-off, put the transmission control lever in low or neutral positions firstly, turn on the solenoid valve of power take-off and put through the working air line of power take-off and the cylinder air line in neutral position: make the power take-off put into gear to work on the one hand and use air pressure difference to put the sub-box synchronizer into the neutral gear on the other hand. Then put the transmission into the required gear (only low gears) according to specific circumstances. At this time, the power take-off is put into gear to work, while the complete vehicle stays still. Parking power take-off" is realized. To realize parking power take-off, the auxiliary transmission must be put into the neutral position. To solve this problem, it is only required to remove the transmission range shift cylinder head and fit a neutral position cylinder.



fmwx340039

1	Range Shift Fork Shaft
2	Range Shift Cylinder
3	Rear Cover Housing
4	Range Shift Cylinder Piston
5	O-ring
6	Locating Ring
7	O-ring

8	Hex Nylon Lock Nut
9	Neutral Position Cylinder
10	Guide Pin
11	Neutral Position Piston
12	O-ring
13	O-ring

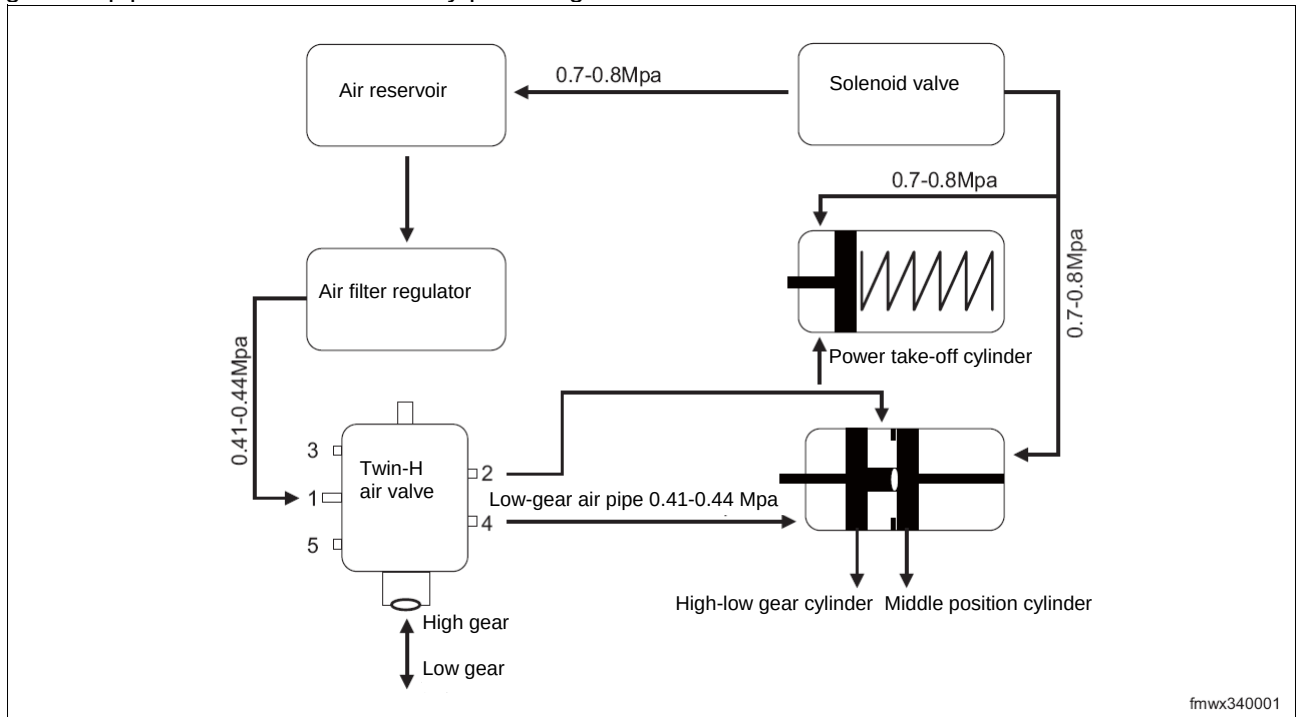
Orifices A and B are connected to the low gear and high gear air pipes of the transmission respectively and to the twin-H air valve of the transmission, with air pressure of 0.41~0.44 Mpa. Orifice C is the compressed air inlet to put the auxiliary transmission in the neutral position, with air pressure of 0.7~0.8 Mpa. In parking power take-off, put the transmission lever in low or neutral gears firstly to make the range shift cylinder piston closely press on the locating ring 6, and then operate the working solenoid valve of the power take-off to make the compressed air of 0.7~0.8 Mpa get into neutral position cylinder 9 from orifice C. Because of pressure difference, neutral position cylinder piston 11 moves to the left

Power Take-off- Power Take-off

until reaching locating ring 6. In this way, transmission range shift cylinder piston 4 will be in neutral position. And the sub-box synchronizer is made to be in neutral position.

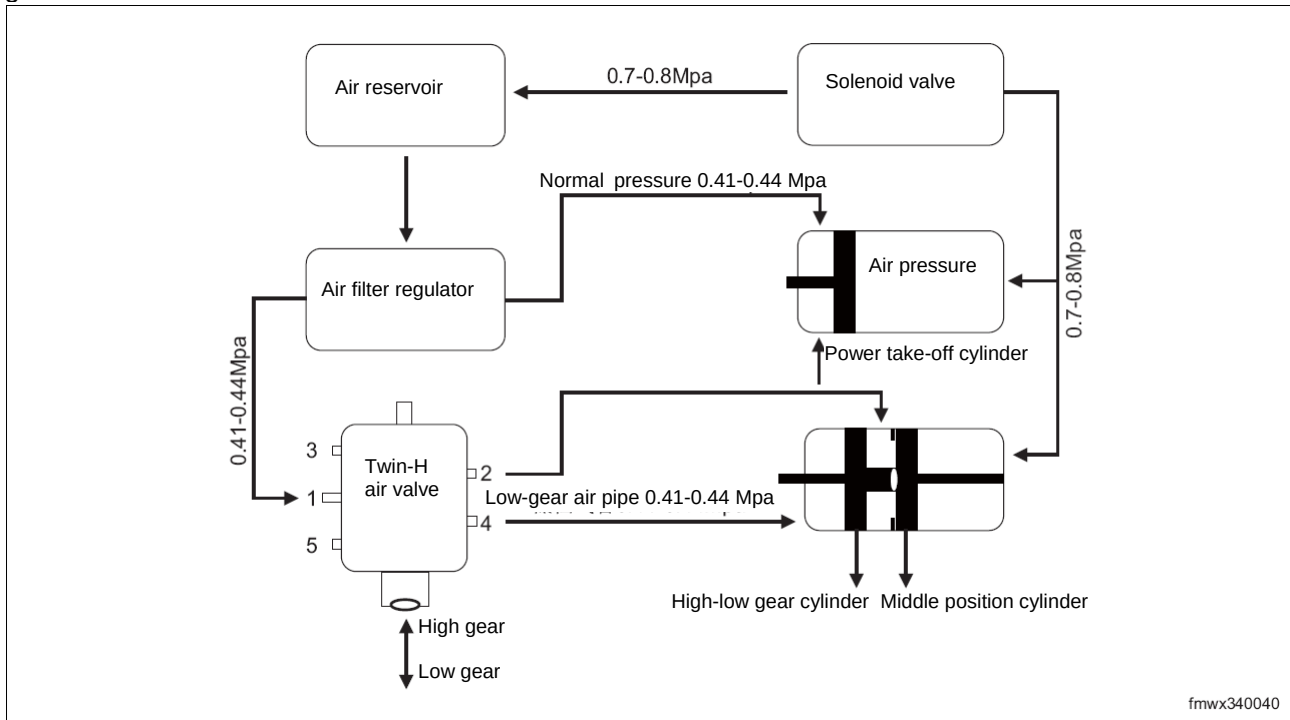
III. Working principle of QH50 power take-off air line

The compressed air of 0.7~0.8 Mpa from the complete vehicle air reservoir is divided into two ways: one way into the air filter regulator of the transmission to supply working air pressure to the transmission so as to realize the high and low gear shift of sub-box synchronizer, and the other into the air inlet of the power take-off solenoid valve. When the solenoid valve of the power take-off is not turned on, the whole air line system of the power take-off has no air and does not work; when the solenoid valve of the power take-off is switched on, 0.7~0.8 Mpa compressed air gets into the working cylinder of the power take-off and the sub-box neutral position cylinder respectively. The air pressure into the working cylinder of the power take-off pushes the cylinder piston of the power take-off to be in gear to work and the power take-off is put in working order; the air pressure into the sub-box neutral position cylinder will push the piston of sub-box gear shift cylinder to be in the middle position (Because of air pressure difference, the air pressure at the air inlet at the rear of neutral position cylinder is 0.7~0.8 Mpa and the working air pressure of transmission sub-box gear shift cylinder is 0.41~0.44 Mpa) and makes the sub-box synchronizer in neutral position. At this time, the power take-off in gear works, but the output shaft does not have power take-off and the vehicle stays still. Parking power take-off is realized. When the solenoid valve of the power take-off is turned off, the cylinder piston will push the power take-off piston to the neutral position through the return spring in the cylinder and the sub-box gear shift cylinder piston will be pushed back to low gears by the 0.41~0.44 Mpa air pressure in the low-gear air pipe. The vehicle is normally put into gear to run.



Power Take-off- Power Take-off**IV. Working principle of QH70 power take-off air line**

The 0.7~0.8 Mpa compressed air from the complete vehicle air reservoir is divided into two ways: on into the air filter regulator of the transmission to provide working air pressure for the transmission so as to realize the high and low gear shift of sub-box synchronizer, and the other into the air inlet of power take-off solenoid valve. The working cylinder of QH70 power take-off has two air ports and the air inlet at its side is normal air with air pressure of 0.41~0.44 Mpa to guarantee the slide sleeve is in neutral when the power take-off does not work. When the solenoid valve of the power take-off is switched on, 0.7~0.8 Mpa compressed air gets into the working cylinder of the power take-off and the sub-box neutral position cylinder respectively. Because of the pressure difference of air into the working cylinder of the power take-off, the air pressure at the air inlet of the power take-off is 0.7~0.8 Mpa and the power take-off is normal air with air pressure of 0.41~0.44 Mpa, thus the power take-off piston is pushed to be in gear to work; the air pressure into the sub-box neutral position cylinder will push the piston of sub-box gear shift cylinder to be in the middle position (Because of air pressure difference, the air pressure at the air inlet at the rear of neutral position cylinder is 0.7~0.8 Mpa and the working air pressure of transmission sub-box gear shift cylinder is 0.41~0.44 Mpa) and makes the sub-box synchronizer in neutral position. At this time, the power take-off in gear works, but the output shaft does not have power take-off and the vehicle stays still. Parking power take-off is realized. When the solenoid valve of the power take-off is turned off, the cylinder piston will push the power take-off piston to the neutral position through the normal air in the cylinder and the sub-box gear shift cylinder piston will be pushed back to low gears by the 0.41~0.44 Mpa air pressure in the low-gear air pipe. The vehicle is normally put into gear to run.



Precautions:

1. Pay attention to adding and changing lubricant in time (The brand of lubricant is the same with that of transmission).
2. The inner chamber of power take-off installed under or at the side of the transmission is connected to the transmission, so separate lubricant adding is not needed; but the inner chamber of power take-off installed at the front of the transmission or at the upper-left or upper-right corner of the rear cover housing is not connected to the transmission, so lubricant need be added separately.
3. The oil change period of power take-offs where lubricant is added separately should be reduced to eliminate impurities produced by running-in. Replace with new oil every 500 working hours hereafter to prevent the lubricant from deteriorating.
4. The oil change period of transmission assembly newly fitted with power take-off should be appropriately reduced to avoid early wear of the power take-off.
5. When any fault or abnormal sound is met, it should be checked in time. Change the damaged parts to guarantee its normal working.
6. Gear shift when the transmission is not in neutral is prohibited.

Fault Symptom Table

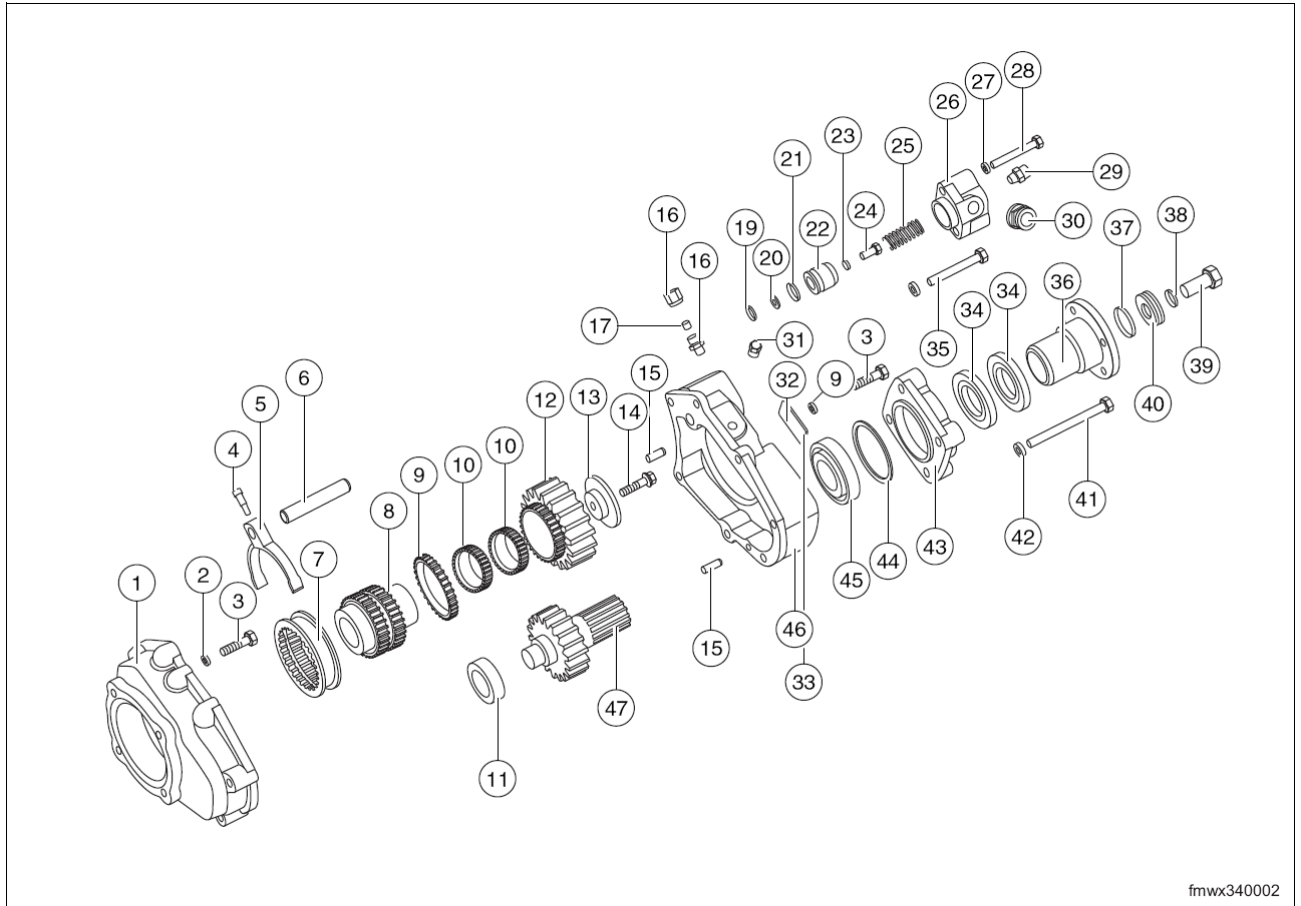
The use of the following table will help you find faults. The order numbers represent the fault possibility in sequence. Check every part according to this sequence and replace them as necessary.

Fault symptoms	Possible Position	Reference
Oil Leakage	1. Bearing cap oil seal (hardened)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	2. The junction surface of power take-off housing and cover	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	3. The junction surface of power take-off housing and transmission sub-box	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
Abnormal sound in power take-off	1. Connections (loose)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	2. Bearing (worn)	Chapter 34 Power Take-off – Power Take-off, Testing & Adjustment
	3. Gear (tooth beat)	Chapter 34 Power Take-off – Power Take-off, Testing & Adjustment
Power take-off failure to be put into gear or taken out of gear	1. Return spring (failed)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	2. Piston locating bolt (loose)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	3. Shift fork/mesh sleeve (worn)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	4. Air line (obstructed)/oil leakage	Air Line Overhaul
The power take-off indicator is not on or abnormal	1. Wire harness connector (loose)/(short)	Circuit Overhaul
	2. Indicator switch (incorrect installation)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation
	3. Indicator switch (damaged)	Chapter 34 Power Take-off – QH50 Power Take-off, Disassembly & Installation



Power Take-off- Power Take-off

Part Drawing



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1	Power Take-off Housing
2	Washer
3	Hex Socket Bolt
4	Locating Bolt of Shift Fork
5	Shift Fork
6	Shift Fork Shaft
7	Mesh Sleeve
8	Hollow Shaft
9	Supporting Spring
10	Needle Bearing
11	Tapered Roller Bearing
12	Input Gear
13	Snap Ring of Input Gear
14	Locating Lock Bolt
15	Locating Pin

25	Return Spring
26	Cylinder Body
27	Washer
28	Hex Bolt
29	Air Pipe Joint of Power Take-off
30	Indicator Switch of Power Take-off
31	Vent Plug
32	Gasket
33	Gasket
34	Oil Seal
35	Hex Bolt
36	Output Flange
37	O-ring
38	Washer
39	Hex Bolt

Power Take-off- Power Take-off

16	Lock Nut of Air Pipe
17	Air Pipe Joint Sleeve
18	Air Pipe Joint Bolt
19	O-ring
20	O-ring
21	O-ring
22	Piston
23	Gasket
24	Hex Socket Bolt

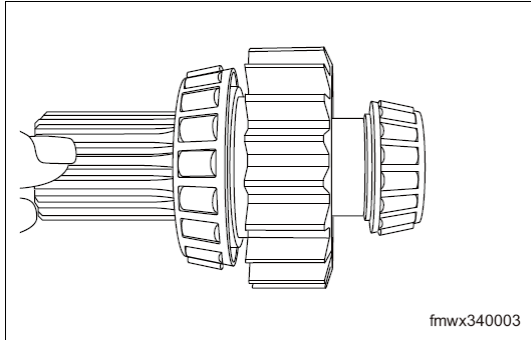
40	Seal Baffle Plate
41	Hex Bolt
42	Gasket
43	Bearing Cap
44	Adjusting Washer
45	Tapered Roller Bearing
46	Power Take-off Cover
47	Output Gear Shaft

Testing & Adjustment

1. Inspection on vehicle

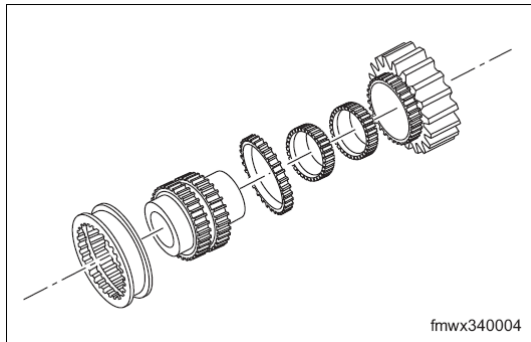
- (a). Check whether the liquid level of power take-off complies with the standard and add or replace with 85W/90 lubricant as applicable.
- (b). Check whether there is air leakage for the air pipe of power take-off.
- (c). Check whether the switch harness of power take-off is installed firmly.
- (d). Check whether the connecting piece bolts become loose and tighten them one by one as required.

2. Check the power take-off output shaft assembly



- (a). Check whether the gears are pitted or tooth beat.
- (b). Check whether the bearing is worn and pitted.

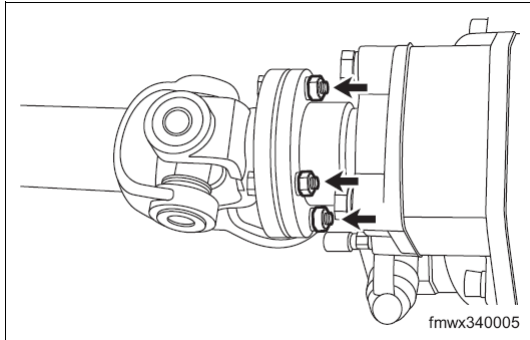
3. Check the input hollow shaft assembly



- (a). Check whether the mesh sleeves are obviously worn.
- (b). Check whether the gears are pitted and tooth beat.
- (c). Check whether the needle bearing is worn.
- (d). Check whether the hollow shaft gears are worn and tooth beat.

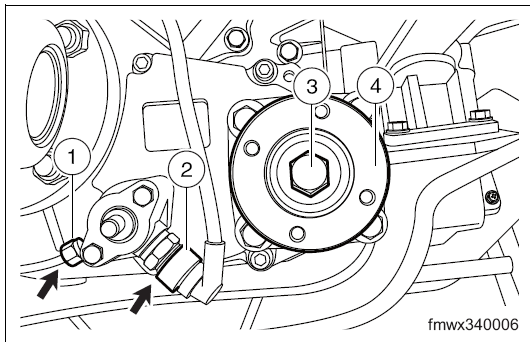
QH50 Power Take-off Disassembly & Installation

1. Disconnect the battery negative cable



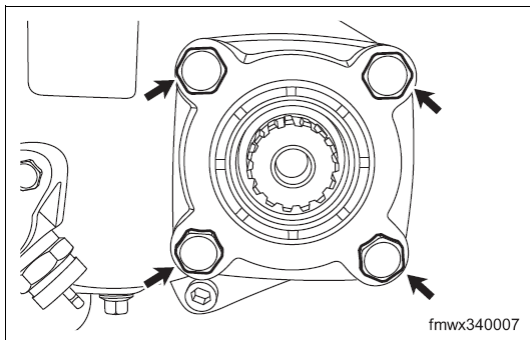
2. Dismantle the power take-off drive shaft assembly

- (a). Dismantle the four connecting bolts for the power take-off drive shaft.
- (b). Remove the drive shaft assembly.



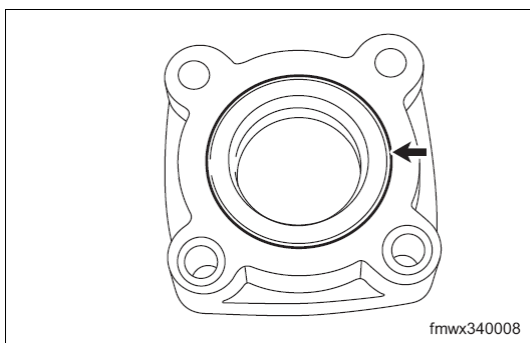
3. Dismantle the accessory connection on the power take-off

- (a). Dismantle power take-off air pipe 1.
- (b). Dismantle power take-off indicator switch 2.
- (c). Dismantle flange fastening bolt 3.
- (d). Remove flange 4.

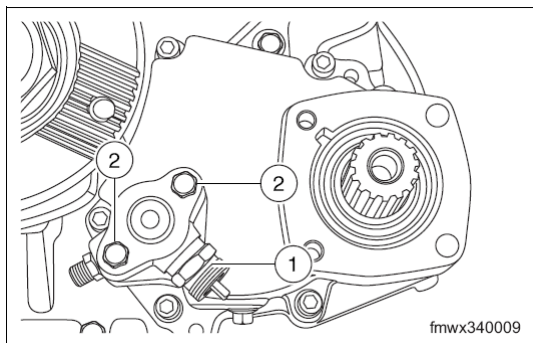


4. Dismantle the bearing cap

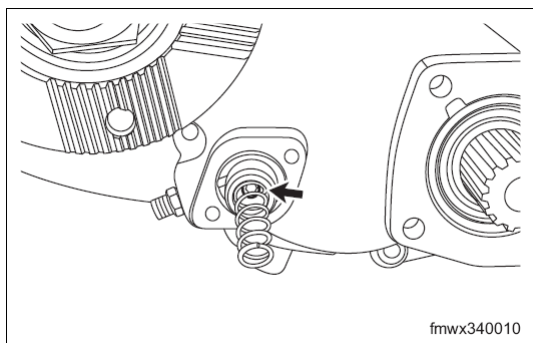
- (a). Dismantle the four connecting bolts.
- (b). Remove the bearing cap.



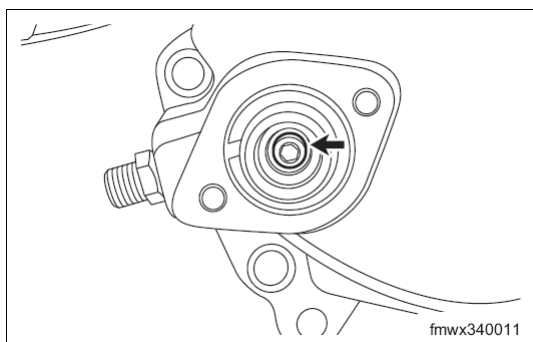
- (c). Dismantle the oil seal.

Power Take-off- QH50 Power Take-off

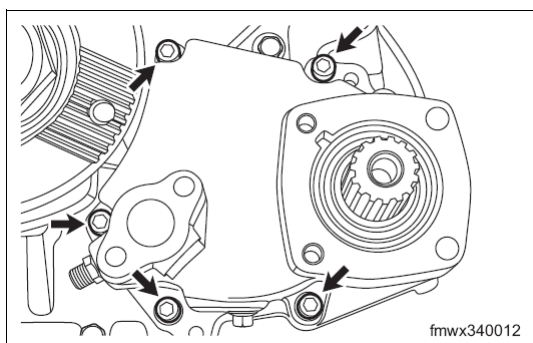
5. **Dismantle the power take-off cylinder body assembly**
- (a). Dismantle power take-off switch 1.
 - (b). Loosen the two connecting bolts 2 for the power take-off cylinder.
 - (c). Remove power take-off cylinder.



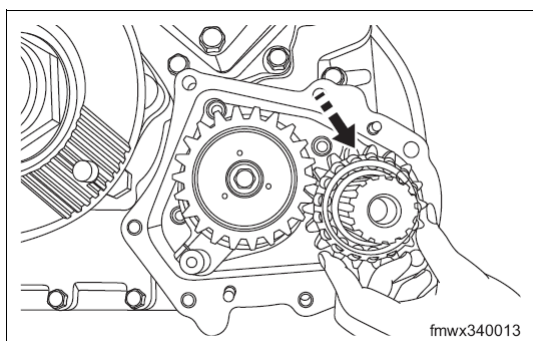
- (d). Remove the return spring.



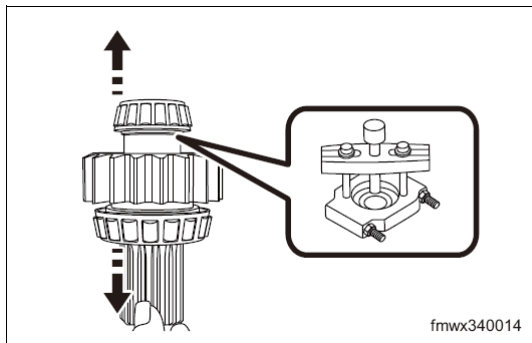
- (e). Loosen the hex socket bolts and remove the power take-off piston.



6. **Dismantle the power take-off cap**
- (a). Loosen the five Hex socket bolts 2 for the power take-off cap.
 - (b). Knock the power take-off cap lightly to separate the power take-off cap and housing.

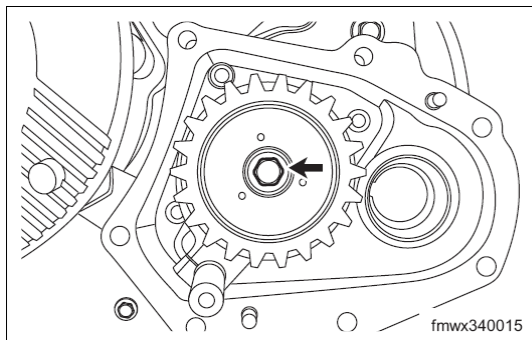


7. **Dismantle the power take-off output shaft assembly**
- (a). Remove the output shaft assembly.



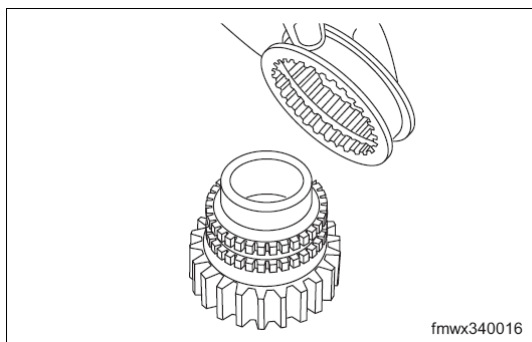
8. Separate the output shaft

- (a). Pull out the bearings and bearing outer rings at both ends.



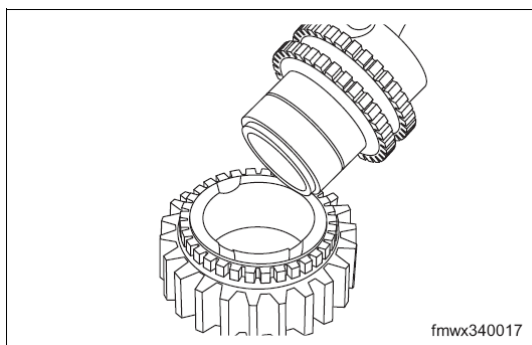
9. Dismantle the input hollow shaft of power take-off

- (a). Loosen the bolt.
(b). Remove the snap ring.
(c). Remove the input shaft assembly and the shift fork.

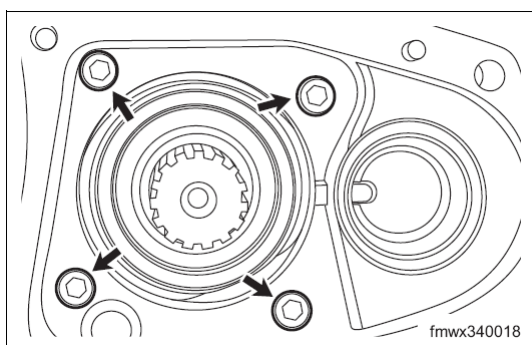


10. Separate the input hollow shaft assembly

- (a). Remove the mesh sleeve.

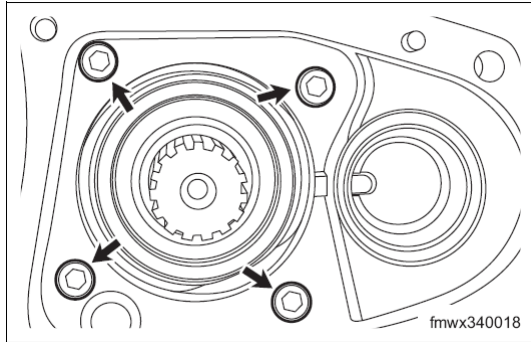


- (b). Separate the hollow shaft from the input gear.
(c). Remove the two groups of needle bearings.
(d). Remove the supporting spring.



11. Separate the power take-off housing from the transmission sub-box

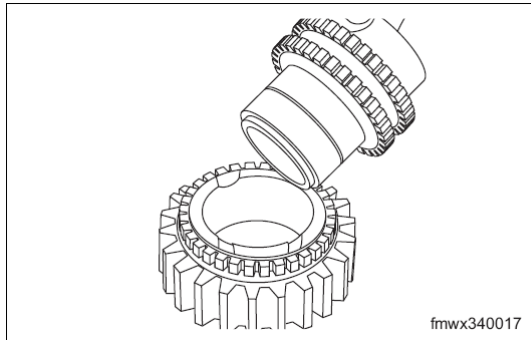
- (a). Loosen the four hex socket bolts.
(b). Remove the power take-off housing.
(c). Replace the bearing outer ring of output shaft.

Power Take-off- QH50 Power Take-off**12. Install the power take-off housing**

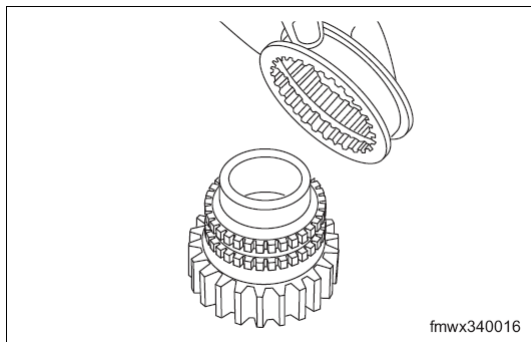
- (a). Clean the contact face of housing and transmission sub-box and apply plane sealant on it evenly.

Sealant: Loctite 510 plane sealant

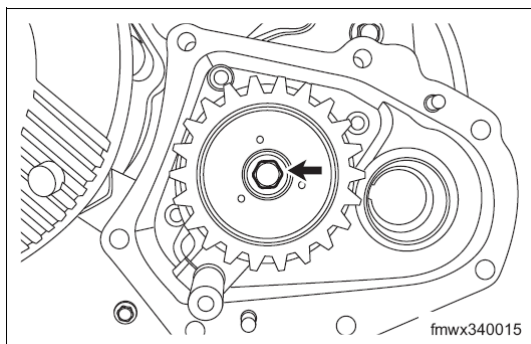
- (b). Install the housing and align the threaded holes.
(c). Tighten the four hex socket bolts.

**13. Assemble the input hollow shaft assembly**

- (a). Install the supporting spring to the hollow shaft.
(b). Install two groups of needle bearings to the hollow shaft.
(c). Set the input gear sleeve into the hollow shaft.



- (d). Install the mesh sleeve to the hollow shaft.

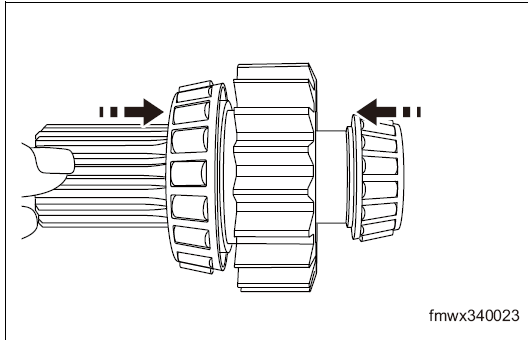
**14. Install the power take-off input hollow shaft**

- (a). Clean the power take-off input shaft assembly.
(b). Fit the shift fork and input shaft assembly into the housing.
(c). Tighten the bolt.

Caution:

Loctite 242 adhesive sealant need be applied on the bolt.

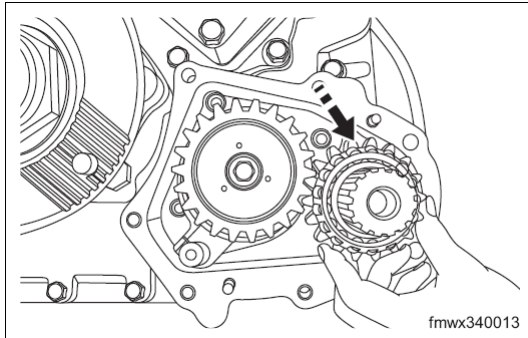
Torque: 64N.m



15. Assemble the output shaft

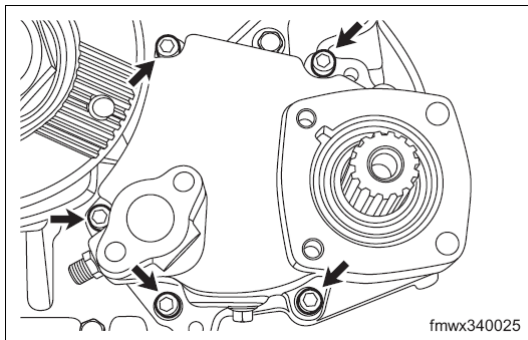
- (a). Install two groups of bearings to the input shaft.

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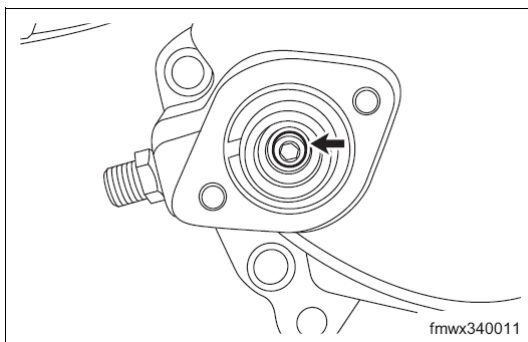
16. Install the power take-off output shaft

- (a). Clean the output shaft assembly.
(b). Install the output shaft.



17. Install the power take-off cover

- (a). Clean the contact face of power take-off cover.
(b). Install the gasket.
(c). Connect the power take-off cover to the housing and align the threaded holes.
(d). Tighten the five hex. bolts.
Torque: 28N.m

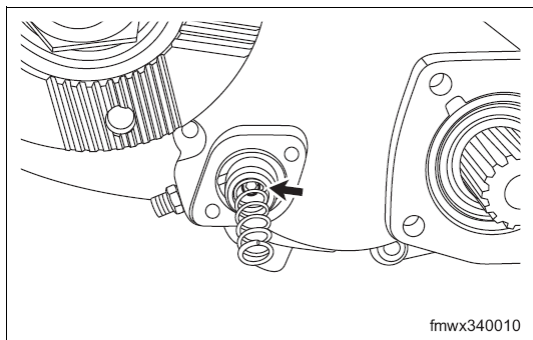


18. Install the power take-off cylinder body assembly

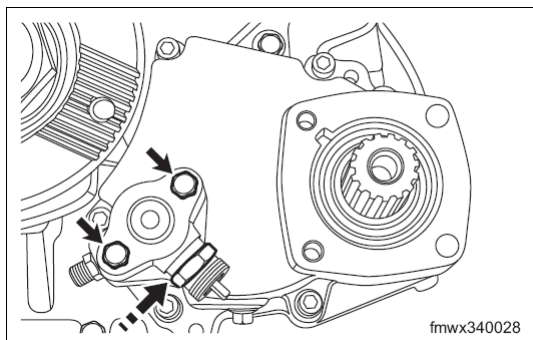
- (a). Apply lubricating grease on the piston sealing ring and install the piston to the power take-off cover.
(b). Tighten the bolt.
Torque: 9N.m

Caution:

Make sure to use new O-ring.

Power Take-off- QH50 Power Take-off

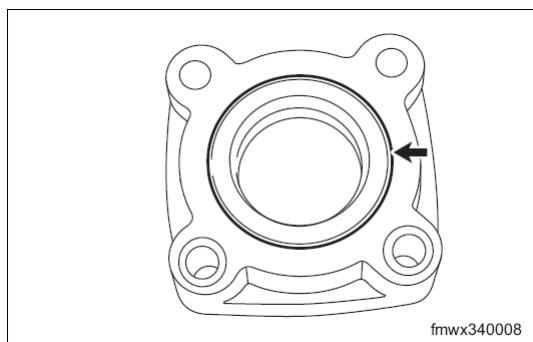
- (c). Install the return spring.



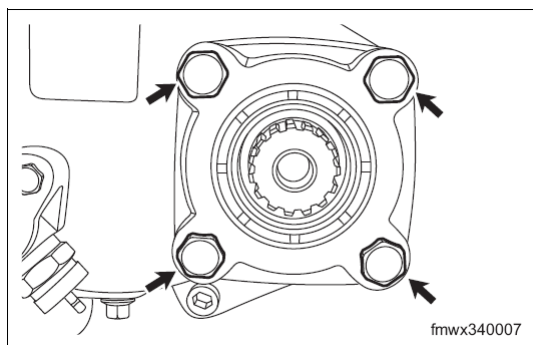
- (d). Install the power take-off cylinder body.
 (e). Tighten the bolt.
Torque: 23N.m
 (f). Install the power take-off switch.

Caution:

Whether the washer of power take-off switch is appropriate, or inaccurate display of indicator will be caused.

**19. Install the bearing cap**

- (a). Clean the bearing cap.
 (b). Install oil seal.

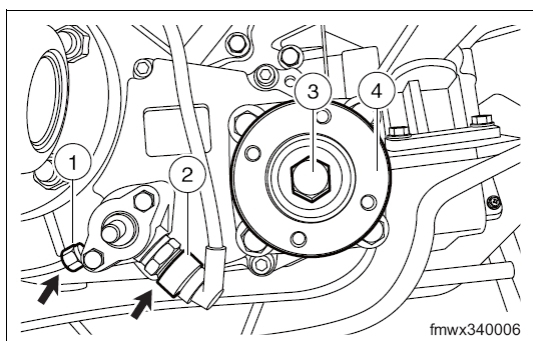


- (c). Install the bearing cap to the power take-off cover and tighten the bolt.

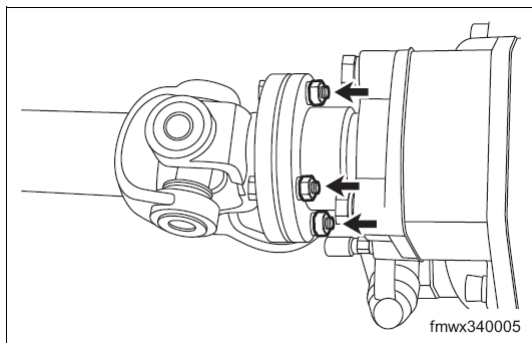
Torque: 45N.m

Caution:

Apply Loctite 598 plane sealant on the junction surface.

**20. Install power take-off accessories.**

- (a). Install flange 1 and tighten bolt 2.
Torque: 95N.m
 (b). Install the power take-off indicator switch harness connector 3.
 (c). Install air pipe 4.



21. Install the power take-off drive shaft assembly

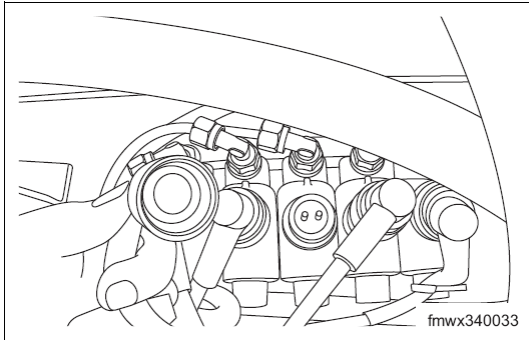
- (a). Install the power take-off drive shaft.
- (b). Tighten the bolt.

Torque: 37N.m

22. Connect the battery negative cable

Power Take-off Solenoid Valve Overhaul

1. Check the power take-off solenoid valve



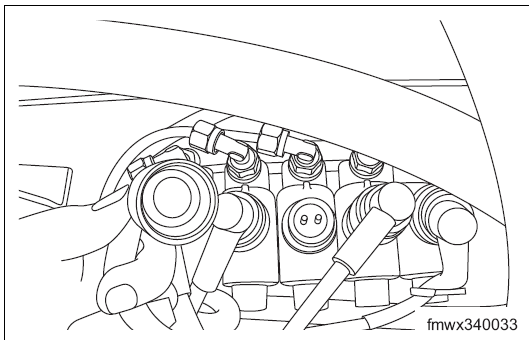
- (a). Pull out the harness connectors of power take-off solenoid valve.
- (b). Enable self-discharging function and measure the voltage between the two terminals with multimeter.

Standard value: 24V

Hint:

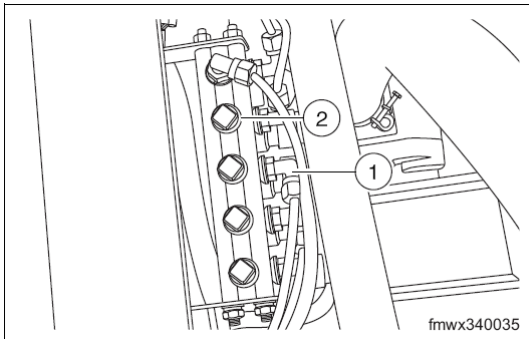
If the voltage is abnormal, check the circuit. Refer to Chapter 04, Diagnosis – Power Take-off Solenoid Valve Circuit, Overhaul. If the voltage is normal and the solenoid valve does not work, replace the power take-off solenoid valve.

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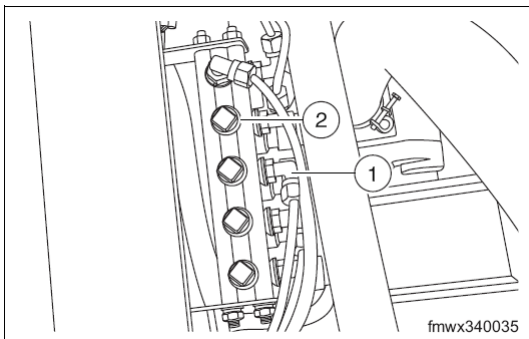


2. Dismantle the power take-off solenoid valve

- (a). Dismantle the harness connector of power take-off solenoid valve.

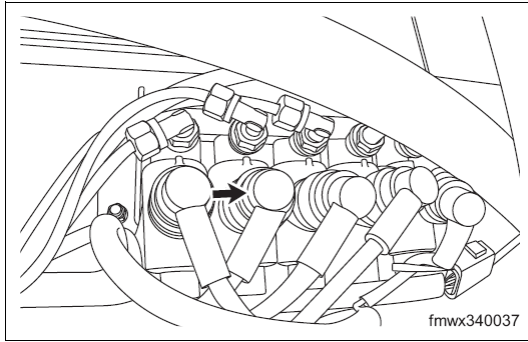


- (b). Dismantle air pipe joint nut 1.
- (c). Dismantle solenoid valve connecting bolt 2 and power take-off solenoid valve.



2. Dismantle the power take-off solenoid valve

- (a). Dismantle the power take-off solenoid valve and tighten solenoid valve connecting bolt 2.
- (b). Connect air pipe joint nut 1.



- (c). Install the harness connector of power take-off solenoid valve.

Steering Wheel & Steering Column

Steering Wheel & Steering Column 41-3

General 41-3

Precautions 41-4

Fault Symptom Table 41-5

Part Drawing 41-6

Testing & Adjustment 41-7

Steering Wheel (Left Rudder) 41-9

Replacement 41-9

Steering Wheel (Right Rudder) 41-11

Replacement 41-11

Steering Column (Left Rudder) 41-12

Dismantlement and Installation 41-12

Steering Column (Right Rudder) 41-15

Dismantlement and Installation 41-15

Steering Wheel & Steering Column

General

The system mainly consists of steering wheel and steering column with adjustable mechanism assembly, steering drive shaft, protection tube assembly, dust cover, etc. The steering force attached to the steering wheel, which is given by the driver, is passed on to the steering gear assembly

Precautions

1. Operation Precautions for Steering Wheel & Steering Column

- (a) The replacement of any parts shall be done in conformity with the manual instructions and with care.
- (b) Incorrect operation may affect the performance of the steering system or even endanger people.

Warning:

If booster steering system has been repaired before, accurate liquid level of steering liquid cannot be caught except for discharging the air in the steering system. The air in the steering liquid may result in noises generated by the power steering pump, and after running for some time, it may result in the breakdown of the power steering pump.

Do not start any vehicle, when the inlet or outlet hose of the power steering device is disconnected. When the hoses are disconnected, all the connectors of the hose must be plugged and covered. Otherwise, it will pollute or cause to loose the power steering fluid, and damage the system.

The duration of the steering wheel in limit position shall not exceed 5s, and otherwise, it may damage the steering pump.

When adding or thoroughly replacing the liquid, make sure the right power steering liquid is used. If incorrect liquid is used, it may result in the damages of hoses and seals, and liquid leakage.

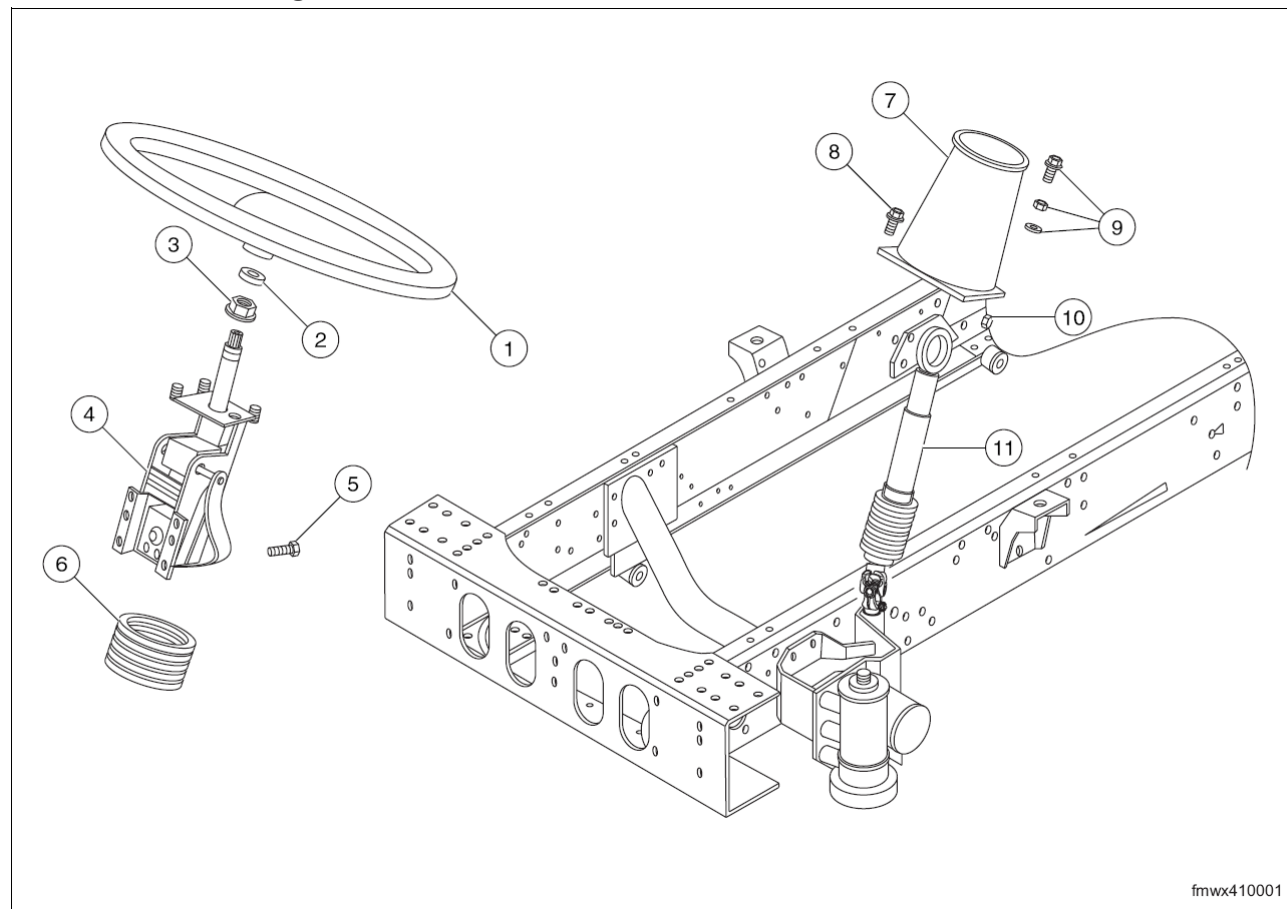
Steering Wheel & Steering Column - Steering Wheel & Steering Column

Fault Symptom Table

The following table will help you find the faults. The serial No. means the sequence of fault possibility. Inspect each part as per this sequence, and if needed, replace that part.

Fault Symptom	Possible Position	Reference
Free Travel of the Steering Wheel is too large.	Lock Bolt of Steering Drive Shaft (loosened)	Chapter 41 Steering Wheel & Steering Column-Steering Column, Dismantlement and Installation
	Steering Drive Shaft (wear and tear)	Chapter 41 Steering Wheel & Steering Column-Steering Column, Testing & Adjustment
	Steering Tie Rod (loosened)	Chapter 24 Front Axle-Steering Tie Rod, Overhaul
	Steering Drag Link (loosened)	Chapter 42 Power Steering Mechanism-Steering Drag Link, Overhaul
	Steering Gear (loosened)	Chapter 42 Power Steering Mechanism-Steering Gear, Overhaul
	Steering Gear (wear or incorrect adjustment)	Chapter 42 Power Steering Mechanism-Steering Gear, Overhaul

Part Drawing



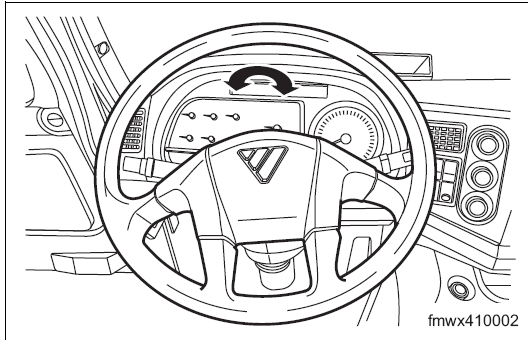
1	Steering Wheel Assembly
2	Thin Hex Nut
3	Spring Washer
4	Steering Column with Adjustable Mechanism Assembly
5	Hex Flange Face Bolt
6	Dust Cover

7	Protection Tube Assembly
8	Protection Tube Connecting Bolt
9	Hex Head Bolt, Spring Washer and Flat Washer Assembly
10	Prevailing torque type Hex Flange Lock Nut
11	Steering Drive Shaft Assembly

Steering Wheel & Steering Column - Steering Wheel & Steering Column

Testing & Adjustment

1. Free travel of the steering wheel



(a) Inspection

- Return the steering wheel in order to make the front wheel faces right ahead; concatenate the steering booster detector to the outlet end of steering pump and oil inlet end of steering gear; start the engine and idly run, at this time, the measured no-load circulating pressure is about 5 bar. Slowly turn the steering wheel to the right until gage pressure rises up to 6 bar, and then measure the right free movement of the steering wheel, which should be less than 20mm. Slowly turn the steering wheel to the right until gage pressure rises up to 6 bar, and then measure the right free movement of the steering wheel, which should be less than 20mm.

Free travel: $\leq 40\text{mm}$

(b) Adjustment

- Loosen hex nut A, clockwise rotate slotted screw B to turn down the free travel and turn up it by anti-clock wise rotation, and lock nut A until the free travel complies with the standard value.

Caution: check relevant parts before adjusting. (Refer to “Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Fault Symptom Table”) check maximum steering angle of the front wheel, and adjust it as required. (Refer to “Chapter 21 A Front Axle-Front Axle Assembly, Front Wheel Toe-in”)

2. Inspect steering column assembly

(a) Inspect steering shaft

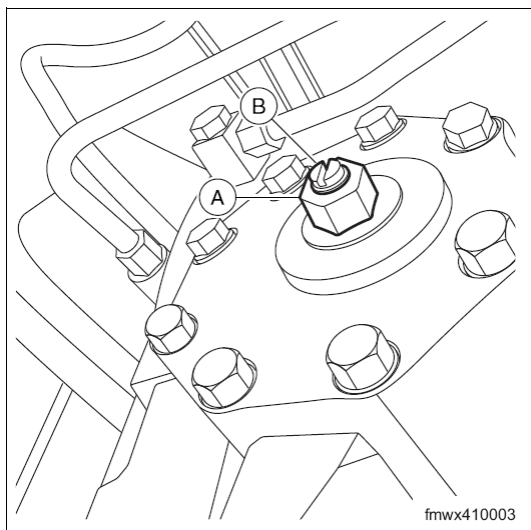
- Inspect straightness of the steering shaft.

Straightness: 0.5mm

If the straightness of steering shaft exceeds limit value, replace the steering column assembly with a new one.

(b) Inspect spline shaft, spline sleeve and universal joint fork.

- Inspect and confirm whether the spline shaft, spline sleeve and spline of the universal joint fork are rusted, or have scars and cracks or not.
- Inspect and confirm whether there are more than 2 gear teeth with distortion and damage in the spline. If the above fault exists, replace it with a new steering column assembly.



- (c) Inspect steering column universal joint
- Inspect the surface of universal joint bearing to make sure there is no fault like spalling, crack or short of needle, etc.
 - Inspect bearing seal packing and seal cover to make sure they are valid.
 - Inspect universal joint cross shaft neck to make sure there is no fault like indentation, spalling, eccentric wear, crack, etc.
 - Inspect whether the rotation of universal joint is smooth or not. If any of the above faults exists, replace the steering column assembly with a new one.
 - Inspect the gap between the cross shaft bearing and shaft neck.

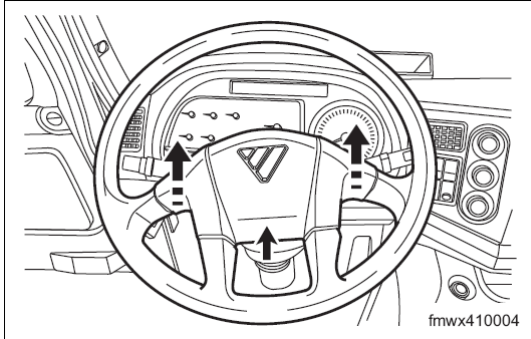
Gap: $\leq 0.1\text{mm}$

If the gap between the cross shaft bearing and shaft neck exceeds the limit value, a new steering column assembly needs to be replaced.

Steering Wheel (Left Rudder)

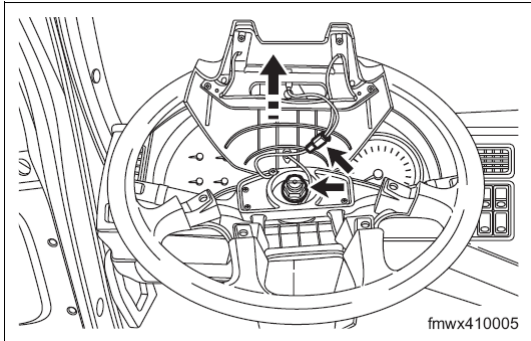
Replacement

1. Precautions for operation of steering wheel, refer to "Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Precautions"

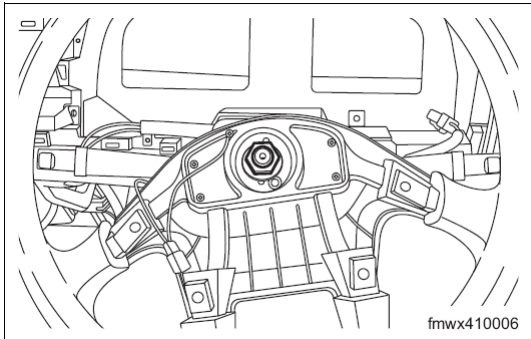


2. Dismantle horn button

- (a) Return the steering wheel in order to make the front wheel toward right ahead.
- (b) Remove the steering wheel respectively at the left side and right side of horn button with hands.



- (c) Turn over the horn button, and pull out the 2 wiring harness connectors which connect to the steering wheel.

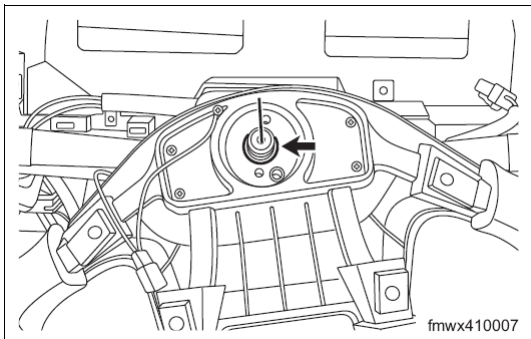


3. Dismantle the steering wheel

- (a) Loosen and remove the steering wheel nuts.
- (b) Remove the spring washer.

Caution:

Store it with care to avoid damaging the surface of steering wheel.



- (c) Make assembly marks on the steering shaft and steering wheel.

Caution:

Make sure the assembly marks are distinct.

- (d) Pull the steering wheel out of the steering shaft with steering wheel puller.

41-10

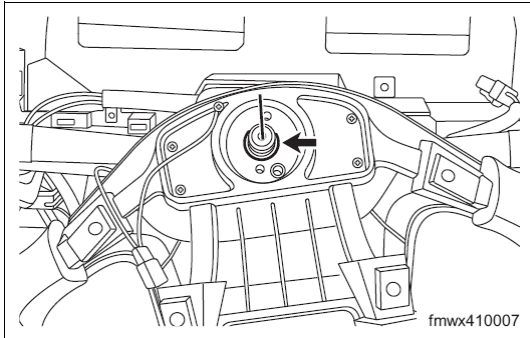
Steering Wheel & Steering Column - Steering Wheel (Left Rudder)

4. Inspect the steering wheel

- (a) Inspect whether steering wheel rim have any warping, crack or fracture.

Caution:

If any of the above faults exists, replace the steering column assembly with a new one.



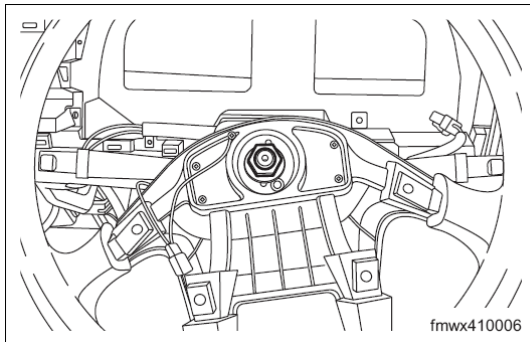
5. Install the steering wheel

- (a) Install the steering wheel onto the steering shaft in accordance with the assembly marks.

Caution:

Be sure to install it in accordance with the assembly marks.

41

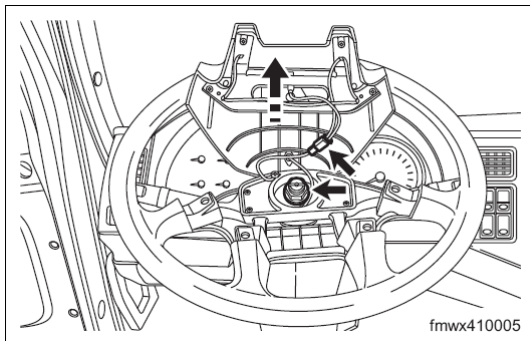


- (b) Install spring washer and tighten the steering wheel nuts.

Torque: 70±10N.m

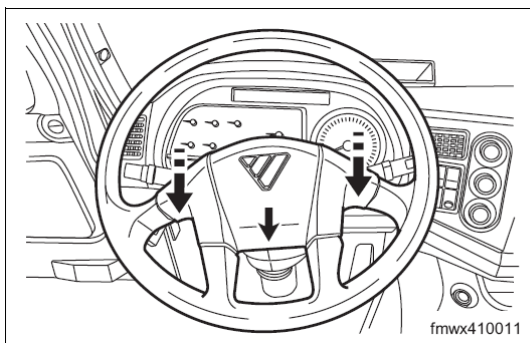
Caution:

Do not use impact wrench.



6. Install horn button

- (a) Connect the 2 wiring harness connectors.



- (b) Lightly press the horn button with your hands, and install it onto the steering wheel.

Steering Wheel (Right Rudder) Replacement

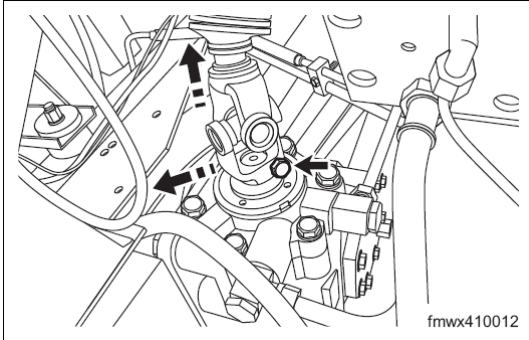
Hint:

The replacement of right rudder steering wheel, refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel (Left Rudder), Replacement.

Steering Column (Left Rudder)

Dismantlement and Installation

1. Precautions for operation of steering column, refer to "Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Precautions"
2. Dismantle the steering wheel, refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel (Left Rudder), Replacement.
3. Dismantle the combination switch assembly; refer to Chapter 55 Wiper and Washer-Combination Switch, Replacement.
4. Dismantle ignition switch assembly; refer to Chapter 18 Starting/Preheating System-Ignition Switch, Replacement.

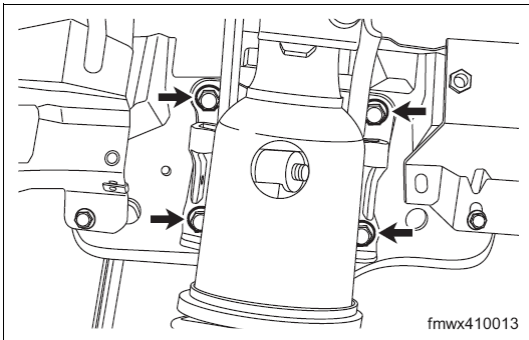


5. Dismantle steering column with adjustable mechanism assembly

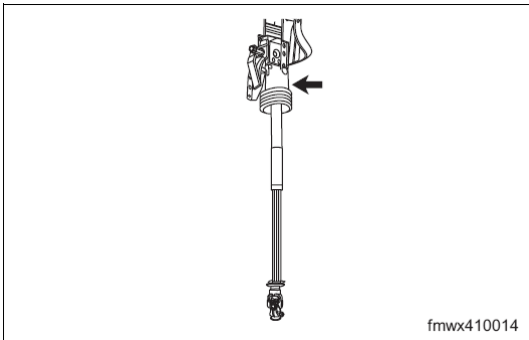
- (a) Loosen bolt, pull steering drive shaft spline sleeve universal joint fork out of the spline shaft at the top of steering gear worm.

Caution:

Make assembly marks on steering drive shaft spline sleeve universal joint fork and steering gear worm.



- (b) Dismantle the 4 fastening bolts of the steering column.

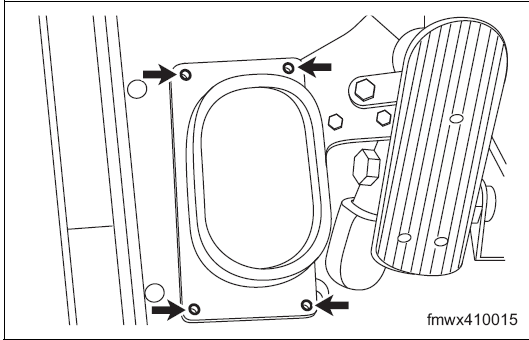


- (c) Remove the steering column with adjustable mechanism assembly
- (d) Remove dust cover and steering drive shaft assembly in proper order.

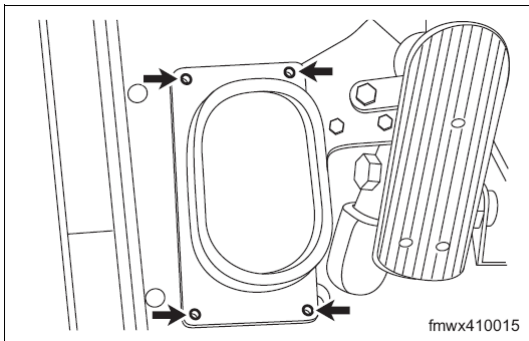
Caution:

Make assembly marks on steering drive shaft external spline and steering column.

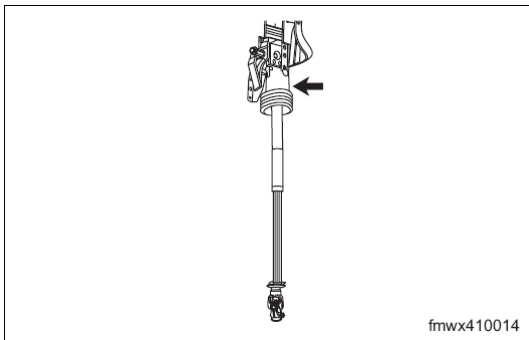
Steering Wheel & Steering Column - Steering Column (Left Rudder)

**6. Dismantle protection tube assembly**

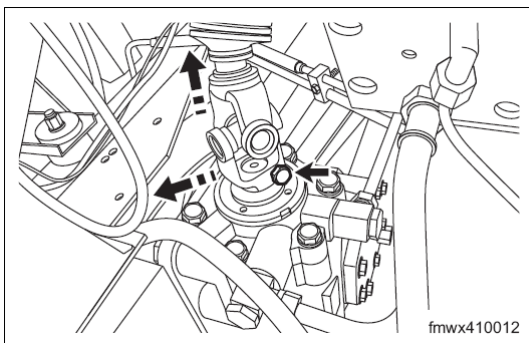
- (a) Dismantle protection tube fastening bolts.
- (b) Remove the protection tube.

7. Inspect steering column assembly; refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Testing & Adjustment**8. Install protection tube assembly**

- (a) Install the protection tube onto cab floor.
- (b) Tighten up the protection tube fastening bolts.

Torque: 10±1N.m**41****9. Install steering column assembly**

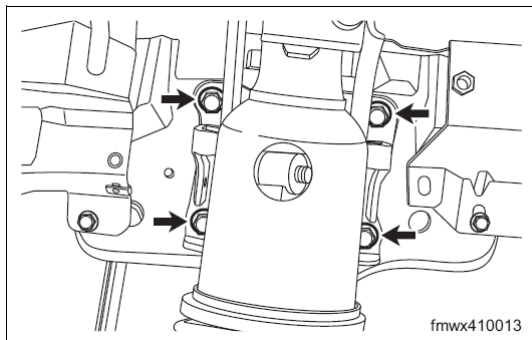
- (a) Install the steering drive shaft and dust cover into the steering column in proper order.

Caution:**Be sure to install them in accordance with the assembly marks.**

- (b) Make the steering column assembly passes through the protection tube, and install the steering drive shaft spline sleeve universal joint onto spline shaft at the top of steering gear worm.

- Tighten up the bolts.

Torque: 60±10N•m**Caution:****Make sure they are installed in accordance with the assembly marks.**



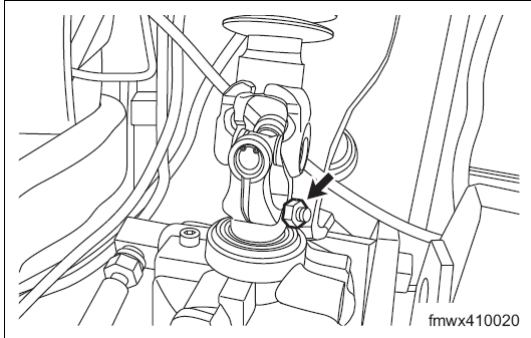
- (c) Install steering column fastening bolts.
- Tighten up the bolts.
- Torque: $23 \pm 2 \text{ N} \cdot \text{m}$**

10. Install ignition switch assembly; refer to Chapter 18 Starting/Preheating System-Ignition Switch, Replacement.
11. Install the combination switch assembly; refer to Chapter 55 Wiper and Washer-Combination Switch, Replacement.
12. Install the steering wheel; refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel (Left Rudder), Replacement.

Steering Column (Right Rudder)

Dismantlement and Installation

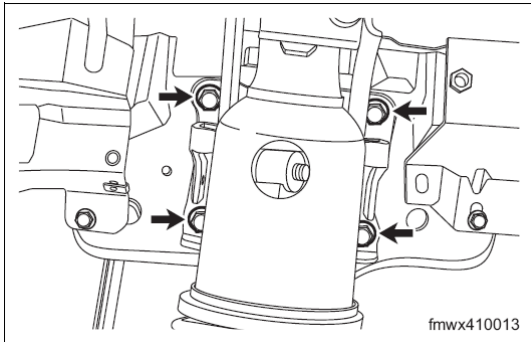
1. Precautions for operation of steering column, refer to "Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Precautions"
2. Dismantle the steering wheel, refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel (Left Rudder), Replacement.
3. Dismantle the combination switch assembly; refer to Chapter 55 Wiper and Washer-Combination Switch, Replacement.
4. Dismantle ignition switch assembly; refer to Chapter 18 Starting/Preheating System-Ignition Switch, Replacement.



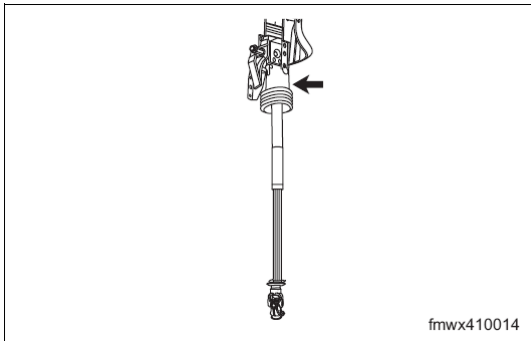
5. Dismantle steering column with adjustable mechanism assembly
 - (a) Loosen bolt, pull steering drive shaft spline sleeve universal joint fork out of the spline shaft at the top of steering gear worm.

Caution:

Make assembly marks on steering drive shaft spline sleeve universal joint fork and steering gear worm.



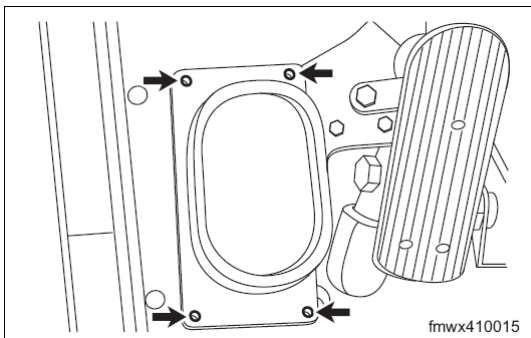
- (b) Dismantle the 4 fastening bolts of the steering column.



- (c) Remove the steering column with adjustable mechanism assembly
- (d) Remove dust cover and steering drive shaft assembly in proper order.

Caution:

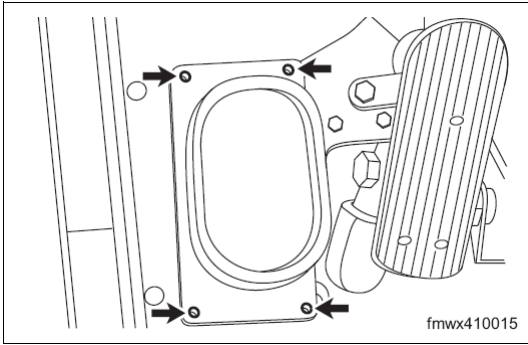
Make assembly marks on steering drive shaft external spline and steering column.



6. Install protection tube assembly
 - (a) Dismantle protection tube fastening bolts.
 - (b) Remove the protection tube.

Steering Wheel & Steering Column - Steering Column (Right Rudder)

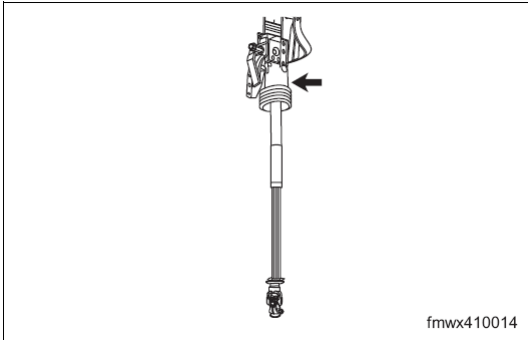
7. Inspect steering column assembly; refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel & Steering Column, Testing & Adjustment



8. Install protection tube assembly

- (a) Install the protection tube onto cab floor.
- (b) Tighten up the protection tube fastening bolts.

Torque: $10\pm1\text{N}\cdot\text{m}$

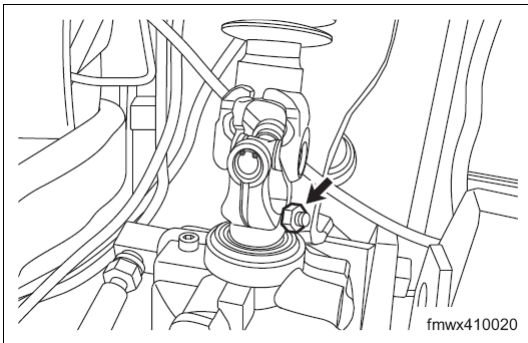


9. Install steering column assembly

- (a) Install the steering drive shaft and dust cover into the steering column in proper order.

Caution:

Be sure to install them in accordance with the assembly marks.



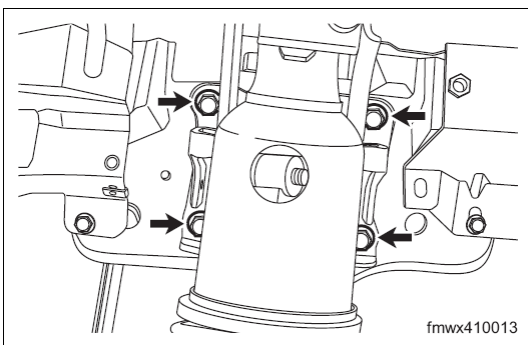
- (b) Make the steering column assembly passes through the protection tube, and install the steering drive shaft spline sleeve universal joint onto spline shaft at the top of steering gear worm.

- Tighten up the bolts.

Torque: $60\pm10\text{ N}\cdot\text{m}$

Caution:

Be sure to install them in accordance with the assembly marks.



- (c) Install steering column fastening bolts.

- Tighten up the bolts.

Torque: $23\pm2\text{N}\cdot\text{m}$

- 10. Install ignition switch assembly; refer to Chapter 18 Starting/Preheating System-Ignition Switch, Replacement.
- 11. Install the combination switch assembly; refer to Chapter 55 Wiper and Washer-Combination Switch, Replacement.
- 12. Install the steering wheel; refer to Chapter 41 Steering Wheel & Steering Column-Steering Wheel (Left Rudder), Replacement.

Power Steering Mechanism

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Power Steering System

General

Most heavy-duty vehicles use hydraulic booster steering system. There are two working types of booster media: constant flow type and constant voltage type; constant flow type power steering is a dynamic hydraulic system with booster media always in circulation status; while constant voltage type relies on static hydraulic booster of accumulator. According to the composition of booster mechanism, power steering can also be classified into integral type and separated type. Integral type combines control mechanism (distributing valve), actuating mechanism (cylinder) and steering mechanism of booster mechanism as a whole; while separated type holds the components separately. Kunlun Vehicle uses integral hydraulic constant flow type power steering system. Power steering system comprises steering pump assembly, CQ8111d steering gear assembly, steering plumbing arm, steering drag link, steering fluid reservoir, hydraulic circuit, etc.

Precautions

1. Precautions for Steering System Operation

- a) Follow the instructions in this manual when replacing accessories, and be cautious.
- b) Inappropriate operation may influence performance of steering system and even endanger personal safety.
- c) Different brands of steering fluid can not be mixed, or it may shorten the service life of system components.
- d) Hydraulic circuit of this vehicle type uses return oil filter method (that is, steering fluid filter is installed at oil-return side in the steering pump instead of oil-suction side); therefore, when replacing or filling steering fluid, clean the fluid reservoir at first, and operate in dust-free location; pay special attention not to allow contaminant to fall in the fluid reservoir, or system components may be damaged.
- e) When disconnecting steering gear and steering mechanism, remain the front wheel at the position when the vehicle runs in straight line, and fix the steering plumbing arm at the vertical position; the position of limit adjustment valve of steering gear may be changed by randomly changing the direction, which causes mechanical damage due to overload on limiting position.

Power Steering System - Power Steering System**Fault Symptom Table**

Use the following table to help you find the causes of faults. The sequence number refers to the order of the possibility of the faults. Inspect each part according to the order and replace as needed.

Fault Symptom	Possible Cause	Reference
Excessive free gap of steering wheel	1. Locking bolt of steering drive shaft universal joint (loosened)	Chapter 41 Steering Wheel & Steering Column - Steering Column Assembly, Dismantlement and Installation
	2. Steering gear (loosened)	Chapter 42 Power Steering Mechanism - Steering Gear Assembly, Overhaul
	3. Steering gear (worn-out or inappropriate adjustment)	Chapter 42 Power Steering Mechanism - Steering Gear with Rocker Arm Assembly, Overhaul
	4. Steering drag link connecting rod (loosened)	Chapter 41 Steering Wheel & Steering Column - Steering Column Assembly, Overhaul
	5. Steering tie rod connecting rod (loosened)	Chapter 24, Front Axle - Steering Tie Rod Assembly, Overhaul
Heavy steering wheel	1. Front shaft (overload)	Chapter 24, Front Axle - Front Shaft, Overhaul
	2. Tire (worn-out)	Chapter 23 Wheel & Tire - Wheel & Tire Assembly, Testing & Adjustment
	3. Tire (low tire pressure)	Chapter 23 Wheel & Tire - Wheel & Tire Assembly, Testing & Adjustment
	4. Front wheel alignment (inappropriate)	Chapter 24 Front Axle - Front Wheel Alignment, Testing & Adjustment
	5. Steering fluid (air intake) (insufficient)	Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment Chapter 42 Power Steering Mechanism - Steering Fluid, Replacement
	6. Steering drive shaft (bent or excessive tight bearing)	Chapter 41 Steering Wheel & Steering Column - Steering Column Assembly, Testing & Adjustment
	7. Steering gear (worn-out or damaged)	Chapter 42 Power Steering Mechanism - Steering Gear Assembly, Overhaul
	8. Steering pump (worn-out or damaged)	Chapter 42 Power Steering Mechanism - Steering Pump Assembly, Replacement
	9. Knuckle pin (insufficient gap)	Chapter 24 Front Axle - Steering Knuckle, Overhaul
	10. Steering fluid reservoir (blocked)	Chapter 42 Power Steering Mechanism - Steering Fluid Reservoir Assembly, Replacement

Power Steering System - Power Steering System

Fault Symptom	Possible Cause	Reference
Incorrect steering wheel revolutions	1. Steering drag link (deformed)	Chapter 42 Power Steering Mechanism - Steering Drag Link Assembly, Replacement
	2. Steering plumbing arm (incorrect angle)	Chapter 42 Power Steering Mechanism - Steering Gear Assembly, Overhaul
	3. Steering gear (worn-out or damaged)	Chapter 42 Power Steering Mechanism - Steering Gear Assembly, Overhaul
	4. Steering knuckle limit bolt (incorrect adjustment)	Chapter 24 Front Axle - Steering Knuckle, Overhaul
Steering wheel shaking	1. Tire (different tire pressures)	Chapter 23 Wheel & Tire - Wheel & Tire Assembly, Testing & Adjustment
	2. Front wheel alignment (inappropriate)	Chapter 24 Front Axle - Front Axle Assembly, Testing & Adjustment
	3. Damper (damaged)	Chapter 21 Front Mounting - Front Damper, Overhaul Chapter 22 Rear Mounting - Rear Damper, Overhaul
	4. Front leaf spring (loosened or damaged)	Chapter 21 Front Mounting - Front Leaf Spring Assembly, Overhaul Chapter 22 Rear Mounting - Rear Leaf Spring Assembly, Overhaul
	5. Wheel and tire assembly (unbalanced or worn-out)	Chapter 23 Wheel & Tire - Wheel & Tire Assembly, Testing & Adjustment Chapter 23 Wheel & Tire - Wheel & Tire Assembly, Testing & Adjustment
	6. Steering gear (loosened or worn-out)	Chapter 42 Power Steering Mechanism - Steering Gear with Rocker Arm Assembly, Overhaul
	7. Brake Drum (unbalanced)	Chapter 26 Service Brake - Front Wheel Brake, Overhaul
	8. Front wheel bearing (worn-out)	Chapter 24 Front Axle - Front Wheel Hub Brake Drum Assembly, Overhaul
	9. Knuckle pin (excessive tight)	Chapter 24 Front Axle - Steering Knuckle, Overhaul
	10. Steering knuckle (deformed)	Chapter 24 Front Axle - Steering Knuckle, Overhaul
	11. Frame (deformed)	Chapter 28, Frame - Frame, Maintenance

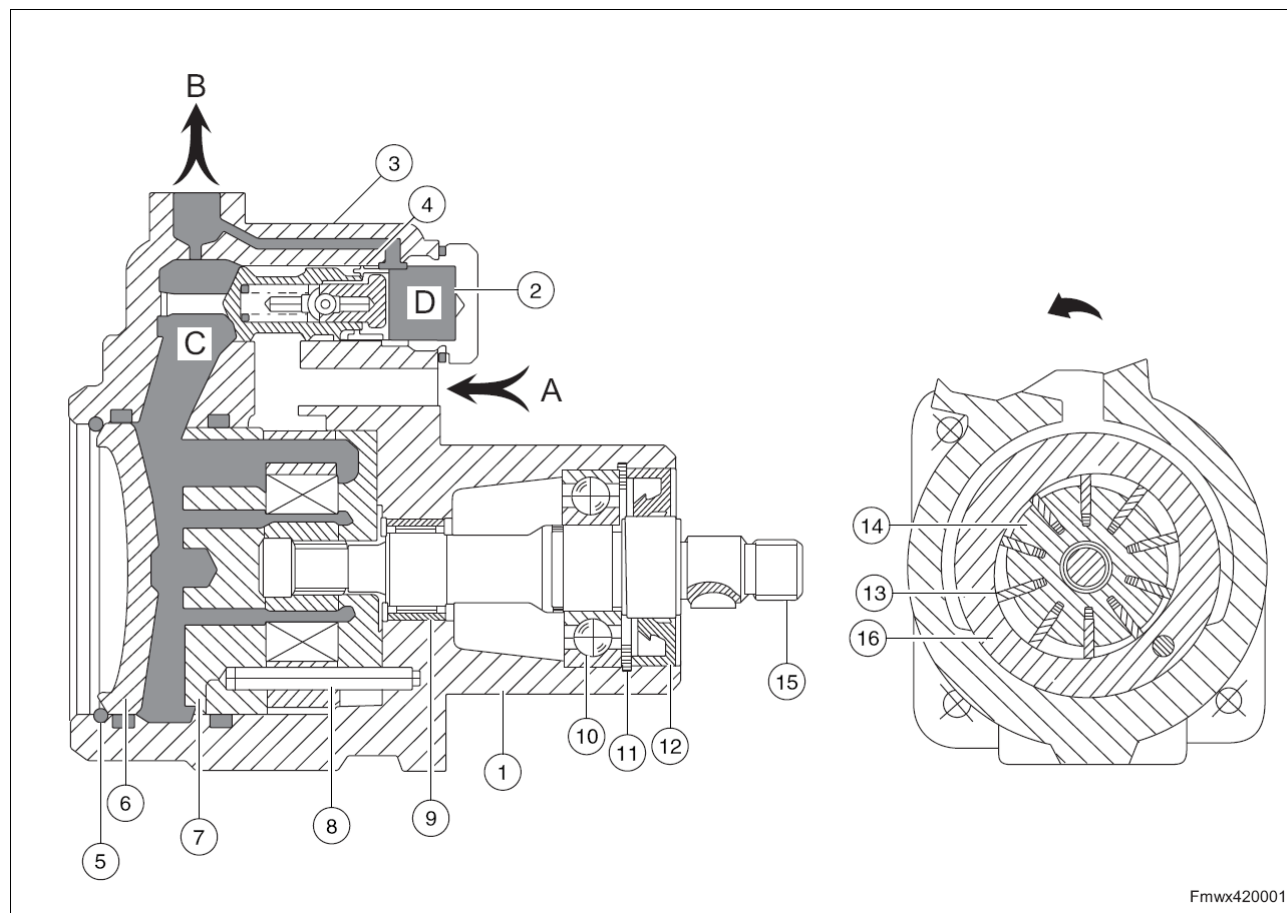
Power Steering System - Power Steering System

Fault Symptom	Possible Cause	Reference
Abnormal sound in steering	1. Steering fluid (wrong type)	Chapter 42 Power Steering Mechanism - Power Steering System, Notes
	2. Steering hydraulic system (mixed with air)	Chapter 42 Power Steering Mechanism - Power Steering System, Personalized Inspection
	3. Steering gear (loosened or worn-out)	Chapter 42 Power Steering Mechanism - Steering Gear Assembly, Overhaul
	4. Steering pump (worn-out or damaged)	Chapter 42, Power Steering Mechanism - Steering Pump Assembly, Replacement
	5. Drag link ball (worn-out or damaged)	Chapter 42 Power Steering Mechanism - Steering Drag Link Assembly, Replacement
	6. Steering column universal joint (loosened)	Chapter 41 Steering Wheel & Steering Column - Steering Column Assembly, Dismantlement and Installation
	7. Tie rod ball (worn-out or damaged)	Chapter 24 Front Axle - Steering Tie Rod, Overhaul
Insufficient steering booster	1. Steering fluid (insufficient)	Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment
	2. Steering hydraulic system (mixed with air)	Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment
	3. Steering fluid reservoir (filter screen blocked)	Chapter 42 Power Steering Mechanism - Steering Fluid Reservoir Assembly, Replacement
	4. Steering pump (worn-out or damaged)	Chapter 42 Power Steering Mechanism - Steering Pump Assembly, Replacement
	5. Steering column universal joint (unsmooth)	Chapter 41 Steering Wheel & Steering Column - Steering Column Assembly, Dismantlement and Installation

Working Principle

1. Working Principle of Steering Pump

Steering pump mainly comprises pump housing 1, revolving shaft 15, blade 13, rotor 14 and outer rotor 16. As to ensure that rotor oil pump have a stable output capacity and the maximum rated output pressure, install flow valve 3 and safety valve 4 at the output end of pump. Install steering pump at timing gear housing of the engine; camshaft gear will drive the pump to rotate the gear. When the engine is operating, blade pump will rotate and blades in the rotor slot will move close to the pump curved surface under the influence of centrifugal force and oil pressure. Sealed chamber is formed between blade and blade. The area of increasing volume of sealed chamber forms a suction chamber. The pump will finish movements of oil-suction and oil-pressure twice in per revolution. Because suction chamber and pressure chamber are in symmetric distribution, hydraulic radial force on the shaft is balanced. The capacity of pump is decided by the width and rotation speed of rotor; the output pressure of pump is decided by system resistance. As to limit the maximum pump pressure, set safety valve 4 inside of the pump. When the increasing external load of power steering system brings pump pressure up to more than 130bar, safety valve will open to unload. As to ensure a stable output capacity of pump, a flow control mechanism is set inside the pump, which comprises safety valve 4 and flow metering valve 3. When the pump is at a low rotation speed, valve 3 will close oil-out chamber and oil-in chamber under the influence of return spring. As the rotation speed of pump is increasing, the capacity of pump is also increasing. Due to the throttling effect of safety valve 4, there will be pressure difference between front chamber C and rear chamber D of valve 4: $\Delta P = P_c - p_d$ (P_c : pressure of chamber C; P_d : pressure of chamber D); the pressure difference will increase as the increase of the capacity of pump. When the pump is at the set rotation speed, which is, the capacity of pump has reached a certain figure, ΔP formed by chamber C and chamber D will overcome pre-tightening force of return spring. And valve 3 will move to the left under the pressure difference, as a consequence, the channel between oil-out chamber and oil-in chamber will be opened and part of the oil will form an internal recycling. As the capacity of pump is increasing, the pressure difference ΔP is also increasing. And therefore, the opening of valve 3 is increasing as well as internal discharge flow as to ensure that the output capacity is almost stable. As shown in following picture



1	Pump Casing
2	Spring

10	Bearing
11	Bearing Snap Ring

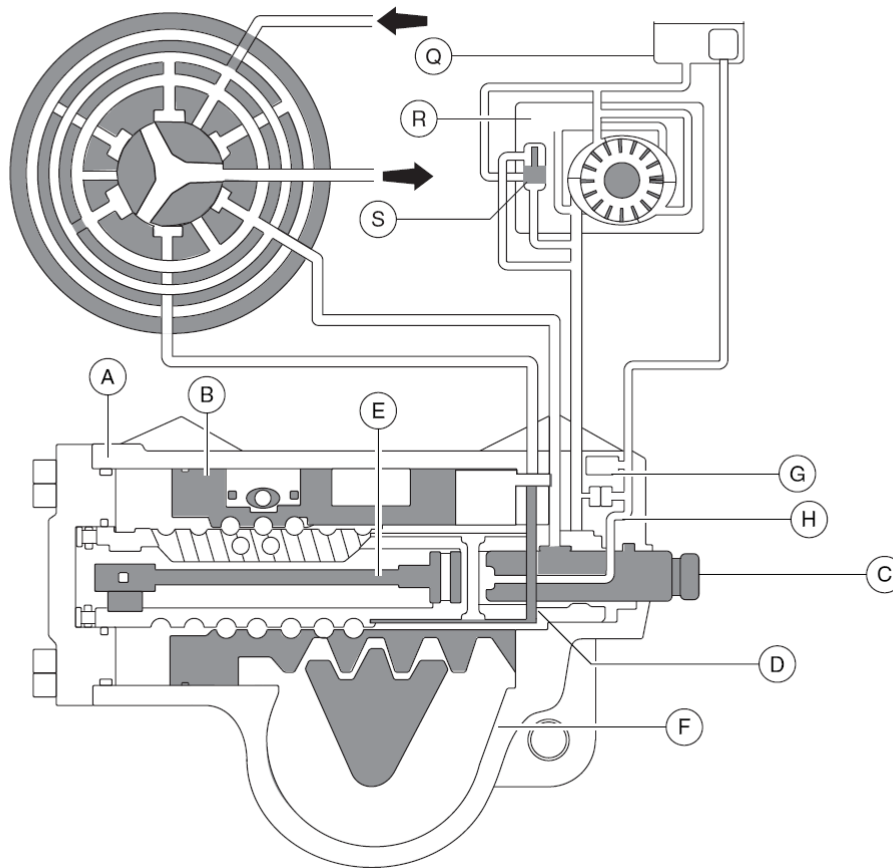
Power Steering System - Power Steering System

3	Flow Control Valve
4	Safety Valve
5	End Cover Snap Ring
6	End Cover
7	Distributor
8	Locating Pin
9	Needle Bearing

12	Oil Seal
13	Blade of Rotor
14	Rotor
15	Rotor Shaft
16	Outer Rotor
A	Oil Inlet (Low Pressure)
B	Oil Outlet (High Pressure)

2. Working Principle of Steering Gear

As the power source of steering system, the steering pump receives the low-pressure oil which flows back from the steering gear and supplies oil to the steering pump at the same time. In the steering gear, the housing (A) and the piston (B) form a cylinder, and the piston converts the rotary motion of the steering shaft (C) into linear motion and rotates the rocker arm shaft (F). The piston (B) and the worm (C) move relative to each other by means of steel balls arranged in a circle. When the worm rotates, the steel balls sequentially enter the worm surface, and can move to and fro on the worm through the circulating pipe. The control valve consists of the rotary valve (C) and the valve pocket (D) which are respectively provided with 6 slots on their cylindrical surfaces. The torsion rod (E) is respectively connected with the rotary valve and the valve pocket by fixing pins, and enables the control valve to stay in the intermediate position when the steering wheel is not rotated. The safety valve (G) can limit the abnormal oil pressure of the steering gear. The oil charge valve (H) fills oil to the steering gear through the oil return pipe when the steering gear operates but the steering pump does not operate. The positions between control slots in the rotor correspond to the positions between control slots in the valve socket. Oil flows to the axial slots (N and O) in the valve socket through oil inlet seams (J and K), and then, it can reach one end and both ends of the boosting piston through the axial oil passage. When the control valve is in the intermediate position, the oil reaches both ends of the boosting piston and then returns to the tank through three oil return slots (P) of the rotor. The above process is as shown in the following picture:



Fmwx420058

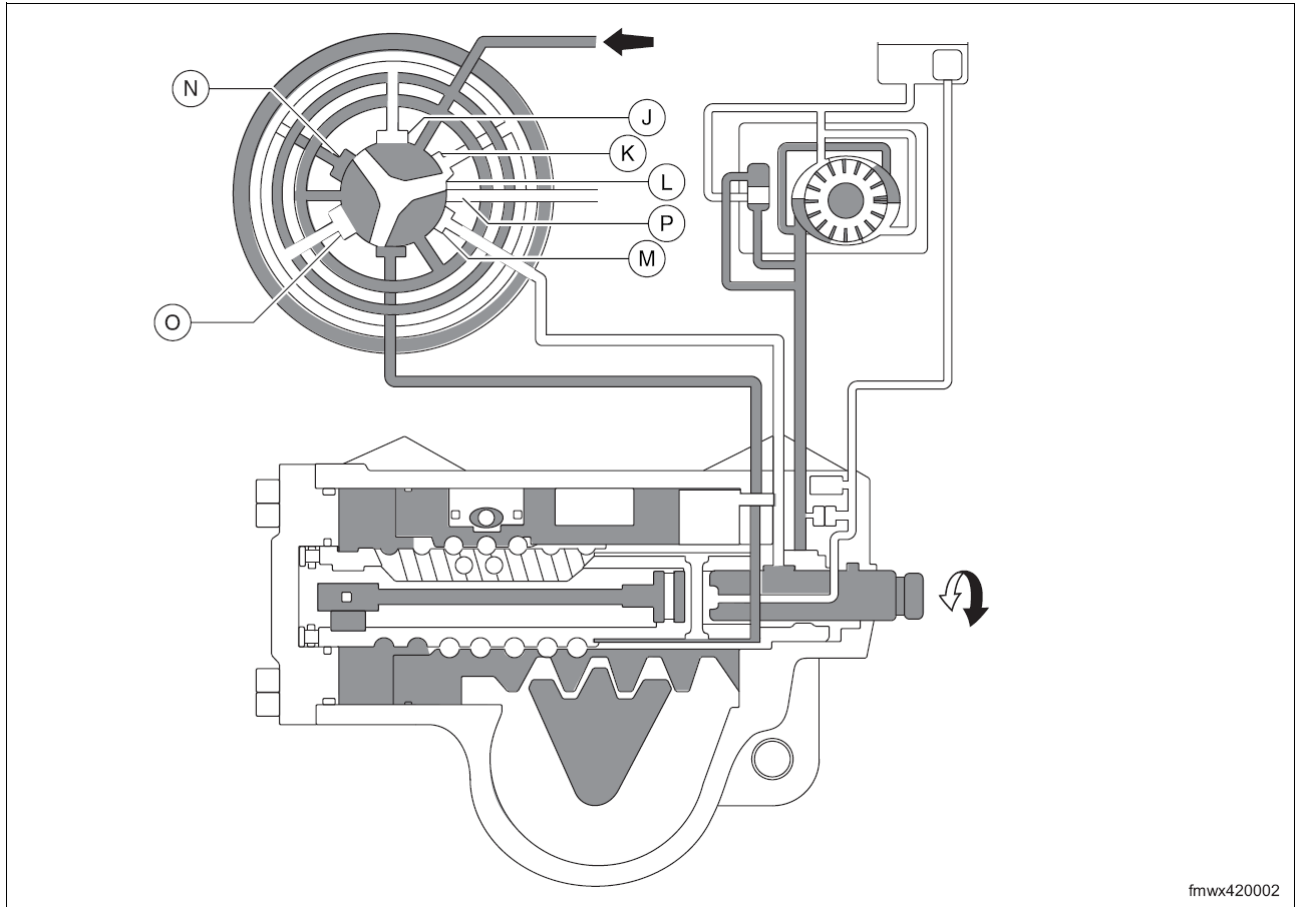
A	Housing
B	Piston
C	Steering Shaft Rotary Valve
D	Valve Pocket Worm
E	Torsion Rod
F	Rocker Arm Shaft

G	Safety Valve
H	Oil Charge Valve
Q	Fluid Reservoir
R	Rotor Blade
S	Permanent Flow Valve

When the steering wheel turns right, the control slot on the control valve rotor deflects clockwise. The oil inlet seam (K) opens big enough to pass the oil; the other oil inlet seam (J) is closed to prevent oil running to the axial slot (O) on the valve pocket. Thus, oil can only flow from the oil inlet seam (K) to the

Power Steering System - Power Steering System

axial slot (N) on the valve pocket and pass through the steel balls rollaway nest to the left end of piston. At the moment, oil in the left end of piston is discharged, which through the opened oil return seam (M) and the oil return slots (P) and through the oil duct in the rotor runs back to fluid reservoir. As shown in following picture:

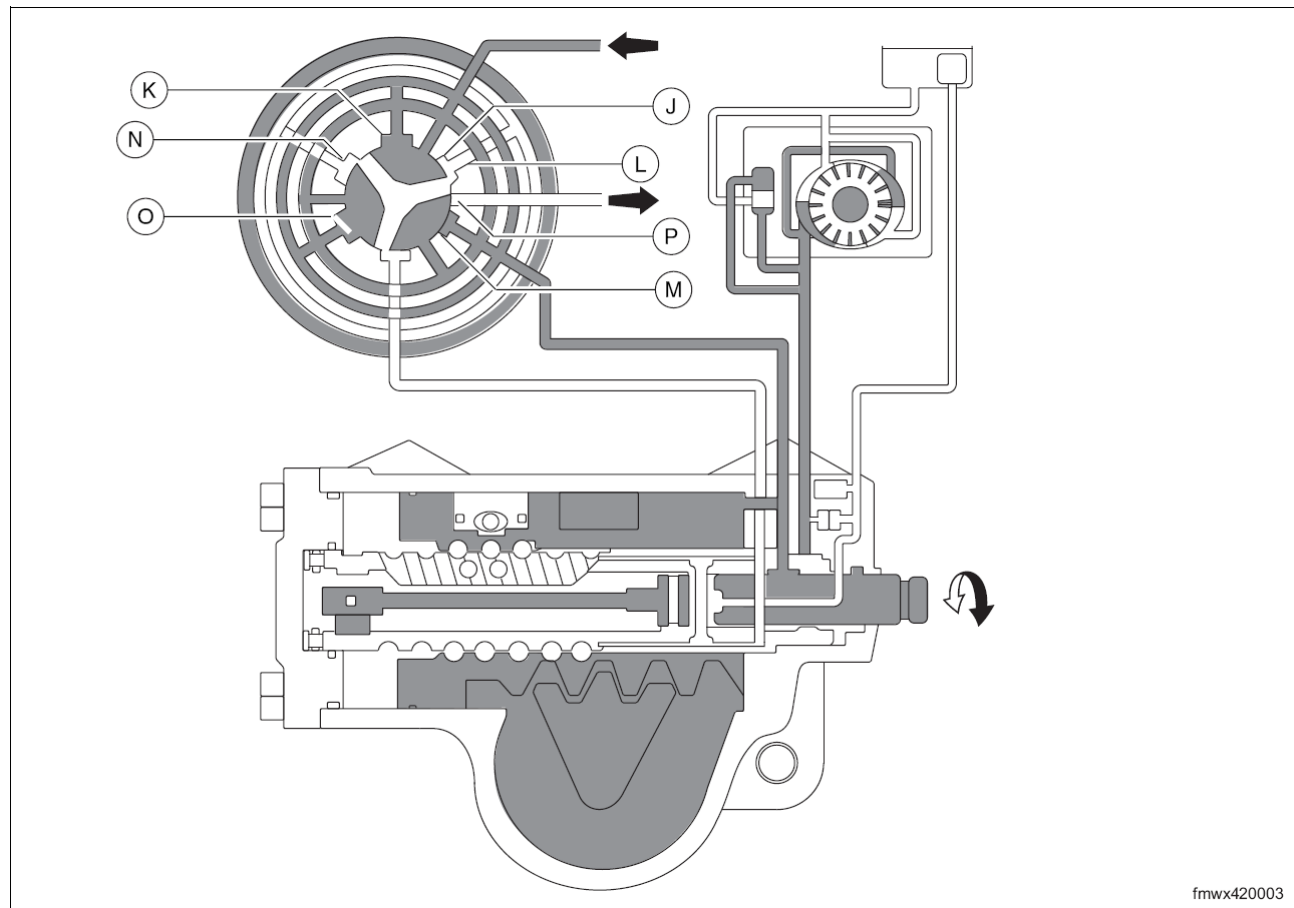


fmwx420002

J	Oil Inlet Seam
K	Oil Inlet Seam
L	Oil Return seam
M	Oil Return seam

N	Axial Slot
O	Axial Slot
P	Oil Return Slot

When the steering wheel turns left, the control slot on the control valve rotor deflects counterclockwise. The oil flows to the right end of the piston through the opened oil inlet seam (J) and the axial slot (O). The oil on the left end of piston passes through the oil return slot (P), the steel balls rollaway nest, the oil return seam (L) and through the oil duct in the rotor runs back to the fluid reservoir. The pressure of right end of piston is big so that the piston moves left, which achieves boosting power. As shown in following picture:



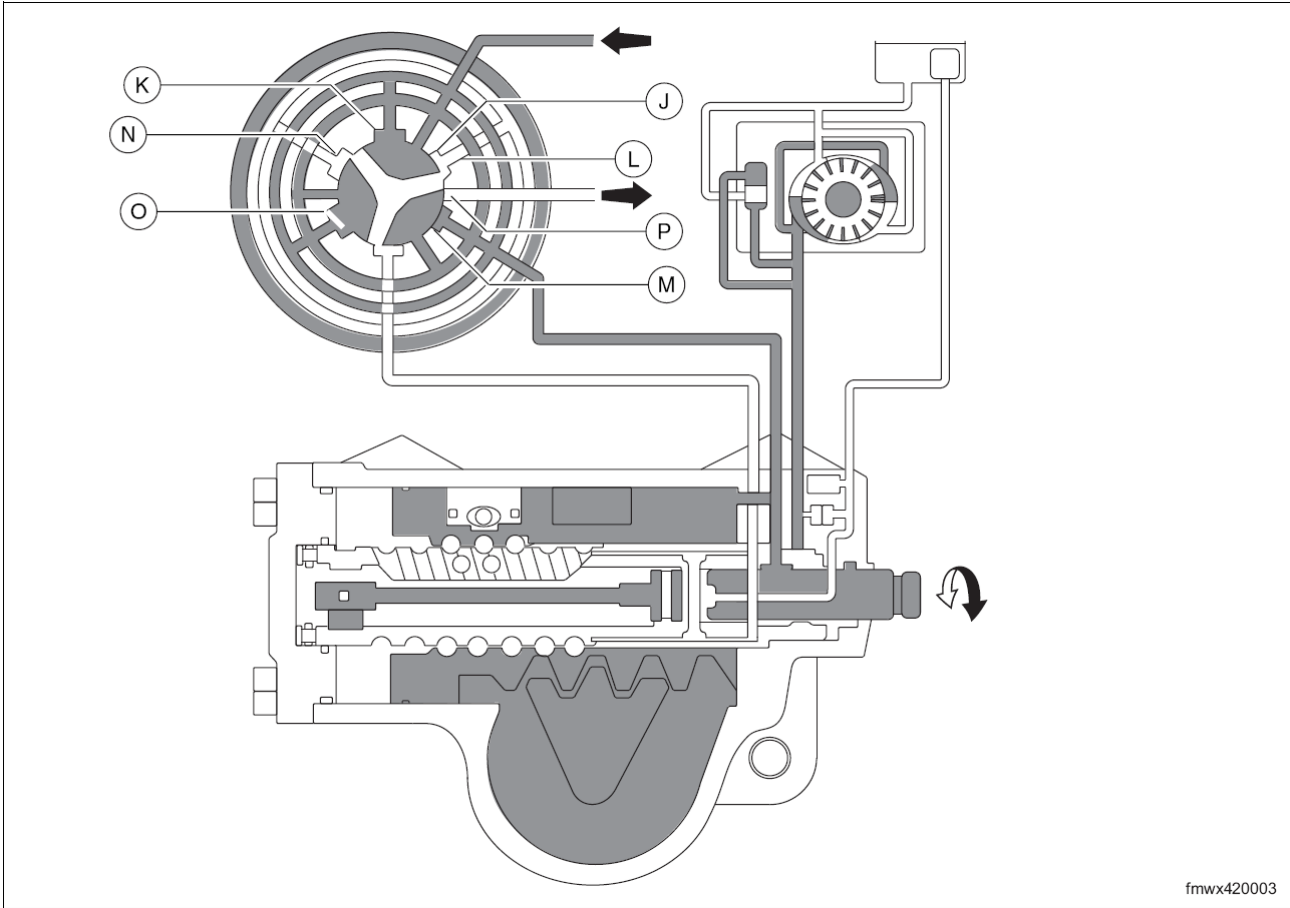
fmwx420003

J	Oil Inlet Seam
K	Oil Inlet Seam
L	Oil return seam
M	Oil return seam

N	Axial Slot
O	Axial Slot
P	Oil Return Slot

A left and right limit valves are installed in the steering gear. The steering limit valves prevent the steering gear from steering the limit position by maximum working pressure; therefore, it protects the steering gear and the steering pump and prevents parts from damage due to high pressure and from oil temperature too high. Thus, it ensures the safety of parts in the limit position. When the hydraulic steering limit valve opens, the steering gear can strike outwardly; however, as the hydraulic boosting power effect is decreased dramatically, the steering force needed on the steering wheel increases significantly until it reaches the mechanical limit position of steering. As shown in following picture:

Power Steering System - Power Steering System



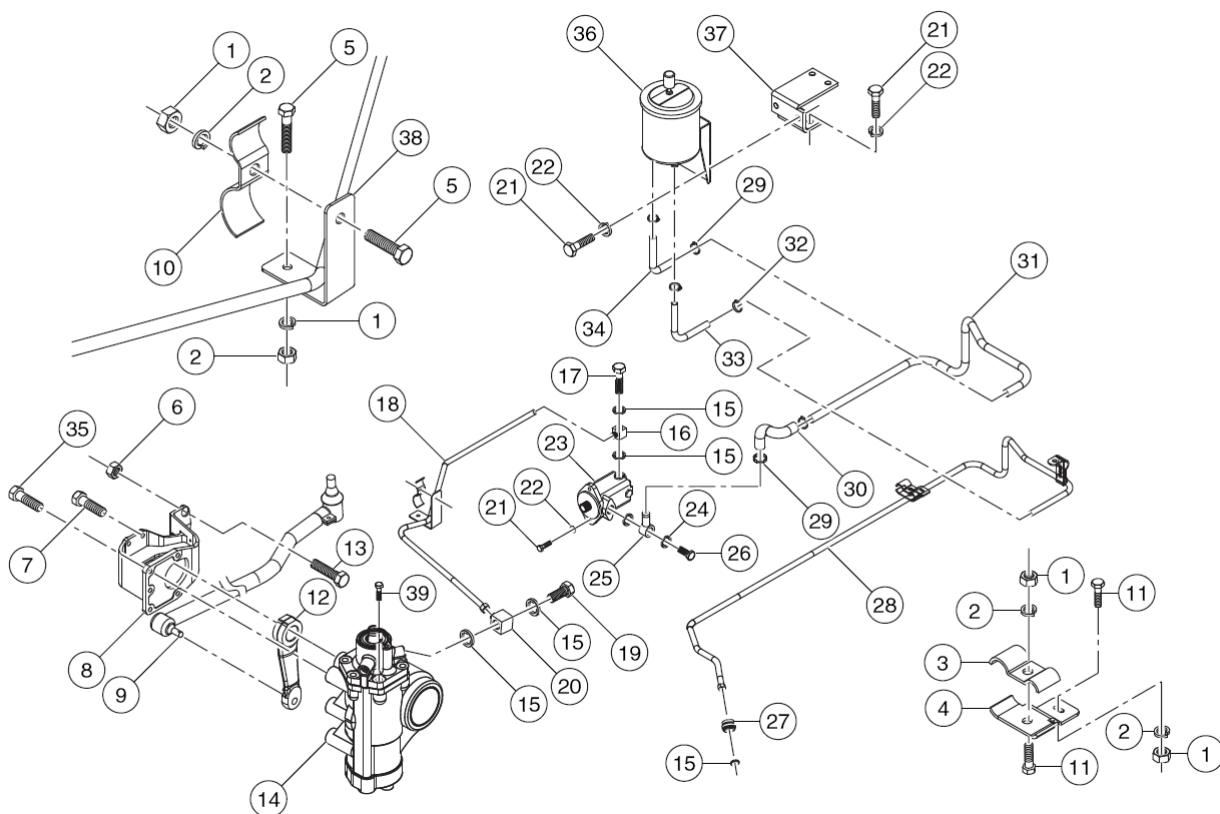
42

T	RH Spool
U	LH Spool
V	RH Piston Chamber

W	LH Piston Chamber
X	RH Adjusting Screw
Y	LH Adjusting Screw

Power Steering System - Power Steering System

Part Drawing



Fmwx420005

1	Hex Nut, Style I
2	Spring Washer
3	Pipe Clamp
4	Oil Pipe Bracket
5	Hex Head Bolt
6	Self-locking Nut
7	Hex Head Bolt - Fine Thread
8	Steering Gear Bracket
9	Steering Drag Link Assembly
10	Pipe Clamp 2
11	Hex Head Bolt
12	Steering Plumbing Arm
13	Hex Head Bolt - Fine Thread
14	Steering Gear Assembly
15	Sealing Washer

21	Hex Head Bolt
22	Spring Washer
23	Steering Pump Assembly
24	Sealing Washer
25	Annular Joint Assembly
26	Hollow screws
27	Swivel screw--body
28	Oil Return Pipe Assembly
29	Worm Drive Type Hose Clamp, Style B
30	Suction Hose
31	Suction Pipe
32	Worm Drive Type Hose Clamp, Style B
33	Oil Return Hose
34	Suction Hose 1
35	Hex Head Bolt

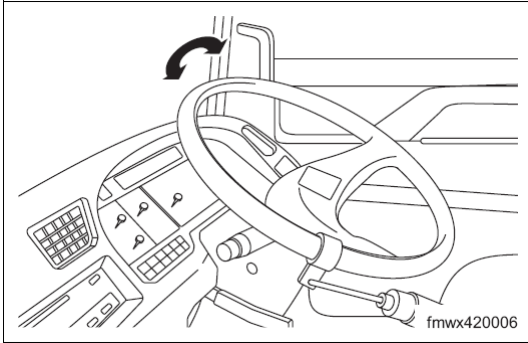
Power Steering System - Power Steering System

16	Bulkhead Union Body
17	Bulkhead Link Bolt
18	High-pressure Oil Pipe Assembly
19	Link Bolt
20	Pipe Joint

36	Steering Fluid Reservoir Assembly
37	Steering Fluid Reservoir Bracket
38	Oil Pipe Bracket
39	Hex Head Bolt

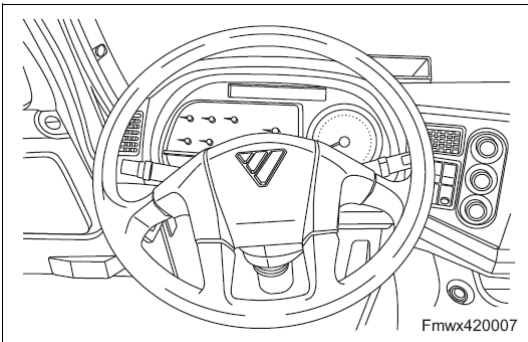
Testing & Adjustment

1. Measure the needed acting force



- (a) Park the vehicle on a dry smooth road for measurement, and set the parking brake firmly. Start engine and let it idle running until the liquid temperature reaches 50 – 60 °C (122– 140°F), then inspect the acting force that are needed for rotating the steering wheel by the pull scale. Acting force of steering wheel:

Standard value: 32N



2. Inspect steering liquid level

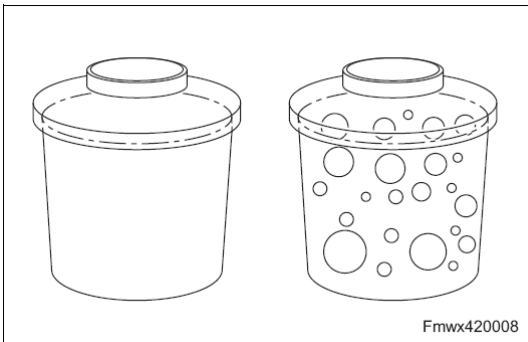
Hint:

- Park the vehicle on a smooth road.
- If the liquid level is low, it indicates that some brake system components may leak liquid; please inspect and repair the system according to the needs.
- Inspect the steering liquid level at regular interval, at least driving 5000 km (or a month) a time.

- (a) Keep the engine idle running.
 (b) Turn the steering wheel several times within the left and right limit positions to increase the steering fluid temperature. Steering liquid temperature: 60 ~ 80°C

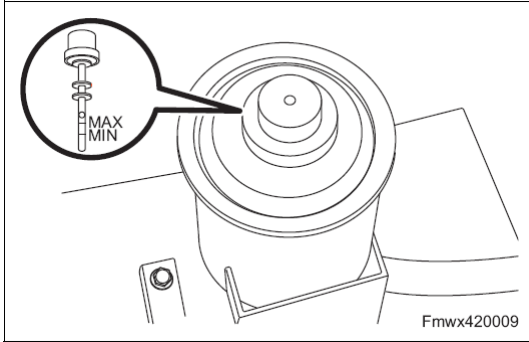
Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.



- (c). Inspect whether the steering fluid is muddy or has bubbles. If the steering fluid is muddy or has bubbles, air bleeding shall be carried out for the steering fluid. Refer to Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment, Hydraulic Circuit Exhaust.

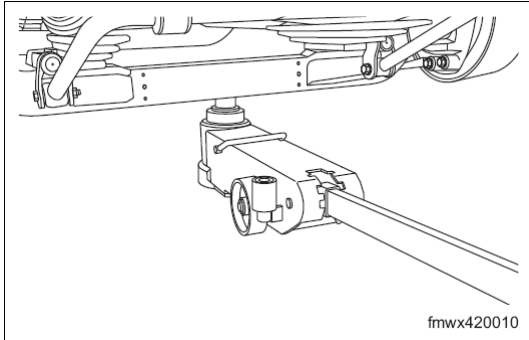
Power Steering System - Power Steering System



- (d). Observe the steering liquid level, which at least shall be at the maximum position of the scale of oil dipstick.

Caution:

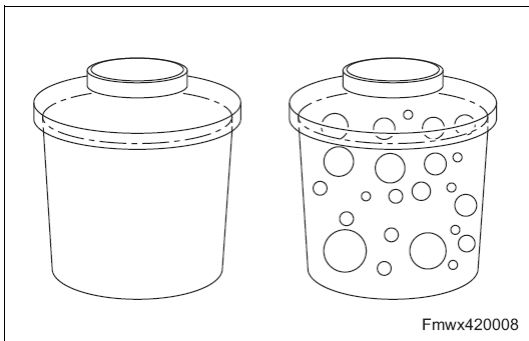
When diesel engine at work, the steering liquid level exceeding 1 ~ 2mm of normal position is normal.

**3. Hydraulic circuit exhaust**

- (a). Raise the front wheel by jack until it is above ground level.
 (b). Unscrew the cover of the steering fluid reservoir.
 (c). Stop the running of engine and turn carefully the steering wheel several times clockwise and anticlockwise until it touches the knuckle arm stop block.

Caution:

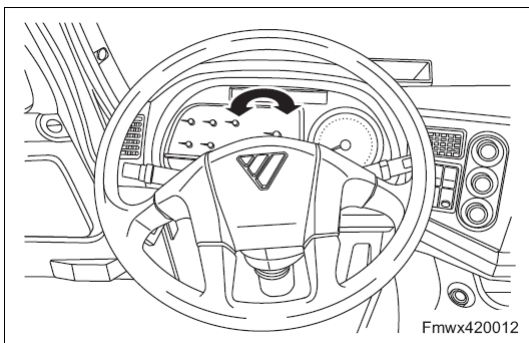
The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.



- (d). Start engine and let it idle running and turn the steering wheel several times on the left and right limit positions until the steering fluid level in the steering fluid reservoir is no longer declined and no bubbles generated.

Caution:

Observe the steering fluid level and supply the steering fluid promptly.

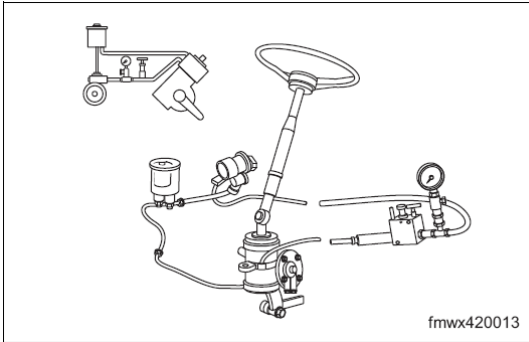


- (e). Lower the front wheel by jack and turn carefully the steering wheel several times clockwise and anticlockwise when the engine runs idle.

Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.

- (f). Test the vehicle on the road and ensure that the steering operates smoothly and there is no abnormal noise when turning the steering wheel.
 (g). Observe once again and recharge the steering fluid to the marked position of oil dipstick. Refer to Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment, Inspect Steering Liquid Level.



4. Inspect the steering pump

- (a). Disconnect the high-pressure oil pipe's connection to the steering gear and the steering pump. Refer to Chapter 42 Power Steering Mechanism - Hydraulic Circuit, Dismantlement and Installation.
- (b). Concatenate a pressure gage with range 150 bar and a switch between the steering gear and the steering pump.
- (c). Turn on the switch to full and start engine and keep running at a low velocity.
- (d). Turn off the switch gradually; if the system pressure reaches 117~143 bar, the steering pump is normal; otherwise, the steering pump shall be replaced. Refer to Chapter 42 Power Steering Mechanism - Steering Pump Assembly, Replacement.

Caution:

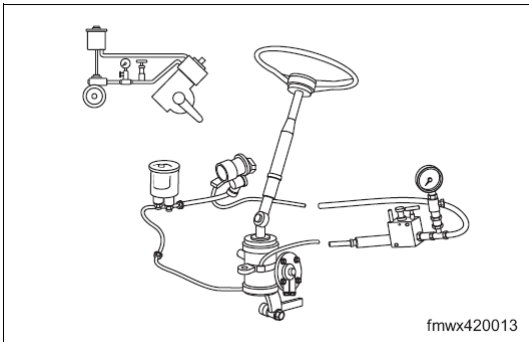
The switches shall be turned off gradually with turn-off time no exceeding 5s and the engine shall keep running in low speed condition.

5. Adjust the steering limit valves

- (a). Jack up the front axle H-beam by jack, making the front wheel off the ground.
- (b). Strike the steering wheel to a limit position towards a direction and its negative direction respectively and the adjustment of steering limit valves is completed.

Caution:

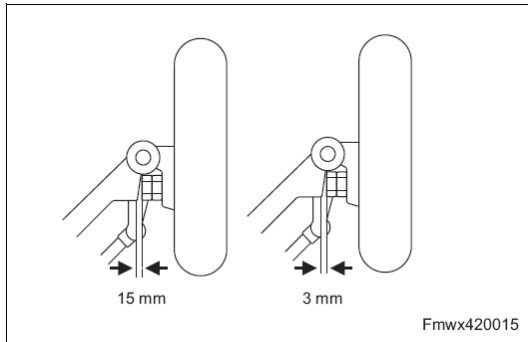
The adjustment of steering limit valves is automatic and there is no need to dismantle steering gear for adjustment. Special attention shall be paid to the connection of the steering wheel and the steering mechanism before carrying out the operation.



6. Inspect tightness of the steering gear

- (a). Disconnect the high-pressure oil pipe's connection to the steering gear and the steering pump. Refer to Chapter 42 Power Steering Mechanisms - Hydraulic Circuit, Dismantlement and Installation.

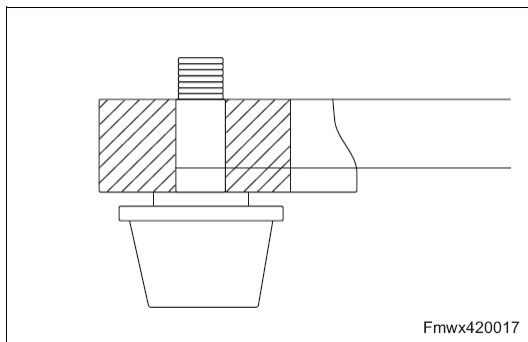
Power Steering System - Power Steering System



- (b). Jack up the front axle H-beam by jack, making the front wheel off the ground.
- (c). Place a steel plate with thickness of 15mm between the front wheel limit screw and the lug boss.
- (d). Start engine and keep running at a low speed; turn the front wheel to one side limit position and pull the steering wheel towards the direction of rotation and then towards the negative direction.

Caution:

The pressure on both sides shall reach 117 ~ 143 bar; otherwise, the steering gear assembly shall be replaced; Refer to Chapter 42 Power Steering Mechanism - Steering Gear Assembly (Left Rudder), Overhaul.

**7. Inspect each joint of the drag link**

- (a). Inspect the contact area between the front ball of the horizontal steering drag link and the steering plumbing arm.
 - Paint red lead powder evenly on the front tapered axle of the steering drag link and the surface inside the installment hole of the steering plumbing arm.
 - Insert the left joint assembly tapered axle of the steering drag link into the installment hole of the steering plumbing arm and then take it out to inspect the contact indentation.

Standard:

The contact is even, and the contact area is not larger than 3/4 of the whole length of the tapered axle.

Caution:

If the contact is not even or the contact area is larger than 3/4 of the whole length of the tapered axle, replace with a new horizontal steering drag link assembly and a new steering plumbing arm; refer to Chapter 42 Power Steering Mechanism - Steering Drag Link Assembly, Replacement; Chapter 42 Power Steering Mechanism - Steering Gear Assembly (Left Rudder), Overhaul.

- (b). Inspect the contact area between the rear ball of the horizontal steering drag link and the steering plumbing arm.

Hint:

The steps of inspecting the rear ball of the steering drag link and the steering plumbing arm are same as the steps of inspecting the front ball of the steering drag link and the steering plumbing arm.

Standard: the contact is even, and the contact area is not larger than 3/4 of the whole length of the tapered axle.

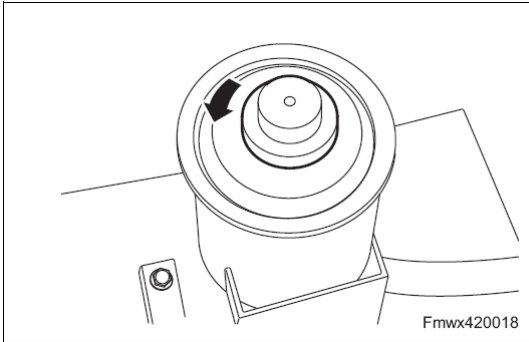
Caution:

If the contact is not even or the contact area is larger than 3/4 of the whole length of the tapered axle, replace with a new horizontal steering drag link assembly and a new steering plumbing arm; refer to Chapter 42, Power Steering Mechanism - Steering Drag Link Assembly, Replacement; and Chapter 24, Front Axle - Knuckle, Overhaul.

Steering Fluid (Left Rudder)

Replacement

1. Lift the vehicle head



2. Drain oil

- (a). Use safety frame to support the left and right front wheels to be off the ground at the same time.
- (b). Rotate the cover of steering fluid reservoir anticlockwise and take it down.
- (c). Loosen the nut and pull out the low-pressure oil pipe assembly 1 from the return opening of the steering gear.
- (d). Start up the engine and run idly.
- (e). Release the steering fluid in the steering pump and the steering fluid reservoir.
- (f). Rotate repeatedly the steering wheel between the left and right limit positions until no steering fluid flows out.

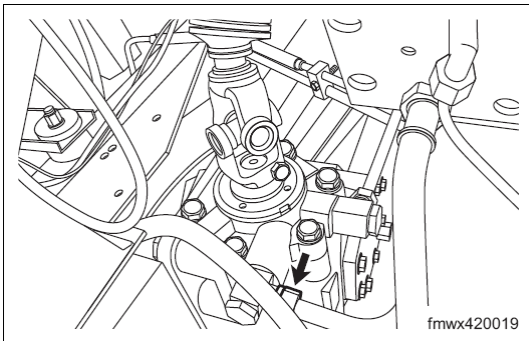
Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.

3. Refill

- (a). Apply sealant on the opening of the low-pressure oil pipe assembly.

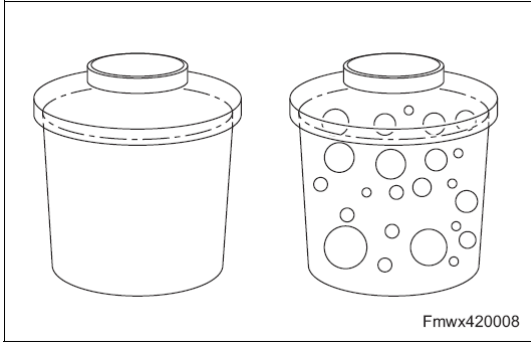
Sealant: Loctite 567.



- (b). Insert the low-pressure oil pipe assembly 1 into the opening of the steering gear and tighten the nut.

Torque: 120±10 N•m

Power Steering System - Steering Fluid (Left Rudder)



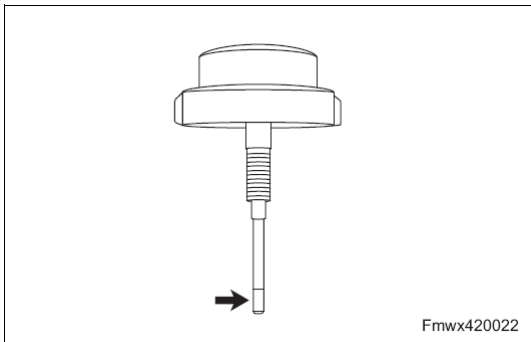
- (c). Fill the steering fluid into the steering fluid reservoir.

Ste0065ring fluid: ATF-III

- (d). Keep the engine idle running.
(e). Rotate repeatedly the steering wheel between the left and right limit positions until the level of the steering fluid in the steering fluid reservoir does not descend any more and no bubble occurs.

Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.

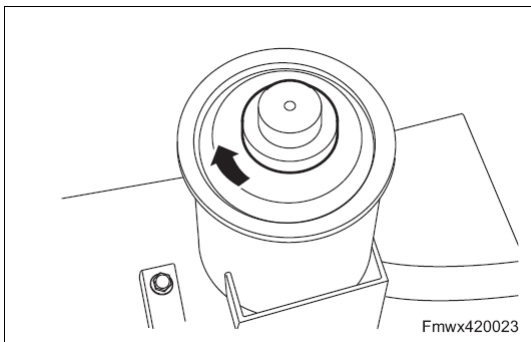


- (f). Inspect the level of the steering fluid.
• The oil level shall be at the maximum when the diesel does not work.

Caution:

When the diesel is working, the oil level being at 1~2mm above the maximum is normal.

42



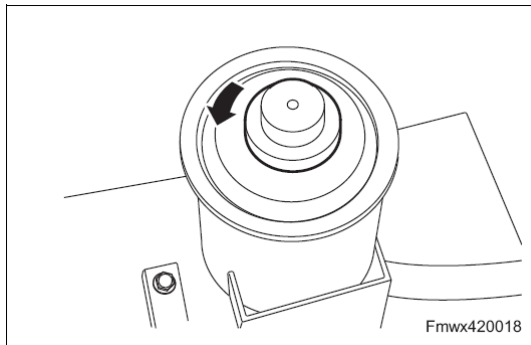
- (g). Clockwise tighten the cover of the steering fluid reservoir.
(h). Shut down the engine.
(i). Lay down the vehicle.

4. Put down the vehicle head

Steering Fluid (Right Rudder)

Replacement

1. Lift the vehicle head



2. Drain oil

- (a). Use safety frame to support the left and right front wheels to be off the ground at the same time.
- (b). Rotate the cover of steering fluid reservoir anticlockwise and take it down.

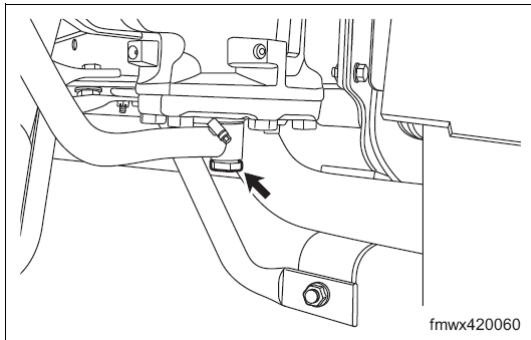
- (c). Loosen the nut and pull out the low-pressure oil pipe assembly from the return opening of the steering gear.
- (d). Start the engine and run idly.
- (e). Release the steering fluid in the steering pump and the steering fluid reservoir.
- (f). Rotate repeatedly the steering wheel between the left and right limit positions until no steering fluid flows out.

Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.

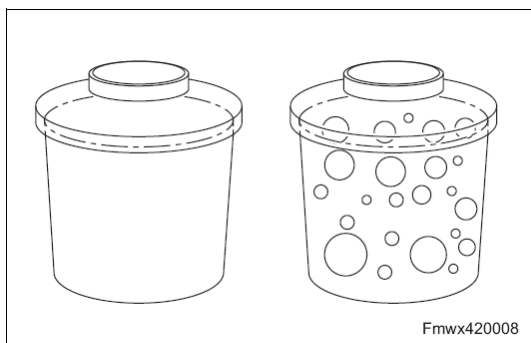
3. Refill

- (a). Apply sealant on the opening of the low-pressure oil pipe assembly.
Sealant: Loctite 567.



- (b). Insert the low-pressure oil pipe assembly 1 into the opening of the steering gear and tighten the nut.

Power Steering System - Steering Fluid (Right Rudder)



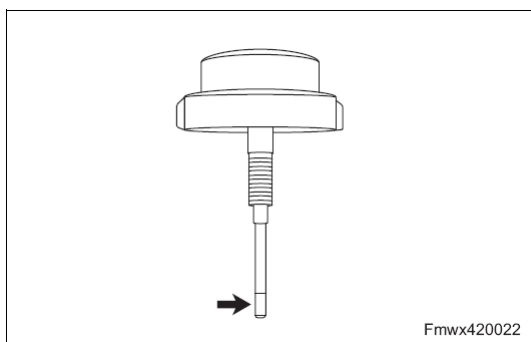
- (c). Fill the steering fluid into the steering fluid reservoir.

Steering fluid: ATF-III

- (d). Keep the engine idle running.
(e). Rotate repeatedly the steering wheel between the left and right limit positions until the level of the steering fluid in the steering fluid reservoir does not descend any more and no bubble occurs.

Caution:

The detention time of steering wheel at the limit position shall not exceed 5s so as not to damage the steering gear.

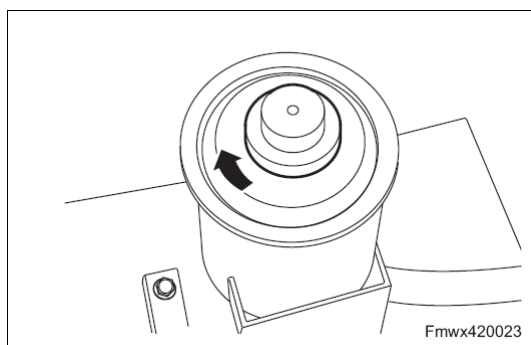


- (f). Inspect the level of the steering fluid.
• The oil level shall be at the maximum when the diesel does not work.

Caution:

When the diesel is working, the oil level being at 1~2mm above the maximum is normal.

42



- (g). Clockwise tighten the cover of the steering fluid reservoir.
(h). Shut down the engine.
(i). Lay down the vehicle.

4. Put down the vehicle head

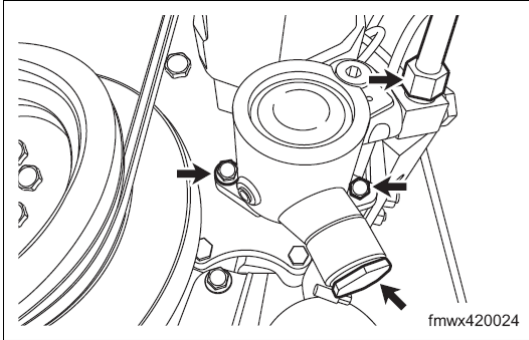
Steering Pump Assembly

Replacement

Hint:

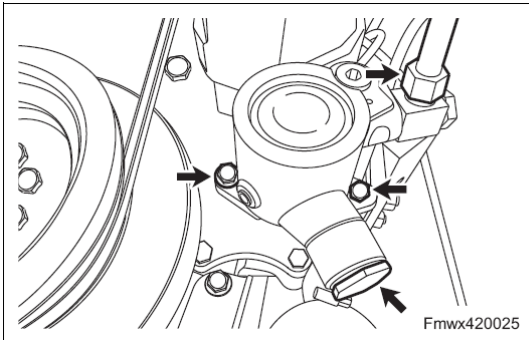
- The steering pump assembly is a precise part and shall not be disassembled for overhaul at random.
- If the steering pump assembly is damaged, replace with a new one.

1. Drain oil; refer to Chapter 42 Power Steering - Steering Fluid, Replacement



2. Dismantle the steering pump assembly

- (a). Loosen the terminal nut and take off the high-pressure oil pipe assembly from the oil outlet of the steering pump assembly.
- (b). Loosen the hoop and take off the suction pipe assembly of the oil pump from the oil inlet of the steering pump assembly.
- (c). Loosen 2 bolts and take off the steering pump assembly.



3. Install the steering pump assembly

- (a). Put the steering pump assembly onto the plane and tighten 2 bolts.
- (b). Put the suction pipe assembly of the oil pump onto the oil inlet of the steering pump assembly and tighten the hoop.
- (c). Apply sealant on the opening of the high-pressure oil pipe assembly.

Sealant: Loctite 567

- (d). Put the high-pressure oil pipe assembly onto the oil outlet of the steering pump assembly and tighten the terminal nut.

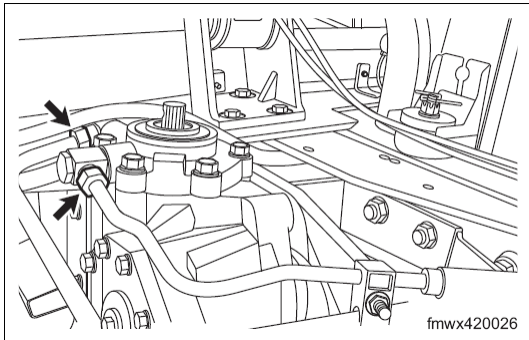
Torque: 23 ±2N•m

4. Refill the steering fluid; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Left Rudder), Replacement.

Steering Gear Assembly (Left Rudder) Overhaul

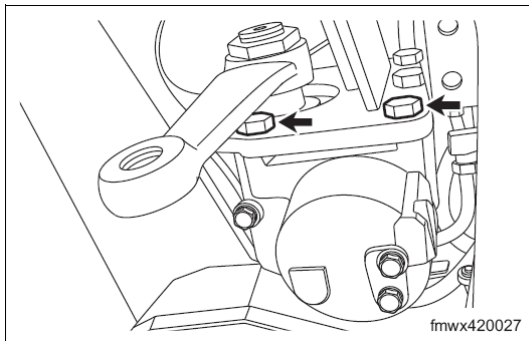
Hint:

- The steering gear is a precise and safety part and shall not be disassembled for overhaul at random.
 - If damaged, replace with a new steering gear.
1. **Drain the steering fluid: refer to Chapter 42 Power Steering Mechanism - Steering Fluid, Replacement**
 2. **Separate the universal joint of the steering column spline sleeve from the steering gear; refer to Chapter 41 Steering Wheel & Steering Column - Steering Column (Left Rudder), Dismantlement and Installment**
 3. **Separate the drag link from the steering plumbing arm; refer to Chapter 42 Power Steering Mechanism - Steering Drag Link, Replacement**



4. Dismantle the steering gear assembly

- (a). Loosen the terminal nut and pull out the high-pressure oil pipe assembly from the oil inlet of the steering gear.
- (b). Loosen the nut and pull out the low-pressure oil pipe assembly from the return opening of the steering gear.

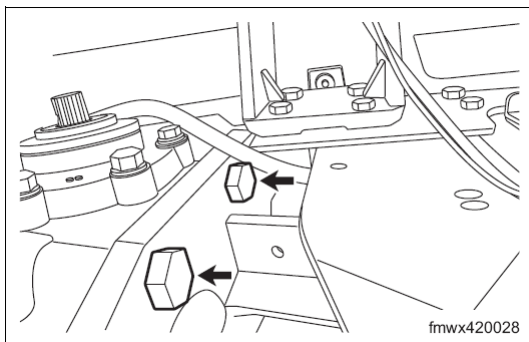


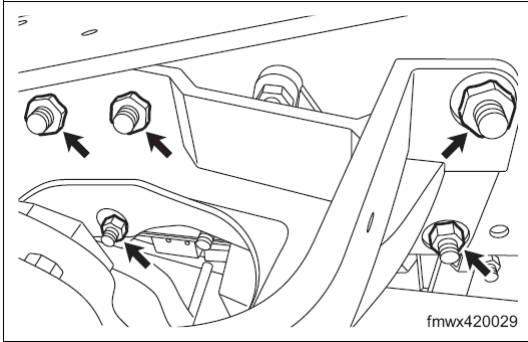
- (c). Disconnect the steering plumbing arm from the steering gear.
 - Dismantle the fixing nut of the steering plumbing arm.

Caution:

Make the fitting marks on the steering plumbing arm and its arm.

- (d). Dismantle the 4 fixing bolts in the lower part of the steering gear.
- (e). Dismantle the 2 fixing bolts in the upper part of the steering gear.
- (f). Separate the steering gear from the steering gear bracket.



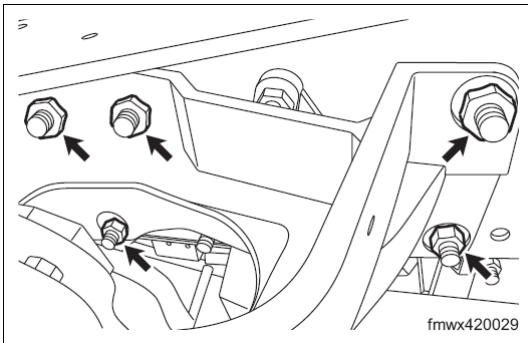


5. Dismantle the steering gear bracket

- (a). Dismantle the 5 fixing bolts of the steering gear bracket.
- (b). Remove the steering gear bracket.

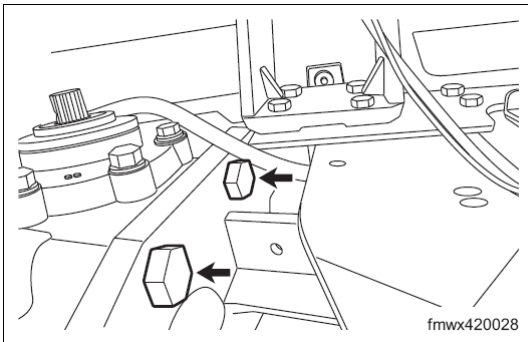
6. Inspect the steering gear and the steering plumbing arm

- (a). Use magnaflux to inspect whether the steering plumbing arm axle and the steering gear housing have any crack.
- (b). Inspect whether the steering plumbing arm axle spline has any distortion or damage.
- (c). Inspect the steering plumbing arm.
 - Inspect whether the steering plumbing arm has any distortion or crack.
 - Inspect whether the steering plumbing arm spline and the spline teeth are seriously worn.If there are above problems, replace with a new steering gear or a new steering plumbing arm.



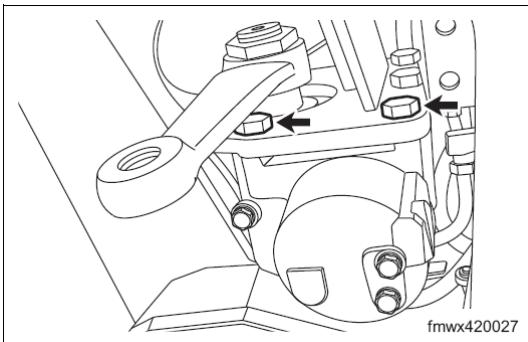
7. Install the steering gear bracket

- (a). Install the steering gear bracket onto the vehicle frame.
 - Fix the nut.**Torque: 325 ± 25 N•m**



8. Install the steering gear assembly

- (a). Install the steering gear assembly onto the steering gear bracket.
- (b). Install the 2 fixing bolts in the upper part of the steering gear.

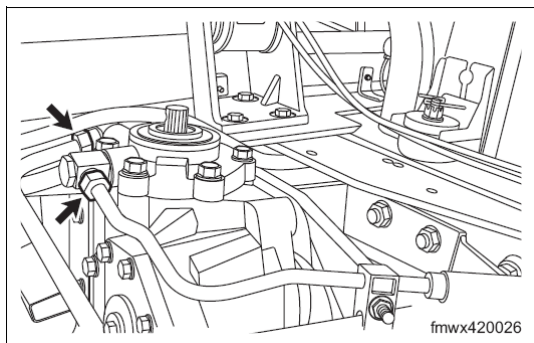


- (c). Install the 2 fixing bolts in the lower part of the steering gear.
 - Tighten the 4 fixing bolts of the steering gear.**Torque: 565 ± 15 N•m**
- (d). Install the plumbing arm.
 - Tighten the fixing bolt of the plumbing arm.

Caution:

Install according to the fitting marks.

Power Steering System - Steering Gear Assembly (Left Rudder)



- (e). Put the high-pressure oil pipe assembly onto the oil inlet of the steering gear and tighten the terminal nut.

Torque: 120 ± 10 N•m

- (f). Put the low-pressure oil pipe assembly onto the return opening of the steering gear and tighten the terminal nut.

Torque: 120 ± 10 N•m

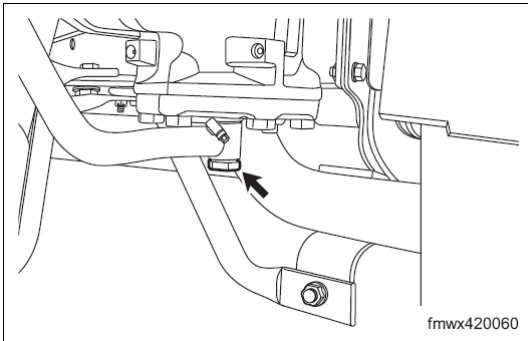
9. **Steering Column - Steering Column (Left Rudder), Dismantlement and Installment**
10. **Connect the universal joint of the steering column spline sleeve with the steering gear; refer to Chapter 41 Steering Mechanism - Steering Column (Left Rudder), Overhaul**
11. **Refill the steering fluid; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Left Rudder), Replacement**

Steering Gear Assembly (Right Rudder) Overhaul

Hint:

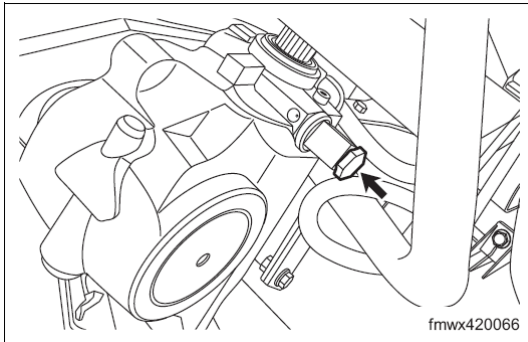
- The steering gear is a precise and safety part and shall not be disassembled for overhaul at random.
 - If damaged, replace with a new steering gear.
1. **Drain the steering fluid: refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Right Rudder), Replacement**
 2. **Separate the universal joint of the steering column spline sleeve from the steering gear; refer to Chapter 41 Steering Wheel & Steering Column - Steering Column (Left Rudder), Dismantlement and Installment**
 3. **Separate the drag link from the steering plumbing arm; refer to Chapter 42 Power Steering Mechanism - Steering Drag Link, Overhaul**

42

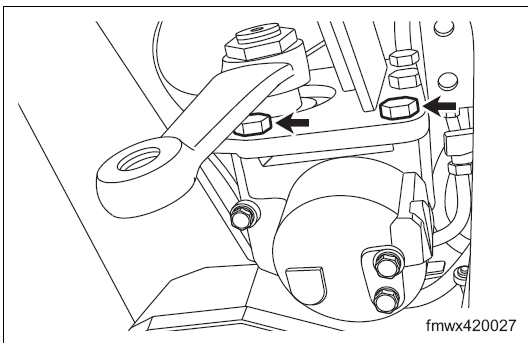


4. Dismantle the steering gear assembly

- (a). Loosen the terminal nut and pull out the high-pressure oil pipe assembly from the oil inlet of the steering gear.



- (b). Loosen the nut and pull out the low-pressure oil pipe assembly from the return opening of the steering gear.

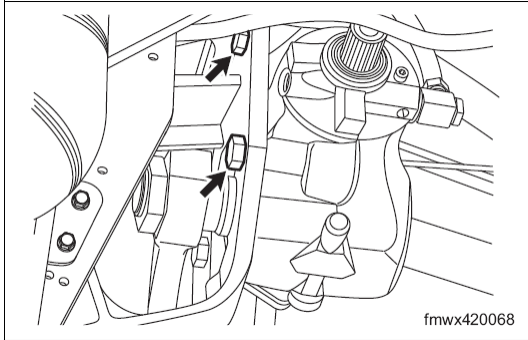


- (c). Disconnect the steering plumbing arm from the steering gear.
 - Dismantle the fixing nut of the steering plumbing arm.

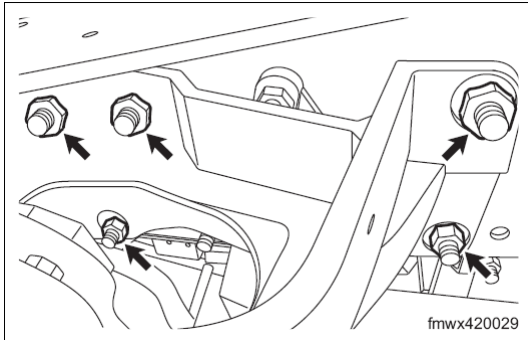
Caution:

Make the fitting marks on the steering plumbing arm and its arm.

- (d). Dismantle the 2 fixing bolts in the lower part of the steering gear.

Power Steering System - Steering Gear Assembly (Right Rudder)

- (e). Dismantle the 2 fixing bolts in the upper part of the steering gear.
- (f). Separate the steering gear from the steering gear bracket.

**5. Dismantle the steering gear bracket**

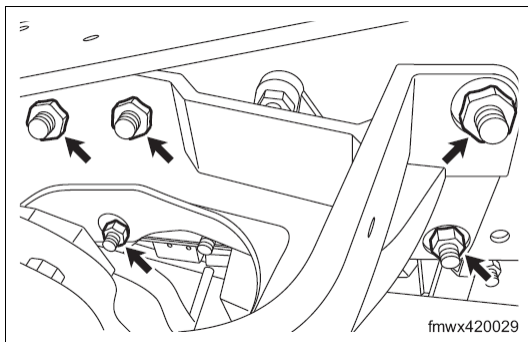
- (a). Dismantle the 5 fixing bolts of the steering gear bracket.
- (b). Remove the steering gear bracket.

42

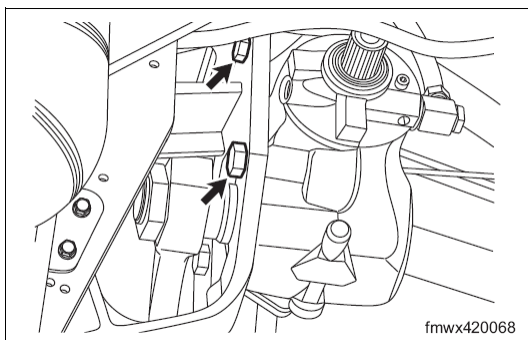
6. Inspect the steering gear and the steering plumbing arm

- (a). Use magnaflux to inspect whether the steering plumbing arm axle and the steering gear housing have any crack.
- (b). Inspect whether the steering plumbing arm axle spline has any distortion or damage.
- (c). Inspect the steering plumbing arm.
 - Inspect whether the steering plumbing arm has any distortion or crack.
 - Inspect whether the steering plumbing arm spline and the spline teeth are seriously worn.

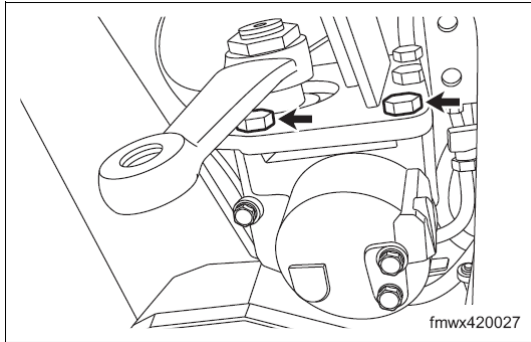
If there are above problems, replace with a new steering gear or a new steering plumbing arm.

**7. Install the steering gear bracket**

- (a). Install the steering gear bracket onto the vehicle frame.
 - Fix the nut.
- Torque: 325±2N.m**

**8. Install the steering gear assembly**

- (a). Install the steering gear assembly onto the steering gear bracket.
- (b). Install the 2 fixing bolts in the upper part of the steering gear.



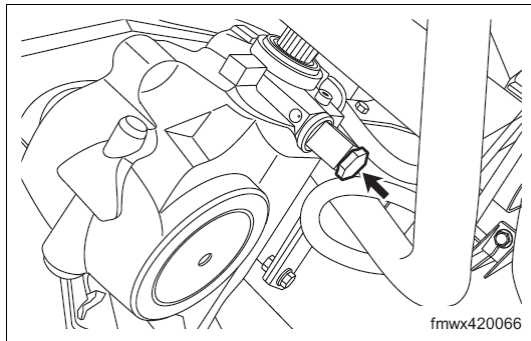
- (c). Install the 2 fixing bolts in the lower part of the steering gear.
- Tighten the 4 fixing bolts of the steering gear.

Torque: 565 ± 15 N•m

- (d). Install the plumbing arm.
- Tighten the fixing bolt of the plumbing arm.

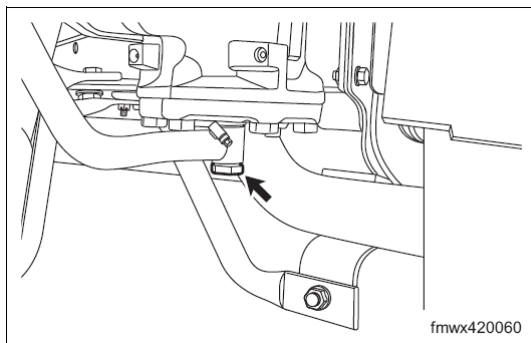
Caution:

Install according to the fitting marks.



- (e). Put the high-pressure oil pipe assembly onto the oil inlet of the steering gear and tighten the terminal nut.

Torque: 120 ± 10 N•m

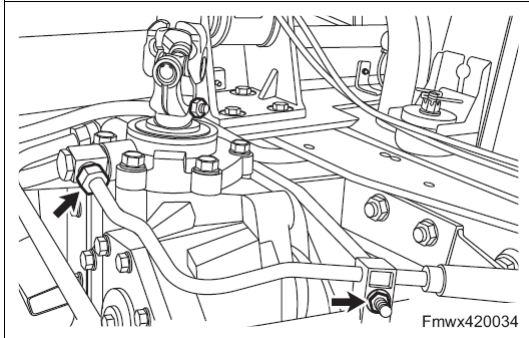


- (f). Put the low-pressure oil pipe assembly onto the return opening of the steering gear and tighten the terminal nut.

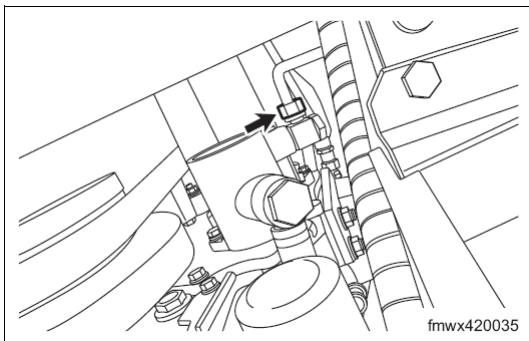
9. Separate the drag link from the steering plumbing arm; refer to Chapter 42 Power Steering Mechanism - Steering Drag Link, Overhaul
10. Separate the universal joint of the steering column spline sleeve from the steering gear; refer to Chapter 41 Steering Wheel & Steering Column - Steering Column (Right Rudder), Dismantlement and Installment
11. Refill the steering fluid; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Left Rudder), Replacement

Hydraulic Circuit Dismantlement and Installation

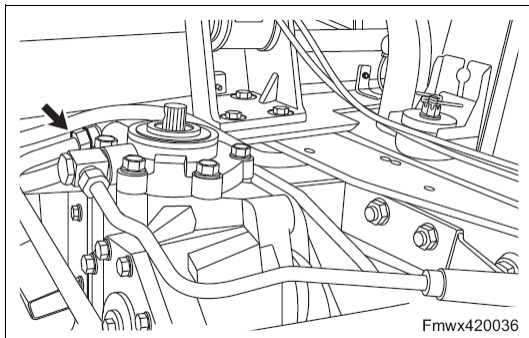
1. Drain oil: refer to Chapter 42 Power Steering - Steering Fluid (Right Rudder), Replacement



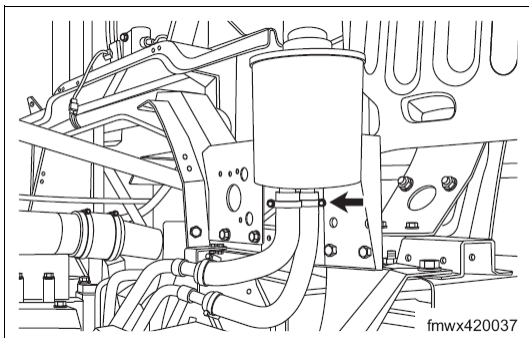
2. **Dismantle the high-pressure oil pipe assembly**
- (a). Loosen the terminal nut and pull out the high-pressure oil pipe assembly from the oil inlet of the steering gear.
 - (b). Loosen the bolts of the oil pipe clamp assembly and take down the oil pipe clamp assembly



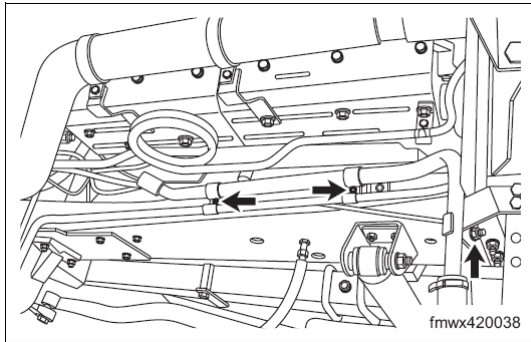
- (c). Loosen the terminal nut and take off the high-pressure oil pipe assembly from the oil outlet of the steering pump assembly.



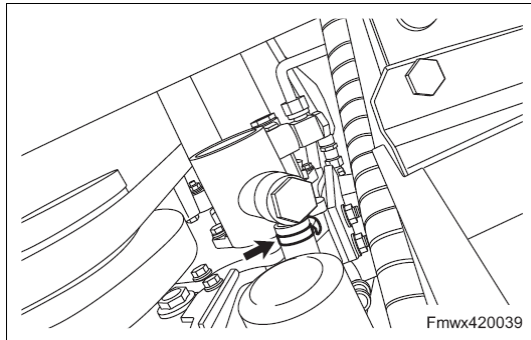
3. **Dismantle the low-pressure oil pipe**
- (a). Loosen the nut and pull out the low-pressure oil pipe assembly from the return opening of the steering gear.



- (b). Loosen the hoop and pull the low-pressure oil pipe assembly out of the oil inlet of the steering fluid reservoir.

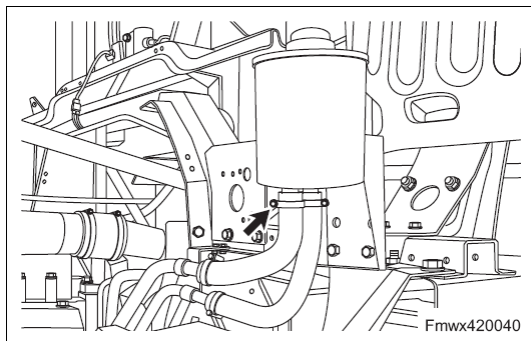


- (c). Loosen the bolts of the oil pipe clamp and take down the low-pressure oil pipe assembly.

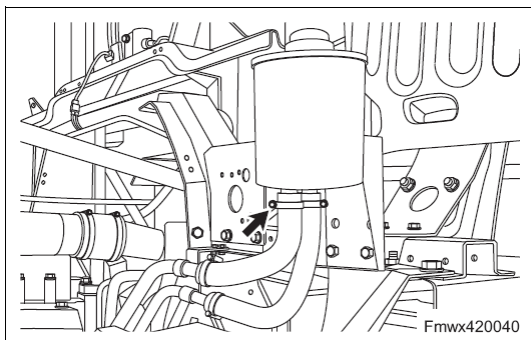


4. Dismantle the steering pump oil inlet pipe assembly

- (a). Loosen the hoop and pull the pump oil inlet pipe assembly out of the oil inlet of the steering pump assembly.

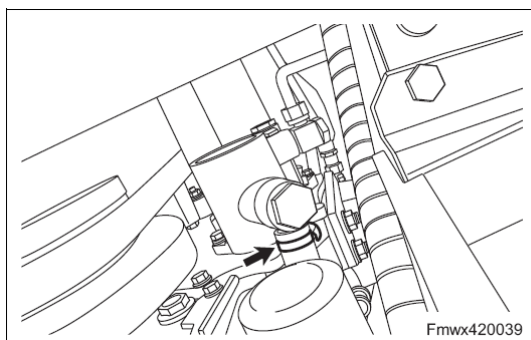


- (b). Loosen the hoop and pull the steering pump oil inlet pipe assembly out of the oil outlet of the steering fluid reservoir.
(c). Take down the steering pump oil inlet pipe assembly.

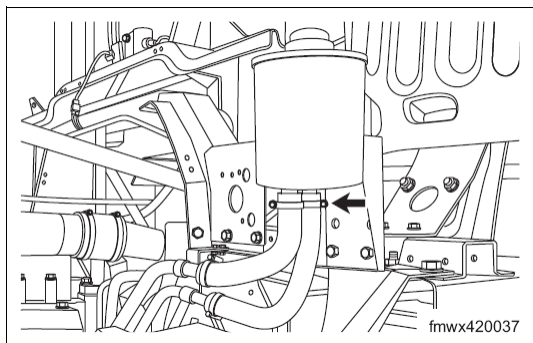


5. Install the steering pump oil inlet pipe assembly

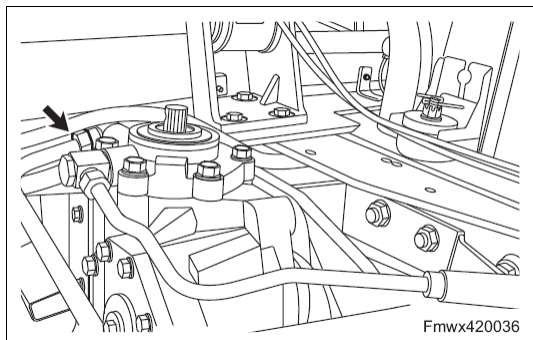
- (a). Put the steering pump oil inlet pipe onto the steering fluid reservoir outlet and screw up the hoop.



- (b). Put the steering pump oil inlet pipe onto the steering fluid reservoir inlet and screw up the hoop.

Power Steering System - Hydraulic Circuit**6. Install the low-pressure oil pipe**

- (a). Put the low-pressure oil pipe assembly onto the steering fluid reservoir inlet and screw up the hoop.



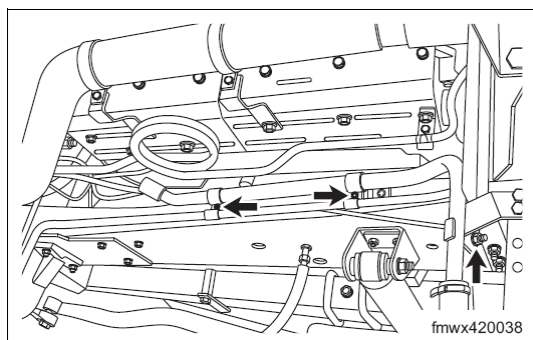
- (b). Apply sealant on the opening of the low-pressure oil pipe assembly.

Sealant: Loctite 567.

- (c). Put the low-pressure oil pipe assembly into the return opening of the steering gear and tighten the terminal nut.

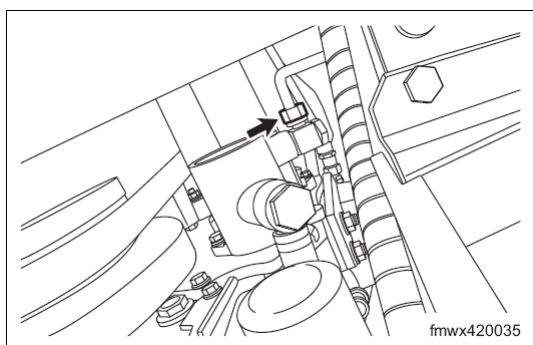
Torque: $120 \pm 10 \text{ N.m}$

42



- (d). Install the oil pipe clamp assembly and screw up the bolts.

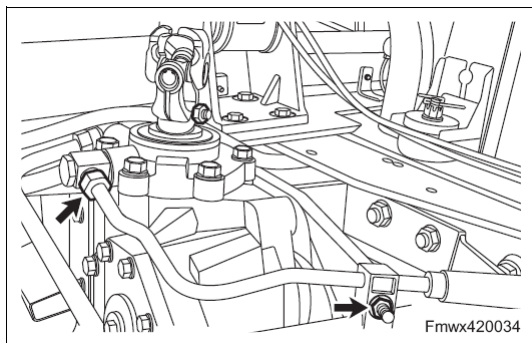
Torque: $23 \pm 2 \text{ N.m}$

7. Install the high-pressure oil pipe

- (a). Apply the sealant on high-pressure oil pipe assembly and its opening.

Sealant: Loctite 567.

- (b). Put the high-pressure oil pipe assembly onto the steering pump outlet and screw up the joint nut.



- (c). Insert the high-pressure oil pipe assembly into the steering gear inlet and screw up the joint nut.

Torque: $120 \pm 10 \text{ N.m}$

- (d). Install the oil pipe clamp assembly and screw up the bolts.

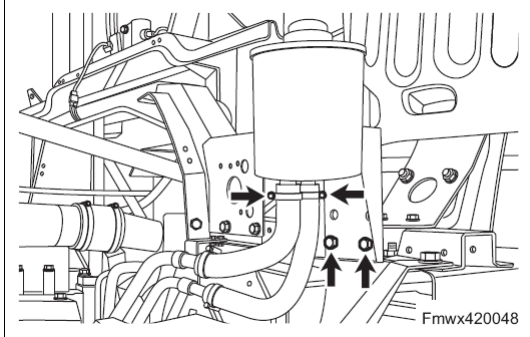
Torque: $120 \pm 10 \text{ N.m}$

8. Refill the steering fluid; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Right Rudder), Replacement

Steering Fluid Reservoir Assembly

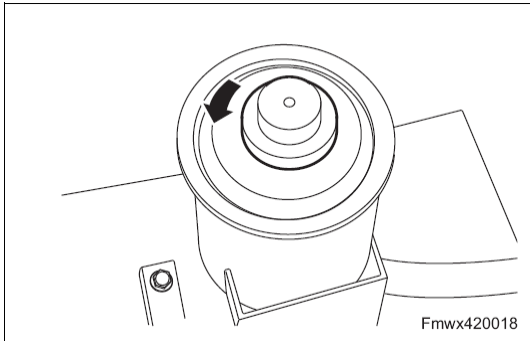
Dismantlement and Installation

1. **Drain oil; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Left Rudder), Replacement**



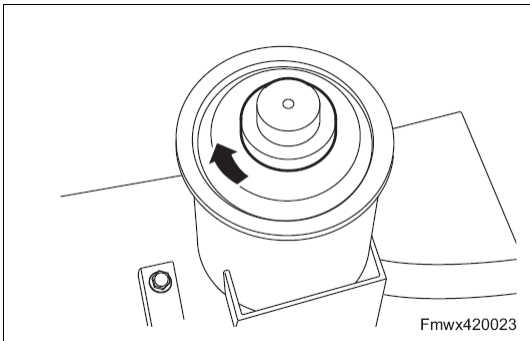
2. **Dismantle the steering fluid reservoir assembly**

- (a). Loosen the hoop and pull the low-pressure oil pipe assembly out of the oil inlet of the steering fluid reservoir.
- (b). Loosen the hoop and pull the steering pump oil inlet pipe assembly out of the oil outlet of the steering fluid reservoir.
- (c). Dismantle the bolts fastening the steering fluid reservoir to the bracket.



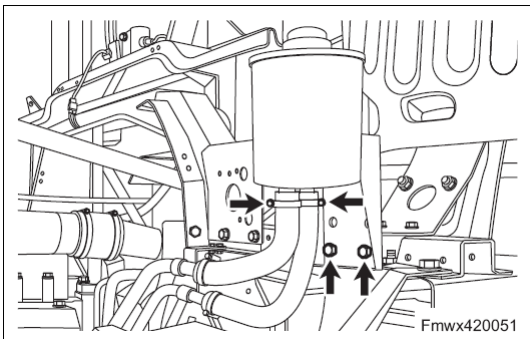
3. **Dismantle the cover of the steering fluid reservoir**

- (a). Rotate the cover of steering fluid reservoir anticlockwise and take it down.



4. **Install the cover of the steering fluid reservoir**

- (a). Clockwise tighten the cover of the steering fluid reservoir.



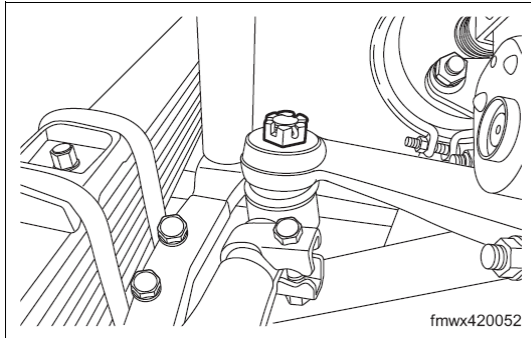
5. **Install the steering fluid reservoir assembly**

- (a). Install the steering fluid reservoir on the bracket and screw up the bolts.
Torque: 23±2N·m
- (b). Put the pump oil inlet pipe onto the oil inlet of the steering fluid reservoir and screw up the hoop.
- (c). Put the low-pressure oil pipe assembly onto the oil inlet of the steering fluid reservoir and screw up the hoop

6. **Refill the steering fluid; refer to Chapter 42 Power Steering Mechanism - Steering Fluid (Left Rudder), Replacement.**

Steering Drag Link Assembly Overhaul

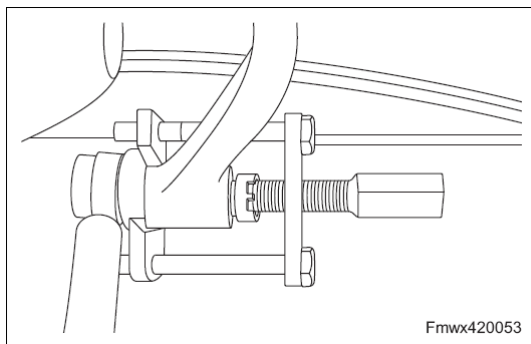
1. Disconnect the connection of the steering drag link and knuckle arm



- (a). Pull out the cotter pin and loosen the hex slotted nut.

Caution:

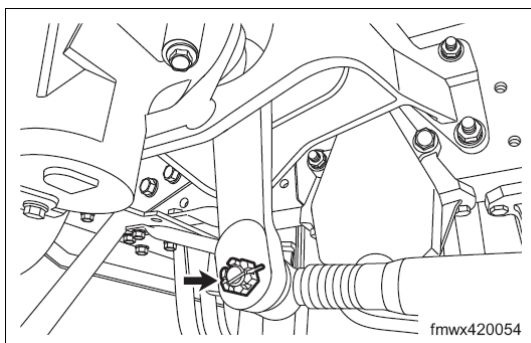
The dismantled cotter pin can not be reused.



- (b). Separate the drag link from the knuckle arm with a ball clamp.

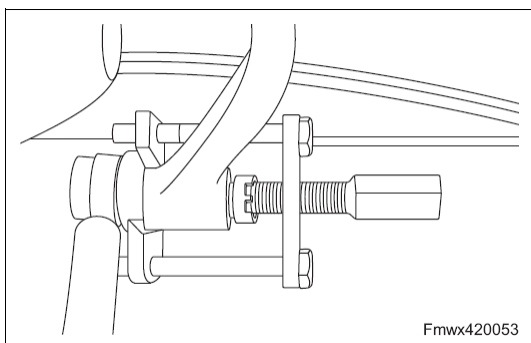
Caution:

Do not damage the ball dust cover during the usage of the ball clamp.



2. Disconnect the connection of the steering drag link and steering plumbing arm

- (a). Pull out the cotter pin and loosen the hex slotted nut.



- (b). Separate the drag link from the steering plumbing arm with a ball clamp.

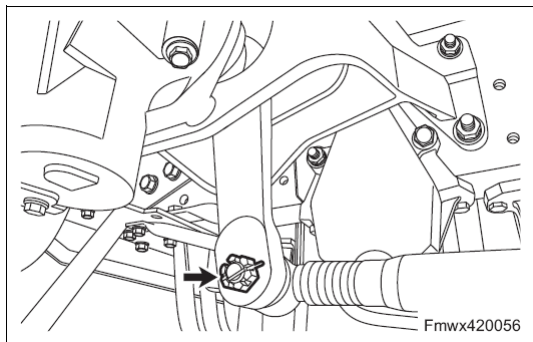
Caution:

Make front marks for the link toward the front part of the vehicle and do not damage the ball dust cover during the usage of the ball clamp.

3. Inspect the steering drag link

- (a). Inspect whether the ball is loose
(b). Inspect the contact surface between the tapered axle and steering plumbing arm & knuckle arm; refer to Chapter 42 Power Steering Mechanism - Power Steering System, Testing & Adjustment

Power Steering System - Steering Drag Link Assembly

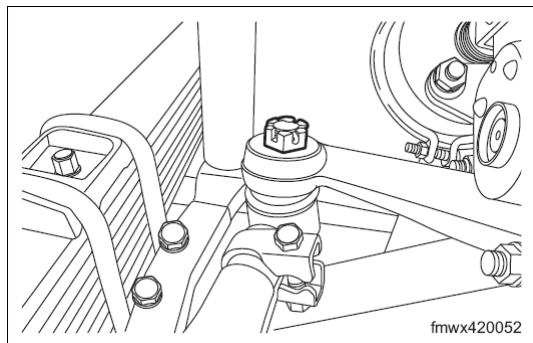


4. Install the steering drag link assembly

- (a). Install the steering drag link into the steering plumbing arm, screw up the hex slotted nut and install the cotter pin.

Caution:

Make sure the side of the drag link installed into the steering plumbing arm is the front part of the drag link. Make sure to use new cotter pin.



- (b). Install the steering drag link into the steering plumbing arm, screw up the hex slotted nut and install the cotter pin.

Torque: 180N•m

Caution:

Make sure to use new cotter pin.

Heater & Air Conditioner

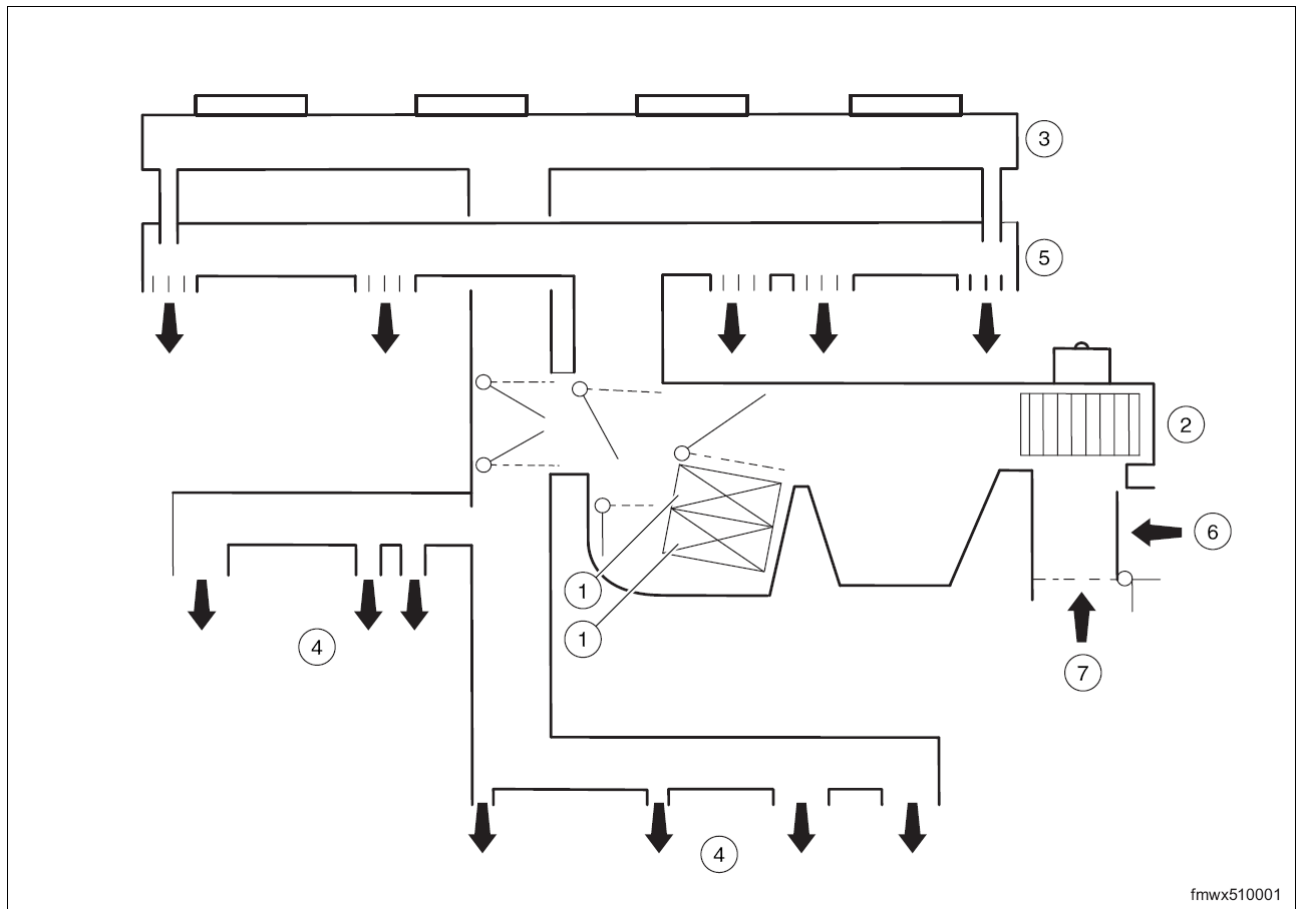
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Heater & Air Conditioner

General

Heater



1	Heater Core
2	Blower
3	Defroster
4	Floor Exit

5	Dashboard Outlet
6	Internal Air
7	External Air

When the engine starts preheating, the heated engine coolant will be sent into the heater core. The heating system provides heat into the carriage, so as to preheat it. External air is recycled by the heater core of heating device and then sent back to the carriage. The most comfortable carriage temperature can be selected and maintained by controlling external air and heater core air. The heat temperature sent into the carriage is controlled by the temperature control knob. This control knob can open and close bleed door, so it can control the air flow through the heater core.

And also, the most comfortable temperature in the carriage can be selected and maintained by using the internal and external cycle switch with different operation modes. The internal and external cycle switch will be used to select external air or internal air cycle. When the switch is turned to "external cycle", the external air will always be introduced into the carriage. When the switch is turned to "internal cycle", the air cycle will be limited to internal air excluding external air, and the air in the carriage will be heated rapidly. However, the switch is normally set to "external cycle" to prevent the windshield from fogging.

Control Switch Assembly

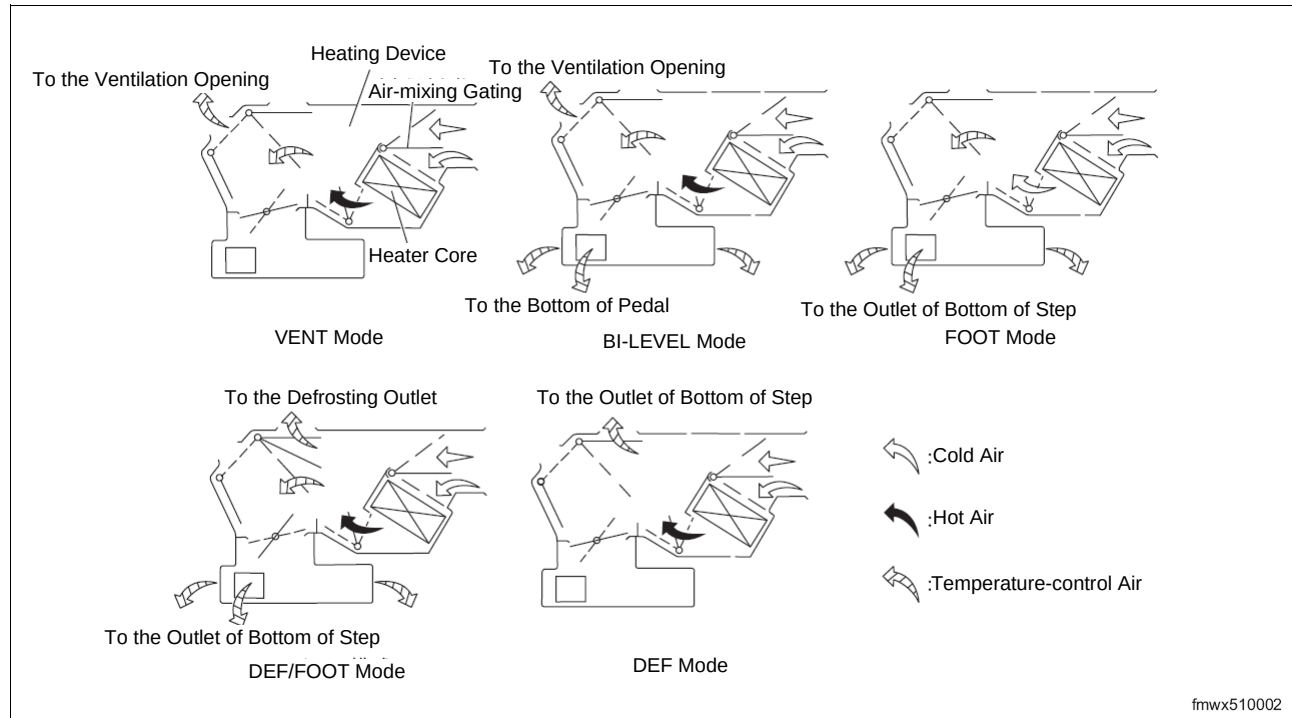
Heater & Air Conditioner - Heater & Air Conditioner

This vehicle is equipped with electric-control switch assembly. It controls the bleed door and model air door of the heating device and internal and external air cycle air door of the blower assembly through the motor. Fan control device is used to control air by adjusting the four gears of resistor from “1” (low) to “4” (high).

Ventilation

Please set the “internal and external cycle switch” to “external switch” and open the fan of blower for ventilation. When this position is selected, heating can be carried out, and fresh air can be introduced at the same time. The blower can also send the external fresh air into the inner part of the vehicle, so as to ensure sufficient ventilation.

Mode Switch



The mode switch can introduce the hot air into the carriage through different outlets.

- 1. Ventilation-** when this position is selected, the air will be exhausted from the above air outlet. The air flow is controlled by the fan control knob.
- 2. Bi-level positive pressure ventilation-** when this position is selected, the air flow is diverted between the above air outlet and step bottom outlet in which the hot air will be sent to the floor air outlet and the cold air will be sent to the above air outlet.
- 3. Step bottom ventilation-** when this position is selected, the air flow will be sent to the step bottom only.
- 4. Defrosting/step bottom ventilation-** when this position is selected, the air flow will be sent to the step bottom, and about 30% of the flow will be sent to the windshield at the same time.
- 5. Defrosting-** when this position is selected, most of the air will be sent to the windshield and a small part of the air will be sent to the side window.

Internal and External Cycle Switch

The suction of external air and the cycle of internal air can be controlled by the switch. By pressing down the internal and external cycle switch, the heat can be passed very rapidly when the blower assembly mode gating is switched off. When this position is selected, external air won't be sent into the carriage.

Heater & Air Conditioner - Heater & Air Conditioner**Fan Switch**

This switch controls the rotation speed of the blower motor. It adjusts the air flow that is sent to the defroster, step bottom and ventilation pipe.

1.Low	2. Mid-low	3 Mid-high	4.High
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Temperature Control Knob

When the temperature control knob is at the "cold"(blue) position, the air bleed door is closed to stop the air flow from flowing to the heater core. When the temperature control lever is at the "hot" (red) position, the air bleed door is open to let air flow through the heater core and heat the carriage. When the control knob is at the middle position, the air that arrives at the heater core will be more or be less. In this mode, the temperature in the carriage can be adjusted.

Compressor

The compressor mainly performs two functions:

It will compress the low pressure and low temperature coolant vapor coming from the evaporator into the high pressure and high temperature coolant vapor that goes into the condenser. Besides, it can suck the coolant and refrigerating oil through the air conditioning system.

This vehicle is equipped with rotary inclined-plate compressor (10S15C)

The rotary inclined (lean) plate of the rotary inclined-plate compressor is fixed at the shaft. When the shaft rotates, the rotating power of the rotary inclined plate will be transformed into the reciprocating movement of the piston so as to suck in and compress coolant gas.

The shaft seal (lip-seal) is fixed between the valve plate, shaft and cylinder head so as to prevent coolant gas from leaking. Quantitative compressor oil is placed inside the oil plate.

The compressor oil provides oil to the cylinder and bearing through the oil pump connected to the rotary inclined-plate shaft.

For some compressors, the pressure difference generated between sucking and releasing pressure will replace the oil pump in lubricating work.

Besides, the compressor oil used will vary in line with the different types of the compressors.

For mode 10S15C, the specified compressor oil quantity is 120ml.

Don't mix two or even more types of different oil.

If the oil is used in a wrong way, the lubricating effect will be reduced and the compressor will suffer from stuck phenomenon or failure.

The solenoid clutch joint is waterproof

Solenoid Clutch

The compressor can transmit by the driving belt of crankshaft pulley. If the compressor is started each time when the engine is started, the engine will be overloaded. The magnetic clutch transmits the power from the engine to the compressor. It started when the air conditioner is open and it cuts the power from the engine to the compressor when the air conditioner is closed.

Condenser Assembly

The condenser assembly is placed at the back of the headlight. It sends the coolant into the cooling fin so as to realize quick hot exchange.

Besides, it can also cool and liquefy the high pressure and high temperature vapor through radiator fan or external air.

The failure of condenser can be categorized into two kinds: leakage or blockage. The blockage of condenser will generate too much discharge pressure of the compressor. If partial blockage appears, the coolant will expand quickly when passing the blocked part.

Therefore, ice or frost will be quickly formed after the blockage. If the air that goes through the condenser or radiator is obstructed, high discharge pressure will be formed. When the condenser functions normally, the outlet line of the coolant will be slightly colder than the inlet line.

This vehicle is equipped with parallel flow condenser. The large heating section at the inner surface can add the radiation heat, while the ventilation resistance is reduced accordingly.

Pressure Switch

The pressure switch is placed at the pipeline of coolant. It is used to "open" or "close" electromagnet when the coolant high and low pressure fluctuates randomly.

Clutch

- Low pressure side pressure 20~40MPa
- High pressure side pressure 160~200MPa

Evaporator

The evaporator cools and dehumidifies the air before the air enters into the air-conditioner outlet. High pressure liquid coolant enters into the low pressure section of the evaporator through the expansion valve. The air heat that goes through the evaporator core is lost at the surface of the core cooling device, and the air is cooled.

Along with the loss of heat on the surface of the air and evaporator core, the moisture inside the vehicle is condensed at the outside surface of the evaporator core and drained in the form of water. When the evaporator fails, it's manifested in insufficient supply of cold air. The Cause of failure normally is that the filthy substance blocks it or the motor of the blower fails.

Evaporator core with multi-layered shutter is monolayer box, and only one box is placed below the core.

Expansion Valve

This expansion valve is external pressure mode, and it is placed at the inlet side of the evaporator.

Before sending the liquid coolant to the evaporator, the expansion valve force the high pressure liquid coolant to pass through the small inlet and outlet, so as to transform the high pressure liquid coolant coming from the receiver /dryer into low pressure liquid coolant.

This expansion valve is composed of temperature sensor, separator, ball valve, valve seat, spring regulating screw, etc.

The temperature sensor is connected with the outlet pipe of the evaporator so as to transform the temperature change into pressure and then send the pressure to the superior membrane.

The coolant pressure will be passed to the superior membrane through the external even pressing power pipe.

The ball valve is connected with the membrane. The openness of the expansion valve is determined by the membrane pressure and spring pressure.

The expansion valve is in charge of regulating the coolant flow rate. Accordingly, when the expansion valve fails, discharge pressure and sucking pressure will both be lowered, causing insufficient cooling ability of the evaporator.

Heater & Air Conditioner - Heater & Air Conditioner

Electronic Thermostat

The thermostat is composed of temperature sensor and thermostat device which reduces the system noise through the electric circuit.

The electronic thermostat is placed at the outlet of the evaporator core for checking the temperature of the evaporator cold air. Temperature signals will be sent to the thermostat device

This signal is compared by the thermostat device and then transmitted to the output end so that the air-conditioner compressor relay can be started and the magnetic clutch is switched to "open" or "closed", thus preventing freezing of the evaporator.

The sensor is characterized in that: when the temperature is raised, the resistance will be reduced; when the temperature is lowered, the resistance will be increased.

Coolant Pipeline

1. When the following symptoms happen, the coolant pipeline is blocked:

Inlet pipeline: the blocked inlet pipe will lead to the lowered sucking pressure, discharge pressure and lowered cooling performance or no cooling of the compressor,

2. Discharge pipeline: the blockage of the discharge pipeline will often lead to the leakage of the discharge pipeline.

3. Liquid pipeline: lower discharge and sucking pressure indicate blockage in the liquid pipeline.

Coolant hose with lower penetration rate of coolant and water can be used. Special nylon layer is placed inside the hose with lower penetration rate.

Precautions

Relevant procedures, regulations and cautions shall be followed in maintenance of air conditioning system.

- Keep the working area clean.
- Protective goggles and gloves shall be worn when operating the cooling system.
- Pay attention to the harm of carbon monoxide generated when starting the engine.
- Pay attention to the discharged coolant in the enclosed or unventilated garage.
- Normally disconnect the negative cables of the battery, discharge and recover the coolant when repairing the air conditioning system.
- When discharging and recovering the coolant, do not discharge too fast for it will take the compressor oil out of the system.
- Discharge the moisture and pollutant out of the system. When disconnecting or dismantling any pipeline or component, immediately cover the joint with a plug or cover.
- The cover or plug shall not be dismantled in reconnection or installation.
- When the pipeline is disconnected or reconnected, two wrenches shall be used to support the pipeline joint to prevent distortion or any other damages.
- New O-ring shall be installed whenever dismantling the joint.
- Use new specified compressor oil to mop the O-ring when connecting any hose or pipeline.
- The compressor (PAG) oil used shall verify according to different compressor models. The specified compressor oil to the model must be mopped.
- When dismantling and replacing the components required to discharge the coolant circuit, the order below shall be followed to conduct specified operations of the chapter:
 1. **Coolant recovery/recycle/filling system or similar device shall discharge and recover the coolant completely.**
 2. **Dismantle and replace damaged components.**
 3. **After discharging, the air conditioning system shall be filled with coolant and inspected for leakage.**

The coolant, a chemical mixture, shall follow special management regulations to prevent harm to any personnel.

- Normally wear protective goggles and gloves.
- Normally work in a ventilated environment. No welding or steam cleaning may be conducted on any vehicle-mounted air condition pipeline or part (or places nearby).
- If anyone has physical contact with R-134a to any part of his body, cooling water must be used to wash the contacted part and seek medical assistance immediately.
- If any R-134a container needs to be transported or moved by vehicle, do not place it inside the carriage.
- If R-134a needs to be filled from bigger container to smaller one, it shall, by no means, be filled. Normally leave a space for expansion above the level.
- R-134a containers shall be stored under 40°C condition.

Warning:

- **If your eyes have physical contact with R-134a, seek medical assistance immediately.**
- **Do not wipe the infected eye. Use lots of fresh water to wash the infected part so as to let the coolant temperature rise to its condensation point.**
- **Seek for correct medical treatment as much as possible. If your skin touches R-134a, treatment for cold injury must be used at once to the injured part.**

Heater & Air Conditioner - Heater & Air Conditioner**Fault Symptom Table**

Use the following table to help you find the failure. The sequence number refers to the order of the possibility of the failures. Inspect each part according to the order and replace as needed.

The heater does not generate heat

Fault Symptom Table	Possible Cause	Reference
No heat	1. Coolant of the engine(low level)	Add coolant
	2. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	3. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	4. Air duct(blocked)	Ventilate the air duct
	5. Blower(damaged)	Chapter 51 Heater & Air Conditioner - Heater, Overhaul
	6. Heater core and/or hose (blocked)	Chapter 51 Heater & Air Conditioner - Heater, Overhaul
	7. Engine(lower water temperature)	Overhaul the engine cooling system
	8. Air duct/hose (unaligned)	Reinstall the air duct/hose
Over heat	1. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	2. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner-Heater, Overhaul
	3. Engine(too hot)	Overhaul the engine cooling system

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The air heating system generates too much noise

Failure Symptom	Possible Cause	Reference
Sound of cackles	1. Coolant of the engine(low liquid level)	Chapter 51 Heater & Air Conditioner - Coolant, Overhaul
	2. Engine(too hot)	Overhaul the engine cooling system

The cooling system fails

Failure Symptom	Possible Cause	Reference
Not generating cooling or generate insufficient cooling	1. Solenoid clutch (not functioning)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	2. Fin of the solenoid clutch (filthy substance causes slipping)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	3. Driving belt (loosened or ruptured)	Chapter 51 Heater & Air Conditioner- Compressor, Overhaul
	4. Compressor (stuck)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	5. Refrigeration oil (leakage)	Chapter 51 Heater & Air Conditioner- Coolant, Overhaul
	6. Coolant (insufficient or excessive)	Chapter 51 Chapter 51 Heater & Air Conditioner- Coolant, Overhaul
	7. Cooling system (leakage)	Chapter 51 Heater & Air Conditioner-Air Conditioner Pipe, Overhaul
	8. Condenser (blocked or insufficient radiation)	Chapter 51 Heater & Air Conditioner- Condenser, Overhaul
	9. Temperature control knob (damaged)	Chapter 51 Heater & Air Conditioner- Air Conditioner Control Switch, Overhaul
	10. Bleed door motor (damaged)	Chapter 51 Heater & Air Conditioner- -Heater Overhaul
	11. Bleed door (damaged)	Chapter 51 Heater & Air Conditioner- Heater, Overhaul
	12. Expansion valve(blockage)	Chapter 51 Heater & Air Conditioner- Evaporator, Overhaul
Insufficient air flow rate	1. Evaporator(blocked or frosted)	Chapter 51 Heater & Air Conditioner- Evaporator, Overhaul
	2. Air duct(air leakage)	Replace the air duct
	3. Blower(damaged)	Chapter 51 Heater & Air Conditioner- Blower, Overhaul

Heater & Air Conditioner - Heater & Air Conditioner**Interrupted cooling**

Failure Symptom	Possible Cause	Reference
Interrupted air flow	1. Blower(damaged)	Chapter 51 Heater & Air Conditioner-Blower, Overhaul
	2. Air duct(blocked)	Ventilate the air duct
Interrupted operation of the compressor	1. Belt(slipped)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	2. Solenoid clutch(damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	3. Compressor(damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	4. Three-state pressure switch(damaged)	Chapter 51 Heater & Air Conditioner- Fluid Reservoir, Overhaul
Blower and compressor operate normally with interrupted cooling	1. Temperature sensor kit(loosened)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	2. Expansion valve(ice blocked)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	3. Intermittent system foreign substance blockage	Ventilate or change relevant pipes

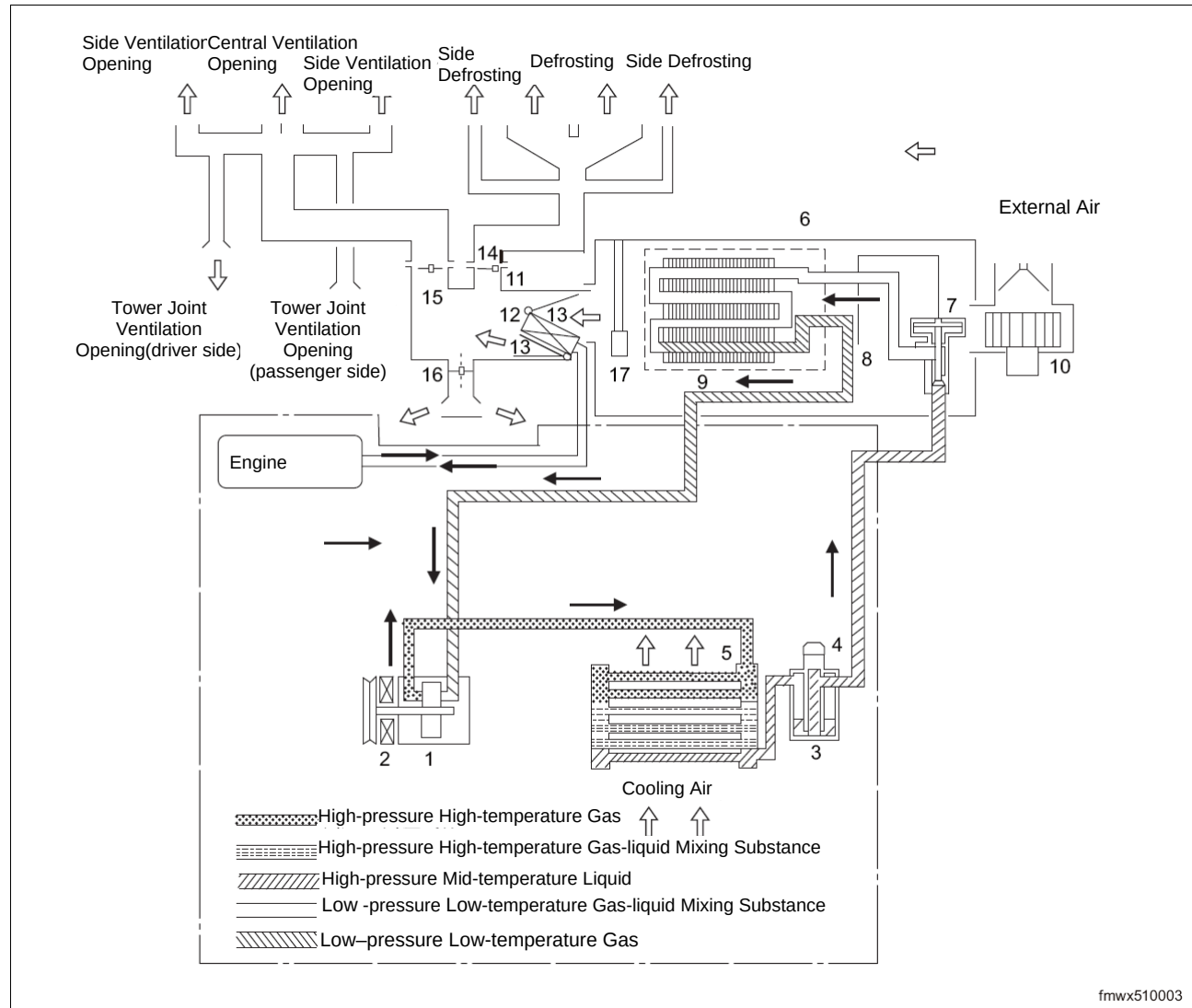
51

The cooling system generates too much noise

Failure Symptom	Possible Cause	Reference
System external noise	1. Belt (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	2. Compressor bracket (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	3. Compressor (damaged)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	4. Solenoid clutch(slipped)	Chapter 51 Heater & Air Conditioner-Compressor, Overhaul
	5. Refrigeration oil (too little or none)	Chapter 51 Heater & Air Conditioner-Refrigeration Oil, Overhaul
	6. Blower(damaged)	Chapter 51 Heater & Air Conditioner-Blower, Overhaul

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System internal noise	1. Coolant (insufficient or too much)	Chapter 51 Heater & Air Conditioner-Coolant, Overhaul
	2. Expansion valve(water vapor in the system)	Chapter 51 Heater & Air Conditioner-Evaporator, Overhaul
	3. Compressor vibrates(high pressure too high)	Chapter 51 Heater & Air Conditioner- Coolant, Overhaul

Working Principle

1	Air Compressor
2	Solenoid Clutch
3	Receiver / Dryer
4	Pressure Switch
5	Condenser
6	Evaporator Assembly
7	Expansion Valve

10	Blower Motor
11	Heater
12	Heater Core
13	Bleed Door
14	Defrosting-mode Air Door
15	Ventilation-mode Air Door
16	Heating-mode Air Door

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8	Te Temperature Sensor
9	Evaporator Core

17	Electronic Thermostat
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As the coolant changes from liquid to gas, then returns to liquid again and again in the cycle, the cooling cycle system includes the following four processes.

Evaporation

Coolant changes from liquid to gas in the evaporator. Coolant fog that enters into the evaporator will quickly evaporate. Liquid coolant can remove a certain degree of heat (latent heat of evaporation) from the air next to the evaporator core cooling fins, and evaporate quickly. The elimination of heat makes the air cooled, and the cool air that comes out of the fin can reduce the temperature inside the vehicle. After the coolant liquid which is sent from the expansion valve and evaporative coolant gas entering into the evaporator, the liquid will convert to gas.

With the change from liquid to gas, the pressure inside the evaporator must be kept low enough to meet the requirements of evaporation at low temperature. Therefore, evaporative coolant will be sucked into the compressor.

Compression

Coolant will be compressed in the compressor and then output gaseous coolant with high temperature and pressure.

Evaporative coolant in the evaporator will be sucked into the compressor. This function can retain coolant in the evaporator in low pressure for evaporation, even under conditions close to 0 °C.

Additionally, the coolant which is sucked into the compressor will be compressed in the compressor cylinder, thus increasing sufficient pressure and temperature to enable the coolant easy to liquefy at normal temperature.

Condensation

Coolant in the condenser gets cooled through the inversion of external air and gas liquid. High-temperature high-pressure gas from the compressor is gradually cooled and liquefied in the role of external air, and then it outputs gas-liquid mixed coolant of high-pressure, and finally gets stored in the dryer. The heat which is radiated by high-temperature high-pressure gas in the compressor to the external air is called condensing heat. This is the heat (evaporation heat) that the coolant removes from the vehicle through the evaporator and the compression mechanism.

Expansion

Expansion valve can reduce the pressure of the liquid coolant, so that the liquid can be evaporated. The process of reducing the pressure to accelerate evaporation before sending the liquid coolant to the evaporator is called expansion. Moreover, the expansion valve controls the flow rate of the coolant, and reduces the pressure in the same time.

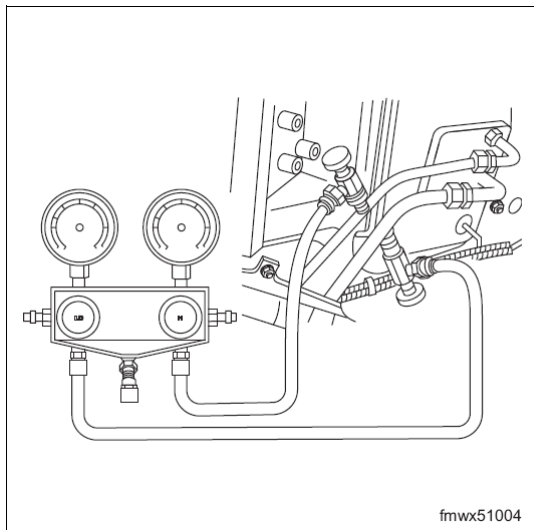
That is to say, the coolant amount evaporated in the evaporator is determined by the heat removed in a decided evaporation temperature. Importantly, the coolant amount should be precisely controlled to ensure its accuracy.

Testing & Adjustment

Inspect the cooling system with a manifold pressure meter

Inspect Condition:

- The ambient temperature is about 25 ~ 30 °C
- Engine operates at idle speed
- The switch of air conditioner is in the "ON" position
- The blower motor is operated in the "4" (H) gear
- The temperature control knob is set in the "coldest" position
- The internal and external cycle switch is in the "internal cycle" position
- Close all the air doors



Connect manifold pressure meter

Low-pressure side:

About 20-40MPa

High-pressure side:

About 160-200MPa

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Results	Symptoms	Failure Cause	Corrective Measures
Reading of the high side pressure meter is abnormally high	Air flow through the condenser is reduced or does not exist	• The condenser is blocked or dirty	• Clean the condenser
	When using water to cool the condenser, there is no bubble inside the observation mirror (Cooling is not sufficient)	• There is too much coolant in the system	• Inspect the observation mirror • Discharge and recycle the coolant, re-add it to the required amount
	The pressure decreases rapidly after stopping the air conditioner	• • There is air in the system	• Empty and refill the coolant

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Reading of the high side pressure meter is abnormally low	Cooling is not sufficient and there is too much bubble inside the observation mirror	The coolant is not sufficient in the system	- Inspect the observation mirror - Inspect for leakage - Discharge and recycle the coolant, re-add it to the required amount
	The low-pressure meter indicates vacuum	The expansion valve is blocked or damaged	Replace the expansion valve
	Frost or dew appears in the coolant pipeline before and after the dryer expansion valve, and the low-pressure meter indicates vacuum	Foreign substance or water in the dryer causes blockage	Inspect whether the system has any blockage and replace it
	The high and low pressure meter reaches equilibrium quickly after switching off the air conditioner	- The compressor seal is damaged - Damage of the compressor gasket causes insufficient compression	Replace the compressor
Reading of the low side pressure meter is abnormally high	Reading of the low-pressure meter reduces after cooling the condenser with water	There is too much coolant in the system	Discharge and recycle the coolant, re-add it to the required amount
	Temperature of the low-pressure hose next to the coolant compressor pipeline joints is lower than that next to the evaporator	- The valve works poorly due to the damage of expansion valve temperature sensor - Time for opening the expansion valve is too long	Replace the expansion valve
	The high and low pressure meter reaches an equilibrium position quickly after switching off the air conditioner	Gasket of the compressor is damaged	Replace the compressor
	Air conditioner had been switched off before the carriage is cold enough	The electronic thermostat is damaged	Inspect the electronic thermostat and replace it if needed
The low side pressure is abnormally low	Condenser is not hot, and there is too much bubble inside the observation mirror	The coolant is not sufficient	- Inspect the observation mirror - Inspect for leakage - Discharge and recycle the coolant, re-add it to the required amount
	Frost appears on the expansion valve inlet pipeline	The expansion valve is blocked	Replace the expansion valve
	Temperature difference between in and out pipeline of the coolant of the dryer is apparent	The dryer is blocked	Replace the dryer
	Coolant pipe of the export expansion valve is not cooling, and the low-pressure meter indicates vacuum	Temperature sensor of the expansion valve is damaged, and the valve can not properly regulate the flow of the coolant	Replace the expansion valve
	The discharging temperature is low and air flow of the exhaust port is hampered	The evaporator core is frozen	Inspect the electronic thermostat and replace it if needed
	Reading of the low-pressure meter is low, or indicates vacuum	The coolant pipeline is obstructed or blocked	Replace the coolant pipeline

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Both of the low and high side pressures are abnormally high	When using water to cool the condenser, there is no bubble inside the observation mirror (Cooling is not sufficient)	There is too much coolant in the system	- Inspect the observation mirror - Discharge and recycle the coolant, re-add it to the required amount
	Air flow through the condenser is reduced	Air flow through the condenser is reduced	Clean the condenser
	The pressure hose of the suction side (low pressure) is not cold	There is air in the system	Discharge and recycle the coolant, re-add it to the required amount
Both of the low and high side pressures are abnormally low	Cooling is not sufficient and there is too much bubble inside the observation mirror	The coolant is not sufficient in the system	- Inspect the observation mirror - Discharge and recycle the coolant, re-added it to the required amount

Read the readings of the observation mirror

Temperature of High and Low pressure Pipe	Status of the Observation Mirror	Cycle Status of the Air Conditioner
The high-pressure pipeline is hotter and the low-pressure pipeline is cooler, temperature difference between the two pipelines is apparent	It is almost transparent, bubble flow can be seen, but they will disappear after opening the throttle valve 	Eligible
The high-pressure pipeline is hotter and the low-pressure one is cooler, temperature difference between the two pipelines is not apparent	You can see the bubbly flowing all the time, sometimes it is transparent, and sometimes there are more bubbles 	Bad (inadequate coolant)
Temperature of the high-pressure and low-pressure pipelines is almost the same	You can see the mist objects indistinctly 	Bad (almost non-coolant)
The high-pressure pipeline is hot enough and the low-pressure one only has micro heat, and a temperature difference exists between the two pipelines	Even when the fan is under the "4" gear (the windows are all open) at idle speed, it presents the transparent status 	Bad (too much coolant)

The observation mirror can provide an accurate diagnosis only under the following conditions. If you can test the vehicle under these circumstances, you should inspect the appearance of the observation mirror, and compare it with the figure.

- The engine operates at idle speed
- Open the air conditioner switch
- Blower fan works at the highest speed
- Internal and external cycle switch is in the "internal cycle" position
- Set the temperature control knob to the coldest gear
- The ambient temperature is less than 30 °C and the humidity is below 70%

Caution:

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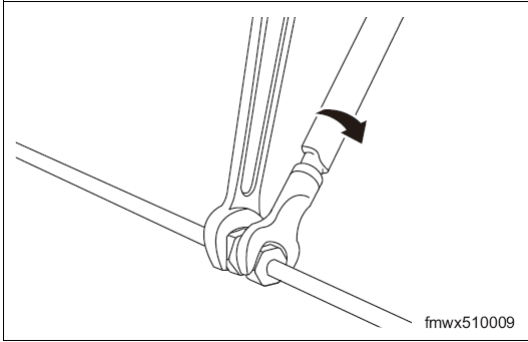
If you can not move the vehicle to the test location which meets these specifications, the observation mirror will not be used for diagnosis. You have to discharge and recycle the coolant, and then refill the system with specified amount of coolant. After that, you can continue to inspect the performance of the system.

- High side pressure is lower than **160MPa**

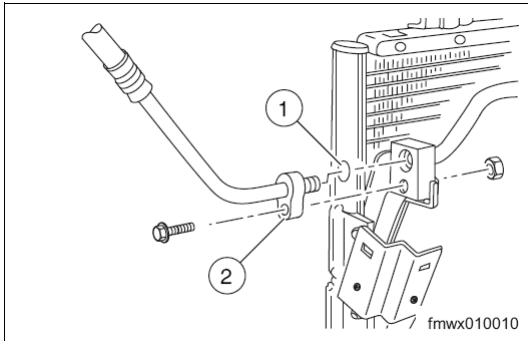
Caution:

If the high side pressure is higher than the specified value, then the observation mirror will not be used for diagnosis. You have to discharge and recycle the coolant, and then refill the system with specified amount of coolant. So that it can continue to inspect the performance of the system later.

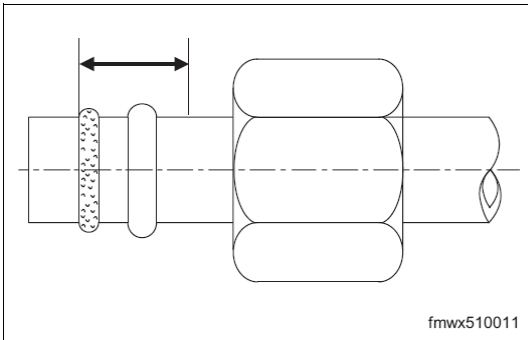
Repair leak parts of the coolant Connections of the coolant pipeline



Install a new O-ring if needed. When connecting or disconnecting the pipeline, you should use two wrenches to prevent distortion or damage in the connecting part.



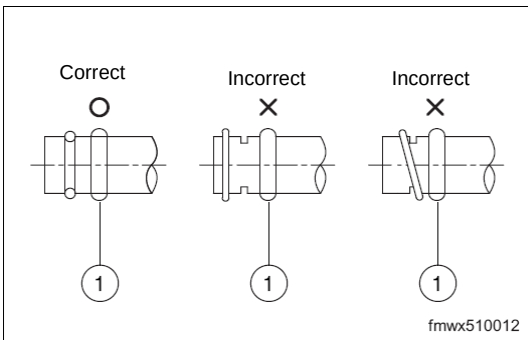
When connecting the coolant pipeline of the segment joints, insert the part of the mating place to the connection hole of the device firmly, and fasten them with bolts.



Before connecting, smear special compressor oil around the O-ring.

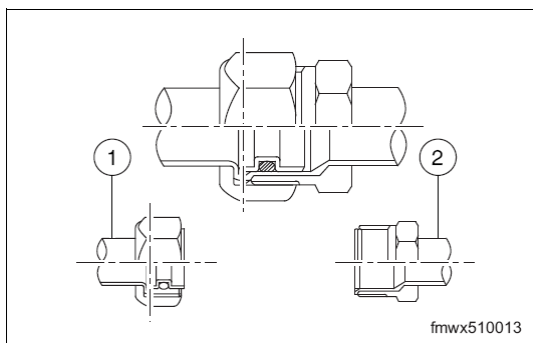
Caution:

The compressor (PAG) oil used will vary in line with the different types of the compressors. Be sure to use the compressor oil specially stipulated for this type of compressor.



O-ring (1) must be aligned with the raise part of the coolant pipeline.

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Plug nut (2) into the connector (1). First, fasten the nut by hand as much as possible, and then fasten the nut at the specified torque.

Leakage of the coolant pipe joints

1. Inspect torque of the coolant pipeline joints, and if it is too loose, fasten it to the specified one

Caution:

Use two wrenches to prevent distortion or damage caused to the pipeline.

Caution:

Do not be too tight.

2. Conduct a leakage test on the part of the coolant pipeline joints
3. If the leakage still exists, discharge and recycle the coolant from the system
4. Replace the O-ring

Caution:

O-ring can not be reused. It should always be changed with a new one.

Caution:

Be sure to smear special compressor oil around the new O-ring.

5. Re-fasten the coolant pipeline connection to the specified torque

Caution:

Use two wrenches to prevent distortion or damage caused to the pipeline.

6. Empty, refill and re-test the system

Hose leakage

If the compressor inlet or outlet hose leaks, you must replace the entire hose. Cutting or division of the coolant hose due to the maintenance need is not allowed.

1. Find the leakage

2. Discharge and recycle the coolant

3. Remove the hose assembly

Caution:

Cover the joint openings parts immediately.

4. Connect the new hose assembly

Caution:

Use two wrenches to prevent distortion or damage caused to the pipeline.

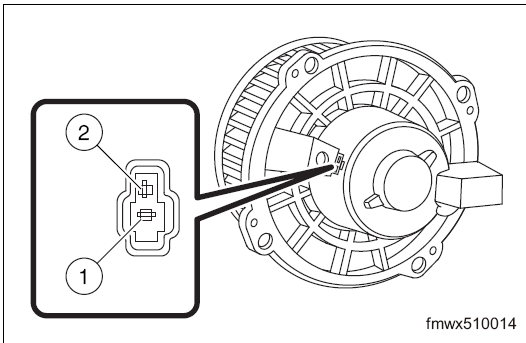
5. Empty, refill and re-test the system

Compressor leak

If the leak is set in the vicinity of the compressor shaft seal or a shell, you have to replace the compressor.

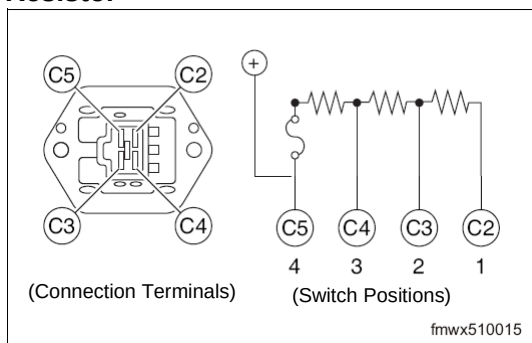
Blower Motor

- 1. Disconnect the joint from the blower motor**
- 2. Connect the positive terminal of the battery to terminal 1, and the negative terminal to terminal 2 of the blower motor**
- 3. Be sure to inspect whether the blower motor is working normally**



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Resistor

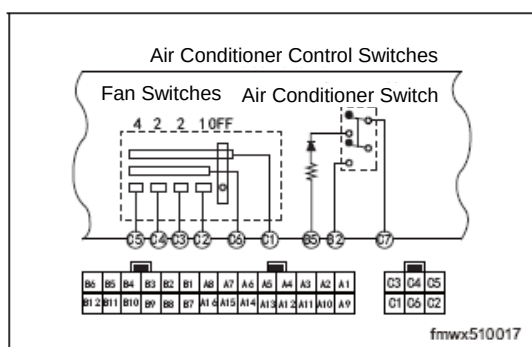


1. Disconnect the resistor connector
2. Inspect the continuity and the resistance between the resistor terminals

Terminals Switch Positions	C1	C2	C3	C4	C5	Resistance 24V
1						Conductive
2						Conductive
3						Conductive
4						Conductive

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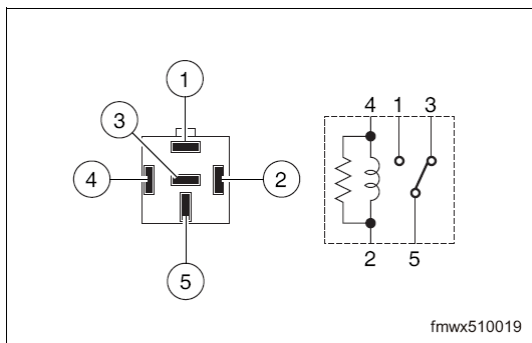


1. Inspect the continuity between the connecting terminals in the side of fan switches and air conditioner switches

		Connection Terminals		C1	C2	C4	C6	C3	C5	B3	B3	B7
		Switch Positions										
Fan Switches	Off											
	1		○	○	○							
	2		○	○	○	○						
	3		○	○	○	○						
	4		○	○	○	○	○					
Air Conditioner Switches	Off									○	○	○
	On									○	○	○

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Air Conditioner Compressor and the Condenser Relay

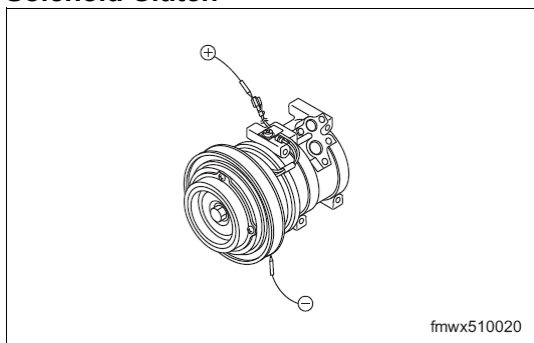


1. Inspect the continuity of the relay side between the connecting terminals

Measurement Terminals	Apply Battery Voltage between 2-4	Continuity of the Voltage
3 - 5	No	Conductive
1 - 5	No	Unconductive
3 - 5	Yes	Unconductive
1 - 5	Yes	Conductive

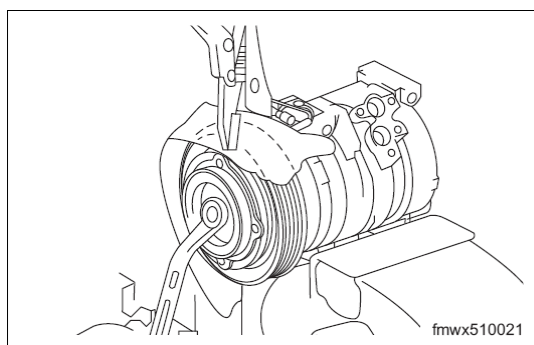
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Solenoid Clutch

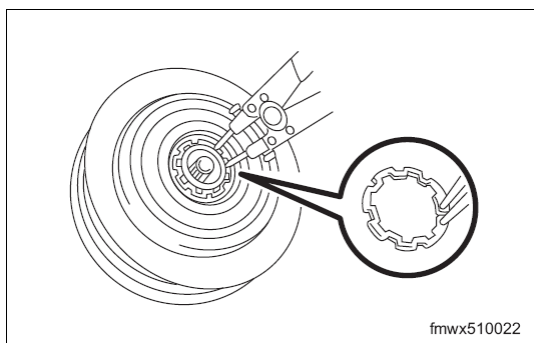


1. Disconnect the wiring harness connector of the solenoid clutch
2. Apply the battery voltage to the connection terminal in the side of the clutch; see whether the solenoid clutch is attached to the pulley

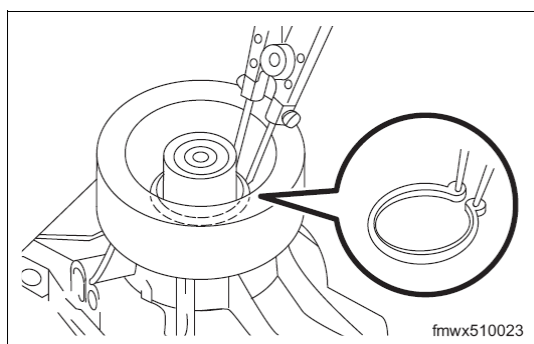
Gap adjustment of the solenoid clutch



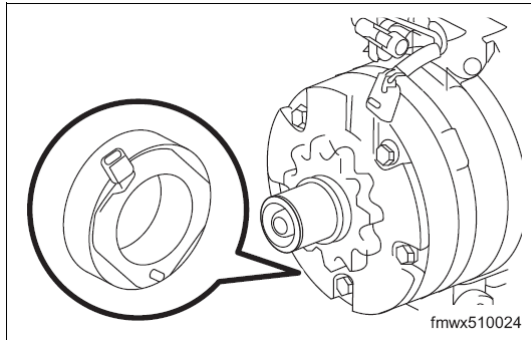
1. Place the solenoid clutch on the bench vice
2. Fix the solenoid clutch with pliers
3. Dismantle the bolt and the pressure plate



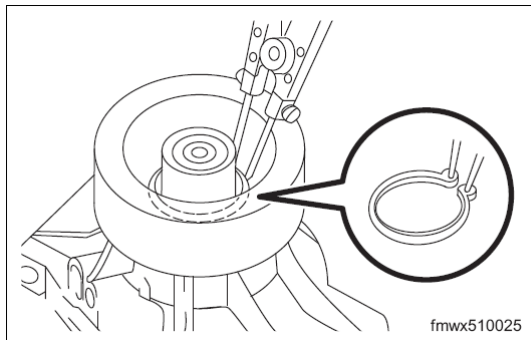
4. Dismantle the clamp with the pincer, and then dismantle the pulley



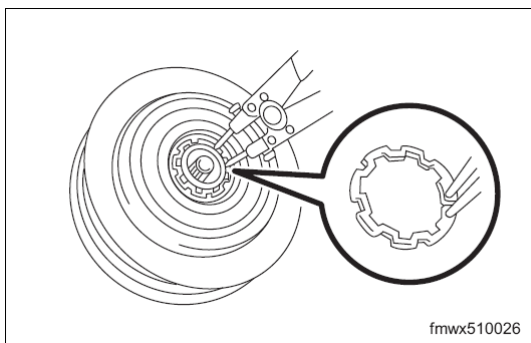
5. Dismantle the clamp with the pincer, and then dismantle the electromagnetic



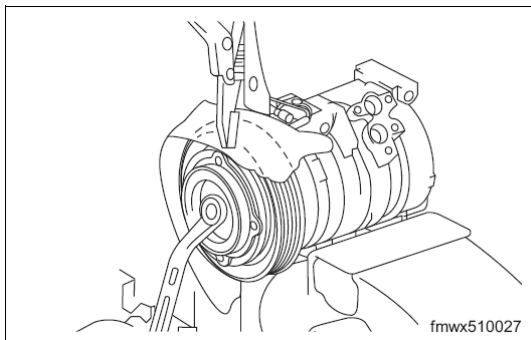
6. Install the electromagnet
Caution:
Align the locating mark of the installation



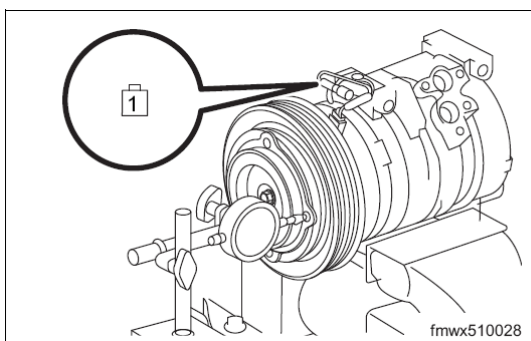
7. Put on a new clamp



8. Install the pulley and put on a new clamp



9. Install the compressor on the bench vice
10. Fix the solenoid clutch with the bench vice, and then fasten the bolt

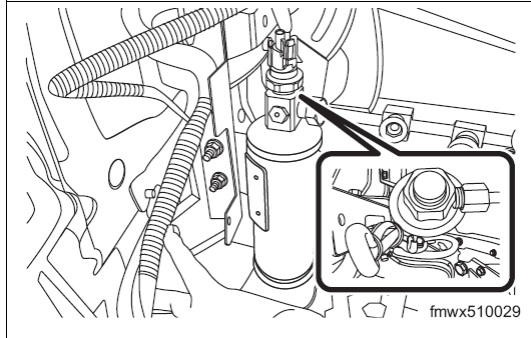


11. Measure the gap through connecting and disconnecting the solenoid clutch
Align the locating mark of the installation. Torque:
N.m
Standard value: **0.35 ~ 0.60 mm**
If the measured value is not in the standard range, dismantle the pressure plate, and then adjust the pulley.

Caution:
Adjustment must be less than 3 times.

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Pressure Switch



1. Install a manifold pressure meter on the pipeline
2. Connect the multi-meter (ohm gear) to the pressure switch. When pressure of the cooling system changes, inspect the on and off between the pins according to the figure
3. If the operating conditions do not meet the standards, replace the pressure switch

High-pressure side pressure value	Idling	160~200MPa
Low-pressure side pressure value	Idling	20~40MPa

Electronic thermostat

1. Change the mode switch to "ventilation", and the internal and external cycle switch to "internal cycle", thus opening the air conditioner.
2. When the temperature control knob changes from the "coolest" to the "hottest", see whether the solenoid clutch is switched on or off.

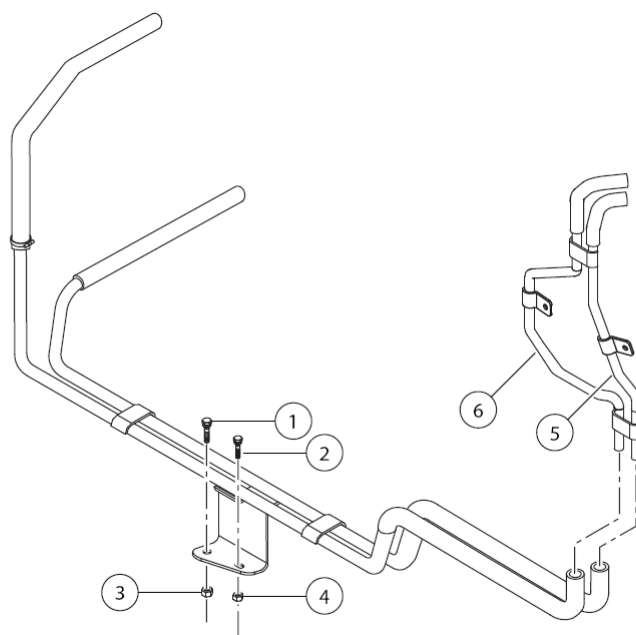
Caution:

The time for reaching the "off" point depends on the 3.5 ± 0.5 °C cold or warm air detecting by the electronic thermostat temperature sensor.

3. When the solenoid clutch is "on" and "off", measure the voltage between connecting terminal 1 and terminal 2 in the side of the chassis.

Terminal No.	Solenoid Clutch	Voltage
1 - 2	On	0V
	Off	Battery voltage

Heater Water Pipe Part Drawing



fmwx510030

1	Bolt
2	Bolt
3	Fixing Nut

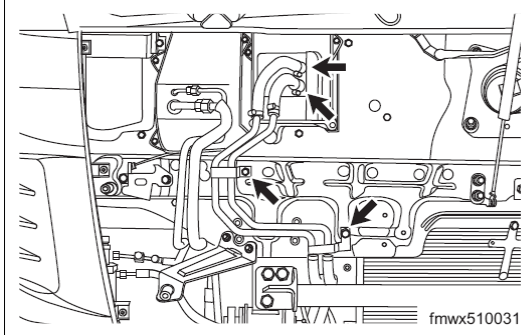
4	Fixing Nut
5	Heater Water Pipe
6	Heater Water Pipe

Overhaul

Hint:

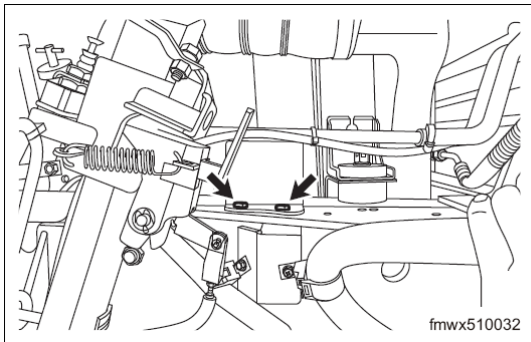
Part Drawing, refer to Chapter 51, Front Mounting—Heater Water Pipe, Part Drawing

1. **Discharge the antifreeze, refer to Chapter 14, Cooling - Cooling System, Testing & Adjustment**
2. **Open the front cover**

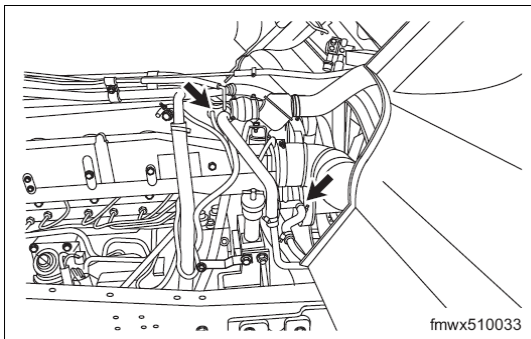


3. Dismantle the heater water pipe

- (a). Dismantle the strap of the heater water pipe.
- (b). Dismantle the fixing nut of the heater water pipe.



- (c). Dismantle the fixing nut of the heater water pipe in the engine compartment.

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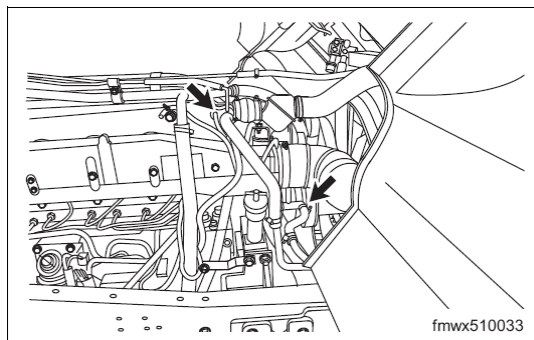
- (d). Disconnect the heater water pipe from the engine, and dismantle the front bumper.

4. Inspect the heater water pipe

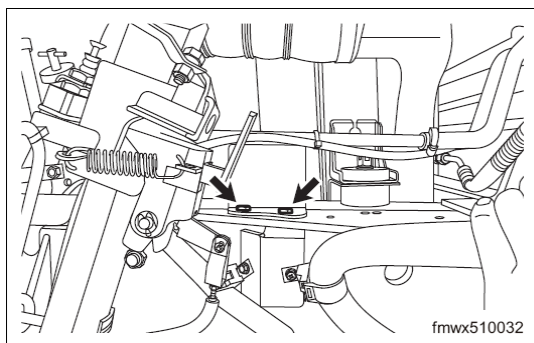
- (a). Inspect hoses for cracks, damage and ageing.
- (b). Inspect the rigid tube for corrosion and damage.

Caution:

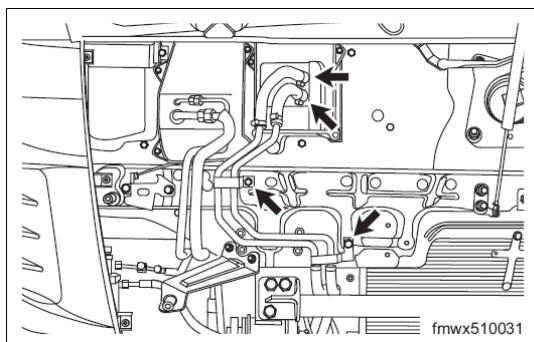
If there is any exception, replace a new heater water pipe.



- 5. Install the heater water pipe**
(a). Install the heater water pipe to the engine.



- (b). Install the fixing nut of the heater water pipe in the engine compartment.

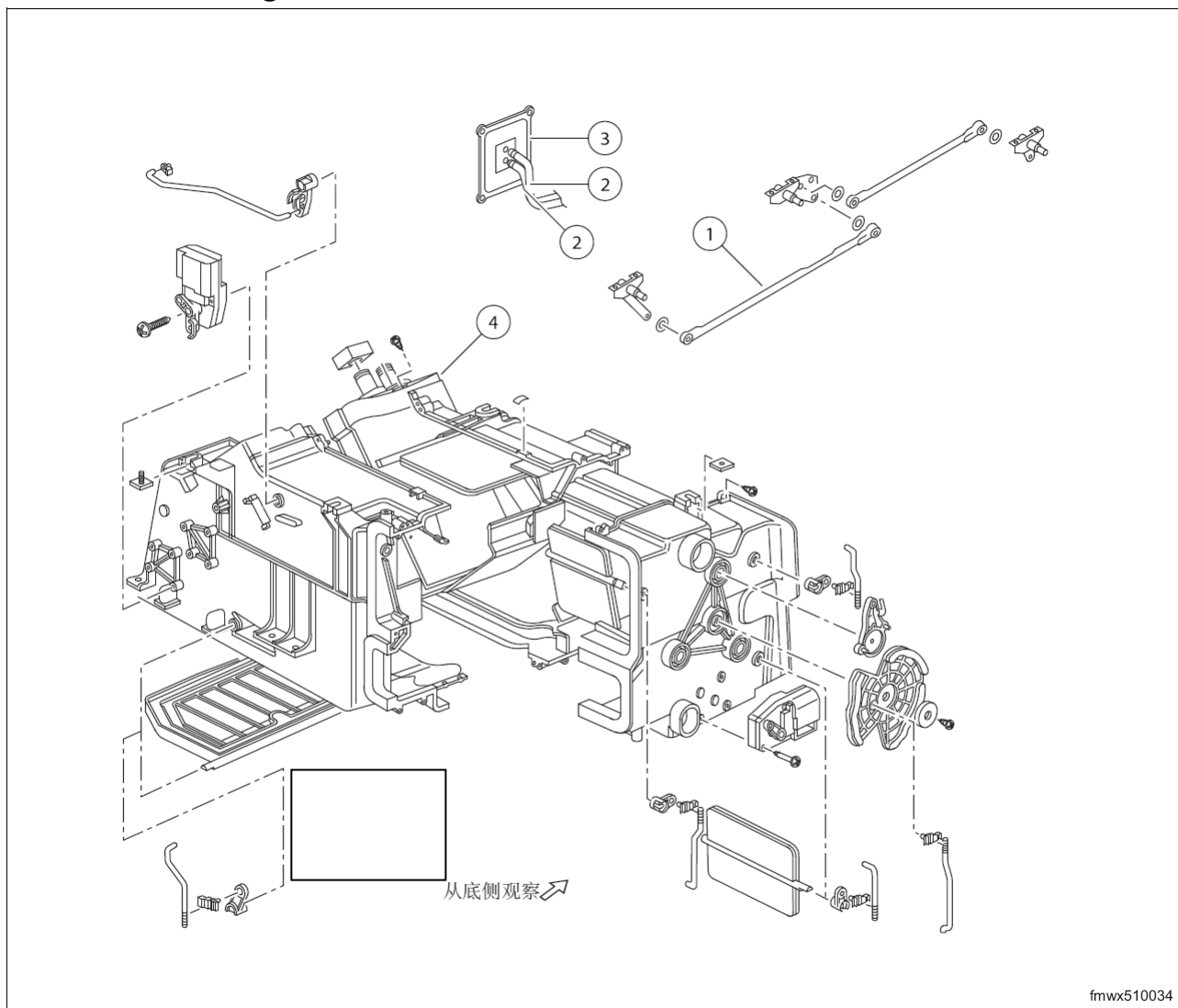


- (c). Install the fixing nut of the heater water pipe.
(d). Install the strap of the heater water pipe.

- 6. Close the front cover**
7. Refill the antifreeze, refer to Chapter 14, Cooling - Cooling System, Testing & Adjustment.

Heater

Part Drawing



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1	Windshield Wiper Connection Rod
2	Heater Hose

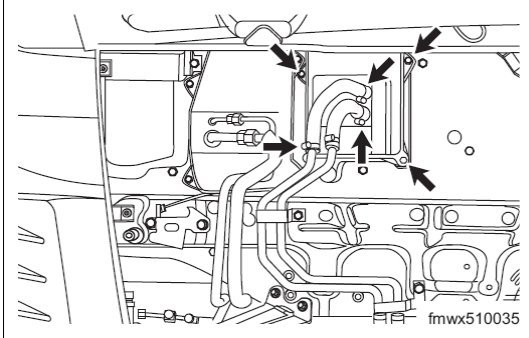
3	Heater Core Cover
4	Heater Core

Overhaul

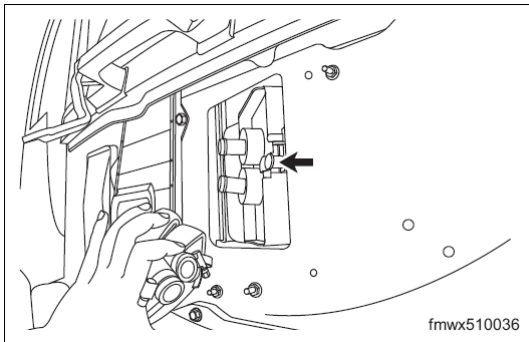
Hint:

Part Drawing, refer to Chapter 51, Front Mounting-Heater, Part Drawing

1. Turn off the main power
2. Discharge the antifreeze, refer to Chapter 14, Cooling - Cooling System, Testing & Adjustment
3. Open the front cover



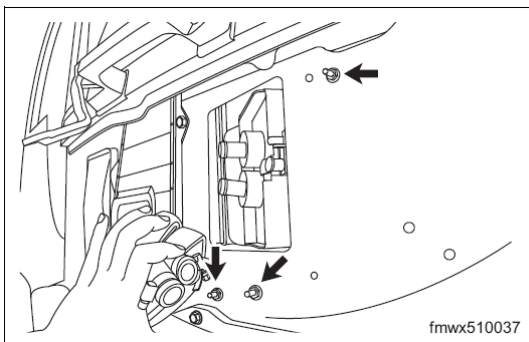
4. Dismantle the heater core
 - (a). Disconnect the heater water pipe.
 - (b). Dismantle the heater core cover.



- (c). Dismantle the fixing nut of the heater core.
 - (d). Remove the heater core.

5. Inspect the heater core

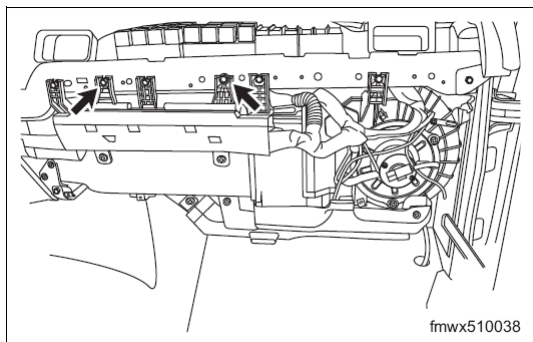
- (a). Inspect whether the fin of the heater core is damaged.
- (b). Observe whether there is foreign substance blocked on the heater core.
- (c). Refill the heater core with antifreeze, and observe heater core leakage.



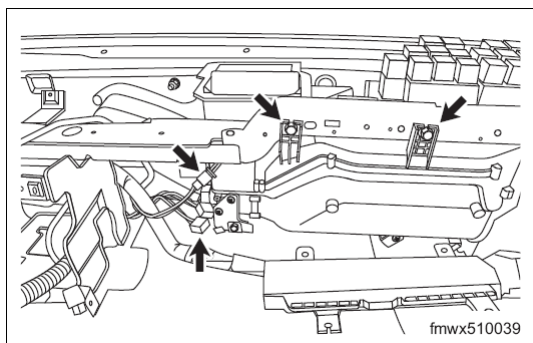
6. Dismantle the heater assembly

- (a). Dismantle the fixing nut of the heater.

Heater & Air Conditioner - Heater



- (b). Dismantle the wiring harness.
- Dismantle the dashboard, refer to Chapter73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.
 - Dismantle the harness fixing bolt.

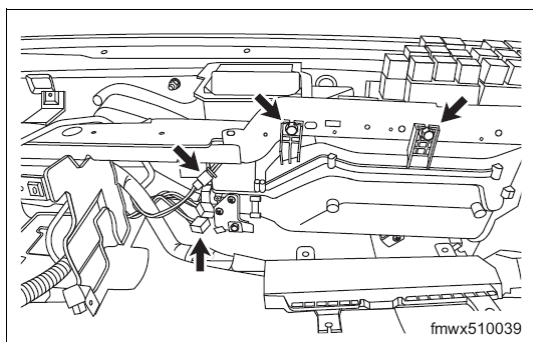


- (c). Dismantle the heater fixing bolt.
 (d). Disconnect the motor wiring harness connector of bleed door.
 (e). Dismantle the heater.

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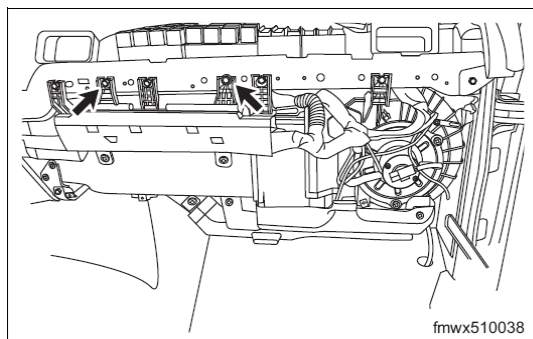
7. Inspect the heater housing

- (a). Inspect whether the heater housing is damaged.
 (b). Inspect whether bleed door of the heater is damaged.
 (c). Inspect the pivot shift of the control gate.
 (d). Inspect whether air door motor of the heater is damaged.

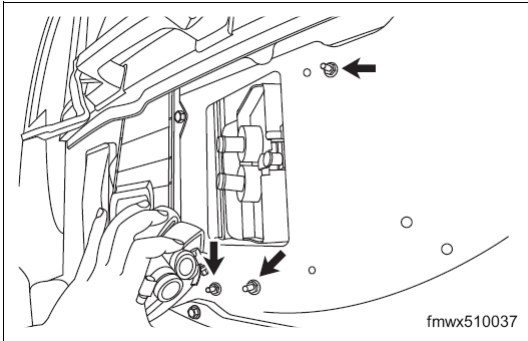


8. Install heater assembly

- (a). Install fixing bolt of the heater.
 (b). Connect the motor wiring harness connector of bleed door.

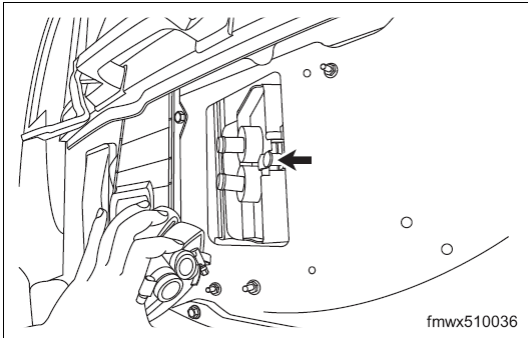


- (c). Install the harness.
- Install fixing bolt of the harness.
 - Install the dashboard, refer to Chapter73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.



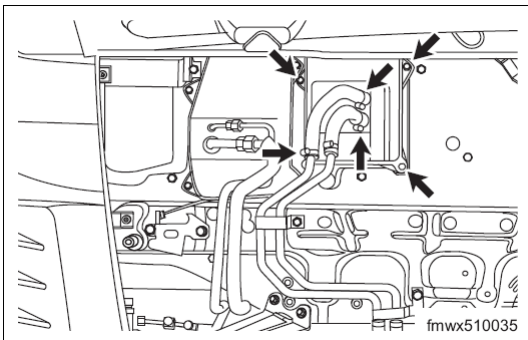
9. Install the heater assembly

- (a). Install fixing nut of the heater assembly.



- (b). Install the heater core.

- (c). Install fixing bolt of the heater core.



- (d). Install the heater core cover.

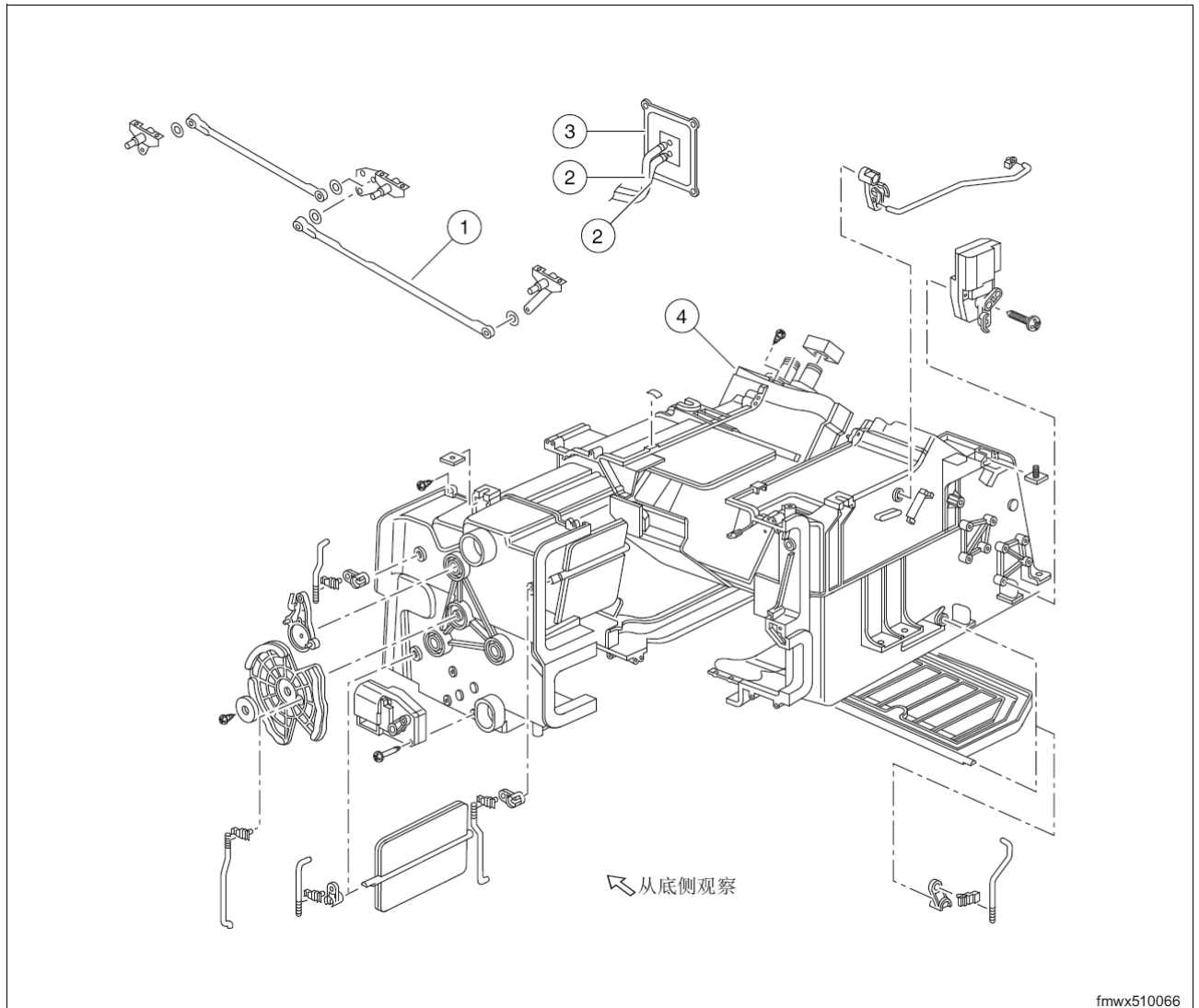
- (e). Connect the heater water pipe.

10. Close the front cover

11. Refill the antifreeze, refer to Chapter 14, Cooling - Cooling System, Testing & Adjustment.

Heater (Right Rudder)

Part Drawing



1	Windshield Wiper Connecting Rod
2	Heater Hose

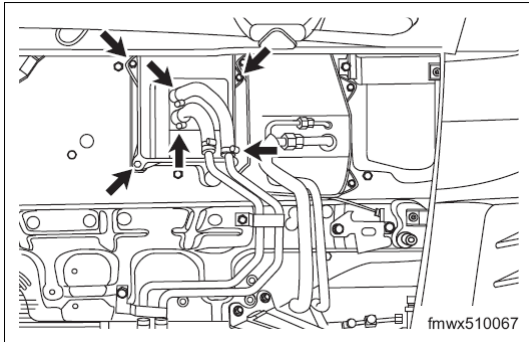
3	Heater Core Cover
4	Heater Core

Overhaul

Hint:

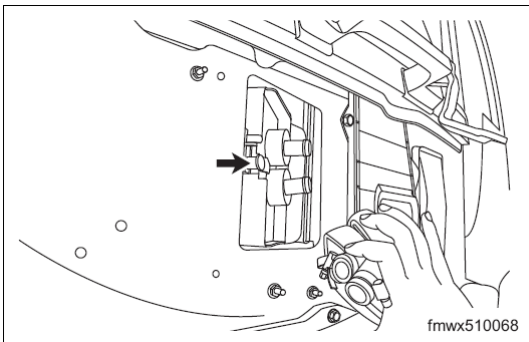
Part Drawing, refer to Chapter 51, Front Mounting-Heater, Part Drawing

1. Turn off the main power.
2. Discharge the antifreeze, refer to Chapter 14, Cooling-Cooling System, Testing & Adjustment.
3. Open the front cover.



4. Dismantle the heater core.
 - (a) Disconnect the heater water pipe.
 - (b) Dismantle the heater core cover

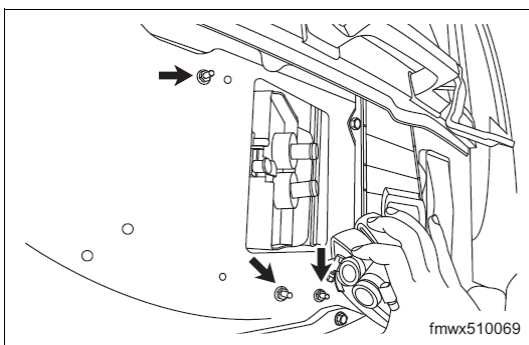
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- (c) Dismantle the fixing bolt of the heater core.
 - (d) Remove the heater core.

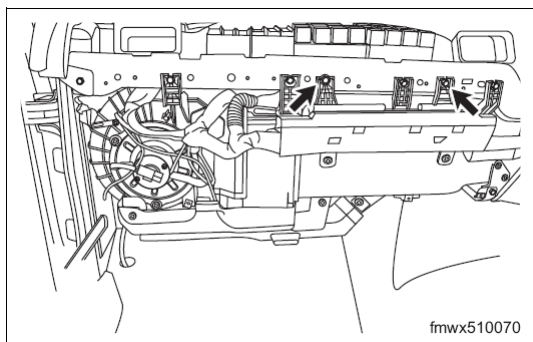
5. Inspect the heater core.

- (a) Inspect whether the fin of the heater core is damaged.
- (b) Observe whether there is foreign substance blocked on the heater core.
- (c) Refill the heater core with coolant, and observe heater core leakage.

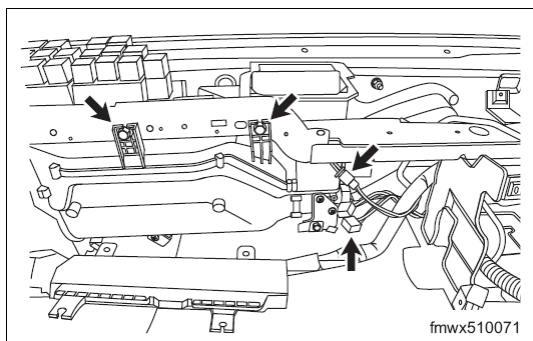


6. Dismantle the heater assembly.
 - (a) Dismantle the fixing nut of the heater.

Heater & Air Conditioner - Heater (Right Rudder)



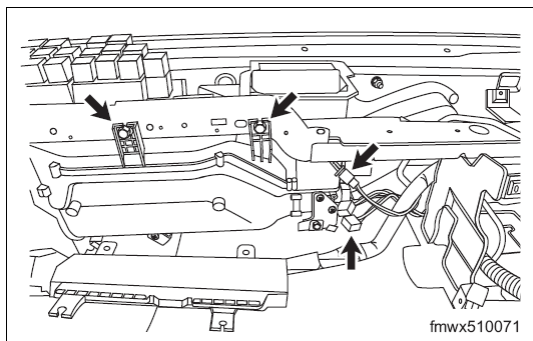
- (b) Dismantle the wiring harness.
- Dismantle the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.
 - Dismantle the harness fixing bolt.



- (c) Dismantle the heater fixing bolt.
 (d) Disconnect the motor wiring harness connector of bleed door.
 (e) Dismantle the heater.

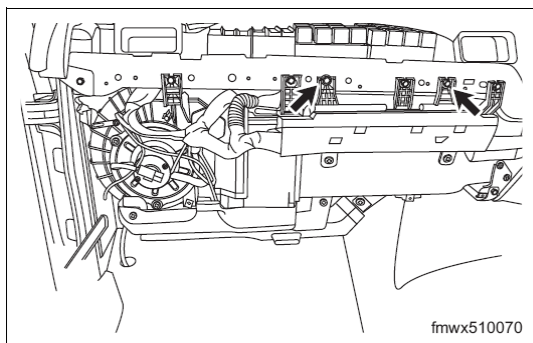
7. Inspect the heater housing.

- (a) Inspect whether the heater housing is damaged.
 (a) Inspect whether bleed door of the heater is damaged.
 (c) Inspect the pivot shift of the control gate.
 (d) Inspect whether the air door motor of the heater is damaged.

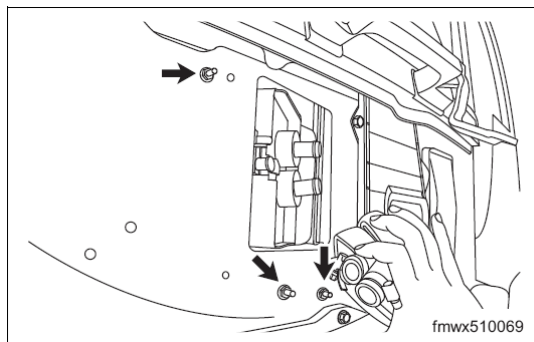


8. Install heater assembly.

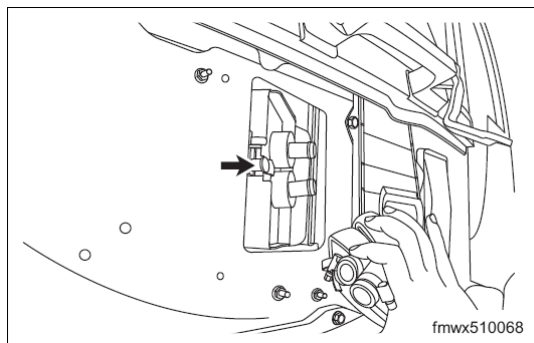
- (a) Install fixing bolt of the heater.
 (b) Connect the motor wiring harness connector of bleed door.



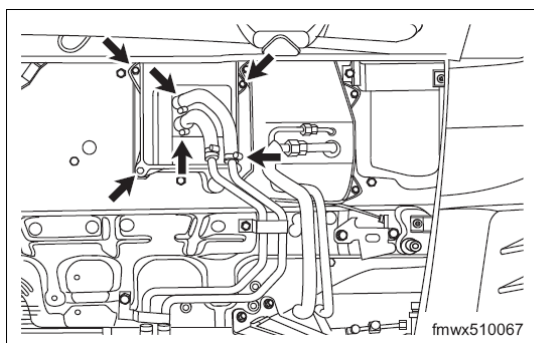
- (c) Install the harness.
- Install the fixing bolt of the wiring harness.
 - Install the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.



- 9. Install the heater assembly.**
(a) Install fixing nut of the heater assembly.



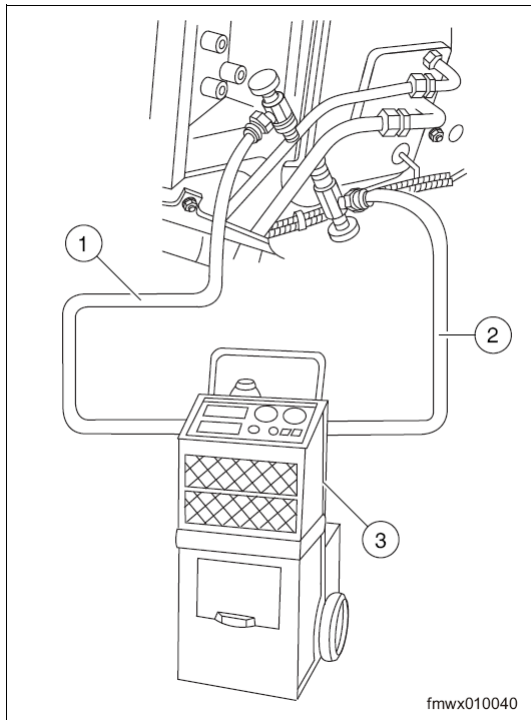
- (b) Install the heater core.
(c) Install fixing bolt of the heater core.



- (d) Install the heater core cover.
(e) Connect the heater water pipe.

- 10. Close the front cover.**
11. Refill the antifreeze, refer to Chapter 14, Cooling-Cooling System, Testing & Adjustment.

Coolant Replacement



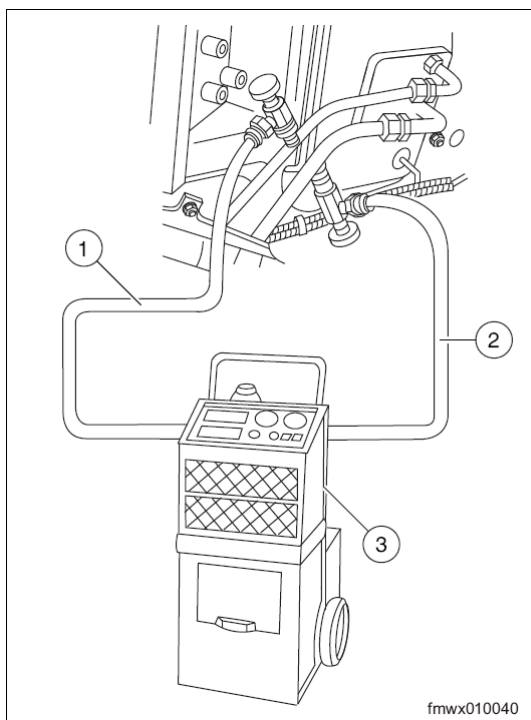
1. Discharge the coolant.

- (a) Switch on the air conditioner switch.
- (b) The engine operates at the idle speed for 5 to 6 minutes; circulates the coolant; and collects the refrigeration oil in each part into the compressor as much as possible.
- (c) Stop the engine.
- (d) Recycle the coolant.

Warning:

The coolant would contaminate the environment, so please do not discharge the coolant into the air.

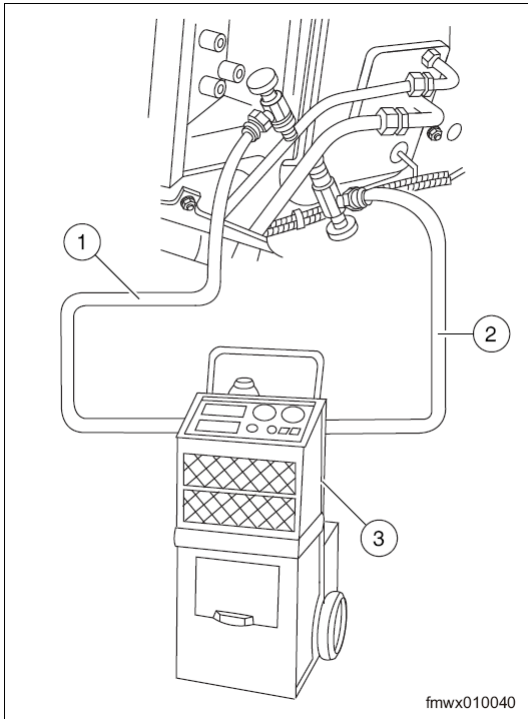
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2. Evacuation

- (a) Connect the manifold of the pressure meter.
 - (b) Connect the centre hose of the manifold of the pressure meter installed on the entrance of the vacuum pump.
 - (c) Operate the vacuum pump; switch on the stop valve; and then switch on two hand valves.
 - (d) When the low pressure meter indicates about 100kPa, continue to evacuate for 5 minutes or more.
 - (e) Switch off two hand valves and stop the operation of the vacuum pump.
- (f) Make sure that the pressure keeps unchanged after 10 minutes.
 - If the pressure changes, inspect whether the system leaks.
 - If there is leakage, refasten the joint of the coolant pipeline and repeat the evacuation process.
 - (g) If there is no leakage, restart the vacuum pump for 20 minutes or more. If making sure that the manifold pressure of the pressure meter is 100kPa, switch off the two hand valves.

- (h) Switch off the forward stop valve. Stop the operation of the vacuum pump and disconnect the centre hose from the vacuum pump.



3. Refill the coolant.

- (a) Before connecting the filling valve to the coolant container, please rotate the filling valve lever at anticlockwise until the needle completely retracts.
- (b) Rotate the riveting nut with collar at anticlockwise until it reaches the highest position (to the filling valve).
- (c) Install the filling valve in the coolant container.
- (d) Rotate the riveting nut with collar at clockwise and connect the centre hose of the manifold pressure meter to the filling valve.
- (e) Manually fasten the riveting nut with collar; rotate the lever of the filling valve at clockwise to lower the needle; and drill in the coolant container.
- (f) Rotate the lever of the filling valve at anticlockwise to lift the needle. Fill the coolant in the container into the air conditioning system by operating the pressure meter of the manifold.

Caution:

Absolutely make sure that the empty coolant container is not reused.

- (g) Ensure correct evacuation.
- (h) Connect the centre hose of the manifold pressure meter to the coolant container.
 - Rotate the lever of the filling valve at anticlockwise; clear the filling pipeline and all air in the centre hose of the manifold pressure meter.
- (i) Switch on low-pressure hand valve and refill about 200g coolant.
 - Make sure that the high-pressure hand valve is switched off.
 - Do not refill the coolant by putting the coolant container to the bottom up.
- (j) Switch off the low-pressure hand valve of the manifold pressure meter.
 - Make sure that the pressure rating is not reached.
- (k) Inspect the leakage condition of the coolant with R-134a leak detector.
 - If there is leakage, repair the leakage joint and re-evacuate.
- (l) If no leakage has been discovered, switch on the low-pressure hand valve of the manifold pressure meter and continue filling the coolant into the system.
- (m) For the difficulty in filling the system, conduct the following steps.
 - Operate the engine at idle speed and close all doors.
 - Switch on the air conditioner switch.
 - Set the fan control knob (fan switch) at the highest gear.

Warning:

Absolutely make sure that the high-pressure hand valve is not switched on. If switching on the high-pressure hand valve, the gases of the high-pressure coolant will backflow which may results in burst of the coolant container.

- (n) When the coolant evacuates, replace the coolant container with a new one by conducting the following processes.
 - Switch off the low-pressure hand valve.
 - Lift the needle upward and dismantle the filling valve.

Heater & Air Conditioner - Coolant

- Re-install the filling valve to the new coolant container.
- Clear the residual air in the centre hose of the manifold pressure meter.
- (o) Fill the quantified coolant into the system and switch off the low-pressure hand valve. If the filling volume is not set, evaluate the time for stopping filling by observing the high and low value of the pressure meter and flowing condition (transparency, bubble or muddiness) of the coolant in the sight hole.
 - Water temperature of the radiator: maintains stable state.
 - Air conditioner switch: ON.
 - Temperature regulator: the temperature of the induced air in the internal cycle is adjusted at 25~30°C.
 - Fan switch: position 4.
 - Switchover of the internal and external air: internal cycle.
 - Doors: all open.
 - Windows: all open.
 - Evaluate the filling volume of the coolant.
- (p) After completing the above filling processes, turn off the air conditioner and turn on the air conditioner until it is back to the balanced pressure status. Turn on the air condition and repeat the evaluation.
- (q) Switch off the low-pressure hand valve and filling valve of the coolant container.
- (r) Stop the operation of the air conditioner and engine.
- (s) Disconnect the high and low pressure hoses on the joint of the manifold pressure meter.

4. Inspect the air conditioner system.

- When there is no bubble in the observation mirror, the system is filled up, refer to Chapter 51, Heater & Air Conditioner-Air Conditioning System, Testing & Adjustment.
- Inspect the high and low values of the manifold pressure meter, refer to Chapter 51, Heater & Air Conditioner-Air Conditioning System, Testing & Adjustment.
- Inspect the leakage condition of the coolant by R-134a leakage detector, refer to Chapter 51, Heater & Air Conditioner-Air Conditioning System, Testing & Adjustment.

Caution:

At the moment after filling the coolant, the high and low pressures are a little higher and the needle expands to the left side of the pressure meter; but it will tend to be stable finally on the pressure-adjusting valve as follows:

- Ambient temperature is 25~30°C.
- High-pressure side: about 160~200MPa.
- Low-pressure side: about 20~40MPa

Refrigeration oil

Overhaul

1. **Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Replacement.**
2. **Discharge the refrigeration oil.**
 - (a) Dismantle the compressor, refer to Chapter 51, Heater & Air Conditioner-Compressor, Overhaul.
 - (b) Pour out the refrigeration oil from the compressor.
3. **Inspect the refrigeration oil.**
 - (a) Antithesis: put the standard refrigeration oil into test tube as the standard oil; take out the refrigeration oil to be inspected and put it into a test tube of the same size for comparison; if the color of the inspected oil is pale yellow or orange, the oil is still usable; if it turns red brown muddy fluid, the oil is unusable. (b) Paper dropping: take out one drop of refrigeration oil to be inspected and drop on the clean white paper; for a moment, observe the color of the oil dripping; if the color is shallow and well distributed, then there is no foreign substance in the oil and the oil is usable; if there is black spot at the centre part of the oil, then the oil has deteriorated and is unusable.
4. **Filling in refrigeration oil.**
 - (a) Install the compressor, refer to Chapter 51, Heater & Air Conditioner-Compressor, Overhaul.
 - (b) Pour in the refrigeration oil in the specified amount.

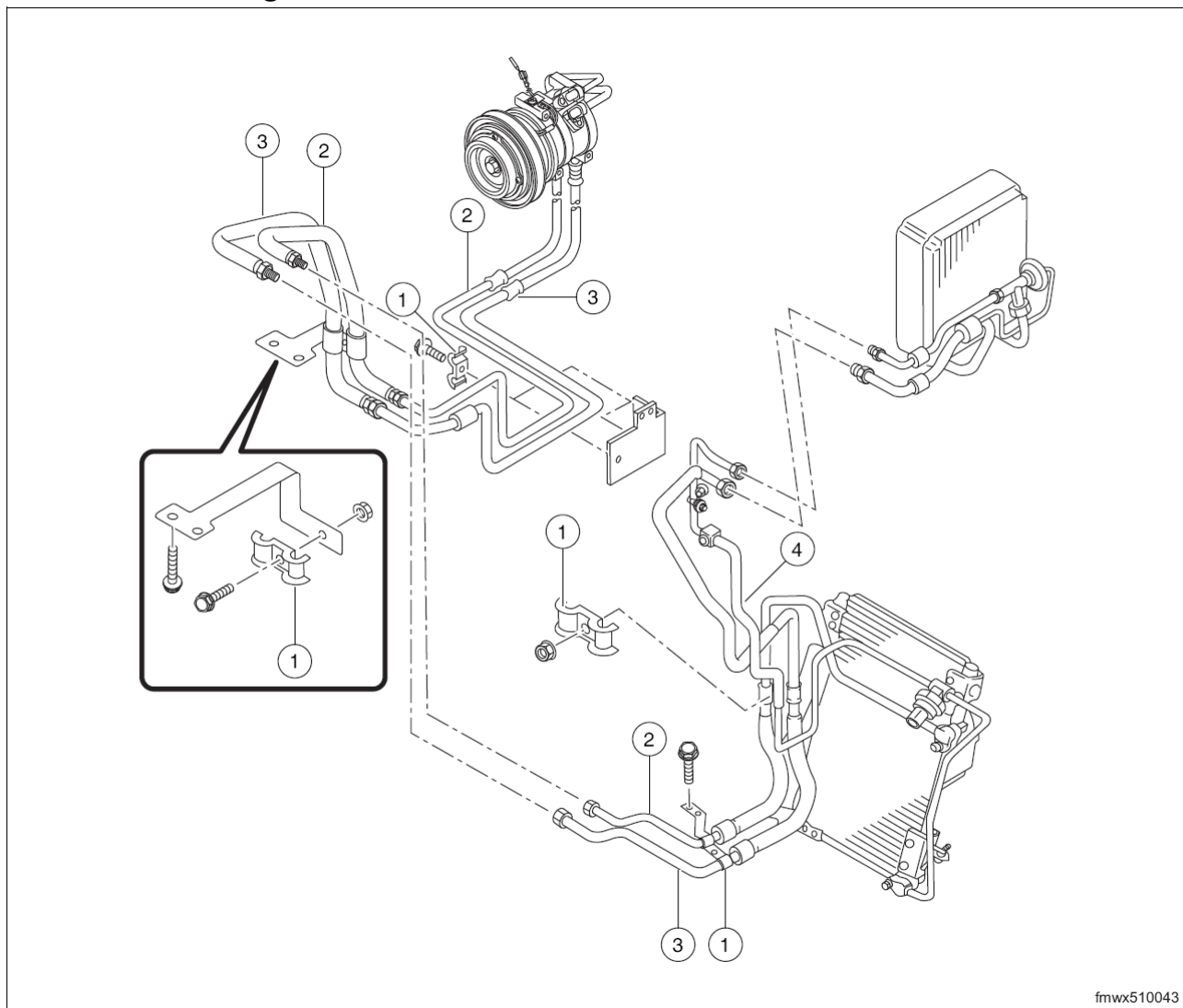
Caution:

Generally, there is no need to fill the additional refrigeration oil into the newly installed air conditioner, because the volume of the refrigeration oil (accounting for 14%~18% of the volume of the coolant in the air conditioning system) in the new compressor is sufficient for the whole system.

If the air conditioning system has been repaired for more than two times or lacks of refrigeration oil in the system due to other reasons, refill the refrigeration oil. After replacing the system, refill a given amount of refrigeration oil.

5. **Refill the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Replacement.**
6. **Heat up the engine to the normal working temperature.**
7. **Inspect whether the coolant leaks, refer to Chapter 51, Heater & Air Conditioner-Heater and Air Conditioner, Testing & Adjustment.**

Cooling Pipe Part Drawing



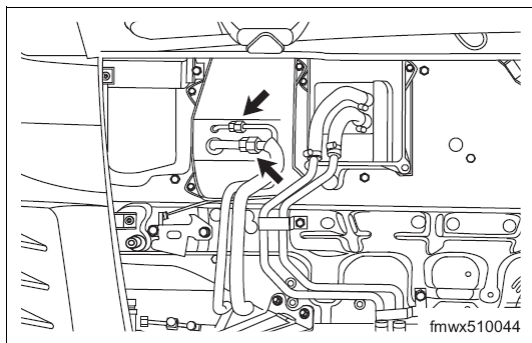
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1	Fixture/Clamp
2	Cooling Pipe (Compressor-Condenser)

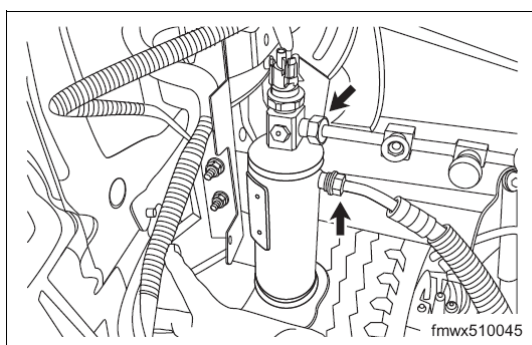
3	Cooling Pipe (Compressor-Evaporator)
4	Cooling Pipe (Condenser-Evaporator)

Overhaul

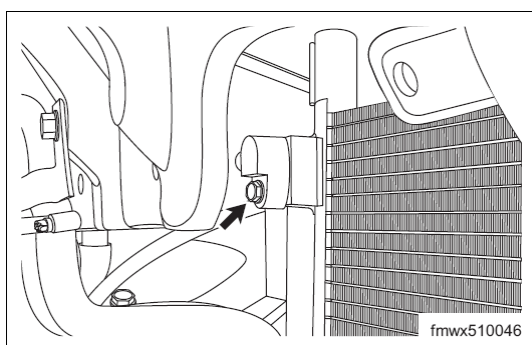
1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Replacement.
2. Open the front cover.



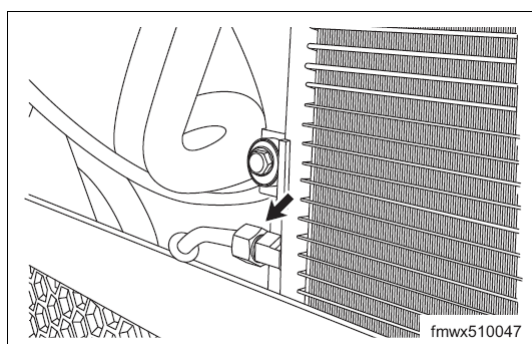
3. **Dismantle the cooling pipe.**
 - (a) Disconnect the cooling pipe of the evaporator.



- (b) Disconnect the cooling pipe of the dryer.

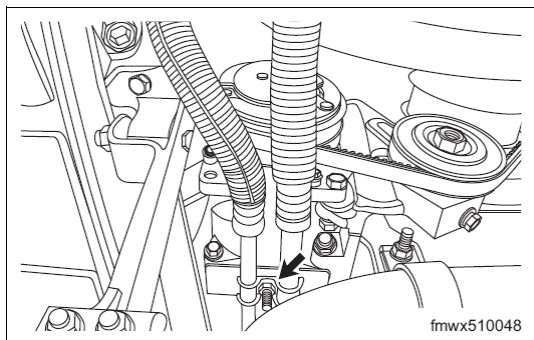


- (c) Disconnect the cooling pipe of the condenser.

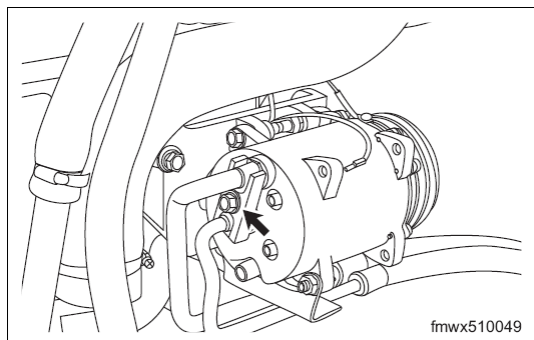


- (d) Disconnect the cooling pipe of the condenser.

Heater & Air Conditioner - Cooling Pipe

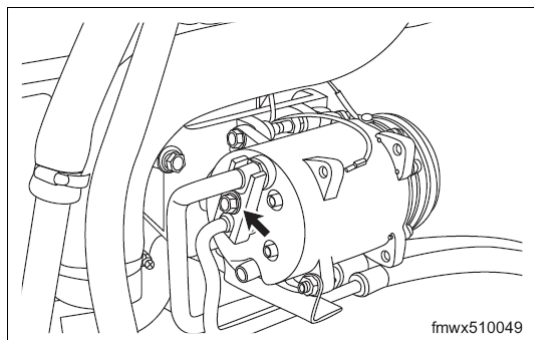


- (e) Dismantle the clamp of the cooling pipe of the compressor.

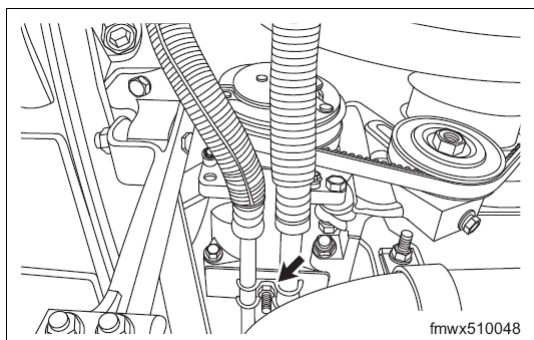


- (f) Disconnect the cooling pipe of the compressor.

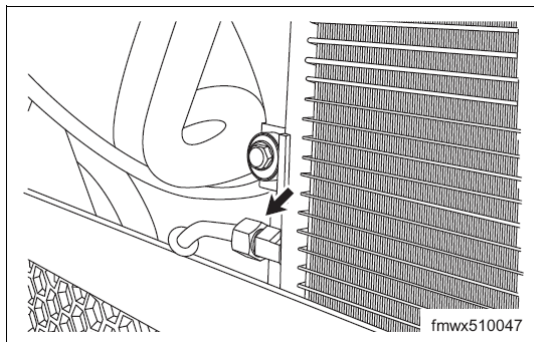
4. Inspect the cooling pipe, refer to Chapter 51, Heater & Air Conditioner-Heater and Air Conditioner, Testing & Adjustment.



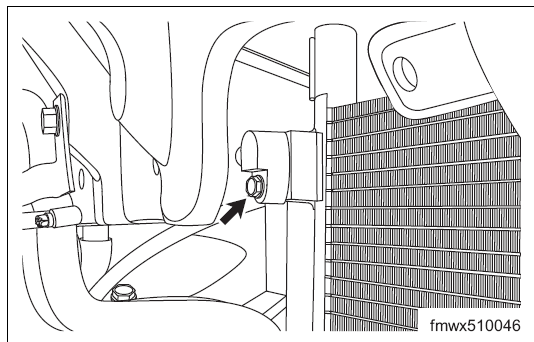
- 5. Install the cooling pipe.**
(a) Connect the cooling pipe of the compressor.



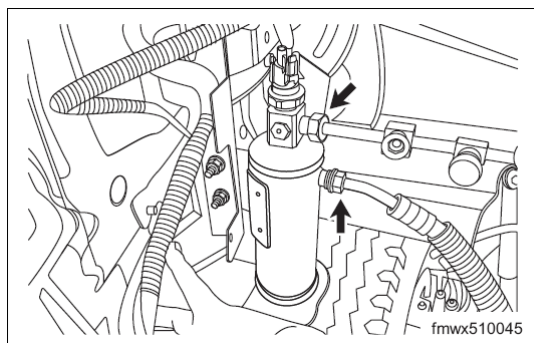
- (b) Install the clamp of the cooling pipe of the compressor.



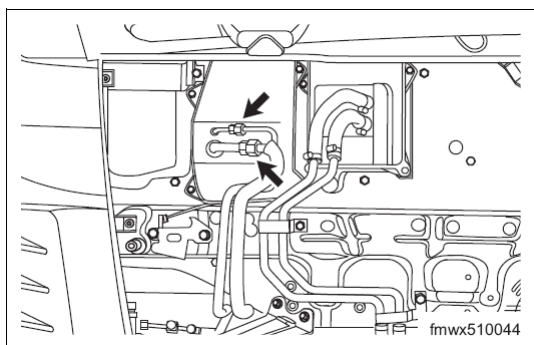
(c) Connect the cooling pipe of the condenser.



(d) Connect the cooling pipe of the condenser.



(e) Connect the cooling pipe of the dryer.

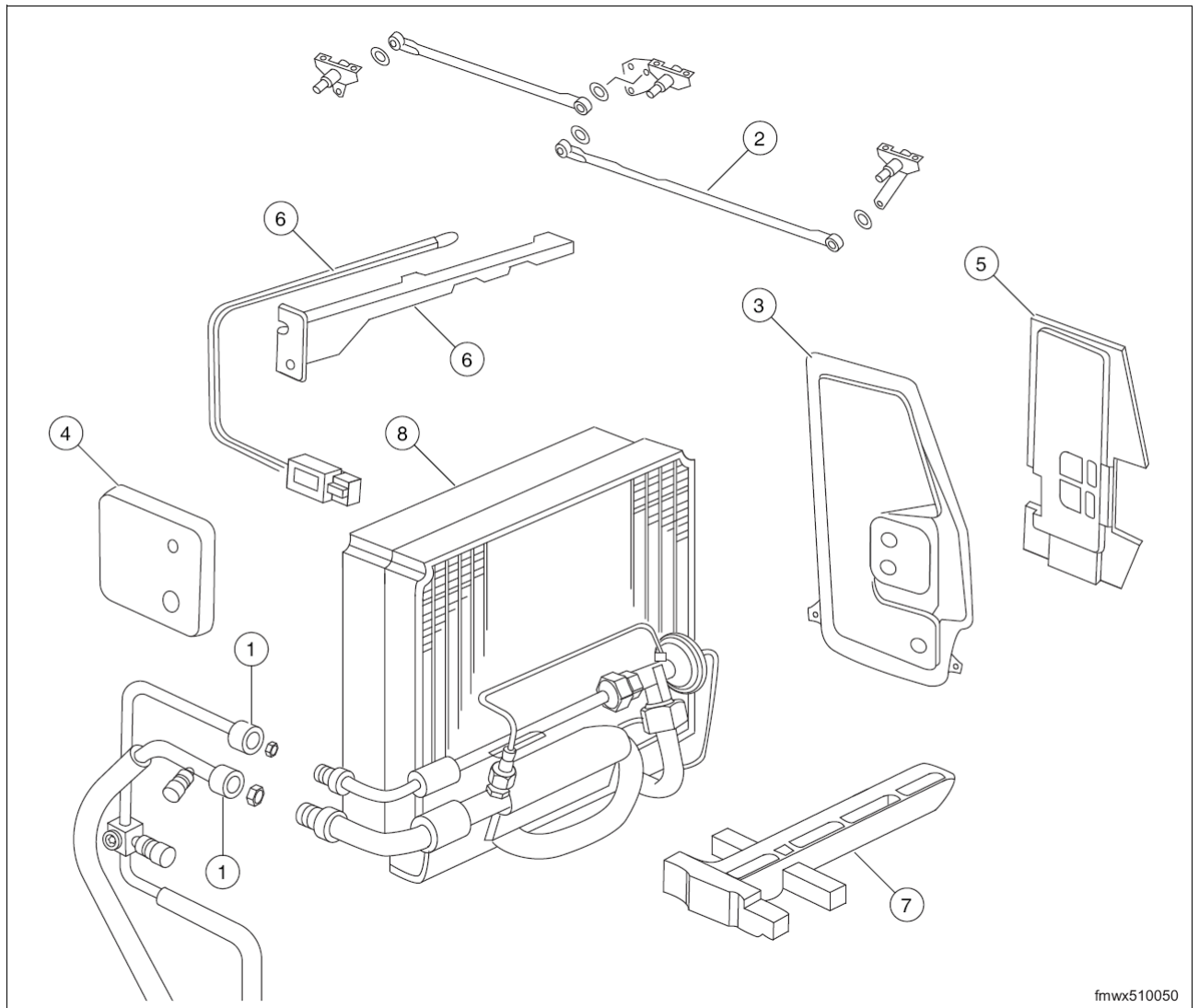


(f) Connect the cooling pipe of the evaporator.

6. Close the front cover.
7. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Overhaul.
8. Refill the refrigeration oil, refer to Chapter 51, Heater & Air Conditioner-Refrigeration Oil, Overhaul.

Evaporator

Part Drawing



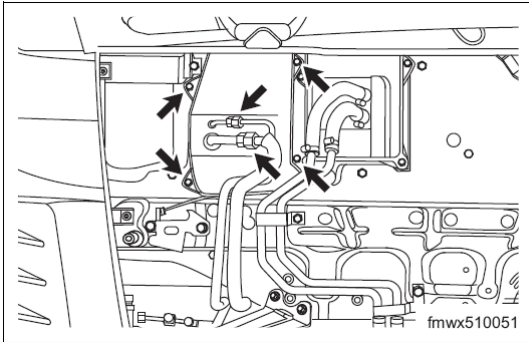
51

1	Cooling Pipe
2	Windshield Wiper Connecting Rod
3	Outer Cover of the Evaporator
4	Insulator

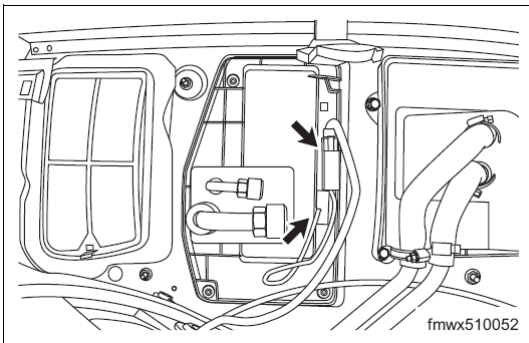
5	Inner Cover of the Evaporator
6	Electronic Thermostat
7	Base Cover
8	Evaporator Core Assembly

Overhaul

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Replacement.
2. Open the front cover.



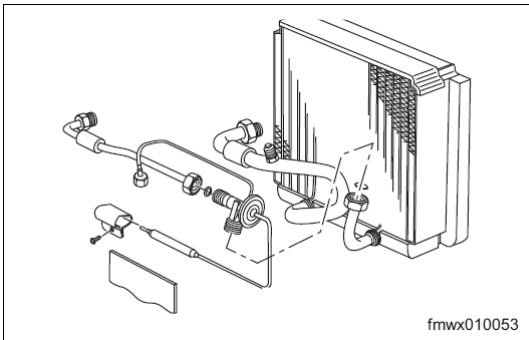
3. Dismantle the cooling pipe of the evaporator.
Caution:
Cover the sealing cover of the front opening of the pipeline immediately.
4. Dismantle the cover of the evaporator.



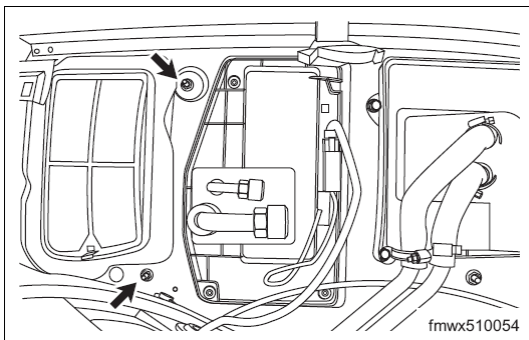
5. Dismantle the evaporator core.
 - (a) Disconnect the wiring harness connector of the electronic thermostat.
 - (b) Disconnect the cooling pipe of the dryer.
 - (c) Remove the evaporator core.

6. Inspect the evaporator core.

- (a) Inspect whether there is smudginess, damage or deformation on the surface of the evaporator core.
- (b) Water submerging method: enclose 1.67MPa pressure into the evaporator and submerge for 5 minutes; check whether there is bubble on the surface.

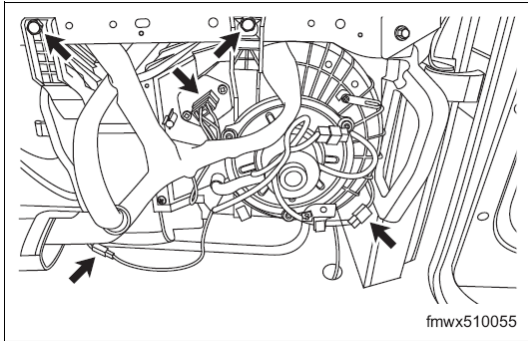


7. Dismantle the expansion valve.
 - (a) Carefully tear out the insulator.
 - (b) Dismantle the fixing clamp of the sensor.
 - (c) Use backup wrench for disconnecting all coolant pipelines. Then dismantle the expansion valve.



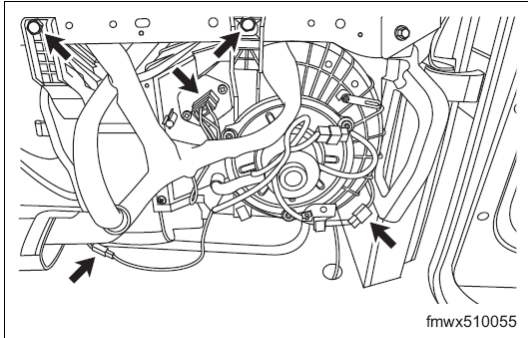
8. Dismantle the fixing bolt of the evaporator.

Heater & Air Conditioner - Evaporator



9. Dismantle the evaporator.

- (a) Dismantle the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.
- (b) Dismantle the wiring harness.
- (c) Dismantle the lower ventilating duct.
- (d) Disconnect the wiring harness connector of the blower.
- (e) Disconnect the motor wiring harness connector of the internal and external cycle air door.

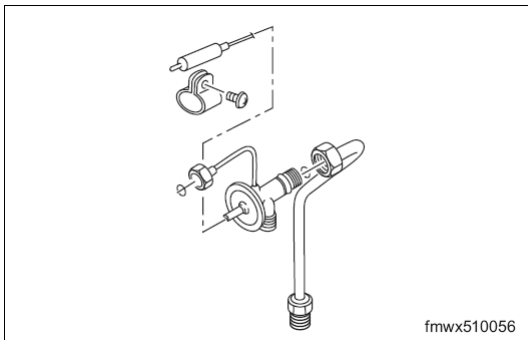


10. Install the evaporator.

- (a) Connect the motor wiring harness connector of the internal and external cycle air door.
- (b) Connect the wiring harness connector of the blower.
- (c) Install the lower ventilating duct.
- (d) Install the wiring harness.
- (e) Install the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter-Dashboard, Overhaul.

51

11. Install the fixing bolt of the evaporator.

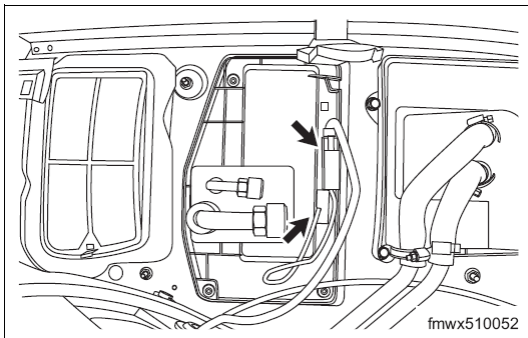


12. Install the expansion valve.

- (a) Install the expansion valve and use backup wrench for connecting all coolant pipelines.
- (b) Install the fixing clamp of the sensor.
- (c) Carefully tear out the insulator.

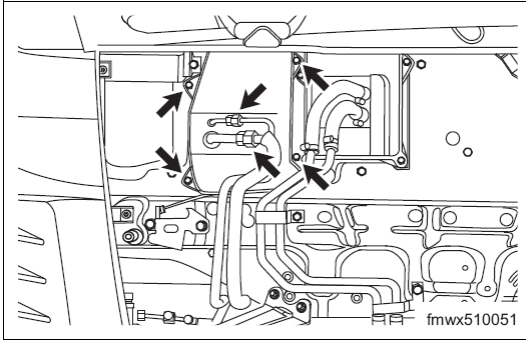
Caution:

- The O-ring can not be reused. It should always be changed with a new one.
- When connecting the pipelines, be sure that the specified new refrigeration oil is smeared on the O-ring.
- Be sure that the sensor and insulator of the expansion valve are installed on the original position.
- Fill 50ml specified new refrigeration oil for the new evaporator core for installing the new evaporator core.



13. Install the evaporator core.

- (a) Embed the evaporator core.
- (b) Install the baffle plate of the evaporator core.
- (c) Connect the wiring harness connector of the electronic thermostat.



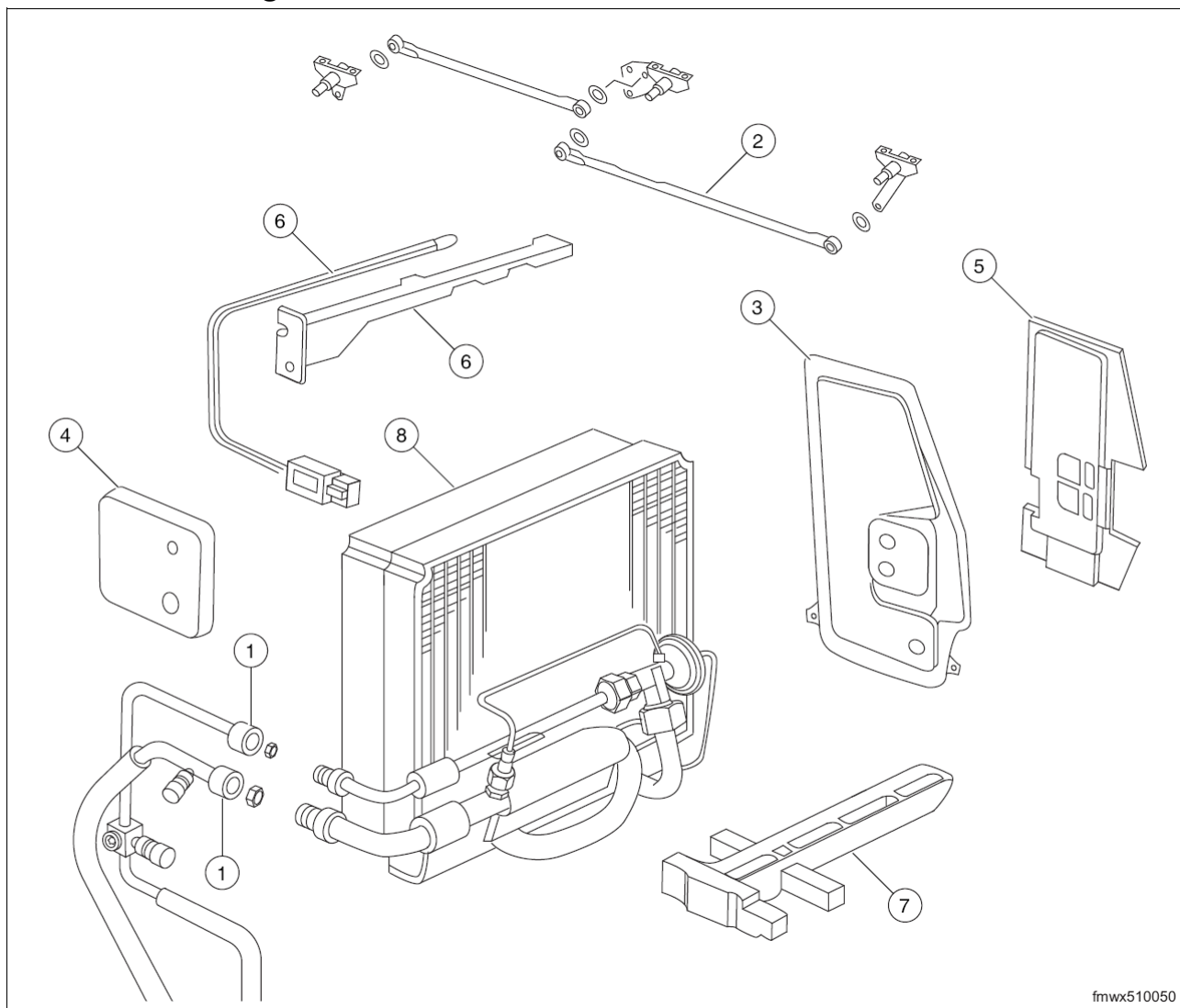
14. Install the cover plate of the evaporator.
15. Install the cooling pipe of the evaporator.

16. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner-Coolant, Overhaul.
17. Close the front cover.

Heater & Air Conditioner - Evaporator (Right Rudder)

Evaporator (Right Rudder)

Part Drawing



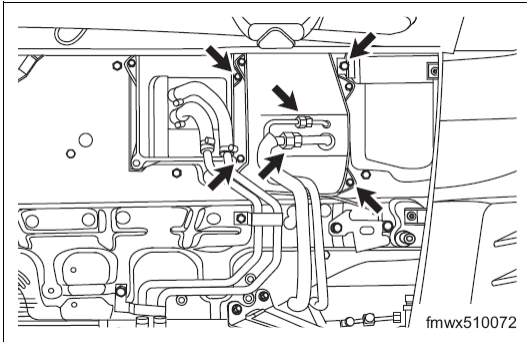
fmwx510050

1	Cooling Pipe
2	Windshield Wiper Connecting Rod
3	Outer Cover of the Evaporator
4	Insulator

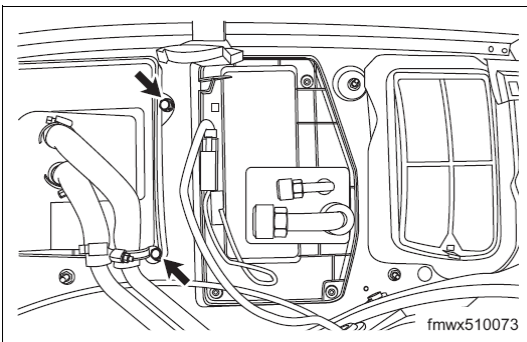
5	Evaporator Inner Cover
6	Electronic Thermostat
7	Base Cover
8	Evaporator Core Assembly

Overhaul

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
2. Open the front cover



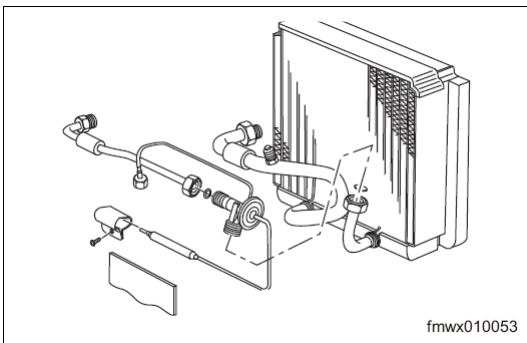
3. Dismantle the cooling pipe of the evaporator.
Caution:
Cover the sealing cover of the front opening of the pipeline immediately.
4. Dismantle the cover of the evaporator



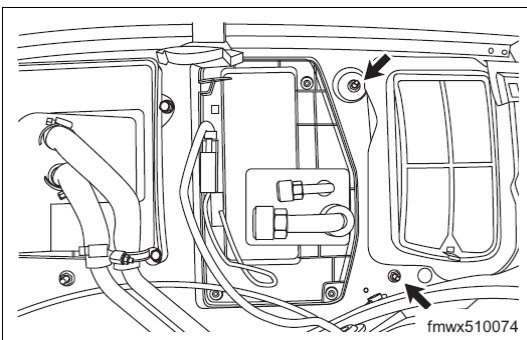
5. Dismantle the evaporator core.
 - (a). Disconnect the wiring harness connector of the electronic thermostat.
 - (b). Disconnect the cooling pipe of the dryer.
 - (c). Remove the evaporator core.

6. Inspect the evaporator core.

- (a). Inspect whether there is smudginess, damage or deformation on the surface of the evaporator core.
- (b). Water submerging method: enclose 1.67MPa pressure into the evaporator and submerge for 5 minutes; check whether there is bubble on the surface.

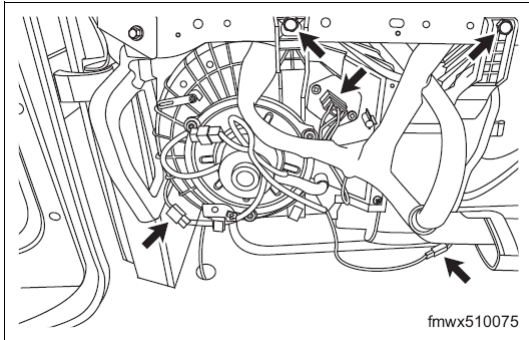


7. Dismantle the expansion valve
 - (a). Carefully tear out the insulator.
 - (b). Dismantle the fixing clamp of the sensor.
 - (c). Use backup wrench for disconnecting all coolant pipelines. Then, dismantle the expansion valve.



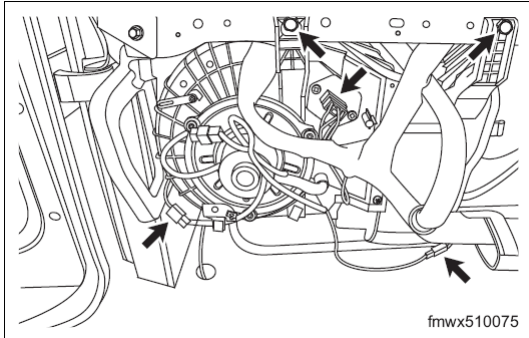
8. Dismantle the fixing bolt of the evaporator.

Heater & Air Conditioner - Evaporator (Right Rudder)



9. Dismantle the evaporator

- Dismantle the dashboard, refer to Chapter 73, Dashboard/Instrument/ Cigarette Lighter – Dashboard, Overhaul.
- Dismantle the wiring harness.
- Dismantle the lower ventilating duct.
- Disconnect the wiring harness connector of the blower.
- Disconnect the motor wiring harness connector of the internal and external cycle air door.

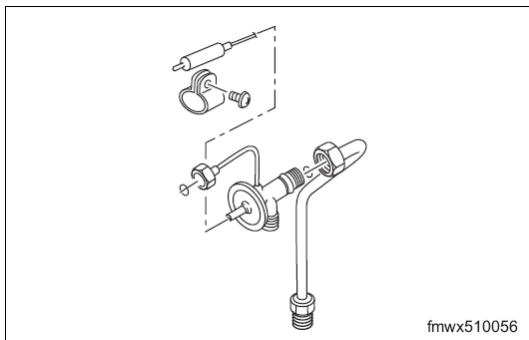


10. Install the evaporator

- Connect the motor wiring harness connector of the internal and external cycle air door.
- Connect the wiring harness connector of the blower.
- Install the lower ventilating duct.
- Install the wiring harness.
- Install the dashboard, refer to Chapter 73, Dashboard/Instrument/ Cigarette Lighter – Dashboard, Overhaul

51

11. Install the fixing bolt of the evaporator.

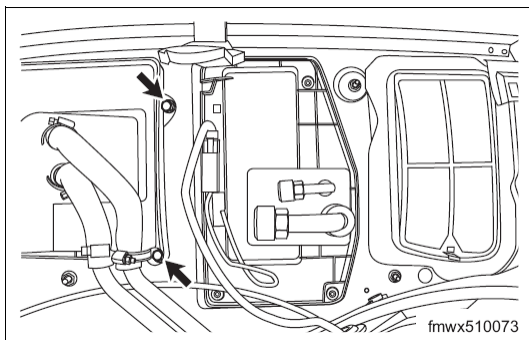


12. Install the expansion valve

- Install the expansion valve and use backup wrench for connecting all coolant pipelines.
- Install the fixing clamp of the sensor.
- Carefully tear out the insulator.

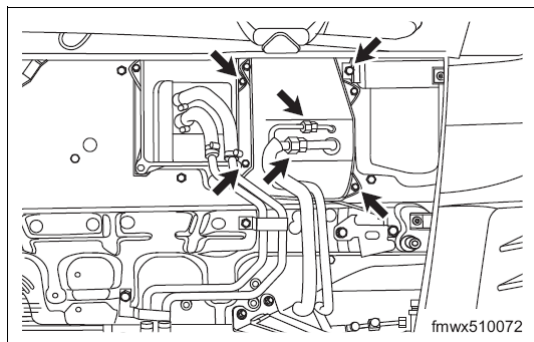
Caution:

- The O-ring can not be reused. It should always be changed with a new one.
- When connecting the pipelines, be sure that the specified new refrigeration oil is smeared on the O-ring.
- Be sure that the sensor and insulator of the expansion valve are installed on the original position.
- Fill 50ml specified new refrigeration oil for the new evaporator core for installing the new evaporator core.



13. Install the evaporator core

- Embed the evaporator core.
- Install the baffle plate of the evaporator core.
- Connect the wiring harness connector of the electronic thermostat.

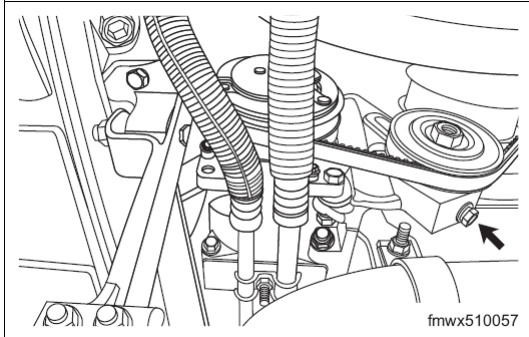


- 14. Install the cover plate of the evaporator**
- 15. Install the cooling pipe of the evaporator.**

- 16. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Overhaul**
- 17. Close the front cover**

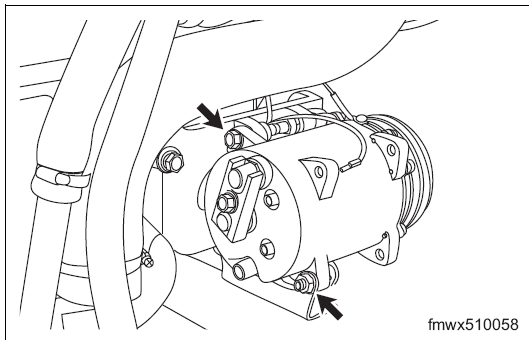
Compressor Overhaul

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement.

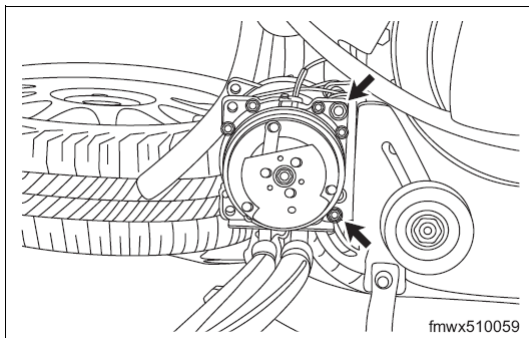


2. Dismantle the compressor belt
 - (a). Dismantle the tension pulley.

3. Dismantle the cooling pipe of the compressor, refer to Chapter 51, Heater & Air Conditioner – Cooling Pipe, Overhaul

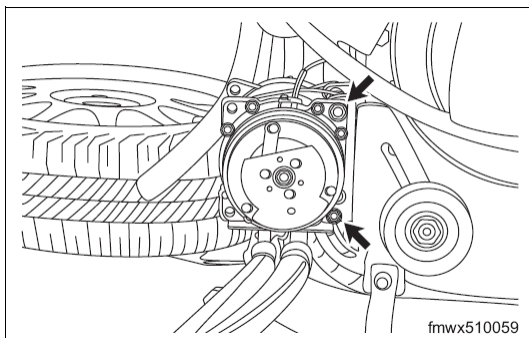


4. Dismantle the compressor
 - (a). Disconnect the wiring harness connector of the compressor.

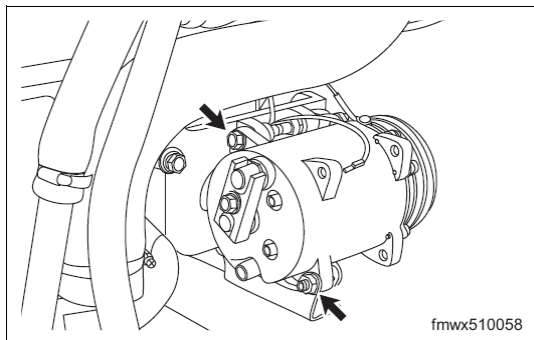


- (b). Dismantle the fixing bolt of the compressor.

5. Inspect the compressor, refer to Chapter 51, Heater & Air Conditioner –Heater and Air Conditioner, Testing & Adjustment

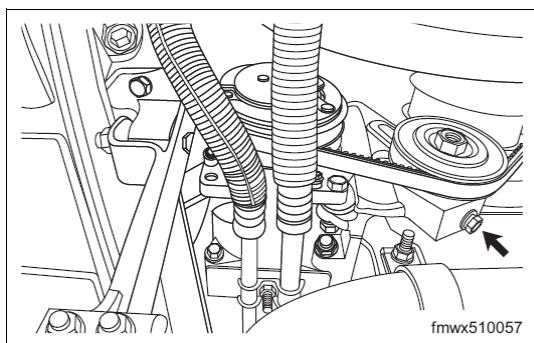


6. Install the compressor
 - (a). Install the fixing bolt of the compressor.



- (b). Connect the harness connector of the compressor.

- 7. Install the cooling pipe of the compressor, refer to Chapter 51, Heater & Air Conditioner – Cooling Pipe, Overhaul**



- 8. Install the compressor belt**

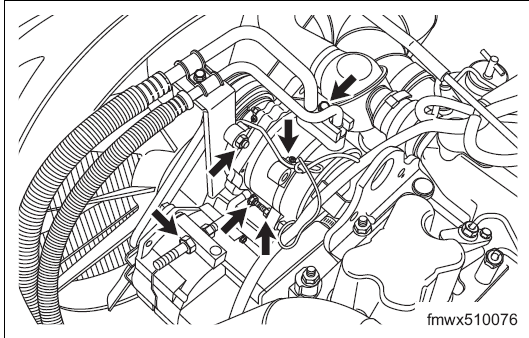
- (a). Install the tension pulley.

- 9. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Overhaul**
10. Inspect the refrigeration oil, refer to Chapter 51, Heater & Air Conditioner –Refrigeration Oil, Overhaul

Compressor (Right Rudder)

Overhaul

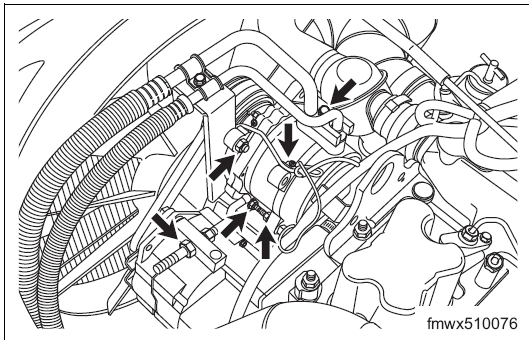
1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
2. Dismantle the compressor belt



3. Dismantle the compressor

- (a). Disconnect the harness connector of the compressor.
- (b). Dismantle the air conditioner pipe of the compressor.
- (c). Dismantle the tensioner of the compressor.
- (d). Dismantle the fixing nut of the compressor.

4. Inspect the compressor, refer to Chapter 51, Heater & Air Conditioner –Heater and Air Conditioner, Testing & Adjustment

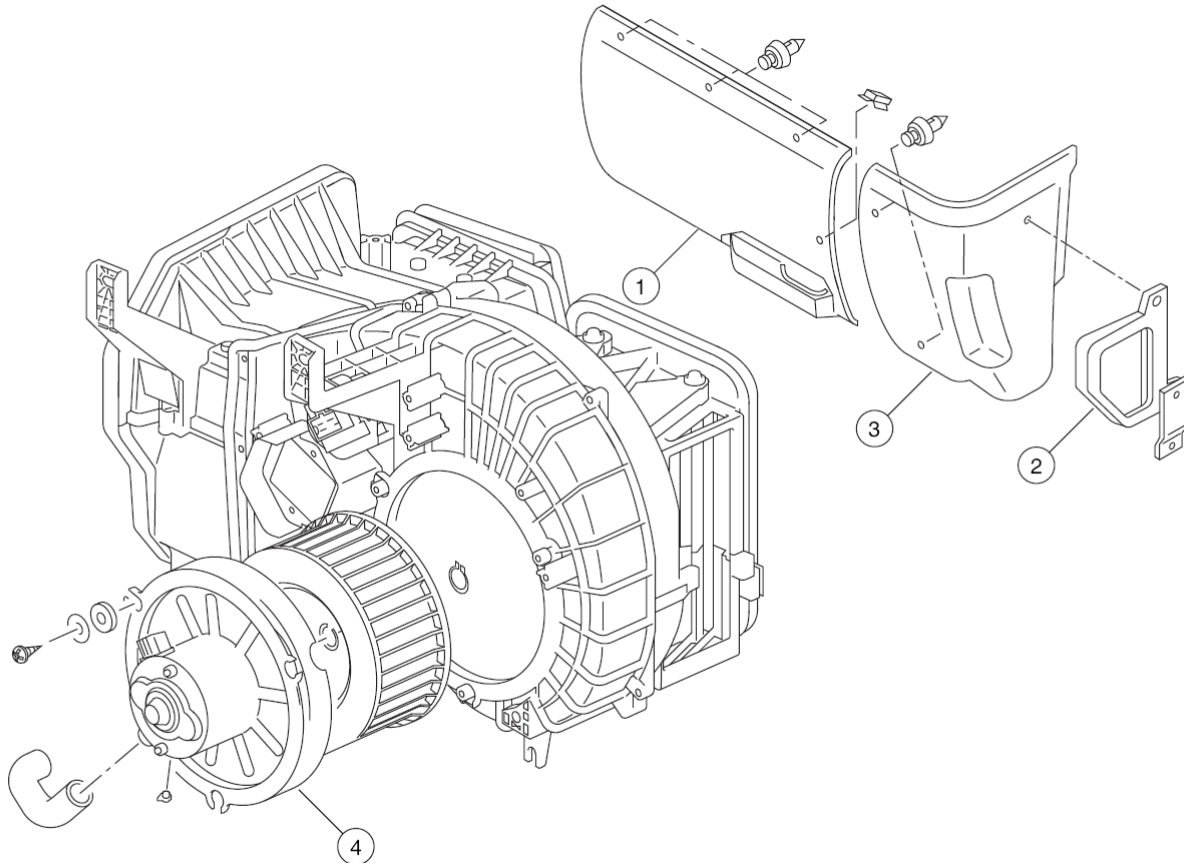


5. Install the compressor

- (a). Install the fixing nut of the compressor.
- (b). Install the tensioner of the compressor.
- (c). Install the air conditioner pipe of the compressor.
- (d). Connect the harness connector of the compressor.

6. Install the compressor belt
7. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Overhaul
8. Inspect the refrigeration oil, refer to Chapter 51, Heater & Air Conditioner –Refrigeration Oil, Overhaul

Blower Part Drawing



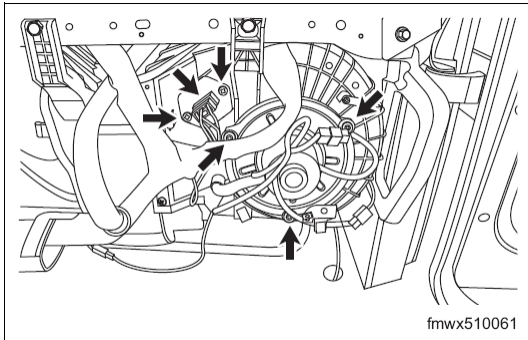
fmwx510060

1	Dashboard
2	Armrest

3	Dashboard
4	Blower Motor

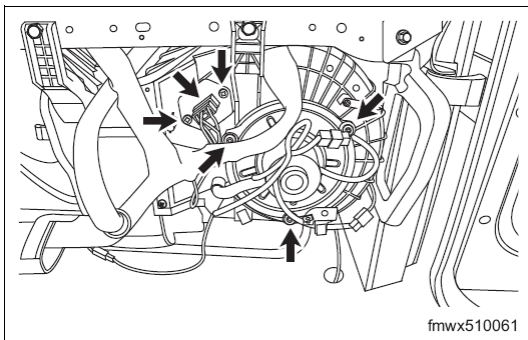
Overhaul

1. Turn off the main power
2. Dismantle the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter – Dashboard, Overhaul



3. Dismantle the blower motor and resistor
 - (d). Disconnect the harness connector of the blower motor.
 - (b). Dismantle the fixing bolt of the blower motor.
 - (c). Disconnect the harness connector of the resistor.
 - (d). Dismantle the fixing bolt of the resistor.

4. Inspect the blower motor, refer to Chapter 51, Heater & Air Conditioner –Heater and Air Conditioner, Testing & Adjustment
5. Inspect the resistor, refer to Chapter 51, Heater & Air Conditioner –Heater and Air Conditioner, Testing & Adjustment
6. Inspect the air door motor, refer to Chapter 51, Heater & Air Conditioner – Testing & Adjustment

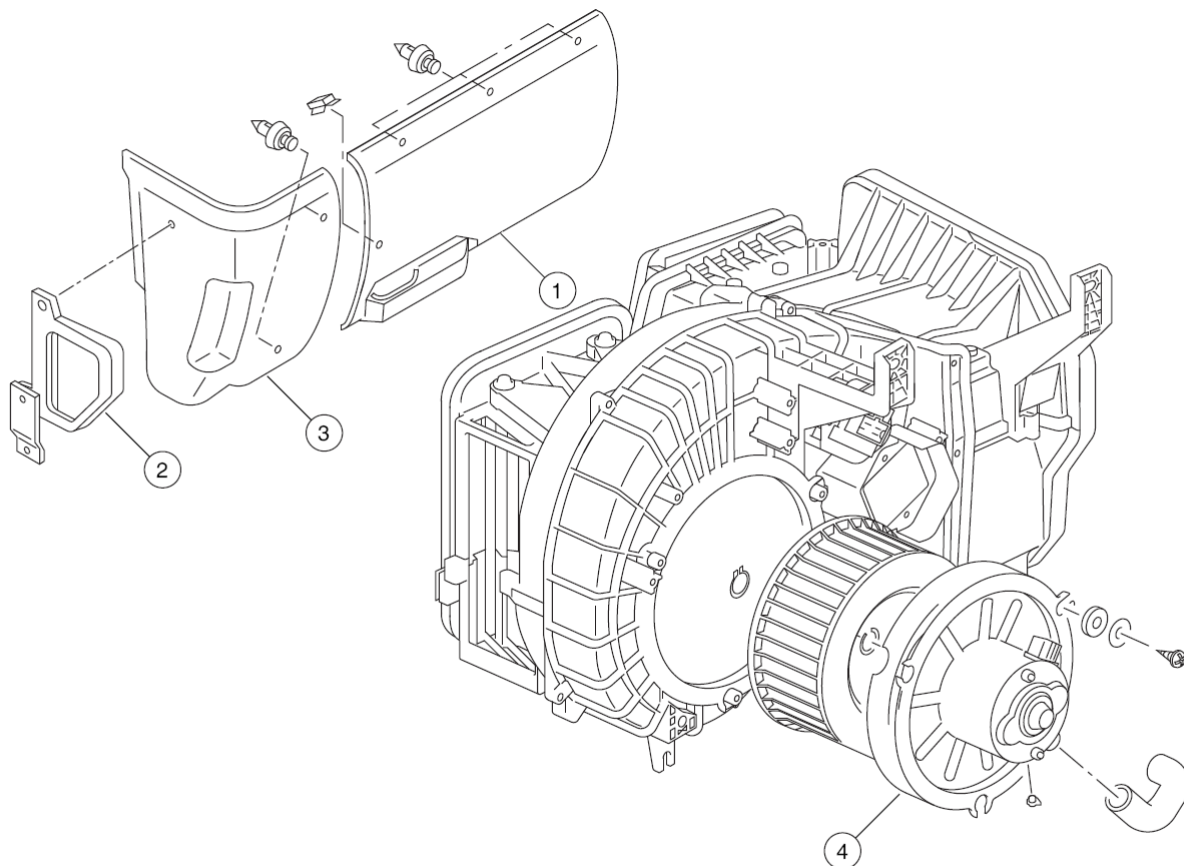


7. Install the blower motor and resistor
 - (a). Install the fixing bolt of the resistor.
 - (b). Connect the harness connector of the resistor.
 - (c). Install the fixing bolt of the blower motor.
 - (d). Connect the harness connector of the blower motor.

8. Install the dashboard, refer to Chapter 73, Dashboard/Instrument/ Cigarette Lighter – Dashboard, Overhaul

Blower (Right Rudder)

Part Drawing



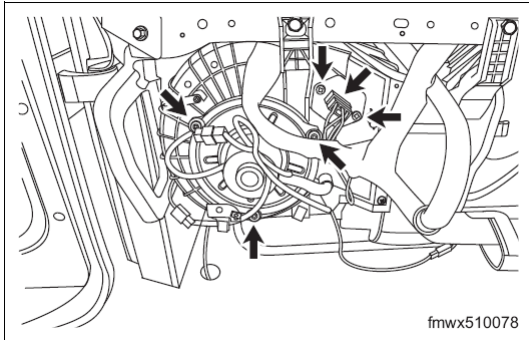
fmwx510077

1	Dashboard
2	Armrest

3	Dashboard
4	Blower Motor

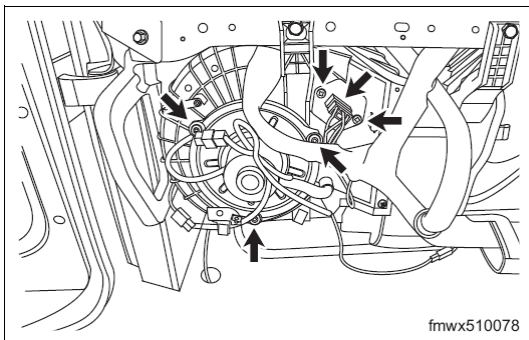
Overhaul

1. Turn off the main power
2. Dismantle the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter – Dashboard, Overhaul



3. Dismantle the blower motor and resistor
 - (a). Disconnect the harness connector of the blower motor.
 - (b). Dismantle the fixing bolt of the blower motor.
 - (c). Disconnect the harness connector of the resistor.
 - (d). Dismantle the fixing bolt of the resistor.

4. Inspect the blower motor, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment
5. Inspect the resistor, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment
6. Inspect the air door motor, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment



7. Install the blower motor and resistor
 - (a). Install the fixing bolt of the resistor.
 - (b). Connect the harness connector of the resistor.
 - (c). Install the fixing bolt of the blower motor.
 - (d). Connect the harness connector of the blower motor.

8. Install the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter – Dashboard, Overhaul

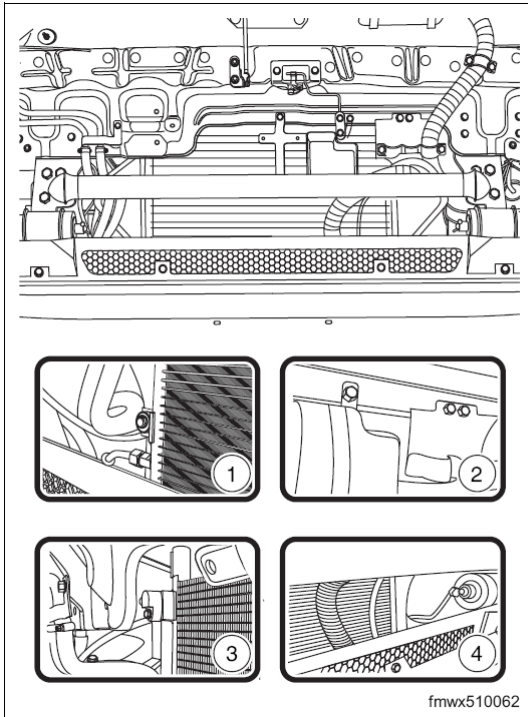
Condenser

Overhaul

Caution:

Because the condenser which is a heat exchanger has many fine and fragile parts in structure and material (especially for heat sinks), be careful not to drop, collide or scrape it during the removal.

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
2. Open the front cover



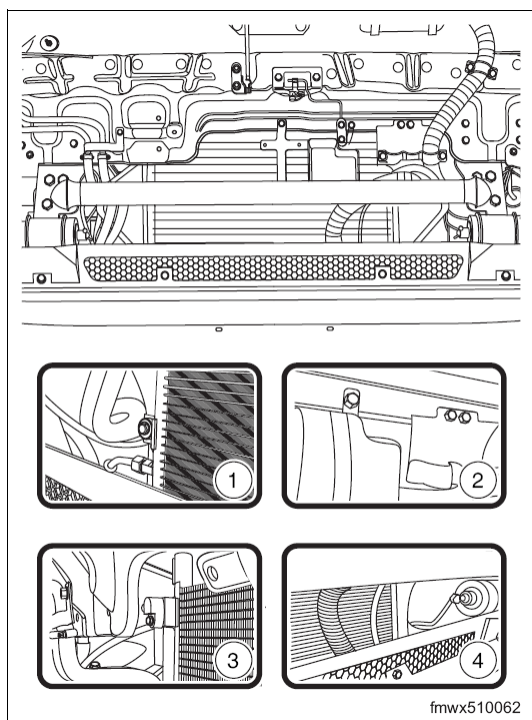
3. Dismantle the condenser

- (a). Dismantle the cooling pipe of the condenser, refer to Chapter 51, Heater and Air Conditioner – Cooling Pipe, Overhaul.
- (b). Dismantle the condenser.

4. Inspect the condenser

- (a). Inspect whether there is smudginess, damage or deformation on the surface of the condenser.
 - If the condenser fins are dirty, clean with water and dry with compressed air.
 - If the condenser fins are distorted, trim them with a fin comb.
- (b). Inspect whether the condenser leaks.
 - Use the leakage inspection equipment for inspecting the air leakage at the pipeline joint.

Heater & Air Conditioner - Condenser



5. Install the condenser

- (a). Install the condenser
- (b). Install the cooling pipe of the condenser; refer to Chapter 51, Heater and Air Conditioner – Cooling Pipe, Overhaul.

6. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
7. Heat up the engine to the normal temperature
8. Inspect whether the coolant leaks, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment.

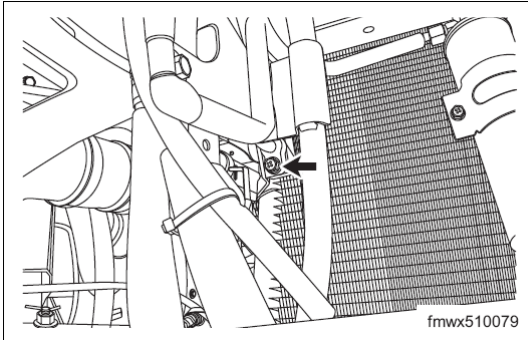
Condenser (Right Rudder)

Overhaul

Caution:

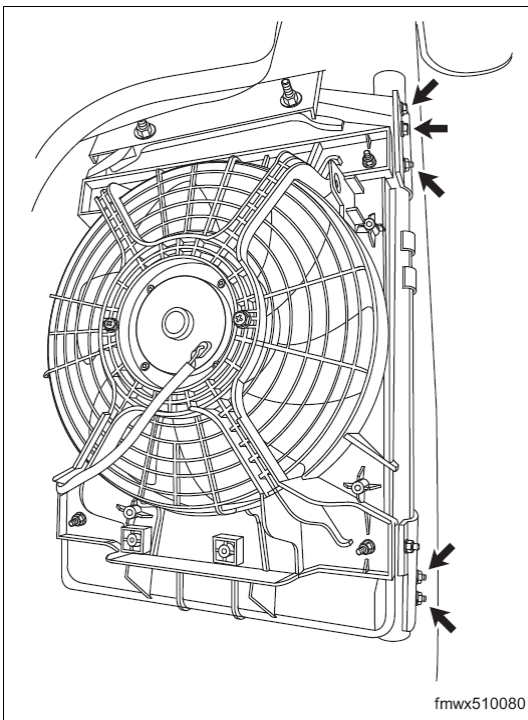
Because the condenser which is a heat exchanger has many fine and fragile parts in structure and material (especially for heat sinks), be careful not to drop, collide or scrape it during the removal.

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
2. Open the front cover



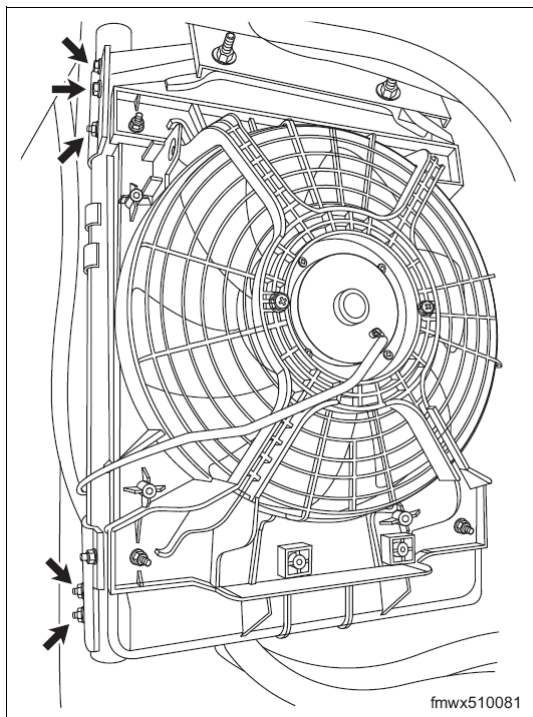
3. Dismantle the condenser

- (a). Dismantle the cooling pipe of the condenser.



- (b). Dismantle the fixing bolt and nut of the condenser.

Heater & Air Conditioner - Condenser (Right Rudder)

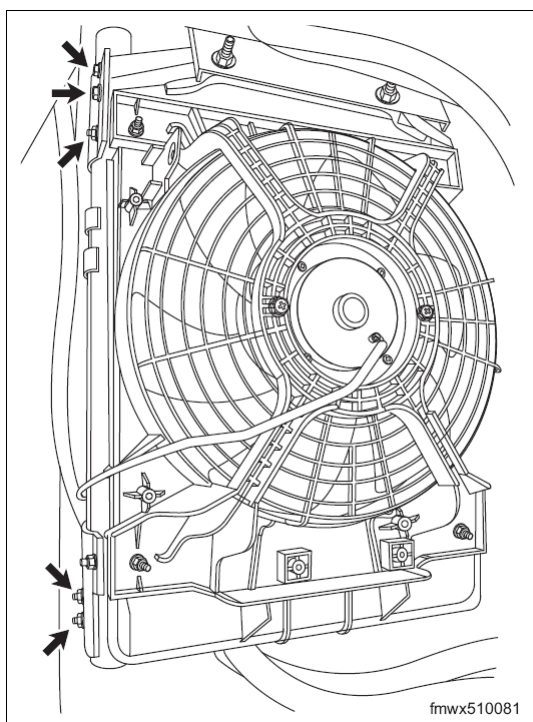


- (c). Dismantle the cooling pipe of the condenser.
- (d). Dismantle the fixing bolt and nut of the condenser.

51

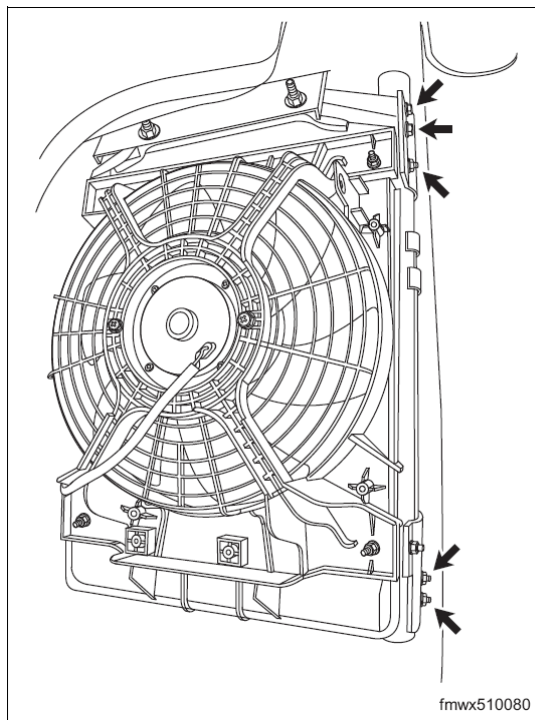
4. Inspect the condenser

- (a). Inspect whether there is smudginess, damage or deformation on the surface of the condenser.
 - If the condenser fins are dirty, clean with water and dry with compressed air.
 - If the condenser fins are distorted, trim them with a fin comb.
- (b). Inspect whether the condenser leaks.
 - Use the leakage inspection equipment for inspecting the air leakage at the pipeline joint.

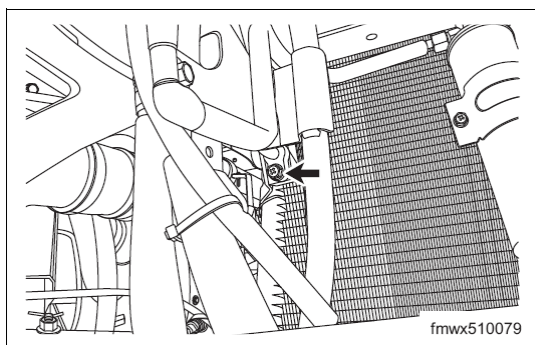


5. Install the condenser

- (a). Install the fixing bolt and nut of the condenser.
- (b). Install the cooling pipe of the condenser.



(c). Install the fixing bolt and nut of the condenser.

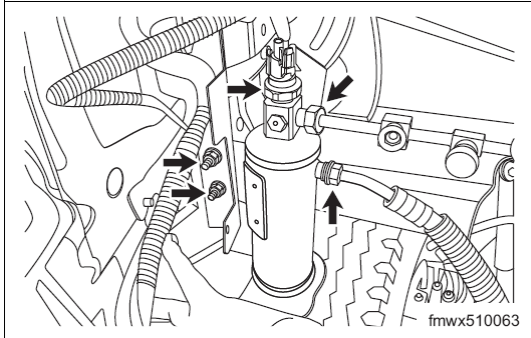


(d). Install the cooling pipe of the condenser.

6. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
7. Heat up the engine to the normal temperature
8. Inspect whether the coolant leaks, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment

Fluid Reservoir Overhaul

1. Discharge Coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement



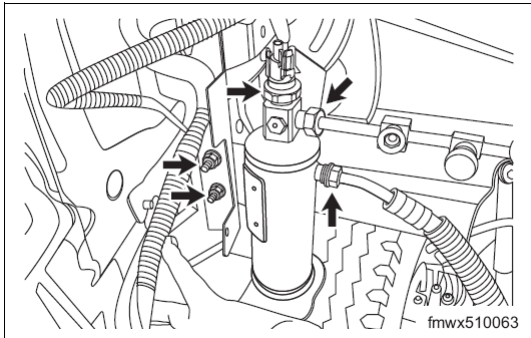
2. Dismantle the fluid reservoir

Sealant: Loctite 567 sealant.

- (a). Dismantle the cooling pipe of the condenser, refer to Chapter 51, Heater and Air Conditioner – Cooling Pipe, Overhaul.
- (b). Disconnect the harness connector of the dual pressure switch.
- (c). Dismantle the fixing nut of the liquid reservoir.

3. Inspect the liquid reservoir

- (a). Inspect whether the liquid reservoir housing is damaged.



4. Install the liquid reservoir

- (a). Install the fixing nut of the liquid reservoir.
- (b). Connect the harness connector of the dual pressure switch.
- (c). Dismantle the cooling pipe of the liquid reservoir; refer to Chapter 51, Heater and Air Conditioner – Cooling Pipe, Overhaul.

51

5. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement

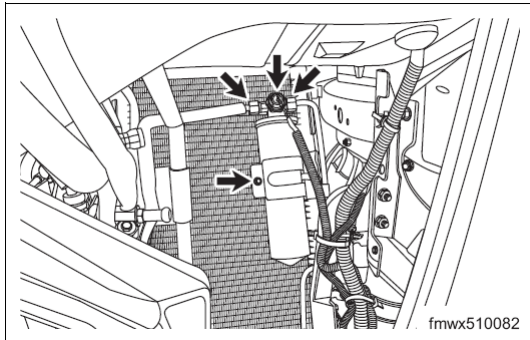
6. Heat up the engine to the normal working temperature

7. Inspect whether the coolant leaks, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment

Liquid Reservoir (Right Rudder)

Overhaul

1. Discharge the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement

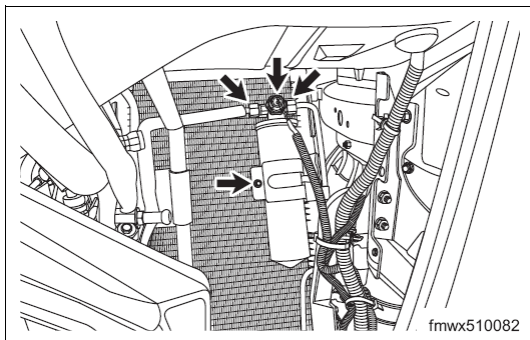


2. Dismantle the liquid reservoir

- (a). Dismantle the cooling pipe of the liquid reservoir.
- (b). Disconnect the harness connector of the dual pressure switch.
- (c). Dismantle the fixing nut of the liquid reservoir.

3. Inspect the liquid reservoir

- (a). Inspect whether the liquid reservoir housing is damaged.



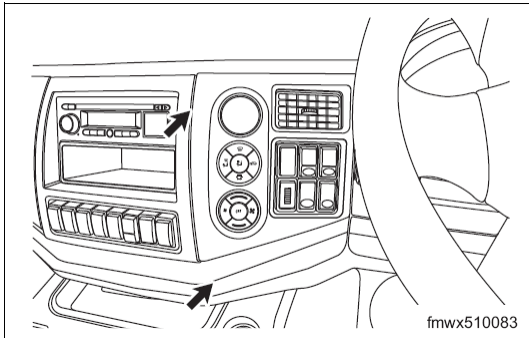
4. Install the liquid reservoir

- (a). Install the fixing nut of the liquid reservoir.
- (b). Connect the harness connector of the dual pressure switch.
- (c). Dismantle the cooling pipe of the liquid reservoir.

5. Refill the coolant, refer to Chapter 51, Heater & Air Conditioner – Coolant, Replacement
6. Heat up the engine to the normal working temperature
7. Inspect whether the coolant leaks, refer to Chapter 51, Heater & Air Conditioner – Heater and Air Conditioner, Testing & Adjustment.

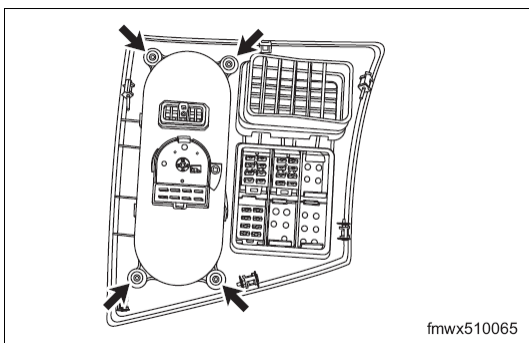
Air Conditioner Control Switch Overhaul

1. Turn off the main power



2. Dismantle the air conditioner control switch.

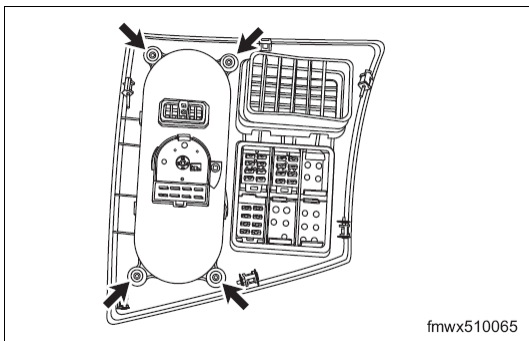
- (a). Pry out the trim strip.
- (b). Pry out the control switch panel of the air conditioner.
- (c). Disconnect the harness connector of the air conditioner control switch.



- (d). Dismantle the fixing bolt of the air conditioner control switch.

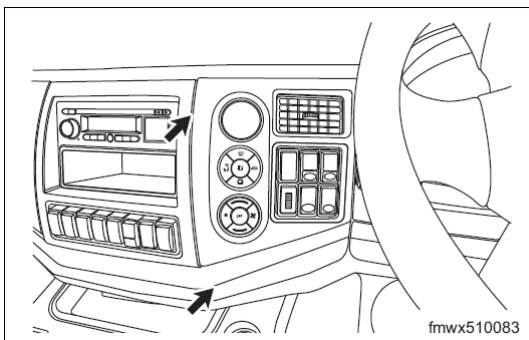
51

3. Inspect the air conditioner control switch, refer to Chapter 51 - Heater & Air Conditioner, Testing & Adjustment



4. Install the air conditioner control switch.

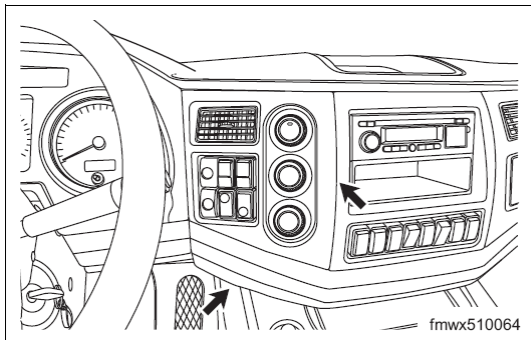
- (d). Install the fixing bolt of the air conditioner control switch.



- (b). Connect the harness connector of the air conditioner control switch.
- (c). Connect the control switch panel of the air conditioner.
- (d). Install the trim strip.

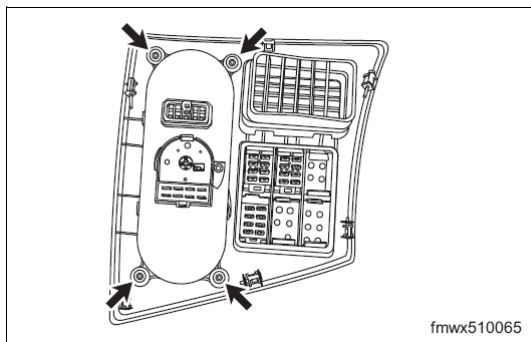
Air Conditioner Control Switch (Right Rudder) Overhaul

1. Turn off the main power



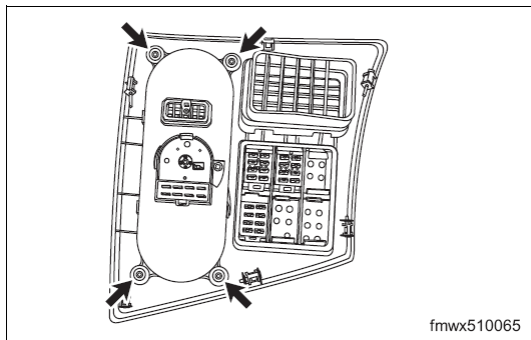
2. Dismantle the air conditioner control switch

- (a). Pry out the trim strip.
- (b). Pry out the control switch panel of the air conditioner.
- (c). Disconnect the harness connector of the air conditioner control switch.



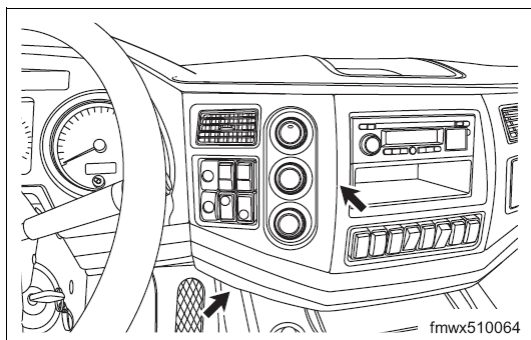
- (d). Dismantle the fixing bolt of the air conditioner control switch.

3. Inspect the air conditioner control switch, refer to Chapter 51 - Heater & Air Conditioner, Testing & Adjustment



4. Install the air conditioner control switch.

- (d). Install the fixing bolt of the air conditioner control switch.



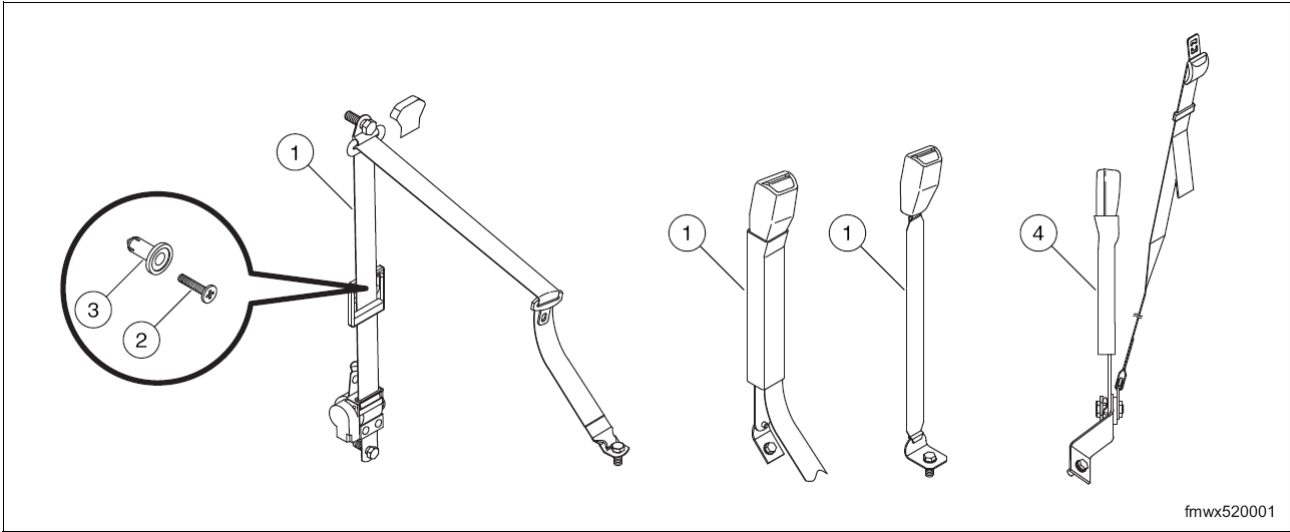
- (b). Connect the harness connector of the air conditioner control switch.
- (c). Pry out the control switch panel of the air conditioner.

Seat Belt

- Seat Belt Assembly 52-3**
 - Part Drawing 52-3
- Driver’s Seat Belt..... 52-4**
 - Overhaul 52-4
- Driver’s Seat Buckle 52-6**
 - Overhaul 52-6
- Middle Seat Belt Buckle 52-7**
 - Overhaul 52-7
- Middle Seat Buckle..... 52-8**
 - Overhaul 52-8

Seat Belt Assembly

Part Drawing



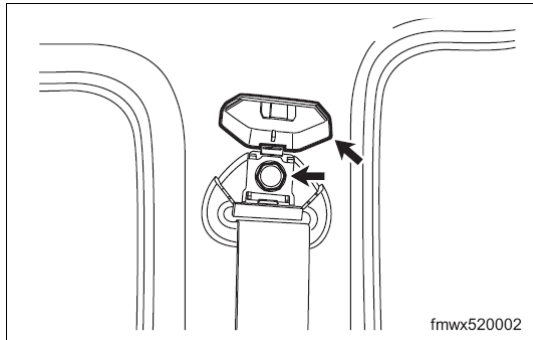
1	Seat Belt Retractor Assembly
2	Middle Seat Buckle Assembly

6	Driver's Seat Buckle Assembly
7	Passenger's Seat and Middle Seat Buckle Assembly

Driver's Seat Belt Overhaul

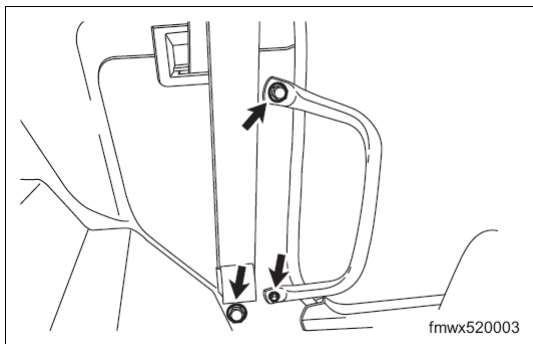
Hint:

Part Drawing, refer to Chapter 52: Seat Belt - Seat Belt Assembly, Part Drawing

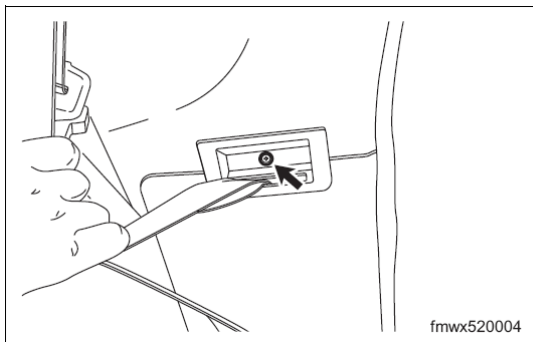


1. Dismantle driver's seat belt

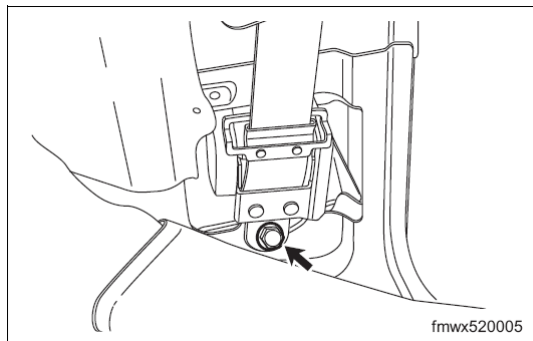
- (a) Open the trim cover of the driver's seat belt.
- (b) Dismantle the top fixing bolt of the seat belt.



- (c) Dismantle the door armrest.
- (d) Dismantle the bottom fixing bolt of seat belt



- (e) Dismantle the plastic bolt and plastic nut of the seat belt.
- (f) Dismantle the lower guard plate on the left side wall



- (g) Dismantle the fixing bolt of the seat belt retractor.

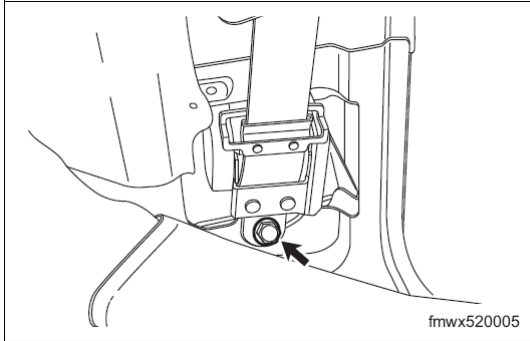
Seat Belt - Driver's Seat Belt

2. Inspect seat belt assembly

- (a) Requirement for mesh belt performance: clean and smooth surface, good hand feel; evenly woven belt free of stain, crack, flash, burr or defects.
- (b) Requirement for retractor performance: it should retract smoothly and return automatically at installation angle.

Caution:

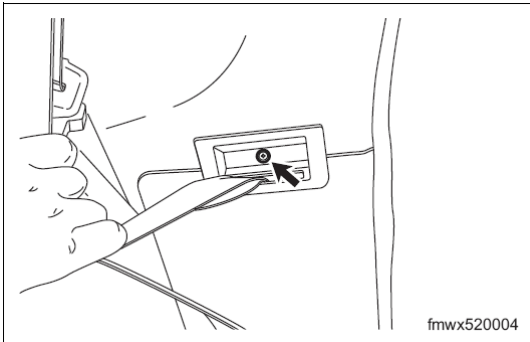
If the seat belt fails to meet performance requirements, replace the seat belt assembly with a new one.



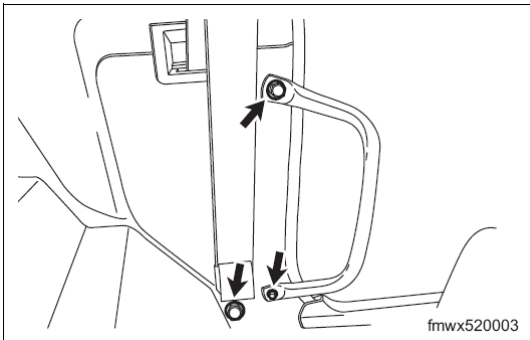
3. Install driver's seat belt

- (a) Screw down the fixing bolt of the seat belt retractor.

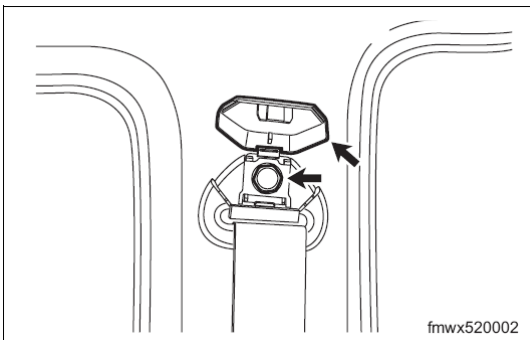
Torque: 60N.m



- (b) Install the lower guard plate on the left side wall
- (c) Install plastic bolt and plastic nut of seat belt.



- (d) Install the bottom fixing bolt of the seat belt
- (e) Install the door armrest.

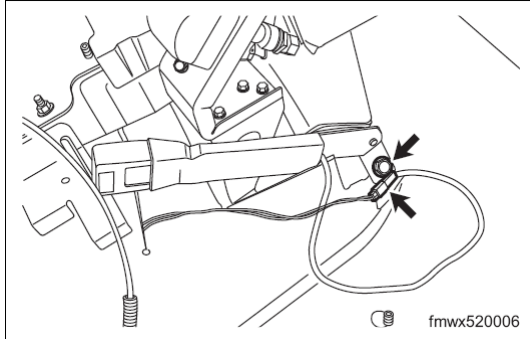


- 4. Dismantle the driver's seat belt
- (a) Install the top fixing bolt of seat belt
- (b) Close the trim cover of driver's seat belt.

Driver's Seat Buckle Overhaul

Hint:

Part Drawing, refer to Chapter 52: Seat Belt - Seat Belt Assembly, Part Drawing



1. Dismantle driver's seat buckle

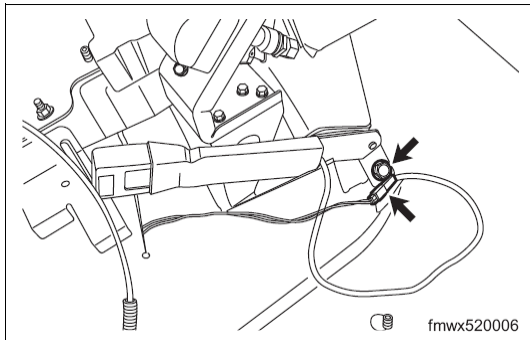
- (a) Remove the floor carpet.
- (b) Disconnect the wiring harness connector of seat belt lamp
- (c) Dismantle the buckle fixing bolt

2. Inspect driver's seat buckle

- (a) Requirements for buckle performance: when the lock tongue is inserted or the buckle is unfastened, it should be felt in the right place. The buckle shall not unlock automatically and assembly shall not fail.
- (b) Insert seat belt and inspect whether seat belt lamp works normally.

Caution:

If driver's seat buckle can not meet performance requirements, replace it with new buckle assembly.



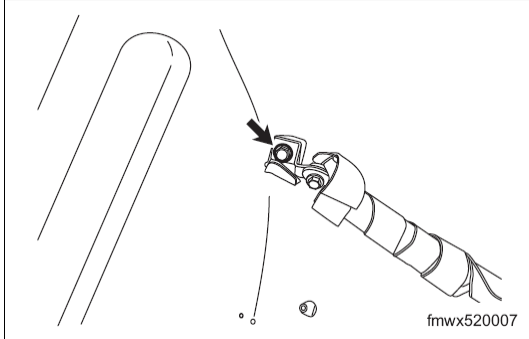
3. Install driver's seat buckle

- (a) Install the buckle fixing bolt
Torque: 60N.m
- (b) Connect the wiring harness connector of seat belt lamp
- (c) Cover with the floor carpet.

Middle Seat Belt Buckle Overhaul

Hint:

Part Drawing, refer to Chapter 52: Seat Belt - Seat Belt Assembly, Part Drawing



1. Dismantle middle seat belt buckle and co-driver's seat belt buckle.

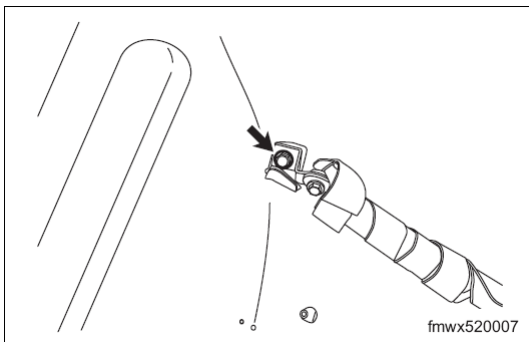
- (a) Remove the floor carpet.
- (b) Dismantle the seat belt and buckle fixing bolt

2. Inspect middle seat belt buckle and co-driver's seat belt buckle.

- (a) Requirements for mesh belt performance: clean and smooth surface, good hand feel; evenly woven belt free of stain, crack, flash, burr or defects.
- (b) Requirements for buckle performance: when the lock tongue is inserted or the buckle is unfastened, it should be felt in the right place. The buckle shall not unlock automatically and assembly shall not fail.

Caution:

If middle seat belt buckle and co-driver's seat belt buckle fail to meet performance requirements, replace them with new seat belt and buckle assembly.



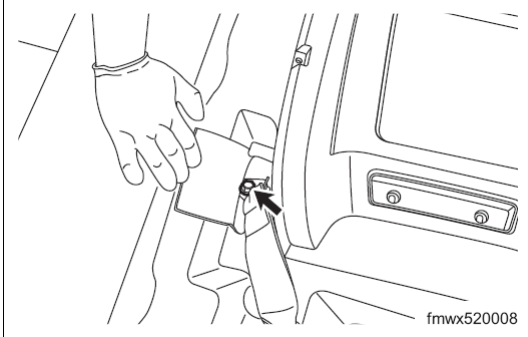
3. Install middle seat belt buckle and co-driver's seat belt buckle.

- (a) Install the seat belt and buckle fixing bolt
Torque: **60N.m**
- (b) Cover with the floor carpet.

Middle Seat Buckle Overhaul

Hint:

Part Drawing, refer to Chapter 52: Seat Belt - Seat Belt Assembly, Part Drawing



1. Dismantle middle seat buckle

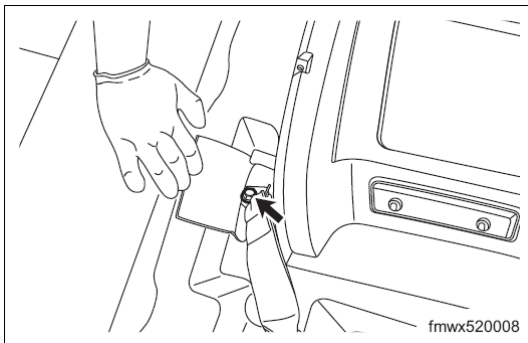
- (a) Remove the floor carpet.
- (b) Dismantle the fixing bolt of the middle seat buckle

2. Inspect middle seat buckle

- (a) Requirements for mesh belt performance: clean and smooth surface, good hand feel; evenly woven belt free of stain, crack, flash, burr or defects
- (b) Requirements for buckle performance: when inserting lock tongue is inserted or the buckle is unfastened, it should be felt in the right place. The buckle shall not unlock automatically and assembly shall not fail.

Caution:

If middle seat buckle can not meet performance requirements, replace it with new seat buckle assembly.



3. Install middle seat buckle

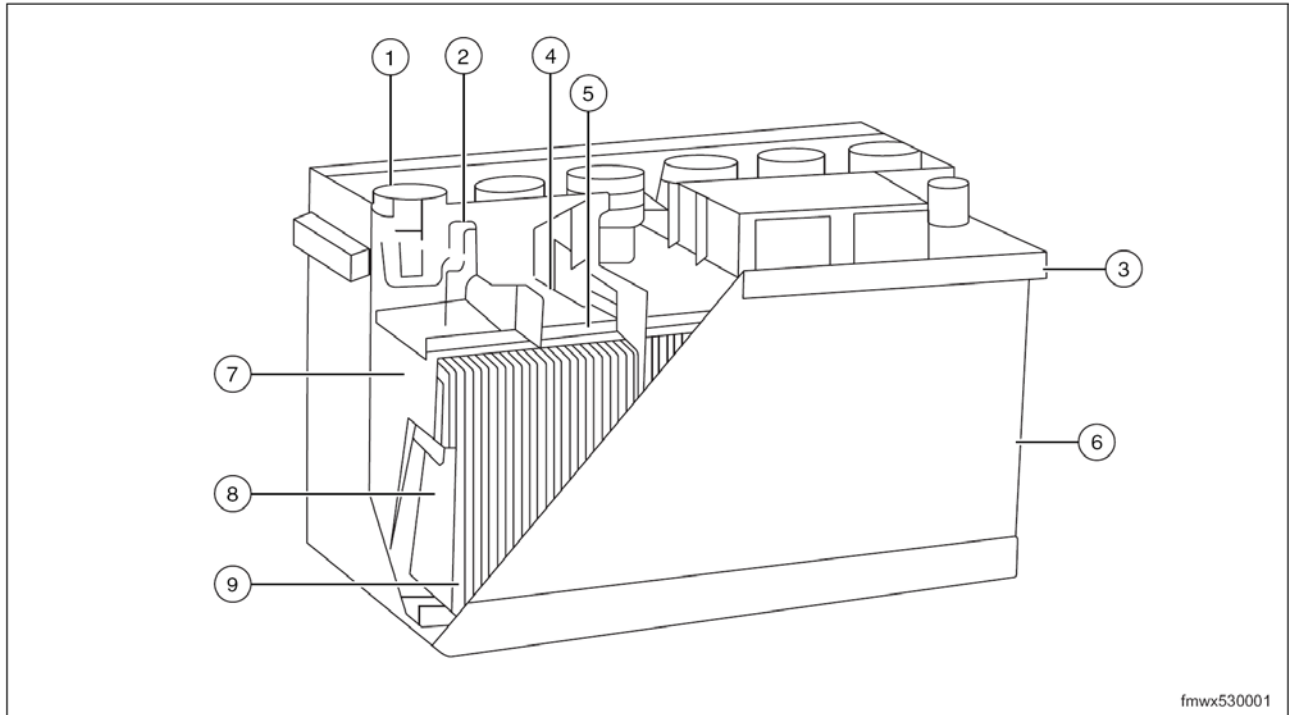
- (a) Install the fixing bolt of middle seat buckle.
Torque: 60N.m
- (b) Cover with the floor carpet.

Battery

Battery	53-3
General	53-3
Precautions	53-5
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Injection.....	53-15
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Battery

General Structure



1	Blow-cock
2	Negative Pole
3	Battery Cover
4	Connection Through the Wall
5	Busbar

6	Entire Tank
7	Negative Plate
8	Separator
9	Positive Plate

1. The role of the slab lattice: to support the active materials, and conduct electricity so that the current will be distributed uniformly. The slab lattice is usually made of lead antimony alloy, wherein, antimony can increase the mechanical strength and the casting properties. However, antimony will accelerate the precipitation of hydrogen and accelerate the consumption of electrolyte, and can also lead to self-discharge of battery and decaying of the lattice frame, thus shortening the battery life. Currently, lead - low antimony alloy lattice frame and lead - calcium - tin alloy lattice frame are popular. And maintenance-free batteries use lead calcium alloy.
2. Battery separator is made of mipor rubber, plastic fiberglass, etc. Battery separator must have the characteristics of high porosity, small bore diameter, acid resistance, no secretion of harmful impurities, certain intensity, low resistance in the electrolyte, chemical stability, etc. Its main roles include:
 - (a). To prevent short-circuit of the positive and negative plates.
 - (b). To let pass the positive and negative ions in the electrolyte.
 - (c). To stop or slow down the shedding of the active materials in the positive and negative plates, so as to prevent damage due to vibration of the positive and negative plates.
3. The main role of the electrolyte is to conduct electric current to participate in electrochemical reaction. Electrolyte is prepared from strong sulfuric and treated water, and the purity and density of electrolyte have a major impact on the capacity and life of the battery. Automotive batteries use dilute sulphuric acid with the electrolyte density of $1.280 \pm 0.005\text{g/cm}^3$ (25°C).
4. Battery shell and cover are containers for positive and negative plates and electrolyte, and are mainly made of plastic and rubber materials.

Battery - Battery

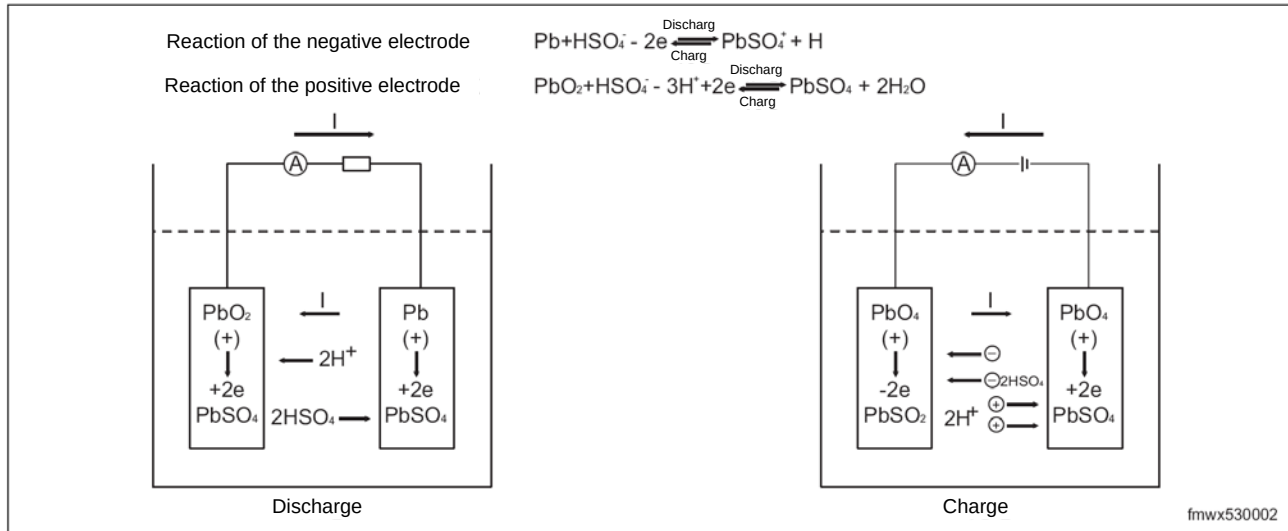
5. The blow-cock is made of plastic, is used for sealing the battery, preventing air from entering the battery, and avoiding oxidation of the polar plates. The blind holes on the blow-cock must be pierced with nails before using the battery, so as to ensure smooth gas escape.
6. In addition to the above major components, the battery is also provided with components like connecting slat, terminals, poles, level indicator, etc

Precautions

1. The battery must be charged in a dry room, where the temperature must be appropriate at 5 - 40°C.
2. Batteries must not be overlapped or placed directly on the ground. They should be placed on a wooden frame far from alkaline batteries or other chemicals.
3. Source of ignition shall be prohibited at the charging location, which shall be far from heat.
4. Electrolyte temperature should not exceed 45°C, otherwise cooling measures should be taken (to reduce or stop the charge current or place in a water trough to cool).

Working Principle

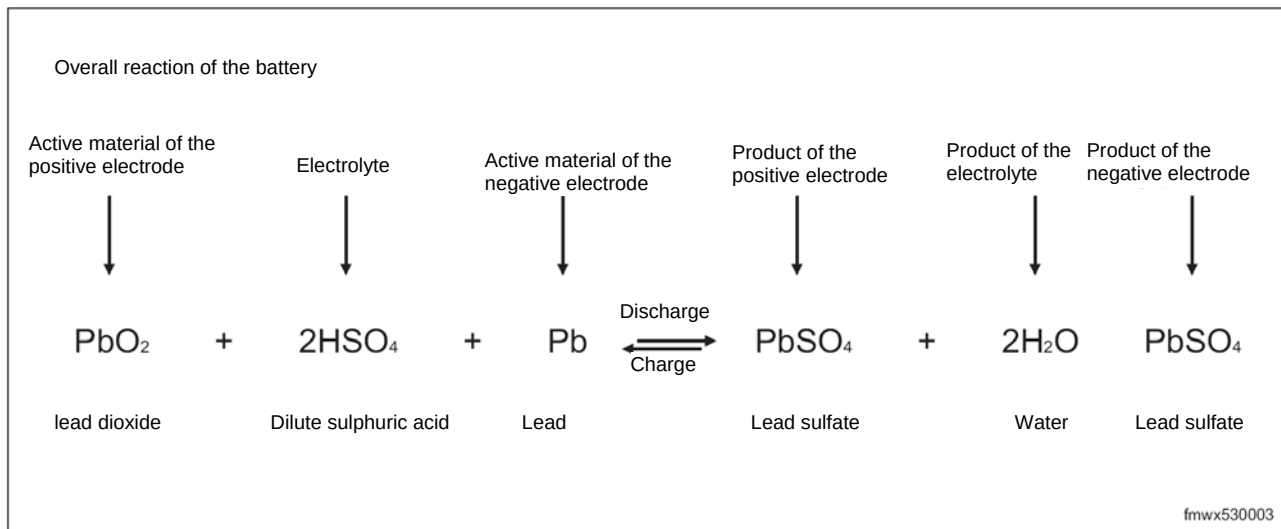
The active material of the positive electrode of a lead acid battery is lead dioxide; the active material of the negative electrode is spongy metallic lead; the conductive medium is sulfuric acid (electrolyte). In the charge and discharge process of the battery, the positive and negative electrodes will go through the following reaction to convert electrical energy into chemical energy and store the energy in the battery, or convert electrical energy into chemical energy to supply for the outside users.



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Discharge: H_2SO_4 density decreases, PbSO_4 at the positive and negative electrodes increases, the inherent resistance increases, electrolyte density decreases, the battery electromotive force decreases.

Charge: the electrolyte concentration increases, the inherent resistance decreases, the battery electromotive force increases, and there will be a lot of bubbles due to water electrolysis in the late period of charging.



After discharging, the active materials of both electrodes are converted into lead sulfate. This theory interprets the current generating reaction of lead acid batteries, and is known as the "double sulfate" theory.

Battery - Battery**Fault Symptom Table**

The table below will help you find the fault. The No. represents the possible sequence of the faults. Check each part in this sequence, and replace the parts as needed.

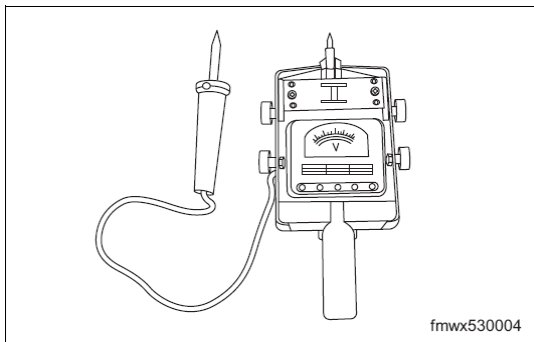
Symptom	Possible Position	Reference
Battery is running low	1. Long-term placement of the battery.	Chapter 53 - Battery – Battery, Testing & Adjustment
	2. Battery plates (vulcanized)	Chapter 53 - Battery – Battery, Testing & Adjustment
	3. Battery (Internal short circuit)	Chapter 53 - Battery – Battery, Testing & Adjustment
	4. Battery plates (arched)	Chapter 53 - Battery – Battery, Testing & Adjustment
	5. Polar plates (active material shedding)	Chapter 53 - Battery – Battery, Testing & Adjustment
	6. Polarity reversal of single-cell battery	Chapter 53 - Battery – Battery, Testing & Adjustment
Explosion	1. Battery (over charging)	Chapter 53 - Battery – Battery, Testing & Adjustment
	2. Battery (Internal short circuit, vulcanized)	Chapter 53 - Battery – Battery, Testing & Adjustment
	3. Contact with fire	-
The liquid level drops too fast	1. Excess charge current	Chapter 53 - Battery – Battery, Testing & Adjustment
	2. Shell leakage	Chapter 53 - Battery – Battery, Testing & Adjustment
	3. Vulcanization or short circuit of single-cell battery	Chapter 53 - Battery – Battery, Testing & Adjustment
Battery cover and poles have yellow and white materials	1. Shell leakage	Chapter 53 - Battery – Battery, Testing & Adjustment
Battery frozen	2. Low specific gravity of electrolyte	Chapter 53 - Battery – Battery, Testing & Adjustment

Testing & Adjustment

Visual Check

1. Check whether the appearance of the battery is intact, and whether the connection of the fixed rod and wire is secure.
2. Observe the electrolyte level of the battery: it is prescribed that the electrolyte level shall be 10 - 15mm higher than the top surfaces of the polar plates, and distilled water shall be added if lower than the prescribed level.
3. Observe whether there is any fissure in the battery shell and the central separator, and beat the shell and the central separator with a wooden stick to determine whether there is any sound of damage, especially at the junctions of the central separator and the four walls, where cracks occur often and should be carefully checked.
4. If an inspection glass is available, green means fully charged, red and white mean low battery or no electricity.

Capacity Test



1. The high-rate discharge tester, also known as discharge tongues, consists of a DC voltage meter and a load resistor.
2. The two tongues should be pressed tightly onto the positive and negative electrodes of the battery for 5s when measuring. Observe the voltage the battery can maintain in case of heavy load discharge to accurately determine the discharge level and the starting capacity of the battery.
3. Different brands of high-rate discharge testers shall use the original value based on the provisions of the instruction book of their original manufacturers. Generally, the single-cell voltage of a battery in good technical conditions should be 1.5V or more, and should remain stable within 5s. If the internal voltage drops rapidly within 5s or the voltage of a certain single cell is more than 0.1V lower than any other, it means that the battery is faulty.

The following table compares the results measured with a high rate discharge tester.

Display area	Determination	Treatment
White area	Adequate	Continue to use
Green area	Normal	Continue to use
Yellow area	Inadequate charge	Recharge
Red area	No power	Recharge

Battery Charging

Caution:

- The battery must be charged in a dry room, where the temperature must be appropriate at 5 - 40°C.
- Batteries must not be overlapped or placed directly on the ground. They should be placed on a wooden frame far from alkaline batteries or other chemicals.
- Source of ignition shall be prohibited at the charging location, which shall be far from heat.
- Electrolyte temperature should not exceed 45°C, otherwise cooling measures should be taken (to reduce or stop the charge current or place in a water trough to cool).

Battery - Battery

Constant Current Charge

Constant current charge includes: initial charge, supplementary charge, ordinary charge and balanced charge.

- Initial charge refers to the first charge of a non-dry charged battery before the use. After electrolyte is injected, the non-dry charged battery should be placed idle for 1 - 6 h, and should be charged only when the temperature drops to below 35°C.
- In first charge, the current should be generally 0.07C20A (i.e., $0.07 \times 20 = 1.4A$); when a single cell voltage reaches 2.4V, continue to charge with the current halved.
- Supplementary charge applies to a dry-charged battery of poor dry-charged performance after stored for a long time or a fully charged battery without use for a month or so after injection of acid. The current for supplementary charge is 0.1C20A, the duration of supplementary charge is about 5 hours, or determined according to the length of storage time.
- Ordinary charge refers to a charge of a battery after the initial charge. The current of the first phase of an ordinary charge is 0.1C20A, with the voltage raised to above 2.4V / single cell after charging for 8 - 12 h, and continues to charge for about 10h with the current halved. The charge volume is generally more than 1.5 times higher than the discharge capacity, or 1.3 to 1.5 times the rated capacity.
- Balanced charge refers to the method to charge where a battery is fully charged in the ordinary charge method first, and then continues to be charged with 0.035C20A current. When bubbles emerge evenly in the battery and the temperature rises, suspend charging within 1h. Repeat this process for 3 to 4 times. Stop charging when a single battery can produce a large number of bubbles and the voltage and electrolyte density tend to be stable.

Constant Voltage Charge

Constant voltage charge refers to the charge of a battery with a certain constantly stable voltage. The charging current is higher at the beginning, and then it is gradually decreased. The voltage of constant voltage charge is usually 2.3 - 2.4 V, where little gas is produced and little water is consumed. Therefore, constant voltage charge is commonly used with maintenance-free sealed lead-acid batteries.

Rapid Charge

Rapid charge is a method of intermittent charging which uses high current and pulse and discharges within a short period of time. Rapid charge is usually completed with 1 to 2-time C20A high current.

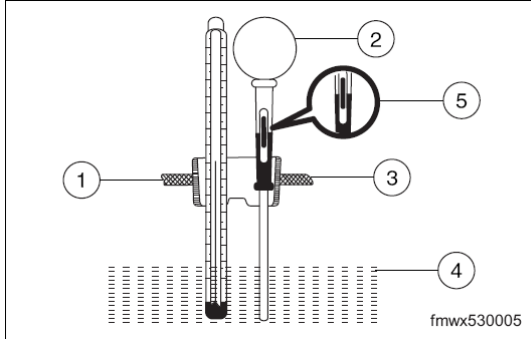
Signs to Determine Full Charge

- (a). A large number of bubbles are produced in single cells.
- (b). The voltage of single cells is 2.6 - 2.8V, and the determined values remain stable in 2 hours or more.
- (c). The specific gravity of the electrolyte reaches $1.280 \pm 0.01g/cm^3$ (25°C), and the determined values remain stable in more than 2 hours.

Battery - Battery**Add Water to a Battery****Caution:**

The operator should wear goggles, acid-resistant gloves, rubber shoes or boots, and rubber aprons. The electrolyte container must be made of acid and heat resistant plastic, glass, ceramics, or lead, etc.

1. Uncover the water injection holes, and check the electrolyte level. The lowest level should be at the top of the polar plate.



2. Determine the electrolyte density.

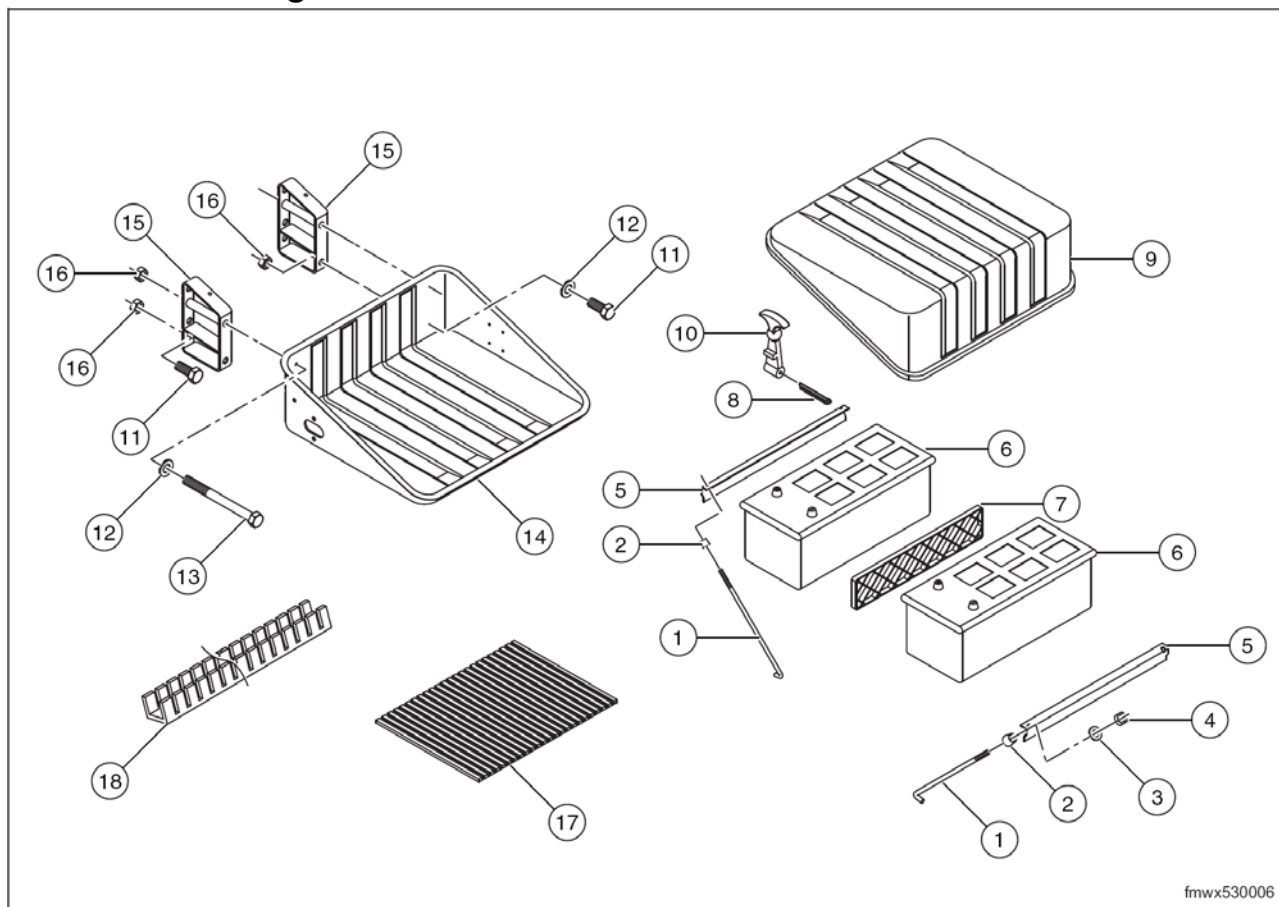
3. If you cannot see the electrolyte, add water until the polar plate is soaked.
4. Seal the covers and tighten them all.
5. Fully charge the battery before adding water again.
6. Unscrew the covers and check the electrolyte level and electrolyte density on completion of charging.

Specific Gravity	Determination	Treatment
Above 1.300	Electrolyte concentration too high or error in adding liquid	Add distilled water or deionized water
1.250 - 1.280	good	Continue to use
1.220 - 1.250	Insufficient charging	Replenish
1.100 - below 1.220	Overdischarging, concentration too low	Charge and then check
Difference between the specific gravity of each cell is over 0.04	Possible fault in single cell	Charge and then check



Battery - Battery

Part Drawing



53

1	Tightening Rod
2	Rubber Buffer Block
3	Small Washer
4	Prevailing Torque Type All-metal Hex Nut, Style 1
5	Clamp Bracket
6	Low Temperature Battery
7	Separator
8	Cotter Pin
9	Battery Case Cover

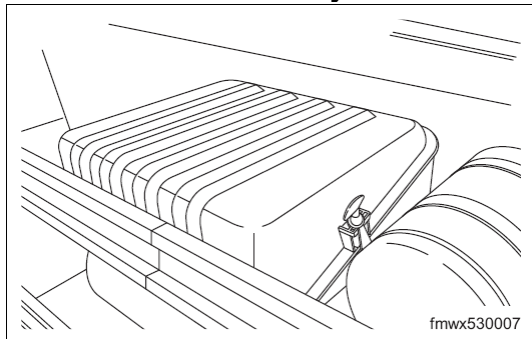
10	Battery Case Cover
11	Towing Hook
12	Hex Head Bolt
13	Battery Case
14	Hex Head Bolt
15	Battery Support
16	Prevailing Torque Type All-metal Hex Nut, Style 1
17	Rubber Backing Plate
18	Threading Jacket

Battery Replacement

Hint:

Part Drawing, refer to Chapter 53, Battery - Battery, Part Drawing.

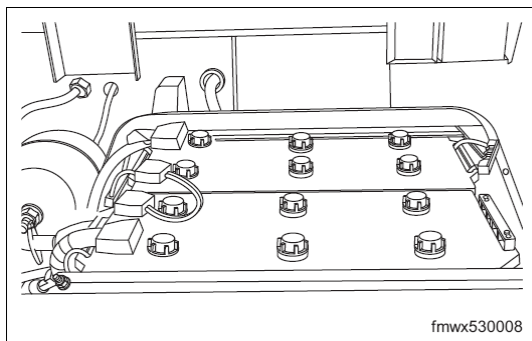
1. Turn off the battery switch



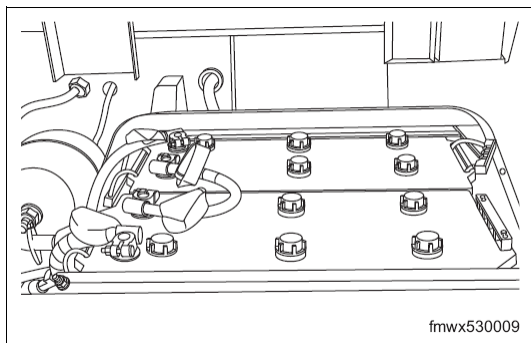
2. Open the battery case cover.

3. Dismantle the battery.

(a). Open the protective casing of battery pole.



Battery - Battery



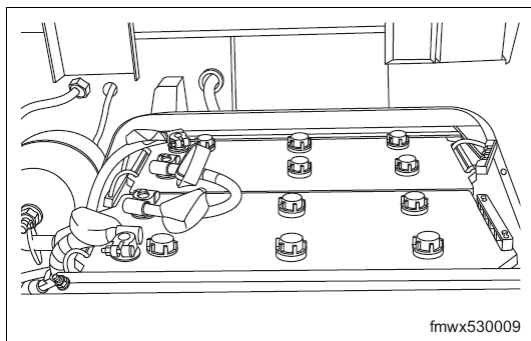
(b). Dismantle the battery cables.

Caution:

Remove the negative cable first.

(c). Dismantle the clamp bracket.

(d). Take out the battery and the separator.



4. Install the battery

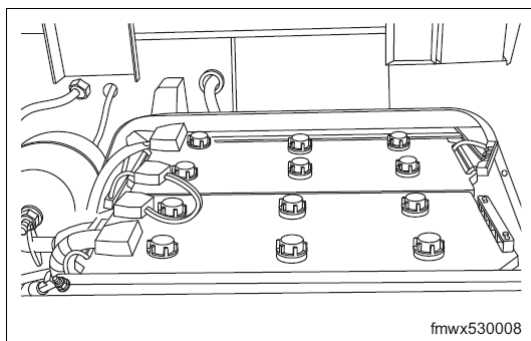
(a). Install the battery and the separator.

(b). Install the clamp bracket.

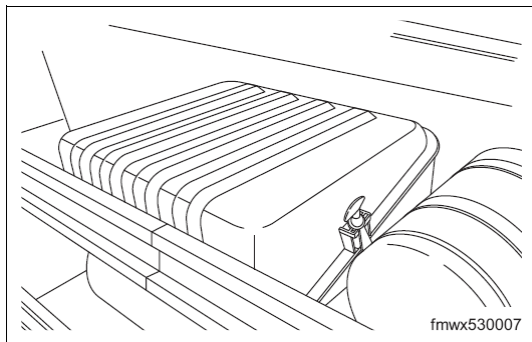
(c). Install the battery cables.

Caution:

Clean the poles and apply grease, install the positive cable first.



(d). Cover with the pole protective casing.



Maintenance

Maintenance

1. Use and Maintenance of the Battery in Winter

- (a). Always keep the battery in a fully charged state, so as to avoid freezing due to decrease of the specific gravity of electrolyte, which will lead to container rupture, bending polar plates, falling fragments of the active material, etc.
- (b). Add electrolyte with specific gravity of 1.40 to adjust in winter, according to the following Table.

Measured electrolyte temperature	+ 45	+ 30	+ 15	0	-15	-30	-45
Modified value of aerometer reading	+0.02	+0.01	0	-0.01	-0.02	-0.03	-0.04

- (c). It is only allowed to add water in winter when the engine is running and when the generator is charging the battery, so as to avoid freezing caused by uneven mixture of water and the electrolyte.
- (d). As the battery capacity decreases in winter, the engine must be preheated before cold start, and the duration that the starter is connected each time should not be more than 15s, the interval between two starts should be 2 to 3 min. If the machine doesn't work after three times of starting, there must be engine failure. And eliminate the failure first before restarting.

2. Use of New Battery

- (a). For the dry-charged batteries, inject electrolyte that meets the requirements into the battery. See Chapter 53, Battery - Electrolyte, Injection. The battery can be used in half an hour. And initial charge is unnecessary. But it will be better to charge for 3 - 4h, as this will be more beneficial to the battery performance.
- (b). For a non-dry charged battery, initial charge is necessary before use.

Electrolyte

Injection

1. Configuration of Electrolyte

Caution:

The operator must wear protective goggles, rubber gloves, plastic aprons and rubber boots to prevent burns. If sulfuric acid is spilled on clothing, immediately soak in 10% soda solution, and then rinse with water.

Caution:

The container for preparation of electrolyte must be an acid and heat resistant glazed ceramic or glass tank, plastic tank, or lead lined wooden tank.

- Clean the utensils before preparation, and rinse with pure water.
- When preparing electrolyte, put the pure water needed into the container, and inject the concentrated sulfuric acid slowly into the water and keep stirring. Pure water mustn't be injected into the concentrated sulfuric acid, otherwise you may be burnt by splashing acid.
- Lead-acid battery electrolyte is prepared with pure water and concentrated sulfuric acid, and its density is $1.280 \pm 0.005 \text{ g/cm}^3$ (25°C).
- Electrolyte density conversion formula: $d_{25} = d_t + 0.007 (t - 25)$.
 - d_{25} : electrolyte density at 25°C .
 - d_t : electrolyte density when the temperature is t .
 - 0.007: temperature coefficient.
 - t : measured electrolyte temperature.
- The electrolyte temperature should be measured simultaneously when measuring the specific gravity, and then convert the measured specific gravity into the specific gravity at 15°C . As the temperature is increased by 1°C , the specific gravity of electrolyte will be reduced by 0.007g/cm^3 , and out national standard is 15°C . Therefore, the specific gravity must be corrected according to the temperature, e.g., add the correction value if higher than 15°C , and subtract the correction value if lower than 15°C .

2. Selection of the Specific Gravity of Electrolyte

When the specific gravity of electrolyte increases, the freezing-point of electrolyte decreases, risk of freezing will be reduced, and the battery capacity will also be improved. But if the specific gravity is too great, the electrolyte viscosity will increase, which results in penetration difficulty, decreases the battery capacity, accelerates the carbonization of wood separator, and easily vulcanizes the polar plates, thus shortening the battery life. Therefore, different specific gravity of electrolyte should be chosen according to different conditions of use. Refer to the following table for the selection of the different specific gravity of electrolyte in different climatic conditions and different areas.

Climatic Conditions	The Specific Gravity of Electrolyte of Fully Charged Battery at 15°C	
	Winter	Summer
In Areas below -40°C in Winter	1.31	1.27
In Areas above -40°C in Winter	1.29	1.25
In Areas above -30°C in Winter	1.28	1.25
In Areas above -20°C in Winter	1.27	1.24
In Areas above 0°C in Winter	1.24	1.24

Battery - Electrolyte**3. Selection of Specific Gravity of Electrolyte**

When it is necessary to adjust the specific gravity of electrolyte in seasonal change, the battery should be fully charged, and then the specific gravity should be measured. If the specific gravity is improper, suck out a certain amount of electrolyte with a straw, and add distilled water if the specific gravity is higher than necessary; and add 1.40 g / cm³ of electrolyte if the specific gravity is lower than necessary. Charge the battery for a while to make it mixed evenly, and then measure the specific gravity until it is proper. The adjustment of the specific gravity of battery electrolyte in winter shall be in line with the following table.

Discharge Level	Full Charge		25%		50%		75%		100%	
Specific Gravity and Freezing Point of Electrolyte	Specific Gravity 15°C	Freezing Point 0°C	Specific Gravity 15°C	Freezing Point 0°C	Specific Gravity 15°C	Freezing Point 0°C	Specific Gravity 15°C	Freezing Point 0°C	Specific Gravity 15°C	Freezing Point 0°C
	1.310	-76	1.270	-58	1.230	-36	1.190	-22	1.150	-14
	1.290	-70	1.250	-50	1.210	-28	1.170	-18	1.130	-10
	1.280	-69	1.240	-42	1.200	-25	1.160	-16	1.120	-9
	1.270	-58	1.230	-36	1.190	-22	1.150	-14	1.110	-8
	1.250	-50	1.210	-28	1.170	-18	1.130	-10	1.090	-6
	1.240	-42	1.200	-25	1.160	-16	1.120	-9	1.080	-5

4. Injection of Electrolyte

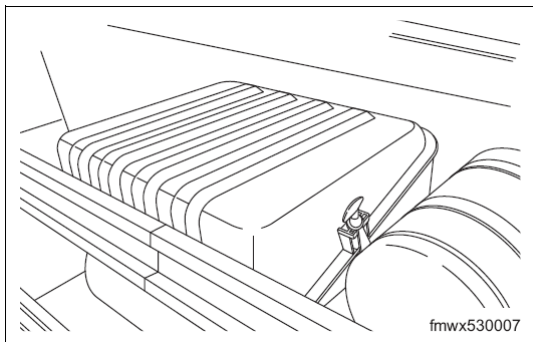
Caution:

The operator must wear protective tools before injection of electrolyte. If sulfuric acid is spilled on clothing, soak in 10% soda solution immediately, and rinse with clean water.

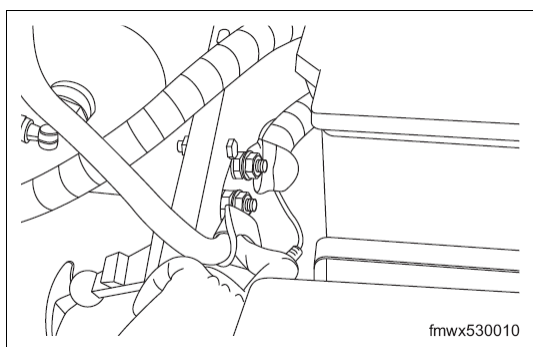
- (a). Remove the blow-cock. Ensure that the bleeder vent of the blow-cock is through, and the sealing gasket and sealing paper under the blow-cock must be removed after the acid injection.
- (b). The electrolyte must be cooled to below 30°C before injection.
- (c). Inject the prepared electrolyte into every single cell, wherein, the electrolyte level must be the same as that of the highest mark on the shell, the electrolyte level in the rubber tank must be 10 - 15mm higher than the separator.
- (d). Tighten the blow-cock to prevent leakage of acid.

Battery Switch Replacement

1. Turn off the Battery Switch

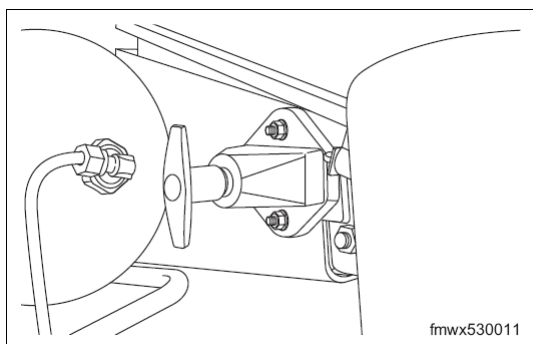


2. Open the battery case cover.

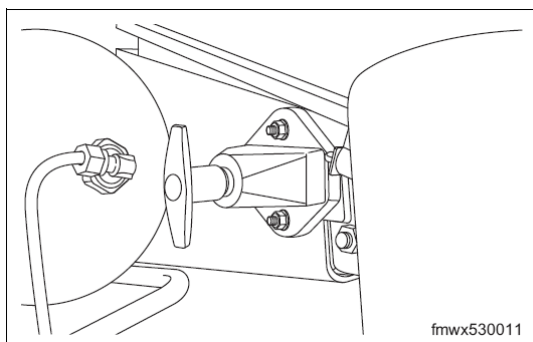


3. Dismantle the battery switch.

- (a). Open the wiring terminal hood of the battery switch.
- (b). Dismantle the battery switch wiring terminal.



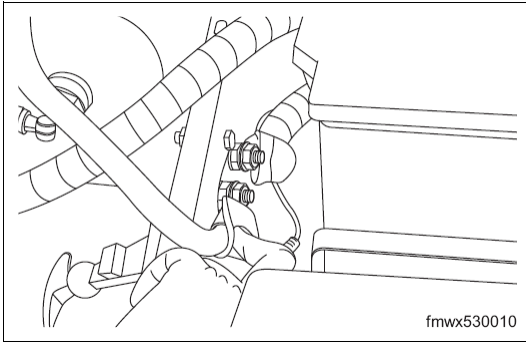
- (c). Dismantle the fixing bolt of the battery switch.



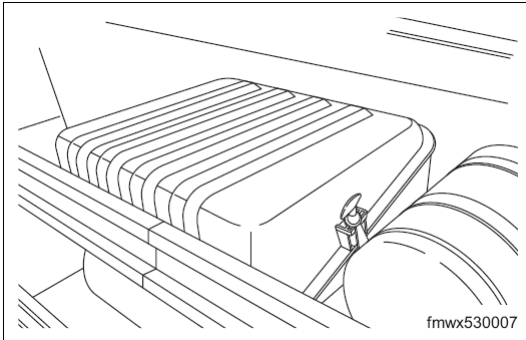
4. Install the battery switch.

- (a). Install the fixing bolt of the battery switch .

Battery - Battery Switch



- (b). Install the wiring terminal of the battery switch.
- (c). Close the wiring terminal hood of the battery switch.



- 5. Close the battery case cover.

Lighting

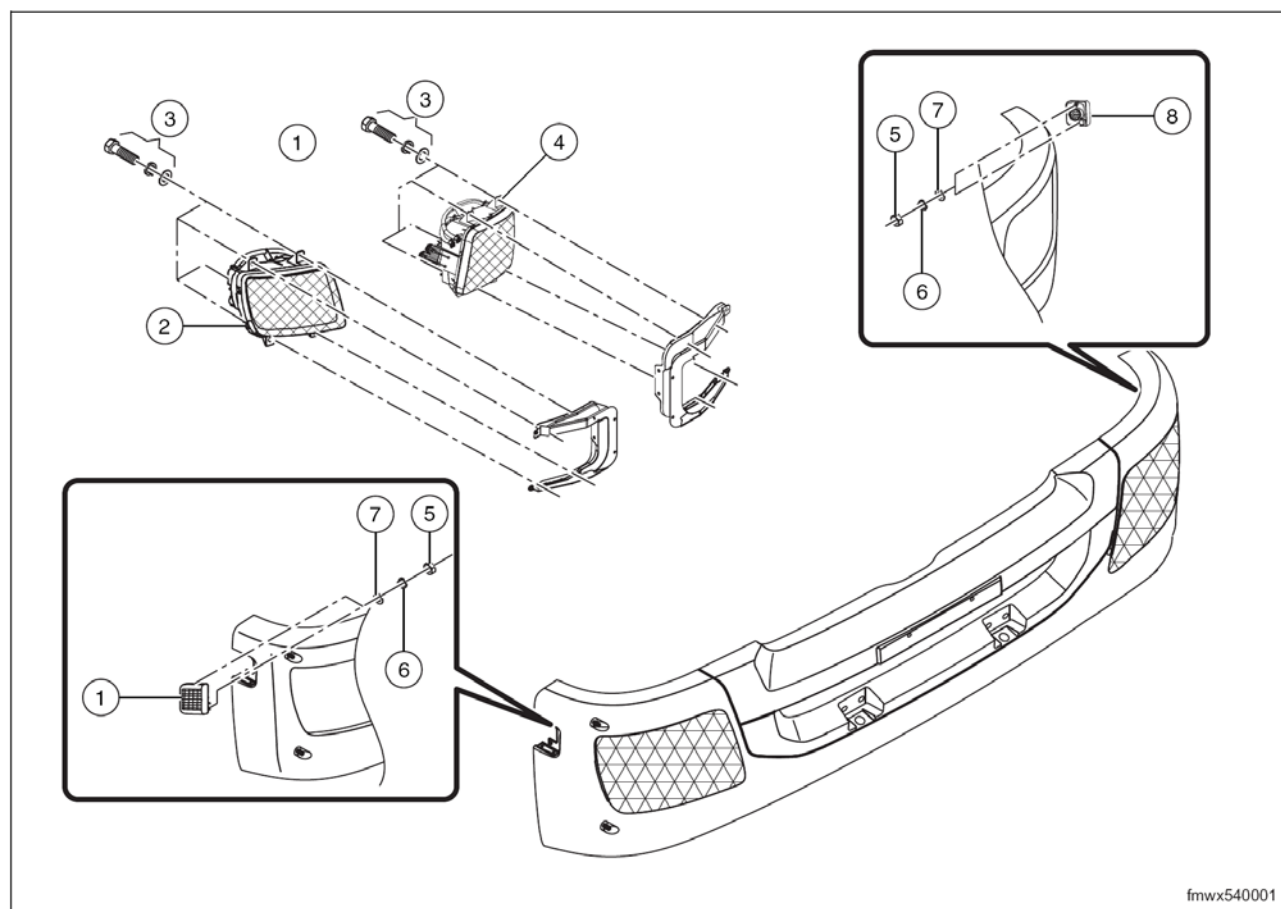
Lighting system	54-3
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Part Drawing	54-4
Front Combination Lamp	54-7
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Turn Signal Lamp	54-14
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Clearance Lamp	54-15
Replacement.....	54-15
Marker Lamp	54-17
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Step Lamp	54-19
Replacement.....	54-19
Interior Lamp.....	54-20
Replacement.....	54-20
Combination Tail Lamp.....	54-22
Replacement.....	54-22
Door Lamp Switch	54-25
Replacement.....	54-25

Lighting System

Precautions

1. **Cut off the power**
 - (a). Before removal or installation of any electrical equipment, and any exposed electrical terminal easily accessible to any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
 - (b). Turn off the ignition switch, unless otherwise specified.
2. **If the surface of the halogen bulb becomes greasy, the life of the bulb will be shortened, and bulb baking out will occur due to overheating.**
3. **The halogen bulb must be handled very carefully. As any high pressure, dropping, knock or any damage to the bulb will result in explosion and rupture.**
4. **The operator must wear protective goggles when replacing a halogen bulb.**
5. **Make sure to hold the lamp holder when taking a bulb to prevent contact with the glass.**
6. **Prepare a bulb which can be used immediately. If the duration of removing a bulb from a vehicle is too long before replacing a bulb, the reflector will absorb dust and water vapor.**
7. **Replace any bulb with a counterpart of the same power.**
8. **After a bulb has been replaced, reinstall and fix the lamp holder. In case water vapor has entered in the lamp holder, the reflector will become blurred.**

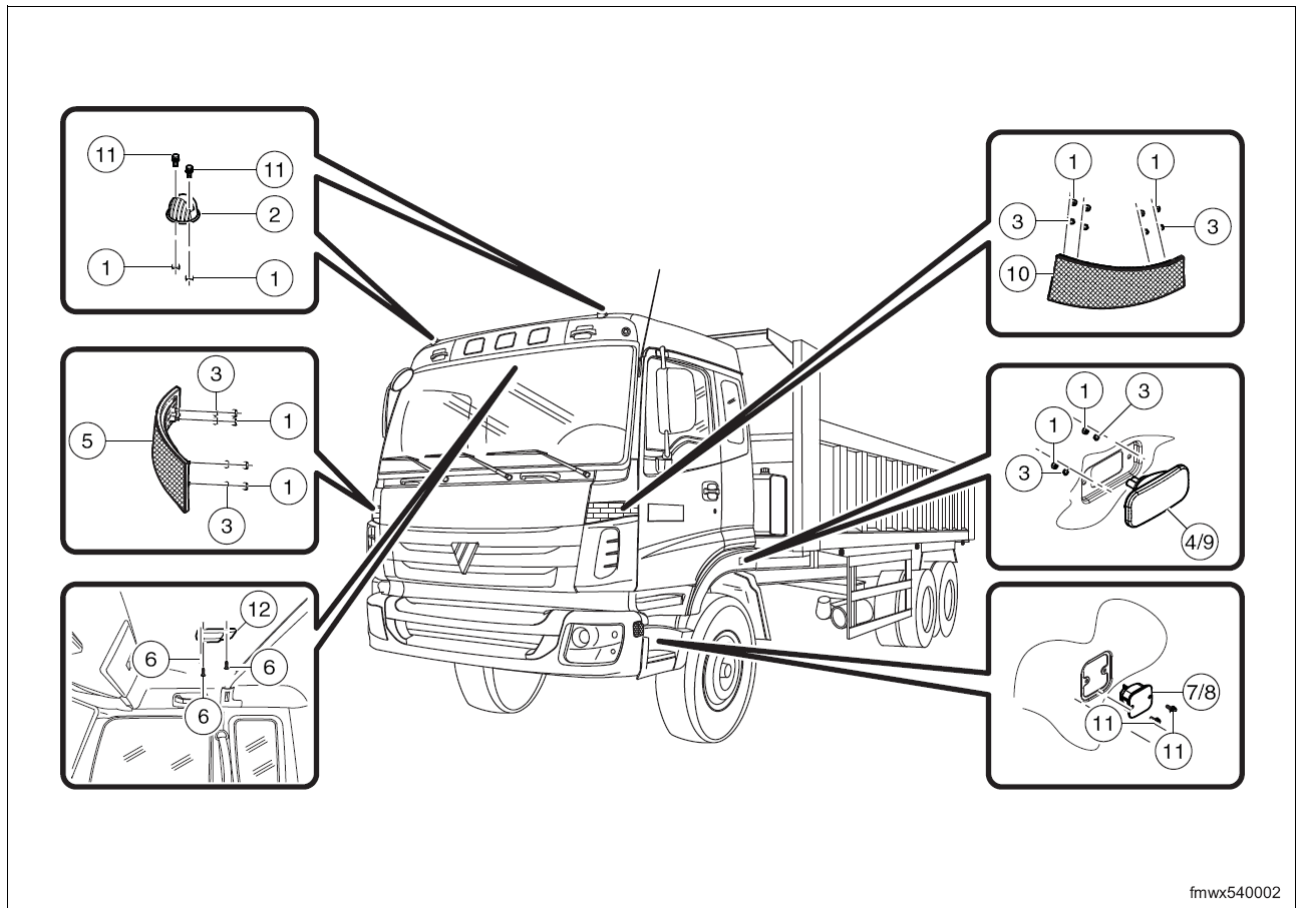
Part Drawing



1	LH Turn Signal Assembly
2	RH Front Combination Lamp Assembly
3	Hex Head Bolt, Spring Washer and Flat Washer Assembly
4	LH Front Combination Lamp Assembly

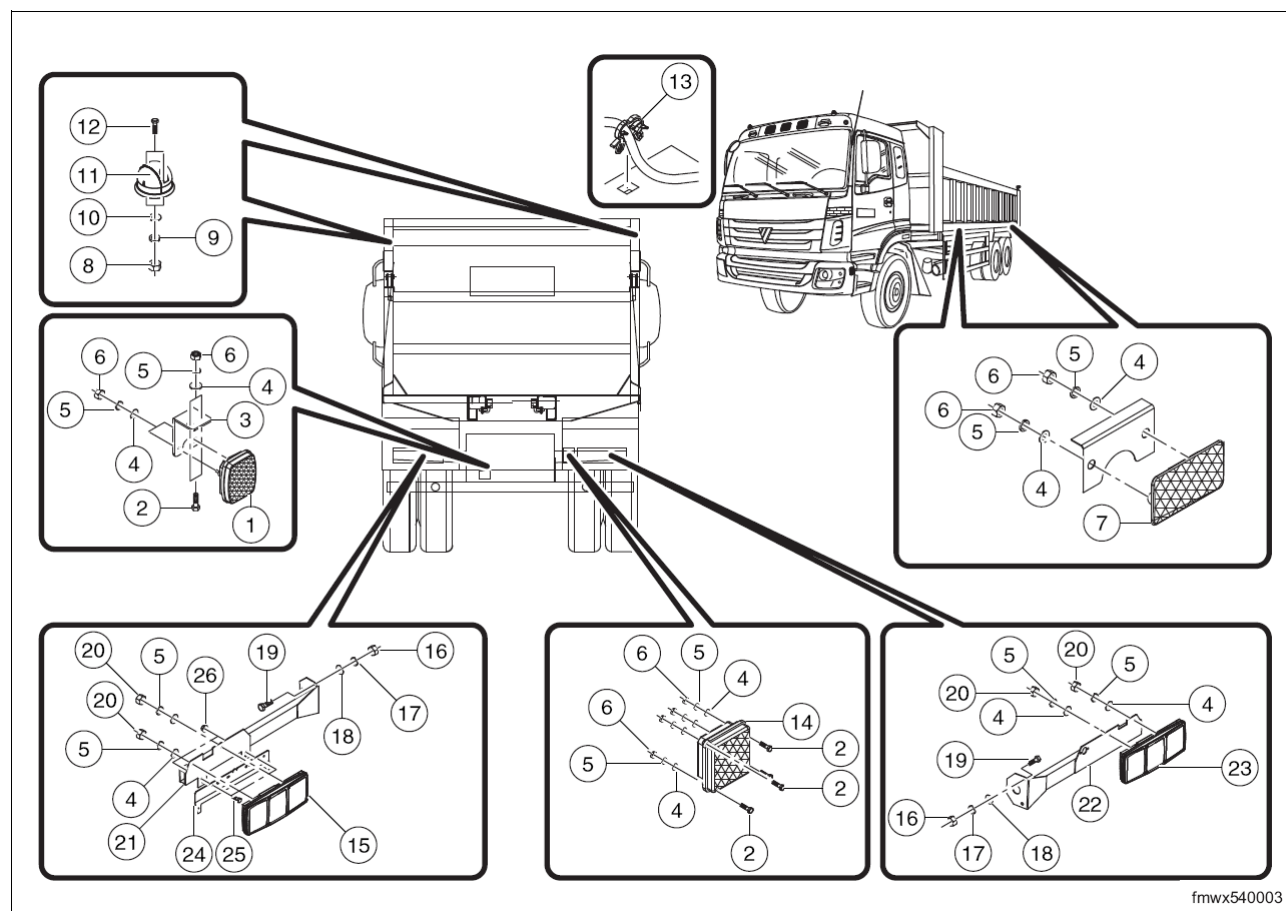
5	Hex Nut
6	Spring Washer
7	Flat Washer
8	LH Turn Signal Assembly

Lighting - Lighting system



1	Hex Nut, Style 1
2	Clearance Lamp
3	Spring Washer
4	RH Side Marker Lamp Assembly
5	RH Decoration Lamp Assembly
6	Cross Recessed Pan Head Screw

7	RH Step Lamp
8	LH Step Lamp
9	LH Side Marker Lamp Assembly
10	LH Decoration Lamp Assembly
11	Hex Head Bolt, Spring Washer and Flat Washer Assembly
12	Interior Lamp



1	RR Fog Lamp
2	Hex Head Bolt
3	RR Fog Lamp Fixation
4	Flat Washer
5	Spring Washer
6	Hex Nut, Style 1
7	Side Marker Lamp
8	Nut
9	Spring Washer
10	Flat Washer
11	Rear Clearance Lamp
12	Hex Head Bolt
13	Fine Corrugated Pipe Wire Clamp

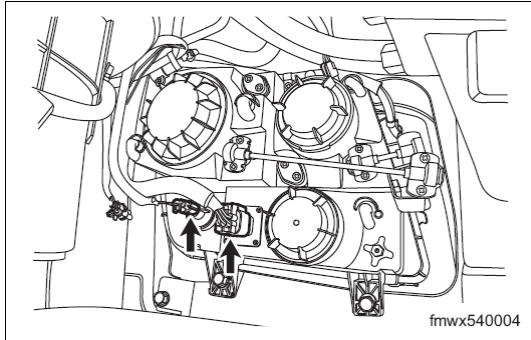
14	Reversing Lamp
15	LH Combination Tail Lamp
16	Hex Nut, Style 1
17	Spring Washer
18	Flat Washer
19	Hex Head Bolt
20	Hex Nut, Style 1
21	LH Combination Tail Lamp Fixation
22	RH Combination Tail Lamp Fixation
23	RH Combination Tail Lamp
24	RR License plate Support Assembly
25	Bolt
26	Hex Flange Face Nut

Front Combination Lamp Replacement

Hint:

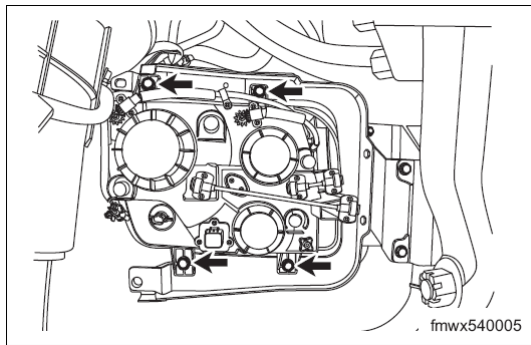
Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.

1. Open the driver's cab.



2. Dismantle the left front combination lamp assembly.

- (a). Remove the front combination lamp connector.

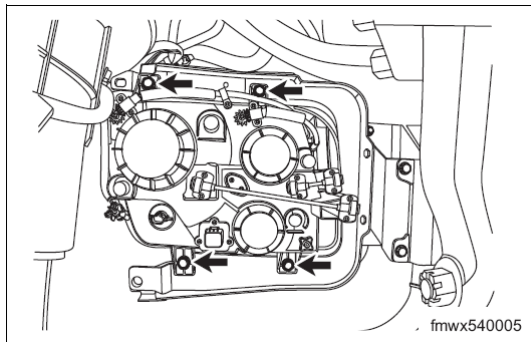


- (b). Dismantle the fixing bolt of the left front combination lamp, and remove the left front combination lamp assembly.

Hint:

The steps to dismantle the right front combination lamp assembly are the same as those to dismantle the left front combination lamp assembly.

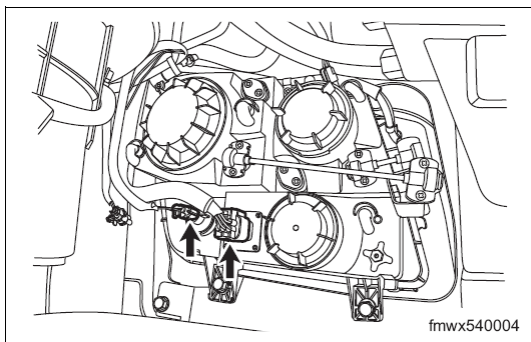
54



3. Install the left front combination lamp assembly.

- (a). Install the fixing bolt of the left front combination lamp.

Torque: 63N.m



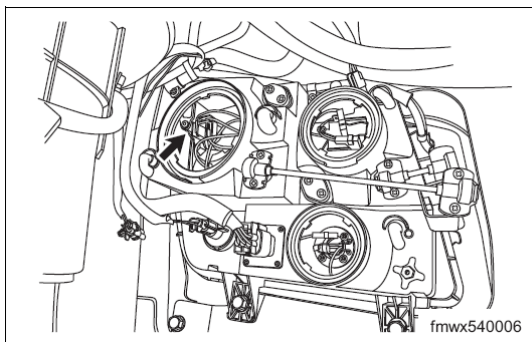
- (b). Connect the front combination lamp connector.

Hint:

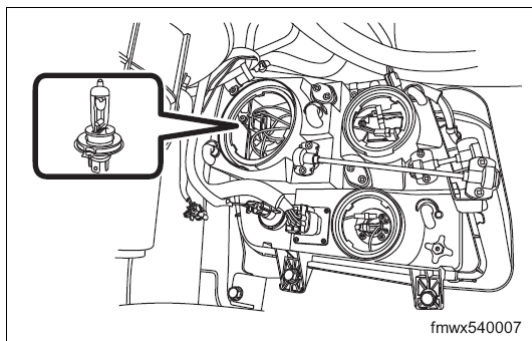
The steps to install the right front combination lamp assembly are the same as those to install the left front combination lamp assembly.

4. Close the driver's cab.

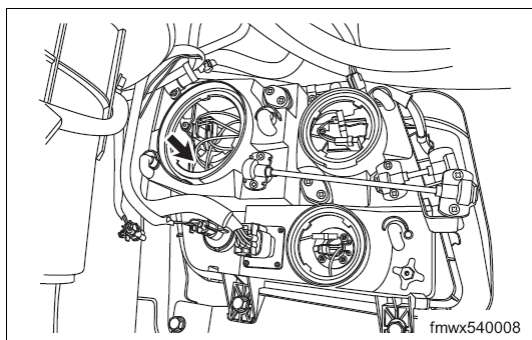
5. Adjust the front combination lamp assembly, refer to Chapter 54, Lighting - Front Combination Lamp, Adjustment.



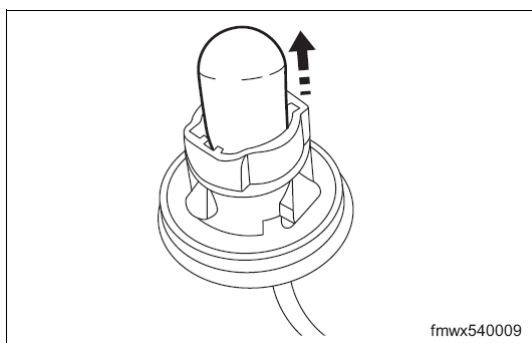
1. **Dismantle the left front low beam bulb.**
 - (a). Dismantle the sealing cover, and disconnect the connector.



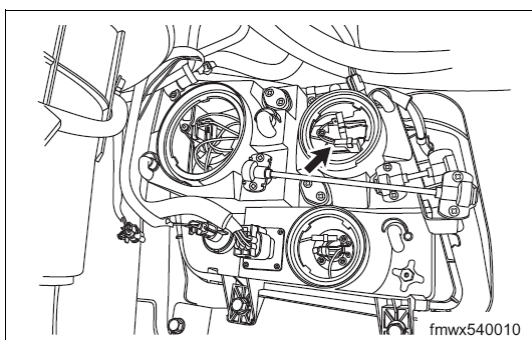
- (b). Loosen the steel buckle, and remove the low beam bulb.



2. **Dismantle the left front side lamp bulb.**
 - (a). Screw out the side lamp holder.

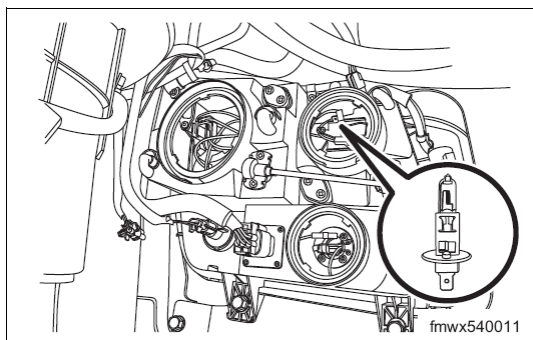


- (b). Dismantle the side lamp bulb.

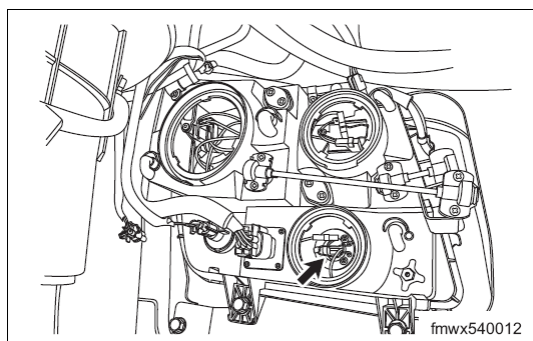


3. **Dismantle the left front high beam bulb.**
 - (a). Dismantle the sealing cover, and disconnect the connector.

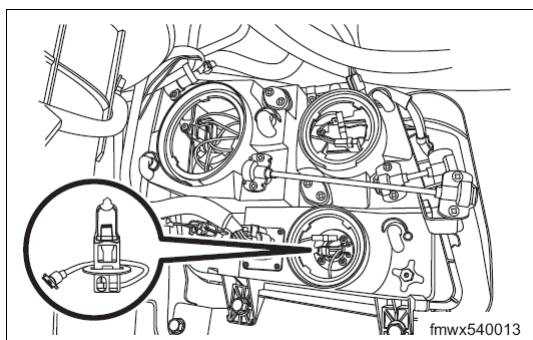
Lighting - Front Combination Lamp



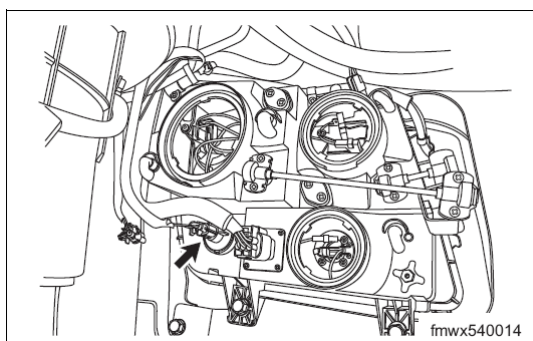
- (b). Loosen the steel buckle, and remove the high beam bulb.



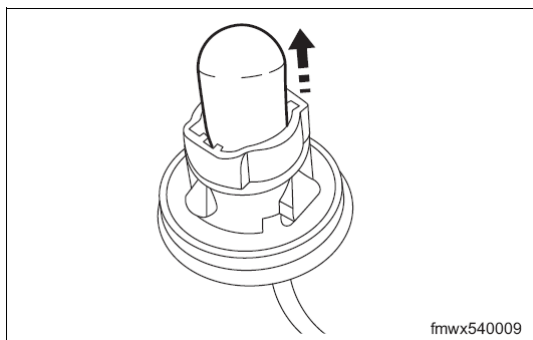
- 4. Dismantle the left front fog lamp bulb.**
(a). Dismantle the sealing cover, and disconnect the connector.



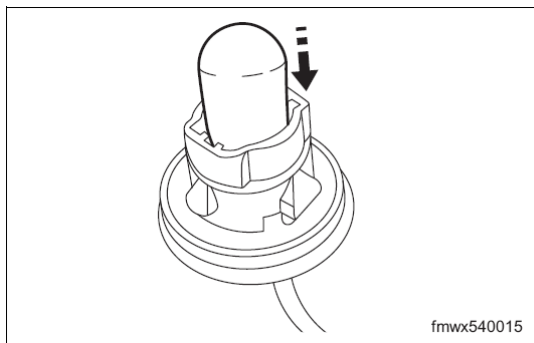
- (b). Loosen the steel buckle, and remove the fog lamp bulb.



- 5. Dismantle the left front turn signal lamp bulb.**
(a). Screw out the turn signal lamp holder.

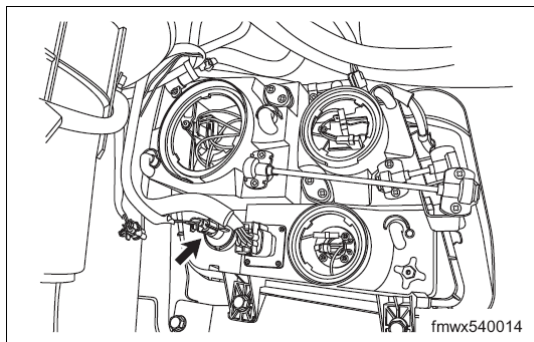


- (b). Dismantle the turn signal lamp bulb.
Hint:
The steps to dismantle the right front combination lamp bulb are the same as those to dismantle the left front combination lamp bulb.

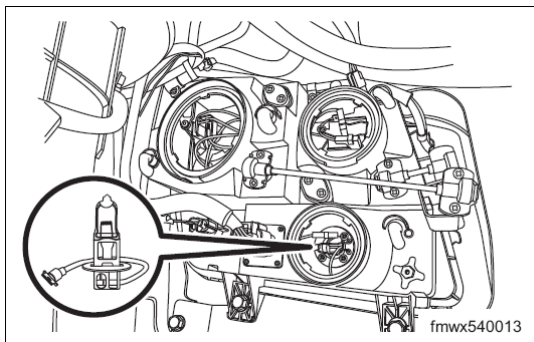


6. Install the left front turn signal lamp bulb.

(a). Install the turn signal lamp bulb.

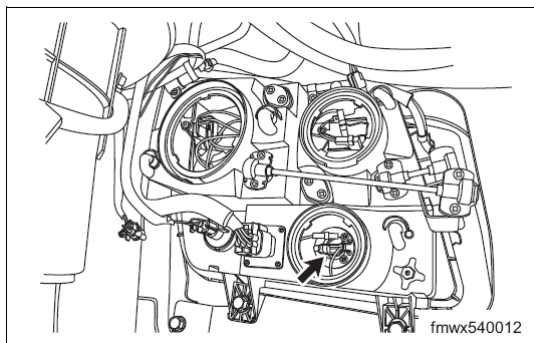


(b). Screw in the turn signal lamp holder.

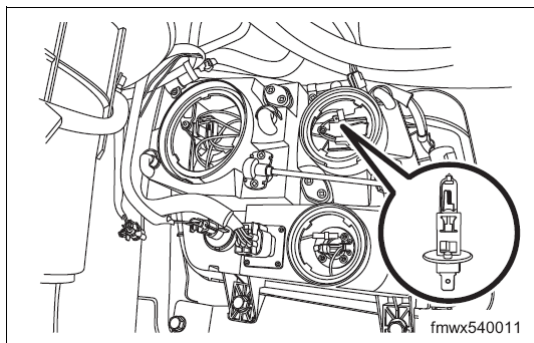


7. Install the left front fog lamp bulb.

(a). Install the fog lamp bulb, and clasp the steel buckle.



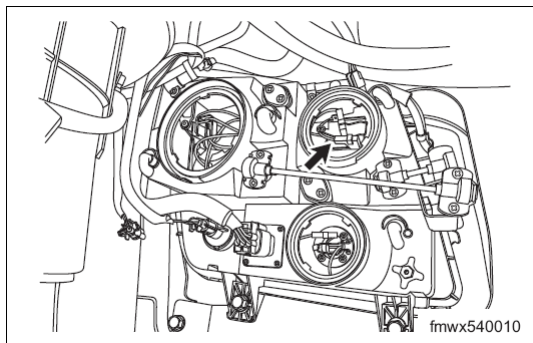
(b). Connect the connector, and install the sealing cover.



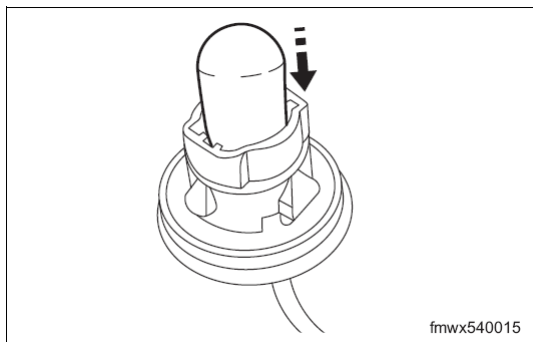
8. Install the left front high beam bulb.

(a). Install the high beam bulb, and fasten the steel buckle.

Lighting - Front Combination Lamp

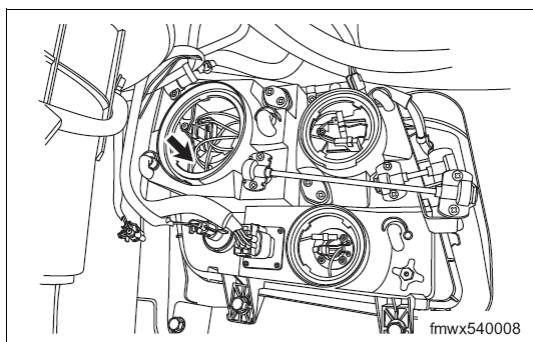


- (b). Connect the connector, and install the sealing cover.

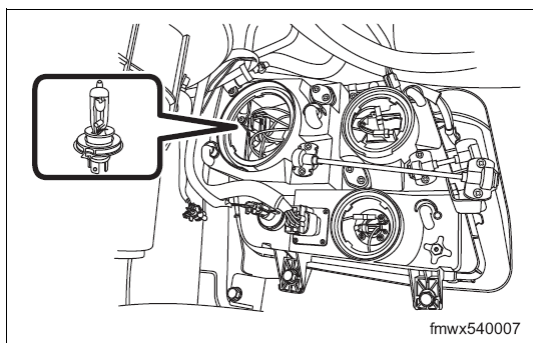


9. Install the left front side lamp bulb.

- (a). Install the side lamp bulb.

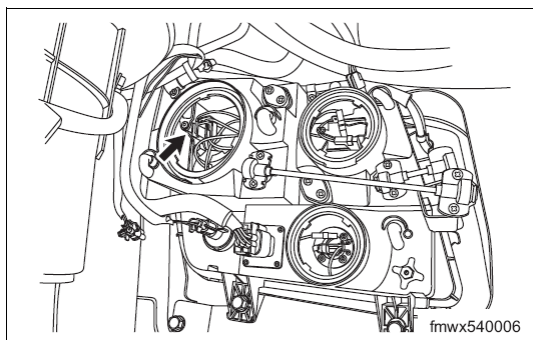


- (b). Screw in the side lamp holder.



10. Install the left front low beam bulb.

- (a). Install the low beam bulb, and fasten the steel buckle.



- (b). Connect the connector, and install the sealing cover.

Hint:

The steps to install the right front combination lamp bulb are the same as those to install the left front combination lamp bulb.

Lighting - Front Combination Lamp

11. Adjust the front combination lamp assembly, refer to Chapter 54, Lighting -Front Combination Lamp, Adjustment.

Adjustment

1. Adjustment of Headlamp Illumination Range

(a). Adjust the vehicle to the following conditions.

- The surroundings of the front combination lamp may not be deformed.
- Stop the vehicle on flat ground.
- The tire pressure should be at the standard value (Refer to "Chapter 23, Tire and Wheel - Tire and Wheel Assembly, Testing & Adjustment").
- The driver sits in the vehicle, and the vehicle must stay in a readily movable state (full tank).

(b). Check the headlamp illumination range.

- Prepare a thick piece of white paper.
- Put the paper perpendicular to the ground at a position 3m away from the front combination lamp.
- Make sure that the centerline of the vehicle and the paper form a 90° angle.
- Draw a horizontal line on the paper to indicate the position that the light of the headlamp should reach.
- Draw a vertical line on the paper to indicate the position where the central line locates.
- Draw two vertical lines to indicate the position that the light of the headlamp should reach (the line perpendicular to the right headlamp and line perpendicular to the left headlamp).
- Draw a horizontal line (connecting the two markers of the centers of the two dipped headlamps) to indicate the position that the light of the headlamp should reach (the horizontal line of the right front combination lamp and the horizontal line of the left front combination lamp).
- Be sure to measure in an appropriate method and try to avoid impact on the other lights.
- Adjust the horizontal position of the headlamps to "0" position, and then adjust the angle of the front combination lamp.

Hint:

The horizontal line of the right headlamp and the horizontal line of the left headlamp should be 0.4° lower than the ground level.

- Start the engine.
- Turn on the front combination lamp.
- Check whether the illumination range of the headlamps meet the requirements.
- If it doesn't meet the requirements, adjust along the vertical direction of the headlamps.

(c). Adjust the headlamp illumination range along the vertical direction: Tighten the adjustment bolt to adjust the headlamp illumination range to the standard range.

Hint:

Turn the screwdriver clockwise, and the illumination range will move up. Turn the screwdriver counterclockwise, and the illumination range will move down.

2. Adjustment of the Front Fog Lamp Illumination Range

(a). Fog lamp illumination range can be adjusted in the vertical direction by turning the adjustment bolt.

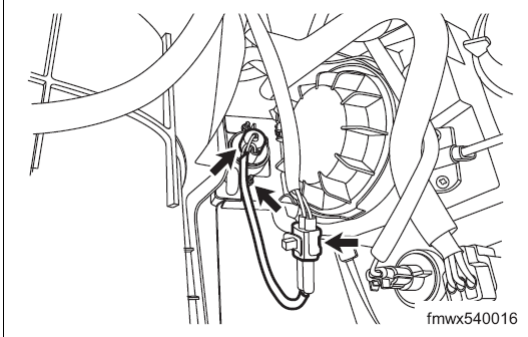
Hint:

Turn the screwdriver clockwise, and the illumination range will move up. Turn the screwdriver counterclockwise, and the illumination range will move down.

Turn Signal Lamp Replacement

Hint:

Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.

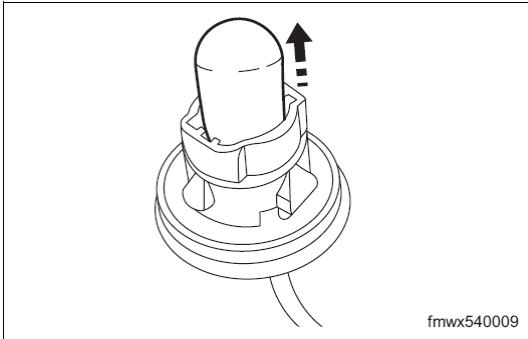


1. Dismantle the left turn signal assembly

- (a). Disconnect the connector of the left turn signal lamp.
- (b). Dismantle the fixing nut of the left turn signal assembly, and remove the turn signal lamp assembly.

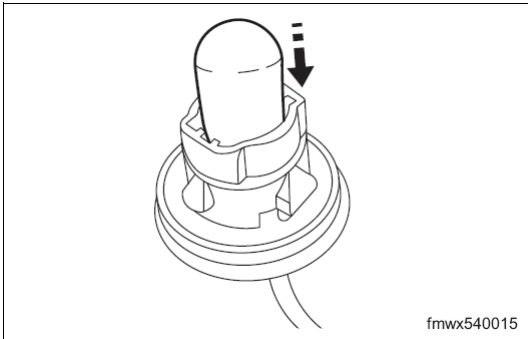
Hint:

The steps to dismantle the left turn signal assembly are the same as those to dismantle the left turn signal assembly.



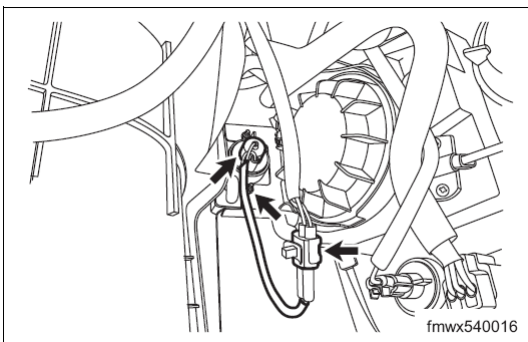
2. Dismantle the turn signal lamp bulb

- (a). Screw out the turn signal lamp holder.
- (b). Dismantle the turn signal lamp bulb.



3. Install the turn signal lamp bulb.

- (a). Install the turn signal lamp bulb.
- (b). Screw in the turn signal lamp holder.



4. Install the left turn signal assembly.

- (a). Install the fixing nut of the left turn signal assembly.
- (b). Connect the connector of the left turn signal lamp.

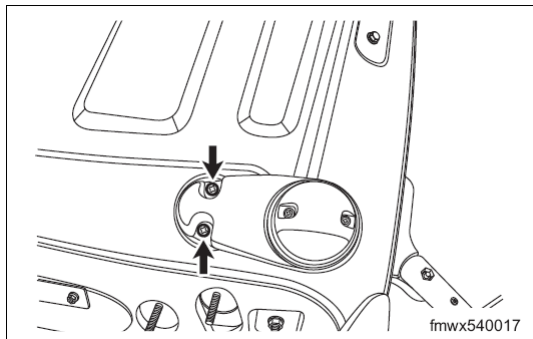
Hint:

The steps to assemble the left turn signal assembly are the same as those to assemble the left turn signal assembly.

Clearance Lamp Replacement

Hint:

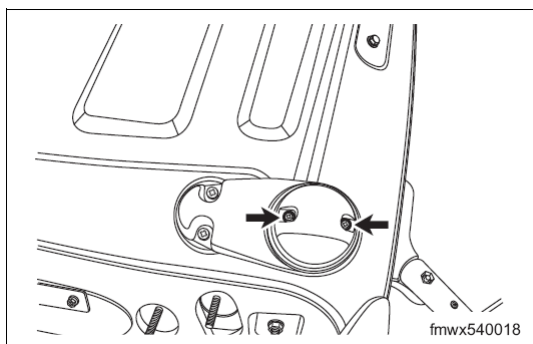
Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.



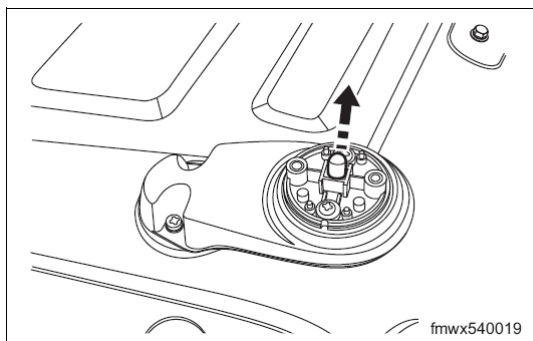
1. **Dismantle the left clearance lamp assembly**
 - (a). Dismantle the fixing screws of the left clearance lamp.
 - (b). Disconnect the connector of the clearance lamp, and remove the clearance lamp assembly.

Hint:

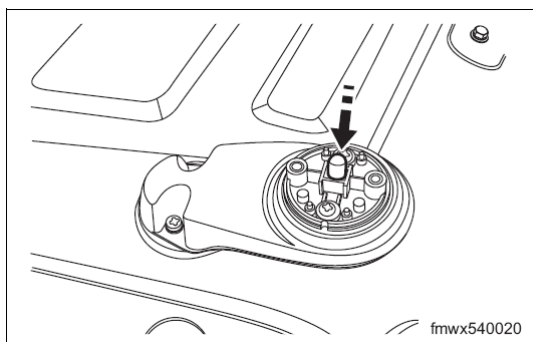
The steps to dismantle the right clearance lamp assembly are the same as those to dismantle the left clearance lamp assembly.



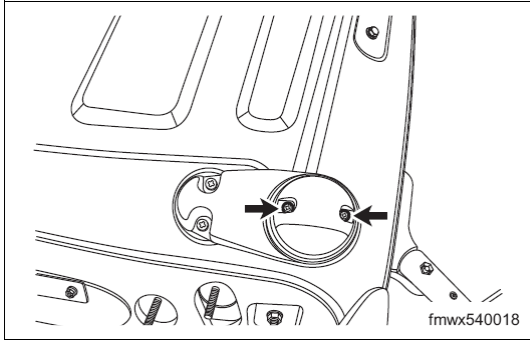
2. **Dismantle the clearance lamp bulb.**
 - (a). Dismantle the lampshade fixing screws of the clearance lamp, and remove the lampshade.



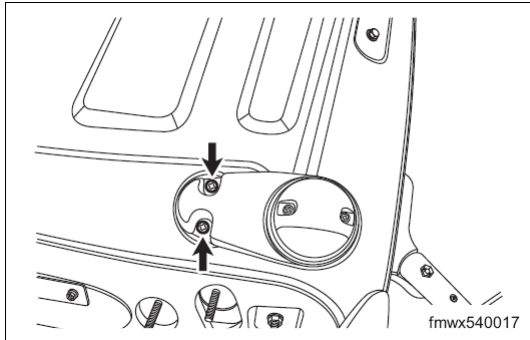
- (b). Pull out the clearance lamp bulb.



3. **Install the clearance lamp bulb.**
 - (a). Install the clearance lamp bulb.



- (b). Install the lampshade fixing screws of the clearance lamp.



4. Install the left clearance lamp assembly.

- (a). Connect the connector of the clearance lamp.
(b). Install the fixing screws of the left clearance lamp.

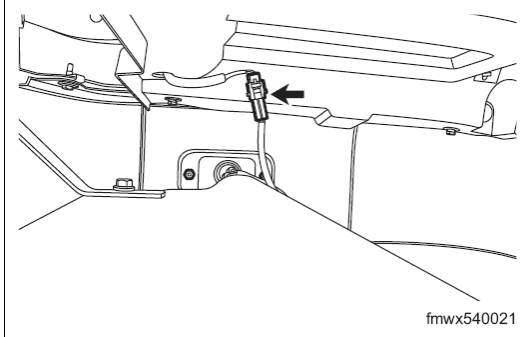
Hint:

The steps to install the right clearance lamp assembly are the same as those to install the left clearance lamp assembly.

Marker Lamp Replacement

Hint:

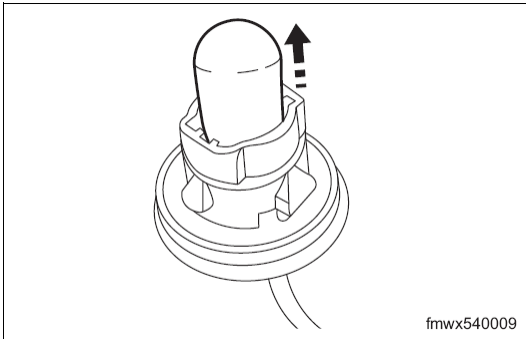
Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.



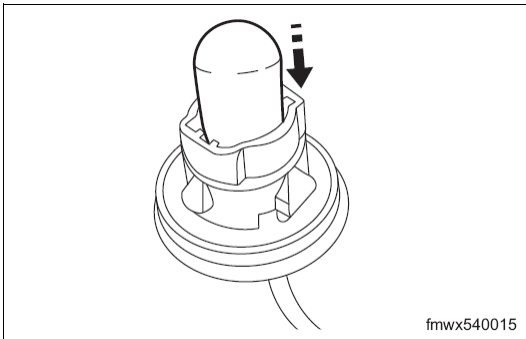
- 1. Dismantle the left front marker lamp assembly**
 - (a). Disconnect the connector of the left front marker lamp.
 - (b). Dismantle the fixing nut of the left front marker lamp assembly, and remove the marker lamp assembly.

Hint:

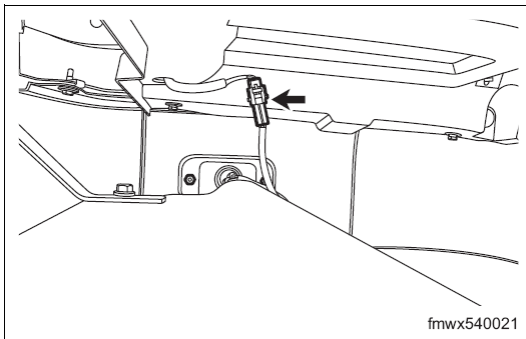
The steps to dismantle the right front marker lamp assembly are the same as those to dismantle the left front marker lamp assembly.



- 2. Dismantle the marker lamp bulb**
 - (a). Screw out the marker lamp holder.
 - (b). Dismantle the marker lamp bulb.



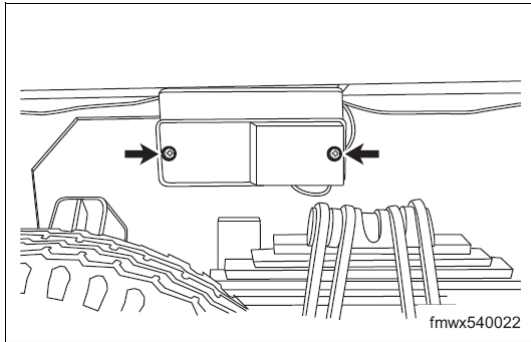
- 3. Install the marker lamp bulb**
 - (a). Install the marker lamp bulb.
 - (b). Screw in the marker lamp holder.



- 4. Install the left front marker lamp assembly**
 - (a). Install the left front marker lamp assembly fixing nut of the left front marker lamp assembly.
 - (b). Connect the connector of the left front marker lamp.

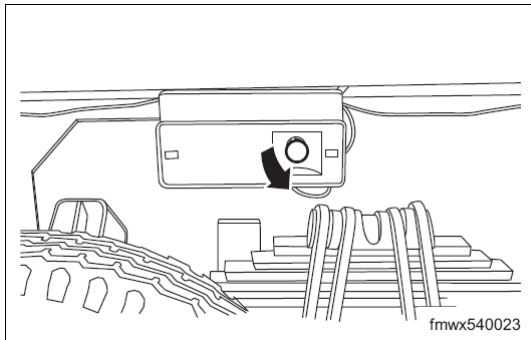
Hint:

The steps to install the right front marker lamp assembly are the same as those to install the left front marker lamp assembly.



5. Dismantle the left rear marker lamp bulb

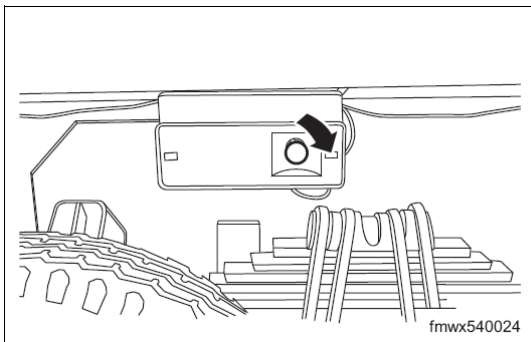
- (a). Dismantle the lampshade fixing screws of the left rear marker lamp.



- (b). Screw out the marker lamp bulb.

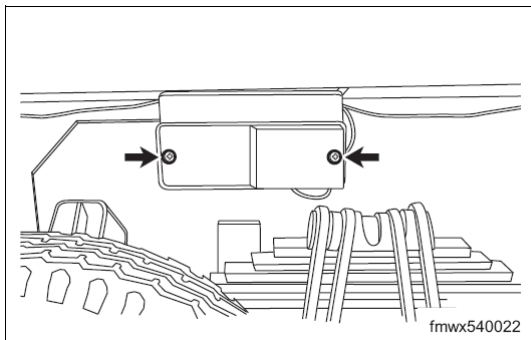
Hint:

The steps to dismantle the right rear marker lamp bulb are the same as those to dismantle the left rear marker lamp bulb



6. Install the left rear marker lamp bulb

- (a). Screw in the marker lamp bulb.



- (b). Install the lampshade fixing screws of the left rear marker lamp.

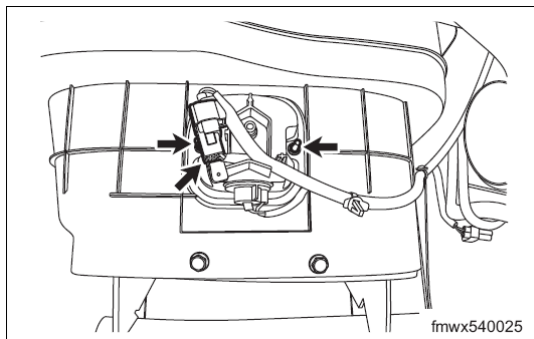
Hint:

The steps to install the right rear marker lamp bulb are the same as those to install the left rear marker lamp bulb.

Step Lamp Replacement

Hint:

Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.

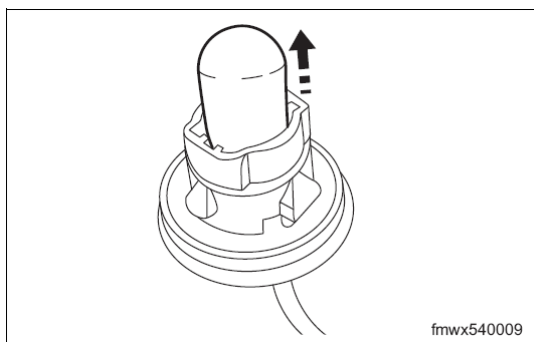


1. Dismantle the left step lamp assembly

- Disconnect the connector of the step lamp.
- Dismantle the fixing nut of the step lamp, and remove the step lamp assembly.

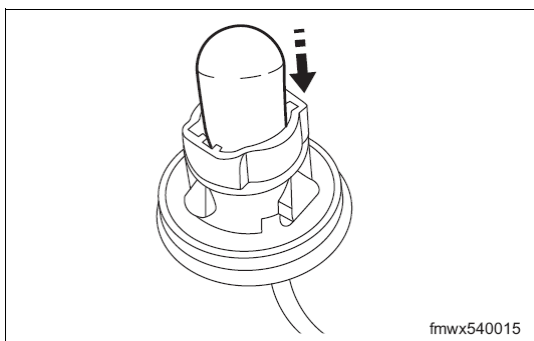
Hint:

The steps to dismantle the right step lamp assembly are the same as those to dismantle the left step lamp assembly.



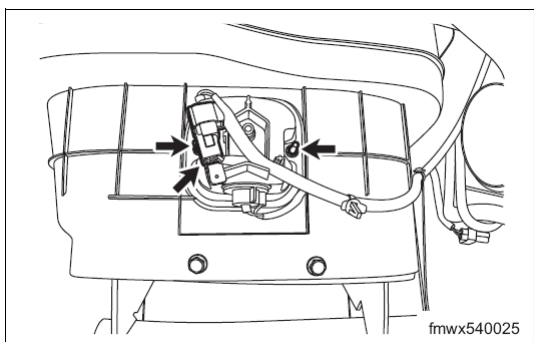
2. Dismantle the step lamp bulb

- Screw out the step lamp holder.
- Dismantle the step lamp bulb.



3. Install the step lamp bulb

- Install the step lamp bulb.
- Screw in the step lamp holder.



4. Install the left step lamp assembly

- Install the fixing nut of the step lamp.
- Connect the connector of the step lamp.

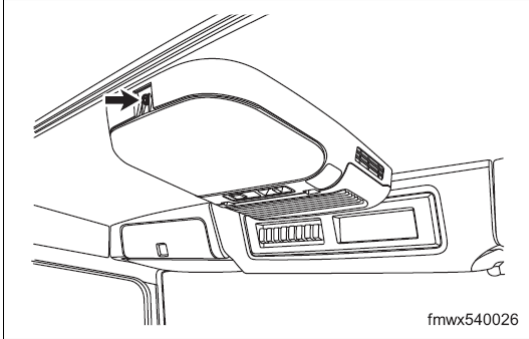
Hint:

The steps to install the right step lamp assembly are the same as those to install the left step lamp assembly.

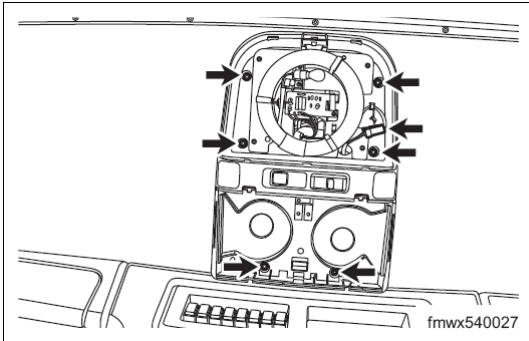
Interior Lamp Replacement

Hint:

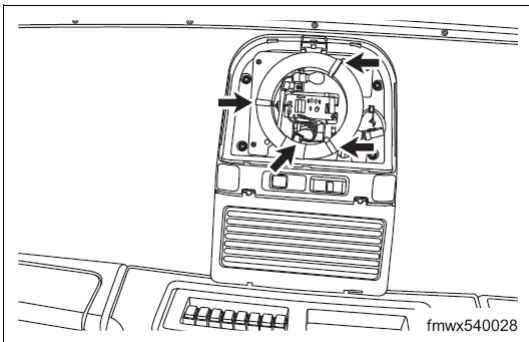
Part Drawing, refer to Chapter 54, Lighting - Lighting System, Part Drawing.



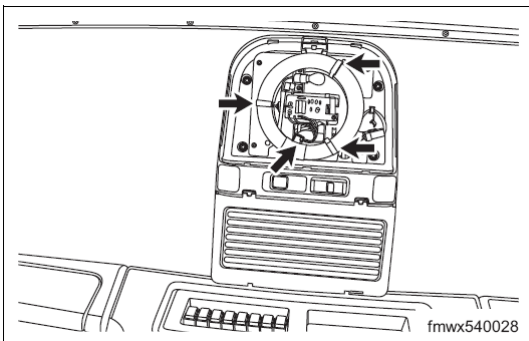
- 1. Dismantle the interior lamp assembly**
 - (a). Prize up the blank cap of the lampshade screw.
 - (b). Dismantle the lampshade fixing screws, and remove the lampshade.
 - (c). Dismantle the trim panel of the Interior Lamp.



- (d). Disconnect the connector, dismantle the fixing bolt of the interior lamp, and remove the interior lamp assembly.

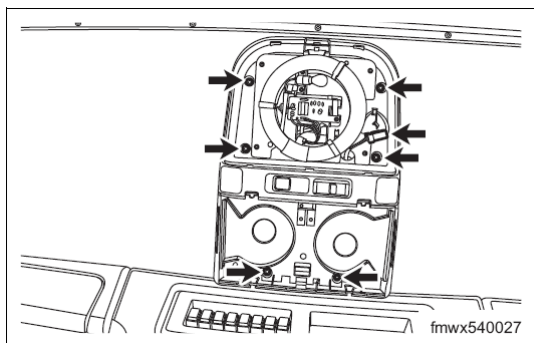


- 2. Dismantle the interior lamp bulb**
 - (a). Disconnect the connector of the interior lamp bulb.
 - (b). Loosen the steel buckle, and remove the interior lamp bulb.



- 3. Install the interior lamp bulb**
 - (a). Clasp the steel buckle.
 - (b). Connect the connector of the interior lamp bulb.

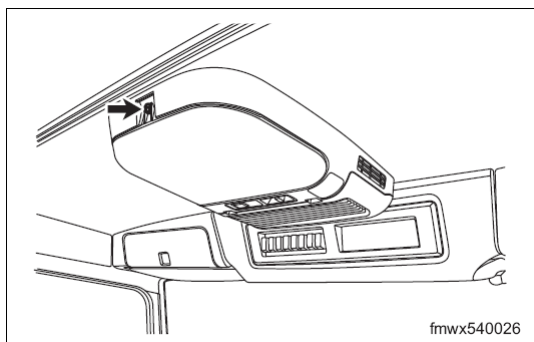
Lighting - Interior Lamp



4. Install the interior lamp assembly

- (a). Install the fixing bolt of the interior lamp, and connect the connector.

Torque: 23N.m

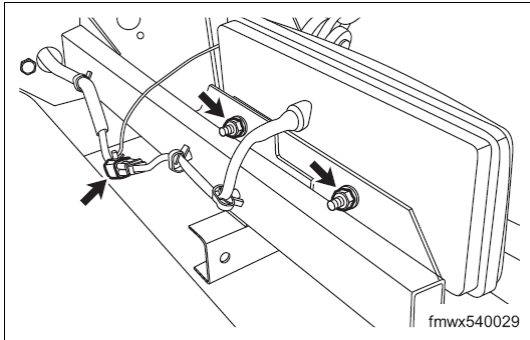


- (b). Install the trim panel of the interior lamp.
(c). Install the lampshade fixing screws.
(d). Install the blank cap of the lampshade screw.

Combination Tail Lamp

Replacement

Part Drawing, refer to Chapter 54, Lighting-Lighting System, Part Drawing.

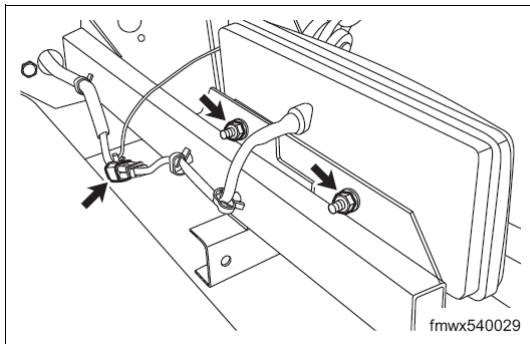


1. Dismantle the left combination tail lamp assembly

- (a). Disconnect the connector of the left combination tail lamp assembly.
- (b). Dismantle the fixing nut of the left combination tail lamp assembly, and remove the left combination tail lamp assembly.

Hint:

The steps to dismantle the right combination tail lamp assembly are the same as those to dismantle the left combination tail lamp assembly.

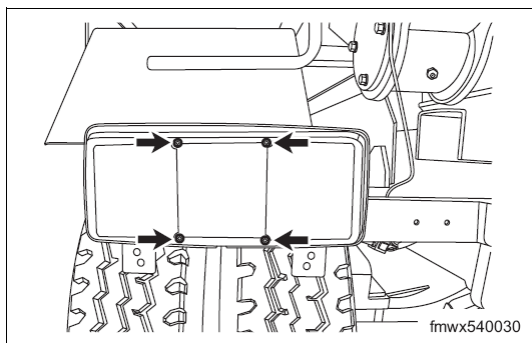


2. Install the left combination tail lamp assembly

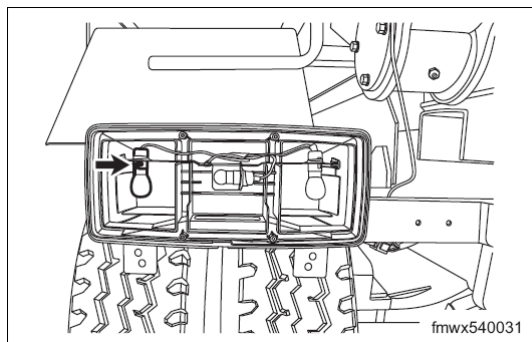
- (a). Install the fixing nut of the left combination tail lamp assembly.
- (b). Connect the connector of the left combination tail lamp assembly.

Hint:

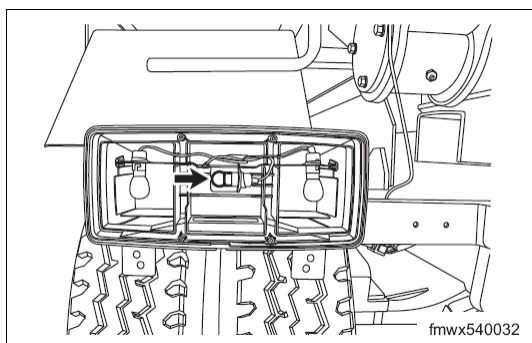
The steps to install the right combination tail lamp assembly are the same as those to install the left combination tail lamp assembly.

Lighting - Combination Tail Lamp

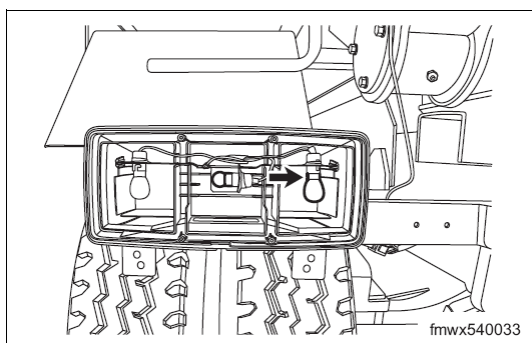
- 1. Dismantle the left combination tail lamp bulbs**
- (a). Dismantle the lampshade fixing screws of the left combination tail lamp.



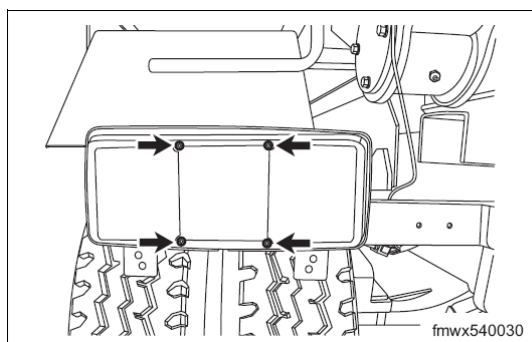
- (b). Dismantle the left rear turn signal lamp bulb.



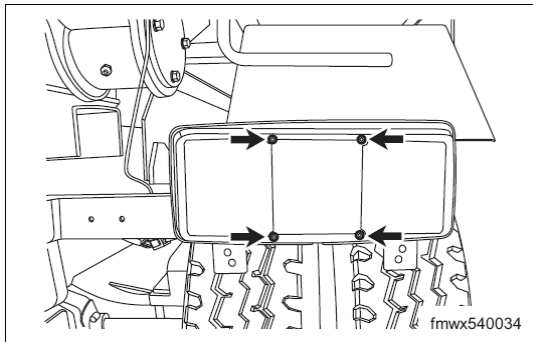
- (c). Dismantle the right rear stop lamp bulb.



- (d). Dismantle the reversing lamp bulb.

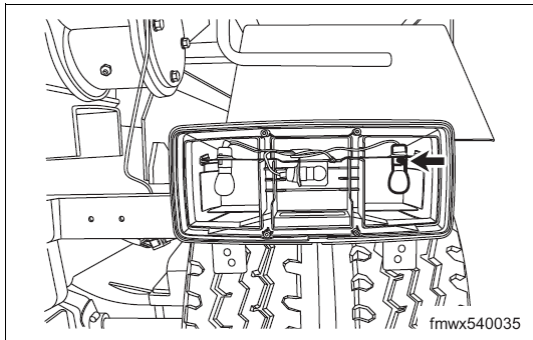


- 2. Install the left combination tail lamp bulbs**
- (a). Install the left combination tail lamp bulbs.
Hint:
The bulbs can be installed one by one in sequence.
- (b). Install the lampshade fixing screws of the left combination tail lamp.

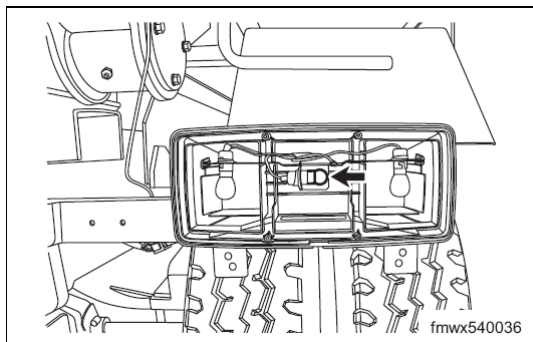


3. Dismantle the right combination tail lamp bulbs

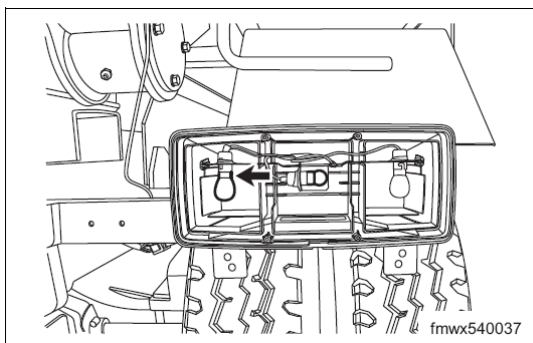
- (a). Dismantle the lampshade fixing screws of the right combination tail lamp.



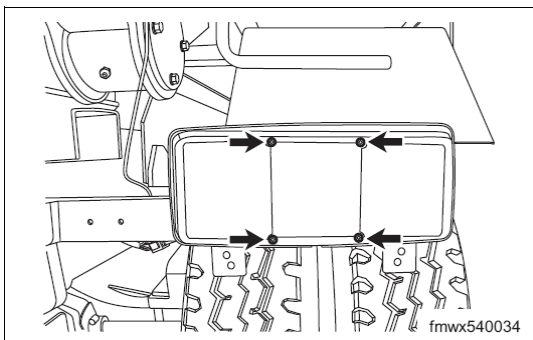
- (b). Dismantle the right rear turn signal lamp bulb.



- (c). Dismantle the right rear stop lamp bulb.



- (d). Dismantle the reversing lamp bulb.



4. Install the right combination tail lamp bulbs

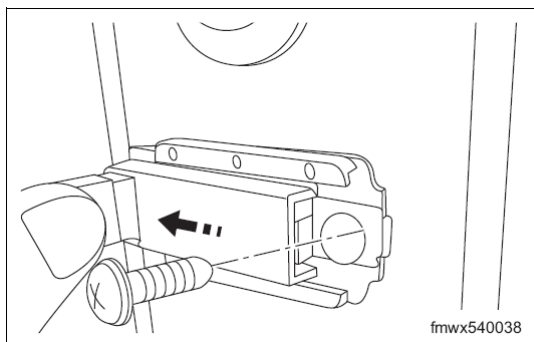
- (a). Install the right combination tail lamp bulbs.

Hint:

The bulbs can be installed one by one in sequence.

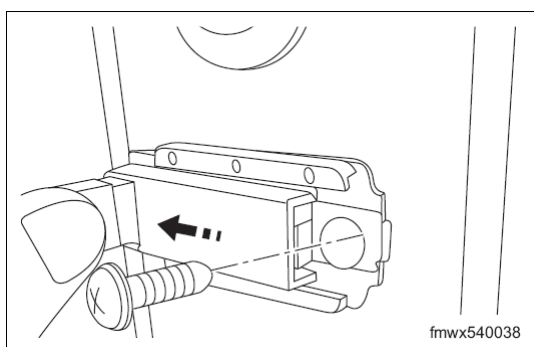
- (b). Install the lampshade fixing screws of the right combination tail lamp.

Door Lamp Switch Replacement



1. Dismantle the left door lamp switch

- (a). Prop the door lamp switch, and dismantle fixing screws of the door lamp switch.
- (b). Disconnect the connector, and dismantle the door lamp switch.



2. Install the left door lamp switch

- (a). Connect the connector of the door lamp switch.
- (b). Prop the door lamp switch, and install the fixing screws of the door lamp switch.

Wiper & Washer

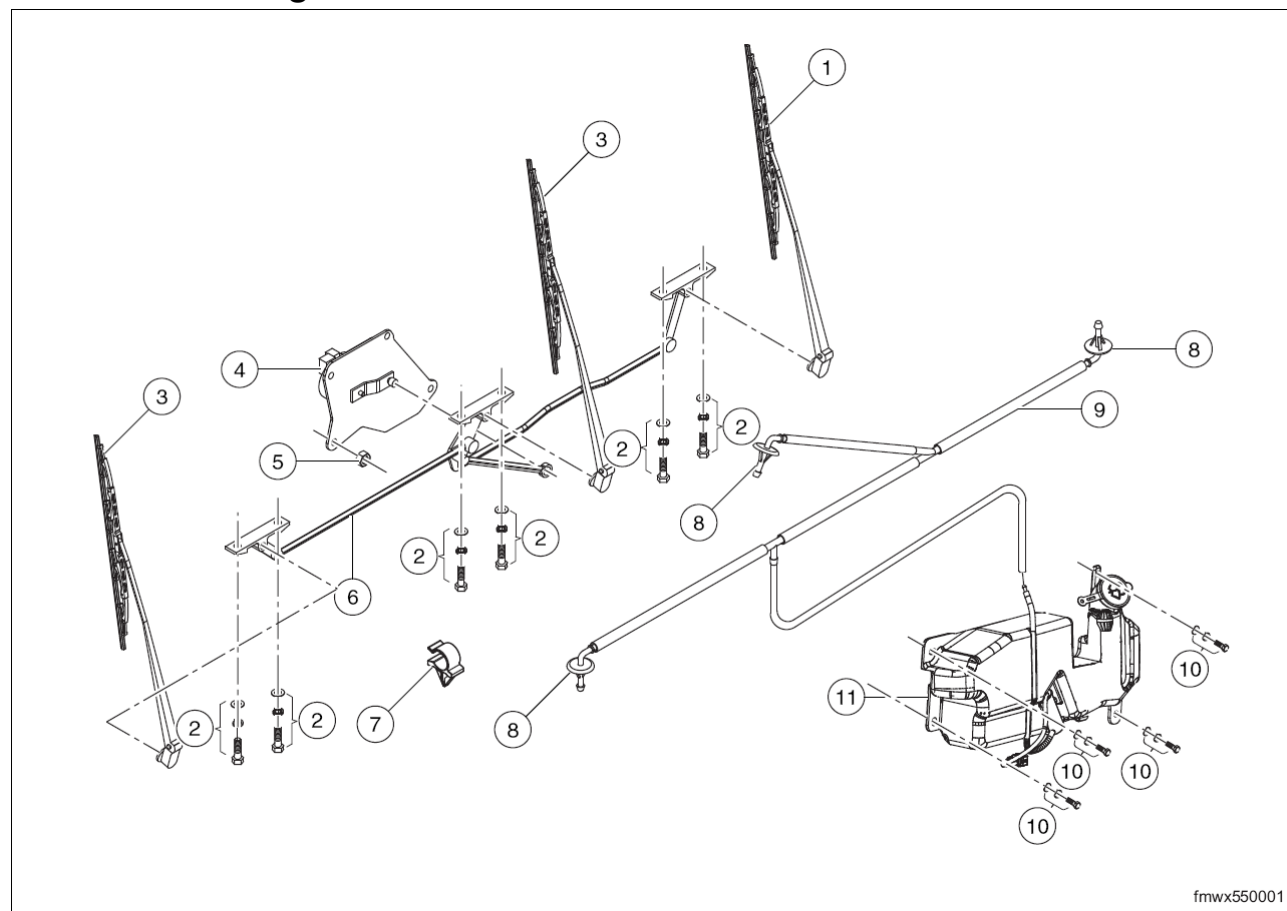
Wiper & Washer	55-3
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Link Gear	55-6
Replacement.....	55-6
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Replacement.....	55-8
Washer	55-9
Replacement.....	55-9
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Replacement.....	55-10

Wiper & Washer

Precautions

1. DO NOT operate the wiper when the windshield is dry, otherwise the windscreen will be scratched.
 2. DO NOT operate the wiper if it is sticky or frozen because of snow, otherwise the wiper system will be damaged.
 3. Cleaning solution should be added in the washing tank. DO NOT operate the washer when no cleaning solution is in the washing tank, otherwise the washer motor will be damaged.
 4. Cut off the power
 - (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
 - (b). Turn off the ignition switch, unless otherwise specified.
- .

Part Drawing



1	LH Wiper Blade Assembly
2	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
3	RH Wiper Blade Assembly
4	Wiper Motor Assembly
5	Prevailing torque type all-metal hexagon nuts with flange
6	Wiper Link Gear Assembly

7	Pipe Clamp
8	Double Junction
9	Water Pipe Assembly
10	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
11	Washing Tank Assembly

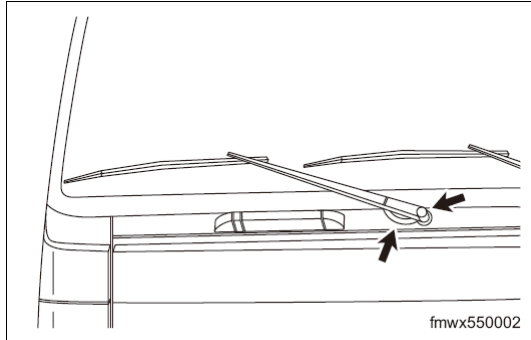
Wiper Arm Assembly

Replacement

Hint:

Part Drawing, refer to Chapter 55, Wiper & Washer -Wiper & Washer Assembly, Part Drawing.

1. Run the wiper arm to auto stop position

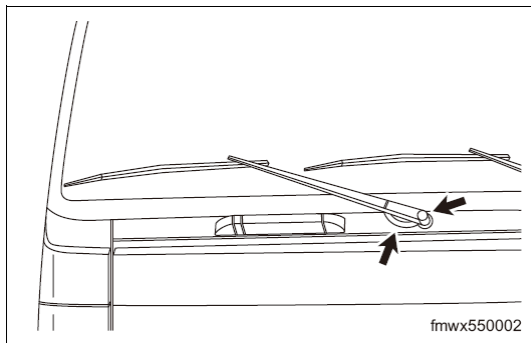


2. Dismantle the right wiper arm assembly

- Disconnect the nozzle pipe.
- Prize up the blank cap of the wiper arm.
- Dismantle the fixing nut of the wiper arm assembly.

Hint:

The steps to dismantle the left and the middle wiper arm assemblies are the same as those to dismantle the right wiper arm assembly.



3. Install the right wiper arm assembly

- Install the fixing nut of the wiper arm assembly.
- Install the blank cap of the wiper arm.
- Connect the nozzle pipe.

Hint:

The steps to install the left and the middle wiper arm assemblies are the same as those to install the right wiper arm assembly.

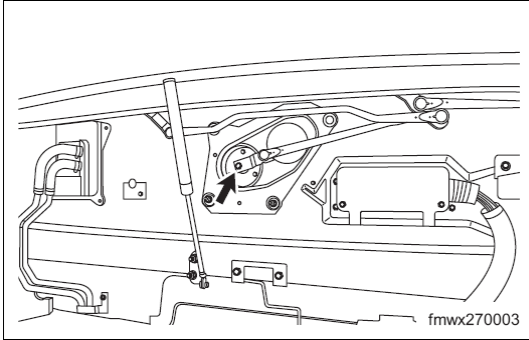
4. Check whether the wiper arm works smoothly and whether it returns normally.

Link Gear Replacement

Hint:

Part Drawing, refer to Chapter 55, Wiper & Washer -Wiper & Washer Assembly, Part Drawing.

1. Dismantle the wiper arm assembly, refer to Chapter 55, Wiper & Washer-Wiper Arm Assembly, Replacement.
2. Open the front turnover cover

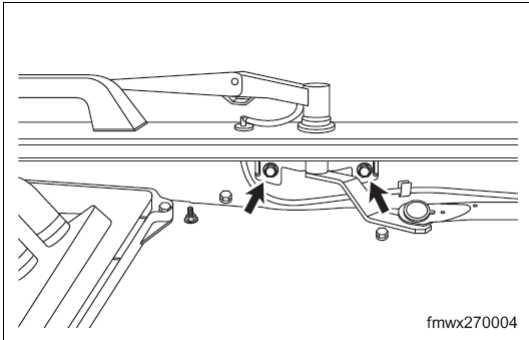


3. Dismantle the link gear assembly

- (a). Dismantle the connecting nut for the wiper motor and the link gear.

Caution:

Proper marking is required when dismantling so as to ensure accuracy of installation.

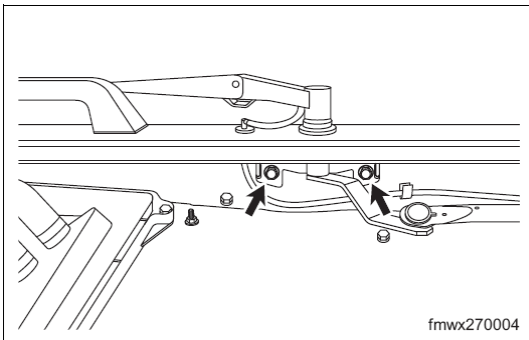


- (b). Dismantle the fixing bolts of the right link gear.

Hint:

The steps to dismantle fixing bolts on the left and in the middle are the same as those to dismantle the bolts on the right.

- (c). Remove the link gear assembly.



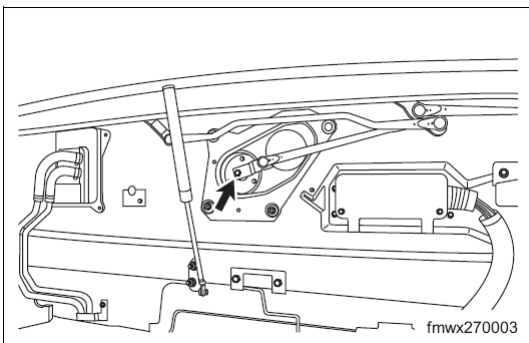
4. Install the link gear assembly

- (a). Install the fixing bolts of the right link gear.

Hint:

The steps to install fixing bolts on the left and in the middle are the same as those to install the bolts on the right.

Torque: 23N.m



- (b). Install the connecting nut for the wiper motor and the link gear.

Torque: 63N.m

Caution:

Corresponding Proper marking is required when dismantling so as to ensure accuracy of installation.

Wiper & Washer - Link Gear

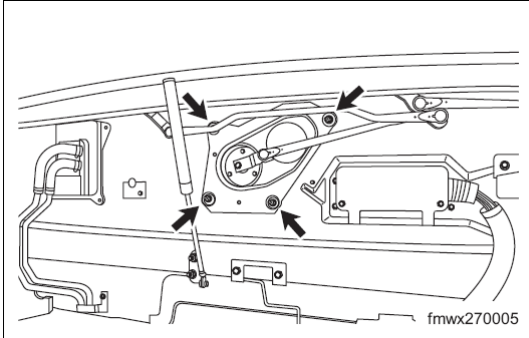
5. Close the front turnover cover
6. Install the wiper arm assembly, refer to Chapter 55, Wiper & Washer-Wiper Arm Assembly, Replacement.

Wiper Motor Replacement

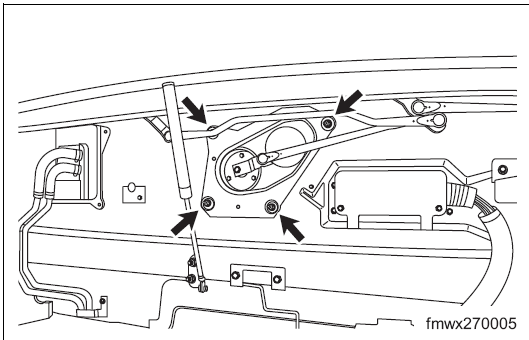
Hint:

Part Drawing, refer to Chapter 55, Wiper & Washer-Wiper & Washer Assembly, Part Drawing.

1. Dismantle the wiper arm assembly, refer to Chapter 55, Wiper & Washer-Wiper Arm Assembly, Replacement
2. Open the front turnover cover.
3. Dismantle the link gear assembly, refer to Chapter 55, Wiper & Washer-Link Gear, Replacement.



4. Dismantle the wiper motor assembly
 - (a). Dismantle the wiper motor fixing nut.
 - (b). Disconnect the connector of the wiper motor.



5. Install the wiper motor assembly
 - (a). Connect the connector of the wiper motor.
 - (b). Install the wiper motor fixing nut.

Torque: 63N.m

6. Install the link gear assembly, refer to Chapter 55, Wiper & Washer-Link Gear, Replacement.
7. Close the front turnover cover
8. Install the wiper arm assembly, refer to Chapter 55, Wiper & Washer-Wiper Arm Assembly, Replacement.

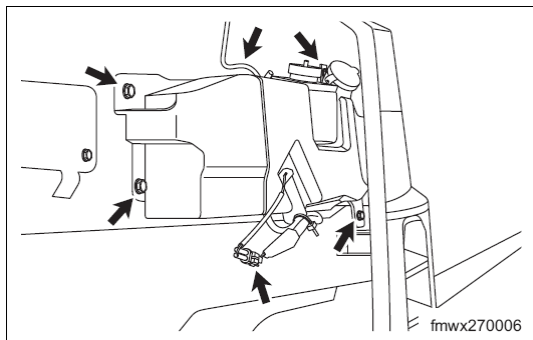
Washer

Replacement

Hint:

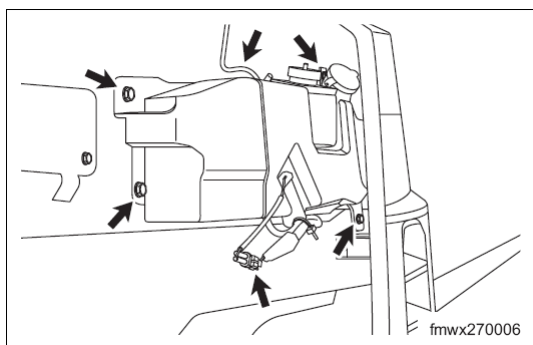
Part Drawing, refer to Chapter 55, Wiper & Washer-Wiper & Washer Assembly, Part Drawing.

1. Open the front turnover cover



2. Dismantle the washer assembly

- (a). Disconnect the washer hose and the washer motor connector.
- (b). Dismantle the washer fixing bolt.



3. Install the washer assembly

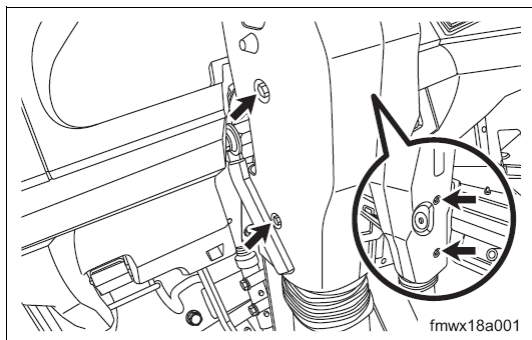
- (a). Install the washer fixing bolt.
- (b). Connect the washer hose and the washer motor connector.

Torque: 23N.m

4. Close the front turnover cover

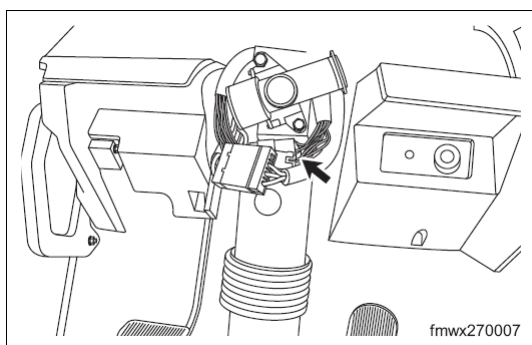
Combination Switch Replacement

1. Turn off the main power supply



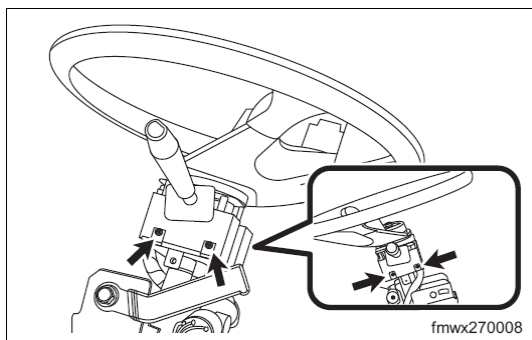
2. Dismantle the trim panel of the steering column

- (a). Dismantle the fixing bolts of the trim panel of the steering column.

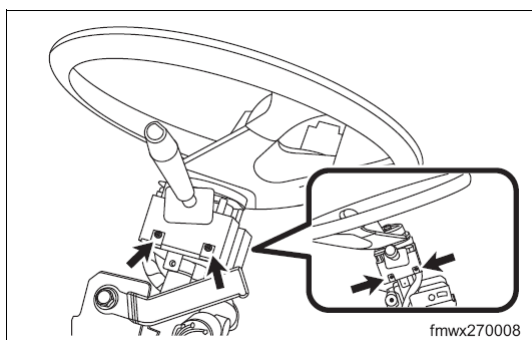


3. Dismantle the combination switch assembly

- (a). Disconnect the combination switch connector.



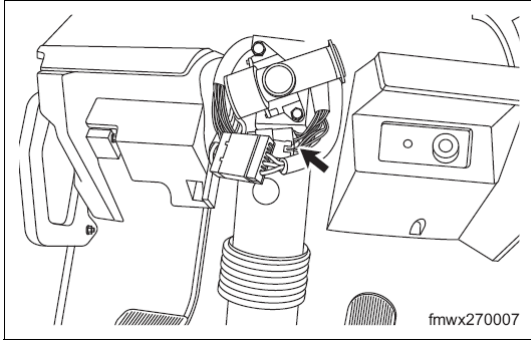
- (b). Dismantle the combination switch fixing screws.



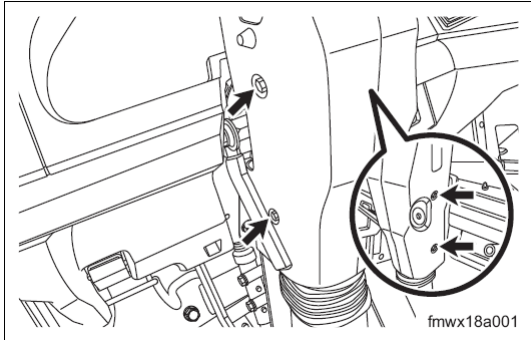
4. Install the combination switch assembly

- (a). Install the combination switch fixing screws.

Wiper & Washer - Combination Switch



- (b). Connect the combination switch connector.



- 5. Install the trim panel of the steering column**
(a). Install the fixing bolts of the trim panel of the steering column.

- 6. Turn on main power supply**

Audio System

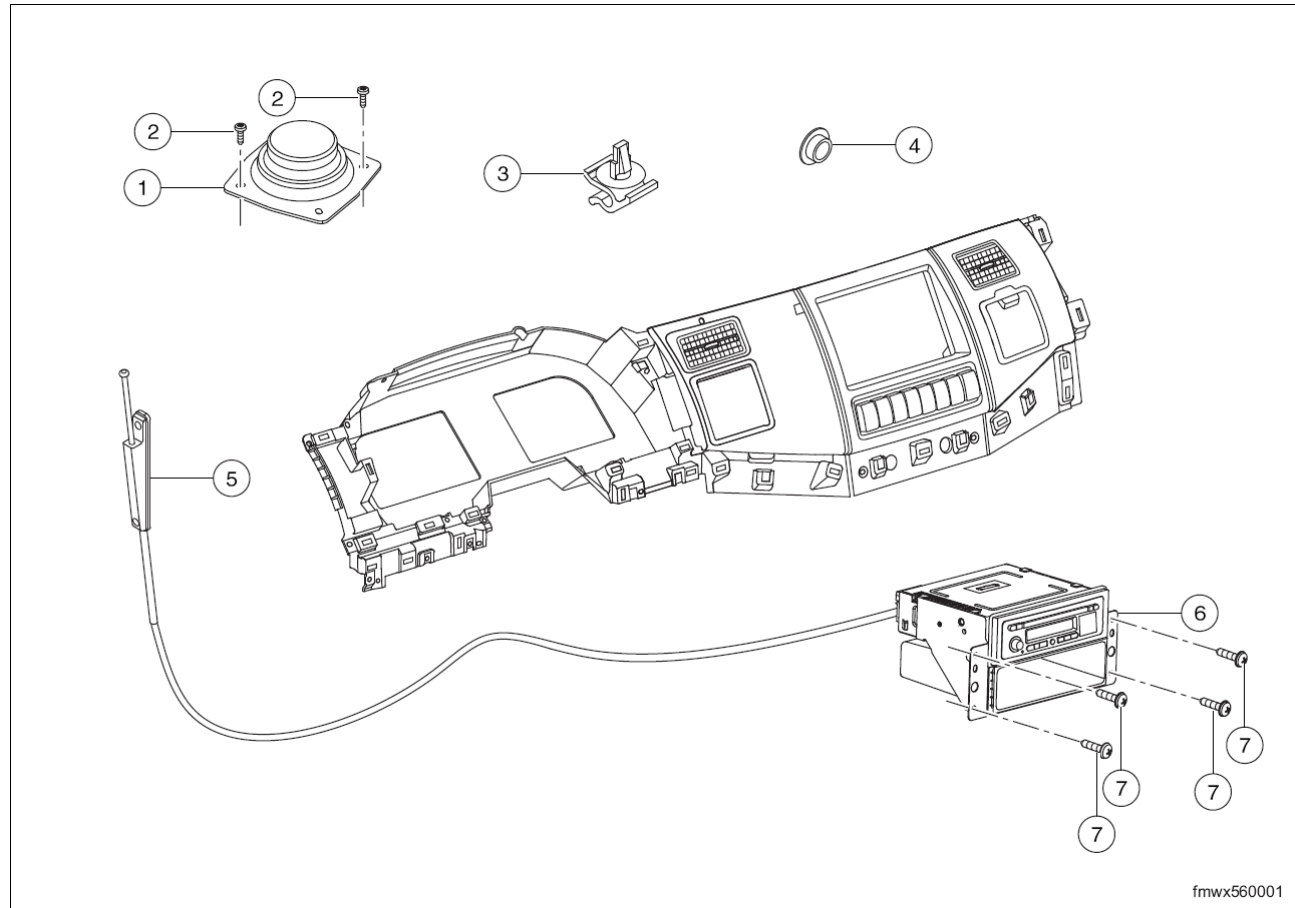
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Radio & Tape Player	56-5
Replacement.....	56-5
Loudspeaker	56-7
Replacement.....	56-7
Antenna	56-8
Replacement.....	56-8

Audio System

Precautions

1. **Cut off the power**
 - (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
 - (b). Turn off the ignition switch, unless otherwise specified.
2. **Disconnection of the negative cable of the battery will reset the clock of the instrument cluster, but the odometer will not be reset.**
3. **Disconnection of the negative cable of the battery will result in loss of the settings saved by the audio system.**
 - (a). The audio system must be reset after reconnection of the negative cable of the battery.

Part Drawing



1	Loudspeaker
2	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
3	Drawing Clamp
4	Grommet

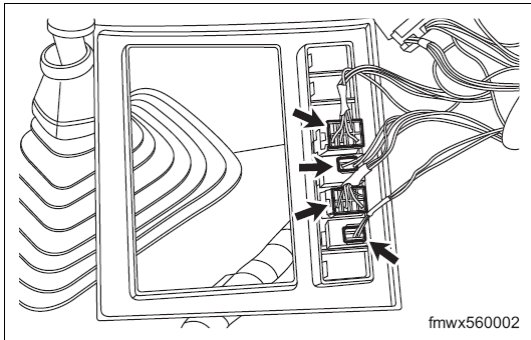
5	Antenna Assembly
6	MP3 Radio & Tape Player
7	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly

Radio & Tape Player Replacement

Hint:

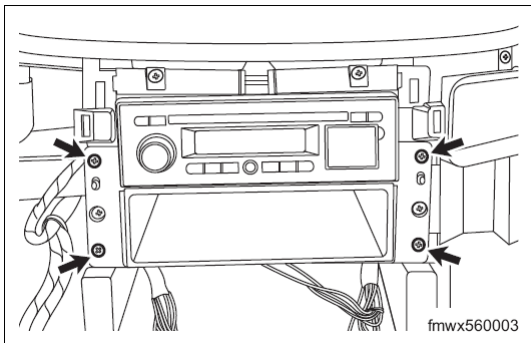
Part Drawing, refer to Chapter 56, Audio System - Audio System, Part Drawing.

1. Turn off the main power supply



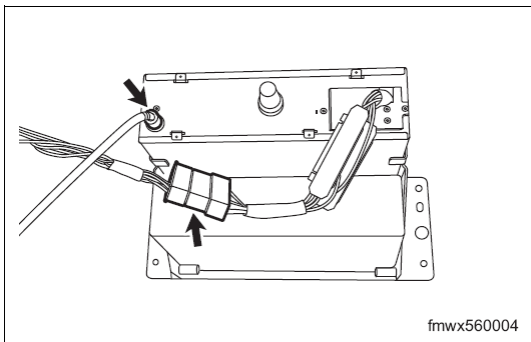
2. Dismantle the middle panel assembly

- (a). Slowly prize up the middle panel with special tools.
- (b). Disconnect the socket connector on the middle panel.

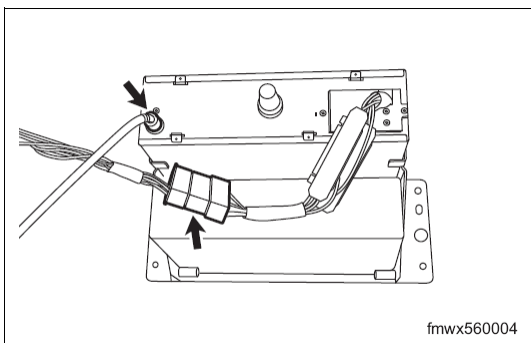


3. Dismantle the radio & tape player assembly

- (a). Dismantle the fastening screws of the radio & tape player .

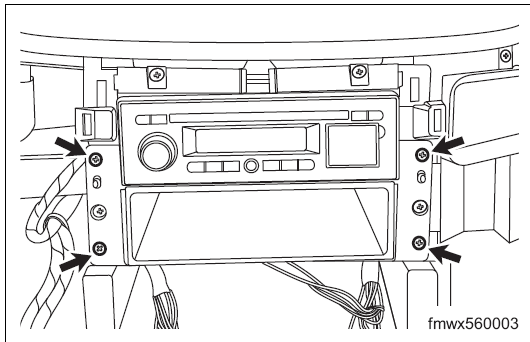


- (b). Disconnect the socket connector and the antenna plug of the radio & tape player.

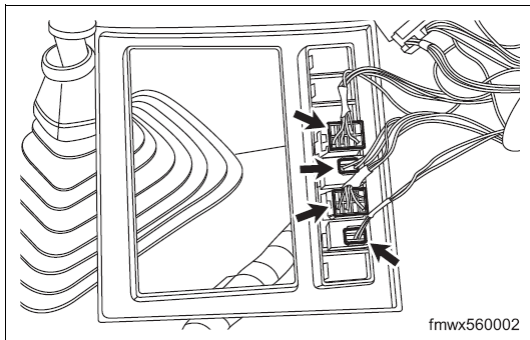


4. Install the radio & tape player assembly

- (a). Connect the socket connector and the antenna plug of the radio & tape player .



- (b). Install the fastening screws of the radio & tape Player .
Torque: 7 N.m



5. Install the middle panel assembly

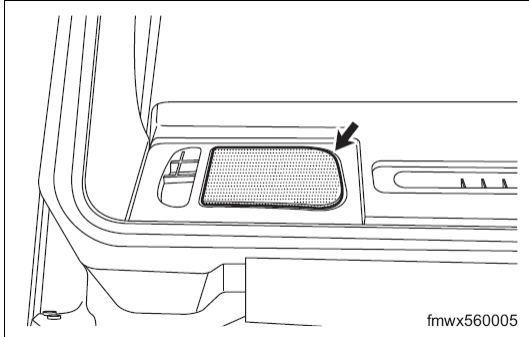
- (a). Connect the socket connector on the middle panel.
(b). Install the middle panel.

6. Turn on main power supply

Loudspeaker Replacement

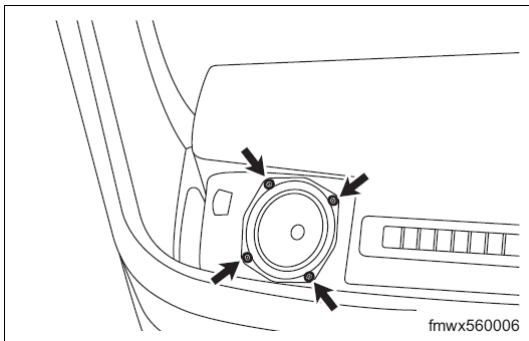
Hint:

Part Drawing, refer to Chapter 56, Audio System - Audio System, Part Drawing.



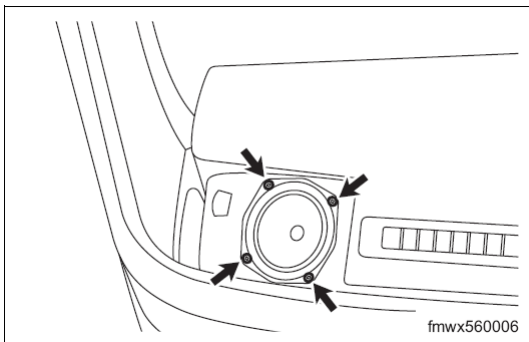
1. Dismantle the loudspeaker cover

- (a). Slowly prize up the loudspeaker cover with special tools, and be careful not to scuff the ornamental plate.



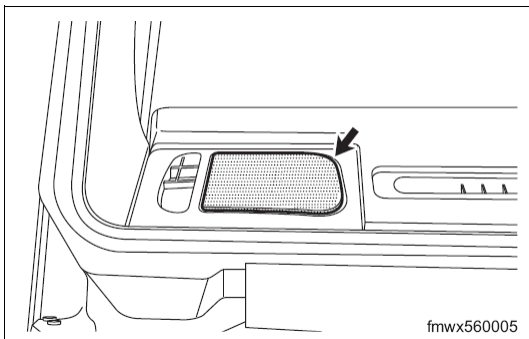
2. Dismantle the loudspeaker assembly

- (a). Dismantle the loudspeaker fastening screws.
- (b). Disconnect the loudspeaker socket connector.



3. Install the loudspeaker assembly

- (a). Connect the loudspeaker socket connector.
- (b). Install the loudspeaker fastening screws.



4. Install the loudspeaker cove

Antenna Replacement

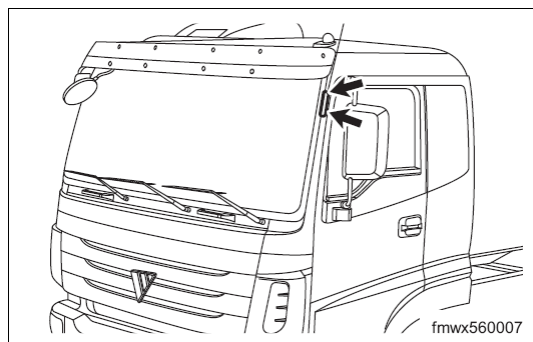
Hint:

Part Drawing, refer to Chapter 56, Audio System - Audio System, Part Drawing.

1. **Disconnect the radio & tape player antenna plug, refer to Chapter 56, Audio System - Radio & Tape Player , Replacement**



2. **Dismantle the antenna assembly**
 - (a). Dismantle the antenna assembly fastening screws.
 - (b). Remove the antenna assembly.



3. **Install the antenna assembly**
 - (a). Install the antenna assembly fastening screws.

4. **Connect the radio & tape player antenna plug, refer to Chapter 56, Audio System - Radio & Tape Player, Replacement.**

Horn

Horn	57-3
Fault Symptom Table	57-3
Inspection.....	57-3
Replacement.....	57-4

Horn - Horn

Horn

Fault Symptom Table

The following table will help you find the fault. The serial numbers represent the possible sequence of the faults. Check each part in this sequence, and replace the parts as needed.

Fault Symptoms	Possible Cause	Reference
Mute horn	1. Horn (damaged)	Chapter 57, Horn-Horn,Replacement
	2. Horn switch (damaged)	Chapter 57, Horn-Horn,Replacement
	3. Harness	Chapter 04, Horn-Mute Electric Horn
	4. Relay	Chapter 04, Horn-Mute Electric Horn
	5. Fuse	Chapter 04, Horn-Mute Electric Horn
Unstoppably Ringing Horn	1. Horn switch (damaged)	Chapter57, Horn-Horn, Replacement.
	2. Harness	Chapter 04, horn-Unstoppably Ringing Electric Horn
	3. Relay	Chapter 04, horn-Unstoppably Ringing Electric Horn

Inspection

1. Horn Assembly

(a). Apply battery voltage between the horn terminals.

If the horn does not ring, replace the horn assembly.

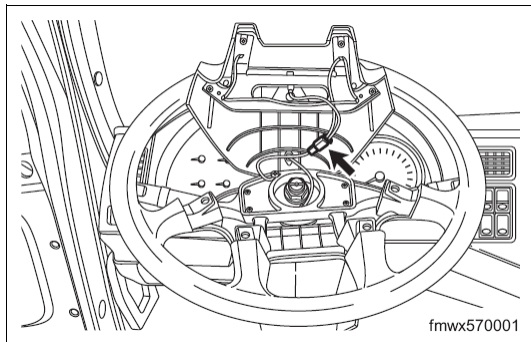
2. Horn Switch

(a). Press the horn switch, and check whether the horn can be heard.

(b). Release the horn switch, and check whether the horn button is back in place and whether the horn has stopped ringing.

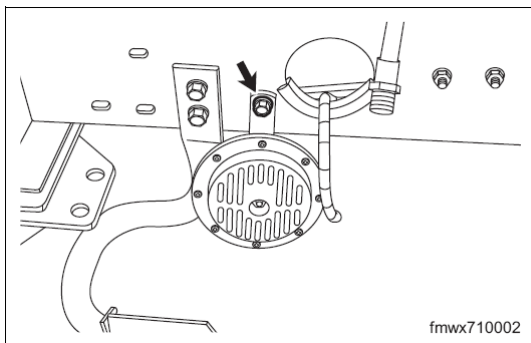
If the situation does not meet the standards, repair the horn switch or replace the steering wheel assembly.

Replacement



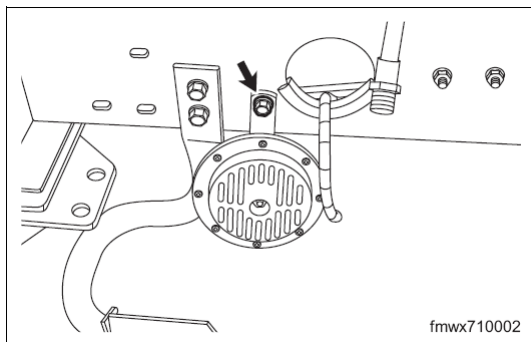
1. Dismantle the horn switch

- (a). Open horn switch cover.
- (b). Disconnect the horn switch socket connector.



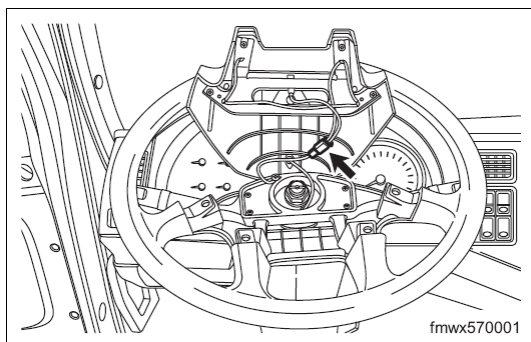
2. Dismantle the horn assembly

- (a). Disconnect the horn plug.
- (b). Dismantle the horn fixing bolts.



3. Install the horn assembly

- (a). Install the horn fixing bolts.
Torque: 23N.m
- (b). Connect the horn plug.



4. Install the horn switch

- (a). Connect the horn switch socket connector.
- (b). Install the horn switch cover.

Circuit Diagram

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Maintenance and Caution.....	61-10	Information on Wiring Harness	
Fault Detection.....	61-17	Connector.....	61-111
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Introduction

Remarks

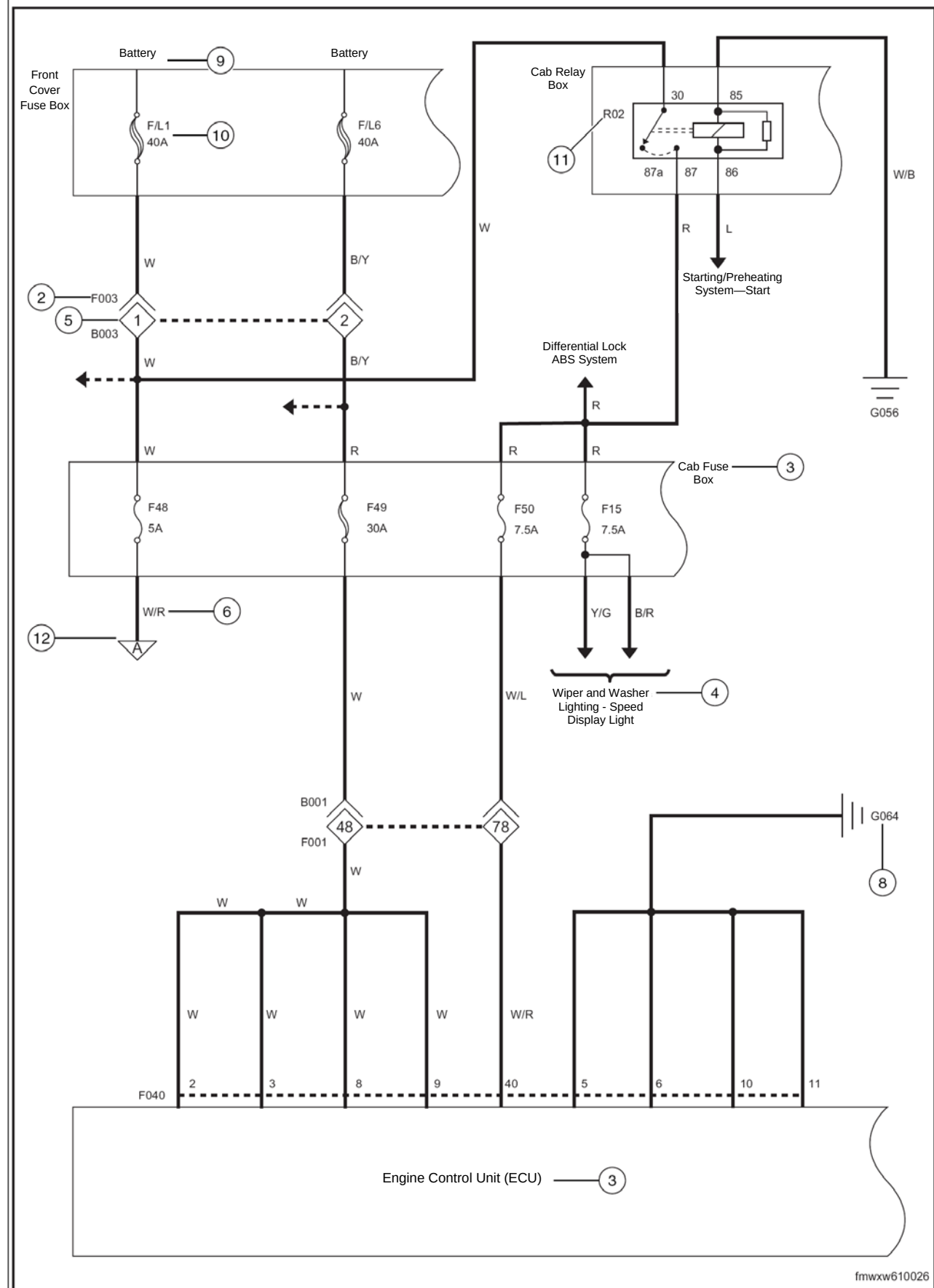
Caution: Any dismantled fastener must be reinstalled to its original position. If a fastener needs to be replaced, the part number of the new fastener must be correct. If no fastener of this part number is available, one of the same dimension and strength (or rigidity) may be used instead. Fasteners cannot be reused should be replaced with new ones. Thread locking agent must be applied to any fastener which needs it. The torque value must be correct when installing a fastener. Violation of the above conditions may result in damage to parts or systems.

Caution: When replacing a fuse, a relay or a load component, the capacity and the model of the selected must be the same as the original. Violation of the above conditions may result in damage to parts or systems, and may also cause fire.

The specifications of the chassis electrical system are 24-volt, with the negative electrode grounded. The wire diameter must be suitable for the applicable circuit requirements and the color classification (the cables must be distinguished by color for easy identification). The wire diameter is determined by the load capacity and the length of the wire required. Vehicle wiring harnesses include: body wiring harness, front frame wiring harness, rear frame wiring harness, gearbox wiring harness, engine wiring harness, dumping gear wiring harness, roof wiring harness, and battery cables. According to their different locations, the wiring harnesses will be protected with insulating tape or corrugated pipes. Each system circuit consists of a power supply, wires, fuses, relay switches, load components and ground wires, all of which are shown in the circuit diagram. All the electrical devices are classified based on the systems in this manual. This manual also summarizes and details the fault diagnosis, check, removal and installation procedures of the main parts shown on the circuit diagram of each system. Refer to the diagnosis section, and replace the parts as needed.

How to Use This Manual

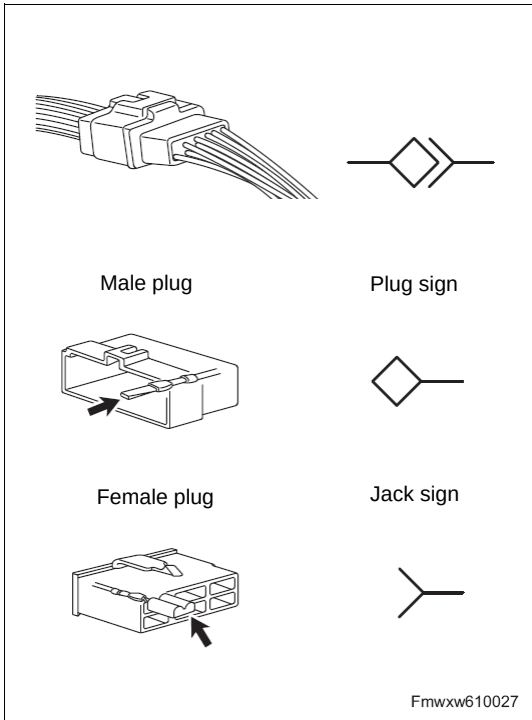
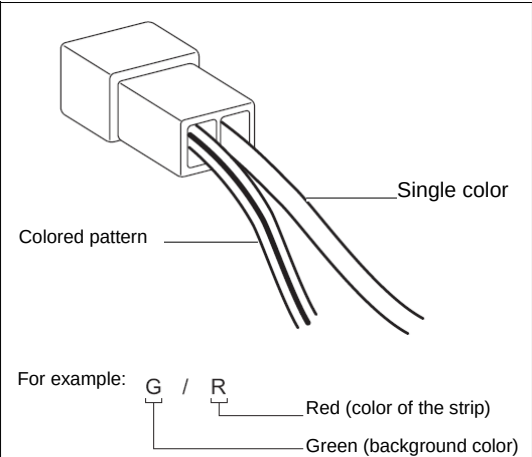
Engine Control System —ECU Power Supply /Grounding



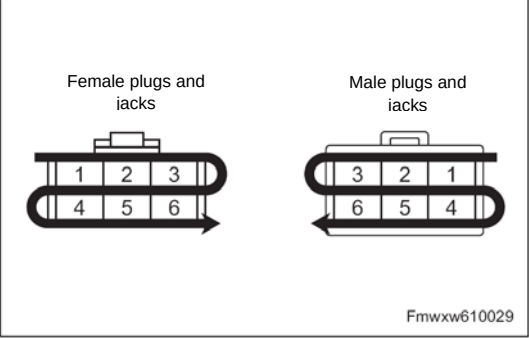
Circuit Diagram - Introduction

No.	Name	Description																																				
1	System Name																																					
2	No. of Wiring Harness Connector	The numbering principle of the wiring harness connectors of this circuit diagram is based on the wiring harnesses. For example: the No. of the wiring harness plug of the engine control unit (ECU) in the engine wiring harness is E01, where E is the wiring harness code, and 01 is the plug sequence number. Description of the wiring harness No. and the wiring harness connector No.: <table><tr><th>Definition</th><th>Name</th></tr><tr><td>BM</td><td>Body Wiring Harness</td></tr><tr><td>B---</td><td>Connector of the Body Wiring Harness</td></tr><tr><td>EN</td><td>Engine Wiring Harness</td></tr><tr><td>E---</td><td>Connector of the Engine Wiring Harness</td></tr><tr><td>EC</td><td>ECU Wiring Harness</td></tr><tr><td>C---</td><td>Connector of the ECU Wiring Harness</td></tr><tr><td>GX</td><td>Gearbox Wiring Harness</td></tr><tr><td>X---</td><td>Connector of the Gearbox Wiring Harness</td></tr><tr><td>RF</td><td>Roof Wiring Harness</td></tr><tr><td>R---</td><td>Connector of the Roof Wiring Harness</td></tr><tr><td>UT</td><td>Dumping Gear Wiring Harness</td></tr><tr><td>U---</td><td>Connector of the Dumping Gear Wiring Harness</td></tr><tr><td>FF</td><td>Front Frame Wiring Harness</td></tr><tr><td>F---</td><td>Connector of the Front Frame Wiring Harness</td></tr><tr><td>TF</td><td>Rear Frame Wiring Harness</td></tr><tr><td>T---</td><td>Connector of the Rear Frame Wiring Harness</td></tr><tr><td>Z---</td><td>Other Connectors</td></tr></table>	Definition	Name	BM	Body Wiring Harness	B---	Connector of the Body Wiring Harness	EN	Engine Wiring Harness	E---	Connector of the Engine Wiring Harness	EC	ECU Wiring Harness	C---	Connector of the ECU Wiring Harness	GX	Gearbox Wiring Harness	X---	Connector of the Gearbox Wiring Harness	RF	Roof Wiring Harness	R---	Connector of the Roof Wiring Harness	UT	Dumping Gear Wiring Harness	U---	Connector of the Dumping Gear Wiring Harness	FF	Front Frame Wiring Harness	F---	Connector of the Front Frame Wiring Harness	TF	Rear Frame Wiring Harness	T---	Connector of the Rear Frame Wiring Harness	Z---	Other Connectors
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Z---	Other Connectors																																					
3	Part Name																																					
4	Connection Information to Other System																																					

Circuit Diagram - Introduction

5	Wiring harness connector	Wiring harness and wiring harness connector; the diamond graph indicates male plug, the No. in the diamond graph is the No. of a pin; and the arrow graph indicates a female jack.  Male plug Plug sign Female plug Jack sign Fmwxxw610027																								
6	Wire color	If the wire is double-colored, the first letter shows the background color of the wire, and the second letter shows the color of the strip, with “/” between separating the two.  Colored pattern Single color For example: G / R Red (color of the strip) Green (background color) <table><tr><td>Black</td><td>White</td><td>Red</td><td>Green</td><td>Yellow</td><td>Brown</td></tr><tr><td>B</td><td>W</td><td>R</td><td>G</td><td>Y</td><td>Br</td></tr><tr><td>Pink</td><td>Blue</td><td>Gray</td><td>Violet</td><td>Orange</td><td>Light green</td></tr><tr><td>P</td><td>L</td><td>Gr</td><td>V</td><td>O</td><td>Lg</td></tr></table> Fmwxxw610028	Black	White	Red	Green	Yellow	Brown	B	W	R	G	Y	Br	Pink	Blue	Gray	Violet	Orange	Light green	P	L	Gr	V	O	Lg
Black	White	Red	Green	Yellow	Brown																					
B	W	R	G	Y	Br																					
Pink	Blue	Gray	Violet	Orange	Light green																					
P	L	Gr	V	O	Lg																					

Circuit Diagram - Introduction

7	Pin No.	Shows the pin No. of the connector. Note that the sequences of the pin No. of the wiring harness connectors butted with each other form mirror images of each other, as shown in the following figure: 
8	Grounding Point	About the marking of the serial numbers beginning with G and the locations of the grounding points, refer to grounding distribution for details.
9	Type of Power Supply	The type of the power supply provided to the fuse. The battery indicates battery supply, ACC indicates the power output when the ignition switch is "ACC", ON indicates the power output when the ignition switch is "ON", ST indicates the power output when the ignition switch is "START/HEAT".
10	Fuse No.	It consists of a fuse code and the sequence number. The code of the fuse located at the front flip cover of the driver's cab is F/L, and the code of the fuse located in the driver's cab is F. See Relay Box and Fuse Box for details of fuse No.
11	Relay	The code of interior relay is R. See Relay Box and Fuse Box for details.
12	To Be Continued in the Next Page	If the circuit diagram of a system requires more than one page, the starting point of a circuit will be represented by an outbound triangular arrow, and the ending point will be represented by an inbound triangular arrow. If more than one circuit is continued to the next page, these circuits will be represented by letters A, B, C, etc.

Circuit Diagram - Component Symbol
Component Symbol

Symbol	Symbol Meaning	Symbol	Symbol Meaning	Symbol	Symbol Meaning
	Battery		Twisted Wire		Horn/buzzer
	Grounding		Monofilament Bulb		Connected Cross-circuit
	Low-load Fuse		Relay		Unconnected Cross-circuit
	Medium-load Fuse		Single-speed Motor		Normally-open Switch
	High-load Fuse		Adjustable Speed Motor		Normally-closed Switch
	Resistor		Two-filament Bulb		Double-throw Switch
	Adjustable Resistor		Connector		Reed Switch
	Temperature Sensor		Diode		Capacitor
	Coil Sensor		LED		Cigarette Lighter
	Solenoid Valve		Loudspeaker		Preheater/heater

Fault Diagnosis and Maintenance

Fault Diagnosis Process

Check a faulty circuit in the following steps:

1. Confirm the contents of the customer's complaint

In order to ensure proper maintenance, confirm the fault symptoms described by the customer. Carefully check the associated components to confirm the symptoms and make records. Breaking down of any component before confirmation of the scope and causes of the fault is not allowed.

2. Read circuit diagram and analyze cause

Analyze the entire circuit of a subsystem circuit diagram of a faulty component from the power supply to its grounding, judge and check the maintenance operation solution. If you cannot check the maintenance operation solution, refer to the description in the relevant sections of the maintenance manual of the system and understand the principle of work. And you also need to check any other circuit used together with the faulty circuit, for example, refer to such system circuit as the fuse, grounding, switches, etc, used together on the circuit diagram. Check any shared circuit not checked in Step 1. If other components in the shared circuit work properly, the fault must be in this circuit. If all the components on the shared circuit are at fault, the fuse or the grounding circuit may be at fault.

3. Check the circuits and components

Any circuit diagram should be used at any time together with its maintenance manual. Refer to the check steps in the diagnostic part of the maintenance manual. For a module control circuit, the components must be tested with the help of a diagnostic device. Effective fault diagnosis should be a logical and reasonable process of operation. Start checking from the most vulnerable components which can be most easily checked in accordance with the fault diagnosis process in the diagnostic sections of the maintenance manuals.

4. Fault maintenance

In case a fault is detected, refer to the description about trouble shooting in the circuit diagram and the maintenance manual, for example, the solution for poor grounding, the treatment for wiring harness connectors, etc.

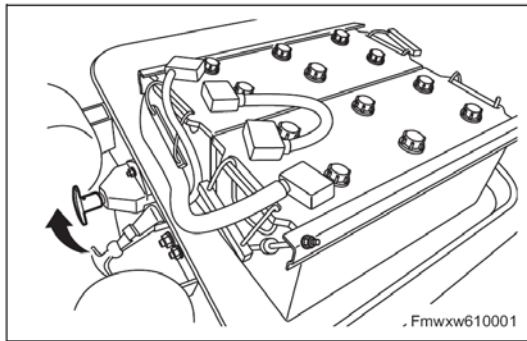
5. Confirm the status of the circuit operation

After trouble shooting and when it is sure that any fault has been solved, re-check to confirm whether all the functions have been restored to normal. In case of a fuse failure, check all the circuits those share this fuse.

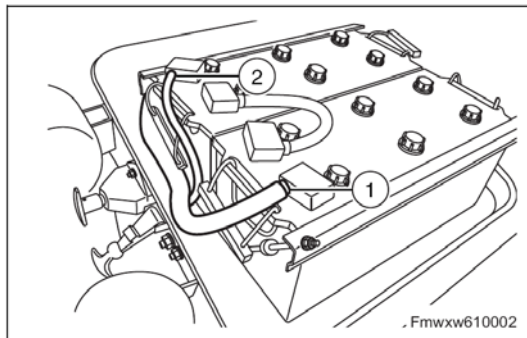
Electrical Fault Diagnosis and Maintenance and Caution

Disconnection of a Battery

1. Confirm that all electrical equipment is turned off



2. Turn off the battery brake switch



3. Disconnect the battery cables

(a). Disconnect the battery grounding cable 1.

(b). Disconnect the positive battery cable 2.

Caution:

The battery grounding cable should be disconnected first. A short circuit may occur if the positive battery cable is disconnected first.

4. Connect the battery cables in the reverse order when disconnecting them

Caution:

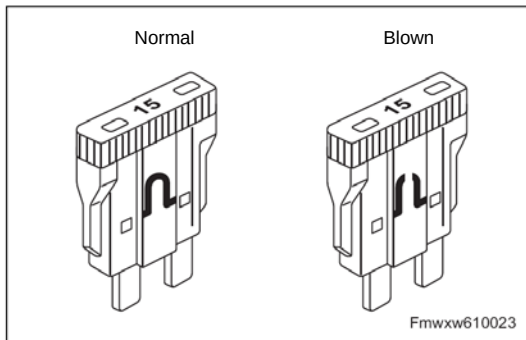
Clean up the battery armatures and the cable connectors. After installation is complete, apply a thin coat of grease on the battery armature to prevent corrosion of the armature and connectors.

Circuit Diagram - Fault Diagnosis and Maintenance

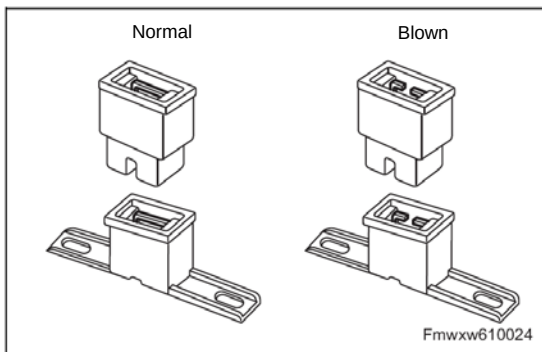
Inspection of the fuses

Caution:

DO NOT replace a blown fuse with a new one of different rated current, as this will result in electrical fire, or cause other serious circuit damage.

**1. Low and medium-load fuses**

- Fuse is the most common form of electrical protection for auto circuit. It is arranged in series in the circuit under its protection. And this fine wire or metal filament will be blown off according to the design and lead to current interruption when the current in the circuit is overloaded (such as a ground wire short circuit). This prevents high-strength surge from reaching other parts of the circuit, thus avoiding damage. Before replacing a fuse, the cause of overload must be determined. The rated current of the new fuse must be the same as that of the old one to be replaced. Blown fuse is easily identified, as shown in the figure.

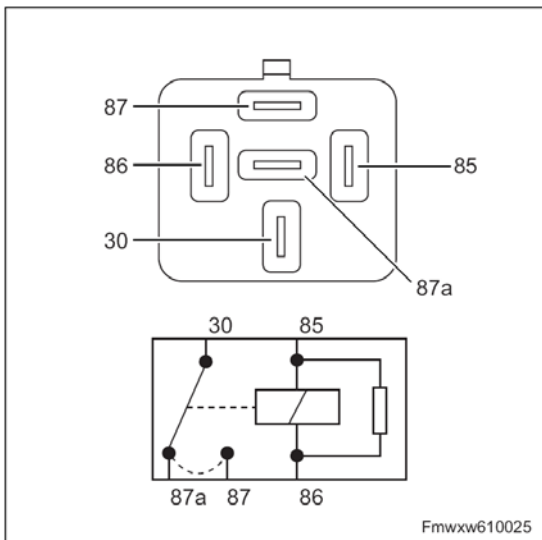
**2. High-load fuse**

- A high-load fuse is used in circuit of high current (starter) or anywhere the use of an ordinary fuse is impractical. Excessive current will melt the fuse strip in the fuse. The current is then interrupted in such a case to avoid fire or circuit damage caused by heat. Before replacing a fuse, be sure to determine the cause of the formation of the excessive current. The rated current of the new fuse must be the same as that of the old one to be replaced. Blown fuse is easily identified, as shown in the figure.

Inspection of the relay

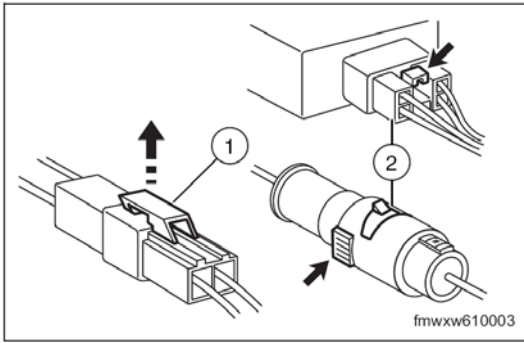
Caution:

DO NOT replace a broken relay with a new one of different rated current.

**1. 24 V relay.**

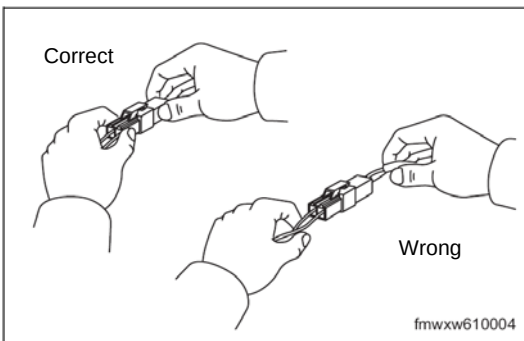
- As the power supply and the load require a switch to be installed with some distance from them. This means that the wire will be longer, the voltage drop will be higher, and the relay can reduce the length of the cable between the power supply and the load, thus reducing the voltage drop between them. Most switches cannot withstand a high passing current, the switch controls the work of the load through the control relay, so that the amperage of the current through the switch will be lower.
- Model: 24V 30/20A.

Operation of the Connector

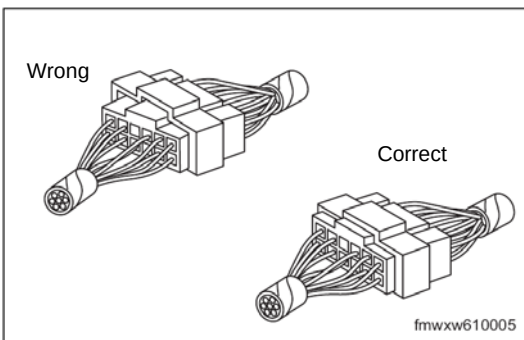


1. Disconnect the connectors

- (a). Some connectors are provided with retainer springs for fixing the connectors firmly together when the vehicle is in motion. Some retainer spring can be released by pulling towards yourself, see 1 And some retainer springs may be released by pressing forward, see 2

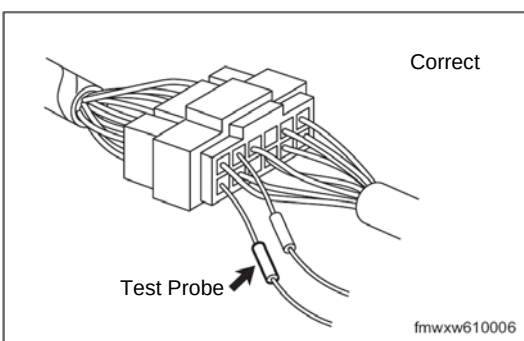


- (b). Confirm the type of the retainer spring on the connector you operate. Firmly grasp the two sides of (plug and jack) of the connector. Release the retainer spring, and carefully pull open the connector ends. DO NOT separate the connector through pulling the wire, otherwise the wire will be broken.



2. Connect the connector

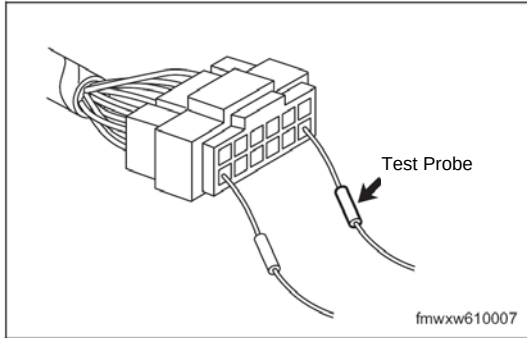
- (a). Please firmly grasp both sides of the connector (plug and jack). Ensure that the connector pins and the pin holes match each other. Ensure that both sides of the connector are aligned. Carefully push both sides of the connector together tightly until a clear clicking sound is heard.



3. Check the circuit from the connector

- (a). Check the circuit with a multimeter. Insert a test probe from one side of the connector.

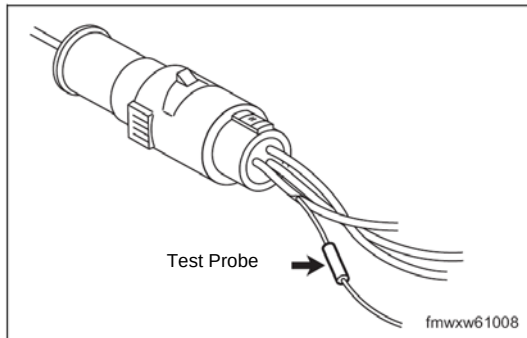
Circuit Diagram - Fault Diagnosis and Maintenance



- (b). Test the circuit from the open end of the connector.

Caution:

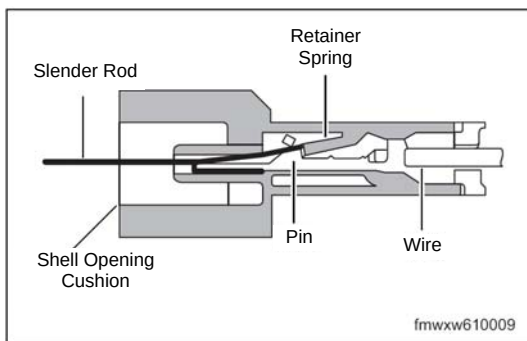
DO NOT test the circuit by inserting a test probe whose pin hole with the diameter greater than that of the pin hole in the open end of the connector. This will break or crack the terminal of the socket connect and/or enlarge the pin hole.



- (c). Keep the connector disconnected, and insert a fine steel needle type test probe clamp into the wire to check the circuit in case the test probe cannot be inserted into a waterproof connector.

Caution:

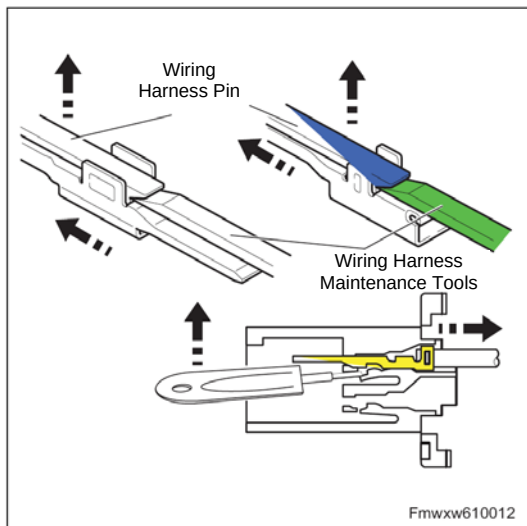
Use special circuit check and test probe clamp tools, otherwise the wire is apt to be damaged.

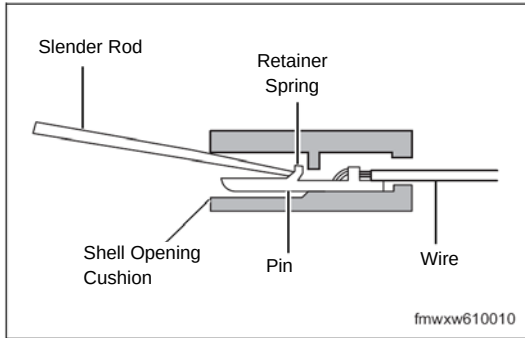


4. Dismantle the connector pin

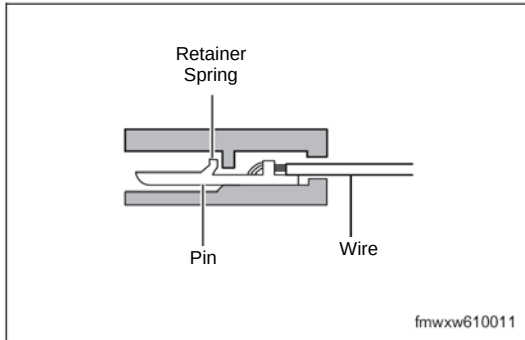
- (a). Type of the shell retainer spring:

- Insert a slender rod into the open end of the connector shell.
- Push up the retainer spring (in the direction of the arrow in Figure). Pull out the wire and the pin from the wire side of the connector.





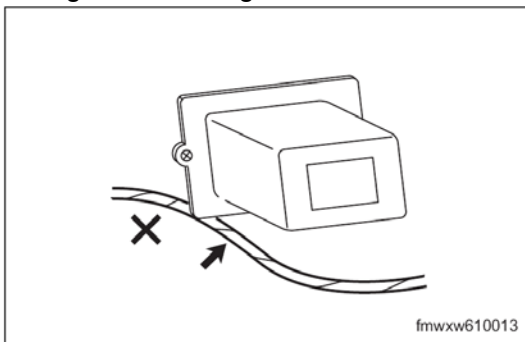
- (b). Type of the pin retainer spring.
- Insert the slender rod into the open end of the connector shell.
 - Flatten the retainer spring (toward the wire side of connector). Pull out the wire and the pin from the wire side of the connector.



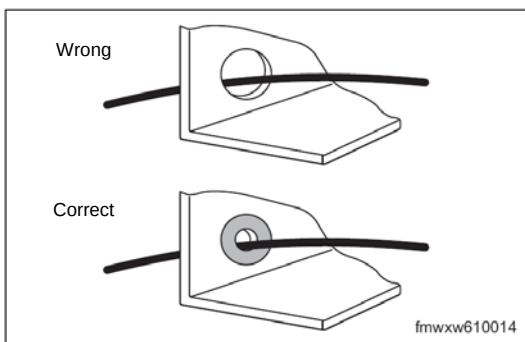
5. Install the connector pin

- Check whether the retainer spring is completely upward.
- Insert the pin from the wire side of the connector, and push in the pin until the retainer spring clamp tightly.
- Gently pull the wire, and make sure that the connector pin is fixed in place.

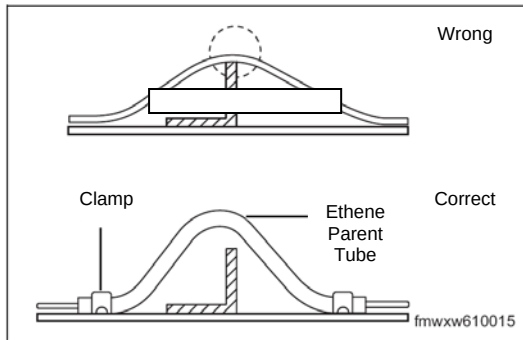
Fixing of the Wiring Harness



- Do not clamp or squeeze the wiring harness when installing a component. All the electrical connectors must be kept clean and fixed.



- A grommet or a protection tube may be used to avoid the contact of the wiring harness with any sharp edge or surface.

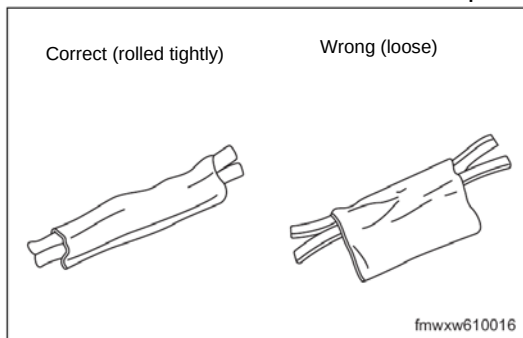
Circuit Diagram - Fault Diagnosis and Maintenance

3. When placing the wiring harness, make sure that there is sufficient clearance between the wiring harness and any other component, and protect the wiring harness with an ethene parent tube and a clamp to avoid direct contact.

4. Wiring harness between the engine and the chassis should have sufficient length to prevent vibration caused by a variety of wear or damage.

Repair of the wire

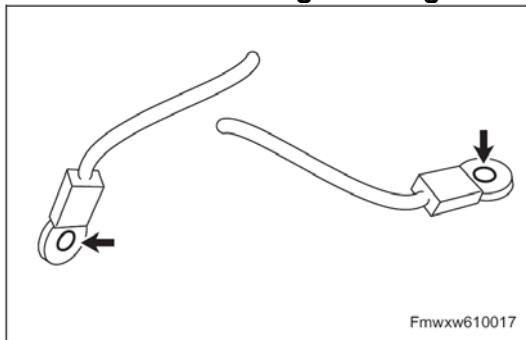
1. **Open the wiring harness**
 - If the wiring harness is stuck by tape, remove the tape. Carefully cut the wiring harness open to avoid damage to the wire insulation. If the wiring harness has plastic casing, it is only necessary to pull out the wire.
2. **Cut the wire**
 - At the beginning, as little as possible wire should be cut from the wiring harness. And then, if you decide to cut longer wire to change the connector position, an extra length may need to be retained to adjust the connecting position to ensure that a proper clearance is kept between each connecting point and any other connecting point, wiring harness branch or joint.
3. **Strip the insulating layer**
 - Only a wire of the same diameter is allowed to be used for replacing an old one. Check whether there is a crack or a cut strand in the stripped wire. If the wire is damaged, replace with a new one of the same core length as that of the old one.
4. **Connect the wire**
 - Overlap the exposed parts of two wires together, twist the wire or use a wire connecting clamp to clamp the exposed parts of the wire together. Make sure that the wire is twisted or clamped tightly.



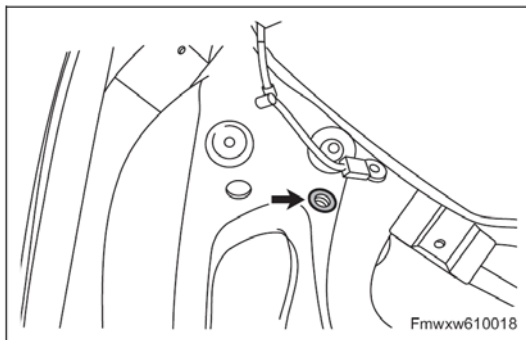
5. **Wrap the wire**
 - (a). Insert a piece of connector tape between and roll up tightly. The electric tape must cover the entire connector. Wind enough tape around the connector, and the thickness of the insulating layer must be doubled. The electric tape must be tight; otherwise the insulating capacity will not be sufficient enough, and the loose wire may be twisted together with other wires in the wiring harness.

Grounding

1. Dismantle the grounding bolt



- 2. Clean the contact surfaces of the grounding rings at the wiring harness side (including vehicle body side and the bolt side) with coarse emery cloth, until the oxide is completely removed.**



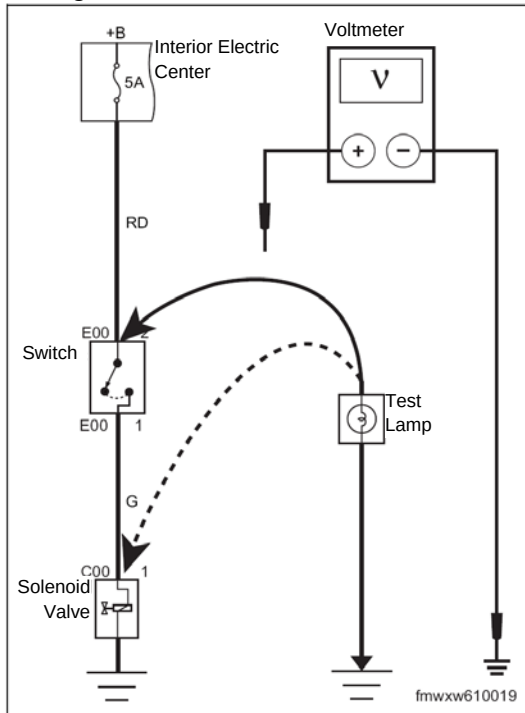
- 3. Clean the vehicle body side and the grounding point with coarse emery cloth, until the surfaces are completely clean.**

- 4. Re-install the grounding wire wiring harness and the fixing bolts, and tighten them with the required torque.**

Circuit Diagram - Fault Diagnosis and Maintenance

Fault Detection

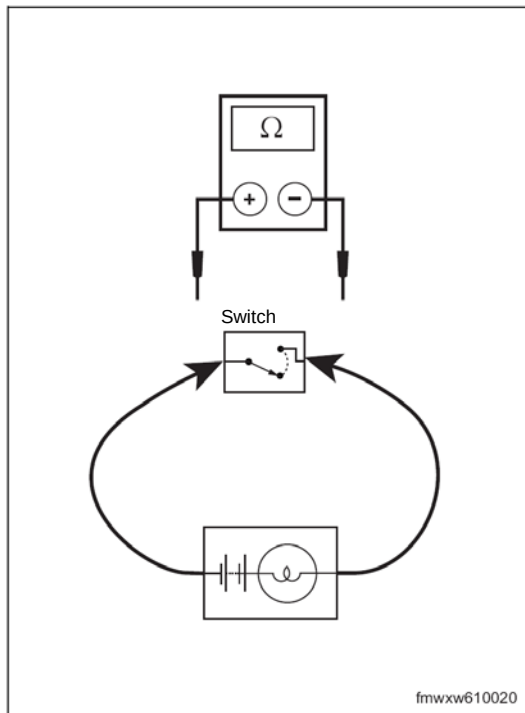
Voltage Detection



Hint: The purpose of voltage detection is to check whether there is voltage at a certain point. It is unnecessary to break down the wire connector when checking a terminal of the wire connector. You may insert the probe of the positive cable in the circuit check tool into the back of the wire connector to test.

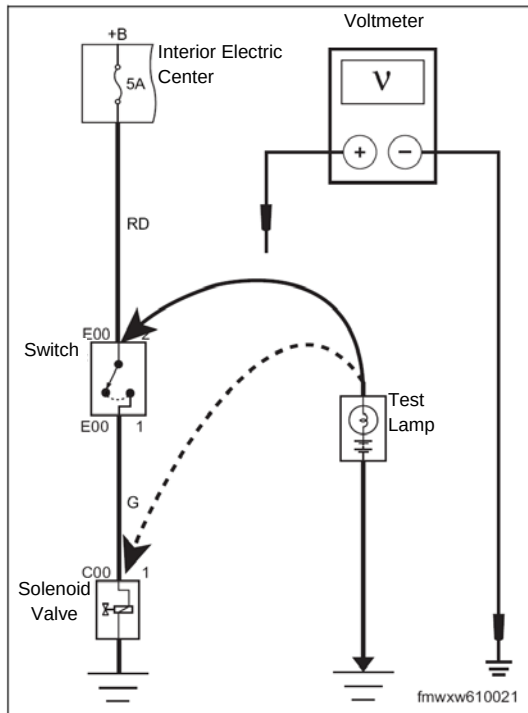
1. **First, connect the negative electrode of the check tool with the negative electrode of the battery when testing the voltage with a test lamp or voltmeter.**
2. **Then connect the other end of the wire of the test lamp or voltmeter with the test position.**
3. **If the test tool is a voltmeter and the displayed value is 1 V or more less than the specified value, the circuit is faulty. If the test tool is a test lamp and the lamp does not shed light, the circuit is faulty.**

Open Circuit Test



1. **Disconnect the negative wiring harness of the battery.**
2. **Connect a wire of a self-powered test lamp or resistance meter with the component to be tested. In case of a resistance meter, connect the two wires of the resistance meter in short circuit, zeroize the resistance meter with a zeroizer.**
3. **Connect another wire of the detector with the other terminal of the load to be checked.**
4. **If the self-powered test lamp sheds light, it means that the circuit is through; in case of a resistance meter, if the resistance is very low or close to 0 Ω, it means that the component is in good conducting state.**

Short Circuit Test

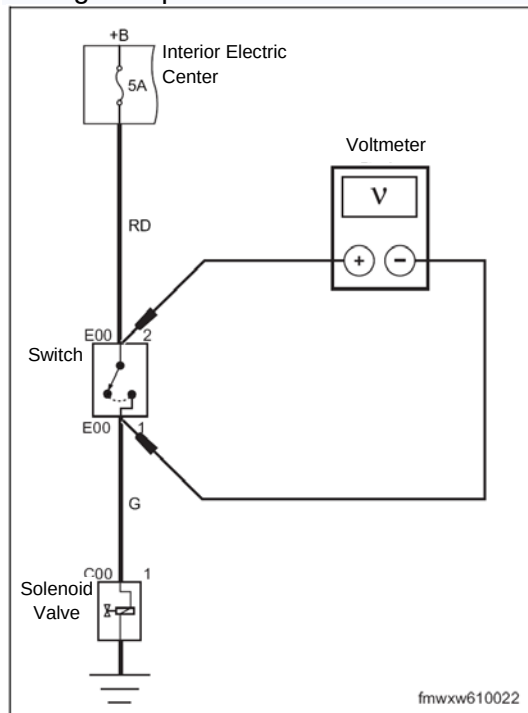


1. Disconnect the negative wiring harness of the battery.
2. Connect one wire of the self-powered test lamp or resistance meter with the output terminal of the fuse.
3. Ground the other wire of the self-powered test lamp or resistance meter.
4. Disconnect all the electrical loads related with the fuse.

Caution: If any of the electrical load of the fuse is connected, the resistance meter will always display low resistance when checking the low resistance load circuits like lamp, etc. Such a case will result in misjudgment.

5. Check all the circuits from the point closest to the fuse.
6. If the self-powered test lamp sheds light or the resistance meter displays a value lower than 5Ω , the checked part is shorted to ground.

Voltage Drop Test



Hint:

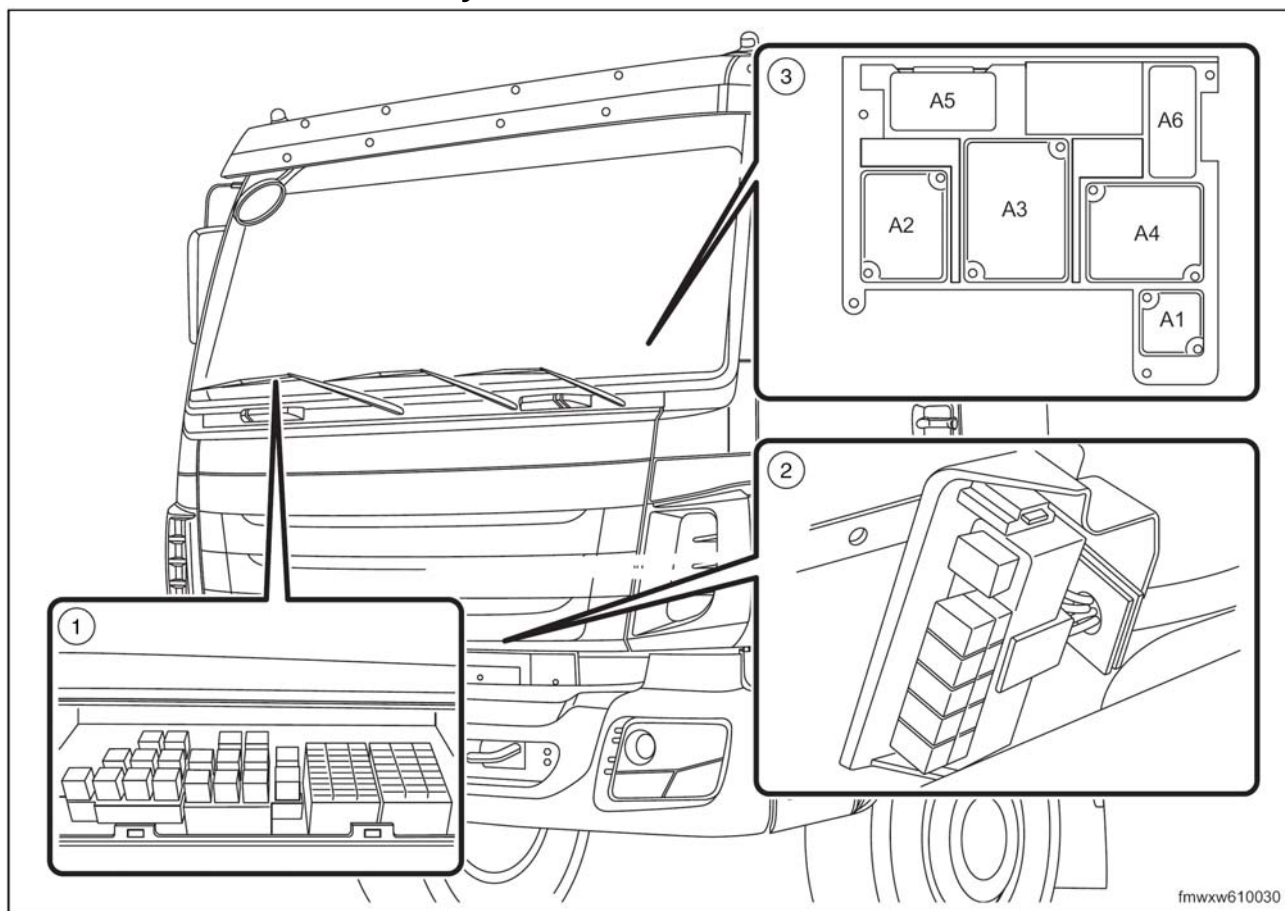
Voltage drop test is to check the voltage drop along the wire, the connector or the switch.

1. Connect the positive wire of the voltmeter with the end of the wire close to the battery (connector side or switch side).
2. Connect the negative wire of the voltmeter with the other end of the wire (the other side opposite to the connector side or switch side).
3. Disconnect or close the switch to allow the circuit to work.
4. The voltmeter will show the voltage difference between the two points.
5. If the voltage difference exceeds 0.1 V (the voltage difference of a 5V circuit should be less than 50mV), the circuit is at fault. Check whether there is any loose, oxidized or corroded connecting circuit.

Circuit Diagram - Relay Box and Fuse Box

Relay Box and Fuse Box

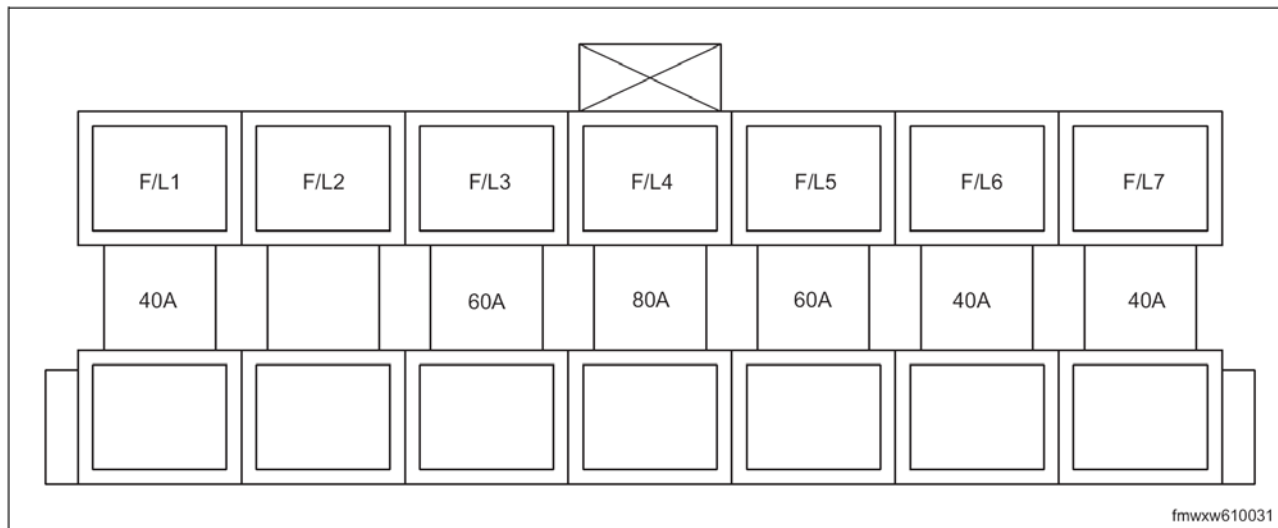
Positions of the Relay Box and Fuse Box



1	Relay Box and Cab Fuse box
2	Front Cover Fuse Box

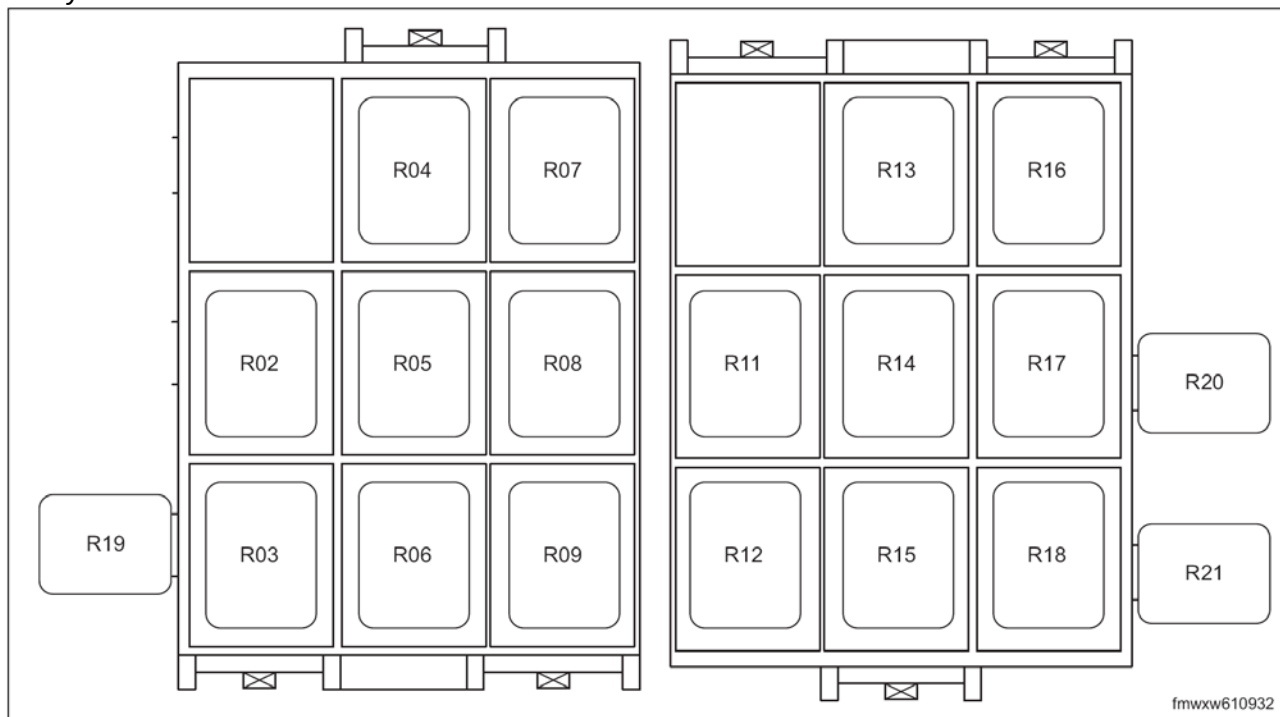
3	Relay Box and Cab Fuse box
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Front Cover Fuse Box



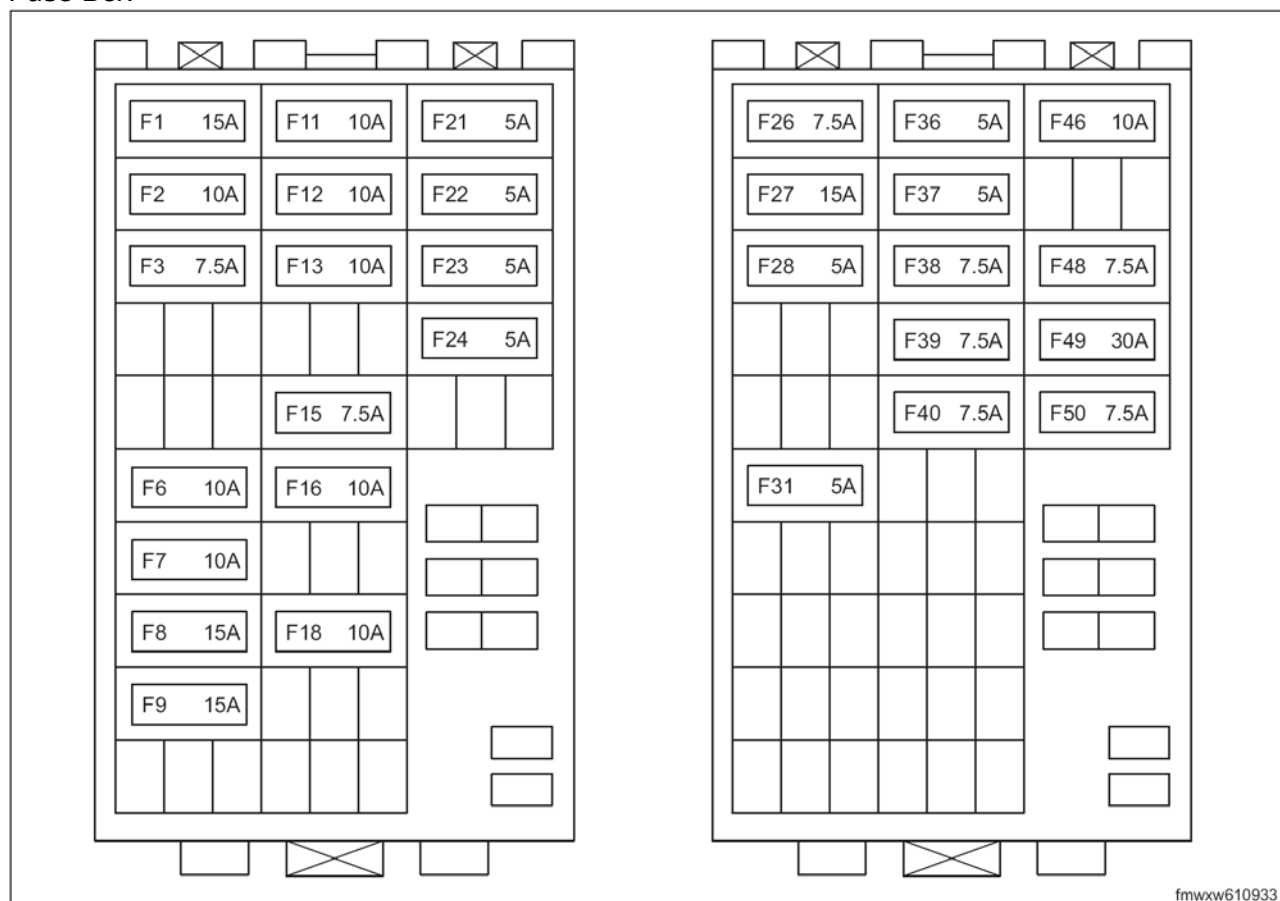
No.	Rated Current	Name
F/L1	40A	-
F/L2	-	-
F/L3	60A	-
F/L4	80A	Generator Fuse

No.	Rated Current	Name
F/L5	60A	-
F/L6	40A	-
F/L7	40A	-

Circuit Diagram - Relay Box and Fuse Box**Relay Box and Cab Fuse box****Relay Box**

No.	Rated Current	Name
R1	-	-
R2	24V 30/20A	IG Power Supply Relay
R3	24V 30/20A	Brake Lamp Relay
R4	24V 30/20A	Rear-View Mirror Heating Relay
R5	24V 30/20A	Reversing Lamp Relay
R6	24V 30/20A	Frame Side Lamp Relay
R7	24V 30/20A	Blower Relay
R8	24V 30/20A	Condenser Relay
R9	24V 30/20A	Compressor Relay
R10	-	-
R11	24V 30/20A	Cigarette Lighter Relay

No.	Rated Current	Name
R12	24V 30/20A	Fog Lamp Relay
R13	24V 30/20A	Horn Relay
R14	24V 30/20A	Upper Beam Relay
R15	24V 30/20A	Lower Beam Relay
R16	24V 30/20A	Speed Display Light B Relay
R17	24V 30/20A	Body Side Lamp Relay
R18	24V 30/20A	Speed Display Light A Relay
R19	24V 30/20A	Brake Switch Relay
R20	24V 30/20A	Speed Display Light C Relay
R21	24V 30/20A	Electric/Air Horn Switching Relay

Circuit Diagram - Relay Box and Fuse Box**Fuse Box**

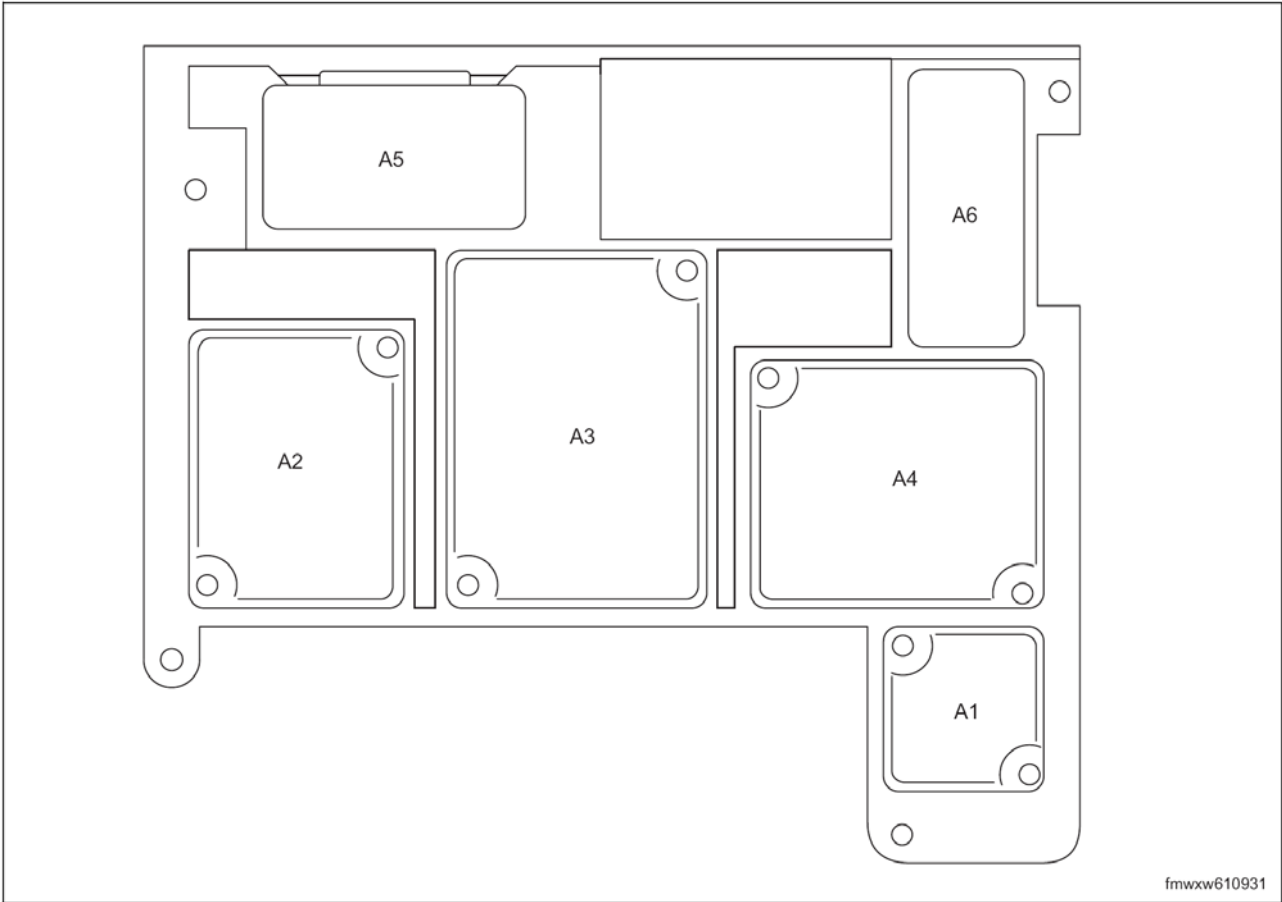
No.	Rated Current	Name
F1	15A	Ignition Lock Fuse
F2	10A	Reversing Lamp Fuse
F3	7.5A	Turn Signal Lamp Fuse
F4	-	-
F5	-	-
F6	10A	Body Side Lamp Fuse
F7	10A	Condenser and Compressor Fuse
F8	15A	Blower Fuse
F9	15A	Cigarette Lighter Fuse
F10	-	-
F11	10A	Wiper Motor Fuse
F12	10A	Left High Beam Fuse
F13	10A	Right High Beam Fuse
F14	-	-

No.	Rated Current	Name
F26	7.5A	Power Operated Heated Door Mirror Fuse
F27	15A	ABS Fuse
F28	5A	ABS 15 Fuse
F29	-	-
F30	-	-
F31	5A	Driving Recorder Fuse
F32	-	-
F33	-	-
F34	-	-
F35	-	-
F36	5A	Memory Fuse
F37	5A	Radio & Tape Player Fuse
F38	7.5A	Exhaust Brake Fuse
F39	7.5A	Brake Lamp Fuse

Circuit Diagram - Relay Box and Fuse Box

F15	7.5A	IG Fuse	F40	7.5A	Instrument Cluster Fuse
F16	10A	Fuel Preliminary Filter Heating Fuse	F41	-	-
F17	-	-	F42	-	-
F18	10A	Frame Side Lamp Fuse	F43	-	-
F19	-	-	F44	-	-
F20	-	-	F45	-	-
F21	5A	Differential Block Fuse	F46	10A	Fog Lamp Fuse
F22	5A	Left Dipped Headlamp Fuse	F47	-	-
F23	5A	Right Dipped Headlamp Fuse	F48	5A	Diagnostic Interface Fuse
F24	5A	Interior Lamp Fuse	F49	30A	ECU General Fuse
F25	-	-	F50	7.5A	ECU (IG) Fuse

Controller Module in the Cab

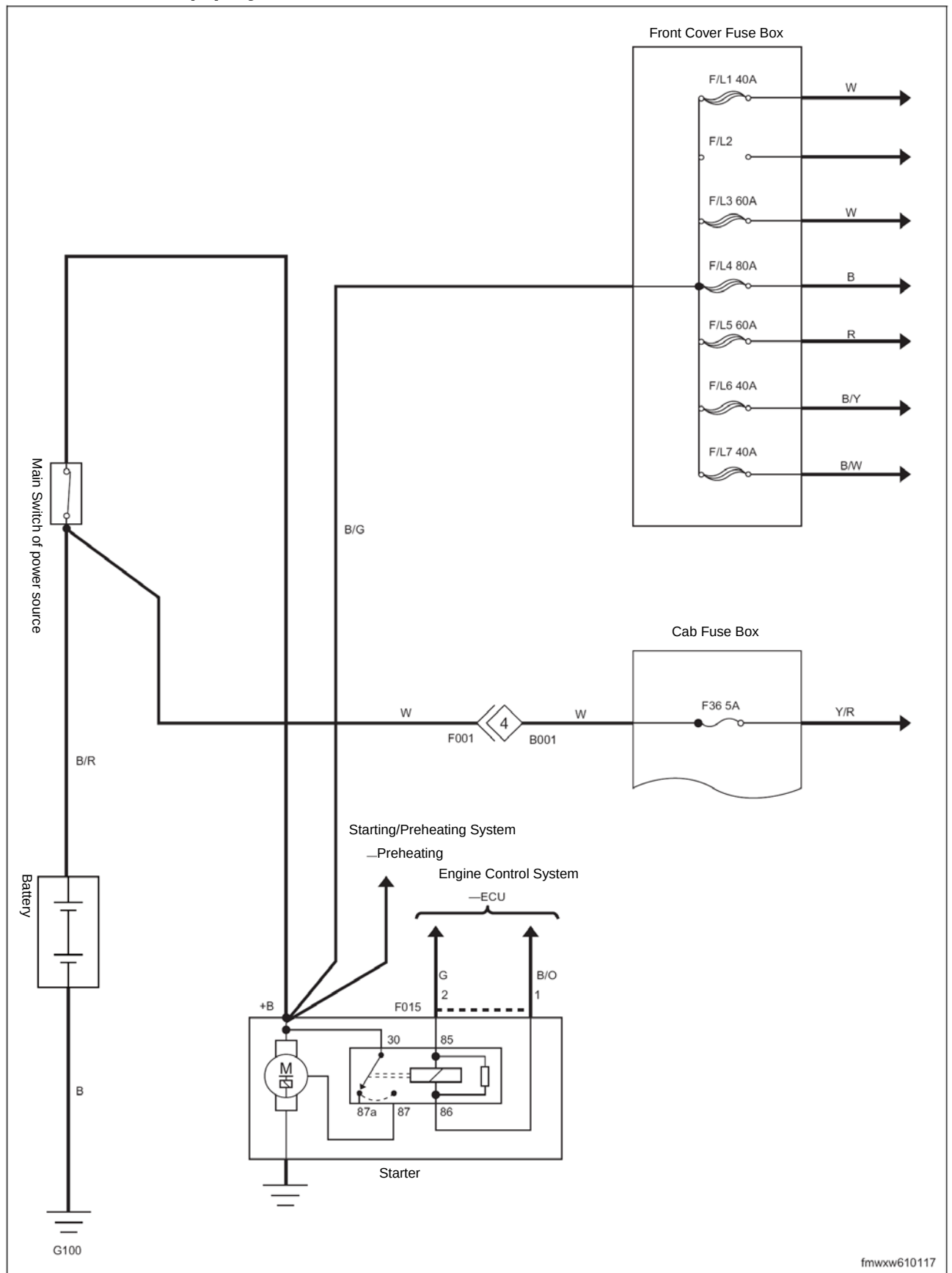


No.	Rated Current	Name
A	-	Burnout Alarm Controller
A	-	Shutdown Controller (state-two)
A	-	Preheating Controller

No.	Rated Current	Name
A	-	Dialer
A	-	Flash Relay
A	-	Twenty-one Controller

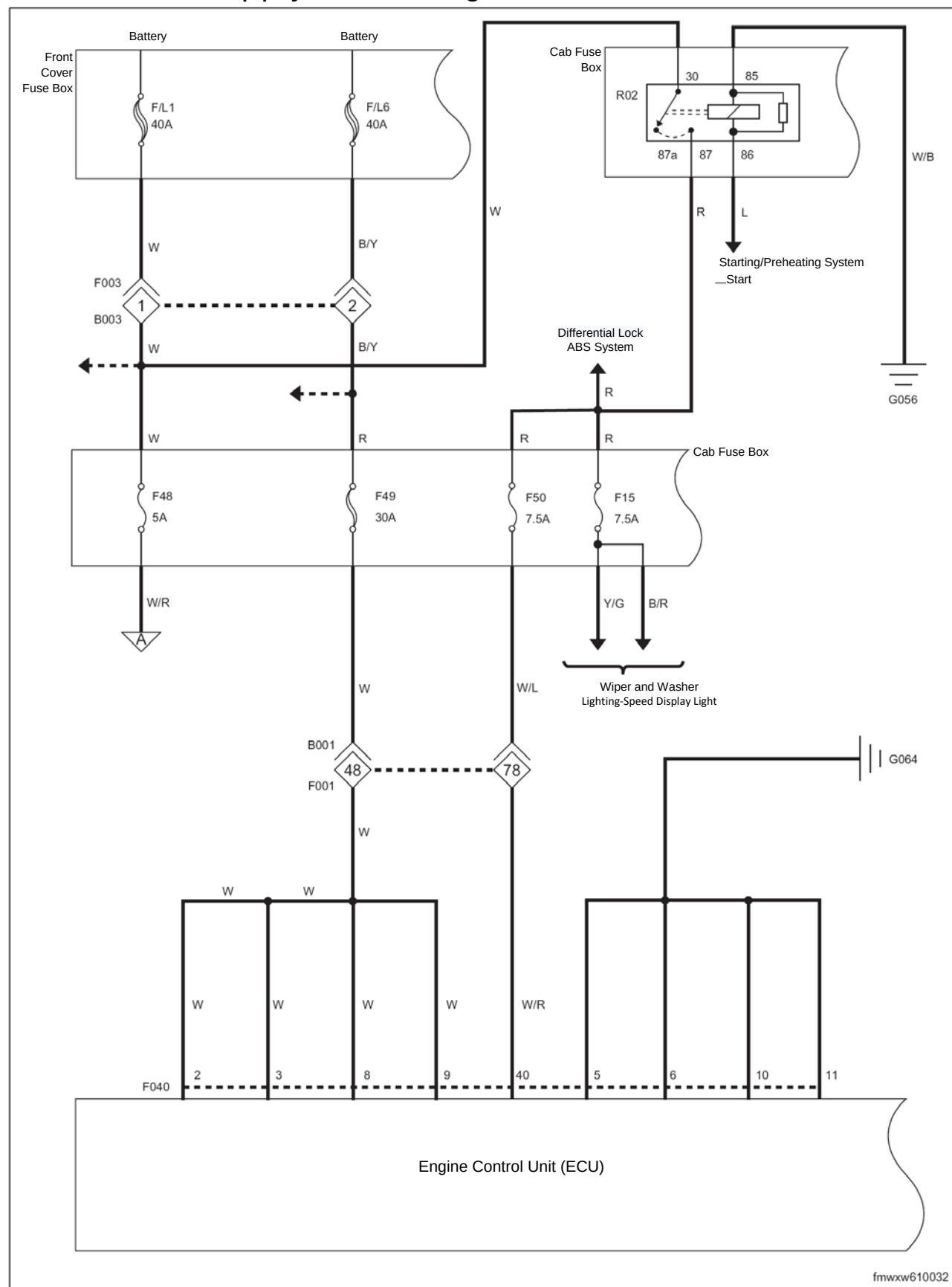
Circuit Diagram - Power Supply

Power Supply



Engine Control System

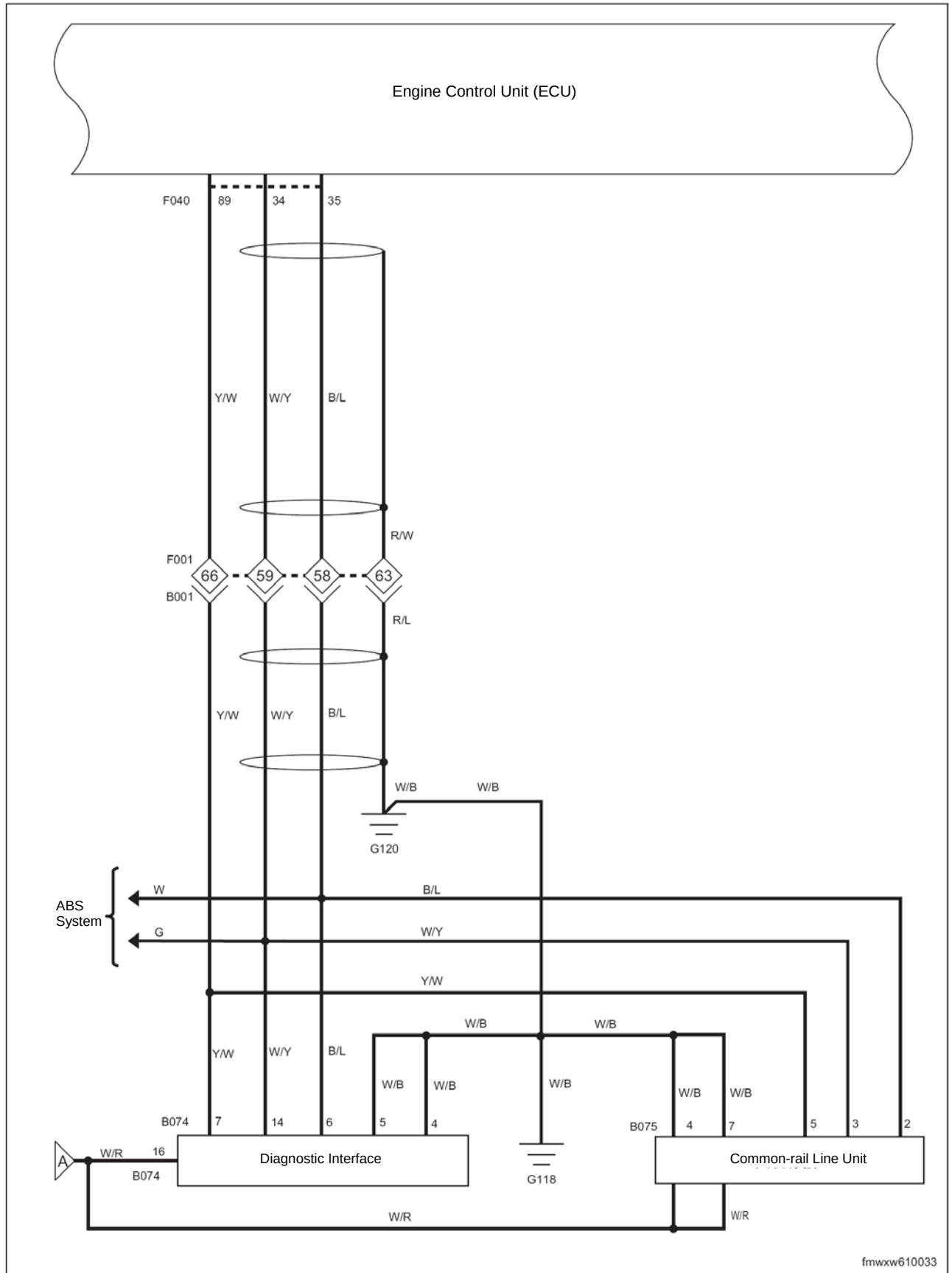
ECU Power Supply/Grounding



fmwxw610032

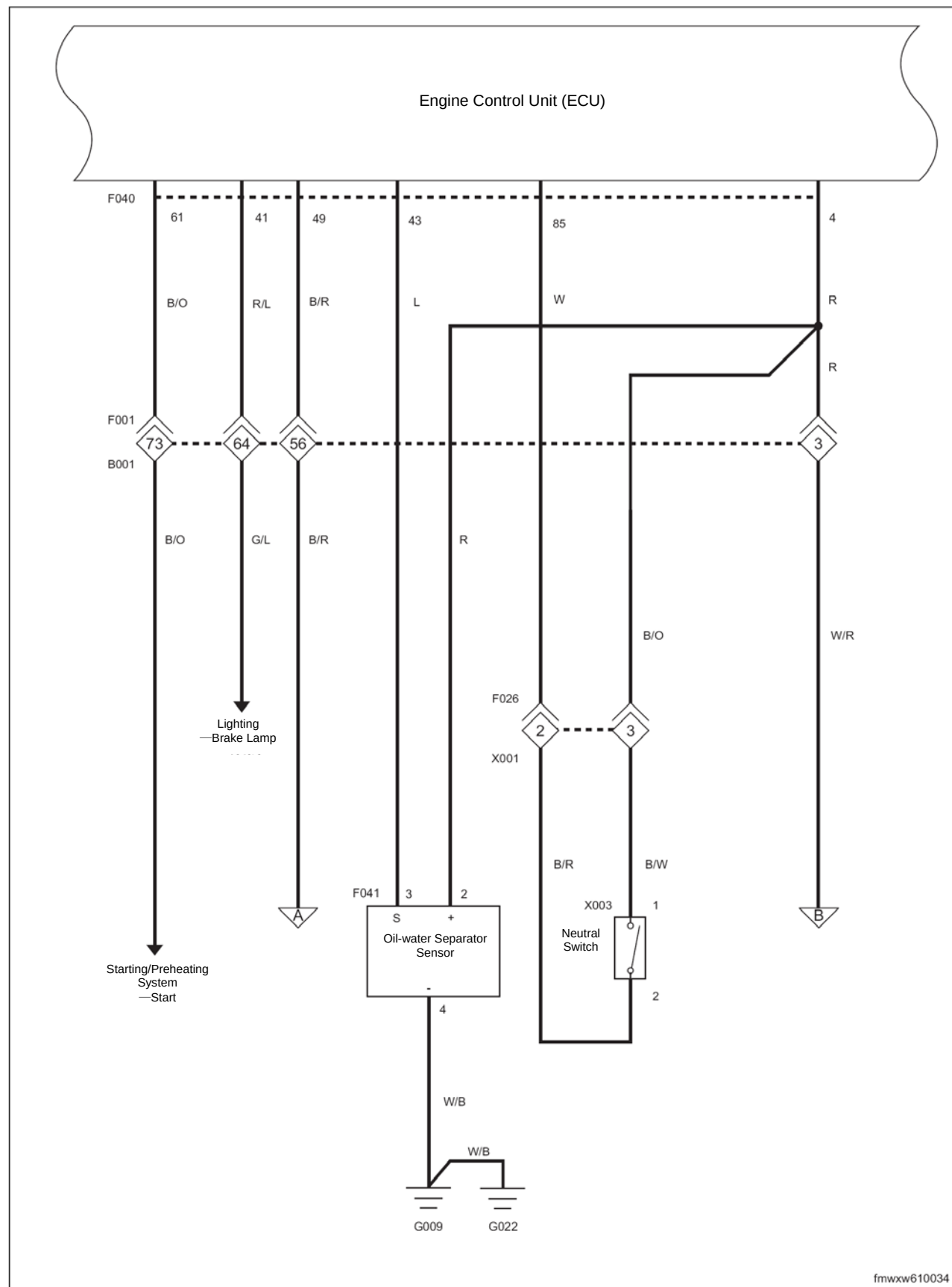
Circuit Diagram - Engine Control System

ECU Power Supply /Grounding (Continued)



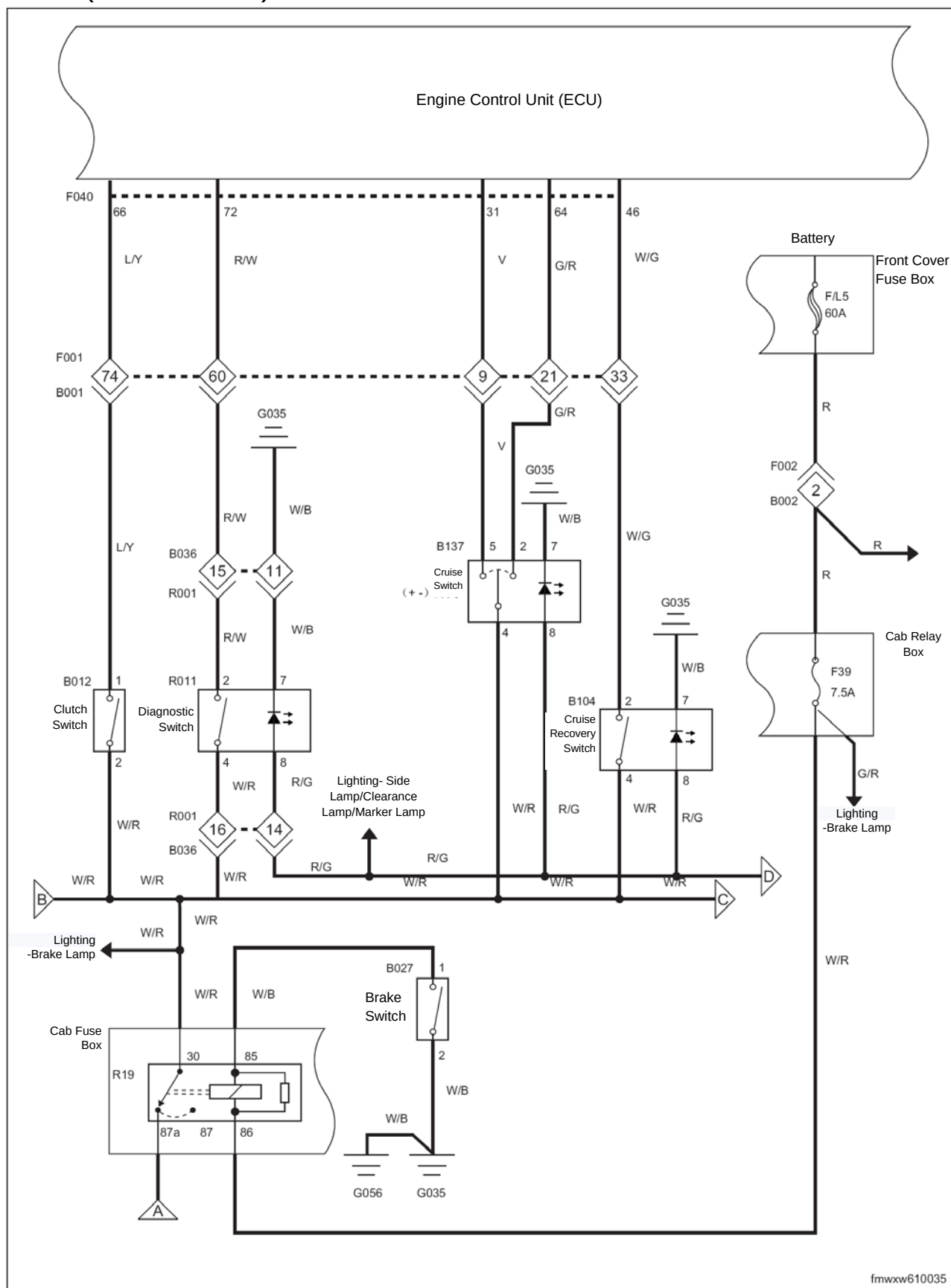
Circuit Diagram - Engine Control System

ECU



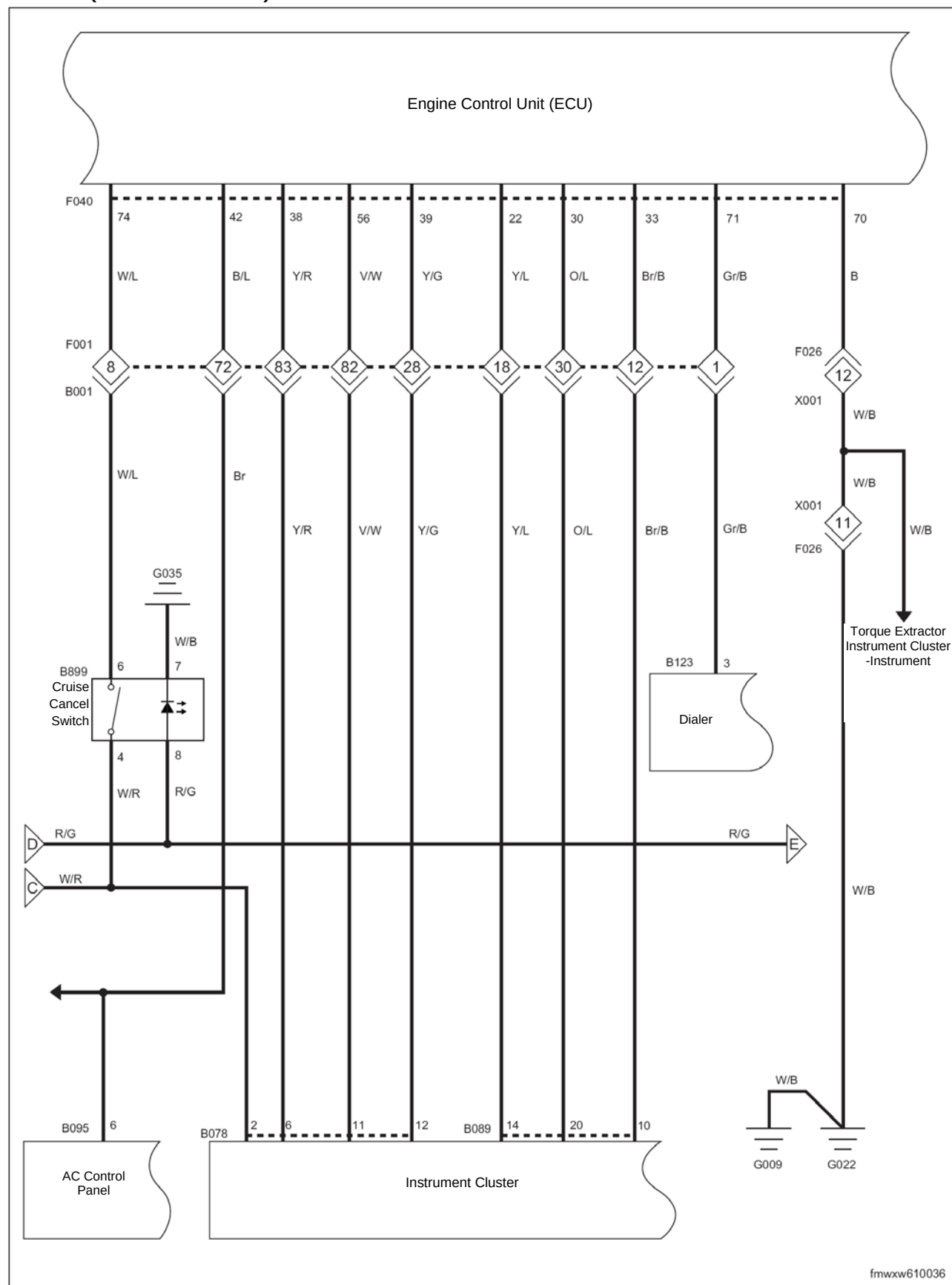
Circuit Diagram - Engine Control System

ECU (Continued)

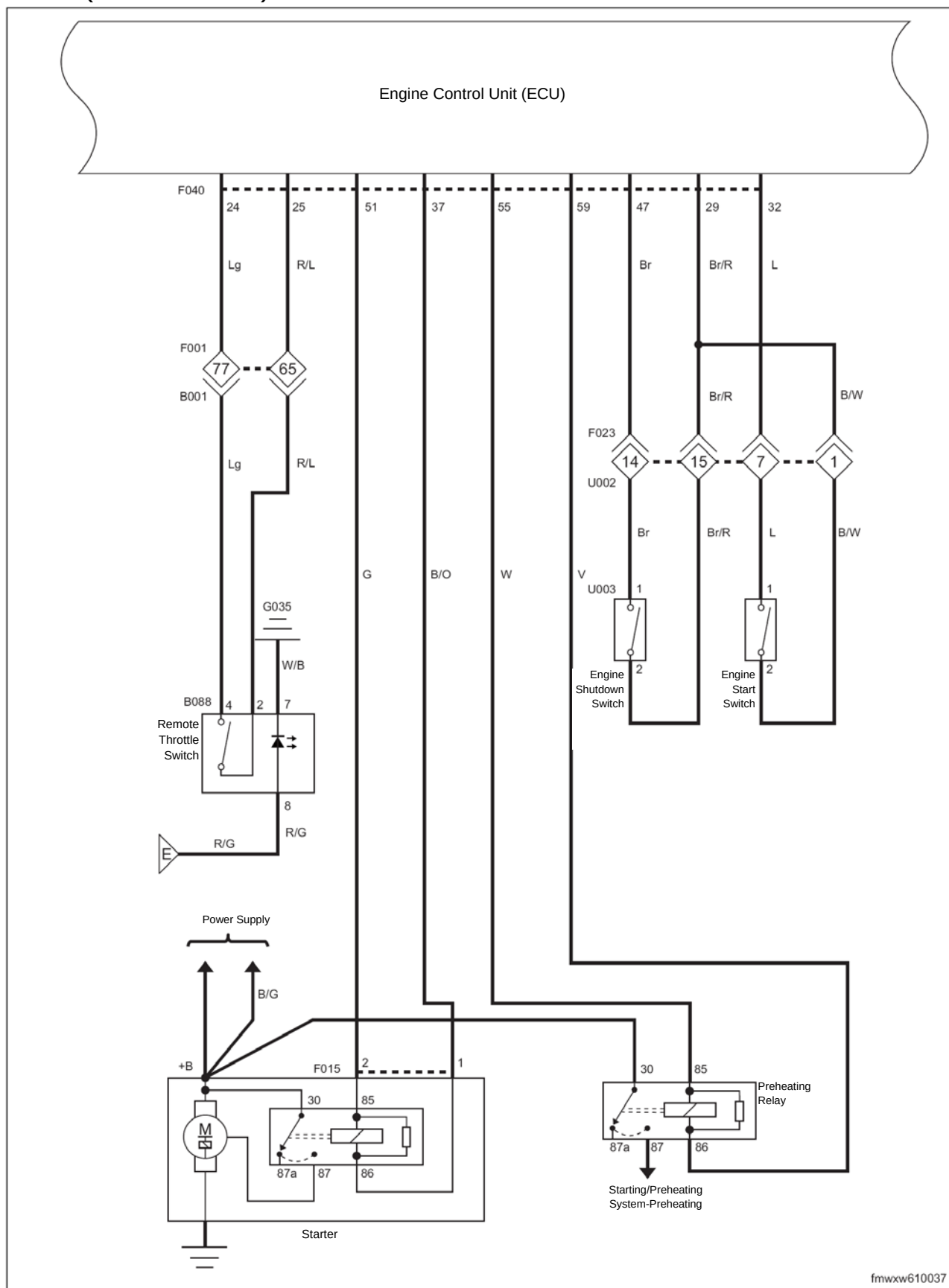


fmwxw610035

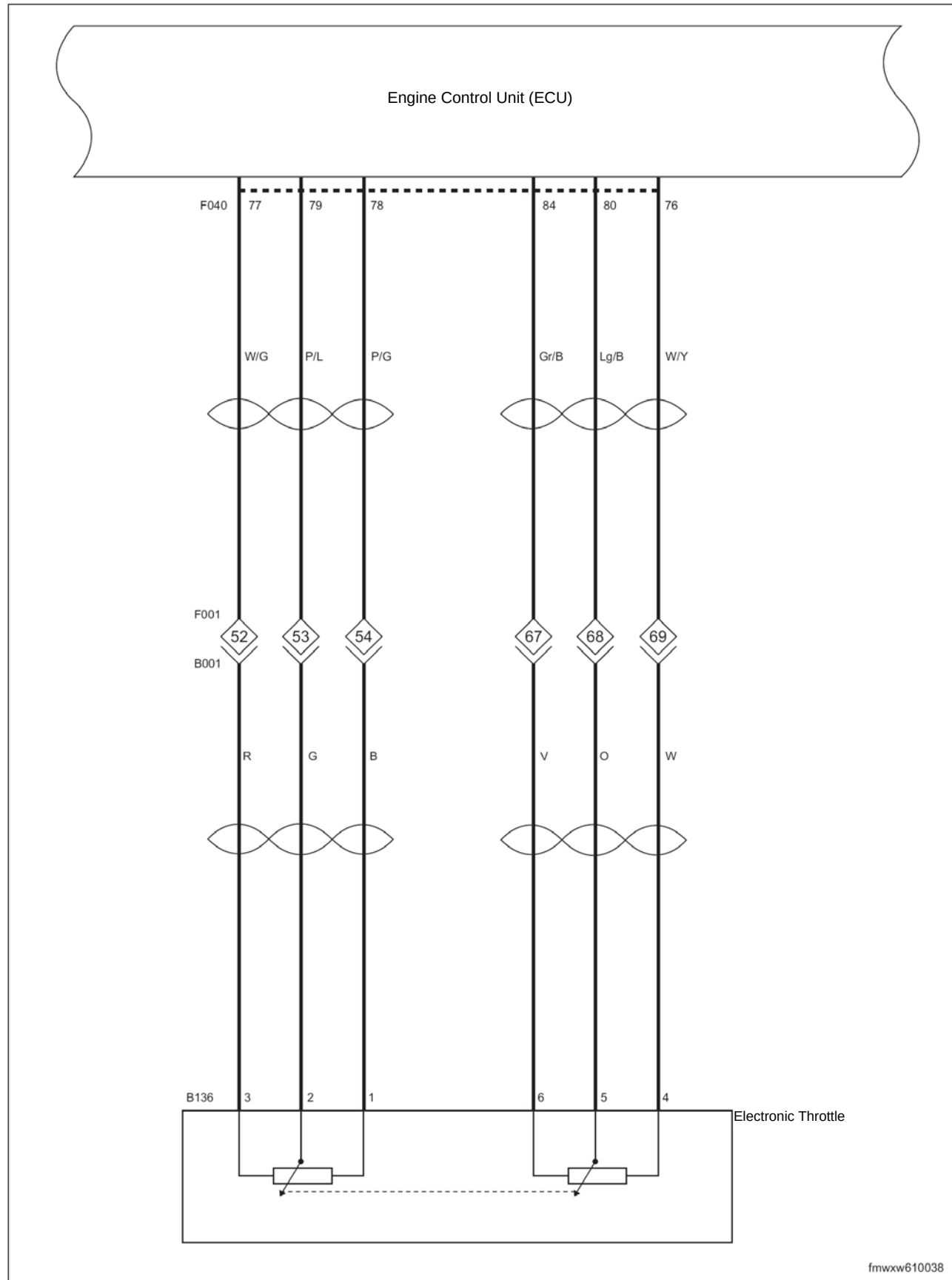
ECU (Continued)



ECU (Continued)

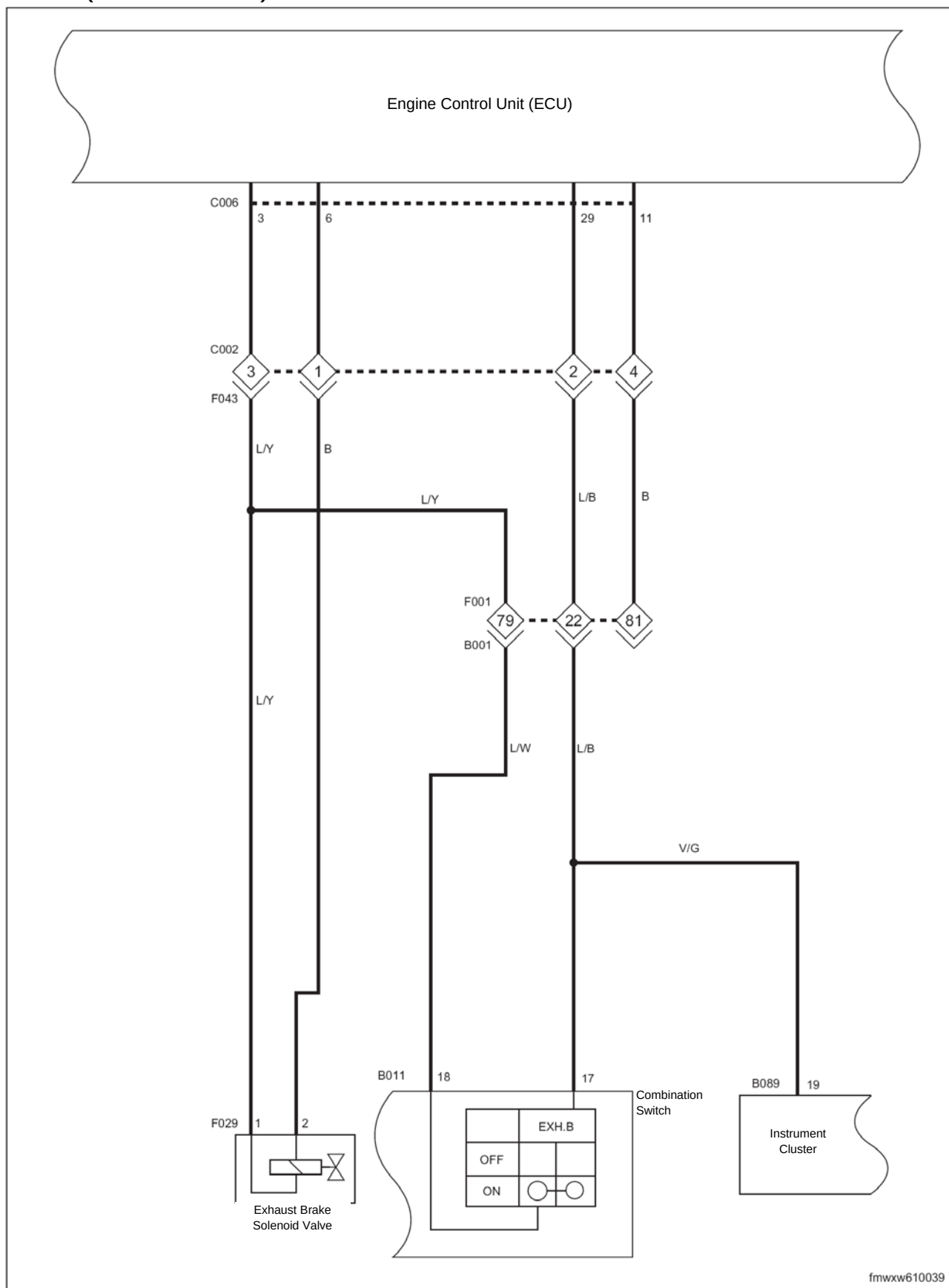


ECU (Continued)



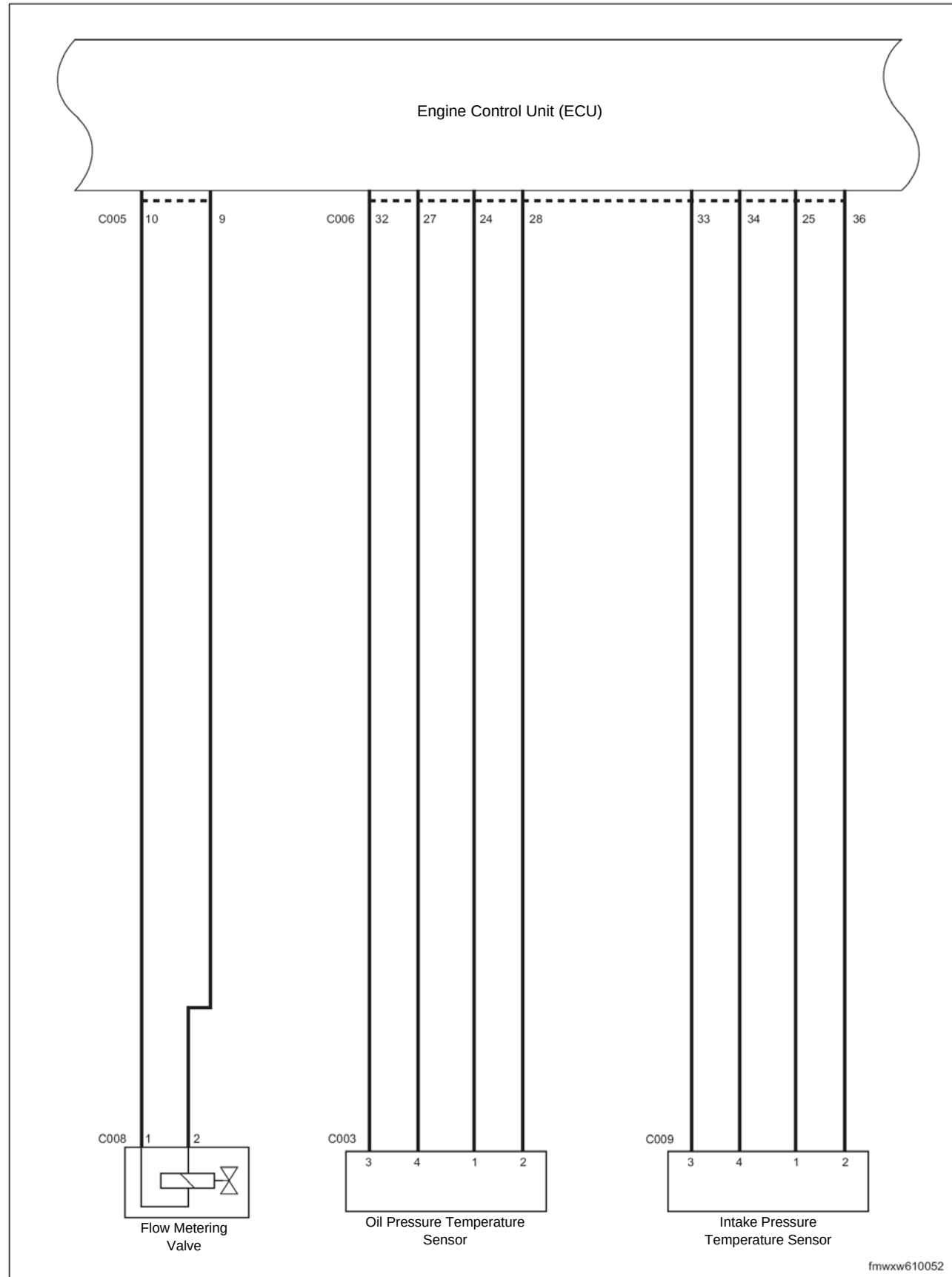
Circuit Diagram - Engine Control System

ECU (Continued)



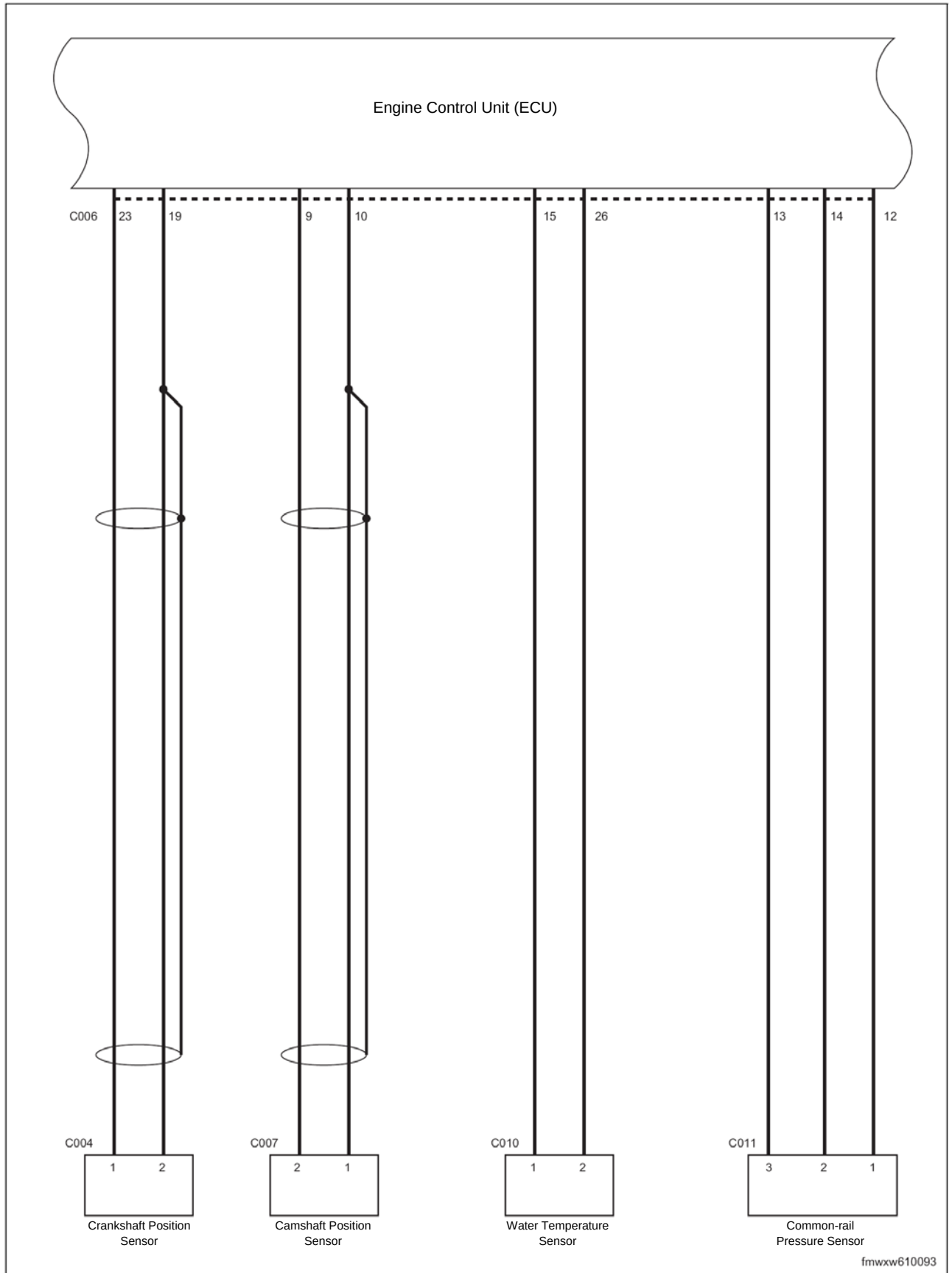
Circuit Diagram - Engine Control System

ECU (Continued)



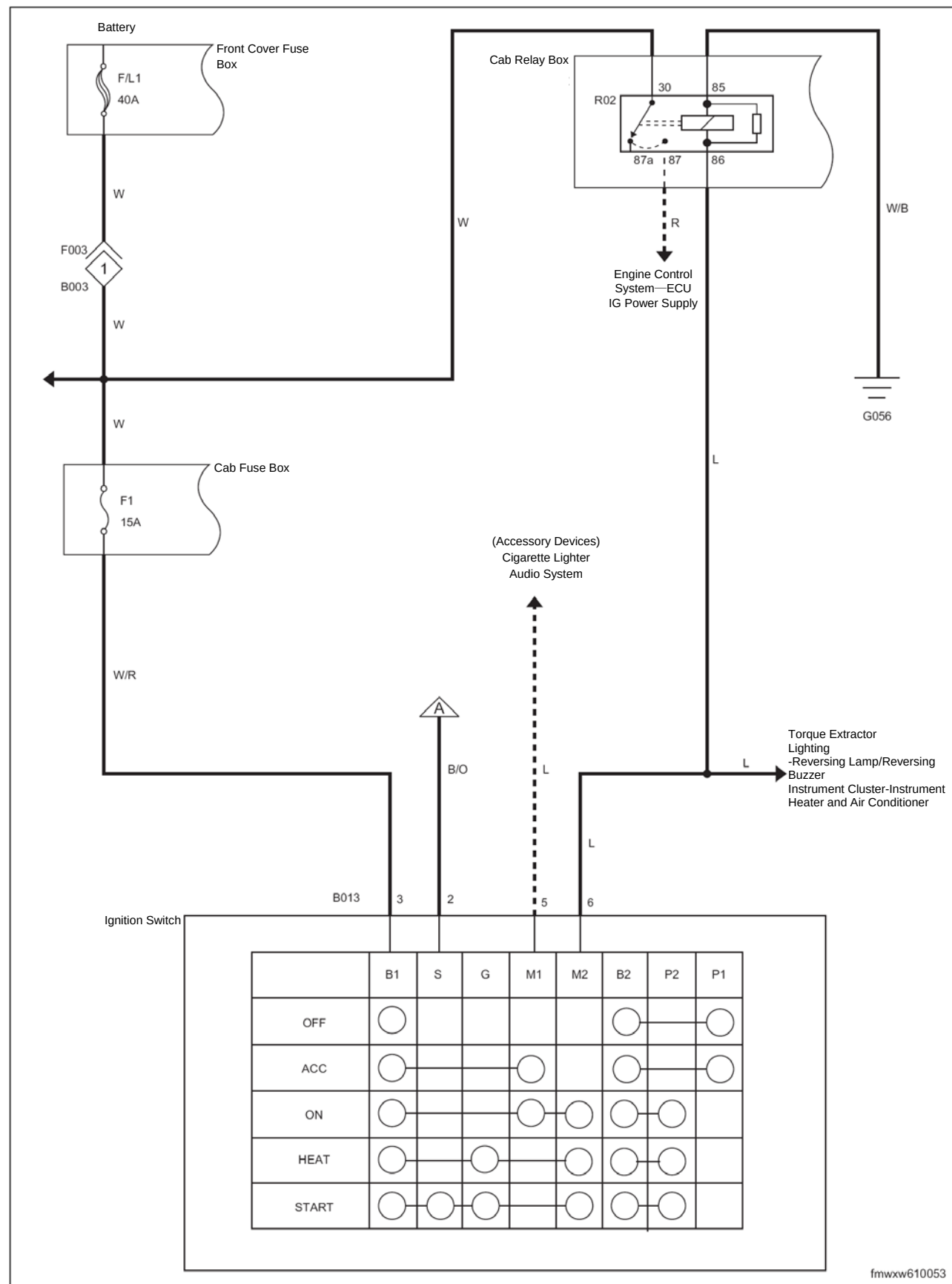
Circuit Diagram - Engine Control System

ECU (Continued)



Start and Preheating System

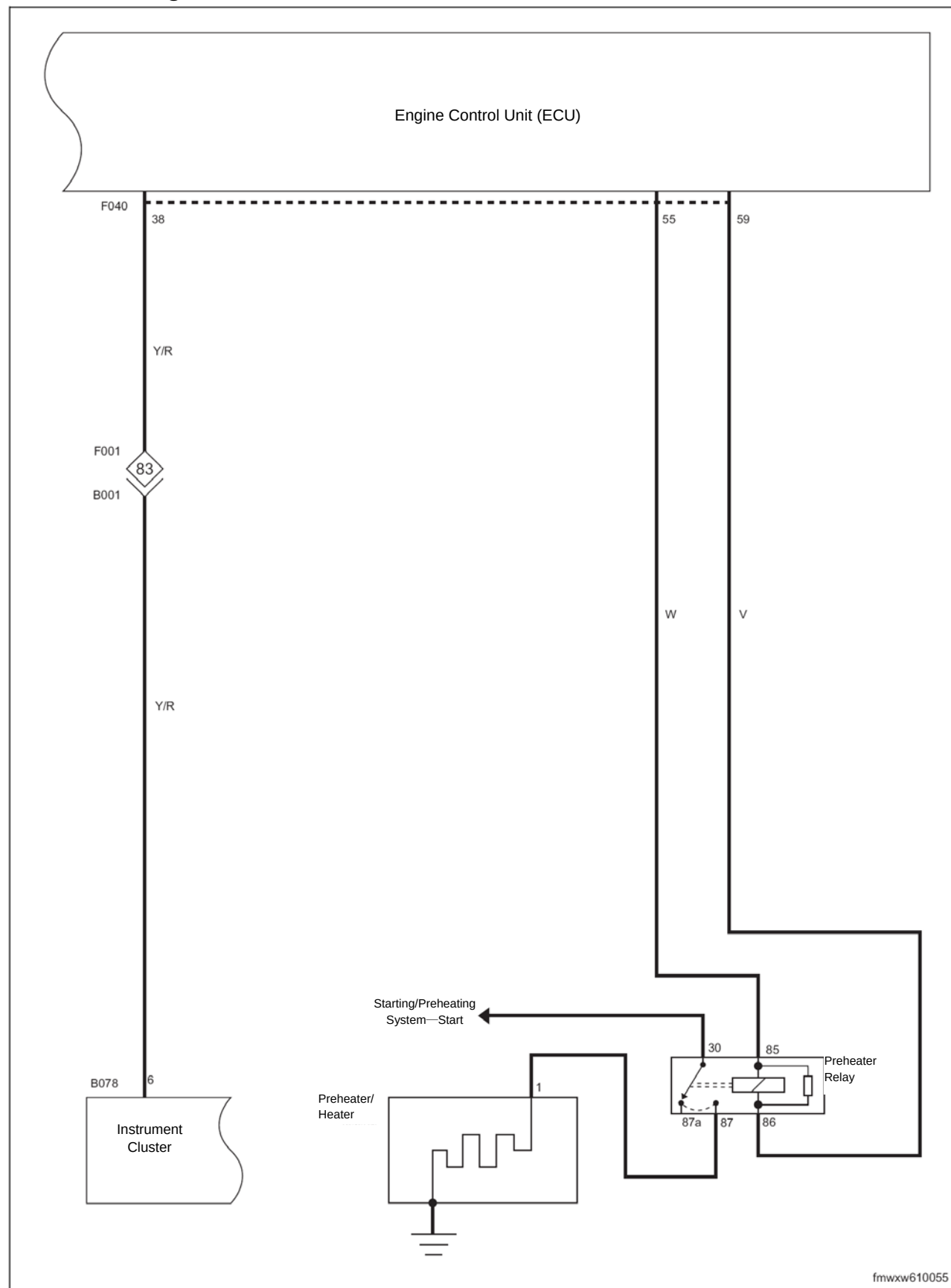
Start



Start (Continued)

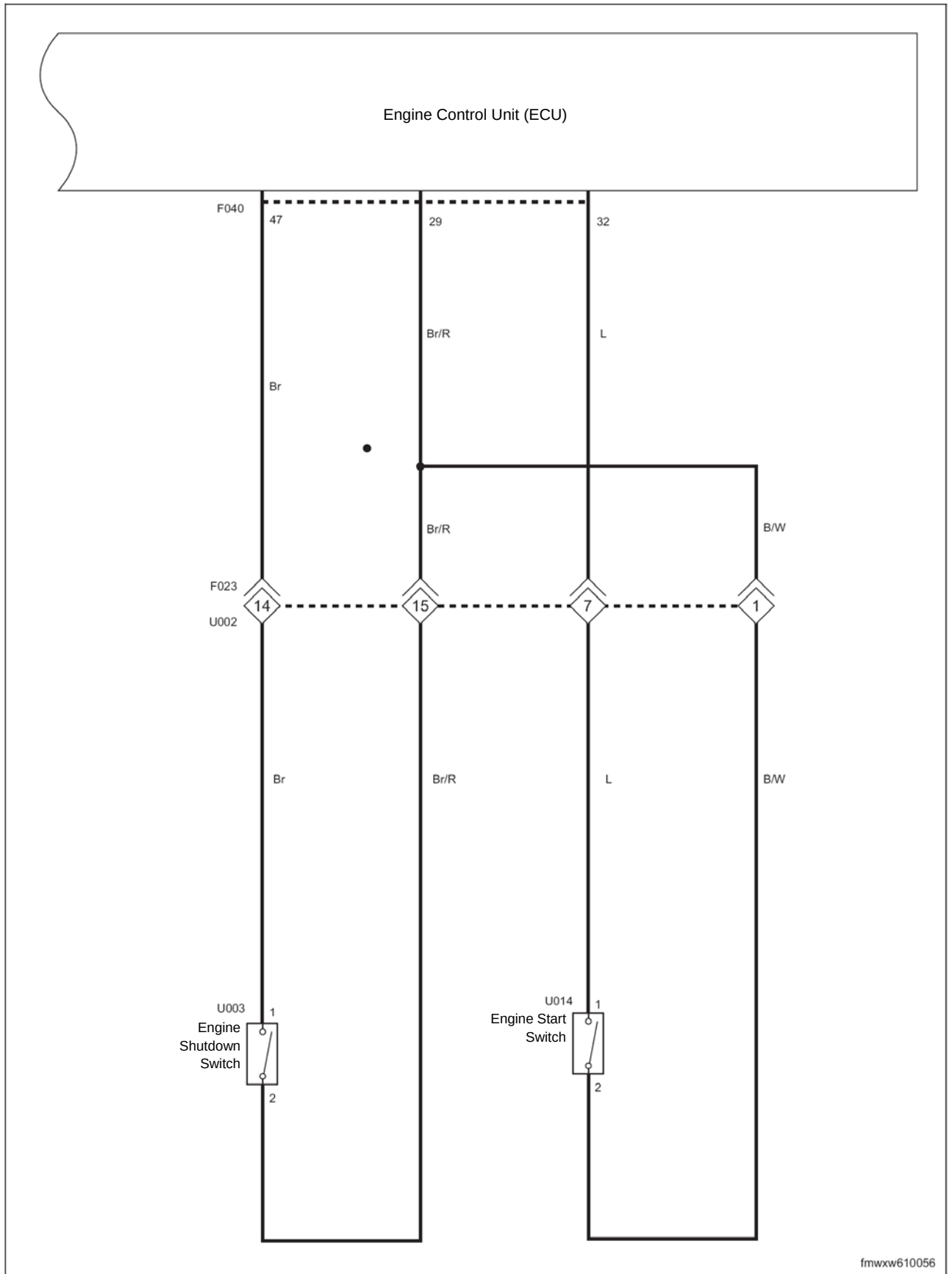


Preheating



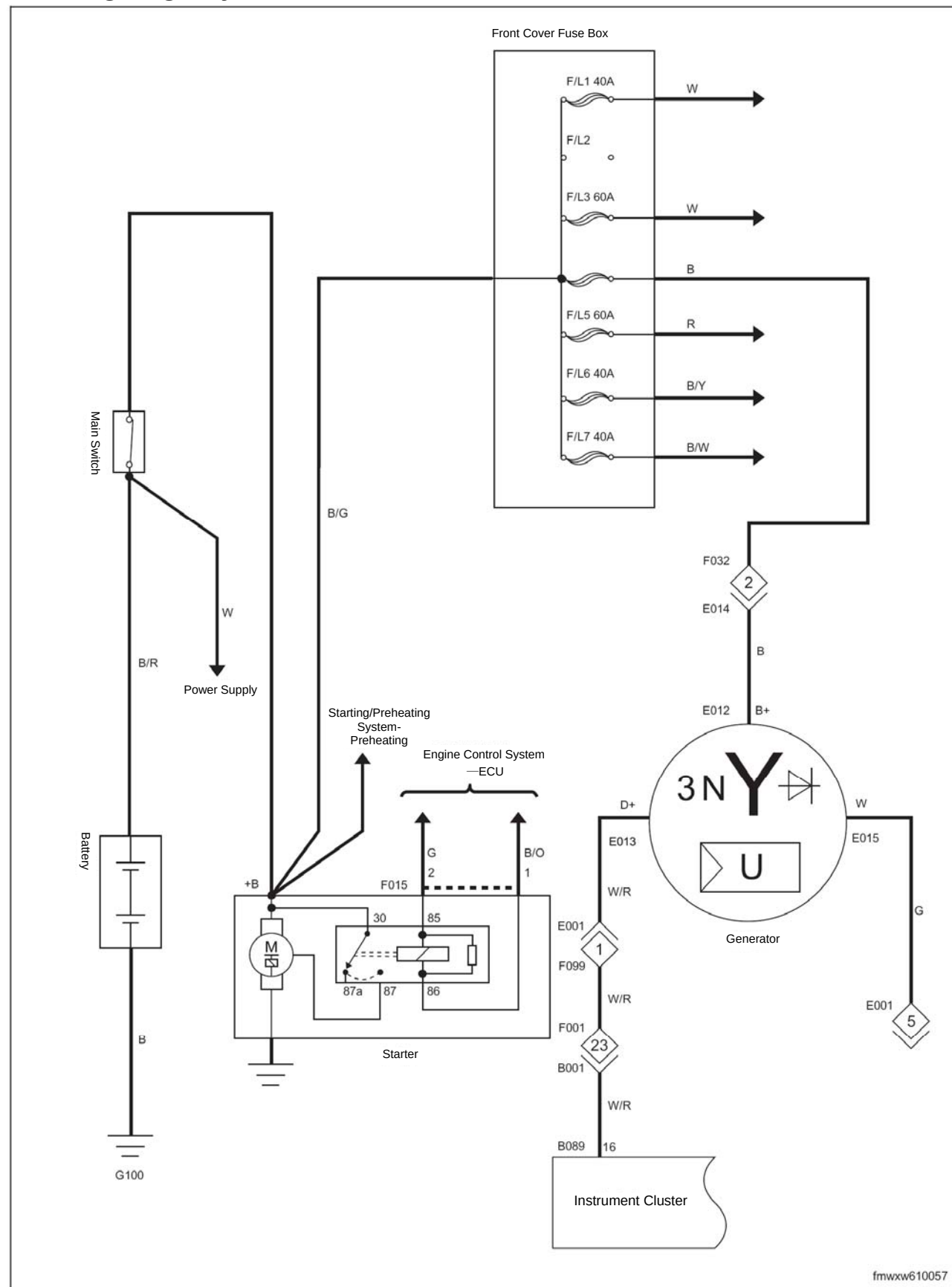
Circuit Diagram - Start and Preheating System

Stock Start



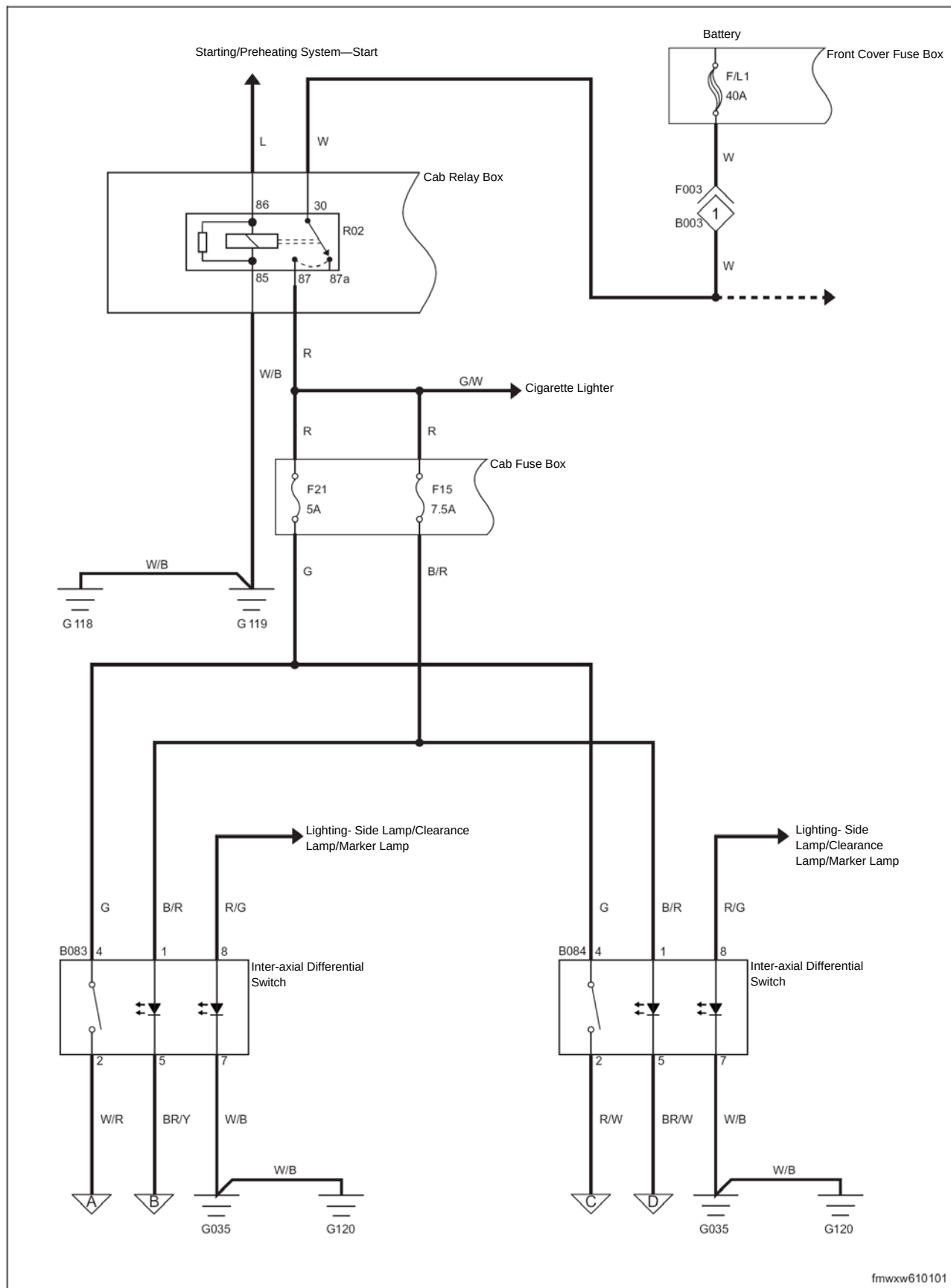
Circuit Diagram - Charging System

Charging System

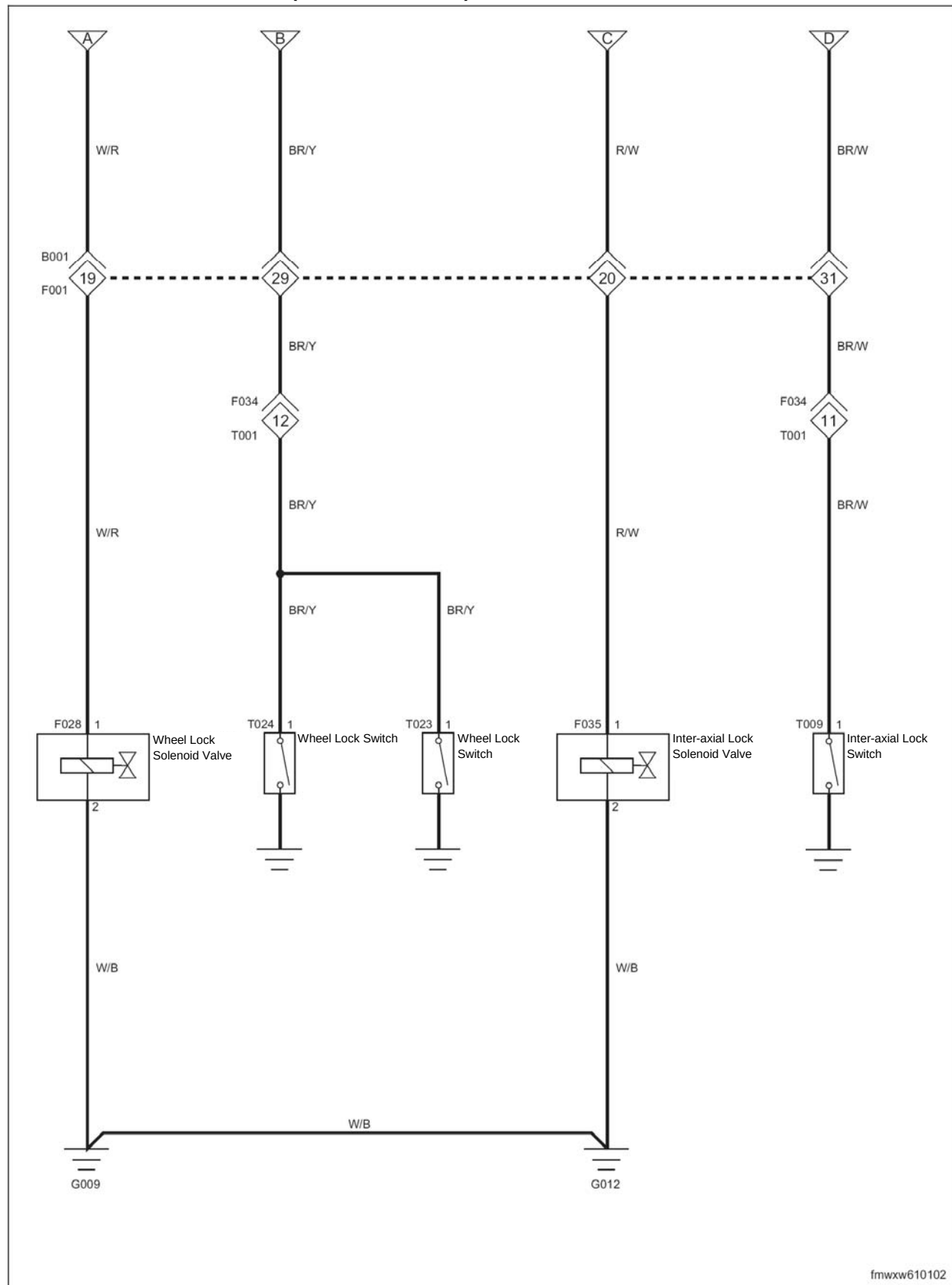


Circuit Diagram - Differential Lock

Differential Lock

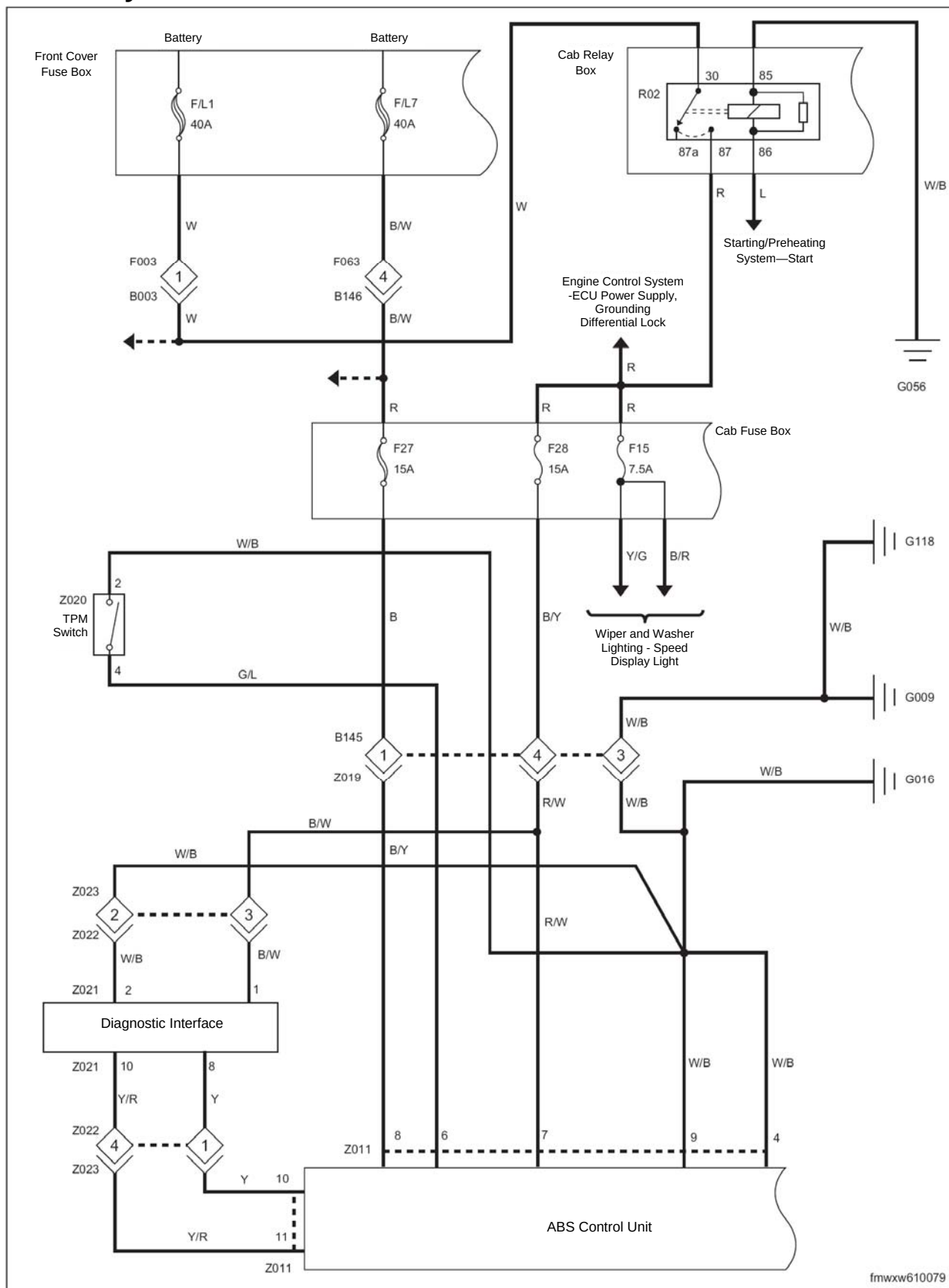


Differential Lock (Continued)

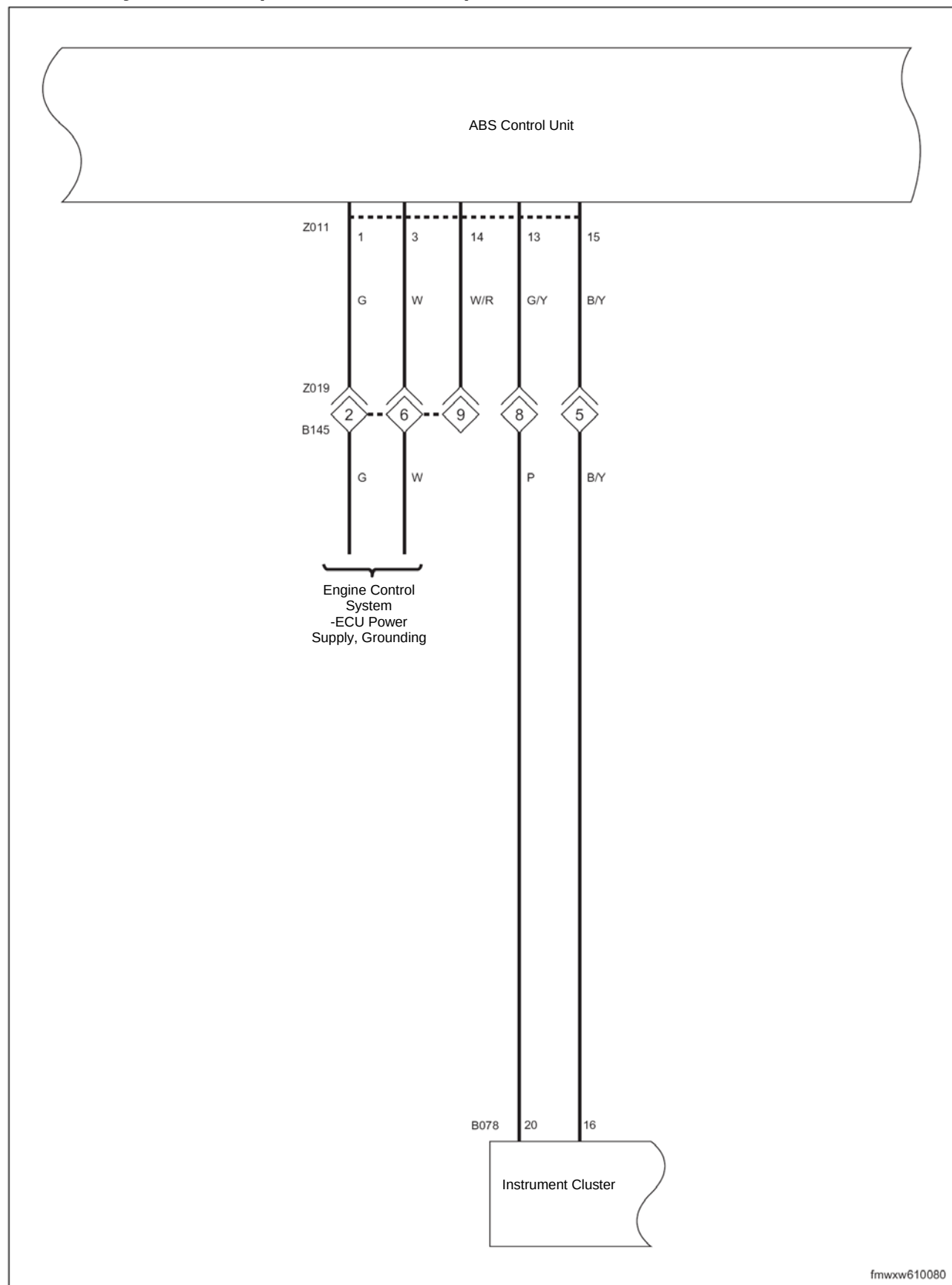


Circuit Diagram - ABS System

ABS System

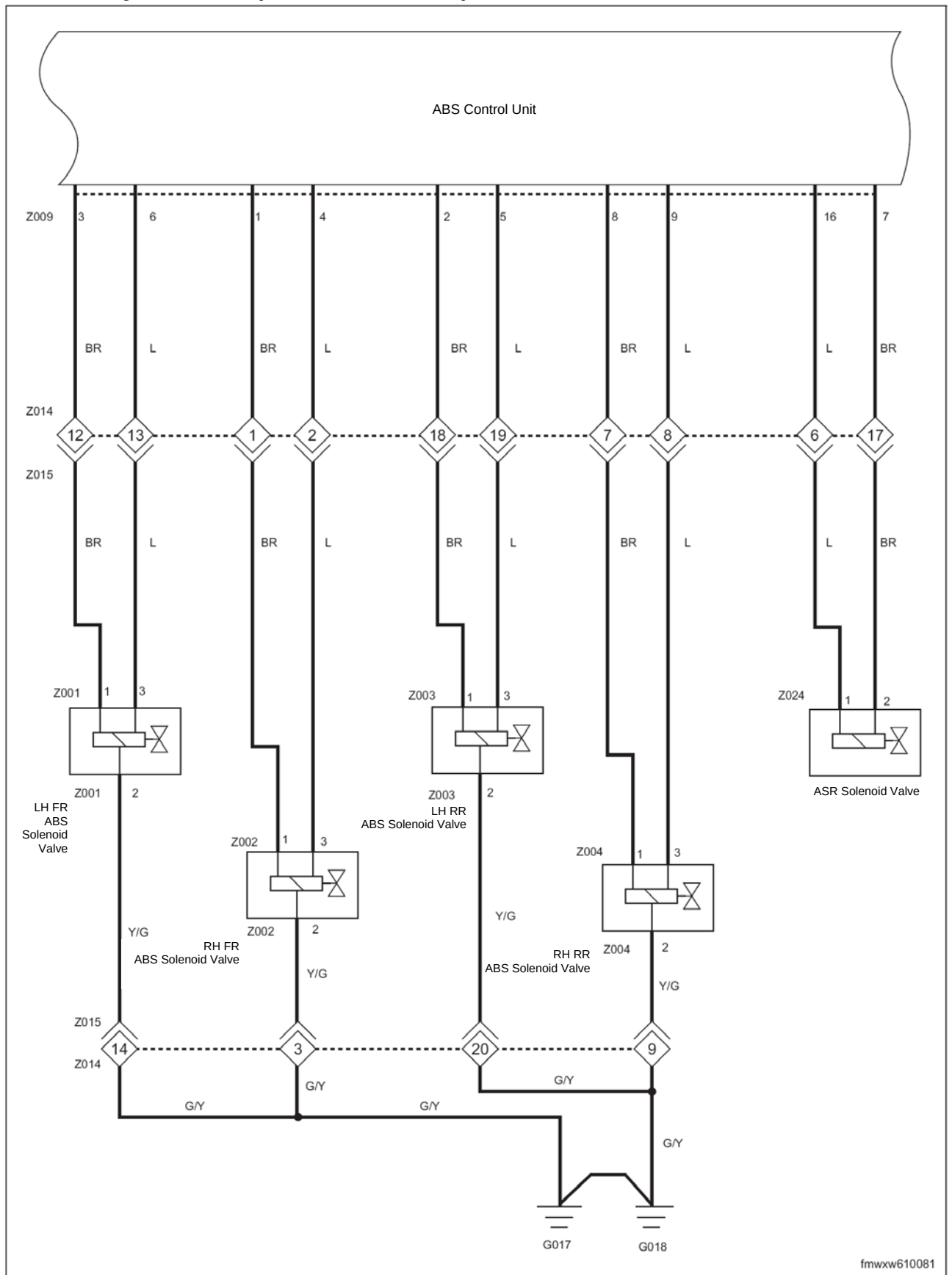


ABS system (Continued)



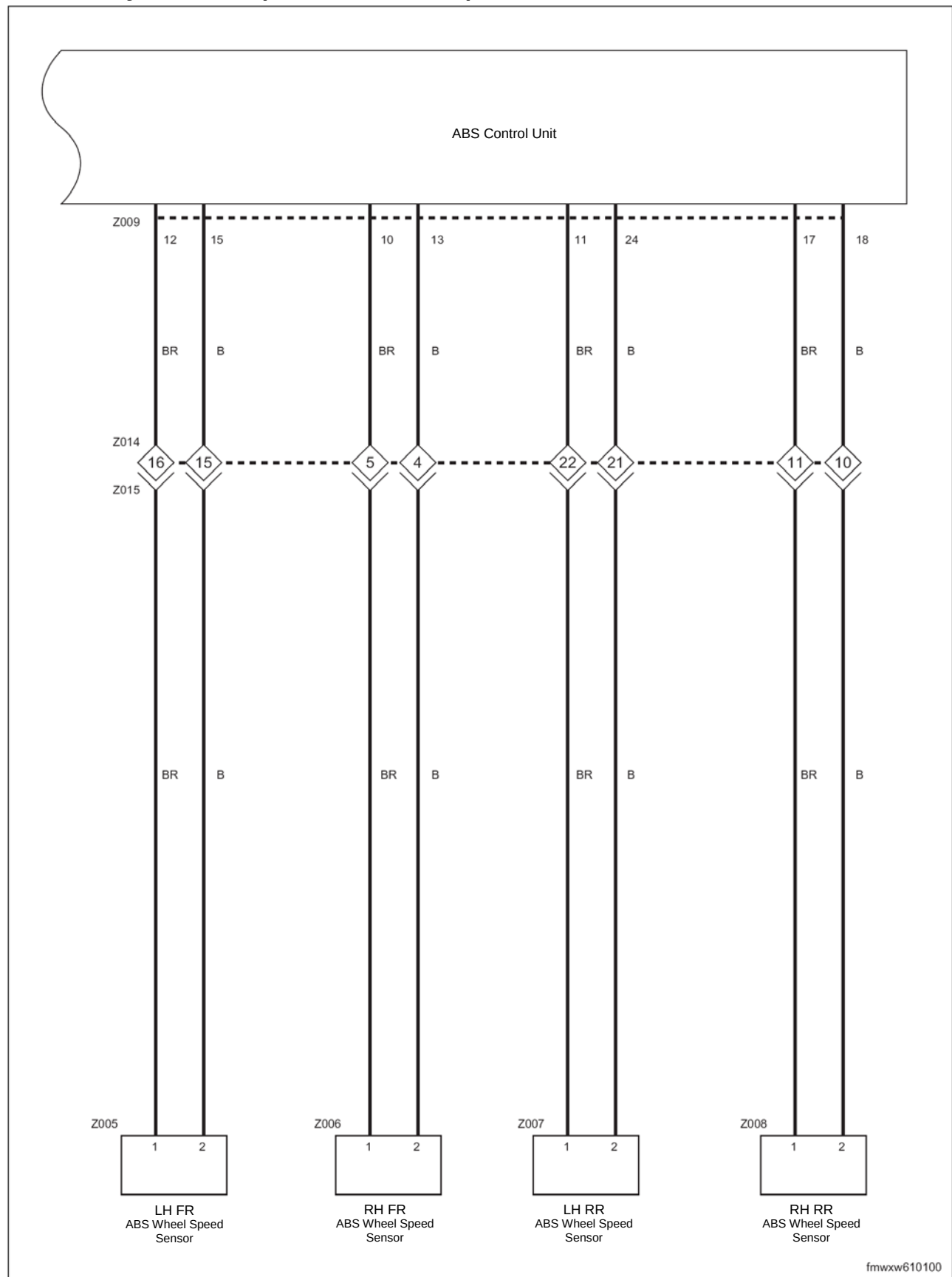
Circuit Diagram - ABS System

ABS System (Continued)



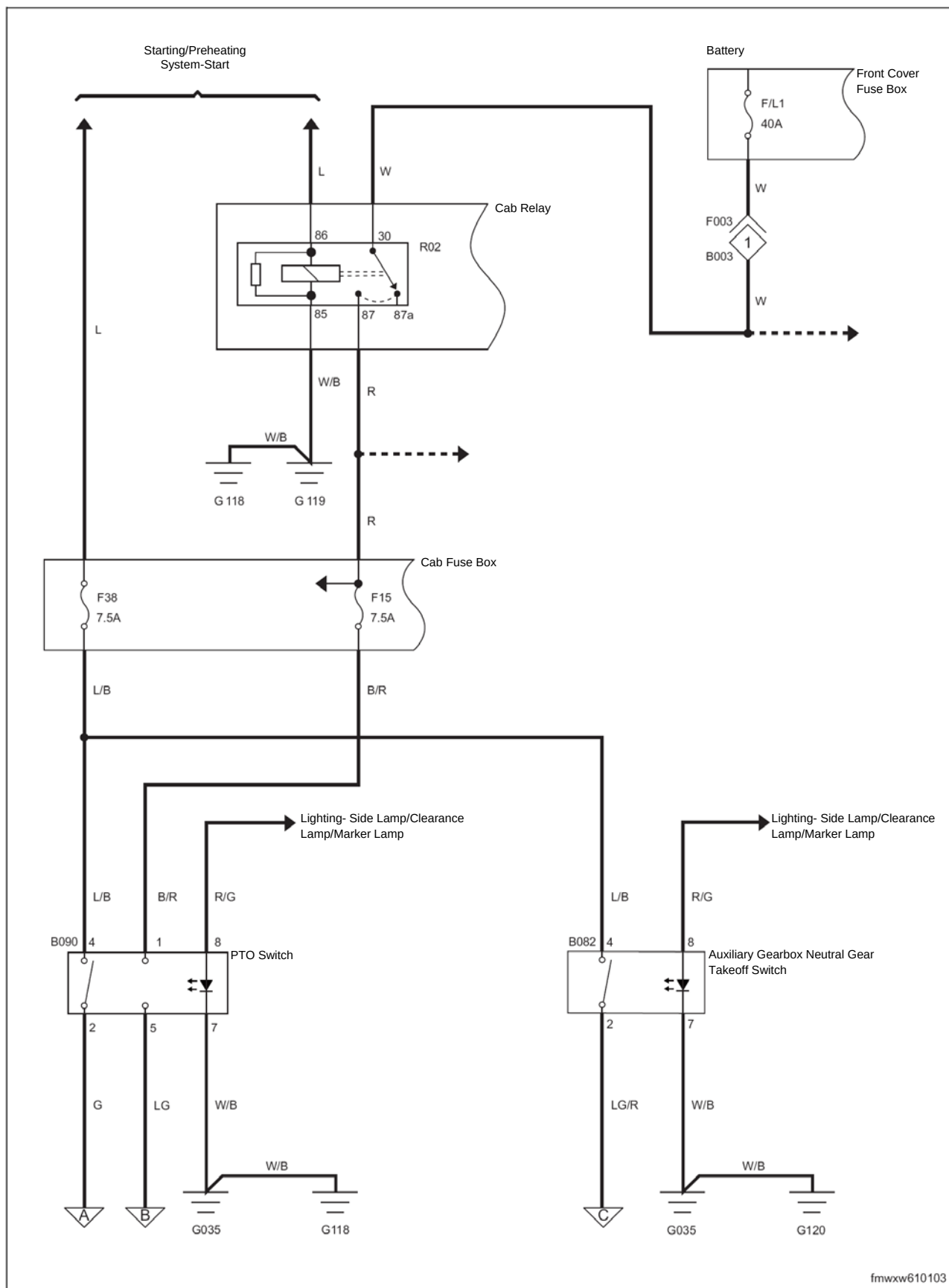
fmwxw610081

ABS System (Continued)

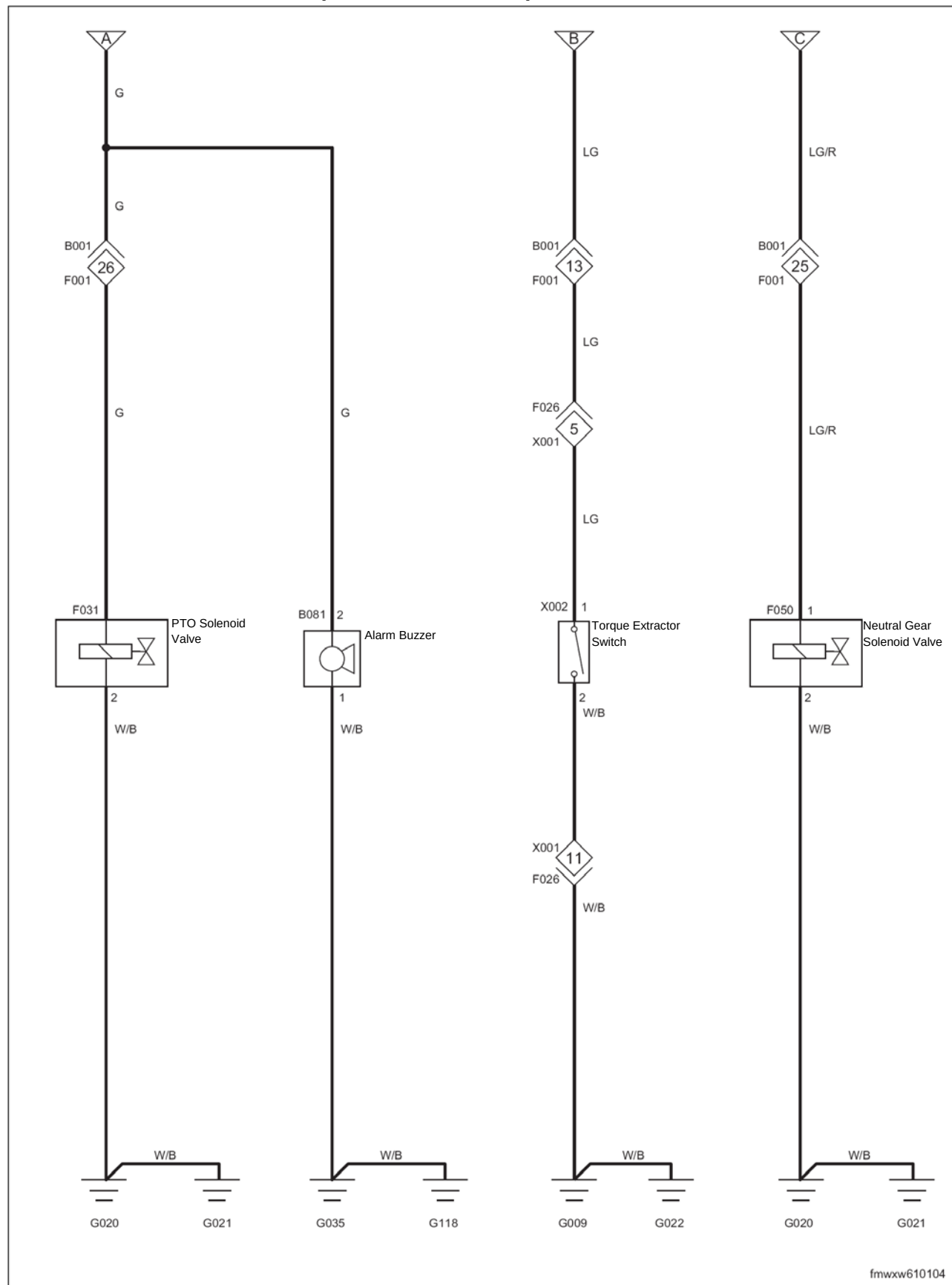


Circuit Diagram - Power Take-off

Power Take-off

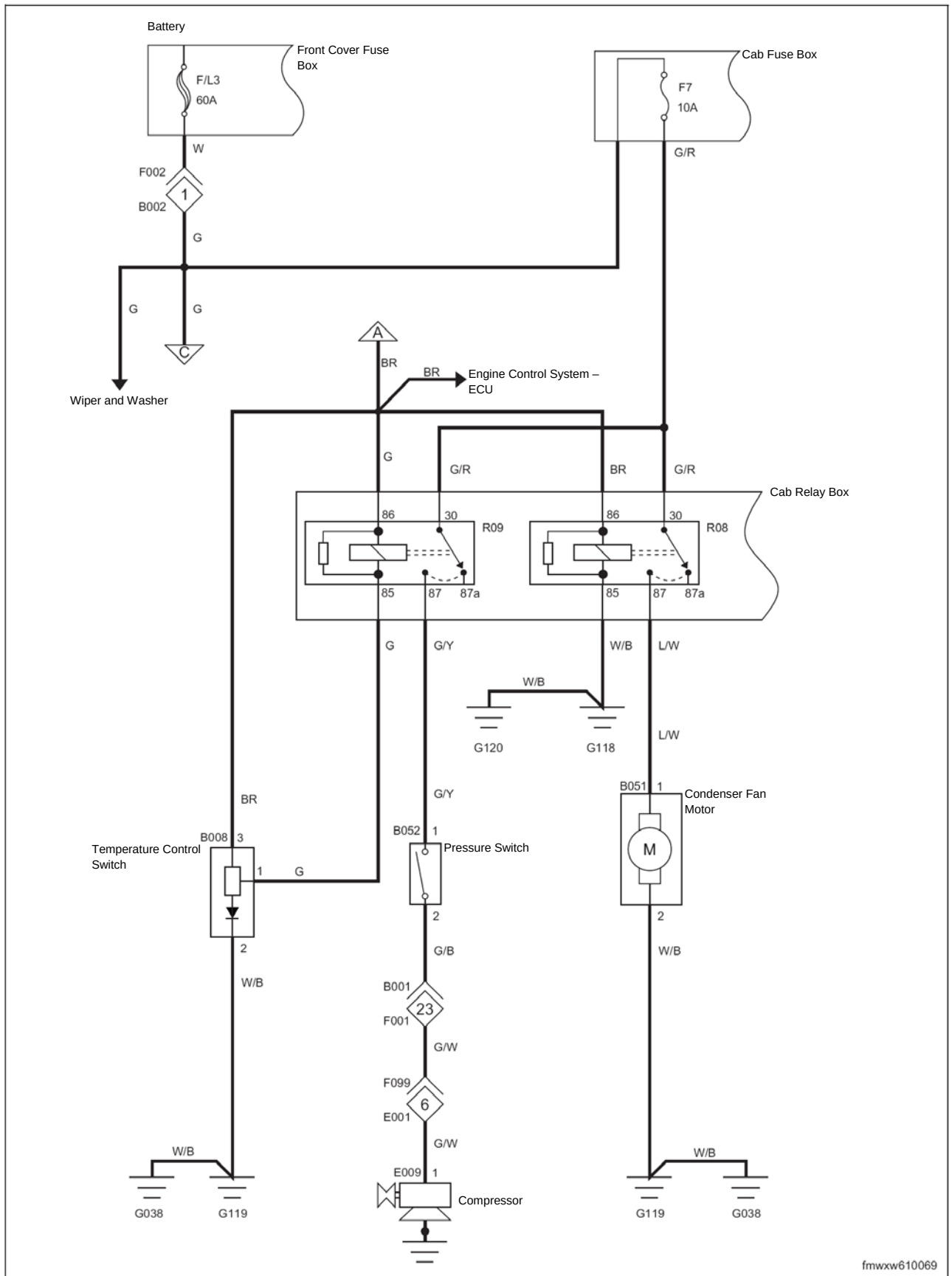


Power Take-off (Continued)

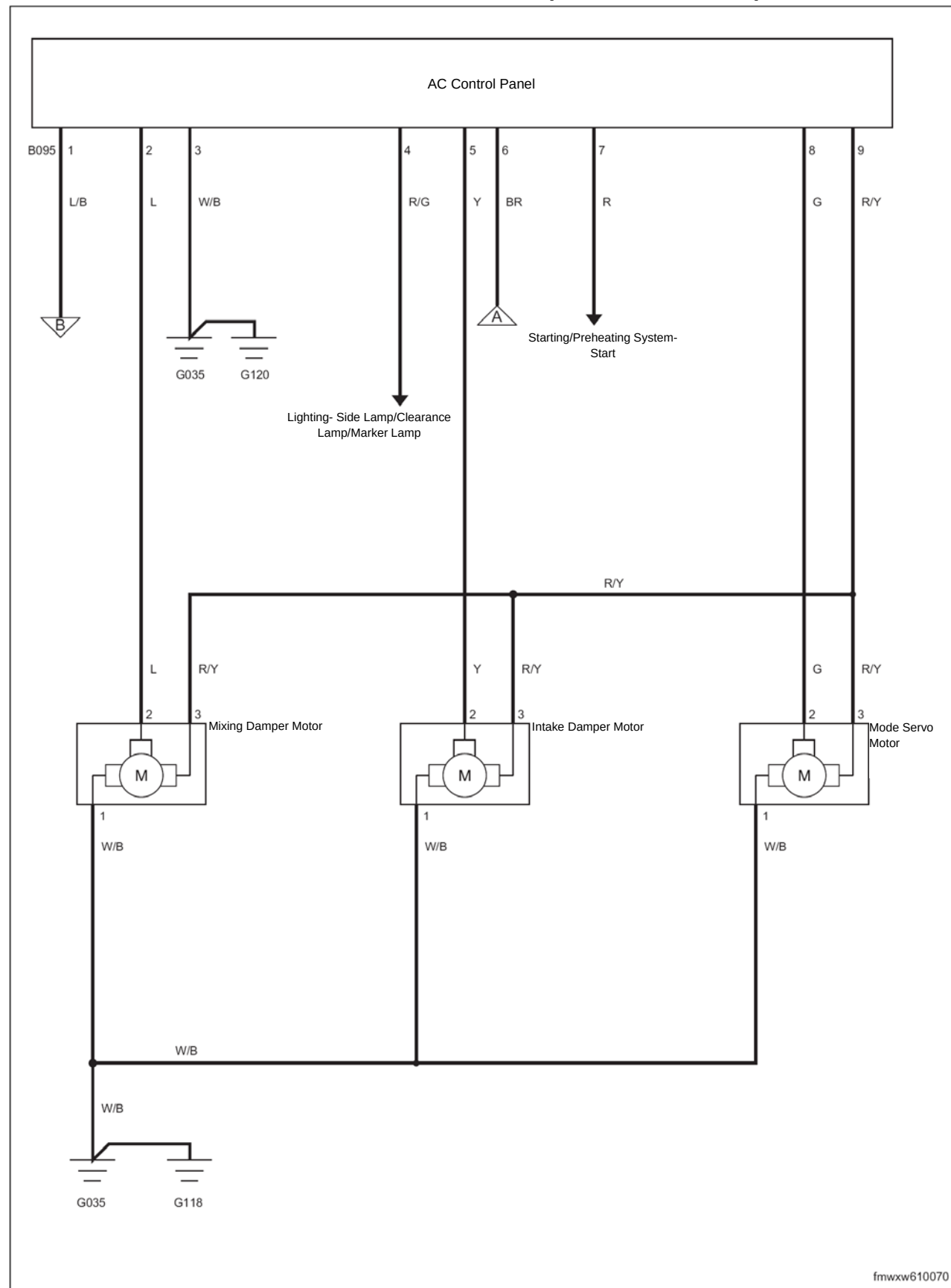


Circuit Diagram - Heater and Air Conditioner

Heater and Air Conditioner

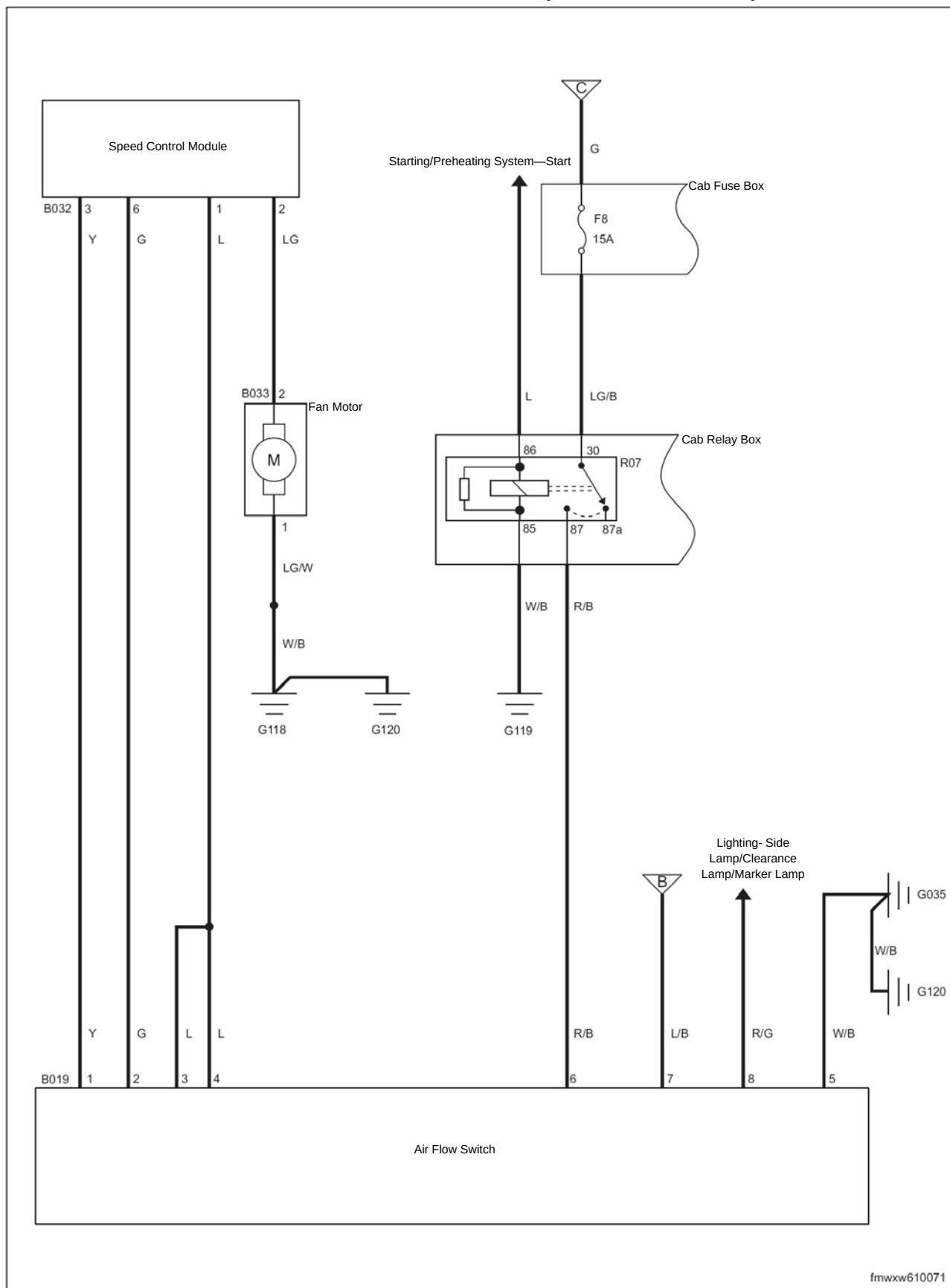


Heater and Air Conditioner (Continued)



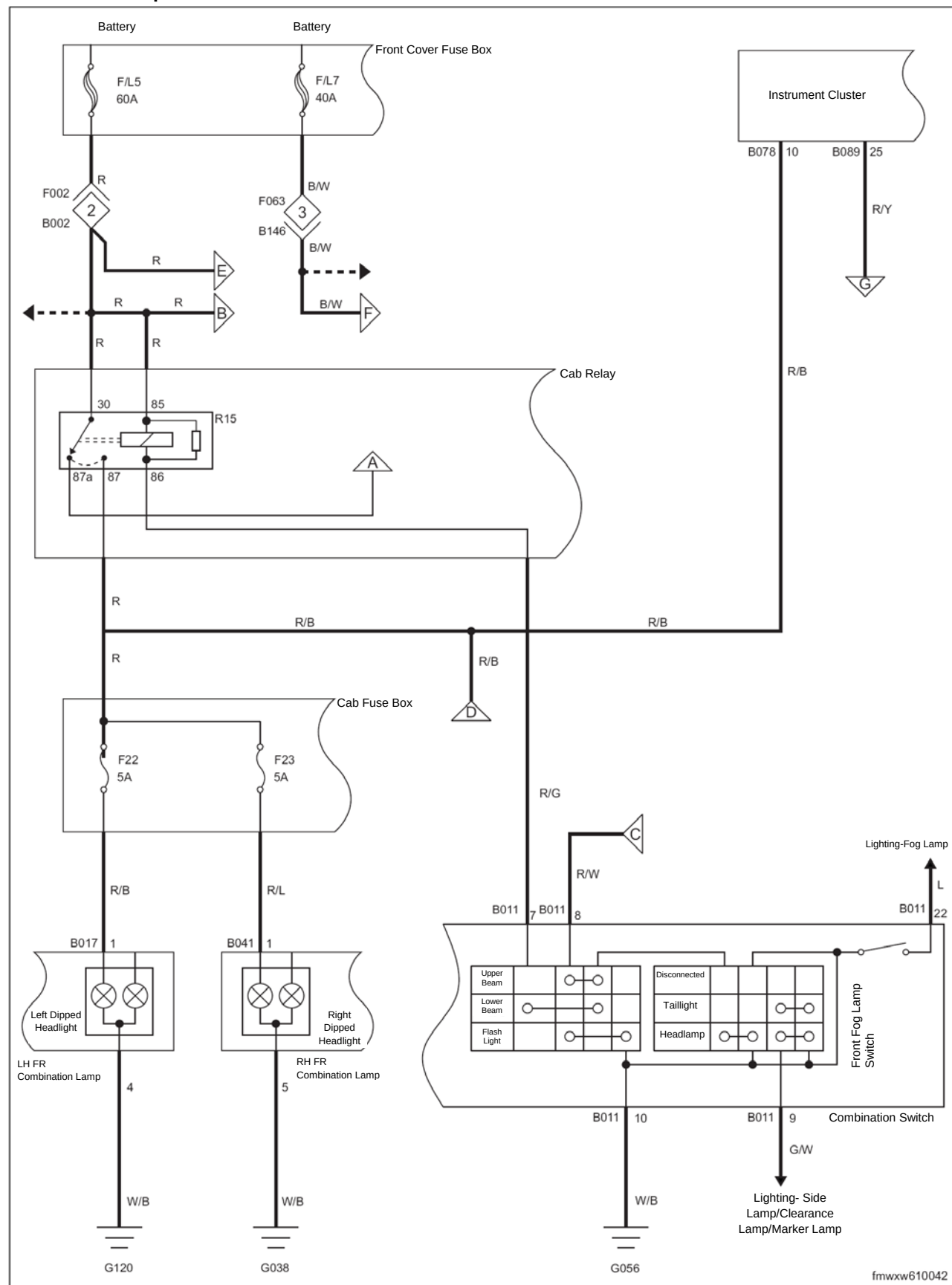
Circuit Diagram - Heater and Air Conditioner

Heater and Air Conditioner (Continued)



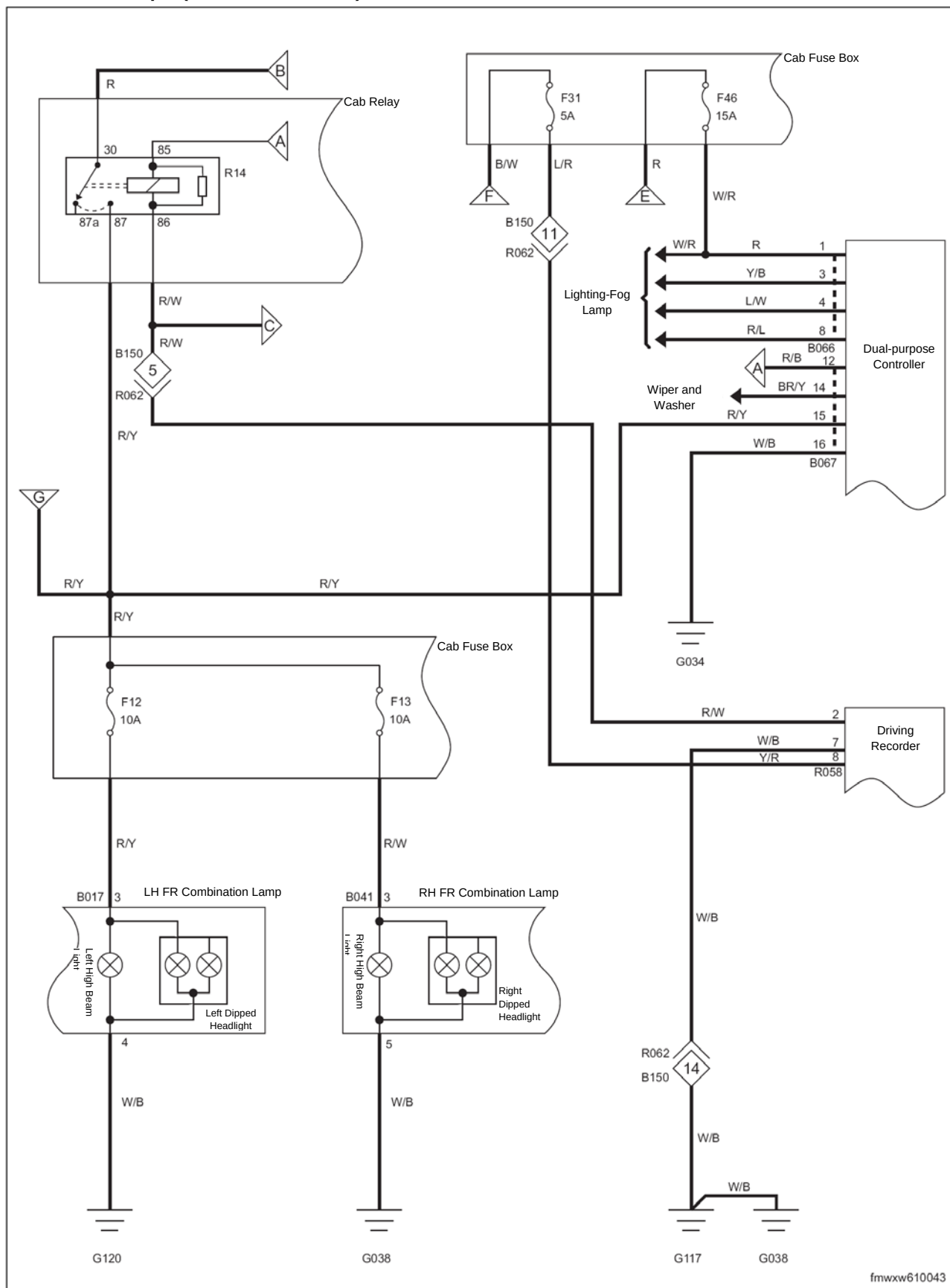
Lighting

Headlamp

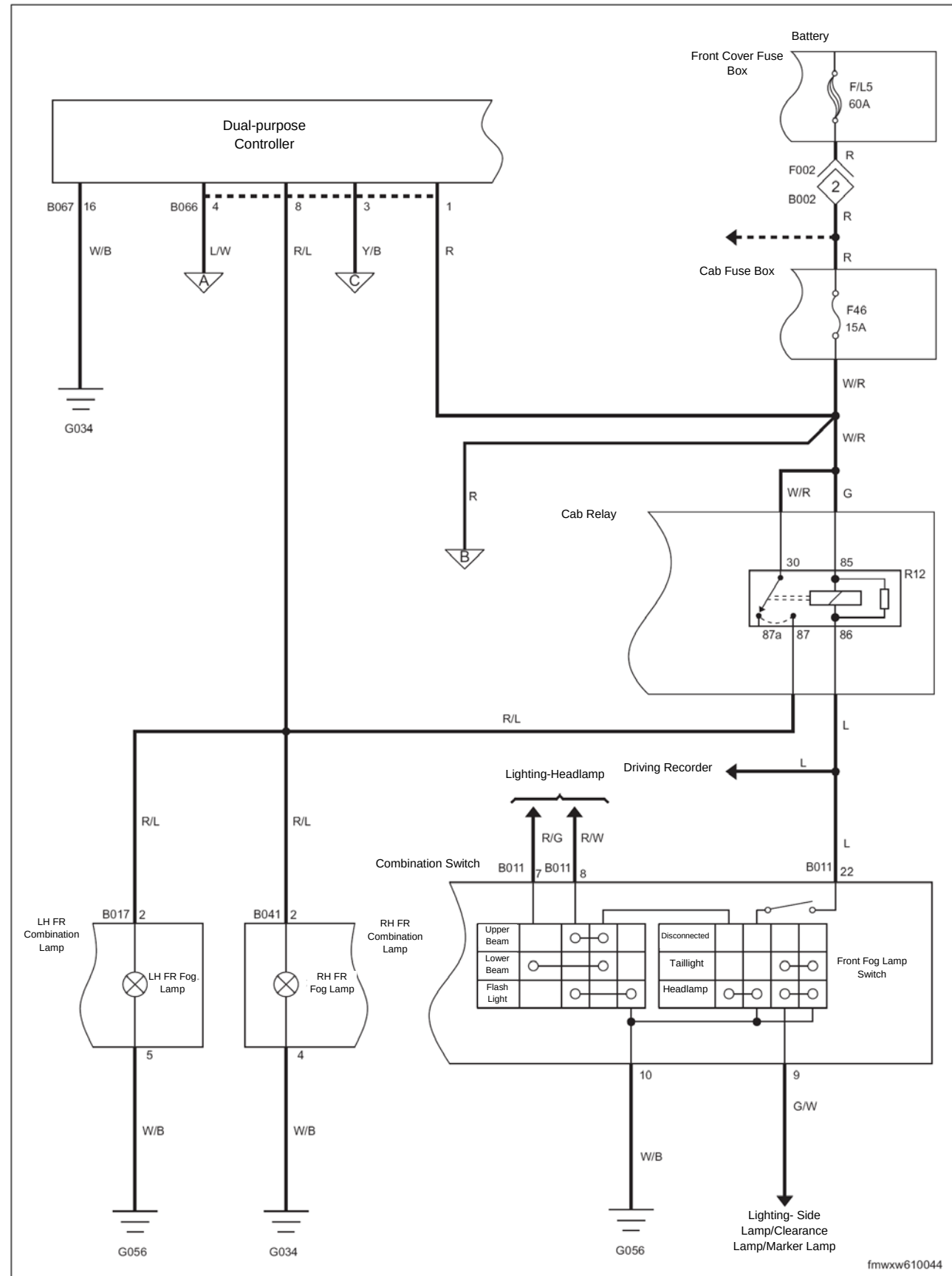


Circuit Diagram - Lighting

Headlamp (Continued)

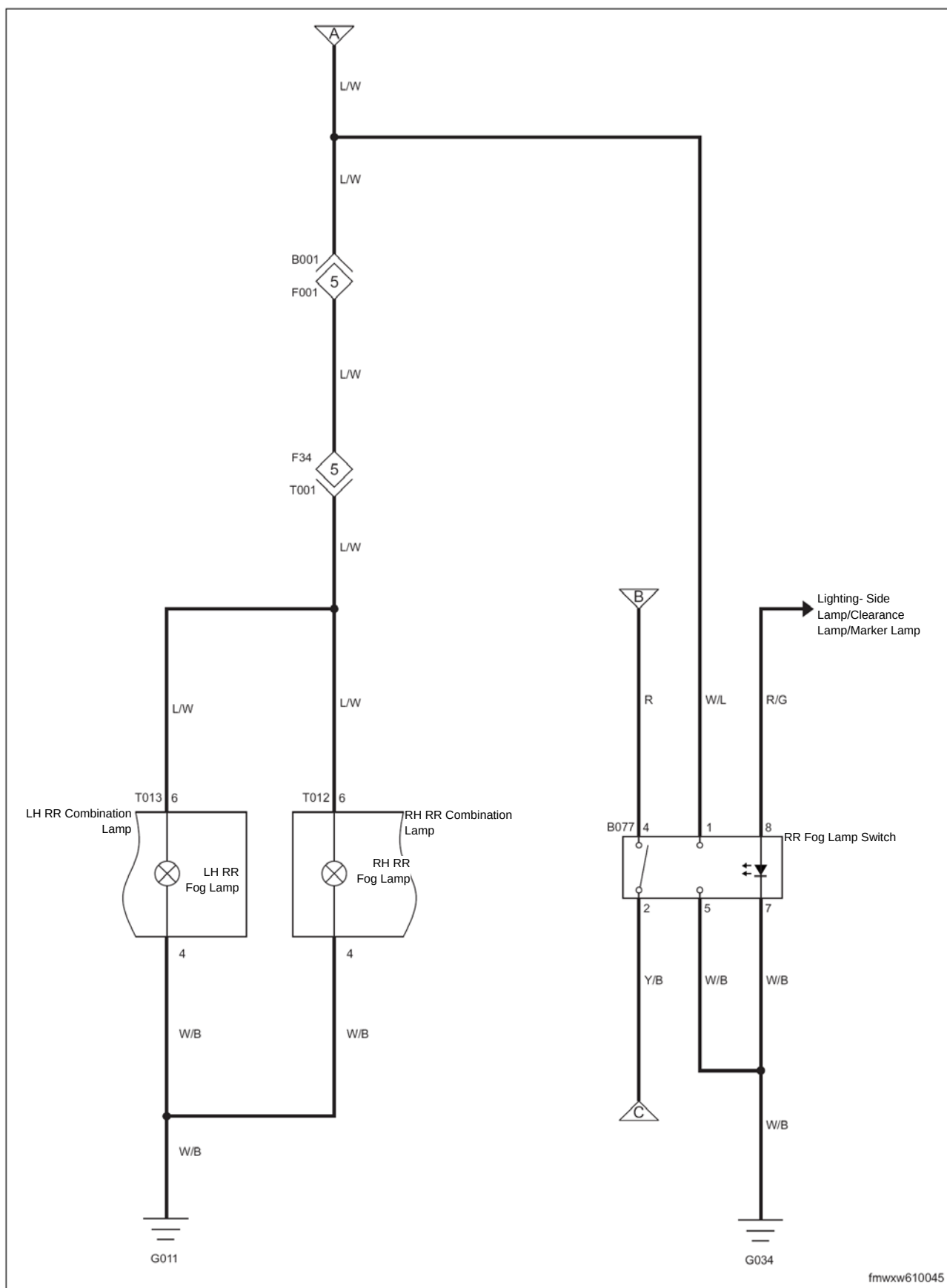


Fog Lamp

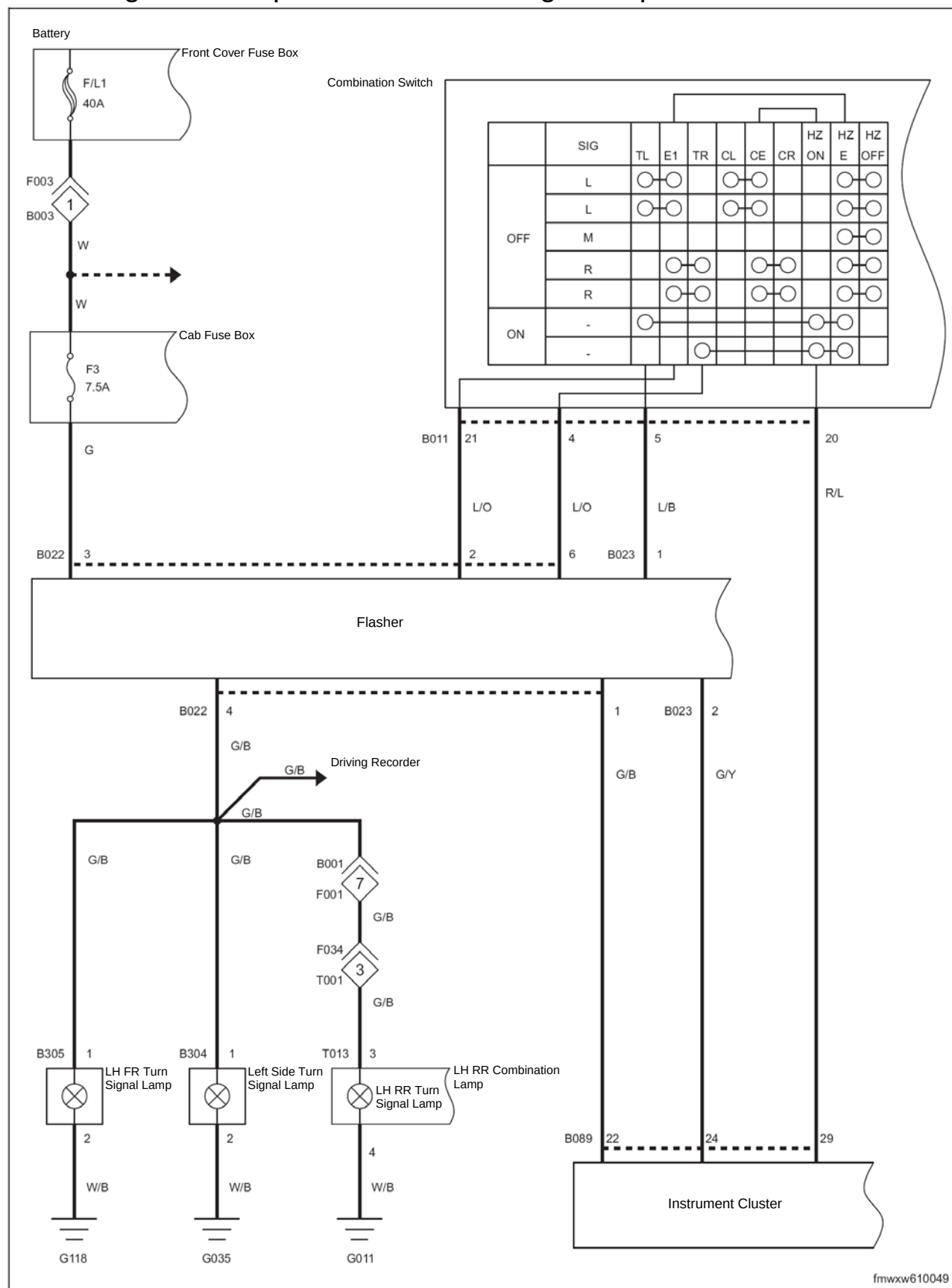


Circuit Diagram - Lighting

Fog Lamp (Continued)

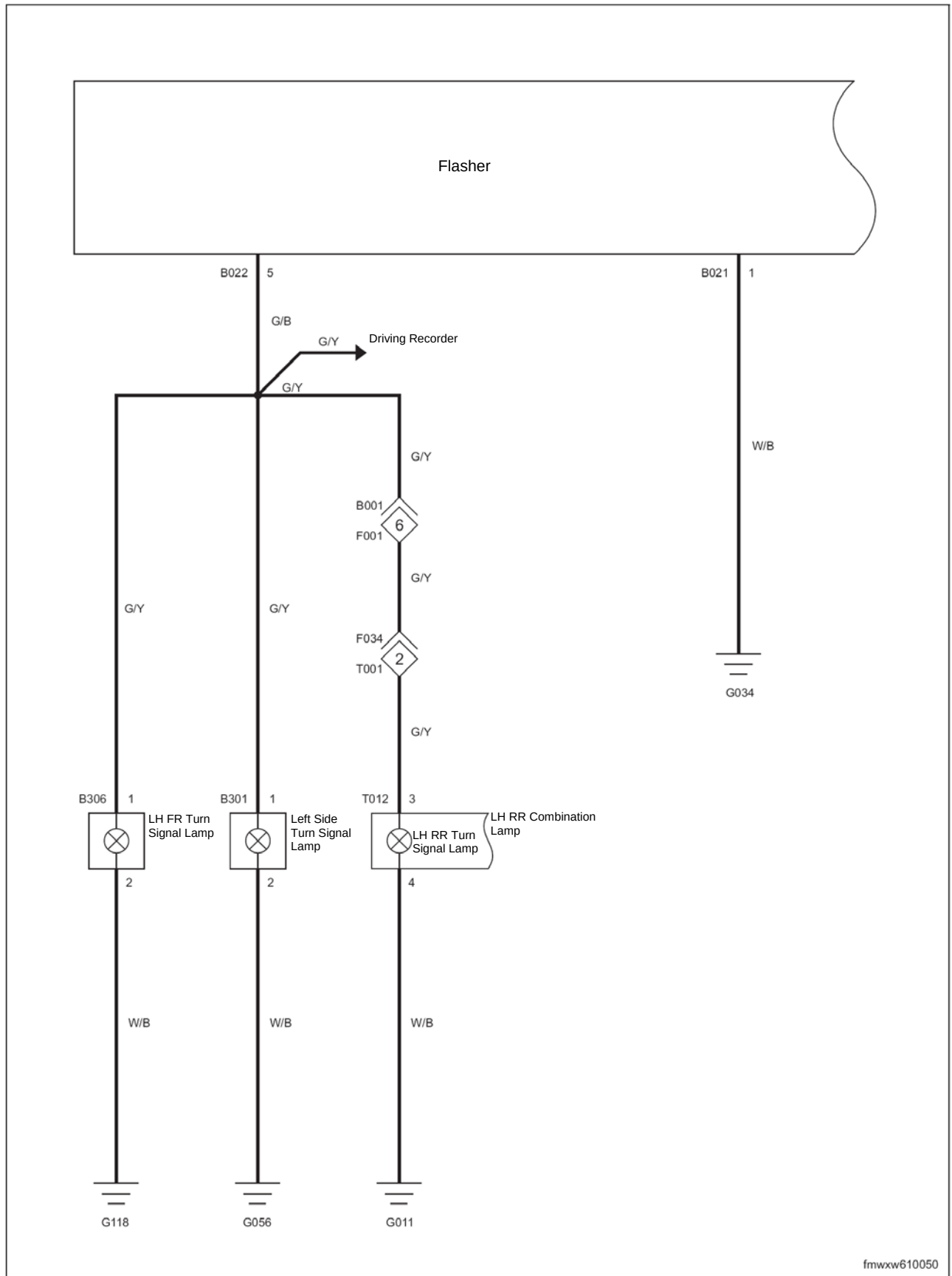


Turn Signal Lamp Hazard Warning Lamp



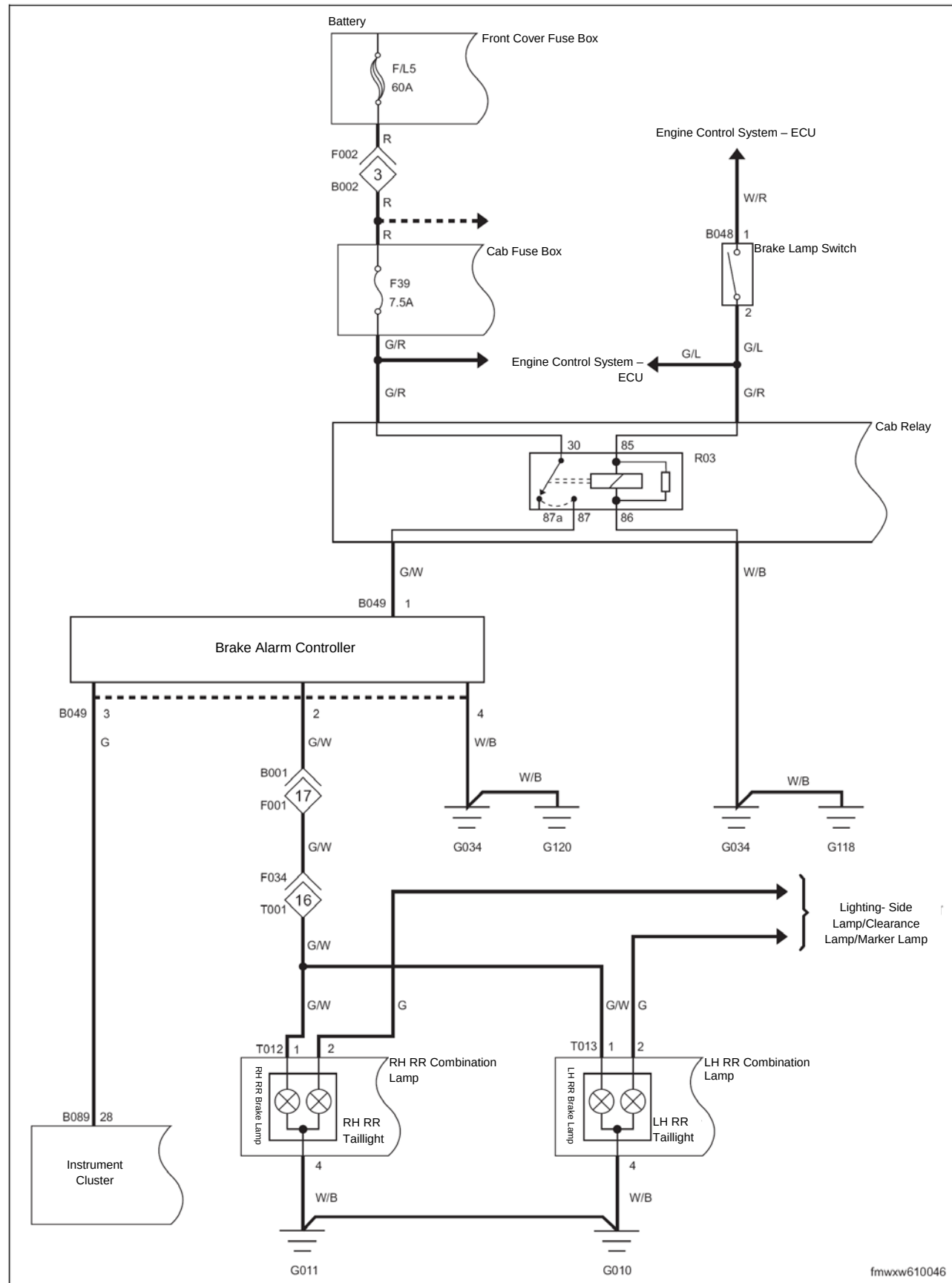
Circuit Diagram - Lighting

Turn Signal Lamp Hazard Warning Lamp (Continued)



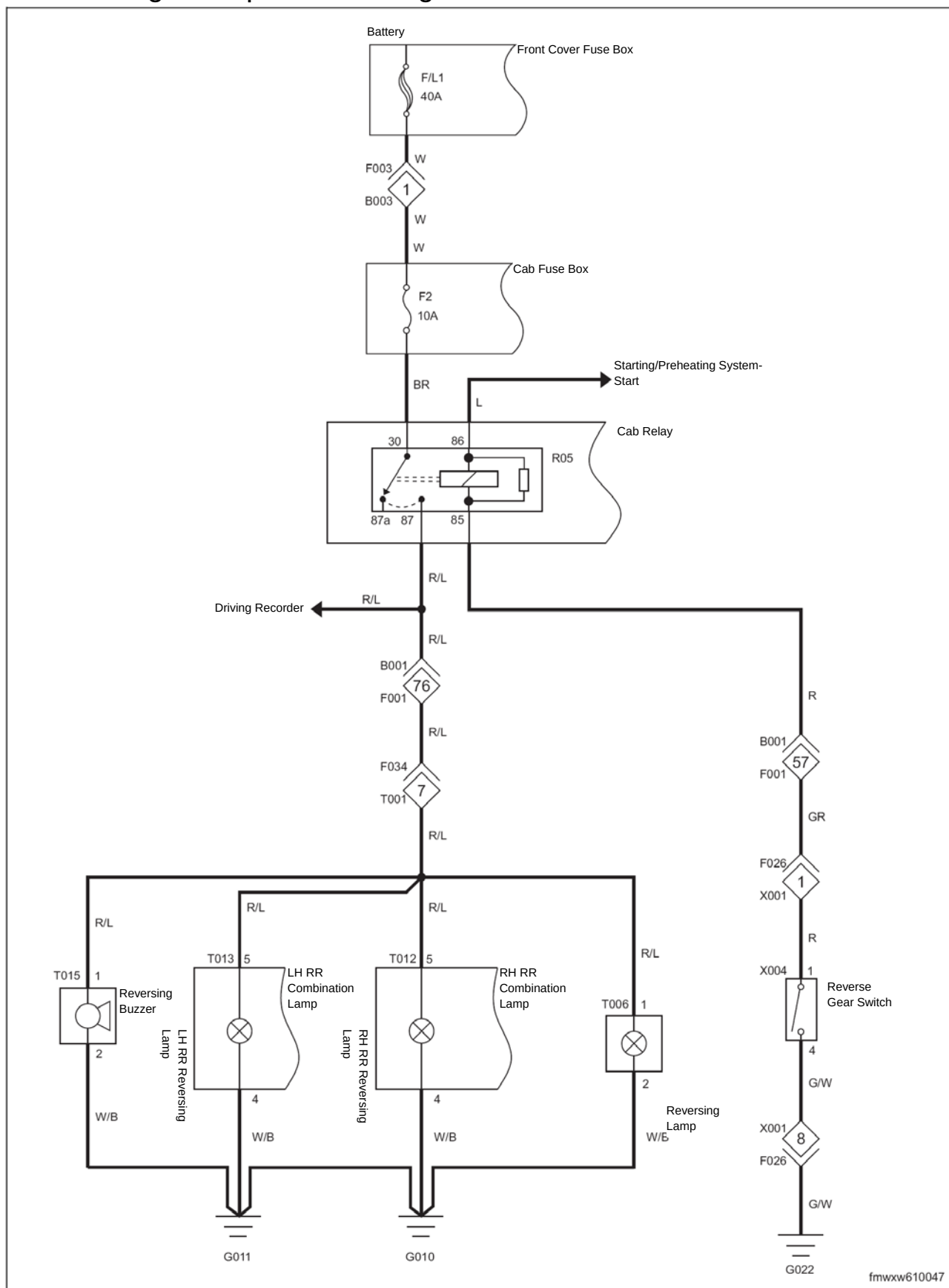
Circuit Diagram - Lighting

Brake Lamp

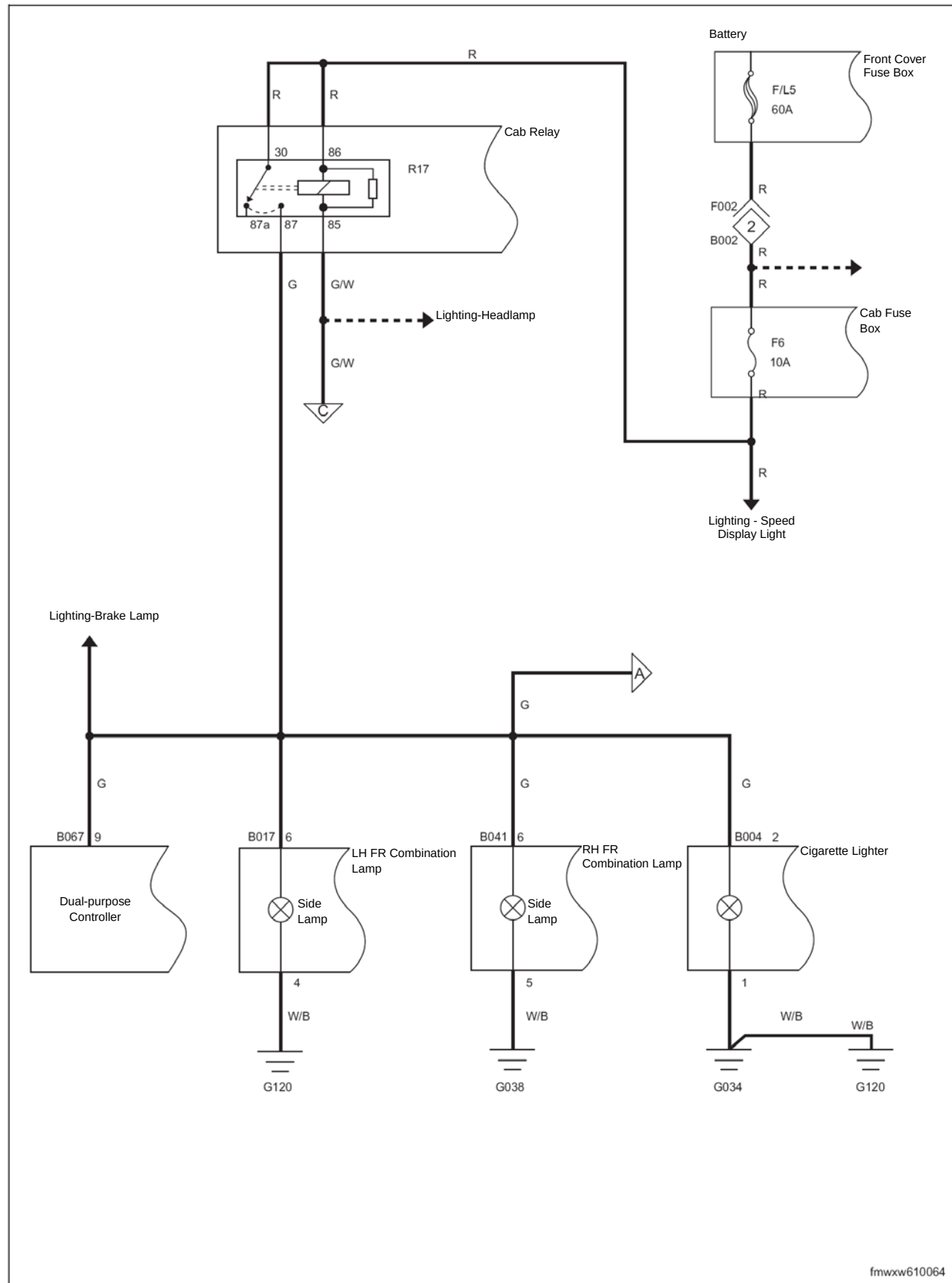


Circuit Diagram - Lighting

Reversing Lamp Reversing Buzzer

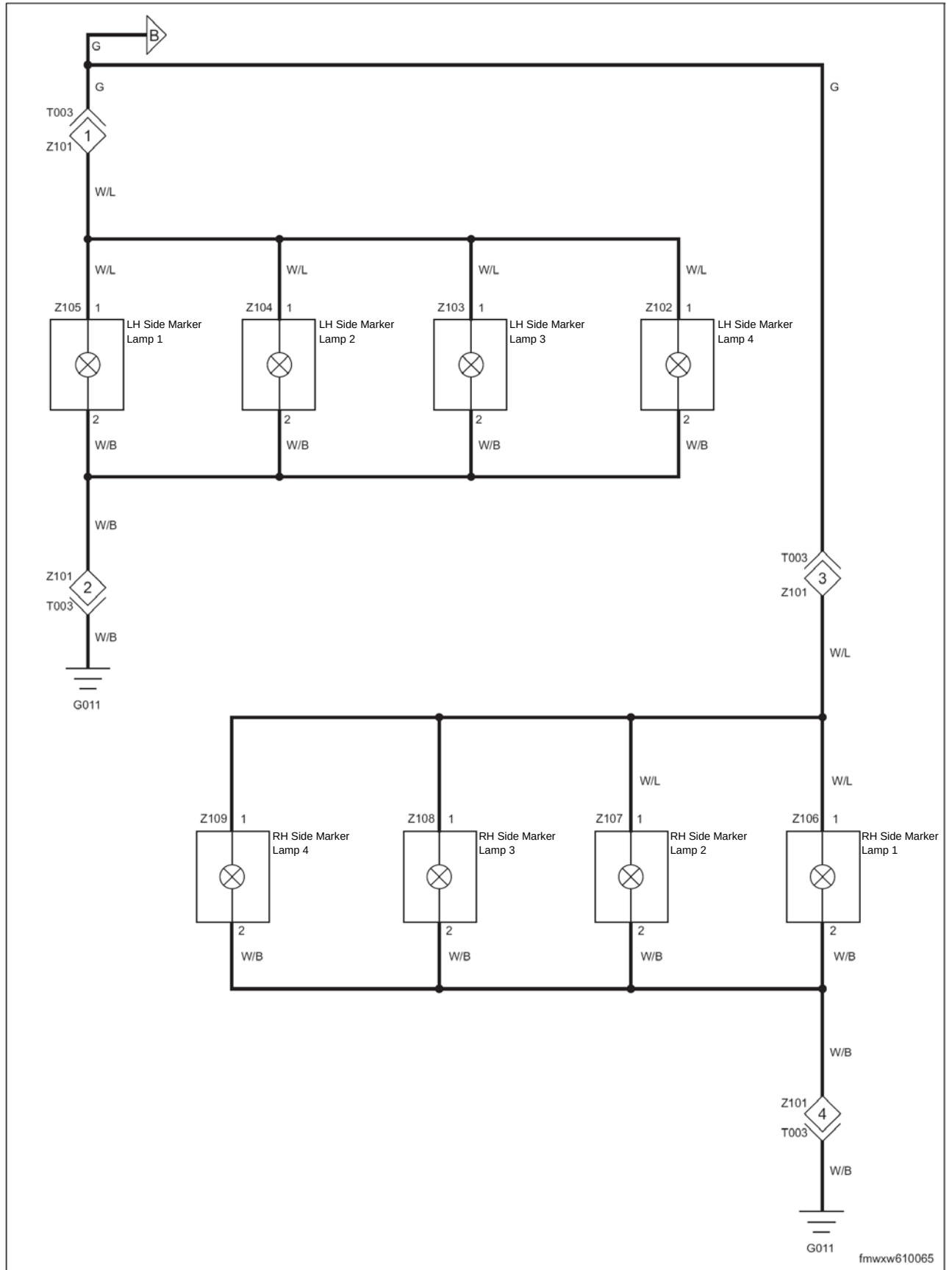


Side Lamp Clearance Lamp Marker Lamp

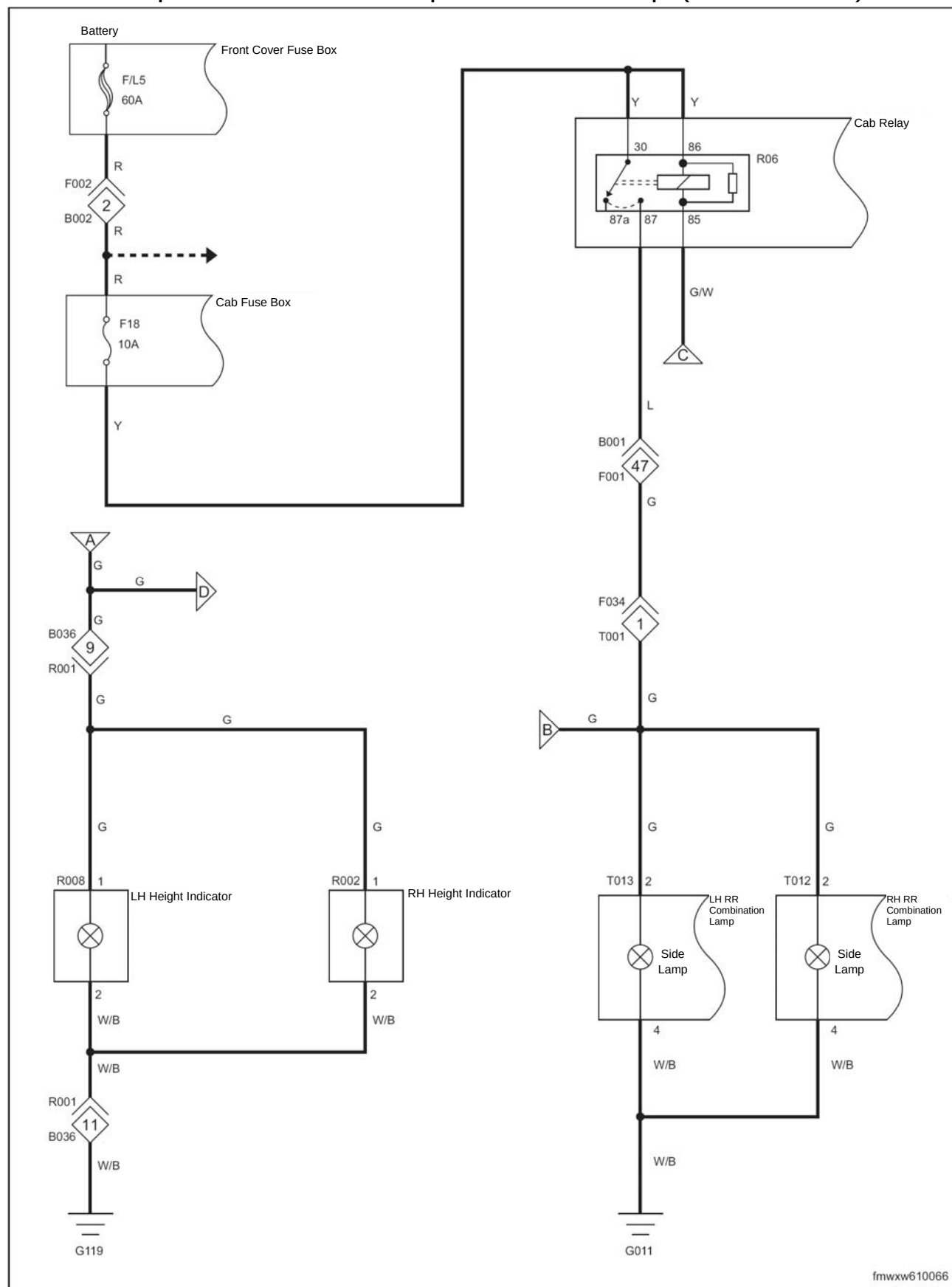


Circuit Diagram - Lighting

Side Lamp Clearance Lamp Marker Lamp (Continued)



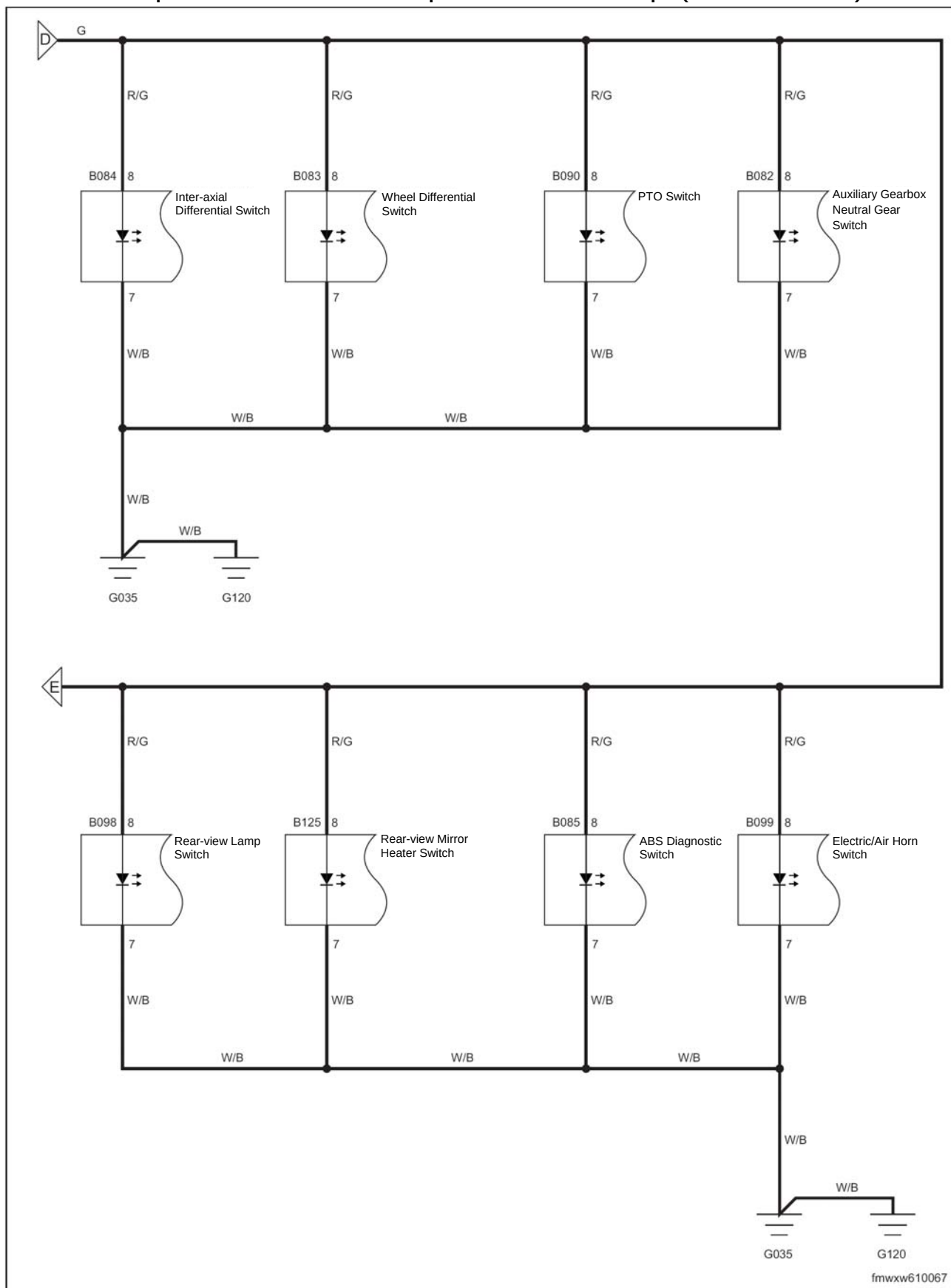
Side Lamp Clearance Lamp Marker Lamp (Continued)



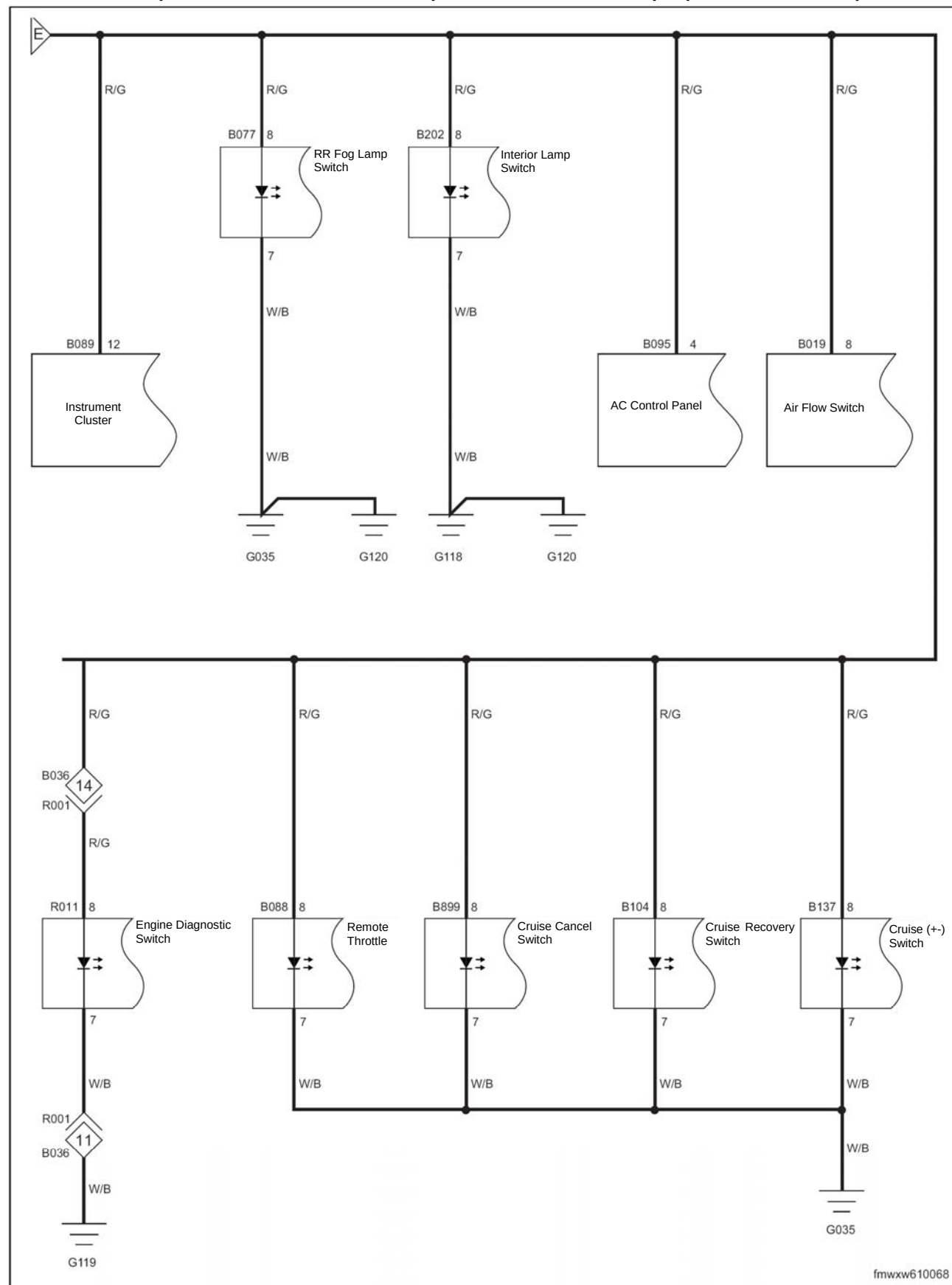
fmwxw610066

Circuit Diagram - Lighting

Side Lamp Clearance Lamp Marker Lamp (Continued)

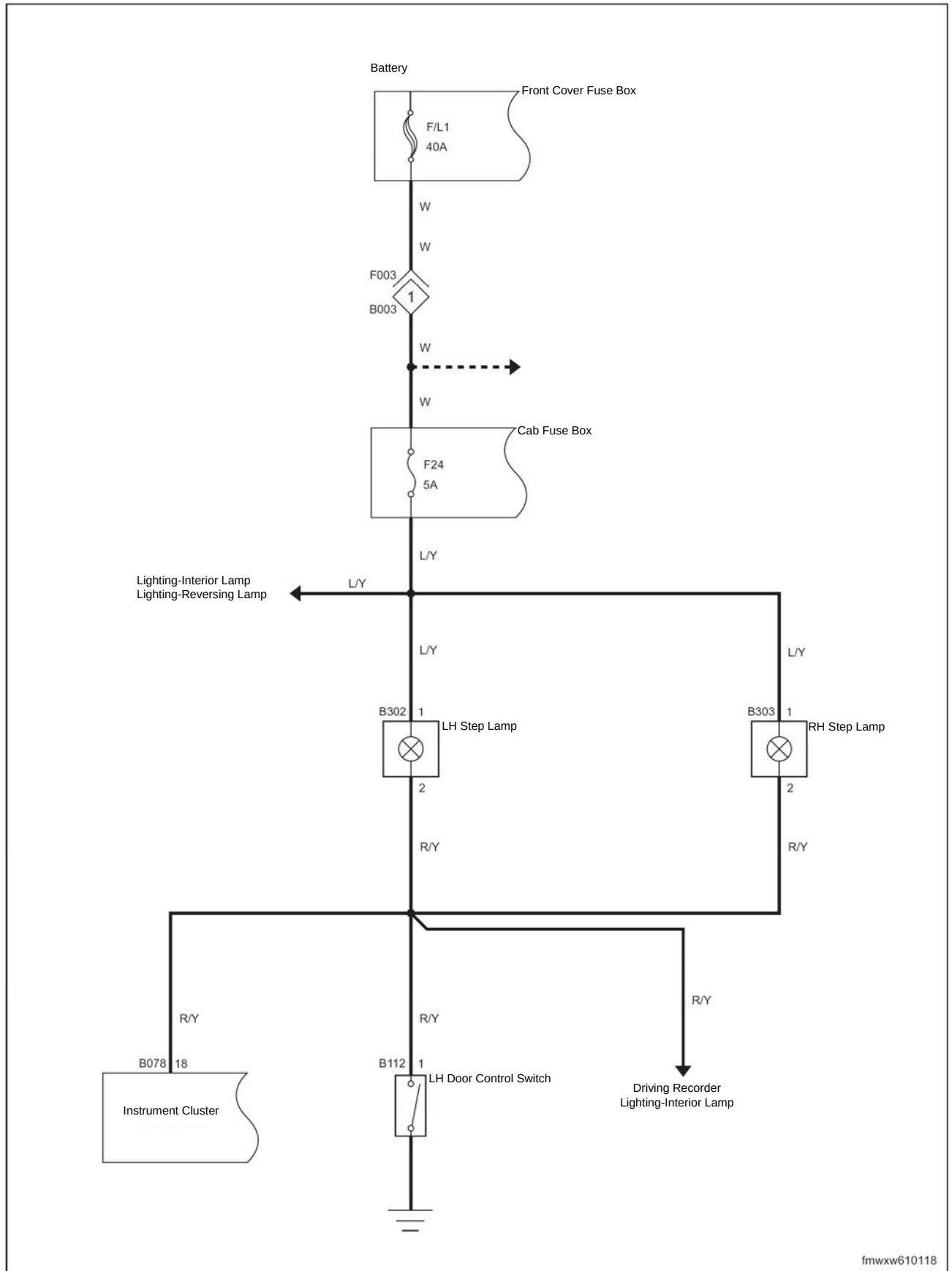


Side Lamp Clearance Lamp Marker Lamp (Continued)

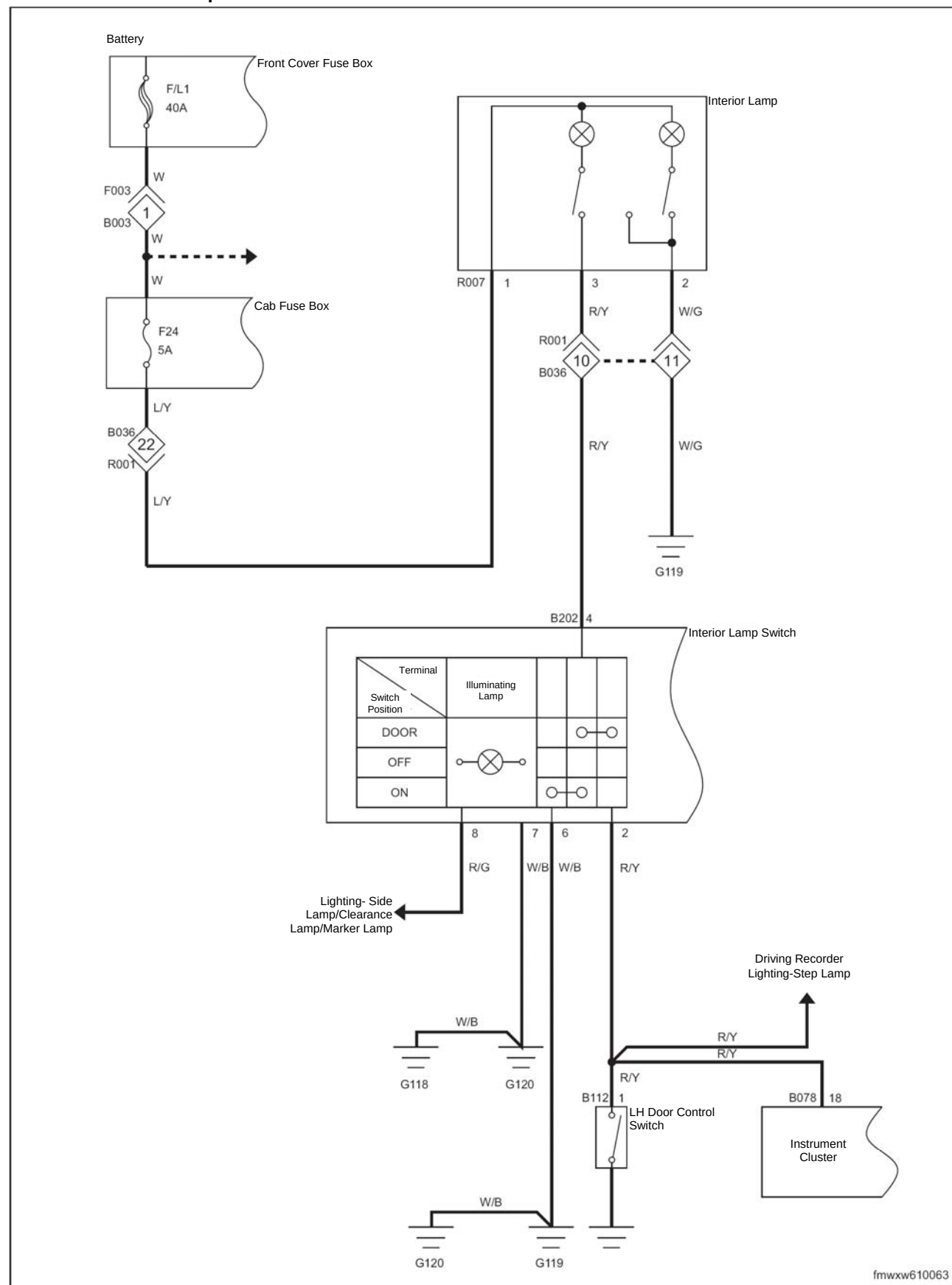


fmwxw610068

Step Lamp

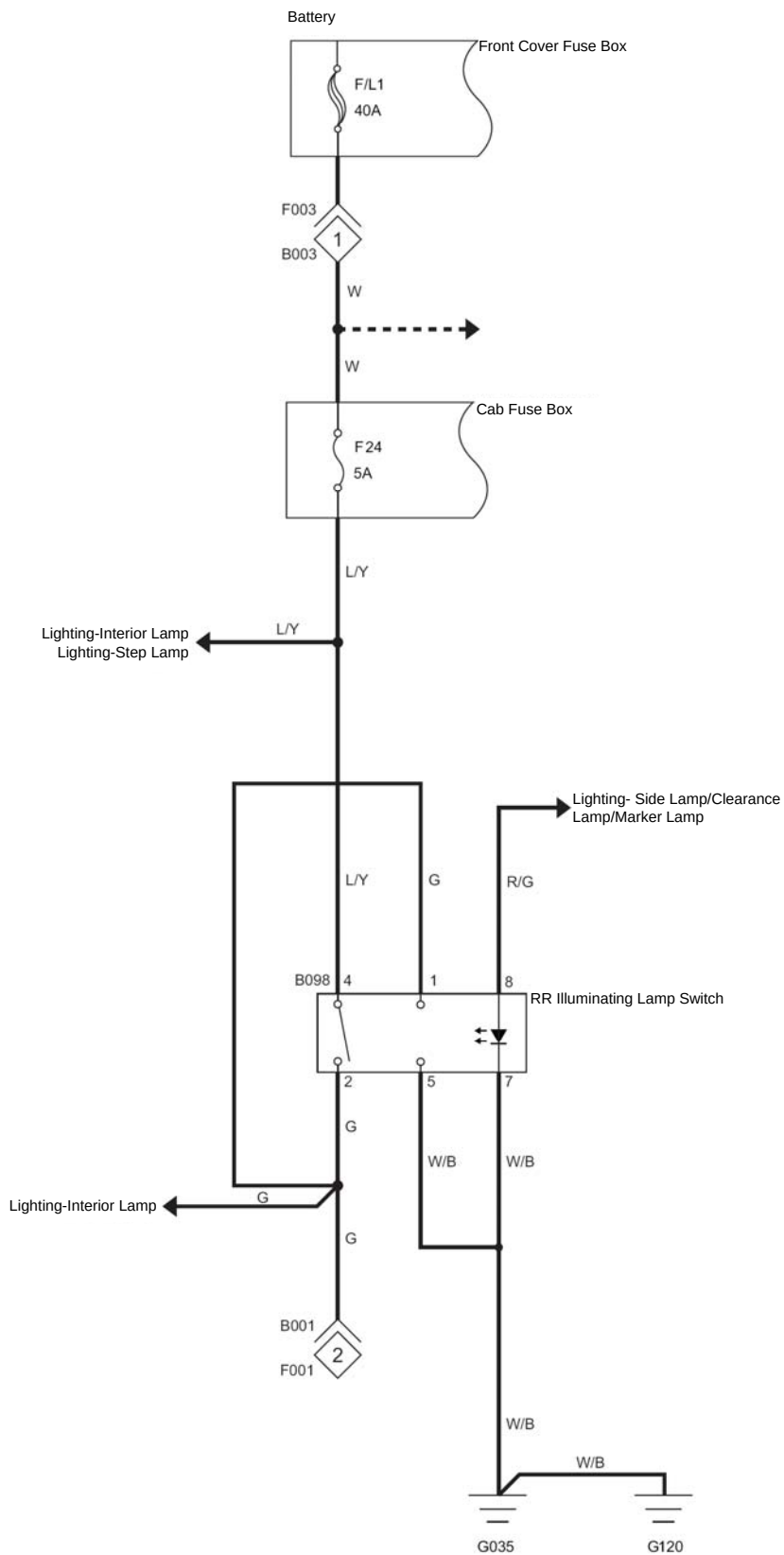


Interior Lamp



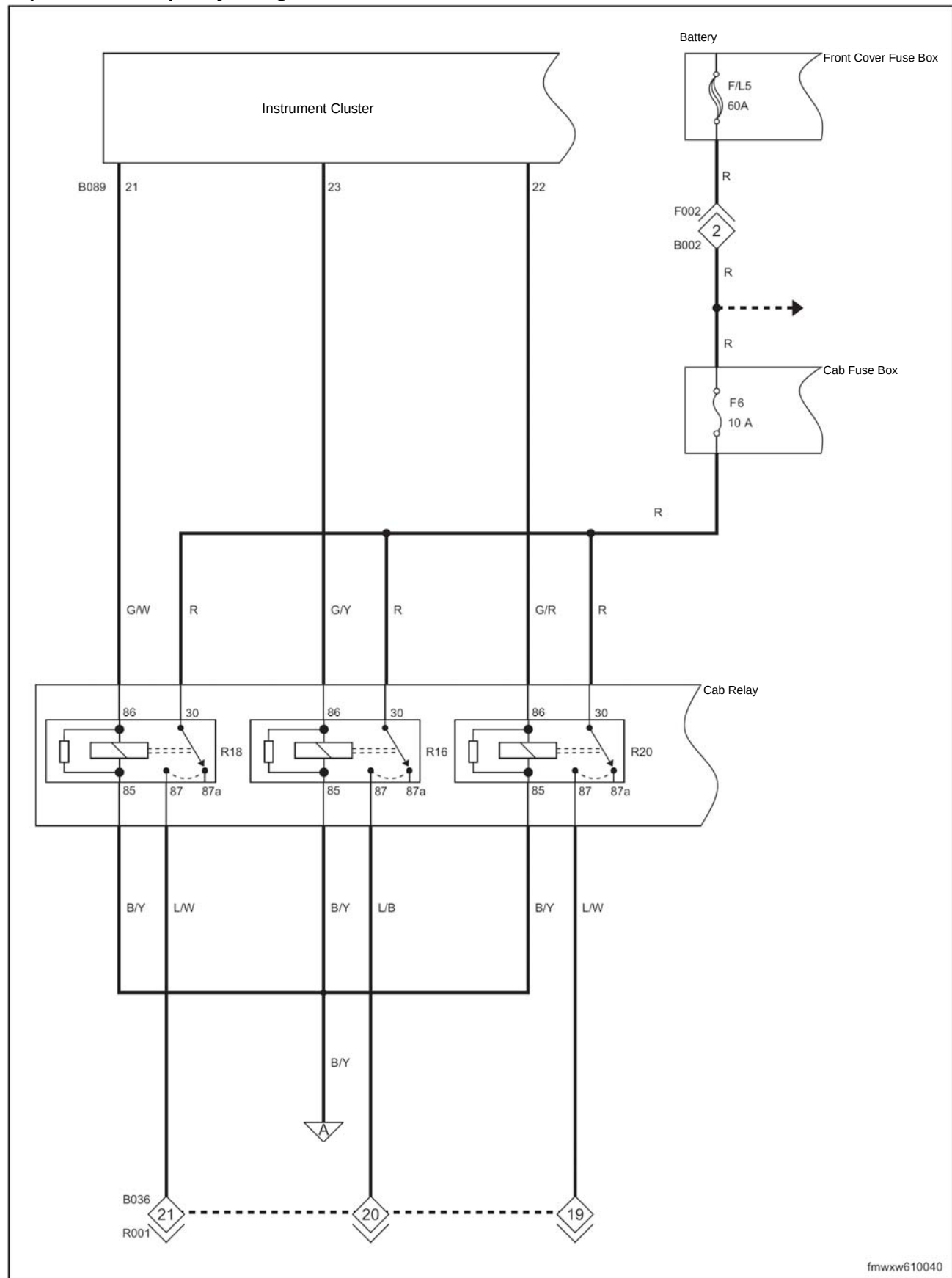
Circuit Diagram - Lighting

RR Illuminating Lamp



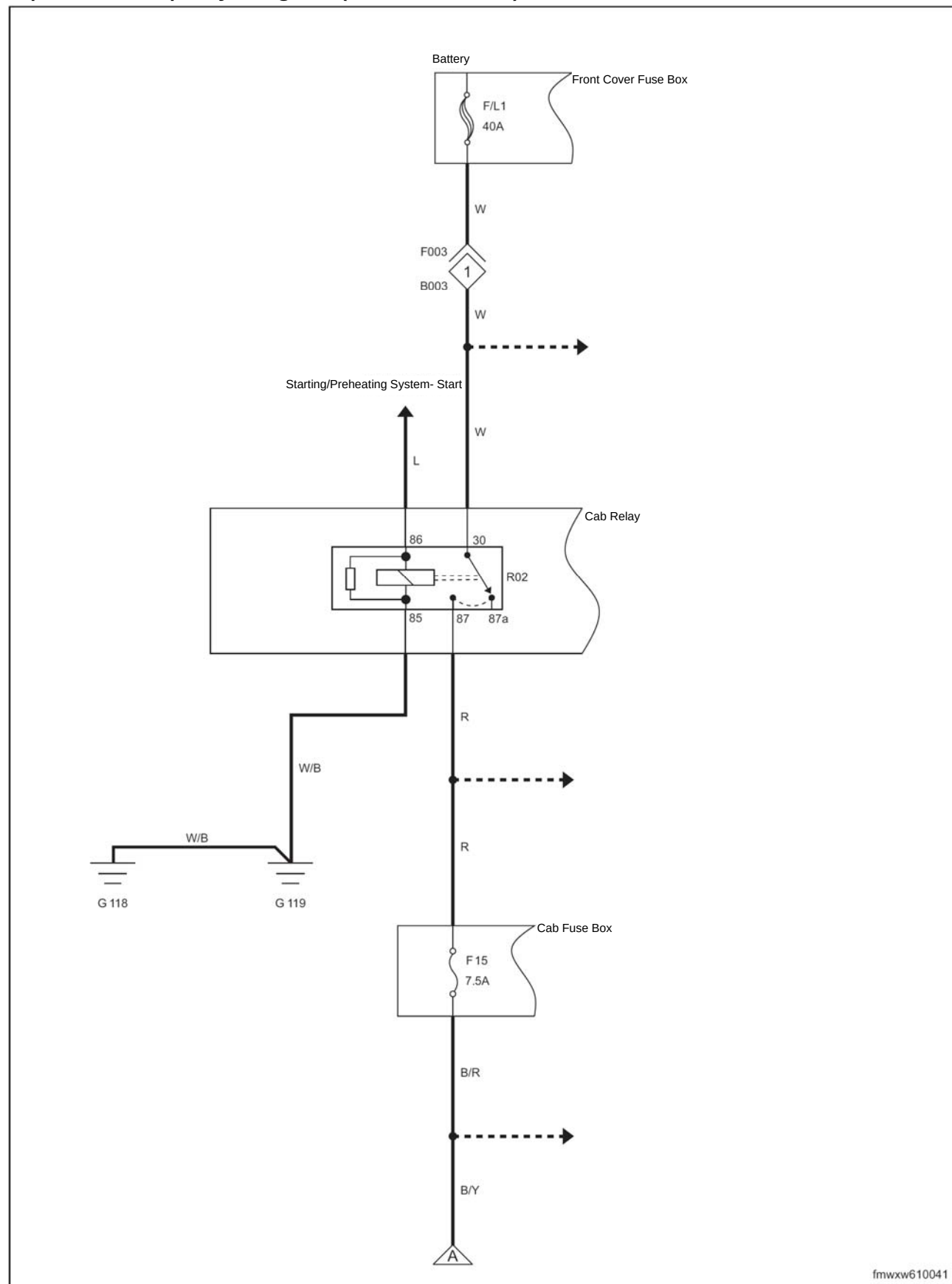
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Speed Display Light

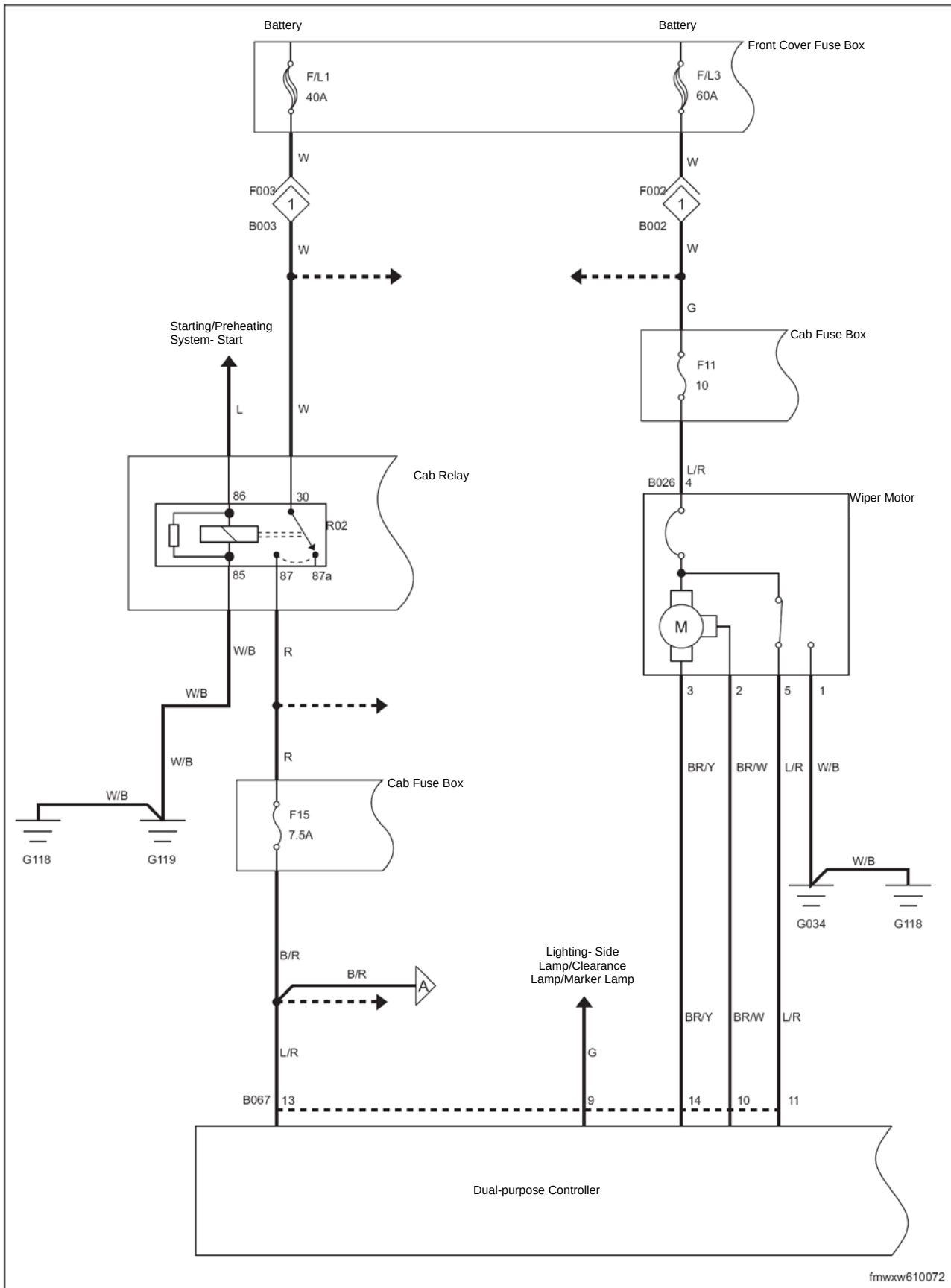


Circuit Diagram - Lighting

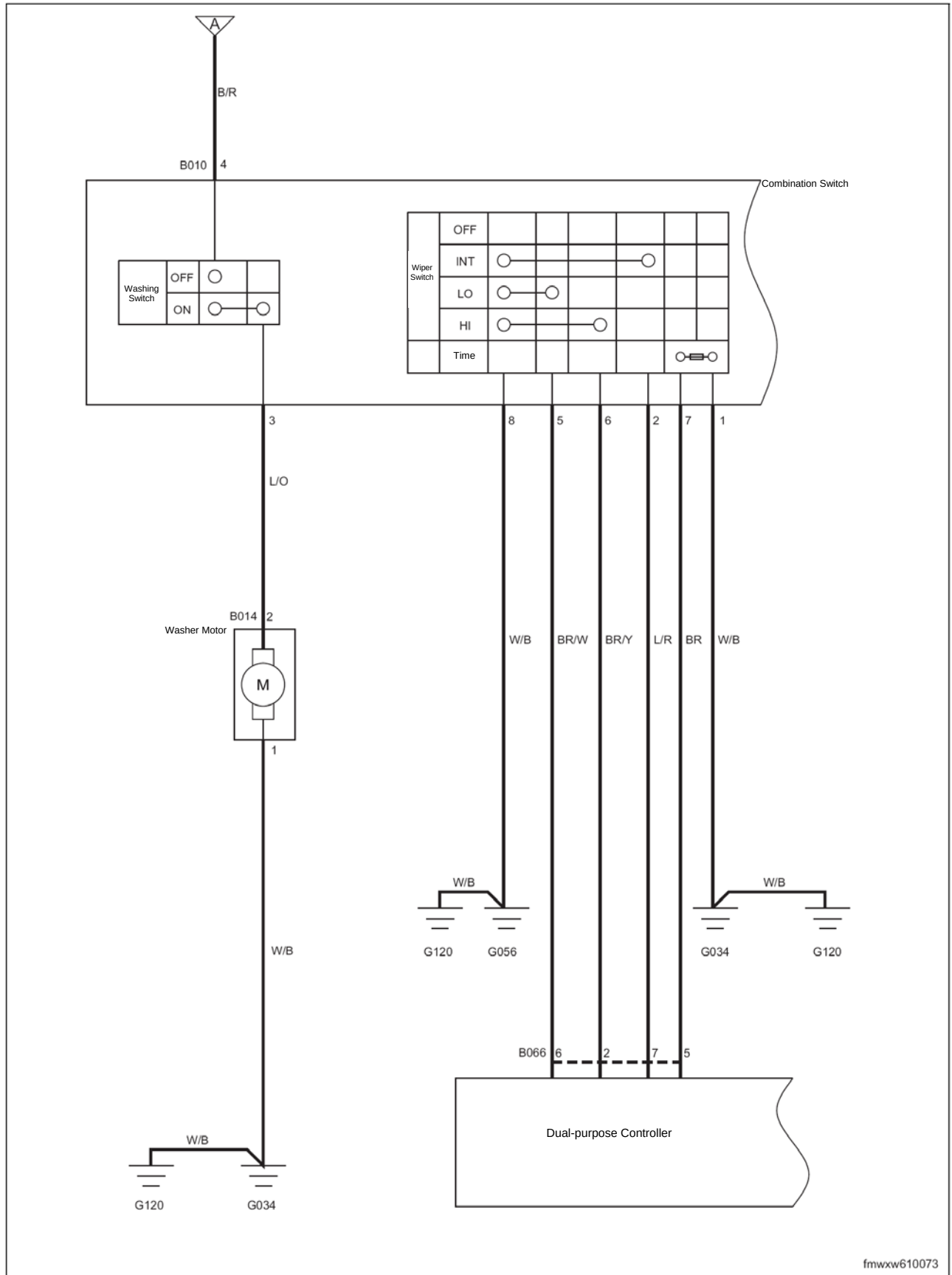
Speed Display Light (Continued)



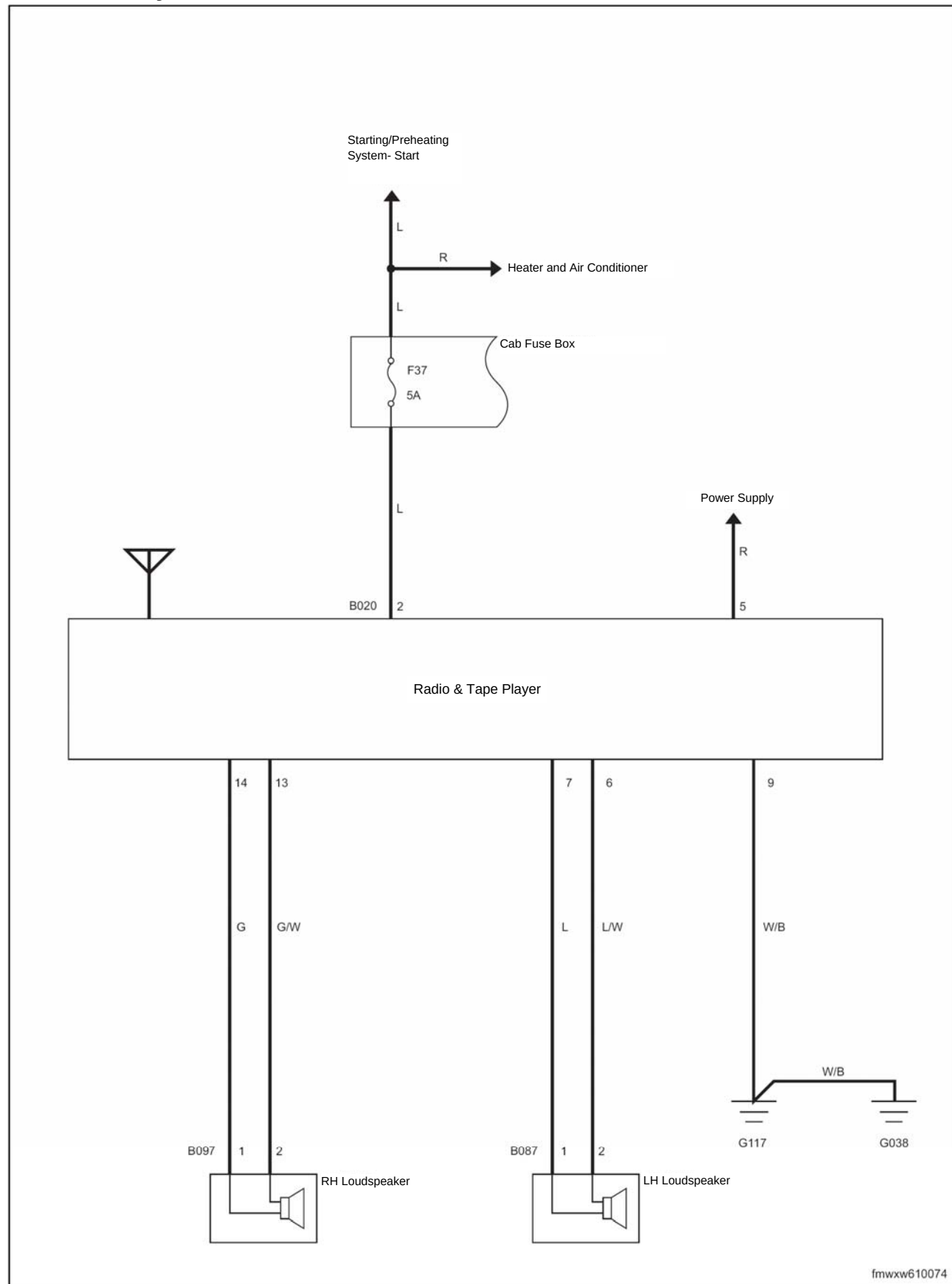
Wiper and Washer



Wiper and Washer (Continued)

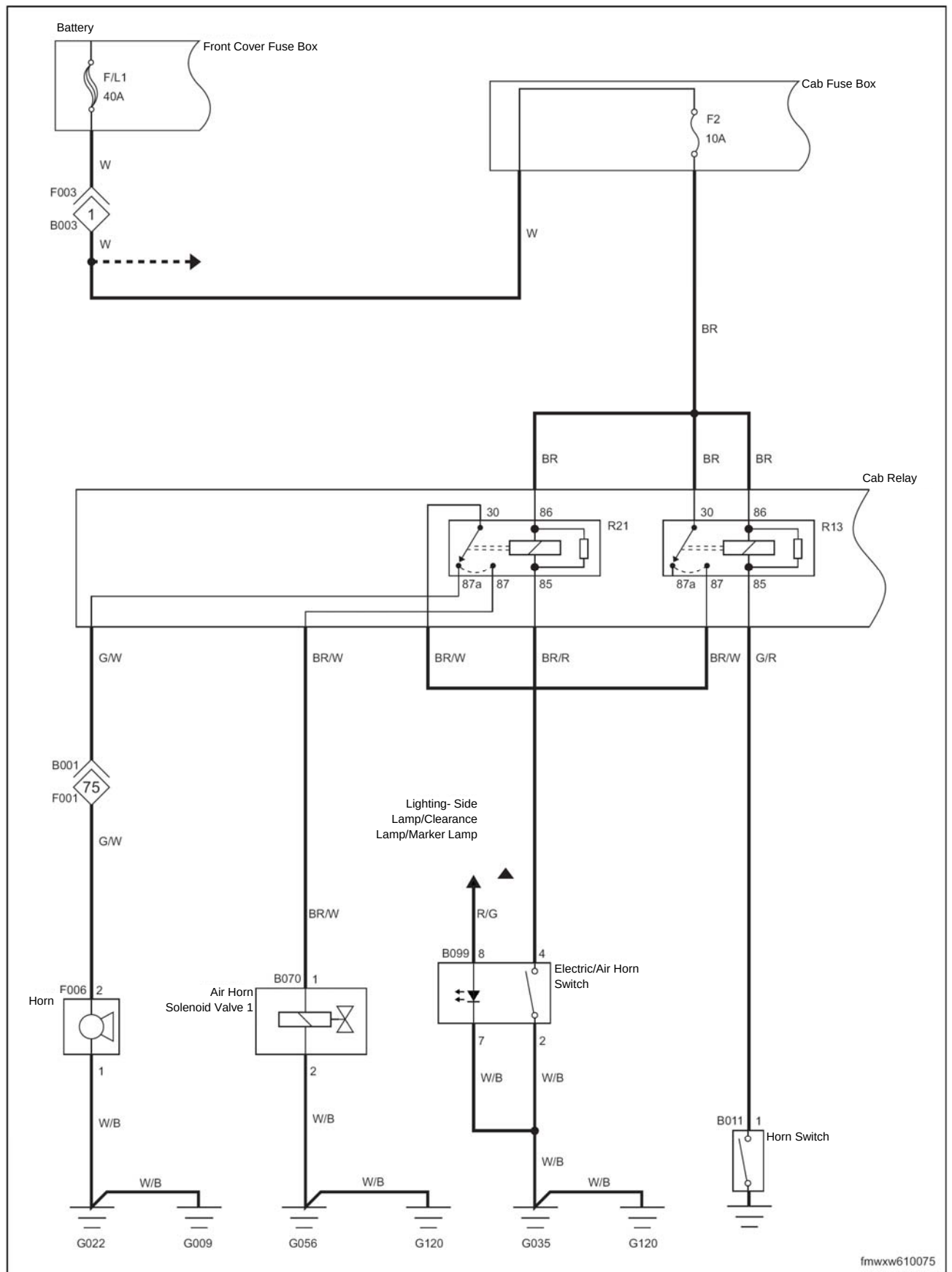


Audio System

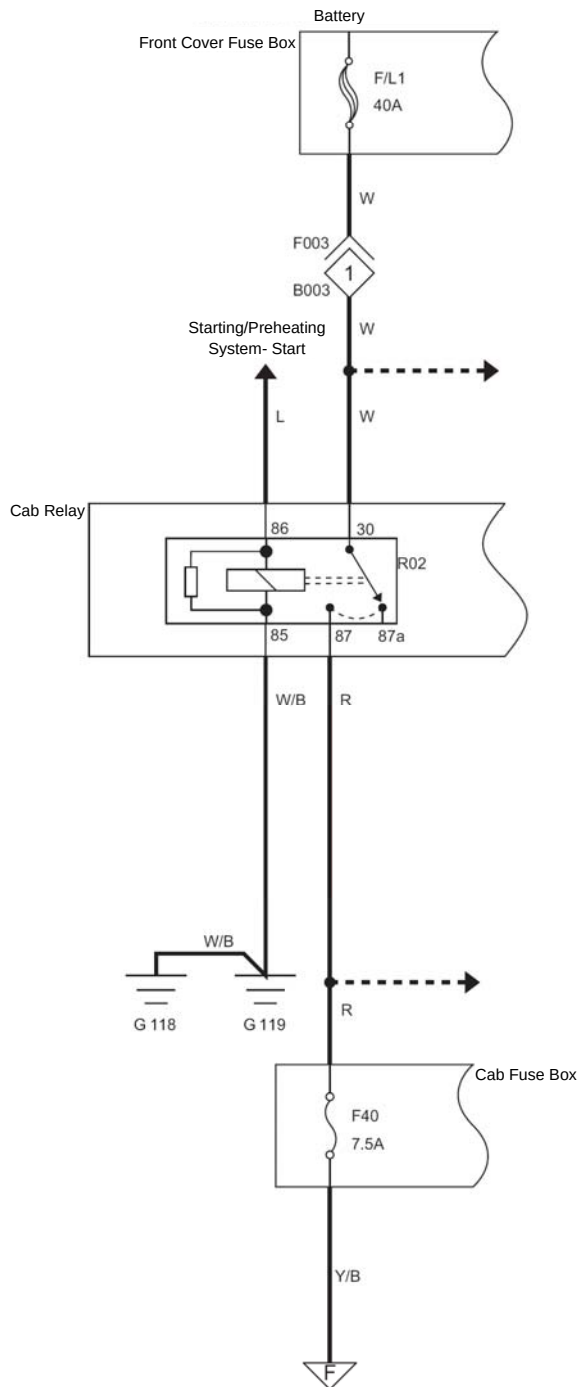


Circuit Diagram - Horn

Horn



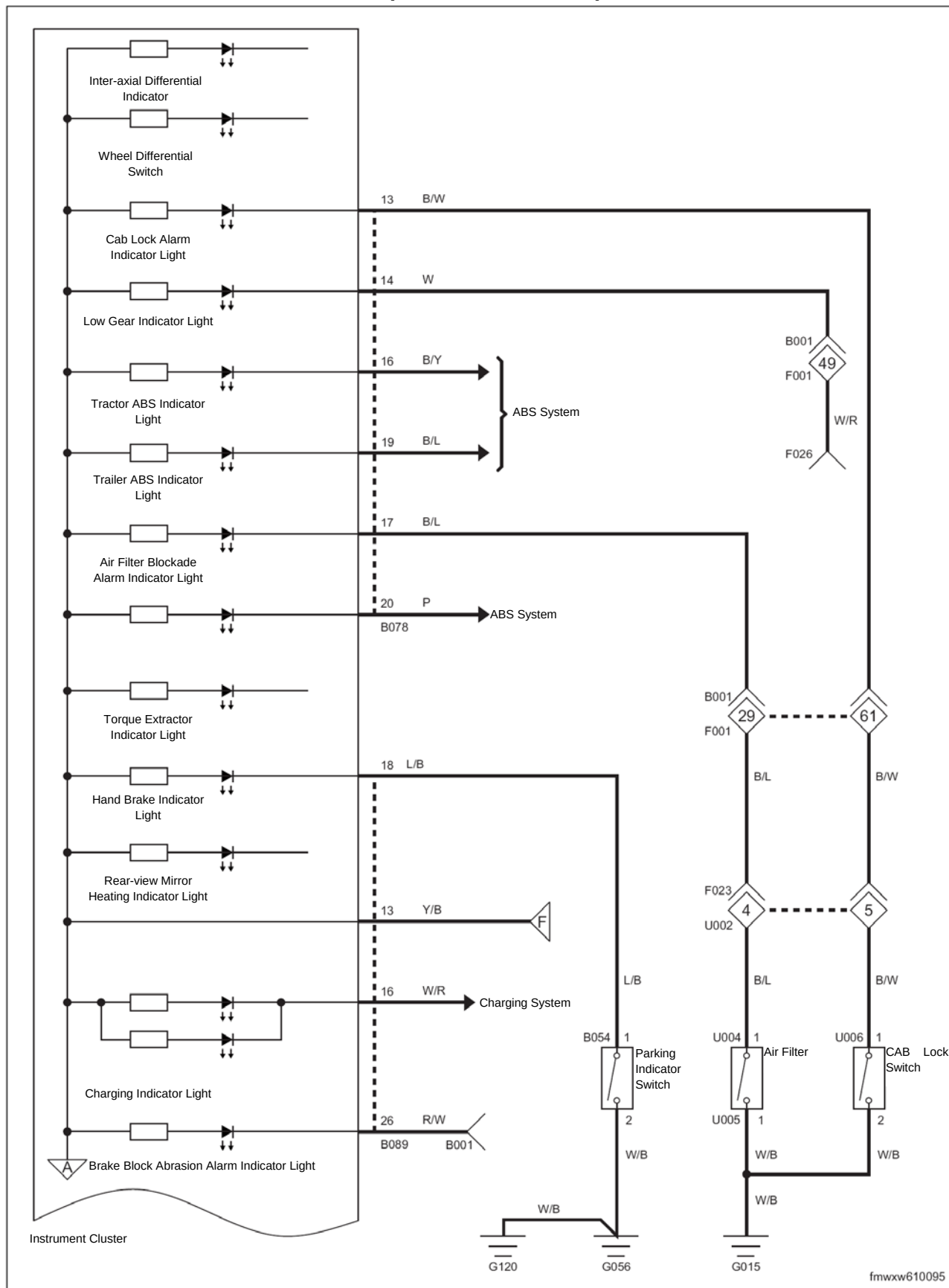
Instrument Cluster



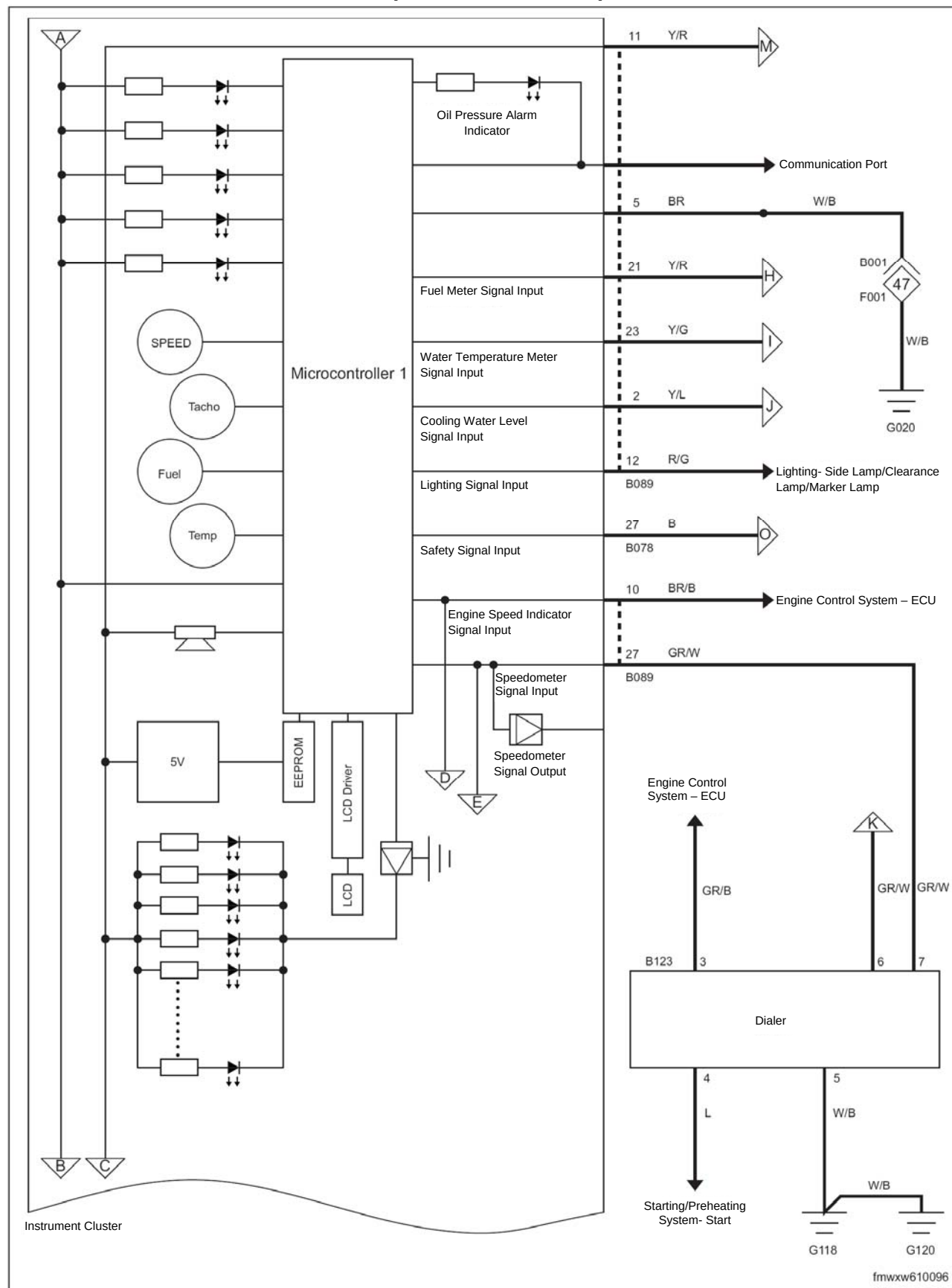
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Circuit Diagram - Instrument Cluster

Instrument Cluster (Continued)

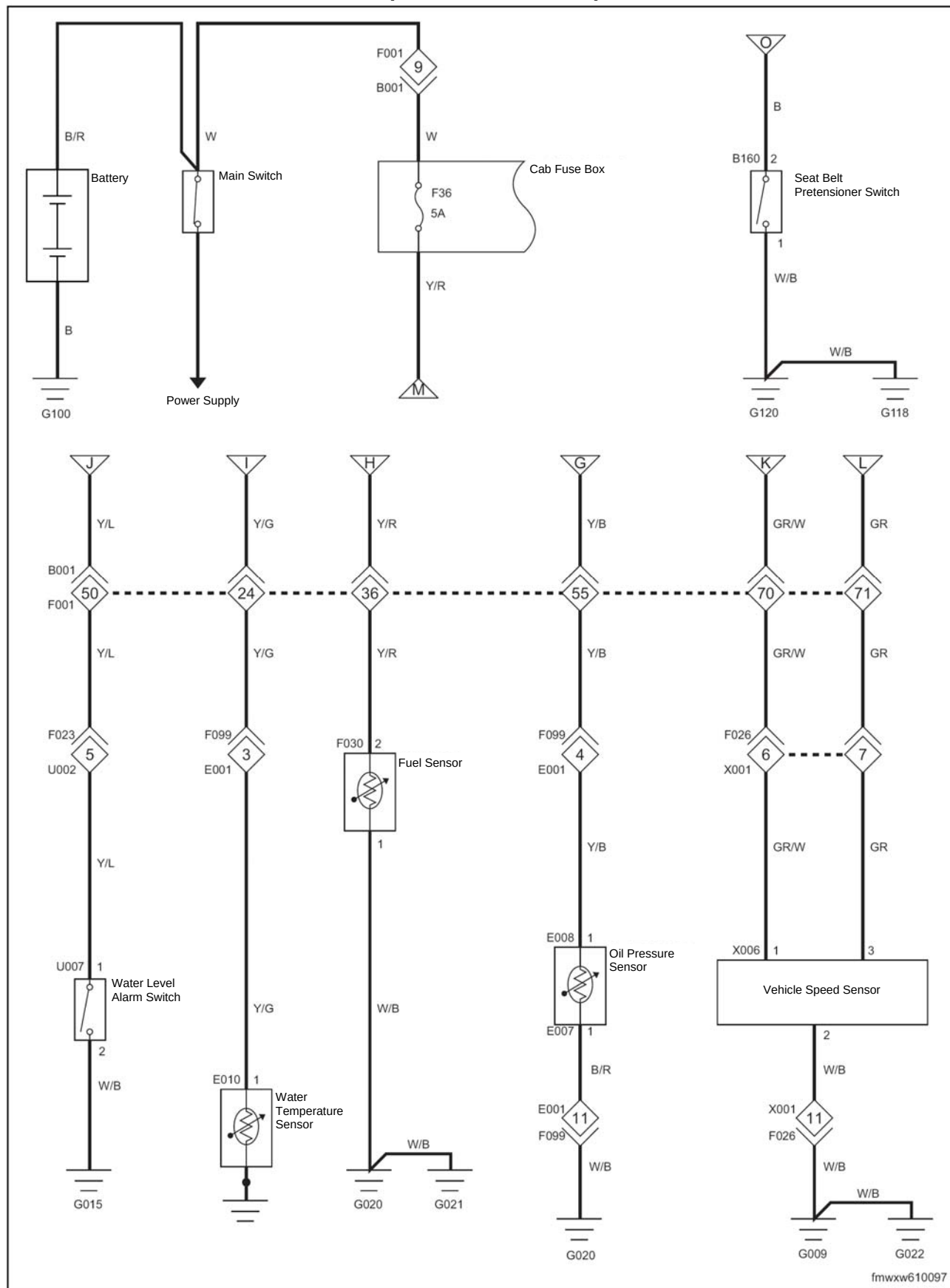


Instrument Cluster (Continued)

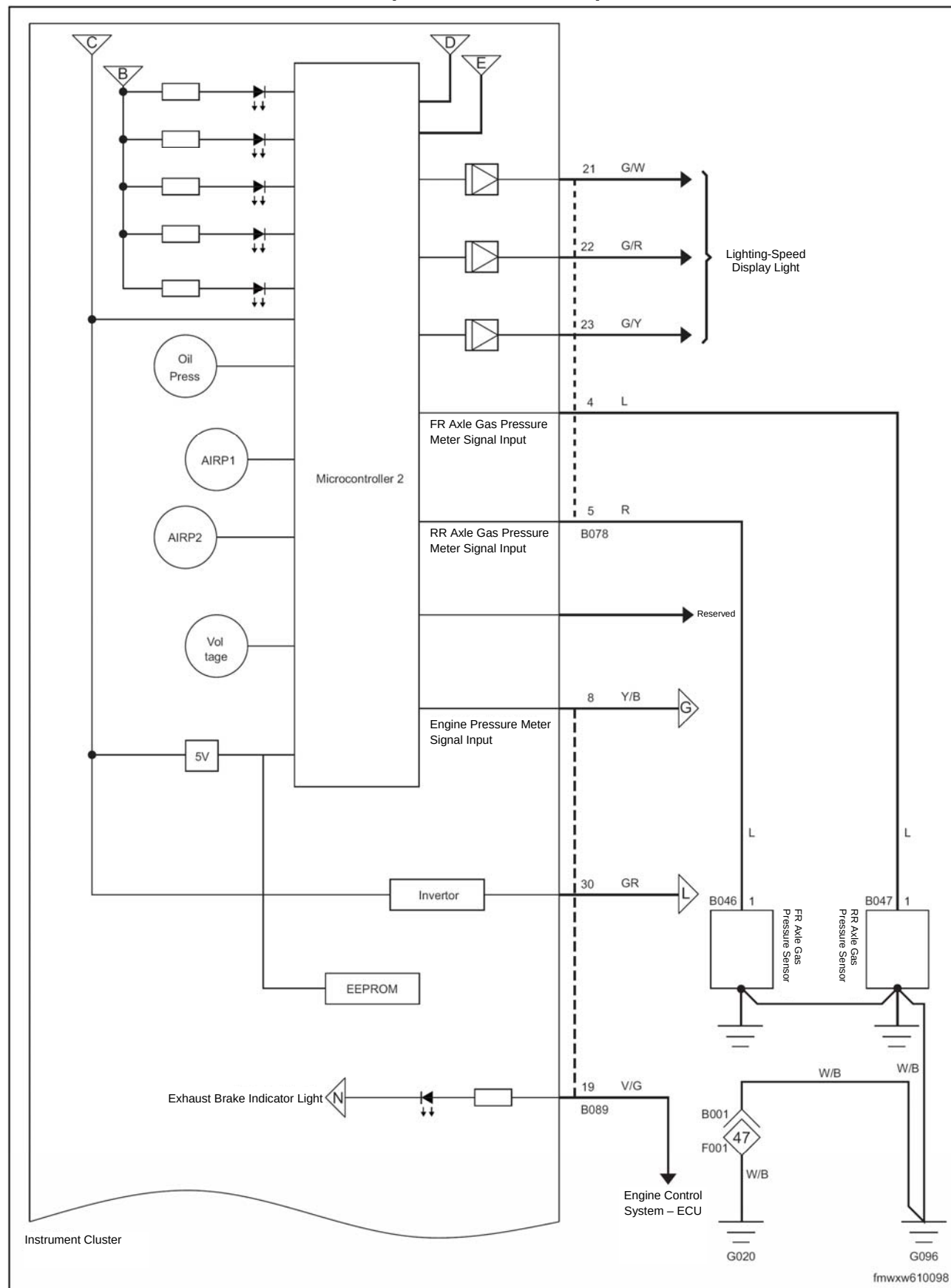


Circuit Diagram - Instrument Cluster

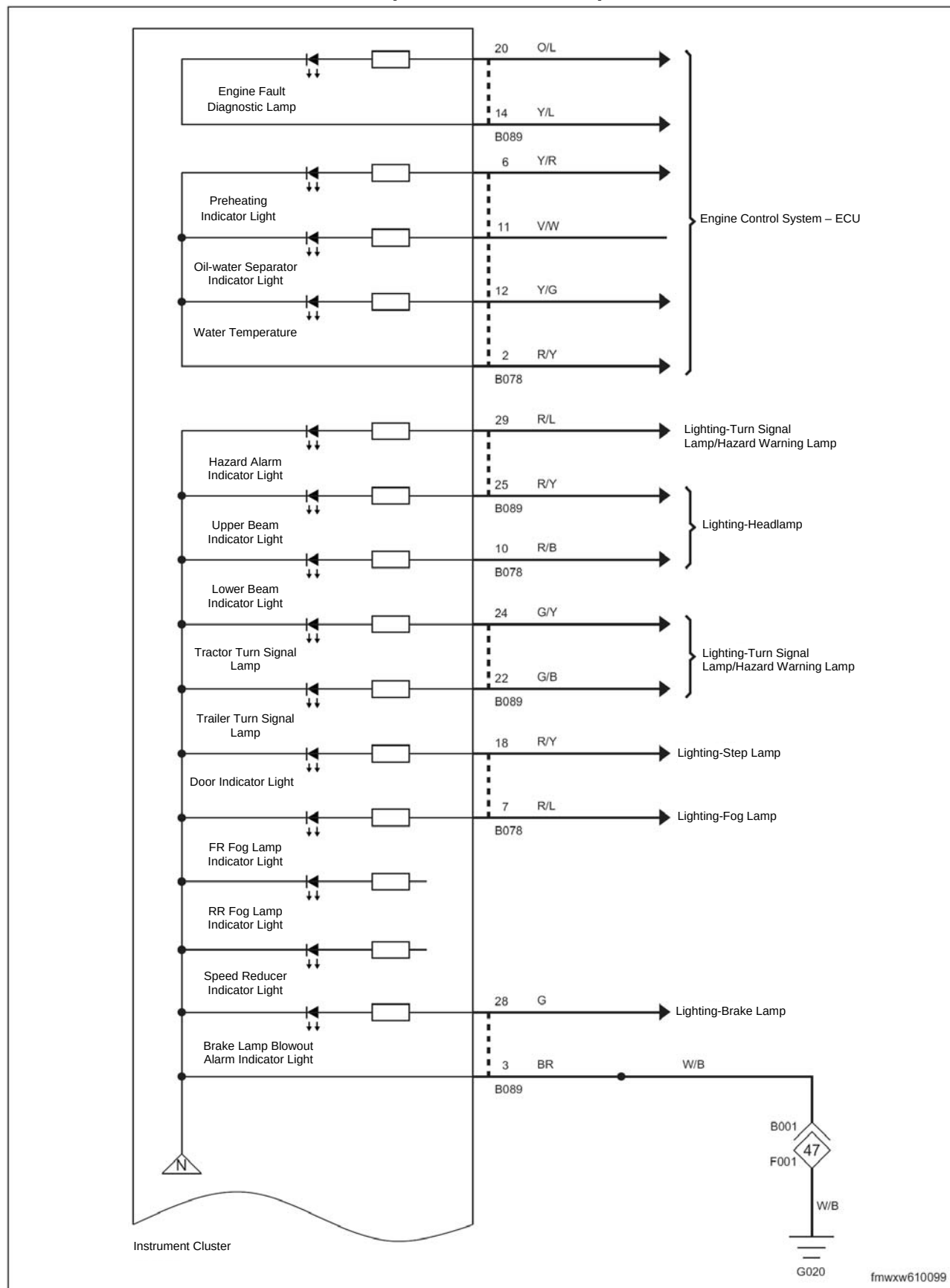
Instrument Cluster (Continued)



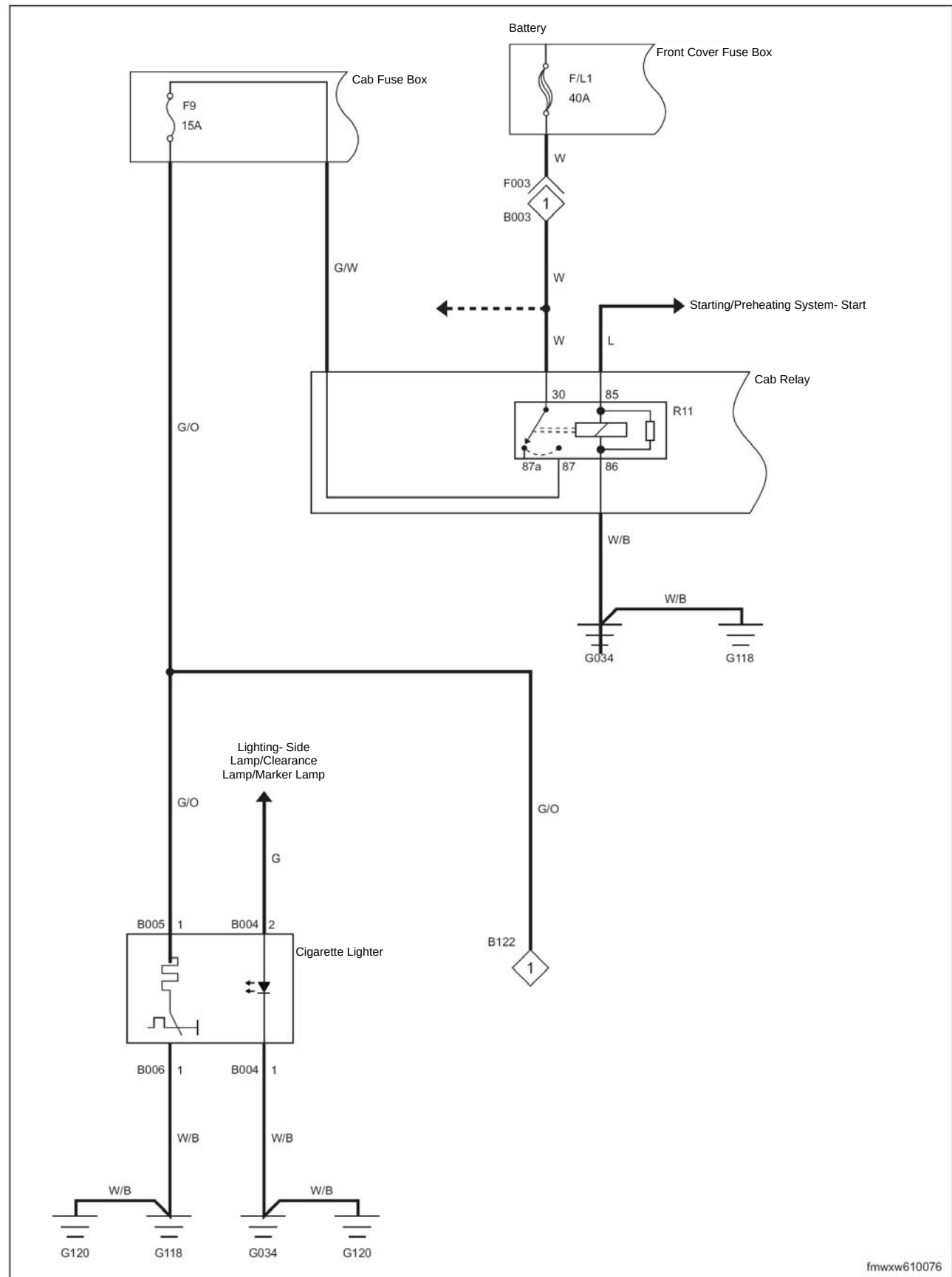
Instrument Cluster (Continued)



Instrument Cluster (Continued)



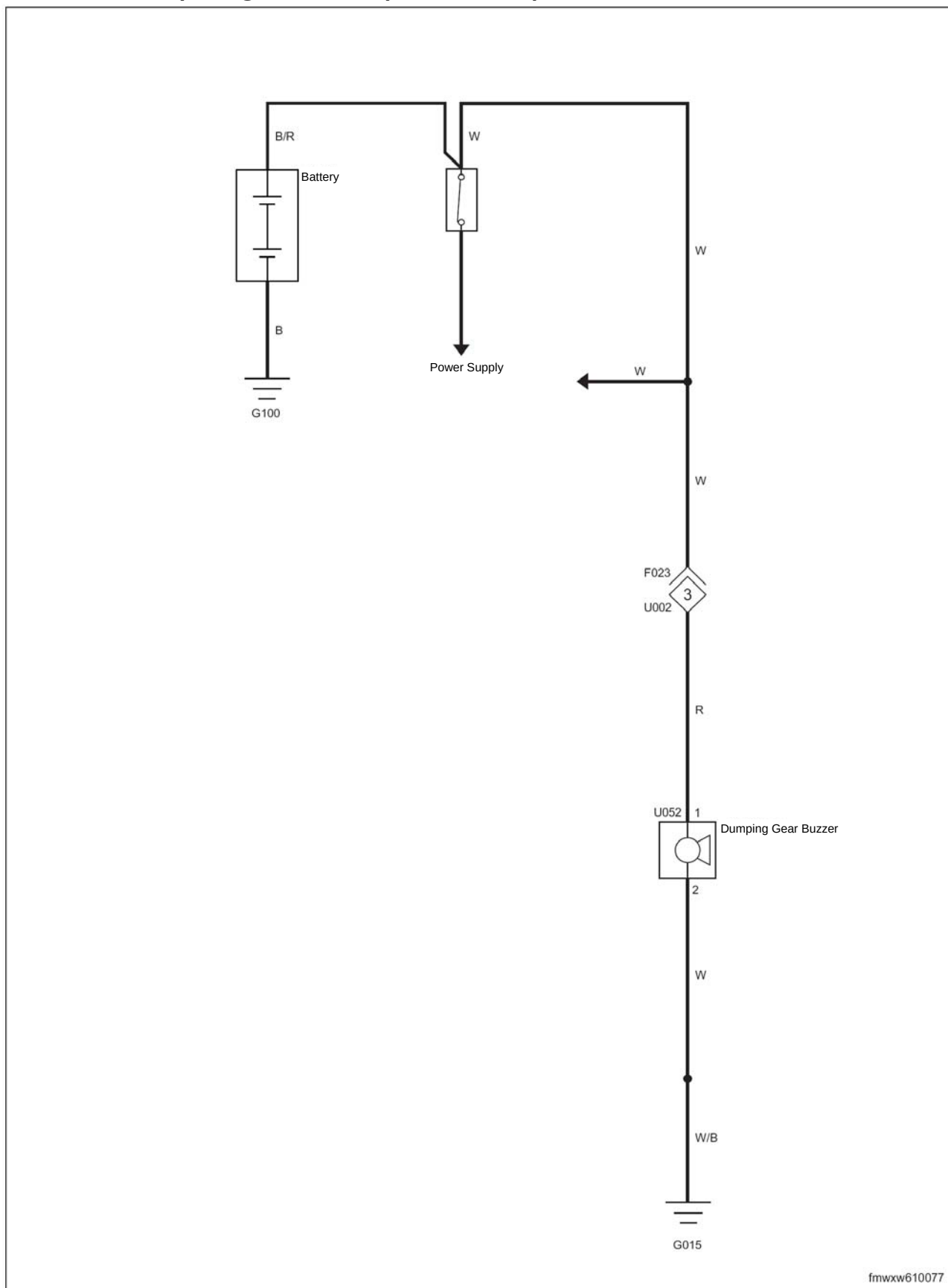
Cigarette Lighter



fmwxw610076

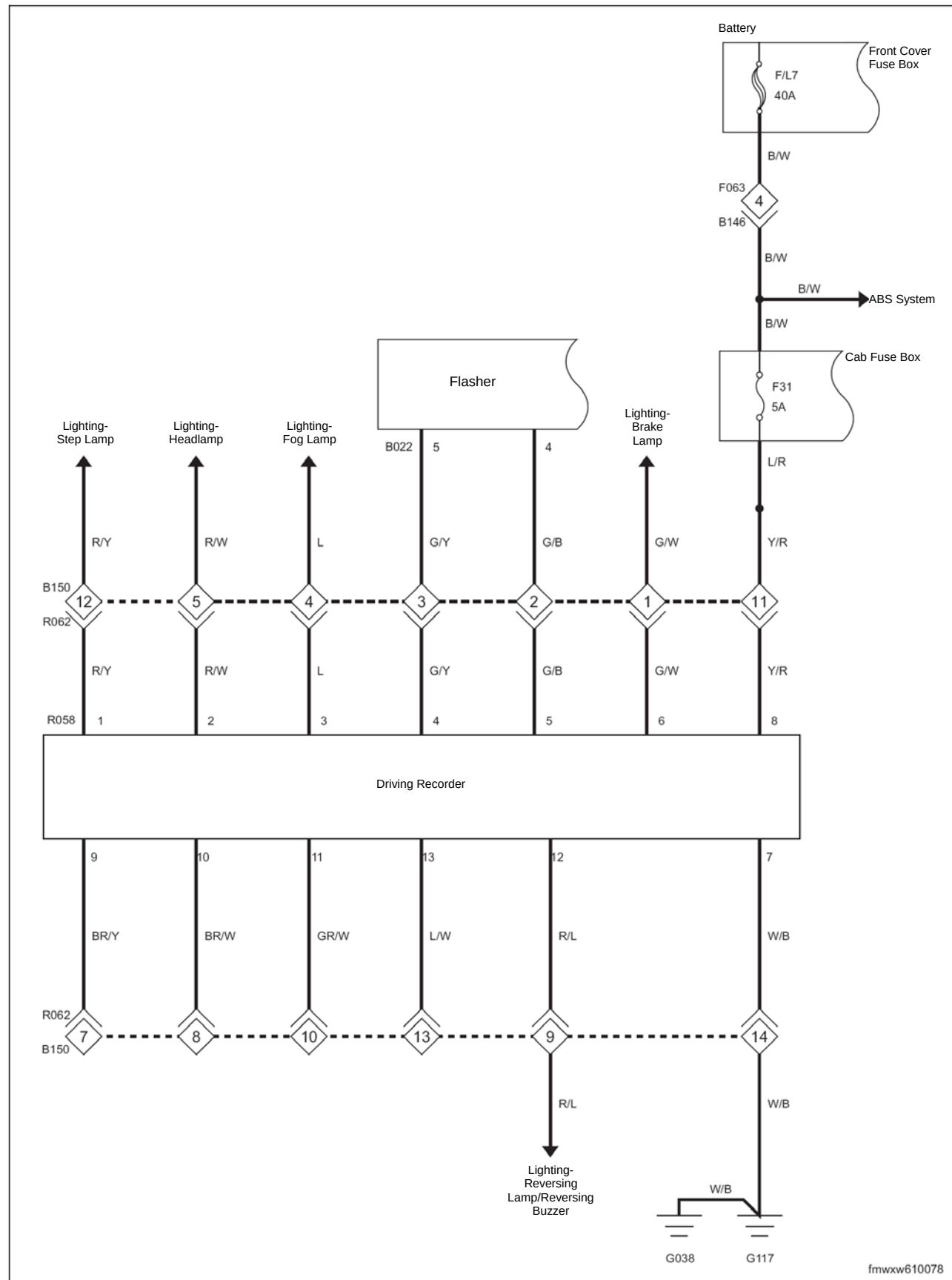
Circuit Diagram - Cab Dumping Gear (Manual)

Cab Dumping Gear (Manual)

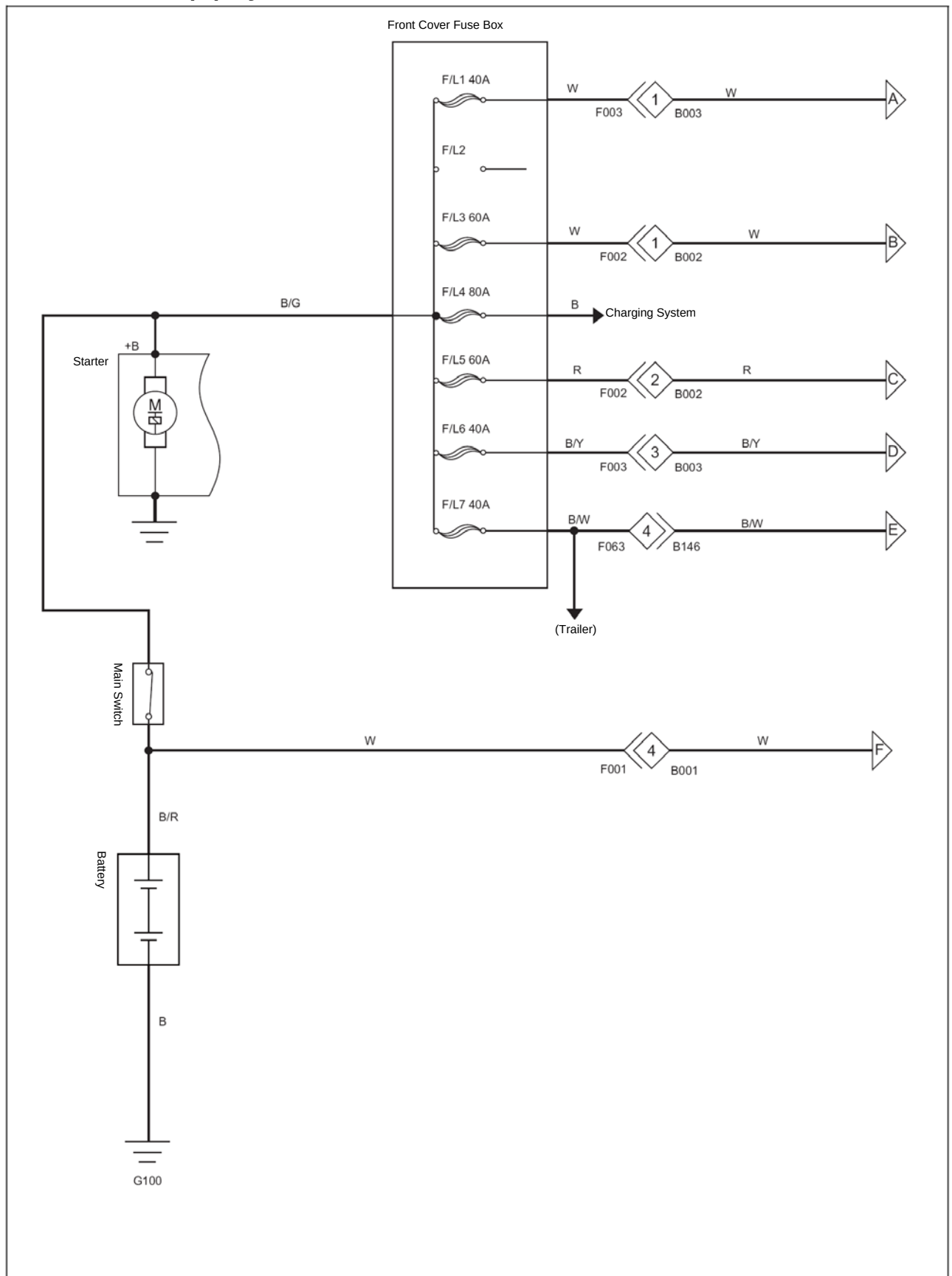


fmwxw610077

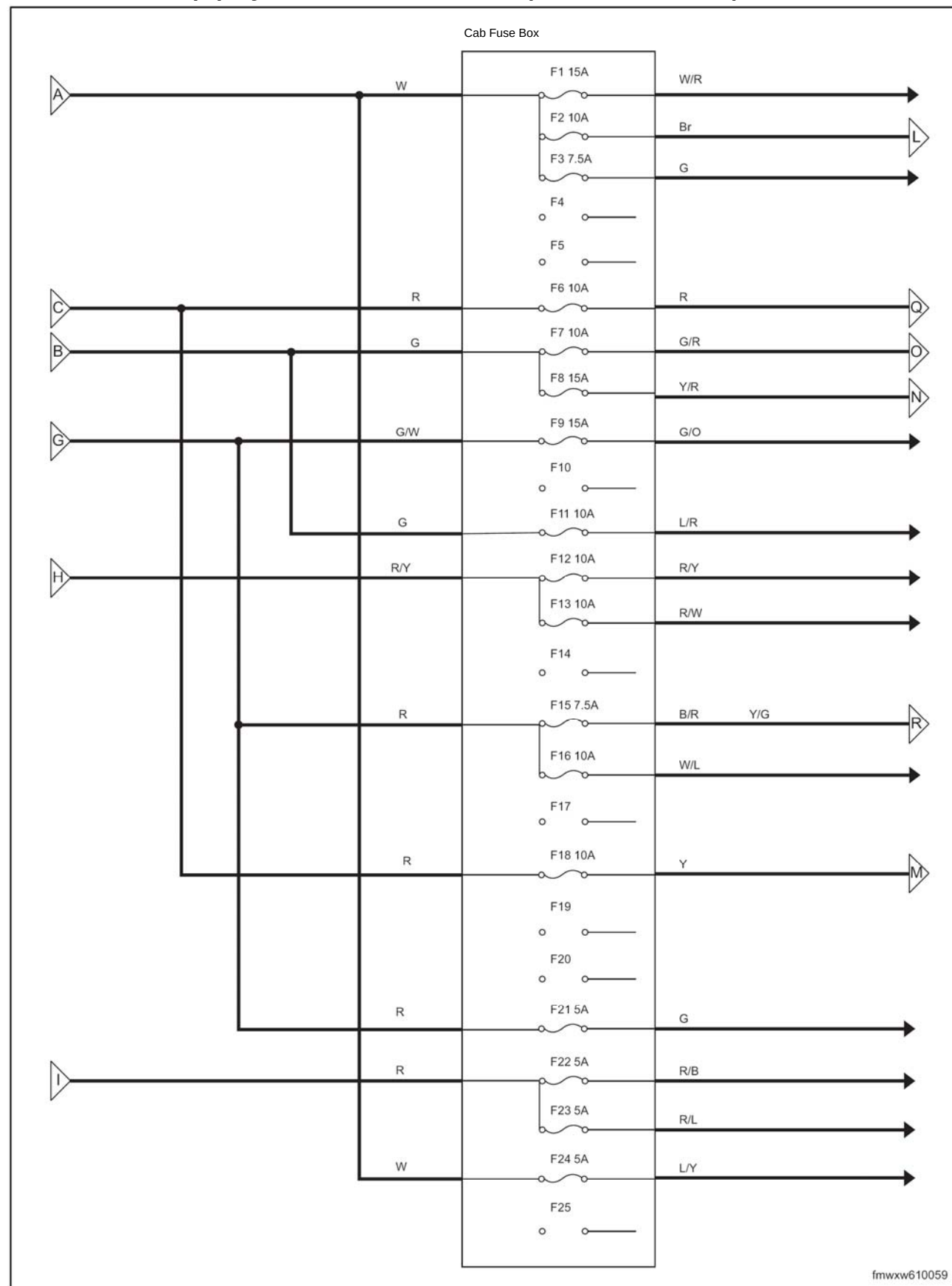
Driving Recorder



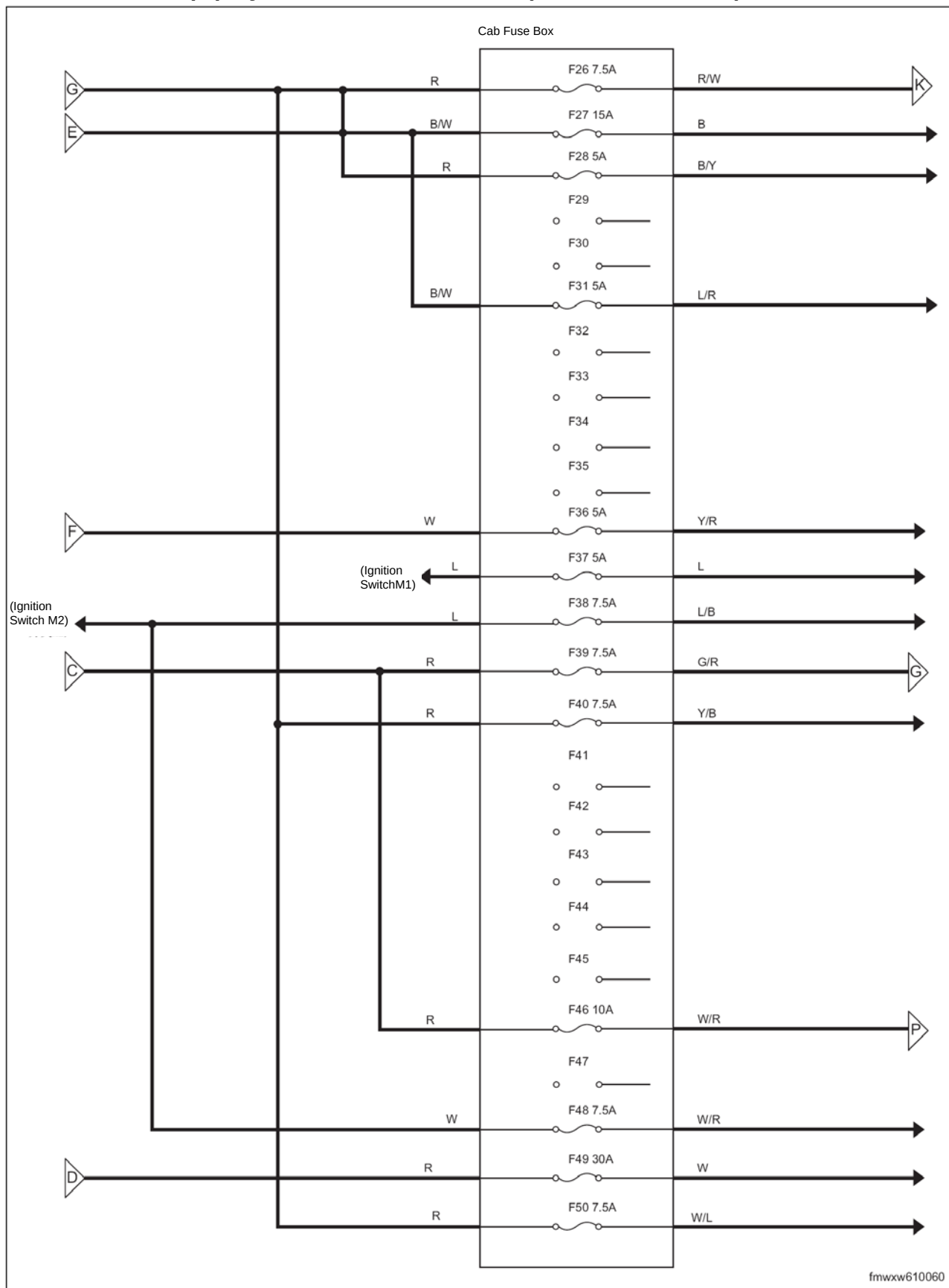
Power Supply Distribution



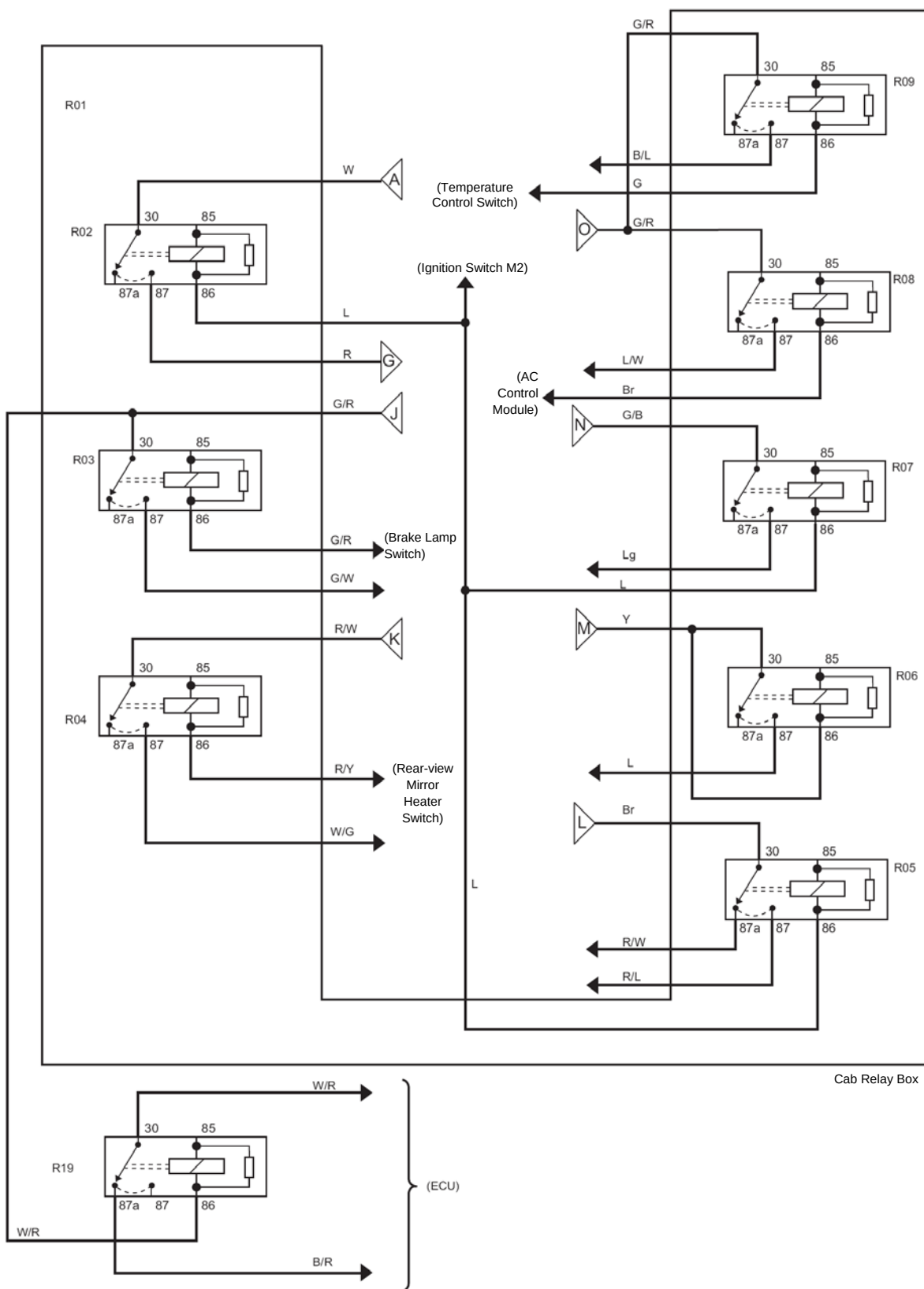
Power Supply Distribution (Continued)



Power Supply Distribution (Continued)

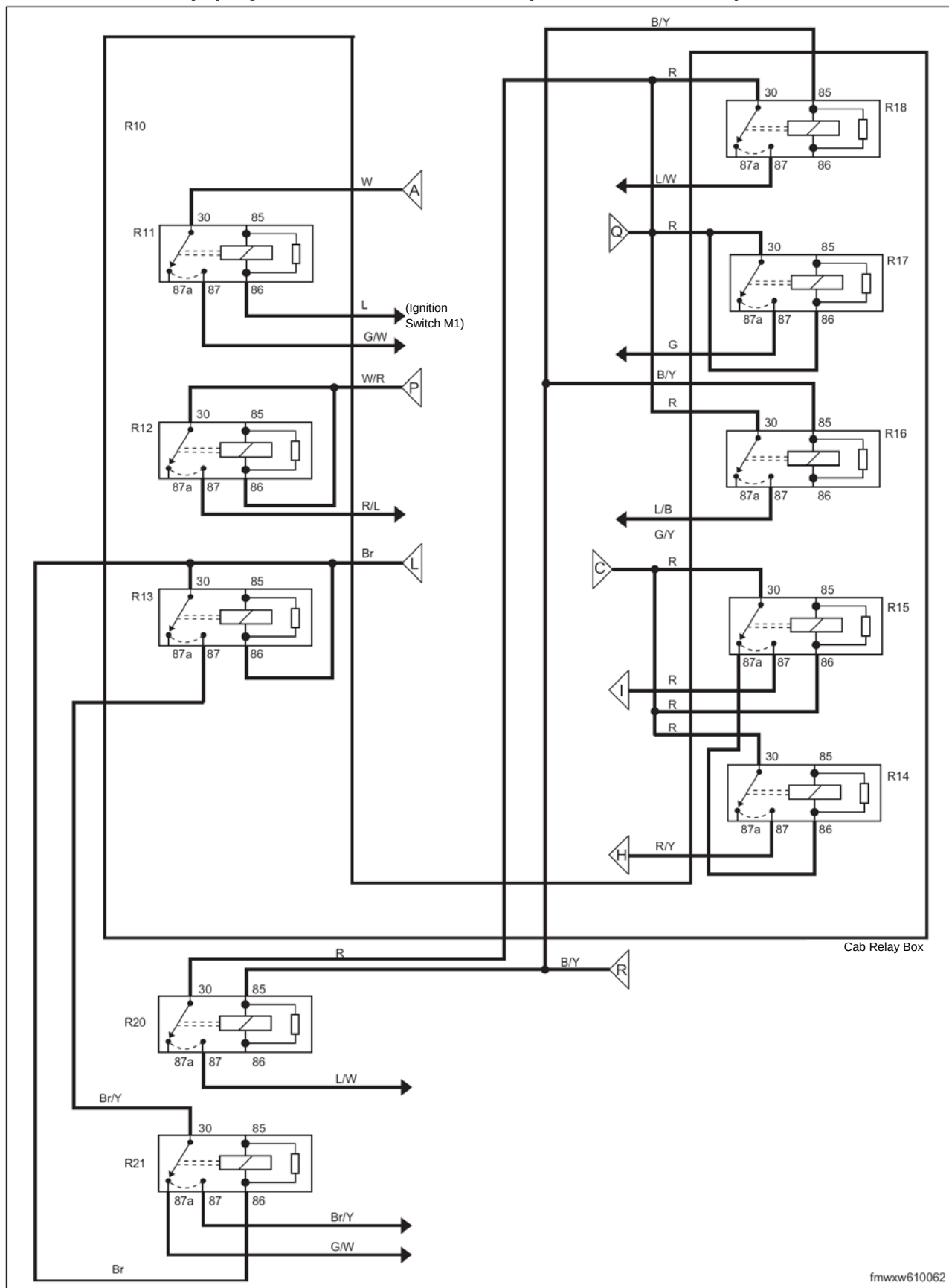


Power Supply Distribution (Continued)

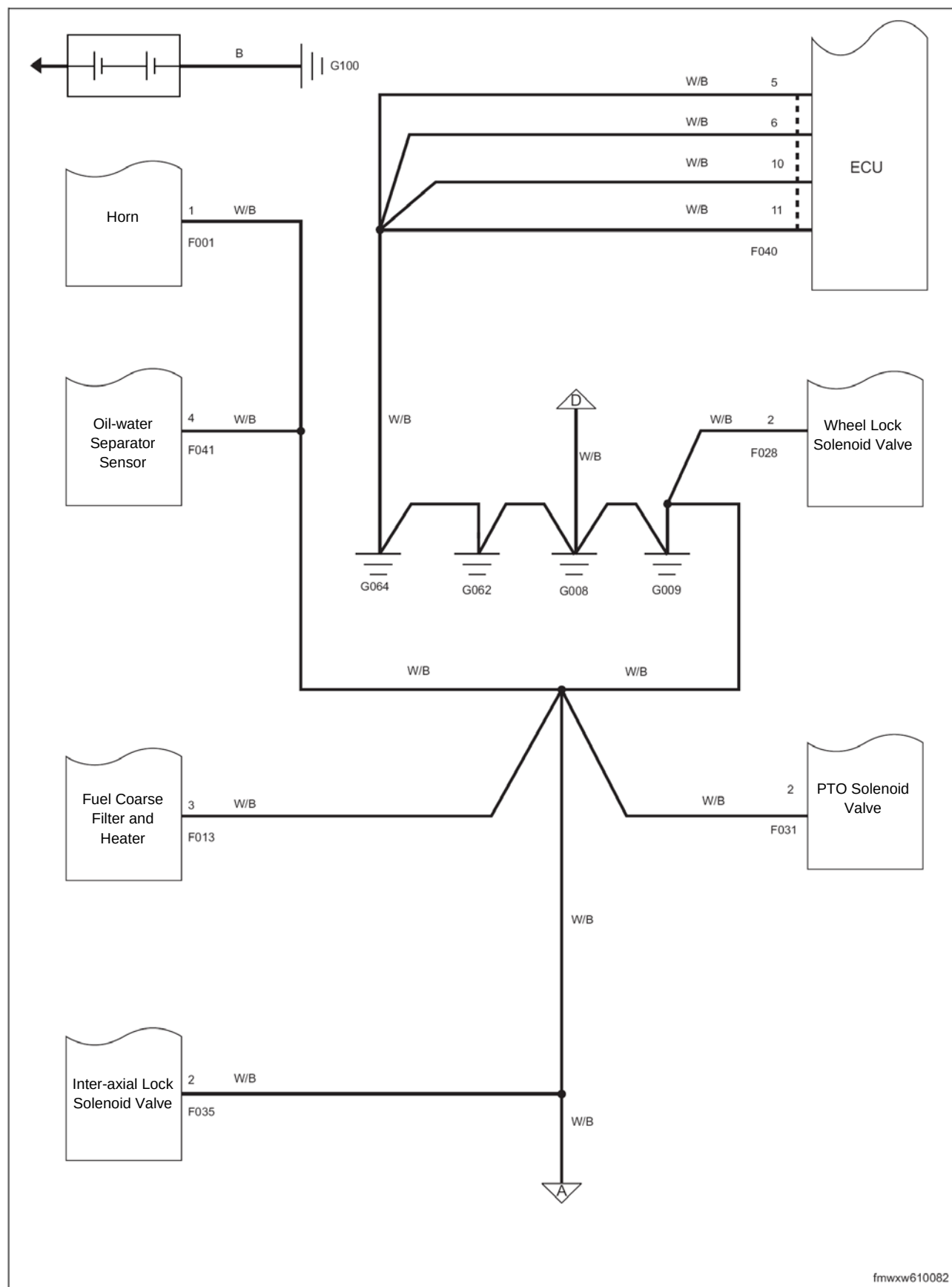


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Power Supply Distribution (Continued)



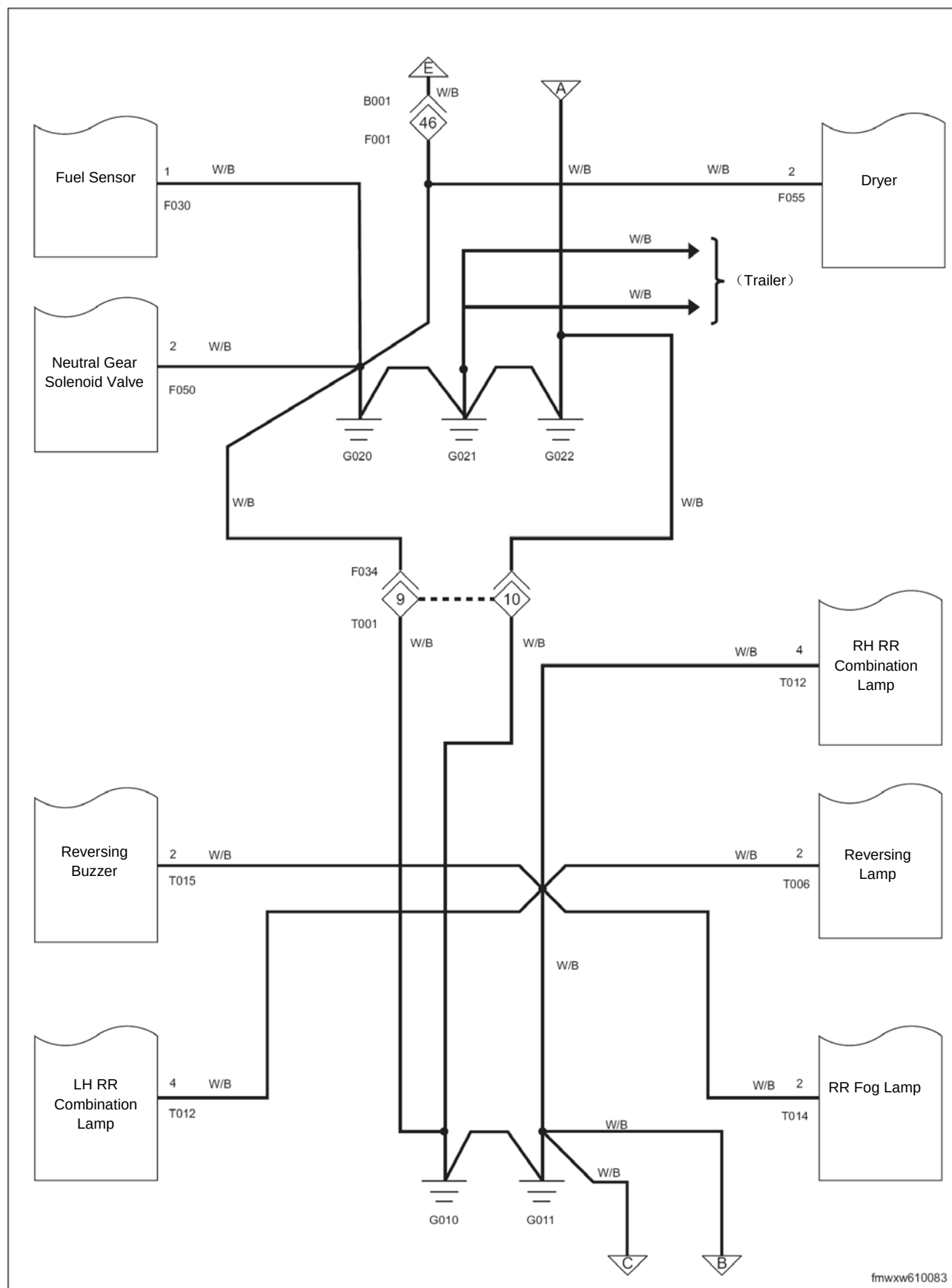
Grounding Distribution (Continued)



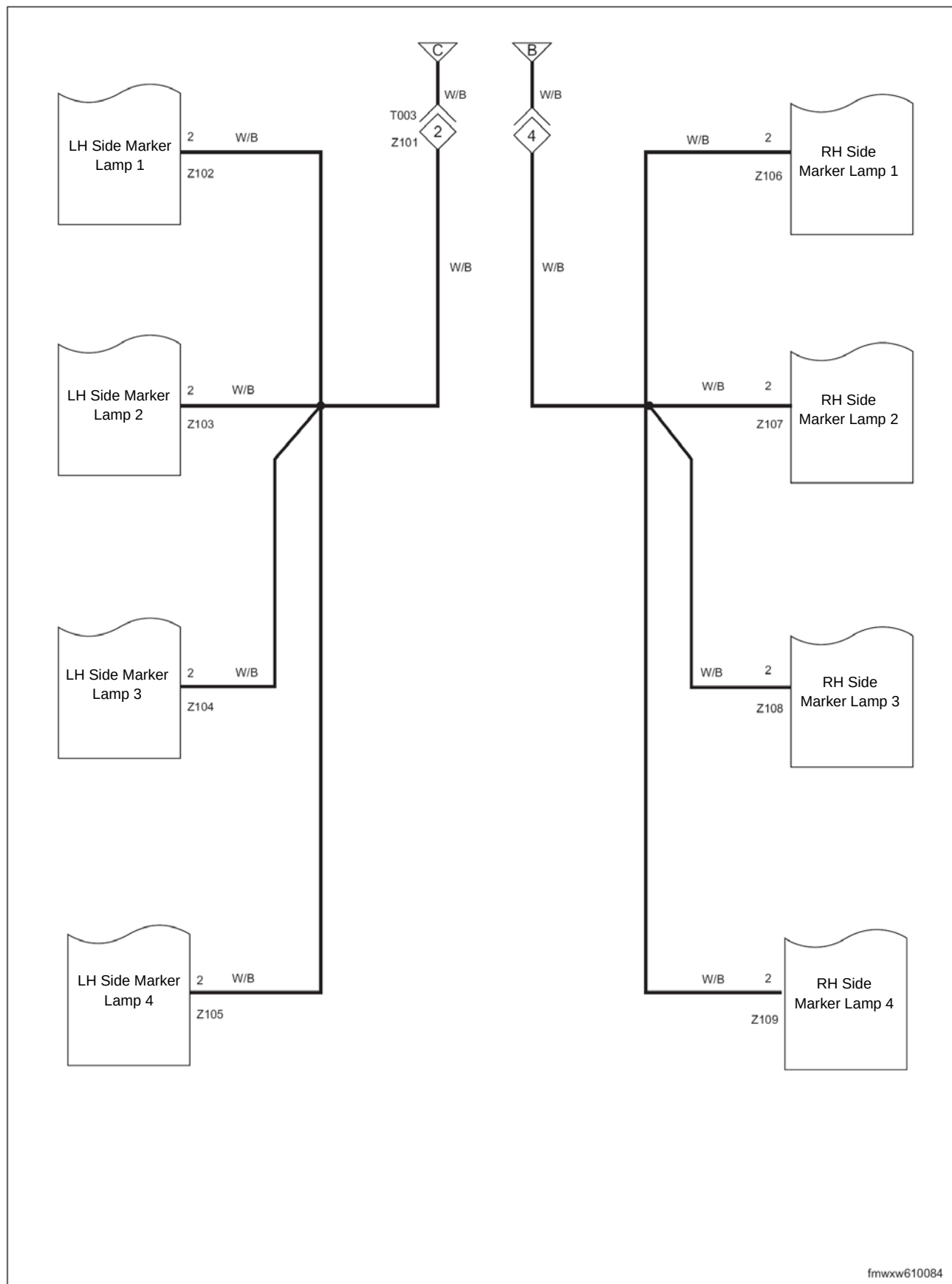
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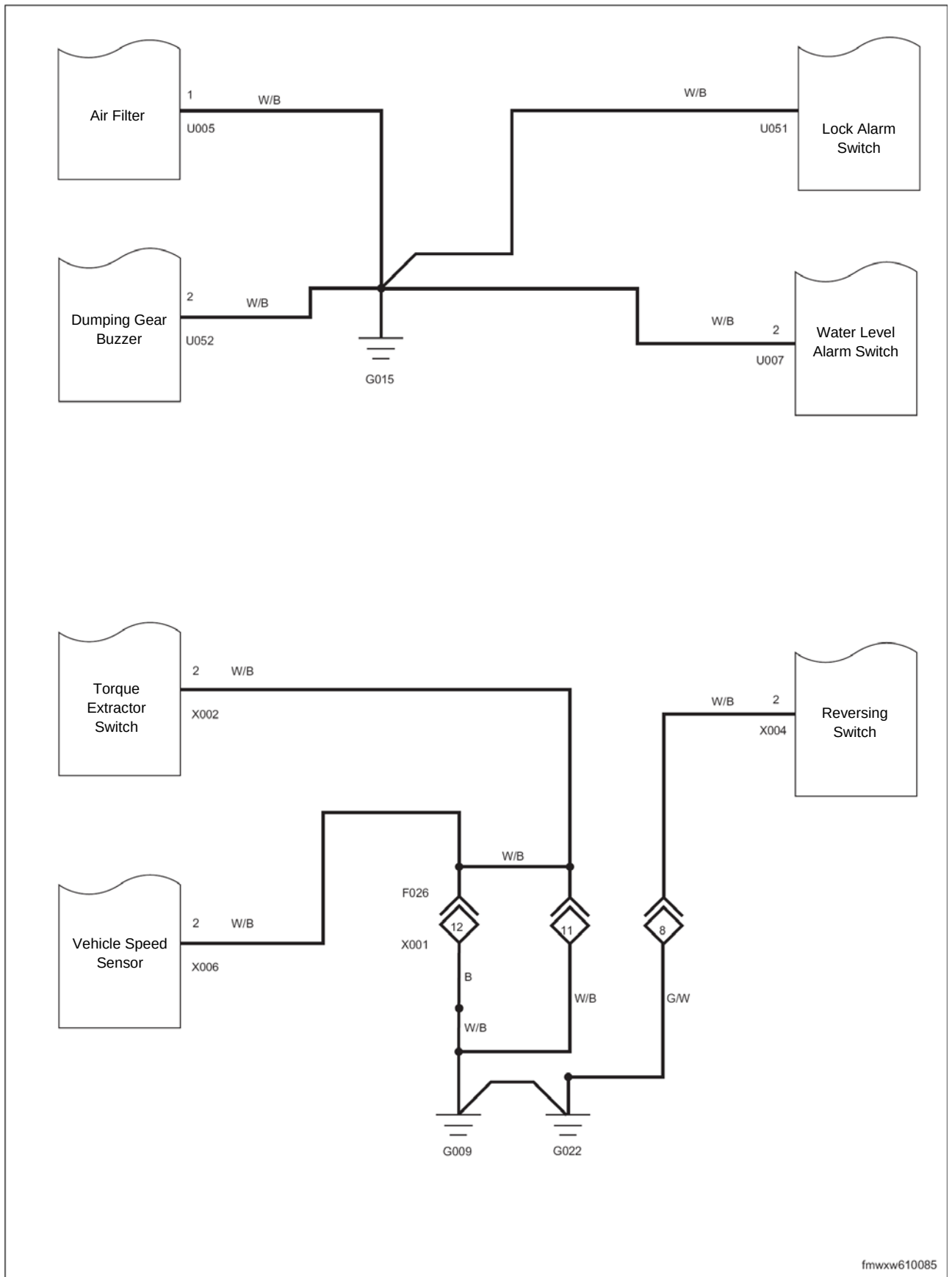
Grounding Distribution (Continued)



Grounding Distribution (Continued)

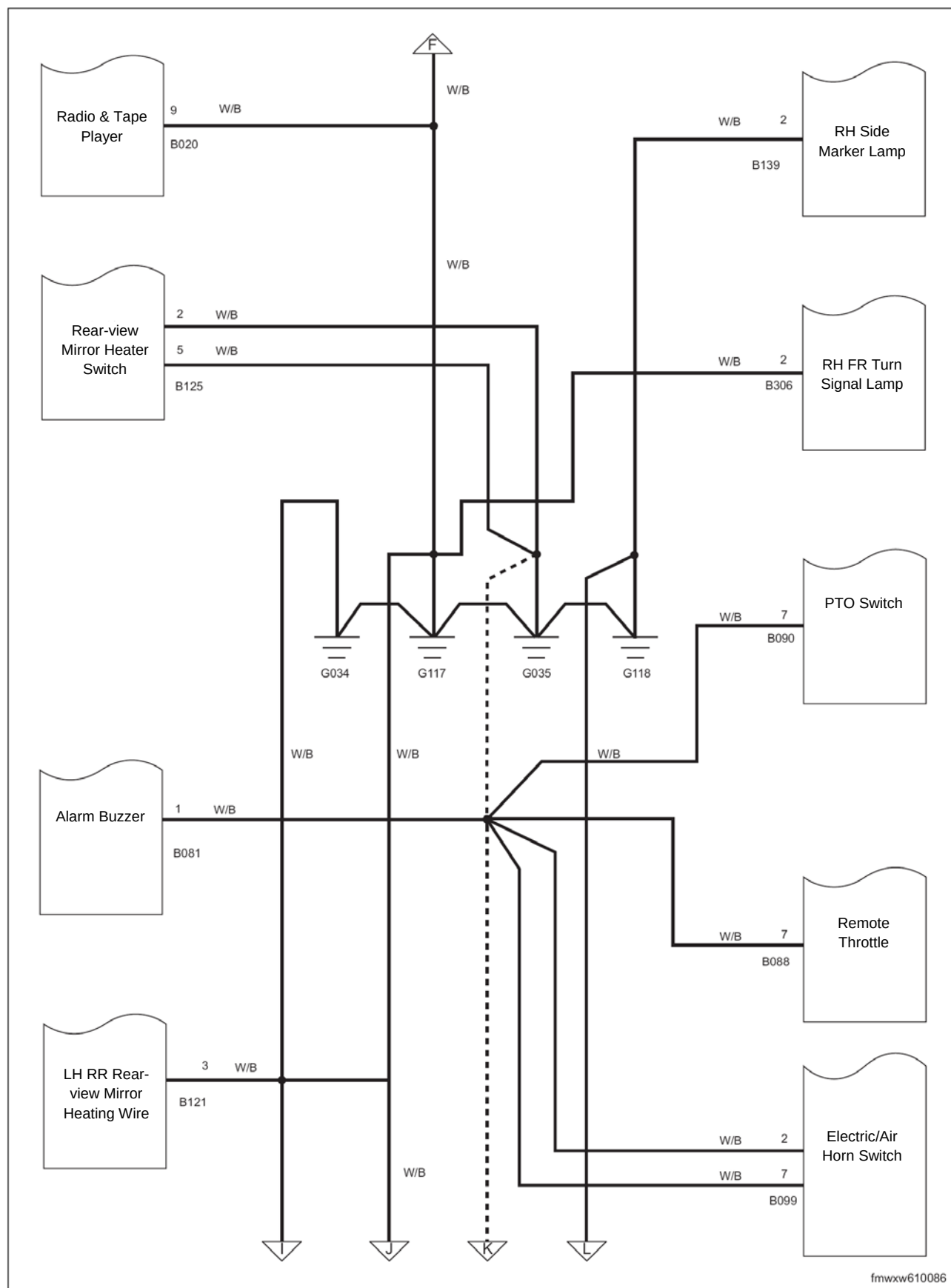


Grounding Distribution (Continued)

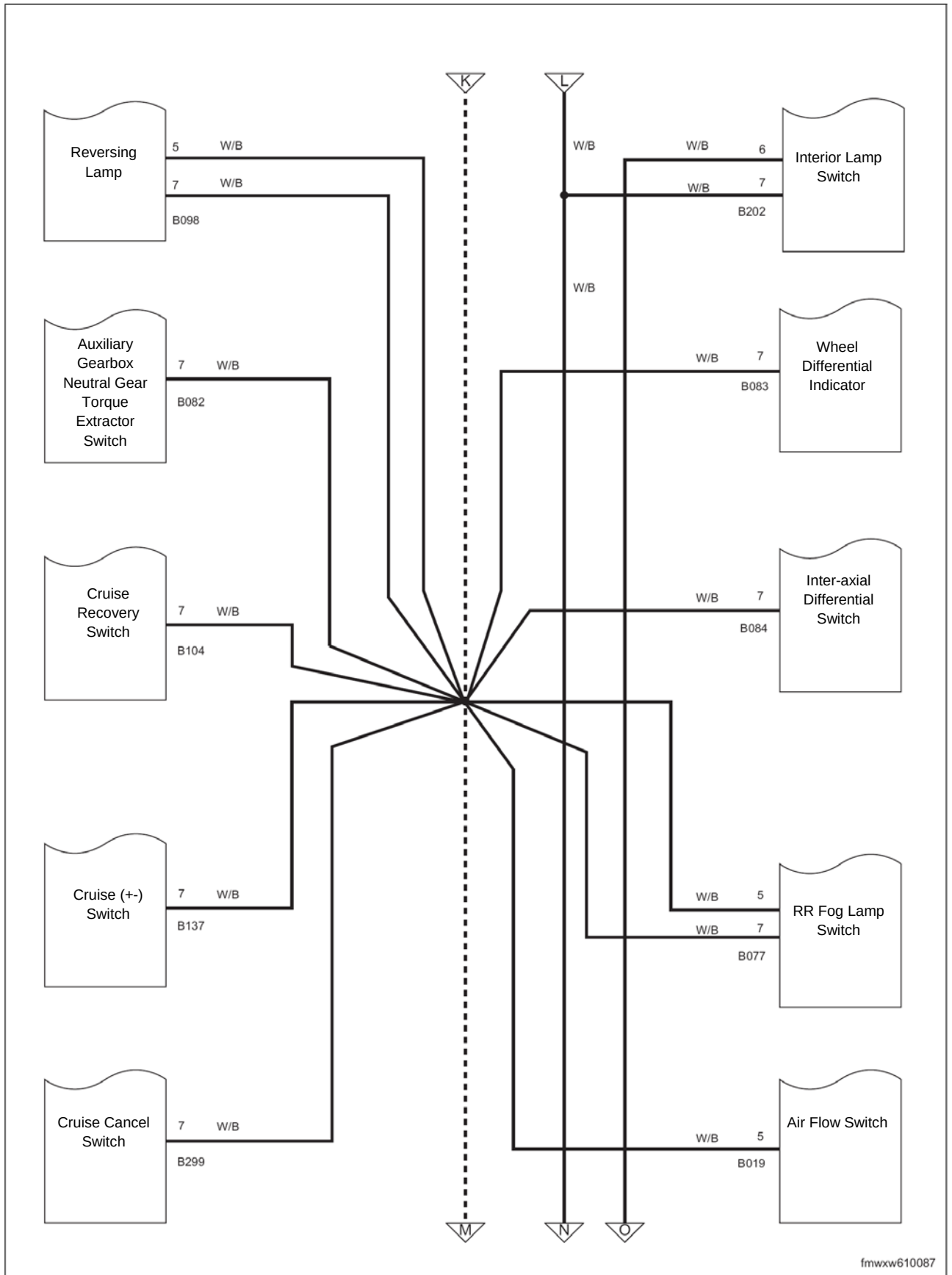


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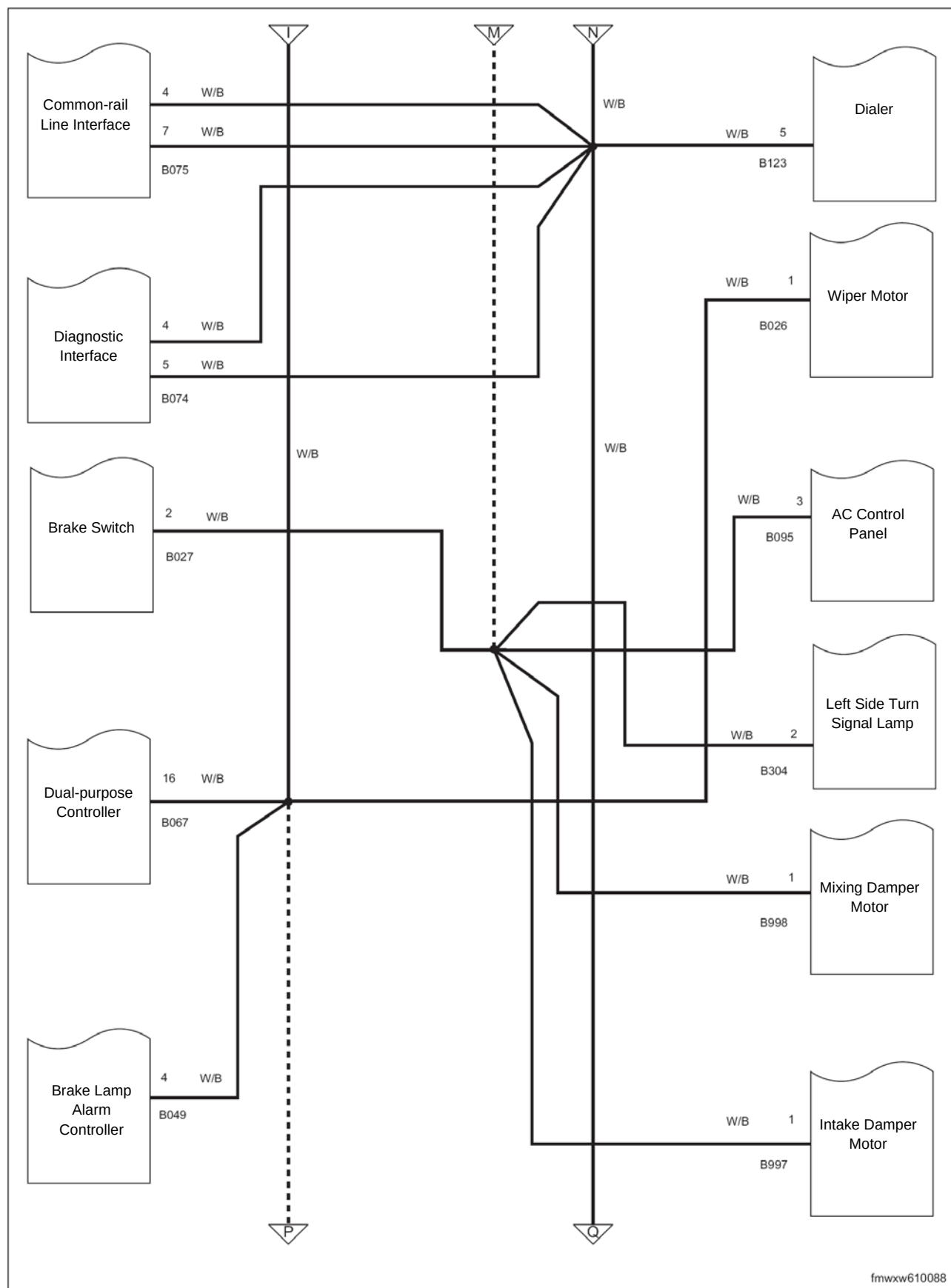
Grounding Distribution (Continued)



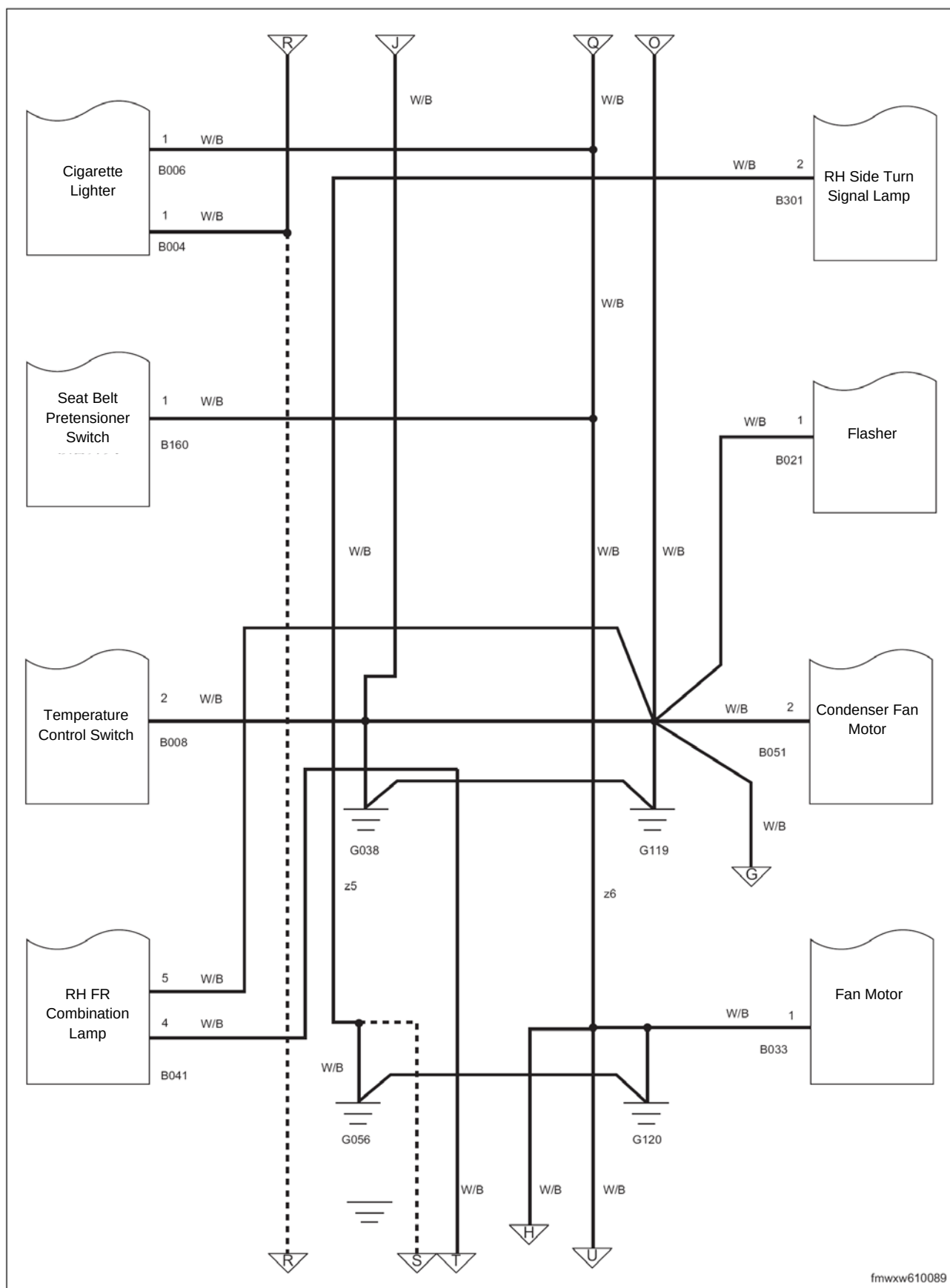
Grounding Distribution (Continued)



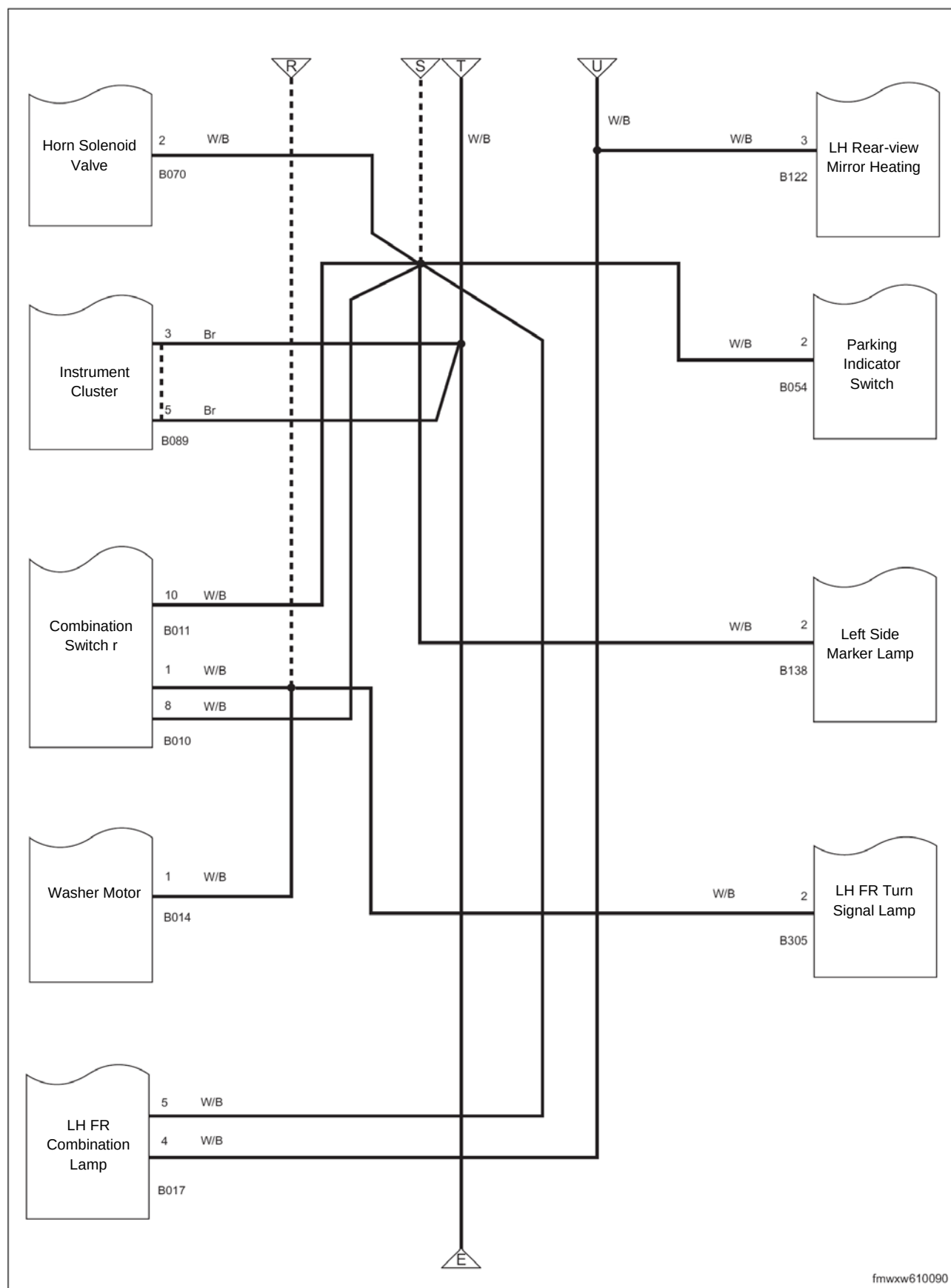
Grounding Distribution (Continued)



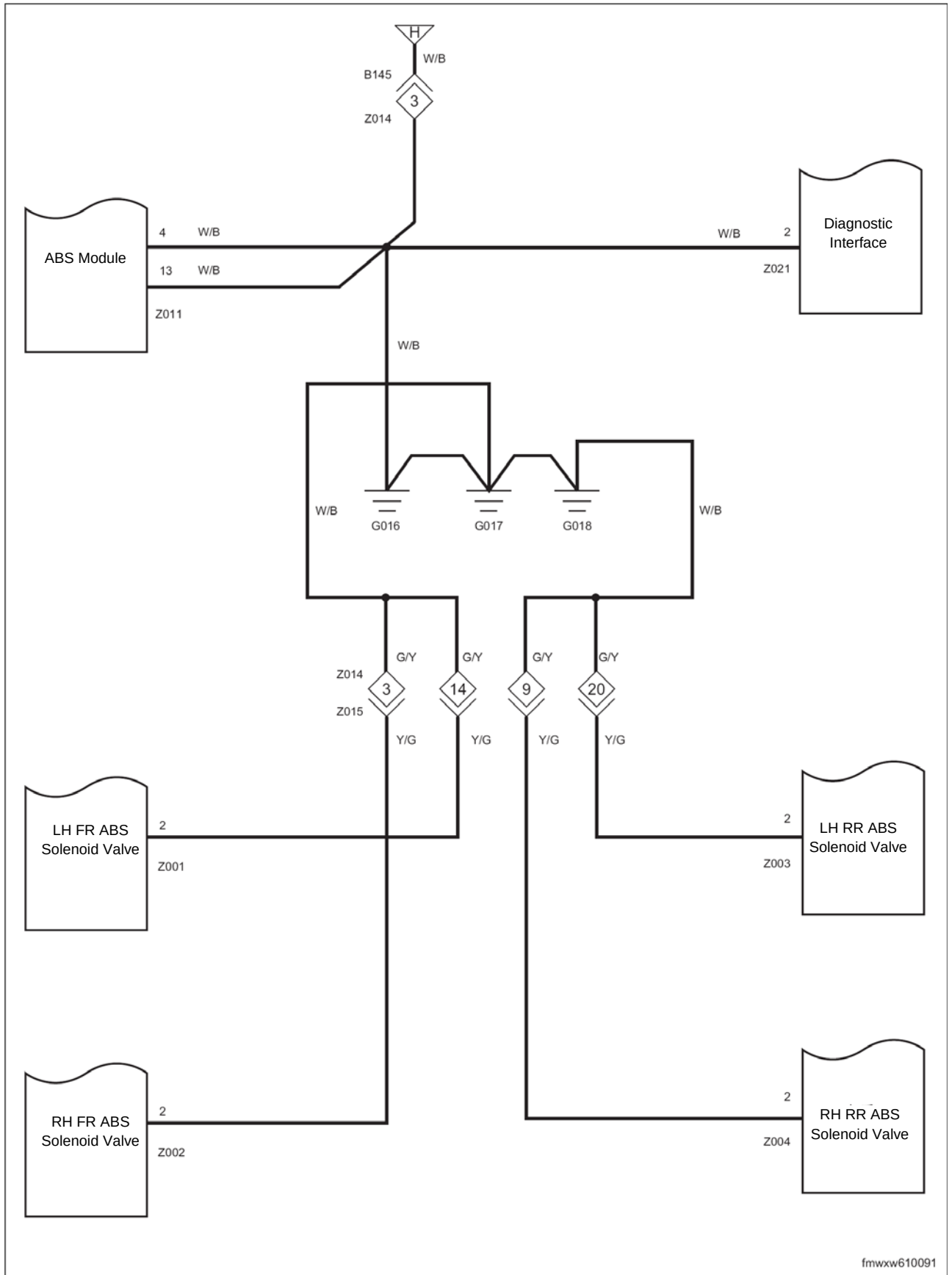
Grounding Distribution (Continued)



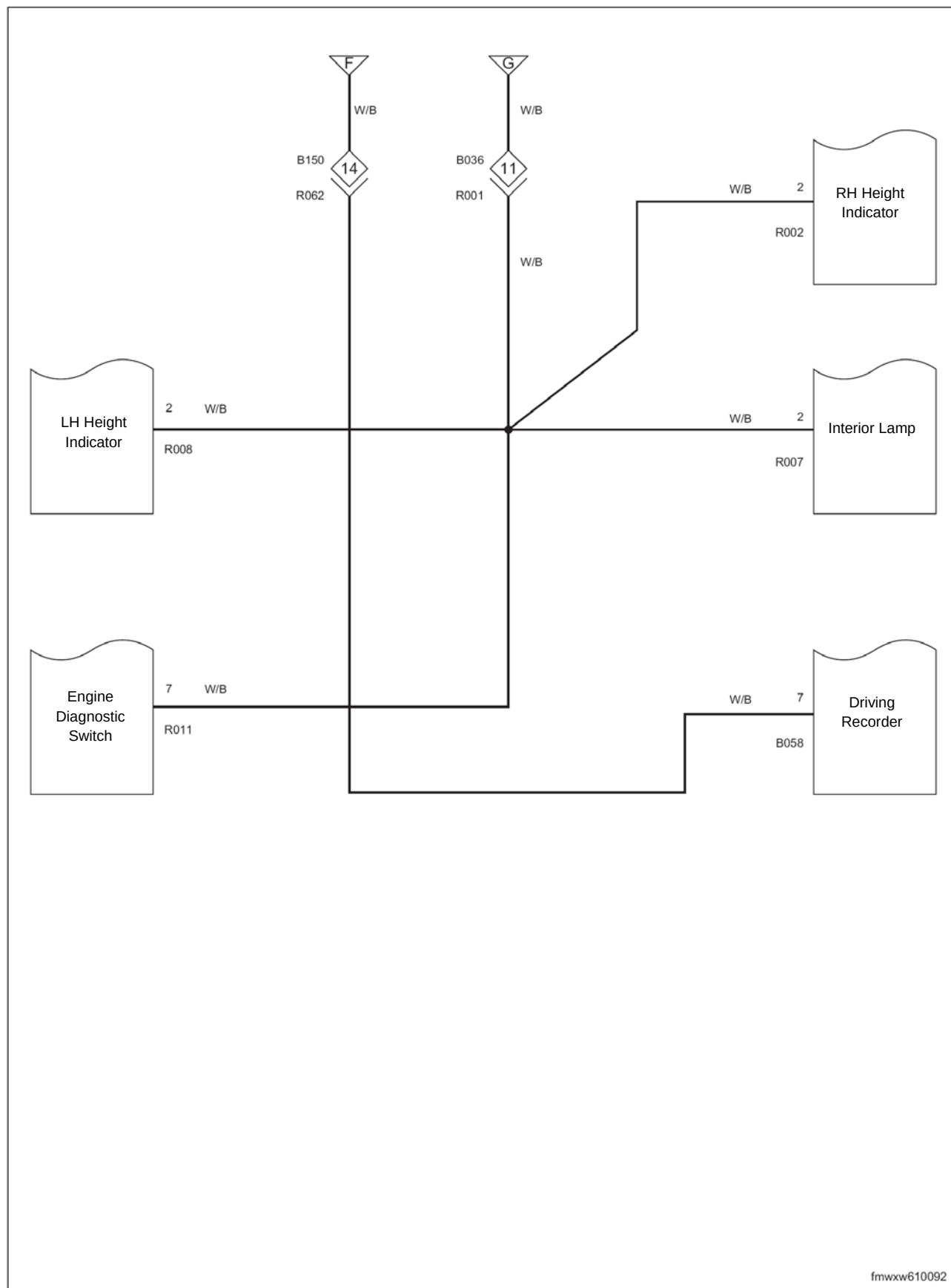
Grounding Distribution (Continued)



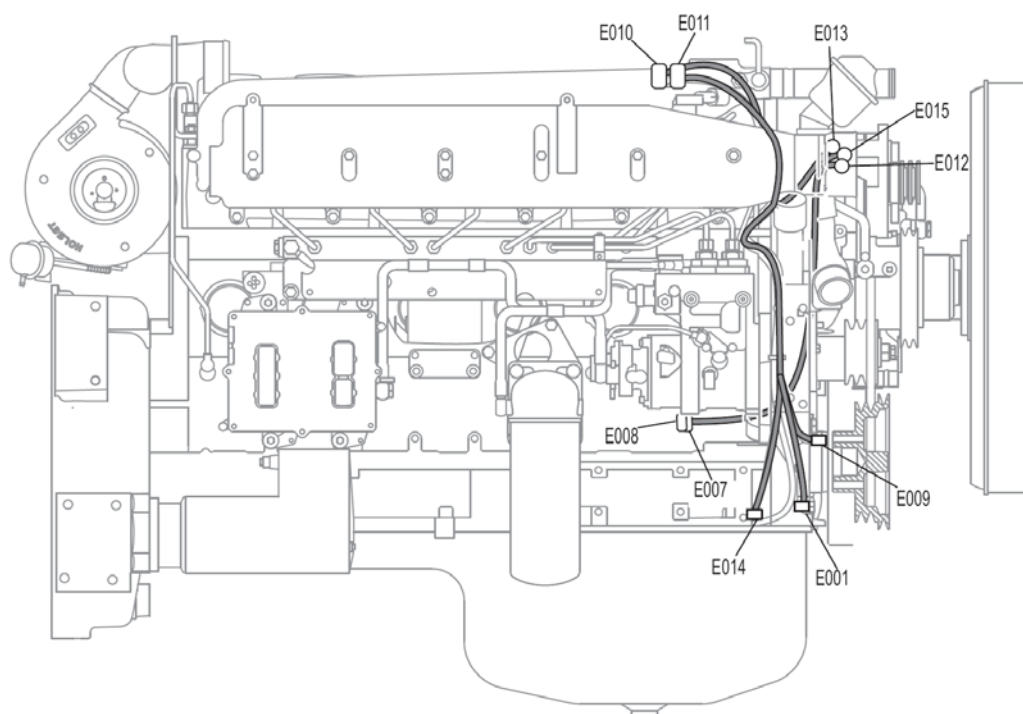
Grounding Distribution (Continued)



Grounding Distribution (Continued)

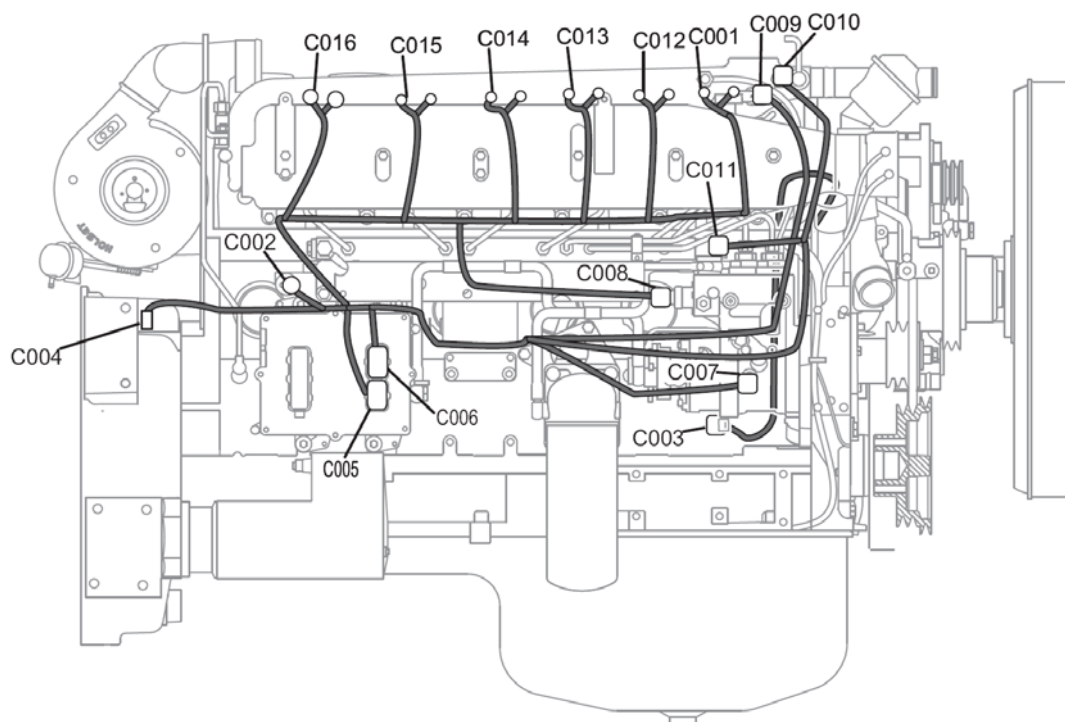


Positions of Wiring Harness Connector (Left Rudder)



E009	To Compressor
E014	To (+B)
E001	To Front Frame Wiring Harness
E008	To Oil Pressure Sensor (+)
E007	To Oil Pressure Alarm Switch

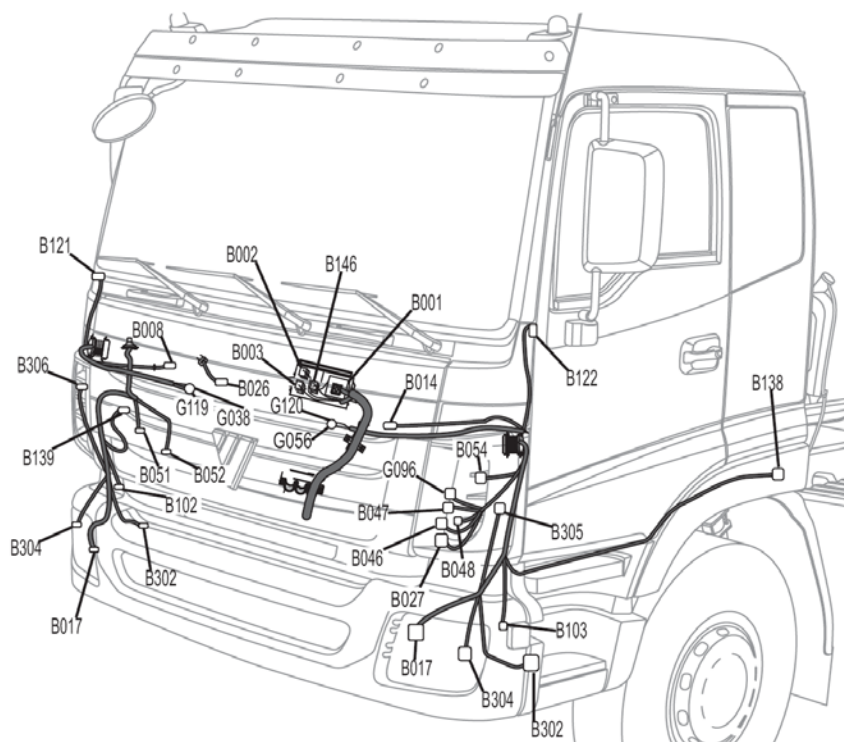
E011	To Water Temperature Alarm Switch
E010	To Water Temperature Sensor
E013	To Generator (D+)
E015	To Generator (W)
E012	To Generator (+B)



C001	To Fuel Injector
C012	To Fuel Injector
C013	To Fuel Injector
C014	To Fuel Injector
C015	To Fuel Injector
C016	To Fuel Injector
C002	To Front Frame Wiring Harness
C004	To Crankshaft Position Sensor

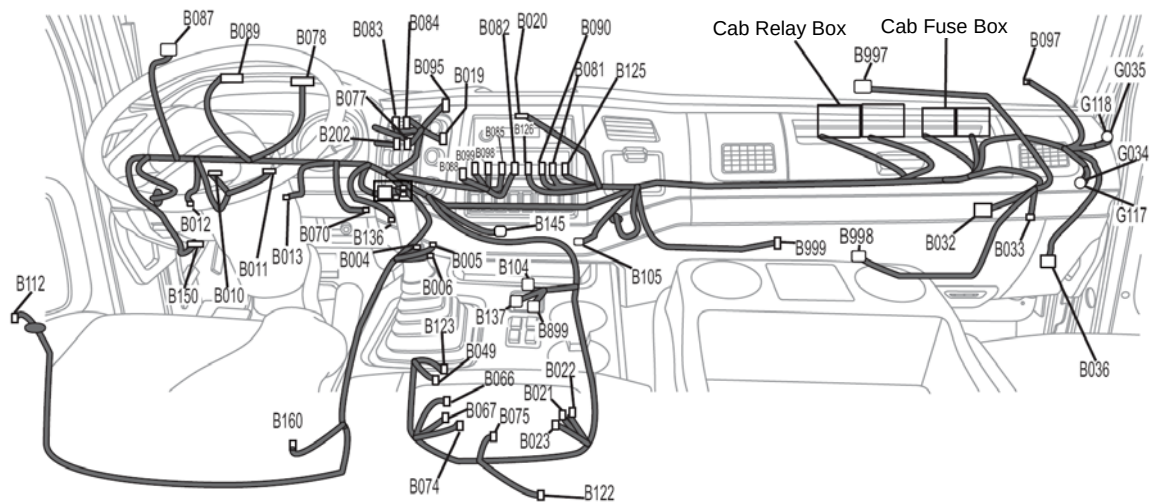
C007	To Camshaft Position Sensor
C008	To Flow Metering Valve
C009	To Booster Pressure Temperature Sensor
C010	To Water Temperature Sensor
C011	To Common-rail Pressure Sensor
C003	To Oil Pressure Temperature Sensor
C005	To Electric Control Unit ECU C
C006	To Electric Control Unit ECU B

Circuit Diagram—Information On Wiring Harness Connector



G120	Grounding 7
G056	Grounding 8
B014	To Washer Motor
B122	To Rear-View Mirror Heating Wire
B054	To Parking Indicator Switch
G096	To FR and RR Axle Gas Pressure Sensor Grounding
B047	To RR Axle Gas Pressure Sensor
B046	To FR Axle Gas Pressure Sensor
B048	To Brake Lamp Switch (main)
B008	To Temperature Control Switch
B121	To RH Rear-view Mirror Heating Wire
G038	Grounding 5
G119	Grounding 6
B051	To Condenser Fan Motor
B052	Pressure Switch
B139	To RH Side Marker Lamp
B001	To Frame Wiring Harness A

B027	To Brake Switch
B138	To LH Side Marker Lamp
B103	To LH Headlamp Reserved
B305	To LH FR Turn Signal Lamp
B017	To LH FR Combination Lamp
G302	To LH Step Lamp
B304	To Left Side Turn Signal Lamp
B102	RH Headlamp Reserved
B306	To RH FR Turn Signal Lamp
B041	To RH FR Combination Lamp
B301	To RH Side Turn Signal Lamp
B303	To RH Step Lamp
B026	To Wiper Motor
B146	ABS Interface
B003	To Frame Wiring Harness C
B002	To Frame Wiring Harness B

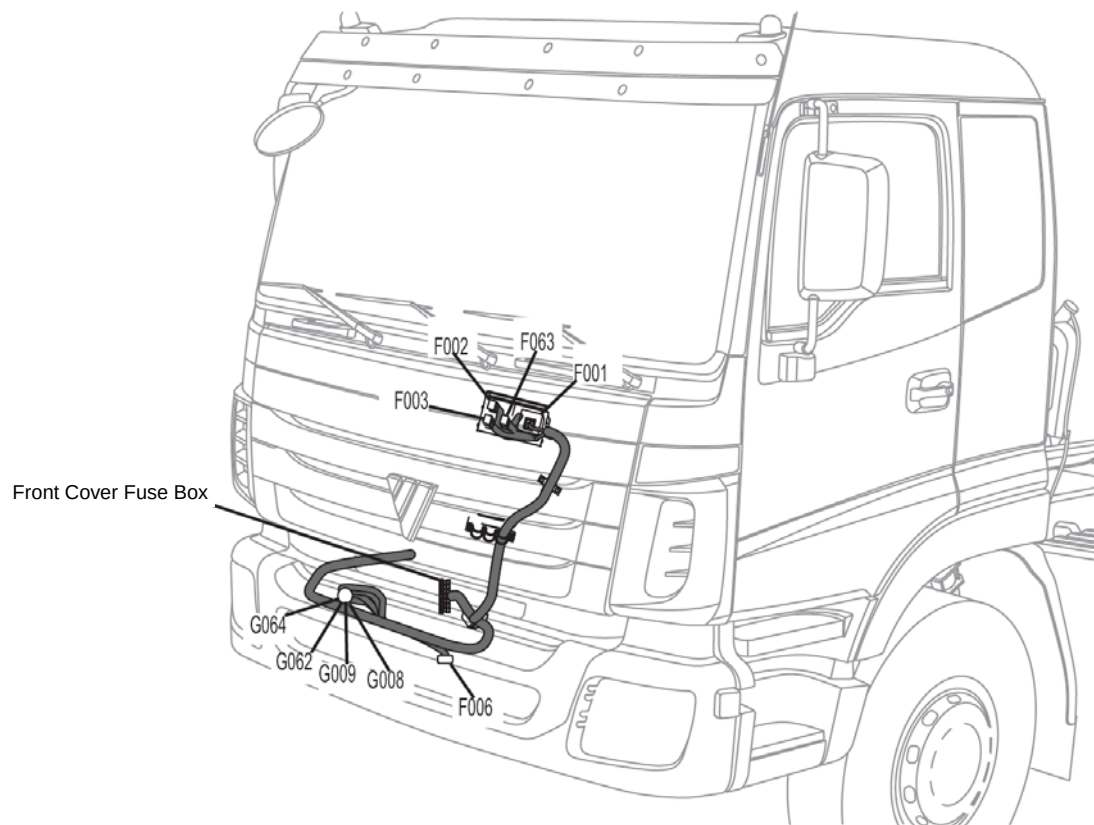


B087	To LH Loudspeaker
B089	To Instrument A
B078	To Instrument B
B077	To RR Fog Lamp Switch
B202	To Interior Lamp Switch
B083	To Wheel Differential Switch
B084	To Inter-axial Differential Switch
B095	To AC Control Panel
B019	To Air Flow Switch
B088	To Remote Throttle
B099	To Electric/Air Horn Switch
B098	To RR Illuminating Lamp Switch
B085	To ABS Diagnostic Switch
B082	To Auxiliary Gearbox Neutral Gear Takeoff Switch
B126	To Multi-state Switch
B020	To Radio & Tape Player
B090	To PTO Switch
B081	To Alarm Buzzer
B125	To Rear-view Mirror Heater Switch
B997	Intake Damper Motor Plug
B097	To RH Loudspeaker
G035	Grounding 3
G118	Grounding 4
G034	Grounding 1
G117	Grounding 2
B010	To Combination Switch B
B012	To Clutch Switch
B150	To Roof Wiring Harness
B011	To Combination Switch A

B036	To Roof Wiring Harness
B033	To Fan Motor Reversing
B032	To Speed Adjustment Module
B998	Mixing Damper Motor Plug
B999	Mode Servo Motor Plug
B105	To Parking Distance Control Radar Buzzer
B145	To ABS Wiring Harness
B122	To Rear-view Mirror Heating Wire
B123	To Dialer
B049	To Brake Lamp Alarm Controller
B066	To Dual-purpose Controller I
B067	To Dual-purpose Controller II
B074	Diagnostic Interface
B075	Common-rail Line Interface
B023	To Flasher III
B021	To Flasher I
B022	To Flasher I
B899	To Cruise Cancel Switch
B137	To Cruise (+-)
B104	To Cruise Recovery Switch
B005	To Cigarette Lighter (+)
B006	To Cigarette Lighter (-)
B004	To Cigarette Lighter Lighting
B160	To Seat Belt Pretensioner Switch
B112	To LH Door Control Switch
B136	To Electric Throttle
B070	To Air Horn Solenoid Valve I
B013	To Ignition Switch

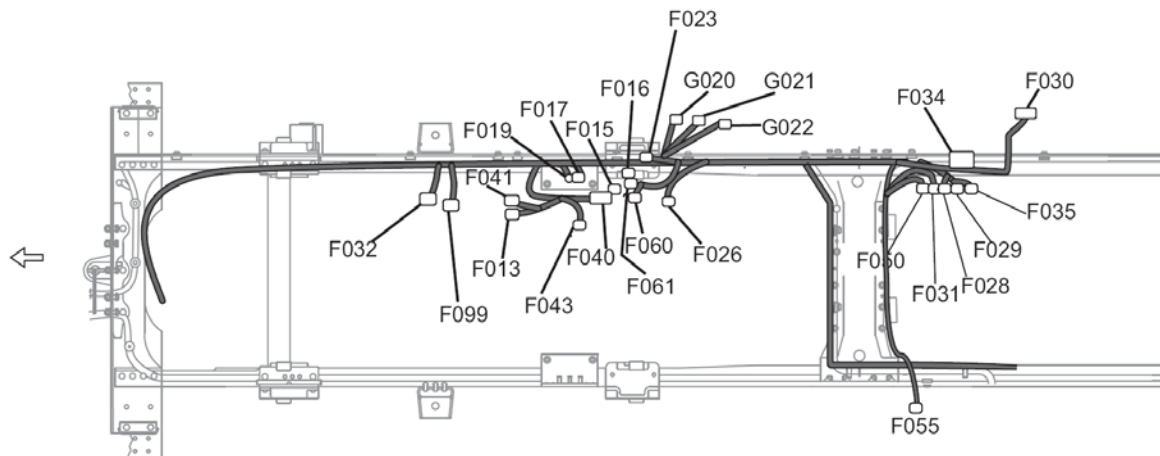


Circuit Diagram—Information On Wiring Harness Connector



F003	To Body Wiring Harness C
F002	To Body Wiring Harness B
F063	To ABS
F001	To Body Wiring Harness A
F006	To High Tone Loudspeaker

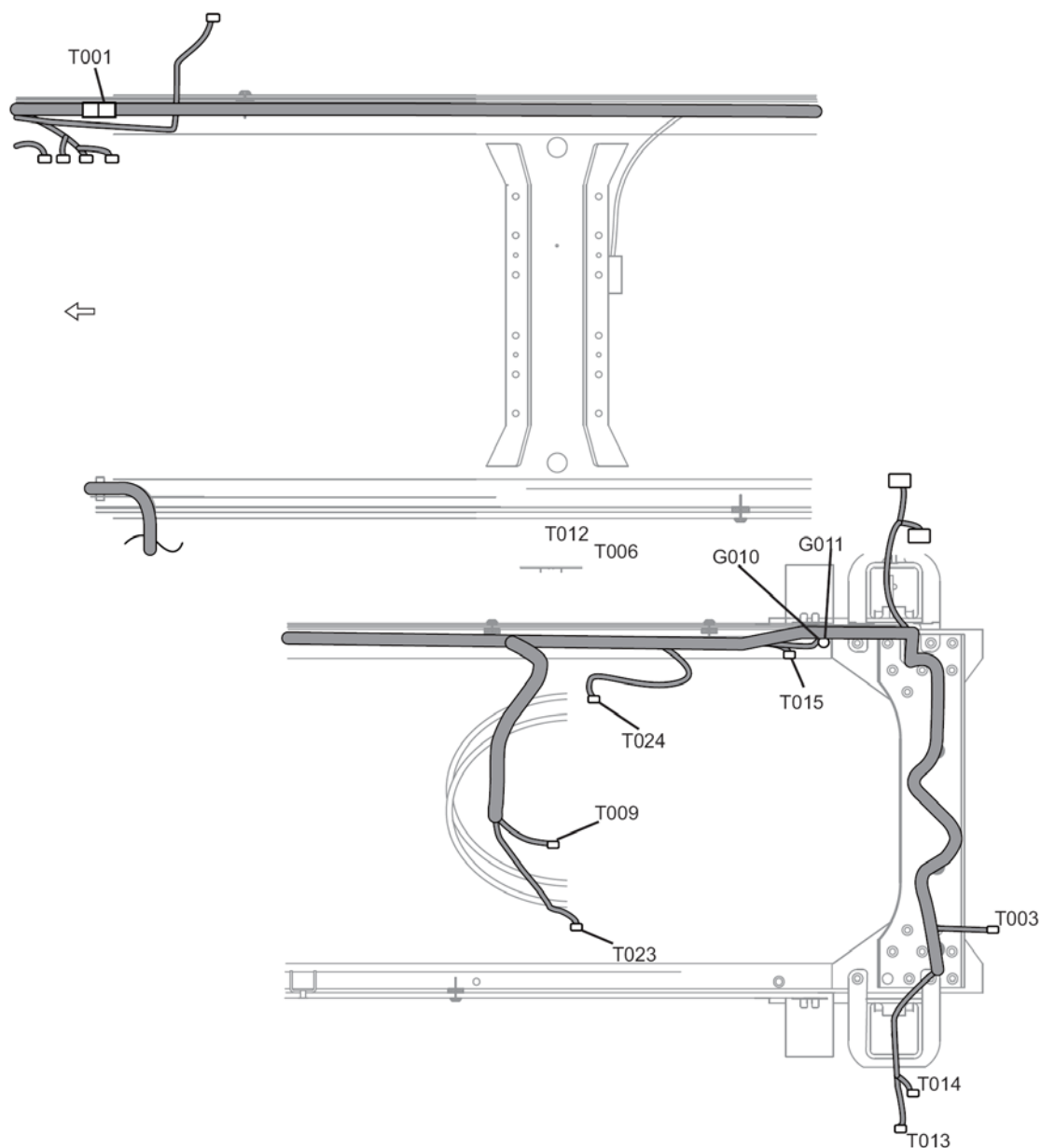
G008	Frame Front Grounding A
G009	Frame Front Grounding B
G062	Frame Front Grounding C
G064	Frame Front Grounding D



F032	To (B+)
F099	To Engine Wiring Harness
F041	To Oil-water Separator Sensor
F013	To Fuel Coarse Filter and Heater
F043	Electrical Control Unit (Interface)
F040	To Electrical Control Unit ECU A
F061	To Trailer
F060	To Trailer ABS A
F026	To Gearbox Wiring Harness
F019	To Starter (+B)
F017	To Memory Power Source
F015	To Starter Relay Coil
F016	To Preheater Relay

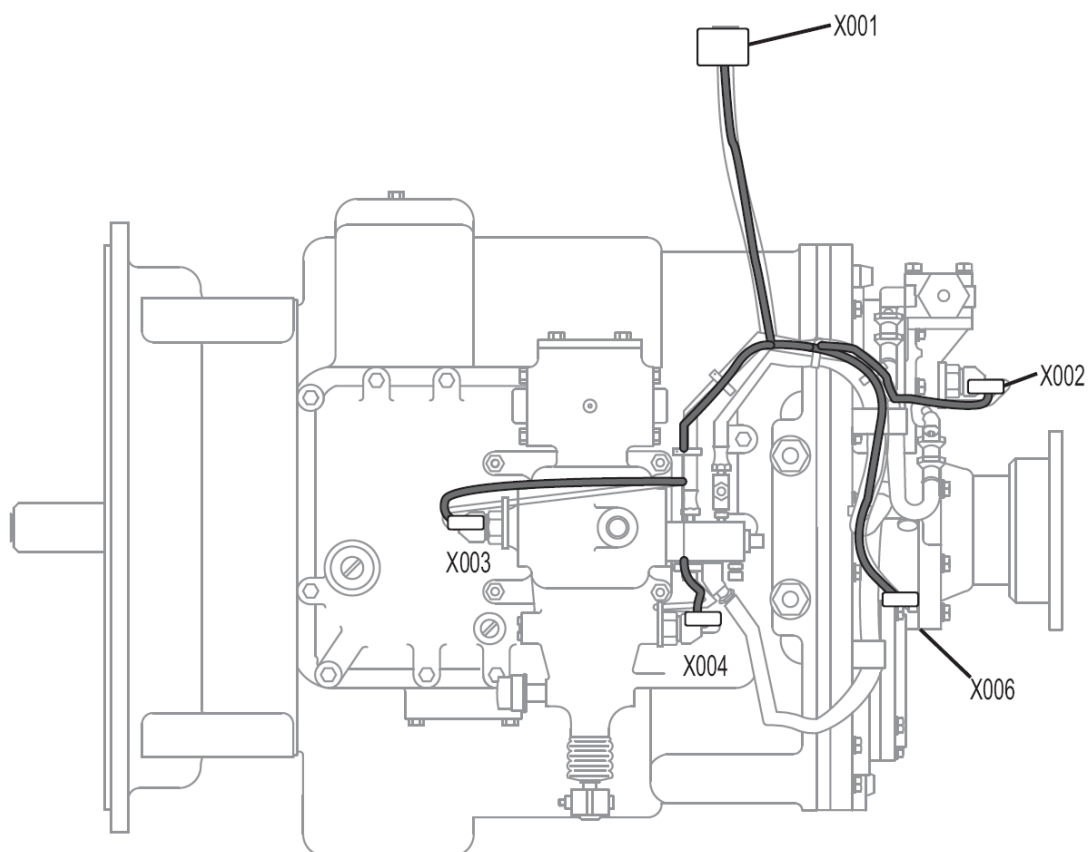
F023	To Dumping Gear Wiring Harness
G020	Frame Front Grounding A
G021	Frame Front Grounding C
G022	Frame Front Grounding B
F034	To Frame Tail Wiring Harness
F030	To Fuel Sensor
F050	To Neutral Gear Solenoid Valve
F031	To PTO Solenoid Valve
F029	To Exhaust Solenoid Valve
F028	To Wheel Lock Solenoid Valve
F035	To Inter-axial Lock Solenoid Valve
F055	To Dryer

Circuit Diagram—Information On Wiring Harness Connector



T001	To Frame Front Wiring Harness
T023	To Wheel Lock Switch (+)
T009	Wheel Lock Switch (+)
T024	Wheel Lock Switch (+)
T015	To Reversing Buzzer
G010	To Frame Tail A

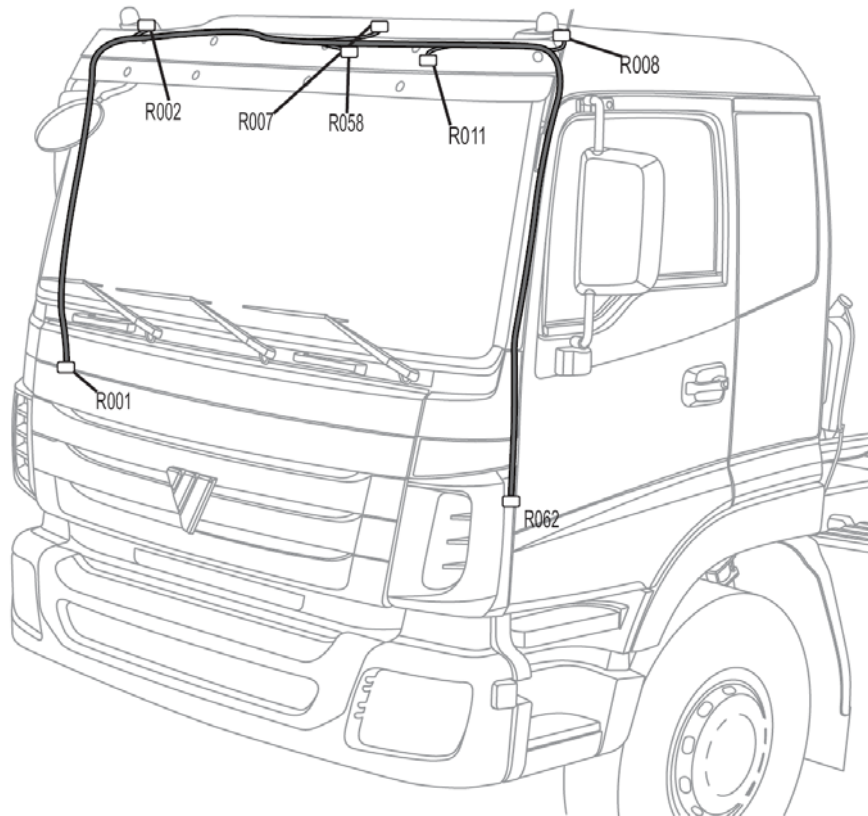
T013	To LH RR Combination Lamp
G011	To Frame Tail Ground Circuit B
T012	To RH RR Combination Lamp
T006	To Reversing Lamp
T003	To Side Marker Lamp Wiring Harness
T014	To RR Fog Lamp



X002	To Torque Extractor Switch
X001	To Frame Front Wiring Harness
X006	To Vehicle Speed Sensor

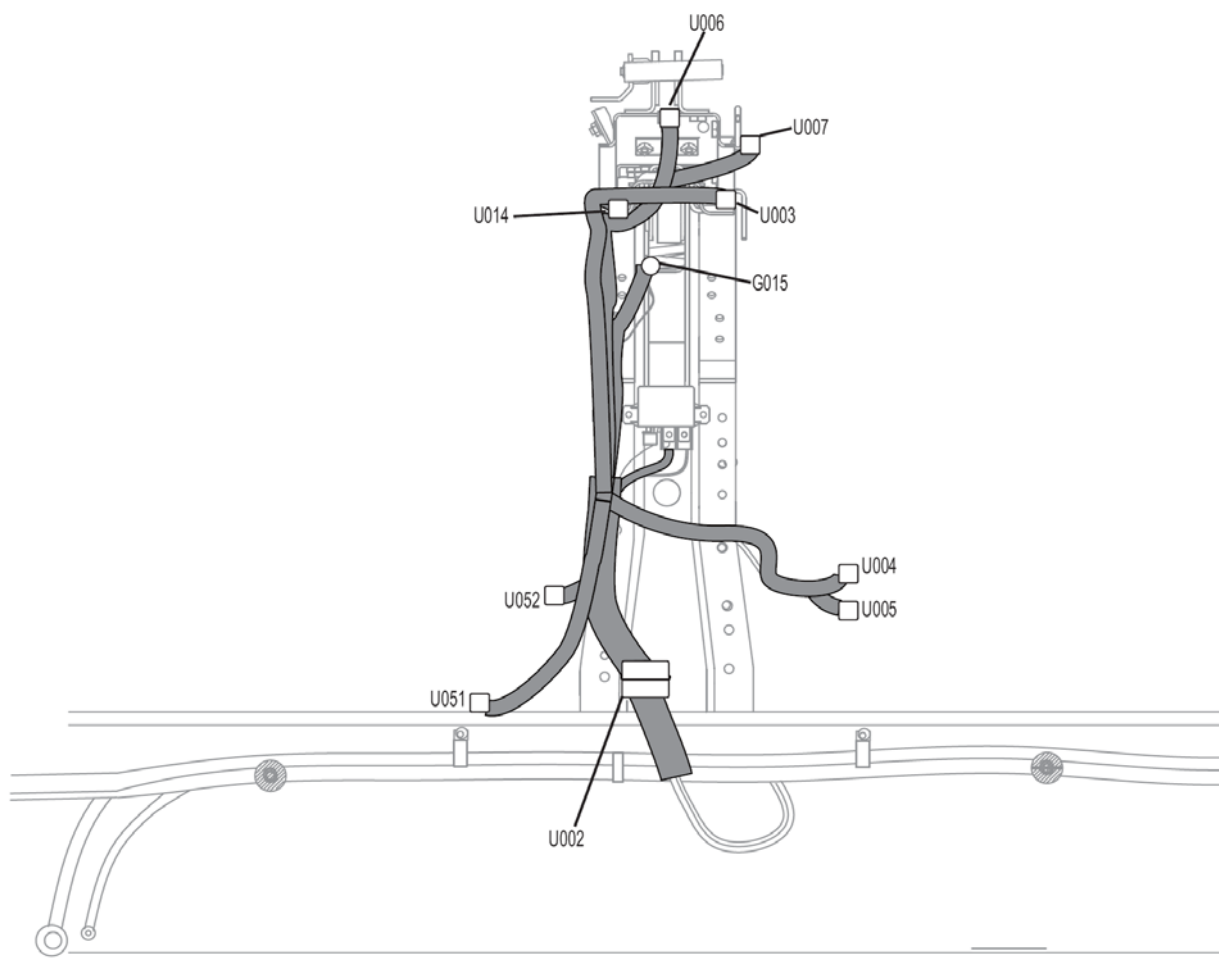
X004	To Reverse Gear Switch
X003	To Neutral Gear Switch

Circuit Diagram—Information On Wiring Harness Connector



R008	To LH Height Indicator
R062	To Body Wiring Harness B
R011	To Engine Diagnostic Switch
R007	To Interior Lamp

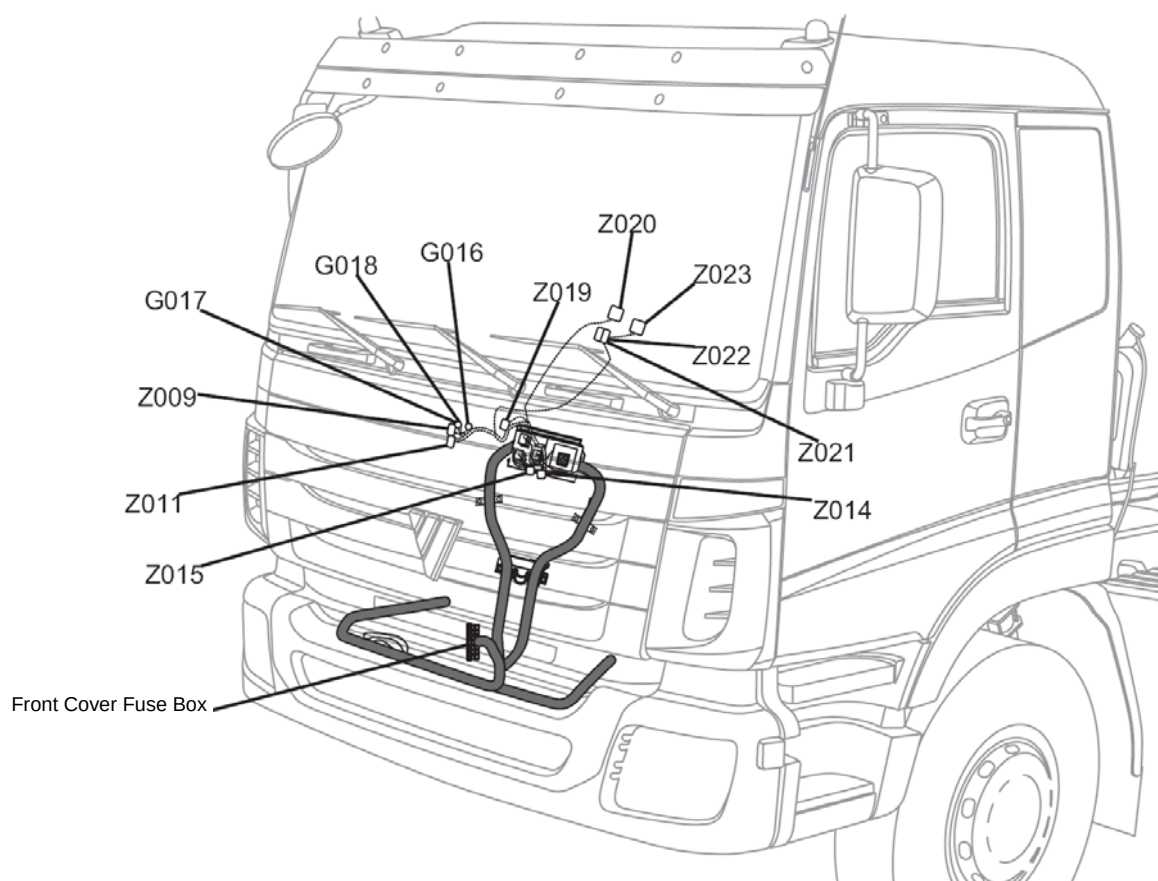
R058	To Driving Recorder
R001	To Body Wiring Harness A
R002	To RH Height Indicator



U004	To Air Filter (+)
U005	To Air Filter (-)
U052	To Dumping Gear Buzzer
G015	Dumping Gear Grounding
U002	To Frame Front Wiring Harness

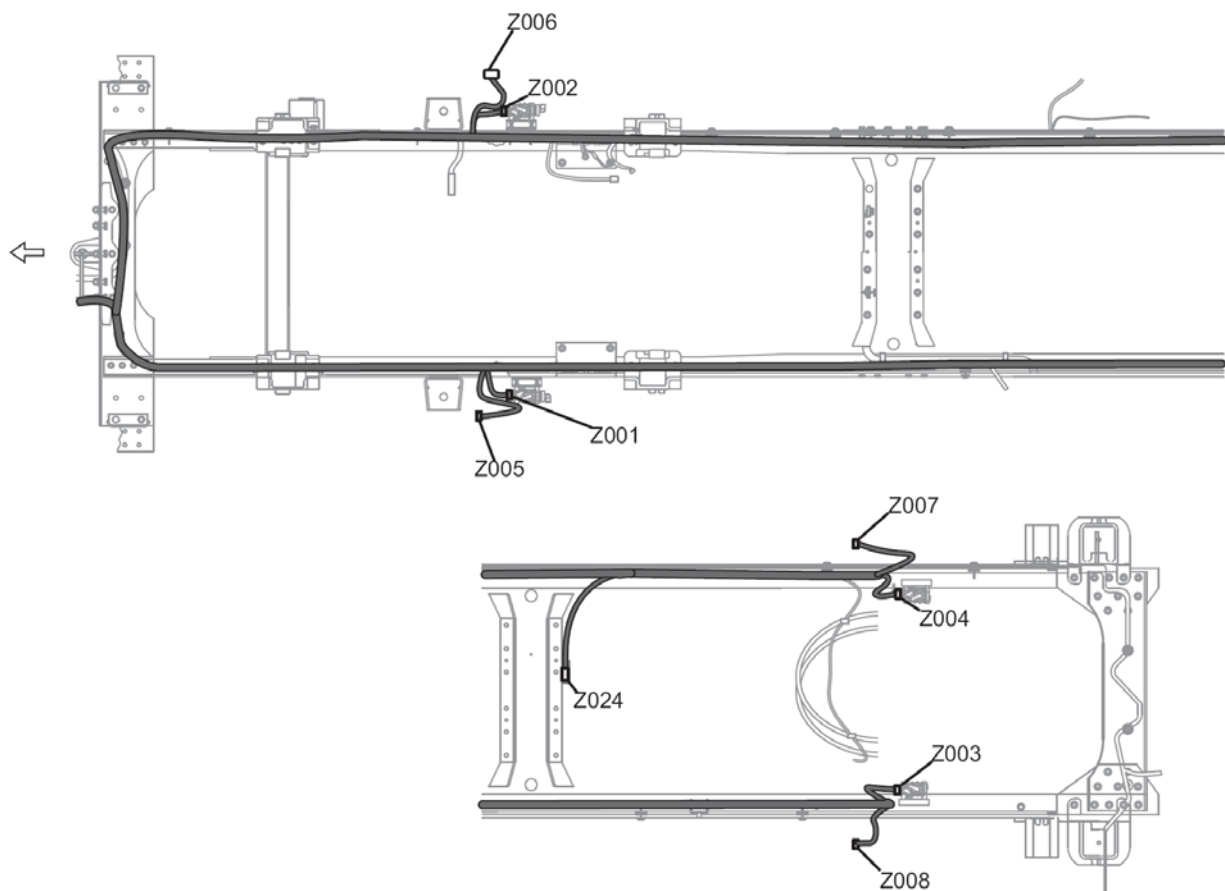
U003	To Engine Shutdown Switch
U051	To Bottom Dead Point
U014	To Engine Start Switch
U007	To Water Level Alarm Switch
U006	To Lock Switch

Circuit Diagram—Information On Wiring Harness Connector



Z014	To ABS
Z015	To ABS Body Wiring Harness
G016	Grounding
G017	Grounding
G018	Grounding
Z019	To ABS Chassis Wiring Harness

Z011	To ABS Module 1
Z020	To TPM Switch
Z021	Diagnostic Interface
Z022	Diagnostic Interface
Z023	Diagnostic Interface
Z009	To ABS Door Control Switch 1

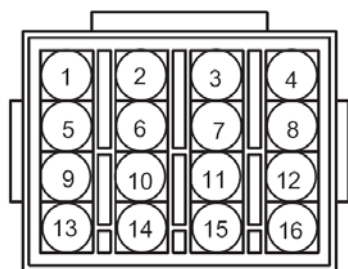


Z001	To LH FR ABS Solenoid Valve
Z002	To RH FR ABS Solenoid Valve
Z003	To LH RR ABS Solenoid Valve
Z004	To RH RR ABS Solenoid Valve
Z005	To LH FR ABS Wheel Speed Sensor

Z006	To RH FR ABS Wheel Speed Sensor
Z007	To LH RR ABS Wheel Speed Sensor
Z008	To RH RR ABS Wheel Speed Sensor
Z024	To ASR Solenoid Valve

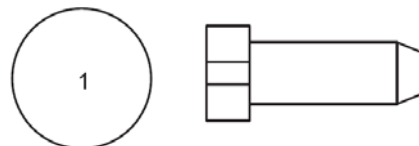
Information on Wiring Harness Connector

T001 To Frame Front Wiring Harness



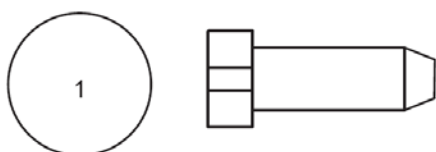
Pin No.	Wire Color	Feature	Remarks
1	G	Lighting Controller (L)	
2	G-Y	Feature	
3	G-B	Turn Flash Light (LL)	
4			Blocked
5	L-W	RR Fog Lamp Switch (L)	
6	G-W	Brake Lamp Relay (L)	
7	R-L	Reversing Relay (L)	
8			Blocked
9	W-B	Frame 1 Ground Circuit A	
10	W-B	Frame Ground Circuit A	
11	BR-W	Inter-axial Lock Indicator	
12	Br-Y	Wheel Lock Indicator Light	
13			Blocked
14			Blocked
15			Blocked
16			Blocked

To Inter-axial Lock Switch(+)



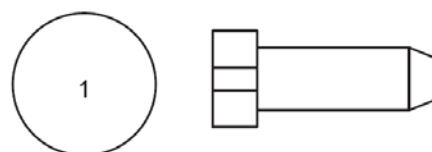
Pin No.	Wire Color	Feature	Remarks
1	Br-W	Inter-axial Lock Switch (B)	

T023 To Wheel Lock Switch (+)



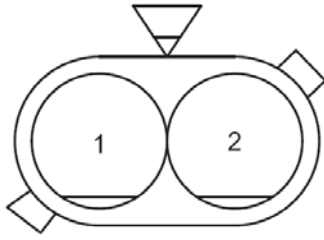
Pin No.	Wire Color	Feature	Remarks
1	Br-Y	Middle Inter-axial Lock Indicator Switch	

T024 To Wheel Lock Switch (-)



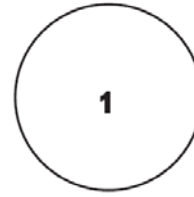
Pin No.	Wire Color	Feature	Remarks
1	Br-Y	RR Inter-axial Lock Indicator Switch	

T015 To Reversing Buzzer



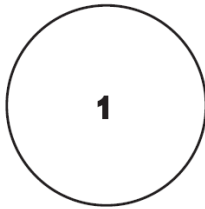
Pin No.	Wire Color	Feature	Remarks
1	R-L	Reversing Buzzer (B)	
2	W-B	Reversing Buzzer(E)	

G010 To Frame Tail Grounding A



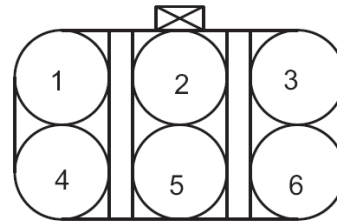
Pin No.	Wire Color	Feature	Remarks
1	W-B	Frame 2 Grounding A	

G011 To Frame Tail Grounding B



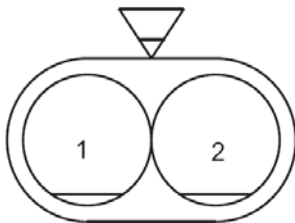
Pin No.	Wire Color	Feature	Remarks
1	W-B	Frame 2 Grounding B	

T012 To RH RR Combination Lamp



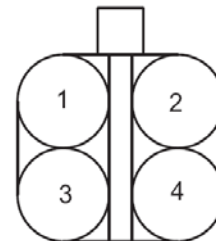
Pin No.	Wire Color	Feature	Remarks
1	G-W	RH RR Brake Lamp	
2	G	RH Taillight	
3	G-Y	RH RR Turn Signal Lamp	
4	W-B	Grounding	
5	R-L	RH RR Reversing Lamp	
6	L-W	RH Fog Lamp (B)	

T006 To Reversing Lamp



Pin No.	Wire Color	Feature	Remarks
1	R-L	Reversing Lamp	
2	W-B	Reversing Lamp (Grounding)	

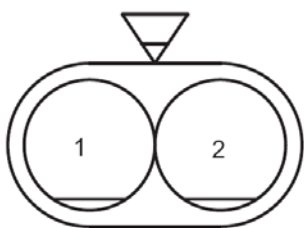
T003 To Side Marker Lamp Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	G	Marker Lamp	
2	WB	Marker Lamp (E)	
3	G	Marker Lamp	
4	WB	Marker Lamp (E)	

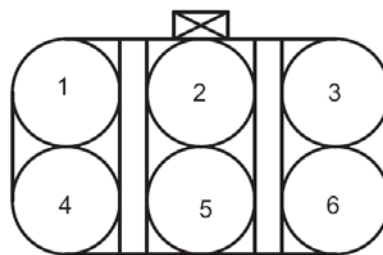
Circuit Diagram—Information On Wiring Harness Connector

T104 To RR Fog Lamp



Pin No.	Wire Color	Feature	Remarks
1	L-W	RR Fog Lamp (B)	
2	W-B	RR Fog Lamp (Grounding)	

T103 To LH RR Combination Lamp



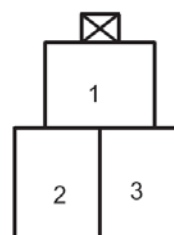
Pin No.	Wire Color	Feature	Remarks
1	G-W	LH RR Brake Lamp (B)	
2	G	LH RR Fog Lamp (B)	
3	G-B	LH RR Turn Signal Lamp (B)	
4	W-B	LH FR Combination Lamp (E)	
5	R-L	LH RR Reversing Lamp (B)	
6	L-W	LH RR Fog Lamp (B)	

F002 To Body Wiring Harness B



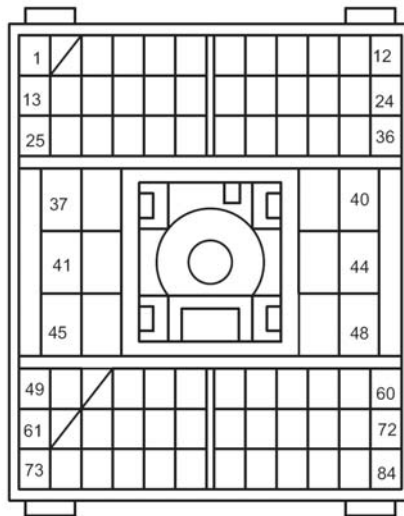
Pin No.	Wire Color	Feature	Remarks
1	W	Fan Motor Fuse (B)	
2	R	Side Lamp Fuse (B)	

F003 To Body Wiring Harness C



Pin No.	Wire Color	Feature	Remarks
1	W	Ignition Switch Fuse R/B	
2	B-Y	ECU Fuse	
3	W-B	Body Ground Circuit	

To Body Wiring Harness A

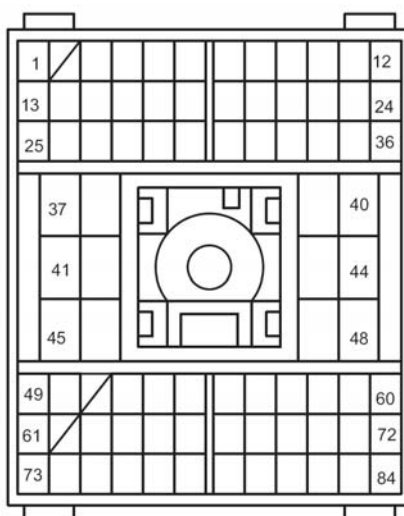


Pin No.	Wire Color	Feature	Remarks
1	GR-B	Vehicle Speed Instrument Output	
2	B-G		
3			Blank
4	W	Memory Fuse (B)	
5	L-W	RR Fog Lamp Switch (L)	
6	G-Y	Reversing Flasher (RL)	
7	G-B	Reversing Flasher (LL)	
8	W-L	Cruise Cancel Switch	
9	V	Cruise (+)	
10	R-B	Parking Distance Control Radar	
11	R-G	Parking Distance Control Radar	
12	Br-B	Engine Speed	
13	Lg	Torque Extractor Indicator Light	
14			Blank
15			Blank
16			Blank
17	G-W	LH Headlamp Controller	
18	Y-L	LH Headlamp (+)	
19	W-R	Wheel Lock Switch	
20	R-W	Inter-axial Lock Switch	
21	G-R	Cruise (-)	
22	L-B	Exhaust Brake Switch	
23	G-W	Pressure Switch (-)	
24	Y-G	Instrument Water Temperature Indicator	
25	Lg-R	Neutral Gear Torque Extractor Switch	

Pin No.	Wire Color	Feature	Remarks
26	G	Torque Extractor Switch	
27	W-R	Instrument Charging Switch	
28	Y-G	Instrument Water Temperature Indicator	
29	B-L	Air Filter Blockade Alarm Indicator Light	
30	O-L	Diagnostic Indicator Lamp (-)	
31	Br-W	Inter-axial Lock Indicator Light	
32	Br-Y	Wheel Lock Indicator Light	
33	W-R	Cruise Recovery	
34	G-R	Turn Flash Light (54L)	
35	G-L	Turn Flash Light (54R)	
36	Y-R	Fuel Sensor (+)	
37	R	Tractor Wiring Harness	
38	W-R	To F15 Fuse	
39			Blank
40			Blank
41	W-L	Body Wiring Harness Interface	
42			Blank
43			Blank
44			Blank
45			Blank
46	W-B	Instrument Sensor Grounding	
47	G	Tail Lamp Relay (L)	
48	W	Main ECU Fuse	
49	W-R	High-low Gear Indicator	
50	Y-L	Instrument Water Level Alarm	

Circuit Diagram—Information On Wiring Harness Connector

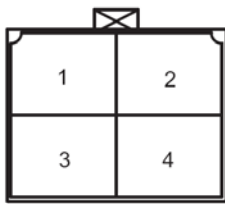
To Body Wiring Harness A



Pin No.	Wire Color	Feature	Remarks
51			Blank
52	W-G	Accelerator Pedal	
53	P-L	Accelerator Pedal	
54	P-G	Accelerator Pedal	
55	Y-B	Oil Pressure Instrument Indicator	
56	B-R	Brake Switch	
57	Gr	Reversing Lamp Relay	
58	B-L	CANH	
59	W-Y	CANL	
60	R-W	Diagnostic Requirement Switch	
61	R-W	Instrument CAB Lock Alarm Indicator Light	
62			Blank
63	R-W	Body Connector	
64	R-L	Brake Lamp Switch	
65	R-L	ECU 1.25	
66	Y-W	Diagnostic Interface	
67	Gr-B	Accelerator Pedal	

Pin No.	Wire Color	Feature	Remarks
68	Lg-B	Accelerator Pedal	
69	W-Y	Accelerator Pedal (SL)	
70	Gr-W		
71	Gr	Instrument 12V Output	
72	B-L	Air Conditioner Switch	
73	B-O	50 Electricity	
74	L-Y	Clutch Switch	
75	G-W	Horn Relay (L)	
76	R-L	Reversing Relay (-S)	
11	Lg	ECU 1.24	
78	W-L	IG Power Supply	
79	L-Y	Tractor Wiring Harness	
80	R-G	Three-state Switch	
81	B	Air Conditioner Approval Relay	
82	V-W	Oil-water Separator Indicator	
83	Y-R	Instrument Preheating Indicator	
84	R-Y	Three-state Switch	

F063 To ABS



Pin No.	Wire Color	Feature	Remarks
1	B-Y	Trailer ABS 15 Fuse (B)	
2	B-L	Trailer ABS Warning Lamp	
3			Blank
4	B-W	Trailer ABS Socket	

F006 To High Tone Loudspeaker



Pin No.	Wire Color	Feature	Remarks
1	W-B	Low Tone Loudspeaker (L)	
2	G-W	Low Tone Loudspeaker (B)	

G064 Frame Front Grounding D



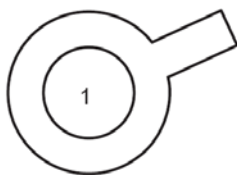
Pin No.	Wire Color	Feature	Remarks
1	W-B	Chassis Wiring Harness Grounding Point D	

G062 Frame Front Grounding C



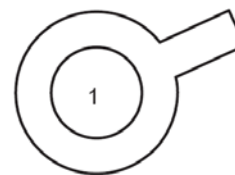
Pin No.	Wire Color	Feature	Remarks
1	W-B	1#Chassis Grounding C	

G008 Frame Front Grounding A



Pin No.	Wire Color	Feature	Remarks
1	W-B	1#Chassis Grounding A	

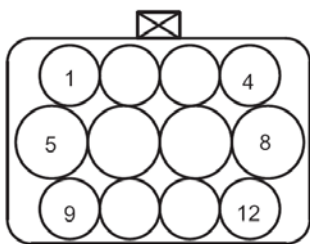
G009 Frame Front Grounding B



Pin No.	Wire Color	Feature	Remarks
1	W-B	1#Chassis Grounding B	

Circuit Diagram—Information On Wiring Harness Connector

F099 To Engine Wiring Harness



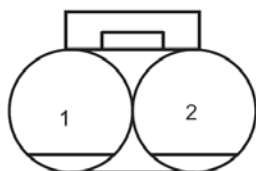
Pin No.	Wire Color	Feature	Remarks
1	W-R		
2			Blocked
3	Y-G	Water Temperature Sensor (+)	
4	Y-B	Oil Pressure Sensor (+)	
5			Blocked
6	G-W	Compressor	
7	VV-B	Oil Pressure Sensor (-)	
8			Blocked
9			Blocked
10			Blocked
11			Blocked
12			Blocked

F032 To (B+)



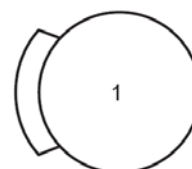
Pin No.	Wire Color	Feature	Remarks
1			Blocked
2	W	Generator (+)	

F015 To Starter Relay Coil



Pin No.	Wire Color	Feature	Remarks
1	B-O	Starter Relay Coil 86	
2	G	Starter Relay Coil 85	

F017 To Memory Power Source



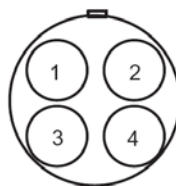
Pin No.	Wire Color	Feature	Remarks
1	W	Power Main Switch (+)	

F019 To Starter



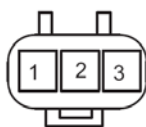
Pin No.	Wire Color	Feature	Remarks
1	B-G	Starter (B)	

F041 To Oil-water Separator Sensor



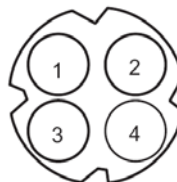
Pin No.	Wire Color	Feature	Remarks
1			Blank
2	R	Oil-water Separator Sensor (+)	
3	L	Oil-water Separator Sensor Signal	
4	W-B	Oil-water Separator Sensor (-)	

F013 To Fuel Coarse Filter and Heater



Pin No.	Wire Color	Feature	Remarks
1	W-L	Fuel Coarse Filter and Heater Power Supply	
2			Blocked
3	W-B	Fuel Coarse Filter and Heater Grounding	

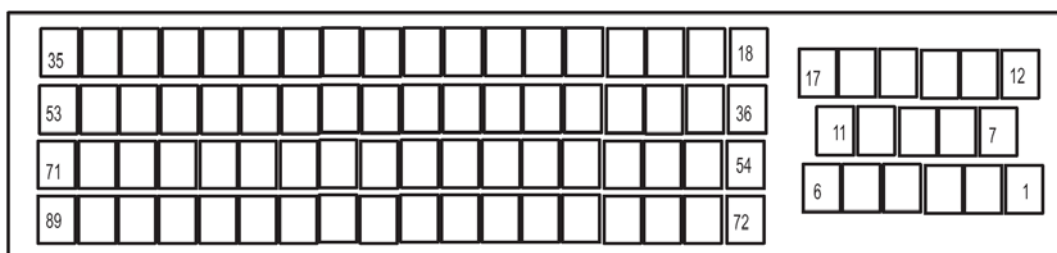
F043 Electrical Control Unit (Interface)



Pin No.	Wire Color	Feature	Remarks
1	B	Exhaust Brake Solenoid Valve	
2	L-B	Exhaust Brake Switch	
3	L-Y	Power Supply 24V	
4	L-W	Air Conditioner Relay	

Circuit Diagram—Information On Wiring Harness Connector

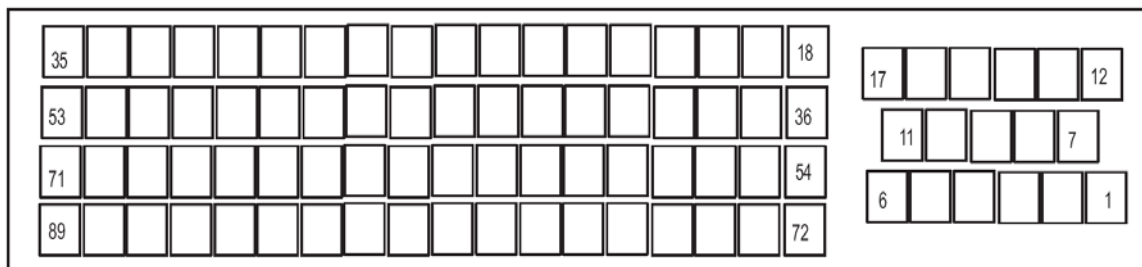
F040 To Electrical Control Unit ECU A



Pin No.	Wire Color	Feature	Remarks
1			Blocked
2	w	ECU	
3	w	ECU	
4	R	ECU24V	
5	W-B	Battery Negative Grounding 3	
6	W-B	Battery Negative Grounding 4	
7			Blocked
8	W	ECU	
9	w	ECU	
10	W-B	Battery Negative Grounding 1	
11	W-B	Battery Negative Grounding 2	
12			Blocked
13			Blocked
14			Blocked
15			Blocked
16			Blocked
17			Blocked
18			Blocked
19			Blocked
20			Blocked
21			Blocked
22	Y-L	Fault Diagnostic Indicator Light (Code Flasher)	
23			Blocked
24	Lg	PTO Switch -	
25	R-L	PTO Switch +	
26			Blocked
27			Blocked
28			Blocked
29	Br-R	5V Circuit Grounding Terminal	
30	O-L	Fault Diagnostic Indicator Light (Code Flasher)	

Pin No.	Wire Color	Feature	Remarks
31	V	Cruise (+)	
32	L	Bottom Start Engine Switch	
33	Br-B	Dashboard Engine Speed Indicator	
34	W-Y	CAN Bus Output	
35	B-L	CAN Bus Output	
36			Blocked
37	B-O	Starter Relay Coil	
38	Y-R	Cold Start Indicator Light	
39	Y-G	Alarm Indicator Light	
40	W-R	Key Switch T15	
41	R-L	Main Brake Switch	
42	B-L	Air Conditioner Switch	
43	L	Fuel Coarse Filter Water Alarm Sensor	
44			Blocked
45			Blocked
46	W-G	Cruise Control/PTO Power Output Control Switch	
47	Br	Bottom Stop Engine Switch	
48			Blocked
49	B-R	Auxiliary Brake Switch	
50			Blocked
51	G	Starter Relay	
52			Blocked
53			Blocked
54			Blocked
55	W	Intake Heater Relay	
56	V-W	Fuel Coarse Filter Water Alarm Sensor	
57			Blocked
58			Blocked
59	V	Intake Heater Relay	
60			Blocked

F040 To Electrical Control Unit ECU A



Pin No.	Wire Color	Feature	Remarks
61	B-O	Key Start Switch T50	
62	R-G	Torque Limit Switch Signal End (Selectable)	
63			Blocked
64	G-R	Cruise Control/PTO Power Output Control	
65	R-Y	Torque Limit Switch Grounding Terminal (Selectable)	
66	L-Y	Clutch Switch	
67			Blocked
68			Blocked
69			Blocked
70	B-W	Vehicle Speed Sensor Grounding Terminal	
71	Gr-B	Vehicle Speed Sensor Signal Terminal	
72	R-W	Fault Diagnostic Switch	
73			Blocked
74	VV-L	Cruise Control/PTO Power Output Control	
75			Blocked

Pin No.	Wire Color	Feature	Remarks
76	W-Y	Accelerator Pedal Sensor APP2 Grounding Terminal	
77	W-G	Accelerator Pedal Sensor APP 1.5V Terminal	
78	P-G	Accelerator Pedal Sensor APP1 Grounding Terminal	
79	P-L	Accelerator Pedal Sensor APP1 Signal Terminal	
80	Lg-B	Accelerator Pedal Sensor APP2 Signal Terminal	
81			Blocked
82			Blocked
83			Blocked
84	Gr-B	Accelerator Pedal Sensor APP2 1.5V Terminal	
55	W	Gearbox Neutral Gear Protection Switch	
86			Blocked
87			Blocked
88			Blocked
89	Y-W	Diagnostic Interface K Wire	

Circuit Diagram—Information On Wiring Harness Connector

G020 Frame Front Grounding A



Pin No.	Wire Color	Feature	Remarks
1	W-B	Instrument Sensor Grounding	

G021 Frame Front Grounding C



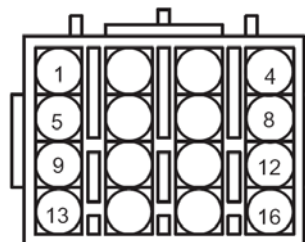
Pin No.	Wire Color	Feature	Remarks
1	W-B		

G022 Frame Front Grounding



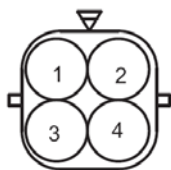
Pin No.	Wire Color	Feature	Remarks
1	W-B	2#Chassis Grounding B	

G023 To Dumping Gear Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	B-W	Engine Start Switch (-)	
2			Blocked
3	R	Dumping Gear Buzzer (+)	
4	B-L	Air Filter	
5	B-W	CAB Indicator Light Switch	
6			Blocked
7	L	Engine Start Switch (+)	
8	Y-L	Water Level Alarm Switch (+)	
9			Blocked
10			Blocked
11			Blocked
12			Blocked
13			Blocked
14	Br	Engine Shutdown Switch (+)	
15	Br-R	Engine Shutdown Switch (-)	
16			Blocked

F060 To Trailer ABS A



Pin No.	Wire Color	Feature	Remarks
1	B-L	Trailer ABS Socket	
2	BO	Trailer ABS Socket	
3	W-B	Trailer ABS ECU (-)	
4			Blocked

F061 To Trailer



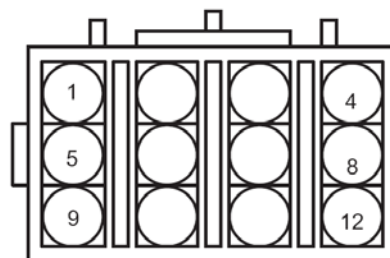
Pin No.	Wire Color	Feature	Remarks
1	B-W	Trailer ABS Socket	
2	W-B	Trailer ABS (-)	

F016 To Preheater Relay (Coil)



Pin No.	Wire Color	Feature	Remarks
1	V	Preheater Relay Coil	
2	W	Preheater Relay Coil	

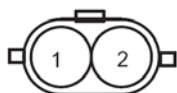
F026 To Gearbox Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	Gr	Reverse Gear Switch +	
2	W	Neutral Gear Switch (-)	
3	B-O	Neutral Gear Switch (+)	
4	W-R	Gear Position Switch +	
5	Lg	Torque Extractor Switch	
6	Gr-W	Vehicle Speed Sensor (SI)	
7	Gr	Vehicle Speed Sensor (IG)	
8	G-W	Reverse Gear Switch-	
9			Blocked
10	R-W	Gearbox Connector	
11	W-B	Gear Position Switch -	
12	B	Vehicle Speed Sensor Grounding	

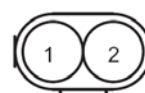
Circuit Diagram—Information On Wiring Harness Connector

F030 To Fuel Sensor



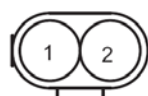
Pin No.	Wire Color	Feature	Remarks
1	W-B	Fuel Sensor (-)	
2	Y-R	Instrument Fuel Indicator	

F029 To Exhaust Solenoid Valve



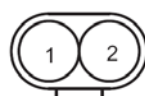
Pin No.	Wire Color	Feature	Remarks
1	L-Y	Exhaust Brake Solenoid Valve (+)	
2	B	Exhaust Brake Solenoid Valve (-)	

F028 To Wheel Lock Solenoid Valve



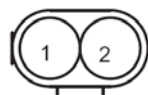
Pin No.	Wire Color	Feature	Remarks
1	W-R	Wheel Lock Solenoid Valve +	
2	W-B	Wheel Lock Solenoid Valve (-)	

F035 To Inter-axial Lock Solenoid Valve



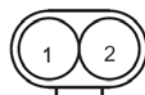
Pin No.	Wire Color	Feature	Remarks
1	R-W	Inter-axial Lock Solenoid Valve +	
2	W-B	Inter-axial Lock Solenoid Valve -	

F050 To Neutral Gear Solenoid Valve



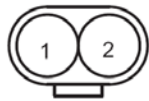
Pin No.	Wire Color	Feature	Remarks
1	Lg-R	Neutral Gear Torque Extraction Solenoid Valve +	
2	W-B	Solenoid Valve Grounding	

F031 To PTO Solenoid Valve



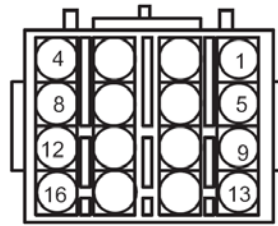
Pin No.	Wire Color	Feature	Remarks
1	G	Torque Extractor Solenoid Valve	
2	W-B	Solenoid Valve Grounding	

F055 To Dryer



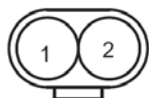
Pin No.	Wire Color	Feature	Remarks
1	Y-G	Dryer (+)	
2	W-B	Dryer (-)	

F034 To Frame Tail Wiring Harness



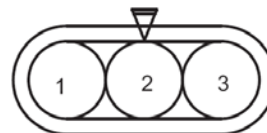
Pin No.	Wire Color	Feature	Remarks
1	G	RH RR Marker Lamp (B)	
2	G-Y	RH RR Turn Signal Lamp (B)	
3	G-B	LH RR Turn Signal Lamp (B)	
4	G-R	Trailer LH Turn Signal Lamp (Flat Truck)	
5	L-W	RR Fog Lamp (B)	
6	G-W	RH RR Brake Lamp (B)	
7	R-L	Trailer Reversing Lamp	
8	G-L	Trailer RH Turn Signal Lamp (Flat Truck)	
9	W-B	Frame 2 Grounding	
10	W-B	Frame 2 Grounding	
11	Br-W	Inter-axial Lock Indicator Light Switch	
12	Br-Y	Wheel Lock Indicator Light Switch	
13	R-B	Parking Distance Control Radar Control Box	
14	R-G	Parking Distance Control Radar Control Box	
15			Blocked
16			Blocked

X002 To Torque Extractor Switch



Pin No.	Wire Color	Feature	Remarks
1	Lg	Torque Extraction Switch (+)	
2	W-B	Torque Extraction Switch (-)	

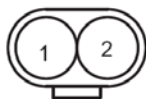
X006 To Vehicle Speed Sensor



Pin No.	Wire Color	Feature	Remarks
1	Gr-W	Vehicle Speed Sensor	
2	W-B	Vehicle Speed Sensor (E)	
3	Gr	Vehicle Speed Sensor (IG)	

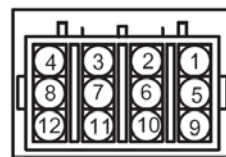
Circuit Diagram—Information On Wiring Harness Connector

X004 To Reverse Gear Switch



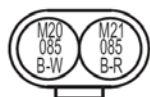
Pin No.	Wire Color	Feature	Remarks
1	R	Reverse Gear Switch (+)	
2	G-W	Reverse Gear Switch (-)	

X001 To Frame Front Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	R	Reversing Lamp Relay	
2	B-R	Gearbox Neutral Gear Protection Switch	
3	B-W	ECU 24V Positive Output	
4			Blocked
5	Lg	Torque Extraction Indicator Light	
6	Gr-W	Instrument (SI)	
7	Gr	Instrument 12V Output	
8	G-W	Body Ground Circuit	
9			Blocked
10		To Shielding Layer	
11	W-B	Body Ground Circuit	
12	W-B	Vehicle Speed Sensor Grounding Terminal	

X003 To Neutral Gear Switch



Pin No.	Wire Color	Feature	Remarks
1	B-W	Neutral Gear Switch (+)	
2	B-R	Neutral Gear Switch (-)	

U004 To Air Filter (+)



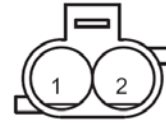
Pin No.	Wire Color	Feature	Remarks
1	B-I	Air Filter -	

U005 To Air Filter (-)



Pin No.	Wire Color	Feature	Remarks
1	W-B	Air Filter (-)	

U052 To Dumping Gear Buzzer



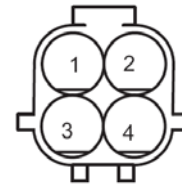
Pin No.	Wire Color	Feature	Remarks
1	R	Dumping Gear Buzzer (+)	
2	W	Dumping Gear Buzzer (-)	

G015 Dumping Gear Grounding



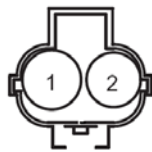
Pin No.	Wire Color	Feature	Remarks
1	W-B	Dumping Gear Grounding	

U051 To Bottom Dead Point Switch



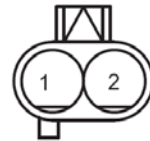
Pin No.	Wire Color	Feature	Remarks
1			Blocked
2			Blocked
3	W	Bottom Dead Point Switch (+)	
4	W-B	Bottom Dead Point Switch (-)	

U003 To Engine Shutdown Switch



Pin No.	Wire Color	Feature	Remarks
1	L	Engine Shutdown Switch (+)	
2	B-W	Engine Shutdown Switch (-)	

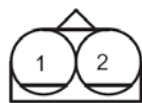
U014 To Engine Start Switch



Pin No.	Wire Color	Feature	Remarks
1	L	Engine Start Switch (+)	
2	B-W	Engine Start Switch (-)	

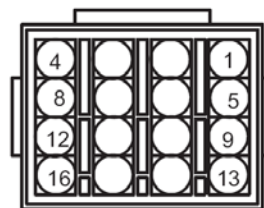
Circuit Diagram—Information On Wiring Harness Connector

U007 To Water Level Alarm Switch



Pin No.	Wire Color	Feature	Remarks
1	Y-L	Water Level Alarm Switch +	
2	W-B	Water Level Alarm Switch	

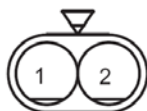
U002 To Frame Front Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	B-W	5V Circuit Grounding Terminal	
2			Blocked
3	R	To Frame Wiring Harness 1	
4	B-L	Instrument Cluster	
5	B-W	Instrument Cluster	
6			Blocked
7	L	Bottom Start Engine Switch	
8	Y-L	Instrument Cluster	
9			Blocked
10			Blocked
11			Blocked
12			Blocked
13			Blocked
14	Br	Bottom Stop Engine Switch	
15	Br-R	5V Circuit Grounding Terminal	
16			Blocked

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U006 To Lock Switch



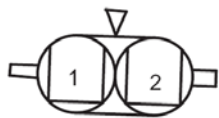
Pin No.	Wire Color	Feature	Remarks
1	B-W	Cab Lock Alarm Switch	
2	W-B	Cab Lock Alarm Switch	

E009 To Compressor



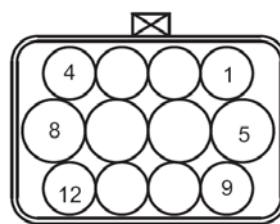
Pin No.	Wire Color	Feature	Remarks
1	G-W	Compressor (+)	

E014 Connected with (+B)



Pin No.	Wire Color	Feature	Remarks
1	B	Engine (B+)	
2			Blocked

E001 To Frame Front Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	W-R	Engine (D+)	
2	G-0	Water Temperature Alarm Indicator Light	
3	Y-G	Water Temperature Sensor (+)	
4	Y-B	Oil Pressure Instrument Indicator	
5	G	Instrument Cluster Speed Signal	
6	G-W	Pressure Switch (-)	
7	B-R	Oil Pressure Alarm Indicator Light	
8			Blocked
9			Blocked
10			Blocked
11			Blocked
12			Blocked

E008 To Oil Pressure Sensor (+)



Pin No.	Wire Color	Feature	Remarks
1	Y-B	Oil Pressure Sensor (+)	

E007 To Oil Pressure Alarm Switch



Pin No.	Wire Color	Feature	Remarks
1	B-R	Oil Pressure Sensor Switch	

Circuit Diagram—Information On Wiring Harness Connector

E011 To Water Temperature Alarm Switch



Pin No.	Wire Color	Feature	Remarks
1	G-O	Water Temperature Sensor Switch	

To Water Temperature Sensor (+)



Pin No.	Wire Color	Feature	Remarks
1	Y-G	Instrument Water Temperature Indicator	

E013 To Generator (D+)



Pin No.	Wire Color	Feature	Remarks
1	W-R	Instrument Charging Indicator	

E015 To Generator (W)



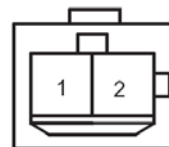
Pin No.	Wire Color	Feature	Remarks
1	G	Generator (W)	

E012 To Generator (+B)



Pin No.	Wire Color	Feature	Remarks
1	B	Generator (B+)	

F008 To LH Height Indicator



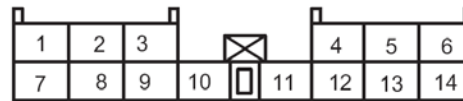
Pin No.	Wire Color	Feature	Remarks
1	G	LH Height Indicator (+)	
2	W-B	LH Height Indicator (-)	

R011 To Engine Diagnostic Switch



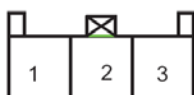
Pin No.	Wire Color	Feature	Remarks
1			Blank
2	W-R	Diagnostic Switch (+)	
3			Blank
4	R-W	Diagnostic Switch (-)	
5			Blank
6			Blank
7	W-B	Diagnostic Illuminating Lamp	
8	050	Diagnostic Switch Lighting	

R062 To Body Wiring Harness B



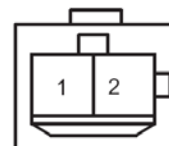
Pin No.	Wire Color	Feature	Remarks
1	G-W	Brake Lamp Relay 87	
2	G-B	Flash Light	
3	G-Y	Flash Light	
4	L	FR Fog Lamp Relay	
5	R-W	Upper Beam	
6			
7	Br-Y	Wiper H	
8	Br-W	Wiper L	
9	R-L	Reversing Lamp Relay (87)	
10	Gr-W	Vehicle Speed Sensor,	
11	Y-R	Roof Interface	
12	R-Y	LH Door Control Switch	
13	L-W	RR Fog Lamp Relay	
14	W-B	Driving Recorder	

R007 To Interior Lamp



Pin No.	Wire Color	Feature	Remarks
1	L-Y	RH Interior Lamp (+)	
2	W-B	Interior Lamp -	
3	R-Y	RH Interior Lamp	

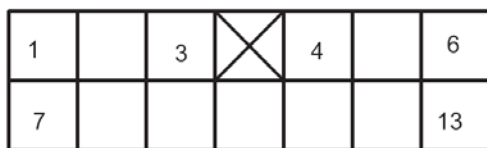
R002 To RH Height Indicator



Pin No.	Wire Color	Feature	Remarks
1	G	RH Height Indicator (+)	
2	W-B	RH Height Indicator (-)	

Circuit Diagram—Information On Wiring Harness Connector

R058 To Driving Recorder



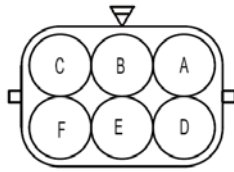
R001 To Body Wiring Harness A



Pin No.	Wire Color	Feature	Remarks
1	R-Y	Driving Recorder (Door)	
2	R-W	Driving Recorder	
3	L	Driving Recorder	
4	G-Y	Driving Recorder (Right Turning)	
5	G-B	Driving Recorder (Left Turning)	
6	G-W	Driving Recorder (Brake)	
7	VV-B	Driving Recorder (-)	
8	Y-R	Driving Recorder (Normal Power)	
9	Br-Y	Driving Recorder	
10	Br-W	Driving Recorder	
11	Gr-W	Driving Recorder (Speed)	
12	R-L	Driving Recorder (Reversing)	
13	L-W	Driving Recorder	

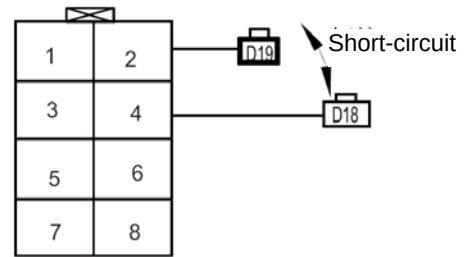
Pin No.	Wire Color	Feature	Remarks
1			Blank
2			Blank
3			Blank
4			Blank
5			Blank
6			Blank
7			Blank
8			Blank
9			Blank
10	R-Y	Door Control Switch	
11	W-B	Body Ground Circuit	
12			Blank
13			Blank
14	R-G	Body Interface	
15	R-W	Fault Diagnostic Switch	
16	VV-R	ECU 24V Positive Output	
17			Blank
18			Blank
19			Blank
20			Blank
21			Blank
22	L-Y	Interior Lamp Fuse	

B136 To Electronic Throttle



Pin No.	Wire Color	Feature	Remarks
A	B	Electronic Throttle, Twisted Tri-wire	
B	G	Electronic Throttle, Twisted Tri-wire	
C	R	Electronic Throttle, Twisted Tri-wire	
D	V	Electronic Throttle, Twisted Tri-wire	
E	O	Electronic Throttle, Twisted Tri-wire	
F	W	Electronic Throttle, Twisted Tri-wire	

B202 To Interior Lamp Switch



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	R Y	Interior Lamp Switch (-)	
3			Blank
4	R Y	Interior Lamp Switch	
5			Blank
6	W-B	Interior Lamp Switch, Grounding	
7	W-B	Interior Lamp Switch Lighting (-)	
8	P-G	Interior Lamp Switch (ILL+)	

B083 To Wheel Differential Switch



Pin No.	Wire Color	Feature	Remarks
1	B-R	Wheel Operation Indicator Light +	
2	W-R	Lock Switch Between Wheels (+)	
3			Blank
4	G	Inter-axial Differential Switch (+)	
5	Br-Y	Wheel Lock Indicator Light	
6			Blank
7	W-B	Wheel Lock Switch Lighting, Grounding	
8	R-G	Wheel Lock Switch (ILL+)	

B084 Inter-axial Differential Switch



Pin No.	Wire Color	Feature	Remarks
1	B-R	Shaft Operation Indicator Light +	
2	R-W	Inter-axial Lock Switch (-)	
3			Blank
4	G	Inter-axial Lock Switch (B)	
5	Br-W	Inter-axial Lock Solenoid Valve Switch (+)	
6			Blank
7	W-B	Inter-axial Lock Switch Lighting, Grounding	
8	R-G	Inter-axial Lock Switch (ILL+)	

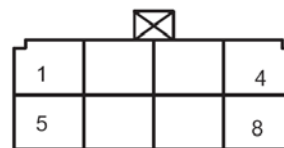
Circuit Diagram—Information On Wiring Harness Connector

B077 To RR Fog Lamp Switch



Pin No.	Wire Color	Feature	Remarks
1	W-L	RR Fog Lamp Indicator Light (L)	
2	Y-B	RR Fog Lamp Switch (L)	
3			Blank
4	R	RR Fog Lamp Switch (B)	
5	W-B	RR Fog Lamp Operation Indicator Light -	
6			Blank
7	W-B	RR Fog Lamp Switch, Grounding	
8	R-G	RR Fog Lamp Switch (ILL+)	

B019 To Air Flow Switch



Pin No.	Wire Color	Feature	Remarks
1	Y	Air Flow Switch	
2	G	Air Flow Switch	
3	L	Air Flow Switch	
4	L	Air Flow Switch	
5	W-B	Air Flow Switch (Grounding)	
6	R-B	Air Flow Switch	
7	L-B	Air Flow Switch	
8	R-G	Air Flow Switch (ILL+)	

B095 To Air Conditioner



Pin No.	Wire Color	Feature	Remarks
1	L-B	Air Conditioner Control Module	
2	L	Air Conditioner Control Module	
3	W-B	Air Conditioner Control Module	
4	R-G	Air Conditioner Control Module (ILL+)	
5	Y	Air Conditioner Control Module	
6	Br	Air Conditioner Control Module	
7	R	Air Conditioner Control Module	
8	G	Air Conditioner Control Module	
9	R-Y	Air Conditioner Control Module	

B005 To Cigarette Lighter (+)



Pin No.	Wire Color	Feature	Remarks
1	G-O	Cigarette Lighter (+)	

B006 To Cigarette Lighter (-)



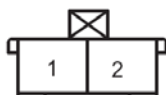
Pin No.	Wire Color	Feature	Remarks
1	W-B	Cigarette Lighter, Grounding	

B004 To Cigarette Lighter Lighting



Pin No.	Wire Color	Feature	Remarks
1	W-B	Cigarette Lighter Lighting, Grounding	
2	G	Cigarette Lighter Lighting (+)	

B160 To Seat Belt Pretensioner Switch



Pin No.	Wire Color	Feature	Remarks
1	W-B	Seat Belt Pretensioner (-)	
2	B	Seat Belt Pretensioner (L)	

B112 To LH Door Control Switch



Pin No.	Wire Color	Feature	Remarks
1	R-Y	Door Control Switch	

Circuit Diagram—Information On Wiring Harness Connector

B088 To Remote Throttle



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	R-L	Remote Throttle Switch +	
3			Blank
4	Lg	Remote Throttle Switch -	
5			Blank
6			Blank
7	W-B	Throttle Switch Indicator Light, Grounding	
8	R-G	Throttle Switch (ILL+)	

B099 To Electric/Air Horn Switch



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	W-B	Electric/Air Changeover Switch, Grounding	
3			Blank
4	Br-R	Electric/Air Changeover Switch (B)	
5			Blank
6			Blank
7	W-B	Electric/Air Changeover Switch Lighting, Grounding	
8	R-G	Cruise Cancel Switch Lighting	

B098 To RR Lighting Switch



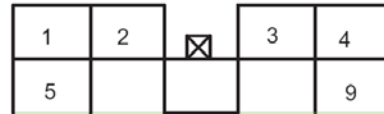
Pin No.	Wire Color	Feature	Remarks
1	G	Interior Lamp	
2	G	RR Lighting Switch (-)	
3			Blank
4	L-Y	RR Lighting Switch (+)	
5	W-B	RR Lighting Operation Indicator Light -	
6			Blank
7	W-B	RR Illuminating Lamp Switch Lighting, Grounding	
8	R-G	RR Illuminating Lamp Switch (ILL+)	

B085 To ABS Diagnostic Switch



Pin No.	Wire Color	Feature	Remarks
1		Blank	
2	W-B		
3			Blank
4	P	ABS Diagnostic Switch	
5			Blank
6			Blank
7	W-B		
8	R-G	ABS Diagnostic Switch (ILL+)	

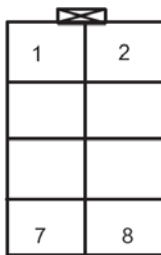
B082 To Auxiliary Gearbox Neutral Gear Torque Extraction Switch B145 To ABS Wiring Harness



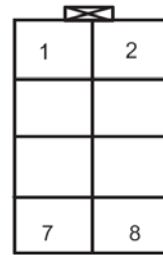
Pin No.	Wire Color	Feature	Remarks
1		Auxiliary Gearbox Neutral Gear Switch (-)	
2	Lg-R		Blank
3			Blank
4	L-B	Auxiliary Gearbox Neutral Gear Torque Extraction Switch (+)	
5			Blank
6			Blank
7	W-B	Auxiliary Gearbox Neutral Gear Lighting Switch, Grounding	
8	R-G	Auxiliary Gearbox Neutral Gear Torque Extraction (ILL+)	

Pin No.	Wire Color	Feature	Remarks
1	B	ABS ECU (UB1)	
2	G	Tractor ABS Interface, SAE J1939 (B)	
3	W-B	ABS, Central Ground	
4	B-Y	ABS ECU (B)	
5	B-Y	ABS ECU (WL)	
6	W	Tractor ABS Interface, SAE J1939 (A)	
7	B-W	ABS Diagnostic Interface (30)	
8	P	Tractor ABS Interface	
9			Blank

B104 To Cruise Recovery Switch



B137 To Cruise (+)

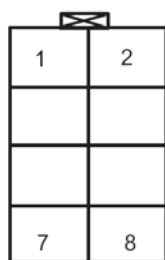


Pin No.	Wire Color	Feature	Remarks
1			Blank
2	W-G	Cruise Recovery Switch	
3			Blank
4	W-R	Cruise Recovery Switch	
5			Blank
6			Blank
7	W-B	Cruise Recovery Switch Lighting, Grounding	
8	R-G	Cruise Recovery Switch Lighting	

Pin No.	Wire Color	Feature	Remarks
1			Blank
2	G-R	Cruise (-)	
3			Blank
4	W-R	Cruise (+)	
5			Blank
6	V	Cruise (+)	
7	W-B	Cruise (+) Switch Lighting, Grounding	
8	R-G	Cruise (+) Switch Lighting	

Circuit Diagram—Information On Wiring Harness Connector

B299 To Cruise Cancel Switch



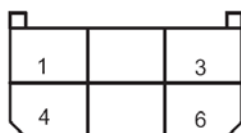
Pin No.	Wire Color	Feature	Remarks
1			Blank
2			Blank
3			Blank
4	W R	Cruise Cancel Switch	
5			Blank
6	W-L	Cruise Cancel Switch	
7	W-B	Electric/Air Horn Switch Lighting, Grounding	
8	R G	Cruise Cancel Switch Lighting	

B021To Flasher 1



Pin No.	Wire Color	Feature	Remarks
1	W-B	Flasher, Grounding	

B022 To Flasher 2



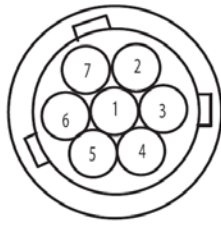
Pin No.	Wire Color	Feature	Remarks
1	G-B	Flasher (K1)	
2	L-O	Flasher Turn Signal Source	
3	G	Flasher (15)	
4	G-B	Flasher (LL)	
5	G-Y	Flasher (RL)	
6	L-O	Flasher (B)	

B023 To Flasher 3



Pin No.	Wire Color	Feature	Remarks
1	L-B	Flasher (L)	
2	G-Y	Flasher (K2)	
3	G-L	Flasher (54R)	
4	G-R	Flasher (54L)	

B075 Common-rail Line Interface



Pin No.	Wire Color	Feature	Remarks
1	W-R	Common-rail Line Interface Power Supply	
2	B-L	Common-rail Line CANH	
3	W-Y	Common-rail Line CANL	
4	W-B	Common-rail Line Interface	
5	Y-W	K-LINE	
6	W R	Common-rail Line Interface Power Supply	
7	W B	Common-rail Line Interface, Grounding	

B122 To Refrigerator



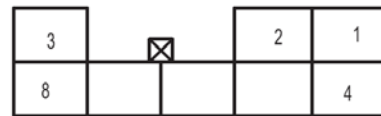
Pin No.	Wire Color	Feature	Remarks
1	G-O	Refrigerator (+)	
2	W-B	Refrigerator (-)	

B074 Diagnostic Interface



Pin No.	Wire Color	Feature	Remarks
1			Blank
2			Blank
3			Blank
4	W-B	Diagnostic Interface, Grounding	
5	W-B	Diagnostic Interface, Grounding	
6	B-L	CANH	
7	Y-W	Diagnostic Interface	
8			Blank
9			Blank
10			Blank
11			Blank
12			Blank
13			Blank
14	W-Y	CANL	
15			Blank
16	W-R	Diagnostic Interface Power Supply	

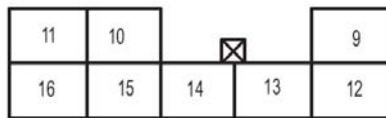
B066 To Dual-purpose Controller 1



Pin No.	Wire Color	Feature	Remarks
1	R	Dual-purpose Controller, RR Fog Lamp Fuse (L)	
2	Br-Y	Dual-purpose Controller	
3	Y B	Dual-purpose Controller, RR Fog Lamp Switch (L)	
4	L-W	Dual-purpose Controller, Light Load (L)	
5	Br	Dual-purpose Controller INT Adjustment	
6	Br-W	Dual-purpose Controller	
7	L-R	Dual-purpose Controller	
8	R-L	Dual-purpose Controller, RR Fog Lamp Signal (FS)	

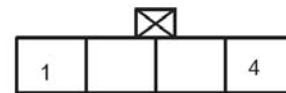
Circuit Diagram—Information On Wiring Harness Connector

B067 To Dual-purpose Controller 2



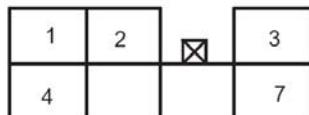
Pin No.	Wire Color	Feature	Remarks
9	G	Dual-purpose Controller, Small Signal Lamp	
10	Br-W	Changeover Switch, Low-speed Output (LO)	
11	L P.	Changeover Switch INT	
12	R-B	Dual-purpose Controller, Lower Beam Lamp Signal (LH)	
13	L P.	Dual-purpose Controller, Wiper IG (B)	
14	Br-Y	Changeover Switch, High-speed Output (HI)	
15	R-Y	Dual-purpose Controller, Upper Beam Signal Lamp (HR)	
16	W-B	Dual-purpose Controller, Grounding (-)	

B049 To Brake Lamp Alarm Controller



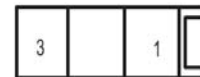
Pin No.	Wire Color	Feature	Remarks
1	G-W	Brake Lamp Alarm Controller (B)	
2	G-W	Brake Lamp Alarm Controller (L)	
3	G	Brake Lamp Alarm Controller (G)	
4	W-B	Brake Lamp Alarm Controller, Grounding	

B123 To Dialer



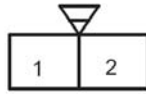
Pin No.	Wire Color	Feature	Remarks
1			
2			
3	Gr-B	Vehicle Speed Output	
4	L	Instrument Adjustment Card (4)	
5	W-B	Instrument Adjustment Card (5)	
6	Gr-W	Instrument Adjustment Card (6), Single-core Shielding Wire	
7	Gr-W	Instrument Adjustment Card (7)	

B999 Mode Servo Motor Plug



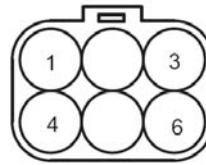
Pin No.	Wire Color	Feature	Remarks
1	W-B	Mode Damper Motor, Grounding	
2	G	Mode Damper Motor	
3	R-Y	Mode Damper Motor +	

B105 To Parking Distance Control Radar Buzzer



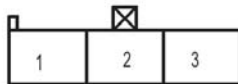
Pin No.	Wire Color	Feature	Remarks
1	R-G	Parking Distance Control Radar Buzzer (B)	
2	R-B	Parking Distance Control Radar Buzzer (L)	

B026 To Wiper Motor



Pin No.	Wire Color	Feature	Remarks
1	W-B	Wiper Motor, Grounding	
2	Br-W	Wiper Motor (LO)	
3	Br-Y	Wiper Motor (HI)	
4	L-R	Wiper Motor (+)	
5	L-R	Wiper Motor	
6			Blocked

B126 To Multi-state Switch



Pin No.	Wire Color	Feature	Remarks
1	R-Y	Torque Limit Switch Grounding Terminal	
2			
3	R-G	Torque Limit Switch Signal Terminal	

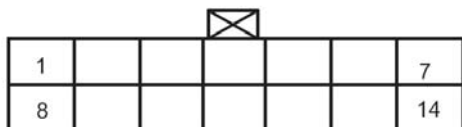
B090 To PTO Switch



Pin No.	Wire Color	Feature	Remarks
1	B-R	PTO Operation Indicator Light	
2	G	Torque Extractor Switch	
3			Blank
4	L-B	Torque Extraction Switch	
5	Lg	Torque Extraction Indicator Light (+)	
6			Blank
7	W-B	PTO Switch Lighting, Grounding	
8	R-G	PTO Switch (Dumper) (ILL+)	

Circuit Diagram—Information On Wiring Harness Connector

B020 To Radio & Tape Player



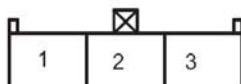
Pin No.	Wire Color	Feature	Remarks
1			Blank
2	L	Radio & Tape Player (ACC)	
3			Blank
4			Blank
5	R	Radio & Tape Player B+	
6	L-W	Radio & Tape Player FL (-)	
7	L	Radio & Tape Player FL(+)	
8			Blank
9	W-B	AD Adapter, Grounding	
10			Blank
11			Blank
12			Blank
13	G-W	Radio & Tape Player FR (-)	
14	G	Radio & Tape Player FR (+)	

B125 To Rear-view Mirror Heater Switch



Pin No.	Wire Color	Feature	Remarks
1	W-G	Rear-view Mirror Heating Operation Indicator Light	
2	R-W	To Rear-view Mirror Heating Relay 85	
3			Blank
4	R-Y	To Rear-view Mirror Heater Switch 1	
5	W-B	Rear-view Mirror Heating Operation Indicator Light -	
6			Blank
7	W-B	To Rear-view Mirror Heater Switch 2	
8	R-G	To Rear-view Mirror Heater Switch 4	

B081 To Alarm Buzzer



Pin No.	Wire Color	Feature	Remarks
1	W-B	Torque Extraction Buzzer -	
2	G	Torque Extraction Buzzer +	
3			Blank

G034 Grounding 1



Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 1# Grounding	

G117 Grounding 2



Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 2# Grounding	

G035 Grounding 3



Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 3# Grounding	

B097 To RH Loudspeaker



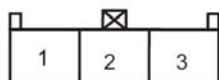
Pin No.	Wire Color	Feature	Remarks
1	G	RH FR Loudspeaker (+)	
2	G-W	RH FR Loudspeaker (-)	

G118 Grounding 4



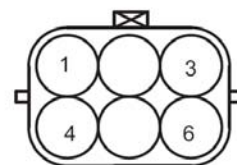
Pin No.	Wire Color	Feature	Remarks
1	W-B	Heat Sealing	

B008 To Temperature Control Switch



Pin No.	Wire Color	Feature	Remarks
1	G	Temperature Control Switch	
2	G-B	Temperature Control Switch (-)	
3	Br	Temperature Control Switch (+)	

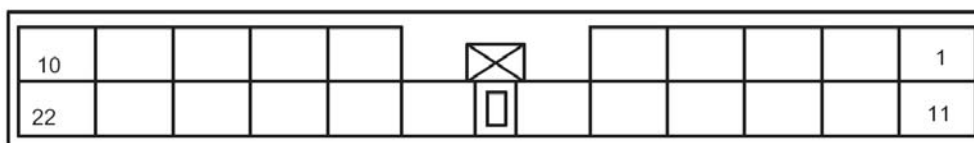
B121 To Rear-view Mirror Heating Wir



Pin No.	Wire Color	Feature	Remarks
1			Blocked
2	W-G	To RH Rear-view Mirror	
3	W-B	To RH Rear-view Mirror	
4			Blocked
5			Blocked
6			Blocked

Circuit Diagram—Information On Wiring Harness Connector

B036 To Roof Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1			Blank
2			Blank
3			Blank
4			Blank
5			Blank
6			Blank
7			Blank
8			Blank
9	G	LH Height Indicator (+)	
10	R Y	Interior Lamp (-)	
11	W-B	Chassis Wiring Harness, Grounding	

Pin No.	Wire Color	Feature	Remarks
12			Blank
13			Blank
14	R-G	Driving Recorder Lighting (ILL+)	
15	R W	Diagnostic Switch -	
16	W-R	Diagnostic Switch +	
17			Blank
18			Blank
19	L-W	Speed Display Light C	
20	L-B	Speed Display Light B	
21	L-W	Speed Display Light A	
22	L-Y	Interior Lamp (+)	

G038 Grounding 5



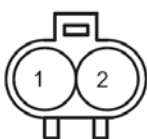
Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 5 Grounding	

G119 Grounding 6



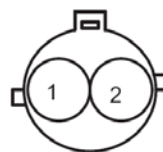
Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 6 Grounding	

B051 To Condenser Fan Motor



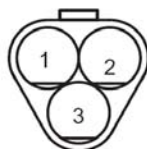
Pin No.	Wire Color	Feature	Remarks
1	L-W	Condenser Fan Motor (+)	
2	W-B	Condenser Fan Motor, Grounding	

B052 Pressure Switch



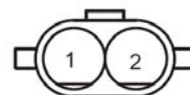
Pin No.	Wire Color	Feature	Remarks
1	G-Y	Pressure Switch (+)	
2	G-B	Pressure Switch (-)	

B102 RH Headlamp Reserved



Pin No.	Wire Color	Feature	Remarks
1	R-W	RH Upper Beam Reserved	
2	R-L	RH Lower Beam Reserved	
3	W-B	Headlamp Reserved, Grounding	

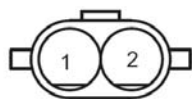
B139 To RH Side Marker Lamp



Pin No.	Wire Color	Feature	Remarks
1	G	RH Side Marker Lamp (+)	
2	W-B	RH Side Marker Lamp (E)	

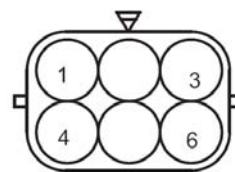
Circuit Diagram—Information On Wiring Harness Connector

B306 To RH FR Turn Signal Lamp



Pin No.	Wire Color	Feature	Remarks
1	G-Y	RH FR Turn Signal Lamp (+)	
2	W-B	RH FR Turn Signal Lamp, Grounding	

B041 To RH FR Combination Lamp



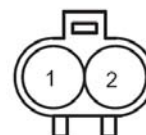
Pin No.	Wire Color	Feature	Remarks
1	R-L	RH Lower Beam Lamp (+)	
2	R-L	RH FR Fog Lamp (+)	
3	R-W	RH Upper Beam Lamp (+)	
4	W-B	LH FR Fog Lamp (-)	
5	W-B	RH Headlamp, Grounding	
6	G	RH FR Width Indicator (+)	

B301 To RH Side Turn Signal Lamp



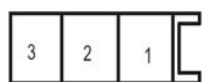
Pin No.	Wire Color	Feature	Remarks
1	G-B	RH Side Turn Signal Lamp (+)	
2	W-B	RH Side Turn Signal Lamp (E)	

B303 To RH Step Lamp



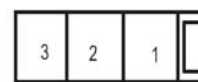
Pin No.	Wire Color	Feature	Remarks
1	L-Y	RH Step Lamp (+)	
2	R-Y	RH Step Lamp (-)	

B998 Mixing Damper Motor Plug



Pin No.	Wire Color	Feature	Remarks
1	W-B	Mixing Damper Motor, Grounding	
2	L	Mixing Damper Motor	
3	R-Y	Mixing Damper Motor +	

B997 Intake Damper Motor Plug



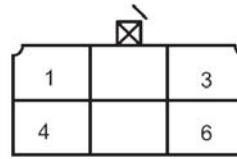
Pin No.	Wire Color	Feature	Remarks
1	W-B	Intake Damper Motor	
2	Y	Intake Damper Motor	
3	R-Y	Intake Damper Motor	

B033 To Fan Motor



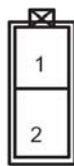
Pin No.	Wire Color	Feature	Remarks
1	Lg-W	Fan (-)	
2	Lg	Fan (+)	

B032 To Speed Adjustment Module



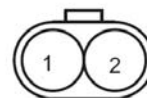
Pin No.	Wire Color	Feature	Remarks
1	L	Speed Adjustment Module	
2	Lg-W	Speed Adjustment Module (B)	
3	Y	Speed Adjustment Module	
4			Blank
5			Blank
6	G	Speed Adjustment Module	

B002 To Frame Wiring Harness B



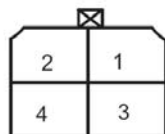
Pin No.	Wire Color	Feature	Remarks
1	W	Main Fuse F/L 6	
2	R	Main Fuse F/L 2	

B070 To Air Horn Solenoid Valve 1



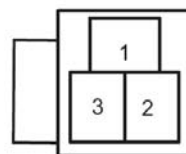
Pin No.	Wire Color	Feature	Remarks
1	Br-W	Air Horn Solenoid Valve (B)	
2	W-B	Air Horn Solenoid Valve (L)	

B146 ABS Interface



Pin No.	Wire Color	Feature	Remarks
1	B-Y	ABS Trailer 6-2	
2	B-L	Trailer ABS (WL)	
3			Blank
4	B-W	F/L 1	

B003 To Frame Wiring Harness C

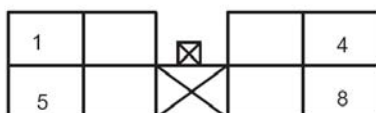


Pin No.	Wire Color	Feature	Remarks
1	W	Main Fuse F/L 1	
2	B-Y	Main Fuse F/L 5	
3	W-B	To Frame Wiring Harness, Grounding	



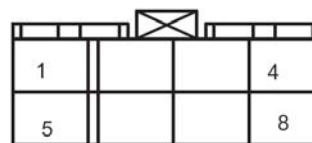
Circuit Diagram—Information On Wiring Harness Connector

B010 To Changeover Switch B



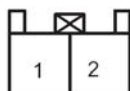
Pin No.	Wire Color	Feature	Remarks
1	W-B	Wiper Motor Speed Governing Line	
2	L-R	Combination Switch (AS)	
3	L-0	Wiper Switch	
4	BR	Motor (+)	
5	Br-W	Combination Switch (L0)	
6	Br-Y	Combination Switch (HI)	
7	Br	Combination Switch	
8	W-B	Wiper Switch, Grounding	

B013 To Ignition Switch



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	B-W	Ignition Switch (50)	
3	W R	Ignition Switch (B1)	
4			Blank
5	L	Ignition Switch (M1)	
6	L	Ignition Switch (M2)	
7			Blank
8			Blank

B012 To Clutch Switch



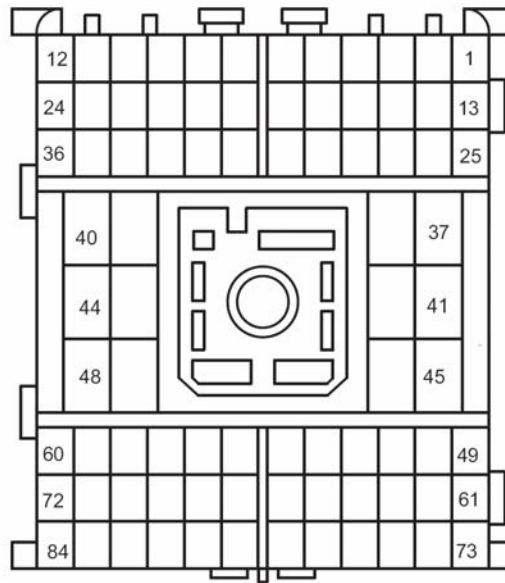
Pin No.	Wire Color	Feature	Remarks
1	L-Y	Clutch Switch (-)	
2	W-R	Clutch Switch	

B087 To LH Loudspeaker



Pin No.	Wire Color	Feature	Remarks
1	L	LH FR Loudspeaker (+)	
2	L-W	LH FR Loudspeaker (-)	

B001 To Frame Wiring Harness A



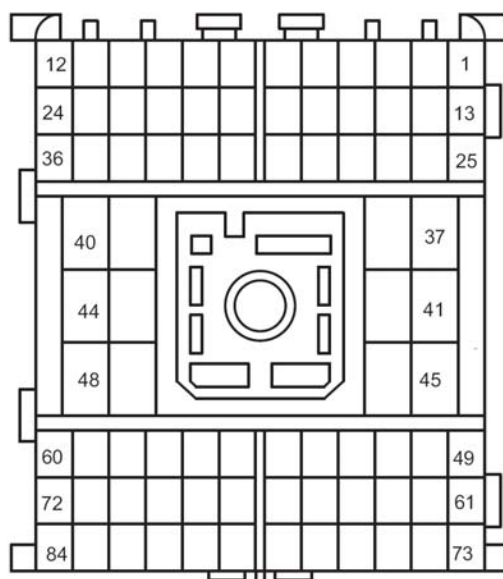
Pin No.	Wire Color	Feature	Remarks
1	Gr-W	Vehicle Speed Sensor Signal Terminal	
2	G	RR Illuminating Lamp (+)	
3			Blank
4	W	Battery Switch (-)	
5	L-W	RR Fog Lamp (+)	
6	G-Y	RH RR Turn Signal Lamp (+)	
7	G-B	LH RR Turn Signal Lamp (+)	
8	W-L	Cruise Control/PTO Power Output Control	
9	V	Cruise Control/PTO Power Output Control Switch	
10	R-B	Parking Distance Control Radar Control Box (B)	
11	R-G	Parking Distance Control Radar Control Box (L)	
12	Br-B	Dashboard Engine Speed Indicator	
13	Lg	Neutral Gear Switch (+)	
14			Blank
15			Blank
16			Blank
17	G-W	Body Turn Signal Lamp	
18	Y-L	Fault Diagnostic Indicator Light (Code Flasher)	
19	W-R	Wheel Lock Solenoid Valve	
20	R-W	Inter-axial Lock Solenoid Valve (+)	
21	G-R	Cruise Control/PTO Power Output Control	
22	L-B	Exhaust Brake Switch	
23	G-B	Air Conditioner Actuator Switch	
24	Y-G	Water Temperature Sensor (+)	
25	Lg-R	Neutral Gear Solenoid Valve (+)	

Pin No.	Wire Color	Feature	Remarks
26	G	Torque Extractor Solenoid Valve (+)	
27	W-R	Generator (D+)	
28	Y-G	Alarm Indicator Light	
29	B-L	Air Filter Blockade Alarm Switch (+)	
30	O-L	Fault Diagnostic Indicator Light (Code Flasher)	
31	Br-W	Wheel Lock Indicator Light	
32	Br-Y	Wheel Lock Solenoid Valve Switch (+)	
33	W-G	Cruise Control/PTO Power Output Control Switch	
34	G-R	LH RR Trailer Turn Signal Lamp (+)	
35	G-L	RH RR Trailer Turn Signal Lamp (+)	
36	Y-R	Fuel Sensor (+)	
37	W-R	ECU 24V Positive Output	
38	Y-G	Dryer (+)	
39			Blank
40			Blank
41	W-L	Frame Wiring Harness Interface	
42			Blank
43			Blank
44			Blank
45			Blank
46	W-B	Frame Wiring Harness, Grounding	
47	L	RR Marker Lamp (+)	
48	W	Battery Anodes 1, 2, 3, 4	
49	W	Gear Position Switch (+)	
50	Y-L	Water Temperature Alarm Switch (+)	



Circuit Diagram—Information On Wiring Harness Connector

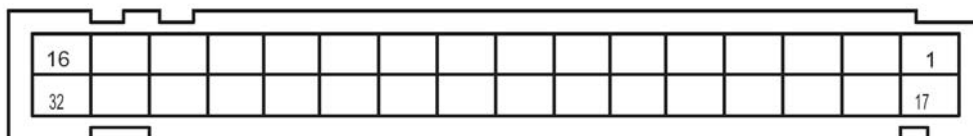
B001 To Frame Wiring Harness A



Pin No.	Wire Color	Feature	Remarks
51			Blank
52	R	Accelerator Pedal Sensor APP1, 5V Terminal	
53	G	Accelerator Pedal Sensor APP1, Signal Terminal	
54	B	Accelerator Pedal Sensor APP1, Grounding Terminal	
55	Y-B	Oil Pressure Sensor (+)	
56	B-R	Auxiliary Brake Switch	
57	R	Reversing Lamp Switch (+)	
58	B-L	CAN Bus Output	
59	W-Y	CAN Bus Output	
60	R-W	Fault Diagnostic Switch	
61	B-W	CAB Lock Switch (+)	
62	R-W	Friction Plate Sensor	
63	R-L	To Shielding Layer of Frame 1	
64	G-L	Main Brake Switch	
65	R-L	Idle Speed Acceleration Switch 1, Signal	
66	Y-W	Wire K of Diagnostic Interface	
67	W	Accelerator Pedal Sensor APP2, 5V Terminal	

Pin No.	Wire Color	Feature	Remarks
68	O	Accelerator Pedal Sensor APP2, Signal Terminal	
69	V	Accelerator Pedal Sensor APP2, Grounding Terminal	
70	Gr-W	Vehicle Speed Sensor	
71	Gr	Single-core Shielding Wire of the Vehicle Speed Sensor (SE)	
72	Br	Air Conditioner Switch	
73	B-O	Key Start Switch T50	
74	L-Y	To Clutch Switch	
75	G-W	Low Tone Loudspeaker (+)	
76	R-L	Reversing Lamp (+)	
77	Lg	Idle Speed Acceleration Switch 1, Internal Grounding	
78	W-L	Key Switch T15	
79	L-W	Power Supply 24V Anode	
80	R-Y	Multi-state Switch	
81			Blank
82	V-W	Water Alarm Indicator Light of Fuel Coarse Filter	
83	Y-R	Cold Start Indicator Light	
84	R-G	Multi-state Switch	

B089 To Instrument A



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	Y-L	Liquid Level Alarm of Instrument Cooling Panel	
3	Br	Instrument, Grounding	
4			Blank
5	Br	Instrument Sensor Grounding	
6			Blank
7			Blank
8	R-B	Oil Pressure Indicator Light	
9			Blank
10	Br-B	Engine Speed Indicator A10	
11	Y-R	Instrument Power Supply (+B)	
12	R-G	Instrument Lighting Input	
13	Y-B	Instrument Power Supply (IG)	
14	Y-L	Engine Diagnostic Indicator Lamp (+)	
15			Blank
16	W-R	Charging Indicator Light	

Pin No.	Wire Color	Feature	Remarks
17			Blank
18	L-B	Parking Indicator	
19	V-G	Exhaust Brake Indicator Light	
20	O-L	Generator Diagnostic Indicator Lamp	
21	Y-R	Instrument Fuel Sensor Input	
22	G-B	Turn Signal Lamp	
23	Y-G	Instrument Water Temperature Indicator (+)	
24	G-Y	Trailer Turn Signal Lamp	
25	R-Y	Upper Beam Indicator Light	
26	R-W	Friction Plate Abrasion Alarm	
27	Gr-W	Single-core Shielding Wire of Instrument Vehicle Speed Signal	
28	G	Blowout Alarm Indicator Light of Brake Lamp	
29	R-L	Hazard Alarm Indicator Light	
30	Gr	Instrument 12V Output	
31			Blank
32			Blank

Circuit Diagram—Information On Wiring Harness Connector

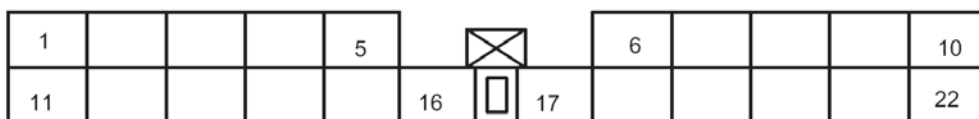
B078 To Instrument B



Pin No.	Wire Color	Feature	Remarks
1			Blank
2	R-Y	Preheating, Oil-water Separator, Cooling Liquid (Positive Control)	
3			Blank
4	L	RR Axle Barometer	
5	R	FR Axle Barometer	
6	Y-R	Preheating Indicator -	
7	R-L	FR Fog Lamp Indicator Light	
8			Blank
9			Blank
10	R-B	Lower Beam Indicator Light	
11	V-W	Oil-water Separator Indicator -	
12	Y-G	Instrument Water Temperature Indicator B12	
13	B-W	CAB Lock Alarm Indicator Light	
14	W	Low Gear Indicator Light	
15			Blank
16	B-Y	ABS Diagnostic Indicator Lamp	

Pin No.	Wire Color	Feature	Remarks
17	B-L	Air Filter Blowout Alarm Indicator	
18	R-Y	Door Control Instrument Indicator Light	
19	B-L	Trailer ABS Diagnostic Indicator Lamp	
20	P	ASR Fault Alarm Indicator Light	
21	G-W	Instrument Vehicle Speed 20kmh	
22	G-R	Instrument Vehicle Speed 60kmh	
23	G-Y	Instrument Vehicle Speed 40kmh	
24			Blank
25			Blank
26			Blank
27	B	Seat Belt Pretensioner (+)	
28			Blank
29			Blank
30			Blank
31			Blank
32			Blank

B011 To Combination Switch A

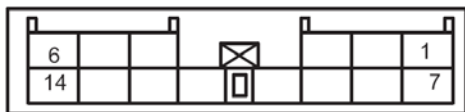


Pin No.	Wire Color	Feature	Remarks
1	G-R	Horn Switch (+)	
2			Blank
3			Blank
4	L-O	Turn Signal Switch	
5	L-B		
6			
7	R-G	Combination Switch (Lower Beam)	
8	R-W	Combination Switch (Upper Beam)	
9	G-W	Body Side Lamp Switch	
10	W-B	Headlamp Switch	
11			Blank

Pin No.	Wire Color	Feature	Remarks
12			Blank
13			Blank
14			Blank
15			Blank
16			Blank
17	L-B	Exhaust Brake Switch -	
18	L-W	Exhaust Brake Switch +	
19			Blank
20	R-L	Hazard Alarm Switch (ON HZ)	
21	L-O	Turn Signal Switch (E1)	
22	L	FR Fog Lamp Switch (+)	

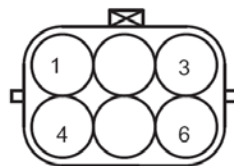
Circuit Diagram—Information On Wiring Harness Connector

B105 To Roof Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1	G-W	Driving Recorder (1)	
2	G-B	Driving Recorder (2)	
3	G-Y	Driving Recorder (3)	
4	L	Driving Recorder (4)	
5	R-W	Driving Recorder (5)	
6			Blank
7	Br-Y		
8	Br-W		
9	R-L	Driving Recorder (8)	
10	Gr-W	Driving Recorder (9)	
11	Y R	Driving Recorder (Normal Power)	
12	R-Y	Driving Recorder (Door)	
13	L-W		
14	W-B	Driving Recorder (12)	

B122 To Rear-view Mirror Heating Wire



Pin No.	Wire Color	Feature	Remarks
1			Blocked
2	W-G	To LH Rear-view Mirror Heating Wire Wiring Harness	
3	W-B	To LH Rear-view Mirror Heating Wire Wiring Harness	
4			Blocked
5			Blocked
6			Blocked

G120 Grounding 7



Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 7 Grounding	

G056 Grounding 8



Pin No.	Wire Color	Feature	Remarks
1	W-B	Tractor Wiring Harness 8 Grounding	

G096 FR and RR Axle Air Pressure Sensors Grounding

B047 To RR Axle Air Pressure Sensor

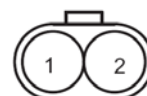


Pin No.	Wire Color	Feature	Remarks
1	W-B	FR and RR Axle Air Pressure Sensors	

Pin No.	Wire Color	Feature	Remarks
1	L	RR Axle Air Pressure and Pressure Sensor (+)	

B014 To Cold Washing Motor

B054 To Parking Indicator Switch



Pin No.	Wire Color	Feature	Remarks
1	W-B	Washer Ground Wire	
2	L-O	Washer Motor (-)	

Pin No.	Wire Color	Feature	Remarks
1	L-B	Brake Switch (+)	
2	W-B	Manual Brake Switch	

B046 To FR Axle Air Pressure Sensor

B048 To Brake Lamp Switch (Main)



Pin No.	Wire Color	Feature	Remarks
1	R	FR Axle Air Pressure and Pressure Sensor (+)	

Pin No.	Wire Color	Feature	Remarks
1	G-L	Brake Lamp Switch (+)	
2	G-L	Brake Lamp Switch (-)	

Circuit Diagram—Information On Wiring Harness Connector

B027 To Brake Switch



Pin No.	Wire Color	Feature	Remarks
1	W-B	Brake Switch	
2	W-B	Brake Switch, Grounding	

B138 To LH Marker Lamp



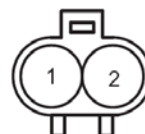
Pin No.	Wire Color	Feature	Remarks
1	G	Left Side Marker Lamp (+)	
2	W-B	Left Side Marker Lamp (E)	

B035 To LH FR Combination Lamp



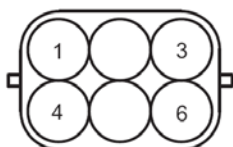
Pin No.	Wire Color	Feature	Remarks
1	G-B	LH FR Turn Signal Lamp (+)	
2	W-B	LH FR Turn Signal Lamp, Grounding	

B032 To LH Step Lamp



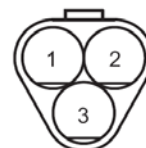
Pin No.	Wire Color	Feature	Remarks
1	L-Y	LH Step Lamp (+)	
2	R-Y	LH Step Lamp (-)	

B017 To LH FR Combination Lamp



Pin No.	Wire Color	Feature	Remarks
1	R-B	LH Lower Beam Lamp (+)	
2	R-L	LH FR Fog Lamp (+)	
3	R-Y	LH Upper Beam Lamp (+)	
4	W-B	LH Headlamp, Grounding	
5	W-B	LH FR Fog Lamp, Grounding	
6	G	LH FR Width Indicator (+)	

B103 LH Headlamp Reserved



Pin No.	Wire Color	Feature	Remarks
1	R-Y	LH Upper Beam Lamp Reserved	
2	R-B	LH Upper Beam Lamp Reserved	
3	W-B	Headlamp Reserved, Grounding	

B304 To Left Side Turn Signal Lamp



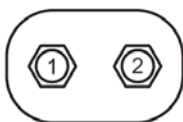
Pin No.	Wire Color	Feature	Remarks
1	G-B	Left Side Marker Lamp (+)	
2	W-B	Left Side Turn Signal Lamp, Grounding	

C001 To Oil Atomizer



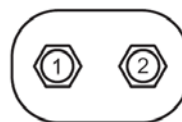
Pin No.	Wire Color	Feature	Remarks
1		Tank 1 Oil Atomizer	
2		Tank 1 Oil Atomizer	

C012 To Oil Atomizer



Pin No.	Wire Color	Feature	Remarks
1		Tank 2 Oil Atomizer	
2		Tank 2 Oil Atomizer	

C013 To Oil Atomizer



Pin No.	Wire Color	Feature	Remarks
1		Tank 3 Oil Atomizer	
2		Tank 3 Oil Atomizer	

C014 To Oil Atomizer



Pin No.	Wire Color	Feature	Remarks
1		Tank 4 Oil Atomizer	
2		Tank 4 Oil Atomizer	

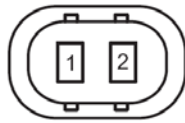
C015 To Oil Atomizer



Pin No.	Wire Color	Feature	Remarks
1		Tank 5 Oil Atomizer	
2		Tank 5 Oil Atomizer	

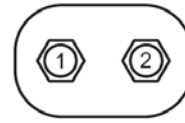
Circuit Diagram—Information On Wiring Harness Connector

C004 To Crankshaft Position Sensor



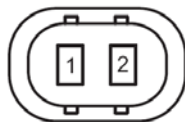
Pin No.	Wire Color	Feature	Remarks
1		Crankshaft Position Sensor (Signal)	
2		Crankshaft Position Sensor (Grounding)	

C016 To Oil Atomizer



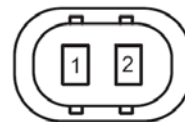
Pin No.	Wire Color	Feature	Remarks
1		Tank 6 Oil Atomizer	
2		Tank 6 Oil Atomizer	

C007 To Camshaft Position Sensor



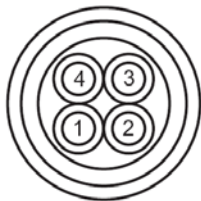
Pin No.	Wire Color	Feature	Remarks
1		Camshaft Position Sensor (Grounding)	
2		Camshaft Position Sensor (Signal)	

C008 To Flow Metering Valve



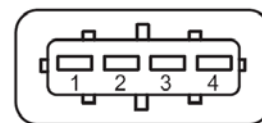
Pin No.	Wire Color	Feature	Remarks
1		Flow Metering Valve	
2		Flow Metering Valve	

C002 To Frame Front Wiring Harness



Pin No.	Wire Color	Feature	Remarks
1		Exhaust Brake Solenoid Valve	
2		Exhaust Brake Switch	
3		Power Supply 24V	
4		Air Conditioner Relay	

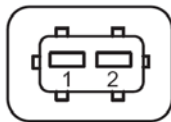
C003 To Oil and Temperature Pressure Sensor



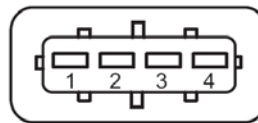
Pin No.	Wire Color	Feature	Remarks
1		Oil Pressure Sensor (Grounding)	
2		Oil Pressure Sensor (Signal)	
3		Oil Pressure Sensor (5V)	
4		Oil Pressure Sensor (Signal)	

C010 To Water Temperature Sensor

C009 To Boosting Pressure and Temperature Sensor

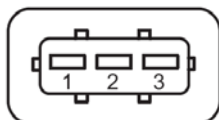


Pin No.	Wire Color	Feature	Remarks
1		Water Temperature Sensor (Signal)	
2		Water Temperature Sensor (Grounding)	



Pin No.	Wire Color	Feature	Remarks
1		Boosting Pressure and Temperature Sensor (Grounding)	
2		Intake Temperature Sensor (Signal)	
3		Boosting Pressure and Temperature Sensor (5V)	
4		Intake Pressure Sensor (Signal)	

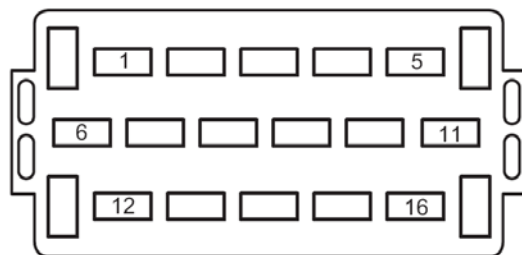
C011 To Common-rail Pressure Sensor



Pin No.	Wire Color	Feature	Remarks
1		Common-rail Pressure Sensor (Grounding)	
2		Common-rail Pressure Sensor (Signal)	
3		Common-rail Pressure Sensor (+5V)	

Circuit Diagram—Information On Wiring Harness Connector

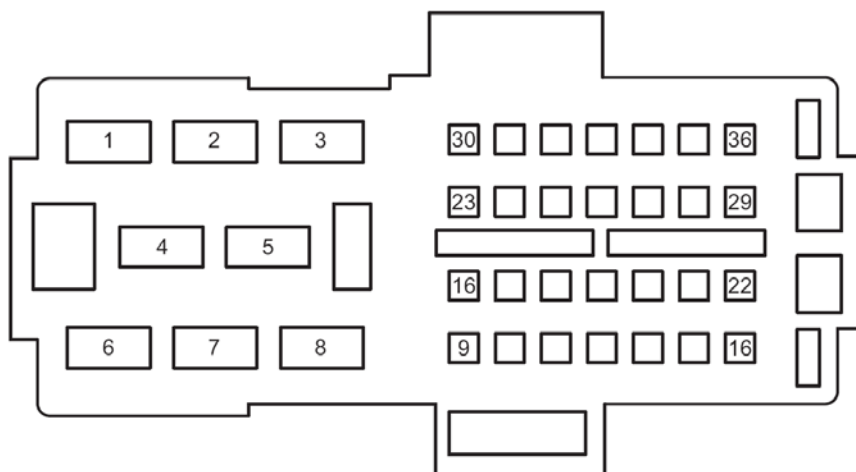
C005 To Electrical Control Unit ECU C



Pin No.	Wire Color	Feature	Remarks
1		Tank 5 Oil Atomizer	
2		Tank 6 Oil Atomizer	
3		Tank 4 Oil Atomizer	
4		Tank 1 Oil Atomizer	
5		Tank 3 Oil Atomizer	
6		Tank 2 Oil Atomizer	
7			Blank
8			Blank

Pin No.	Wire Color	Feature	Remarks
9		Flow Metering Valve	
10		Flow Metering Valve	
11		Tank 2 Oil Atomizer	
12		Tank 3 Oil Atomizer	
13		Tank 1 Oil Atomizer	
14		Tank 4 Oil Atomizer	
15		Tank 6 Oil Atomizer	
16		Tank 5 Oil Atomizer	

C006 To Electrical Control Unit ECU B

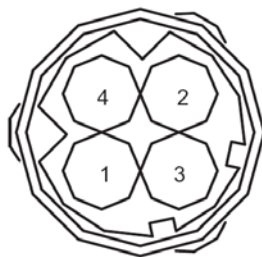


Pin No.	Wire Color	Feature	Remarks
1			Blank
2			Blank
3		24V Power Supply	
4			Blank
5			Blank
6		Exhaust Brake Solenoid Valve	
7			Blank
8			Blank
9		Camshaft Position Sensor (Signal)	
10		Camshaft Position Sensor (Grounding)	
11		Air Conditioner Relay	
12		Common-rail Pressure Sensor (Grounding)	
13		Common-rail Pressure Sensor (+5V)	
14		Common-rail Pressure Sensor (Signal)	
15		Water Temperature Sensor (Signal)	
16			Blank
17			Blank
18			Blank

Pin No.	Wire Color	Feature	Remarks
19		Crankshaft Position Sensor (Grounding)	
20			Blank
21			Blank
22			Blank
23		Crankshaft Position Sensor (Signal)	
24		Oil Pressure Sensor (Grounding)	
25		Boosting Pressure and Temperature Sensor (Grounding)	
26		Water Temperature Sensor (Grounding)	
27		Oil Pressure Sensor (Signal)	
28		Oil Temperature Sensor (Signal)	
29		Exhaust Brake Switch	
30			Blank
31			Blank
32		Oil and Temperature Pressure Sensor (+5V)	
33		Boosting Pressure and Temperature Sensor (+5V)	
34		Intake Pressure Sensor (Signal)	
35			Blank
36		Intake Temperature Sensor (Signal)	

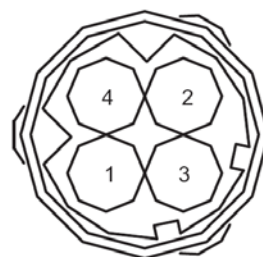
Circuit Diagram—Information On Wiring Harness Connector

2001 To LH FR ABS Solenoid Valve



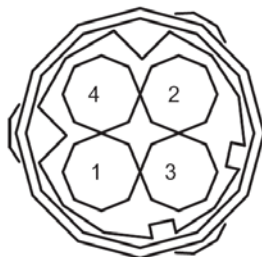
Pin No.	Wire Color	Feature	Remarks
1	Br	Exhaust Coil	
2	Y-G	Grounding	
3	L	Intake Coil	
4			Blocked

2002 To RH FR ABS Solenoid Valve



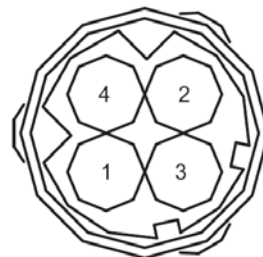
Pin No.	Wire Color	Feature	Remarks
1	Br	Exhaust Coil	
2	Y-G	Grounding	
3	L	Intake Coil	
4			Blocked

2003 To LH FR ABS Solenoid Valve



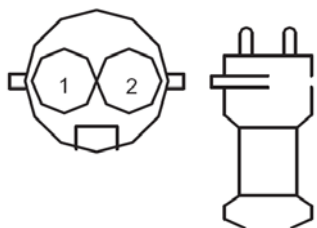
Pin No.	Wire Color	Feature	Remarks
1	Br	Exhaust Coil	
2	Y-G	Grounding	
3	L	Intake Coil	
4			Blocked

2004 To RH RR ABS Solenoid Valve



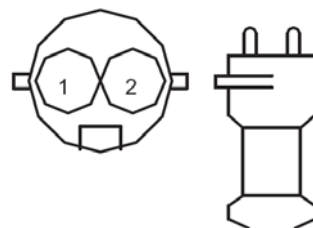
Pin No.	Wire Color	Feature	Remarks
1	Br	Exhaust Coil	
2	Y-G	Grounding	
3	L	Intake Coil	
4			Blocked

2005 To LH FR ABS Wheel Speed Sensor



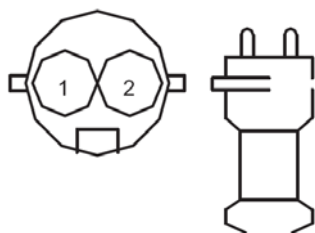
Pin No.	Wire Color	Feature	Remarks
1	Br	ABS Wheel Speed Sensor (+)	
2	B	ABS Wheel Speed Sensor (-)	

2006 To RH FR ABS Wheel Speed Sensor



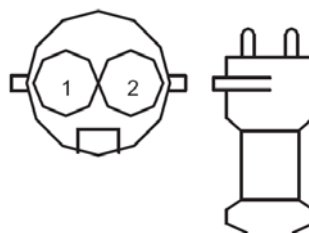
Pin No.	Wire Color	Feature	Remarks
1	Br	ABS Wheel Speed Sensor (+)	
2	B	ABS Wheel Speed Sensor (-)	

Z007 To LH RR ABS Solenoid Valve



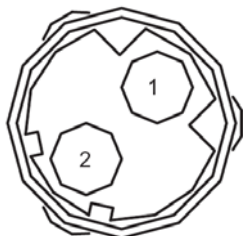
Pin No.	Wire Color	Feature	Remarks
1	Br	ABS Wheel Speed Sensor (+)	
2	B	ABS Wheel Speed Sensor (-)	

Z008 To RH RR ABS Solenoid Valve



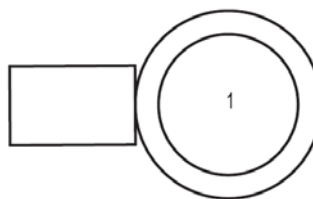
Pin No.	Wire Color	Feature	Remarks
1	Br	ABS Wheel Speed Sensor (+)	
2	B	ABS Wheel Speed Sensor (-)	

Z024 To ASR Solenoid Valve



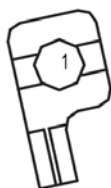
Pin No.	Wire Color	Feature	Remarks
1	L	ASR Solenoid Valve	
2	Br	ASR Solenoid Valve	

G016 Grounding



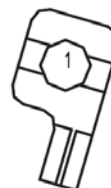
Pin No.	Wire Color	Feature	Remarks
1	W/B	Grounding	

G017 Grounding



Pin No.	Wire Color	Feature	Remarks
1	W/B	Grounding	

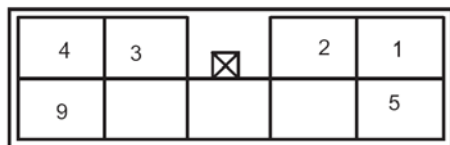
G018 Grounding



Pin No.	Wire Color	Feature	Remarks
1	W/B	Grounding	

Circuit Diagram—Information On Wiring Harness Connector

2019 To ABS Chassis Wiring Harness



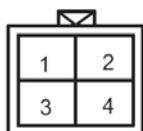
Pin No.	Wire Color	Feature	Remarks
1	B-Y	ABS Relay (L)	
2	G	Tractor ABS Interface SAE J1939 (B)	
3	W-B	ABS Relay (31)	
4	R-W	ABS Fuse (5A)	
5	B-Y	ABS Diagnostic Indicator Lamp (+)	
6	W	Tractor ABS Interface SAE J1939 (A)	
7		ABS Diagnostic Interface	
8	G-Y	ABS Indicator Light	
9	W-R	DBP Relay	

Z020 To TPM Switch



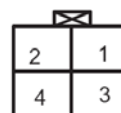
Pin No.	Wire Color	Feature	Remarks
1			Blank
2	W-B	TPM Switch (-)	
3			Blank
4	G-L	TPM Switch (+)	
5			Blank
6			Blank
7			Blank
8			Blank

Z022 Diagnostic Interface



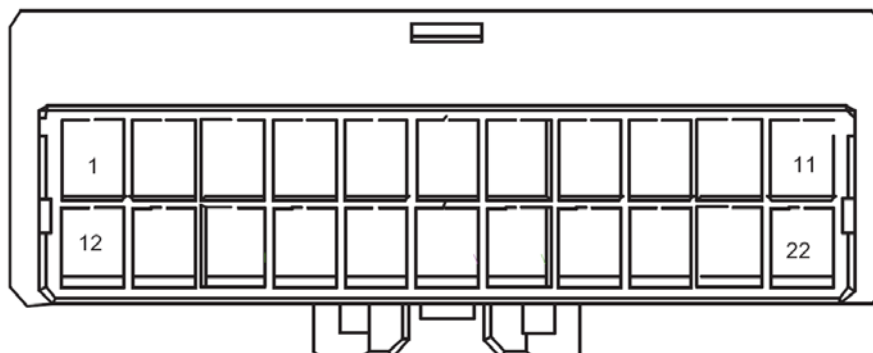
Pin No.	Wire Color	Feature	Remarks
1	Y	ABS Diagnostic Interface K	
2	W-B	ABS Diagnostic Interface (-)	
3	Y-R	ABS Diagnostic Interface L	
4	B-W	ABS Diagnostic Interface (+)	

Z023 Diagnostic Interface



Pin No.	Wire Color	Feature	Remarks
1	Y	ABS Diagnostic Interface K	
2	W-B	ABS Diagnostic Interface (-)	
3	Y-R	ABS Diagnostic Interface L	
4	B-W	ABS Diagnostic Interface (+)	

2014 To ABS Chassis Wiring Harness

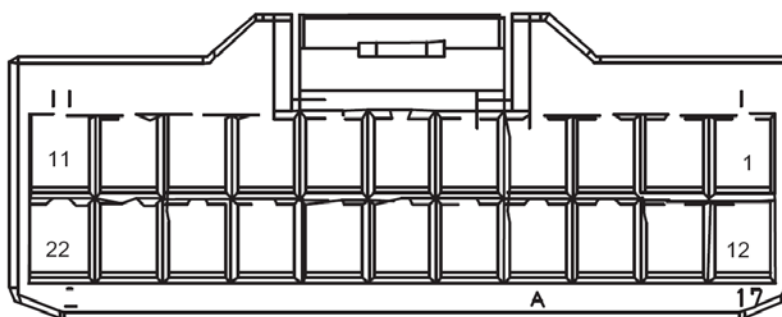


Pin No.	Wire Color	Feature	Remarks
1	Br	Intake Coil of the RH FR Wheel Solenoid Valve	
2	L	Exhaust Coil of the RH FR Wheel Solenoid Valve	
3	G/Y	Exhaust Coil of the RH FR Wheel Solenoid Valve	
4	B	RH FR Wheel Sensor (-)	
5	Br	RH FR Wheel Sensor (+)	
6	L	ASR Solenoid Valve	
7	Br	ABS Diagnostic Interface K	
8	L	ABS Diagnostic Interface L	
9	G/Y	Exhaust Coil of the LH RR Wheel Solenoid Valve	
10	B	RH RR Wheel Sensor (-)	
11	Br	RH RR Wheel Sensor (+)	

Pin No.	Wire Color	Feature	Remarks
12	Br	Intake Coil of the LH FR Wheel Solenoid Valve	
13	L	Intake Coil of the LH FR Wheel Solenoid Valve	
14	G/Y	Exhaust Coil of the LH FR Wheel Solenoid Valve	
15	B	LH FR Wheel Sensor (-)	
16	Br	LH FR Wheel Sensor (+)	
17	L	ASR Solenoid Valve	
18	Br	Intake Coil of the LH RR Wheel Solenoid Valve	
19	L	Exhaust Coil of the LH RR Wheel Solenoid Valve	
20	G/Y	Exhaust Coil of the LH RR Wheel Solenoid Valve	
21	B	LH RR Wheel Sensor (-)	
22	Br	LH RR Wheel Sensor (+)	

Circuit Diagram—Information On Wiring Harness Connector

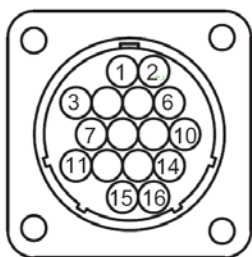
2015 To ABS Body Wiring Harness



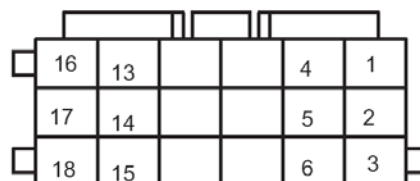
Pin No.	Wire Color	Feature	Remarks
1	Br	Intake Coil of the RH FR Wheel Solenoid Valve	
2	L	Exhaust Coil of the RH FR Wheel Solenoid Valve	
3	Y/G	ABS Center, Grounding (A)	
4	B	RH FR Wheel Sensor (+)	
5	Br	RH FR Wheel Sensor (-)	
6	L	ASR Solenoid Valve	
7	Br	Intake Coil of the RH RR Wheel Solenoid Valve	
8	L	Intake Coil of the RH RR Wheel Solenoid Valve	
9	Y/G	ABS Center, Grounding C	
10	B	RH RR Wheel Sensor (+)	
11	Br	RH RR Wheel Sensor (-)	

Pin No.	Wire Color	Feature	Remarks
12	Br	Intake Coil of the LH FR Wheel Solenoid Valve	
13	L	Intake Coil of the LH FR Wheel Solenoid Valve	
14	Y/G	ABS Center , Grounding B	
15	B	LH FR Wheel Sensor (+)	
16	Br	LH FR Wheel Sensor (-)	
17	L	ASR Solenoid Valve	
18	Br	Intake Coil of the LH RR Wheel Solenoid Valve	
19	L	Exhaust Coil of the LH RR Wheel Solenoid Valve	
20	Y/G	ABS Center , Grounding D	
21	B	LH RR Wheel Sensor (+)	
22	Br	LH RR Wheel Sensor (-)	

Z021 Diagnostic Interface



Z009 To ABS Module 1

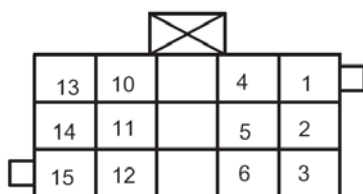


Pin No.	Wire Color	Feature	Remarks
1	B-W	ABS Diagnostic Interface (+)	
2	W-B	ABS Diagnostic Interface (-)	
3			Blank
4			Blank
5			Blank
6			Blank
7			Blank
8	Y	ABS Diagnostic Interface K	
9			Blank
10	Y-R	ABS Diagnostic Interface L	
11			Blank
12			Blank
13			Blank
14			Blank
15			Blank
16			Blank

Pin No.	Wire Color	Feature	Remarks
1	Br	ECU 18-1	
2	Br	ECU 18-2	
3	Br	ECU 18-3	
4	L	ECU 18-4	
5	L	ECU 18-5	
6	L	ECU 18-6	
7	Br	ASR Solenoid Valve	
8	Br	ECU 18-8	
9	L	ECU 18-9	
10	Br	ECU 18-10	
11	Br	ECU 18-11	
12	Br	ECU 18-12	
13	B	ECU 18-13	
14	B	ECU 18-14	
15	B	ECU 18-15	
16	L	ASR Solenoid Valve	
17	Br	ECU 18-17	
18	B	ECU 18-18	

Circuit Diagram—Information On Wiring Harness Connector

Z011 To ABS Module 2

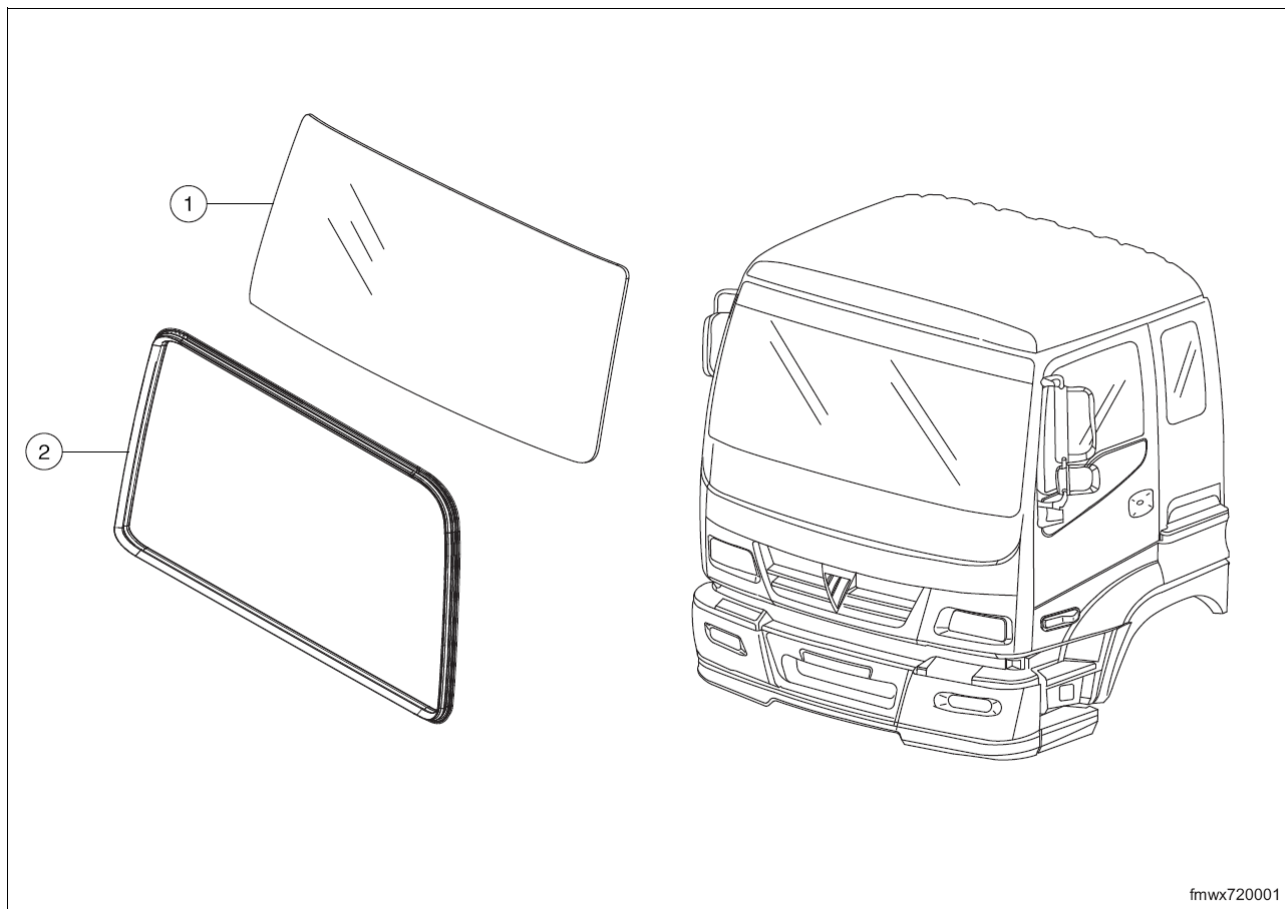


Pin No.	Wire Color	Feature	Remarks
1	G	SAE J1939 (B)	
2			Blank
3	W	SAE J1939 (A)	
4	VV-B	ABS Fuse (5A)	
5			Blank
6	G-L	ECU 14-6	
7	R-W	ABS ECU (+)	
8	B-Y	ABS ECU (UB)	
9	VV-B	ABS ECU (0V)	
10	Y	ECU 18-8	
11	Y-R	ECU 18-9	
12			Blank
13	G-Y	ASR Indicator Light	
14	VV-B	ABS ECU (DBR)	
15	B-Y	ABS ECU (WL)	

Glass, Window Lifter and Rear-view Mirror

Front Windscreen	72-3
Part Drawing	72-3
Replacement.....	72-4
Rear Window Glass	72-6
Part Drawing	72-6
Replacement.....	72-7
Side Window Glass	72-8
Part Drawing	72-8
Replacement.....	72-10
Door Glass	72-11
Part Drawing	72-11
Replacement.....	72-13
Glass Lifter.....	72-15
Part Drawing	72-15
Overhaul	72-16
Exterior Rear-view Mirror.....	72-17
Part Drawing	72-17
Replacement.....	72-18

Front Windscreen Part Drawing



1	Front Windscreen
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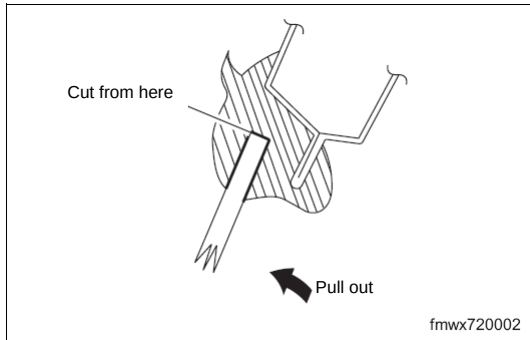
2	Front Windscreen Sealing Strip
---	--------------------------------

Replacement

Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Front Windscreen, Part Drawing.

1. Dismantle the front wiper arm, refer to Chapter 55, Wiper and Washer - Wiper Arm, Replacement



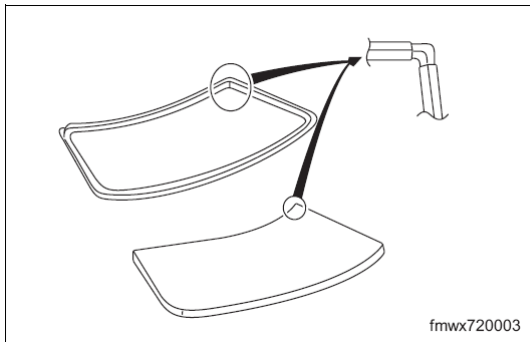
2. Dismantle the front windscreen

- (a). Cut the sealing strip, push out the glass from inside of the cab, and dismantle the glass002E

Caution:

DO NOT damage the surrounding painted surfaces and the glass when removing the glass. If the body flange is damaged, refinish and repair it, as the flange damage will lead to rust.

3. Dismantle the sealing strip for front windscreen



4. Install the sealing strip for front windscreen

- (a). Align the position mark on the sealing strip and the glass, and load the sealing strip. The displacement of the marked must not be more than 3 mm.

- After assembled together, the sealing strip must be parallel to the glass.
- It is better to heat the sealing strip with hot gas at around 75°C before installing the sealing strip.

Caution:

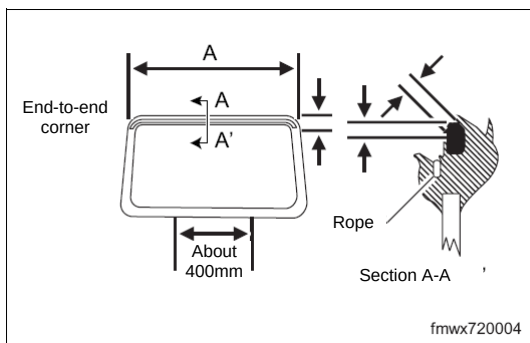
Check to ensure that there is no dust on the worktable surface, so as to prevent foreign bodies from scratching the glass.

- (b). Put a string of $\varnothing 5.0$ to 6.0 mm between the sealing strip openings, and a metal tube of around $\varnothing 8.0$ mm may be used. Entwine the string for one circle, and let it pass through the center the of glass bottom with a clearance of about 400 mm.

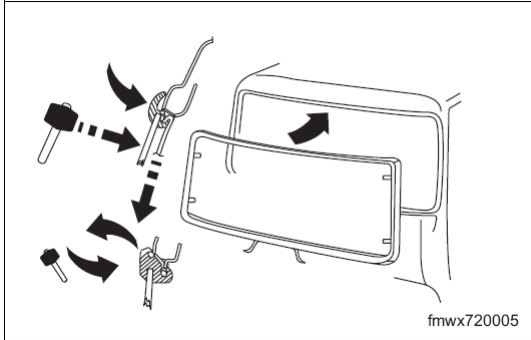
- (c). Apply sealant between the openings in the sealing strip.

Caution:

Ensure that the sealant is applied uninterrupted to prevent leakage. If the clearance of interruption as shown in the figure is more than 200 mm, reapply the sealant.



Glass, Window Lifter and Rear-view Mirror - Front Windscreen



5. Install the front windscreen

- (a). Align the center of the glass with the center of the body, and fix the glass from the outside. Pull the string toward the center of the glass from inside, and fix the opening on the body cam. Firmly support the glass, so as not to sway it.

Caution:

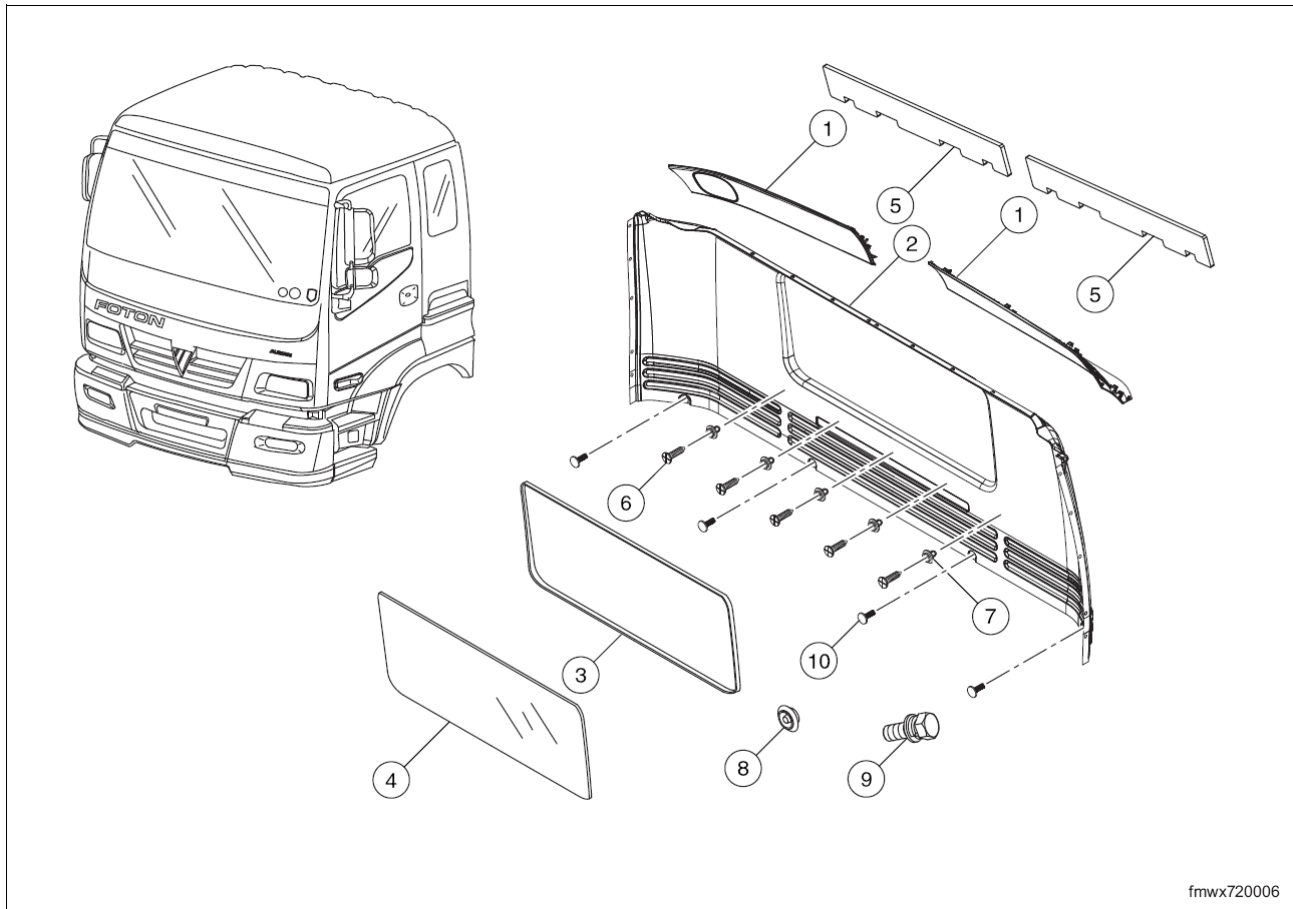
If the body cam is damaged when dismantling the glass, refinish and repair it before installation, as a broken body cam may result in rust. And if the openings are bent or twisted, correct any such problem, as it easily leads to water leakage. In case of a raised sealing strip, level it by tapping with a rubber hammer.

- (b). Wipe off the positioning scratches on the glass surface with kerosene. And Check whether there is leakage.

6. Install the front wiper arm, refer to Chapter 55, Wiper and Washer - Wiper Arm, Replacement.

Rear Window Glass

Part Drawing



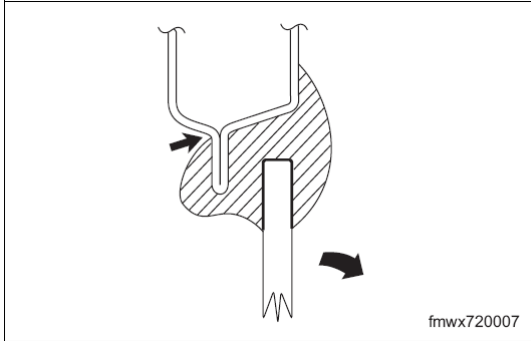
1	Trim Panel, RR Wall
2	Trim Panel, RR Wall
3	RR Window Glass Sealing Strip
4	RR Window Glass
5	RR Wall Acoustic Lining

6	Plastic Bolt
7	Plastic screw
8	Blanking Cover - RR Wall
9	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
10	Buckle -Side Guard Plate

Replacement

Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Rear Window Glass, Part Drawing.



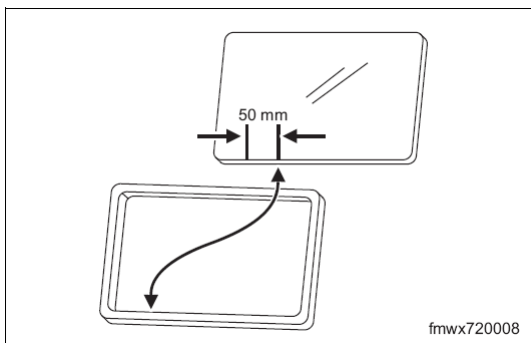
1. Dismantle the rear window glass

- (a). Push the sealing strip out of the body cam from the top edge of the rear window glass. Then slowly push the glass outward until it is completely removed.

Caution:

Be careful not to damage the surrounding painted surfaces and the glass when dismantling the glass. If the body cam is damaged when dismantling the glass, refinish and repair it before installation, as a broken body cam may result in rust.

2. Dismantle the sealing strip of the rear window glass

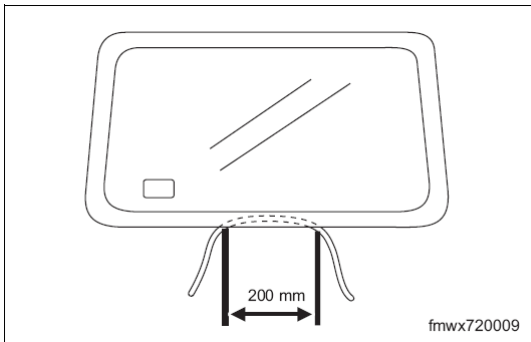


3. Install the sealing strip of the rear window glass

- (a). Install a sealing strip with the adhesive part of the sealing strip at a location about 50 mm away from the glass center from the middle of the scratch on the glass.
- The sealing strip must be parallel to the glass after installed together.

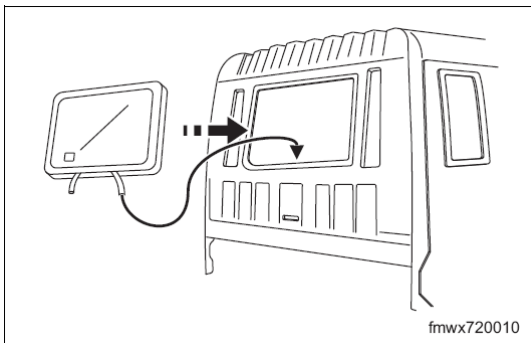
Caution:

Check to ensure that there is no dust on the worktable surface, so as to prevent foreign bodies from scratching the glass.



4. Install the rear window glass

- (a). Put a string of $\varnothing 4.0$ mm between the sealing strip openings, and a metal tube of around $\varnothing 6.0$ mm may be used. Entwine the string for one circle, and let it pass through the center the of glass bottom with a clearance of about 200 mm.



- (b). Align the center of the glass with the center of the body, and fix the glass from the outside. Pull the string toward the center of the glass from inside, and fix the opening on the body cam. Firmly support the glass, so as not to sway it.

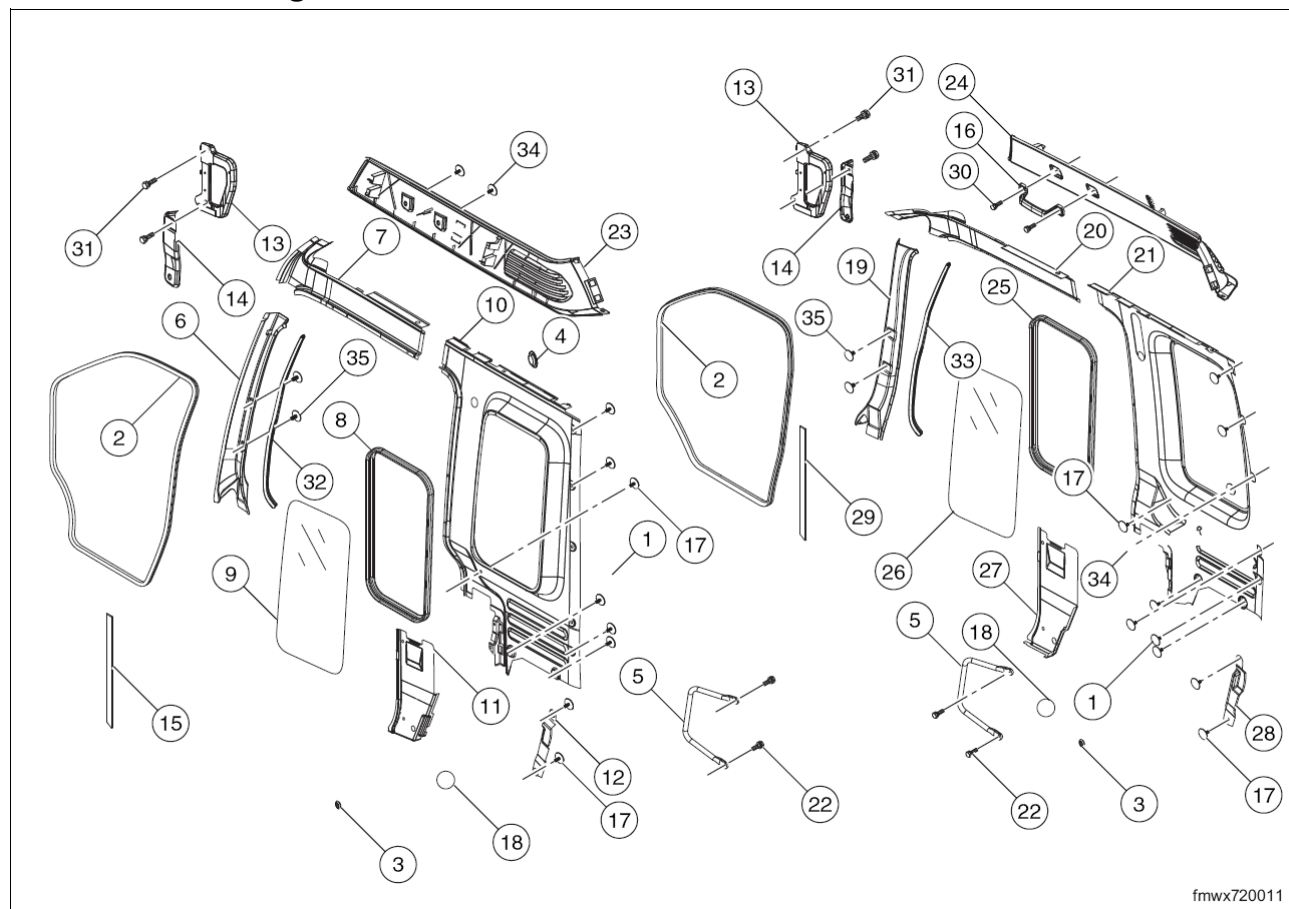
Caution:

If the body cam is damaged when dismantling the glass, refinish and repair it before installation, as a broken body cam may result in rust. And if the openings are bent or twisted, correct any such problem, as it easily leads to water leakage. In case of a raised sealing strip, level it by tapping with a rubber hammer.

- (c). Wipe off the positioning scratches on the glass surface with kerosene. And Check whether there is leakage.

Side Window Glass

Part Drawing



1	Big Buckle
2	Door Frame Protection Stripe Assembly
3	Blanking Cover - FR Wall
4	Blanking Cover - Side Wall
5	Posterior Commode Handle
6	FR Pillar Inner Guard Plate (LH)
7	FR Inner Trim Panel, LH Side Wall
8	LH RR Window Glass Sealing Strip
9	LH RR Window Glass Assembly
10	Upper Inner Guard Plate, LH Side Wall
11	Lower Inner Guard Plate, LH Side Wall
12	LH RR Wall Bracket
13	FR Pillar Armrest Assembly

19	FR Pillar Inner Guard Plate (RH)
20	FR Inner Trim Panel, RH Wall
21	Upper Inner Guard Plate, RH Wall
22	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
23	LH RR Trim Panel
24	RH RR Trim Panel
25	RH RR window Glass Sealing Strip
26	RH RR Window Glass Assembly
27	Lower Inner Guard Plate, RH Wall
28	RH RR Wall Bracket
29	Anti-overflow Adhesive Tape (RH)
30	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
31	Cross Recessed Pan Head Screw, Spring Washer and Plain Cushion Assembly

Glass, Window Lifter and Rear-view Mirror - Side Window Glass

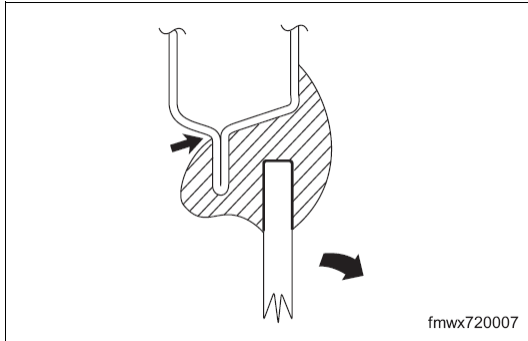
14	Pillar Armrest Bracket
15	Anti-overflow Adhesive Tape (LH)
16	Overhead Handle
17	Buckle -Side Guard Plate
18	Adhesive Hole Sticker $\varnothing$ 25

32	Door Frame Weather Bar Assembly (LH)
33	Door Frame Weather Bar Assembly (RH)
34	Buckle -Side Guard Plate (Black)
35	Big Buckle

Replacement

Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror- Side Window Glass, Part Drawing.



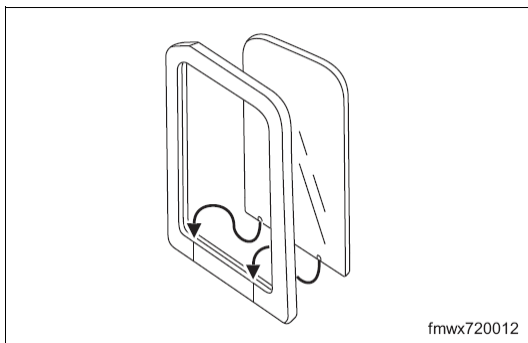
1. Dismantle the side window glass

- (a). Push the sealing strip out of the body cam from the top edge of the rear window glass. Then slowly push the glass outward until it is completely removed.

Caution:

Be careful not to damage the surrounding painted surfaces and the glass when dismantling the glass. If the body cam is damaged when dismantling the glass, refinish and repair it before installation, as a broken body cam may result in rust.

2. Dismantle the side window glass sealing strip



3. Install the side window glass sealing strip

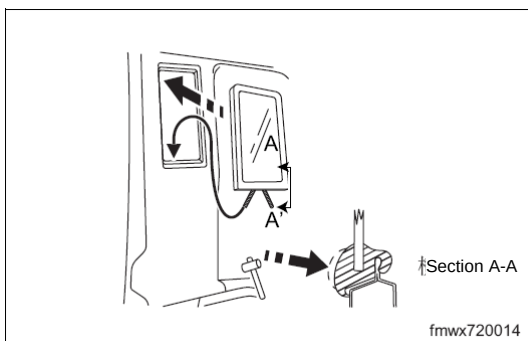
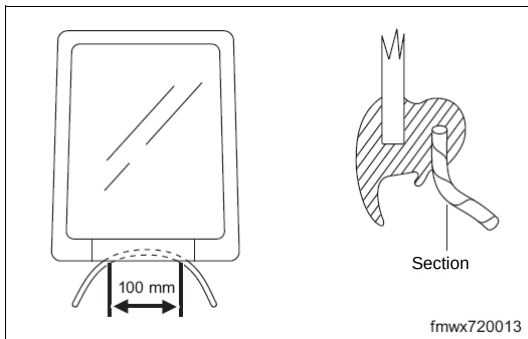
- (a). Loosen the fastening nut at the top. Dock the adhesive part of the sealing strip with the positioning scratch on the glass, and then assemble them together. The displacement the scratch cannot exceed 3 mm.
- The sealing strip must be parallel to the glass when installing.

Caution:

Check to ensure that there is no dust on the worktable surface, so as to prevent foreign bodies from scratching the glass.

4. Install the side window glass

- (a). Put a string of $\varnothing 4.0$ mm between the sealing strip openings, and a metal tube of around $\varnothing 6.0$ mm may be used. Entwine the string for one circle, and let it pass through the center the of glass bottom with a clearance of about 100 mm.



- (b). Align the center of the glass with the center of the body, and fix the glass from the outside. Pull the string toward the center of the glass from inside, and fix the opening on the body cam. Firmly support the glass, so as not to sway it.

Caution:

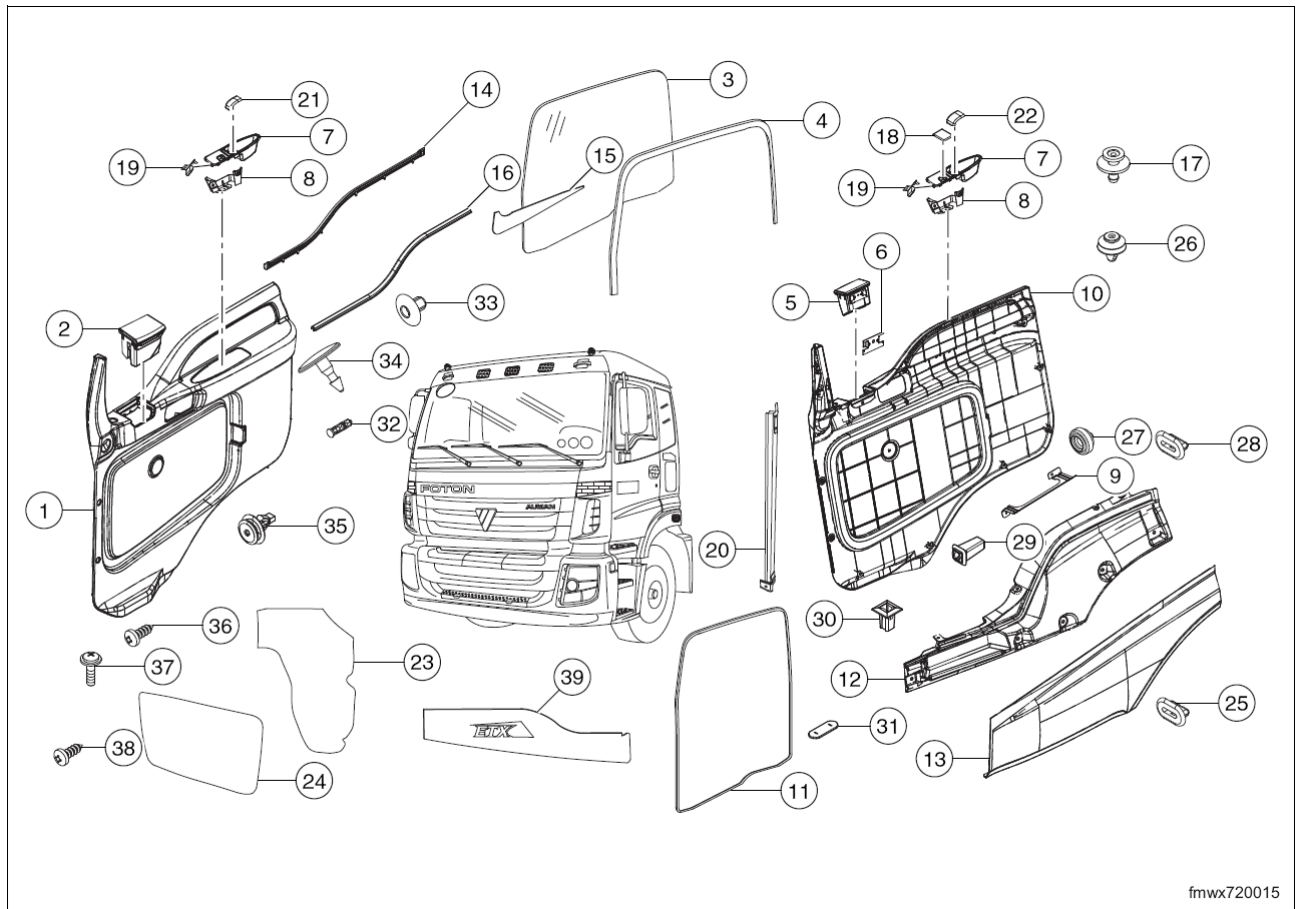
If the body cam is damaged when dismantling the glass, refinish and repair it before installation, as a broken body cam may result in rust. And if the openings are bent or twisted, correct any such problem, as it easily leads to water leakage. In case of a raised sealing strip, level it by tapping with a rubber hammer. Likewise, clean the dust between the sealing strip and the body cam to avoid water leakage.

- (c). Wipe off the positioning scratches on the glass surface with kerosene. And Check whether there is leakage.

Glass, Window Lifter and Rear-view Mirror - Door Glass

Door Glass

Part Drawing



1	Inner Guard Plate Assembly, RH Door
2	Ashtray Assembly (RH)
3	Door Glass Assembly
4	Door Glass Sealing Strip Assembly
5	Ashtray Assembly (LH)
6	Ashtray Bracket
7	Inner armrest Assembly
8	Inner Armrest Bracket
9	Retaining Clamp Assembly
10	Inner Guard Plate Assembly, LH Door
11	Door Sealing Strip
12	Liner Plate, Lower Door Trim Panel
13	Lower Door Trim Panel Assembly
14	External Sealing Strip Assembly for the Door and the Window Sill

21	Blank Cap, RH Inner Armrest
22	Blank Cap, LH Inner Armrest B
23	FR Waterproof Film, Door
24	RR Waterproof Film, Door
25	Cup Head Jam
26	Buckle -Door Guard Plate
27	Round Cushion
28	Buckle Block - Roof Trim Panel
29	Plastic Nut
30	Buckle Block -Ventilating Hood
31	Blanking Cover, Lower Ventilation Opening
32	Buckle -Mudguard
33	Buckle Block -Mudguard
34	FR Door Spike

Glass, Window Lifter and Rear-view Mirror - Door Glass

15	Door and Window Sill Patches
16	Door and window sill Inner Sealing Strip Assembly
17	Buckle
18	Blank Cap A, LH Inner Armrest
19	Armrest Hood Clamp
20	FR Door Guide Rail Assembly

35	Plastic Buckle
36	Cross Recessed Tapping Screw
37	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
38	Cross Recessed Tapping Screw
39	ETX Door Side Label Patch

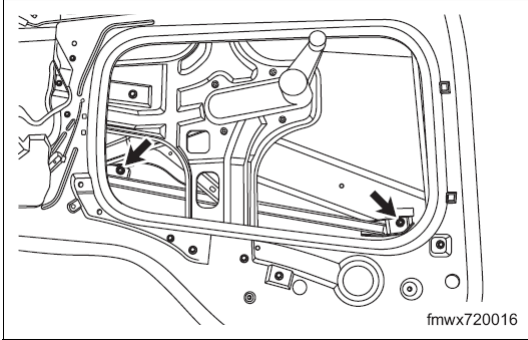


Replacement

Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Door Glass, Part Drawing

1. Dismantle the door inner guard plate, refer to Chapter 76, Interior/Exterior Trim Parts - Door Inner Guard Plate, Replacement
2. Remove the rear waterproof film of the door
3. Dismantle the door glass sealing strip assembly

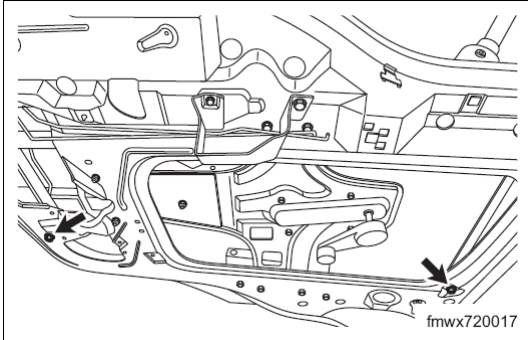


4. Dismantle the door glass assembly

- (a). Adjust the door glass to an appropriate location.
- (b). Dismantle the door glass fixing screws.
- (c). Tilt the door glass about 45° and take it out.

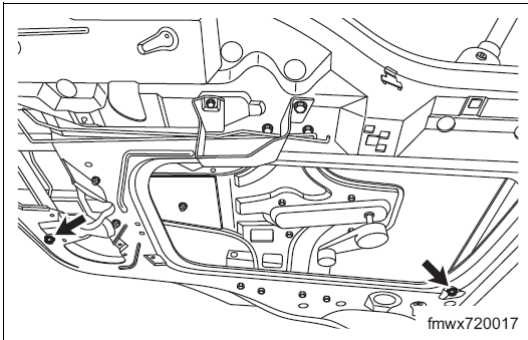
Caution:

Be careful not to drop the glass door



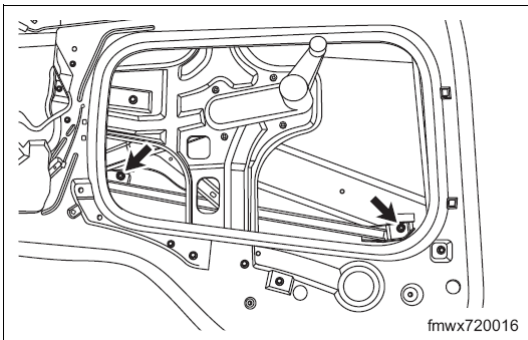
5. Dismantle the door guide rail assembly

- (a). Dismantle the door guide rail fixing bolts.



6. Install the door guide rail assembly

- (a). Install the door guide rail fixing bolts.
Torque: 9N.m

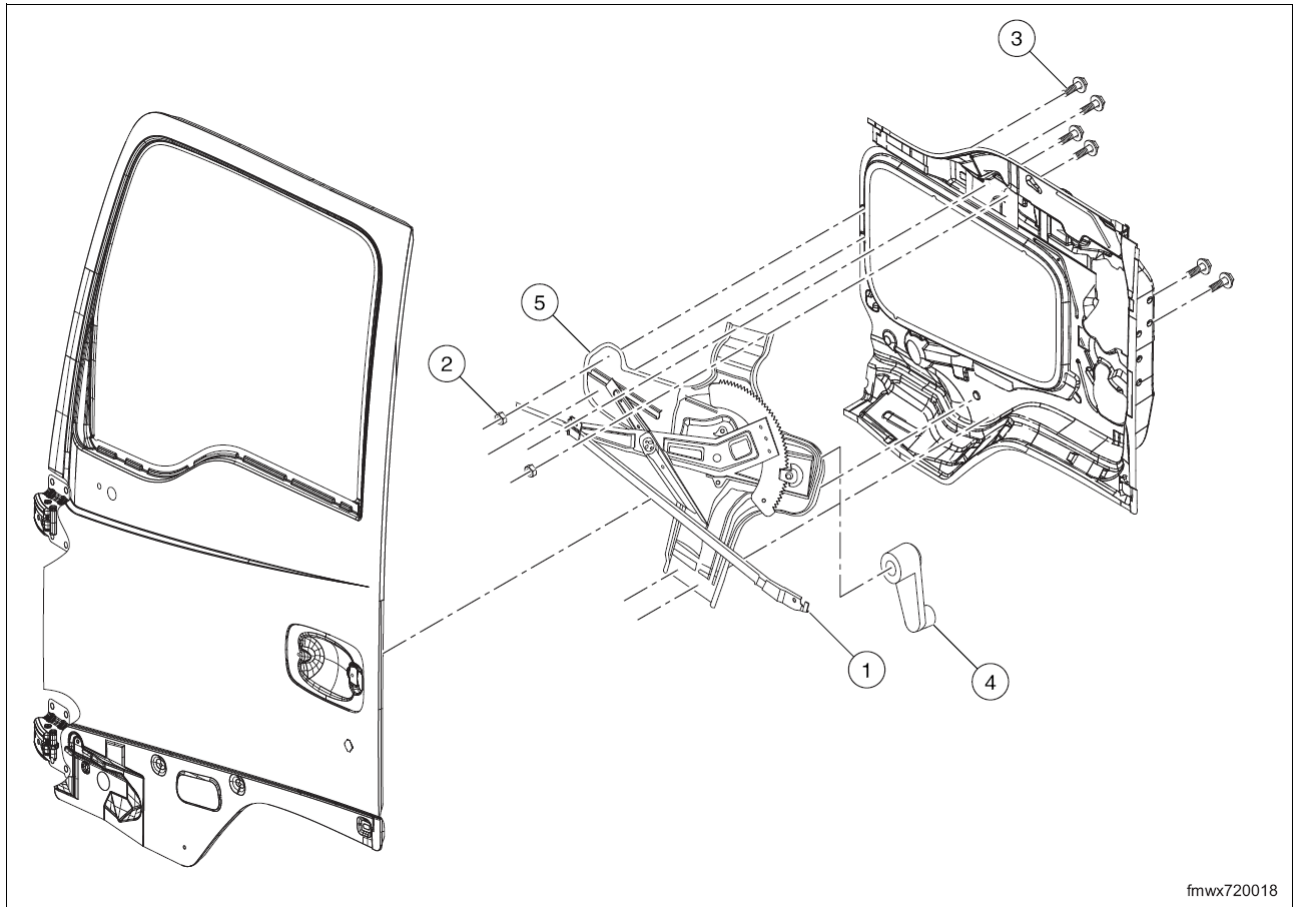


7. Install the door glass assembly

- (a). Tilt the door glass about 45° and install it.
- (b). Install the door glass fixing screws.

8. Install the door glass sealing strip assembly
9. Install the rear waterproof film of the door
10. Install the door inner guard plate, refer to Chapter 76, Interior/Exterior Trim parts - Door Inner Guard Plate, Replacement.

Glass Lifter Part Drawing



1	Glass Lifter Assembly
2	Hex Flange Face Nut
3	Screw, Plain Cushion and Spring Washer Assembly

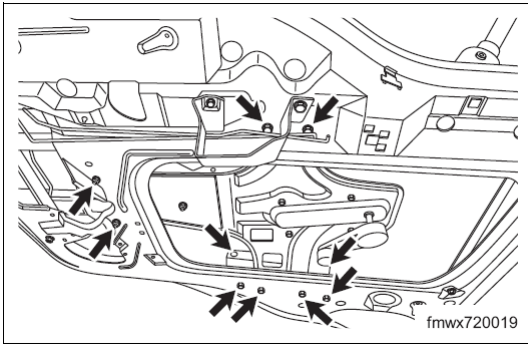
4	Riser Crank Assembly
5	Riser Support Plate Assembly

Overhaul

Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Glass Lifter, Part Drawing

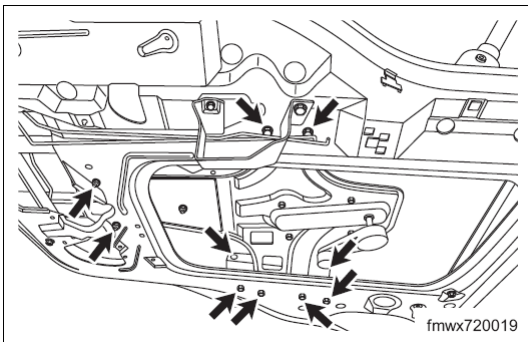
1. Dismantle the door inner guard plate, refer to Chapter 76, Interior/Exterior Trim parts - Door Inner Guard Plate, Replacement
2. Remove the rear Waterproof Film of the Door
3. Dismantle the door glass, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Door Glass, Replacement.



4. Dismantle the glass lifter assembly
 - (a). Dismantle the fixing bolts and nuts of the glass lifter.

5. Check the glass lifter assembly

- (a). Check the glass lifter to see whether there is deformation. If it is deformed, replace the glass lifter.
- (b). Check all the movable roller wheels to see whether there is abrasion and deformation. If so, replace the glass lifter.
- (c). Check the rocker ratchet. If the fit clearance between the rocker ratchet and the engaging teeth of the window rocker is too large or if the rocker ratchet is dislocated, replace the glass lifter.
- (d). Check the rocker shaft and turn the rocker shaft. The rocker shaft should feel smooth without "clicking" sound; otherwise, replace the glass lifter.



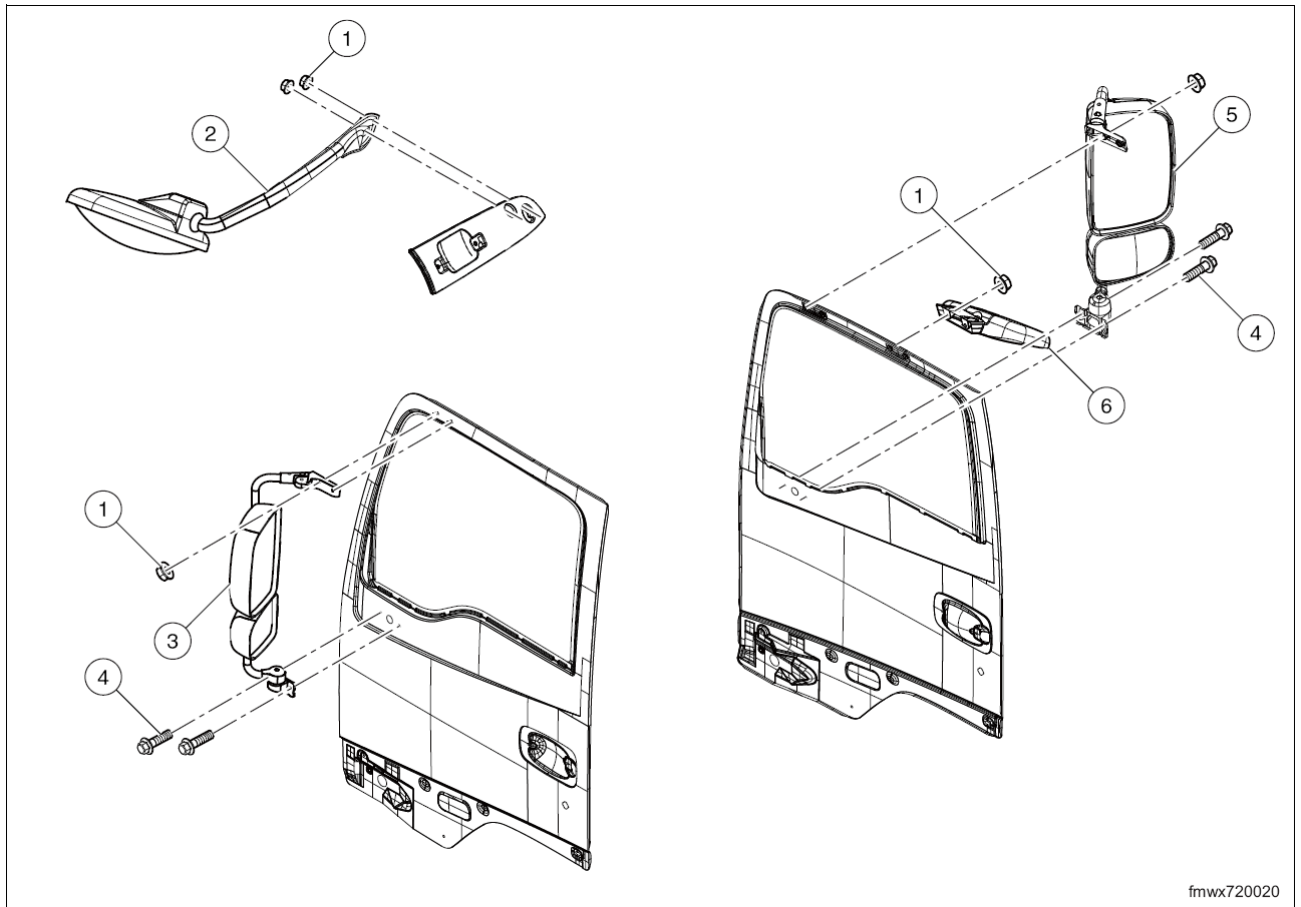
6. Install the glass lifter assembly

- (a). Install the fixing bolts and nuts of the glass lifter.
Torque: 9N.m

7. Install the door glass, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Door Glass, Replacement
8. Install the rear waterproof film of the door
9. Install the door inner guard plate, refer to Chapter 76, Interior/Exterior Trim parts - Door Inner Guard Plate, Replacement

Exterior Rear-view Mirror

Part Drawing



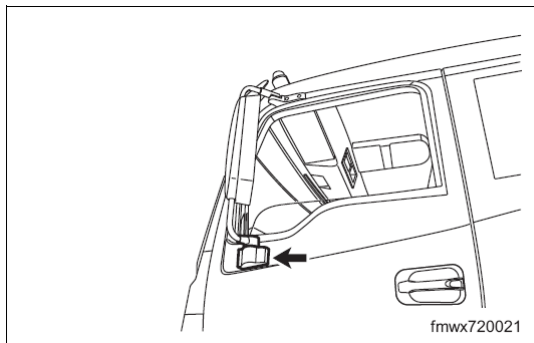
1	Hex Flange Face Nut
2	FR Down-view Mirror Assembly
3	LH Rear-view Mirror Assembly

4	Hex Key Fillister Head Screw
5	RH Rear-view Mirror Assembly
6	Side Down-view Mirror Assembly

Replacement

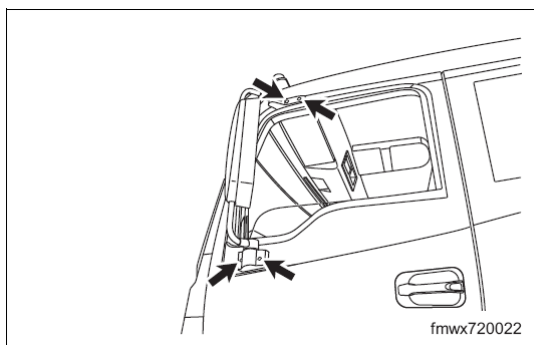
Hint:

Part Drawing, refer to Chapter 72, Glass, Window Lifter and Rear-view Mirror - Exterior Rear-view Mirror, Part Drawing

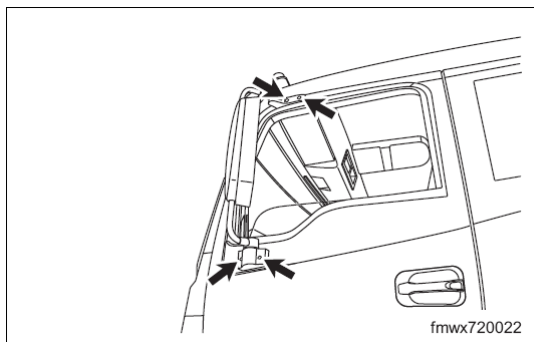


1. Dismantle the left rear-view mirror assembly

- (a). Dismantle the bottom cover of the left rear-view mirror.

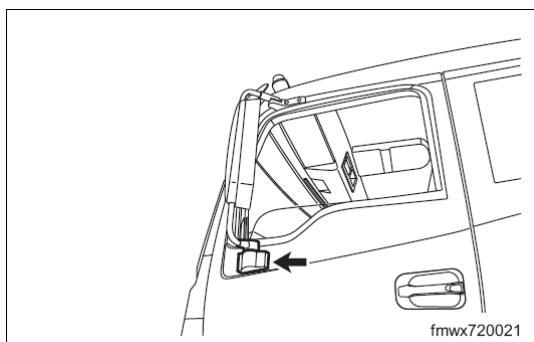


- (b). Dismantle the hex key fixing screws and fixing nuts of the left rear-view mirror.



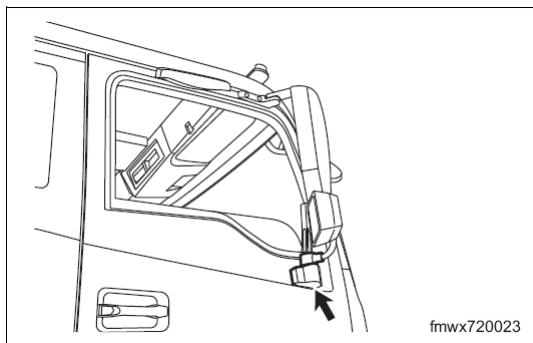
2. Install the left rear-view mirror assembly

- (a). Install the hex key fixing screws and fixing nuts of the left rear-view mirror.
Torque: **20N.m**

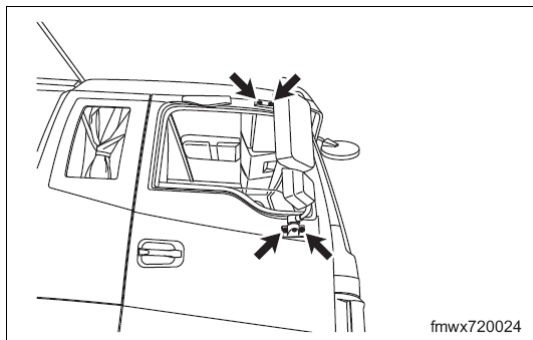


- (b). Install the bottom cover of the left rear-view mirror.

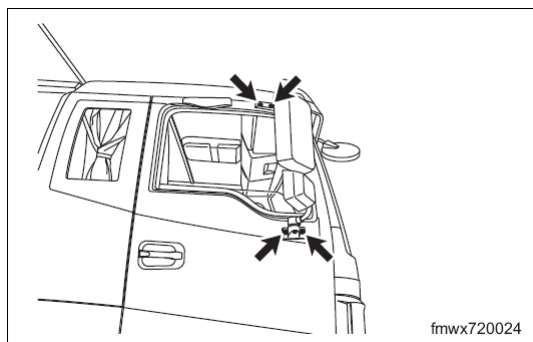
Glass, Window Lifter and Rear-view Mirror - Exterior Rear-view Mirror



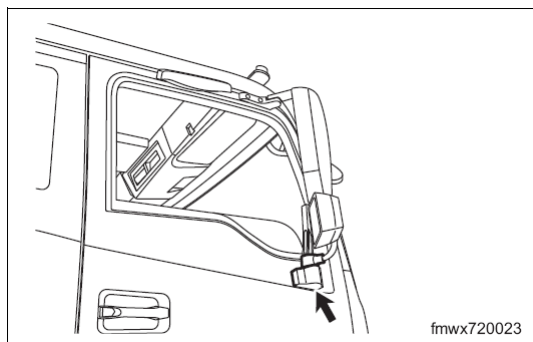
1. **Dismantle the left rear-view mirror assembly**
 - (a). Dismantle the bottom cover of the left rear-view mirror.



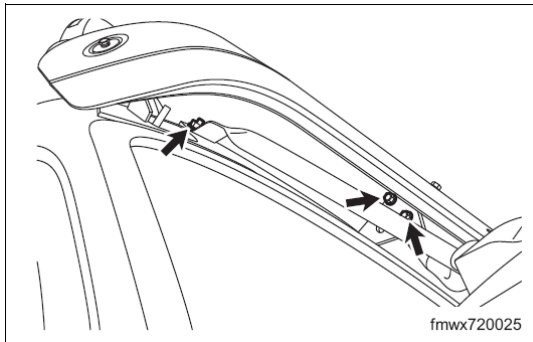
- (b). Dismantle the hex key fixing screws and fixing nuts of the left rear-view mirror.



2. **Install the left rear-view mirror assembly**
 - (a). Install the hex key fixing screws and fixing nuts of the left rear-view mirror.
Torque: **20N.m**

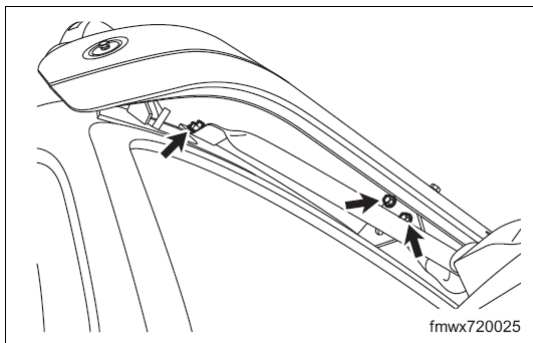


- (b). Install the bottom cover of the left rear-view mirror.



1. Dismantle the front down-view mirror assembly

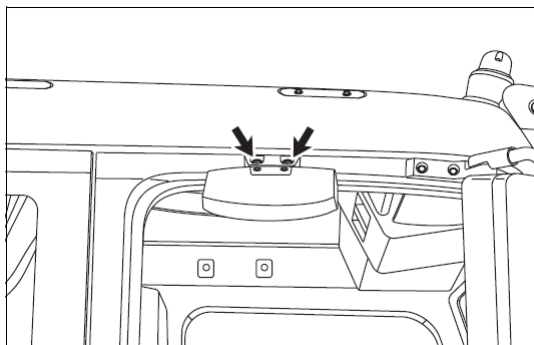
- (a). Dismantle the fixing bolts and nuts of the front down-view mirror.



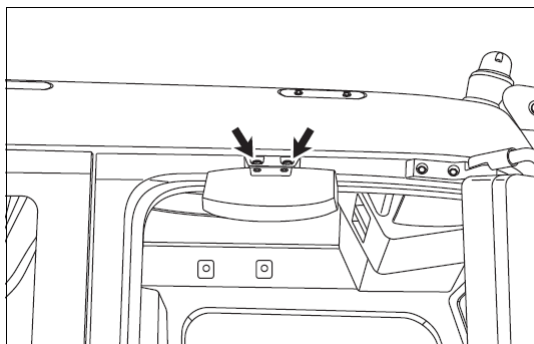
2. Install the front down-view mirror assembly

- (a). Install the fixing bolts and nuts of the front down-view mirror.
Torque: **20N.m**

Glass, Window Lifter and Rear-view Mirror - Exterior Rear-view Mirror



1. Dismantle the side down-view mirror assembly
- (a). Dismantle the fixing nut of the side down-view mirror.



2. Install the side down-view mirror assembly
- (a). Install the fixing nut of the side down-view mirror.
Torque: **24N.m**

Dashboard, Instrument, Cigarette Lighter

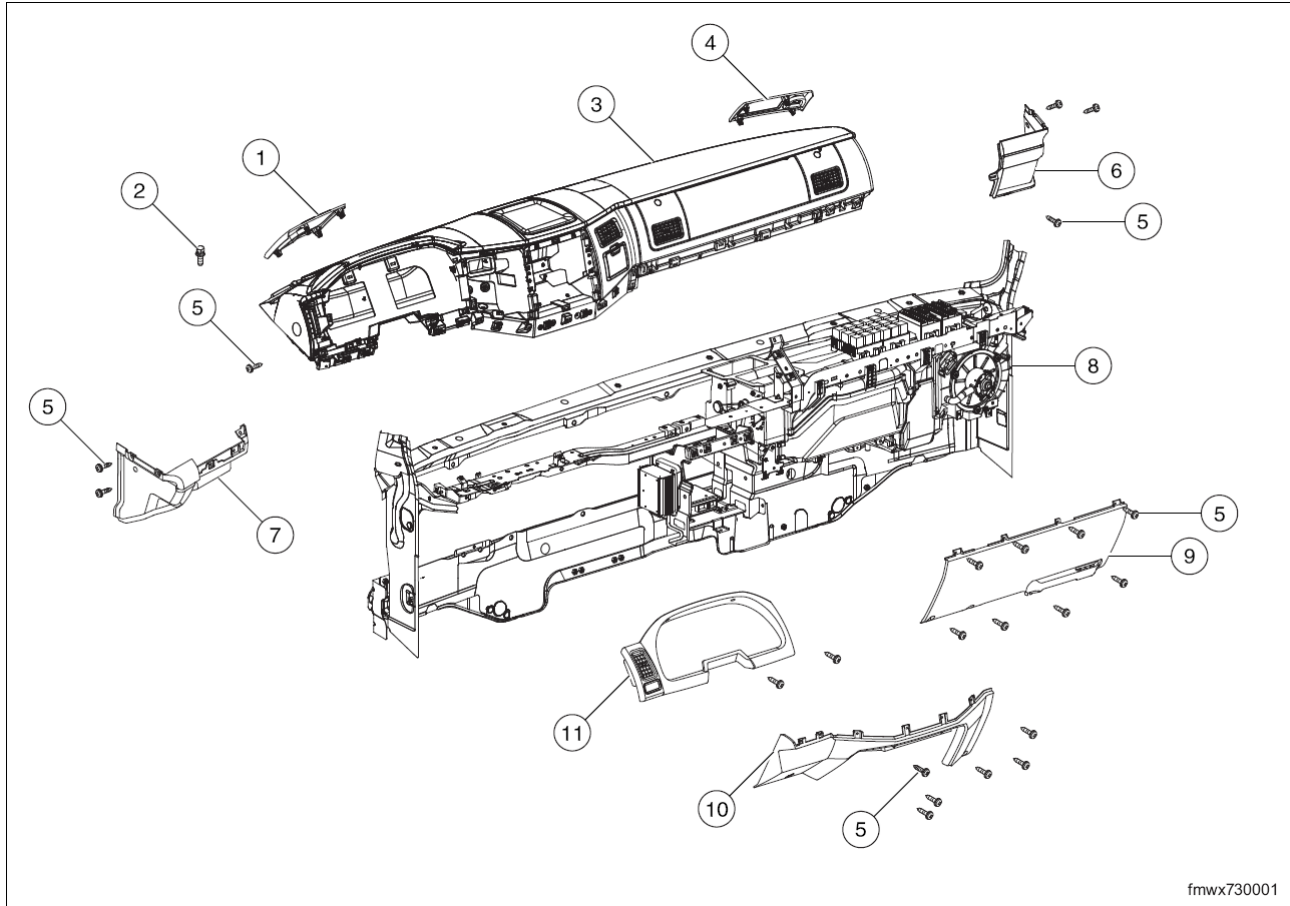
Dashboard.....	73-3
Precautions	73-3
Part Drawing	73-4
Replacement.....	73-6
Instrument Cluster.....	73-11
Part Drawing	73-11
Replacement.....	73-12
Cigarette Lighter.....	73-14
Part Drawing	73-14
Replacement.....	73-15

Dashboard

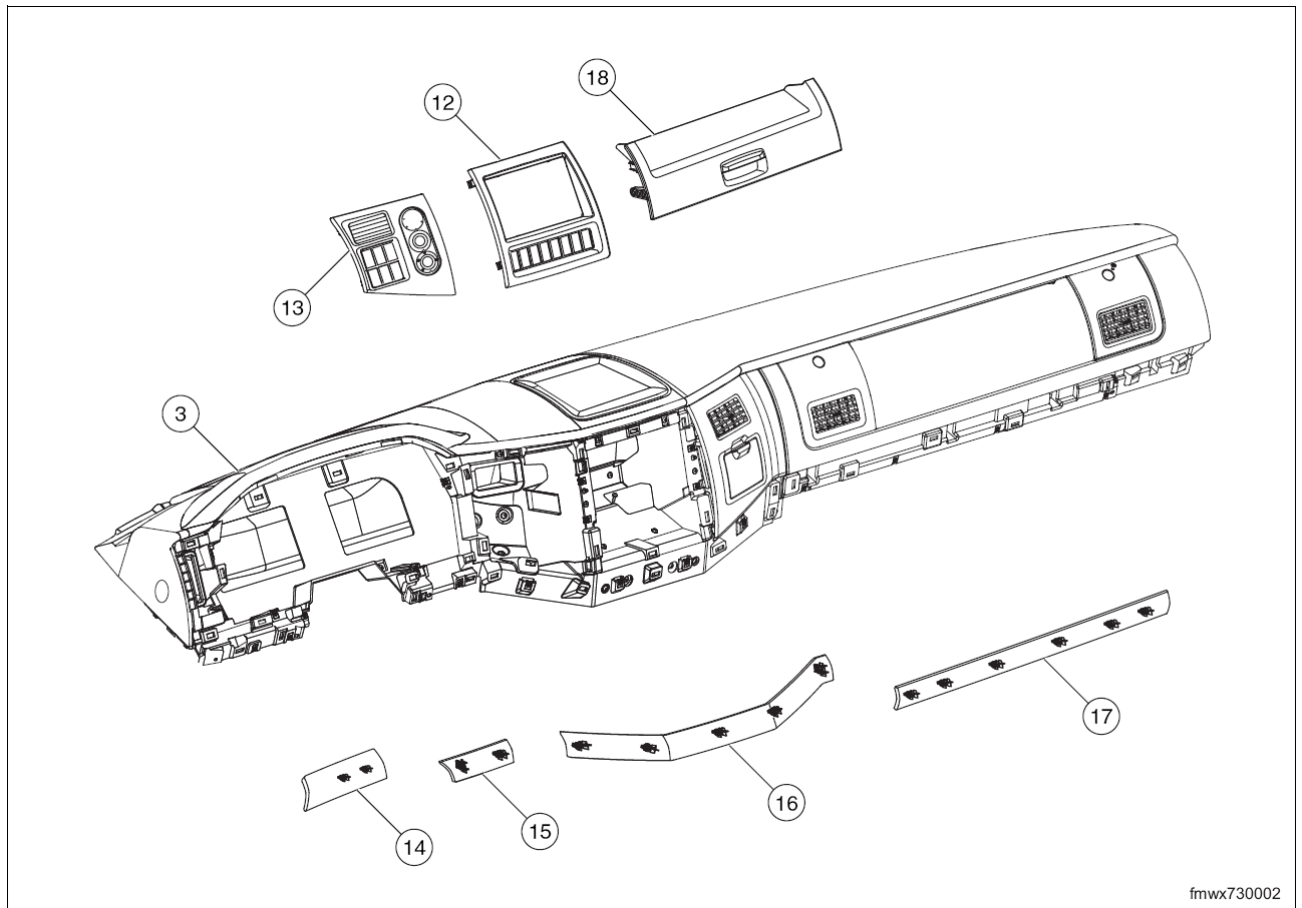
Precautions

1. **The clock of the instrument cluster will be reset after dismantlement of the instrument panel, but the odometer will not be reset.**
2. **The settings saved by the audio system will be lost after dismantling the instrument panel**
 - (a) After installation of the instrument panel, the audio system must be reset.
3. **Cut off the power**
 - (a). Before removal or installation of any electrical equipment or any exposed electrical terminal which can be easily contacted by any tool or equipment, be sure to disconnect the negative battery cable first to prevent personal injury or vehicle damage.
 - (b). Turn off the ignition switch, unless otherwise specified.

Part Drawing



Dashboard, Instrument, Cigarette Lighter - Dashboard



1	LH Horn Hood Assembly
2	Hex Head Bolts, Spring Washer And Flat Washer Assembly
3	Instrument Panel Subassembly
4	RH Horn Hood Assembly
5	Tapping Screw
6	RH Corner Plate Assembly
7	LH Corner Plate Assembly
8	ST4.2 Leaf Spring Nut
9	Co-driver Side Apron Plate Assembly

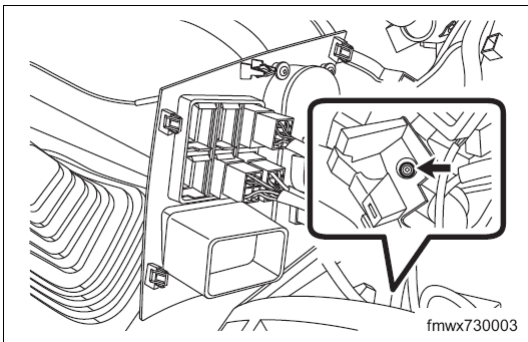
10	Intermediate and Lower Apron Plate Assembly
11	Instrument Hood Assembly
12	Intermediate Panel Assembly
13	Intermediate and LH Panel Assembly
14	Driver Side LH Trim Assembly
15	Driver Side RH Trim Assembly
16	Intermediate Trim Assembly
17	Co-driver Side Trim Assembly
18	Relay Box Cover Assembly

Replacement

Hint:

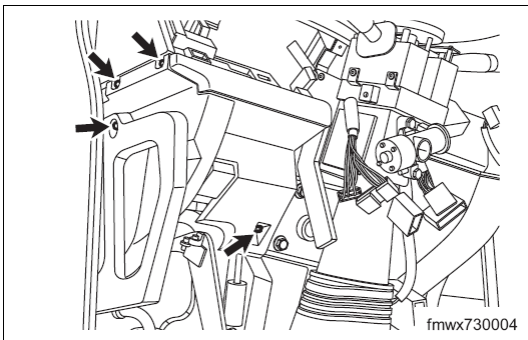
Part Drawing, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Dashboard, Part Drawing.

1. Turn off the main power supply
2. Place the steering wheel at the lowest position
3. Dismantle the driver side right trim assembly
4. Dismantle the intermediate trim assembly
5. Dismantle the co-driver side trim assembly
6. Dismantle the instrument cluster assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Instrument Cluster, Replacement
7. Dismantle the intermediate and left panel assembly, refer to Chapter 51, Air Heater and Air Conditioning - Control Module, Overhaul.

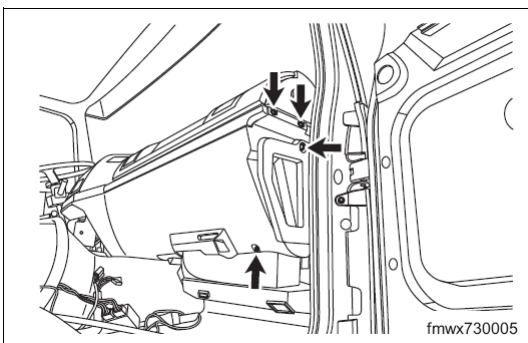


8. Dismantle the fixing screws of the dashboard and the instrument keel.

9. Dismantle the radio & tape player, refer to Chapter 56, Audio System - Radio & Tape Player, Replacement

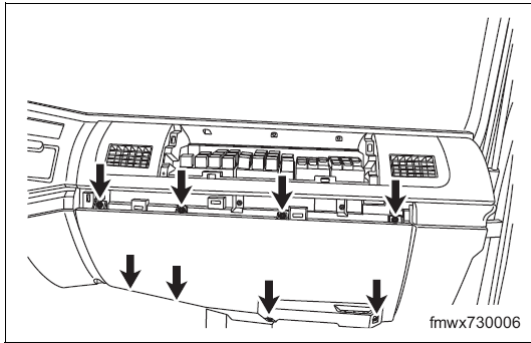


10. Dismantle the left corner plate assembly
 - (a). Dismantle the fixing bolts at the upper part of the left front pillar armrest.
 - (b). Dismantle the fixing screws of the left corner plate, and remove the left corner plate assembly.



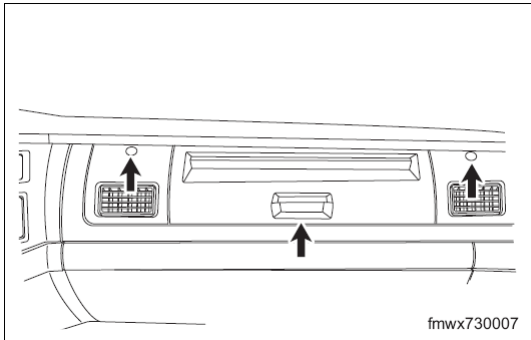
11. Dismantle the right corner plate assembly
 - (a). Dismantle the fixing bolts at the upper part of the right front pillar armrest.
 - (b). Dismantle the right corner plate fixing screws, and remove the left corner plate assembly.

Dashboard, Instrument, Cigarette Lighter - Dashboard



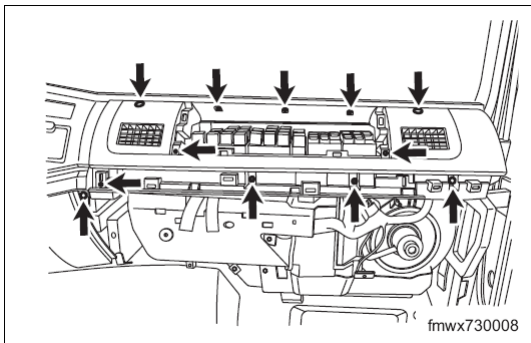
12. Dismantle the co-driver side apron plate assembly

- (a). Dismantle the fixing screws of the co-driver side apron plate.



13. Dismantle the co-driver side panel assembly

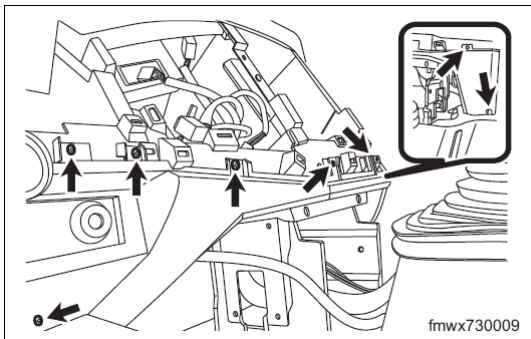
- (a). Remove the relay box cover, and dismantle the blanking covers at both sides.



- (b). Dismantle the fixing screws of the co-driver side panel.

14. Dismantle the intermediate platform rear assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter, Replacement.

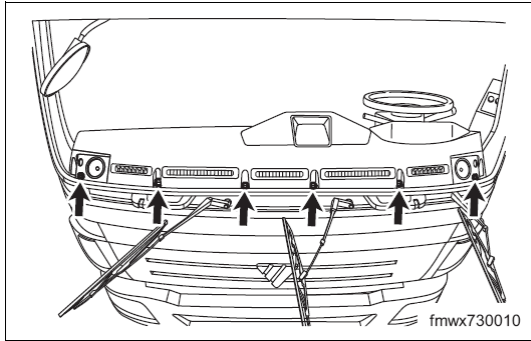
15. Dismantle the intermediate platform front assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter, Replacement.



16. Dismantle the intermediate and lower apron plate assembly

- (a). Dismantle the fixing screws of the intermediate and lower apron plate.

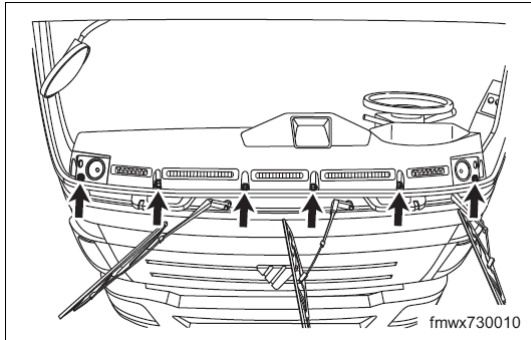
17. Dismantle the loudspeaker assembly, refer to Chapter 56, Audio System - Loudspeaker, Replacement



- 18. Dismantle the instrument panel subassembly**
(a). Dismantle the fixing bolts of the instrument panel subassembly, and remove the instrument panel subassembly.

Caution:

Do not damage any surface of the instrument panel. The instrument panel subassembly should be placed in a dry and ventilated room away from any heat source and chemicals. Several persons should work together when handling the instrument panel subassembly.



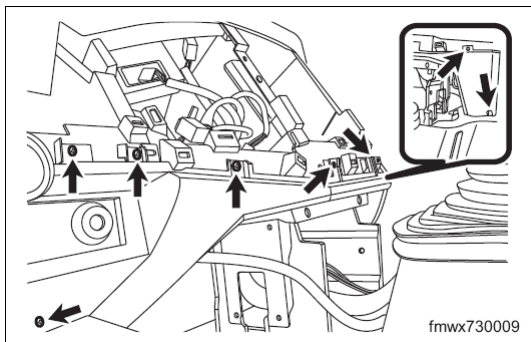
- 19. Install the instrument panel subassembly**
(a). Install the fixing bolts of the instrument panel subassembly.

Torque: 40N.m

Caution:

Do not squeeze or twist the wire wiring harnesses.

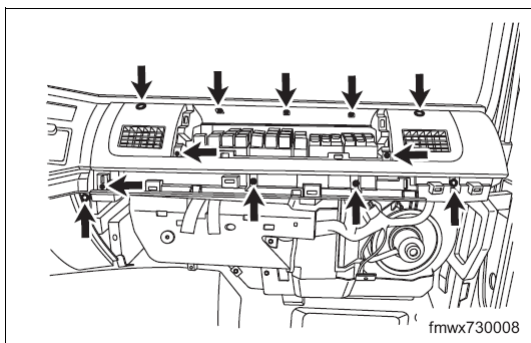
- 20. Install the loudspeaker assembly, refer to Chapter 56, Audio System - Loudspeaker, Replacement**



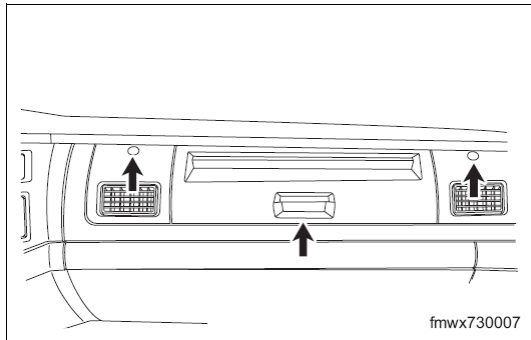
- 21. Install the intermediate and lower apron plate assembly**

- (a). Install the fixing screws of the intermediate and lower apron plate.

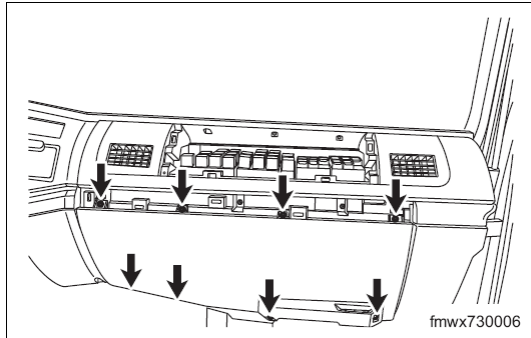
- 22. Install the intermediate platform front assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter, Replacement**
23. Install the intermediate platform rear assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter, Replacement



- 24. Install the co-driver side panel assembly**
(a). Install the fixing screws of the co-driver side panel.

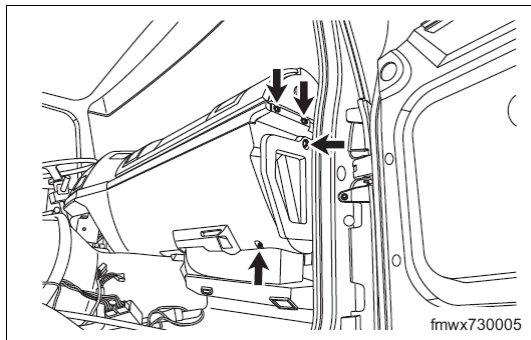
Dashboard, Instrument, Cigarette Lighter - Dashboard

- (b). Install the relay box cover, and then install the blanking covers at both sides.



25. Install the co-driver side apron plate assembly

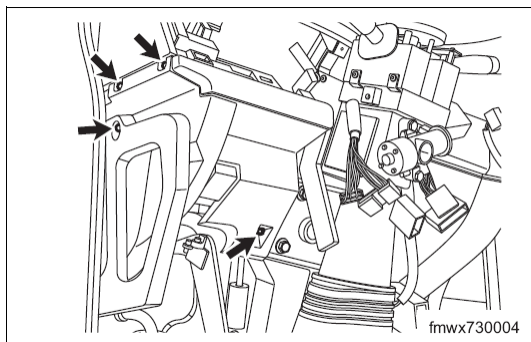
- (a). Install the fixing screws of the co-driver side apron plate.



26. Install the right corner plate assembly

- (a). Install the fixing screws of the right corner plate.
(b). Install the fixing bolts at the upper part of the right front pillar armrest.

Torque: **8N.m**

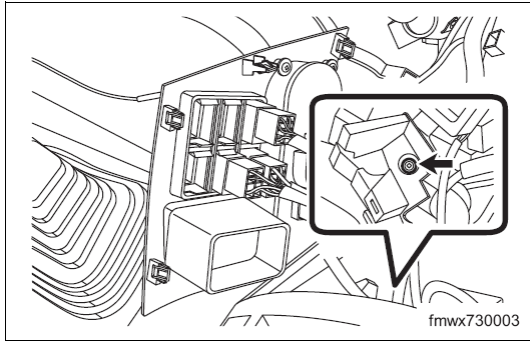


27. Install the left corner plate assembly

- (a). Install the fixing screws of the left corner plate.
(b). Install the fixing bolts at the upper part of the left front pillar armrest.

Torque: **8N.m**

- 28. Install the radio & tape player, refer to Chapter 56, Audio System -Radio & Tape Player, Replacement**

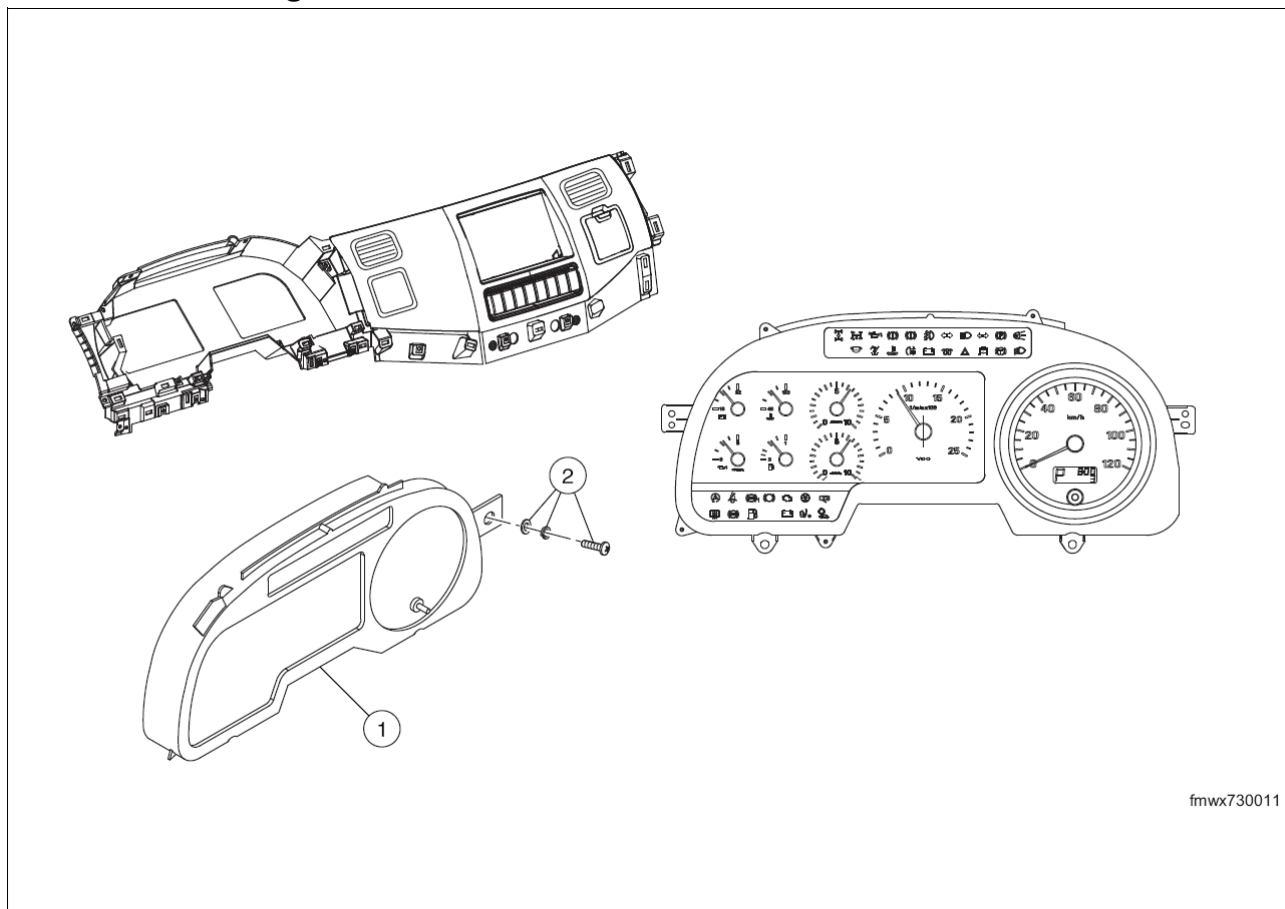


- 29. Install the dashboard and the instrument keel fixing screws**

- 30. Install the Intermediate and left panel assembly, refer to Chapter 51, Air Heater and Air Conditioning - Control Module, Overhaul.**
- 31. Install the instrument cluster assembly, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Instrument Cluster, Replacement**
- 32. Install the co-driver side trim assembly**
- 33. Install the intermediate trim assembly**
- 34. Install the driver side right trim assembly**
- 35. Adjust the steering wheel to the appropriate position**
- 36. Turn on the main power supply**

Instrument Cluster

Part Drawing



1	Instrument Cluster Assembly
---	-----------------------------

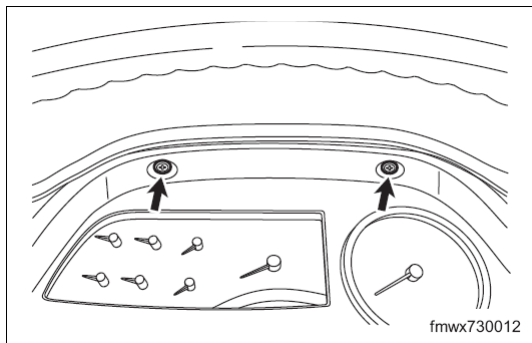
2	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
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Replacement

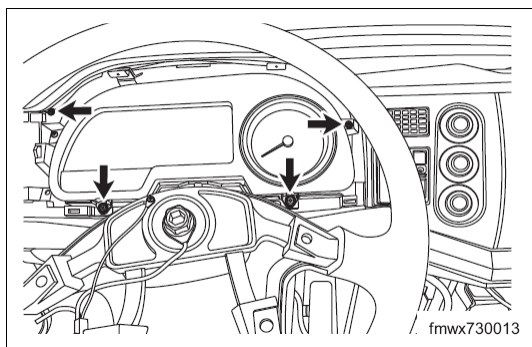
Hint:

Part Drawing, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Instrument Cluster, Part Drawing.

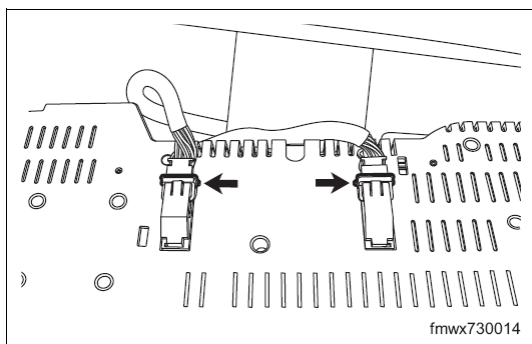
1. Turn off the main power supply
2. Place the steering wheel at the lowest position



3. Dismantle the Instrument hood assembly
 - (a). Dismantle the Instrument hood fixing screws, and pull out the instrument hood assembly in the backward direction.



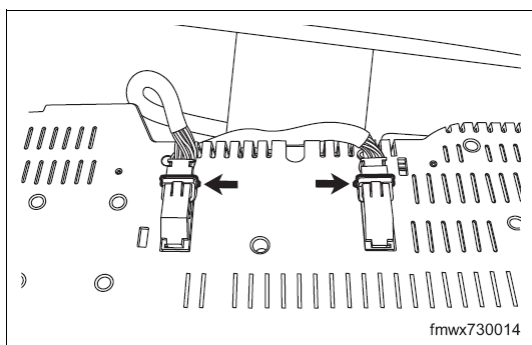
4. Dismantle the instrument cluster assembly
 - (a). Dismantle the instrument cluster fixing screws.



- (b). Dismantle the connector of the instrument cluster assembly.

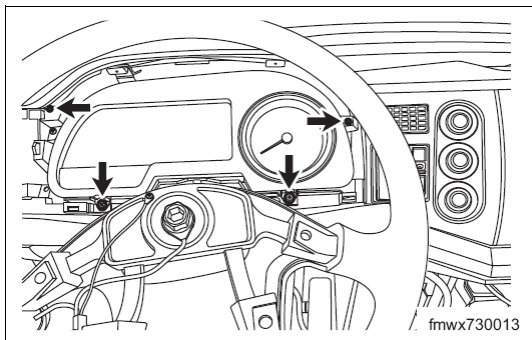
Caution:

What should be held when pull out the connector is the wiring harness connector instead of the wiring harness.

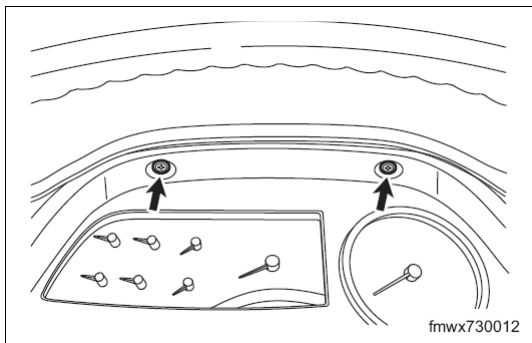


5. Install the instrument cluster assembly
 - (a). Install the connector of the instrument cluster assembly.

Dashboard, Instrument, Cigarette Lighter - Instrument Cluster



- (b). Install the instrument cluster fixing screws.

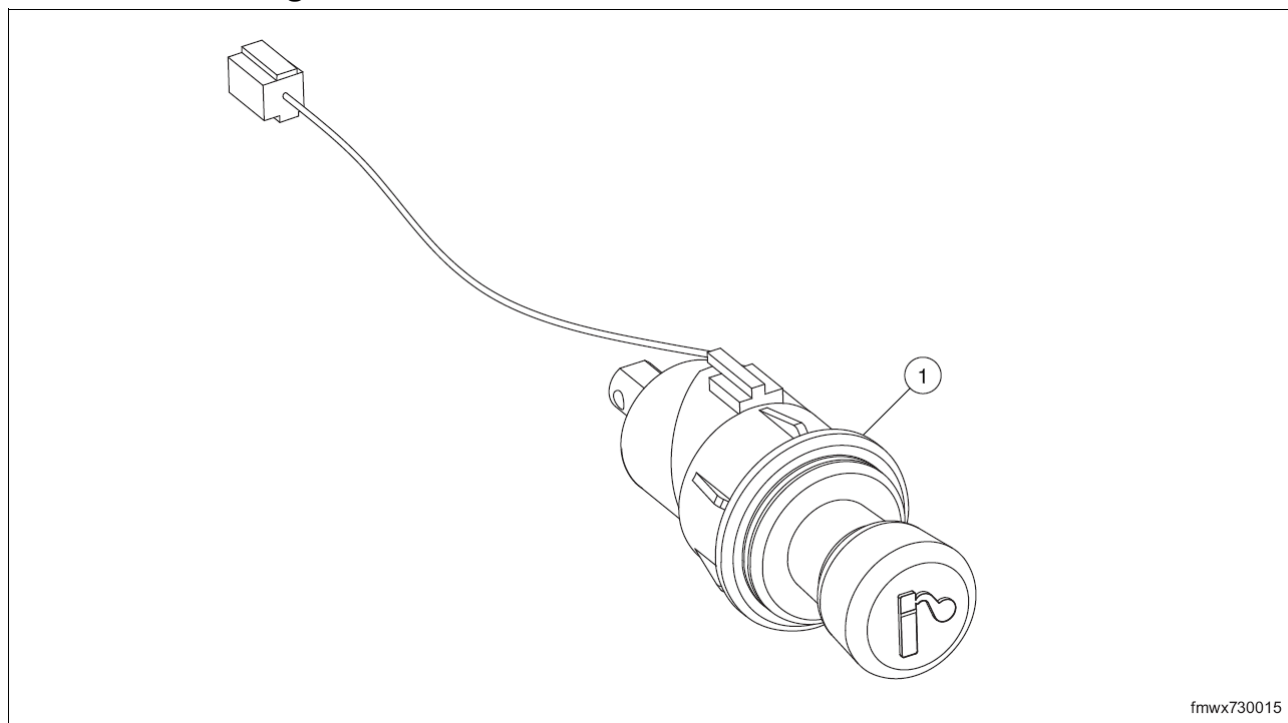


- 6. Install the instrument hood assembly**
(a). Install the instrument hood fixing screws.

- 7. Adjust the steering wheel to the appropriate position**
8. Turn on the main power supply

Cigarette Lighter

Part Drawing



fmwx730015

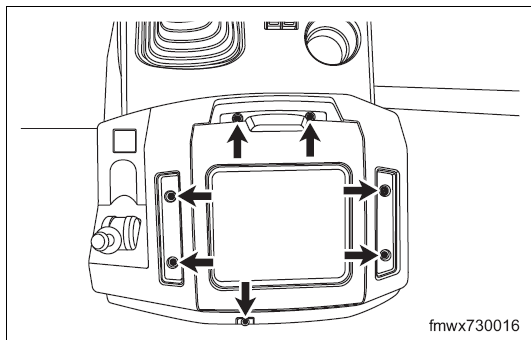
1	Cigarette Lighter Assembly
---	----------------------------

Replacement

Hint:

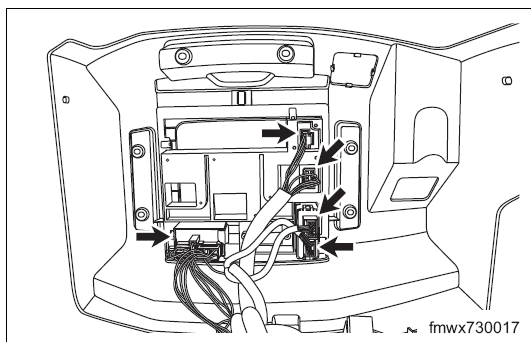
Part Drawing, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter, Part Drawing.

1. Turn off the ignition switch
2. Pluck off the cigarette lighter head

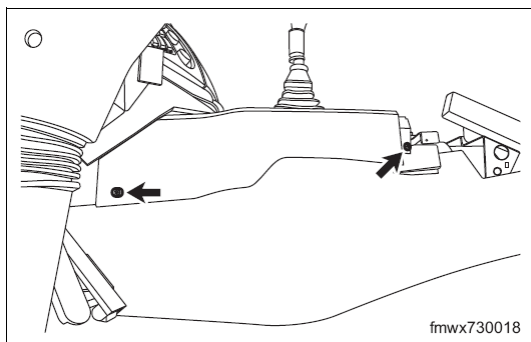


3. Dismantle the intermediate platform rear assembly

- (a). Dismantle the fixing screws of the intermediate platform rear assembly, and remove the intermediate platform rear assembly.

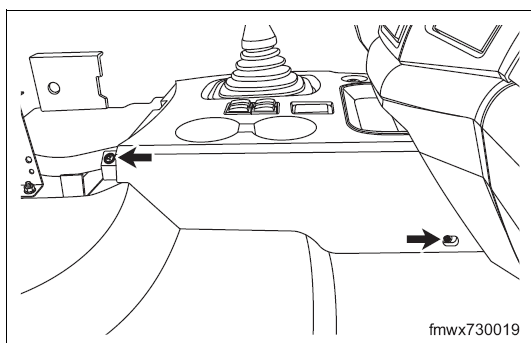


- (b). Disconnect the connector of any part.

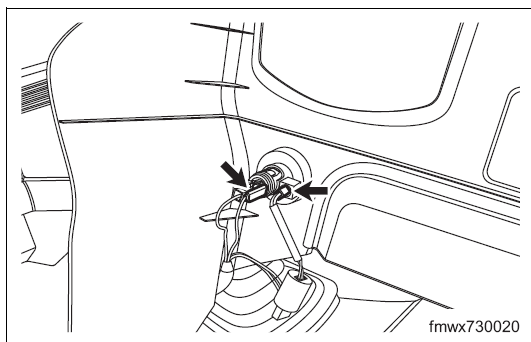


4. Dismantle the intermediate platform front assembly

- (a). Dismantle the fixing screws at the right side of the intermediate platform front assembly.

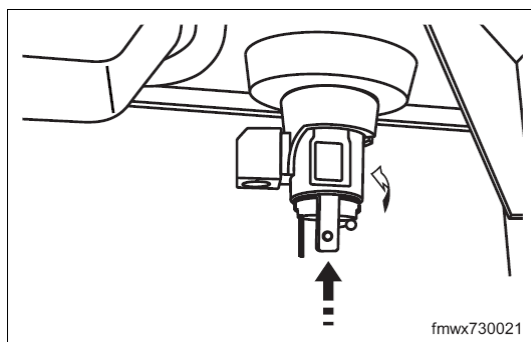


- (b). Dismantle the fixing screws at the right side of the intermediate platform front assembly.

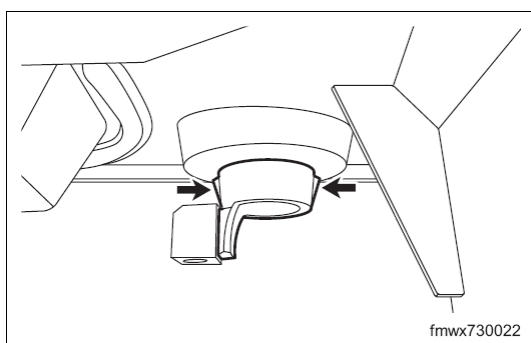


5. Dismantle the cigarette lighter seat assembly

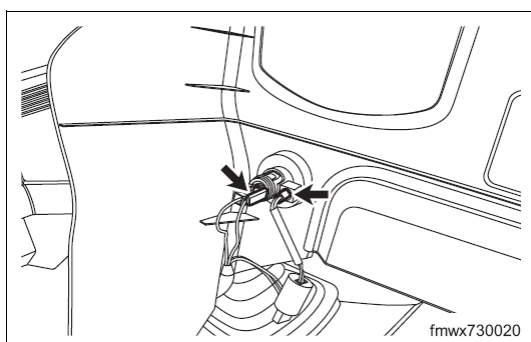
- (a). Turn over the intermediate platform front assembly, and disconnect the connector of the cigarette lighter power source.
- (b). Dismantle the illuminator lamp of the cigarette lighter seat.



- (c). Turn the inner circle of the cigarette lighter pedestal about 60° from the rear part and remove the pedestal.

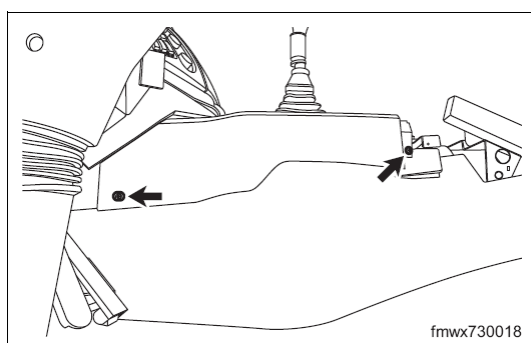


- (d). Loosen the buckle of the illuminator lamp seat of the cigarette lighter with a pair of sharp-nose pliers, and remove the illuminator lamp seat.



6. Install the cigarette lighter seat assembly

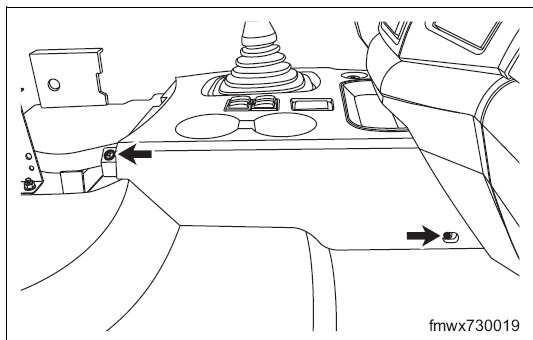
- (a). Install the cigarette lighter illuminator lamp seat of the cigarette lighter and the cigarette lighter pedestal.
- (b). Install the connector of the cigarette lighter power source, and install the illuminator lamp of the cigarette lighter seat.



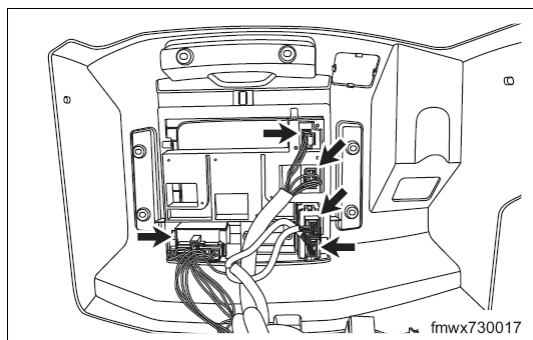
7. Install the intermediate platform front assembly

- (a). Install the fixing screws at the left side of the intermediate platform front assembly.

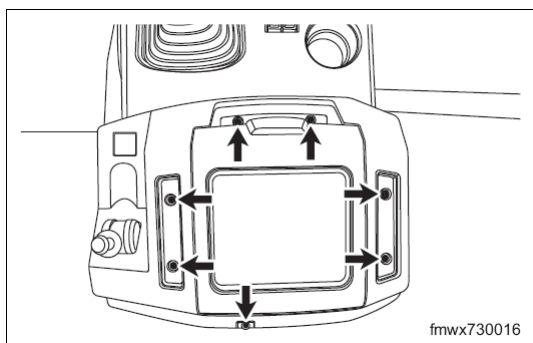
Dashboard, Instrument, Cigarette Lighter - Cigarette Lighter



- (b). Install the fixing screws at the right side of the intermediate platform front assembly.



8. Install the intermediate platform rear assembly
(a). Install the connector of any part.



- (b). Install the fixing screws of the intermediate platform rear assembly.

9. Insert the cigarette lighter head

10. Turn on the ignition switch, and confirm whether the cigarette lighter works normally.

Seats

Seat Assembly	74-3
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Seat Assembly

General

Driver seats of the heavy trucks are divided into three types: air bag shock absorption luxury type, hydraulic shock absorption standard type, and steel bracket comfortable type.

Air Bag Shock Absorption Luxury Type Driver Seat:

The shock absorption of the seat can be automatically adjusted according to the weight of the driver; therefore, such a seat is very comfortable. The shock absorption air bag is made of components imported from Germany, and has excellent reliability and high durability. The air bag shock absorption luxury type driver seat has the functions of headrest, lumbar pad adjustment, armrest adjustment, and can be provided with an optional seat electric heater, which makes the driver safer and more comfortable when driving.

Precautions

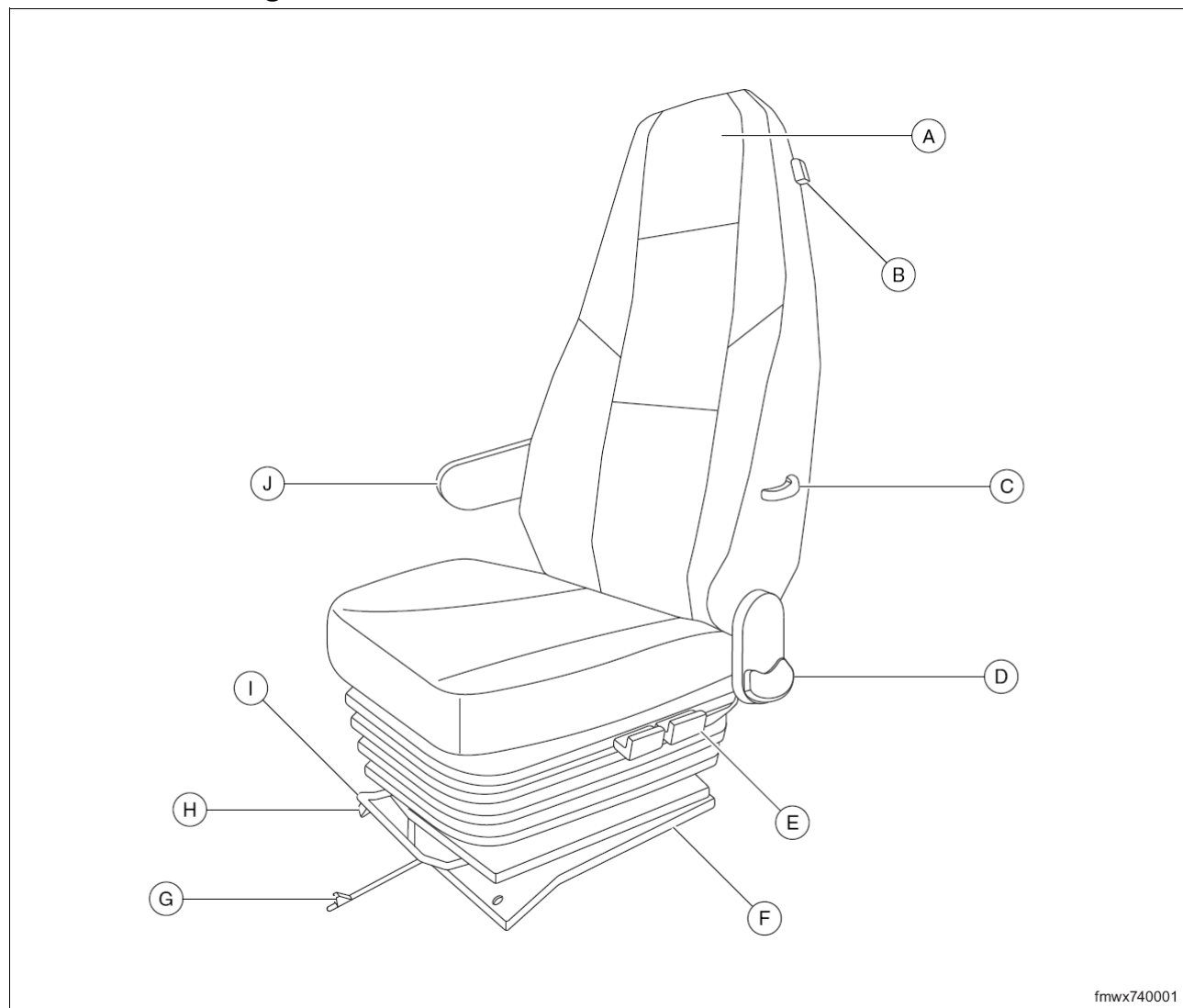
1. Do not store any tools, debris, etc., below the driver seat, so as not to affect the functions and the working life of the seat. The shock absorption system should be kept clean, and the debris, etc, must be cleaned in a timely manner.
2. In case of a pothole in the road, apply the latch hook in front of the shock absorber in time for proper protection.

Precautions Each Time after the Vehicle Has Covered 10,000 km:

1. Check all bolts and nuts at any part of the seat, and ensure that none of them is loose. Tighten in a timely manner if any of them is loose.
2. Clean up the dirt in the adjustment mechanism regularly, and apply lithium lubricant in the chute.
3. Check the air valve and the air cock of the air bag shock absorption luxury type driver seat to see whether any component has fallen off or whether there is leakage. If yes, repair or replace in a timely manner.
4. The seat consists of a shock absorption system, a seat riser, a seat slide, an angle adjuster, etc., all of which are connected by bolts; wherein, the entire assembly and all its subassemblies must be replaced in case of damage of any of the mechanisms.
5. Such vulnerable components as the handle and hood of the angle adjuster, the seat slide handle, the lumbar pad handle, etc can be individually replaced.

Driver Seat

Part Drawing



The functions and use of the seat are described as follows:

74

Item	Range of Adjustment	Method of Adjustment
A. Adjustment of the angles at the front and back of the headrest (except the comfortable type)	0°~15°	1. Move the headrest at the top part of the backrest forward and backward until it is appropriate.
B. Seat Label	-	-
C. Adjustment of the Waist Straightener	Three levels adjustable	1. Move the handle upward (downward) until it properly straightens the waist.
D. Adjustment of the backrest angle	80°~180°	1. Move the handle forward, rotate the backrest to an appropriate position, and then release the handle.
E. Vertical adjustment of the rear part of the seat	Seven levels adjustable, ranging from 0 to 60 mm.	1. Move the handle upward, increase (decrease) the force applied to the cushion downward (upward) to lower (raise) the rear end of the cushion to an appropriate position, and then release the handle.

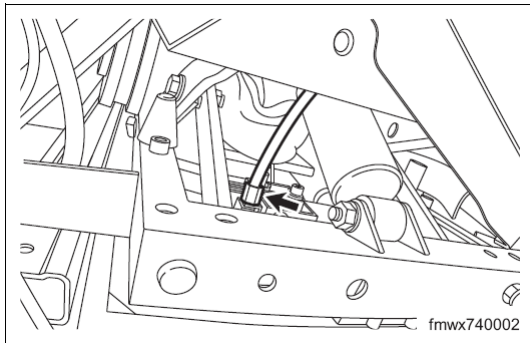
Seats - Co-driver Seat

Item	Range of Adjustment	Method of Adjustment
F. Vertical adjustment of the front part of the seat	Seven levels adjustable, ranging from 0 to 60mm.	1. Move the handle upward, increase (decrease) the force applied to the cushion downward (upward) to lower (raise) the rear end of the cushion to an appropriate position, and then release the handle.
G. Connected with the body air pipe (peculiar to the air bag shock absorption luxury type driver seat)	-	-
H. Adjustment of the seat slide	0 to ± 90 mm	1. Move the handle upward, and move the seat forward (backward) to an appropriate, and then release the handle.
I. Adjustment of the shock absorption state	-	1. Turn the handle clockwise, and apply appropriate force to the seat vertically downward. The seat will be fixed when the handle is locked and the air bag does not work. 2. For conversion into the shock absorption state, turn the handle counter-clockwise and apply appropriate force to the seat vertically downward to unlock. And the air bag works properly again.
J. Seat armrest	Two levels adjustable	-

Dismantlement and Installation

Hint:

Part Drawing, refer to Chapter 74, Seat - Driver Seat, Part Drawing.

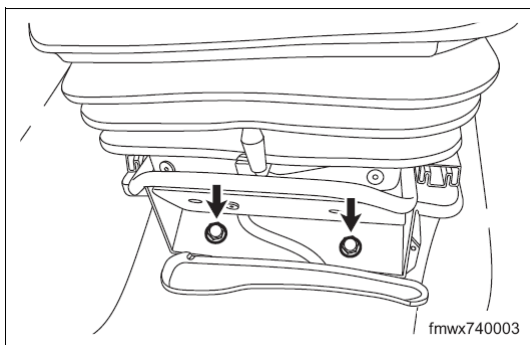


1. Dismantle the air pipe of the air bag of the driver seat

- (a). Adjust the driver seat to the maximum height.
- (b). Dismantle the air pipe of the air bag of the driver seat.

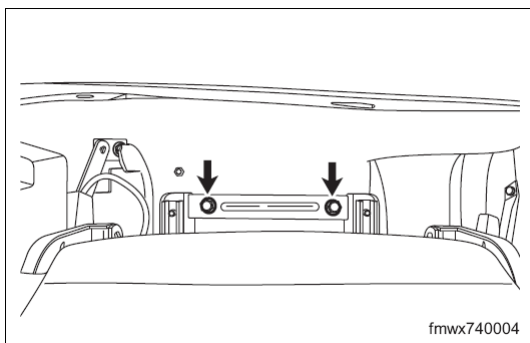
Caution:

An oil pipe wrench must be used.

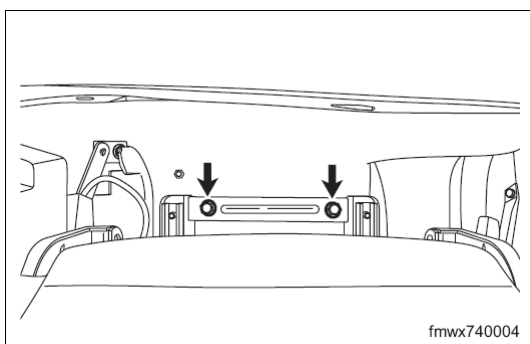


2. Dismantle the fixing bolts and nuts of the driver seat

- (a). Slide the driver seat to the rear end of the seat slide.
- (b). Dismantle the fixing bolts at the front end of the driver seat.



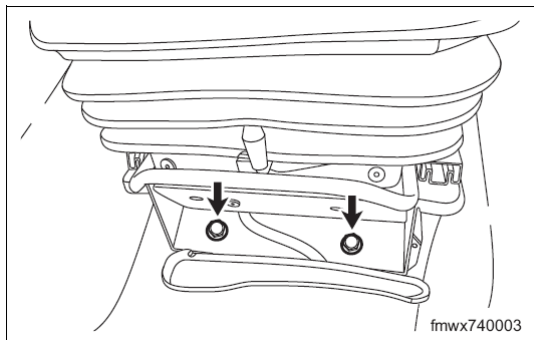
- (c). Slide the driver seat to the front end of the seat slide.
- (d). Dismantle the fixing nuts at the rear end of the driver seat to dismantle the driver seat.



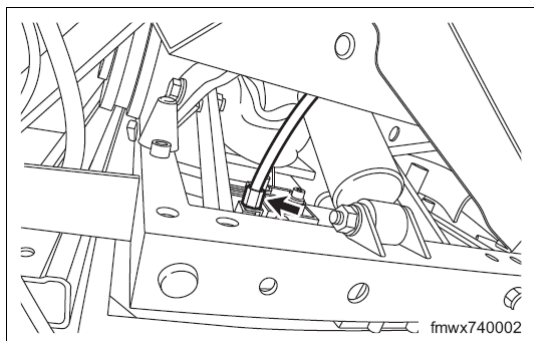
3. Install the fixing bolts and nuts of the driver seat

- (a). Put the seat at the installation location and install the fixing nuts at the rear end.
Torque: **40N.m**

Seats - Co-driver Seat



- (b). Slide the driver seat to the rear end of the seat slide.
- (c). Install the fixing bolts at the front end of the driver seat.
Torque: **40N.m**

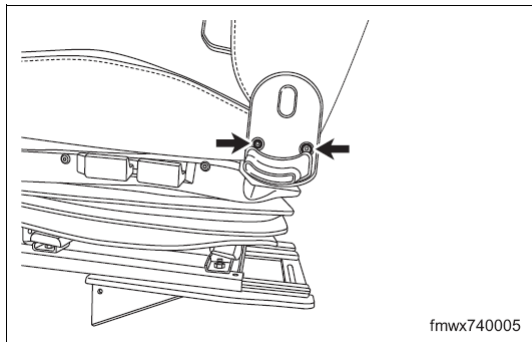


- 4. **Install the air pipe of the air bag of the driver seat.**
 - (a). Adjust the driver seat to the maximum height.
 - (b). Install the air pipe of the air bag of the driver seat.

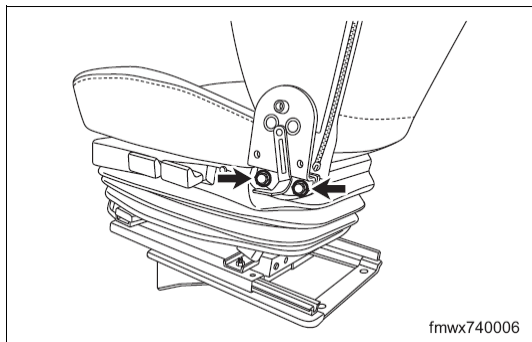
Caution:

An oil pipe wrench must be used.

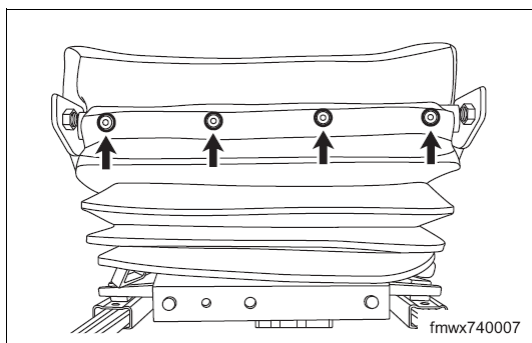
Disassembly and Assembly



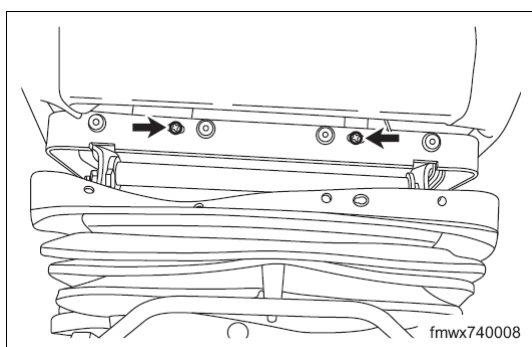
1. **Dismantle the driver seat backrest assembly**
 - (a). Remove the handle of the backrest angle adjuster, and remove the screw of the angle adjuster cover.



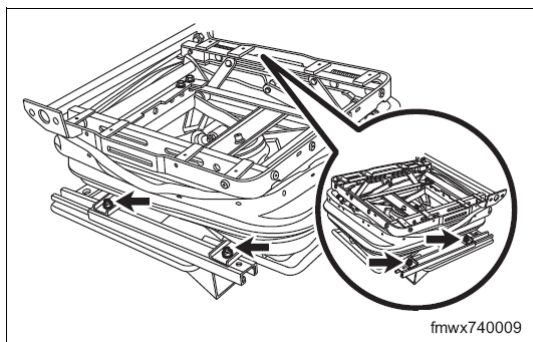
- (b). Dismantle the fixing bolts of the backrest angle adjuster assembly.



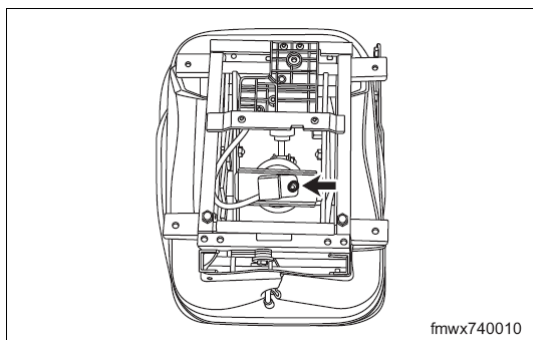
2. **Dismantle the driver seat cushion assembly**
 - (a). Remove the handles of the risers at the front and rear ends of the cushion, and remove the buckle of the seat dust cap.



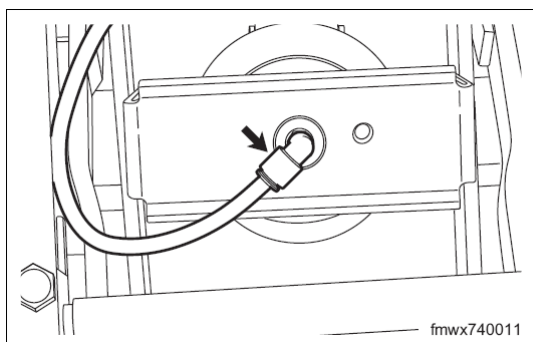
- (b). Dismantle the fastening screws of the driver seat cushion.

Seats - Co-driver Seat**3. Dismantle the driver seat slide assembly**

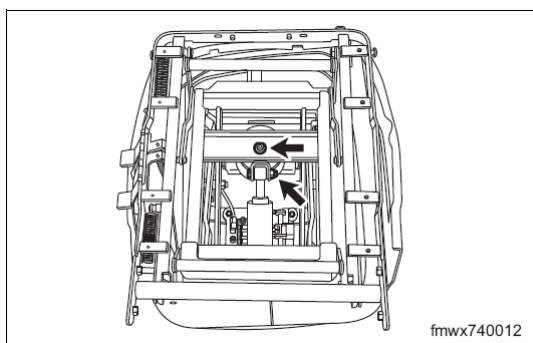
- (a). Dismantle the fixing nuts of the driver seat slide assembly.

**4. Dismantle the shock absorption air bag assembly of the driver seat**

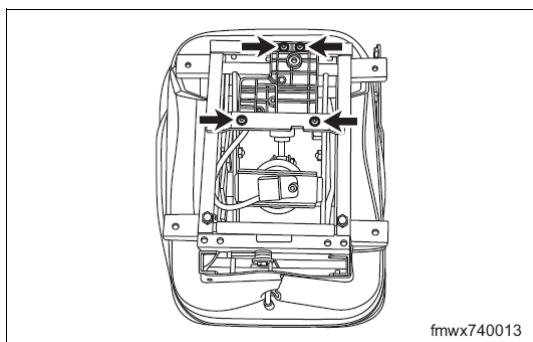
- (a). Dismantle the hex head bolts of the air pipe cover of the shock absorption air bag.



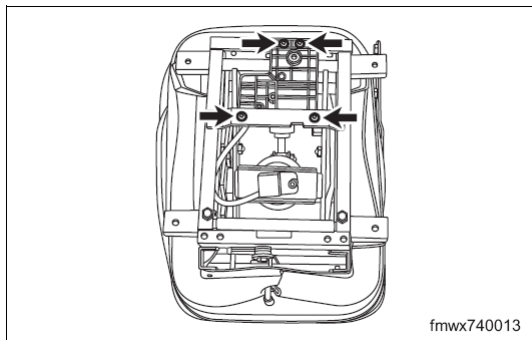
- (b). Dismantle the air pipe of the shock absorption air bag.



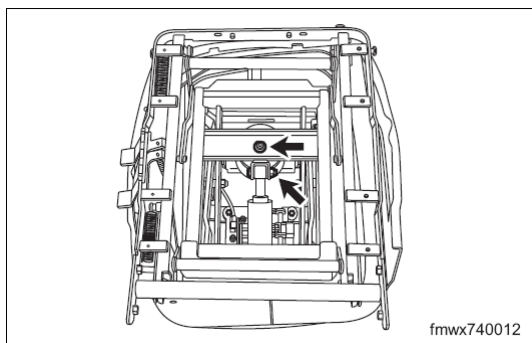
- (c). Dismantle the fixing hex head bolts of the shock absorption air bag.
(d). Dismantle the connecting bolts of the seat damper assembly.

**5. Dismantle the driver seat air valve assembly**

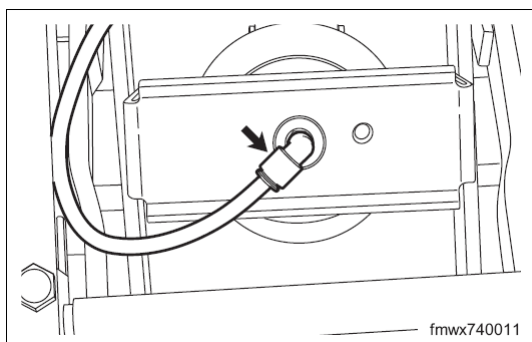
- (a). Dismantle the fastening screws of the driver seat air valve assembly.



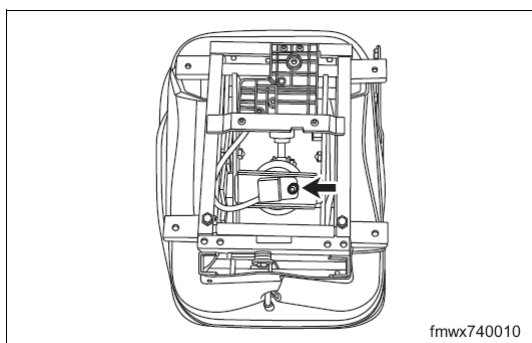
- 6. Install the driver seat air valve assembly**
(a). Install the fastening screws of the driver seat air valve assembly.



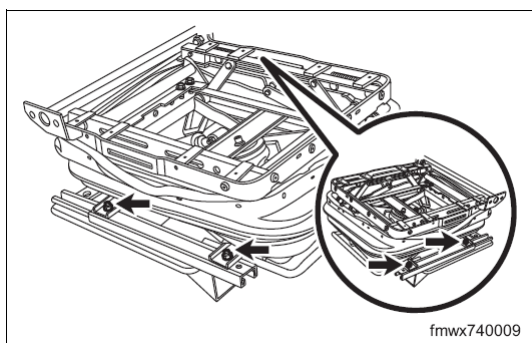
- 7. Install the shock absorption air bag assembly of the driver seat**
(a). Install the fixing hex head bolts of the shock absorption air bag.
(b). Install the connecting bolts of the seat damper assembly.
Torque: **63N.m**



- (c). Install the air pipe of the shock absorption air bag.

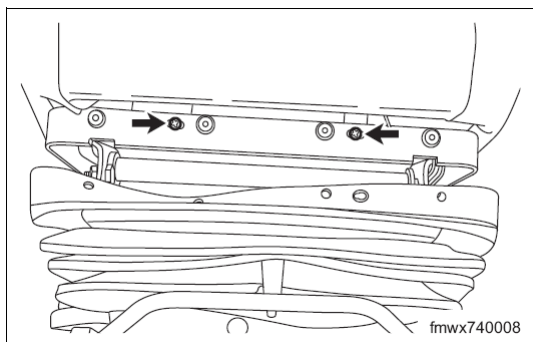


- (d). Install the hex head bolts of the air pipe cover of the shock absorption air bag.



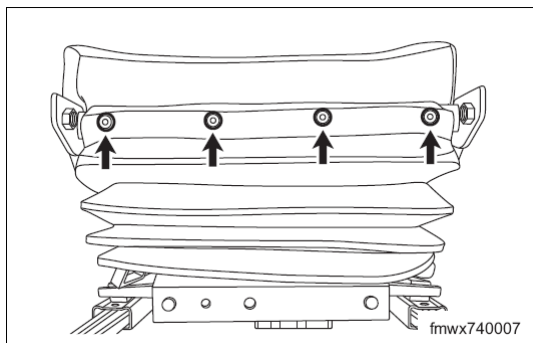
- 8. Install the driver seat slide assembly**
(a). Install the fixing nuts of the driver seat slide assembly.
Torque: **63N.m**

Seats - Co-driver Seat

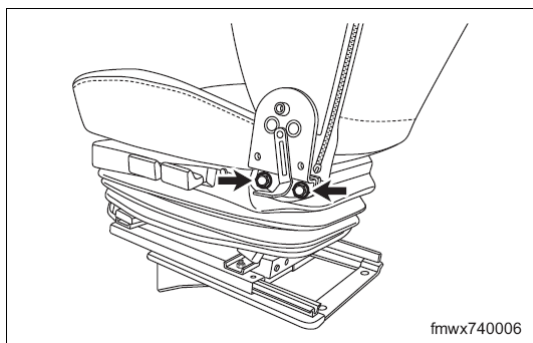


9. Install the driver seat cushion assembly

- (a). Install the fastening screws of the driver seat cushion.

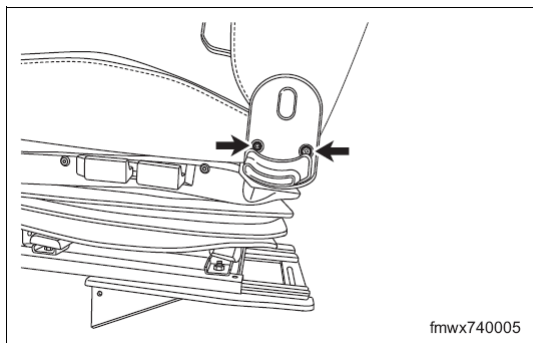


- (b). Install the buckle of the seat dust cap, and install the handles of the risers at the front and rear ends of the cushion.



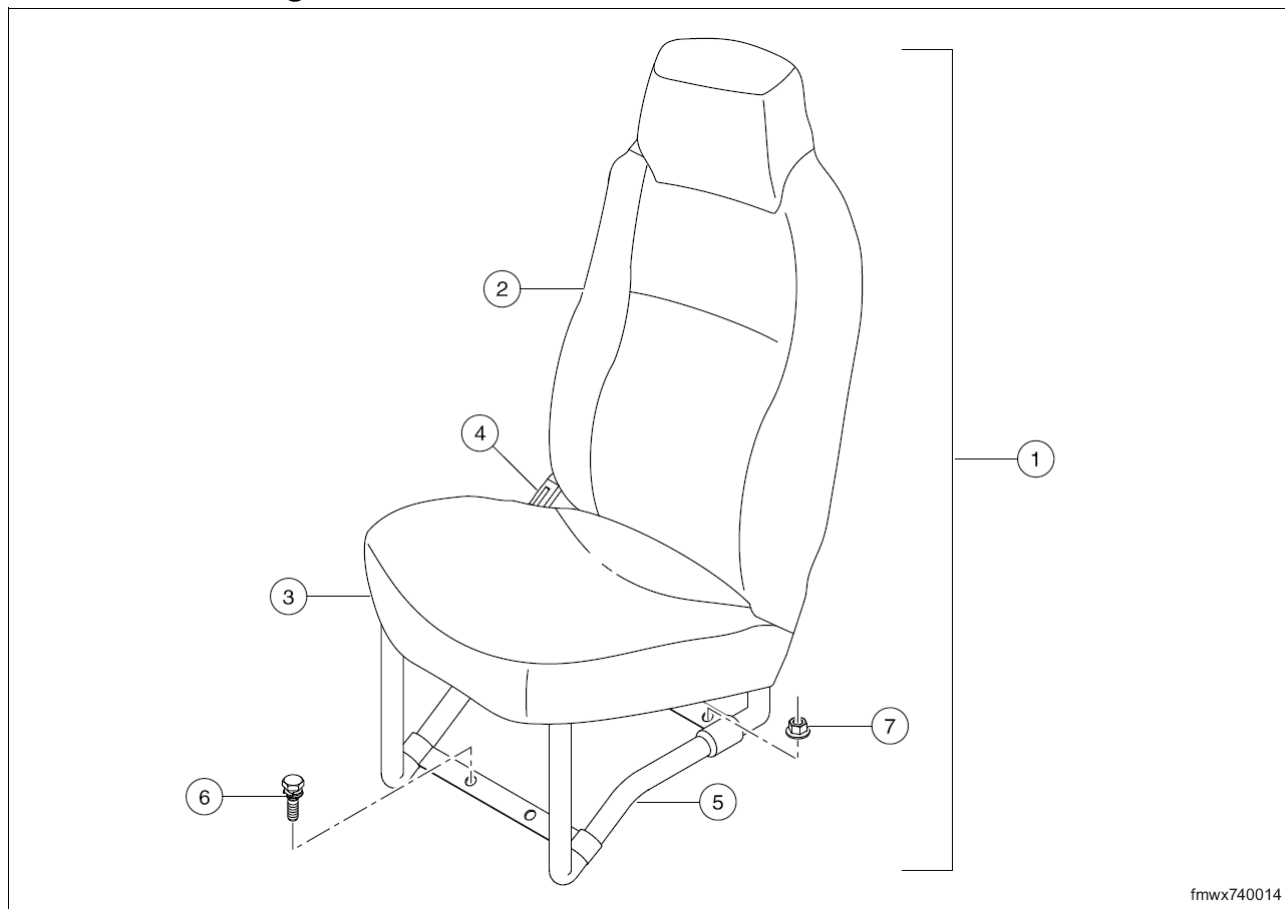
10. Install the driver seat backrest assembly

- (a). Install the fixing bolts of the backrest angle adjuster assembly.
Torque: **63N.m**



- (b). Install the screw of the angle adjuster cover, and install the handle of the backrest angle adjuster.

Co-driver Seat Part Drawing



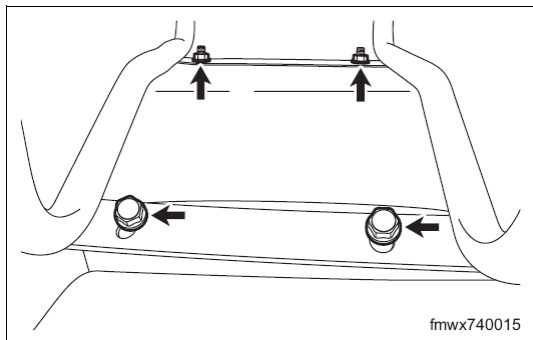
1	Co-driver Seat Assembly
2	Backrest Assembly
3	Seat Cushion Assembly
4	Angle Adjuster Assembly

5	Seat Support Mechanism Assembly
6	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
7	Hex Flange Face Nut

Replacement

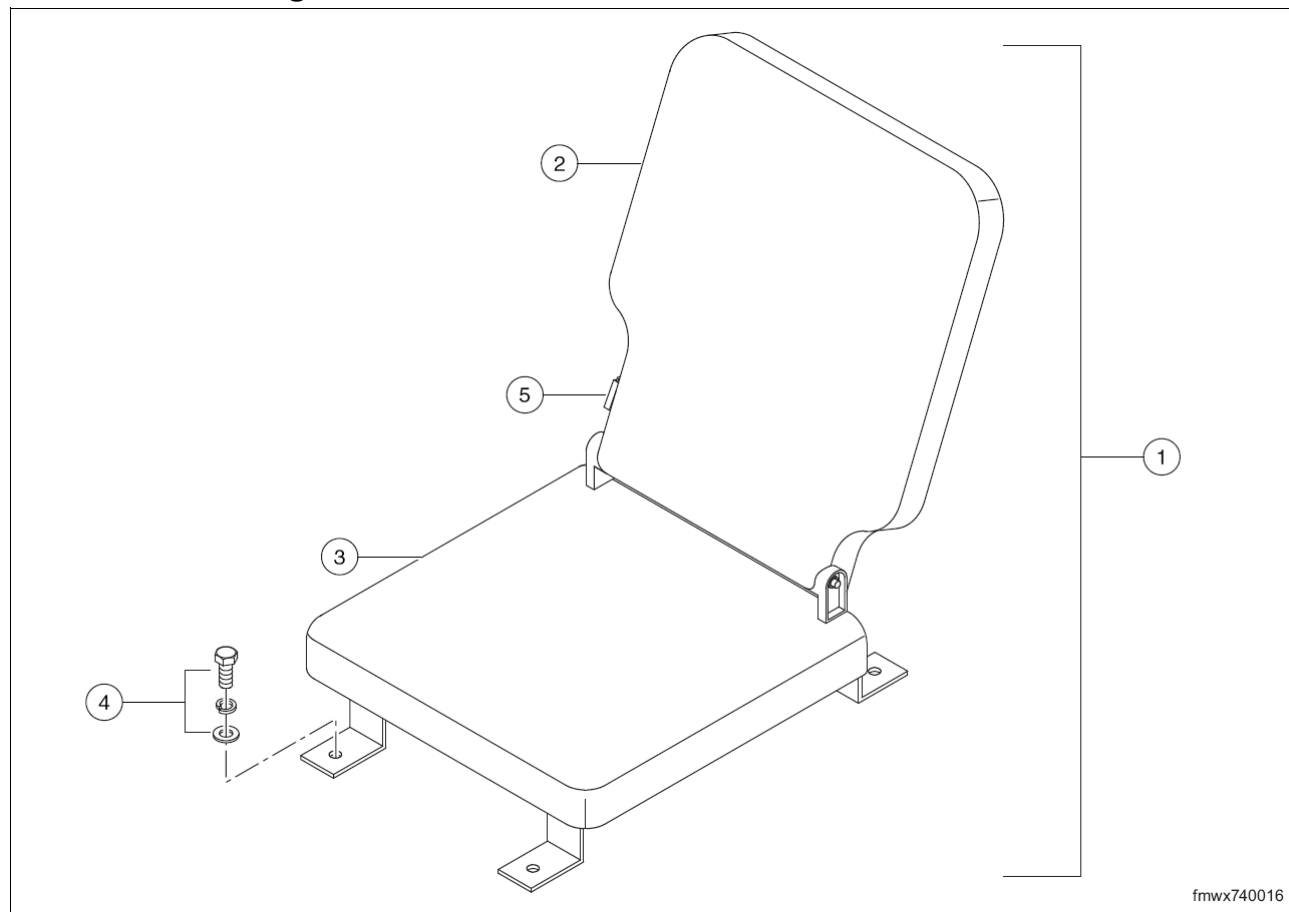
Hint:

Part Drawing, refer to Chapter 74, Seat - Co-driver Seat, Part Drawing.



- 1. Dismantle the co-driver seat**
 - (a). Dismantle the fixing bolts and nuts of the co-driver seat.
- 2. Install the co-driver seat**
 - (a). Install the fixing bolts and nuts of the co-driver seat.
Torque: **40N.m**

Middle Seat Part Drawing



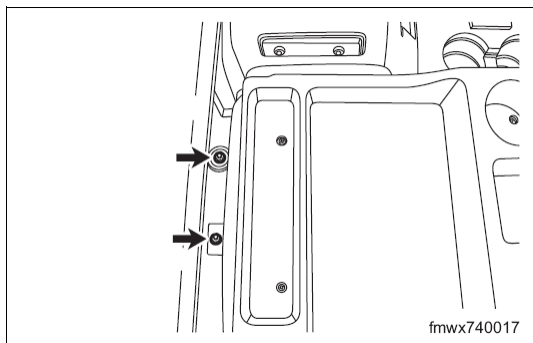
1	Middle Seat Assembly
2	Middle Seat Backrest Assembly
3	Middle Seat Cushion Assembly

4	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
5	Angle Adjuster Assembly

Replacement

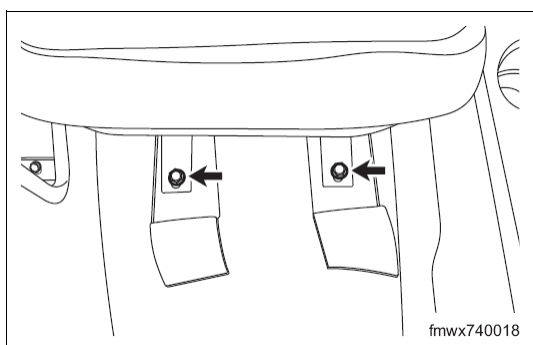
Hint:

Part Drawing, refer to Chapter 74, Seat - Middle Seat, Part Drawing

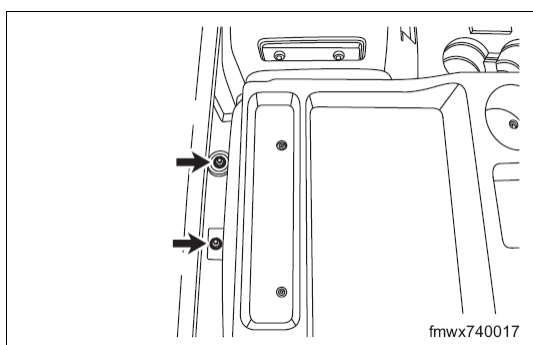


1. Dismantle the middle seat

- (a). Dismantle the middle seat fixing nuts.

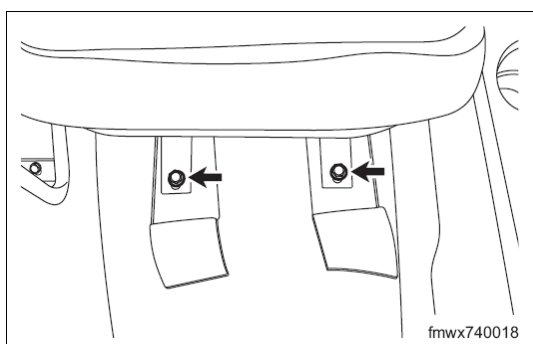


- (b). Dismantle the middle seat fixing bolts.



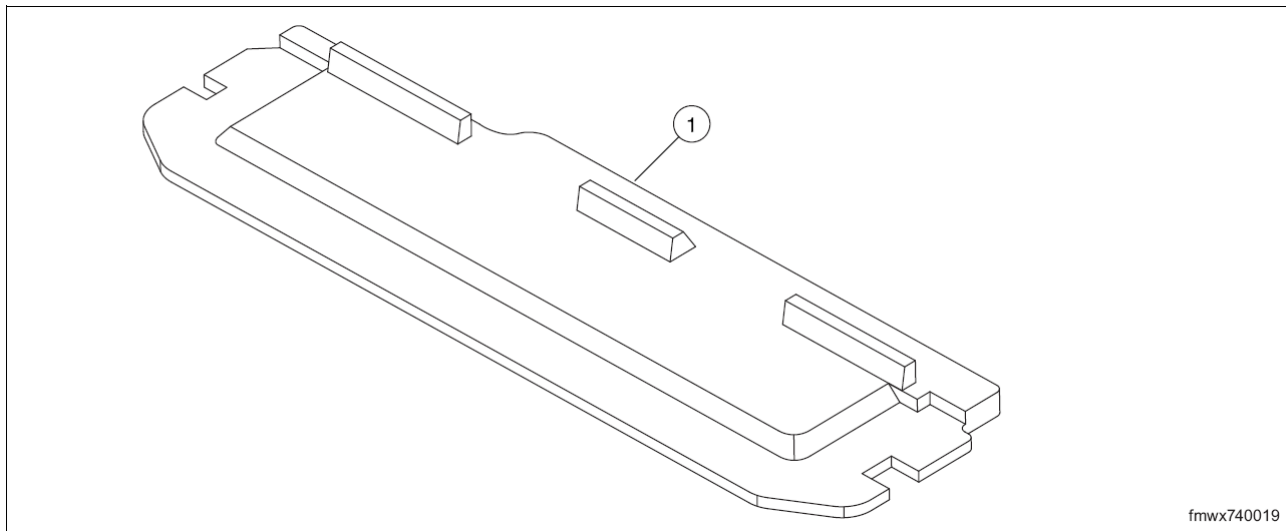
2. Install the middle seat

- (a). Install the middle seat fixing nuts.
Torque: **20N.m**



- (b). Install the middle seat fixing bolts.
Torque: **20N.m**

Sleeper Device Part Drawing

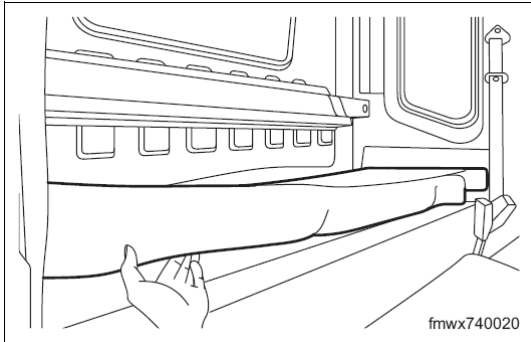


1	Sleeper Cushion Assembly
---	--------------------------

Replacement

Hint:

Part Drawing, refer to Chapter 74, Seat — Sleeper Device, Part Drawing

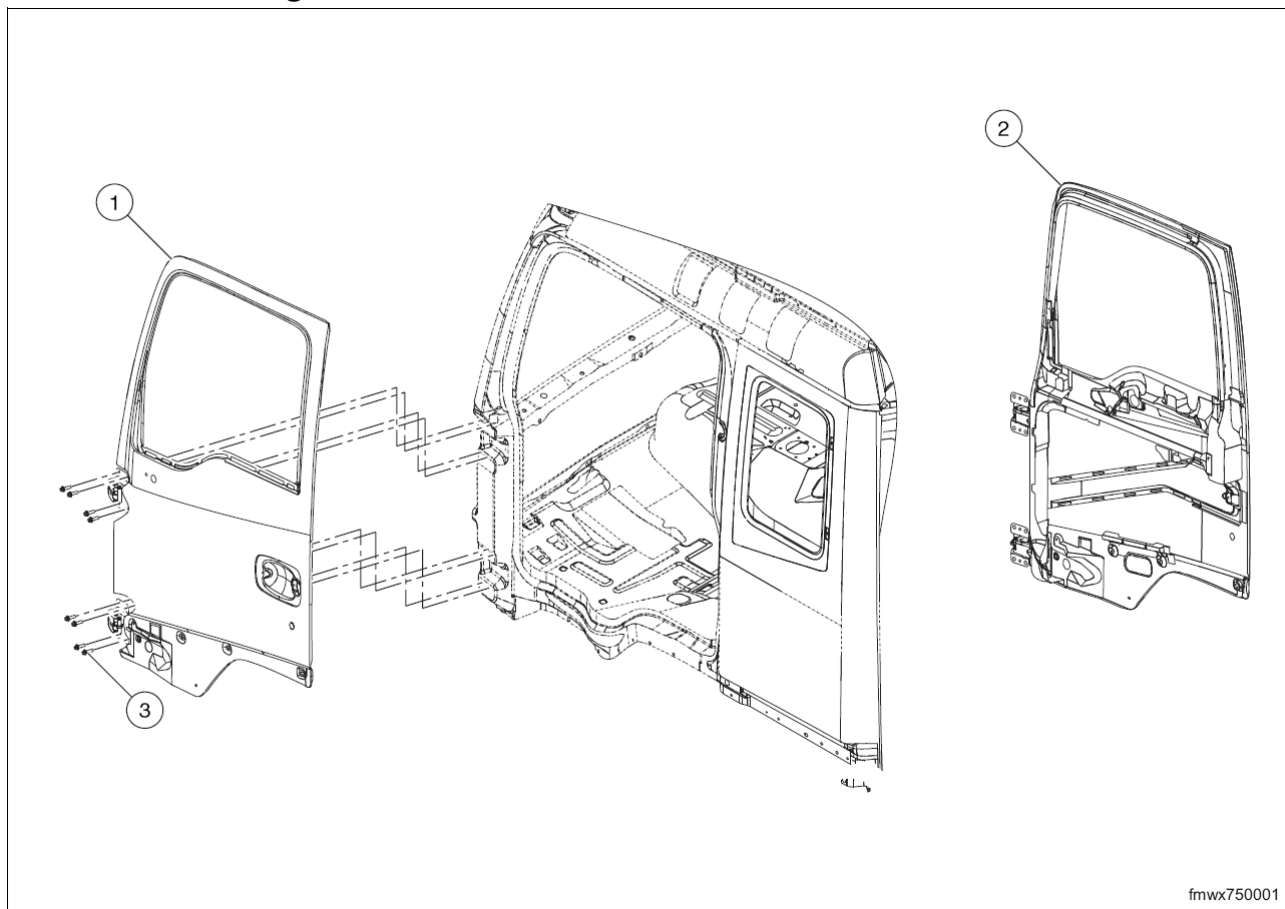


1. **Open the sleeper cushion assembly to dismantle or replace.**

Door, Lock, Door Handle

Door Assembly	75-3
Part Drawing	75-3
Adjustment	75-4
Replacement.....	75-4
Lock	75-13
Part Drawing	75-13
Replacement.....	75-14
Door Handle	75-17
Replacement.....	75-17

Door Assembly Part Drawing



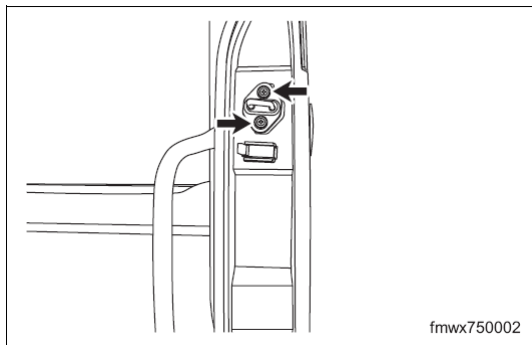
1	LH FR Door Assembly
2	RH FR Door Assembly

3	Hex Flange Face Bolt with Teeth in Bearing Surface
---	--

Adjustment

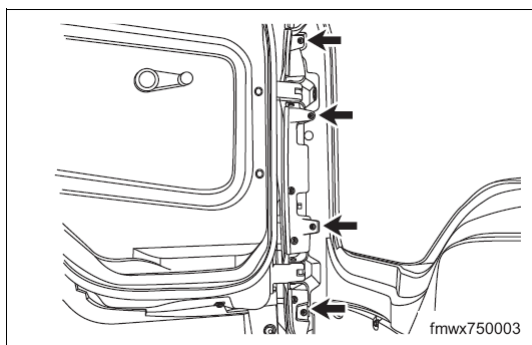
Hint:

Part Drawing, refer to Chapter 75, Door, Lock, Door Handle - Door Assembly, Part Drawing.



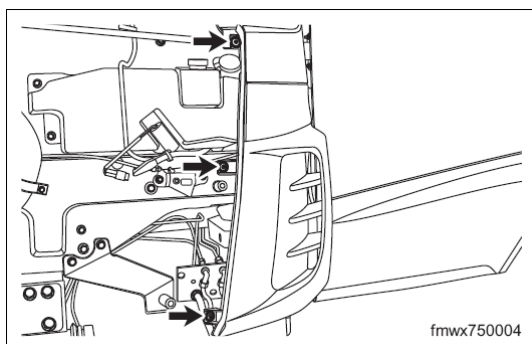
1. Loosen the left front buckle

- (a). Loosen the screw of the left front buckle until the buckle can be moved.

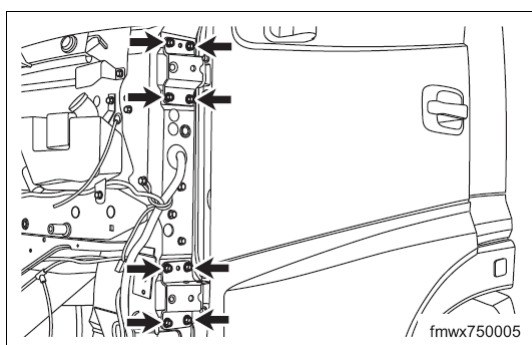


2. Remove the left trim corner plate

- (a). Dismantle the fixing screws of the left trim corner plate.



- (b). Open the front turnover cover, dismantle the fixing screws of the left trim corner plate, and remove the left trim corner plate.



3. Loosen the left front door hinge

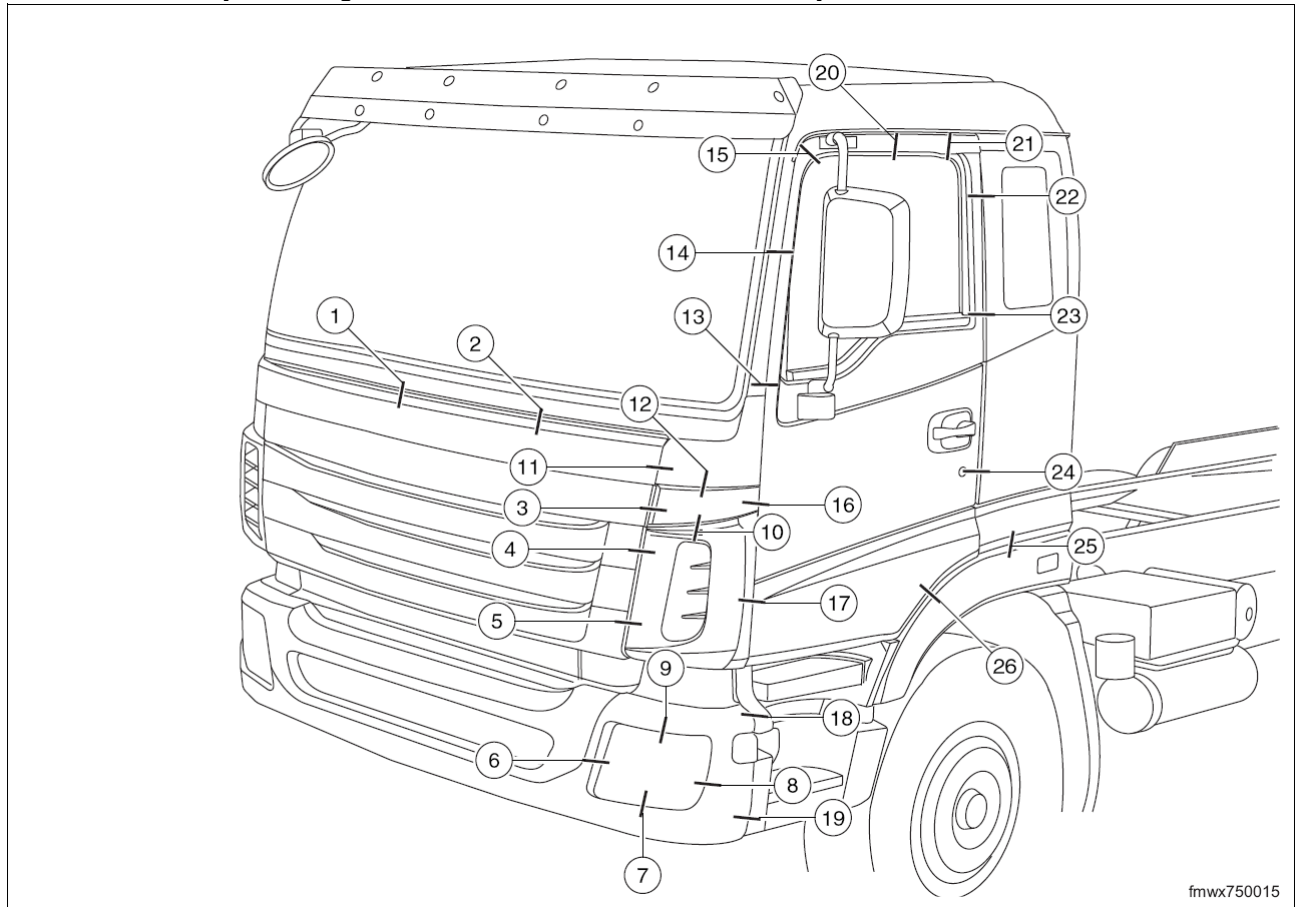
- (a). Slowly loosen the fixing bolts of the left front door hinge so that the door can be moved a little.

Door, Lock, Door Handle - Door Assembly**4. Adjust the left front door**

- (a). Adjust the clearance of the left front door according to the dimensions shown in the following figure until the clearance between the door and the cab is moderate, and then tighten the left front door hinge and the bolts of the buckle.

Hint:

The method to adjust the right front door is the same as that to adjust the left front door.



	Clearance	Flatness		Clearance	Flatness
1	5mm	0	14	5mm	0
2	5mm	0	15	5mm	0
3	5mm	0	16	5mm	0
4	5mm	0	17	5mm	0
5	5mm	0	18	14.5mm	0.7mm
6	6.2mm	4.13mm	19	14.4mm	0
7	7.4mm	7.21mm	20	5mm	0
8	6.2mm	7.67mm	21	5mm	0
9	6.4mm	7.21mm	22	7mm	0
10	0.5mm	0	23	7mm	0
11	5mm	0	24	7mm	0

75-6

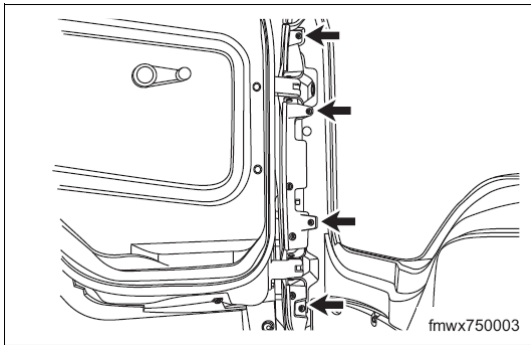
Door, Lock, Door Handle - Door Assembly

12	0.5mm	0	25	10mm	
13	5mm	0	26	10mm	

Replacement

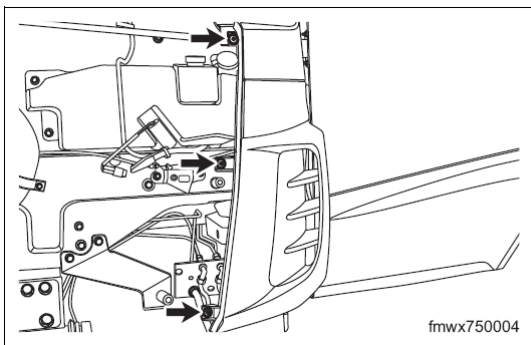
Hint:

Part Drawing, refer to Chapter 75, Door, Lock, Door Handle - Door Assembly, Part Drawing.

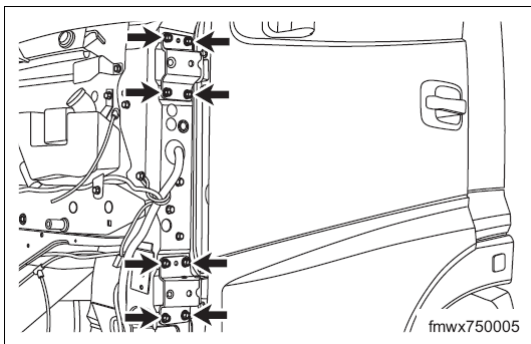


1. Dismantle the left trim corner plate

- (a). Dismantle the fixing screws of the left trim corner plate.

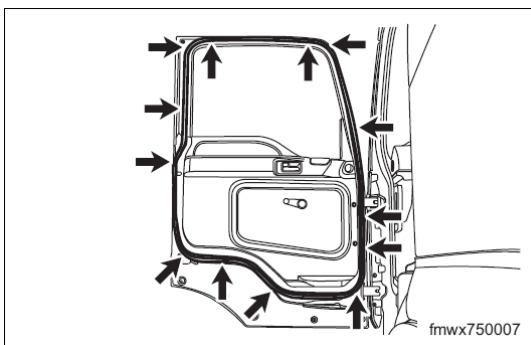


- (b). Open the front turnover cover, dismantle the fixing screws of the left trim corner plate, and remove the left trim corner plate.



2. Dismantle the left front door assembly

- (a). Dismantle the fixing bolts of the left front door hinge.
(b). Dismantle the left front door assembly.

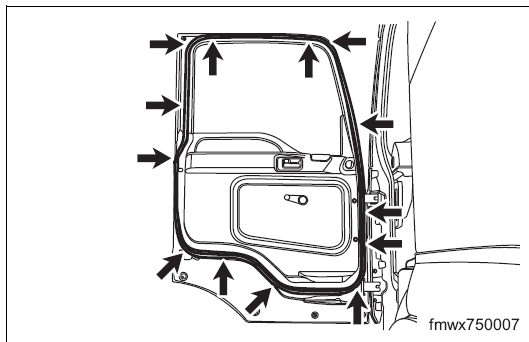


3. Dismantle the seal of the left front door

- (a). Dismantle the seal of the left front door buckle, and remove the seal.

Caution:

The removed buckle cannot be reused.

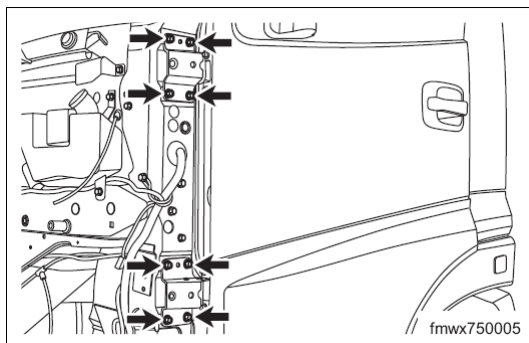


4. Install the seal of the left front door

- (a). Install the seal of the left front door, and fix the buckle of the door seal.

Caution:

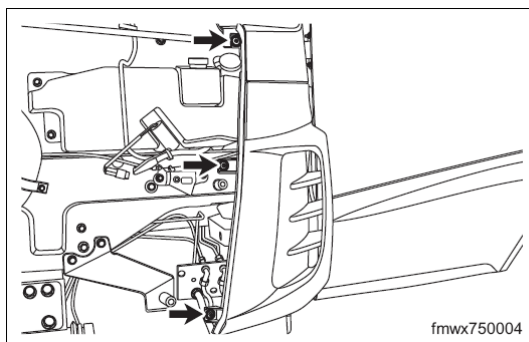
The buckle is a one-off piece and a new one should be used for installation.



5. Install the left front door assembly

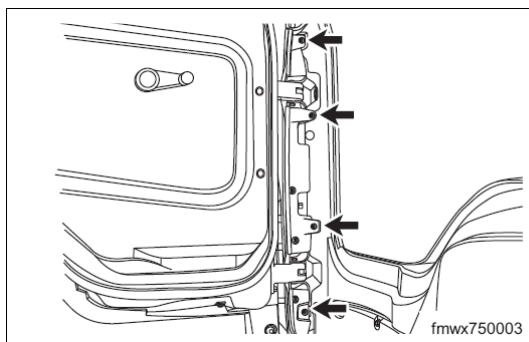
- (a). Install the fixing bolts of the left front door hinge.
Torque: 30N.m

6. Adjust the left front door, refer to Chapter 75, Door, Lock, Door Handle - Door Assembly, Adjustment.



7. Install the left trim corner plate

- (a). Install the fixing screws of the left trim corner plate, and close the front turnover cover.

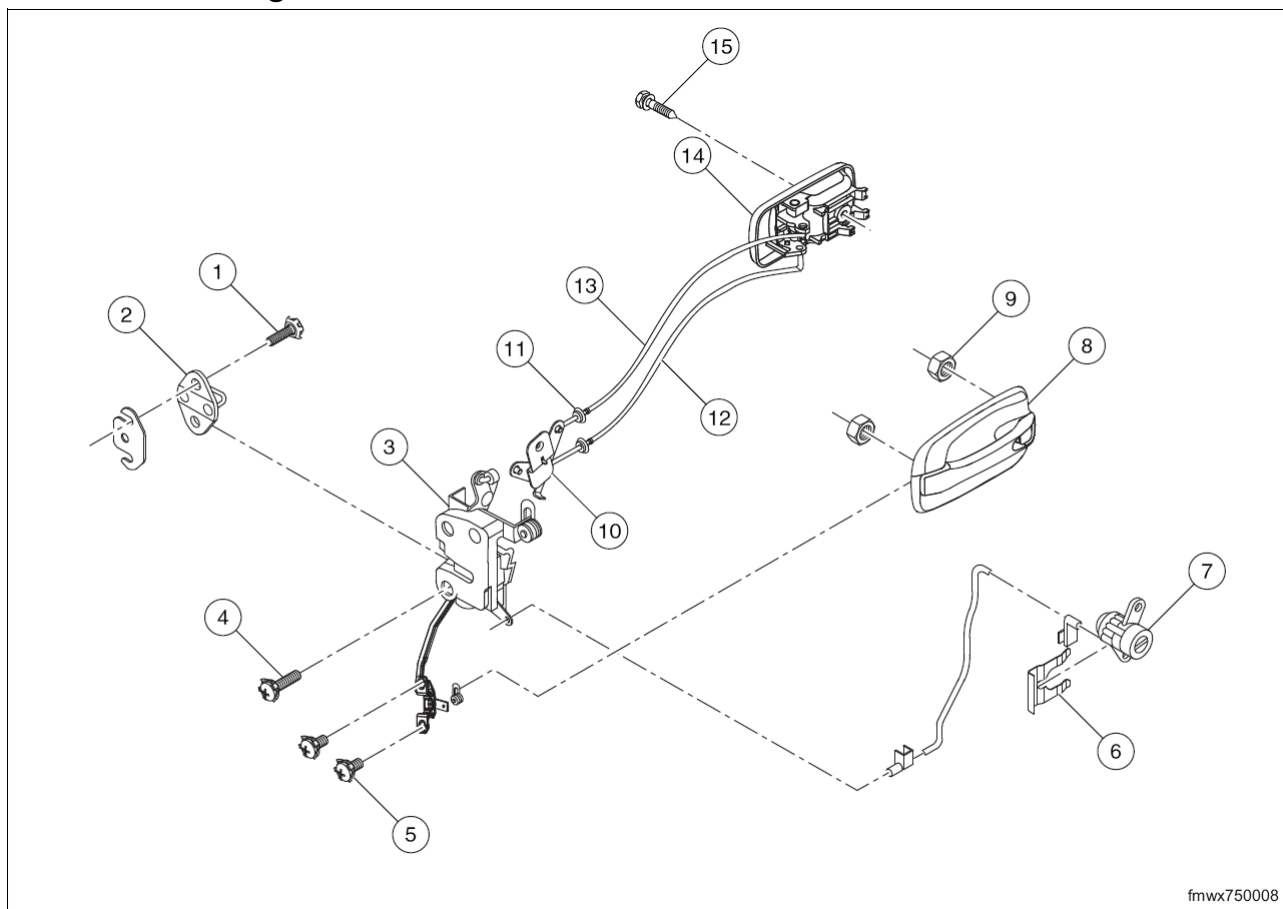


- (b). Install the fixing screws of the left trim corner plate.

Door, Lock, Door Handle - Lock

Lock

Part Drawing



fmwx750008

1	Cross Recessed Countersunk Screw and Taper Washer Assembly
2	Buckle Assembly
3	FR Lock Body Assembly
4	Cross Recessed Countersunk Screw and Taper Lock Washer Assembly
5	Cross Recessed Countersunk Screw
6	Fixing Clamp
7	Lock Core Assembly
8	Outward-opening Handle Assembly

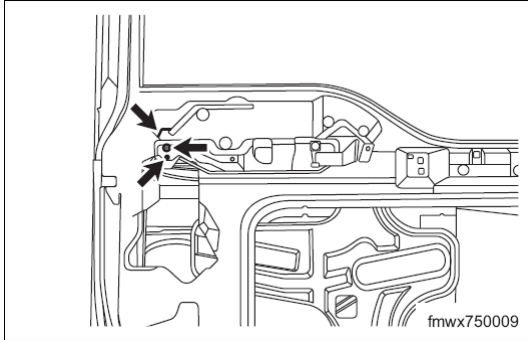
9	Hex Flange Face Nut
10	Drive Mechanism Assembly
11	Fixing Catch Seat
12	Inward-opening Pull Rod
13	Interior Locking Pull Rod
14	Inward-opening Handle Assembly
15	Cross Recessed Pan Head Tapping Screw and Big Washer Assembly

Replacement

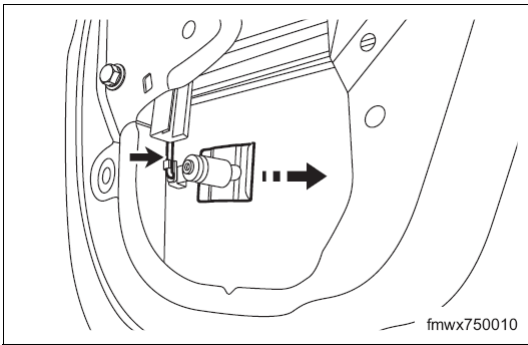
Hint:

Part Drawing, refer to Chapter 75, Door, Lock, Door Handle - Lock, Part Drawing.

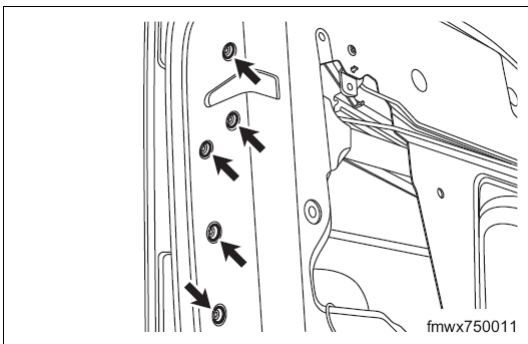
1. **Dismantle the door inner guard plate, refer to Chapter 76, Interior & Exterior Trim Parts - Door Inner Guard Plate, Replacement**
2. **Dismantle the door front waterproof film**



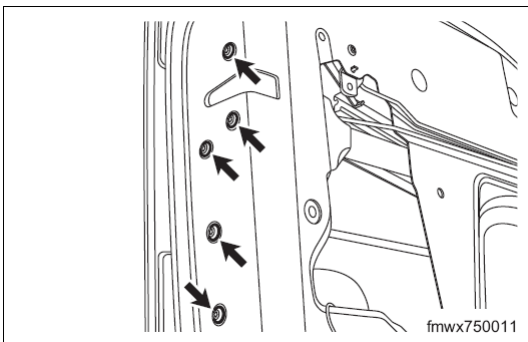
3. **Dismantle the drive mechanism assembly**
 - (a). Disconnect the interior locking pull rod and the inward-opening pull rod.
 - (b). Dismantle the screws of the drive mechanism.



4. **Dismantle the lock core assembly**
 - (a). Disconnect the lifting link of the lock core.
 - (b). Dismantle the fixing clamp of the lock core.

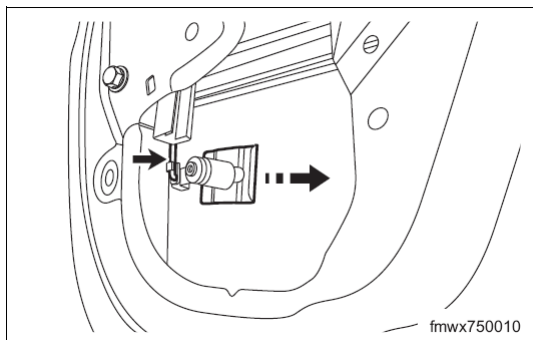


5. **Dismantle the front lock assembly**
 - (a). Dismantle the fixing screws of the front door lock body.

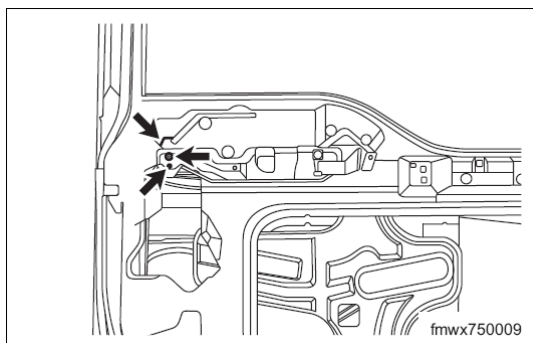


6. **Install the front lock assembly**
 - (a). Install the fixing screws of the front door lock body.

Door, Lock, Door Handle - Lock



- 7. Install the lock core assembly**
(a). Install the fixing clamp of the lock core.
(b). Install the lifting link of the lock core.



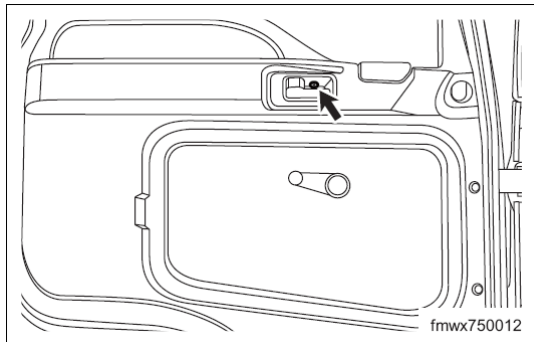
- 8. Install the drive mechanism assembly**
(a). Install the screws of the drive mechanism.
(b). Install the interior locking pull rod and the inward-opening pull rod.

- 9. Install the door front waterproof film**
10. Install the door inner guard plate, refer to Chapter 76, Interior & Exterior Trim Parts - Door Inner Guard Plate, Replacement

Door Handle Replacement

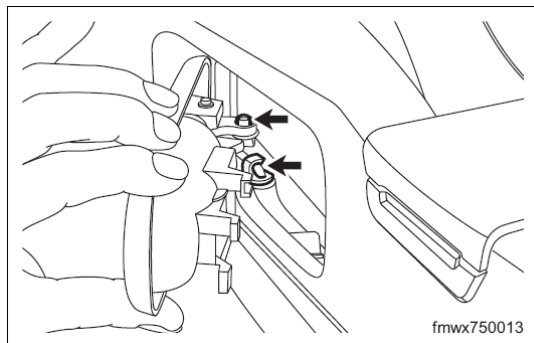
Hint:

Part Drawing, refer to Chapter 75, Door, Lock, Door Handle - Lock, Part Drawing.

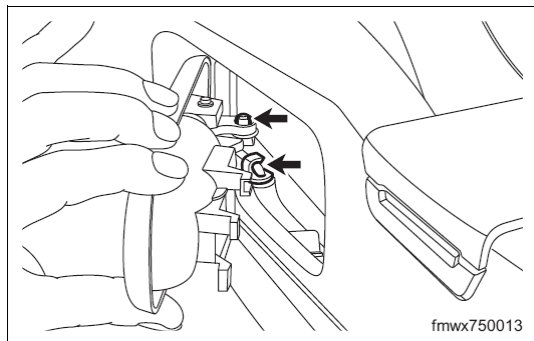


1. Dismantle the inward-opening handle assembly

- (a). Dismantle the fixing screws of the inward-opening handle.

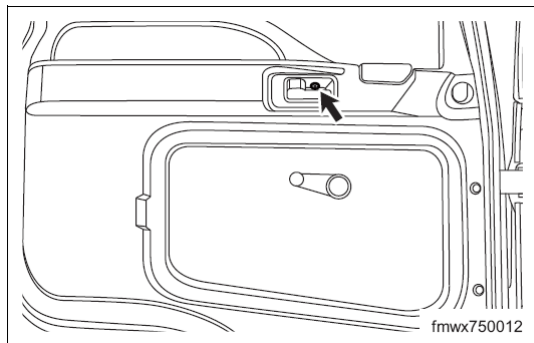


- (b). Disconnect the interior locking pull rod and the inward-opening pull rod.



2. Install the inward-opening handle assembly

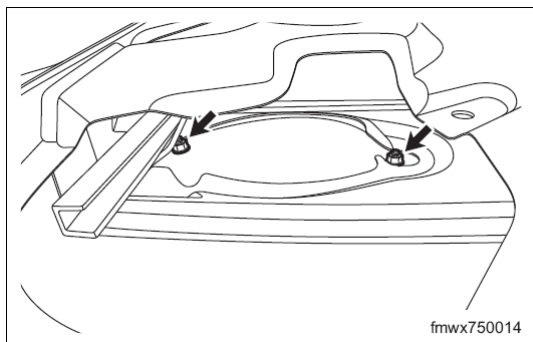
- (a). Install the interior locking pull rod and the inward-opening pull rod.



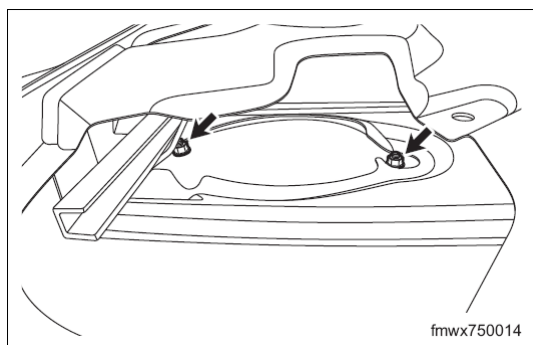
- (b). Install the fixing screws of the inward-opening handle.

Door, Lock, Door Handle - Door Handle

1. **Dismantle the door inner guard plate, refer to Chapter 76, Interior & Exterior Trim Parts - Door Inner Guard Plate, Replacement**
2. **Dismantle the door front waterproof film**



3. **Dismantle the outward-opening handle**
(a). Dismantle the fixing nuts of the outward-opening handle.



4. **Install the outward-opening handle**
(a). Install the fixing nuts of the outward-opening handle.

5. **Paste the door front waterproof film**
6. **Install the door inner guard plate, refer to Chapter 76, Interior & Exterior Trim Parts - Door Inner Guard Plate, Replacement**

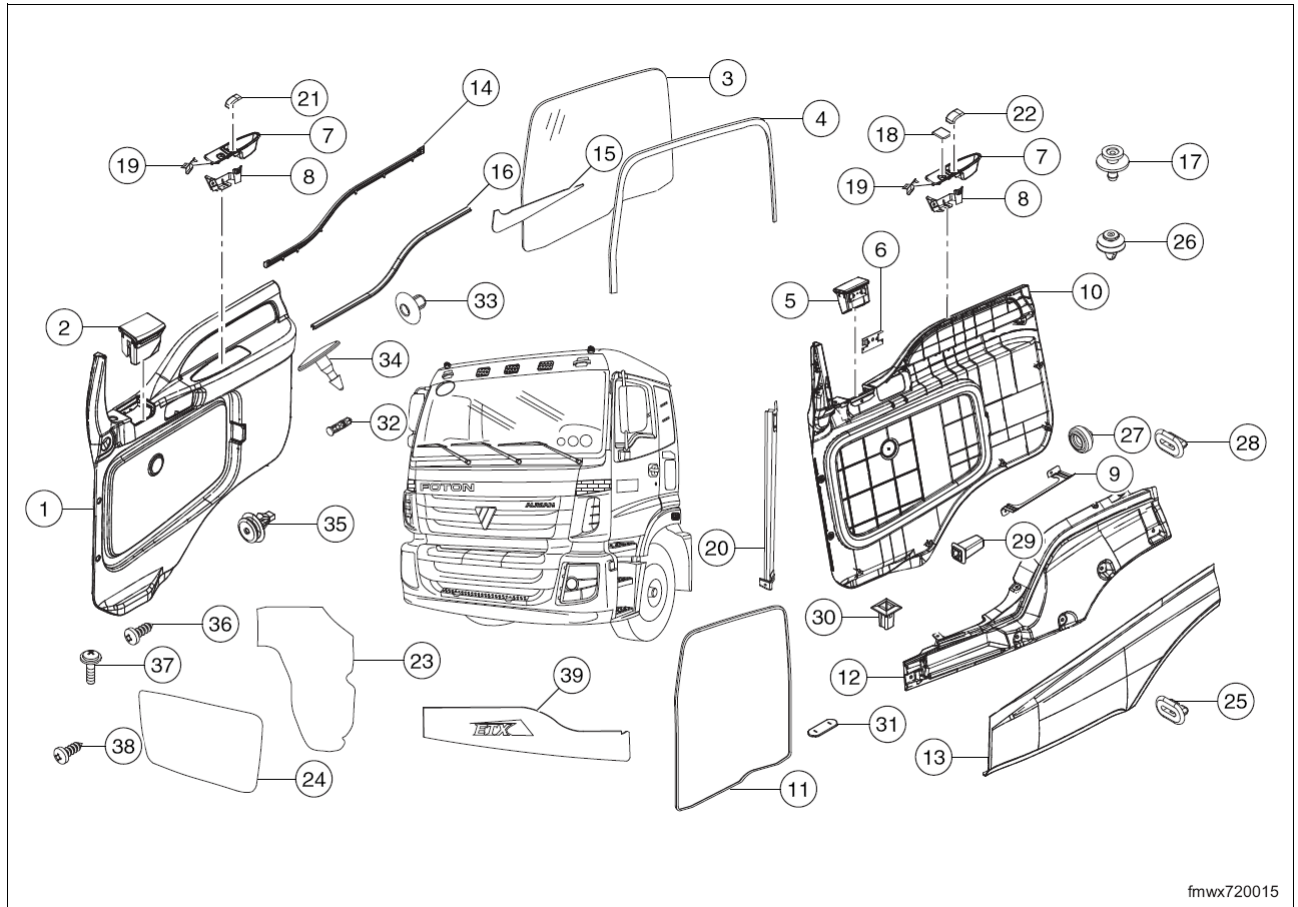
Interior & Exterior Trim Parts

Door Inner Guard Plate	76-3
Part Drawing	76-3
Replacement.....	76-5
Sun Visor Device	76-8
Part Drawing	76-8
Replacement.....	76-9
Carpet	76-11
Part Drawing	76-11
Replacement.....	76-13
Front Bumper.....	76-15
Part Drawing	76-15
Replacement.....	76-16
Mudguard	76-19
Part Drawing	76-19
Replacement.....	76-21
Front Cover	76-23
Part Drawing	76-23
Replacement.....	76-24
Trunk Parapet	76-26
Replacement.....	76-26

Interior & Exterior Trim Parts - Door Inner Guard Plate

Door Inner Guard Plate

Part Drawing



fmwx720015

1	Inner Guard Plate Assembly, RH Door
2	Ashtray Assembly (RH)
3	Door Glass Assembly
4	Door Glass Seal Assembly
5	Ashtray Assembly (LH)
6	Ashtray Bracket
7	Inner Armrest Assembly
8	Inner Armrest Bracket
9	Retaining Clamp Assembly
10	Inner Guard Plate Assembly of the LH Door
11	Door Seal
12	Liner Plate, Door Lower Trim Panel
13	Door Lower Trim Panel Assembly
14	External Seal Assembly, Door and Window Sill

21	Blank Cap, RH Inner Armrest
22	Blank Cap B, LH Inner Armrest
23	Front Waterproof Film, Door
24	Rear Waterproof Film, Door
25	Cup Head Jam
26	Buckle - Door Guard Plate
27	Round Buffer Pad
28	Buckle Seat - Roof Trim Panel
29	Plastic Nut
30	Buckle Seat - Ventilating Hood
31	Plug, Lower Ventilation Opening
32	Buckle - Mudguard
33	Buckle Seat-Mudguard
34	FR Door Spike

Interior & Exterior Trim Parts - Door Inner Guard Plate

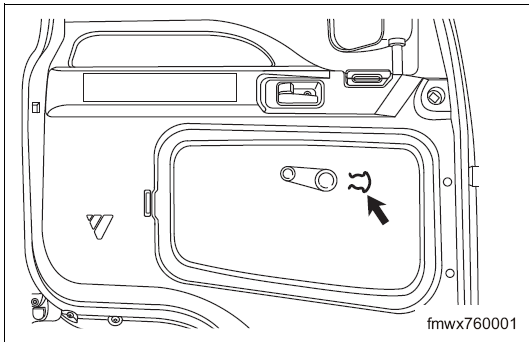
15	Door and Window Sill Patches
16	Door and Window Sill Inner Seal Assembly
17	Buckle
18	Blank Cap A of the LH Inner Armrest
19	Armrest Hood Clamp
20	FR Door Guide Rail Assembly

35	Plastic Buckle
36	Cross Recessed Tapping Screw
37	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
38	Cross Recessed Tapping Screw
39	ETX Door Side Label Patch

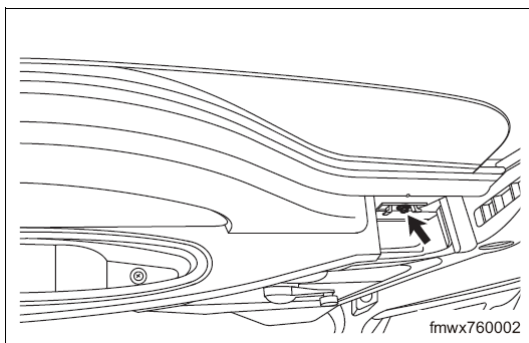
Replacement

Hint:

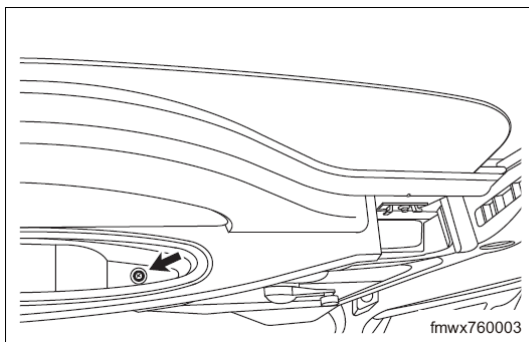
Part Drawing, refer to Chapter 76, Interior & Exterior Trim Parts -Door Inner Guard Plate, Part Drawing.



- 1. Dismantle the glass lifter crank**
 - (a). Dismantle the spring buckle of the crank, and remove the crank.

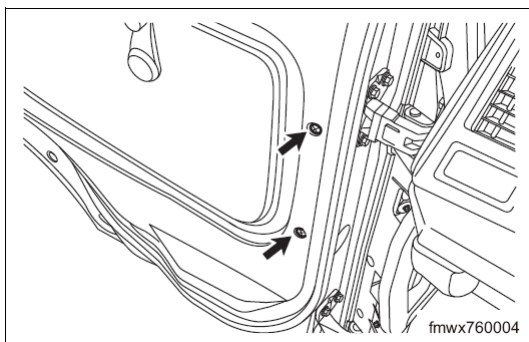


- 2. Dismantle the ashtray bracket**
 - (a). Remove the ashtray, and dismantle the fixing screws of the ashtray bracket.

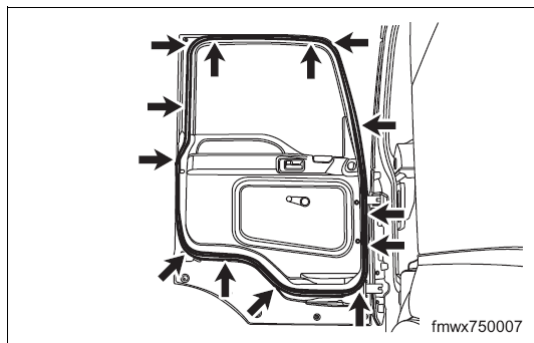


- 3. Dismantle the inner armrest assembly**
 - (a). Remove the blank cap of the inner armrest, and remove the fixing screws of the inner armrest assembly. Dismantle the Inner armrest assembly.

- 4. Dismantle the inward-opening handle, refer to Chapter 75, Door, Lock, Door Handle - Door Handle, Replacement**



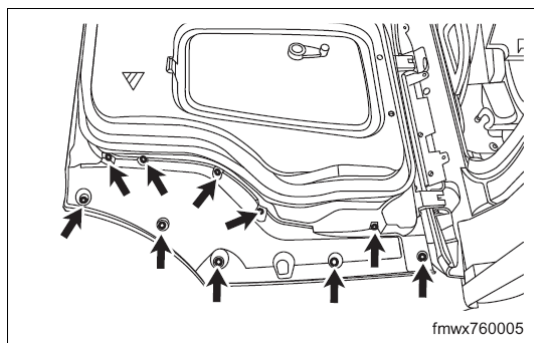
- 5. Dismantle the door inner guard plate assembly**
 - (a). Dismantle the front door spike.



(b). Dismantle the door inner guard plate.

Caution:

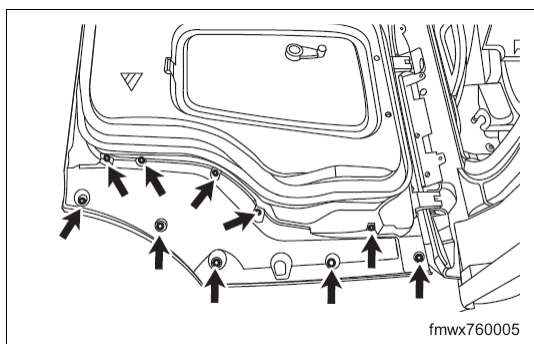
Any broken buckle of the inner guard plate must be replaced with a new one.



6. Dismantle the liner plate of the door lower trim panel

(a). Dismantle the plastic buckle.

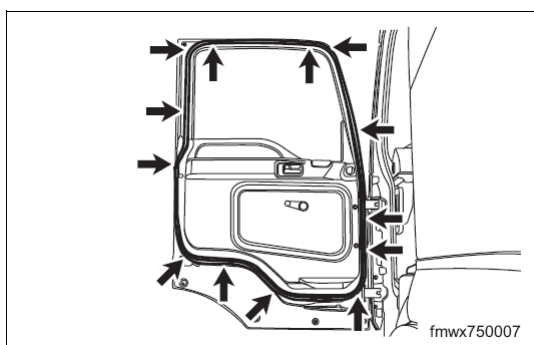
(b). Dismantle the fixing bolts and the fixing nuts of the liner plate of the door lower trim panel.



7. Install the liner plate of the door lower trim panel

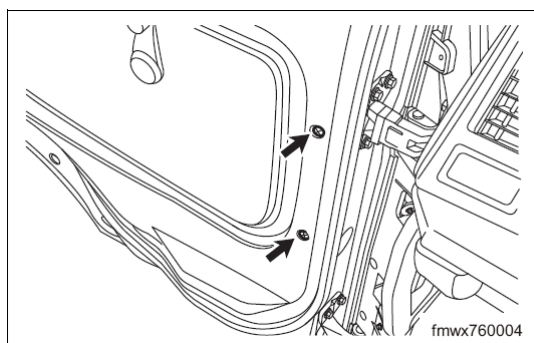
(a). Install the fixing bolts and the fixing nuts of the liner plate of the door lower trim panel.

(b). Install the plastic buckle.



8. Install the door inner guard plate assembly

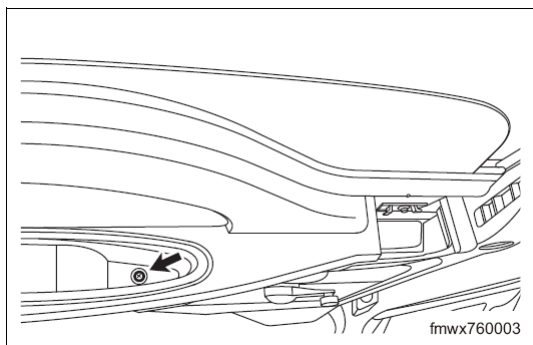
(a). Install the door inner guard plate.



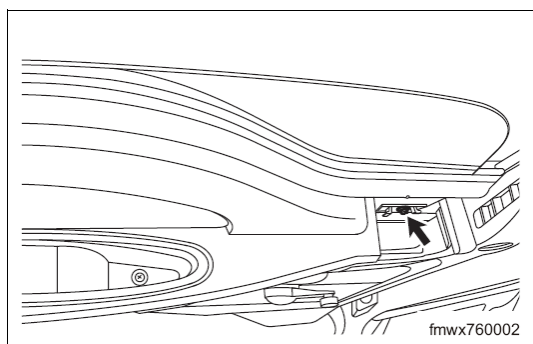
(b). Install the front door spike.

Interior & Exterior Trim Parts - Door Inner Guard Plate

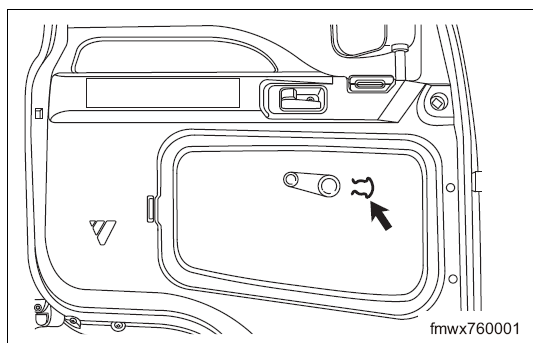
- 9. Install the inward-opening handle, refer to Chapter 75, Door, Lock, Door Handle - Door Handle , Replacement**



- 10. Install the inner armrest assembly**
(a). Install the fixing screws of the inner armrest assembly, and install the blank cap of the inner armrest.



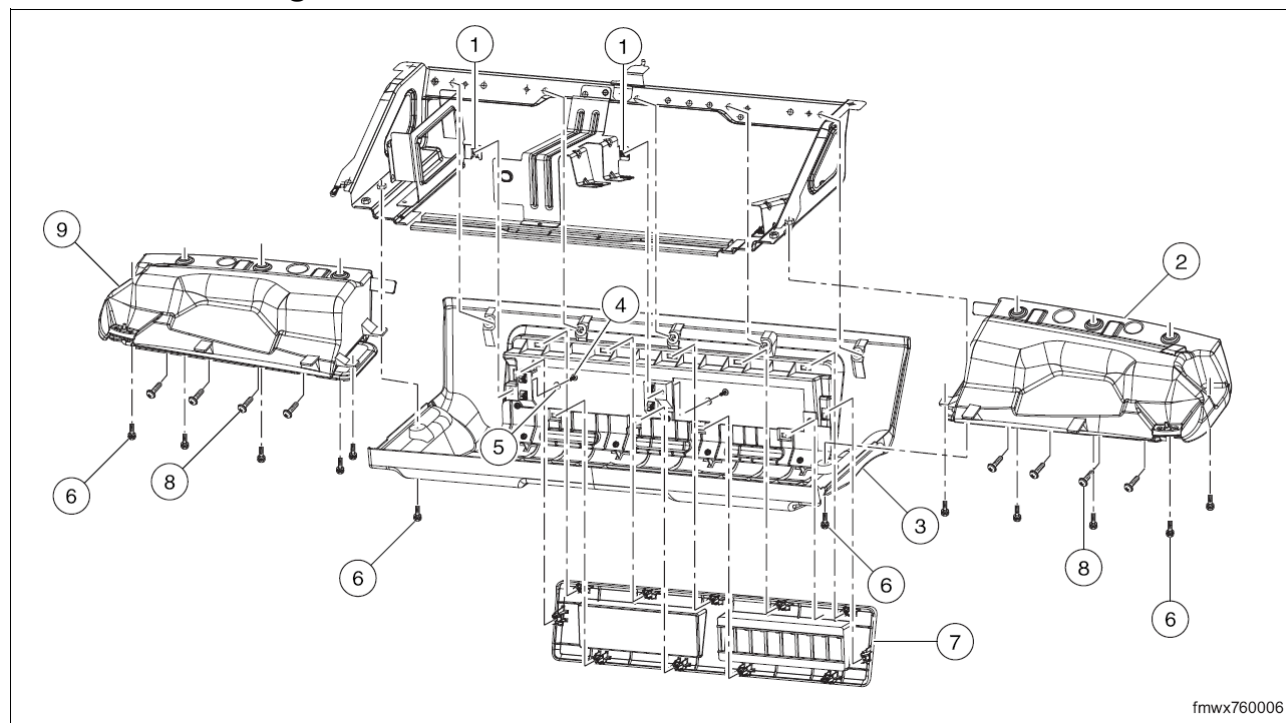
- 11. Install the ashtray bracket**
(a). Install the fixing screws of the ashtray bracket, and install the ashtray.



- 12. Install the glass lifter crank**
(a). Install the spring buckle of the crank.

Sun Visor Device

Part Drawing



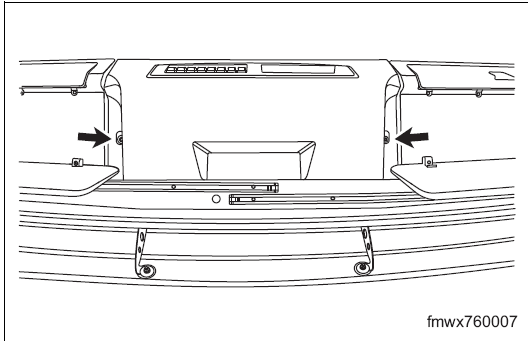
1	ST4.2 Leaf Spring Nut
2	LH Top Filing Cabinet Subassembly
3	Flat Top Filing Cabinet Intermediate Panel Assembly
4	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
5	Flat Washer

6	Hex Head Bolt, Spring Washer and Flat Washer Assembly
7	Switch Panel Assembly
8	Screw Assembly
9	RH Top Filing Cabinet Subassembly

Replacement

Hint:

Part Drawing, refer to Chapter 76, Interior & Exterior Trim Parts - Sun Visor Device, Part Drawing.

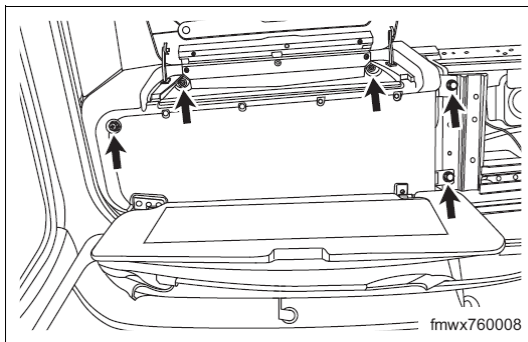


1. Dismantle the flat top filing cabinet intermediate panel assembly

- (a). Dismantle the fixing bolts of the flat top filing cabinet intermediate panel.
- (b). Prize up the buckle at the back of the panel, pluck off the switch connector, and remove the flat top filing cabinet intermediate panel assembly.

Caution:

Any broken panel buckle must be replaced with a new one.

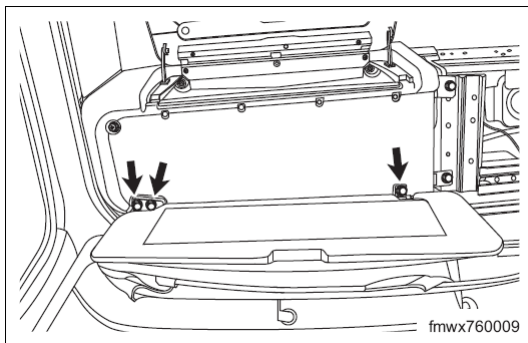


2. Dismantle the left top filing cabinet subassembly

- (a). Dismantle the fixing bolts of the left top filing cabinet subassembly, and remove the left top filing cabinet subassembly.

Hint:

The steps to dismantle the right top filing cabinet subassembly are the same as those to dismantle the left subassembly.

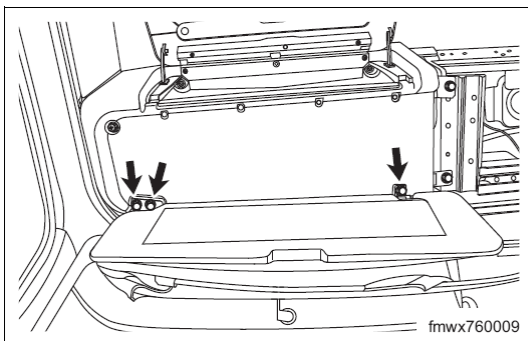


3. Dismantle the left sun visor assembly

- (a). Dismantle the fixing screws of the left sun visor assembly, and remove the left sun visor assembly.

Hint:

The steps to dismantle the right sun visor assembly are the same as those to dismantle the left assembly.

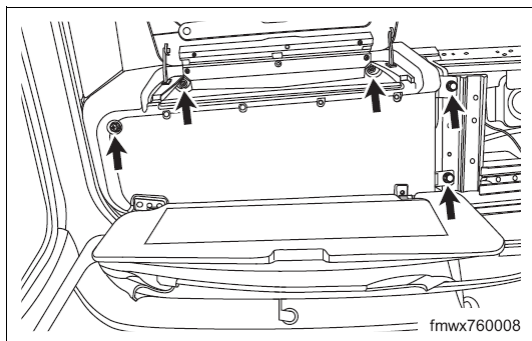


4. Install the left sun visor assembly

- (a). Install the fixing screws of the left sun visor assembly.

Hint:

The steps to install the right sun visor assembly are the same as those to install the left assembly.

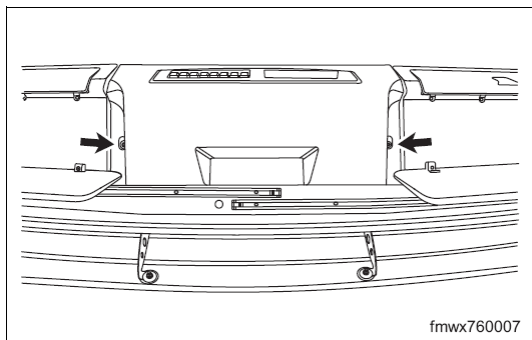


5. Install the left top filing cabinet subassembly

- (a). Install the fixing bolts of the left top filing cabinet subassembly.

Hint:

The steps to install the right top filing cabinet subassembly are the same as those to install the left subassembly.

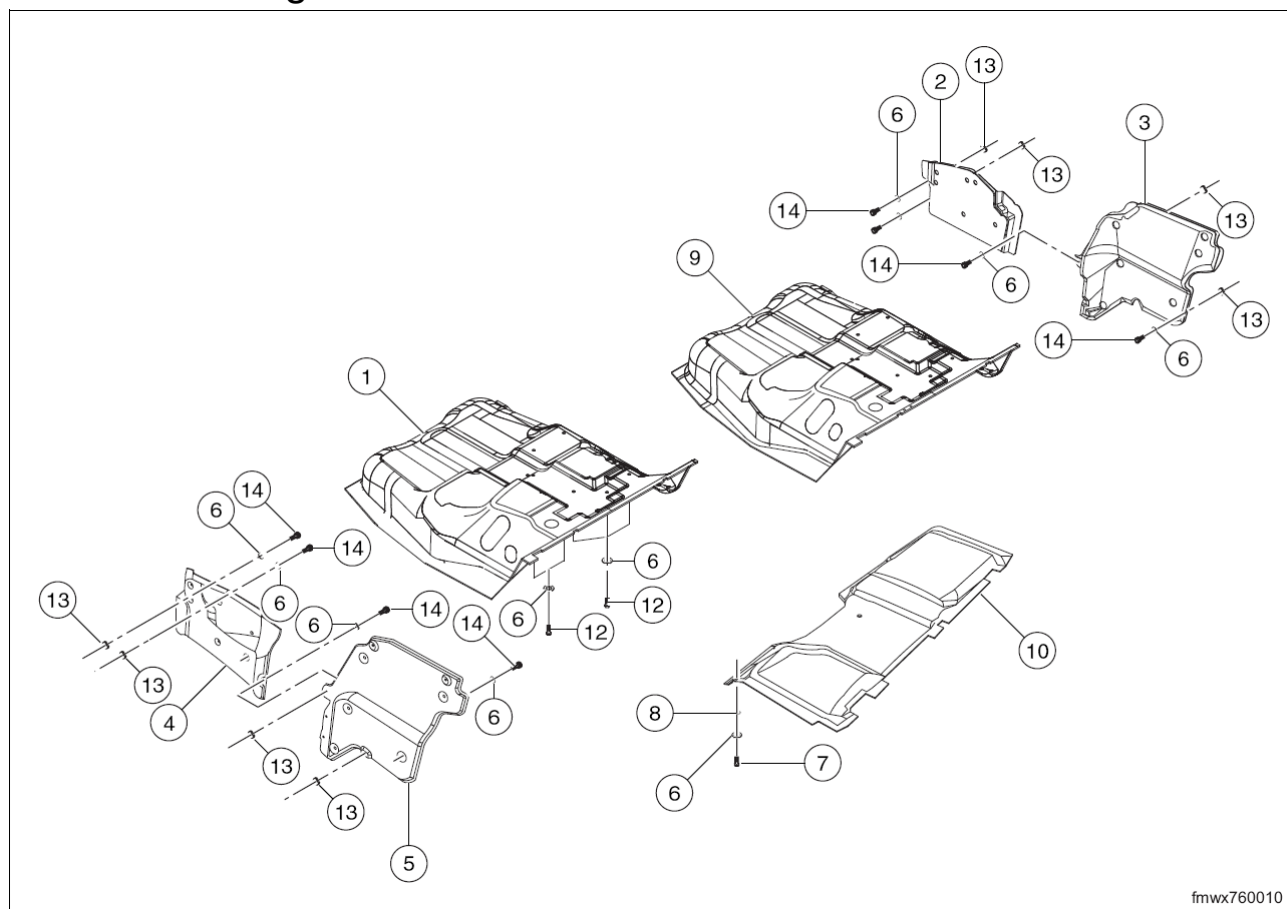


6. Install the flat top filing cabinet intermediate panel assembly

- (a) Connect the switch connector, and install the flat top filing cabinet intermediate panel assembly.
(b). Install the fixing bolts of the flat top filing cabinet intermediate panel.

Carpet

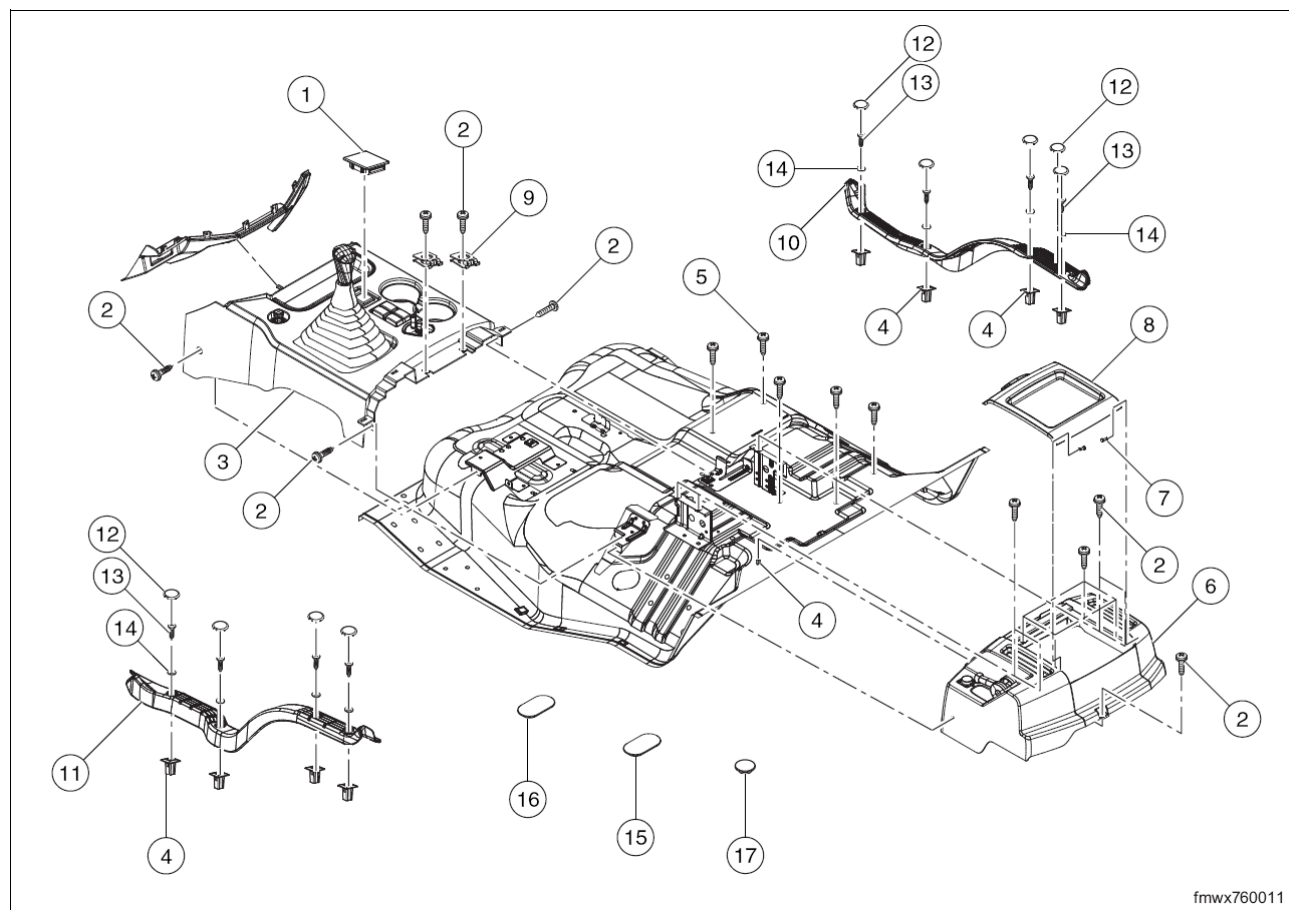
Part Drawing



fmwx760010

1	Swelling Heat Insulation Pad
2	RH FR Acoustic Lining
3	RH RR Acoustic Lining (symmetric with the left side)
4	LH FR Acoustic Lining
5	LH RR Acoustic Lining
6	Big Washer
7	Tapping Screw

8	Big Washer
9	Carpet Assembly
10	RR Floor Heat Insulation Pad
11	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
12	Hex Head Bolt, Spring Washer and Flat Washer Assembly
13	2-shaped Hex Nut
14	Hex Head Bolt, Spring Washer and Plain Cushion Assembly



fmwx760011

1	Rear-view Mirror Electric Switch Blank Cap
2	Tapping Screw
3	Intermediate Platform Front Assembly
4	Plastic Nut
5	Recessed Pan Head Tapping Screw and Flat Washer Assembly
6	Intermediate Platform Rear Assembly
7	Cover Axle Pin
8	Intermediate Platform Central Rear Cover Assembly
9	ST4.2 Leaf Spring Nut

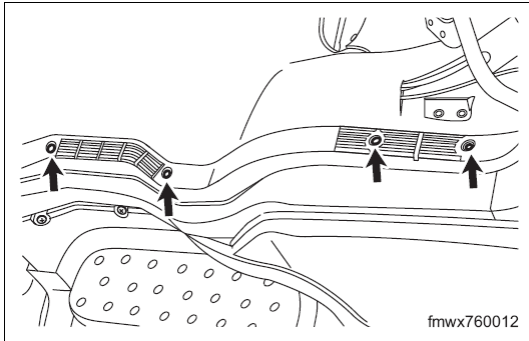
10	RH Carpet Trim Strip
11	LH Carpet Trim Strip
12	Trim Strip Plug
13	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
14	Flat Washer
15	Big Plug for floor swelling and Slotted Hole
16	Floor LH Slotted Hole Cover
17	PVC Plug 35

Replacement

Hint:

Part Drawing, refer to Chapter 76, Interior & Exterior Trim Parts - Carpet, Part Drawing.

1. Dismantle the driver's seat, refer to Chapter 74, Seat - Driver's seat, Dismantlement and Installation
2. Dismantle the co-driver's seat, refer to Chapter 74, Seat - Co-driver's Seat, Replacement
3. Dismantle the middle seat, refer to Chapter 74, Seat - Middle Seat, Replacement
4. Dismantle the sleeper device, refer to Chapter 74, Seat - Sleeper Device, Replacement
5. Dismantle the dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Dashboard, Replacement
6. Dismantle the transmission control mechanism, refer to Chapter 31, Transmission-Transmission Control Mechanism, Dismantlement and Installation
7. Dismantle the steering gear assembly, refer to Chapter 42, Steering Gear and Accessories - Steering Gear, Dismantlement and Installation
8. Dismantle the brake pedal, refer to Chapter 26, Service Brake - Brake Pedal, Overhaul
9. Dismantle the accelerator pedal, refer to Chapter 17, Engine Control - Accelerator Pedal, Replacement
10. Dismantle the trunk tilt control valve, refer to Chapter 77, Cab - Dismantlement and Installation of Cab Assembly



11. Dismantle the left carpet trim strip

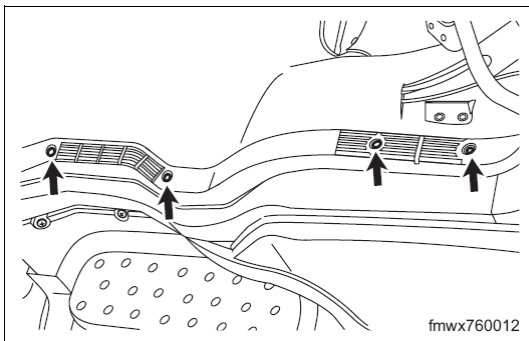
- (a). Dismantle the plug of the left trim strip.
- (b). Dismantle the fixing screws of the left trim strip.

Hint:

The steps to dismantle the right side are the same as those to dismantle the left side.

12. Dismantle the carpet assembly

13. Install the carpet assembly



14. Install the left carpet trim strip

- (a). Install the fixing screws of the left trim strip .
- (b). Install the Plug of the left trim strip.

Hint:

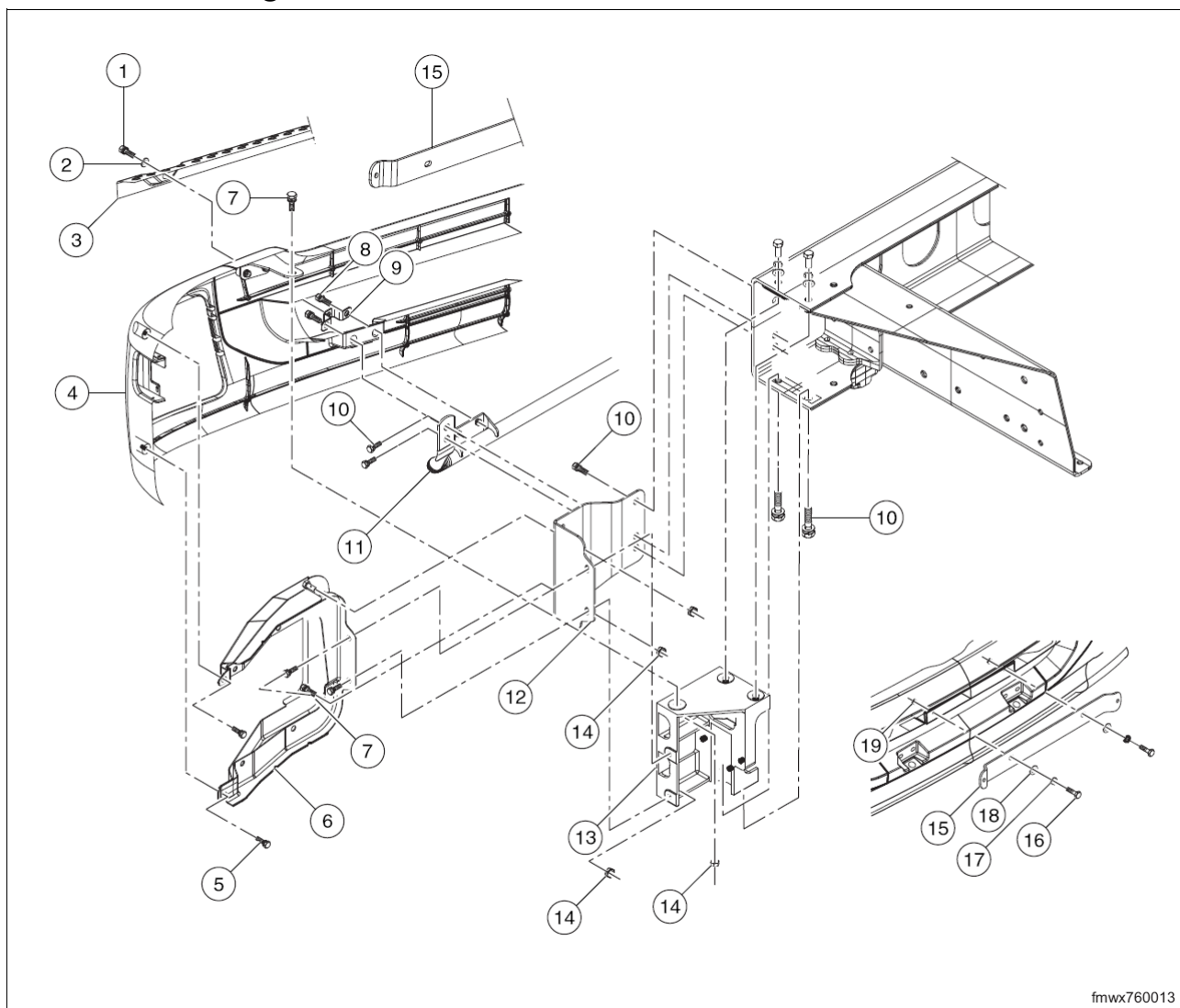
The steps to install the right side are the same as those to install the left side.

15. Install the trunk tilt control valve, refer to Chapter 77, cab -Dismantlement and Installation of Cab Assembly
16. Install the accelerator pedal, refer to Chapter 17, Engine Control - Accelerator Pedal, Replacement
17. Install the brake pedal, refer to Chapter 26, Service Brake - Brake Pedal, Overhaul
18. Install the steering gear assembly, refer to Chapter 42, Traversing Mechanism and Accessories - Steering Gear, Dismantlement and Installation
19. Install the Transmission control mechanism, refer to Chapter 31, Transmission-Transmission Control Mechanism, Dismantlement and Installation

Interior & Exterior Trim Parts - Carpet

20. Install the Dashboard, refer to Chapter 73, Dashboard, Instrument, Cigarette Lighter - Dashboard, Replacement
21. Install the sleeper device, refer to Chapter 74, Seat - Sleeper Device, Replacement
22. Install the middle seat, refer to Chapter 74, Seat - Middle Seat, Replacement
23. Install the co-driver's seat, refer to Chapter 74, Seat - Co-driver's seat, Replacement
24. Install the driver's seat, refer to Chapter 74, Seat - Driver's seat, Dismantlement and Installation

Front Bumper Part Drawing



fmwx760013

1	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
2	Big Washer
3	Bumper Foot Rest
4	Bumper Subassembly
5	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
6	Headlamp Bracket Assembly
7	Hex Head Bolt, Spring Washer and Flat Washer Assembly
8	Hex Head Bolt, Spring Washer and Flat Washer Assembly
9	Bumper Foot Rest Bracket Assembly

11	Bumper Support Pipe Assembly
12	Headlamp Bracket Connecting Bracket
13	Frame Connecting Bracket
14	Hex Nut, Style 1
15	FR License Plate Support Assembly
16	Hex Head Bolt
17	Spring Washer
18	Flat Washer
19	Hex Flange Face Nut

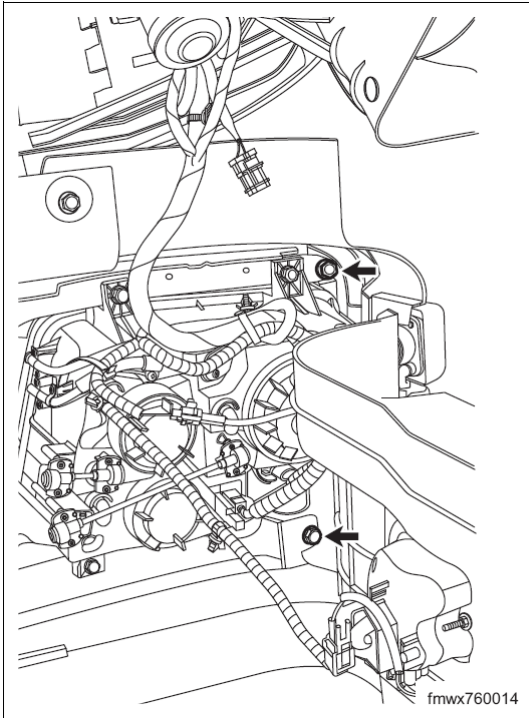
10	Hex Head Bolt, Plain Cushion and Spring Washer Assembly
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Replacement

Hint:

Part Drawing, refer to Chapter 76, Interior & Exterior Trim Parts - Front Bumper, Part Drawing.

1. **Open the front turnover cover plate**
2. **Open the cab**

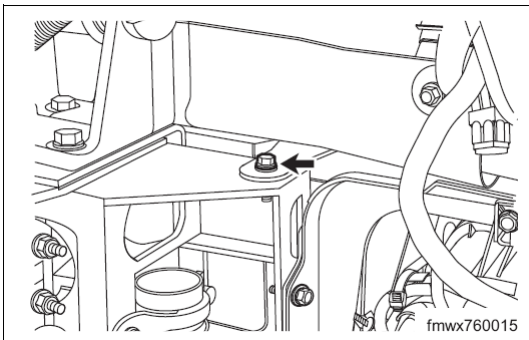


3. **Dismantle the front bumper assembly.**

- (a). Dismantle the fixing bolts of the front bumper and the headlamp bracket .

Hint:

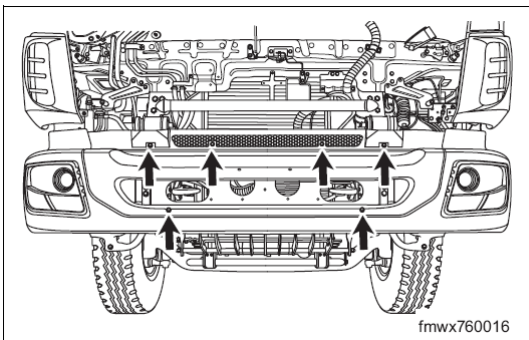
The steps to dismantle the left side are the same as those to dismantle the right side.



- (b). Dismantle the fixing bolts of the front bumper and the front anti-collision beam.

Hint:

The steps to dismantle the left side are the same as those to dismantle the right side.

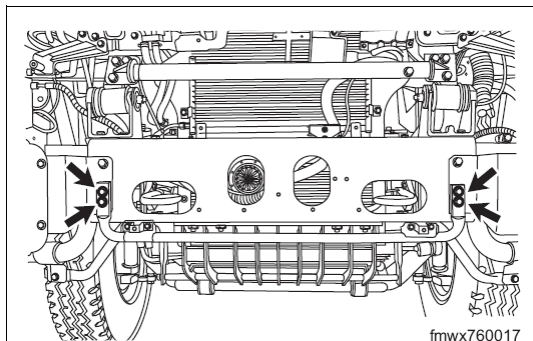


- (c). Dismantle the fixing bolts of the front bumper, and remove the front bumper assembly.

Caution:

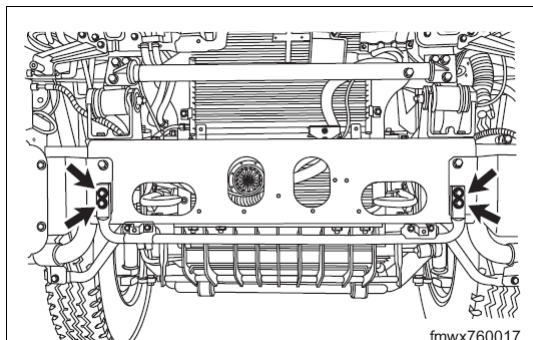
The front bumper is very heavy and must be handled by several persons.

Interior & Exterior Trim Parts - Front Bumper



4. Dismantle the front bumper support pipe assembly

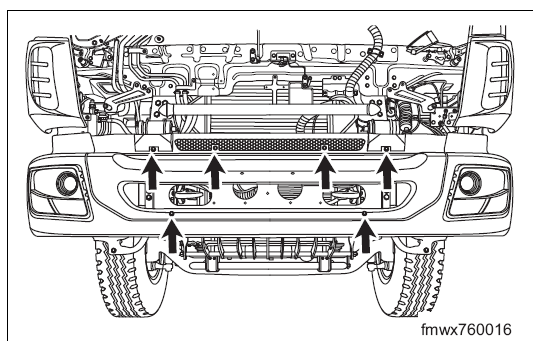
- (a). Dismantle the fixing bolts of the front bumper support pipe.



5. Install the front bumper support pipe assembly

- (a). Install the fixing bolts of the front bumper support pipe.

Torque: 100N.m



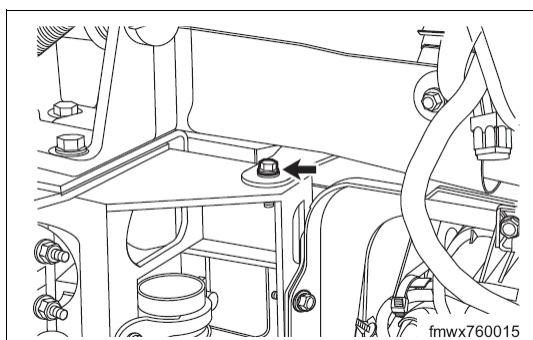
6. Install the front bumper assembly

- (a). Install the fixing bolts of the front bumper.

Caution:

The front bumper is very heavy and must be handled by several persons.

Torque: 40N.m

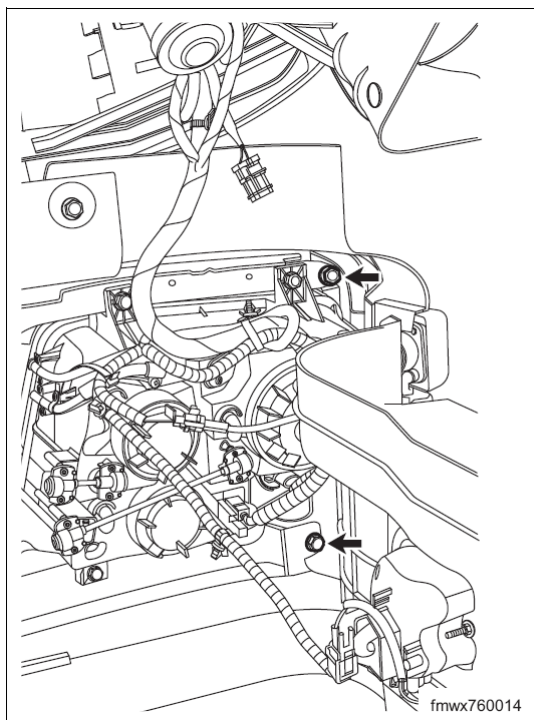


- (b). Install the fixing bolts of the front bumper and the front anti-collision beam.

Hint:

The steps to install the left side are the same as those to install the right side.

Torque: 100N.m



- (c). Install the fixing bolts of the front bumper and the headlamp bracket.

Hint:

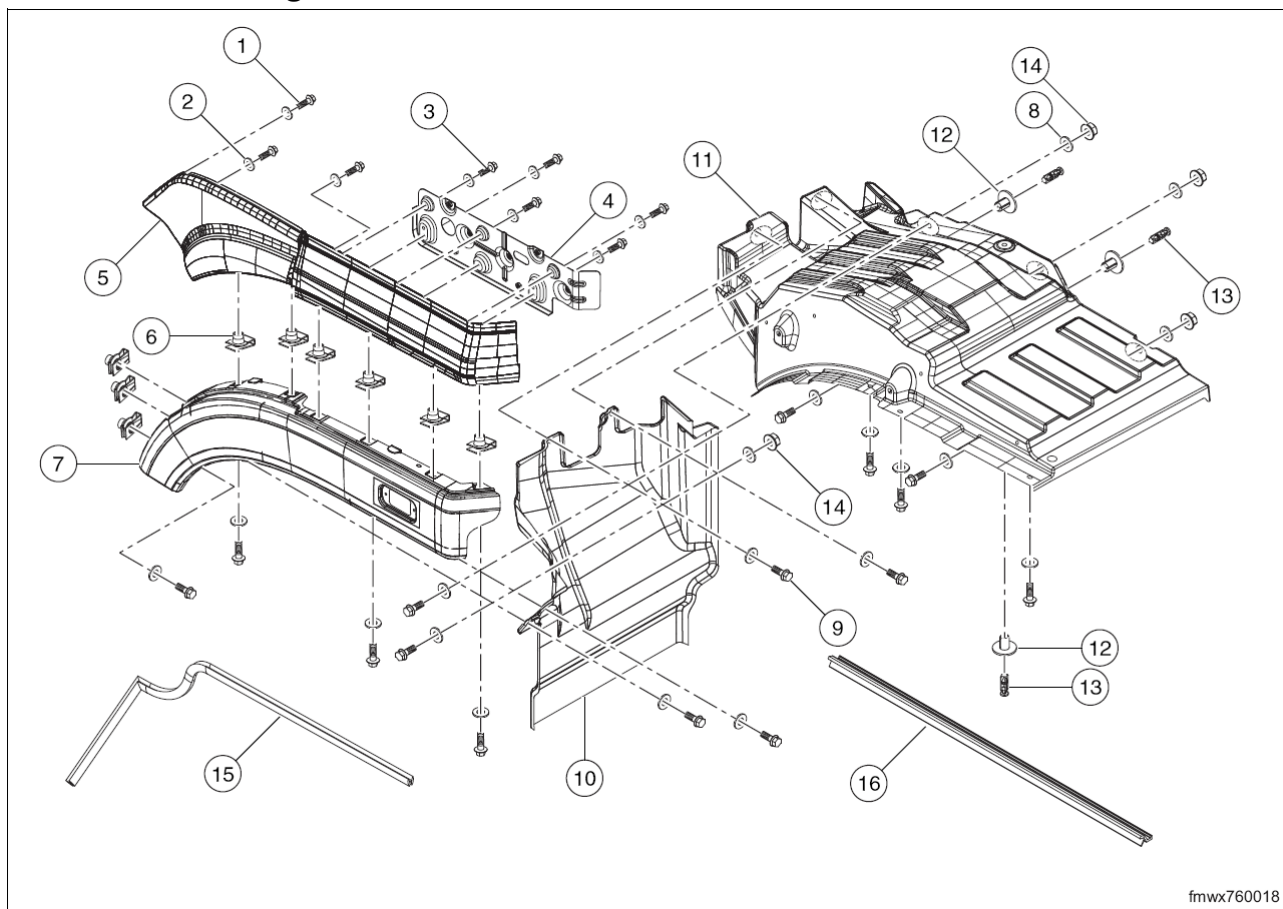
The steps to install the left side are the same as those to install the right side.

Torque: **40N.m**

7. Close the cab
8. Close the front turnover cover plate

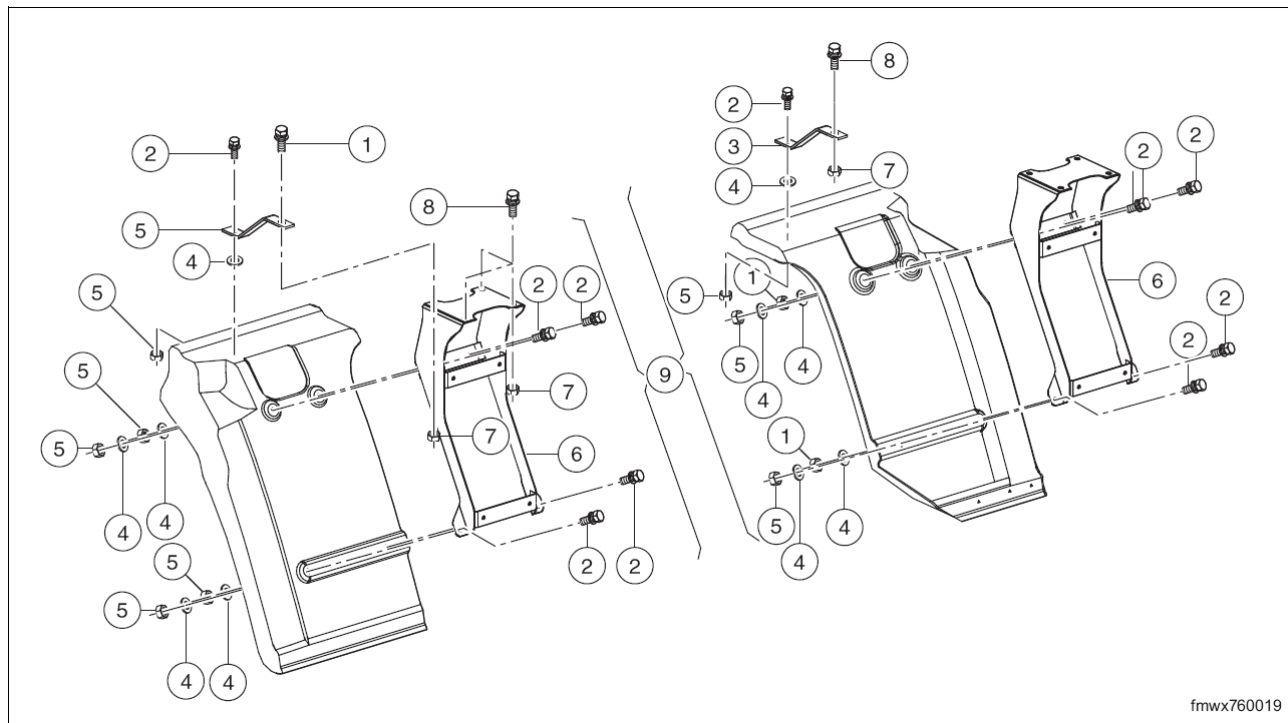
Mudguard

Part Drawing



1	Hex Flange Face Bolt
2	Flat Washer
3	Bolt
4	Fender Support Assembly
5	Fender
6	Leaf Spring Nut, Style B
7	Auxiliary Wheel House
8	Flat Washer

9	Hex Flange Face Bolt
10	FR Wheel Mudguard
11	Wheel Mudguard
12	Buckle Block — Mudguard
13	Buckle — Mudguard
14	Hex Nut, Style 1
15	Fender Seal
16	RR Seal, Fender



fmwx760019

1	Hex Head Bolt, Spring Washer and Flat Washer Assembly
2	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
3	Interior Connecting Bracket I
4	Big Washer
5	Hex Nut, Style 1

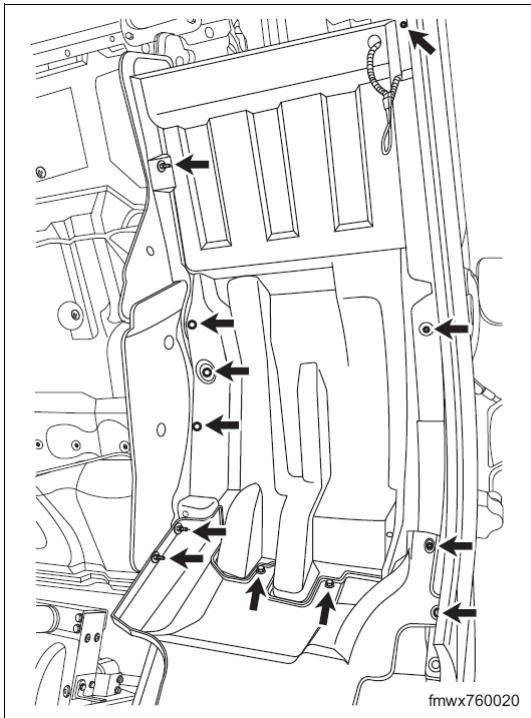
6	RR Fender Support Assembly
7	Hex Nut, Style 1
8	Hex Head Bolt, Spring Washer and Flat Washer Assembly
9	RR Fender Assembly

Replacement

Hint:

Part Drawing; refer to Chapter 76, Interior & Exterior Trim Parts - Mudguard, Part Drawing.

1. Open the cab



2. Dismantle the wheel mudguard assembly

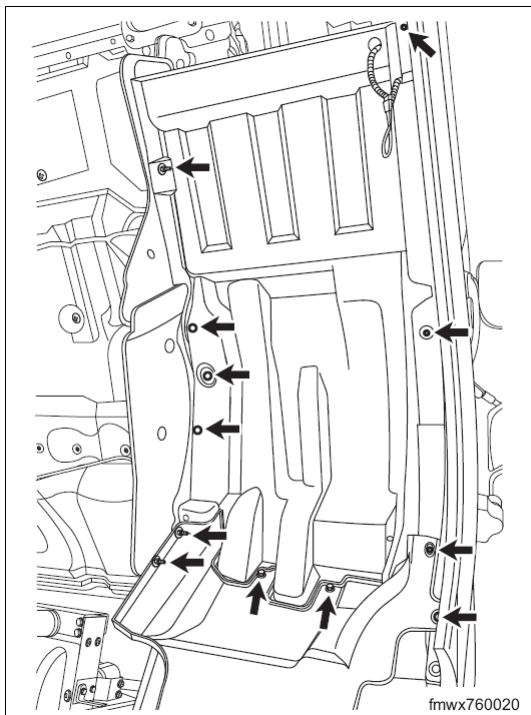
- (a). Disconnect the connector of the marker lamp.
- (b). Dismantle the fixing bolts, nuts and buckles of the wheel mudguard.

Caution:

Any broken buckle must be replaced with a new one.

Hint:

The steps to dismantle the left side are the same as those to dismantle the right side.

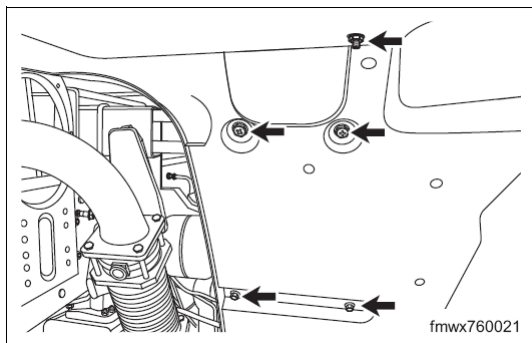


3. Install the wheel mudguard assembly

- (a). Install the fixing bolts, nuts and the buckles of the wheel mudguard.
- (b). Install the connector of the marker lamp.

Hint:

The steps to install the left side are the same as those to install the right side.

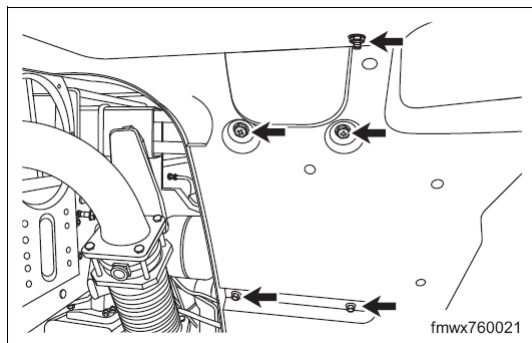


4. Dismantle the rear mudguard assembly

(a). Dismantle the fixing nuts of the rear mudguard.

Hint:

The steps to dismantle the right side are the same as those to dismantle the left side.



5. Install the rear mudguard assembly

(a). Install the fixing nuts of the rear mudguard.

Hint:

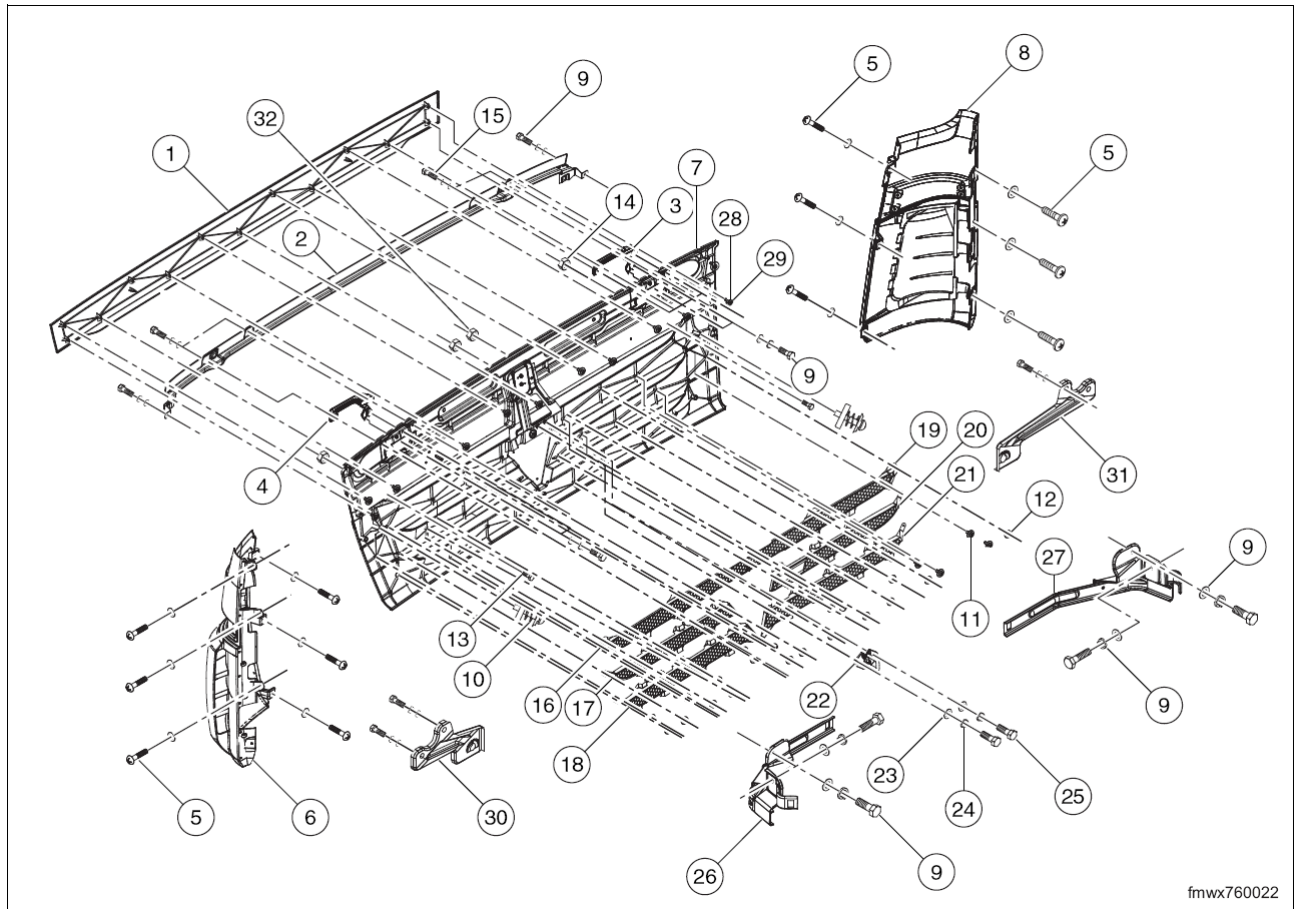
The steps to install the right side are the same as those to install the left side.

6. Close the cab.

Interior & Exterior Trim Parts - Front Cover

Front Cover

Part Drawing



fmwx760022

1	Front Cover Trim Panel
2	Screen Wiper Fixing Plate Welded assembly
3	RH FR Wall Armrest and Hinge Assembly
4	LH FR Wall Armrest and the Hinge Assembly
5	Cross Recessed Pan Head Tapping Screw and Flat Washer Assembly
6	LH Trimming Corner Plate Assembly
7	LH Turnover Cover Assembly
8	RH Trimming Corner Plate Assembly
9	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
10	Turnover Cover Lock Buckle Assembly
11	Cross Recessed Pan Head Tapping Screw-C-type (top and bottom shells)
12	Big Washer
13	Hex Flange Face Bolt

17	LH middle screen
18	LH lower screen
19	RH upper screen
20	RH middle screen
21	RH lower screen
22	Retaining Lock Hook Pin Assembly
23	Flat Washer
24	Spring Washer
25	Hex Head Cross Recessed Bolt
26	LH Corner Plate Lower Bracket Welded Assembly
27	RH Corner Plate Lower Bracket Welded Assembly
28	Cross Recessed Pan Head Tapping Screw
29	Flat Washer

14	Hex Flange Face Nut
15	Hex Head Bolt, Spring Washer and Plain Cushion Assembly
16	LH Upper Screen

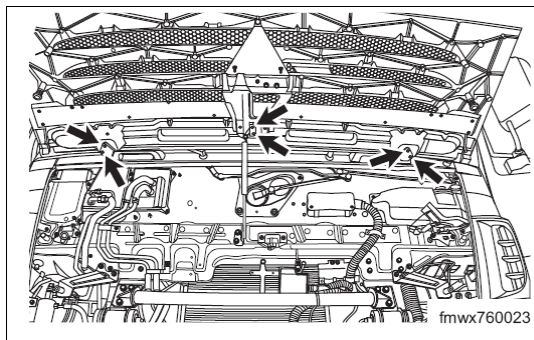
30	Buffer Block Right Bracket
31	Buffer Block Left Bracket
32	Hex Flange Face Bolt

Replacement

Hint:

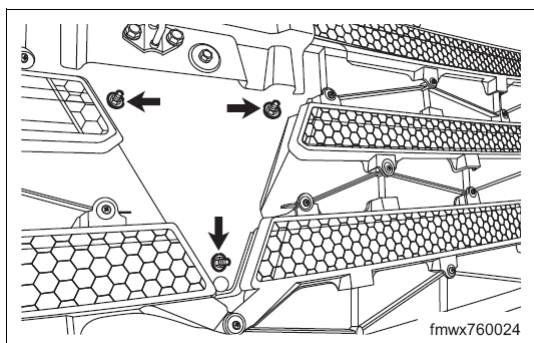
Part Drawing; refer to Chapter 76, Interior & Exterior Trim Parts - Front Cover, Part Drawing.

1. Open the front turnover cover



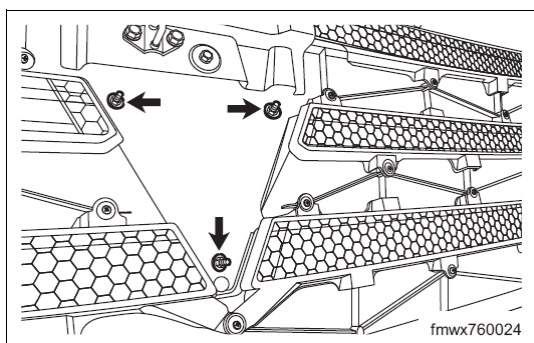
2. Dismantle the front turnover cover assembly

- Dismantle the fixing bolts of the front turnover cover stay bar.
- Dismantle the fixing bolts of the front turnover cover hinge.



3. Dismantle the Foton mark assembly

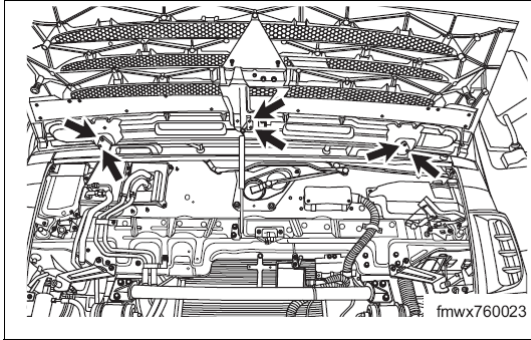
- Dismantle the fixing nuts of the Foton mark.



4. Install the Foton mark assembly

- Install the fixing nuts of the Foton mark.

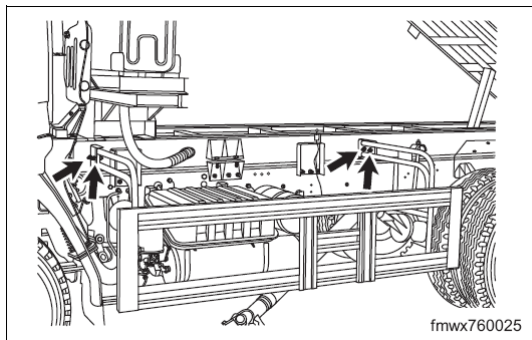
Interior & Exterior Trim Parts - Front Cover



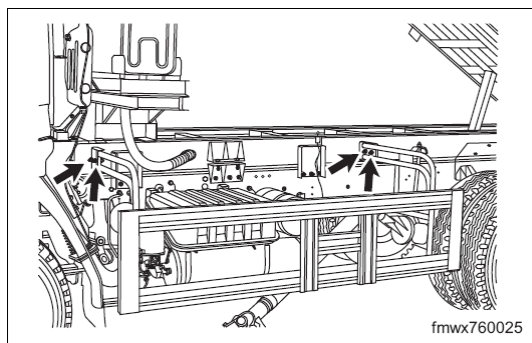
- 5. Install the front turnover cover assembly**
- (a). Install the fixing bolts and hinge of the front turnover cover.
 - (b). Install the fixing bolts of the front turnover cover stay bar.
Torque: **40N.m**

- 6. Close the front turnover cover**

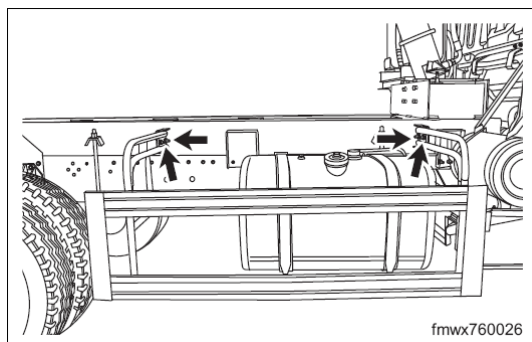
Trunk Parapet Replacement



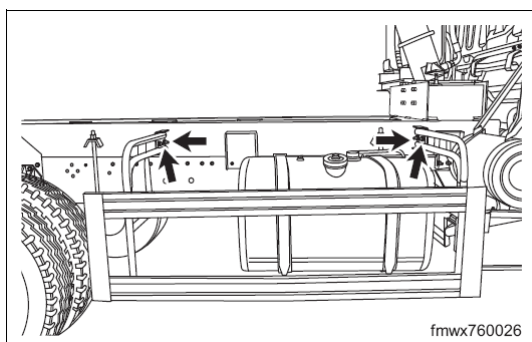
- 1. Dismantle the left trunk parapet assembly**
(a). Dismantle the fixing bolts of the left fender wall.



- 2. Install the left trunk parapet assembly**
(a). Install the fixing bolts of the left fender wall.
Torque: **97N.m**



- 3. Dismantle the right trunk parapet assembly**
(a). Dismantle the fixing bolts of the right fender wall.



- 4. Install the right trunk parapet assembly**
(a). Install the fixing bolts of the right fender wall.
Torque: **97N.m**

Cab

Dismantlement and Installation of Cab 77-3

Dismantlement of Cab..... 77-3

Installation of Cab 77-6

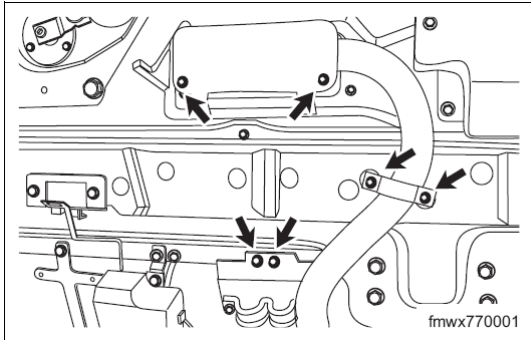
Dismantlement and Installation of Cab

Dismantlement of Cab

Hint:

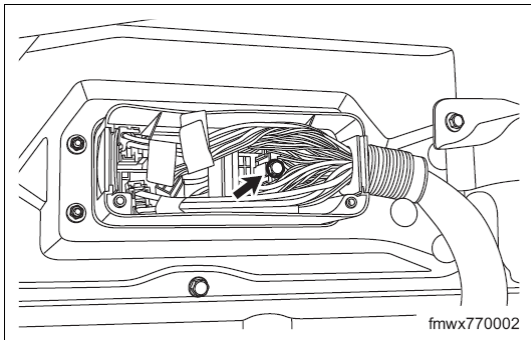
Try to prevent any external component from contacting braking fluid which will dissolve paint. The working surface must be flat. And any object in the cab and on the roof must be removed.

1. **Open the front turnover cover, and turn off the main power supply**
2. **Open the cab.**
3. **Disconnect the headlamp wiring harness connector, refer to Chapter 54, Lighting- Front Combination Lamp, Replacement**
4. **Disconnect the plug of the courtesy lamp wiring harness, refer to Chapter 54, Lighting - Courtesy Lamp, Replacement**

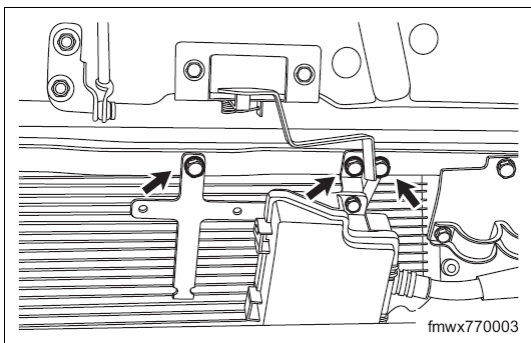


5. **Disconnect the wiring harness of the front cover, and remove the fixing bolts of the wiring harness**

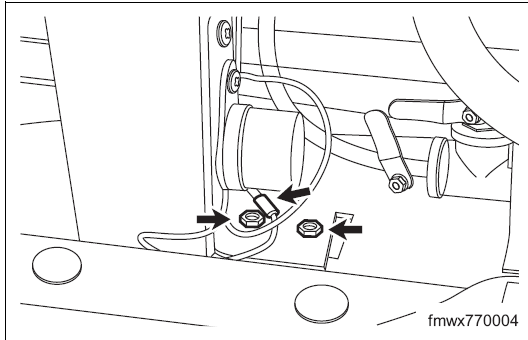
(a). Dismantle the bolts of the wiring harness box cap of the front cover and the wiring harness fixing bolts.



(b). Dismantle the fixing bolts of the wiring harness connector, and disconnect all the plugs of the front cover wiring harness.

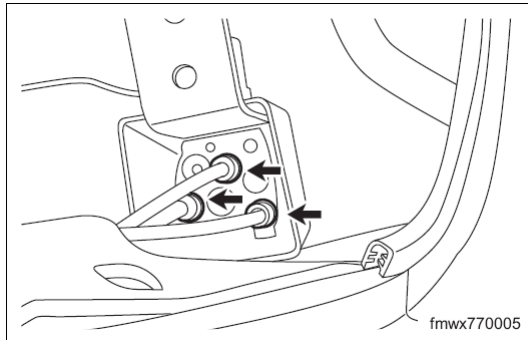


6. **Disconnect the fixing bolts of the general fuse and the grounding wire of the front shroud**



7. **Disconnect the air pipe of the trunk tilt control valve and the plug of the buzzer wiring harness**

(a). Dismantle the fixing bolts of the trunk tilt control valve and the plug of the buzzer wiring harness.

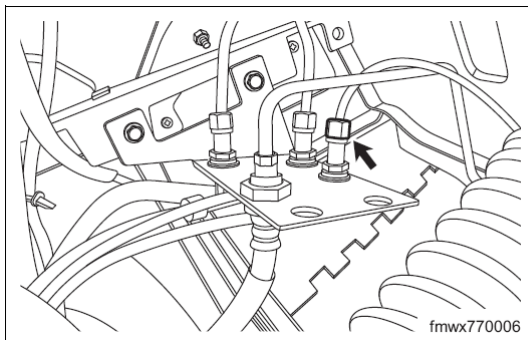


(b). Disconnect the air pipe of the trunk tilt control valve (by pulling out of the cab)

Caution:

The air pipe should be marked to avoid confusing in installation.

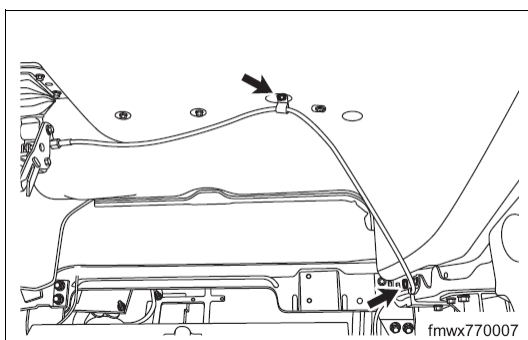
8. Disconnect the high and low pressure pipes and the fixing bolts of the air conditioner, refer to Chapter 51, Air Heater and Air Conditioning - Cooling Pipe, Overhaul
9. Disconnect the high and low pressure pipes of the reservoir, refer to Chapter 51, Air Heater and Air Conditioning - Reservoir, Overhaul
10. Disconnect the heater water pipe and the fixing bolts, refer to Chapter 51, Air Heater and Air Conditioning- Heater Water Pipe, Overhaul
11. Disconnect the air pipe of the parking brake
12. Disconnect the air pipe of the clutch master cylinder, refer to Chapter 32, Clutch - Clutch Master Cylinder, Overhaul
13. Disconnect the air pipe of the main brake valve and the wiring harness connector, refer to Chapter 26, Service Brake - Main Brake Valve, Overhaul



14. Disconnect the air pipe of the pressure gauge

Caution:

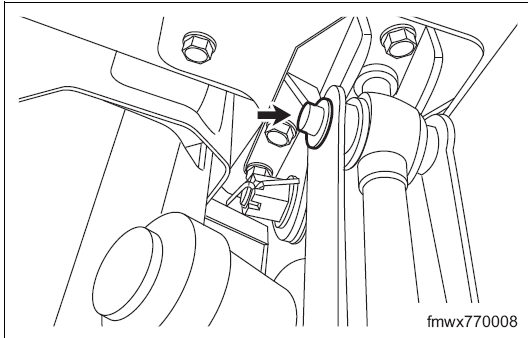
The color circles on the air pipe must be corresponding with each other to avoid confusing.



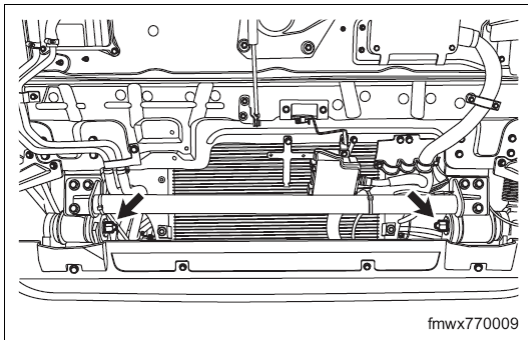
15. Dismantle the fixing bolts of the lubricant pipe of the gear lever.

Cab - Dismantlement and Installation of Cab

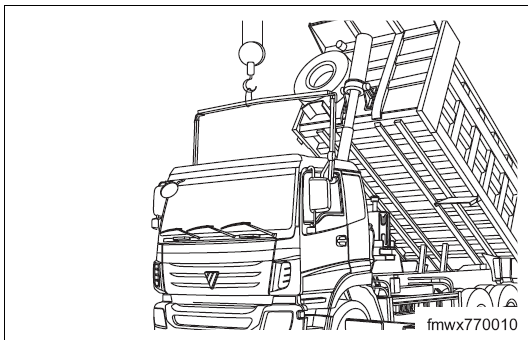
16. Dismantle the steering shaft, refer to Chapter 42, Steering Gear and Accessories - Steering Gear Assembly, Overhaul
17. Dismantle the connecting bolts of the transmission control mechanism, refer to Chapter 31, Transmission -Transmission Control Mechanism, Dismantlement and Installation
18. Close the cab.
19. Lower the front window glasses at both sides, and place the cab suspending wire a little ahead of the middle part of the cab. Raise the suspending wire slowly until it supports the cab.



20. Dismantle the pin roll of the turnover cylinder assembly



21. Dismantle nuts of the left and the right trip shaft



22. Hoist the cab assembly

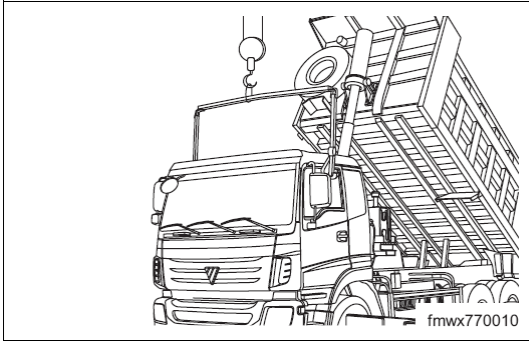
Warning:

Place the cab on the bracket quickly. Access to the position below the hoisted cab is strictly forbidden. Proper safety measures must be taken in the process of operation.

Caution:

Ensure that no cable, hose, pipe end, etc, will entwine the frame when hoisting the cab assembly.

Installation of Cab



1. Hoist the cab assembly

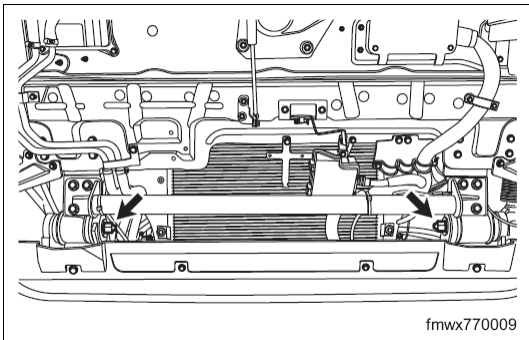
- (a). Slowly lift the suspending wire to hoist the cab and place the cab at the installation location at the front.

Warning:

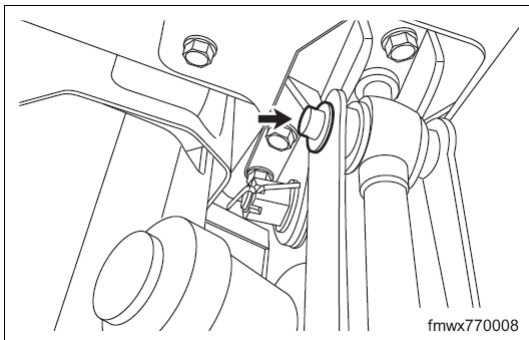
Place the cab on the bracket quickly. Access to the position below the hoisted cab is strictly forbidden. Proper safety measures must be taken in the process of operation.

Caution:

Ensure that no cable, hose, pipe end, etc, will entwine the frame when hoisting the cab assembly.

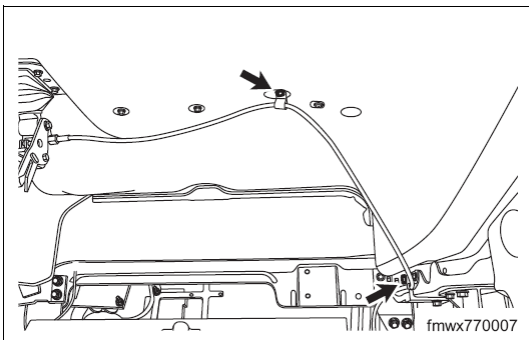


2. Install the nuts of the left and right trip shafts
Torque: 163~199N.m

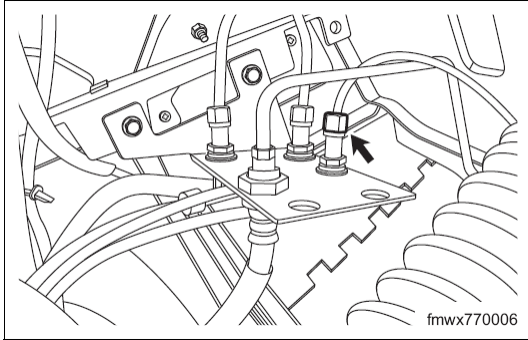


3. Install the pin roll of the turnover cylinder assembly

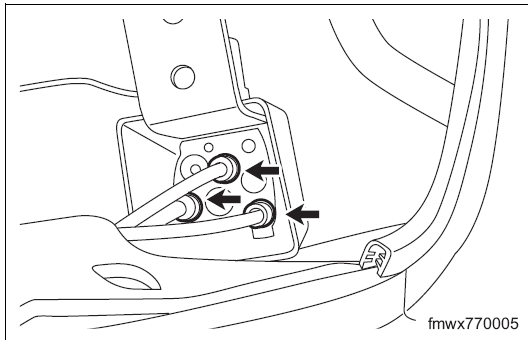
4. Remove the cab suspending wire, and slowly turn over the cab.
5. Install the Connecting bolts of the transmission control mechanism, refer to Chapter 31, Transmission-Transmission Control Mechanism, Dismantlement and Installation
6. Install the steering shaft, refer to Chapter 42, Steering Gear and Accessories - Steering Gear Assembly, Overhaul



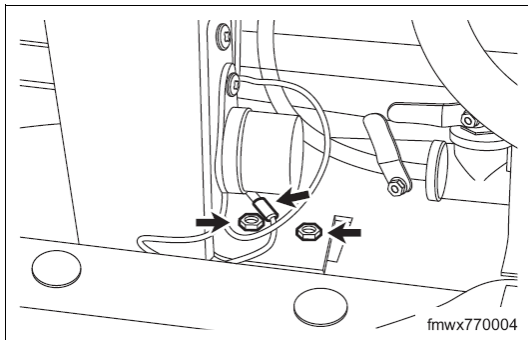
7. Install the fixing bolts of the gear lever lubricant pipe

Cab - Dismantlement and Installation of Cab**8. Install the air pipe of the pressure gauge**

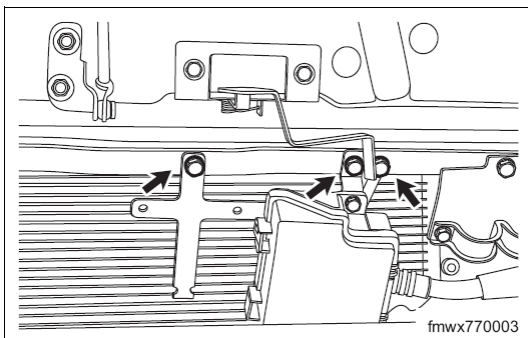
9. Install the air pipe of the main brake valve and the wiring harness connector, refer to Chapter 26, Service Brake - Main Brake Valve, Overhaul
10. Install the air pipe of the clutch master cylinder, refer to Chapter 32, Clutch - Clutch Master Cylinder, Overhaul
11. Install the air pipe of the parking brake
12. Install the heater water pipe and the fixing bolts, refer to Chapter 51, Air Heater and Air Conditioning- Heater Water Pipe, Overhaul
13. Install the high and low pressure pipes of the reservoir, refer to Chapter 51, Air Heater and Air Conditioning - Reservoir, Overhaul
14. Install the high and low pressure pipes and the fixing bolts of the air conditioner, refer to Chapter 51, Air Heater and Air Conditioning- Cooling Pipe, Overhaul

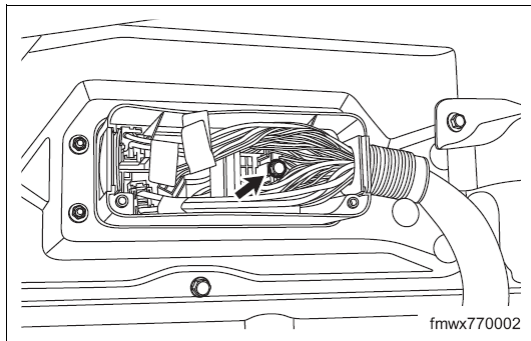
**15. Install the air pipe of the trunk tilt control valve and the plug of the buzzer wiring harness**

- (a). Install the air pipe of the trunk tilt control valve.

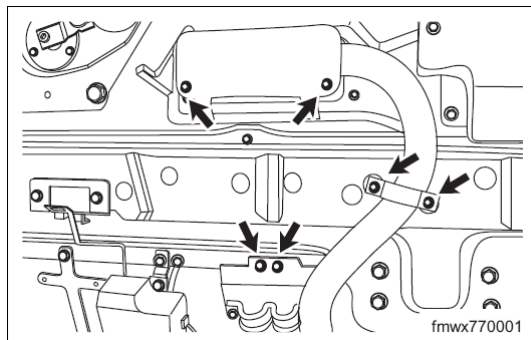


- (b). Install the fixing bolts of the trunk tilt control valve and the plug of the buzzer wiring harness.

**16. Install the fixing bolts of the general fuse and the grounding wire of the front shroud**



- 17. Install the wiring harness connectors of the front cover and the wiring harness fixing bolts**
- (a). Install all the wiring harness connectors of the front cover, and install the fixing bolts of the wiring harness connector.



- (b). Install the bolts of the wiring harness box of the front cover cap and the wiring harness fixing bolts.

18. Install the plug of the courtesy lamp wiring harness, refer to Chapter 54, Lighting - Courtesy Lamp, Replacement
19. Install the wiring harness connector of the front illuminating lamp, refer to Chapter 54, Lighting- Front Combination Lamp, Replacement
20. Close the cab.
21. Close the front turnover cover, and turn on the main power supply

Hydraulic Dump System

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Hydraulic Dump System

General

The trunk tilting mechanism of a common dump truck usually consists of three parts, i.e., a hydraulic system, a lifting mechanism, and a control mechanism. The hydraulic system consists of a hydraulic pump, a fuel tank, a distribution valve, high and low pressure oil pipes and joints, an oil cylinder and auxiliary components. The lifting mechanisms are divided into the front-push type, mid-push type, and the side-dump type. The control mechanisms are divided into the manual type and the pneumatic type. Front-push type dump truck: the oil cylinder of a front-push type dump truck is directed installed on the trunk; the piston rod end is connected with the subframe supporting seat. A limit valve is installed in order to ensure security and prevent roll-over.

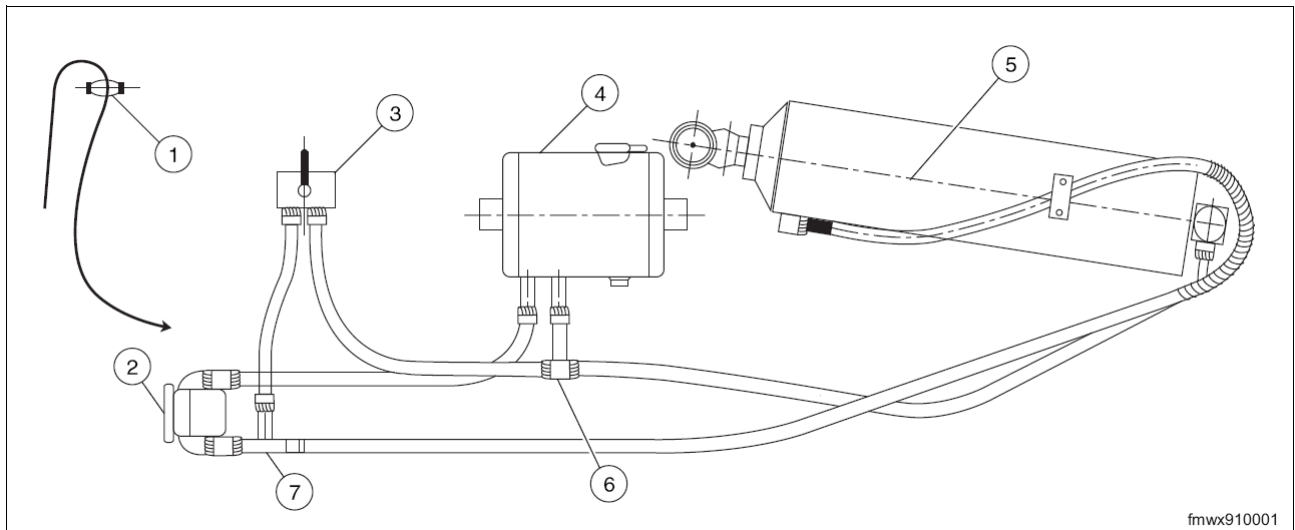
Mid-push type dump truck: mid-push type dump trucks are divided into "T" type and "F" type. The "T"-type structure is also known as oil cylinder front-push connecting rod assembly mechanism, consisting of a triangular arm, a tie rod assembly, a T-shaped shaft, etc. The bottom of the oil cylinder is installed on the hydraulic cylinder supporting seat of the subframe, the piston rod side is installed on the triangular arm of the trunk. The "F"-shaped structure is also known as the oil cylinder and hydraulic connecting rod assembly. The triangular arm is installed on the subframe and rotates around the shaft, the bottom end of the oil cylinder is installed on the triangular arm, and the piston end is connected to the trunk.

Side-dump type dump truck: the side-dump type dump truck has a number of tanks working together. It lifts to the side, and must be provided with a synchronous valve to ensure the synchronization of the work of each oil cylinder.

1. Control Mechanism

According to the control method of the distribution valve, the control mechanism can be divided into the following three types, i.e., rotary valve control, air valve control and flexible shaft direct control.

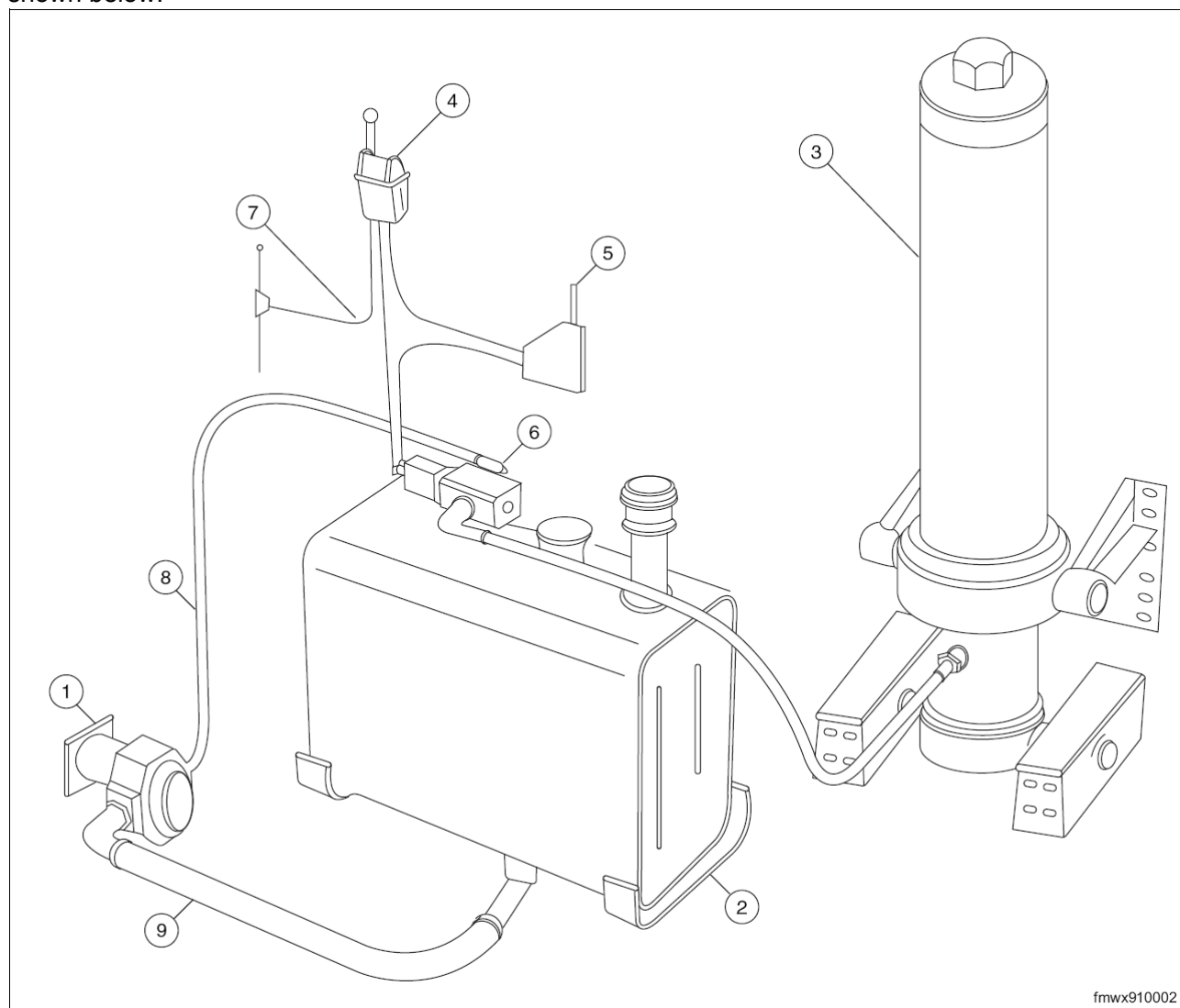
Rotary valve control is as shown below. The rotary valve is installed on the subframe and has a pneumatic control distribution valve, and is used to push and pull the flexible shaft to manipulate the rotary valve handle to change the direction of the fluid flow. Some dump trucks are provided with a rotary valve installed on the cab floor so that the driver can directly control the rotary valve handle to control the direction of the fluid flow.



1	Tee Push-and-pull Reversing Valve
2	Gear Pump
3	Manual Rotary Valve
4	Auxiliary Fuel Tank
5	Oil Cylinder
6	Low Pressure Tee
7	High Pressure Tee

Hydraulic Dump System - Hydraulic Dump System

Air valve control actuates the distribution valve and controls the flow of oil through controlling a combined control air valve. The structure and principle of the air valve control hydraulic system are shown below.

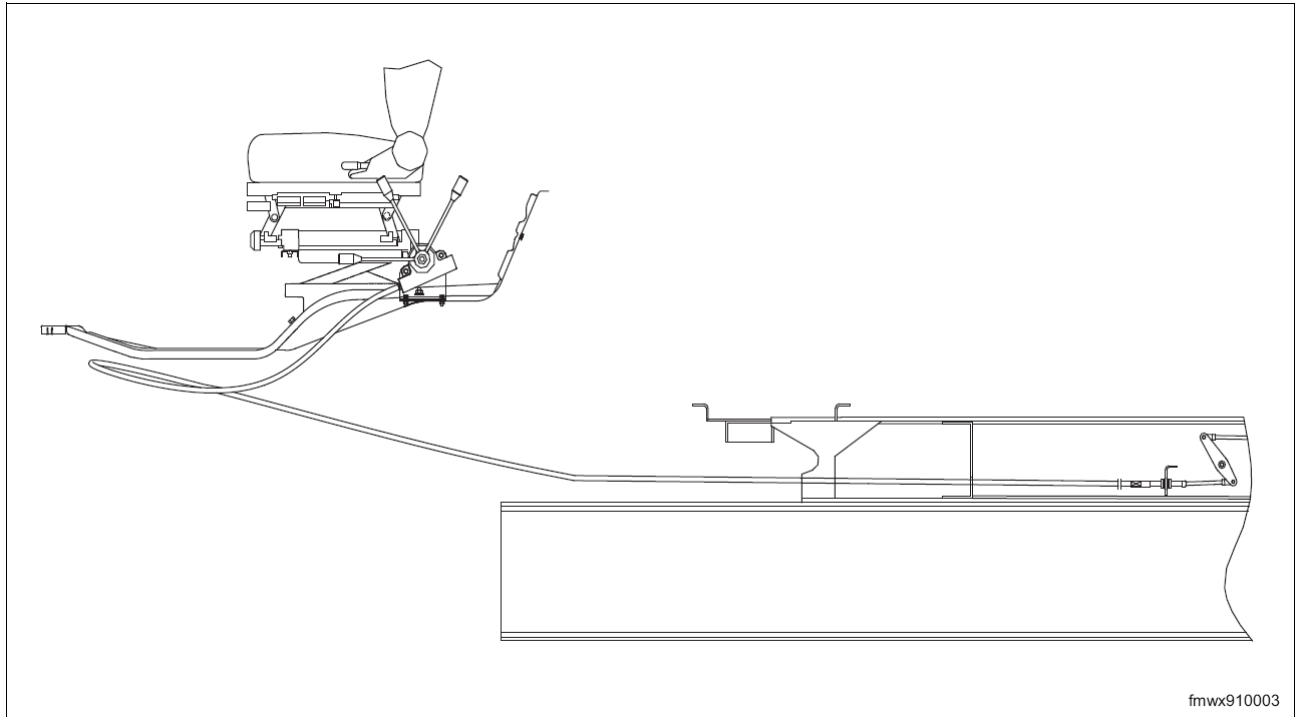


1	Gear Pump
2	Fuel Tank
3	Oil Cylinder
4	Pneumatic control Distribution Valve
5	Limit Valve

6	Lifting Valve
7	Windpipe
8	High Pressure Oil Pipe
9	Low Pressure Oil Pipe

Hydraulic Dump System - Hydraulic Dump System

The flexible shaft is directly controlled. It uses an integrated manual pump and changes the direction of the oil flow through controlling the push-and-pull flexible shaft to control the integrated pump, as shown below.



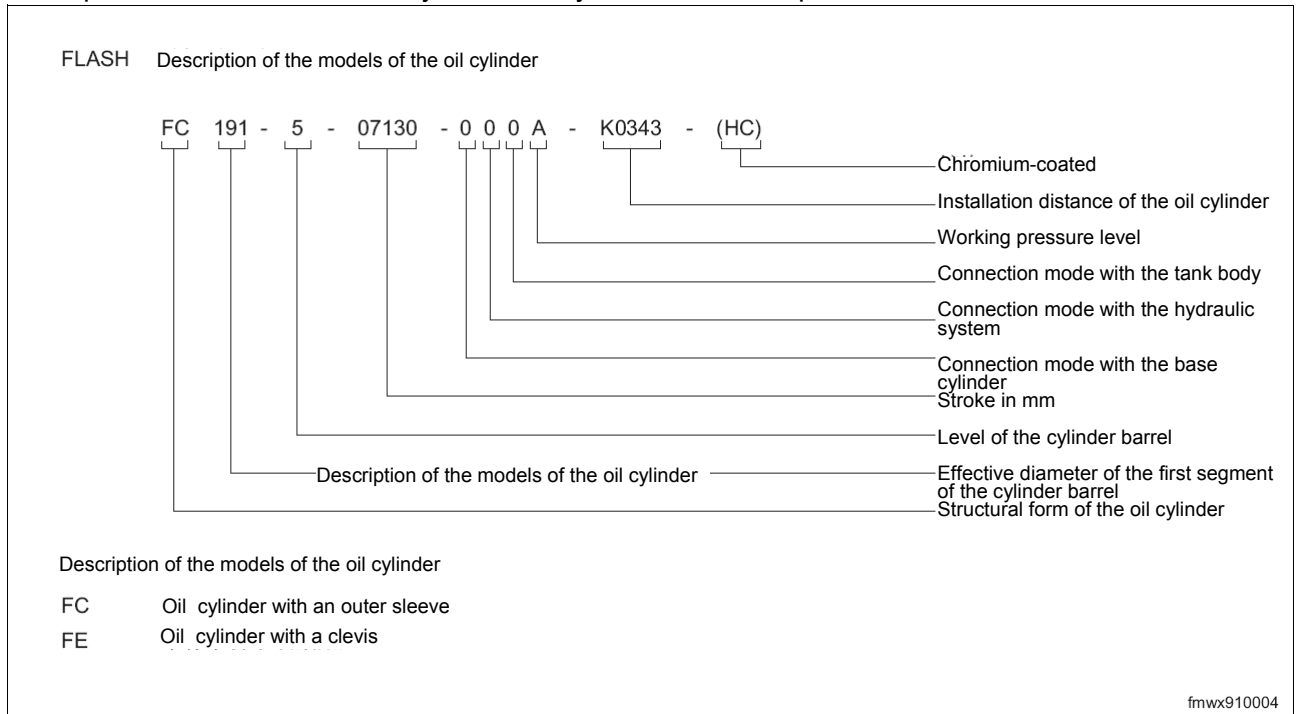
fmwx910003

2. Hydraulic System

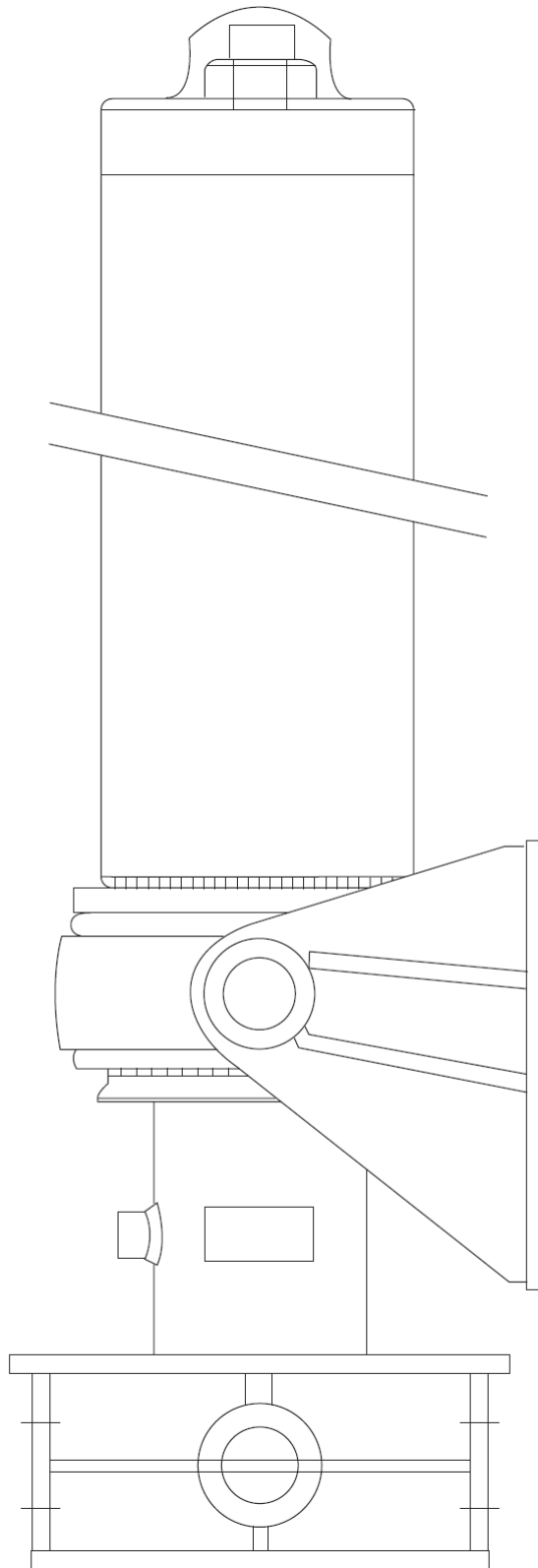
The hydraulic system consists of a tank, a pump, a valve, a pipe line and an oil cylinder.

(a). Hydraulic Cylinder

Description of the models of the hydraulic oil cylinder of the dump truck



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fmwx910005

Technical Parameters	FC-type Oil Cylinder	FE-type Oil Cylinder
Cylinder Weight	319kg	167kg
Total Volume	92L	56L

Hydraulic Dump System - Hydraulic Dump System

Technical Parameters	FC-type Oil Cylinder	FE-type Oil Cylinder
Working Volume	86L	52L
Maximum Pressure	190bar	190bar
Maximum Flow Rate	190L/min	190L/min
Maximum Forward Tilting Angle of Cylinder	10°	30°
Maximum Thrust Force of the First Segment * *	35ton	30ton

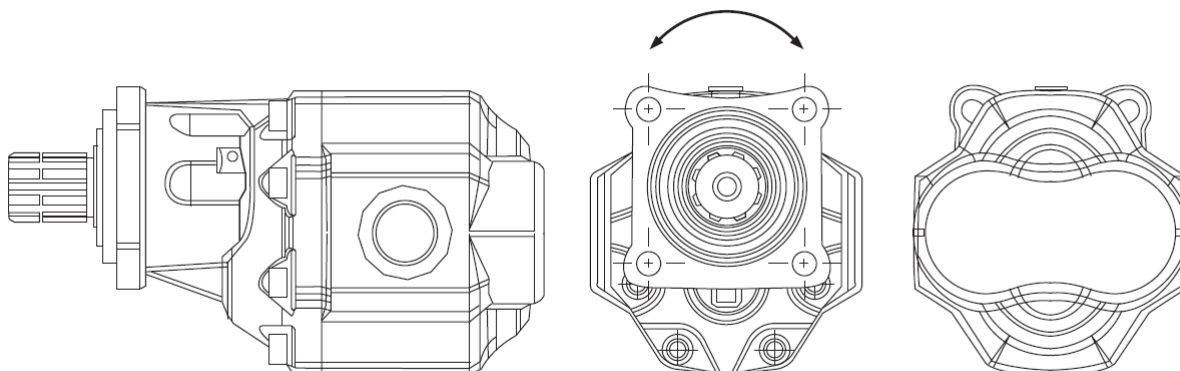
* * When the hydraulic oil cylinder is installed with a high inclination angle, the thrust force of the first segment may be the greatest. See the calculation procedure of HYVA dump truck.

FE-type Cylinder										
Number of Segments	1	2	3	4	5	6	7	8	9	
Effective Diameter [mm]	149	129	110							Total
Stroke [mm]	1, 280	1, 300	1, 300							3, 880

FC-type Cylinder										
Number of Segments	1	2	3	4	5	6	7	8	9	
Effective Diameter [mm]	169	149	129							Total
Stroke [mm]	1, 350	1, 370	1, 370							5, 460

Hydraulic Dump System - Hydraulic Dump System**(b). Gear Pump**

See the following figure for the structure of the HYVA gear pump.



fmwx910006

Technical Properties	14571200C	14571210C	56260008	Unit
Output Volume	81.7	100.5	83.6	cm ³ /r
Maximum Peak Pressure	300	260	235	bar
Maximum Intermittent Pressure	220	190	230	bar
Maximum Continuous Pressure	200	170	220	bar
Maximum No-load Speed	0.7		2, 200	min ⁻¹
Maximum Speed under Intermittent Pressure	2, 500	2, 250	2, 000	min ⁻¹
Minimum Speed under Intermittent Pressure	300	600	600	min ⁻¹
Oil Temperature Range	-20 - 95	-25 - 80	-25-95	°C
Pressure Range of Oil Inlet	0 - 1.5	0-1.5	0-1.5	bar(abs)
Range of Recommended Oil Viscosity	46 - 68	32 - 65	46-68	mm ² /s(cst)
Range of Oil Viscosity under Normal Working Fluid Pressure	1 - 220	9 - 220	1-220	mm ² /s(cst)
Maximum Starting Viscosity	75	75	75	mm ² /s(cst)
Filter				
- Working Pressure <200bar	25	25	25	m
- Working Pressure > 200bar	10	10	10	m
Inlet - from Inside Thread	1 '	1, 25 "	1 "	B.S.P
Outlet - from Inside Thread	1 '	1, 25 "	1 "	B.S.P
Minimum Bore Diameter of the Inlet	1.75	1.75	1.75	inch



Hydraulic Dump System - Hydraulic Dump System

Castellated Shaft DIN 5462	8X32X36	8X32X36	6X26X30	mm
Total	15.9	16.1	20.4	Kg

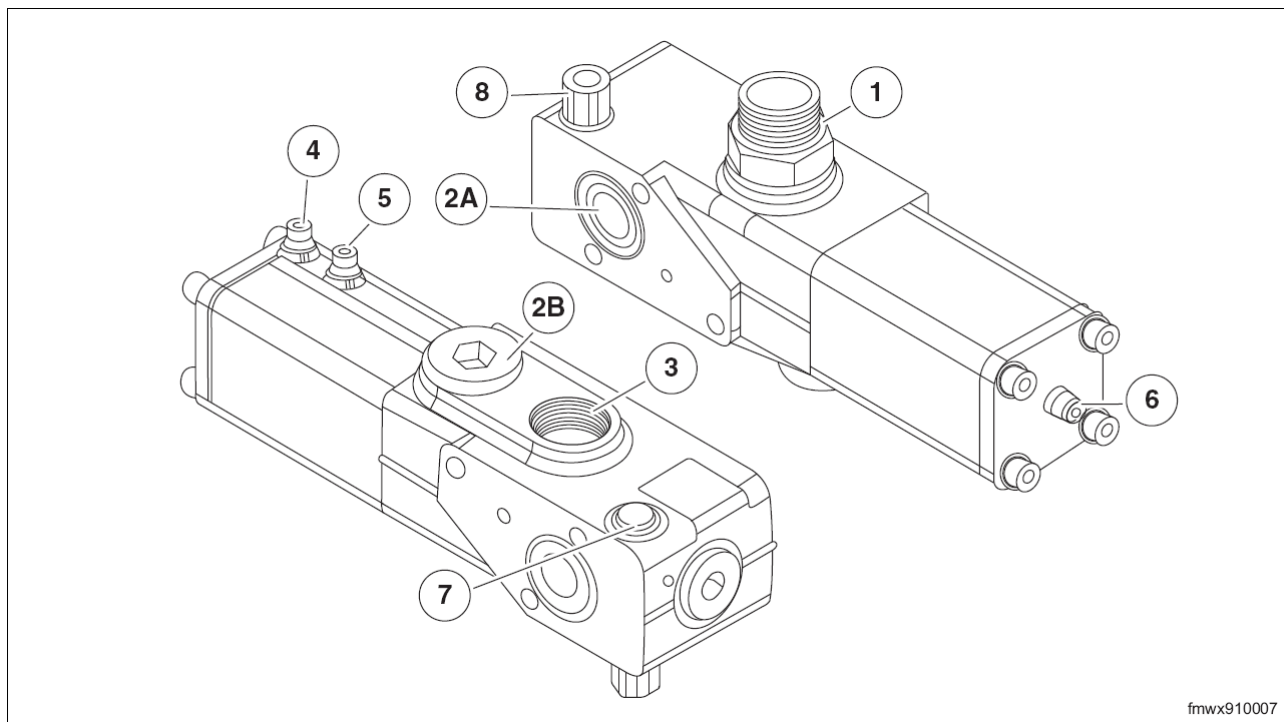
Working principle: the power is input from the input shaft and drives a pair of toothed wheels, which are engaged together, to rotate. The oil inlet side forms vacuum. The hydraulic oil in the fuel tank is sucked into the oil inlet side by the oil suction pipe and rotates along with the meshing gear, and is transported from the suction port to the pumping port to form pressurized oil when meeting resistance. Sealing clearance is formed between the tooth crests and the shell and the engaging teeth to avoid backflow of the oil.

In the working process of the oil pump, the hydraulic oil flows into the bearings through the axial gap to lubricate the bearings, and then the oil flowing into the small ends of the seal rings flows back into the suction reservoir through the holes of the front and rear pump covers and the holes of the side panels. A large O-shaped sealing washer is arranged at the junction of the pump body and the pump cover to prevent external leakage; a small sealing washer is arranged at the bearing to prevent internal leakage, and a block ring is used to prevent the axial movement of the seal.

Two self-acting oil seals are arranged on the input shaft of the front pump cover of the oil pump, wherein, the outer one is used to shield dust, and the inner one is used for sealing. In case of oil loss due to damage to any of the two seals, the damaged seal must be replaced in time.

Caution: the clearance between the toothed wheel and the shell of the pump is very narrow, and the components of the oil pump are lubricated with hydraulic oil. Therefore, excessively high viscosity of the hydraulic oil or filth in the hydraulic oil may result in poor lubrication; the filth in the oil may damage the side panels of the toothed wheel, making the friction surface rough. The oil pump may stop working in such a case.

(c). PT-type Lifting Valve



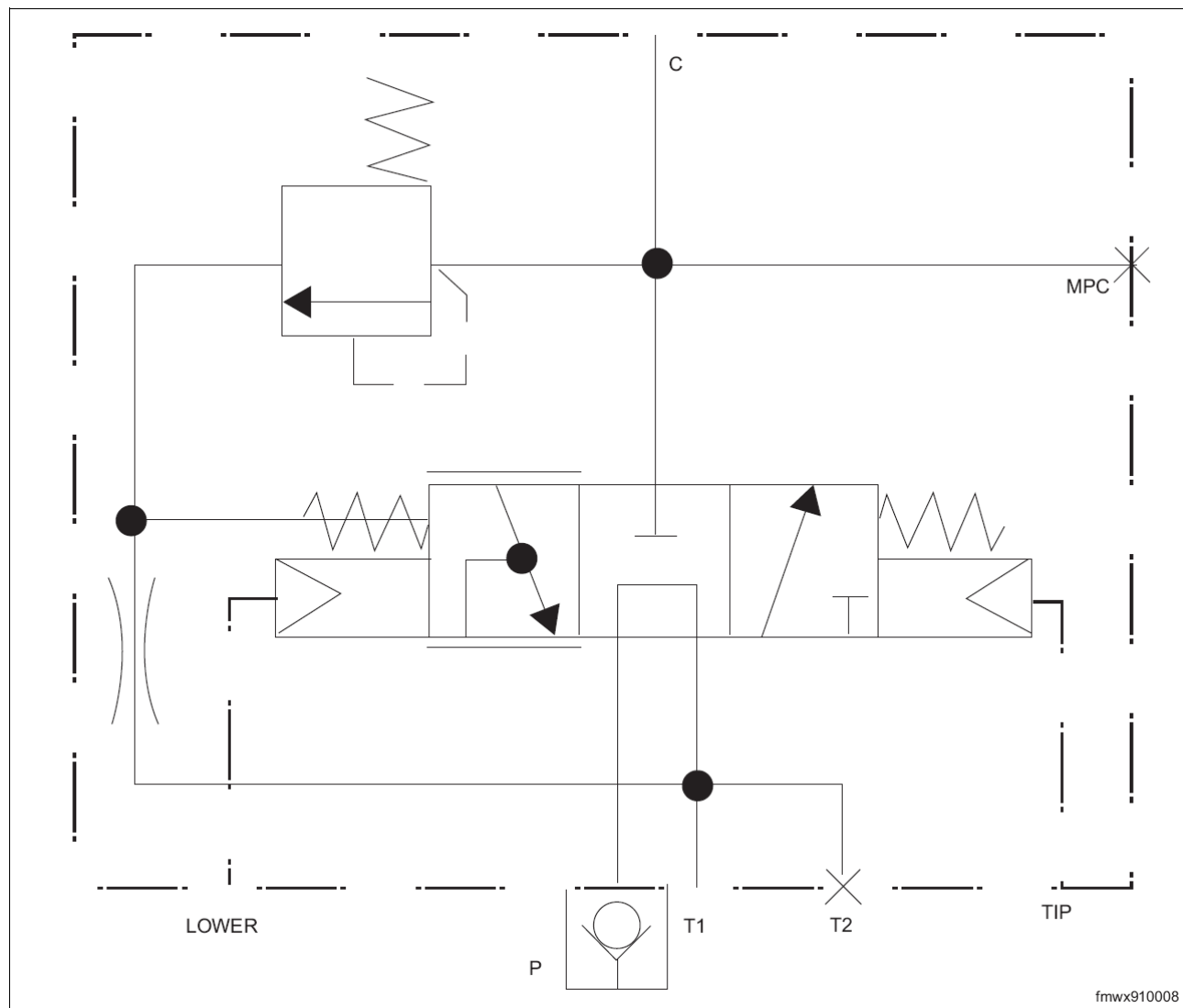
fmwx910007

1	Oil Pump Interface (P)
2A	Fuel Tank Return Port (T)
2B	Standby Fuel Tank Return Port (T)
3	Fuel Tank Interface
4	Pneumatic control Valve/ Lifting Interface

5	Pneumatic Control Valve/Lowering Interface
6	Lowering Rate Adjustment Valve
7	Pressure Gauge Interface
8	Overflow Valve

Hydraulic Dump System - Hydraulic Dump System

Working Principle of the Hydraulic System



fmwx910008

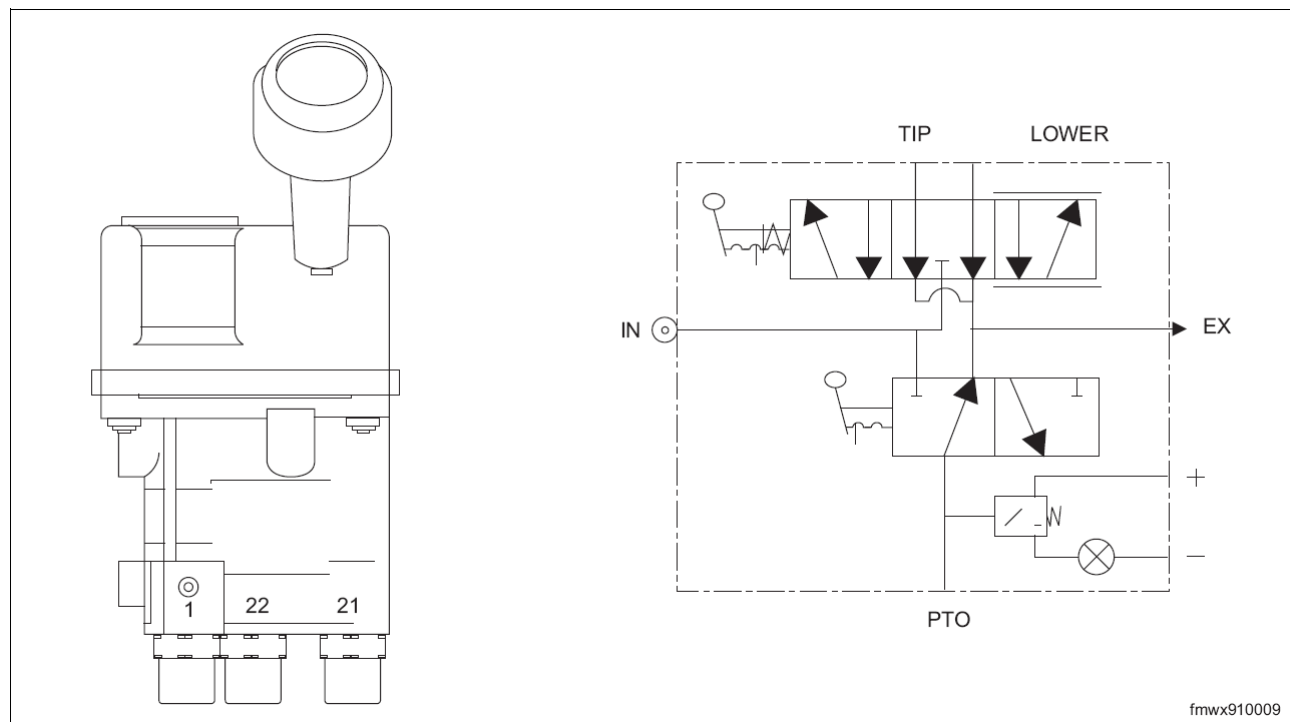
Technical Specifications	
Model	A slide valve with an intermediate bypass. The flow rate of the hydraulic oil may be controlled proportionally with a pneumatic pilot valve at the falling back position.
Hydraulic Pipe Joint	G1"
Maximum Peak Pressure	350 bar
Pneumatic Pressure	6-10 bar
Maximum Flow Rate	220 L/min
Maximum Pressure of the T Port	15 bar
Filter Accuracy	≤ 25μm(ISO 18/13)
Type of the Hydraulic Oil	Mineral Oil (DIN 51524/51525)
Viscosity Range of the Hydraulic Oil	12-100 mm ² /s
Temperature Range of the Hydraulic Oil	-25 /+80°C
Total	6.4 Kg

Hydraulic Dump System - Hydraulic Dump System

Part Number	Hydraulic Valve Type	Maximum Working Pressure (bar)
147 67 317	PT-1220-170	170
147 67 319	PT 1220-190	190
147 67 322	PT-1220-220	220

3. Pneumatic Control Distribution Valve

Structure of the Pneumatic Control Valve

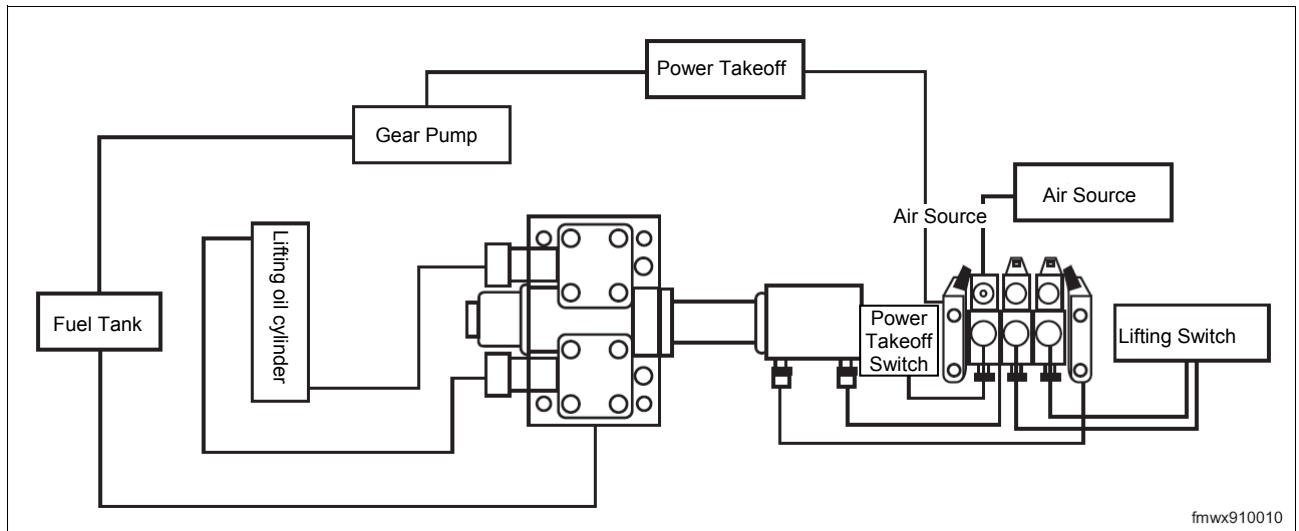


Technical Properties of the Pneumatic Control Valve

- Two-way operated valve with the valve position controlled pneumatically, with oil lifting, lowering and the intermediate suspension functions;
- When using a hydraulic valve with proportional lowering function, the returning speed of the trunk can be controlled by operating the control lever of the control valve;
- The functions of the HYVA control valve are shown by symbols on the valve body.

Hydraulic Dump System - Hydraulic Dump System

The pneumatic control distribution valve is a critical component to control the hydraulic lifting oil cylinder.



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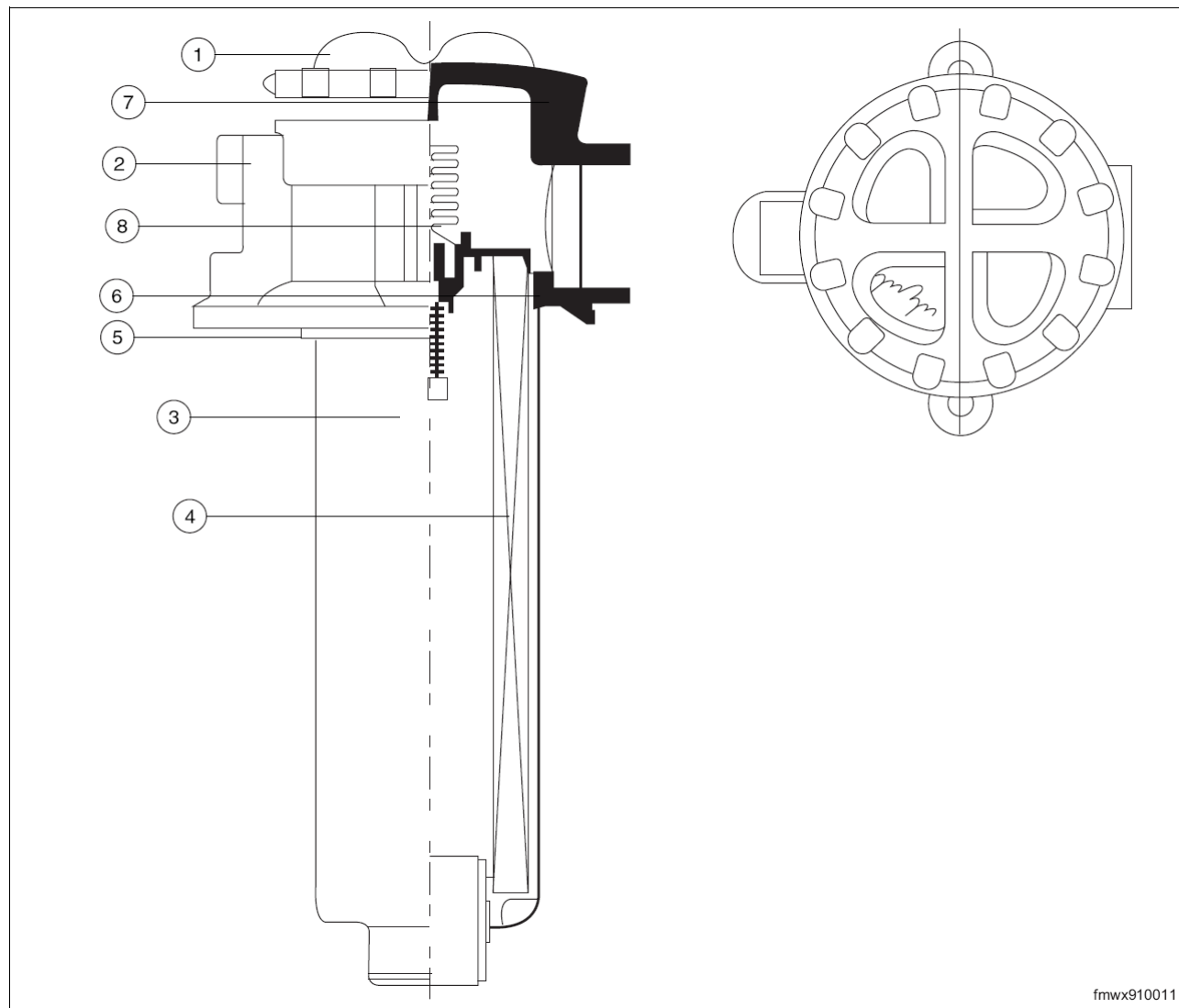
Working principle of the pneumatic control distribution valve:

The pneumatic control distribution valve has six interfaces, and the “LOW” interfaces and the “OFF” interfaces are communicated with each other with tees, and the power take-off will be disconnected automatically when the trunk lowers.

When the air source is opened, high pressure air enters the combination electromagnetic air valve (the triple is shown in the figure as an example as only three single pieces are needed in the lifting system) to raise the lifting system to the lifting gear, the buzzer emits audio signals to actuate the electromagnetic air valve which controls the pneumatic control distribution valve to start working. The electromagnetic air valve promotes the air cylinder of the distribution valve to move. At this point, the distribution valve is at the lifting location, and pokes the power take-off switch to control the electromagnetic air valve of the power take-off box to work, thus actuating the power take-off box to work and the gear pump to pump oil. The high pressure oil goes through the pneumatic control distribution valve and enters the butt end of the lifting oil cylinder to actuate the lifting operation of the system; and then the lifting switch is poked to the intermediate suspension level, where no electromagnetic valve works, the distribution valve returns automatically, thus achieving intermediate suspension of the operation; in order to maintain the system at the lowering location, poke the lifting switch to the lowering level to activate the work of the electromagnetic air valve which controls the lowering of the pneumatic control distribution valve, and to push the air cylinder of the distribution valve to work. At this point, the distribution valve is at the lowering location, the high pressure oil returns the oil cylinder through the outlet at the low pressure end.

Special Reminder: the power take-off should be maintained at the closed position at the intermediate suspension and the lowering locations. And all the mechanisms must be idle after use, i.e., both the power take-off switch and the lifting switch must be maintained at the intermediate suspension state.

4. Scavenge Filter



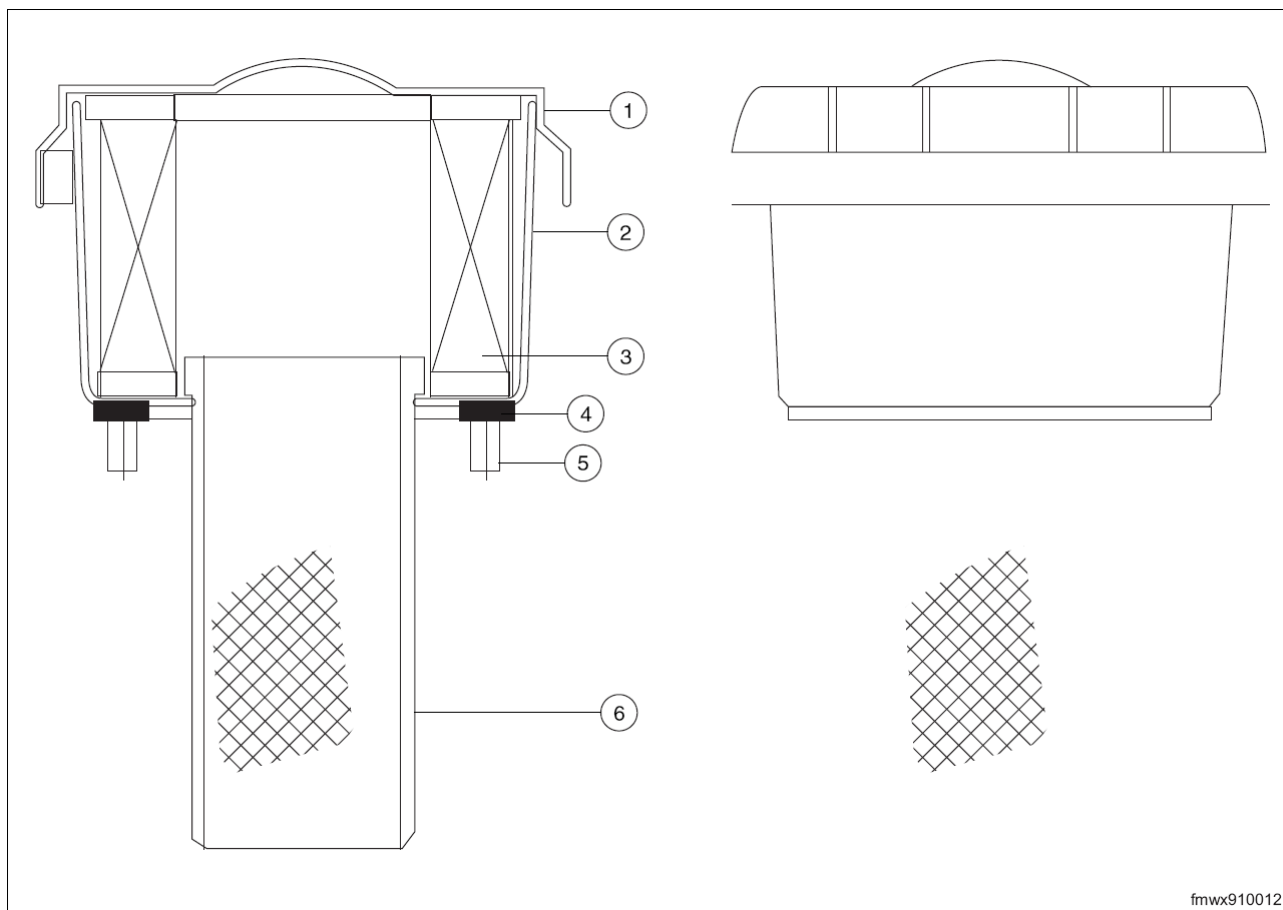
1	Roof Cover
2	Shell
3	Flange Oil Pipe
4	filter Core

5	Sealing Element
6	O-ring
7	O-ring
8	Spring

Hydraulic Dump System - Hydraulic Dump System

Technical Parameters	
Nominal Flow Rate	150 L/min (clean filter element)
Peak Flow Rate	300 L/min
Discharge Pressure	1.75 bar±10%
Breaking Pressure	10 bar
Filter Element	25μ (nominal diameter)-β25 = 25
Temperature Range	-25℃ to +110℃
Sewage Suction Capacity	15gr.at 2 bat
Filter Area	1730cm ²
Hint: The filter element must be replaced twice a year	

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5. Air Filter

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Hydraulic Dump System - Hydraulic Dump System

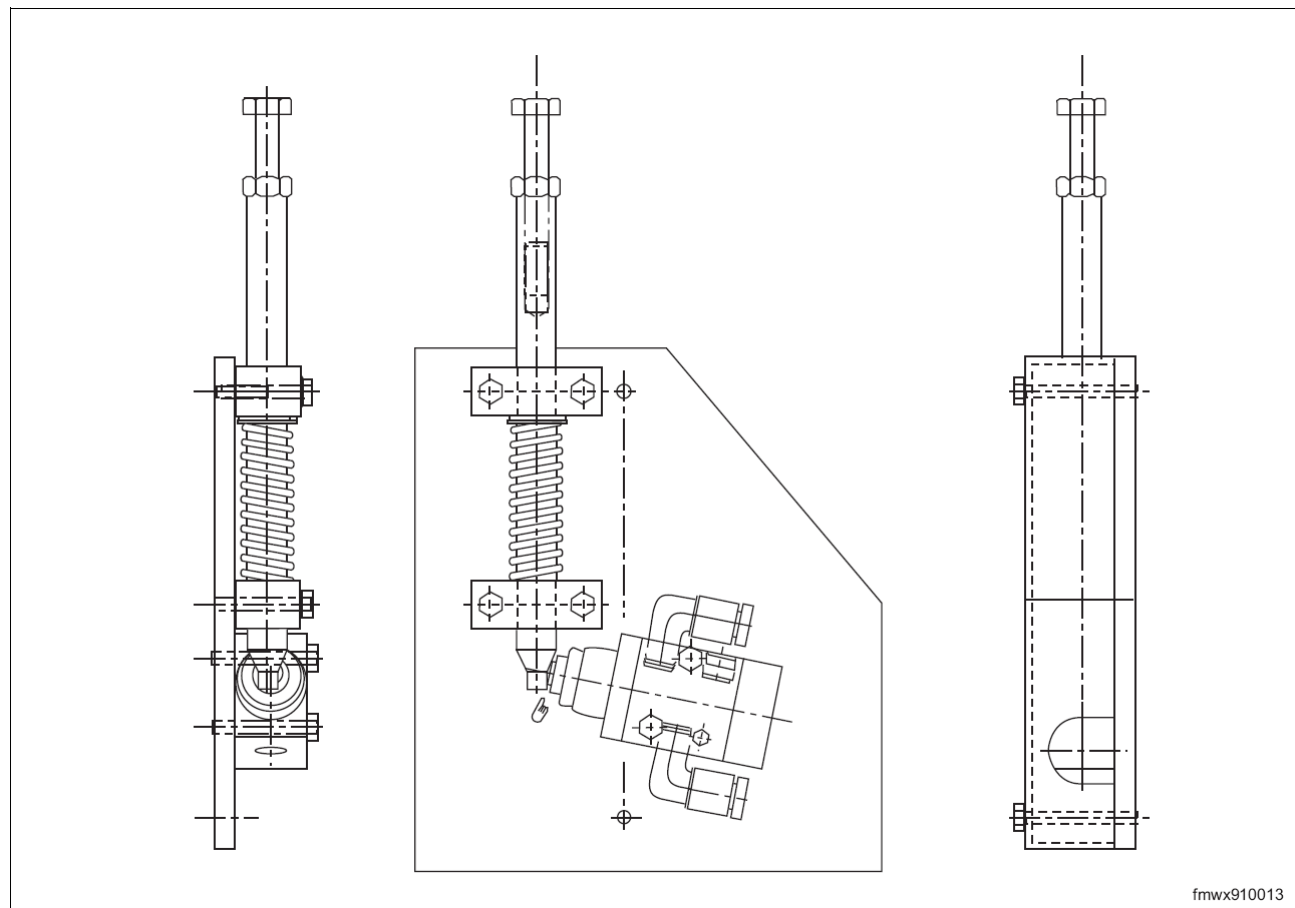
1	Air Filter Cover
2	Air Filter Shell
3	Flange Oil Pipe

	Sealing Ring
	Bolt
	Pipe

Technical Parameters

Filter Accuracy	10 µm
Discharge Capacity	1, 350L/min
Temperature Range	-40℃ to +100℃
Maximum Filling Rate	40L/min
Hint: The filter element must be replaced twice a year	

6. Limit Valve



Hydraulic Dump System - Hydraulic Dump System

Technical Parameters	
Maximum Working Pressure	10 bar
Interface Dimensions	G1/8
Windpipe Specifications	6mm

7. Accessories

(a). Drive shaft

As different vehicle models use different drive shafts, attention should be paid to the flanges, splines and the total lengths when replacing.

(b). Hydraulic tank

Hydraulic oil is stored in the hydraulic tank, the upper part of which is provided with a bleeder vent, the suction port is provided with a filter core with the oil accuracy of not less than 25 μ m. Plugging of the filter core will often result in vibration and whistling of the oil suction pipe and/or damage to the oil pump. Therefore, the liquid oil must be cleaned and the filter core must be replaced regularly.

(c). Stabilizing Bracket

The stabilizing bracket is used for the front lifting gear and has the function of stabilizing the trunk in the horizontal direction.

8. Lubrication

As the work environment of the dump truck is severe and the dump truck does heavy work for a long period of time, it must be well lubricated according to the requirements. The lubrication of its chassis must meet the requirements in the Instructions for the Use and Maintenance of the Chassis. Lubrication of the body must meet the following requirements:

No.	Position	Frequency
1	Zerk nipples at the friction sites of the upper and lower small pin rolls and sleeves of the hydraulic cylinder	Once a week
2	Zerk nipples of the oil pump drive shaft	Once every ten days
3	Zerk nipples at the friction sites of the upper and lower small pin rolls and sleeves of the tie rods	Once a week
4	Zerk nipples at the friction sites of the upper and lower small pin rolls and sleeves of the tripods	Once a week
5	Zerk nipples at the rear rotary shaft and the sleeves of the shelter	Once a week
6	Zerk nipples at the hinge axis and seats of the rear board of the shelter	Once a week

9. Hydraulic Oil

Different types of hydraulic oil should be used according to different ambient temperature.

One-stage single-acting hydraulic cylinder:

Ambient Temperature (°C)	-40 to 5	-10 to 25	5 to 40
Oil Grade	No. 13 machinery oil	No. 20 machinery oil	No. 30 machinery oil
50°C Viscosity Centistoke	12 to 14	17 to 23	27 to 33
Freezing Point (°C) No Higher Than	-45	-15	-10

In general, a one-stage single-acting hydraulic cylinder uses about 25 to 40 liters of oil, a multi-stage hydraulic cylinder uses about 50 to 80 liters.

Caution:

The use of hydraulic oil of high viscosity under the conditions of low temperature will result in high pressure loss and slow down the lowering of the shelter. In addition, excessive wear and tear of the oil pump will be caused due to the increase in the working pressure. On the contrary, the use of hydraulic oil of low viscosity under the conditions of high temperature will result in leakage in the seals of the oil pumps, hydraulic cylinders, piping, etc, thus lengthening the time of lifting.

Besides changing the oil of the hydraulic system according to the changes of the ambient temperature, it is also recommended to replace for once after lifting 5, 000 times. In addition,

Hydraulic Dump System - Hydraulic Dump System

such components of the hydraulic system as oil pumps, lifting valves, hydraulic cylinders, etc, are sophisticated components working together; therefore, the hydraulic oil in the system must be checked frequently in order to extend their service life, and must be replaced in a timely manner in case any filth is found.

Precautions

1. The maximum allowable total mass and maximum allowable shaft load of a dump truck shall not exceed 3% of the allowable value of the original chassis.
2. The lifting and lowering of the trunk must be stable and smooth, and no vibration, collision or clamping stagnation shall be allowed.
3. The largest difference between the maximum lifting angle of the trunk and the designed value shall not exceed ± 2 degrees.
4. The self descending angle (static descending angle) of the trunk shall not exceed 2.5 degrees after the trunk is lifted for 20 degrees and maintained still for 5m in case of 20% overload conditions.
5. The time for lifting and lowering shall not exceed 20s.

1. Working Principle of the Hydraulic System

P10 Power Take-off

TIP lifting

LOW Lowering

IN

EX

Pneumatic Circuit

Hydraulic Circuit

1

2

3

4

5

G

H

P

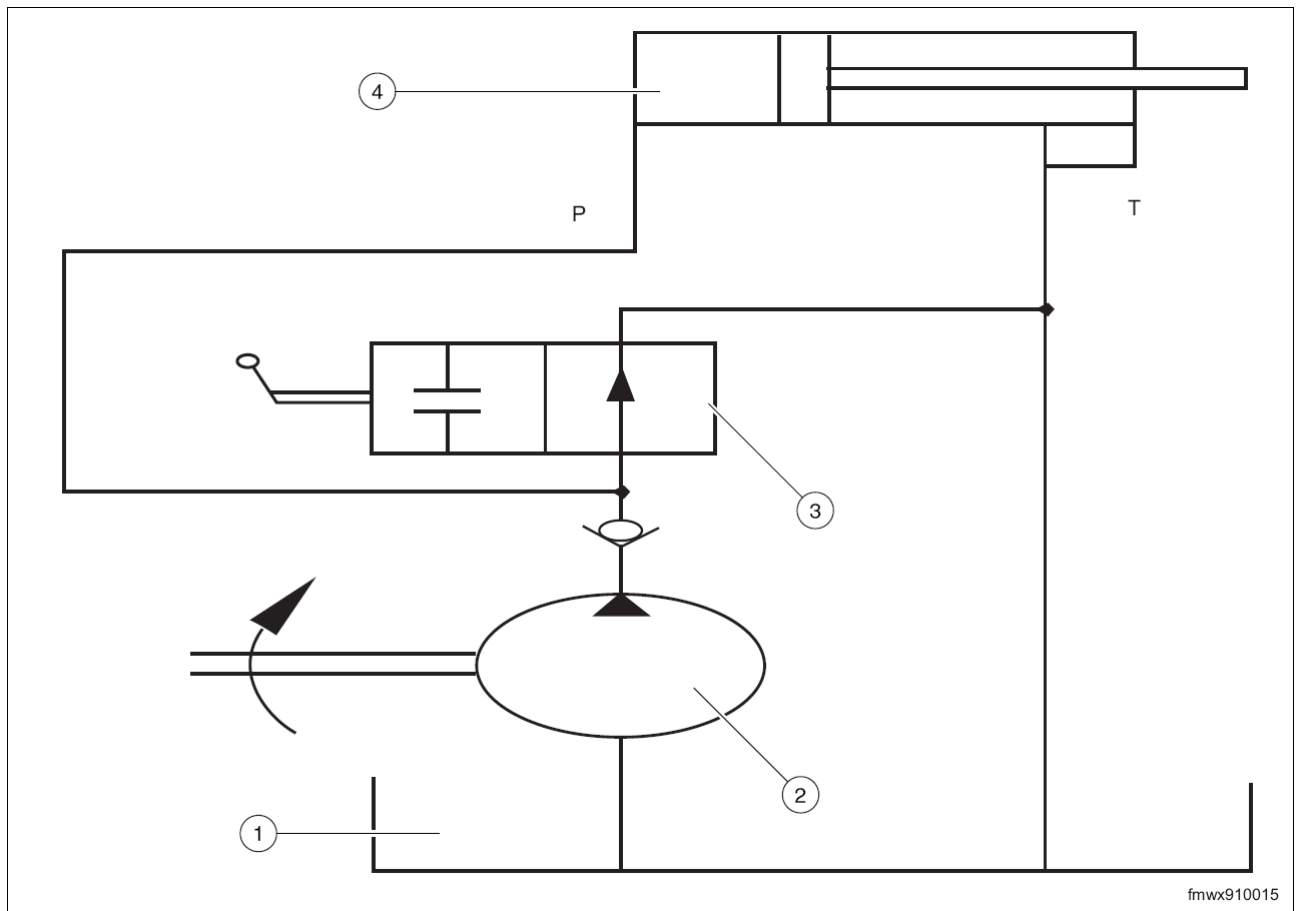
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1	Fuel Tank
2	Gear Pump
3	Lifting Valve

4	Oil Cylinder
5	Pneumatic Control Valve

Hydraulic Dump System - Hydraulic Dump System

(b). Working Principle of the Hydraulic System (Manual Control Mid-push T-type)

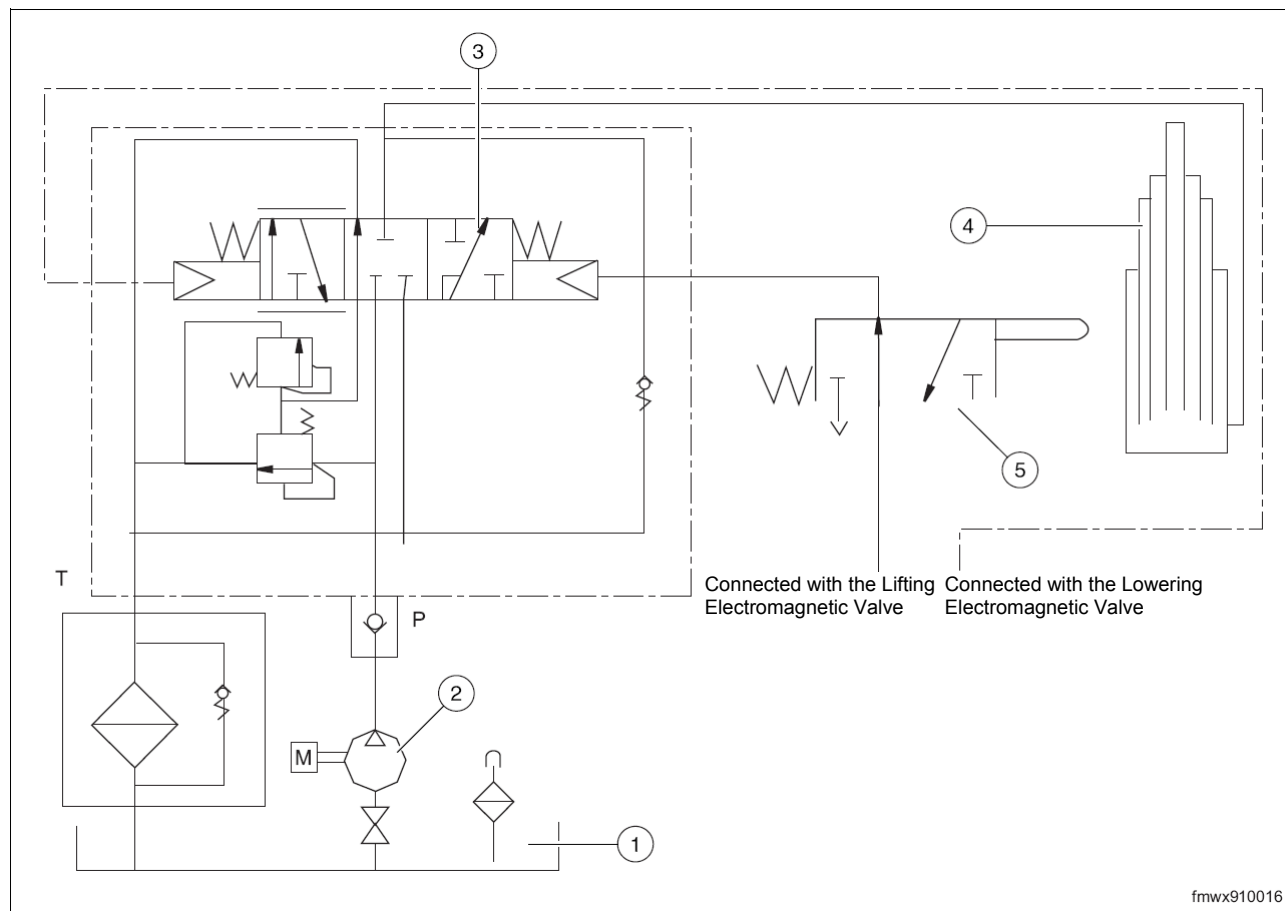


1	Fuel Tank
2	Gear Pump

3	Lifting Valve
4	Oil Cylinder

Hydraulic Dump System - Hydraulic Dump System

(c). Working Principle of the Hydraulic System (Front-Push Type)

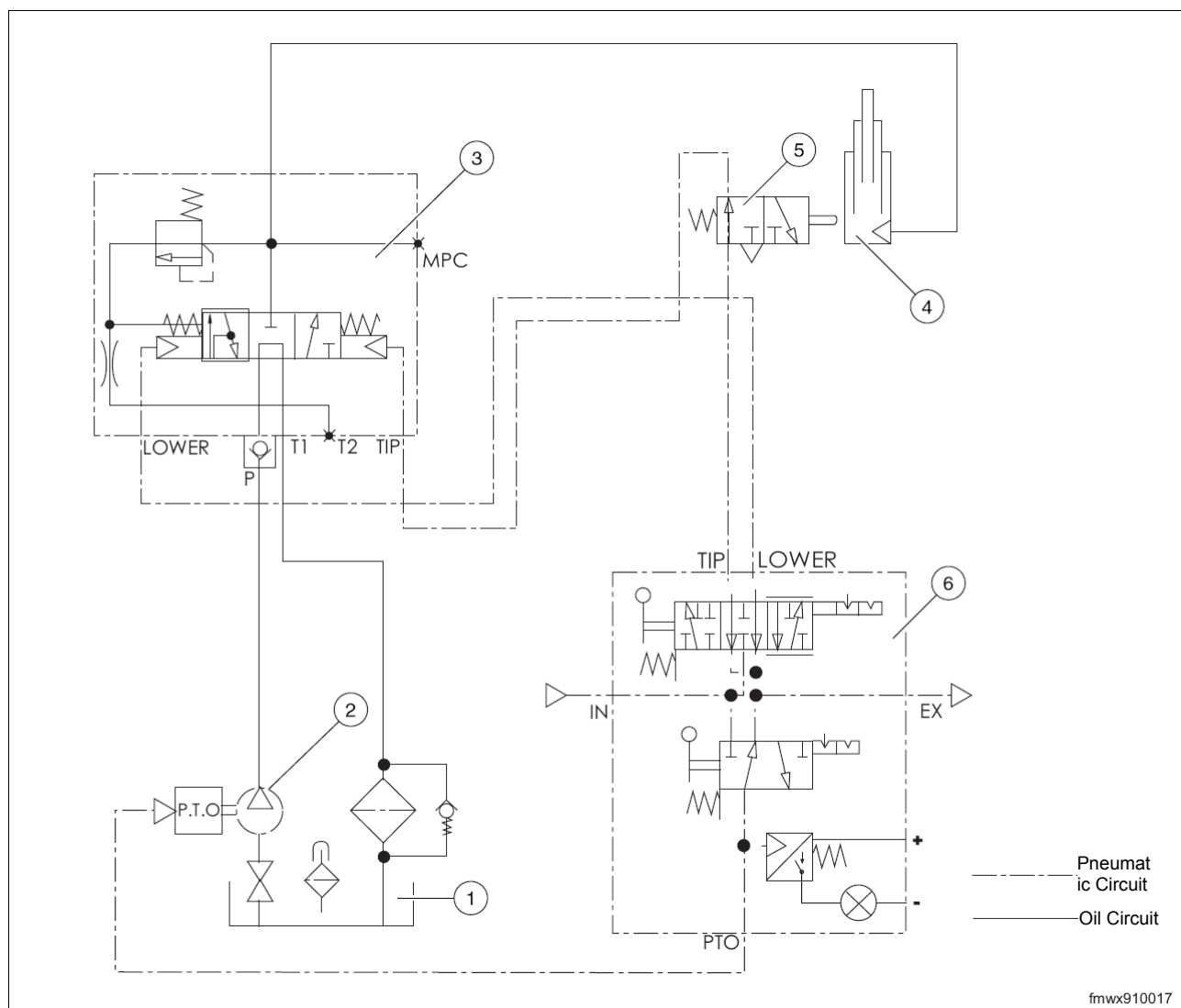


1	Fuel Tank
2	Gear Pump
3	Lifting Valve

4	Oil Cylinder
5	Pneumatic Control Valve

Hydraulic Dump System - Hydraulic Dump System

- (d). Working Principle of the Hydraulic System of HYVA Dump Truck (provided with a PT-type Lifting Valve)



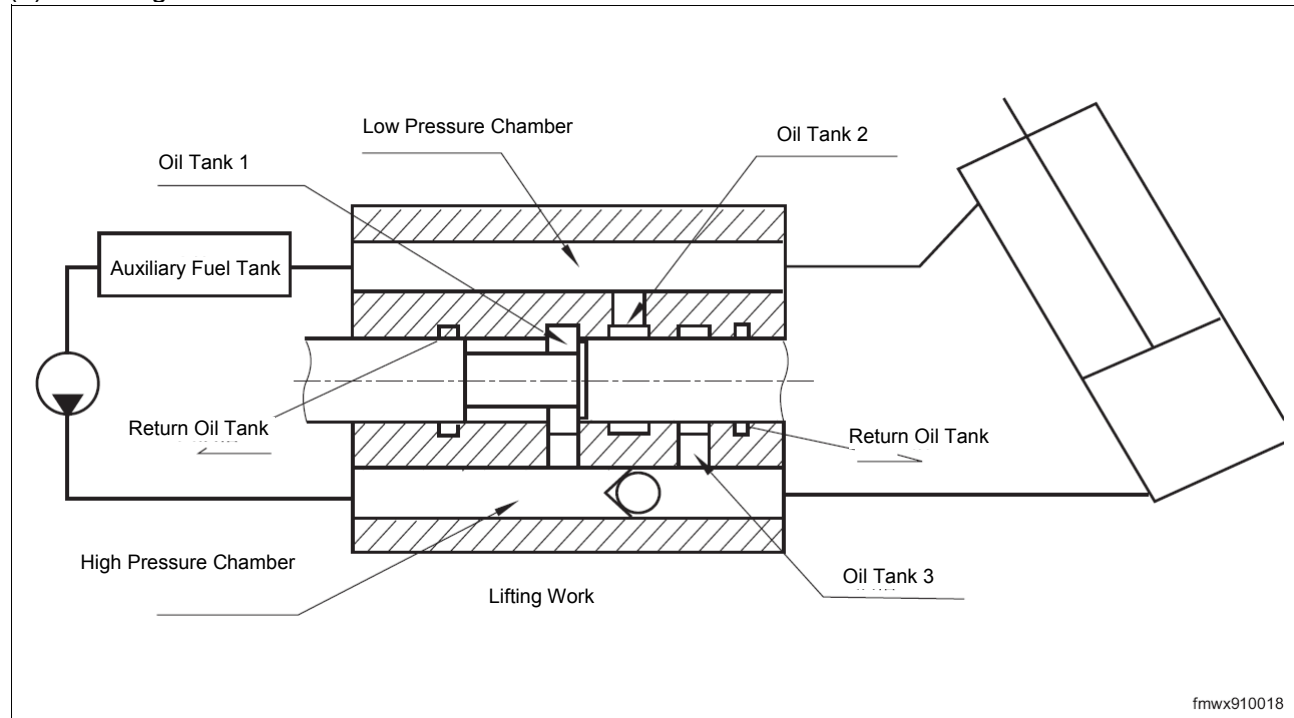
1	Fuel Tank
2	Gear Pump
3	PT-type Lifting Valve

4	Oil Cylinder
5	Pneumatic Control Valve
6	Pneumatic Control Valve

Hydraulic Dump System - Hydraulic Dump System

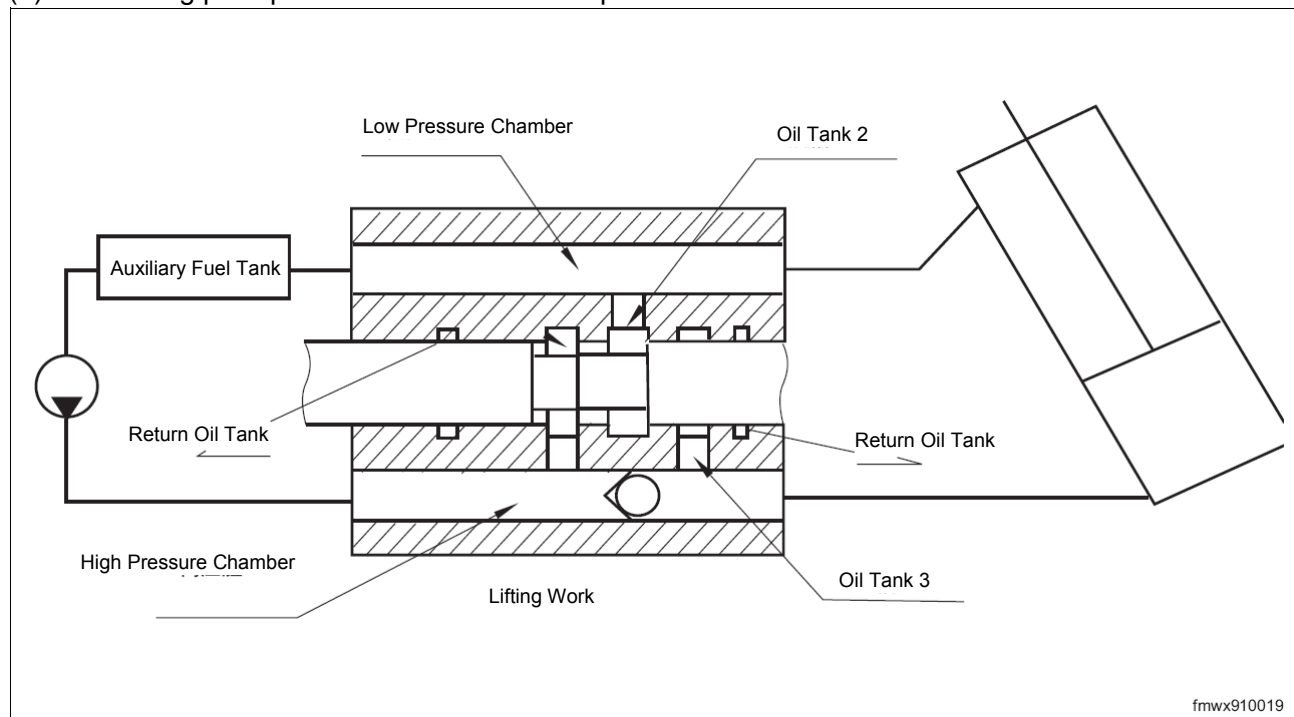
2. Working Principle of the Hydraulic Lifting System

(a). Lifting State



When the shelter needs to be lifted, poke the lifting switch to the lifting state to activate the work of the electromagnetic valve, which pushes the mandrel of the distribution valve to move to the position shown in the figure to close the oil tanks 2 and 3. And turn on the power take-off switch to start the gear pump to suck oil from the auxiliary oil cylinder through the low pressure oil pipe. The high pressure oil can only be filled into the lower chamber of the oil cylinder through the non-return valve in the distribution valve. Through the function of the high pressure oil, the oil cylinder piston pushes the piston rod to rise out of the oil cylinder to lift the shelter by pushing until the shelter is lifted to the maximum height. After the shelter reaches the maximum height and the oil cylinder piston is at the location of the unloading trough, the upper and lower chambers of the oil cylinder are communicated with each other for discharging.

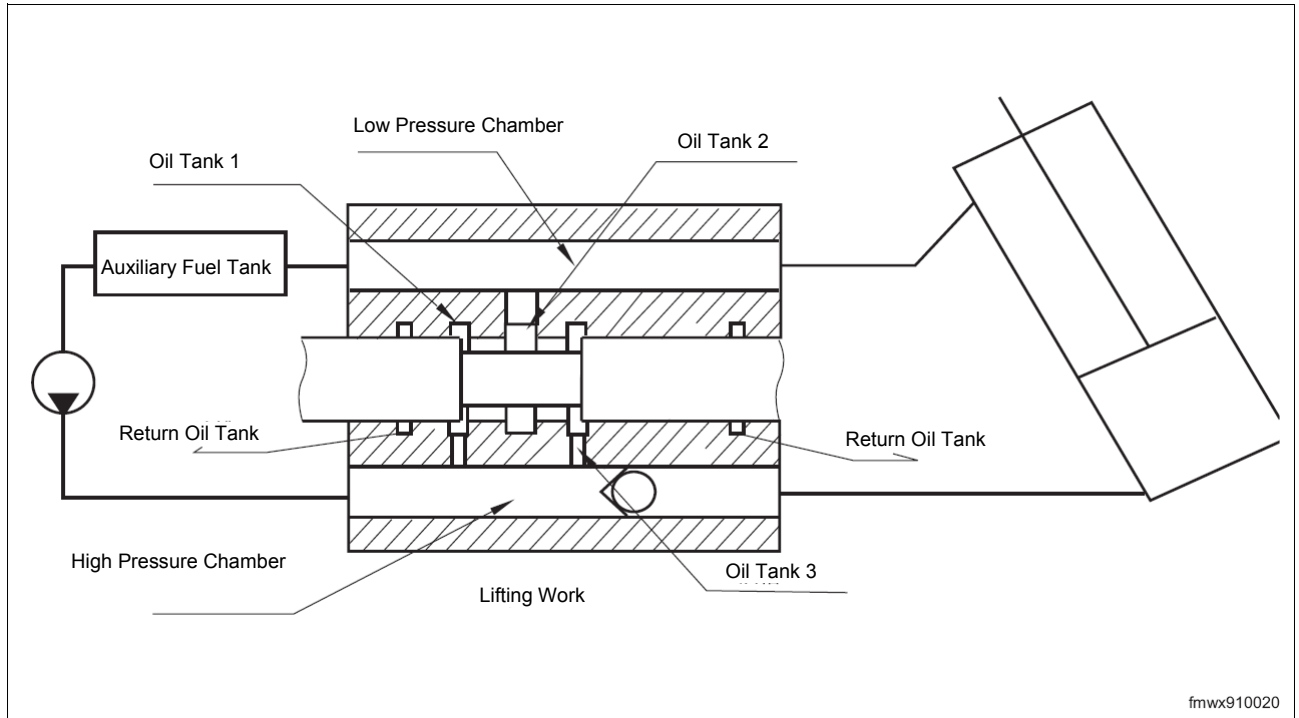
(b). Working principle of the Intermediate suspension state.



Hydraulic Dump System - Hydraulic Dump System

When the shelter is lifted to a certain height and needs to be suspended, turn off the power take-off switch and poke the lifting switch to the intermediate suspension position, the electromagnetic valve starts to work and pushes the mandrel of the distribution valve to move to the position shown in the figure. At this point, the high pressure oil in the oil cylinder cannot return to the low pressure end due to the function of the sealed oil tank of the mandrel and the one-way sealing performance of the non-returning valve, and maintains in the state.

(c). Working Principle of the Lowering State



When the shelter is lowered, poke the lifting switch to the lowering position. The power take-off switch will remain in the OFF state, the electromagnetic valve starts working and pushes the mandrel of the distribution valve to move to the position shown in the figure. Through the function of the self gravity of the shelter, the high pressure oil in the lower chamber of the oil cylinder runs through the pressure pipe and is distributed to Oil Tank 3 by the distribution valve, and returns to the auxiliary oil cylinder through the Oil Tank 2. The upper chamber of the oil cylinder sucks oil at the same time, and the shelter maintains in the lowering state.

Fault Symptom Table

The following table will help you find the fault. The serial numbers represent the possible sequence of the faults. Check each part in this sequence, and replace the parts as needed.

Fault Symptoms	Possible Cause	Reference
The oil pump does not rotate	1. The lifting switch, the power take-off switch or the relay does not work properly.	Replacement
	2. Fault in the power line	Check the power line
	3. Fault in the pneumatic control valve	Repair or replace
	4. Gas line leakage	Repair or replace
	5. Obstruction or filth in the oil pump	Repair or replace
	6. Fault in the power take-off	Overhaul
	7. Fault in the drive shaft	Repair or replace
The oil pump works properly, but the lifting is abnormal.	1. Oil shortage in the system	Charge to the full
	2. Fault in the control valve	Repair or replace
	3. Oil leakage in the system	Overhaul
	4. Fault in the oil cylinder	Repair or replace
	5. The gas valve of the pneumatic control lifting valve does not work	Repair or replace
	6. Fault in the flexible shaft in case of manual control mode, and fault in the fluid control valve in case of hydraulic control mode.	Replacement
Lifting of the shelter is unstable	1. Air penetrated into the oil pipe	Discharge the air
	2. The seal of the oil cylinder is aged or fault in the seal	Replacement
	3. Oil is short in the oil cylinder	Charge to the full
	4. Hinge damaged	Replacement
	5. Oil filth	Replace the oil
	6. Severe overload	Load properly
The trunk cannot be lowered after lifting	1. Lifting on a slope	Lift on a flat ground
	2. Fault in the pneumatic control distribution valve	Check and replace
	3. The piston rod or sleeve of the oil cylinder is bent.	Repair or replace
	4. The oil cylinder is deformed or any component of the dumping mechanism is obstructed	Dismantle , check and replace
The lowering speed of the trunk is too low	1. Poor lubrication of the distribution valve	Dismantle, check and repair
	2. Obstruction in the oil pipe	Dismantle, check and clean
	3. Poor lubrication at the hinge joints	Dismantle, check and repair

Hydraulic Dump System - Hydraulic Dump System

Sinking of carriage	1. External leakage in the system	Check the external leakage
	2. The piston ring of the oil cylinder is blocked by filth, ruptured or a sealing element is broken, and the internal leakage is serious.	Repair the parts or replace the cylinder
	3. The valve core of the pneumatic control reversing valve is blocked by foreign bodies.	Dismantle and clean
No suspension in the process of lifting or lowering	1. The lifting valve rod cannot bounce back.	Remove the burrs or impurities at the lower end of the valve rod.
	2. The centering spring does not work.	Replace
	3. Fault in the reversing valve in the hydraulic control mode	Repair or replace
	4. Positioning in the manual control mode is unreliable	Overhaul
The power take-off of the pneumatic control valve cannot be disconnected automatically (in the pneumatic mode)	1. The filter element in the OFF interface is blocked	Dismantle and clean
	2. The disconnection movement is not effective	The sealing ring is damaged and replace it.
	3. The disconnection is insufficient when replacing the handle.	Dismantle and check the moving arm and properly install it; poke the handle repeatedly until it is disconnected.
The lifting and lowering actions are ineffective (in the pneumatic control mode)	1. The engineering block of the pneumatic control valve leaks air	Seal with 806 sealant
	2. The filter element of the IN port of the pneumatic control valve is blocked	Clean the blocked part
	3. The pneumatic control valve or the sealing ring of the valve rod is blocked	Replace the sealing ring with a new one
	4. Fault in the pneumatic control valve	Dismantle, check and repair
The lifting angle is insufficient	1. Oil shortage	Charge to the full
	2. Air penetrated in the oil	Discharge the air and charge oil to the full
	3. The limit valve is poorly adjusted (front-push type)	Readjust
The drive shaft of the oil pump is deformed or broken	1. The lifting operation is too rash at full loading capacity	Operate according to the requirements
	2. The power take-off has run at high rate for a long time without disengaging	Ensure that the power take-off has changed gear in service
	3. The installation clearance is too narrow	Check and adjust
	4. Poor dynamic equalization	Check and replace
	5. The oil line is blocked	Check and repair
	6. Severe overload	Load according to the requirements
The gear pump is blown out	1. The power take-off is not disengaged, and the pump has run for a long time at zero load	
	2. Oil shortage, excessively long lifting duration	Charge the oil to the full as required
	3. There is no lubrication gap in the drive shaft of the oil pump	Check and adjust
	4. Long time of overload operation	Operate at the rated load

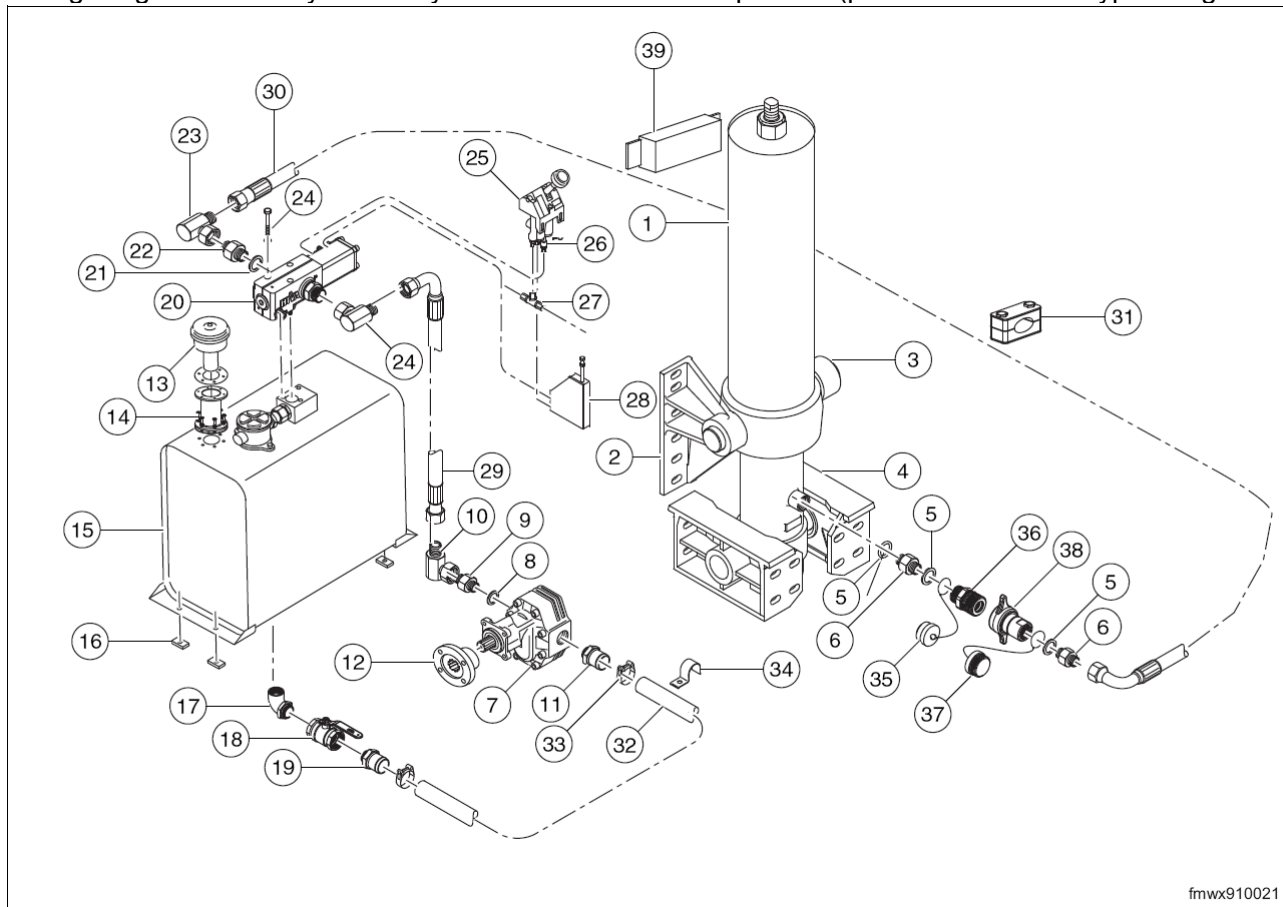
Hydraulic Dump System - Hydraulic Dump System

Oil cylinder leakage	1. Internal leakage is caused by scratch in the cylinder, aged or broken sealing component, etc	Replace the sealing component, broken component, or the oil cylinder
	2. External leakage is caused due to that the seal of the oil inlet joint is broken or loose, the piston rod is scratched, the sealing component is damaged, or the guiding hole of the cylinder is scratched.	Fasten the joint, and replace the sealing component, damaged part or the oil cylinder.
	3. The oil cylinder is maintained at the lifting state when out of service, and the piston rod is rusted and damaged the seal.	Withdraw the oil cylinder when out of service
	4. As a result of hinge attrition, the lifting angle of the trunk is tilted, and the oil cylinder damaged the seal due to the radial force on the oil cylinder (especially in case of a front-push type oil cylinder)	Correct or replace the hinge, and remind the user to apply lubricant as required.
Oil pipe broken	1. Poor quality of raw material	Replace with a qualified oil pipe
	2. The oil pipe is too long, and it is not reliably fixed and wears other components.	Fix the pipe with a pipe clamp
	3. Oil cylinder deformed	Replace a component or the assembly
	4. The valve core is clogged and pressurized	Clean and dredge the blockage.
	5. Hinge attrition rod deformation and swelling, which generates resistance and pressure in lifting	Replace the worn and/or deformed component
	6. Operation at severe overload	Operate at the rate load
Whistling in operation	1. The oil pump is blocked and doesn't suck oil smoothly	Check and dredge
	2. The hydraulic oil has high viscosity and is filthy	Replace with clean hydraulic oil
	3. The oil type is incorrect	Replace the hydraulic oil as require in the instruction manual
	4. The lifting frequency is too high under high pressure	Reduce the lifting frequency and cool the cylinder
Rupture in such components as the trunk, subframe, etc.	The trunk bears shearing and twisting force at the same time at the joints with both ends of the oil cylinder when lifting, cracks appear at locations of poor welding and extend; the flip seat at the rear part of the trunk and the connecting seats at both ends of the T-type lifting oil cylinder bear great portion of the force of the dump truck, and are most likely to suffer from ruptures.	If the joints between the dumping sleeve hole of the rear trunk of the subframe, the bracket of the pulling arm, and the oil cylinder supporting seat are through and ruptured, and the welding accuracy cannot be ensured in field work, apply to replace these components.
		The trunk, the subframe and other parts should be mostly welded. Bear a hole of around $\Phi 4$ at the originating point of the rupture when welding to stop the extension of the rupture. Use a J506 welding rod, and prewar the welding rod and insulate it to ensure the depth of the weld. It is better to use H08Mn2Si arc welding wire if available.
Abnormal wear and tear	1. After long time of use of the dump truck, the hinges are torn, loose, or deformed and make "crunching" sounds in operation as a result of poor lubrication, rash lifting or discharging in uneven places.	Replace the bearing bush. And replace the shaft and/or the shaft sleeve if worn. And remind the user to follow the operation instructions and lubricate regularly.
	2. If both ends of the oil cylinder of a new truck are asymmetrically torn, and the lower support shaft of the oil cylinder and the oil cylinder bedplate are asymmetrically torn, the assembly and adjustment dimensions must be incorrect.	Measure the dimensions and report the results to the Customer Relations Department.

Hydraulic Dump System - Hydraulic Dump System

Part Drawing

Wiring Diagram of the Hydraulic System of the HYVA Dump Truck (provided with a PT-type lifting valve)



fmwx910021

1	FC214-5-09030-000B-K0486 Oil Cylinder
2	RH Lifting Bracket
3	LH Lifting Bracket
4	Chassis Bracket
5	1" Combination Washer
6	1" Through Joint
7	100L-BI-4H-SB Gear Pump
8	1.25" Combination Washer
9	1.25"-1" transition joint
10	1" Right Angle Joint
11	LP Pipe Joint 1.25"-LP28
12	Pump Coupling
13	Air Filter Assembly

21	1" Combination washer
22	1" Through Joint
23	1" Right Angle Joint
24	PT Valve Installation Kit
25	Pneumatic Control Valve
26	Pneumatic Control Valve Installation Kit
27	Tee Gas Circuit Joint
28	FC-type Limit Valve
29	HP 16-2500-00-90 High Pressure Oil Pipe
30	HP 16-4000-00-90 High Pressure Oil Pipe
31	High Pressure Oil Pipe Strap (optional)
32	2m Low Pressure Oil Pipe
33	Pipe Clamp

Hydraulic Dump System - Hydraulic Dump System

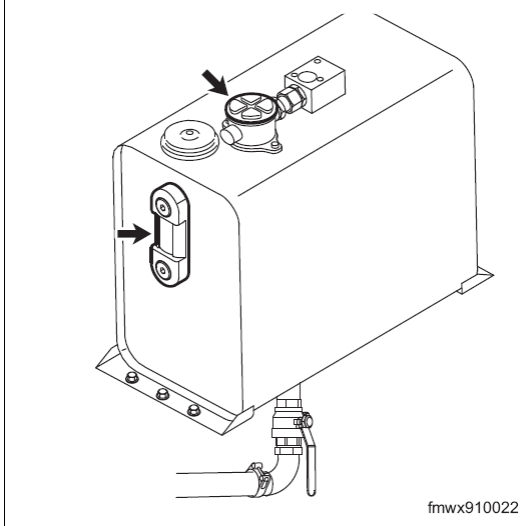
14	Oil Cylinder High Flange Assembly
15	262L 224L-RM-MP-RF-LI Oil Cylinder
16	Oil Cylinder Cushion Block
17	LP Coupling Bend 1.5"BSPOT-1.5"BSPIT
18	1.5" Ball Valve
19	Low Pressure Pipe Joint 1.5"
20	PT-type Lifting Valve

34	Pipe Strap
35	Male Quick Joint Dustproof Cover
36	Male Quick Joint
37	Female Quick Joint Dustproof Cover
38	Female Quick Joint 1
39	Oil Cylinder Anti-shock Block (Optional)

Hydraulic Oil (Front-Push Type Dump Truck)

Emptying and Injection

1. Place the manual control valve at the "Lowering" position
2. Place the oil catcher below the mouth of the low pressure inlet pipe of the oil pump
3. Dismantle the low pressure inlet pipe of the oil pump, and the hydraulic oil will flow from the mouth of the low pressure inlet pipe into the oil catcher.
4. Install low pressure inlet pipe of the oil pump



5. Open the return oil filter cover
6. Inject the new hydraulic oil from the return oil filter
7. Observe the scale of the oil level in the oil cylinder
8. When the level reaches the scale, stop injection
9. Run the vehicle and lift and lower the trunk for several times
10. Lift the trunk to the maximum height
11. Observe the scale of the oil level in the oil cylinder again
12. Add oil until it reaches the scale
13. Screw up the cover of the return oil filter.

Hint:

If there is air in the system, the air will be automatically discharge by lifting for several times at the beginning.

14. Lower the trunk

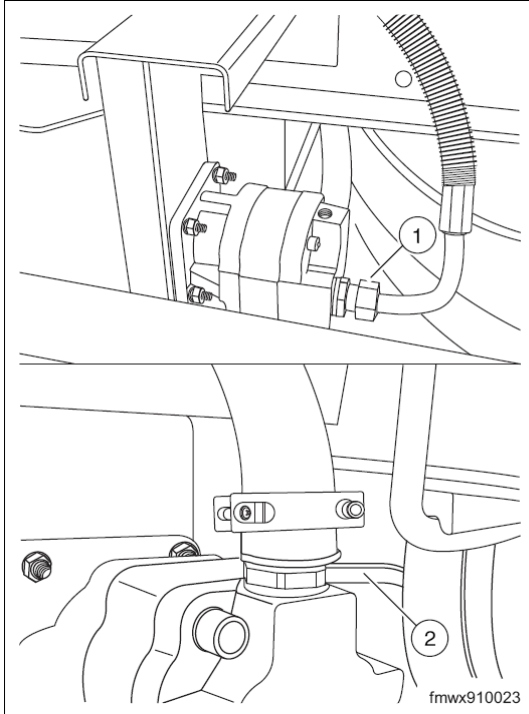
Oil pump

Overhaul

1. Lift the trunk, and raise the anti-drop frame, and properly support it

Warning: Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

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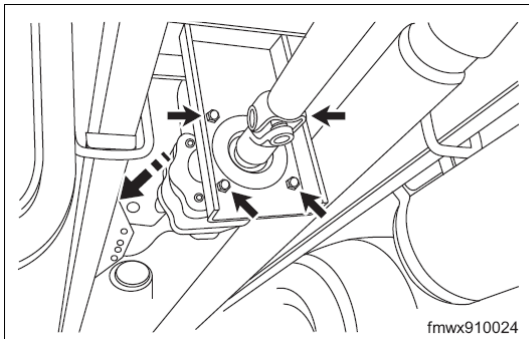
2. Dismantle the oil pipe.

(a). Dismantle the high pressure oil pipe.

(b). Dismantle the low pressure oil pipes.

Caution:

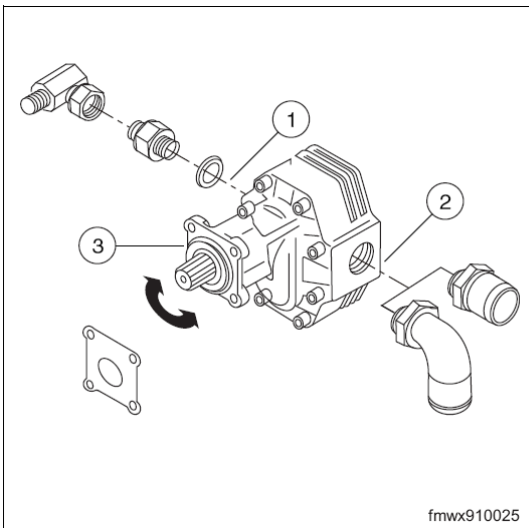
The oil pump and the joint should be clogged up with a blocking piece after dismantled to avoid contamination.



3. Dismantle the oil pump.

(a). Dismantle the fixing bolts of the oil pump.

(b). Pull out the oil pump from the spline trough of the drive shaft.



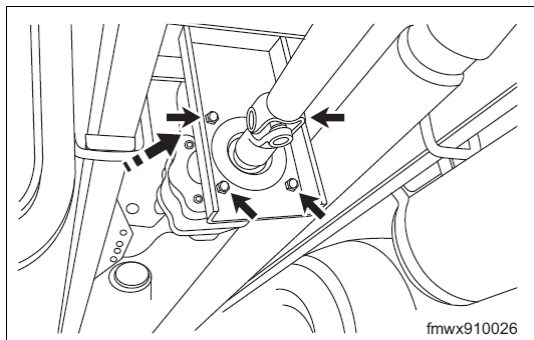
4. Check the oil pump, and replace it in case of the following

(a). The oil pump does not rotate smoothly.

(b). Oil leaks from three (3) positions in the oil seal of the oil pump shaft.

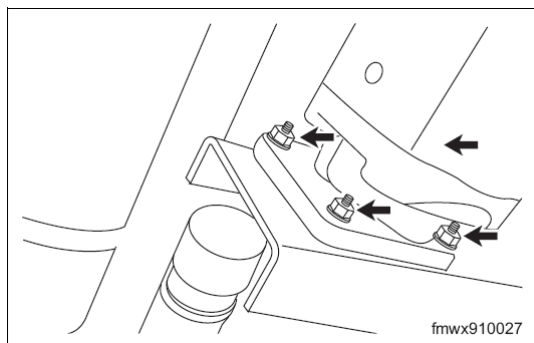
(c). Two (2) positions of the oil pump inlet have not suction force when rotating the oil pump shaft; there is air discharge from one (1) position of oil outlet.

Hydraulic Dump System - Oil pump



5. Install the oil pump

- (a). Insert the drive shaft spline trough into the spline shaft on the oil pump
- (b). Install the fixing bolts of the oil pump.

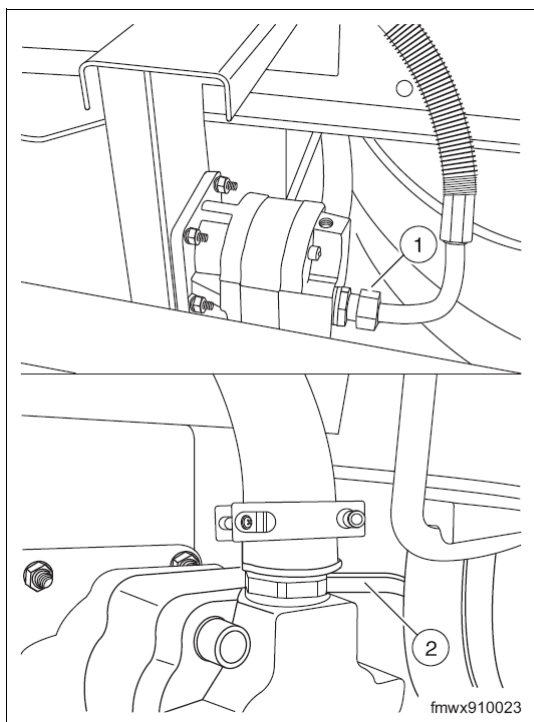


6. Tighten the fixing bolts of the oil pump

Torque: 81 ± 8 N.m

Caution:

The blocking pieces at any mouth of any oil pump and joint must be installed and dismantled in a timely manner, and the operator shouldn't wear gloves in dismantlement and installation, as this may result in contamination.



7. Connect the oil pipes

- (a). Install the high pressure oil pipe.
Torque: **140N.m**
- (b). Connect the low pressure oil pipe.

Caution:

The connection of the oil pipes must be reliable without mutual interference, dead corner, excessively low altitude, contact with the ground, etc.

8. Lower the trunk

Dump Component Overhaul

1. Ensure that the trunk is smoothly laid on the subframe

Warning:

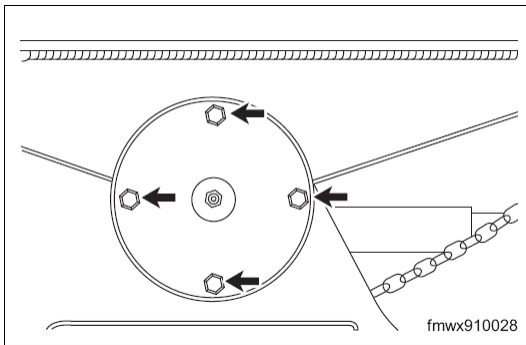
Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed.

Caution:

The dump board and the dump shaft have great weight, and try not to be hurt by them.

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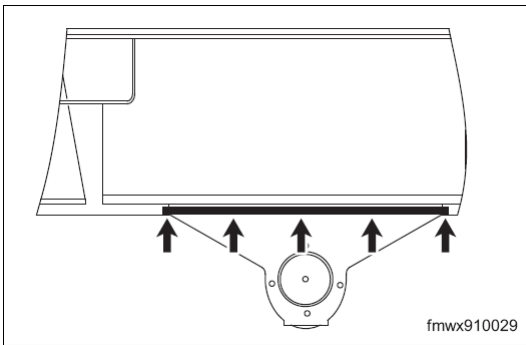
2. Dismantle the shaft covers at both sides



3. Cut open the welded joints of the dump board and the trunk bottom with an abrasive wheel cutter

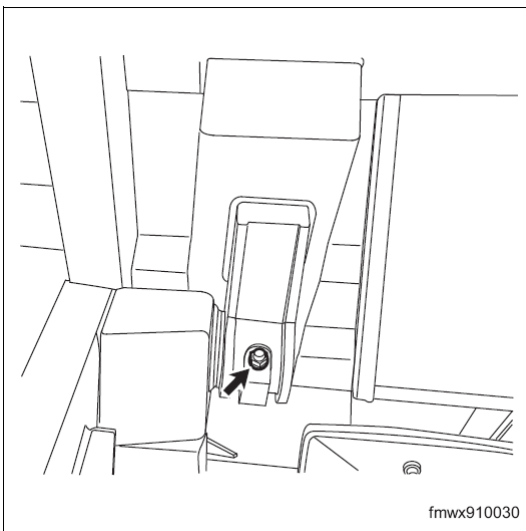
Hint:

For a vehicle with a withdrawable dump shaft, dismantle the dump shaft instead of cutting the dump board or the welded joints at the bottom of the trunk when dismantling the dump shaft or separating the trunk from the subframe.

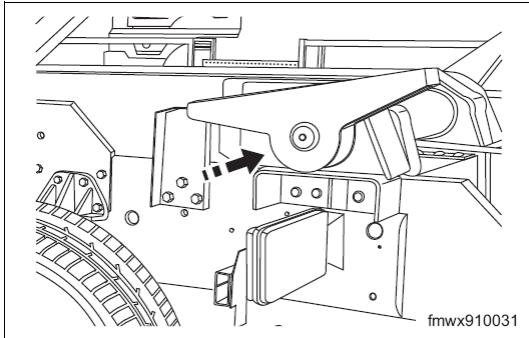


4. Dismantle the Dump Component (withdrawable dump shaft)

- (a). Dismantle the alemite fitting at both sides.
- (b). Dismantle the dump shaft locking bolts.



Hydraulic Dump System - Dump Component

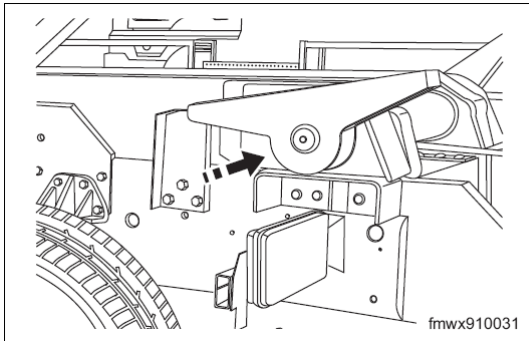


- (c). Knock the dump shaft out of the dump shaft hole in the subframe with a copper rod.

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5. Dismantle the Dump Component (non-withdrawable dump shaft)

- (a). Dismantle the dump boards at both sides and the outer washers.
 - (b). Weld the contacting periphery of the shafts and the subframe, and cut it open with an abrasive wheel cutter.
- 6. Check the dump shaft and the dump board, and replace the dump shaft or dump board in case of the following**
- (a). Check the dump shaft and the dump board to see whether there is any rust, scratch or collision in the surface.
 - (b). Check the fitting surfaces and the friction surfaces of the dump board and the dump shaft and the surfaces of other components to see whether there is any rust, scratch and collision.



7. Install the Dump Component (withdrawable dump shaft)

- (a). Align the dump shaft with the installation hole in the dump shaft on the subframe, and insert the dump shaft in the installation hole.

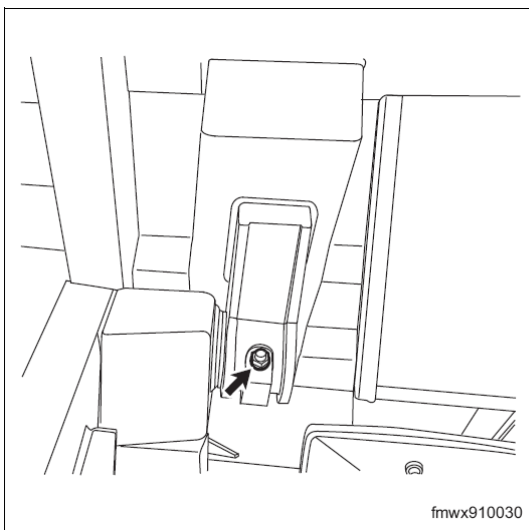
Caution:

DO NOT knock with a steel hammer and try to avoid forced operation.

- (b). Install the outer washers at both sides of the dump shaft, and then install the dump board sheath at both sides of the dump shaft.

Caution:

All the casting labels must be placed at the front side uniformly. The dump board should be close to the longitudinal center of the subframe as much as possible, and clearance should not be too wide. If the clearance is too wide, increase the thickness of the washer (by 5mm at the maximum). But the thickness at both sides must be equal.



8. Install the Dump Component (non-withdrawable dump shaft)

- (c). Rotate the dump shaft so that the semicircle orifice in the dump shaft and the bolt hole in the dump shaft remain concentric. Insert the connecting bolt forward from the rear part, together with the spring washer, the nut and the fastening bolt.

Hydraulic Dump System - Dump Component

- (a). Align the dump shaft with the installation hole in the dump shaft on the subframe, and insert the dump shaft in the installation hole, and weld the contacting periphery of the dump shaft and the subframe.

Caution:

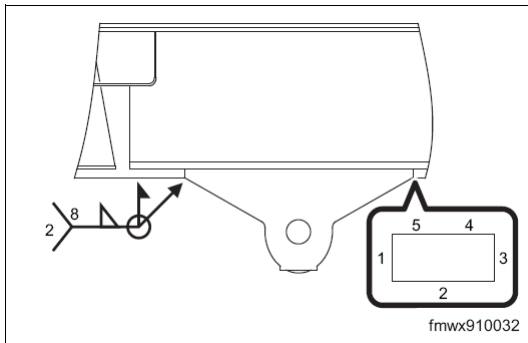
DO NOT knock with a steel hammer and try to avoid forced operation.

Ensure that there are no such defects as crack, slag inclusion, air port, incomplete fusion, etc, in the any welding seam.

- (b). Install the outer washers at both sides of the dump shaft, and then install the dump board sheath at both sides of the dump shaft.

Caution:

All the casting labels must be placed at the front side uniformly. The dump board should be close to the longitudinal center of the subframe as much as possible, and clearance should not be too wide. If the clearance is too wide, increase the thickness of the washer (by 5mm at the maximum). But the thickness at both sides must be equal.

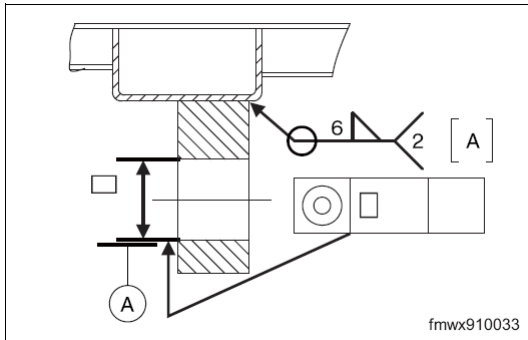


9. Weld the dump board

Caution:

The clearance between the dump board and the trunk should be less than 2mm. If it is more than 2mm, add a load on the base plate in the trunk to adjust the clearance.

- (a). The positions of the trunk marked 1, 2, 3, And 4 should be welded before lifting (i.e., the positions with welding space before lifting the trunk).



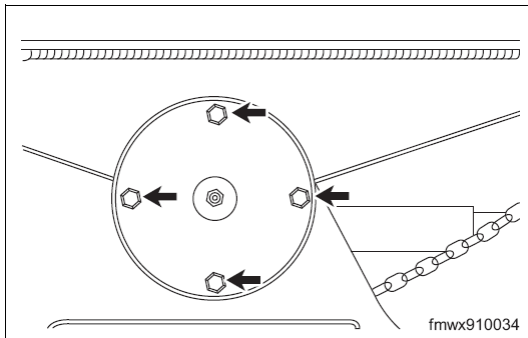
- (b). Lift the trunk and raise the anti-drop frame to support the bottom end of the trunk in the non-slipping block.
- (c). Weld the seams in at the interior side of the dump board which are not welded.

Caution:

Weld the welding seams connecting the base plate and the dump board, and control the welding parameters to reduce deformation due to welding.

Welding current: $I=150-200A$, welding voltage: $U=21-25V$, gas flow rate: 10-15L min, welding rate: $V=40-50cm$ min (adjust the welding parameters in this range according to the thickness of the workpieces. Welding with excessively high current and voltage is strictly forbidden)

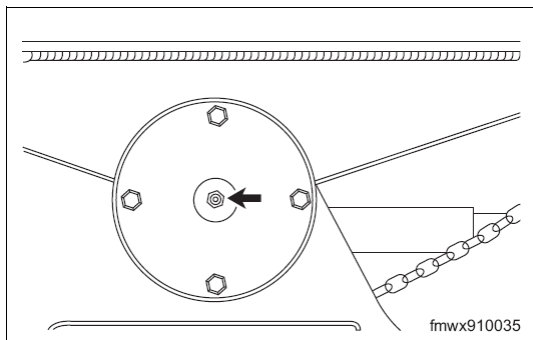
Ensure that the seams are completely welded, avoid any incomplete and missed part, ensure the high quality of the welding, clean any welding slag, and polish the welding bead.



10. Install the shaft covers at both sides

Torque: $8.5\pm1N.m$

Hydraulic Dump System - Dump Component



11. Install the alemite fitting, and inject lubricant into both sides of the alemite fittings of the dump shaft, until the lubricant is spilling over

12. Lower the trunk

Oil Cylinder (Front-push Dump Truck)

Dismantlement and Installation

1. Lift the trunk, raise the anti-drop frame, and properly support it

Warning:

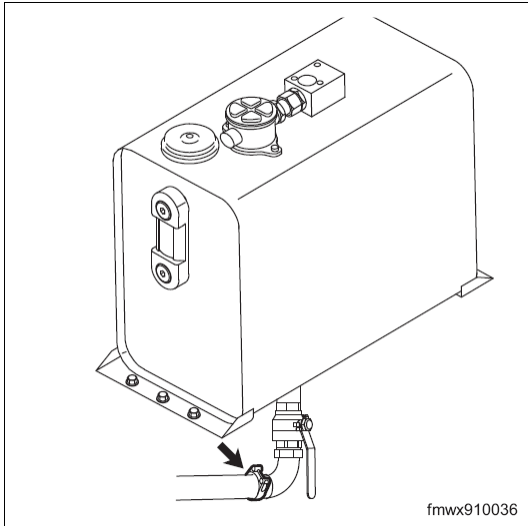
Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

2. Empty the hydraulic oil, refer to Chapter 91, Hydraulic Dump System - Hydraulic Oil, Emptying and Injection
3. Dismantle the lifting valve, refer to Chapter 91, Hydraulic Dump System - Lifting Valve (Front-push Dump Truck), Overhaul

4. Disconnect outlet pipe at the bottom of the oil cylinder

Caution:

After the joint is dismantled, a blocking piece should be used to block up the port in a timely manner to avoid contamination.

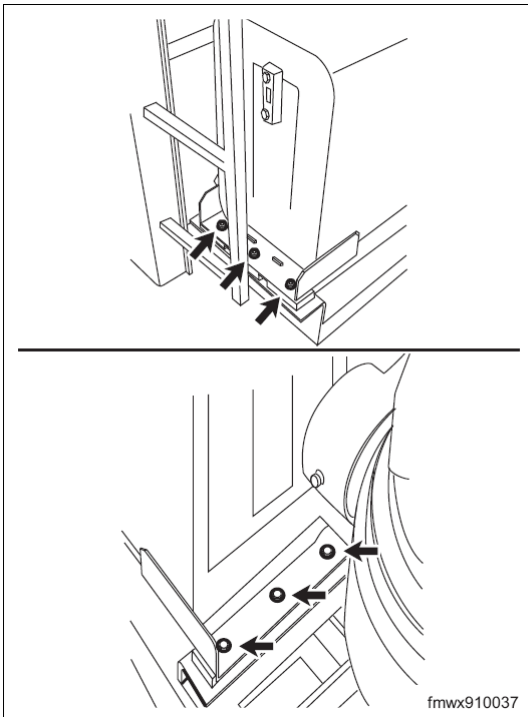


5. Dismantle the oil cylinder

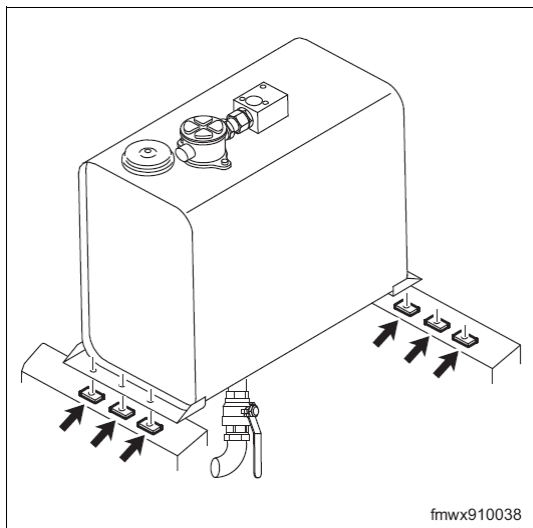
- (a). Dismantle the fixing bolts at both sides of the oil cylinder.
- (b). Remove the oil cylinder.

Caution:

The oil cylinder is very heavy and requires more than two technicians to handle.



Hydraulic Dump System - Oil Cylinder (Front-push Dump Truck)



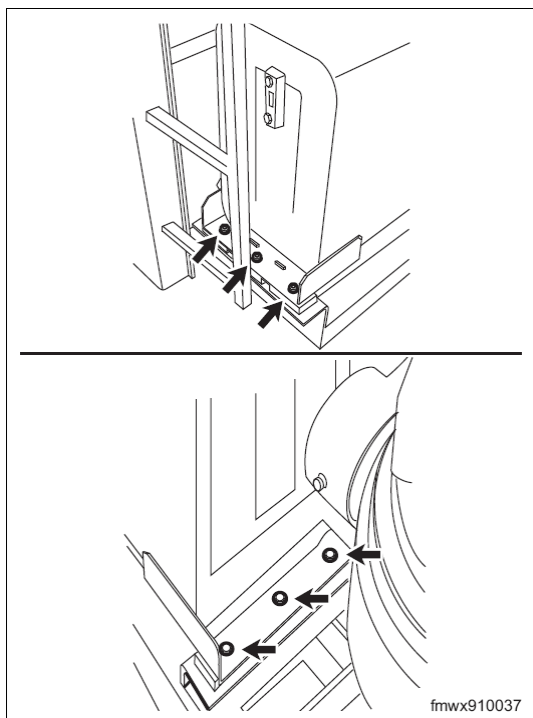
6. Install the oil cylinder

- (a). Place a piece of rubber on the oil cylinder installation seat, and then put the oil cylinder on the rubber and align the installation hole in the bolt.

Caution:

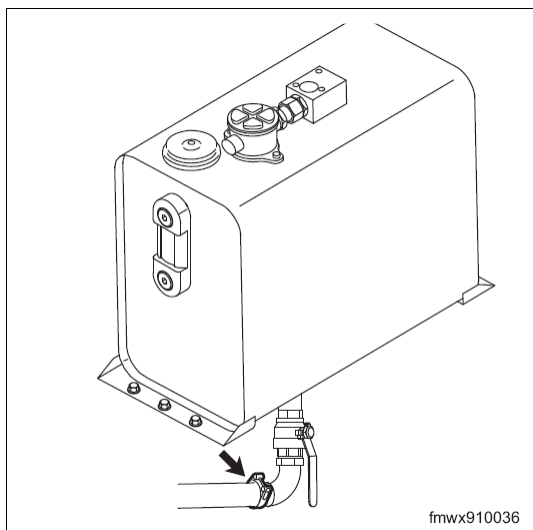
The oil cylinder is very heavy and requires more than two technicians to handle.

91



- (b). Install the fixing bolts at both sides of the oil cylinder.

Torque: **15 N.m**



7. Connect the outlet pipe at the bottom of the oil cylinder

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Hydraulic Dump System - Oil Cylinder (Front-push Dump Truck)

8. Install the lifting valve
9. Inject hydraulic oil
10. Lower the trunk

Lifting Valve (Front-push Dump Truck)

Overhaul

1. Lift the trunk, raise the anti-drop frame, and properly support it

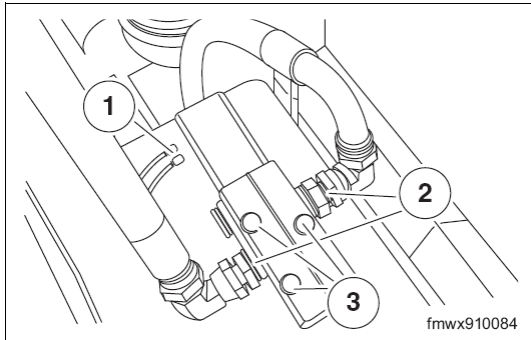
Hint:

If the trunk cannot be lifted due to failure, place the riser handle at the "Lowering" position, and hoist the shelter with a derrick truck, and then properly support the shelter with a support pole.

Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

2. HYVA PT-type Lifting Valve



3. Disconnect the pipe connection of the lifting valve

Caution:

After the joint is dismantled, a blocking piece should be used to block up the port in a timely manner to avoid contamination.

(a). Disconnect the windpipe.

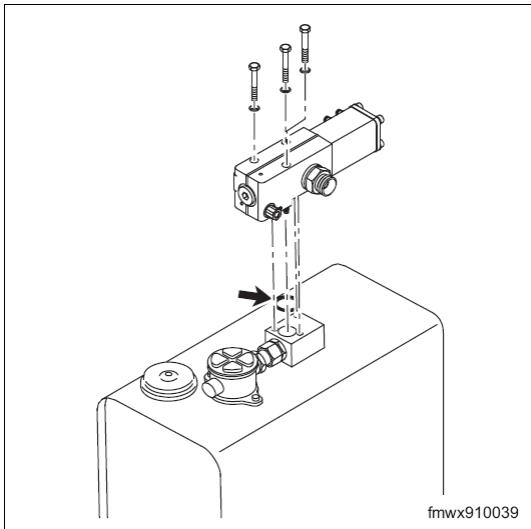
Hint:

Empty the remaining gas in the vehicle first before dismantling the windpipe.

(b). Disconnect the inlet and outlet pipes.

(c). Prize up the decorative cap of the bolt installation hole, and dismantle the fixing bolts of the lifting valve.

4. Check whether the lifting valve is intact, and replace with a new one if it is damaged



5. Install the lifting valve

(a). Place a new O-type sealing washer between the valve seat and return port of the valve body.

Caution:

Replace the O-type sealing washer between valve seat and the valve body with a new one.

(b). Install the fixing bolts of the lifting valve, bolt installation hole decorative cap.

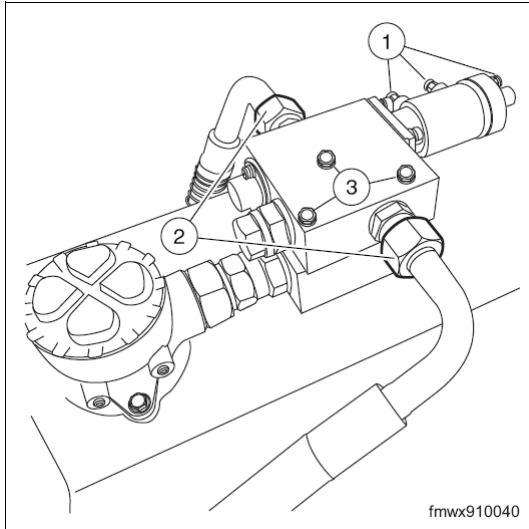
Torque: **15 N.m**

(c). Install the inlet and outlet pipes.

Torque: **75 N.m**, Torque: **75 N.m**

(d). Install the windpipe.

6. Lift the valve (general)



7. Disconnect the pipe connection of the lifting valve

Caution:

After the joint is dismantled, a blocking piece should be used to block up the port in a timely manner to avoid contamination.

(a). Disconnect the windpipe.

Hint:

Empty the remaining gas in the vehicle first before dismantling the windpipe.

(b). Disconnect the inlet and outlet pipes.

(c). Dismantle the fixing bolts of the lifting valve.

8. Check whether the lifting valve is intact, and replace with a new one if it is damaged

9. Install the lifting valve

(a). Place a new O-type sealing washer between the valve seat and return port of the valve body.

Caution:

Replace the O-type sealing washer between the valve seat and the valve body with new one.

(b). Install the fixing bolts of the lifting valve, the decorative cap of the bolt installation hole.

Torque: **15 N.m**

(c). Install the inlet and outlet pipes.

Torque: **75 N.m, 75 N.m**

10. Check the hydraulic oil, and charge if it is insufficient, and discharge the air, refer to Chapter 91, Hydraulic Dump System - Hydraulic Oil, Emptying and Injection

11. Lower the trunk

Limit Valve (Front-push Dump Truck)

Overhaul

1. Lift the trunk, raise the anti-drop frame, and properly support it

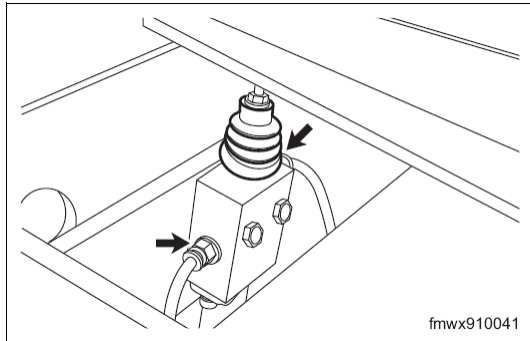
Hint:

If the trunk cannot be lifted due to failure, place the riser handle at the "Lowering" position, and hoist the shelter with a derrick truck, and then properly support the shelter with a support pole.

Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

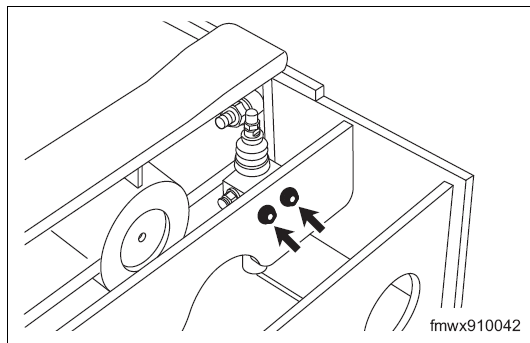
2. Limit Valve (General)



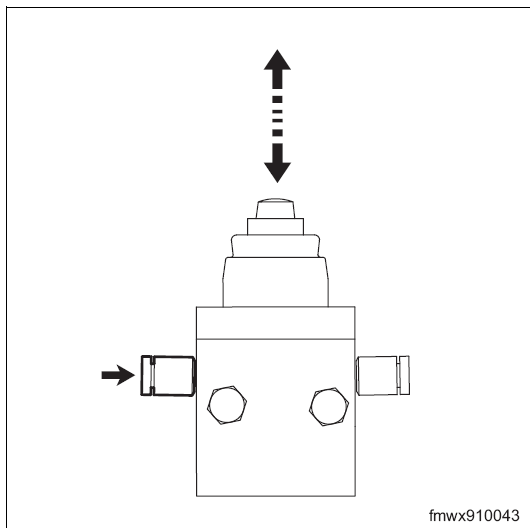
3. Disconnect the windpipes at both sides of the limit valve

Hint:

Empty the remaining gas in the vehicle first before dismantling the windpipe.

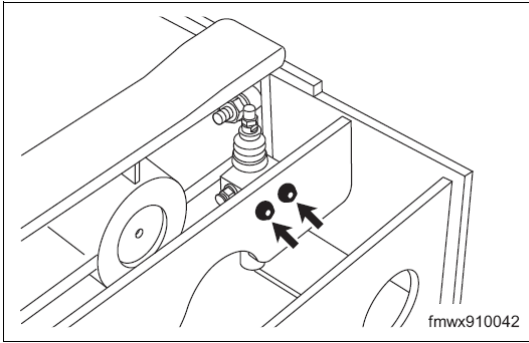


4. Dismantle the fixing bolts of the pressure limiting valve



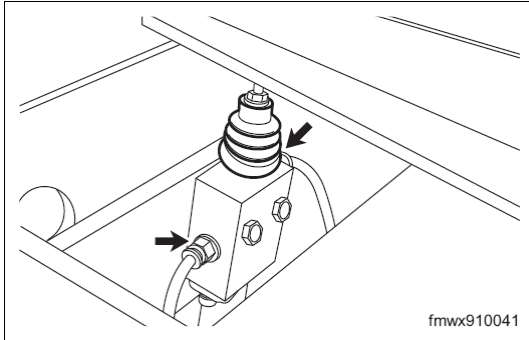
5. Check the limit valve

- (a). Inject high pressure air into the air port from the limit valve.
- (b). Press/loosen the shaft rod of the limit valve by hand, and check the pressure limiting valve to see whether the it can be turned on and off. If it cannot be turned on or off, replace the pressure limiting valve with a new one.



6. Install the fixing bolts of the pressure limiting valve

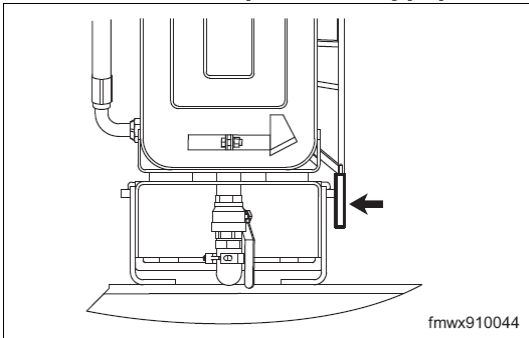
Torque: 23 ± 2 N.m



7. Connect the windpipes at both sides of the limit valve

8. Lift the trunk, check the pressure limiting valve to see whether the contact of the shaft rod is normal; otherwise, adjust the length of the shaft rod of the pressure limiting valve.

9. Limit Valve (HYVA FC type)

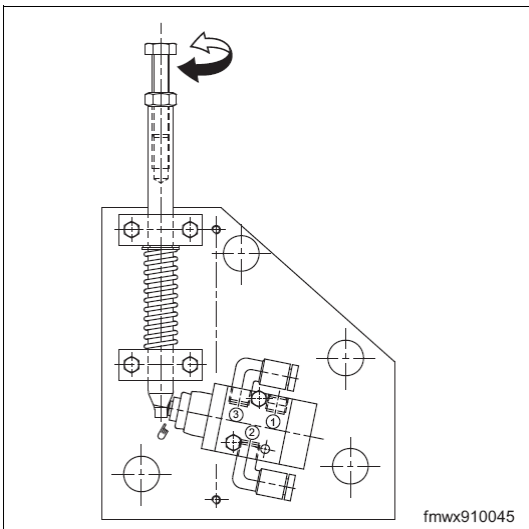


10. Disconnect the windpipes at both sides of the limit valve, and remove the fixing bolts

Hint:

Empty the remaining gas in the vehicle first before dismantling the windpipe.

11. Connect the windpipes at both sides of the limit valve, and install the fixing bolts



12. Adjust the limit valve

- Loosen the locking nuts on the adjustment bolts, and screw in the adjustment bolts to the end of their threads.
- Lift the wagon slowly to the maximum stroke at low engine speed.
- Adjust the limiting device to the start position, and then lower the cylinder by 150mm and support it with a wagon support pole, and turn the adjustment bolt for about $2 \times 1 / 2$ circle anticlockwise, until it contacts the object of its role.
- Lift the wagon at the maximum engine speed, and check whether the oil cylinder has reached the end of the stroke. If it has reached the end, screw it in for one circle of the thread counterclockwise with the adjustment screw.
- Repeat the previous step until the oil cylinder will not reach end of stroke.
- Lock up the adjustment bolt with a locking nut.

Hydraulic Dump System - Limit Valve (Front-push Dump Truck)

Caution:

Stop the lifting operation at once when the oil cylinder reaches the peak and the pressure is increased.

13. Lower the trunk

Air Filter (Front-push Dump Truck)

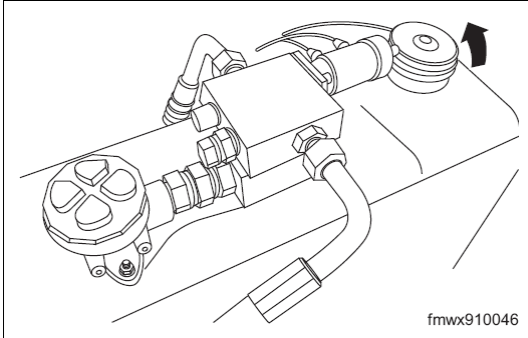
Overhaul

1. Lift the trunk, raise the anti-drop frame, and properly support it

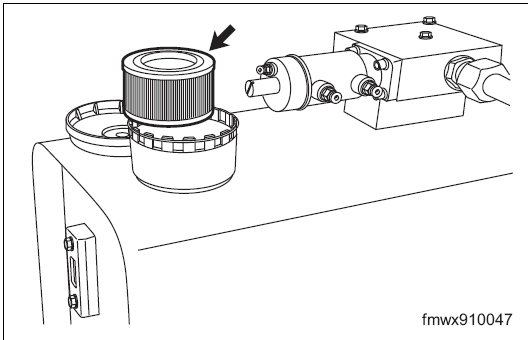
Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

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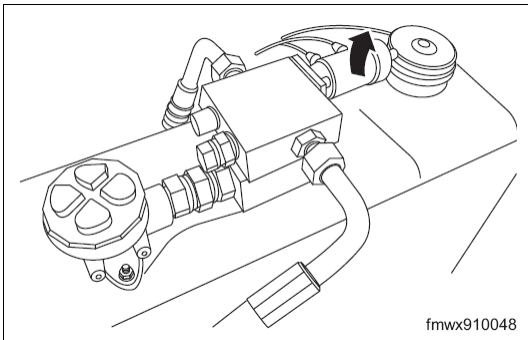


2. Unscrew the air filter cover, and remove the filter



3. Check the air filter, and replace it with a new one in the following cases

- (a). Check the air filter whether it is too filthy.
- (b). Check the air filter whether it is deformed or damaged.



4. Install the filter, and screw up the cover

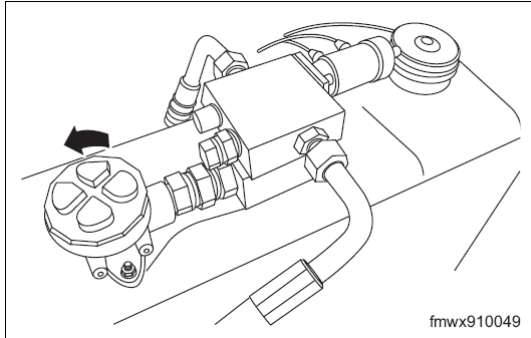
5. Lower the trunk

Return Oil Filter (Front-push Dump Truck) Overhaul

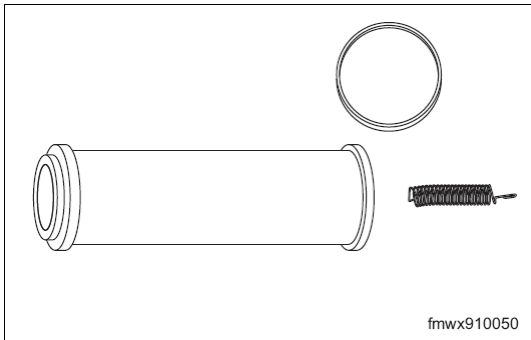
1. Lift the trunk, raise the anti-drop frame, and properly support it

Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

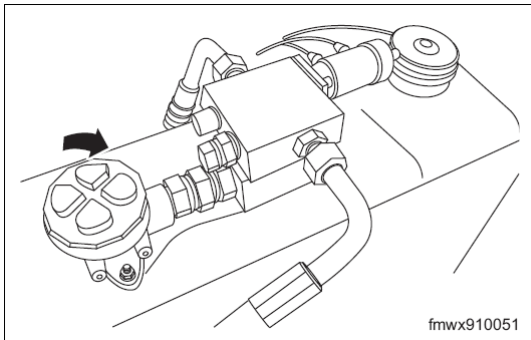


2. Unscrew the return oil filter cover, and remove the filter



3. Check the return oil filter, and replace it with a new one in the following cases

- (a). Check the return oil filter whether it is too filthy.
- (b). Check the return oil filter whether it is deformed or damaged.



4. Install the filter, and screw up the cover

5. Lower the trunk

Oil Cylinder (Front-push Dump Truck)

Overhaul

1. Lift the trunk, raise the anti-drop frame, and properly support it

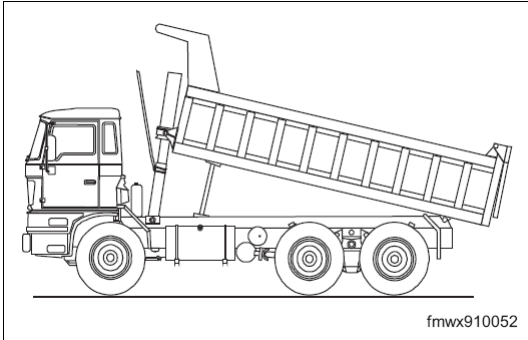
Hint:

The barrel part of the oil cylinder may be dismantled from the truck when repairing an HYVA FC-type oil cylinder, and the outer sleeve may be remained on the shelter.

Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

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2. Dismantle the connection between the oil cylinder and the trunk

- Tie up the oil cylinder properly with a sling (so as to preventing the oil cylinder from falling off in the process of dismantling), and then lift the oil cylinder with an appropriate lifting appliance
- Dismantle the terminal locking nuts of the oil cylinder, and slowly lift the wagon with the hydraulic system until the first segment of the barrel is exposed.

Hint:

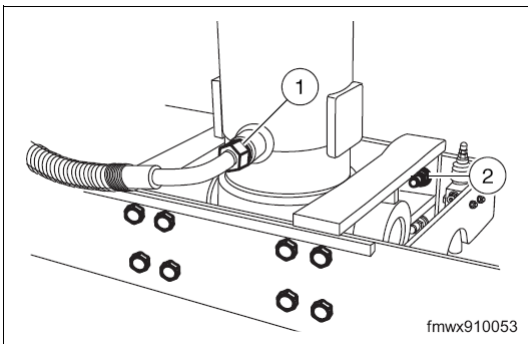
If the trunk cannot be lifted due to failure, place the riser handle at the "Lowering" position, and hoist the shelter with a derrick truck, and then properly support the shelter with a support pole.

- Remove the barrel part out of the outer sleeve.

Caution:

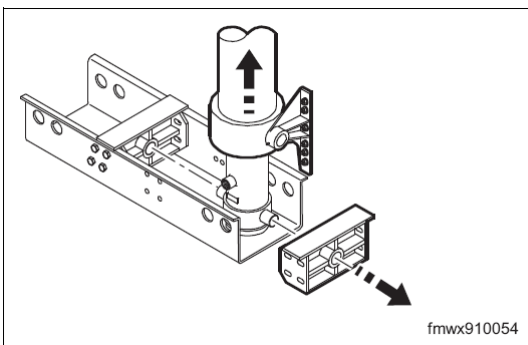
Ensure that the wagon and the oil cylinder are properly supported.

3. Place the pneumatic control valve at the "Lowering" position to allow the barrel to slide back into the oil cylinder.



4. Dismantle the connection between the oil cylinder and the chassis

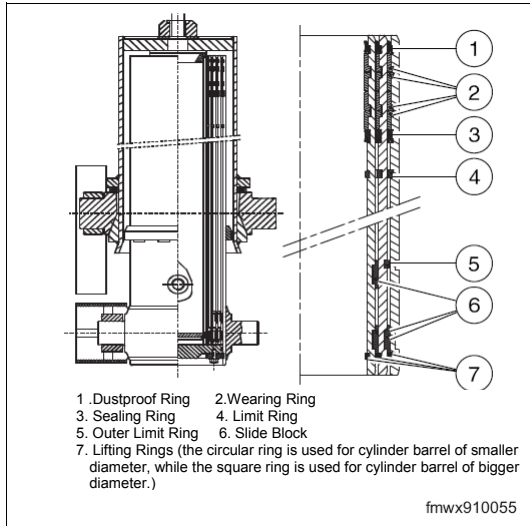
- Dismantle the oil cylinder inlet pipe.
- Dismantle the support beam at one side of the oil cylinder.



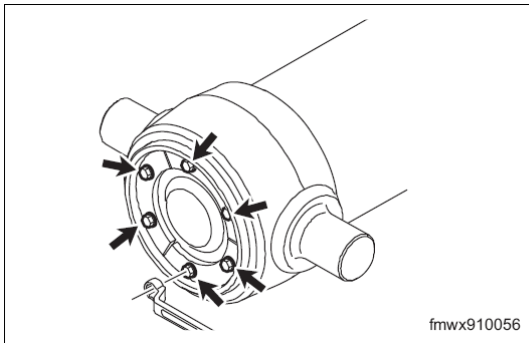
5. Remove the oil cylinder

- Move the oil cylinder support beam to one side.
- Remove the oil cylinder from the other oil cylinder support beam.

Hydraulic Dump System - Oil Cylinder (Front-push Dump Truck)



6. Structure of the Oil Cylinder



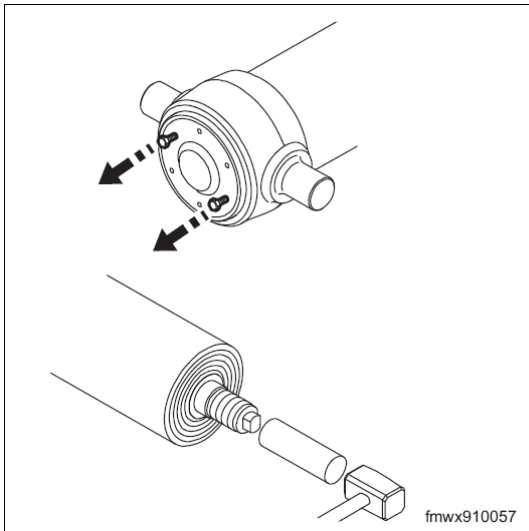
7. Disassembly oil cylinder, and open the base barrel

- (a). Place the oil cylinder on a clean surface with the oil port downward.

Caution:

Fix the oil cylinder to avoid damage or personal injury. Clean up all the waste oil (A V-device is most recommendable).

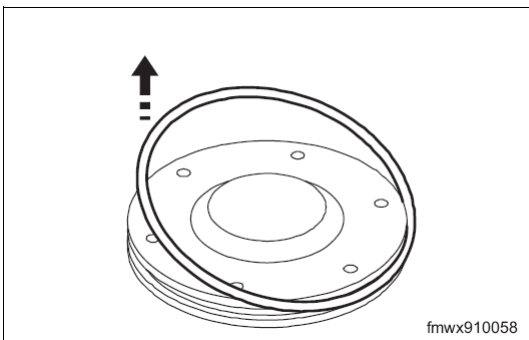
- (b). Dismantle the bolts in the bottom cover with a closed wrench, and then remove the locking piece.



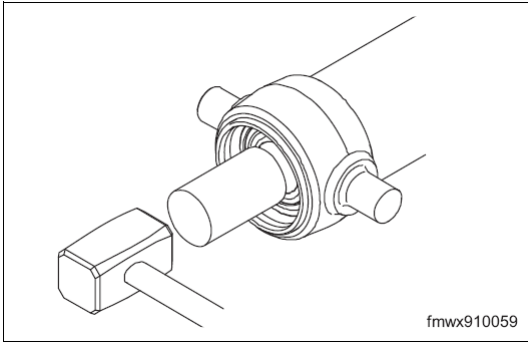
- (c). Dismantle the bottom cover.

Hint:

The bottom cover can be dismantled in either of the following ways: Pull it out with the two screws in the bottom cover or knock the head of the piston cylinder with a rubber hammer to force it out of the bottom cover.



- (d). Remove the O-ring on the bottom cover.

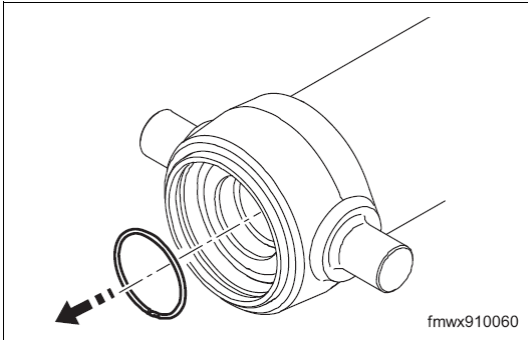


8. Dismantle the piston rod

Hint:

The piston rod with a diameter of less than 129mm is provided with two semi-circular arc slide blocks, which should be removed at first and properly placed to prevent loss or damage. The piston rod with a diameter of more than 129mm is provided with only one arc-shaped slide block, which doesn't need to be removed.

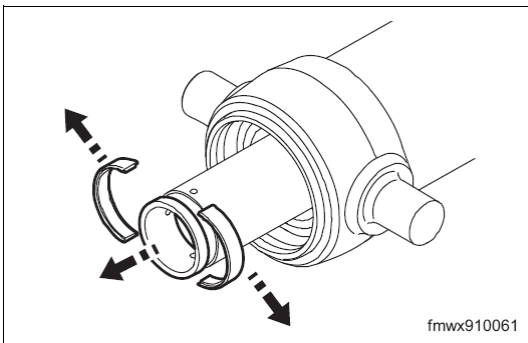
(a). Push the piston rod forward until the retainer spring in the interior wall of the next segment of cylinder is seen.



(b). Pry out the lifting ring with a screwdriver.

Caution:

The lifting ring may pop out in the process of prying.



(c). Push back the piston rod, and the piston rod can be removed from the bottom of the oil cylinder.

9. Dismantle the barrel

Caution:

- The cylinder should be placed on a clean desktop to prevent scratches and other damage
- Do not remove the limit ring inside the barrel. The entire segment of the barrel must be replaced if the limit ring is damaged.
- The sealing washer and the dustproof ring cannot be reused.
- Do not use a screwdriver or any other sharp tool when dismantling the sealing washer and the dustproof ring, so as to avoid damage to the positioning trough and leakage. The support ring can be pried up with a screwdriver.

(a). Dismantle the barrel.

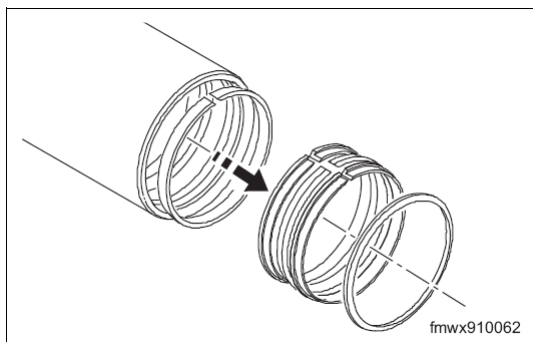
Caution: before removing one segment of the barrel from the bottom of the oil cylinder, the lifting ring of the next segment must be removed first.

(b). Remove the lifting ring or the floating ring and the piston dismantling rod, and then remove the barrel from the bottom of the oil cylinder.

Hint:

The other sections of the barrel can be removed in the previous procedure.

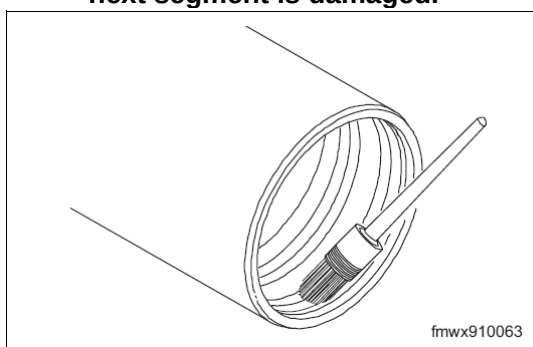
Hydraulic Dump System - Oil Cylinder (Front-push Dump Truck)



- (c). Remove the sealing washer, the dustproof ring and the support ring from the interior trough of each section of barrel.

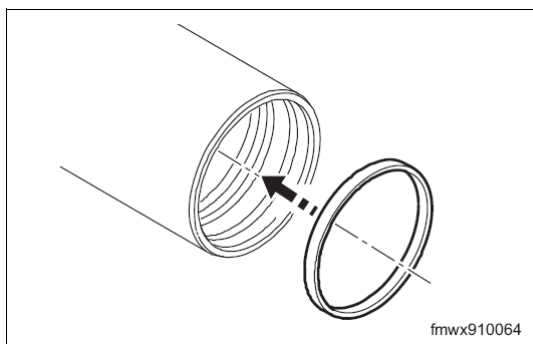
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10. Carefully clean all the barrels, the positioning troughs, and the barrel surfaces to see whether they are flat and smooth. Check the slide blocks of each segment, and replace any damaged one. If any slide block is damaged, check whether the interior wall of the next segment is damaged.

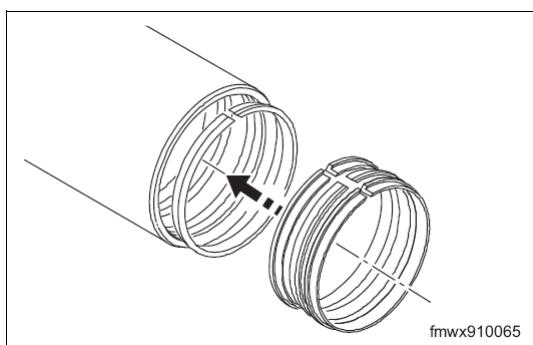


11. Install Kit

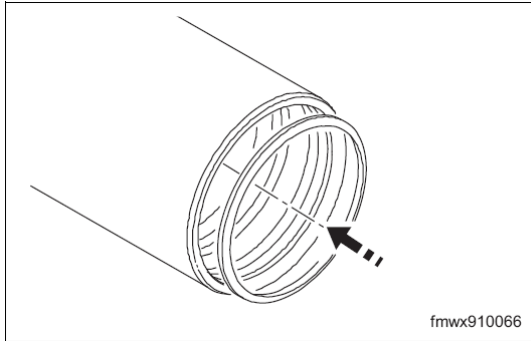
- (a). Lubricate installation kit and positioning trough.



- (b). Install the sealing washer.



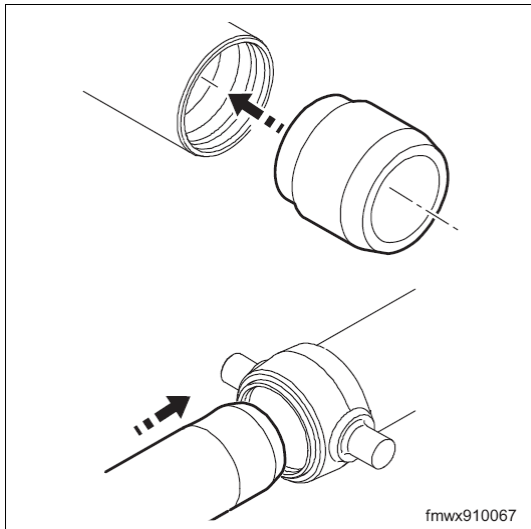
- (c). Install the support ring.



(d). Install the dustproof ring.

Caution:

Ensure that each ring is in the corresponding trough; otherwise, it is likely to lead to jamming or damage.

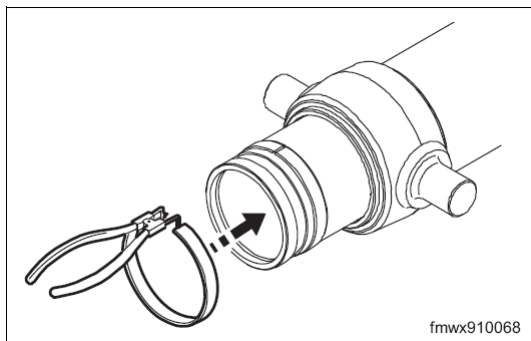


12. Install the barrel

(a). Push the entire of the first segment of barrel into the base barrel. Be careful not to scrap the barrel with the limit ring.

Hint:

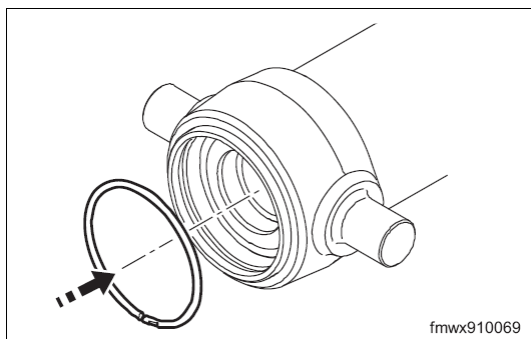
The barrel may encounter some resistance when passing through the installation kit. Some special installation guide rings may be used to avoid injury and make the assembly easier.



(b). Place the slide block at the end of the barrel and apply sufficient lubricant. Push the barrel further into the base barrel until the slide block is completely in the base barrel.

Hint:

The other sections of the barrel can be installed in the previous procedure.



(c). After one barrel is properly installed, install the lifting ring in the corresponding positioning trough in the interior wall of the previous segment of barrel (except the base barrel of the oil cylinder).

Caution:

The side of the top slide block with a right angle should face upward when installing the slide block.

13. Install the piston rod

Hint:

The installation procedure for the piston rods of all of the FC-type oil cylinders are the same as those for the other barrels in most cases.

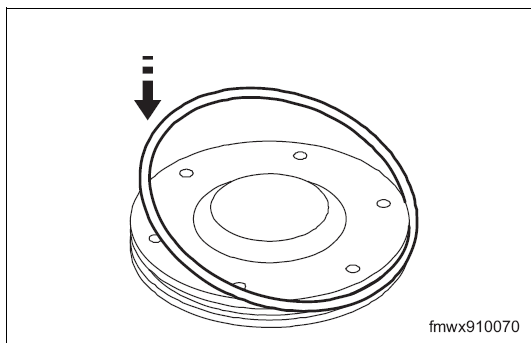
(a). Place a ring type filling in each trough of the piston rod, and apply the appropriate lubricant before installation.

Hydraulic Dump System - Oil Cylinder (Front-push Dump Truck)

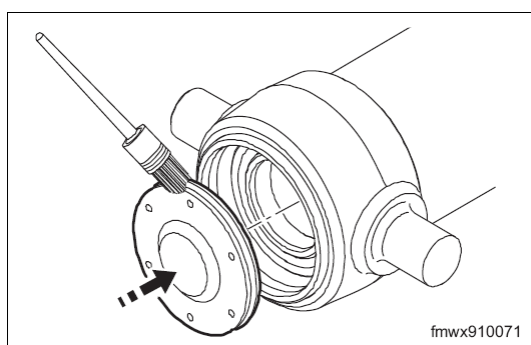
(b). Install the piston rod.

Caution:

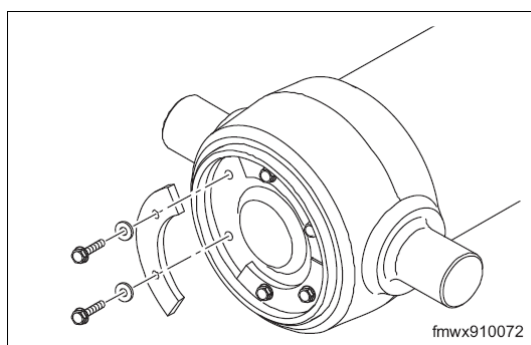
DO NOT install the piston rod from the top end of the oil cylinder before installing the ring type filling.

**14. Install the base plate**

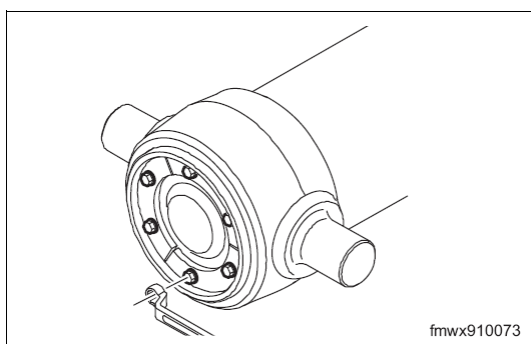
(a). Install a new "O"-ring on the base plate.



(b). Apply sufficient lubricant on the base plate.



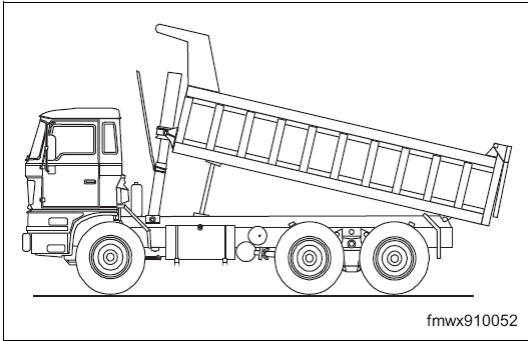
(c). Install the 3 locking pieces to fix the bottom cover.



(d). Screw up the bolt and the spring pad of the locking piece.

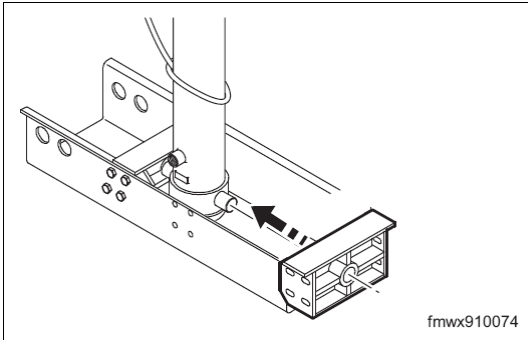
Caution:

Use a new fixing bolt and spring pad.



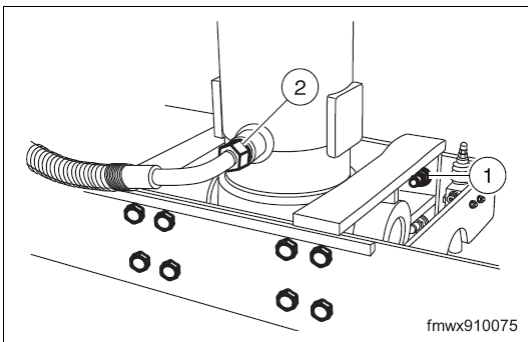
15. Hoist the oil cylinder

- (a). Tie up the oil cylinder properly with a sling, and then lift the oil cylinder with an appropriate lifting appliance
- (b). Move the oil cylinder onto the support beam.
- (c). Insert the oil cylinder sleeve into the outer sleeve of the oil cylinder.



16. Install the oil cylinder

- (a). Install the other oil cylinder support beam.



17. Install the connection between the oil cylinder and the chassis

- (a). Install the fixing bolts of the oil cylinder support beam.
Torque: **210 N.m**
- (b). Install the oil cylinder inlet pipe.
Torque: **75 N.m**

18. Check the hydraulic oil, and charge if it is insufficient, and discharge the air, refer to Chapter 91, Hydraulic Dump System - Hydraulic Oil, Emptying and Injection

19. Slowly lift the oil cylinder with the hydraulic system until the oil cylinder reaches the bottom part of the outer sleeve of the oil cylinder.

20. Install the self-locking nut.

Torque: **800 N.m**

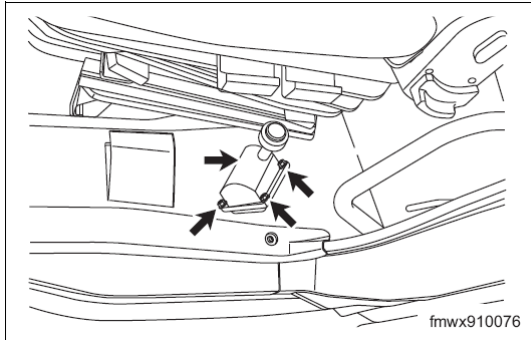
Caution:

The self-locking nut on the outer sleeve cannot be reused.

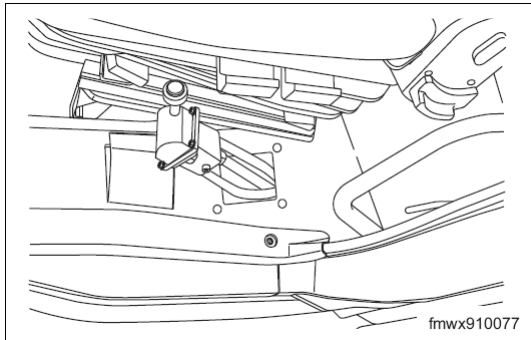
21. Remove the support pole

22. Lower the trunk

Manual Air Valve (Front-push Dump Truck) Overhaul



1. Dismantle the fixing bolts of the air valve



2. Dismantle the air valve

- (a). Withdraw air valve from the top.
- (b). Disconnect the connection of the windpipe at the bottom of the air valve.

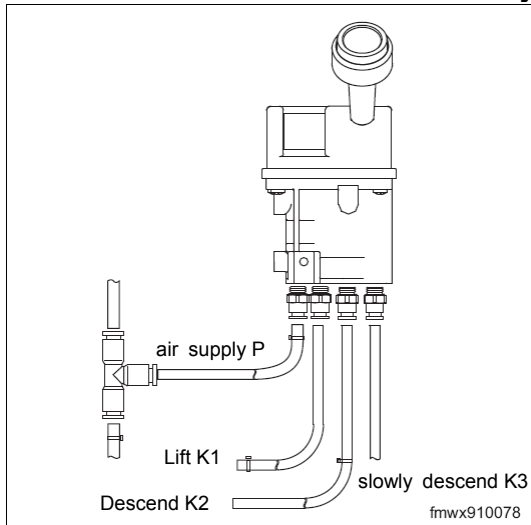
Caution:

Mark every windpipe before dismantling, so as to avoid mis-installation.

Hint:

Empty the remaining gas in the vehicle first before dismantling the windpipe.

3. Check whether the components and parts can rotate flexibly, and replace the manual air valve with a new one if necessary.

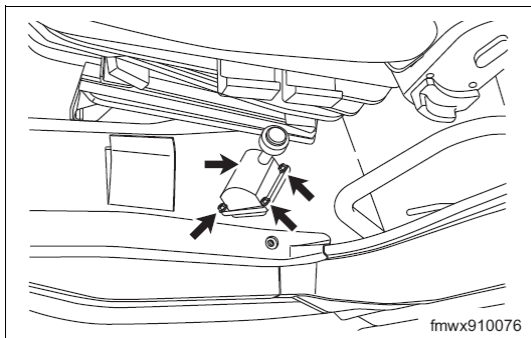


4. Install the air valve

- (a). Connect the windpipe at the bottom of the air valve.

Caution:

Insert the windpipes to the corresponding positions in the air valve according to the marks, so as to ensure correct installation of the windpipes.

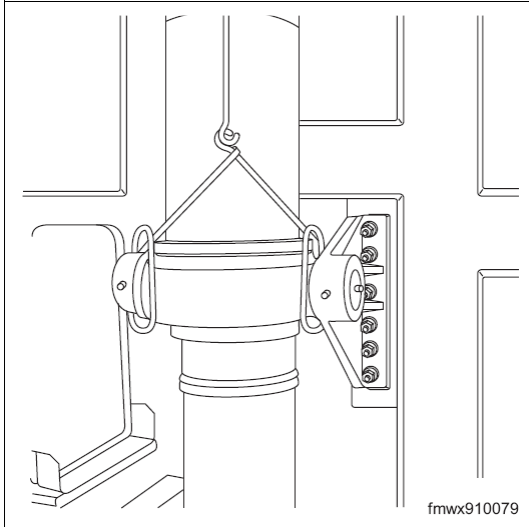


5. Install the fixing bolts of the air valve
Torque: 23±2 N.m

Trunk (Front-push Dump Truck)

Dismantlement and Installation

1. Lift the cab.



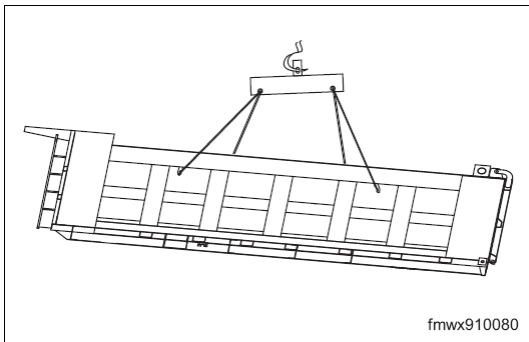
2. Dismantle the connection between the oil cylinder and the trunk

- (a). Tie up the oil cylinder properly with a sling, and then lift the oil cylinder with an appropriate lifting appliance and fix it properly, so as to prevent it from falling off.

Warning:

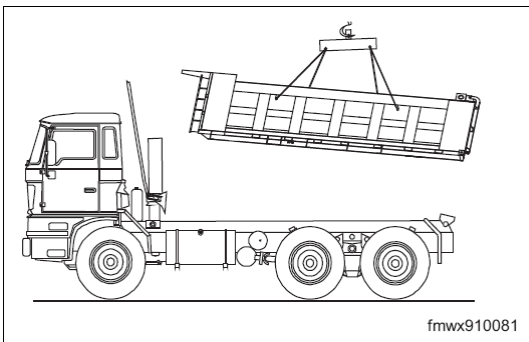
Ensure that the oil cylinder is vertically fixed. If the oil cylinder is not firmly fixed, it is likely to cause loss of life or damage to the components and parts.

- (b). Dismantle the fixing bolts between the oil cylinder and the trunk.



3. Install a sling on the trunk hook, and clamp the sling on the hook of the derrick truck. Lift the derrick truck to fasten the sling.

4. Disconnect the connection between the trunk and the Dump Component, refer to Chapter 91, Hydraulic Dump System-Dump Component, Overhaul

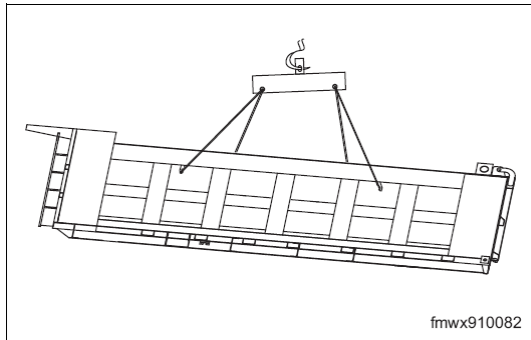


5. Lift the trunk, and place it smoothly

Warning:

Make sure no one is under the trunk. The handling speed cannot be too fast to avoid swinging of the trunk; otherwise, it may endanger the safety of life or damage parts and components.

Hydraulic Dump System - Trunk (Front-push Dump Truck)



6. Hoist the trunk

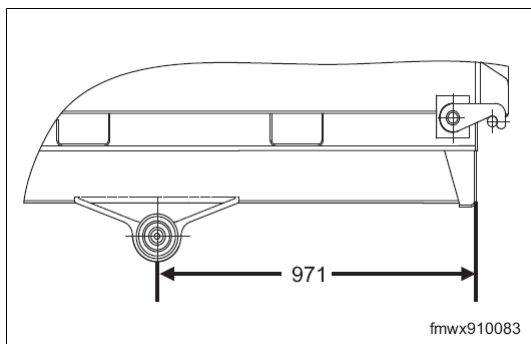
- Install the sling, and clamp the sling on the hook of the derrick truck.
- Handle the trunk.

Caution:

The handling speed cannot be too fast to avoid swinging of the trunk. The distance between the trunk and the ground shouldn't be too long. Raise the derrick truck when reaching the subframe, and suspend a little when the height of the trunk bottom is higher than that of the subframe, until the trunk is lifted onto the subframe and in parallel to the subframe.

Caution:

Lift the trunk with a 10 degree angle and with the anterior part higher than the posterior part.



7. Adjust the location of the trunk until it meets the requirements

Caution:

The vertical beam of the trunk base plate must contact the subframe, and the deviation between the transverse center of symmetry and the center of symmetry of the subframe shall not exceed 2mm after they contact each other, and both the anterior and posterior parts of the trunk must meet the requirements.

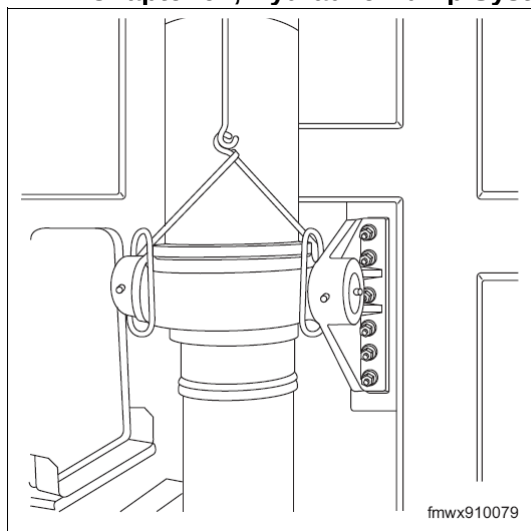
The misalignment of the vertical central line of the trunk and the vertical center of the chassis shall not exceed 8mm.

The left and the right symmetrical parts at the outer edge of the body shall not exceed 20mm.

Caution:

The adjustment speed must be slow, and the lifting height shall not be 500mm higher than the subframe. Nobody should be allowed to have access to the part of 1m around the trunk, except the operators and other auxiliary persons.

8. Connect or weld the connection between the trunk and the Dump Component, refer to Chapter 91, Hydraulic Dump System - Dump Component, Overhaul



9. Install the fixing bolts between the oil cylinder and the trunk

Torque: 210 N.m

10. Lower the cab

Hydraulic Cylinder (Mid-push T-Type Dump Truck) Dismantlement and Installation

1. Lift the trunk, raise the anti-drop frame, and properly support it

Hint:

If the trunk cannot be lifted due to failure, place the riser handle at the "Lowering" position, and lift the trunk with a derrick truck.

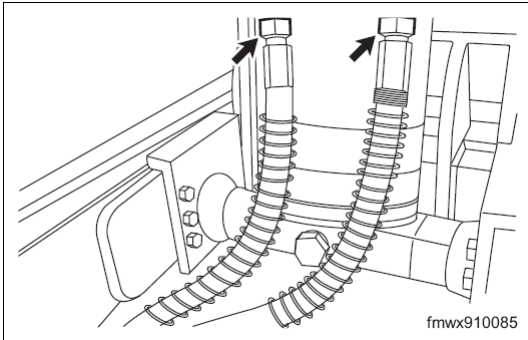
Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

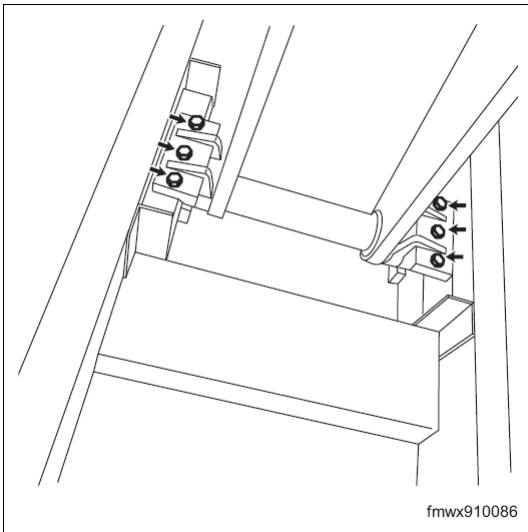
Hang the reinforcing bar of the triangular arm with the sling, and raise the derrick truck to fasten the sling.

91

3. Dismantle the oil pipe

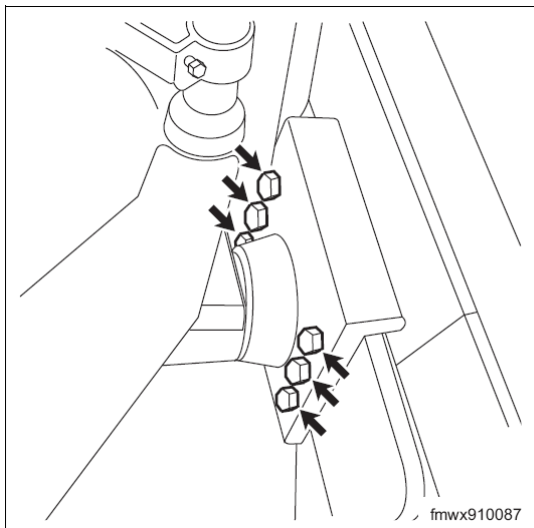


4. Dismantle the connecting bolts between the triangular arm and the trunk



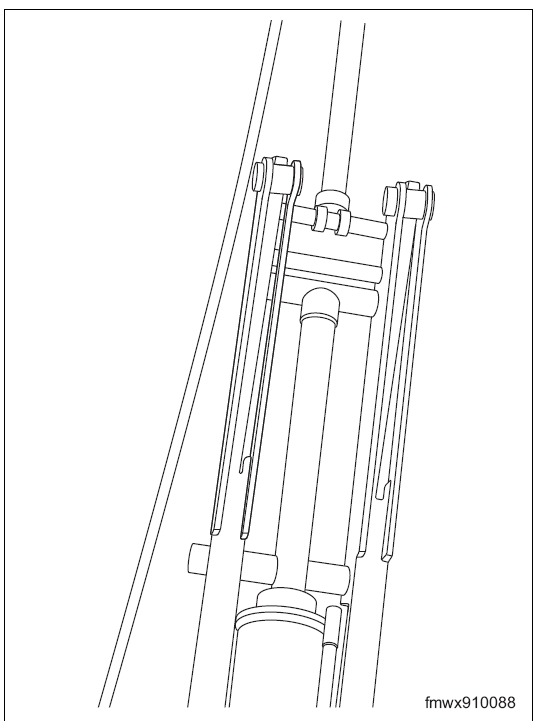
5. Dismantle the pin roll on the big pulling arm

Hydraulic Dump System - Hydraulic Cylinder (Mid-push T-Type Dump Truck)



6. Dismantle the fixing bolts of the hydraulic cylinder supporting seat

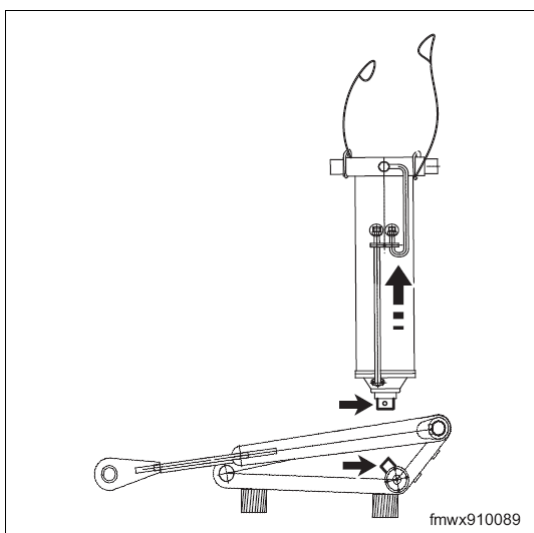
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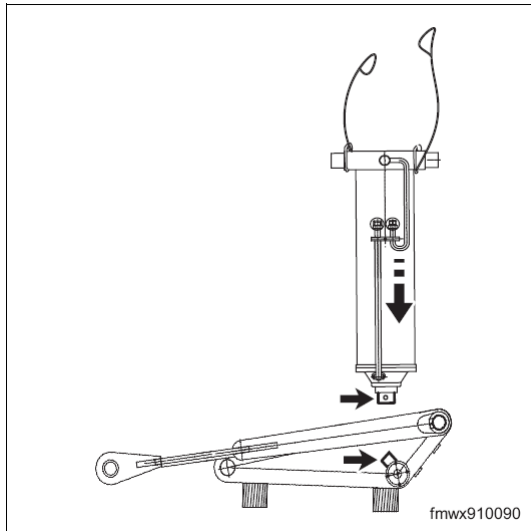
7. Lift the triangular arm, and lower the triangular arm slowly

Warning:

Make sure no one is under the trunk. The handling speed cannot be too fast to avoid swinging of the trunk; otherwise, it may endanger the safety of life or damage parts and components.



8. Disassemble the tilting mechanism and the hydraulic cylinder
- (a). Dismantle pin hole of the tilting mechanism and the head shaft of the hydraulic cylinder which are connected with pin rolls.
 - (b). Lift out the hydraulic cylinder with the sling



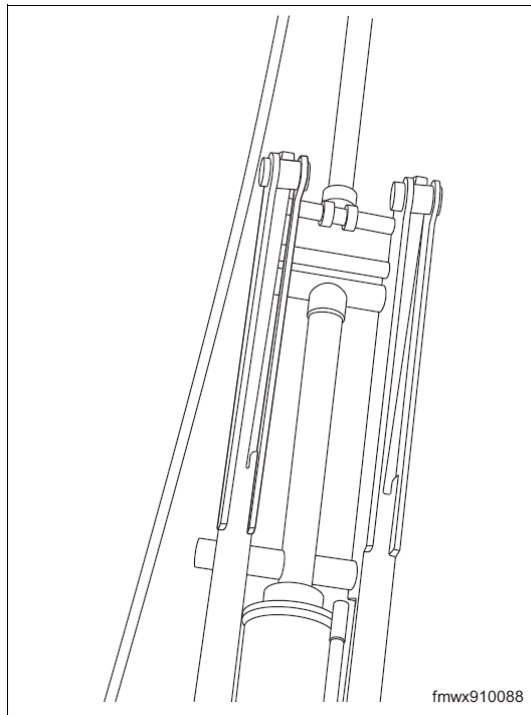
9. Assemble the tilting mechanism and the hydraulic cylinder

- (a). Place two 100x100mm sleepers on the ground horizontally in parallel with a distance of 750mm between each other.
- (b). Tie up the reinforcing bars of the tilting mechanism with the sling, and move the tilting mechanism onto the sleepers by suspension.

Caution:

The handling speed cannot be too fast to avoid swinging of the workpieces.

- (c). Lift the hydraulic cylinder into a vertical shape and move to the lifting mechanism.
- (d). Adjust the position so that the pin holes of the tilting mechanism and the connecting holes of the head shaft of the hydraulic cylinder are aligned. Connect them with the pin rolls, place a flat washer, make the tilting mechanism pass through the split pin, and open the split pin with a pair of sharp-nose pliers to form an angle of 60-90°.



10. Hoist the tilting mechanism and the hydraulic cylinder component

- (a). Hang the reinforcing bar of the triangular arm with the sling.
- (b). Move the triangular arm vertically to the corresponding position on the subframe.

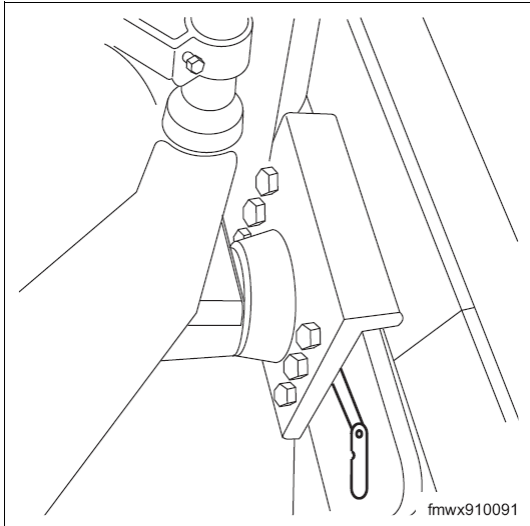
Hint:

The piston rod of the oil cylinder will protrude about 500 mm after lifted.

Caution:

The handling speed cannot be too fast to avoid swinging of the workpieces.

- (c). Apply proper amount of No. 2 lithium base grease on the circumference of the oil cylinder shaft and in the hydraulic cylinder supporting seat.
- (d). Sheathe the hydraulic cylinder supporting seat at the exterior part of the two rotating shafts, and preinstall them.

Hydraulic Dump System - Hydraulic Cylinder (Mid-push T-Type Dump Truck)

- (e). Move the derrick truck to connect the hydraulic cylinder supporting seat and the channel beams at both sides of the subframe.

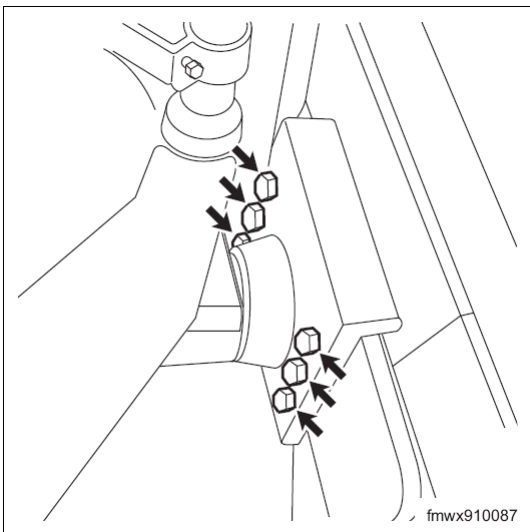
Caution:

The clearance between the supporting seat and the subframe shall not exceed 1mm.

Warning:

DO NOT place your hand in the vicinity of the hydraulic cylinder supporting seat when assembling the hydraulic cylinder supporting seat and the subframe, so as to avoid injuring your hand.

91

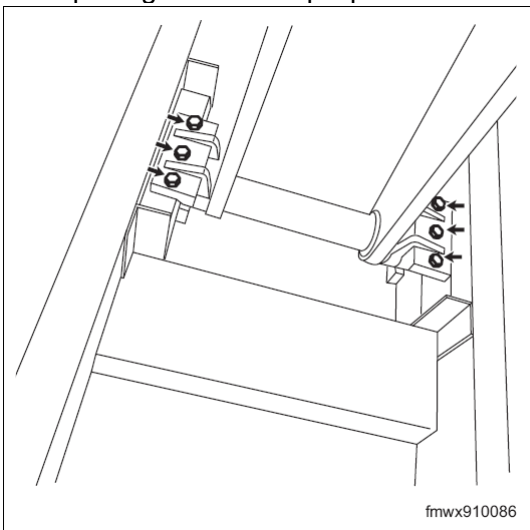
**11. Install the fixing bolts of the hydraulic cylinder supporting seat**

- (a). Apply 1262 thread adhesive at the junction of the thread.
- (b). Make the bolt pass through the subframe, together with the spring washer and the nut, and tighten them up in the diagonal sequence.
Torque: **287-336 N.m**

12. Insert the pin roll from the outside of the big pulling arm into the inside, together with the split pin of the washer.**Caution:**

Apply a little amount of lubricant before installing the pin roll.

The openings of all the split pins must face the end of the subframe with the cleavage angle of 60-90°.

**13. Connect the triangular arm and the trunk**

- (a). Operate the derrick truck to adjust the triangular arm to the appropriate height.
- (b). Install the two lifting shaft seats separately at the suspension ends of the triangular arm, align the installation positions of the trunk and the triangular arm. Attach the two surfaces of the lifting shaft seats to the vertical beam of the trunk, and make the three installation holes of the lifting shaft seats and the three installation holes of the bracket assembly on the trunk base plate correspondingly eccentric.
- (c). Make the connecting bolts pass through the slotted holes in the exterior side in the downward direction, and then pass through the (trunk) bracket assembly and the lifting shaft seats, together with the spring washer, and tighten with nuts.

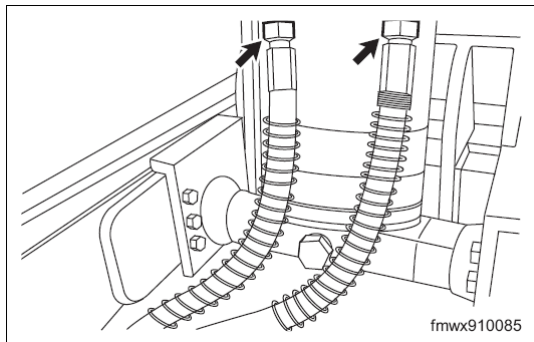
Torque: **300-750 N.m**

Caution:

Apply 1262 thread adhesive at the junction of the thread. Do not tighten the bolts at one time, and try to fasten them at 2 or 3 times.

14. Connect the oil pipes

Torque: 140 N.m



15. Inject grease at the alemite fittings until the grease spills over.

16. Lower the trunk



Manual Flexible Shaft (Mid-push T-type dump truck)

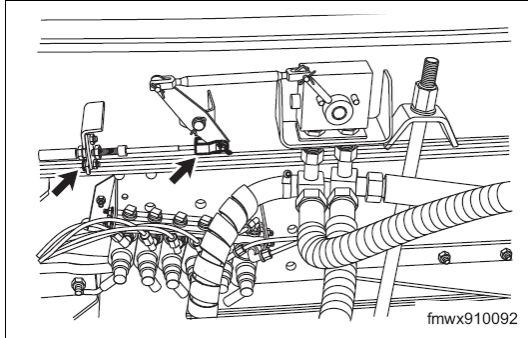
Overhaul

1. Lift the trunk, raise the anti-drop frame, and properly support it
2. Lift the cab

Warning:

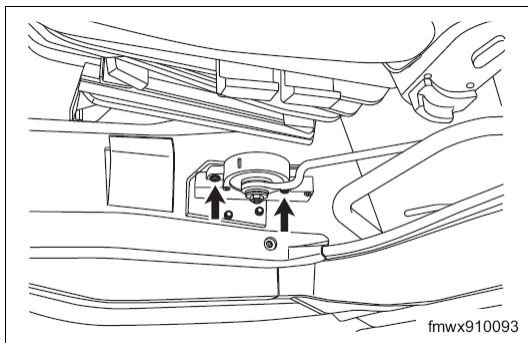
Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed

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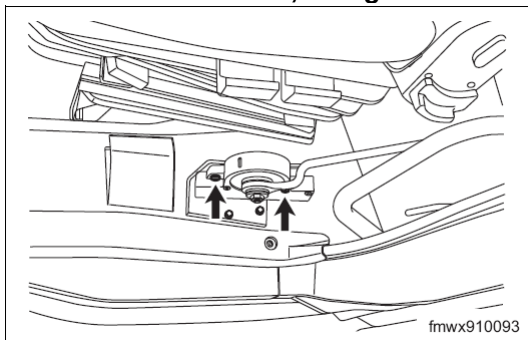
3. Dismantle the connection at the front end of the flexible shaft
 - (a). Disconnect the cable connection of the flexible shaft from the rotary valve operating handle.
 - (b). Dismantle the fixing plate at the front end of the flexible shaft from the flexible shaft bracket.

4. Shear the fixing strip of the flexible shaft cable

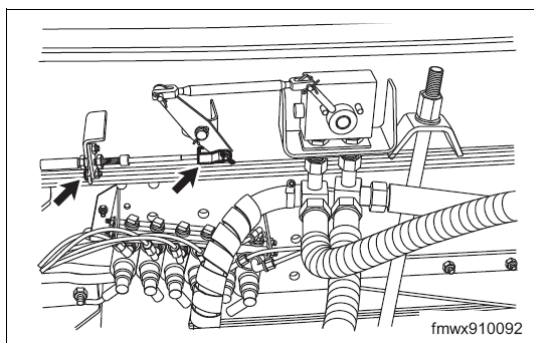


5. Dismantle the handle of the manual flexible shaft.

6. Withdraw the flexible shaft from the truck.
7. Make one end of the flexible shaft pass through the cab from the side, and pass by the front of the cab, and goes to the rotary valve along the frame.



8. Install the manual flexible shaft handle



9. Install cable of the flexible shaft

- (a). Fix the fixing plate on the front end of the flexible shaft onto the flexible shaft bracket.
- (b). Fix the rotary valve operating handle at the front end, connect the flexible shaft and the bottom end of tie rod with a pin roll, together with the flat washer, and fix with a split pin fix with a cleavage angle of 60-90°.

10. Tie up the cable, and use a anti-attrition sleeve a the position where the cable contacts the frame to avoid cable attrition
11. Lower the cab.
12. Lower the trunk

Rotary Valve (Mid-push T-type Dump Truck) Overhaul

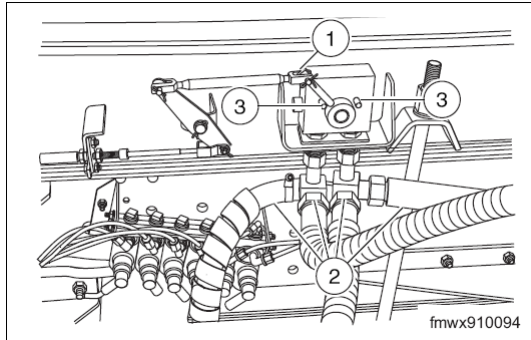
1. Lift the trunk, raise the anti-drop frame, and properly support it

Hint:

If the trunk cannot be lifted due to failure, place the riser handle at the "Lowering" position, and hoist the shelter with a derrick truck, and then properly support the shelter with a support pole.

Warning:

Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed.



2. Dismantle the rotary valve

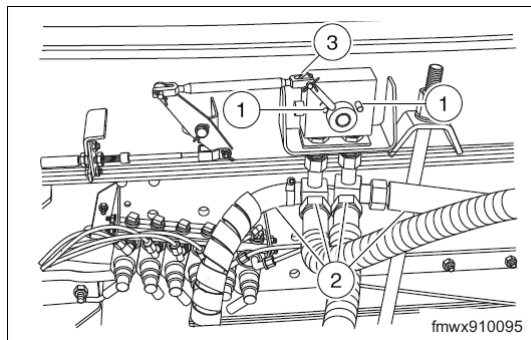
Caution:

After the joint is dismantled, a blocking piece should be used to block up the port in a timely manner to avoid contamination.

- Disconnect the cable connection of the rotary shaft from the control tie rod of the rotary valve.
- Disconnect the inlet and outlet pipes.
- Dismantle the rotary valve the fixing bolts.

Caution:

Check whether the rotary valve is intact, and replace with a new one if it is damaged.



3. Install the rotary valve

- Install the rotary valve the fixing bolts.
- Connect the inlet and outlet pipes.
- Connect the control tie rod of the rotary valve and the rotary valve rod with a pin roll, together with the flat washer, and fix with a split pin, with a cleavage angle of 60-90°.

Caution:

The link gear must work smoothly after installation.

- Check the hydraulic oil, and charge if it is insufficient, and discharge the air, refer to Chapter 91, Hydraulic Dump System - Hydraulic Oil, Emptying and Injection
- Lower the trunk

Trunk (Mid-push T-type Dump Truck)

Dismantlement and Installation

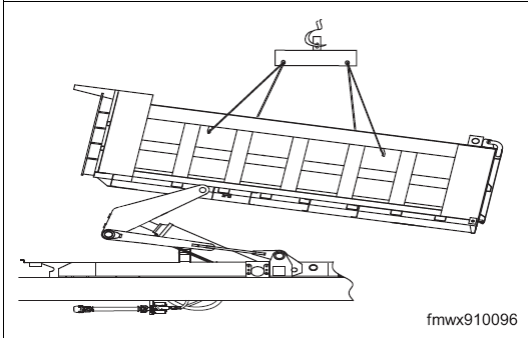
1. Lift the trunk, raise the anti-drop frame, and properly support it

Warning:

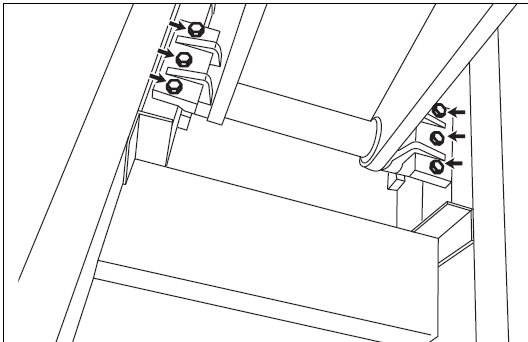
Ensure that the trunk is properly supported and fixed. It is life threatening to work under a trunk which is not properly supported and fixed.

2. Lift the cab.

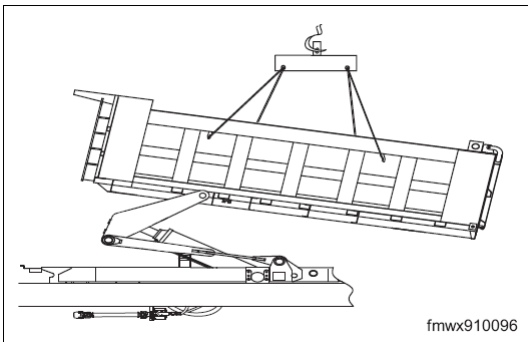
3. Install the sling on the trunk hook, and clamp the sling on the hook of the derrick truck. Raise the derrick truck to fasten the sling



4. Dismantle the connecting bolts between the triangular arm and the trunk

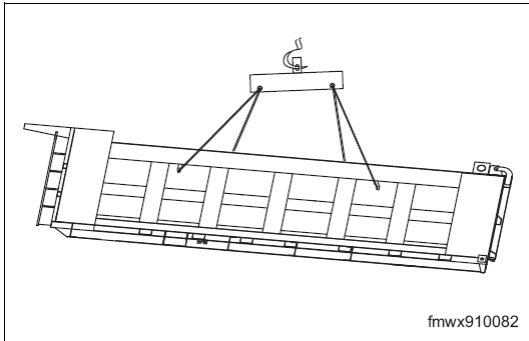


5. Disconnect connection between the trunk and the Dump Component, refer to Chapter 91, Hydraulic Dump System- Dump Component, Overhaul



6. Lift the trunk and lower it slowly and smoothly
Warning:
Make sure no one is under the trunk. The handling speed cannot be too fast to avoid swinging of the trunk; otherwise, it may endanger the safety of life or damage parts and components.

Hydraulic Dump System - Trunk (Mid-push T-type Dump Truck)



7. Hoist the trunk

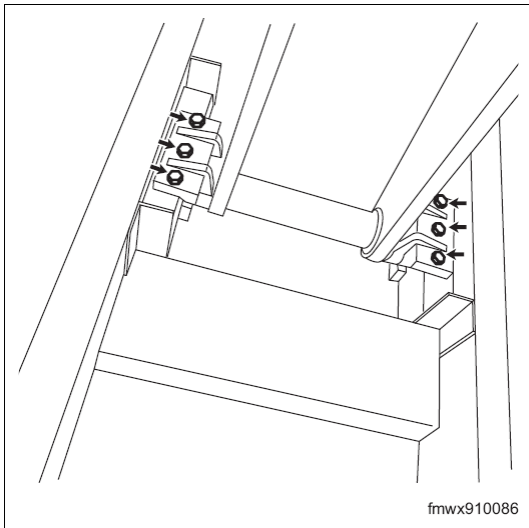
- Install the sling, and clamp the sling on the hook of the derrick truck.
- Handle the trunk.

Caution:

The handling speed cannot be too fast to avoid swinging of the trunk. The distance between the trunk and the ground shouldn't be too long. Raise the derrick truck when reaching the subframe, and suspend a little when the height of the trunk bottom is higher than that of the maximum point of the triangular arm of the subframe, until the trunk is lifted onto the subframe.

Caution:

Lift the trunk with a 10 degree angle and with the anterior part higher than the posterior part.



8. Connect the triangular arm and the trunk

- Install the two lifting shaft seats separately at the suspension ends of the triangular arm, and align the installation positions of the trunk and the triangular arm. Attach the two surfaces of the lifting shaft seats to the vertical beam of the trunk, and make the three installation holes of the lifting shaft seats and the three installation holes of the bracket assembly on the trunk base plate correspondingly eccentric.
- Make the connecting bolts pass through the slotted holes in the exterior side in the downward direction, and then pass through the (trunk) bracket assembly and the lifting shaft seats, together with the spring washer, and tighten with nuts.

Torque: 300-750 N.m

Caution:

Apply 1262 thread adhesive at the junction of the thread. Do not tighten the bolts at one time, and try to fasten them at 2 or 3 times.

9. Adjust the location of the trunk until it meets the requirements

- Withdraw the anti-drop frame, adjust the derrick truck to lower the trunk slowly, and the contact the subframe smoothly.
- Measure the rear suspension of the trunk, and adjust the position of the trunk until it is 500mm higher than the subframe.

Caution:

Nobody should be allowed to have access to the part of 1m around the trunk, except the operators and other auxiliary persons, in the process of adjustment.

Caution:

The vertical beam of the trunk base plate must contact the subframe, and the deviation between the transverse center of symmetry and the center of symmetry of the subframe shall not exceed 2mm after they contact each other, and both the anterior and posterior parts of the trunk must meet the requirements.

The misalignment of the vertical central line of the trunk and the vertical center of the chassis shall not exceed 8mm.

The left and the right symmetrical parts at the outer edge of the body shall not exceed 20mm.

10. Connect or weld the connection between the trunk and the Dump Component, refer to Chapter 91, Hydraulic Dump System - Dump Component, Overhaul

11. Lower the cab

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