

JAC

SHOP MANUAL

4DA1 SERIES

Mainly for the truck HFC1042K2(D800)



JAC INTERNATIONAL

2007.10

JAC motors

4DA1 SERIES

SHOP MANUAL

Foreword

This shop manual was prepared as reference to properly carry out servicing and maintenance on JAC vehicles.

All the maintenance data in this manual is based on the model HFC1042K2 (D800/D801). And it also can be as reference for the other models listed in the Chapter "General". Their main common configurations are as follows: HFC4DA1(HFC4DA1-1) engine; JAC MSB-5M transmission, hydraulic brake and JAC new model cabin.

All information in this manual is the latest data and status of the vehicle at the time of publishing for your reference. However, due to technological advance or product updating etc., all contents in this manual are subject to modification. We reserve the right of modification of this manual without prior notice.

Please inform Customer Service Department of JAC International if there is any mistake, and you will be highly appreciated.

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General

General

Specifications

Vehicle Model

VIN

The mechanic performance table of bolts in China

Main specifications of the trucks equipped with 4DA1-1 engine

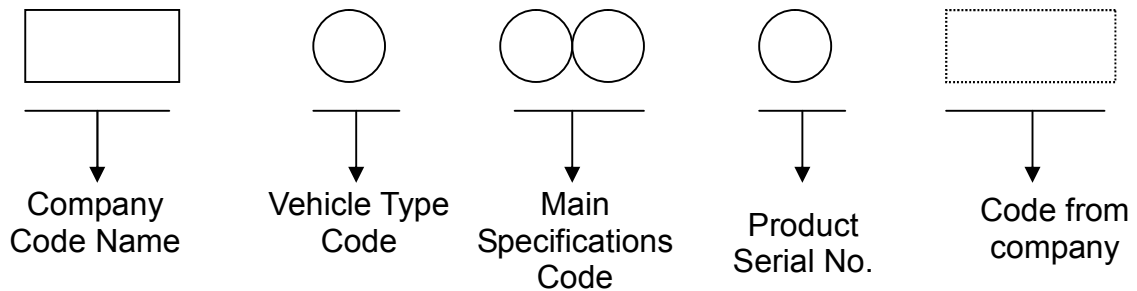
The common configurations: HFC4DA1-1 engine, displacement: 2771cc; Max Power (HP/rpm): 92/3600; Max Torque (N.m/rpm) : 202/2100-2300; JAC MSB-5M transmission, hydraulic brake, JAC new model cabin, no power assist of clutch.

Model 型号	Serious Number produce 结构区别号	Cabin 驾驶室	Final gear ratio 后桥速比	Tyre 轮胎	Overall Size (mm) (L*W*H) 整 车尺寸	Wheelbase (mm) 轴距	Gross Vehicle Weight (kg) 最大质量	Max Speed (km/h) 最大时速	Seating Capacity 额定成员数	Air Conditioner 空调	Power Steering 动转	Pre-heater 预热	Exhaust Braking 排气制动
HFC1035KD	D817	Single	5.375	7.00R16 Rear single	4850*1730*2240	2490	3900	110	2	○	○	×	√
HFC1042K2RD	D819	Double	5.375	7.00R16 Rear single	4875*1715*2215	2490	3900	110	2+3	○	○	0	○
HFC1040K/KR1	D830/D831	Single/King Cab	D803-6.142	6.50-16	5745*1866*2213	3000	4930	90	2	○	○	√	√
HFC1045K2/R1	B802/803	Single/King Cab	B1DAB0-5.571	6.50R16/6.50-16	5980*1998*2220	3308	5735	95	3	○	○	√	√
HFC1045K2	B832	Single/King Cab	B1DAB0-5.571	6.50R16/6.50-16	5980*1998*2220	3308	5735	95	3	○	√	√	○
HFC1040K2	D800/D801	Single/King Cab	D800-6.142	7.00R16	5995*1900*2250	3360	5740	100	2	○	○	√	√
HFC1042KR	D802	double	D800-6.142	7.00R16	5995*1900*2250	3360	4490	100	2+3	○	○	√	√
HFC1035KD	D874	Single	5.375	7.00R16 Rear single	4850*1730*2240	2490	3900	110	2	○	√	√	√

Remark: √:Standard Equipment ○:Optional ●:Under develop ×:Not Available

General

Vehicle Model



Company Code Name: HFC-----represents JAC motor

Vehicle Type Code: 1---Cargo truck 2---Off-road vehicle 3---Dumper
4---Tractor 5---Special purpose vehicle 6---Passenger car
7---Sedan 9---Semitrailer

Main Specifications Code: 25---represents the maximum gross weight is 25 tons.

Product serial No.: 1---Product development serial No. (1st change, 2nd development)

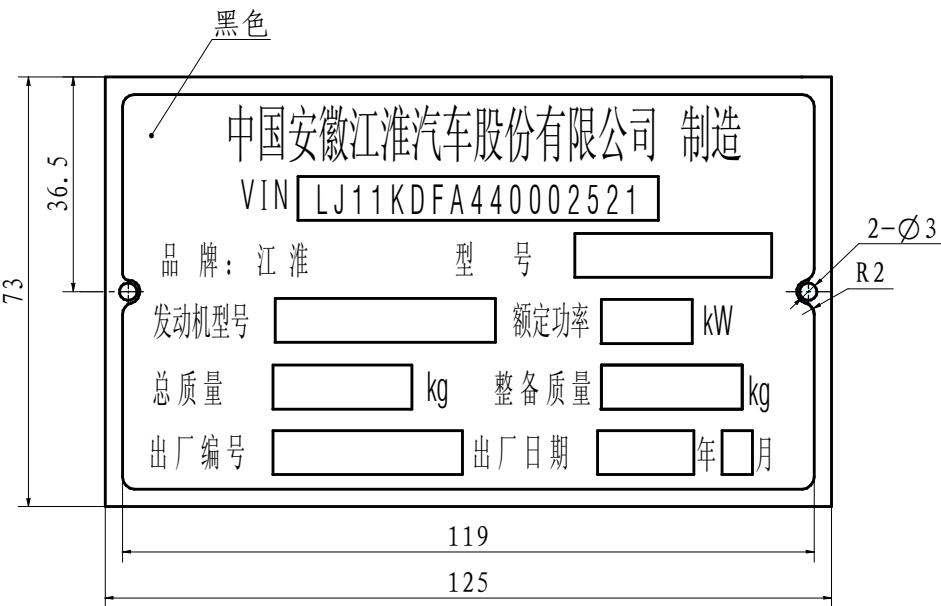
Code from company: K---Diesel R1---King cabin

For example: HFC3251KR1 represents JAC vehicle with king cab, 25 tons maximum gross weight, the first change.

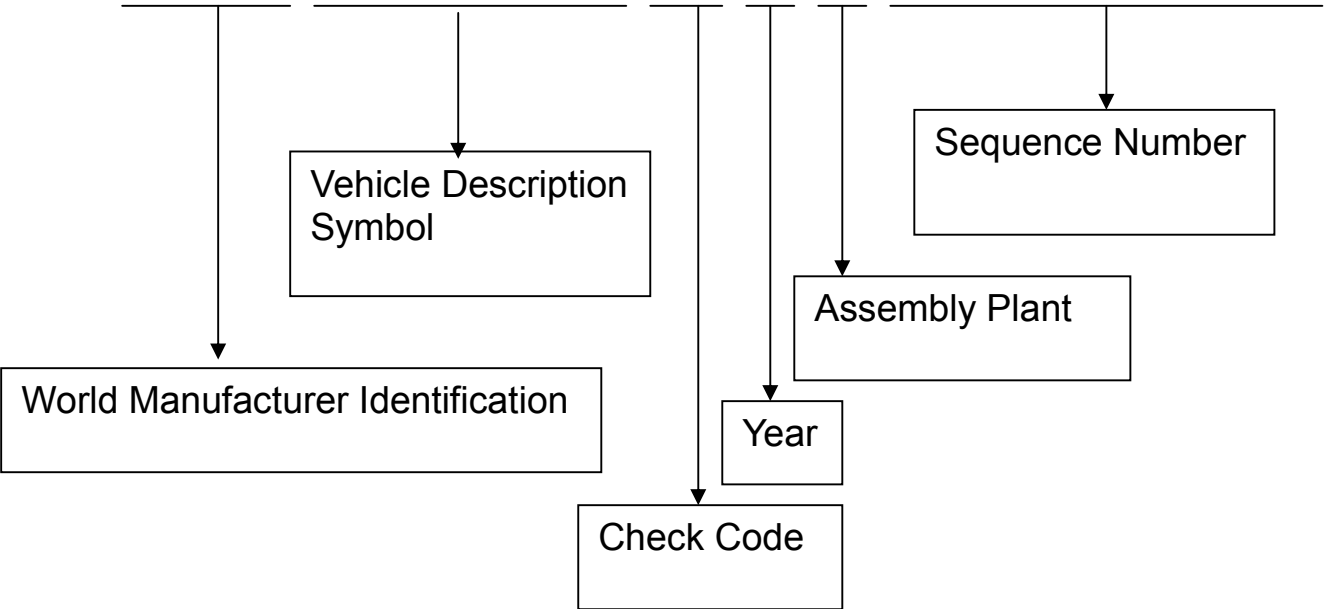
General

VIN----Vehicle Identification Number

VIN comprises of 17 digits. They separately represent:



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
L	J	1	1	K	D	B	C	X	8	X	X	X	X	X	X	X



General

The mechanic performance table of bolts in China

Quality Grade(mark)	6.8	8.8	9.8	10.9	12.9
Tensile strength limit σ_b max(MPa)	600	800	900	1040	1220
Yield limit σ_s max(MPa)	480	640	720	940	1100
Corresponding to Hyundai standards	4T	6T	7T	8T	10T

The number before the radix point represents one percent of the nominal tensile strength;

The number after the radix point represents ten times of the ratio of the nominal yield limit and nominal tensile strength.

Section I

Engine

HFC4DA1(4DA1-1)



Introduction

We prepare this manual to help technicians get to know and understand 4DA1 Series engine so that they are able to master quick maintenance and service.

The manual gives you instructions on assembly and disassembly of parts and systems of 4DA1 Series engine, general maintenance standards, special tools as well as common fault diagnosis and troubleshooting.

Our products are subject to continuous innovation. If any information in this manual is not applicable for the innovative products, the discrepancies will be modified in a second edition.

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1. Maintenance

1.1 Diagnosis and troubleshooting

1.1.1 Start problems

1. The starter motor fails to work.		
Check	Causes	Remedies
Battery	The battery terminal post is loose. There is bad connection caused by oxidation or corrosion.	Clean and/or tighten the loose terminal post(s)
	The battery is uncharged or in shortage of charge.	Charge the battery or replace the old battery with a new one
	The belt of fan is loose or broken.	Adjust the belt of fan, or replace it
Fuse	The fuse is short circuited.	Replace the fuse with a new one
Starter switch	The starter switch or relay has failed.	Replace the starter switch or relay
Starter motor	The solenoid switch has failed.	Repair or replace the solenoid switch
	The starter motor has failed.	Repair or replace the starter motor
2. The starter motor works well, but the engine fails to run.		
Battery	The battery terminal post is loose. There is bad connection caused by oxidation or corrosion.	Clean and/or tighten the loose battery terminal post(s)
	The battery is uncharged or in shortage of charge.	Charge the battery or replace the old battery with a new one
	The belt of fan is loose or broken.	Adjust the belt of fan, or replace it
Starter motor	The pinion is broken.	Replace the broken pinion
	The solenoid switch has failed.	Repair or replace the solenoid switch
	The brush is worn or the brush spring is too soft.	Replace the brush and/or the brush spring
Engine	The piston or crankshaft bearing is jammed or damaged.	Repair or replace the damaged part(s)

3. The engine rotates but it cannot be ignited to start.		
Check	Causes	Remedies
Brake mechanism of engine	The fuel cut-off solenoid valve is broken.	Replace the fuel cut-off solenoid
The fuel fails to flow into the injection pump.		
Fuel	The fuel tank is empty.	Fill in the fuel tank
Fuel pipe system	The fuel pipe is clogged or broken. The fuel tube joint is loose.	Repair or replace the fuel pipe Retighten the fuel tube joint
Fuel filter	The fuel filter overflow valve cannot be closed.	Repair or replace the fuel filter overflow valve

✖		A fuel filter component is clogged.	Replace the fuel filter component or the filter element
	Fuel system	There is air in the fuel system.	Release the air from the fuel system
	Fuel feed pump	The fuel feed pump is broken.	Repair or replace the fuel feed pump
	The fuel flows into the injection pump.		
	Fuel	The fuel in service is incorrect.	Use the correct fuel
		There is water in the fuel system.	Replace the fuel
	Fuel system	There is air in the injection pump.	Release the air from the fuel system
	Fuel injector	The fuel injector is jammed.	Replace the fuel injector
		The opening pressure of fuel injector is too low.	Adjust or replace the fuel injector
		Atomizing is bad.	
	Injection pump	The damage of fuel injector results in fuel dripping after injection.	Replace the delivery valve
		Something is wrong with the control rack of injection pump.	Repair or replace the control rack of injection pump
		The injection pump plunger is worn or jammed.	Repair or replace the injection pump plunger assembly
		The drive shaft of injection pump is jammed or damaged.	Replace the drive shaft
		The governor spring of injection pump is jammed.	Replace the governor spring of injection pump

4. Quick start system

Preparation work

1. Disconnect the connector of temperature switch
2. Verify whether the glow plug is power on
 - a) Confirm the start switch is at OFF position
 - b) Use voltmeter to connect cylinder wall with any glow plug
 - c) Switch the start switch to the ON position

If the glow plug is power on, the voltmeter indicates 12 V. If the pointer of voltmeter doesn't move, it means the glow plug is power off.

3. Trouble shooting

The glow plug is power on.

Check	Causes	Remedies
The indicator lamp of glow plug is off.	The indicator lamp is broken.	Replace the indicator lamp
Quick start timer	The quick start timer is broken.	Replace the quick start timer
The indicator lamp of glow plug is on for 0.3 s.	The quick start timer is broken.	Replace the quick start timer

✖	The indicator lamp of glow plug is on for 3.5 s.	After the engine is started, switch the start switch from ST (start) to ON. If the relay of glow plug keeps closed for less than 14 s, it indicates something is wrong with the quick start timer.	Replace the quick start timer
		Switch the start switch from OFF to ON. If the relay of glow plug keeps closed for less than 14 s, it indicates something is wrong with the quick start timer.	Replace the quick start timer
	Temperature switch	The temperature switch is broken.	Replace the temperature switch
	Connectivity of glow plug	The connectivity of glow plug is bad.	Replace the glow plug
The glow plug is power off.			
	The indicator lamp of glow plug is off.	The fuse of indicator lamp blows out.	Replace the broken fuse
	Quick start timer	The quick start timer is broken.	Replace the quick start timer
	The indicator lamp of glow plug is on for 3.5 s.	The glow plug relay is broken. When the start switch is switched from OFF to ON, the glow plug relay is not switched on.	Replace the glow plug relay
		The quick start timer is broken.	Replace the quick start timer
		A line fault occurs in the circuit of glow plug relay.	Repair or replace corresponding line(s)
		The fuse blows out or there is a line fault. When the start switch is switched from OFF to ON, the glow plug relay is switched on.	Replace the fuse or corresponding line(s)

1.1.2 Unstable idle speed

Check	Causes	Remedies
Idle speed system	The idle speed is not proper.	Adjust the idle speed
High idle speed control device	The high idle speed control device is broken.	Repair or replace the high idle speed control device.
Throttle control system	The adjustment of throttle control system is not proper.	Adjust the throttle control system
Fuel system	Leakage or blockage occurs in the fuel system.	Repair or replace the fuel system
	There is air in the fuel system.	Release the air from the fuel system
	There is water in the fuel system.	Replace the fuel

✖	Fuel filter	A fuel filter component is clogged.	Replace the fuel filter component or the filter element.
	Fuel feed pump	The fuel feed pump is broken.	Repair or replace the fuel feed pump.
	Fuel injector	The fuel injector is jammed.	Replace the fuel injector
		The opening pressure of fuel injector is too low. Atomizing is bad.	Adjust or replace the fuel injector
	Injection pump	The damage of delivery valve results in fuel dripping after injection.	Replace the delivery valve
		Injection timing is not proper.	Adjust injection timing
		The injection volume is too low.	Increase injection volume
		The idle speed spring is broken.	Replace the idle speed spring
		The shifter is broken	Repair or replace the shifter
		The regulator valve is not at proper position.	Adjust or replace the regulator valve
		The plunger spring is broken	Replace the plunger spring
		The plunger is worn.	Replace the plunger assembly
		The cam is worn.	Replace the worn cam
	Valve clearance	The valve clearance is not proper.	Adjust the valve clearance
	Compression pressure	The gasket of cylinder head is worn.	Replace relevant parts
		The cylinder liner is worn. The piston ring is sticky.	

1.1.3 Insufficient power

Check	Causes	Remedies
Air filter	An air filter component is clogged.	Clean or replace the filter component
Fuel	There is water in the fuel.	Replace the fuel
Fuel filter	A fuel filter component is clogged.	Replace the fuel filter component or the filter element
Fuel feed pump	The fuel feed pump is broken.	Repair or replace the fuel feed pump
Fuel injector	The fuel injector is jammed.	Replace the fuel injector
	The opening pressure of fuel injector is too low. Atomizing is bad.	Adjust or replace the fuel injector
High pressure fuel pipe	The high pressure fuel pipe is damaged or blocked.	Replace the high pressure fuel pipe
Injection pump	The regulator valve is damaged.	Repair or replace the regulator valve

		The delivery valve is damaged.	Replace the delivery valve
		The timer is broken.	Repair or replace the timer
		The cam is worn.	Replace the worn cam
		The control lever doesn't work well.	Adjust or replace the control lever
		The injection timing is not correct.	Adjust injection timing Repair or replace the injection pump timer
		The governing spring is too soft.	Replace the governing spring
		The plunger is worn.	Replace the plunger assembly
	Compression pressure	The gasket of cylinder head is worn. The cylinder liner is worn. The piston ring is sticky.	Replace relevant parts
	Valve clearance	The valve clearance is not proper.	Adjust the valve clearance
	Valve spring	The valve spring is too soft or broken.	Replace the valve spring
	Exhaust system	The exhaust pipe is clogged.	Clean the exhaust pipe
	Seal of full-load adjusting screw	The seal of adjusting screw is opened or improperly adjusted.	Properly adjust the seal of adjusting screw and seal again

1.1.4 High fuel consumption

Check	Causes	Remedies
Fuel system	There is a fuel leak.	Repair or replace corresponding parts of fuel system
Air filter	An air filter component is clogged.	Clean or replace the air filter component
Idle speed	The idle speed is not adjusted properly.	Adjust the idle speed
Fuel injector	The opening pressure of fuel injector is too low. Atomizing is bad.	Adjust or replace the fuel injector
Fuel injection timing	Fuel injection timing is not correct.	Adjust the fuel injection timing
Injection pump	The damage of delivery valve results in fuel dripping after injection.	Replace the delivery valve
Valve clearance	The valve clearance is not proper.	Adjust the valve clearance
Compression pressure	The gasket of cylinder head is worn. The cylinder liner is worn. The piston ring is sticky.	Replace relevant parts
Valve spring	The valve spring is too soft or broken.	Replace the valve spring

✖ 1.1.5 High oil consumption

Check	Causes	Remedies
Engine oil	The oil type is not correct.	Replace the engine oil
	The oil volume is too high.	Adjust the oil level
Oil seal and gasket	The oil leaks from the oil seal and/or gasket.	Replace the oil seal and/or gasket
Air vent	The air vent is blocked.	Clean the air vent
Intake valve and exhaust valve	The valve stem and valve guide are worn.	Replace intake valve, exhaust valve and valve guide

1.1.6 Engine overheating

Check	Causes	Remedies
Cooling water	The cooling water is insufficient.	Supply enough cooling water
Fan clutch	The oil leaks from the fan clutch.	Replace the fan clutch
Fan belt	Loose or damaged fan belt results in slipping.	Replace the fan belt
Radiator	The radiator cap is damaged or the radiator core is blocked.	Replace the radiator cap or clean the radiator core
Water pump	The water pump is broken.	Repair or replace the water pump
Cylinder head and cylinder block Sealed cap	Damaged cylinder head results in leakage of cooling water.	Replace the sealed cap
Thermostat	The thermostat is broken.	Replace the thermostat
Cooling system	The cooling system is clogged by foreign matters.	Remove foreign matters from the cooling system
Fuel injection timing	Fuel injection timing is not correct.	Adjust the fuel injection timing

1.1.7 White smoke coming out of engine exhaust

Check	Causes	Remedies
Cooling water	The cooling water is insufficient.	Supply enough cooling water
Fuel	There is water in the fuel system.	Replace the fuel
Fuel injection timing	Fuel injection timing is delayed.	Adjust the fuel injection timing
Compression pressure	The gasket of cylinder head is worn. The cylinder liner is worn. The piston ring is sticky.	Replace relevant parts
Intake valve and exhaust valve Valve oil seal	The valve oil seal is worn. The valve stem and valve guide are worn.	Replace valve oil seal, valve and valve guide

✖ 1.1.8 Black smoke coming out of engine exhaust

Check	Causes	Remedies
Air filter	An air filter component is clogged.	Clean or replace the air filter component
Fuel injector	The opening pressure of fuel injector is too low. Atomizing is bad.	Adjust or replace the fuel injector
Fuel injection timing	Fuel injection timing is not correct.	Adjust the fuel injection timing
Injection pump	The damage of delivery valve results in fuel dripping after injection.	Replace the delivery valve
	The injection volume is too high.	Reduce injection volume

1.1.9 Low oil pressure

Check	Causes	Remedies
Engine oil	The oil viscosity is not correct. The oil volume is too low.	Replace the engine oil Increase the oil volume
Oil pressure gauge or assembly	The oil pressure gauge or assembly is broken.	Repair or replace the oil pressure gauge or assembly
Oil pressure indicator light	The indicator light is broken.	Replace the indicator light
Oil filter	An oil filter component is clogged.	Replace the oil filter component or the filter element
Safety valve and bypass valve	The safety valve is jammed and/or the bypass valve spring is too soft.	Replace the safety valve and/or bypass valve spring
Oil pump	The oil pump strainer is blocked.	Clean the oil pump strainer
	A component in the oil pump is worn.	Replace relevant parts in the oil pump.
Rocker shaft	The rocker shaft bearing is worn.	Replace the rocker shaft bearing
Camshaft	The camshaft and its bearing are worn.	Replace the camshaft and its bearing
Crankshaft and bearing	The crankshaft and its bearing are worn.	Replace the crankshaft and/or its bearing

1.1.10 Abnormal engine noise

1. Engine slap Verify the engine is completely warmed up before troubleshooting.		
Check	Causes	Remedies
Fuel	The fuel is not correct.	Replace the fuel
Fuel injection timing	Fuel injection timing is not proper.	Adjust the fuel injection timing
Fuel injector	The opening pressure of fuel injector or atomizing is not proper.	Adjust or replace the fuel injector

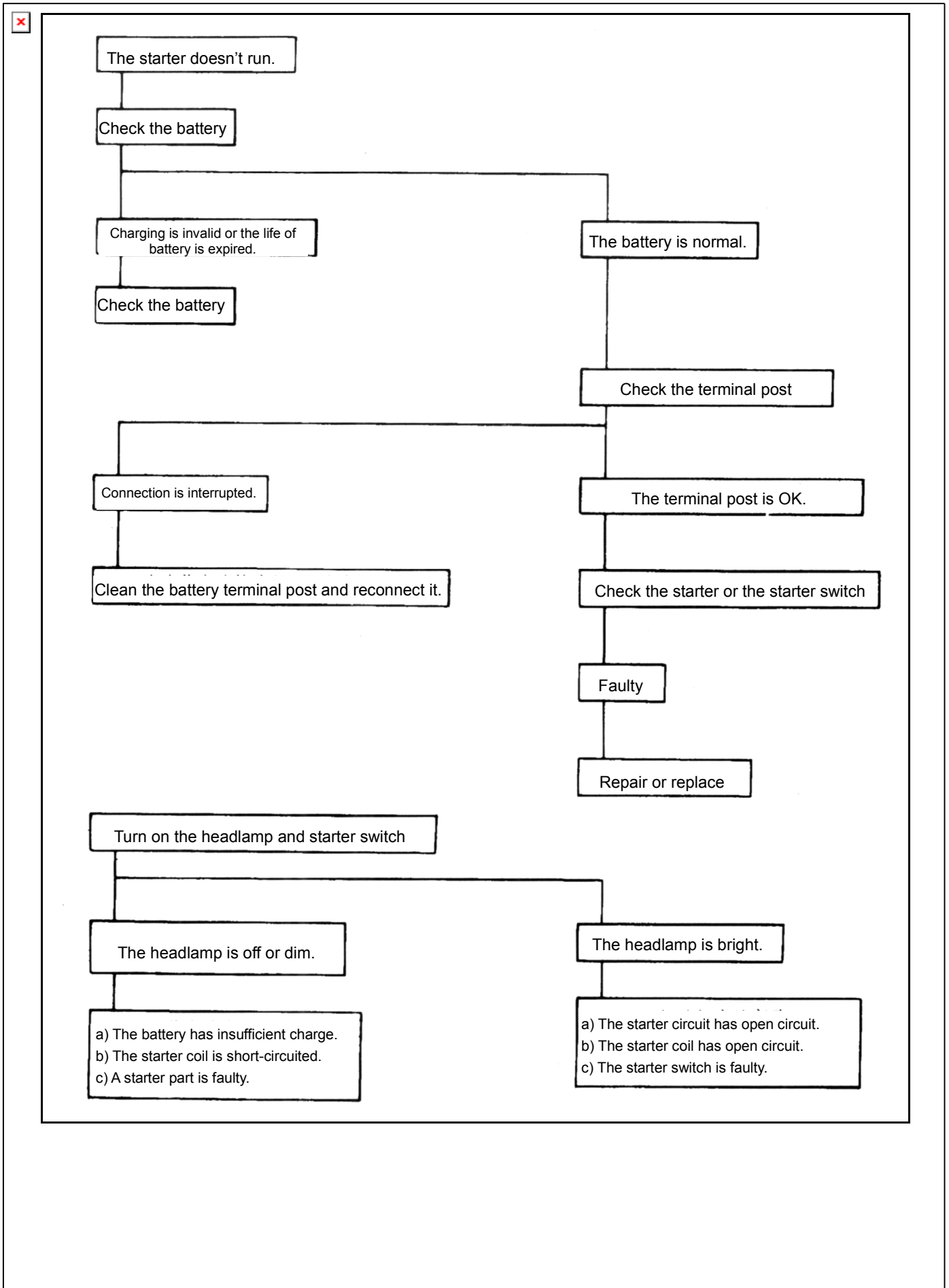
✖	Compression pressure	The gasket of cylinder head is worn. The piston ring is broken.	Replace the gasket of cylinder head or piston ring
	2. Air leak noise		
	Exhaust pipe	The connection of exhaust pipe is loose. The exhaust pipe is broken.	Tighten the connection of exhaust pipe Replace the exhaust pipe
	Fuel injector and/or glow plug	The fuel injector and/or glow plug are loose.	Replace the gasket Tighten the fuel injector and/or glow plug
	Exhaust manifold	The connection to exhaust manifold is loose.	Tighten the connection to exhaust manifold
	Cylinder head gasket	The cylinder head gasket is worn.	Replace the cylinder head gasket
	3. Continuous noise		
	Fan belt	The fan belt is loose.	Adjust the tightness of fan belt again.
	Cooling fan	The cooling fan is loose.	Retighten the cooling fan
	Water pump bearing	The water pump bearing is worn or damaged.	Replace the water pump bearing
	Alternator or vacuum pump	The alternator or vacuum pump is broken.	Repair or replace the alternator or vacuum pump
	Valve clearance	The valve clearance is not proper.	Adjust the valve clearance
	4. Clapping noise		
	Check	Causes	Remedies
	Valve clearance	The valve clearance is not proper.	Adjust the valve clearance
	Rocker arm	The rocker arm is broken.	Replace the rocker arm
	Flywheel	The flywheel bolt is loose.	Retighten the flywheel bolt
	Crankshaft and thrust bearing	The crankshaft and/or thrust bearing is worn or damaged.	Replace the crankshaft and/or thrust bearing
	Crankshaft and connecting rod bearing	The crankshaft and/or connecting rod bearing is worn or damaged.	Replace the crankshaft and/or connecting rod bearing
	Connecting rod bushing and piston pin	The connecting rod bushing and piston pin are worn or damaged.	Replace the connecting rod bushing and/or piston pin
	Piston and cylinder liner	The piston and cylinder liner is worn or damaged.	Replace the piston and cylinder liner

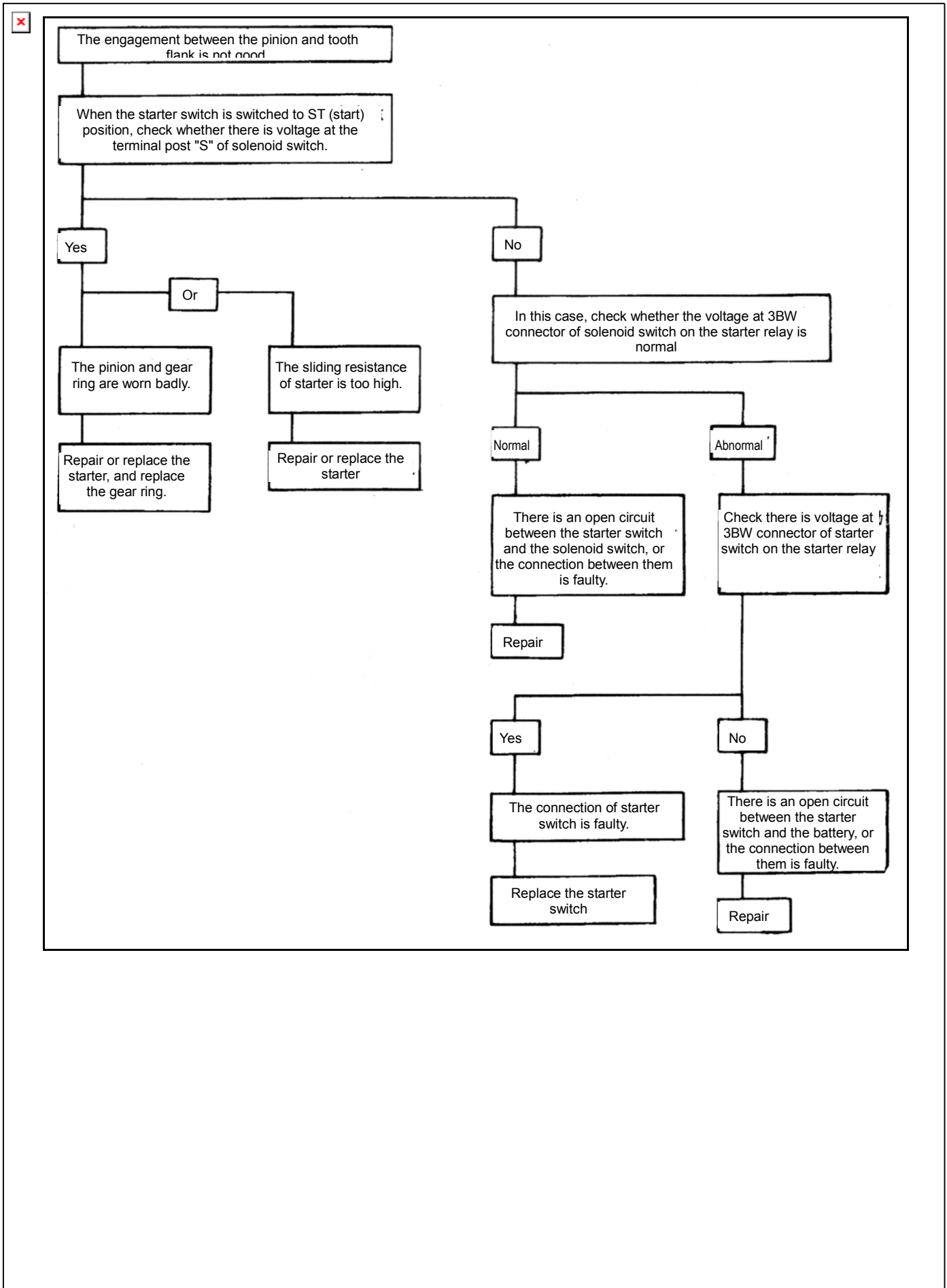
1.1.11 Engine cooling problem

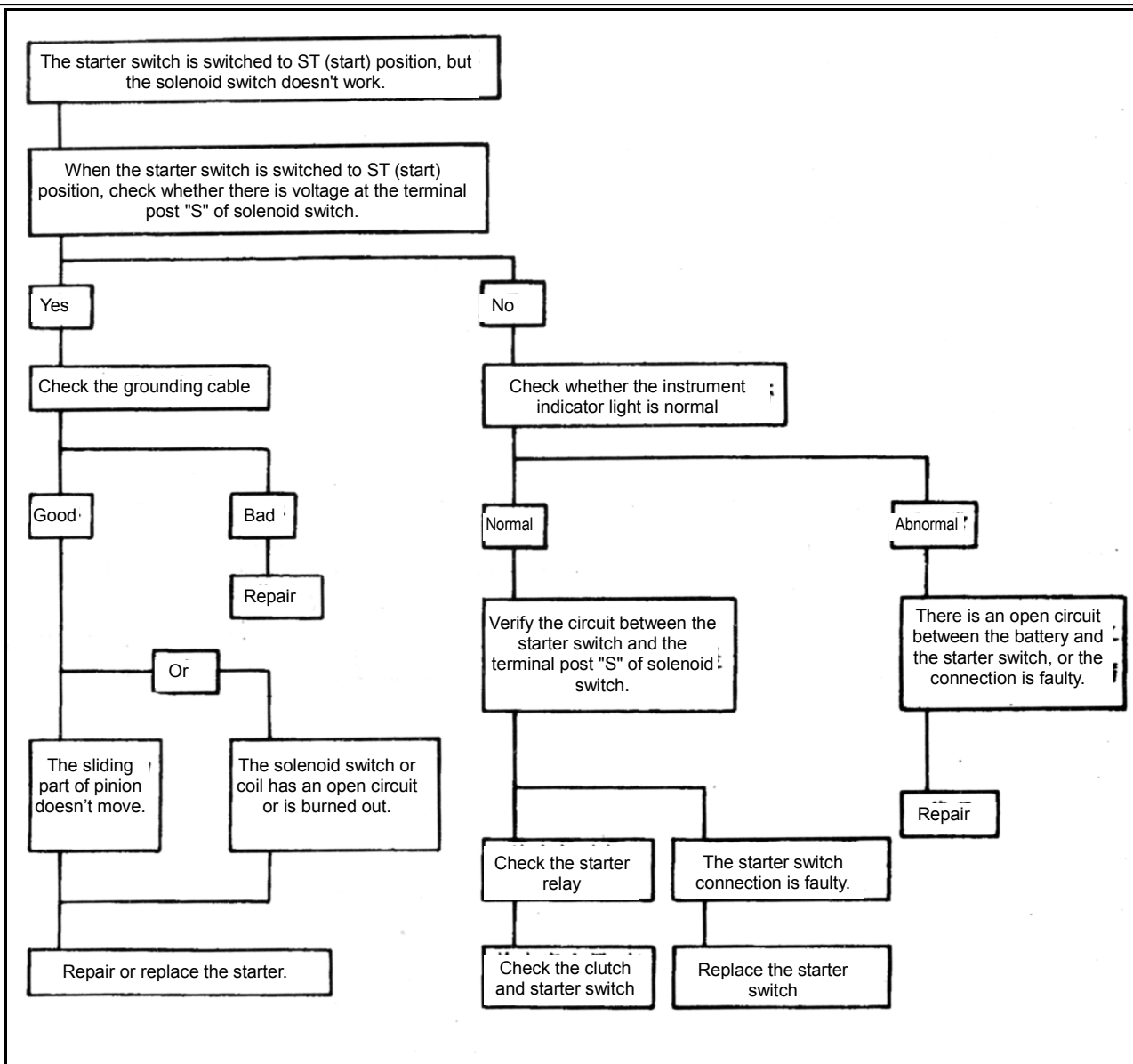
Check	Causes	Remedies
Engine overheating	The coolant level is too low.	Fill in the coolant
	The thermostatic control is broken.	Replace the thermostatic control
	The thermostat is broken.	Replace the thermostat

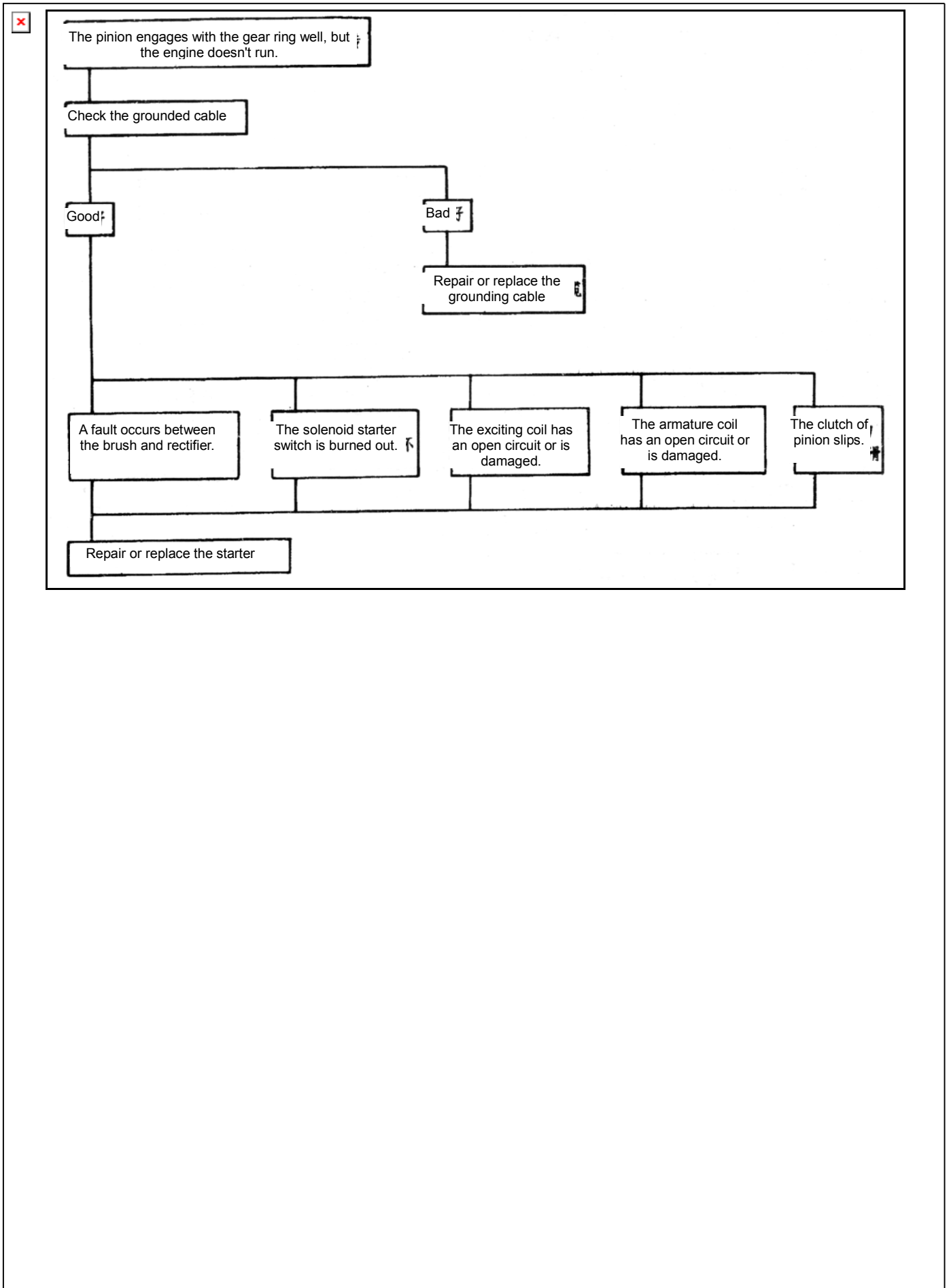
		Something is wrong with the cooling element.	Repair or replace the cooling element
		The radiator is blocked.	Clean or replace the radiator
		The radiator cap is damaged.	Replace the radiator cap
		The oil level is too low or the oil is disqualified.	Fill in or replace the oil
		The cylinder head gasket is worn.	Replace the cylinder head gasket
		The exhaust system is blocked.	Clean the exhaust system or replace the damaged parts
		The fan belt is loose.	Adjust the fan belt
		The fuel injection volume is too high.	Adjust the fuel injection
		The injection timing is not correct.	Adjust the injection timing
	Engine overcooling	The thermostat is broken.	Replace the thermostat
	Long engine preheating time	The thermostat is broken.	Replace the thermostat
		The thermostatic control is broken.	Replace the thermostatic control

Check the battery and make the following diagnoses.











The starter switch is switched from ST to ON, but the starter doesn't stop.

Disconnect the wiring of starter switch and verify the operation of starter switch

Connector No.		B-67				B-68				
Terminal Post No.		1	2	3	4	1	2	4	5	6
Terminal Post No.		ACC	B	ON	ST	B ₁	P ₁	P ₂	W	W
The position of starter switch key	OFF									
	Locked					○	○			
	Accessory	○	○			○	○			
	ON	○	○	○		○	○	○		
	Start		○	○	○	○	○	○		

Besides the wiring mentioned above, other circuits should be opening.

Yes

The solenoid switch contact is melted and hard to move. Otherwise, the return spring is broken or damaged.

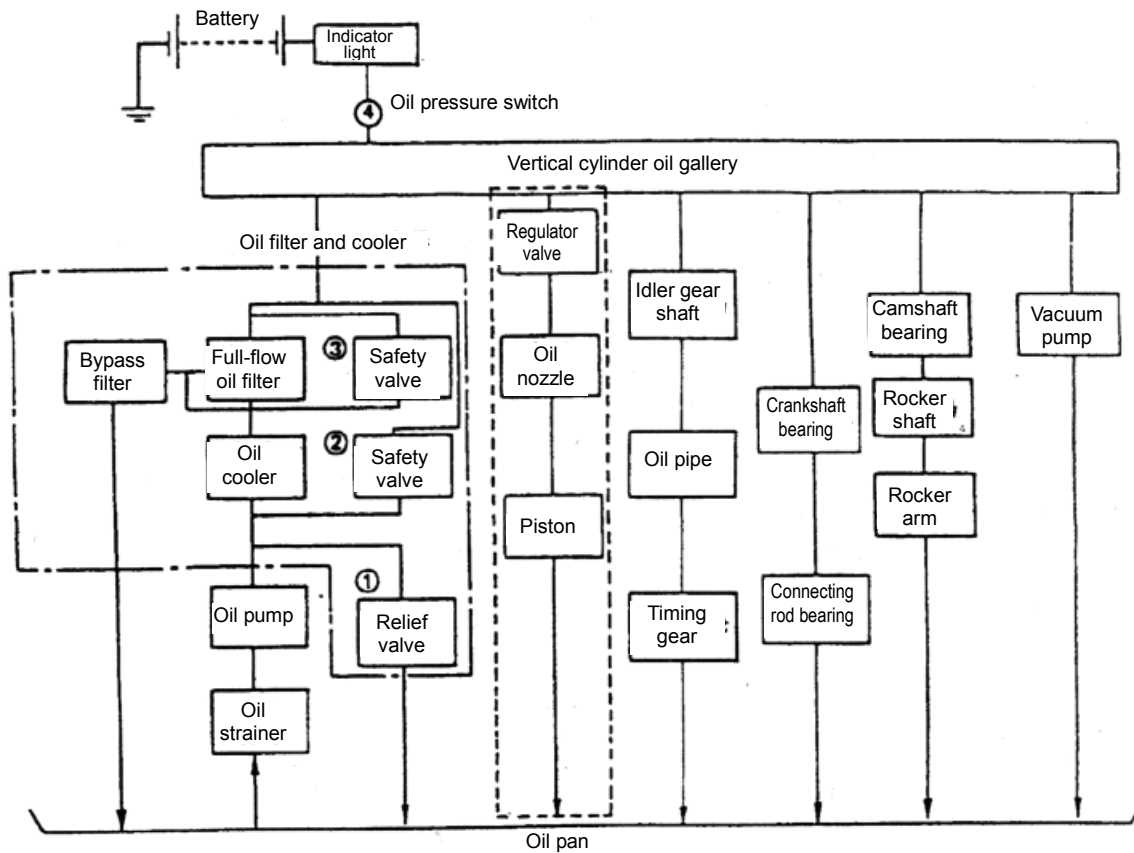
Replace the starter switch

No

Replace the solenoid switch

4DA1 Series oil filter and oil cooler with bypass-type filter

(kPa)



① Opening pressure of relief valve at oil filter: 430-470kPa

② Opening pressure of safety valve at oil filter: 960-100kPa

The lubrication system for 4DA1 Series engine is full-flow type.

The lubricant flows from the oil pump to the vertical cylinder oil gallery through oil cooler and oil filter pump (the replaceable oil filter is equipped on the oil filter). And then, the lubricant is delivered from the vertical cylinder oil gallery to the main parts of engine.

✖ 1.2 Data and specifications

1.2.1 Data and specifications

Item \ Engine model		4DA1		4DA1-1	
Engine type		Natural admission (NA)		Turbocharged Inter-cooling (TCI)	
		Four strokes, high mounted valve, water cooling			
Combustion chamber type		ω type direct injection			
Cylinder liner type		Dry type, thin-wall chrome-plated steel cylinder liner			
Cylinder number - cylinder bore × stroke mm		4—93×102			
Number of piston ring		2 gas rings, 1 oil ring			
Total piston displacement L		2.771			
Compression ratio		18.2		17.5	
Design compression pressure kPa		3040			
Engine weight (net) kg		230		240	
Fuel injection sequence		1—3—4—2			
Fuel injection timing °		16° to the top dead center (before)		12° to the top dead center (before)	
Required fuel type	Ambient temperature	Above 4 ℃	Above -5 ℃	Above -14 ℃	Above -29 ℃
	Light diesel fuel type	0 #	-10 #	-20 #	-35 #
Idle speed r/min		750±50			
Valve clearance (cold)	Intake valve mm	0.30~0.40			
	Exhaust valve mm	0.30~0.40			
Valve clearance (hot)	Intake valve mm	0.30			
	Exhaust valve mm	0.30			
Intake valve	Open (before top dead center) °	24.5			
	Close (after bottom top dead center) °	55.5			
Exhaust valve	Open (before bottom top dead center) °	54			
	Close (after top dead center) °	26			
Lubricant system					
Lubrication method		Pressure feed lubrication and spray lubrication			
Required oil (class AP1)		CF-4 15W-40			
Oil pump type		External gearing			
Oil filter type		Full-flow type, paper element, replaceable			
Oil volume (including oil filter) L		6			
Oil cooler type		Water cooling			

Item	Engine model	4DA1	4DA1-1
Fuel system			
Injection pump type		VE dispensing pump	
Speed governor type		Mechanical, all-speed	
Injector type		Small pressure cell, cellular type	
Injector opening pressure	MPa	19.0-20.0	18.6-19.6
Main fuel filter type		Paper cartridge and water separator	
Air filter type		Dry-type paper filter element	
Alternator output	V-A	14-60	
Starter motor output	V-kW	12-2.8	

1.2.2 Engine cooling

Coolant pump		Centrifugal impeller
Pulley drive ratio		1.12
Thermostat type		Wax-type thermostat, dual valves
Valve opening temperature	°C	82
Valve full opening temperature	°C	95
Coolant total volume	L	10

1.2.3 Starting system

Type		S14-204A
Rating		
Voltage	V	12
Output	kW	2.8
Time	s	30
Number of pinion		9
Rotation direction (view from the pinion end)		Clockwise
Weight (approximate)	kg	5.4
No load characteristics		
Voltage/current	V/A	11/160 or less
Revolution speed	r/min	4100 or above
Load characteristics		
Voltage/current	V/A	11/350 or less
Torque	N • m	8.5
Revolution speed	r/min	1750 or above
Brake characteristics		
Voltage/current	V/A	3/1300 or less
Torque	N • m	31

✖ 1.2.4 Charging system

Type		JFB161
Rated voltage	V	14
Rated output	A	60
Regulation voltage	V	14.4-15
Rated revolution speed	r/min	5000
Rotation direction (view from the pulley end)		Clockwise
Polarity		Negative earth
Operate mode		Continuous rating
Regulator type		IC regulator
Pulley effective diameter	mm	80
Weight (with pump)	kg	6.1

1.3 Maintenance standards

1.3.1 Engine mechanical system

No.	Designation	Standard dimension		Fitting way	Ex-work configuration Clearance (mm)	Wear limit (mm)
		4DA1	4DA1-1			
1.	Contact width of valve and retainer					
	Intake valve	1.7				2.2
	Exhaust valve	2				2.5
2.	Valve sinkage					
	Intake valve	0.65				1.28
	Exhaust valve	0.65				1.20
3.	Valve retainer bore angle	15° , 45° , 75°				
4.	Flank clearance	0.10-0.17				0.30
5.	Axial runout clearance of idler A	0.07				0.20
6.	Tappet outer diameter	$\Phi 13 \begin{smallmatrix} -0.010 \\ -0.028 \end{smallmatrix}$		Gapping	0.01~0.046	0.10
	Tappet bore	$\Phi 13 \begin{smallmatrix} +0.018 \\ 0 \end{smallmatrix}$				
7.	Push rod radial runout				0.3	
8.	Rocker shaft deflection				0.3	
9.	Rocker shaft outer diameter	$\Phi 19 \begin{smallmatrix} 0 \\ -0.02 \end{smallmatrix}$		Gapping	0.01~0.05	0.20
	Rocker bore	$\Phi 19 \begin{smallmatrix} +0.03 \\ +0.01 \end{smallmatrix}$				

	10.	Intake valve stem diameter Valve guide bore	$\Phi 8 \begin{smallmatrix} -0.039 \\ -0.054 \end{smallmatrix}$ $\Phi 8 \begin{smallmatrix} +0.017 \\ 0 \end{smallmatrix}$	Gapping	0.039~0.071	0.20
	11.	Exhaust valve stem diameter Valve guide bore	$\Phi 8 \begin{smallmatrix} -0.064 \\ -0.079 \end{smallmatrix}$ $\Phi 8 \begin{smallmatrix} +0.017 \\ 0 \end{smallmatrix}$	Gapping	0.064~0.096	0.25
	12.	Free height of valve spring Squareness of valve spring	48 $\Phi 1.4$			
	13.	Idler A bearing outer diameter Idler A bearing inner diameter	$\Phi 45 \begin{smallmatrix} -0.025 \\ -0.055 \end{smallmatrix}$ $\Phi 45 \begin{smallmatrix} +0.025 \\ 0 \end{smallmatrix}$	Gapping	0.025~0.080	0.20
	14.	Cylinder liner bore Overtopping height of the cylinder liner to the body	$\Phi 93 \begin{smallmatrix} +0.060 \\ +0.021 \end{smallmatrix}$ 0~0.08			
	15.	Axial runout clearance of camshaft Cam height of camshaft	 42.02 ± 0.05	Gapping	0.05~0.114	0.20 0.38
	16.	Inner diameter of camshaft bearing bush Camshaft journal diameter	$\Phi 50 \begin{smallmatrix} +0.025 \\ 0 \end{smallmatrix}$ $\Phi 50 \begin{smallmatrix} -0.025 \\ -0.055 \end{smallmatrix}$	Gapping	0.025~0.080	0.12
	17.	Camshaft bearing bush deflection			0.02	0.10
	18.	Piston pin Piston pin hole	$\Phi 31 \begin{smallmatrix} 0 \\ -0.005 \end{smallmatrix}$ $\Phi 31 \begin{smallmatrix} +0.010 \\ +0.002 \end{smallmatrix}$	$\Phi 34 \begin{smallmatrix} 0 \\ -0.005 \end{smallmatrix}$ $\Phi 34 \begin{smallmatrix} +0.010 \\ +0.002 \end{smallmatrix}$	Gapping	0.002~0.015 0.03
	19.	Connecting rod big end thickness Crankshaft connecting rod journal bore	$33 \begin{smallmatrix} 0 \\ -0.04 \end{smallmatrix}$ $33 \begin{smallmatrix} +0.250 \\ +0.175 \end{smallmatrix}$	Gapping	0.175~0.290	0.35
	20.	Intake/exhaust valve cold clearance		Gapping	0.3~0.4	
	21.	Main shaft diameter Main bearing halfshell (after assembly)	$\Phi 70 \begin{smallmatrix} -0.068 \\ -0.086 \end{smallmatrix}$ $\Phi 70 \begin{smallmatrix} -0.003 \\ -0.033 \end{smallmatrix}$	Gapping	0.031~0.066	0.11
	22.	Piston pin outer diameter Connecting rod bushing inner diameter	$\Phi 31 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$ $\Phi 31 \begin{smallmatrix} +0.020 \\ +0.008 \end{smallmatrix}$	$\Phi 34 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$ $\Phi 34 \begin{smallmatrix} +0.020 \\ +0.008 \end{smallmatrix}$	Gapping	0.008~0.026 0.05

✕	23.	Crankshaft connecting rod journal Connecting rod bearing halfshell hole (after assembly)	$\Phi 53 \begin{matrix} -0.070 \\ -0.085 \end{matrix}$ $\Phi 53 \begin{matrix} -0.016 \\ -0.041 \end{matrix}$	Gapping	0.029~0.069	0.10
	24.	Piston outer diameter grouping Group A Group B Group C Cylinder liner grouping (after pressing in) Group A Group B Group C	92.957~92.970 92.970~92.983 92.983~92.996 93.021~93.034 93.034~93.047 93.047~93.060	Grouping Gapping	0.051~0.077	
	25.	Piston ring end gap First gas ring Second gas ring Oil ring Piston ring end gap First ring Second ring Oil ring	0.2~0.4 0.2~0.4 0.1~0.3 0.09~0.125 0.05~0.075 0.03~0.07	0.2~0.4 0.6~0.85 0.35~0.65 0.078~0.139 0.045~0.09 0.03~0.07		1.5 0.15 0.15 0.15
	26.	Vertical height of injector to cylinder head lower undersurface	$3.94 \begin{matrix} +0.36 \\ -0.23 \end{matrix} \text{ mm}$ $2.41 \begin{matrix} +0.53 \\ -0.31 \end{matrix} \text{ mm}$			

1.3.2 General terms for diesel performance

Net power

The correction value for effective power outputted by the engine with all on-board parts

Total power

The correction value for effective power outputted by the engine with essential parts for operation

Rated power

The total output power given by the manufacturer at the specified rated speed according to the specific engine application, as indicated on the nameplates of engine HFC4DA1 and 4DA1-1

Maximum power

The maximum total power outputted by the engine at full-load working condition, which is generally greater than or equal to the rated power

Load

The ratio between the actual engine output power and the possible maximum power at the same speed, which is expressed by percentage

Maximum no load governed speed

The speed which the engine reaches when the accelerator reaches its limit and the engine runs under no load working condition

To avoid diesel overspeed, the speed indicates the maximum speed control given by the injection

 pump governor. The maximum no load governed speed of HFC4DA1 and 4DA1-1 is 4000~4200 rpm.

Maximum rated speed

The maximum speed that the governor allows at full load.

The maximum rated speed of HFC4DA1 and 4DA1-1 is 3600 rpm.

Minimum rated speed

1. The allowable minimum speed at the following three maximum speed of engine: 45% of maximum rated speed, 1000rpm and the speed provided by the idling governor, whichever is greater. The minimum rated speed of HFC4DA1 and 4DA1-1 is 1620 rpm.

2. The minimum speed specified by the manufacturer

Full load filter paper type smoke

Under full load (i.e. external characteristics) working condition, the blackening of filter paper in a specific area (working diameter: 32 mm) by the smoke in a specified length of air column taken from the engine exhaust pipe

To measure the speed range from the minimum to the maximum rated speed, arrange proper testing points including full load working conditions at the maximum power speed and maximum torque speed.

Free accelerating working condition

When the engine runs at idle speed, the condition that pedaling the accelerator pedal rapidly but gently to make the injection pump provide maximum fuel

Keep this condition before the engine reaches the allowable maximum speed given by the governor. Once it reaches the maximum speed, release the accelerator pedal to make engine returns to idling.

Free accelerating filter paper type smoke

Under free accelerating working condition, the blackening of filter paper in a specific area (working diameter: 32 mm) by the smoke in a specified length of air column taken from the engine exhaust pipe

Speed characteristics

The characteristics of main performance index (torque, power, oil consumption, exhaust temperature and smoke, etc.) changes depending on the speed when the engine fuel governing mechanism keeps the same

External characteristic

The speed characteristic when the engine fuel governing mechanism is fully opened

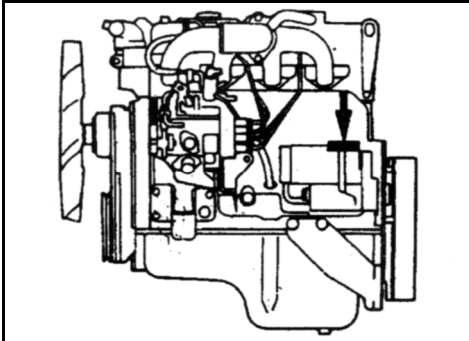
It is also called full load speed characteristic.

Load characteristic

The characteristic of performance index changes depending on load when the engine keeps running at the same speed



1.4 Maintenance work



Only qualified personnel should be allowed to perform general maintenance work.

Type marking

Engine Serial Number

The engine serial number is stamped at the left side of the rear end of cylinder block.

1.4.1 Air filter

Dry-type paper filter element

Depending on the type of filter element, the method for cleaning a filter element is different.

Dust accumulated at the filter element

Turn the filter element by hand and blow the compressed air into the filter element in order to blow off the dust.

Pressure of compressed air (392-490 kPa)

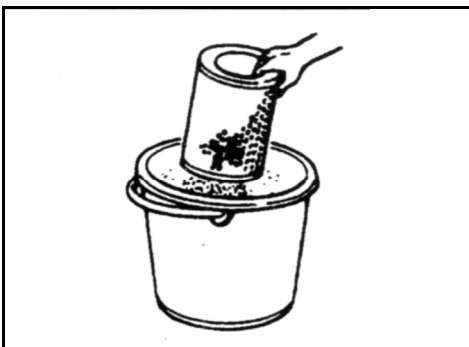
Caution:

Protect the filter element from colliding by other objects in cleaning. Otherwise, the filter element may be damaged.



Carbon and dust accumulated at the filter element

1. Prepare the cleaning liquid for air filter (DonaldmnDI400) originally provided by JAC, and dilute it with water.
2. Immerse the filter element in the cleaning liquid for 20 minutes.





3. Take the filter element out of the cleaning liquid and flush it with running water. The water pressure should be less than 274 kPa.

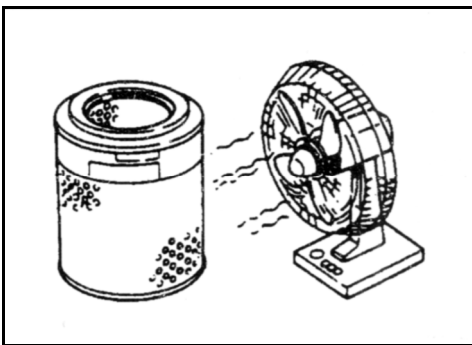
4. Dry the filter element at a place with good ventilation. Use a fan for quick drying.

Note:

Never use the compressed air or open fire for quick drying.

It may result in damage of filter element.

Generally, it will take two to three days to completely dry a filter element. In this case, a standby should be prepared for temporary use.



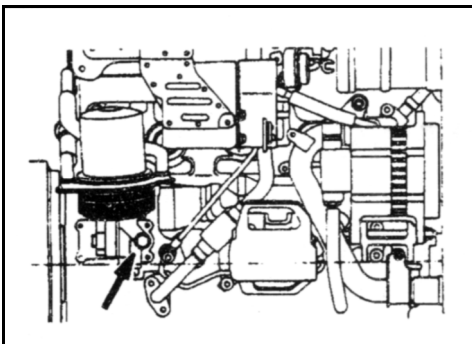
1.4.2 Lubricant system

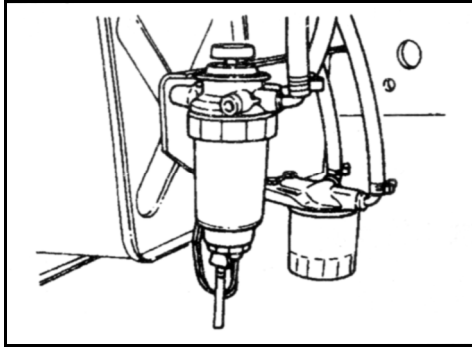
Main oil filter (paper filter element)

Replace procedure

1. Loosen the oil drain plug to drain out the oil.
2. Several minutes later, retighten the oil drain plug.
3. Unscrew the used filter counter-clockwise with a filter wrench.
4. Clean the fitting surface of oil cooler to ensure suitable fitting with the new oil filter.
5. Apply a thin layer of oil to the O-ring.
6. Screw in the new oil filter until the filter O-ring makes perfect contact with the sealing surface.
7. Further screw in the filter by 1+1/4 turn with a filter wrench.

Filter wrench: 1010300FA-9101





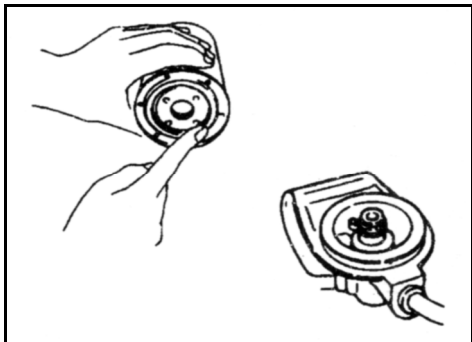
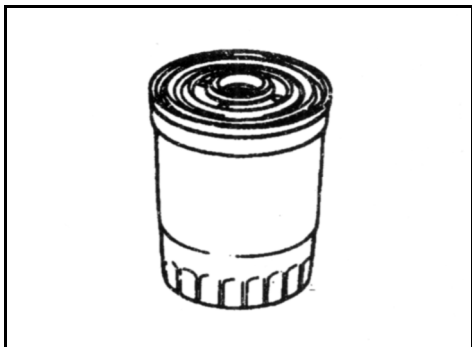
8. Check the oil level. If necessary, fill in some oil until the oil level reaches the specified level. The filling oil volume is approximate 0.7 L.
9. Start the engine and verify there is no oil leak from the main oil filter.

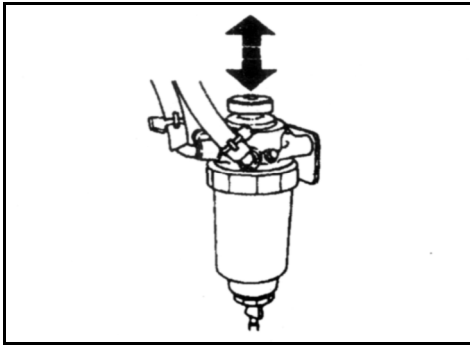
1.4.3 Fuel system

Fuel filter

Replace procedure

1. Unscrew the used filter counter-clockwise with a filter wrench.
2. Clean the fitting surface of the filter upper cover to ensure suitable fitting with the new fuel filter.
3. Screw in the fuel filter until it makes perfect contact with the sealing surface.
4. Further screw in the filter by N 2/3 turn with a filter wrench.

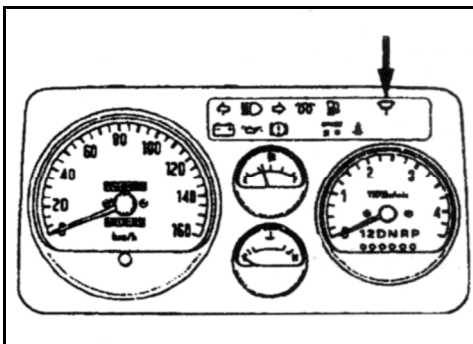




5. Loosen the bleeder plug on the overflow valve of injection pump.
6. Operate the priming pump until the fuel flows out of the fuel filter.
7. Retighten the bleeder plug.
8. Repeatedly operate the priming pump and verify there is no fuel leak.

Note:

It is strongly recommended that you should use a fuel filter provided by JAC or an original one.



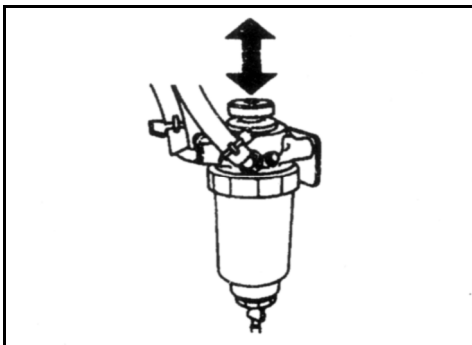
Procedure of water drain from the fuel filter

If water content in the water separator exceeds the specified value, the indicator light will light up. Discharge water and other impurities from the water separator according to the following steps.

1. Park the vehicle at a safe place.
2. Open the engine hood and put a container (approximate 0.2 L) at the end of ethylene hose under the water drain plug of water separator.
3. Unscrew the water drain plug counter-clockwise (about five turns) and operate the priming pump about ten times until approximate 0.1 L water drains out.
4. Once the water drains is finished, screw in the water drain plug clockwise and manually operate the priming pump several times.
5. Verify there is no fuel leak from the water drain plug after the engine starts.

Also, verify the indicator light of fuel filter is off.

If frequent water drain from a water separator is required, you may ask for a fuel tank for water drain from a local JAC distributor.



Bleeding

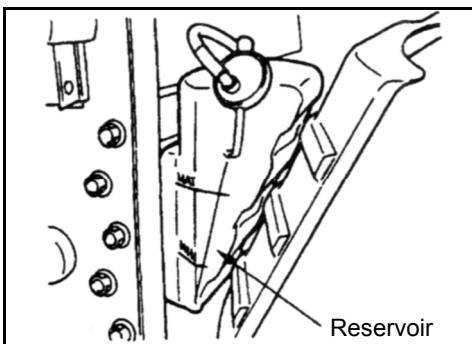
1. Loosen the bleeding screw on the overflow valve of injection pump.
2. Operate the priming pump until the fuel with foam flows out of the bleeding screw.
3. Tighten the bleeding screw.
4. Repeatedly operate the priming pump and verify there is no fuel leak.

1.4.4 Cooling system

Coolant level

Check the coolant level. If necessary, fill in the radiator reservoir.

If the coolant level falls under "MIN", carefully check whether there is a leakage in the cooling system. And then, fill in the coolant until it reaches "MAX".



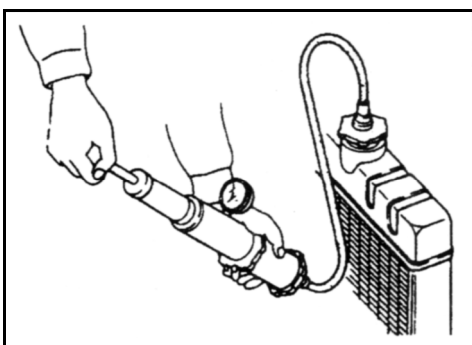
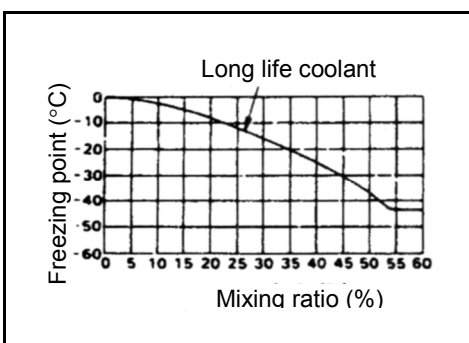
Note:

Never make a reservoir overflow.

The radiator filler cap should be opened only if it is very necessary.

Coolant level check can only be performed when the engine is cold.

For mixing ratio between the cooling water and anti-freezer, please refer to the left figure.



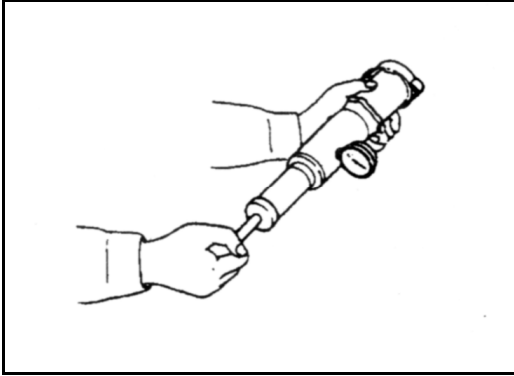
Cooling System Check

Place an American tester for radiator filler on the radiator.

Apply test pressure on the cooling system and check the leakage.

The test pressure shall not exceed the specified pressure.

Test pressure: 196kPa



Radiator filler cap check

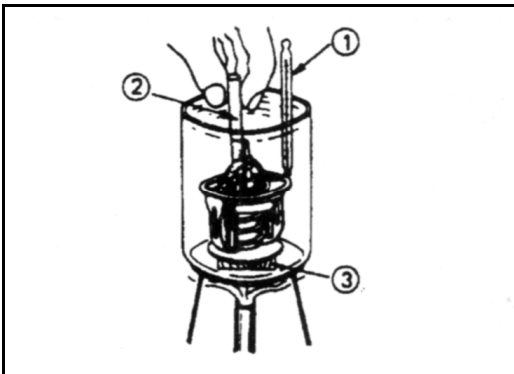
The radiator filler cap is designed to keep the pressure at 105 kPa in the cooling system. Use radiator filler cap tester to check the cap. If the radiator filler cap doesn't keep at the specified pressure in testing, it shall be replaced by a new one.

The pressure of radiator filler cap

Pressure valve

88-118 kPa

Negative pressure valve (reference value) 1.0 -3.9 kPa



Thermostat test

1. Completely immerse the thermostat in the water.

2. Heat up the water.

Continuously stir the water to avoid directly heating the thermostat.

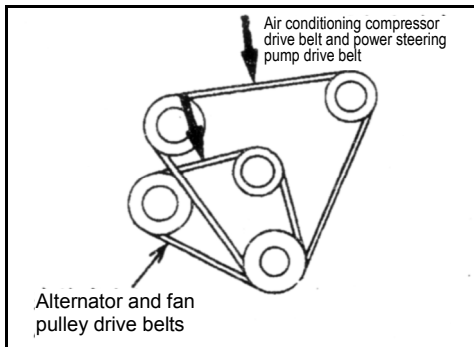
3. Check the initial opening temperature of thermostat.

The initial opening temperature of thermostat:
82°C

4. Check the full opening temperature of thermostat.

The full opening temperature of thermostat:
95°C

The valve lift at full opening: 8mm



1.4.5 Drive belt adjustment

Check whether the drive belt is worn or damaged. If necessary, replace it with a new one. Check the belt tension. If necessary, make proper adjustment.

- Check the belt tension.
- Press the central section of belt by a force of 100N and check deflection of each belt.
- Standard deflection

	mm
Alternator and fan pulley drive belts	8-10
Air conditioning compressor drive belt	
Power steering pump drive belt	

Alternator drive belt

- Mount the alternator drive belt and adjust the belt tension.
- Mount fixing bolts and tighten them to the specified torque.

Alternator

Fixing bolt torque 37.5

Adjusting plate fixing bolt torque 25

Air conditioning compressor pulley drive belt and power steering pump drive belt

- Move the oil pump to adjust the oil pump drive belt tension

Tighten the bolt to the specified torque.

Adjuster locking bolt torque 37 N · m



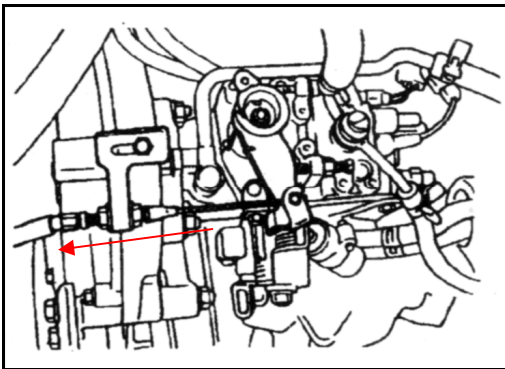
1.4.6 Engine control (governed speed, valve clearance, injection timing, compression pressure)

Idle speed check

1. Handle the parking brake and brake driving wheels.
2. Place the transmission at neutral position.
3. Start the engine and warm it up.
4. Remove the engine control cable from the control lever.
5. Mount the tachometer on the engine.
6. Check the engine idle speed.

If the engine idle speed exceeds the specified range, you must make adjustment.

Engine idle speed: 750 ± 50 r / min



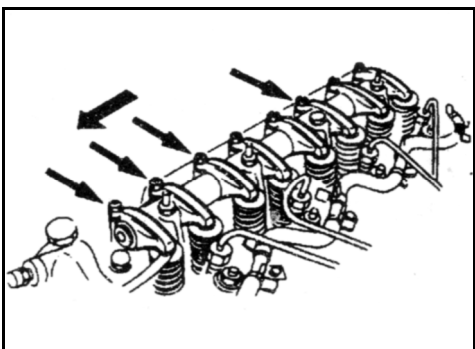
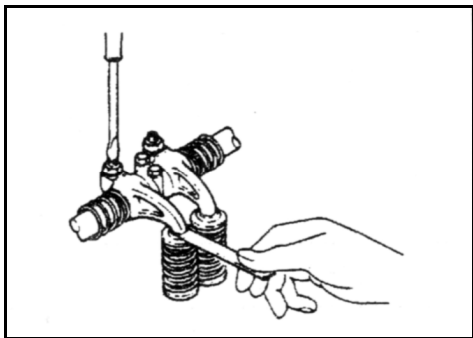
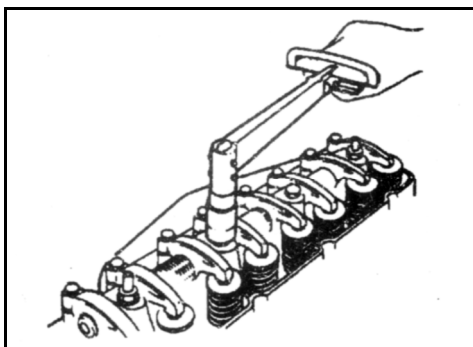
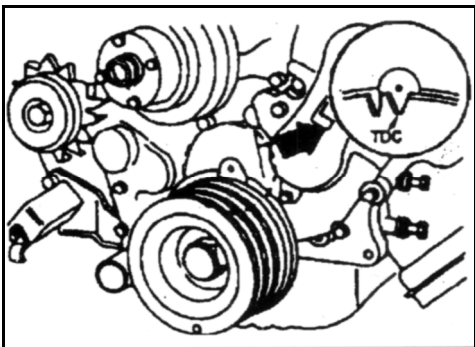
Adjust the idle speed

1. Loosen the locking nut (s) of idle adjusting bolt (s) on the injection pump.
2. Use idle adjusting bolt to adjust idle speed to the specified range.
3. Use the locking nut (s) to lock the idle adjusting bolt (s).
4. Check the idle speed control cable is tightened (no looses).

If necessary, eliminate any loose of the cable.

Accelerator control cable adjustment

1. Loosen clamp bolts for the accelerator cables.
2. Check whether the control knob is turned to the idle speed position.
3. Place the accelerator lever at the fully closed position, and then tighten the control cable in the arrow direction to eliminate any loose.



Valve clearance adjustment

1. Turn the crankshaft until the to the crankshaft damper reaches the top dead center. When the line aligns the timing pointer, either the first cylinder piston or the fourth cylinder piston locates at the top dead center of compression stroke.

2. Check whether there is any loose rocker shaft seat nut.

Before adjust the valve clearance, tighten any loose rocker shaft support nut.

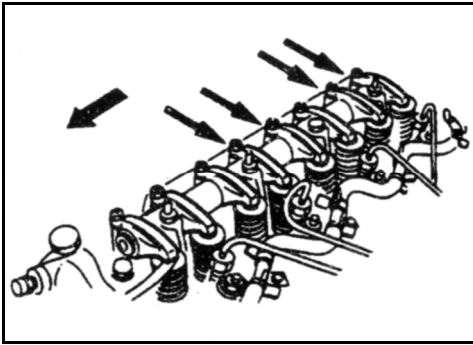
Torque of rocker shaft support nut 55 N • m

3. Check the clearance at the intake valve push rod and exhaust valve push rod in the first cylinder.

If there is clearance at the intake valve push rod and exhaust valve push rod in the first cylinder, the piston in the first cylinder locates at the top dead center of compression stroke.

If there is compression force applied on the intake valve push rod or exhaust valve push rod in the first cylinder, the piston in the fourth cylinder locates at the top dead center of compression stroke.

Adjust the valve clearance in the first or fourth cylinder when corresponding cylinder piston locates at the top dead center.



Valve clearance (cold) :
0.3-0.4 mm(optimum value: 0.35 mm)

4. Loosen each valve clearance adjusting screw as shown in the figure.
5. Insert a proper clearance gauge between the rocker arm and valve stem.
6. Turn the valve clearance adjusting screw until you feel there is slight resistance on the clearance gauge.
7. Screw down the locking nut.
8. Turn the crankshaft 360° .
9. Realign the timing marking at the crankshaft damper pulley to the line of top dead center.
10. Adjust clearance for other valves as shown in the figure.

✖ Adjust injection timing

Step 1 Remove the front screw (at the rear end of injection pump) on the injection pump distribution plunger.

Step 2 Mount special tools for injection advance angle adjustment: dial indicator and gauge stand.

Step 3 Turn the engine crankshaft clockwise to a position with approximate 45° to the top dead center of the first cylinder.

Step 4 Turn the engine crankshaft about 8° to left or right, the pointer of dial indicator shall stand still.

Step 5 Turn the dial indicator to zero the pointer. The position of dial indicator shall not be changed after zero adjustment.

Step 6 Turn the crankshaft clockwise to the top dead center. For assembly, to determine the top dead center, use a lever indicator to measure the height difference between top surface of piston in the first cylinder and upper surface of body. For commissioning and inspection, alignment timing marking (position marking of crankshaft pulley top dead center and timing marking on the gear case) is allowed to use.

Step 7 Unscrew two tight nuts to the injection pump flange and the connecting bolt to the injection pump support.

Step 8 Pull the injection pump inward or outward to make the reading of dial indicator show X mm.

Step 9 Screw down two tight nuts to the fuel pump flange and the connecting bolt to the injection pump support. Fuel pump running shall be avoided in screwing.

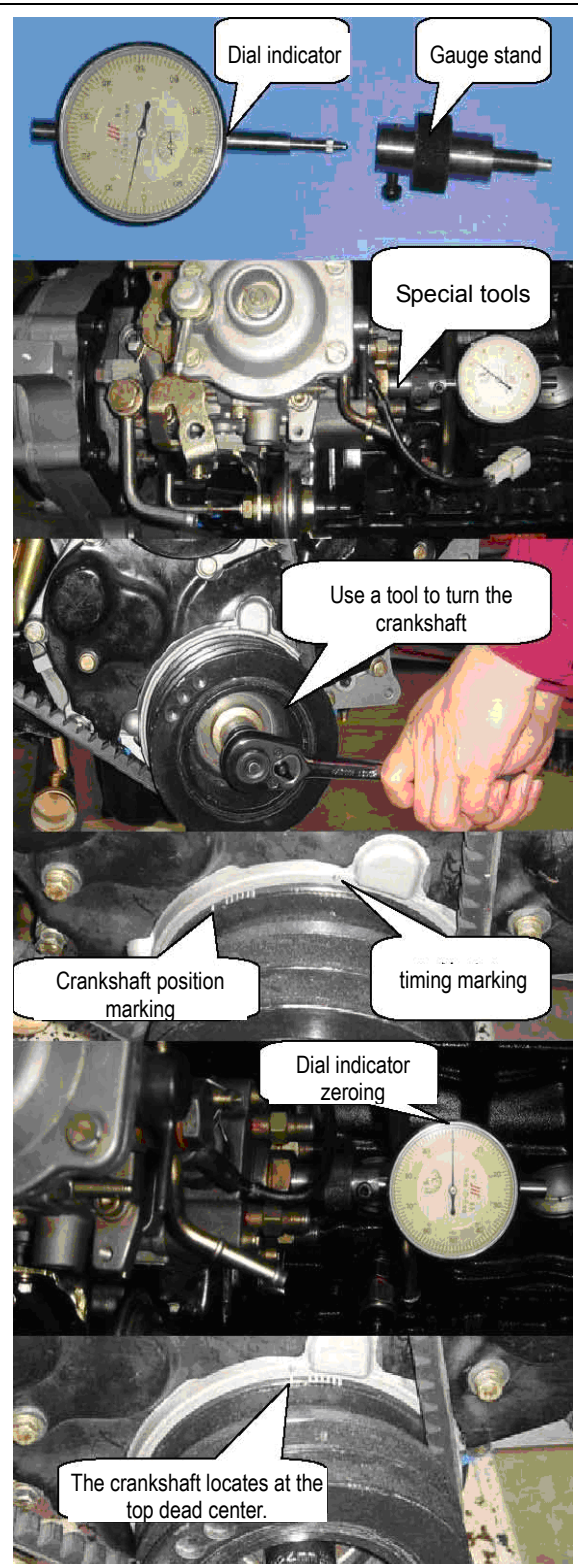
Step 10 Repeat Step 3 to verify zero adjustment. If the zero adjustment is not proper, return to Step 5.

Step 11 Repeat Step 6 to verify the reading of dial indicator. If the reading is not correct, return to Step 7.

Step 12 Remove the special tools: dial indicator and gauge stand.

Step 13 Mount the front screw on the injection pump distribution plunger. Injection advance angle adjustment is over.

Type	X Value (mm)
HFC4DA1	1.60
HFC4DA1-1	1.50



 The essential torque is given below.

Tightening torque for the tight nuts to the injection pump flange: $25 \pm 5 \text{ Nm}$;

Tightening torque for the connecting bolt to the injection pump support: $25 \pm 5 \text{ Nm}$;

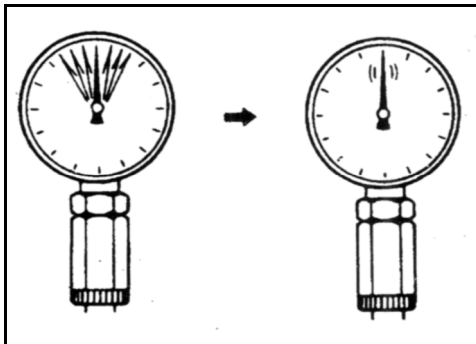
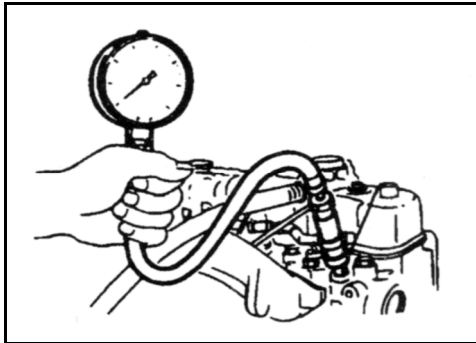
Tightening torque for the bolt to the distributive head of injection pump: $35 \pm 5 \text{ Nm}$;

Tightening torque for the nut to the high pressure fuel pipe: $30 \pm 5 \text{ Nm}$

If the special tools like dial indicator and seat stand are not available, it is allowed to use "Overflow" method to make injection advance angle adjustment.

Note:

A new cooper gasket must be used when you mount a plug at the top of distributor.



Compression pressure measurement

1. Start the engine and keep idling until the coolant temperature reaches 70-80°C.

2. Remove the following parts:

- ★ All glow plugs (or injectors)(Measuring at the injector hole or the glow plug hole is optional depending on different gauge outfits.)
- ★ Fuel cut solenoid connector
- ★ Fuse for Quick On Start System(QOS) on a connector

3. Mount the joint and pressure gauge in the glow plug hole in the first cylinder (or in the injector hole).

Compression pressure gauge
(with joint): 1002100FA-9101
Joint: 1002100FA-9102

4. Use the starter motor to run the engine and record the readings on the pressure gauge.

Compression pressure at 200 r/min

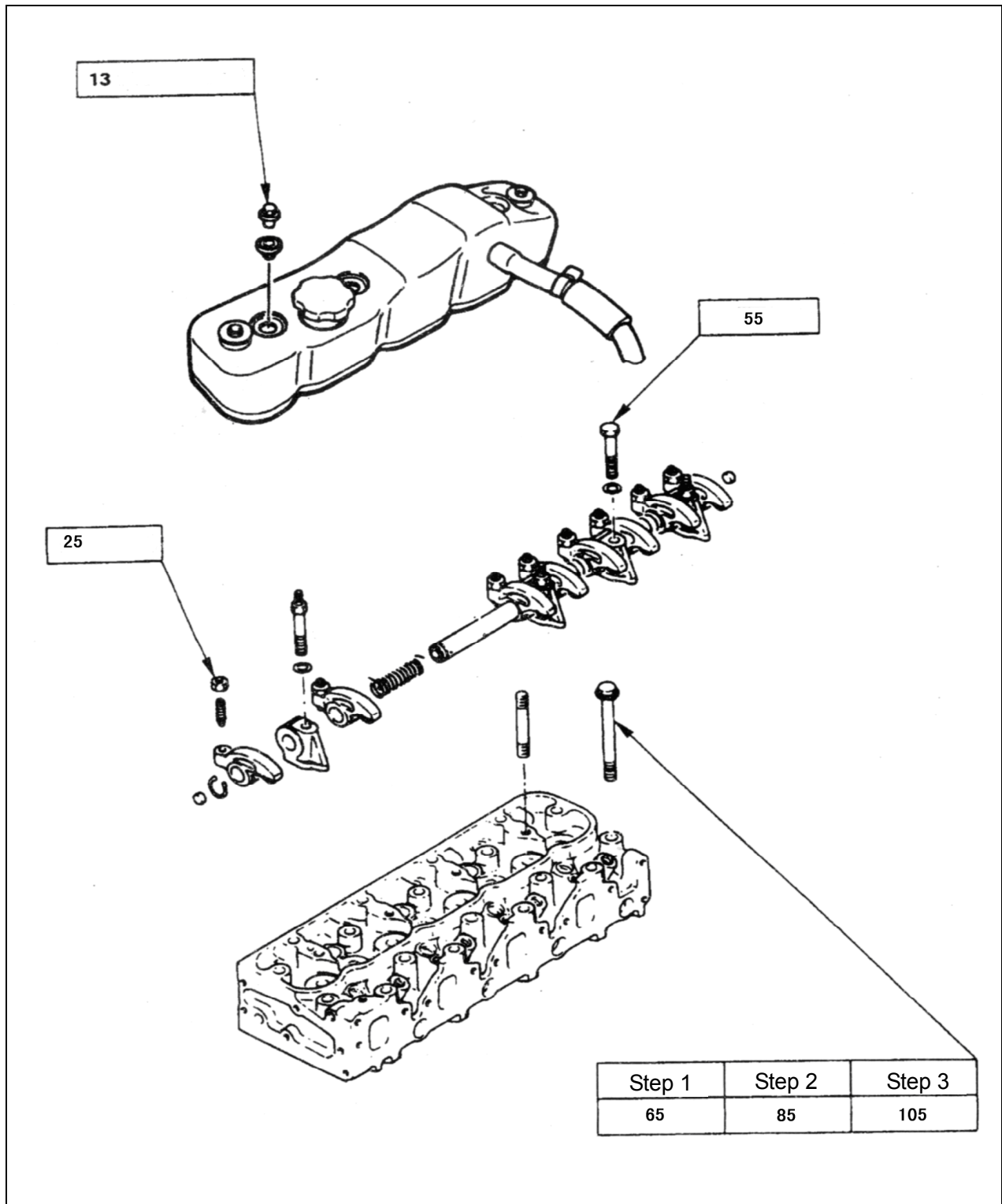
Nominal	Limit
3040	2158

5. For other cylinders, repeat Step 3 and 4.
If the measured value is less than the limit value, refers to the section "Diagnosis and troubleshooting" in this manual.



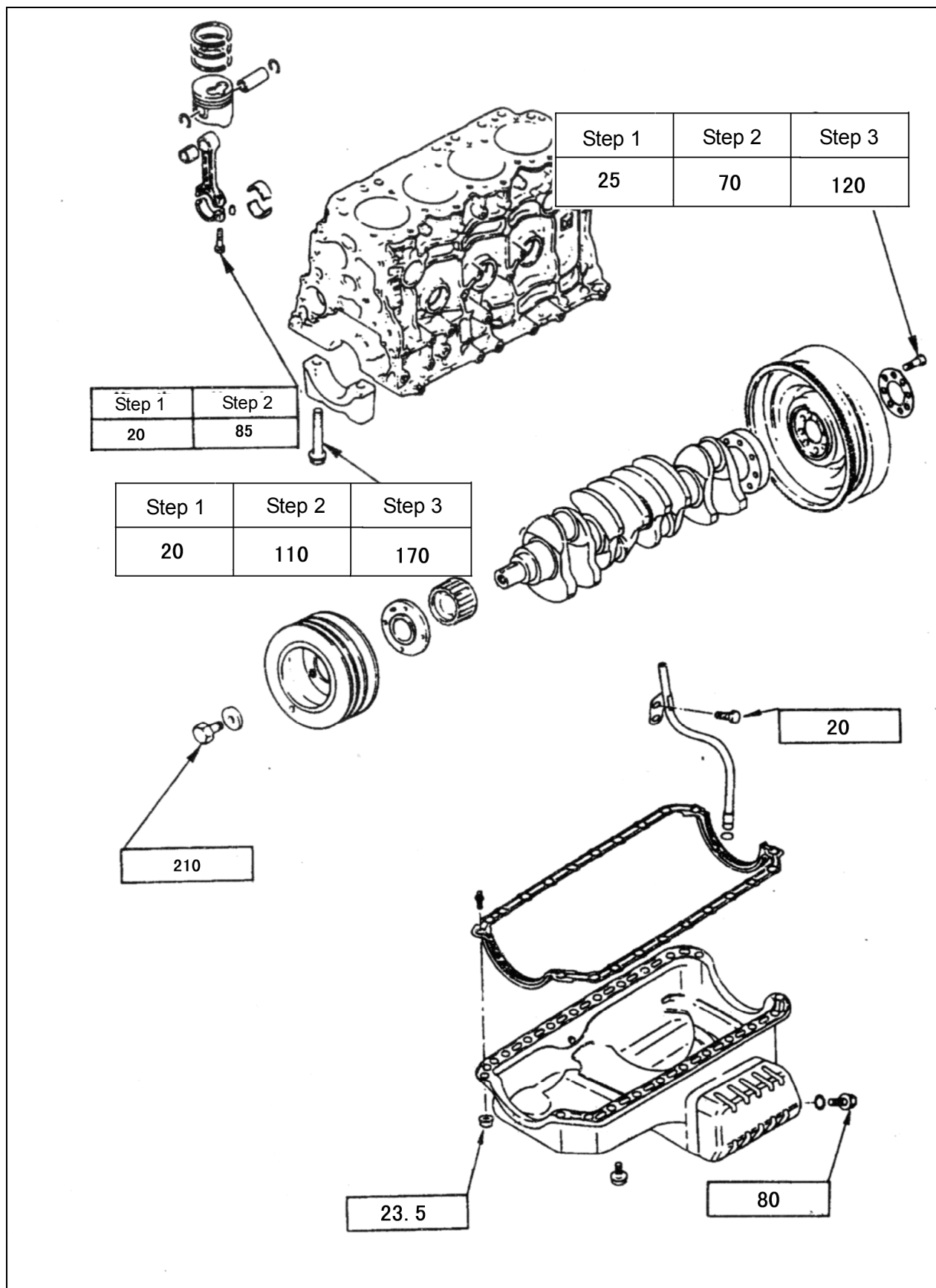
1.5 Tightening torque

1.5.1 Torque for cylinder head, cylinder head cover and rocker shaft support (N·m)

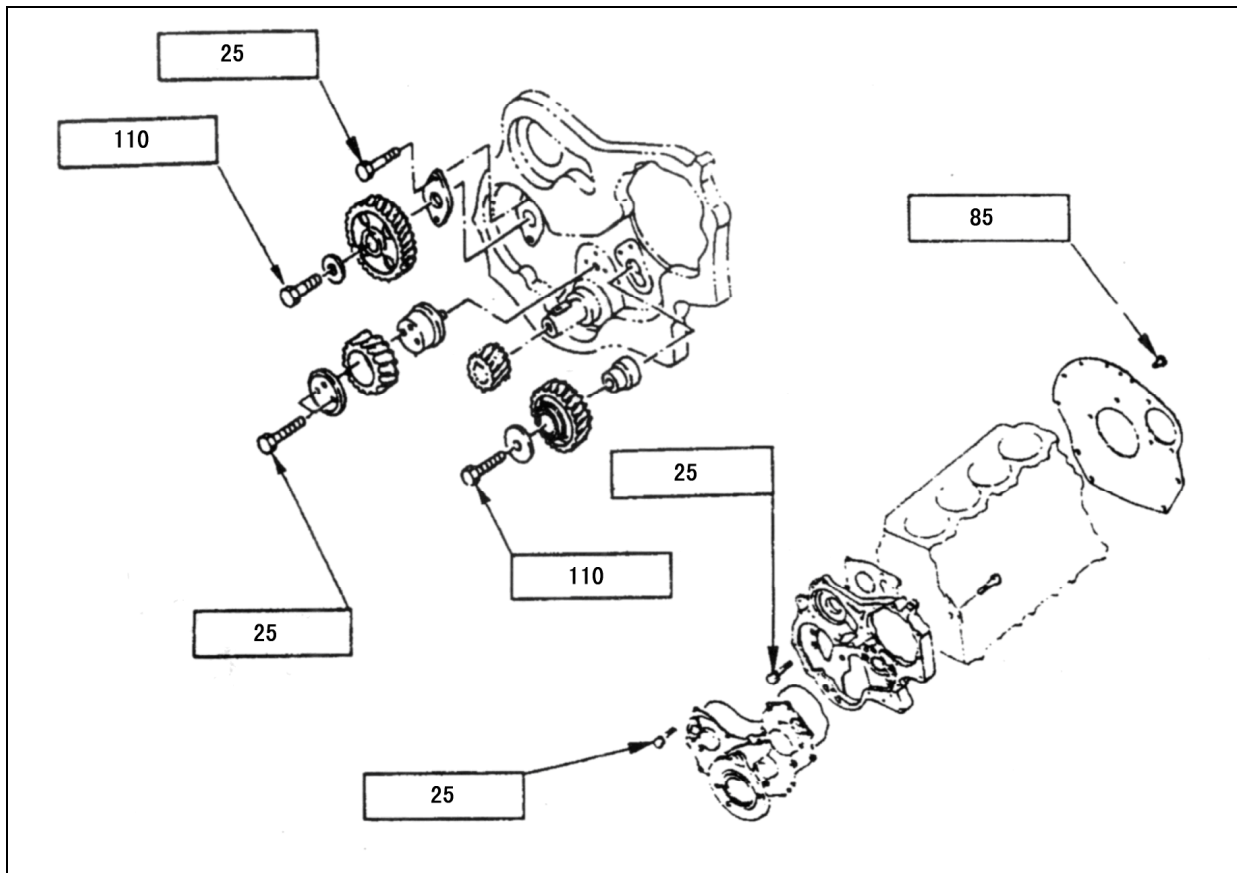




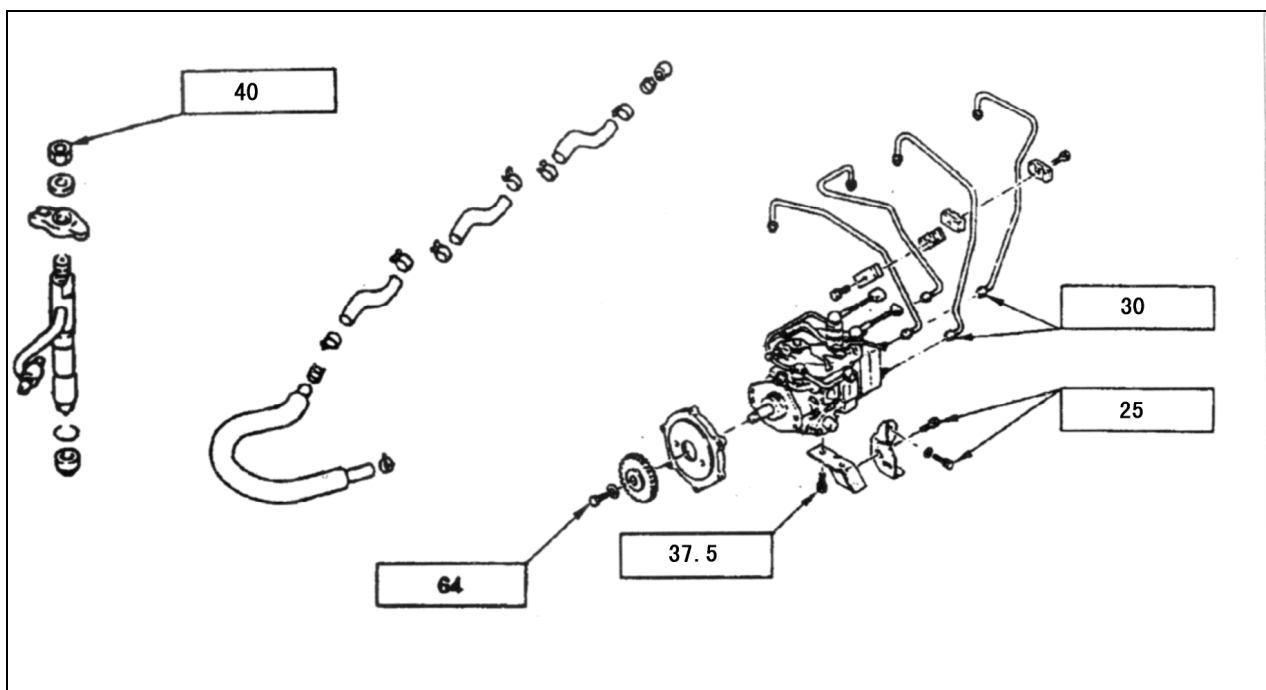
✖ **1.5.2 Torque for crankshaft, bearing cap, connecting rod bearing cap, crankshaft damper pulley, flywheel and oil pan (N·m)**



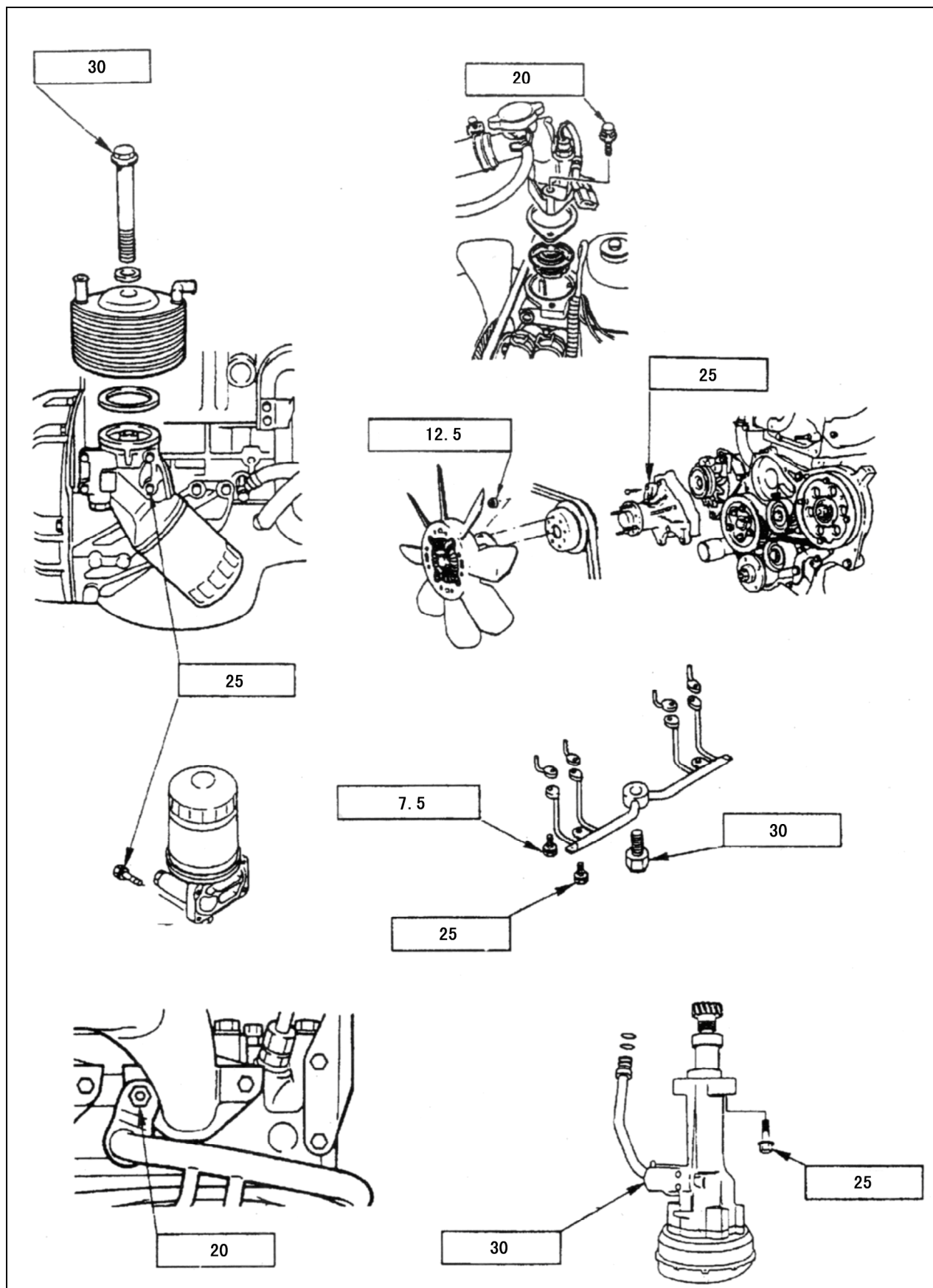
1.5.3 Torque for timing pulley chamber, timing pulley, timing gear and camshaft race (N·m)



1.5.4 Engine fuel system (N·m)

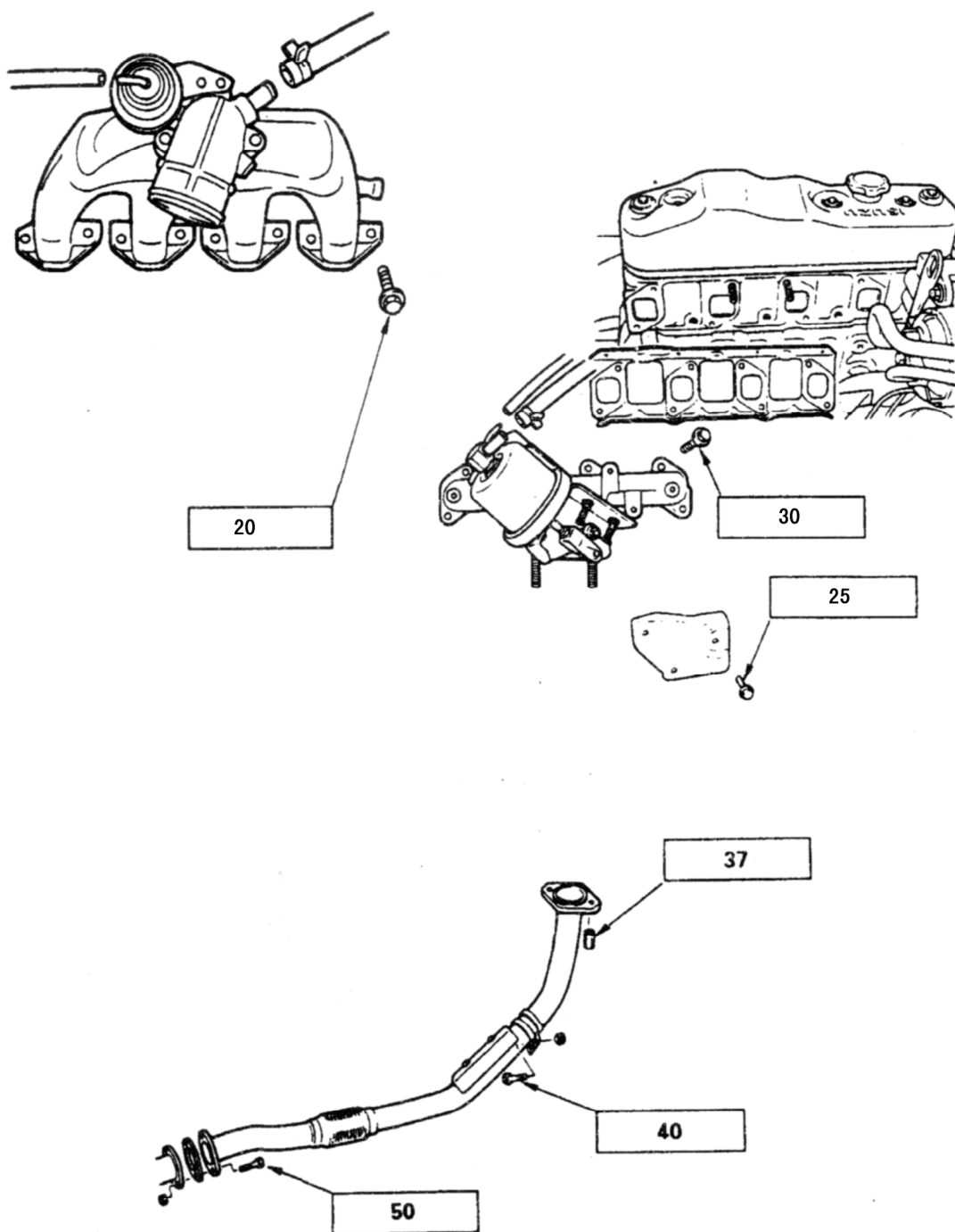


1.5.5 Torque for cooling system and lubricant system (N·m)

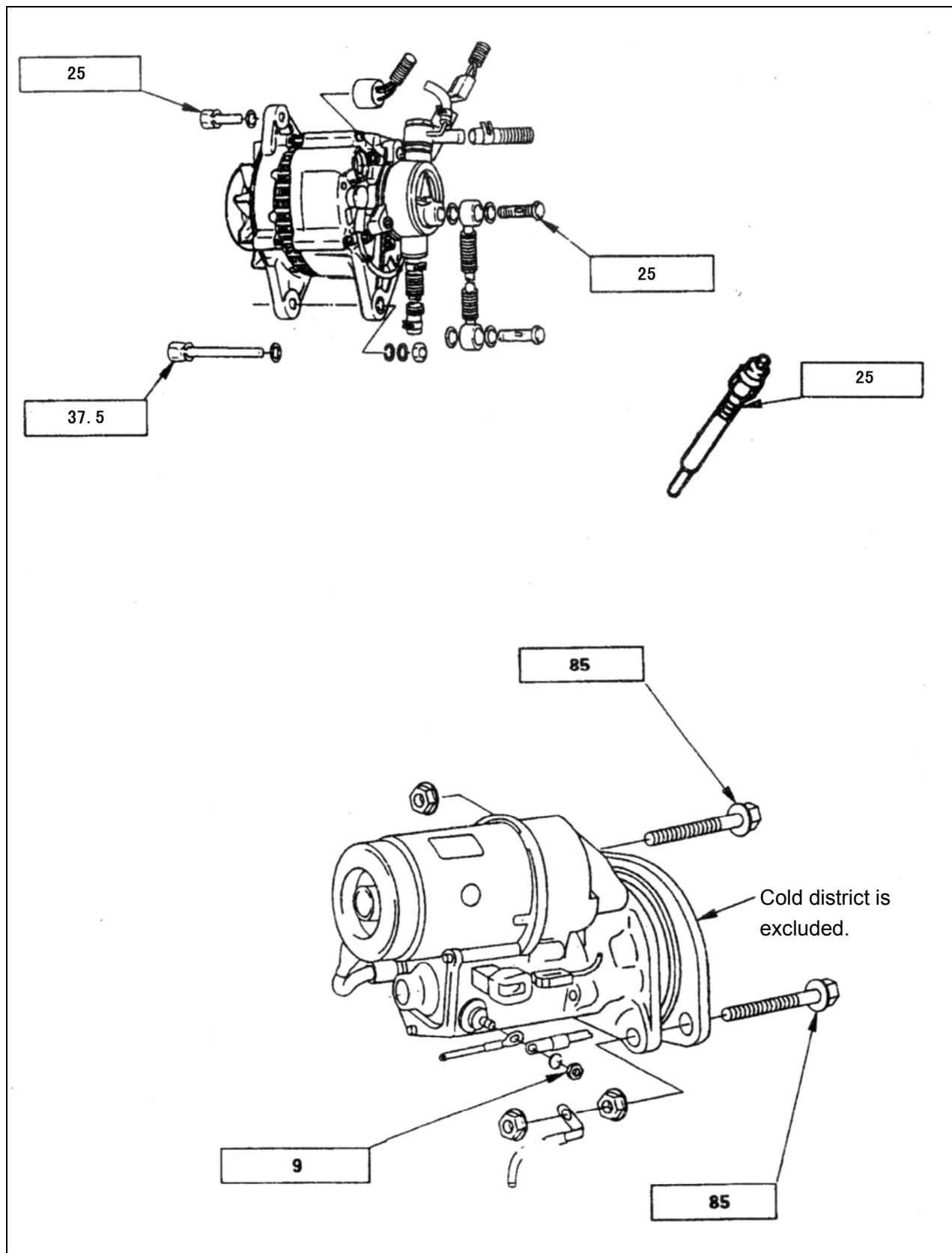




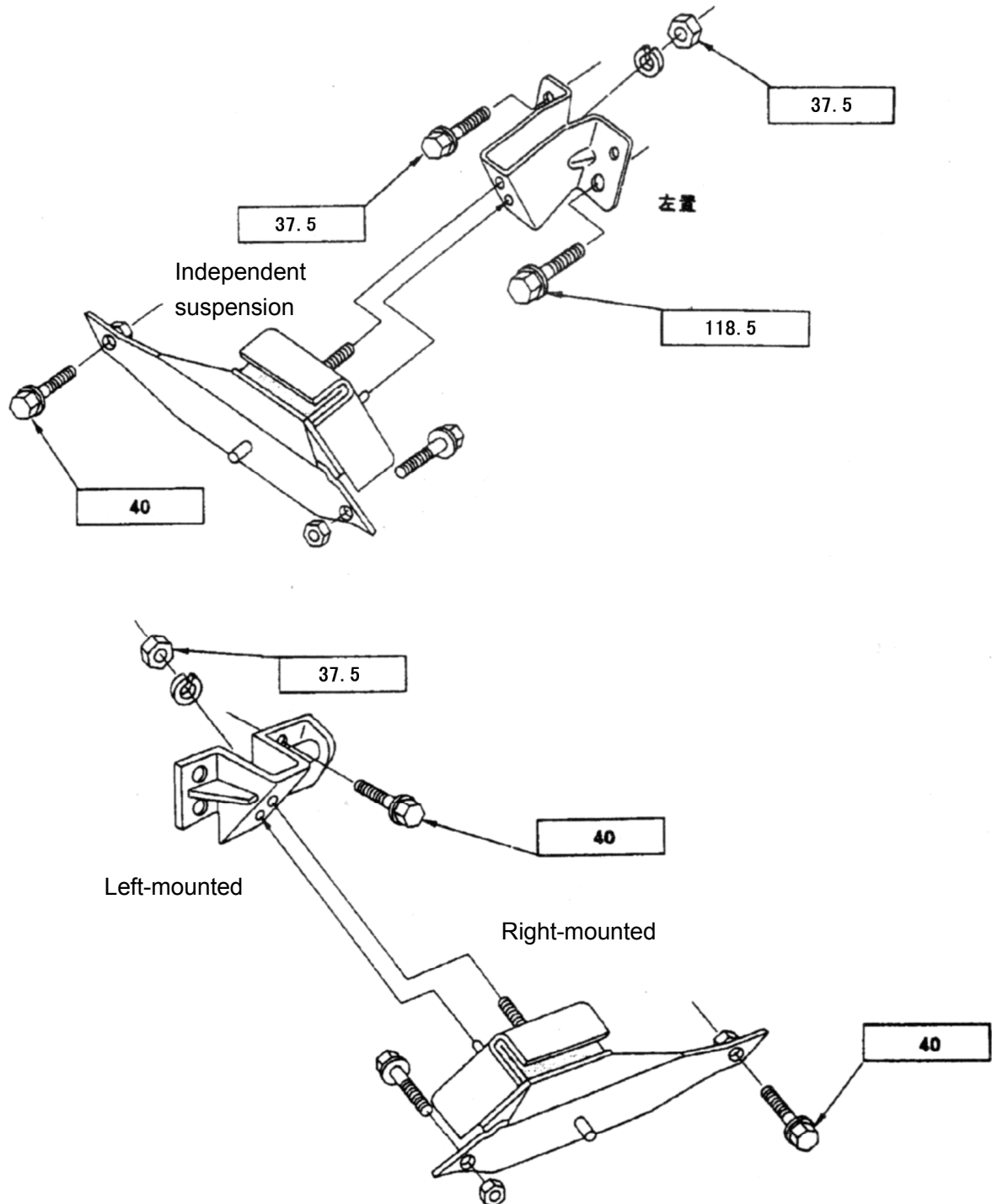
1.5.6 Torque for intake manifold, exhaust manifold and exhaust pipe (N·m)



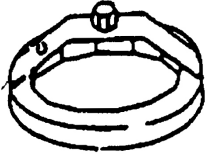
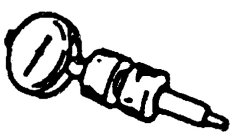
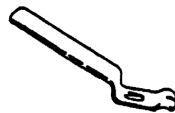
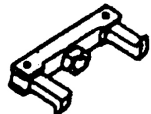
1.5.7 Engine electrical system (N·m)

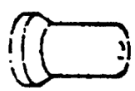


✖ 1.5.8 Torque for engine mounting bracket (N·m)



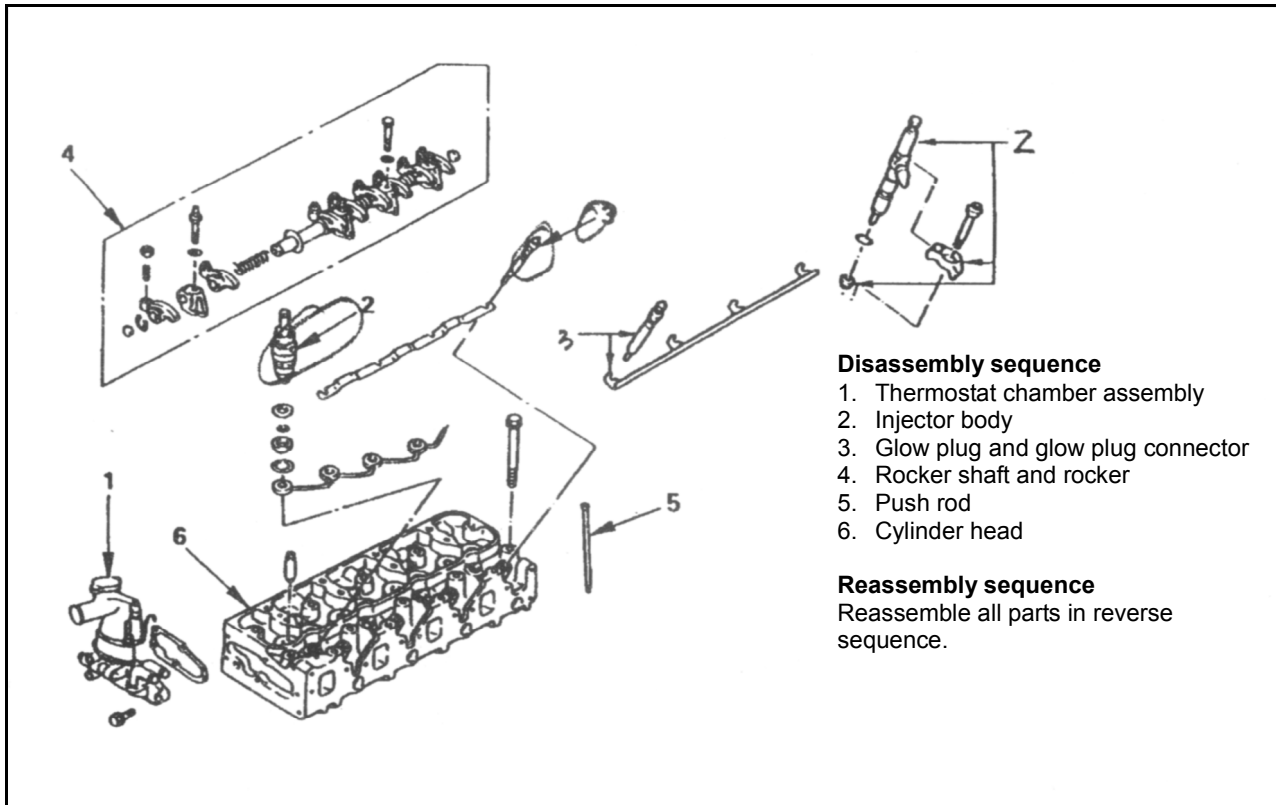
1.6 Special tools

Illustration	Tool No.	Tool Name
	1010300FA-9101	Oil filter wrench
	1003016FA-9101	Valve oil seal erector
	1003102FA-9101	Valve guide replacer
	1002100FA-9101	Compression pressure gauge
	1002100FA-9102	Pressure gauge joint
	1100300FA-9101	Measuring unit
	1002420FA-9101	Front oil seal erector
	1002430FA-9101	Rear oil seal erector
	1003015FA-9101	Valve spring compressor
	1007017FA-9101	Camshaft gear puller

	1002107FA-9101	Camshaft bearing replacer
	1002430FA-9102	Rear oil seal remover
	1002106FA-9101	Cylinder liner erector
	1002106FA-9102	Cylinder liner remover
	1004001FA-9102	Piston mounting taper sleeve
	1007011FA-9101	Timing gear puller
	1007011FA-9102	Crankshaft timing gear erector
	1002420FA-9101	Front oil seal erector

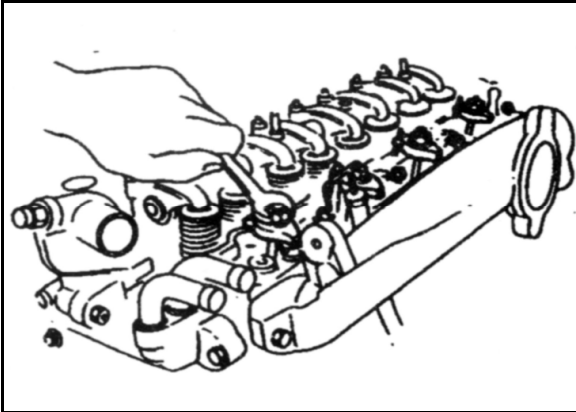
2. Engine mechanical system

2.1 Cylinder head



Note:

- In disassembly, you should collect all parts of valve set and identify each part so that they will return to their original positions by assembling.
- Before you remove the cylinder head from the engine and disassemble the valve mechanism, you should carry out a compression test and record the test result.

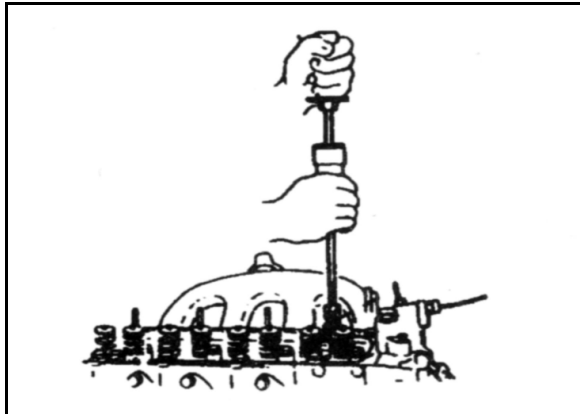


Disassembly

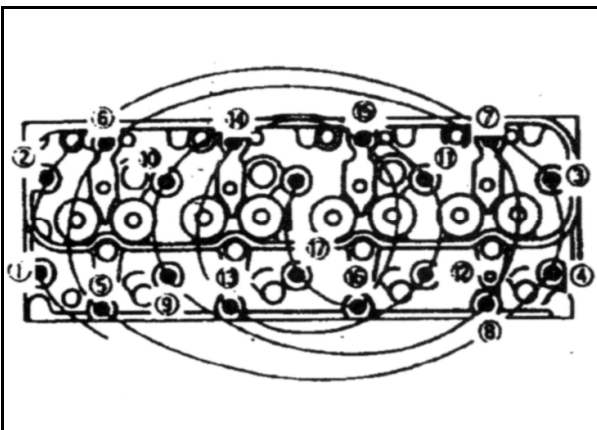
1. Thermostat casing and water outlet assembly

2. Injector body

- 1) Unscrew the injector body support nut.



- 2) Use an injector remover and a sliding hammer to disassemble the injector and its support together.



3. Glow plug and glow plug connection board

4. Rocker shaft and rocker

5. Push rod

6. Cylinder head

- Unscrew the cylinder head bolts in several times according to the sequence number given in the figure. Unscrew a bolt in at least two times.

Note:

If you don't unscrew the cylinder head bolts in several times according to the sequence number, bad effect like warping may incur on the undersurface of cylinder head.



Cleaning

- Cylinder head bolt
- Cylinder head

Carefully clean up any oil sludge, smoke and carbon deposit until the natural color of metal is exposed. Never use an electrical wire brush on any gasket or sealing surface.

Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

- Check whether there is leakage, corrosion or blow-by gas of cylinder head gasket and contact surface. If a gasket fails, investigate the causes:
 - Improper assembling
 - Loose or warping cylinder head
 - Insufficient tightening torque for the cylinder head bolt
 - Warping cylinder block surface
- 1. Check whether the cylinder head bolt thread is damaged or drawn out. Also, check whether the cylinder head is damaged caused by improper tool usage.

Caution

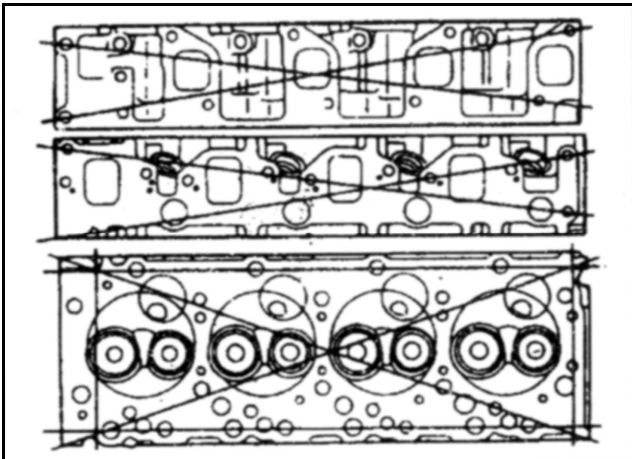
Any questionable bolt must be replaced by a new one.

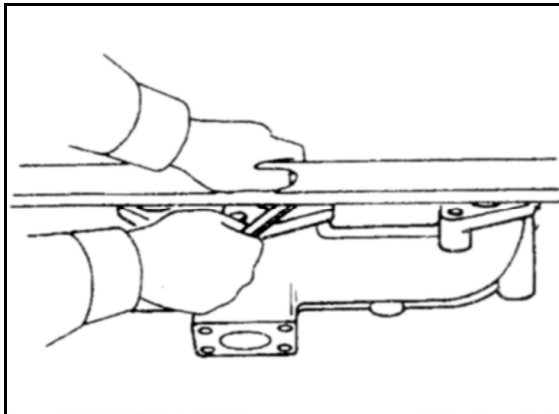
2. Check whether there is any crack on the cylinder head, particularly the valve edge and exhaust port.
3. Check whether there is any corrosion at the cylinder head cover plate, any sand or loose hole inside the cylinder head.

Caution

Never repair the key surface of cylinder head. If it is broken, replace it with a new one.

4. There are strict requirements for flatness of cylinder head undersurface and contact surface of intake and exhaust manifolds. Use grinding process to repair these surfaces. If the surface "flatness" exceeds the specified value, you should grind the surface until the flatness meets the requirement. If the flatness exceeds the specified value too much, the part shall be replaced by a new one.





	mm	
	Nominal	Limit
Warpage of cylinder head undersurface	0.05 or less	0.20
Height of cylinder head	92	91.55

5. Check the contact surface of water jacket bowl-like plug.
6. Use a ruler or clearance gauge to measure the warpage of contact surface between the exhaust manifold and cylinder head.
If the measurement value is greater than the nominal value but less than then limit value, you should regrinding the contact surface between the exhaust manifold and cylinder head.
If the measurement value exceeds the specified limit, the manifold has to be replaced.

Warpage of exhaust manifold mm

Nominal	Limit
0.05 or less	0.20

Reassembly

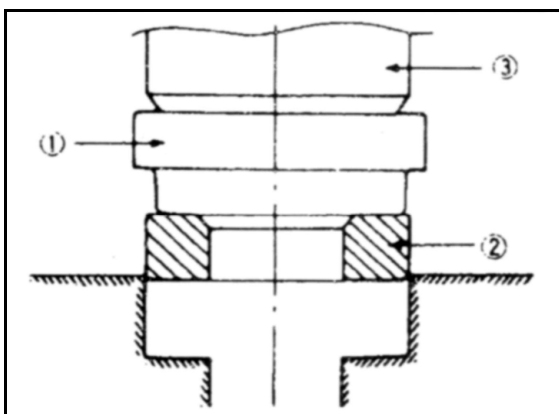
6. Cylinder head

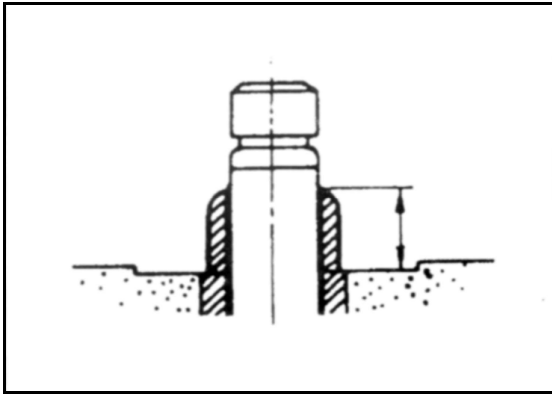
- 1) Mount the valve seat
 1. Carefully place the attachment ① (its outer diameter is slightly less than that of valve seat) on the valve seat ②.

Note

Make sure that the surface contacting with the valve seat is the smooth side of attachment.

2. Use a table press ③ to gradually press the attachment until the valve seat seats in place.





Note

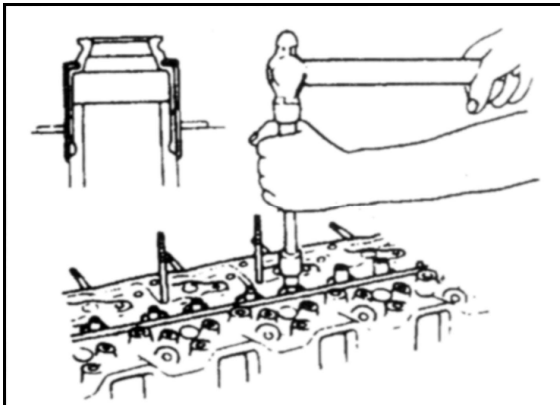
Never apply excess compressive force on the valve seat when you use a table press. Otherwise, the valve seat may be damaged.

Measure upper height of valve guide from the upper surface of cylinder head.

Upper height of valve guide (H) (reference value)
13 mm

Note

If a valve guide has been disassembled, you should replace the valve and valve guide in pairs.



2) Lower spring seat

3) Valve stem oil seal

- Mount a new oil seal to the valve.
- Use a special tool to guide.
Oil seal erector: 1003016FA-9101

4) Valve

- Apply oil to the part above the borehole diameter of valve stem before you install a valve.

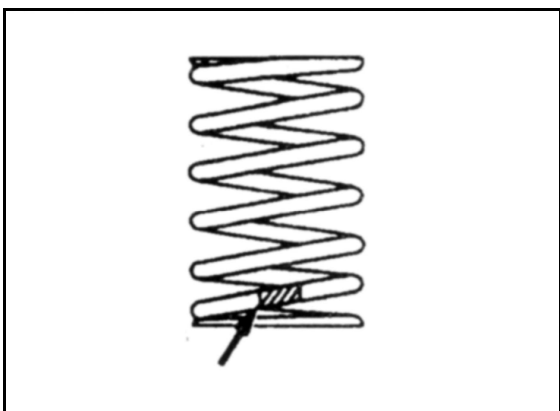
5) Valve spring

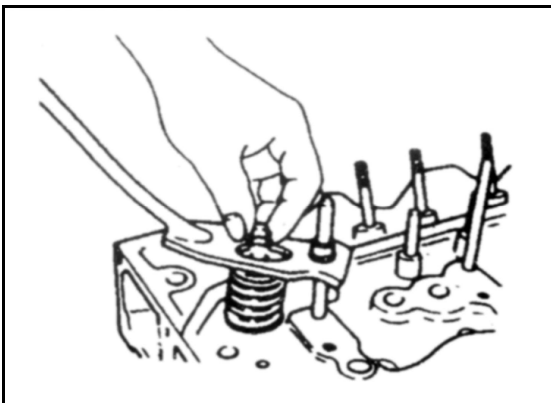
- Mount the valve spring on the upper spring seat.

Caution

- The section with painting on the valve spring shall be placed downwards.
- Supply compressed air from glow plug hole to cylinder until the valve seats in place.
- Install the valve cotter with special tools.

Valve spring compressor: 1003015FA-9101





6) Valve cotter

- Use a spring compressor to press the valve spring to the proper position.
- Mount the spring seat and valve cotter.
- Use a soft-faced hammer to tap the cotter head until it seats in place.

Valve spring compressor: 1003015FA-9101

5. Push rod

4. Rocker shaft and rocker

- Tighten the rocker shaft fixing bolt.

$55 \pm 5 \text{ N} \cdot \text{m}$

3. Glow plug and glow plug connection board

- Tighten the glow plug.

$25 \pm 5 \text{ N} \cdot \text{m}$

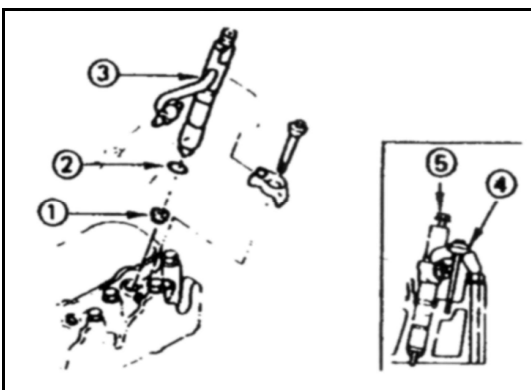
2. Injector body

- 1) Install the injector copper gasket ① and O-ring ② onto the injector body ③. Make sure tight contact between the O-ring and injector groove.
- 2) Apply oil in the cylinder head hole where the injector body seats.
- 3) Mount the injector body and injector pressure plate together to the cylinder head.

$40 \pm 5 \text{ N} \cdot \text{m}$

- 4) Tighten the injector body nut and gasket ⑤ to the specified torque.

$40 \pm 5 \text{ N} \cdot \text{m}$





2. Fuel injector

- Use a wrench or a special tool to tighten the nut (s) on the fuel injector to the specified torque as shown in the figure.

Caution

- **When you mount the return pipe, injector and injection pipe, use air to blow off dust.**

Injector tightening torque $34 \pm 5 \text{ N} \cdot \text{m}$

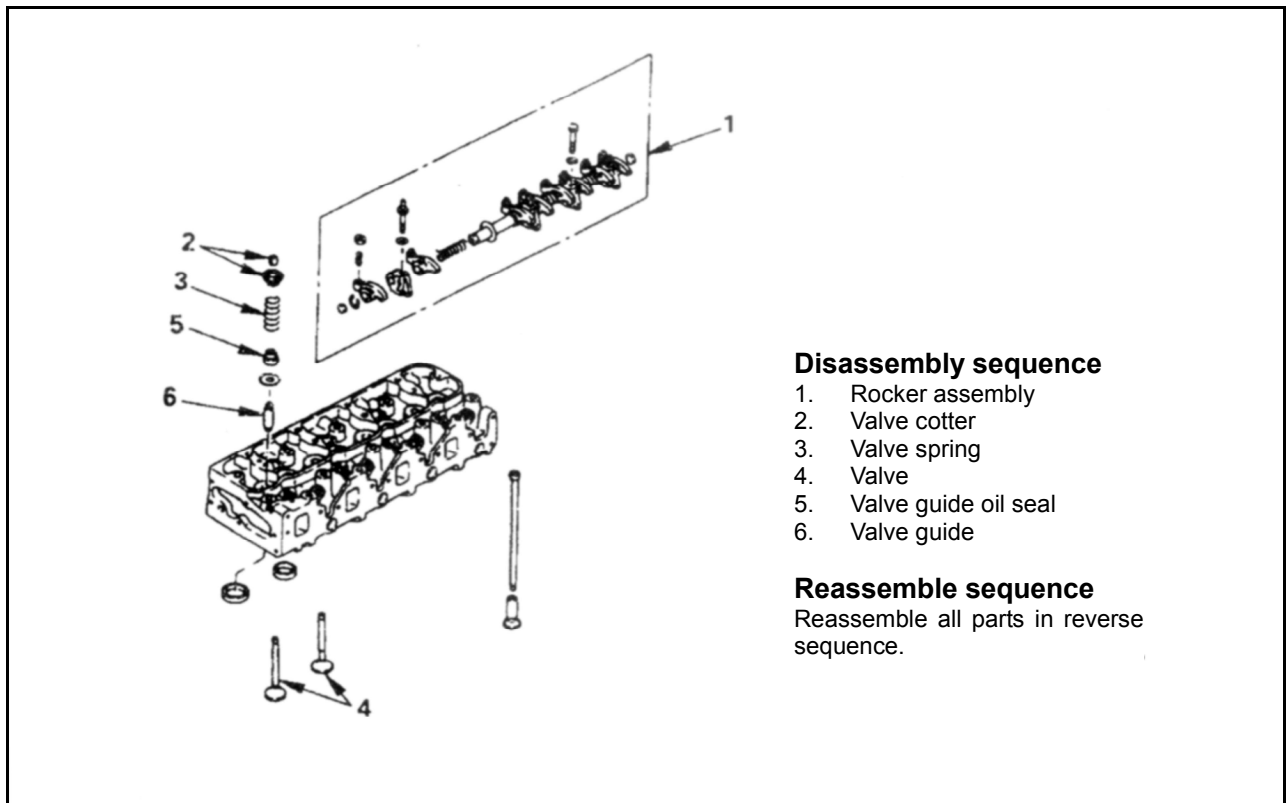
1. Thermostat casing assembly

- Tighten the thermostat casing assembly fixing bolt.

$25 \pm 5 \text{ N} \cdot \text{m}$



2.2 Valve spring, valve guide oil seal, valve guide and push rod



Disassembly

1. Rocker assembly

2. Valve cotter

Use a special tool to compress the valve spring.
Valve spring compressor: 1003015FA-9101

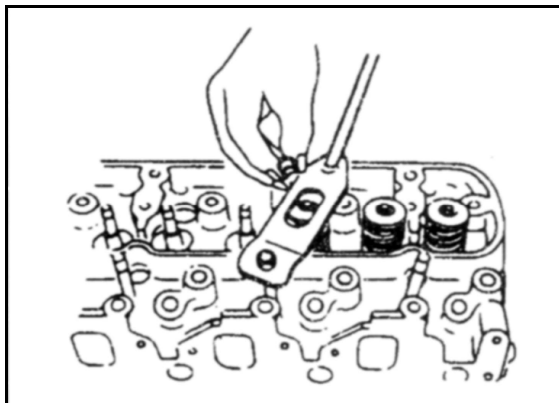
3. Valve spring

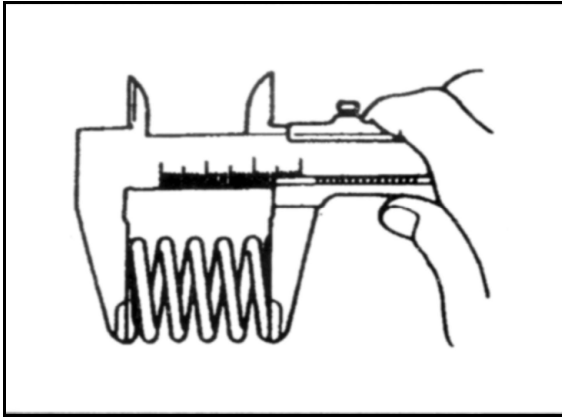
4. Valve

5. Valve guide oil seal

6. Valve guide

Valve guide replacer: 1003102FA-9101





Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

Valve spring

Caution

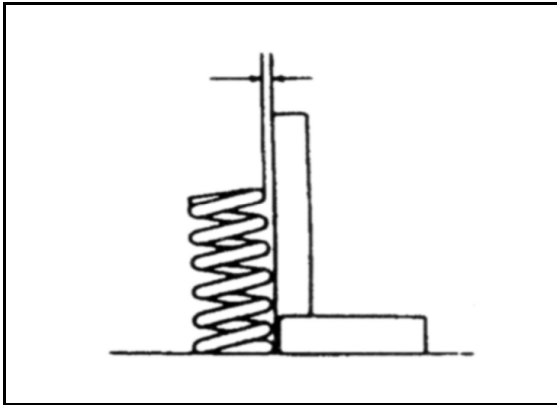
Visually check the valve spring. If there is damage or obvious abnormal abrasion, you should replace it with a new one.

1. Free height

- Measure the free height of valve spring. If the height is less than the specified limit value, the spring shall be replaced.

Free height mm

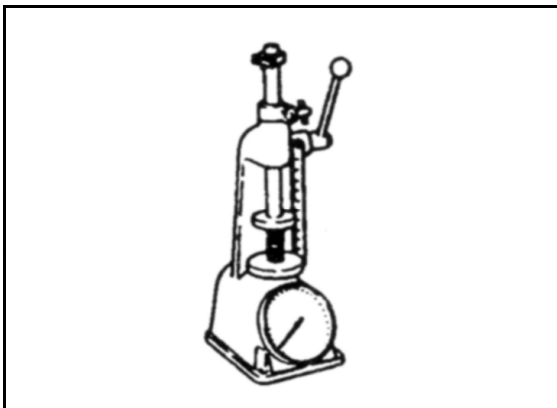
Nominal	Limit
48.0	47.10



2. Squareness

- Use a steel square to measure the squareness of valve spring. The measurement value shall be less than 1.2 mm.
- If measurement value exceeds prescribed limit, the valve spring shall be replaced.

Limit 1.5 mm



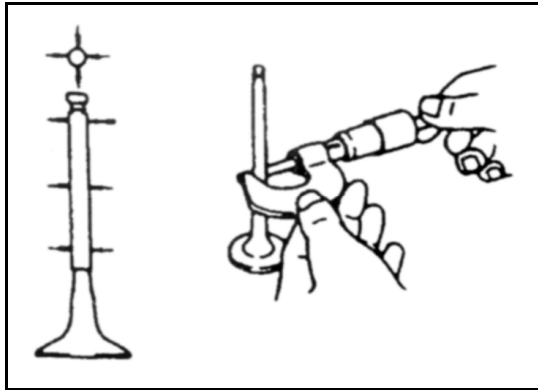
3. Spring tension

- Use a spring tester to compress the spring to the installation height. Measure the compression spring tension.

If the measured tension is lower than the prescribed limit, the spring shall be replaced.

Tension N

Installation height	Nominal	Limit
38.9mm	296	268



Valve guide

Caution

Carefully clean up the carbon deposit at the valve head to protect the valve seat contact surface from damaging.

Carefully check whether there is any damage or abnormal abrasion on the valve stem.

If so, replace the valve and valve guide in pairs.

1. Valve guide clearance

- Use a micrometer to measure the outer diameter of valve stem.

If the out diameter of valve stem is lower than the specified limit, replace the valve and valve guide in pairs.

Mm

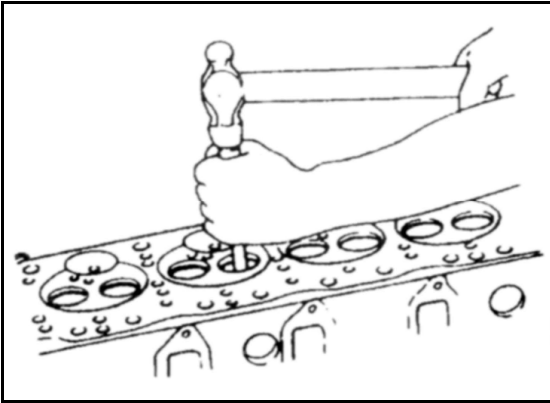
		Nominal	Limit
Valve stem diameter	Intake valve	7.946-7.961	7.880
	Exhaust valve	7.921-7.936	7.850

- Use a micrometer to measure the inner diameter of valve guide.
- Make a subtraction between the valve guide inner diameter and the valve stem outer diameter.

If the subtraction value is lower than the specified limit, replace the valve and valve guide in pairs.

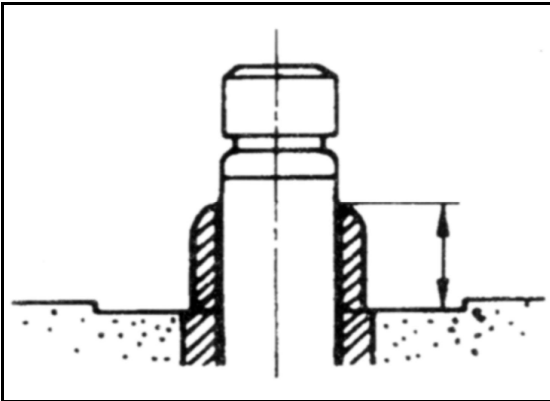
Valve guide clearance mm

	Nominal	Limit
Inlet clearance	0.200	7.880
Exhaust clearance	0.250	7.850



Valve guide replacement

1. Use a special tool to knock the valve guide out from one side of combustion chamber.
Valve guide replacer: 1003102FA-9101



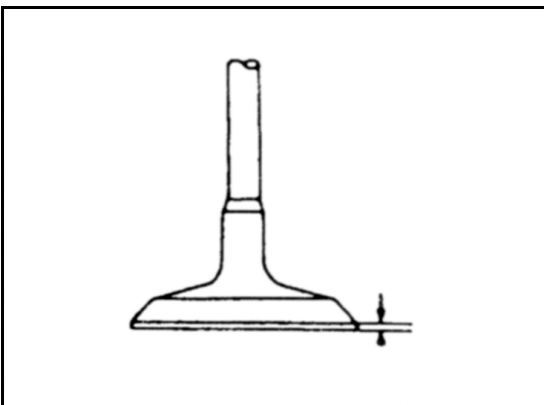
2. Apply oil to the outer surface of valve guide.
Use a special tool to mount a new valve guide from one side of cylinder head upper surface and check the valve guide height.
Valve guide replacer: 1003102FA-9101
Height 13 mm

Note

If a valve guide has been disassembled, you should replace the valve and valve guide in pairs.

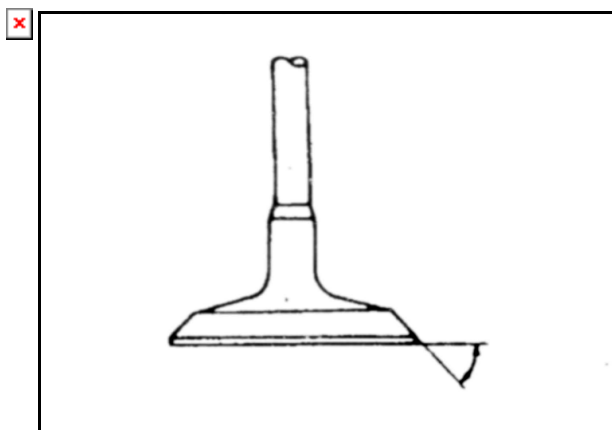
Valve thickness

1. Measure the valve thickness.
2. If the measured value is lower than the specified limit, replace the valve and valve guide in pairs.



Valve thickness mm

	Nominal	Limit
Intake valve	1.76	1.25
Exhaust valve	1.5	



Valve seat conical surface angle on the valve

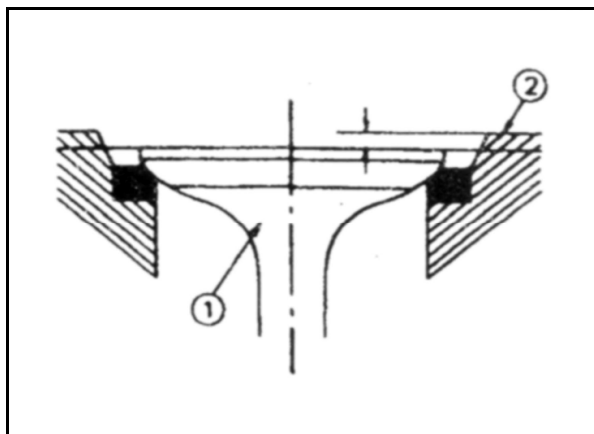
1. Measure the valve seat conical surface angle.
2. If the measurement value exceeds the limit, you should replace the valve, valve guide and valve seat together.

Nominal: 45°

Valve sinkage

1. Mount the valve (1) to the cylinder head (2).
2. Use a depth gauge or a ruler and steel square to measure the valve sinkage from the bottom surface of cylinder head.

If the measurement value exceeds prescribed limit, the valve seat shall be replaced.



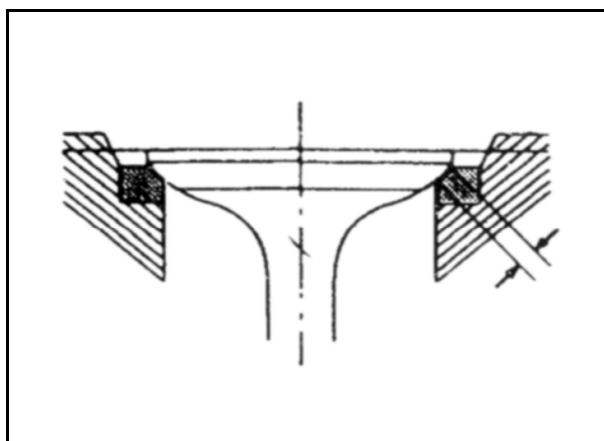
Valve sinkage mm

	Nominal		Limit
	Intake valve	Exhaust valve	
4DA1 Series	0.65	0.65	1.28
			1.20

Valve contact width

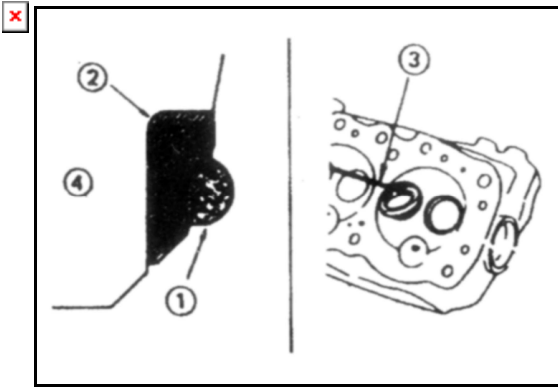
1. Check the roughness and flatness of valve contact surface. Make sure that the contact surface is smooth.
2. Measure the valve contact width.

If the measurement value exceeds prescribed limit, the valve seat shall be replaced.



Contact width mm

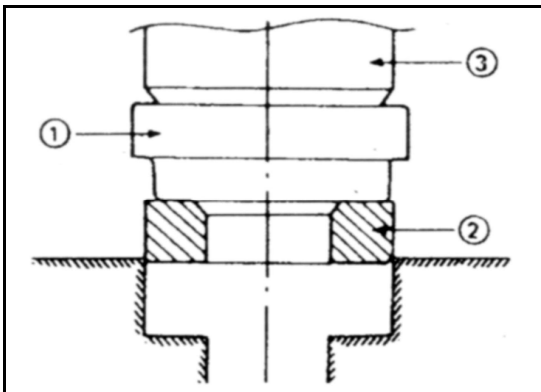
Nominal		Limit
Intake valve	Exhaust valve	
1.7	2	2.2
		2.5



Valve seat replacement

Disassemble valve seat

1. Perform arc welding at the inside periphery ① of valve seat ②.
2. Cool down the valve seat for several minutes.
The contraction will facilitate the disassembly of valve seat.
3. Use a screwdriver ③ to pry off the valve seat.
Carefully pry off it. Otherwise, the cylinder head ④ may be damaged.
4. Carefully clean up carbon deposits and other foreign matters on the valve seat installation hole of cylinder head.



Assemble valve seat

1. Carefully place the attachment ① (its borehole diameter is slightly less than that of valve seat) on the valve seat ②.

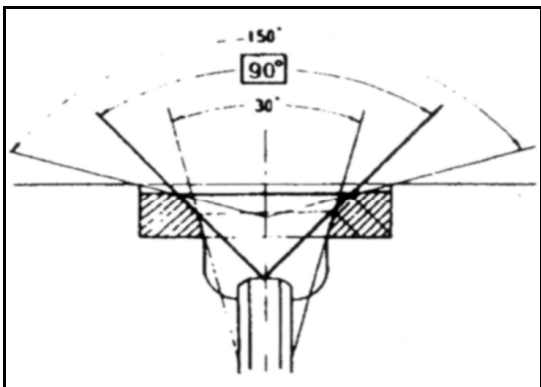
Note

Make the smooth side of attachment contact with the valve seat.

2. Use a table press ③ to gradually press the attachment until the valve seat seats in place.

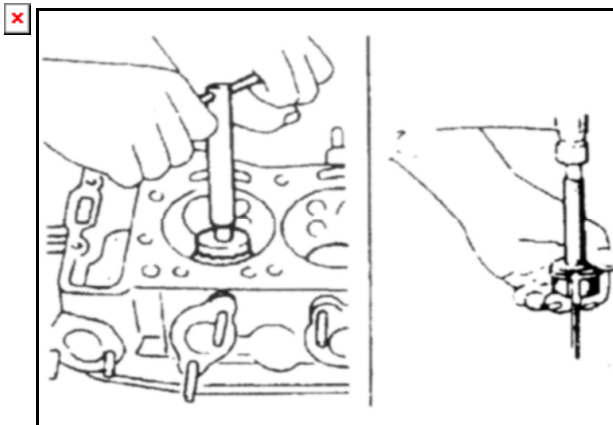
Note

Never apply excess compressive force on the valve seat when you use a table press. Otherwise, the valve seat may be damaged.



Valve seat correction

1. Clean up the carbon deposit on valve seat surface.
2. Use a milling cutter (blade angle of 15° , 45° and 75°) to minimize abrasion and rough areas of valve seat so that the contact width reaches the nominal value.
You should only eliminate abrasion and rough areas. Don't cut off too much. Carefully avoid cutting off good areas on valve seat surface.

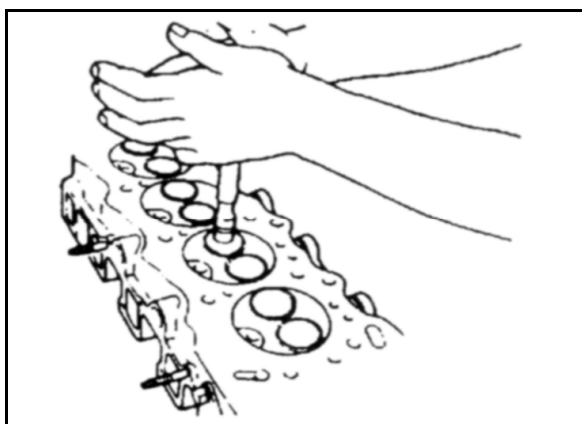


Valve seat angle: 45°

Note

You may use an adjustable milling cutter guide lever. It is not allowed to stir the milling cutter guide lever in the valve guide hole.

3. Apply grinding paste on valve seat surface.
4. Insert the valve into the valve guide.
5. Turn the valve for perfect fitting with the valve seat while tapping it from top or bottom.
6. Check the valve contact width is proper.
7. Check whether the valve seat surface has completely contacted with the whole valve periphery.



Bending of push rod

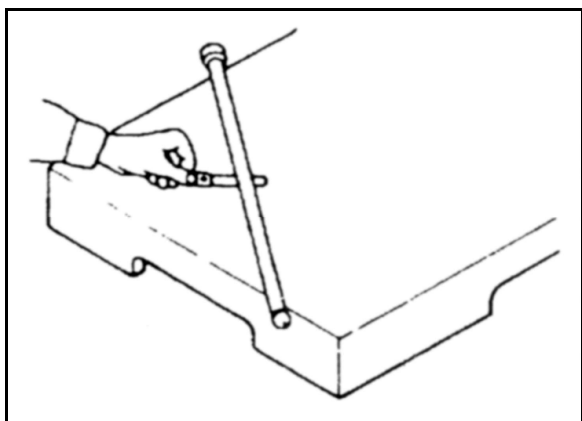
1. Put the push rod on a platform.
2. Roll the push rod along the platform and use a feeler gauge to measure bending of push rod. If the measurement value exceeds prescribed limit, the push rod shall be replaced.

Push rod bending limit:

0.4 mm or less

3. Visually check whether there is any excess abrasion or damage at both ends of push rod.

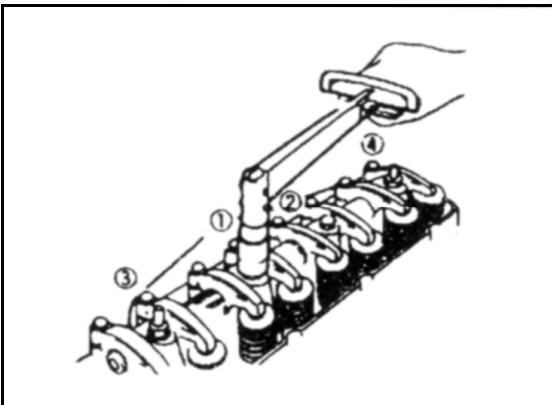
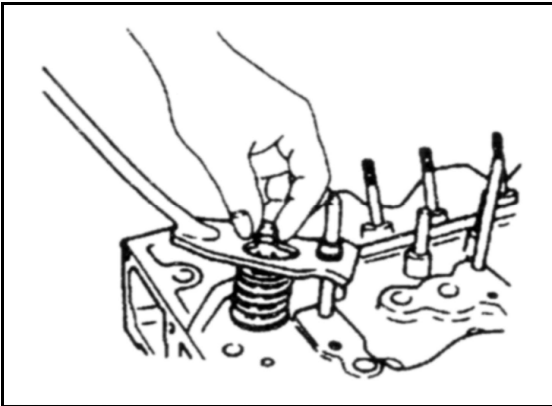
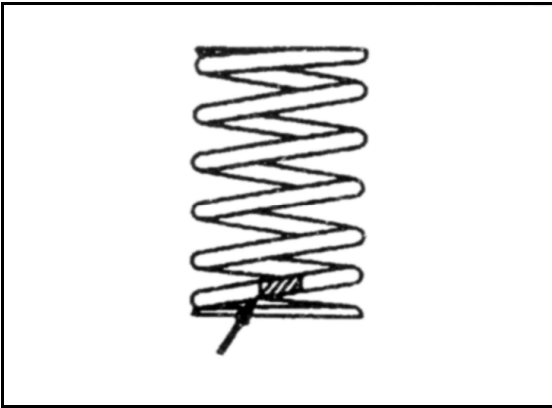
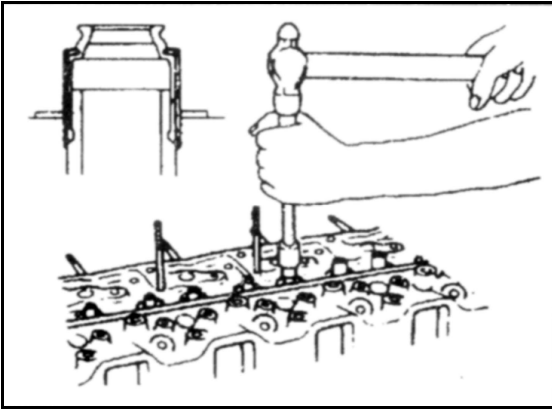
If so, replace the push rod.



Reassembly

6. Valve guide

- Apply oil to the outer surface of valve guide. Use a special tool to mount a new valve guide from one side of camshaft.



Valve guide replacer: 1003102FA-9101

5. Valve guide oil seal

- Press in a new oil seal with a special tool.
Oil seal erector: 1003016FA-9101

4. Valve

- Apply oil to the outer surface of valve stem.

3. Valve spring

- Mount the valve spring on the upper spring seat. The section with painting on the valve spring shall be placed downwards (i.e. the spring with less pitch placed downwards).

2. Valve cotter

- Use a spring compressor to press the valve spring to a proper position.
- Mount the spring seat and valve cotter.
- Use a soft-faced hammer to slightly tap the cotter head until it seats in place.

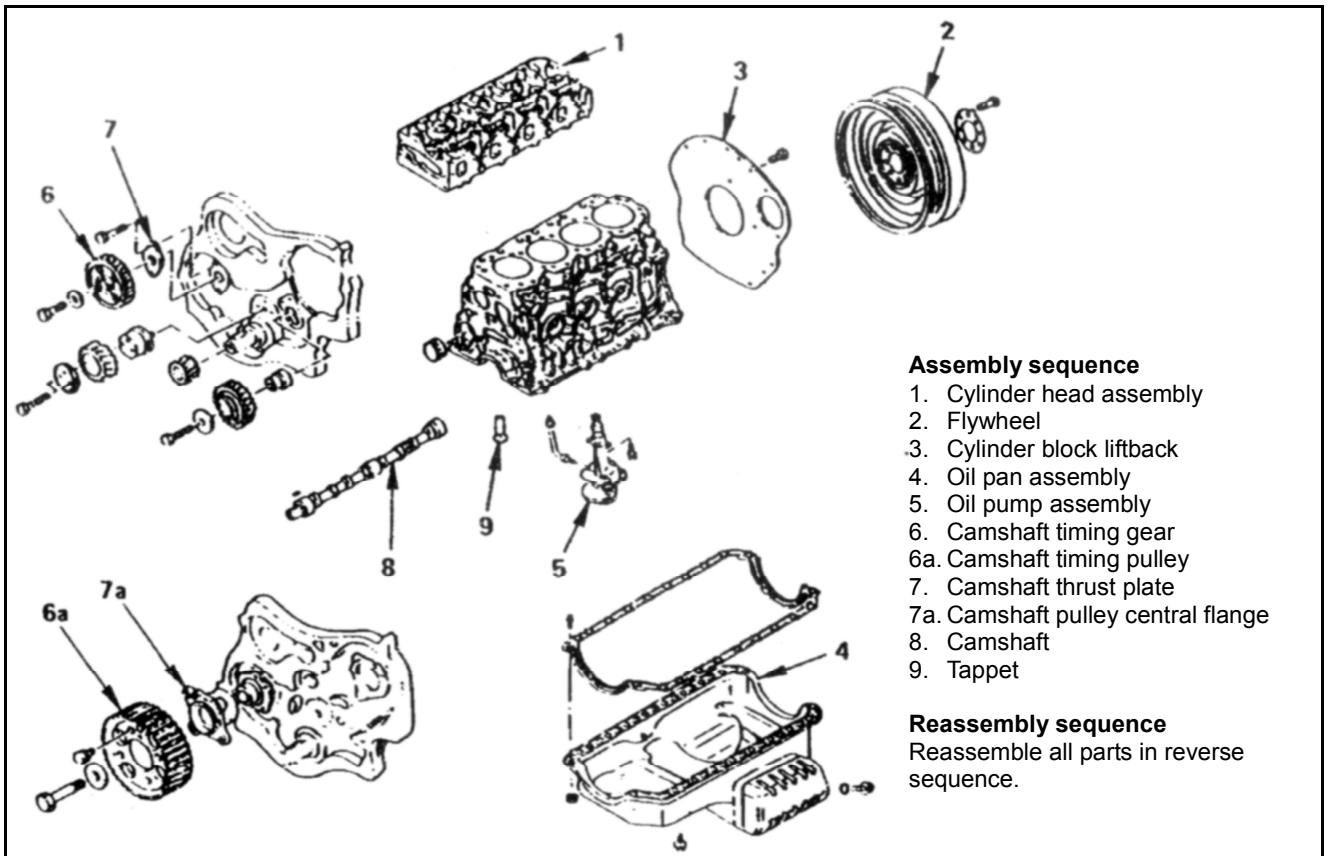
Valve spring compressor: 1003015FA-9101

1. Rocker assembly

Installation torque: $55 \pm 5 \text{ N} \cdot \text{m}$



2.3 Camshaft and tappet



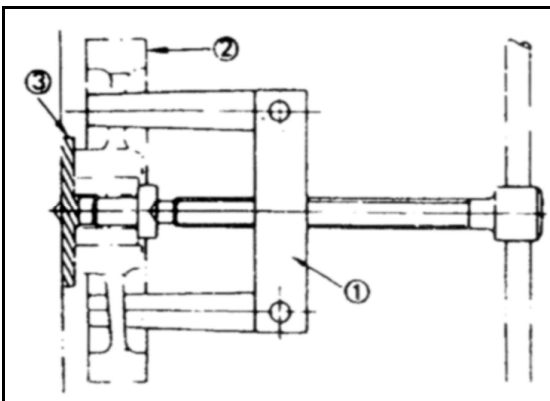
Disassembly

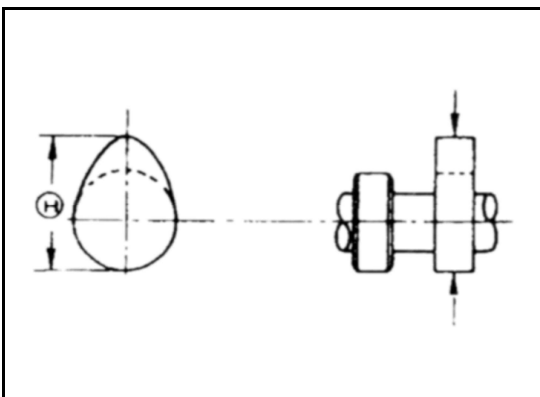
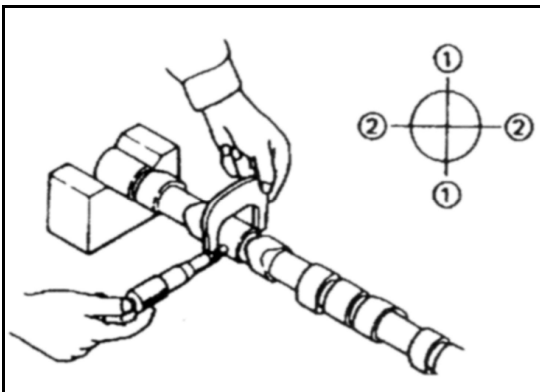
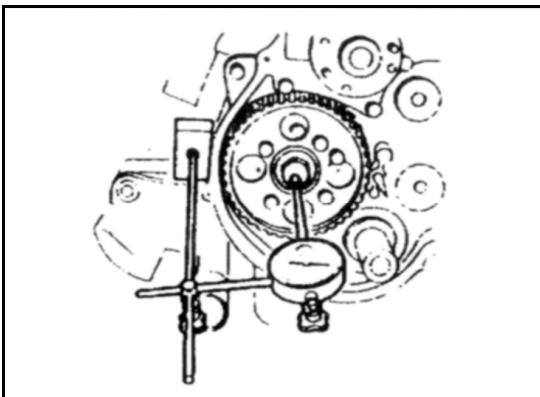
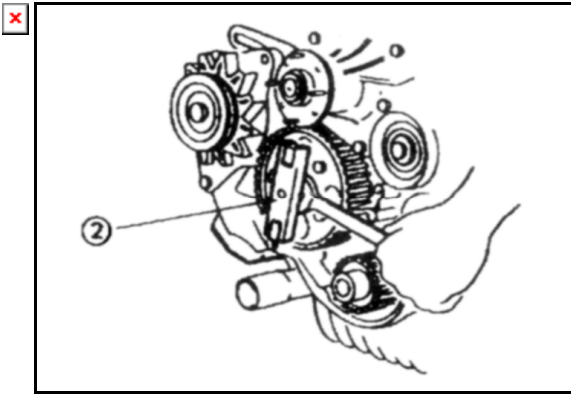
1. Cylinder head assembly
2. Flywheel
3. Flywheel baffle
4. Oil pan assembly
5. Oil pump assembly
6. Camshaft timing gear
 - Remove camshaft timing gear bolt(s) from the camshaft.

Note

Fasten the camshaft to avoid turning.

- Pull out camshaft timing gear ② with a universal puller ①. Universal puller: 1007017FA-9101
- Remove the thrust washer ③.





7. Camshaft thrust washer

8. Camshaft

9. Tappet

Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

1. Measure the camshaft thrust clearance

- Measure the camshaft axial clearance with a dial gauge.

This shall be done before disassembling the camshaft gear.

If the camshaft axial clearance exceeds prescribed limit, the thrust washer shall be replaced.

Camshaft axial clearance mm

Nominal	Limit
0.005-0.114	0.2

2. Camshaft journal outer diameter

- Use a micrometer to measure the outer diameter of each camshaft journal in direction ① and ②. If the measurement value exceeds prescribed limit, the camshaft shall be replaced.

Journal outer diameter mm

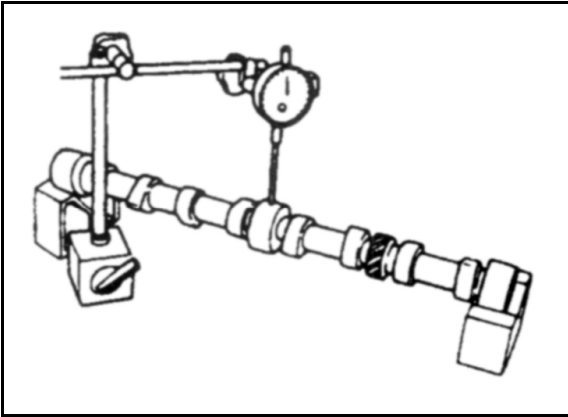
Nominal	Limit
49.945—49.975	49.60

3. Cam height

- Use a micrometer to measure the cam height
a. If the measurement value is lower than the prescribed value, the cam shall be replaced.

Cam height mm

Nominal	Limit
42.02±0.05	41.65



4. Camshaft radial runout

- Put the camshaft on a V block.
- Measure the radial runout with a dial gauge.

If the measurement value exceeds prescribed limit, the camshaft shall be replaced.

Radial runout mm

Nominal	Limit
0.04 or less	0.10

5. Camshaft and camshaft bearing clearance

- Measure the camshaft bearing inner diameter with a dial gauge.

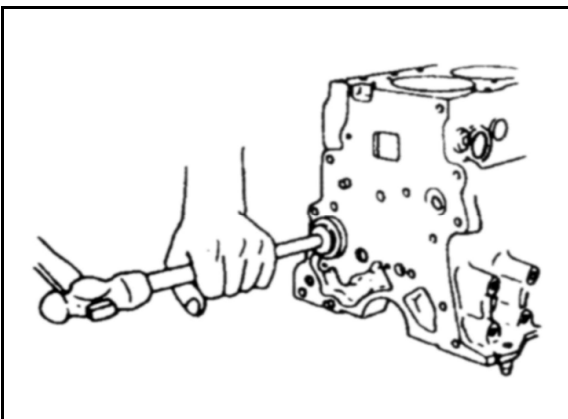
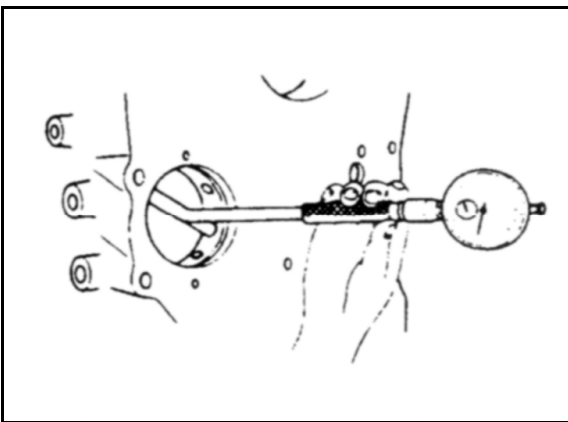
Camshaft bearing inner diameter mm

Nominal	Limit
50.00—50.03	50.08

Camshaft bearing clearance mm

Nominal	Limit
0.025—0.080	0.12

If the camshaft bearing inner diameter or the journal clearance exceeds the prescribed values, the camshaft bearing shall be replaced.



Camshaft bearing replacement



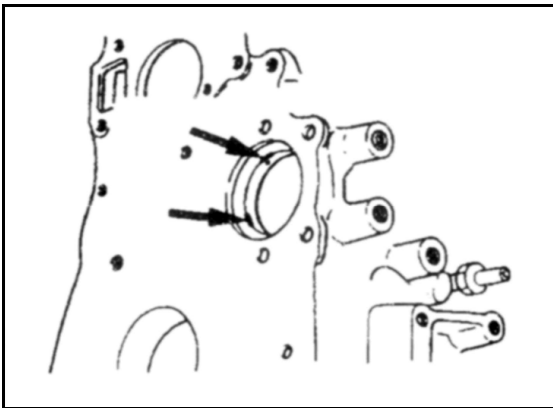
Camshaft bearing disassembly

1. Remove cylinder block stopper.
2. Disassemble the camshaft bearing with a camshaft bearing replacer.



Camshaft bearing replacer:

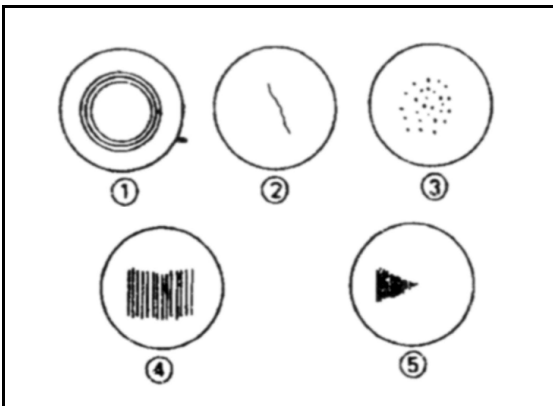
1002107FA-9101



Camshaft bearing assembly

1. Align the oil hole on the bearing to the oil hole on the cylinder block.
2. Mount the camshaft bearing with a camshaft bearing replacer.

Camshaft bearing replacer: 1002107FA-9101



Tappet

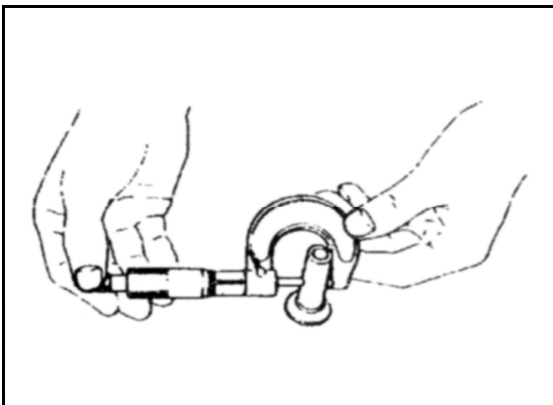
Visually check whether there is any point corrosion, crack and other abnormalities on contact surface between the camshaft and tappet. If so, replace the tappet.

See left figure.

- ① Normal contact
- ② Crack
- ③ point corrosion
- ④ Abnormal contact
- ⑤ Abnormal contact

Note

The tappet has spherical surface. Never use an oilstone or similar tools to grind the spherical surface when you repair the tappet. If the tappet is damaged, you must replace it with a new one.

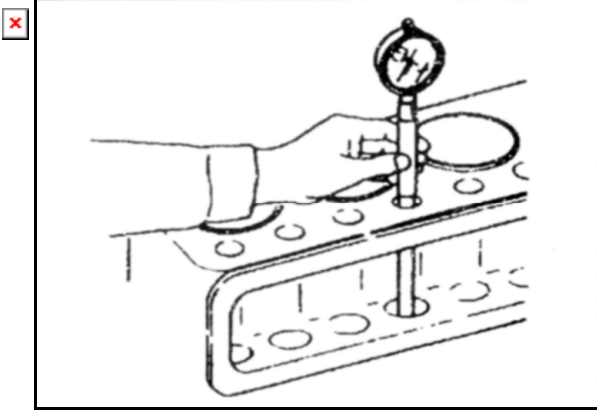


Tappet outer diameter

1. Measure the tappet outer diameter with a dial gauge. If the measurement value exceeds prescribed limit, the tappet shall be replaced.

Tappet outer diameter mm

Nominal	Limit
12.72—12.90	12.70



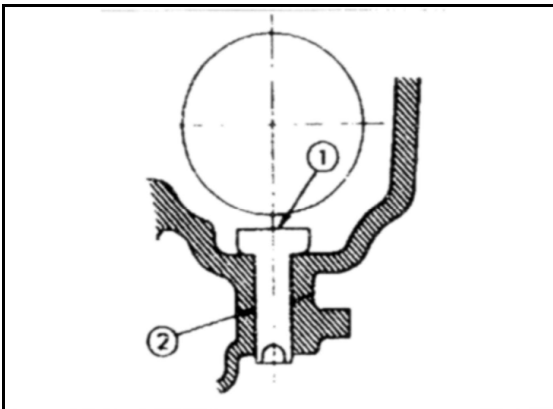
2. Measure the upper tappet installation hole inner diameter on the cylinder block and calculate the clearance.

If the clearance exceeds the limit value, replace the tappet and/or cylinder block.

Clearance between the tappet and tappet hole

mm

Nominal	Limit
0.010-0.046	0.10



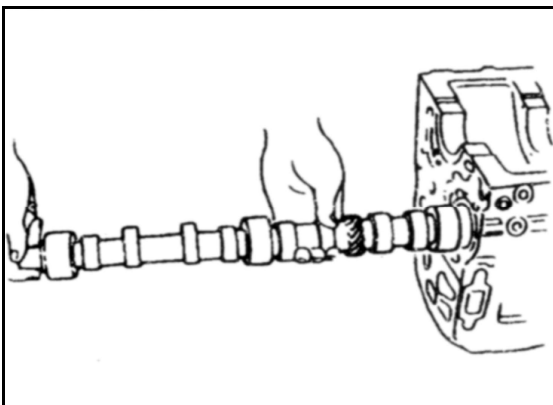
Reassembly

9. Tappet

- 1) Apply oil to the tappet ① and in the upper tappet installation hole on the cylinder block.
- 2) Determine the tappet position according to the identification made in disassembling (if the tappet is newly used).

Note

The tappet shall be installed before assembling the camshaft.



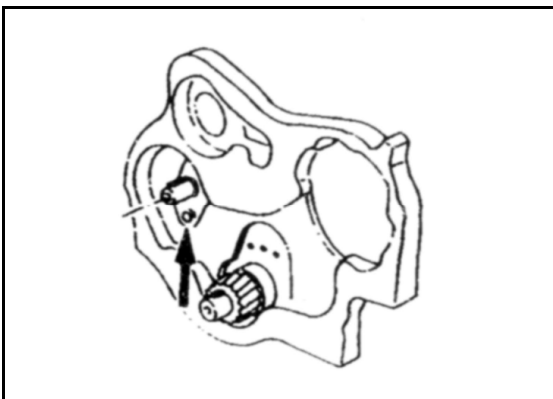
8. Camshaft

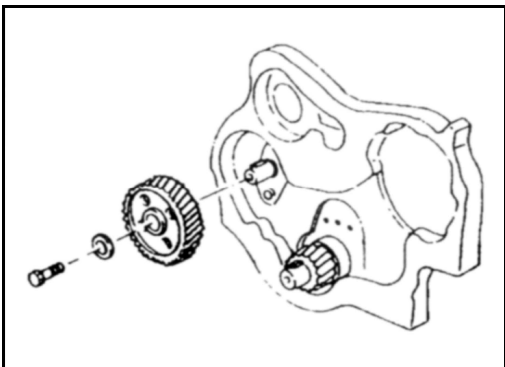
- 1) Apply oil to the camshaft and camshaft bearing.
 - 2) Install the camshaft to the cylinder block.
- Be careful not to damage the camshaft bearing.

7. Camshaft thrust washer

Mount the thrust washer to the cylinder block and tighten the thrust washer bolt (s) to specified torque.

Thrust washer bolt torque : $25 \pm 5 \text{ N} \cdot \text{m}$

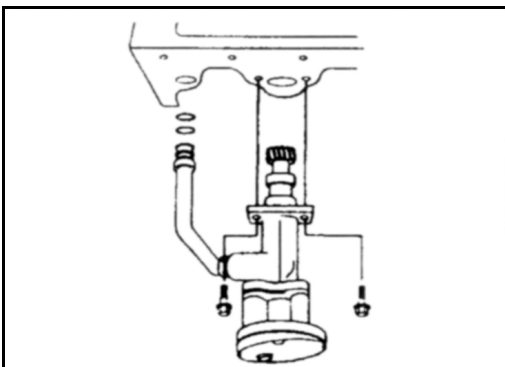




6. Camshaft timing gear

- 1) Install camshaft timing gear to the camshaft. The timing gear mark ("Y-Y") shall face outwards.
- 2) Tighten the timing gear bolt to the specified torque.

Timing gear bolt torque $110 \pm 10 \text{ N} \cdot \text{m}$



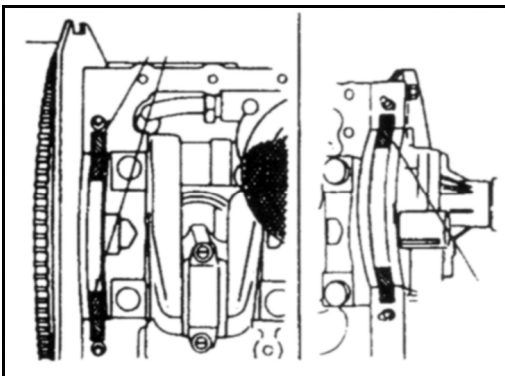
5. Oil pump assembly

- Apply some oil on the oil pipe O-ring and mount it to the cylinder block O-ring groove.
- Install the oil pump assembly and oil outlet pump to the cylinder block. Tighten the fixing bolt(s) to specified torque.

$25 \pm 5 \text{ N} \cdot \text{m}$

- Tighten sleeve nut(s) to the following specified torque:

$30 \pm 5 \text{ N} \cdot \text{m}$

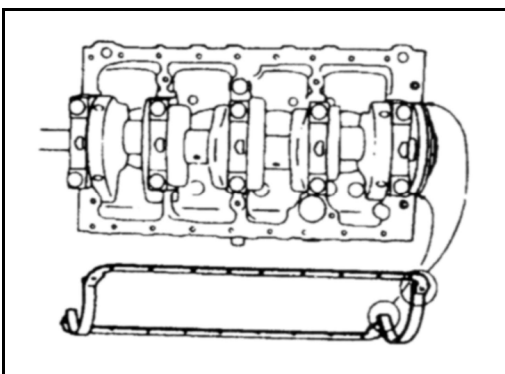


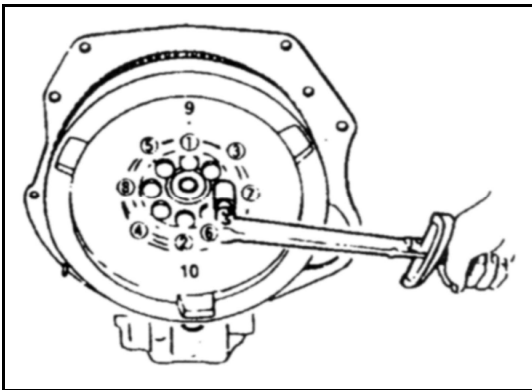
4. Oil pan assembly

As shown in the figure, apply recommended silica gel (Loctite 598) or equivalent in alignment on the arc area of the fifth bearing cap, groove, the arc area of timing gear casing and oil pan gasket.

- Mount the rear lip of seal washer into the groove of the fifth bearing cap.
- Make sure the lip perfectly contacts with the groove.
- Install the oil pan to the cylinder block.
- Tighten oil pan bolt(s) to the specified torque.

Oil pan bolt torque $23.5 \pm 3.5 \text{ N} \cdot \text{m}$





3. Flywheel baffle

- Tighten the flywheel baffle fixing bolts to the specified torque.

Flywheel baffle bolt torque $85 \pm 10 \text{ N} \cdot \text{m}$

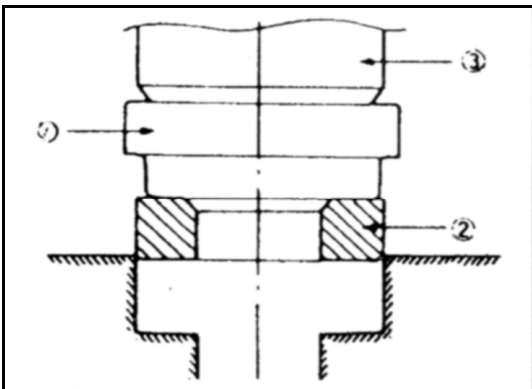
2. Flywheel

- Apply some oil to fixing bolts.
- Screw down the flywheel bolts to the specified torque in two steps by torque tightening method.

Tighten them as the sequence number shown in the figure.

Flywheel bolt torque $\text{N} \cdot \text{m}$

Step 1	Step 2	Step 3
25	70	120 ± 10



1. Cylinder head assembly

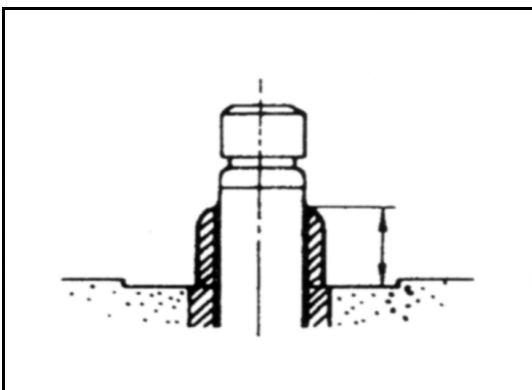
- Assemble the valve seat

- Carefully place the attachment ① (its outer diameter is less than that of valve seat) on the valve seat ②.

Note

Make the smooth side of attachment contact with the valve seat.

- Use a table press ③ to gradually press the attachment until the valve seat seats in place.

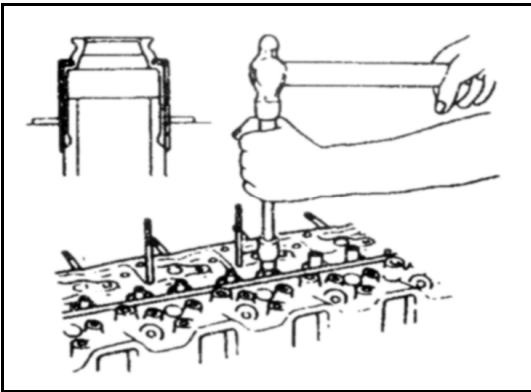


Note

Never apply excess compressive force on the valve seat when you use a table press. Otherwise, the valve seat may be damaged.

Measure the upper height of valve guide from the upper surface of cylinder head.

Upper height of valve guide (H) (reference value):
13 mm



Note

If a valve guide has been disassembled, you should replace the valve and valve guide in pairs.

2) Lower spring seat

3) Valve stem oil seal

- Mount a new oil seal to the valve.
- Use a special tool to guide.

Oil seal erector: 1003016FA-9101

4) Valve

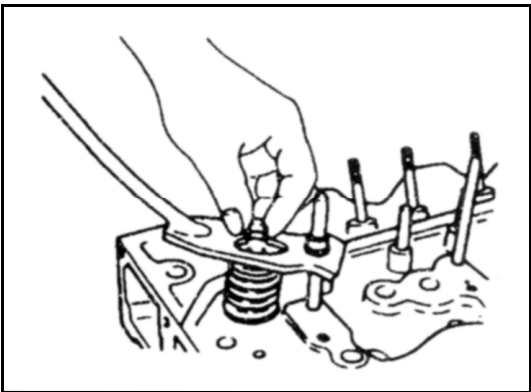
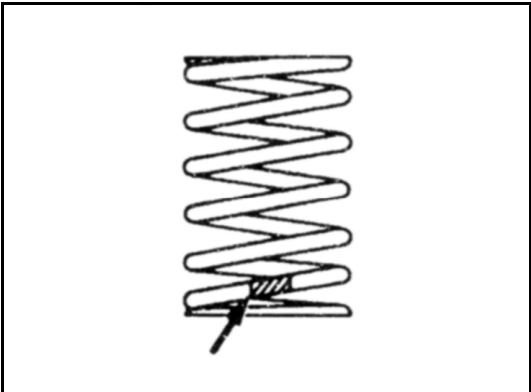
5) Valve spring

- Mount the valve spring on the upper spring seat.

Caution

- The section with painting on the valve spring shall be placed downwards.
- Supply compressed air from glow plug hole to cylinder until the valve seats in place.
- Install the valve cotter with a special tool.

Valve spring compressor: 1003015FA-9101



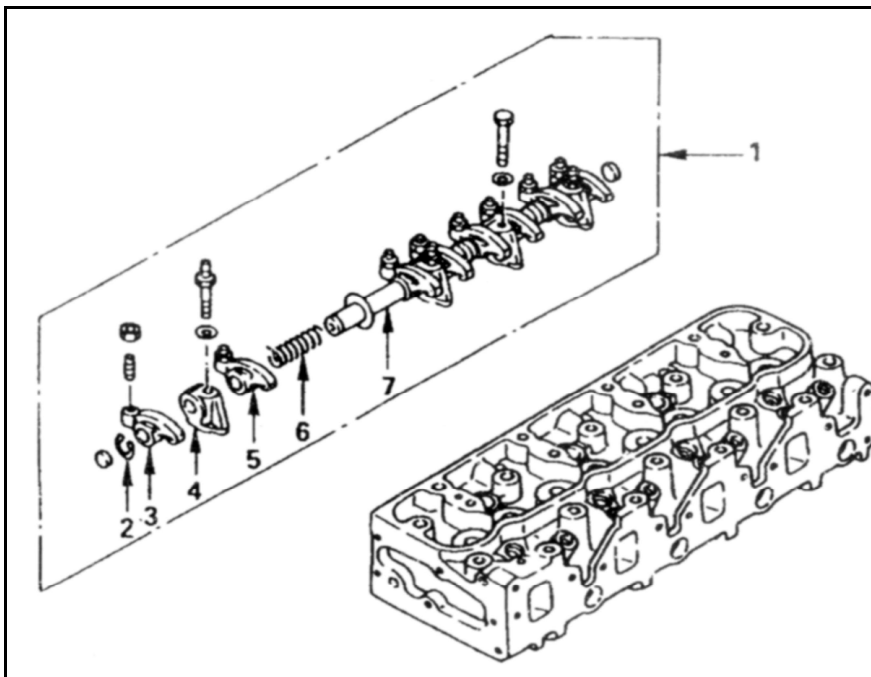
6) Valve cotter

- Use a spring compressor to press the spring in place.
- Mount the spring seat and valve cotter.
- Use a soft-faced hammer to tap the cotter head until it seats in place.

Valve spring compressor: 1003015FA-9101



2.4. Rocker arm assembly



Disassembling sequence:

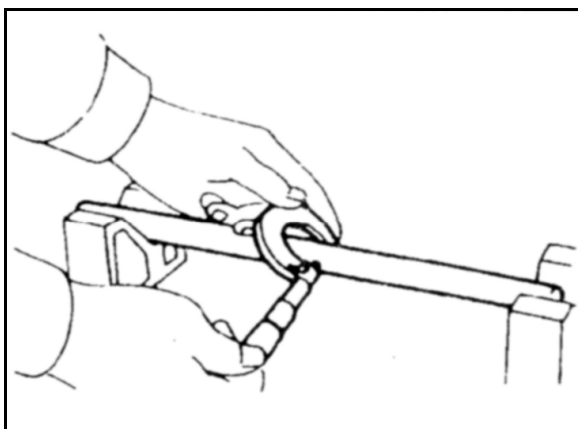
1. Rocker shaft assembly
2. Rocker shaft elastic retainer
3. Rocker arm
4. Rocker shaft support
5. Rocker arm
6. Rocker shaft spring
7. Rocker shaft

Reassembling sequence:

Reassemble all parts in reverse sequence.

Disassembly

1. Rocker shaft assembly
2. Elastic retainer of rocker shaft
3. Rocker arm
4. Rocker shaft retainer
5. Rocker arm
6. Rocker shaft spring
7. Rocker shaft



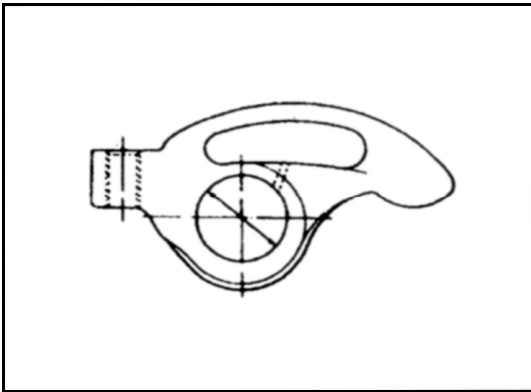
Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

Measure the outer diameter of rocker shaft at its swinging position with a dial gauge.

Replace the rocker shaft if the diameter exceeds prescribed limit.

mm.	
Nominal	Limit
18.98—19.00	18.9



Oil film clearance

1. Measure the inner diameter of rocker shaft hole with a vernier caliper or dial gauge.

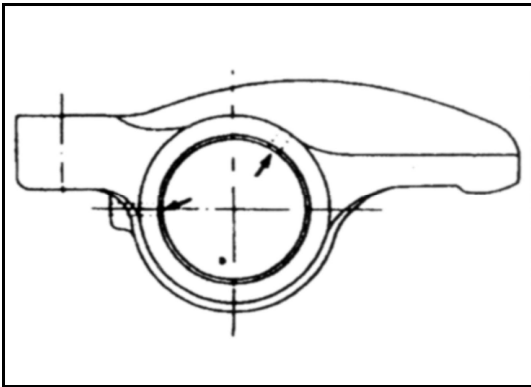
Inner diameter of rocker shaft hole mm

Nominal	Limit
19.010—19.030	19.100

2. Measure the outer diameter of rocker shaft. If the measured value exceeds prescribed limit, replace rocker arm or rocker shaft.

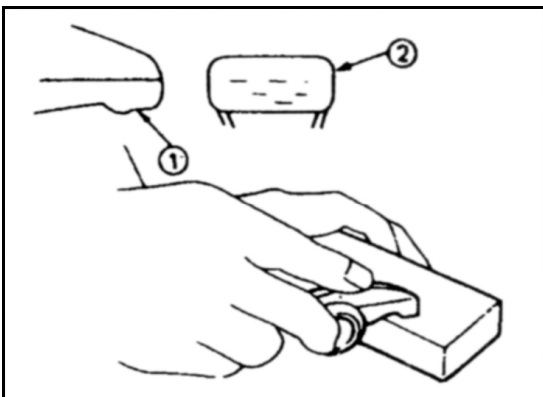
Clearance between rocker arm and rocker shaft mm

Nominal	Limit
0.01—0.05	0.10



3. Check the upper oil hole of rocker arm is blocked.

Blow clean the oil hole of rocker shaft with compressed air if necessary.

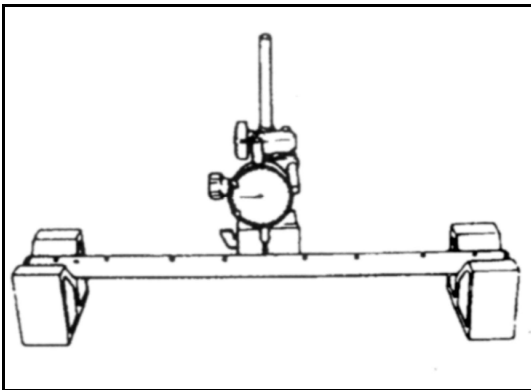


Rocker arm correction

Check there is abrasion or scratch with the upper valve stem contact surface.

If there is slight abrasion or scratch of step shape with the contact surface, polish it with oil.

The rocker arm has to be replaced if this abrasion or scratch is serious.



Radial runout of rocker shaft

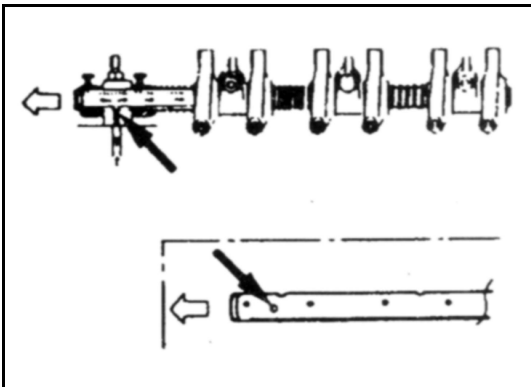
1. Put the rocker shaft on a V block.
2. Measure the radial runout at middle part of rocker shaft with a dial gauge.

If the radial runout is slight, correct this runout with a table press.

If the radial runout of rocker shaft exceeds prescribed limit, the rocker shaft has to be replaced.

Radial runout of rocker shaft mm

Limit
0.2



Reassembly

7. Rocker shaft

- Apply a thin layer of oil to the rocker shaft.
- The rocker shaft should be placed in such a way that the bigger hole ($\varnothing 4$) faces the engine forepart.
- Install the rocker shaft, rocker shaft retainer and spring together.

6. Rocker shaft spring

5. Rocker arm

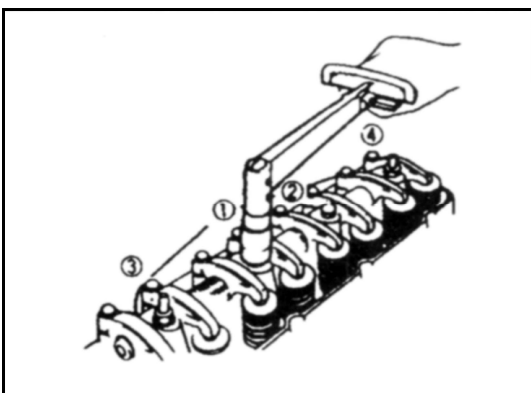
4. Rocker shaft retainer

3. Rocker arm

2. Elastic retainer of rocker shaft

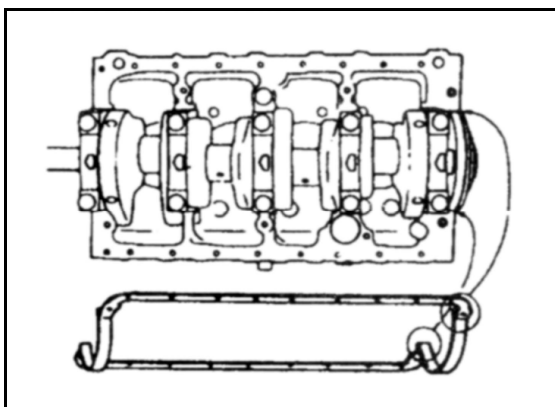
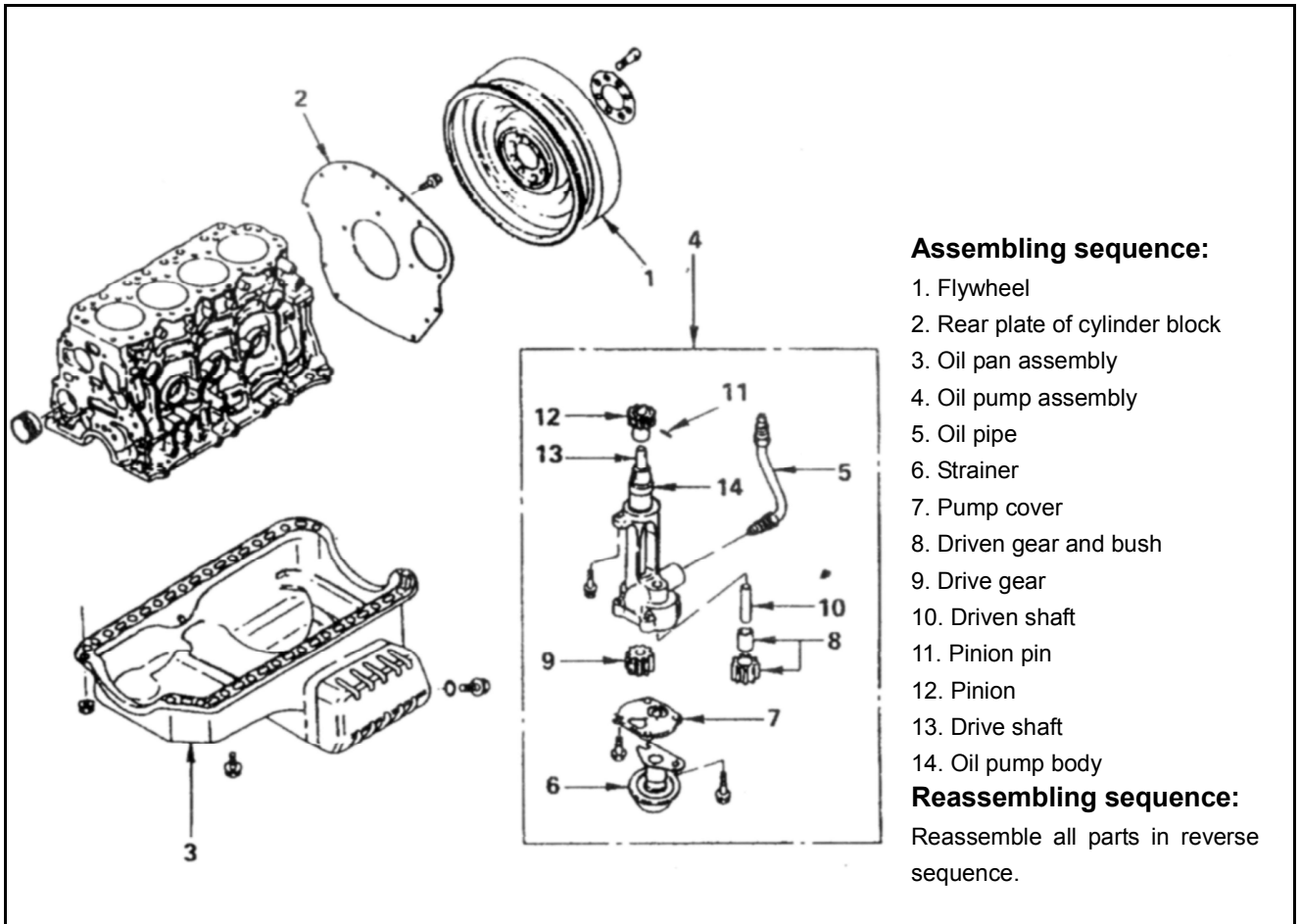
1. Rocker shaft assembly

- Install the rocker shaft assembly on the cylinder head.
- Tighten the flywheel baffle fixing bolts to the specified torque.



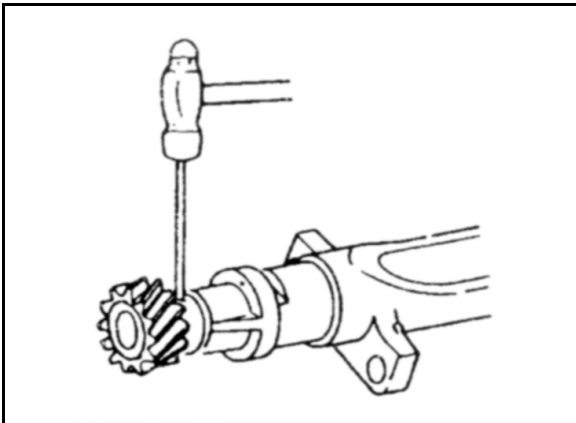


2.5 Oil pump

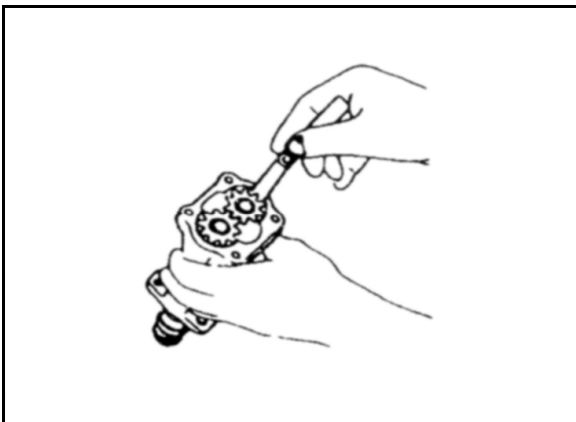


Disassembly

1. Flywheel
2. Flywheel baffle
3. Oil pan assembly



4. Oil pump assembly
5. Oil pipe
6. Strainer
7. Pump cover
8. Driven gear and bush
9. Drive gear
10. Driven shaft
11. Pinion pin
 - File flat the tip of pinion stop pin.
 - Knock out the pinion pin with a hammer and bar.
 - Remove the pinion.
12. Pinion
13. Drive shaft
14. Oil pump body



Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

Housing and gear

The oil pump assembly must be replaced if one of the following conditions is found:

- The driven gear sleeve is worn or damaged seriously.
- The upper gear teeth is worn or damaged seriously.

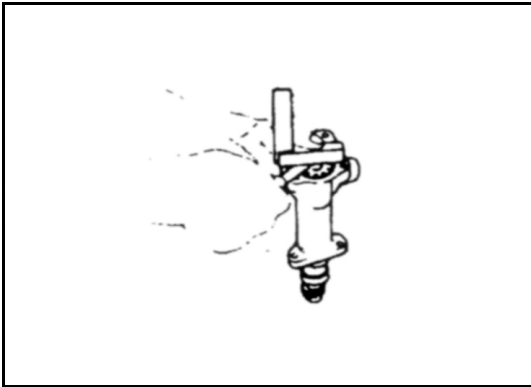
Clearance between upper gear teeth and inner housing wall

- Measure the clearance between upper gear teeth and inner housing wall with a clearance gauge.
- If the clearance between upper gear teeth and inner housing wall exceeds prescribed limit, either the gear or housing has to be replaced.

Clearance between upper gear teeth and inner housing wall

mm

Nominal	Limit
0.14	0.20

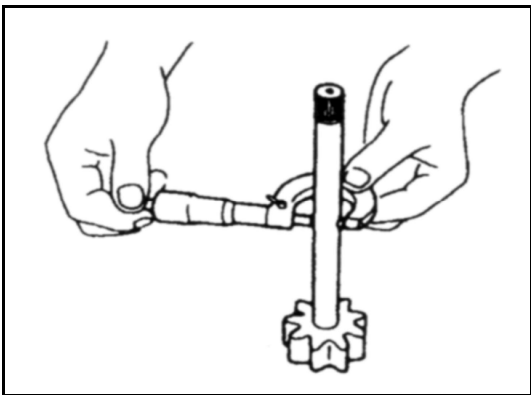


Clearance between gear and cover

- Measure the clearance between gear and cover with a clearance gauge.
- If the clearance between gear and cover exceeds prescribed limit, the housing must be replaced.

Clearance between gear and cover mm

Nominal	Limit
0.06	0.15

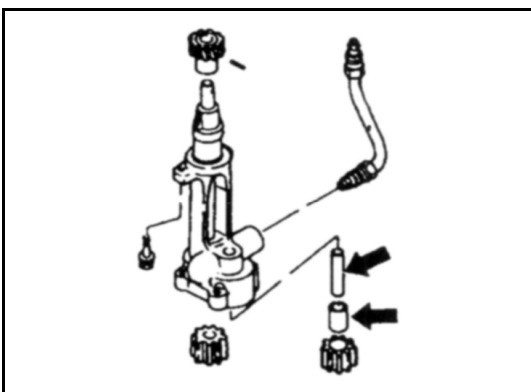


Clearance between drive shaft and oil pump body

- Use a micrometer to measure the borehole diameter of drive shaft.
- Measure the inner diameter of pump body with a dial gauge.
- If the Clearance between drive shaft and oil pump body exceeds prescribed limit, the oil pump assembly has to be replaced.

Clearance between drive shaft and oil pump body mm

Nominal	Limit
0. 04	0. 20



Clearance between driven shaft and bush

- Use a micrometer to measure the outer diameter of driven shaft.
- Measure the inner diameter of bush with a dial gauge.
- If the clearance between driven shaft and bush exceeds prescribed limit, the bush must be replaced.

Clearance between driven shaft and bush mm

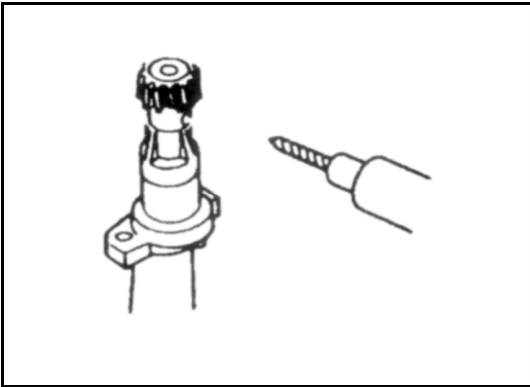
Nominal	Limit
0.05	0.15

Reassembly

14. Oil pump body

13. Drive shaft

12. Pinion



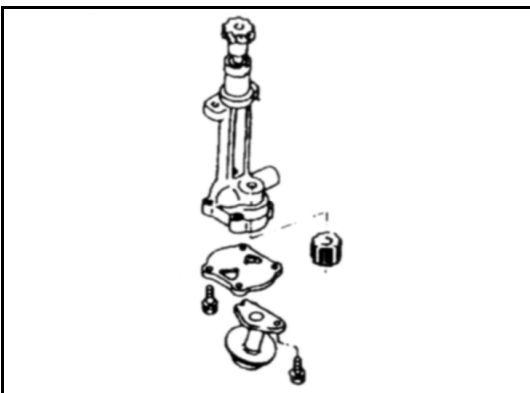
11. Pinion pin

- Install new drive shaft on the pump body.
- Install the pinion on the drive shaft.
- Drill a hole with $\phi 5\text{mm}$ (0.20in) bore bit for the pinion and drive shaft to pass through.
- Insert the pinion pin into the hole.
Rivet the pin.

10. Driven shaft

9. Drive gear

8. Driven gear and bush



7. Pump cover

6. Strainer assembly

- Mount the strainer assembly and screw down its fixing bolts.

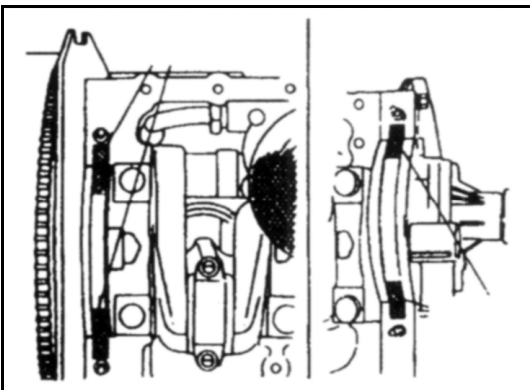
20±5 N·m

5. Oil pipe

4. Oil pump assembly

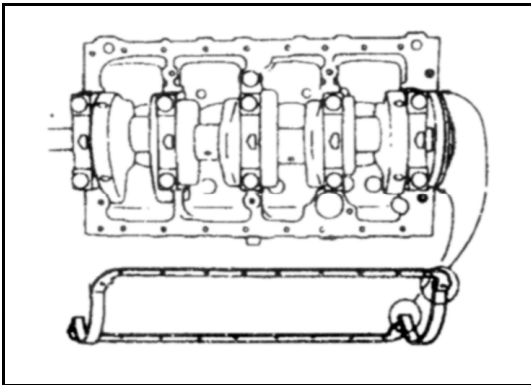
- Apply oil containing molybdenum to the oil pump driven gear and camshaft drive gear.
- Tighten the oil pump fixing bolts to the specified torque.

20±5 N·m



3. Oil pan assembly

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.

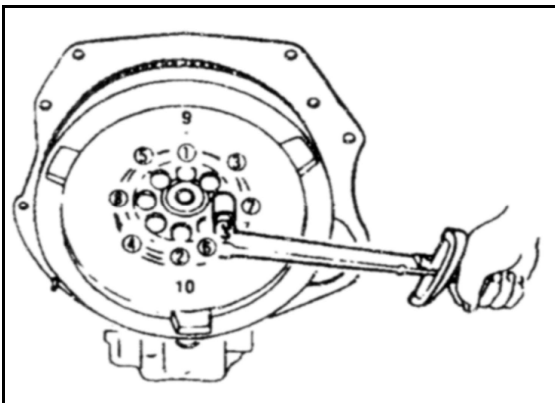


- Mount the rear lip of seal washer into the groove of the fifth bearing cap.
- Make sure that the lip is perfectly in contact with the groove.
- Install the oil pan on the cylinder block.
- Tighten oil pan bolt(s) to the specified torque.

Oil pan bolt torque: $23.5 \pm 3.5 \text{ N}\cdot\text{m}$

2. Flywheel baffle

- Align the flywheel baffle with the anchor pin of cylinder block, and tighten flywheel baffle bolt(s) to the specified torque: $85 \pm 10 \text{ N}\cdot\text{m}$



1. Flywheel

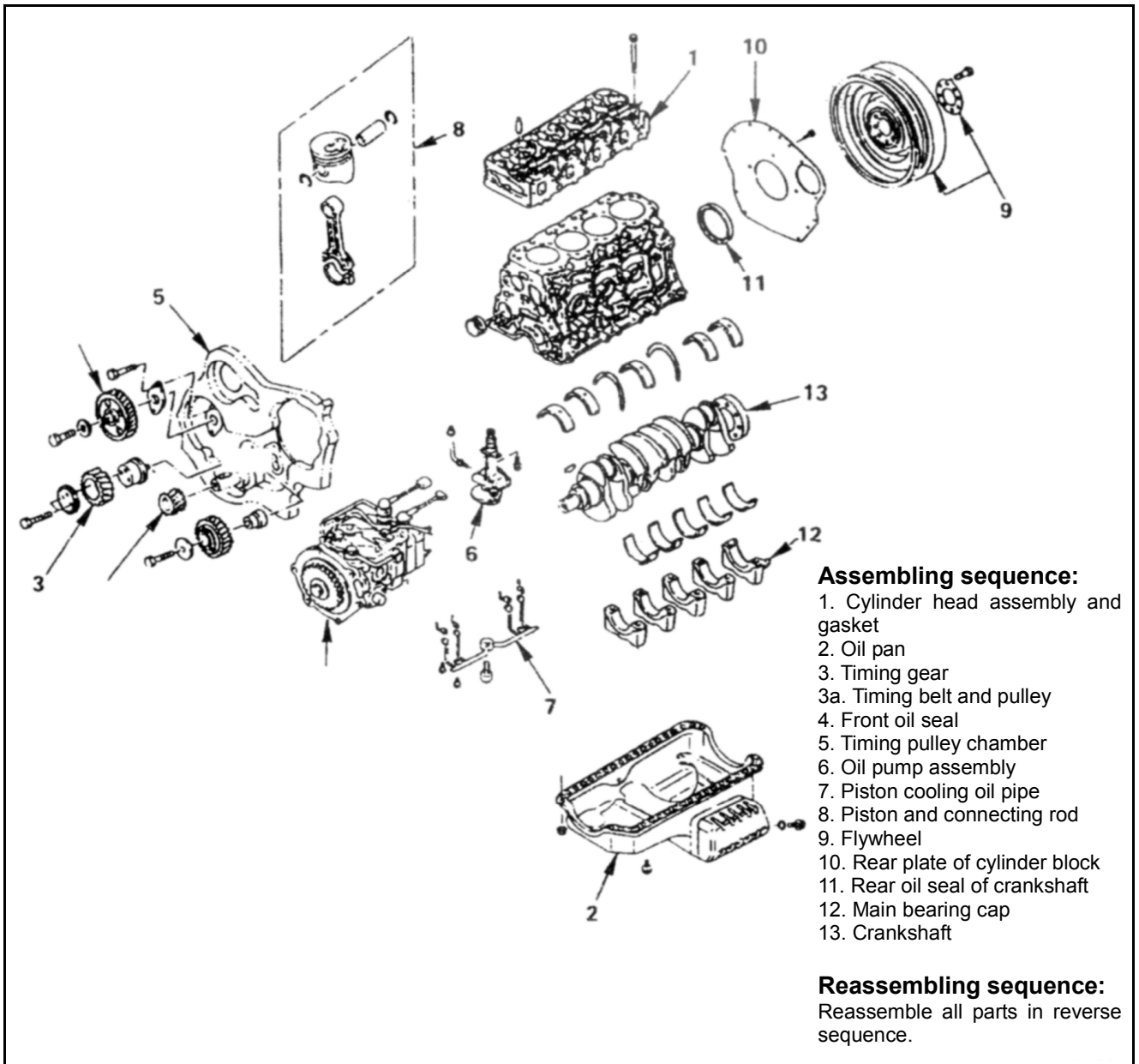
- Apply some oil to fixing bolt.
- Screw down the flywheel bolts to the specified torque in two steps by torque tightening method.

Flywheel bolt torque $\text{N}\cdot\text{m}$

Step I	Step II	Step III
25	70	120 ± 10

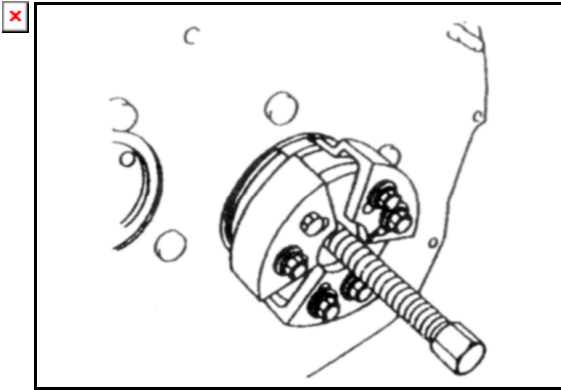


2.6. Crankshaft



Disassembly

1. Cylinder head assembly and gasket
2. Oil pan assembly
3. Timing gear
4. Timing gear chamber
5. Oil pump assembly
6. Piston cooling oil pipe



7. Piston and connecting rod

8. Flywheel

9. Flywheel baffle

10. Rear oil seal

- Push in the oil seal, install the special tools according to the sequence shown in the diagram to facilitate removing the oil seal.

Rear oil seal remover: 1002430FA-9102

Note: Take care not to damage the flywheel baffle and crankshaft sealing surface during oil seal removal.

11. Main bearing cap

12. Crankshaft

Inspection and repair

If excessive abrasion or damage is found during checking, adjust, repair and replace parts in time.

1. Crankshaft

Thrust clearance

Install dial gauge according to the sequence shown in the diagram and measure the thrust clearance of crankshaft.

If the thrust clearance exceeds prescribed limit, the thrust bearing shall be replaced in pair.

Thrust clearance mm

Nominal	Limit
0.040-0.201	0.30

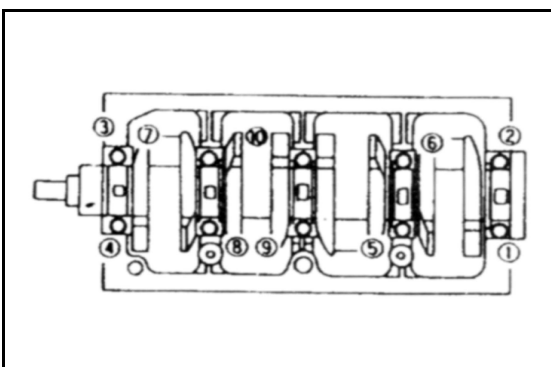
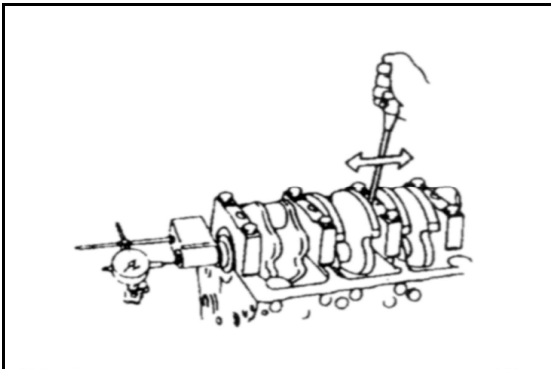
2. Main bearing clearance

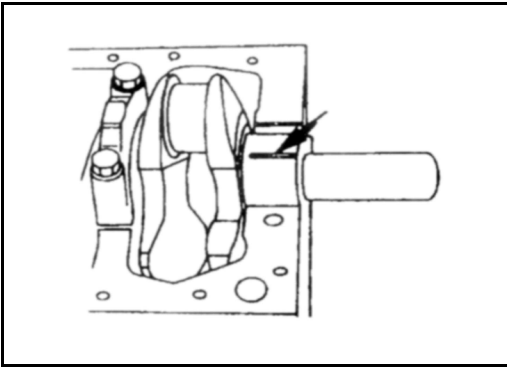
- 1) Remove the main bearing cap according to the sequence shown in the diagram.

Place the removed main bearing cap according to the sequence number of cylinder.

- 2) Remove crankshaft. Dismantle main bearing.
- 3) Clean the upper and lower bearings and main journal of crankshaft.
- 4) Check the bearing is damaged or excessively worn.

If excessive abrasion or damage is found during checking, the bearing has to be replaced in pair.





- 5) Install the upper bearing and thrust washer on their original positions. Carefully install the crankshaft.
- 6) Mount the lower bearing to the bearing cap in its original position.
- 7) Install plastic cord clearance gauge on the main journal of crankshaft.
- 8) Install main bearing cap. Apply oil to the threads and mating surfaces of bolts. Tighten the bolt to the specified torque.

170±10 N·m

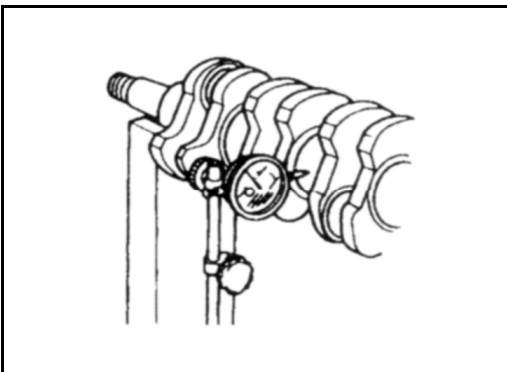
Note:

The crankshaft is not allowed to rotate.

- 9) Remove main bearing cap.
- 10) Measure the width of plastic cord clearance gauge and determine the oil film clearance. If the oil film clearance exceeds prescribed limit, the main bearing and (or) crankshaft has to be replaced in pair.
- 11) Remove the plastic cord clearance gauge off bearing and crankshaft.
Dismantle crankshaft and bearing.

Oil film clearance mm(in)

Nominal	Limit
0. 031—0. 066	0. 11

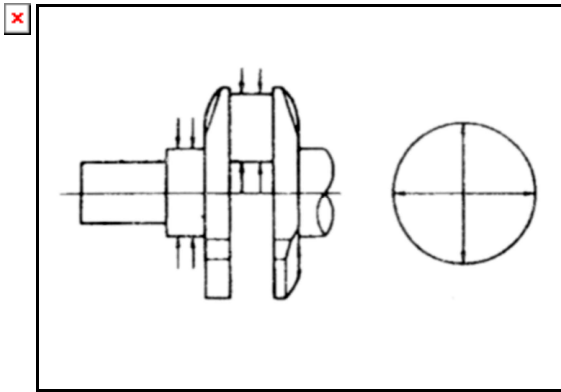


3. Radial runout

- 1) Carefully put the crankshaft on a V block. Slowly rotate the crankshaft and measure the radial runout. If the radial runout of crankshaft exceeds prescribed limit, the crankshaft has to be replaced.

Radial runout mm

Nominal	Limit
0.05 or less	0. 08



Measure the diameter of main journal and crankpin and the uneven abrasion.



If the abrasion of crankshaft exceeds prescribed limit, the crankshaft has to be replaced.

mm

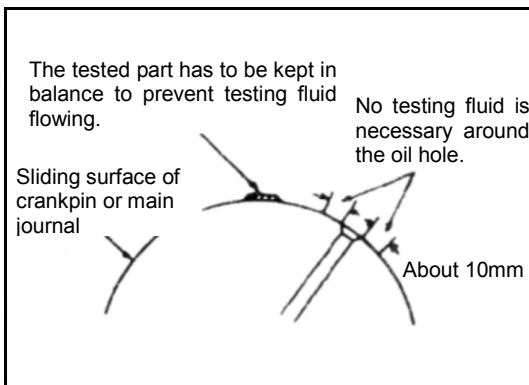
	Nominal	Limit
Main journal diameter	69.91—69.932	69.910
Crankpin diameter	52.91—52.930	52.900
Uneven abrasion limit	0.05 or less	0.08

Crankshaft inspection

Check the main journal of crankshaft and crankpin surface are damaged or excessively worn.

Check there is excessive abrasion or damage on the mating surface of oil seal.

Check the oil hole is blocked.



Inspection on soft nitrogen treatment of crankshaft

1. Thoroughly clean the crankshaft with a kind of organics. There must be no oil stains on the tested surface.
2. Prepare some solution containing 5%—10% ammonium cupric chloride (dissolved in distilled water).
3. Apply the solution on the tested surface with an injector.

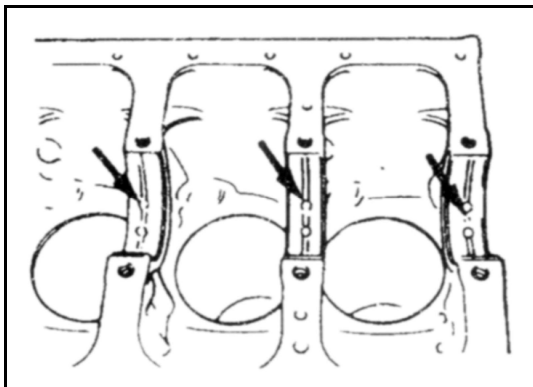
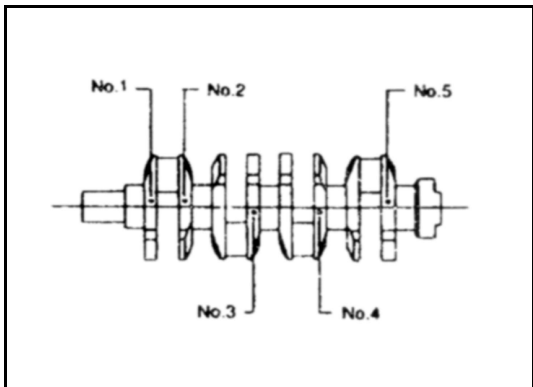
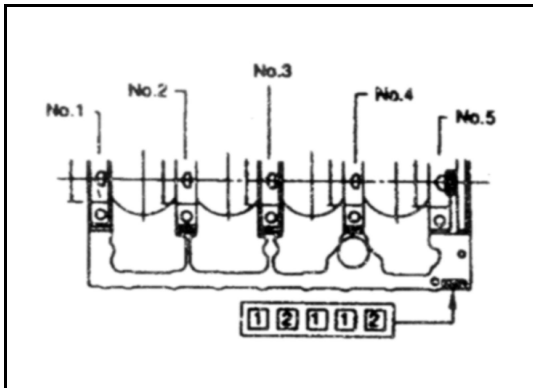
Keep the tested surface in full level state to prevent solution flowing.

Note:

The solution is not allowed to wash the oil hole and area around.

Test

1. Wait for 30—40 seconds.
- If the color does not change after 30—40 seconds, the crankshaft can be used.
- If the color changes (the tested surface becomes copper color), the crankshaft has to be replaced.



2. Clean the crankshaft surface with steam immediately after test is completed.

Note:

There is high corrosiveness with ammonium cupric chloride solution. Therefore, it is absolutely necessary to clean the crankshaft surface immediately after test is completed.

Crankshaft bearing selection

When assembling new crankshaft bearing or replacing old bearing, see the selection table below.

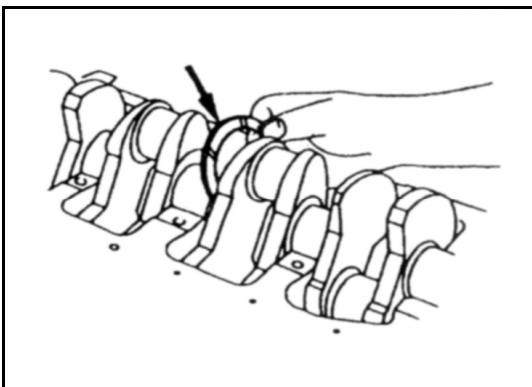
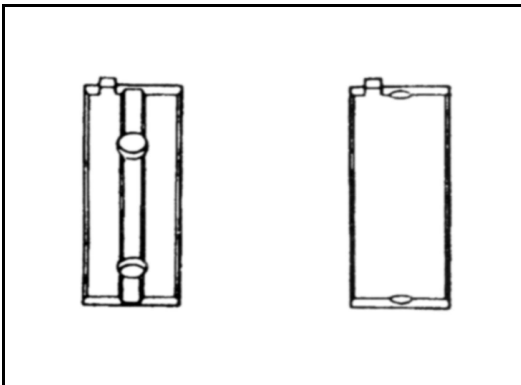
When selecting and installing new crankshaft bearing, pay attention to the diameter size mark of the upper journal hole and crankshaft main journal 2.

Note:

Although there are oil grooves and holes (cylinder block side) with all the upper bearings of main journal and there are not oil grooves and holes (bearing cap side) with all the lower bearings, still pay attention to identify them during assembly.



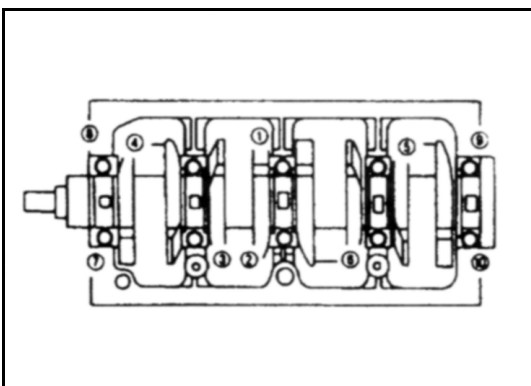
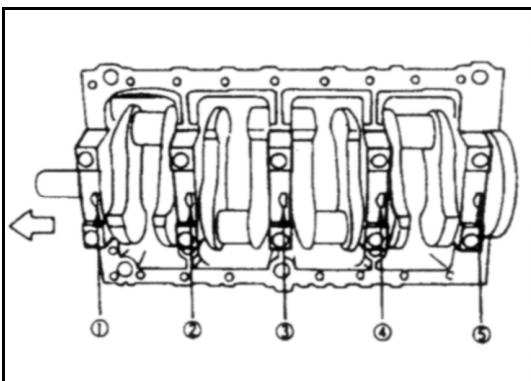
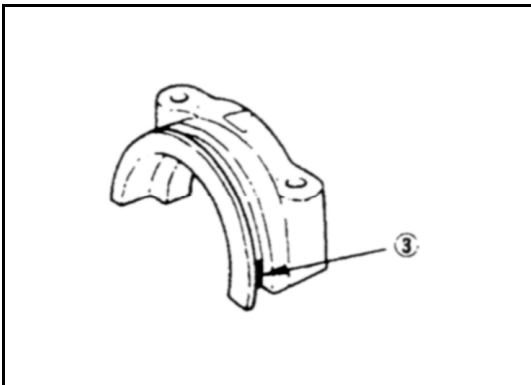
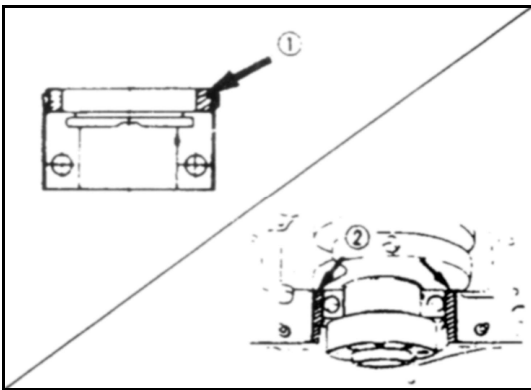
Main bearing hole diameter (mm)		Crankshaft main journal diameter (mm)		Main bearing size mark	Oil film clearance
Size mark	Bore diameter	Size mark	Outer diameter		
1	73.988-74.000	1	>69.926-69.932	Black ($\Phi 2^{+0.010}_{+0.006}$)	0.036-0.062
		2	>69.920-69.926	Blue ($\Phi 2^{+0.014}_{+0.010}$)	0.034-0.060
		3	69.914-69.920		0.040-0.066
2	73.975-73.987	1	>69.926-69.932	Green ($\Phi 2^{+0.006}_{+0.002}$)	0.031-0.057
		2	>69.920-69.926		0.037-0.063
		3	69.914-69.920	Black ($\Phi 2^{+0.010}_{+0.006}$)	0.035-0.061



Reassembly

13. Crankshaft

- Install the main bearing on the cylinder block and main bearing cap.
- Make sure that their positions are correct.
- Apply fresh oil to the upper and lower main bearing surfaces.
- Carefully install the crankshaft.
- Apply oil to the thrust washer.
- Install the thrust washer on the third main journal. Its oil groove must face the crankshaft.



12. Main bearing cap

- Apply recommended liquid sealant or other equivalents to the fifth crankshaft bearing cap ① as shown in the drawing.
- Install arc gasket ② on the fifth bearing cap. Put the arc gasket into the bearing cap groove with fingers.
- Apply recommended liquid sealant or other equivalents to the fifth crankshaft bearing cap ③ as shown in the drawing.
- Apply recommended liquid sealant or other equivalents to points ③ and ④ of the fifth crankshaft bearing cap cylinder block mating surface as shown in the drawing.

Note:

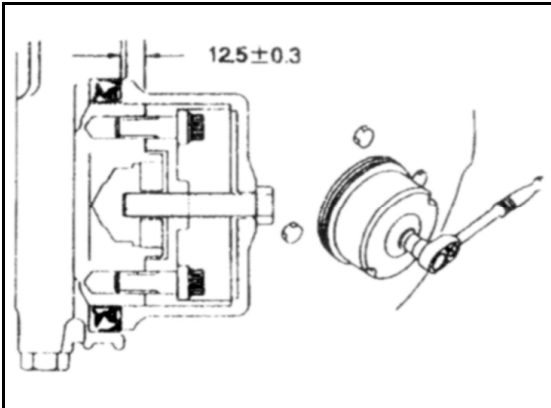
Ensure that there is no oil stain on the mating surface of bearing cap before coating liquid sealant.

Make sure the liquid sealant does not block cylinder thread hole and bearing.

- Install the bearing cap, and make sure the arrow mark on its top points at engine forepart.
- Apply oil to crankshaft bearing cap bolts.
- Tighten the crankshaft bearing cap bolts step by step in several times according to the sequence shown in the drawing until specified torque is reached.

Nm

Step I (sealing torque)	Step II (sealing torque)	Step III (final torque)
20	110	170

**Note:**

Manually rotate the crankshaft to check whether it is flexible.

11. Rear oil seal of crankshaft

Install the oil seal on the cylinder block with an oil seal erector.

Rear oil seal erector: 1002430FA-9101

Notes:

Clean the rust and chips off the press-in portion of the oil seal.

Pay attention to the press-in direction of the oil seal.

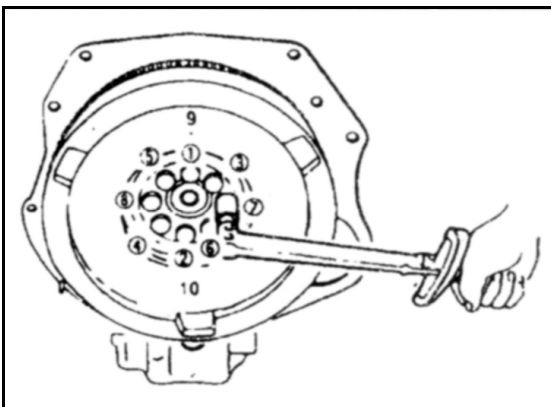
- 1) Connect the adaptors of special tools to the rear end of the crankshaft with two bolts.
- 2) Install the oil seal to the periphery of the adaptors.
- 3) Insert the socket into the adaptor and screw down the bolt (M12XL75L=70) until the adaptor tip is in contact with the socket.
- 4) Remove the adaptor and socket.
- 5) Check the oil seal installation depth and flatness after it is installed.

Depth standard: $12.5 \pm 0.3 \text{ mm}$

**10. Flywheel baffle**

Align the baffle with the upper anchor pin of cylinder block.

Tighten the flywheel baffle bolts to the specified torque: $85 \pm 10 \text{ N} \cdot \text{m}$

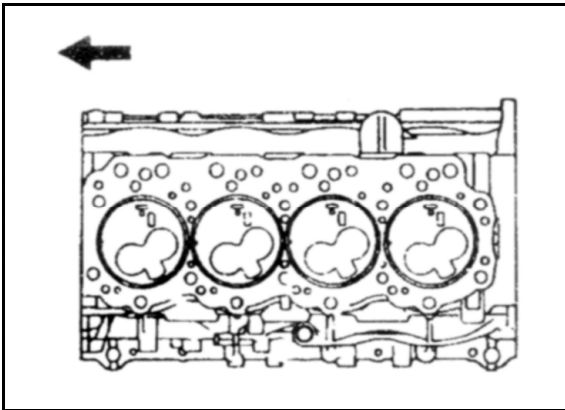
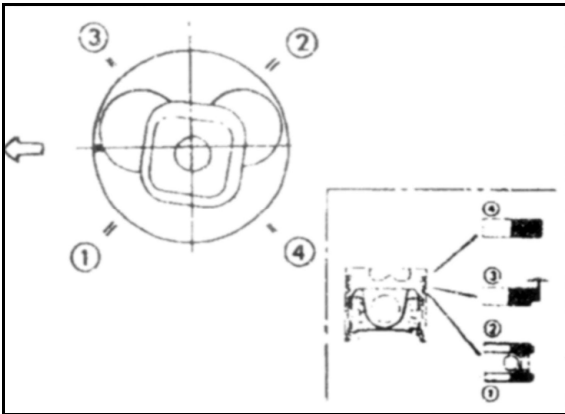
**9. Flywheel**

- 1) Thoroughly clean out the oil stains on the crankshaft thread(s).
- 2) Install the flywheel on the crankshaft, and then mount the washer(s).
- 3) Apply oil to flywheel bolt thread(s).
- 4) Align the flywheel with the anchor pin of crankshaft.
- 5) Screw down the flywheel bolts to the specified torque in two steps by torque tightening method. Tightening sequence is shown in the diagram.



Flywheel bolt torque N·m

Step I (sealing torque)	Step II (sealing torque)	Step III (final torque)
25	70	120 ± 10



8. Piston and connecting rod assembly

- Apply oil to cylinder hole, connecting rod bearing, crankpin, piston ring and piston. Check the position of piston ring opening is correct.

- Encase piston/connecting rod assembly into each cylinder with a piston ring compressor. The front mark must face the engine forepart.
- The number on cap should be in pair with the one on connecting rod. Align the printing mark on connecting rod with the one on cap.
- Apply oil to the threads and mating surfaces of nuts.
- Screw down the connecting rod cap nuts in two steps by torque tightening method according to the following descriptions.

N·m

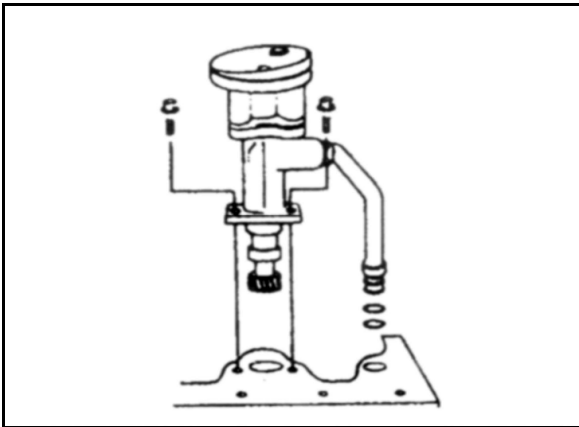
First step (pretightening)	Second step (tightening)
20	85±5

Check the crankshaft rotates freely after the connecting rod nuts are tightened.

7. Piston cooling oil pipe

- Tighten bolt(s) and injection nozzle plug(pressure limiting valve) to the specified torque.

Bolt:	20±5 N·m
Injection nozzle plug (pressure limiting valve):	30±5 N·m



6. Oil pump assembly

- 1) Prepare some solution containing 80% oil and 20% supramoly.
- 2) Apply a thin layer of the above solution to the teeth of oil pump pinion.
- 3) Install the oil pump and tighten bolt(s) to the specified torque.

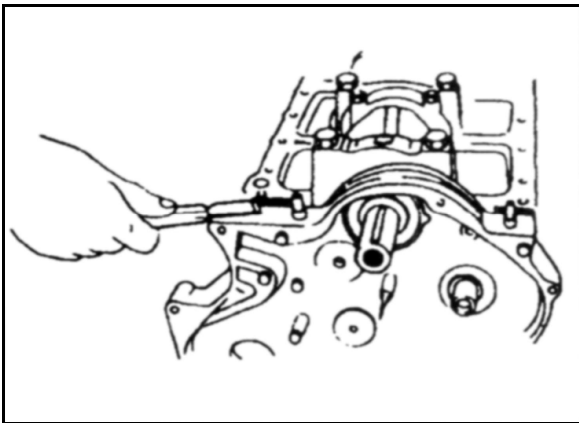
25±5 N·m

Note:

Take care not to damage O-ring when screwing down oil pipe bolt(s).

- 4) Tighten sleeve nut(s) to the specified torque:

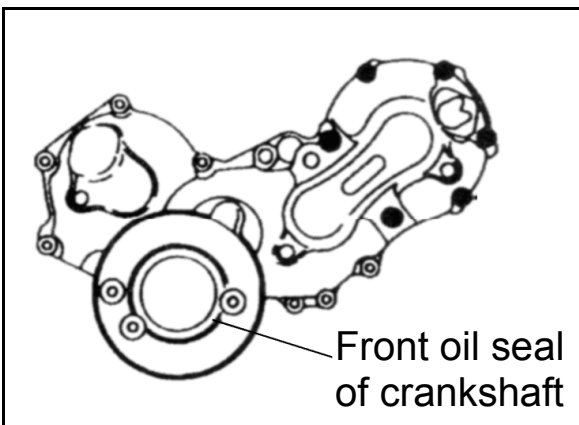
30±5 N·m



5. Timing pulley chamber

- 1) Install timing pulley chamber on the cylinder block.
- 2) Use bolt(s) to tighten both timing pulley chamber and timing pulley chamber gasket(s) to the specified torque.

25±5 N·m



- 3) Cut off the gasket tip on the mating surface (as shown in the diagram).

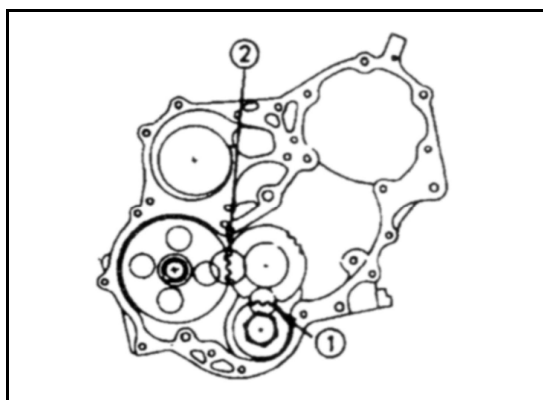
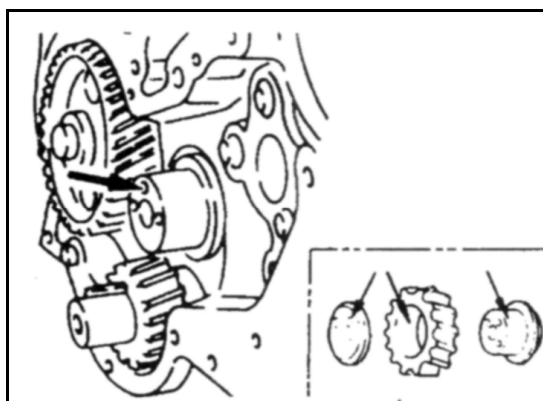
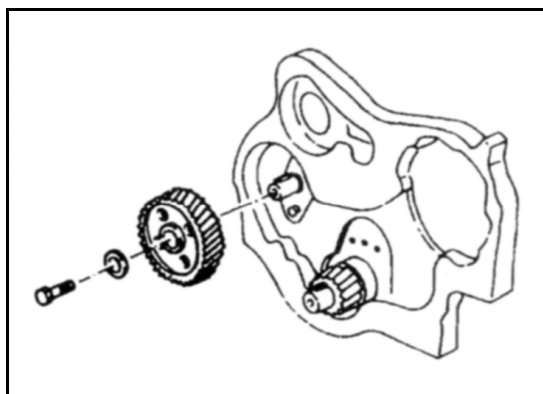
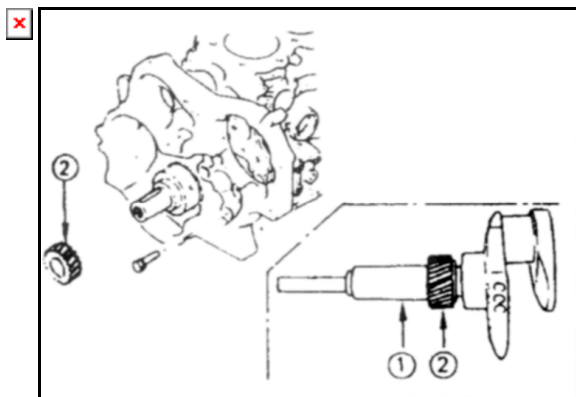
4. Front oil seal of crankshaft

Install the front oil seal of crankshaft on the gear chamber cover assembly with a front oil seal erector as shown in the diagram.

Front oil seal erector: 1002420FA-9101

Note:

Take care not the twist the front oil seal.



3. Timing gear

11) Crankshaft gear

- ① Install crankshaft gear
- ② Install crankshaft gear ② with crankshaft gear erector ①. Crankshaft gear timing mark ("K-X") must face the outside.

10) Camshaft timing gear

- ① Install camshaft timing gear to the camshaft with timing gear mark ("Y-Y") toward outside.
- ② Tighten camshaft timing gear bolt(s) to the specified torque:

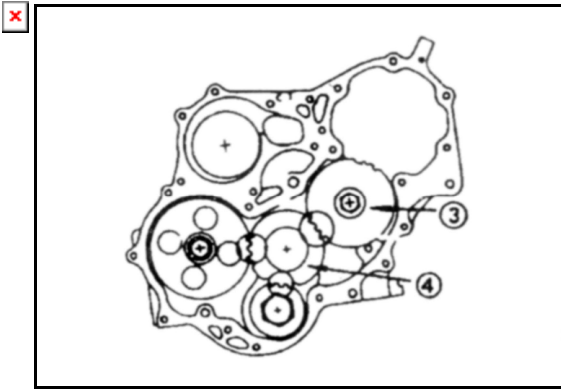
110±10 N·m

9) Idler gear

- ① Apply some oil to the idler gear and its shaft.
The oil hole in idler gear shaft must face upward.
- ② Idler gear setting marks "X" and "Y" should face the engine forepart during assembly.

- ③ Align idler gear setting mark "X" with setting mark "X-X" of crankshaft timing gear ①.
- ④ Align idler gear setting mark "Y" with setting mark "Y-Y" of camshaft timing gear ②.
- ⑤ Install thrust ring and bolt(s) on the cylinder block.
Thrust ring oil hole must be toward upward, while its chamfer shall face the outside.
- ⑥ Tighten idler gear bolt(s) to the specified torque.

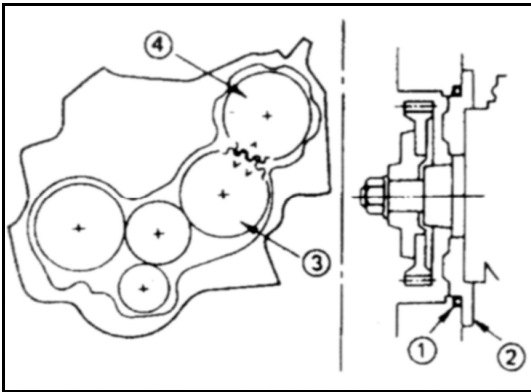
25±5 N·m



8) Idler gear "B" and its shaft

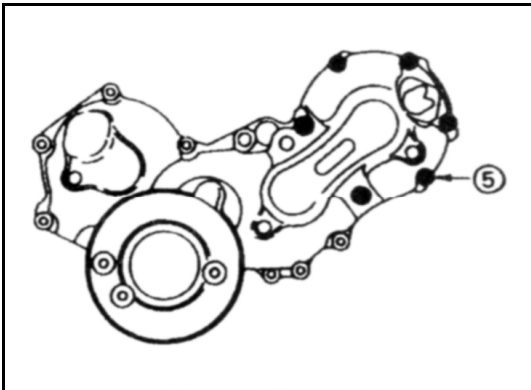
- ① Apply some oil to the idler gear and its shaft.
- ② Align idler gear setting marks "B" ③ "Z" with "A" ④ "Z-Z".
- ③ Tighten idler gear bolt(s) to the specified torque.

110±10 N·m



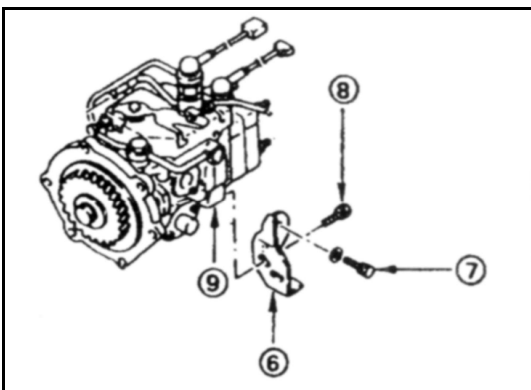
7) Injection pump

- ① Install O-ring ① on injection pump flange ②.
- ② Install the injection pump to the timing gear chamber. Align idler marks "B" ③ "V-V".



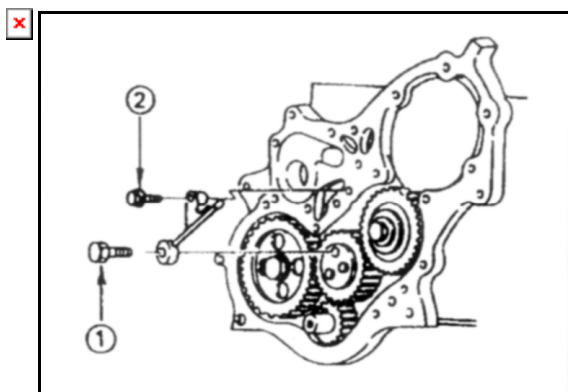
- ③ Temporarily tighten six injection pump nuts ⑤.

The final screwing down of injection pump nuts is conducted after the rear support bolt(s) of injection pump is tightened.



- ④ Install rear support ⑥ and rear support bolt ⑦ of injection pump on the cylinder block.
- ⑤ Mount rear support bolt ⑧ to the injection pump support ⑨. Finally tighten rear support bolts ⑦ and ⑧ to the specified torque.

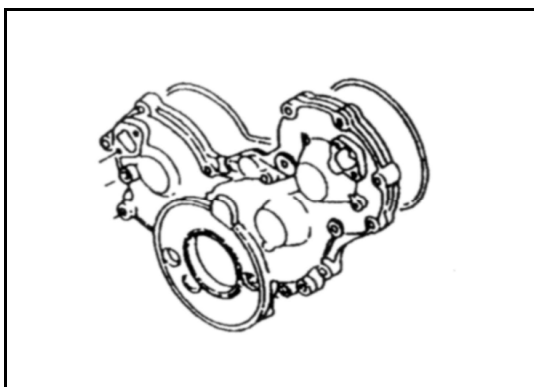
25±5 N·m



6) Timing gear injection pipe

- ① Install the oil pipe to the timing gear chamber and idler gear "A".
- ② Tighten oil pipe punching bolt ① and bolt ② to the specified torque.

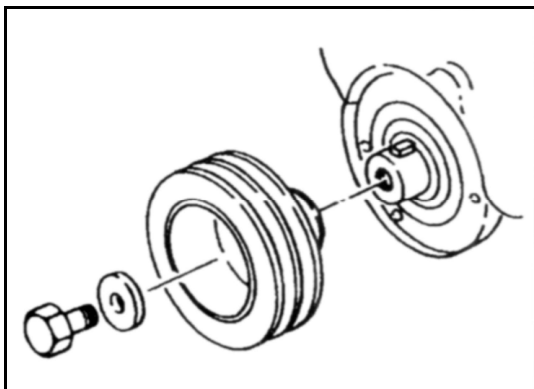
20±5 N·m



5) Timing gear chamber cover

- ① Align the timing gear chamber with timing gear chamber anchor pin, then install timing gear chamber cover.
- ⑥ Tighten gear chamber cover bolt to the specified torque.

25±5 N·m



4) Crankshaft damper pulley

Screw down the crankshaft damper pulley bolt(s) to the specified torque.

Note:

While screwing down the damper pulley bolt(s), fix the flywheel gear to prevent crankshaft rotating.

210±15 N·m

3) Cooling fan assembly

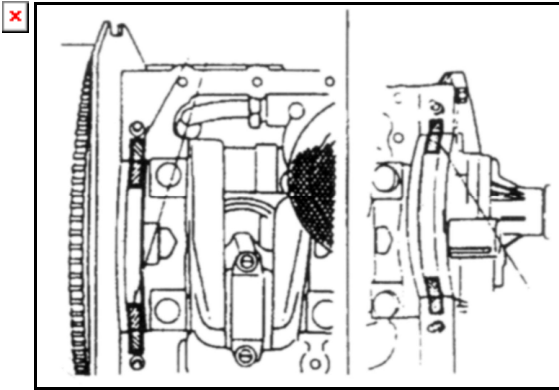
- Install the fan pulley and cooling fan assembly to the water pump in turn and tighten the bolt to the specified torque.

12.5±2.5N·m

2) Drive belts of the alternator and power steering pump

- Mount drive belts of the alternator and power steering pump and adjust the belt tension.
- Press the belt center with 100N force.

Drive belt deflection 8~10 mm

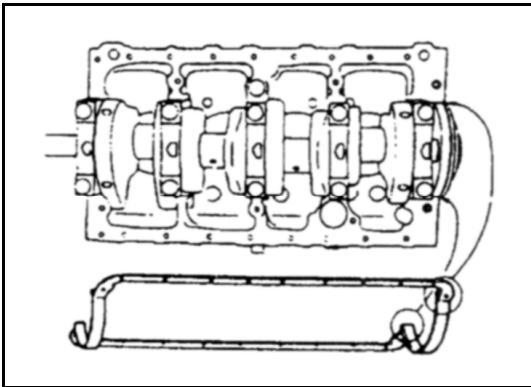


1) Fan guard

- Install the fan guard and coolant storage tank hose.
- Fill in coolant.

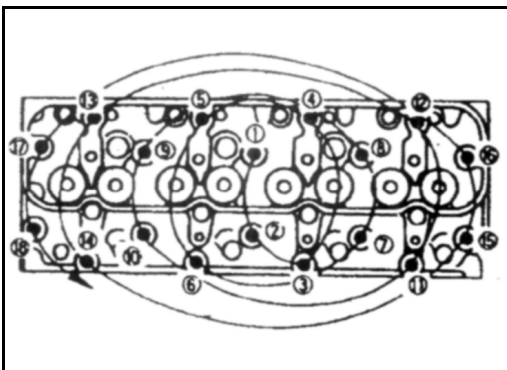
2. Oil pan assembly

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.



- Mount the rear lip of seal washer into the groove of the fifth bearing cap.
- Make sure the lip perfectly contacts with the groove.
- Install the oil pan to the cylinder block.
- Tighten oil pan bolt(s) to the specified torque.

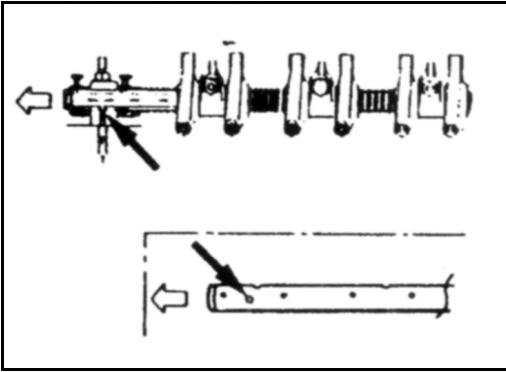
Oil pan bolt torque: $23.5 \pm 3.5 \text{ N} \cdot \text{m}$



1. Cylinder head

Cylinder head assembly

- ① Mount the anchor pin to the cylinder block.
- ② Install cylinder head gasket with top mark toward upside.
- ③ Clean the lower cylinder head surface and upper cylinder block surface.
- ④ Mount the cylinder head carefully.
- ⑤ Apply oil to the threads and mating surfaces of cylinder head bolts.
- ⑥ Tighten the cylinder head bolts to the specified torque in three steps according to the sequence shown in the diagram.



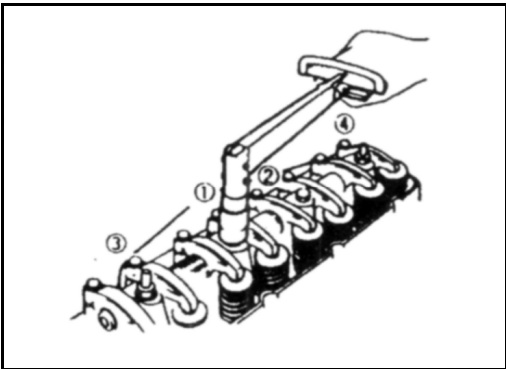
Cylinder head bolt torque		N·m
Step I	Step II	Step III
65	85	105±5

Push rod

- Apply oil to the push rod and insert it into the cylinder head.

Rocker shaft assembly

- ① Loosen all adjusting screws.
- ② Install the rocker shaft so that the bigger oil hole (Φ4) faces engine forepart.



- ③ Tighten the rocker shaft support bolt(s) to the specified torque according to the sequence shown in the diagram.

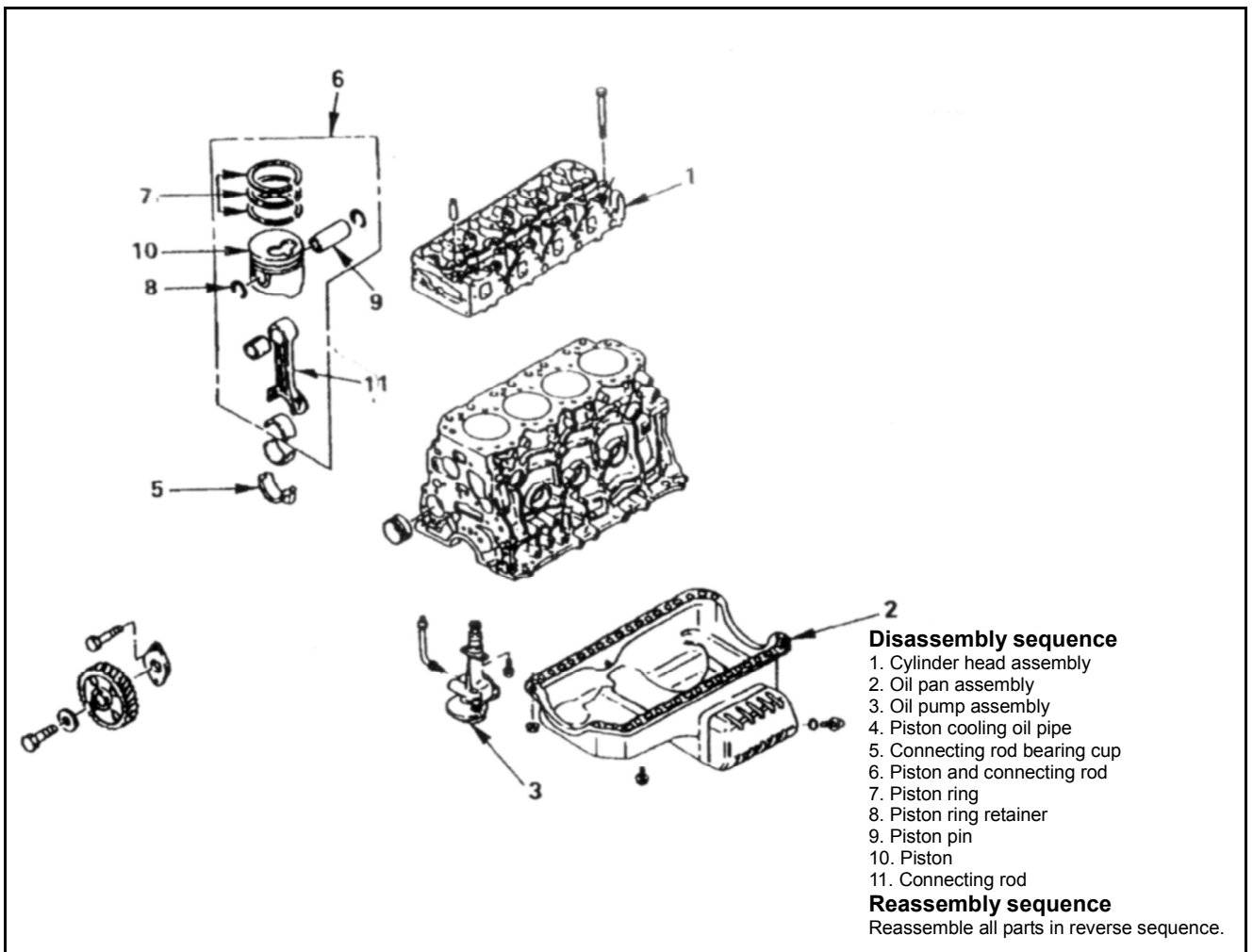
Rocker shaft support bolt torque

55±5 N·m

- Adjust the valve clearance.



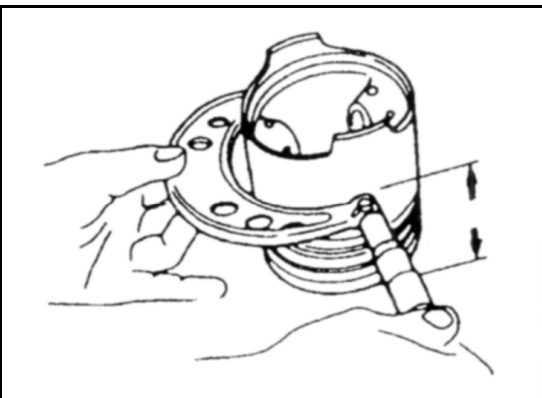
2.7. Piston and connecting rod



Disassembly

1. Cylinder head assembly
2. Oil pan assembly
3. Oil pump assembly
4. Piston cooling oil pipe
5. Connecting rod cap
6. Piston and connecting rod

- Scrape carbon deposits on upper cylinder wall with a scraper before disassembling the piston and connecting rod.



7. Piston ring

- Remove the piston ring with a piston ring expander.
- Place the removed piston ring as the sequence number in the drawing.

8. Piston ring retainer

- Dismantle piston pin retainer with pliers.

9. Piston pin

Note:

Place parts removed from each cylinder. All the parts have to be reassembled to the original positions.

10. Piston

11. Connecting rod

Inspection and repair

Piston and piston ring

Piston

Carefully clean up carbon deposits on the piston top and piston ring groove.

Notes:

Never use metal brush for cleaning the piston. Otherwise it will damage the piston. Visually inspect if there are any cracks, scratches or other signs of excessive abrasion on each piston.

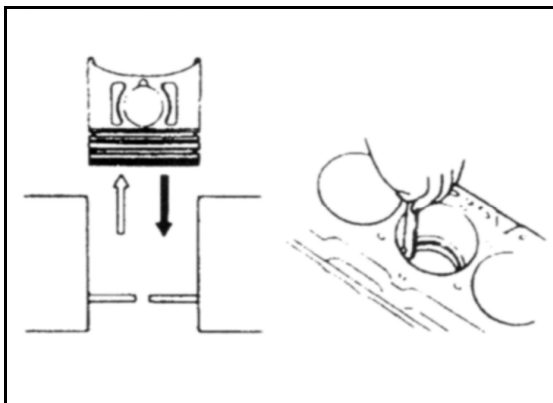
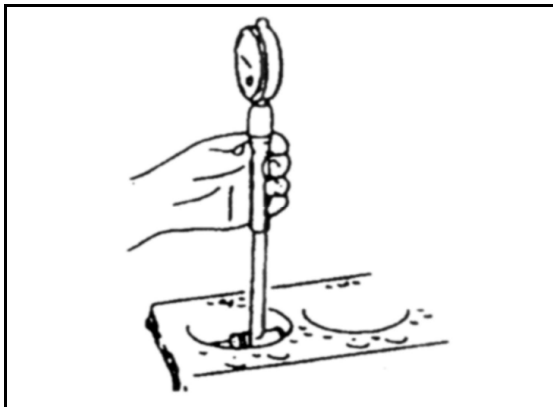
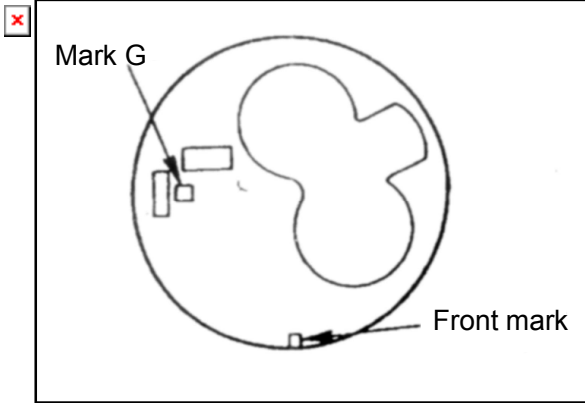
If so, replace the piston.

Piston outer diameter

1. Measure the outer diameter of the piston at the position of each piston group.

Position of each piston group:

Distance to the piston top is 73.9 mm



Outer diameter groups of 4DA1 series pistons

Diameter mark	Outer diameter	mm
A	92.957~92.970	
B	92.970~92.983	
C	92.983~92.996	

4 DA1 series cylinder liner bore diameters

Diameter mark	Outer diameter	mm
A	93. 021~93. 034	
B	93. 034~93. 047	
C	93. 047~93. 060	

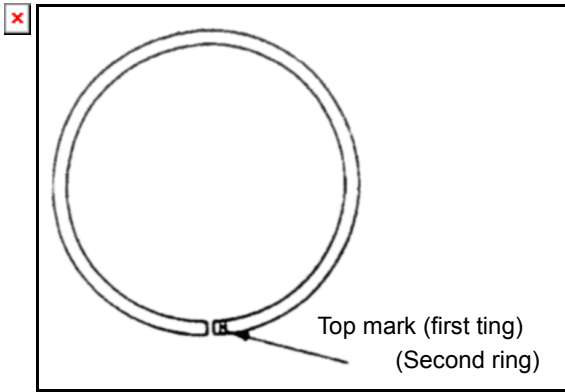
Measure the cylinder bore diameter (refer to "Inspection of the cylinder block" in this section). If the piston clearance does not comply with the specified values, replace the piston and/or cylinder liner.

Piston clearance	mm
4DA1 Series	0.051~0.077

Piston ring

If during engine overhaul it is found that any part is worn-out or damaged, you should replace it.

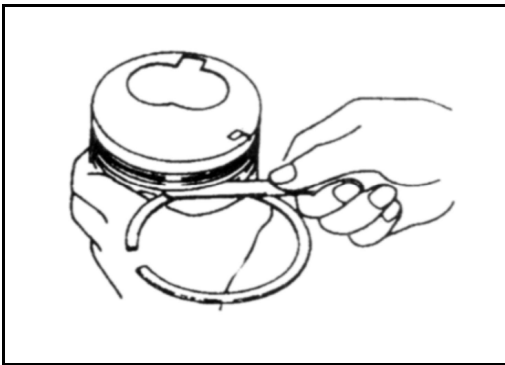
1. Piston ring opening measurement
 - Install the piston ring into the cylinder liner.



- Push the piston ring with the piston into the most narrow part of the cylinder liner bore in such a way that it is vertical to the cylinder wall.

4DA1 series piston ring opening gap mm

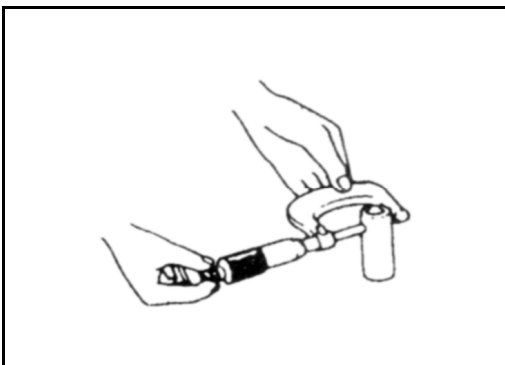
Piston ring	4DA1	4DA1-1	Limits
First gas ring	0.2~0.4	0.2~0.4	1.5
Second gas ring	0.2~0.4	0.6~0.85	1.5
Oil ring	0.1~0.3	0.35~0.65	1.5



2. Measure the clearance between the piston ring groove and piston ring with a clearance gauge. If the clearance exceeds the specified limits, you should replace the piston

4DA1 series piston ring end gap mm

Piston ring	4DA1	4DA1-1	Limits
First gas ring	0.09~0.125	0.078~0.139	0.15
Second gas ring	0.05~0.075	0.045~0.09	0.15
Oil ring	0.03~0.07	0.03~0.07	0.15



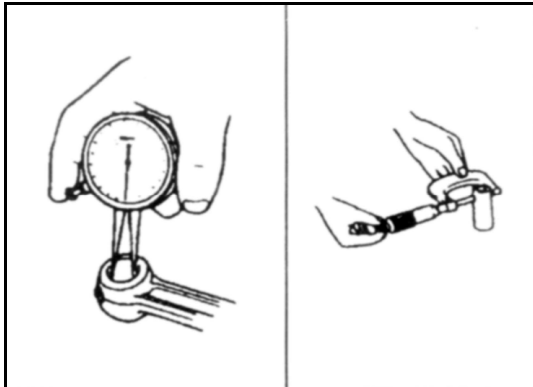
Piston pin

Visually inspect if there are any cracks, scratches or other signs of abrasion on the piston pin and replace the piston pin if necessary.

1. Measure the piston pin outer diameter with a micrometer at three positions in two directions. If the measurement values exceed the specified limits, the piston pin has to be replaced.

Piston pin outer diameter mm

	Nominal	Limits
4DA1	30.994~31.000	30.970
4DA1-1	33.994~34.000	33.970



2. Measure the inner diameter of the connecting rod small end. If the clearance between the connecting rod small end and pin does not comply with the specified values, you have to change the connecting rod or bushing and pin.

mm

Nominal	Limits
0.008~0.026	0.05

3. Insert the piston pin into the piston and rotate it. If the pin rotates freely and is compact with the piston, it means the clearance is permissible. If there is any clearance or the surface between them is rough, measure the clearance. If the clearance exceeds the specified values, you have to replace the piston and piston pin.

mm

	Nominal	Limits
4DA1 系列	0.002~0.016	0.04

Replacing the bushing

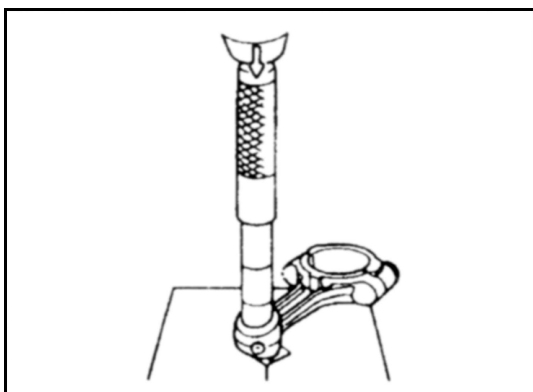
Disassembly: use suitable compression bar and table press or hammer.

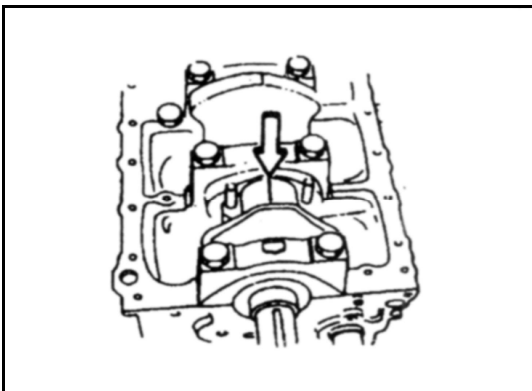
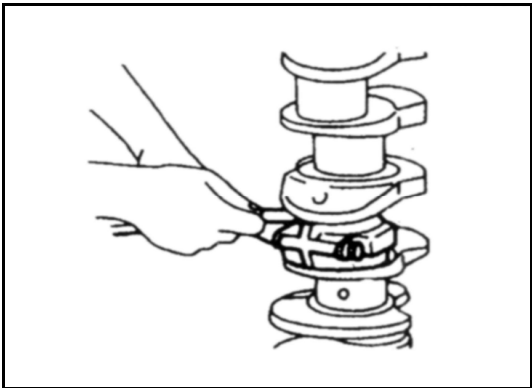
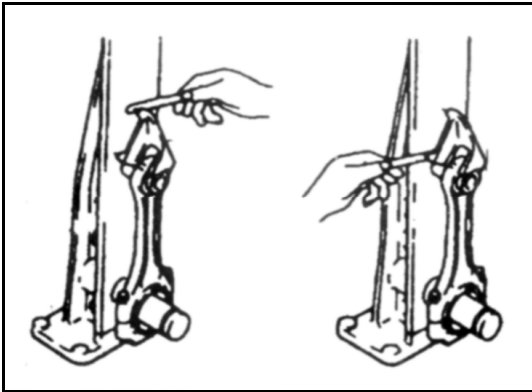
Assembly: use suitable compression bar and table press

Notes:

The bushing should be aligned with the oil hole on the connecting rod.

Grind the bushing bore with a pin hole grinder before mounting new bushing.





Connecting rod

1. Check the centerline deviations of two connecting rod holes with a connecting rod aligner.

If the amount of inclination or twist exceeds the specified limits, you have to replace the connecting rod.

	mm	
	Nominal	Limits
Amount of inclination (Per 100m)	0.08 or less	0.20
Twist (Per 100m)	0.05 or less	0.15

2. Measure the axial clearance of the connecting rod

Measure the connecting rod thrust clearance at its big end with a clearance gauge.

If the clearance exceeds the specified limits, you have to replace the connecting rod.

Axial clearance		mm
Nominal	Limit	
0.175~0.290	0.350	

3. Measure the oil film clearance between the connecting rod and crankshaft:

- 1) Remove the connecting rod cap nut and the cap.

Place the removed connecting rod according to the cylinder sequence number

- 2) Clean the connecting rod bearings and crankpin.

- 3) Inspect the connecting rod bearings carefully.

Even if there is only one damaged or severely worn-out bearing, all the bearings have to be replaced. Reassemble the bearings to their original positions. Place a plastigage on the crankpin.

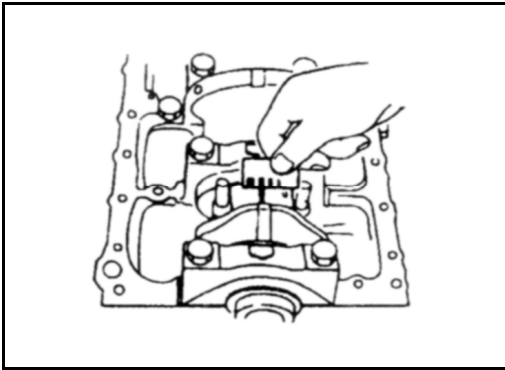
- 4) Reinstall the connecting rod cap to its original position.

- 5) Screw down the connecting rod cap nut to the specified torque in two steps via torque tightening method according to the following instructions.

	N·m	
	First step (pretightening)	Second step (tightening)
4DA1 Series	20	85

Note:

Never rotate the crankshaft.



- 6) Remove the connecting rod cap
- 7) Measure the plastigage width and determine the oil film clearance. If the oil film clearance exceeds the prescribed limit, the connecting rod bearings shall be replaced in pair.
- 8) Remove the plastigage from the bearings and crankpin.

Clearance between the crankshaft main journal and bearing mm

	Nominal	Limit
4DA1 Series	0.029—0.066	0.100

Reassembly

11. Connecting rod

10. Piston

9. Piston pin

Apply oil to the piston pin and piston pin hole.

8. Piston ring retainer

Apply a thin layer of oil to the piston pin. Manually press the piston pin into piston pin hole.

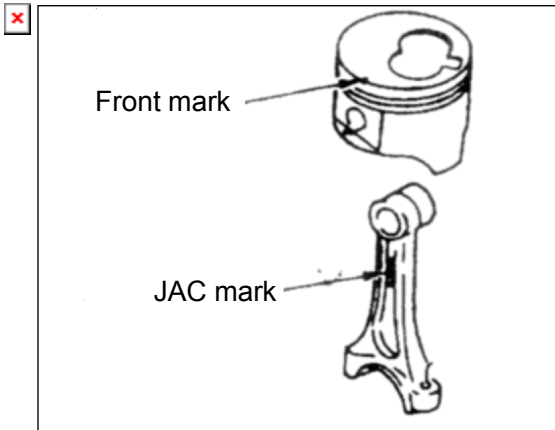
Weigh each piston and connecting rod assembly.

Select the piston and connecting rod assembly in such a way that the assembly weight difference varies within the specified limits.

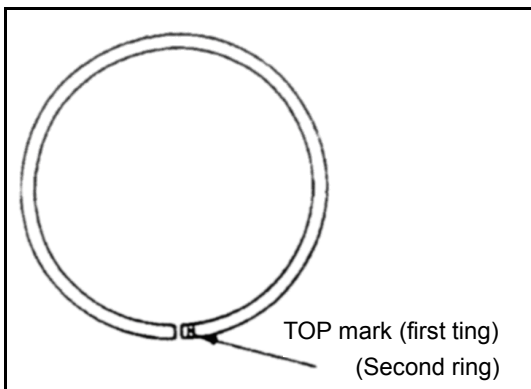
Weight variation after combined as an assembly	4DA1	Less than 10g
	4DA1-1	Less than 8g

Note:

When replacing the piston/connecting rod assembly, do not change the piston/piston pin assembly.

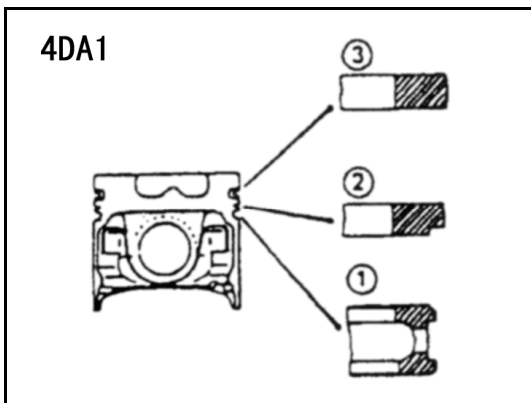


- Mount the piston onto the connecting rod in such a way that the piston front mark and connecting rod mark should face the same direction.

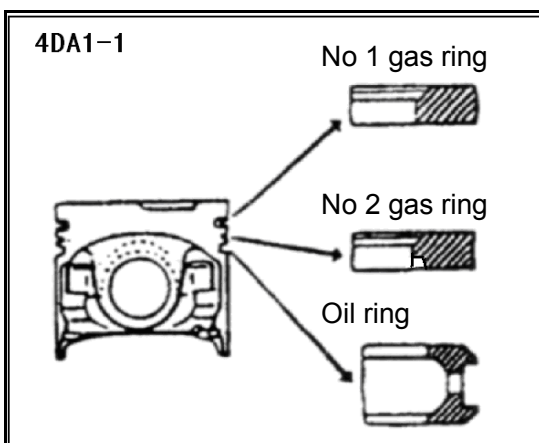


7. Piston ring

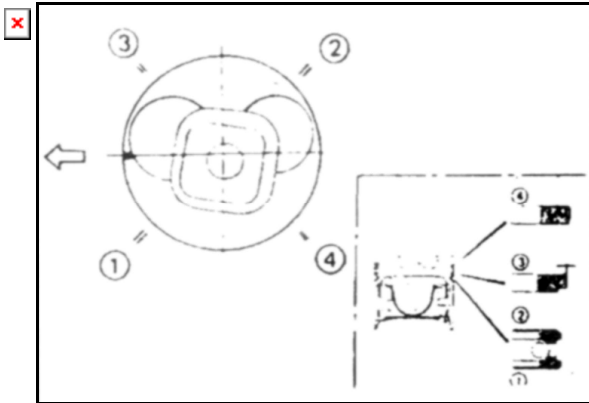
- Install the piston ring with a piston ring expander.
The TOP mark should face upward during gas ring erection.
- The position of the identification sign is shown in the drawing.



- Mount the piston ring in following sequence.
- ① Oil ring
- Oil ring with a spiral cup ring
- ② Second gas ring
- ③ First gas ring
- The TOP mark should face upward during gas ring erection.



- First gas ring: TOP.
- Second gas ring: TOP.
- Apply some oil to all piston rings after installing the rings.
Check whether all piston rings can rotates freely.
- Install the bearings onto the connecting rod and its cap.
Apply fresh oil to the bearing surfaces.



6. Piston and connecting rod

- Apply oil to the cylinder hole, connecting rod bearings and crankpin.
- Check whether the piston ring opening position is correct.
- Install the piston/connecting rod assembly into each cylinder with a piston ring compressor.
- The front mark must be towards the engine forepart.

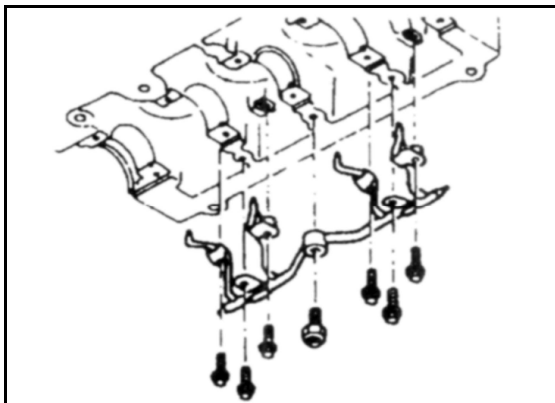
5. Connecting rod bearing cap

- Screw down the connecting rod cap nut in two steps via torque tightening method according to the following instructions.

N·m

	First step (pretightening)	Second step (tightening)
4DA1 Series	20	85

Check if the crankshaft rotates freely after tightening the cap nut.



4. Piston cooling oil pipe

- Mount the piston cooling oil pipe to the cylinder block.
- Screw down the oil pipe bolt and relief valve to the specified torque.

Oil pipe bolt torque N·m

(1)M8×1.25	25
------------	----

N·m

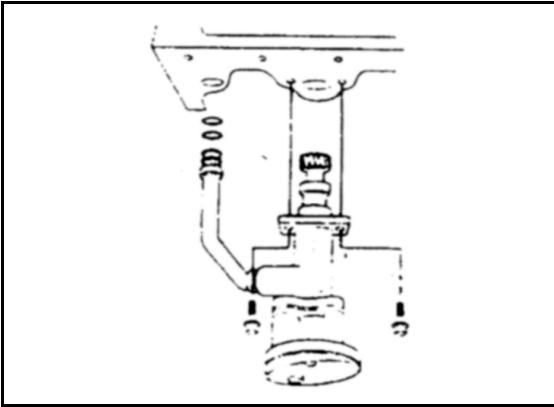
(2)M6×1.00	7.5
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Oil-pressure adjusting valve torque N·m

(3)M16×1.5	30
------------	----

Note:

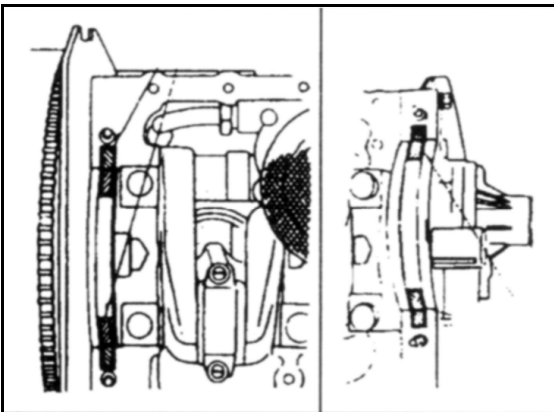
Turn the crankshaft slowly; make sure the piston and the oil injection pipe don't interfere with each other.



3. Oil pump assembly

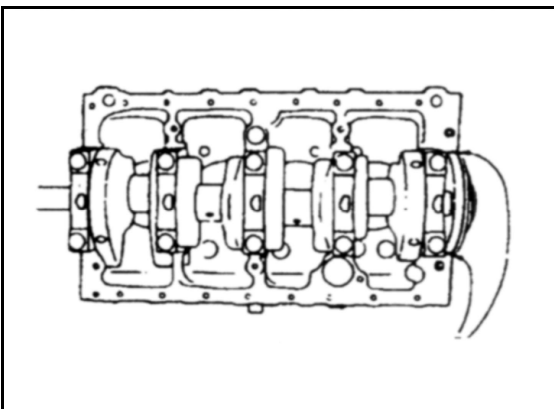
- Apply some oil on the oil pipe O-ring and mount it to the cylinder block O-ring groove.
- Install the oil pump assembly and oil pump to the cylinder block and tighten the fixing bolt(s) to the specified torque: 25 ± 5 N·m

Tighten sleeve nut(s) to the following specified torque: 30 ± 5 N·m



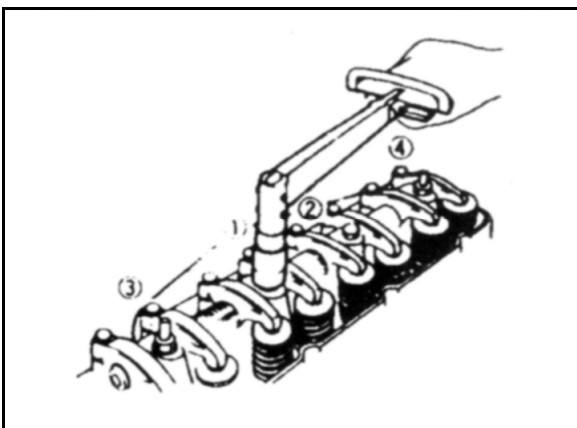
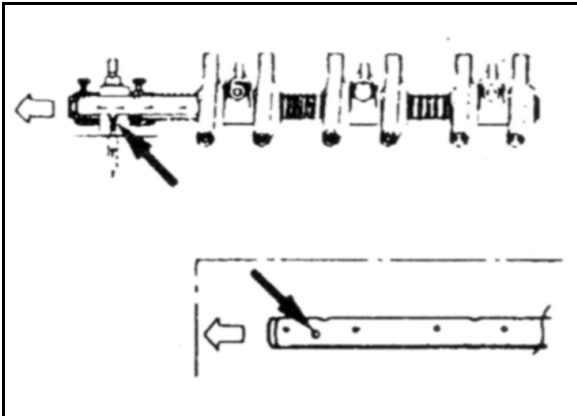
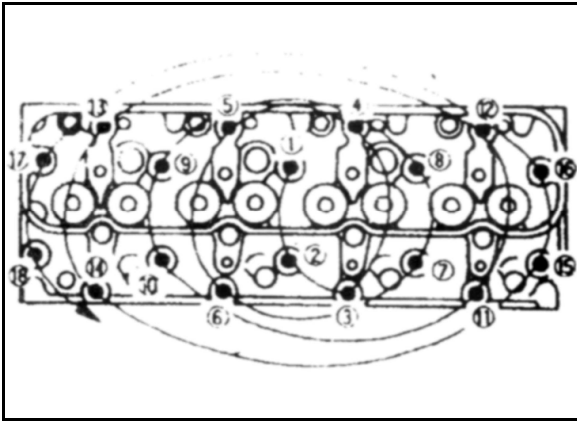
2. Oil pan assembly

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.
- Mount the rear lip of seal washer into the groove of the fifth bearing cap.



- Make sure that the lip is perfectly in contact with the groove.
- Install the oil pan to the cylinder block.
- Tighten oil pan bolt(s) to the specified torque

Oil pan bolt torque: 23.5 ± 3.5 N·m



1. Cylinder head assembly

- ① Mount the anchor pin to the cylinder block.
- ② Install cylinder head gasket with its top mark toward upside.
- ③ Clean the lower cylinder head surface and upper cylinder block surface.
- ④ Mount the cylinder head carefully.
- ⑤ Apply oil to the threads and mating surfaces of cylinder head bolts.
- ⑥ Tighten the cylinder head bolts to the specified torque in three steps according to the sequence shown in the diagram.

Cylinder head bolt torque N·m

Step I	Step II	Step III
65	85	105±5

Push rod

- Apply oil to the push rod and insert it into the cylinder head.

Rocker shaft assembly

- ① Loosen all adjusting screws.
- ② Install the rocker shaft so that the bigger oil hole (Φ4) faces engine forepart.

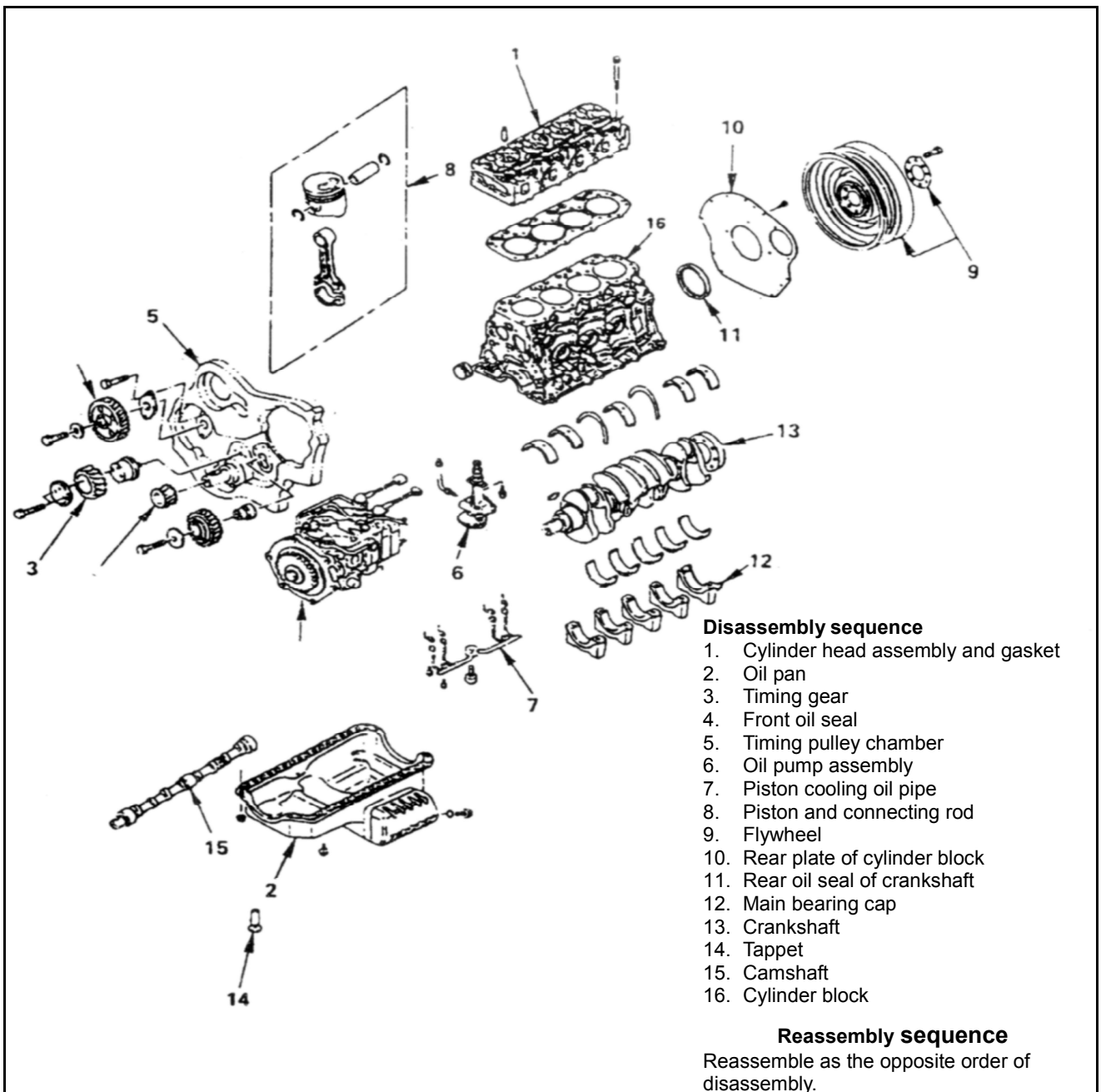
- ③ Tighten the rocker shaft support bolt(s) to the specified torque according to the sequence shown in the diagram.

Rocker shaft support bolt torque 55±5 N·m

- Adjust the valve clearance

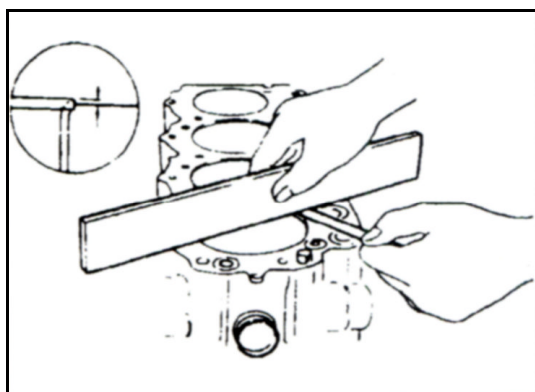


2.8 Cylinder block



Disassembly

1. Cylinder head assembly and gasket



2. Oil pan assembly
3. Timing gear
4. Front oil seal
5. Timing pulley chamber
6. Oil pump assembly
7. Piston cooling oil pipe
8. Piston and connecting rod
9. Flywheel
10. Flywheel baffle
11. Rear oil seal of crankshaft
12. Main bearing cap
13. Crankshaft
14. Tappet
15. Camshaft
16. Cylinder block

Inspection and repair

If excessive abrasion and damage is found during checking, adjust, repair and replace parts in time.

1. Remove the gasket(s) and any other attached matters on the surface of cylinder block.

Be careful to prevent matters falling into the cylinder block by accident.

Take care not to scratch the cylinder block.

2. Carefully remove the oil pump, rear oil seal retainer and the seal on the oil pan assembly surface.

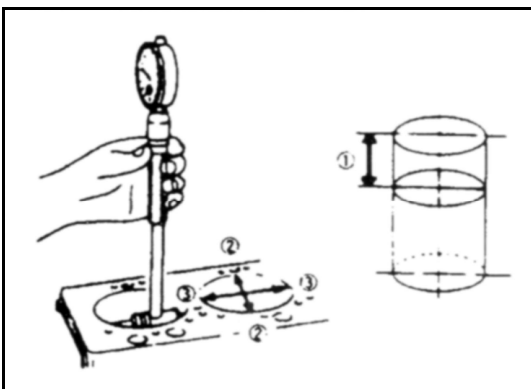
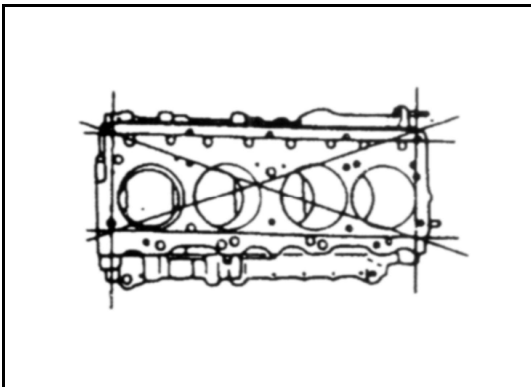
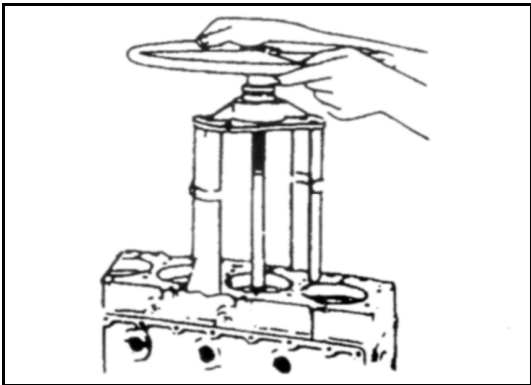
3. Wipe the cylinder block clean.

Inspection of cylinder liner protrusion size

1. Put ruler ① at the top edge of cylinder liner to be measured.
2. Measure the protrusion size of each cylinder liner with clearance gauge ②.

The difference between any two adjacent cylinders in cylinder liner protrusion height shall not exceed 0.05mm.

Standard value	mm
0~0.08	



Flatness

1. Remove the dowel from cylinder block.
2. Install cylinder liner detacher on the cylinder liner.
3. Check the base on the detacher shaft covers the bottom edge of cylinder liner firmly.
4. Slowly rotate the detacher shaft hand wheel anticlockwise to pull out the cylinder liner.

Detacher base of cylinder liner:

1002106FA-9102 (4DA1 Series)

Note: be careful not to damage the upper surface of cylinder during disassembling the cylinder liner.

5. Measure four edges and two diagonals of cylinder block upper surface with ruler ① and clearance gauge ②.

If measurement value exceeds the limit, the cylinder block has to be replaced.

Measurement of cylinder liner bore diameter

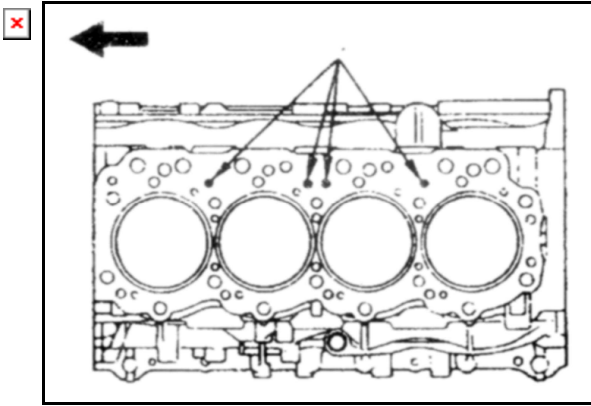
Measure the bore diameter of cylinder liner along thrust direction ②-② and the axial direction ③ of crankshaft with inside dial indicator in the depth of 20mm, 90mm, 160mm, and take the average value of 6 sizes as group size.

If measurement value exceeds prescribed limit, the cylinder liner has to be replaced.

Notes:

The inner surface of dry cylinder liner is chromalized, so it is not allowed to reface or perform honing.

If there are nicks or burns with the inner surface of cylinder liner, the cylinder liner has to be replaced.



Group selection of cylinder liner

Measure the inner diameter of cylinder block and choose appropriate cylinder liner group.

Standard over-fitting mm

0.001~0.019

Too little over-fitting of cylinder liner will have adverse effect on cooling efficiency of engine.

If the over-fitting of cylinder liner is too large, it will be difficult for the cylinder liner to encase gas.

Note:

There are two ways to select cylinder liner.

Method I

The surface of the cylinder block has been marked during manufacturing to indicate the correct size of cylinder liner. Cylinder liner groups (1, 2, 3, 4, etc.) are written with permanent ink. When there is doubt with cylinder liner marks, select the cylinder liner properly with the method below.

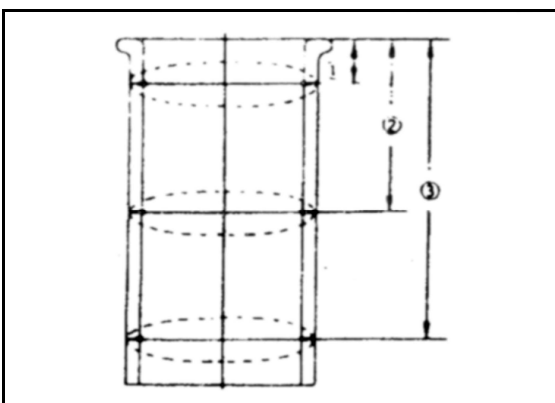
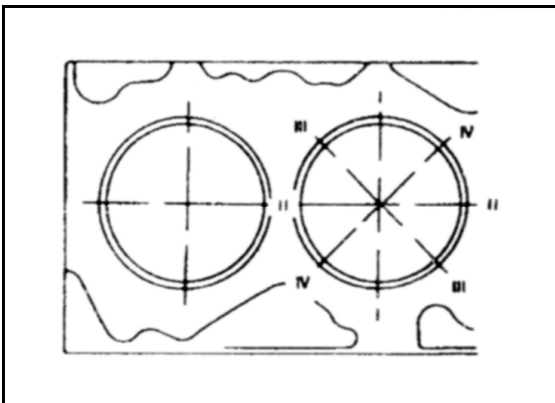
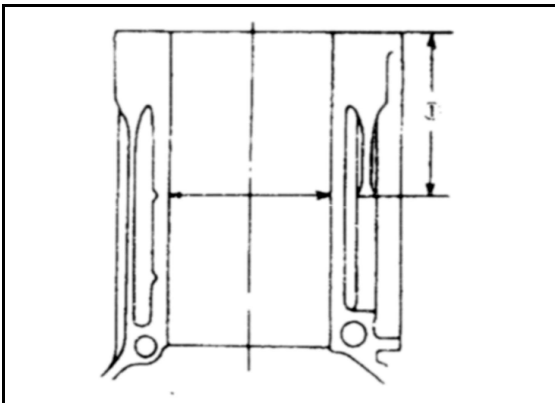
Method II

Measurement of cylinder block bore diameter

1) Measure the diameter at measuring point (A)

①-①、②-②、③-③。

The measuring point is the position 20mm, 90mm, 160mm away from the cylinder block surface.



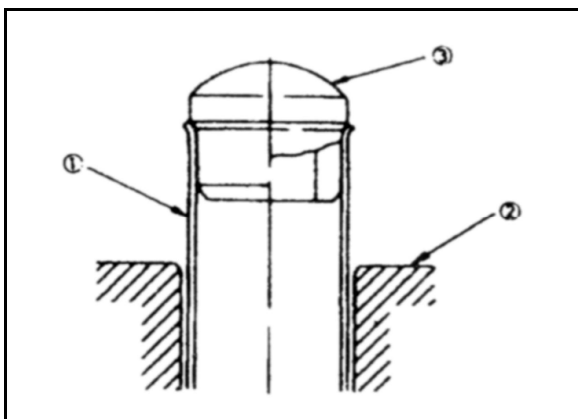


- 2) Calculate the average value of 6 measured sizes to determine appropriate cylinder liner group.
- 3) Refer to the table below according to the average value, and apply proper cylinder liner.

4DA1 Series

mm

Cylinder liner groups	Average value of cylinder bore diameter	Outer diameter of cylinder liner
0	94.991~95.000	95.001~95.010
1	95.001~95.010	95.011~95.020
2	95.011~95.020	95.021~95.030
3	95.021~95.030	95.031~95.040
4	95.031~95.040	95.041~95.050

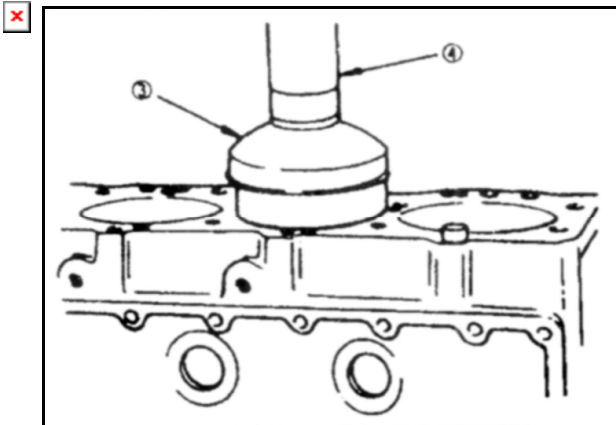


Cylinder liner installation

1. Install the cylinder liner with special tools.
 - 1) Thoroughly clean the cylinder liner and hole surface with new kerosene or diesel oil.
 - 2) Dry the surface of cylinder liner hole with compressed air. Cylinder liner erector 1002106FA-9101

Note:

Be sure to carefully remove all the foreign matters from the cylinder liner and cylinder hole before installation.



- 3) Insert cylinder liner ① into cylinder block ② from the top of cylinder block.

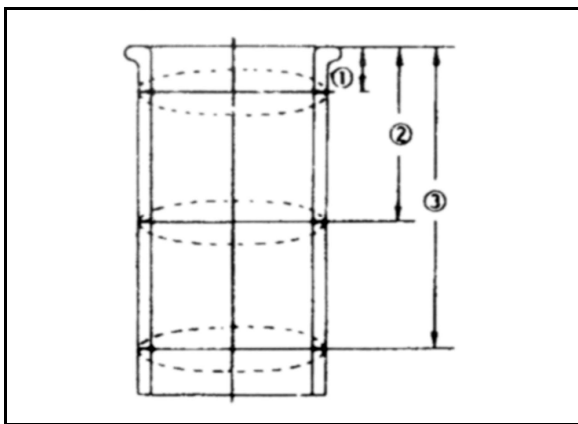
- 4) Install cylinder liner erector ③ at the top of cylinder liner.

The position of cylinder block shall ensure that the erector center is directly under desk-top pressing machine shaft ④.

Erector 1002106FA-9101

Note:

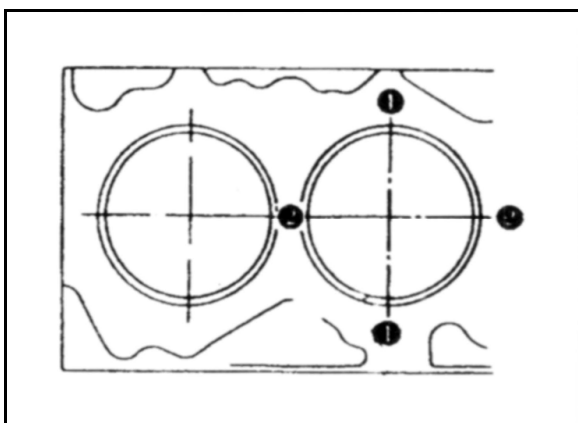
Check the cylinder liner is in vertical with desk-top pressing machine and without swinging.



- 5) Apply detent force 500kg (4900N) to the cylinder liner with desk-top pressing machine.
- 6) Apply 2500ka (1102.5lb/24500N) force to put the cylinder liner in place completely.
- 7) After the cylinder liner is installed, measure the protrusion size.

See "Inspection of cylinder liner protrusion size" in this chapter.

Measure the inner diameter of cylinder liner hole and choose appropriate piston group.

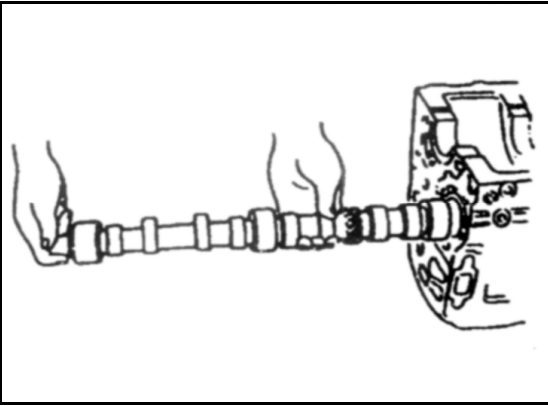


Reassembly

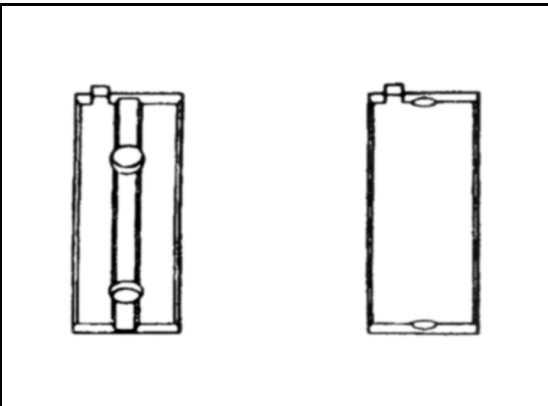
16. Cylinder block

15. Camshaft

- Coat oil on tappet and in the installation hole of upper cylinder block tappet.
- Fix position according to the position mark made during removal (if the tappet is reused).



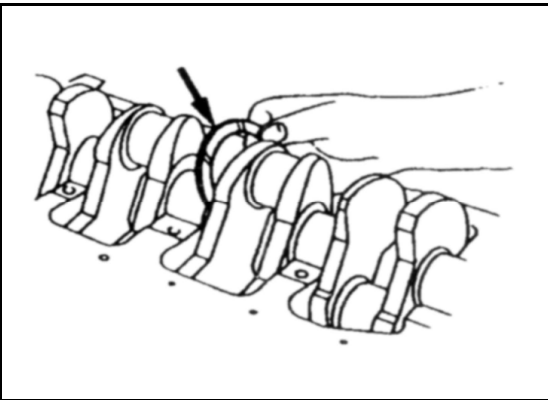
- Coat oil on the camshaft and camshaft bearing.
- Install the camshaft on the cylinder block.
Be careful not to damage the camshaft bearing.



14. Tappet

13. Crankshaft

- Install the main bearing on the cylinder block and main bearing cap.
- Ensure that their position is correct.
- Apply fresh oil to the upper and lower main bearing surfaces.
- Carefully install the crankshaft.



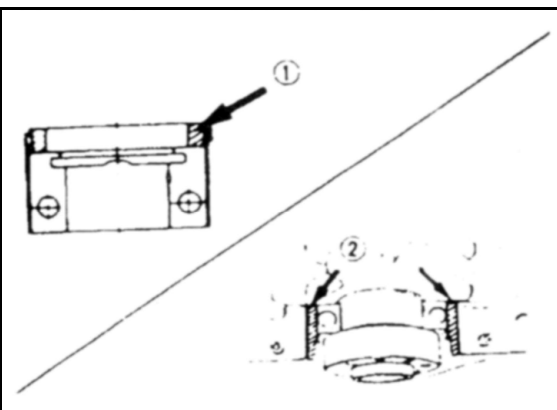
- Apply oil to the thrust plate.
- Install the thrust plate at the third main journal bearing. Its oil groove must face the crankshaft.

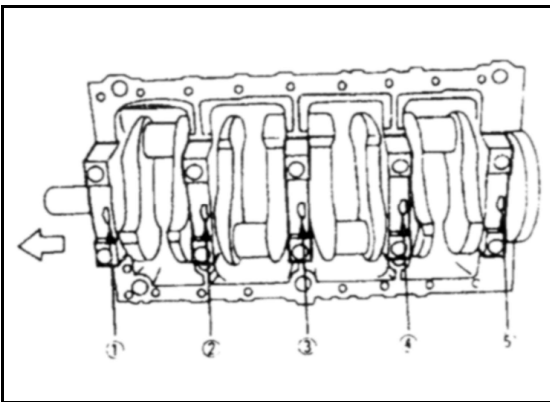
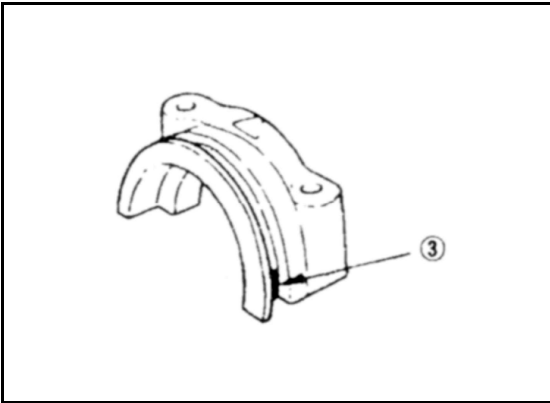
12. Main bearing cap

- Apply recommended liquid sealant or other equivalents to the fifth crankshaft bearing cap ① as shown in the drawing.
- Install arc gasket ② on the fifth bearing cap. Put the arc gasket into the bearing cap groove with fingers.

Note:

Ensure that there is no oil stain on the mating surface of bearing cap before coating liquid sealant. Make sure the liquid sealant does not block cylinder thread hole and bearing.





- Apply recommended liquid sealant or other equivalents to the fifth crankshaft bearing cap ③ as shown in the drawing

- Install the bearing cap, and make sure the arrow mark on its top points at engine forepart.

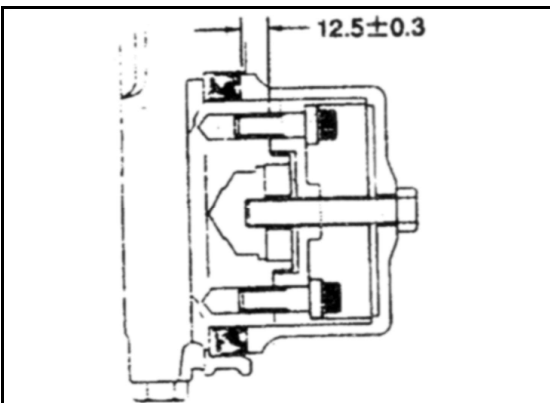
- Apply oil to crankshaft bearing cap bolts.

- Tighten the crankshaft bearing cap bolts step by step in several times as the sequence shown in the drawing until specified torque is reached:

$170 \pm 10 \text{ Nm}$

Note:

Manually rotate the crankshaft to check it is flexible.



11. Rear oil seal of crankshaft

- Install the oil seal on the cylinder block with an oil seal erector.

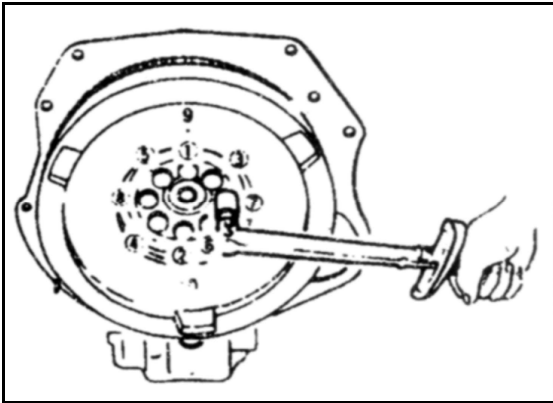
Rear oil seal erector: 1002430FA-9101

Notes:

Clean the rust and chips off the press-in portion of the oil seal.

Pay attention to the press-in direction of the oil seal.

- 1) Use two bolts to connect the adaptors of special tools to the rear end of the crankshaft.
- 2) Install the oil seal to the periphery of the adaptors.



- 3) Insert the socket into the adaptor and screw down the bolt until the adaptor tip is in contact with the socket.
- 4) Remove the adaptor and socket.
- 5) Check the oil seal size after it is installed.

Standard value	mm
12.5 ± 0.3	

10. Flywheel baffle

- Tighten the flywheel baffle fixing the bolt(s) to the specified torque:

$$85 \pm 10 \text{ N} \cdot \text{m}$$

9. Flywheel

- Apply oil to the fixing bolts.
- Screw down the flywheel bolts to the specified torque in two steps via torque tightening method.

Tighten them as the sequence number shown in the drawing.

8. Piston and connecting rod

- 1) Press the piston pin into piston pin hole with fingers.

Weigh each piston and connecting rod assembly. Select the piston and connecting rod assembly in such a way that the assembly weight difference varies within the specified limits.

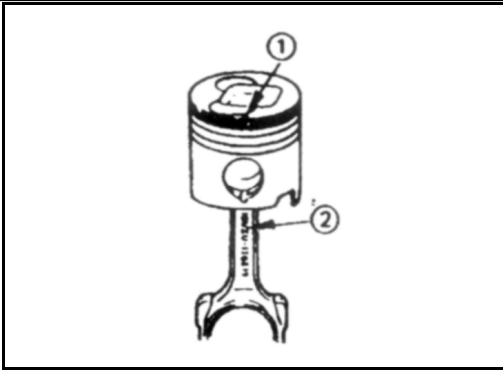
Weight variation after combined as an assembly	4DA1	4DA1-1
	Less than 10g	Less than 8g

- 2) Clamp the connecting rod by a vice. Be careful not to damage the connecting rod.
- 3) Encase the piston pin retainer into piston with pliers.

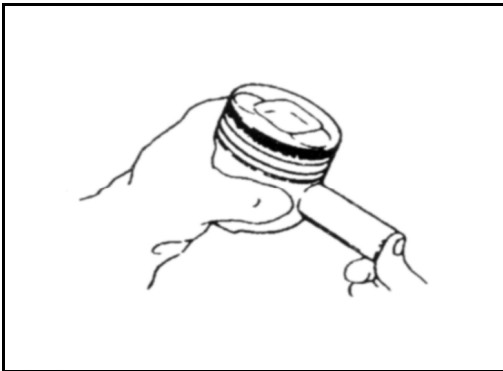
Note:

When changing the piston/connecting rod assembly, do not change the piston/piston pin assembly.

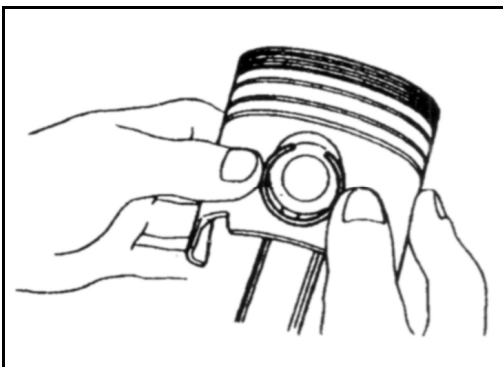




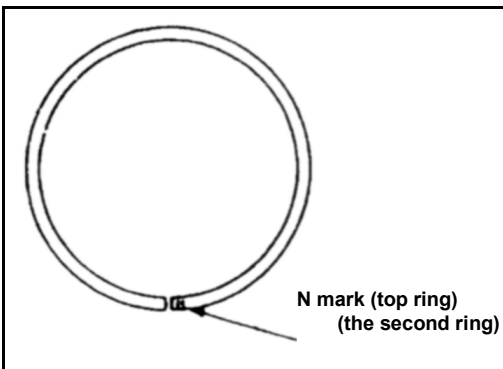
- 4) Install the piston onto the connecting rod. Mark ① on the piston head and casting symbol “F908” ② on the connecting rod should be toward the same direction.



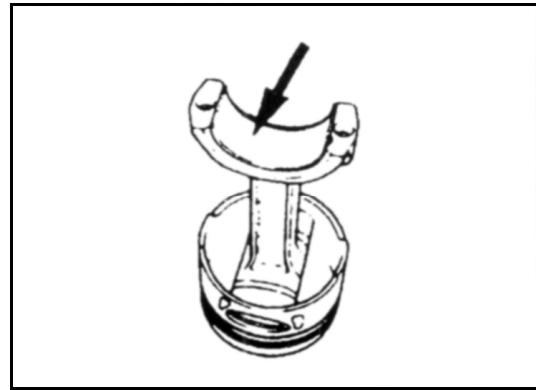
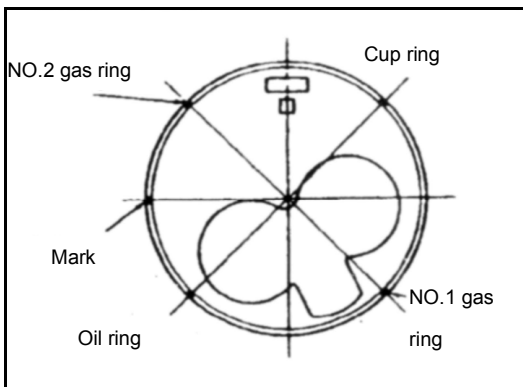
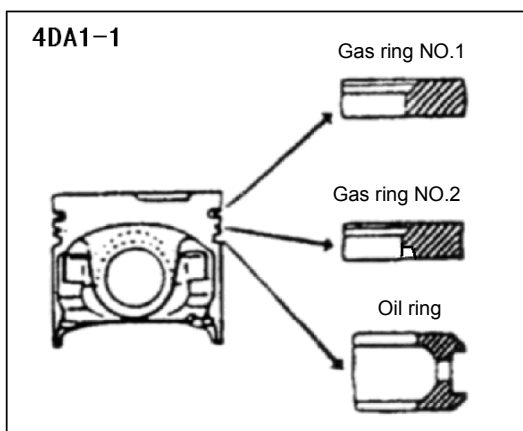
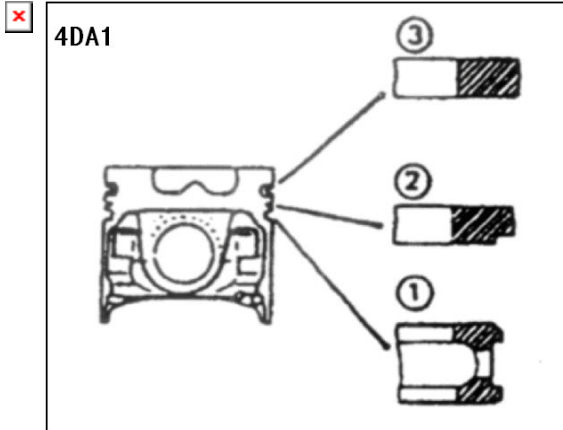
- 5) Apply oil to the piston pin and piston pin hole. Forcibly push the piston pin into piston with fingers until it is in contact with piston pin retainer.



- 6) Forcibly press the piston pin retainer into piston retainer groove with fingers. Check whether the connecting rod swings freely on the piston pin.



- 7) Install the piston ring with piston ring expansion lip. The TOP mark on gas ring should be toward upwards. Identification sign is shown in the drawing.



8) Mount three piston rings with a piston ring replacer.

Piston ring replacer:

Install the piston ring as the sequence number shown in the drawing.

- ① Oil ring
- ② The second gas ring
- ③ The first gas ring

Notes:

Make sure that the surface with marks is toward the upward when gas ring is installed.

Encase the spiral cup ring into the oil ring, and make sure that there is no clearance at any side of the spiral cup ring before the oil ring is installed.

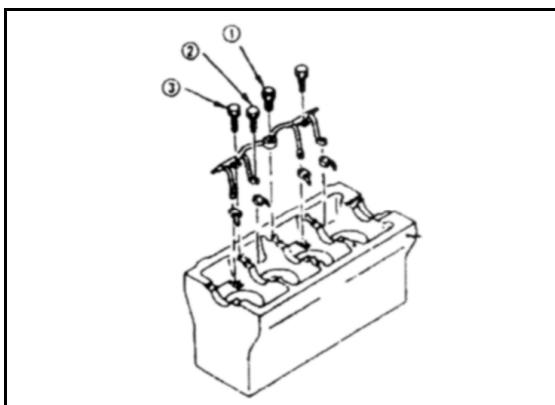
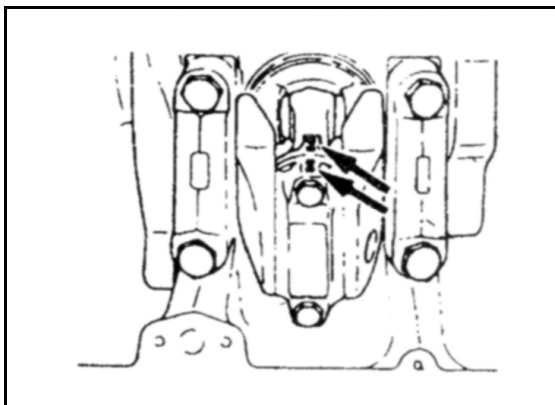
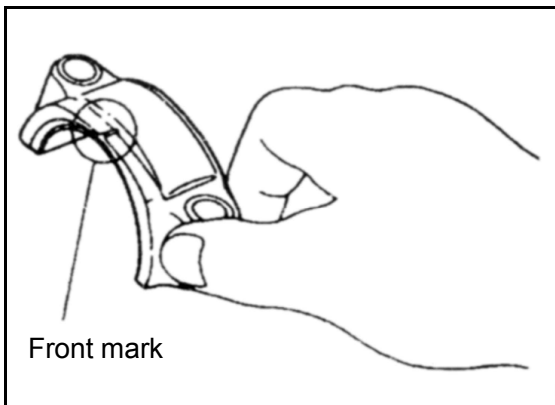
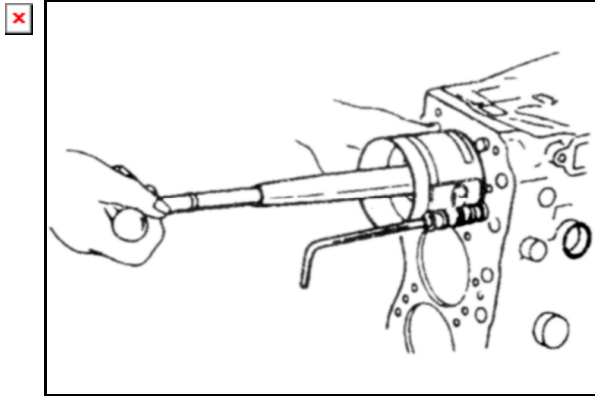
9) Apply some oil to the piston ring surface.

10) Check whether the piston ring turns freely in the piston ring groove.

11) Place the piston ring opening as shown in the drawing.

12) Carefully remove the oil stains or other foreign matters from the back of connecting rod bearing or the installation surface of connecting rod bearing.

13) Apply some oil to the upper bearing surface.
Apply some oil to the cylinder wall.



14) Place the piston in such a way that the front mark on the bearing cap must be toward the engine forepart.

Encase the piston into engine block with piston installation taper sleeve.

Piston installation taper sleeve:

1004001FA-9102

15) Push in the piston with a hammer handle until the connecting rod touches the crankpin. In addition, rotate the crankshaft until the crankpin is at bottom dead center.

16) Place the bearing cap in such a way that its front mark is toward the engine forepart.

17) Install connecting rod bearing cap. Align the cylinder sequence mark on connecting rod bearing cap with the one on connecting rod.

18) Apply oil to the thread and mating surface of each connecting rod bearing cap bolt.

19) Screw down the connecting rod bearing cap bolt to the specified torque in two steps via torque tightening method.

Torque of connecting rod bearing cap bolt N • m

	First step (pre-tightening)	Second step (tightening)
4DA1 Series	20	85

Note:

Manually rotate the crankshaft to check whether it is flexible.

7. Piston cooling oil pipe

6. Oil pump assembly

5. Timing pulley chamber

4. Front oil seal

3. Timing gear

2. Oil pan assembly

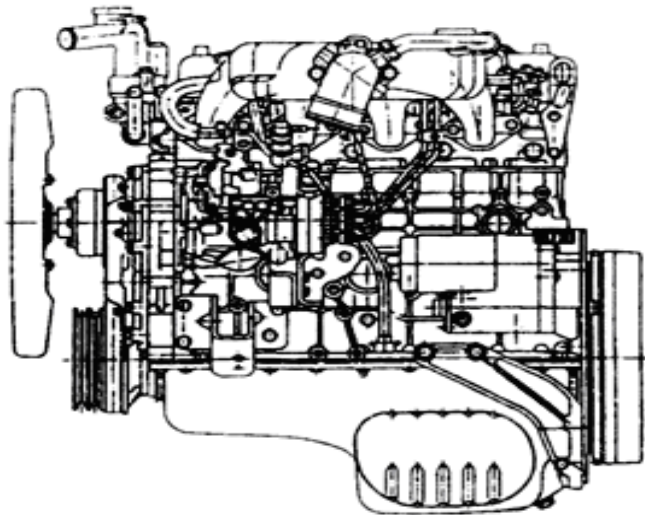
1. Cylinder head assembly and gasket

See “Crankshaft” in 2.6 for the reassembly of “7 - 1”.



3.4 DA1 Series Engine

3.1 General



4DA1 Series

ω type combustion chamber is adopted in 4DA1 Series engine, and this kind of design provides outstanding economical efficiency of fuel within wide running range.

The cylinder head gasket is piled up with sheet steel.

Tighten the fixing bolts of such parts as cylinder head, connecting rod and flywheel with torque tightening method.

Dry cylinder liner made of chromized steel has high durability.

The piston with automatic heat compensation is supported with cast steel, which is used to reduce the noise resulted from heat expansion and cold engine.

The crankshaft by soft nitrogen treatment has long life. Because of its soft nitrogen treatment, the crankshaft can not be refaced.

Both the crankshaft main bearing and connecting rod bearing are made of aluminum alloy. This kind of bearing is particularly easy to be damaged when encountering foreign matters such as metal chips.

Therefore, it is very important to keep the oil hole and other associated surfaces clean and remove foreign matters.

The crankshaft's soft nitrogen treatment (nitrogen treatment) improves its intensity, and saves the step of refacing crankpin and main journal.

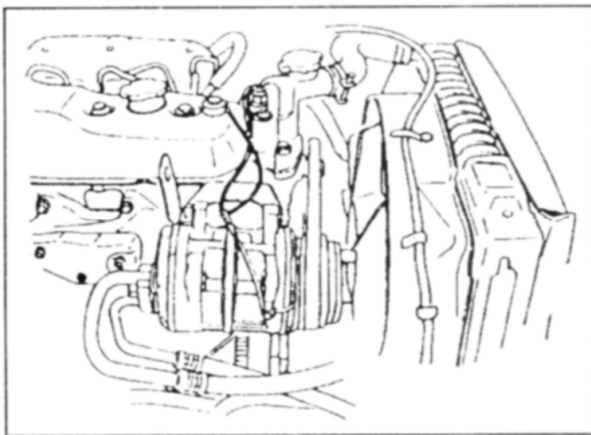
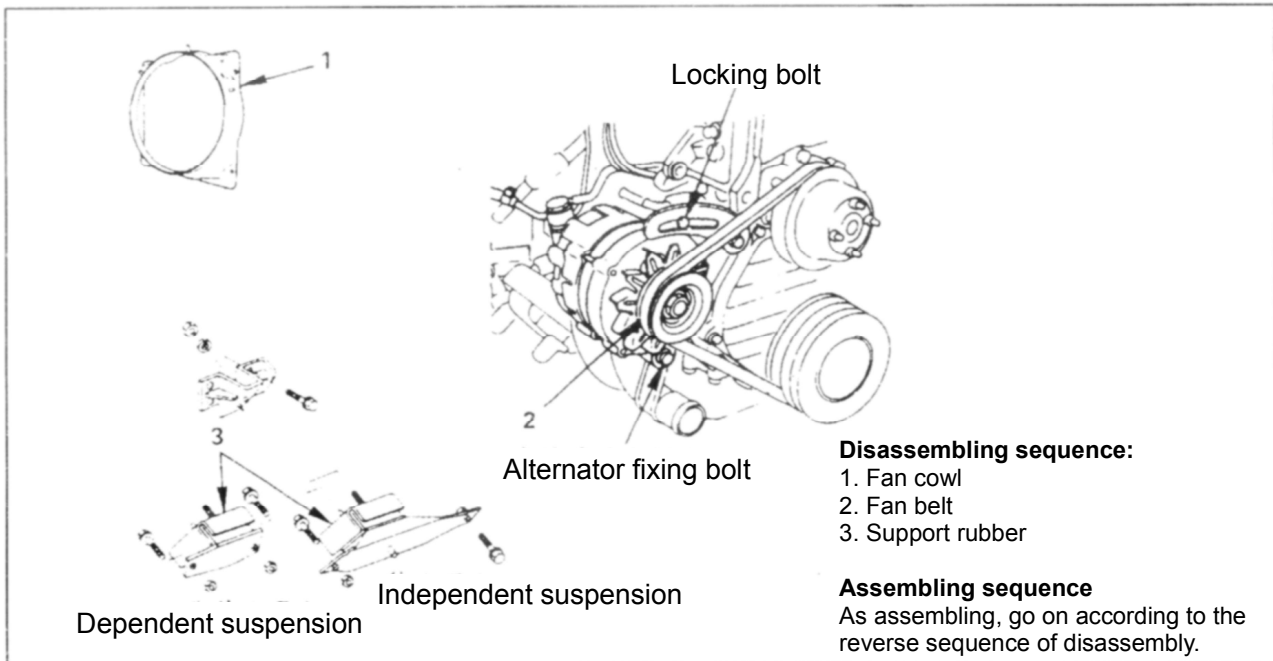
4DA1-1 engine is equipped with fuel injection device for cooling piston in the fuel line, and the fuel is injected toward piston from the fuel line of cylinder block via non-turn valve.

Be careful not to damage the oil nozzle when disassembling and assembling piston and connecting rod.

4DA1 Series is direct injection engine, and the fuel injector had five holes, which enables inlet air and fuel injection to gain optimum mixing ration.



3.2 Right support of engine



Disassembly

Preparation:

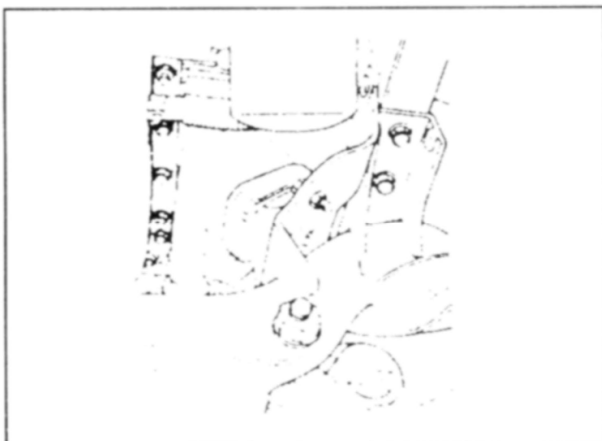
- Remove the ground cables of battery.

1. Fan guard

- Remove the storage tank hose and fan guard.

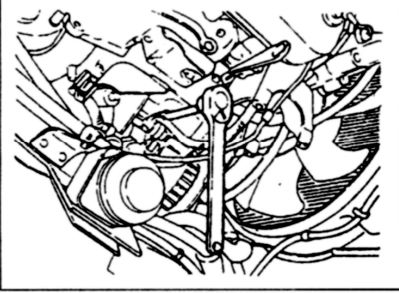
2. Fan belt

- Remove locking bolts of adjusting plate.
- Loosen the alternator fixing bolt and then remove the fan pulley drive belt.



3. Support rubber

- Remove the two fixing nuts at the beam side.



- Remove the generator from the engine.
- Remove the support rubber nut from engine foot rest side.
- Lift the engine to remove the support rubber.



Assembly

3. Support rubber

- Lift the engine to install the support rubber.
- Tighten the fixing nut(s) to the specified torque.



Engine foot rest side

N • m

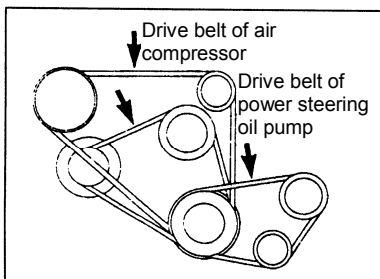
8



Beam side

N • m

40



2. Fan pulley drive belt

- Install the fan pulley drive belt.
- Press the middle part of fan pulley drive belt with 100N force to let the belt go down for 8-10mm.
- Tighten the fixing nut(s) to the specified torque.



Generator fixing bolt

N • m

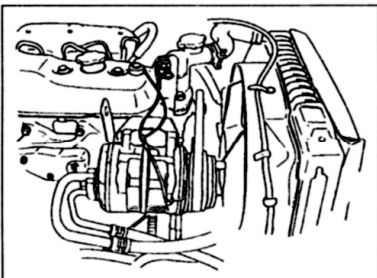
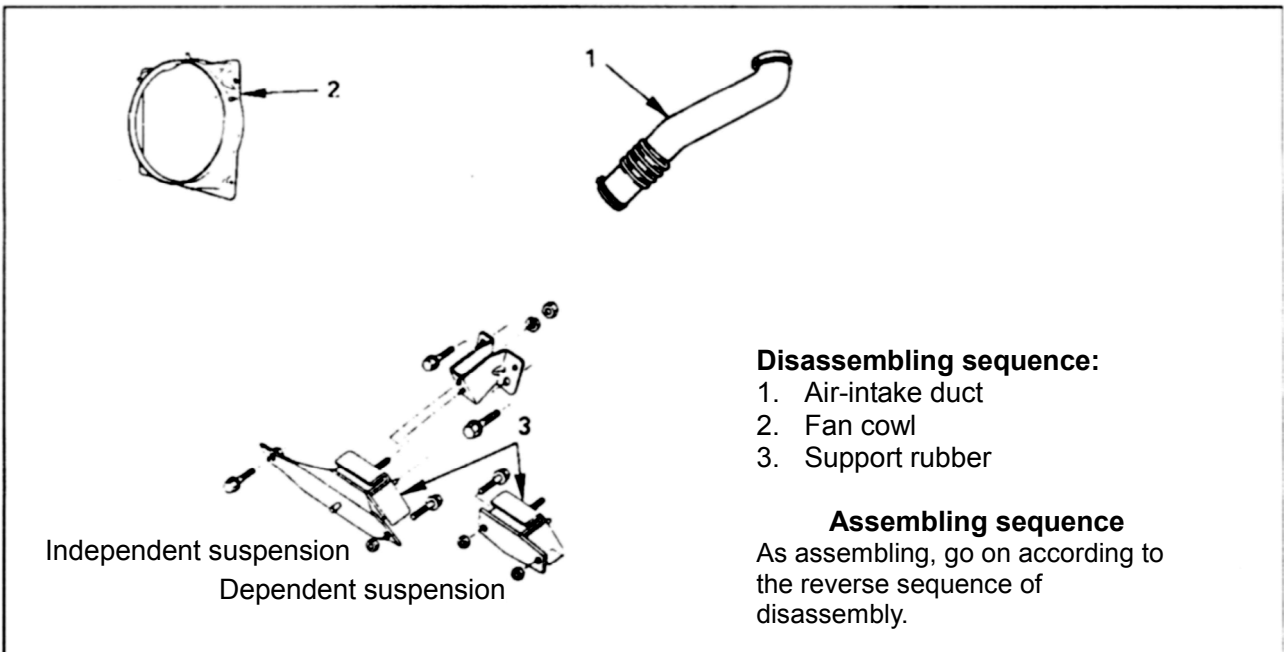
37.5

1. Fan guard

- Install the fan guard and tighten the storage tank hose.



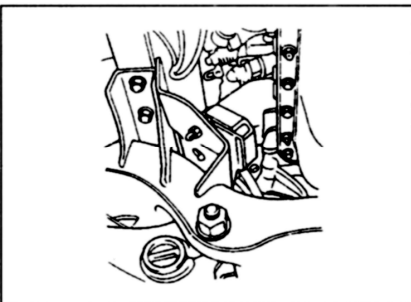
3.3 Left support of engine

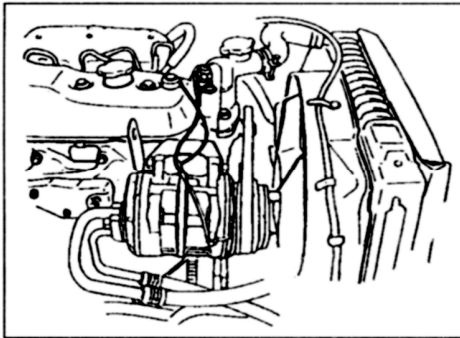


Disassembly

Preparation:

- Remove the ground cables of battery.
- 1. Air-intake duct**
 - Remove the air-intake duct.
 - 2. Fan guard**
 - Remove the storage tank hose and fan guard.
 - 3. Support rubber**
 - Remove the two fixing bolts at beam side.

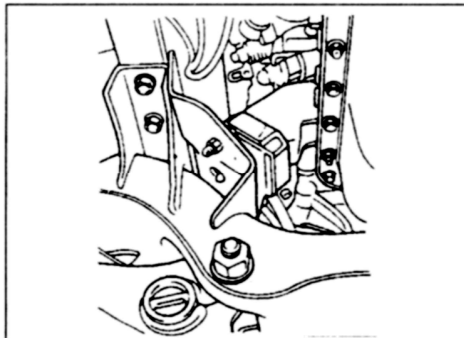




- Remove the support from engine foot rest side.
- Remove the support rubber nut from engine foot rest side.
- Lift the engine to remove the support rubber.



Assembly



3. Support rubber

- Lift the engine to install the support rubber.
- Tighten the fixing nut(s) to the specified torque.



Engine foot rest side

N • m

82



Beam side

N • m

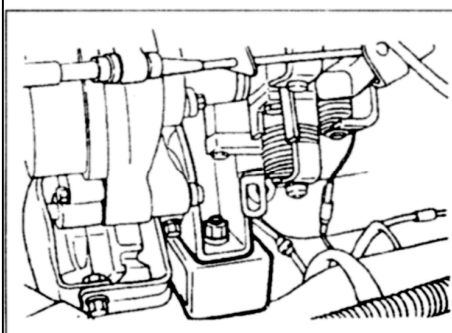
40

2. Fan guard

- Install the fan guard and tighten the storage tank hose.

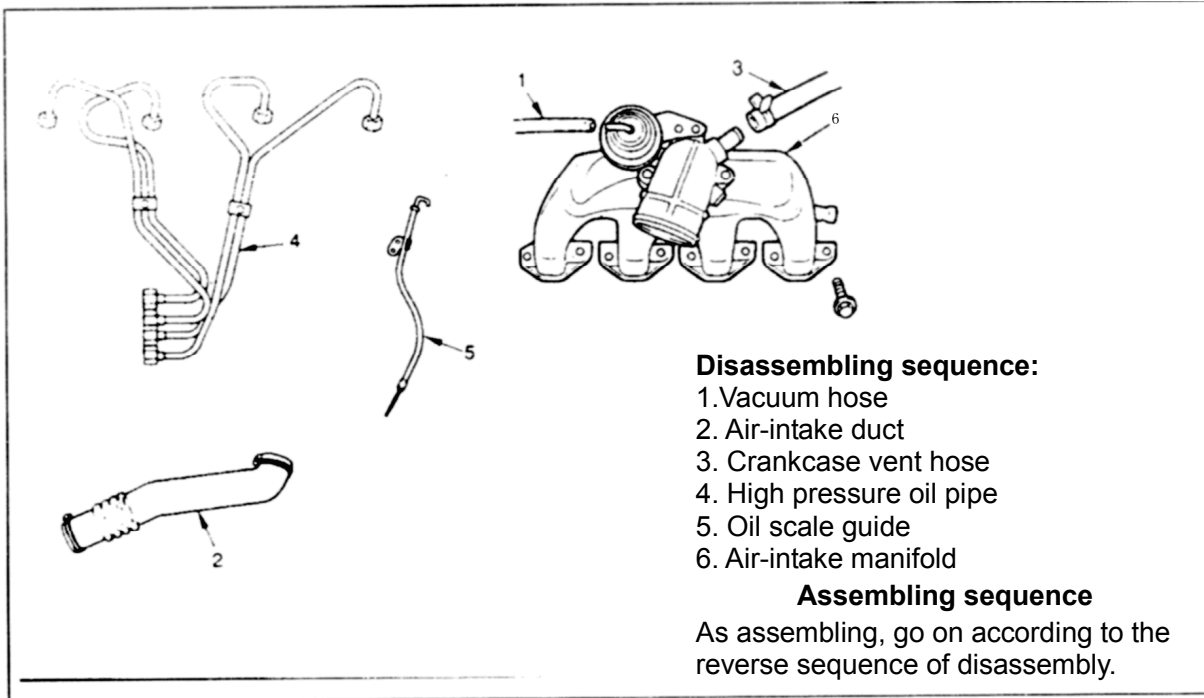
1. Air-intake duct

- Install the air-intake duct.
- Connect the ground cables of battery.





3.4 Air-intake manifold



Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge coolant completely.

1. Vacuum hose

2. Air-intake duct

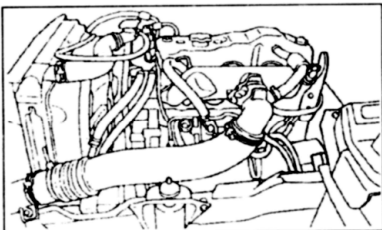
3. Crankcase vent hose

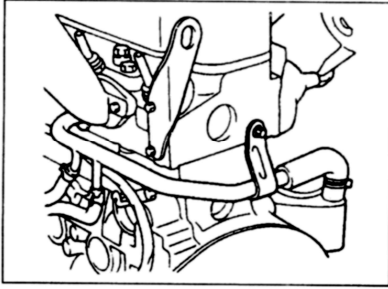
4. High pressure oil pipe

- Unscrew high pressure oil pipe clip.
- Loosen the taper nut(s) at injection pump side.
- Loosen the taper nut(s) at injector side, remove the pipe and put it aside.

5. Oil scale guide

- Remove the fixing bolt(s) and disassembly the oil scale guide.





6. Air-intake manifold

- Remove the fixing bolt(s) and nut(s) of manifold.

Assembly

6. Air-intake manifold



- Tighten the fixing bolt(s) and nut(s) to the specified torque.

Bolt and nut

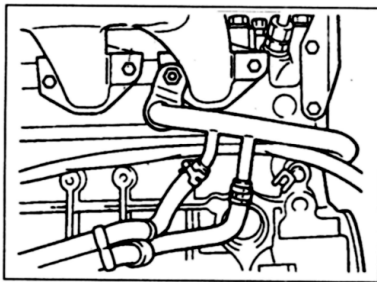
N • m

20



5. Oil scale guide

- Install the guide and tighten it together with the manifold.



4. High pressure oil pipe

- Connect the high pressure oil pipe and tighten the taper nut(s) to the specified torque.

Taper nut torque

N • m

30

- Install the clip of high pressure oil pipe at the original position.

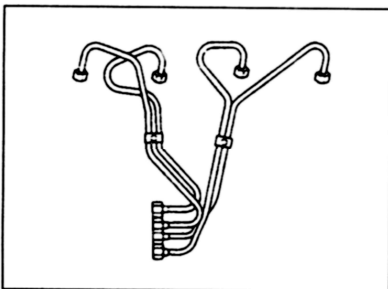
3. Crankcase vent hose

2. Air-intake duct

1. Vacuum hose

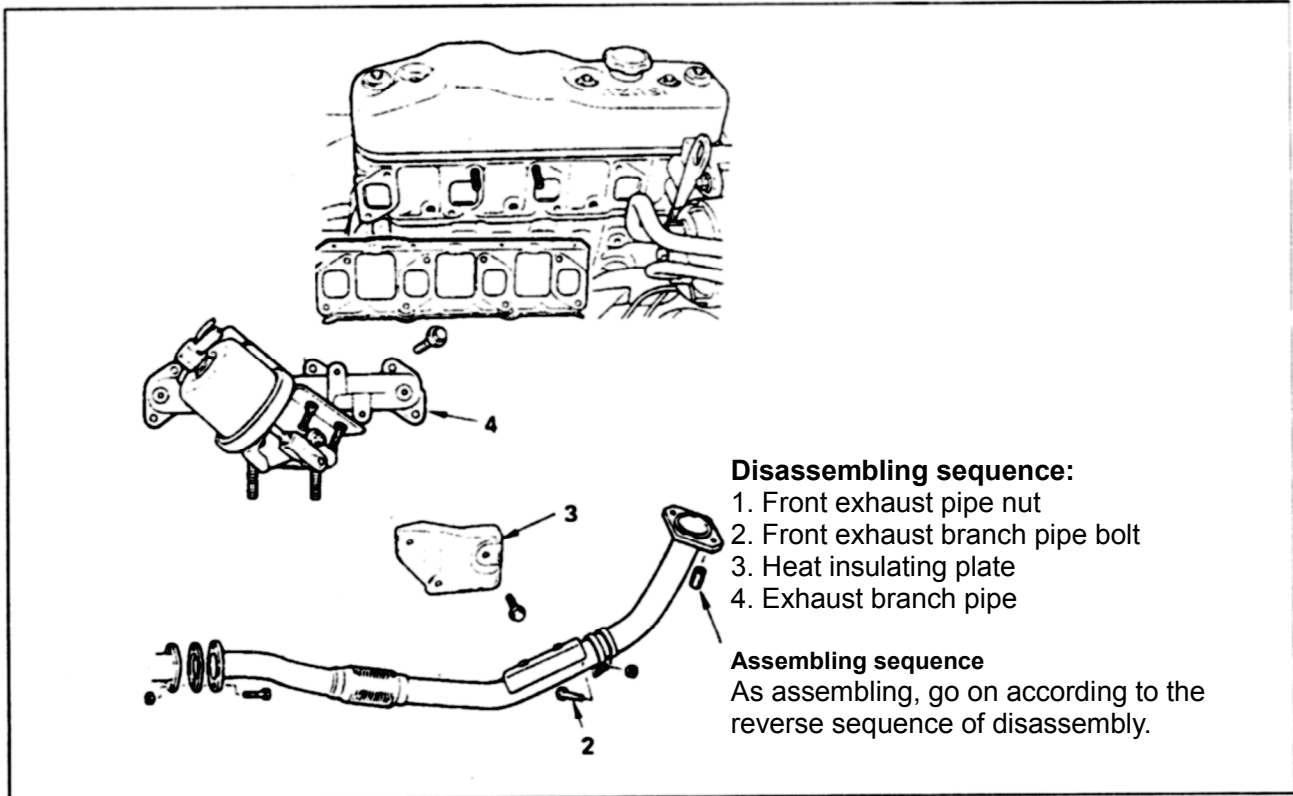


- Connect the ground cables of battery.
- Add some coolant.
- Start the engine and check whether the coolant leaks.





3.5 Exhaust manifold



Disassembly

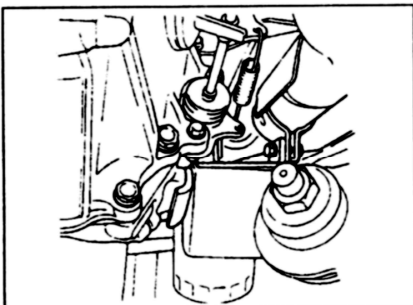
Preparation:

- Remove the ground cables of battery.

1. Front exhaust pipe nut

- Remove the fixing nut(s) at exhaust manifold side.

2. Front exhaust pipe support bolt.



**3. Heat insulating plate****4. Exhaust manifold**

- Remove the bolt(s) and nut(s) of manifold, and then dismount the manifold and gasket(s).

**Assembly****4. Exhaust manifold**

- Tighten the fixing bolt(s) and nut(s) to the specified torque.

Manifold bolt torque	N.m
----------------------	-----



30

3. Heat insulating plate

- Install the heat insulating plate and tighten the bolt(s) to the specified torque.

Heat insulating plate bolt torque	N.m
-----------------------------------	-----



25

2. Front exhaust pipe support bolt

- Tighten the fixing bolt(s) to the specified torque.



Support bolt torque	N.m
---------------------	-----

40

1. Front exhaust pipe nut

- Tighten the fixing nut(s) to the specified torque.

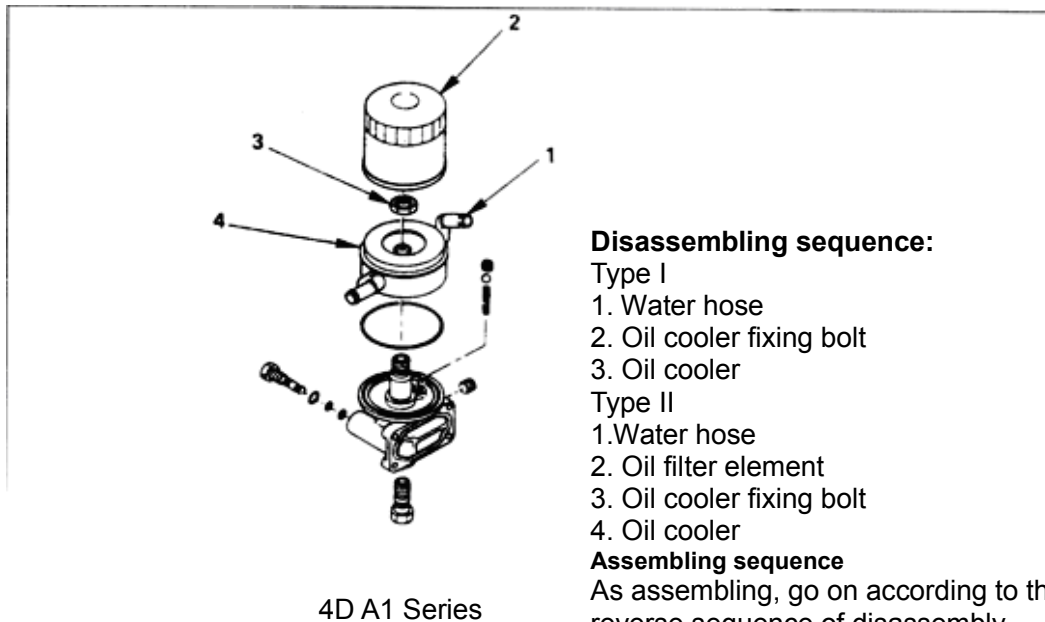
N.m

40

- Connect the ground cables of battery.
- Start the engine and check whether the coolant leaks.



3.6 Oil cooler



Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge the coolant completely.
- Place the wiping cloth at oil cooler 9 to prevent oil immersion.

1. Water hose

- Remove water inlet and outlet hoses.

2. Oil filter element

3. Fixing nut of oil cooler

4. Oil cooler

Inspection



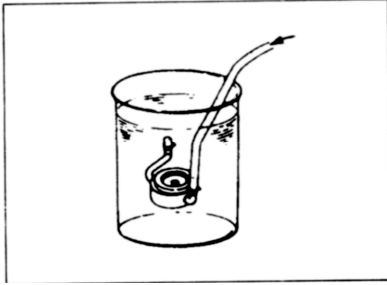
Relief valve

1. Install an oil pressure gauge at the position where the oil line is near oil filter.
2. Start the engine and check the opening pressure of the relief valve.

Opening pressure of relief valve

kg/cm²

	4.7
--	-----

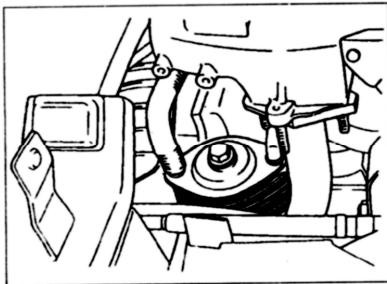


3. Oil cooler

Inspection of water passage leakage

1. Block one end of the oil cooler water passage.
2. Immerse the oil cooler into the water.
3. Add compressed air at the other end of the oil cooler water passage.

(2kg/cm²(28.5pai/19.60kpa)), bubbles rising on the surface indicates that there is leakage with the water passage.



Assembly

3. Oil cooler

- Install O ring onto the oil filter and place the oil cooler.

2. Fixing nut of oil cooler

Tighten the fixing nut(s) of oil cooler to the specified torque.

Oil cooler nut torque

N.m

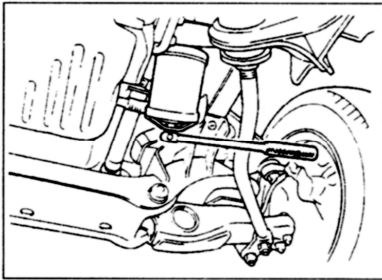
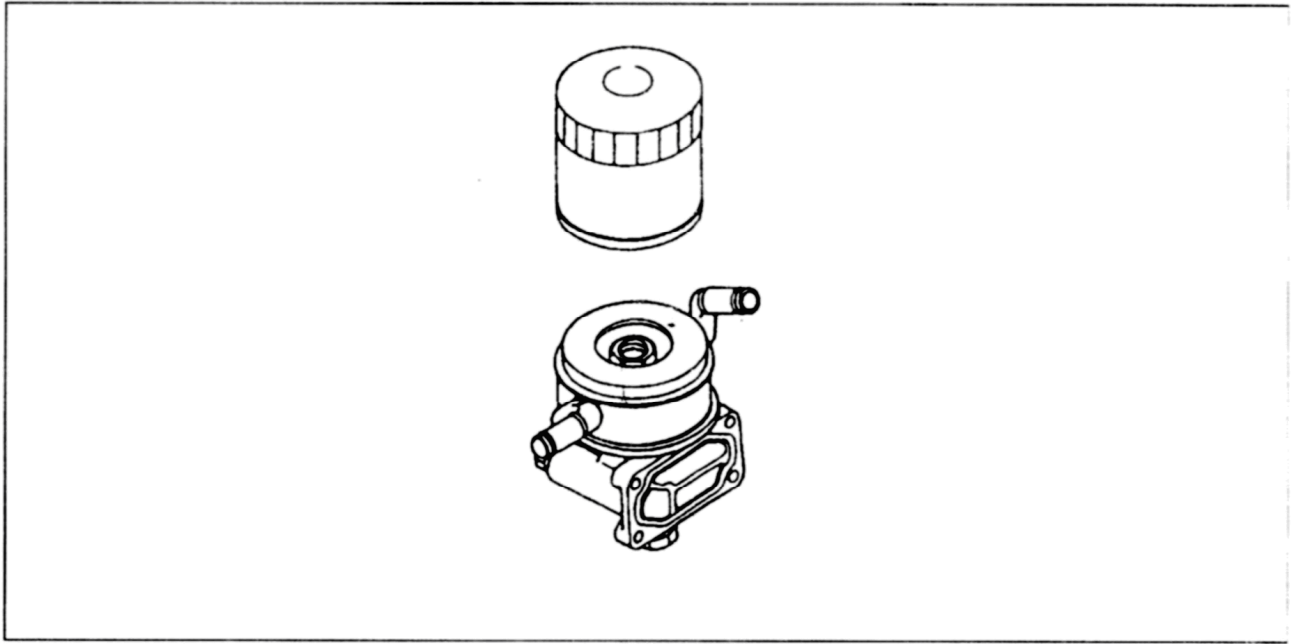


30

1. Water hose

- Connect the water hose.
- Connect the ground cables of battery.
- Start the engine and check whether the oil leaks.

 Oil filter element



Disassembly

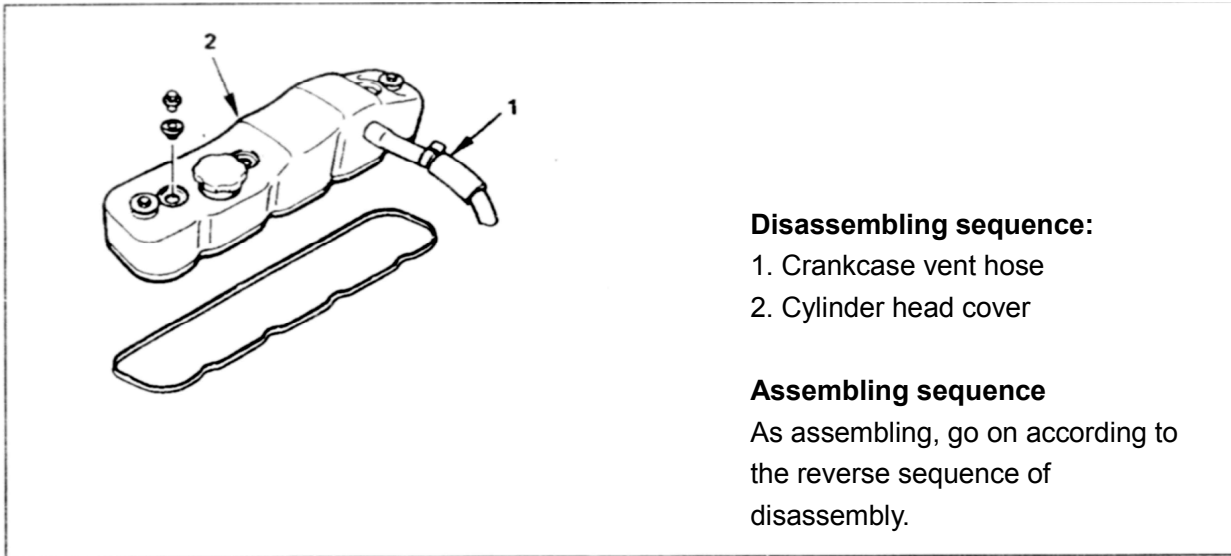
- Place a container under the oil filter to receive oil.
- Remove the oil filter element with a filter wrench.
- Filter wrench: 1010300FA-9101

Assembly

- Coat a thin layer of oil on the oil filter O ring.
- Screw new oil filter element into the filter until the sealing surface is jointed with O ring.
- Tighten the oil filter with the filter wrench, and screw down another $1\frac{1}{8}$ circles for I type, while screw down another $1\frac{1}{4}$ circles for II type.
- Start the engine and check whether the oil leaks from the oil filter.



3.8 Cylinder head cover



Disassembly



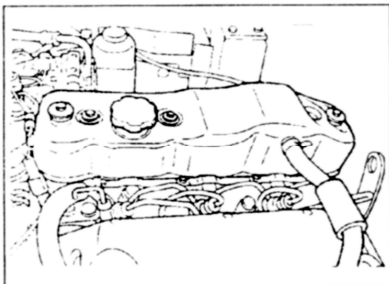
Preparation:

- Remove the ground cables of battery.

1. Crankcase vent hose

- Dismantle crankcase vent hose from air-intake duct side.

2. Cylinder head cover



Assembly



2. Cylinder head cover

- Apply oil to the rocker arm and valve spring.
- Install the gasket(s) of cylinder head cover on the cylinder head cover.

The gasket(s) must be flat and without damage.



- Tighten the cylinder head cover nut(s) to the specified torque.

N·m

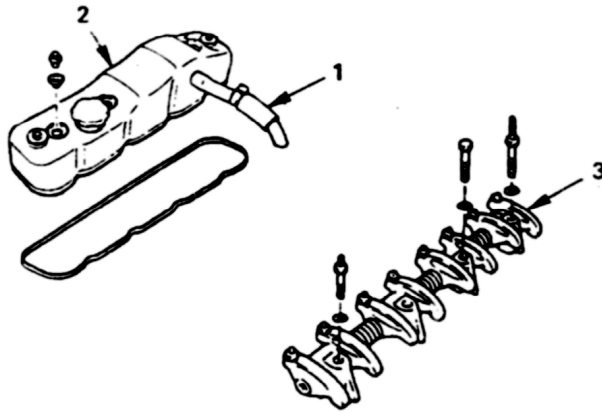
13

1. Connect the crankcase vent hose.

- Connect the crankcase vent hose to the air-intake pipe.
- Connect the ground cables of battery.



3.9 Rocker shaft assembly



Disassembling sequence:

1. Crankcase vent hose
2. Cylinder head cover
3. Rocker shaft assembly

Assembling sequence

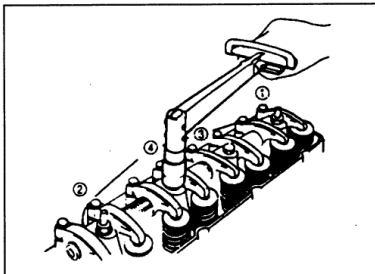
As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

Remove the ground cables of battery.



1. Crankcase vent hose
2. Cylinder head cover
3. Rocker shaft assembly

Loosen the bolt(s) and nut(s) of rocker shaft support in sequence and remove the rocker shaft assembly.



Assembly

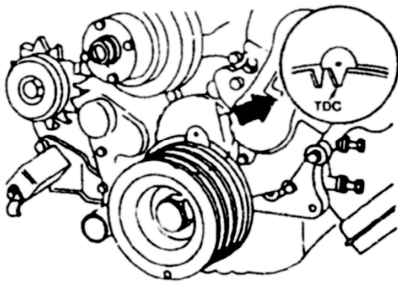
3. Rocker shaft assembly



- Install the rocker shaft so that the bigger oil hole ($\Phi 4$) locates at engine forepart.
- Align the fixing bolts with the holes on the rocker shaft, and tighten them to the specified torque.

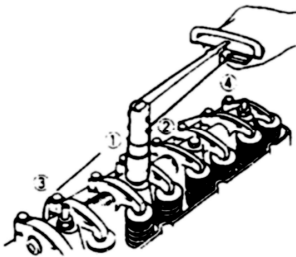
N. m

55



Valve clearance adjustment

- ① Rotate the crankshaft until TDC line of the crankshaft damper pulley is aligned with timing pointer, and either the first cylinder piston or the fourth cylinder piston is at the top dead center (TDC) of compression stroke.



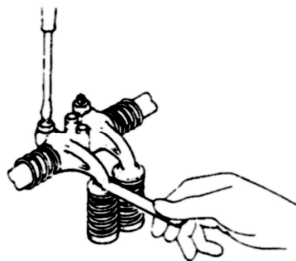
- ② Check the nuts of rocker shaft support are loose.
Tighten all the loose nuts of the rocker shaft support before adjusting valve clearance.



Rocker shaft support nut torque

N.m

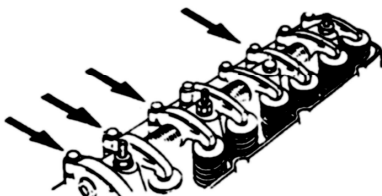
55



- ③ Check the clearance between intake valve and exhaust valve push rod for the first cylinder. If there is clearance between intake valve and exhaust valve push rod for the first cylinder, the first cylinder piston locates at the top dead center of compression stroke.

If there is no clearance between intake valve and exhaust valve push rod for the first cylinder, the fourth cylinder piston locates at the top dead center of compression stroke.

Top dead center of the first cylinder compression stroke



The piston of cylinder must locate at the top dead center of compression stroke when the valve clearance of the first cylinder or fourth cylinder is adjusted.



Valve clearance (cold state)

mm

0.3-0.4

- ④ Loosen the adjustment screw(s) for each valve clearance shown in the drawing.
- ⑤ Insert a clearance gauge with proper thickness between the rocker arm and valve stem end.



Top dead center of the fourth
cylinder compression stroke



- ⑥ Rotate the adjustment screw(s) for valve clearance until a touch of resistance is felt on the clearance gauge.
- ⑦ Tighten the locking nut(s) firmly.
- ⑧ Rotate the crankshaft for 360°.
- ⑨ Then align TDC line of crankshaft damper pulley with timing pointer.
- ⑩ Adjust the clearance of other valves shown in the drawing.

2. Cylinder head cover



- Install the cylinder head cover and tighten the bolt(s) to the specified torque.

N. m

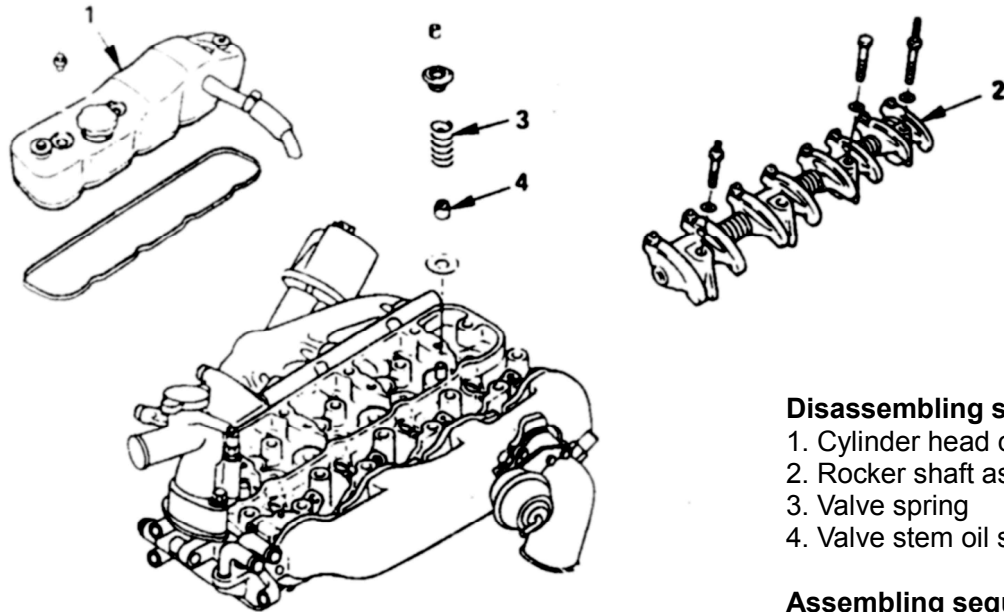
13

1. Crankcase vent hose

- Connect the ground cables of battery.



3.10 Valve stem oil seal and valve spring



Disassembling sequence:

1. Cylinder head cover
2. Rocker shaft assembly
3. Valve spring
4. Valve stem oil seal

Assembling sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

- Remove the ground cables of battery.

1. Cylinder head cover

2. Rocker shaft assembly

- Loosen the bolt(s) and nut(s) of rocker shaft support in sequence and remove the rocker shaft assembly.

3. Valve spring

- Compress the valve spring with a special tool and remove the valve cotter.

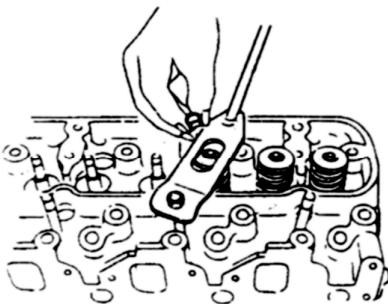


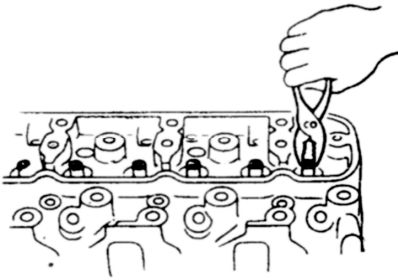
Valve spring compressor: 1003015FA-9101



Caution:

- Place the removed valve springs as the cylinder number sequence.





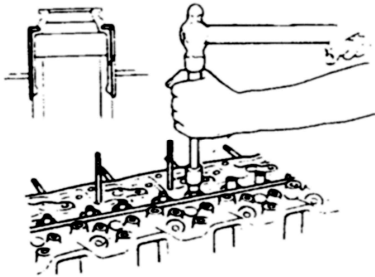
4. Valve stem oil seal

- Remove the valve stem oil seals with pliers.



Caution:

The valve stem oil seal that has been removed should not be used again.



Assembly

4. Valve stem oil seal

- Install new valve stem oil seals on the valve guide with a special tool.

Special tool: 1003016FA-9101

3. Valve spring

- Place upper valve spring retainer on the valve spring.



Caution:

- The colored part of valve spring should be downward.
- Add compressed air to the cylinder from glow plug and lift the valve to set it in place.
- Install the valve cotter with special tool.

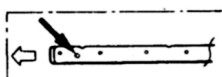
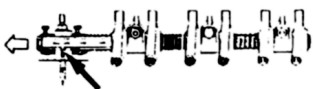


- Valve spring compressor: 1003015FA-9101



2. Rocker shaft assembly

- Install the rocker shaft so that the bigger oil hole ($\Phi 4$) locates at engine forepart.
- Align the fixing bolts with the holes on the rocker shaft, and tighten them to the specified torque.



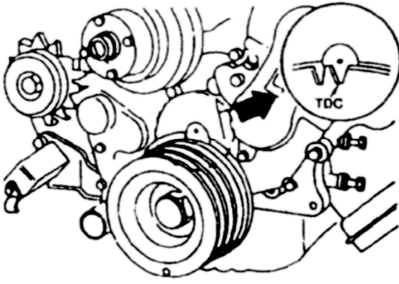
N·m

55

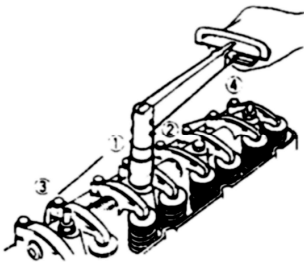
- Valve clearance adjustment



Valve clearance adjustment



- ① Rotate the crankshaft until TDC line of the crankshaft damper pulley is aligned with timing pointer, and either the first cylinder piston or the fourth cylinder piston is at the top dead center (TDC) of compression stroke.



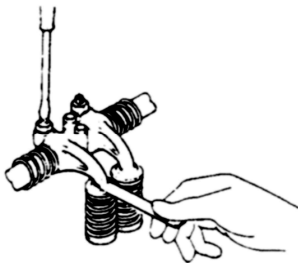
- ② Check the nuts of rocker shaft support are loose.
Tighten all the loose nuts of the rocker shaft support before adjusting valve clearance.



Rocker shaft support nut torque

N.m

55



- ③ Check the clearance between intake valve and exhaust valve push rod for the first cylinder. If there is clearance between intake valve and exhaust valve push rod for the first cylinder, the first cylinder piston locates at the top dead center of compression stroke.

If there is no clearance between intake valve and exhaust valve push rod for the first cylinder, the fourth cylinder piston locates at the top dead center of compression stroke.



The piston of cylinder must locate at the top dead center of compression stroke when the valve clearance of the first cylinder or fourth cylinder is adjusted.



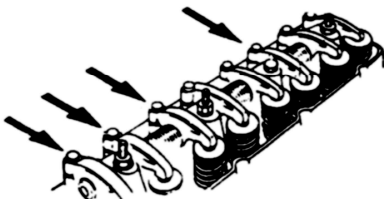
Valve clearance (cold state)

mm

0.3-0.4

- ④ Loosen the adjustment screw(s) for each valve clearance shown in the drawing.
- ⑤ Insert a clearance gauge with proper thickness between the rocker arm and valve stem end.

Top dead center of the first cylinder compression stroke





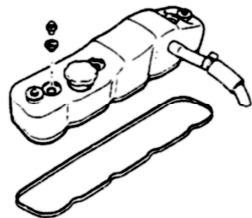
Top dead center of the fourth cylinder compression stroke



- ⑥ Rotate the adjustment screw(s) for valve clearance until a touch of resistance is felt on the clearance gauge.
- ⑦ Tighten the locking nut(s) firmly.
- ⑧ Rotate the crankshaft for 360°.



- ⑨ Then align TDC line of crankshaft damper pulley with timing pointer.
- ⑩ Adjust the clearance of other valves shown in the drawing.



1. Cylinder head cover

- Apply oil to the rocker arm and valve spring.
- Install the gasket(s) of cylinder head cover on the cylinder head cover. The gasket(s) must be flat and without damage.
- Install the cylinder head cover and tighten the bolt(s) to the specified torque.

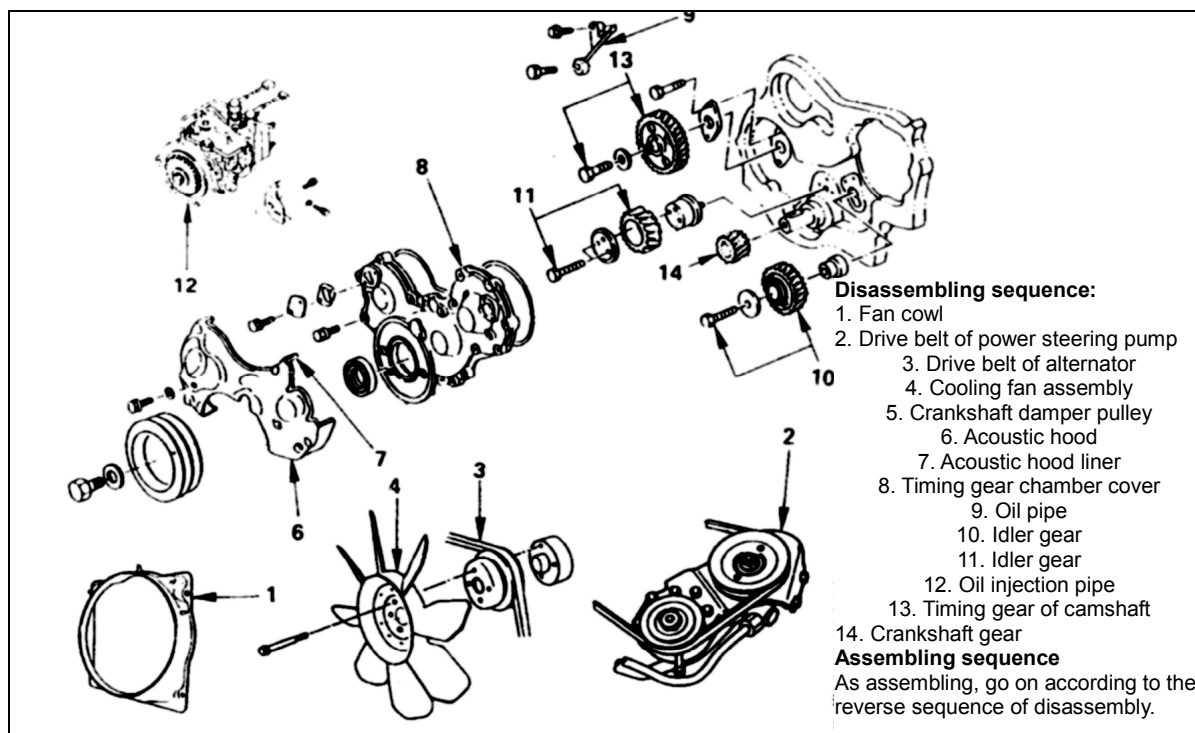


Cylinder head cover bolt torque	N • m
13	

- Connect crankcase vent hose.
- Connect the ground cables of battery.



3.11 Timing gear



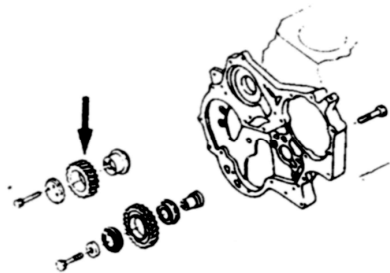
Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge the coolant completely.

1. Fan guard
2. Power steering pump drive belt
 - Unscrew the bracket bolt(s) and adjusting bolt(s) for power steering pump and remove the drive belt.
3. Alternator drive belt
 - Unscrew the alternator bracket bolt(s) (lower part) and adjusting plate locking bolt(s) and remove the drive belt.
4. Cooling fan assembly
 - Unfasten tight nut(s), and dismount fan assembly, collar and fan pulley.
5. Crankshaft damper pulley
6. Acoustic hood
7. Acoustic hood liner
8. Timing gear chamber cover





9. Oil pipe

10. Idler gear

- 1) Measure the timing gear play of camshaft and crankshaft before disassembling the idler gear.
- 2) First measure the axial clearance for idler gear before disassembling the idler gear.

Note:

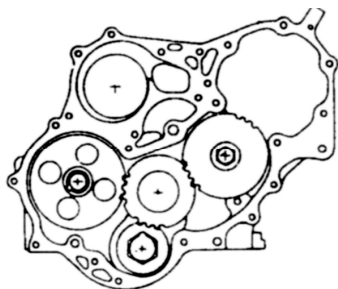
Refer to the following items for details on gear clearance and axial clearance measurement methods.



Timing gear clearance measurement

- 1) Install a dial gauge onto the timing gear to be tested. Fix the gear to be examined and the gear connected to it.
- 2) Swing the gear to be checked left and right as much as possible. Read out the dial gauge readings.

If the measured value exceeds prescribed limit, the timing gear has to be replaced.



Timing gear clearance

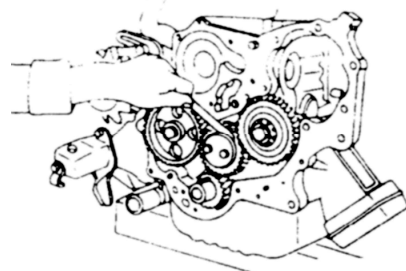
mm

Standard	Limit
0.10--0.17	0.30

Axial clearance measurement of idler gear "A"

Insert a clearance gauge between the idler gear and thrust ring to measure the clearance and determine the axial clearance of idler gear.

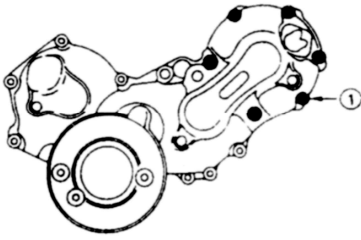
If the measured value exceeds prescribed limit, the thrust ring has to be replaced.



Axial clearance of idler gear

mm

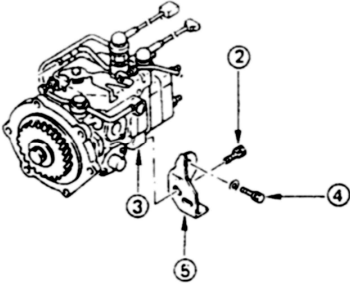
Standard	Limit
0.07	0.2



11. Idler gear

12. Injection pump

1) Remove six injection pump bracket bolts ① from timing gear chamber.



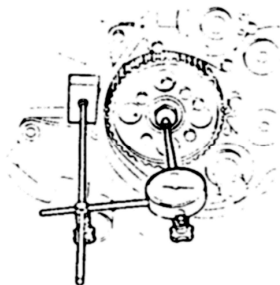
2) Remove rear bracket bolt ② from injection pump bracket ③.

3) Remove rear bracket bolt ④ and bracket ⑤ of injection pump from the cylinder block.

4) Draw out both the injection pump and injection pump timing gear toward the engine backside.

Note:

Cover the hole in injection pump delivery valve body with a cover or equivalents to prevent foreign matters falling into the valve.



13. Camshaft timing gear

1) Measure the axial clearance of camshaft with a dial gauge.

Measure the clearance before disassembling the camshaft gear.

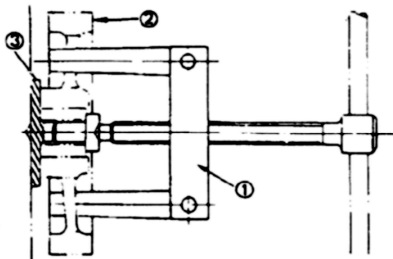
If the axial clearance of camshaft exceeds prescribed limit, the thrust washer has to be replaced.



Axial clearance of camshaft

mm

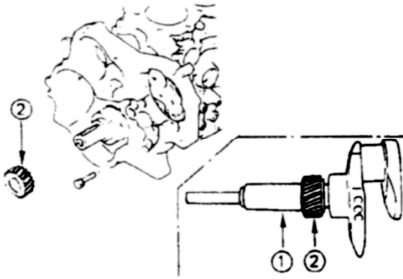
Standard	Limit
0.050--0.114	0.2



2) Remove camshaft timing gear bolt(s) from the camshaft.

Note:

Keep the camshaft fixed to prevent its rotating.



3) Pull out camshaft timing gear② with universal puller ①.

Universal puller: 1007011FA-9101

4) Remove thrust washer ③.

14. Crankshaft gear



Assembly



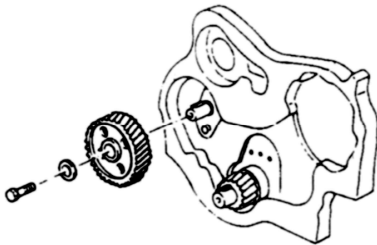
14. Crankshaft gear

1) Install crankshaft gear

2) Install crankshaft gear ② with crankshaft gear erector ①. •

Crankshaft timing gear mark ("X-X") must face the outside.

Crankshaft gear erector: 1007011FA-9102



13. Camshaft timing gear

1) Install the thrust washer onto the cylinder block.



2) Tighten thrust washer bolt(s) to the specified torque.

N·m

25

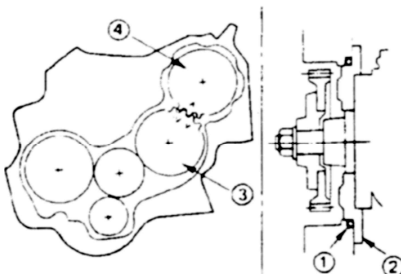
3) Install camshaft timing gear to the camshaft.

The timing gear mark ("Y—Y") has to face the outside.

4) Tighten the timing gear to the specified torque.

N·m

110

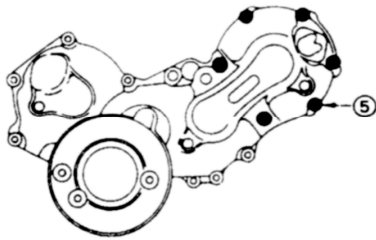


12. Injection pump

1) Install O-ring ① to injection pump flange ②.

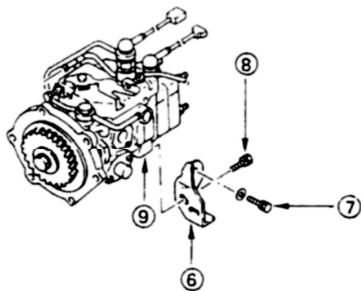
2) Install injection pump to the timing gear chamber.

Align the mark "V-V" of idler gear "B" ③ with the mark "V" of injection pump timing gear ④.



3) Temporarily tighten six nuts ⑤ for injection pump.

The final screwing down of injection pump nuts is conducted after rear bracket bolt(s) of the injection pump is (are) tightened.



4) Install rear bracket ⑥ of injection pump and rear bracket bolt ⑦ on the cylinder block.

5) Mount rear bracket bolt ⑧ to injection pump bracket ⑨.

Do not screw down those bolts.

Rear bracket bolt ⑦ and ⑦ will be tightened to the specified torque after the injection pump nuts are tightened.

6) Tighten the injection pump nuts to the specified torque.

N·m

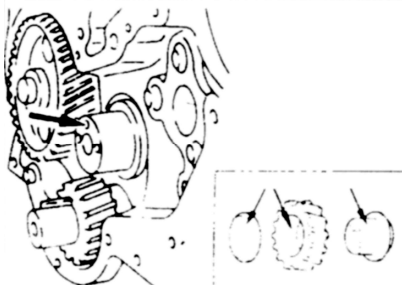
25



7) Screw down injection pump bracket bolt(s) to the specified torque.

N·m

25

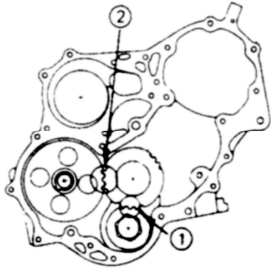


11. Idler gear

1) Apply some oil to the idler gear and its shaft.

The oil hole in idler gear shaft must be toward upward.

2) Arrange idler gear marks "X" and "Y" so that they both face the engine forepart.



- 3) Align idler gear mark "X" with the mark "X—X" of crankshaft timing gear ①.
- 4) Align idler gear mark "Y" with the mark "Y—Y" of camshaft timing gear ②.



- 5) Install the thrust washer and bolt(s) onto the cylinder block.

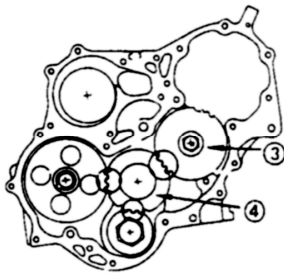


Thrust ring oil hole must be toward upward while its chamfer should face the outside.

- 6) Tighten idler gear bolt(s) to the specified torque.

N·m

20

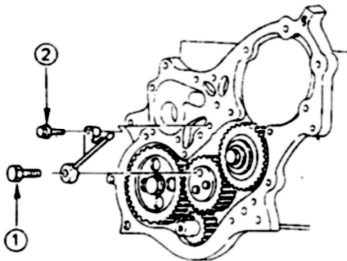


10. Idler gear

- 1) Apply some oil to the idler gear and its shaft.
- 2) Align mark "Z" of gear "B" ③ with mark "Z—Z" of idler gear "A" ④.
- 3) Tighten idler gear bolt(s) to the specified torque.

N.m

110



9. Lubrication oil pipe

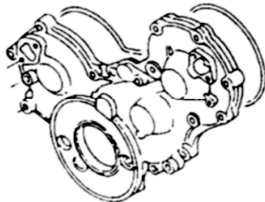
- 1) Install the lubrication oil pipe on the timing gear chamber and idler gear "A".
- 2) Tighten lubrication oil pipe punching bolt ① and bolt ② to the specified torque.

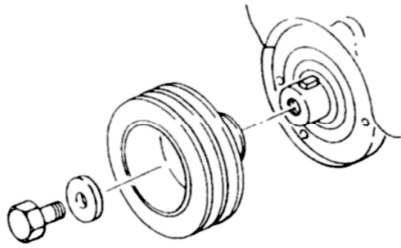
Oil pipe punching bolt torque N • m

20

8. Timing gear chamber cover

- 1) Align timing gear chamber anchor pin with the timing gear chamber, then install timing gear chamber cover.
- 2) Tighten gear chamber cover bolt(s) to the specified torque.





7. Acoustic hood liner

6. Acoustic hood

5. Crankshaft damper pulley

Screw down the crankshaft damper pulley bolt(s) to the specified torque.

Note:

While screwing down the damper pulley, hold the flywheel ring gear to prevent crankshaft rotating.



Pulley bolt torque N · m

210



4. Cooling fan assembly

- Install fan silicone oil clutch and cooling fan assembly (as this sequence) on water pump, and tighten them to the specified torque.

N·m

12.5

3. Alternator drive belt



Install alternator drive belt and adjust the belt tension.

Press the belt center with 100N force.

Drive belt deflection mm

8-10



- Tighten idler gear locking nut(s) to the specified torque.

N·m

25



2. Power steering pump drive belt

- Install power steering pump drive belt and adjust the belt tension.
- Press the belt center with 100N force.

Drive belt deflection mm

8-10



- Tighten idler gear locking nut(s) to the specified torque.

N·m

25

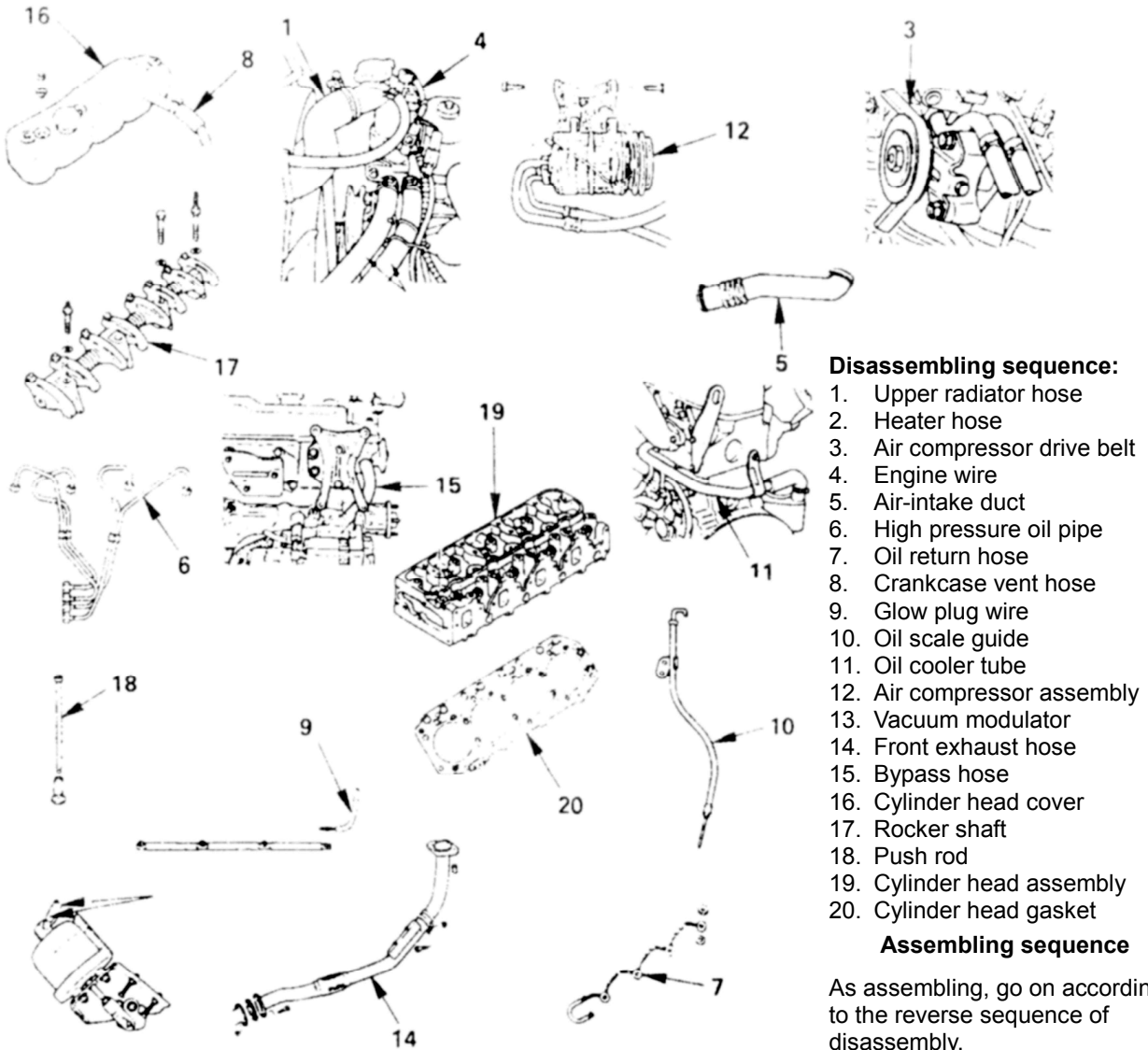


1. Fan guard

- Install fan guard and storage tank hose.
- Add some coolant.
- Start the engine and check the coolant leaks.



3.12 Cylinder head assembly and gasket



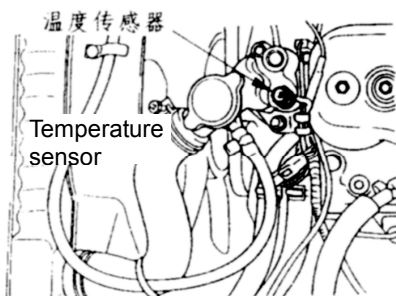
Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge the coolant in the radiator and engine completely.

1. Upper radiator hose

- Remove the upper radiator hose at engine side.



2. Heater hose

- Remove the heater hose from the heater pipe.

3. Air conditioning compressor drive belt

- Unscrew idler locking nut(s).
- Loosen adjusting bolt(s) and remove the drive belt.

4. Engine wire

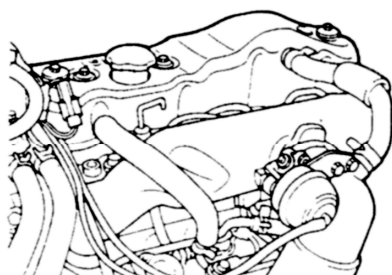
- Detach wire connector from upper thermostat cover component.

5. Air-intake duct

- Remove anchorage clip(s) and air-intake duct.

6. High pressure oil pipe

- Unscrew high pressure oil pipe anchorage clip(s).
- Loosen the taper nut(s) at injection pump side.
- Loosen the taper nut(s) at injection pump side and remove the pipe.



Note:

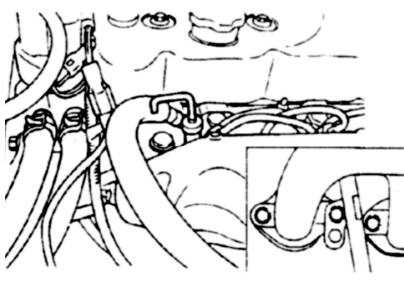
Plug the holes in injector body and delivery valve body to prevent foreign matters falling in.

7. Oil return hose

- Remove the oil return hose at oil return pipe side.

8. Crankcase vent hose

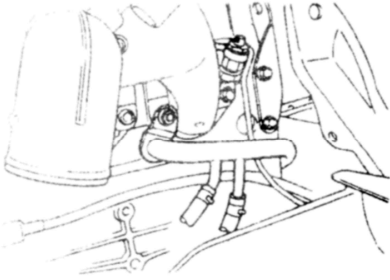
- Dismantle crankcase vent hose(s) from air-intake pipe.



9. Glow plug wire

10. Oil scale guide

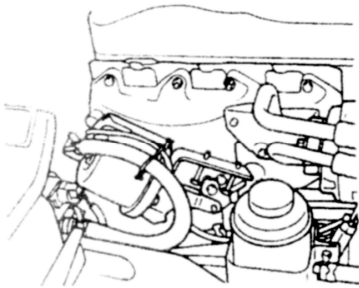
- Remove oil scale guide out of the cylinder head.



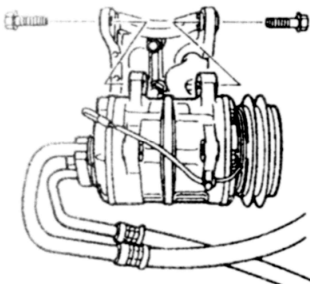
11. Oil cooler tube

- Dismantle the fixing bolt(s) at rear side of cylinder head.

12. Air conditioning compressor assembly



- Remove the wire connector of clutch.
- Remove fixing bolt(s) of the air conditioning compressor and temporarily bind the compressor to the frame side with wires.

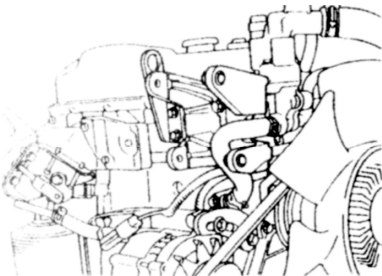


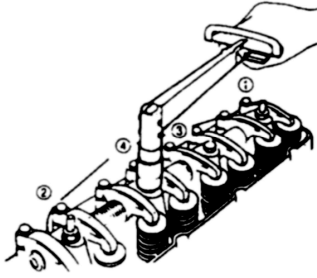
13. Front exhaust pipe

- Remove exhaust pipe fixing bolt(s) out of the exhaust manifolds.
- Remove exhaust pipe support bolt(s).

14. Bypass hose

15. Cylinder head cover





16. Rocker shaft

- Loosen rocker shaft support bolt(s) bit by bit as according to the sequence shown in the diagram.



Note:

Disobedience will have unfavorable influence on the rocker shaft.

17. Push rod

18. Cylinder head assembly

- Loosen cylinder head bolt(s) bit by bit according to the sequence shown in the diagram.

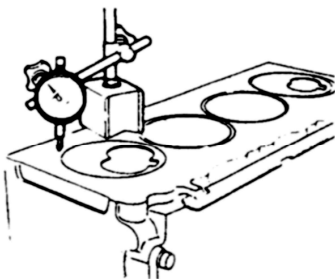


Note:

Disobedience will bring unfavorable influence to the lower surface of cylinder head.

19. Cylinder head gasket

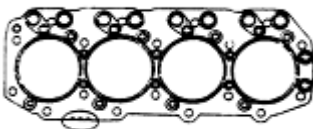
- Remove cylinder head gasket and anchor pin.



Assembly

19. Cylinder head gasket

Before assembling, carefully remove carbon deposits on piston top and upper cylinder block surface and also clean the place where the gasket is installed.





Note:

18. Cylinder head assembly



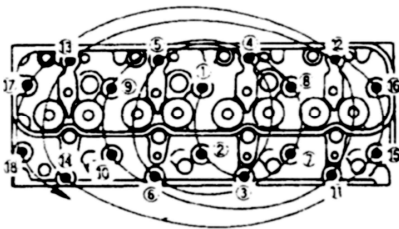
- 1) Install the anchor pin onto the cylinder block.
- 2) Install cylinder head gasket with top mark toward upside.
- 3) Clean the lower cylinder head surface and upper cylinder block surface.
- 4) Mount cylinder head gently.
- 5) Apply oil to the threads and mating surfaces of cylinder head bolts.
- 6) Tighten the cylinder head bolts to the specified torque in three steps according to the sequence shown in the diagram.

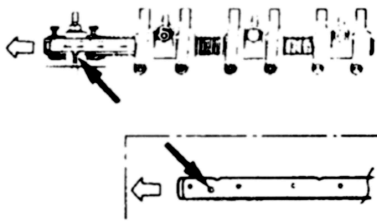
Cylinder head bolt torque N • m

First step	Second step	Third step
65	85	105

17. Push rod

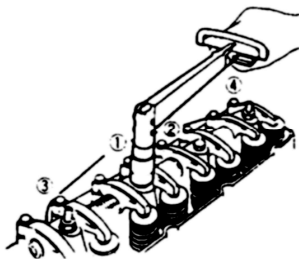
- Apply oil to the push rod and put the rod in cylinder head.





16. Rocker shaft assembly

- 1) Loosen all adjusting screws.
- 2) Install the rocker shaft so that the bigger oil hole ($\Phi 4$) faces engine forepart.

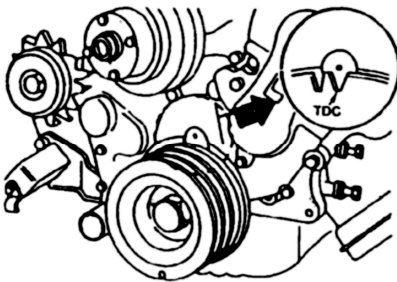


- 3) Tighten the rocker shaft support bolt(s) to the specified torque according to the sequence shown in the diagram.

Rocker shaft support bolt torque N.m

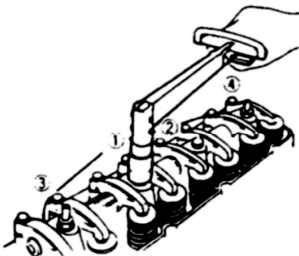
55

- Valve clearance adjustment



Valve clearance adjustment

- ① Rotate the crankshaft until zero scale line of the crankshaft damper pulley is aligned with timing pointer, and either the first cylinder piston or the fourth cylinder piston is at the top dead center (TDC) of compression stroke.



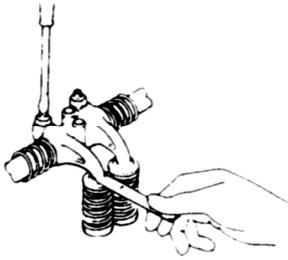
- ② Check the nuts of rocker shaft support are loose.

Tighten all the loose nuts of the rocker shaft support before adjusting valve clearance.

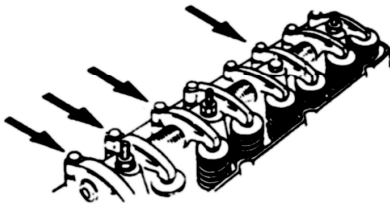
Rocker shaft support nut torque

N.m

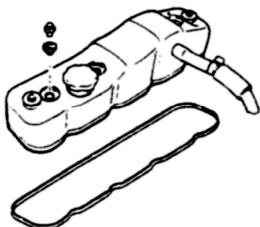
55



Top dead center of the first cylinder compression stroke



Top dead center of the fourth cylinder compression stroke



- ③ Check the clearance between intake valve and exhaust valve push rod for the first cylinder. If there is clearance between intake valve and exhaust valve push rod for the first cylinder, the first cylinder piston locates at the top dead center of compression stroke. If there is no clearance between intake valve and exhaust valve push rod for the first cylinder, the fourth cylinder piston locates at the top dead center of compression stroke.



- The piston of cylinder must locate at the top dead center of compression stroke when the valve clearance of the first cylinder or fourth cylinder is adjusted.

Valve clearance (cold state) mm

0.3-0.4

- ④ Loosen the adjustment screw(s) for each valve clearance shown in the drawing.
- ⑤ Insert a clearance gauge with proper thickness between the rocker arm and valve stem end.
- ⑥ Rotate the adjustment screw(s) for valve clearance until a touch of resistance is felt on the clearance gauge.
- ⑦ Tighten the locking nut(s) firmly.
- ⑧ Rotate the crankshaft for 360°.
- ⑨ Then align zero scale line of crankshaft damper pulley with timing pointer.
- ⑩ Adjust the clearance of other valves shown in the drawing.

15. Cylinder head cover



- Apply oil to the rocker arm and valve spring.
- Install cylinder head cover gasket(s) of on the cylinder head cover.
- The gasket(s) must be flat and without damage.
- Tighten cylinder head cover nut(s) to the specified torque.

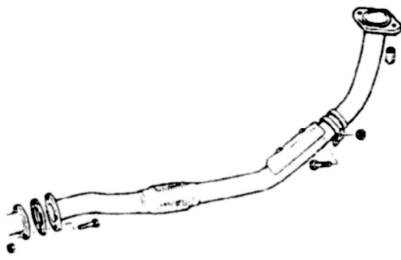


Cylinder head cover torque

N.m

13

14. Bypass hose

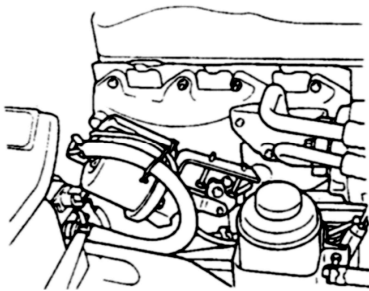


13. Front exhaust pipe

- Connect the pipe with manifold and tighten bolt(s) and nut(s) to the specified torque.

Manifold nut torque	N • m
	37

Pipe support bolt torque	N • m
	40

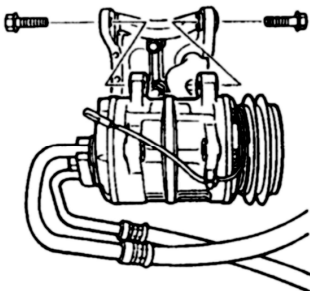


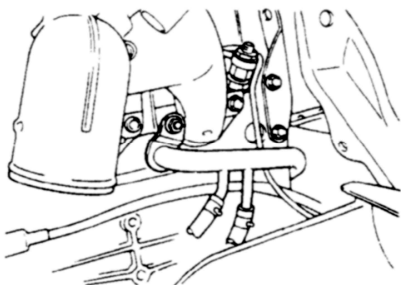
12. Air conditioning compressor assembly

- Install the fixing bolt(s) of air conditioning compressor and screw down the bolt(s) to the specified torque.



Compressor bolt torque	N.m
	20

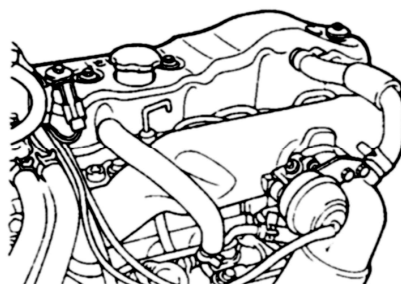




11. Oil cooler tube

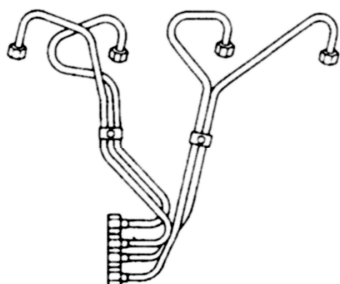
- Install tube bolt(s) and tighten the bolt(s) to the specified torque.

Tube nut torque	N • m
25	



10. Oil scale guide

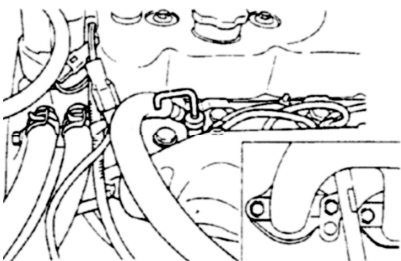
9 Glow plug wire connector



8. Crankcase vent hose

7. Oil return hose

- Install oil return hose with new copper washer.



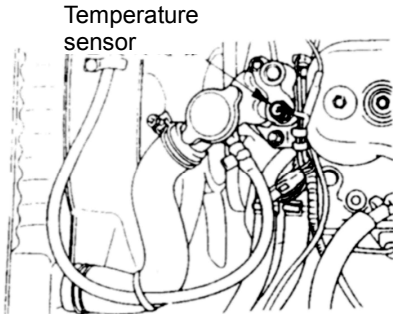
6. High pressure oil pipe

- Install taper nut(s) at injection pump side.
- Install taper nut(s) at injector side.
- Tighten taper nut(s) to the specified torque.

Taper nut torque	N • m
30	

- Assemble the anchorage clip(s) of pipe within specified torque.

5. Air-intake duct



4. Engine wire

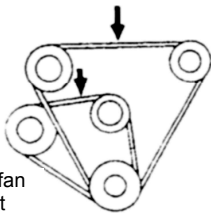
- Connect temperature sensor and thermometer component wire.

2. Air conditioning compressor drive belt

- Check drive belt is worn or damaged, and replace if necessary.
- Check the belt tension, and adjust if necessary.
- Check the tension of drive belt.

4JB1

Air conditioning compressor and power steering pump drive pulley



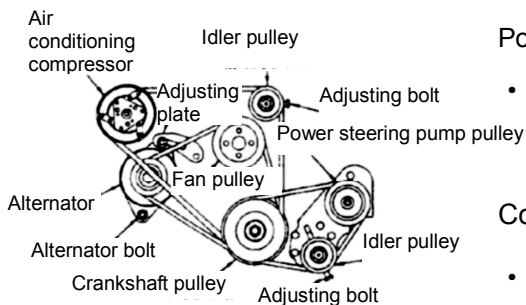
Alternator and fan pulley drive belt

Apply a force of 100N to the belt center and check the deflection of each belt.

- Deflection standard value

mm

	Sinkage
Alternator and fan pulley drive belt	8—10
Air conditioning compressor drive belt	
Power steering pump drive belt	
Tension adjustment	



Power steering pump and air conditioning compressor drive belts.

- Loosen power steering pump locking bolt and adjust belt tension with the adjusting bolt.

Cooling fan pulley belt

- Loosen alternator bracket and locking bolt(s), and then adjust the belt tension with the adjusting bolt of regulator.



Torque standard value

N.m

Alternator fixing bolt	40
Adjusting plate fixing bolt	25
Adjusting plate locking bolt	25

2. Heater hose

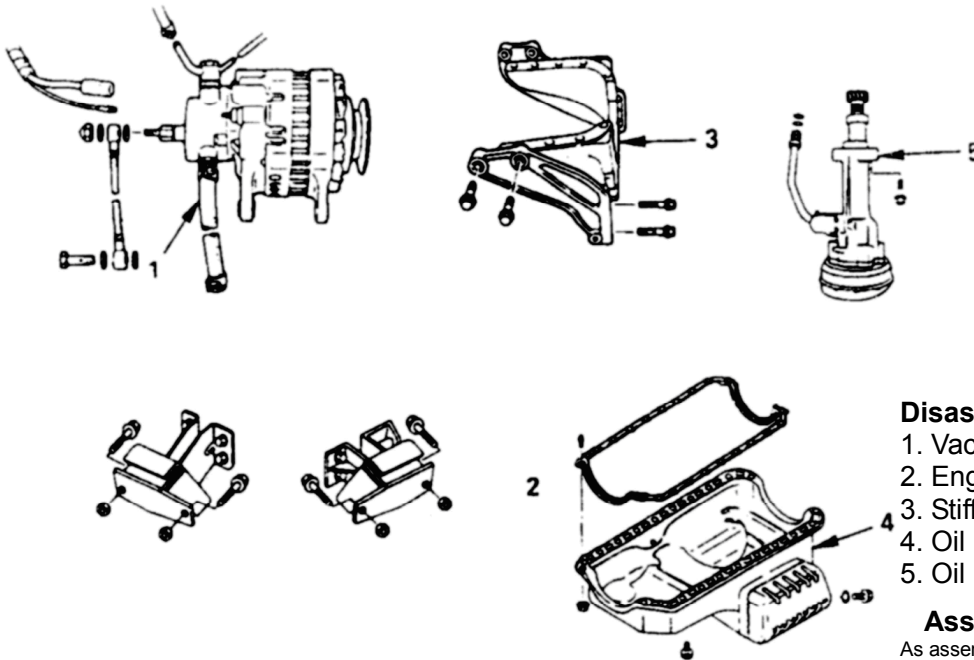
- Install the heater hose, and then tighten the anchorage clip(s) firmly.

1. Upper radiator hose

- Connect the radiator hose, and then tighten the anchorage clip(s) firmly.
- Add some coolant.
- Connect the ground cables of battery.
- Start the engine and check whether the coolant leaks.



3.13 Oil pan



Disassembling sequence:

1. Vacuum oil pump
2. Engine support bolt
3. Stiffener plate
4. Oil pan assembly
5. Oil pump assembly

Assembling sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

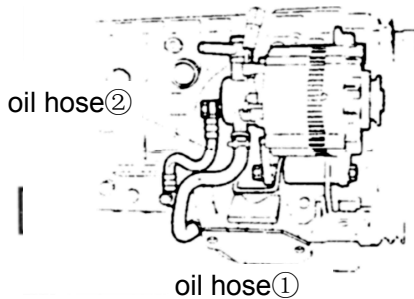
Preparation:

- Remove the ground cables of battery.
- Lift the automobile.
- Discharge the coolant completely.



Note:

Install oil drain plug with new gasket.



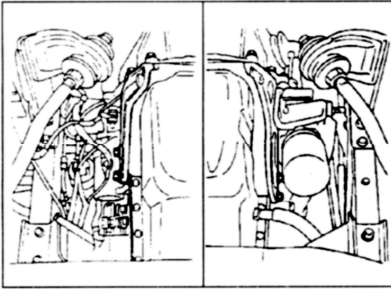
N.m

80



1. Vacuum pump oil hose

- Remove oil hose ① out of the oil pan.

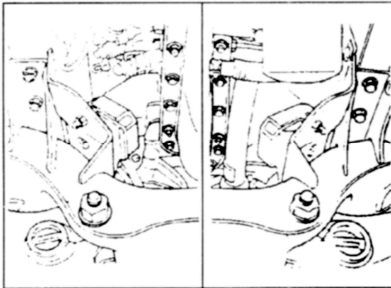


2. Engine support bolt

- Remove engine support bolts at both left and right sides.

3. Stiffener plate and rubber cushion

- Remove exhaust pipe bracket.
- Remove the stiffener plates out of oil pan (both left and right).
- Take out the rubber cushion.



4. Oil pan

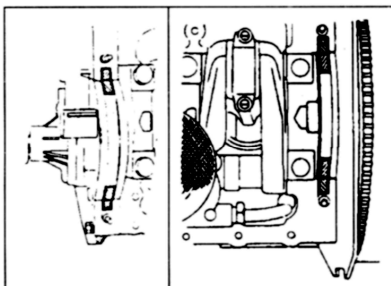
- Lift the engine for about 50mm.
- Remove the oil pan from the cylinder block.

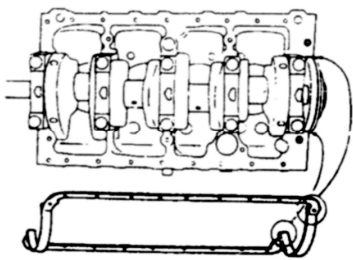


Assembly

4. Oil pan

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.





- Install back lip portion of the gasket into the fifth groove.
- Make sure that the lip portion is compact with the groove.
- Install the oil pan on the cylinder block.



- Tighten oil pan bolt(s) to the specified torque.

Oil pan bolt torque	N • m
23.5	

3. Stiffener plate and rubber cushion

- Install rubber cushion.
- Install the stiffener plates at both left side and right side and



tighten bolts to the specified torque.

Engine block side	N.m
37.5	



Clutch housing side	N.m
87	



- Install exhaust pipe bracket.

2. Engine support bolt

- Install bracket bolts and tighten the bolts to the specified torque.

Bracket bolt torque	N.m
40	

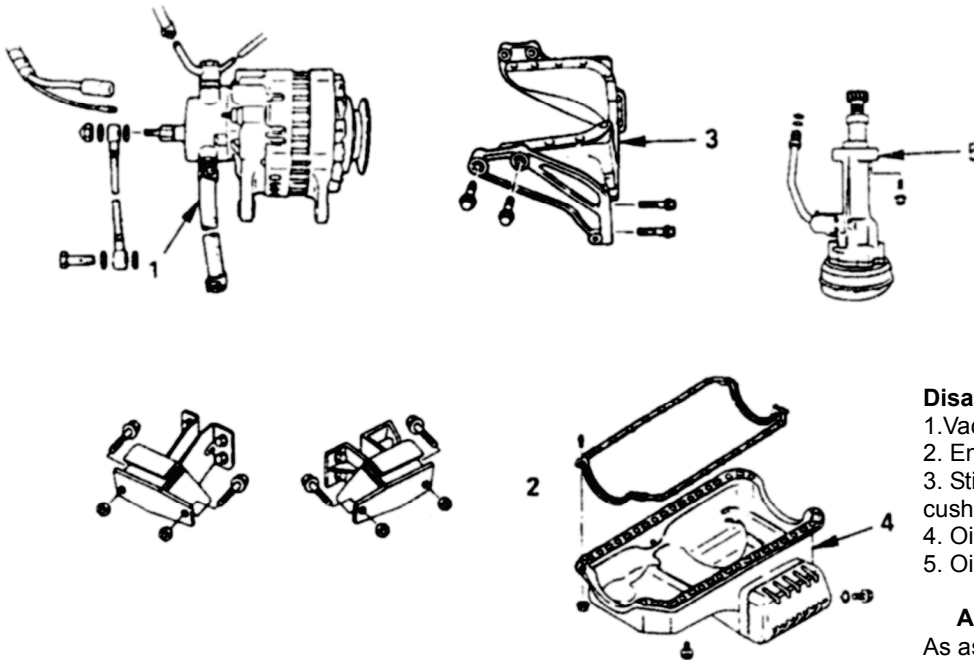
- Install the oil hose on the oil pan.

1. Vacuum pump oil hose

- Add some oil.
- Connect the ground cables of battery.
- Start the engine and check whether the coolant leaks.



3.14 Oil pump assembly



Disassembling sequence:

1. Vacuum oil pump
2. Engine bracket bolt
3. Stiffener plate and rubber cushion
4. Oil pan assembly
5. Oil pump assembly

Assembling sequence

As assembling, go on according to the reverse sequence of disassembly.

Disassembly

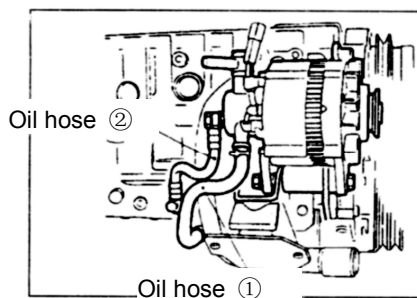
Preparation:



- Remove the ground cables of battery.
- Lift the automobile.
- Discharge the oil completely.

Note:

Install oil drain plug with new gasket.



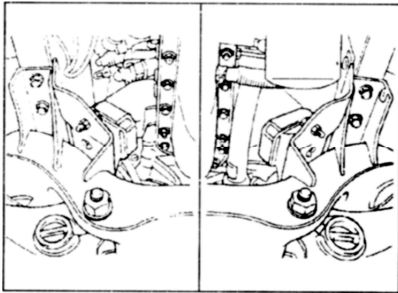
N.m

80



1. Vacuum pump oil hose

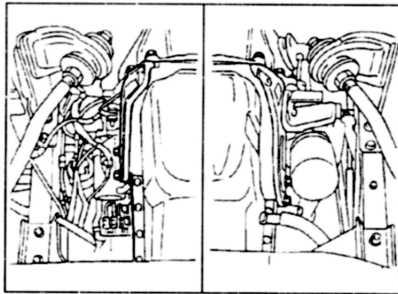
- Remove oil hose ① out of the oil pan.



2. Engine support bolt

- Remove engine support bolts at both left and right sides.

3. Stiffener plate



- Remove exhaust pipe bracket.
- Remove the stiffener plates out of oil pan (both left and right).

4. Oil pan assembly

- Lift the engine for about 50mm.
- Remove the oil pan from the cylinder block.

5 Oil pump assembly

- Remove oil pump assembly from the cylinder block.



Assembly

- Prepare some solution containing 80% oil and 20% supramoly.
- Apply solution to the oil pump pinion teeth.

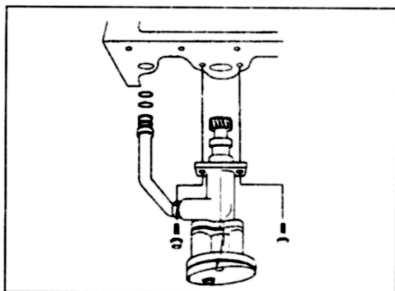


5. Oil pump assembly

- Apply some oil to the oil pipe O-ring and put it into the cylinder block O-ring groove.
- Install the oil pump assembly with oil pipe to the cylinder block, and tighten fixing bolts to the specified torque.



N.m



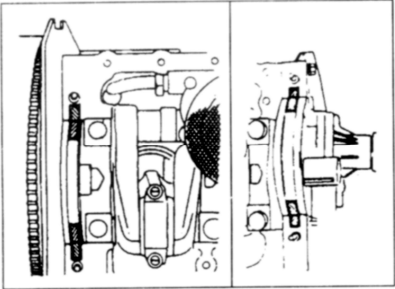
25



Tighten sleeve nut(s) to the specified torque.

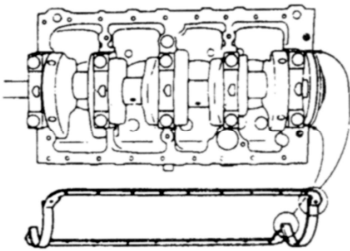
N.m

30



4. Oil pan assembly

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.



- Install back lip portion of the gasket into the fifth groove.
- Make sure that the lip portion is compact with the groove.
- Install the oil pan on the cylinder block.
- Tighten oil pan bolt(s) to the specified torque.



Oil pan bolt torque N • m

23.5

3. Stiffener plate

- Install the stiffener plate and tighten bolt(s) to the specified torque.



Engine block side N.m

37.5



Clutch housing side N.m

87

- Install exhaust pipe bracket.



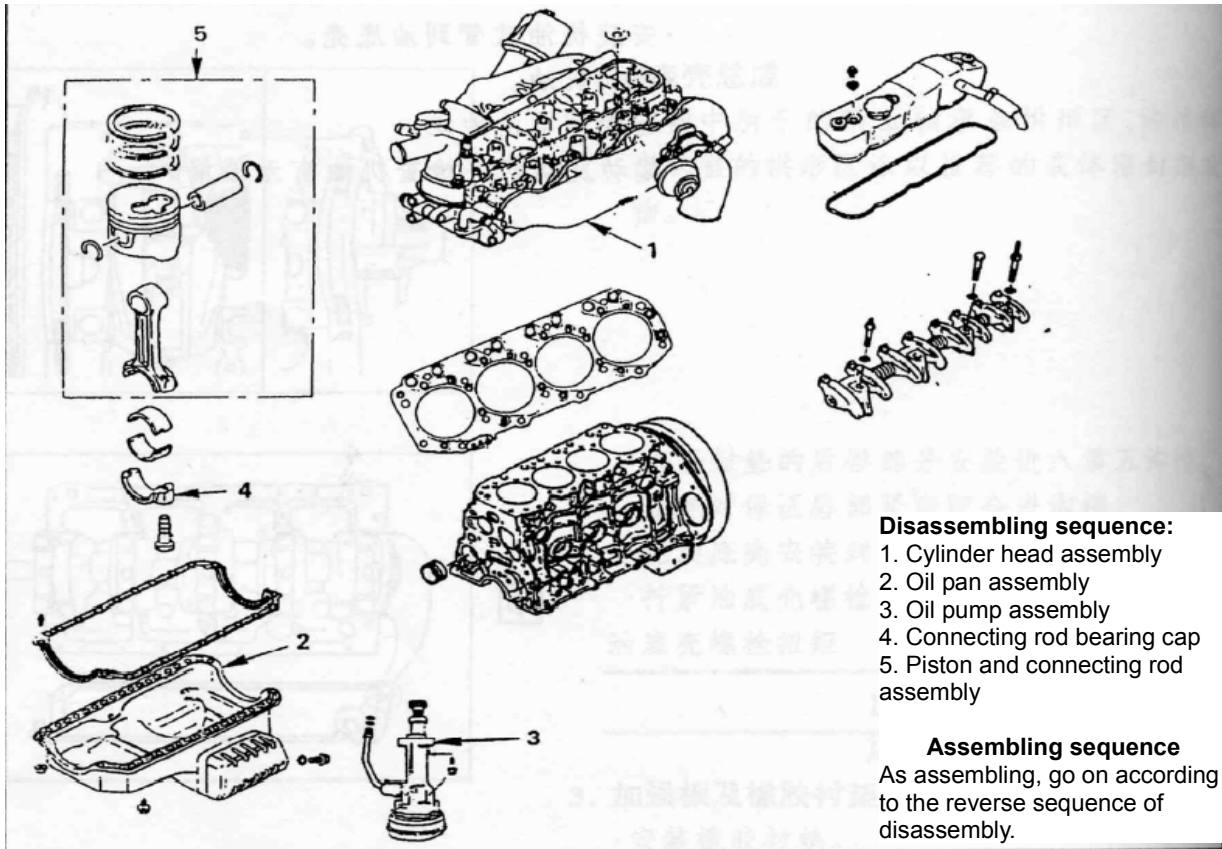
2. Engine support bolt

- Lay down the engine, and install bracket bolts and tighten the bolts to the specified torque.

1. Vacuum pump oil hose

- Install the oil hose on the oil pan.
- Add some oil.
- Connect the ground cables of battery.
- Start the engine and check whether the oil leaks.

3.15 Piston, Piston ring and connecting rod



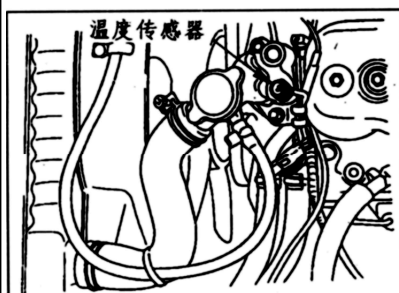
Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge the coolant completely.
- Discharge the oil completely.

Note

- Install oil drain plug with new gasket.



N.m

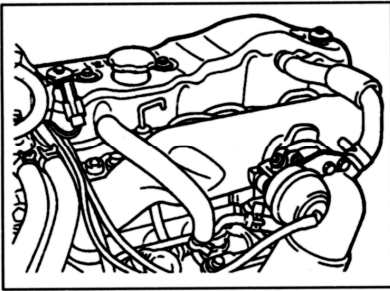
80

1. Cylinder head assembly

1) Upper radiator hose

- Remove the upper heater hose at engine side.

2) Heater hose



- Remove the heater hose from the heater pipe.

3) Air conditioning compressor drive belt

- Unscrew idler locking nut(s).
- Loosen adjusting bolt(s) and remove the drive belt.

4) Engine wire

- Detach wire connector from upper thermostat cover component.

5) Air-intake duct

- Remove anchorage clip(s) and air-intake duct.

6) High pressure oil pipe

- Unscrew high pressure oil pipe anchorage clip(s).
- Loosen the taper nut(s) at injection pump side.
- Unscrew taper nut(s) at fuel injector side and remove high pressure oil pipe(s).

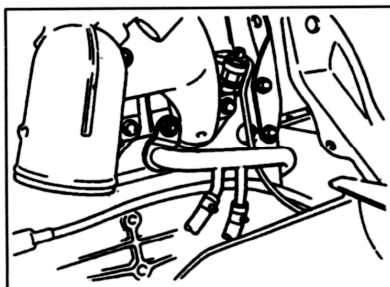


7) Oil return hose

- Remove the oil return hose at oil return pipe side..

8) Crankcase vent hose

- Dismantle crankcase vent hose(s) from air-intake pipe.



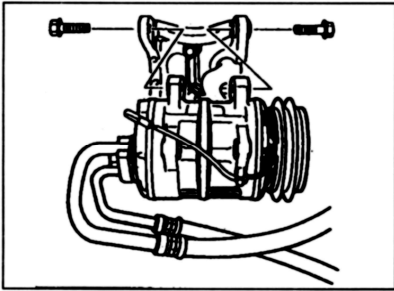
9) Glow plug wire

10) Oil scale guide

- Remove oil scale guide out of the cylinder head.

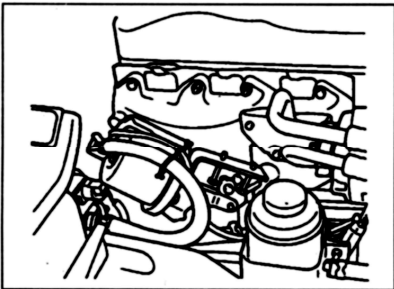
11) Oil cooler tube

- Remove pipe bracket bolt(s) at rear side of cylinder head.
- Remove cooler tube from the cylinder head.



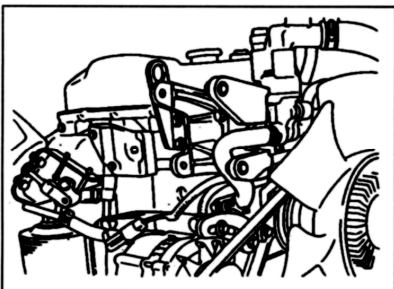
12) Air conditioning compressor assembly

- Remove the wire connector of clutch.
- Remove the wire connector of electromagnetic clutch.
- Remove fixing bolt(s) of the air conditioning compressor and temporarily bind the compressor side with wires.



13) Vacuum modulator hose

- Remove vacuum modulator hose from the vacuum modulator.

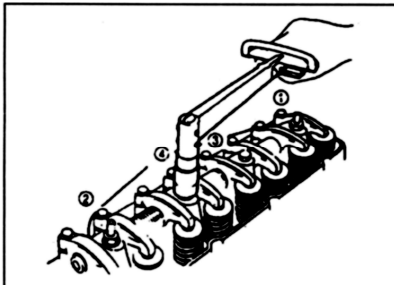


14) Front exhaust pipe

- Remove exhaust pipe fixing bolt(s) from the exhaust manifold.
- Remove exhaust pipe support bolt(s).

15) Bypass hose

16) Cylinder head cover



17) Rocker shaft

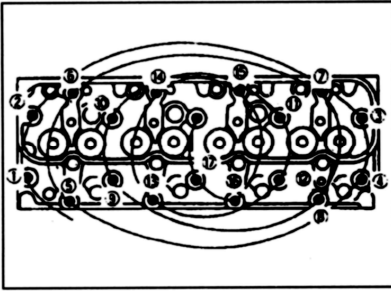
- Loosen rocker shaft support bolt(s) bit by bit according to the sequence shown in the diagram.



Note:

Disobedience will have unfavorable influence on the rocker shaft.

18) Push rod



19) Cylinder head assembly

- Loosen cylinder head bolt(s) bit by bit according to the sequence shown in the diagram.

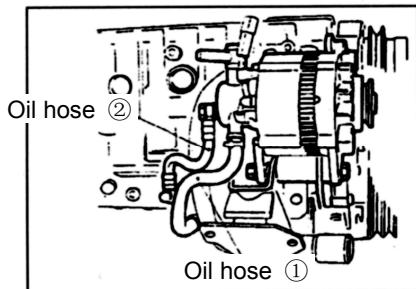


Note:

Disobedience will bring unfavorable influence to the lower surface of cylinder head.

20) Cylinder head gasket

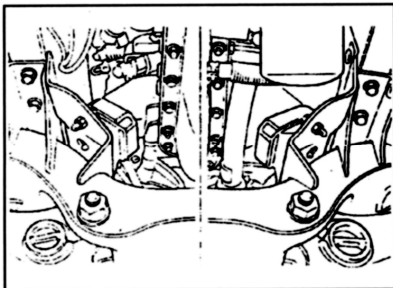
- Remove cylinder head gasket and anchor pin.



2. Oil pan assembly

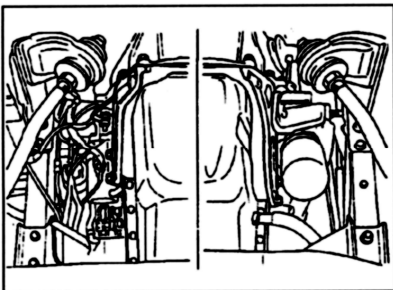
1) Vacuum pump oil hose

- Remove oil hose ① out of the oil pan.



2) Engine support bolt

- Remove engine support bolt(s).



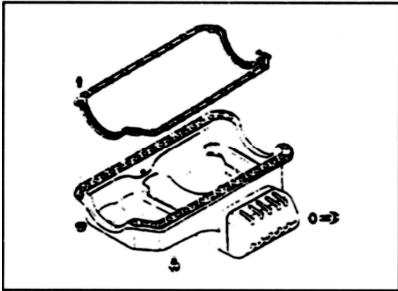
3) Stiffener plate

- Remove exhaust pipe bracket.
- Remove stiffener plate.



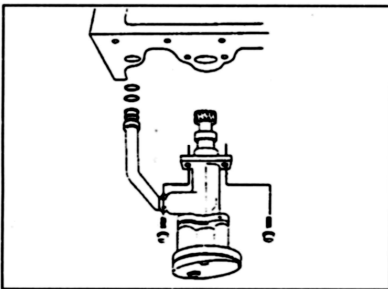
4) Oil pan

- Lift the engine for about 50mm.
- Remove the oil pan from the cylinder block.



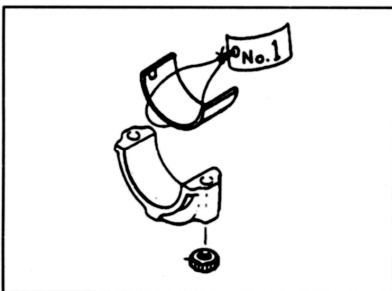
3. Oil pump assembly

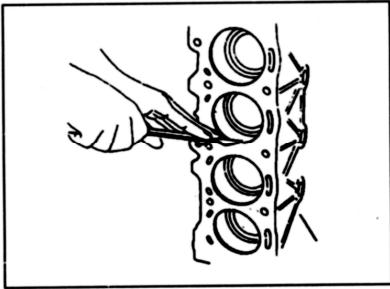
- Remove the oil pump from the cylinder block.



4. Connecting rod bearing cap

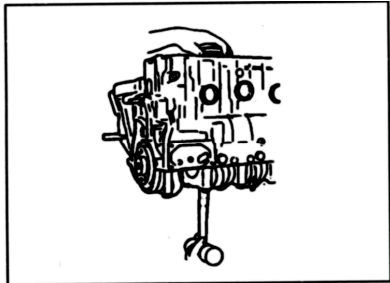
- If it is intended to reassemble the lower bearing of connecting rod, please attach a label to each bearing, and mark the disassembling sequence of cylinder and its installation position.



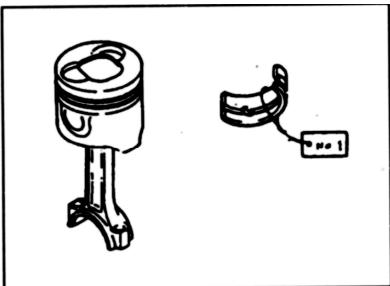


5. Piston and connecting rod with upper bearing

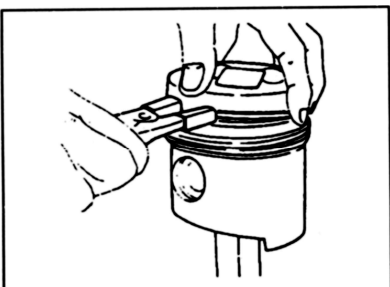
- 1) Scrape carbon deposits on upper cylinder wall with a scraper before disassembling the piston and connecting rod.



- 2) Move the piston to the top of cylinder head, push upward the lower part of connecting rod with a hammer handle or equivalents, then take out the piston and connecting rod.



- 3) If it is intended to reassemble the upper bearing of connecting rod, please attach a label to each bearing, and mark the disassembling sequence of cylinder and its installation position.



- 4) Clamp the connecting rod with a vice.

Take care not to damage the connecting rod.

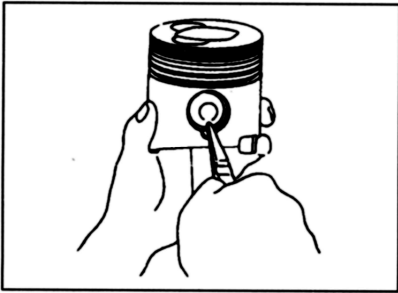
Remove each piston ring with piston ring replacer.

Do not try to remove the piston ring with other tools other than piston ring replacer.

Excessive tension of piston ring will reduce the elastic force of piston ring.

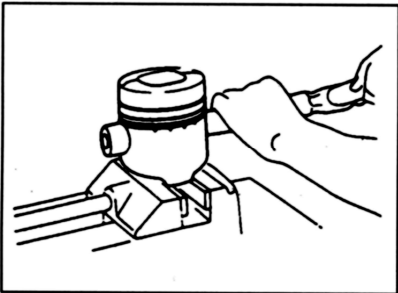


5) Dismantle piston pin retainer with pliers.



6) Gently knock out the piston pin with hammer and bar copper.

If it is intended to reassemble piston and piston pin, please attach a label to each piston and piston pin, and mark the disassembling sequence of cylinder and its installation position.



Assembly

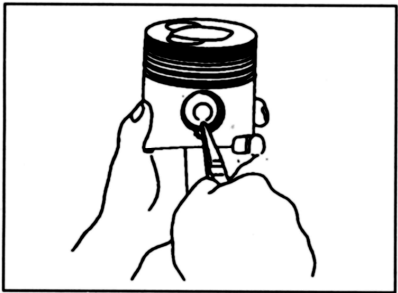
5. Piston and connecting rod with upper bearing

1) Try to push the piston pin into piston pin hole with your finger pressure.

Weigh each piston and connecting rod assembly.

Select the piston and connecting rod set in such a way that the weight difference of various assemblies is within the specified limits.

Model	Assembly mass difference (g)
4DA1	≤ 10
4DA1-1	≤ 8



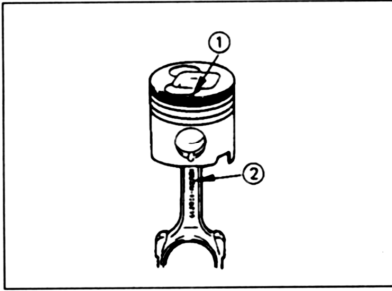
2) Clamp the connecting rod with a vice.

Take care not to damage the connecting rod.

3) Encase piston pin retainer to the piston with pliers.

Note:

When replacing the piston/connecting rod assembly, do not change the piston/piston pin assembly.

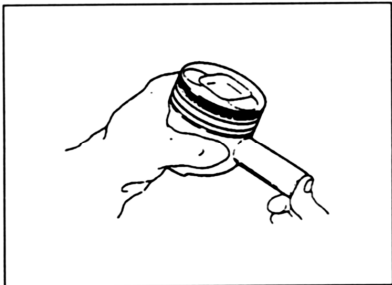


4) Install the piston onto the connecting rod.

Front mark ① on the piston head and connecting rod “F908” casting symbol ⑦ should face the same direction.



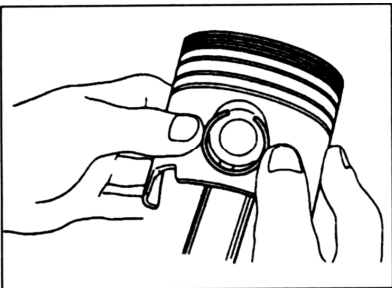
5) Add oil to the piston and piston pin hole.



Push piston pin into the piston with your finger until it touches the piston pin retainer.

6) Press the piston pin retainer into piston retainer groove with fingers.

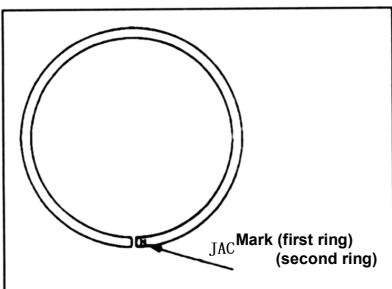
Check whether the connecting rod can freely swing on the piston pin.

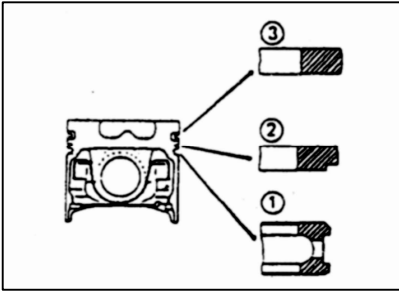


7) Install piston ring and piston packing ring.

The gas ring mark “JAC” should face upward.

Identification mark is shown in the drawing.





8) Assemble three piston rings with a piston ring replacer.



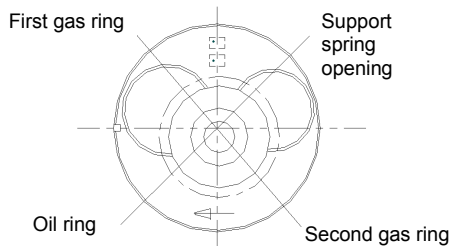
The assembling sequence of piston ring is shown in the diagram.

- ① Oil ring
- ② Second gas ring
- ③ First gas ring

Note:

Mount the gas rings with chamfer toward upward.

Install the spiral ring into oil ring groove and make sure that there is no clearance at either side of the packing ring before the oil ring is installed.



9) Apply some oil to the piston ring surface.

10) Check whether the piston ring can turn freely in piston ring groove.

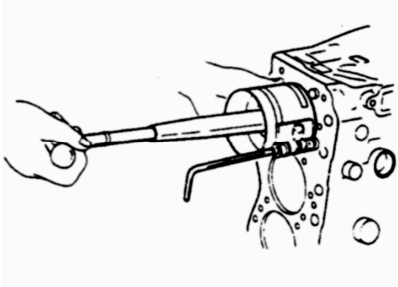
11) The cutout position for placing piston ring is shown in the drawing.

12) Carefully wipe off the foreign bodies on connecting rod bearing back and bearing mating surface.

13) Apply some oil to the upper bearing surface.



Apply some oil to the cylinder wall.



- 14) The front mark on piston head must be toward the engine forepart during installation.

Compress the piston ring with a piston ring compressor.



Piston ring compressor: 1004022FA-9101

- 15) Push in the piston with a hammer handle until the connecting rod touches the crankpin.

In the meanwhile, rotate the crankshaft until the crankpin reaches its bottom dead center.



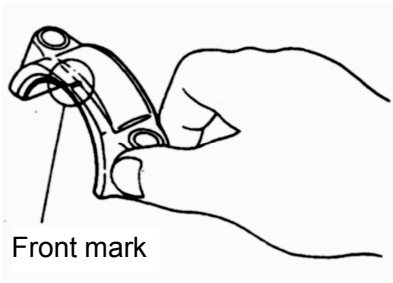
4. Connecting rod bearing cap

- 1) The front mark on the bearing cap must be toward the engine forepart during installation.

- 2) Install connecting rod bearing cap.

Align the cylinder sequence mark on connecting rod bearing cap with the one on connecting rod.

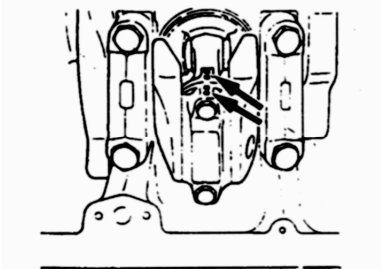
- 3) Apply oil to the thread and mating surface of each connecting rod bearing cap bolt.



- 4) Screw down connecting rod bearing cap bolt to the specified torque in two steps via torque tightening method.

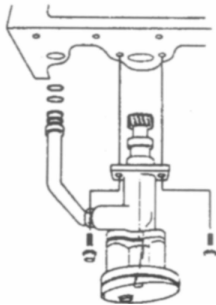
Connecting rod bearing cap bolt torque N • m

First step (sealing torque)	Second step (final torque)
20	85



Note:

Manually rotate the crankshaft to check whether it is flexible.



3. Oil pump assembly

- Prepare some solution containing 80% oil and 20% supramoly.
- Apply solution to the oil pump pinion teeth.
- Apply some oil to the oil pipe O-ring and put it into the cylinder block O-ring groove.
- Install the oil pump assembly with oil pipe on the cylinder block, and tighten fixing bolts to the specified torque.



Oil pump bolt torque N • m

25



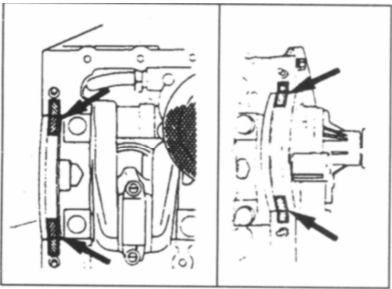
Sleeve nut torque

N • m

30

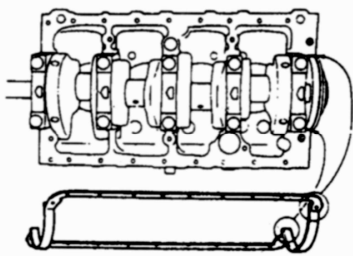
Note:

Be careful not to damage O-ring when tightening the oil pipe bolt(s).



2. Oil pan assembly

- 1) Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.



2) Install back lip portion of the gasket into the fifth groove.

Make sure the lip portion is compact with the groove.

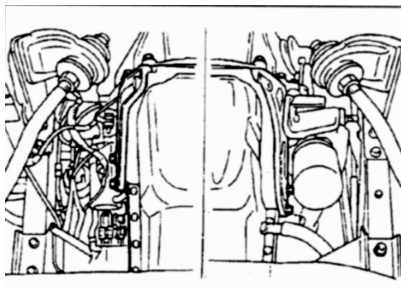
3) Install the oil pan to the cylinder block.

Tighten oil pan bolt(s) to the specified torque.



Oil pan bolt torque $\text{N} \cdot \text{m}$

23.5

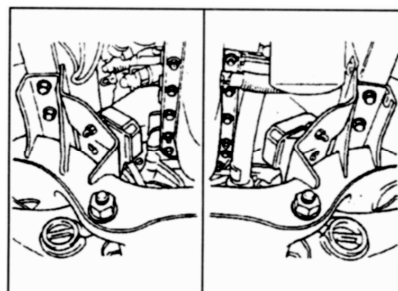


4) Install the stiffener plate and tighten bolt(s) to the specified torque.

Engine block side

Stiffener plate bolt torque N.m

30

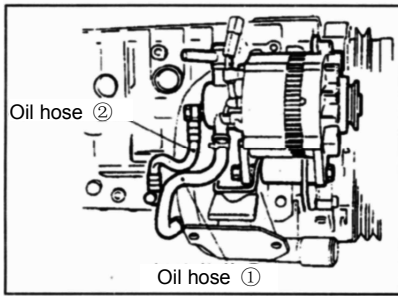


5) Install exhaust pipe bracket.

6) Install support rubber and tighten nut(s) to the specified torque.

Support rubber nut torque N.m

40



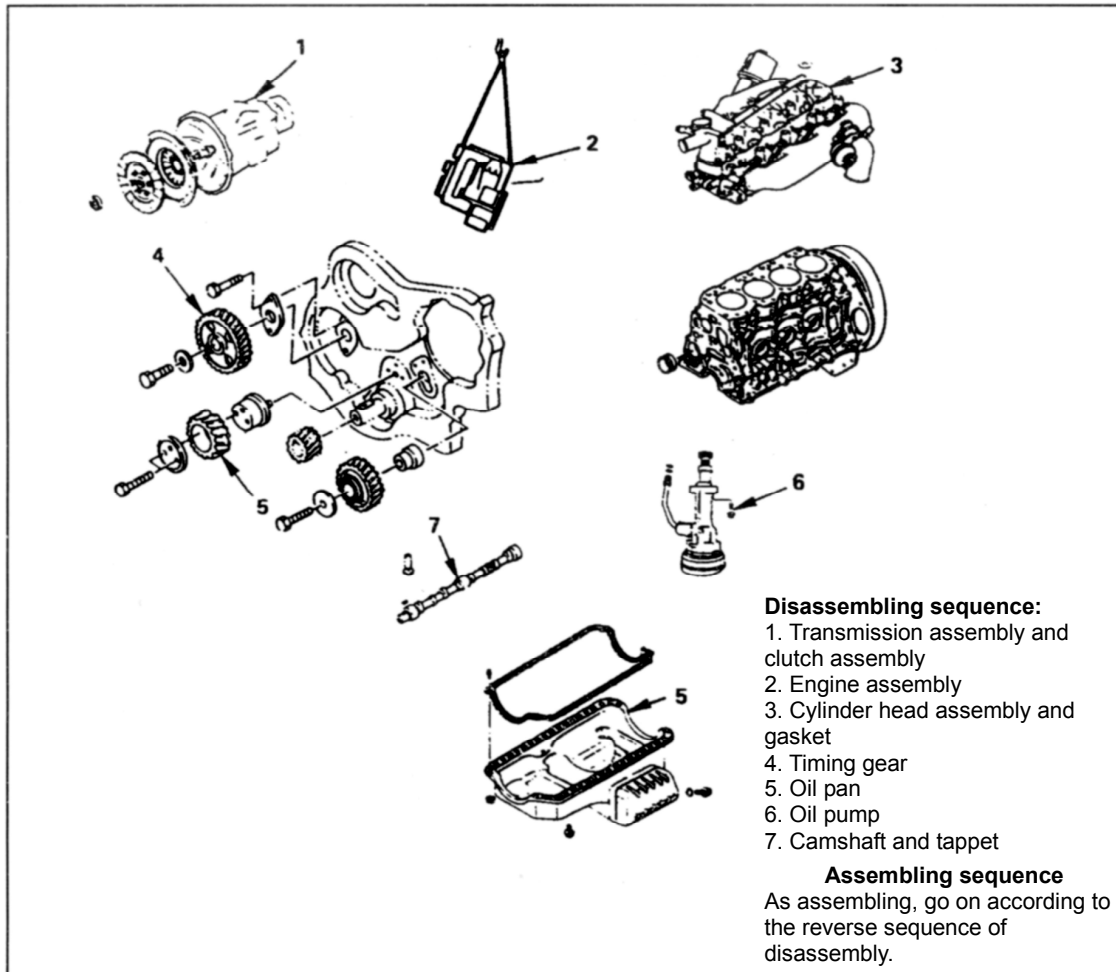
7) Mount vacuum pump oil hose ① to the oil pan.

1. Cylinder head assembly

Refer to “3.12 Cylinder head assembly and gasket”.



3.16 Camshaft and tappet



Disassembly

Preparation:

- Remove the ground cables of battery.
- Discharge coolant completely.
- Discharge the oil completely.

Note:

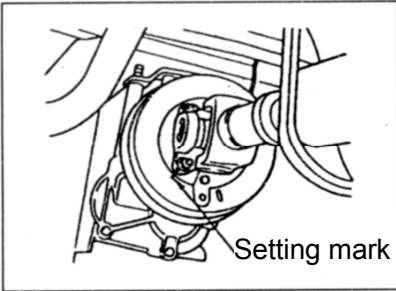
Install oil drain plug with new gasket.



Oil drain plug torque

N • m

80



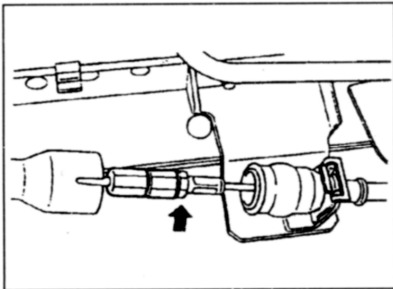
1. Transmission assembly and clutch assembly

- Hoist the automobile and support it with a suitable and safe bench.

1) Transmission

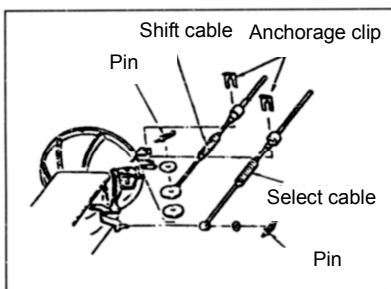
① Transmission

- Make a setting mark on the flange yoke and parking brake drum.
- Disassemble the drive shaft on the flange yoke.
- Move aside the drive shaft and bind it on the frame so as to facilitate maintenance work.



② Parking brake cable

- Move the connecting cover away.
- Dismantle connecting bolts.
- Remove anchorage clips and withdraw bracket cables.

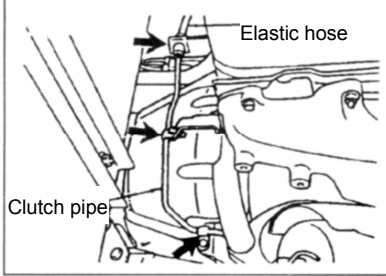


③ Wire connector

- Detach the wire connectors of vehicle speed sensor, neutral switch and backup light switch.

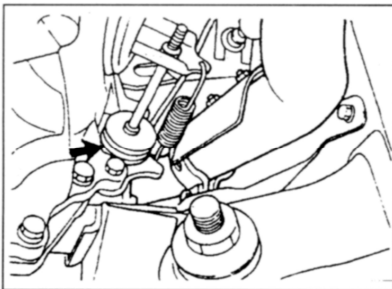
④ Shift and select cables

- Remove the shift and select cables at transmission side.

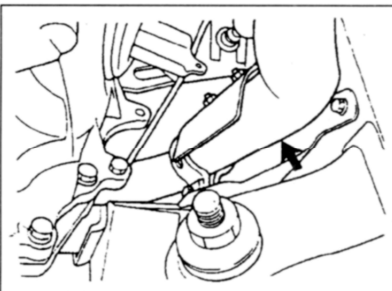


⑤ Clutch slave cylinder

- Remove the clutch hose clips and clip bracket (only for vehicles with right steering wheel).



- Disassemble the lower slave cylinder assembly together with hoses, and bind them to the frame so as to facilitate maintenance work.



⑥ Exhaust brake assembly

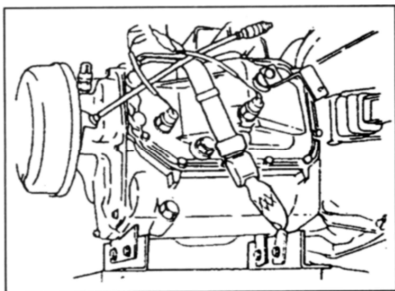
⑦ Front exhaust pipe

⑧ Transmission assembly

Note:

Sometimes the exhaust pipe bracket, gear control bracket and anchorage clips are at mounting positions or directions. In order to prevent this, please make correct mounting marks on those parts.

- Use a transmission jack to jack up the transmission.



Caution:

In order to prevent transmission overturn, use chains or belts to secure it to the jack.

Do not let the transmission hover over the clutch, or it will destroy the clutch.

- Remove nuts securing the transmission bracket at beam side.
- Angles of the engine and transmission have to be adjusted so that they can be easily disassembled.



- Use a jack or crane to jack up the rear part of engine.

Caution:

After jacking up the engine, place a wooden block under it to protect the oil pan.

- Remove the transmission binding bolts.
- Draw out the transmission assembly backwards.

⑨ Bracket

2) Clutch

- Hoist the vehicle and support it with a suitable and safe bench.



Caution:

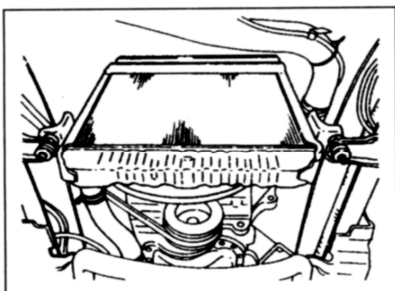
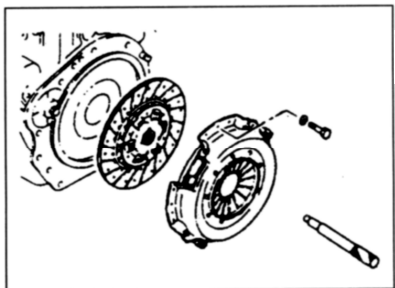
Make sure that no clutch fluid is left on the coating surface, or wash it away immediately.



① Pressure plate assembly

② Driven plate assembly

- Use a guiding centralizer to prevent the driven plate assembly falling freely.
- Mark the flywheel and pressure plate flange to ensure alignment during installation.
- Loosen fixing bolts of the pressure plate assembly.

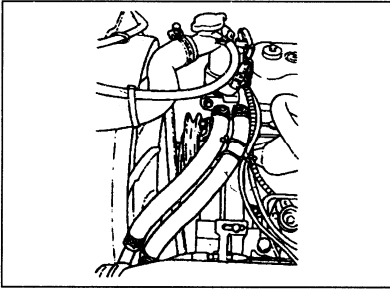


2. Engine assembly

1) Radiator assembly

- Remove the upper and lower hoses of the radiator.
- Remove storage tank hose.
- Remove the shock-absorbing rubber at both sides.
- Remove radiator support.

2) Air intake duct



3) Heater hose

4) Engine control cable

- Unscrew the locking nut(s) at the bracket and remove throttle wire(s) from the injection pump control lever.

5) Glow plug wire

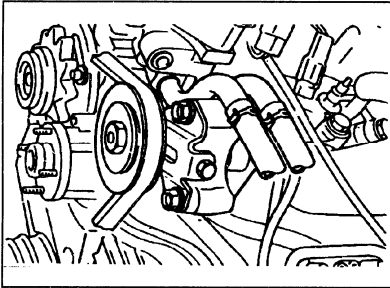
6) Fuel hose

- Remove fuel inlet hose and return hose.

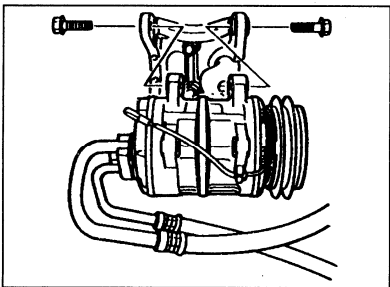
7) Oil pressure switch wire

8) Air conditioning compressor assembly

- Unscrew idler locking nut(s).
- Loosen adjusting nut(s) and remove the drive belt.

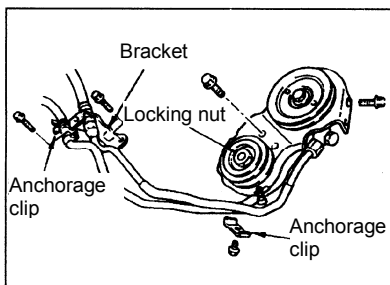


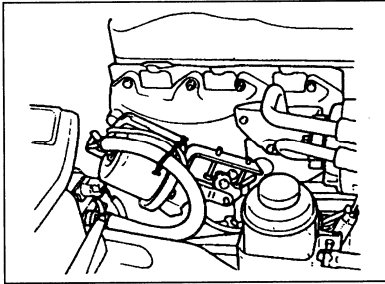
- Remove the wire connector of electromagnetic clutch.
- Remove fixing bolt(s) of the air conditioning compressor and temporarily bind the compressor to the frame with wires.



9) Power steering pump and bracket assembly (power steering type)

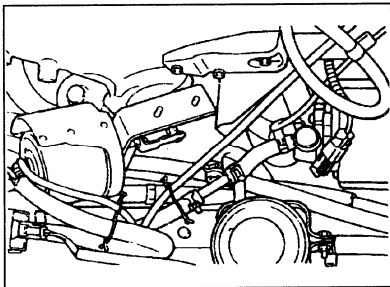
- Unscrew idler locking nut(s).
- Loosen adjusting nut(s) and remove the drive belt.
- Remove pipe bracket fixing bolt(s) and anchorage clip (s).
- Remove power steering pump fixing bolt(s) and temporarily bind the pump to the frame with wires.





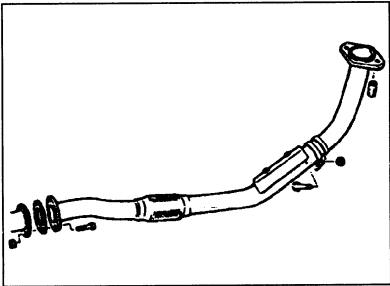
10) Modulator vacuum hose (exhaust brake type)

- Remove the vacuum hose at modulator side.



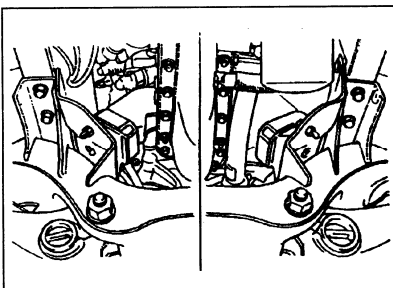
11) Vacuum pump hose (exhaust brake type)

- Remove the vacuum hose at both vacuum tank and solenoid valve sides.



12) Front exhaust pipe

- Remove exhaust pipe fixing bolt(s) from the exhaust manifold.
- Remove exhaust pipe support bolt(s).
- Remove fixing nut(s) from front exhaust pipe.



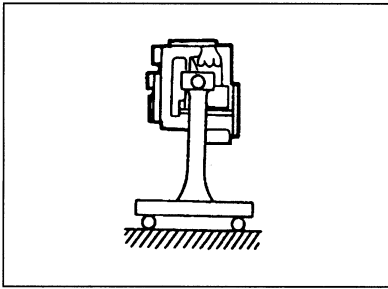
13) Support rubber

① If mounted at right side

- Remove the two fixing nuts at beam side.

② If mounted at the left side

- Remove the two fixing nuts at beam side.



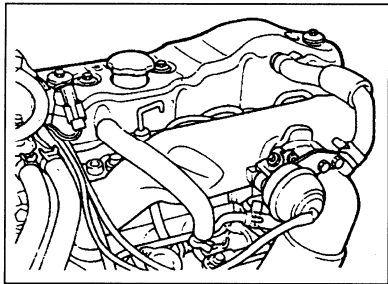
14) Engine assembly

- Slowly hoist the engine with a crane.
- Lift the engine with its front part higher than rear part.
- While taking out the engine assembly, be careful to avoid breaking any oil pipe, brake pipe, etc.
- Place the engine on an engine support.

3. Cylinder head assembly and gasket

1) High pressure oil pipe

- Unscrew high pressure oil pipe anchorage clip(s).
- Loosen the taper nut(s) at injection pump side.
- Unscrew taper nut(s) at fuel injector side and remove high pressure oil pipe(s).

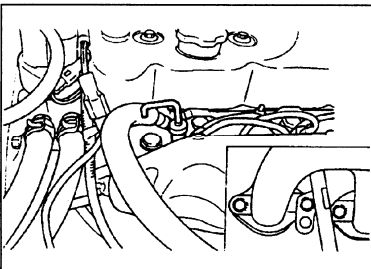


2) Oil return hose

- Remove the oil return hose at oil return pipe side.

3) Crankcase vent hose

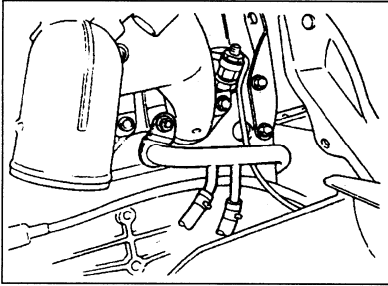
- Dismantle crankcase vent hose(s) from air-intake duct.



4) Glow plug wire

5) Oil scale guide

- Remove oil scale guide out of the cylinder head.



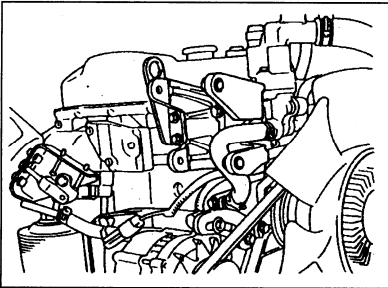
6) Oil cooler tube

- Remove pipe bracket fixing bolt(s) at rear side of cylinder head.
- Remove oil scale guide out of the cylinder head.

7) Bypass hose

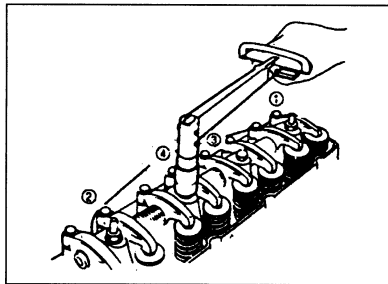
8) Cylinder head cover

- Remove crankcase vent hose and cylinder head cover bolt(s).



9) Rocker shaft

- Loosen rocker shaft support bolt(s) bit by bit according to the sequence shown in the diagram.



Note:

Disobedience will bring unfavorable influence to the rocker shaft.

10) Push rod

11) Cylinder head assembly

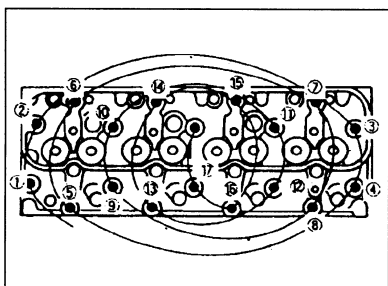
- Loosen cylinder head bolt(s) bit by bit according to the sequence shown in the diagram.



Note:

Disobedience will bring unfavorable influence to the lower surface of cylinder head. 12) Cylinder head gasket

- Remove cylinder head gasket and anchor pin.



4. Timing gear

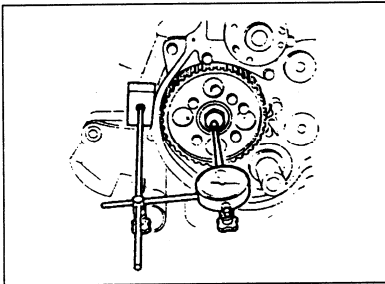
1) Cooling fan assembly

- Unfasten tight nut(s), and dismount the fan assembly and fan pulley.



- 2) Crankshaft damper pulley
- 3) Acoustic hood
- 4) Acoustic hood liner
- 5) Timing gear chamber cover
- 6) Camshaft timing gear

- ① Measure the axial clearance of camshaft with a dial gauge.
Measure the clearance before disassemble the camshaft gear.
If the axial clearance of camshaft exceeds prescribed limit, the thrust washer has to be replaced.



Axial clearance of camshaft

mm

Standard	Limit
0. 050—0. 114	0. 2

- ② Remove camshaft timing gear bolt(s) from the camshaft.

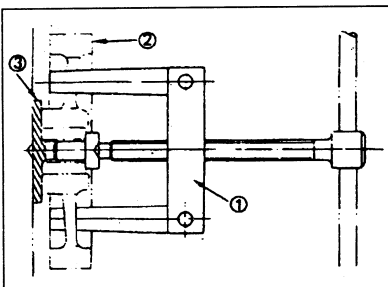
Note:

Keep the camshaft fixed to prevent its rotating.

- ③ Pull out camshaft timing gear ② with a universal puller ①.

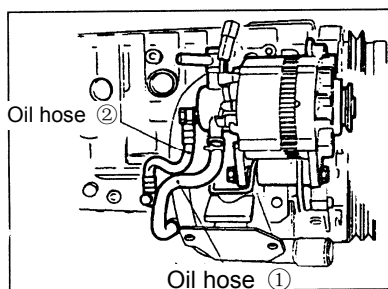


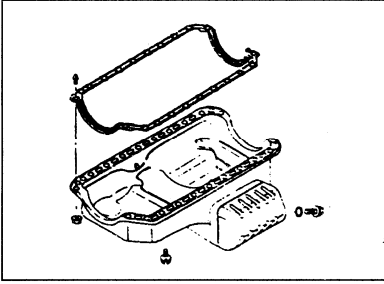
- ④ Remove the thrust washer ③.



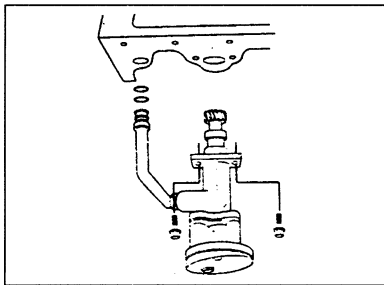
5. Oil pan

- Remove vacuum pump oil hose ① out of the oil pan.



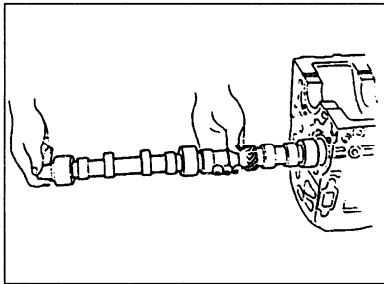


- Remove stiffener plate and rubber cushion from both sides of the oil pan.
- Dismantle oil pan bolt(s) and remove the oil pan from the cylinder block.



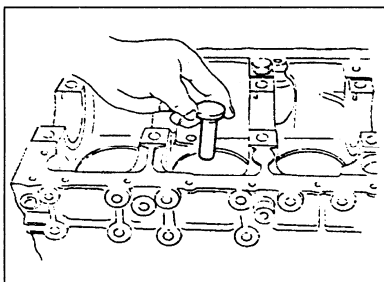
6. Oil pump assembly

- Remove oil pump assembly from the cylinder block.



7. Camshaft and tappet

- Remove the oil pan from the cylinder block.
- Be careful not to damage the camshaft bearing.



- Take out the tappet from the cylinder block.



Assembly

7. Camshaft and tappet



- Coat oil on the tappet and in the installation hole of cylinder block tappet.
- Place the tappet according to the position mark made during removing (if the tappet is intended to be reused).

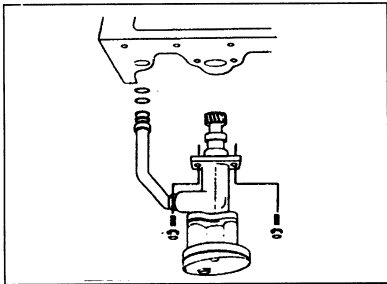
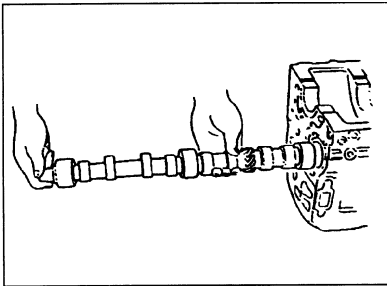


Note:

The tappet must be installed before camshaft is assembled.



- Coat oil on the camshaft and camshaft bearing.
 - Install the camshaft on the cylinder block.
- Be careful not to damage the camshaft bearing.



6. Oil pump assembly



- Prepare some solution containing 80% oil and 20% supramoly.
- Apply enough solution to the oil pump pinion teeth.
- Apply some oil to the oil pipe O-ring and put it into the cylinder block O-ring groove.
- Install the oil pump assembly with oil pipe on the cylinder block, and tighten fixing bolts to the specified torque.



Oil pump bolt torque

N • m

25

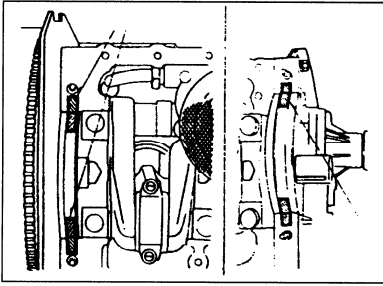


Tighten sleeve nut(s) to the specified torque.

Sleeve nut torque

N • m

30



5. Oil pan

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section shown in the diagram.

- Install back lip portion of the gasket into the fifth groove.

- Make sure that the lip portion is compact with the groove.

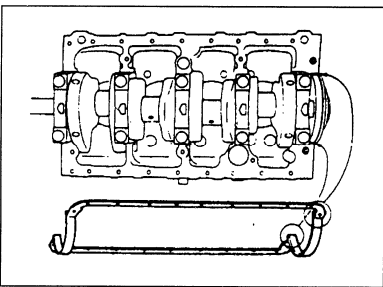
- Install the oil pan to the cylinder block.

- Tighten oil pan bolt(s) to the specified torque.

Oil pan bolt torque

N • m

23.5



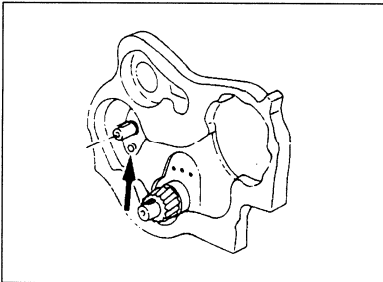
4. Timing gear

7) Camshaft timing gear

- Install the thrust washer onto the cylinder block and tighten thrust washer bolt(s) to the specified torque.

N • m

25



- Install camshaft timing gear to the camshaft.

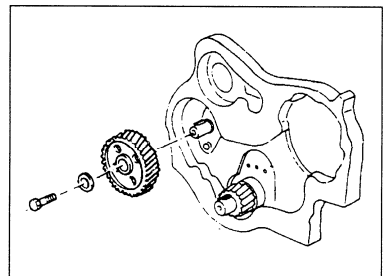
The timing gear mark ("Y—Y") has to face the outside.

Align idler gear marks "B" "V-V" with injection pump timing gear mark "V".

Align idler gear marks "B" "Z" with idler gear marks "A" "Z-Z".

Arrange idler gear setting marks "X" and "Y" so that they both face the engine forepart.

Align idler gear mark "X" with crankshaft timing gear mark "X—X".





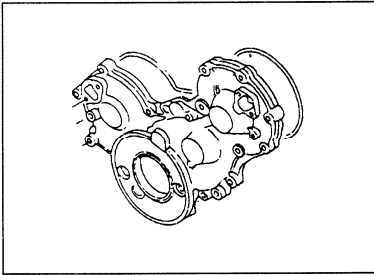
Align idler gear mark “Y” with camshaft timing gear mark “Y—Y”.

- Tighten the timing gear to the specified torque.



Timing gear bolt torque N • m

110



6) Timing gear chamber cover

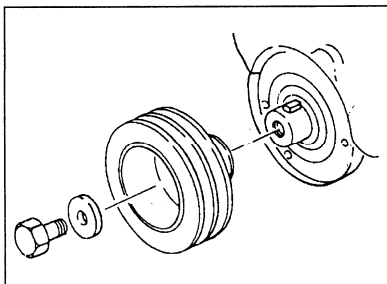
Align timing gear chamber anchor pin with the timing gear chamber, then install timing gear chamber cover.

Tighten gear chamber cover bolt to the specified torque.

Gear chamber cover bolt torque

N • m

25



5) Acoustic hood liner

6) Lower acoustic hood

7) Upper acoustic hood

2) Crankshaft damper pulley

Screw down the crankshaft damper pulley bolt(s) to the specified torque.

Note:

While screwing down the damper pulley, hold the flywheel ring gear to prevent crankshaft rotating.



Crankshaft pulley bolt torque

N • m

210

1) Cooling fan assembly



- Install the fan pulley and cooling fan assembly (in this installation order) on water pump, and tighten those parts to the specified torque.

N•m

12.5



3. Cylinder head assembly and gasket

Refer to “3.12 Cylinder head assembly and gasket”.

2. Engine assembly

14) Engine assembly

- Hoist the engine support with a crane.

13) Support rubber

- Tighten fixing bolts to the specified torque after all of them (left: 2, right: 2) have been inserted into their corresponding holes.

Support rubber bolt torque N.m

40

12) Front exhaust pipe

- Connect exhaust pipe and tighten nut(s) to the specified torque.

Exhaust pipe nut torque N • m

67

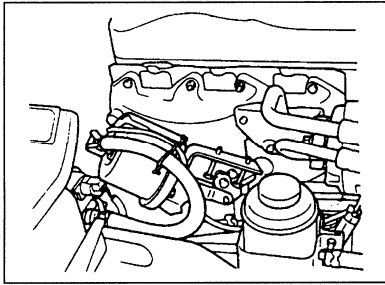
- Install exhaust pipe support bolts and tighten bolts and nuts to the specified torque.

Support bolt and nut torque N • m

40

11) Vacuum pump hose

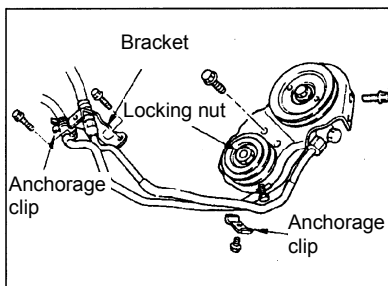
- Install the vacuum hose at both vacuum tank and solenoid valve sides.



- Connect the vacuum hose to the modulator.

9) Power steering pump and bracket assembly (power steering type)

- Install power steering pump and pipe bracket, then tighten bolts to the specified torque.



Pump bolt torque N • m

20

Pipe bracket bolt torque N • m

20



Anchorage clip bolt torque N • m

10

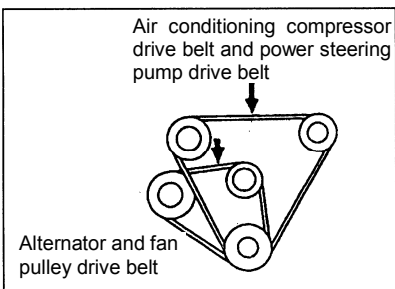


- Install power steering pump drive belt and adjust the belt tension.



- Check drive belt is worn or damaged, and replace if necessary.
- Check the belt tension, and adjust if necessary.
- Press the central section of belt with a force of 100N and check the deflection of each belt.
- Deflection standard value

mm



	Initial tension
Power steering pump drive belt	8—10

- Loosen power steering pump locking bolt(s) and adjust belt tension with adjusting bolt.

10) Modulator vacuum hose



Power steering pump locking bolt torque

N • m



37.5

Idler locking nut torque

N • m



25

8) Air conditioning compressor assembly

- Install the fixing bolt(s) of air conditioning compressor and screw down the bolt(s) to the specified torque.

Compressor fixing bolt torque

N • m

20

- Connect the wire connector of electromagnetic clutch.
- Install air compressor drive belt and adjust the belt tension.
- Check drive belt is worn or damaged, and replace if necessary.
- Check the belt tension, and adjust if necessary.
- Press the central section of belt with a force of 100N and check the deflection of each belt.
- Deflection standard value

mm



Initial tension



Air conditioning compressor drive belt 8—10

- Loosen air conditioning compressor locking bolt(s) and adjust belt tension with the adjusting bolt of adjuster.

Idler locking nut torque

N • m

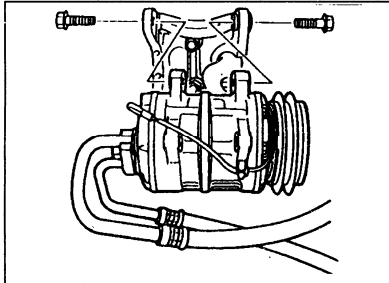
25

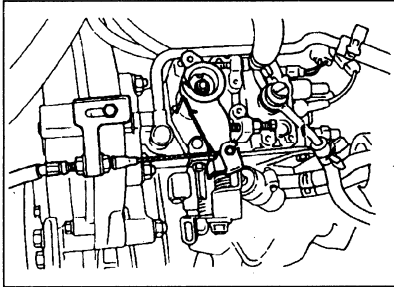
7) Oil pressure switch wire

- Connect oil pressure switch wire connector.

6) Fuel hose

- Connect fuel delivery hose and return hose, and then tighten the anchorage clip(s) firmly.



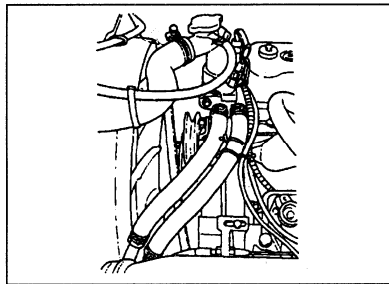


5) Glow plug wire

- Install wire connector and tighten bolt(s) firmly.

4) Engine control cable

- ① Mount the control cable to engine control lever.
- ② Place the throttle lever at fully-off position and pull tight the control cable along the arrow direction to prevent slackness.
- ③ Tighten the throttle cable bracket bolt(s).

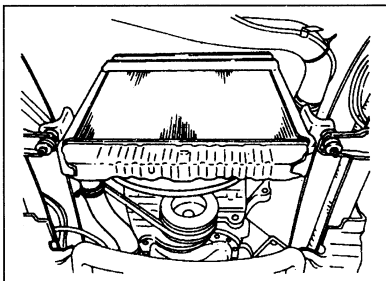


3) Heater hose

- Connect the radiator hose, and then tighten the anchorage clip(s) firmly.

2) Air intake duct

- Connect the air-intake duct, and then tighten the anchorage clip(s) firmly.

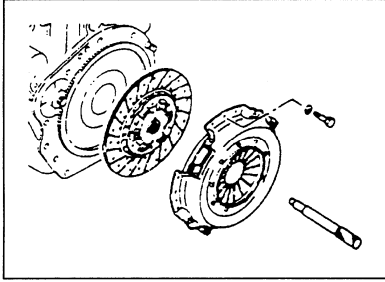


1) Radiator assembly

- ① Install shock-absorbing rubber at both sides.
- ② Mount radiator support.
- ③ Connect the upper and lower hoses of the radiator.
- ④ Connect storage tank hose.

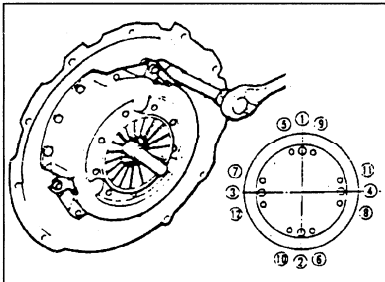
1. Transmission assembly and clutch assembly

2) Clutch



② Driven plate assembly

- Apply multifunctional supramoly grease to the splines of driven plate hub.
- Mount the driven plate assembly with a guiding centralizer.



① Pressure plate assembly

- Screw down pressure plate fixing bolts in turn.



Pressure plate fixing bolt torque

N • m

25

- Remove the guiding centralizer.

Note:

If a new pressure plate is installed, make sure to remove the protection diaphragm spring cable after tightening the pressure plate to the specified torque.

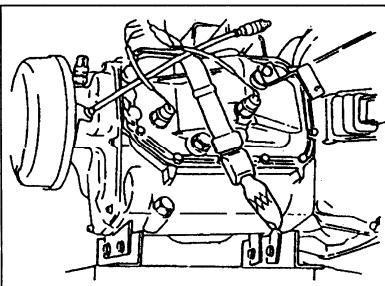
1) Transmission

⑨ Mounting bracket

Mounting bracket nut torque

N • m

69



⑧ Transmission assembly

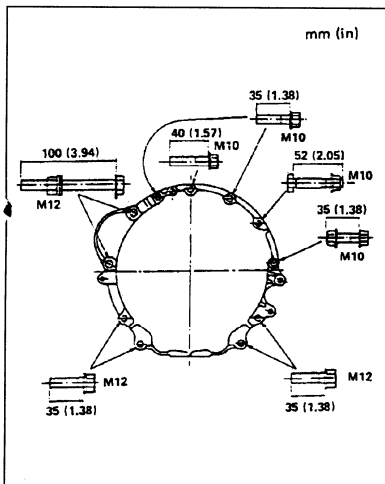
- Use a transmission jack to jack up the transmission.



Caution:

In order to prevent transmission overturn, use chains or belts to secure it to the jack.

- Shift the transmission to high speed gear.
- Tilt the transmission in the same straight line with the engine.
- Rotate parking brake drum outputs to ease the clutch spline engagement.



Clutch cover to flywheel casing bolt torque

N • m

M10: 46

M12: 91

- Hoist the engine and let the transmission enter the rear transmission bracket.



Rear engine support nut and bolt torque

N • m

M10: 40

M12: 69

⑦ Front exhaust pipe



Front exhaust pipe bolt torque

N • m

37

⑥ Exhaust brake assembly



Exhaust brake bolt torque

N • m

17

⑤ Clutch slave cylinder



Slave cylinder bolt torque

N • m

20



- Adjust the slave cylinder before mounting return spring.

- Unscrew the push rod locking nut.
- Turn the adjusting nut until it is against the release fork.
- Back off the adjusting nut by 1½ turns. (The free gap of release fork is about 2mm).
- Screw down the locking nut.



Push rod locking nut torque

N • m

16

④ Shift and select cables

③ Wire connector



② Parking brake cable

① Drive shaft

- Align previously made marks.

Drive shaft nut torque

N • m

66



- Connect the ground cables of battery.

- Add some coolant.

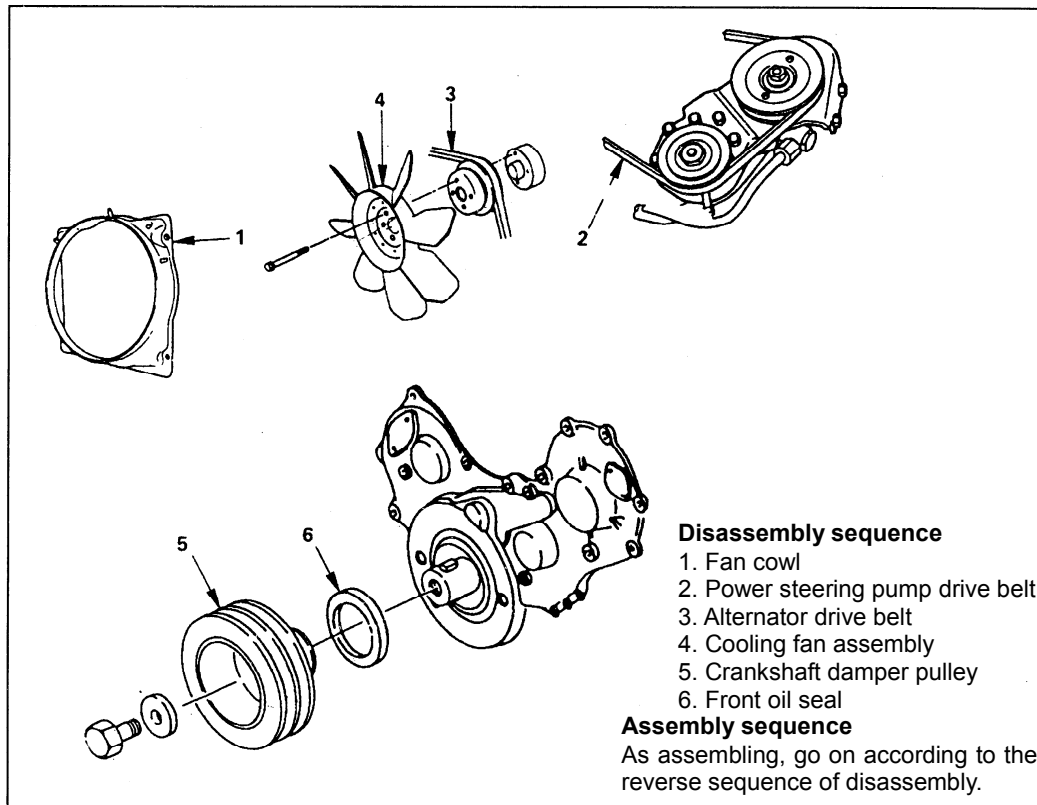


- Add some oil.

- Start the engine and check whether the coolant leaks.



3.17 Crankshaft front oil seal

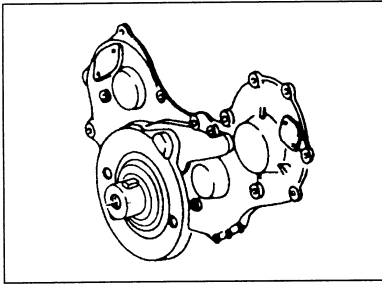


Disassembly



Preparation:

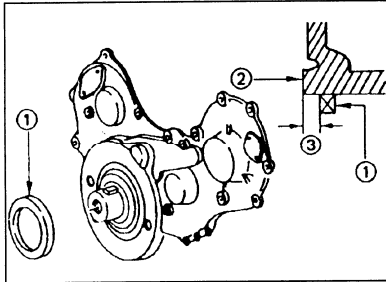
- Remove battery ground cables.
 - Discharge coolant completely.
1. Fan guard
 2. Power steering pump drive belt
 - Unscrew bracket fixing bolt(s) and adjusting bolt(s) of the power steering pump, then remove the drive belt.
 3. Alternator drive belt
 - Unscrew alternator bracket fixing bolt(s) and adjusting plate locking bolt(s), then remove the drive belt.
 4. Cooling fan assembly
 - Unfasten tight nut(s), and dismount the fan assembly, collar and fan pulley.



5. Crankshaft damper pulley
6. Front oil seal

- Tap around the oil seal with a plastic hammer and a screwdriver, and take out the oil seal out of the gear chamber cover.

Exercise care to avoid damaging the seal mating surface.



Assembly

6. Front oil seal

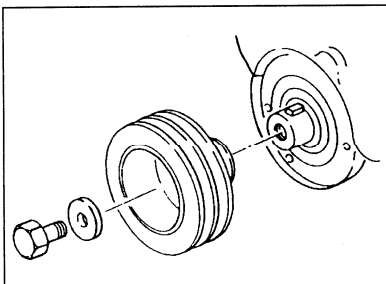
- Mount the oil seal ① onto the gear chamber cover ② with an erector.



Oil seal erector: 1002420FA-9101

Pay attention to the seal mounting level ③ shown in the diagram.

Mounting depth ③ = 1 mm



5. Crankshaft damper pulley

Screw down the crankshaft damper pulley bolt(s) to the specified torque.

Note:



Pulley bolt torque

N·m

210

4. Cooling fan assembly



- Install the fan pulley, spacer block and cooling fan assembly (in this installing order) to a water pump, and tighten those parts to the specified Tightening torque

N·m

12.5

3. Alternator drive belt

- Mount the alternator drive belt and adjust the belt tension.
- Refer to the "Drive belt adjustment" in this section.



2. Front oil seal

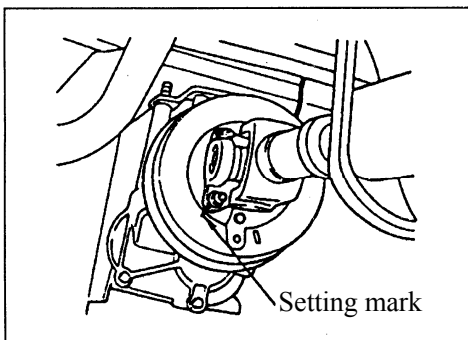
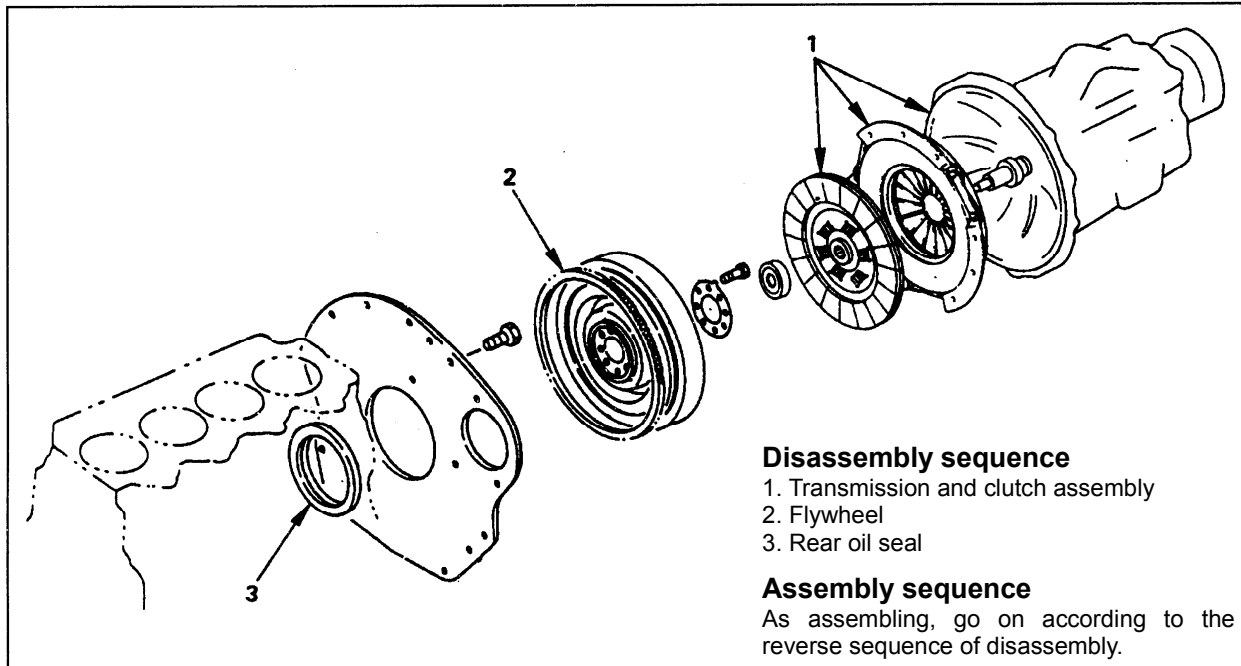
- Mount power steering pump drive belt and adjust the belt tension.
- Refer to the “Drive belt adjustment” in this section.

1. Fan guard

- Install the fan guard and storage tank hose.
- Add in some coolant.
- Start the engine and check whether there is any leakage of the coolant.



3.18 Crankshaft rear oil seal



Disassembly

Preparation:

- Remove the battery ground cable.



1. Transmission and clutch assemblies

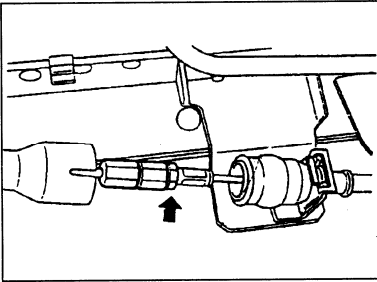
Hoist the car and support it with a suitable and safe bench.

- 1) Transmission

- ① Transmission

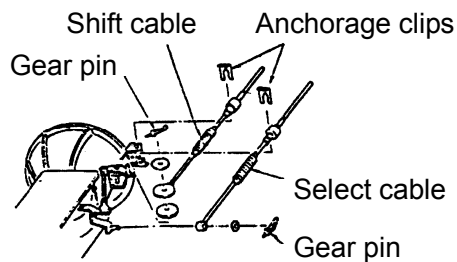
Mark the parking brake drum and flange yoke beforehand.

- Remove the flange yoke drive shaft.
- Put the bundled up drum and flange yoke aside so as to facilitate maintenance work.



② Parking brake cable

- Detach the connecting hood.
- Remove connecting bolts.
- Dismantle anchorage clips and withdraw bracket cables.

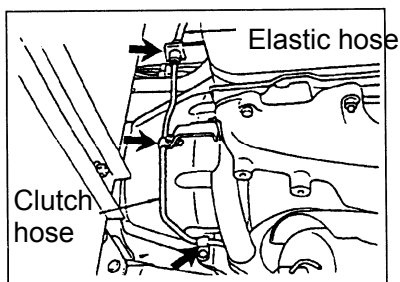


③ Wire connector

- Detach wire connectors of the vehicle speed sensor, neutral switch and back-up light switch.

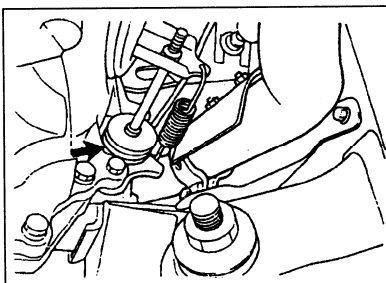
④ Shift and select cables

- Remove the shift and select cables on transmission side.

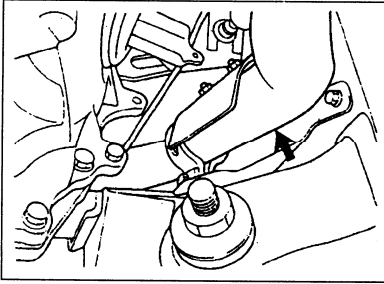


⑤ Clutch slave cylinder

- Remove the clutch hose clips and clip bracket



- Disassemble the slave cylinder assembly with Elastic hoses, and bind it to the frame so as to facilitate the maintenance work.

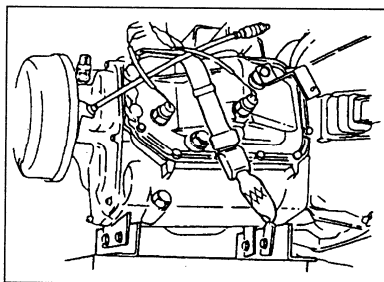


- ⑥ Exhaust brake assembly
- ⑦ front exhaust pipe
- ⑧ Transmission assembly

Notes:

Sometimes the exhaust pipe bracket /gear control bracket and anchorage clips are in the wrong mounting positions or directions. In order to prevent this, please mark correct mounting signs on those parts.

- Use a transmission jack to jack up the transmission.



Caution:

In order to prevent transmission overturn, use chains or belts to secure it to the jack.

Do not let the transmission hover over the clutch, or it will destroy the clutch.

- Remove nuts securing the transmission mounting bracket on the beam side.
- Angles of the engine and transmission have to be adjusted so that they can be easily disassembled.
- Use a jack or crane to jack up the engine rear part.



Caution:

After jacked up the engine, place a wooden block under it to protect the oil pan.

- Remove the transmission binding bolts.
- Draw the transmission assembly backwards.

- ⑨ Mounting bracket

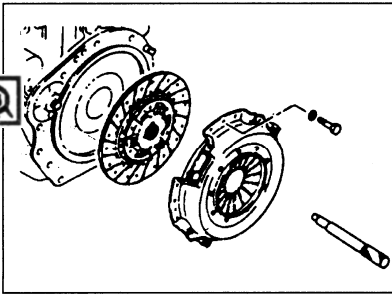
2) Clutch

- Hoist the car and support it with a suitable and safe bench.



Caution:

Make sure no clutch fluid is left on the coating surface, or wash it away immediately.



① Pressure plate assembly

② Driven plate assembly

- Use a guiding centralizer to prevent the driven plate assembly dropping freely.
- Mark the flywheel and pressure plate flange to ensure alignment during installation.
- Loosen fixing bolts in the pressure plate assembly.

2. Flywheel

3. Rear oil seal

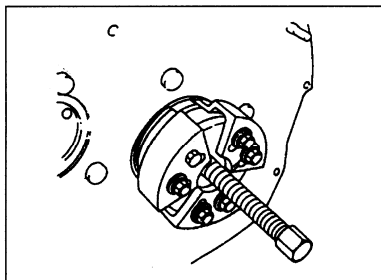
- Push in the oil seal and mount special tools according to the left diagram to dismantle the oil seal.



- Rear oil seal detach: 1002430FA-9101

Note:

Take care to avoid damaging the crankshaft and oil seal pedestal while removing the oil seal.



Assembly

3. Rear oil seal

- Mount the oil seal to the cylinder block with an oil seal erector.

Rear oil seal erector: 1002430FA-9102



Notes:

Clean the rust and chips off the press-in portion of the oil seal.

Pay attention to the press-in direction.

1) Use two bolts to connect the adaptor of special tools to the crankshaft rear end.

2) Install the oil seal to the periphery of the adaptor.

3) Insert the socket into the adaptor portion and screw down it with a bolt (M12×1.75L=70) until the adaptor tip is against the socket.

4) Remove the adaptor and socket.

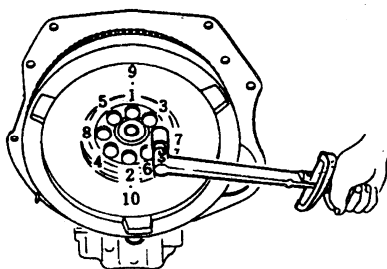
5) Check the oil seal size after it is installed.



Standard value

mm

12. 2—12. 8



2. Flywheel

- Apply some oil to fixing bolts.
- By using of the torque tightening method, screw down the flywheel bolts to the specified torque in two steps according to the left diagram.



Flywheel bolt torque

N·m

Step I

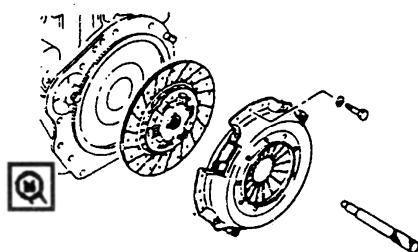
Step II

Step III

25

70

120



1. Transmission and clutch assemblies

2) Clutch

② Driven plate assembly



- Apply multifunctional supramoly grease to the splines of driven plate hub.



- Mount the driven plate assembly with a guiding centralizer.

Guiding centralizer:

1601100FA-9101

① Pressure plate assembly

Screw down pressure plate fixing bolts in turn.



Pressure plate fixing bolt torque

N·m

25

- Remove the guiding centralizer.

Note:

If a new pressure plate is installed, make sure to remove the protection diaphragm spring cable after tightening the pressure plate to the specified torque.

1) Transmission

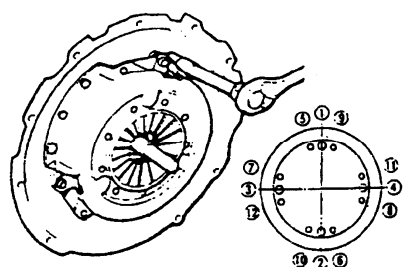
⑨ Bracket

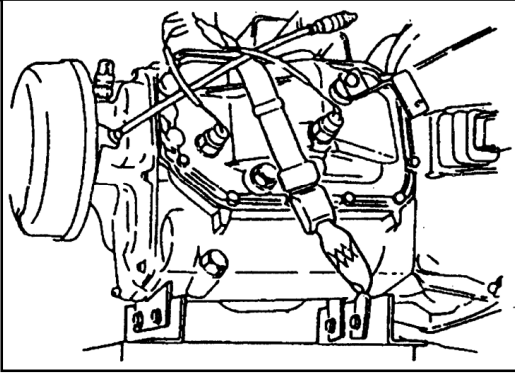


Bracket nut torque

N·m

69





⑧ Transmission assembly

- Use a transmission jack to jack up the transmission.

Caution:

In order to prevent transmission overturn, use chains or belts to secure it to the jack.

- Shift the transmission to high speed gear.
- Make the transmission tilt in the same straight line with the engine.
- Rotate parking brake drum outputs to ease the clutch spline engagement.



Clutch cover to

flywheel casing bolt torque

N·m

M10: 46

M12: 91

- Hoist the engine and let the transmission enter the rear transmission bracket.

Rear engine bracket nut
and bolt torque

N·m

M10: 40

M12: 69

⑦ front exhaust pipe



Front exhaust pipe bolt torque

N·m

37

⑥ Exhaust brake assembly



Exhaust brake bolt torque

N·m

17

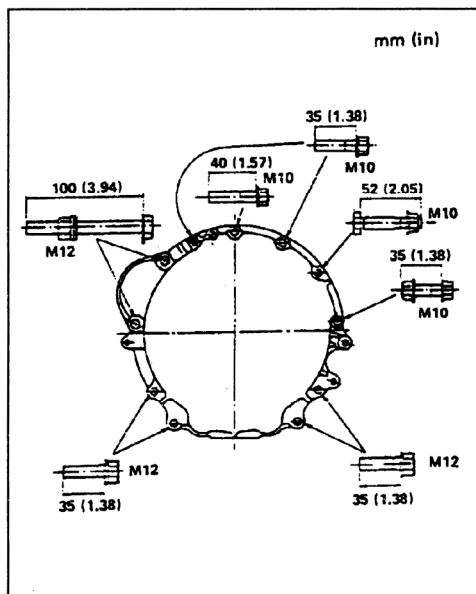
⑤ Clutch slave cylinder



Slave cylinder bolt torque

N·m

19





- Adjust the slave cylinder before mounting return spring.

- Unscrew the push rod locking nut
- Turn the adjusting nut until it is against the release fork.
- Back off the adjusting nut by 1½ turns. (The free gap of release fork is about 2mm/0.1in).
- Screw down the locking nut.



- Push rod locking nut torque N·m

16

- ④ Shift and select cables
- ③ Wire connector
- ② Parking brake cable
- ① Drive shaft



- Align previously made marks.

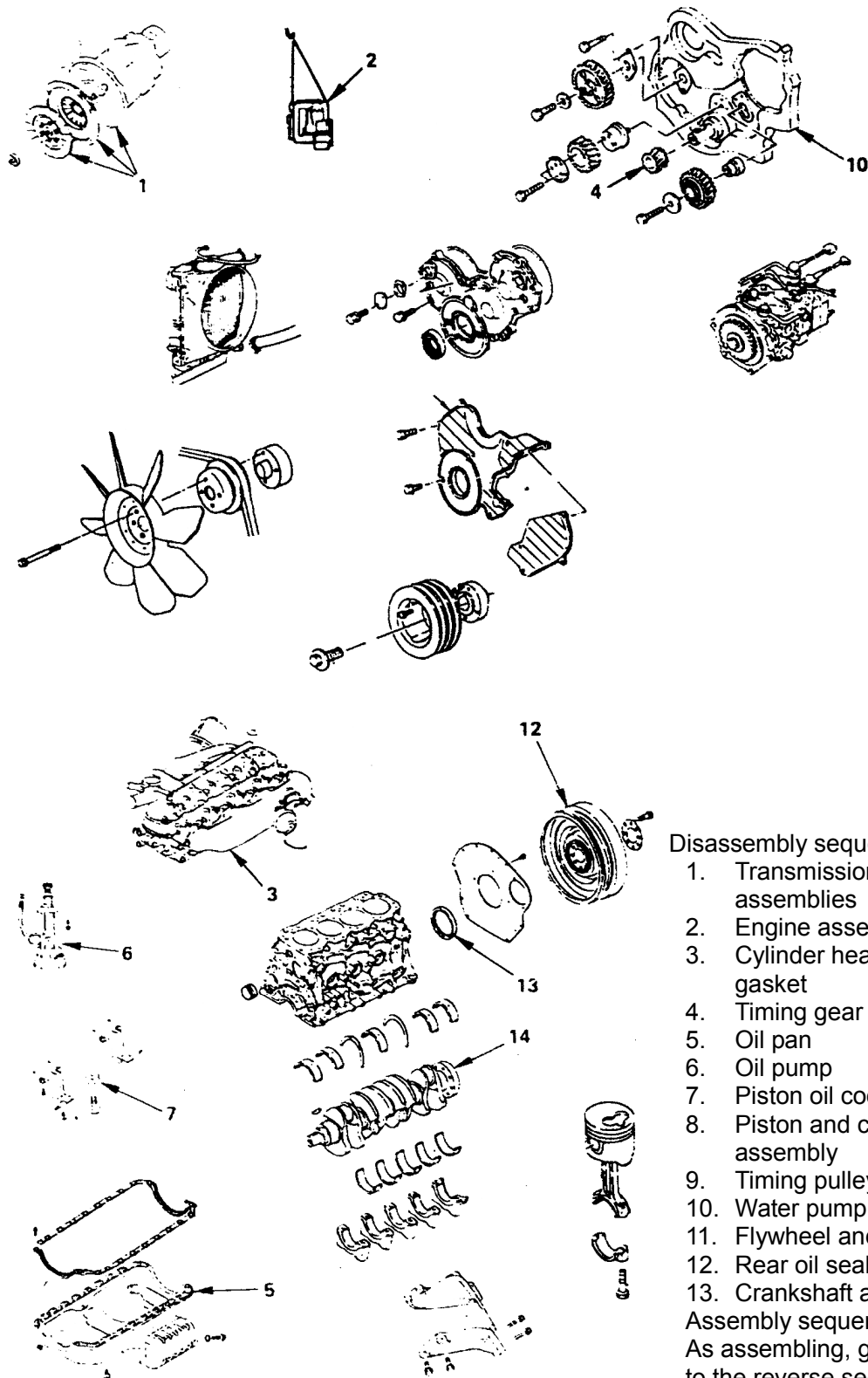
Drive shaft nut torque N·m

66

- Connect battery ground cables.



3.19 Crankshaft and main bearing

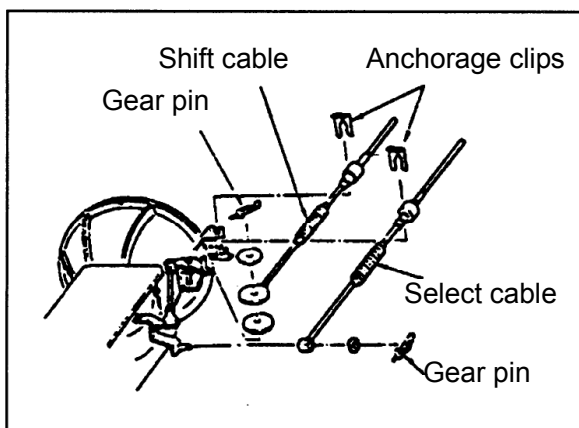
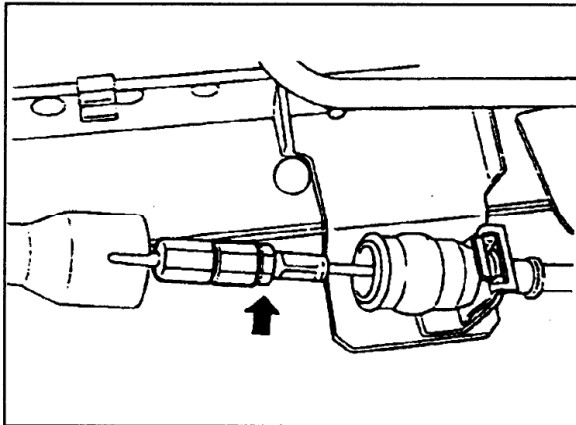
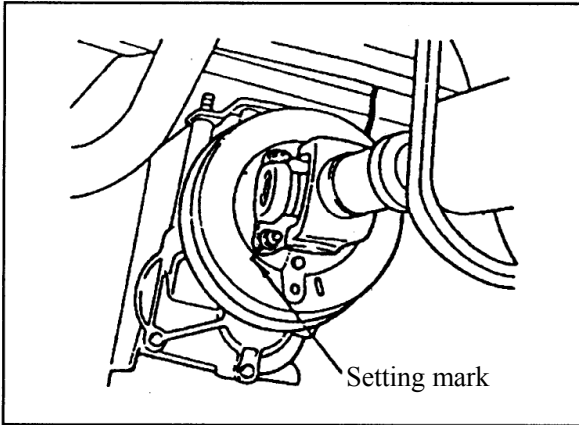


Disassembly sequence

1. Transmission and clutch assemblies
2. Engine assembly
3. Cylinder head assembly and gasket
4. Timing gear
5. Oil pan
6. Oil pump
7. Piston oil cooling pipe
8. Piston and connecting rod assembly
9. Timing pulley chamber
10. Water pump assembly
11. Flywheel and flywheel baffle
12. Rear oil seal
13. Crankshaft and main bearing

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

- Remove battery ground cables.
- Discharge the coolant in the radiator and engine completely.

1. Transmission and clutch assemblies

- Hoist the car and support it with a suitable and safe bench.

1) Transmission

① Transmission

- Mark the parking brake drum and flange yoke beforehand.
- Remove the flange yoke drive shaft.
- Bind the removed drive shaft to the frame so as to facilitate the maintenance work.

② Parking brake cable

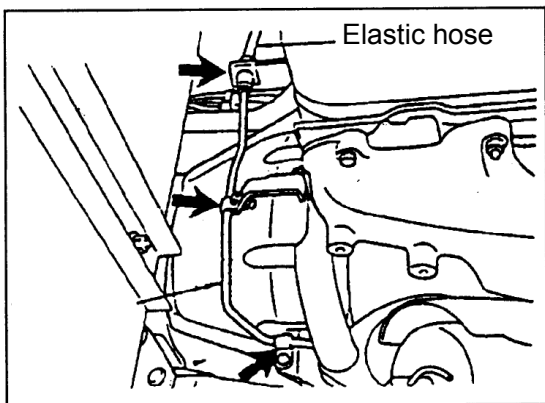
- Detach the connecting hood.
- Remove connecting bolts.
- Dismantle anchorage clips and withdraw bracket cables.

③ Wire connector

- Detach wire connectors of the vehicle speed sensor, neutral switch and back-up light switch.

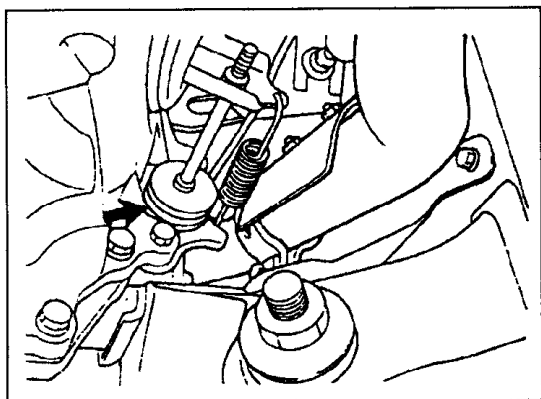
④ Shift and select cables

- Remove the shift and select cables on transmission side.

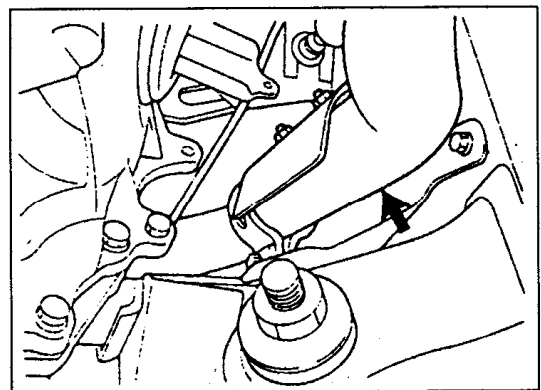


⑤ Clutch slave cylinder

- Remove the clutch hose clips and clip bracket (only for vehicles with right steering wheel).

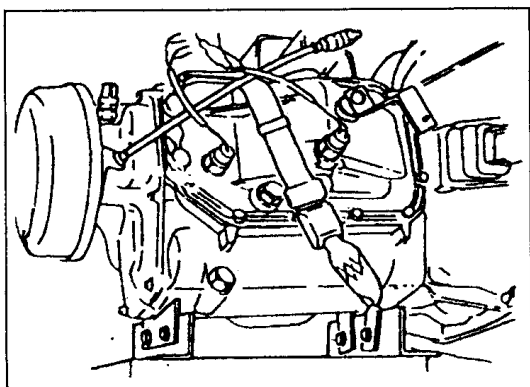


- Disassemble the slave cylinder assembly with Elastic hoses, and bind it to the frame so as to facilitate the maintenance work.



⑥ Exhaust brake assembly

⑦ front exhaust pipe



⑧ Transmission assembly

Notes:

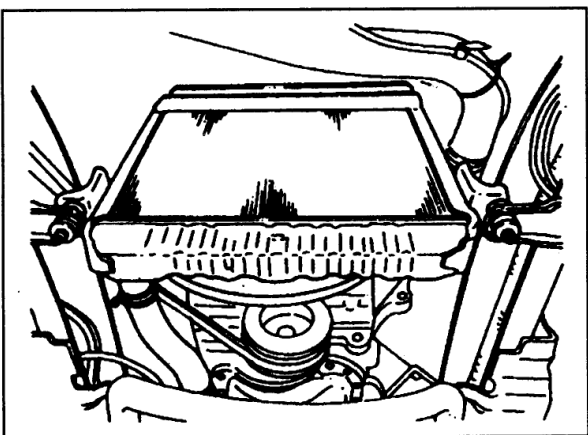
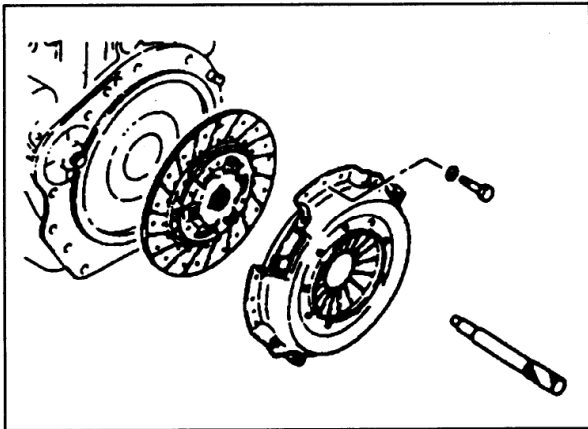
Sometimes the exhaust pipe bracket, gear control bracket and anchorage clips are in the wrong mounting positions or directions. In order to prevent this, please mark correct mounting signs on those parts.

- Use a transmission jack to jack up the transmission.



Caution:

In order to prevent transmission overturn, use chains or belts to secure it to the jack.



Do not let the transmission hover over the clutch, or it will destroy the clutch.

- Remove nuts securing the transmission mounting bracket on the beam side.
- Angles of the engine and transmission have to be adjusted so that they can be easily disassembled.
- Use a jack or crane to jack up the engine rear part.



Caution:

After jacked up the engine, place a wooden block under it to protect the oil pan.

- Remove the transmission binding bolts.
- Draw the transmission assembly backwards.

⑨ Mounting bracket

2) Clutch

- Hoist the car and support it with a suitable and safe bench.



Caution:

Make sure no clutch fluid is left on the coating surface, or wash it away immediately.

① Pressure plate assembly

② Driven plate assembly

- Use a guiding centralizer to prevent the driven plate assembly dropping freely.

- Mark the flywheel and pressure plate flange to ensure alignment during installation.

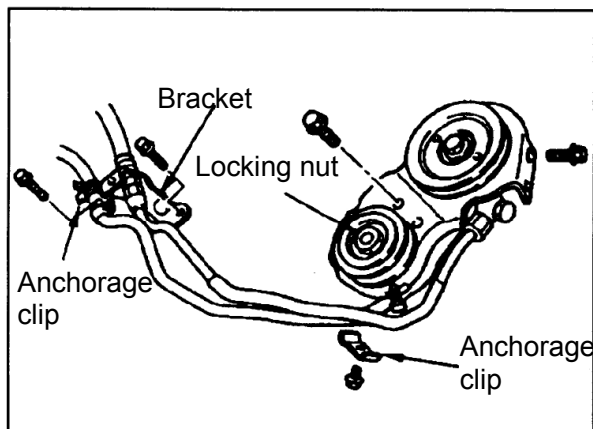
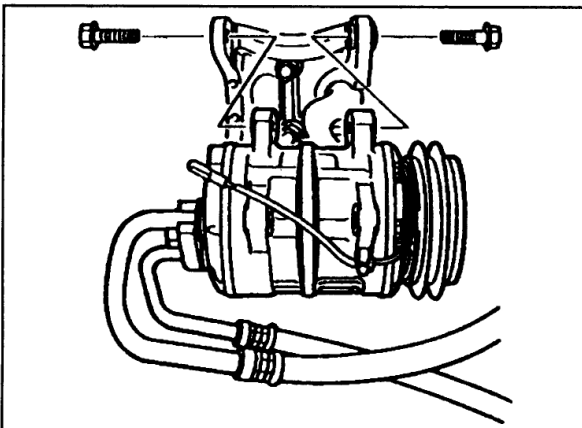
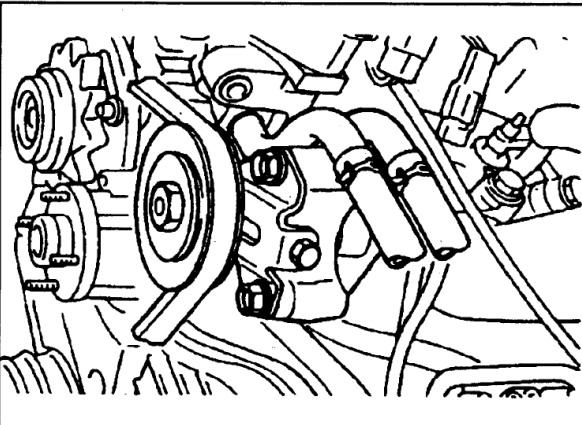
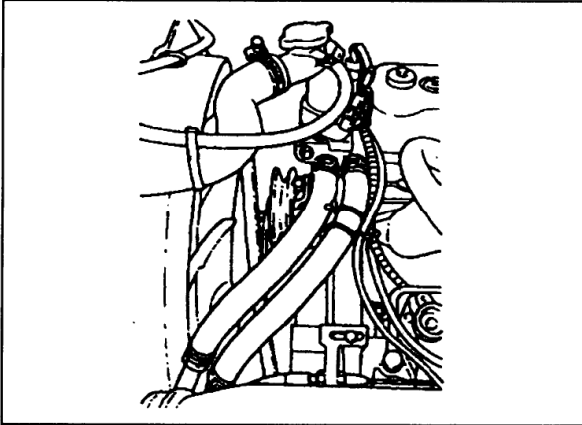
- Loosen fixing bolts in the pressure plate assembly.

2. Engine assembly

1) Radiator assembly

- Remove the upper and lower hoses of the radiator.
- Remove storage tank hose.
- Remove the shock-absorbing rubber on both sides.
- Remove radiator support.

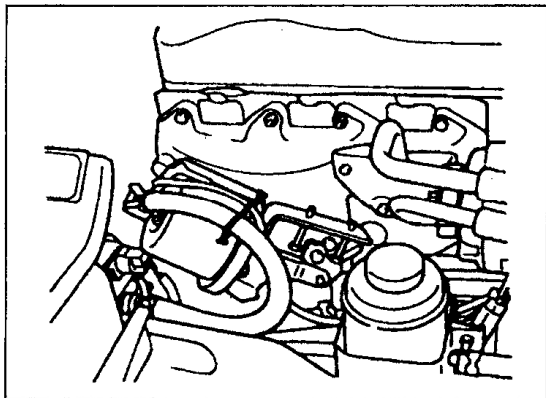
2) Air intake duct



- 3) Heater hose
- 4) Engine control cable
 - Unscrew the locking nut(s) at the bracket and remove throttle wire(s) from the injection pump control lever.
- 5) Glow plug wire
- 6) Fuel hose
 - Remove fuel inlet hose and return hose.
- 7) Oil pressure switch wire
- 8) Air conditioning compressor assembly
 - Unscrew idler locking nut(s)
 - Loosen the adjusting nut(s) and remove the drive belt.

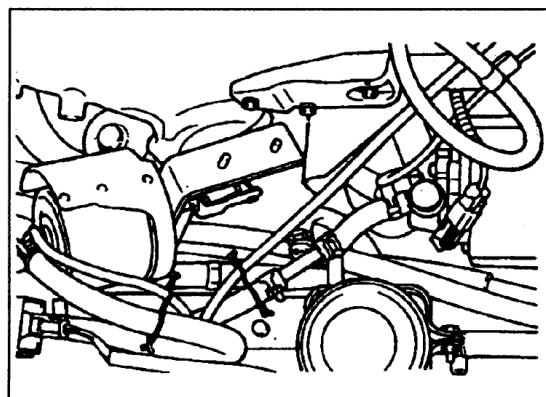
- Remove the magnet clutch wire connector.
- Remove fixing bolt(s) of the air conditioning compressor and bind the compressor to the frame temporarily with wires.

- 9) Power steering pump and bracket assemblies (power steering type)
 - Unscrew idler locking nut(s)
 - Loosen the adjusting nut(s) and remove the drive belt.
 - Remove pipe bracket fixing bolt(s) and anchorage clip (s).
 - Remove power steering pump fixing bolt(s) and bind the pump to the frame temporarily with wires.



10) Front exhaust pipe

- Remove exhaust pipe fixing bolt(s) of the exhaust manifolds.
- Remove exhaust pipe support bolt(s).
- Remove front exhaust pipe fixing nut(s).



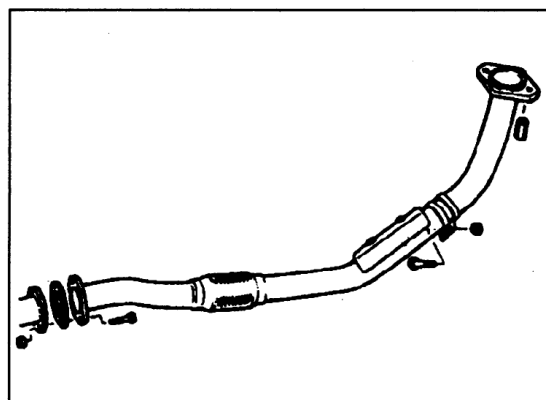
11) Support rubber

① If mounted on the right side

- Remove the two fixing nuts on beam side.

② If mounted on the left side

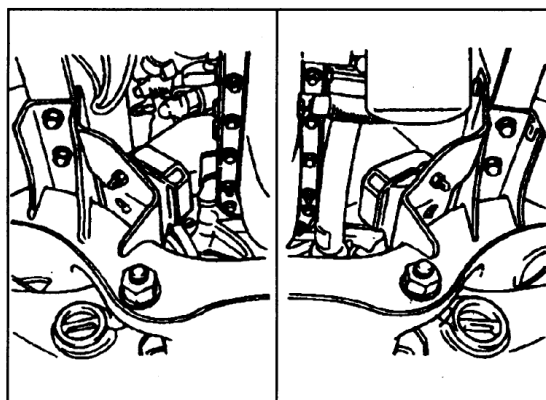
- Remove the two fixing nuts on beam side.



12) Engine assembly

- Slowly hoist the engine by a crane.
- Lift the engine with its front part higher than rear part.

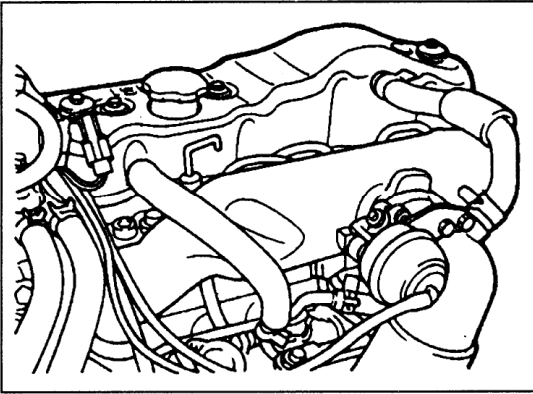
While taking out the engine assembly be careful to avoid breaking any oil pipe, brake pipe, etc.



3. Cylinder head assembly and gasket

1) High pressure oil pipe

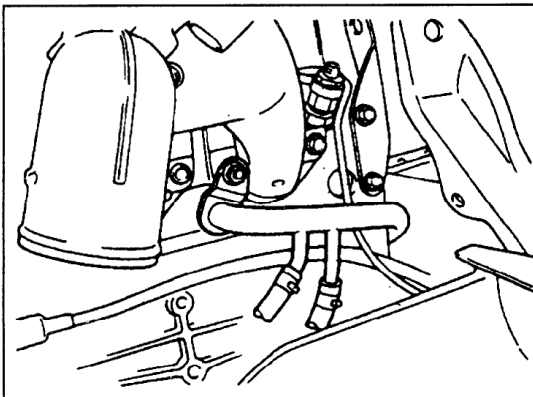
- Unscrew high pressure oil pipe anchorage clip(s).
- Remove taper nut(s) on the injection pump side.
- Remove taper nut(s) on the fuel injector side and high pressure oil pipe.



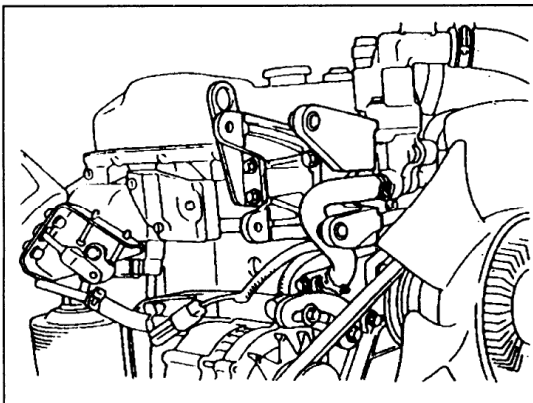
- 2) Oil return hose
 - Remove oil return hose(s) of the injection pump.
- 3) Crankcase vent hose(s)
 - Dismantle crankcase vent hose(s) from the air-intake duct.



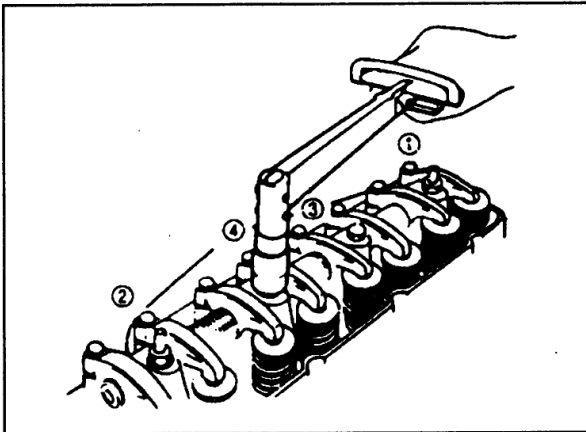
- 4) Glow plug wire
- 5) Oil scale guide
 - Remove oil scale guide out of the cylinder head.



- 6) Oil cooler tube D
 - Remove pipe bracket fixing bolt(s) on the rear side of cylinder head.
 - Remove cooler tube from the cylinder head.



- 7 Bypass hose
- 8) Cylinder head cover
 - Remove crankcase vent hose and cylinder head cover bolt(s).



9) Rocker shaft

- Loosen rocker shaft support bolt(s) bit by bit according to the sequence shown in the diagram.

Note:



Disobedience will bring unfavorable influence to the rocker shaft.

10) Push rod

11) Cylinder head assembly

- Loosen cylinder head bolt(s) bit by bit according to the sequence shown in the diagram.

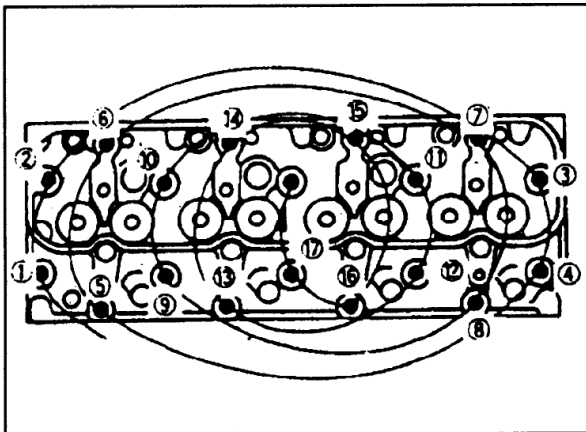
Note:



Disobedience will bring unfavorable influence to the cylinder head lower surface.

12) Cylinder head gasket

- Remove cylinder head gasket and anchor pin.



4. Timing gear

1) Cooling fan assembly

- Unfasten tight nut(s), and dismount the fan assembly and fan pulley.

2) Crankshaft damper pulley

3) Acoustic hood

4) Acoustic hood liner

5) Timing gear chamber cover

- Remove oil seal from the timing gear chamber cover.

6) Oil pipe

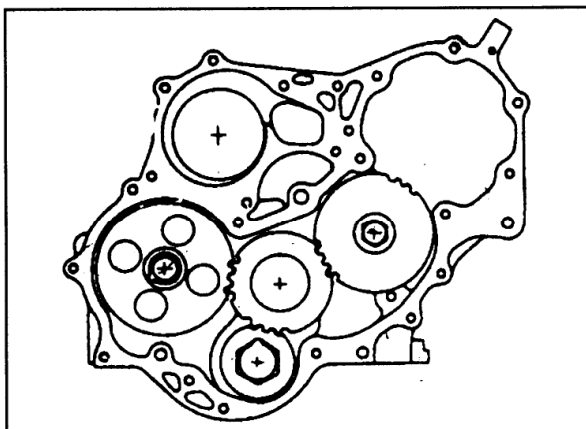
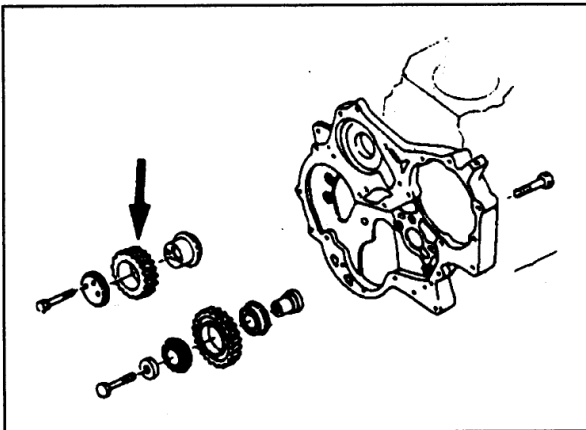
7) Idler gear

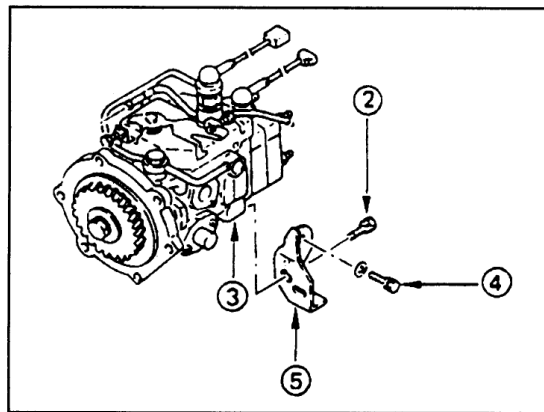
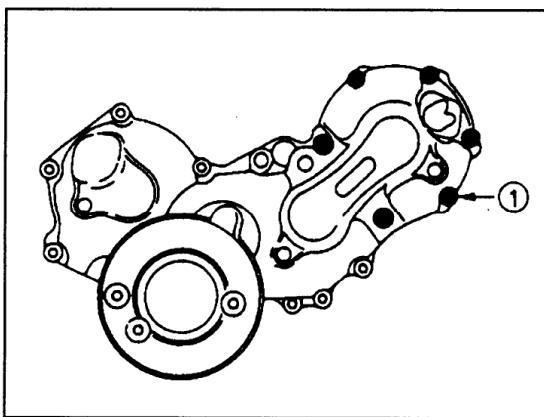
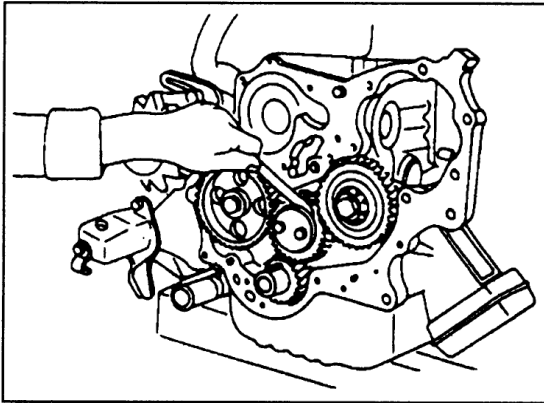
- Measure camshaft and crankshaft timing gear clearances before disassembling the idler gear.

- Measure axial clearance for idler gear before disassembling the idler gear.

Note:

Refer to the following items while measuring gear clearance and axial clearance.





Timing gear clearance measurement



- 1) Install a dial gauge onto the timing gear to be tested.

Fix the gear to be tested and the gear connected to it.

- 2) Swing the gear to be tested left and right.

Read out the dial gauge readings.

If the measured value exceed prescribed limit, the timing gear has to be replaced.



Timing gear clearance mm

Standard value	Limit
0.10—0.17	0.30

Axial clearance measurement of idler gear "A"

Measure the clearance between idler gear A and thrust ring with a clearance gauge and determine the idler gear axial clearance.

If the measured value exceeds prescribed limit, the thrust ring has to be replaced.

Idler gear axial clearance mm

Standard value	Limit
0.07	0.2

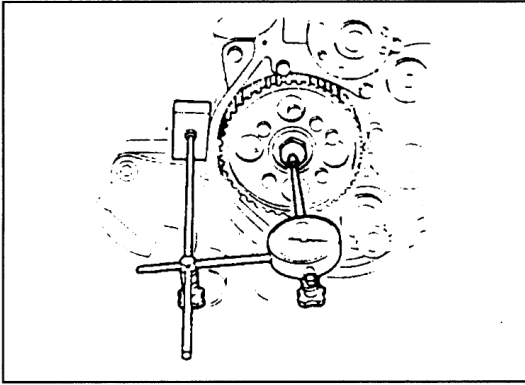
- 9) Idler gear

- 10) Injection pump

- Remove six injection pump bracket bolts① from the timing gear chamber.
- Remove rear bracket bolt② from the injection pump bracket③.
- Remove rear bracket bolt④ and bracket⑤ from the cylinder block.
- Drag both the injection pump and injection pump timing gear out towards the engine backside.

Note:

Cover the hole in injection pump delivery valve body with a cover or equivalents to prevent foreign bodies falling into the valve.



11) Camshaft timing gear

- ① Measure the camshaft axial clearance with a dial gauge.

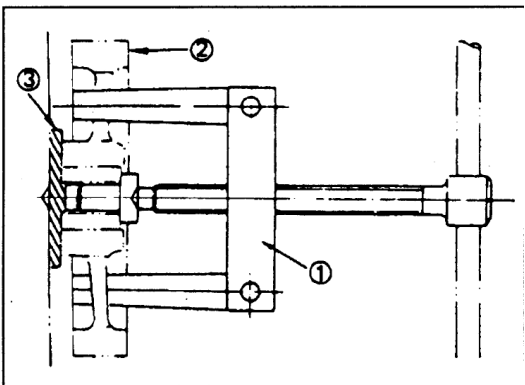
Measure the clearance before disassemble the camshaft gear.



If the camshaft axial clearance exceeds prescribed limit, the thrust washer has to be replaced.

Camshaft axial clearance mm

Standard value	Limit
0.050—0.114	0.2



- ② Remove camshaft timing gear bolt(s) from the camshaft.

Note:

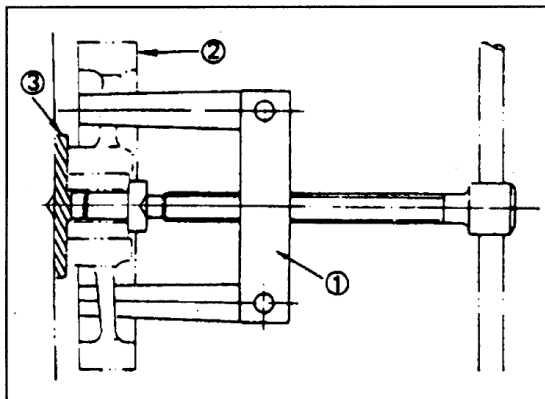
Protect the camshaft against rotating.



- ③ Pull out camshaft timing gear② with a universal puller①.

Universal puller: 1007011FA-9101

- ④ Remove the thrust washer③.

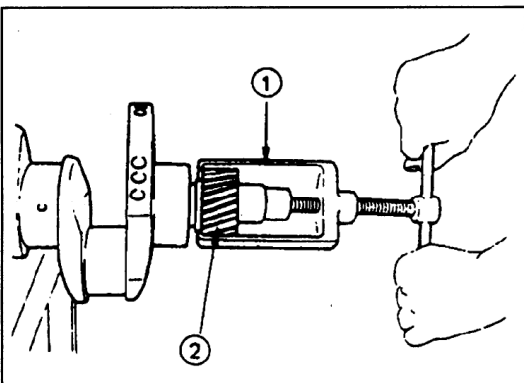


12) Crankshaft gear



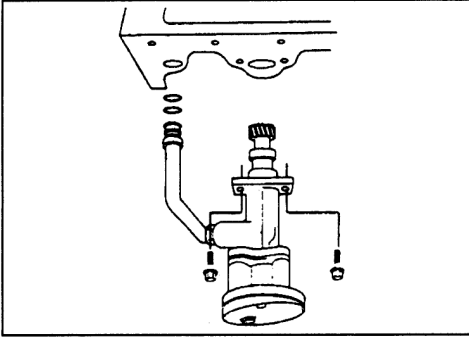
- Detach crankshaft gear② with crankshaft gear detacher①.

Crankshaft timing gear detacher:
1007011FA-9101



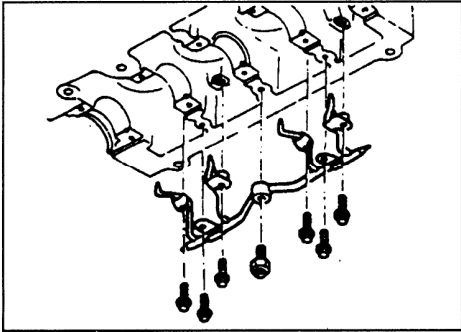
5. Oil pan

- Remove the stiffener plate from both sides of the oil pan.
- Remove the oil pan from the cylinder block.



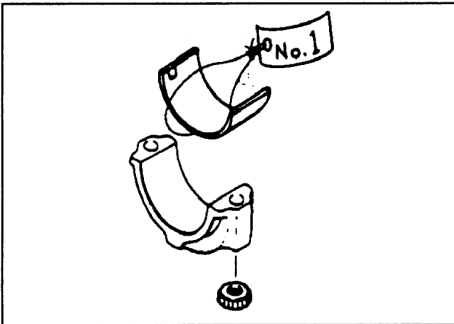
6. Oil pump

- Remove the oil pump from the cylinder block.



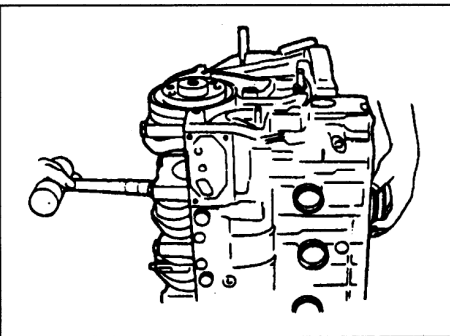
7. Piston cooling oil pipe (4DA1-1) / hexagonal head plug (4DA1)

- Remove the oil cooling pipe from the cylinder block.



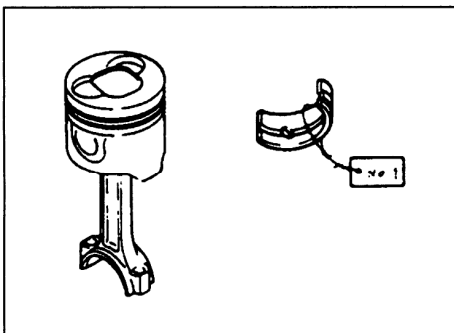
8. Piston and connecting rod assembly

- If it is intended to reassemble the lower bearing of connecting rod, please attach a label to each bearing, then mark the cylinder disassembling sequence and its installation position.

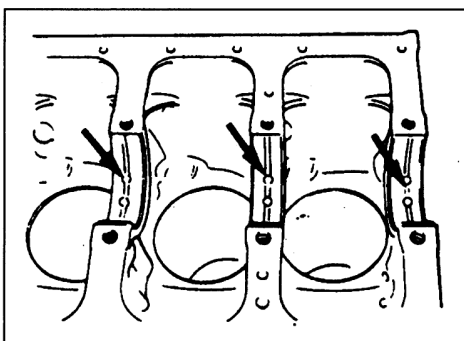
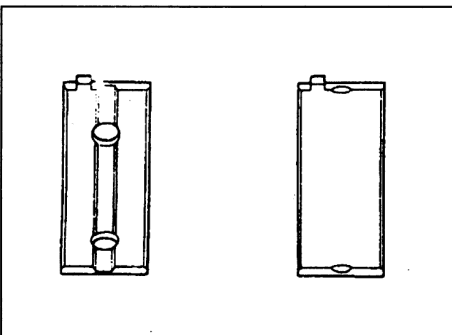
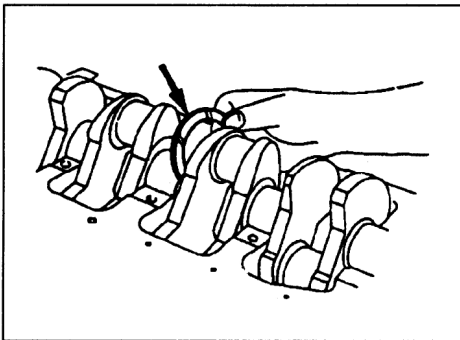
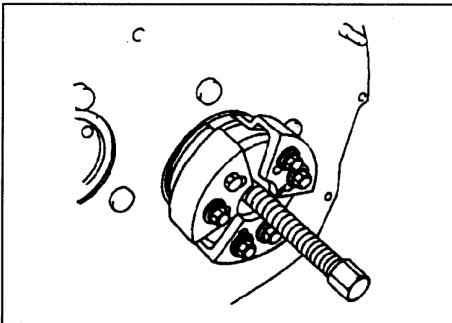
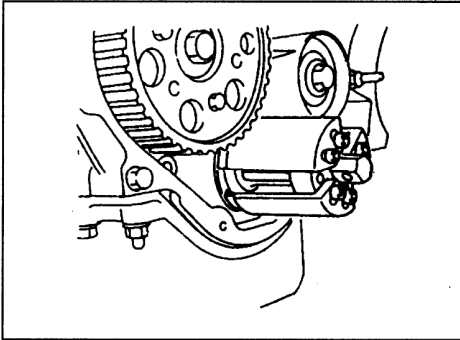


- Scrape carbon deposits on upper cylinder wall with a scraper before disassembling the piston and connecting rod.

Move the piston to cylinder head, push upwards connecting rod underpart with a hammer handle or equivalents, and then take out the piston and connecting rod.



- If it is intended to reassemble the upper bearing of connecting rod, please attach a label to each bearing, then mark the cylinder disassembling sequence and its installation position.



9. Timing pulley chamber
10. Water pump assembly
11. Flywheel and flywheel baffle
 - Install flywheel stopper.
 - Loosen flywheel fixing bolt(s) and remove the flywheel.
 - Disassemble the flywheel baffle from cylinder block.
12. Rear oil seal
 - Push in the oil seal and mount special tools according to the left diagram to dismantle the oil seal.

Rear oil seal detacher: 1002430FA-9101

Note:

While disassembling, take care to avoid damage the flywheel baffle and crankshaft sealing surface.
13. Crankshaft and main bearing
 - 1) Remove main bearing cap and thrust plate.
 - 2) Disassemble the crankshaft carefully.
 - 3) Disassemble the upper crankshaft bearing.



Assembly

13. Crankshaft and main bearing
 - The upper crankshaft bearing has an oil hole and oil groove while the lower bearing doesn't.
 - Apply fresh oil to the upper and lower main bearings.
 - Make sure the main bearings are in the correct positions.
 - Wipe off foreign bodies on the bearings.
 - Mount crankshaft main bearings to the cylinder block and main bearing cap.



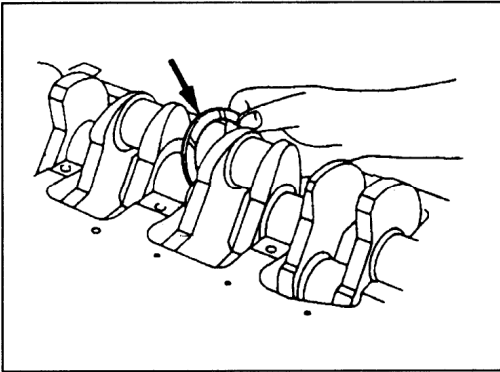
Note:



Do not apply oil to bearing backside and cylinder bearing mating surface.

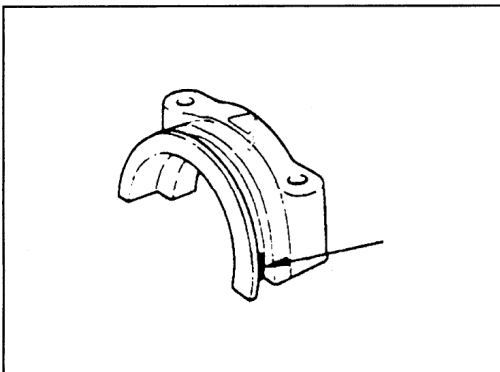


- Bearings should be installed in correct positions.
- Apply fresh oil to the upper and lower main bearings.

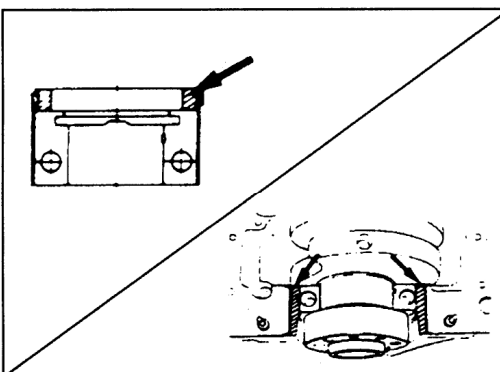


- Install the crankshaft carefully.
- Apply oil to the thrust plate.
- Mount the thrust plate to the third main journal.

The oil groove on thrust plate must be facing the crankshaft.



- Apply recommended liquid sealant or equivalents to the fifth crankshaft bearing cap as shown in the drawing.



- Apply recommended liquid sealant or equivalents to the fifth crankshaft bearing cap surface mating with cylinder block as shown in the drawing.

Notes:



Before applying liquid sealant, make sure there is no oil on the main bearing cap mating surface.

Make sure the liquid sealant will not block cylinder thread hole and bearings.

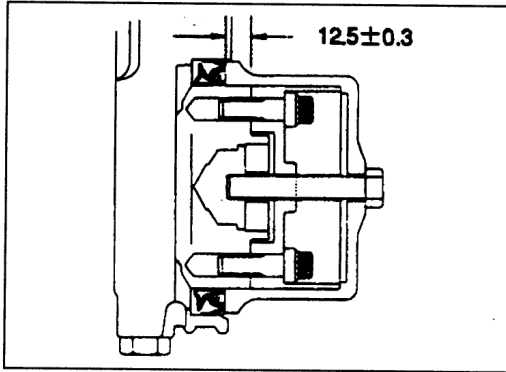
- While mounting bearing caps, arrow signs on each bearing cap must point to the engine forepart.
- Apply oil to crankshaft bearing cap bolts.
- Tighten the crankshaft bearing cap bolts to the specified torque bit by bit as shown in the drawing.

N·m

170

Note:

Manually rotate the crankshaft to check whether it is flexible.

**12. Crankshaft rear oil seal**

Mount the oil seal to the cylinder block with an oil seal erector.

Rear oil seal erector: 1002430FA-9102

Notes:

Clean the rust and chips off the press-in portion of the oil seal.

Pay attention to the press-in direction.

- 1) Use two bolts to connect the adaptor of special tools to the crankshaft rear end.
- 2) Install the oil seal to the periphery of the adaptor.



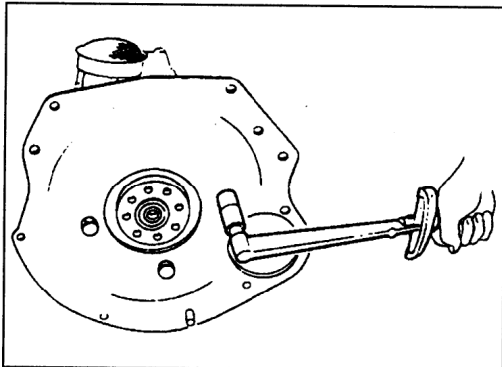
- 3) Insert the socket into the adaptor portion and screw down it with a bolt (M12×1.75L-70) until the adaptor tip is against the socket.

- 4) Remove the adaptor and socket.

- 5) Check the oil seal size after it is installed.

Standard value	mm
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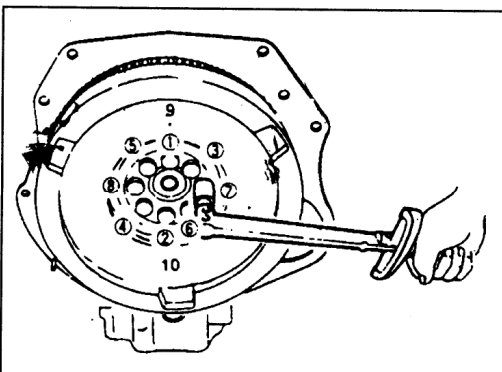
12.2—12.8

**11. Flywheel and cylinder block flywheel baffle**

- Align the flywheel baffle with cylinder block anchor pin(s).
- Tighten the flywheel baffle to the specified torque.

Flywheel baffle bolt torque	N·m
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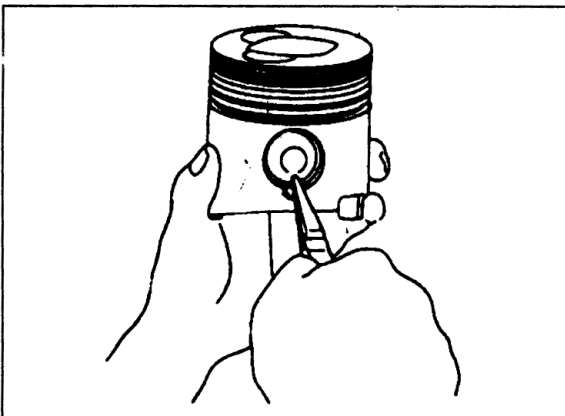
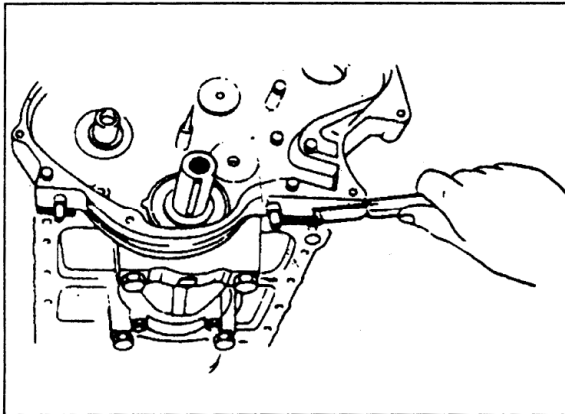
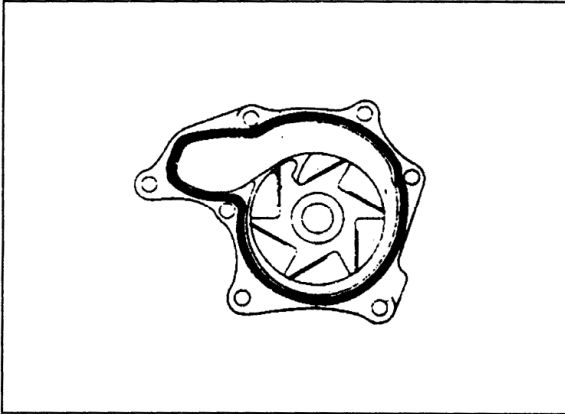
85



- Lock the crankshaft with hardwood so as to prevent the flywheel rotating.
- Apply oil to flywheel bolt thread.
- Align the flywheel with crankshaft anchor pin(s).
- By using of the torque tightening method, screw down the flywheel bolts to the specified torque in two steps according to the diagram.

Flywheel bolt torque	N·m		
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Step I	Step II	Step III
25	70	120



10. Water pump



- Install a O-ring to water pump body.
- Install water pump and tighten the bolt(s) to the specified torque.

Water pump bolt torque	N·m
25	

- Eliminate the gasket burrs.

9. Timing gear chamber

- Install the timing gear chamber to the cylinder block. Exercise care to avoid bending front oil seal.
- Tighten the timing gear chamber and its gasket to the specified torque.



Timing gear chamber Bolt torque	N·m
25	

8. Piston and connecting rod assembly

- 1) Try to manually push the piston pin into piston pin hole.

Weigh each piston and connecting rod assembly.

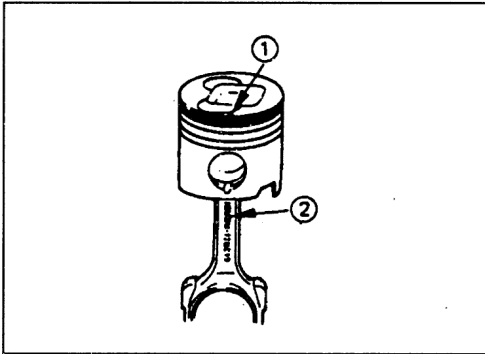
Select the piston and connecting rod set in a way that different assembly weight differences are in the specified limits.

	Weight differences while assembled
4DA1	10
4DA1-1	8

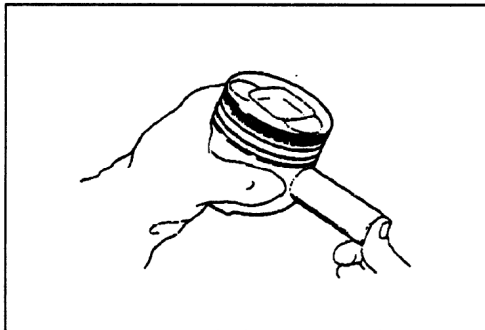
- 2) Clamp the connecting rod by a vice
Take care not to damage the connecting rod.
- 3) Mount piston pin retainer to the piston with pliers.

Note:

When replacing the piston / connecting rod assembly, do not change the piston / piston pin assembly.

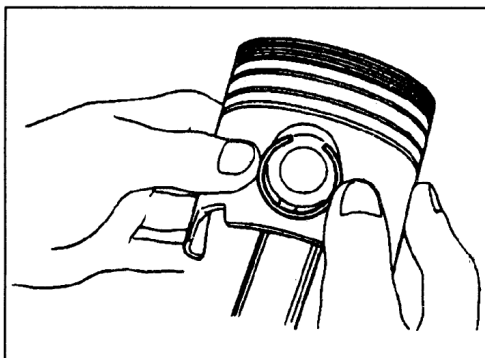


4) Install the piston onto the connecting rod.
Mark ① on the piston head and connecting rod “F908” casting symbol ② should point to the same direction.



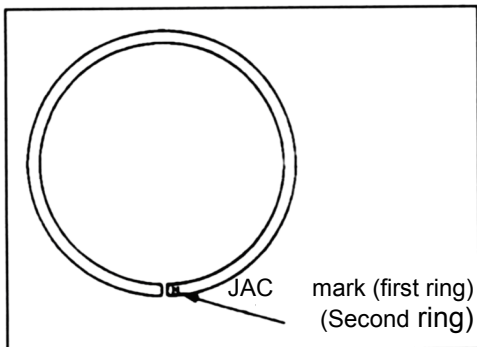
5) Add oil to the piston pin and piston pin hole.

Manually push piston pin into the piston until it is against the piston pin retainer.

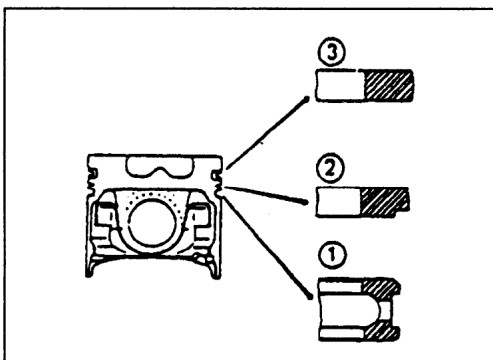


6) Manually mount the piston pin retainer into piston retainer groove.

Check whether the connecting rod can freely swing on the piston pin.



7) Install piston ring and piston packing ring.
The gas ring mark JAC should face upwards.
Identification sign is shown in the drawing.



8) Mount three piston rings with a piston ring erector.

The piston ring mounting sequence is shown in the drawing.

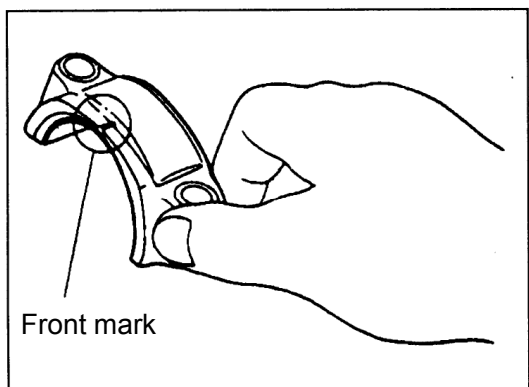
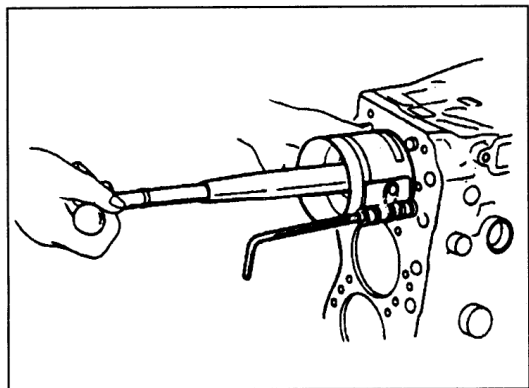
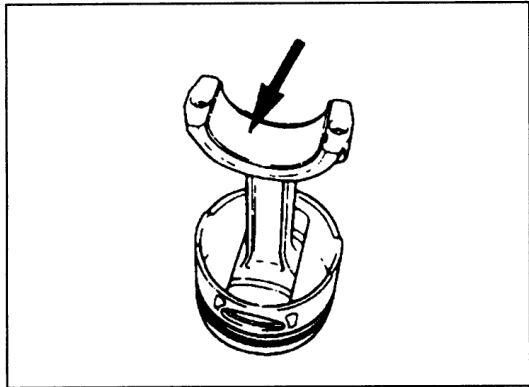
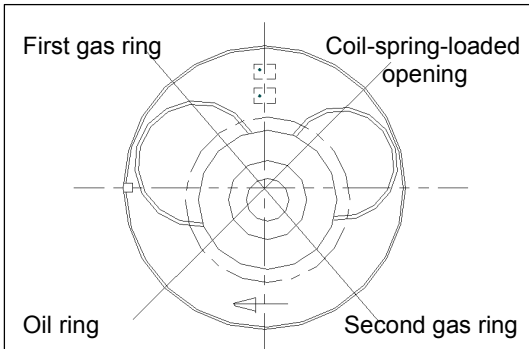
① Oil ring

② Second gas ring

③ First gas ring

Note: When mounting gas rings the chamfer is facing upwards.

Install the helical piston packing ring into oil ring groove and make sure that the packing ring and the oil ring are closely meshed.



9) Apply some oil to the piston ring surface.

10) Check whether the piston ring can turn freely in piston ring groove.

11) The cutout position for placing piston ring is shown in the drawing.



12) Carefully wipe off the foreign bodies on connecting rod bearing backside and bearing seat joint faces.



13) Apply some oil to the upper bearing surface.

Apply some oil to the cylinder wall.



14) While installing, the piston head mark must be towards the engine forepart.

Compress the piston ring with a piston ring compressor.

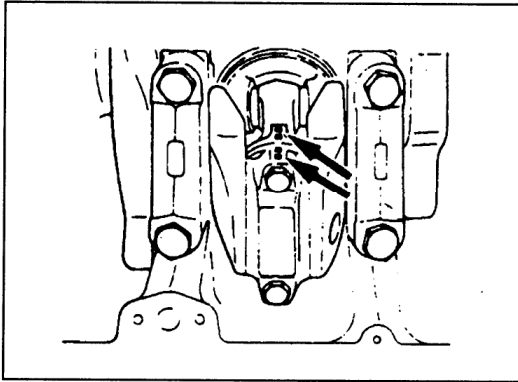
Piston ring compressor: 1004022FA-9101

15) Push in the piston with a hammer handle until the connecting rod touches the crankpin. In the meanwhile rotate the crankshaft until the crankpin reaches its bottom dead center.

16) While installing, the bearing cap upper front mark must be towards the engine forepart.

17) Install connecting rod bearing cap.

Align the cylinder sequence mark on connecting rod bearing cap with the one on connecting rod.



18) Apply oil to each connecting rod bearing cap bolt thread and bearing seat joint faces.

19) Screw down connecting rod bearing cap bolt to the specified torque in two steps by utilizing the torque tightening method.



Connecting rod bearing cap bolt torque N·m

First step (sealing torque)	Second step (final torque)
20	85



Note:

Manually rotate the crankshaft to check whether it is flexible.

7. Piston cooling oil pipe (4DA1-1) / hexagonal head plug (4DA1)



- Mount the piston cooling oil pipe to the cylinder block.

Screw down oil pipe bolt and check valve to the specified torque.



4AD1-1 oil pipe bolt torque N·m

①M8X1. 25	20
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②M6X1. 00	7.5
-----------	-----



Oil pressure regulating valve torque

③M16X1. 5	30
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4DA1 hexagonal head plug moment

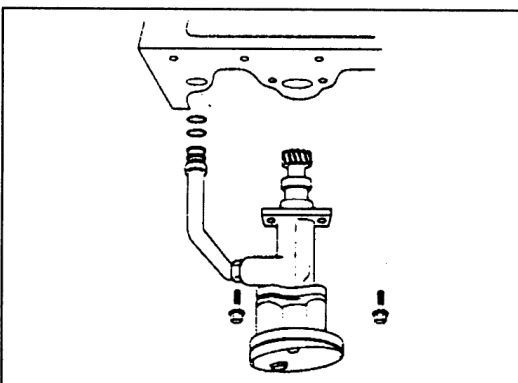
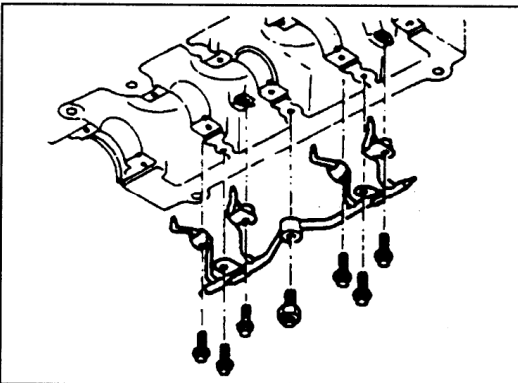
45

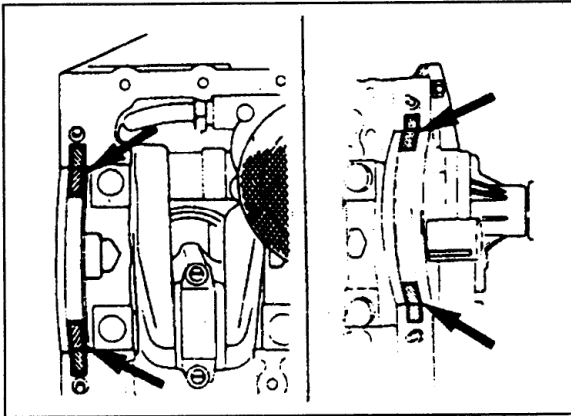
Note:

Turn the crankshaft slowly; make sure the piston and the oil injection pipe don't interfere with each other.

6. Oil pump assembly

- Prepare some solution containing 80% oil and 20% supramoly.
- Apply enough solution to the oil pump pinion teeth.
- Apply some oil to oil pipe O-ring and put it into the cylinder block O-ring groove.
- Install the oil pump assembly with oil pipe to the cylinder block, and tighten fixing bolts to the specified torque.





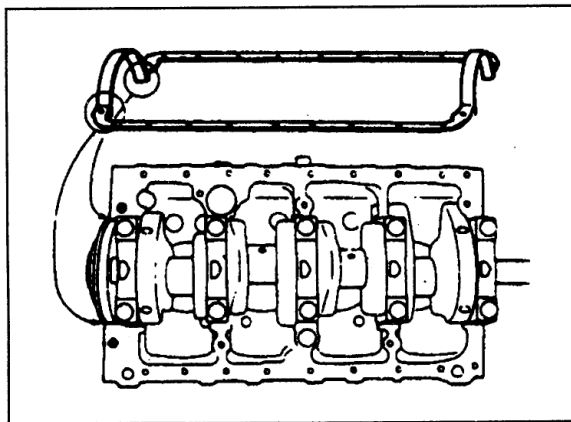
Oil pump bolt torque	N·m
25	

- Tighten sleeve nut(s) to the specified torque.

Sleeve nut torque	N·m
30	

Note:

Be careful not to destroy the O-ring when tightening the oil pipe bolt(s).

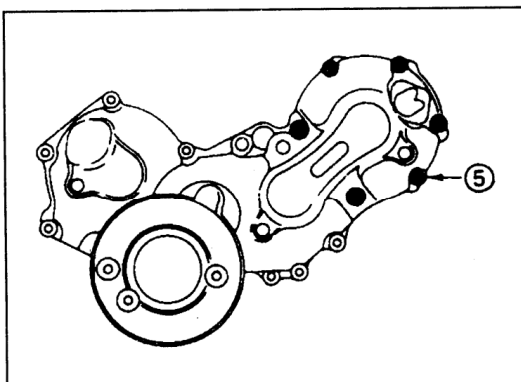
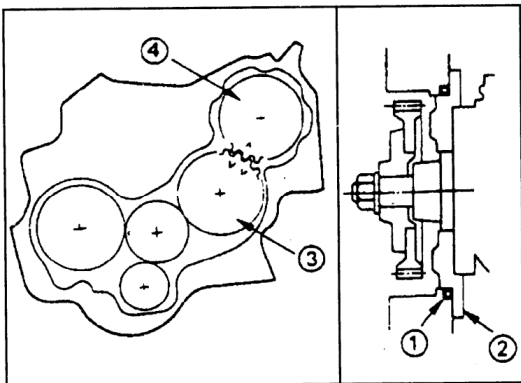
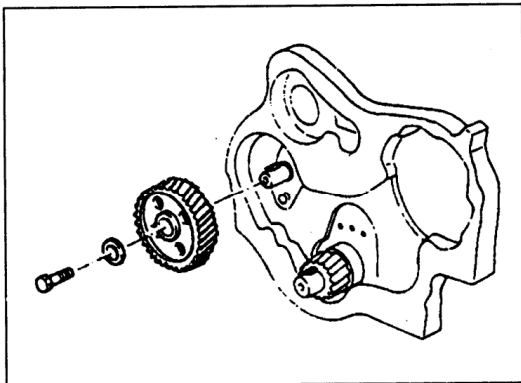
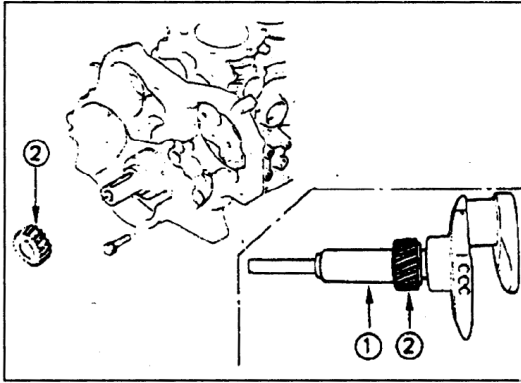


5. Oil pan assembly

- Apply recommended liquid sealant or equivalents to the fifth bearing cap arch section, groove and timing gear chamber arch section.

- Install back lip portion of the gasket into the fifth groove.
- Make sure the lip portion is compact with the groove.
- Install the oil pan to the cylinder block.
- Tighten oil pan bolt(s) to the specified torque.

Oil pan bolt torque	N·m
23.5	



4. Timing gear

12) Crankshaft gear



- Install crankshaft gear
- Install crankshaft gear ② with crankshaft gear erector ①.
- Crankshaft timing gear mark ("X-X") should face outwards.

Crankshaft gear erector: 1007011FA-9102

11) Camshaft timing gear

- Install the thrust washer onto the cylinder block.
- Tighten thrust washer bolt(s) to the specified torque.



N·m

25

- Install camshaft timing gear to the camshaft.

The timing gear mark ("Y—Y") has to face outwards.

- Tighten the timing gear to the specified torque.

Timing gear bolt torque

N·m

110

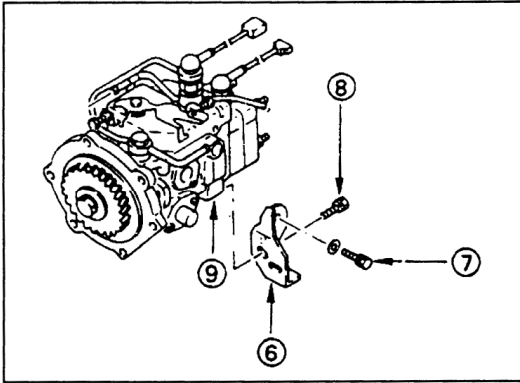
10) Injection pump

- ① Install O-ring ① to the injection pump flange ②.
- ② Install the injection pump to the timing gear chamber.

Align the mark "V-V" of idler gear "B" ③ with the mark "V" of injection pump timing gear ④.

- ③ Temporarily tighten Six injection pump nuts ⑤.

The final screwing down of injection pump nuts is conducted after tightening the injection pump rear bracket bolt(s).



④ Install injection pump rear bracket⑥ and rear bracket bolt⑦ to the cylinder block.

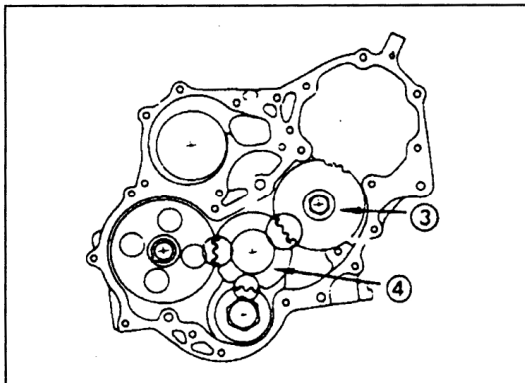
⑤ Mount rear bracket bolt⑧ to the injection pump bracket⑨.

Do not screw down those bolts.

Rear bracket bolt⑦ and ⑧ will be tightened to the specified torque after tightening the injection pump nuts.

⑥ Tighten the injection pump nuts to the specified torque.

Injection pump nut torque	N·m
30	



⑦ Screw down injection pump bracket bolts to the specified torque.

Pump bracket bolt torque	N·m
25	

9) Idler gear "B" and its shaft

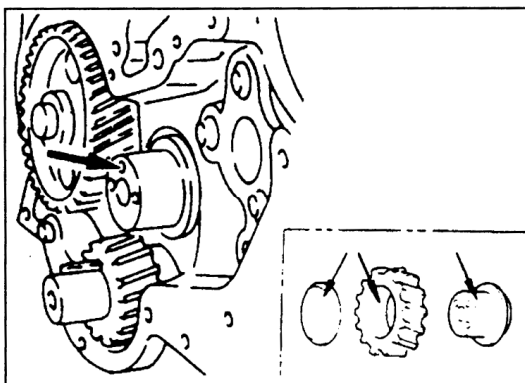
① Apply some oil to the idler gear and its shaft.

② Align mark "Z" of gear "B" ③ with mark "Z—Z" of idler gear "A" ④.

• Tighten idler gear bolt(s) to the specified torque.



Idler gear bolt torque	N·m
110	



8) Idler gear

① Apply some oil to the idler gear and its shaft.

The oil hole in idler gear shaft must be facing upwards.

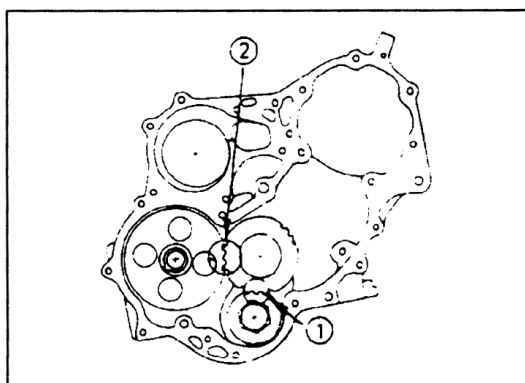
② Arrange idler gear marks "X" and "Y" so that they both face the engine forepart.

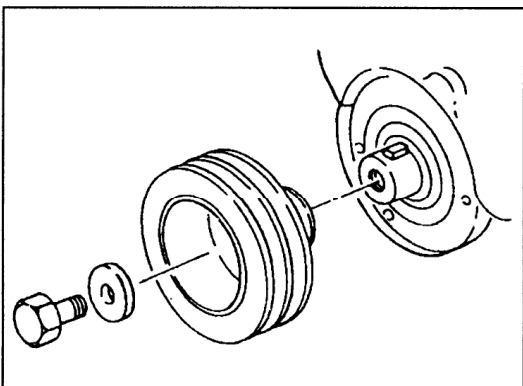
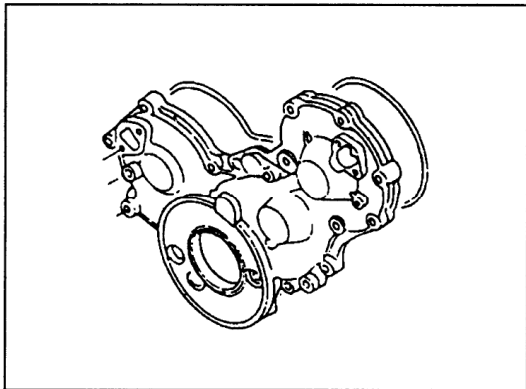
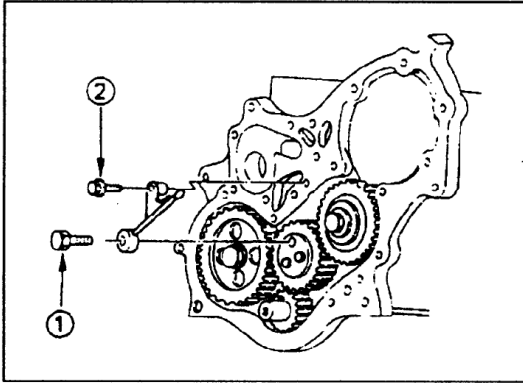
③ Align idler gear mark "X" with the mark "X—X" of crankshaft timing gear①.

③ Align idler gear mark "Y" with the mark "Y—Y" of crankshaft timing gear②.

⑤ Install the thrust ring and bolt to the cylinder body passing through the idler gear.

Thrust ring oil hole must be facing upwards while its chamfer facing outwards.





- ⑥ Tighten idler gear bolt to the specified torque.

Idler gear bolt torque	N·m
25	



- 7) Timing gear oil pipe

Install the oil pipe to timing gear chamber and idler gear "A".

Tighten oil pipe eyebolt① and bolt② to the specified torque.

Oil pipe punching bolt torque	N·m
20	

- 6) Timing gear chamber cover

Align timing gear chamber anchor pin with the timing gear chamber, then install timing gear chamber cover.

Tighten gear chamber cover bolt to the specified torque.

- 5) Acoustic hood liner

- 4) Acoustic hood

- 3) Upper acoustic hood

- 2) Crankshaft damper pulley



Screw down the crankshaft damper pulley bolt(s) to the specified torque.

Note:

While screwing down the damper pulley, hold the flywheel ring gear to prevent crankshaft rotating.



Pulley bolt torque	N·m
210	

- 1) Cooling fan assembly

- Install the fan pulley, spacer block and cooling fan assembly (in this installing order) to a water pump, and tighten those parts to the specified Tightening torque.

N·m

12.5

3. Cylinder head assembly

2. Engine assembly

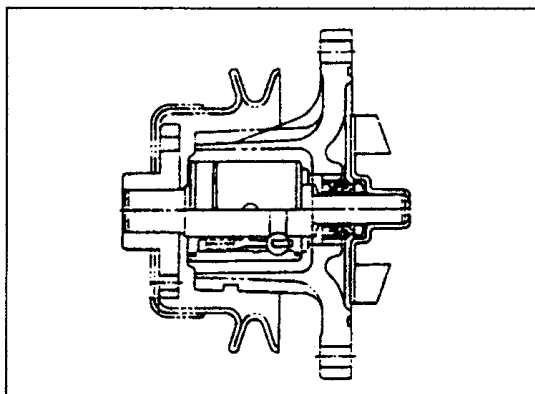
1. Transmission and clutch assemblies

"3-1" is referred to the "3.16 shaft and tappet" section.

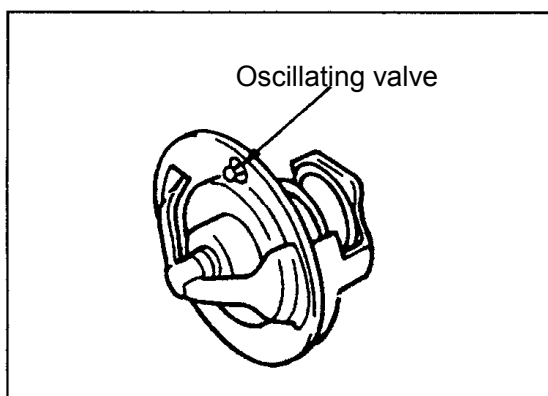


4 Engine cooling system

4.1 General



The engine cooling system is a pressure type coolant forced circulation version. It has a radiator cover and its differential pressure and boiling point are 98 ~ 196kpa and 120°C respectively. The system consists of a water pump, thermostat, fan, radiator and other components. Circulating coolant is used to cool down the oil in oil filter and turbocharger.

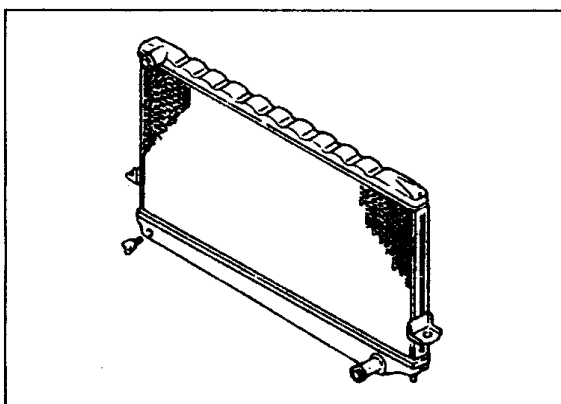


Water pump

It is a vane centrifugal pump driven by V drive belt.

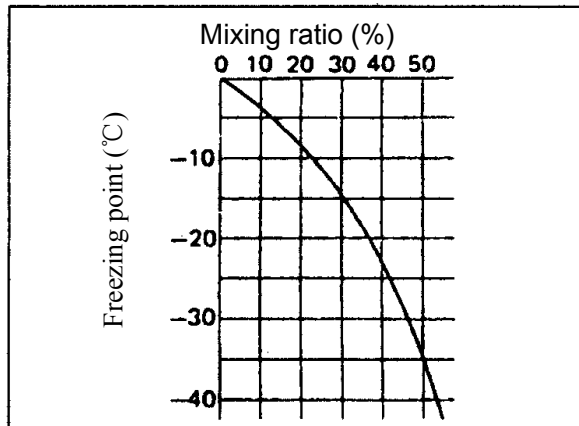
Thermostat

The thermostat belongs to wax type with an oscillating valve installed on the original valve. It is installed on the thermostat body.



Radiator

It is a tube type radiator with corrugated fins. In order to increase the boiling point, a cap with a valve is installed on the cylinder head thermostat body. This valve opens at the pressure 0.90—1.20kg/cm².



Anti-freezer

- The relationship between mixing ratio and freezing point

The freezing point temperature of engine coolant changes with the ratio of anti-freezer in water.

Correct mixing ratio can be determined according to the graph. Do not add the attached anti-rust agent or additive with enhancing cooling ability to the cooling system without approval of JAC Automotive Co., Ltd.

- Mixing ratio calculation

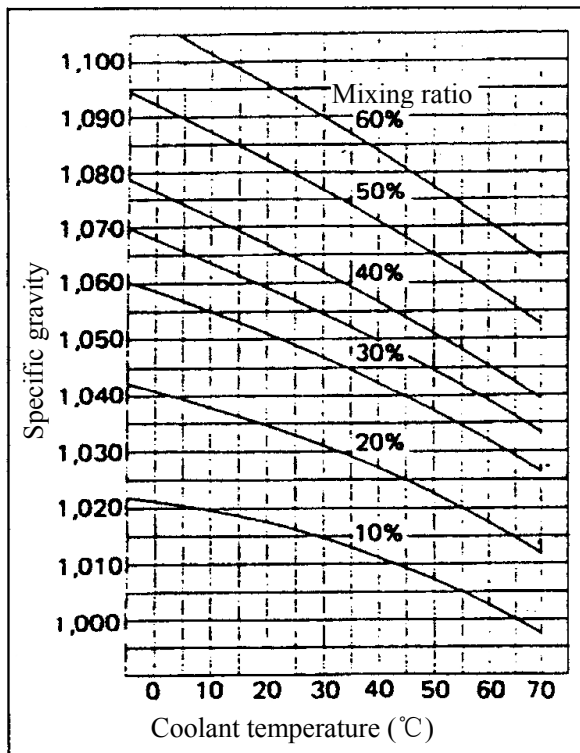
$$\text{Maxing ratio} = \frac{\text{Anti-freezer (L/qt)}}{\text{Anti-freezer (L/qt)} + \text{water (L/qt)}}$$

Note: Anti-freezer + water = 10L

Total volume of the cooling system

E.g., total volume of the cooling system is 10L

Mixing ratio%	Anti-freezer L/qt (En) / qt (Ame))	Water L/qt (En) / qt(Ame))
0	0 (0)	10(8.80 / 10.57)
5	0.5(0.44 / 0.53)	9.5(8.36 / 10.04)
10	1.0(0.88 / 1.06)	9.0(7.92 / 9.51)
15	1.5(1.32 / 1.59)	8.5(7.48 / 8.98)
20	2.0(1.76 / 2.11)	8.0(7.04 / 8.45)
25	2.5(2.20 / 2.64)	7.5(6.60 / 7.93)
30	3.0(2.64 / 3.17)	7.0(6.16 / 7.40)
35	3.5(3.08 / 3.70)	6.5(5.72 / 6.87)
40	4.0(3.52 / 4.23)	6.0(5.28 / 6.34)
45	4.5(3.96 / 4.76)	5.5(4.84 / 5.81)
50	5.0(4.40 / 5.28)	5.0(4.40 / 5.28)

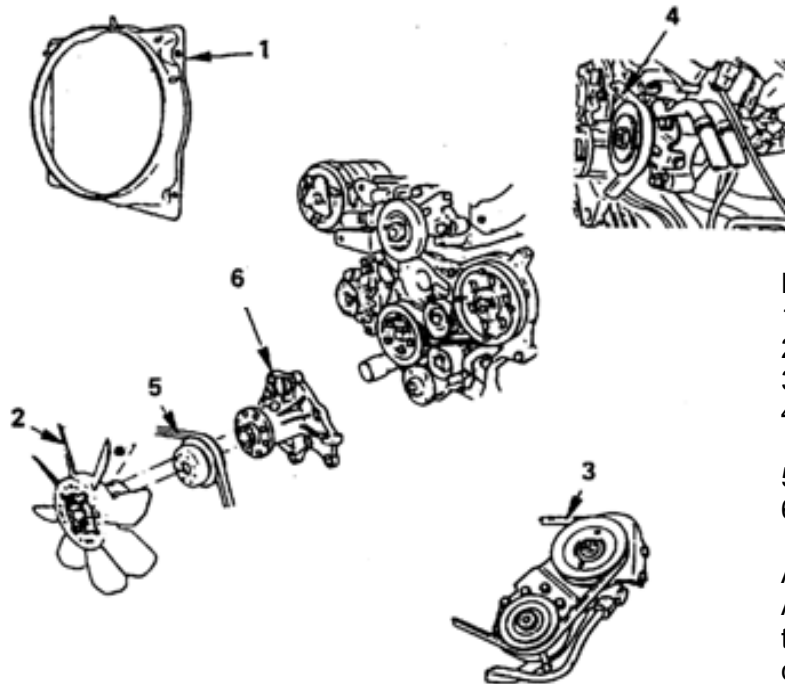


- Mixing ratio

Measure the specific gravity of engine cooling system coolant in 0°C to 50°C temperatures with a draft hydrometer, and then determine the coolant mixing ration according to the graph.



4.2 Water pump



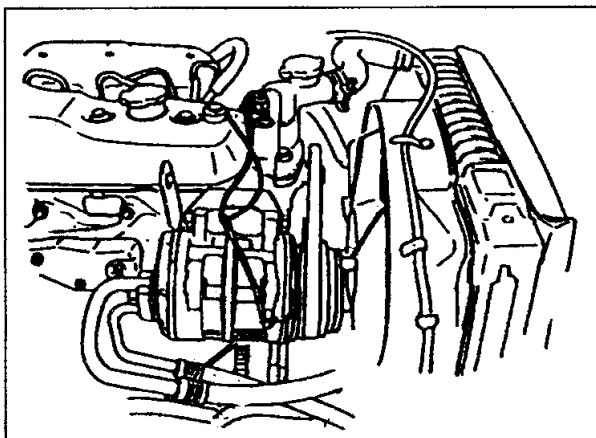
Disassembly sequence

1. Fan cowl
2. Fan assembly
3. Power steering pump drive belt
4. Air conditioning compressor drive belt
5. Alternator drive belt
6. Water pump assembly

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

4.2.1 On-vehicle repair

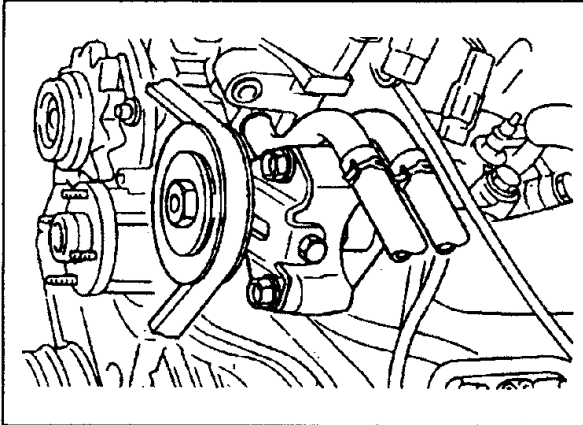


Disassembly

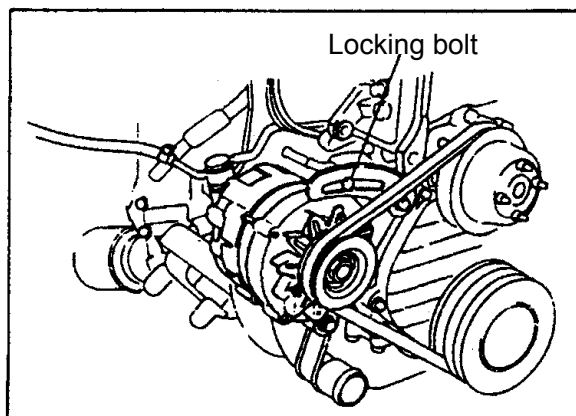
Preparation:

- Remove battery ground cables.
- Discharge the coolant.

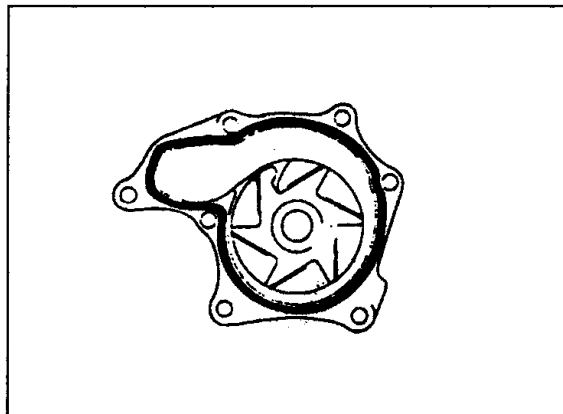
1. Fan cowl
 - Remove storage tank hose and fan cowl.
2. Fan assembly
 - Unscrew the locking nut(s) and take out the fan assembly.
3. Power steering pump drive belt
 - Loosen idler locking nut(s) and adjusting bolt(s), and then remove the drive belt.



4. Air conditioning compressor
 - Loosen ac compressor idler locking nut(s) and adjusting bolt(s).
Dismount the drive belt.



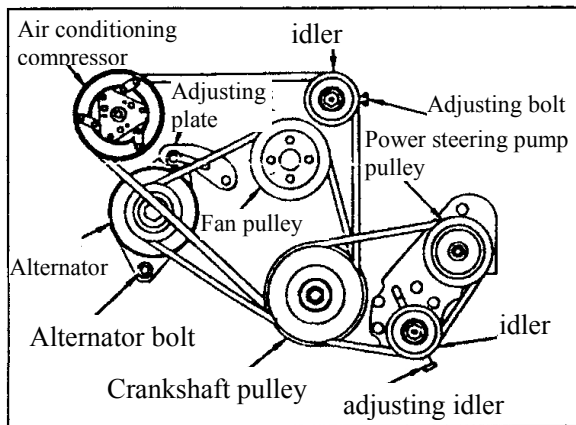
5. Alternator drive belt
 - Unscrew alternator fixing bolt(s) and adjusting plate locking bolt(s), then remove the drive belt.



Assembly

6. Water pump assembly
 - Detach the O-ring.
 - Put the O-ring into the water pump groove.
 - Install water pump assembly and tighten the bolt(s) to the specified torque.

Water pump fixing bolt torque	N·m
25	



Inspection

If during inspection it is found that the water pump is severely worn or damaged, repair the water pump and replace the worn-out parts. The whole water pump assembly has to be replaced in case of one of the following problems.

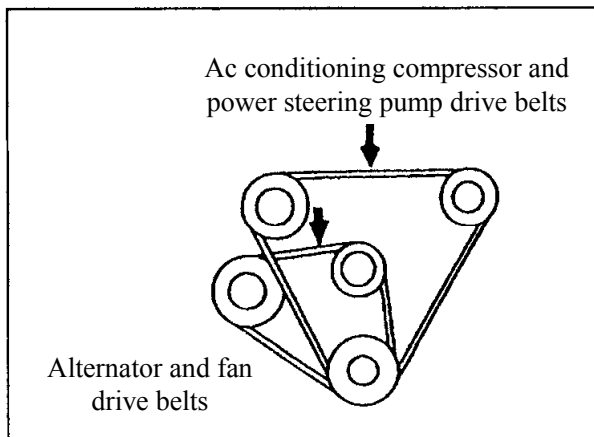
- There is a crack on the water pump body.
- The coolant leaks from the water seal.
- The ball bearing is loose or produces unusual noise.
- Water pump impeller cracked or experienced corrosion.

5. Alternator drive belt

4. Air conditioning compressor drive belt

3. Power steering pump drive belt

- Install and adjust those drive belts. Inspect whether the drive belts are intact. Replace them if necessary. Check the belt tension, if necessary adjust the tension.
- Apply a force of 100N to those belts and check the deflection of each belt.



• Standard deflection

mm

	Initial tension
Alternator drive belt	8—10
Air conditioning compressor drive belt	
Power steering pump drive belt	

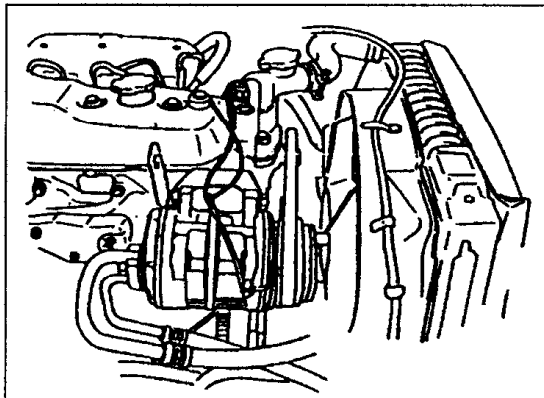


	Generator fixing bolt torque	N·m
	40	
	Adjusting plate fixing bolt torque	N·m
	25	
	Ac compressor idler locking nut torque	N·m
	27	
	Power steering pump idler locking nut torque	N·m
	27	

2. Fan assembly

- Fix the fan pulley and fan assembly onto the water pump, and tighten them to the specified torque.

Fan pulley nut torque	N·m
12.5	

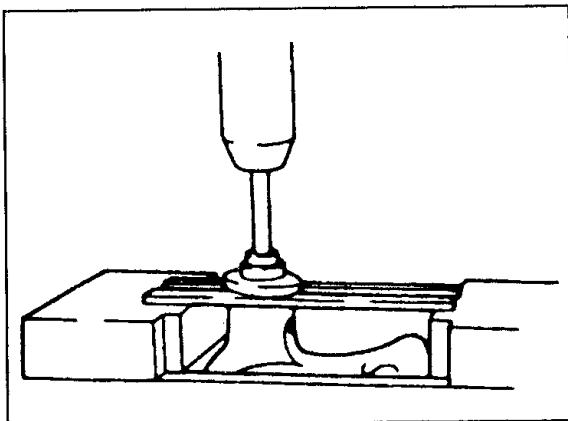
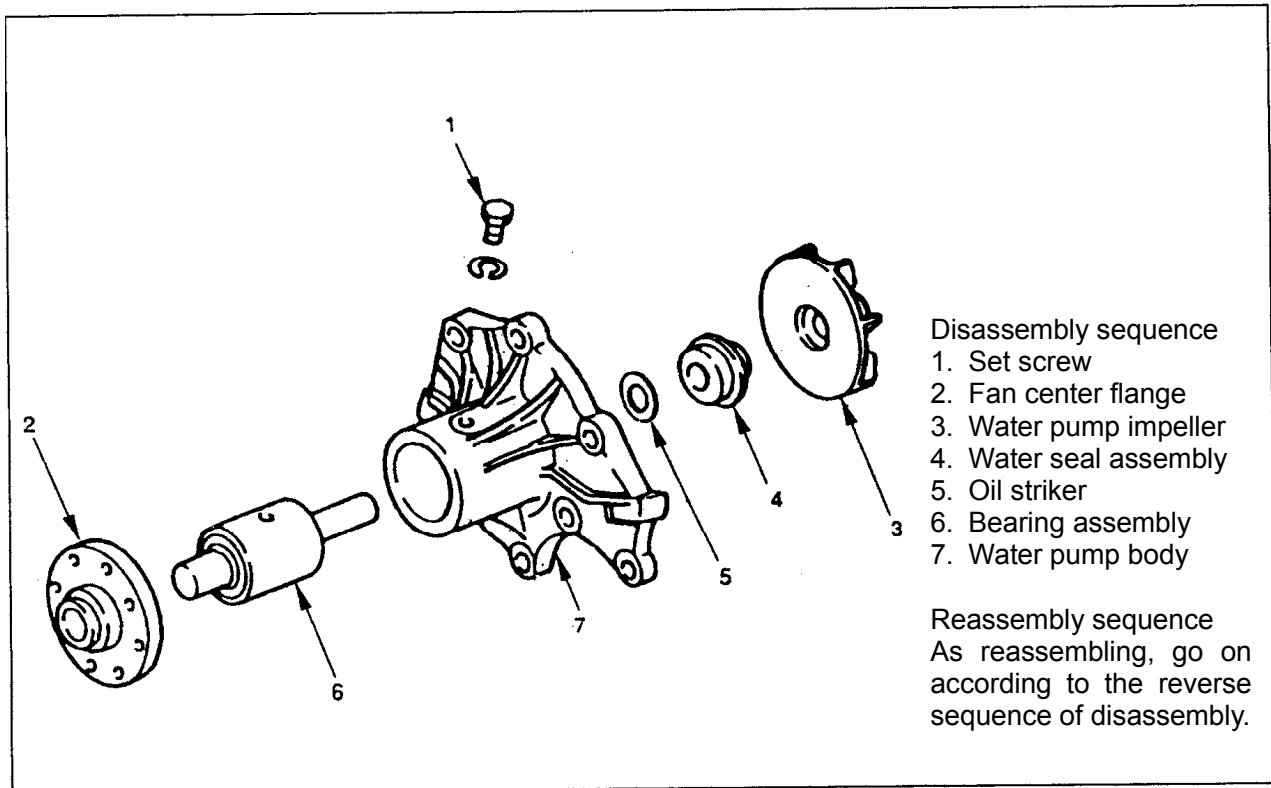


1. Fan cowl

- Install the fan cowl and storage tank hose.
- Connect battery ground cables.
- Fill in coolant.
- Start the engine and check whether there is any leakage of the coolant.

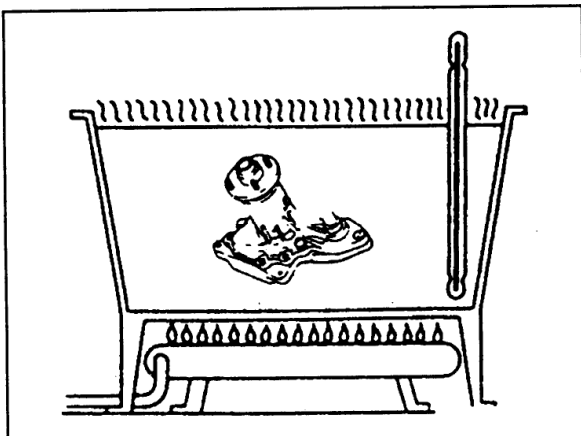


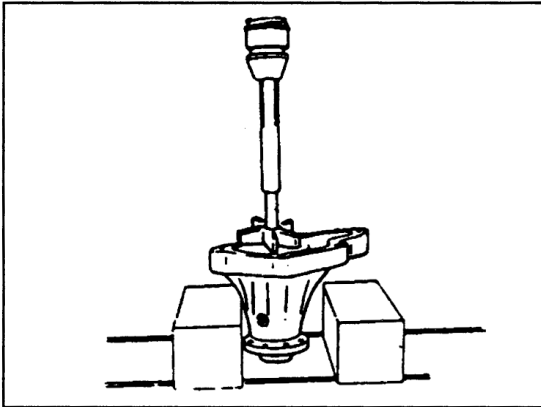
4.2.2 Single-piece repair



Disassembly

1. Set screw
2. Fan center flange
 - Push down the fan center flange with a bench press and compression bar.
3. Water pump impeller
4. Water seal assembly
5. Oil striker
6. Bearing assembly
 - 1) Heat up water pump body in hot water (80-90°C / 176-194°F).



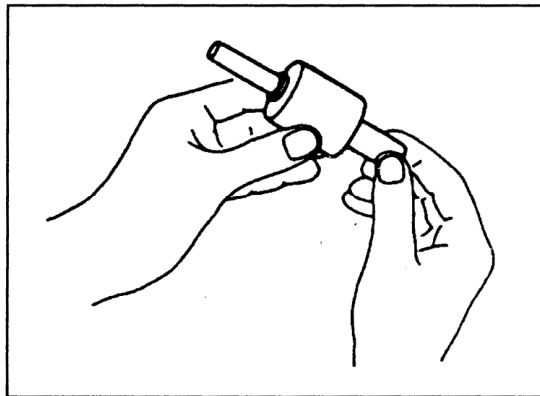


- 2) Push down the water pump impeller, water seal assembly and bearing assembly with a bench press and compression bar.

Note:

Do not attempt to disassemble the water pump impeller with a hammer, or it will destroy the impeller.

7. Water pump body

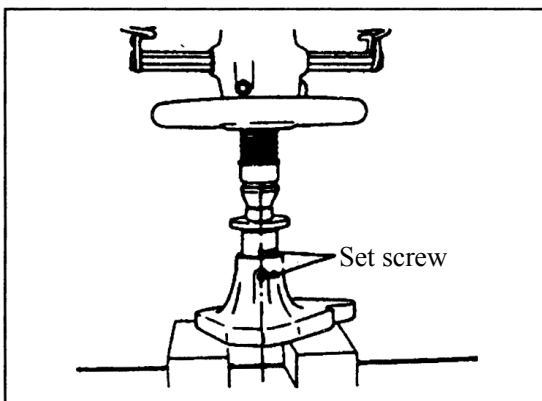


Inspection and repair

- If during inspection it is found that the water pump is severely worn or damaged, adjust and repair it and replace the worn-out parts.

Bearing assembly

- Check if there is any noise, stuck and other unusual phenomena in the bearing assembly.



Reassembly

7. Water pump body



6. Bearing assembly

1. Set screw

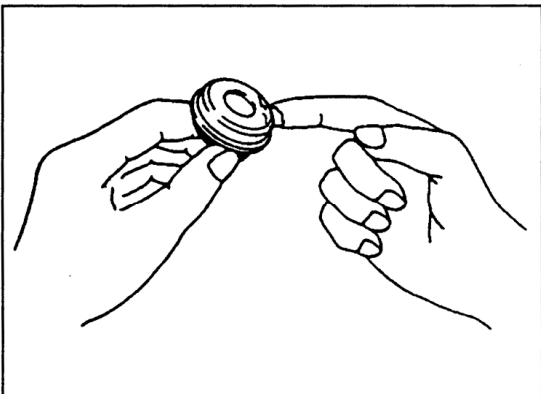
- 1) Align bearing set screw(s) with water pump body set screw(s).
- 2) Press the bearing assembly into the water pump body.
- 3) Fix the bearing with set screw(s).

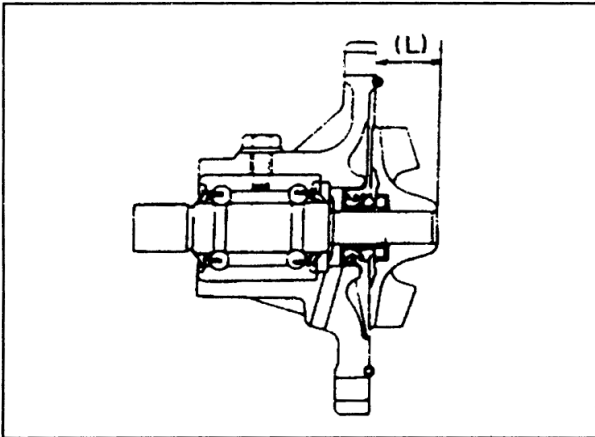
5. Oil striker



4. Water seal assembly

- 1) Coating a thin layer of liquid sealant on the water seal assembly outer edge.
- 2) Install the water seal assembly.

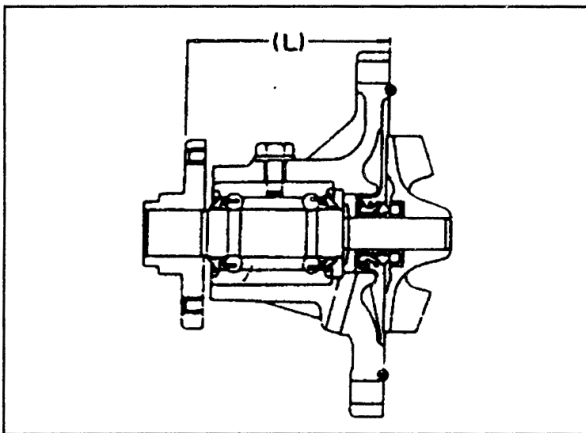




3. Water pump impeller

- 1) Install the water pump impeller with a bench press.
- 2) Measure the distance between water pump impeller protrusion and water pump body end face. The water pump impeller protrusion size has to be ensured.

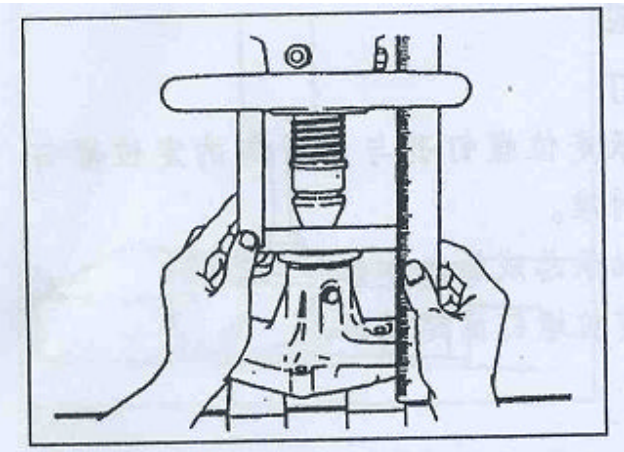
Impeller protrusion size (L)	mm
24.6	



2. Fan center flange

Measure the distance between fan fitting surface and rear fan cover.

Fan center distance	mm
Standard value	
79.2—79.8	

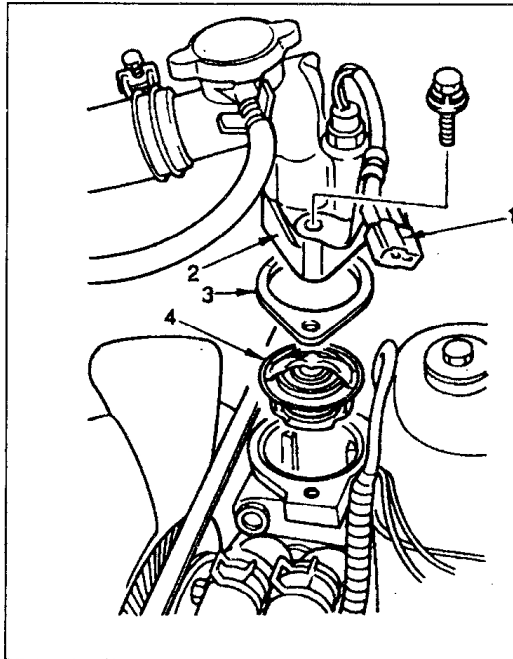


Notes:

1. Never disassemble and install the fan center flange and water pump impeller for the second time while mounting those units onto the water pump shaft with a bench press. Otherwise replace the whole water pump assembly. Disassembling and installing those units for the second time will lead to the water pump broken during engine operation with serious overheating.
2. If the force applied to fan center flange and water pump impeller is less than 1960N (200kg / 44lb), replace the water pump assembly.
3. Do not use hammers or similar tools to knock the bearing into water pump body, or it will destroy the bearing.



4.3 Thermostat



Disassembly sequence

1. Switch wire bundle
2. Water outlet pipe
3. Gasket
4. Thermostat

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

Disassembly



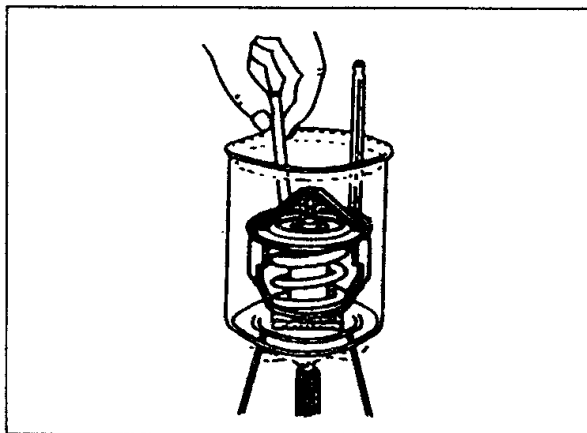
Preparation:

- Remove battery ground cables.
- Drain off the coolant in the radiator and generator .

1. Switch wire bundle
2. Water outlet pipe

Unscrew the fixing bolt(s). Remove both the water outlet pipe and radiator hose.

3. Gasket
4. Thermostat



Inspection

Put the thermostat assembly into water.

Place a wooden block under the water container.

Do not heat up the thermostat directly.

Increase water temperature gradually with continuous stirring so as to keep the water temperature in the container be equalized.

Confirm the main valve opens at the specified temperature.

Valve opening temperature °C

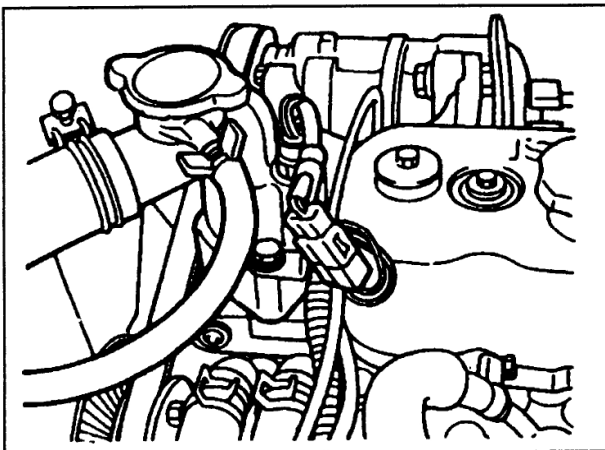
82

Confirm the secondary valve fully opens at the specified temperature.

Valve fully opening temperature °C

95

If during inspection it is found that the thermostat is severely worn or damaged, repair it and replace the worn parts.



Assembly

4. Thermostat
3. Gasket
2. Water outlet pipe
 - Connect water outlet pipe and tighten the bolt(s) to the specified torque.



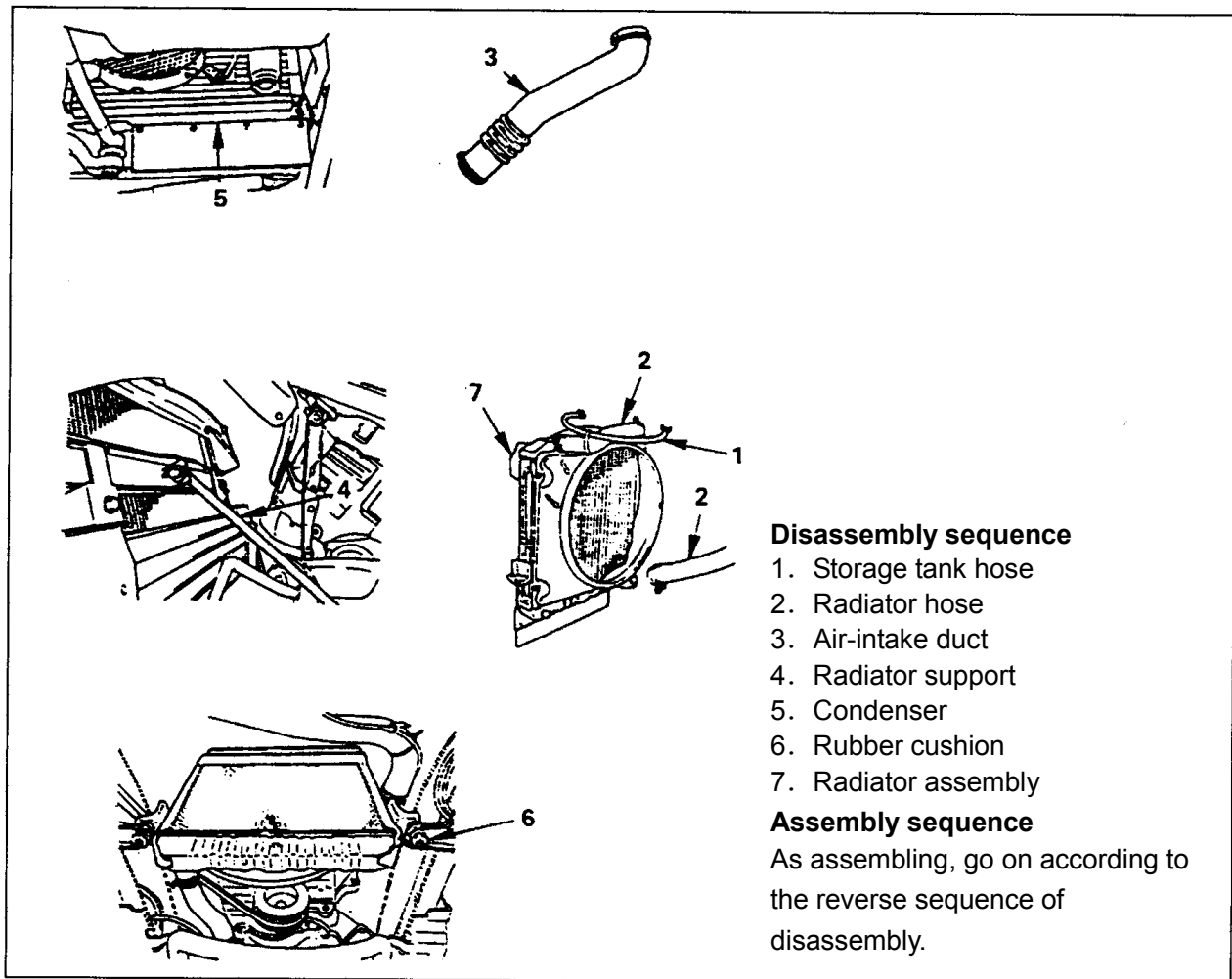
N·m

19

1. Switch wire bundle
 - Install the switch wire bundle.
 - Connect battery ground cables.
 - Fill in coolant.
 - Start the engine and check whether there is any leakage of the coolant.



4.4. Radiator



Disassembly

Preparation:

- Remove battery ground cables.
- Loosen drain plug and discharge the coolant.

1. Storage tank hose
 - Remove the lower hose from the radiator.
2. Radiator hose
 - Remove the upper and lower hoses from the engine.
3. Air-intake duct
4. Radiator support

5. Condenser

- Remove the condenser from the radiator and bind it to the vehicle front with wires temporarily.

6. Rubber cushion

- Remove the rubber cushions on both bottom sides.

7. Radiator assembly

- Remove upwards the radiator assembly with hose(s). Notes
Take care to avoid the fan blades scratching the radiator core.



Inspection

Radiator cap

- Measure the pressure valve opening pressure with a radiator cap tester.

If the opening pressure exceeds standard values, replace the radiator cap.

Check opening pressure of the vacuum valve installed in the radiator cap valve seat center.

Valve opening pressure	N·m
88. 2—117. 6	

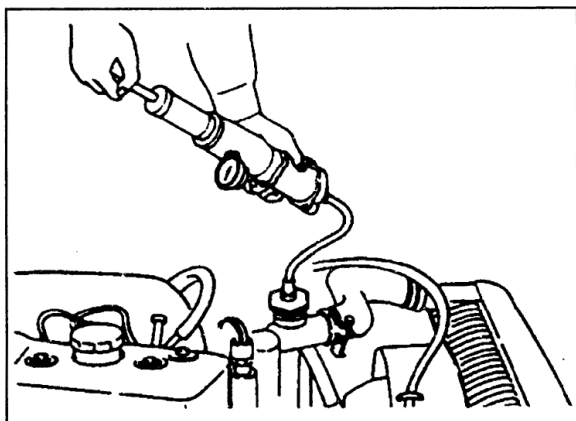
If the vacuum valve can't move smoothly due to rust or dust, clean or replace the radiator cap.

Radiator core

- Fin distortion will deteriorate the thermolysis effect and cause the cooling system to be overheated. Flatten the fin and take care to avoid damaging the fin bottom part.
- Clean off the dust and other foreign bodies.

Wash the radiator

- Wash radiator inside and coolant passage with water and neutral detergent. Clean the scale and incrustant completely.



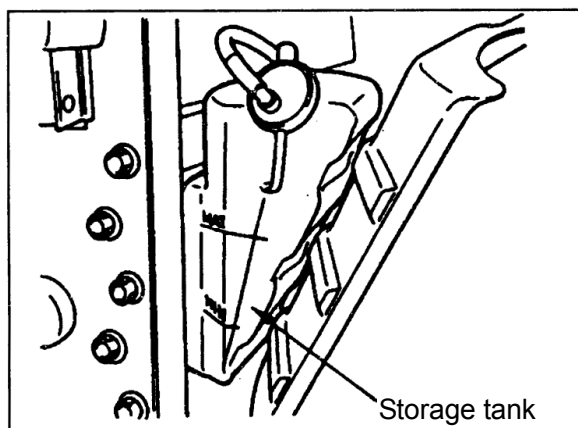
Check whether there is any coolant leakage.

- Feed the compressed air with pressure of 196.9kPa (28.4psi) through the filler neck into the radiator by a radiator cap tester, then check if there is any leakage in the cooling system.



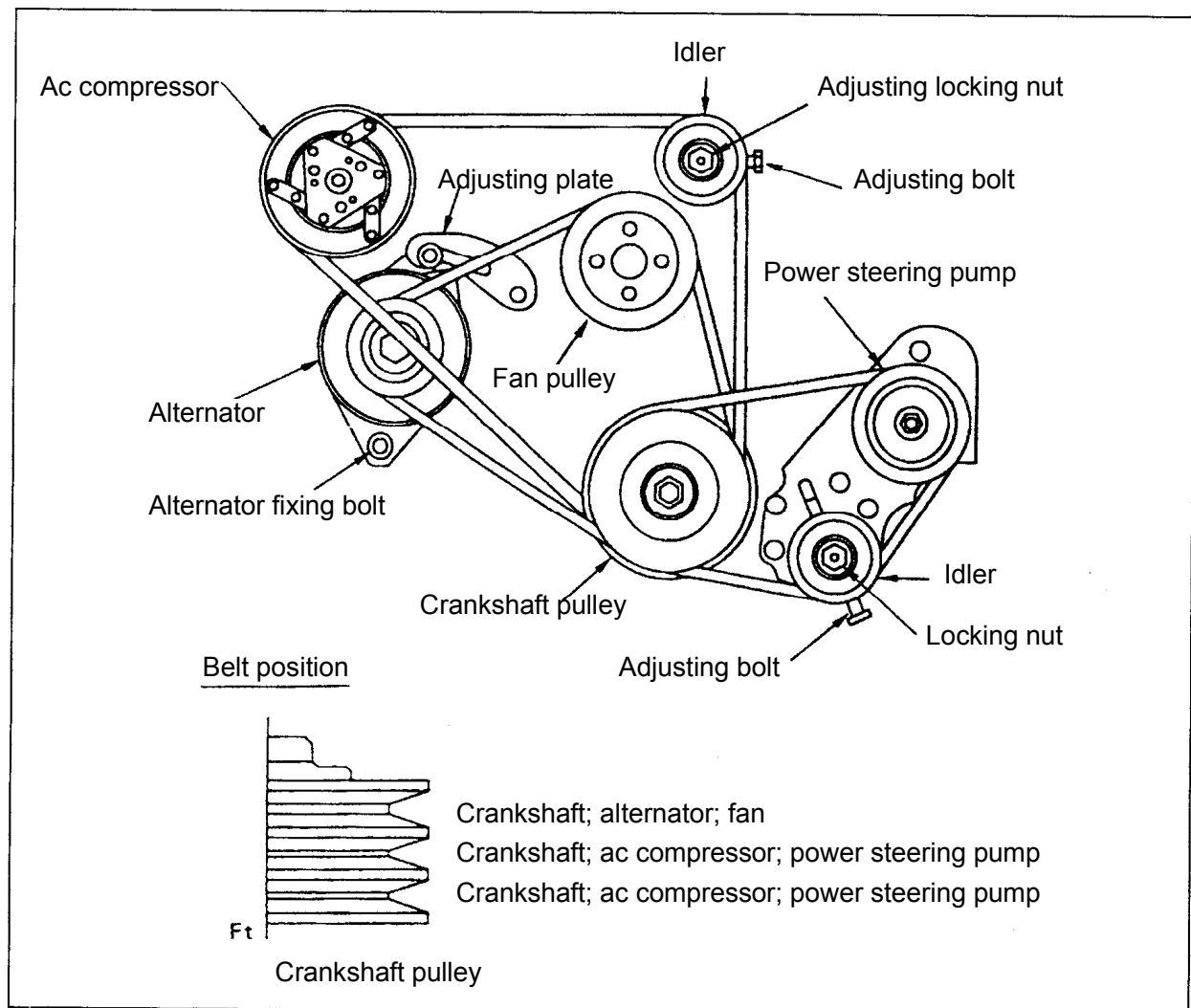
Assembly

7. Radiator assembly
 - Install the radiator.
6. Rubber cushion
 - Mount the rubber cushions to the both bottom sides of the radiator.
 - Install the radiator assembly with hose(s). Take care to avoid the fan blades scratching the radiator core.
5. Condenser
4. Radiator support
3. Air-intake duct
 - Connect the air-intake duct and fix the clip(s).
2. Radiator hose
 - Connect the inlet hose and outlet hose to the engine.
 - Connect battery ground cables.
 - Fill in coolant.
 - Fill in coolant until it goes up to the radiator filler neck and MAX mark of the storage tank.
1. Storage tank hose
 - Start the engine and warm it up. Inspect the coolant level.





4.5 Drive belt adjustment



Inspection

Inspect whether the drive belts are intact. Replace them if necessary. Check the belt tension, if necessary adjust the tension.

- Check belt tension.
- Apply a force of 100N to those drive belts and check the deflection of each belt.
- Standard deflection



	mm
	Belt tension while adjusting
Alternator and fan pulley drive belts Air conditioning compressor drive belt Power steering pump drive belt	8—10



Belt tension adjustment

1. Fan pulley drive belt

- Loosen generator bracket locking bolt. Adjust belt tension with adjusting bolts on the adjusting plate. Tighten the bolt to the specified torque.

Generator fixing bolt torque	N·m
37.5	
Adjusting plate fixing bolt torque	N·m
25	

2. Power steering pump and ac compressor pulley belts

- Loosen power steering pump locking nut and adjust belt tension with the adjusting bolt.

Tighten locking nut to the specified torque.

Locking nut torque	N·m
27	



5 Fuel system

5.1 General

Remember the following points while working on fuel supply system:

- While the fuel supply system is working you should cut off battery ground cables anytime except when carrying out tests that need batteries.
- Always prepare dry chemical fire extinguishers (class B) near the work place.
- Replace all removed oil pipes and parts with same ones.

The fuel supply system consists of a fuel tank, water separator, fuel filter, injection pump and fuel injector.

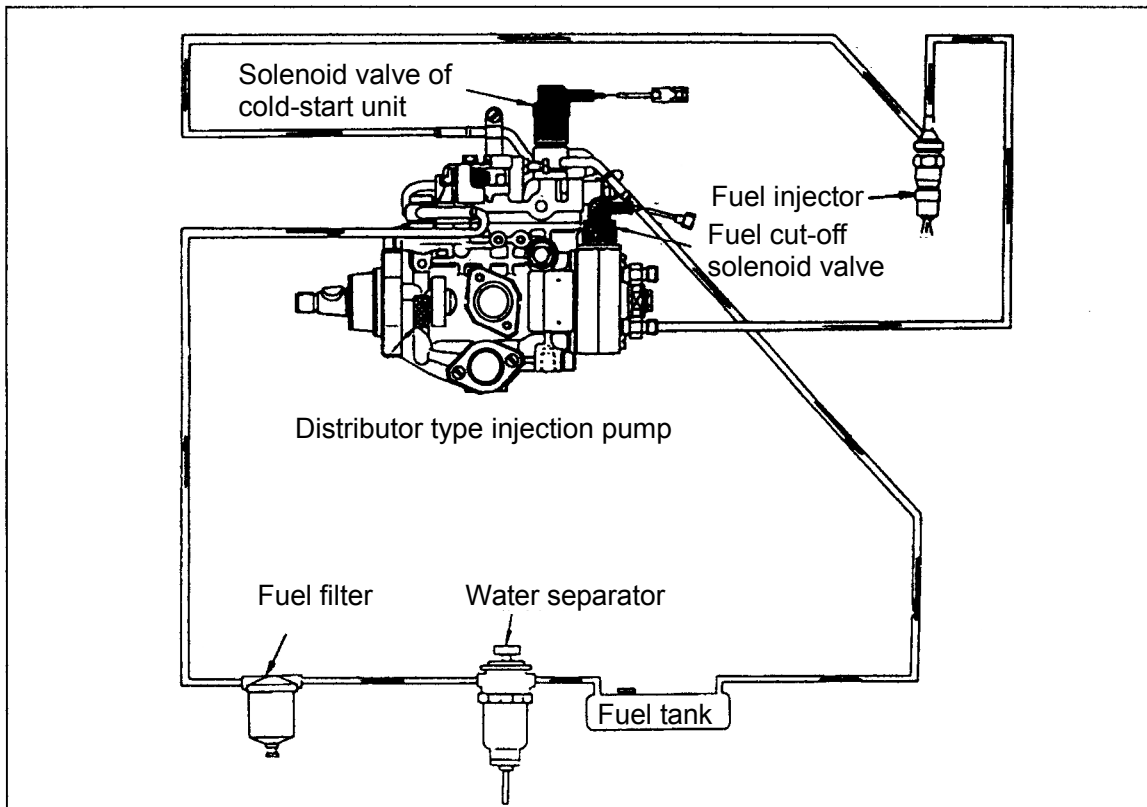
Clean and inspect the O-ring. Replace them if necessary.

Before repairing any part of the fuel supply system, relieve the pressure in pipes.

Before repairing the fuel supply system, please read the product manual and consult to repairing drawings.

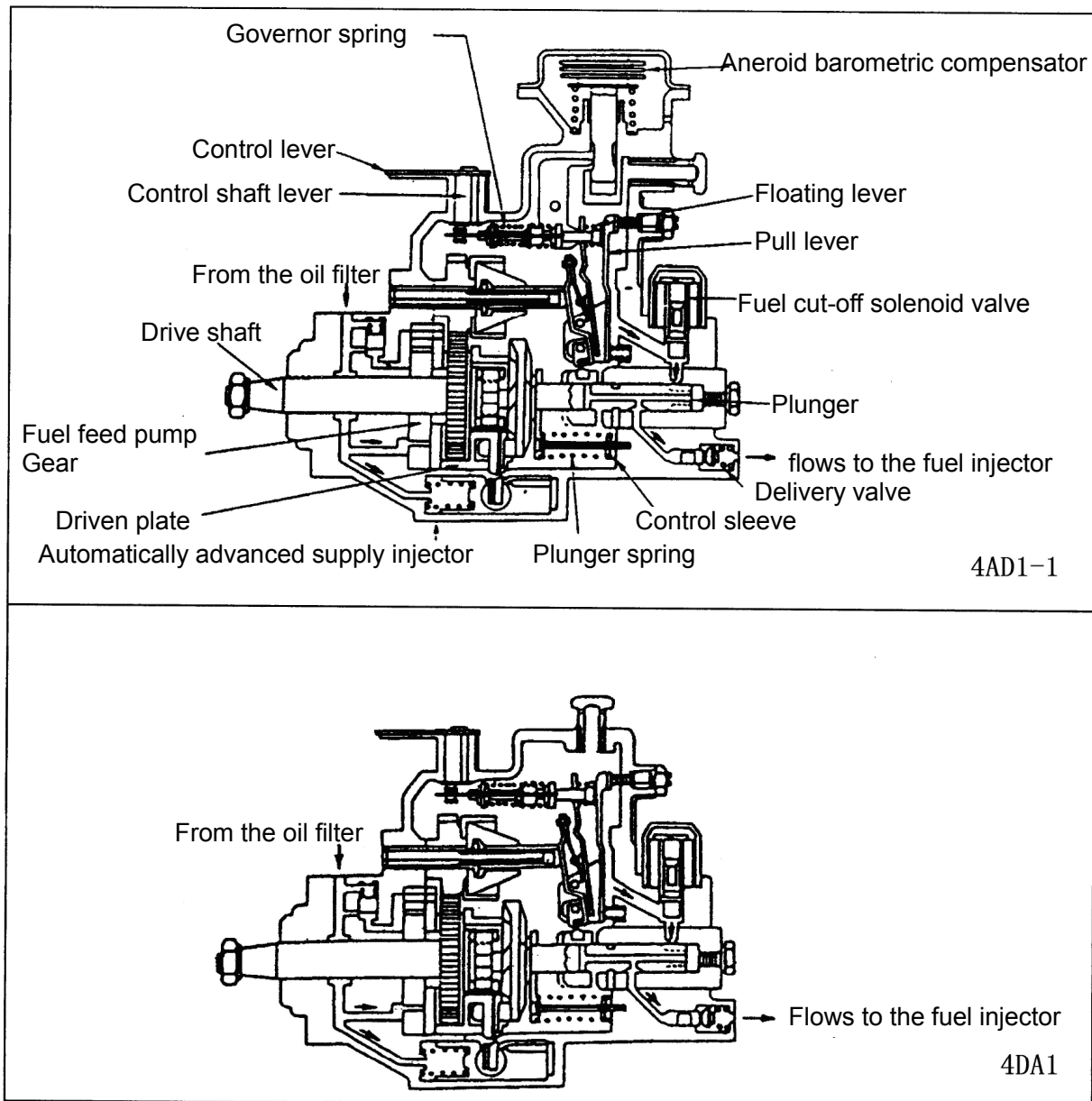
A certain amount of fuel in the fuel tank flows through water separator and fuel filter – filters off moistures and other foreign bodies in the fuel, and then goes through the injection pump plunger to the fuel injector in the best time, so the engine can work effectively.

Fuel flowing schematic diagram





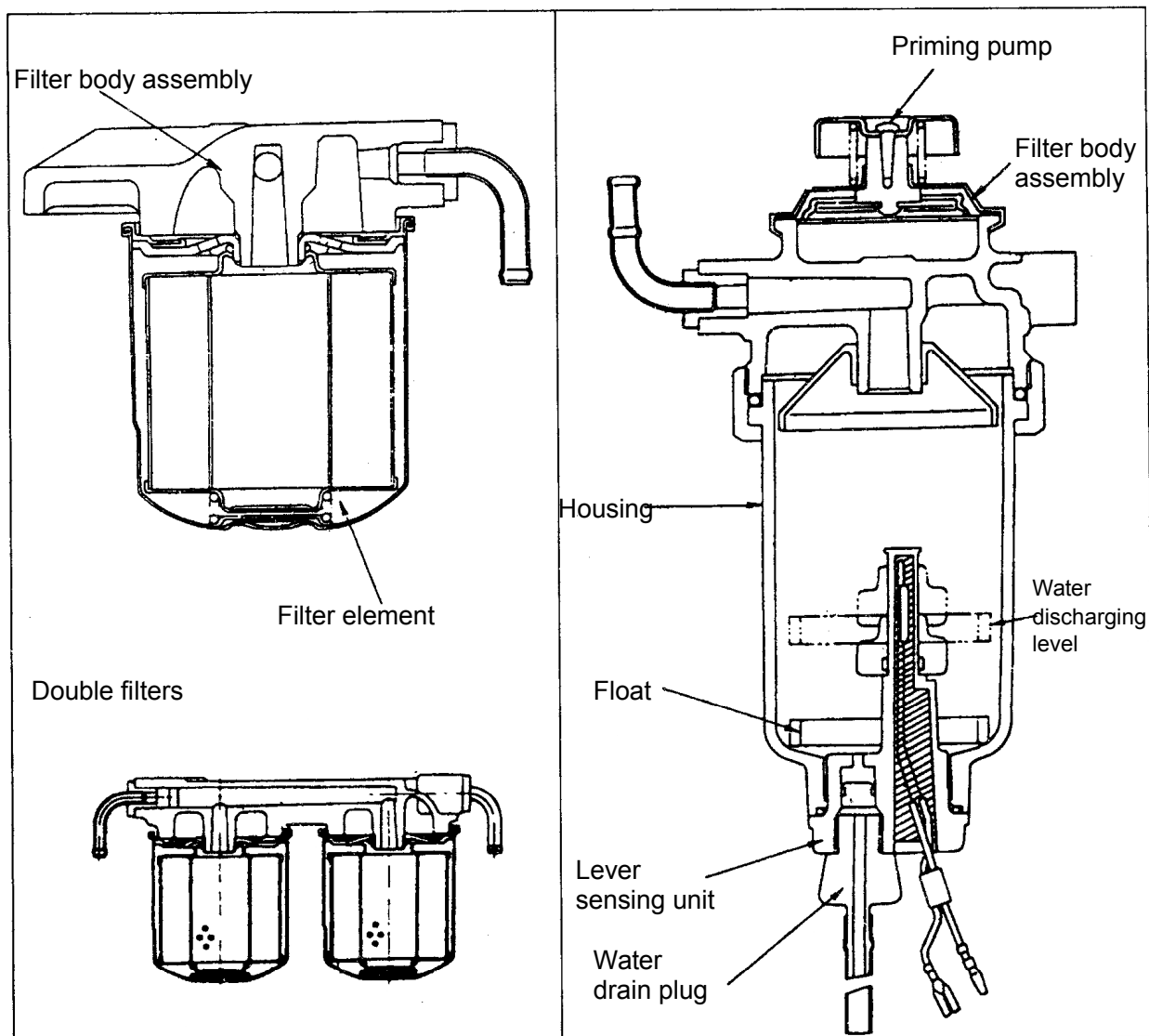
Injection pump



A distributor type injection pump is used. A Reciprocating / Rotating plunger will deliver equal fuel to each fuel injector and this has no relationship with the cylinder number. The governor, automatically advanced supply injector and fuel feed pump are all installed in the injection pump case.

This injection pump features a compact and lighter structure, which works efficiently. Aneroid barometric compensator can be used in vehicles operating in plateau areas and it can regulate the mixing ratio of fuel air.

× Fuel filter and water separator

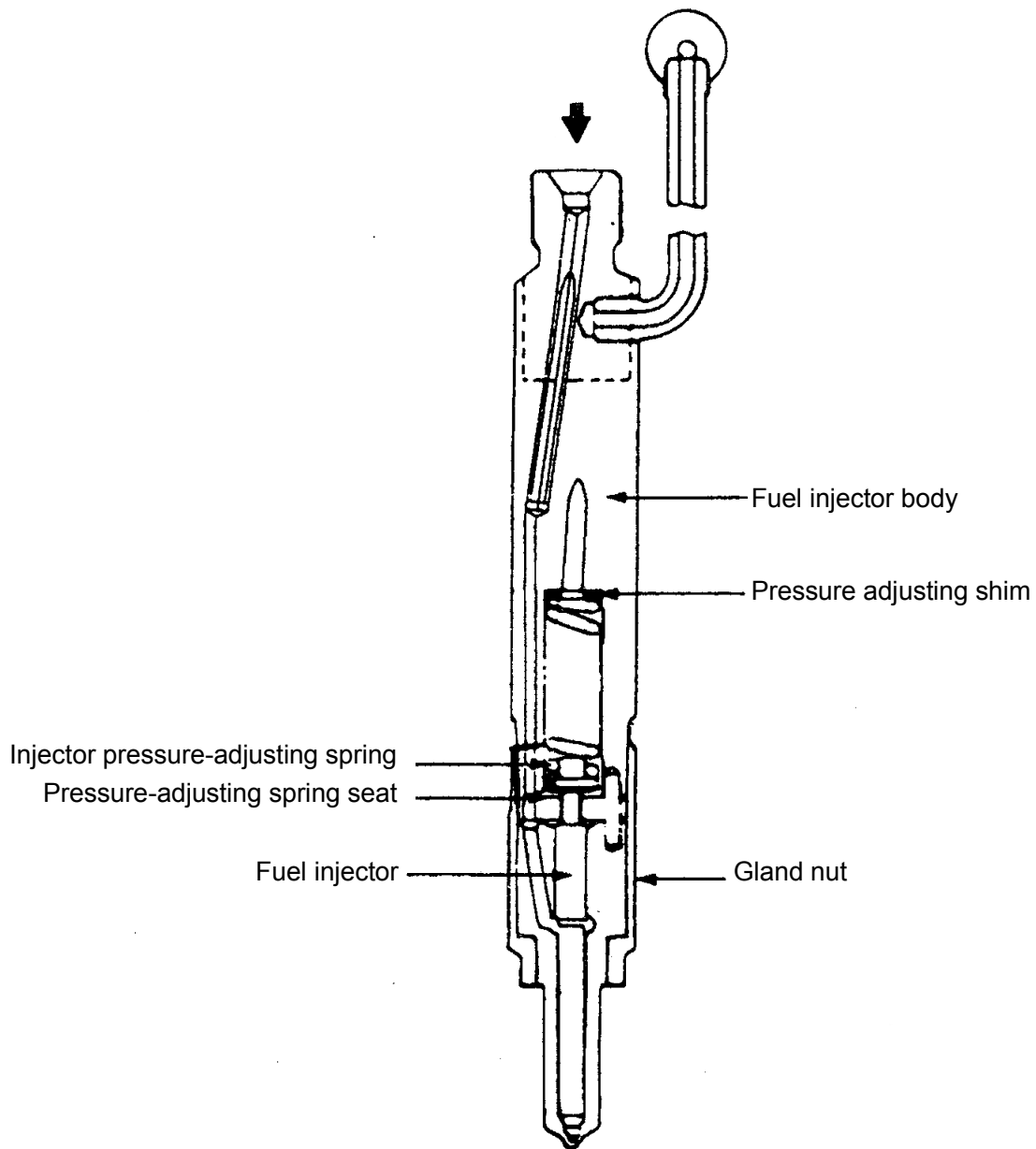


Besides the distributor type injection pump, a filter and water separator is also used. The injection pump inside is lubricated with the flowing fuel. The fuel must be clean. Before the fuel flows into the injection pump, the fuel filter and water separator will filter off moistures and other foreign bodies in the fuel.

There is a float in the water separator. When the float rises up to the specified level, a warning light reminds the workers to discharge water in the water separator.

There is a membrane priming pump installed on the top of the water separator. Use this pump when discharging water and air.

✖ Fuel injector



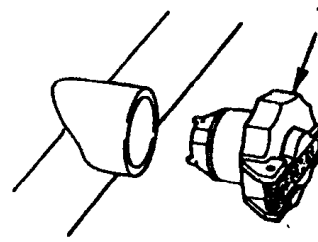
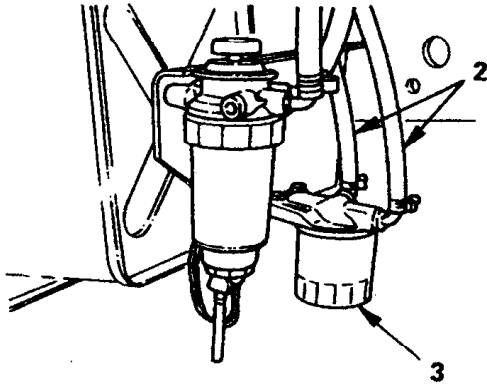
The fuel injector injects high-pressure fuel from the injection pump via an injector nozzle into the combustion chamber.

4DA1 Series generators use hole-type fuel injector. It has five nozzles. The fuel injector consists of injector body and fuel injection nozzle pairs assembly.

The high-pressure fuel coming from the injection pump injects via into the combustion chamber the injector and injector nozzle.



5.2 Fuel filter assembly



Disassembly sequence

1. Fuel filter cap
2. Fuel hose
3. Fuel filter assembly

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

- Remove battery ground cables.
1. Fuel filter cap
 2. Fuel hose
 - Remove the fuel hose connected to the fuel filter body.
 - Plug hose ends to prevent fuel overflowing.
 3. Fuel filter assembly
 - Loosen the fixing bolt(s) on the fuel filter bracket.



ASSEMBLY

3. Fuel filter assembly
 - Assemble the fuel filter bracket and screw down the fixing bolt(s).
2. Fuel hose
 - Connect the fuel hose to the filter body.

1. Fuel filter cap

- Connect battery ground cables.
- Deliver fuel to the injection pump with a priming pump, and then discharge the air in the fuel supply system.

Fuel filter element

 Disassembly



- Remove the filter element with a filter wrench.
- Filter wrench: 1010300FA-9101

 Assembly

- Clean the filter element installing surface so that the element can be installed securely.



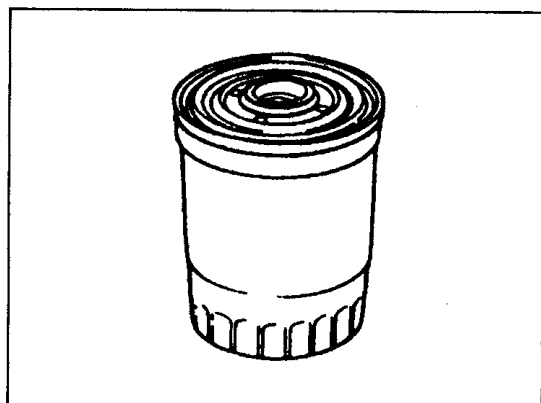
- Coating a thin layer of fresh engine oil on the new element O-ring.
- For discharging air, fill some fuel into the new element.
- Screw on the new element until the filter O-ring sticks to the seal surface seamlessly. Exercise care to avoid fuel flowing out.



- Further screw on the element by $\frac{1}{3}$ - $\frac{2}{3}$ turn with a filter wrench.
- Filter wrench: 1010300FA-9101

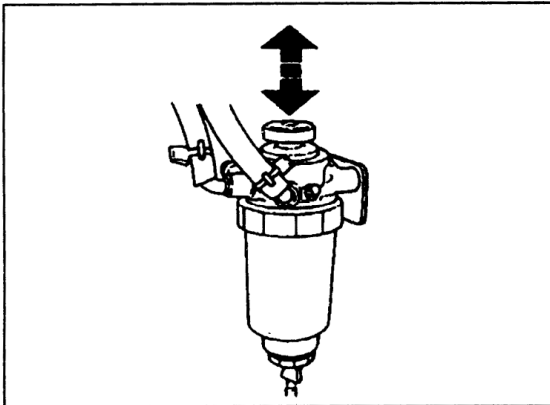
Air bleed

- Squeeze up the air inside fuel supply system to the injection pump by starting the priming pump.
- Loosen injection pump bleeder plug and start the priming pump until the air bleeds totally.





- Tighten the bleeder plug.
- Start the engine. If the engine can't start within 10 seconds, repeat the above air bleed operation.
- Make sure there is no fuel leakage and tighten the priming pump cover.

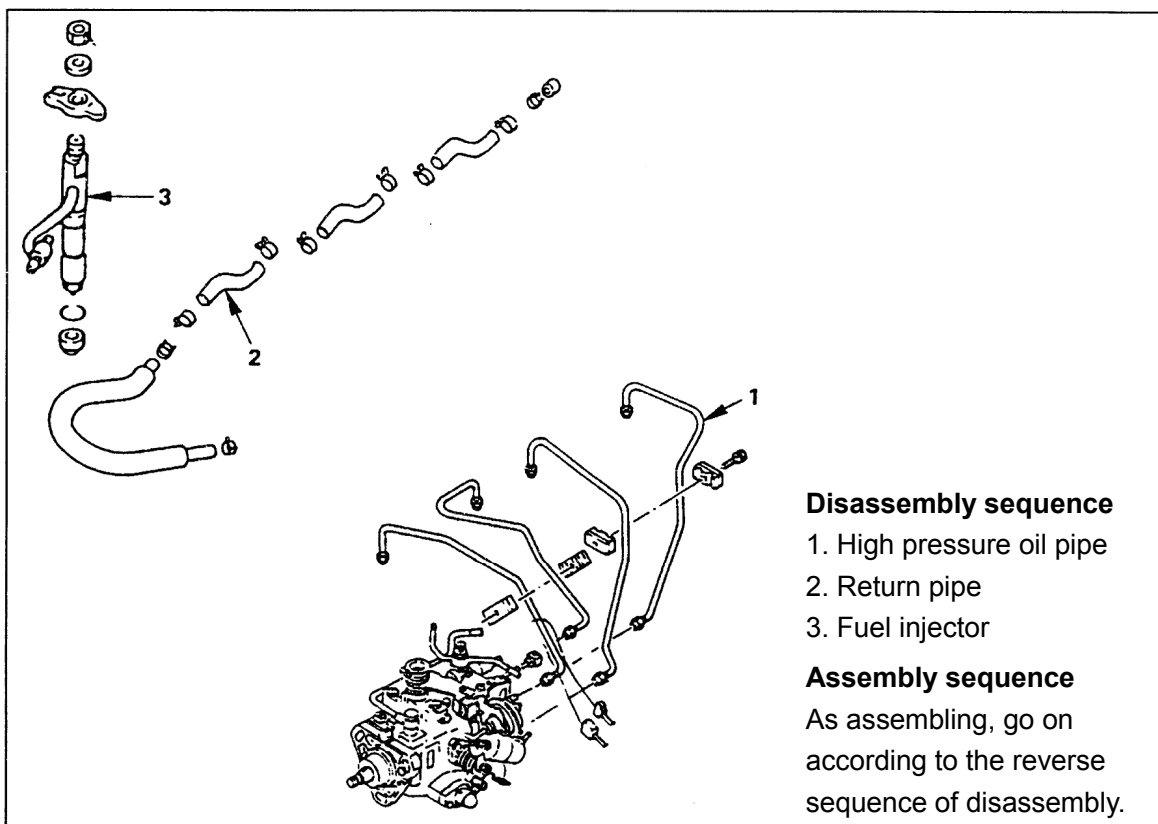


Water drain

- When the water in oil-water separator reaches the specified amount, the warning light will give a signal. Here drain water in the following steps.
- Connect a vinyl hose to the water drain plug.
- Loosen the water drain plug.
- Start the priming pump for several times to drain the water.
- Tighten the plug after draining the water.
- Start the priming pump for several times to check whether there is any fuel leakage.
- Check whether the warning light has gone out.



5.3 Fuel injector



Disassembly

Preparation:

- Remove battery ground cables.
1. High pressure oil pipe
 - Loosen high pressure oil pipe clamp.
 - Loosen the taper nut(s) on the injection pump side.
 - Loosen the taper nut(s) on the fuel injector side and put aside the high pressure oil pipe after disconnecting it.
 2. Return pipe
 3. Fuel injector

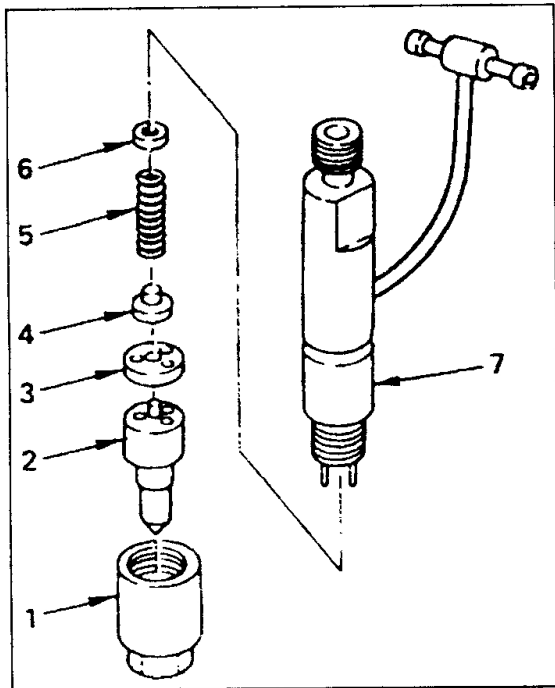


Inspection

- Install the fuel injector on the injector tester.

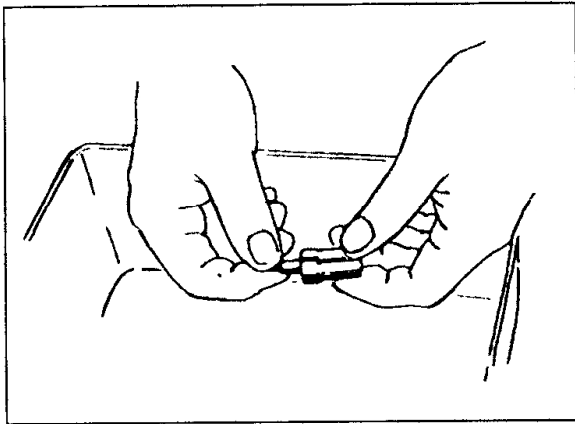
When the oil pressure is 185kg / cm², check if there is any oil leakage from the head portion of the injector.

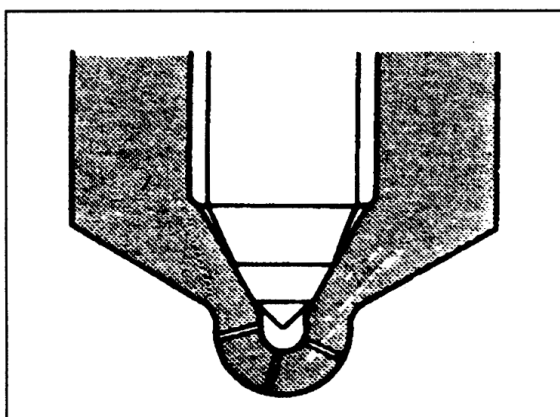
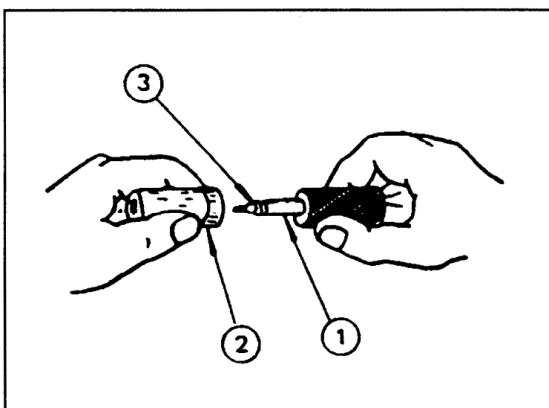
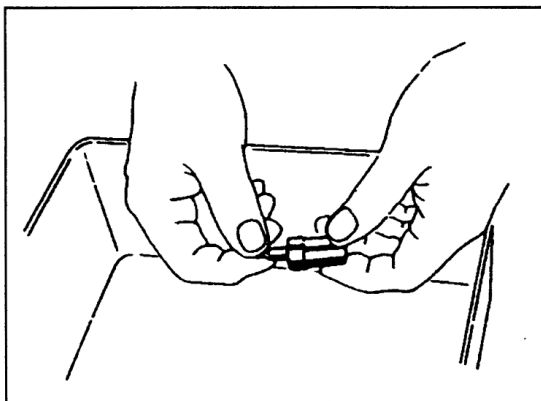
Replace them if there is any leakage.



Disassembly

1. Gland nut
2. Fuel injection nozzle pairs
 - 1) Remove injector parts from the injector body.
Attach a label to each injector part and the injector body to ensure that they are reassembled to the original positions.
Do not change the assembly of injector parts and the injector body.
 - 2) In order to prevent dust entering the injector, put it in a tool pan full of clean diesel oil.
3. Spacer
4. Pressure-adjusting spring seat
5. Pressure-adjusting spring
6. Pressure-adjusting shim
7. Injector body





Inspection and repair

If during inspection it is found that the injector is severely worn or damaged, you have to adjust and repair the injector and replace the worn-out parts.

Inspection on fuel injection nozzle pairs

1. Remove the needle valve from the needle valve body of oil nozzle.
2. Carefully wash the needle valve of oil nozzle and the valve body in clean oil.
3. Check if the needle valve moves smoothly in the needle valve body. If this is not the case, repair the needle valve and needle valve body.



Grinding procedure of fuel injection nozzle pairs

1. Grind the needle valve of oil nozzle ① and needle valve body ② with chrome and animal oil grinding paste.

Notes:

Do not apply excessive chrome and animal oil grinding paste to the needle valve seat joint faces. Too much paste will lead to the severe abrasion of the needle valve and valve cone.

2. Carefully wash the needle valve and the valve body in clean oil after grinding.

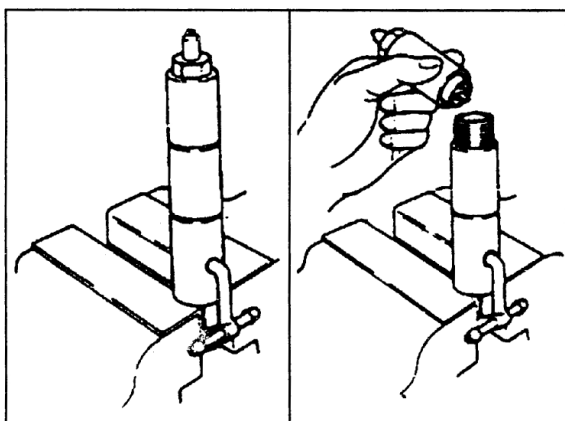
Inspection on the needle valve body of oil nozzle and the needle valve

Check if the needle valve body of oil nozzle and needle valve are damaged and distorted.

If during inspection it is found that the needle valve and valve body are damaged or distorted, replace them.

Reassembly

7. Injector body
6. Pressure-adjusting shim
5. Pressure-adjusting spring
4. High pressure spring seat
3. Spacer



2. Fuel injection nozzle pairs

1. Gland nut

Tighten gland nut to the specified torque.

N·m

69



Injector adjustment

- 1) Install the fuel injector on the injector tester.
- 2) Pressurize the injector tester to check if the injector opens at the specified pressure.

MPa

4DA1	19 — 20
4DA1-1	18.6 — 19.6

If the injector doesn't inject oil under the specified pressure, adjust it with suitable adjusting shim according to different pressure classes.

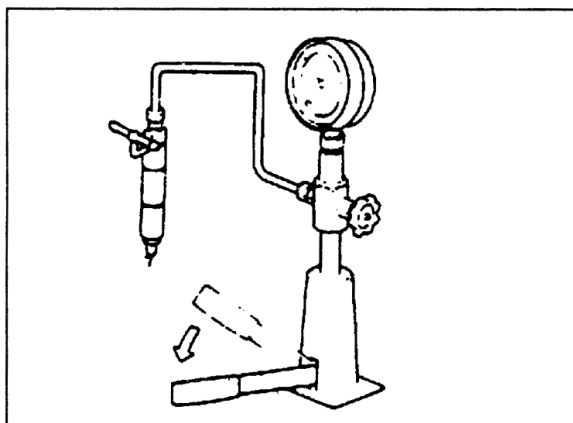
Adjusting shim available mm

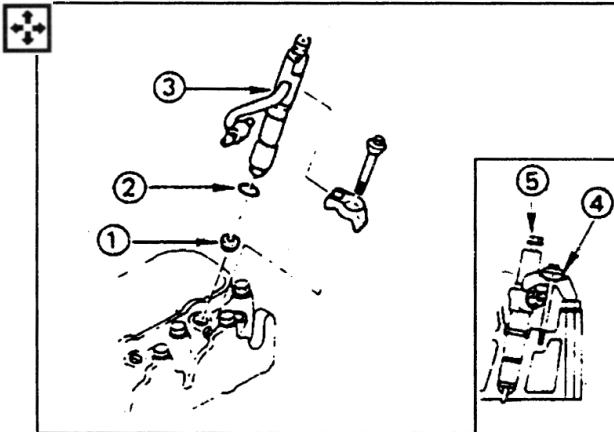
Thickness range	0.50—1.50
Grading thickness	0.025
Total no. of adjusting shims	40

Decrease or increase the thickness of adjusting shims by one grade will increase or reduce the injector opening pressure by 369.46kPa.

Warning:

The testing liquid in the injector is injected under high pressure, so it may burn your skin easily. During testing, your hands should keep away from the injector tester.





Assembly

3. Fuel injector

- 1) Install the injector gasket ① and O-ring ② onto the injector body ③.

The O-ring should be placed in the injector groove.

- 2) Fill engine oil into the injector body nozzle on the cylinder head.
- 3) Install both the injector body and injector pressure plate onto the cylinder head and tighten to the specified torque.

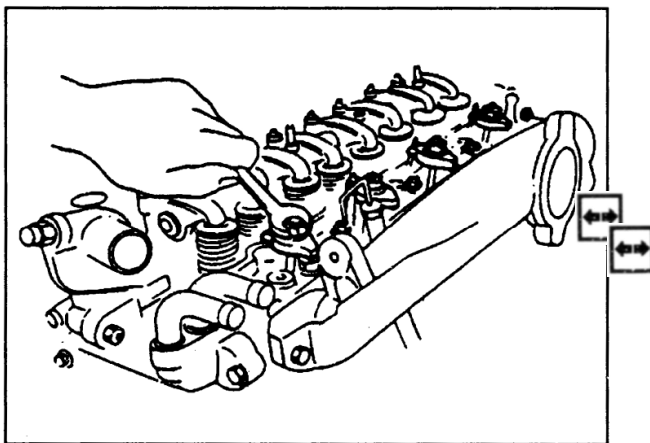
N·m

37

- 4) Tighten the injector body nut and shim ⑤ to the specified torque.

N·m

35

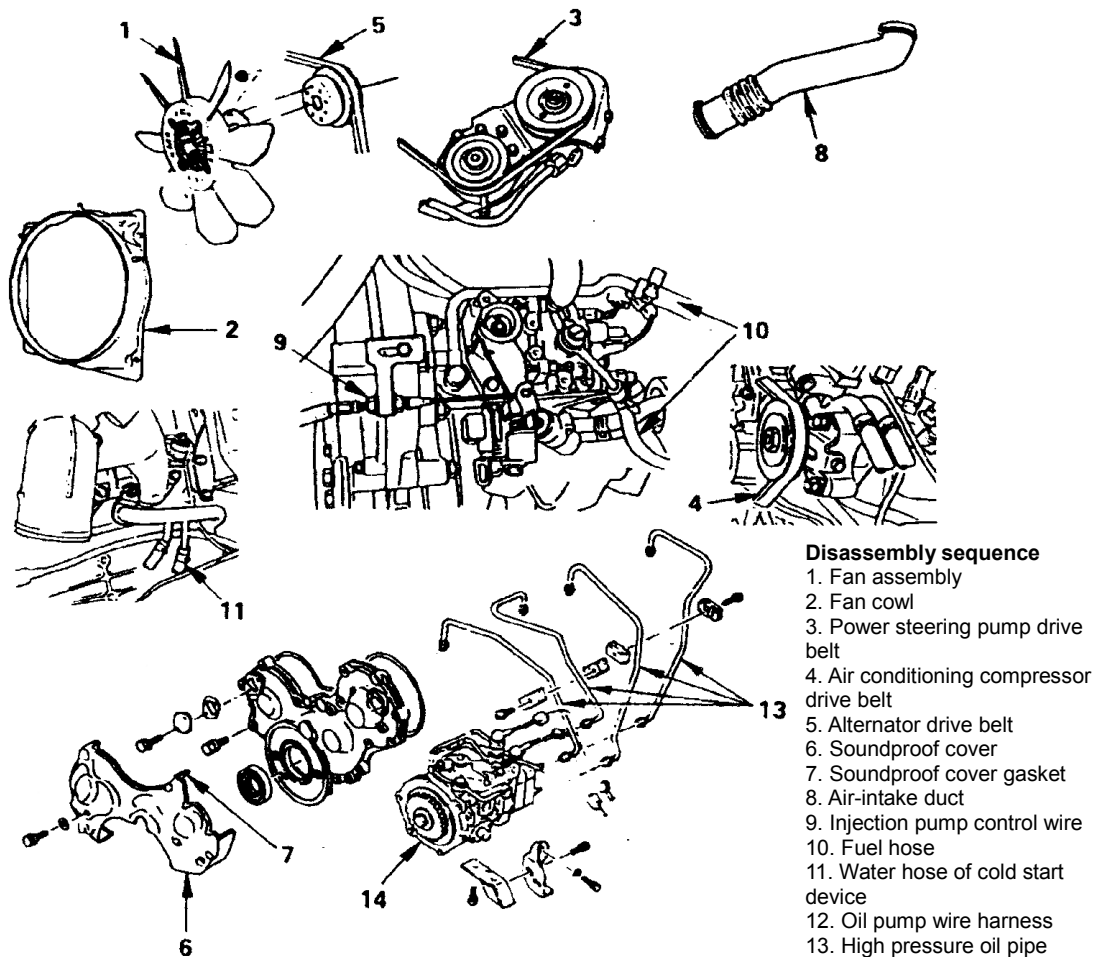


2. Return pipe

1. High pressure oil pipe



5.4 Injection pump assembly



Disassembly sequence

1. Fan assembly
2. Fan cowl
3. Power steering pump drive belt
4. Air conditioning compressor drive belt
5. Alternator drive belt
6. Soundproof cover
7. Soundproof cover gasket
8. Air-intake duct
9. Injection pump control wire
10. Fuel hose
11. Water hose of cold start device
12. Oil pump wire harness
13. High pressure oil pipe

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.

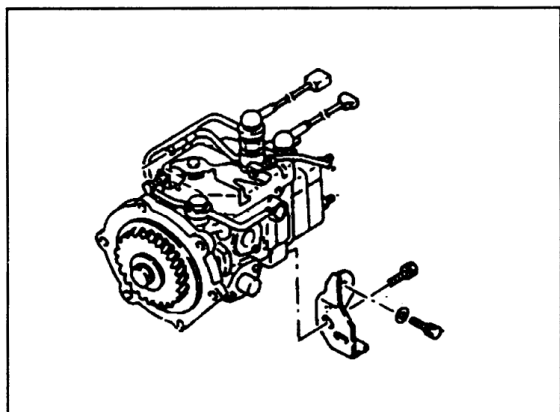
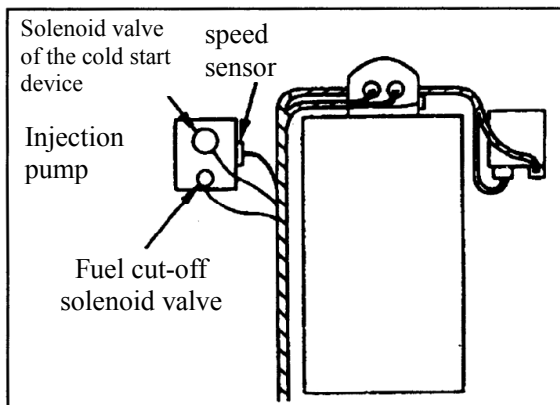
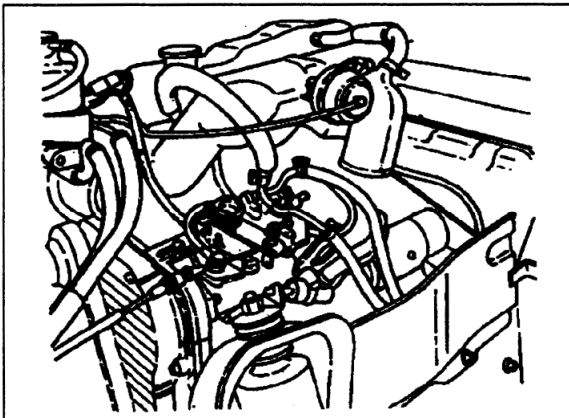
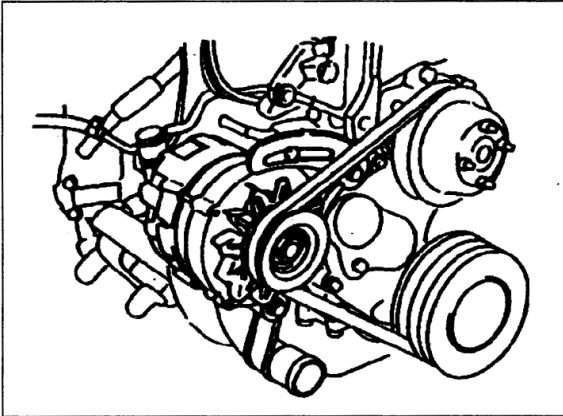


Disassembly

Preparation:

- Remove battery ground cables.
- Discharge the coolant.

1. Fan assembly
 - Remove the gland nut(s), fan assembly, collar and fan pulley.
2. Fan cowl
3. Power steering pump drive belt
 - Unscrew power steering pump fixing bolt(s) and adjusting bolt(s), then remove the drive belt.



4. Air conditioning compressor drive belt
 - Loosen idler locking nut(s) and adjusting bolt(s) of the air conditioning compressor and then remove the drive belt.
5. Alternator drive belt
 - Unscrew alternator fixing bolt(s) (lower side) and adjusting plate locking bolt(s), then remove the drive belt.
6. Soundproof cover
7. Soundproof cover gasket
8. Air-intake duct
9. Injection pump control wire
 - Remove the control wire bracket bolt(s) and control wire.
10. Fuel hose
 - Disconnect fuel inlet hose and return hose.
11. Water hose of cold start device (CSD)
 - Disconnect the water hose from the injection pump side.
12. Injection pump wire harness
 - Dismount the speed sensor (with a tachometer), solenoid valve of the cold start device (CSD) and the fuel cut-off solenoid valve.
13. High pressure oil pipe
 - Loosen high pressure oil pipe clamp.
 - Remove the taper nut(s) on the injection pump side.
 - Remove taper nut(s) on the fuel injector side and high pressure oil pipe.

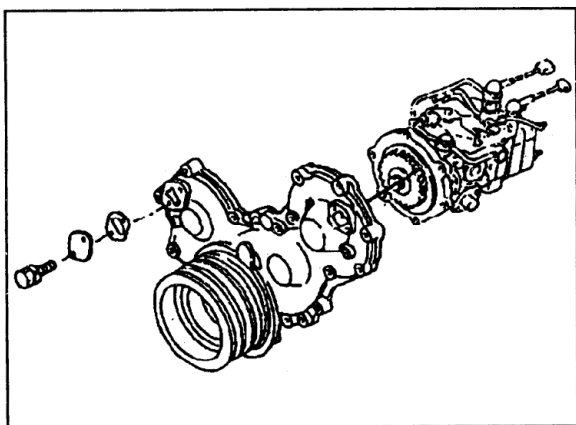


Caution:

- Plug the holes in injector body and delivery valve body to prevent foreign bodies falling in.
14. Injection pump assembly
 - Loosen injection pump fixing nut(s).
 - Unscrew the adjusting and locking bolts in the injection pump rear bracket.
 - Unscrew the generator side fixing bolt(s). Take out the injection pump from the engine backside.

Notes:

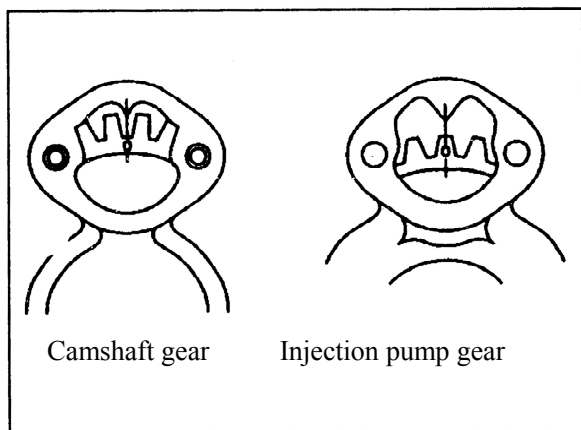
- Cove holes in injection pump delivery valve body with a cap (or equivalents) to prevent foreign bodies falling into the valve.



Assembly

14. Injection pump assembly

1. Mount inspection hole covers on the camshaft timing gear side of the timing gear chamber and the timing gear side of the injection pump.
2. Turn the crankshaft clockwise and check whether the II °C mark on the crankshaft pulley is aligned with the index. Place the piston of the first cylinder on the top dead center of the compression stroke.
3. Observe and check if the scale on the timing gear mark "O" is aligned with the hole index via the inspection hole on crankshaft timing gear side.
4. Align the injection pump gear mark "O" with the inspection hole index and install the injection pump assembly.
 - Screw on the injection pump fixing bolts and tighten them to the specified torque.

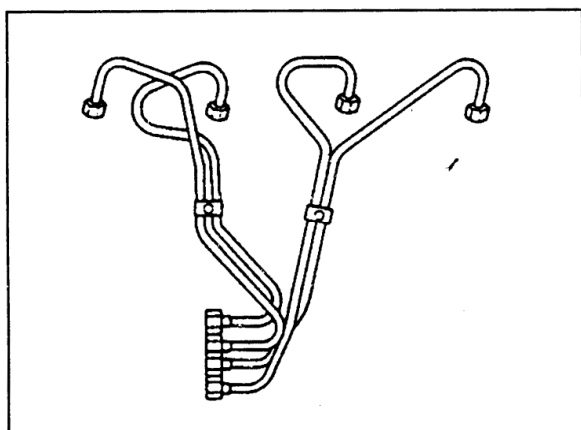


Injection pump fixing bolt torque	N·m
25	

13. High pressure oil pipe

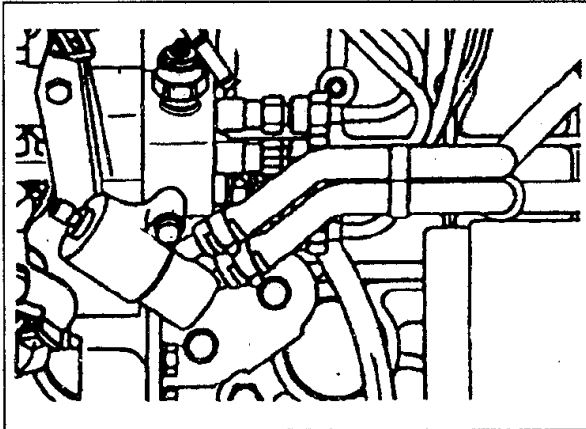
- Connect the high pressure oil pipes to the injection pump side and fuel injector side and screw down these pipes.
- Install the oil pipe fixing clips in the original positions.

	N·m
30	

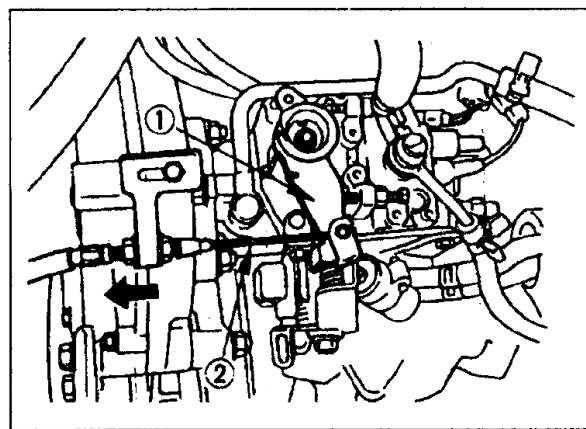


12. Injection pump wire harness

- Fix the injection pump wire harness and connect it to the switch.

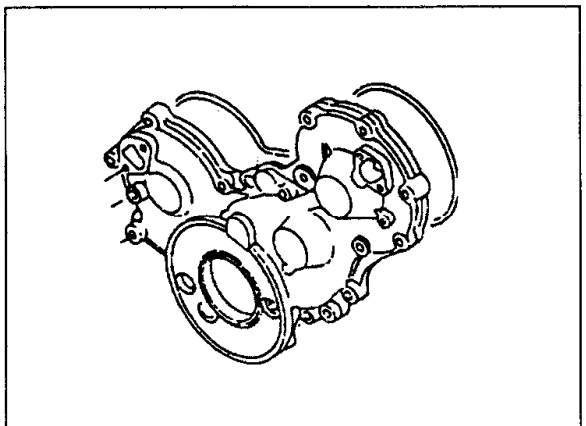


11. Water hose of cold start device
- Connect the water hose of cold start device and tighten the fixing clip(s).

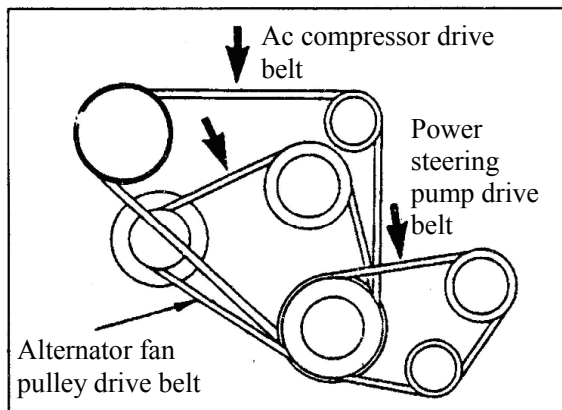


10. Fuel hose
- Connect the fuel inlet hose and return hose.
- Connect the defuelling hose(s).
9. Injection pump control wire
- 1) Connect the control wire rope to the engine control lever.
 - 2) Place the throttle lever in fully cut-off position and pull tight the control wire towards the arrow direction to prevent it being slack.
 - 3) Tighten the throttle wire bracket bolt(s).

8. Air-intake duct
7. Soundproof cover gasket
6. Soundproof cover

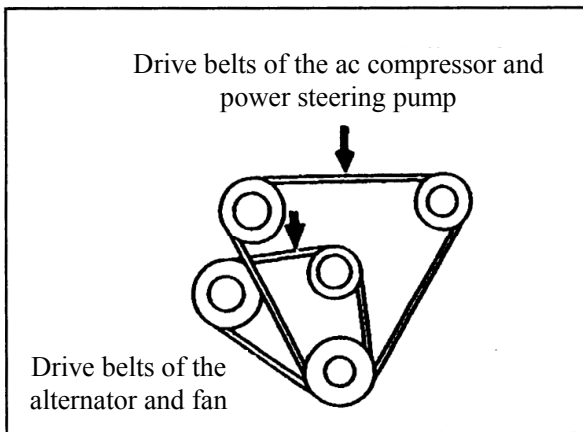


5. Alternator drive belt
- Mount the alternator drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.



Drive belt deflection	mm
8—10	

- Screw on the fixing bolt and tighten it to the specified torque.



Generator fixing bolt torque	N·m
37.5	

Adjusting plate fixing bolt torque	N·m
25	

4. Air conditioning compressor drive belt
 - Mount the ac compressor drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.力。



Drive belt deflection	mm
8—10	



- Tighten the idler locking nut to the specified torque.

	N·m
27	

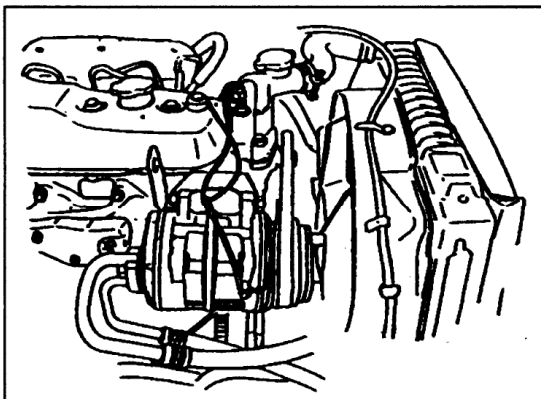
3. Power steering pump drive belt
 - Mount the power steering pump drive belt and adjust the belt tension.
 - Apply a force of 100N to the middle part of the drive belt.力。



Drive belt deflection	mm
8—10	

- Tighten the idler locking nut to the specified torque.

	N·m
27	

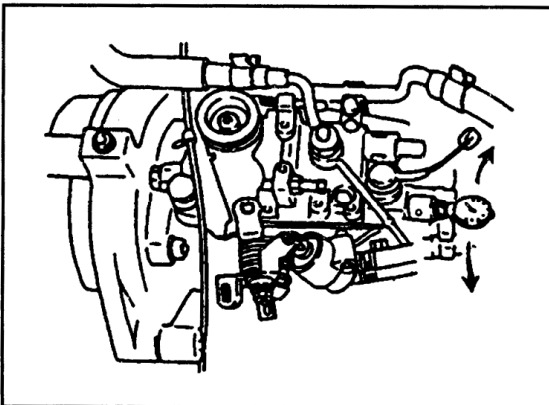
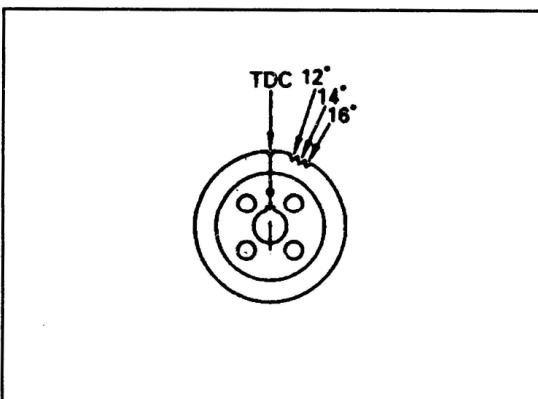
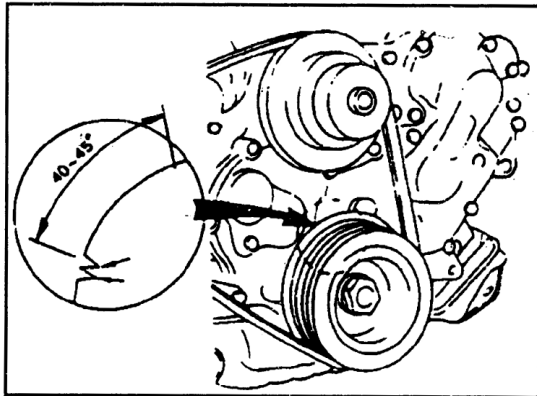
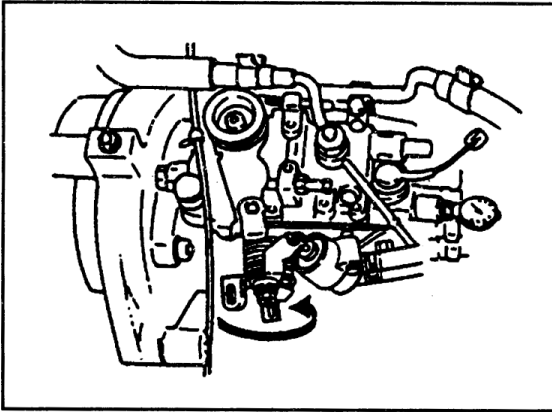


2. Fan cowl
 - Install the fan cowl and storage tank hose.
1. Fan assembly
 - Fix the fan pulley, collar and fan assembly onto the water pump in sequence, and tighten them to the specified torque.

N·m

12.5

- Connect battery ground cables.
- Fill in coolant.



Fuel supply and timing adjustment

- Place the piston of the first cylinder on the top dead center.
- Remove the top plug of the injection pump distributor.
- Dismantle wax type cold start device with screwdriver hand lever.
- Mount a dial indicator and pre-elevate to 1 mm.



Measuring instrument: 1100300FA—9101

- Place the top dead center mark on the crankshaft damper pulley at a position 30°-45° to the index.
- Place the dial indicator at the "0" position.
- Turn the crankshaft left and right slightly and observe if the dial indicator is still at the "0" position.
- Turn the crankshaft in normal direction and read out the dial gauge readings in the following cases.

4DA1 16° to the top dead center (before)

4DA1-1 12° to the top dead center (before)

Dial indicator readings mm

4DA1	1.60
4DA1-1	1.50

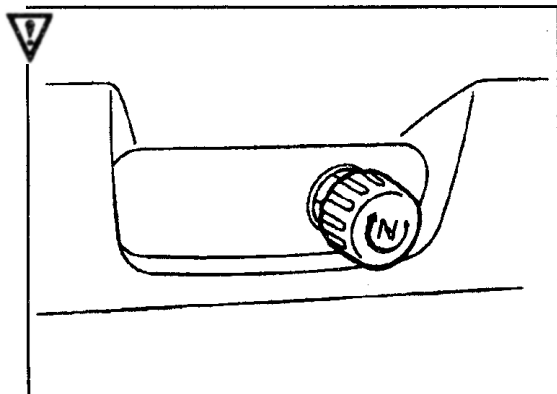
If the readings are improper, unscrew the injection pump fixing nut and the bracket adjusting bolt. Adjust the readings by changing the injection pump mounting position. When the dial gauge readings change to the specified values, tighten the fixing nut and bolt to the specified torques.

Injection pump fixing nut torque	N·m
25	

Adjusting Bolt torque	N·m
25	

- Tighten the top plug of the injection pump distributor to the specified torque after removing the measuring instrument.

N·m	
35	



Caution:

- While mounting the top plug of the injection pump distributor, you should use a new copper gasket.
- Connect the high pressure oil pressure.
- Fix the oil pipe clamp.

Carry out idle speed inspection and adjustment

- 1) Pull the parking brake lever and lock the drive wheel (s).
- 2) Set the transmission gear to neutral shift.
- 3) Start the engine and operate it at idle speed until the water temperature rises to 70°-80°.
- 4) Reverse the idle control knob. Remove the control wire from the injection pump control lever.
- 5) Install the engine tachometer.
- 6) Check the idle speed.

If the idle speed exceeds the specified limit, correct it.

Specified value (r / min) = 700-800

- 1) Unscrew the locking nut of the idle speed adjusting bolt.
- 2) Turn the idle speed adjusting bolt and adjust the idle speed to the specified value.
- 3) Tighten the locking nut and adjusting bolt.
- 4) Check the control wire tension and pull tight this wire if necessary.



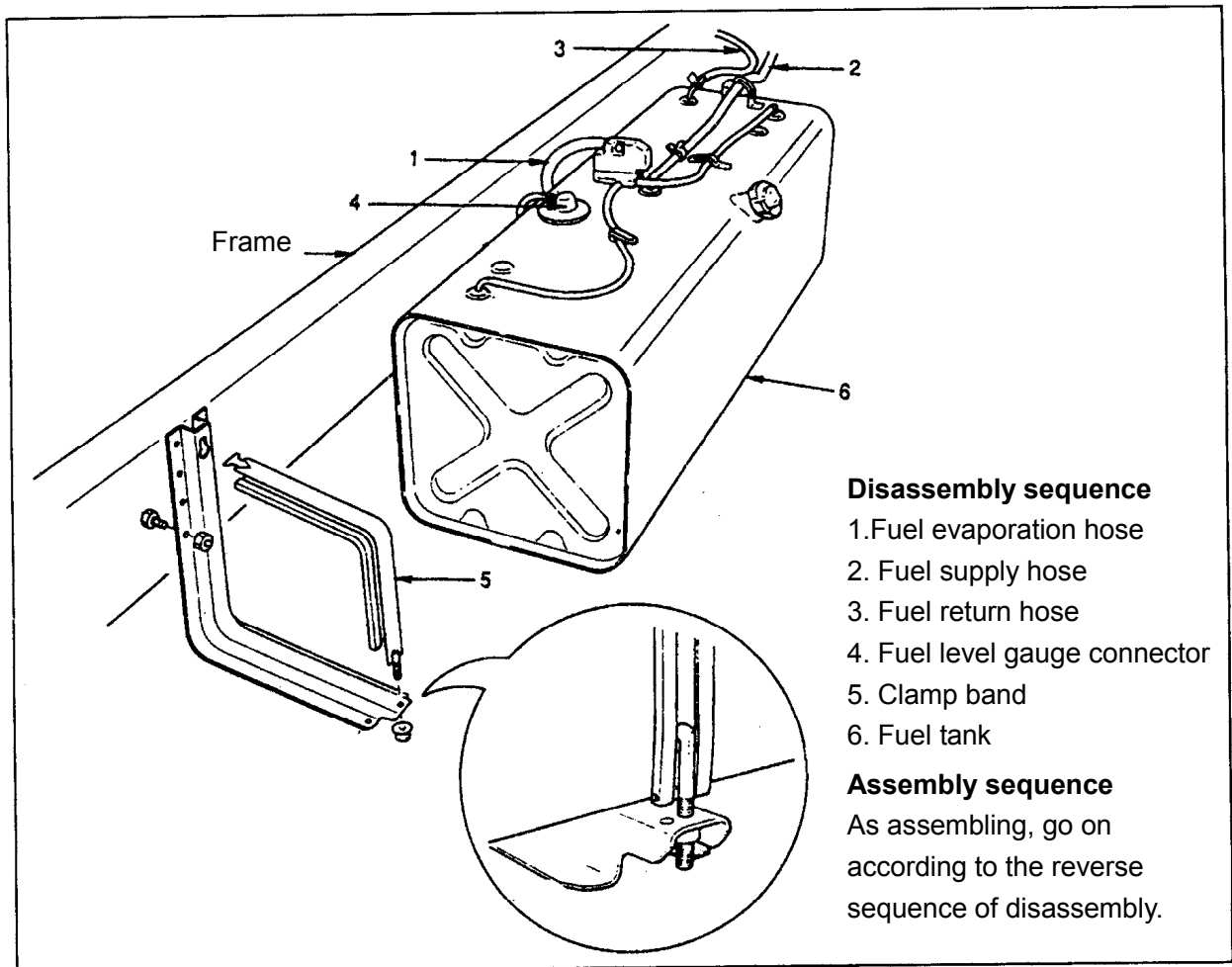
5.5 Fuel system related parameters

Test conditions

Items	Conditions	
Model	4DA1	4DA1-1
Fuel injector		
Injector type	KBAL—P001	KBAL—P001
Fuel injection nozzle pairs	DSLA153P009	DLLA153P034
Injector opening pressure (Mpa)	19 — 20	18.6 — 19.6
Size of high pressure oil pipe		
Inner diameter	1.6	
Outer diameter	6.5	
Length	430	
Feeding pressure (kPa)	19.61	
Test fuel	SAE standard test diesel oil (SAE967D)	
	ISO standard test diesel oil (ISO4113)	
Test fuel temperature ℃	48—52	



5.6 Fuel tank



Disassembly

Preparation:

- Remove battery ground cables.
- Open the fuel filter cap
- Drain oil via the oil drain plug
- Tighten the oil drain plug to the specified torque after draining the oil.

N·m

29

1. Fuel evaporation hose
2. Fuel supply hose
3. Fuel return hose
 - Plug hose ends to prevent the fuel flowing out. Fasten the hose to the frame with plugged end upward.

-
4. Fuel lever gauge connector
 - Remove the fuel lever gauge connector.
 5. Clamp band
 - Loosen the fixing nut of the fuel tank clamp band. Draw out the clamp band from one end of the frame.
 6. Fuel tank
 - Withdraw the fuel tank.

Note:
If it is impossible to withdraw the fuel tank, remove the bracket and pull out the fuel tank downwards..



Assembly

6. Fuel tank

Note:
If the bracket is removed while pulling out the fuel tank, mount it to the frame and tighten it to the specified torque.

	N·m
	55

- While mounting the fuel tank to the bracket, you have to place a piece of cushion on the bracket.

5. Clamp band
 - Tighten the clamp band nuts to the specified torque.

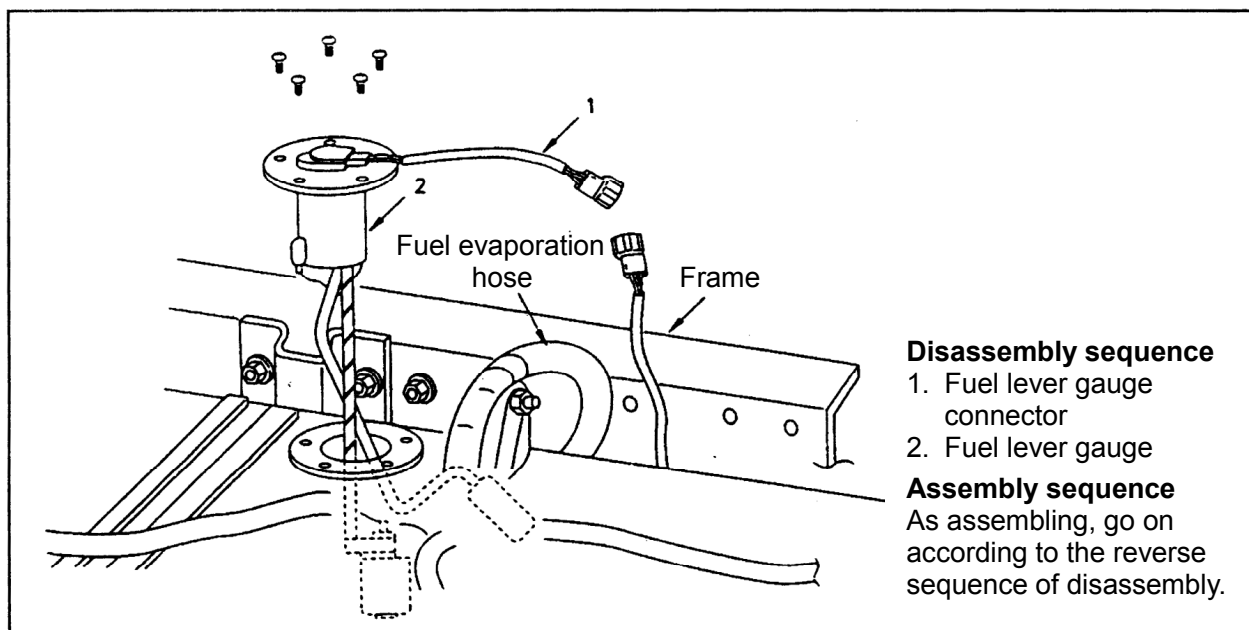


	N·m
	12

4. Fuel lever gauge connector
 - Connect the fuel lever gauge connector.
3. Fuel return hose
2. Fuel supply hose
 - Insert the hose into the oil pipe with insert depth above 25mm.
1. Fuel evaporation hose
 - Feed fuel into the fuel tank.
 - Connect battery ground cables.



5.7 Fuel lever gauge



Disassembly sequence

1. Fuel lever gauge connector
2. Fuel lever gauge

Assembly sequence

As assembling, go on according to the reverse sequence of disassembly.



Disassembly

Preparation:

- Remove battery ground cables.
1. Fuel lever gauge connector
 - Remove the connector from the fuel lever gauge.
 2. Fuel lever gauge
 - Unscrew the fuel lever gauge fixing bolt (s) and remove the gauge.



Note:

- After removing the fuel lever gauge, plug the tank port with cotton waste to prevent dirt falling into the tank.



Assembly

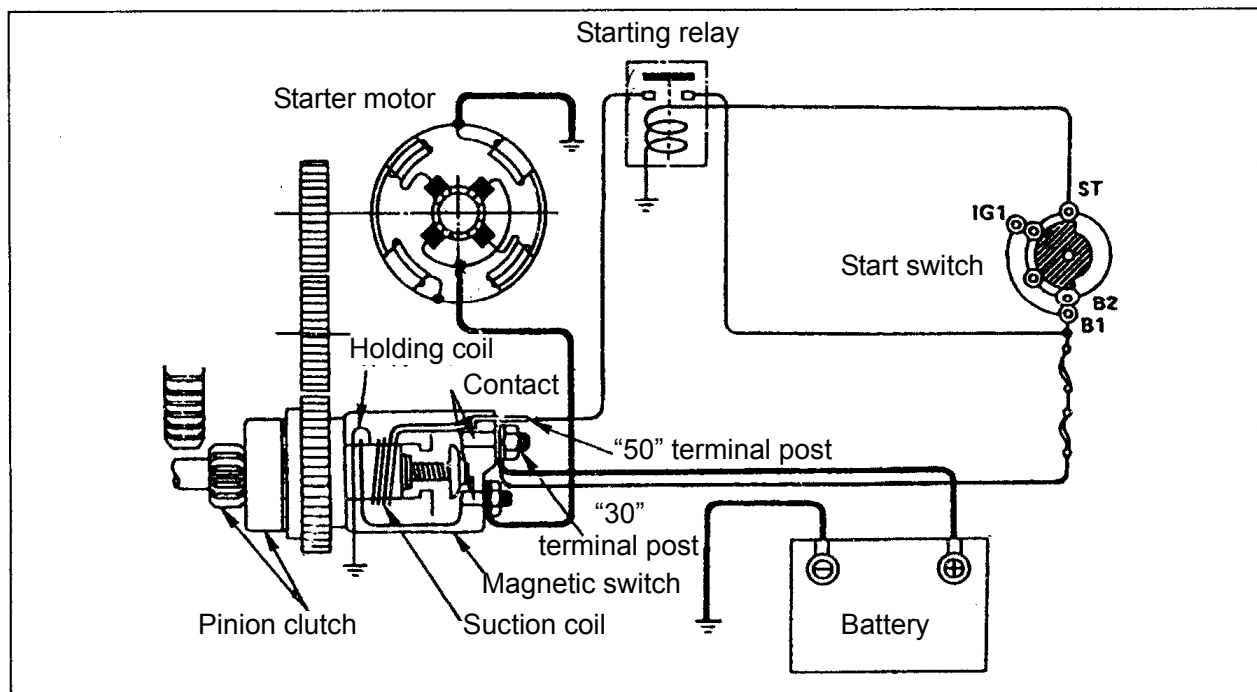
2. Fuel lever gauge
1. Fuel lever gauge connector
 - Connect the wire connector to the fuel lever gauge



6 Starting system

6.1 General

The starting system consists of battery, starter motor, start switch, starting relay, etc. These parts are connected according to the diagram. The diagram shows the details of the starting circuit.



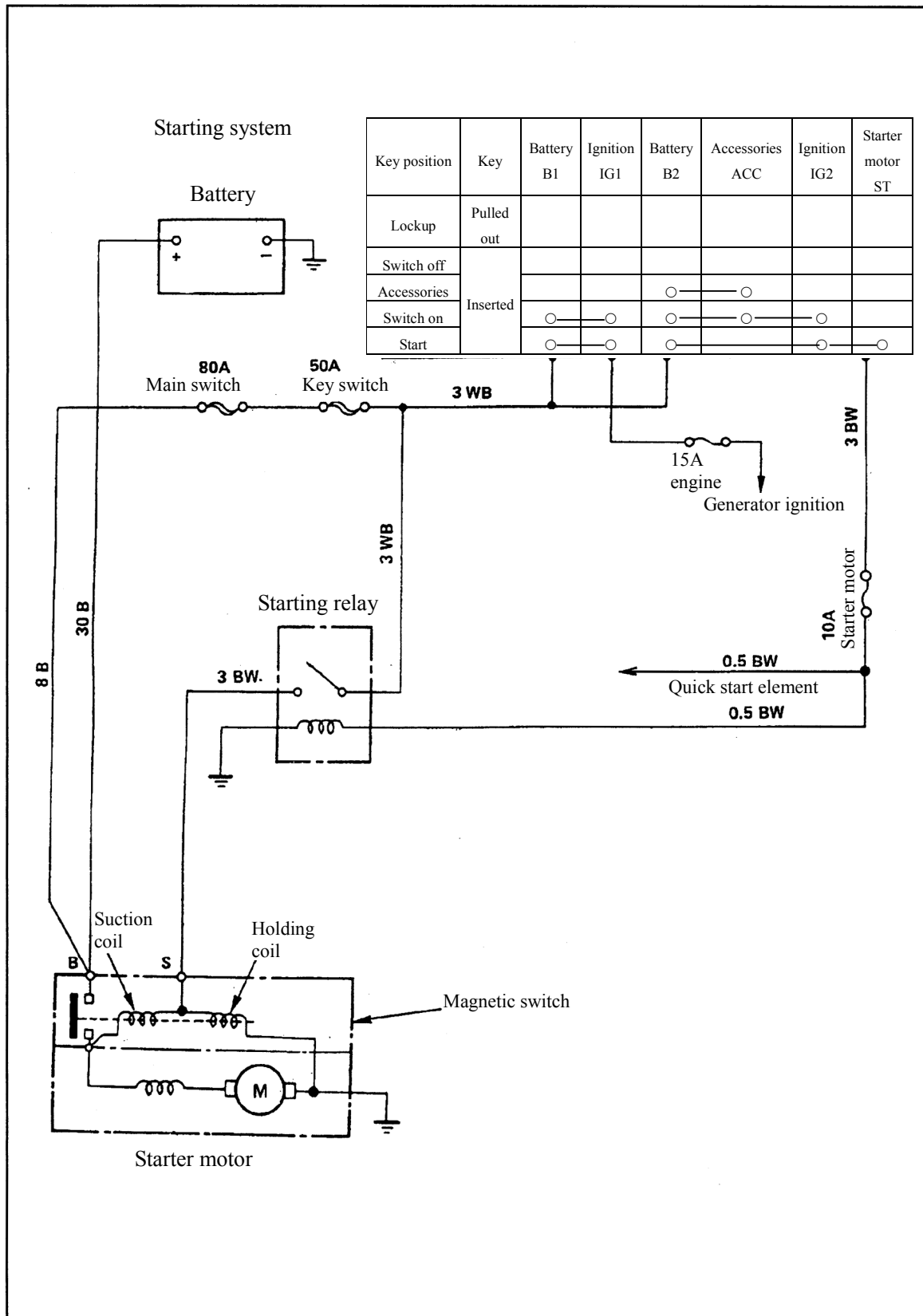
The starting system utilizes the gear reduction magnetic starter motor and its shaft can be used as pinion shaft. When the start switch is switched on, the magnetic switch contact closes causing the armature to rotate. Meanwhile, Move the movable core by suction and push the pinion forward to engage with the ring gear by a deflector rod. Then the ring gear starts to run and the engine starts. When the engine is started and the start switch is switched off, the movable core returns to the original position while the pinion runs out of the ring gear, then the armature stops. When the engine speed is higher than the pinion's, the latter stays in idle state, so it can't drive the armature.

Note:

The starting circuit diagram is only for information and the overall circuit diagram is prevail in specific cases.

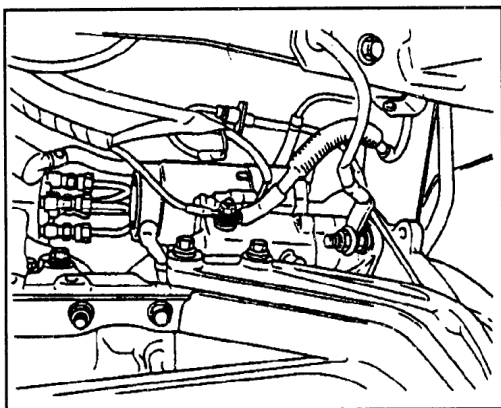
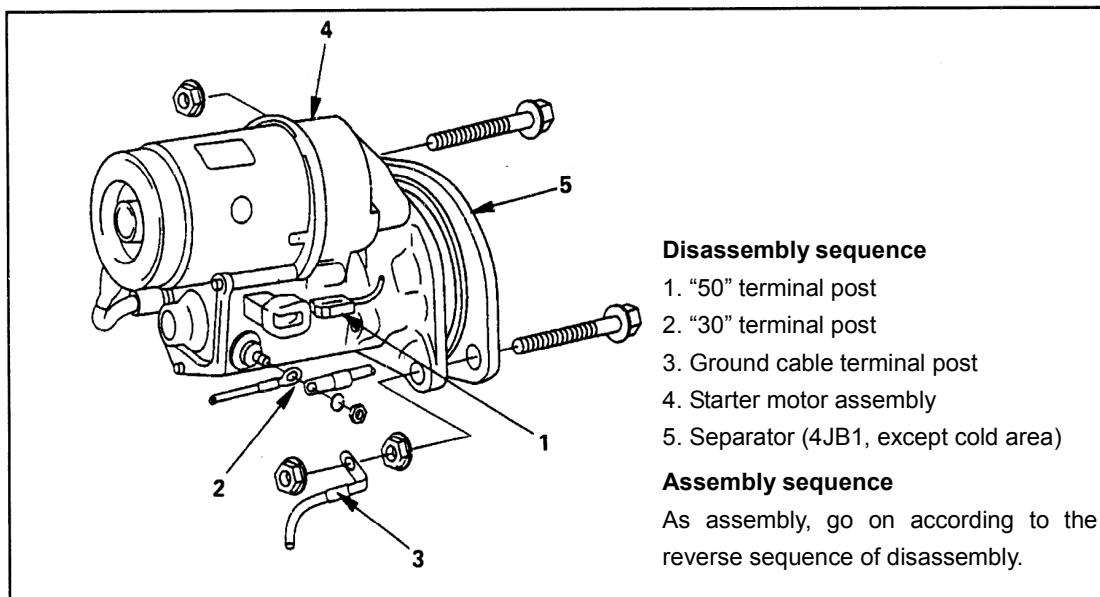


6.2 Starting circuit





6.3 Starter motor



Disassembly

Preparation:

- Remove the ground cables of battery.

1. "50" terminal post
2. "30" terminal post
3. Ground cable terminal post
4. Starter motor assembly
5. Separator (except cold area)

Assembly

5. Separator (except cold area)
4. Starter motor assembly
 - Tighten the fixing bolt(s) and nut(s) to the specified torque.

Starter motor bolt and nut torque	N·m
-----------------------------------	-----

81

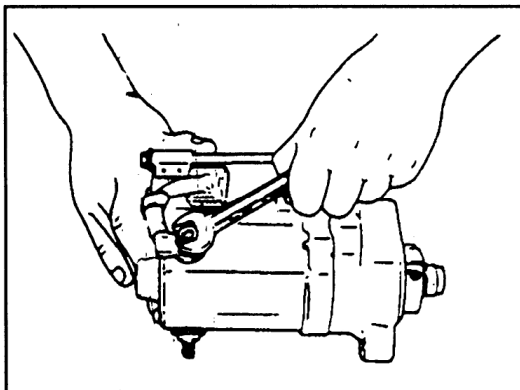
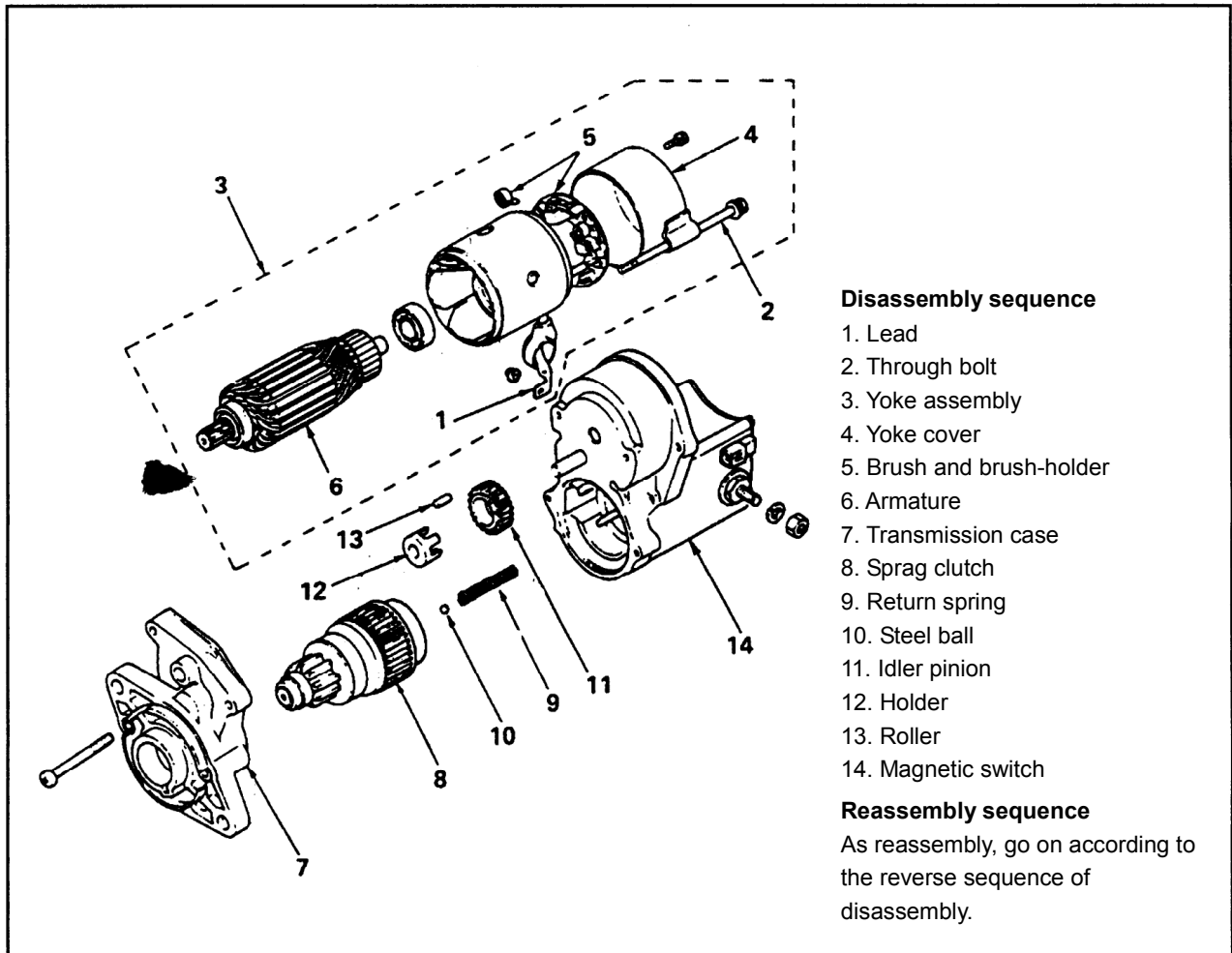
3. Ground cable terminal post
 - Connect the ground cable terminal post.
2. "50" terminal post
 - Connect the wire connector.
1. "30" terminal post
 - Connect the battery cable and start switch wire terminal posts, and tighten nuts to the specified torque.

Fixing nut torque	N·m
-------------------	-----

9

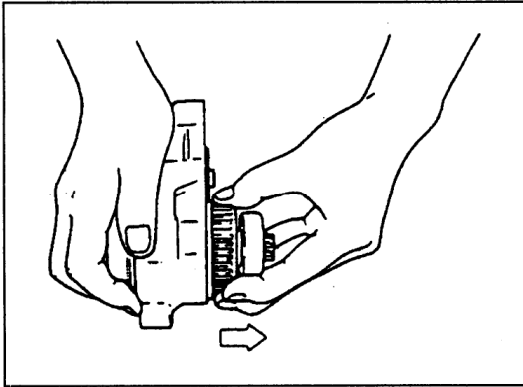


Single-piece repair

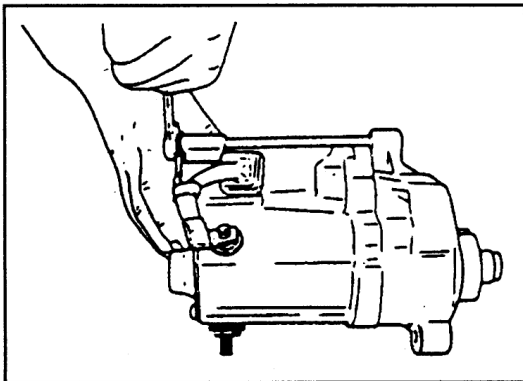


Disassembly

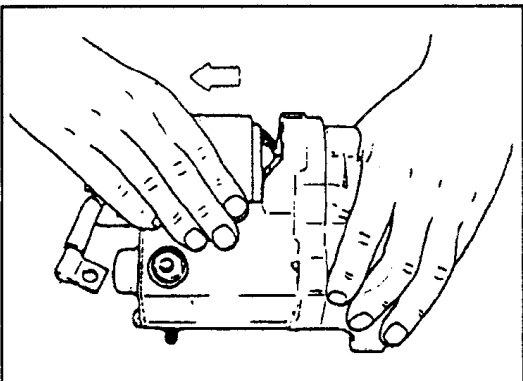
1. Lead
Remove the magnetic switch lead.



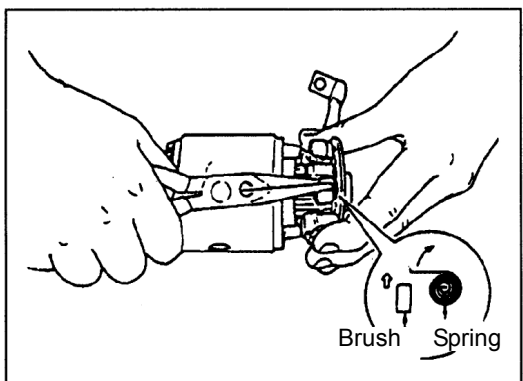
2. Through bolt
Unscrew the yoke through bolt.



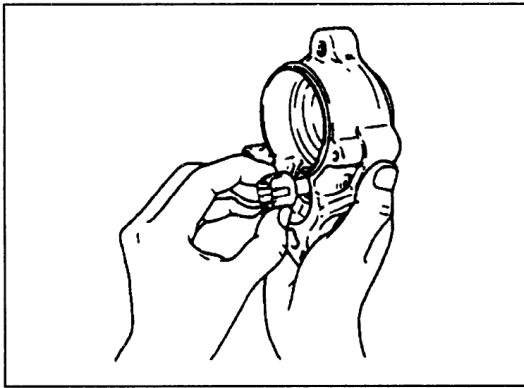
3. Yoke assembly
Dismantle the magnetic switch yoke.
4. Yoke cover



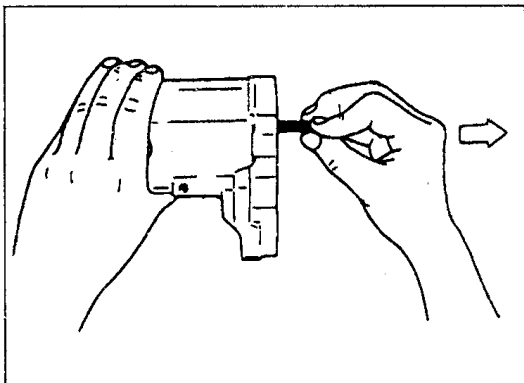
5. Brush and brush-holder
Remove (pull out) the brush and brush-holder from the armature with long nose pliers.
6. Armature
7. Case



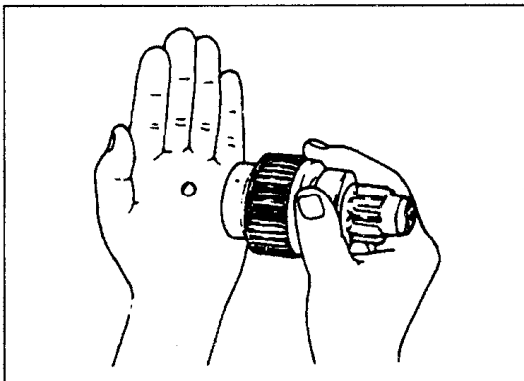
8. Sprag clutch
Remove the sprag clutch from the case



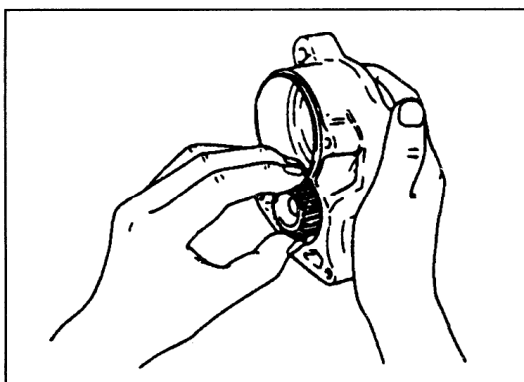
9. Return spring
Remove the return spring from the magnetic spring.



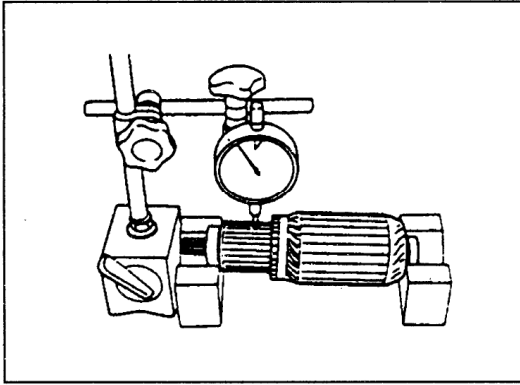
10. Steel ball
Dismantle the steel ball from the sprag clutch.



11. Idler pinion
Remove the idler pinion from the case.



12. Holder
Remove the holder from the case.
13. Roller
14. Magnetic switch



Inspection and repair

If during inspection it is found that some parts are worn-out, damaged or flawed, remove or replace these parts.

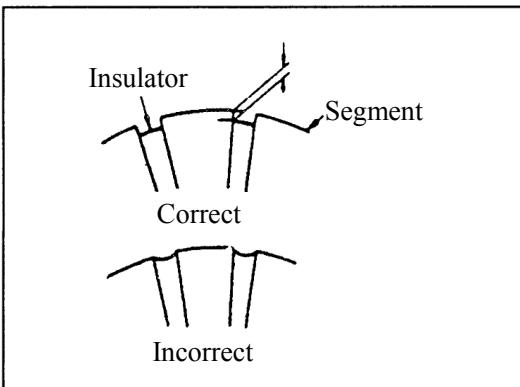


Armature

Check the radial runout of the commutator. If the runout exceeds the limits, replace the commutator.

Radial runout mm

kW	Standard value	Limit
2.2	0.02	0.05
2.0		



Check if the mica sheet is worn-out.

The depth of mica sheet mm

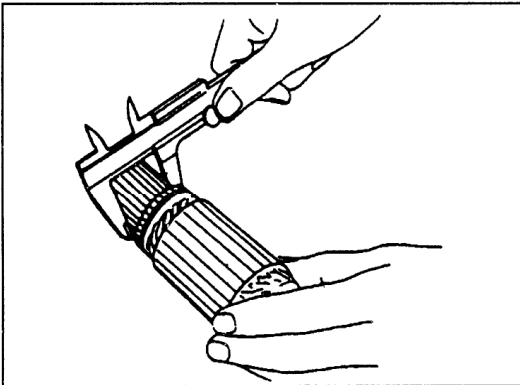
kW	Standard value	Limit
2.2	0.7—0.9	0.20
2.0		



Check the outer diameter of the commutator.

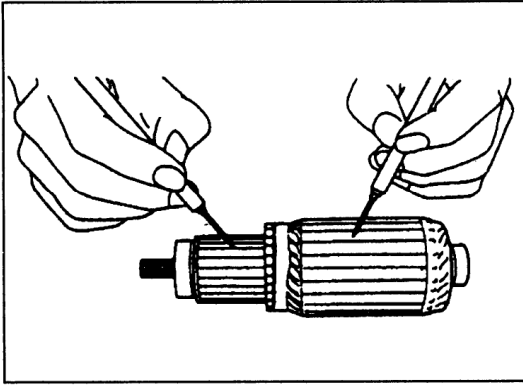
Outer diameter of the commutator mm

kW	Standard value	Limit
2.2	35.00	34.00
2.0		



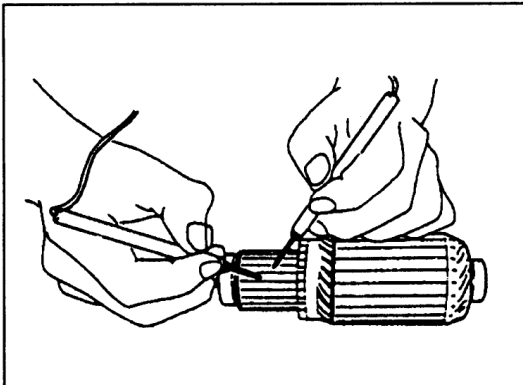
Short circuit test for the armature

Place the armature in the coil short circuit tester to check if there is any short circuit in the armature. Touch the armature core with a piece of saw blade when rotating the armature slowly. It will cause the saw blade to vibrate and stick to the core if the armature is in short-circuit state. If the saw blade vibrates and sticks to the core, you have to replace the armature for it is short-circuited.



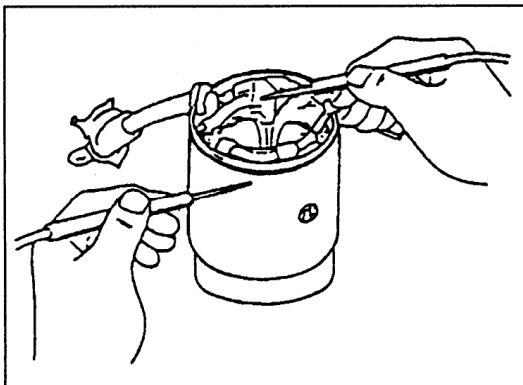
Earth test for the armature

Touch the segment and armature core with test probes of the multimeter to check if the armature is in open-circuit state. If the armature circuit is closed, it means the armature has been earthed. If this is the case, replace the armature.



Closed circuit test for the armature

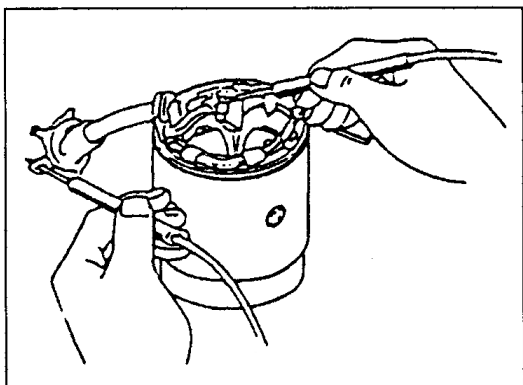
Touch two segments with both test probes of the multimeter. All test points should be in closed-circuit state. If there is any open circuit, replace the armature.



Yoke

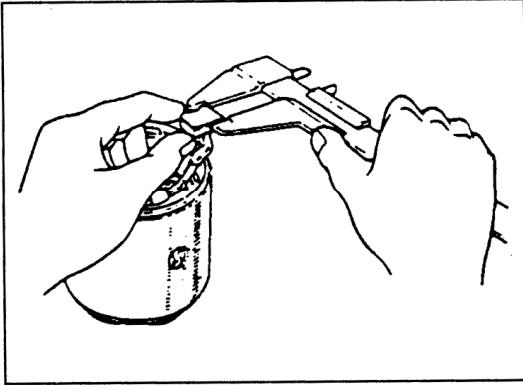
Earth test for the field winding

Touch the field winding wire or brush with one test probe of the multimeter and the yoke outer surface with another test probe to check if the winding is in open-circuit state. If the multimeter shows a closed circuit, it means the field winding has been earthed and you have to replace the yoke assembly.



Closed circuit test for the field winding

Touch the "C" terminal post wire with one test probe and the brush with another test probe to check if the field winding is in closed-circuit state. If there is an open circuit, replace the yoke assembly.

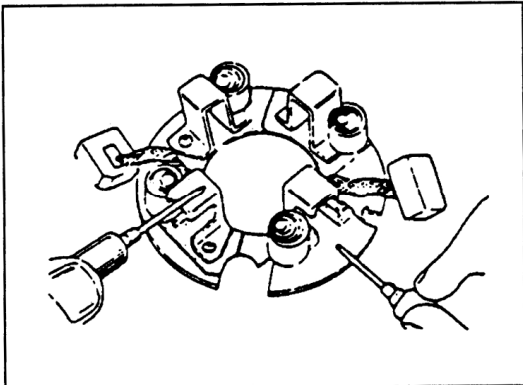


Brush and brush-holder

Measure the brush length. If the worn-out length exceeds the limit, replace the brush.

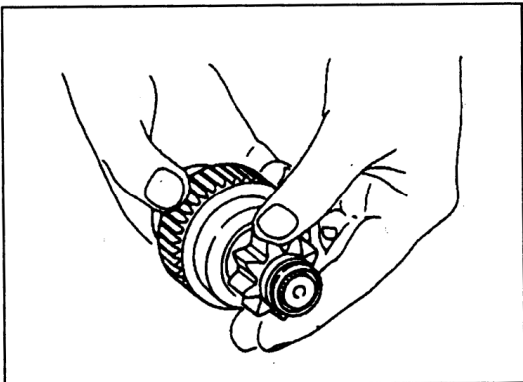
Brush length mm

kW	Standard value	Limit
2.2	14.5	10
2.0	16	



Insulation test for the brush-holder

Check if the brush-holder is insulated with a multimeter. Touch the brush-holder plate with one test probe and the positive brush-holder with another test probe. The brush-holder should be in open-circuit state.

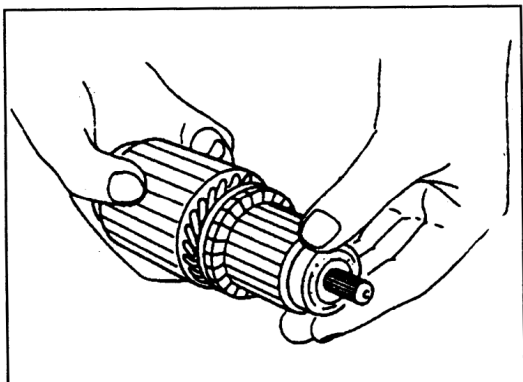


Sprag clutch

Check whether the pinion teeth are worn-out or damaged and replace the pinion if so.

It should be smoothly to turn the pinion clockwise.

But when the pinion is turned anti-clockwise, it should be locked up.



Bearing

Check if the bearings are worn-out and damaged. If there is any noise during bearing operation, you have to replace the bearings.

Reassembly

As reassembly, go on according to the reverse sequence of disassembly and pay attention to the following items:

- magnetic switch
- Idler
- Clutch assembly
- Case

1) Install the clutch assembly to the magnetic switch.

2) Mount the idler and case.

Note:

Remember to mount the steel ball and spring between the clutch and magnetic switch. Install the roller onto the idler beforehand.

Magnetic switch

Temporarily mount a magnetic switch between the clutch and case and carry out the following tests. The duration of each test should not be longer than 3 to 5 seconds.

1. Test of pullout binding force

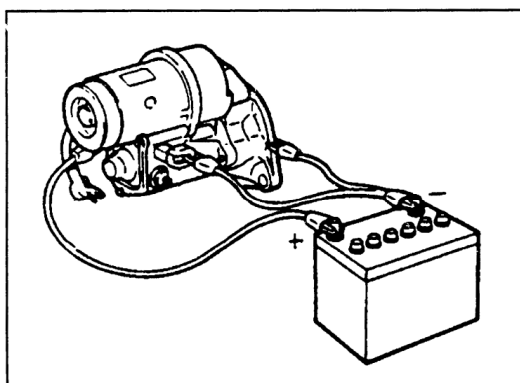
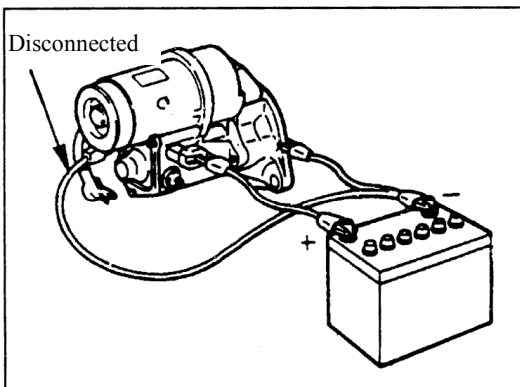
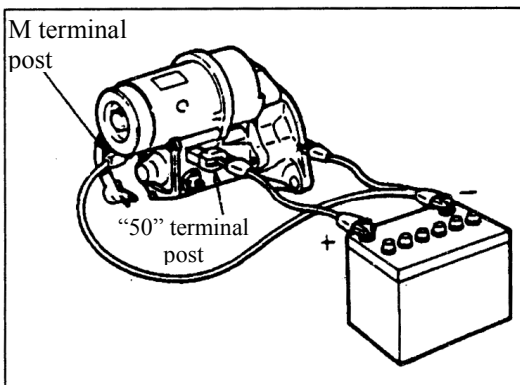
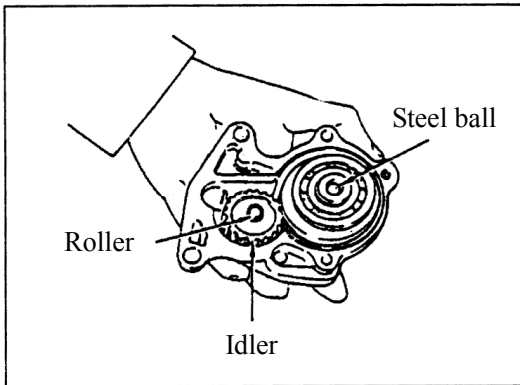
The negative terminal post of the battery is connected to the magnetic body and M terminal post. While the current is flowing from the positive terminal post to the "50" terminal post, the pinion should chatter.

2. Holding test

Remove the M terminal post wire. The pinion remains chattering.

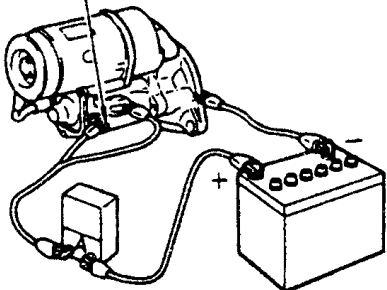
3. Return test

The negative battery terminal post is connected to the "50" terminal post and case. The positive battery terminal post is connected to the M terminal post. At this time the pinion should chatter. After the "50" terminal post wire is removed, the pinion should return to its original position immediately.





“30” terminal post



4. Current value

Complete the circuit according to the diagram and measure the current value.

Standard value = 120A or lower

Notes:

You should use fully charged batteries.

Choose heavy gage wire for the flowing-through high current.



This diagram illustrates the exploded view of a diesel engine assembly. The components are numbered as follows:

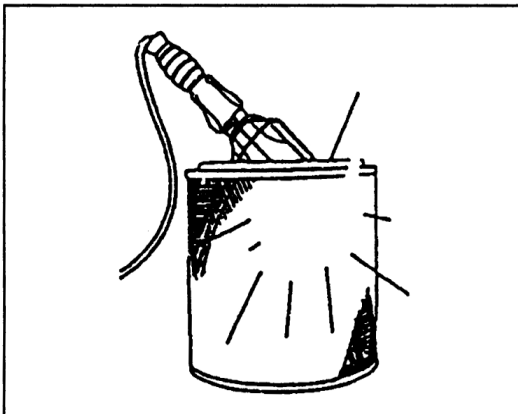
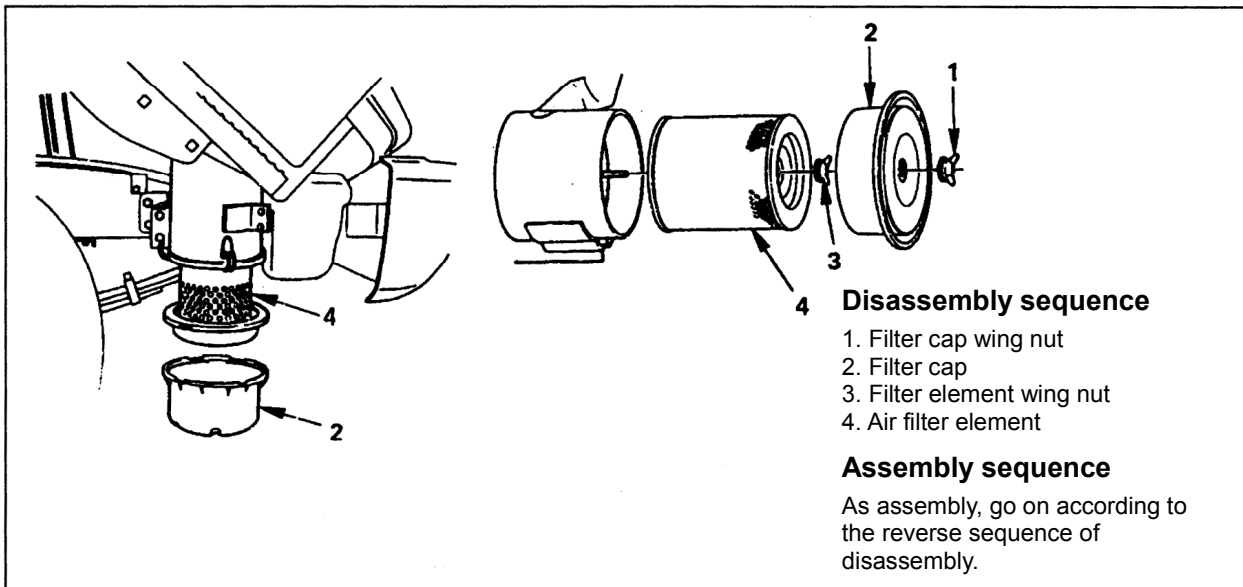
- 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40
- Referenced part: 参照 (Reference)

The assembly includes various components such as the cylinder head, intake manifold, fuel system, and exhaust system, shown in their relative positions for assembly.

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7.1 Air filter



Disassembly

1. Filter cap wing nut
2. Filter cap
3. Filter element wing nut
4. Air filter element

Cleaning

- Clean the air filter inside.
- Clean the air filter cap.

Inspection

- Check if the air filter element is intact and clear or with holes by light.

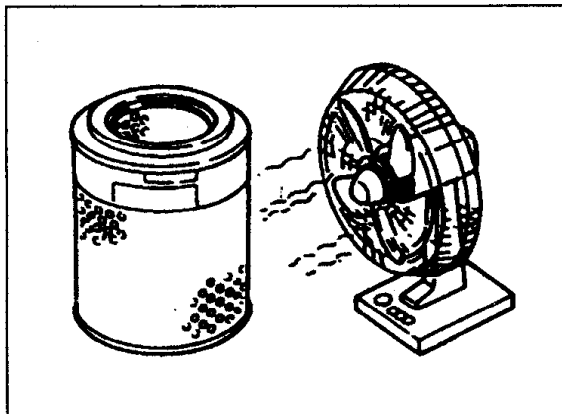
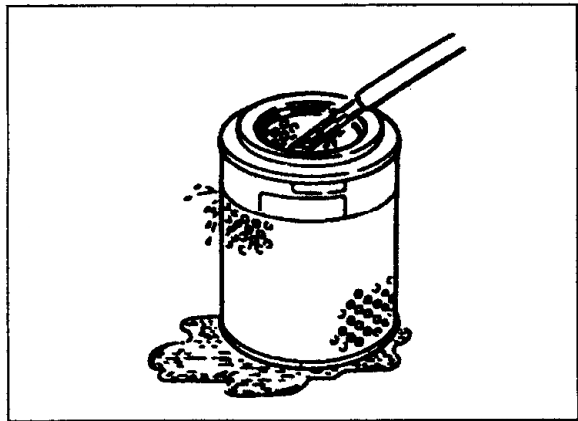
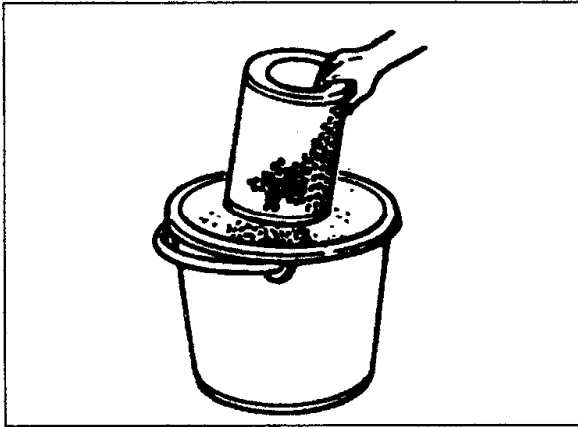
Cleaning method



Dust accumulated at the filter element

Manually turn the filter element and blow the compressor air into the element in order to blow off the dust.

Pressure of compressed air	kPa
392—490	



Caution:

In order to protect the filter element, do not knock the element with other objects during cleaning.

Filter element with carbon and dust accumulated

1. Prepare the filter cleaning liquid originally provided by JAC and dilute it with water.
2. Immerse the filter element in the cleaning liquid for 20 minutes.
3. Take the element out of the cleaning liquid and flush it with running water. The water pressure should not exceed 2.8kg / cm² (274kPa / 40psi).
4. Dry the filter element at a place with good ventilation. Use a fan for quick drying.

Note:

Never use the compressed air or open fire for quick drying or it will damage the filter element. It will take two to three days to completely dry a filter element. In this case, it would be better if a standby element were available.

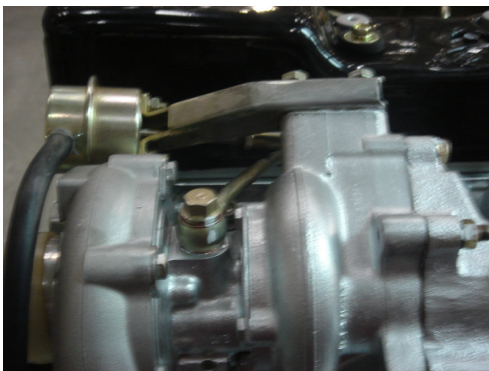
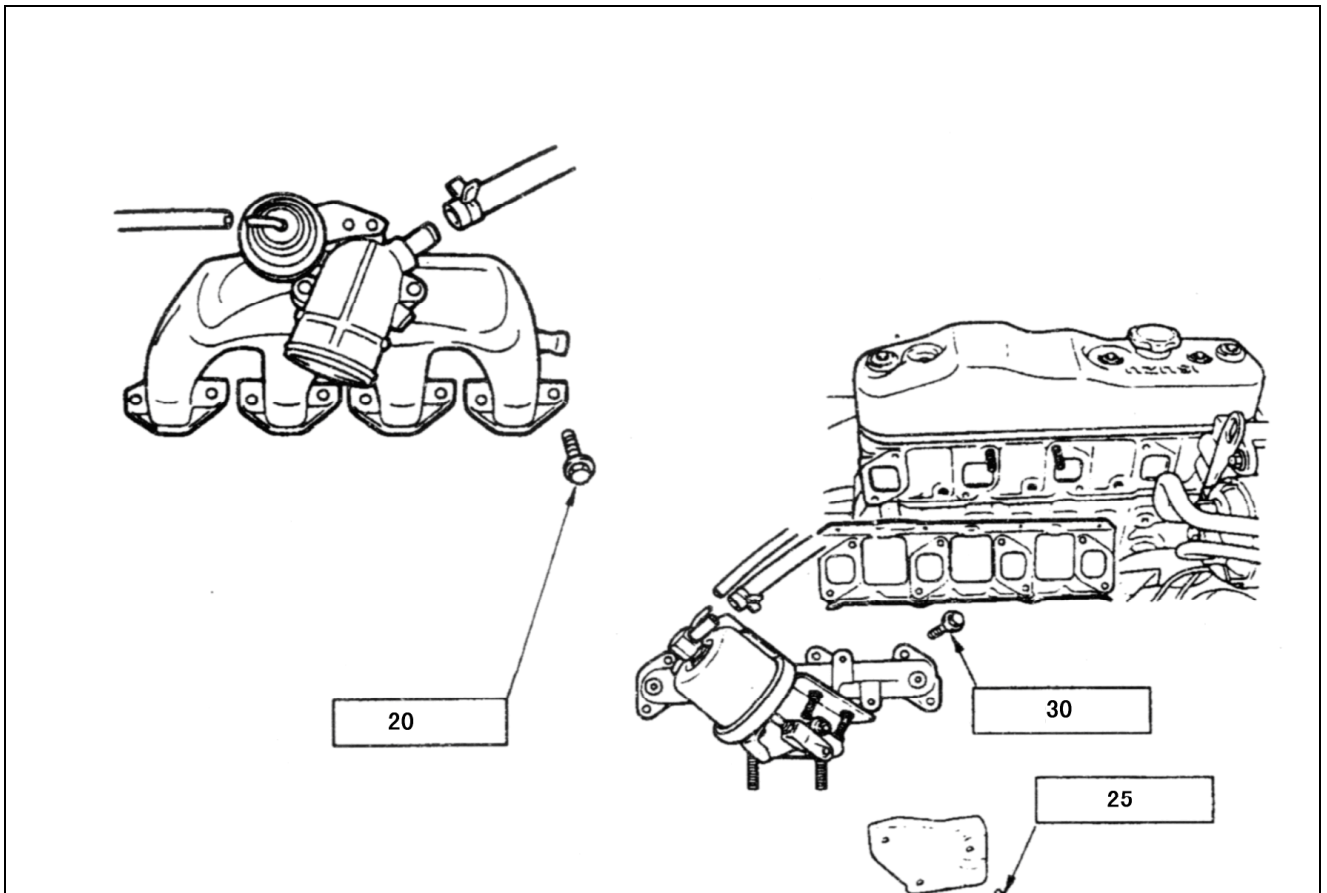


Assembly

4. Air filter element
3. Filter element wing nut
2. Filter cap
1. Filter cap wing nut

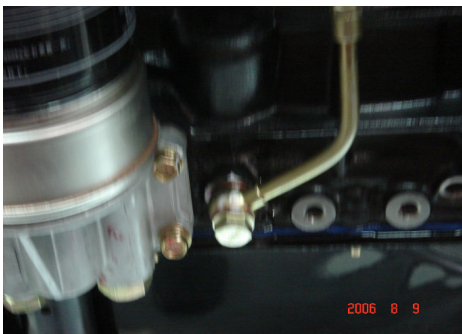


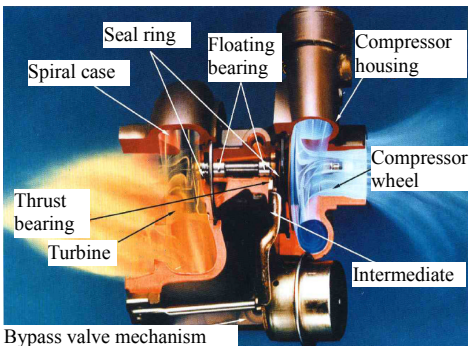
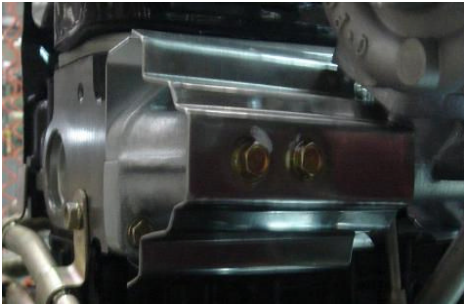
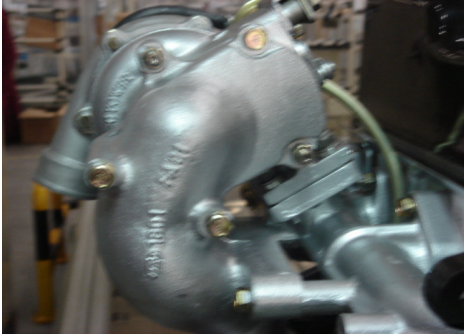
7.2 Exhaust pipe and charger assembly



Disassembly

1. Loosen the binding bolt(s) of the charger lubrication oil pipe with a wrench.





2. Unscrew the charger exhaust pipe bolt with a wrench and remove the charger exhaust pipe.

3. Remove the exhaust pipe heat insulator.

4. Remove the charger and exhaust manifold subassembly

5. Disassemble the charger assembly

Inspection

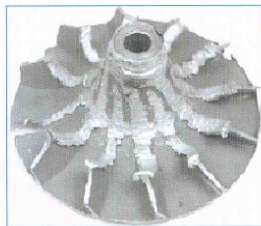
- (1) Check the airtightness and tightening of the connecting pipes between the air filter and charger and between the charger and engine intake/exhaust pipes.
- (2) Check if the fuel inlet/return hoses of the turbocharger are damaged or blocked and if the connecting bolt on the connector is tight.
- (3) Check of the oil quality and clean or replace the oil.
- (4) Check the air filter and clean or replace the element periodically.

Notes

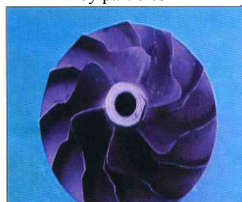
- (1) Protect the charger return pipe from being bended or damaged.
- (2) Make sure the fuel inlet/return hoses of the charger are unblocked.
- (3) Always check the airtightness of the connecting pipes between the charger and engine.
- (4) The duration of idle state shouldn't be too +long



Compressor impeller damaged by particles



Compressor impeller damaged by solid objects



Compressor impeller damaged by dust



Turbine impeller damaged by particles

- (5) Make sure the crankcase oil pipes are unblocked.
- (6) Prevent the lower blow-by gas of the engine to be too much

Faulty diagnosis:

The purpose of faulty diagnosis is to find out the diesel fault and its reason, so as to clear the fault. If the charger has been removed, you can't carry out the faulty diagnosis. Never replace the charger before finding out the fault and clear it.

Inspect and determine whether the charger is damaged directly according to the follow items:

- A) If the charger rotor rotates smoothly.
- B) Check if the compressor wheels are damaged via the compressor inlet.
- B) Check if the compressor wheels rub with the case via the compressor inlet.

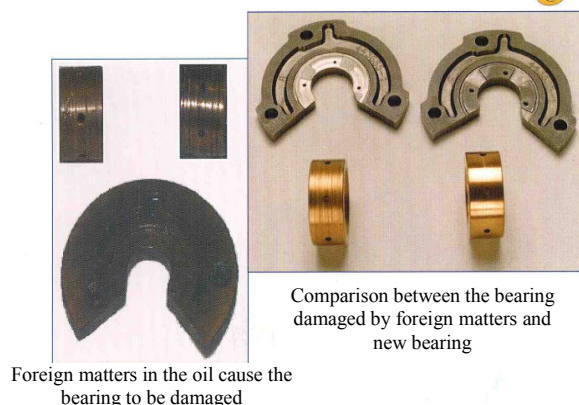
There are four main causes for charger failure:

- A) Foreign matters entering in
- B) Lubrication oil impure or aging
- C) Lack of lubrication oil
- D) Improper use and failure to maintain

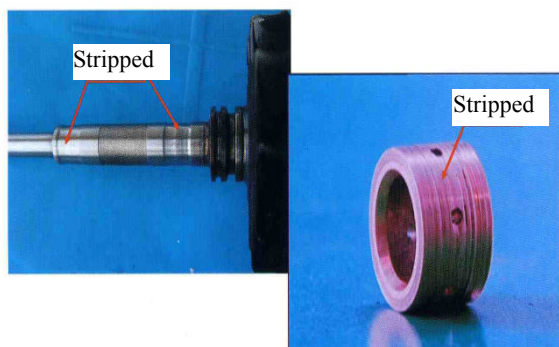
A)

- ①. Compressor side:
 - a. The seal for intake pipes is poor and the air directly goes into the compressor impeller without filtering;
 - b. Replace the air filter without consulting to the regulations or use poor quality filter element;
 - c. Foreign matters enter the front intake pipes during maintenance.
- ②. Turbine side:
 - a. Some parts in the diesel cylinder are damaged.
 - b. Objects like bolts have fell into the exhaust pipes while connecting the exhaust manifold.

Any matters going into the manifold will break the charger rotor balance, which will block the rotor and break the pivot ultimately.



Foreign matters in the oil cause the bearing to be damaged



Damage caused by foreign matters

B) Impure lubrication oil:

- Replace the lubrication oil filter without consulting to the regulations or use poor quality filter element
- The filter element has broken down or the filter in the main diesel oil gallery has been blocked.
- Replace the lubrication oil without consulting to the regulations, and didn't clean the main diesel oil gallery before replacing the oil.
- Foreign matters have fell into the lubrication oil pipe during charger replacing or pre-fabrication.
- The sealer or gasket fragments have fell into the lubrication oil gallery.

C) Lubrication oil insufficient or aging:

- Replace the lubrication oil without consulting to the regulations or use inferior oil;
- The diesel stops abruptly after heavy-load operation without idling;
- The engine starts without idling;
- There is no pre-fabrication before replacing the charger



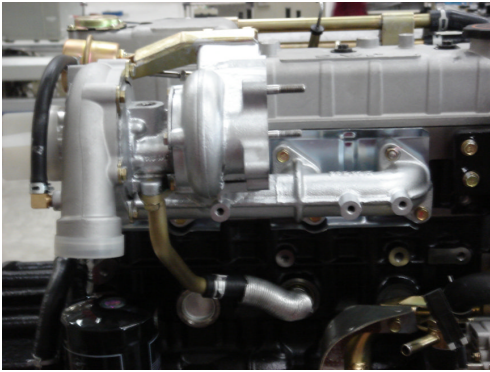
Assembly

- Install the charger assembly and tighten the charger union nut (remember to replace the gasket during charger installation)

Nut tighten torque Nm

25

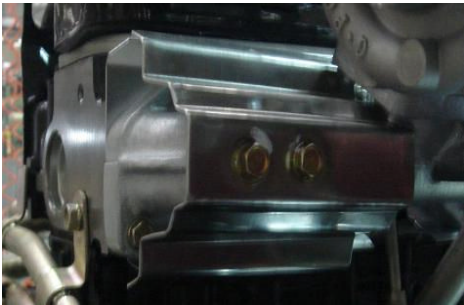




4. Install the charger and exhaust manifold subassembly to the cylinder head (remember to replace the exhaust pipe gasket)

Bolt tighten torque	Nm
---------------------	----

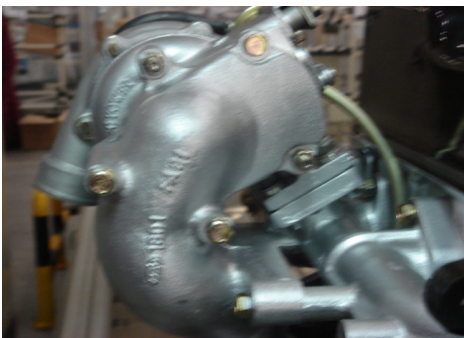
30



3. Remove the exhaust pipe heat insulator.

Bolt tighten torque	Nm
---------------------	----

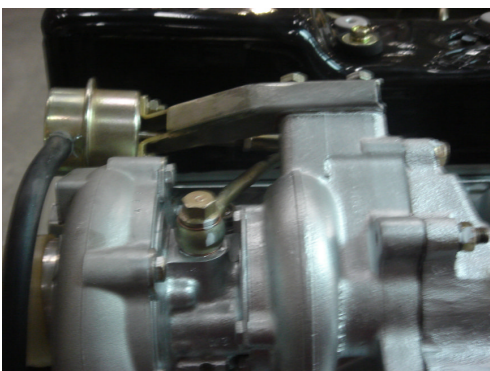
25



2. Connect the charger exhaust pipe and tighten the connecting bolt

Bolt tighten torque	Nm
---------------------	----

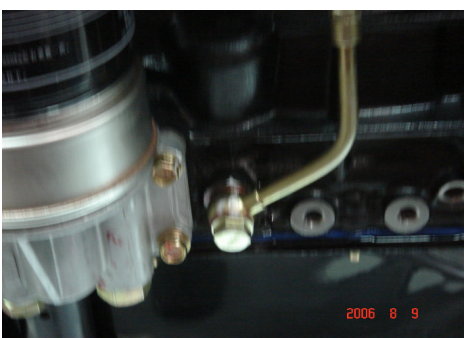
25



1. Connect the charger lubrication oil pipe and tighten the two punching bolts

Punching bolt II (M12) tighten torque	Nm
---------------------------------------	----

41



Punching bolt I (M14) tighten torque	Nm
--------------------------------------	----

55

Section II

Chassis

Clutch

Clutch equipment

General

Main technical parameters

Clutch assembly

Clutch control equipment

Clutch master cylinder

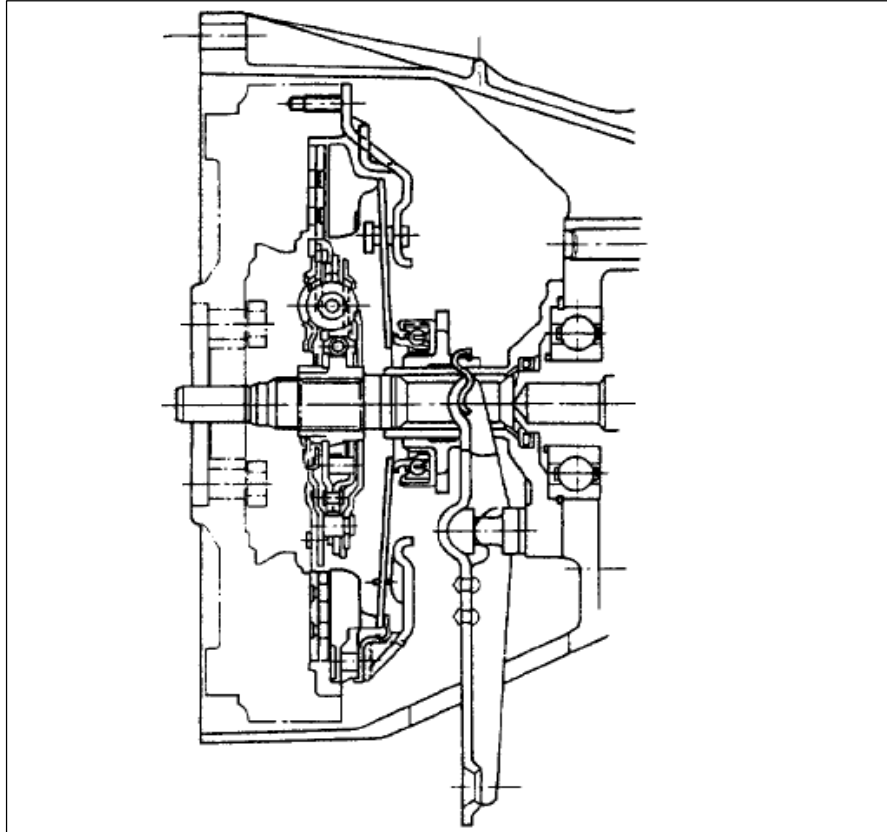
Clutch cylinder

Troubleshooting

Clutch

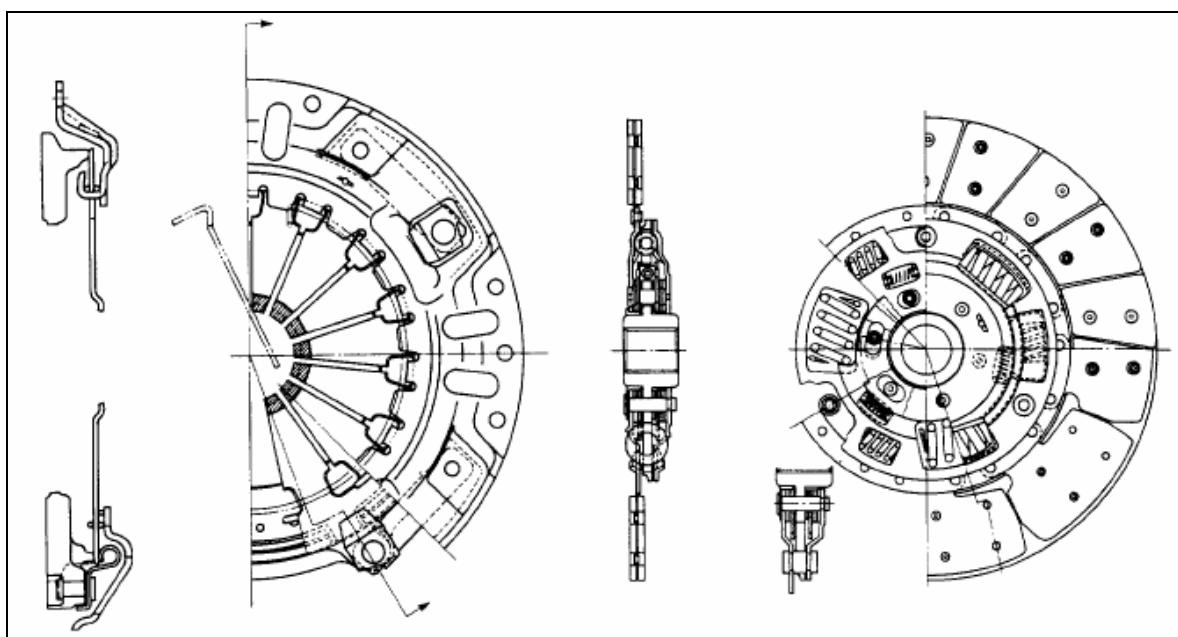
General

Clutch assembly



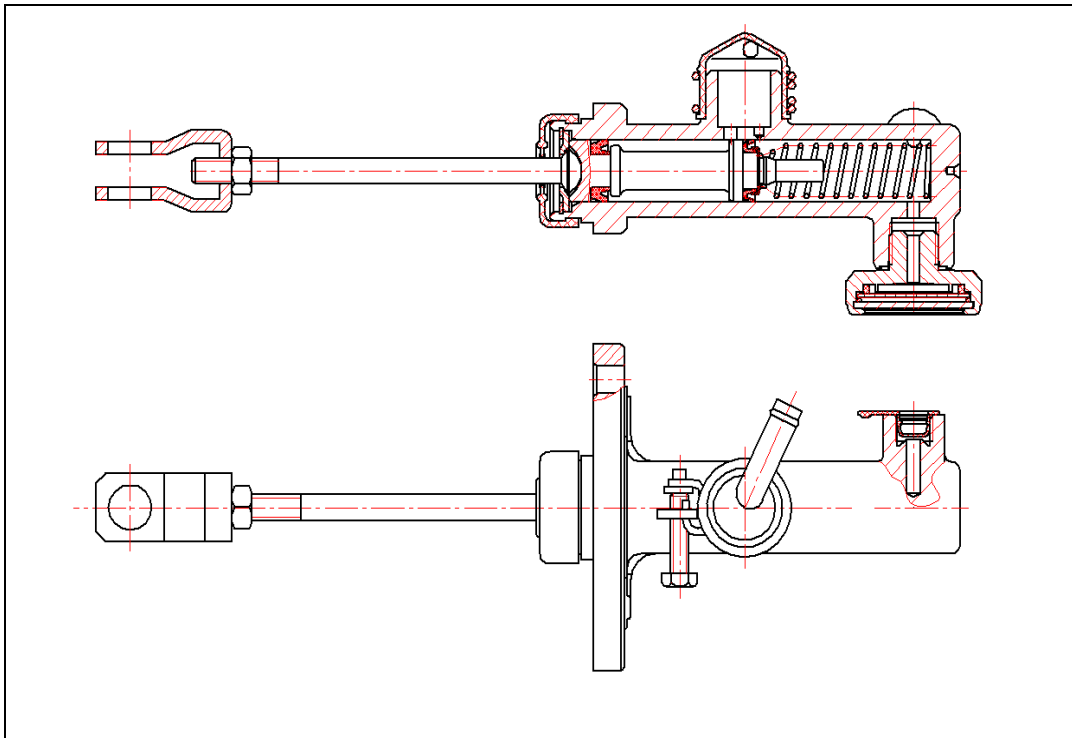
Clutch pressure plate assembly

Clutch slave disc assembly

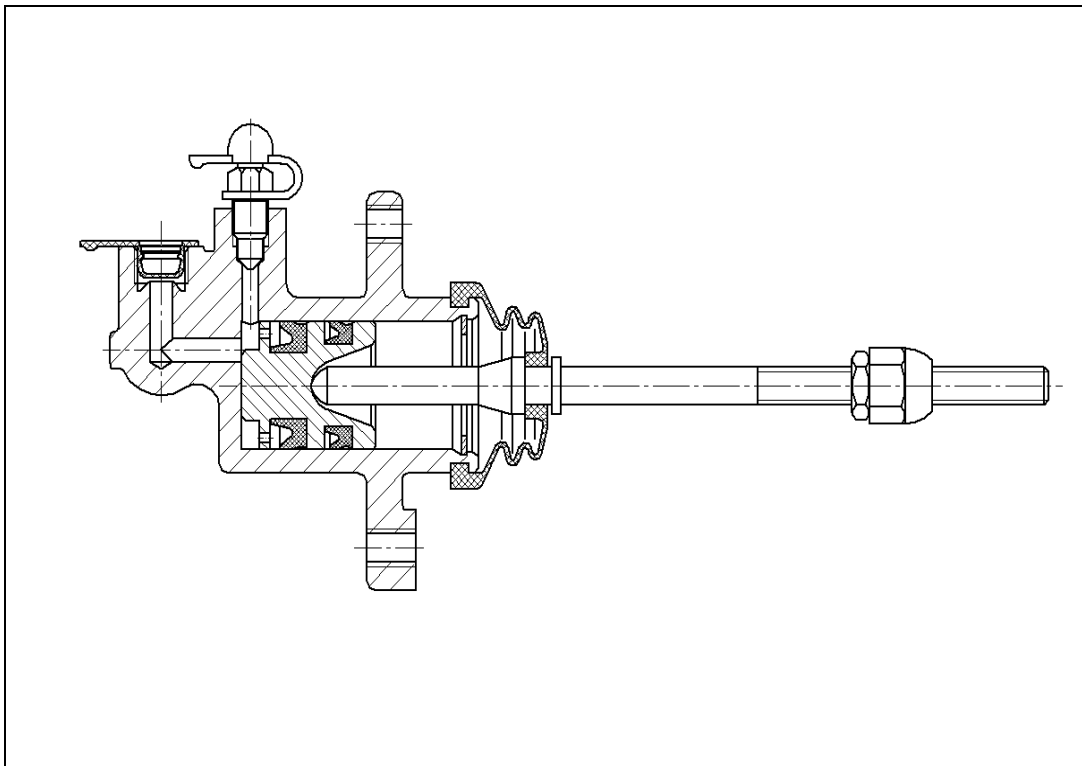


Clutch

Clutch master cylinder



Clutch cylinder



Clutch

Main technical parameters

Slave disc

Type	Dry single diaphragm type with damping spring
Size	Φ250mm
Quantity of damping springs	4

Friction disc

ID×OD	160×250
Quantity × thickness	2×3.5

Pressure plate

Type	Diaphragm spring
Max. pressing force	6276N

Hydraulic cylinder

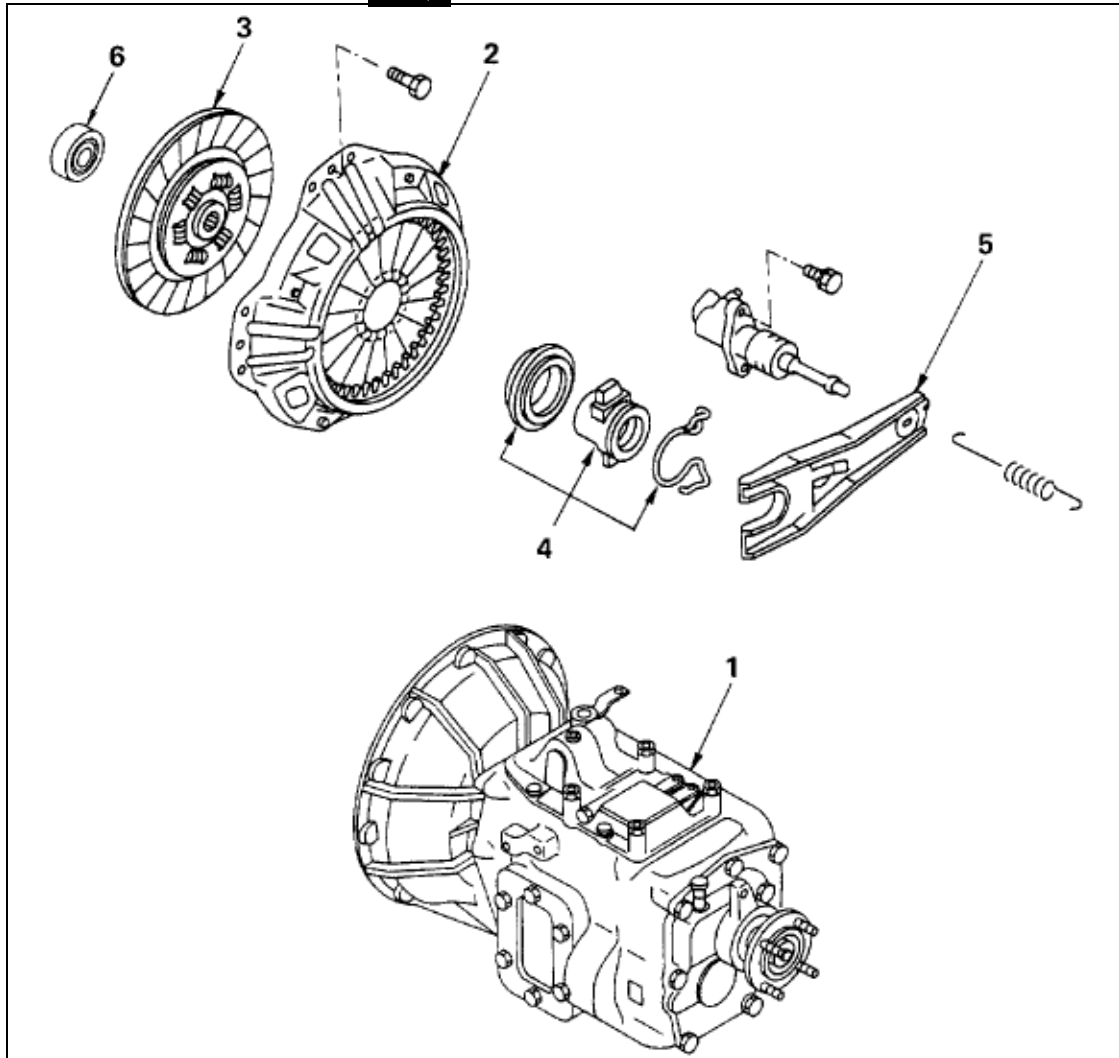
Clutch master cylinder bore × stroke	Φ19.05×35 (mm)
Clutch cylinder bore × stroke	Φ26.99×19.05 (mm)

Clutch

Clutch assembly



Disassembling drawing



Disassembling sequence

1. Transmission assembly; 2. Clutch pressure plate; 3. Clutch slave disc 4. Release sleeve;
5. Disengaging fork; 6. Guide bearing

Clutch

Steps of disassembling (according to sequence)

Jack up the vehicle and safely support it.

1. Remove transmission (for operations, refer to the transmission part of this manual)
2. Pressure plate assembly;
3. Slave disc assembly.

Use a guide axle to prevent free sipping and fall of slave disc assembly.

Make markings on flywheel and pressure plate, which shall be used for alignment during reassembling.

4. Remove **clutch release fork**.
5. Release sleeve assembly.

Remove release sleeve along with return spring.



Caution: Avoid flow of brake fluid onto painted surfaces during disassembling.

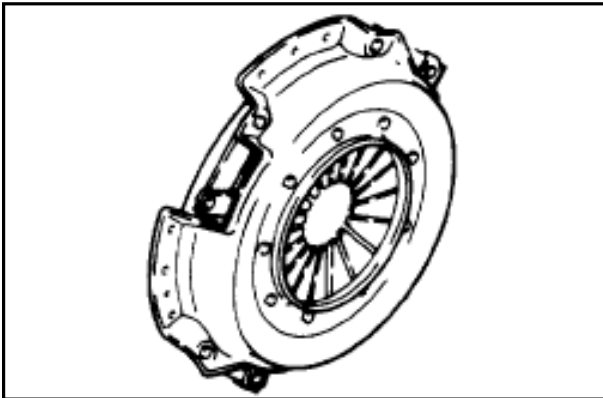
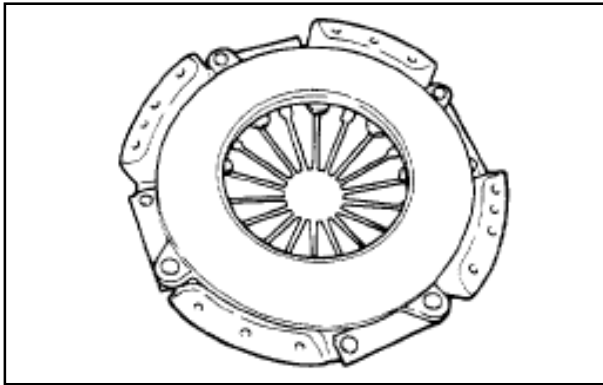
Immediately wipe out any such fluid on painted surfaces.



Inspection and repair

In case of excessive wear, damage or other fault found during inspection, make necessary adjustment and repair, or replace corresponding parts.

Clutch



Pressure plate assembly

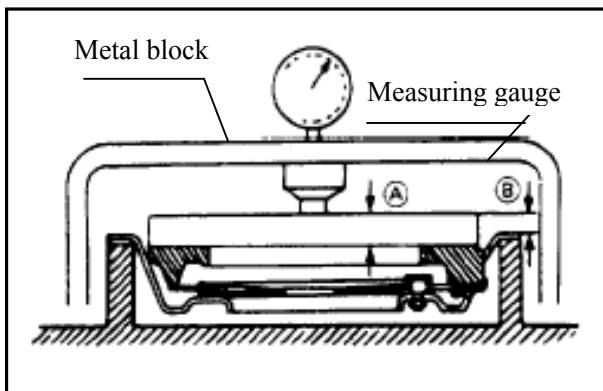
Perform visual inspection of pressure plate wear, thermal crack, bending deform. In case of excessive wear or bending deform, or too deep thermal crack, replace the pressure plate.

(Pressure plate deformation—— measure planeness of pressure plate friction face; replace pressure plate assembly if the limit value is exceeded. Limit: 0.3mm)



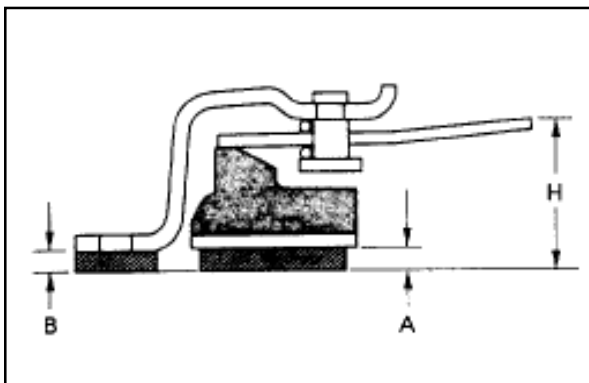
Clutch cover

Perform visual inspection of wear, crack or other damage of the whole clutch cover. Clutch cover with excessive wear, crack or other damage must be replaced.



Mounting pressing force

- 1) Put clutch pressure plate upside-down;
 - 2) Place an 8mm thick metal block on pressure plate;
 - 3) Press pressure plate down till distance "B" is 0mm.
 - 4) Record pressure reading on the gauge.
- Standard pressure: 6276N

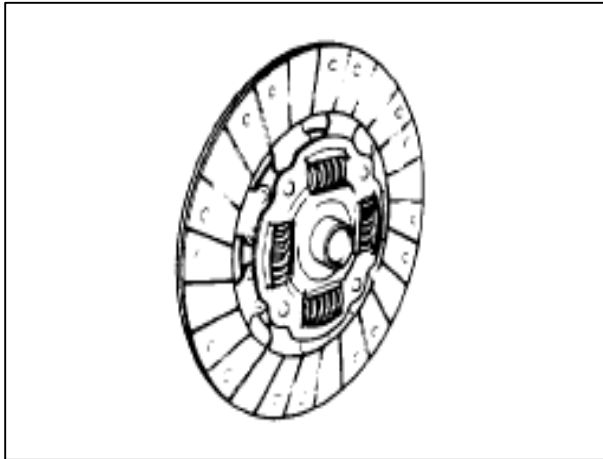


Height of diaphragm spring disengaging finger

- 1) Place an 8mm thick metal block under pressure plate
- 2) Press pressure plate down till distance "B" is 0mm. 2 methods can be used:
 - a. press top of pressure plate down;
 - b. tighten pressure plate mounting bolts.
- 3) Measure from base plane to disengaging finger end.

Standard height: 40±1mm

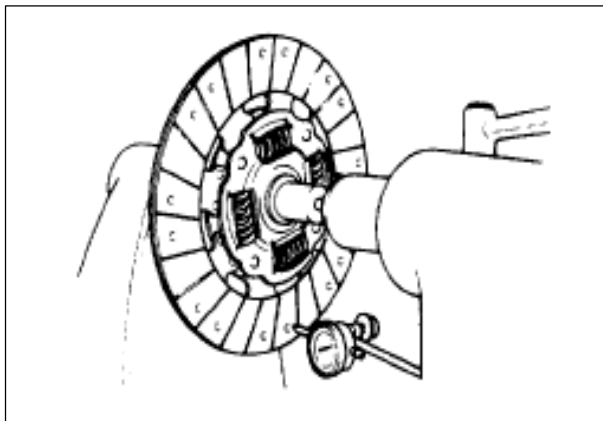
Clutch



Slave disc assembly

Visually check **torsion spring** for looseness, softening and cracking; in case of any of these, replace slave disc assembly.

Visually check friction surface for crack, grease or excessive charring; in case of any of these, clean or replace slave disc assembly. Check if this assembly can move smoothly on transmission first shaft spline.



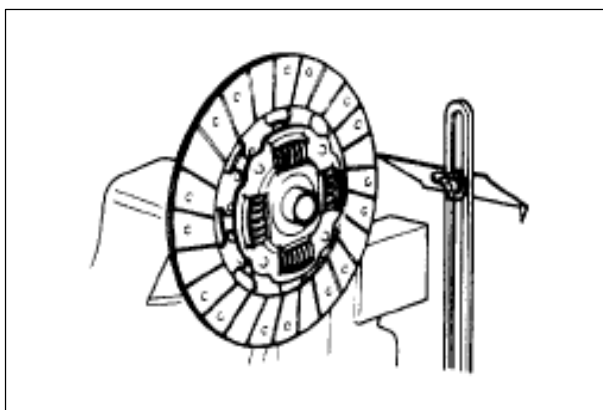
Deform of slave disc

Insert guide axle in spline hub.

Guide axle must be kept very smooth and straight. Fit a scale gauge on slave disc outer circle and slowly rotate slave disc assembly to obtain reading on the gauge.

If measured value exceeds a limit, replace slave disc assembly.

Limit value: 1.0mm



Wear of slave disc spline hub

Clean insides of spline hub.

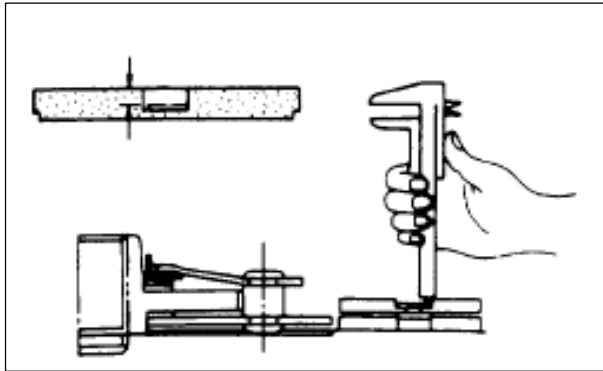
Fit slave disc on transmission 1st shaft spline.

Fit a surface measuring instrument on outer circle of slave disc. Slowly rotate slave disc and measure change of outer circle.

Replace slave disc assembly if measured value exceeds a limit.

Wear limit of slave disc spline hub: 1.0mm

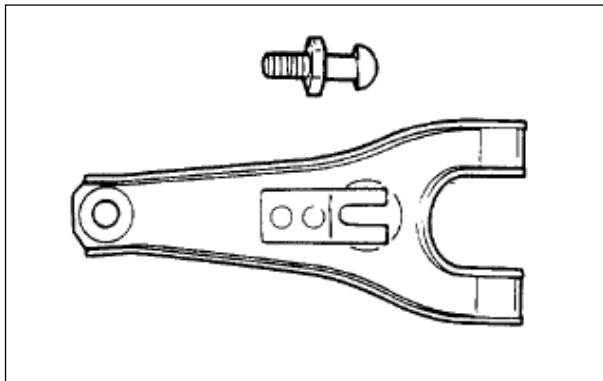
Clutch



Slave disc rivet head depth

Use a depth gauge to measure distance from rivet head to friction surface. Measure both sides. If measured value is less than a limit. Replace slave disc assembly.

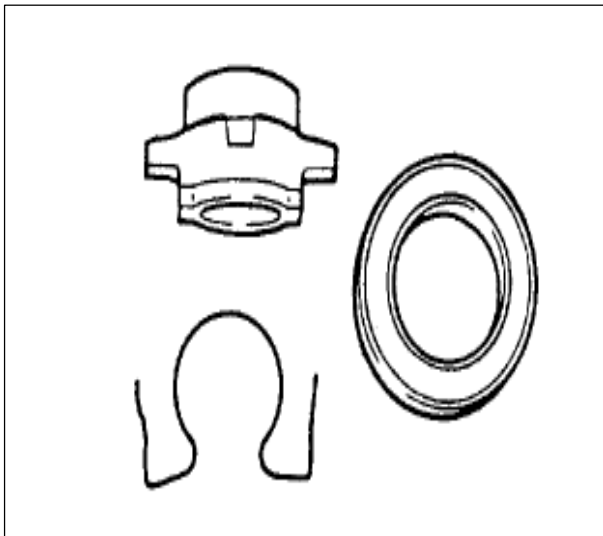
Rivet head depth limit: 0.2mm



Release yoke and support

Visually check surface of release yoke in contact with release sleeve and support.

Replace part in case of excessive wear or surface roughness.



Release sleeve assembly

Before disassembling release sleeve assembly, check wear and roughing of release sleeve assembly.

A. Surface of release bearing is rough or noise is heard in rotation when being lightly pressed.

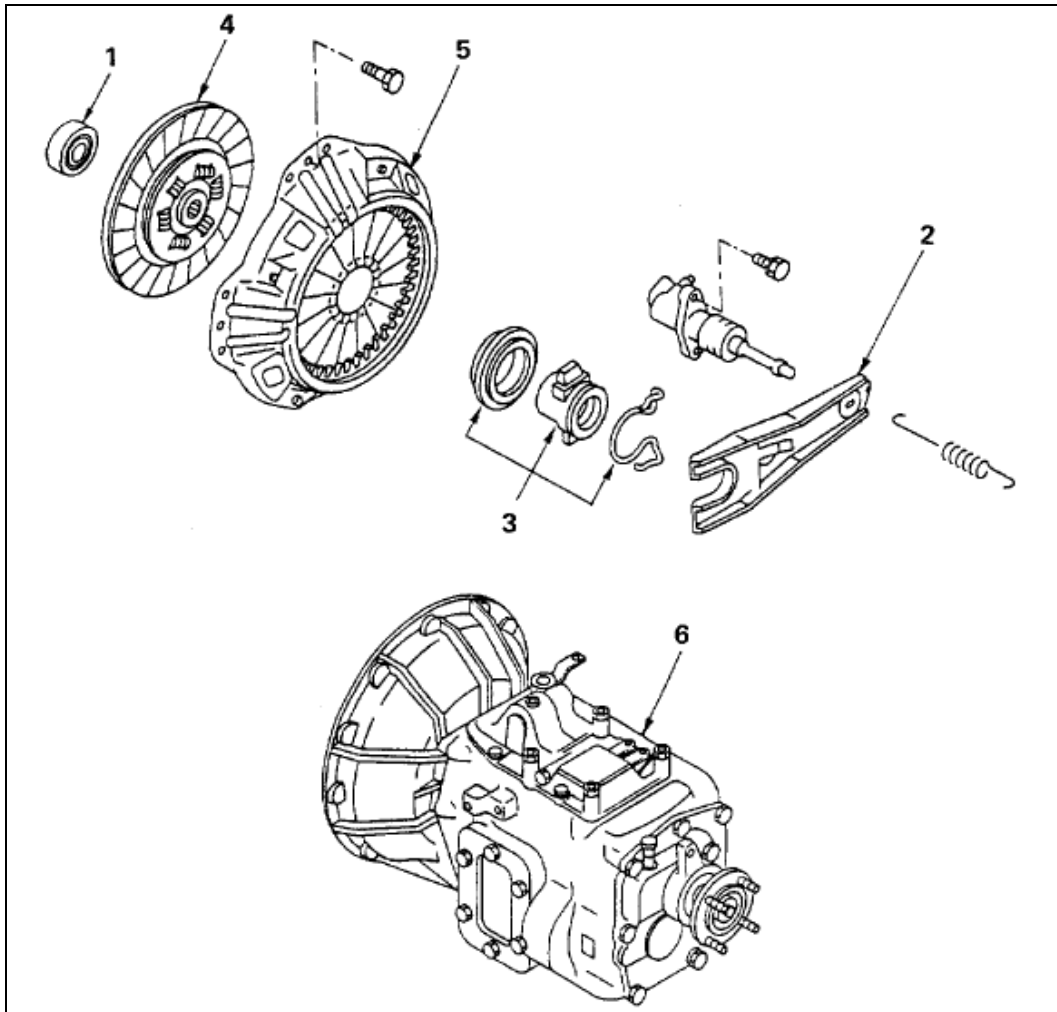
B. Surface is rough or damaged (surface in contact with release yoke and release bearing front cover face).

Warning: The release bearing is loaded with lubricant in advance. Do not place this bearing in solvent for cleaning, as this will dissolve the lubricant. Note that do not disassemble the release sleeve if there is no problem. Visually check return spring for cracking and softening. Part replacement is required in case of such situations.

Clutch



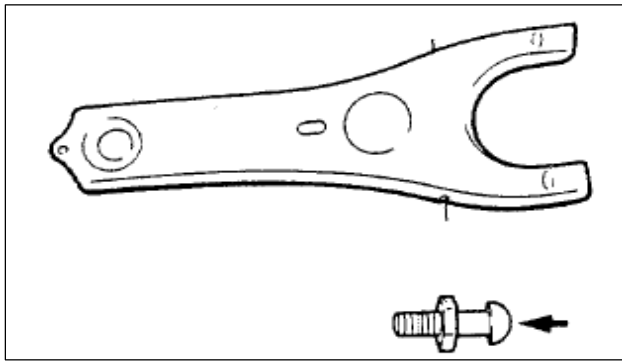
Reassembling



Sequence of reassembling

1. Guide bearing; 2. Clutch release fork; 3. Release sleeve assembly; 4. Slave disc assembly;
5. Pressure plate assembly; 6. Transmission

Clutch



Reassembling steps

1. Release yoke

Apply Supramoly multi-purpose grease on surface of release yoke in contact with release sleeve assembly and support.

2. Release sleeve assembly

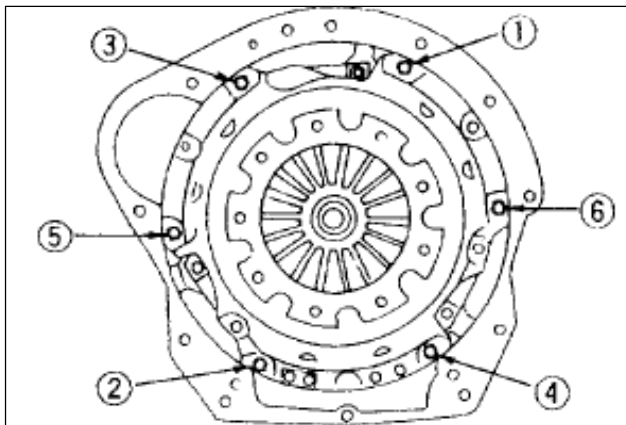
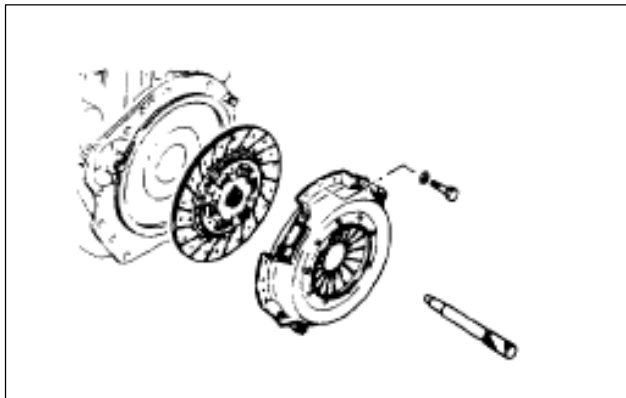
it release sleeve with return spring.

3. Slave disc assembly

4. Pressure plate assembly

Apply Supramoly multi-purpose grease inside slave disc spline hub.

Use guide axle to install slave disc assembly.



Tighten pressure plate mounting bolts in the sequence shown by numbers.

Tightening torque for pressure plate mounting bolts: 18N·m

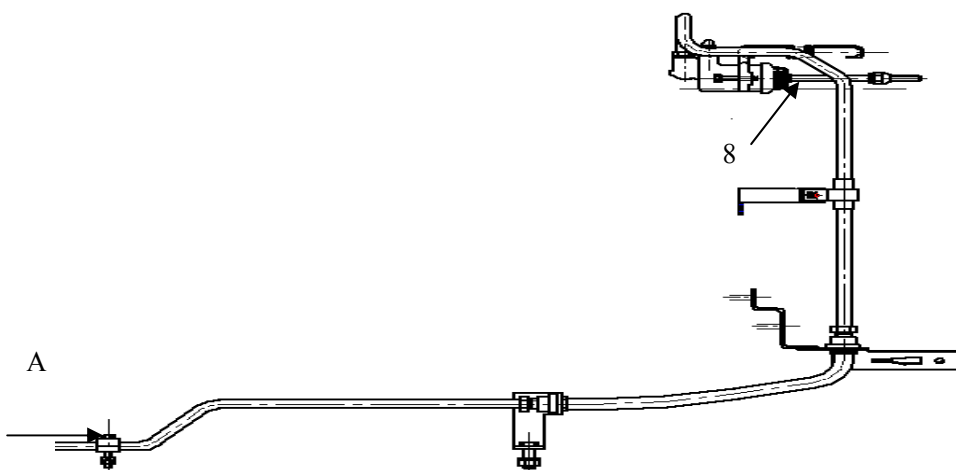
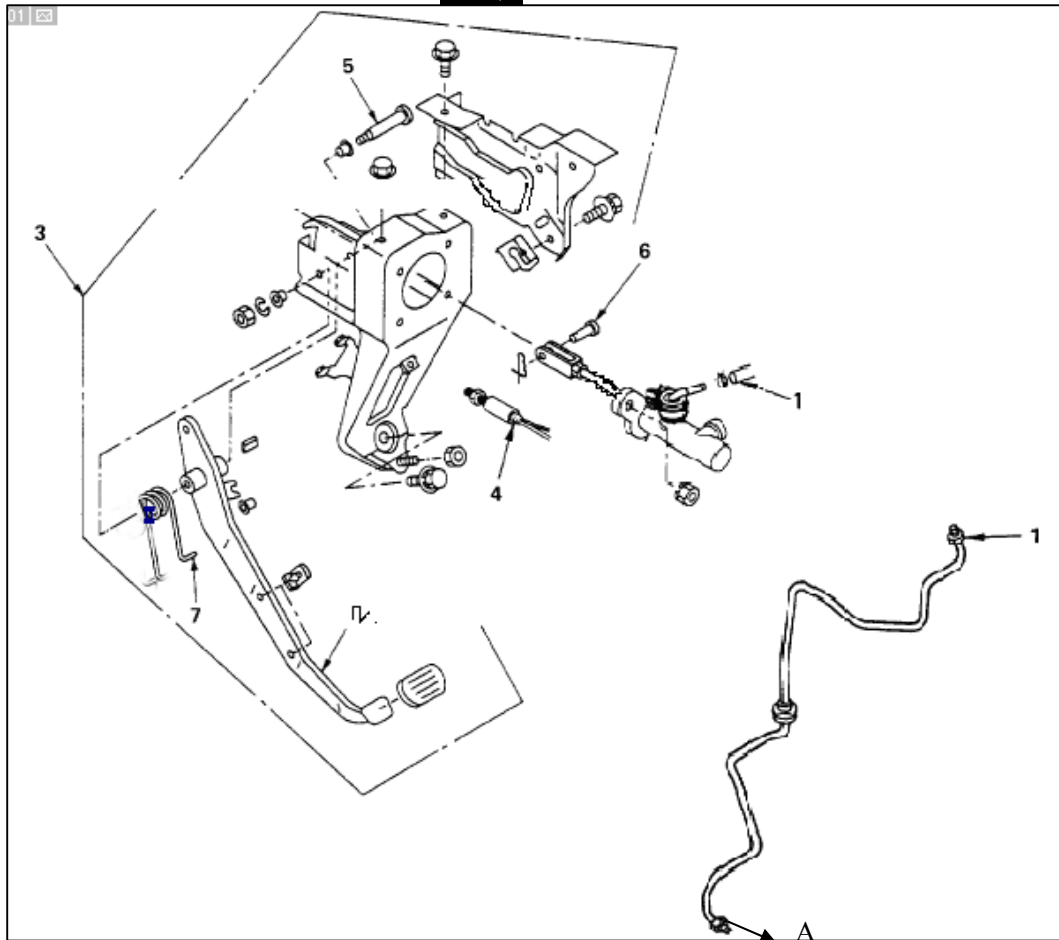
Warning: After tightening of pressure plate mounting bolts, remove steel wire protecting diaphragm spring.

Clutch

Clutch control equipment



Disassembling



Disassembling sequence

1. Clutch pipe and hose; 2. Clutch pedal; 3. Clutch pedal and support assembly; 4. Clutch switch

Clutch

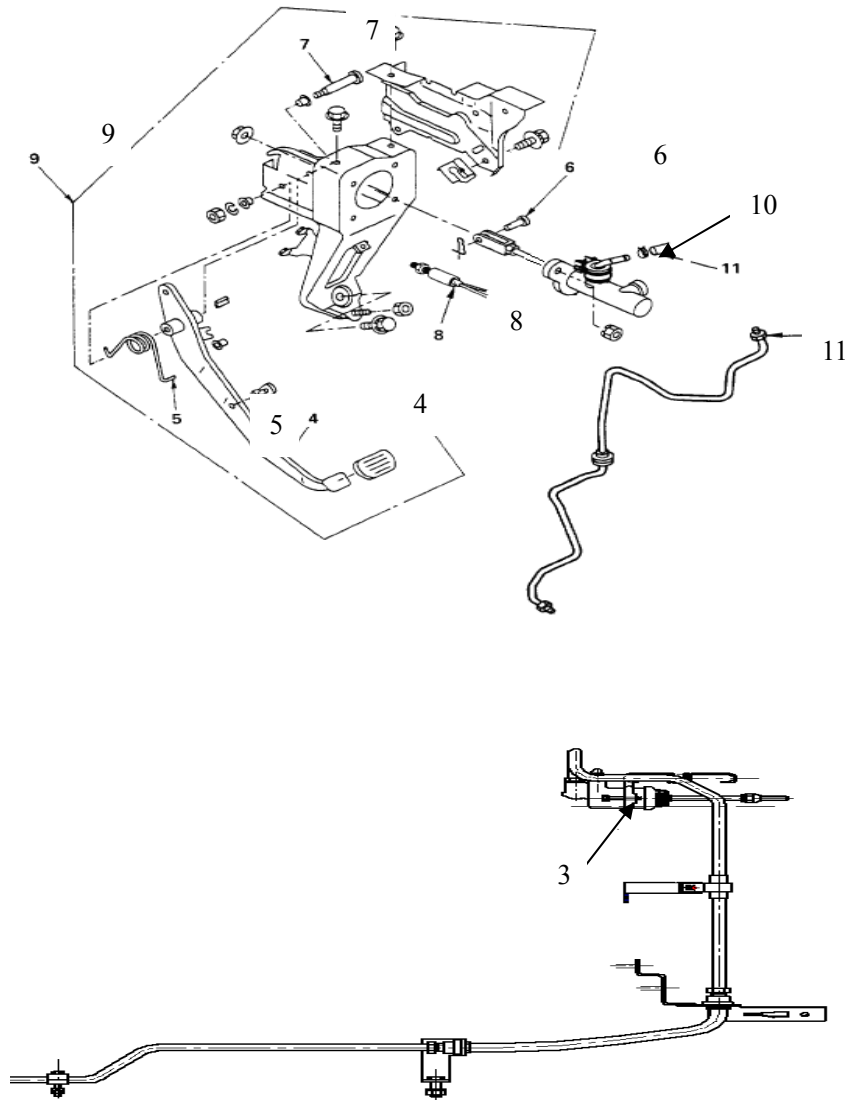
or limit bolt; 5. Axle; 6. Pin; 7. Spring; 8. Clutch cylinder

Inspection and repair

In case of excessive wear or damage of part found during inspection, make necessary adjustment, or repair or replace parts.



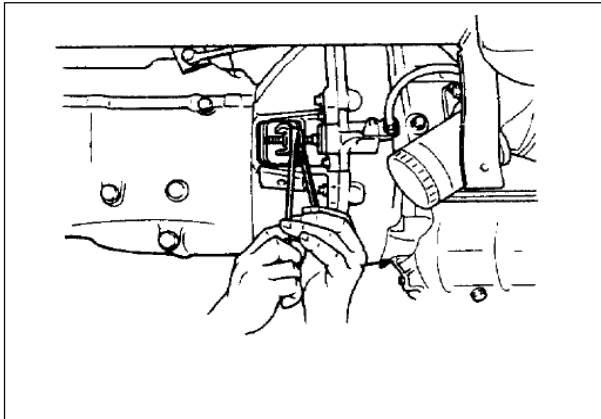
Reassembling



Reassembling sequence

1. Clutch cylinder; 2. Hose; 3. Clutch cylinder; 4. Clutch pedal; 5. Return spring; 6. Pin; 7. Axle; 8. Clutch switch or limit bolt; 9. Clutch pedal and support assembly; 10. Master cylinder oil inlet hose; 11. Clutch pipe and hose

Clutch



Assembling steps

1. Clutch cylinder

Clutch cylinder mounting bolts mounting torque: 16 N•m

Before assembling clutch cylinder return spring, first adjust clutch cylinder jogger.

- 1) Loosen clutch jogger lock nut;
- 2) Rotate jogger till pushing against

disengaging fork;

3) Rotate jogger back by 1.5 rounds (free travel of the fork is about 2mm)

4) Tighten lock nut (19 N•m)

2. Clutch hose

3. Clutch master cylinder

Install clutch master cylinder on clutch pedal and support. Tightening torque for mounting nut shall be 13N•m

4. Clutch pedal

5. Return spring

6. Pin

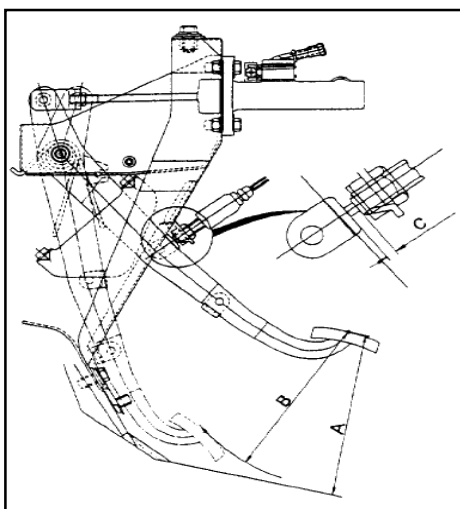
7. Axle

8. Clutch switch or limit bolt

9. Clutch pedal and support assembly

Tightening torque for bolts of clutch pedal and support assembly is 38N•m.

After above assembling, adjust clutch control equipment.



Clutch pedal height and travel

1) Loosen clutch master cylinder jogger lock nut

2) Rotate jogger to adjust pedal

Clutch pedal height A: 160-180mm

Clutch pedal travel B: 160-170mm

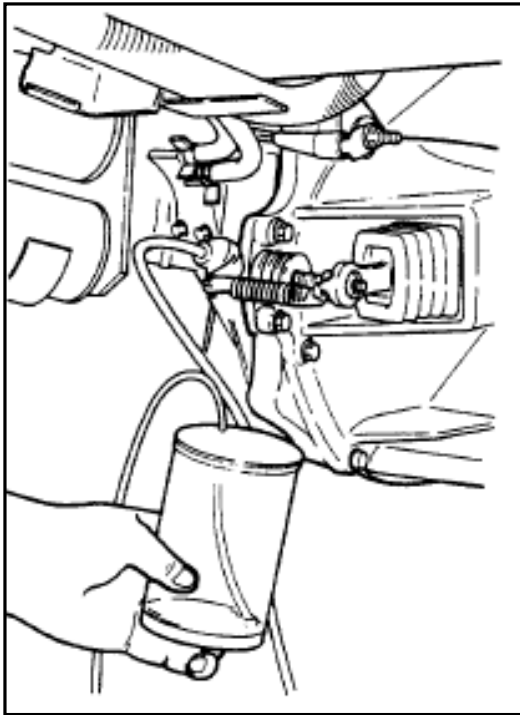
3) Clutch master cylinder jogger lock nut tightening torque is 13N•m

4) Reinstall instrument and adjust clutch pedal free travel

1) Loosen clutch switch or pedal limit bolt.

2) Adjust clutch switch or pedal limit bolt so that clutch pedal free travel is 3-5mm.

Clutch



Venting of clutch pipeline

Follow the steps below:

1. Pull parking brake tight;
2. Add brake fluid in oil storage pot to max. level. During venting, note brake fluid in the pot.
3. Remove rubber cap on venting screw of clutch cylinder. Connect one end of a plastic pipe to this screw and the other end to a transparent vessel filled with brake fluid.
4. Continuously step down clutch pedal for a number of times and then keep the pedal down.
5. With the pedal stepped down, loosen venting screw to vent air. Later, tighten the venting screw.
6. Repeat above operations till air in pipeline is completely vented.

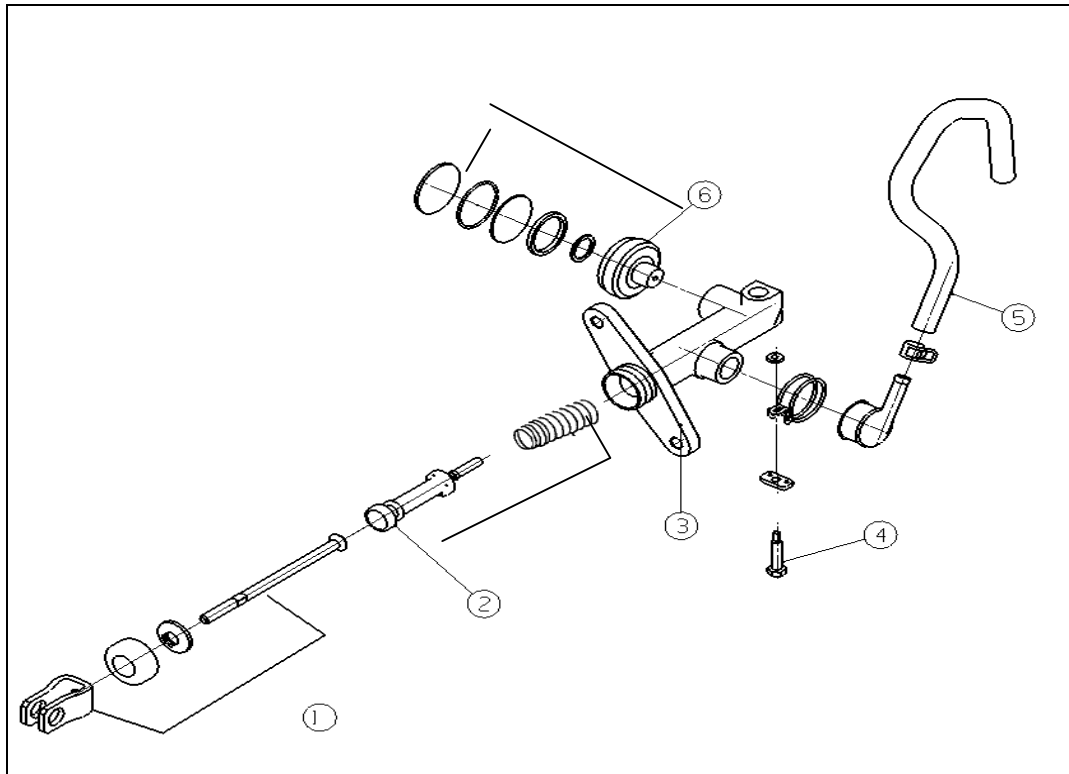
After venting operation, add brake fluid in the oil storage pot to the "MAX" marking.

Clutch

Clutch master cylinder



Disassembling

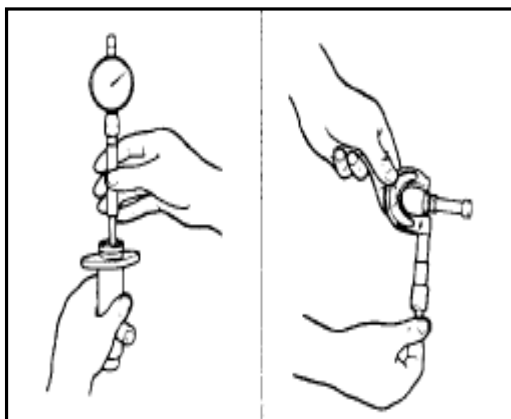


Disassembling sequence

1. Jogger and dust sleeve; 2. Piston assembly and return spring; 3. Cylinder body; 4. Clip;
5. Oil inlet hose; 6. Valve seat assembly

Inspection and repair

In case of excessive wear or damage found during inspection, make necessary adjustment, repair or replacement of parts.



Clutch master cylinder assembly

Use brake fluid to clean clutch master cylinder body. Check oil return hole for clogging; clean if necessary.

Measure ID of master cylinder body.

Master cylinder ID: 19.050---19.102mm

Clearance between clutch master cylinder piston and ID of the cylinder: 0.12mm (limit)

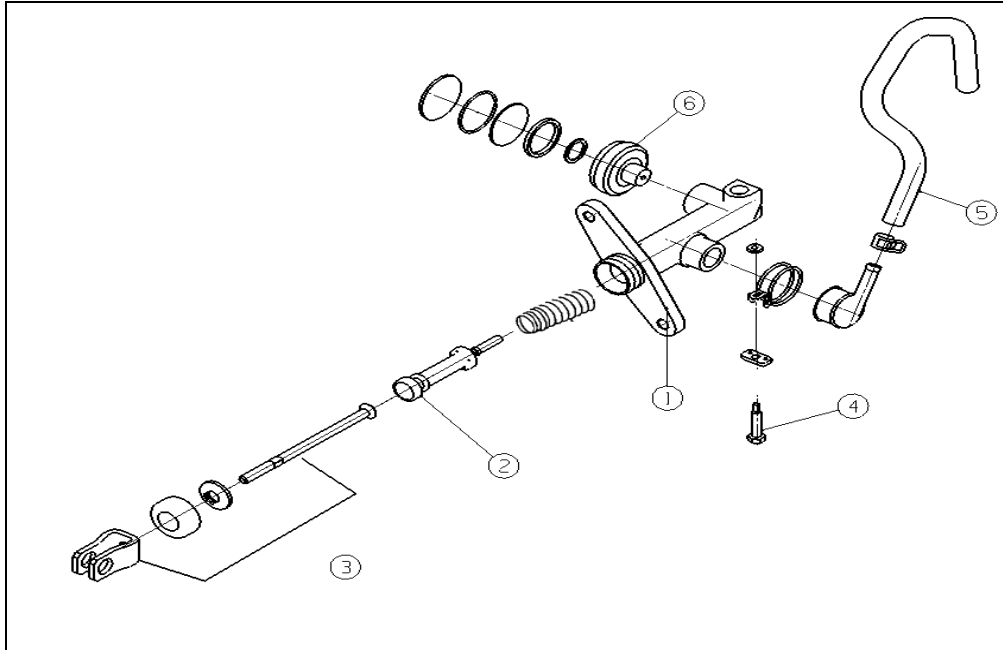
Warning: For disassembled clutch master cylinder,

repair pack must be replaced.

Clutch



Reassembling



Reassembling sequence

1. Cylinder body; 2. Piston assembly and return spring; 3. Jogger and dust sleeve; 4. Clip;
5. Oil inlet hose; 6. Valve seat assembly

Precautions on reassembling:

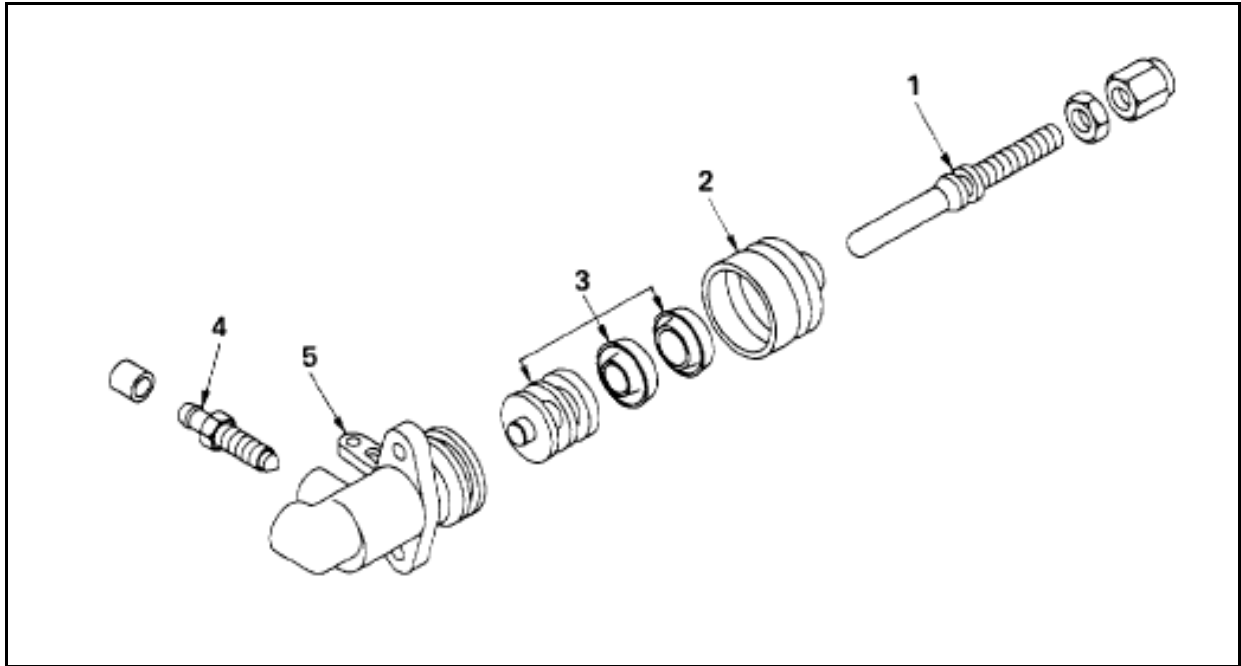
1. Before reassembling, use clean brake fluid to wet pump body and piston;
2. Apply a thin layer of grease on the rubber cup;
3. Prevent damage of rubber cup lip during assembling.

Clutch

Clutch cylinder



Disassembling

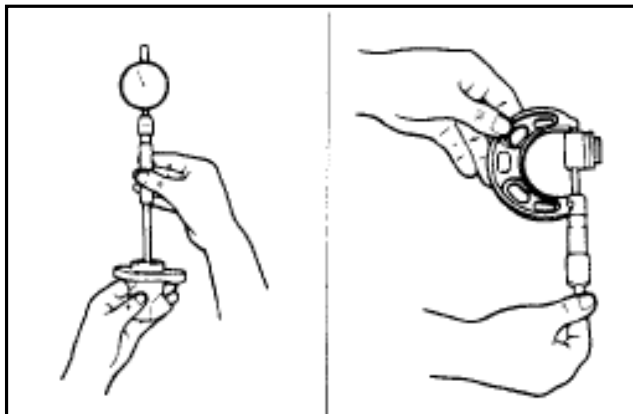


Sequence of disassembling

1. Jogger; 2. Dust cover; 3. Piston assembly; 4. Venting screw; 5. Cylinder body

Inspection and repair

In case of excessive wear or damage of part found during inspection, make necessary adjustment or repair/replacement of the part.



Clutch cylinder assembly

Use brake fluid to clean clutch cylinder body.

Measure master cylinder inner diameter.

Master cylinder ID: 26.99---27.042mm

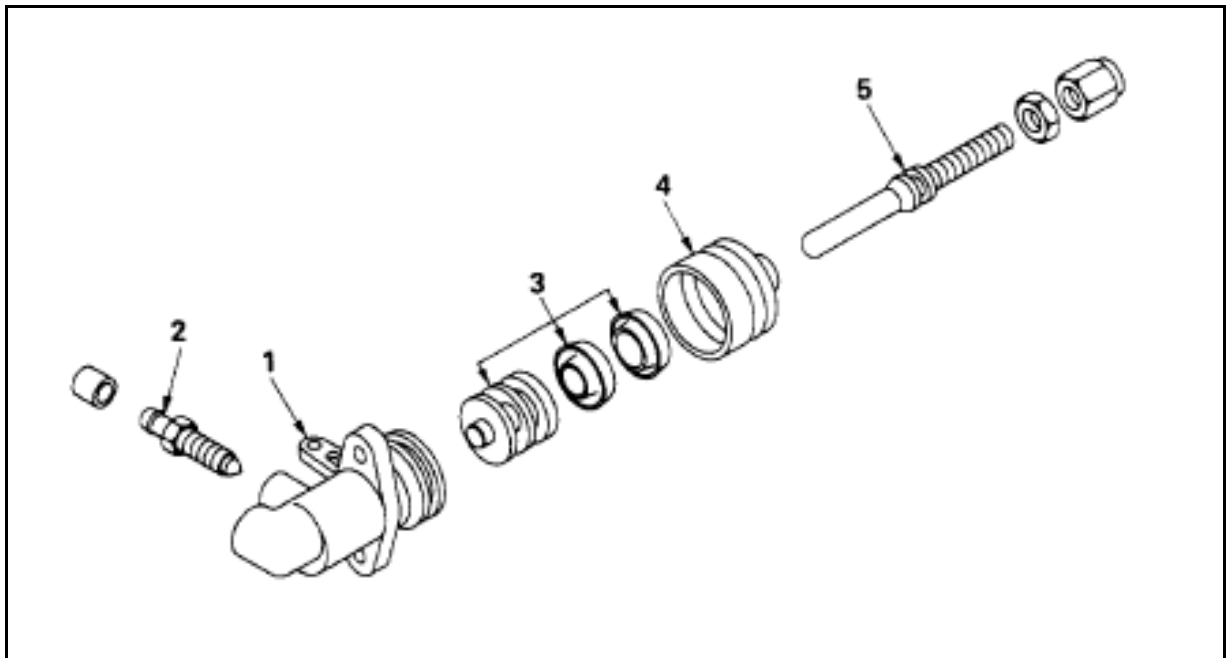
Clearance between clutch cylinder piston and cylinder ID: 0.12mm (limit)

Warning: For disassembled clutch cylinder, repair pack must be replaced.

Clutch



Reassembling



Sequence of reassembling

1. Push rod; 2. Dust cover; 3. Piston assembly; 4. Venting screw; 5. Cylinder body

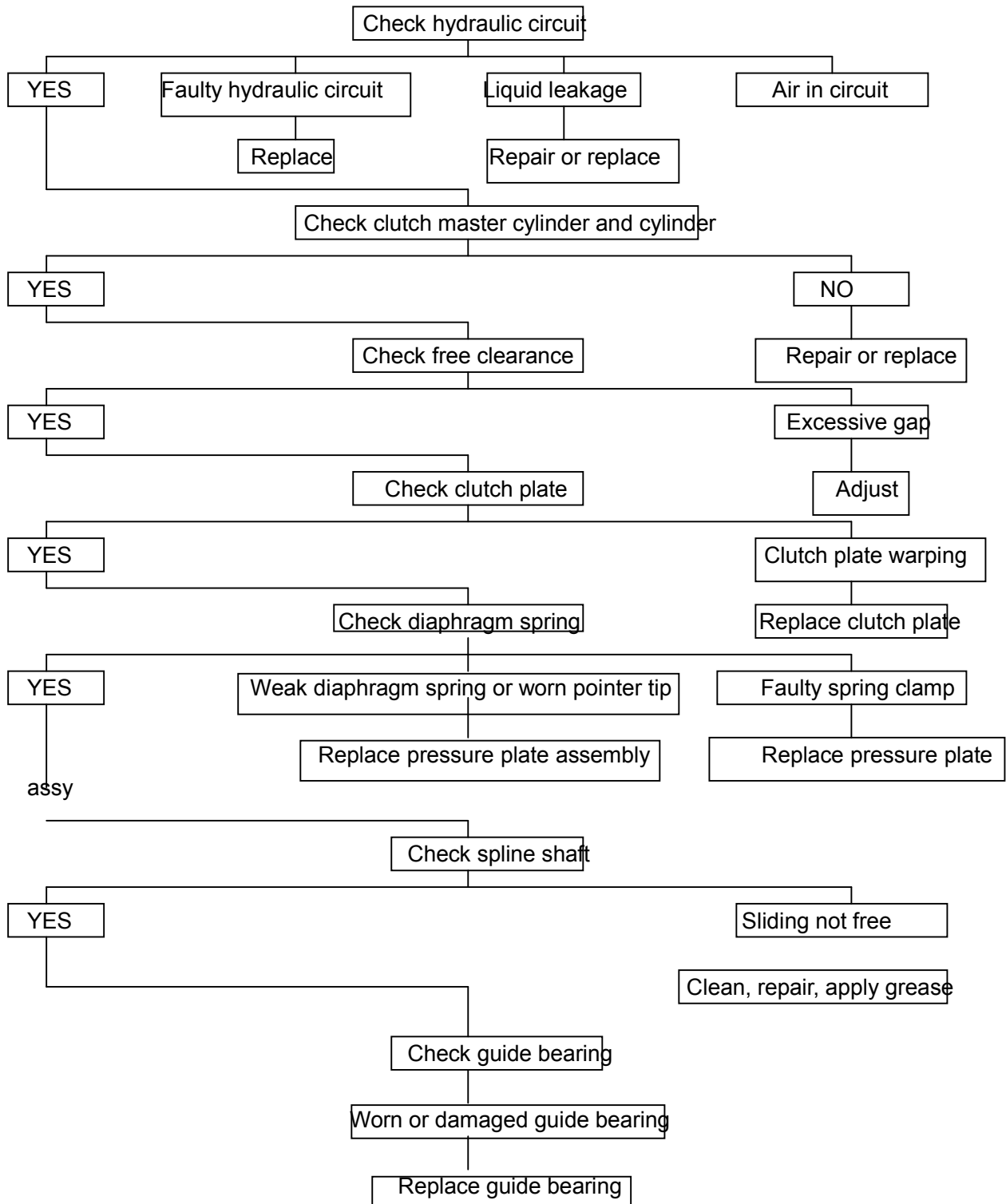
Precautions on reassembling:

1. Before reassembling, use clean brake fluid to wet pump body and piston;
2. Apply a thin layer of grease on rubber cup;
3. Prevent damage of rubber cup lip during assembling.

Clutch

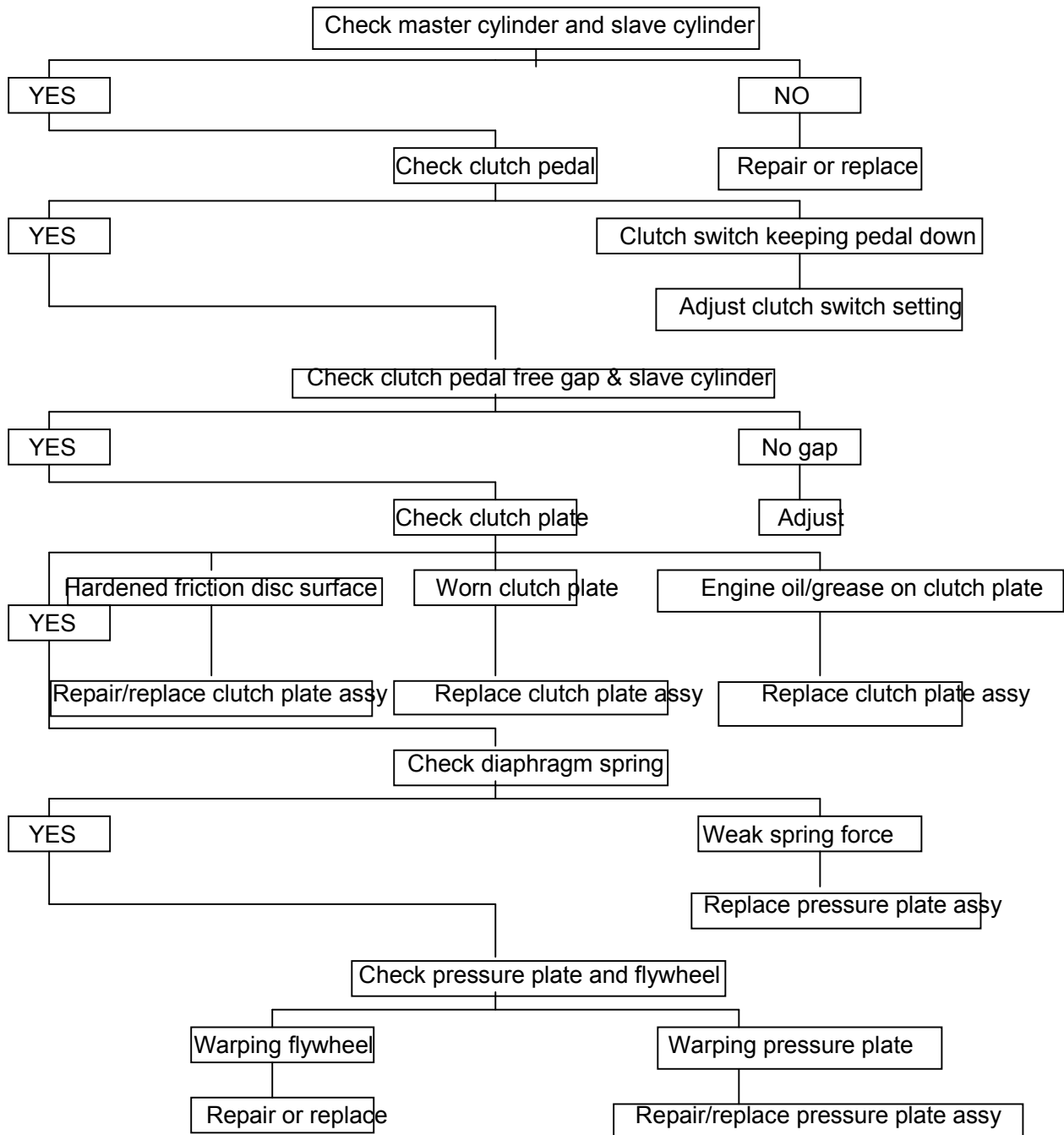
Troubleshooting

Sluggish clutch (noise of gear grinding during shifting)



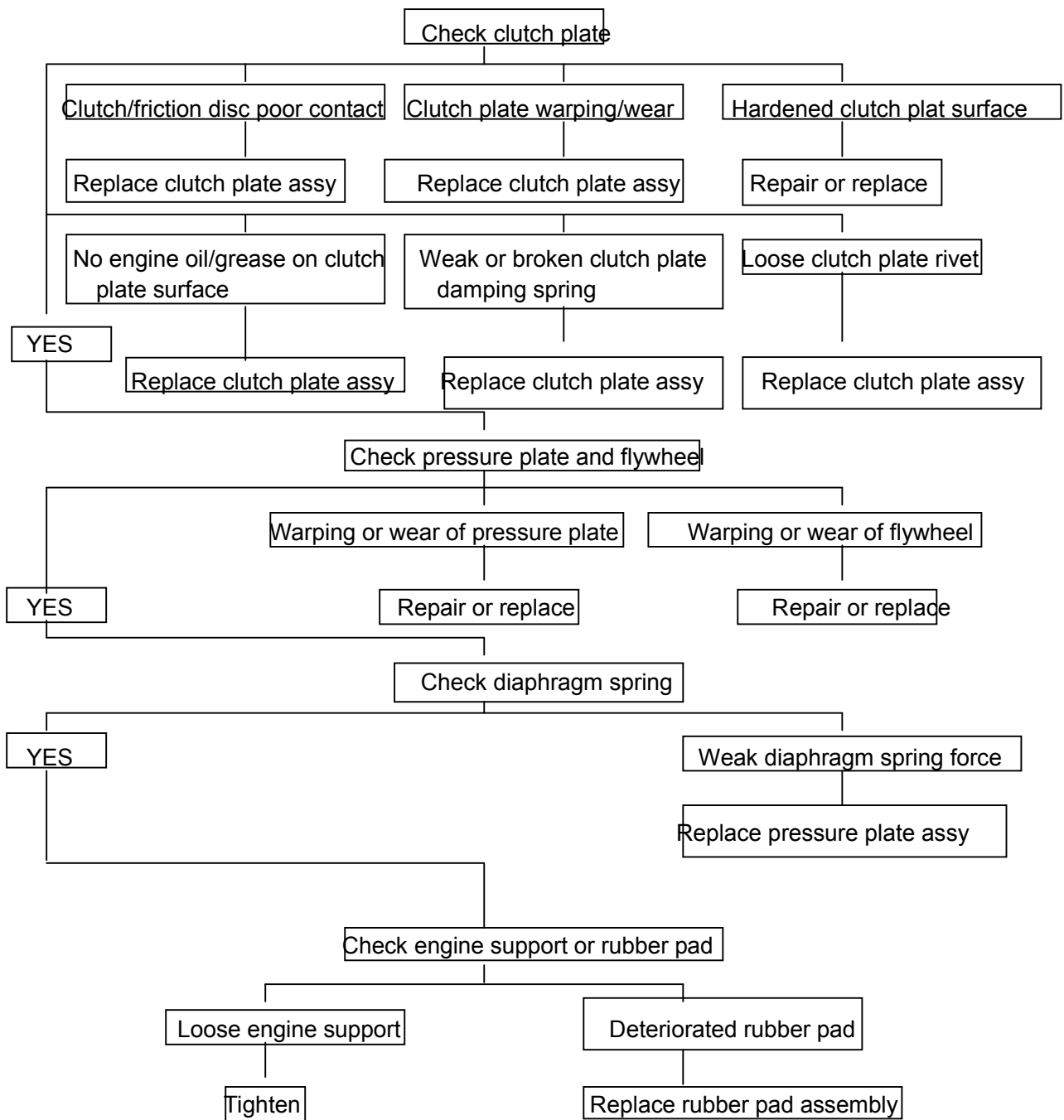
Clutch

Slipping of clutch



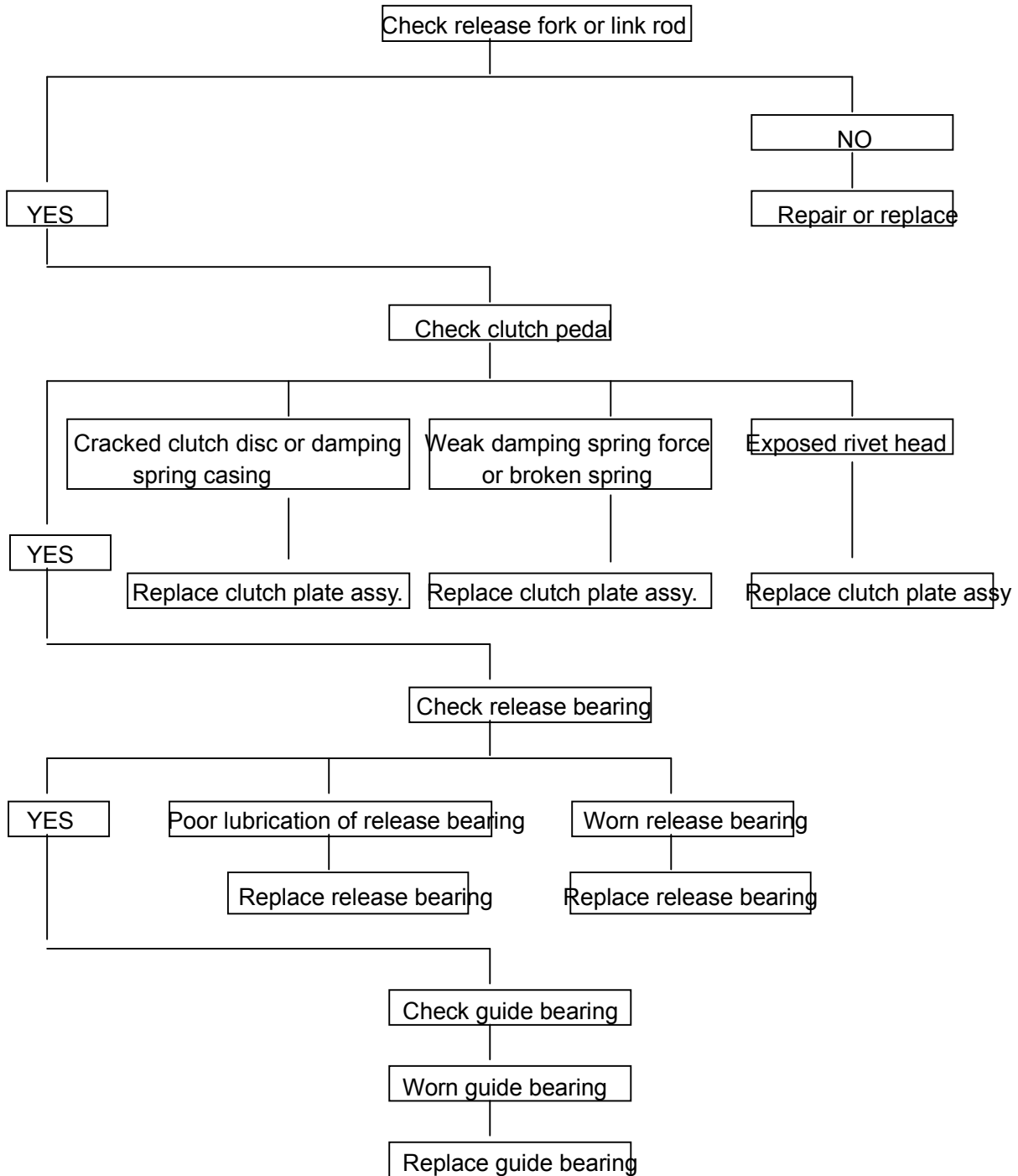
Clutch

Vibration of clutch (clutch vibration during engaging start of clutch)



Clutch

Noise of clutch (check clutch noise during engaging and disengaging of clutch to determine cause of noise)



Gearbox Assembly

General

Technical parameters

Tightening torque

Gearbox disassembling

Inspection and repair

Gearbox reassembling

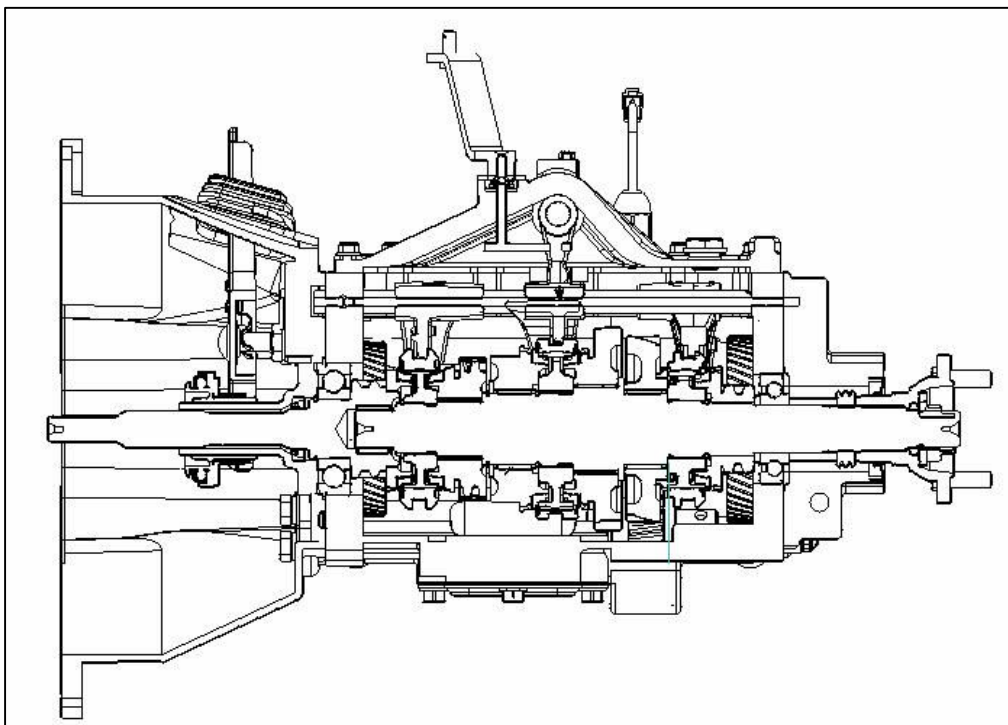
Trouble shooting

General

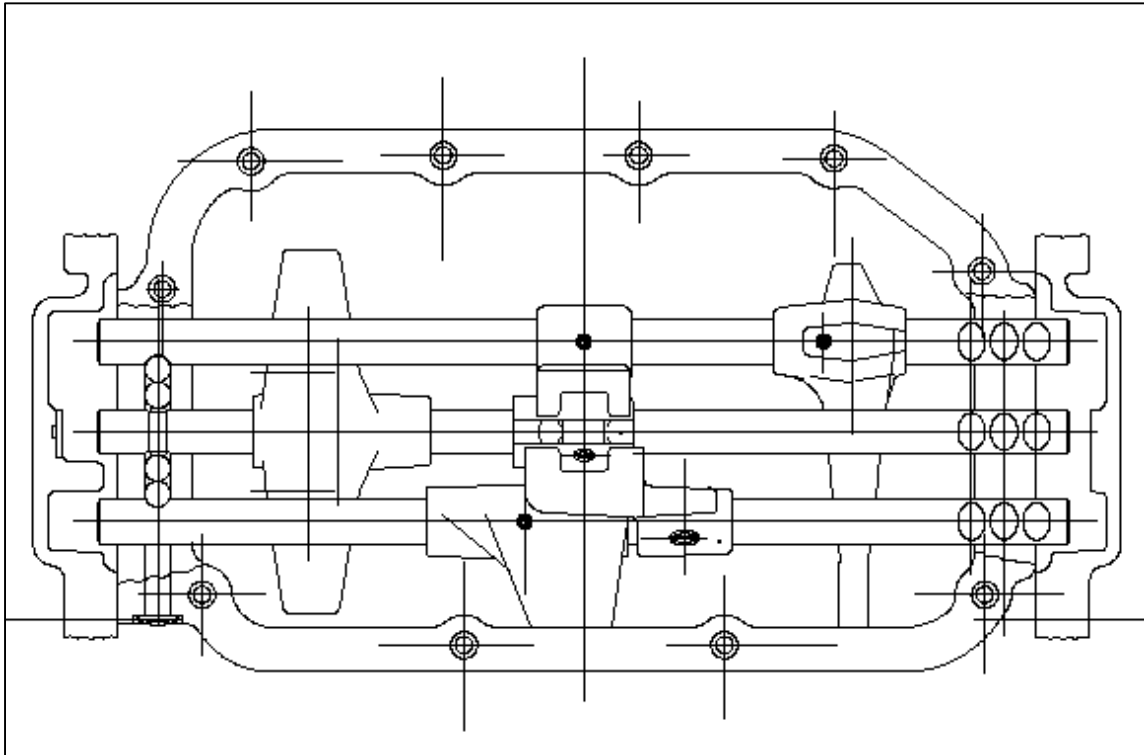
1) Direction for use

1. All forward gears of MSB-5M (reinforced) gearbox have clamping ring synchronizer, in order to reduce abrasion between the gear and the synchronizer and enable the synchronizer and gear to declutch smoothly so as to prevent the gear being destroyed, the action of shifting the gear must be gentle. Only after the vehicle has stopped steadily can forward gear be shifted to reverse gear or reverse gear to forward gear.
2. Special attention must be paid to: The fifth gear of gearbox is overdrive gear; to avoid the overdrive gear being damaged, the fifth gear can only be used when the vehicle is not overloaded, the road surface condition is excellent, and the vehicle is running at the speed above 50 km/h. When at the fifth gear, in case some kind of situation requires the vehicle to slow its speed to below 50 km/h, it is necessary to shift to lower gear; if it continues to run at the fifth gear, it is extremely easy to break up the fifth gear.
3. The gearbox uses 80W/90 GL-4 gear oil in winter and 85W/90 GL-4 gear oil in summer. Generally, the vehicle has to change its gear oil after running every 6,000 km. After draining dirty oil, put the gearbox at reversing gear, jack up the rear axle, pour kerosene into it, let the gearbox gear rotate for 2-3 minutes, then after draining the dirty oil again, fill it with pure gear oil.
4. When the vehicle is running downhill, it does not allowed to turn off the engine; and it is forbidden to start the engine by using the inertia running downhill under the flameout condition, so as to avoid the gear being damaged.

2) Assembling diagram



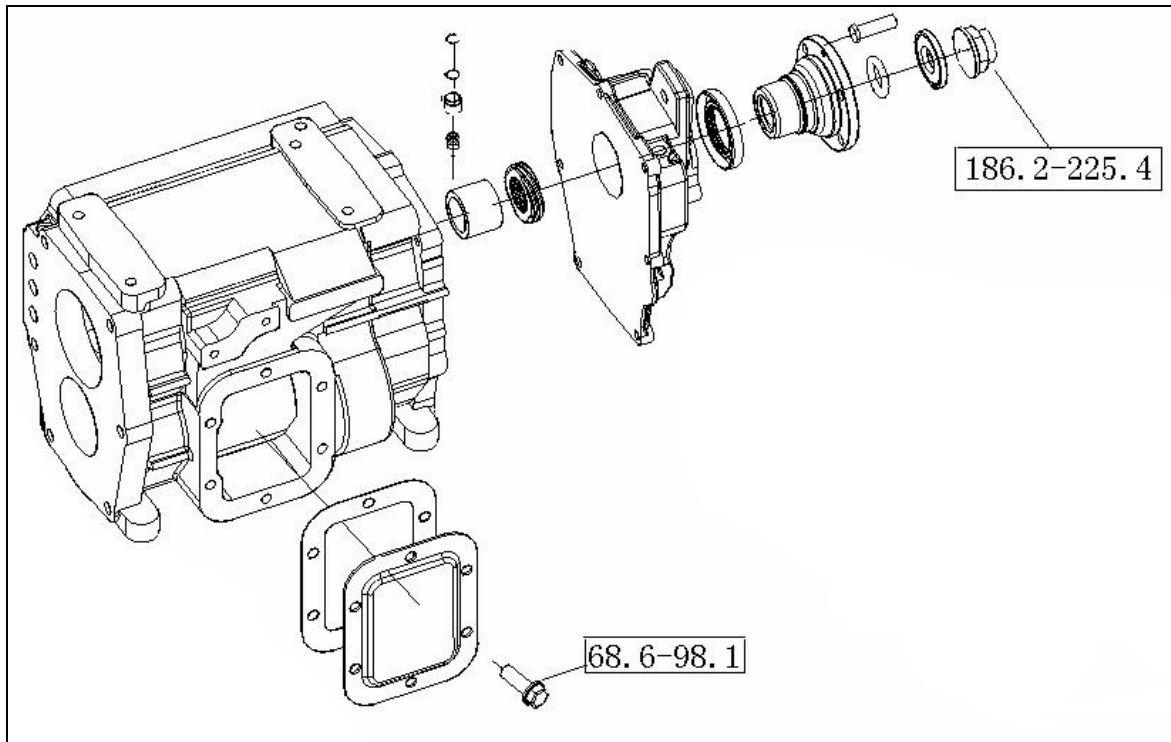
3) Diagram of gear shifting mechanism

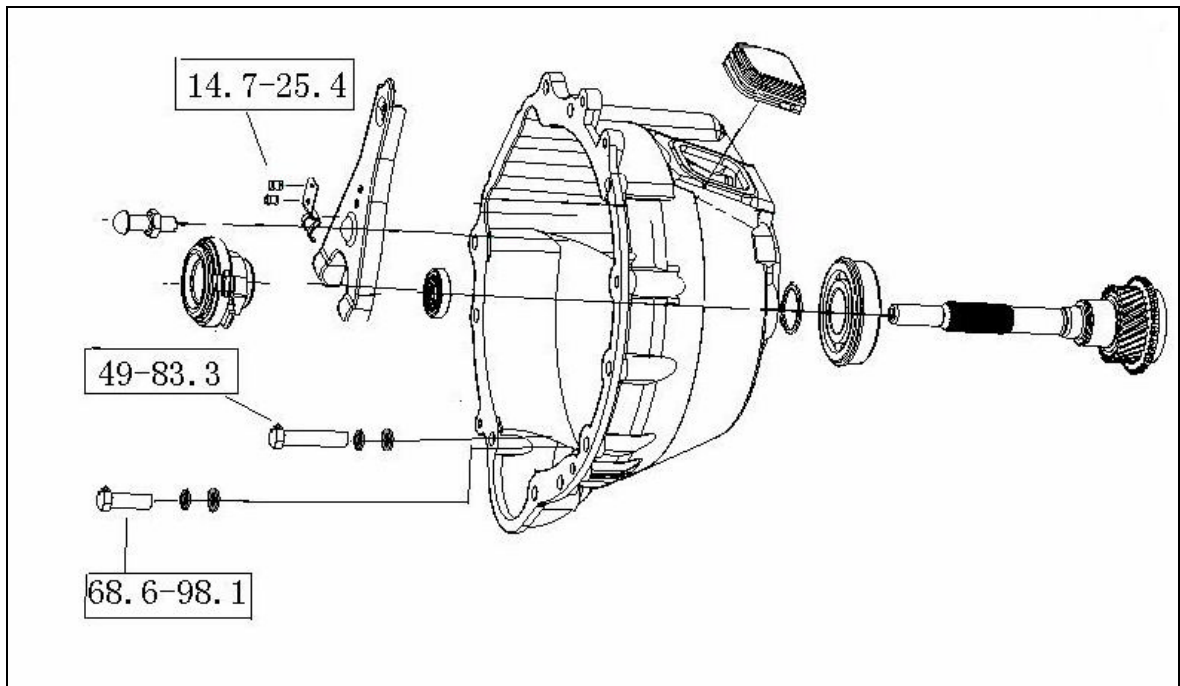
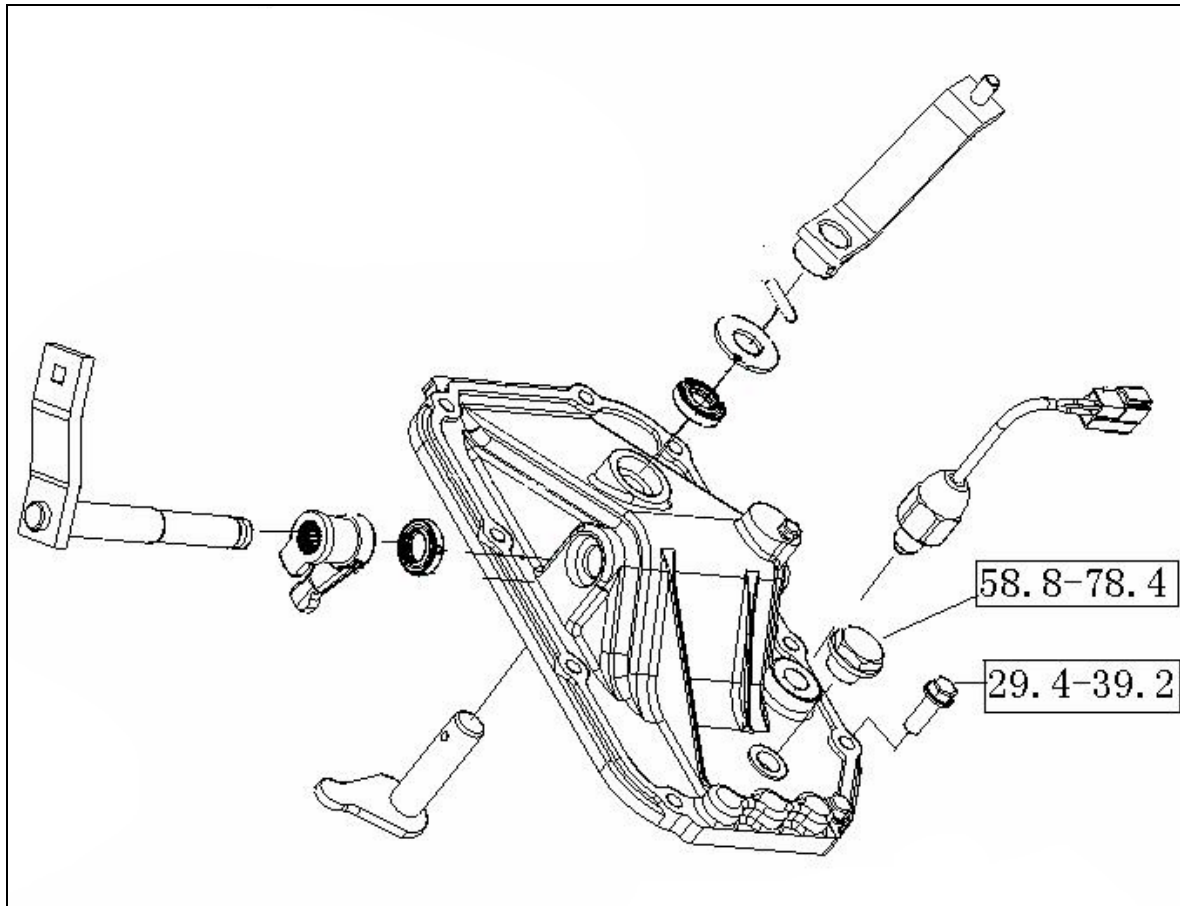


Technical parameters

Rated input torque	254.8N·m
Assembly mass	Approx. 78Kg
Speed ratio	1st 5.529
	2nd 2.782
	3rd 1.641
	4th 1
	5th 0.785
	Rev 5.271
Lube oil amount	2.7L
Lube oil brand	Use (GL-4) 85W/90 in summer
	Use (GL-4) 80W/90 in winter

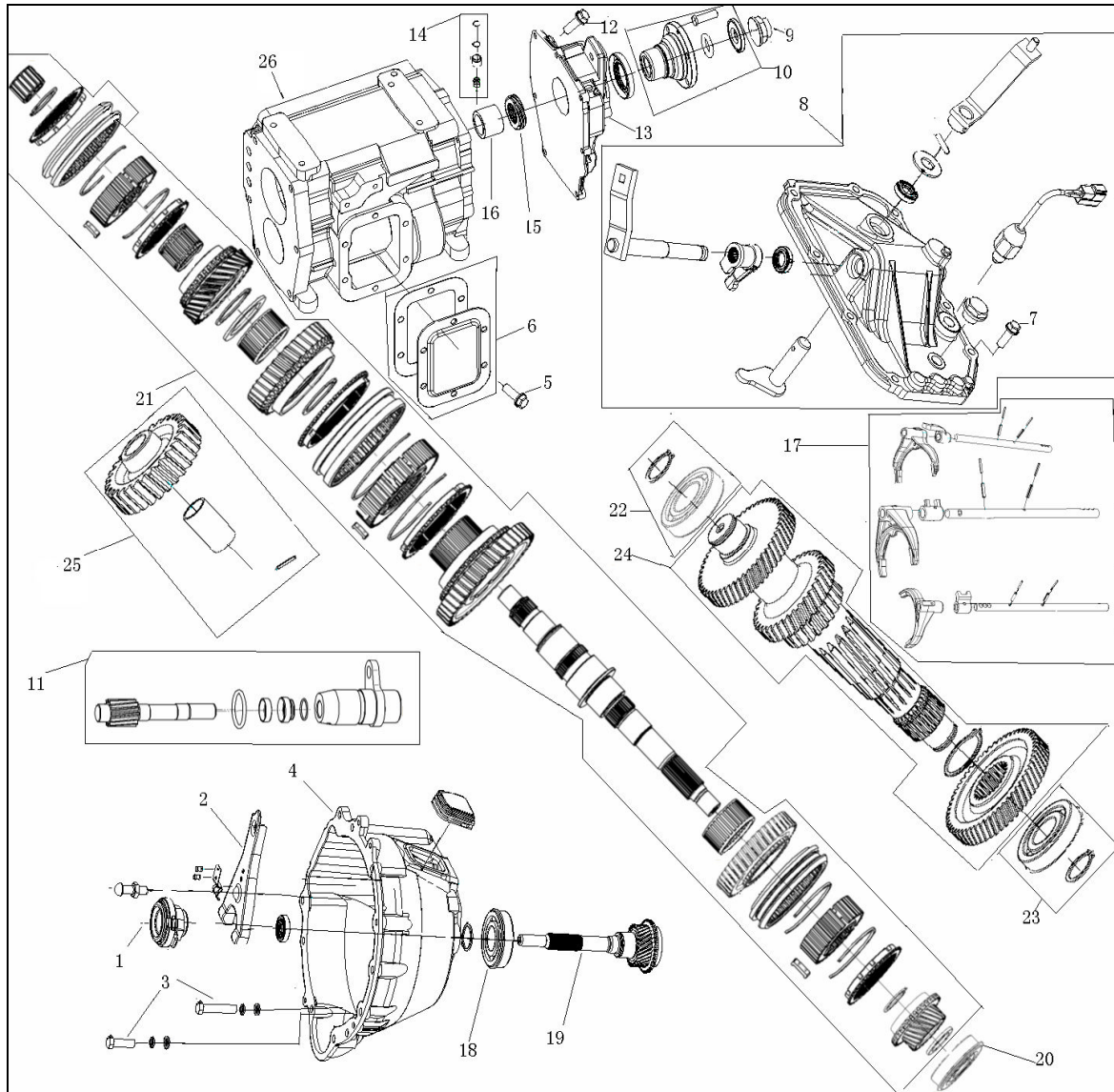
II. Tightening torque N·m





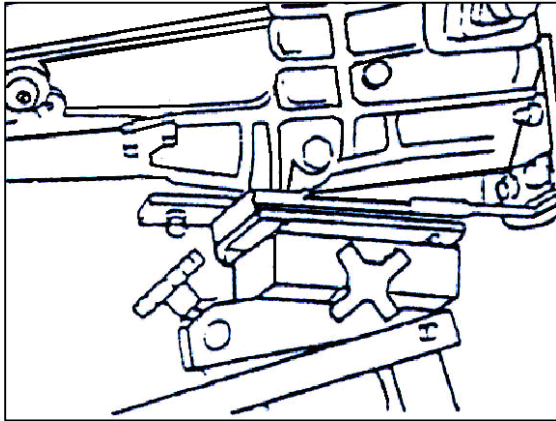
III. Gearbox disassembling drawing

Disassembling of large parts



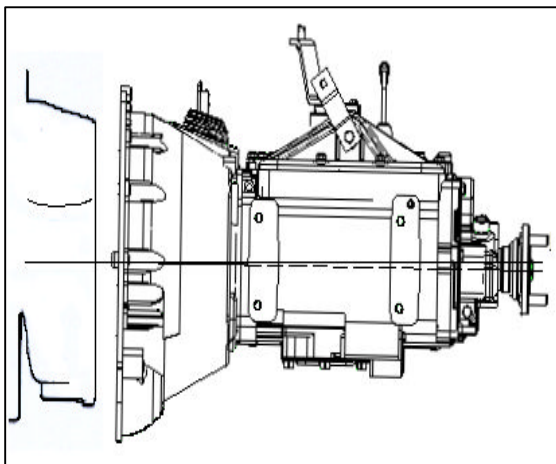
Disassembling sequence:

- | | | |
|---|---|--|
| 1 Separation bearing | 11 Odometer driven gear | 20 Secondary axle bearing |
| 2 Separation shifting yoke assembly | 12 Rear cover bolt | 21 Secondary axle assembly |
| 3 Clutch housing bolt | 13 Rear cover | 22 Intermediate axle front bearing, retaining ring |
| 4 Clutch housing | 14 Breather valve | 23 Intermediate axle rear bearing, retaining ring |
| 5 Gearbox side cover bolt | 15 Odometer driven gear driving gear | 24 Intermediate axle assembly |
| 6 Gearbox gear side cover and side cover gasket | 16 Odometer driven gear driving gear spacer | 25 Reversing gear |
| 7 Gearbox top head bolt | 17 Shifting yoke and shifting yoke shaft | |
| 8 Top head assembly | 18 Primary axle bearing | |
| 9 Second axle nut | 19 Primary axle assembly | |
| 10 Flange | | |



Important operation-- gearbox assembling

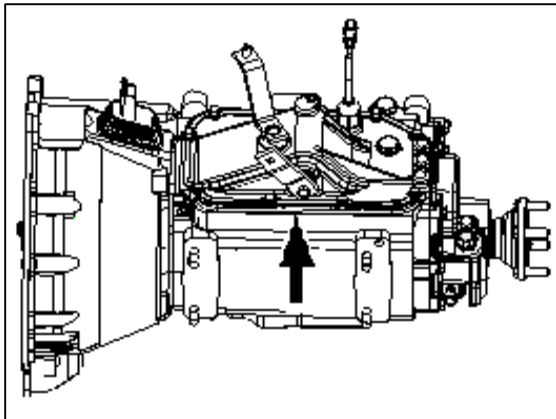
When disassembling, do use jack or similar tool so as to guarantee safety of disassembling and facilitate disassembling.



Assembling

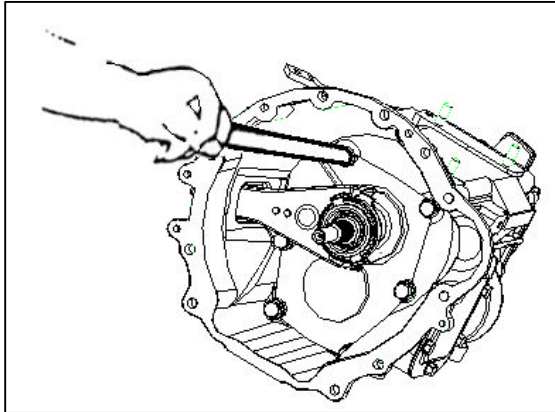
Gearbox assembly

- (1) Align the inclined line of gearbox to the inclined line of engine.
- (2) Adjust the gearbox to the direct gear position, turn the secondary axle flanged disc to align it with clutch.



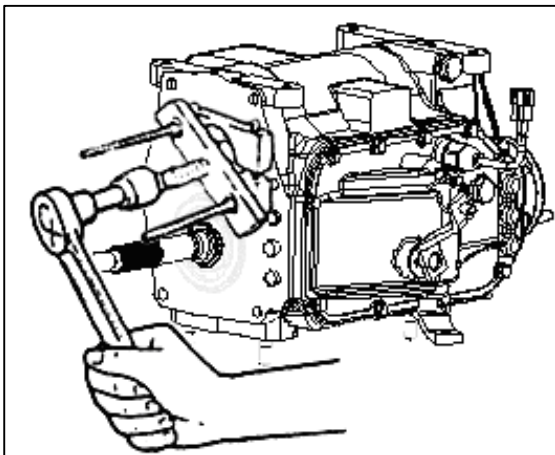
Gearbox cover assembly

Insert a screwdriver to the groove indicated by the arrow in the picture. Remove the gearbox cover assembly from the gearbox body. Do not disassemble it roughly, be careful and put it down gently.



Clutch housing bolts

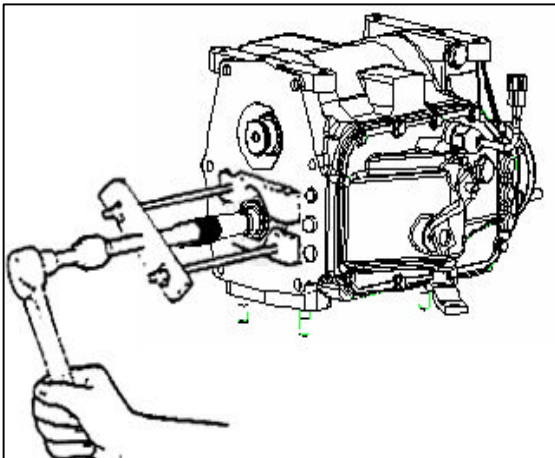
Torque (N·M) 68.6-91.3



Intermediate axle front bearing

Use a copper bar and a hammer to strike the rear end of the axle, move the intermediate axle for about 3mm.

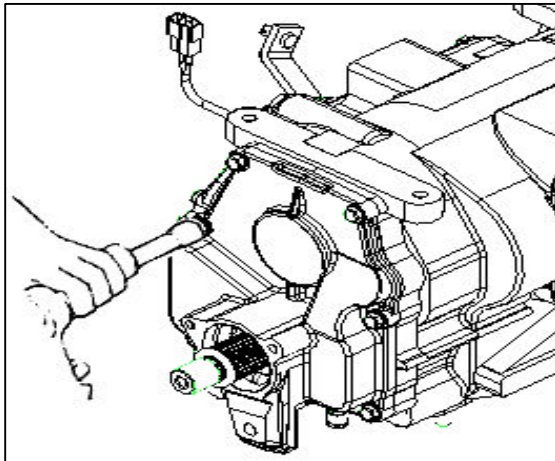
Use special tool to insert to the stop ring groove; remove the front bearing.



Primary axle ball bearing

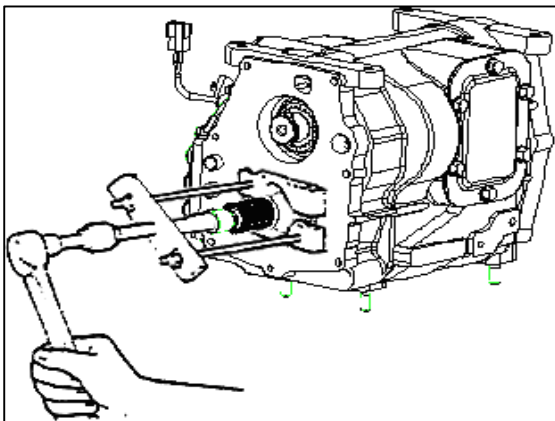
Use a copper bar and a hammer to strike the rear end of the axle; move the primary axle for about 3mm.

Use special tool to insert into the brake ring groove; remove the ball bearing.



Gearbox rear cover bolts

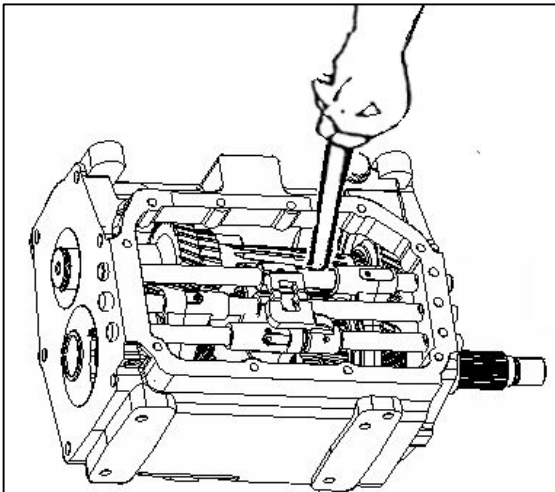
Torque (N·M) 68.6-91.3



Secondary axle ball bearing

Use a copper bar and a hammer to strike the rear end of the axle; move the secondary axle for about 3mm.

Use special tool to insert into the brake ring groove; remove the bearing.

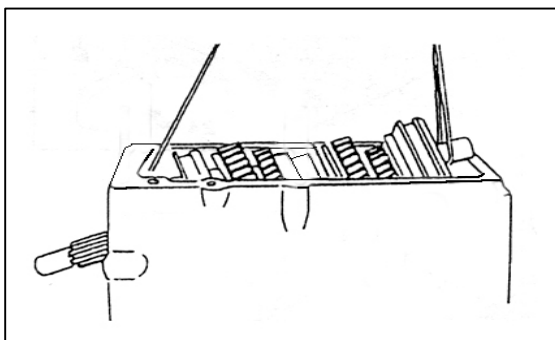


Spring pin, shifting yoke, shifting yoke shaft

Before disassembling, put all the shifting yoke axles at neutral position.

After pushing out the spring pin, push the rear end of the shifting yoke shaft forward.

Then, strike the rear end of the shifting yoke shaft forward and gently, remove the shifting yoke and the shifting yoke shaft.

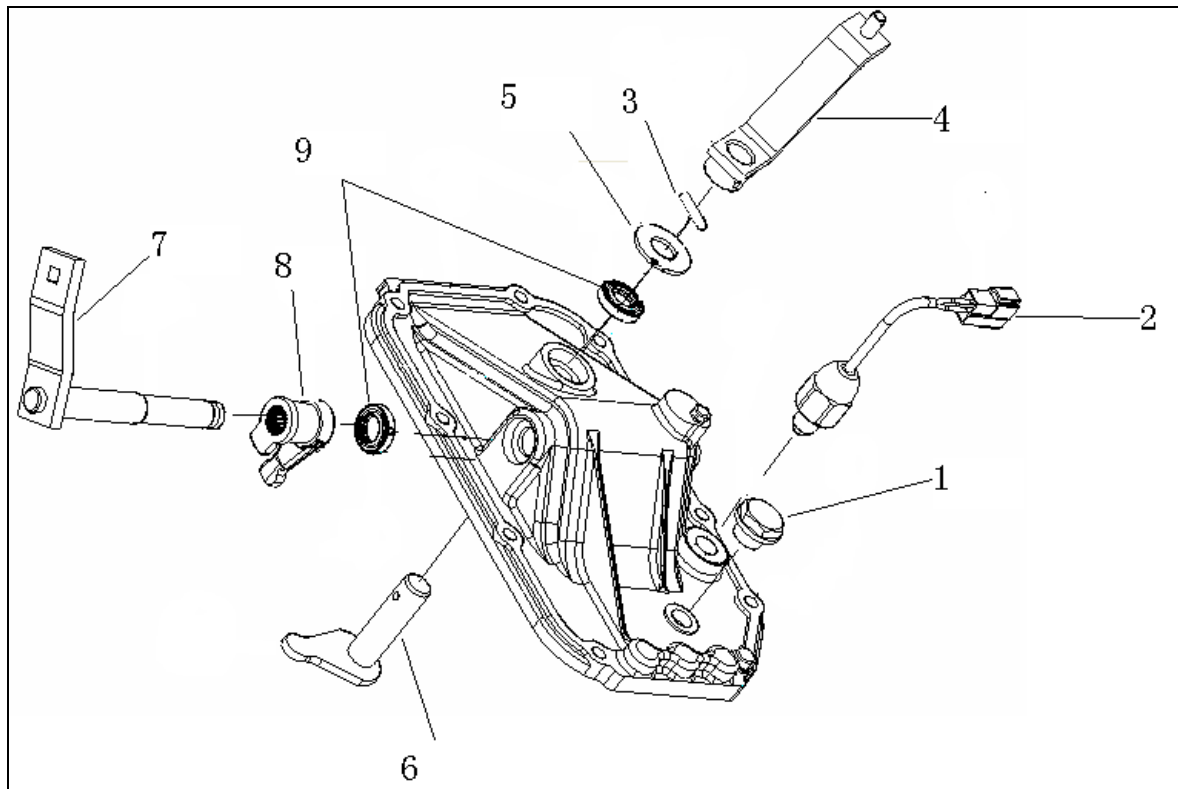


Secondary axle assembly

When disassembling, use strong steel cable, and pay attention to safety.

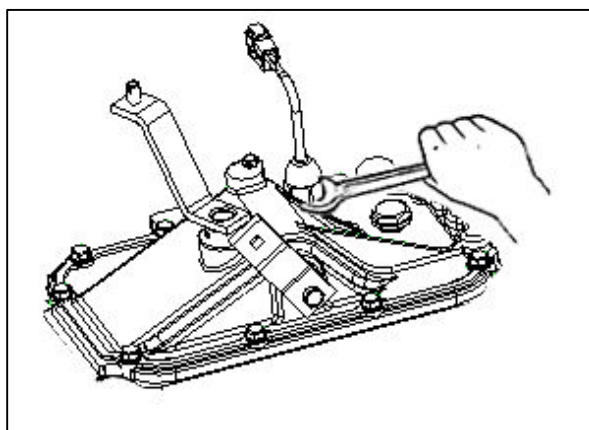
Disassembling of small parts

Top head assembly



Disassembling sequence:

1 Oil filling plug 2 Reversing lamp switch 3 Elastic cylindrical pin 4 External selected gear rocker arm combined part 5 Plain washer 6 Internal selected gear rocker arm 7 External shifting gear rocker arm combined part 8 Internal shifting gear rocker arm 9 Oil seal

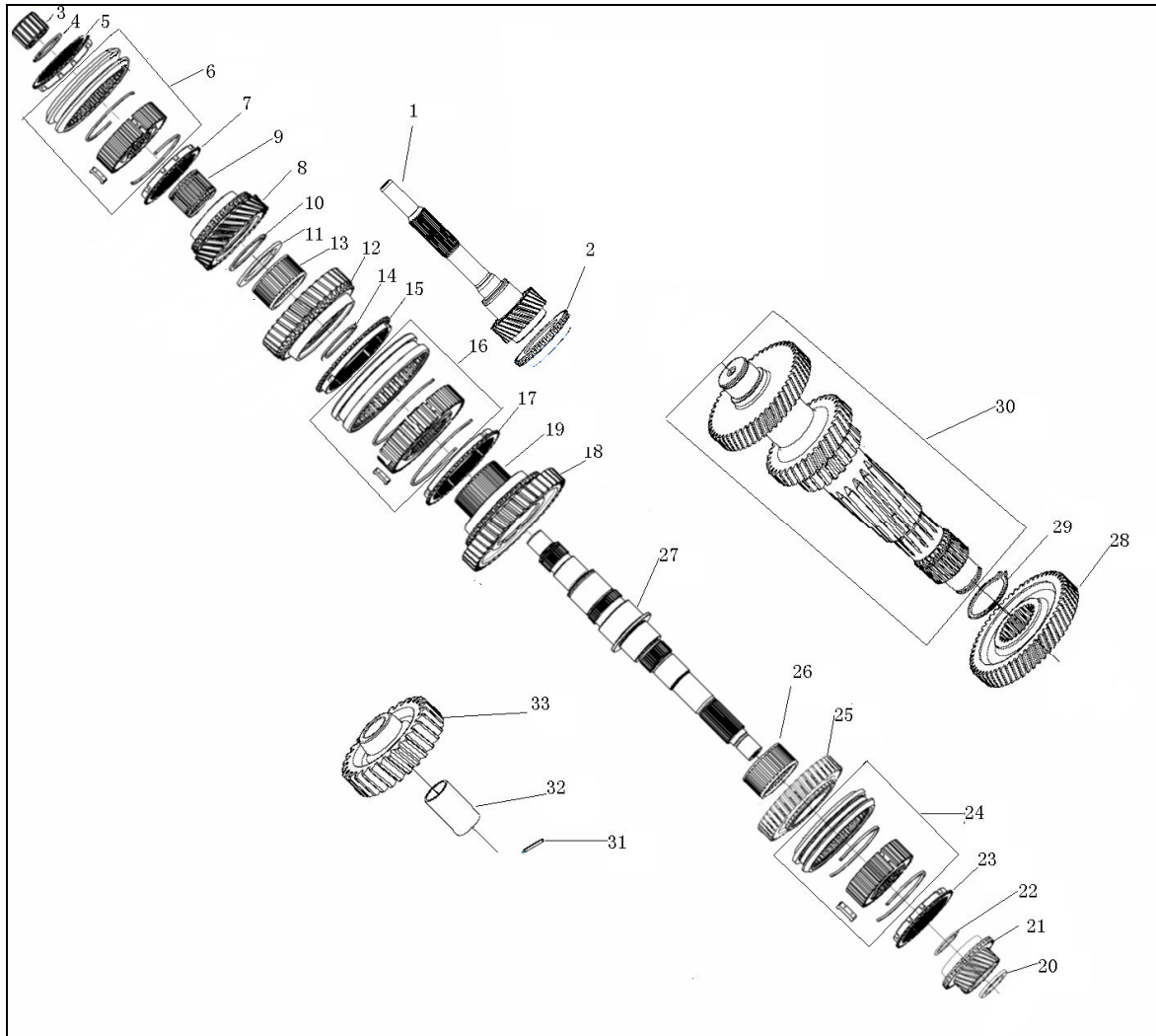


Important operation

Reversing lamp switch

Torque N·m 30-50

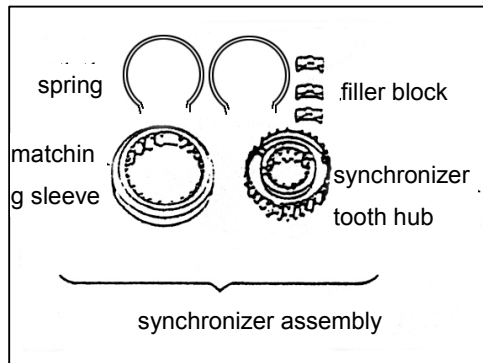
Primary axle assembly, secondary axle assembly, intermediate axle assembly, reversing gear



Disassembling sequence:

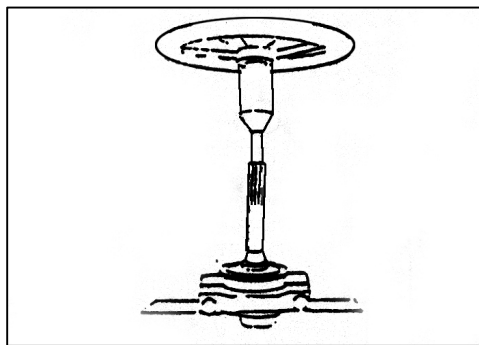
- | | | |
|-------------------------------------|--|------------------------------------|
| 1 Primary axle | 14 Retaining ring | 23 R/5 gear synchronizer gear ring |
| 2 Primary axle connection gear ring | 15 1/2 gear synchronizer gear ring | 24 R/5 gear synchronizer assembly |
| 3 Needle roller bearing | 16 1/2 gear synchronizer assembly | 25 Secondary axle reversing gear |
| 4 Retaining ring | 17 1/2 gear synchronizer gear ring | 26 Needle roller bearing |
| 5 3/4 gear synchronizer gear ring | 18 Secondary axle first gear | 27 Secondary axle |
| 6 3/4 gear synchronizer assembly | 19 Needle roller bearing | 28 Intermediate axle fifth gear |
| 7 3/4 gear synchronizer gear ring | 20 Secondary axle fifth gear thrust washer | 29 Retaining ring |
| 8 Secondary axle third gear | 21 Secondary axle fifth gear | 30 Intermediate axle assembly |
| 9 Needle roller bearing | 22 Retaining ring | 31 Reversing axle pin |
| 10 Retaining ring | | 32 Reversing axle |
| 11 Secondary axle thrust washer | | 33 Reversing gear |
| 12 Secondary axle second gear | | |
| 13 Needle roller bearing | | |

Essential points for attention



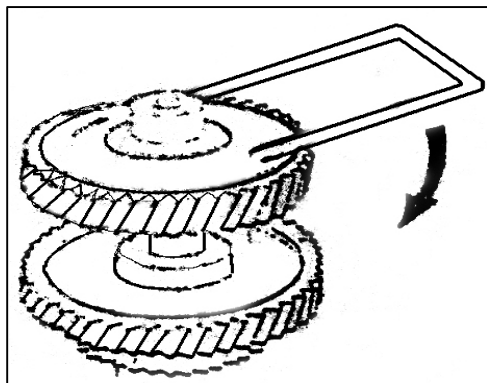
Synchronizer assembly

Disassemble the synchronizer assembly altogether; then disassemble the gear sleeve, slide block, spring and synchronizer tooth hub.



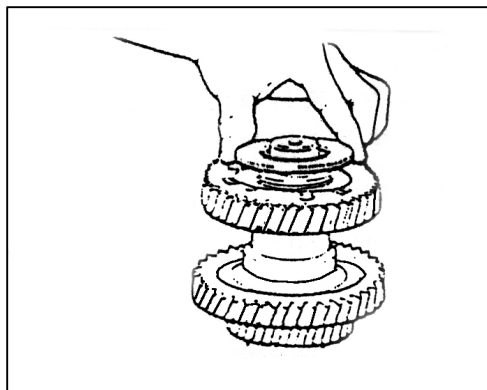
Ball bearing

When disassembling, use bench press.



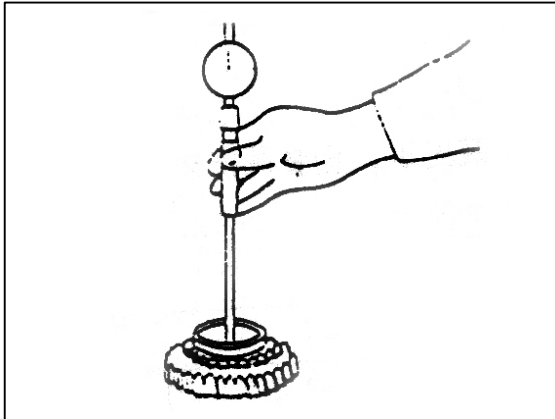
Retaining ring

Remove the retaining ring with ring pliers.



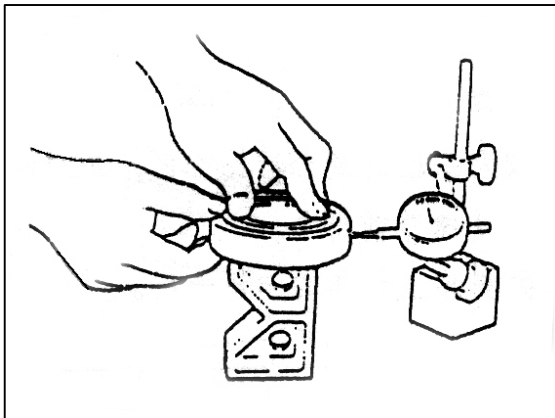
Thrust plate

IV. Inspection and repair



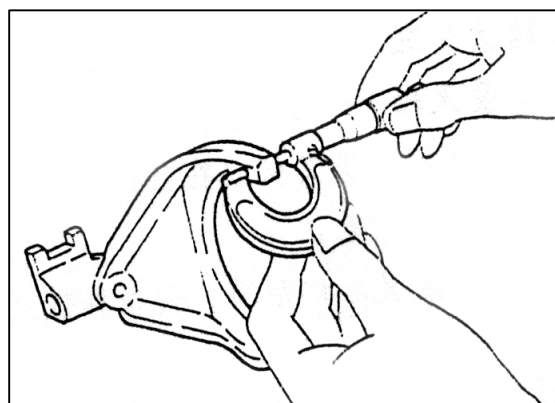
Gear inner hole

Gear 1, 2, 5	Standard	Limit
	0.05-0.09mm	0.2mm



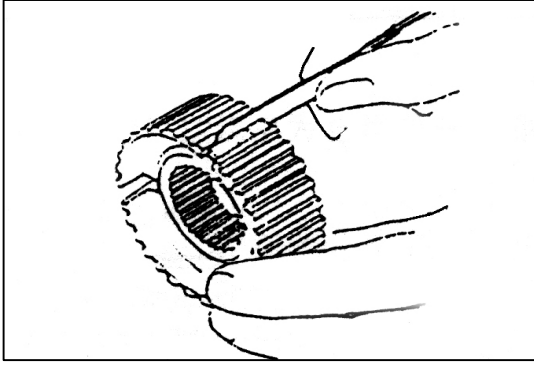
Ball bearing radial runout

Limit	0.2mm
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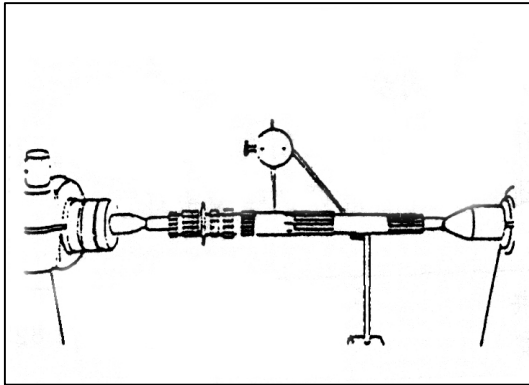
Shifting yoke

Standard	Limit
10.0mm	9.0mm

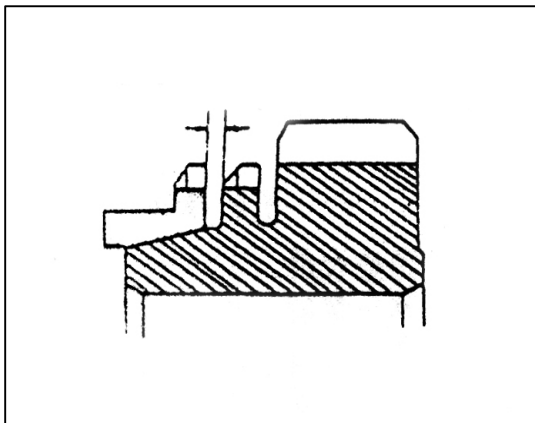


Gap between synchronizer tooth hub
and slide block

Standard	0.09-0.31mm
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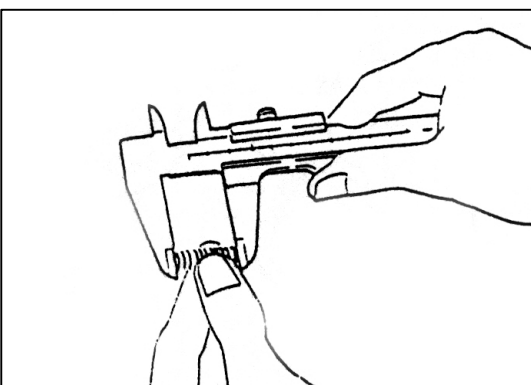


★ Important operation—Secondary axle
radial runout



Gap between synchronizer gear
ring and connection gear

Gear	Standard	Limit
Gear 3, 4	1.0mm	0.5mm
Gear 1, 2, 5	1.5mm	



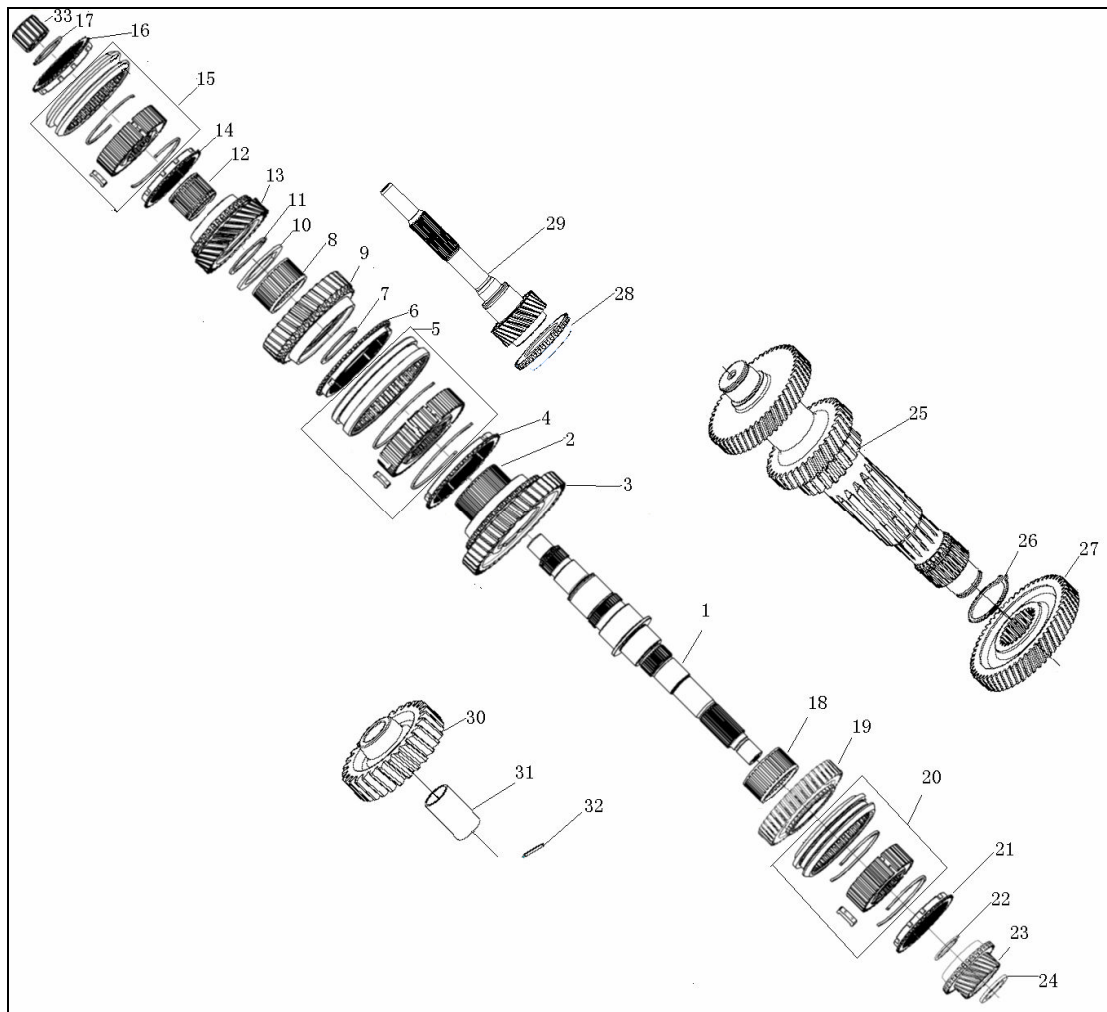
Limit spring free length

Standard	Limit
39.8mm	38.5mm

V. Gearbox reassembling

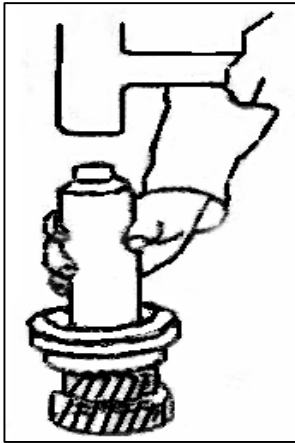
Reassembling of small parts

Secondary axle assembly, primary axle assembly, intermediate axle assembly, reversing axle assembly



Reassembling sequence:

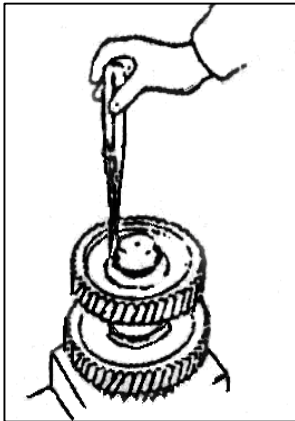
1 Secondary axle 2 Needle roller bearing 3 Secondary axle first gear 4 1/2 gear synchronizer gear ring 5 1/2 gear synchronizer assembly 6 1/2 gear synchronizer gear ring 7 Retaining ring 8 Needle roller bearing 9 Secondary axle second gear 10 Secondary axle thrust washer 11 Retaining ring 12 Needle roller bearing 13 Secondary axle third gear 14 3/4 gear synchronizer gear ring 15 3/4 gear synchronizer assembly 16 3/4 gear synchronizer gear ring 17 Retaining ring 18 Needle roller bearing 19 Secondary axle reversing gear 20 R/5 gear synchronizer assembly 21 R/5 gear synchronizer gear ring 22 Retaining ring 23 Secondary axle fifth gear 24 Secondary axle fifth gear thrust washer 25 Intermediate axle assembly 26 Retaining ring 27 Intermediate axle fifth gear 28 Primary axle 29 Primary axle connection gear 30 Reversing gear 31 Reversing axle 32 Reversing axle pin 33 Needle roller bearing



Important operation

Synchronizer assembling

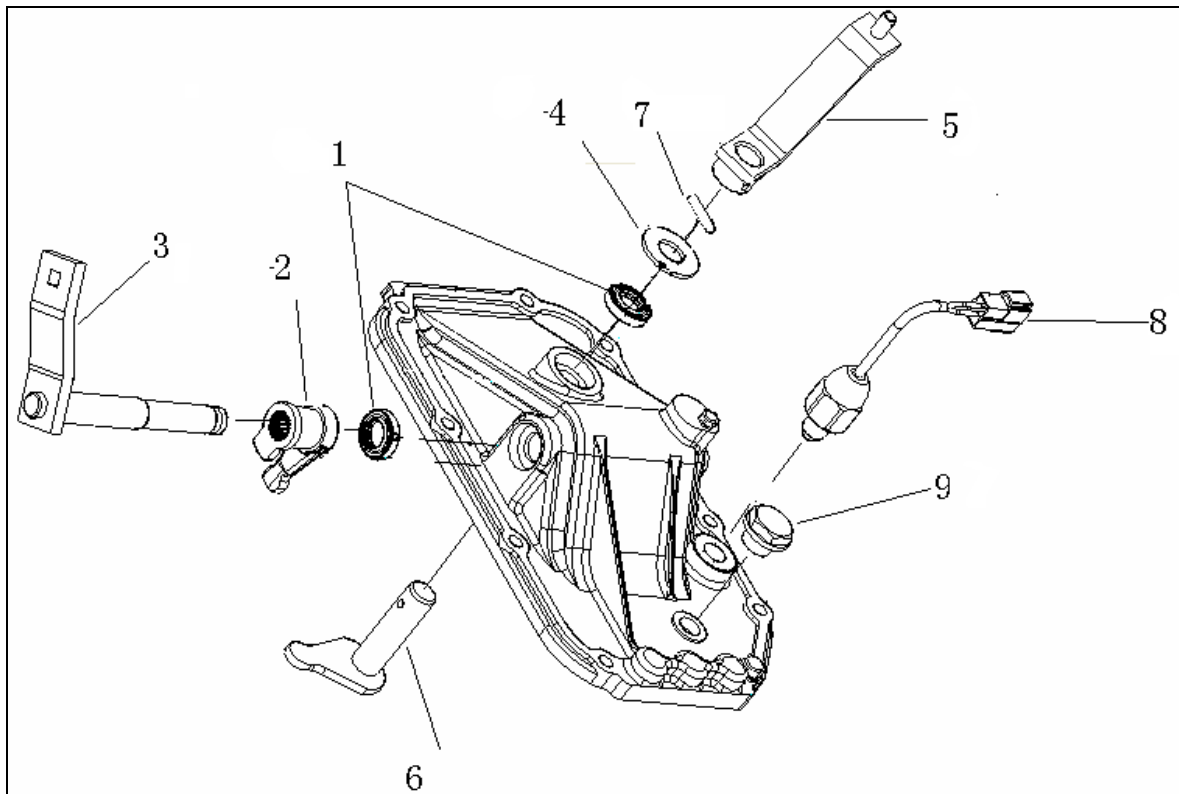
When pressing the synchronizer assembly onto the secondary axle, take care not to fall off the synchronizer gear sleeve, slide block, and synchronizer spring.



Retaining ring assembling

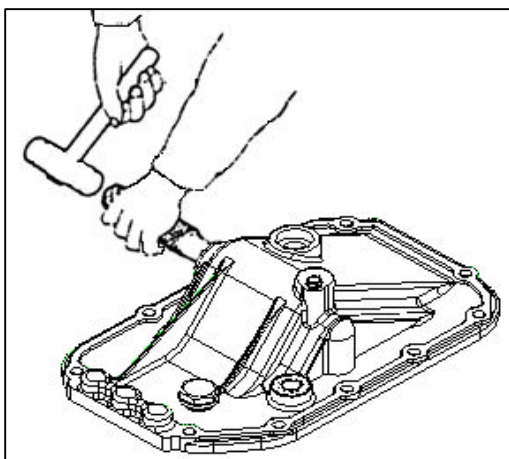
Select appropriate retaining ring to insert in, and get a minimum axial gap.

Top head reassembling



Reassembling sequence:

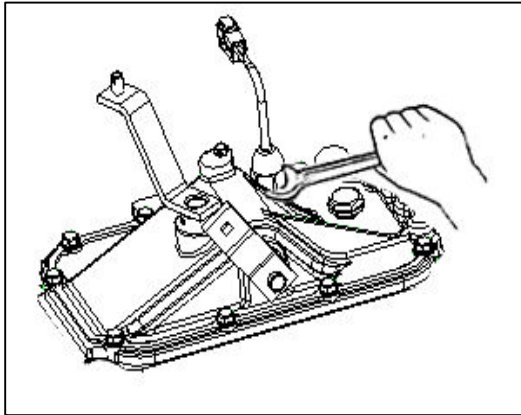
1 Oil seal 2 Inner shifting gear rocker arm 3 Outer shifting gear rocker arm combined part 4 Plain washer 5 External selected gear rocker arm combined part 6 Inner selected gear rocker arm 7 Elastic cylindrical pin 8 Reversing lamp switch 9 Oil filling plug



Important operation

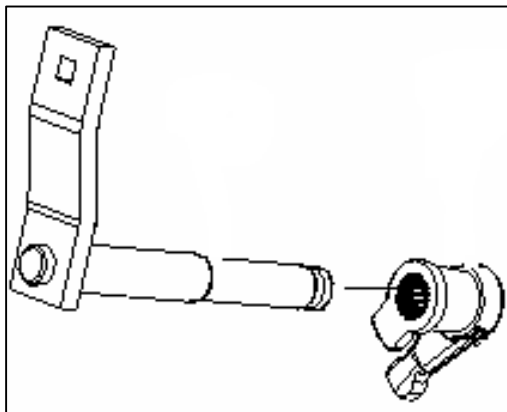
Oil seal assembling

Strike the oil seal into place gently with special tools.



Reversing lamp switch

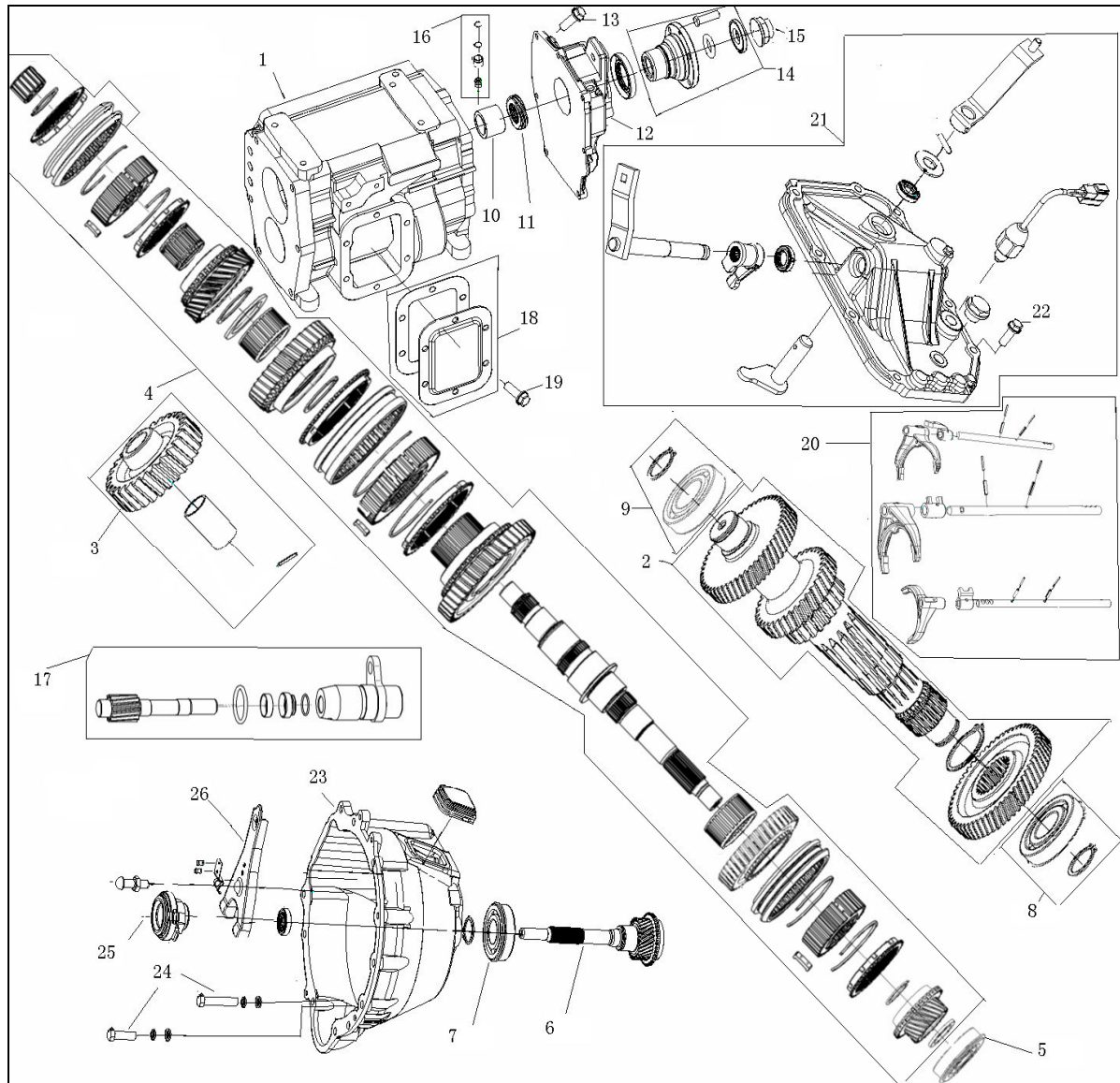
Torque	N·m	30-50
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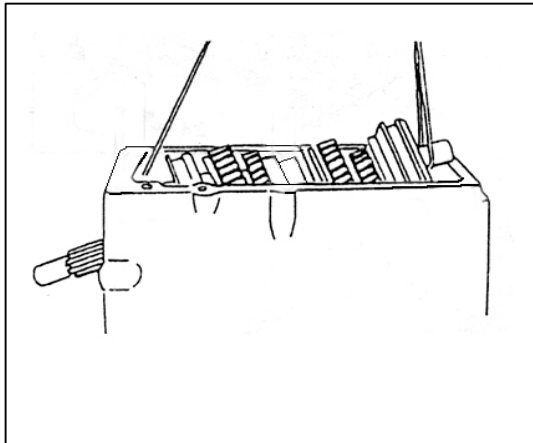
Internal/external shifting gear rocker arm

Assembling of internal/external shifting gear rocker arm

Large parts reassembling



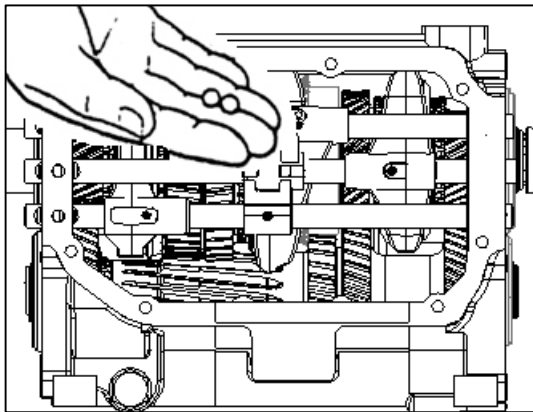
1 Housing 2 Intermediate axle assembly 3 Reversing gear 4 Secondary axle assembly 5 Secondary axle bearing 6 Primary axle assembly 7 Primary axle bearing 8 Intermediate axle rear bearing, retaining ring 9 Intermediate axle front bearing, retaining ring 10 Inner driven gear and driving gear spacer 11 Inner driven gear driving gear 12 Rear cover and oil seal 13 Rear cover bolt 14 Flange 15 Secondary axle nut 16 Breather valve 17 Inner driven gear 18 Side cover and side gasket 19 Side cover bolt 20 Shifting yoke, shifting yoke shaft 21 Top head assembly 22 Top head bolt 23 Clutch housing 24 Clutch housing bolt 25 Separation bearing 26 Separation shifting yoke assembly



Important operation

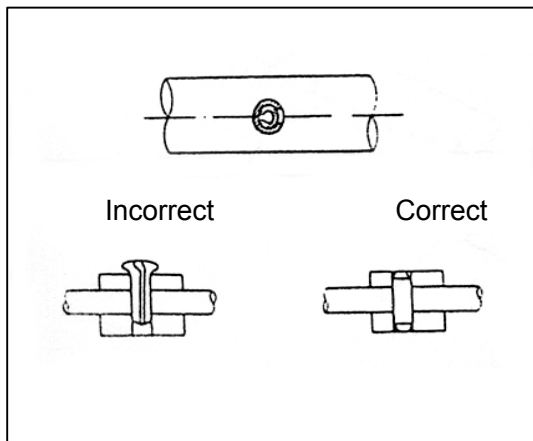
Secondary axle assembling

Use strong steel cable while assembling, and pay attention to safety.



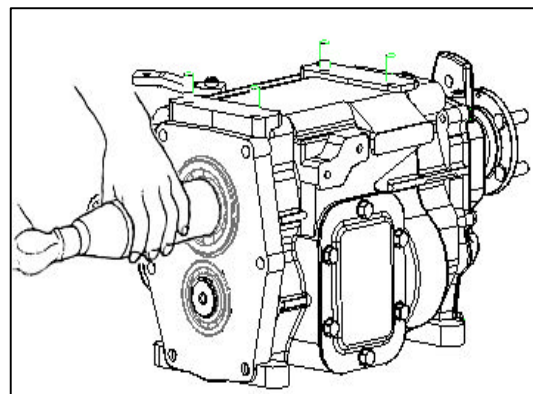
Interlocking pin, steel ball

Put the steel ball into the housing, insert the interlocking pin into pin hole of shifting yoke, make it arrive at the other side of the housing through the case hole, 3/4 gear shifting yoke, and 3/4 gear shifting block in sequence.



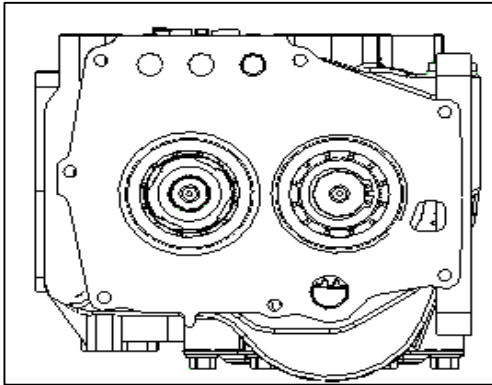
Spring pin

Do not reuse the disassembled spring pin; replace it with a new one.



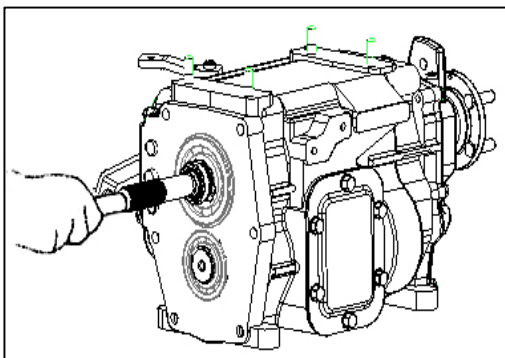
Primary axle bearing

Please assemble it with special purpose sleeve.



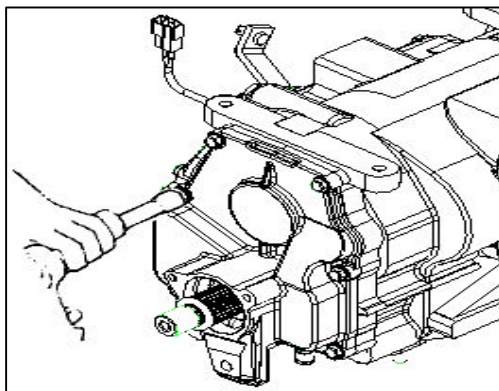
Clutch housing

Apply the connection surface of the clutch housing with liquid sealant.



Primary axle

Assemble primary axle into the gearbox; and make sure the primary axle turns flexibly.



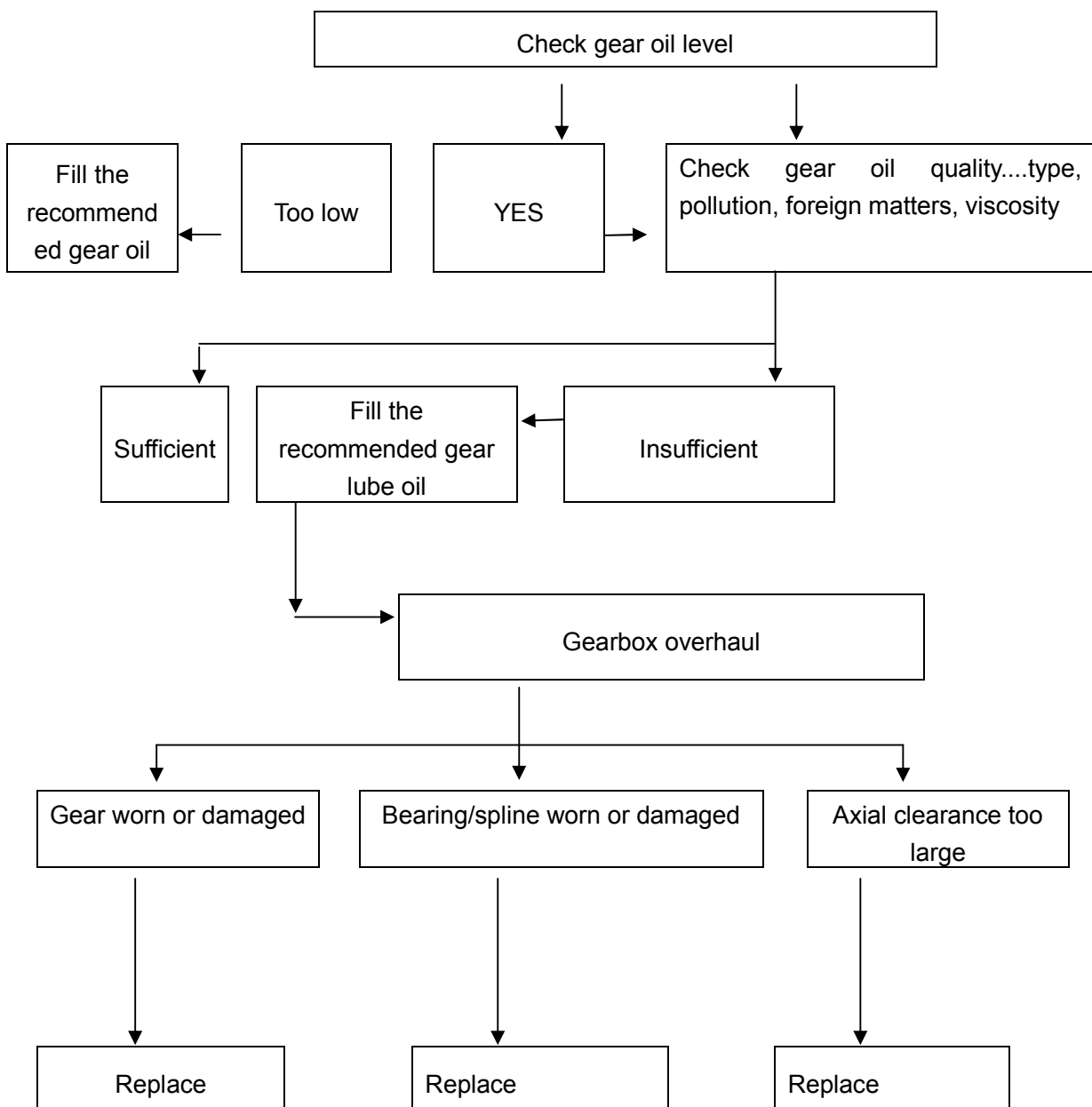
Gearbox rear cover bolt

Torque (N·m)	68.6-91.3
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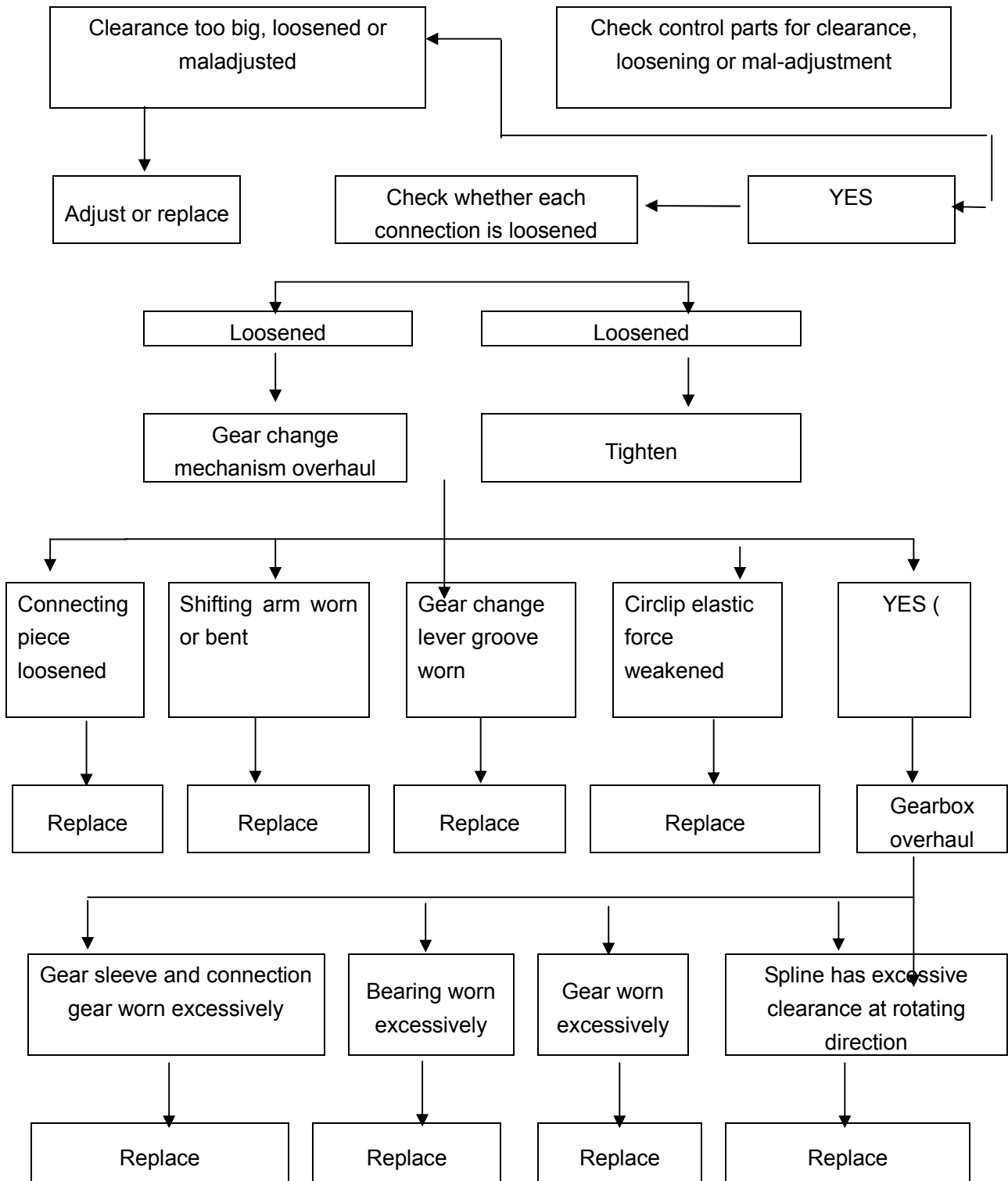
VI. Trouble shooting

1. Gearbox noises

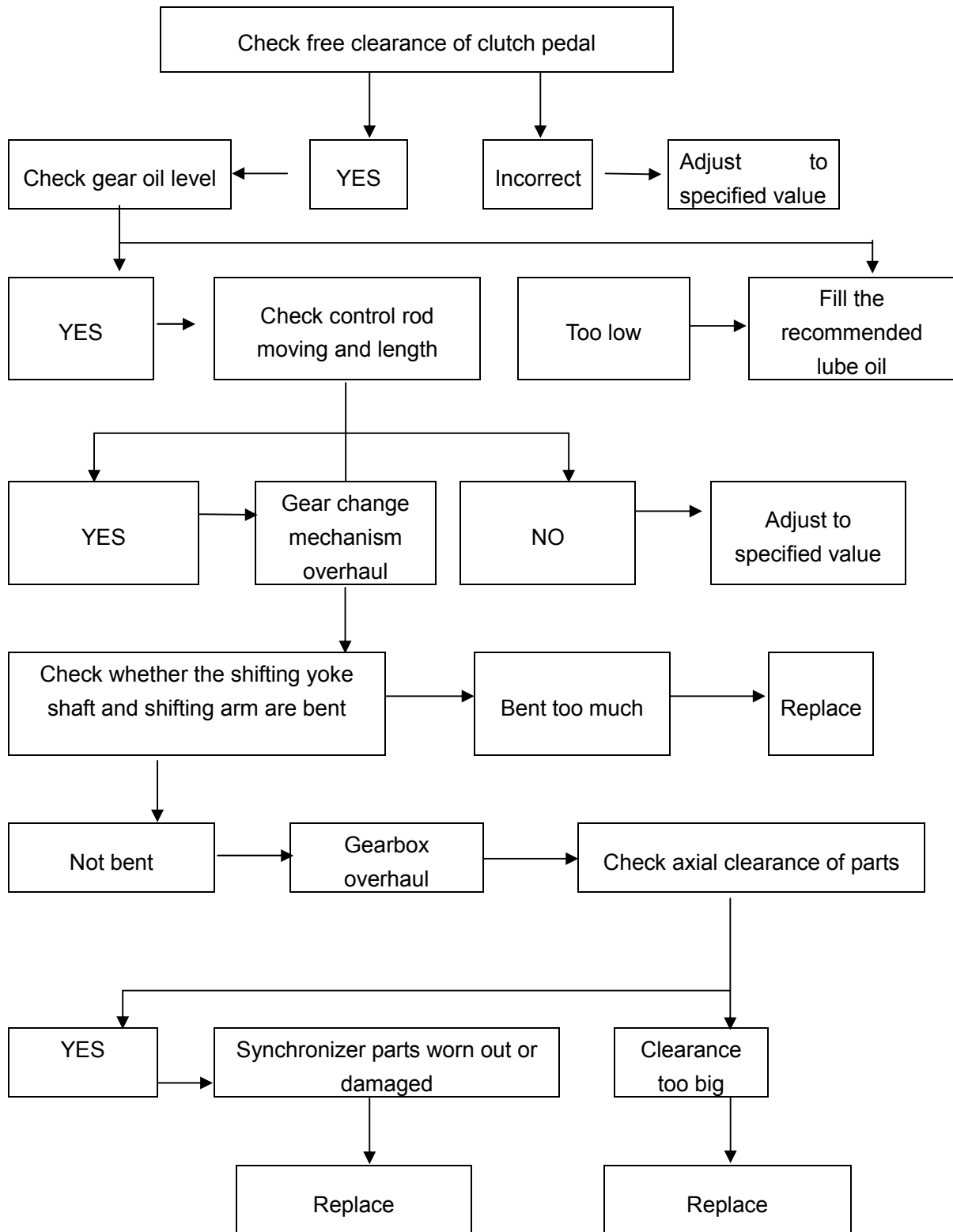
If there is noise coming from the gearbox area during idling, inspect the clutch first. If the noise stops when treading down the clutch pedal, it shows the noise is coming from the gearbox.



II. Gear out-of-gear



III. Gear cannot shift smoothly (having noise when shifting)



Drive shaft

General

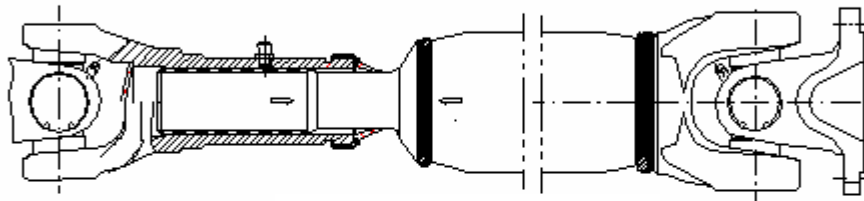
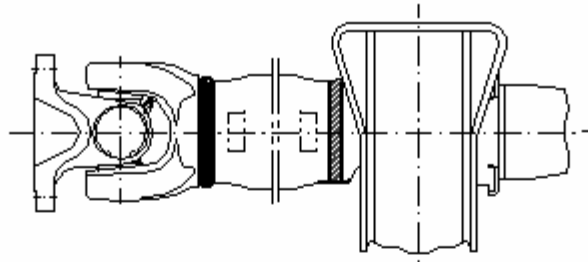
Technical parameters

Fixed torque

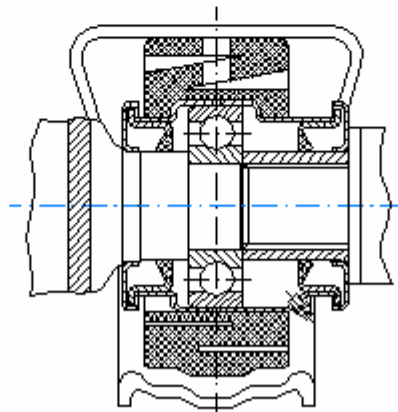
Disassembling and reassembling

Trouble-shooting

General



Drive shaft assembly



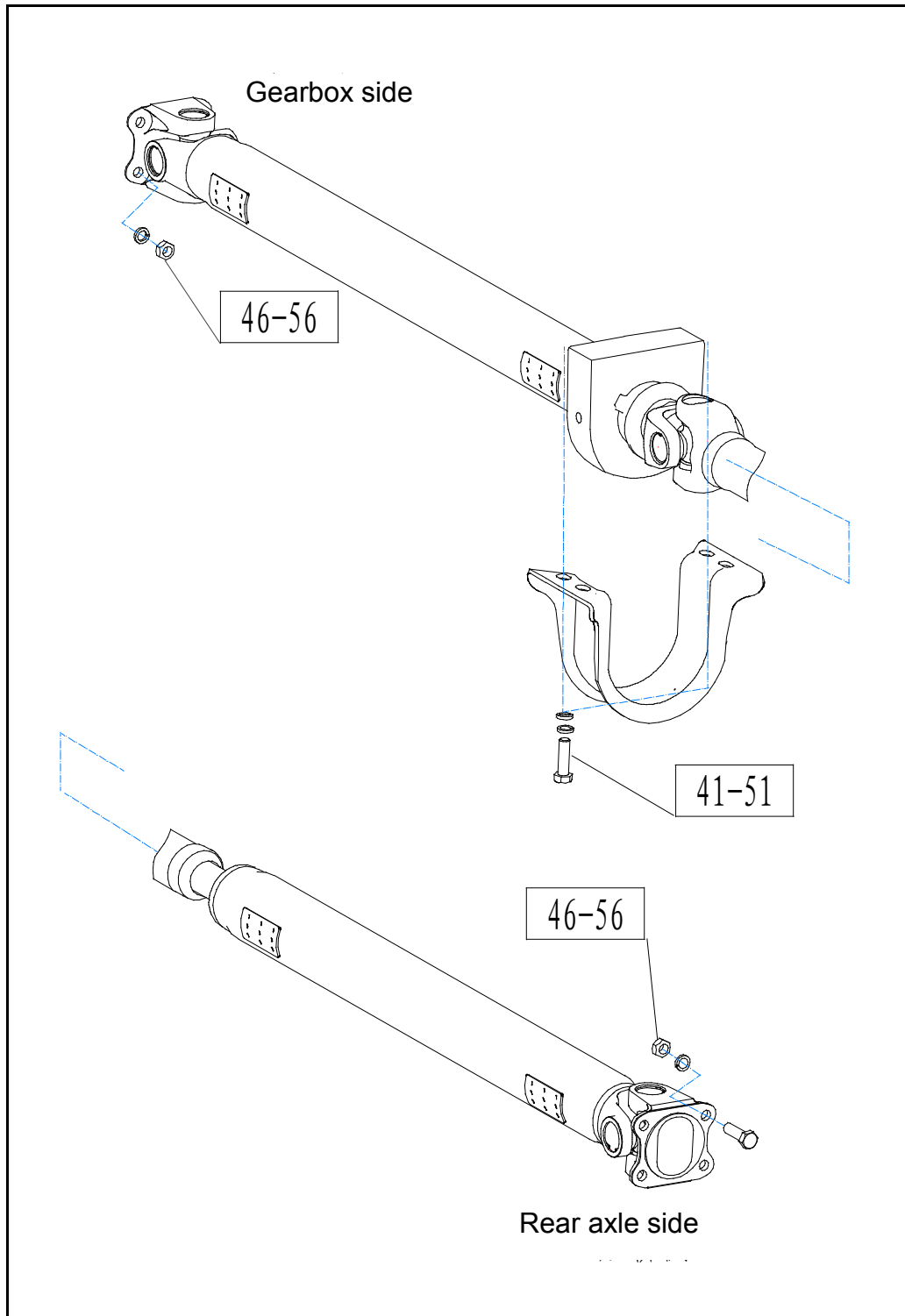
Middle support assembly

Technical parameters

Bearing fixing mode		Outer spring ring
Cross length	Mm	71
Cross length outside diameter	Mm	18.44
Shaft tube specification	Diameter × thickness Mm	69×2.5
Flange bolt specification		φ10
Flange dimension	Reference diameter Mm	φ85
Max. unbalance	g·cm/rpm	Not exceeding 35/3200

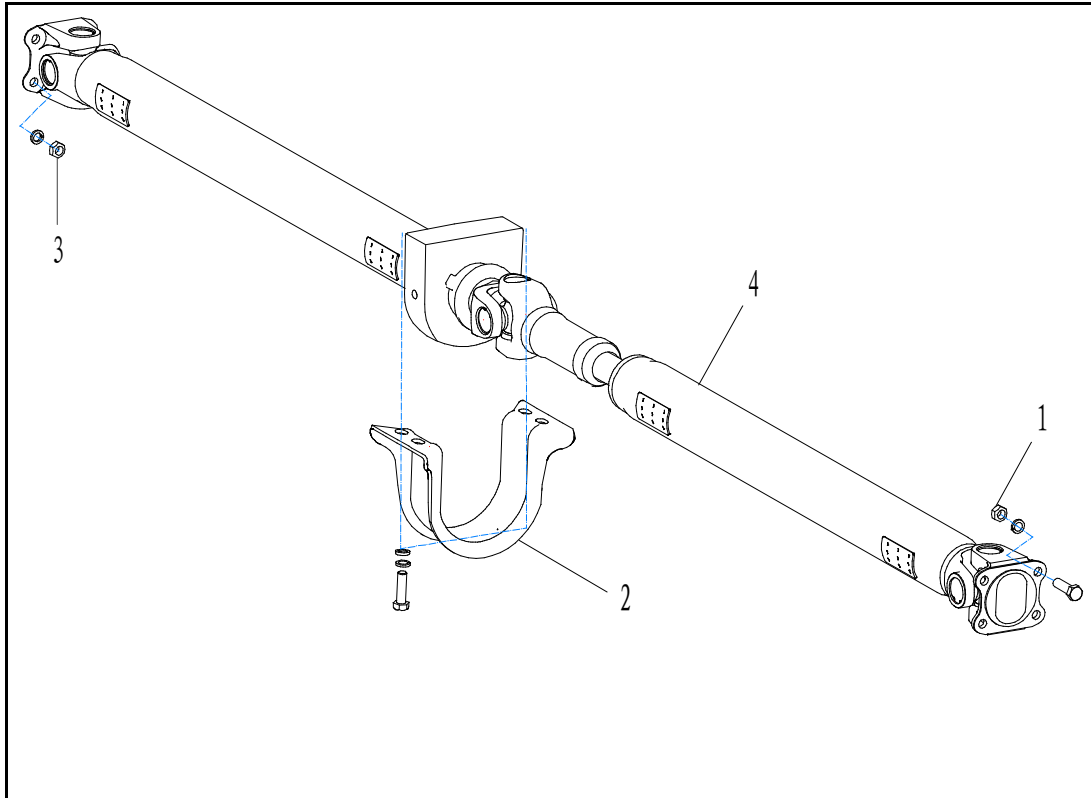
Fixed torque

N·m



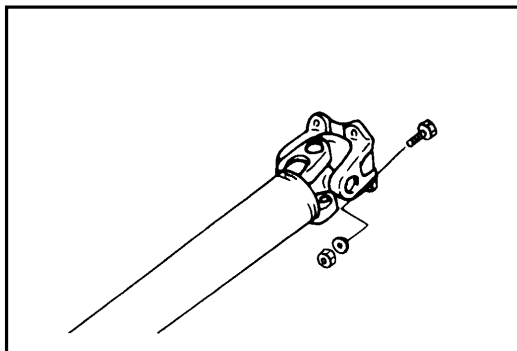


Disassembling



Disassembling steps

1. Differential end nut
2. Middle suspension
3. Transmission end nut
4. Drive shaft assembly



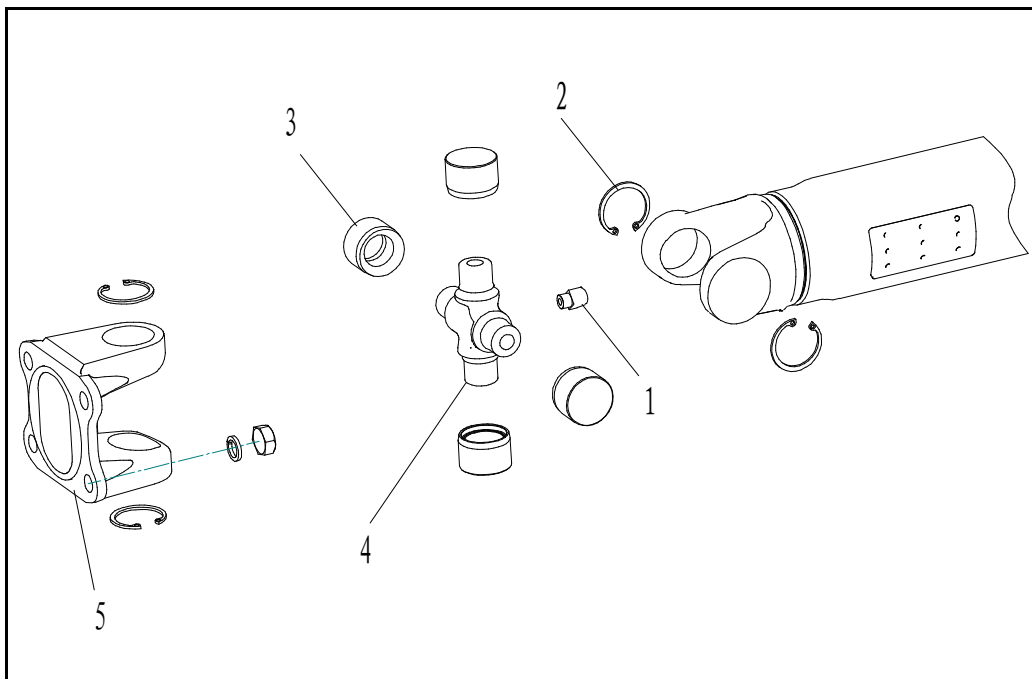
Important operation

As the drive shaft requires good balance, assembly mark should be made on the universal joint during the disassembling.



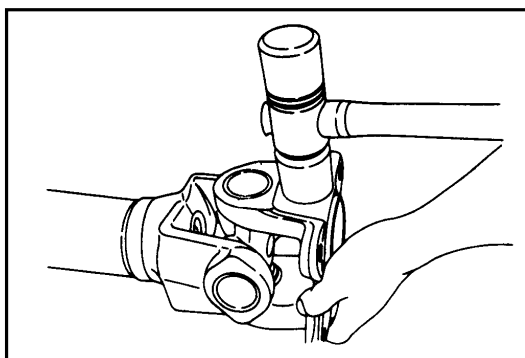
Disassembling

Universal joint



Disassembling sequence

- | | |
|-------------------------------------|----------------|
| 1. Cross grease nipple | 4. Cross |
| 2. Universal bearing retaining ring | 5. Flange yoke |
| 3. Needle bearing | |



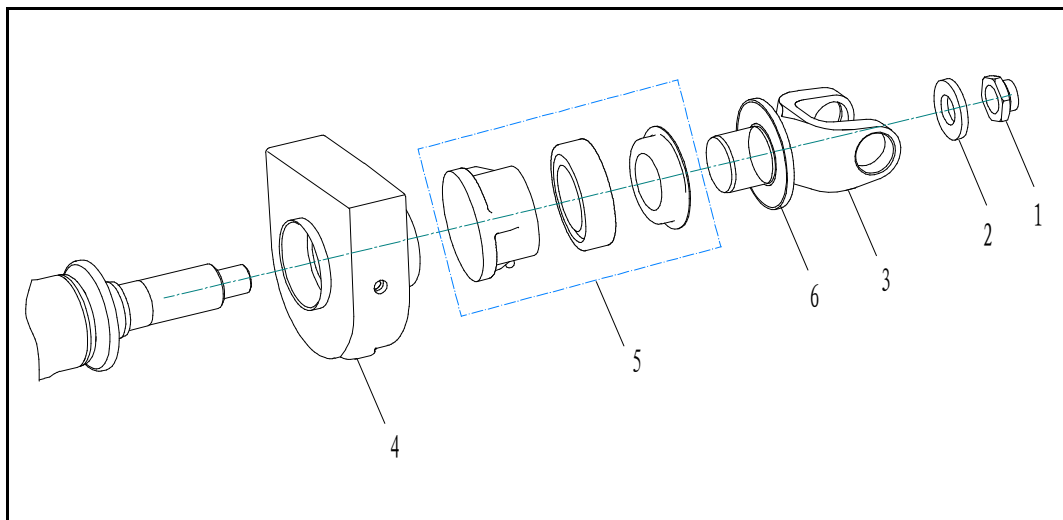
Importance operation - disassembling



1. Needle bearing

Knock on the flange yoke to remove the bearing and then tap on the cross to remove the needle bearing. Remove the other bearings in the same way.

Center bearing



Disassembling sequence

- | | |
|------------------|-------------------|
| 1. Nut | 5. Center bearing |
| 2. Washer | 6. Dust shield |
| 3. Yoke | |
| 4. Middle rubber | |



Inspection and repair

If wearing or other faults are found on the components during the inspection, repair or replacement should be carried out.

Cross

Needle bearing

Flange yoke

Yoke

Center bearing

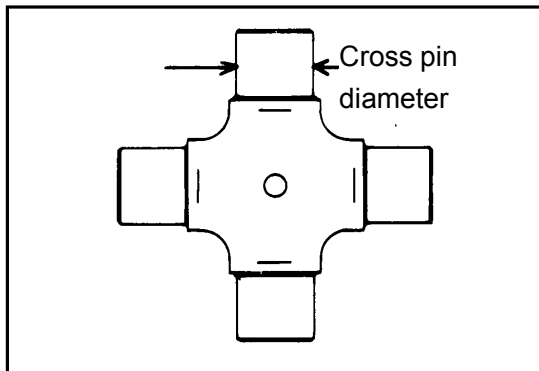
Vibration isolating rubber bearing

Bracket



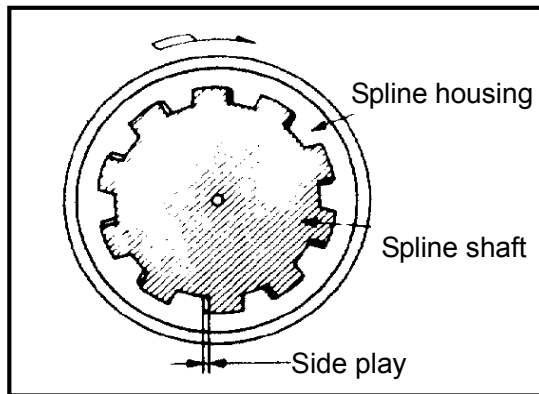
Visual inspection

Check the following components for wearing, damage and other abnormal conditions.



Cross pin diameter

(mm)	
Dimension	Limit
18.44	18.34



Hj Spline side play

(mm)	
Standard	Limit
0.1	0.3



Unbalance inspection (for reference only)

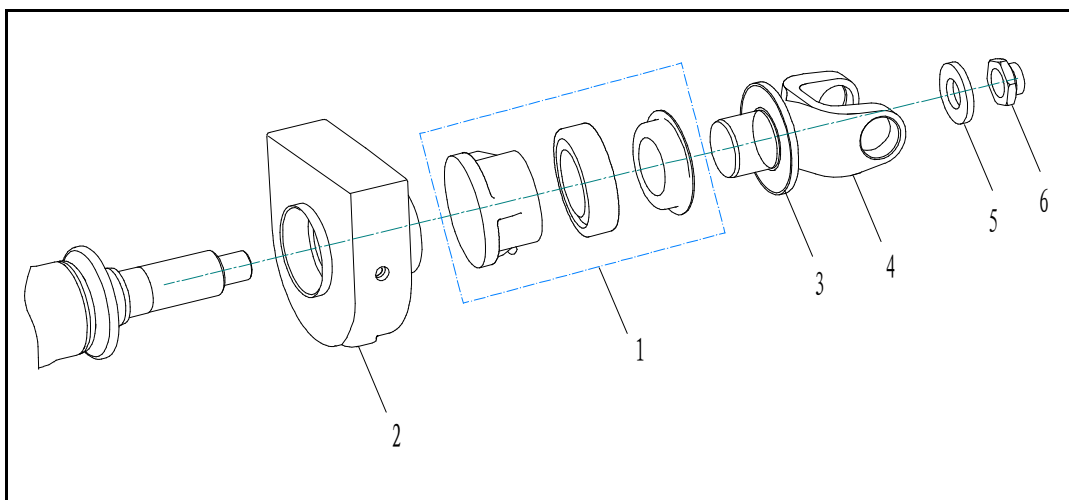
Measure the unbalance value of certain point in cross.

Speed at measurement (rpm)	Unbalance (g·cm)
3200	35



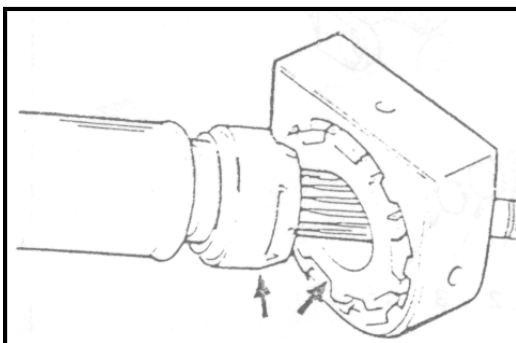
Reassembling

Center bearing



Disassembling sequence

- | | |
|-------------------|-----------|
| 1.. Middle rubber | 5. Washer |
| 2. Center bearing | 6. Nut |
| 3. Dust shield | |
| 4. Yoke | |



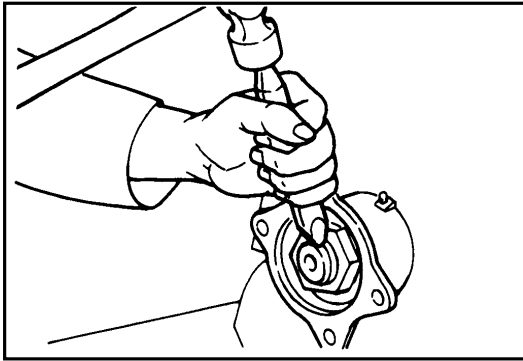
Important operation

Apply grease on oil seal lip and middle bearing

Grease. Recommended grease type:

Fuchs EPT-2.5 grease

Filling-up quantity 20 - 25g.

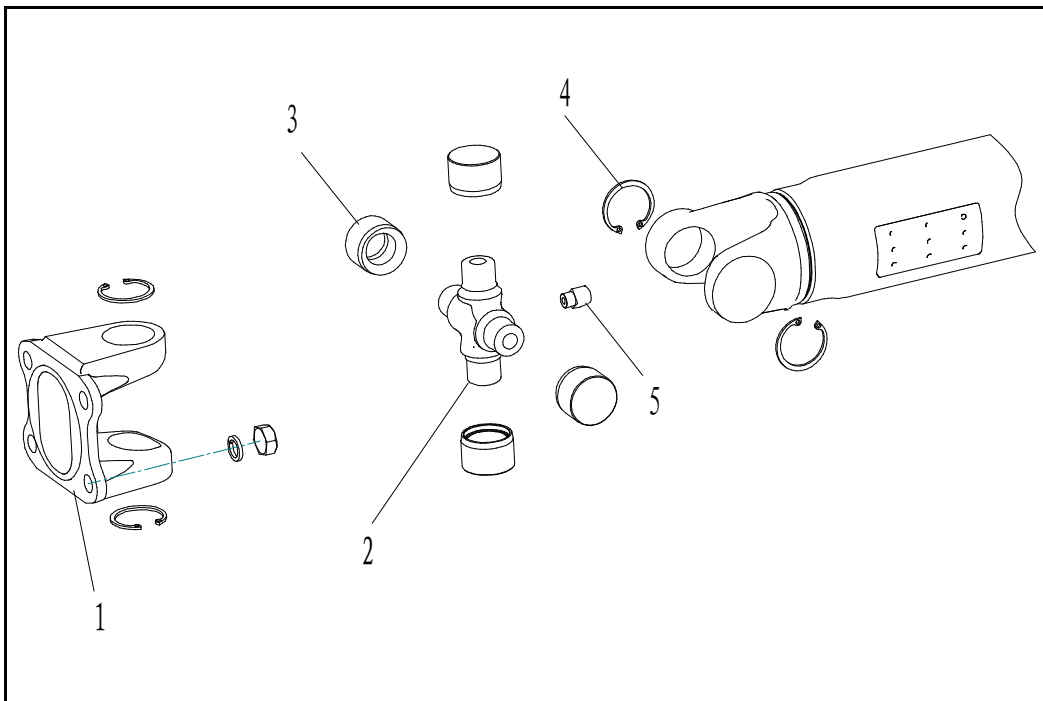


Important operation

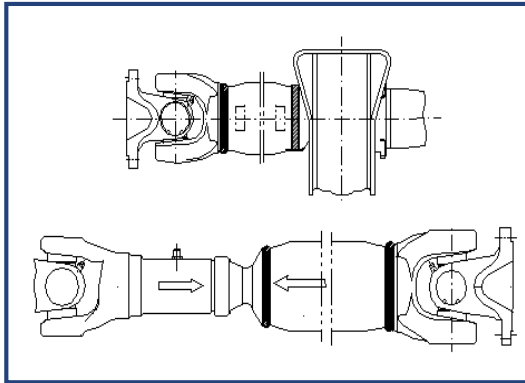
Staking on the nut after the middle nut is tightened.

Two symmetrically on circumference.

Universal joint



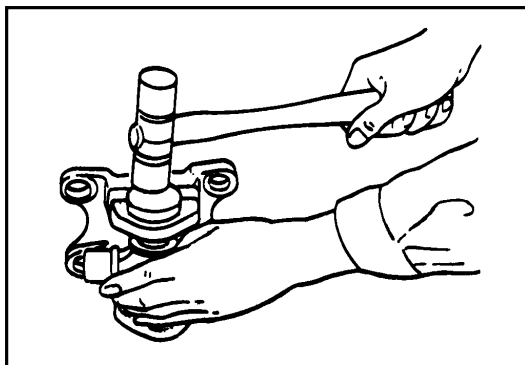
- | | |
|-------------------|-------------------------------------|
| 1. Flange yoke | 4. Universal bearing retaining ring |
| 2. Cross | 5. Cross grease nipple |
| 3. Needle bearing | |



Important operation - - - reassembling

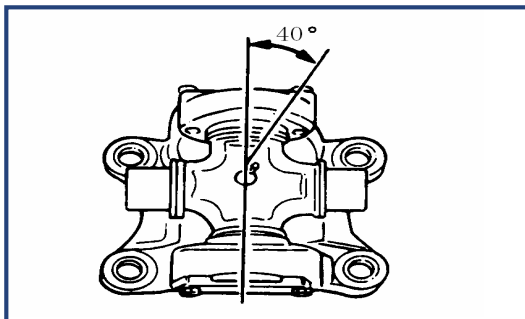
1. Flange yoke

The flange yoke of the drive shaft must be installed as shown in the figure. The spline spindle and spline yoke should be assembled in alignment as shown by the arrow.



2. Needle bearing

Apply Fuchs EPT - 2.5 grease on the oil seal and needle bearing. Use cross as the guide to fit needle bearing in the flange yoke by knocking with soft face hammer.



3. Cross grease nipple

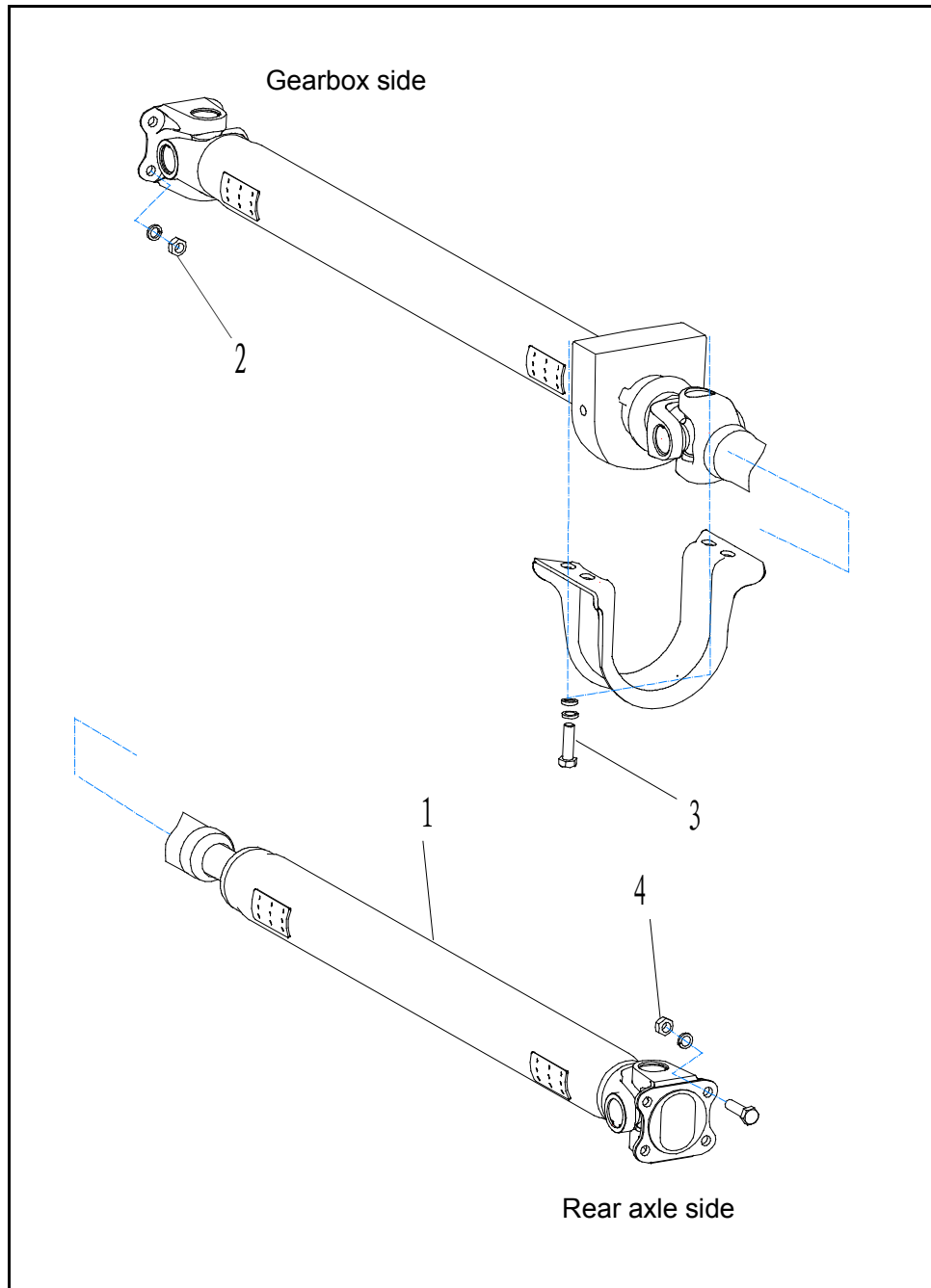
Install the grease nipple to the specified angle on the cross. Make sure that the grease nipples face upward.



4. Universal bearing retaining ring

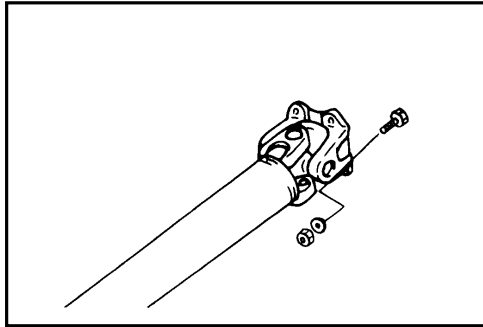
Do not use worn universal bearing retaining ring. After the bearing is installed, select and fit the appropriate universal bearing retaining ring to make the cross end play not exceed 0.1mm.

Assembly



Assembling steps

1. Drive shaft assembly
2. Transmission end nut
3. Middle suspension
4. Differential end nut

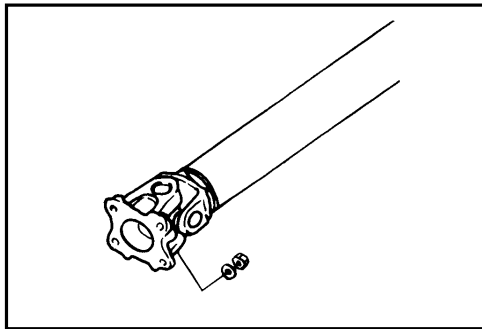


Importance operation - Assembly



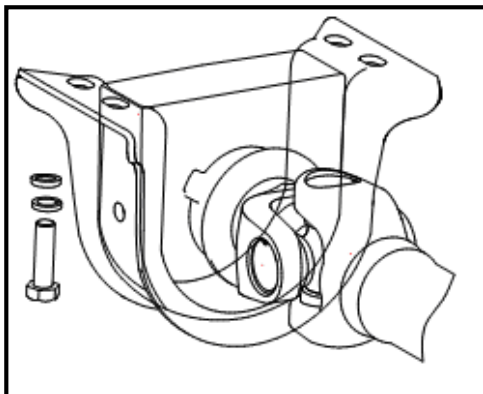
1. Transmission side nut

Torque (N·m)	46-56
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2. Differential end nut

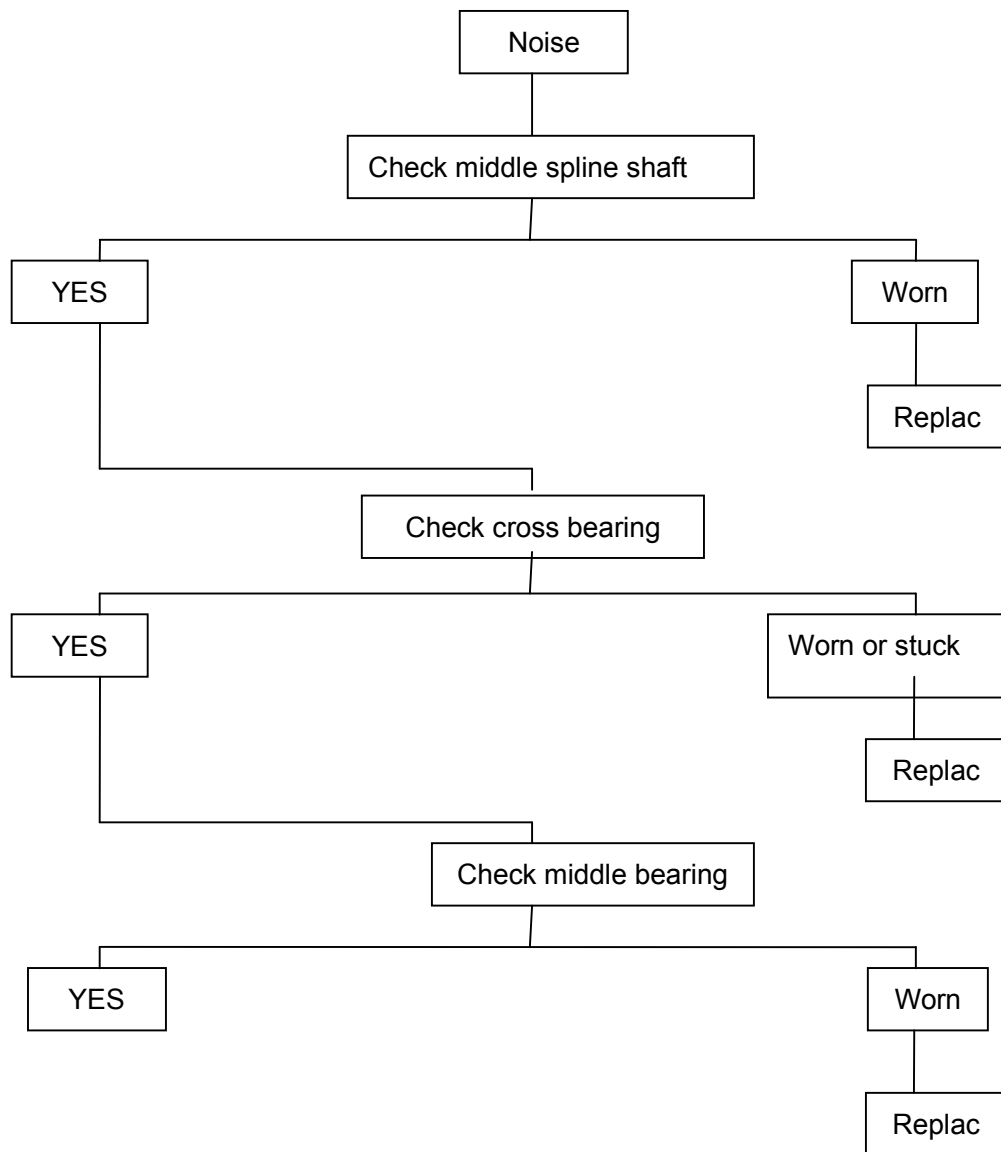
Torque (N·m)	46-56
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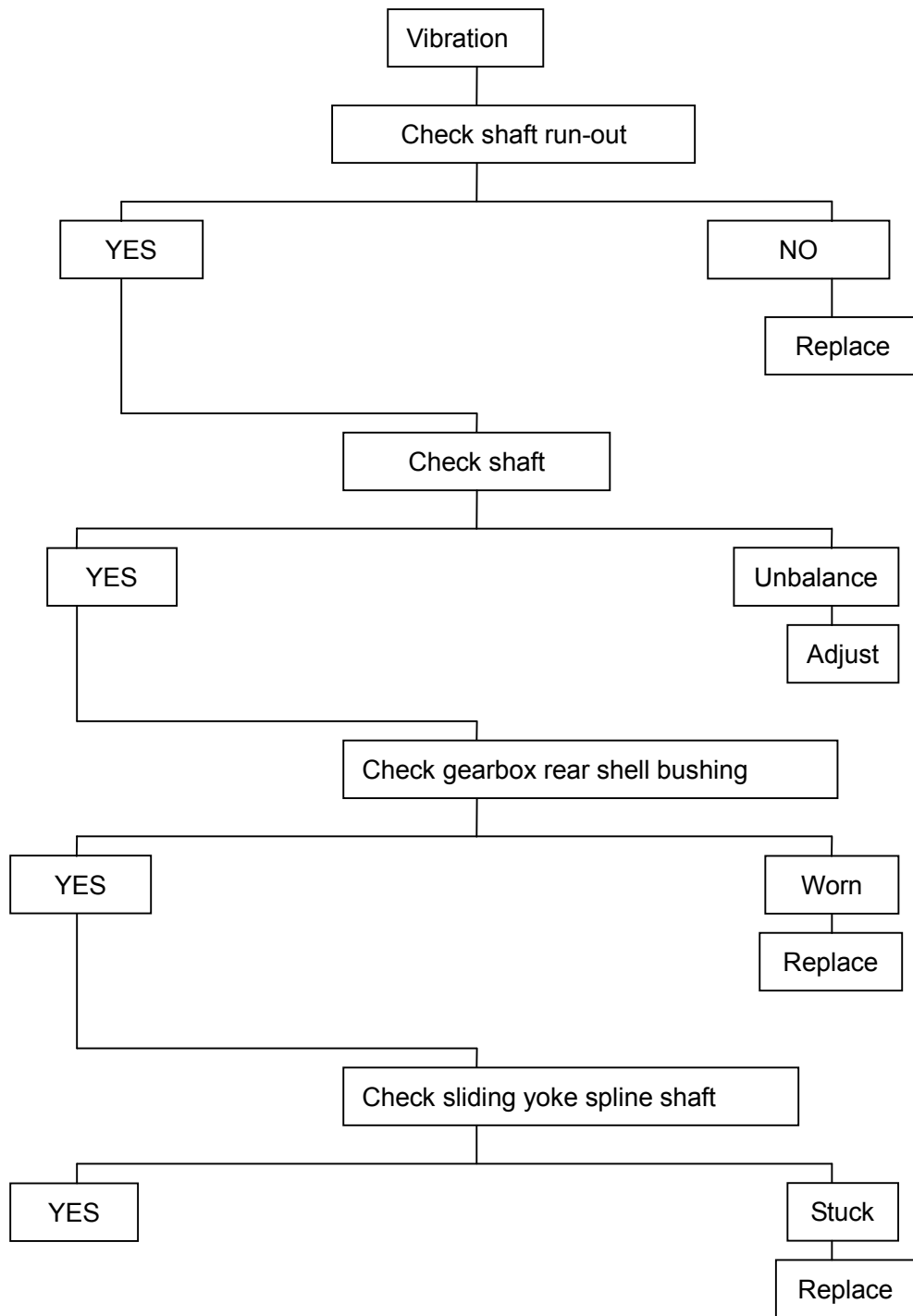


Middle support nut

Torque (N·m)	41-51
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Trouble-shooting





Rear Axle

Rear Axle Assembly

- Chapter I Introduction of Rear Axle Structure**
- Chapter II Disassembling, inspection, and reparation**
- Chapter III Assembly and adjustment of rear axle assembly**
- Chapter IV Use and maintenance of rear axle assembly**
- Chapter V Trouble shooting of rear axle**

Rear Axle

Chapter I Introduction of Rear Axle Structure

I. General description of the structure

Types of Rear Axle Structure (Table 1)

Item	Content
Type of axle case	Press-welding integral type
Type of axle shaft support	Full floating type
Type of reduction gear	Single-stage hypoid spiral bevel gear
Number of planetary gears	4 planetary gears
Rated axle load	4 tons
Maximum output torque	8500N·m

This series of rear axle is the drive axle for two-wheel drive vehicle, and the rear suspension is of the rigid-axle type suspension structure. It is composed of the final gear, differential and axle case etc., which is the final reduction and driving mechanism in the automotive power transmission system. The final gear can both change the power transmission direction, and reduce the rotation speed and increase the torque. It is composed of the drive gear and the driven gear. The end with spline of the drive gear is jointed to the propeller shaft universal joint assembly through the drive gear flange, and the middle of it is supported by two conical bearings which are installed in opposite direction, so as to bear the axial force and the tangential force. The small face neck of the drive gear is installed on the conical roller bearing, which only bears the radial force. The driven gear is fixed on the differential left casing by the bolts.

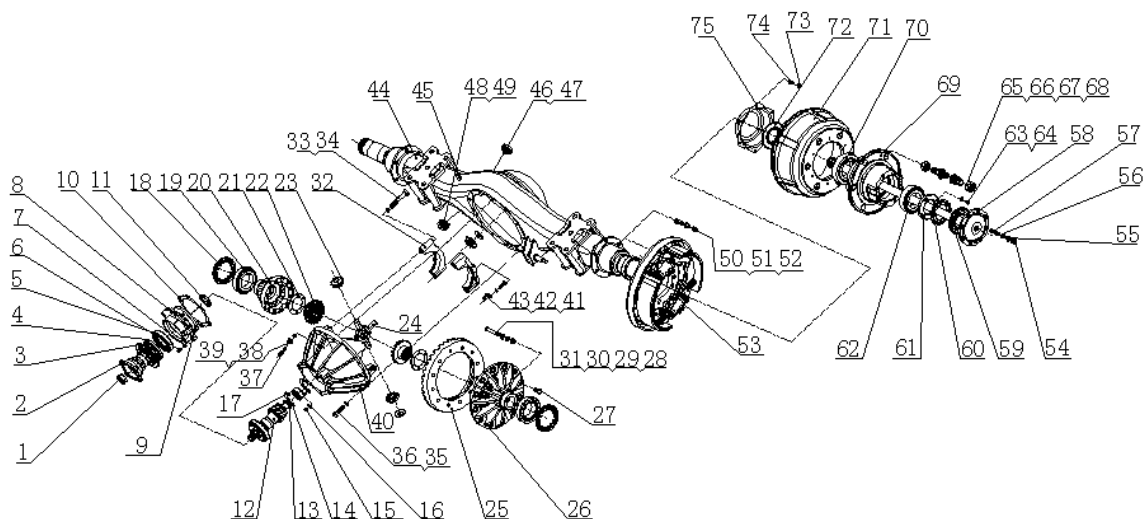
Differential allows the left wheel and the right wheel to generate different rotation speed, it is composed of such components as the differential right casing and left casing, cross shaft, four planetary gears, and two axle shaft gears etc.

One end of the rear-axle shaft is jointed to the axle shaft gear with spline, the flange on other end is connected to the hub and brake drum assembly by the bolts.

Rear Axle

II. Explosion diagram and details of rear axle assembly:

1.	Drive gear flange self-lock nut	2.	Drive gear flange	3.	Dust fender	4.	Oil seal-drive gear
5	Drive gear inner and outer bearing	6	Bearing seat bolt	7	Spring washer	8	Drive gear bearing seat
9	Adjusting washer-bearing seat	10	O-ring	11	Compressible spacer	12	Drive gear
13	Guide bearing spring collar	14	Guide bearing guard assembly	15	Type 1 Hex nut	16	Spring washer
17	Drive gear guide bearing	18	Differential bearing adjusting nut	19	Differential bearing	20	Differential casing (right)
21	Axle shaft gear thrust washer	22	Axle shaft gear	23	Planetary gear	24	Planetary gear shaft
25	Driven gear	26	Differential casing (left)	27	Bolt-driven gear	28	Bolt-differential casing
29	Nut-differential casing	30	Spring washer	31	Flat washer	32	Bearing cap
33	Bearing cap bolt	34	Spring washer	35	Reduction casing bolt	36	Spring washer
37	Reduction casing bolt	38	Reduction casing nut	39	Spring washer	40	Final drive casing
41	Hex bolt	42	Locking plate-adjusting nut	43	Spring washer	44	Rear axle casing assembly
45	Normally open vent plug	46	Filler plug	47	Filler plug sealing ring	48	Drain plug
49	Drain plug sealing ring	50	Find thread hex bolt	51	Type 1 fine thread hex nut	52	Spring washer
53	Rear brake assembly (left and right)	54	Axle shaft nut	55	Taper sleeve	56	Spring washer
57	Axle shaft bolt	58	Axle shaft	59	Axle shaft oil seal	60	Lock washer
61	Bearing nut	62	Rear hub outer bearing	63	Hex bolt	64	Spring washer
65	Tyre bolt	66	Tyre outer nut	67	Tyre inner nut	68	Rear hub inner nut
69	Rear hub	70	Rear hub inner bearing	71	Rear brake drum	72	Rear hub inner oil seal
73	Hex bolt	74	Spring washer	75	Oil catcher		



Rear Axle

III. Sealant and Adhesive Applied on Rear Axle (Table 2)

Item	Specified sealant and adhesive
Installation surfaces of the rear axle casing assembly and final reduction assembly	515 Anaerobic sealant
Driven gear bolt	GY-340 Anaerobic sealant
Differential casing bolt	GY-340 Anaerobic sealant
Reduction casing bolt	Mechanical sealant 605
Hub inner cavity	ZL-2 GB5671-85 Automobile General purpose Lithium Base Grease.
Installation of the final reduction assembly components	No. 10 motor oil

VI. Detailed List of Rear Axle Wearing Parts (Table 3)

Description	Quantity
Drive gear oil seal	1
Rear hub inner oil seal	2
Rear hub inner bearing	2
Rear hub outer bearing	2
Drive gear inner bearing	1
Drive gear outer bearing	1
Axle shaft oil seal	2
Drive gear nut	1
Differential bearing	2
Left and right plate friction lining	2 pieces for each
O-ring	1
Drive gear, bearing seat adjusting washer	According to actual need

Rear Axle

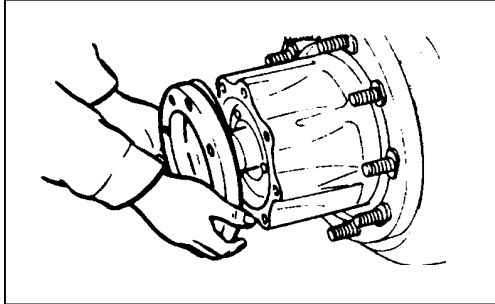
V. Table of Main Bolts Tightening Torque (Table 4)

Bolt (nut) Name	HF15015 (N.m)
Drive gear nut	250~280
Drive gear bearing seat bolt	75~113
Bolt –driven gear	108~161
Differential casing bolt	45~79
Reduction casing bolt	45~79
Guide bearing guard plate bolt	16~26
Bearing cap bolt	122~185
Adjusting nut locking plate bolt	16~26
Rear brake back plate nut	78~115
Axle shaft bolt	45~79
Hub inner nut	287~346
Lock washer small hex bolt	6~12
Filler plug	44.1~53.9
Drain plug	44.1~53.9

Rear Axle

Chapter II Disassembling, Inspection and Reparation of Rear Axle

I. Disassembling

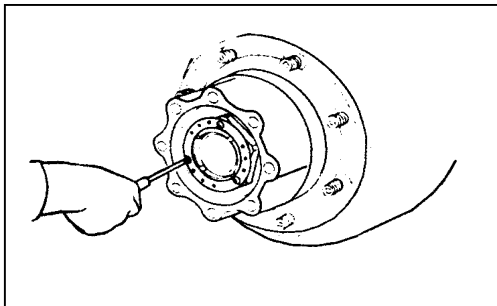


Remove the rear axle

1. Put wooden wedges under the wheel in the front and behind, to hold the wheel in position.
2. Loosen the wheel nuts of the outer side wheel.
3. Jack up the rear axle.

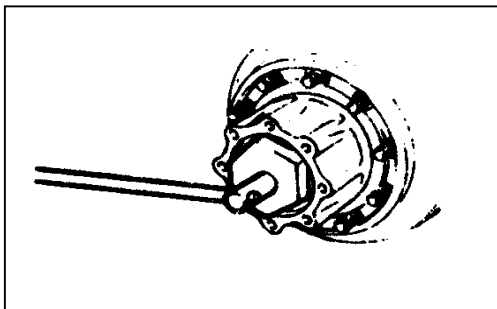
Remove the axle shaft

1. Loosen the axle shaft nuts.
2. Remove the axle shaft. If it is difficult to remove the axle shaft, use copper hammer to slightly knock on the axle shaft flange, until the axle shaft is loosen off.



Disassemble the wheel hub

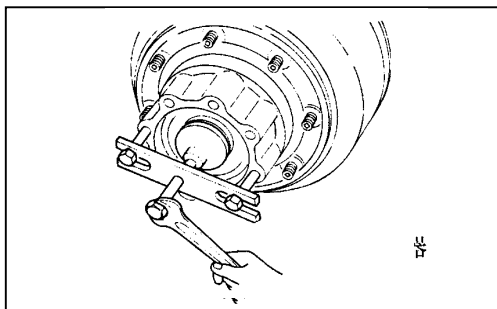
1. Remove the lock washer.



2. Remove the nub bearing lock nut.

Note:

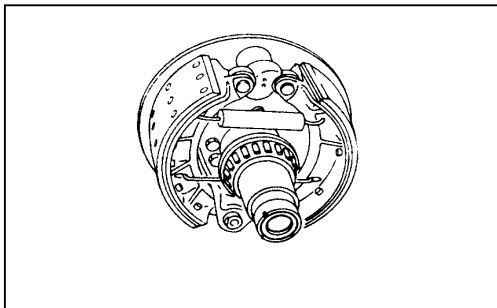
Use the hub bearing adjusting nut spanner to remove the adjusting nut.



3. Remove the wheel hub assembly.

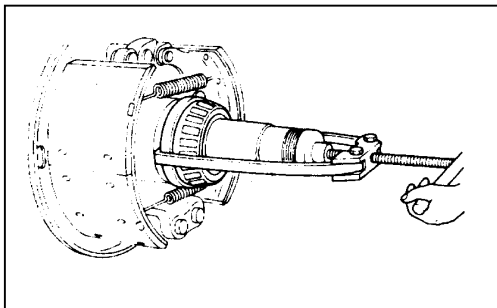
Note: use rear hub extractor, to remove the hub.

Rear Axle

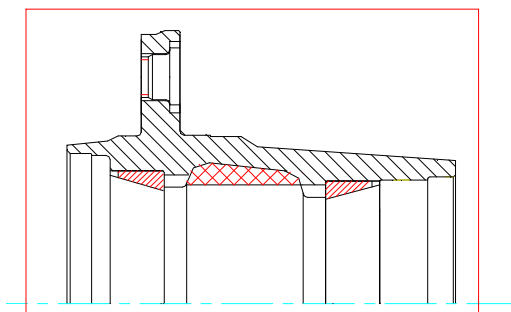


4. Remove the axle shaft oil seal from the end of the axle sleeve.

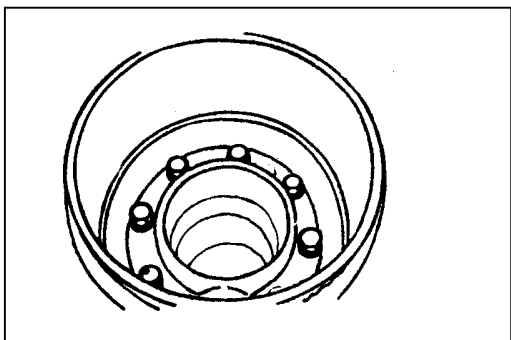
Note: when assembling, the outer ring of the axle shaft oil seal shall be applied with lithium base grease and then pressed into the rear hub.



5. Remove the oil seal from the hub assembly.

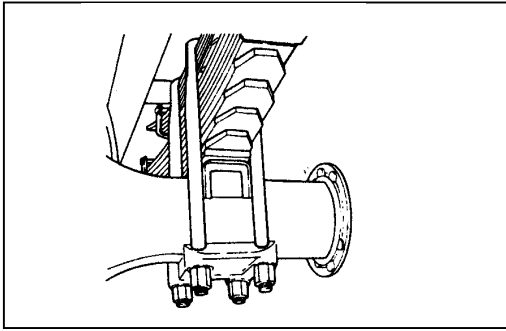


6. Remove the bearing cup of the inner and outer bearing.



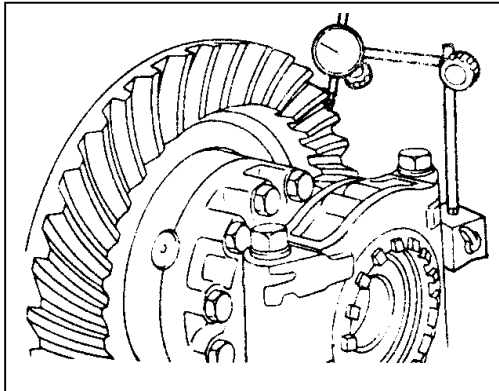
7. Remove the brake drum and oil retainer.

Rear Axle



Disassemble the axle case and the final reduction gear

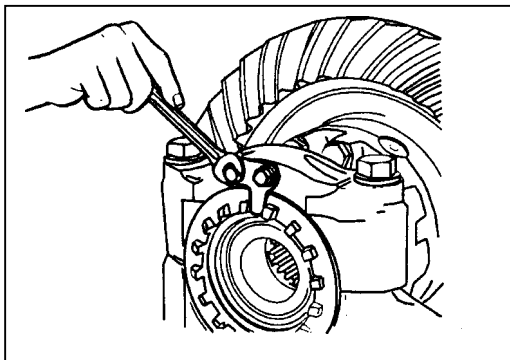
- 1) Bleed out the final reduction gear lubricating oil.
 - 2) Disassemble the connection between the propeller shaft and main reduction gear.
 - 3) Use jack to remove the final reduction gear assembly.
 - 4) Remove the hose, steel pipe, and wire cluster.
 - 5) Remove the brake assembly.
 - 6) Remove the rear axle.
- Jack up the axle casing.
 - Remove the U bolt and upper and lower base plates, lower down the jack, and pull out the axle casing.



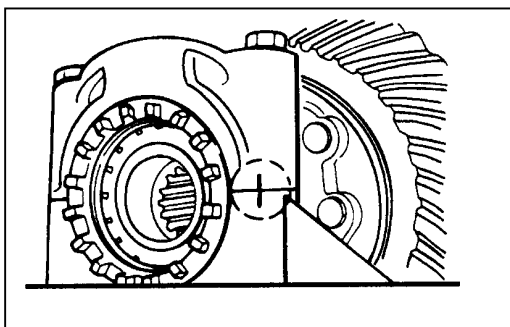
Disassemble the main reduction gear assembly

- 1) Before disassembling, measure and record the tooth clearance of the drive gear and the driven gear.

Note: After adjustment, check the engagement of the gears.



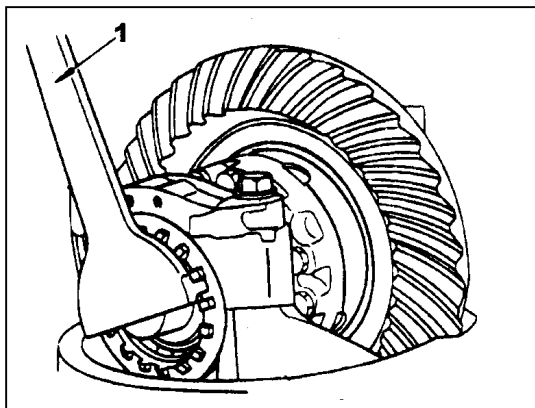
- 2) Remove the locking plate;



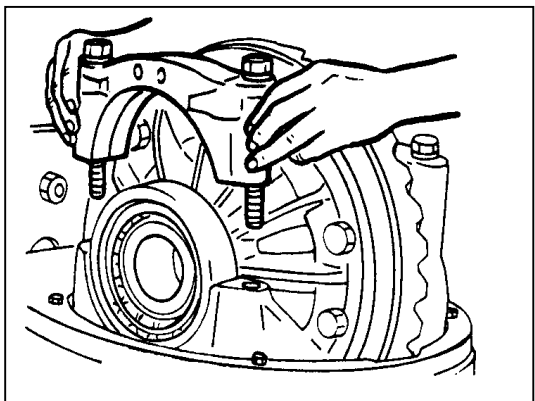
- 3) Make assembly marks on the bearing cap and casing;

The disassembled bearing cap and reduction casing shall be placed separately per left and right according to the matching number, in order to avoid mismatching during re-assembling.

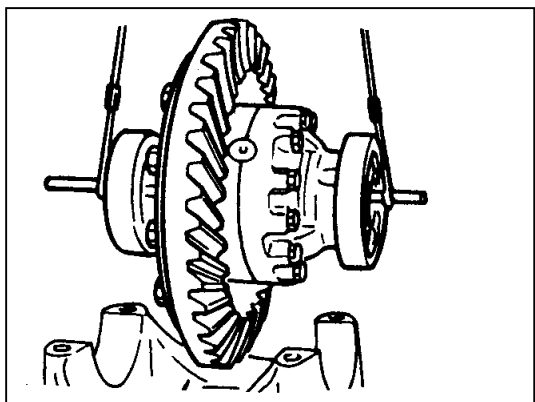
Rear Axle



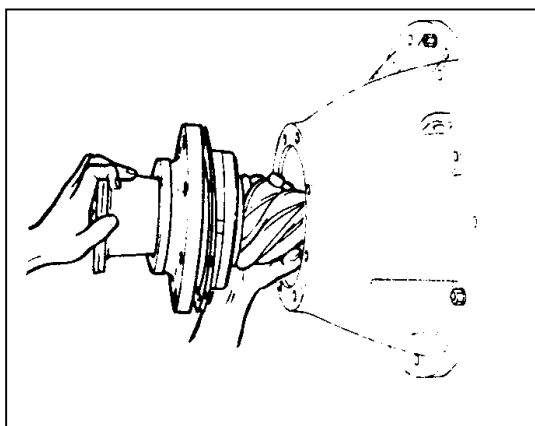
4) Loosen the fixing bolts of the bearing cap, use differential spanner to remove the adjusting nut;



5) Remove bearing cap and bolt;

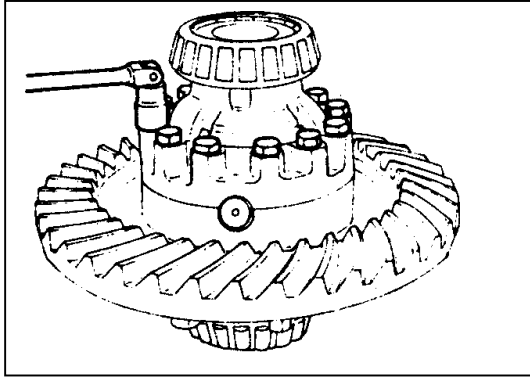


6) Remove the differential assembly;



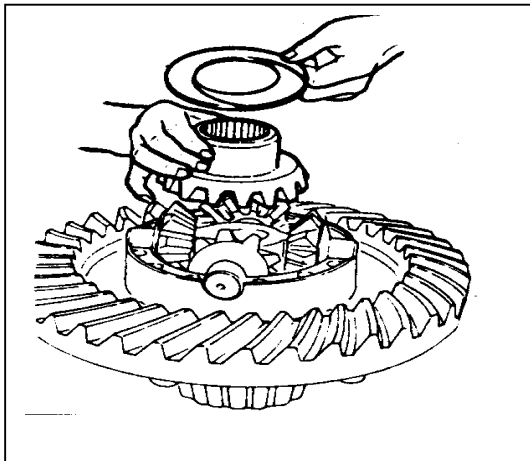
7) Use stripper to remove the drive gear assembly, at the same time remove the adjusting washer;

Rear Axle

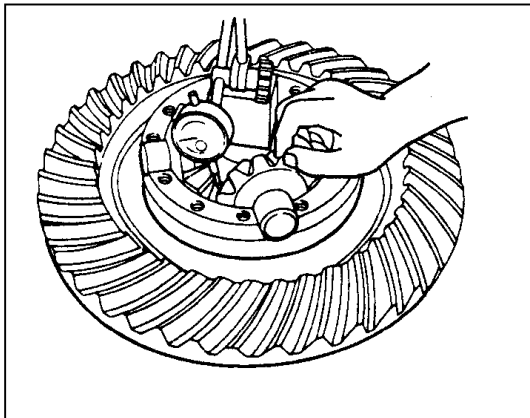


Disassemble the differential assembly

- 1) Remove the differential right casing;

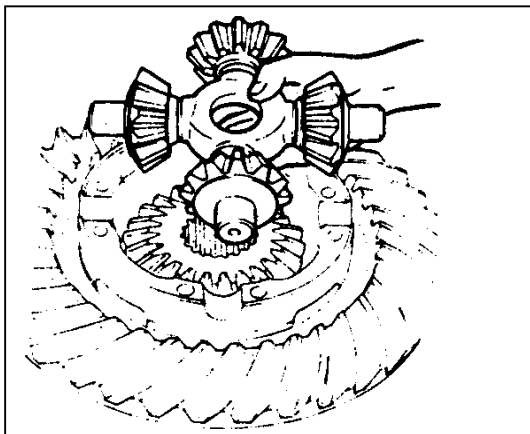


- 2) Remove the axle shaft gear and washer;



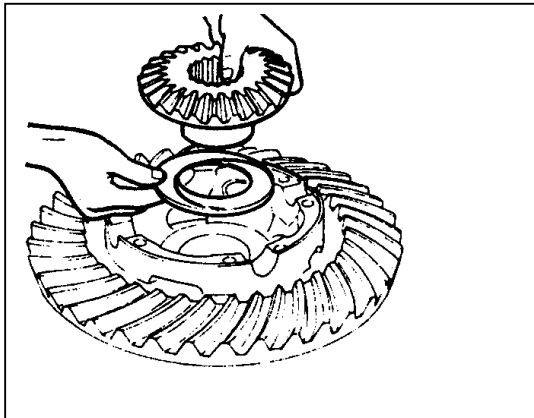
- 3) Measure and record the tooth clearance of the planetary gear;

Note: when measuring the tooth clearance, make sure to press down the planetary gear cross shaft.



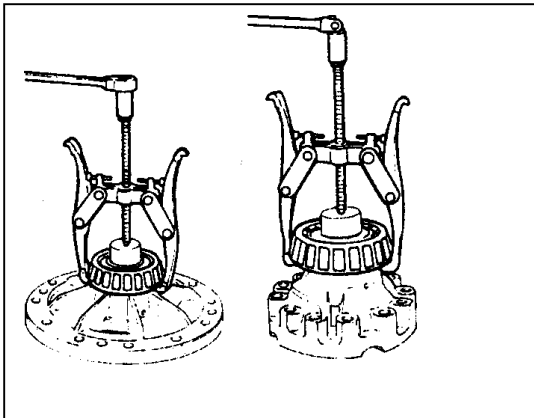
- 4) Remove the planetary gear cross shaft assembly, and then remove the planetary gear and washer from the cross shaft;

Rear Axle

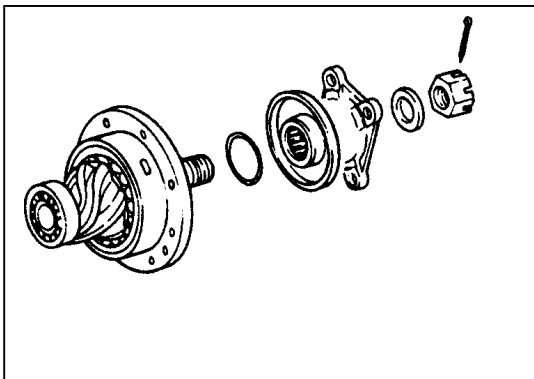


5) Take out the axle shaft gear and the thrust washer on the axle shaft;

6) Remove the driven gear;

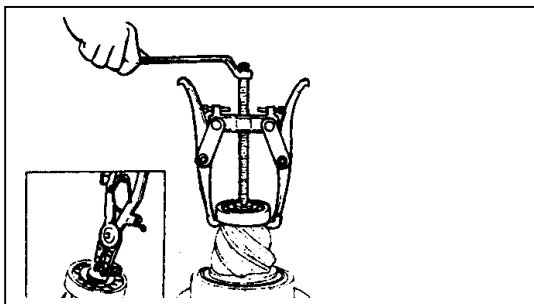


7) Remove the differential bearing from the differential casing;



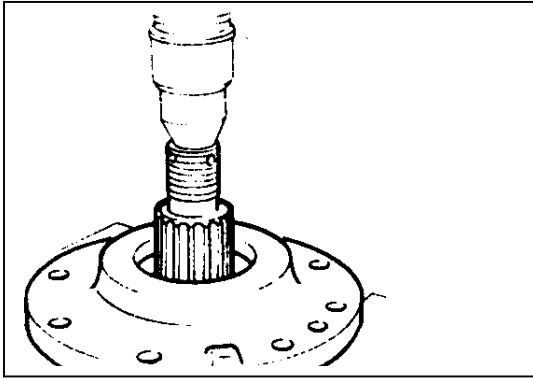
Disassembling of the drive gear

1) Remove the drive gear flange.

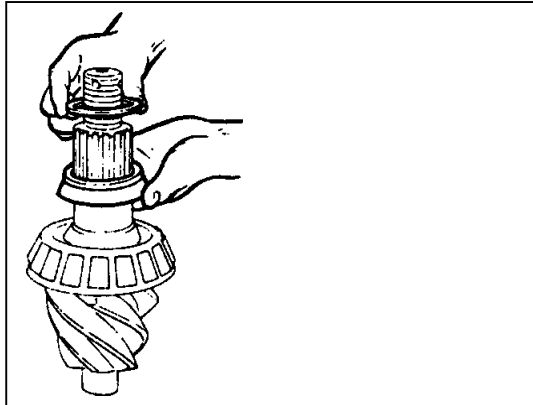


3) Remove the stopper elastic ring for shaft and take off the drive gear guide bearing;

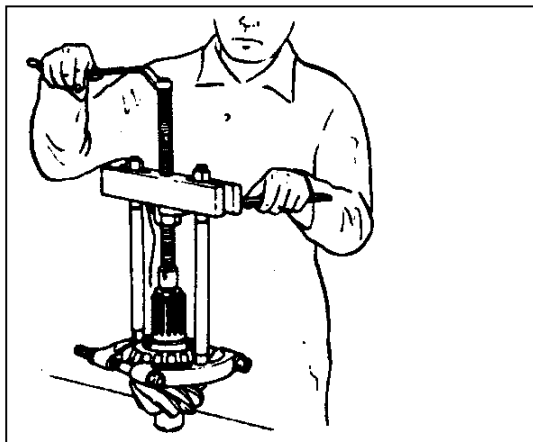
Rear Axle



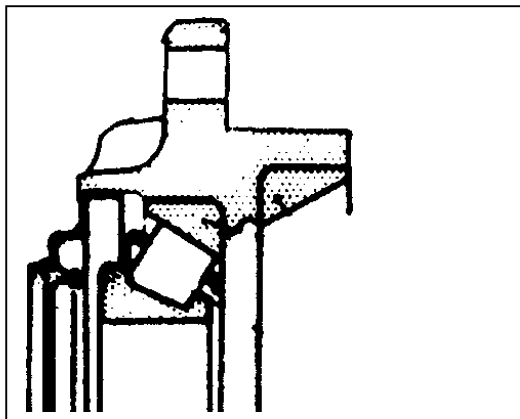
4) Press out the drive gear from the bearing seat;



5) Remove the adjusting washer and the bearing spacer;



6) Remove the bearing from the drive gear;



7) Remove the oil seal from the bearing seat;

8) Remove the bearing cone, remove the bearing cup.

Rear Axle

Key points for check-up during disassembling

1. Check the drive gear flange for any wearing or damage.
2. Check the bearing for any wearing or color change.
3. Check the gears for any crack.
4. Check the drive gear and driven gear for any wearing or crack.
5. Check the axle shaft gear, planetary gear, and planetary gear shaft for any wearing or crack.
6. Check the axle shaft spline for any wearing or damage.

II. Table of Rear Axle Maintenance Parameters (Table V)

Item	Value
Drive and driven gear clearance	0.18~0.23mm
Planetary, axle shaft gear clearance	0-0.15 mm
Drive gear rotational torque	Without oil seal Apply gear oil 10-20 Kgf·cm
Rear axle gear oil	Hyperbolic gear oil: (GL-5) 85W/90 Volume: 3.5 L
Oil applied on the outer rim and lip of the axle shaft oil seal, and drive gear oil seal	ZL-2 GB5671-85 Automobile General Purpose Lithium Base Grease.
Clearance between friction lining and brake drum	0.4-0.7 mm (Hydraulic brake)

III. Rear axle inspection and reparation

1. Special measuring instrument or tools shall be used for the inspection of components.

Judgment on whether a component can continue in service shall be made according to the specified maintenance standard table. The broken parts shall be repaired and replaced according to the requirements. In case one of a pair of matching parts is worn out, which causes the clearance go beyond the specified value, this part and the other matching part shall all be replaced as per the corresponding requirements.

2. From the view of preventive maintenance, some of the parts which are still within the reparation limit or wearing limit shall also be replaced before they exceed the limit.
3. Carefully check the appearance of all the components, through the assigned methods as visual inspection or red pigment penetration etc. If the outside appearance of the component has the following abnormal signs, the said component shall be repaired or replaced as per the

Rear Axle

requirements.

Abnormal signs:

- Uneven wear
- Eccentric wear
- Scrape
- Crack
- Distortion
- dead or weaken (refer to spring)
- Bending deflection
- Abnormal noise (refer to bearing)
- Loosen
- Color change or seize up
- Rust
- Deterioration (refer the brake friction lining)

4. All the rubber pieces, such as O-ring, oil seal, and gasket etc. shall be discarded after removal, and they are not allowed to be re-used.

5. In case the transmission system generates abnormal sound or vibrates, first check the total free play of the rear axle, and then determine whether it is necessary to disassemble the final reduction gear assembly.

Place the vehicle on the level ground, put the transmission gear and transfer gearbox on neutral position, pull up the parking brake lever and jack up the vehicle. Turn the flange clockwise to the end, and make matching marks on the flange dust fender and the reduction casing, and then turn the flange counter clockwise to the end, measure the moving distance of the two matching marks, the ultimate free play is 6mm, if the free play exceed that limit, it indicates excessive gear clearance of the rear axle, and the rear axle shall be disassembled to make adjustment.

Abnormal sound is also one type of noise, it mainly appears as the abnormal sounds generated under different service conditions (such as vehicle speed, road conditions), like knocking sound or screeching sound, some of the sounds will gradually disappear through breaking-in, while some of the sounds will get louder and louder. This is mainly because of the improper assembly and adjustment. Under the precondition of good quality components, most of such problems can be solved through adjusting the assembling clearance.

6. Failure of brake return mainly is the problem that the brake seized up after being stepped down and cannot continue the brake operation. This problem mainly can be solved by adjusting the brake assembly clearance.

Item	Reparation Standard	Wearing Limit	Remarks
Wear of rear axle leaf spring location hole		1mm	
Radial jumping of left, right axle shaft sleeve outer bearing journal	—	0.1mm	
Radial jumping of axle shaft middle un-machined surface	—	1.5mm	
End surface jumping of the hub and axle shaft flange coupling surface	—	0.15mm	

Rear Axle

Chapter III Assembling and Adjustment of Rear Axle Assembly

I. Assembling and adjustment of rear axle assembly

(1) The assembling of the final reduction gear assembly is following the reverse procedure of the above disassembling procedure, before assembling all the components shall be kept clean, free of such foreign substances as oil dirt, iron dust etc. Apply NO.10 motor oil for lubrication during assembling, and make adjustment as per the following requirements:

1. Drive gear inner and outer bearing preloading

1.1 When assembling the final reduction gear, the conical roller bearing shall have certain assembly preload, that is, to give certain preloading force on the basis of eliminating the bearing clearance. The purpose of it is to reduce the axial replacement caused by the axial force generated during the transmission process of conical gear, so as to increase the supporting rigidity of the shaft, and ensure the normal engagement of the conical gear pair. But it also shall not be too tight, if it is too tight, it will cause low transmission efficiency, and speed up the wearing of the bearing.

1.2 Adjustment of the drive gear bearing preloading force: under the condition of drive gear flange nut tightening torque, install the drive gear oil seal, the drive gear is not engaged with the driven gear, and ensure the drive gear bearing preloading torque (see Table 5). The adjustment of preload is made by increasing and reducing the drive gear bearing adjusting washers in between the drive gear inner and outer bearings (for specifications, see Table 6). Reduce the number of adjusting washers; the preloading torque is increased; while increase the number of adjusting washers, the preloading torque is decreased.

2. Differential bearing preload adjustment

2.1 Adjustment of differential bearing: the differential bearing shall be adjusted to have certain preloading force, so as to obtain 0.01-0.02 interference on both sides of it, apply gear oil to the bearing rotating part under the condition of no engagement between drive gear and driven gear, the start up friction torque is 0.686-1.586N.m. The differential bearing preload adjustment is realized through the tightening of the differential bearing nut. When adjusting, first put on the bearing cap freely, when the adjusting ring can be turned smoothly, then tighten the bearing cap bolt, and after that adjust the preloading force. The locking slot on the adjusting nut after the adjustment shall be aligned with the locking plate. After adjustment, the driven gear shall not have end float misalignment.

2.2 Differential gear clearance adjustment

Use dial gage to measure the differential gear meshing backlash on the planetary gear. Note: take measurement from more than three points, the standard value is: 0~0.15mm; limit value: 0.3mm。

Rear Axle

3. Adjustment of drive and driven gear backlash, and meshing mark

3.1 Adjustment of gear backlash

The normal meshing backlash and the gear backlash variables of the drive and driven gear is shown in table 5. When adjusting the gear backlash, the measurement shall be taken on four positions which are evenly distributed along the circumference of the driven gear, the measuring head of the micrometer shall be perpendicular to the surface of the measured point.

3.2 Adjustment of drive and driven gear meshing mark

First apply red lead to the teeth of drive gear, and then turn the drive and driven gear repeatedly by hand, there will be red marks on the two working sides of the driven gear, if the marks on the standard rotation and reverse rotation working sides of the driven gear are on the middle of the tooth depth and closer to the small end, and occupies 60% of the tooth face, then it is a correct meshing. See attached Figure (I). The position of correct meshing marks is adjusted through the adjustment of the drive gear bearing adjusting washer (for specifications, see Table 6) and the differential bearing adjusting nut.

In order to keep the adjusted differential bearing preload from being changed, the number of circles of the adjusting nut being turned in on one side shall be equal to the number of circles of the adjusting nut being turned out on the other side. Check and confirm the clearance again, and then lock up the locking plate.

(II) The assembling of the rear hub with brake drum assembly is as per the reverse procedure of disassembling, and the adjustment to be made during assembling is as follows:

1. Adjustment of rear hub bearing backlash

Tighten the bearing nut until the brake drum is no possible or difficult to move, and then slightly loosen the bearing nut by 1/6-1/8 circle, turn the brake drum, under the condition of no contact between brake friction disc and the brake drum, the tangent tensile force measured at the tyre bolt shall be (3-5kg) , or the brake drum can be turned freely by hand.

(III) Rear brake braking clearance adjustment:

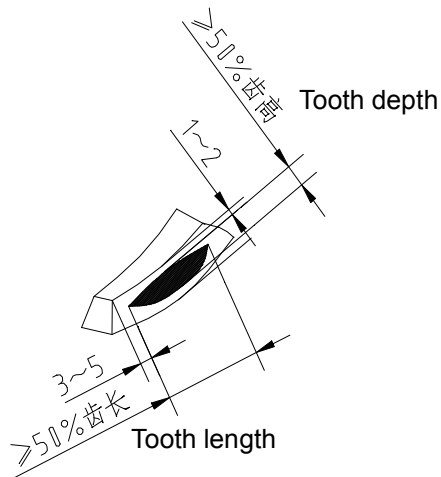
1. Liquid brake: for the two-way balanced type brake, first move the two brake chamber adjusting gears respectively as per the arrow direction indicated at the back plate adjusting hole, so that the brake drum is tightly against the brake lining, and then turn the brake chamber adjusting gear back by 5-9 teeth, to allow the brake drum to move freely.

In the actual maintenance process, adjustment shall be made strictly according to the above procedures and requirements.

Table 6 Washer Specifications (mm)

Drive gear bearing seat adjusting washer		Drive gear bearing adjusting washer	
0.10	0.18	0.05	0.20
0.12	0.20	0.08	0.25
0.14	0.35	0.12	0.35
0.16	0.50	0.15	1.00

Rear Axle



Contact status of driven gear working tooth face	Causes	Adjusting method	A-Adjust tooth face contact area
Deviate to crest	Drive gear too far from the driven gear	1. Drive gear away from the drive gear 2. Drive gear closer to driven gear to achieve correct backlash (add washer)	
Deviate to root	Drive gear is too close to the driven gear	1. Drive gear closer to the drive gear 2. Drive gear away from the driven gear to achieve correct backlash (reduce washer)	
Deviate to small	Driven gear is too close to the drive gear	1. Drive gear away from the drive gear 2. Drive gear away from the driven gear to achieve correct backlash (reduce washer)	
Deviate to big end	Driven gear is too far from the drive gear	1. Drive gear closer to the drive gear 2. Drive gear closer to driven gear to achieve correct backlash (add washer)	

(Figure 1)

Adjustment Method of Gear Meshing Backlash

Rear Axle

Chapter IV Use and Maintenance

I. Hyperbolic gear has strict requirement on the lubricating oil, the axle casing is only allowed to be filled with specified hyperbolic gear oil. It is not allowed to use normal gear oil as substitution or to be mixed with normal gear oil, otherwise it will cause tooth face early wearing, and even the gear is "shaved bald".

II. The conical gear of the rear axle final reduction gear has been selected and adjusted before ex-work, therefore, under normal condition, it is necessary to be disassembled and adjusted. It can be disassembled and adjusted only when the gear is worn out, the gear clearance exceeds the specified value or the bearing axial clearance is too big, and the component is damaged and need to be replaced.

III. The dirt and dust layer on the vent plug of rear axle casing shall be frequently cleaned off. In primary maintenance, it shall be removed and washed clean, to ensure that the vent pipe is unblocked. Blocked vent pipe will cause the pressure in the rear axle casing rising up, and lead to oil leakage at oil seal and joint place of the drive gear, at the same time, and the lubricating oil level inside of the casing shall also be checked.

1. In the first time of secondary maintenance for a new car, the lubricating oil shall be replaced. After a new car has been driven for 40000Km or 24 month, the rear axle lubricating oil shall be replaced. First bleed out the gear oil in the rear axle casing, fill in kerosene, and drain it out after cleaning, and then fill in GL-5 (85W/90) lubricating oil. It is not allowed to substitute with normal gear oil. After the lubricating oil has been replaced when the car has been driven for 80000Km or 48 month, it will be replaced once every 50000Km of driving.

After that, check the lubricating oil quality every four times of the secondary maintenance, if there are deteriorations such as color change or getting thinner, it shall be replaced with new oil.

2. Check the wearing conditions of the brake shoe lining and the brake drum. After a new car is driven for 40000Km or 24 month, check the wearing status of the brake shoe lining and the brake drum, measure the thickness of the place on the brake lining with the severest wearing, the standard value is 4.6mm, and the limit value is 1.0mm. When the thickness of the brake lining is smaller than the limit value, the brake lining shall be replaced.

IV. In the third maintenance, the rear axle can be disassembled, and inner cavity and final reduction gear assembly can be cleaned. After that, tighten the bolts and nuts for each part as per the specified torque.

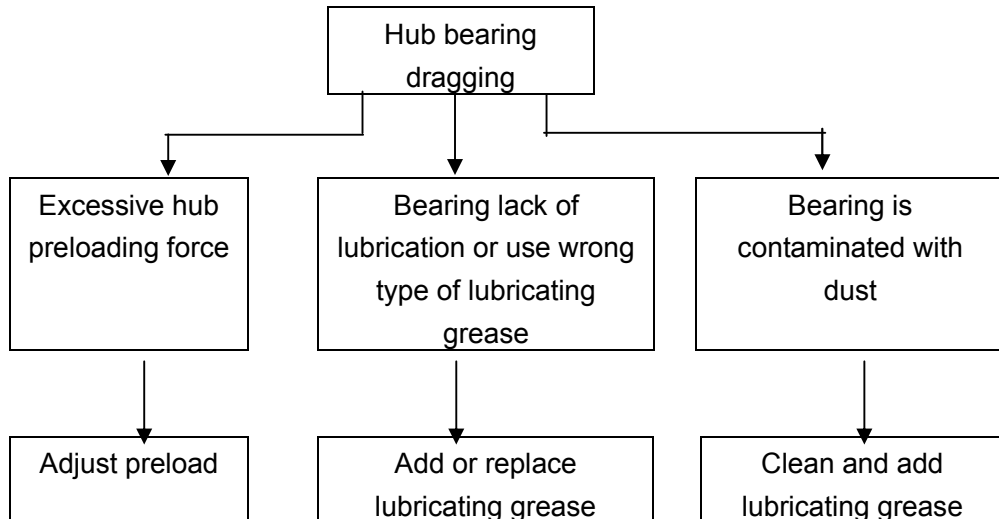
V. Points of attention:

1. The vehicle shall not be loaded with the weight that exceeding its maximum loading capacity.
2. During the driving process of the vehicle, in order to avoid impact damage to the gears, it is not allowed to improve the obstacle crossing capacity of the vehicle by releasing the clutch abruptly.

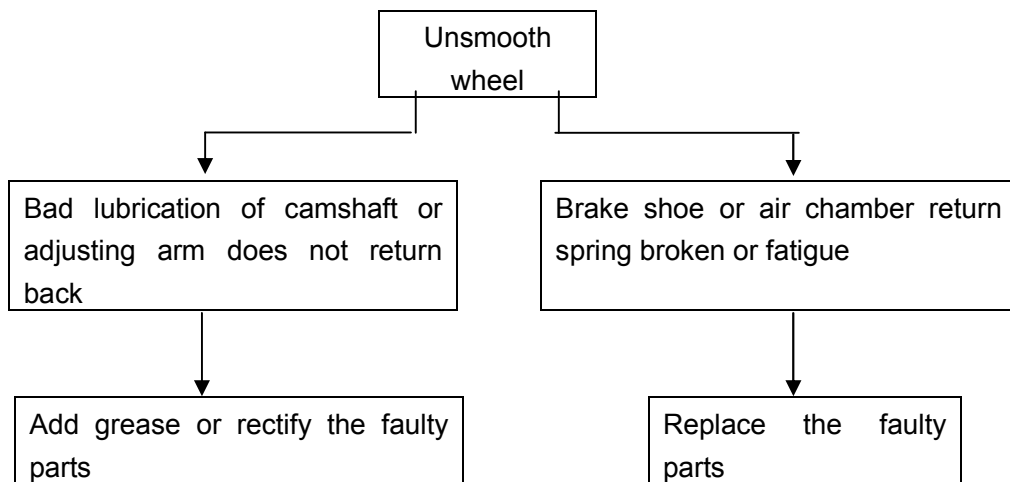
Rear Axle

Chapter V Trouble Shooting

I. Hub bearing dragging

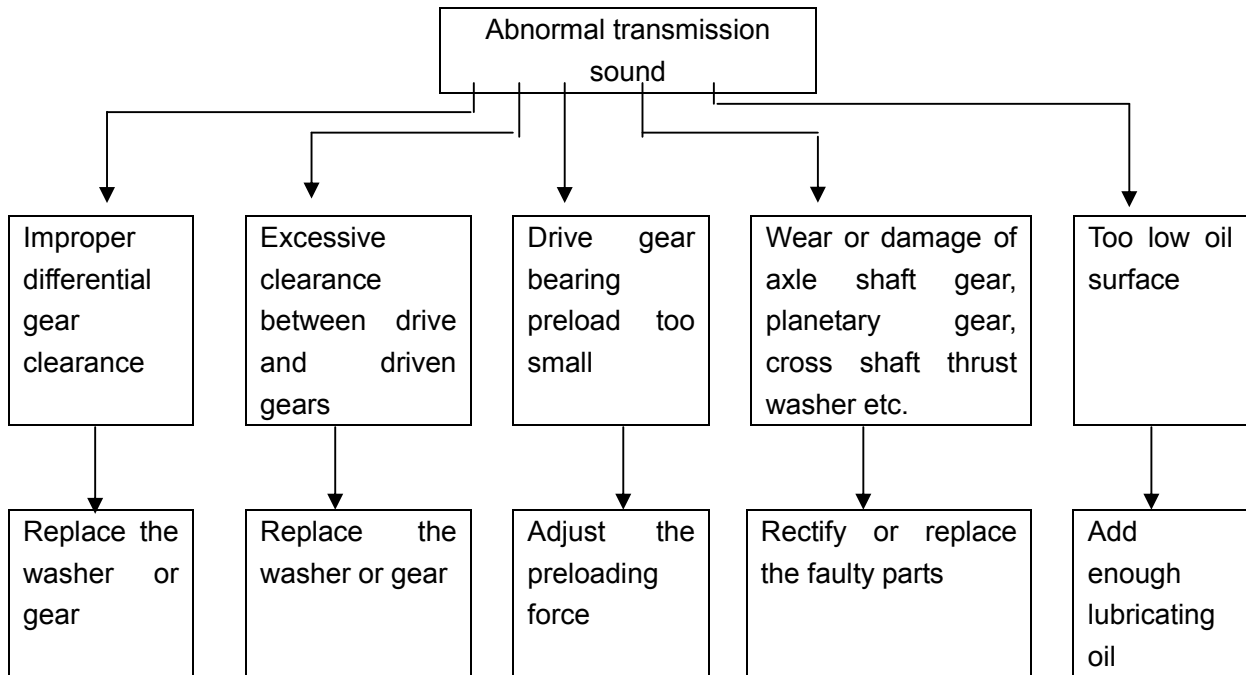


II. Unsmooth wheel

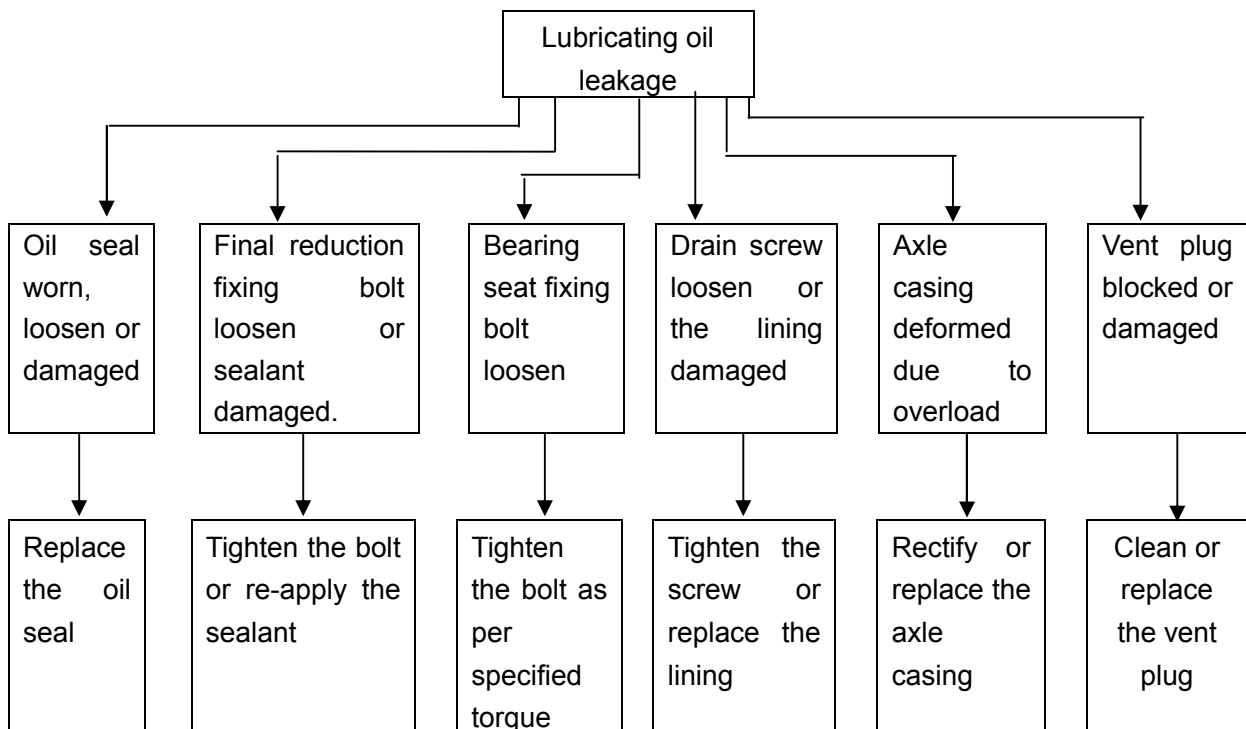


Rear Axle

III. Abnormal transmission sound

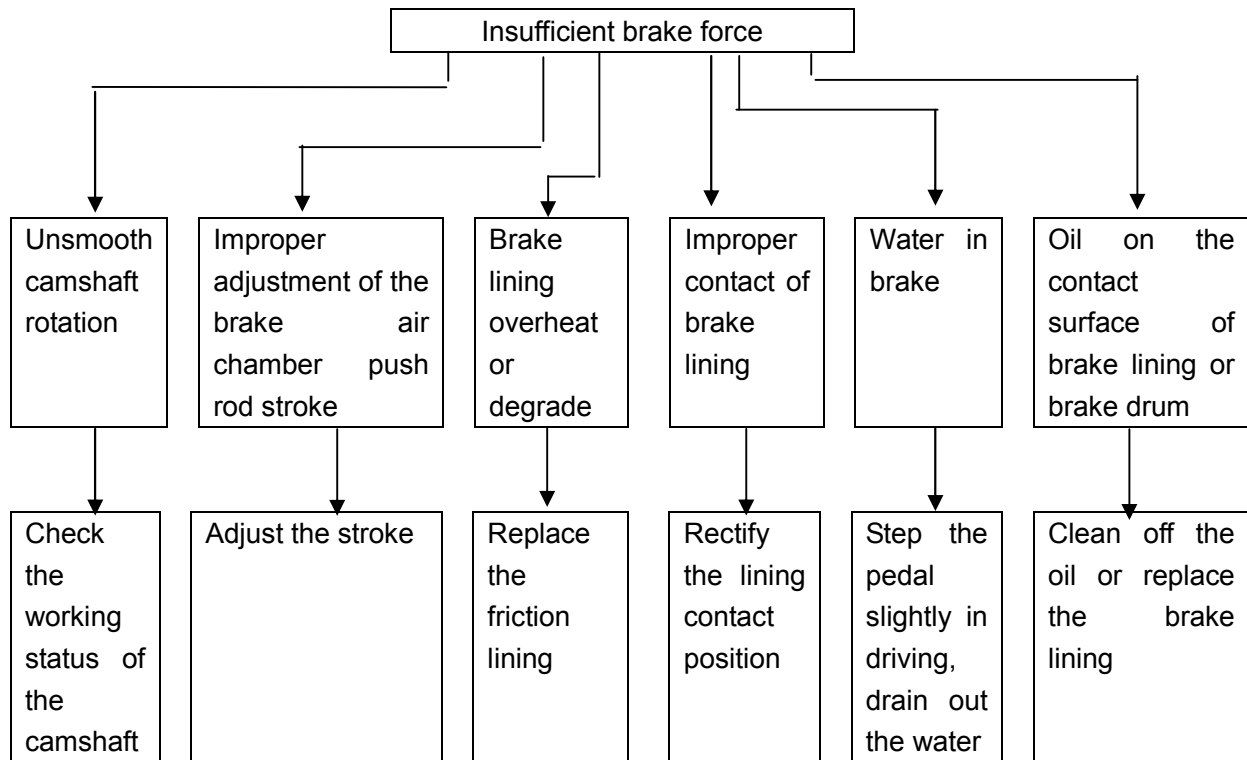


IV. Lubricating oil leakage

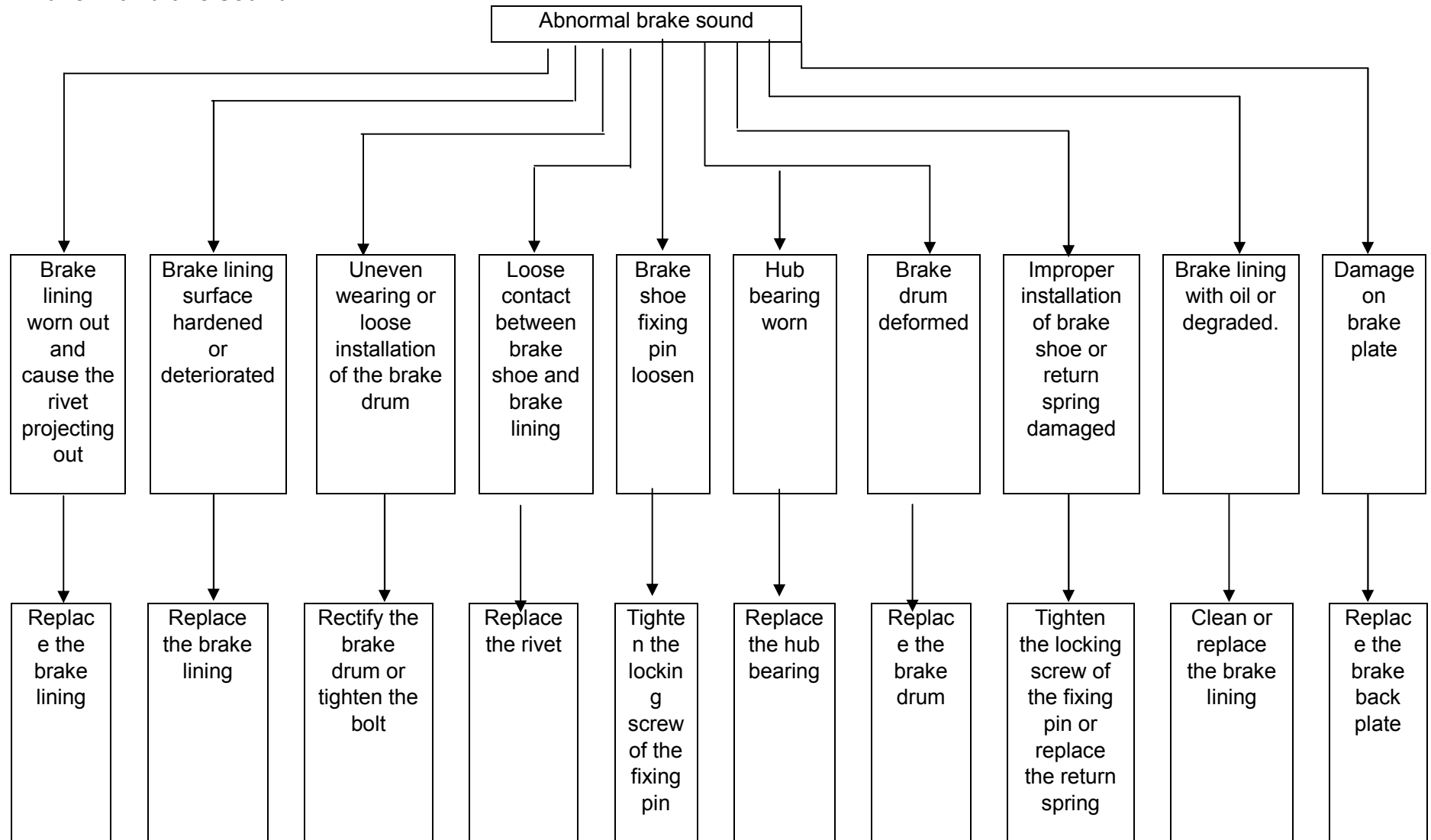


Rear Axle

V. Insufficient brake force



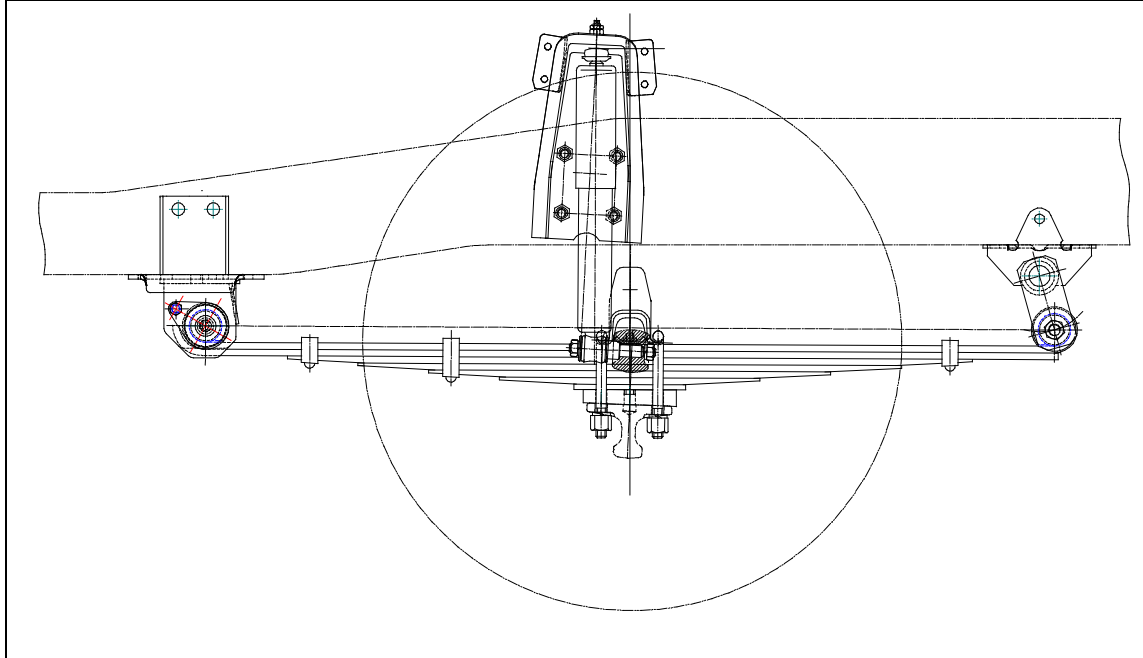
VI. Abnormal brake sound



Front Suspension

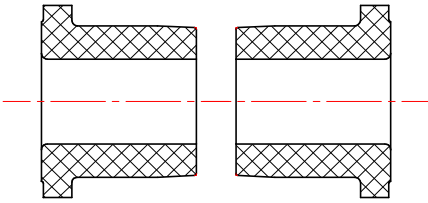
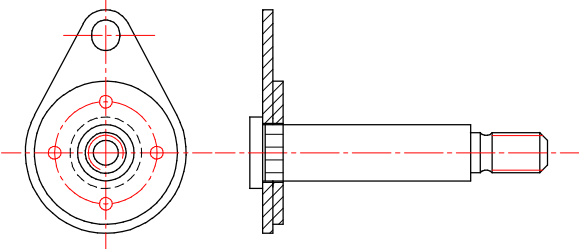
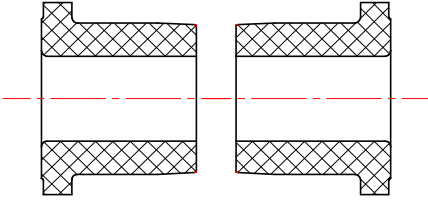
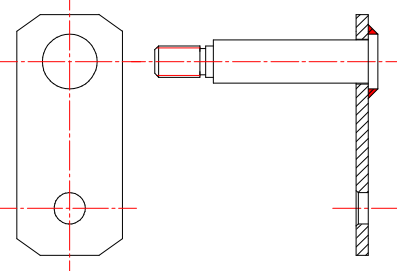
Front suspension

General



Front Suspension

Specifications

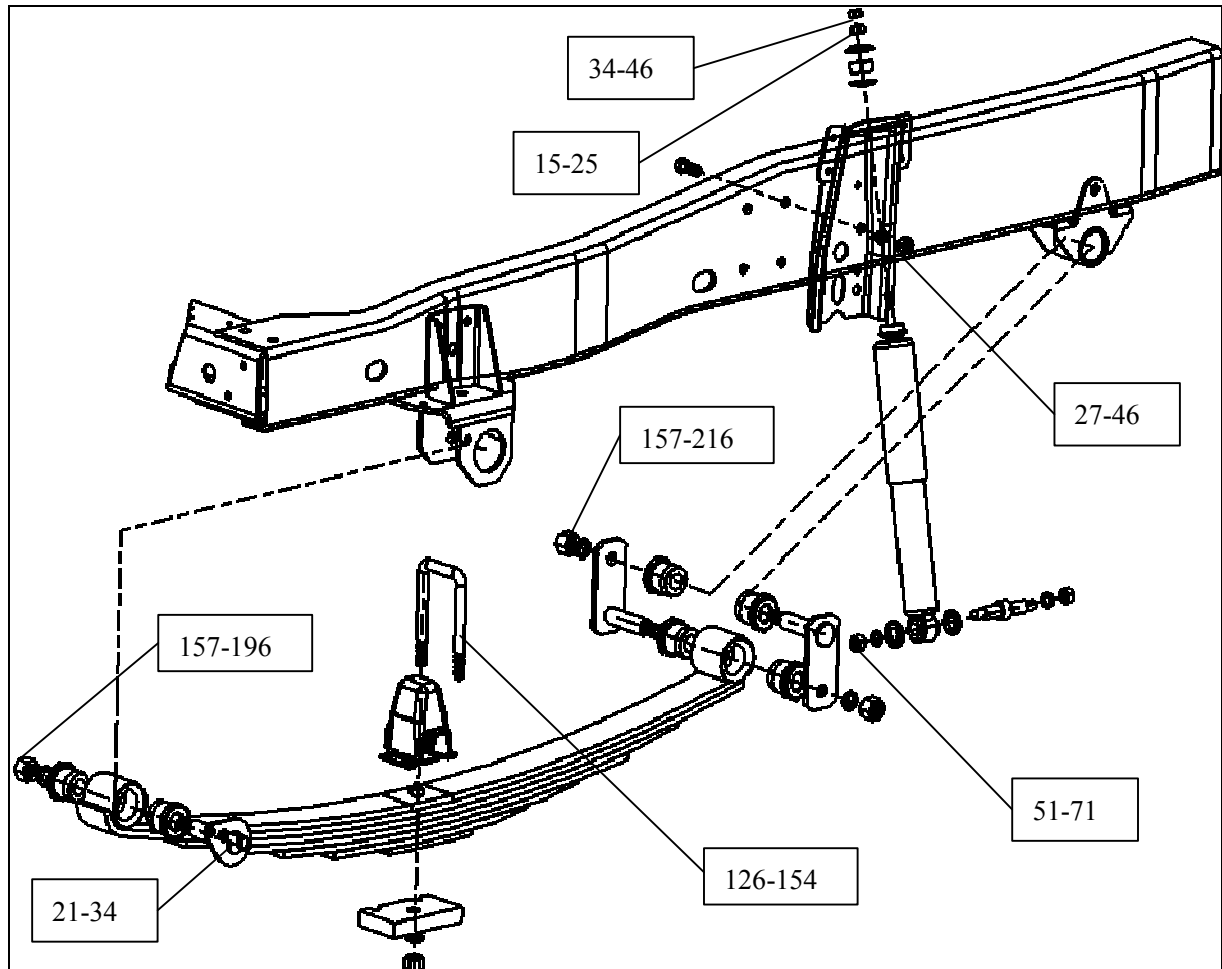
	HFC1042K2
Front suspension	
Spring type	Semi-elliptic blade type leaf spring
Length mm	1140
Width mm	60
Front fixing part	Rubber bushing with flange pin 
Pin type	
Rear fixing bushing type	Metal rubber bushing with flange 
Pin type	
Shock absorber type	Double-acting hydraulic cylinder type

Front Suspension



Tightening torque

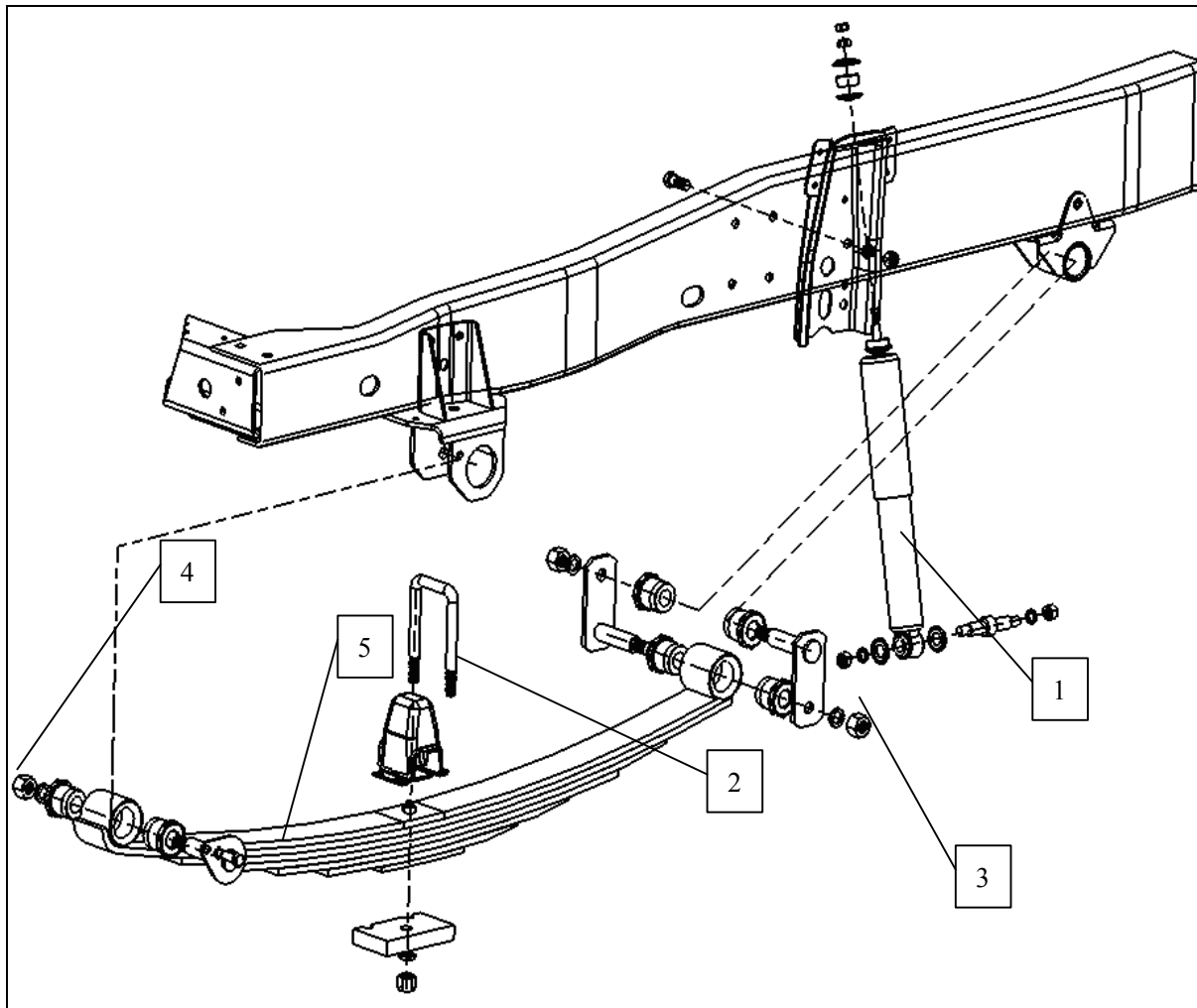
(Unit:N·m)



Front Suspension

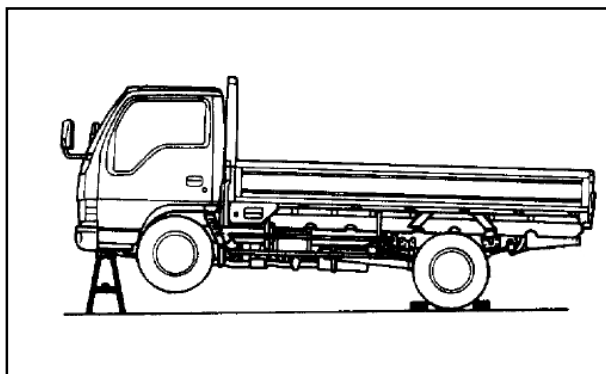


Disassembling



Disassembling sequence

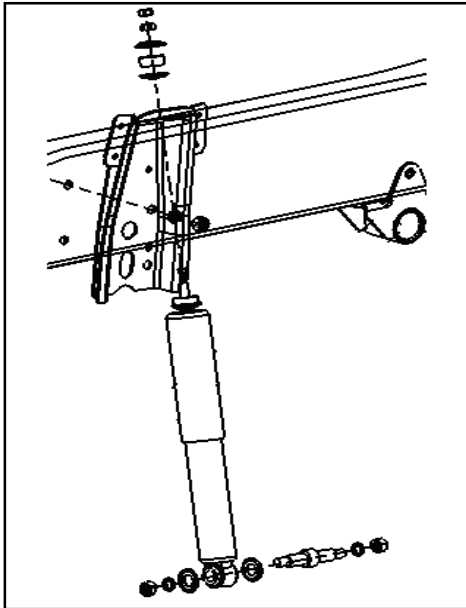
1. Front shock absorber
2. U-bolt
3. Lifting lug pin
4. Fixed pin
5. Leaf spring



Preparations

First, block well the rear wheels, then jack up the vehicle, and then jack up the front axle with a screw jack.

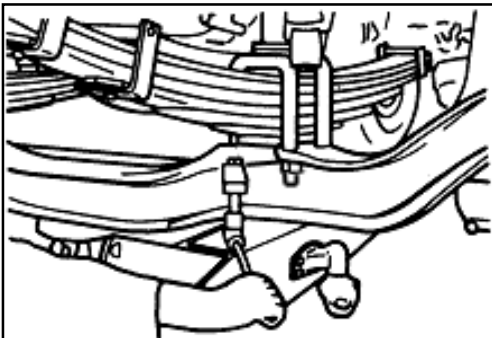
Front Suspension



Important operation-Disassembling

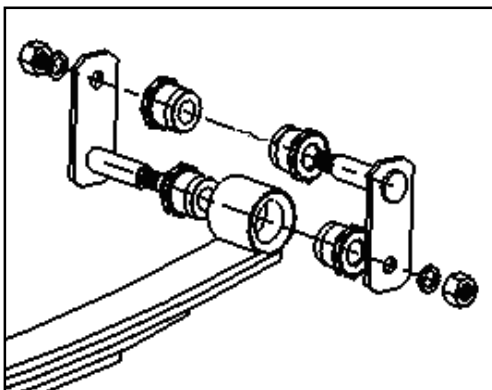
1. Front shock absorber

Disassemble the shock absorber assembly, nut, washer and bearing bush by following the sequence indicated in the diagram.



2. U-bolts

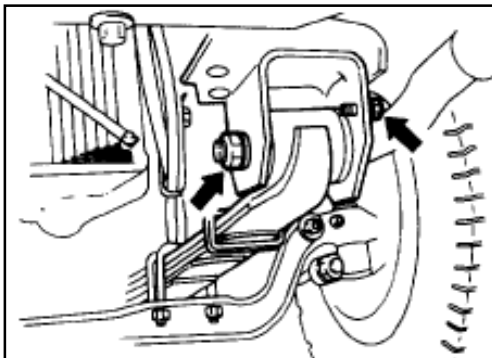
- (1) Loosen U-bolts and nuts (not remove them)
- (2) Lift up the vehicle and rest it on the chassis bracket
- (3) Remove U-bolts and nuts



3. Lifting lug pin



Take care not to damage the thread and leaf spring pin cylindrical surface.



4. Retainer pin



Take care not to damage the thread and leaf spring pin cylindrical surface.

Front Suspension

Leaf spring assembly **Buffer block**
Leaf spring clamp **Shock absorber**
Center bolt **Rubber bushing**
U-bolt
Retainer pin
Lifting lug pin



Inspection and repair:

If excessive wearing or damage is found during inspection, it is necessary to repair or replace the parts.

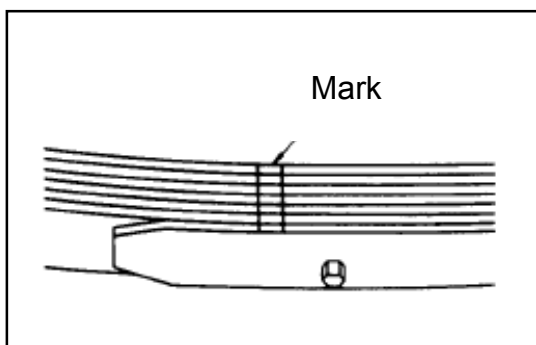


Visual inspection

Inspect the parts listed on the left side visually; if they are damaged or out of use, replace them.

Shock absorber

1. Inspect leakage of shock absorber; little leakage is allowed.
2. After the vehicle has been running for certain amount of distance, inspect whether the temperature of shock absorber has risen; if the temperature has not risen, it means it does not work; so it must be replaced.
3. Stretch the shock absorber; if no resistance is felt, it means the shock absorber does not work; so it must be replaced.
4. Inspect the bushing at both ends of the shock absorber; if they are excessively worn, replace them.

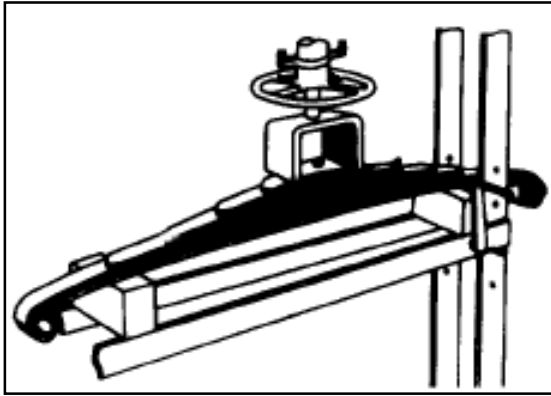


Replacing of leaf spring

1. Before disassembling the leaf spring, make an assembling mark on the side surface.
2. Apply grease on both sides of the leaf spring.
3. When disassembling and reassembling, use bench press.
4. Do not reuse the disassembled center bolt; replace it with a new one.

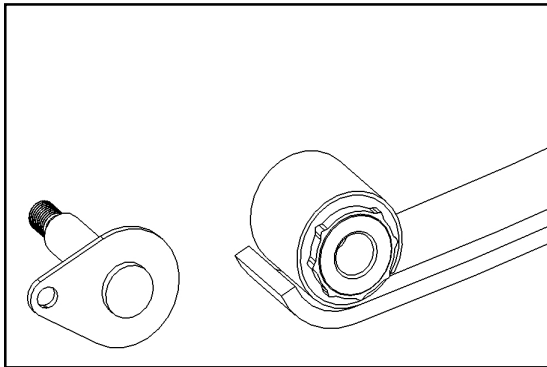
When replacing leaf spring, use the leaf spring marked with "A,B,C" that means the same camber.

Front Suspension



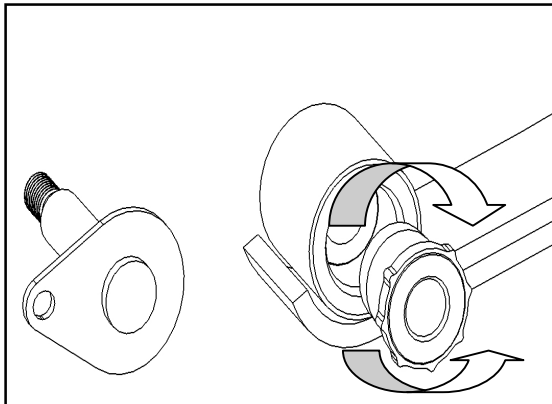
Center bolt

Tightening torque of center bolt: 34-44N.m



Measure the gap between leaf spring bushing and leaf spring pin.

If the gap is more than 1mm, replace the leaf spring bushing or the leaf spring pin.



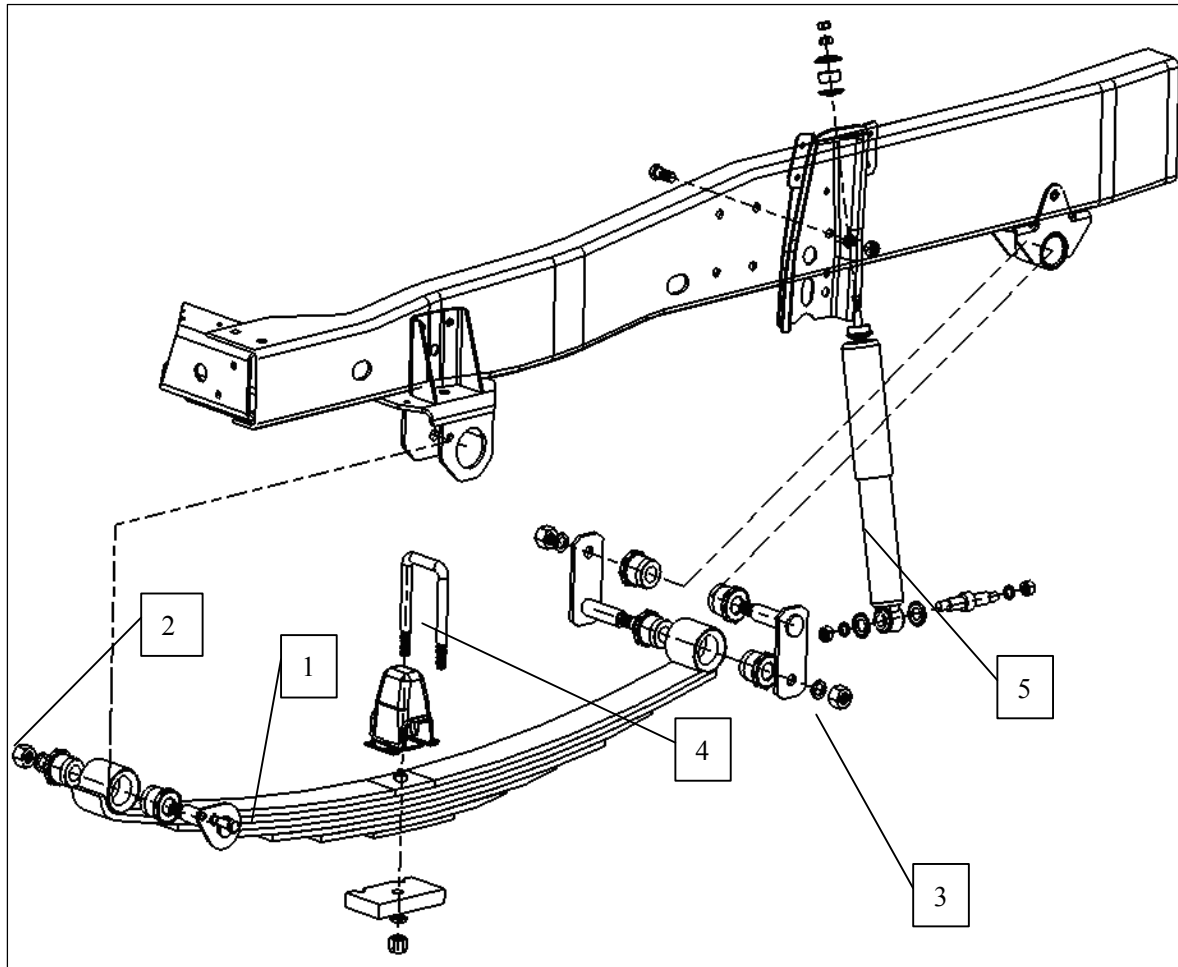
Replacing of leaf spring bushing

Screw out leaf spring bushing with hand and screw in a new one.

Front Suspension



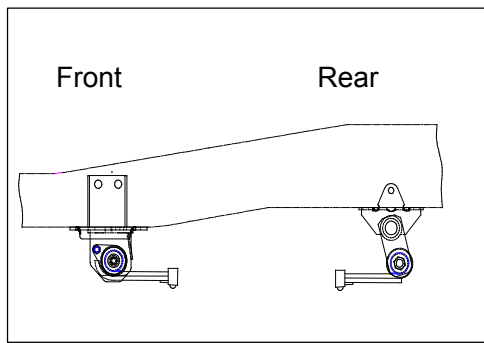
Reassembling



Disassembling sequence

1. Leaf spring 2. Retainer pin 3. Lifting lug pin 4. U-bolt 5. Front shock absorber

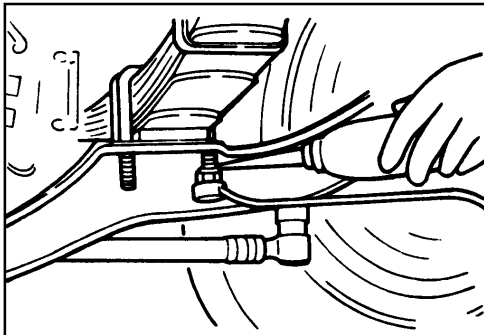
Front Suspension



Important operation - assembling

Leaf spring assembly

The assembling direction of leaf spring must be the same as that of the original state.



Nut

U- bolt

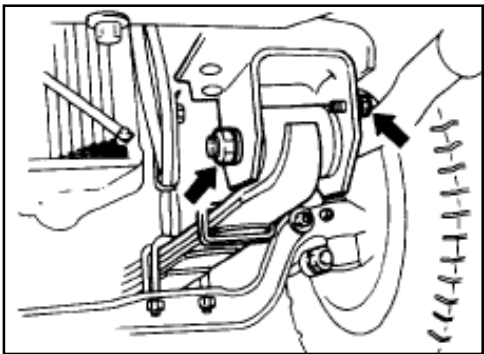
(1) Park the vehicle on a level surface, install the U-bolt at the corresponding position of the leaf spring

(2) Lift up the vehicle.

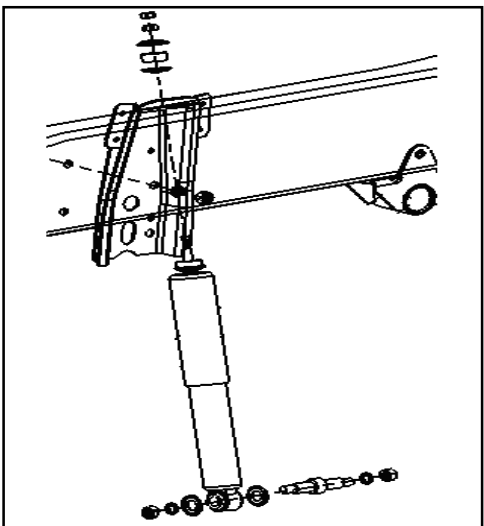
(3) Align the front axle holes and the U-bolt.

(4) Apply machine oil to the nuts before tightening them so as to avoid damaging the thread.

(5) Tighten the nuts.



Install the leaf spring pin; tighten it to the specified torque.



Front shock absorber assembly

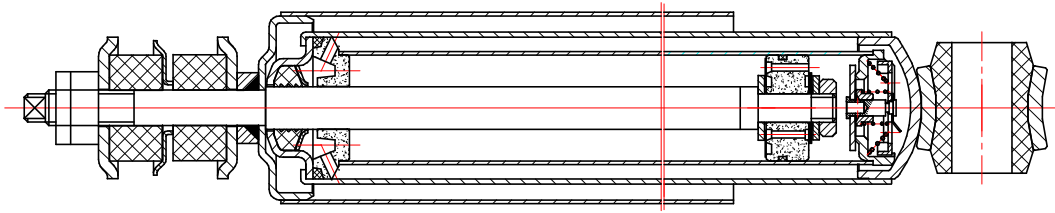
Nut, washer and rubber bearing bush

Disassemble the shock absorber assembly, nut, washer and bearing bush by following the sequence indicated in the diagram.

Tighten the nut until the washer contacts the end fitting surface.

Front Suspension

Front shock absorber assembly



Main data and specification

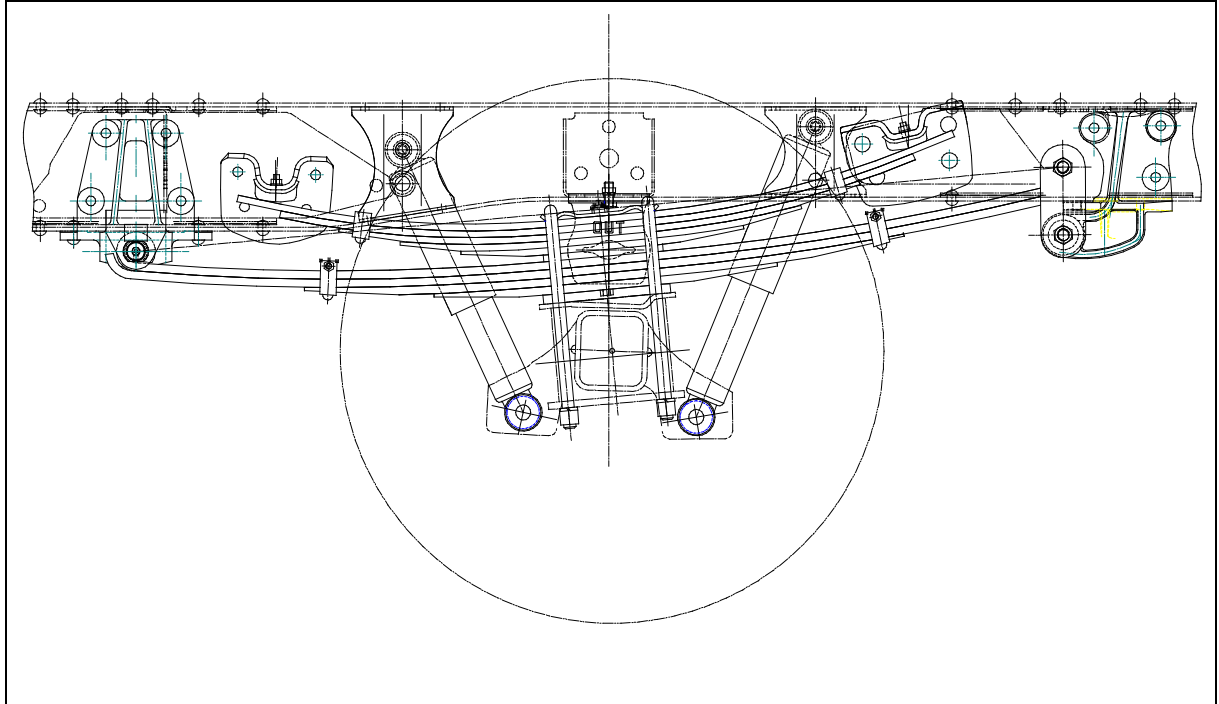
Types	Two-way hydraulic cylindrical shock absorber	
Max. outer diameter of liquid storage cylinder	(mm)	∅ 45
Max. outer diameter of boot	(mm)	∅ 53
Main stroke	(mm)	220
Compression length	(mm)	335
Extension length	(mm)	555

Rear Suspension

Rear suspension

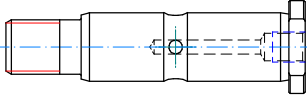
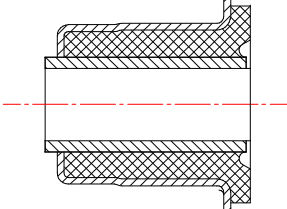
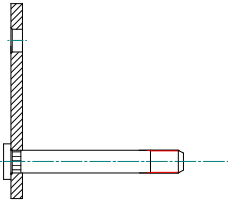
General

HFC1042K2



Rear Suspension

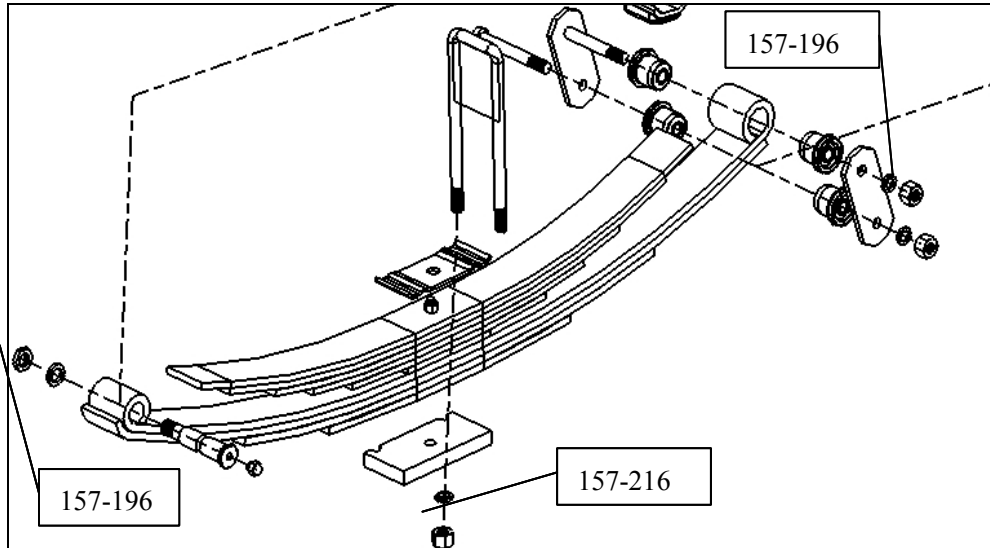
Specifications

	HFC1042K2
Rear suspension	
Spring type	Semi-elliptic blade type leaf spring
Length mm	1250
Width mm	70
Front fixing bushing type	Metal bushing with flange pin 
Pin type	
Rear fixing bushing type	Metal rubber bushing with flange 
Pin type	
Shock absorber type	Two-way hydraulic cylindrical shock absorber

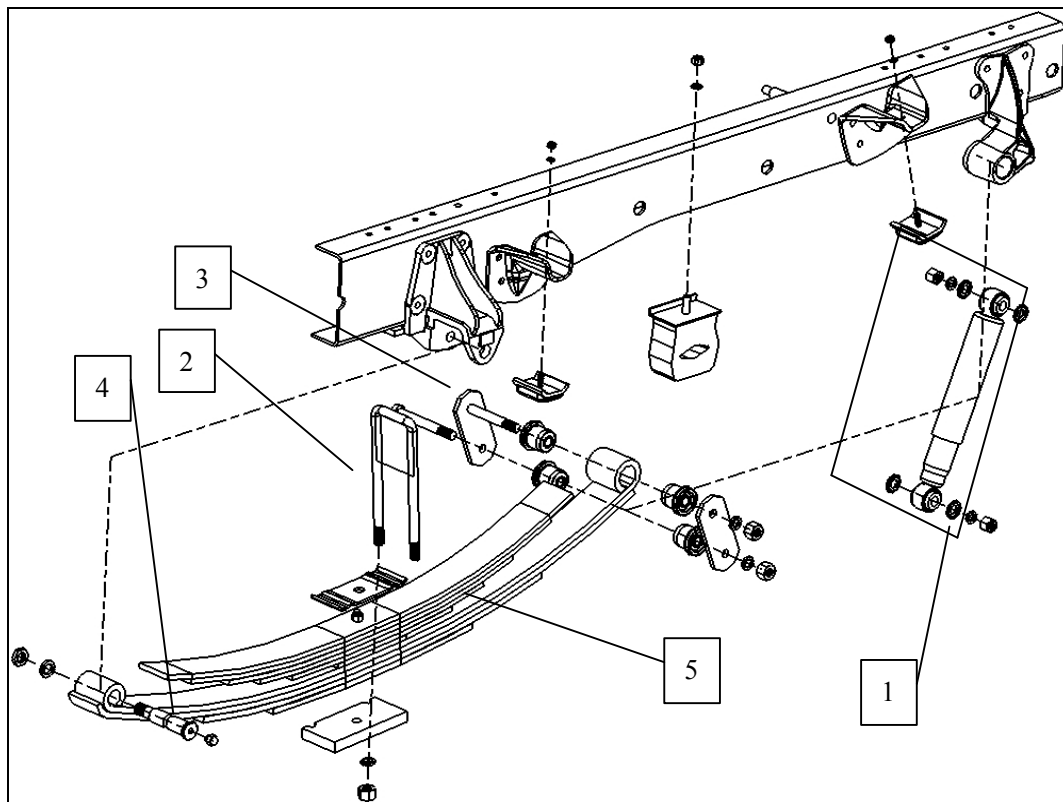
Rear Suspension

Tightening torque

(Unit:N·m)



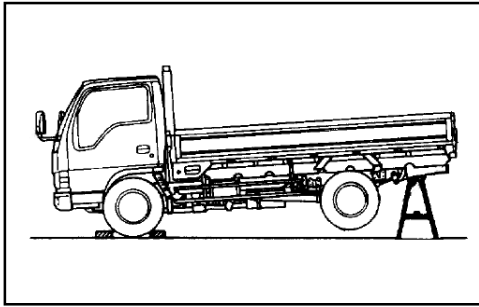
Disassembling



Disassembling sequence

1. Rear shock absorber
2. U-bolt
3. Lifting lug
4. Leaf spring pin
5. Leaf spring

Rear Suspension

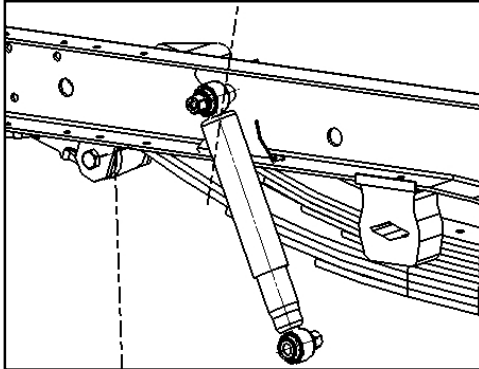


Preparations

First, block well the front wheels, then jack up the vehicle, and then jack up the rear axle with screw jack.

1. Rear shock absorber

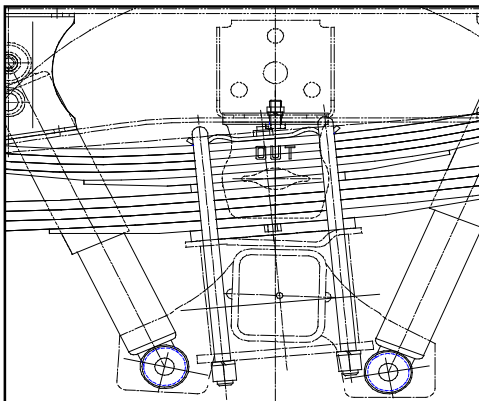
Remove the shock absorber by loosening the shock absorber mounting nut.



Important operation

2. U-bolt

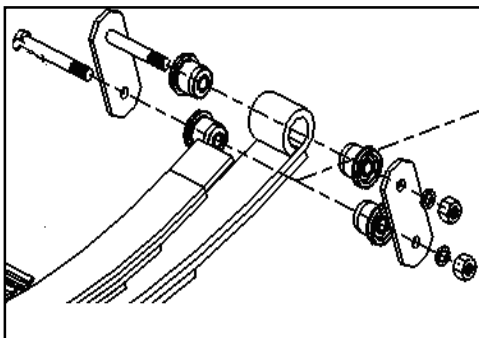
After loosening U-bolt and nut, lift up the vehicle; remove the U-bolt by resting the vehicle on the chassis bracket; then remove the rear axle assembly.



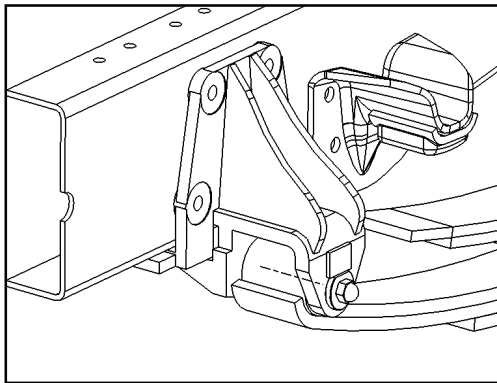
Important operation

3. Lifting lug

Loosen lifting lug nut; remove the lifting lug plate and pin.



Rear Suspension



4. Leaf spring pin

Jack up leaf spring assembly with a screw jack, remove the nut, and then pull out the bolt.



Take care not to damage the thread and leaf spring pin cylindrical surface.



Inspection and repair:

Visual inspection: If wearing, damage or any other abnormality is found during inspection, repair or replace the parts according to the actual condition.

Leaf spring assembly	Shock absorber
Leaf spring clamp	Buffer block
Center bolt	Rubber bushing
U-bolt	Auxiliary spring rubber cushion
Leaf spring pin	
Lifting lug pin	



Visual inspection

Inspect the parts listed on the left side visually for any wearing, damage or abnormality.

Other inspection and repair steps are the same as that of the front suspension.

Replacing of leaf spring assembly

1. Before disassembling the leaf spring, make an assembling mark on the side surface of the leaf spring.

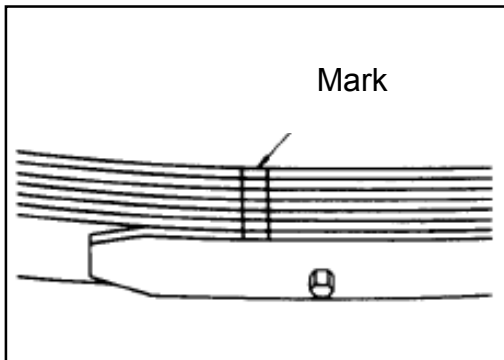
2. Apply grease on both sides of the leaf spring.

3. When disassembling and reassembling, use

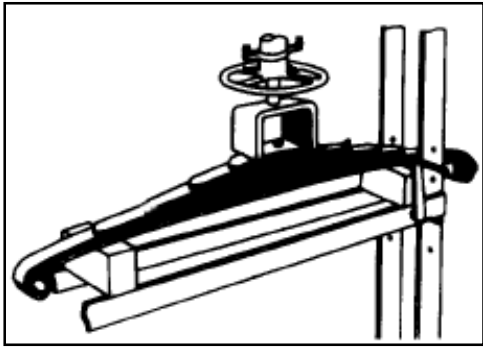
the bench press.

4. Do not reuse the disassembled center bolt; replace it with a new one.

When replacing leaf spring, use the leaf spring marked with "A,B,C" that means the same camber.

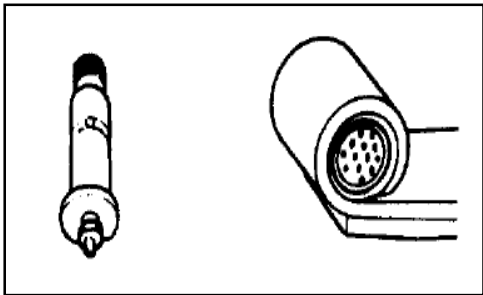


Rear Suspension



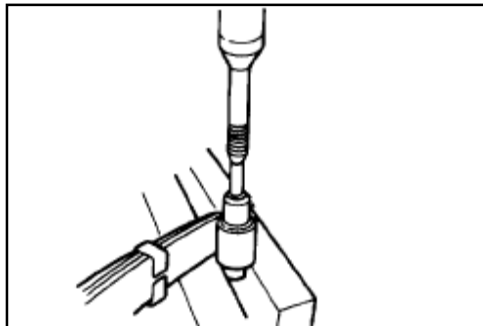
Center bolt

Torque (N.m) 90-110



Clamping bolt

Torque (N.m) 20



Measure the gap between leaf spring bushing and leaf spring pin.

If the gap is more than 0.4mm, replace the leaf spring bushing or the leaf spring pin.

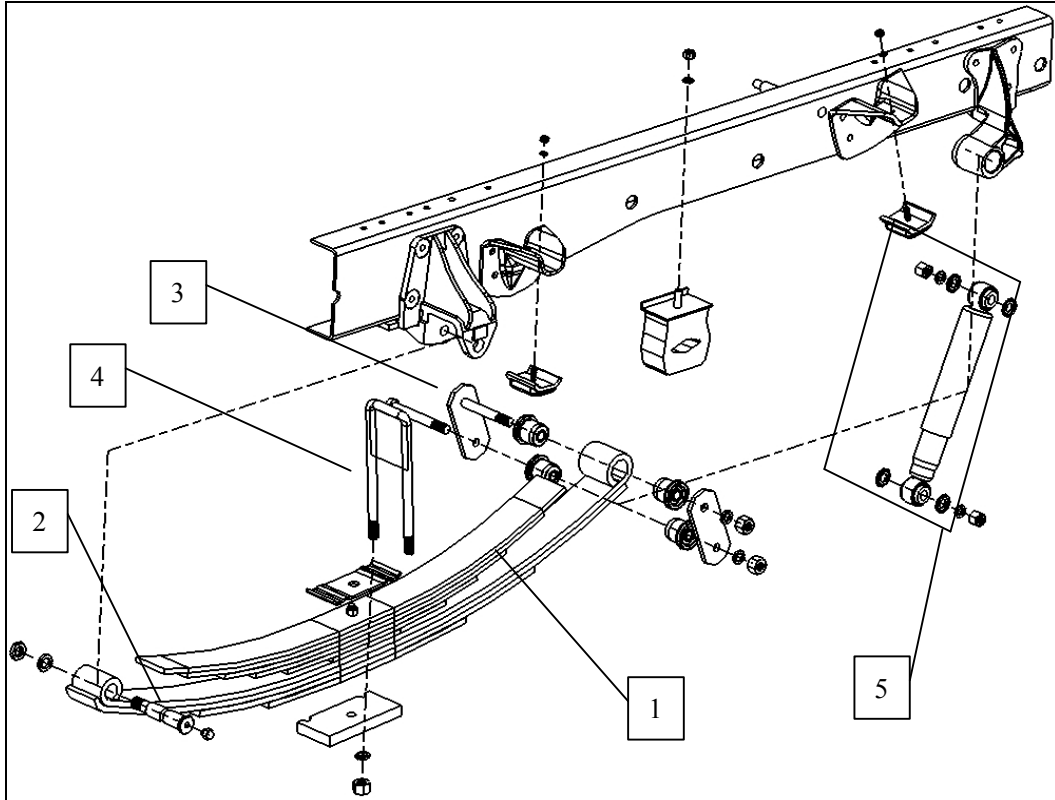
Replacing of leaf spring bushing

Disassemble and reassemble the leaf spring bushing with special equipment.

Rear Suspension



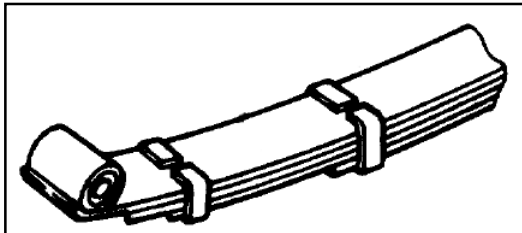
Reassembling



Reassembling sequence

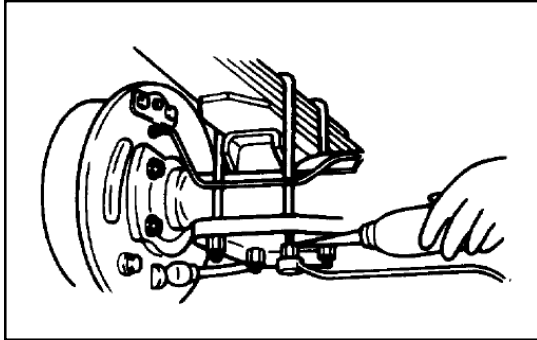
1. Leaf spring 2. Leaf spring pin 3. Lifting lug 4. U-bolt and nut 5. Rear shock absorber

Rear Suspension



Important operation-Assembling

The assembling direction of leaf spring must be the same as that of the original state.



U- bolt

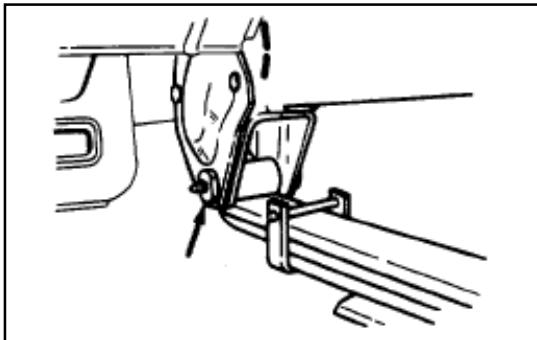
(1) Park the vehicle on a level surface, install the U-bolt in the corresponding position of the leaf spring.

(2) Lift up the vehicle.

(3) Align the front axle holes and the U-bolt.

(4) Apply machine oil on nuts before tightening them so as to avoid damaging the thread.

(5) Tighten the nuts.

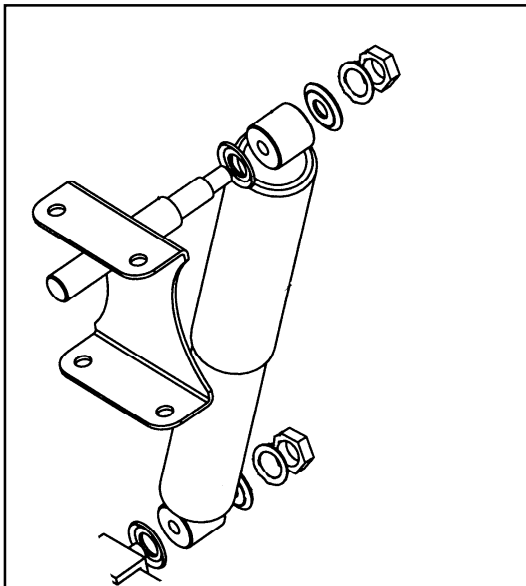


Install the leaf spring pin; tighten it to the specified torque.

Torque (N.m) 157-196



Fill in grease after assembling.



Rear shock absorber assembly

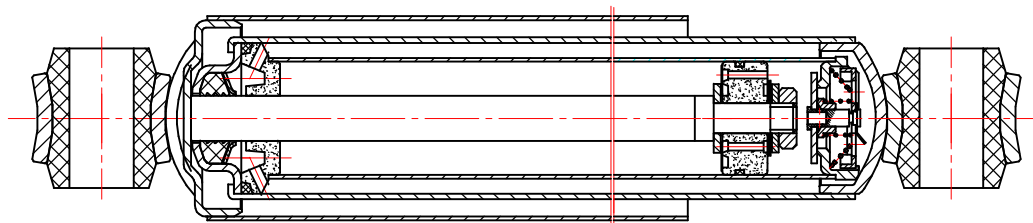
Nut, washer and rubber bearing bush

Disassemble the shock absorber assembly, nut, washer and bearing bush by following the sequence indicated in the diagram.

Tighten the nut until the washer contacts the end fitting surface.

Rear Suspension

Rear shock absorber assembly

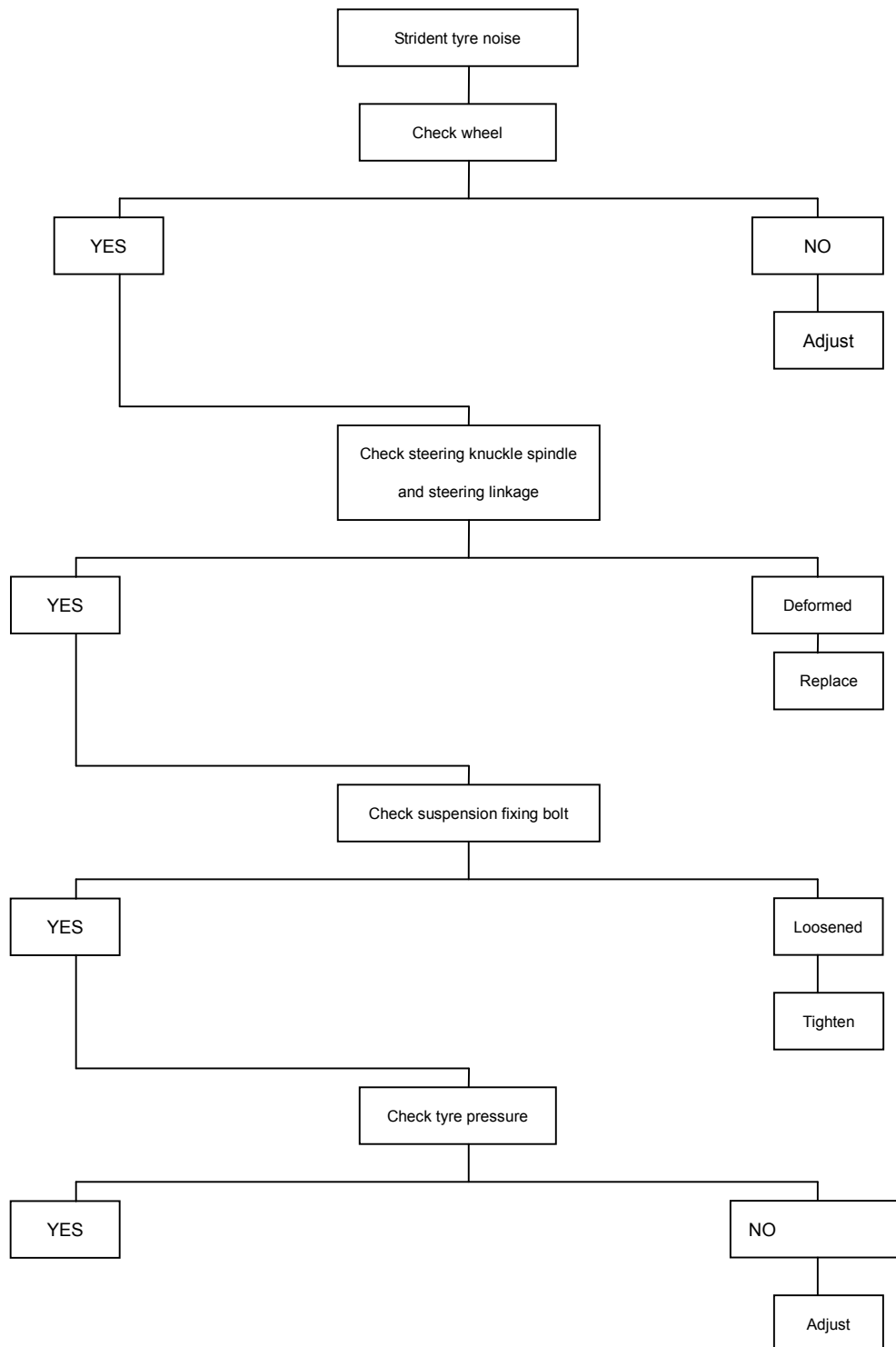


Main data and specification

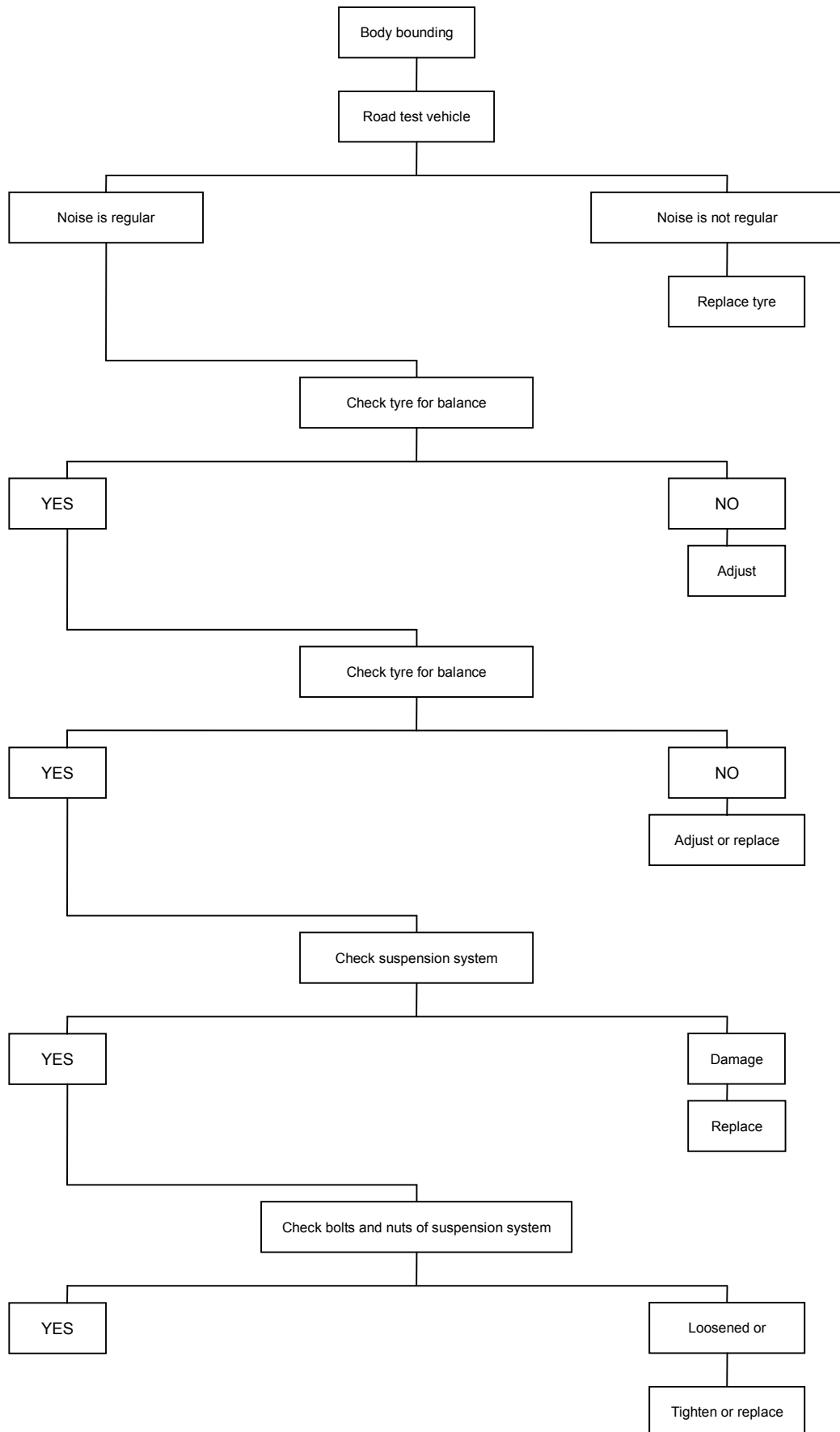
Types	Two-way hydraulic cylindrical shock absorber	
Max. outer diameter of liquid storage cylinder	(mm)	∅ 45
Max. outer diameter of boot	(mm)	∅ 53
Main stroke	(mm)	220
Compression length	(mm)	336
Extension length	(mm)	556

Rear Suspension

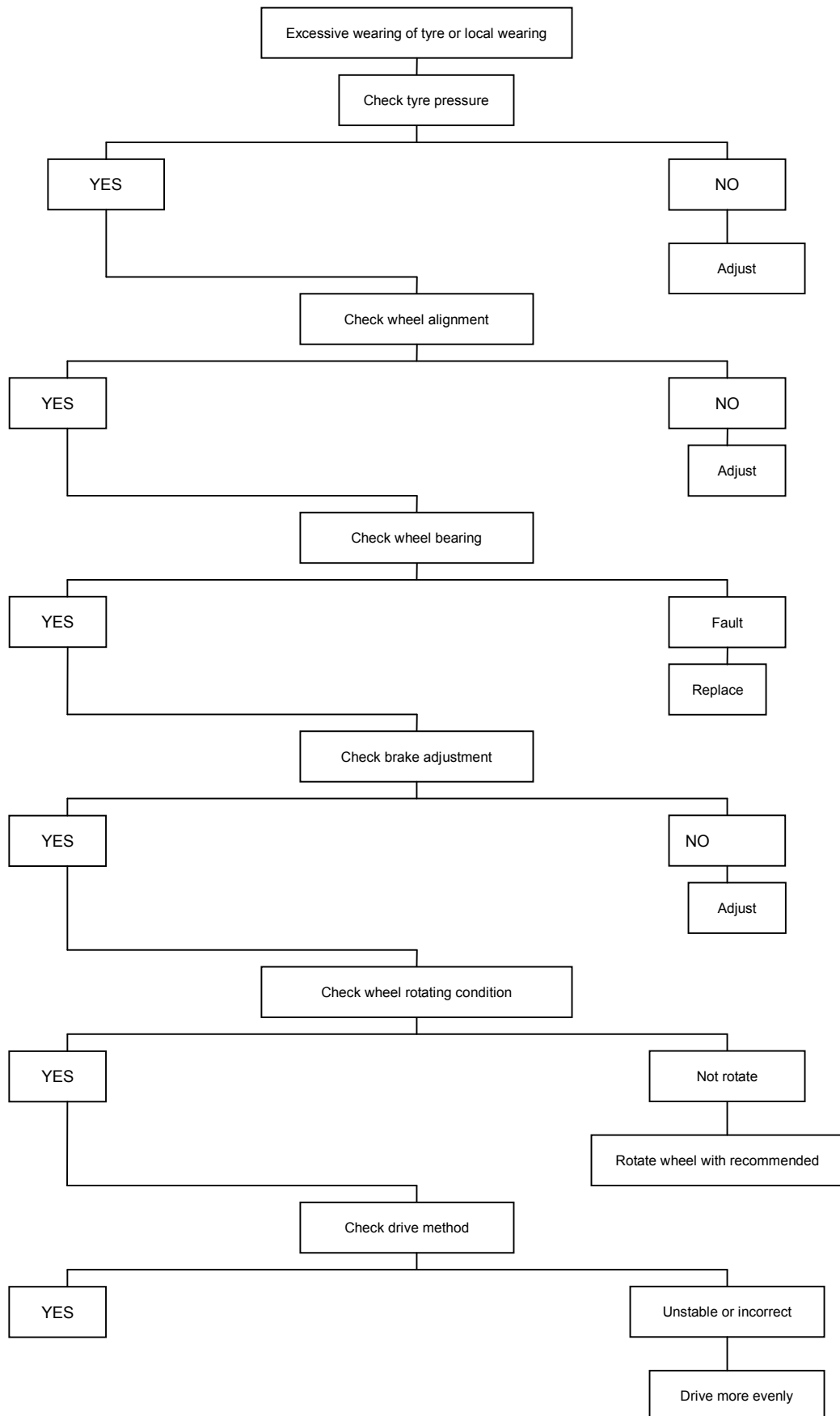
Trouble shooting of front suspension



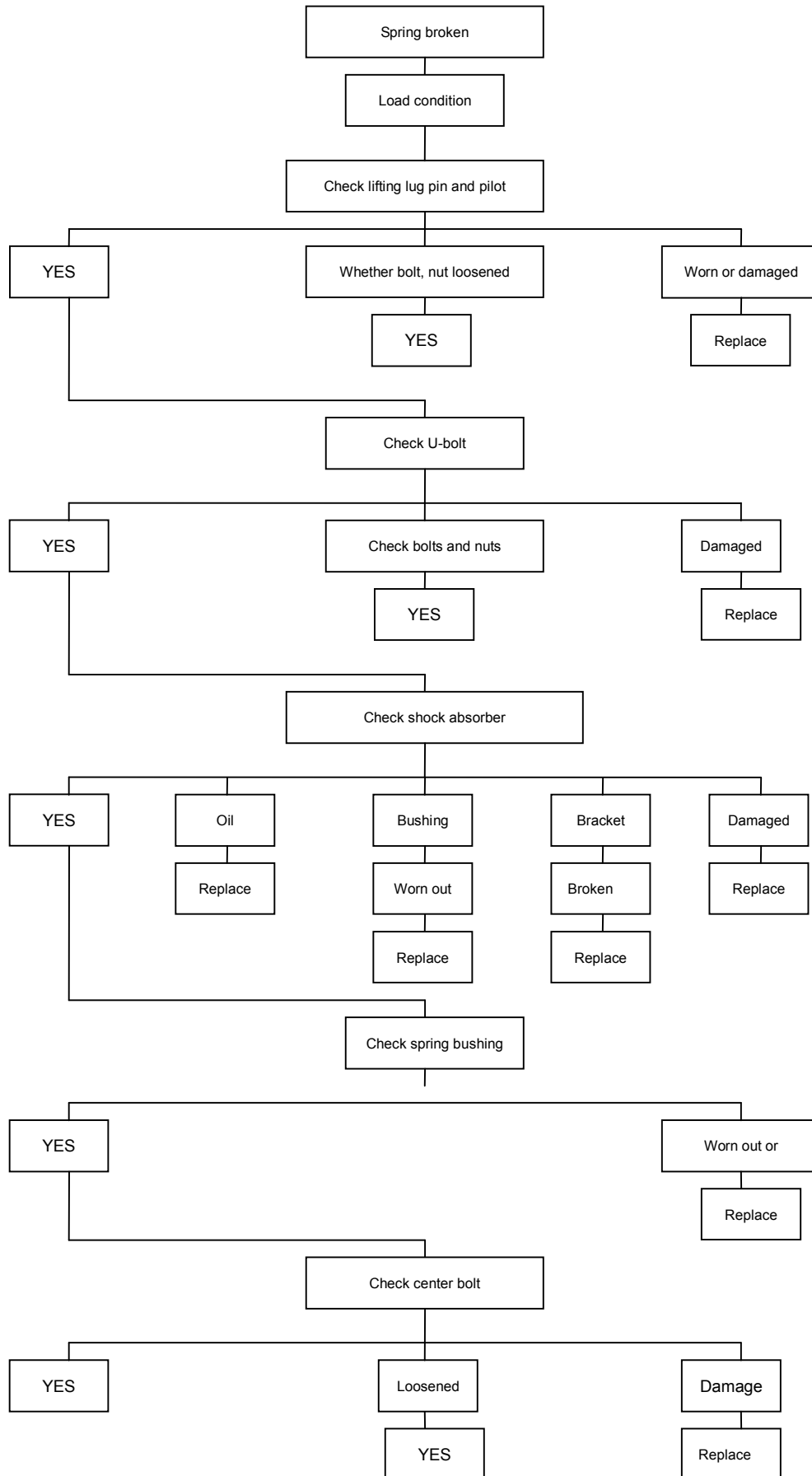
Rear Suspension



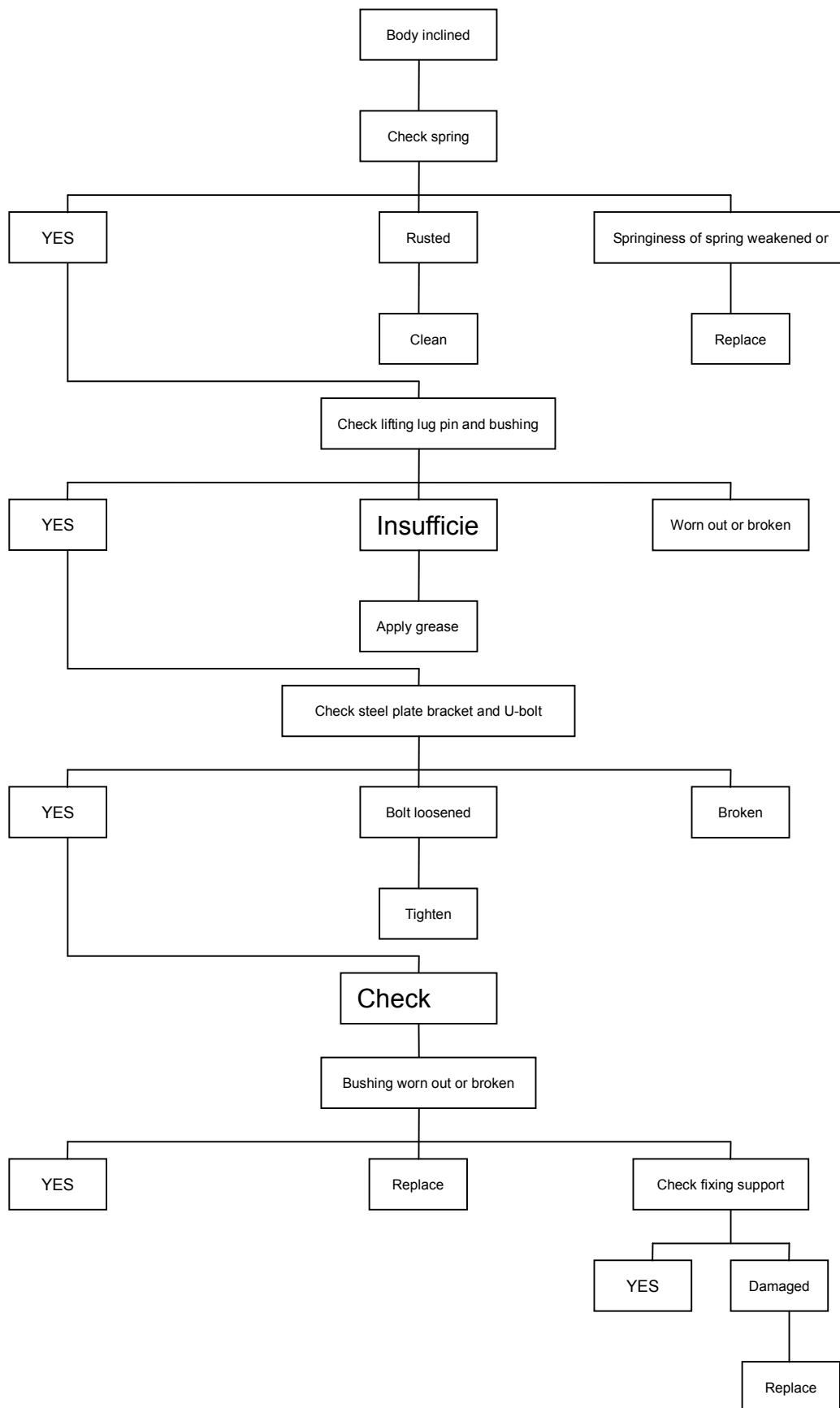
Rear Suspension



Rear Suspension

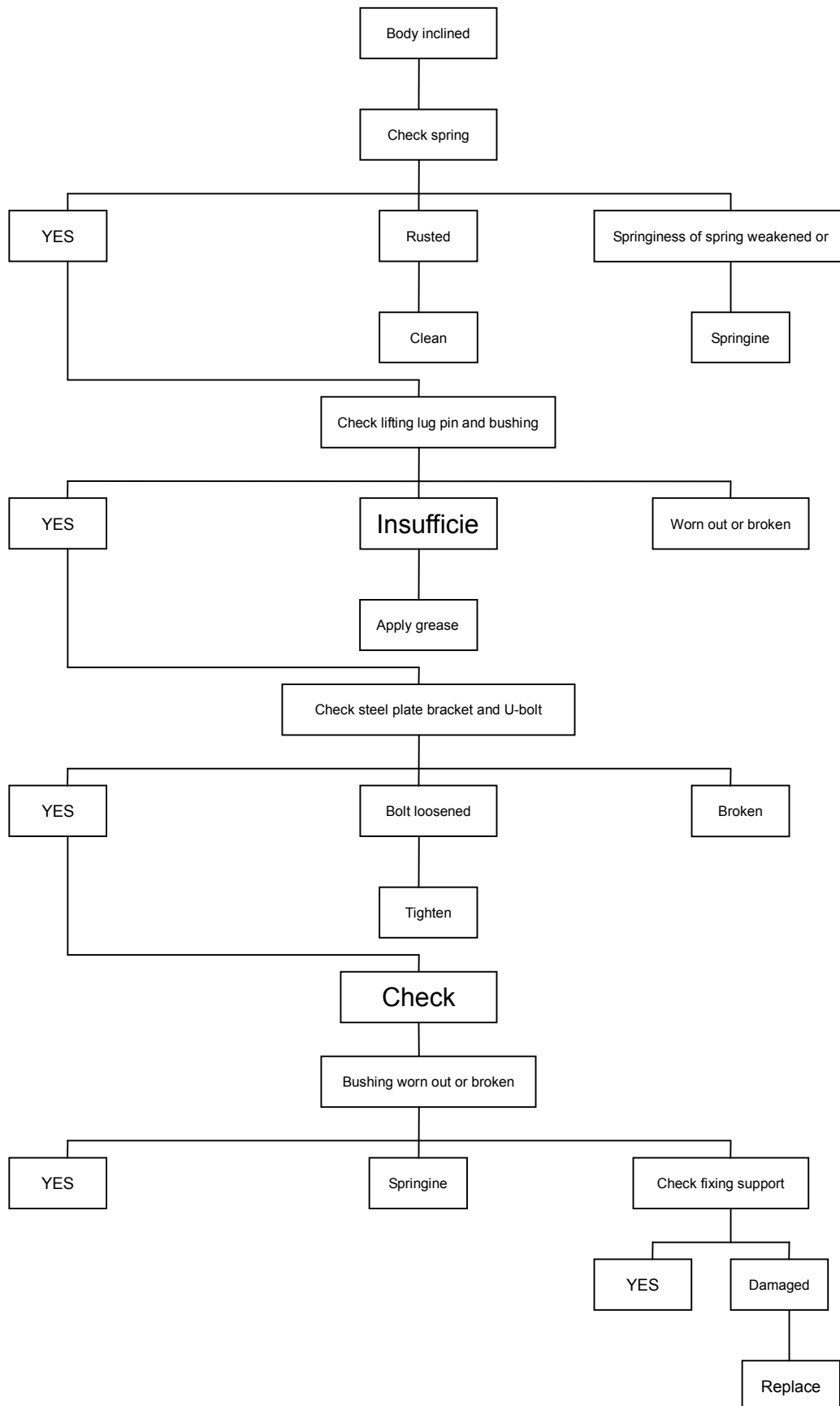


Rear Suspension

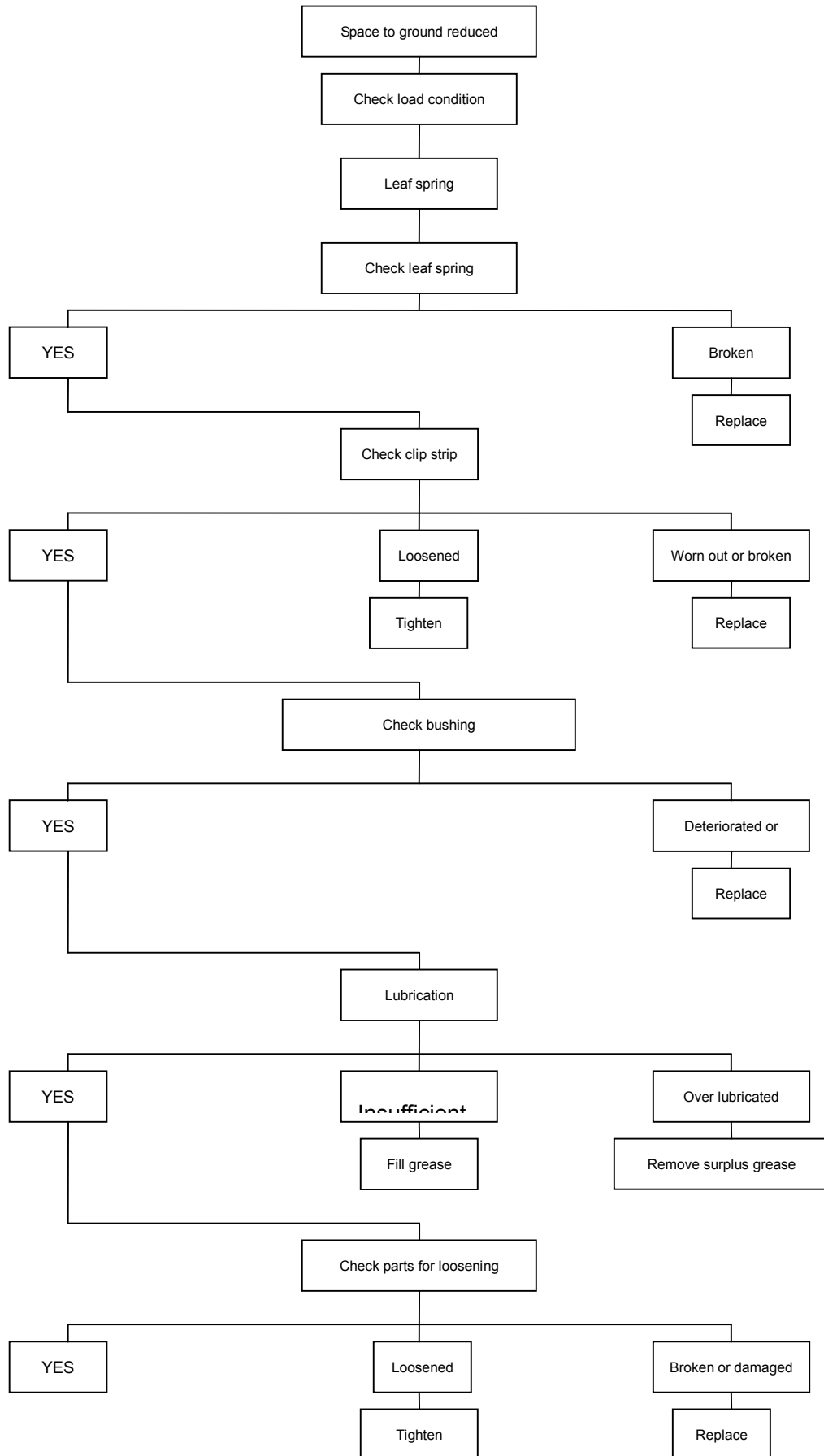


Rear Suspension

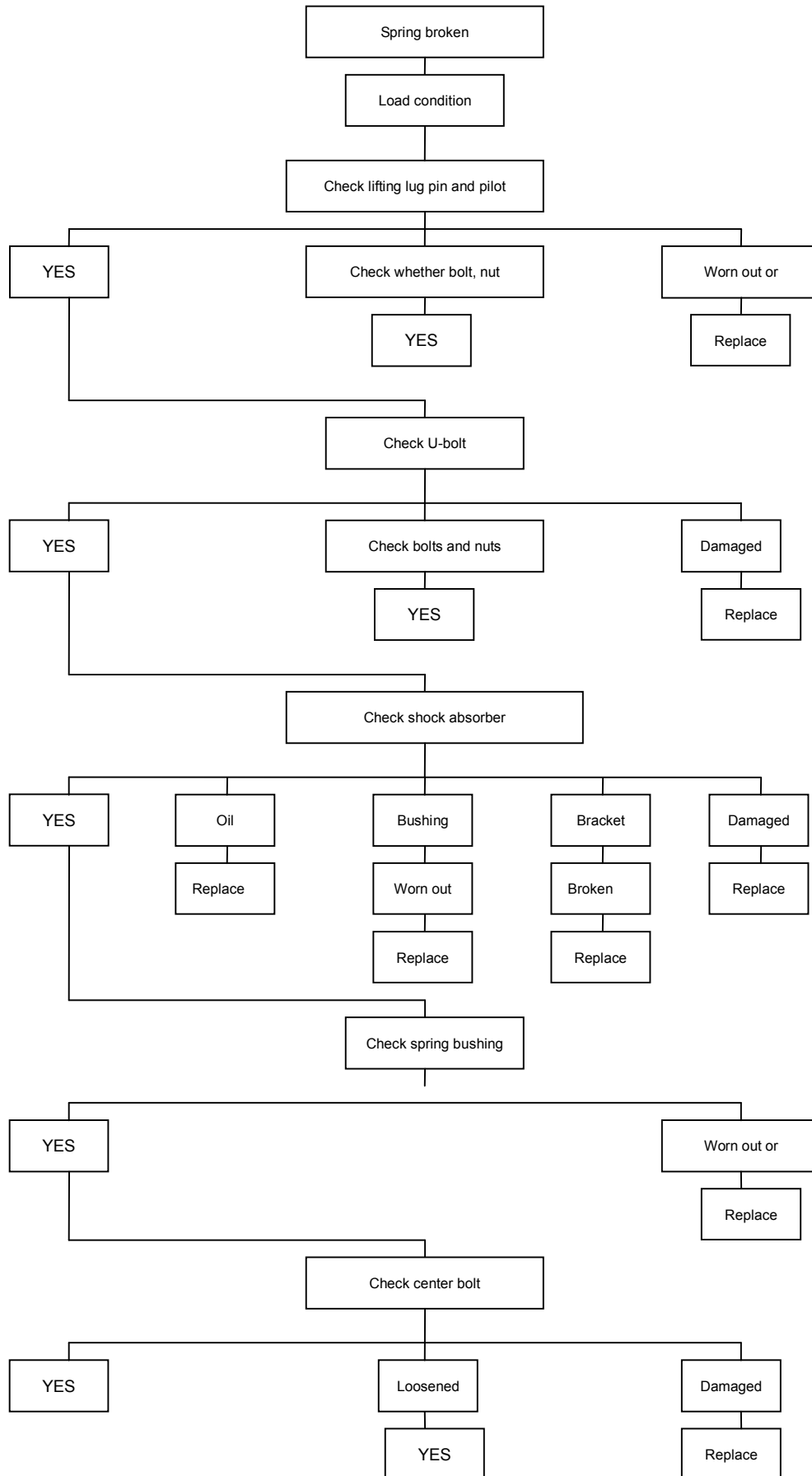
Trouble shooting of rear suspension



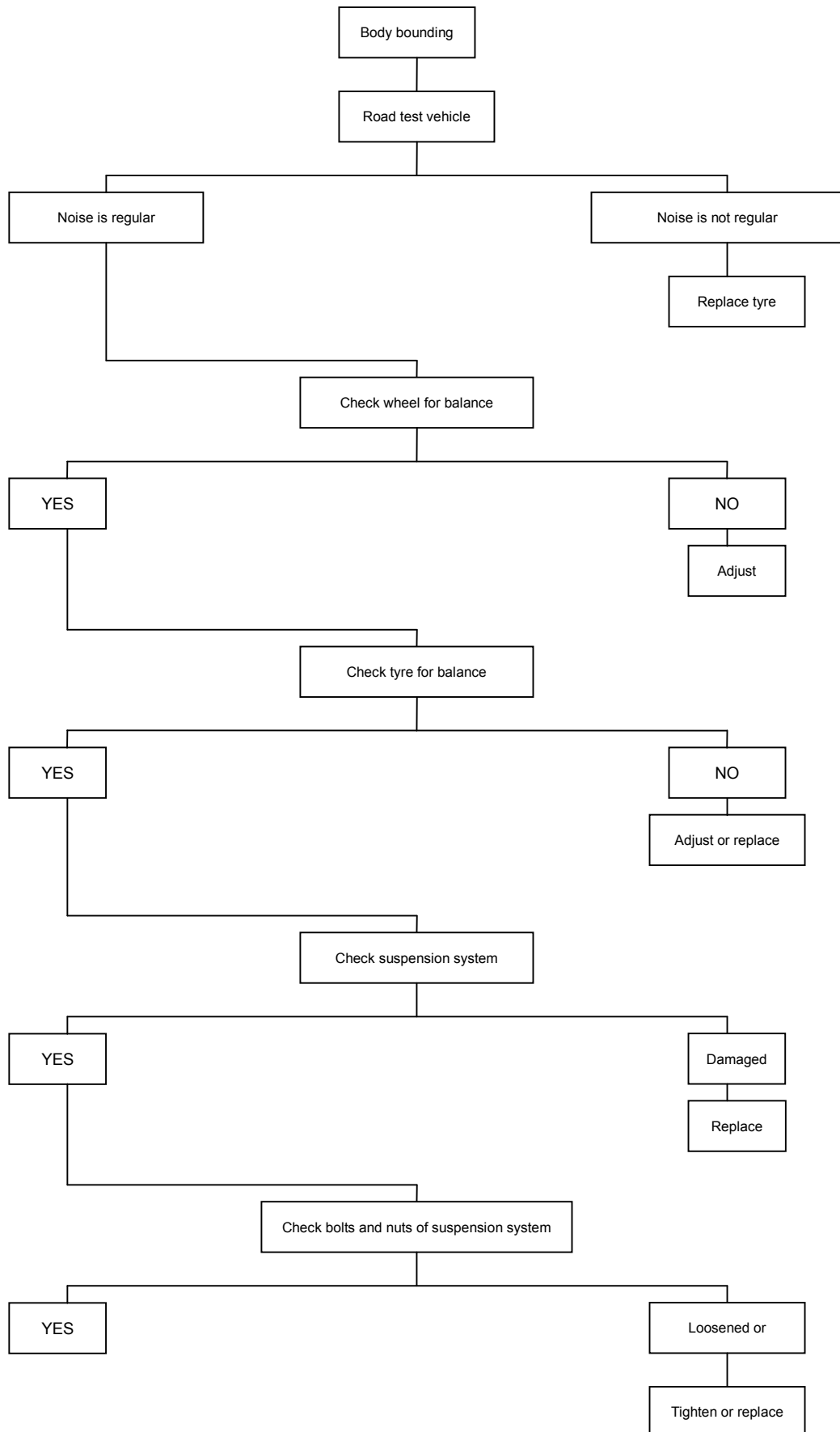
Rear Suspension



Rear Suspension



Rear Suspension



Front axle assembly

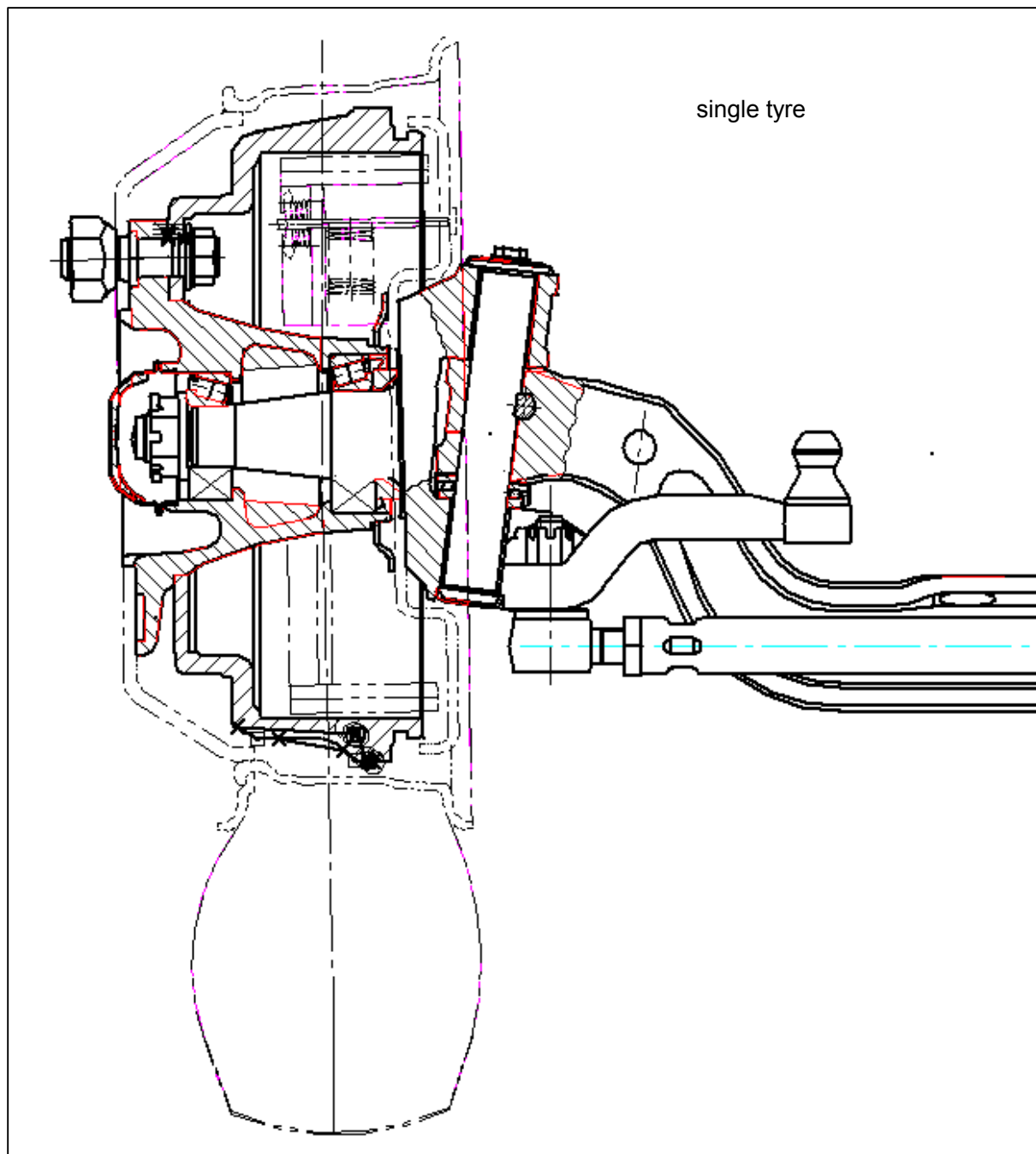
General

Technical parameter

Tightening torque of main bolts and nuts on front axle

Inspection and repair

General



The front axle of this model is integrally supported by I beam.

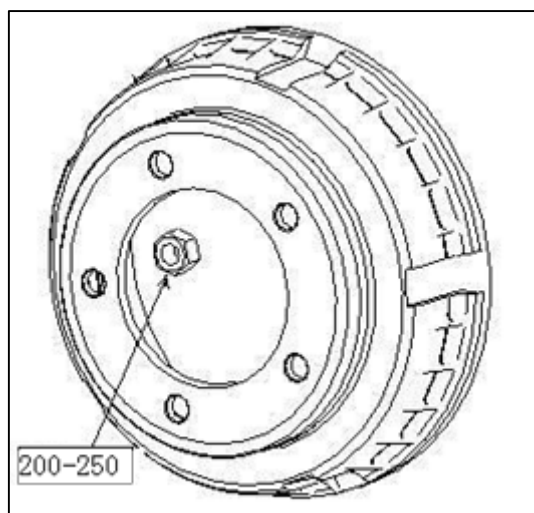
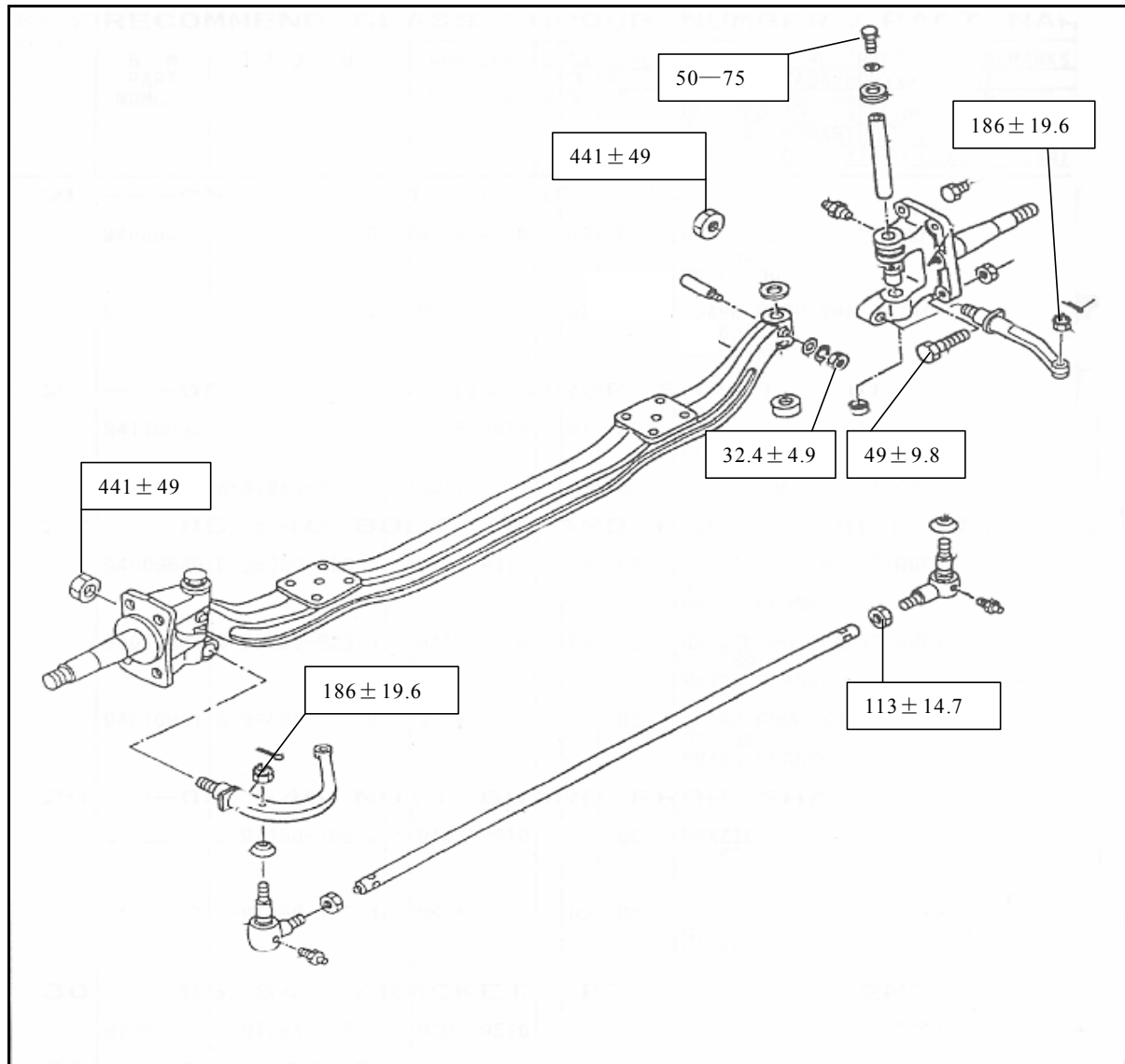
Main data and specifications of front axle

Transmission system form	4X2
Tread (mm)	1440
Front wheel alignment	
Front wheel toe-in	Diagonal tyre 3—7 (mm)
	Radialply tyre 1—3 (mm)
Front wheel camber	1° (degree)
Positive caster	2°40' (degree)
Kingpin inclination	7.5° (degree)
Steering angle	Inner turn 37° (degree)
	Outer turn 30° (degree)
Amount of grease used for bearing on the side of wheel hub	320 (g)

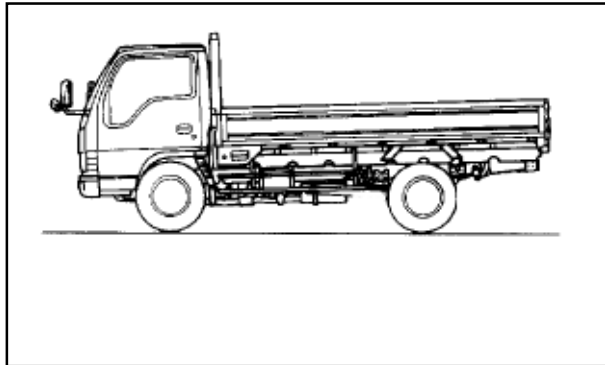


Tightening torque of main bolts and nuts of the front axle

Unit N·m



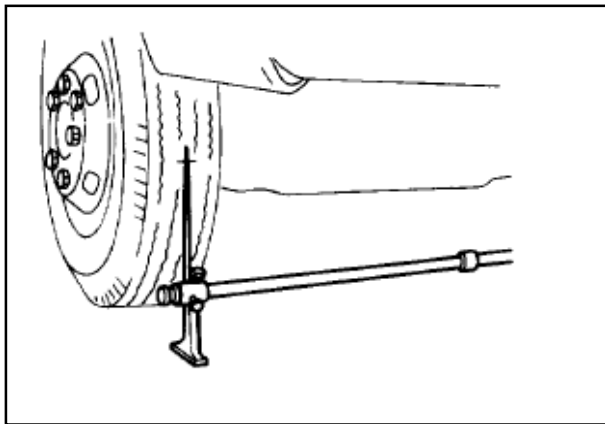
Inspection and repair



Adjustment of front wheel alignment

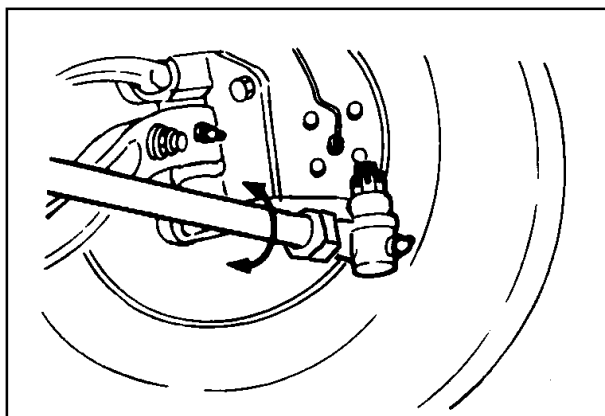
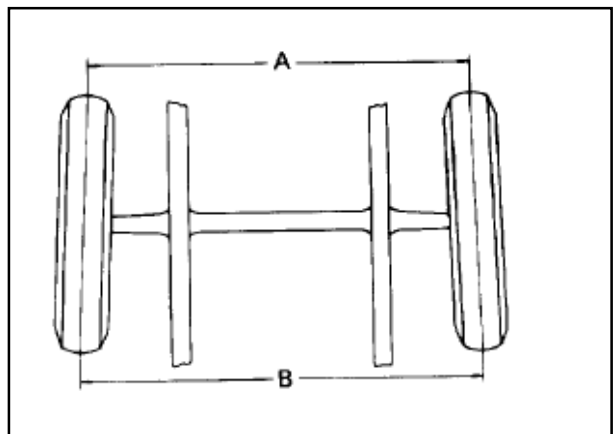
1. Measurement and adjustment of toe-in

- (1) Place front wheel on a flat place.
- (2) Mark the centre of tyre wheel track with chalk.
- (3) Place toe-in measuring device on the central position of wheel.



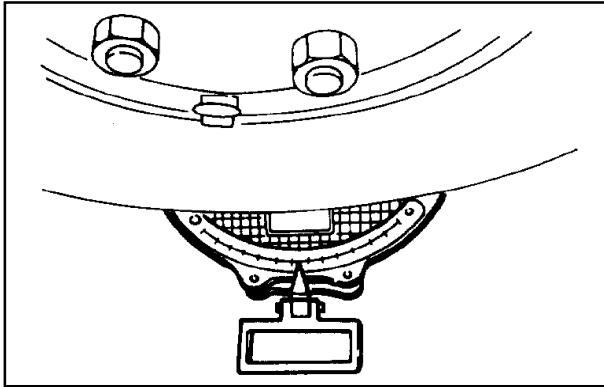
- (4) Measure the distance (A) between tyre centrelines in front of vehicle.
- (5) Push the vehicle back and forth to turn every wheel of 180°.
- (6) Measure the distance (B) of tyre centreline on the backside of front wheel according to the original mark.

Toe-in equals to B less A



In case of misalignment of the toe-in

- (7) Unscrew the clamping screw on the end of connection rod.
- (8) Turn the connection rod with a pipe wrench to adjust toe-in.



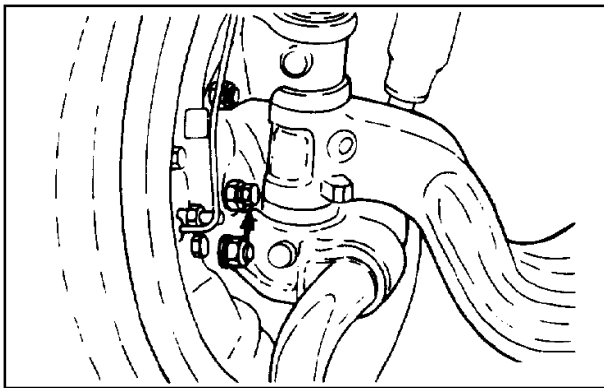
2. Turning radius

(1). Put a wood block beneath back wheel, the thickness of which is the same as that of measuring device.

(2). Put front wheel on the device and ensure it is located at the centre of the device

(3). Turn front wheel to maximum position in clockwise and counter clock-wise direction respectively.

Note: step on brake pedal when turning the front wheel.



Inner turning angle

Outer turning angle

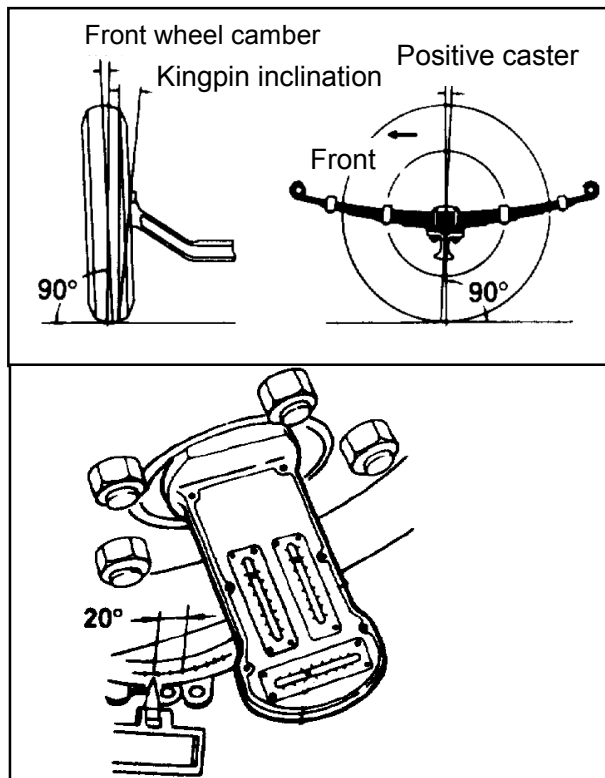
If turning angle is incorrect, make adjustment.

Adjustment steps:

(1). Unscrew the lock nut of adjusting bolt on steering knuckle

(2). Adjust the height of bolt until steering angle meets requirement.

(3). Tighten the lock nut.



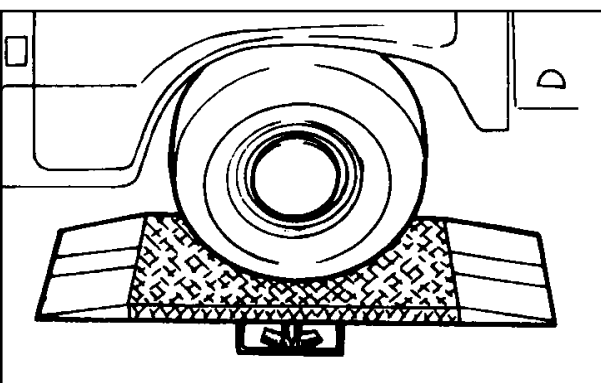
3. Other parameters of front wheel alignment.

- (1). Remove front wheel hub cover.
- (2). Mount a measuring device of front wheel alignment parameter on the end of steering knuckle. Calibrate front wheel turning angle to zero.
- (3). Measure the front wheel alignment parameters in the fig.

- If the front steel spring is fatigue
- If the front I beam is deformed
- If main pin, main pin bushing and bearing are worn excessively

4. In case of incorrectness of parameter measurement

Repair relevant parts in the left column.



alignment.



Measurement of side slip

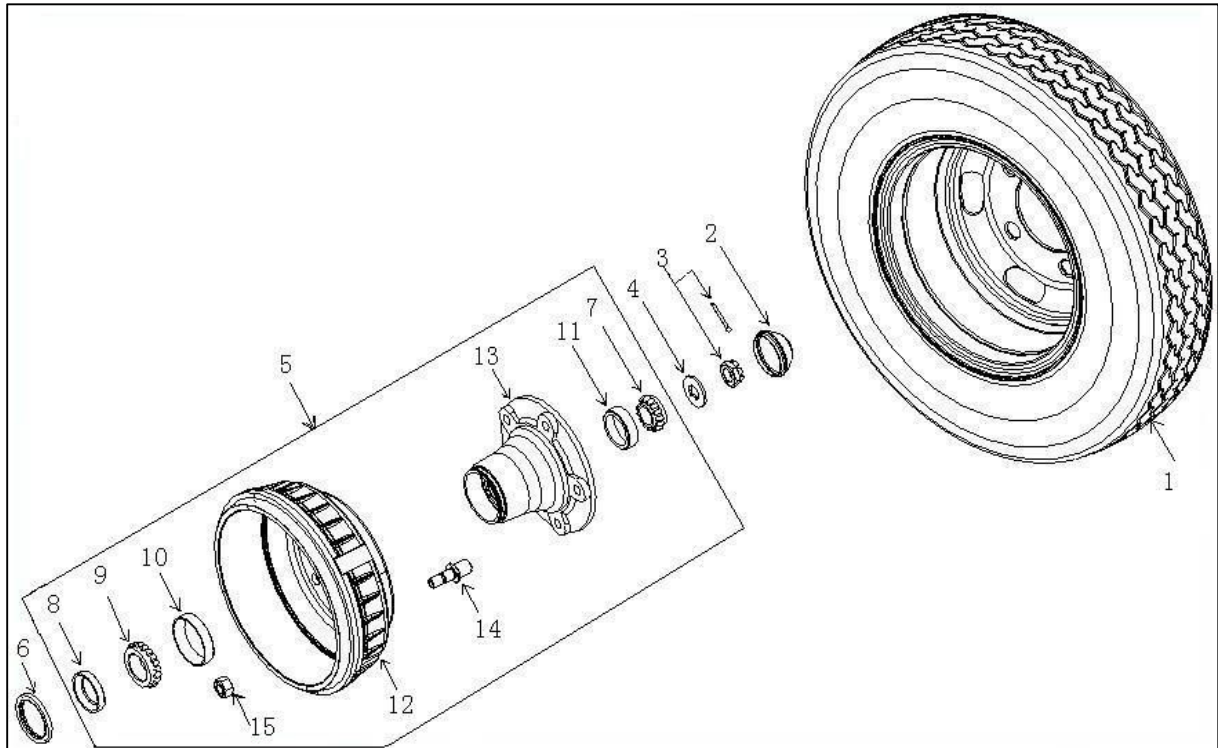
Measurement of side slip should be done after measurement and adjustment of toe-in and positive caster.

- (1) Slow the rolling wheel as possible to pass over the side slip measuring instrument. Read the side slip measuring instrument.
- (2) If side slip value exceeds 5 mm/m, readjust front wheel

Front wheel hub and brake drum



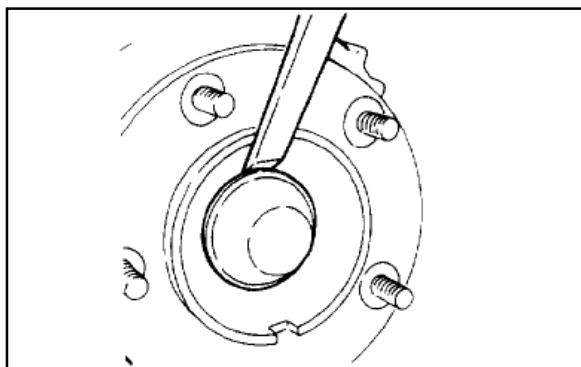
Disassembling



Disassembling sequence:

1.wheel 2. wheel hub cover 3. split pin slotted nut 4. washer 5.wheel hub and brake drum assembly 6. wheel hub oil seal seat 7. wheel hub outer bearing 8. wheel hub inner bearing oil seal 9. wheel hub inner bearing nut 10.wheel hub inner bearing outer race 11. wheel hub outer bearing outer race 12. brake drum 13. wheel hub 14. tyre bolt 15. inner nut

Installation sequence is just opposite to the disassembling sequence.



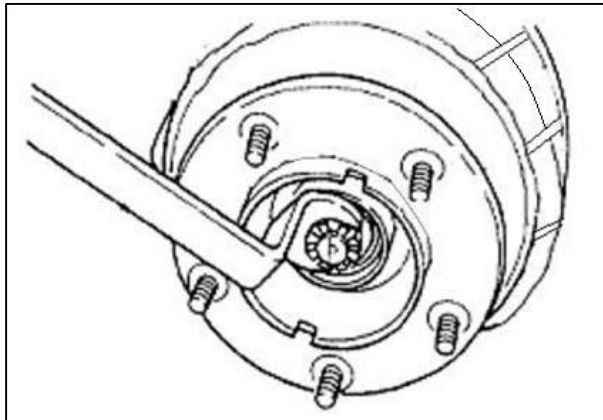
Main operating steps for disassembling

Pull the parking brake and jack up front axle.

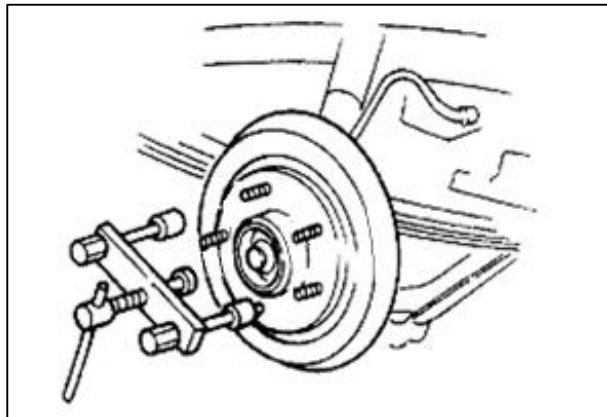
1. Remove wheel.
2. Remove wheel hub cover.



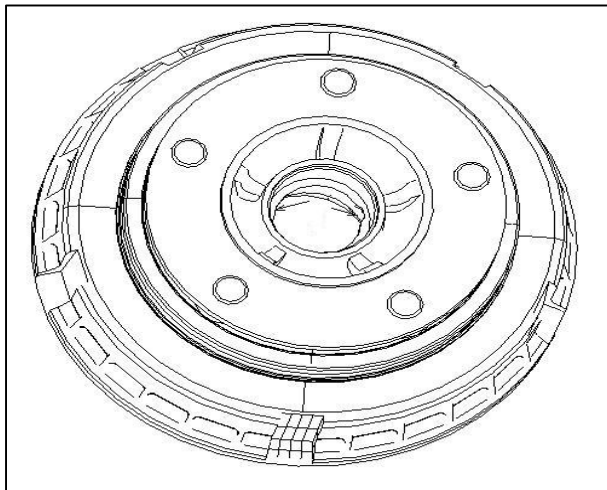
Take care not to damage the contacting surface of wheel hub cover.



3. Remove split pin slotted nut.



4. Remove wheel hub and brake drum assembly with an extractor.



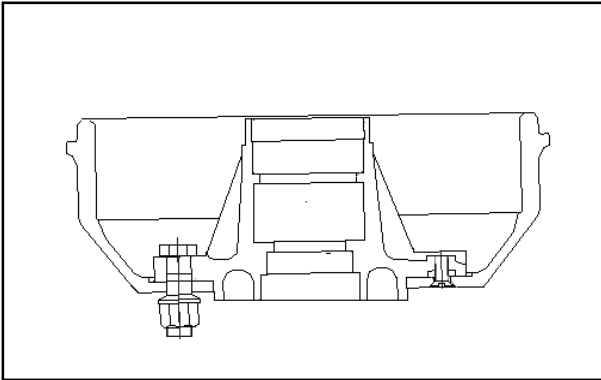
5. Remove bearing bushing outer race.

1. **Wheel hub**
2. **Wheel hub bearing, oil seal**
3. **Knuckle groove**
4. **Brake drum**
5. **Brake shoe, gasket, etc.**

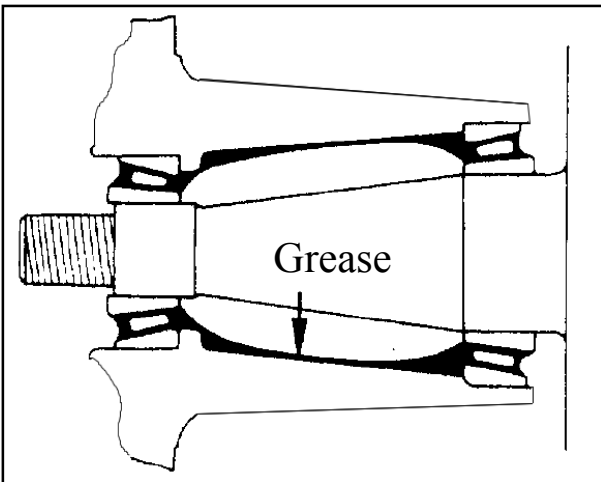


Inspection and repair

Visual inspection of the parts listed in the left for damage or failure.



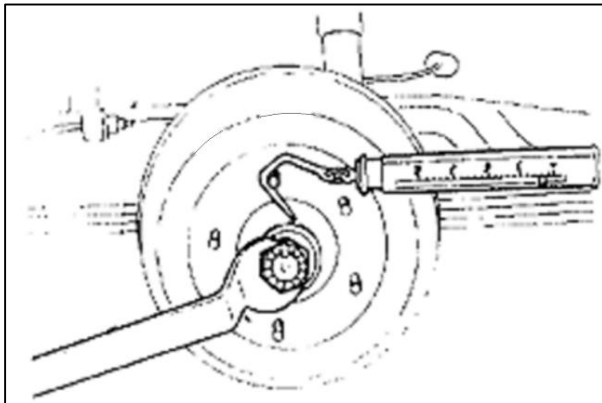
Main operating steps of installation.



Add grease according to the fig.

Inside wheel hub 280 g

Inside wheel hub cover 40g



Adjustment of preload of wheel hub bearing.

Adjust the clearance of brake gasket in the first place.

Adjust bearing preload with wheel hub nut.

It proves to be ok if the pulling force at the wheel bolt is measured as follows:

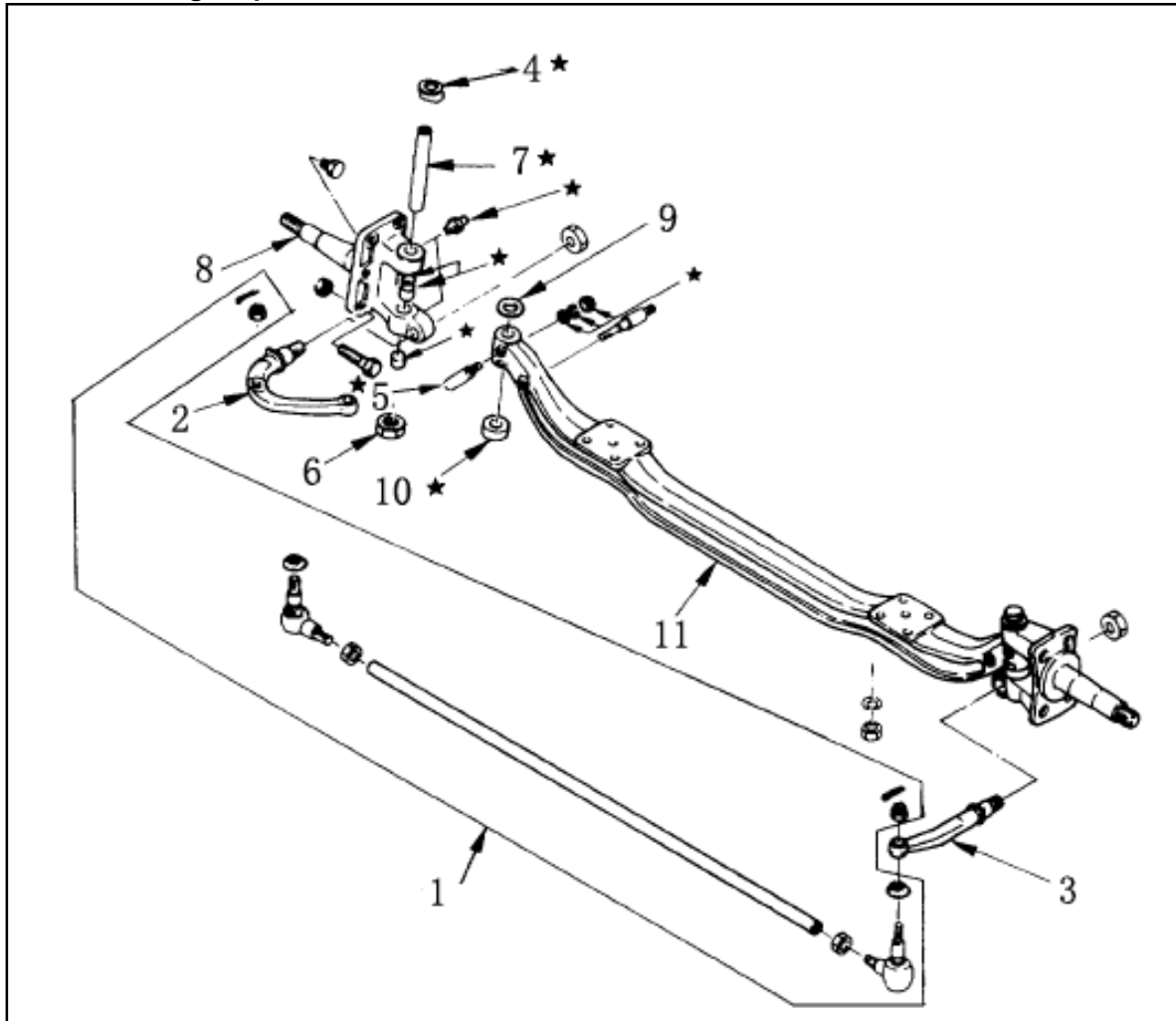
11.7—26.4N

Front axis and steering knuckle

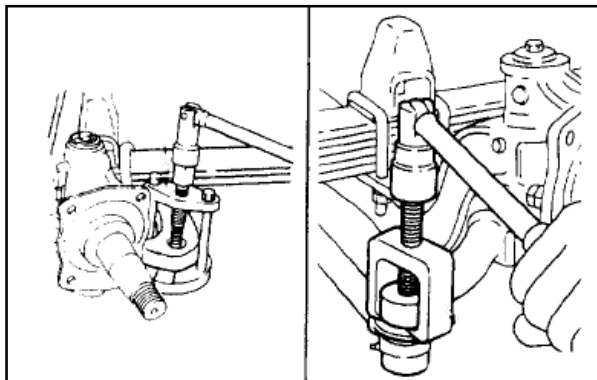


Disassembling

Disassembling sequence



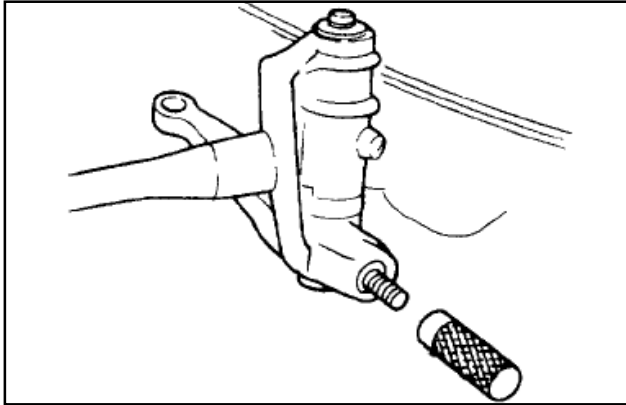
1. String rod assembly 2. Steering bend arm 3. Steering straight arm 4. Main pin upper cover
5. Lock bolt 6. Main pin lower cover 7. Main pin
8. Steering knuckle assembly 9. Adjusting washer 10. Thrust bearing 11. I beam



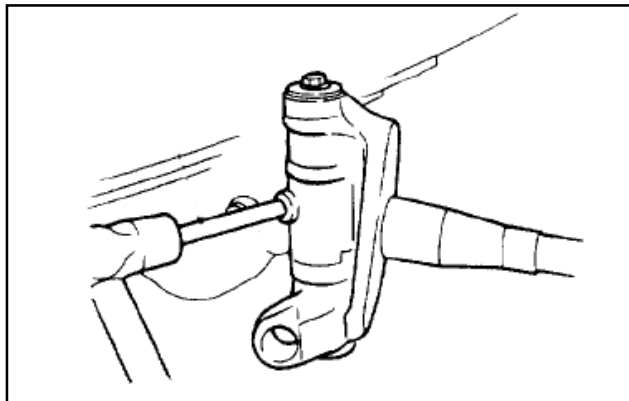
Main operating steps of disassembling

Pull parking brake and jack up front axle.

Remove string rod assembly with an expeller.



Put a brass stick on the steering straight arm and punch with a hammer when removing the steering straight arm.



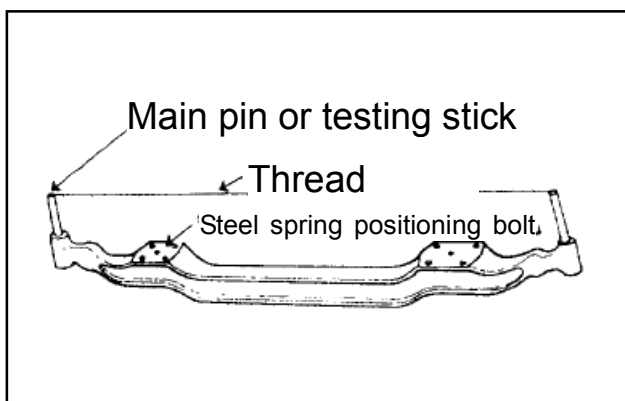
Remove lock bolt.

I beam
Steering knuckle
Steering straight arm
String rod Main pin
Thrust bearing
Adjusting gasket and bushing
String rod ball



Inspection and repair

Visual inspection of the parts listed in the left for damage or failure.

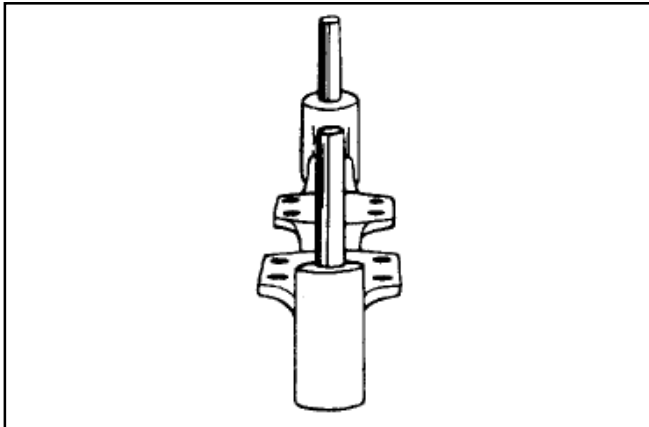


Repair I beam

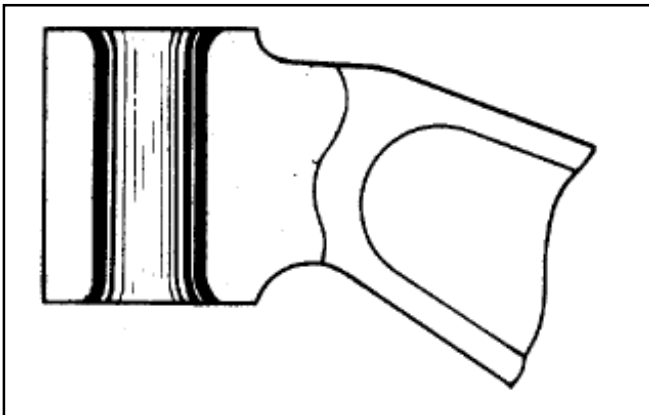
Insert main pin or testing stick into I beam hole.

Pull straight a thread between the centres of the sticks

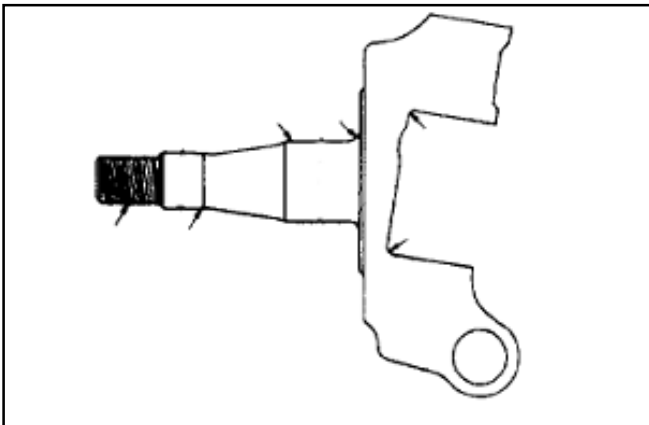
Observe if the thread aligns with two steel spring positioning bolt holes.



Observe if the two main pins or testing sticks align with each other from side view.

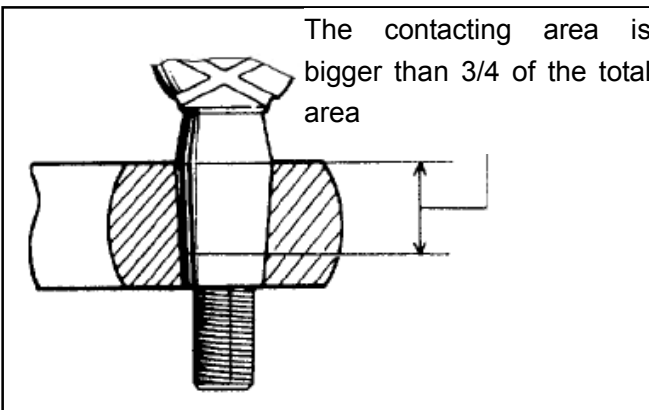


Inspect the main pin hole surface for any deformation and wear.



Observe the damage situation of the steering knuckle surface, especially of the parts pointed by arrows in the fig.

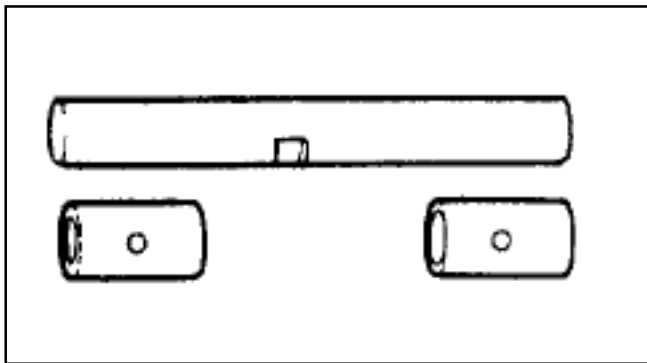
Inspect with magnetic inspection equipment.



Check contacting situation of steering straight arm, Steering bend arm and ball cone by colouring the contacting area.

The contacting area should be bigger than $\frac{3}{4}$ of the total area.

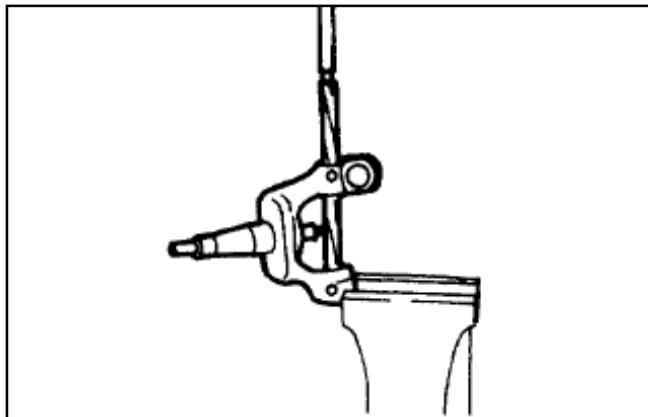
Otherwise, change relevant parts.



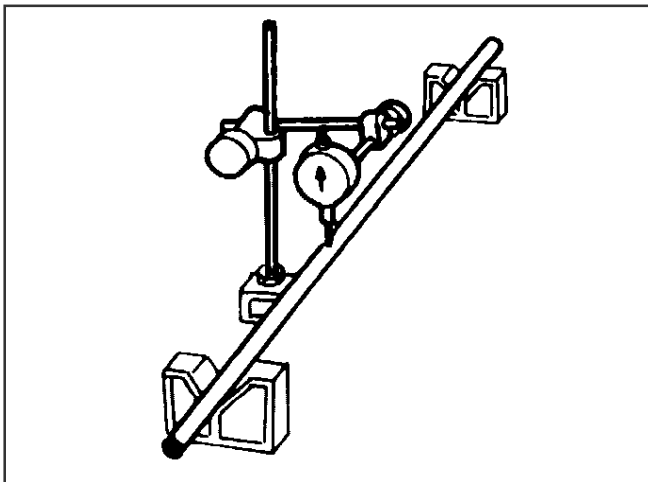
Measure the clearance between main pin and kingpin bush.

The clearance should be less than 0.15mm.

Otherwise, change bush.



If the new bush is too tight after put in, carefully machine the inside surface of the bush with a reamer.



Concentricity of connection rod is 1mm.

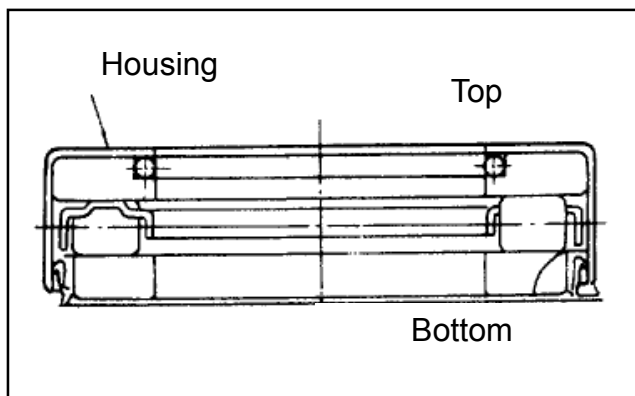
Main operating steps of installation

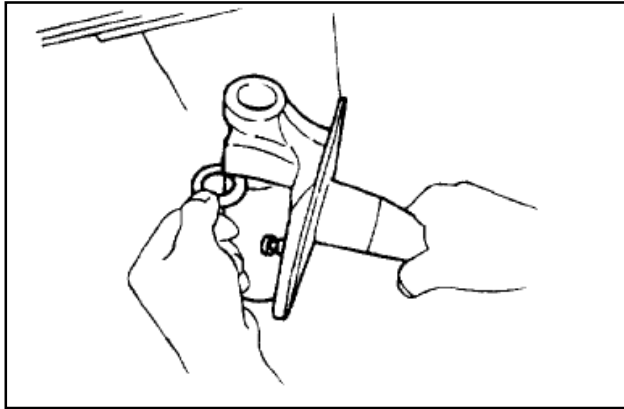


Add proper amount of grease before installation Thrust bearing



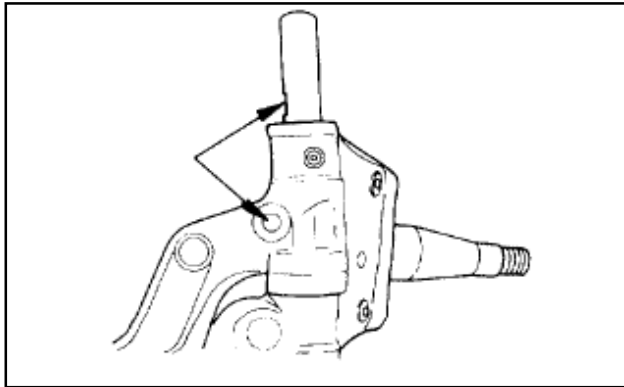
Take care not to make wrong direction.





Measure the clearance between steering knuckle and I beam flange so as to choose gasket with appropriate thickness.

Standard clearance after installation of gasket is 0 to 0.1mm.



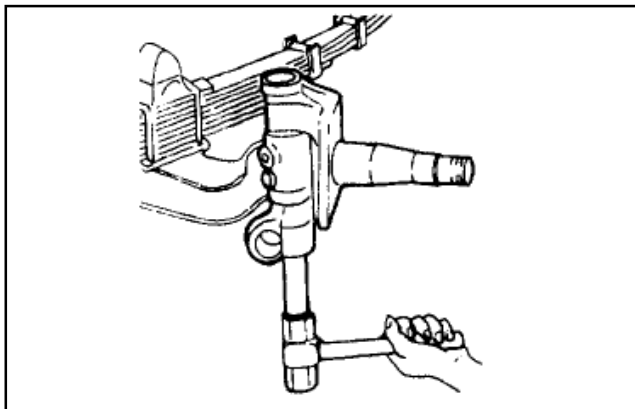
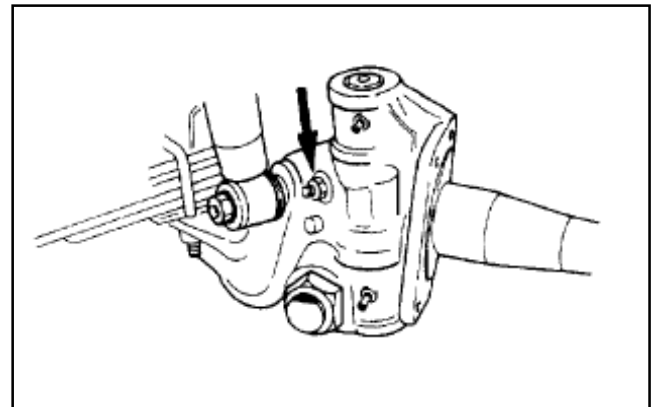
Ensure notch on the main pin align with lock bolt hole when installing main pin.

Steering knuckle should turn freely after filling grease.

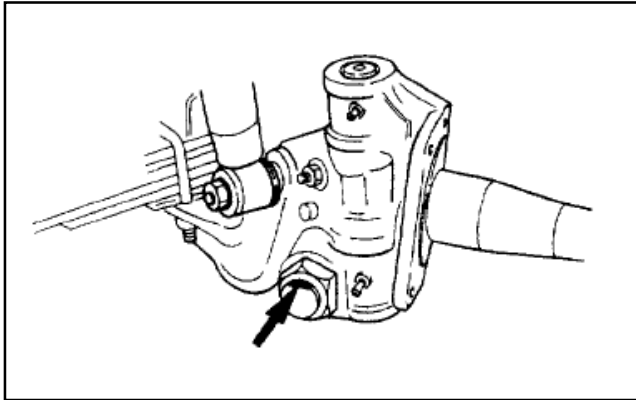


Install lock bolt

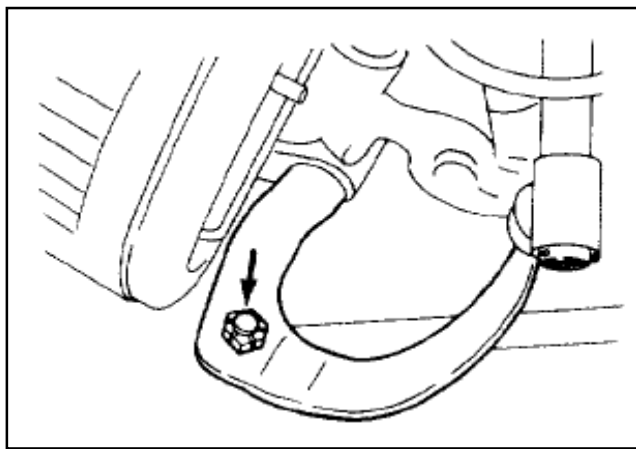
Tighten it to specified torque.



Install main pin cover with an appropriate round bar.



Tighten steering straight arm and steering bend arm to specified torque.



Screw string rod ball to specified torque.

Steering

Steering

General

Specifications

Torque

Steering column and steering shaft

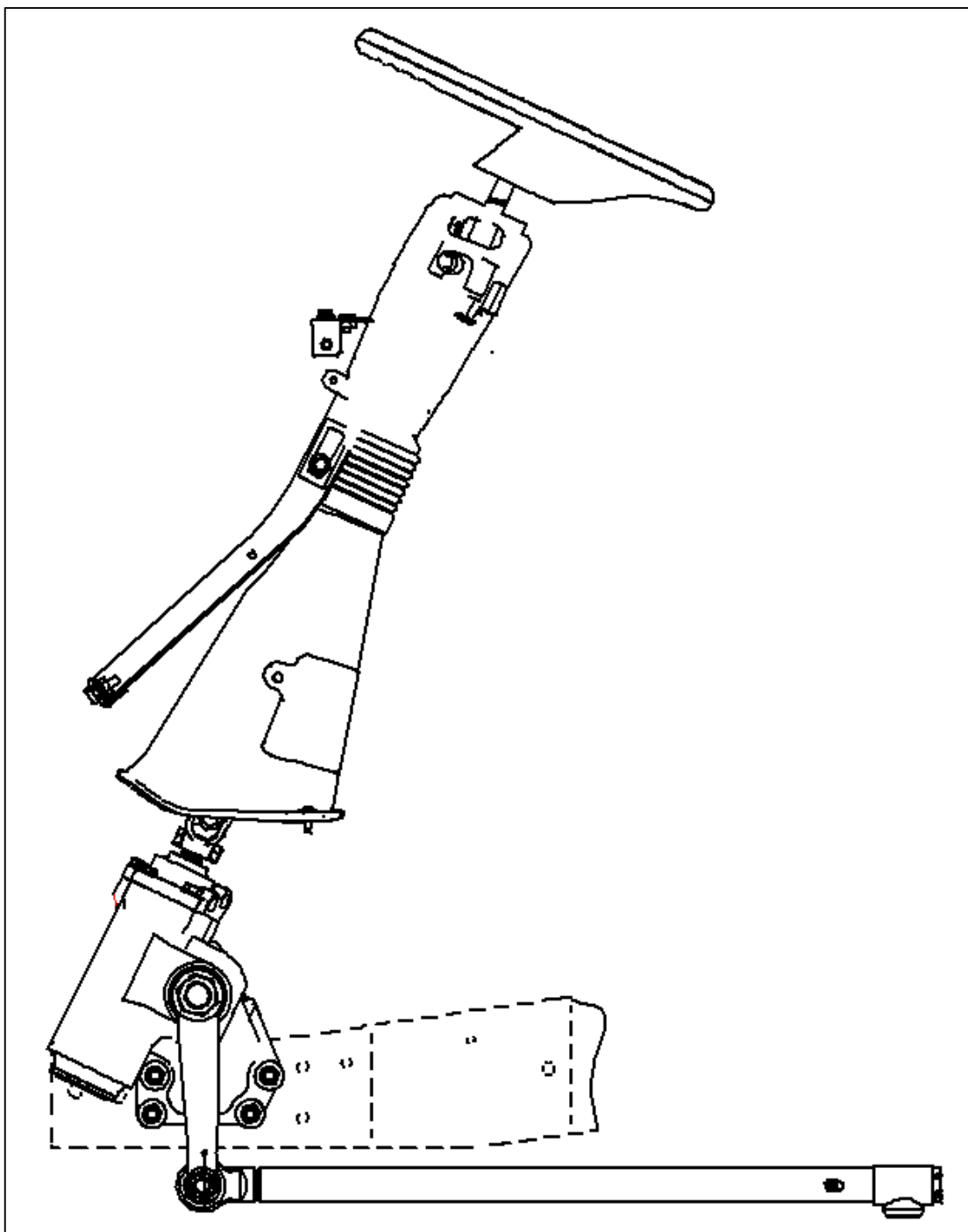
Steering gear disassembling

Power steering fluid filling and attention points

Trouble shooting

Steering

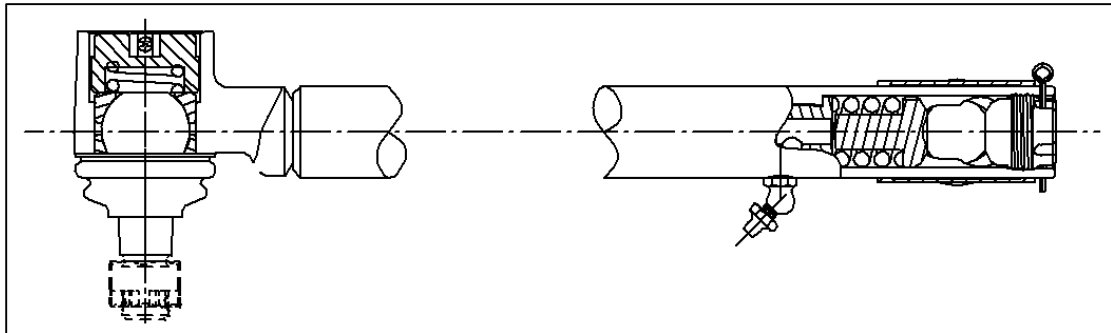
General Steering gear



This model is provided with rotary valve type power steering gear

Steering

Steering linkage



Specifications

Steering column and shaft

		Tiltable steering gear
Steering wheel	Ø mm	430
Back play	°	10~15
Steering shaft type		dual connector
Adjustable range	Back and forth °	11

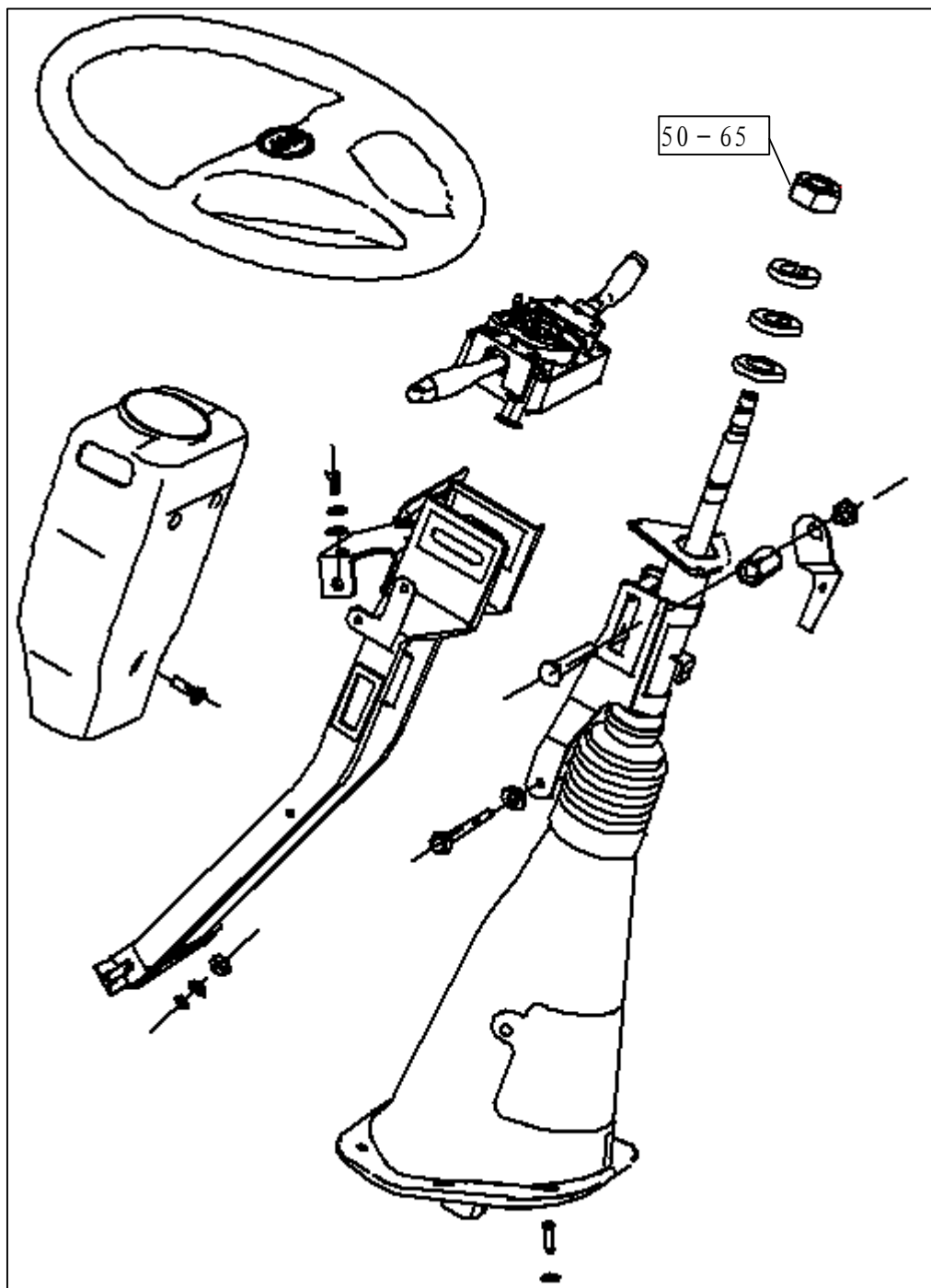
Major specifications of the power steering gear

Max. applicable front shaft load	2500kg
Max. theoretical output torque	1580N.m
Steering round	4.2
Output angle	±46°
Output spline (OD×gear)	Φ17.5×36
Output spline (big end OD×gear)	Φ35×36
Operating pressure	10.3Mpa
Applicable operating temp.	-40℃ ~ 135℃
Rated pump flow	(8-11)L/min
Net weight	18kg

Steering

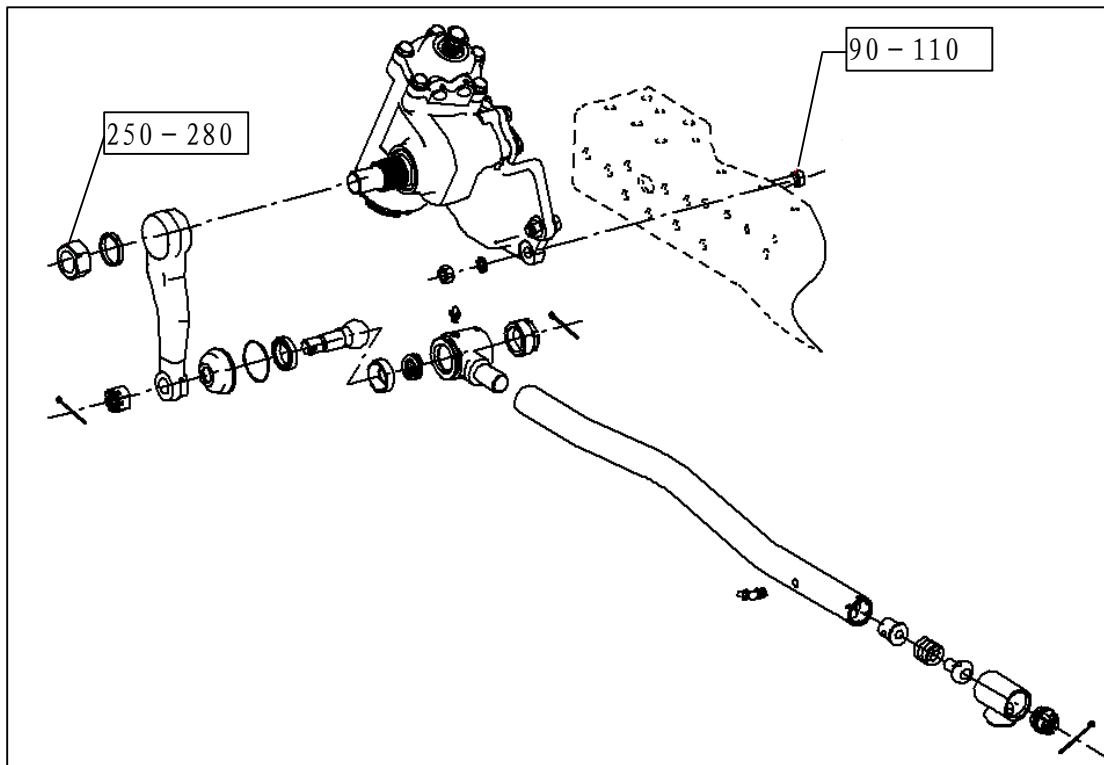
Torque (N·m)

Steering column



Steering

Device and tie rod

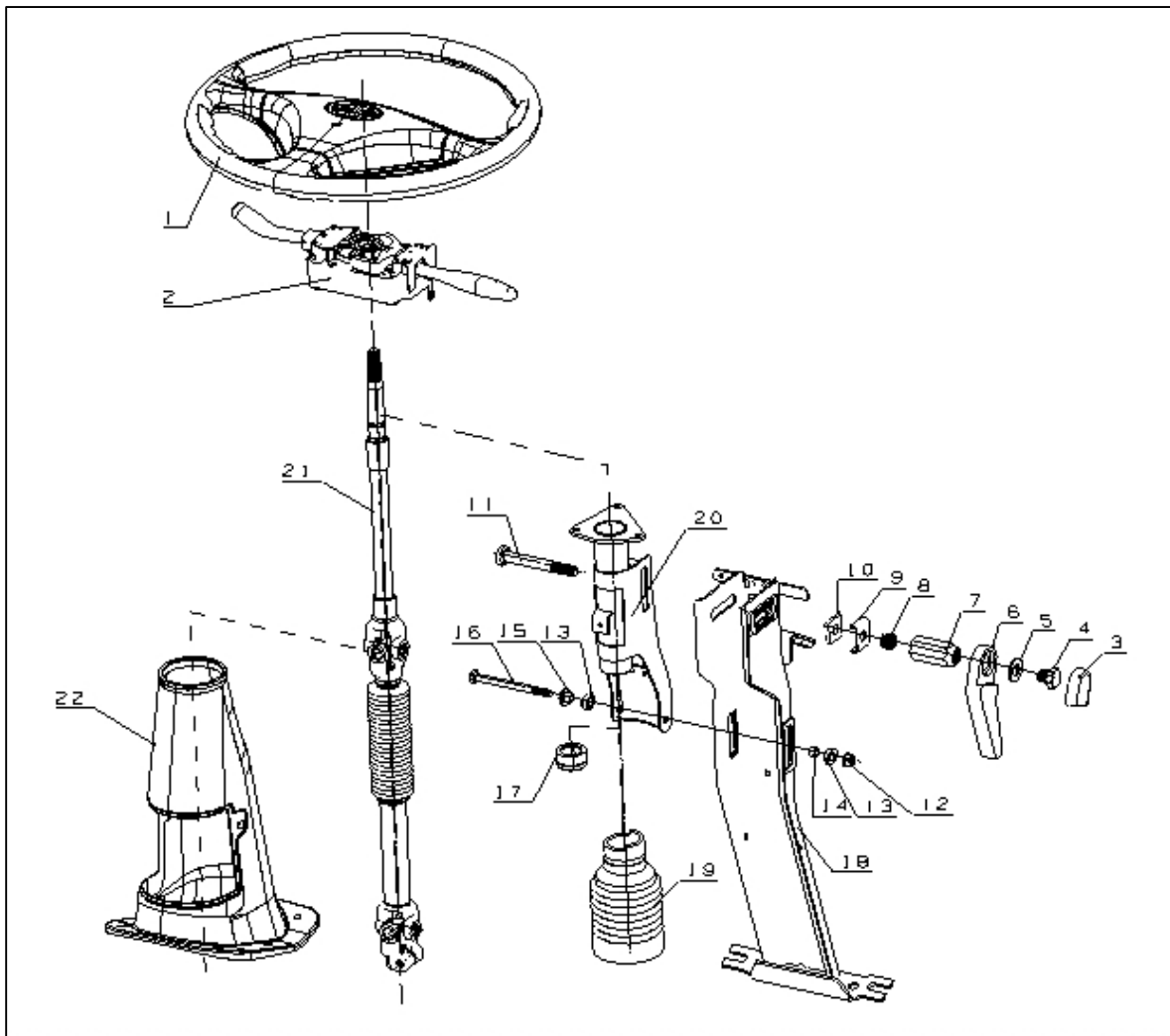


Steering

Steering column and steering shaft



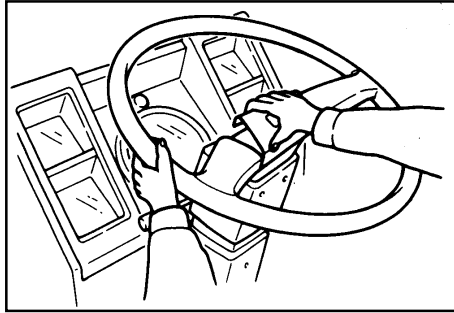
Disassembling and assembling



Disassembling sequence (just contrary to assembly sequence)

- | | |
|--|---|
| 1. Steering wheel assembly | 12. Hex flanged face luck nut |
| 2. Grouped switch assembly | 13. Nylon limit bushing |
| 3. Steering column handle cover | 14. Bushing |
| 4. Hex head bolt | 15. Shaft sleeve |
| 5. Flat gasket | 16. Hex head bolt |
| 6. Steering column handle | 17. Steering column shaft sleeve assembly |
| 7. Steering column adjusting lever nut | 18. Adjustable steering support assembly |
| 8. Spring | 19. Steering column pipe dust cover |
| 9. Limit support | 20. Steering column pipe welding assembly |
| 10. Adjusting piece | 21. Steering drive shaft assembly |
| 11. Adjusting nut | 22. Steering column enclosure assembly |

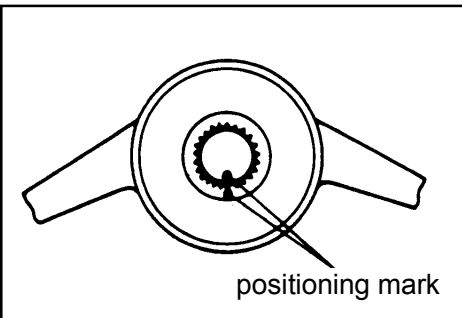
Steering



Important operation--Disassembling

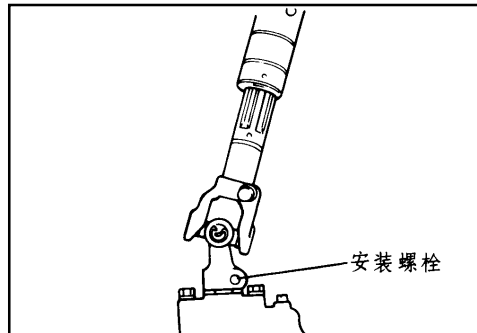
Horn button

Pull out the horn button.



Steering wheel

Turn the steering wheel and steering shaft aside, make the mark, to ensure that parts will be in the original positions during assembly.



shaft and steering knuckle

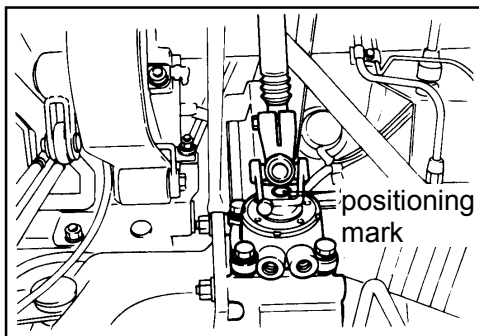
and support the cabin with the

marks on the steering knuckle

Bolt: fix the worm fork

(1) Tilt the cabin up, strut.

(2) Make positioning and worm.



(3) Remove the fixing bolts with pneumatic spanner or fixed wrench, and then pull out the flange fork.

(4) Lower down the cabin slowly.



Inspection and repair

Necessary correction or parts replacement shall be made if any abrasion, damage or other abnormalities are found during inspection.

Steering



Reassembling

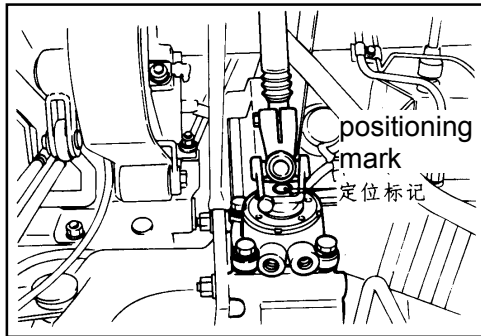
The reassembling sequence is contrary to that of the disassembling.



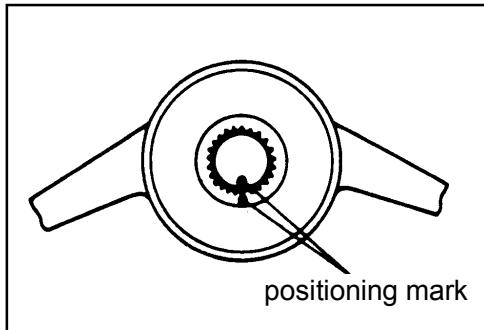
Important operation--Assembling



Bolt: fix the worm shaft and the steering knuckle fork.



In fixing, alignment shall be made with the positioning marks made



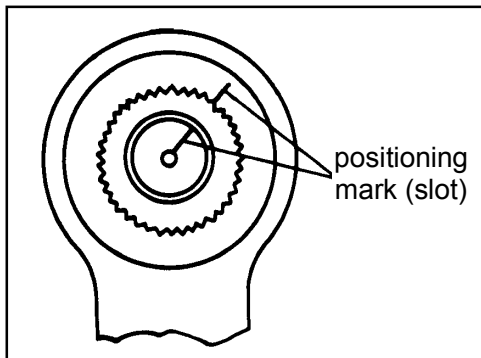
Steering wheel

Turn the steering wheel and steering shaft aside, make the mark, to ensure that parts will be in the original positions during assembly.



Important operation--Disassembling

Note: Before removing the steering gear assembly, take down the inlet/outlet hoses of the power steering pipes first. At this time, pay special attention to the connector and screw plug, or seal the oil injection port with ribbon after the oil pipe is taken down, to prevent dust or other foreign matters getting in.



Important operation--Assembling

Steering vertical arm



Align with the positioning mark.

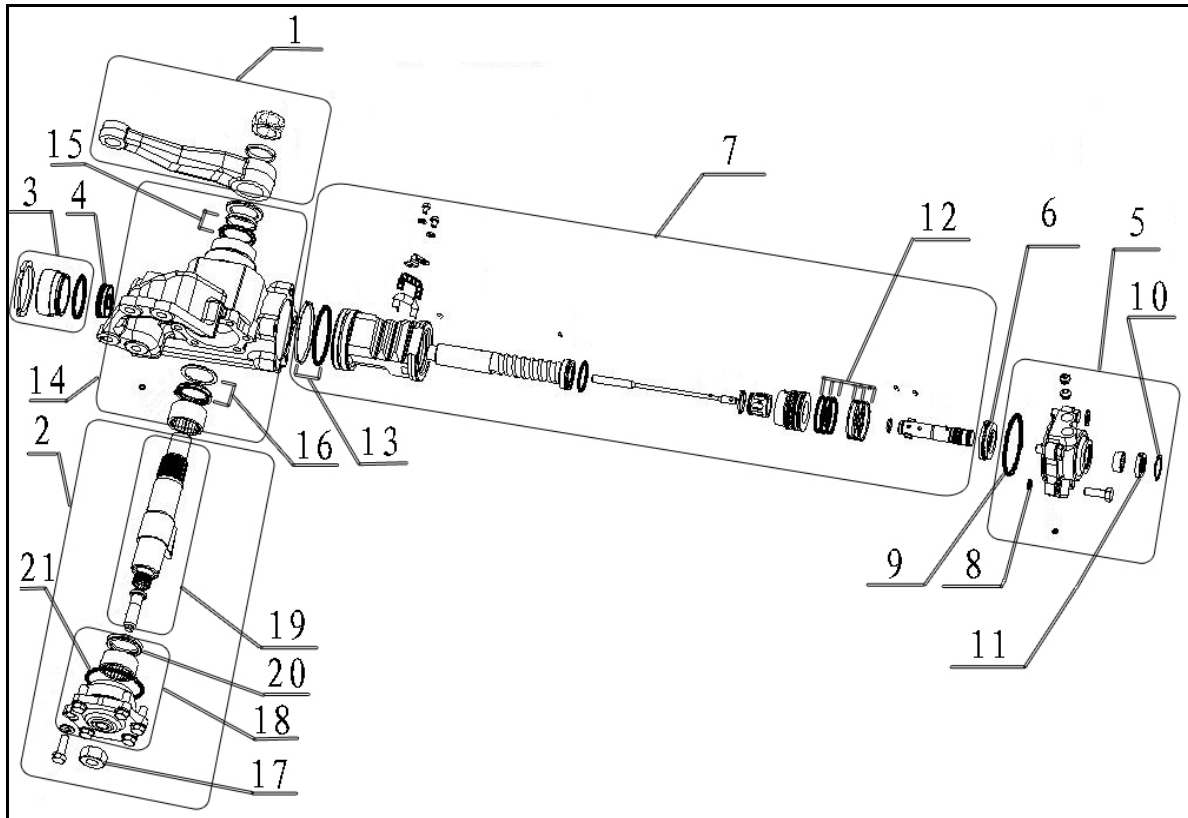


Tightening torque range: torque (N.m) 250--270

Steering



Steering gear disassembling

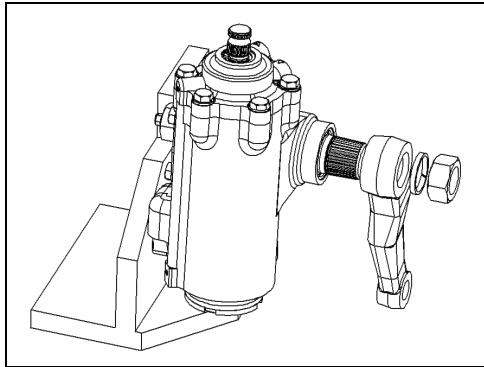


Disassembling sequence

- | | |
|---|---|
| 1、big nut elastic washer + rocker | 2、side cover +rocker-arm shaft assembly |
| 3、locknut + adjusting nut assembly | 4、thrust needle bearing |
| 5、upper casing assembly | 6、thrust ball bearing |
| 7、rotary valve worm nut assembly | 8、valve bush seal ring + valve bush seal washer |
| 9、small O ring | 10、Upper casing O ring |
| 11、elastic retainer ring | 12、input cup |
| 13、steering nut seal washer + seal ring | 14、lower casing assembly |
| 15、output end cup + gasket | 16、output end seal washer + seal ring |
| 17、locknut | 18、side cover assembly |
| 19、rocker-arm shaft assembly | 20、side cover O ring |
| 21、side cover cup | |

Steering

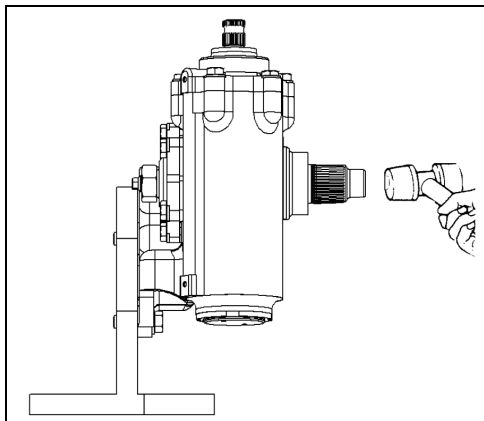
Important disassembling steps:



1. Big nut +elastic washer +rocker

Turn the big nut counterclockwise by a torque wrench, remove the elastic washer, and take down the rocker arm.

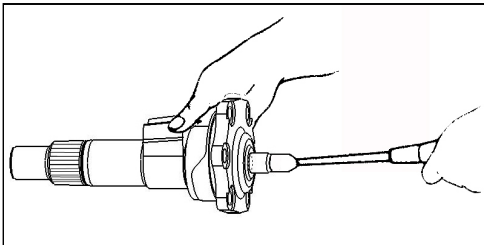
Note: Do not hammer the rocker arm when taking down it, otherwise the side cover and rocker-arm shaft assembly will be damaged; and do not damage the small cone hole in the rocker arm.



2. Side cover assembly + rocker shaft assembly

Turn the input shaft to have the assembly in the middle position (the drawing shows that marked line on small end face of the rocker arm is downward). Remove the fixing screws of the side cover.

Hit the small end face of the rocker arm with a rubber hammer, and take down the side cover assembly and the rocker-arm shaft assembly.



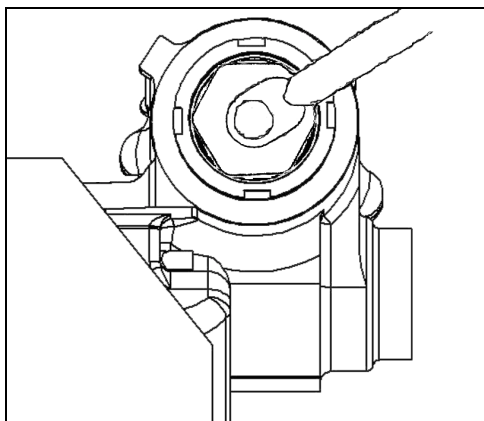
18. Side cover assembly

19. Rocker-arm shaft assembly

Turn the adjusting screw clockwise, and takedown the rocker arm shaft assembly from the side cover assembly.



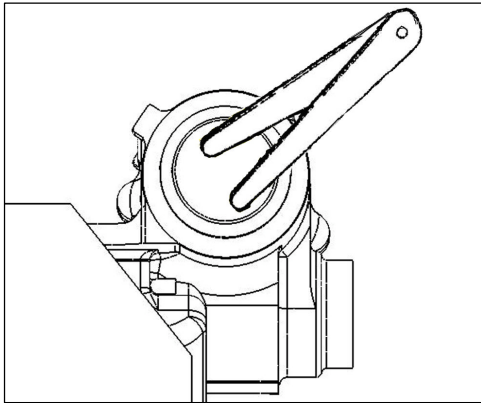
Warning: Further disassembling of rocker arm assembly is not allowed, or it will be damaged; the side cover assembly cannot be further disassembled except the O ring, or it will get damaged.



3. Locknut + adjusting nut assembly

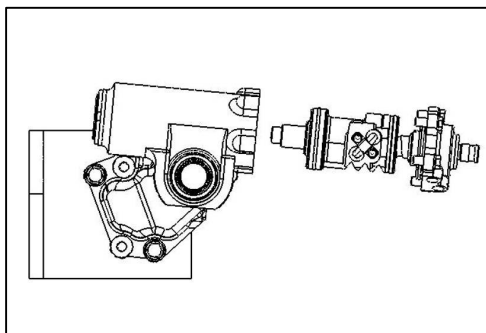
Use the tool shown in the drawing to remove the locknut, take care not to damage the O ring.

Steering



3. Adjusting nut

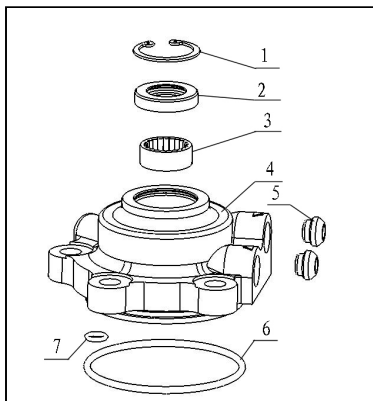
Use the tool shown in the drawing to remove the locknut, take care not to damage the O ring on it.



5. Upper case assembly

7. Rotary valve worm nut assembly

When taking down the above 2 assemblies, take care not to lose the thrust ball bearing (4) and its different parts(6).



5. Upper case assembly

Disassembly sequence:

1、 elastic retainer ring for holes

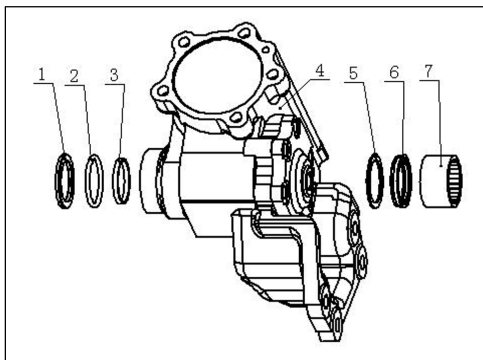
2、 cup on input side

4、 upper case

6、 upper case O ring

7、 small O ring

Note: The needle bearing (3) and the connector(5) shall not be taken down, or they will be damaged.



14.Lower case assembly

Disassembly sequence:

1、 Cup on output side

2、 Lower case

3、 Seal ring on output side

4、 Seal washer on output side

5、 Dust ring assembly

Note: The needle bearing (7) shall not be taken down, or it will be damaged.

Steering



Inspection and repair

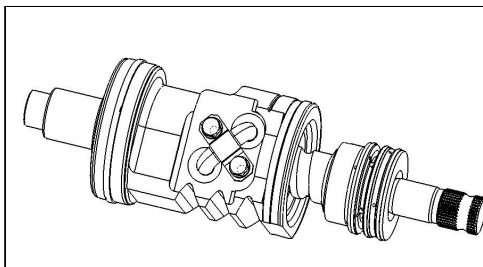
Necessary repair or replacement shall be made if any parts abrasion; damage or other problems are found during inspection.

- lower case
- rocker arm assembly
- rotary worm nut assembly
- oil seal cup
- bearing
- O ring and seal ring



Visual inspection:

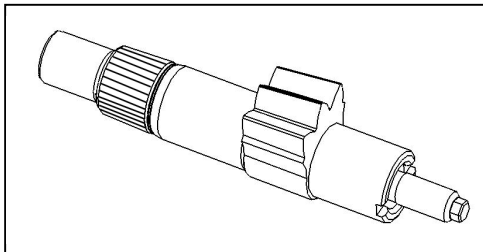
Check for any abrasion, damage or other problems of the following parts.



Turning of the worm nut

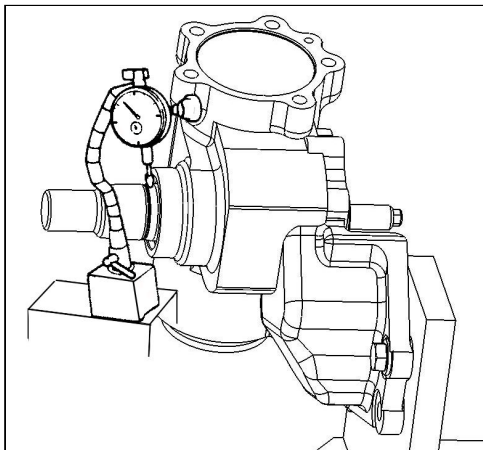
Turn the worm to see if it's smooth. Check the spiral chute, the valve bush seals and the nut seal for any damage.

Note: Do not disassemble the assembly and do not damage the outer round surface of the nut. If the valve bush seal or nut seal is damaged, change them with new ones.



Rocker arm assembly

Check the rocker tooth section and the bearing support for any abnormal wear. If any, have them changed at the authorized service station or manufacturer.



Clearance between rocker shaft and needle bearing on output side

Limit (mm): 0.2

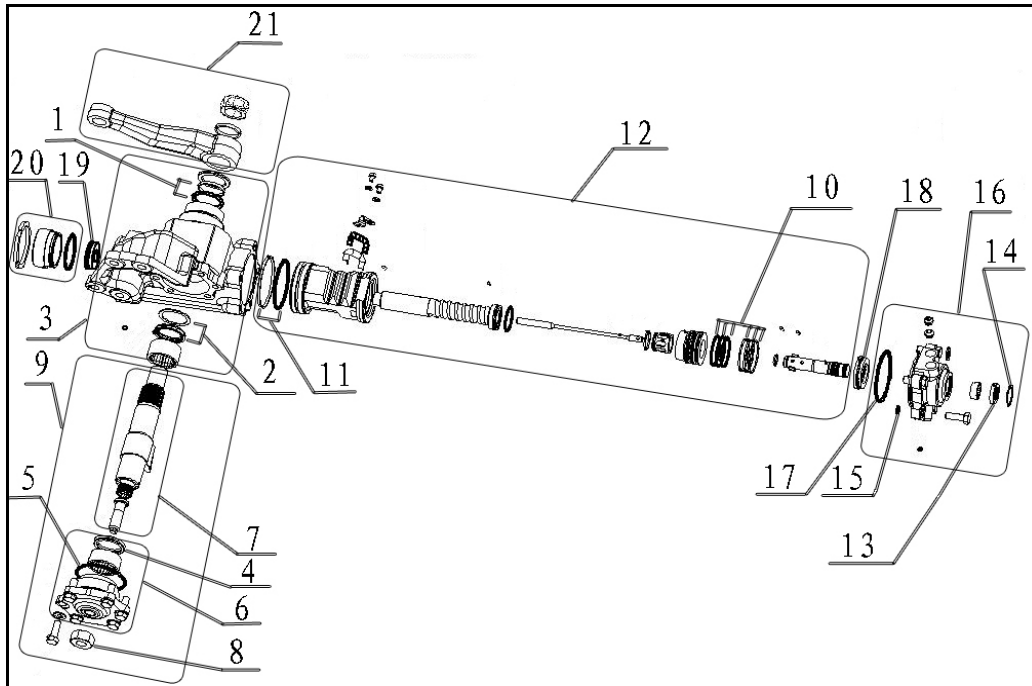


Clearance between nut and lower case piston hole

Limit (mm) :0.15

Steering

Reassembling of steering gear



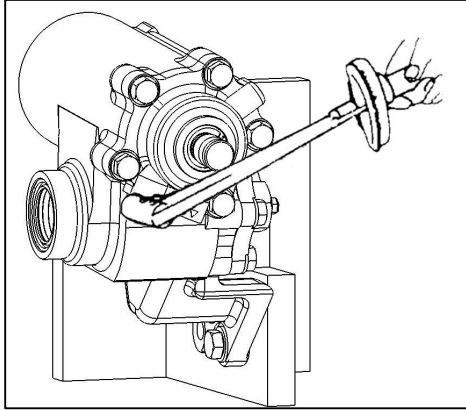
Reassembling sequence:

- | | |
|---|--|
| 1、 output side cup+ gasket | 2、 output side seal washer + seal ring |
| 3、 lower case assembly | 4、 side cover O ring |
| 5、 side cover cup | 6、 side cover assembly |
| 7、 rocker shaft assembly | 8、 locknut |
| 9、 side cover assembly + rocker shaft assembly | 10、 input cup |
| 11、 steering nut seal washer+ seal ring | 12、 rotary valve worm nut assembly |
| 13、 elastic retainer ring for holes | 14、 upper case O ring |
| 15、 valve bush seal ring + valve bush seal washer | 16、 upper case assembly |
| 17、 small O ring | 18、 thrust ball bearing |
| 19、 thrust needle bearing | 20、 locknut+ adjusting nut assembly |
| 21、 big nut +elastic washer +rocker arm | |

Steering



Warning: The worm, nut, steel ball and valve components in the rotary valve worm nut assembly are sophisticated parts that do not allow further disassembling; otherwise, all the assembly will be damaged. And the screwed out length should be controlled between the worm and nut, or the steel balls will fall out of the chute. All the seals must be changed with new ones after disassembling.



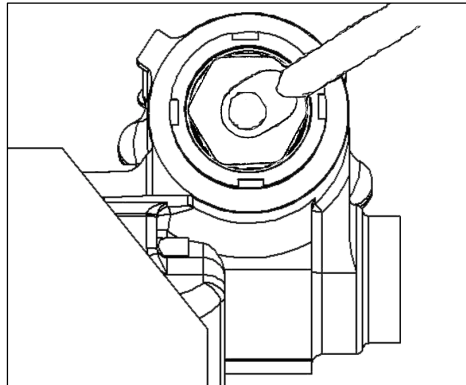
9、upper case assembly

screw tightening torque: 45N·m~55N·m



14、locknut

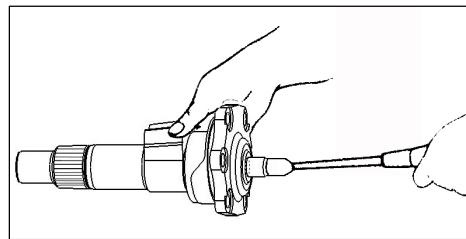
locking torque: 180N·m~210N·m



15、rocker shaft assembly

18、side cover assembly

Turn the adjusting screw of the rocker shaft assembly counterclockwise, until the rocker shaft end gets contact with the side cover bottom, and then turn 3-4 rounds backward.

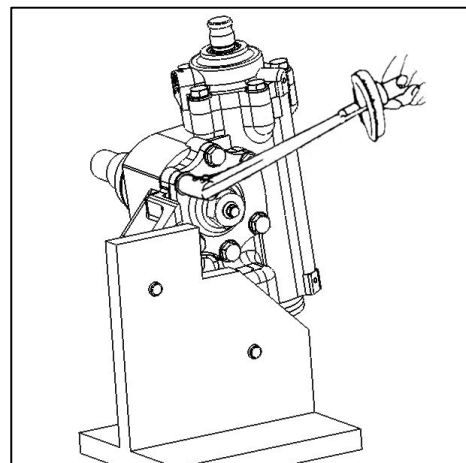


Side cover assembly +rocker shaft assembly

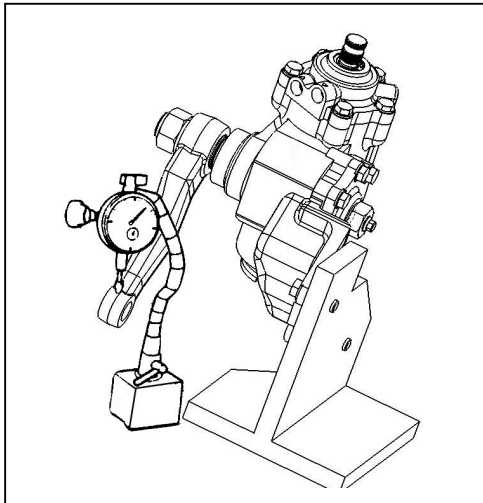
Screw tightening torque: 45N·m~55N·m



Warning: If the teeth are not installed correctly, the steering gear will have insufficient travel in one direction, causing a steering accident. In fixing the gear rack, check the spline for any damage, to avoid scratches in the oil seal of the cup.



Steering



11、locknut (side cover)

Adjust the clearance between the rocker shaft gear rack and nut rack

- (1) Fix the steering rocker arm
- (2) Have the steering gear in straight forward position (middle)

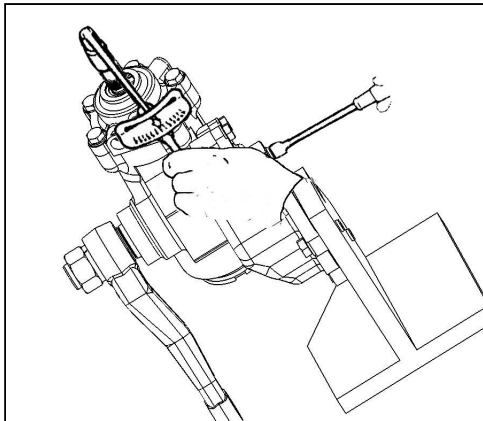


- (3) Adjust the clearance to the specified value

Gear clearance (mm): ≤ 0.33



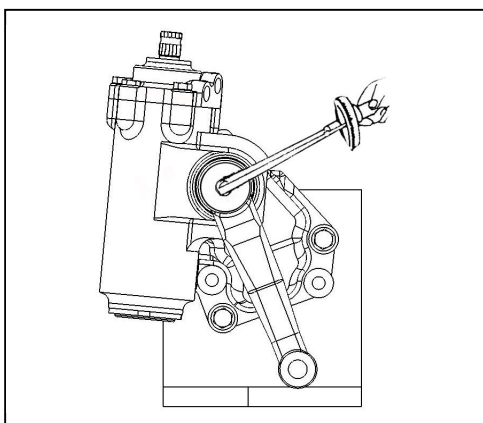
- (4) Tighten the locknut
Tightening torque (N·m): 65~80



- (5) Check the start torque of the input shaft



Start torque (N·m): 0.4~1.2



21、Tighten the rocker arm



In fixing the rocker arm, ensure that the tightening torque of the small end face of the rocker arm is:

250 N·m~280N·m



Warning: ① If non specified power steering fluid is used or two kinds of fluids are mixed, the sealing will fail, which causes no boosting for steering. ② If the steering gear stays too long at a limit position during operation, the steering oil pump will get damaged.

Steering

Power steering fluid filling and attention points

Oil filling: Fill the oil tank with oil first, start the engine, operate the drive pump at low speed to fill the hydraulic system with oil. During the engine running, the oil level in the tank will go down continuously, so, oil filling is needed all the time to avoid air suction into the pump. At the same time, turn the steering wheel right and left to its limit positions repeatedly for several times, until the oil in the tank stops going down.

Oil change: jack up the front axle and open the oil reservoir cover. Open the return oil port of the steering gear, and start the engine in short time less than 15 seconds. Turn the steering wheel right and left continuously to its limit positions to drain off all the oil inside, and then fill in oil as per the filling procedure.

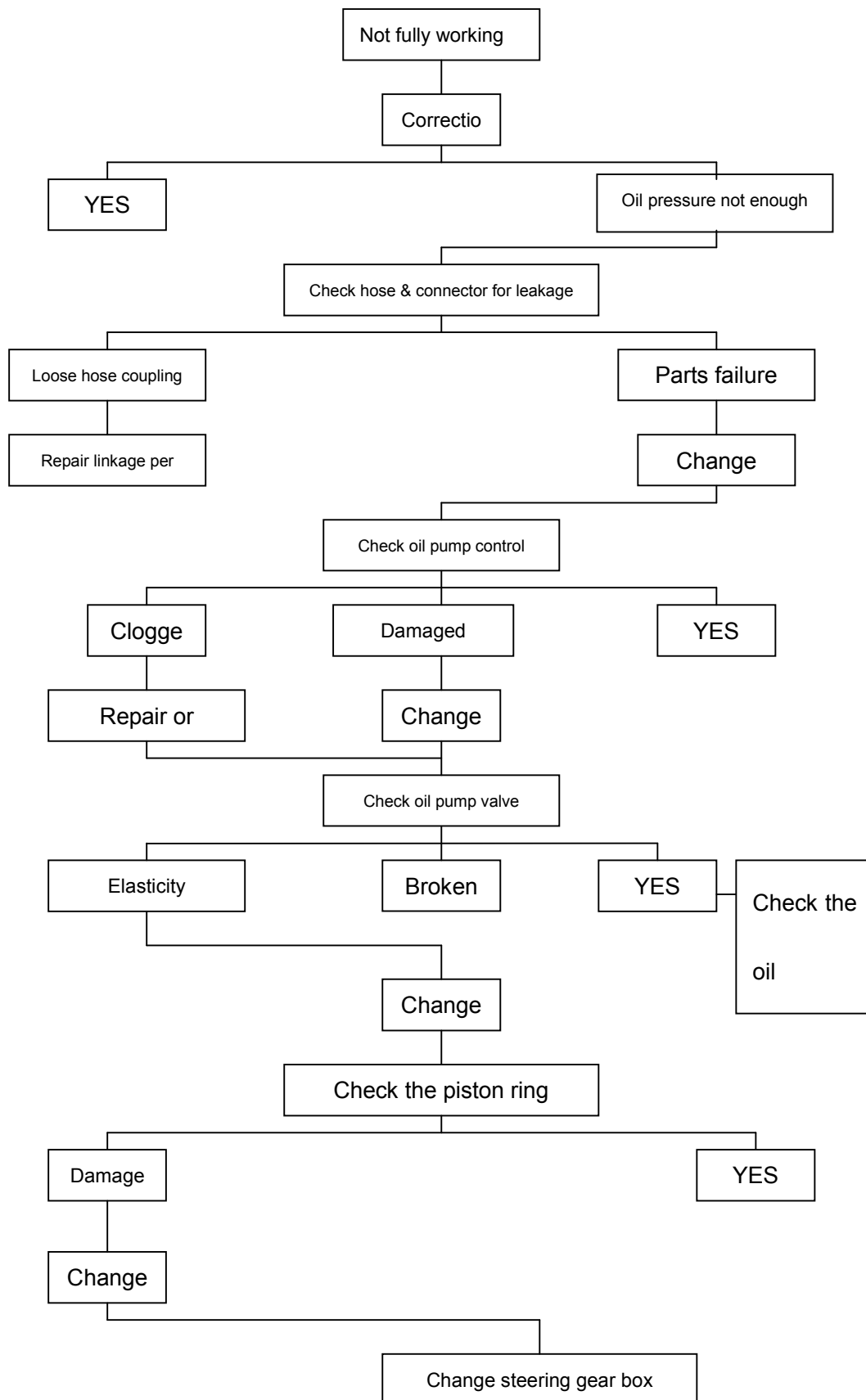
Exhaust: jack up the front axle, it will also do to remove the connecting rod, have the engine at idling, and turn the steering wheel right and left to its limit positions for several times drain off the air and vaporized oil. When bubbles are removed, the oil level in the tank will go down, and now oil shall be added from time to time until the oil level gets stable. By now the exhaust process is finished.

Attention:

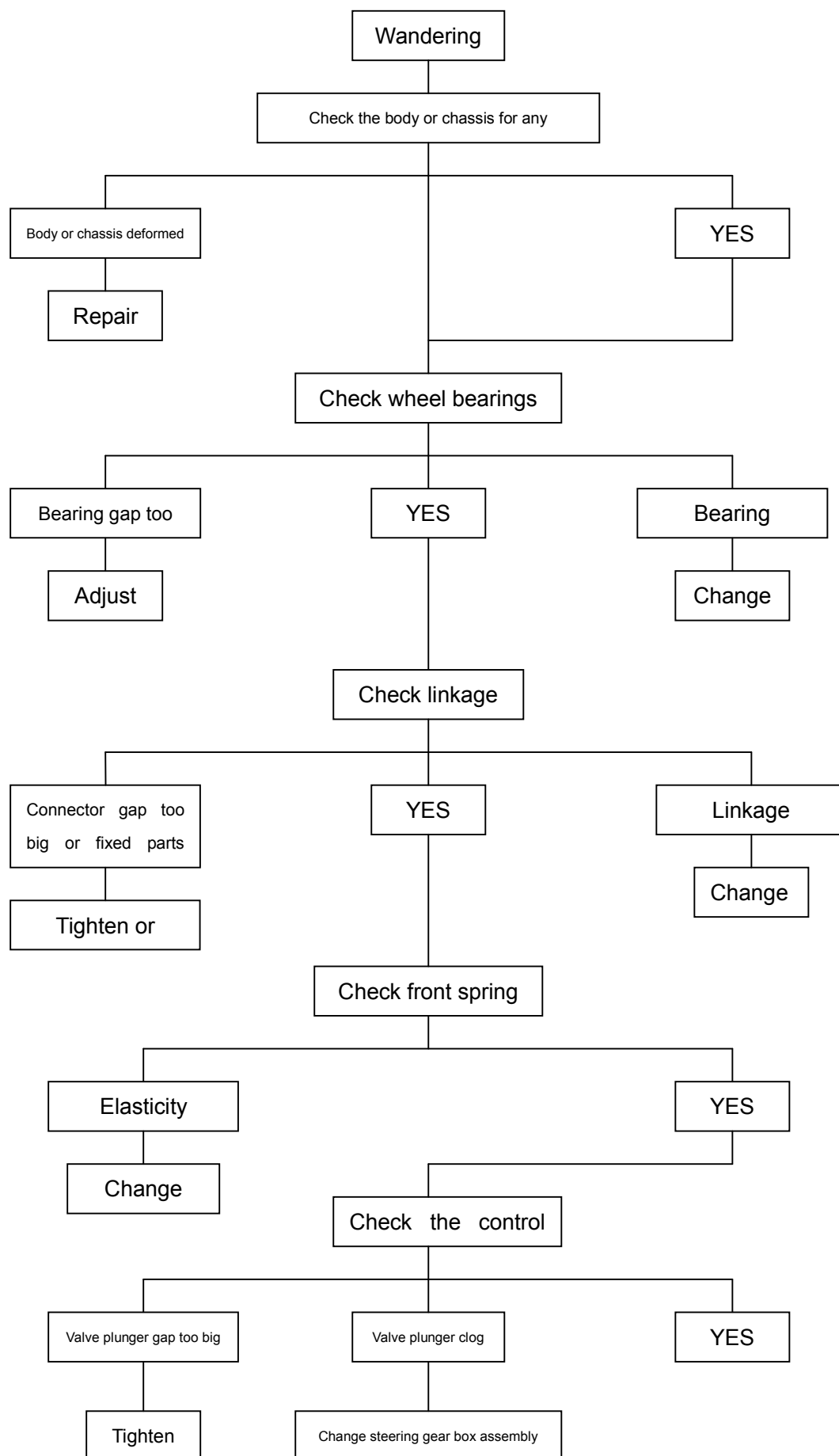
1. It is forbidden to mix oils of different types for use.
2. The oil to be filled must pass the filter strainer in the oil reservoir of the steering system.
3. Oil must be added up to between the two specified scale marks on the measuring scale in the oil reservoir (After the engine is started for 3-5 minutes, check the oil filling if it is between the specified scale marks. If over-filled, oil will overflow after the engine is started; if under-filled, the rotary blade pump will get burnt down).
4. In regular oil change, the oil reservoir and filter element inside shall be cleaned and washed, without any foreign matters allowed in. Take special care that no cotton fabric textiles are used (such as cotton yarn and emery cloth, etc) to wipe the parts in order not to have any of them taken into the system and cause failures.

Steering

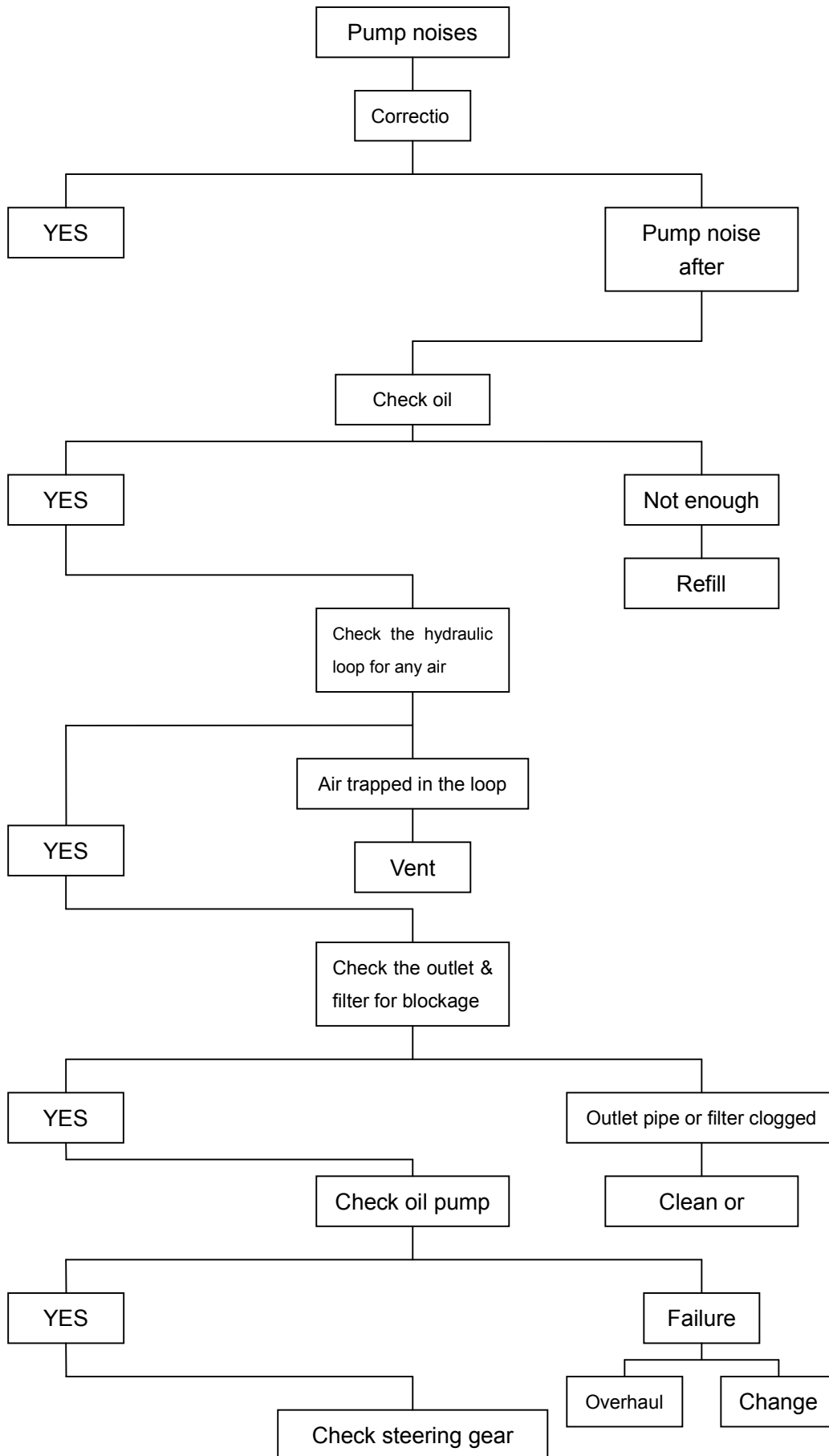
Trouble shooting



Steering



Steering



Brake

Brake and Control System

General

Technical parameters

Tightening torque

Front brake assembly

Rear brake assembly

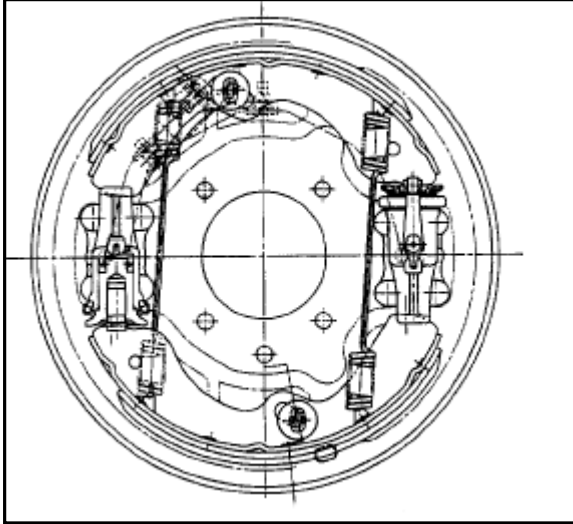
Parking brake assembly

Trouble shooting

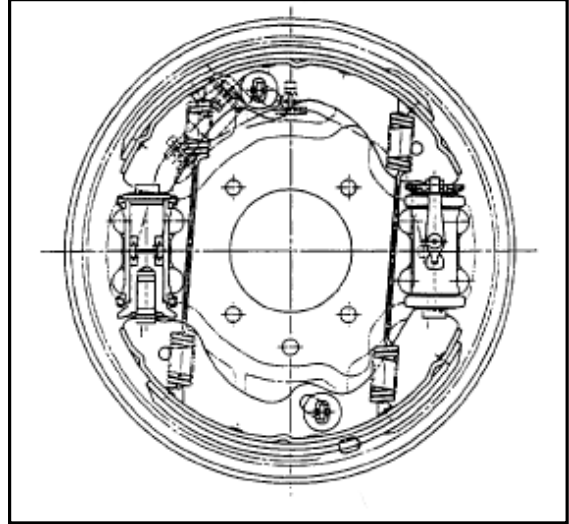
Brake

General

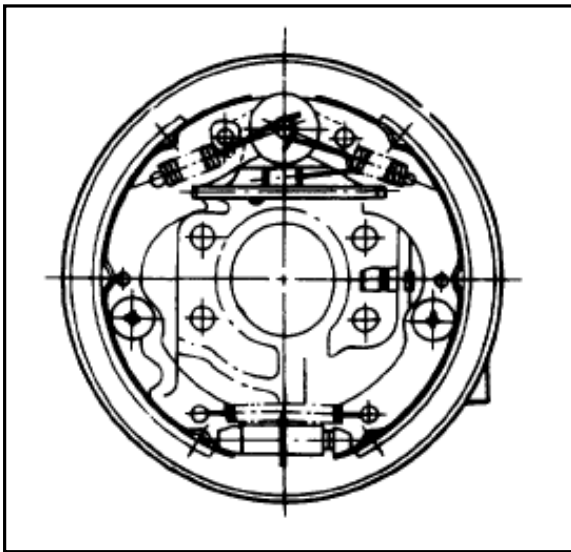
Front brake assembly



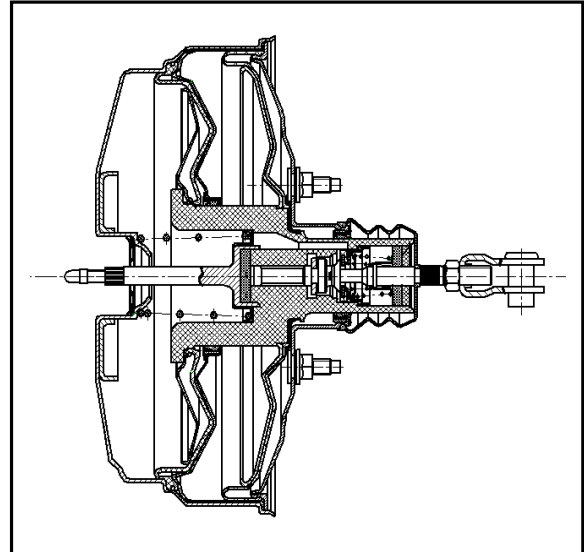
Rear brake assembly



Parking brake

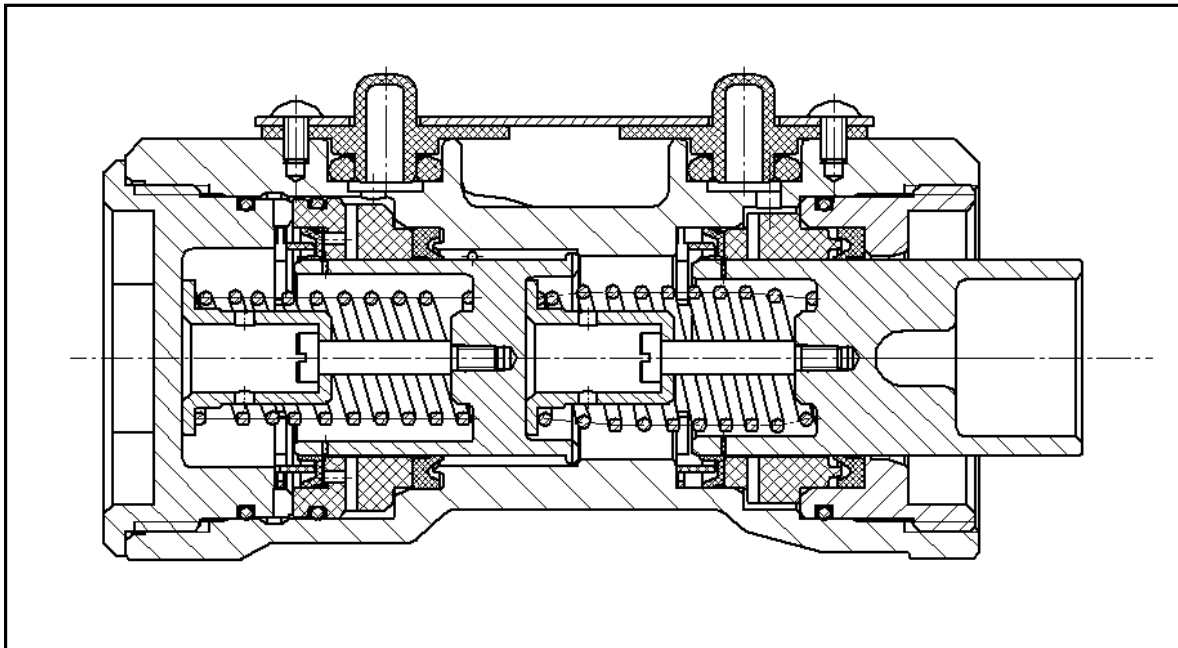


Vacuum booster

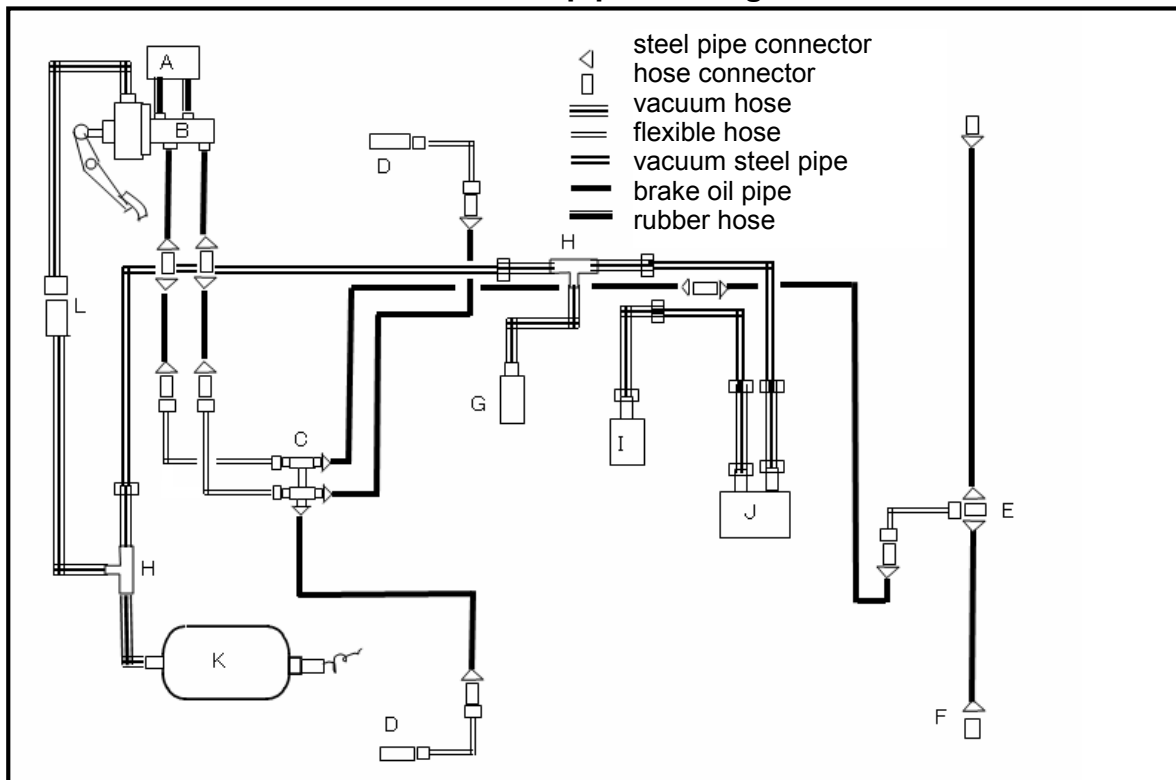


Brake

Brake master cylinder



Brake pipe drawing



A、oil pot; B、vacuum booster, with serial master brake cylinder assembly; C、5-way connector; D、front wheel cylinder; E、oil pipe tee; F、rear wheel cylinder; G、vacuum pump; H、vacuum pipe tee; I、venting aux. brake; J、venting aux. brake solenoid valve; K、vacuum barrel; L、vacuum pipe connecting plate.

Brake

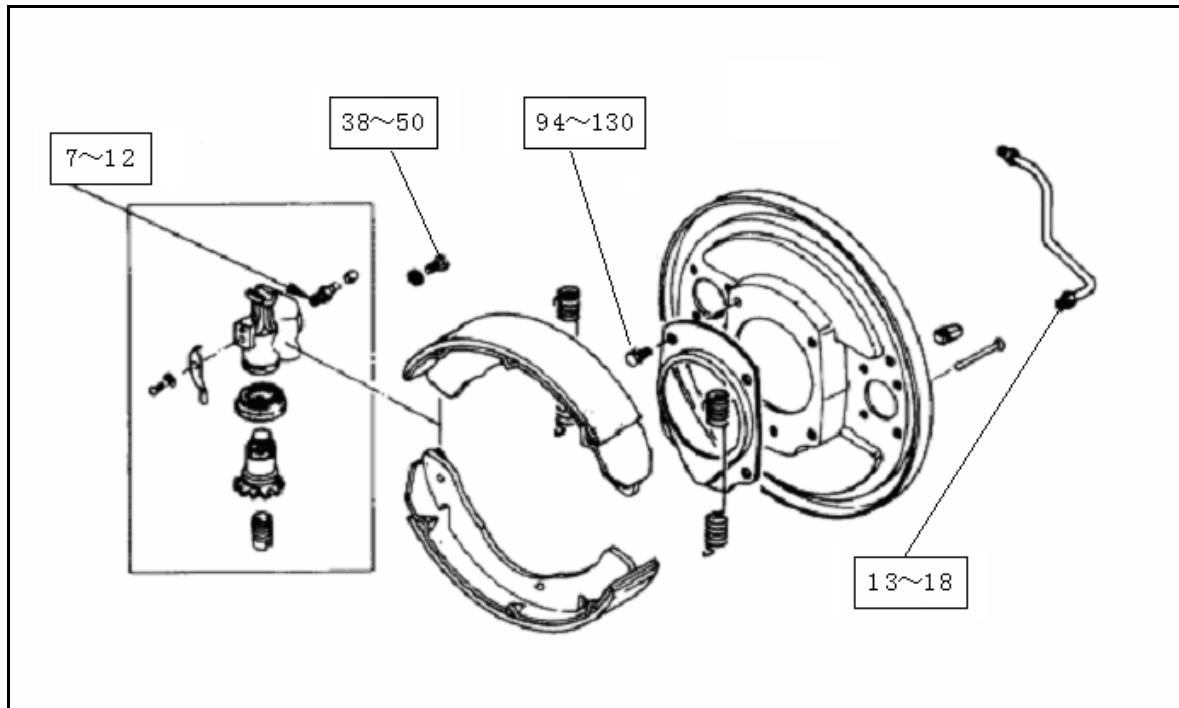
Brake Specifications

Service brake			
		Front	Rear
Type		Dual leading shoe	Duo duplex shoe
Brake drum ID (mm)		320	320
Friction plate size	Length (mm)	307	307
	Width (mm)	75	75
	Thickness (mm)	8.1	8.1
Brake shoe return spring	Free length (mm)	208.0	208.0
	Design length (mm)	224.0	224.0
	Design load (N)	225~275	225~275
Clearance between friction plate and brake shoe (mm)		Below 0.05 at rivet, below 0.2 at side, below 0.3 at end face	
Brake master cylinder			
ID (mm)		31.75	
Piston stroke (front + rear) (mm)		18+15.5	
Wheel cylinder			
		Front	Rear
ID (mm)		30.16	30.16
Parking brake			
Brake drum	ID (mm)	178	
Friction plate size	Length (mm)	193	
	Width (mm)	35	
	Thickness (mm)	5.0	
Brake shoe return spring	Spring serial No.	First	Second
	Free length (mm)	62	49
	Design length (mm)	70	57
	Design load (N)	108~132	90~110
Vacuum booster			
Diaphragm diameter (mm)		228+203	
Stroke (mm)		35	
Pedal			
Free stroke (mm)		5~8	

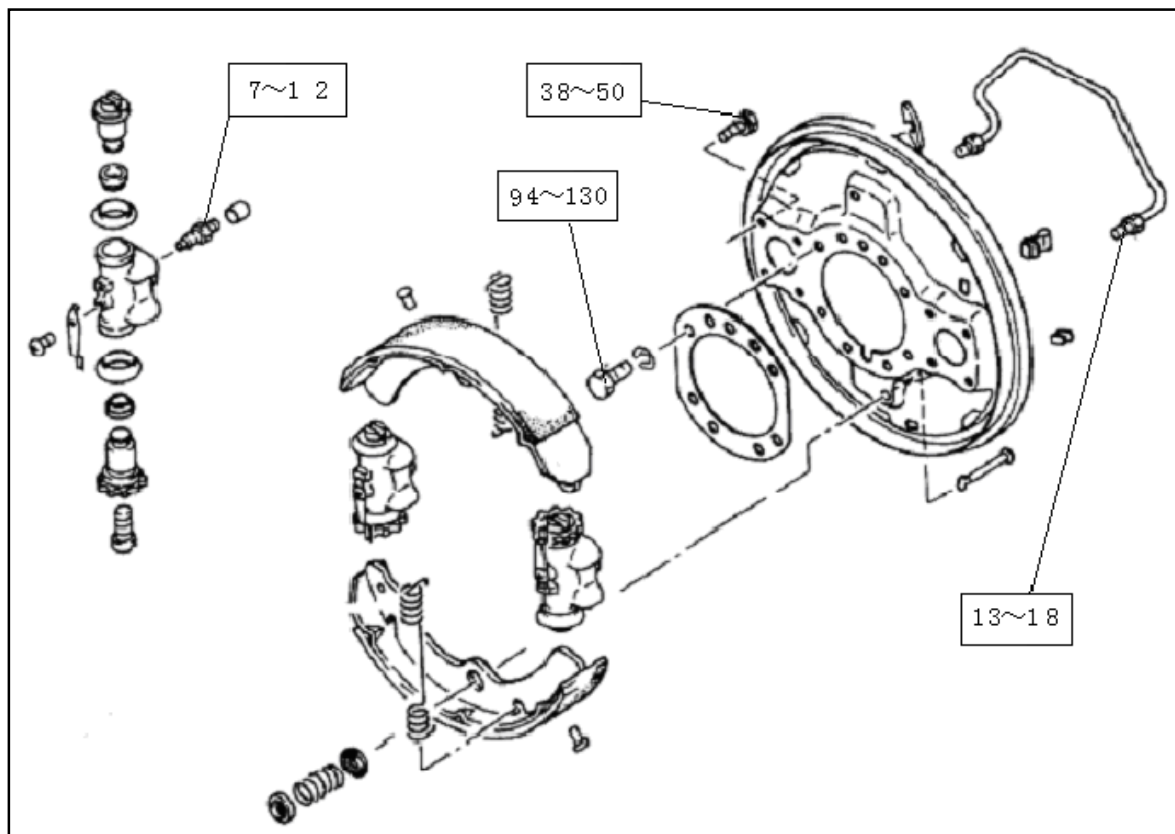
Brake

Fixed torque (N·m)

Front brake assembly (two leading shoe)



Rear brake assembly (two leading shoe)

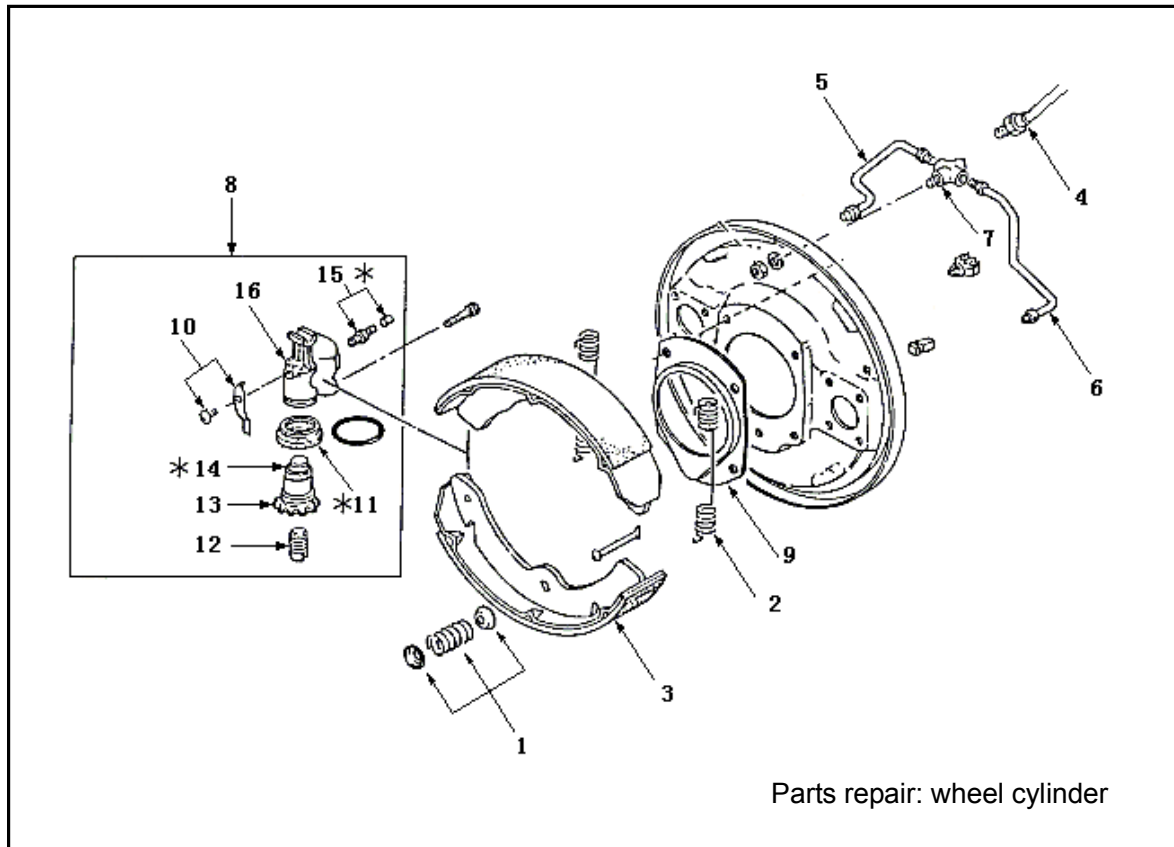


Brake

Front brake assembly (two leading shoe)



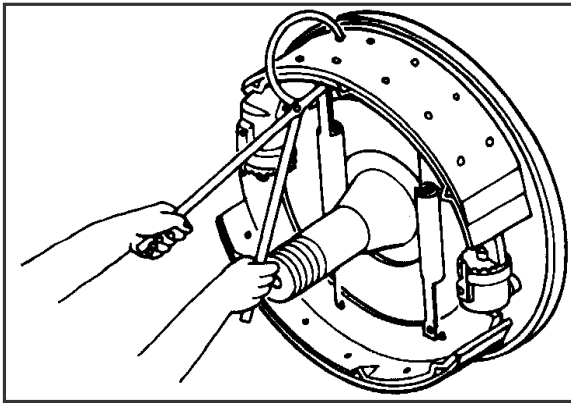
Disassembling



Disassembling sequence

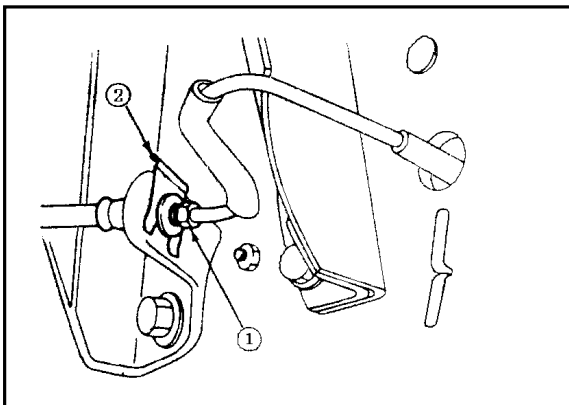
- | | |
|--|--------------------------------|
| 1. brake shoe spring rod, hold down spring and spring holder | 9.oil cover |
| 2. brake shoe return spring | 10.locking claw |
| 3. brake shoe assembly | 11.shield |
| 4. brake hose | 12.piston |
| 5. brake connecting pipe | 13.adjusting screw |
| 6. brake connecting pipe | 14.piston cup |
| 7. tee connector assembly | 15.venting screw and its cover |
| 8. wheel cylinder assembly | 16.wheel cylinder body |

Brake



Important operation

2、 Remove the return spring of the brake shoe.



4、 Hose

Loosen the connecting nut ①, and take down the clip ② and the hose.

- brake drum
- brake friction plate
- wheel cylinder body
- piston
- piston cup
- return spring

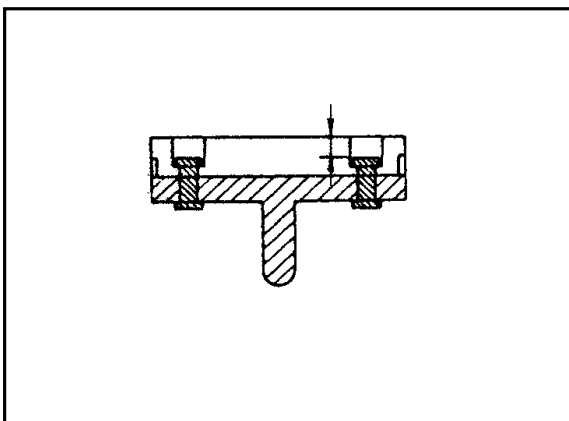


Inspection and repair

Repair or replace the parts if they are found worn out, damaged or with other problems after inspection.

Visual inspection

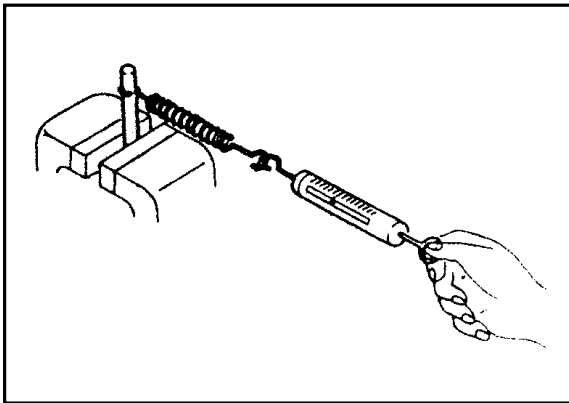
Check the following parts for any abrasion, corrosion, scratches or other problems.



Thickness of brake friction plates

Max. thickness: 1.0mm

Brake

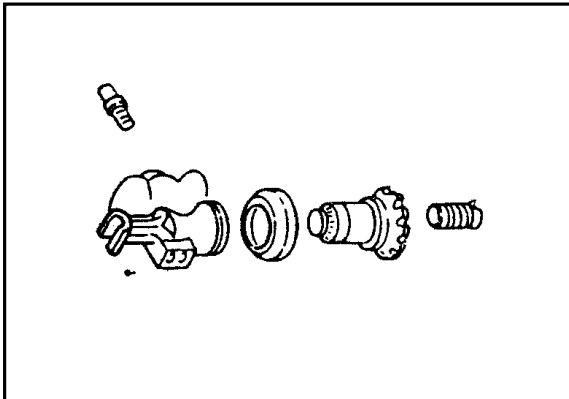


Return spring

Free length: 208.0mm

Design length: 224.0mm

Design load: 225~275N



Washing wheel cylinder parts

The wheel cylinder parts must be washed with clean brake fluid.



Do not use any mineral based cleaning solution like gasoline, kerosene, and acetone, paint thinner, CO₄, etc.



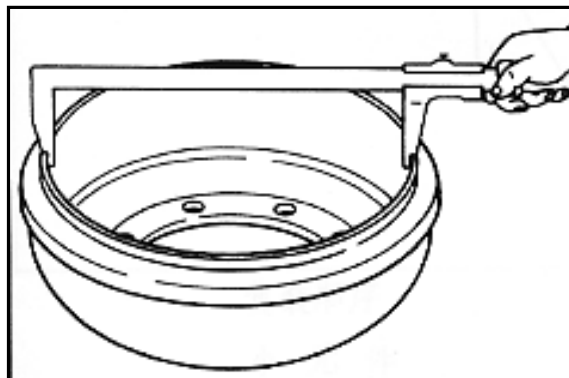
Piston cup

Check the piston cup for any abrasion, deformation, damage or other problems.

Clearance between wheel cylinder and piston



Max: 0.15mm.



Brake drum

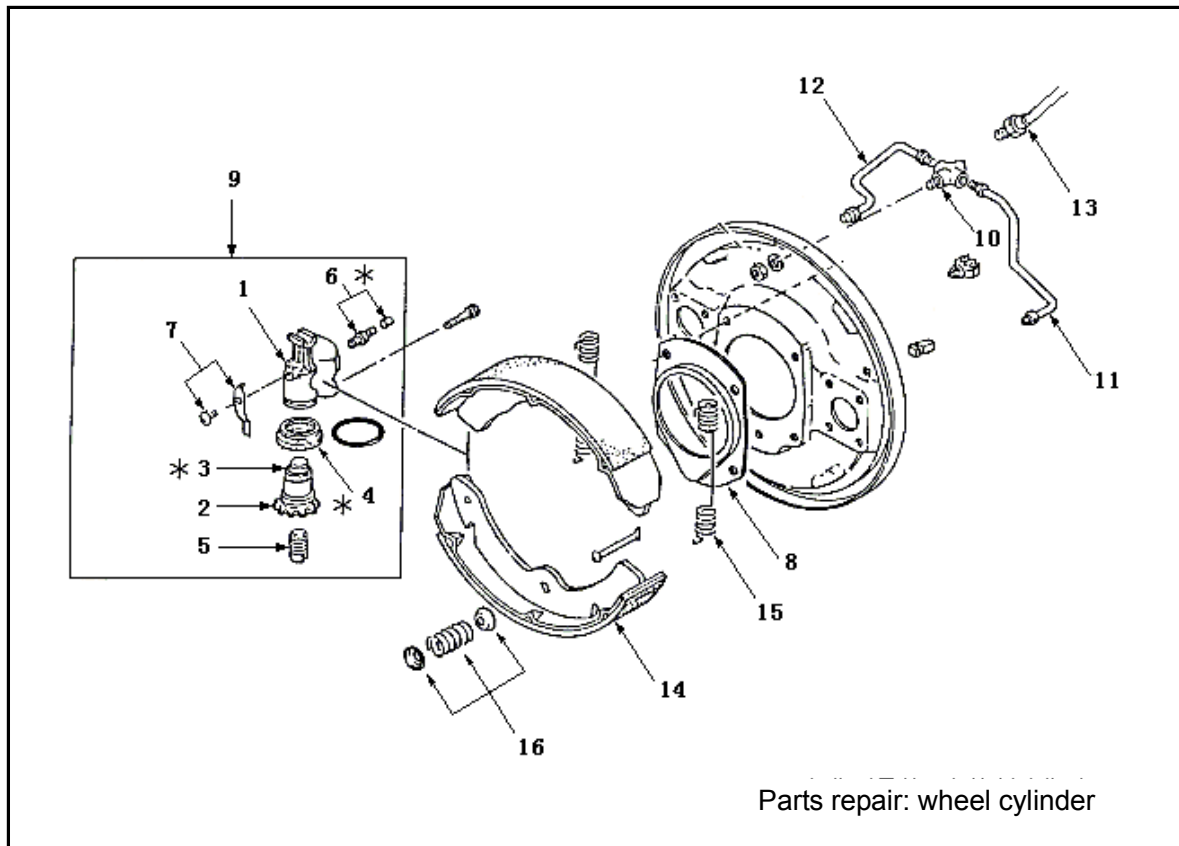
mm

	Standard	Maximum
ID	320	321.5
Out-of-roundness	≤0.13	

Brake



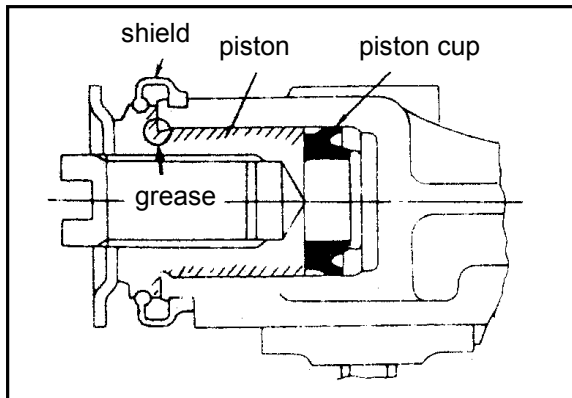
Reassembling



Reassembling sequence

- | | |
|--------------------------------|--|
| 1. wheel cylinder body | 9. wheel cylinder assembly |
| 2. piston brake shoe | 10. tee connector assembly |
| 3. piston cup | 11. brake connecting pipe |
| 4. shield | 12. brake connecting pipe |
| 5. adjusting screw | 13. brake hose |
| 6. venting screw and its cover | 14. brake shoe assembly |
| 7. locking claw | 15. return spring |
| 8. oil cover | 16. brake shoe spring rod, hold down spring and its holder |

Brake



Important operation



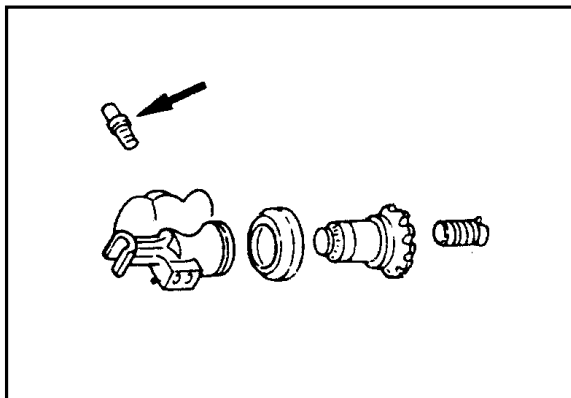
3. Piston cup

When fixing the piston cup, have its butterfly side facing the cylinder. First, apply clean brake fluid to the piston cup, take care not to damage the cup lip. Apply rubber grease to the piston shoulder.



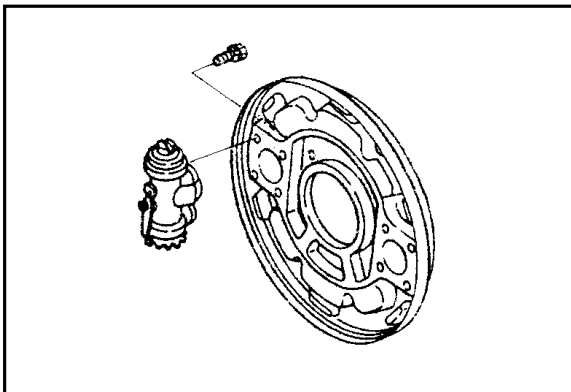
4. Shield

To prevent water entry, apply clean brake fluid to the shield inner surface.



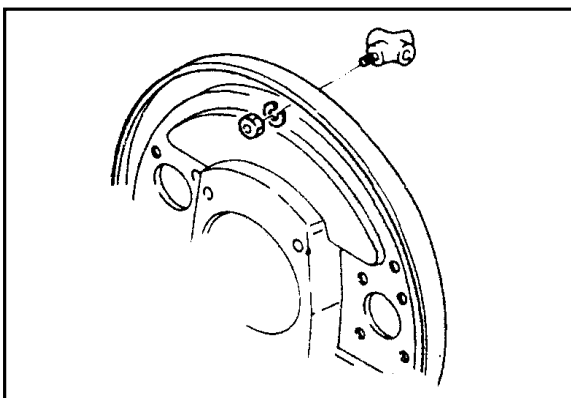
6. Venting screw

Tightening torque: 7~12N·m



9. Wheel cylinder assembly

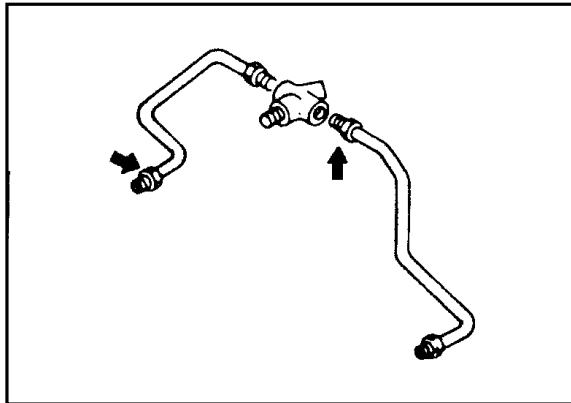
Tightening torque: 38~50N·m



10. Tee connector assembly

Tightening torque: 14~23N·m

Brake

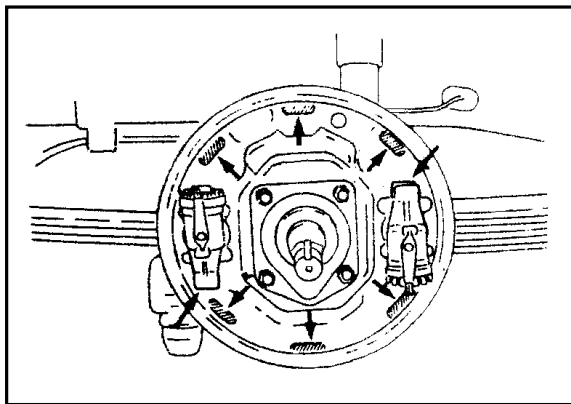
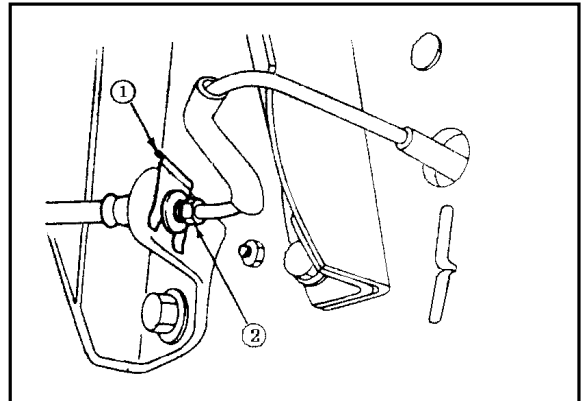


11,12. Tee connector assembly

Tightening torque: 13~19N·m

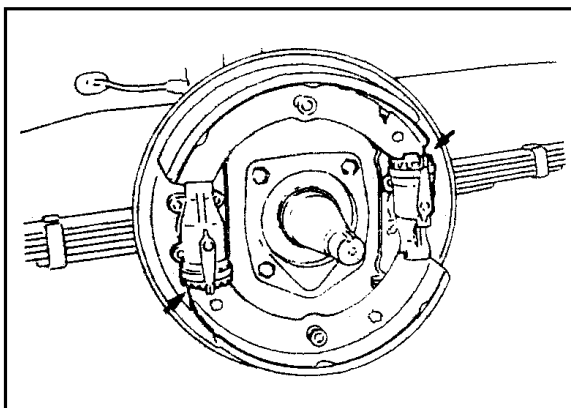
13. Hose

Fix the hose clip ① on the bracket, and tighten the connecting nut ②.



14. Brake shoe

Apply a thin layer of heat resistance grease to the brake shoe, wheel cylinder and the inner surface of the back plate.



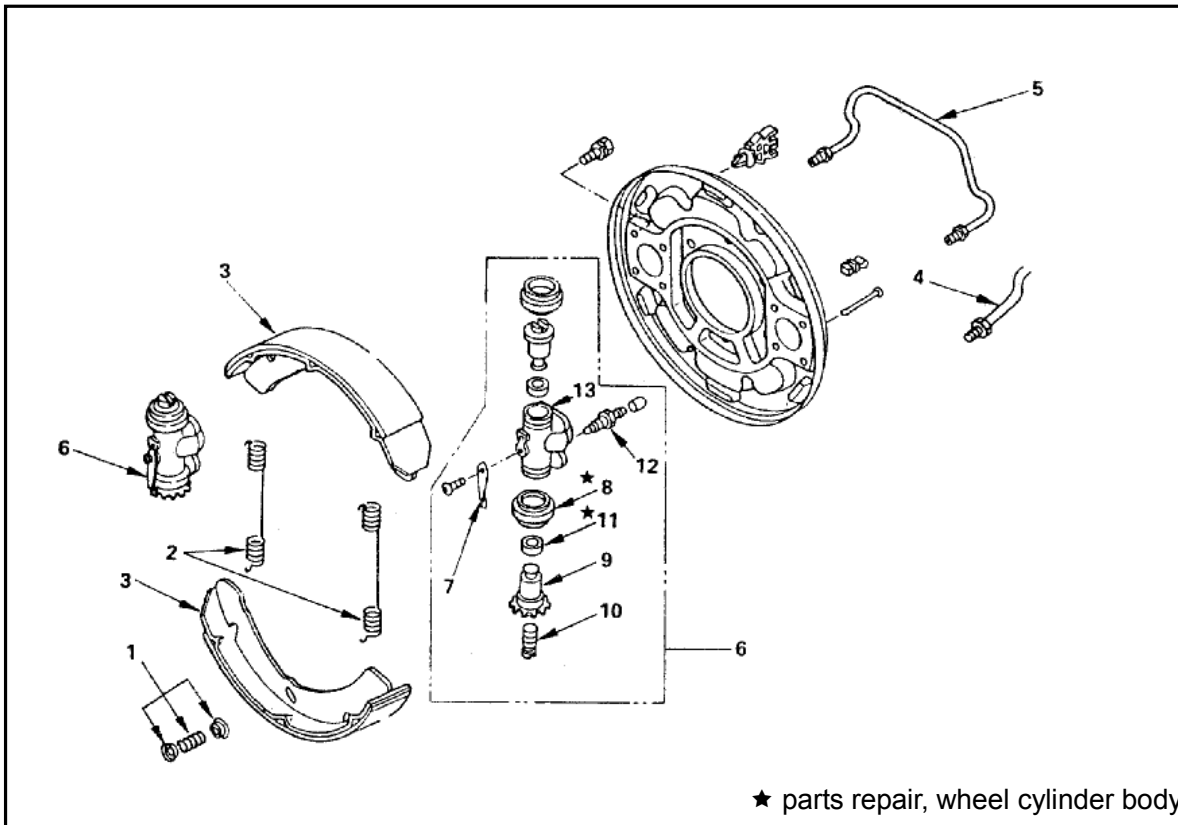
When fixing the brake shoes, have their tip sides facing the wheel cylinder and the adjuster.

Brake

Rear brake assembly (two leading shoe)



Disassembling



★ parts repair, wheel cylinder body

Disassembling sequence

- | | |
|--|--------------------------------|
| 1. brake shoe spring rod, hold down spring and spring holder | 8.shield |
| 2. brake shoe return spring | 9.piston |
| 3. brake shoe assembly | 10.adjusting screw |
| 4. brake connecting pipe | 11.piston cup |
| 5. brake connecting pipe | 12.venting screw and its cover |
| 6. wheel cylinder assembly | 13.wheel cylinder body |
| 7. locking claw | |

Brake



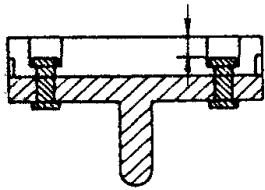
Inspection and repair

Repair or replace the parts if they are found worn out, damaged or with other problems after check.

- brake drum
- brake friction plate
- wheel cylinder body
- piston
- piston cup
- return spring

Visual inspection

Check the following parts for any abrasion, corrosion, scratches or other problems.



Thickness of brake shoe friction plate

Max. thickness: 1.0mm

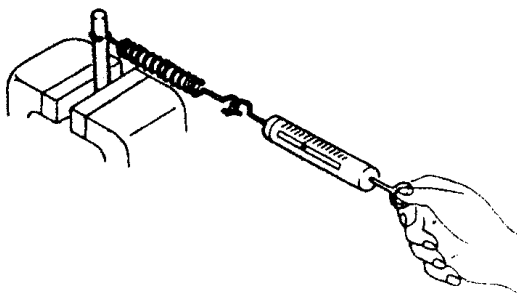


Return spring

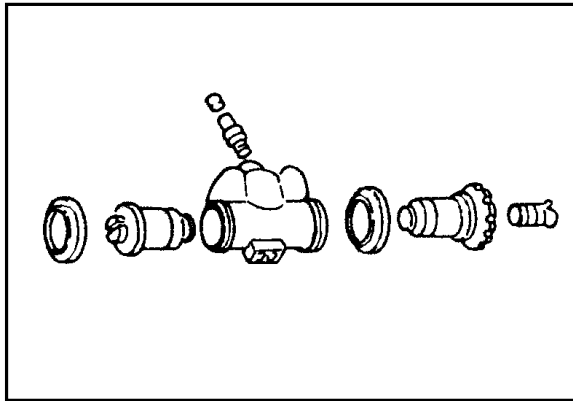
Free length: 208.0mm

Design length: 224.0mm

Design load: 225~275N



Brake



Washing wheel cylinder parts

The wheel cylinder parts must be washed and with clean brake fluid.

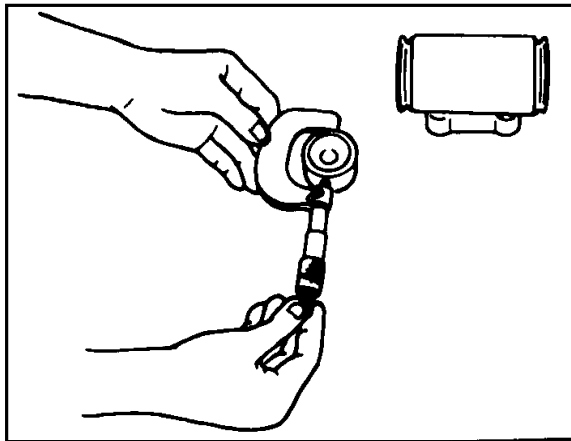


Do not use any mineral based cleaning solution like gasoline, kerosene, and acetone, paint thinner, CO₄, etc.



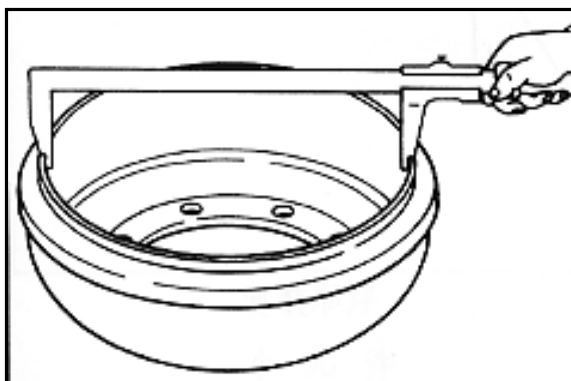
Piston cup

Check the piston cup for any abrasion, deformation, damage or other problems.



Clearance between wheel cylinder and piston

Max: 0.15mm.



Brake drum

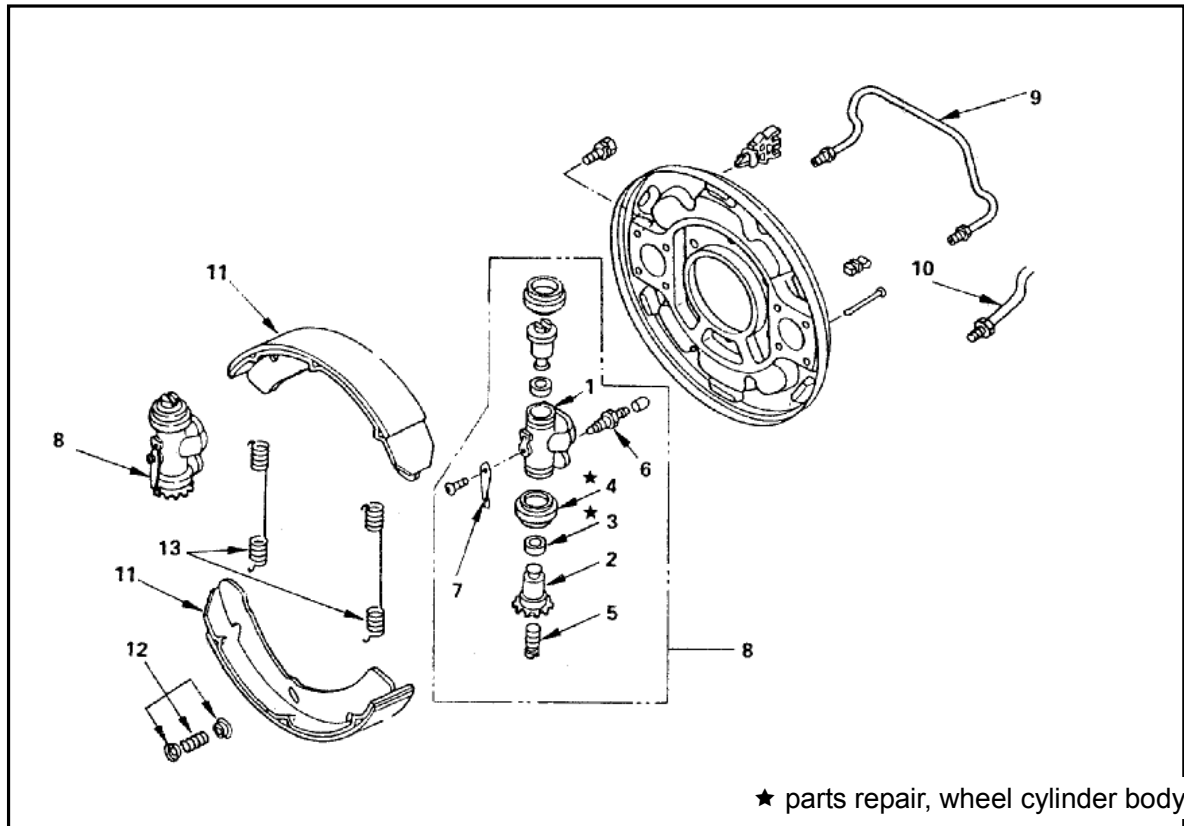
mm

	Standard	Limits
ID	320	321.5
Out-of-roundness	≤0.13	

Brake



Reassembling

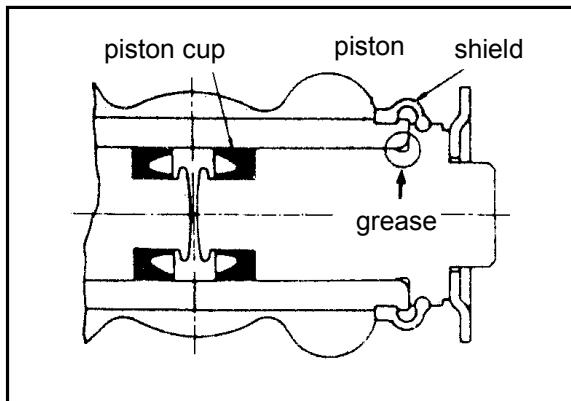


★ parts repair, wheel cylinder body

Reassembling sequence

- | | |
|--|--|
| 1. wheel cylinder body | 8. wheel cylinder assembly |
| 2. piston | 9. piston brake connecting pipe |
| 3. piston cup | 10. brake connecting pipe |
| 4. shield | 11. brake shoe assembly |
| 5. adjusting screw brake connecting pipe | 12. brake shoe spring rod, hold down
spring and spring holder |
| 6. venting screw and its cover | 13. brake shoe return spring |
| 7. locking claw | |

Brake



Important operation



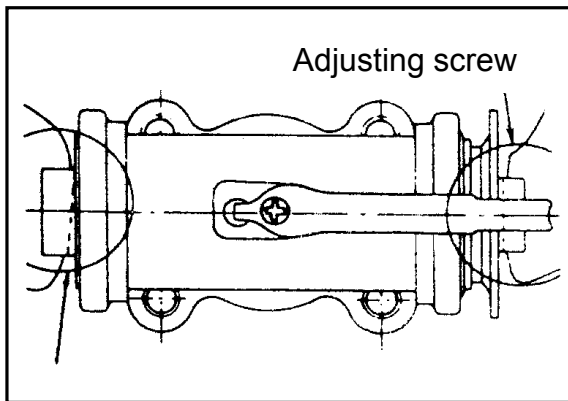
3. Piston cup

When fixing the piston cup, have its butterfly side facing the cylinder. First, apply clean brake fluid to the piston cup, then insert the cup. Take care not to damage the cup lip. Apply rubber grease to the piston shoulder.



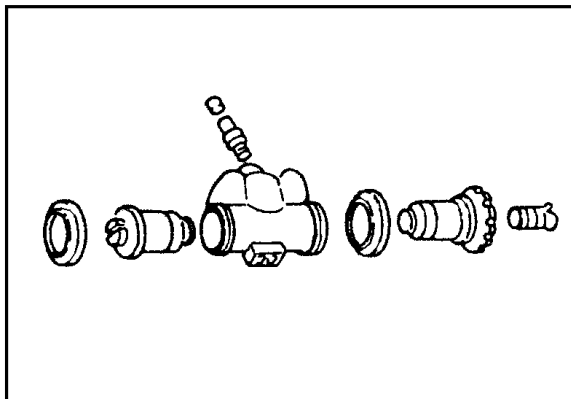
4. Shield

To prevent water entry, apply clean brake fluid to the shield inner surface.



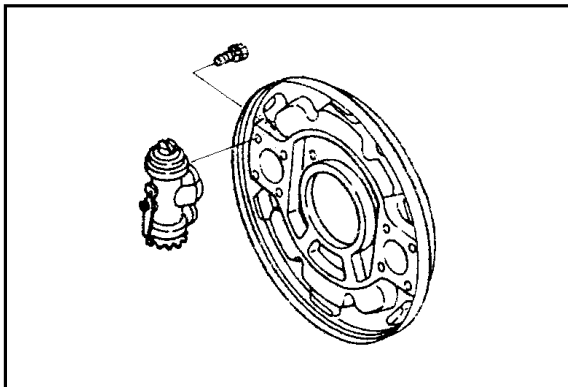
5. Adjusting screw

When fixing the wheel cylinder adjuster, have the shallow slot side face the outside.



6 Venting screw

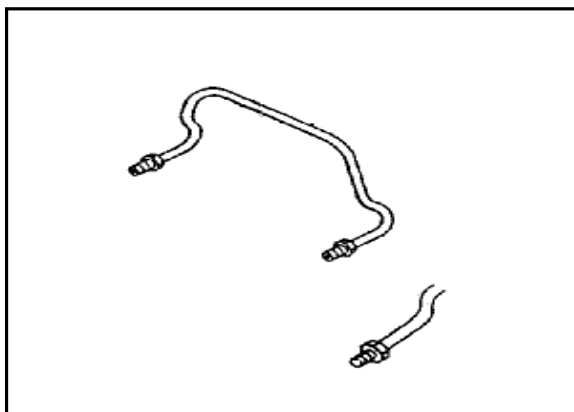
Tightening torque 7~12N·m



9. Wheel cylinder assembly

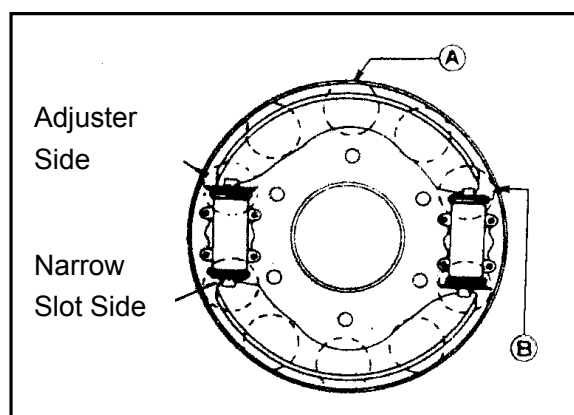
Tightening torque: 38~50N·m

Brake



9, 10. Brake connecting pipe

Tightening torque: 13~19N·m



11. Brake shoe

Apply a thin layer of heat resistant grease to the back plate A between the brake shoe and wheel cylinder as well as the inner part B.



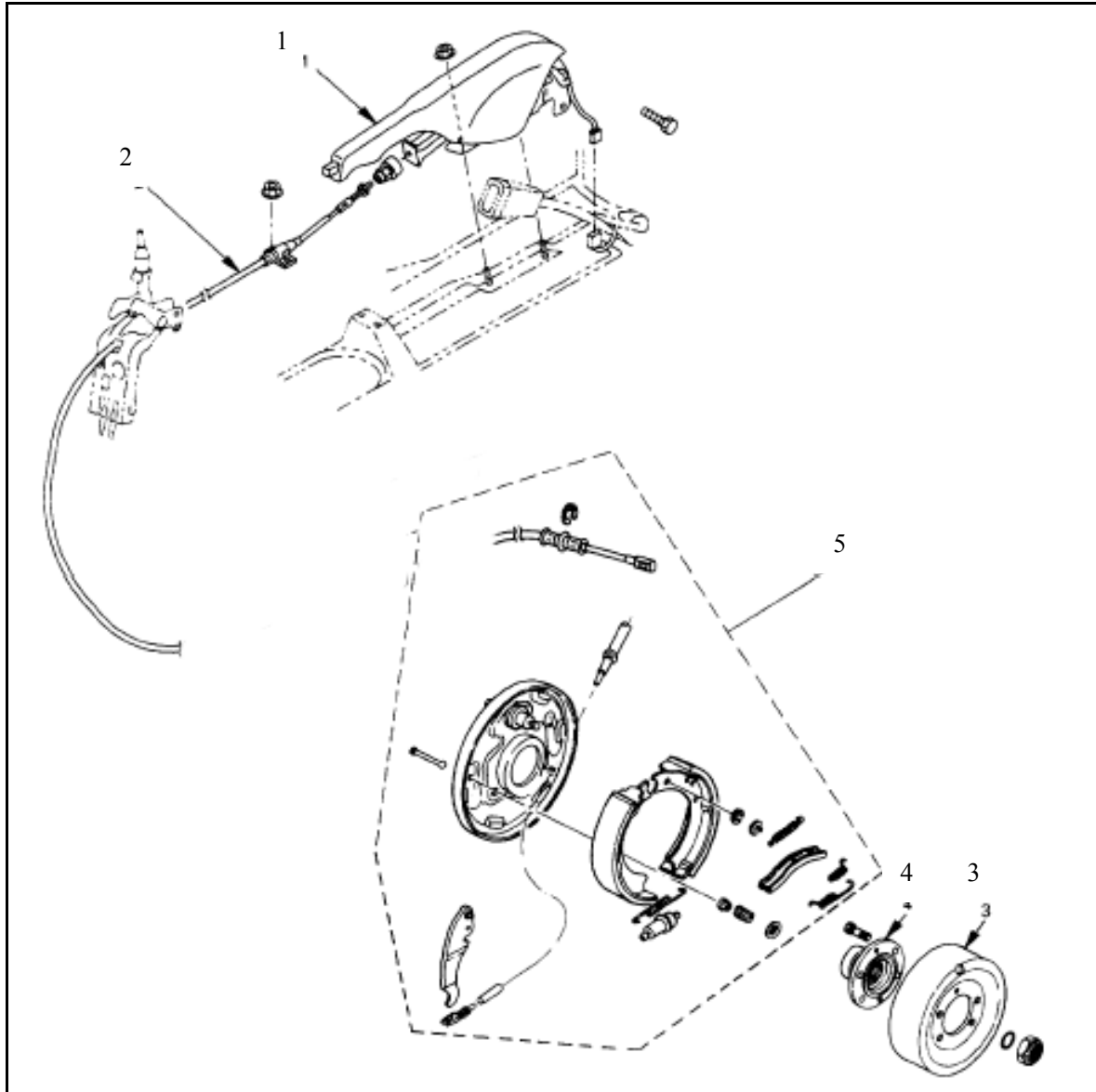
When fixing the brake shoes, have the tips face the wheel cylinder and adjuster.

Brake

Parking brake



Disassembling



Disassembling sequence

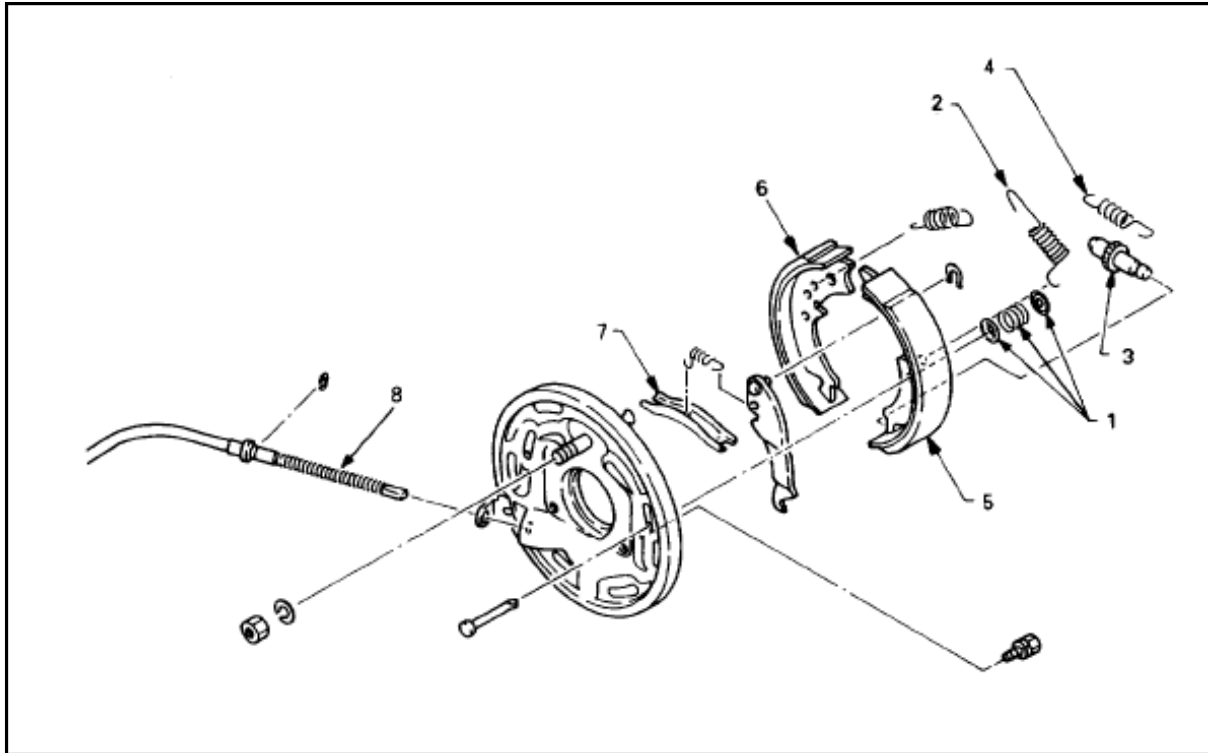
1. Parking brake handle
2. Parking brake control cable
3. Parking brake drum
4. Flange
5. Parking brake

Brake

Parking brake

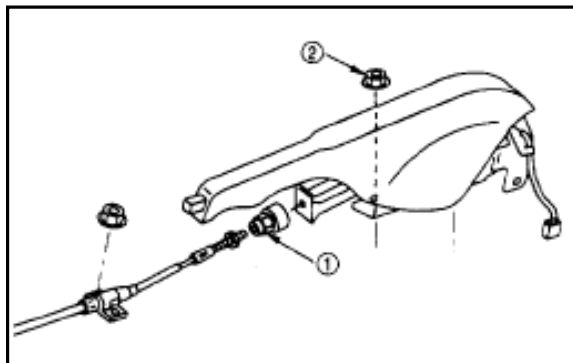


Disassembling



Disassembling sequence

1. pull-rod spring 2. return spring 3. adjuster 4. adjusting spring 5. 2nd brake shoe and lever assembly 6. 1st brake shoe assembly 7. hold down rod 8. control cable assembly



Disassembling steps

Loosen the adjusting nut①, and remove the control cable from the handle.

Loosen the nut② before removing the handle.

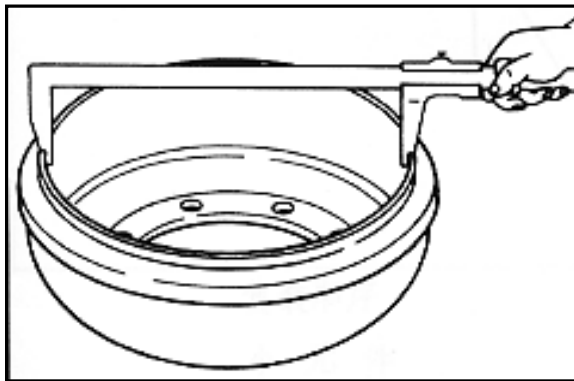
Brake



Inspection and repair

Repair or replace the parts if they are found worn out, damaged or with other problems after check.

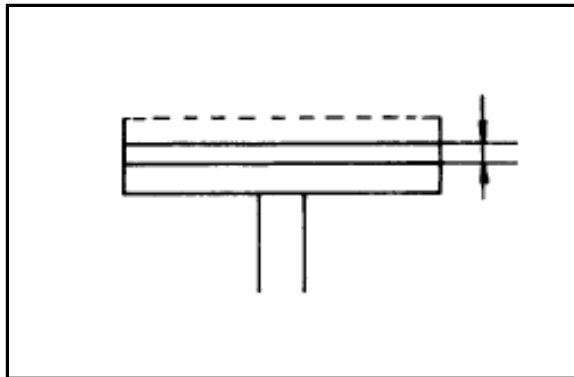
- brake drum
- brake friction plate
- return spring
- strut
- control cable
- control handle



Brake drum

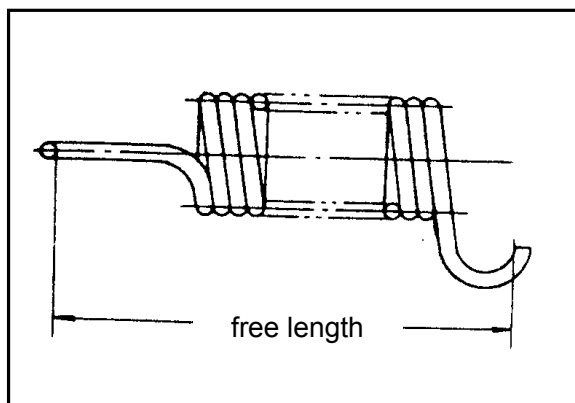
mm

	Standard	Limit
ID	178	179
Out-of-roundness	≤0.13	



Thickness of brake friction plates

Measure the thickness of brake lining by a vernier caliper. If it is less than 1mm thick, the brake shoe assembly should be changed.



Return spring

Free length: 62.1mm

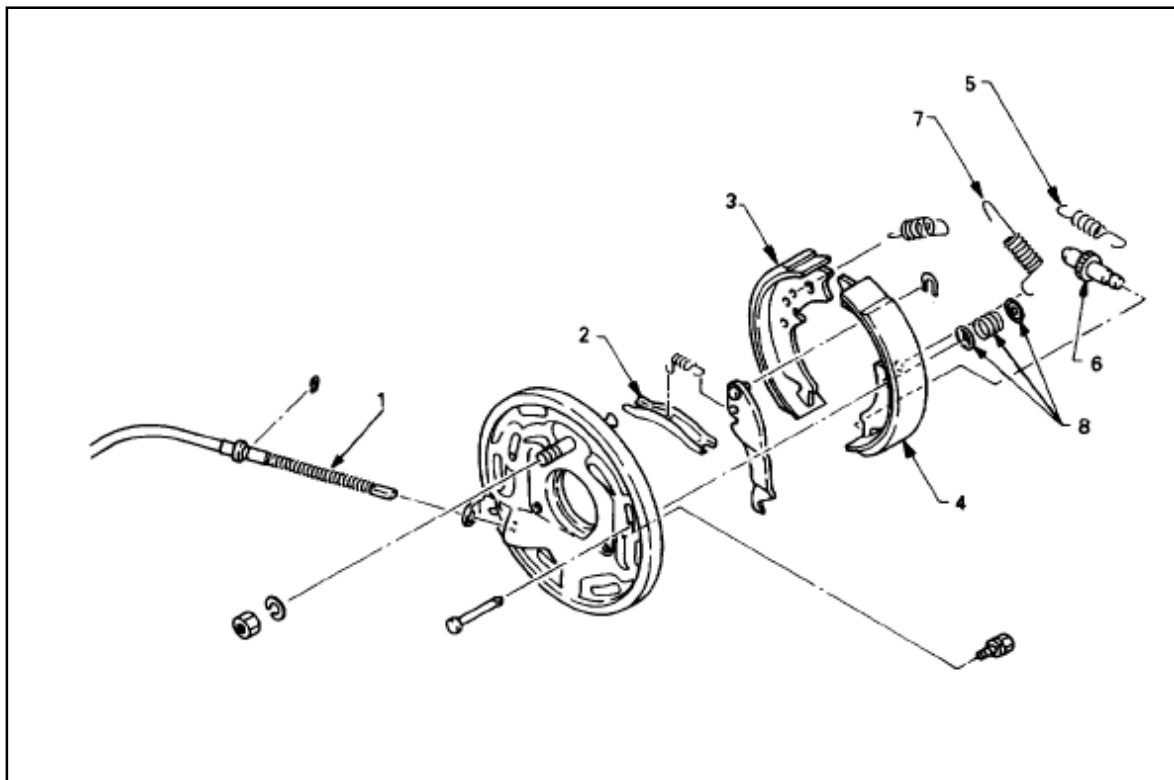
Design length: 66.9mm

Design load: 54~66N

Brake

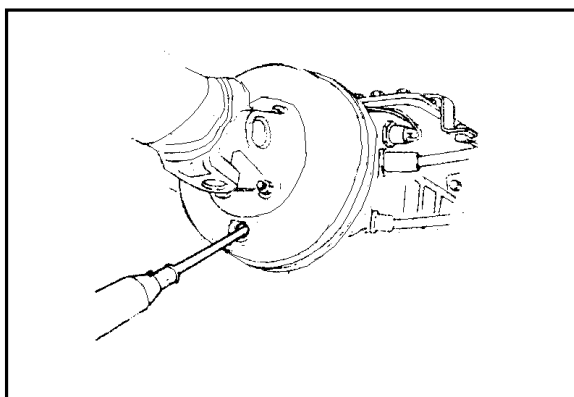


Reassembling



Reassembling sequence

1. control cable assembly 2. push rod 3. 1st brake shoe assembly 4. 2nd brake shoe and lever assembly 5. adjusting spring 6. adjuster 7. return spring 8. pull-rod spring



Adjustment of parking brake

Brake friction plate adjustment

Move the adjuster upward with a screw driver, until the brake drum is locked. And then move the adjuster back for about 25 notches. The clearance between the brake drum and friction plates is about 0.5mm by now.

Adjustment of the parking brake handle travel

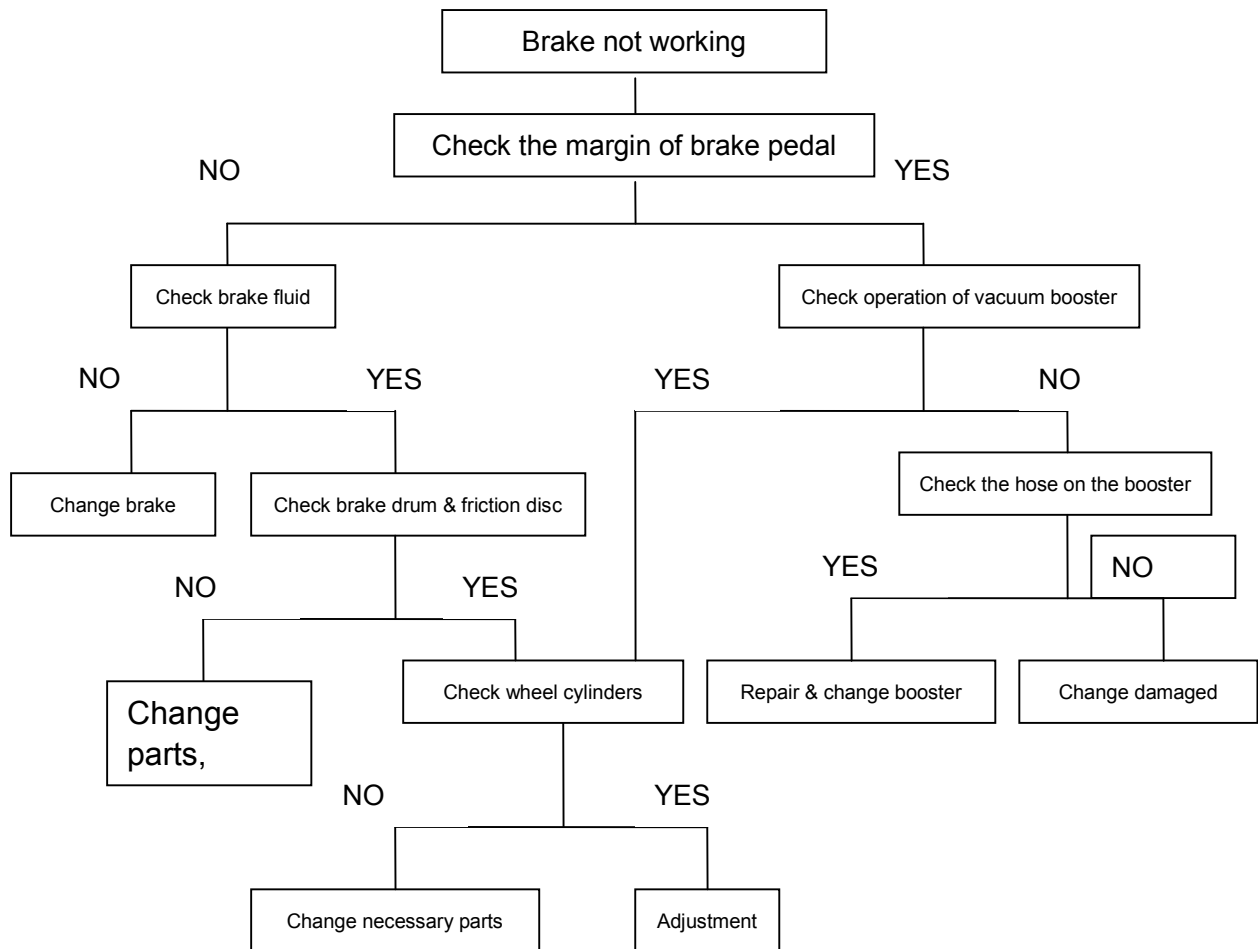
Pull up the parking brake handle to the end, count the number of the gears in the brake lever. If the parking brake handle is pulled with a force of 300N, its travel covers 9 to 14 notches. Adjust the parking brake if necessary.

Before adjustment of the parking brake, make sure that the clearance of the rear brake shoe is already adjusted.

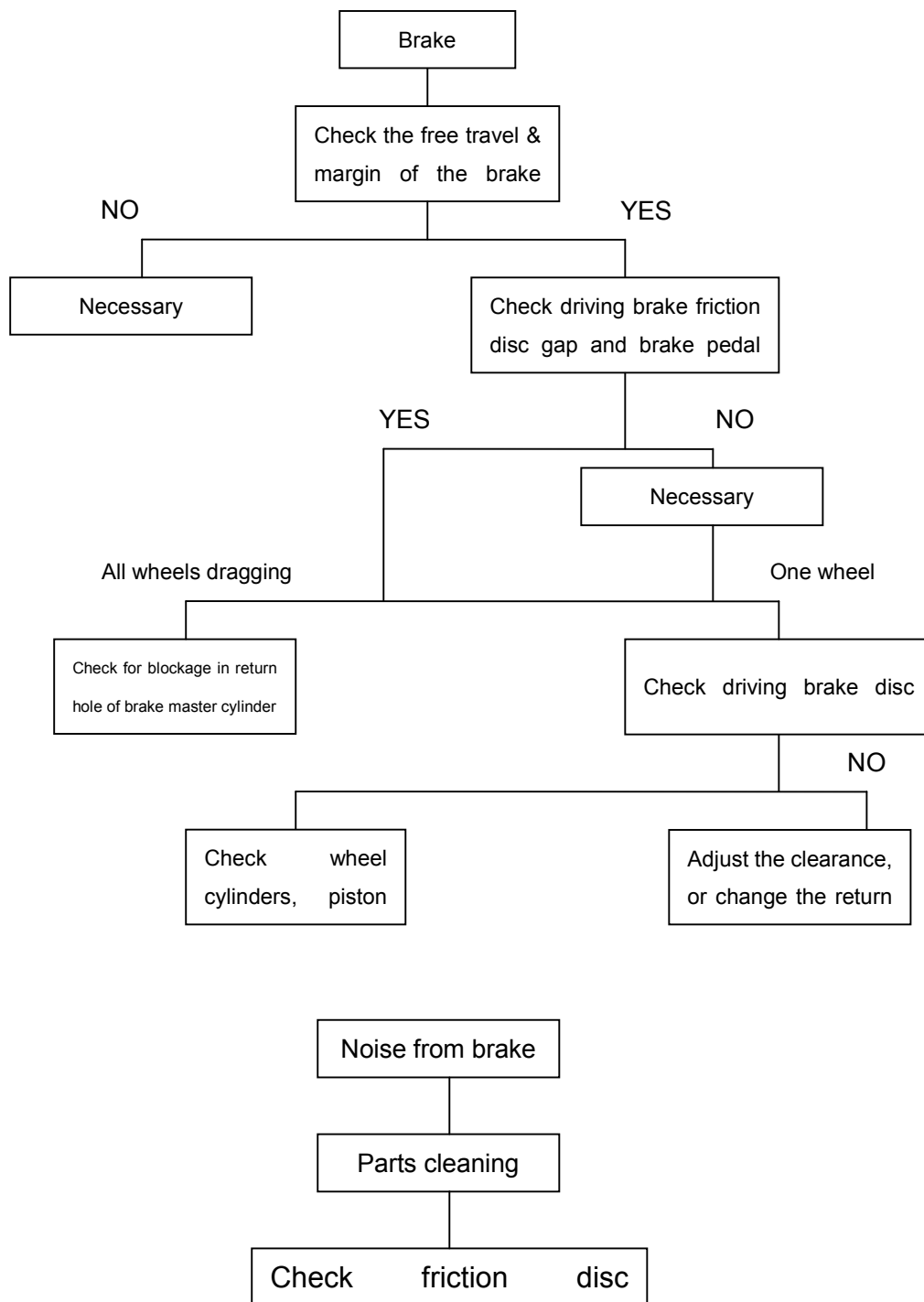
1. Loosen the locknut, rotate the adjuster to adjust the travel distance.
2. Tighten the locknut.

Brake

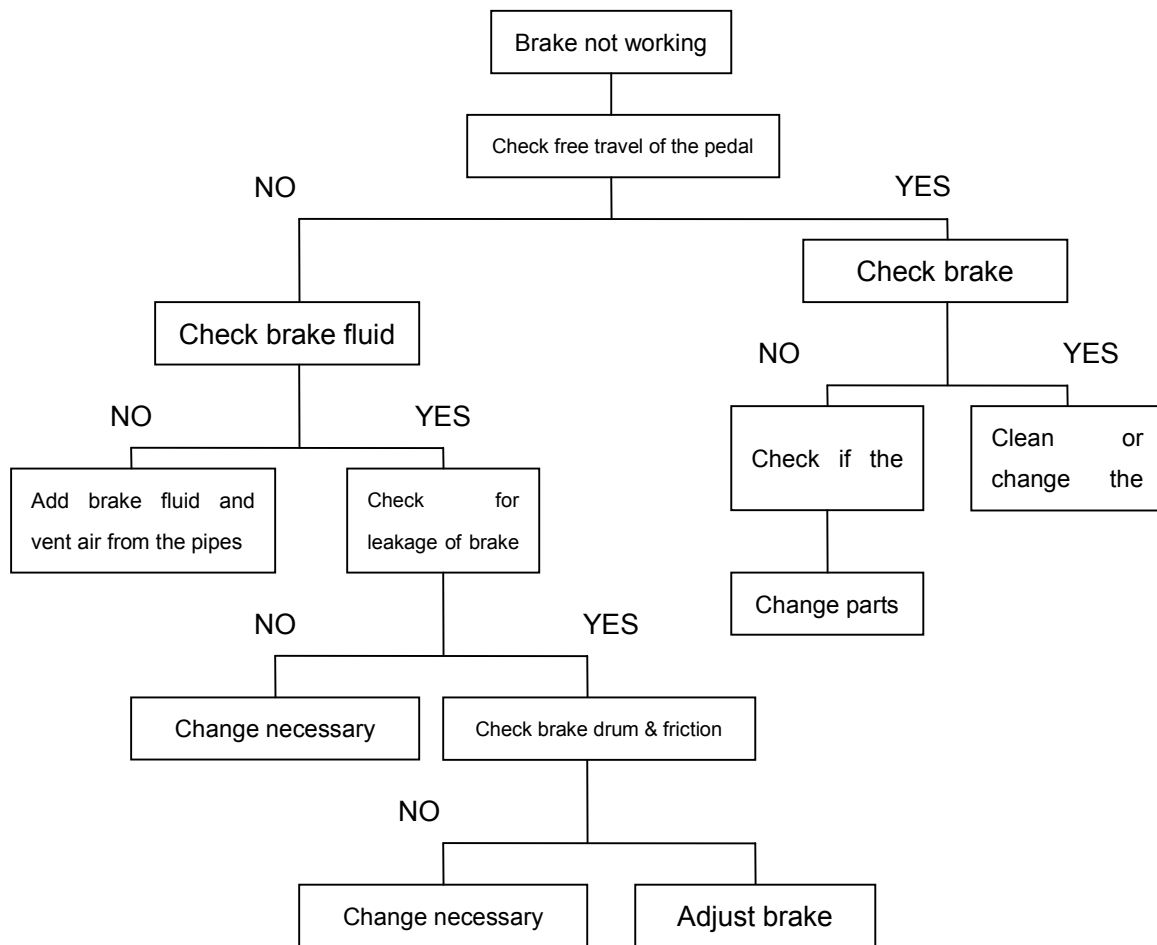
Trouble shooting



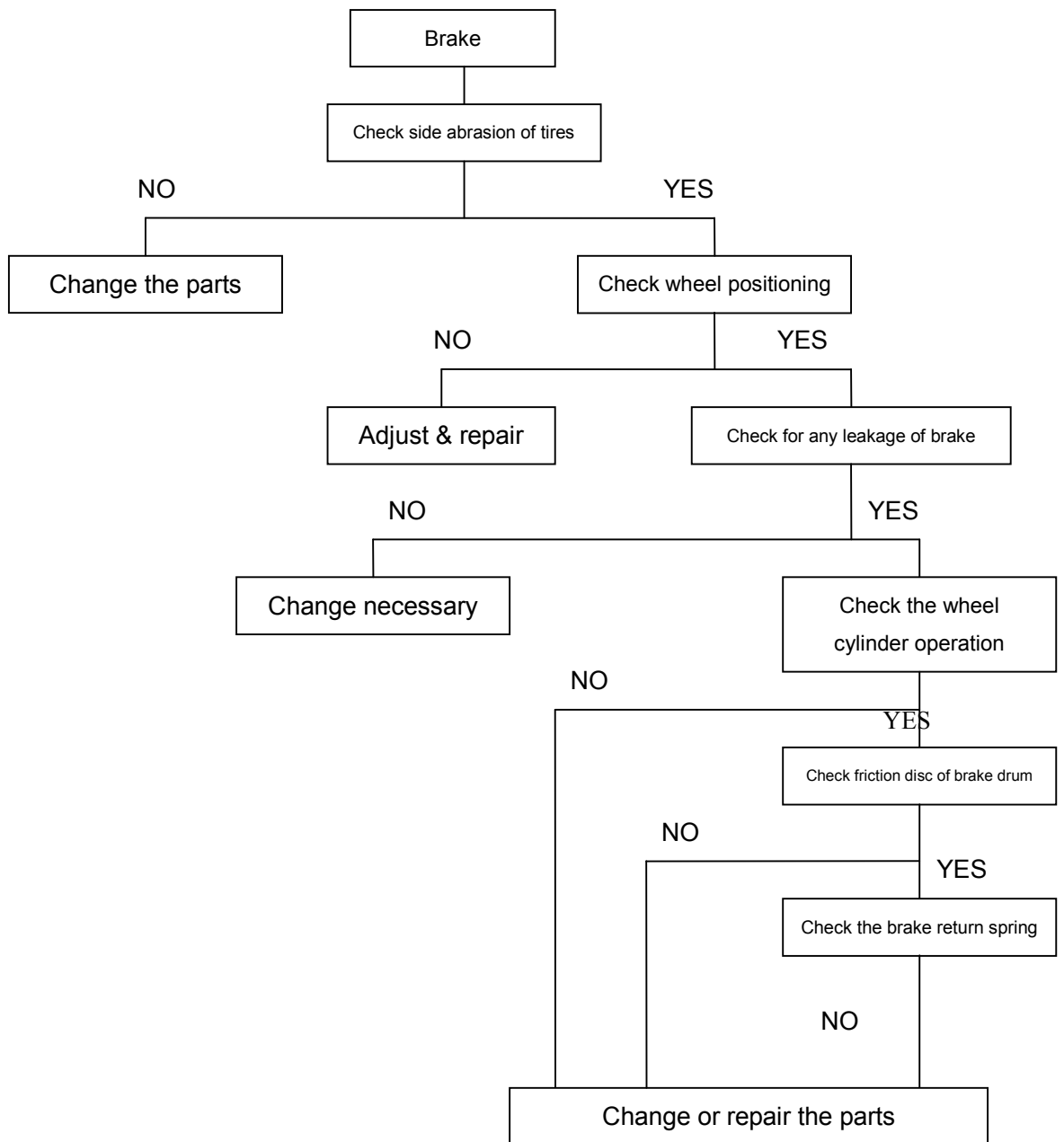
Brake



Brake



Brake



Electrical System

Electrical System

General

I . Operation table

II. Electric diagram identification

1. Wire code identification:

2 . Electrical component identification:

III .Electrical designations and usages of the complete vehicle

1. Battery
2. Starter
3. Generator
4. Speed sensor
5. Electric preheating
6. Fuel cutoff solenoid valve
7. Wiper
- 8 .Washer
9. Headlamp
- 10 .Front small lamp
11. License lamp
12. Direction signal lamp and hazard warning lamp
13. Rear combination lamp
- 14 .Reversing lamp and switch
15. Interior lamp and switch 150
16. Brake lamp and switch
17. Parking brake lamp and switch
- 18 Fog lamp and switch
19. Electric horn
20. Vacuum alarm
- 21 .Various relays
- 22 .Combined switches
23. Combined instrument
- 24 .CD player
25. Idle speed boost device
26. Exhaust brake controller
27. Electrical device

Electrical System

General

I . Operation table

		12 V	
		4DA1-1	4DA1
Battery	6-QA-100D	B	B
Instrument	Speedometer	B	B
	Thermometer	B	B
	Fuel meter	B	B
Headlamp	Two abnormal shape crystal headlamps	B	B
Fog lamp		B	B
Illuminator	Speedometer	B	B
	Thermometer	B	B
	Fuel meter	B	B
	Meter board	B	B
Indicator and caution lamp	Direction indicator and hazard lamp	B	B
	Far beam indicator	B	B
	Parking brake indicator	B	B
	Brake liquid level indicator	B	B
	Heating plug indicator	B	B
	Oil pressure indicator	B	B
	Exhaust brake indicator	B	B
	Water separator indicator	B	B
Brake lamp and reversing lamp		B	B
Interior lamp	Three level lamp changes	B	B
	Intermittent wiper	B	B
Cigarette lighter		B	B
Horn		B	B
CD player and stereo radio cassette player		B	O
Buzzer	Vacuum warning buzzer	B	B
Warm air and air conditioner		B	O
Manually-operated door and window		B	B
Motor-driven door and window		O	O
Note: B: Standard equipment O: Optional			

Electrical System

II. Electric diagram identification

1. Wire code identification:

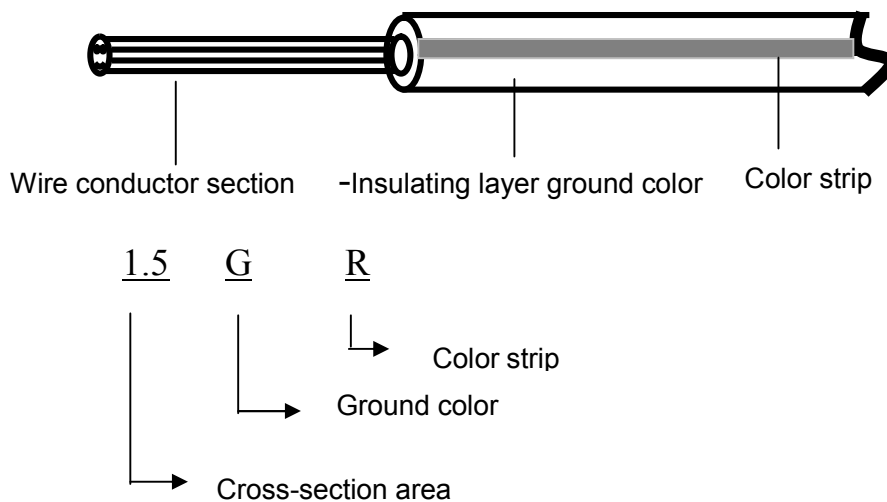
Specifications and colors of wires on the wiring diagram are distinguished by different codes. As different countries use different color codes for the wires, JAC product users and maintenance personnel should identify the wires according to Wire Color Code in Electric Maintenance Manual of JAC automobile.

E.g.: 1.5GR

1.5-----Section of wire conductor is 1.5 mm²

G-----Color of insulating layer is green

R-----Color strip is red



Color codes of cables

Application circuit	Vinyon insulated wire					
	Black (B)	Black - white (BW)	Black- yellow (BY)	Black- red (BR)		
Starter motor	Black (B)	Black - white (BW)	Black- yellow (BY)	Black- red (BR)		
Charging circuit	White (W)	White- red (WR)	White- black (WB)	White- blue (WL)	White- Green (WG)	
Lamp circuit	Red (R)	Red- white (RW)	Red- black (RB)	Red- yellow (RY)	Red- green (RG)	Red- blue (RL)
Signal circuit	Green (G)	Green- white (GW)	Green- red (GR)	Green- yellow (GY)	Green- black (GB)	Green- orange (GO)
Metering circuit	Yellow (Y)	Yellow- red (YR)	Yellow- black (YB)	Yellow- black (YB)		Blue - yellow (LY)
Wiper circuit	Blue (L)	Blue- white (LW)	Blue- red (LR)	Blue- black (LB)	Blue- orange (LO)	
Miscellaneous	Lamp green (Lg)	Lamp green - black (LgB)	Lamp green - red (LgR)			
	Brown (Br)	Brown- white (BrW)	Brown- red (BrR)	Brown- yellow (BrY)		

Electrical System

2 . Electrical component identification:

Electrical components in the JAC automobile electrical diagrams are indicated in common general signs. Refer to Common Automobile Electrical Signs for details.

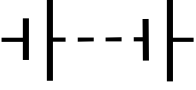
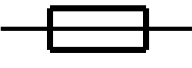
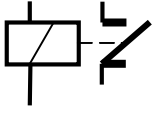
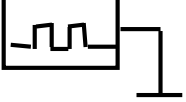
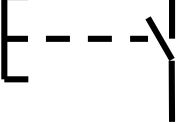
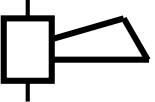
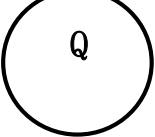
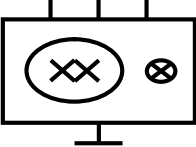
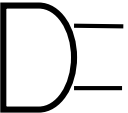
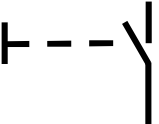
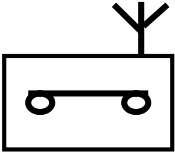
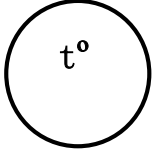
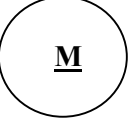
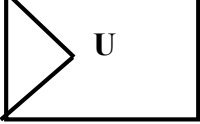
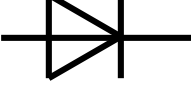
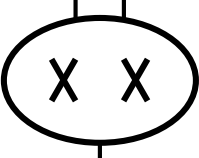
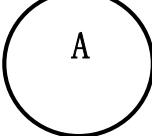
				
Battery unit	Fuse	Relay	Flasher	Button switch
				
Solenoid valve	Electric horn	Illuminator, indicator	Speaker	Fuel gauge
				
Combination lamp	Buzzer	General hand switch sign	Radio cassette player	Thermometer
				
Motor	Voltage regulator	Semiconductor diode	Twin-filament lamp	Ammeter

Fig. 2 Common automobile electrical signs

III .Electrical designations and usages of the complete vehicle

1. Battery

(1) Battery is a kind of reversible low voltage direct current power supply that can convert chemical energy into electric energy and vice versa. Lead acid battery is supplied by JAC, which is dry-charged battery.

(2) Electrolyte in the battery is prepared by pure sulfuric acid and pure distilled water in a certain proportion. Electrolyte purity is an important factor affecting the electrical performance and service life of the battery. As the industrial sulphuric acid and

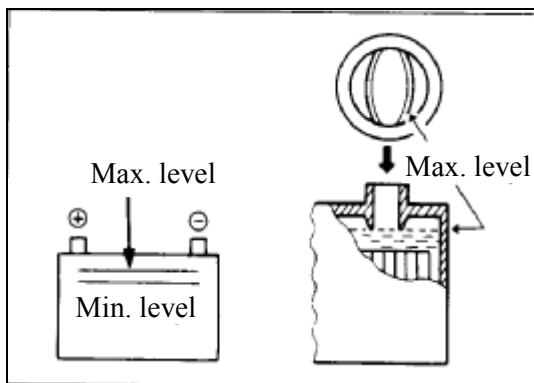
Electrical System

ordinary water contains foreign materials as copper and iron that accelerate the self discharge, it cannot be used in battery. The sulfuric acid and distilled water used must meet specialized standard.

(3) The battery is composed of six separate single cells that are connected in series with led rod. The voltage of a single cell is 2V, so the nominal voltage of one battery of six cells of series connection is 12V.

(4) The battery has charging hole that is sealed by plug screw. Charging hole plug screw has vent hole to release hydrogen and oxygen generated from chemical reaction. The vent hole must be kept clear in service. The shell may crack or explode if it is clogged.

(5) Battery inspection: a If the electrolyte level is too low, please add distilled water to the max. liquid level; b If the measured specific weight is under 1.23 (at 20°C), add or replace the electrolyte.; c Keep the terminals reliably connect, remove any corrosive marks and keep the battery terminal, power line and earth wire connection clean.



Battery inspection:

1. Check the terminal post for looseness and corrosion
Keep the connection reliable. Remove any corrosive mark and keep the connection clean.
2. Check the electrolyte level of the battery
If the electrolyte level is too low, please add distilled water to the max. liquid level

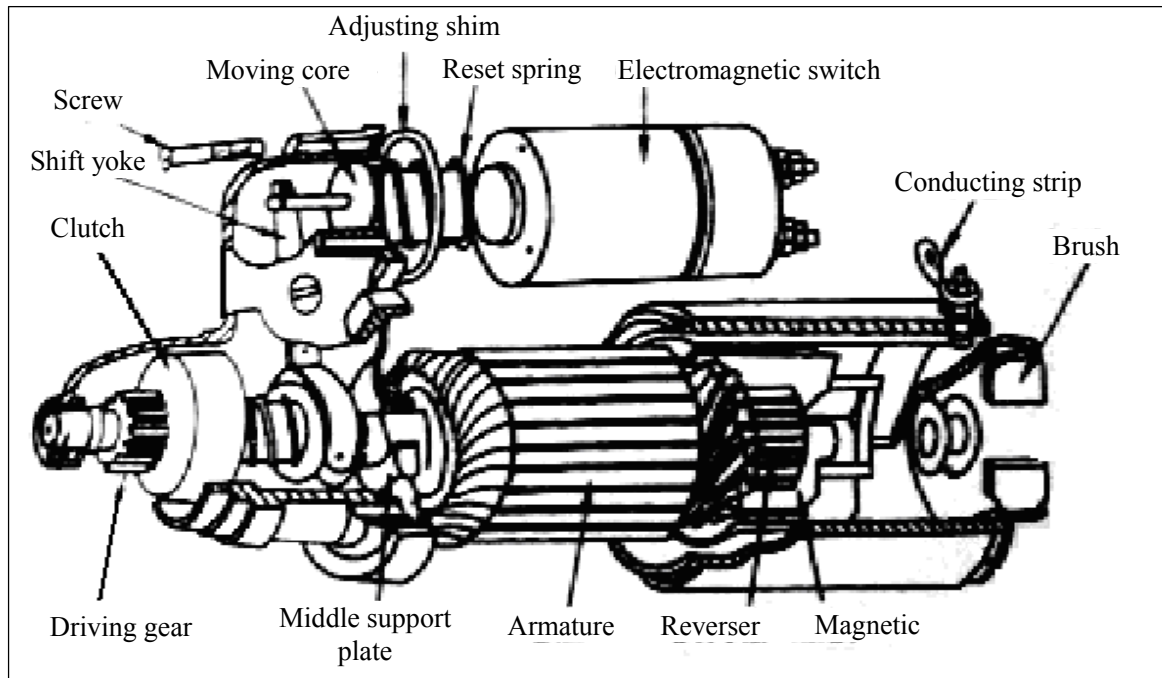
2. Starter

The function of starter is to convert the electric energy of battery into mechanical energy to drive the engine.

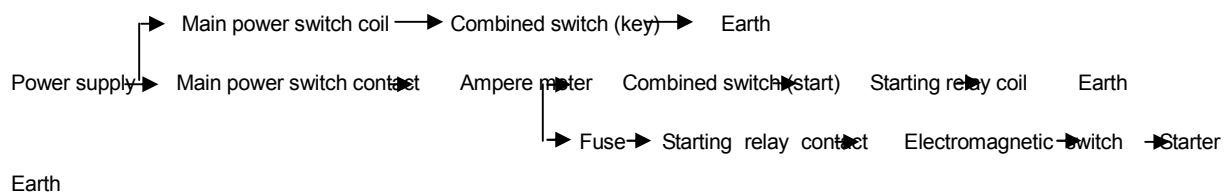
The starter used in this vehicle is 12V DC series excitation motor. It is composed of three parts: (1) DC series excitation motor: to convert the electric energy of battery into mechanical energy to generate torque; (2) Drive mechanism, also called engaging mechanism: To engage the driving gear of the starter into the engine flywheel toothed ring when the engine is started, so that the torque of starter is transmitted to the engine crankshaft, and to disengage the driving gear of starter and the engine flywheel toothed ring after the engine is started; (3) Control device: To connect and disconnect the starter and battery.

Electrical System

Starter structure:



Starter operating circuit:



The maintenance personnel should carry out inspection and repair for the lines indicated by the starter operating circuit diagram.

3. Generator

AC generator is the main power for the automobile. It is actually a self-exciting three-phase synchronous generator. There are three windings at an interval of 120° on the stator core of the generator. The ends of the three windings are connected, which are usually called star connection. The rotor has field winding on it. Magnetic field is generated when direct current passes the rotor winding. When the rotor is turned by the engine, relative cutting movement is generated between magnetic line of the rotor and three-phase winding of the fixed stator. Three phase alternating electromotive force, i.e., AC power, is generated in the three-phase winding. DC power is used in automobile circuit. So the AC power generated by the AC generator must be rectified before using. The rectifying is made mainly by the silicon rectifier in the generator. The three phase bridge full wave circuit composed of several silicon diodes commutates alternating current into direct current.

Silicon rectifying shunt excitation AC generator is adopted in this vehicle, which is

Electrical System

composed of three phase AC motor and silicon diode rectifier. Minus earth is adopted. Do not connect otherwise, or the generator may be damaged.

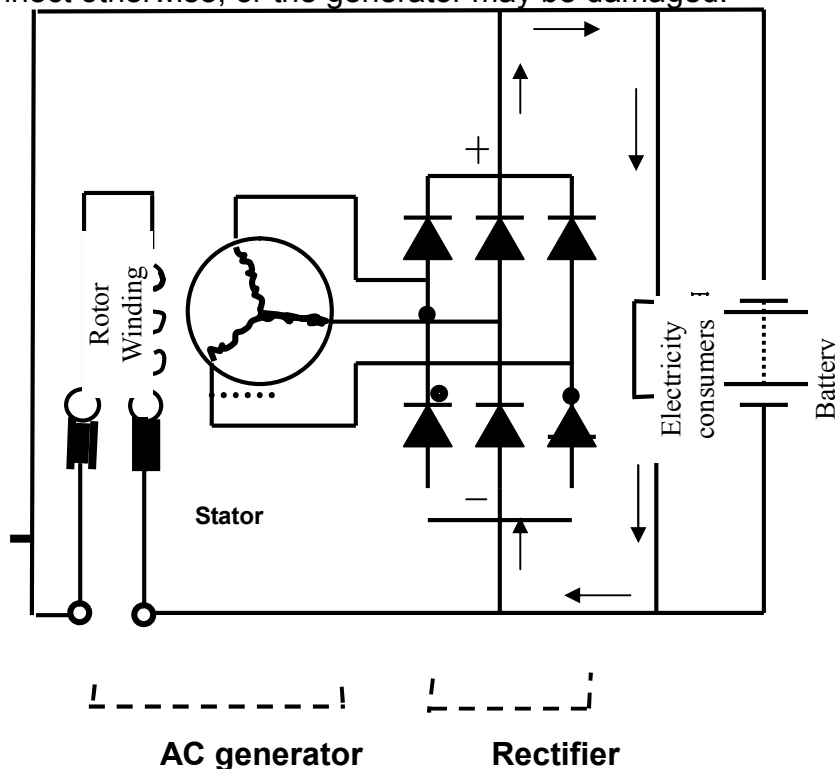


Fig. 1 AC generator wiring diagram

4. Speed sensor

Speed sensor is fit on the generator end. The signal is taken from generator speed signal terminal P. The number of pole pairs is 6. The generator and engine transmitting ratio is 82: 145. The sensor output waveform is regular square wave.

5. Electric preheating

Electric preheating for the engine is adopted in cold season for this vehicle. The heating wires should not be electrified for more than 30 sec., or they may be damaged.

If the preheating effect is not good, check if the circuit is switched on first. If the circuit is OK, use universal meter to check the heating wire and replace the burned-out electric heater.

6. Fuel cutoff solenoid valve

There is one electronic component on the rear end of the engine injection pump. Its function and wiring is as follows:

The electrical component is fuel cutoff solenoid valve. Its function is the same with that

Electrical System

of electric engine shut down device. The fuel cutoff solenoid valve is powered on when the engine is started. The electric magnet lifts up the seal iron, so the injection pump of the engine starts to supply oil and the engine starts normal operation. When the engine needs to be shut down, turn the key to shutdown position, so the fuel cutoff solenoid valve is power off and the seal iron cut the fuel path by the spring operation.

Power supply → Fuse → Ignition lock → LOCK (shutdown)

7. Wiper

The electric wiper of this vehicle is automatic reset type. For installation, the motor should be in reset state. Then connect the link rod and wiper blade (wiper blade position should be in reset state).

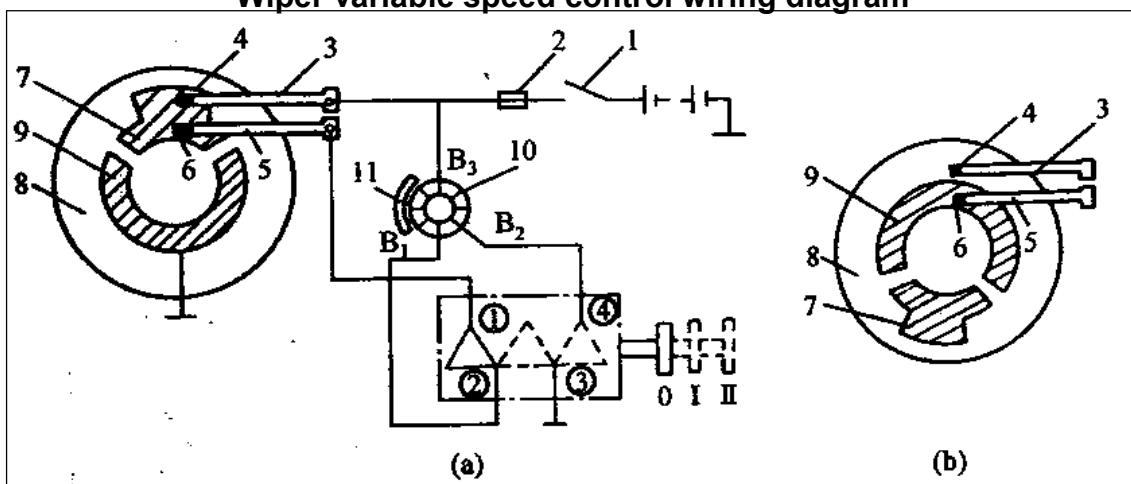
The variable speed switch controls the motor circuit to implement variable speed wiping. The variable speed control circuit is as shown in the figure. The control process is as follows:

a) Low speed wiping. When the power switch is ON and the variable speed switch is in I position, the current flow is as follows: battery positive pole → power switch → fusing element → brush B₃ → armature → brush B₁ → variable speed switch I position earth → battery negative terminal. As the brush B₂ has an offset angle, the wiper blade swings fast when the motor is running at high speed.

b) When the power switch is ON and the variable speed switch is in II position, the current flow is as follows: battery positive pole → power switch → fusing element → brush B₃ → armature → brush B₂ → variable speed switch II position earth → battery negative terminal. As the brush B₂ has an offset angle, the wiper blade swings fast when the motor is running at high speed.

c) Shutdown and reset. The automatic reset mechanism of motor wiper is as shown in Fig. 1—21 (b). The nylon impeller is embedded with copper ring 7 and 9. The copper ring has two parts. The larger copper ring 9 is connected to the casing to earth. Contact piece 3 and 5 is made of phosphorus copper or other elastic material.

Wiper variable speed control wiring diagram



Electrical System

1-Power switch; 2-Fusing element; 3、 5-Auto reset contactor; 4, 6-Contact;

7, 9-Auto reset slide ring (copper ring); 8-Worm wheel; 10-Armature; 11 - Permanent magnet

Contact 4 and 6 is riveted on one end. As contact 3 and 5 is elastic, when impeller 8 turns, contact 4 and 6 maintains contact with the end surface of impeller 8 (including copper ring 7 and 9).

When wiper variable speed switch is in "0" position, if the rubber brush does not stop at bottom edge of the windshield glass, the impeller turning will make contact 6 and copper ring 9 connect, so the current keeps flowing into the armature. Here the current forms a circuit from battery positive pole→power switch→fusing element→brush B1→variable speed switch→contact piece 5→contact 6→copper ring 9→earth→battery negative terminal. The motor runs at low speed until the impeller turns to the position shown in Fig. 1—21 (a) and contact 4 and 6 connects with copper ring 7.

When contact 4 and 6 is connected with copper ring 7, the motor cannot stop immediately owing to the inertia force of armature turning. Instead, electricity is generated with engine operation. As the direction of electromotive force generated by armature winding is opposite to that of external supply voltage, the current flows in the circuit of brush B3→contact piece 3→contact 4→copper ring 7→contact 6→contact piece 5→variable speed switch→brush B1. Torque is also generated (called brake torque) to make the motor stop immediately. Here the rubber brush is just reset to the bottom edge of the windshield.

The maintenance personnel can look for the fault of wiper circuit according to the wiper working principle and variable speed control wiring diagram.

a. Main components

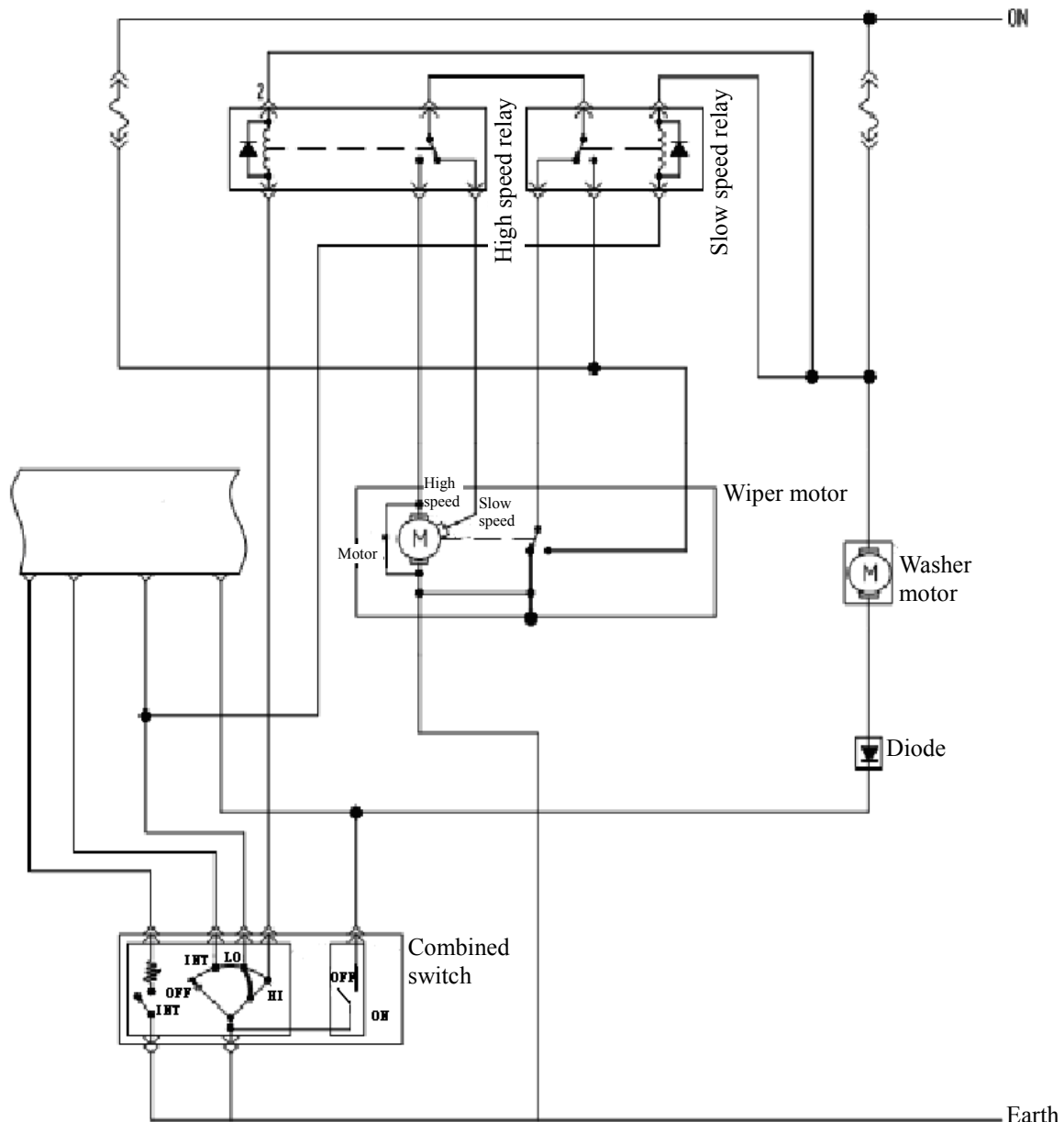
Designation	Quantity	Mounting position
Connecting rod assembly	1	Bottom edge of front windshield
Wipe rod and brush assembly (left)	1	Front windshield
Wipe rod and brush assembly (right)	1	Front windshield
Rain wiper motor assembly	1	Inside the cab
Washer jug assembly	1	Inside the cab
Water pipe assembly	1	Inside the cab
Nozzle assembly	2	Cab front panel
Control switch (combined switch)	1	On steering column
Wiper relay	2	Inside the cab fuse box

Electrical System

b. Functional requirements

- I. Three operation modes of high speed, low speed and intermittent
- II. Automatic reset function of wiper rod
- III. Interval of intermittent operation can be adjusted
- IV. Linked control of washer and wiper

c. Circuit design



8 .Washer

Dust or dirt may get onto the windshield glass during the driving. To ensure good sight of the driver, most vehicles have windshield glass washer.

When the washing engine armature is powered on, it turns in the permanent magnetic field. When the armature shaft turns, it drives the pump shaft via coupling, so the

Electrical System

pump rotor also rotates. The pump rotor pumps the washing liquid from the pot to the wind shield via the outlet hose and the nozzle. In the meantime, the wiper blade swings to remove the dirt on the wind shield glass.

To use the washer, switch on the washing pump before the wiper. The continuous work time of washing pump should not exceed 5s, interval not be less than 10s. When there is no washing liquid in the pot, do not switch on the washing pump. Otherwise, the motor may be damaged.

9. Headlamp

The headlamp of this vehicle is anti-glare combination lamp. The bulb is twin filament type (long-distance beam/short-distance beam). When long-distance beam is switched on, the long-distance beam indicator on the dashboard illuminates at the same time. Lamp switch and change is operated from the group switch.

If the lamp is not ON, please check in the following sequence.

Step	Inspection content	Method
1	Check if the fuse is blown	If the fuse is blown, replace it after the cause is found. If not, check the next item.
2	Check if the lamp relay operates normally	Turn on the lamp switch to see if the headlamp relay operates. Or use a universal meter to check if the relay terminal is OK.
3	Check the headlamp bulb	If the result of the above checks is acceptable, please check if the bulb is damaged. If not, check the next step.
4	Check if the wiring connectors are reliable	Check if all the terminals are reliably connected according to the wiring diagram.
5	Check the combined switch (lamp switch)	Check if the lamp switch on the group switch can be normally turned on



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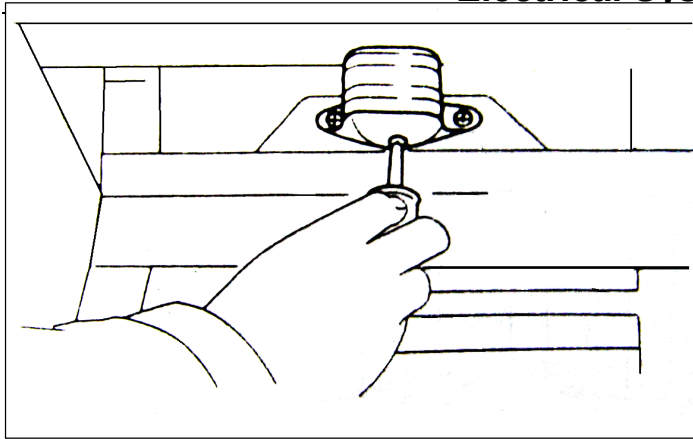
graph LR
    PS[Power supply] --> Fuse[Fuse]
    Fuse --> RC[Relay coil]
    Fuse --> RCT[Relay contact]
    RC --> CS[Combined switch]
    CS --> Earth1[Earth]
    RCT --> FSL[Front small lamp]
    FSL --> Earth2[Earth]

```

11. License lamp

The trouble shooting method is the same with that of small lamp.

Electrical System



License lamp
To replace the bulb, remove one screw fixing the lens.

Check for fault according to the license lamp operating circuit:

Power supply → Fuse → Relay coil → Combined switch → Earth
→ Relay contact → License lamp → Earth

12. Direction signal lamp and hazard warning lamp

The direction lamp and front small lamp is combined. It is on the top of the combined lamp. The light color is yellow. The operating circuit of the direction lamp is shown below:

Power supply → Fuse → Flasher ----→ Combined switch ----→ Left and right direction lamp → Earth
-----→ Left and right direction lamp → Earth
-----→ Warning switch

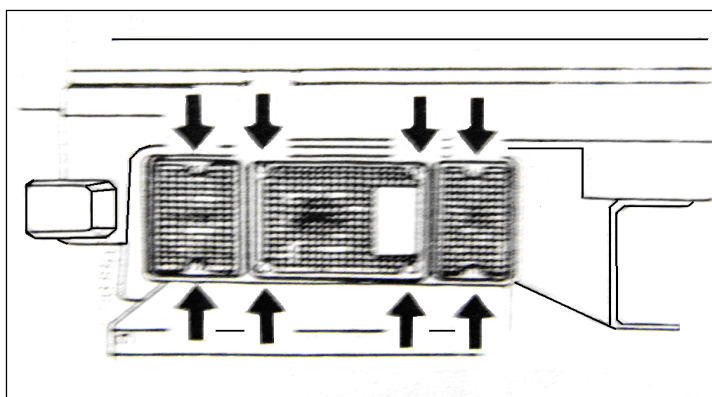
The direction lamp circuit should be checked according to the circuit diagram. When the vehicle is at fault or there is other danger, turn on the warning switch. The bulbs of the direction lamp flicker at the same time to give a warning. The trouble shooting method is the same as above.

13. Rear combination lamp

Rear lamp is a combined lamp with brake lamp, reversing lamp and direction lamp at the bottom of the rear of the vehicle on both left and right. The color is red. The rear lamp control switch is on the lamp switch of the combined switch. Its circuit is:

Power supply → Fuse → Relay coil → Combined switch → Earth
→ Relay contact → Rear lamp → Earth

Note: The rear lamp use the same relay with front small lamp. It also share the same fuse with front small lamp, license lamp, fog lamp and instrument lamp. The maintenance personnel should pay attention to this in maintenance. The trouble shooting method of rear lamp is the same with that of front small lamp.



Rear combination lamp
To replace the bulb, unscrew the four bolts fixing the lens.

Electrical System

14 .Reversing lamp and switch

Reversing lamp position is the same with that of rear lamp. The reversing lamp light is white in color. The reversing lamp works together with the reverse gear switch mounted on the gearbox. Its operating circuit is:

Power supply→Fuse→Reverse gear switch→Reversing lamp→Earth

Note: the reversing lamp shares the same fuse with brake lamp and roof lamp. Please pay attention to this in maintenance and repair.

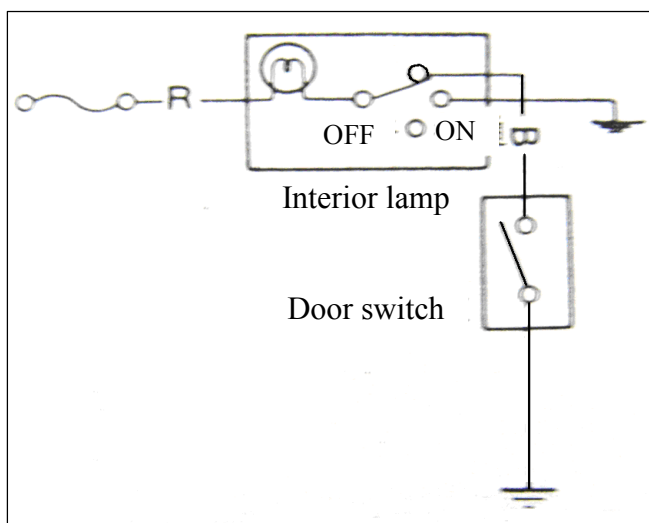
15. Interior lamp and switch 150

The interior lamp is at the middle of the upper edge of the front windshield of the cab. It has two switches, one is the roof lamp composite switch and the other is the door post switch installed on the left door post of the cab. Its operating circuit is:

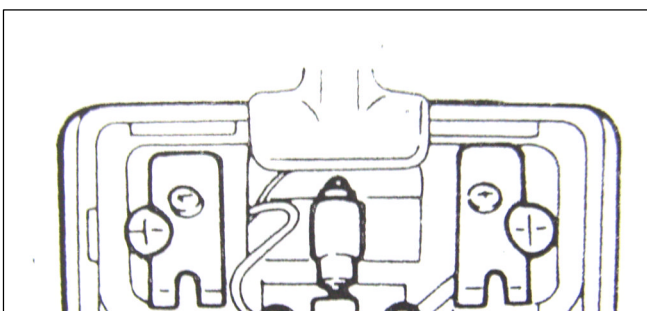
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graph LR
    PS[Power supply] --> F[Fuse]
    F --> IL[Interior lamp]
    IL --> ILS[Interior lamp switch]
    ILS --> E1[Earth]
    IL --> DPS[Door post switch]
    DPS --> E2[Earth]

```



Interior lamp switch circuit diagram



Interior lamp switch position

Electrical System

ON ←OFF→ Door

16. Brake lamp and switch

Brake lamp position is the same with that of rear lamp. The brake lamp light is red and the brightness is higher than that of rear lamp. The brake lamp works together with the brake lamp switch mounted on the brake pedal. Its operating circuit is:

Power supply→ Fuse→Brake switch→Brake lamp→Earth

Note: the brake lamp shares the same fuse with reversing lamp and roof lamp. Please pay attention to this in maintenance and repair.

17. Parking brake lamp and switch

Parking brake switch is integrated with parking brake control lever. When the manual control lever is lifted, the parking brake switch is ON. Here the parking brake indicator on the dashboard turns ON. Let down the manual control lever, and the parking brake switch is OFF and the parking brake indicator is OFF. Its operating circuit is:

Power supply→Fuse →Parking brake indicator→Parking brake switch →Earth

Parking brake indicator sign on the dashboard



18 Fog lamp and switch

The fog lamp is combined with the headlamp and its light color is yellow. The working principle of fog lamp is: when you drive on a foggy day, first switch on any lamp on the combined switch and then press the fog lamp switch to turn it on. Turn off the lamp switch on the combined switch or the fog lamp switch to turn off the fog lamp.

Fog lamp operating circuit:

Power supply → Fuse → Relay coil→ Combined switch→Earth

→ Relay contact →Fog lamp switch →Fog lamp→ Earth

Note: The fog lamp shares the same fuse with the front small lamp, rear lamp, license lamp and instrument lamp. The maintenance personnel should pay attention to it in repair.

16

Electrical System

20. Vacuum alarm

When the vacuum pressure in the vacuum cylinder exceeds certain value, the pressure contact on the vacuum horn closes to complete the circuit. The vacuum alarm buzzer and alarm lamp on the dashboard is switched on to warn the driver to find out the cause.

The vacuum abstraction is carried out by the vacuum pump on the generator. The maintenance personnel should pay attention to this in repair.

Alarm lamp identification:



21 .Various relays

The relays for this vehicle include lamp relay, horn relay, warm air relay, starting relay and preheating relay. As the lamp, horn and warm air does not consume high current, relay of the same specification is used for these current consumers. The solenoid switch of the starter and heating plug consumes high current, so they use special purpose relays that are installed in the chassis electric box. From left to right, starting, preheating, horn, air conditioner and braking relay.

22 .Combined switches

The combined switch is a switch integrating power, start, lamp, wiper, washer and direction lamp. There are many lines together, so faults are likely to occur here. It will help the maintenance personnel a lot to know about the structure of the combined switch in electric trouble shooting.

Combined switch structural diagram

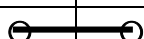
1. Ignition switch working position conduction diagram

Contact code and power Working gear	B	ACC 220W	ON 240W	R 60W	ST 220W	P1 40W	P2 40W	B1	R1 60W	R2	Remarks
Wire color	B	L	BY	BR	BW	LY	LW	L	R	Y	
Specification mm ²	5.0	3.0	3.0	3.0	3.0	1.0	1.0	1.0	0.75	0.75	
LOCK						○	○	○			
ACC	○	○				○	○	○			

Electrical System

ON										
START										Automatic reset
Power switch	Key in									
	Key out									

2 Lamp switch beam selection and overtaking signal conduction diagram

Contact code		BT	E	J	B	BH	HU	
Rated power		80W		120W	10W	150W	150W	
Gear	OFF							Overtaking
								
	Small lamp							Overtaking
								
	Headlamp							
								Overtaking
	Long-distance beam							

Electrical System

3 Direction switch, warning switch, exhaust brake switch and horn conduction diagram

Contact code		TL	TB	TR	B1	F	B2	EX	ER	HO
Rated power		72W	144W	72W	120W		120W			120W
Warning switch	Direction switch									
OFF	L									
	OFF									
	R									
ON	L									
	OFF									
	R									
Exhaust brake switch	OFF									
	ON									
Horn										

4 Wiper switch and water spraying switch

Water spraying	Wiping	11	E1	12	AS	L	H	E2	W	E3
OFF	OFF									
	INT									
	LO									
	HI									
ON	OFF INT LO HI									

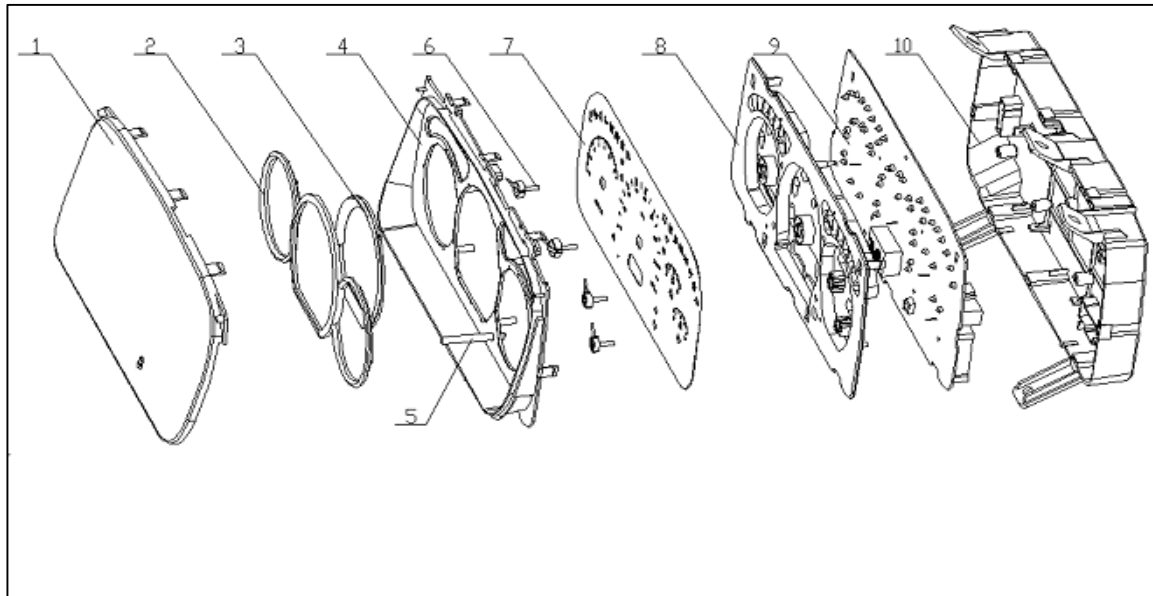
EZ

Electrical System

23. Combined instrument

Instrument

Disassembling and reassembling



Disassembling sequence:

- | | |
|---------------------------------|------------------------|
| 1. Transparent top cover | 6. Pointer component |
| 2. Instrument decorative ring A | 7. Gauge plate |
| 3. Instrument decorative ring B | 8. Middle cover |
| 4. Black frame | 9. Circuit board parts |
| 5. Reset rod | 10. Bottom cover |

Disassembling sequence:

Follow the reverse order of disassembling to reassemble.

Electrical System

1 Instrument indicator:

No.	Designation	Function	Color
1	Engine oil pressure alarm lamp	ON when the engine oil pressure is too low	Red
2	Charging indicator	ON when the battery discharges	Red
3	Parking brake alarm lamp	ON when the parking brake is switched on	Red
4	Preheat indicator	ON during the preheating	Yellow
5	Exhaust brake indicator	ON when the exhaust brake is switched on	Yellow
6	Left/right direction indicator	ON when the direction lamp is switched on	Green
7	Beam indicator lamp	ON when the headlamp is switched on	Blue
8	Fog lamp indicator	ON when the fog lamp is switched on	Yellow
9	Hazard alarm lamp indicator	ON when the hazard alarm is switched on	Red
10	Fuel oil level alarm lamp	ON when the fuel oil level is low	Yellow
11	Small lamp indicator	ON when the small lamp is switched on	Yellow
12	Door open alarm lamp	ON when the door is open	Red
13	ABS alarm lamp	ON when the ABS system is at fault	Yellow
14	Brake fault alarm lamp	ON when the brake is at fault or the brake fluid is low	Red

1) Main component installation

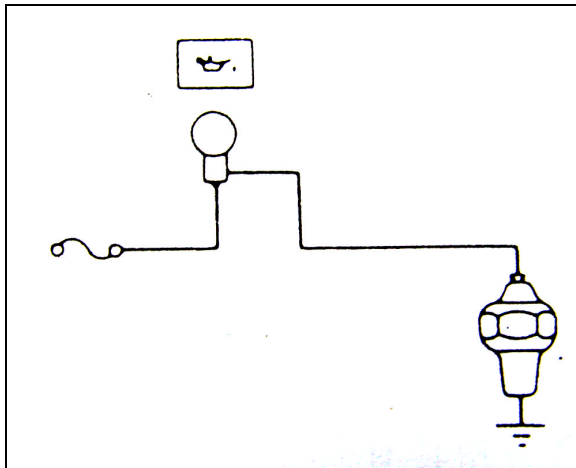
Main component	Model	Mounting position
Combined instrument	Stepping motor type	Under dashboard
Speed meter/odometer	Electronic	Middle of combined instrument
Odometer sensor		On gearbox output shaft
Engine oil pressure sensor	Varistor type	On engine oil pipe
Water temperature sensor	Thermister	On engine water inlet pipe

Electrical System

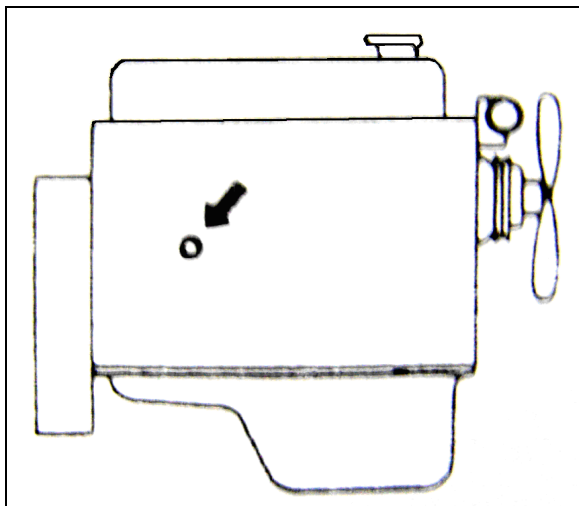
Fuel oil sensor	Varistor type	Inside oil tank
-----------------	---------------	-----------------

Electrical System

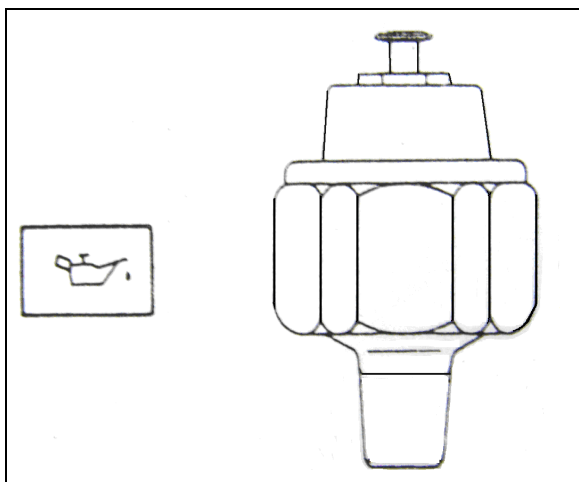
2) Indicator and warning switch:



Engine oil pressure indicator switch
Wiring diagram



Indicator switch position

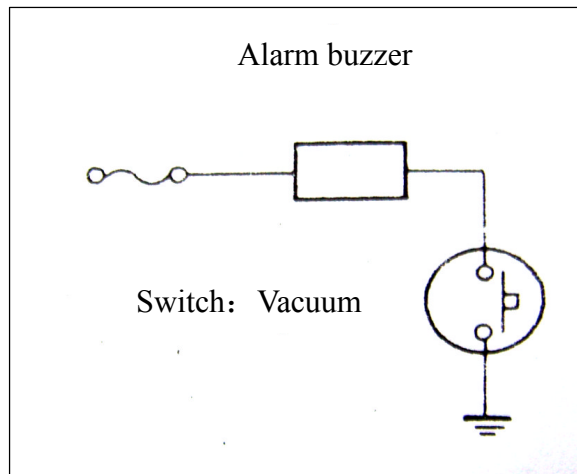


Switch specification

Working pressure: 0.3- 0.5 KSC.

When the oil pressure is as low as the switch action pressure, the indicator is ON.

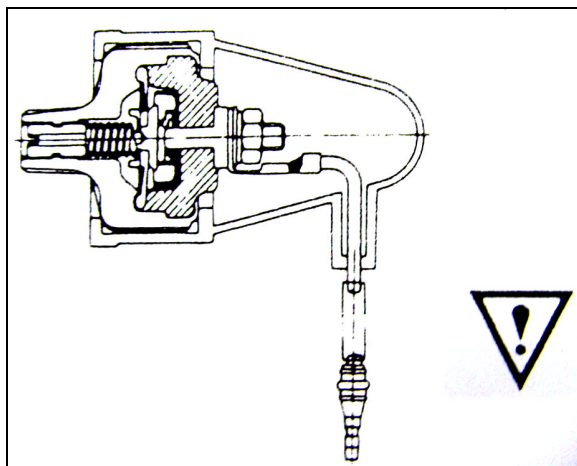
Electrical System



Vacuum alarm switch

Wiring diagram

Its position is the inner side of the left pedal in the cab.

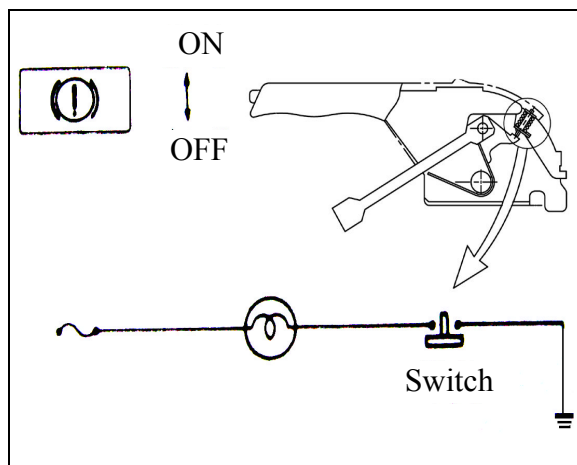


Switch specification

Stamping sign: 350

Negative pressure (mm hg): 320- 380

Note: The switch has working negative pressure mark. Make sure that you replace it with switch of the same negative pressure when necessary.



Parking brake switch

Wiring diagram

Electrical System

2 Technical requirements:

Technical requirements of combined instrument

3801910D800 Combined instrument assembly

The basic deviation requirements are as follows:

Basic deviation									
Speedometer (stepping motor type)	Indicated speed Km/h	20	40	60	80	100	120	140	160
	Allowable deviation Km/h	±3	+5 0	+5 0	+5 0	+5 0	+6 0	+7 0	—
	Transmitting ratio	1:637			Interface mode		Sensor type		
Fuel gauge (stepping motor type)	Indicated mark	E			1/2		F		
	Basic resistance (Ω)	97			32.5		6		
	Allowable deviation (Ω)	±16			±6.5		±3		
	Sensor	Designation		Fuel oil sensor		Model		RG1164B1	
Water temperature gauge (stepping motor type)	Indicated mark (°C)	C (50)			100		H (115)		
	Basic resistance (Ω)	230			40.4		26.4		
	Allowable deviation (Ω)	±30			±5		±1.5		
	Sensor	Designation		Water temperature sensor		Model		WG1371	

All alarm indication systems of 3801910D800 instruments conform to GB4094 - 1999 Signs of automobile controls, indicators and signal devices.

DJY7121-1.6-20;DJY7141-1.6-20;DJY7121A-1.6-20 combined socket is adopted for the instruments.

24 .CD player

A single disk dual track CD player is mounted on this vehicle. The L channel speaker is mounted in the left door and the R channel speaker is mounted in the right door.

If you find that some functions do not work, please read carefully the operation instructions in the manual first before you send it for repair. You can check the player according to the following table. It will help you fix the trouble.

Electrical System

Please send the player to the maintenance service station if the fault cannot be fixed.
Do not disassemble the player to repair it by yourself.

General situation

The player does not work and there is no display.

- Check the fuse connection of the player and vehicle
- Check the voltage.

The player works but there is no sound or the sound is very low

- Raise the volume.
- Check the front and rear, left and right balance setting of the horn.
- Check the antenna and connection.

Horn volume lowers by itself

- The internal safety circuit can prevent the internal temperature from exceeding certain value.
- Raise the volume after the temperature is lowered.

Reception

Cannot get the channel:

- Check if the antenna is fully drawn and if the connection is right.
- Check if the negative terminal (brown line) is grounded (chassis).
- Please use manual tuning if the signal is too weak.

Poor reception:

- Some vehicle (such as Volkswagon and SEAT) needs a 12 V antenna on the top. Please consult your dealer if there is 12 V power supply to this antenna.

CD

CD ERROR is displayed:

- Check if the CD is correctly inserted, and make sure that the CD is not broken or dirty.

Distortion of sound

- CD cannot be read, damaged or dirty.

CD player out of operation:

- Moisture may condensate on the laser magnetic head when it is very cold. Turn it to radio reception for about 5 minutes to let the moisture evaporate.

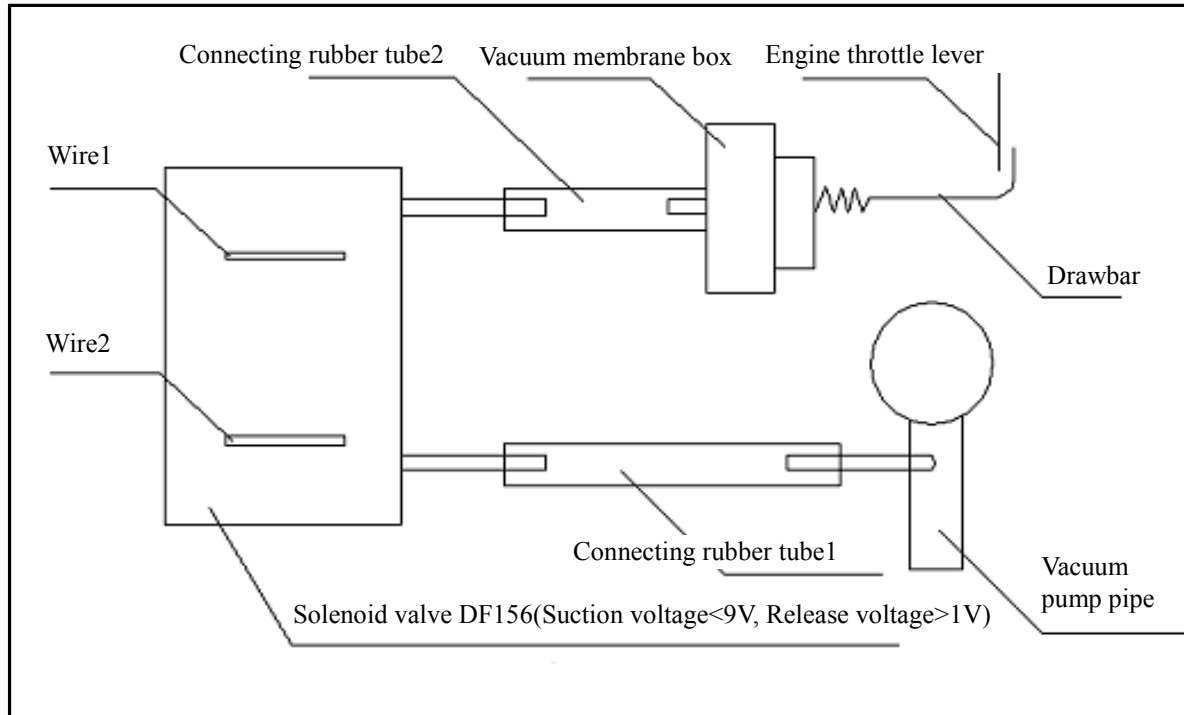
NO CD or NO DISC is displayed.

- Check if there is CD in the CD player.

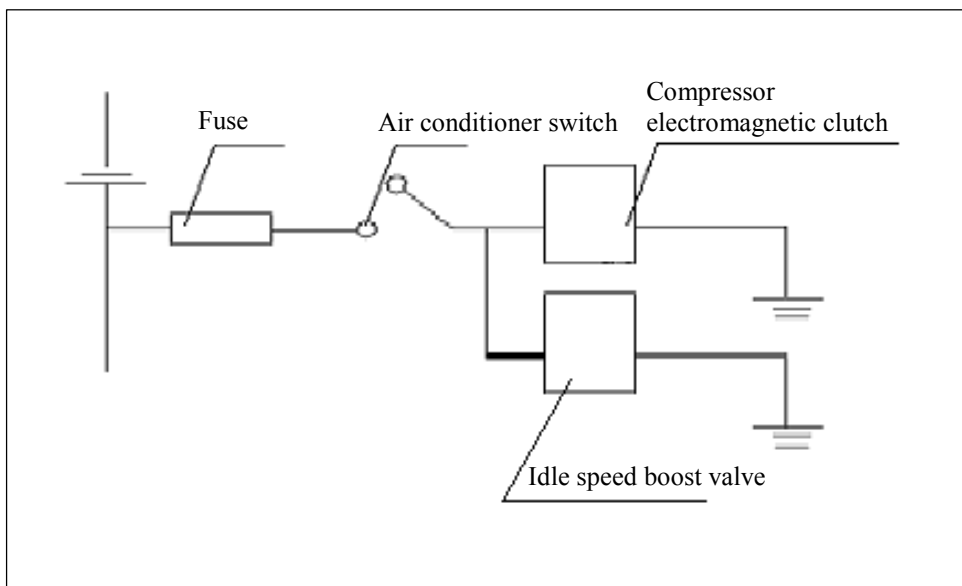
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25. Idle speed boost device

A solenoid valve called idle speed boost device is fitted on the rear end (left side of the chassis) of the vacuum pump on the engine. When the engine is at idle speed and the air conditioner is switched on, it boosts the idle speed of 700r/min to 850 ± 50 r/min, so that the power generation meets the requirements of the air-conditioner. Its functional diagram is as follows:

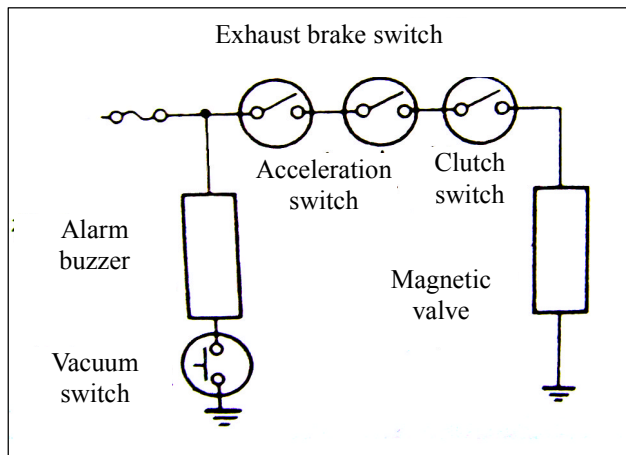


When the air conditioner is switched on, the solenoid valve of the idle speed boost device operates so that rubber tube 1 and rubber tube 2 is connected. With the vacuum membrane, the fuel up lever is pushed by the push rod to the fuel up direction, so that the engine idle is raised to 850 ± 50 r/min. The wiring diagram is as follows:

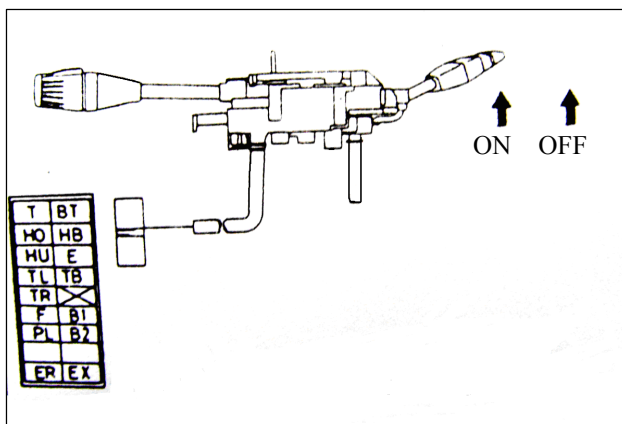


Electrical System

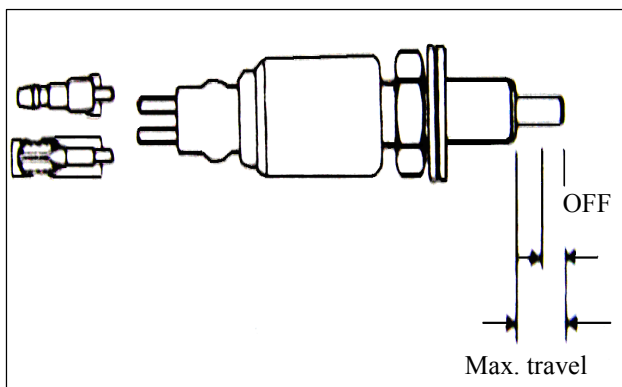
26. Exhaust brake controller



1. Wiring diagram



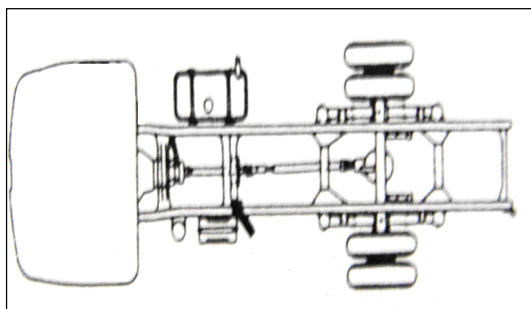
2. Switching diagram



3. Accelerator and clutch switch:

Maximum stroke: 4mm;

Working stroke: 2.0-2.8mm.



4. Position of exhaust brake solenoid valve (left arrow)

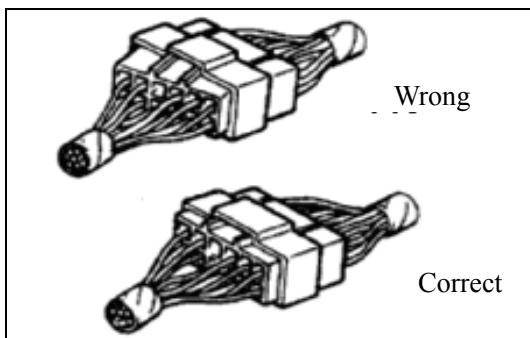
Electrical System

27. Electrical device

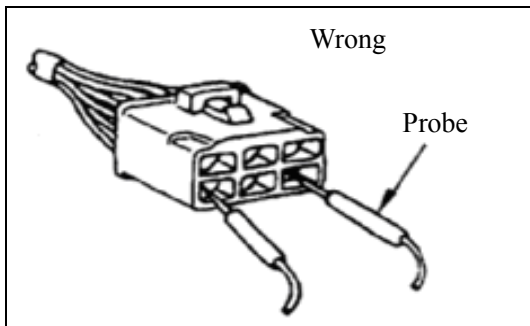


Disassembly of line bundle connector:
Please always both hands to cut the connector. Drawing the connector with single hand will result in rupture of the wire terminal.

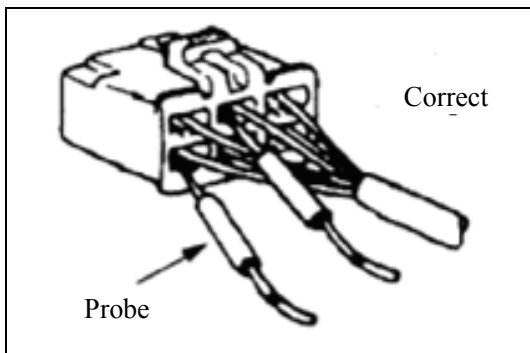
Note: press the lock plates on both sides before drawing out the connector to cut.



Connection of line bundle connector:
Clench both sides (male and female) of the connector and make sure that the connector terminal pins match and align with the holes. Press both sides of the connector carefully until you hear a clear click.

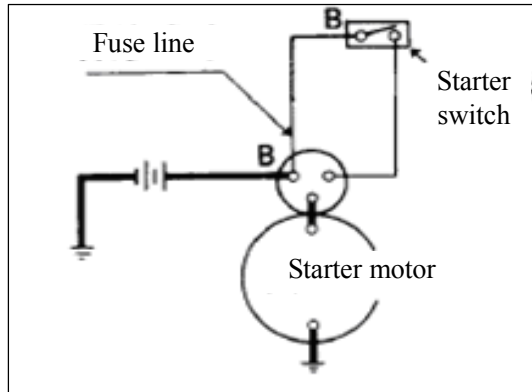


Inspection of line bundle connector:
Use circuit tester to check the connector continuity. Insert test probe from side of the connector wire



Do not insert the test probe in connector open end

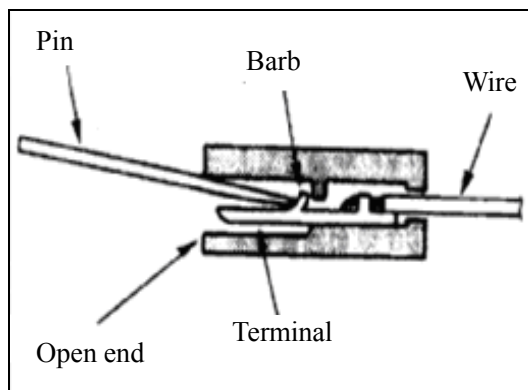
Electrical System



Inspection of fuse line:

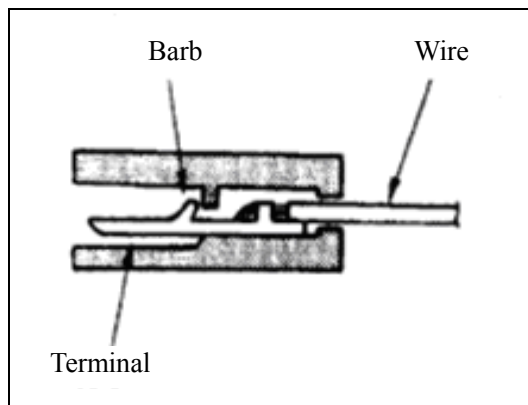
The fuse line is fitted on battery positive terminal and starter switch B terminal

If there is over current, the fuse is blown to protect the main power supply from being overloaded. Please use universal meter to check the continuity of the circuit.



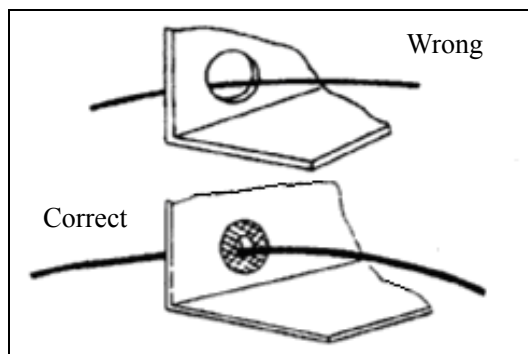
Disassembly of wire terminal

1. Insert a pin into the open end of the connector shell
2. Press the barb (facing the connector wire side) and pull the wire on the connector wire side.



Insertion of wire terminal:

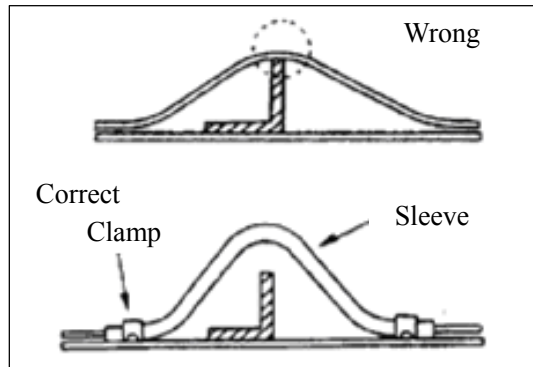
1. Check if the barb is completely open.
2. Insert the terminal from connector wire side and press it until the barb fixes it firmly.
3. Pull the wire gently to reset the terminal.



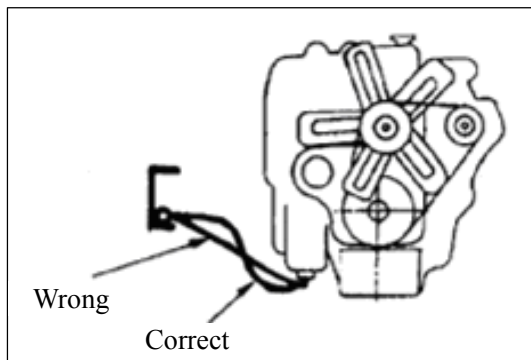
Precautions of line bundle arrangement:

Use jacket or sleeve to protect the line bundle and avoid direct contact with sharp edge or surface.

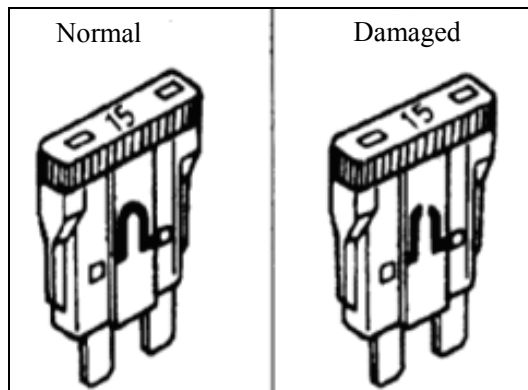
Electrical System



There should be sufficient clearance between the line bundle and bracket. Use ethylene sleeve and clip to protect the line bundle and avoid direct contact.



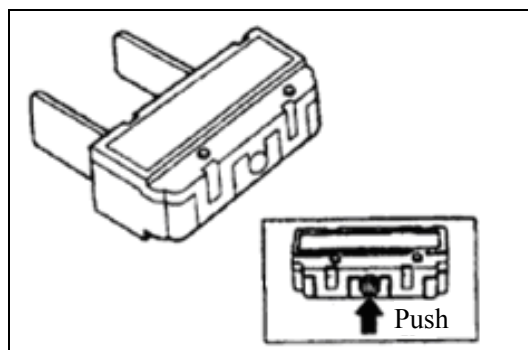
The line bundle between the engine and chassis should be long enough to avoid abrasion or damage owing to vibration.



Fuse:

Fuse is the most used circuit protection of vehicle circuit. When there is over current in the circuit, the fuse is blown to prevent the high current from damaging other parts in the circuit. Find out the cause of overload current and solve the problem before you replace the fuse.

Use new fuse of the same ampere to replace the original one. Otherwise, there will be line burning or other serious damage to the circuit.



Circuit breaker:

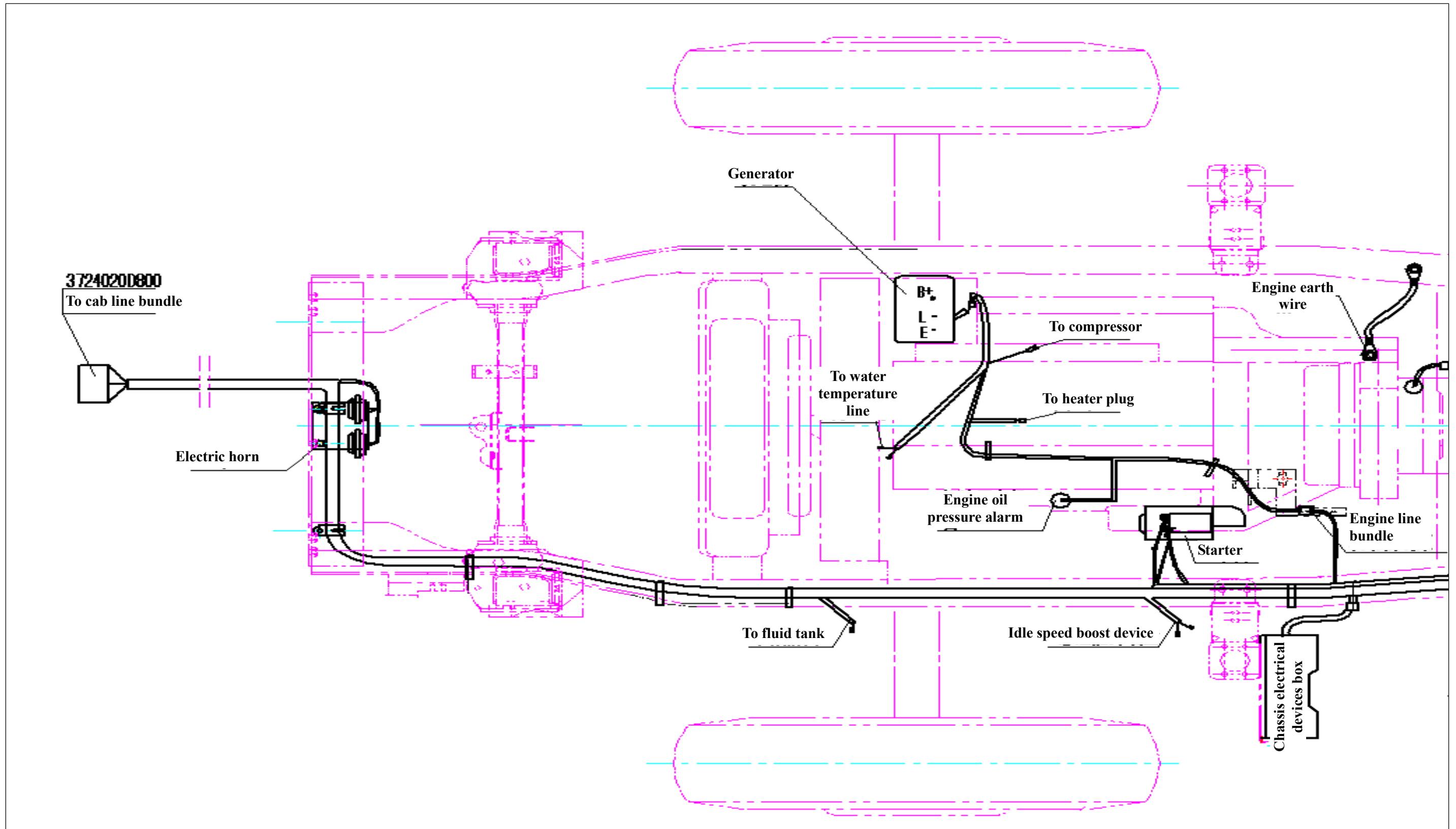
Breaker is a protective device to open the circuit when the load current exceeds the rated breaker capacity.

If there is short circuit or other form of overload, the over current will open the circuit on both sides of the breaker. When the circuit is open, the breaker button pops up.

Electrical System

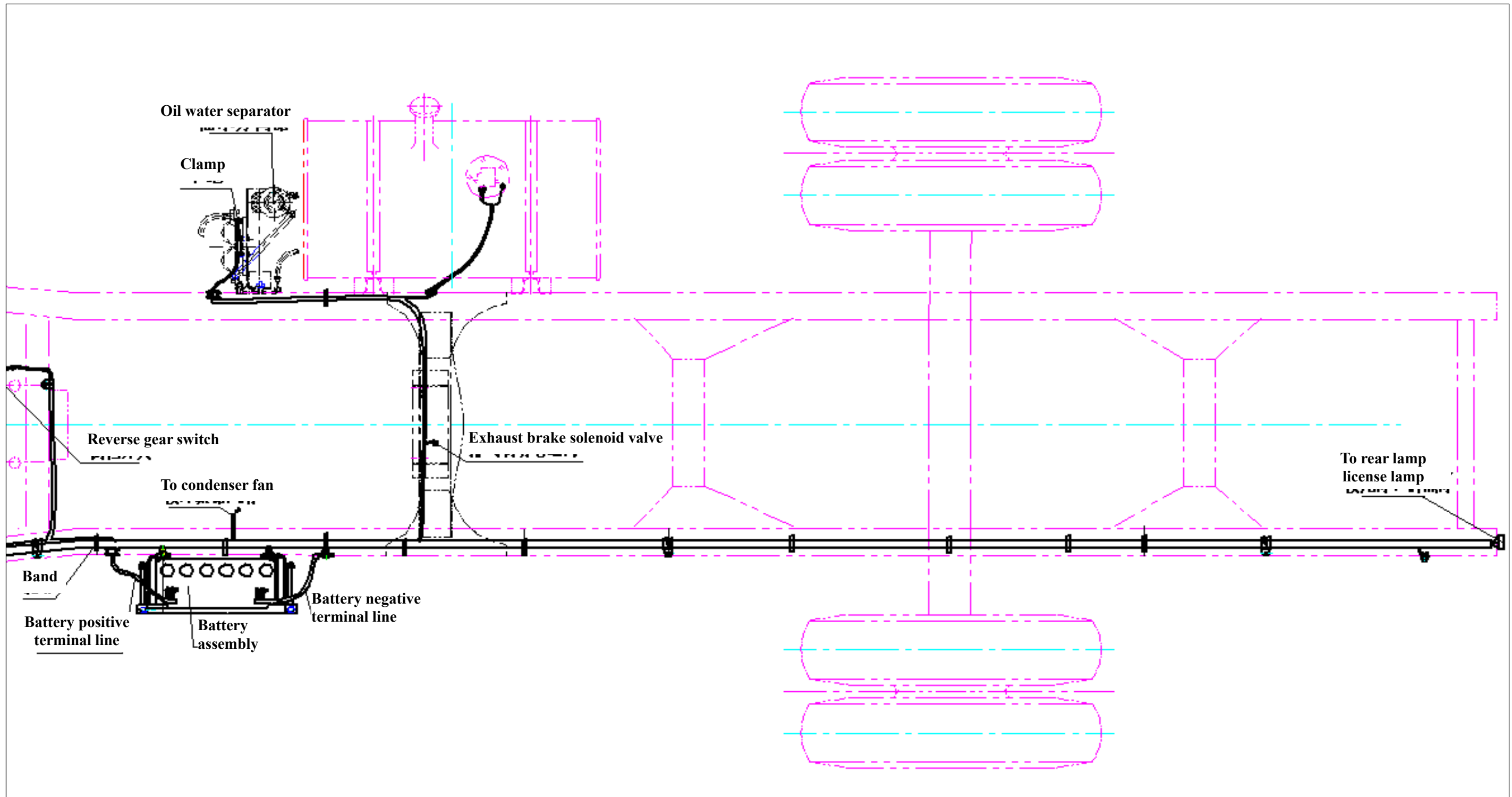
Chassis electrical device diagram:

Front side:



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Middle and rear side:



Electrical System

Air heating & air conditioning equipment

Generator

Technical parameters

Disassembling and reassembling

Troubleshooting

Electrical System

General

1. Air conditioner refrigeration cycle

1.1 main parts of refrigeration system

Refrigeration cycle system of integrated air conditioner (warming and cooling) of JAC vehicle mainly consists of compressor, compressor exhaust hose, condenser assembly, reservoir, HP hose, F type expansion valve, evaporator assembly, and LP hose. The reservoir assembly includes internal drier and filter etc., as well as HP/LP pressure switches, sight mirror and fusible plug installed on casing.

1.2 Refrigerating principle

The compressor sucks in and compresses low temperature, low pressure refrigerant gas to generate high temperature, high pressure refrigerant gas, which will be sent to condenser via HP hose for condensing, releasing heat to air passing condenser and being condensed to high pressure medium temperature liquid. This liquid flows to the reservoir where impurities in refrigerant are filtered and water content is removed, and then flows to expansion valve via HP hose, where it is changed to low pressure, low temperature liquid-gas mixture by throttling and depressurizing effect of the valve, and then enters the evaporator. This mixed refrigerant will evaporate in the evaporator and absorb heat from air inside vehicle and flowing pass the evaporator to become superheated gas, which will enter compressor for next refrigeration cycle. Air inside vehicle passing the evaporator will discharge heat to the evaporator and become cold air. In addition, since temperature of evaporator surface is lower than air dew point, water vapor in air will condense to become dew that will be drained outside the vehicle, hence reducing temperature and humidity of air inside vehicle. Fig.1 shows air conditioning refrigeration schematic diagram.

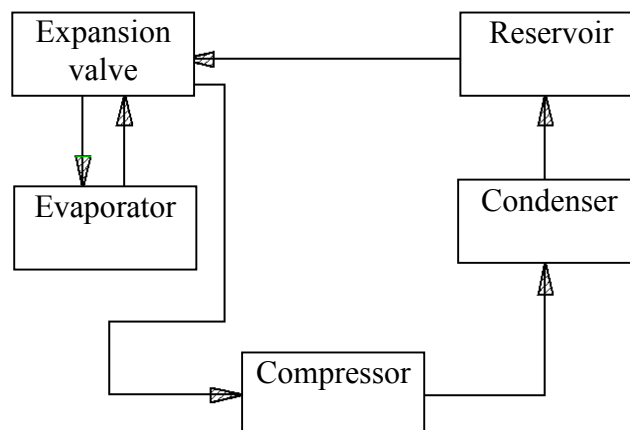


Fig.1 Air conditioning refrigeration schematic diagram

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2. Air conditioning warming cycle

2.1 Main parts of warming system

Warming cycle system of integrated air conditioner (warming and cooling) of JAC vehicle mainly consists of warm air blower, engine, water pump, water valve, water tank and pipelines etc.

2.2 Warming principle

By means of a water pump, hot coolant of engine is pumped into warm air blower core, where heat exchange occurs to release heat to air inside vehicle. Later, this coolant returns to the water tank and enters next warming cycle.

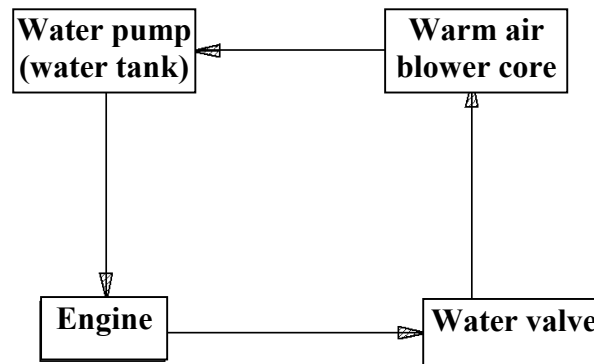


Fig.2 Air conditioning warming schematic diagram

3. Electric control

3.1 Main parts of electric control

The electric control mainly consists of power supply switch, electromagnetic clutch, controller, defrosting thermistor, defrosting temperature controller, HP/LP pressure switches, electric control box, governing resistor, and connection harness etc.

3.2 Electric control principle

The controller is the control center of air conditioning (refrigerating and warming parts). Electronic elements in the electric control box are used to control On/Off of refrigerating and warming, and adjustment of AC fan rotation speed and temperature.

The power supply switch is used to control driving power of the air conditioning. This switch is a main part of the controller and functions to turn AC on or off (also referred to as A/C switch). At gears 1, 2, 3 and 4, refrigeration will be executed.

3.2.1 Temperature control

The defrosting thermistor is a control element that senses temperature of discharged air from evaporator. It directly converts temperature to electric signal and transmits

Electrical System

this signal to the defrosting temperature controller inside electric control box. The defrosting temperature controller receives electric signal from defrosting thermistor and control On/Off of compressor EM clutch according to set parameters (i.e. On/Off of air conditioning refrigeration cycle), so as to control temperature inside the vehicle.

The electric control box is the execution center of air conditioning control. It receives commands from controller and feedback electric information from defrosting thermistor, and uses internal relays to control On/Off of compressor clutch.

3.2.2 Pressure protection control

The HP/LP pressure switch is a safety part used to ensure safe operation of refrigeration system. When the high pressure is $\geq 3.14\text{MPa}$ or low pressure is $\leq 0.2\text{MPa}$, this switch will be turned off, disengaging compressor clutch and stopping the refrigeration system. When system high pressure falls to 2.5MPa or system low pressure rises to 0.23MPa , this switch will be turned on, engaging compressor clutch and starting the refrigeration system.

Technical parameters

1. Technical parameters

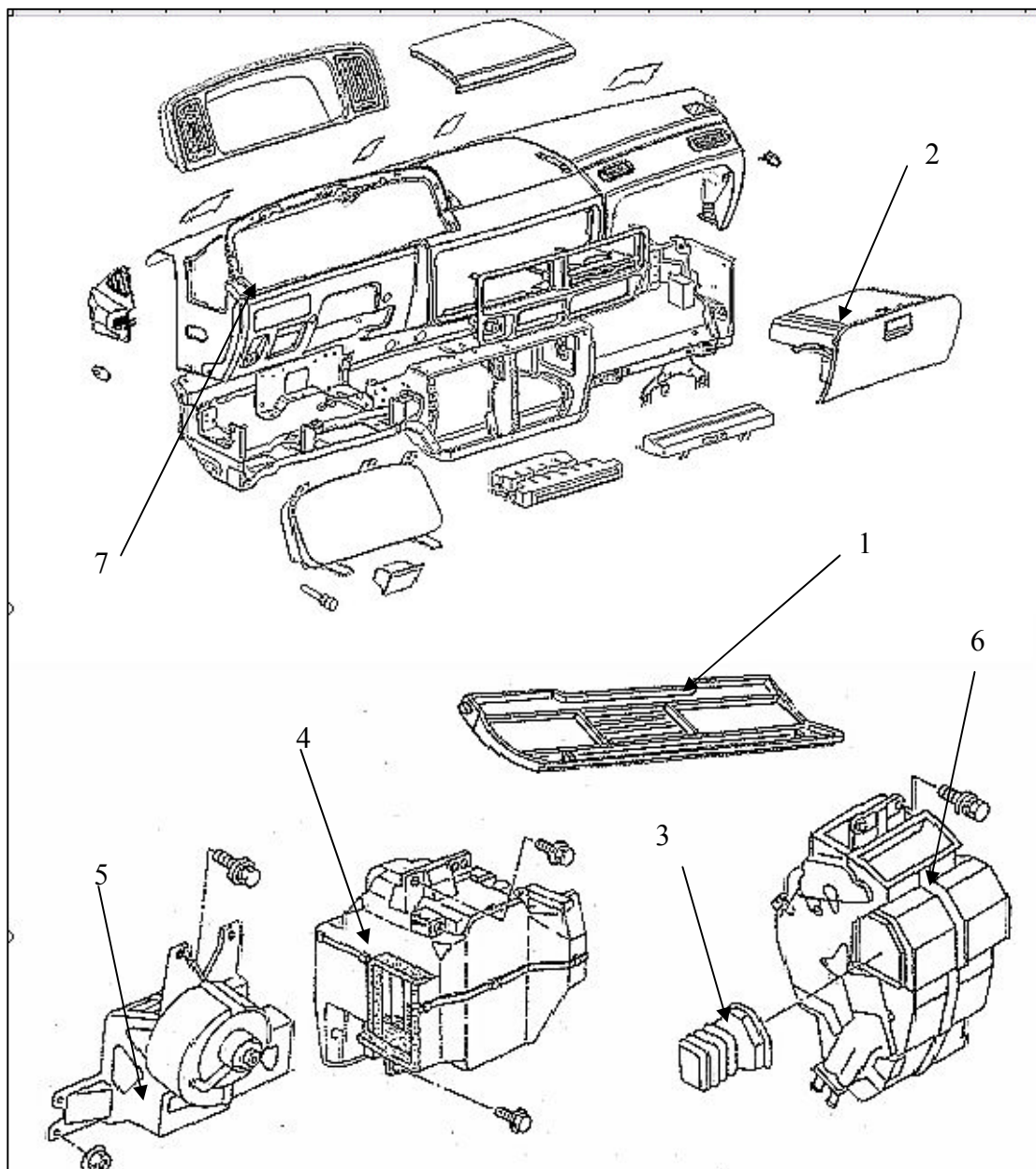
S/N	General item	Sub-item	Parameter
1	Cooling medium	Code	R134a
		Amount of filling	0.85kg
2	Refrigerating oil	Code	PAG56
		Amount of filling	150g
3	Compressor	Model	5H14
		Voltage	12V
		Displacement	$138\text{cm}^3/\text{r}$
4	Condenser with reservoir assembly	Condenser heat sinking capacity	9000W
		Voltage	12V
		Maximum current	15A
		Air flow	$1800\text{m}^3/\text{h}$
5	Front evaporator/heater assembly	Refrigerating capacity	3900W
		Heating capacity	4000W
		Voltage	12V
		Maximum current	18A
		Air flow	$350\text{m}^3/\text{h}$
7	2-state pressure switch	High pressure protection characteristics	Disconnected at $\geq 3.14\text{Mpa}$ Connected at $\leq 2.5\text{Mpa}$
		Low pressure protection	Disconnected at

Electrical System

		characteristics	≤0.2Mpa Connected at ≥0.23Mpa
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2. Structure of main parts of air conditioning

2.1 Heating equipment, blower equipment and evaporator



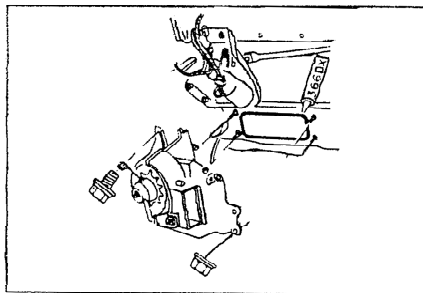
1. Lower cover; 2. Fuse and relay box; 3. Ventilating air duct; 4. Evaporator; 5. Blower; 6. Heating equipment; 7. Instrument stand

For removal of heating equipment, blower and evaporator from instrument stand, follow this sequence: 1. lower cover 2. fuse and relay box 3. →ventilating air duct→ 4. evaporator →5. blower → 6. heating equipment.

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Sequence of assembling is the reverse of this sequence. For tightening torques, refer to the table below:

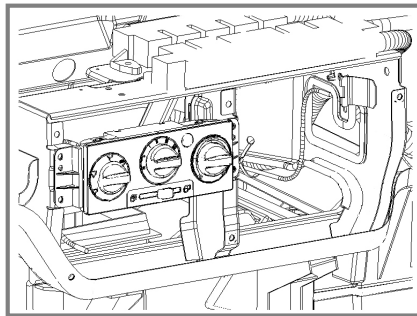
Diameter of thread (mm)	Pitch (mm)	Tightening torque (N·m)		
		Standard value	Maximum	Minimum
6	1	9	12	6
8	1.25	23	26	16
8	1	25	28	17
10	1.5	59	75	37
10	1.25	63	79	45
10	1	64	80	46
12	1.75	95	111	73
12	1.5	97	113	75
12	1.25	99	115	78



Important operation-assembling

- To assembly blower, prevent water leakage.

Sealant	Butyl rubber (none-dry type)
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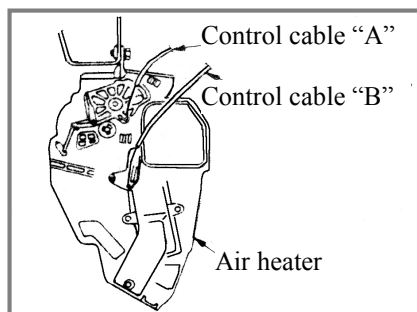


Air conditioning panel

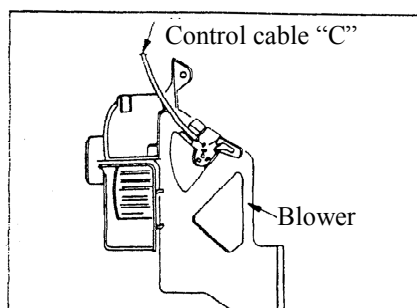
- Turn mode handle to left most (FACE direction);
- Turn temperature lever to left most (COLD direction);
- Turn inner/outer air control lever to left most (INSIDE direction)



- Hang control cable "C" on blower clip, press butterfly nut to bottom and fix cable on clip;
- Hang control cable "B" on heater clip, press butterfly nut to bottom and fix cable on clip.

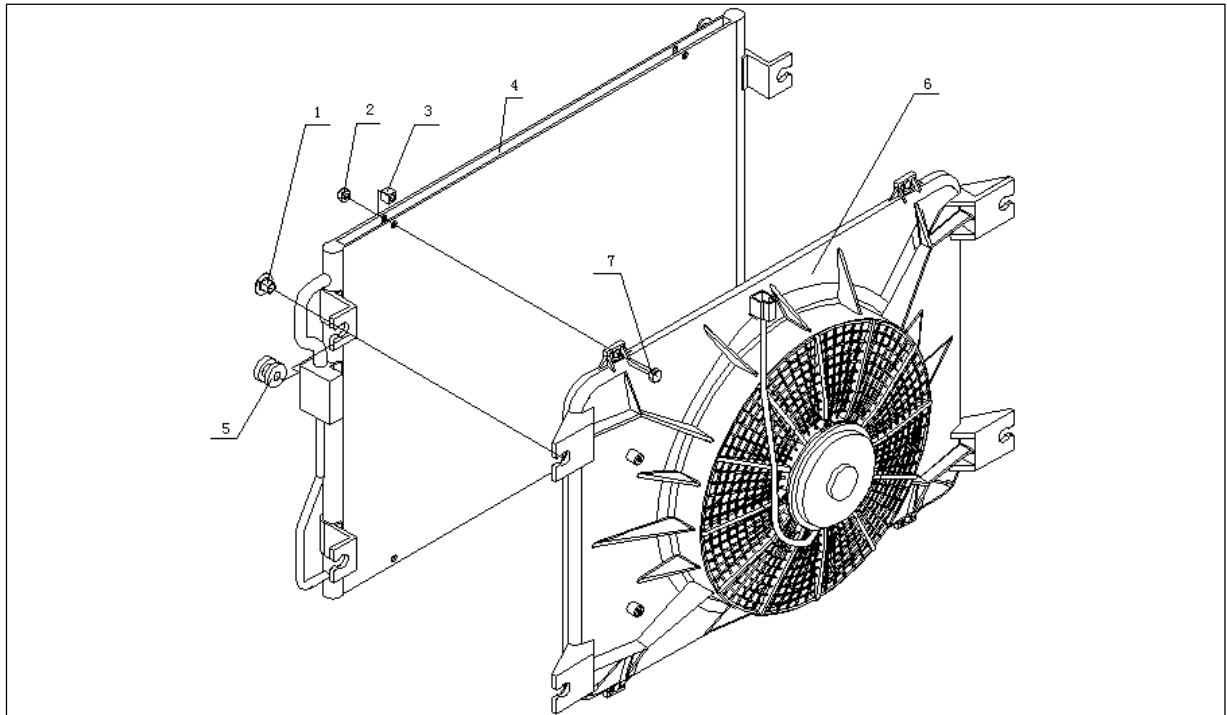


- Hang control cable "C" on blower clip, press butterfly nut to bottom and fix cable on clip



Electrical System

2.2 Structure of condenser assembly



1. Condenser damping pad sleeve;

2. Hex flanged face nut;

3. Pad;

4. Condenser core;

5. Condenser damping pad;

6. Condensing fan assembly;

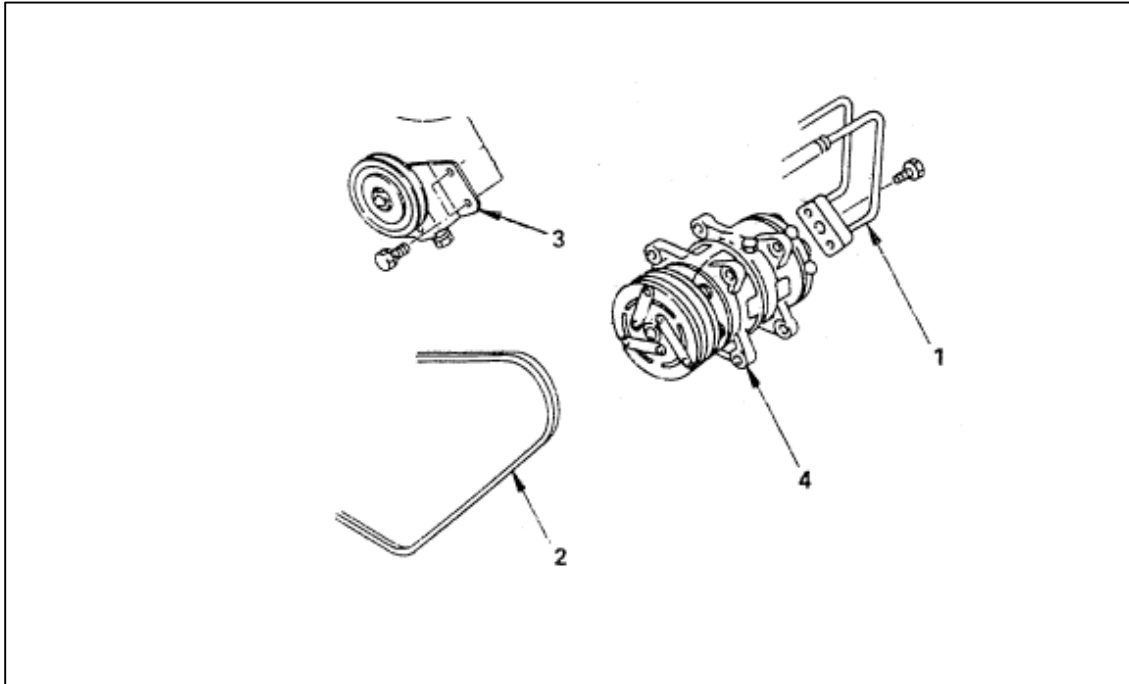
7. Bolt combination

Important operations

1. When removing pipe from each device, avoid damaging connecting nut or the pipe.
2. Cover pipe port with plastic cloth to avoid ingress of dust in pipe.

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2.3 Disassembling and assembling of compressor



Disassembling sequence:

1. Pipe
2. Belt
3. Idler
4. Compressor

Assembling sequence:

4. Compressor
3. Idler
2. Belt
1. Pipe

Important operations

1. To remove pipe from each device, avoid damaging connecting nut or the pipe.
2. Cover pipe port with plastic cloth to avoid ingress of dust in pipe.

Operation prompts

- 1.1 To avoid accidents and ensure safety of relevant personnel, non-discipline personnel must not perform disassembling or repair.
- 1.2 Use of open flame or smoking is prohibited.
- 1.3 Always wear working clothes during working. Ensure intact protective devices.
- 1.4 Perform operation in a well ventilated environment.
- 1.5 Before starting the engine, confirm that there is no tool, measuring instrument or other part on moving and rotating parts, and parts through which electric current flows.
- 1.6 Before start of engine, blow horns to warn operating workers and confirm safety.
- 1.7 To check electric lines, take care not to touch terminals or other parts through which electric current flows; otherwise short circuit may occur due to human body or

Electrical System

other part.

1.8 Use fuses of rated capacity. Avoid burning of electric devices such as relay and fire.

1.9 When using hose and hard pipeline, take care to avoid leakage of gas.

1.10 Thoroughly clean dust at hose or hard pipeline connecting part and inside pipelines; prevent gas leakage and abnormal operation.

1.11 Avoid water or oil etc. on fan, fan motor or V belt, so as to prevent damage and fire.

1.12 Before shutdown of air conditioner is confirmed, do not touch belt or fan to avoid injury.

1.13 Do not place refrigerant cans on engine or radiator, so as to prevent serious accident.

1.14 Do not subject refrigerant cans to direct sunshine, moisture, or temperatures exceeding 40°C, so as to prevent serious accident. Store these cans at a cool and dry place.

1.15 Store refrigerant cans where no fierce collision with other hard matter or iron ware etc. will occur, so as to avoid serious accident.

1.16 When handling refrigerant gas, wear protective goggles to avoid injury of eyes. In case such gas enters the eye, timely wash with large amount of clear water to prevent frostbite; if serious, go to hospital at once.

Items that must be inspected before AC system maintenance or diagnosis

2.1 Visually check hoses for damage and friction.

2.2 Ensure that condenser fins are not blocked by insects, impurities and dirt etc.,

2.3 And that fins have no apparent falling.

2.4 Correct operating direction of condenser fan.

2.5 No overheating of engine water tank.

2.6 Check tension of driving belt and for damage.

2.7 Operation of compressor.

2.8 Check for clogging of evaporator drain hose.

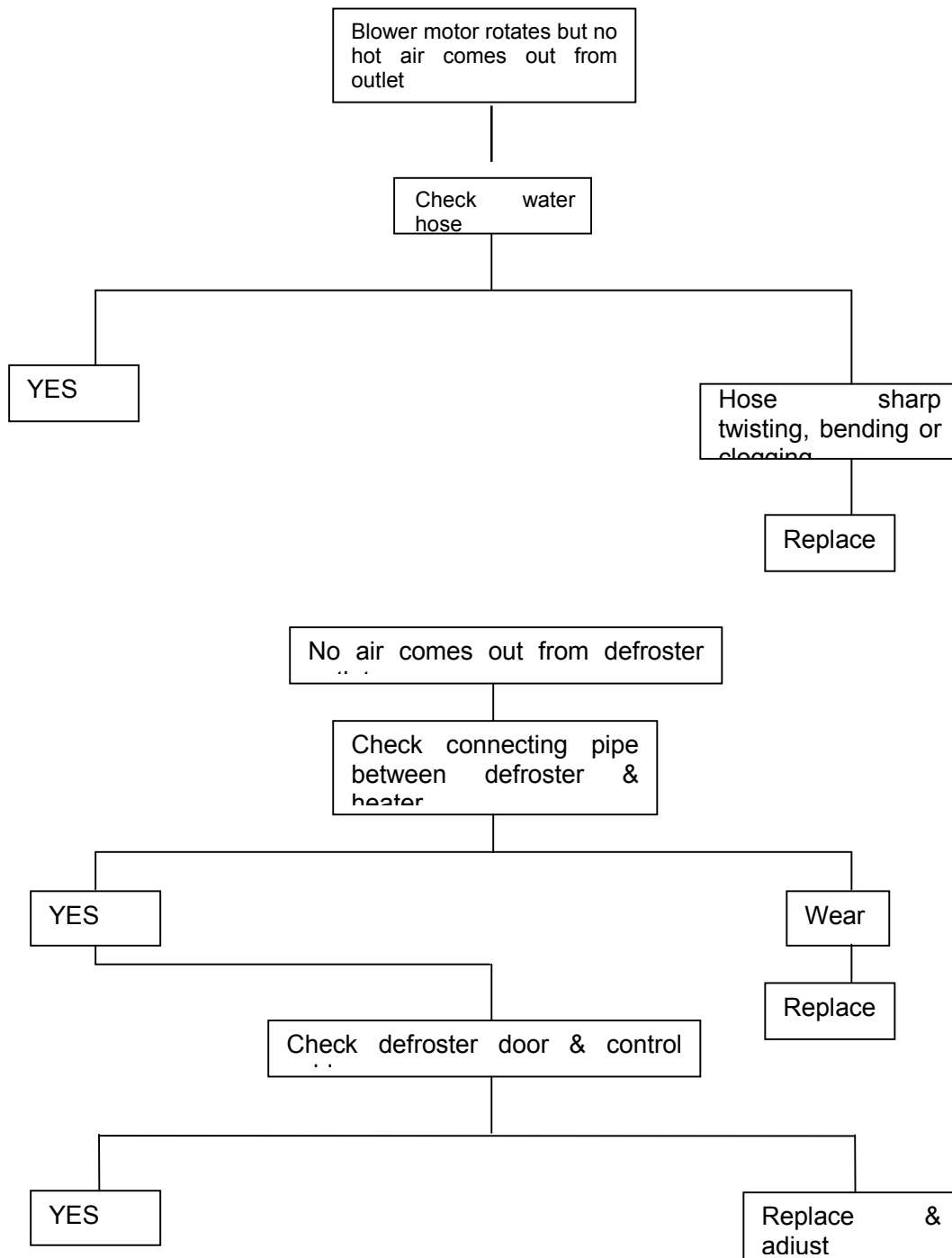
2.9 Check free action of switch at each air outlet.

2.10 Check if blower and evaporator fan can operate at specified fan speed.

2.11 Check that there is no apparent refrigerant leakage or oily dirt on device or pipeline connector.

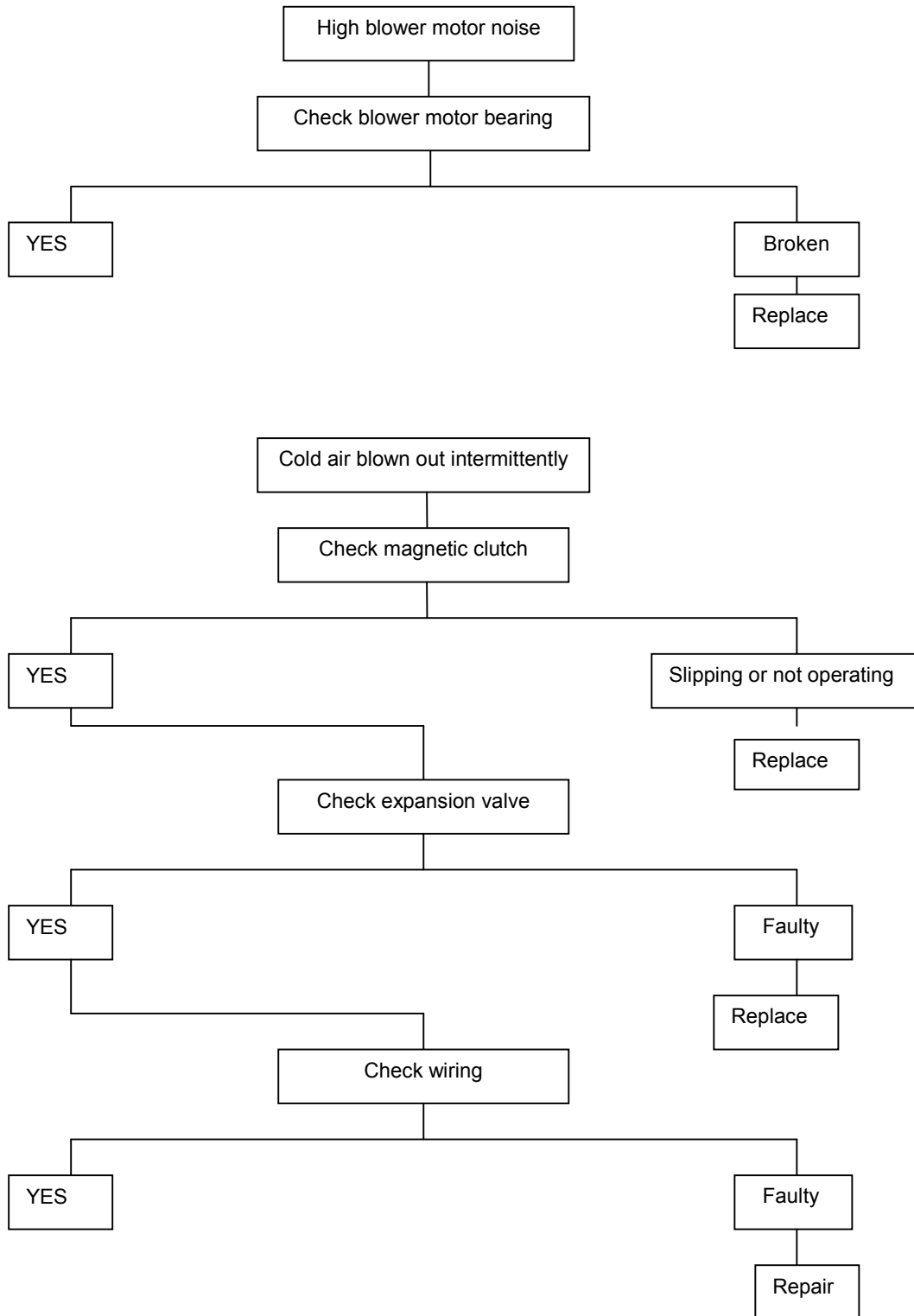
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Troubleshooting





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