

# SHOP MANUAL

# WB97R-5

## BACKHOE-LOADER

SERIAL NUMBER

**WB97R-5 F50003** and up







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## IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine.

The service and repair techniques recommended by Komatsu and describe in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed by Komatsu for the purpose.

To prevent injury to workers, the symbol  is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be carefully followed. If any danger arises or may possibly arise, first consider safety, and take necessary steps to face.



## SAFETY

### GENERAL PRECAUTIONS

Mistakes in operation extremely dangerous.

Read all the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions written on the decals which are stuck on the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
  - Always wear safety glasses when hitting parts with a hammer.
  - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

### PREPARATIONS FOR WORK

7. Before adding or making any repairs, park the machine on hard, level ground, and block the wheels to prevent the machine from moving.
8. Before starting work, lower outrigger, bucket or any other work equipment to the ground. If this is not possible, use blocks to prevent the work equipment from falling down. In addition, be sure to lock all the control levers and hang warning sign on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine.  
Never jump on or off the machine.  
If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

### PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.  
Before disconnecting or removing components of the hydraulic circuit and engine cooling circuit, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are not hot when the engine is stopped, so be careful not to get burned. Wait for the oil water to cool before carrying out any work on the cooling water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative ( - ) terminal first.

14. When raising heavy components, use a hoist or crane. Check that the wire rope, chains and hooks are free from damage.  
Always use lifting equipment which has ample capacity. Install the lifting equipment at the correct places.  
Use a hoist or crane and operate slowly to prevent the component from hitting any other part.  
Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring.  
Damage wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately.  
Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places. Replace any damage parts with new parts. When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly tightened.
21. When assembling or installing parts, always use specified tightening torques.  
When installing the parts which vibrate violently or rotate at high speed, be particularly careful to check that they are correctly installed.
22. When aligning two holes, never insert your fingers or hand.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurement.
24. Take sure when removing or installing wheels.

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## **FOREWORD**

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This shop manual has been prepared as an aid to improve the quality of repairs by giving the operator an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

The manual is divided into chapters on each main group of components; these chapters are further divided into the following sections.

### **STRUCTURE AND FUNCTION**

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

### **TESTING AND ADJUSTMENTS**

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating «Problems» to «Causes» are also included in this section.

### **REMOVAL AND INSTALLATION**

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

### **STANDARD MAINTENANCE**

This section gives the judgement standards when inspecting disassembled parts.

#### **NOTE**

**The specifications contained in this shop manual are subject to change at any time and without any notice.**

**Contact your Komatsu distributor for the latest information.**

## HOW TO READ THE SHOP MANUAL

### VOLUMES

Shop manual are issued as a guide to carry out repairs. These various volumes are designed to avoid duplicating the same information.

### DISTRIBUTION AND UPDATING

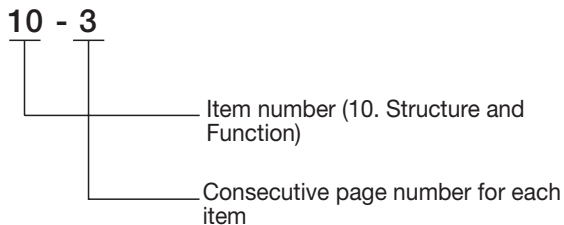
Any additions, amendments or other changes will be sent to Komatsu distributors.

Get the most up-to-date information before you start any work.

### FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.

2. Following examples show you how to read the page number.  
Example:



3. Additional pages: additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.

Example:

**10-4**  
**10-4-1**  
**10-4-2**  
**10-5**

Added pages

### REVISED EDITION MARK

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

### REVISIONS

Revised pages are shown on the LIST OF REVISED PAGES between the title page and SAFETY page.

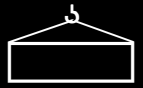
### SYMBOLS

In order to make the shop manual greatly helpful, important points about safety and quality are marked with the following symbols.

| Symbol | Item              | Remarks                                                                                                                |
|--------|-------------------|------------------------------------------------------------------------------------------------------------------------|
|        | Safety            | Special safety precautions are necessary when performing the work.                                                     |
|        |                   | Extra special safety precautions are necessary when performing the work because it is under internal pressure.         |
|        | Caution           | Special technical precautions or other precautions for preserving standards are necessary when performing the work.    |
|        | Weight            | Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc. |
|        | Tightening torque | Parts that require special attention for the tightening torque during assembly.                                        |
|        | Coat              | Parts to be coated with adhesives and lubricants etc.                                                                  |
|        | Oil, water        | Places where oil, water or fuel must be added, and their quantity.                                                     |
|        | Drain             | Places where oil or water must be drained, and quantity to be drained.                                                 |



# HOISTING INSTRUCTIONS



Heavy parts (25 kg or more) must be lifted with a hoist etc. In the Disassembly and Assembly section, every part weighing 25 kg or more is clearly indicated with the symbol

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
  - Check for removal of all bolts fastening the part to the relative parts.
  - Check for any part causing interference with the part to be removed.

## 2. Wire ropes

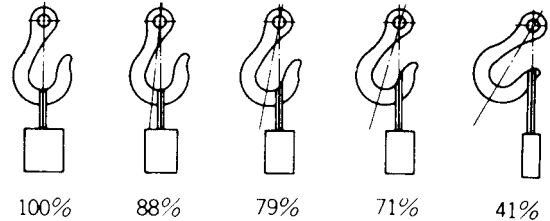
- 1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

| WIRE ROPES<br>(Standard «S» or «Z» twist ropes<br>without galvanizing) |                       |
|------------------------------------------------------------------------|-----------------------|
| Rope diameter (mm)                                                     | Allowable load (tons) |
| 10.0                                                                   | 1.0                   |
| 11.2                                                                   | 1.4                   |
| 12.5                                                                   | 1.6                   |
| 14.0                                                                   | 2.2                   |
| 16.0                                                                   | 2.8                   |
| 18.0                                                                   | 3.6                   |
| 20.0                                                                   | 4.4                   |
| 22.4                                                                   | 5.6                   |
| 30.0                                                                   | 10.0                  |
| 40.0                                                                   | 18.0                  |
| 50.0                                                                   | 28.0                  |
| 60.0                                                                   | 40.0                  |

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

- 2) Sling wire ropes from the middle portion of the hook. Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result.

Hooks have maximum strength at the middle portion.



- 3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.



Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can cause dangerous accidents.

- 4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.

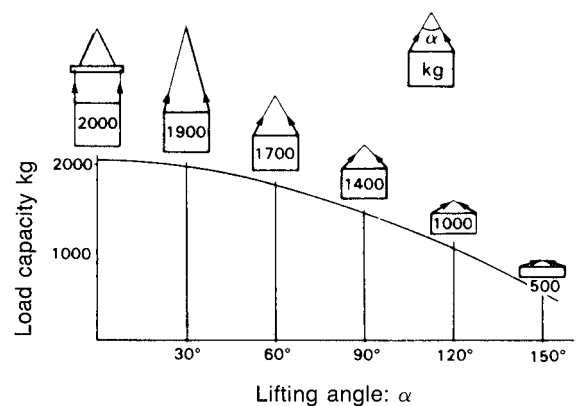
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles.

The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.

When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended.

This weight becomes 1000 kg when two ropes make a 120° hanging angle.

On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.

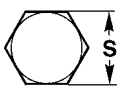




## STANDARD TIGHTENING TORQUE

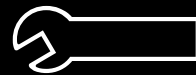
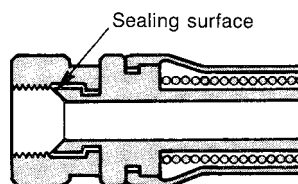
The following charts give the standard tightening torques of bolts and nuts.  
Exceptions are given in section of «Disassembly and Assembly».

### 1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUT

| Thread diameter of bolts (mm) | Pitch of bolts (mm) | Width across flat (mm)                                                            |                                                                                   | 8.8      |          | 10.9     |          |
|-------------------------------|---------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------|----------|----------|----------|
|                               |                     |  |  | kgm      | Nm       | kgm      | Nm       |
| 6                             | 1                   | 10                                                                                | 8                                                                                 | 0.96±0.1 | 9.5±1    | 1.3±0.15 | 13.5±1.5 |
| 8                             | 1.25                | 13                                                                                | 6                                                                                 | 2.3±0.2  | 23±2     | 3.2±0.3  | 32.2±3.5 |
| 10                            | 1.5                 | 17                                                                                | 8                                                                                 | 4.6±0.5  | 45±4.9   | 6.5±0.6  | 63±6.5   |
| 12                            | 1.75                | 19                                                                                | 10                                                                                | 7.8±0.8  | 77±8     | 11±1     | 108±11   |
| 14                            | 2                   | 22                                                                                | 12                                                                                | 12.5±1   | 122±13   | 17.5±2   | 172±18   |
| 16                            | 2                   | 24                                                                                | 14                                                                                | 19.5±2   | 191±21   | 27±3     | 268±29   |
| 18                            | 2.5                 | 27                                                                                | 14                                                                                | 27±3     | 262±28   | 37±4     | 366±36   |
| 20                            | 2.5                 | 30                                                                                | 17                                                                                | 38±4     | 372±40   | 53±6     | 524±57   |
| 22                            | 2.5                 | 32                                                                                | 17                                                                                | 52±6     | 511±57   | 73±8     | 719±80   |
| 24                            | 3                   | 36                                                                                | 19                                                                                | 66±7     | 644±70   | 92±10    | 905±98   |
| 27                            | 3                   | 41                                                                                | 19                                                                                | 96±10    | 945±100  | 135±15   | 1329±140 |
| 30                            | 3.5                 | 46                                                                                | 22                                                                                | 131±14   | 1287±140 | 184±20   | 1810±190 |
| 33                            | 3.5                 | 50                                                                                | 24                                                                                | 177±20   | 1740±200 | 250±27   | 2455±270 |
| 36                            | 4                   | 55                                                                                | 27                                                                                | 230±25   | 2250±250 | 320±35   | 3150±350 |
| 39                            | 4                   | 60                                                                                | —                                                                                 | 295±33   | 2900±330 | 410±45   | 4050±450 |

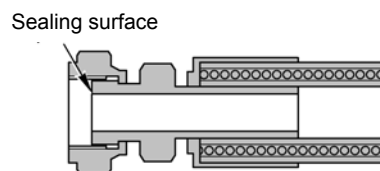
This torque table does not apply to bolts or nuts which have to fasten nylon or other parts non-ferrous metal washer.

★ Nm (newton meter): 1 Nm = 0.102 kgm


**2. TIGHTENING TORQUE FOR NUTS OF FLARED**


Use these torques for nut part of flared.

| Thread diameter<br>of nut part<br>(mm) | Width across flats<br>of nut part<br>(mm) | TIGHTENING TORQUE |            |
|----------------------------------------|-------------------------------------------|-------------------|------------|
|                                        |                                           | kgm               | Nm         |
| 1/2" - 20                              | 17                                        | 2.6±0.5           | 25.5±4.9   |
| 9/16" - 18                             | 17                                        | 4±0.5             | 39.2±4.9   |
| 3/4" - 16                              | 22                                        | 6.7±2             | 65.7±19.6  |
| 7/8" - 14                              | 27                                        | 8±2               | 78.5±19.6  |
| 1.1/16 - 12                            | 32                                        | 9.7±3             | 95.15±29.4 |
| 1.5/16 - 12                            | 38                                        | 17±3              | 166.7±29.4 |
| 1.5/8 - 12                             | 50                                        | 20±5              | 196.2±49   |
| 22                                     | 27                                        | 8±2               | 78.5±19.6  |
| 33                                     | 41                                        | 20±5              | 196.2±49   |



| Thread diameter<br>of nut part<br>(mm) | Width across flats<br>of nut part<br>(mm) | TIGHTENING TORQUE |         |
|----------------------------------------|-------------------------------------------|-------------------|---------|
|                                        |                                           | kgm               | Nm      |
| 9/16" - 18                             | 17                                        | 2.3-2.5           | 23-25   |
| 11/16" - 16                            | 22                                        | 3.4-3.9           | 33-38   |
| 13/16" - 16                            | 24                                        | 5.2-5.8           | 51-57   |
| 1" - 14                                | 30                                        | 8.2-9.2           | 80-90   |
| 1.3/16 - 12                            | 36                                        | 12.2-13.3         | 120-130 |
| 1.7/16 - 12                            | 41                                        | 15.3-17.3         | 150-170 |
| 1.11/16 - 12                           | 50                                        | 18.4-20.4         | 180-200 |
| 2" - 12                                | 57                                        | 20.4-24.4         | 200-240 |



## COATING MATERIALS

The recommended coating materials prescribed in Komatsu Shop Manuals are listed below:

| Nomenclature                                                        | Code        | Applications                                                                                                                                                                      |
|---------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Adhesives                                                           | ASL800010   | Used to apply rubber pads, rubber gaskets and cork plugs.                                                                                                                         |
|                                                                     | ASL800020   | Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.                                                                                  |
|                                                                     | Loctite 222 | Used for low resistance locking of screws, check nuts and adjustment nuts.                                                                                                        |
|                                                                     | Loctite 242 | To prevent the loosening of bolts, nuts and plugs and the leakage of oil. Used for medium resistance locking of screws and nuts of every type, and for locking keys and bearings. |
|                                                                     | Loctite 262 | Used for high resistant of threaded parts that can be removed with normal tools.                                                                                                  |
|                                                                     | Loctite 270 | Used for high resistant locking and for sealing threaded parts, bolts and stud bolts.                                                                                             |
|                                                                     | Loctite 542 | Used for sealing the union threads for hydraulic tubes.                                                                                                                           |
|                                                                     | Loctite 573 | Used for sealing rather exact plane surfaces when the option of possible future dismantling is required.                                                                          |
|                                                                     | Loctite 601 | Used for high resistant locking of mechanical components that can be removed only after heating                                                                                   |
|                                                                     | Loctite 675 | Used to lock cylindrical couplings and for the permanent locking of threaded parts, and also to lock shafts to bearings, gears, pulleys, pins, bushings, etc.                     |
| Gasket sealant                                                      | ASL800060   | Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.                                   |
|                                                                     | Loctite 510 | Used by itself on mounting flat surface<br>(Clearance between surfaces within 0.2 mm)                                                                                             |
|                                                                     | Loctite 518 | Used by itself on mounting flat surface<br>(Clearance between surfaces within 0.5 mm)                                                                                             |
| Antifriction compound<br>(Lubricant including Molybdenum disulfide) | ASL800040   | Applied to bearings and taper shaft to facilitate press-fitting and to prevent sticking, burning or rusting.                                                                      |
| Grease<br>(Lithium grease)                                          | ASL800050   | Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.                                                            |
| Vaseline                                                            | —           | Used for protecting battery electrode terminals from corrosion                                                                                                                    |

## ELECTRIC

## ELECTRIC

In the wiring diagrams various colour and symbols are employed to indicate the thickness of wires.

This wire code table will help you understand WIRING DIAGRAMS.

Example: R–N 1.5 indicates a cable having a nominal number 1.5 and red coating with black stripe.

**CLASSIFICATION BY THICKNESS**

| Nominal number | Copper wire    |                   |                    | Cable O.D. (mm) | Current rating (A) |
|----------------|----------------|-------------------|--------------------|-----------------|--------------------|
|                | Number strands | Ø of strands (mm) | Cross section (mm) |                 |                    |
| 0.5            | 16             | 0.20              | 0.35               | 1.55            | 3.5                |
| 1              | 14             | 0.30              | 0.99               | 2.80            | 11                 |
| 1.5            | 21             | 0.30              | 1.48               | 3.35            | 14                 |
| 2.5            | 35             | 0.30              | 2.47               | 3.80            | 20                 |
| 4              | 56             | 0.30              | 3.95               | 4.60            | 28                 |
| 6              | 84             | 0.30              | 5.93               | 5.20            | 37                 |
| 10             | 84             | 0.40              | 10.55              | 7.10            | 53                 |
| 50             | 399            | 0.40              | 50.11              | 14              | 160                |

**CLASSIFICATION BY COLOUR AND CODE**

|        | Primary    | Auxiliary          |     |                   |     |                  |     |                |     |                  |     |
|--------|------------|--------------------|-----|-------------------|-----|------------------|-----|----------------|-----|------------------|-----|
| Code   | A          | A–B                | A/B | A–G               | –   | A–N              | A/N | A–R            | A/R | A–V              | A/V |
| Colour | Light Blue | Light Blue – White |     | Light Blue–Yellow |     | Light Blue–Black |     | Light Blue–Red |     | Light Blue–Green |     |
| Code   | B          | B–G                | –   | B–N               | B/N | B–R              | B/R | –              | B/V | –                | –   |
| Colour | White      | White–Yellow       |     | White–Black       |     | White–Red        |     | White–Green    |     | –                |     |
| Code   | C          | C–B                | C/B | C–L               | –   | C–N              | –   | –              | –   | –                | –   |
| Colour | Orange     | Orange–White       |     | Orange–Blue       |     | Orange–Black     |     | –              |     | –                |     |
| Code   | G          | G–N                | G/N | G–R               | –   | G–V              | –   | –              | –   | –                | –   |
| Colour | Yellow     | Yellow–Black       |     | Yellow–Red        |     | Yellow–Green     |     | –              |     | –                |     |
| Code   | H          | H–L                | –   | H–N               | H/N | –                | –   | –              | –   | –                | –   |
| Colour | Grey       | Grey–Blue          |     | Grey–Black        |     | –                |     | –              |     | –                |     |
| Code   | L          | L–B                | L/B | L–G               | –   | –                | L/N | –              | –   | –                | –   |
| Colour | Blue       | Blue–White         |     | Blue–Yellow       |     | Blue–Black       |     | –              |     | –                |     |
| Code   | M          | M–B                | –   | M–N               | M/N | M–V              | –   | –              | –   | –                | –   |
| Colour | Brown      | Brown–White        |     | Brown–Black       |     | Brown–Green      |     | –              |     | –                |     |
| Code   | N          | –                  | –   | –                 | –   | –                | –   | –              | –   | –                | –   |
| Colour | Black      | –                  |     | –                 |     | –                |     | –              |     | –                |     |
| Code   | R          | R–G                | –   | R–N               | R/N | R–V              | –   | –              | –   | –                | –   |
| Colour | Red        | Red–Yellow         |     | Red–Black         |     | Red–Green        |     | –              |     | –                |     |
| Code   | S          | S–G                | –   | S–N               | –   | –                | –   | –              | –   | –                | –   |
| Colour | Pink       | Pink–Yellow        |     | Pink–Black        |     | –                |     | –              |     | –                |     |
| Code   | V          | V–B                | –   | V–N               | V/N | –                | –   | –              | –   | –                | –   |
| Colour | Green      | Green–White        |     | Green–Black       |     | –                |     | –              |     | –                |     |
| Code   | Z          | Z–B                | Z/B | Z–N               | Z/N | –                | –   | –              | –   | –                | –   |
| Colour | Violet     | Violet–White       |     | Violet–Black      |     | –                |     | –              |     | –                |     |

**COMPOSITION OF THE COLOURS**

The coloration of two-colour wires is indicated by the composition of the symbol listed.

Example: G–V = Yellow-Green with longitudinal colouring

G/V = Yellow-Green with transversal colouring

## WEIGHT TABLE

 This weight table is a guide for use when transporting or handling components.

Unit: kg

| Machine model                            | WB97R-5 |
|------------------------------------------|---------|
| Engine assembly - Muffler - Exhaust pipe | 394     |
| Radiator - exchanger                     |         |
| Hydraulic oil tank (empty)               | 10      |
| Fuel tank (empty)                        | 68      |
| Front counterweight                      | 372     |
| Engine hood                              | 32      |
| Cabin (without seat)                     |         |
| Seat                                     |         |
| Engine-gear box-pump group               |         |
| Piston pump                              | 36.8    |
| Transmission                             | 254     |
| Front axle                               | 295     |
| Rear axle                                | 435     |
| Front wheel                              |         |
| Rear wheel                               |         |
| Work equipment                           | 1100    |
| • Boom                                   | 313     |
| • Shovel                                 | 436     |
| • Fulcrum lever                          | 13x4    |
| • Tilt lever                             | 32.5x2  |
| • Raise cylinder                         | 46x2    |
| • Tilt cylinder                          | 35x2    |
| Work equipment                           |         |
| • with standard arm                      | 850     |
| • with long arm                          | 885     |
| • with jig arm                           | 1030    |
| Boom                                     | 248     |
| Arm                                      |         |
| Long arm                                 |         |
| Boom swing bracket                       | 162.5   |
| Backframe                                | 246     |
| Control valve (8-spool)                  |         |
| Control valve (10-spool)                 |         |
| Jig arm                                  | 460     |
| Outriggers                               | 39x2    |
| Boom cylinder                            | 87.5    |
| Arm cylinder                             | 67      |
| Bucket cylinder                          | 52.5    |
| Outriggers cylinder                      | 27.5x2  |
| Swing cylinder                           | 34x2    |
| Bucket                                   | 158     |

## TABLE OF OIL AND COOLANT QUANTITIES

| TANK /<br>RESERVOIR                               | FLUID                                                             | AMBIENT TEMPERATURE |     |     |   |    |    |    |    |       |  | CAPACITY (l)            |        |
|---------------------------------------------------|-------------------------------------------------------------------|---------------------|-----|-----|---|----|----|----|----|-------|--|-------------------------|--------|
|                                                   |                                                                   | -30                 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 °C |  | 1 <sup>st</sup> filling | Change |
| Engine oil pan                                    | OIL<br>ACEA E5 - E4                                               |                     |     |     |   |    |    |    |    |       |  | 13                      | 13     |
|                                                   | OIL<br>API CI-4<br>ACEA E7                                        |                     |     |     |   |    |    |    |    |       |  |                         |        |
| Hydraulic system                                  | OIL API<br>CF - CF2 - CD                                          |                     |     |     |   |    |    |    |    |       |  | 98                      | 40     |
| Hydraulic system with biodegradable oil           |                                                                   |                     |     |     |   |    |    |    |    |       |  | 98                      | 40     |
| Front axle: Differential                          | OIL<br>UTTO FLUID                                                 |                     |     |     |   |    |    |    |    |       |  | 7                       | 7      |
| Final reduction gear (ea)                         |                                                                   |                     |     |     |   |    |    |    |    |       |  | 0.75                    | 0.75   |
| Rear axle: Differential and final reduction gears |                                                                   |                     |     |     |   |    |    |    |    |       |  | 15                      | 15     |
| Hydraulic transmission                            | OIL GM<br>DEXRON® II D                                            |                     |     |     |   |    |    |    |    |       |  | 20                      | 20     |
| Braking system                                    | (DEXRON® is a registered trademark of General Motors Corporation) |                     |     |     |   |    |    |    |    |       |  | 0.8                     | 0.8    |
| Fuel tank                                         | DIESEL OIL                                                        |                     | ★   |     |   |    |    |    |    |       |  | 150                     | —      |
| Engine cooling system                             | PERMANENT COOLANT (★★)                                            |                     |     |     |   |    |    |    |    |       |  | 15                      | —      |

★ ASTM D975 N. 1

★★ Special red permanent antifreeze suitable for aluminium radiators. If pure, dilute with water (50%).

## TABLE OF OIL AND COOLANT QUANTITIES

ASTM: America Society of Testing and Materials

SAE: Society of Automotive Engineers

API: American Petroleum Institute

MIL: Military Specification

CCMC: Common Market Constructors Committee

First filling quantity:

total quantity of oil, including the oil for the components and pipes.

Oil change quantity:

quantity of oil necessary to fill the system or unit during the normal inspection and maintenance operations.

### NOTE:

- (1) When the diesel oil sulphur content is less than 0.5%, change the engine oil according to the periodic maintenance intervals indicated in the operation and maintenance manual. In the diesel oil sulphur content exceeds 0.5% change the engine oil according to the following table:

| Sulphur content  | Engine oil change interval |
|------------------|----------------------------|
| from 0.5 to 1.0% | 1/2 of regular interval    |
| over 1.0%        | 1/4 of regular interval    |

- (2) When starting the engine at temperatures below 0 °C, use engine oil SAE 10W, 20W-20, even if during the day the temperature increases by 10 °C.
- (3) Use engine oil with CD classification; if oil with CC classification is used, reduce the engine oil change interval by a half.
- (4) Use original products, which have characteristics specifically formulated and approved for the engine, the hydraulic circuit of equipment and for reductions.



## CONVERSION TABLE

### METHOD OF USING THE CONVERSION TABLE

The conversion table in this section is provided to enable simple conversion of figures.  
For details of the method of using the conversion table, see the example given below.

#### EXAMPLE

- Method of using the conversion table to convert from millimeters to inches.

#### 1. Convert 55 mm into inches.

- 1 - Locate the number 50 in the vertical column at the left side, take this as (A), then draw a horizontal line from (A).
- 2 - Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).
- 3 - Take the point where the two lines cross as (C). This point (C) gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 in.

#### 2. Convert 550 mm into inches

- 1 - The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
- 2 - Carry out the same procedure as above to convert 55 mm to 2.165 in.
- 3 - The original value (550 mm) was divided by 10, so multiply 2.165 in. by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 in.

From millimeters to inches

1 mm = 0.03937 in.

|    | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0  | 0     | 0.039 | 0.079 | 0.118 | 0.157 | 0.197 | 0.236 | 0.276 | 0.315 | 0.354 |
| 10 | 0.394 | 0.433 | 0.472 | 0.512 | 0.551 | 0.591 | 0.630 | 0.669 | 0.709 | 0.748 |
| 20 | 0.787 | 0.827 | 0.866 | 0.906 | 0.945 | 0.984 | 1.024 | 1.063 | 1.102 | 1.142 |
| 30 | 1.181 | 1.220 | 1.260 | 1.299 | 1.339 | 1.378 | 1.417 | 1.457 | 1.496 | 1.536 |
| 40 | 1.575 | 1.614 | 1.654 | 1.693 | 1.732 | 1.772 | 1.811 | 1.850 | 1.890 | 1.929 |
| 50 | 1.969 | 2.008 | 2.047 | 2.087 | 2.126 | 2.165 | 2.205 | 2.244 | 2.283 | 2.323 |
| 60 | 2.362 | 2.402 | 2.441 | 2.480 | 2.520 | 2.559 | 2.598 | 2.638 | 2.677 | 2.717 |
| 70 | 2.756 | 2.795 | 2.835 | 2.874 | 2.913 | 2.953 | 2.992 | 3.032 | 3.071 | 3.110 |
| 80 | 3.150 | 3.189 | 3.228 | 3.268 | 3.307 | 3.346 | 3.386 | 3.425 | 3.465 | 3.504 |
| 90 | 3.543 | 3.583 | 3.622 | 3.661 | 3.701 | 3.740 | 3.780 | 3.819 | 3.858 | 3.898 |

**CONVERSION TABLE****From mm to in.**

1 mm = 0.03937 in.

|    | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0  | 0     | 0.039 | 0.079 | 0.118 | 0.157 | 0.197 | 0.236 | 0.276 | 0.315 | 0.354 |
| 10 | 0.394 | 0.433 | 0.472 | 0.512 | 0.551 | 0.591 | 0.630 | 0.669 | 0.709 | 0.748 |
| 20 | 0.787 | 0.827 | 0.866 | 0.906 | 0.945 | 0.984 | 1.024 | 1.063 | 1.102 | 1.142 |
| 30 | 1.181 | 1.220 | 1.260 | 1.299 | 1.339 | 1.378 | 1.417 | 1.457 | 1.496 | 1.536 |
| 40 | 1.575 | 1.614 | 1.654 | 1.693 | 1.732 | 1.772 | 1.811 | 1.850 | 1.890 | 1.929 |
| 50 | 1.969 | 2.008 | 2.047 | 2.087 | 2.126 | 2.165 | 2.205 | 2.244 | 2.283 | 2.323 |
| 60 | 2.362 | 2.402 | 2.441 | 2.480 | 2.520 | 2.559 | 2.598 | 2.638 | 2.677 | 2.717 |
| 70 | 2.756 | 2.795 | 2.835 | 2.874 | 2.913 | 2.953 | 2.992 | 3.032 | 3.071 | 3.110 |
| 80 | 3.150 | 3.189 | 3.228 | 3.268 | 3.307 | 3.346 | 3.386 | 3.425 | 3.465 | 3.504 |
| 90 | 3.543 | 3.583 | 3.622 | 3.661 | 3.701 | 3.740 | 3.780 | 3.819 | 3.858 | 3.898 |

**From kg to lb.**

1 kg = 2.2046 lb.

|    | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | 0      | 2.20   | 4.41   | 6.61   | 8.82   | 11.02  | 13.23  | 15.43  | 17.64  | 19.84  |
| 10 | 22.05  | 24.25  | 26.46  | 28.66  | 30.86  | 33.07  | 35.27  | 37.48  | 39.68  | 41.89  |
| 20 | 44.09  | 46.30  | 48.50  | 50.71  | 51.91  | 55.12  | 57.32  | 59.53  | 61.73  | 63.93  |
| 30 | 66.14  | 68.34  | 70.55  | 72.75  | 74.96  | 77.16  | 79.37  | 81.57  | 83.78  | 85.98  |
| 40 | 88.18  | 90.39  | 92.59  | 94.80  | 97.00  | 99.21  | 101.41 | 103.62 | 105.82 | 108.03 |
| 50 | 110.23 | 112.44 | 114.64 | 116.85 | 119.05 | 121.24 | 123.46 | 125.66 | 127.87 | 130.07 |
| 60 | 132.28 | 134.48 | 136.69 | 138.89 | 141.10 | 143.30 | 145.51 | 147.71 | 149.91 | 152.12 |
| 70 | 154.32 | 156.53 | 158.73 | 160.94 | 163.14 | 165.35 | 167.55 | 169.76 | 171.96 | 174.17 |
| 80 | 176.37 | 178.57 | 180.78 | 182.98 | 185.19 | 187.39 | 189.60 | 191.80 | 194.01 | 196.21 |
| 90 | 198.42 | 200.62 | 202.83 | 205.03 | 207.24 | 209.44 | 211.64 | 213.85 | 216.05 | 218.26 |

**CONVERSION TABLE**
**From liter to U.S. Gall.**
 $1 \ell = 0.2642 \text{ U.S. Gall.}$ 

|    | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | 0      | 0.264  | 0.528  | 0.793  | 1.057  | 1.321  | 1.585  | 1.849  | 2.113  | 2.378  |
| 10 | 2.642  | 2.906  | 3.170  | 3.434  | 3.698  | 3.963  | 4.227  | 4.491  | 4.755  | 5.019  |
| 20 | 5.283  | 5.548  | 5.812  | 6.076  | 6.340  | 6.604  | 6.869  | 7.133  | 7.397  | 7.661  |
| 30 | 7.925  | 8.189  | 8.454  | 8.718  | 8.982  | 9.246  | 9.510  | 9.774  | 10.039 | 10.303 |
| 40 | 10.567 | 10.831 | 11.095 | 11.359 | 11.624 | 11.888 | 12.152 | 12.416 | 12.680 | 12.944 |
| 50 | 13.209 | 13.473 | 13.737 | 14.001 | 14.265 | 14.529 | 14.795 | 15.058 | 15.322 | 15.586 |
| 60 | 15.850 | 16.115 | 16.379 | 16.643 | 16.907 | 17.171 | 17.435 | 17.700 | 17.964 | 18.228 |
| 70 | 18.492 | 18.756 | 19.020 | 19.285 | 19.549 | 19.813 | 20.077 | 20.341 | 20.605 | 20.870 |
| 80 | 21.134 | 21.398 | 21.662 | 21.926 | 22.190 | 22.455 | 22.719 | 22.983 | 23.247 | 23.511 |
| 90 | 23.775 | 24.040 | 24.304 | 24.568 | 24.832 | 25.096 | 25.361 | 25.625 | 25.889 | 26.153 |

**From liter to U.K. Gall.**
 $1 \ell = 0.21997 \text{ U.K. Gall.}$ 

|    | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | 0      | 0.220  | 0.440  | 0.660  | 0.880  | 1.100  | 1.320  | 1.540  | 1.760  | 1.980  |
| 10 | 2.200  | 2.420  | 2.640  | 2.860  | 3.080  | 3.300  | 3.520  | 3.740  | 3.950  | 4.179  |
| 20 | 4.399  | 4.619  | 4.839  | 5.059  | 5.279  | 5.499  | 5.719  | 5.939  | 6.159  | 6.379  |
| 30 | 6.599  | 6.819  | 7.039  | 7.259  | 7.479  | 7.699  | 7.919  | 8.139  | 8.359  | 8.579  |
| 40 | 8.799  | 9.019  | 9.239  | 9.459  | 9.679  | 9.899  | 10.119 | 10.339 | 10.559 | 10.778 |
| 50 | 10.998 | 11.281 | 11.438 | 11.658 | 11.878 | 12.098 | 12.318 | 12.528 | 12.758 | 12.978 |
| 60 | 13.198 | 13.418 | 13.638 | 13.858 | 14.078 | 14.298 | 14.518 | 14.738 | 14.958 | 15.178 |
| 70 | 15.398 | 15.618 | 15.838 | 16.058 | 16.278 | 16.498 | 16.718 | 16.938 | 17.158 | 17.378 |
| 80 | 17.598 | 17.818 | 18.037 | 18.257 | 18.477 | 18.697 | 18.917 | 19.137 | 19.357 | 19.577 |
| 90 | 19.797 | 20.017 | 20.237 | 20.457 | 20.677 | 20.897 | 21.117 | 21.337 | 21.557 | 21.777 |

**CONVERSION TABLE**
**From Nm to lb.ft.**

1 Nm = 0.737 lb.ft.

|     | 0       | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0   | 0       | 0.737   | 1.474   | 2.211   | 2.948   | 3.685   | 4.422   | 5.159   | 5.896   | 6.633   |
| 10  | 7.370   | 8.107   | 8.844   | 9.581   | 10.318  | 11.055  | 11.792  | 12.529  | 13.266  | 14.003  |
| 20  | 14.740  | 15.477  | 16.214  | 16.951  | 17.688  | 18.425  | 19.162  | 19.899  | 20.636  | 21.373  |
| 30  | 22.110  | 22.847  | 23.584  | 24.321  | 25.058  | 25.795  | 26.532  | 27.269  | 28.006  | 28.743  |
| 40  | 29.480  | 30.217  | 30.954  | 31.691  | 32.428  | 33.165  | 33.902  | 34.639  | 35.376  | 36.113  |
| 50  | 36.850  | 37.587  | 38.324  | 39.061  | 39.798  | 40.535  | 41.272  | 42.009  | 42.746  | 43.483  |
| 60  | 44.220  | 44.957  | 45.694  | 46.431  | 47.168  | 47.905  | 48.642  | 49.379  | 50.116  | 50.853  |
| 70  | 51.590  | 52.327  | 53.064  | 53.801  | 54.538  | 55.275  | 56.012  | 56.749  | 57.486  | 58.223  |
| 80  | 58.960  | 59.697  | 60.434  | 61.171  | 61.908  | 62.645  | 63.382  | 64.119  | 64.856  | 65.593  |
| 90  | 66.330  | 67.067  | 67.804  | 68.541  | 69.278  | 70.015  | 70.752  | 71.489  | 72.226  | 72.963  |
| 100 | 73.700  | 74.437  | 75.174  | 75.911  | 76.648  | 77.385  | 78.122  | 78.859  | 79.596  | 80.333  |
| 110 | 81.070  | 81.807  | 82.544  | 83.281  | 84.018  | 84.755  | 85.492  | 86.229  | 86.966  | 87.703  |
| 120 | 88.440  | 89.177  | 89.914  | 90.651  | 91.388  | 92.125  | 92.862  | 93.599  | 94.336  | 95.073  |
| 130 | 95.810  | 96.547  | 97.284  | 98.021  | 98.758  | 99.495  | 100.232 | 100.969 | 101.706 | 102.443 |
| 140 | 103.180 | 103.917 | 104.654 | 105.391 | 106.128 | 106.865 | 107.602 | 108.339 | 109.076 | 109.813 |
| 150 | 110.550 | 111.287 | 112.024 | 112.761 | 113.498 | 114.235 | 114.972 | 115.709 | 116.446 | 117.183 |
| 160 | 117.920 | 118.657 | 119.394 | 120.131 | 120.868 | 121.605 | 122.342 | 123.079 | 123.816 | 124.553 |
| 170 | 125.290 | 126.027 | 126.764 | 127.501 | 128.238 | 128.975 | 129.712 | 130.449 | 131.186 | 131.923 |
| 180 | 132.660 | 133.397 | 134.134 | 134.871 | 135.608 | 136.345 | 137.082 | 137.819 | 138.556 | 139.293 |
| 190 | 140.030 | 140.767 | 141.504 | 142.241 | 142.978 | 143.715 | 144.452 | 145.189 | 145.926 | 146.663 |

**CONVERSION TABLE****From Nm to kgm**

1 Nm = 0.102 kgm

|     | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0   | 0      | 0.102  | 0.204  | 0.306  | 0.408  | 0.510  | 0.612  | 0.714  | 0.816  | 0.918  |
| 10  | 1.020  | 1.222  | 1.224  | 1.326  | 1.428  | 1.530  | 1.632  | 1.734  | 1.836  | 1.938  |
| 20  | 2.040  | 2.142  | 2.244  | 2.346  | 2.448  | 2.550  | 2.652  | 2.754  | 2.856  | 2.958  |
| 30  | 3.060  | 3.162  | 3.264  | 3.366  | 3.468  | 3.570  | 3.672  | 3.774  | 3.876  | 3.978  |
| 40  | 4.080  | 4.182  | 4.284  | 4.386  | 4.488  | 4.590  | 4.692  | 4.794  | 4.896  | 4.998  |
| 50  | 5.100  | 5.202  | 5.304  | 5.406  | 5.508  | 5.610  | 5.712  | 5.814  | 5.916  | 6.018  |
| 60  | 6.120  | 6.222  | 6.324  | 6.426  | 6.528  | 6.630  | 6.732  | 6.834  | 6.936  | 7.038  |
| 70  | 7.140  | 7.242  | 7.344  | 7.446  | 7.548  | 7.650  | 7.752  | 7.854  | 7.956  | 8.058  |
| 80  | 8.160  | 8.262  | 8.364  | 8.466  | 8.568  | 8.670  | 8.772  | 8.874  | 8.976  | 9.078  |
| 90  | 9.180  | 9.282  | 9.384  | 9.486  | 9.588  | 9.690  | 9.792  | 9.894  | 9.996  | 10.098 |
| 100 | 10.200 | 10.302 | 10.404 | 10.506 | 10.608 | 10.710 | 10.812 | 10.914 | 11.016 | 11.118 |
| 110 | 11.220 | 11.322 | 11.424 | 11.526 | 11.628 | 11.730 | 11.832 | 11.934 | 12.036 | 12.138 |
| 120 | 12.240 | 12.342 | 12.444 | 12.546 | 12.648 | 12.750 | 12.852 | 12.954 | 13.056 | 13.158 |
| 130 | 13.260 | 13.362 | 13.464 | 13.566 | 13.668 | 13.770 | 13.872 | 13.974 | 14.076 | 14.178 |
| 140 | 14.280 | 14.382 | 14.484 | 14.586 | 14.688 | 14.790 | 14.892 | 14.994 | 15.096 | 15.198 |
| 150 | 15.300 | 15.402 | 15.504 | 15.606 | 15.708 | 15.810 | 15.912 | 16.014 | 16.116 | 16.218 |
| 160 | 16.320 | 16.422 | 16.524 | 16.626 | 16.728 | 16.830 | 16.932 | 17.034 | 17.136 | 17.238 |
| 170 | 17.340 | 17.442 | 17.544 | 17.646 | 17.748 | 17.850 | 17.952 | 18.054 | 18.156 | 18.258 |
| 180 | 18.360 | 18.462 | 18.564 | 18.666 | 18.768 | 18.870 | 18.972 | 19.074 | 19.176 | 19.278 |
| 190 | 19.380 | 19.482 | 19.584 | 19.686 | 19.788 | 19.890 | 19.992 | 20.094 | 20.196 | 20.298 |

**CONVERSION TABLE**
**From kgm to lb.ft.**

1 kgm = 7.233 lb.ft.

|     | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0   | 0      | 7.2    | 14.5   | 21.7   | 28.9   | 36.2   | 43.4   | 50.6   | 57.9   | 65.1   |
| 10  | 72.3   | 79.6   | 86.8   | 94.0   | 101.3  | 108.5  | 115.7  | 123.0  | 130.2  | 137.4  |
| 20  | 144.7  | 151.9  | 159.1  | 166.4  | 173.6  | 180.8  | 188.1  | 195.3  | 202.5  | 209.8  |
| 30  | 217.0  | 224.2  | 231.5  | 238.7  | 245.9  | 253.2  | 260.4  | 267.6  | 274.9  | 282.1  |
| 40  | 289.3  | 296.6  | 303.8  | 311.0  | 318.3  | 325.5  | 332.7  | 340.0  | 347.2  | 354.4  |
| 50  | 361.7  | 368.9  | 376.1  | 383.4  | 390.6  | 397.8  | 405.1  | 412.3  | 419.5  | 426.8  |
| 60  | 434.0  | 441.2  | 448.5  | 455.7  | 462.9  | 470.2  | 477.4  | 484.6  | 491.8  | 499.1  |
| 70  | 506.3  | 513.5  | 520.8  | 528.0  | 535.2  | 542.5  | 549.7  | 556.9  | 564.2  | 571.4  |
| 80  | 578.6  | 585.9  | 593.1  | 600.3  | 607.6  | 614.8  | 622.0  | 629.3  | 636.5  | 643.7  |
| 90  | 651.0  | 658.2  | 665.4  | 672.2  | 679.9  | 687.1  | 694.4  | 701.6  | 708.8  | 716.1  |
| 100 | 723.3  | 730.5  | 737.8  | 745.0  | 752.2  | 759.5  | 766.7  | 773.9  | 781.2  | 788.4  |
| 110 | 795.6  | 802.9  | 810.1  | 817.3  | 824.6  | 831.8  | 839.0  | 846.3  | 853.5  | 860.7  |
| 120 | 868.0  | 875.2  | 882.4  | 889.7  | 896.9  | 904.1  | 911.4  | 918.6  | 925.8  | 933.1  |
| 130 | 940.3  | 947.5  | 954.8  | 962.0  | 969.2  | 876.5  | 983.7  | 990.9  | 998.2  | 1005.4 |
| 140 | 1012.6 | 1019.9 | 1027.1 | 1034.3 | 1041.5 | 1048.8 | 1056.0 | 1063.2 | 1070.5 | 1077.7 |
| 150 | 1084.9 | 1092.2 | 1099.4 | 1106.6 | 1113.9 | 1121.1 | 1128.3 | 1135.6 | 1142.8 | 1150.0 |
| 160 | 1157.3 | 1164.5 | 1171.7 | 1179.0 | 1186.2 | 1193.4 | 1200.7 | 1207.9 | 1215.1 | 1222.4 |
| 170 | 1129.6 | 1236.8 | 1244.1 | 1251.3 | 1258.5 | 1265.8 | 1273.0 | 1280.1 | 1287.5 | 1294.7 |
| 180 | 1301.9 | 1309.2 | 1316.4 | 1323.6 | 1330.9 | 1338.1 | 1345.3 | 1352.6 | 1359.8 | 1367.0 |
| 190 | 1374.3 | 1381.5 | 1388.7 | 1396.0 | 1403.2 | 1410.4 | 1417.7 | 1424.9 | 1432.1 | 1439.4 |

**CONVERSION TABLE**
**From bar to psi (lb/in<sup>2</sup>)**

1 bar = 14.503 psi

|     | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0   | 0      | 14.5   | 29.0   | 43.5   | 58.0   | 72.5   | 87.0   | 101.5  | 116.0  | 130.5  |
| 10  | 145.0  | 159.5  | 174.0  | 188.5  | 203.0  | 217.5  | 232.0  | 246.5  | 261.0  | 275.6  |
| 20  | 290.0  | 304.6  | 319.1  | 333.6  | 348.1  | 362.6  | 377.1  | 391.6  | 406.1  | 420.6  |
| 30  | 435.1  | 449.6  | 464.1  | 478.6  | 493.1  | 507.6  | 522.1  | 536.6  | 551.1  | 565.6  |
| 40  | 580.1  | 594.6  | 609.1  | 623.6  | 638.1  | 652.6  | 667.1  | 681.6  | 696.1  | 710.6  |
| 50  | 725.1  | 739.6  | 754.1  | 768.6  | 783.2  | 797.7  | 812.2  | 826.7  | 841.2  | 855.7  |
| 60  | 870.2  | 884.7  | 899.2  | 913.7  | 928.2  | 942.7  | 957.2  | 971.7  | 986.2  | 1000.7 |
| 70  | 1015.2 | 1029.7 | 1044.2 | 1058.7 | 1073.2 | 1087.7 | 1102.2 | 1116.7 | 1131.2 | 1145.7 |
| 80  | 1160.2 | 1174.7 | 1189.2 | 1203.7 | 1218.2 | 1232.7 | 1247.2 | 1261.8 | 1276.3 | 1290.8 |
| 90  | 1305.3 | 1319.8 | 1334.3 | 1348.8 | 1363.3 | 1377.8 | 1392.3 | 1406.8 | 1421.3 | 1435.8 |
| 100 | 1450.3 | 1464.8 | 1479.3 | 1493.8 | 1508.3 | 1522.8 | 1537.3 | 1551.8 | 1566.3 | 1580.8 |
| 110 | 1595.3 | 1609.8 | 1624.3 | 1638.8 | 1653.3 | 1667.8 | 1682.3 | 1696.8 | 1711.3 | 1725.8 |
| 120 | 1740.4 | 1754.9 | 1769.4 | 1783.9 | 1798.4 | 1812.9 | 1827.4 | 1841.9 | 1856.4 | 1870.8 |
| 130 | 1885.4 | 1899.9 | 1914.4 | 1928.9 | 1943.4 | 1957.9 | 1972.4 | 1986.9 | 2001.4 | 2015.9 |
| 140 | 2030.4 | 2044.9 | 2059.4 | 2073.9 | 2088.4 | 2102.9 | 1217.4 | 2131.9 | 2146.4 | 2160.9 |
| 150 | 2175.4 | 2189.9 | 2204.4 | 2218.9 | 2233.5 | 2248.0 | 2262.5 | 2277.0 | 2291.5 | 2306.0 |
| 160 | 2320.5 | 2335.0 | 2349.5 | 2364.0 | 2378.5 | 2393.0 | 2407.5 | 2422.0 | 2436.5 | 2451.0 |
| 170 | 2465.5 | 2480.0 | 2494.5 | 2509.0 | 2523.5 | 2538.0 | 2552.5 | 2567.0 | 2581.5 | 2596.0 |
| 180 | 2610.5 | 2625.0 | 2639.5 | 2654.0 | 2668.5 | 2683.0 | 2697.7 | 2712.1 | 2726.6 | 2641.1 |
| 190 | 2755.6 | 2770.0 | 2784.6 | 2799.1 | 2813.6 | 2828.1 | 2842.6 | 2857.1 | 2871.6 | 2886.1 |
| 200 | 2900.6 | 2915.1 | 2929.6 | 2944.1 | 2958.6 | 2973.1 | 2987.6 | 3002.1 | 3016.6 | 3031.1 |
| 210 | 3045.6 | 3060.1 | 3074.6 | 3089.1 | 3103.6 | 3118.1 | 3132.6 | 3147.1 | 3161.6 | 3176.1 |
| 220 | 3190.7 | 3205.2 | 3219.7 | 3234.2 | 3248.7 | 3263.2 | 3277.7 | 3192.2 | 3306.7 | 3321.2 |
| 230 | 3335.7 | 3350.2 | 3364.7 | 3379.2 | 3393.7 | 3408.2 | 3422.7 | 3437.2 | 3451.7 | 3466.2 |
| 240 | 3480.7 | 3495.2 | 3509.7 | 3524.2 | 3538.7 | 3553.2 | 3567.7 | 3582.2 | 3596.7 | 3611.2 |

**CONVERSION TABLE****TEMPERATURE**

Fahrenheit-Centigrade conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values and read the corresponding Fahrenheit temperature on the right.

$$1^{\circ}\text{C} = 33.8^{\circ}\text{F}$$

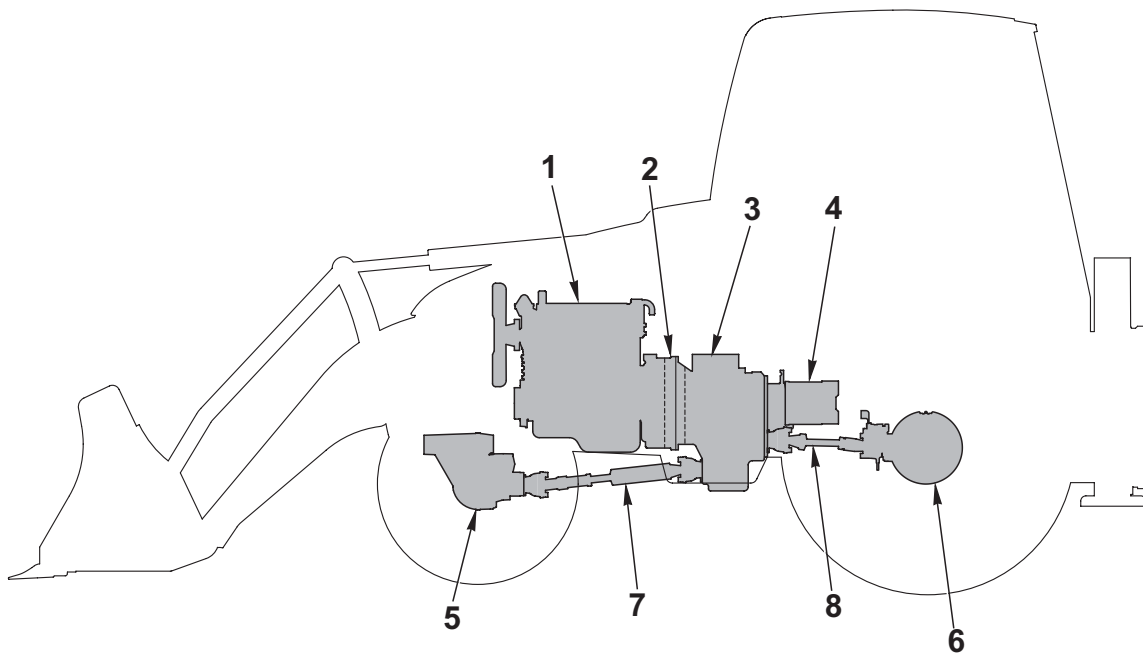
| °C    |            | °F    | °C    |           | °F    | °C   |           | °F    | °C   |            | °F    |
|-------|------------|-------|-------|-----------|-------|------|-----------|-------|------|------------|-------|
| -40.4 | <b>-40</b> | -40.0 | -11.7 | <b>11</b> | 51.8  | 7.8  | <b>46</b> | 144.8 | 27.2 | <b>81</b>  | 117.8 |
| -37.2 | <b>-35</b> | -31.0 | -11.1 | <b>12</b> | 53.6  | 8.3  | <b>47</b> | 116.6 | 27.8 | <b>82</b>  | 179.6 |
| -34.4 | <b>-30</b> | -22.0 | -10.6 | <b>13</b> | 55.4  | 8.9  | <b>48</b> | 118.4 | 28.3 | <b>83</b>  | 181.4 |
| -31.7 | <b>-25</b> | -13.0 | -10.0 | <b>14</b> | 57.2  | 9.4  | <b>49</b> | 120.2 | 28.9 | <b>84</b>  | 183.2 |
| -28.9 | <b>-20</b> | -4.0  | -9.4  | <b>15</b> | 59.0  | 10.0 | <b>50</b> | 122.0 | 29.4 | <b>85</b>  | 185.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -28.3 | <b>-19</b> | -2.2  | -8.9  | <b>16</b> | 60.8  | 10.6 | <b>51</b> | 123.8 | 30.0 | <b>86</b>  | 186.8 |
| -27.8 | <b>-18</b> | -0.4  | -8.3  | <b>17</b> | 62.6  | 11.1 | <b>52</b> | 125.6 | 30.6 | <b>87</b>  | 188.6 |
| -27.2 | <b>-17</b> | 1.4   | -7.8  | <b>18</b> | 64.4  | 11.7 | <b>53</b> | 127.4 | 31.1 | <b>88</b>  | 190.4 |
| -26.7 | <b>-16</b> | 3.2   | -7.2  | <b>19</b> | 66.2  | 12.2 | <b>54</b> | 129.2 | 31.7 | <b>89</b>  | 192.2 |
| -26.1 | <b>-15</b> | 5.0   | -6.7  | <b>20</b> | 68.0  | 12.8 | <b>55</b> | 131.0 | 32.2 | <b>90</b>  | 194.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -25.6 | <b>-14</b> | 6.8   | -6.1  | <b>21</b> | 69.8  | 13.3 | <b>56</b> | 132.8 | 32.8 | <b>91</b>  | 195.8 |
| -25.0 | <b>-13</b> | 8.6   | -5.6  | <b>22</b> | 71.6  | 13.9 | <b>57</b> | 134.6 | 33.3 | <b>92</b>  | 197.6 |
| -24.4 | <b>-12</b> | 10.4  | -5.0  | <b>23</b> | 73.4  | 14.4 | <b>58</b> | 136.4 | 33.9 | <b>93</b>  | 199.4 |
| -23.9 | <b>-11</b> | 12.2  | -4.4  | <b>24</b> | 75.2  | 15.0 | <b>59</b> | 138.2 | 34.4 | <b>94</b>  | 201.2 |
| -23.3 | <b>-10</b> | 14.0  | -3.9  | <b>25</b> | 77.0  | 15.6 | <b>60</b> | 140.0 | 35.0 | <b>95</b>  | 203.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -22.8 | <b>-9</b>  | 15.8  | -3.3  | <b>26</b> | 78.8  | 16.1 | <b>61</b> | 141.8 | 35.6 | <b>96</b>  | 204.8 |
| -22.2 | <b>-8</b>  | 17.6  | -2.8  | <b>27</b> | 80.6  | 16.7 | <b>62</b> | 143.6 | 36.1 | <b>97</b>  | 206.6 |
| -21.7 | <b>-7</b>  | 19.4  | -2.2  | <b>28</b> | 82.4  | 17.2 | <b>63</b> | 145.4 | 36.7 | <b>98</b>  | 208.4 |
| -21.1 | <b>-6</b>  | 21.2  | -1.7  | <b>29</b> | 84.2  | 17.8 | <b>64</b> | 147.2 | 37.2 | <b>99</b>  | 210.2 |
| -20.6 | <b>-5</b>  | 23.0  | -1.1  | <b>30</b> | 86.0  | 18.3 | <b>65</b> | 149.0 | 37.8 | <b>100</b> | 212.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -20.0 | <b>-4</b>  | 24.8  | -0.6  | <b>31</b> | 87.8  | 18.9 | <b>66</b> | 150.8 | 40.6 | <b>105</b> | 221.0 |
| -19.4 | <b>-3</b>  | 26.6  | 0.0   | <b>32</b> | 89.6  | 19.4 | <b>67</b> | 152.6 | 43.3 | <b>110</b> | 230.0 |
| -18.9 | <b>-2</b>  | 28.4  | 0.6   | <b>33</b> | 91.4  | 20.0 | <b>68</b> | 154.4 | 46.1 | <b>115</b> | 239.0 |
| -18.3 | <b>-1</b>  | 30.2  | 1.1   | <b>34</b> | 93.2  | 20.6 | <b>69</b> | 156.2 | 48.9 | <b>120</b> | 248.0 |
| -17.8 | <b>0</b>   | 32.0  | 1.7   | <b>35</b> | 95.0  | 21.1 | <b>70</b> | 158.0 | 51.7 | <b>125</b> | 257.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -17.2 | <b>1</b>   | 33.8  | 2.2   | <b>36</b> | 96.8  | 21.7 | <b>71</b> | 159.8 | 54.4 | <b>130</b> | 266.0 |
| -16.7 | <b>2</b>   | 35.6  | 2.8   | <b>37</b> | 98.6  | 22.2 | <b>72</b> | 161.6 | 57.2 | <b>135</b> | 275.0 |
| -16.1 | <b>3</b>   | 37.4  | 3.3   | <b>38</b> | 100.4 | 22.8 | <b>73</b> | 163.4 | 60.0 | <b>140</b> | 284.0 |
| -15.6 | <b>4</b>   | 39.2  | 3.9   | <b>39</b> | 102.2 | 23.3 | <b>74</b> | 165.2 | 62.7 | <b>145</b> | 293.0 |
| -15.0 | <b>5</b>   | 41.0  | 4.4   | <b>40</b> | 104.0 | 23.9 | <b>75</b> | 167.0 | 65.6 | <b>150</b> | 302.0 |
|       |            |       |       |           |       |      |           |       |      |            |       |
| -14.4 | <b>6</b>   | 42.8  | 5.0   | <b>41</b> | 105.8 | 24.4 | <b>76</b> | 168.8 | 68.3 | <b>155</b> | 311.0 |
| -13.9 | <b>7</b>   | 44.6  | 5.6   | <b>42</b> | 107.6 | 25.0 | <b>77</b> | 170.6 | 71.1 | <b>160</b> | 320.0 |
| -13.3 | <b>8</b>   | 46.4  | 6.1   | <b>43</b> | 109.4 | 25.6 | <b>78</b> | 172.4 | 73.9 | <b>165</b> | 329.0 |
| -12.8 | <b>9</b>   | 48.2  | 6.7   | <b>44</b> | 111.2 | 26.1 | <b>79</b> | 174.2 | 76.7 | <b>170</b> | 338.0 |
| -12.2 | <b>10</b>  | 50.0  | 7.2   | <b>45</b> | 113.0 | 26.7 | <b>80</b> | 176.0 | 79.4 | <b>175</b> | 347.0 |



# 10 STRUCTURE AND FUNCTION

|                                 |    |                                              |     |
|---------------------------------|----|----------------------------------------------|-----|
| POWER TRAIN.....                | 2  | AIR-CONDITIONING UNIT .....                  | 98  |
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## POWER TRAIN



RKZ09600

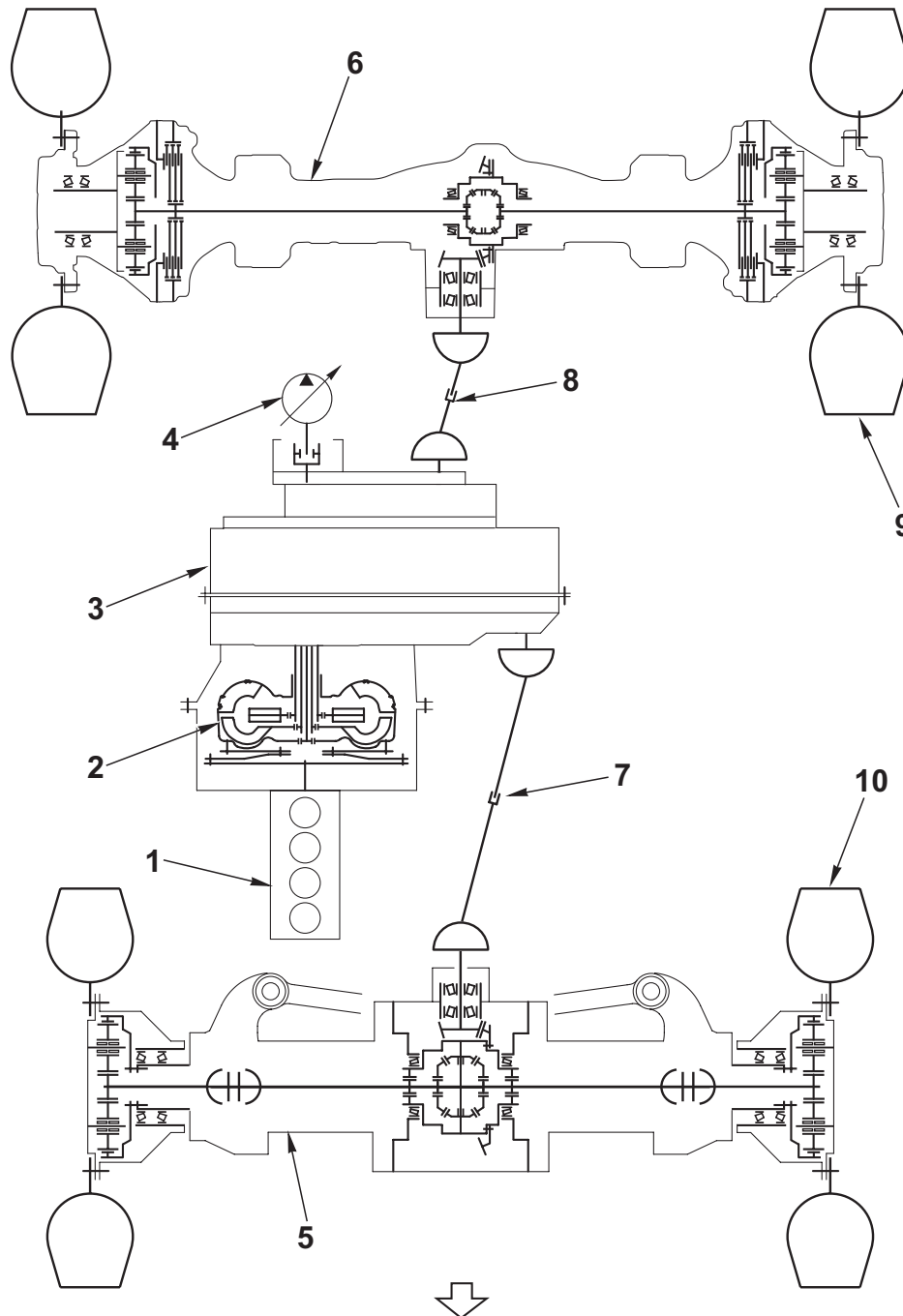
### DESCRIPTION

- The driving power for the engine (1) is transmitted through the flywheel to the converter (2). The converter (2) uses hydraulic oil to convert the torque transmitted by the engine (1) into driving power. The converter (2) transmits motion to the drive shaft of the transmission (3) and to the drive shaft of the hydraulic pump (4).
- The transmission (3) is electro-hydraulic in all its functions (power shuttle); direction and speed can be selected manually from a dedicated control unit and is managed by solenoid valves.
- The driving power is transmitted from the transmission (3) to the front (5) and rear (6) axles through the cardan drive shafts (7 and 8).
- The driving power transmitted to the front (5) and rear (6) axles is reduced by the differentials and then transmitted to the planetary gear through the differential shafts.

## STRUCTURE AND FUNCTION

## POWER TRAIN

| Gears    | Front axle   |              |           |        | Rear axle    |              |           |        |
|----------|--------------|--------------|-----------|--------|--------------|--------------|-----------|--------|
|          | Transmission | Differential | Planetary | Total  | Transmission | Differential | Planetary | Total  |
| 1st gear | 5.533        | 2.462        | 6.000     | 81.722 | 5.533        | 2.750        | 6.400     | 97.338 |
| 2nd gear | 3.360        |              |           | 49.627 | 3.360        |              |           | 59.136 |
| 3rd gear | 1.532        |              |           | 22.627 | 1.532        |              |           | 26.963 |
| 4th gear | 0.810        |              |           | 11.963 | 0.810        |              |           | 14.256 |



RKZ09610

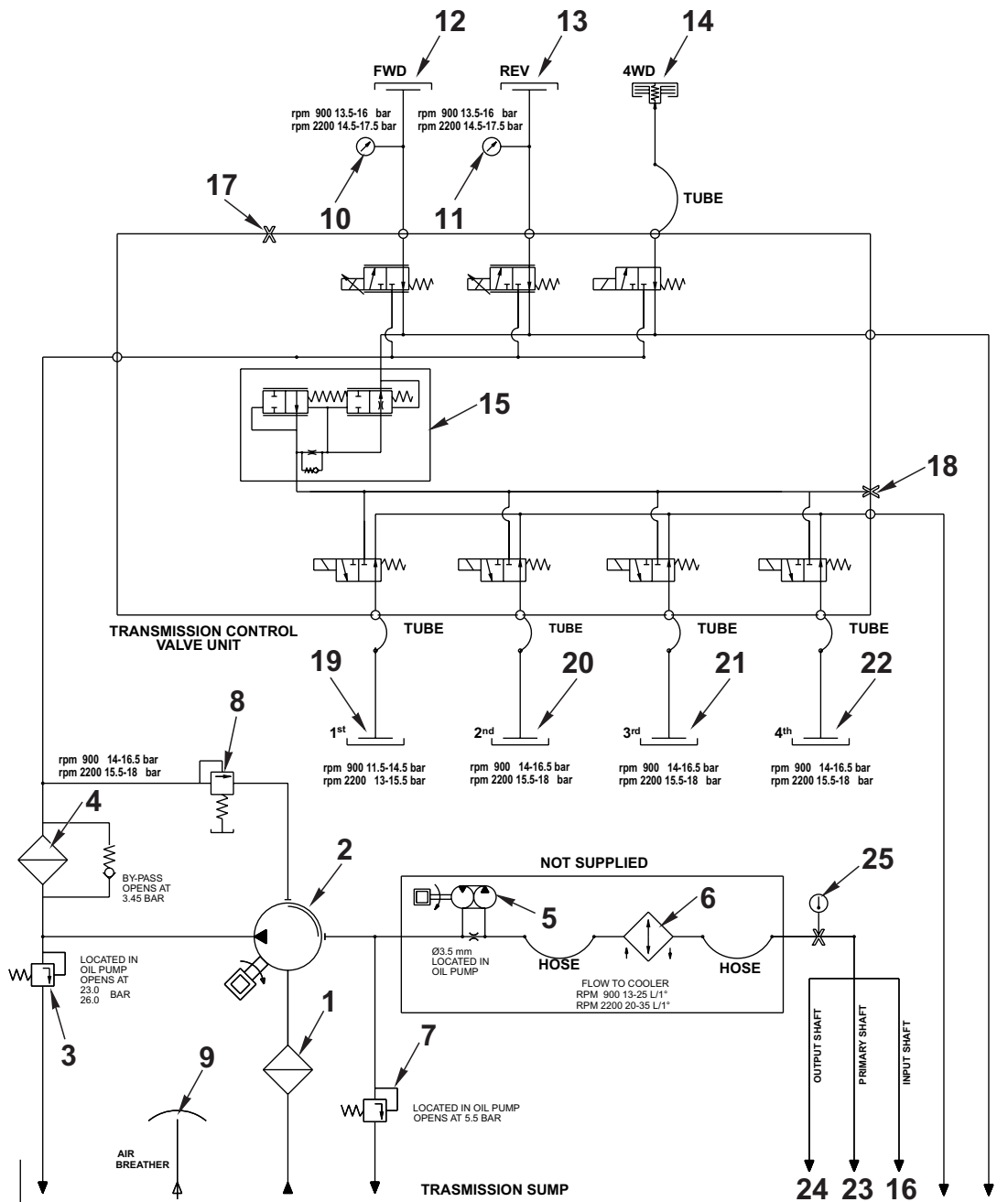
1. Diesel engine
2. Converter
3. Transmission
4. Hydraulic pump

5. Front axle
6. Rear axle
7. Front cardan drive shaft
8. Rear cardan drive shaft

9. Rear wheels
10. Front wheels

## TRANSMISSION (4WD)

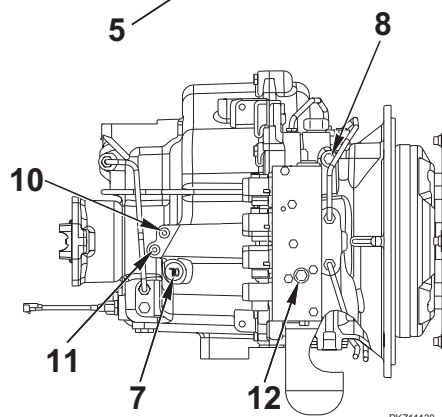
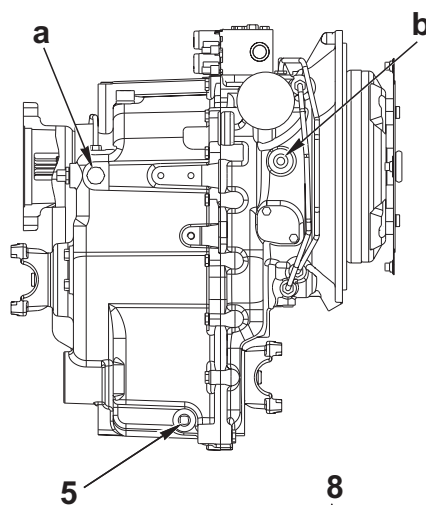
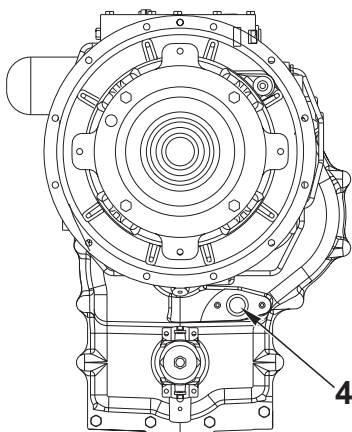
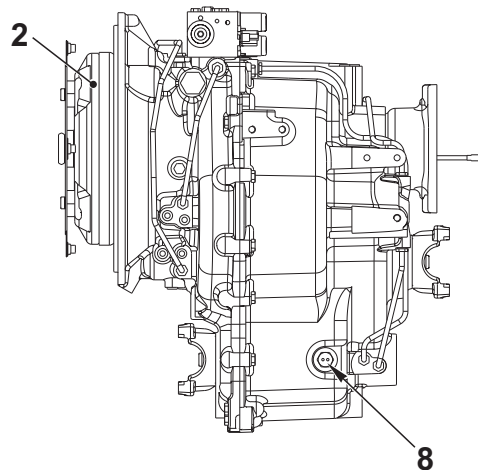
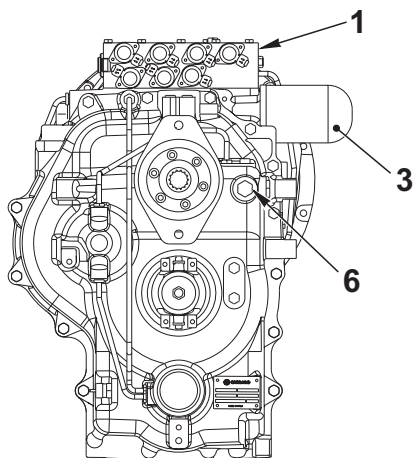
### Hydraulic converter-transmission circuit diagram



RKZ11120

1. Suction filter (250 µm)
2. Pump
3. Oil screen drain valve
4. Spin-on filter (10 µm)
5. Converter
6. Radiator
7. Torque converter pressure relief valve
8. Pressure control/flow divider valve
9. Vent
10. FORWARD engagement pressure check
11. REVERSE engagement pressure check
12. FORWARD engagement
13. REVERSE engagement
14. 4WD engagement/disengagement
15. Modulating valve
16. Input shaft lubrication (A pivot)
17. Backhoe oil feed port
18. Drive engagement pressure check
19. 1st gear engagement
20. 2nd gear engagement
21. 3rd gear engagement
22. 4th gear engagement
23. Main shaft lubrication (B shaft)
24. Output shaft lubrication (C/E shafts)
25. Oil temperature thermostat port from oil cooler

## TRANSMISSION

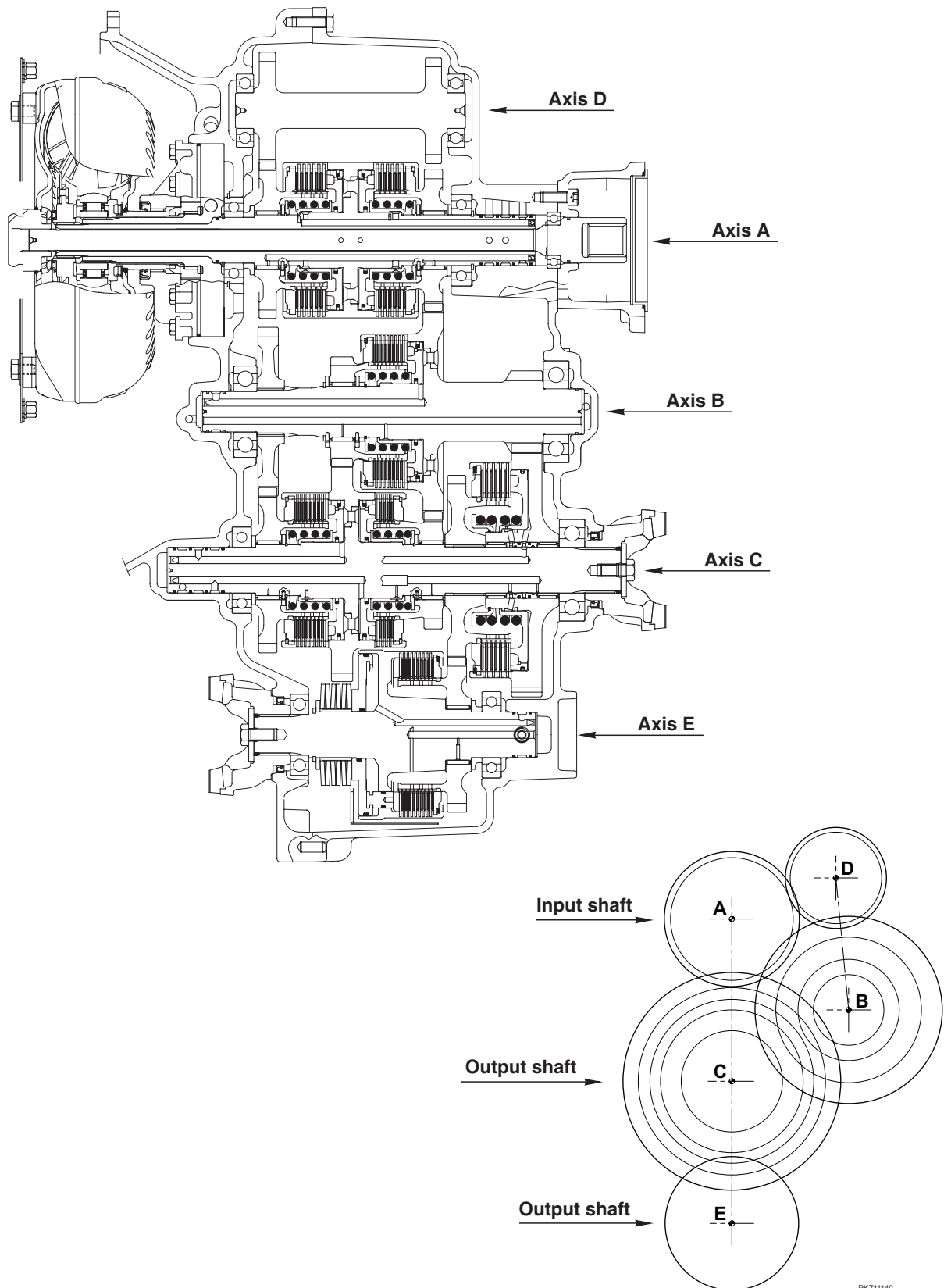


RKZ11130

- a. To the oil cooler
- b. From the oil cooler
- 1. Control valve group
- 2. Converter
- 3. Oil filter
- 4. Oil refilling port
- 5. Oil drain plug
- 6. Oil temperature sensor

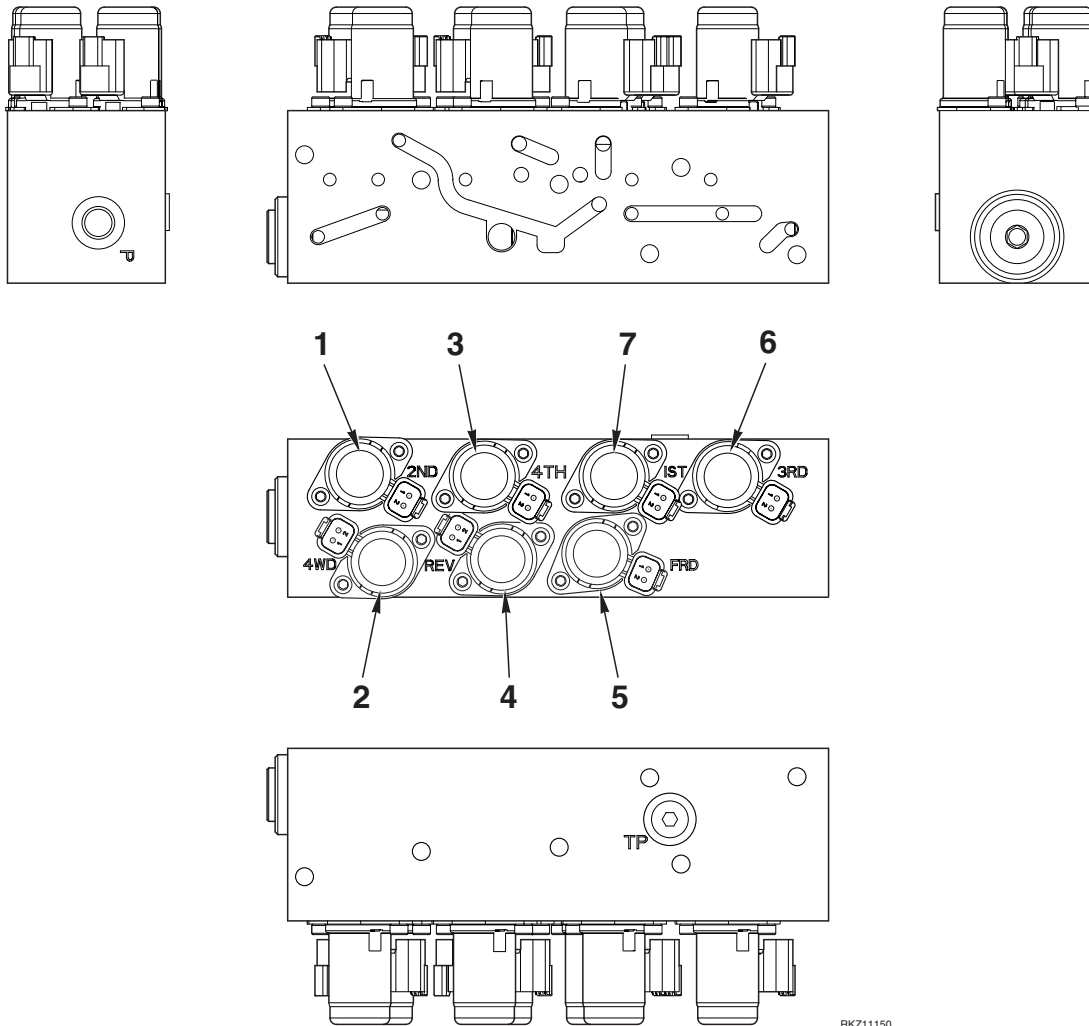
- 7. Vent plug
- 8. Revolution sensor
- 9. Converter input pressure check port
- 10. Reverse engagement pressure check port
- 11. Forward engagement pressure check port
- 12. PPC valve feed pressure check port

Kinematics diagram



RKZ11140

## CONTROL VALVE BLOCK



RKZ11150

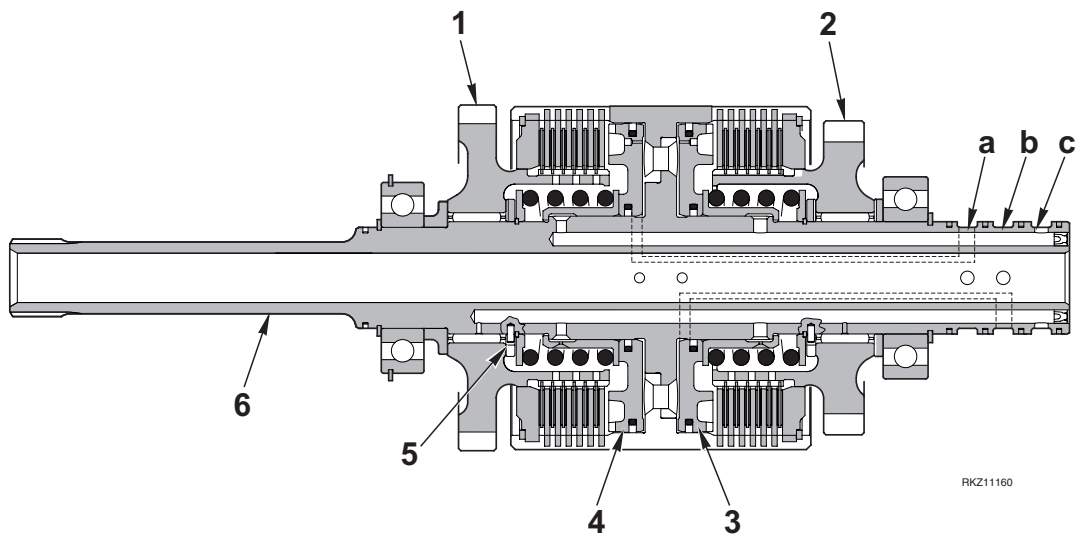
### ELECTRICAL COMPONENTS

1. C24 – 2nd gear solenoid valve (ED6)
2. C27 - 4WD solenoid valve(ED5)
3. C26 – 4th gear solenoid valve (ED2)
4. C21 - Reverse gears command solenoid valve (ED4)
5. C22 – Forward gear solenoid valve (ED3)
- 6 - C25 – 3rd gear solenoid valve (ED7)
7. C23 – 1st gear solenoid valve (ED1)



## DRIVE SHAFTS

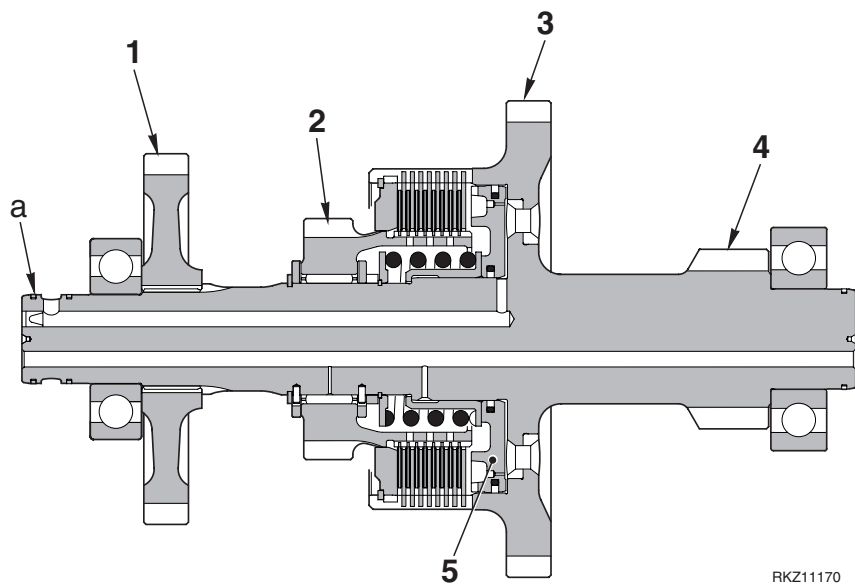
### Drive shaft for forward and reverse movement



- a. Port commanding reverse clutch
- b. Port commanding forward clutch
- c. Lubrication port

- 1. Reverse gear clutch (Z=37)
- 2. Forward gear (Z=37)
- 3. Reverse clutch piston
- 4. Forward clutch piston
- 5. Shoulder ring
- 6. Driven shaft

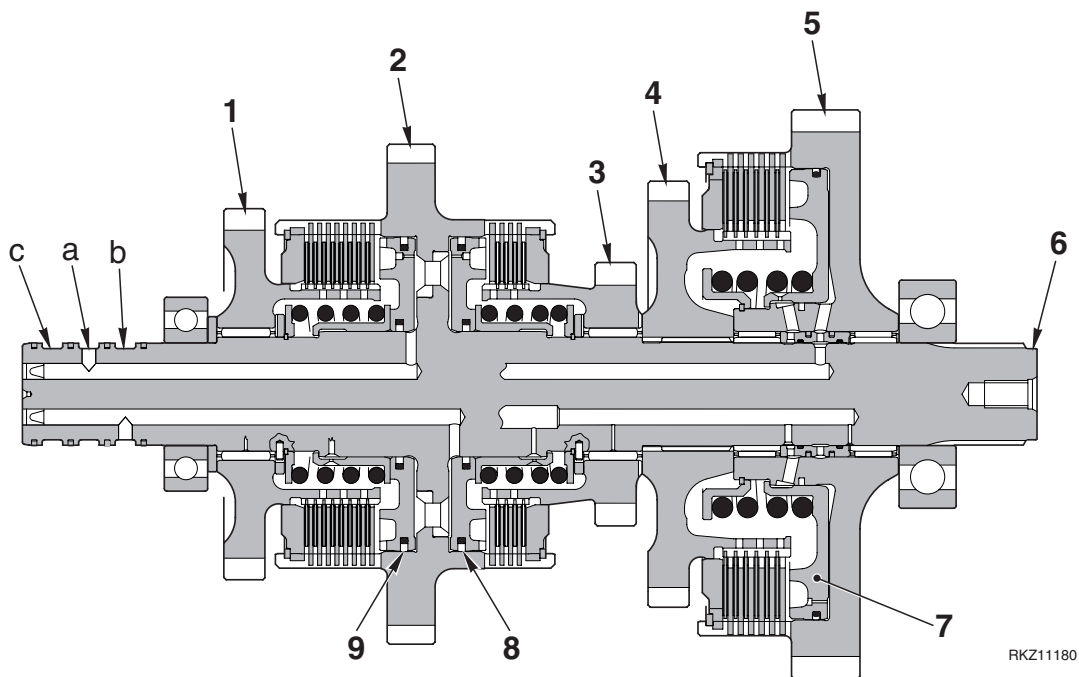
### Drive shaft



- a. 2nd gear port

- 1. 3rd drive gear (Z=45)
- 2. 2nd drive gear (Z=28)
- 3. 4th drive gear (Z=58)
- 4. 1st drive gear (Z=17)
- 5. 2nd gear piston

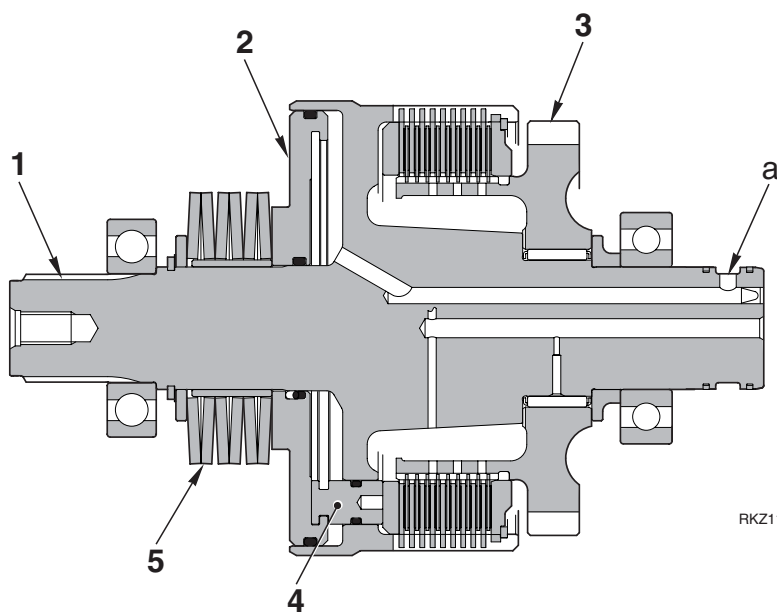
### Driven gear shaft



RKZ11180

- |                                |                                |
|--------------------------------|--------------------------------|
| a. 4th gear port               | 4. 4WD drive gear (Z=51)       |
| a. 3rd gear port               | 5. 1st gear driven gear (Z=60) |
| a. 1st gear port               | 6. Rear output shaft           |
| 1. 3rd gear driven gear (Z=44) | 7. 1st gear piston             |
| 2. 2nd gear driven gear (Z=60) | 8. 4th gear piston             |
| 3. 4th gear driven gear (Z=30) | 9. 3rd gear piston             |

### 4WD driven shaft

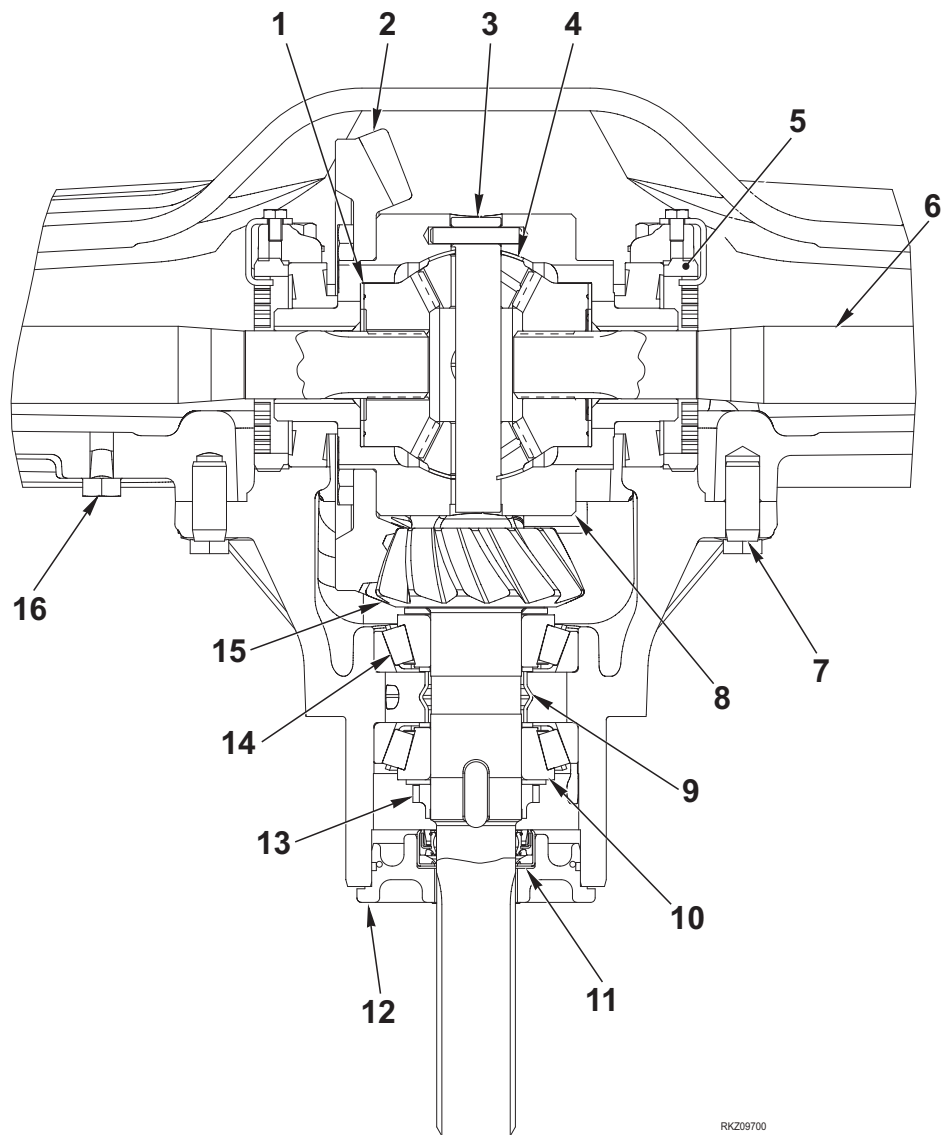


RKZ11190

- |                                   |                           |
|-----------------------------------|---------------------------|
| a. 4WD disengagement command port | 3. 4WD gear driven (Z=41) |
| 1. Front output shaft             | 4. Piston (n°3).          |
| 2. 4WD disengagement piston       | 5. Spring                 |

## FRONT AXLE

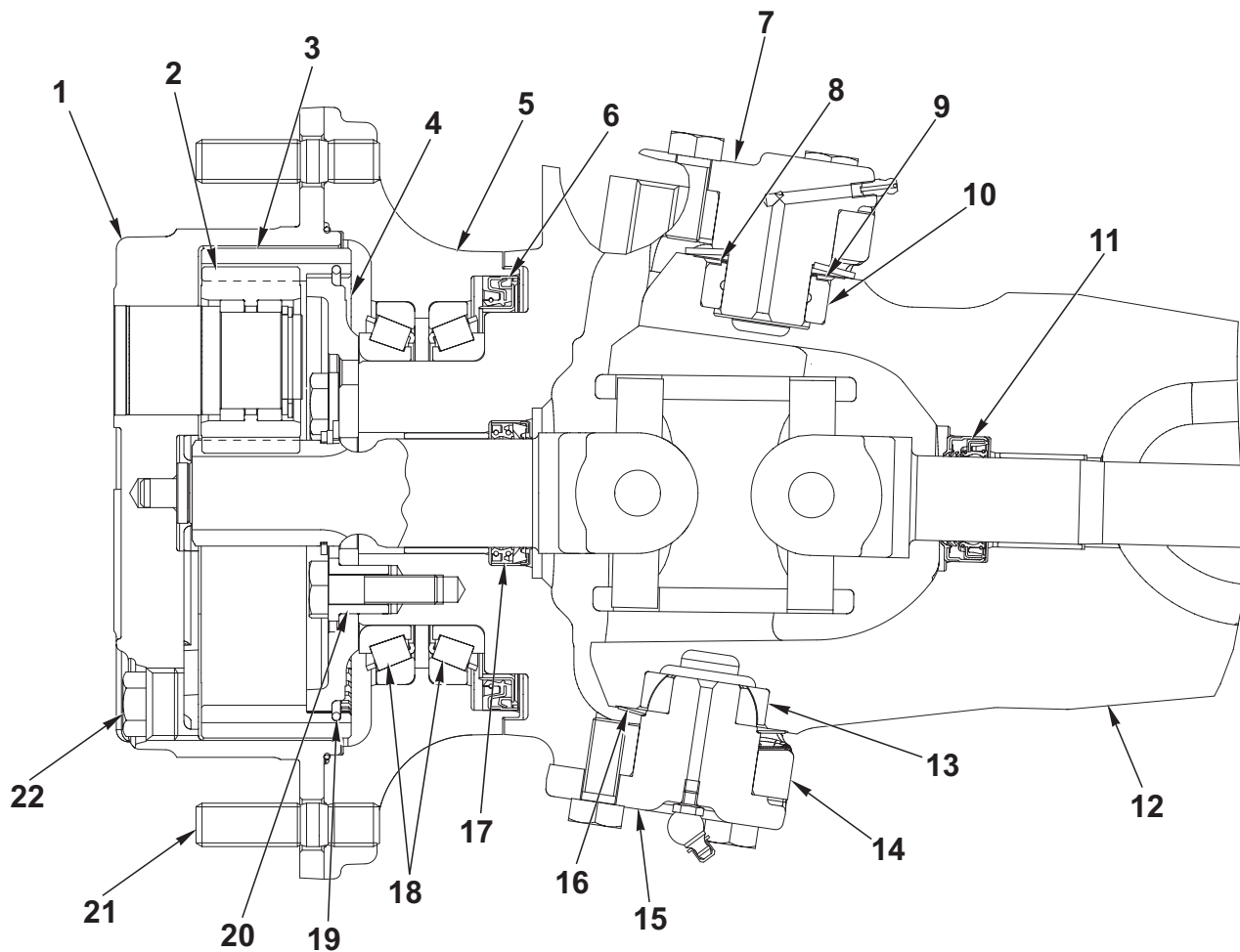
### Differential



- 1. Planetary gear
- 2. Ring gear (Z=32)
- 3. Planetary gear pin
- 4. Planetary gear
- 5. Ring nut
- 6. Half-axle
- 7. Pin
- 8. Differential housing

- 9. Spacer
- 10. Bearing
- 11. Sealing ring
- 12. Cover
- 13. Ring nut
- 14. Bearing
- 15. Bevel pinion (Z=13)
- 16. Oil refilling plug

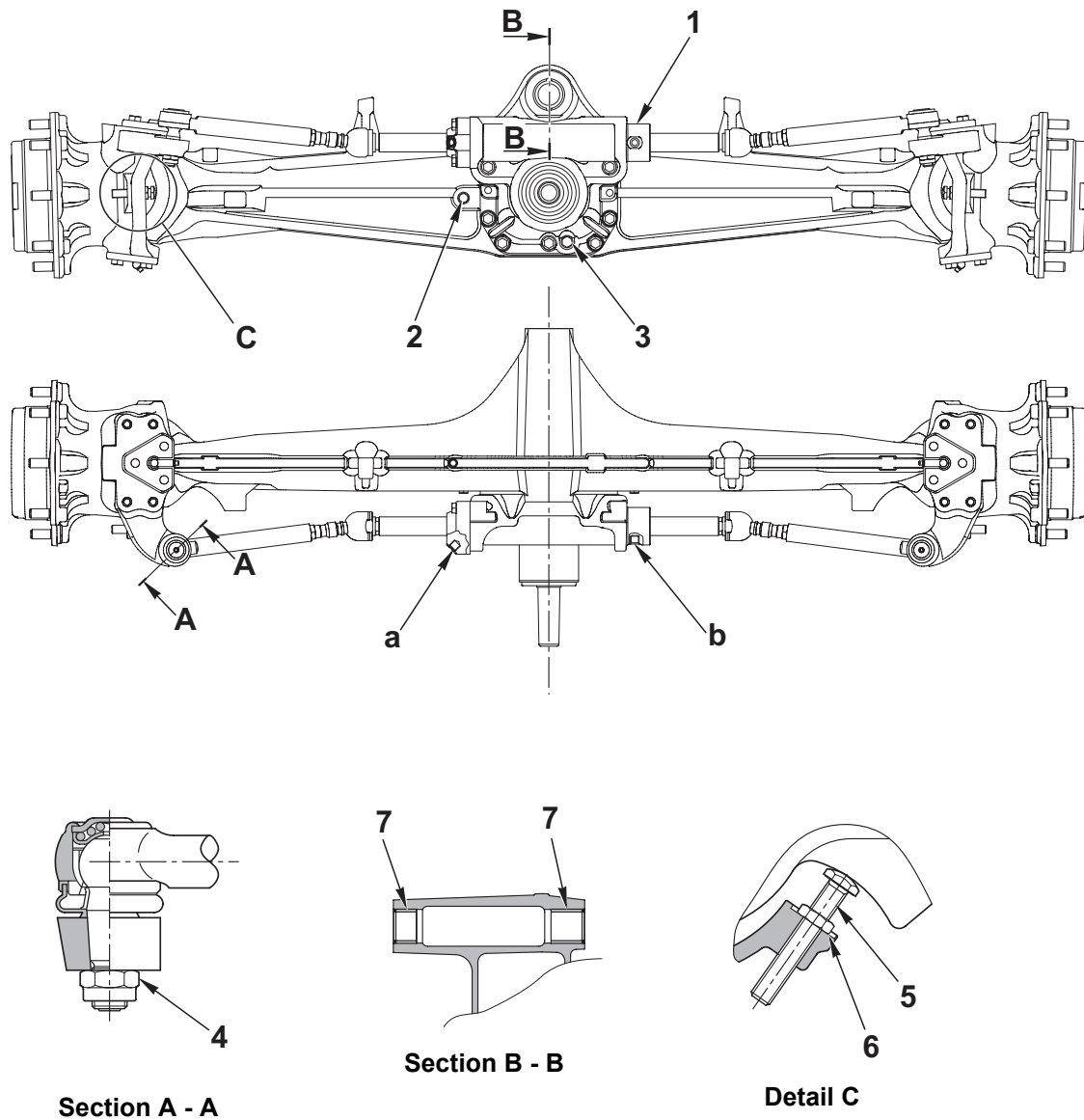
Final reduction gear - Joint



RKZ09710

- |                       |                       |
|-----------------------|-----------------------|
| 1. Planetary gear     | 12. Axle body         |
| 2. Planetary (Z=23)   | 13. Bearing           |
| 3. Ring gear (Z=32)   | 14. Joint             |
| 4. Crown wheel holder | 15. Pin               |
| 5. Wheel hub          | 16. Protection        |
| 6. Sealing ring       | 17. Sealing ring      |
| 7. Pin                | 18. Bearing           |
| 8. Shim               | 19. Snap ring         |
| 9. Protection         | 20. Centering bushing |
| 10. Bushing           | 21. Stud bolt         |
| 11. Sealing ring      | 22. Plug              |

### Steering unit cylinder



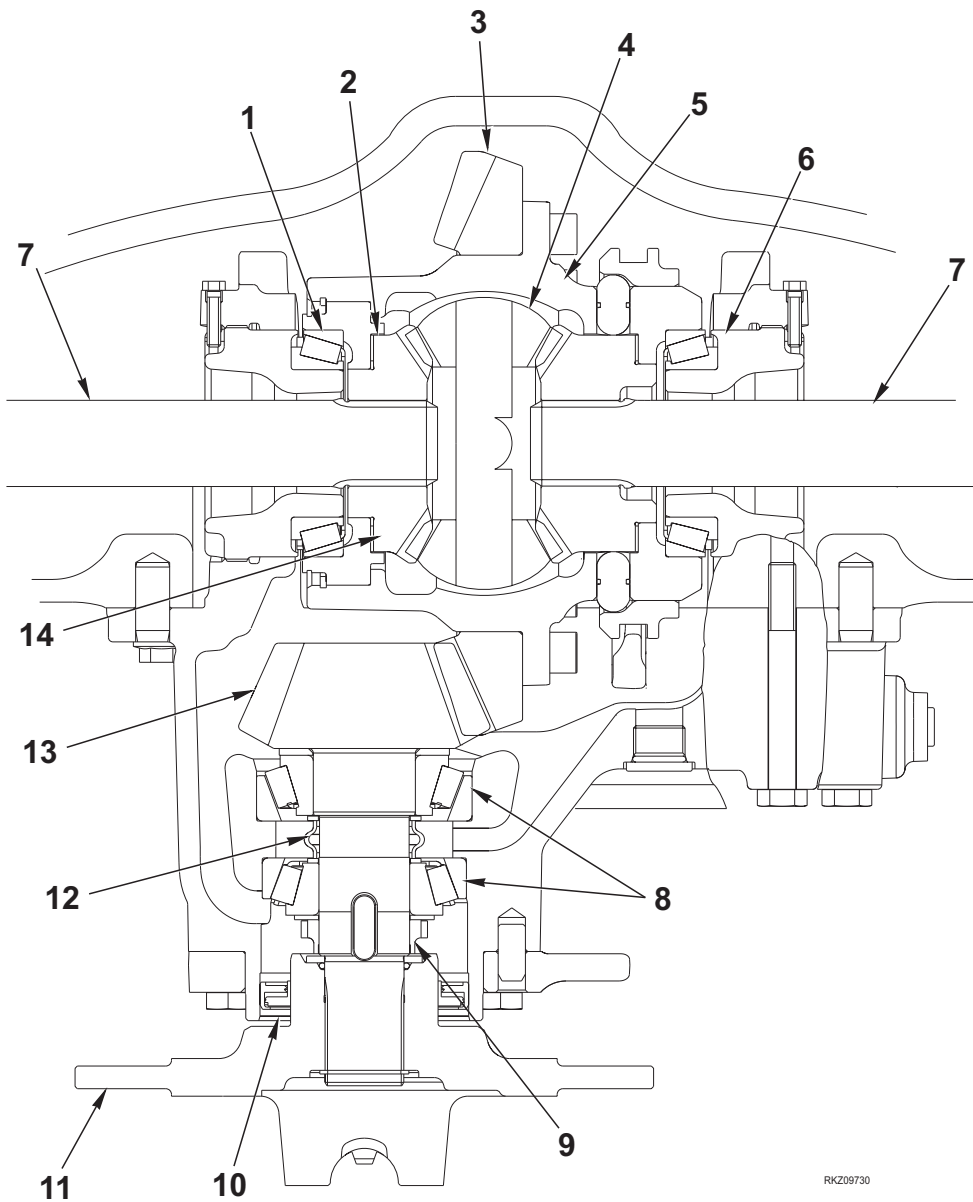
RKZ09720

1. Steering cylinder
2. Oil refilling plug
3. Oil drain plug
4. Nut
5. Adjusting screw
6. Nut
7. Bushing

- Port a - From the steering unit (L Port)
- Port b - From the steering unit (R Port)

## REAR AXLE

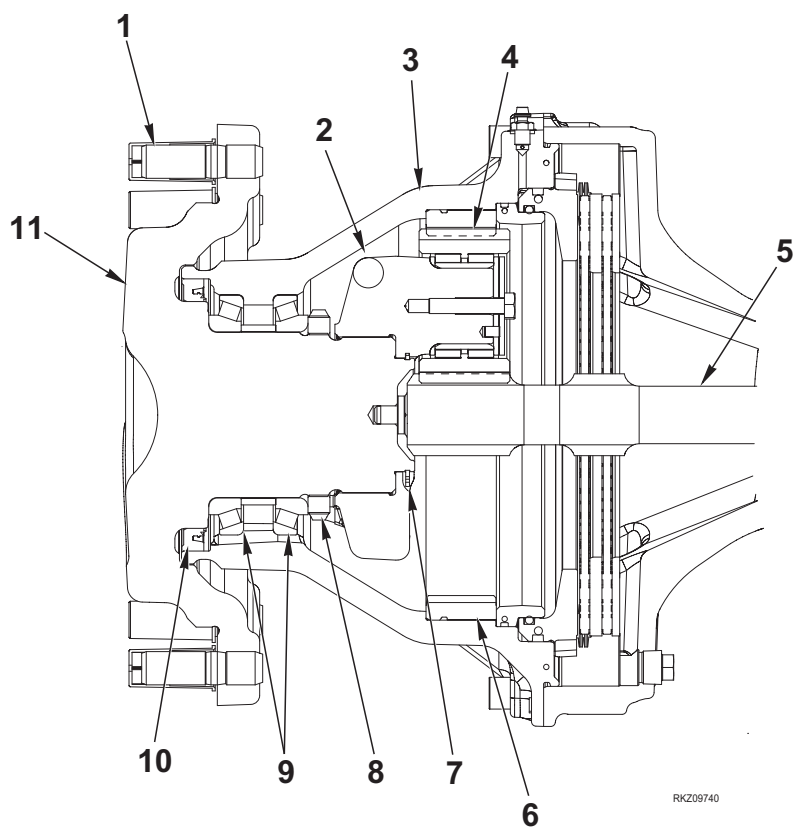
### Differential



RKZ09730

- |                         |                         |
|-------------------------|-------------------------|
| 1. Bearing              | 8. Bearing              |
| 2. Planetary gear       | 9. Ring nut             |
| 3. Ring gear (Z=32)     | 10. Sealing ring        |
| 4. Planetary gear       | 11. Flange              |
| 5. Differential housing | 12. Spacer              |
| 6. Ring nut             | 13. Bevel pinion (Z=13) |
| 7. Half-axle            | 14. Planetary gear      |

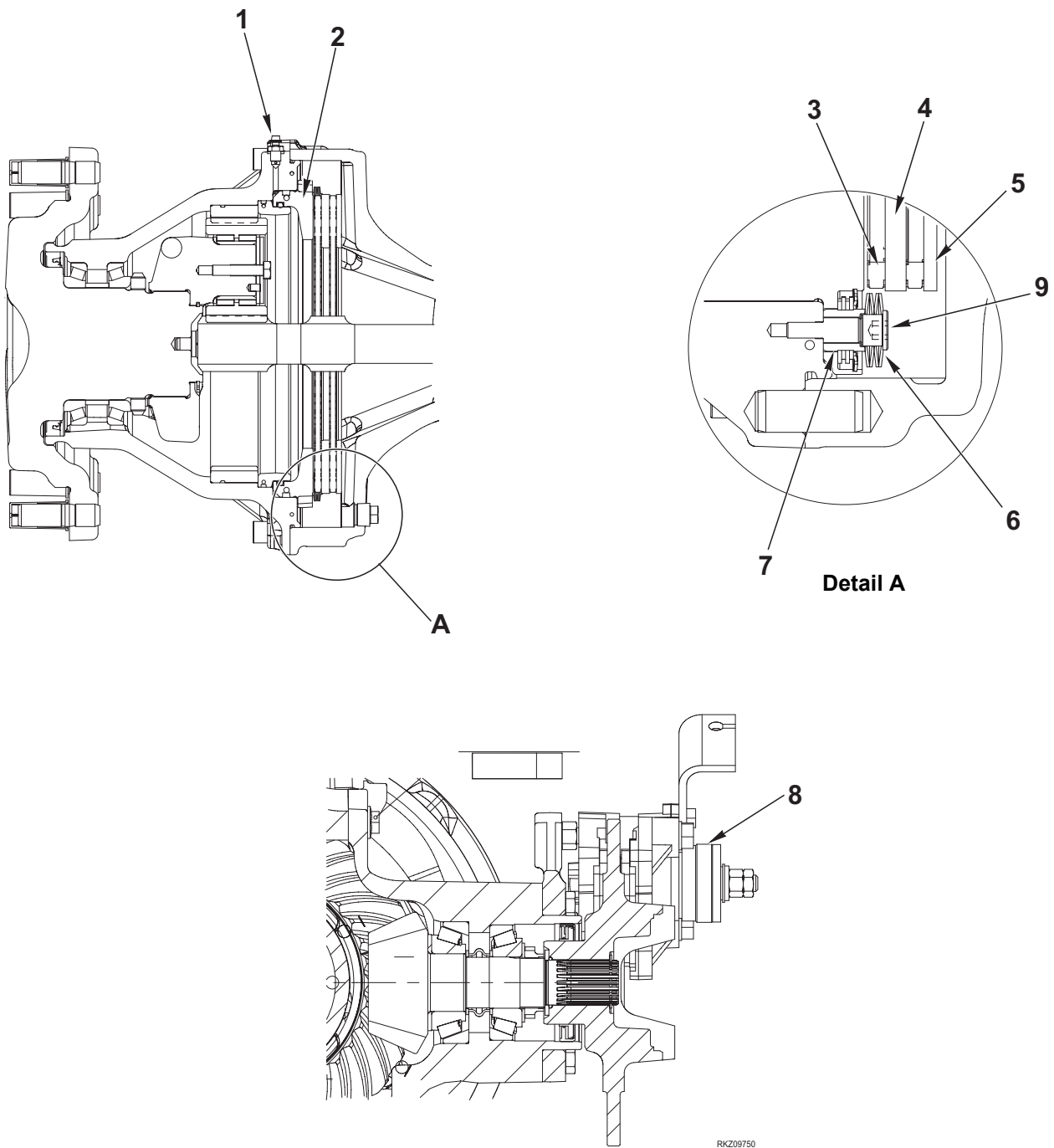
Final reduction gear



- 1. Stud bolt
- 2. Planetary gear
- 3. Bell
- 4. Planetary gear
- 5. Half-axle (Z=15)
- 6. Ring gear (Z=32)

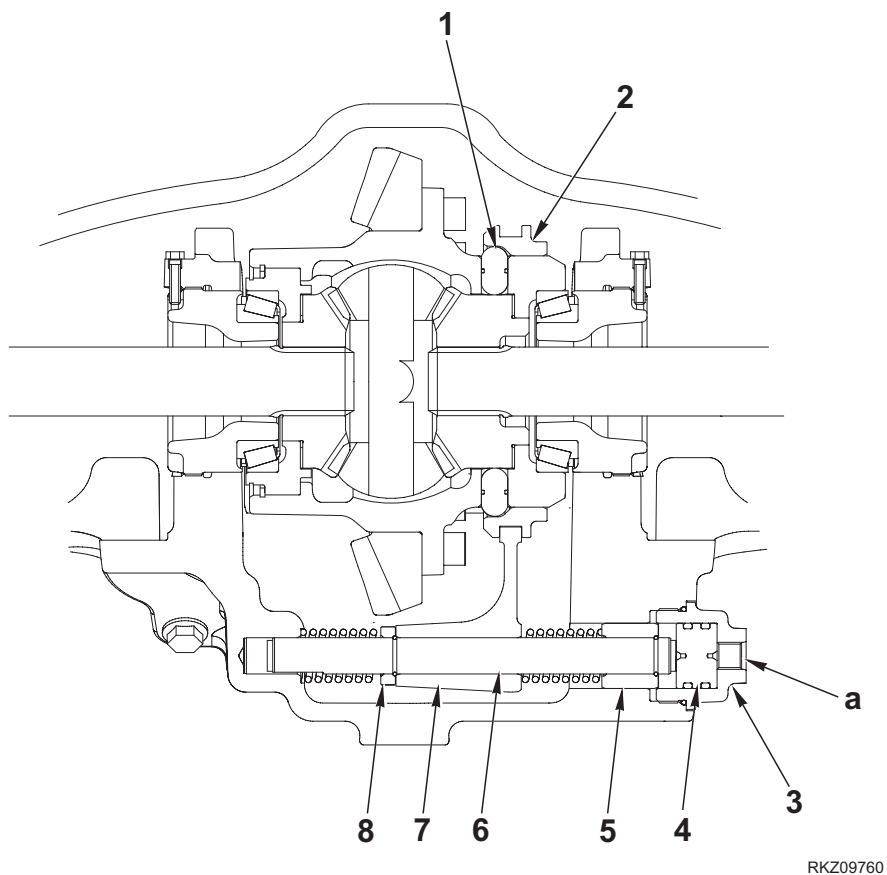
- 7. Snap ring
- 8. Ring nut
- 9. Bearing
- 10. Gasket
- 11. Wheel hub

Brakes





Differential lock



a. From servocontrol solenoid valve group EV1  
(Port B2)

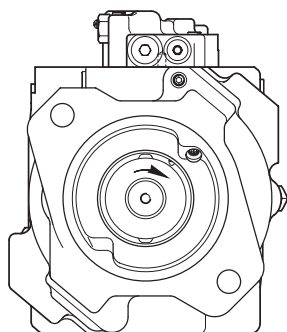
1. Pin
2. Sleeve
3. Cover
4. Piston
5. Guide bushing
6. Control rod
7. Fork
8. Spacer

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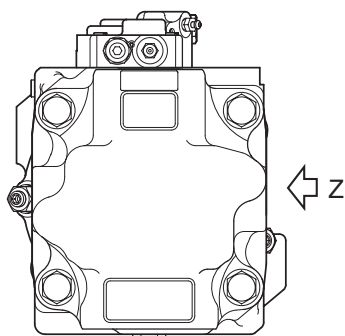
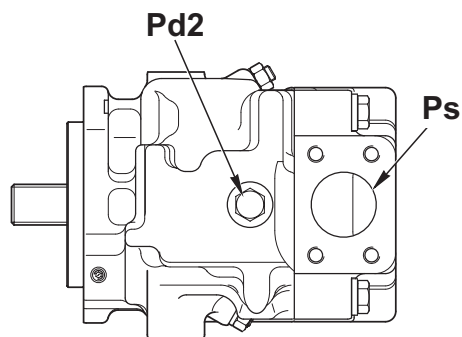


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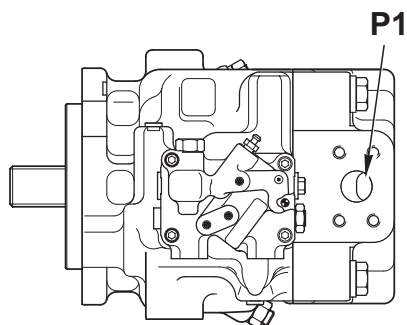
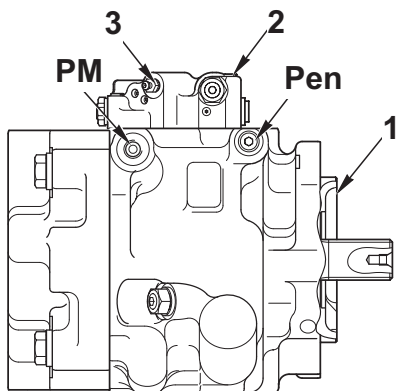
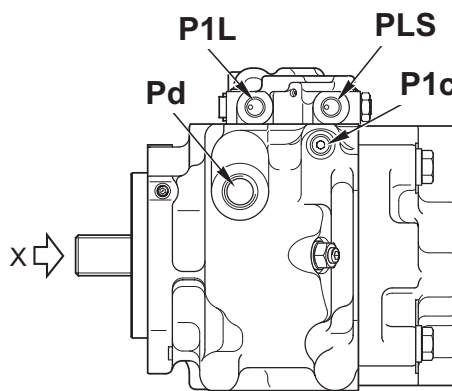
## HYDRAULIC PUMP



View X



View Z



RKZ09410

### COMPONENTS

1. Hydraulic pump
2. Delivery control valve
3. Oil refilling plug

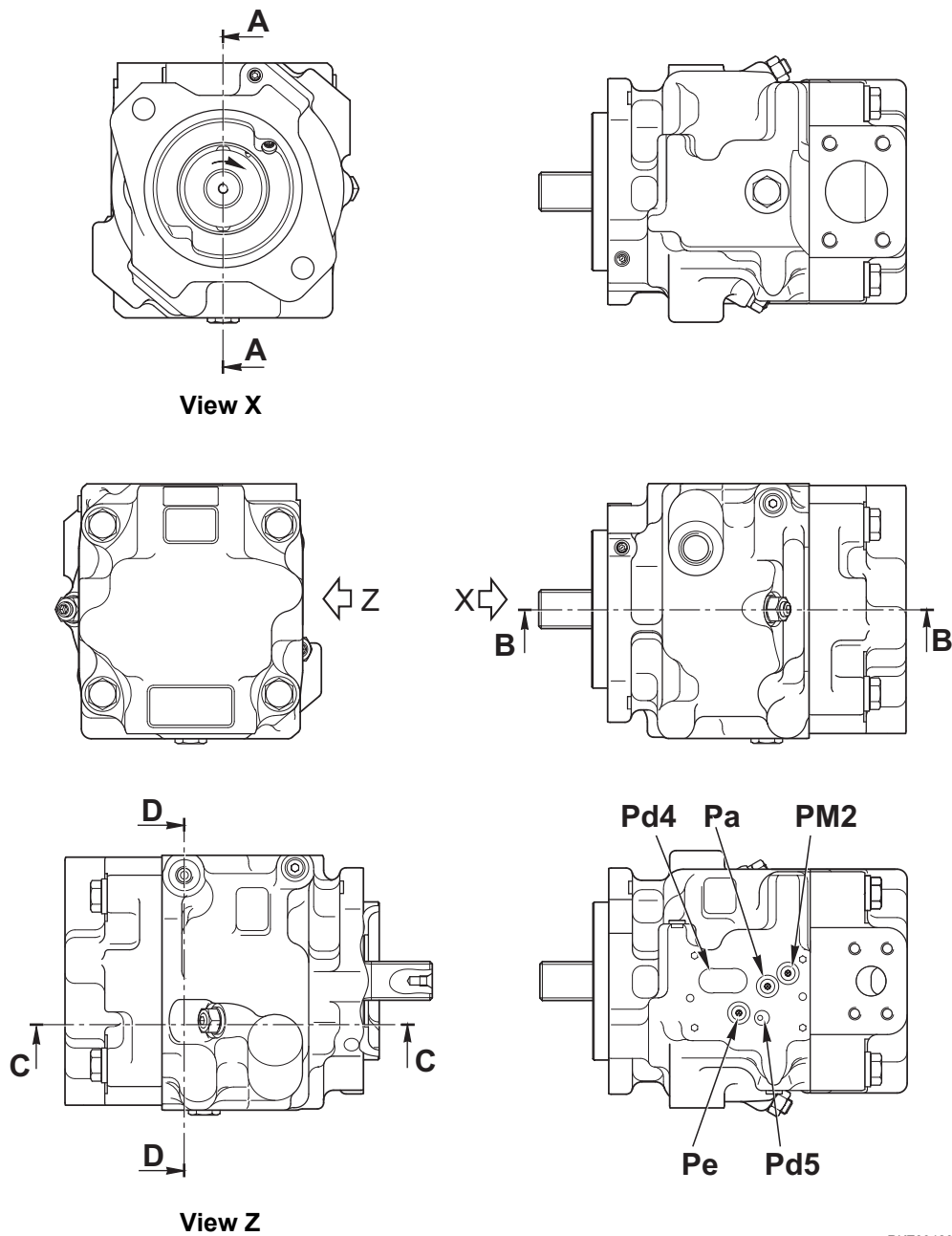
### CONNECTIONS

Port P1 - To the shovel control valve (Port P)  
 Port Pd - To hydraulic tank  
 Port Ps - From hydraulic tank  
 Port P1L - From control valve (Port Pp)  
 Port PLS - From control valve (Port LS)  
 Port PM - From EV1 solenoid valve group (Port PM)

### PORT FUNCTIONS

Port P1 - Pump delivery  
 Port Pd - Drain  
 Port Ps - Intake of oil  
 Port P1L - Pump delivery pressure input  
 Port P1C - Quick connect for pump delivery pressure  
 Port Pd2 - Drain plug  
 Pen port - Delivery control pressure check  
 Port PLS - Load Sensing signal input  
 Port PM - Operating mode control signal input

## 1. MAIN PUMP



RKZ09420

### PORT FUNCTIONS

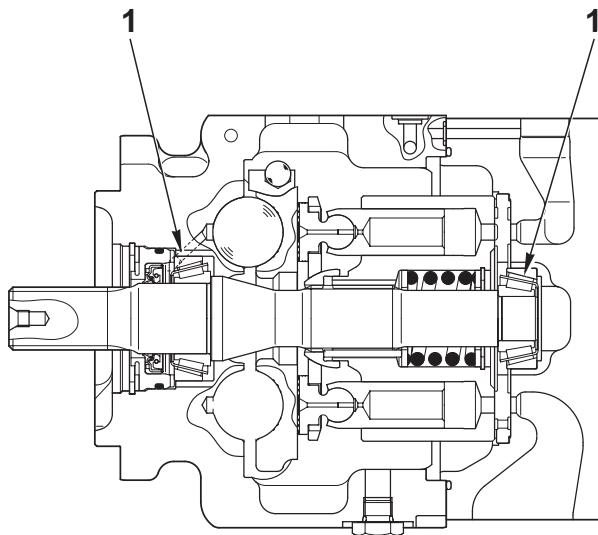
Port Pa - Delivery control group feed

Port Pe - Delivery control signal

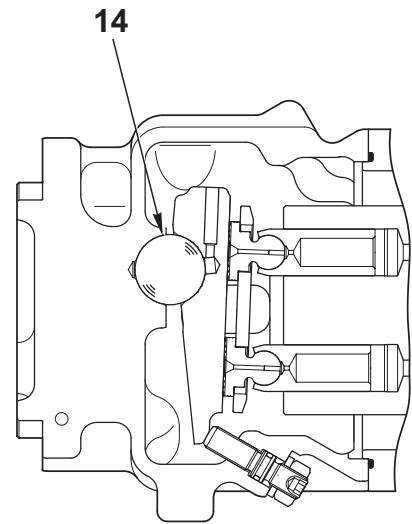
Port Pd4 - Drain

Port Pd5 - Drain

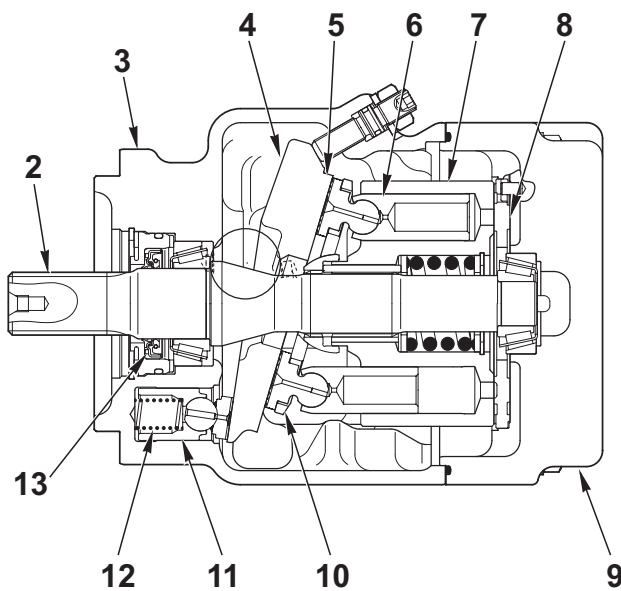
Port PM2 - Operating mode signal



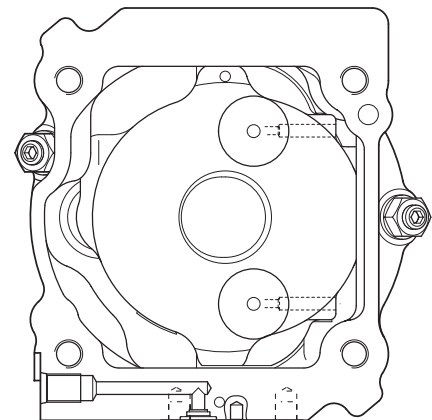
Section A - A



Section C - C



Section B - B



Section D - D

RKZ09520

- |                   |                    |
|-------------------|--------------------|
| 1. Bearing        | 8. Swash plate     |
| 2. Input shaft    | 9. Cover           |
| 3. Hydraulic pump | 10. Shoe guide     |
| 4. Swash plate    | 11. Control piston |
| 5. Shoe           | 12. Spring         |
| 6. Piston         | 13. Sealing ring   |
| 7. Cylinder block | 14. Ball           |

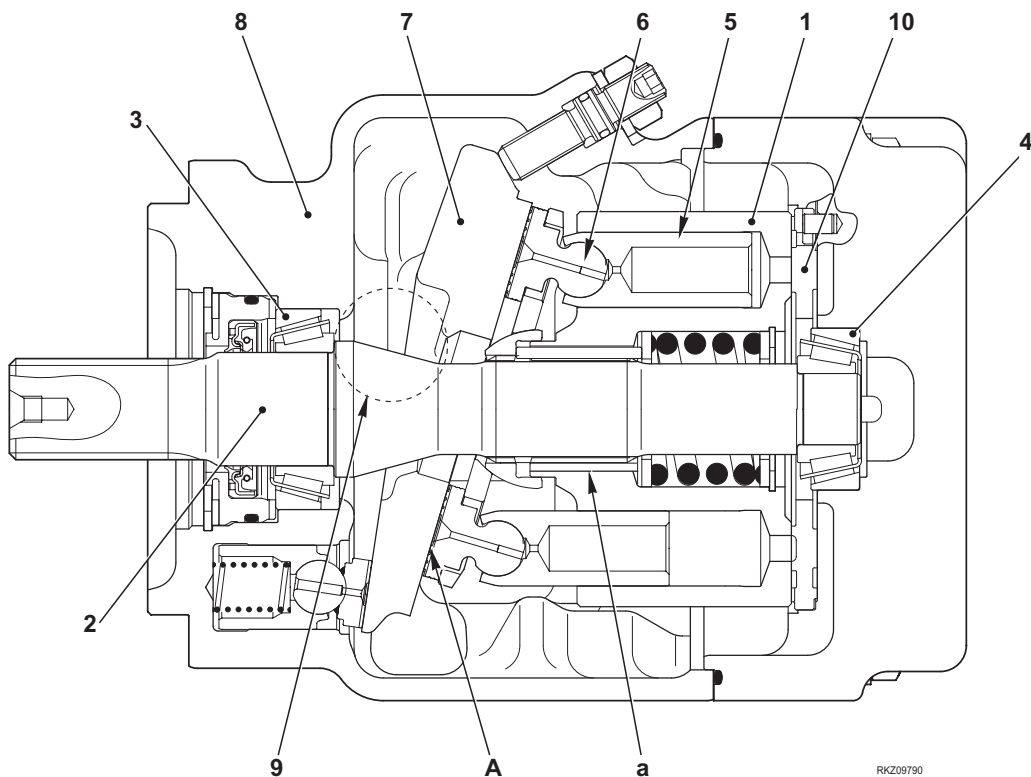
## STRUCTURE AND FUNCTION

## HYDRAULIC PUMP

### FUNCTION

The rotation and torque transmitted to the pump shaft is converted into hydraulic energy and pressurized oil is delivered according to the load requirements.

The amount of oil delivered can be modified by changing the angle of the swash plate.



### STRUCTURE

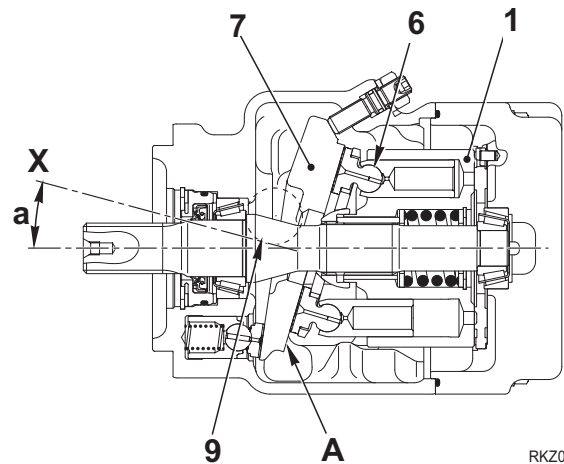
- Groove **a** supports and makes cylinder block (1) an integral part of shaft (2), and shaft (2) is supported by front and rear bearings (3), (4).
- The end of piston (5) is a concave ball, and shoe (6) is caulked to it to form one unit. Piston (5) and shoe (6) form a spherical bearing.
- Swash plate (7) is supported by pump body (8) and ball (9), and has a flat surface **A**. Shoe (6) remains in contact with swash plate (7) and slides in a circular movement. Pressurised oil is introduced between shoe (6) and swash plate (7) forming a static bearing that allows shoes (6) to slip.
- The pistons (5) perform their relative movements in an axial direction, inside cylindrical chambers fashioned in the cylinder block (1).
- The rotation of the cylinder block (1) pressurises the oil inside the chambers of the block; pressure is adjusted by the valve plate (10). The surface of the swash plate (10) is so designed that the oil pressure always remains within acceptable limits. The oil in each chamber is drawn in and discharged through holes in the valve plate (10).



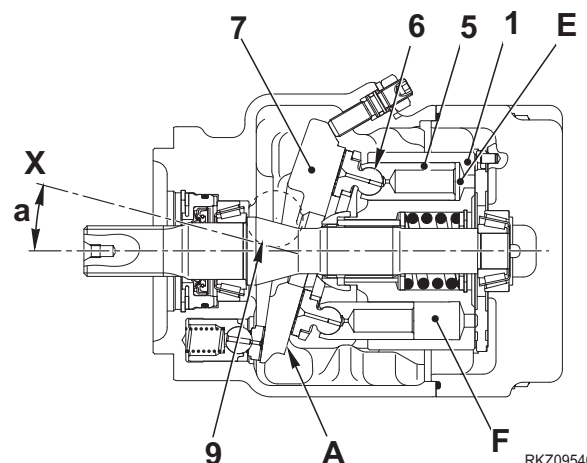
## OPERATION

## 1. Pump operation

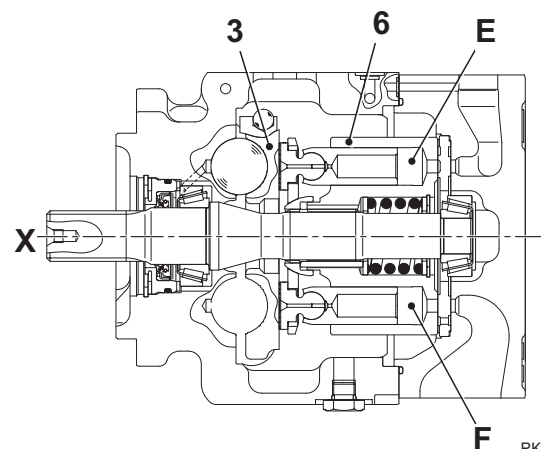
- 1 - The cylinder block (1) rotates with the shaft (2), and the shoe (6) slides on the flat surface **A**. When this happens, the swash plate (7) rotates on the ball (9), and the angle **a** between the axis of the cylinder block (1) and the axis **X** of the swash plate (3) changes. The angle **a** is known as the swash plate angle.
- 2 - When the axis **X** of the swash plate (7) retains the angle **a** in relation to the axis of the cylinder block (1), flat surface **A** acts as a cam for the shoe (6). This is why the piston (5) slides inside the cylinder block (1), creating a difference between volumes **E** and **F** and therefore causing the suction and delivery of oil in a quantity that is equivalent to the difference between those volumes ( $F - E = \text{delivery}$ ). In other words, when cylinder block (1) rotates, chamber **F** decreases in volume causing oil to be delivered to the circuits, while chamber **E** increases in volume causing oil to be suctioned. (The illustration shows the state of the pump when suction at chamber **F** and delivery at chamber **E** are complete).
- 3 - When the center line **X** of the swash plate (7) and the center line of the cylinder block (1) are perfectly aligned (the swash plate angle  $a = 0$ ), the difference between the volumes **E'** and **F'** within the cylinder block (1) becomes 0 and the pump does not take in or deliver any oil.
- 4 - In brief, the angle of the swash plate **a** is proportional to pump delivery.



RKZ09530



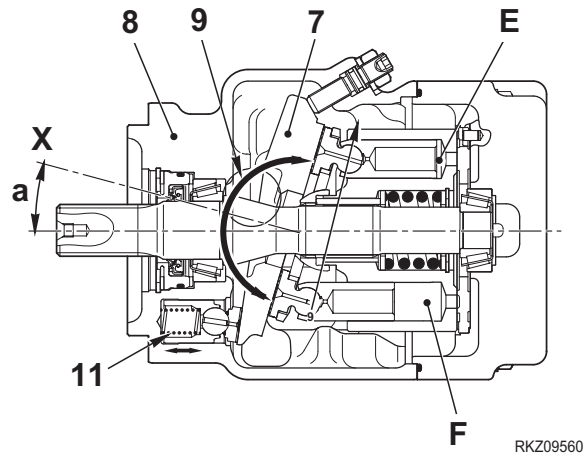
RKZ09540



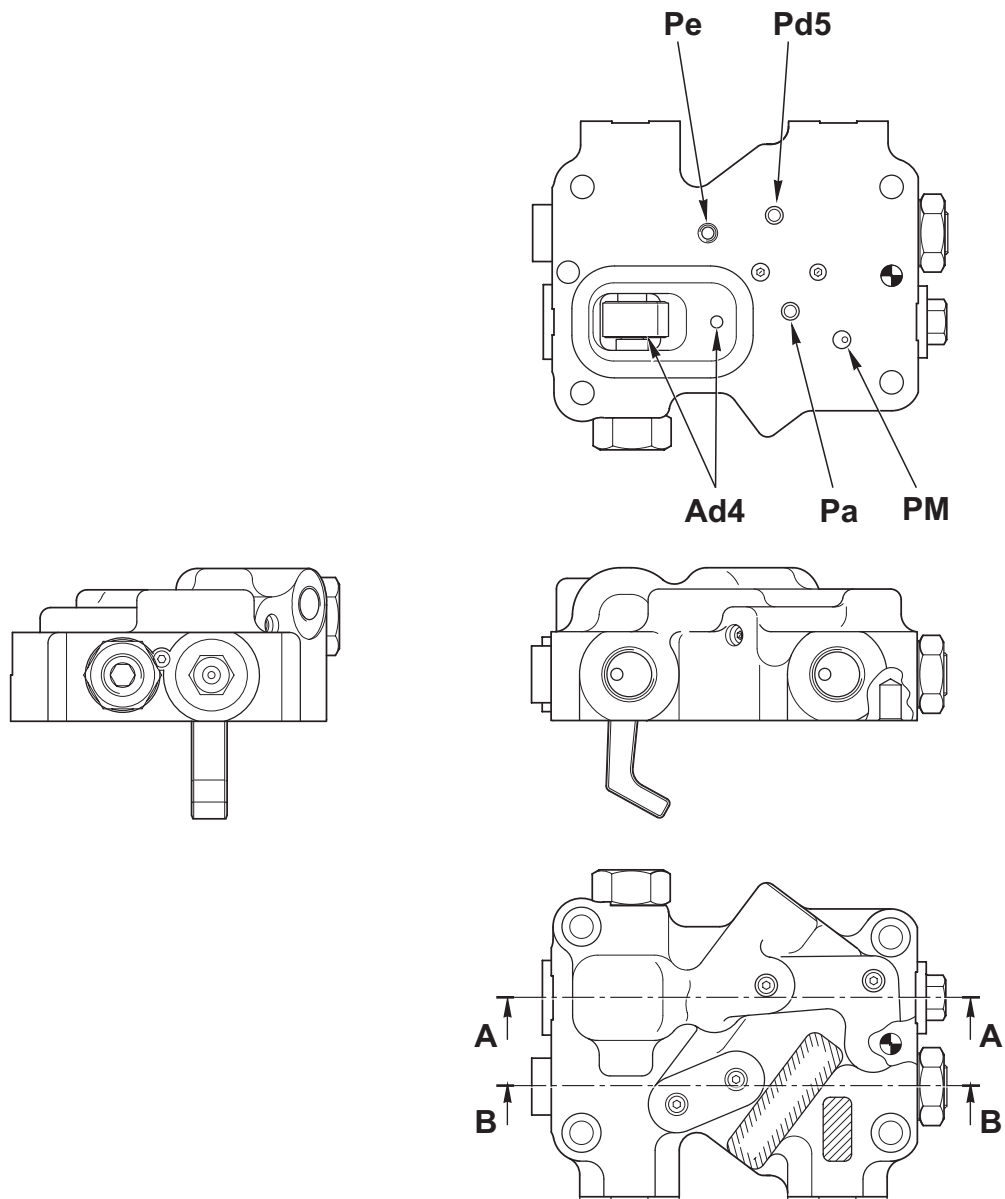
RKZ09550

## 2. Control of Delivery

- 1 - When angle **a** of the swash plate increases, the difference between volumes **E** and **F** increases too, and this makes delivery **Q** increase accordingly. Angle **a** of the swash plate is varied by the servo-piston (11).
- 2 - The servo-piston (11) moves in a reciprocating linear motion caused by pressure signals from the PC and LS valves. The linear motion is transmitted to the swash plate (7). The swash plate is supported by the pump body (8) through the ball (9), and this is the reason why the swash plate (7) moves in a semicircular alternate motion.



## 2. DELIVERY CONTROL VALVE



RKZ09430

### PORT FUNCTIONS

T port - Drain

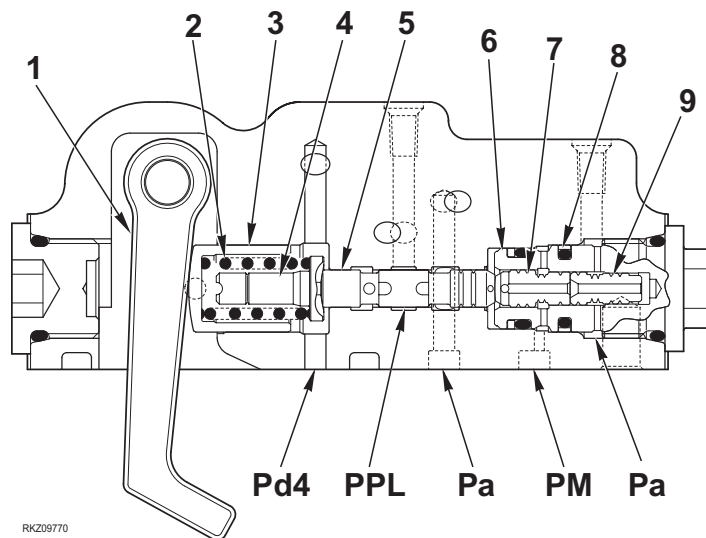
P1 port - Delivery control group feed

Pd4 port - Drain

PE port - Delivery control signal output

PM port - Operating mode signal input

## 2.1 PC VALVE



Section A - A

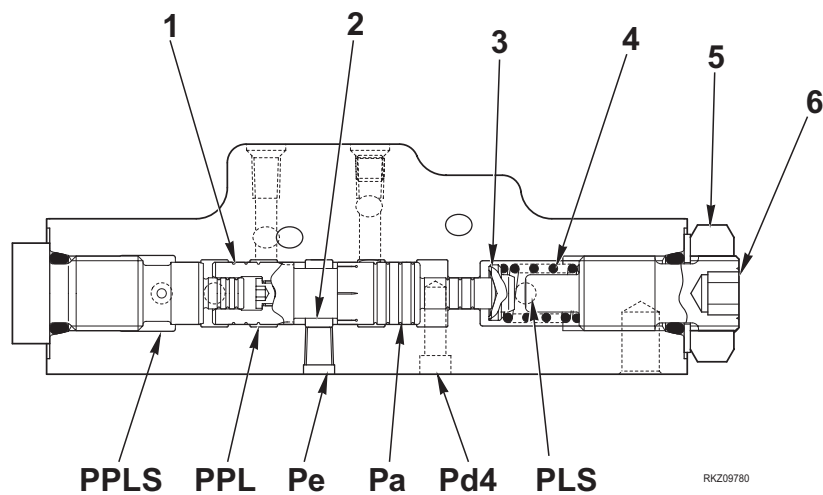
### COMPONENTS

1. Lever
2. Spring
3. Retainer
4. Seat
5. Spool
6. Sleeve
7. Piston
8. Gasket
9. Piston

### PORT FUNCTIONS

- T port - Drain  
PA Port - Pump delivery pressure  
PM port - Operating mode signal input  
PPL port - Delivery control signal output

## 2.2 LS VALVE



Section B - B

### COMPONENTS

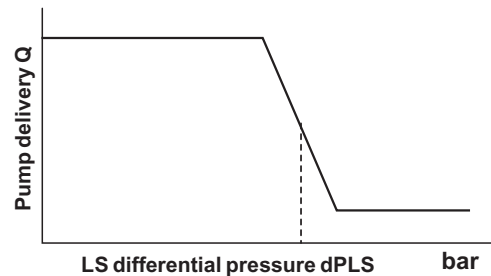
1. Spool
2. Plug
3. Seat
4. Spring
5. Nut
6. Plug

### PORT FUNCTIONS

- T port - Drain  
PA Port - Pump delivery pressure  
PE port - Delivery control signal  
PLS port - LS signal input  
PPL port - Delivery control signal input  
PPLS port - LS pump signal input

**LS VALVE FUNCTION**

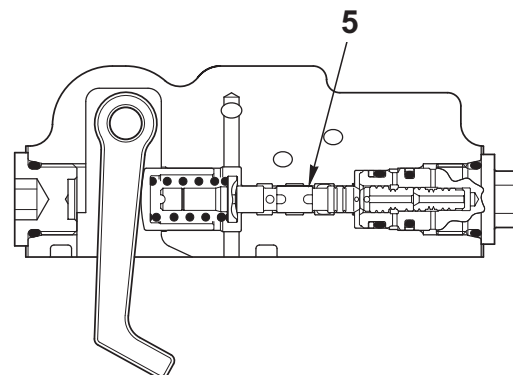
- The LS valve controls the pump delivery according to the stroke of the control valve lever, i.e., in function of the delivery demands made by the actuators.
- The LS valve detects the actuator's delivery needs by means of the differential pressure DPLS existing between pressure PPLS (control valve input pressure) and pressure PLS (control valve output pressure). The sensing of this differential pressure permits control of the main pump delivery **Q**. (PPLS, PLS and DPLS are, respectively, the pump pressure, the Load Sensing pressure, and the difference in pressure between these two values).
- In other words, the LS valve detects the pressure difference DPLS generated by the passage of the oil flow through the surface freed by the control valve spool, and controls the pump delivery **Q** so as to keep the pressure drop constant.  
It can therefore be assumed that the pump delivery is proportional to the demands made known by the control valve.
- Pump pressure PPLS (pump pressure at control valve input) and pressure PLS (Load Sensing pressure) are introduced into the LS valve. The relation between differential pressure DPLS and pump delivery varies as shown in the diagram on the right.



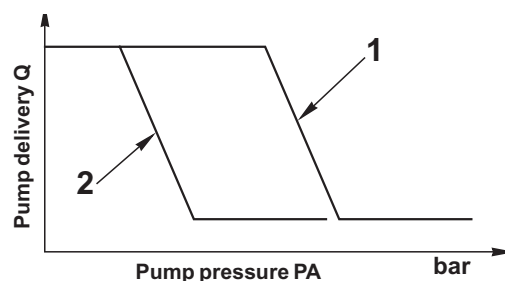
RKZ09570

### PC (Power Control) VALVE FUNCTION

- The PC valve performs an approximate power check, and ensures that the hydraulic horse-power absorbed by the pump does not exceed the horse-power delivered by the endothermal engine.
- This is achieved by limiting the pump delivery  $Q$  in function of the delivery pressure PPLS, even if the LS valve requests an increase in delivery  $Q$  due to the larger section freed by the control valve spool, in the presence of high pressure pump delivery.
- In other words, when during operation the delivery  $Q$  increases and the delivery pressure PPLS also increases simultaneously, the PC valve reduces the pump delivery  $Q$ . When the delivery pressure PPLS decreases, the PC valve increases the pump flow.
- As pressure PC increases, the relation between pressure PA and delivery  $Q$  is changed in accordance with the force applied by pressure PC.
- In other words, when the force applied by pressure PC is added to the force applied by the pump's delivery pressure against the spool (5), the relation between pump delivery pressure and delivery is switched from "1" to "2" in accordance with increment "X".



RKZ09800



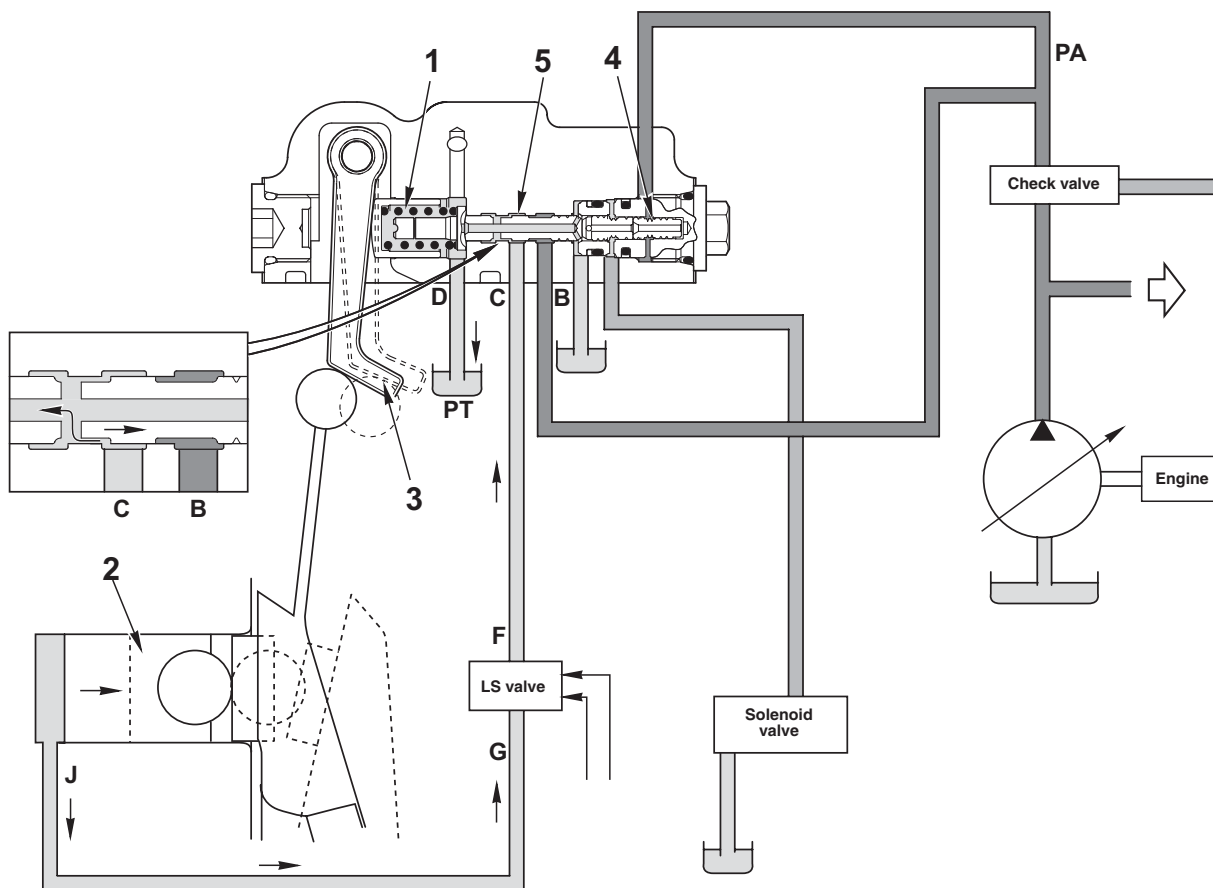
RKZ09580

## PC VALVE OPERATION

### 1. Spring operation

- PC valve spring loading (3) is defined by swash plate position.
- If control piston (6) moves to the right, spring (3) is compressed by lever (2) and spring loading increases.

### 2. When pump pressure PA is low

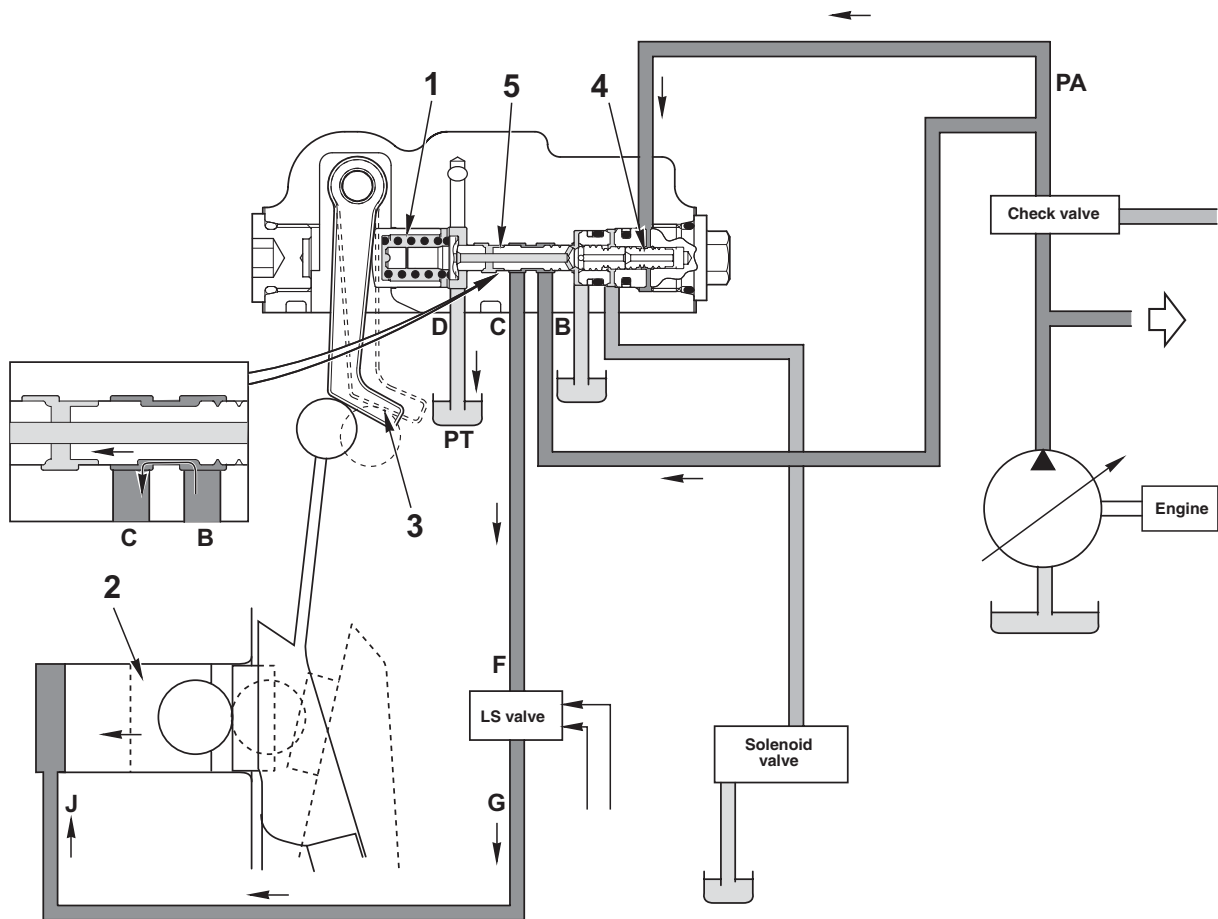


RKZ09490

- The force applied by the pressure against the spool (4) decreases, and the spool (5) shifts slightly to the right. At the same time, a connection opens between passages C and D, and pressurised oil from valve LS is sent for relief (PT).
- Simultaneously, passages F and G on valve LS are interconnected: pressure at passage J is sent for relief (PT), and the control piston (2) shifts to the left.
- Pump delivery increases as a result.
- When the control piston (2) moves, the lever (3) moves to the left, and the spring (1) expands, thereby reducing its load on the spool (5). Consequently, the spool (5) moves to the left and stops the oil flow between C and D, and a passage opens between ports B and C.
- As a result of that, the pressure in C increases, and the control piston (2) stops.



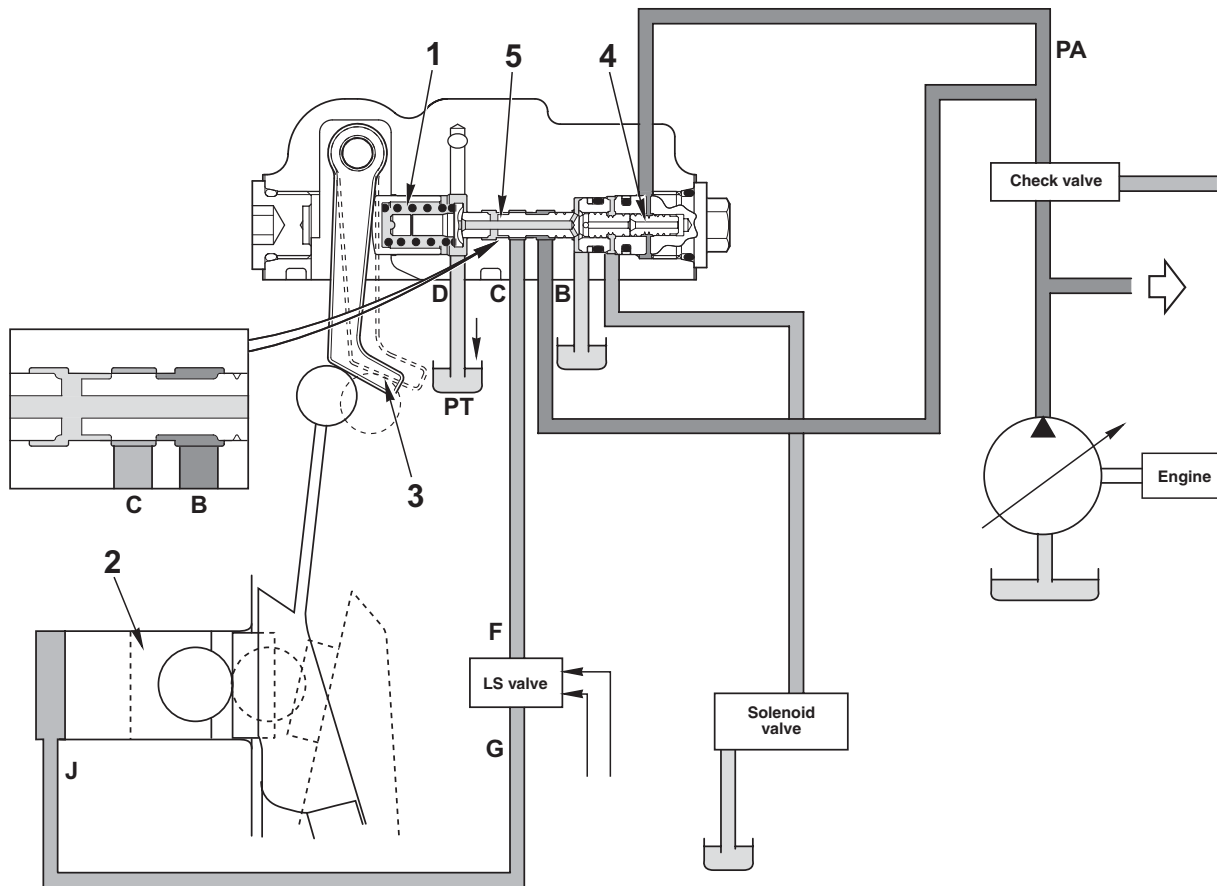
### 3. When pump pressure PA is high



RKZ09500

- The force applied by the pressure against the spool (4) increases, and the spool (5) shifts slightly to the left. At the same time, a connection opens **C** and **B**, and the pressure of the oil sent to valve LS becomes equivalent to the pump's delivery pressure (PA).
- Simultaneously, passages **F** and **G** in valve LS are interconnected, and pressure at port **J** becomes equivalent to the pump's delivery pressure (PA), and the control piston (2) shifts to the right.
- Pump delivery decreases as a result.
- When the control piston (2) moves, the lever (3) moves to the right, and the spring (1) compresses, thereby increasing its load on the spool (5). Consequently, the spool (5) moves to the right and stops the oil flow **C** and **B**, and a passage opens **D** and **C**.
- As a result of that, the pressure in **C** decreases, and the control piston (2) stops.

4. When equilibrium has been reached

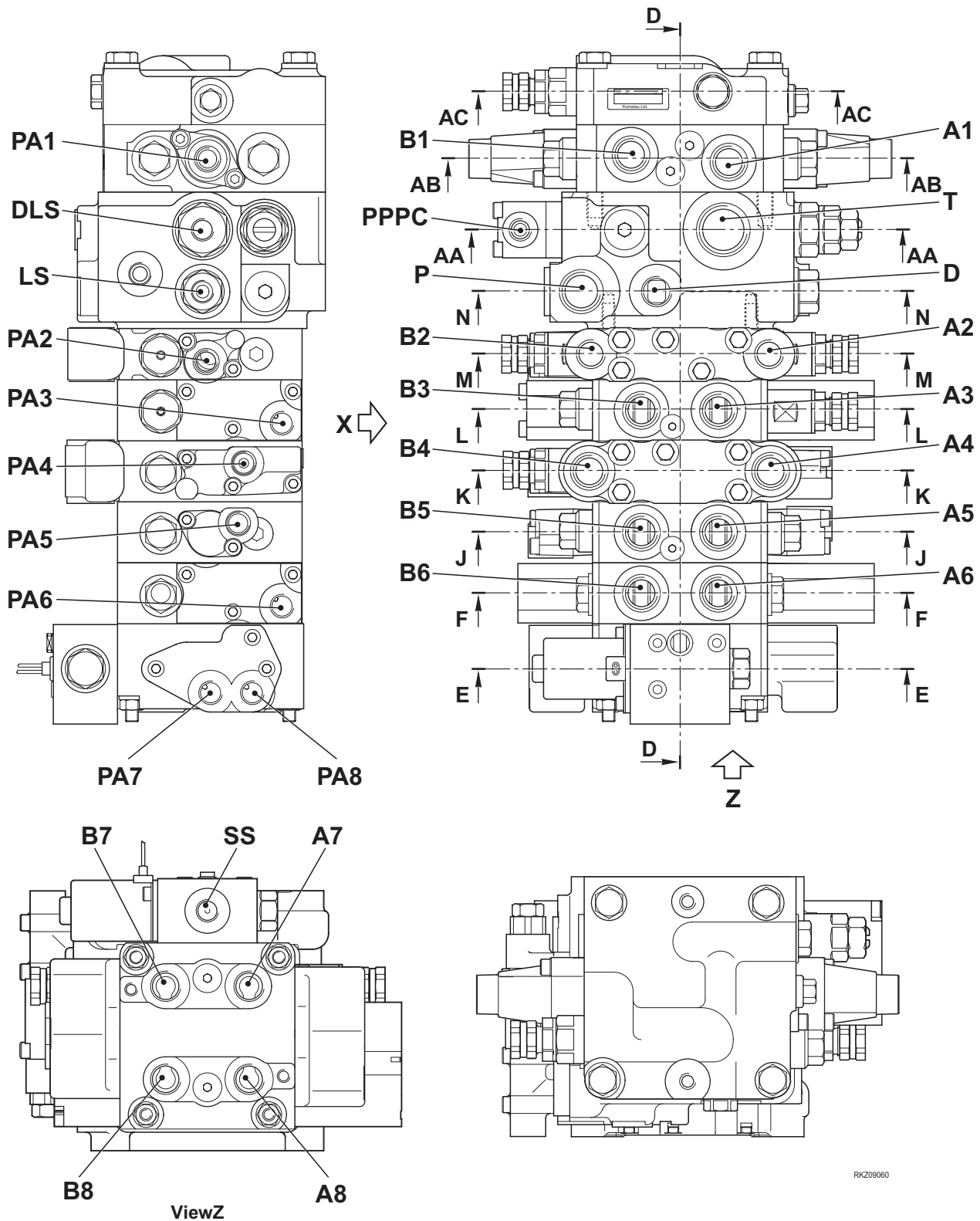


RKZ09510

- The equilibrium between the force applied by pressure PA against spool (4) and the force applied by spring (1) against spool (5) is what determines the position at which the control piston (2) (hence pump delivery) stops.

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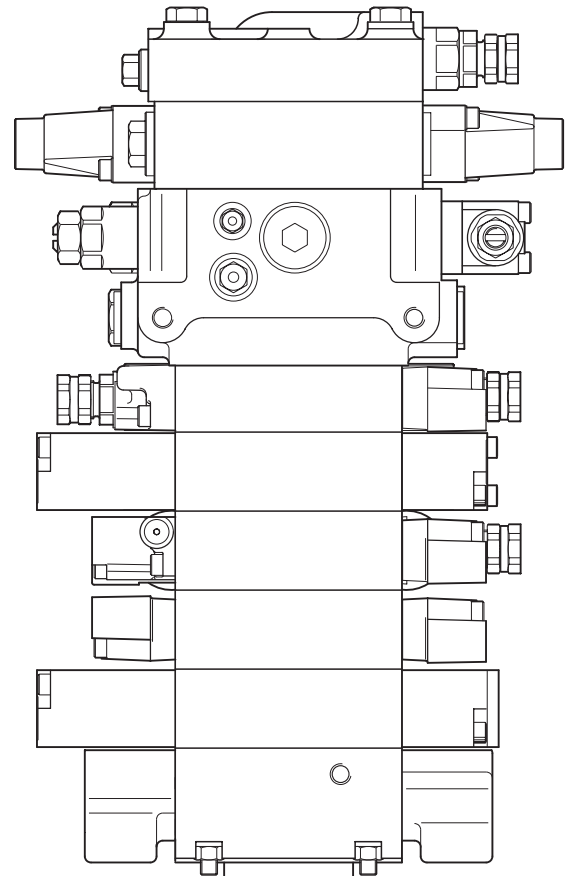
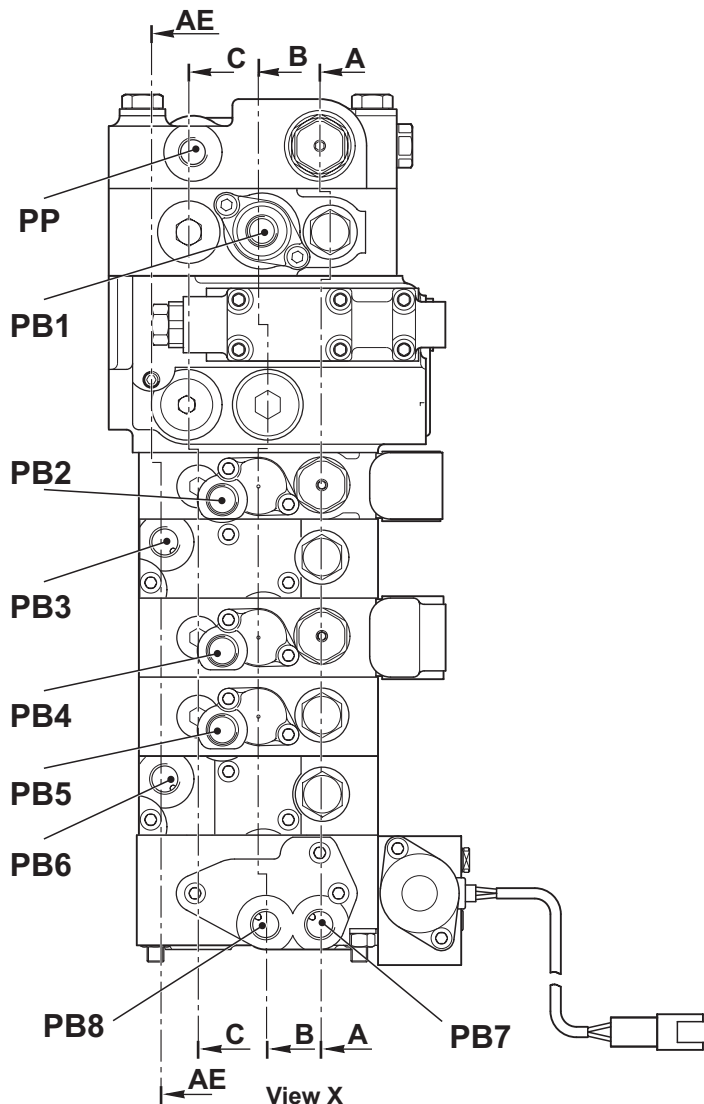
## 8-SPOOL CONTROL VALVE



RKZ09060

## STRUCTURE AND FUNCTION

## 8-SPOOL CONTROL VALVE



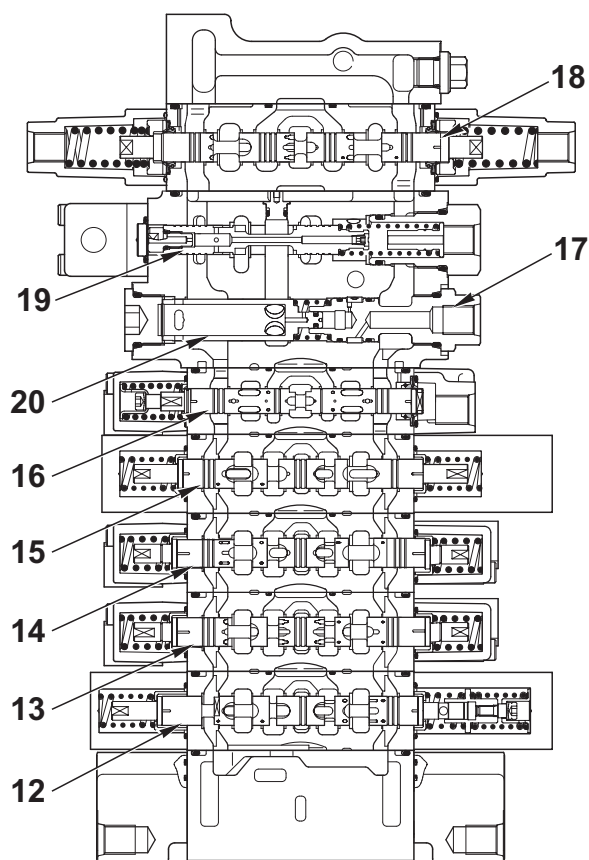
RKZ09070

- A1 - To the arm cylinder (Head side)
- A2 - To the boom (LH-RH) swing cylinder (Bottom side)
- A3 - To the shovel cylinders (Bottom side)
- A4 - To the boom cylinder (Bottom side)
- A5 - To the backhoe bucket cylinder (Head side)
- A6 - To the shovel arm raise cylinder (Bottom side)
- A7 - To the RH outrigger cylinder (bottom side)
- A8 - To the LH outrigger cylinder (bottom side)
- B1 - To the arm cylinder (Bottom side)
- B2 - To the boom (LH-RH) swing cylinder (Head side)
- B3 - To the shovel cylinders (Head side)
- B4 - To the boom cylinder (Head side)
- B5 - To the backhoe bucket cylinder (Bottom side)
- B6 - To the shovel arm raise cylinder (Head side)
- B7 - To the RH outrigger cylinder (Head side)
- B8 - To the LH outrigger cylinder (Head side)
- LS - To the hydraulic pump (PLS port)
- P - From hydraulic pump (P1 port)
- D - To the steering unit (P Port)
- DLS - From the steering unit (LS Port)
- PP - To the hydraulic pump (P1L port)

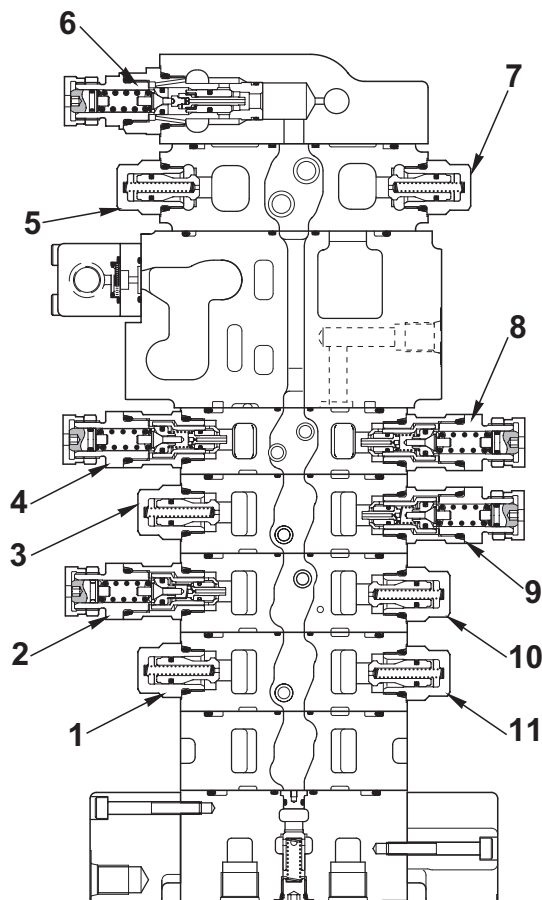
- T - To hydraulic tank
- TS - To hydraulic tank
- PPPC - To solenoid valve group EV1 (P Port)
- SS - To the backhoe plate lock cylinders
- PA1 - From backhoe LH PPC valve (port 3)
- PA2 - From backhoe LH PPC valve (port 4)
- PA3 - From the shovel PPC valve (P2 port)
- PA4 - From backhoe RH PPC valve (port 3)
- PA5 - From backhoe RH PPC valve (port 4)
- PA6 - From the shovel PPC valve (P3 port)
- PA7 - From the outriggers PPC valve (P1 port)
- PA8 - From the outriggers PPC valve (P3 port)
- PB1 - From backhoe LH PPC valve (port 1)
- PB2 - From backhoe LH PPC valve (port 2)
- PB3 - From the shovel PPC valve (P1 port)
- PB4 - From backhoe RH PPC valve (port 1)
- PB5 - From backhoe RH PPC valve (port 2)
- PB6 - From the shovel PPC valve (P4 port)
- PB7 - From the outriggers PPC valve (P2 port)
- PB8 - From the outriggers PPC valve (P4 port)

## STRUCTURE AND FUNCTION

## 8-SPOOL CONTROL VALVE



**B - B**



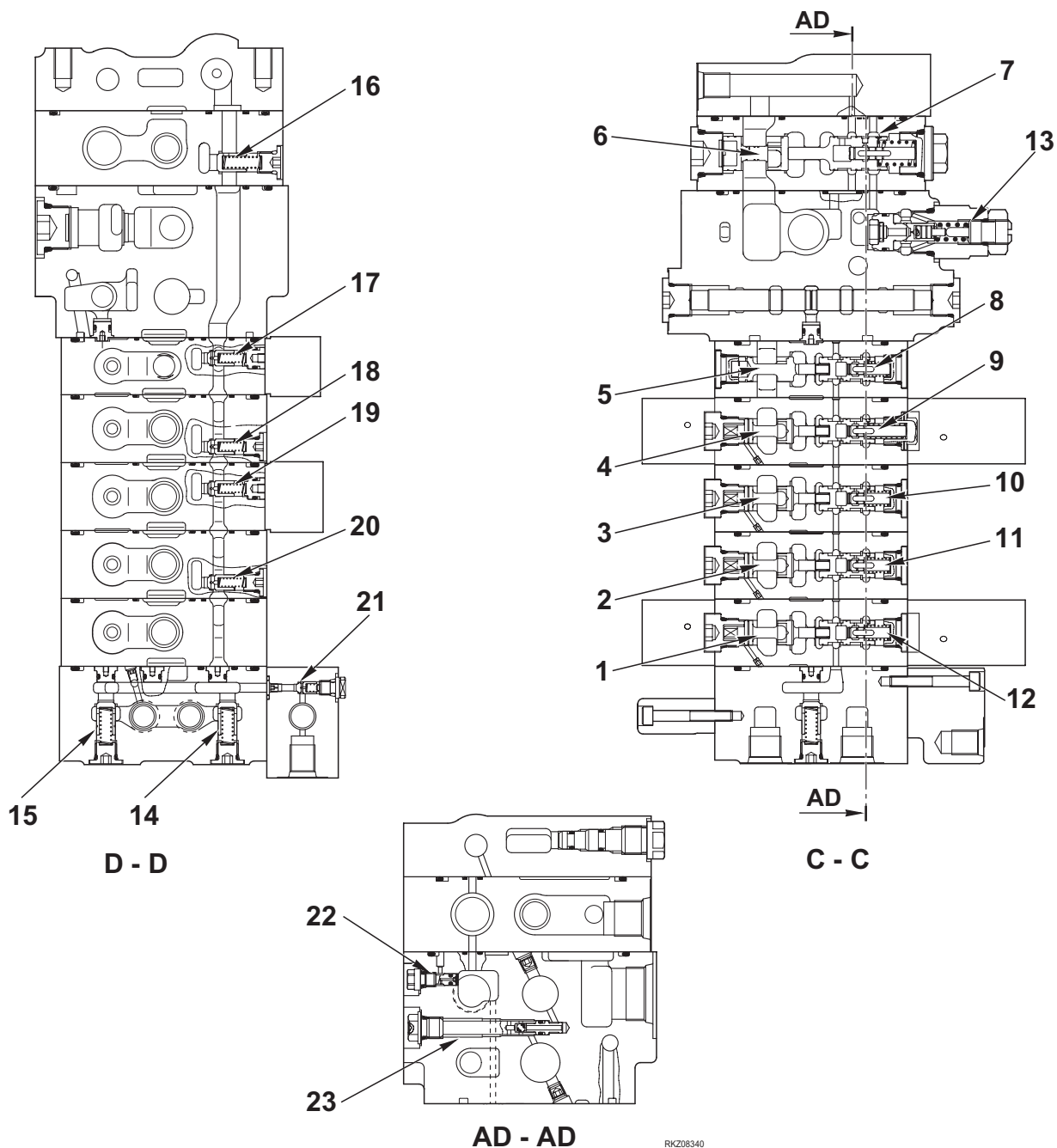
**A - A**

RKZ09080

- |                                                     |                                    |
|-----------------------------------------------------|------------------------------------|
| 1. Anticavitation valve<br>(backhoe bucket curl)    | 12. Spool (shovel arm control)     |
| 2. Anti-shock/anticavitation valve<br>(boom raise)  | 13. Spool (backhoe bucket control) |
| 3. Anticavitation valve (shovel dump)               | 14. Spool (boom control)           |
| 4. Anti-shock/anticavitation valve (LH swing)       | 15. Spool (front bucket control)   |
| 5. Anticavitation valve (arm out)                   | 16. Spool (boom swing control)     |
| 6. Safety valve                                     | 17. LS by-pass plug                |
| 7. Anticavitation valve (arm in)                    | 18. Spool (arm control)            |
| 8. Anti-shock/anticavitation valve (RH swing)       | 19. Spool (priority valve)         |
| 9. Anti-shock/anticavitation valve<br>(shovel curl) | 20. Unloading valve                |
| 10. Anticavitation valve (boom lower)               |                                    |
| 11. Anticavitation valve<br>(backhoe bucket dump)   |                                    |

## STRUCTURE AND FUNCTION

## 8-SPOOL CONTROL VALVE



### PRESSURE REDUCING VALVE

1. Shovel arm
2. Backhoe bucket
3. Boom
4. Front bucket
5. Boom swing
6. Arm

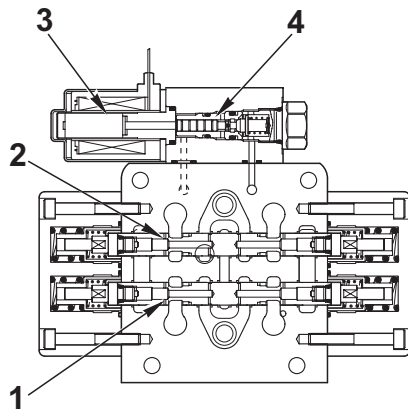
### DELIVERY CONTROL VALVE

7. Arm
8. Boom swing
9. Front bucket
10. Boom

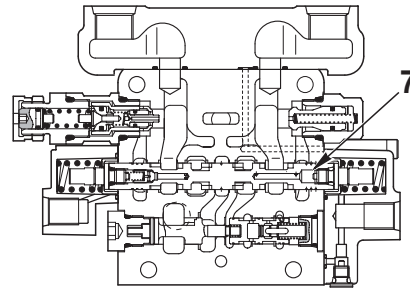
11. Backhoe bucket
12. Shovel arm
13. Max. pressure valve
14. Check valve
15. Check valve
16. Check valve
17. Check valve
18. Check valve
19. Check valve
20. Check valve
21. Check valve
22. LS, DLS pressure check valve
23. LS by-pass plug

## STRUCTURE AND FUNCTION

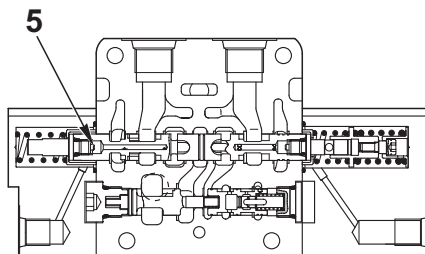
## 8-SPOOL CONTROL VALVE



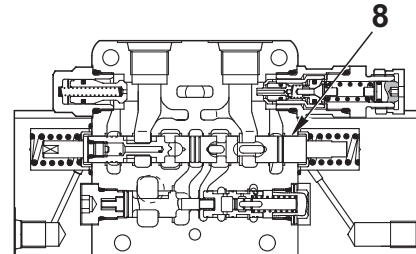
**E - E**



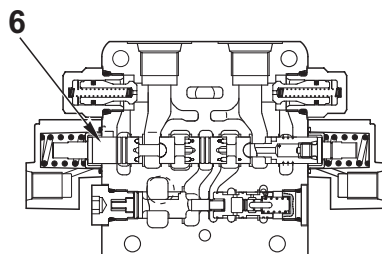
**K - K**



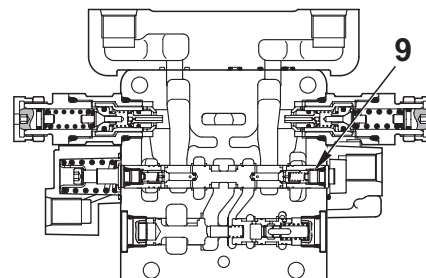
**F - F**



**L - L**



**J - J**



**M - M**

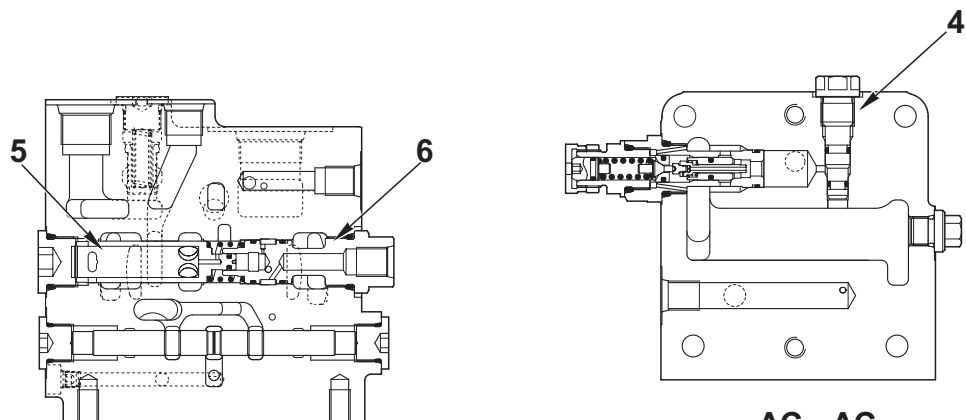
RKZ09100

1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)

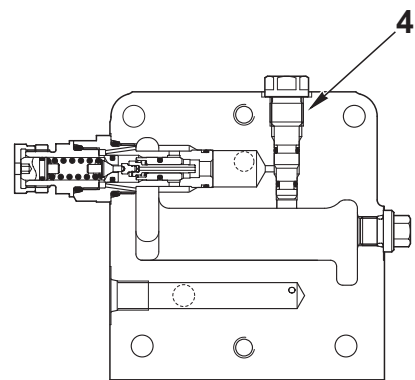


## STRUCTURE AND FUNCTION

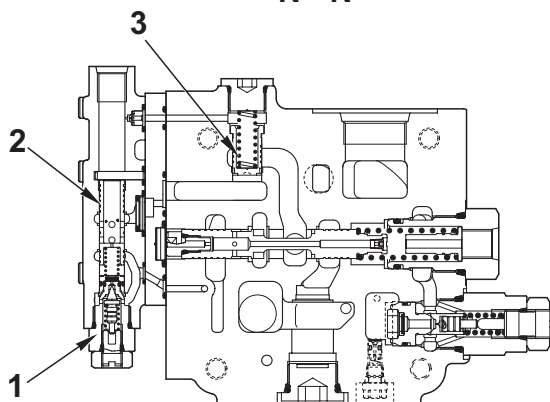
## 8-SPOOL CONTROL VALVE



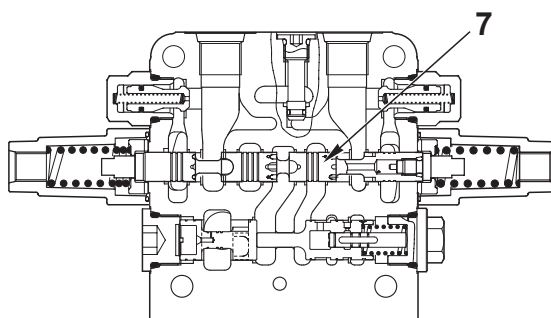
**N - N**



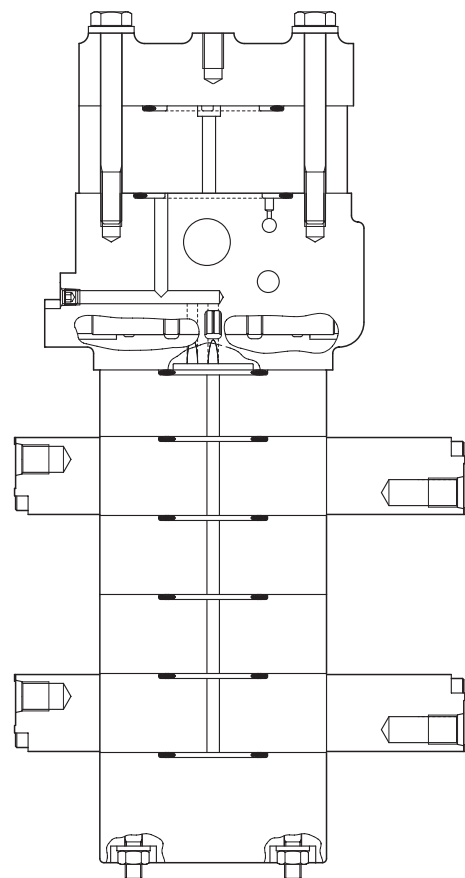
**AC - AC**



**AA - AA**



**AB - AB**

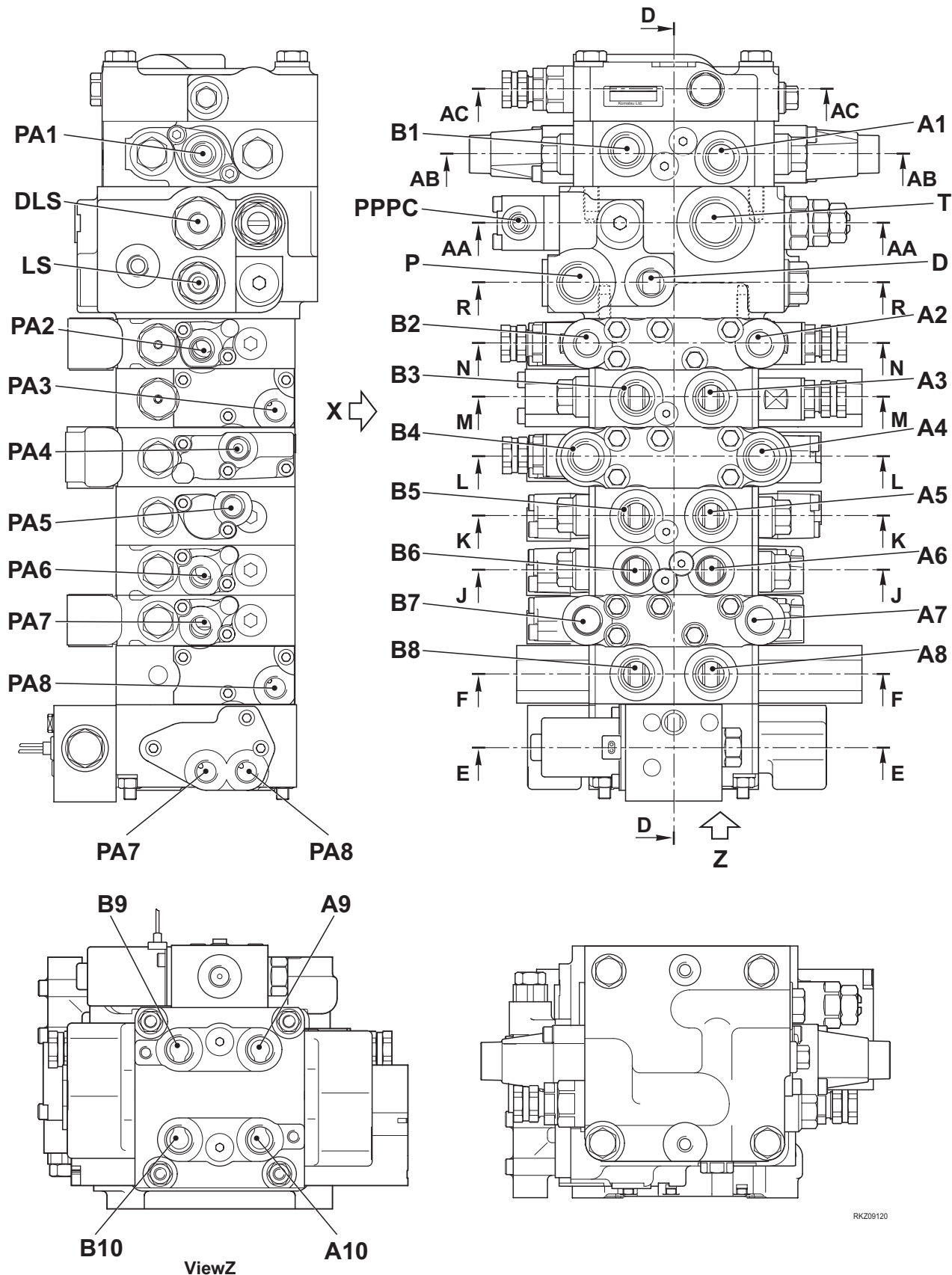


**AE - AE**

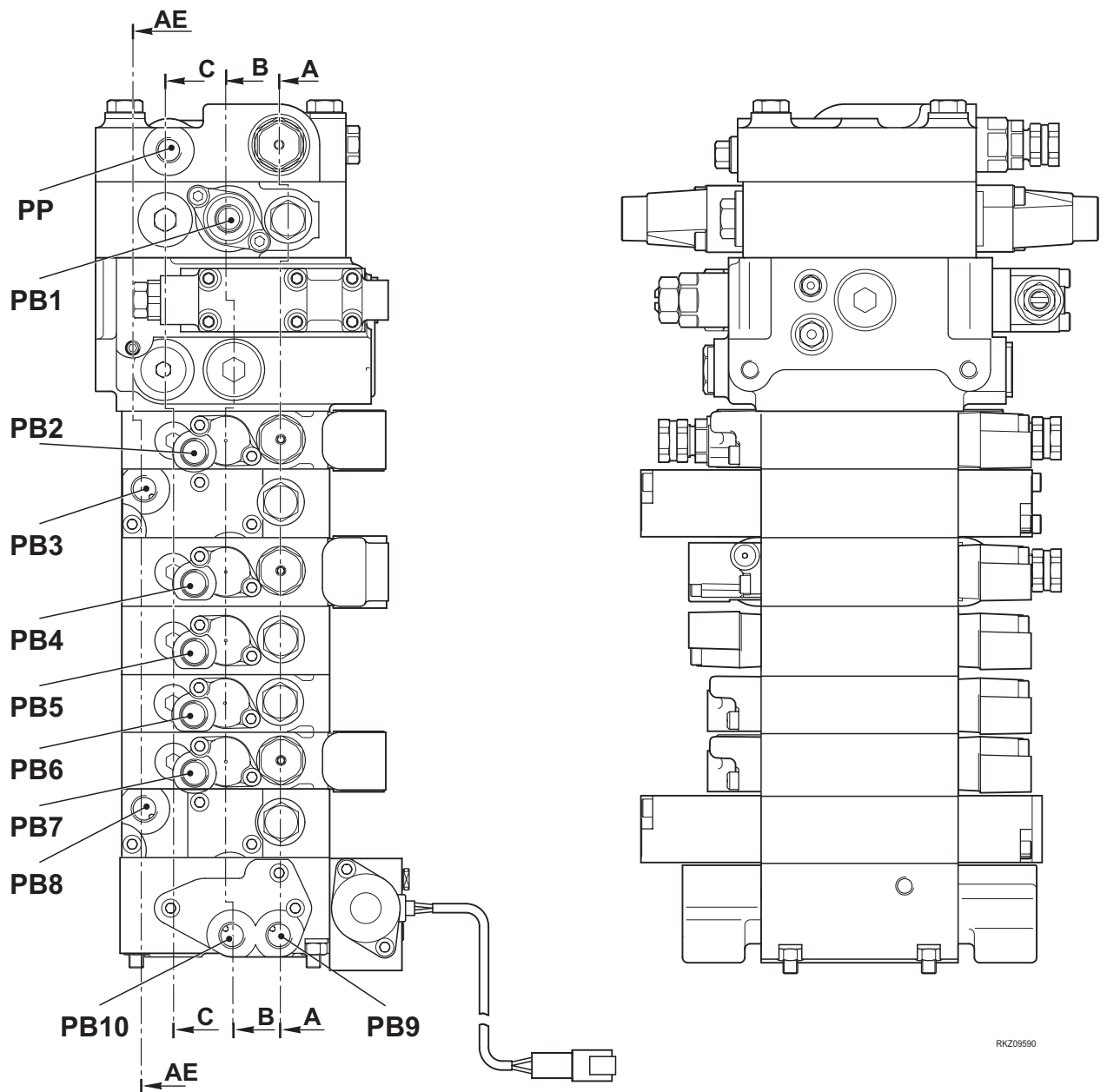
RKZ09110

1. Servocontrol max. pressure valve
2. Max. pressure valve spool
3. Sequential reducing valve
4. Blow out plug
5. Unloading valve
6. LS by-pass plug
7. Spool (Arm control)

## 10-SPOOL CONTROL VALVE



RKZ09120



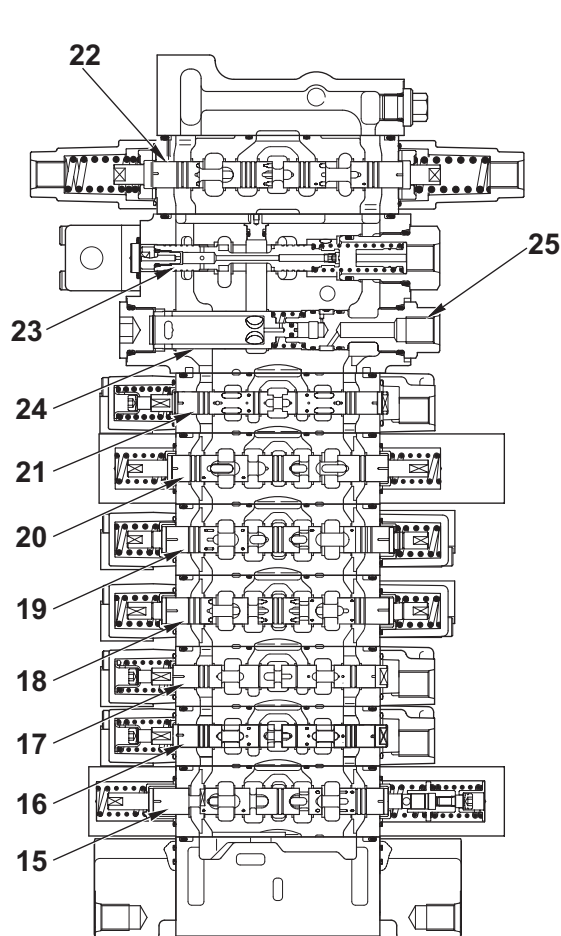
## STRUCTURE AND FUNCTION

## 10-SPOOL CONTROL VALVE

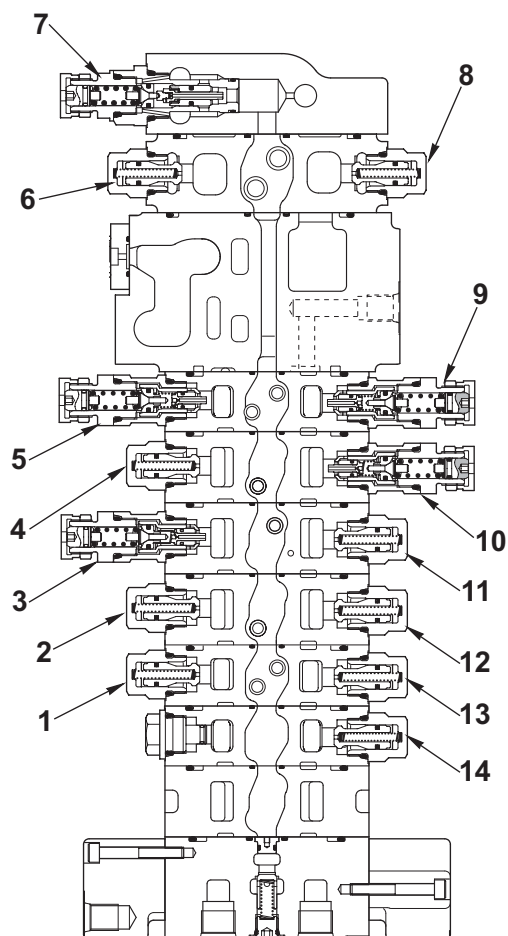
- A1 - To the arm cylinder (Head side)
- A2 - To the boom (LH-RH) swing cylinder (Bottom side)
- A3 - To the shovel cylinders (Bottom side)
- A4 - To the boom cylinder (Bottom side)
- A5 - To the backhoe bucket cylinder (Head side)
- A6 - To the 4 in 1 bucket cylinder (Bottom side)
- A7 - To the jig arm cylinder (Bottom side)
- A8 - To the shovel arm raise cylinder (Bottom side)
- A9 - To the RH outrigger cylinder (Bottom side)
- A10 - To the LH outrigger cylinder (Bottom side)
- B1 - To the arm cylinder (Bottom side)
- B2 - To the boom (LH-RH) swing cylinder (Head side)
- B3 - To the shovel cylinders (Head side)
- B4 - To the boom cylinder (Head side)
- B5 - To the backhoe bucket cylinder (Bottom side)
- B6 - To the 4 in 1 bucket cylinder (Head side)
- B7 - To the jig arm cylinder (Head side)
- B8 - To the shovel arm raise cylinder (Head side)
- B9 - To the RH outrigger cylinder (Head side)
- B10 - To the LH outrigger cylinder (Head side)
- LS - To the hydraulic pump (PLS port)
- P - From hydraulic pump (P1 port)
- D - To the steering unit (P Port)
- DLS - From the steering unit (LS Port)
- PP - To the hydraulic pump (P1L port)
- T - To hydraulic tank
- TS - To hydraulic tank
- PPPC -To solenoid valve group EV1 (P Port)
- SS - To the backhoe plate lock cylinders
- PA1 - From backhoe LH PPC valve (port 3)
- PA2 - From backhoe LH PPC valve (port 4)
- PA3 - From the shovel PPC valve (P2 port)
- PA4 - From backhoe RH PPC valve (port 3)
- PA5 - From backhoe RH PPC valve (port 4)
- PA6 - From solenoid valve group EV1 (A1 Port)
- PA7 - From solenoid valve group EV2 (A2 Port)
- PA8 - From the shovel PPC valve (P3 port)
- PA9 - From the outriggers PPC valve (P1 port)
- PA10 - From the outriggers PPC valve (P3 port)
- PB1 - From backhoe LH PPC valve (port 1)
- PB2 - From backhoe LH PPC valve (port 2)
- PB3 - From the shovel PPC valve (P1 port)
- PB4 - From backhoe RH PPC valve (port 1)
- PB5 - From backhoe RH PPC valve (port 2)
- PB6 - From solenoid valve group EV1 (B1 Port)
- PB7 - From solenoid valve group EV2 (B2 Port)
- PB8 - From the shovel PPC valve (P4 port)
- PB9 - From the outriggers PPC valve (P2 port)
- PB10 -From the outriggers PPC valve (P4 port)

## STRUCTURE AND FUNCTION

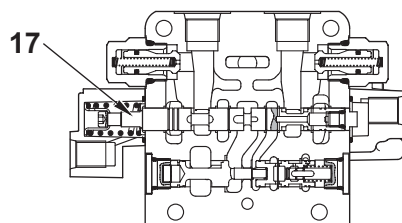
## 10-SPOOL CONTROL VALVE



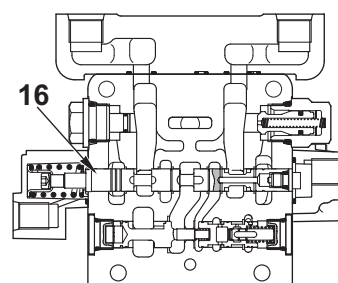
**B - B**



**A - A**



**K - K**



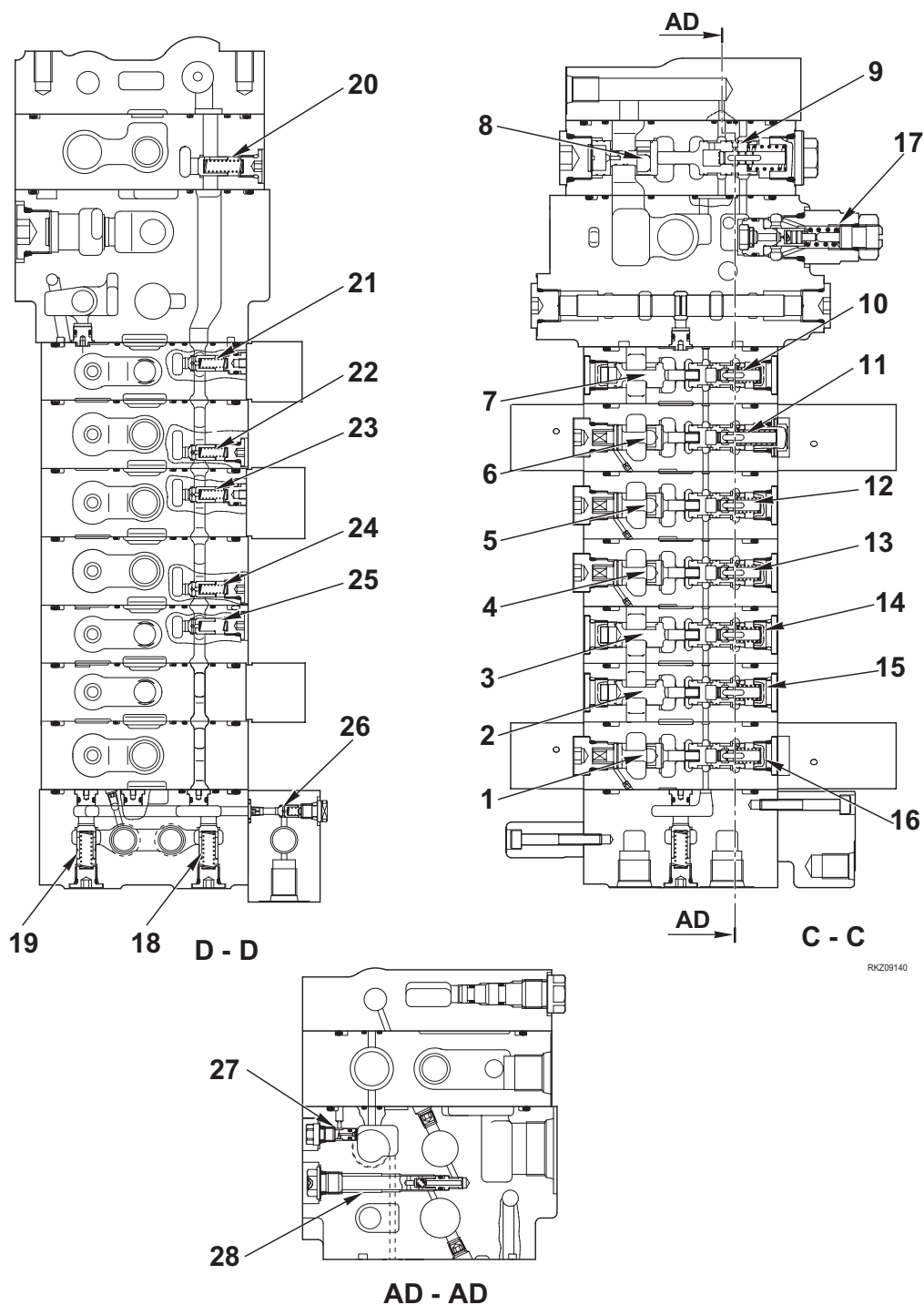
**J - J**

RKZ09130

- |                                                   |                                               |
|---------------------------------------------------|-----------------------------------------------|
| 1. Anticavitation valve (jig arm extend)          | 13. Anticavitation valve (jig arm retract)    |
| 2. Anticavitation valve (backhoe bucket curl)     | 14. Anticavitation valve (4 in 1 bucket dump) |
| 3. Anti-shock/anticavitation valve (boom raise)   | 15. Spool (shovel arm control)                |
| 4. Anticavitation valve (shovel dump)             | 16. Spool (Jig arm control)                   |
| 5. Anti-shock/anticavitation valve (LH swing)     | 17. Spool (4 in 1 bucket control)             |
| 6. Anticavitation valve (arm out)                 | 18. Spool (backhoe bucket control)            |
| 7. Safety valve                                   | 19. Spool (boom control)                      |
| 8. Anticavitation valve (arm in)                  | 20. Spool (front bucket control)              |
| 9. Anti-shock/anticavitation valve (RH swing)     | 21. Spool (boom swing control)                |
| 10. Anti-shock/anticavitation valve (shovel curl) | 22. Spool (arm control)                       |
| 11. Anticavitation valve (boom lower)             | 23. Spool (priority valve)                    |
| 12. Anticavitation valve (backhoe bucket dump)    | 24. Unloading valve                           |
|                                                   | 25. LS by-pass plug                           |

## STRUCTURE AND FUNCTION

## 10-SPOOL CONTROL VALVE



RKZ09140

### PRESSURE REDUCING VALVE

1. Shovel arm
2. Jig arm
3. 4 in 1 bucket
4. Backhoe bucket
5. Boom
6. Front bucket
7. Boom swing
8. Arm

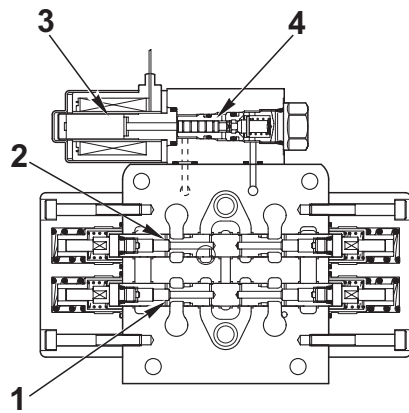
### DELIVERY CONTROL VALVE

9. Arm
10. Boom swing
11. Front bucket
12. Boom
13. Backhoe bucket
14. 4 in 1 bucket
15. Jig arm
16. Shovel arm
17. Max. pressure valve
18. Check valve

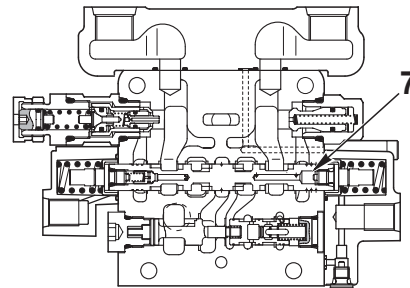
19. Check valve
20. Check valve
21. Check valve
22. Check valve
23. Check valve
24. Check valve
25. Check valve
26. Check valve
27. LS, DLS pressure check valve
28. LS by-pass plug

## STRUCTURE AND FUNCTION

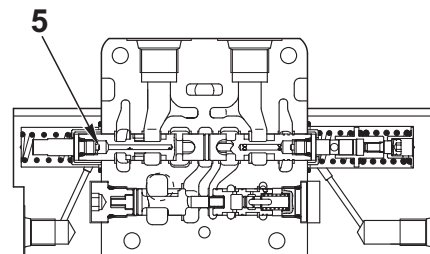
## 10-SPOOL CONTROL VALVE



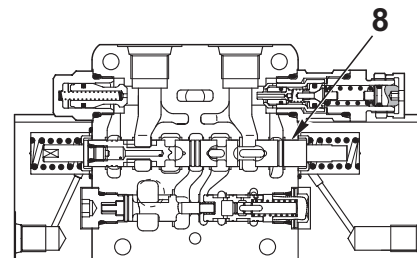
**E - E**



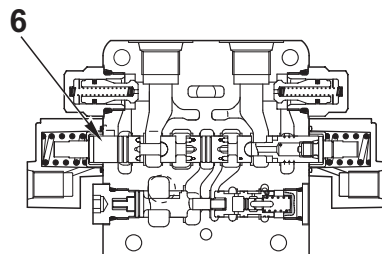
**M - M**



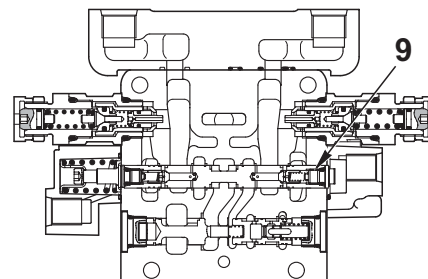
**F - F**



**N - N**



**L - L**



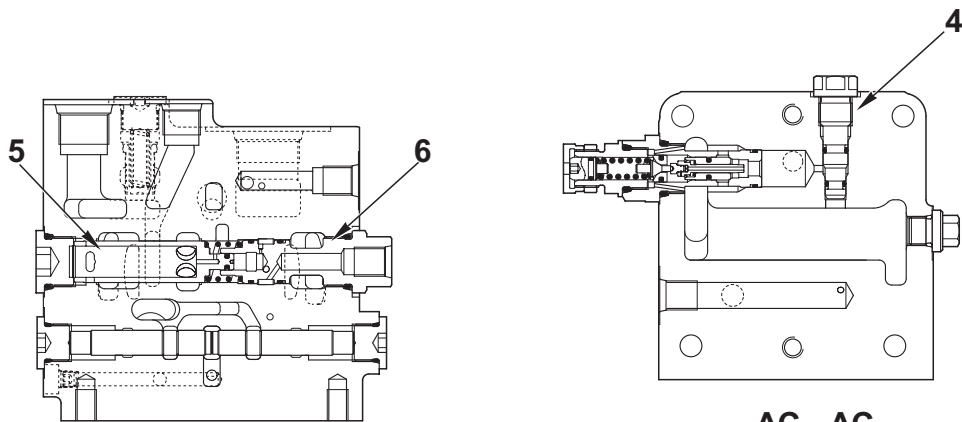
**P - P**

RKZ08101

1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)

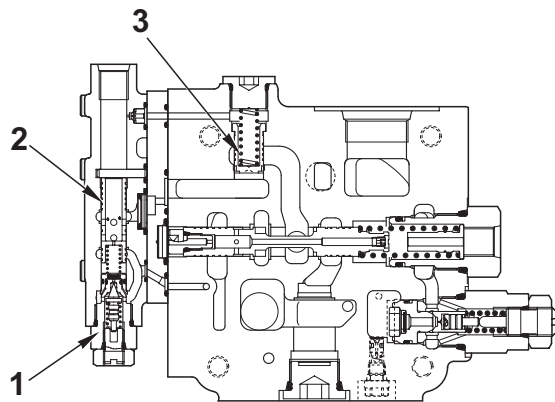
## STRUCTURE AND FUNCTION

## 10-SPOOL CONTROL VALVE

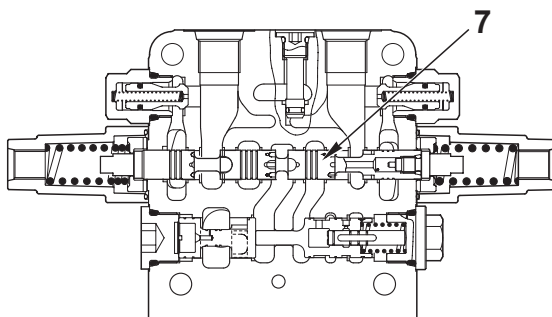


**R - R**

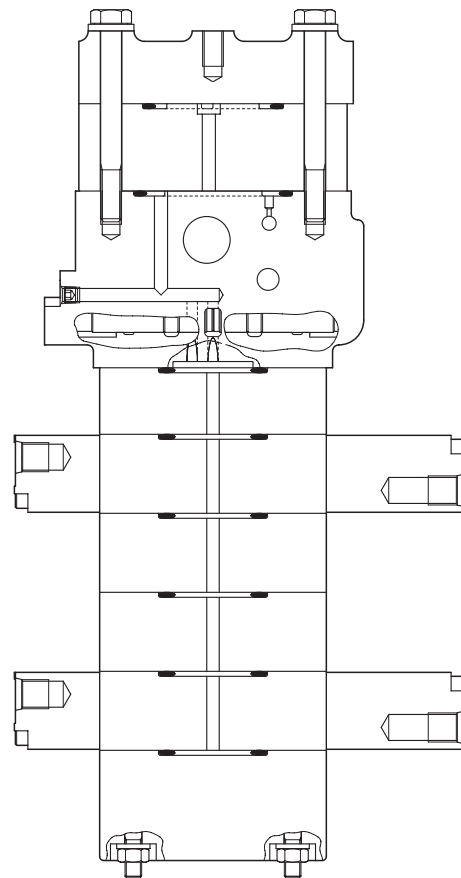
**AC - AC**



**AA - AA**



**AB - AB**



**AE - AE**

RKZ09111

1. Servocontrol max. pressure valve
2. Max. pressure valve spool
3. Sequential reducing valve
4. Blow out plug
5. Unloading valve
6. LS by-pass plug
7. Spool (Arm control)



# CLSS

## 1. DESCRIPTION

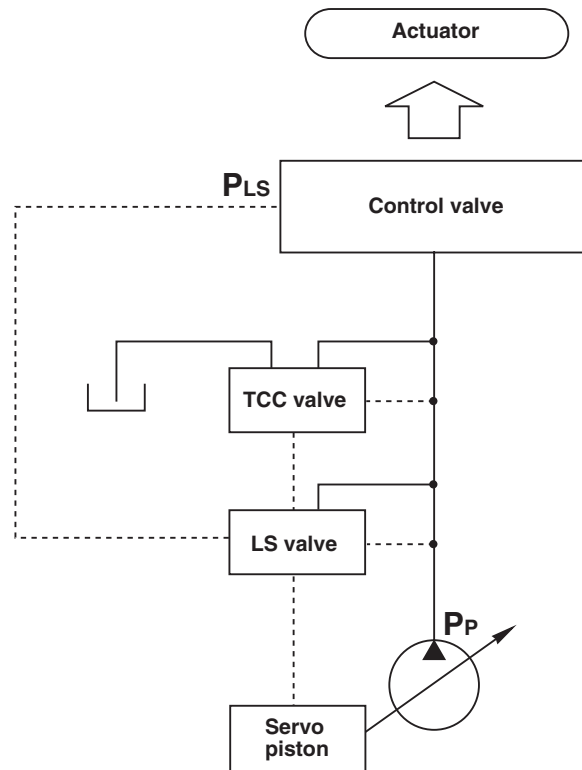
### 1.1 CHARACTERISTICS

The term **CLSS** means Closed Center Load Sensing System, which has the following characteristics:

- High precision control that is independent of the load applied to the movement;
- High precision control of digging action even during delicate manoeuvres;
- Ability to perform complex operations, guaranteed by control of oil flow in function of the aperture surfaces of the shuttles;
- Energy savings guaranteed by control of pump delivery.

### 1.2 STRUCTURE

- The CLSS system includes the variable flow pump, the control valve and the working equipment.
- The pump includes the main pump, the **TCC** valve and the **LS** valve.

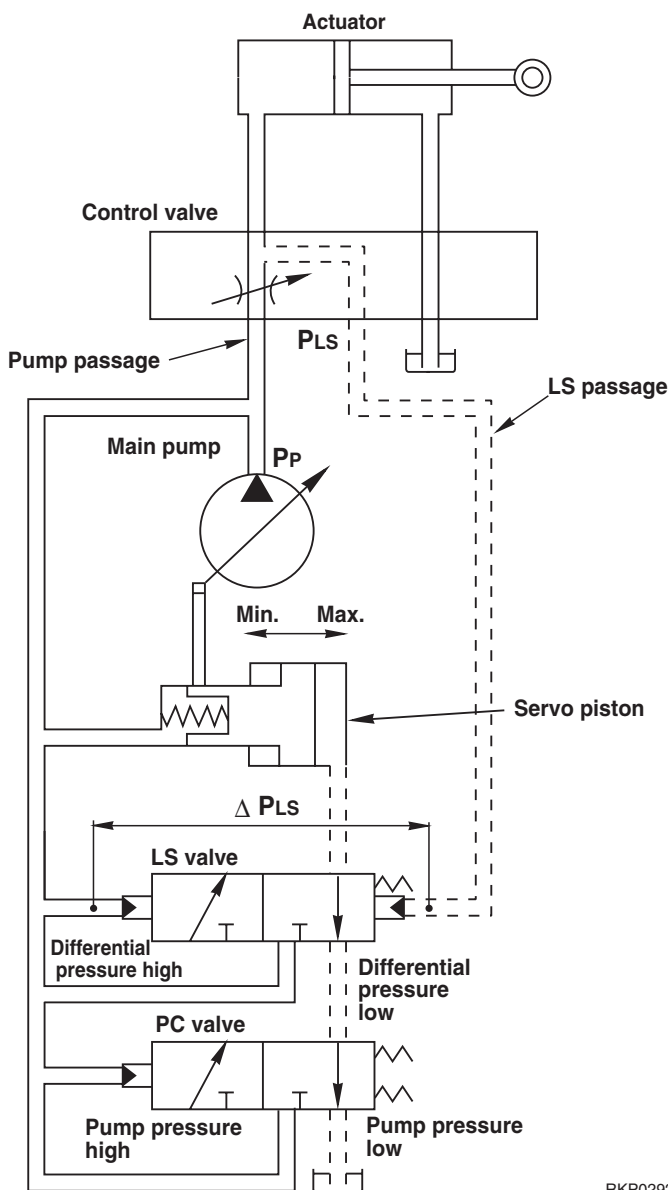


RKP00661

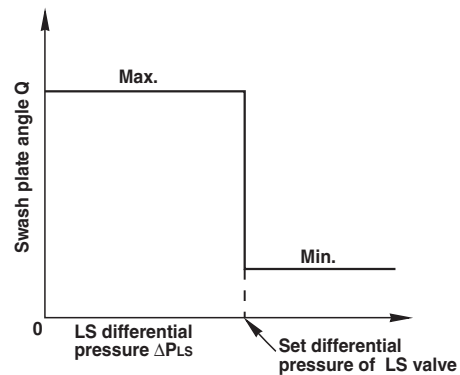
## 2. OPERATING PRINCIPLES

### 2.1 CONTROL OF THE ANGLE OF THE PUMPING PLATE

- The angle of the swash plate (and hence the pump delivery) is controlled in such a way that the differential pressure **DPLS** between the delivery pressure **PP** of the pump and the pressure **PLS** at the outlet of the control valve towards the actuator is maintained at a constant value. (**DPLS**=Pump delivery pressure **PP** – pressure **PLS** of delivery to the actuator.
- If the differential pressure **DPLS** becomes lower than the set pressure of the LS, valve, the angle of the swash plate increases.
- If the differential pressure **DPLS** increases, the angle of the swash plate decreases.
- ★ For details about this movement, see the description of the "HYDRAULIC PUMP".



RKP02921



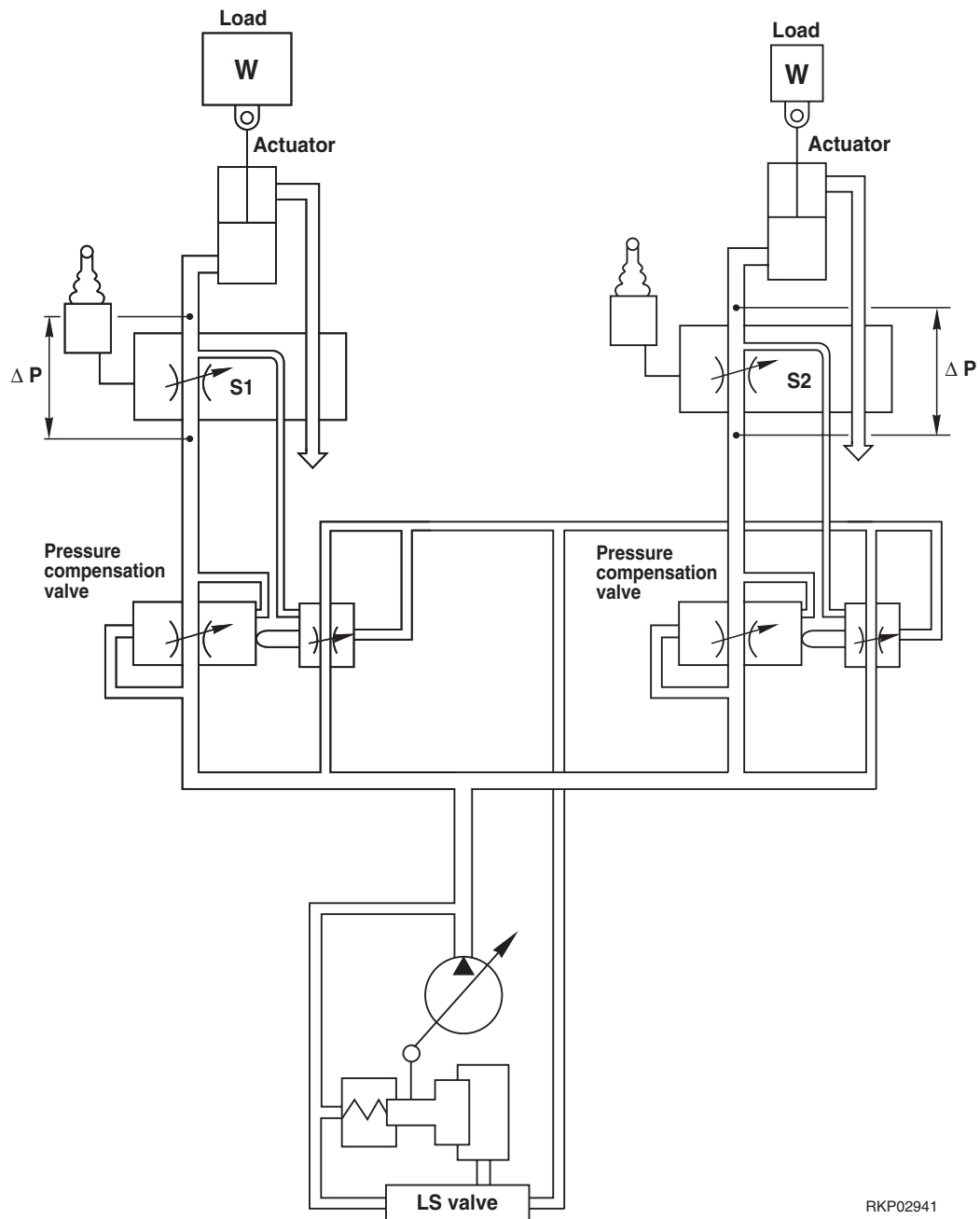
RKP02931

## 2.2 PRESSURE COMPENSATION CONTROL

- The pressure compensation valves are installed downstream from the control valve in order to balance the differential pressure between the loads.

When two or more movements (cylinders) are activated simultaneously, the pressure differences **DP** between the delivery at the control valve inlet and outlets of the control valve are compensated by these valves.

We obtain the distribution of the pump flow in proportion to the areas of passage **S1** and **S2** of each valve.

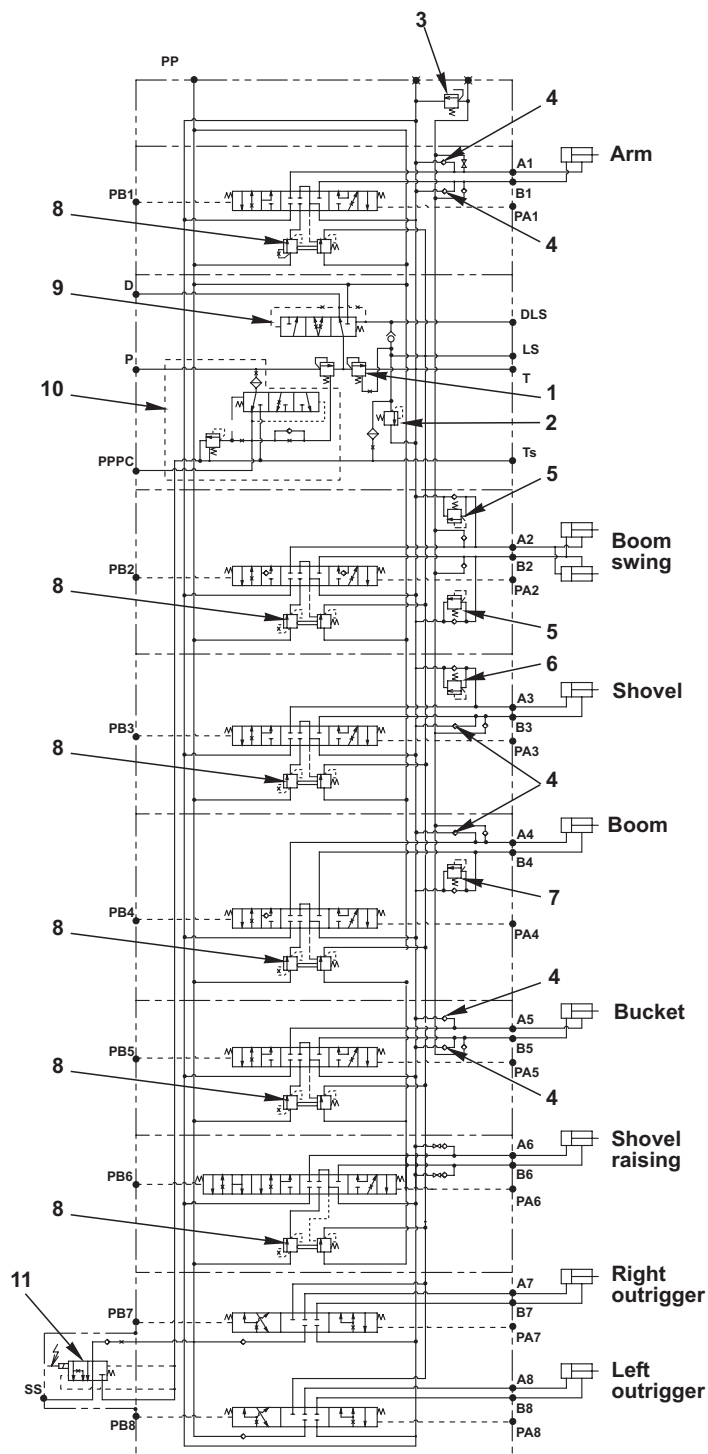


RKP02941

### 3. OPERATION FOR EACH CIRCUIT AND VALVE

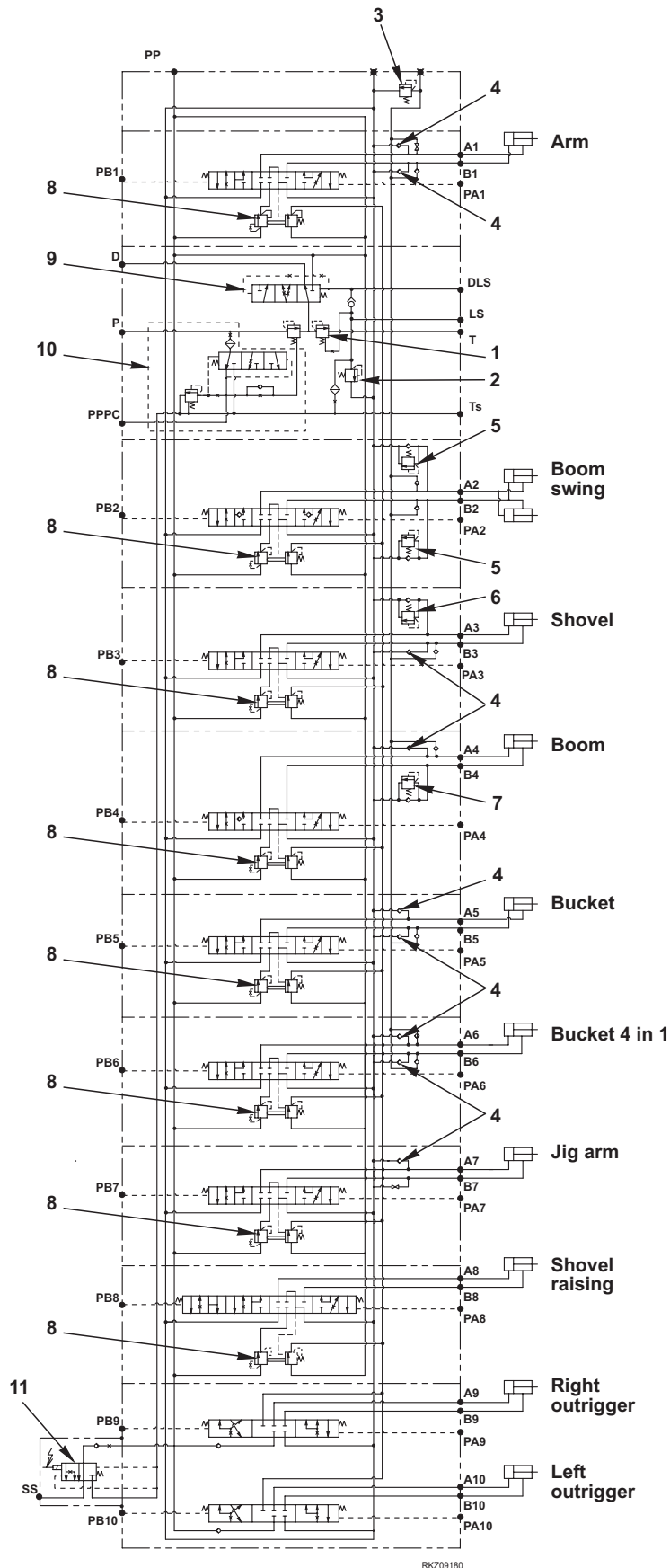
#### 3.1 HYDRAULIC CIRCUIT DIAGRAM AND NAMES OF VALVES

##### 3.1.1 8-spool control valve



1. Unloading valve:  
pressure LS + 27.5 bar
2. Max. pressure valve: 218 bar
3. Safety valve: 270 bar
4. Check valve
5. Anti-shock/anticavitation valve: 215 bar
6. Anti-shock/anticavitation valve: 220 bar
7. Anti-shock/anticavitation valve: 350 bar
8. Pressure compensation valves
9. Priority valve
10. Servocontrols reducing valve
11. Backhoe plate lock valve

### 3.1.1 10-spool control valve

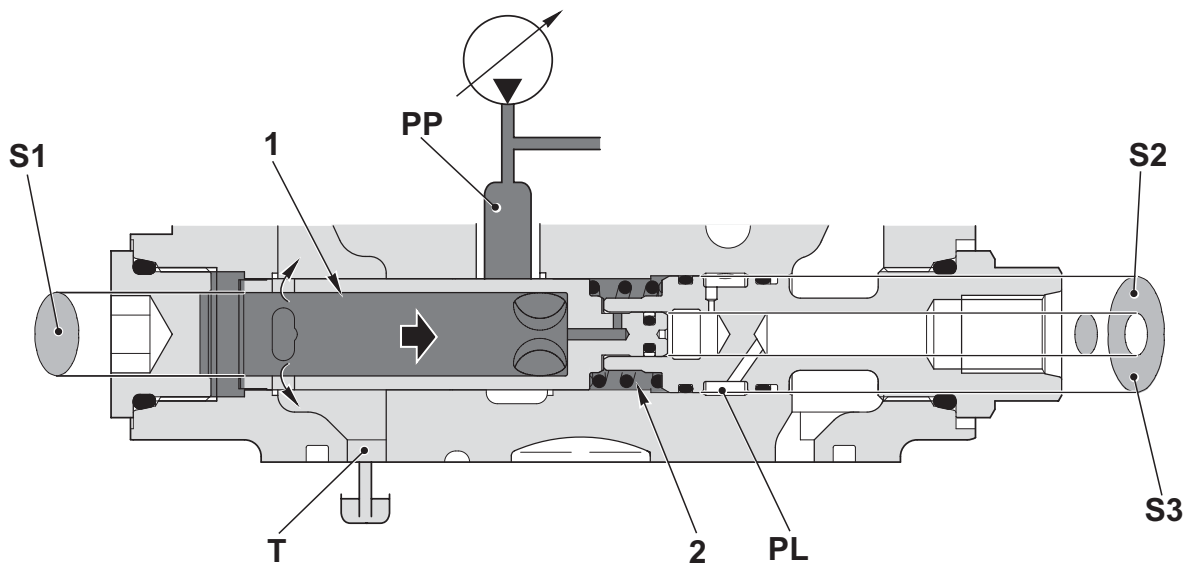


## 3.2 UNLOADING VALVE

### 3.2.1 When the control valve is in "NEUTRAL" position

#### Function

- When the control valve is in "NEUTRAL" position, pump delivery **Q** (resulting from the swash plate being at its min. angle) is sent into the tank circuit.  
When this happens, the pump's delivery pressure **PP** is regulated at 27.5 bar (28 kg/cm<sup>2</sup>) by means of the spring (2) inside the valve.  
(**LS** signal with **PLS** pressure=0 bar (0 kg/cm<sup>2</sup>))



RKZ09190

#### Functioning

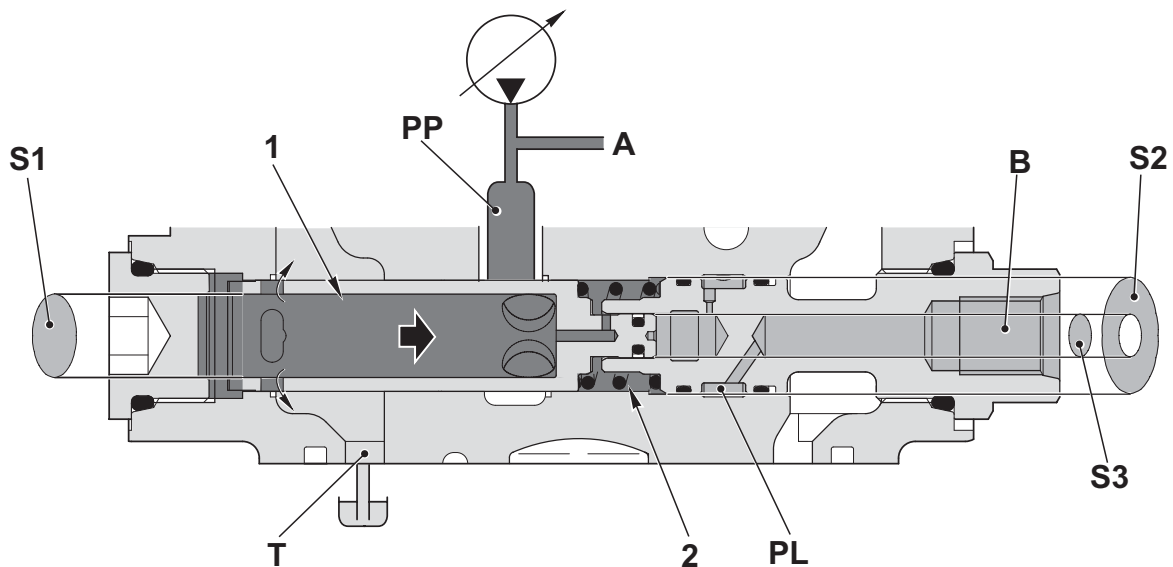
- Pump pressure **PP** acts on spool (1) – left, on surface **S1**, and right, on surface **S2** – whereas Load Sensing pressure **PLS** acts on surface **S2**.
- Since no **LS** signal with **PLS** pressure is generated when the control valve is in "NEUTRAL" position, the only pressure acting on spool (1) in this condition is the pump's delivery pressure **PP** as regulated by spring compression (2).
- As the pump's delivery pressure **PP** increases and the resulting force equals spring loading (2), the spool (1) shifts to the right. The pump's delivery circuit **PP** is then connected to the tank circuit **T** by means of the holes in spool (1).
- This ensures that the pump delivery pressure **PP** stays regulated at 27.5 bar (28 kg/cm<sup>2</sup>).

**PP** = Pump circuit  
**PLS** = Load Sensing circuit  
**T** = Tank circuit  
**A** = To control valve spools

### 3.2.2 Control valve fine control

#### Function

- When the actuators' delivery needs during fine control are within the delivery values related to the minimum angle of the swash plate, the pump's delivery pressure **PP** is regulated by pressure **PLS** at +27.5 bar (28 kg/cm<sup>2</sup>). Since the unloading valve opens when the differential pressure between the pump's delivery pressure **PP** and pressure **PLS** of the **LS** equals spring loading (2) (27.5 bar (28 kg/cm<sup>2</sup>)), the differential pressure **DPLS** becomes 27.5 bar (28 kg/cm<sup>2</sup>).



RKZ09200

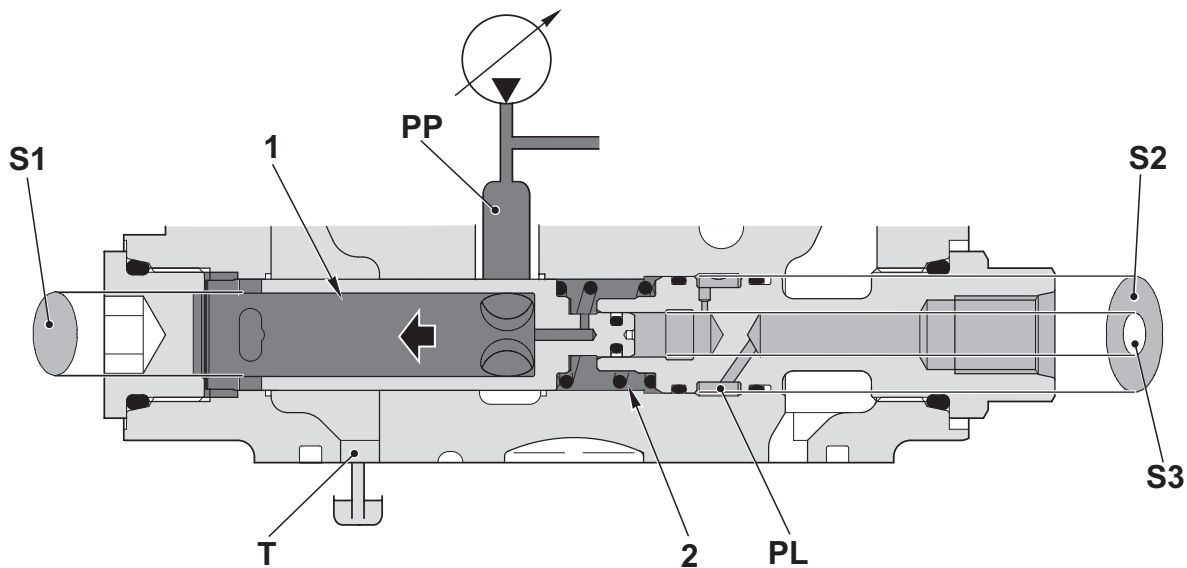
#### Functioning

- When fine controls are performed at the control valve, a **PLS** pressure is generated. This pressure acts on surface **S3** on the right hand side of the spool (1). Since pressure **PLS** of **LS** is low – because the control valve passage is small – the difference with the pump's delivery pressure **PP** is great.
- When the differential pressure between the pump's delivery pressure **PP** and pressure **PLS** of the **LS** equals spring loading (2) (27.5 bar (28 kg/cm<sup>2</sup>)), the spool (1) shifts to the right and, in turn, the pump circuit **PP** connects to the tank circuit **T**.
- The pump's delivery pressure **PP** is regulated by the combination of the pressure from the spring (27.5 bar (28 kg/cm<sup>2</sup>)) and the pressure **PLS** of the **LS**, i.e. when the differential pressure **DPLS** reaches a value of 27.5 bar (28 kg/cm<sup>2</sup>).

### 3.2.3 When the control valve is in use

#### Function

- When the request for oil flow from the actuators exceeds the minimum delivery of the pump during use of the control valve, the connection to the tank circuit is eliminated and the entire pump delivery **Q** is sent to the actuators.



RKZ09210

#### Functioning

- When the control valve spool is caused to perform a longer travel, this generates a pressure **PLS** of the **LS**, which acts on the right hand side of the spool (1). Since the control valve passage is wide, the difference between the pressure **PLS** of the **LS** and the pump's delivery pressure **PP** is small.
- For this reason, since the differential pressure between the pump's delivery pressure **PP** and the pressure **PLS** of the **LS** fails to reach the spring loading pressure value of spring (2) (27.5 bar (28 kg/cm<sup>2</sup>)), the spool (1) is pushed to the left by the spring (2).
- The result is that the connection between the pump delivery circuit **PP** and the tank circuit **T** is excluded and the entire pump delivery **Q** is sent to the actuators.

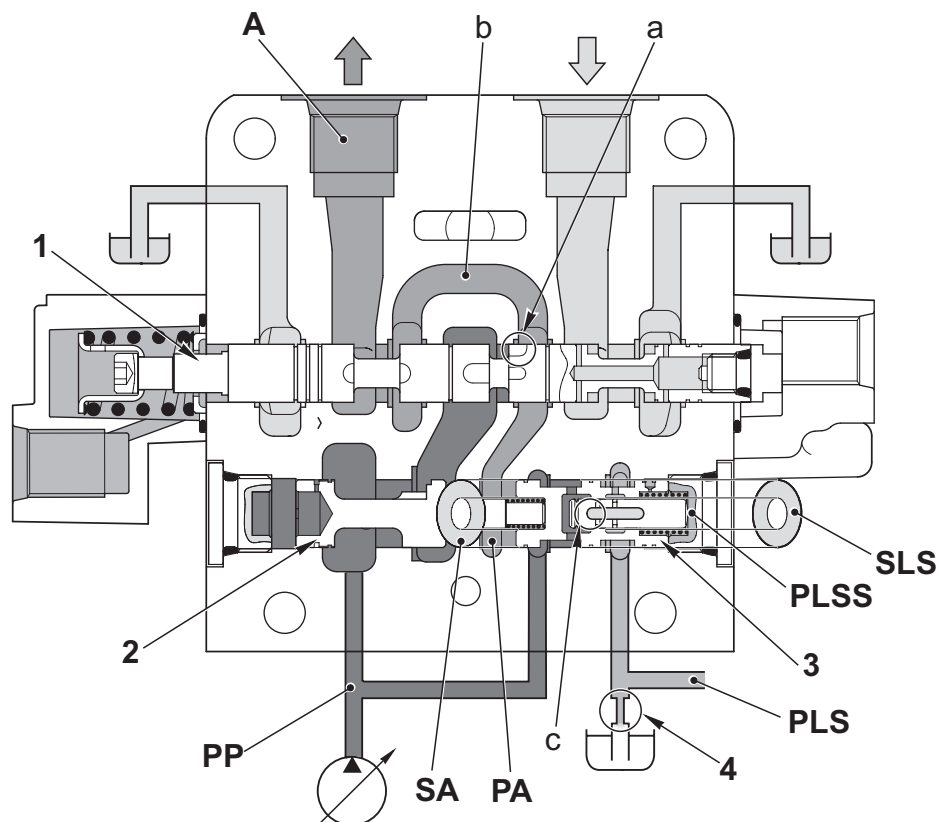


### 3.3 INTRODUCTION OF THE LS PRESSURE

#### Function

- **LS** pressure is the actuator's pressure at control valve output.
- This pressure actually reduces the pump's **PP** pressure – via the pressure compensation group reducing valve (3) – to the same **A** pressure of the actuator circuit and then sends it into the **PLS** circuit of the **LS**.
- In the outriggers control valve, the actuator's pressure **A** is introduced directly into circuit **PLS** of the **LS**

#### 3.3.1 Control valve (working equipment not including outriggers).

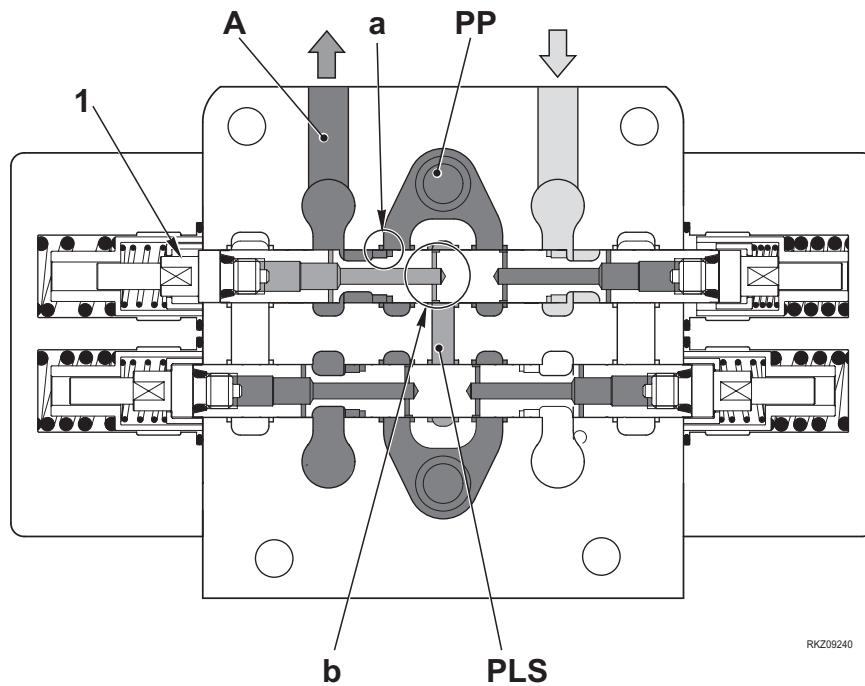


RKZ09220

#### Functioning

- When the spool (1) is operated, pump pressure **PP** starts flowing into the circuit of actuator **A** – from the delivery control valve (2) and from the notch **a** via the duct **b**.
- At the same time, the pressure reducing valve (3) moves to the right thereby making the pump's pressure **PP** drop as it flows through the bottleneck **c**, and causing the pressure to flow into the circuit **PLS** of the **LS** and into the chamber of spring **PLSS**.
- At this point, the **PLS** circuit of the **LS** is connected to the tank circuit **T** by means of the by-pass plug (4). (See the description of the **LS** by-pass plug).
- The pressure acting on the left side of the reducing valve (3) is pressure **PA** (= **A**) of the actuator, whereas the pressure acting on the right hand side is the reduced pressure **PP** of pump delivery.
- The reducing valve (3) therefore balances out when pressure **PA** of the actuators and pressure **PLSS** of the spring chamber are balanced. This in turn allows the pressure **PP** – now reduced by the bottleneck **c** – to be introduced into the **PLS** circuit of the **LS** at the same pressure **A** as the actuator's circuit.

### 3.3.2 Outriggers control valve



#### Functioning

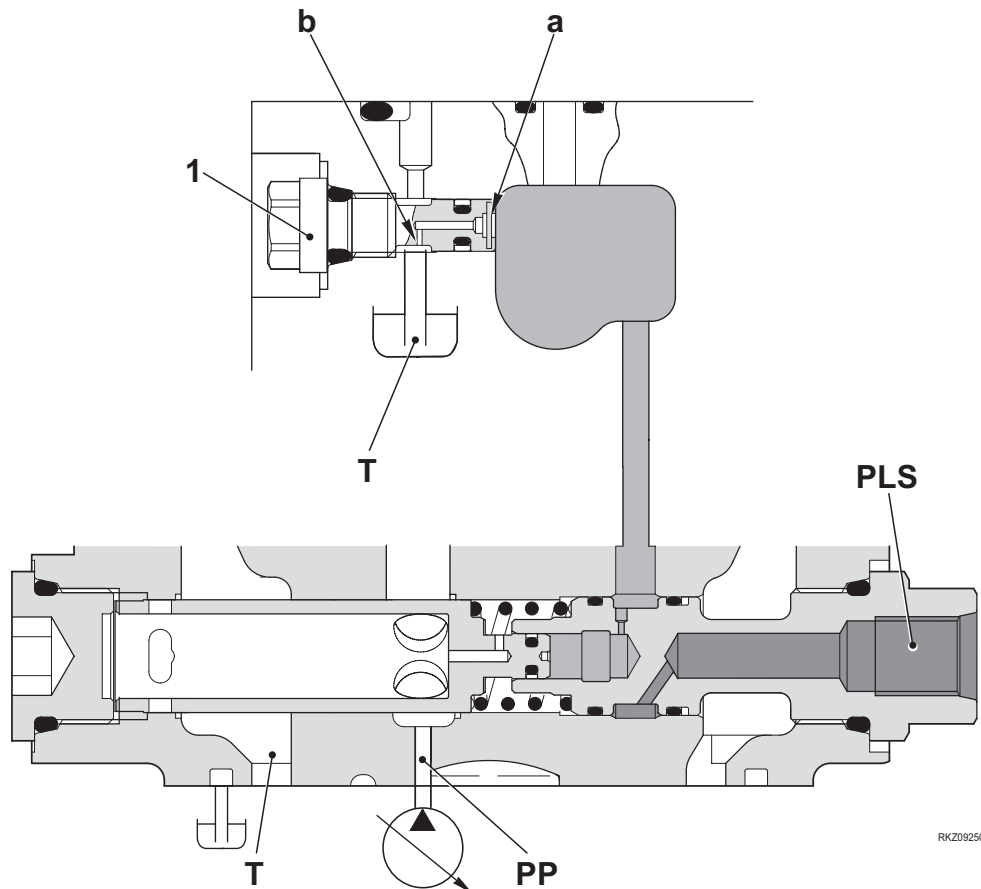
- When the spool (1) is operated, pump pressure **PP** starts flowing into the circuit of actuator **A** through the duct **a**.
- At the same time, pressurised oil is introduced into the **PLS** circuit of the **LS** through holes **b**.

★ The outriggers circuit differs from the working equipment circuit in that the operating pressure of actuator **A** is introduced directly into the **PLS** circuit of the **LS**.

### 3.4 LS BY-PASS PLUG

#### Description

- The **LS** by-pass plug unloads residual pressure from the Load Sensing's **PLS** circuit.
- This makes the increment rate of Load Sensing's **PLS** pressure smoother. Moreover, by eliminating oil (through the bottleneck), a loss of pressure is generated in the flow that is controlled by the spool, and stability is increased as a result, thereby reducing the actual differential pressure **LS**.



#### Functioning

- Pressurised oil in the Load Sensing **PLS** circuit flows through filter **a**, through orifice **b** and into the tank circuit **T**.

**PP** = Pump circuit

**PLS** = Load Sensing circuit

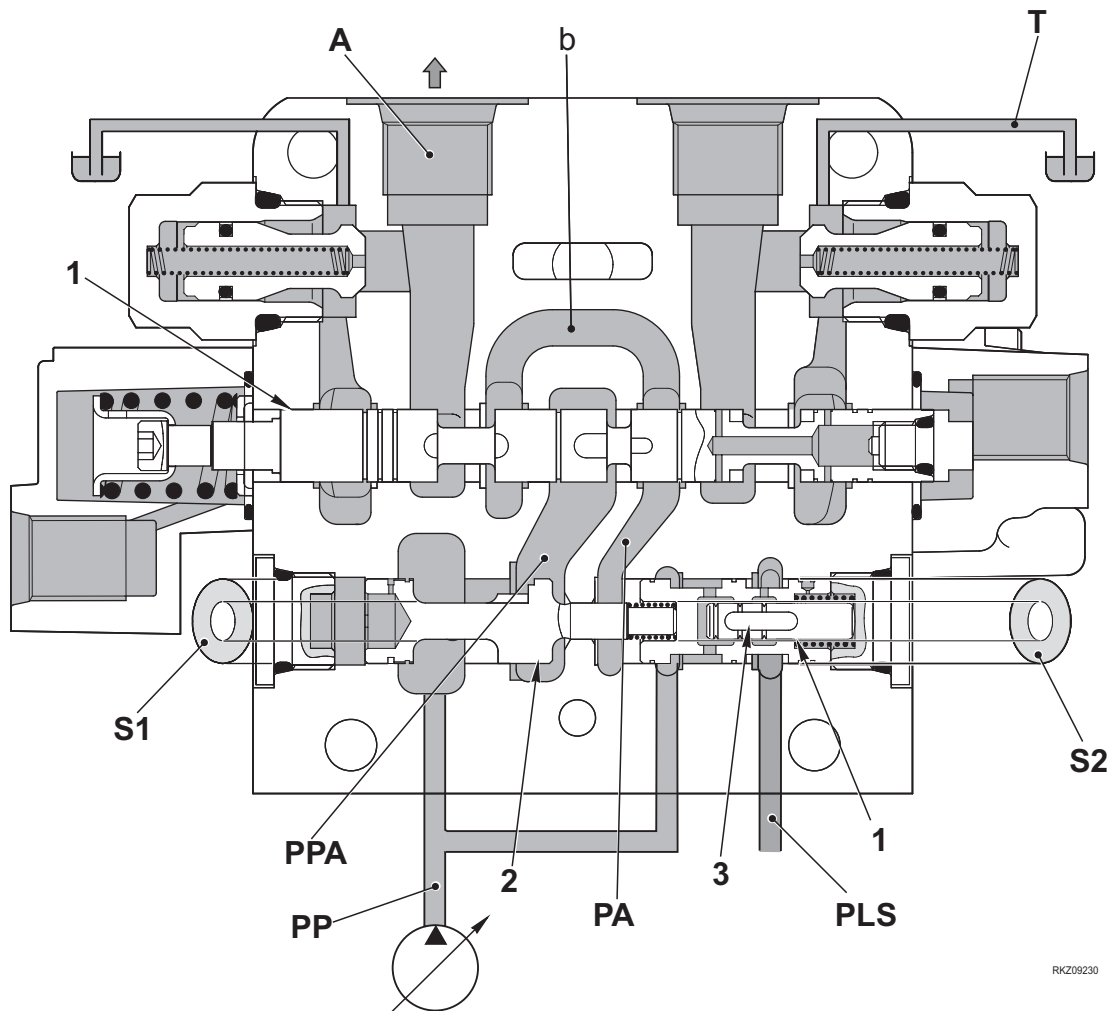
**T** = Drain circuit

## WB97R-5

### 3.6 PRESSURE COMPENSATION VALVE SURFACE/SURFACE RATIO

#### Function

- In order to equalize the characteristics of each actuator, the pressure compensation valve will determine the compensation characteristics by performing a micrometer adjustment of the surface ratio **S1/S2**. This is the ratio of area **S1** (delivery control valve (2) end) to area **S2** (pressure reducing valve (1) end).  
**S1** = surface of the delivery control valve (2) – Surface of piston (3).  
**S2** = surface of pressure reducing valve (1) – Surface of piston (3).



RKZ09230

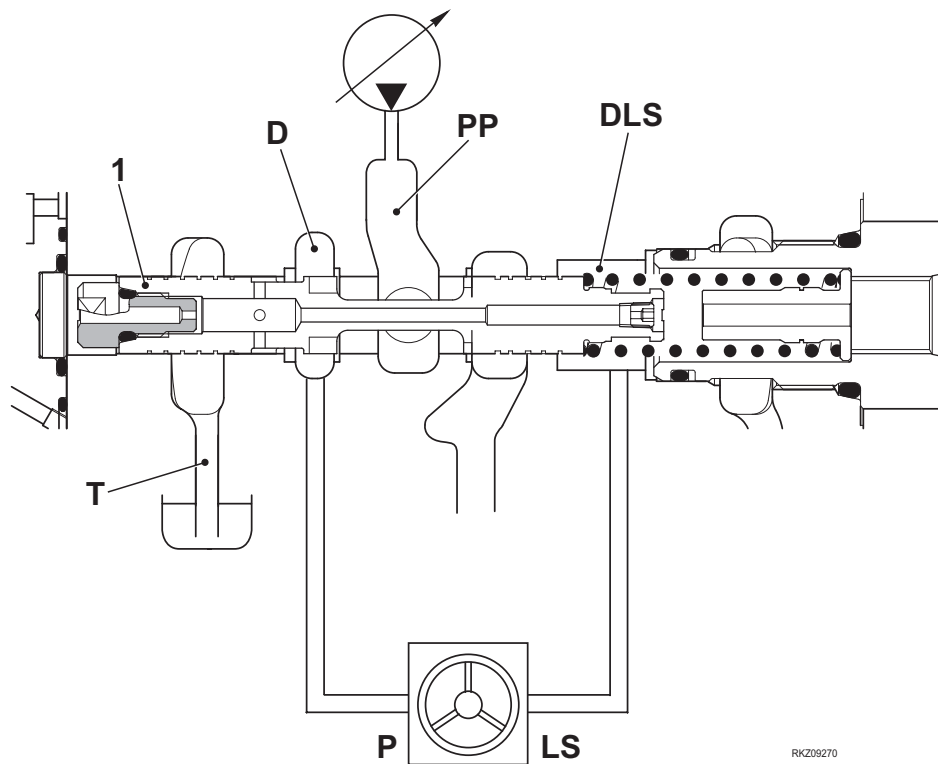
#### Surface ratio (S1:S2) and compensation characteristics

- When the ratio is 1.00 :  
 $[ \text{Pump pressure } PP - \text{Pressure } PPA \text{ upstream of spool} ] \approx [ \text{Load Sensing } PLS \text{ pressure} - \text{Actuator } PA \text{ pressure} (= A) ]$   
 Delivery is distributed proportionally to the opening surfaces of the spool.
- When the ratio is greater than 1.00:  $PP - PPA > PLS - PA (= A)$   
 Delivery distribution is lower than the proportion of the opening surfaces of the spool.
- When the ratio is lower than 1.00:  $PP - PPA < PLS - PA (= A)$   
 Delivery distribution is higher than the proportion of the opening surfaces of the spool.

### 3.7 PRIORITY VALVE

#### Function

- The purpose of the priority valve is to feed pressurised oil to the steering unit and to the other actuators.
- Oil distribution is determined by the position of the spool (1) of the priority valve, which is in turn determined by LS signal, pump delivery, steering circuit pressure, and hydraulic circuit pressure.
- The position of the spool (1) is determined in such a way as to ensure that the oil delivered to the steering unit matches the delivery needs at any time.



RKZ09270

**1**= Priority valve spool

**PP** = Pump circuit

**D** = Steering unit feed circuit

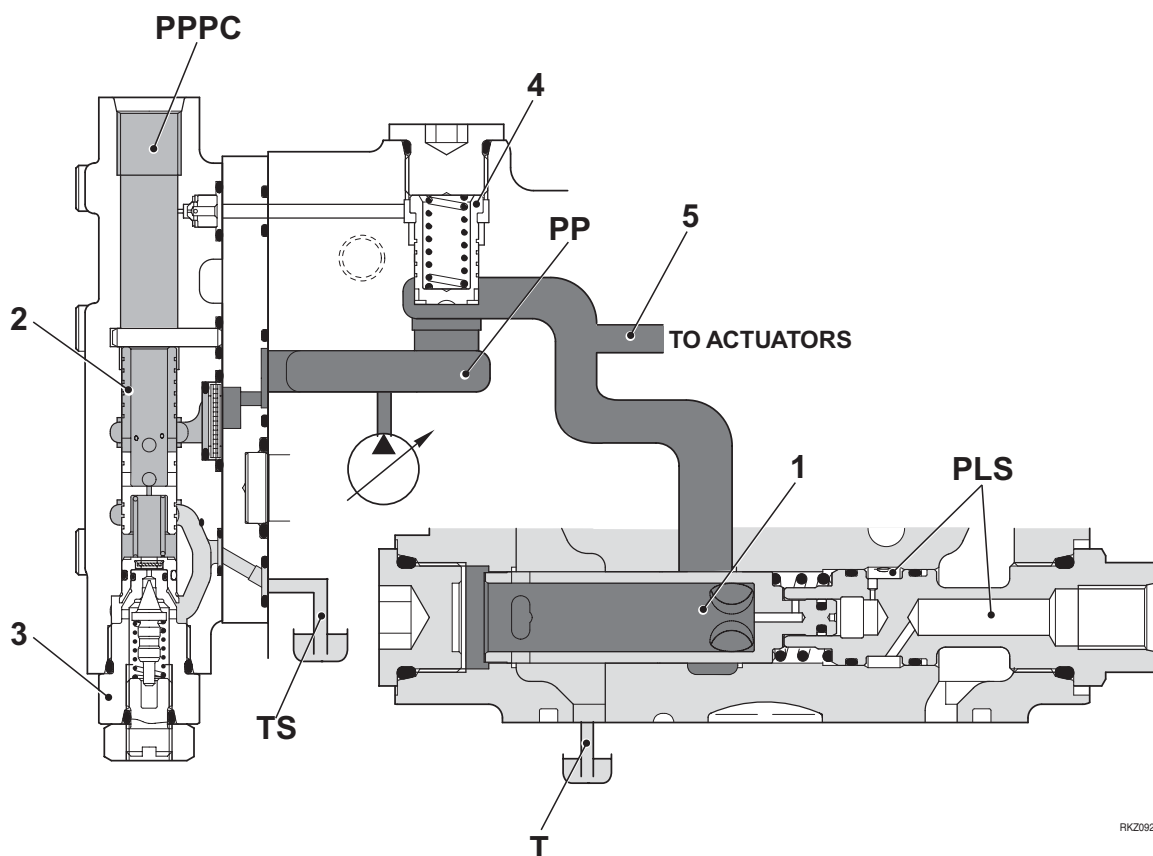
**DLS** = Steering unit LS signal

### 3.8 SERVOCONTROLS REDUCING VALVE

#### Function

- This valve regulates the servocontrol feed pressure at 29 bar (30 kg/cm<sup>2</sup>).
- When actuator pressure is low, the sequential valve closes to permit an increase in the pump's delivery pressure **PP** in order to supply pressure to the servocontrols.

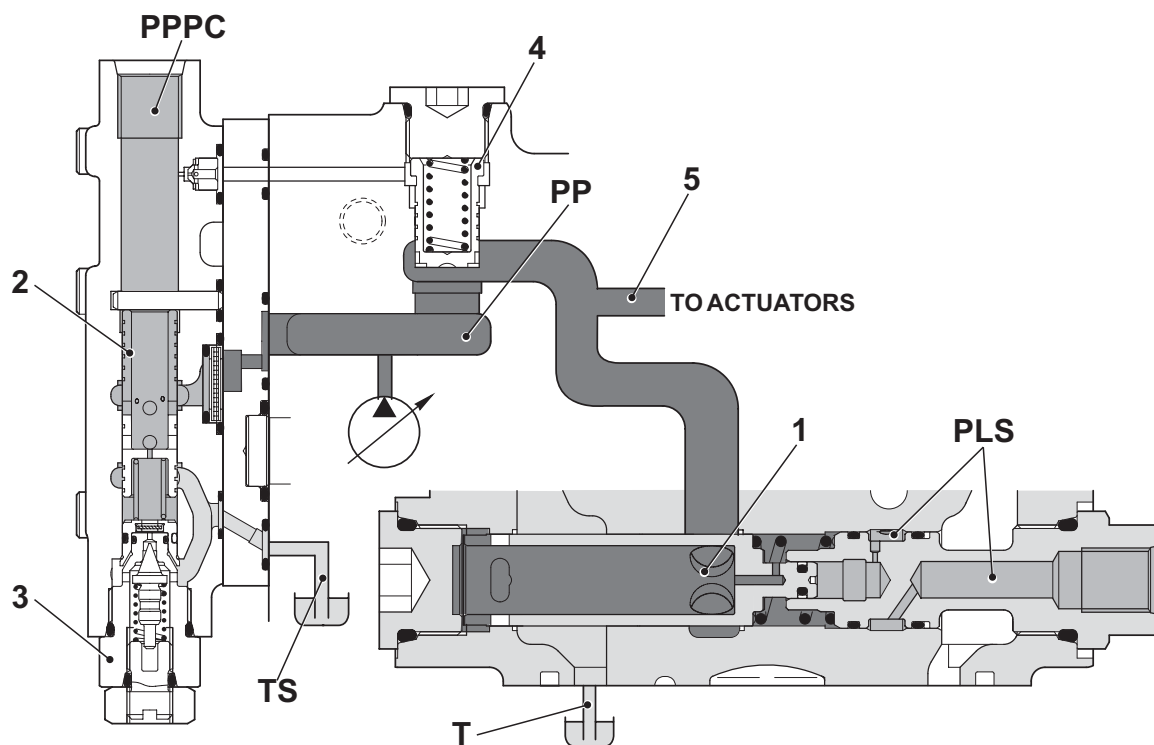
#### 3.8.1 When all actuators are in a neutral condition



#### Functioning

- The spool (1) of the unloading valve moves, and delivery pressure is regulated at 29 bar (30 kg/cm<sup>2</sup>). (For details, see 3.2 UNLOADING VALVE).
- The spool (2) and valve (3) reduce the pump's delivery pressure **PP** to 29 bar (30 kg/cm<sup>2</sup>). Pressure is then sent to the servocontrols via port **PC**.

### 3.8.2 When the control valve is operated

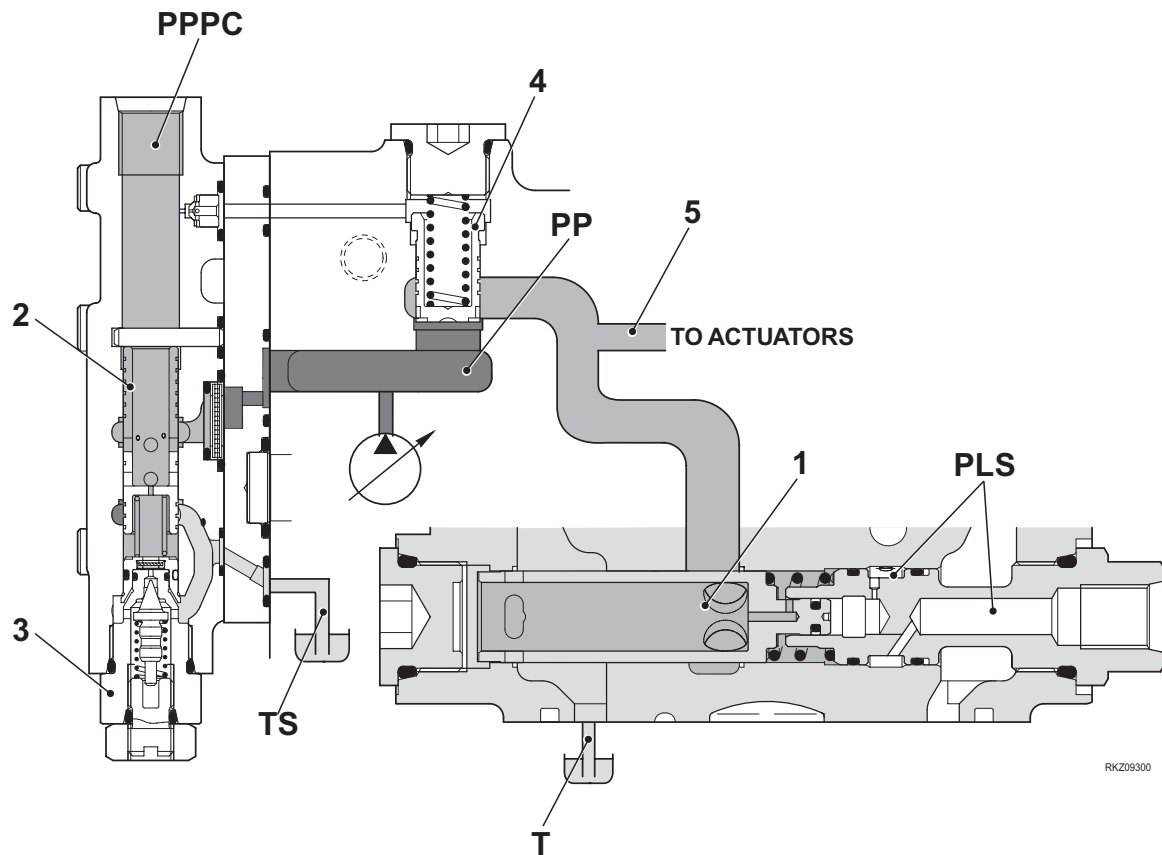


RKZ09290

#### Functioning

- The spool (1) of the unloading valve moves to the left, and the pump's delivery pressure exceeds the pressure of the actuator circuit (5) by an amount equivalent to LS differential pressure. (For details, see 3.2 UNLOADING VALVE).
- If the pump's delivery pressure **PP** exceeds 29 bar (30 kg/cm<sup>2</sup>), valves (2) and (3) reduce pressure **PP** to 29 bar (30 kg/cm<sup>2</sup>). The reduced pressure is then sent to the servocontrols via port **PC**.
- When this occurs, the sequential reducing valve (4) stays open.





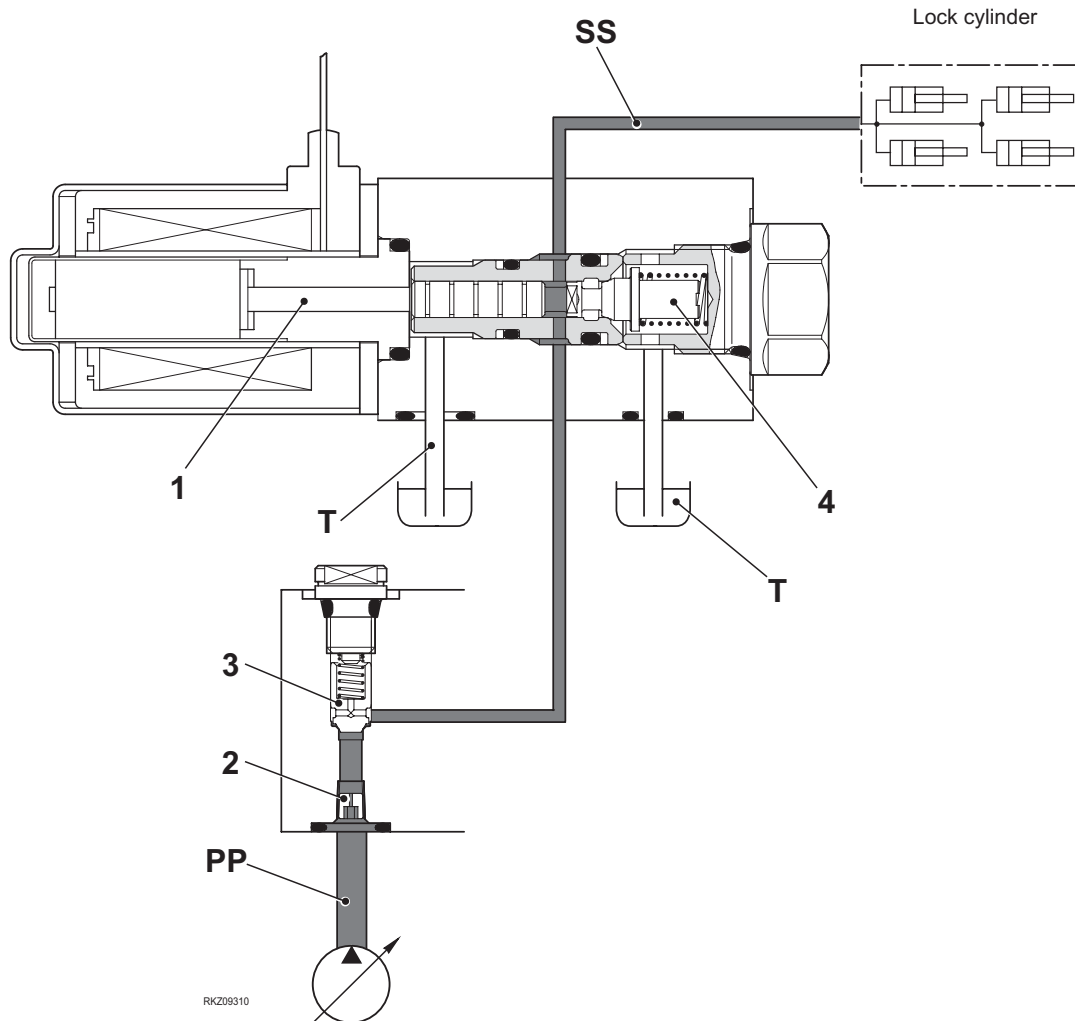
- When the pump's delivery pressure **PP** is lower than 29 bar (30 kg/cm<sup>2</sup>), the sequential reducing valve shifts to the right, thereby reducing the flow of the **PP** pressure to the actuator circuit (5). This generates a pressure gap between **PP** pressure and actuator pressure. **PP** pressure is incremented in excess of 29 bar (30 kg/cm<sup>2</sup>) and is then reduced to 29 bar (30 kg/cm<sup>2</sup>) by valves (2) and (3) to guarantee pressure feed to the servocontrols.

### 3.9 BACKHOE PLATE LOCK SOLENOID VALVE

#### Function

- The purpose of this solenoid valve is to send pump delivery pressure PP to backhoe plate lock cylinders.

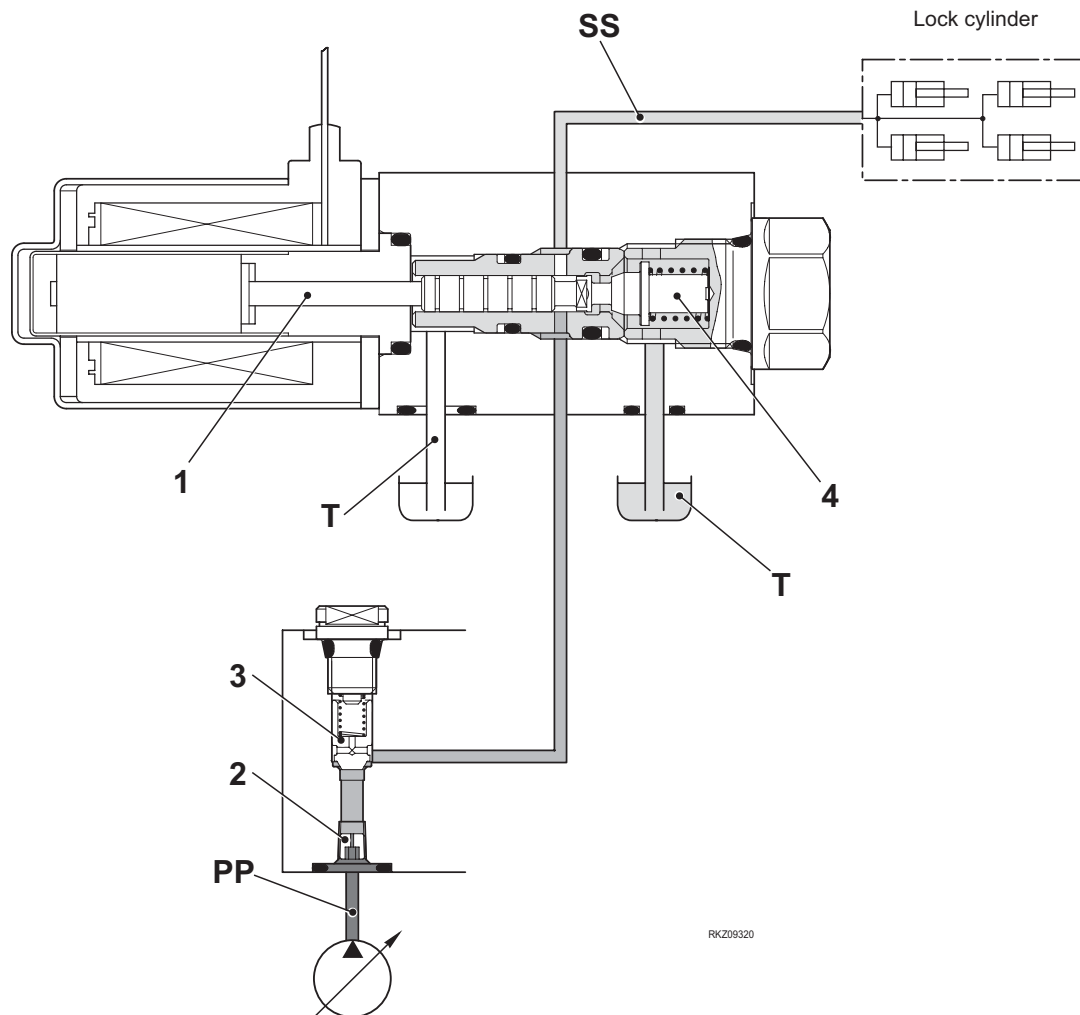
#### 3.9.1 When the solenoid valve is deenergized



#### Functioning

- When the solenoid valve is deenergized, pump delivery pressure **PP** flows through orifice (2) and check valve (3) and into the **SS** circuit of the plate lock cylinders.
- When the entire circuit reaches pump delivery pressure **PP**, the check valve (3) lowers, thereby dividing the circuit, which is therefore kept at the maximum pressure reached by the delivery circuit.

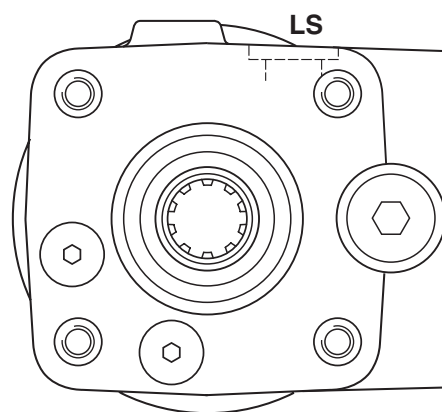
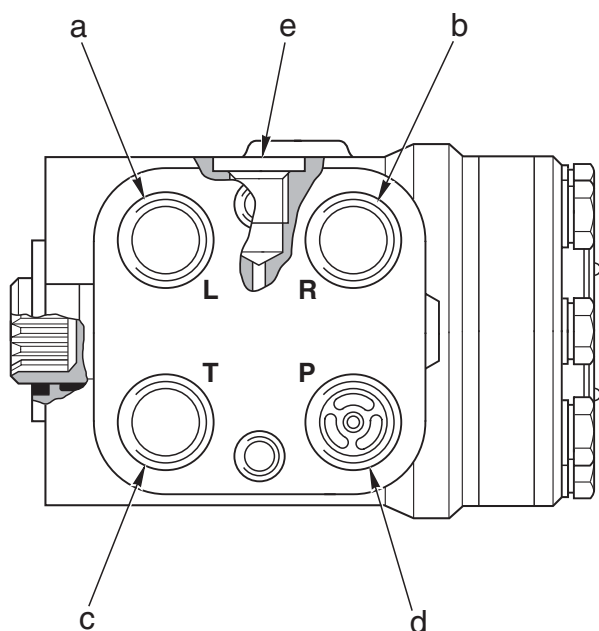
### 3.9.2 When the solenoid valve is energized



#### Functioning

- When the solenoid valve is energized, pressurised oil in the **SS** circuit is sent to the tank circuit through spool (4).
- As a result, the **SS** circuit pressure decreases, and the plate is released, so it can be shifted.

## STEERING UNIT



RKP03740

- |            |                                 |
|------------|---------------------------------|
| a. Port L  | - To steering cylinder (a Port) |
| b. Port R  | - To steering cylinder (b Port) |
| c. Port T  | - To hydraulic tank             |
| d. Port P  | - From control valve (D port)   |
| e. Port LS | - To control valve (DLS port)   |

### TECHNICAL DATA

Steering unit type: OSPC200LS

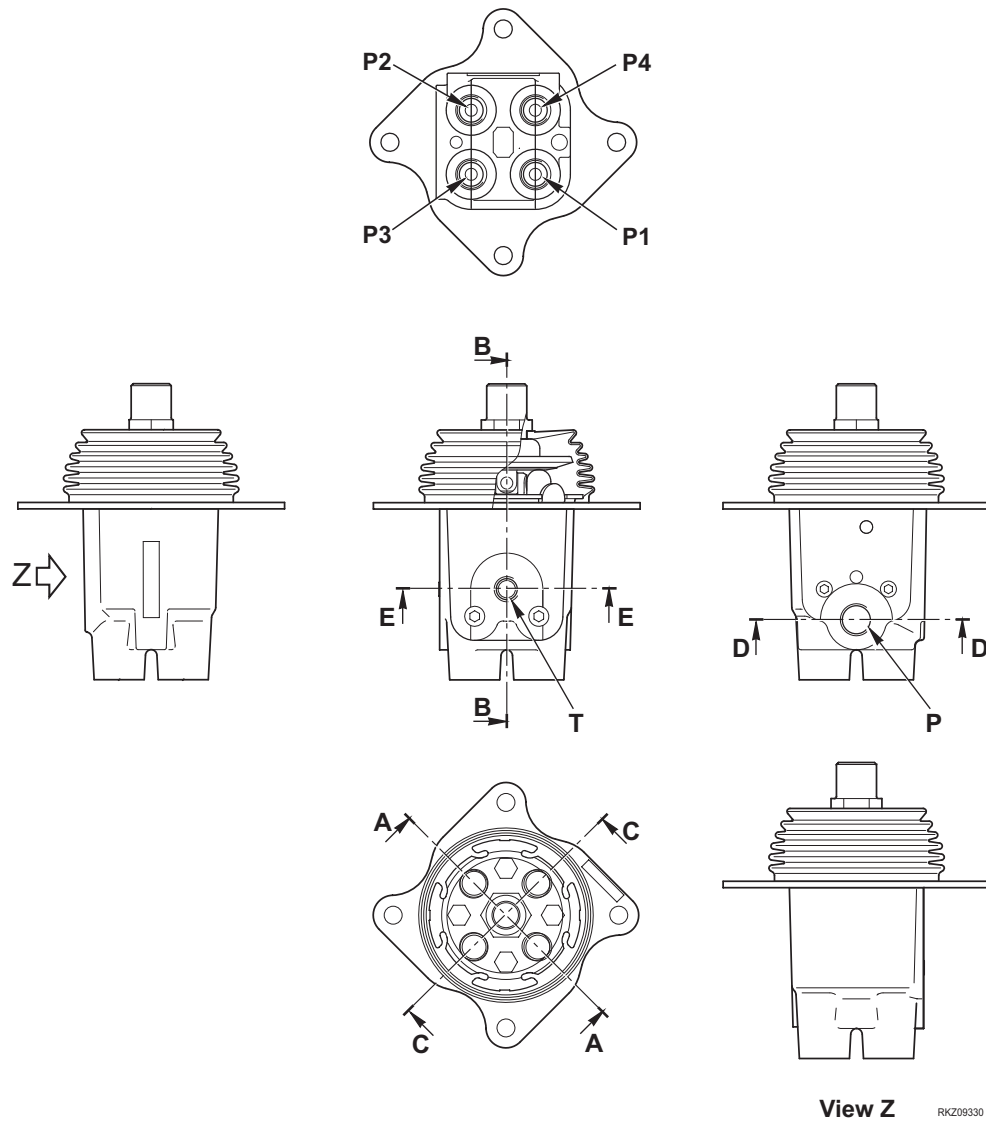
Nominal flow: 20 ℓ

### OPERATION

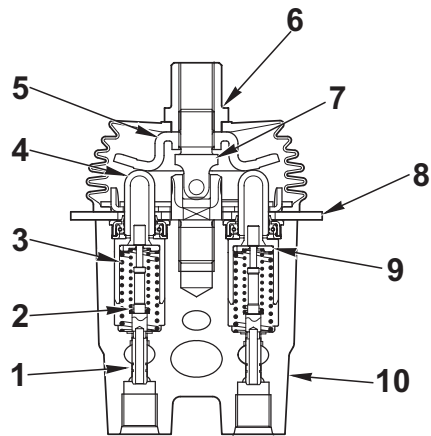
- The steering unit is composed of a control valve and a rotating oil dispenser, and is of the hydrostatic type.
- When the steering wheel is turned, the control valve sends oil from the pump (by means of the rotating oil dispenser) to one of the sides of the steering cylinder. The rotating dispenser ensures that the volume of oil supplied to the cylinder is proportionate to the angle of rotation of the steering wheel.
- In the event of malfunction, the oil dispenser will function automatically as a hand-pump, thus guaranteeing emergency steering.

## PPC VALVES

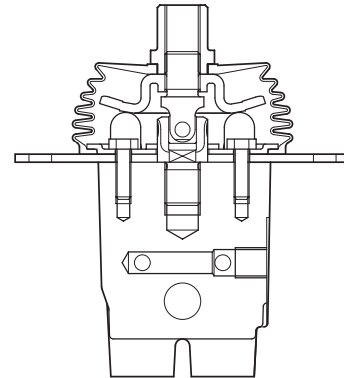
### SHOVEL PPC VALVE (STANDARD)



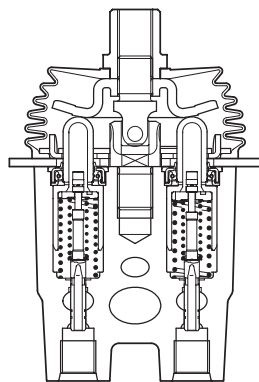
- P1 port - To control valve (PB3 port)
- P2 port - To control valve (PA3 port)
- P3 port - To control valve (PA8 port)
- P4 port - To control valve (PB8 port)
- P port - From EV1 solenoid valve group (VL port)
- Port T - To hydraulic tank



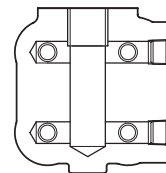
A - A



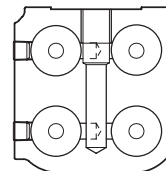
B - B



C - C



D - D



E - E

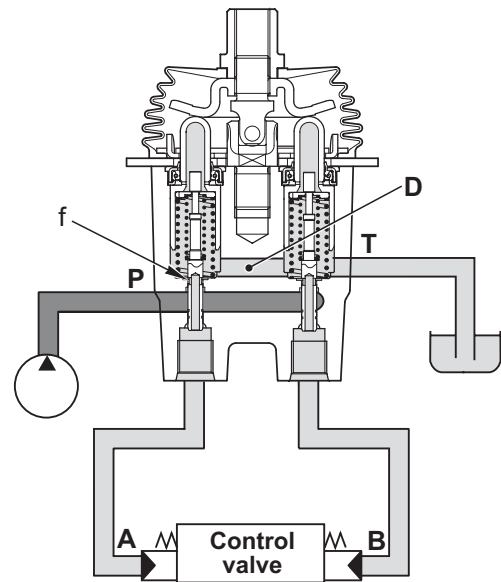
RKZ09340

- |                            |             |
|----------------------------|-------------|
| 1. Spool                   | 6. Nut      |
| 2. Adjusting screw (inner) | 7. Joint    |
| 3. Adjusting screw (outer) | 8. Cover    |
| 4. Piston                  | 9. Retainer |
| 5. Disk                    | 10. Body    |

## OPERATION

## 1. Control lever in neutral position

Control valve ducts **A** and **B** and PPC valve ducts **P1** and **P2** are connected to discharge chamber **D** by means of the calibrated hole **f** in spool (1).



RKZ09450

## 2. During fine control (NEUTRAL → Actuator)

When the disk (5) starts pushing down on the piston (4), the retainer (9) moves as a result. This movement will compress the spring (2) which will in turn act on the spool (1) and push it downwards. As a result of this action, the calibrated hole **f** will be isolated from the discharge chamber **D** and at almost at the same time it will be put in connection with the **PP** chamber, which is directly connected to the servocontrols circuit.

Pressure in the servocontrols circuit will flow through the calibrated hole **f** and into the circuit thereby increasing the pressure in duct **P1-A**.

When pressure **P1** increases, spool (1) is pushed upwards, and calibrated hole **f** is connected back to discharge chamber **D** thereby compressing the spring (2).

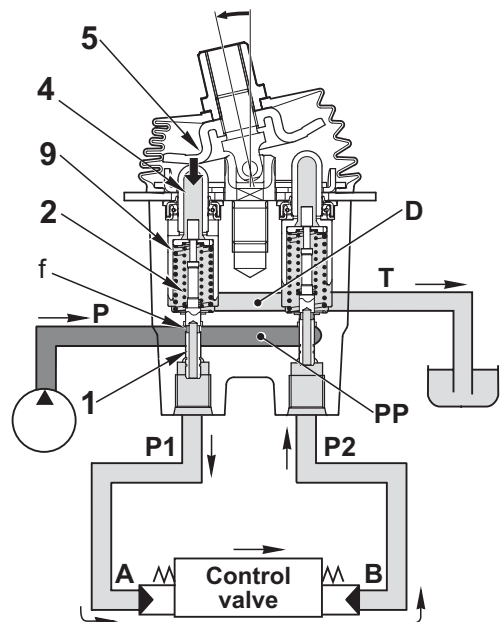
The floating of the spool (1) will continue until calibrated hole **f** is halfway between discharge chamber **D** and pressure chamber **PP**, in other words until the pressure in duct **P1** – the pressure acting on the section of stem (1) – offsets the force applied by the spring (2).

The spring (2) is compressed proportionally to the movement of the disk (5) and therefore, pressure at **P1** increases in proportion to the travel of the disk (5).

The equilibrium position is then kept until the position of piston (4) is changed, i.e.:

- as long as pressures at ports **A** and **P1** are perfectly balanced;
- until pressure in section **A-P1** – i.e. the pressure acting on stem (1) – is enough to counteract the force of the spring (2).

This ensures proportionality between control lever position, **A-P1** circuit pressure, and main control valve stem displacement.



RKZ09470

### 3. During fine control (Actuator → NEUTRAL)

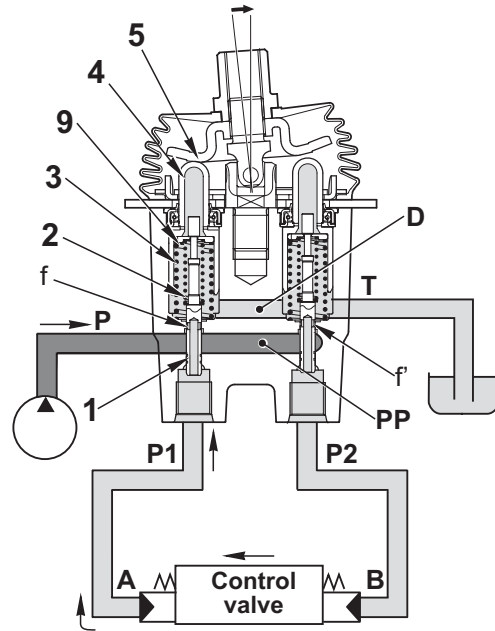
When the disk (5) is released and moved to neutral position, the piston (4) is pushed upwards by the spring (3) acting on the retainer (9), and spool (1) is thrust upwards both by the force of spring (2) and by the force that the pressure in section **A-P1** applies against the stem.

This movement moves the calibrated hole **f** of spool (1) into the discharge chamber **D**, thereby allowing pressure in section **A-P1** to be released.

If pressure **P1** drops too quickly, spool (1) is pushed downwards by spring (2) and the calibrated hole **f** becomes cut off from the discharge chamber **D**; at almost the same time, the calibrated hole **f** is put in connection with pressure chamber **PP** and starts supplying pressure to section **P1** until the pressure corresponding to the control lever position is balanced.

When the spool of the control valve returns, oil flows back into chamber **D**, through calibrated hole **f'**, and into chamber **B** of the control valve spool opposite the operating one.

Oil flows through duct **P2** and into chamber **B** to ensure it is filled properly.

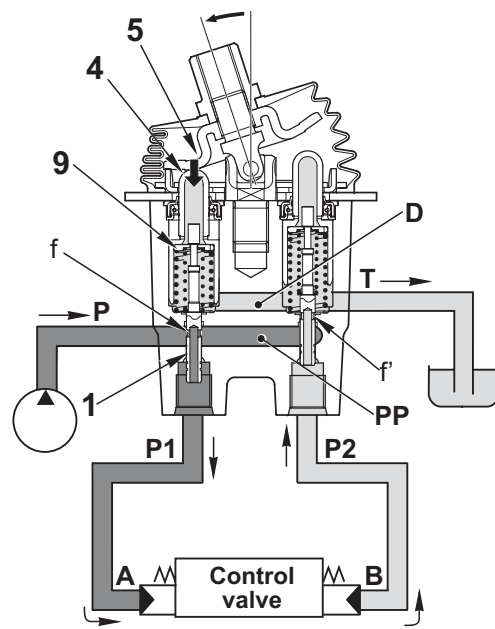


RKZ09480

### 4. During fine control (NEUTRAL → Full stroke)

When the disk (5) pushes down on the piston (4), and the retainer (9) pushes down on the spool (1), calibrated hole **f** is put in direct connection with chamber **PP**, which is in turn connected to a constantly pressurised servocontrols circuit.

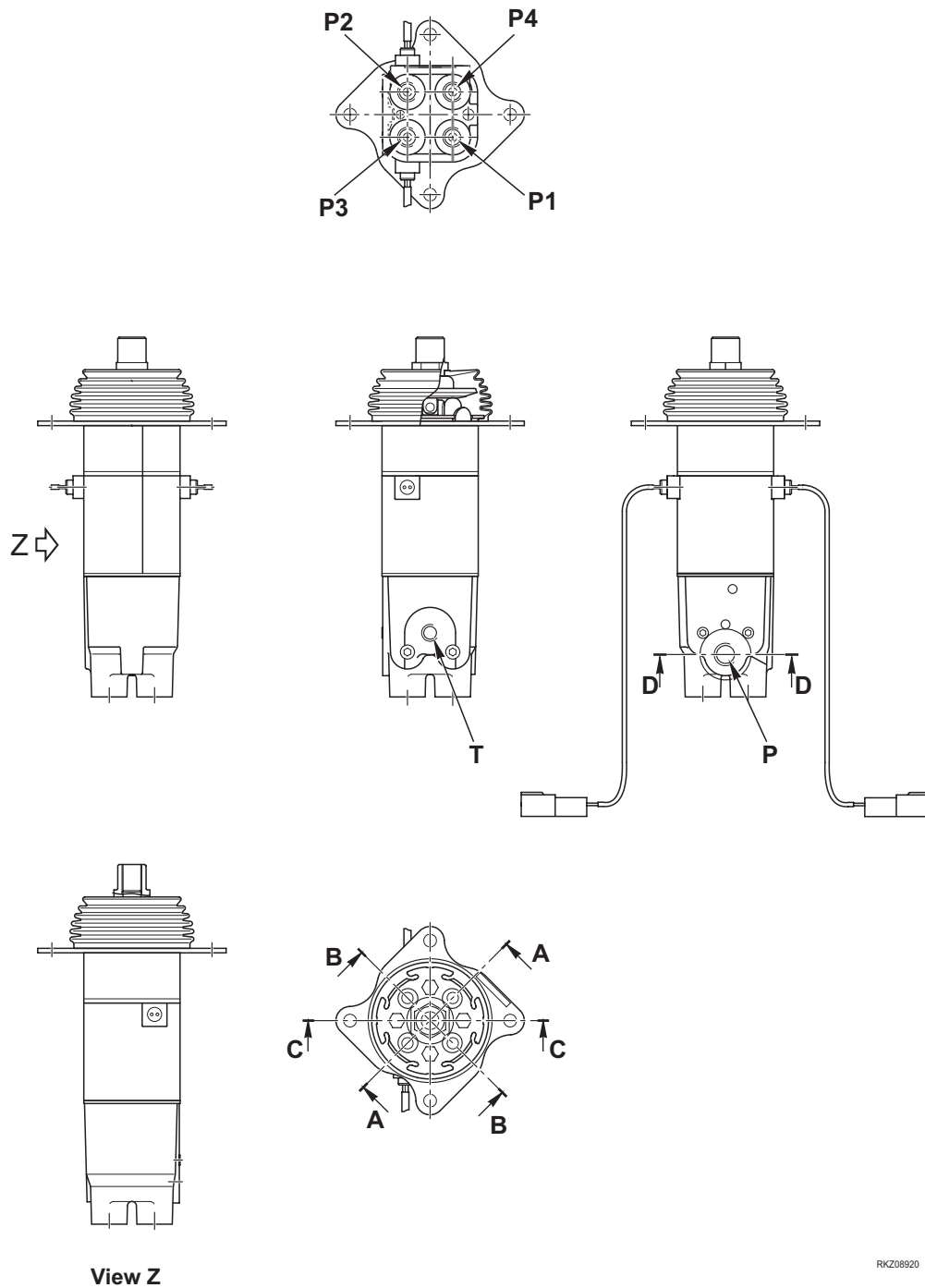
Oil is then allowed to flow directly into section **A-P1**, thereby pushing the stem of the main control valve to the end of its travel. This causes the main control valve to send the oil contained in chamber **B** towards input **P2**, through calibrated hole **f** and into discharge chamber **D**.



RKZ09460



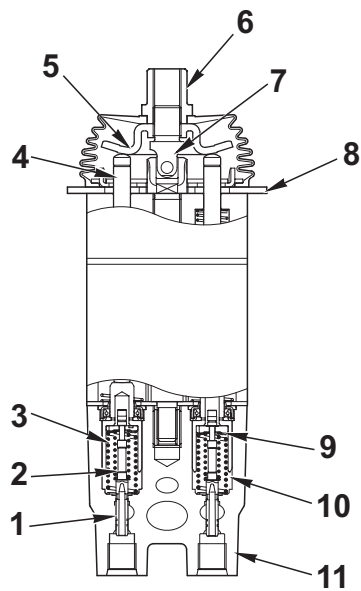
## SHOVEL PPC VALVE (FLOAT + RETURN TO DIG)



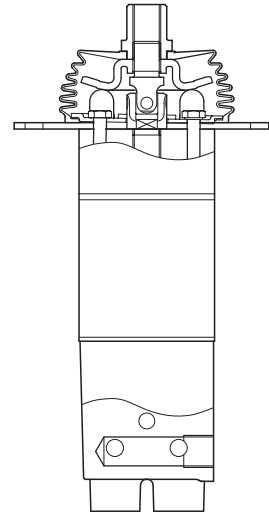
- P1 port - To control valve (PB3 port)
- P2 port - To control valve (PA3 port)
- P3 port - To control valve (PA8 port)
- P4 port - To control valve (PB8 port)
- P port - From EV1 solenoid valve group (VL port)
- Port T - To hydraulic tank

## STRUCTURE AND FUNCTION

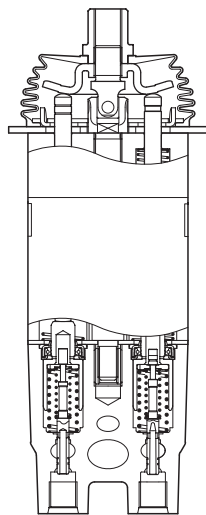
## PPC VALVES



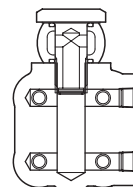
**A - A**



**C - C**



**B - B**



**D - D**

RKZ08980

- |                            |             |
|----------------------------|-------------|
| 1. Spool                   | 7. Joint    |
| 2. Adjusting screw (inner) | 8. Cover    |
| 3. Adjusting screw (outer) | 9. Retainer |
| 4. Piston                  | 10. Piston  |
| 5. Disk                    | 11. Body    |
| 6. Disk                    |             |

## OPERATION

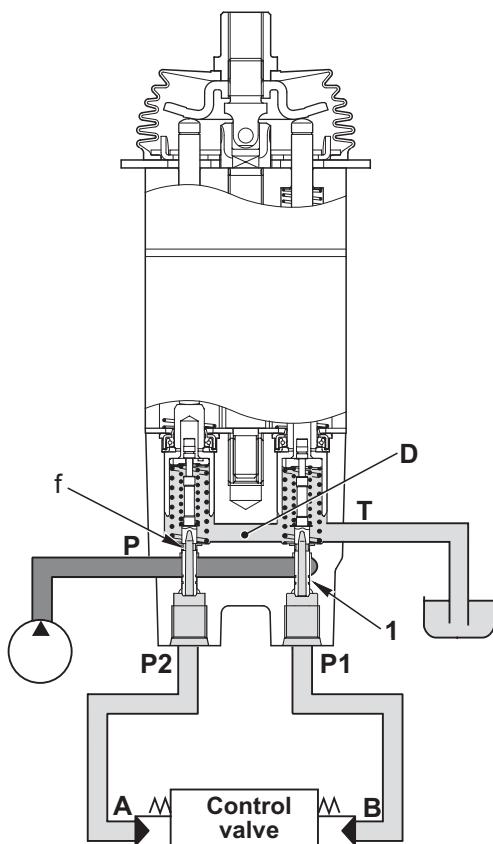
### 1. Control lever in neutral position

- **Shovel PPC valve**

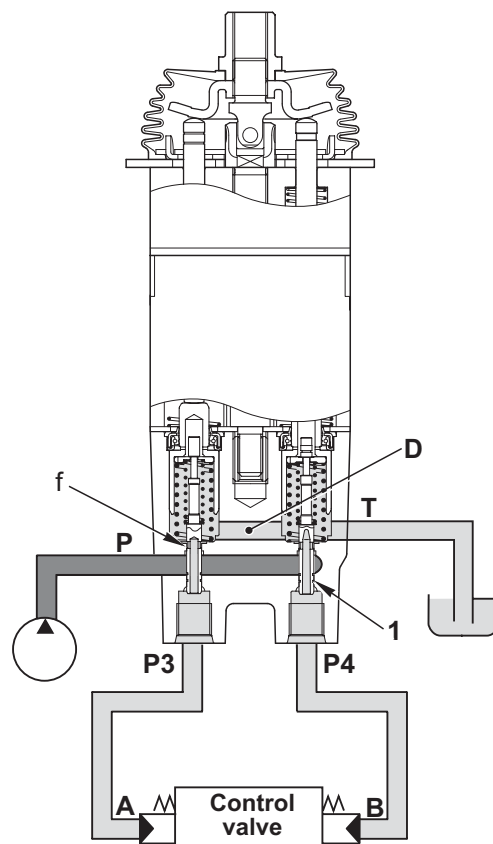
Control valve ducts **A** and **B** and PPC valve ducts **P1** and **P2** are connected to discharge chamber **D** by means of the calibrated hole **f** in spool (1).

- **Shovel raise PPC valve**

Control valve ducts **A** and **B** and PPC valve ducts **P3** and **P4** are connected to discharge chamber **D** by means of the calibrated hole **f** in spool (1).



RKZ08990



## 2. During fine control (NEUTRAL → Actuator)

When the disk (5) starts pushing down on piston (4) and piston (10), the retainer (9) moves as a result. This movement will compress the spring (2) which will in turn act on the spool (1) and push it downwards.

As a result of this action, the calibrated hole **f** will be isolated from the drain chamber **D** and at almost at the same time it will be put in connection with the **PP** chamber, which is directly connected to the servocontrols circuit.

Pressure in the servocontrols circuit will flow through the calibrated hole **f** and into the circuit thereby increasing the pressure in duct **P1-B**.

When pressure **P1** increases, spool (1) is pushed upwards, and calibrated hole **f** is connected back to discharge chamber **D** thereby compressing the spring (2).

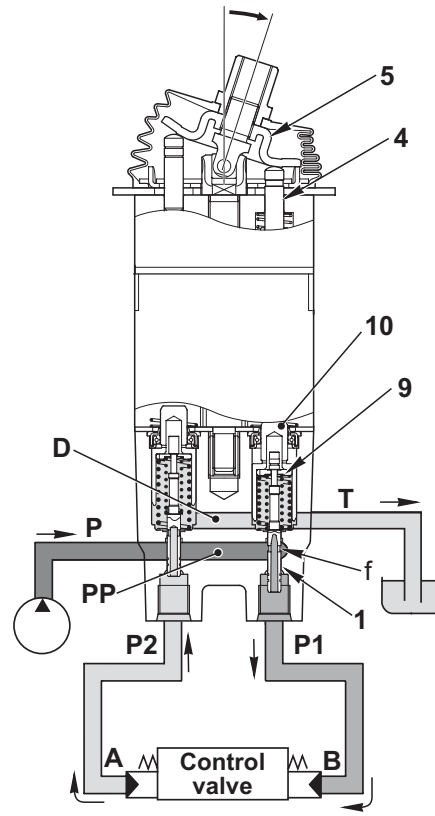
The floating of the spool (1) will continue until calibrated hole **f** is halfway between discharge chamber **D** and pressure chamber **PP**, in other words until the pressure in duct **P1** – the pressure acting on the section of stem (1) – offsets the force applied by the spring (2).

The spring (2) is compressed proportionally to the movement of the disk (5) and therefore, pressure at **P1** increases in proportion to the travel of the disk (5).

The equilibrium position is then kept until the position of piston (4) is changed, i.e.:

- as long as pressures at ports **B** and **P1** are perfectly balanced;
- until pressure in section **B-P1** – i.e. the pressure acting on stem (1) – is enough to counteract the force of the spring (2).

This ensures proportionality between control lever position, **B-P1** circuit pressure, and main control valve stem displacement.



RKZ09000

### 3. During fine control (Actuator → NEUTRAL)

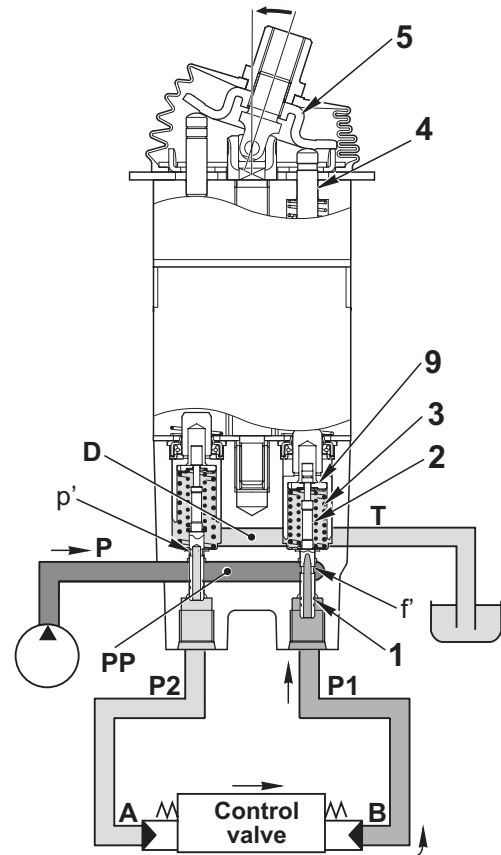
When the disk (5) is released and moved to neutral position, the piston (4) is pushed upwards by the spring (3) acting on the retainer (9), and spool (1) is thrust upwards both by the force of spring (2) and by the force that the pressure in section **B-P1** applies against the stem.

This movement moves the calibrated hole **f** of spool (1) into the discharge chamber **D**, thereby allowing pressure in section **B-P1** to be released.

If pressure **P1** drops too quickly, spool (1) is pushed downwards by spring (2) and the calibrated hole **f** becomes cut off from the discharge chamber **D**; at almost the same time, the calibrated hole **f** is put in connection with pressure chamber **PP** and starts supplying pressure to section **P1** until the pressure corresponding to the control lever position is balanced.

When the spool of the control valve returns, oil flows back into chamber **D**, through calibrated hole **f'**, and into chamber **B** of the control valve spool opposite the operating one.

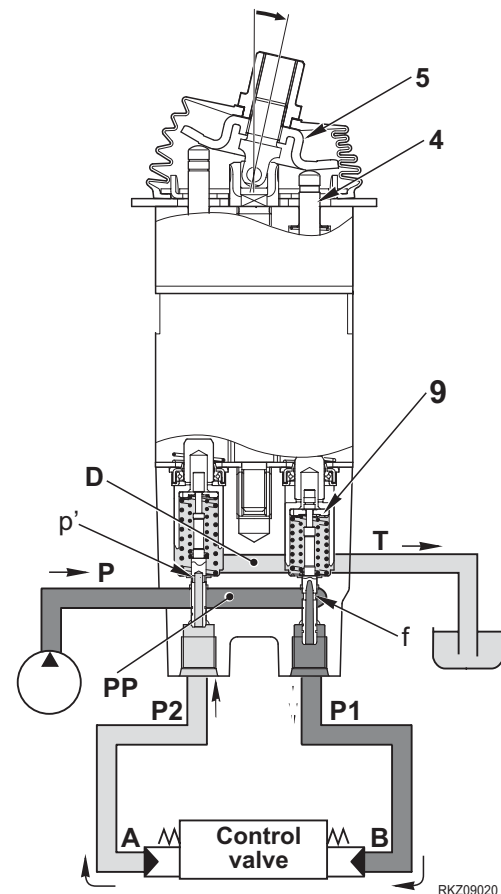
Oil flows through duct **P2** and into chamber **B** to ensure it is filled properly.



### 4. During fine control (NEUTRAL → Full stroke)

When the disk (5) pushes down on the piston (4), and the retainer (9) pushes down on the spool (1), calibrated hole **f** is put in direct connection with chamber **PP**, which is in turn connected to a constantly pressurised servocontrols circuit.

Oil is then allowed to flow directly into section **B-P1** thereby pushing the stem of the main control valve to the end of its travel. This causes the main control valve to send the oil contained in chamber **AB** towards input **P2**, through calibrated hole **f** and into relief chamber **D**.



**5. When control lever is moved to float position**

If piston (4) and piston (10) of the spool controlling the arm (port P4) are pushed downwards by disk (5), the mechanism inside the PPC valve will start locking the spool halfway along its travel.

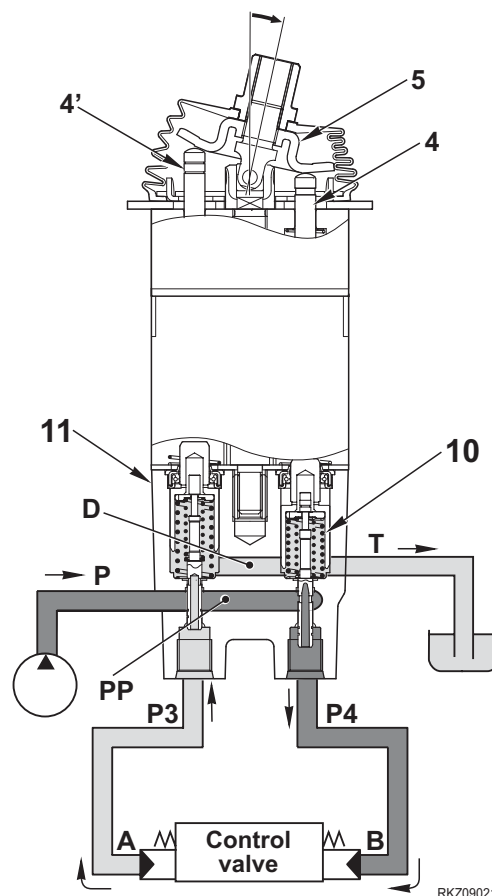
If piston (4') is pushed upwards and the solenoid in the PPC valve is energized, the force generated by the solenoid will retain the piston (4') in place and the arm float condition will be retained – even if the lever is released.

At the same time, the control valve will also be activated and retained in the arm float position.

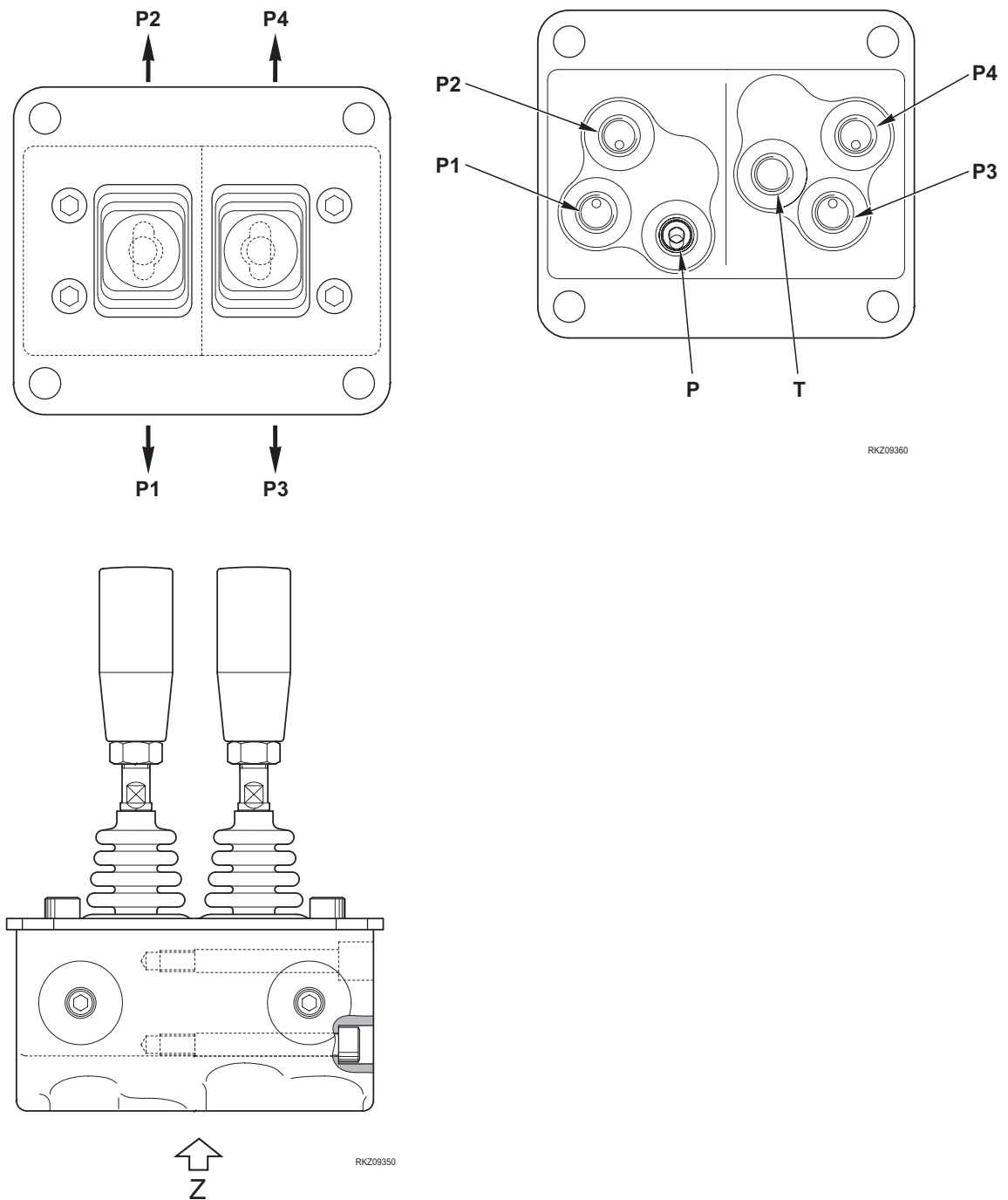
**6. When control lever is moved from float back to neutral position**

The disk (5) can be moved back to neutral position by applying a force that exceeds the force applied by the solenoid.

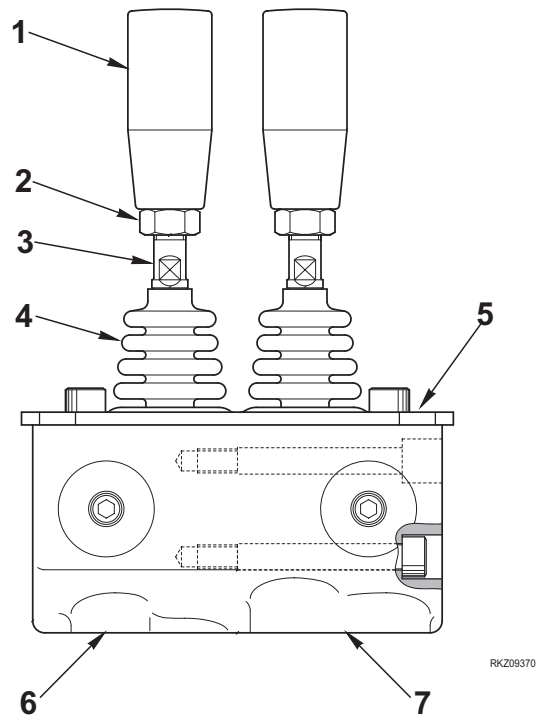
The floating state can also be cancelled, and the lever can move back to neutral position, denenergizing the solenoid.



## OUTRIGGERS PPC VALVE



- P1 port - To control valve (8 spools) (PA7 port)  
To control valve (10 spools) (PA9 port)
- P2 port - To control valve (8 spools) (PB7 port)  
To control valve (10 spools) (PB9 port)
- P3 port - To control valve (8 spools) (PA8 port)  
To control valve (10 spools) (PA10 port)
- P4 port - To control valve (8 spools) (PB7 port)  
To control valve (10 spools) (PB10 port)
- P port - To EV1 solenoid valve group (P2 port)
- Port T - To hydraulic tank

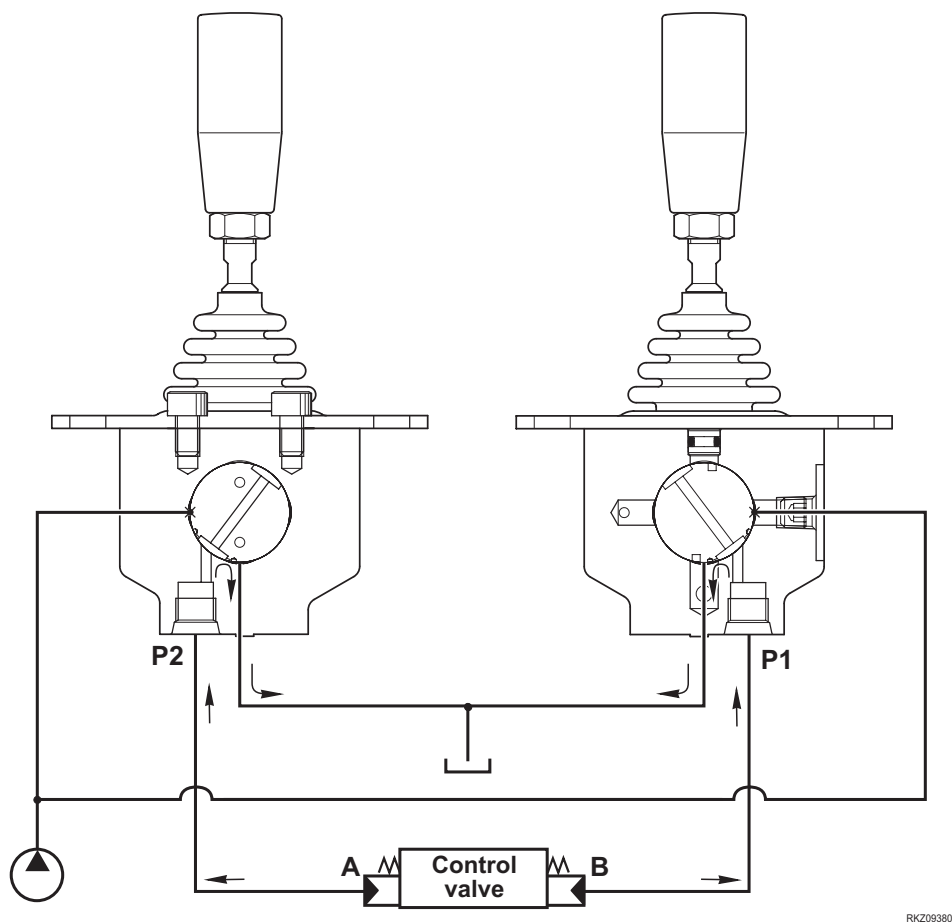


- 1. knob
- 2. Nut
- 3. Lever
- 4. Boot
- 5. Plate
- 6. LH PPC valve body
- 7. RH PPC valve body



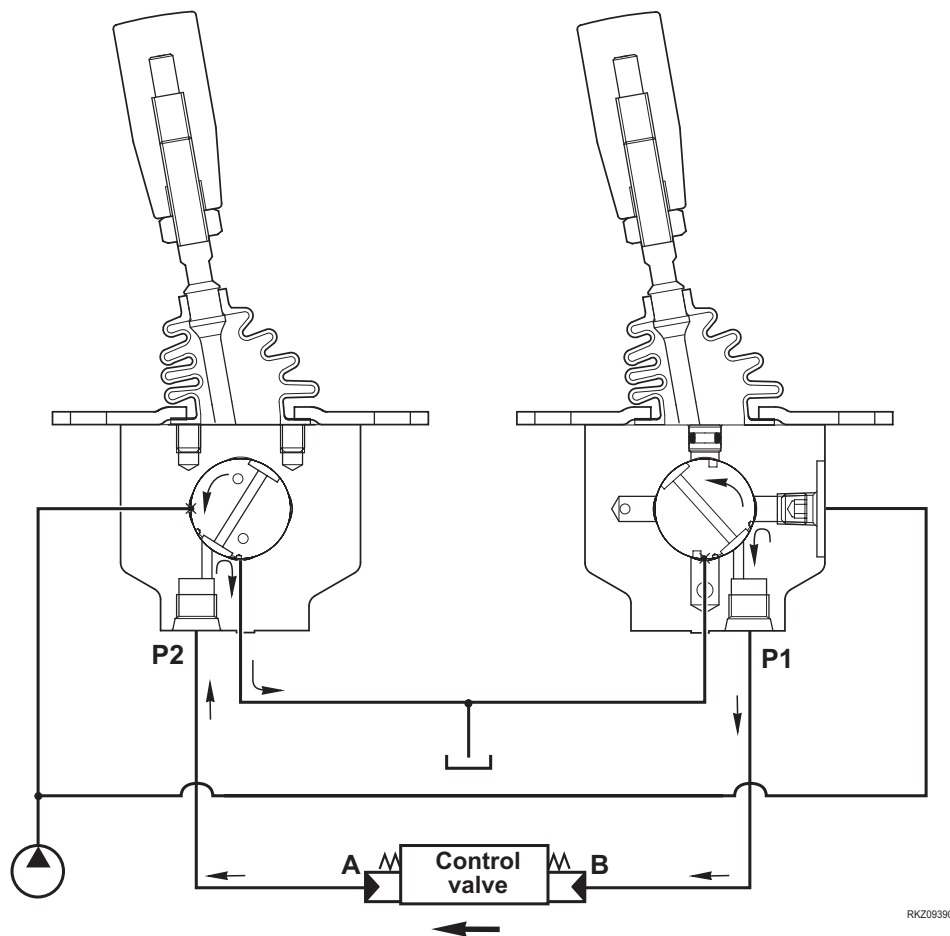
## OPERATION

### 1. Control lever in neutral position



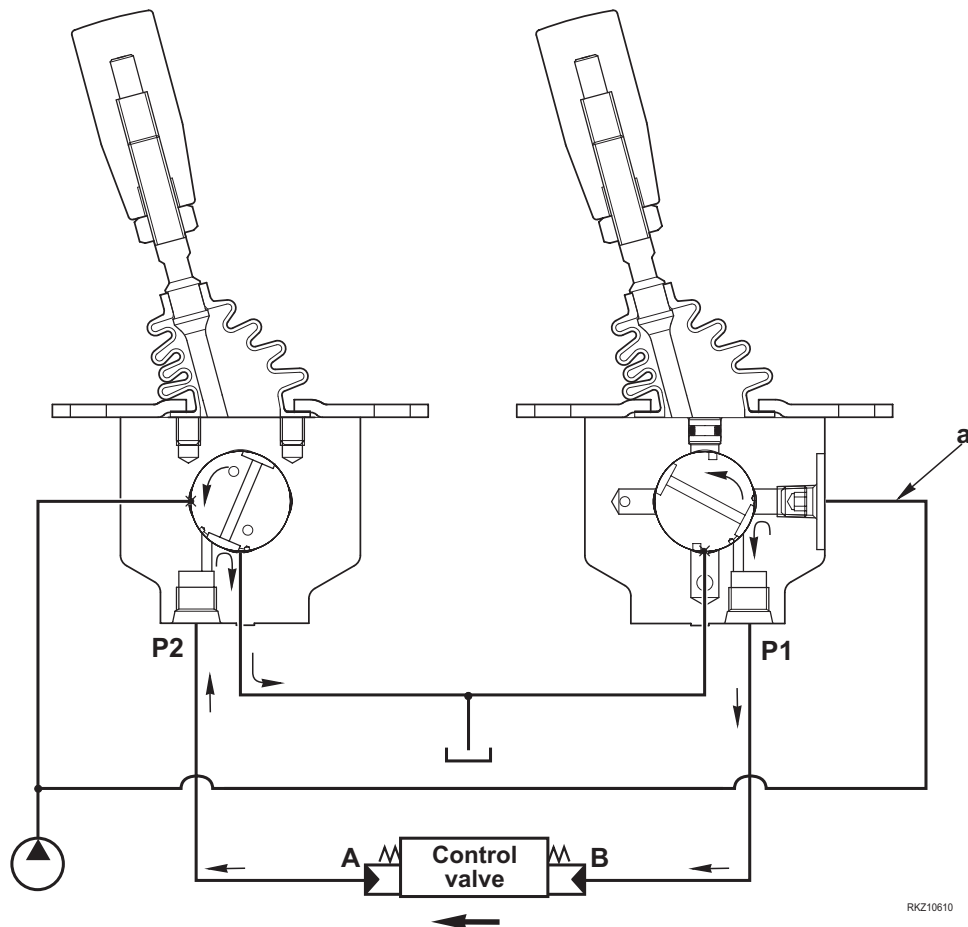
- Ports **A** and **B** of control valve and ports **P1** and **P2** of PPC valves are connected to the tank circuit.
- Hence, the spool is in neutral position.

2. During fine control (NEUTRAL → Actuator)



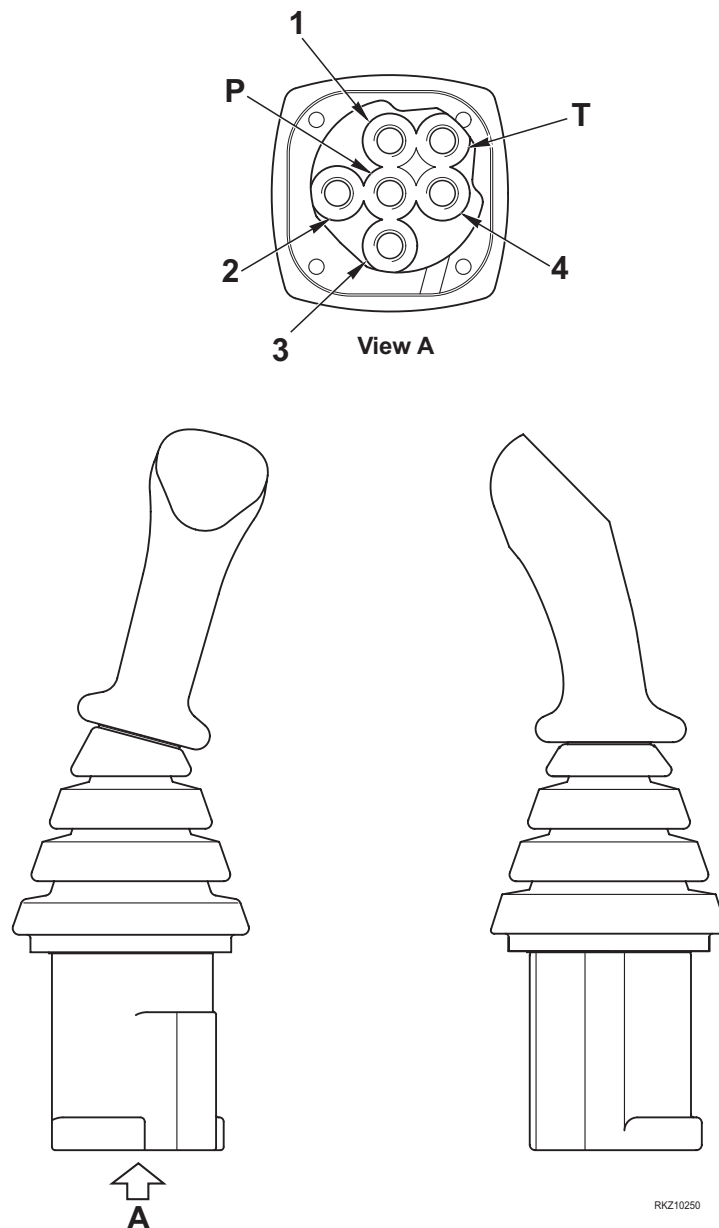
- When the lever (1) is moved in the direction shown by the arrow, the valves (2) are rotated and a passage is opened between delivery duct **a** and port **P1**, while port **P2** remains connected to the tank circuit.
- Pressure at port **P1** increases as the travel of lever (1) increases. Consequently, the spool of the control valve moves to the left by a distance that is proportional to the travel of the lever (1).

3. Control lever at full stroke (Actuator → NEUTRAL)



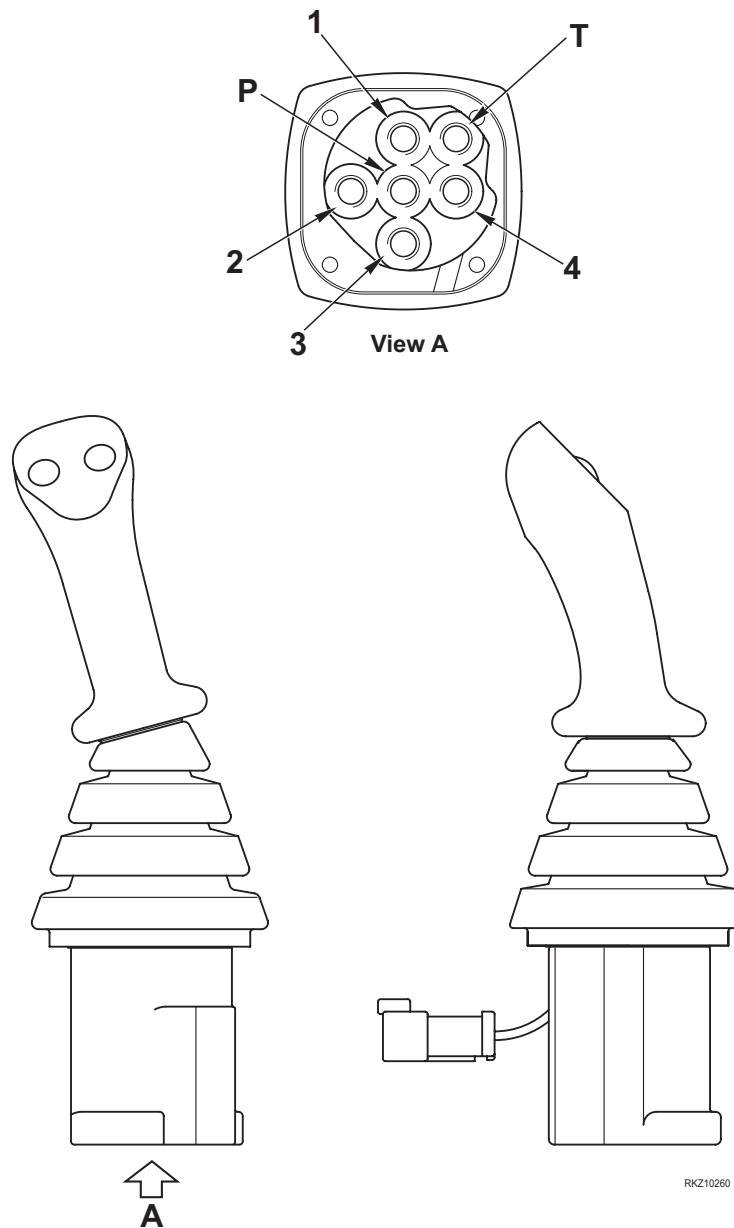
- When lever (1) is moved fully to the left, the valves (2) are fully rotated.
- Port **P1** is then connected directly to delivery duct **a** whereas port **P2** is connected to tank circuit only, and the spool of the control valve performs its full travel.

## BACKHOE LH PPC VALVE



- |          |                                                     |
|----------|-----------------------------------------------------|
| 1 port - | To control valve (Port PB1) (Out arm)               |
| Port T - | To hydraulic tank                                   |
| 4 port - | To backhoe control valve (Port PA2) (LH swing boom) |
| 3 port - | To backhoe control valve (Port PA1) (In arm)        |
| P port - | To EV1 solenoid valve group (VBH port)              |
| 2 port - | To backhoe control valve (Port PB2) (swing boom)    |

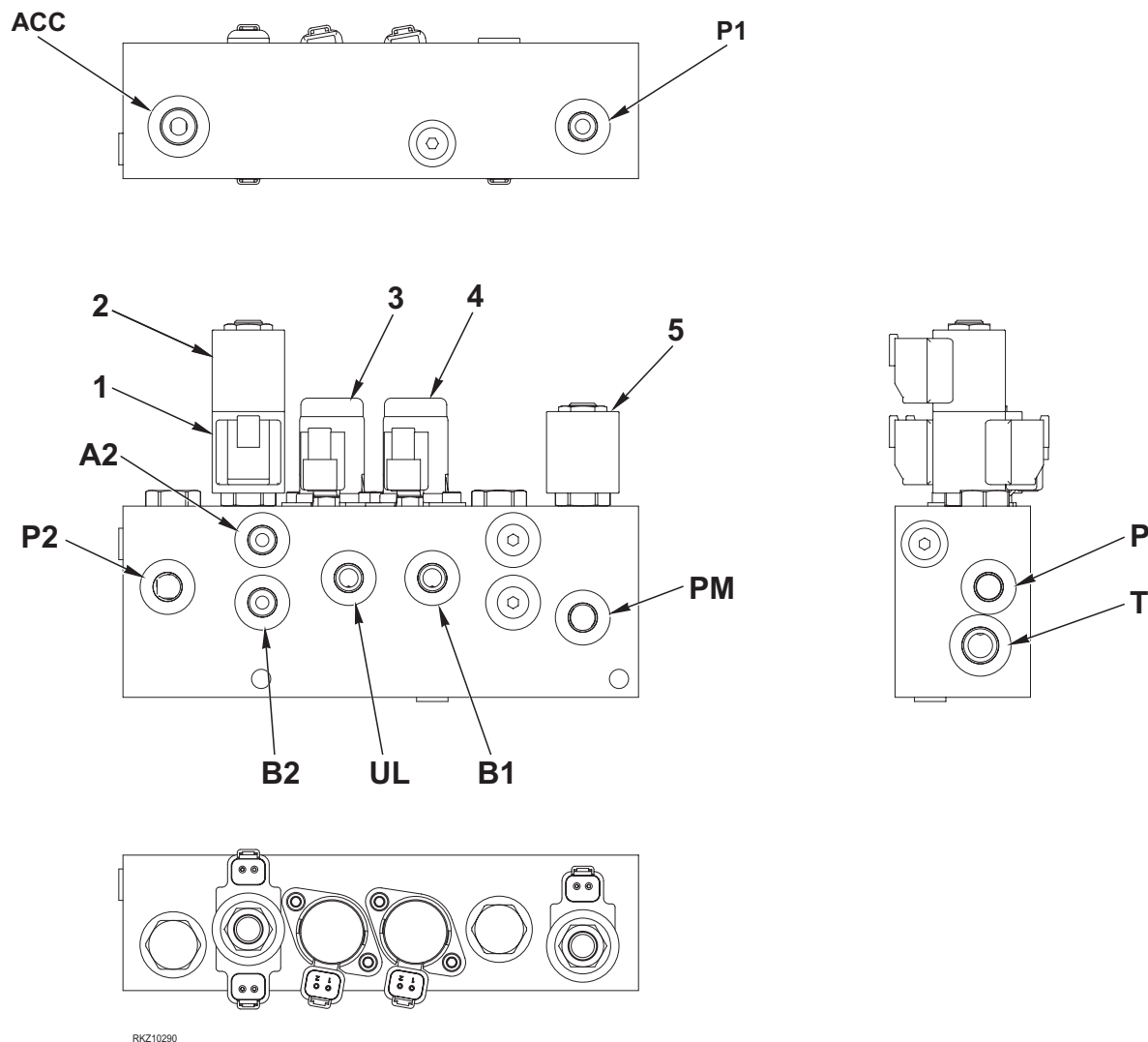
## BACKHOE RH PPC VALVE



- |          |                                                  |
|----------|--------------------------------------------------|
| Port 1 - | To control valve (Port PB4) (raise boom)         |
| Port T - | To hydraulic tank                                |
| Port 4 - | To control valve (Port PA5) (dump bucket)        |
| Port 3 - | To backhoe control valve (Port PA4) (lower boom) |
| Port P - | To solenoid valve group (VBH port)               |
| Port 2 - | To control valve (Port PB5) (curl bucket)        |

## SOLENOID VALVE GROUP (EV1)

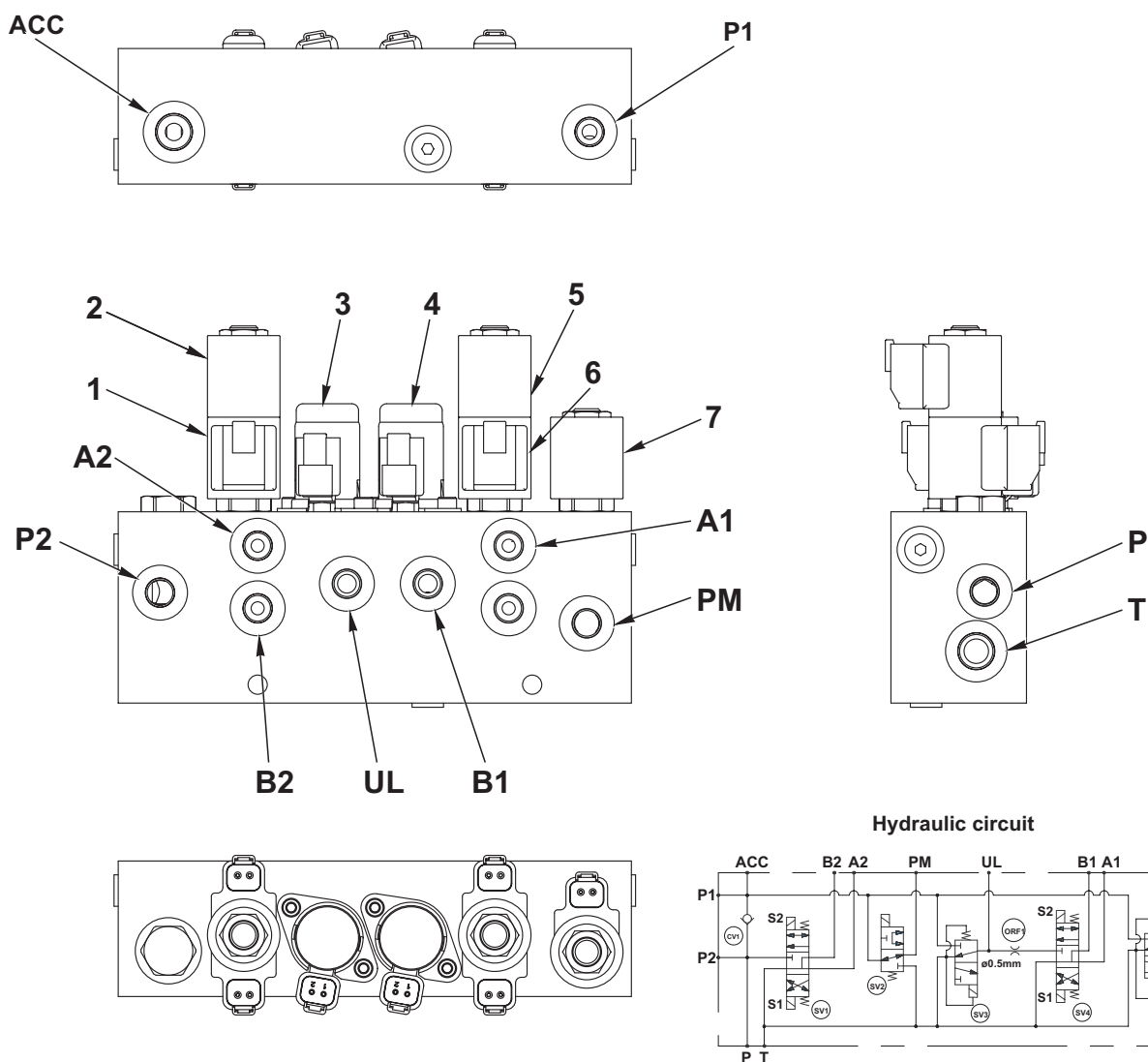
### BACKHOE VERSION WITHOUT 4 IN 1 BUCKET



1. Y94 - Differential lock solenoid valve
2. Y95 - Boom unlock solenoid valve
3. Y90 - Backhoe PPC solenoid valve
4. Y93 - PPC solenoid valve
5. Y91 - Ecopower solenoid valve

- |            |                                  |
|------------|----------------------------------|
| Port Acc - | Accumulator                      |
| Port P1 -  | Pressure tap                     |
| Port P2 -  | To outriggers PPC valve (Port P) |
| Port A2 -  | To boom unlock cylinder          |
| Port B2 -  | To rear axle                     |
| Port VBH - | To backhoe PPC valves (Port P)   |
| Port VL -  | To shovel PPC valve (Port P)     |
| Port PM -  | To hydraulic pump (Port PM)      |
| Port P -   | From control valve (Port PPC)    |
| Port T -   | To hydraulic tank                |

BACKHOE VERSION WITH 4 IN 1 BUCKET



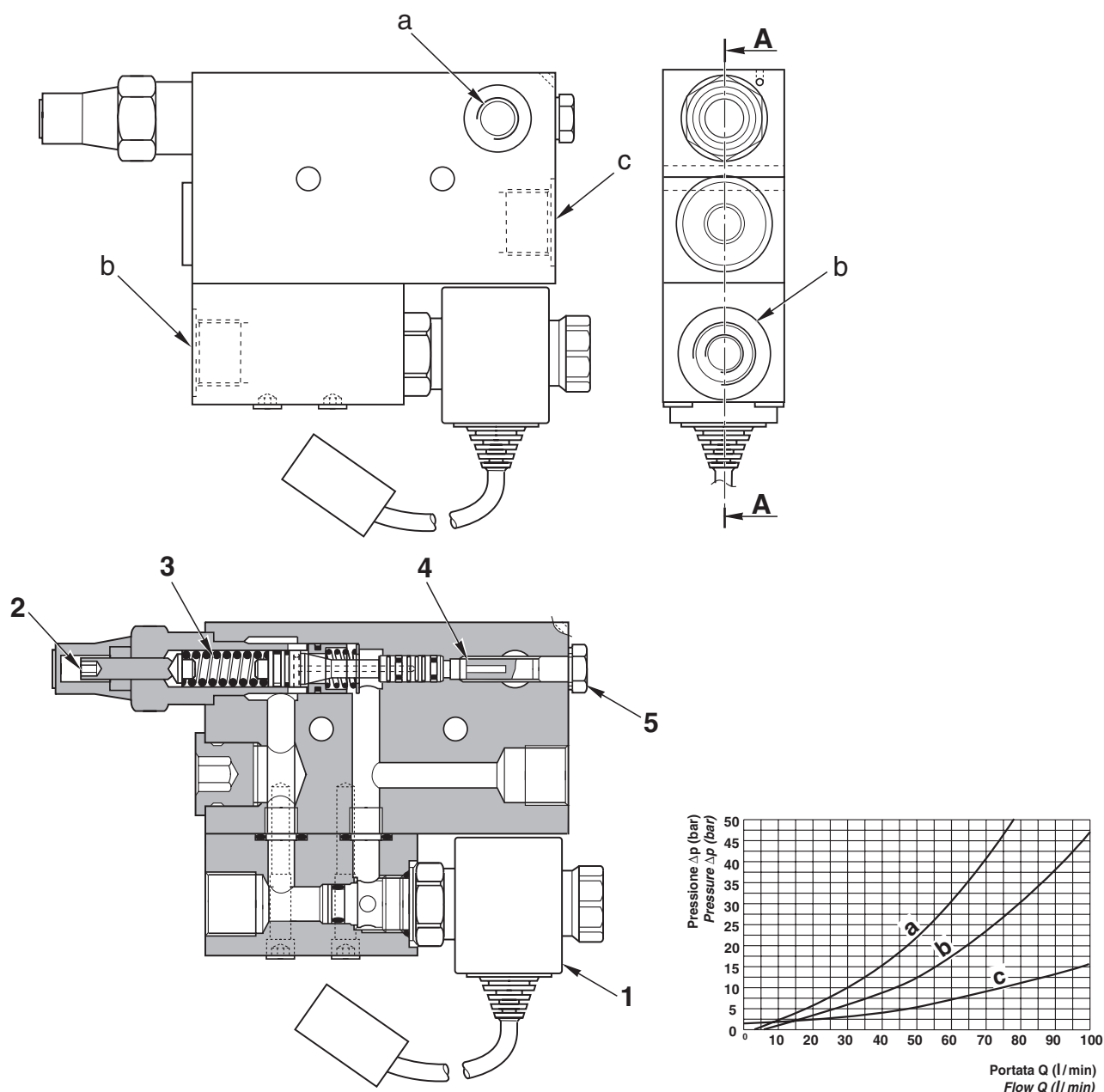
RKZ10300

1. Y94 - Differential lock solenoid valve
2. Y95 - Boom unlock solenoid valve
3. Y90 - Backhoe PPC solenoid valve
4. Y93 - PPC solenoid valve
5. Y98 - Bucket curl solenoid valve
6. Y99 - Bucket dump solenoid valve
6. Y91 - Ecopower solenoid valve

- Port Acc - Accumulator
- Port P1 - Pressure tap
- Port P2 - To outriggers PPC valve (Port P)
- Port A2 - To boom unlock cylinder
- Port B2 - To rear axle
- Port VBH - To backhoe PPC valves (Port P)
- Port VL - To shovel PPC valve (Port P)
- Port A1 - To control valve (Port PA6)
- Port B1 - To control valve (Port PB6)
- Port PM - To hydraulic pump (Port PM)
- Port P - From control valve (Port PPPC)
- Port T - To hydraulic tank

## SAFETY VALVES

### SHOVEL RAISE



RKZ08040

Section A - A

RKZ08050

- a. Port PiL - To the raise cylinders (Head side)
- b. Port V2 - From control valve (8-spool)  
(Port A6)  
From control valve (10-spool)  
(Port A8)
- c. Port C2 - To the raise cylinders (Bottom side)

#### COMPONENTS

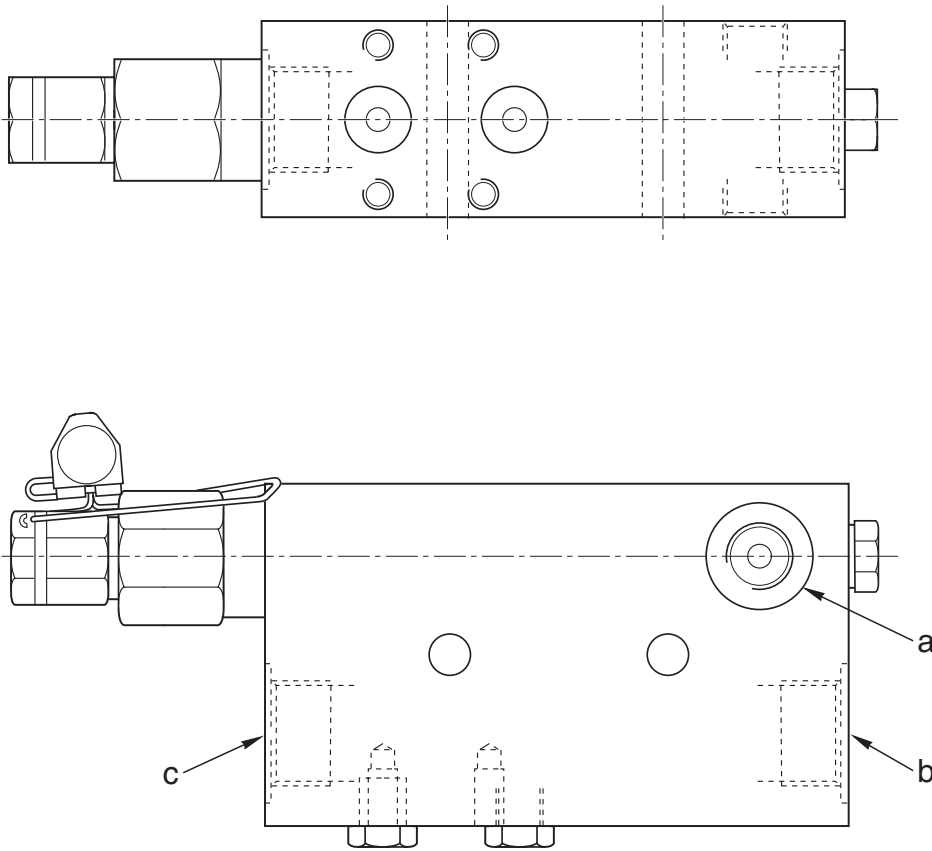
- 1 - Solenoid valve
- 2 - Adjusting screw
- 3 - Spring
- 4 - Spool
- 5 - Unlock screw

#### CHARACTERISTICS

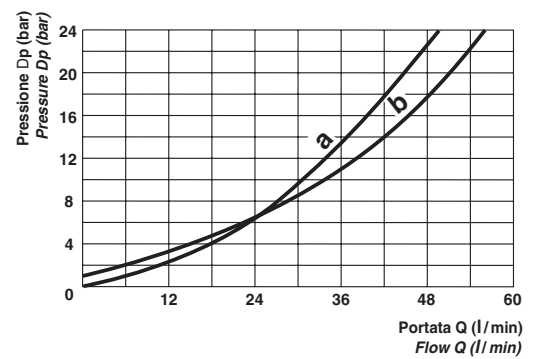
Safety valve calibration:  $220 \pm 10$  bar



## SHOVEL DUMP



RKZ08060



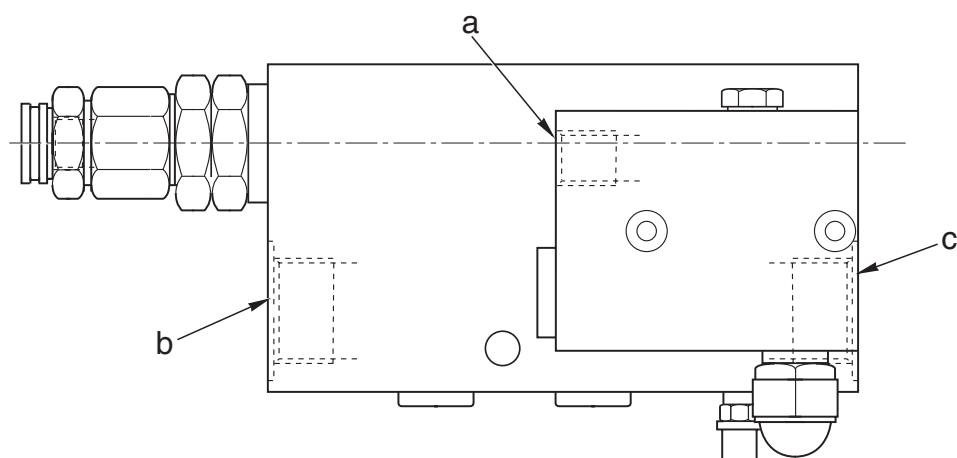
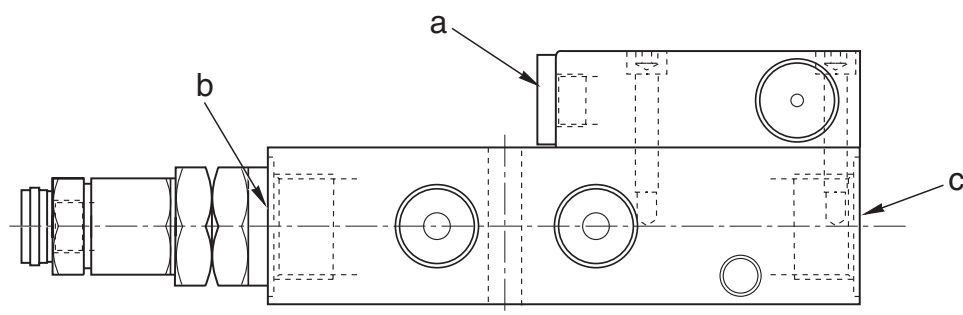
RKZ08070

- a. Port PiL - To the dump cylinder (Bottom side)
- b. Port C2 - To the dump cylinder (Head side)
- b. Port V2 - From control valve (8-spool) (B3 port)

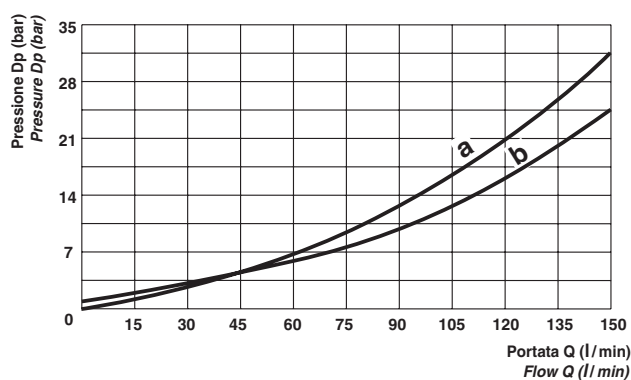
### CHARACTERISTICS

Safety valve calibration:  $220 \pm 10$  bar

## BOOM



RKZ08080



RKZ08090

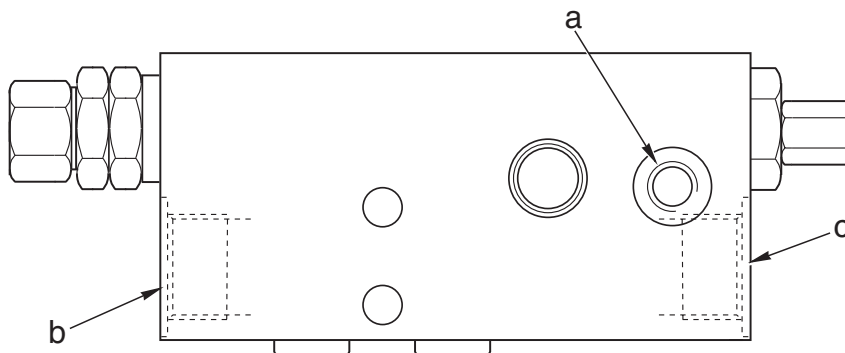
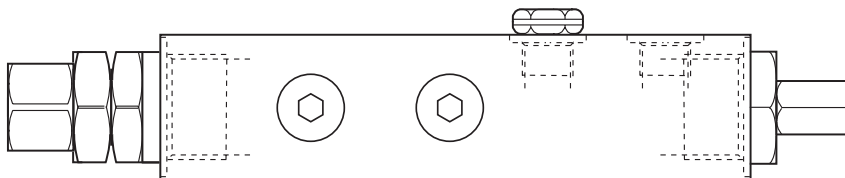
- a. PiL port - To the boom cylinder (bottom side)
- b. V2 port - From control valve (B4 port)
- c. C2 port - To the boom cylinder (Head side)

### CHARACTERISTICS

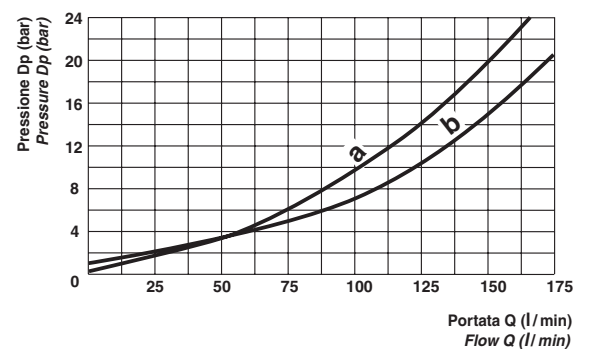
Safety valve calibration 1:  $250 \pm 15$  bar

Safety valve calibration 2:  $200 \pm 20$  bar

## ARM



RKZ08100



RKZ08110

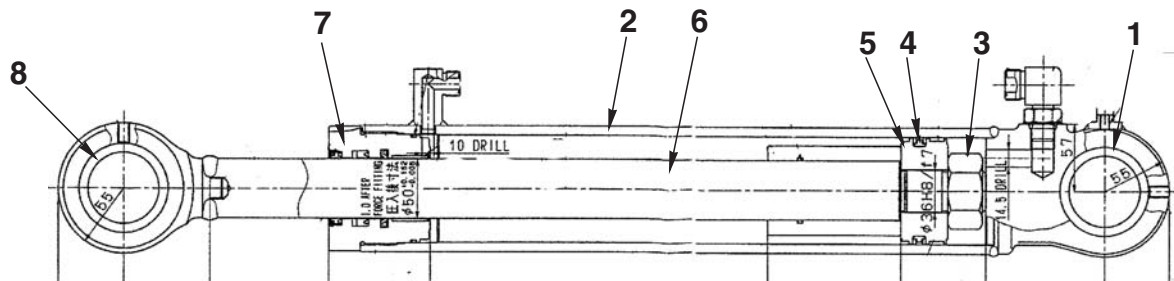
- a. PiL port - To the arm cylinder (bottom side)
- b. V2 port - From control valve (A1 port)
- c. C2 port - To the arm cylinder (Head side)

## CHARACTERISTICS

Safety valve calibration 1: 300 ± 10 bar

## SHOVEL CYLINDERS

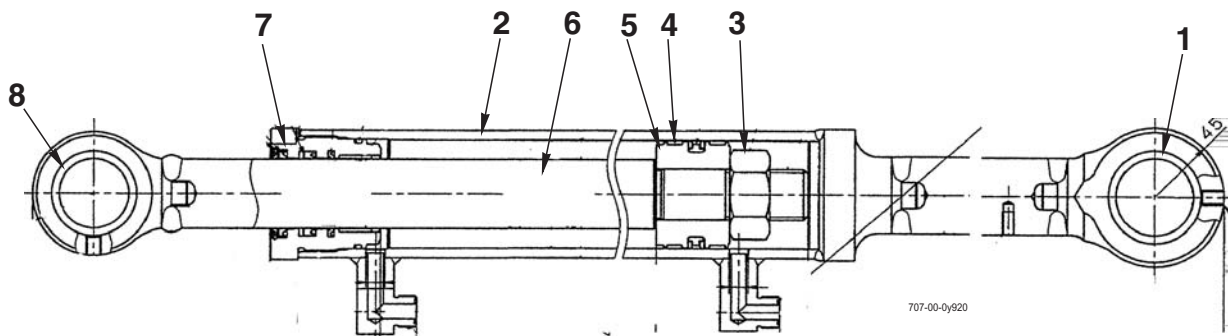
## RAISING CYLINDER



707-00-0y891

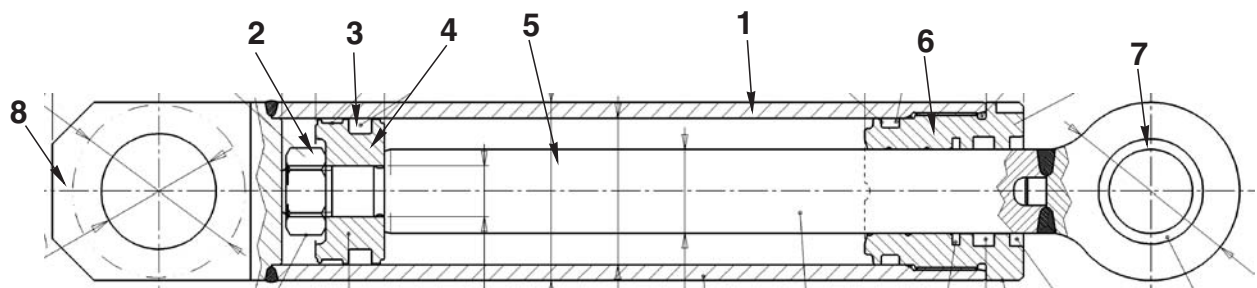
1. Bottom bushing
2. Cylinder
3. Nut
4. Gasket
5. Piston
6. Stem
7. Head
8. Head bushing

## DUMPING CYLINDER



707-00-0y920

1. Bottom bushing
2. Cylinder
3. Nut
4. Gasket
5. Piston
6. Stem
7. Head
8. Head bushing

**4 IN 1 BUCKET**

42N-6C-12800

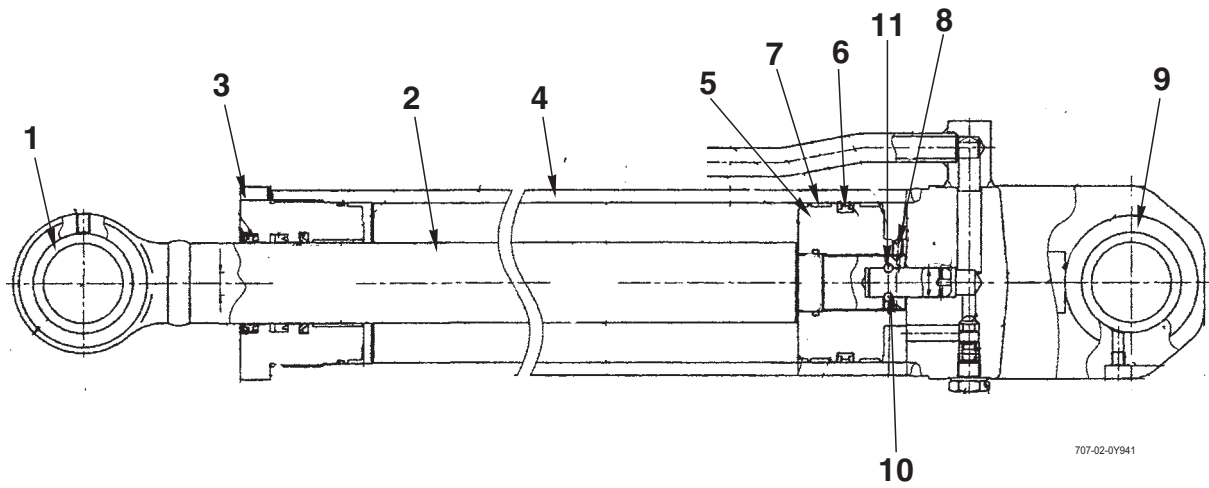
- |             |           |                 |
|-------------|-----------|-----------------|
| 1. Cylinder | 4. Piston | 7. Head bushing |
| 2. Nut      | 5. Stem   |                 |
| 3. Gasket   | 6. Head   |                 |

**CHARACTERISTICS**

| Cylinder                       | Lifting | Dump | 4 in 1 bucket |
|--------------------------------|---------|------|---------------|
| Piston rod diameter            | 50      | 45   | 40            |
| Internal cylinder diameter     | 90      | 70   | 70            |
| Piston stroke                  | 570     | 745  | 230           |
| Max. cylinder length           | 1740    | 2145 | 705           |
| Min. cylinder length           | 1170    | 144  | 475           |
| Key size for piston safety nut | 55      | 40   | 36            |

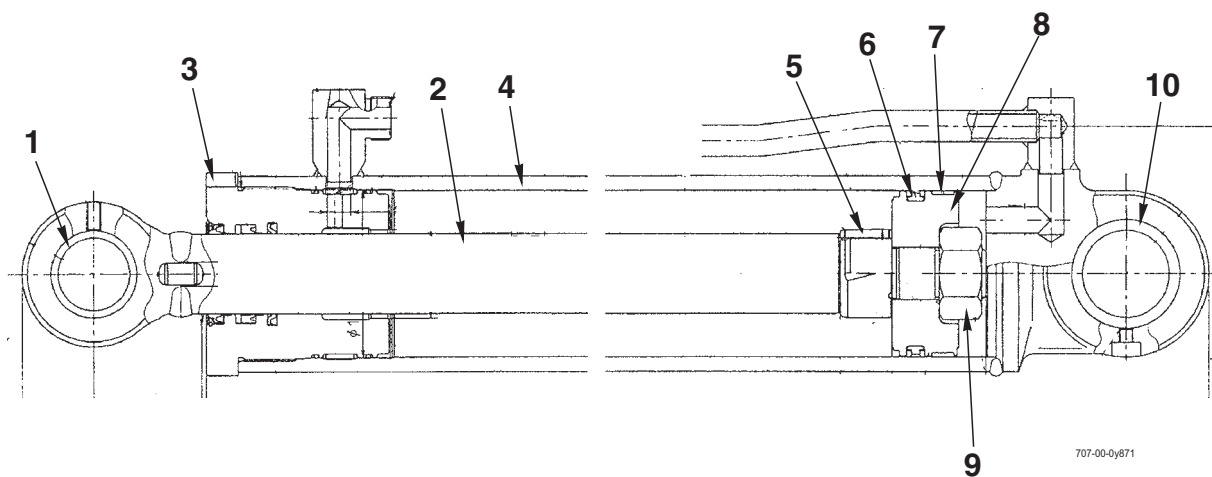
## BACKHOE CYLINDERS

### BOOM CYLINDER



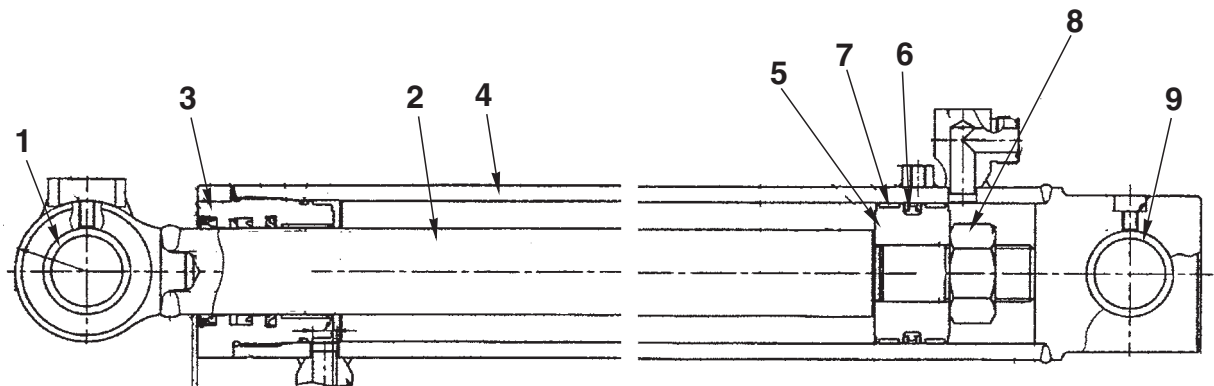
- |                   |                    |                            |
|-------------------|--------------------|----------------------------|
| 1. Bottom bushing | 5. Piston          | 9. Bottom bushing          |
| 2. Stem           | 6. Gasket          | 10. Dowel                  |
| 3. Head           | 7. Guide ring      | 11. Ball-bearings (no. 10) |
| 4. Cylinder       | 8. Cushion plunger |                            |

### ARM



- |                   |                  |                    |
|-------------------|------------------|--------------------|
| 1. Bottom bushing | 5. Brake bushing | 9. Nut             |
| 2. Stem           | 6. Gasket        | 10. Bottom bushing |
| 3. Head           | 7. Guide ring    |                    |
| 4. Cylinder       | 8. Piston        |                    |

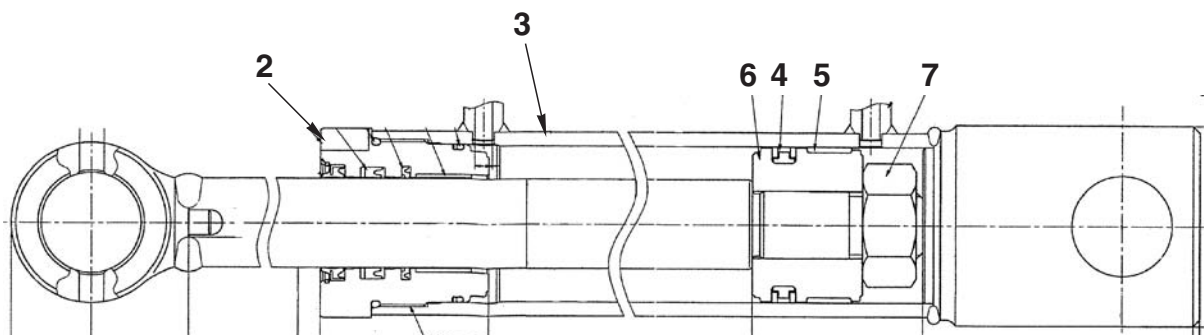
## BUCKET CYLINDER



707-00-0y901

- |                   |             |                   |
|-------------------|-------------|-------------------|
| 1. Bottom bushing | 4. Cylinder | 7. Guide ring     |
| 2. Stem           | 5. Piston   | 8. Nut            |
| 3. Head           | 6. Gasket   | 9. Bottom bushing |

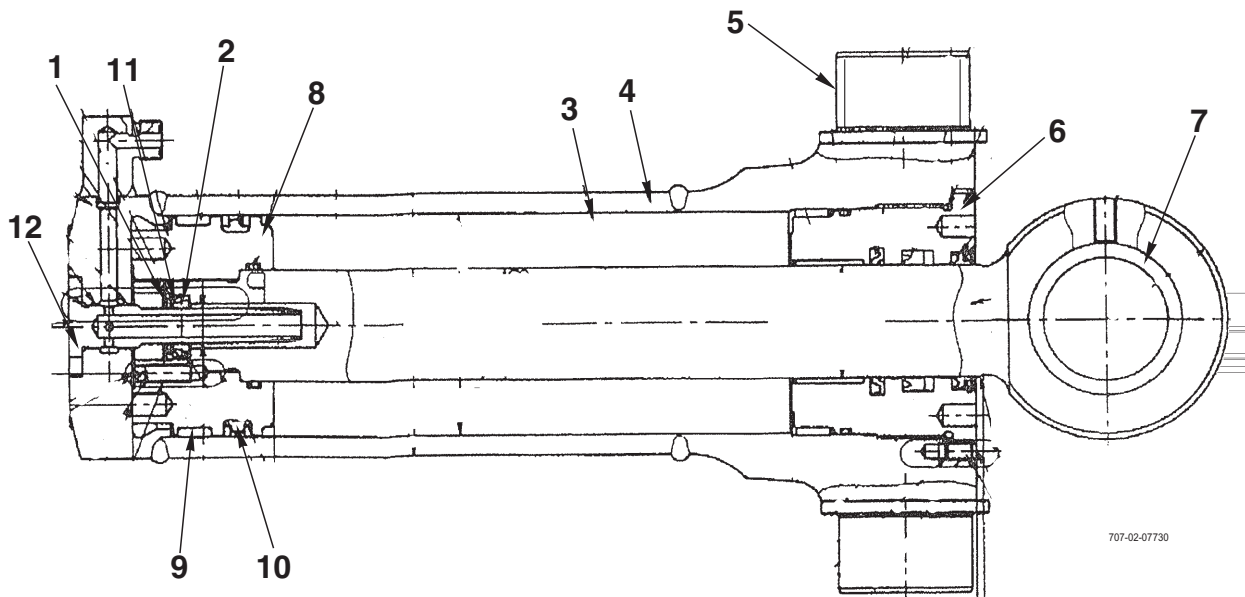
## OUTRIGGER CYLINDER



707-00-0Y0910

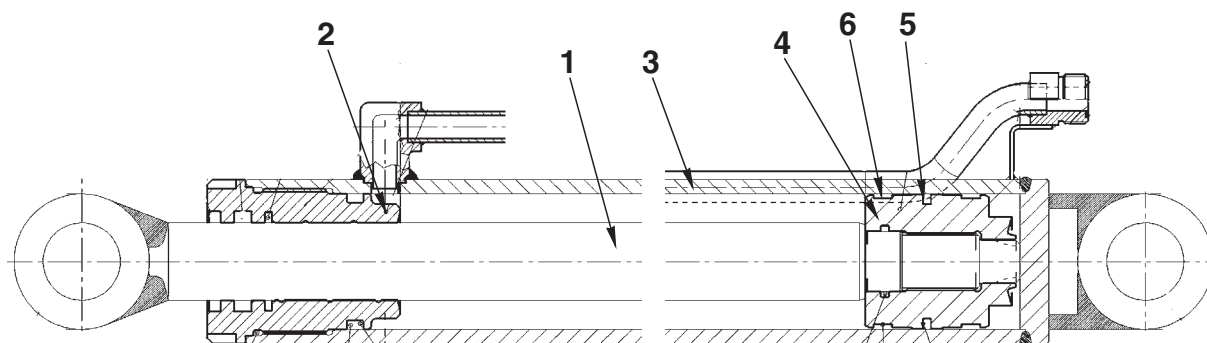
- |             |               |        |
|-------------|---------------|--------|
| 1. Stem     | 4. Gasket     | 7. Nut |
| 2. Head     | 5. Guide ring |        |
| 3. Cylinder | 6. Piston     |        |

## BOOM SWING CYLINDER



- |                     |                   |                     |
|---------------------|-------------------|---------------------|
| 1. Retaining ring   | 5. Bushing        | 9. Guide ring       |
| 2. Restriction ring | 6. Head           | 10. Piston seal     |
| 3. Stem             | 7. Bottom bushing | 11. Spacer          |
| 4. Cylinder         | 8. Piston         | 12. Cushion plunger |

## JIG ARM CYLINDER



- |         |             |               |
|---------|-------------|---------------|
| 1. Stem | 3. Cylinder | 5. Gasket     |
| 2. Head | 4. Piston   | 6. Guide ring |



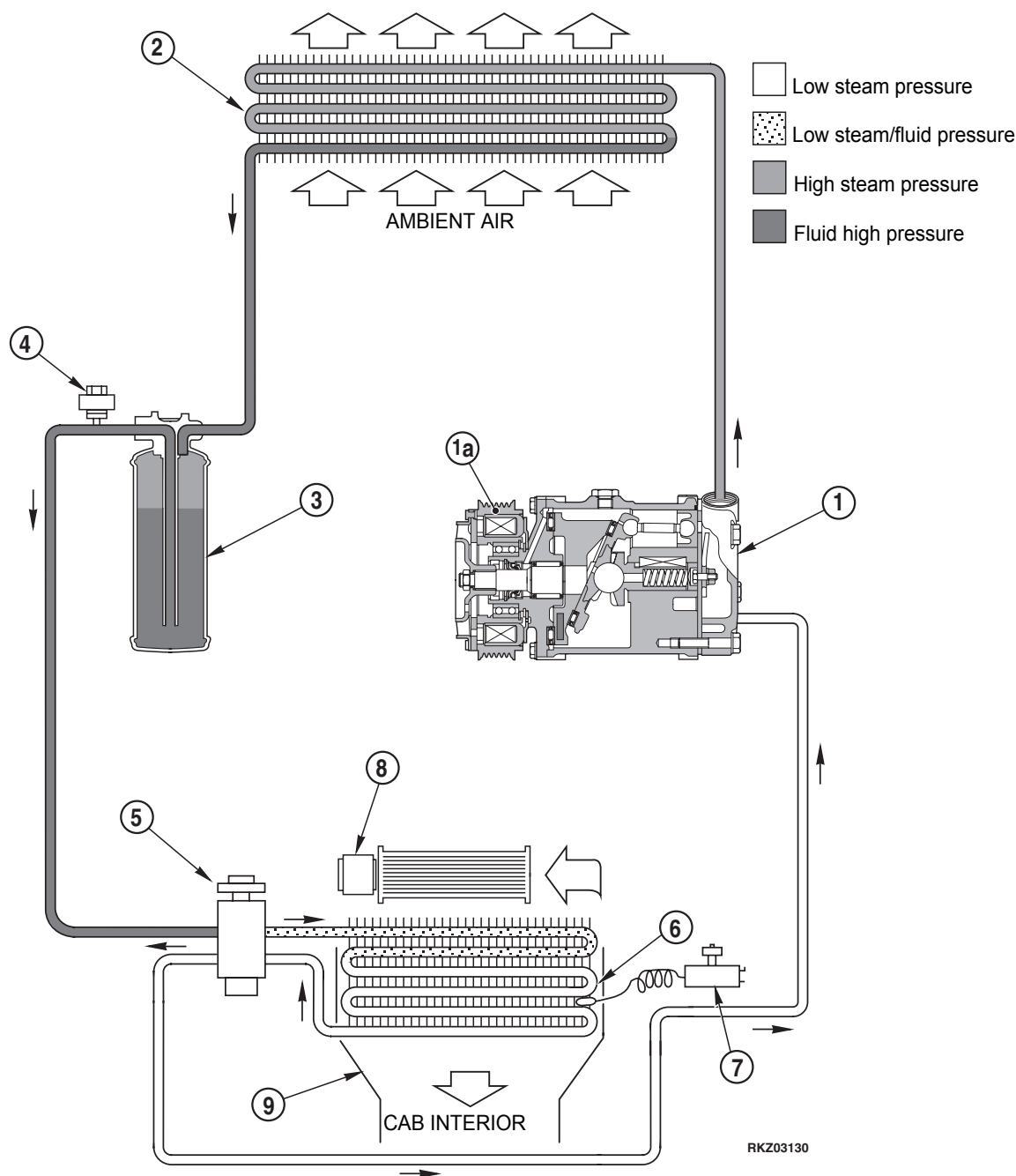
**STRUCTURE AND FUNCTION****BACKHOE CYLINDERS****CHARACTERISTICS**

| Cylinder                       | Boom | Arm  | Bucket |
|--------------------------------|------|------|--------|
| Piston rod diameter            | 60   | 55   | 55     |
| Internal cylinder diameter     | 120  | 115  | 90     |
| Piston stroke                  | 850  | 700  | 765    |
| Max. cylinder length           | 2160 | 1765 | 1850   |
| Min. cylinder length           | 1310 | 1065 | 1085   |
| Key size for piston safety nut | –    | 55   | 55     |

**CHARACTERISTICS**

| Cylinder                       | Outriggers | Boom swing | Jig arm |
|--------------------------------|------------|------------|---------|
| Piston rod diameter            | 40         | 50         | 40      |
| Internal cylinder diameter     | 70         | 100        | 70      |
| Piston stroke                  | 635        | 230        | 1140    |
| Max. cylinder length           | 1690       | 319.5      | 2590    |
| Min. cylinder length           | 1055       | 89.5       | 1450    |
| Key size for piston safety nut | 46         | –          | 46      |

## AIR-CONDITIONING UNIT



1. Compressor
2. Condenser
3. Filter – dehydrator tank
4. Safety pressure switch
5. Expansion valve
6. Evaporator
7. Clutch thermostat sensor
8. Cab air circulation fans
9. Air feeder

### TECHNICAL DATA

- Circuit operating pressure with engine 2500 rpm at an ambient temperature of 25–30°C:  
Regular pressure: 15–17 bar  
Low pressure: 1.6–1.8 bar
- Safe pressures:  
High pressure: 26 bar  
Low pressure: 2.5 bar
- Coolant fluid: R134a
- Coolant quantity: 2250 ±150 g

## OPERATION OF THE AIR CONDITIONING UNIT

The compressor (1) receives drive directly from the driving shaft through a belt, and compressor rotation is caused by a pulley with electromagnetic clutch (1a).

Clutch engagement and disengagement are controlled by the thermostatic sensor (7). When the evaporator reaches the lower limit temperature, the thermostatic sensor comes into operation to command clutch disengagement. When the evaporator reaches the higher limit temperature, the thermostatic sensor commands clutch engagement.

The coolant fluid (in gaseous phase) is drawn into the compressor where it is subjected to compression and an intense heating process; the compressed and heated fluid is then sent into the condenser (2). Here, it reaches condensation temperature as a result of heat extraction due to the air flowing through the condenser fins, and the fluid switches to a high-pressure liquid state.

Subsequently the coolant passes into the drying-filter assembly (3) which performs three functions: it filters out impurities, absorbs any moisture from the circuit and, finally, also functions as a reserve tank.

The coolant in its liquid state is then transferred to the evaporator (6), first passing through an expansion valve (5). The task of this valve is the constant metering of the quantity of fluid in order to maintain optimum evaporation.

In the evaporator, the coolant fluid is subjected to expansion, bringing it up to the critical evaporation point at a temperature of approximately  $-8^{\circ}\text{C}$ .

The flow of air generated by centrifugal fan (8), which passes through the evaporator (6) at ambient temperature is considerably warmer than  $-8^{\circ}\text{C}$ . For this reason it yields heat to the coolant fluid, bringing it up to boiling point and complete evaporation.

On leaving the evaporator (6), the coolant is drawn once more into the compressor (1), and a new cycle starts.

The extraction of heat from the atmosphere in which the evaporator is located leads to the condensation of the water suspended in the air, and hence to dehumidification. The condensate is deposited on the evaporator fins where, if a temperature higher than  $0^{\circ}\text{C}$  is not maintained, it freezes and inhibits the functioning of the evaporator.

The task of keeping the temperature of the evaporator above  $0^{\circ}\text{C}$  (and thus within the optimum limits for heat exchange) is entrusted to a thermostatic sensor (7).

The condensate that forms on the evaporator fins (6) also contains dust, pollens and particles suspended in the air. Continual condensation therefore effectively purifies the air, and the droplets of condensate are released to the exterior.

A fixed quantity of anti-freeze oil is also introduced into the circuit, with the function of lubricating all the mechanical parts of the A/C system. A percentage of this oil circulates constantly throughout the A/C system in atomised form, lubricating the compressor (pistons and bearings) and the expansion valve.

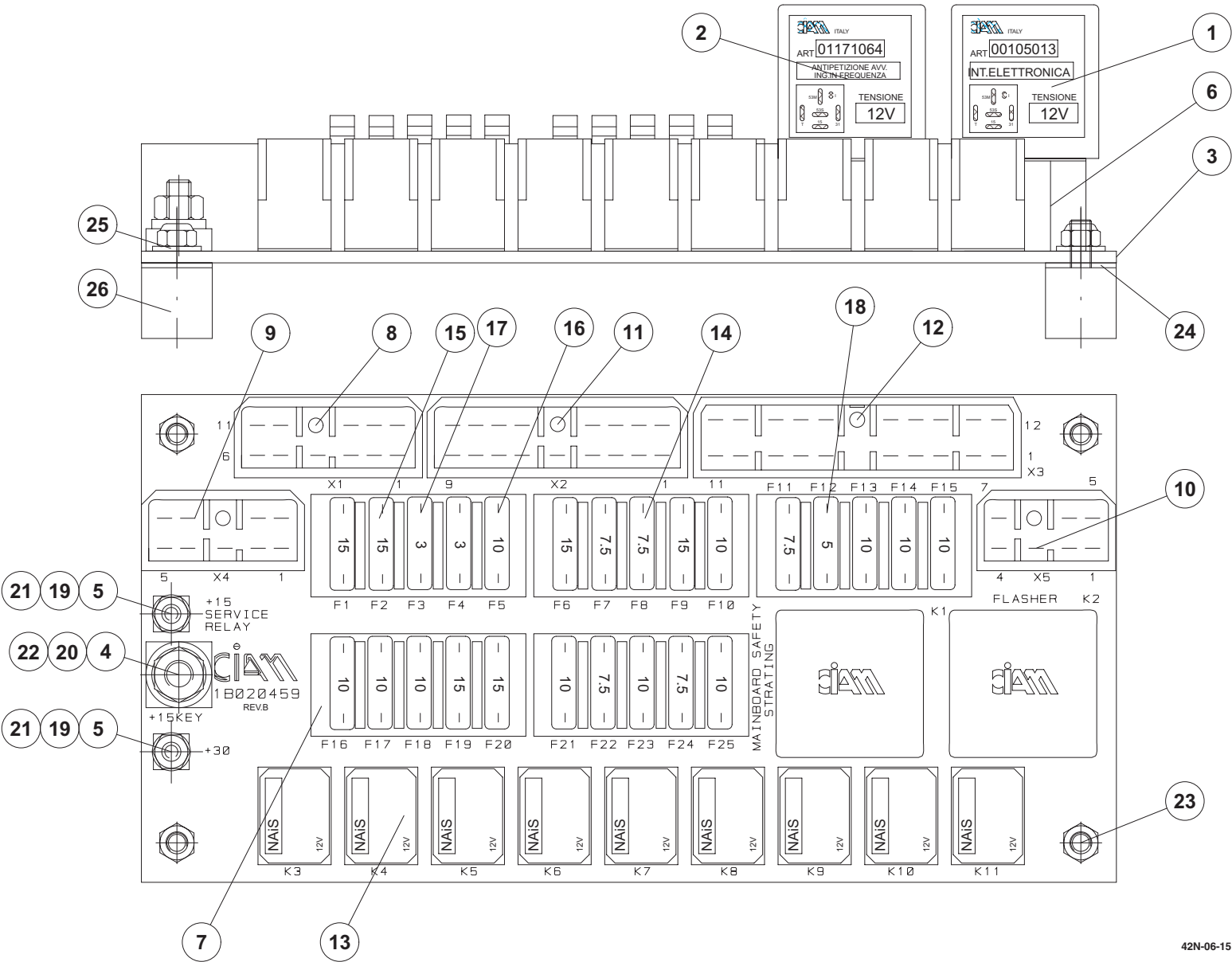
A pressure switch (4) has been inserted in the electrical control circuit to protect the A/C system in the case of a lack of coolant fluid or if the quantity of fluid becomes insufficient due to leakages. This switch will inhibit the engagement of the electromagnetic clutch and hence the functioning of the air-conditioning system.

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FUSE AND RELAY CENTRE

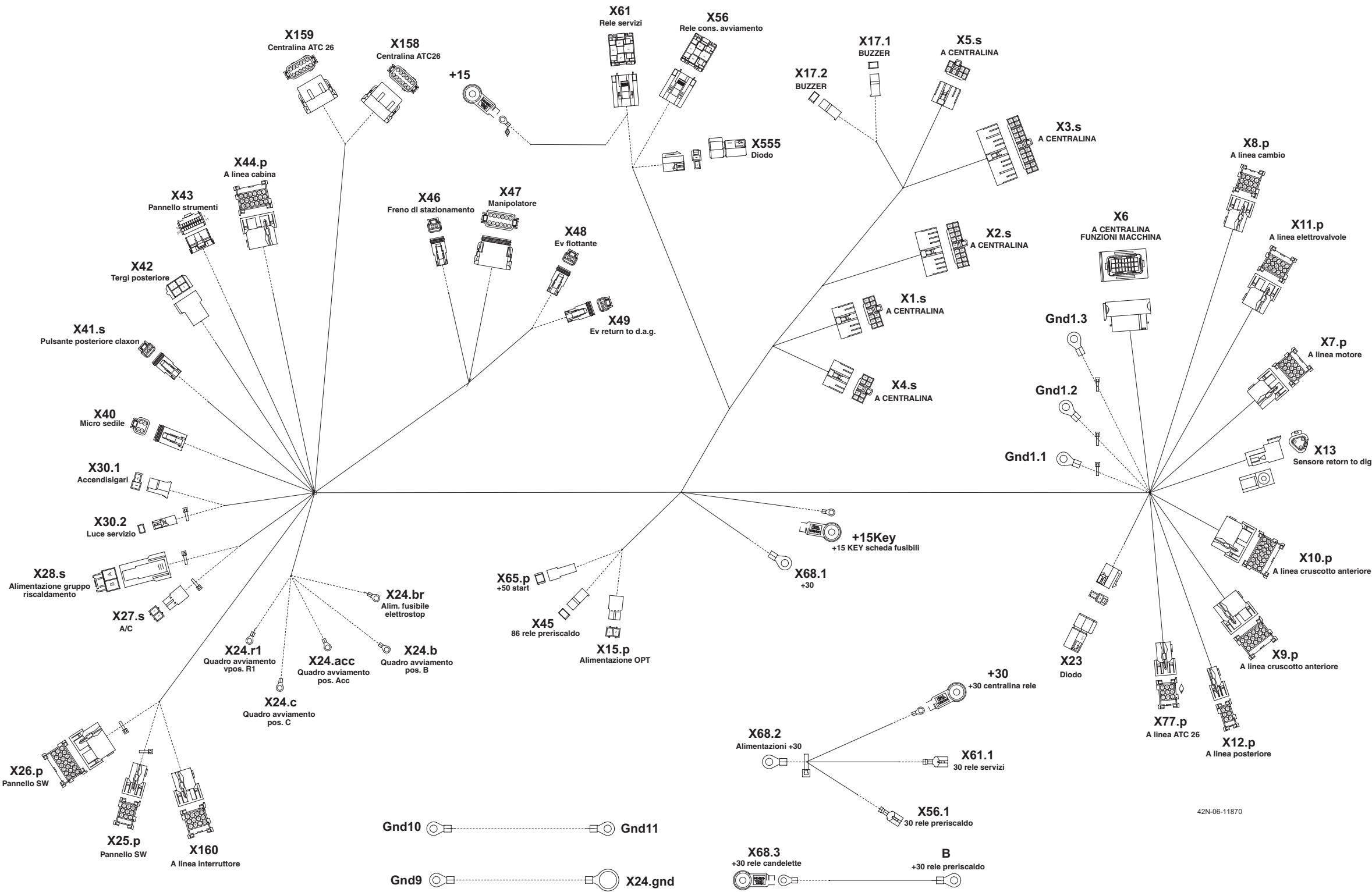
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|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|

| POS | CODICE   | DESCRIZIONE                         |    |
|-----|----------|-------------------------------------|----|
| 1   | 00105013 | INTERMITTENZA ELETTRONICA 12V       | 1  |
| 2   | 01171064 | CENTRALINA ANTIRIPETIZIONE AVV. 12V | 1  |
| 3   | 1B020459 | CIRCUITO STAMPATO                   | 1  |
| 4   | 120231   | TERMINALE DI POTENZA M6             | 1  |
| 5   | 120232   | TERMINALE DI POTENZA M5             | 2  |
| 6   | 124004   | CONNETTORE PORTARELE'SCHEDE         | 2  |
| 7   | 124526   | CONNETTORE PORTAFUFIBILE 5 VIE      | 5  |
| 8   | 125188   | CONNETTORE MARK II 11V SCHEDE       | 1  |
| 9   | 125191   | CONNETTORE MARK II 9V SCHEDE        | 1  |
| 10  | 125223   | CONNETTORE MARKII 7VIE SCHEDE       | 1  |
| 11  | 125224   | CONNETTORE MARKII 17VIE SCHEDE      | 1  |
| 12  | 125225   | CONNETTORE MARKII 21VIE SCHEDE      | 1  |
| 13  | 157137   | RELE' CM1-DP-12V                    | 9  |
| 14  | 163005   | FUSIBILE A LAMA 7.5 A               | 5  |
| 15  | 163006   | FUSIBILE A LAMA 15 A                | 6  |
| 16  | 163007   | FUSIBILE A LAMA 10 A                | 11 |
| 17  | 163010   | FUSIBILE A LAMA 3 A                 | 2  |
| 18  | 163031   | FUSIBILE A LAMA 5 A 257005          | 1  |
| 19  | 190288   | ROND.EL.SP.5,3X8,9X1,2 UNI1751 INOX | 2  |
| 20  | 190289   | ROND.EL.SP.6,4X11,3X1,6 UNI1751INOX | 1  |
| 21  | 190468   | DADO M5 UNI 5588-65 INOX            | 2  |
| 22  | 190479   | DADO M6 UNI 5588 INOX A2            | 1  |
| 23  | 190534   | DADO M4 BLOK UNI 7473 INOX A2       | 4  |
| 24  | 191368   | RONDELLA 3,5X13,6X2 CERTENE         | 4  |
| 25  | 191369   | RONDELLA 4,4X10X1,1 NYLON           | 4  |
| 26  | 191804   | ANTIVIBRANTE M/F M4X10 H15 INOX     | 4  |



DRIVER SEAT WIRING

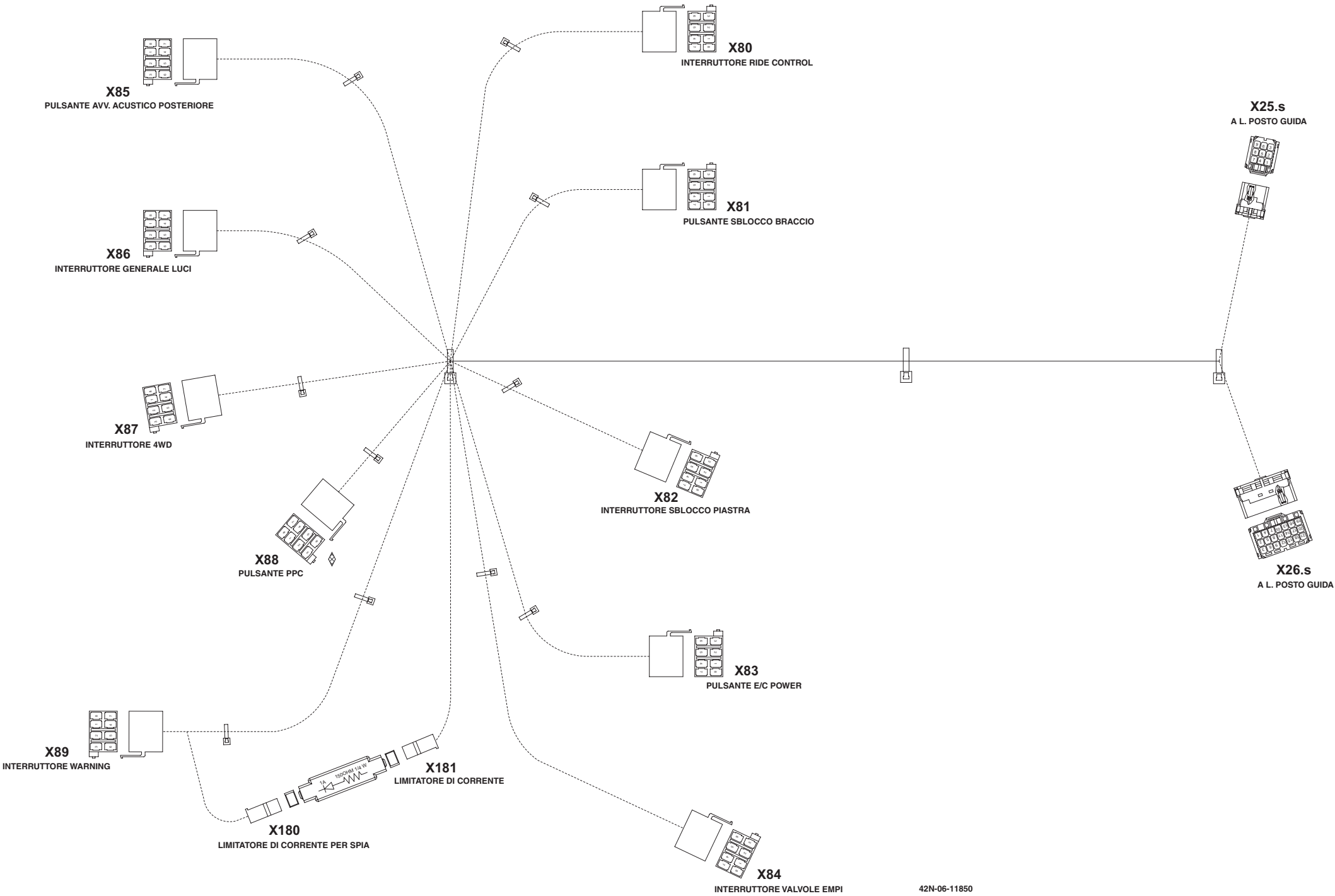
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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|



42N-06-11870

SWITCH PANEL WIRING

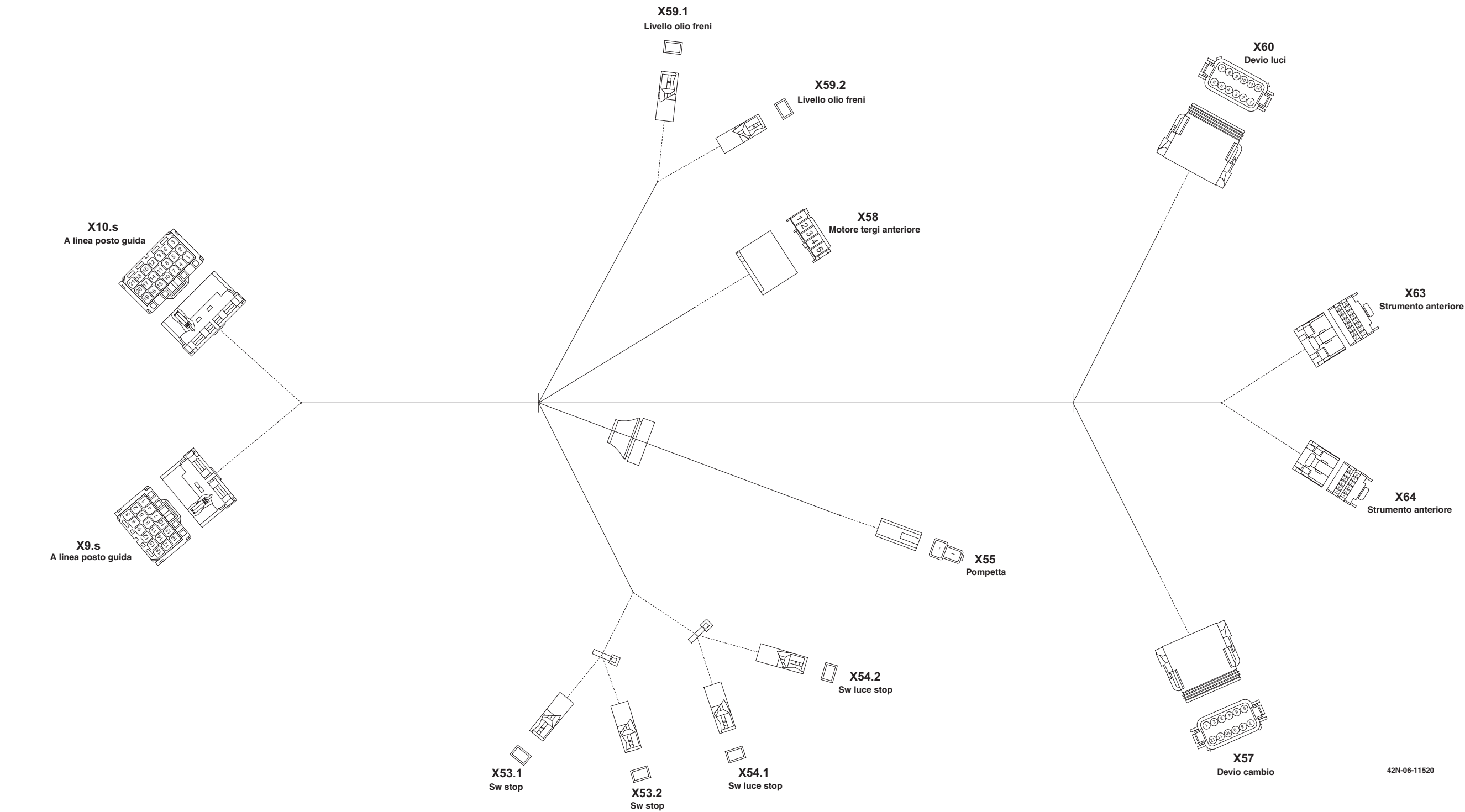
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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
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42N-06-11850

FRONT DASH WIRING

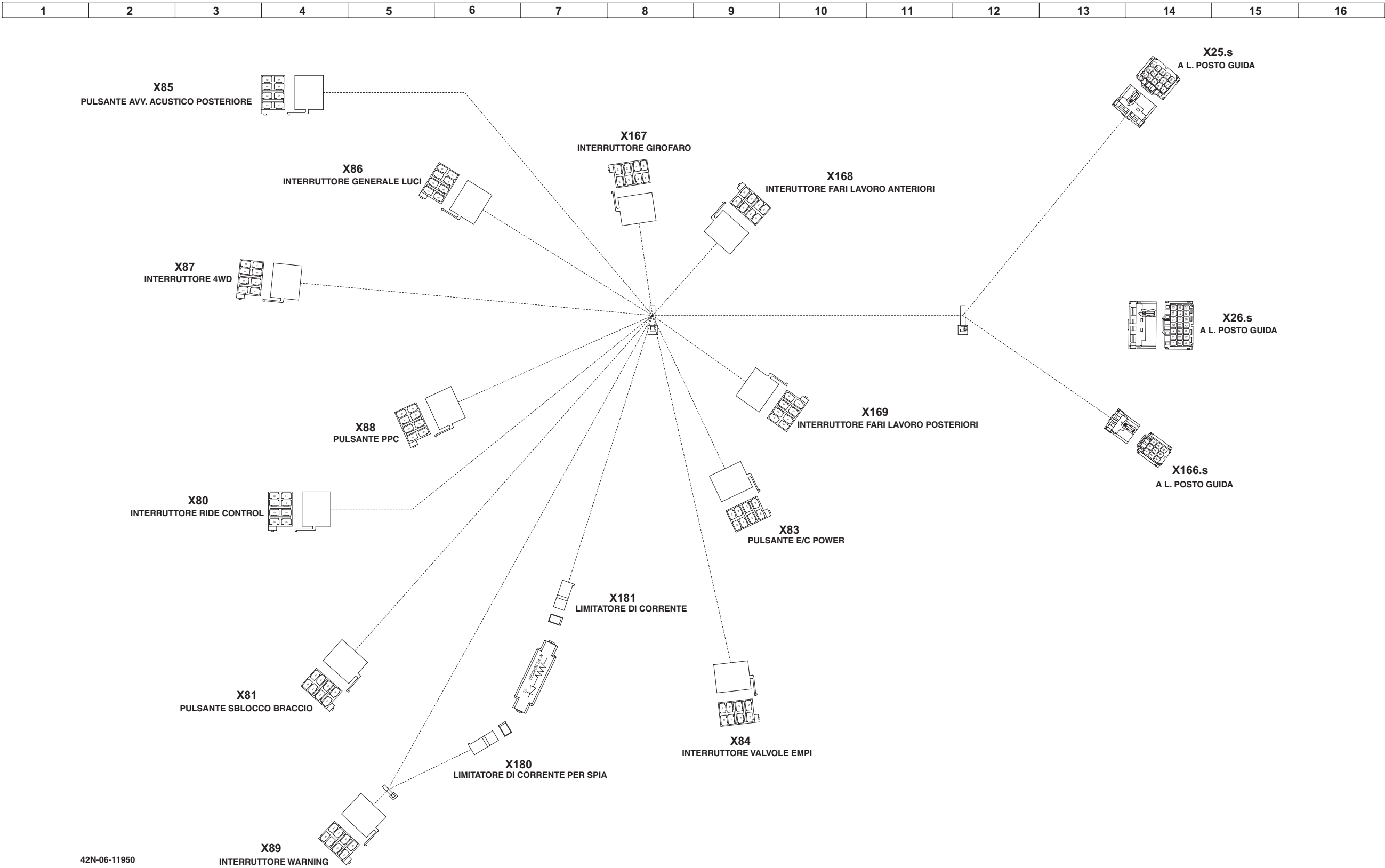
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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
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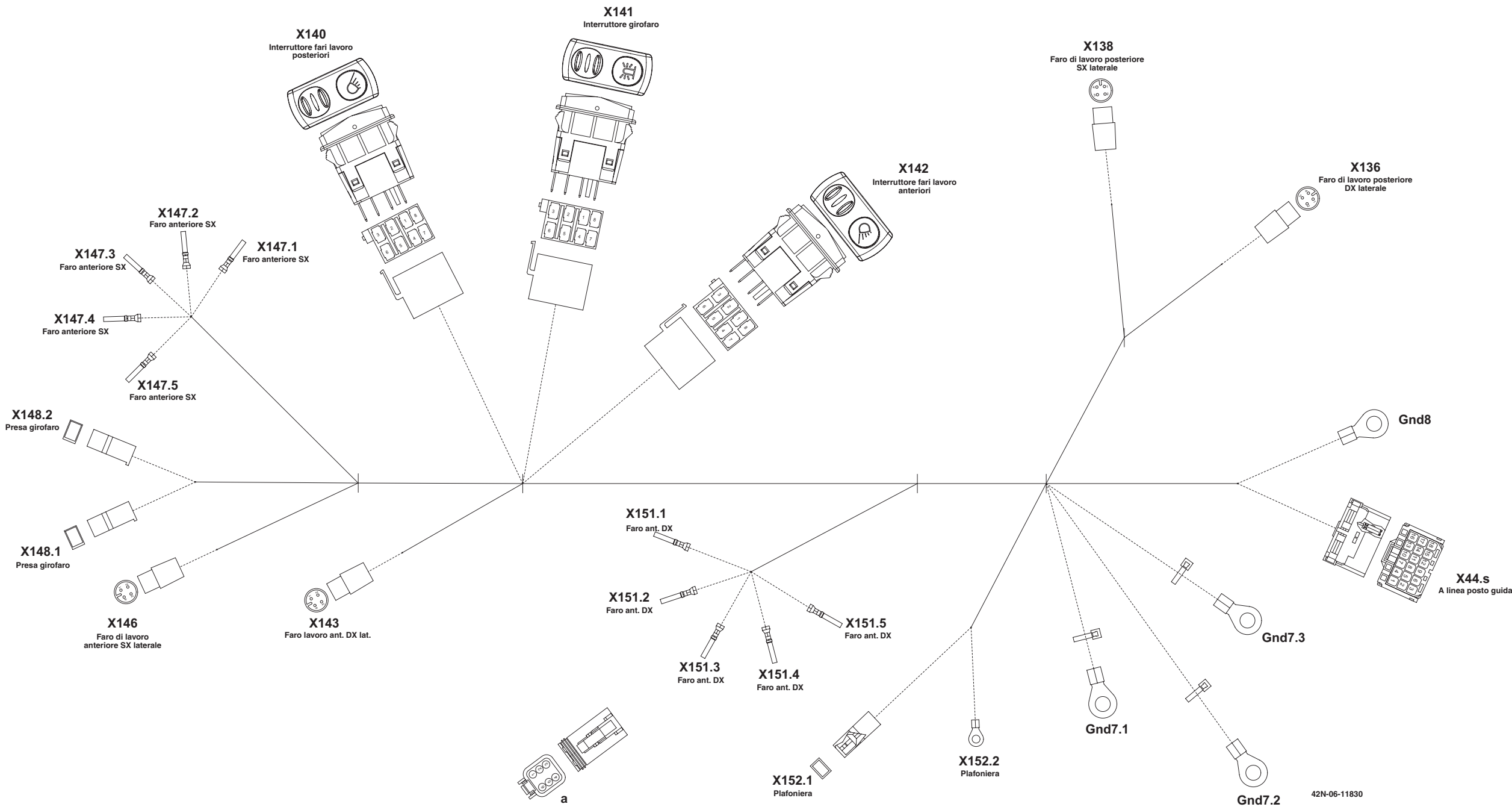


LATERAL DASH WIRING



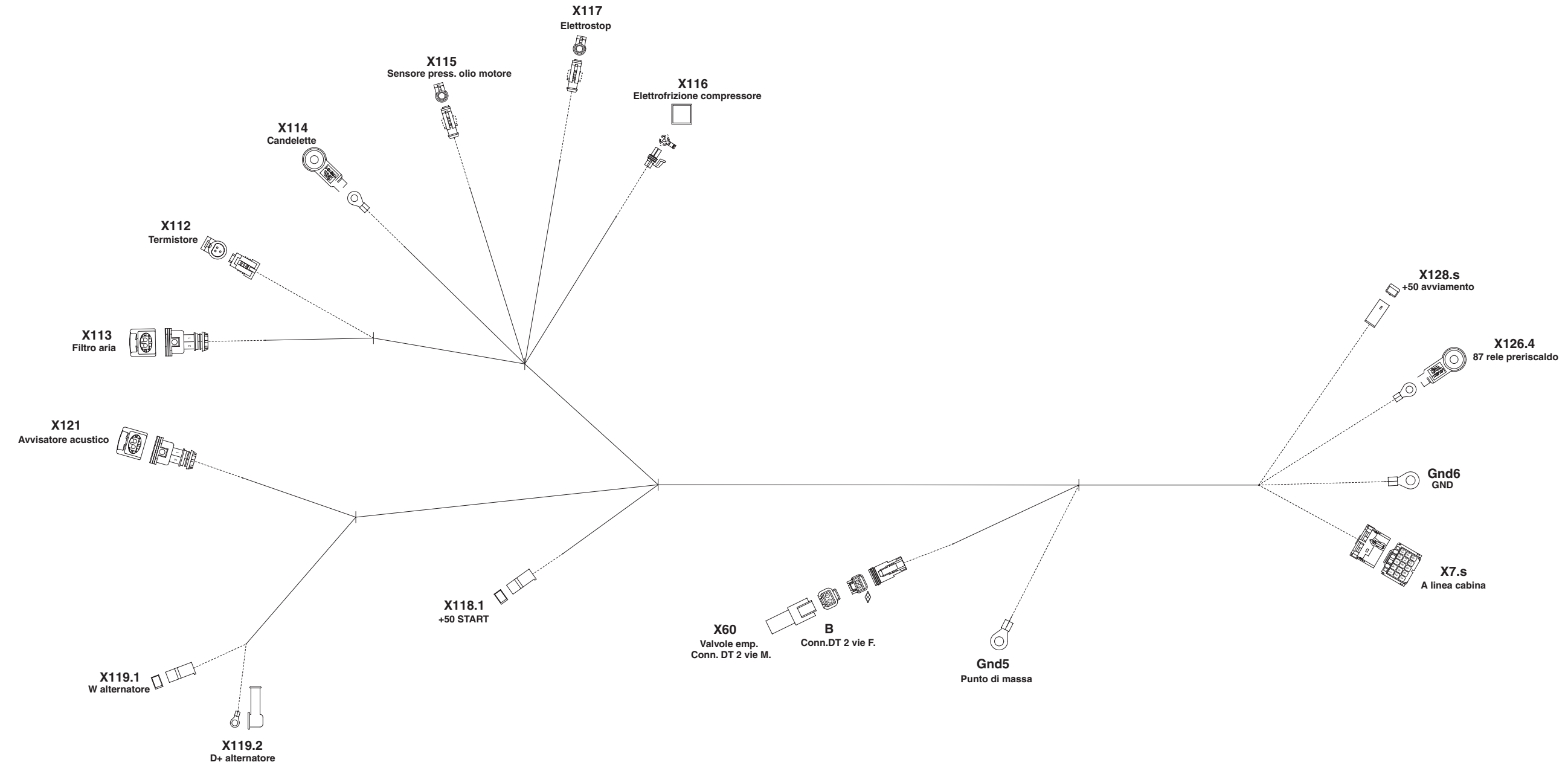
ROOF WIRING

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|



ENGINE WIRING

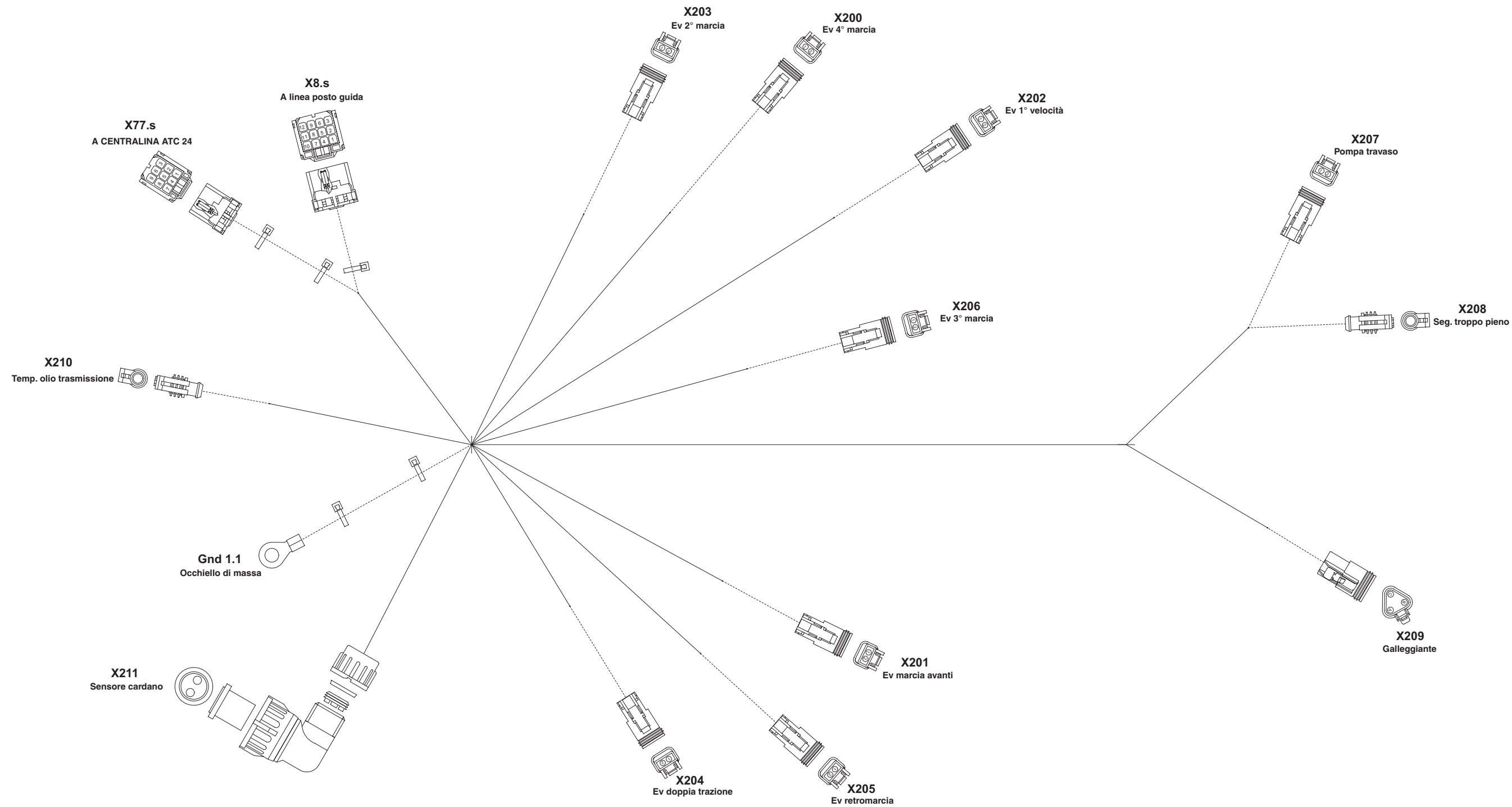
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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|



42N-06-11160

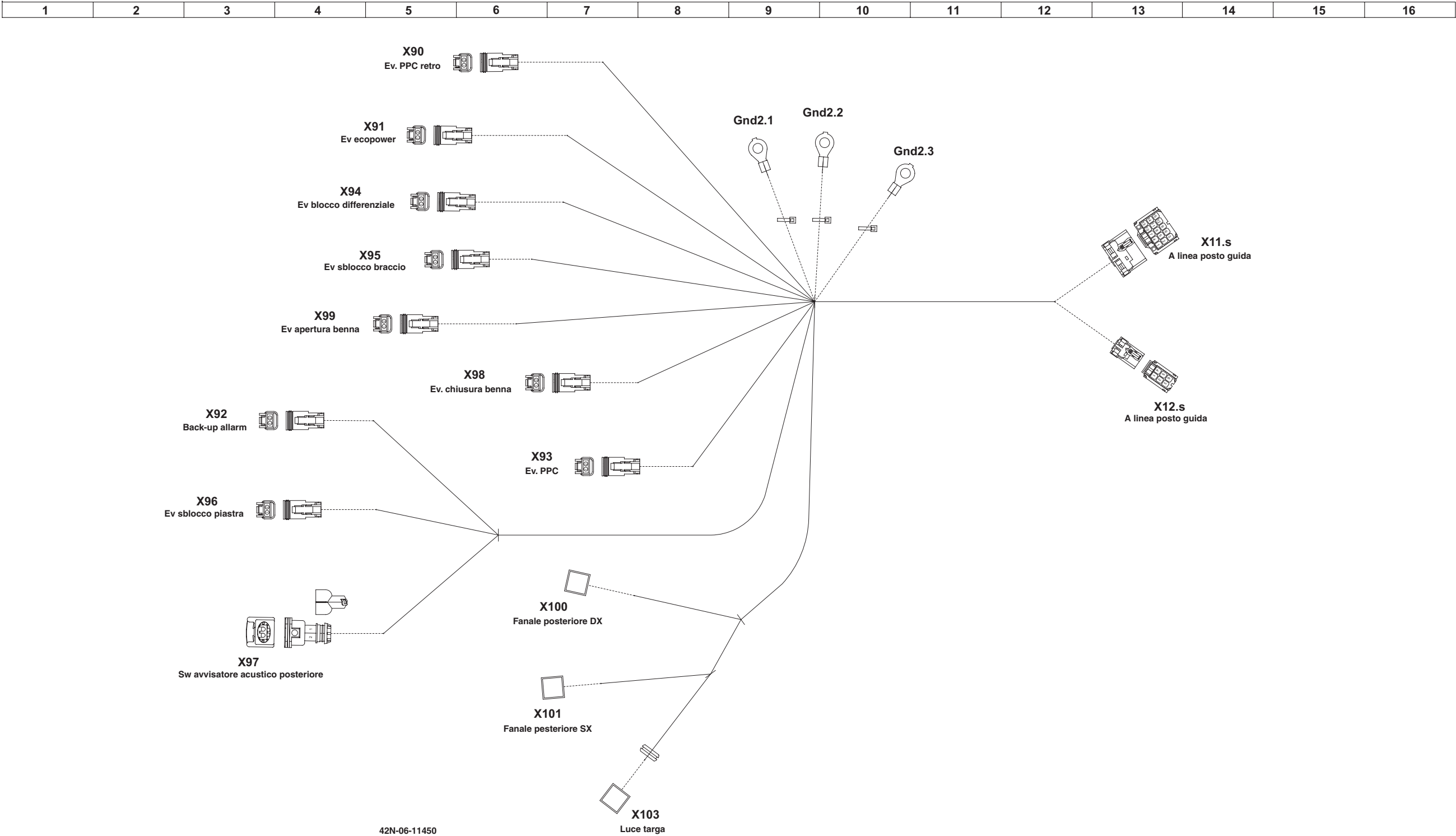
SPEED SELECTOR WIRING

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|



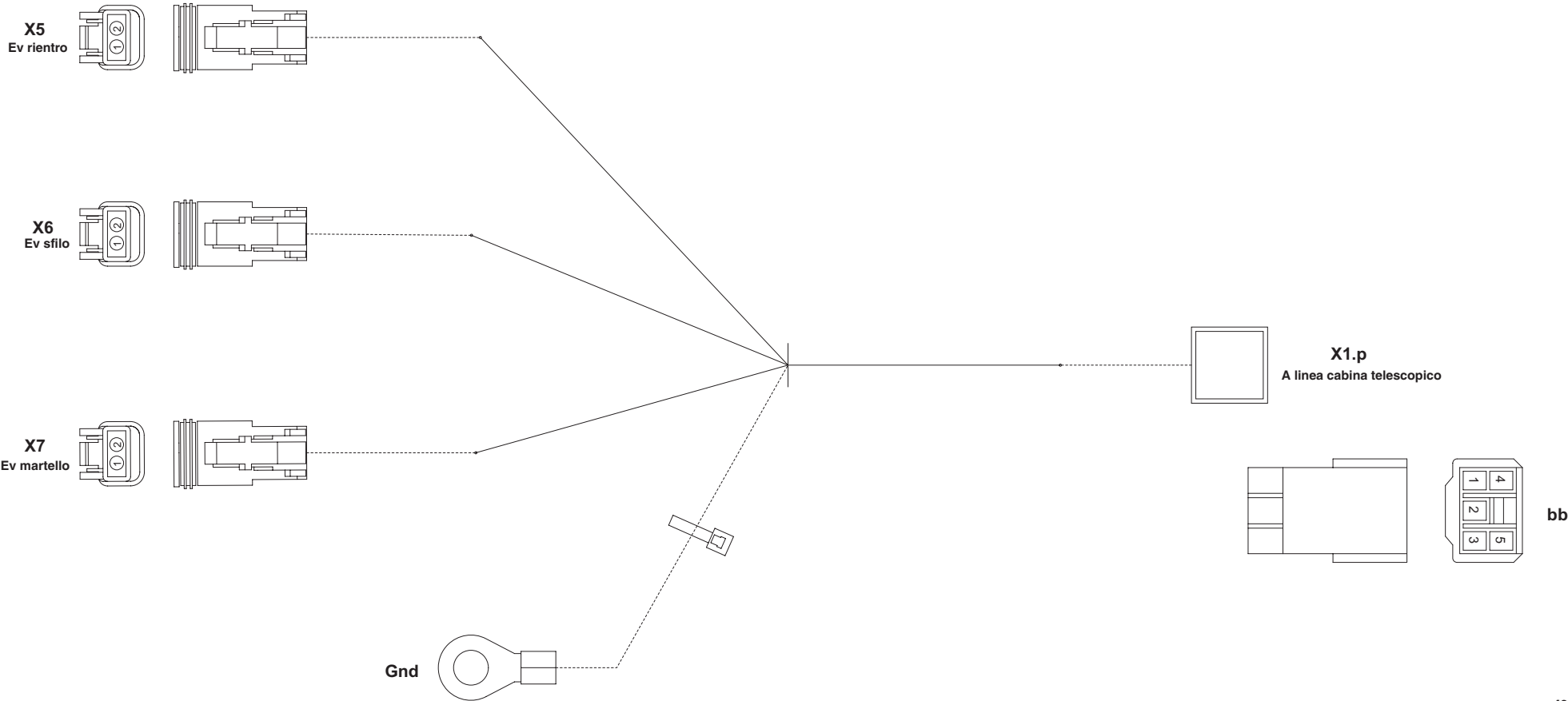
42N-06-11280

BACKHOE WIRING



JIG ARM WIRING

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|

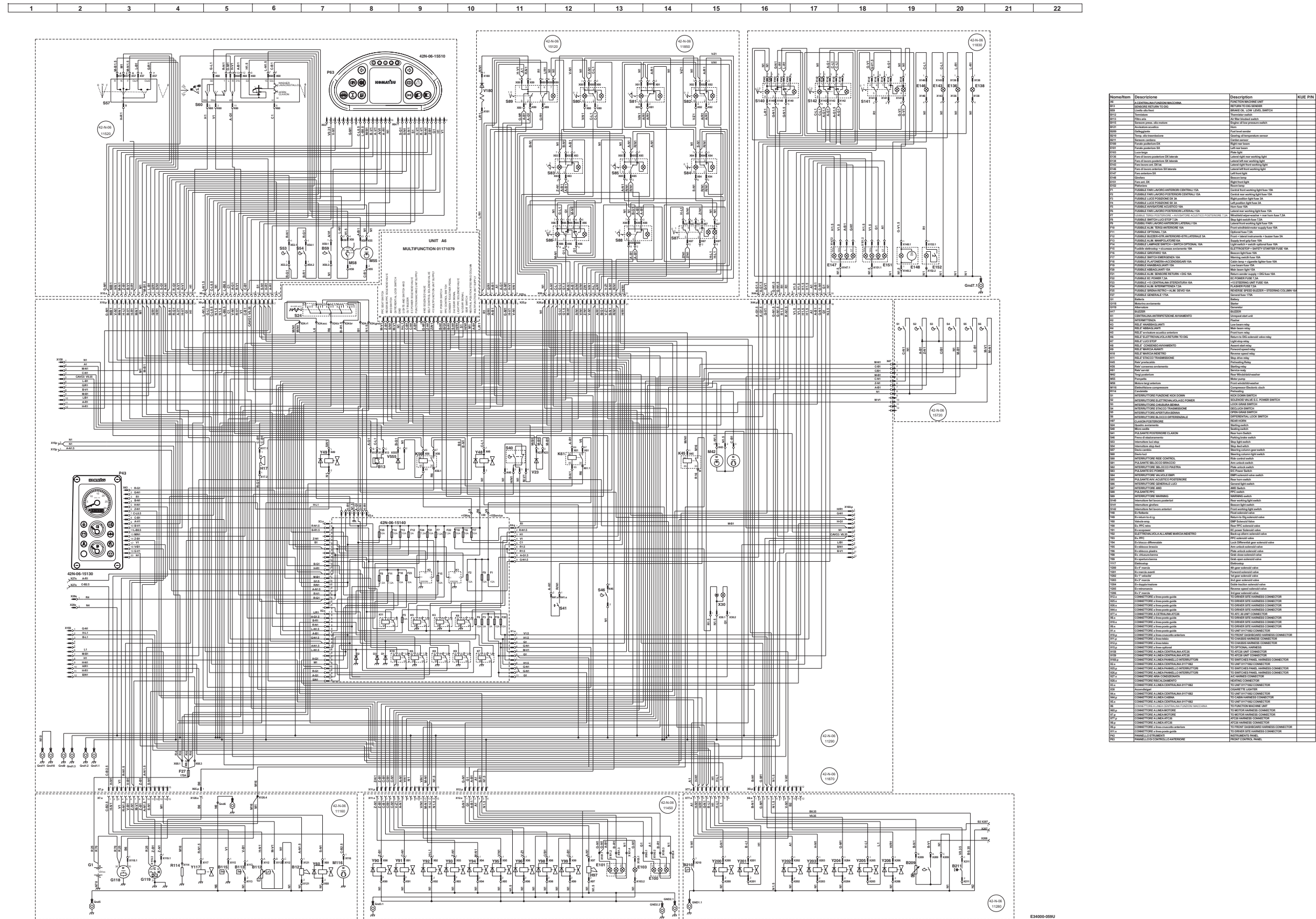




STRUCTURE AND FUNCTION

WIRING DIAGRAM (STANDARD VERSION) (see also Group 90)

WIRING DIAGRAM (STANDARD VERSION) (see also Group 90)



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# 20 TESTING AND ADJUSTMENTS

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## NORMAL OR STANDARD TECHNICAL DATA

| Machine model                          |                                            |                     | WB97R-5        |              |
|----------------------------------------|--------------------------------------------|---------------------|----------------|--------------|
| Check item                             | Test conditions                            | Unit:               | Standard value | Normal value |
| Engine speed<br>(without load):        | High idling                                | rpm                 | 2400±50        | 2350–2450    |
|                                        | Low idling                                 | rpm                 | 1050±50        | 1000–1100    |
|                                        | Calibration speed                          | rpm                 | –              | –            |
| Exhaust gas<br>colour                  | Sudden acceleration                        | Bosch               | –              | <3.0         |
|                                        | At high idling speed                       | index               | <1.5           | <3.0         |
| Valve clearance                        | Intake valve (20°C)                        | mm                  | 0.30±0.05      | 0.30±0.05    |
|                                        | Exhaust (20°C)                             | mm                  | 0.55±0.05      | 0.55±0.05    |
| Compression<br>pressure<br>(SAE30 oil) | Oil temperature: 69–72°C<br>(Engine speed) | bar                 | 34.3±1         | 27.5±1       |
|                                        |                                            | rpm                 | 250            | 250          |
| Engine oil<br>pressure<br>(SAE30 oil)  | With blow-by                               | mm H <sub>2</sub> O | 5–10           | 5–10         |
|                                        | Free exhaust                               |                     | 50.0           | 50.0         |
| Engine oil<br>pressure                 | At high idling speed                       | bar (kPa)           | 3.5 (350)      | –            |
|                                        | At Low idling                              | bar (kPa)           | 0.7 (70)       |              |
| Engine oil<br>temperature              | Entire speed range                         | °C                  | Max. 120       | Max. 120     |
| Fuel<br>injection timing               | B.T.D.C.                                   | mm                  | 1.00           | 1.00±0.05    |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

| Machine model               |                                                                                                       |                                                                                                                                                                                                                                                                               |                              |      | WB97R-5        |   |     |   |                  |   |   |   |
|-----------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------|----------------|---|-----|---|------------------|---|---|---|
| Classification              | Check item                                                                                            | Test conditions                                                                                                                                                                                                                                                               |                              | Unit | Standard value |   |     |   | Normal value     |   |   |   |
| Engine speed                | Accelerator pedal                                                                                     | <div>• Hydraulic oil temperature: 45–55 °C</div> <div>• Converter oil temperature: 80 °C</div> <div>• Engine oil temperature cooling circuit: in the limits</div> <div>• Measurement taken on drive shaft pulley with stroboscopic rev counter.</div>                         | Max.                         | rpm  | 2400±50        |   |     |   | 2350–2450        |   |   |   |
|                             |                                                                                                       |                                                                                                                                                                                                                                                                               | Min.                         |      | 1050±50        |   |     |   | 1000–1100        |   |   |   |
|                             | Accelerator fuel                                                                                      | <div>• Hydraulic oil temperature: 45–55 °C</div> <div>• Converter oil temperature: 80 °C</div> <div>• Engine oil temperature cooling circuit: in the limits</div> <div>• Measurement taken on drive shaft pulley with stroboscopic rev counter.</div>                         | Max.                         |      | 1900±50        |   |     |   | 1850–1950        |   |   |   |
|                             |                                                                                                       |                                                                                                                                                                                                                                                                               | Min.                         |      | 1050±50        |   |     |   | 1000–1100        |   |   |   |
| Control valve               |                                                                                                       |                                                                                                                                                                                                                                                                               |                              | mm   | ℓ              | a | b   | c | ℓ                | a | b | c |
|                             | Arm shovel, shovel, boom, boom swing, 4 in 1 bucket, arm, jig arm cylinder, outrigger, backhoe bucket | • See Fig. A                                                                                                                                                                                                                                                                  |                              |      | –              | 6 | 5.5 | 2 | –                | – | – | – |
| Travel of levers and pedals | Shovel arm control lever                                                                              | <div>• Engine stopped</div> <div>• Knob lever: at the center and at 90° from the lever</div> <div>• Value reading at the end of working stroke plus half measured backlash</div> <div>• Attachments on the ground</div> <div>• Instrument metre w/ millimetre divisions</div> | Neutral → Raise<br>Lower     | mm   | 95<br>95       |   |     |   | 80–110<br>80–110 |   |   |   |
|                             | Shovel control lever                                                                                  |                                                                                                                                                                                                                                                                               | Neutral → Dump<br>Curl       |      | 95<br>95       |   |     |   | 80–110<br>80–110 |   |   |   |
|                             | Boom backhoe control lever                                                                            |                                                                                                                                                                                                                                                                               | Neutral → Raise<br>Lower     |      | 50<br>50       |   |     |   | 40–60<br>40–60   |   |   |   |
|                             | Arm backhoe control lever                                                                             |                                                                                                                                                                                                                                                                               | Neutral → Opening<br>Closing |      | 50<br>50       |   |     |   | 40–60<br>40–60   |   |   |   |
|                             | Bucket backhoe control lever                                                                          |                                                                                                                                                                                                                                                                               | Neutral → Opening<br>Curl    |      | 50<br>50       |   |     |   | 40–60<br>40–60   |   |   |   |
|                             | Boom swing backhoe control lever                                                                      |                                                                                                                                                                                                                                                                               | Neutral → Right<br>Left      |      | 50<br>50       |   |     |   | 40–60<br>40–60   |   |   |   |
|                             | Outriggers control lever                                                                              |                                                                                                                                                                                                                                                                               | Neutral → Up<br>Down         |      | 35<br>35       |   |     |   | 25–45<br>25–45   |   |   |   |
|                             | Fuel control lever                                                                                    |                                                                                                                                                                                                                                                                               | Min. → Max.                  |      | 40             |   |     |   | 30–50            |   |   |   |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

| Machine model                                       |                          |                                                                                                                                                                                                                                                                                                                                           |      | WB97R-5        |                    |
|-----------------------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|--------------------|
| Classification                                      | Check item               | Test conditions                                                                                                                                                                                                                                                                                                                           | Unit | Standard value | Normal value       |
| Travel of levers and pedals                         | Accelerator pedal        | <ul style="list-style-type: none"> <li>Engine stopped</li> <li>Knob lever: at the center and at 90° from the lever</li> <li>Value reading at the end of working stroke</li> </ul> Min. → Max.                                                                                                                                             | mm   | 80             | 65–95              |
|                                                     | Wheel swing              | <ul style="list-style-type: none"> <li>Attachments on the ground</li> <li>Instrument:</li> </ul> Right→Left<br>Left→Right                                                                                                                                                                                                                 | rev. | 3.5<br>3.5     | 3.1–3.9<br>3.1–3.9 |
| Force for lever, pedal and steering wheel operation | Shovel arm control lever | <ul style="list-style-type: none"> <li>Engine speed: min.</li> <li>Oil temperature: 45–55 °C</li> <li>Tool connection at centre of knob and 80 mm away from handle base (see Fig. B)</li> <li>Value reading at the 10 mm before end of working stroke.</li> <li>Instrument force gauge.</li> <li>Ambient temperature: 15-35 °C</li> </ul> | kg   | 1.5            | 1.0–2.0            |
|                                                     | Shovel control lever     |                                                                                                                                                                                                                                                                                                                                           |      | 1.5            | 1.0–2.0            |
|                                                     | Control lever Boom       |                                                                                                                                                                                                                                                                                                                                           |      | 1.8            | 1.3–2.3            |
|                                                     | Arm control lever        |                                                                                                                                                                                                                                                                                                                                           |      | 1.8            | 1.3–2.3            |
|                                                     | Bucket control lever     |                                                                                                                                                                                                                                                                                                                                           |      | 1.3            | 0.8–1.8            |
|                                                     | Boom swing control lever |                                                                                                                                                                                                                                                                                                                                           |      | 1.3            | 0.8–1.8            |
|                                                     | Outriggers control lever |                                                                                                                                                                                                                                                                                                                                           |      | 1.5            | 1.0–2.0            |
|                                                     | Fuel control lever       |                                                                                                                                                                                                                                                                                                                                           |      | 6.0            | 5.0–7.0            |
|                                                     | Accelerator pedal        |                                                                                                                                                                                                                                                                                                                                           |      | 4.0            | 2.5–5.5            |
|                                                     | Steering wheel           | <ul style="list-style-type: none"> <li>Force measured on steering wheel knob at min. RPM for approx. half a revolution under steady motion at a speed of 2.5" per rev.</li> </ul>                                                                                                                                                         |      | –              | –                  |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

| Machine model                          |                              |                                                                                                                                                                                                                                                                                                                 |      | WB97R-5        |              |
|----------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|--------------|
| Classification                         | Check item                   | Test conditions                                                                                                                                                                                                                                                                                                 | Unit | Standard value | Normal value |
| Main valve pressure                    | Control valve                | <ul style="list-style-type: none"> <li>• Engine speed: 2200 rpm</li> <li>• Oil temperature: 45-55 °C</li> <li>• Move arm cylinder to end of stroke and measure the pressure</li> <li>• Instrument: 0-600 bar pressure gauge mounted on adapters at port "P1C".</li> <li>• Working mode switch: POWER</li> </ul> | bar  | 245            | 235–260      |
|                                        | Steering unit                | • Engine speed: 1500±50 rpm                                                                                                                                                                                                                                                                                     |      | 175            | 170–185      |
| Pressures of secondary valves circuits | Shovel (curled)              | <ul style="list-style-type: none"> <li>• Engine speed: min.</li> <li>• Oil temperature: 45-55 °C</li> <li>• Check one circuit at the time</li> <li>• Instrument: 0-600 bar pressure gauge mounted on adapters at port "P1C".</li> <li>• Working mode switch: POWER</li> </ul>                                   | bar  | 270            | 260–280      |
|                                        | Shovel (Dump)                |                                                                                                                                                                                                                                                                                                                 |      | 240            | 230–255      |
|                                        | 4 in 1 bucket (opens-closes) |                                                                                                                                                                                                                                                                                                                 |      | 270            | 260–280      |
|                                        | Boom (raising)               |                                                                                                                                                                                                                                                                                                                 |      | 345            | 320–360      |
|                                        | Boom (lowering)              |                                                                                                                                                                                                                                                                                                                 |      | 270            | 260–280      |
|                                        | Arm (Closing)                |                                                                                                                                                                                                                                                                                                                 |      | 270            | 260–280      |
|                                        | Arm (Out)                    |                                                                                                                                                                                                                                                                                                                 |      | 270            | 260–280      |
|                                        | Boom swing                   |                                                                                                                                                                                                                                                                                                                 |      | 230            | 220–245      |
|                                        | Bucket (curled)              |                                                                                                                                                                                                                                                                                                                 |      | 270            | 260–280      |
|                                        | Bucket (Dump)                |                                                                                                                                                                                                                                                                                                                 |      | –              | –            |
|                                        | Jig arm (out - in)           |                                                                                                                                                                                                                                                                                                                 |      | –              | –            |
|                                        | Hammer (delivery)            |                                                                                                                                                                                                                                                                                                                 |      | 190            | 180–210      |
|                                        | Steering unit (safety)       |                                                                                                                                                                                                                                                                                                                 |      | 225            | 225–245      |

TESTING AND ADJUSTMENTS

NORMAL OR STANDARD TECHNICAL DATA

| Machine model                           |                                      |                                                                                                                                                                                                                                                                                                                                         |      | WB97R-5           |                 |
|-----------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------------|
| Classifi<br>cation                      | Check item                           | Test conditions                                                                                                                                                                                                                                                                                                                         | Unit | Standard<br>value | Normal<br>value |
| Engine speed (with load) -<br>Converter | With converter                       | <ul style="list-style-type: none"> <li>• Engine speed (without load): 2400±50</li> <li>• Hydraulic oil temperature: 45-55 °C</li> <li>• Machine in 3rd gear</li> <li>• Working brakes: engaged.</li> <li>• Working mode switch: POWER</li> </ul>                                                                                        | rpm  | 2175±50           | 2125–2225       |
|                                         | With converter and hydraulic circuit | <ul style="list-style-type: none"> <li>• Engine speed (without load): 2400±50</li> <li>• Hydraulic oil temperature: 45-55 °C</li> <li>• Machine in 3rd gear</li> <li>• Working brakes: engaged.</li> <li>• Shovel raise bottom of stroke</li> <li>• Steering held at the end of stroke</li> <li>• Working mode switch: POWER</li> </ul> |      | 2075±50           | 2025–2125       |
|                                         | Hydraulic circuit at Low idling      | <ul style="list-style-type: none"> <li>• Engine speed: 1050±50</li> <li>• Hydraulic oil temperature: 45-55 °C</li> <li>• Vehicle in neutral</li> <li>• Parking brake: applied</li> <li>• Bucket dump bottom of stroke</li> <li>• Working mode switch: POWER</li> </ul>                                                                  |      | 600               | Min. 600        |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

- ★ The technical data of follow table are referred to a machine with max. 500 kg shovel, 600 mm (max. 160 kg) backhoe bucket and standard arm (or jig arm) closed.

| Machine model                     |            |                                                     |      | WB97R-5        |              |
|-----------------------------------|------------|-----------------------------------------------------|------|----------------|--------------|
| Classification                    | Check item | Test conditions                                     | Unit | Standard value | Normal value |
| Hydraulic drift working equipment | Shovel     | Complete working equipment (Shovel teeth tip lower) | mm   | 150            | 300          |
|                                   |            | Raise cylinder (Cylinder in)                        |      | 12             | 20           |
|                                   |            | Shovel cylinder (Cylinder out)                      |      | 35             | 50           |
|                                   | Backhoe    | Complete working equipment (Bucket teeth tip lower) | mm   | 200            | 350          |
|                                   |            | Boom cylinders (Cylinder out)                       |      | 10             | 20           |
|                                   |            | Arm cylinders (Cylinder out)                        |      | 10             | 20           |
|                                   |            | Bucket cylinder (Cylinder in)                       |      | 8              | 15           |



## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

- ★ The technical data of follow table are referred to a machine with max. 500 kg shovel, 600 mm (max. 160 kg) backhoe bucket and standard arm (or jig arm) closed.

| Machine model                     |            |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | WB97R-5 |                        |              |
|-----------------------------------|------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------------------|--------------|
| Classification                    | Check item |                   | Test conditions                                                                                                                                                                                                                                                                                                                                                                                                                                          | Unit    | Standard value         | Normal value |
| Hydraulic drift working equipment | Backhoe    | Boom swing        | Measuring posture: see Fig. E<br>• Oil temperature: 45-55 °C<br>• Backhoe balanced on the guides bucket in transport condition.<br>• Fully retract arm and bucket cylinder Lift the bucket fulcrum pin 1 m off the ground and swing boom to bottom of stroke in either direction.<br>• Move the machine on a slope of 15° and apply the parking brake.<br>• Stop the engine and, after 1 minute, check the inner cylinder feed back opposite to the boom | mm      | 15                     | 25           |
|                                   |            | Outriggers        | Measuring posture: see Fig. F<br>• Oil temperature: 45-55 °C<br>• Backhoe balanced.<br>• Boom and arm cylinders in, bucket cylinder out<br>• Outriggers at maximum extension.<br>• Engine stopped<br>• Check the frame lowering for each side every 5 min. for a total of 15 minutes.                                                                                                                                                                    |         | 7                      | 15           |
| Cylinder leaking                  | Shovel     | Boom              | • Engine: Max. speed<br>• Oil temperature: 45-55 °C<br>• Leaking check: on the cylinder opposite side to the pressure one.<br>• Check 1 cylinder at a time.<br>• For arm shovel, shovel and for swing, check the two cylinders separately.                                                                                                                                                                                                               | cm³/min | 2.0<br>(each cylinder) | Max. 8.0     |
|                                   |            | Shovel            |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 1.6<br>(each cylinder) | Max. 6.0     |
|                                   | Backhoe    | Boom              |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 3.3                    | Max. 13.5    |
|                                   |            | Arm               |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 3.0                    | Max. 12.0    |
|                                   |            | Bucket            |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 2.4                    | Max. 9.5     |
|                                   |            | Boom swing        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 3.2                    | Max. 13.0    |
|                                   |            | Outriggers        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 3.3                    | Max. 13.5    |
|                                   |            | Side digging boom |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 2.0                    | Max. 8.0     |
|                                   |            | Jig arm           |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         | 1.6                    | Max. 6.0     |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

- ★ The technical data of follow table are referred to a machine with max. 500 kg shovel, 600 mm (max. 160 kg) backhoe bucket and standard arm (or jig arm) closed.

| Machine model        |            |                              |           | WB97R-5        |              |
|----------------------|------------|------------------------------|-----------|----------------|--------------|
| Classification       | Check item | Test conditions              | Unit      | Standard value | Normal value |
| Work equipment speed | Shovel     | Arm shovel                   | Lifting   | 3.6            | 3.1–4.1      |
|                      |            | Cylinders fully out          | Lowering  | 2.6            | 2.2–3.0      |
|                      |            | Shovel at the ground         |           |                |              |
|                      |            | shovel                       | Curl      | 2.3            | 2.0–2.6      |
|                      |            | Cylinders fully out          | Dump      | 2.8            | 2.4–3.2      |
|                      |            | Cylinders fully in           |           |                |              |
|                      | Backhoe    | Boom                         | Lifting ● | 2.7            | 2.3–3.1      |
|                      |            | Cylinders fully in           | Lowering  | 2.0            | 1.7–2.3      |
|                      |            | Teeth bucket on level ground |           |                |              |
|                      |            | Arm                          | Opening   | 3.8            | 3.2–4.3      |
|                      |            | Cylinders fully in           | Closing ● | 4.4            | 3.7–5.1      |
|                      |            | Cylinders fully out          |           |                |              |
|                      |            | Bucket                       | Dump      | 2.4            | 2.0–2.8      |
|                      |            | Cylinders fully in           | Curl      | 3.1            | 2.6–3.6      |
|                      |            | Cylinders fully out          |           |                |              |

## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

- ★ The technical data of follow table are referred to a machine with max. 500 kg shovel, 600 mm (max. 160 kg) backhoe bucket and standard arm (or jig arm) closed.

| Machine model        |            |                                          |                                                                                                                                  |         | WB97R-5 |                |              |
|----------------------|------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------|---------|----------------|--------------|
| Classification       | Check item |                                          | Test conditions                                                                                                                  |         | Unit    | Standard value | Normal value |
| Work equipment speed | Backhoe    | Boom swing                               | Measuring posture: see Fig. M<br>• Engine speed: 1700±50 rpm<br>• Oil temperature: 45-55 °C<br>• Arm vertical<br>• Power mode ON | Right ● | sec.    | 3.2            | 2.7—3.7      |
|                      |            | Right end travel<br>↕<br>Left end travel |                                                                                                                                  | Left ●  |         | 3.2            | 2.7—3.7      |

- Times are referred to the cylinder stroke whitout the brake phase.

**NOTE.** The engine speed (1700 $\pm$ 50 rpm) has to be checked with the procedure described at paragraph «MEASURING ENGINE SPEED» in this section.

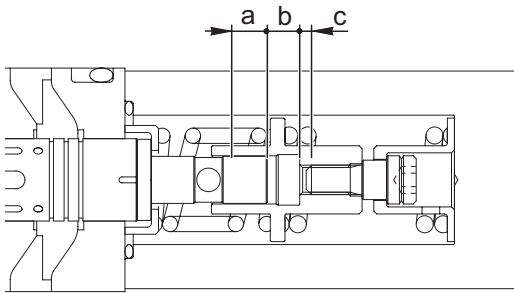
## TESTING AND ADJUSTMENTS

## NORMAL OR STANDARD TECHNICAL DATA

- ★ The technical data of follow table are referred to a machine with max. 500 kg shovel, 600 mm (max. 160 kg) backhoe bucket and standard arm (or jig arm) closed.

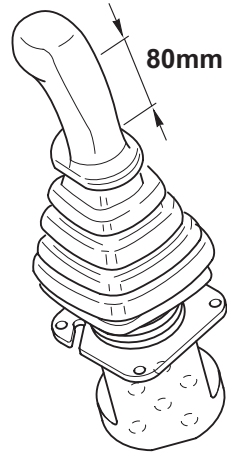
| Machine model  |            |                                                                                                                                                                                                                                                                                                                                 |      | WB97R-5        |              |
|----------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|--------------|
| Classification | Check item | Test conditions                                                                                                                                                                                                                                                                                                                 | Unit | Standard value | Normal value |
| Work equipment | Time lags  | Arm shovel<br>Measuring posture: see Fig. N<br>• Engine speed: Min.<br>• Oil temperature: 45-55 °C<br>• Check the time necessary to lift shovel from level ground.                                                                                                                                                              | sec. | 0              | Max. 2       |
|                |            | Boom<br>Measuring posture: see Fig. P<br>• Engine speed: Min.<br>• Oil temperature: 45-55 °C<br>• With attachments fully extended, lower the boom and check the necessary time from the beginning of machine lifting until bucket is on level ground.                                                                           |      | 0              | Max. 2       |
|                |            | Arm<br>Measuring posture: see Fig. Q<br>• Engine speed: Min.<br>• Oil temperature: 45-55 °C<br>• Put boom at 45°, open completely the arm with curled bucket. Extend arm cylinder and check the time passing between arm stop at dead centre and the restart movement.                                                          |      | 0              | Max. 2       |
|                |            | Bucket<br>Measuring posture: see Fig. R<br>• Engine speed: Min.<br>• Oil temperature: 45-55 °C<br>• Put arm in horizontal position. Tilt back bucket cylinder and then extend it. Check the time passing between bucket stop at dead centre and the restart movement.                                                           |      | 0              | Max. 2       |
|                |            | Outriggers<br>Measuring posture: see Fig. S<br>• Engine speed: Min.<br>• Oil temperature: 45-55 °C<br>• Boom, arm and bucket fully retracted and putted in machine centre position.<br>• Check the time necessary for outriggers to raise the machine from when they lean on level ground.<br>• Check each outrigger at a time. |      | 0              | Max. 2       |

**Fig. A**



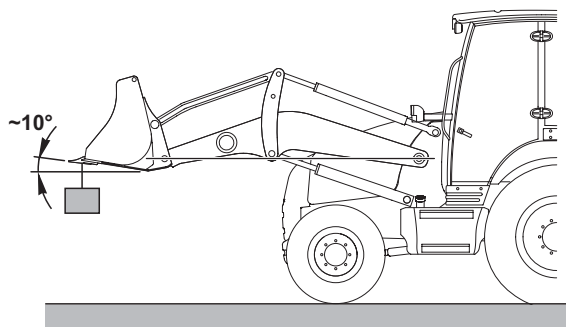
RKZ10840

**Fig. B**



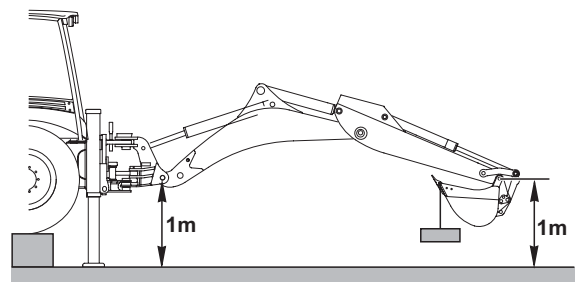
RKZ10860

**Fig. C**



RKZ10680

**Fig. D**

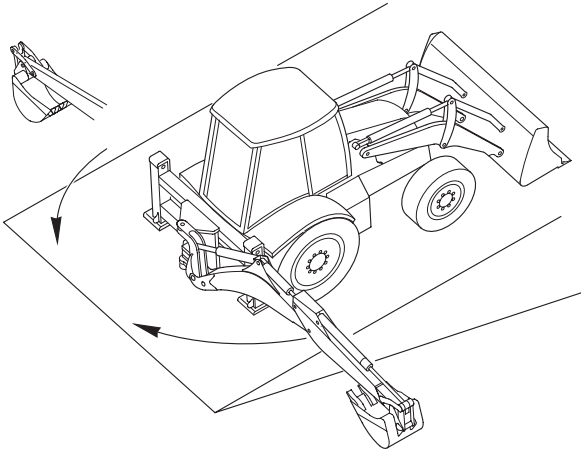


RKZ10690

TESTING AND ADJUSTMENTS

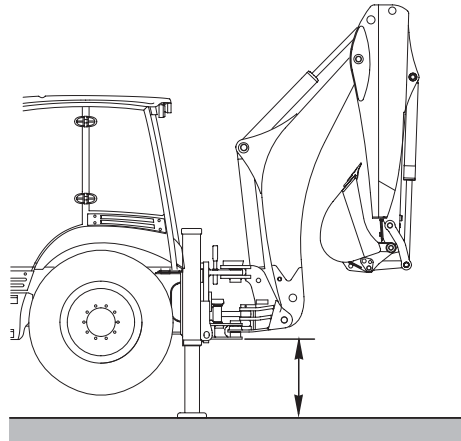
NORMAL OR STANDARD TECHNICAL DATA

**Fig. E**



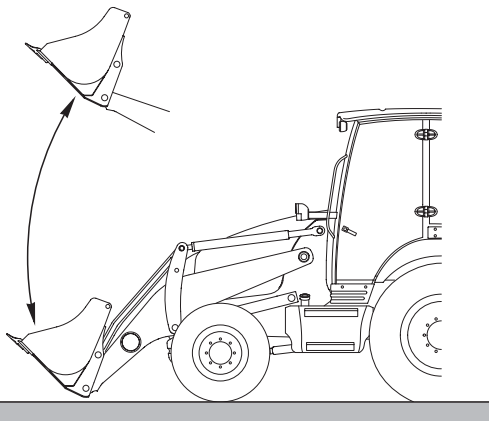
RKZ10700

**Fig. F**



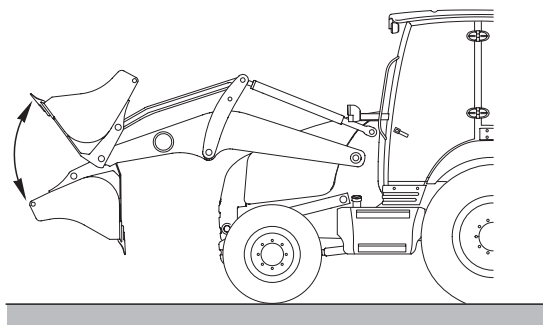
RKZ10830

**Fig. G**



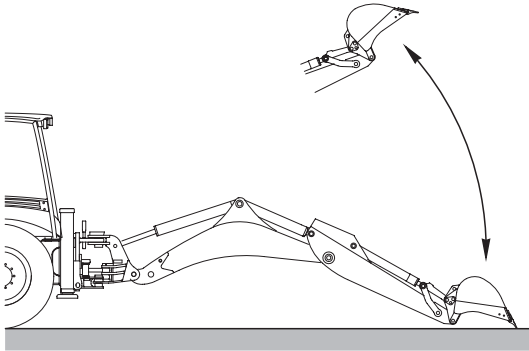
RKZ10720

**Fig. H**



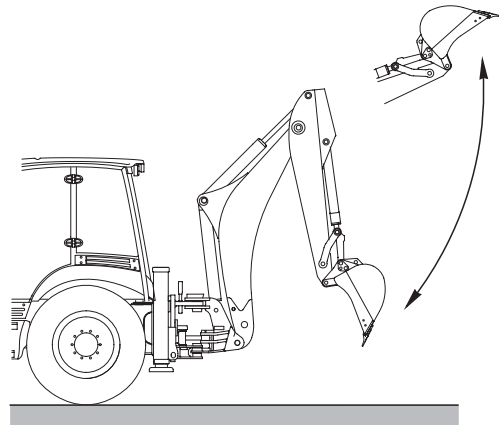
RKZ10730

**Fig. J**



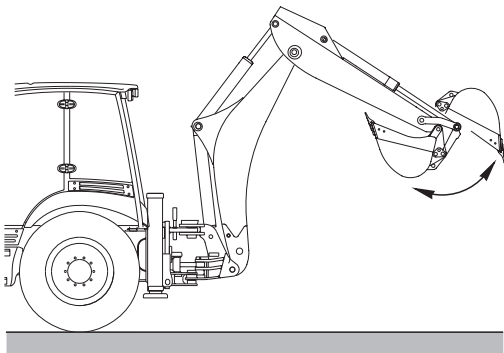
RKZ10740

**Fig. K**



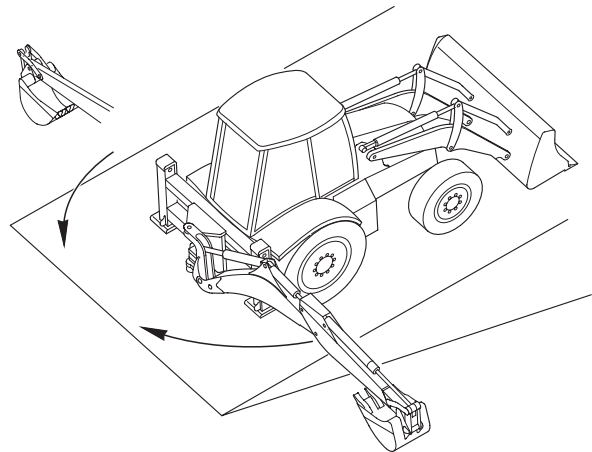
RKZ10750

**Fig. L**



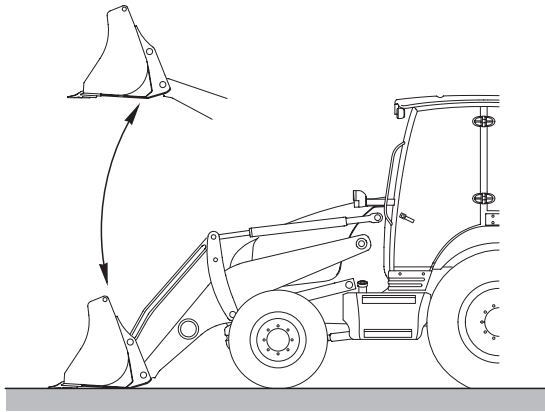
RKZ10780

**Fig. M**



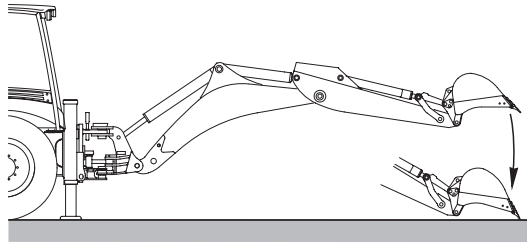
RKZ10760

**Fig. N**



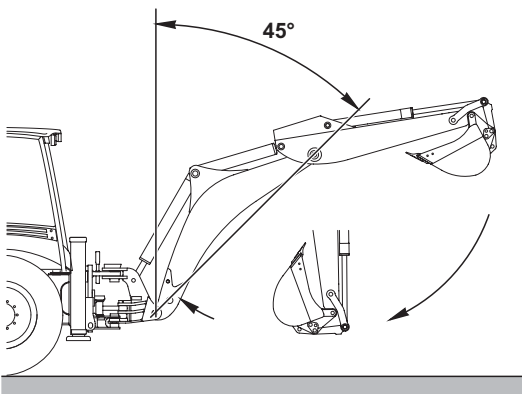
RKZ10790

**Fig. P**



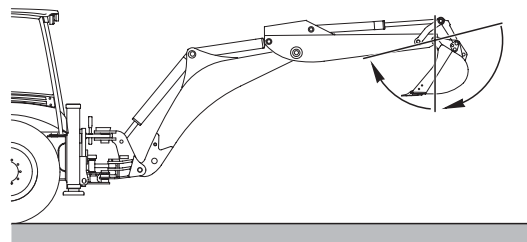
RKZ10800

**Fig. Q**



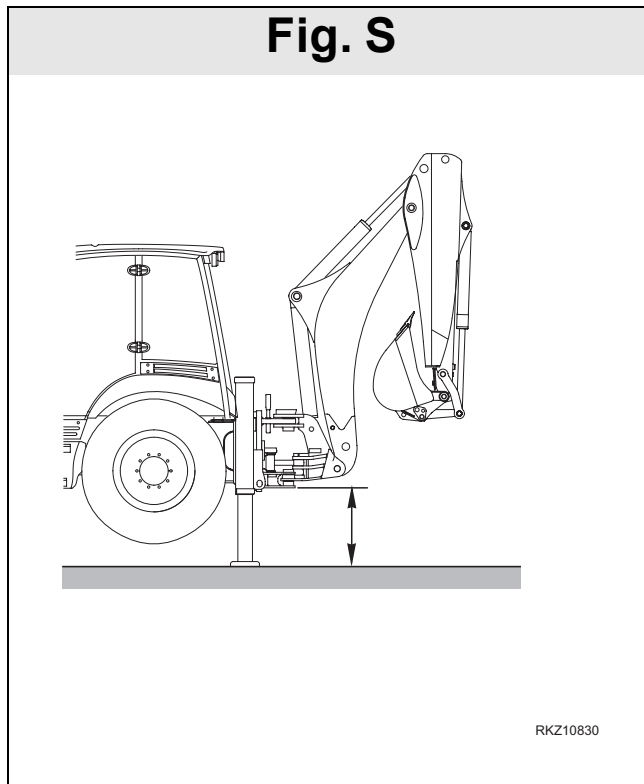
RKZ10810

**Fig. R**



RKZ10820



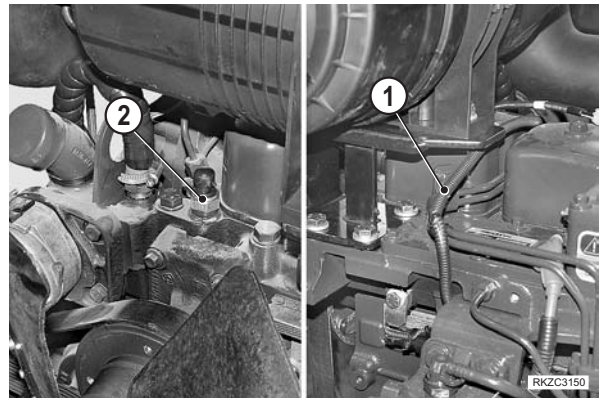


## SPECIAL TOOLS

| Measurement check point | Symbol |   | Code                   | Name                                                    | Q.ty | Note                      |
|-------------------------|--------|---|------------------------|---------------------------------------------------------|------|---------------------------|
| Engine speed            | C      | 1 |                        | Stroboscopic tachometer                                 | 1    | 6 - 30000 rpm             |
| Hydraulic pressure      | E      | 1 | Commercially available | Pressure gauge                                          | 2    | Full scale 60 bar         |
|                         |        | 2 | Commercially available | Pressure gauge                                          | 1    | Full scale 250 bar        |
|                         |        | 3 | Commercially available | Pressure gauge                                          | 1    | Full scale 400 bar        |
|                         |        | 4 | Commercially available | Pressure gauge                                          | 1    | Full scale 600 bar        |
|                         |        | 5 | ATR800200              | Servocontrol kit<br>Differential digital pressure gauge | 1    | 0-1000 bar                |
|                         |        | 6 |                        |                                                         |      |                           |
|                         | F      | 1 |                        | Flow-meter                                              | 1    | Delivery 0–300 ℓ/min.     |
|                         |        | 2 |                        | Pipe fitting kit                                        | 1    | –                         |
| Air-conditioning unit   | M      | 1 | Commercially available | Maintenance station                                     | 1    | For coolant R134a         |
|                         |        | 2 | Commercially available | Thermometer-hygrometer                                  | 1    | Sampling every 15 seconds |
|                         |        | 3 | Commercially available | Leak detector                                           | 1    | For coolant R134a         |

## ADJUSTING VALVE CLEARANCE

- 1 -Park the machine on solid, level ground, apply the parking brake, and remove the ignition key.
- 2 -Remove the intake filter and muffler.  
(For details see "30 REMOVAL AND INSTALLATION").
- 3 -Release from straps and disconnect the wiring harness (1) of the coolant liquid temperature sensor (2).
- 4 -Adjust valve clearance according to the instructions provided in the engine shop manual (code WHBMNEF000).



## ENGINE SPEED TESTS

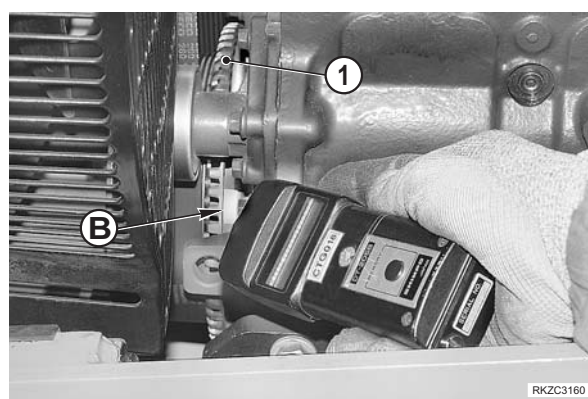
**!** When checking engine speeds, be careful not to touch high temperature parts and not to get caught in rotating parts.

1 -Start the engine and heat the hydraulic oil by performing all normal working motions, including travel.

- ★ Check hydraulic oil temperature with a probe plunged in the reservoir or with a probe applied to the reservoir wall.  
Temperature should be at  $50\pm 5^{\circ}\text{C}$ .

2 -Place the machine on solid level ground with the transmission in NEUTRAL.

3 -Stop the engine and apply a reading notch "B" to the engine pulley (1) for the stroboscopic rev counter.



### • CHECKING ENGINE WITHOUT LOAD

1 -Start engine and check:

Low idling speed without load (accelerator pedal released).

- Minimum speed:  $1050\pm 50$  rpm

High idling speed without load (accelerator pedal at the travel end).

- Maximum speed:  $2400\pm 50$  rpm

- ★ If low and high idling speed with engine without load are not within permissible value, before going on with other operations, check accelerator pedal stoppers and wiring sheathings.  
(See "ADJUSTING ACCELERATOR PEDAL TRAVEL AND ACCELERATOR LEVER").

- **CHECKING ENGINE WITH LOAD**

1. **With the machine in Power mode at MIN.**

- 1 -With the transmission in neutral, idle the engine.
- 2 -Dump shovel and force the movement; let the engine stabilize and then read the engine speed.
  - ★ Normal speed: 600 rpm  
Minimum speed: 600 rpm

2. **With converter stalled**

- 1 -Increase speed to high idling and brake with the working brakes.
- 2 -Hold the brakes while simultaneously engaging 3rd gear; let the engine stabilize, and read the rpm value.
  - ★ Minimum speed: 2125 rpm  
Maximum speed: 2225 rpm



Hold the machine stalled as long as necessary, in any case for not more than 30 sec., and carry out the tests at least 15 sec one from the other.

3. **With converter stalled and hydraulic pump under load**

- 1 -Increase speed to high idling and brake with the working brakes.
- 2 -While holding the brakes:
  - a - engage 3rd FORWARD;
  - b - raise shovel the full travel span and hold in this position;
  - c - steer the wheels fully;
- 3 -In the above conditions, let the engine stabilize, then read the engine rpm.
  - ★ Minimum speed: 2025 rpm  
Maximum speed: 2125 rpm



Hold the machine stalled as little as necessary, in any case for not more than 30 sec., and carry out the tests at least 15 sec one from the other.

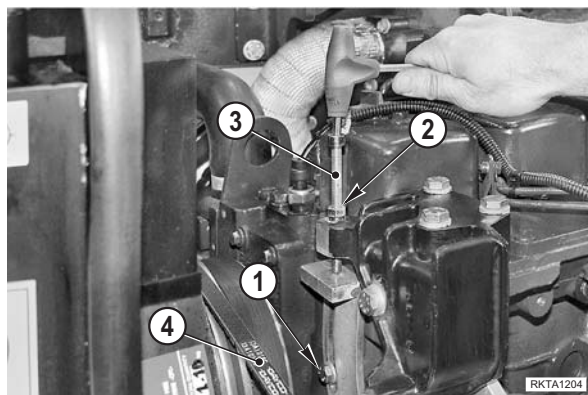
- **ANALYSIS**

- 1 -If readings are not within the required interval, check the engine according to the instructions provided in manual code WHBMNEF000.
- 2 -If the engine has no conditions, adjust the pump's power absorption (PC valve).

## TENSIONING THE AIR-CONDITIONING COMPRESSOR BELT

1 -Loosen the screw (1) and the nut (2).

2 -Turn the screw (3) clockwise to tension the belt (4).



3 -Apply a 10 kg force halfway between compressor pulley (5) and engine pulley (6).

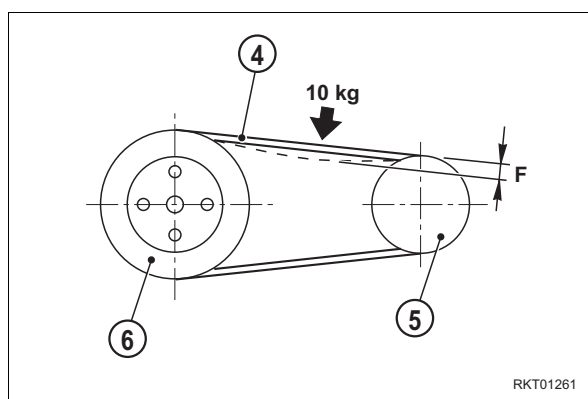
4 -Check the resulting arrow "F".

★ F = 4-6 mm normal tensioning

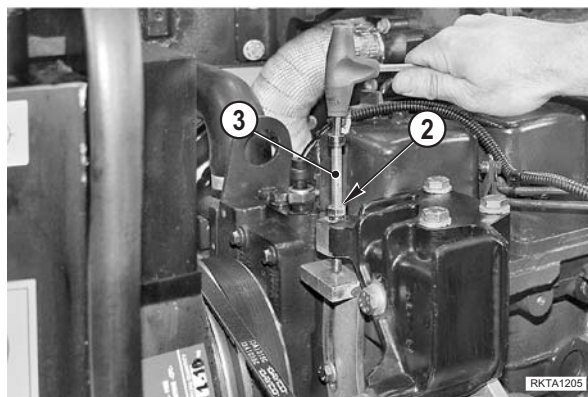
F = 3 mm new belt



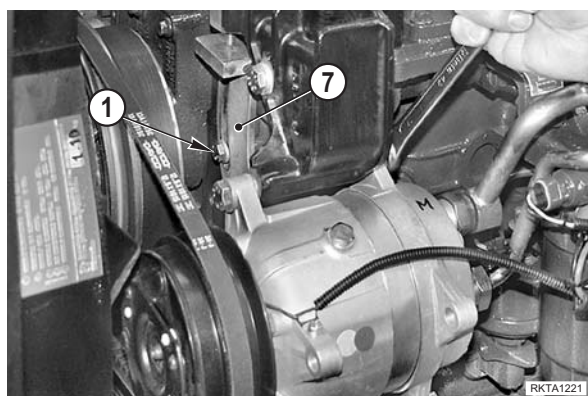
Check belt tension again after 15 minutes of operation.



5 -Once proper tension is reached, retain the position of the adjustment bolt (3) with the nut (2).



6 -Retain the adjustment bracket (7) with the screw (1).



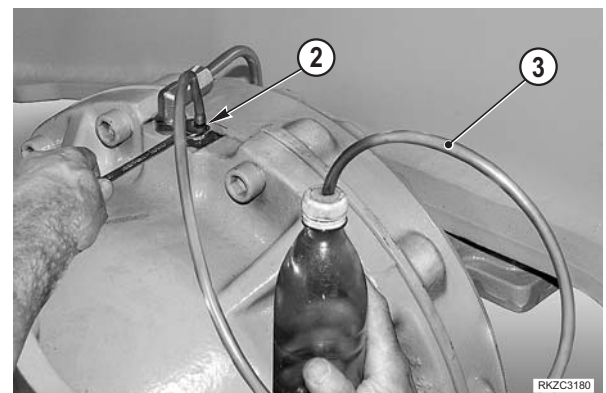
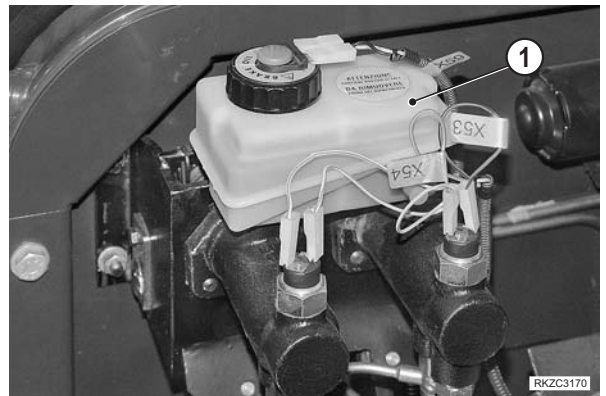
## BLEEDING AIR FROM CIRCUITS - ELIMINATING RESIDUAL PRESSURE

### • Bleeding air from cylinders

- ★ When hydraulic cylinders or associated pipes have been removed, it is necessary to bleed air before using the machine again.
- ★ Perform bleeding on one movement at a time starting from the main cylinders (boom out and boom raise).
  - 1 -Start the engine and run the engine at high speed for about 5 minutes to heat the oil.
  - 2 -Reduce speed to low idling and extend and retract the 1st piston to be bled several times.
    - ★ Extend, lower and retract pistons until about 100 mm from their end of stroke.
  - 3 -Stop the engine, check and top up the oil in the tank.
  - 4 - Bring again the engine at high idling speed and repeat operation of point 2; return the engine at low idling speed and make a complete travel of piston until the hydraulic pump reaches its maximum pressure.
  - 5 - Repeat steps (from Step 2) for all cylinders, frequently checking the oil level in the tank.

### • Air bleeding from braking circuit

- ★ Above operation is to be carried out every time maintenance is made on braking circuit to remove or replace a component, or when air entered into the circuit.
- ★ Machine must be stopped with attachments on level ground.
  - 1 -Make sure that oil in brake system tank (1) is at maximum level.
  - 2 -Remove safety plugs and applied to bleeding screws (2) a vinyl hose (3) to catch oil.
  - 3- Push brake pedal to bottom and, while keeping it pushed, loosen the bleeding screw (2) of the braking unit that is being bled until the pedal reaches the end of its stroke.
  - 4 -Keeping pedal at the end stroke, tighten bleeding screw (2).



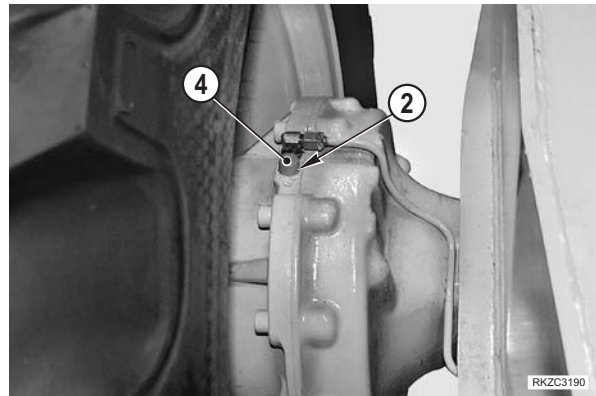
## TESTING AND ADJUSTMENTS

## BLEEDING AIR FROM CIRCUITS - ELIMINATING RESIDUAL

5 -Release brake pedal, wait for few seconds and repeat above operations two or three times until from bleeding screw, oil flows out without air bubbles.

6 -Repeat the same steps for the opposite braking unit.

- ★ Check frequently the oil level in the tank and carry out filling every time level approaches to minimum.
- ★ After air bleeding apply on screws (2) safety plugs (4).



### • Releasing residual pressure from the circuits

1 -Put work attachments on level ground, stop the engine.

2- Move all control levers in all directions to fully release cylinder and servocontrol circuit residual pressure.



## ADJUSTING ACCELERATOR PEDAL TRAVEL AND ACCELERATOR LEVER

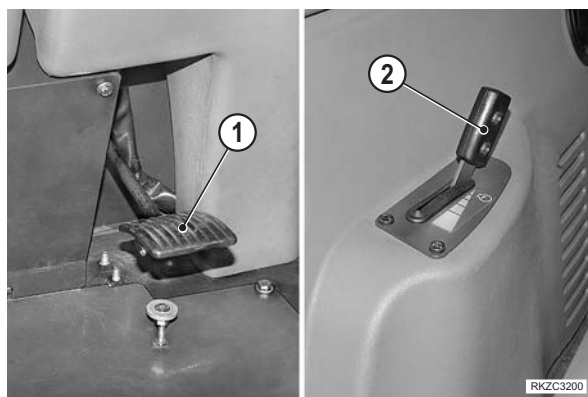
★ Working condition:

- Machine in safety conditions.
- Engine stopped but at operating temperature.
- Low and high idling speed: within permissible values.

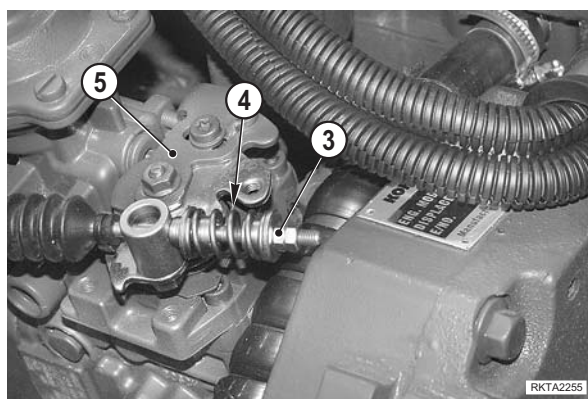
- ★ In order to check high speed engine idling, push the accelerator pedal (1) manually.

- **Accelerator pedal travel adjusting**

- 1 - Make sure that accelerator pedal (1) is fully raised and accelerator lever (2) is at minimum stroke.



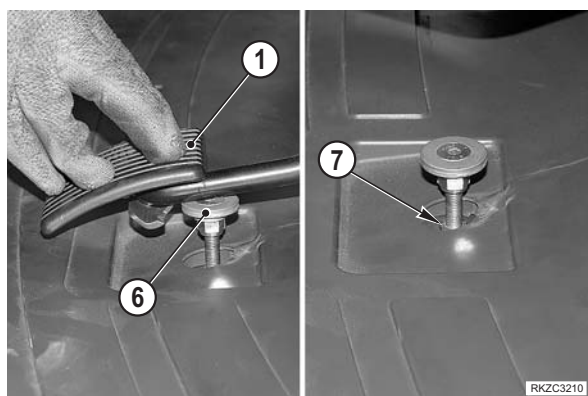
- 2 - Tighten the nut (3) until spring slack is eliminated (4) and spring is preloaded to about 1 mm.



- 3 - Push accelerator pedal until accelerator lever (3) contacts the injection pump high idling adjusting screw.

- 4 - Adjust the end travel stopper (6) of accelerator pedal (1) in this position and lock it with nut (7).

- 5 - Release the accelerator pedal (1).



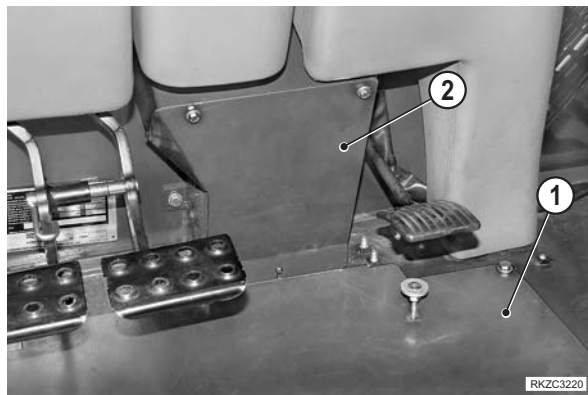
## TESTING AND ADJUSTMENTS

## ADJUSTING ACCELERATOR PEDAL TRAVEL AND ACCELERATOR

### • Accelerator lever travel adjusting

1 -Remove the front mat.

2 -Remove the metal sheet (1) closing the bottom of the cab and the upright guard (2).



3 -Check that the hand accelerator (3) is at end of travel at MIN.

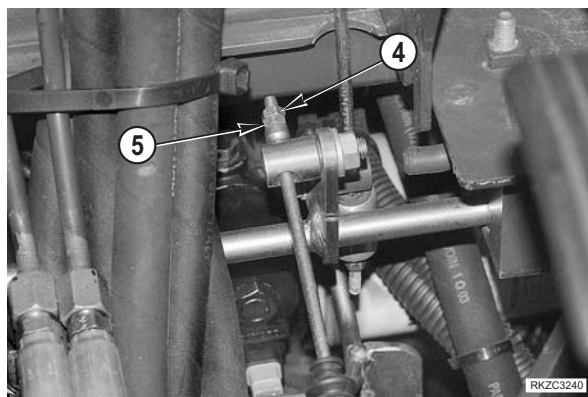
4 -Loosen and unscrew the locking nut (4).



5 -Start the engine and move the hand accelerator (3) to MAX.

6 -Tighten the nut (5) to the required speed for hand accelerator.

★ Engine idling speed:  $1900 \pm 50$  rpm



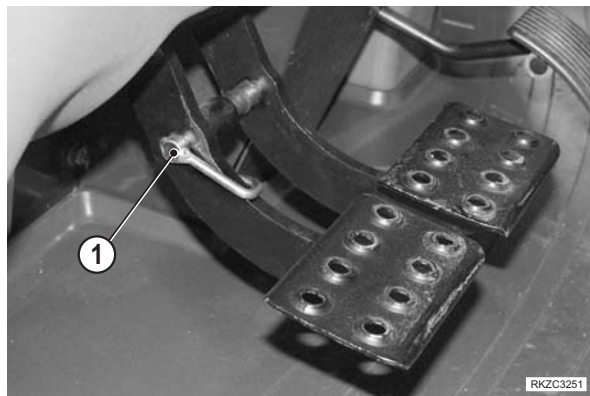
7 -Return to engine low idling speed and retain the position of the nut (5) with the locking nut (4).

8 -Check MAX speed once more by pushing the hand accelerator to end of travel.

## ADJUSTING BRAKE PEDAL SLACK/ALIGNMENT

★ Working condition:

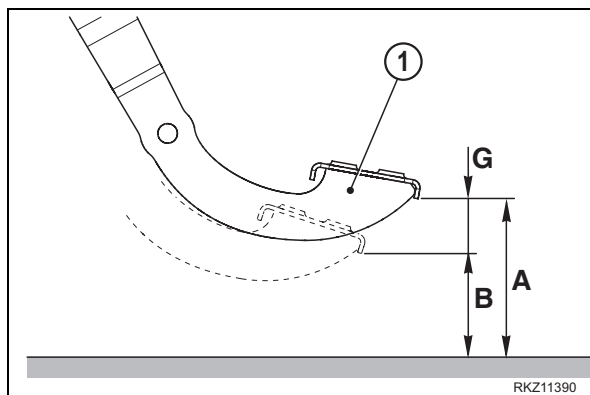
- Set the machine on level surface with attachments on ground level
- Apply the parking brake and remove the ignition key
- Pedal connection pin (1) inserted.



• Control

- 1 -Remove mat.
- 2 -Check height "A" between floor and pedal lower edge.
- 3 -Depress pedals by hand and check height "B" to determine slack "G".

★ Standard clearance: 3-8 mm



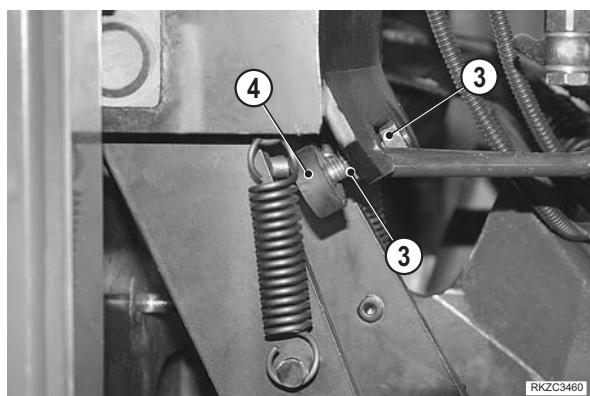
• Adjustment

- 4 -Remove the front cover (2).  
(For details see "30 REMOVAL AND INSTALLATION").



- 5 -Loosen nuts (3) and adjust slack using stoppers (4).
- 6 -When adjustment is complete, secure the stoppers (4).

★ When stoppers are secured, double check to ensure that slack "G" is within range and that the pedals touch the stoppers simultaneously.



## BRAKING SYSTEM CHECKS

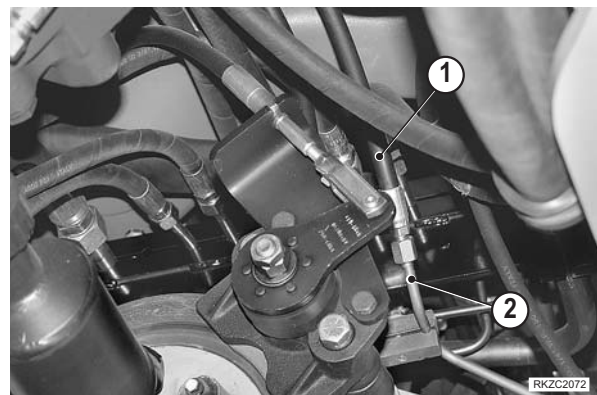
- ★ Working condition:
  - Engine stopped
  - Place the vehicle on firm level ground with the equipment raised and the safety devices activated.
  - Independent brake pedals and oil pan at maximum level.
- ★ The brake system checking procedure consists of two steps:
  - checking the brake pumps;
  - checking the braking groups for leaks.

- **Checking brake pumps and brake system for leaks**

1 - Disconnect hoses (1) from the hoses (2) connecting to the axle braking groups.

2 - Seal either hose (1).

- ★ Plug all pipes/hoses (2) to prevent contamination.



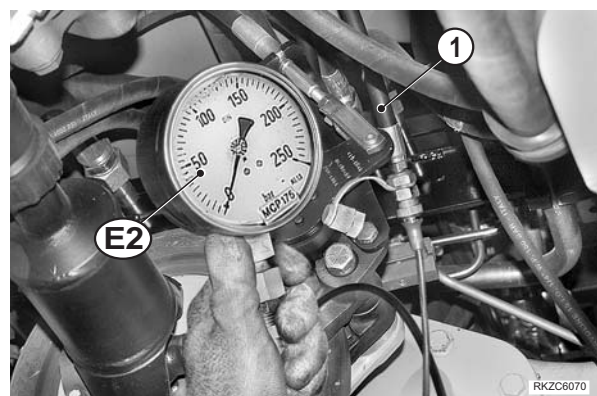
3 - Connect a pressure gauge **E2** (250 bar) to the other hose (1).

4 - Apply either brake pedal until a pressure of approx. 120 bar is reached.

- ★ Do not exceed maximum permitted pressure (150±5 bar).

5 - Hold the pressure on the pedal for at least 2 minutes and verify that pressure and pedal position remain unchanged.

- ★ If the position of the pedal needs to be changed in order to hold the pressure, then the loss of pressure is to be blamed on leaks inside either pump. To confirm whether this is the case, check the oil. If a leak condition exists, the oil will be stirred.





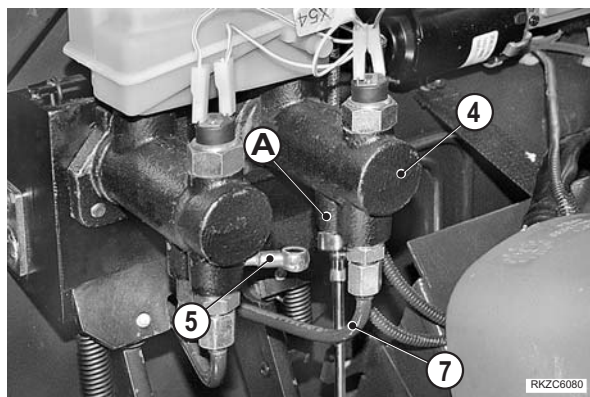
- **Checking individual pumps**

1 -Remove the front lining (3).

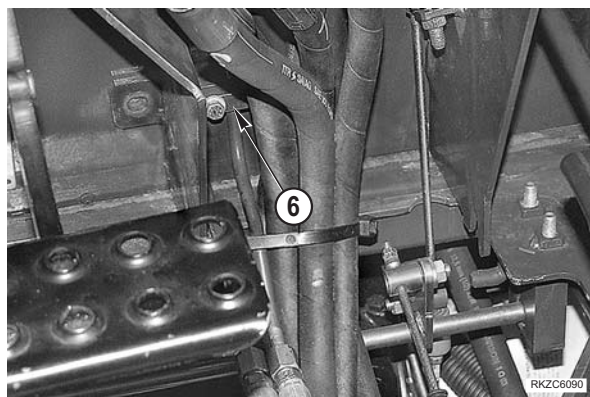


2 -Disconnect the pressure equalizer hose (5) from the brake circuit pump (4) that is being inspected.

3 -Seal the hole of the equalizer (plug "A").



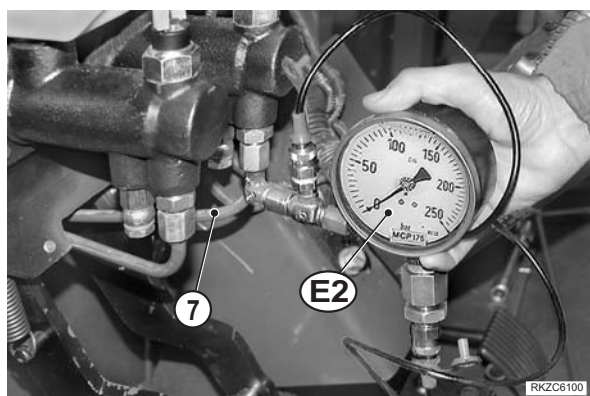
4 -Remove the clamp (6).



5 -Disconnect the delivery hoses (7) from the pump that is being tested. Connect a pressure gauge E2 (250 bar) to the pump during the inspection.

6 -Apply the brake pedal corresponding to the pump and pressurize the circuit to approx. 120 bar.

★ Do not exceed maximum permitted pressure (150±5 bar).



## TESTING AND ADJUSTMENTS

## BRAKING SYSTEM CHECKS

7 -Hold the pressure on the pedal for at least 2 minutes and verify that pressure and pedal position remain unchanged.

- ★ If the position of the pedal needs to be changed in order to hold the pressure, then the loss of pressure is to be blamed on leaks inside the pump, and in this case the pump needs to be changed. To confirm whether this is the case, check the oil. If a leak condition exists, the oil will be stirred.

8 -Repeat for the other pump.

### • Checking the braking groups for leaks.

1 -Disconnect the delivery hose (1) from the braking group that is being inspected.

2 -Connect a suitable tool between the delivery hose (1) and the braking group.

- ★ Check to ensure that the pressure tap (8) is installed between the braking group and the cut out valve (9).

3 -Connect a pressure gauge **E2** (250 bar) to the tool pressure tap and open the cut out valve (9).

4 -Operate the brake pump and pressurize the circuit to 150±55 bar maximum.

5 -Hold the pressure while simultaneously closing the valve (9) to keep the braking circuit that is being inspected under pressure.

6 -Release the brake pedal and monitor pressure gauge **E2** for two minutes.

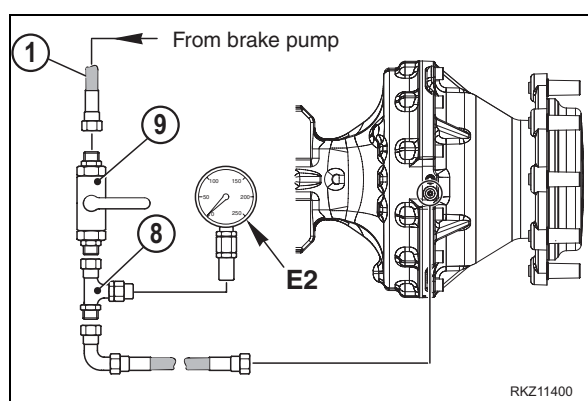
- ★ If the pressure reading changes in the negative, then there is a brake piston seal failure.

⚠ Further evidence of leak is an increase in the level of oil in the axle, and the fact that the oil is stirred as a result. Replace all sealing rings in the various axle sections and completely change the lubricant.

7 -Repeat the test for the other braking group using the same procedure as above.

8 -Restore the braking circuit to operating condition.

⚠ When checks and repair (if any) are complete, bleed the air from the braking groups (See "BLEEDING AIR FROM CIRCUITS - ELIMINATING RESIDUAL PRESSURE").



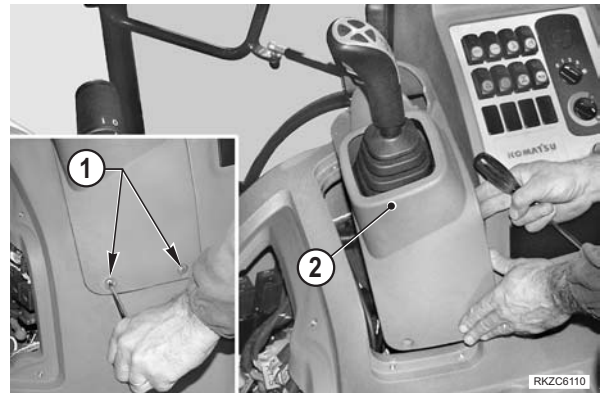
## PARKING BRAKE ADJUSTMENT

- **Functional check**

- ★ Test conditions:

- Tire pressure within the prescribed range.
- Machine in operating conditions without load and on level ground.
- Working brake pedals: connected by a cotter pin.

1 -Remove the screws (1) and remove PPC valve and parking brake casing (2).

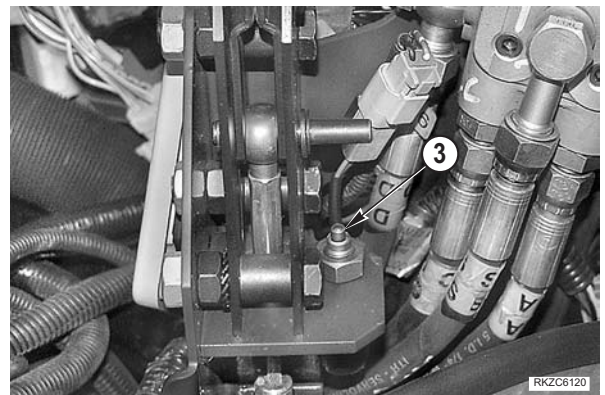


2 -Engage the parking brake.

3 -Press and hold the microswitch (3) while engaging 2nd gear and selecting a direction of movement.

4 -Accelerate engine revs gradually up to 1530±50 RPM.

⚠ If machine attempts to move, release the microswitch to return to N (Neutral).

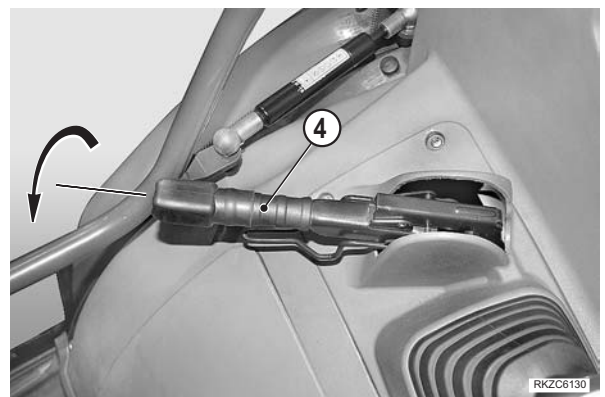


5 -Rotate the end of the lever (4) by 2 or 3 turns counterclockwise.

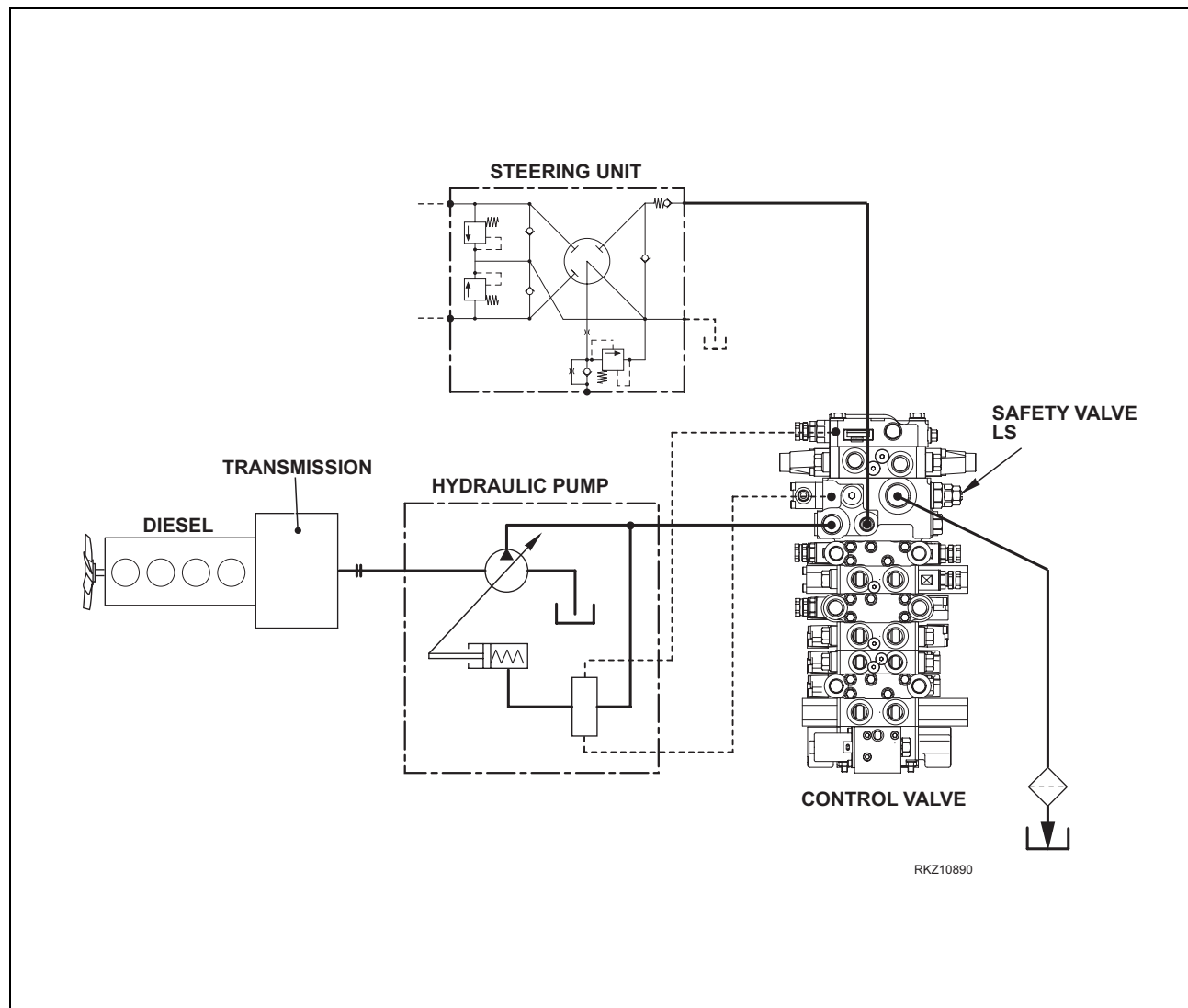
★ Direction of rotation is from the operator' point of view when the operator is sitting on the driver's seat.

6 -Re-apply the parking brake and repeat the test.

★ If a normal braking condition is not achieved after two attempts to adjust the lever, check control cable for slackness and braking disc for wear and replace components as necessary.  
(See "30 REMOVAL AND INSTALLATION" for details).



## CHECKING AND SETTING PRESSURE IN THE ATTACHMENTS HYDRAULIC CIRCUIT



### NOTE

Shown in this section is the servocontrolled version of the control valve.

#### • Introduction

- 1 - The machine is equipped with a single control valve with hydraulically controlled spools. The control valve is protected against overpressure by a single upper valve (or main valve, referred to as "LS safety valve") with adjustable pressure setting.

- 2 - The full pump delivery supplies the control valve.

- 3 - Pump delivery is shut by the priority valve (inside the control valve) when the steering manoeuvre.

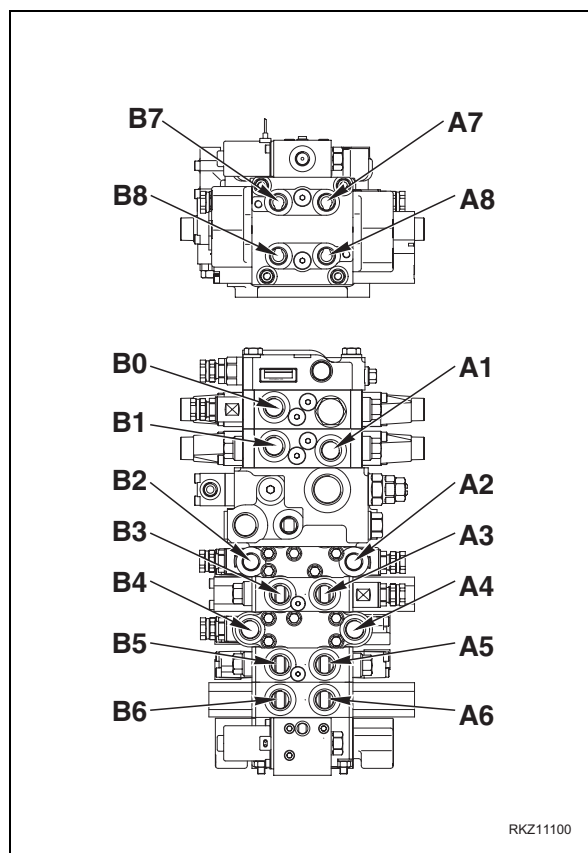


## TESTING AND ADJUSTMENTS

## CHECKING AND SETTING PRESSURE IN THE ATTACHMENTS

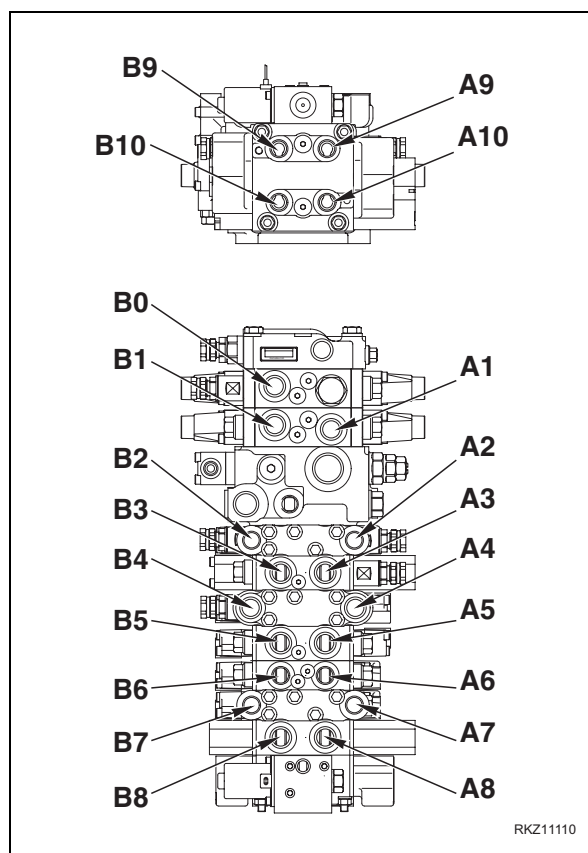
### • 8-spool control valve + Hammer

| Cylinder and movement |          | Port | Set (bar) |
|-----------------------|----------|------|-----------|
| Hammer                |          | B0   | 190       |
| Arm                   | Opens    | A1   | 270       |
|                       | Closes   | B1   | 270       |
| Boom swing            | Right    | A2   | 230       |
|                       | Left     | B2   | 230       |
| Shovel                | Dump     | A3   | 240       |
|                       | Curl     | B3   | 270       |
| Boom                  | Lowering | A4   | 270       |
|                       | Lifting  | B4   | 345       |
| Backhoe bucket        | Dump     | A5   | —         |
|                       | Curl     | B5   | 270       |
| Shovel arm            | Lifting  | A6   | —         |
|                       | Lowering | B6   | —         |
| Right outrigger       | Down     | A7   | —         |
|                       | Up       | B7   | —         |
| Left outrigger        | Down     | A8   | —         |
|                       | Up       | B8   | —         |



### • 10-spool control valve + Hammer

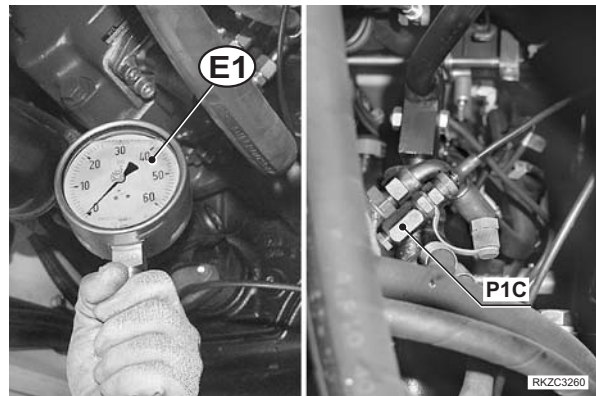
| Cylinder and movement |          | Port | Set (bar) |
|-----------------------|----------|------|-----------|
| Hammer                |          | B0   | 190       |
| Arm                   | Opens    | A1   | 270       |
|                       | Closes   | B1   | 270       |
| Boom swing            | Right    | A2   | 230       |
|                       | Left     | B2   | 230       |
| Shovel                | Dump     | A3   | 240       |
|                       | Curl     | B3   | 270       |
| Boom                  | Lowering | A4   | 270       |
|                       | Lifting  | B4   | 345       |
| Backhoe bucket        | Dump     | A5   | —         |
|                       | Curl     | B5   | 270       |
| 4 in 1 bucket         | Closes   | A6   | 270       |
|                       | Opens    | B6   | 270       |
| Jig arm               | Out      | A7   | —         |
|                       | In       | B7   | —         |
| Shovel arm            | Lifting  | A8   | —         |
|                       | Lowering | B8   | —         |
| Right outrigger       | Down     | A9   | —         |
|                       | Up       | B9   | —         |
| Left outrigger        | Down     | A10  | —         |
|                       | Up       | B10  | —         |



## CHECKING THE SETTING OF MAIN RELIEF AND SECONDARY VALVES

- **Checking the operating pressure of the unloading valve**

- 1 -Connect a pressure gauge **E1** (60 bar) to the pressure tap **P1C** on the pump.
- 2 -Start the engine and run the engine at low idling with all levers in neutral position.



- 3 -In this condition, check the pressure in the hydraulic circuit.

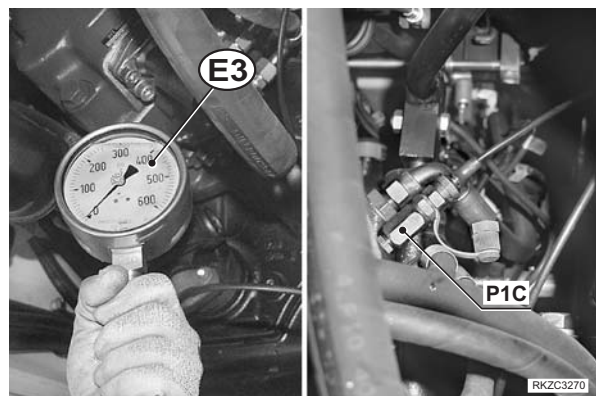
- ★ Normal pressure:  $41 \pm 4$  bar
- ★ The unloading valve cannot be pressure set; if pressure changes from its normal value, replace the valve.

- **Checking main relief valve setting**

- ★ Test conditions:

- Engine: at operating temperature.
- Hydraulic oil:  $45-55^{\circ}\text{C}$
- Working brakes applied

- 1 -Connect a pressure gauge **E3** (600 bar) to pressure tap **P1C** of the pump.



- 2 -Start the engine, move the hand accelerator lever to full throttle and check setting pressure for main relief valve by forcing the shovel arm raise movement the full travel span.

- ★ Nominal pressure: 235-260 bar
- ★ If the main relief valve pressure does not correspond to the nominal pressure value, it must be re-set (For details, see "SETTING THE MAIN RELIEF VALVES AND THE REDUCING VALVES").

- **Checking secondary valves setting (for boom swing, shovel dump, and hammer movements)**

- ★ Test conditions:

- Engine: at operating temperature.
- Hydraulic oil: 45-55 °C
- Working brakes applied

- ★ The pressure readings are to be operated from the same check point.

1 -Connect a pressure gauge **E3** (600 bar) to pressure tap **P1C** of the pump.

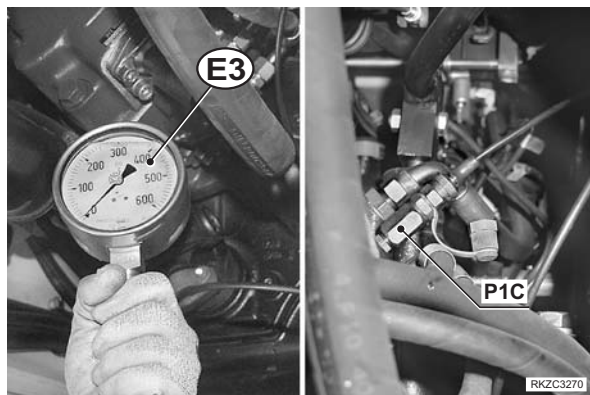
2 -Start the engine and bring the hand accelerator lever up to 2200 rpm.

3 -Check pressure for each movement, with the control lever at the end of its travel and at stabilized pressure.

- ★ Move piston to the end of stroke to check the pressure.

- ★ Normal pressure values:

| Cylinder and movement |       | Set (bar) |
|-----------------------|-------|-----------|
| Hammer                |       | 180–210   |
| Boom swing            | Right | 225–250   |
|                       | Left  | 225–250   |
| Shovel                | Dump  | 235–260   |



## TESTING AND ADJUSTMENTS

## CHECKING THE SETTING OF MAIN RELIEF AND SECONDARY

### • Checking secondary valve setting (for boom raise movement)

#### ★ Test conditions:

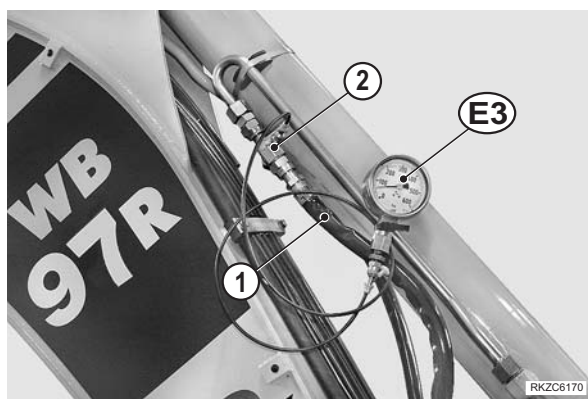
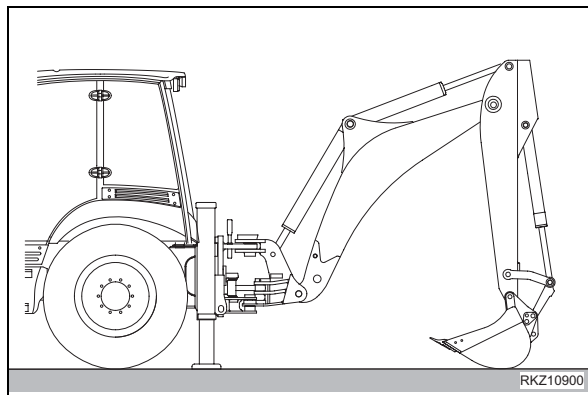
- Engine: at operating temperature.
- Hydraulic oil: 45-55 °C
- Working brakes applied

1 -Set the machine with arm in vertical position and with bucket on level ground leaned on the side.

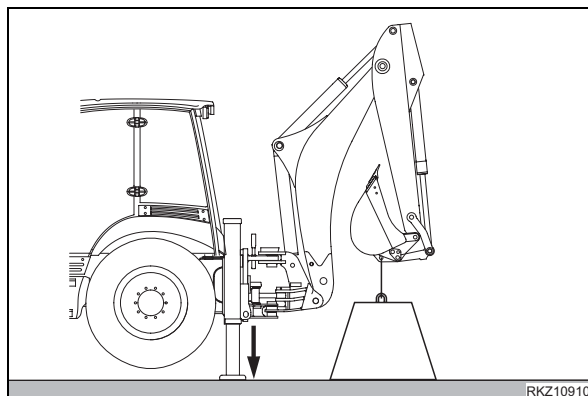
2 -Stop the engine and release residual hydraulic pressures.

3 -Disconnect the hose (1) and connect a tee fitting (2) with adapter.

4 -Connect a pressure gauge **E3** (600 bar) to the adapter.

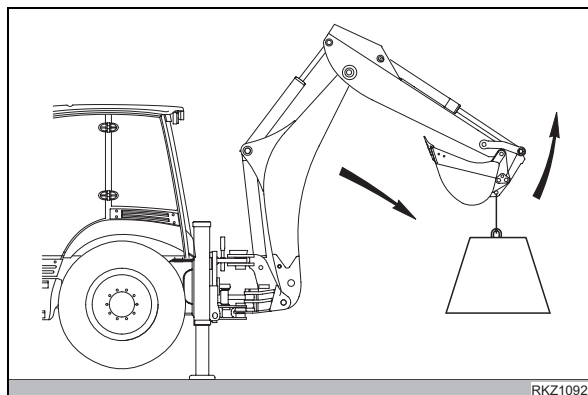


5 -Start the engine, connect a weight of approx. 1500 kg to the bucket, and fully lower the outriggers.



6 -Slowly extend the arm and boom and take the pressure when the boom lowers.

★ Normal pressure: 320-360 bar



## TESTING AND ADJUSTMENTS

## CHECKING THE SETTING OF MAIN RELIEF AND SECONDARY

### • Checking secondary valve setting (for arm in, shovel loading, backhoe bucket loading, boom raise, and 4-in-1 bucket movements)

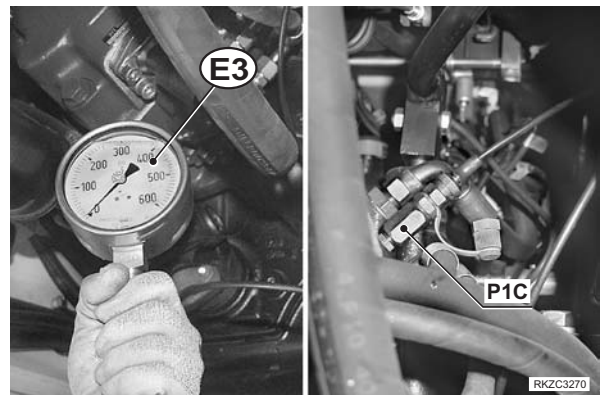
#### ★ Test conditions:

- Engine: at operating temperature.
- Hydraulic oil: 45-55 °C
- Working brakes applied

#### ★ The pressure readings are to be operated from the same check point.

1 -Connect a pressure gauge **E3** (600 bar) to pressure tap **P1C** of the pump.

2 -Start the engine and bring the hand accelerator lever up to 2200 rpm.



3 -Set the main relief valve to a value 30 bar higher than the maximum pressure to be tested.  
(For details, see "Setting the main relief valve").

4 -Check pressure for each movement, with the control lever at the end of its travel and at stabilized pressure.

- ★ Move piston to the end of stroke to check the pressure of the working equipment.
- ★ Normal pressure values:

| Cylinder and movement |          | Set (bar) |
|-----------------------|----------|-----------|
| Arm                   | Closing  | 260–280   |
| Shovel                | Curl     | 260–280   |
| Boom                  | Lowering | 260–280   |
| Backhoe bucket        | Curl     | 260–280   |
| 4 in 1 bucket         | Closes   | 260–280   |
|                       | Opens    | 260–280   |

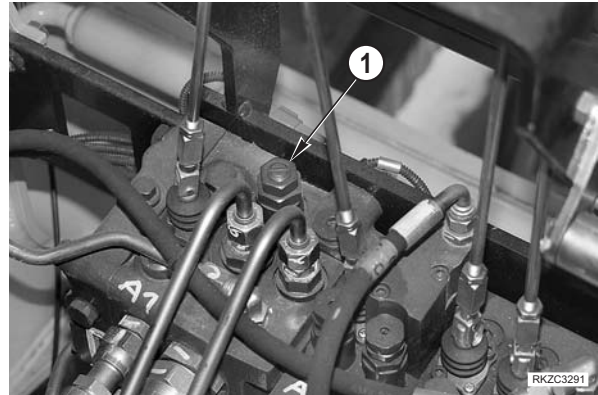


- ★ If one movement fails to reach the setting pressure, then the malfunction is in the tested element.
- ★ If all movements fail to reach the setting pressure, then you need to pressure set or replace the secondary valve.

## SETTING THE MAIN RELIEF VALVES AND THE REDUCING VALVES

### • Setting the main relief valve

1 -Loosen lock nut (1).



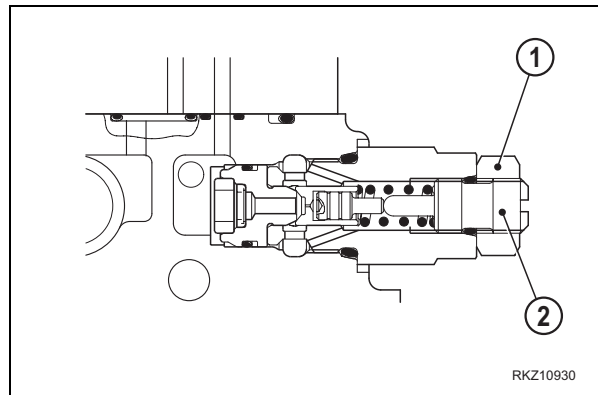
2 -Adjust the pressure using the screw (2).

- To INCREASE pressure turn in CLOCKWISE direction.
- To DECREASE pressure turn in COUNTERCLOCKWISE direction.

3 -Lock the nut (1).

 Nut: 29.4-39.2 Nm

- ★ When adjustment is complete, check the setting of the main relief valve using the procedures used for measurements.



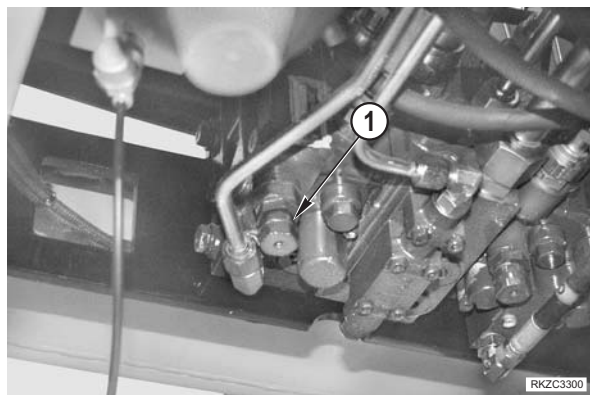


## TESTING AND ADJUSTMENTS

## SETTING THE MAIN RELIEF VALVES AND THE REDUCING VALVES

- **Adjusting secondary valves (for boom swing, shovel dump, hammer, and boom raise movements)**

1 -Loosen nut (1)

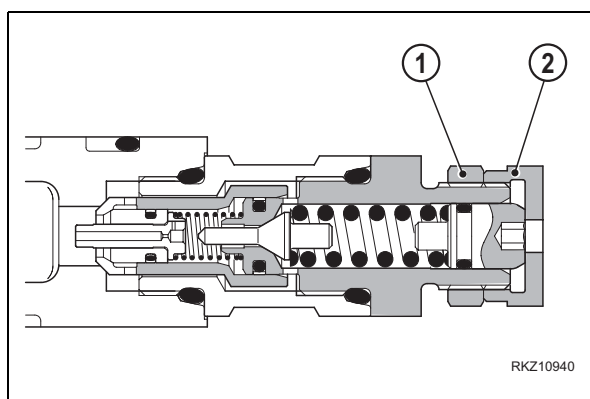


2 -Adjust the pressure using the nut (2).

- To INCREASE pressure turn in CLOCKWISE direction.
- To DECREASE pressure turn in COUNTERCLOCKWISE direction.

3 -Tighten nut (1) while holding nut (2).

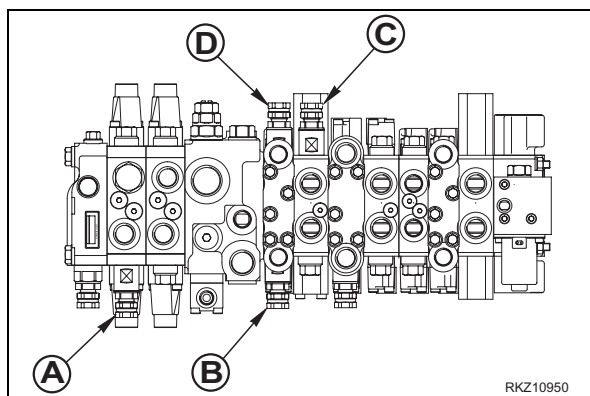
 Nut (1): 39-49 Nm



- **Adjusting the secondary valve (for arm in, shovel curl, backhoe bucket curl, boom raise, and 4-in-1 bucket movements)**

1 -Loosen nut (1).

- A** = hammer secondary valve
- B** = LH swing secondary valve
- C** = shovel dump secondary valve
- D** = RH swing secondary valve

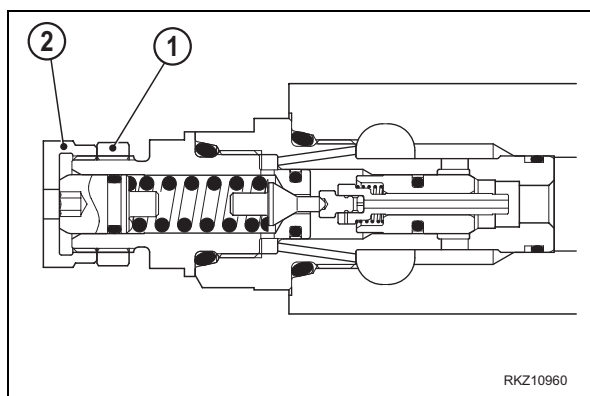


2 -Adjust the pressure using the nut (2).

- To INCREASE pressure turn in CLOCKWISE direction.
- To DECREASE pressure turn in COUNTERCLOCKWISE direction.

3 -Tighten nut (1) while holding nut (2).

 Nut (1): 39-49 Nm



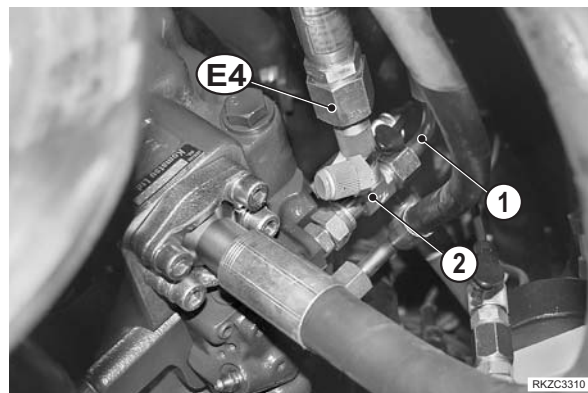
## CHECKING AND ADJUSTING THE LS DIFFERENTIAL PRESSURE - ADJUSTING THE LS VALVE

### • Control

#### ★ Test conditions:

- Engine: stopped but at working temperature.
- Hydraulic oil: 45-55 °C.
- Machine: front equipment on the ground, parking brake applied and boom and arm fully extended.
- Working mode: POWER

1- Disconnect hose (1) from the Load Sensing line, Install a tee with pressure tap (2) and reconnect hose (1).

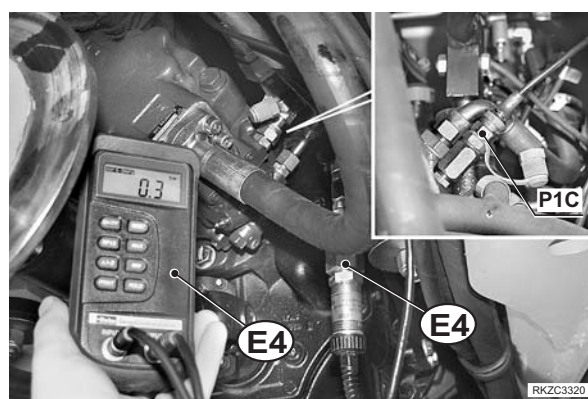


2 -Connect a differential pressure gauge **E4** to adaptor (2) and to pressure tap **P1C** of the pump.

3- Start the engine and run it at low idling (1050±50 rpm) and, without any movement (lever in neutral position), read the DP pressure.

★ Normal value: 41±4 bar

★ If **DPLS** pressure is not within the permissible range, replace the control valve unloading valve.



4 -Simultaneously perform a boom raise and a backhoe bucket curl movement to end of travel and then read the DP pressure.

★ Normal value: 27.5±1.5 bar

★ If the **DPLS** value is not within the permissible range, set the unloading valve.



- **Adjusting the LS valve**

- ★ If the **DPLS** value is not within the specified range, adjust the LS valve as follows:

1 -Loosen the retaining nut (1) and turn the adjustment screw (2).

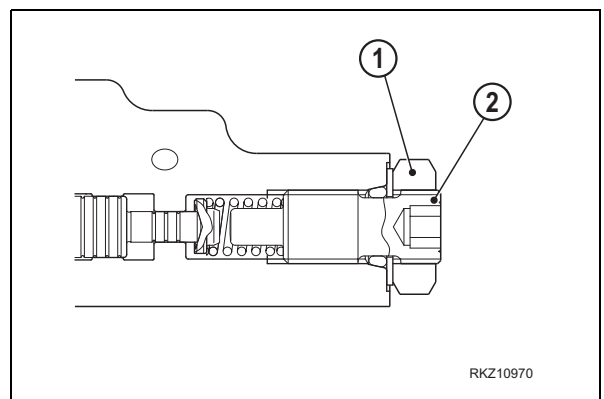
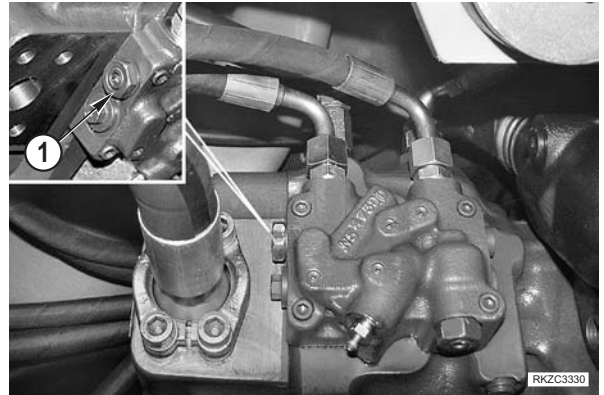
- To INCREASE pressure turn in CLOCKWISE direction.
- To DECREASE pressure turn in COUNTERCLOCKWISE direction.

- ★ Each turn of the adjustment screw (2) will change the pressure by approx. 13 bar.

2 -Lock the nut (3).

 Nut: 27.4-34.3 Nm

3 -When adjustment is complete, check the setting of the LS valve (1) using the procedures used for checking.



## CHECKING AND ADJUSTING SERVOCONTROLS SUPPLY PRESSURE

### • Checking servocontrols supply pressure

#### ★ Test conditions:

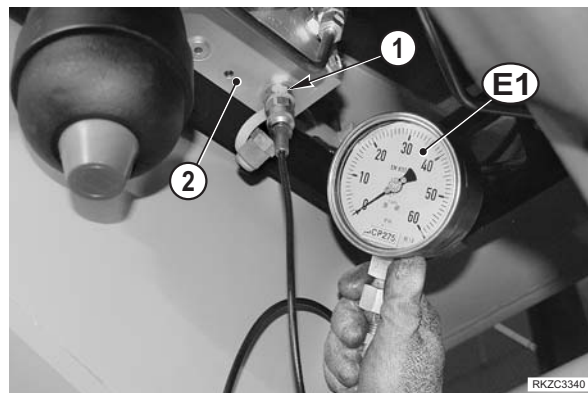
- Engine: at operating temperature.
- Hydraulic oil temperature: 45-55 °C

1 -Connect a pressure gauge **E1** (60 bar) to the pressure tap (1) of the solenoid valve group (2).

2 -Start the engine and run the engine at low idling with all levers in neutral position.

3 -Check the pressure.

- ★ Normal pressure: 37.3±3 bar



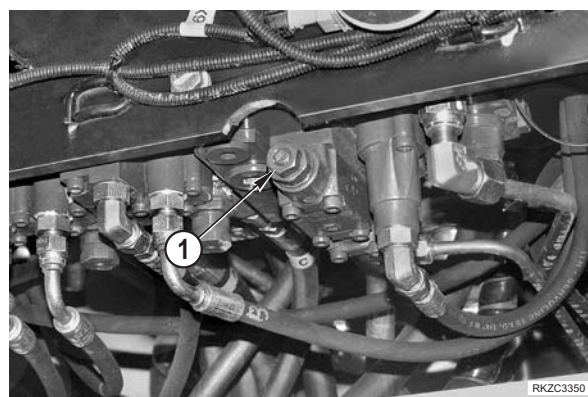
### • Adjusting the servocontrol valve

#### ★ If the pressure value is not within the tolerance range, adjust the valve (1) as follows:

1 -Loosen the retaining nut (2) and turn the adjustment screw (3).

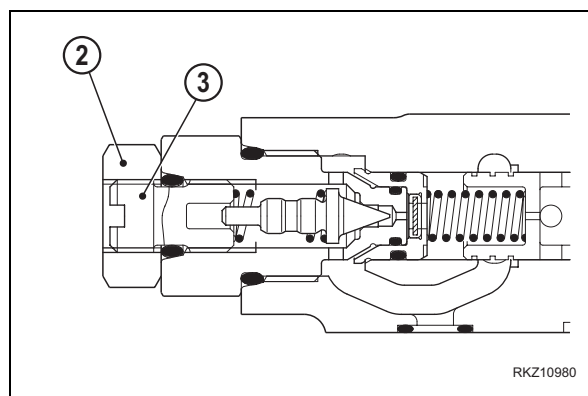
- To INCREASE pressure rotate in CLOCKWISE direction.
- To DECREASE pressure rotate in COUNTERCLOCKWISE direction.

- ★ Each turn of the screw (3) will change the pressure by \_\_\_\_ bar.



2 -Lock the nut (2).

 Nut: 22 ± 2.5 Nm



## ADJUSTING THE PC VALVE

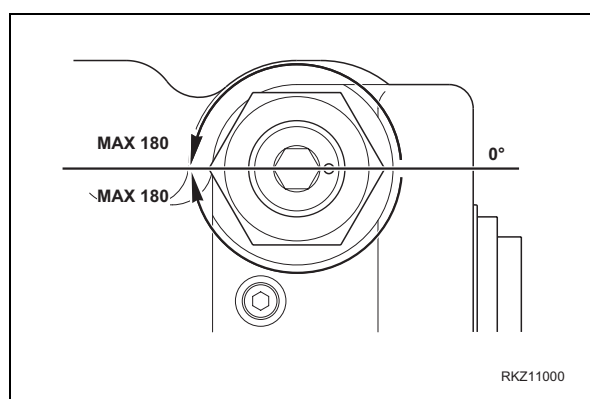
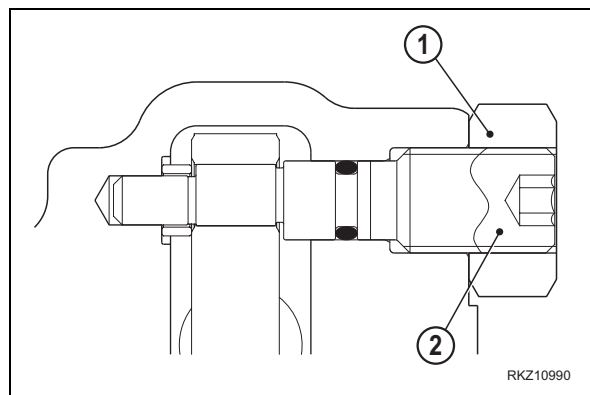
- ★ If pump delivery and LS differential pressure are within permissible values, but you notice that the engine rpm drops as a result of a change in the load, or that working equipment is very slow, it is time to adjust the PC valve.

1 -Loosen the nut (1) and turn the adjustment screw (2).

- ★ To decrease the pump's torque absorption, turn the adjustment screw (2) counterclockwise
- ★ To increase the pump's torque absorption (i.e. to increase the speed of working equipment) turn the adjustment screw (2) clockwise.
- ★ Turn the adjustment screw by not more than 180° in relation to the 0° line, in both directions
- ★ Adjustment screw position on first installation shown

2 -Lock the nut (1).

 Nut: 27.4-34.4 Nm



## TESTING AND SETTING STEERING CONTROL SYSTEM PRESSURE

★ Test conditions:

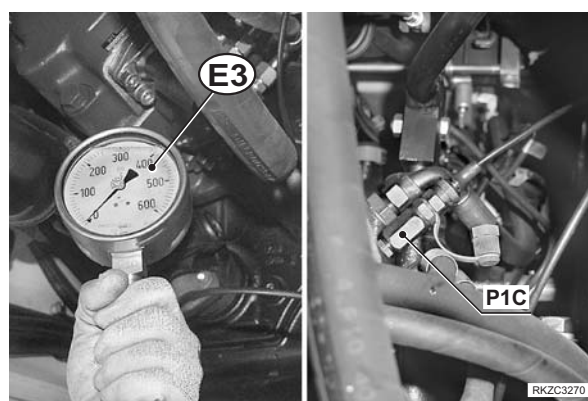
- Engine: operating temperature
- Hydraulic oil: 45-55 °C

• **Control**

- 1 - Connect a pressure gauge **E3** (600 bar) to the pressure tap **P1C** on the backhoe control valve.
- 2 - Start the engine and bring it to idle speed 1500±50 rpm and carry out a total steering.
- 3 - Forcing the steering wheel at the end of stroke, check pressure.

★ Normal pressure: 175-185 bar

- 4 - Check for the other steering direction too.

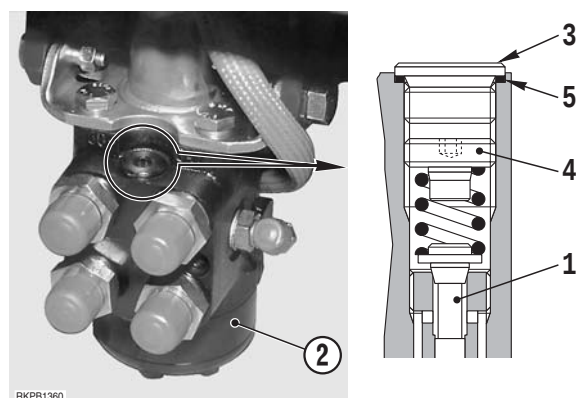


• **Setting**

- ★ If pressure is not within permissible value, carry out setting acting on upper valve (1) of the steering unit (2).

- 1 - Remove the plug (3).
- 2 - Insert a wrench of 4 mm and loosen screw (4).
  - To INCREASE pressure rotate in CLOCKWISE direction.
  - To DECREASE pressure rotate in COUNTERCLOCKWISE direction.
- 3 - Stop the engine and replace the plug (3); ensure that the seal (5) is in its proper position.

⌘ Plug: 50±10 Nm



## CHECKING FOR LEAKS IN THE STEERING CYLINDERS

★ Test conditions:

- Engine: at operating temperature.
- Hydraulic oil: 45-55°C.
- Working brakes: engaged.
- Maximum steering pressure: within permissible limits.

1 -Start the engine and fully steer the wheels in either direction.

2 -Stop the engine.

3 -Disconnect the supply hose (2) from the cylinder (1) on the side where the rod is fully out (3); plug the hose tightly.

4 -Connect a provisional hose to the cylinder (1) to collect any leaking fluid.

5 -Start the engine and operate the engine at high idling speed.

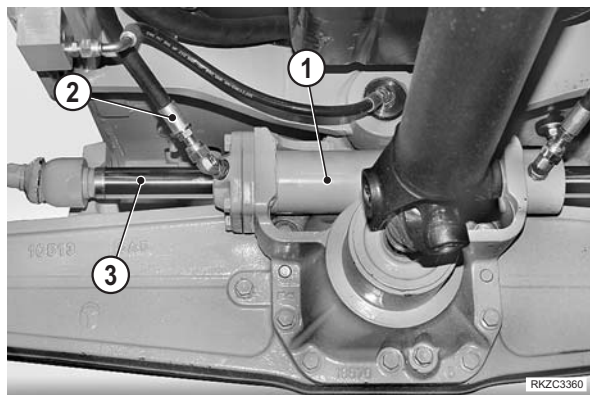
6 -Force the steering wheel to the end of its travel and retain the position for 30 seconds; measure any leak during the following minute.

7 -Release the steering wheel, run the engine at low idling, and then stop the engine.

8 -Check if leakage is normal (see «NORMAL OR STANDARD TECHNICAL DATA).

- ★ Test cylinder on one side only, as there is only one gasket separating the two chambers.

9 -Restore the hydraulic connection, steer the wheel several times in both directions to remove any air from the circuit.

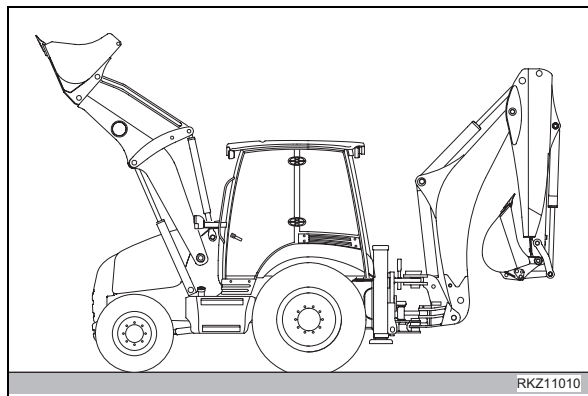


## TESTING PRESSURES IN THE POWER TRAIN GROUP

The power train group can be used to perform pressure tests on the internal hydraulic circuit. These are useful for identifying malfunctions.

Specifically, the tests involve:

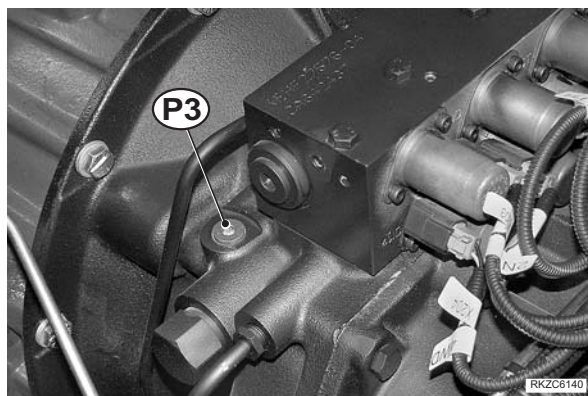
- 1 - Converter oil pressure.
  - 2 - Clutch engagement pressures for both directions of travel.
- ★ Test condition:
- Engine: stopped.
  - Brake pedals: connected by a cotter pin.
  - Machine: on solid and level ground with the equipment raised and safety devices engaged.
  - Lower cab closeout removed.



### • Converter oil pressure

- 1 - Remove the plug (P3) and connect the pressure gauge **E6**.
- 2 - Start the engine and heat the engine and all the fluids up to working temperature. In particular make sure that the power train oil reaches a temperature of  $80 \pm 5$  °C.
- 3 - With the engine at MIN, check the pressure on the pressure gauge **E6**.
  - ★ Idle pressure: 3 bar
- 4 - Gradually increase engine speed to 2200 rpm; take a new reading on pressure gauge **E6**.
  - ★ Normal pressure: 3-9 bar
- 5 - Bring the engine back to MIN and compare the pressure with the normal value.
  - ★ Min. pressure: 3 bar
  - ★ If the pressure value drops to below the permissible lower limit, the power train pump needs an replacement.

 Plug: 30 Nm





### • Clutch engagement pressure

- 1 -Remove the plug (P18) and connect the pressure gauge E6.
- 2 -Start the engine and heat the engine and all the fluids up to working temperature. In particular make sure that the power train oil reaches a temperature of  $80 \pm 5$  °C.
- 3 -Bring the engine up to MIN (idling) and check the pressure on the pressure gauge E6.

★ Normal pressure: Max. 0.3 bar

- 4 -With the working brakes applied, select reverse gear and gradually increase rev speed up to MAX, then take a new reading from the pressure gauge E6.

★ Normal pressure: 13.5-16.5 bar

- 5 -Bring the engine back to MIN and the transmission in neutral position; compare the pressure with the normal value.

★ Normal pressure: Max. 0.3 bar

- 6 -Remove the pressure adapter and replace the plug (P19).

 Plug: 30 Nm

- 7 -Repeat the same test for the FORWARD gear, reading the pressure from the orifice protected by the plug (P17).

- If the pressures are different for the two travel directions, there is a loss of pressure on the clutch piston with lower pressure.

### • Supply pressure

- 1 -Remove the plug (P21) and connect the pressure gauge E6.

- 2 -Start the engine and heat the engine and all the fluids up to working temperature. In particular make sure that the power train oil reaches a temperature of  $80 \pm 5$  °C.

- 3 -Bring the engine up to MIN (idling) and check the pressure on the pressure gauge E6.

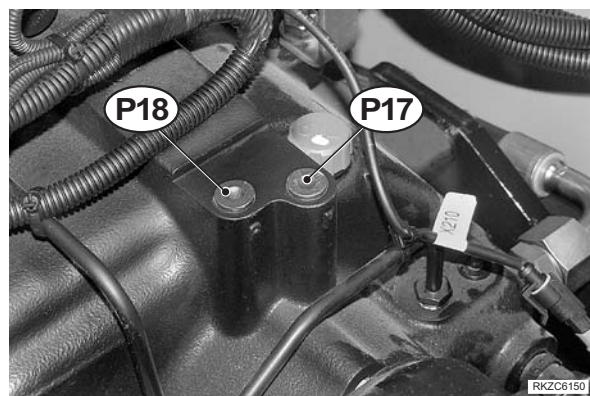
★ Normal pressure: 14-17 bar

- 4 -Gradually increase engine speed to 2.200 rpm; take a new reading on pressure gauge E6.

★ Min. pressure: 14 bar

- ★ If reading drops below minimum, the transmission pump needs replacing.

 Plug: 30 Nm

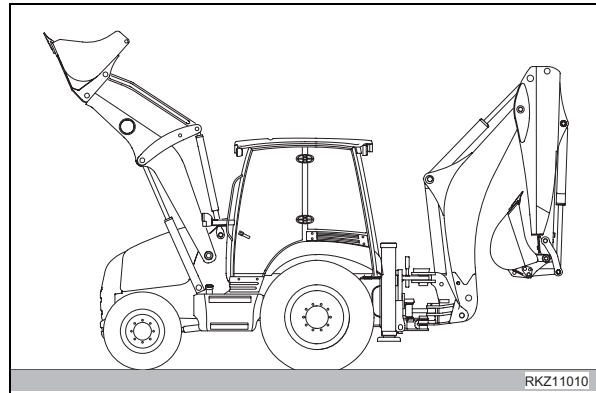


## TESTING THE CORRECT FUNCTIONING OF THE POWER TRAIN CLUTCHES

### ★ Test conditions:

- Engine: stopped.
- Brake pedals: connected by a cotter pin.
- Machine: on solid and level ground with the equipment raised and safety devices engaged.

- ★ This test must be performed after having checked the pressures of the power train group.



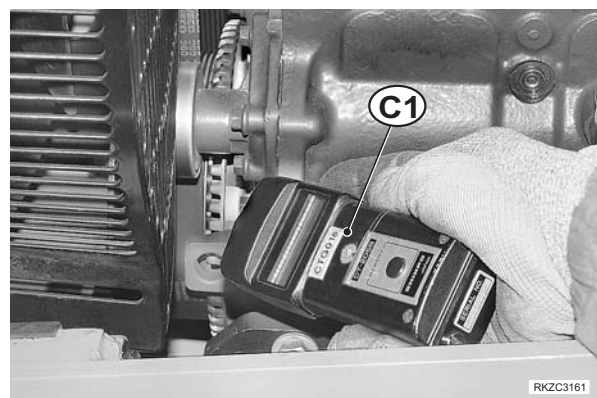
### • Preparation of the machine

- 1 - Prepare a rev. counter **C1** to measure the engine rpm.

⚠ Make sure that the brake pedals are fastened together by the cotter pin (1).

⚠ During the following tests, during the engine acceleration phase with the gear engaged, the condition of the brake disks can also be checked. If, while force is being exerted on the brake pedals, the machine starts to travel (even slowly):

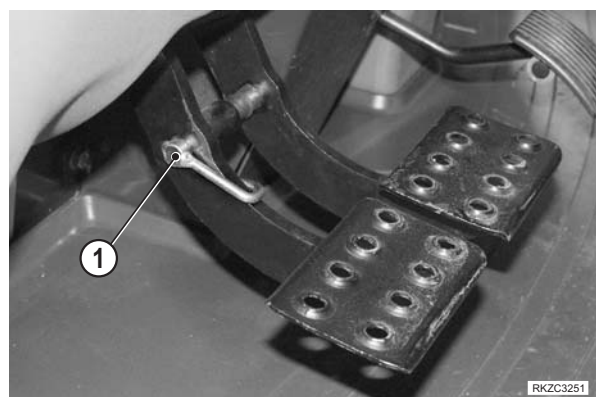
- a - Release the accelerator immediately and stop the engine.
- b - Check the wear on the brake disks and change them before completing the tests. (For details, see "30 REMOVAL AND INSTALLATION").



### • Control

- 1 - Start the engine and heat the engine and all the fluids up to working temperature. In particular make sure that the power train oil reaches a temperature of  $80 \pm 5$  °C.
- 2 - With the engine in idling condition, accelerate to MAX. and check that in this condition the revs remain within permissible limits. (See "ENGINE SPEED TESTS").
- 3 - Brake hard and bring the engine up to MAX.
- 4 - Engage the 3rd gear while braking and accelerating as above; confirm that engine speed decreases to the permissible range (See "CHECKING ENGINE WITH LOAD").
- 5 - Repeat this test in REVERSE gear.

- ★ If the revs are high than the permissible limits, the clutches are worn, and must be replaced.





## ANALYSIS OF CAUSES HYDRAULIC DRIFT

- ★ If working attachments have a hydraulic drift, it is necessary to check if reason is due to cylinders gaskets or to control valve.
- ★ All testing conditions:
  - Engine: at operating temperature
  - Hydraulic oil: 45-55 °C
  - Removal and installation of pipes only after remain pressure removal.

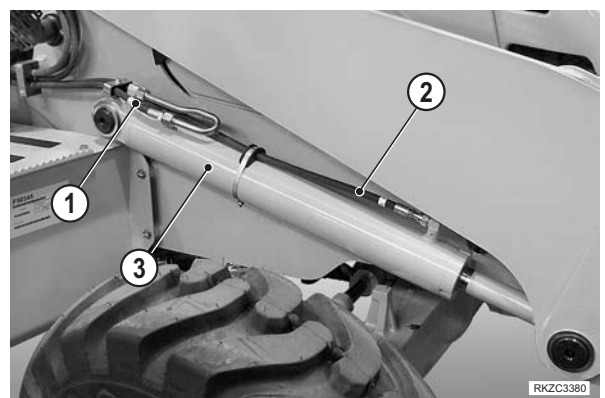
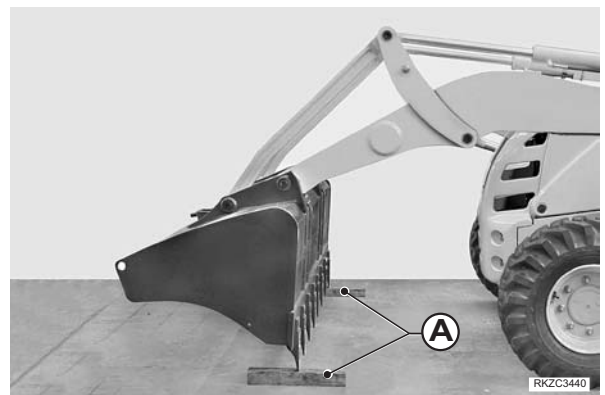
### FRONT EQUIPMENT

#### • Shovel raise check

- 1 -Put the machine with the shovel teeth on blocks "A" of about 10 cm and in vertical position in relation to the ground.
- 2 -Stop the engine and release residual hydraulic pressures.
- 3- Disconnect pipes (1) and (2) from lift cylinders (3) and plug them.
- 4 -Plug cylinders, base side, and apply a temporary pipe, head side, to catch possible oil leakage.
- 5 -Start the engine and curl shovel until the teeth are in tilt position by about 10°.
- 6 -Stop the engine and check shovel link position for 5 minutes.
  - If bucket link has no lowering movement, drift is due to control valve.

To test the individual cylinders, proceed as follows:

- 7 -Carry out with shovel a dump movement to let teeth lean on ground in vertical position.
- 8 -Remove from one of the cylinders the plug fitted on the cylinder bottom side in Phase 4.
- 9 -Start the engine and retract the shovel until to bring the teeth in tilt position of about 10° towards upper.
- 10 -Stop the engine and check the shovel position for 5 minutes.
  - If shovel link has a lowering movement, drift is due to gaskets of plugged cylinder.
- 11 -Repeat operation from stage 8 to stage 10 to check the other cylinder.



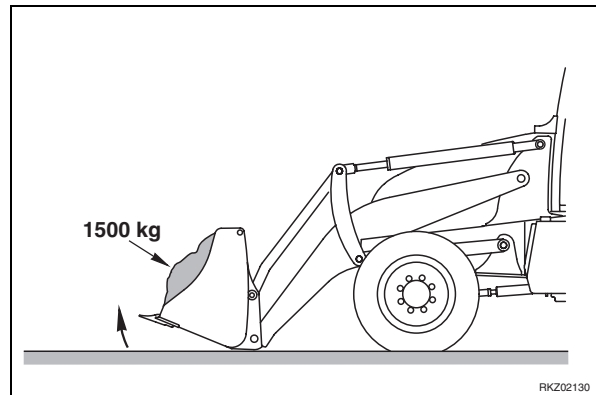
## TESTING AND ADJUSTMENTS

## ANALYSIS OF CAUSES HYDRAULIC DRIFT

### • Shovel dump check

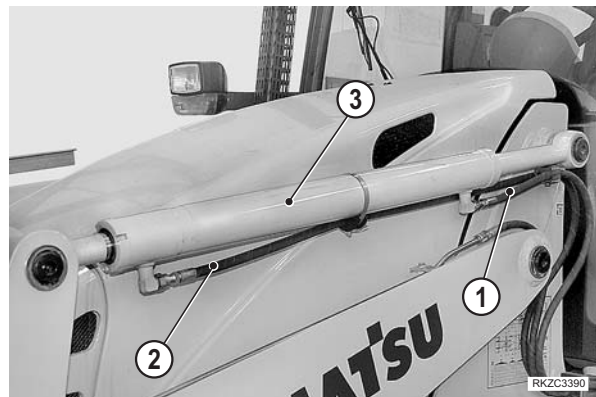
- 1 -Put the machine with shovel on level ground and teeth tilted of about 10°.

Put in the bucket a weight of 1500 kg.



- 2 -Disconnect pipes (1) and (2) from both dump cylinders (3) and plug them to prevent contamination of the ducts.

- 3 -Plug dump cylinder hole, base side, and apply a temporary pipe on head side to catch possible oil leakage.



- 4 -Start the engine and raise the shovel until shovel hinge pin is aligned with shovel arm hinge pin.

- 5 -Stop the engine and check the position of the shovel teeth for 5 minutes.

- If shovel has no swing movement, drift is due to control valve.

To test the individual cylinders, proceed as follows:

- 6 -Lower the shovel to the ground.

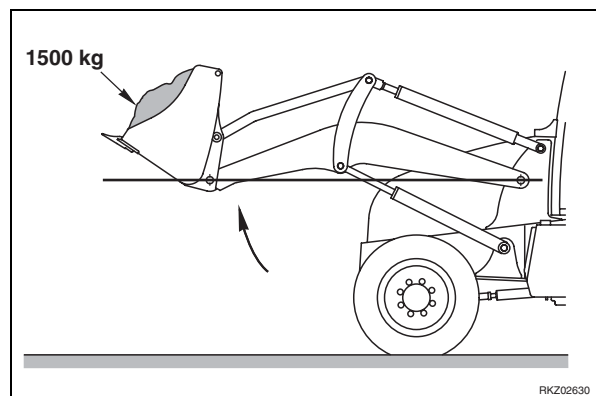
- 7 -Remove from one of the cylinders the plug fitted on the cylinder bottom side in Phase 3.

- 8 -Start the engine and raise the shovel as indicated in phase 4.

- 9 -Stop the engine and check the position of the shovel teeth for 5 minutes.

- If the shovel teeth turn, the drift is due to the gasket seals of the plugged cylinder.

- 10 -Repeat operation from stage 6 to stage 9 to check the other cylinder.



## BACKHOE

★ Test condition:

- Backhoe aligned
- Lifted outriggers

• **Boom testing**

1 -Set the machine with arm in vertical position and with bucket on level ground leaned on the side.

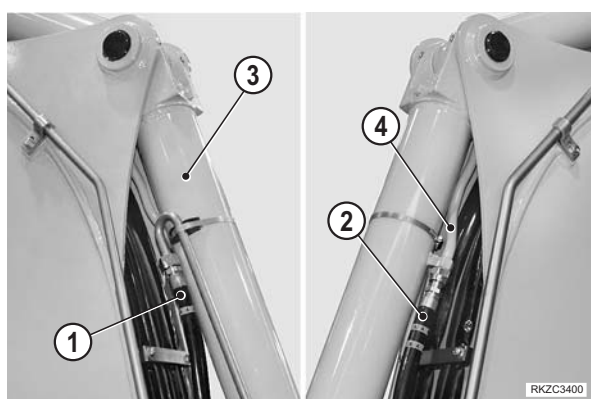
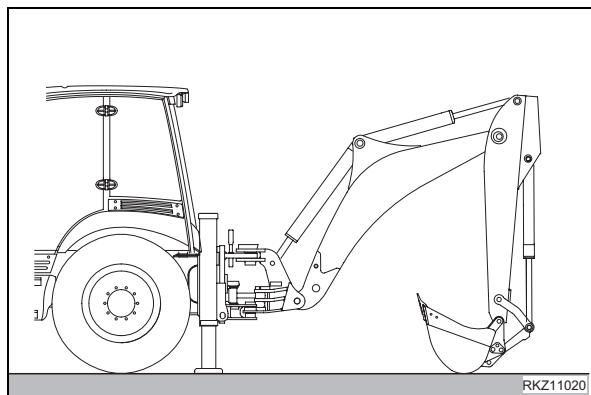
2 -Stop the engine and release residual hydraulic pressures.

3 -Disconnect hoses (1) and (2) that feed cylinder (3).

4 -Plug the two hoses to avoid impurity inlet.

5 -Plug the cylinder head side.

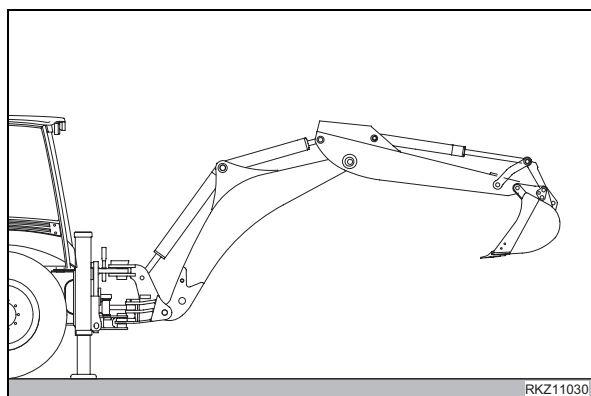
6 -Apply a temporary pipe on pipe (3) base side to catch possible oil leakage.



7 -Start the engine and extend completely the arm.

8 -Stop the engine and check the boom position for 5 minutes.

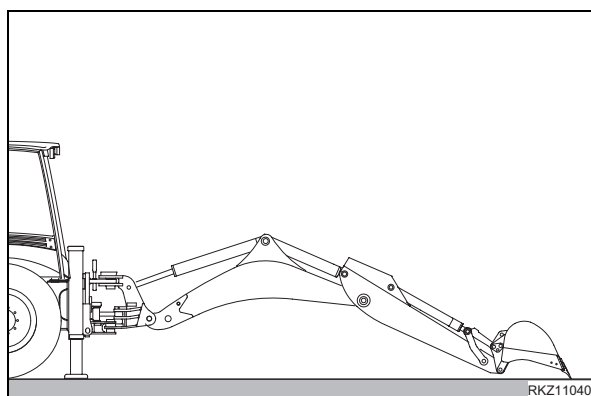
- If boom has a lowering movement, drift is due to cylinder gaskets.
- If boom has no lowering movement, drift is due to control valve.



• **Arm testing**

1 -Set the machine with arm fully extended and with bucket teeth on ground.

2 -Stop the engine and release residual hydraulic pressures.



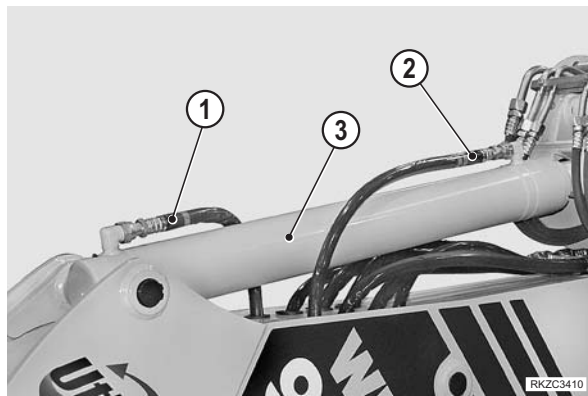
## TESTING AND ADJUSTMENTS

## ANALYSIS OF CAUSES HYDRAULIC DRIFT

3 -Disconnect pipes (1) and (2) pipes from arm cylinder (3) and plug them to avoid impurity inlet.

★ If safety valve is fitted, provide to removal.

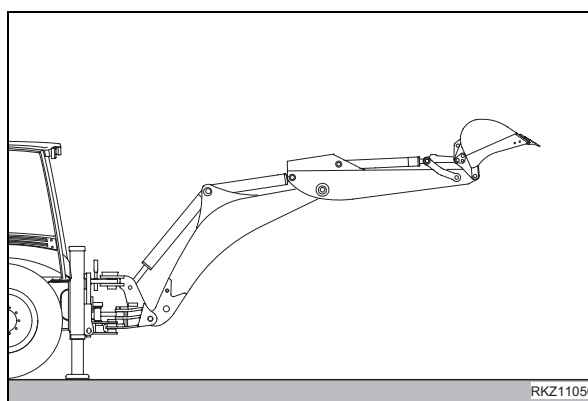
4 -Plug arm cylinder hole on head side and fit a temporary pipe on base side to catch possible oil leakage.



5 -Start the engine and raise the boom.

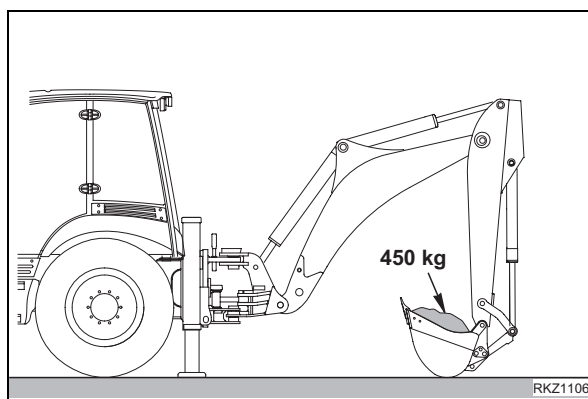
6 -Stop the engine and check the arm position for 5 minutes.

- If arm has a lowering movement, drift is due to cylinder gaskets.
- If arm has no movement, drift is due to control valve.



### • Bucket testing

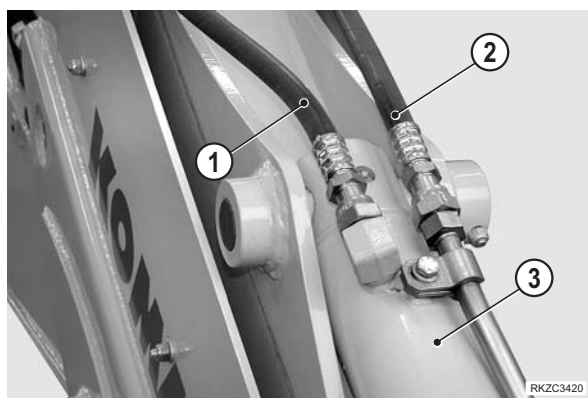
1 -Set the machine with vertical arm and horizontal bucket leaned at level ground on the side.  
Put in the bucket a weight of 450 kg or fill it with earth.



2 -Stop the engine and release residual hydraulic pressures.

3 -Disconnect bucket cylinders (3) pipes (1) and (2) and plug them to avoid impurity inlet.

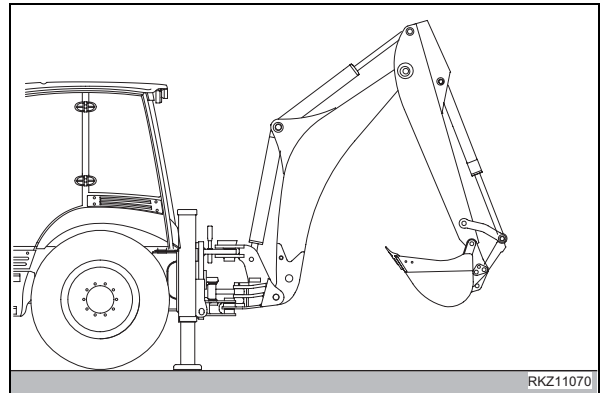
4 -Plug bucket cylinder hole on base side and fit a temporary pipe on head side to catch possible oil leakage.



## TESTING AND ADJUSTMENTS

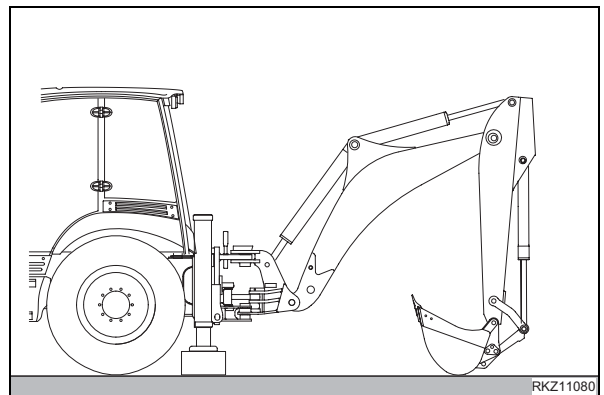
## ANALYSIS OF CAUSES HYDRAULIC DRIFT

- 5 -Start the engine and raise the boom.
- 6 -Stop the engine and check the bucket position for 5 minutes.
  - If bucket has an opening movement, drift is due to cylinder gaskets.
  - If bucket has no movement, drift is due to control valve.

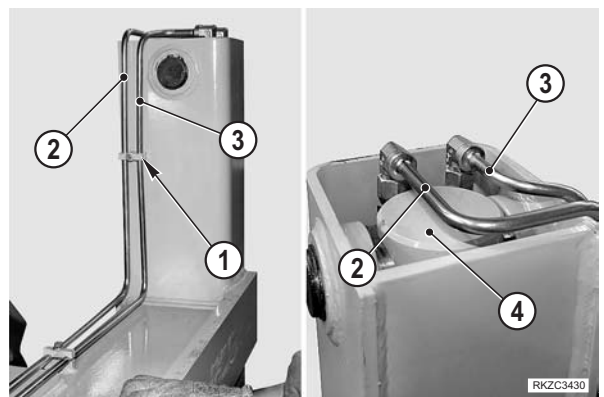


### • Outriggers testing

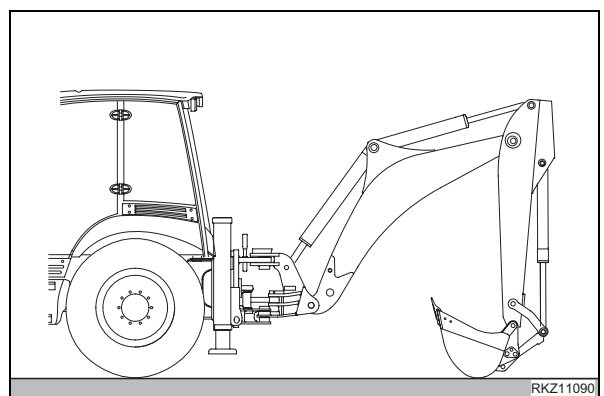
- 1 -Set the machine with arm in vertical position and with bucket on level ground leaned on the side.
- 2 -Put blocks of about 20 cm under the outriggers.
- 3 -Without forcing them, lower the outriggers onto the trestles.



- 4 -Stop the engine and release residual hydraulic pressures.
- 5 -Remove clamp (1) and disconnect from cylinders (4) the pipes (2) and (3).
- 6 -Plug cylinders pipes (2) base side and apply on head sides temporary pipes to catch possible oil leakage.
- 7 -Start the engine, use force on the boom to raise the machine, and remove the trestles supporting the outriggers.



- 8 -Lower the machine and stop the engine.
- 9 -Check the outriggers position for 5 minutes.
  - If one or both outriggers have a lowering movement, drift is due to single or both cylinders.
  - If there is no lowering, drift is due to control valve.



## TESTING THE AIR-CONDITIONING UNIT

★ Test conditions:

- Machine on level ground with the working equipment raised and in safety conditions
- Parking brake engaged

### 1. Testing the working temperature

- 1 -Connect the maintenance station to the high pressure valve (H.P.) and the low pressure valve (L.P.)
- 2 -Start the engine and bring it up to a speed of 1500 rpm.
- 3 -Switch on the A/C unit using the switch in the cab.
- 4 -Select an intermediate ventilation speed inside the cab.
- 5 -Use the thermometer/hygrometer **M2** to check that the temperature inside the cab is equal to or lower than the ambient temperature.

- ★ If the temperature of the cab is higher than the ambient temperature, open the doors and widows and wait until the cab temperature stabilizes at the outside value.

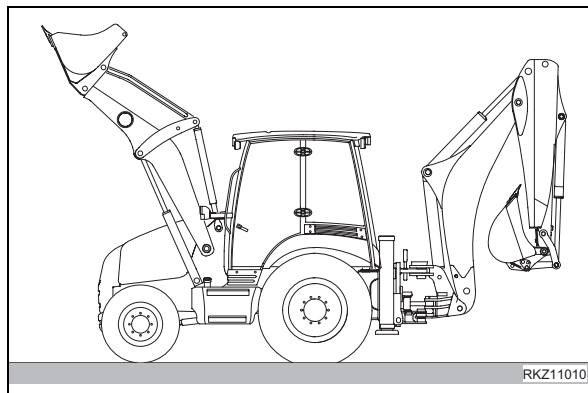
- 6 -Close the doors and windows and let the A/C unit operate in these conditions for 5 - 10 minutes.
- 7 -Use the thermometer **M2** to check the temperature of the air at the central outlets.

- ★ Position the probe as close as possible to the air outlets.

- 8 -Compare the average value of the measured temperatures using the following table:

| Ambient temperature (°C)      | 20    | 25     | 30     | 35     |
|-------------------------------|-------|--------|--------|--------|
| Outgoing air temperature (°C) | 6 – 8 | 8 – 10 | 8 – 12 | 9 – 14 |

- 9 -f the average value of the temperature measured does not fall within the values given in the table, it will be necessary to thoroughly check the unit.



**TESTING AND ADJUSTMENTS****TESTING THE AIR-CONDITIONING UNIT****2. Checking the unit**

Check the unit after the point 1., 2., 3., 4. and 6. of the precedent paragraph.

A diagnosis of faults in the unit is based on the working pressures.

When the pressures do not fall within the values given in the following table, the causes must be sought by checking the high-pressure (H.P.) and low pressure (L.P.) pressure gauges.

| Outside Temperature (°C) | Unit with R134a            |      |                            |      |
|--------------------------|----------------------------|------|----------------------------|------|
|                          | L.P. (kg/cm <sup>2</sup> ) |      | H.P. (kg/cm <sup>2</sup> ) |      |
|                          | Min.                       | Max. | Min.                       | Max. |
| 20                       | 1.2                        | 2.5  | 6.0                        | 9.0  |
| 25                       | 1.0                        | 2.5  | 7.5                        | 10.5 |
| 30                       | 1.1                        | 2.4  | 9.5                        | 13.0 |
| 35                       | 1.3                        | 2.4  | 12.0                       | 15.5 |
| 40                       | 1.5                        | 1.8  | 18.0                       | 18.8 |
| 45                       | 1.8                        | 1.9  | 21.5                       | 22.0 |

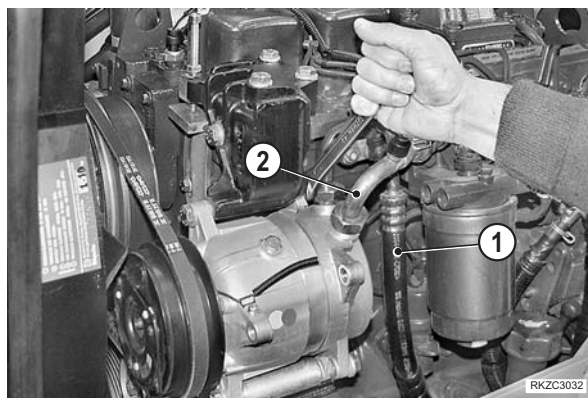
The following conditions may be found:

| Conditions                            | Causes - Faults                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>L.P. high - H.P. normal or low</b> | <ul style="list-style-type: none"> <li>• Electromagnetic pulley that slips or does not engage correctly</li> <li>• Expansion valve blocked in open position</li> <li>• Compressor damaged</li> </ul>                                                                                                                                                                            |
| <b>L.P. low - A.P. high or normal</b> | <ul style="list-style-type: none"> <li>• Expansion valve blocked in closed position or obstructed</li> <li>• Filter saturated with moisture</li> <li>• Obstruction in the L.P. line or in the H.P. line between the filter and the evaporator L.P.</li> </ul>                                                                                                                   |
| <b>L.P.normal - H.P. normal</b>       | <ul style="list-style-type: none"> <li>• Infiltration of hot air into the evaporator group, the pipes or the cab</li> <li>• Hot air circulating in the heating group</li> <li>• Formation of ice on the evaporator</li> </ul>                                                                                                                                                   |
| <b>L.P. high - H.P. high</b>          | <ul style="list-style-type: none"> <li>• Normal condition with very high ambient temperature (higher than 43°C)</li> <li>• Excess coolant (30÷35% more)</li> <li>• Overheating of condenser</li> <li>• Air present in the unit</li> <li>• Obstruction in the H.P. line between the compressor and the condenser-filter tube, behind the measurement point of the H.P</li> </ul> |
| <b>L.P. normal or low - H.P. low</b>  | <ul style="list-style-type: none"> <li>• Normal condition with very low temperature (lower than 5°C)</li> <li>• Lack of coolant (70 - 75% less) (probable leakages)</li> <li>• Obstruction in the H.P. line between the compressor and the condenser-filter tube, before the measurement point of the H.P.</li> <li>• Compressor damaged</li> </ul>                             |
| <b>L.P. roughly equal to H.P.</b>     | <ul style="list-style-type: none"> <li>• Compressor belt missing</li> <li>• Electromagnetic pulley that slips or does not engage</li> <li>• Compressor damaged</li> </ul>                                                                                                                                                                                                       |



## EMPTYING THE AIR-CONDITIONING UNIT

- 1 -Connect the maintenance station **M1** to the service valves (1) and (2) and follow the specific maintenance station instructions relative to the drainage of the unit.
- 2 -Disconnect the group to be substituted or reconditioned immediately after switching off the maintenance station. **Plug the removed or disconnected connection tubes tightly and with a minimum of delay.**
- 3 -Carefully check the quantity of anti-freeze oil recovered and contained in the disassembled parts, since the same quantity must be replaced when the air-conditioning unit is refilled.





# **TROUBLESHOOTING**

## **FRONT AXLE TROUBLESHOOTING**

| <b>Wheel vibration; front tyre resistance; halfshaft breakage</b> |                                                                                              |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                     | <b>REMEDY</b>                                                                                |
| Incorrect installation                                            | Correct installation                                                                         |
| Defective axle                                                    | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                                    | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                            | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Bent halfshaft                                                    | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>Steering is difficult; vehicle goes straight while its turning.</b> |                                                                                              |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                          | <b>REMEDY</b>                                                                                |
| Incorrect installation                                                 | Correct installation                                                                         |
| Defective axle                                                         | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                                         | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                                 | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Broken halfshaft                                                       | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>No differential action; jamming while steering.</b> |                                                                                              |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                          | <b>REMEDY</b>                                                                                |
| Incorrect installation                                 | Correct installation                                                                         |
| Defective axle                                         | Replace the differential in case it does not survive any one of the test phases              |
| Overloading/ incorrect weight distribution             | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>Excess of noise</b>                                       |                                                                                              |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                | <b>REMEDY</b>                                                                                |
| Incorrect installation                                       | Correct installation                                                                         |
| Defective axle                                               | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                               | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                       | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Overloading/ incorrect weight distribution                   | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Incorrect wheel adjustment                                   | Verify group integrity and wheel side bearings.                                              |
| Contamination in the axle box or incorrect assembly of parts | Look for foreign particles. Check assembly of the various parts of the axle.                 |

## TESTING AND ADJUSTMENTS

## TROUBLESHOOTING

| Uneven wear of tyre                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                                                                                                                                                                                                                                                       | REMEDY                                                                                                                                                                                                |
| Incorrect installation                                                                                                                                                                                                                                                                       | Correct installation                                                                                                                                                                                  |
| Defective axle                                                                                                                                                                                                                                                                               | Replace the differential in case it does not survive any one of the test phases                                                                                                                       |
| Bent halfshaft                                                                                                                                                                                                                                                                               | Remove excessive weight and redistribute load, following instructions related to the vehicle                                                                                                          |
| Different rotation radius of the tyres                                                                                                                                                                                                                                                       | Replace the tyre or adjust pressure to have same radius on both tyre                                                                                                                                  |
| Overloading/ incorrect weight distribution                                                                                                                                                                                                                                                   | Remove excessive weight and redistribute load, following instructions related to the vehicle                                                                                                          |
| Blocked halfshaft: <ul style="list-style-type: none"> <li>Abnormal functioning of the differential or breakage/blockage of command device.</li> <li>Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns.</li> </ul> | Blocked halfshaft: <ul style="list-style-type: none"> <li>Verify assembly and all components</li> <li>Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.</li> </ul> |
| Incorrect wheel adjustment                                                                                                                                                                                                                                                                   | Verify group integrity and wheel side bearings.                                                                                                                                                       |

| Friction noise                                                                                                        |                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| CAUSES                                                                                                                | REMEDY                                                                                       |
| Incorrect installation                                                                                                | Correct installation                                                                         |
| Defective axle                                                                                                        | Replace the differential in case it does not survive any one of the test phases              |
| Overloading/ incorrect weight distribution                                                                            | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Spoiled or worn out axle parts                                                                                        | Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.    |
| Contamination in the axle box or incorrect assembly of parts                                                          | Look for foreign particles. Check assembly of the various parts of the axle.                 |
| Incorrect adjustment of bevel gearset:<br>Parts of the transmission worn out.<br>(transmission gears, U joints, etc.) | Replace or adjust as required.                                                               |

| Vibration during forward drive, intermittent noise |                                                                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------------|
| CAUSES                                             | REMEDY                                                                                       |
| Incorrect installation                             | Correct installation                                                                         |
| Defective axle                                     | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                     | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres             | Replace the tyre or adjust pressure to have same radius on both tyre                         |

**TESTING AND ADJUSTMENTS**
**TROUBLESHOOTING**

| <b>Noise while driving</b>                                                                                        |                               |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Excessive backlash between pinion and ring gear                                                                   | Replace                       |
| Worn out pinion and gear ring                                                                                     | Replace                       |
| Worn out pinion bearings                                                                                          | Replace                       |
| Pinion bearings loosened                                                                                          | Replace                       |
| Excessive pinion axial backlash                                                                                   | Replace                       |
| Worn out differential bearings                                                                                    | Replace                       |
| Differential bearings loosened                                                                                    | Replace                       |
| Ring gear out of roundness                                                                                        | Replace                       |
| Low lubricant level                                                                                               | Top up                        |
| Poor or wrong lubricant                                                                                           | Replace                       |
| Bent halfshaft                                                                                                    | Replace                       |
| <b>Noise while driving in neutral</b>                                                                             |                               |
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud.                     | Replace or adjust (see above) |
| Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed) | Replace                       |
| Pinion or input flange worn out                                                                                   | Replace                       |
| <b>Intermittent noise</b>                                                                                         |                               |
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Ring gear damaged                                                                                                 | Replace bevel gear set        |
| Differential box bolts loosened                                                                                   | Tighten to torque             |
| <b>Constant noise</b>                                                                                             |                               |
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Ring gear teeth or pinion damaged                                                                                 | Replace bevel gear set        |
| Worn out bearings                                                                                                 | Replace                       |
| Pinion spline worn out                                                                                            | Replace                       |
| Bent halfshaft                                                                                                    | Replace                       |
| <b>Noise while steering</b>                                                                                       |                               |
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Worn out differential gears                                                                                       | Replace                       |
| Worn out differential box or spider                                                                               | Replace                       |
| Differential thrust washers worn out                                                                              | Replace                       |
| Half shaft spline worn out                                                                                        | Replace                       |

## FRONT AXLE CHECKING AND TROUBLESHOOTING

| Ring gear tooth broken at the outer side                                                   |                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Excessive gear load compared to the one foreseen                                           | Replace bevel gear set<br>Adjust bevel gear set freebacklash                                                                                                                                                                          |
| Incorrect gear adjustment (excessive backlash)                                             |                                                                                                                                                                                                                                       |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                       |
| Ring gear tooth broken side                                                                |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Load bump                                                                                  | Replace bevel gear set<br>Adjust bevel gear set freebacklash                                                                                                                                                                          |
| Incorrect gear adjustment (insufficient backlash)                                          |                                                                                                                                                                                                                                       |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                       |
| Pinion or ring gear teeth or worn                                                          |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Insufficient lubrication; contaminated oil;<br>incorrect lubrication or depleted additives | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute<br>at recommended intervals<br>Use correct lubricants, fill up to the right levels and<br>replace according to the recommended program. |
| Worn out pinion bearings                                                                   |                                                                                                                                                                                                                                       |
| Overheated ring and pinion teeth                                                           |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Prolong ed functioning at high temperatures                                                | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute<br>at recommended intervals                                                                                                             |
| Insufficient lubrication; contaminated oil;<br>incorrect lubrication                       |                                                                                                                                                                                                                                       |
| Pinion teeth pitting                                                                       |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Excessive use axial pinion                                                                 | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute<br>at recommended intervals                                                                                                             |
| Insufficient lubrication                                                                   |                                                                                                                                                                                                                                       |
| Axle beam body bent                                                                        |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Vehicle over loaded                                                                        | Replace axle beam body                                                                                                                                                                                                                |
| Vehicle's accident                                                                         |                                                                                                                                                                                                                                       |
| Load bump                                                                                  |                                                                                                                                                                                                                                       |
| Worn out or pitted bearings                                                                |                                                                                                                                                                                                                                       |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                                |
| Insufficient lubrication; contaminated oil                                                 | Replace bearings.<br>Use correct lubrication, fill up to the right level and substitute<br>at recommended intervals                                                                                                                   |
| Excessive use axial pinion                                                                 |                                                                                                                                                                                                                                       |
| Normal wear out                                                                            |                                                                                                                                                                                                                                       |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                       |

## TESTING AND ADJUSTMENTS

## TROUBLESHOOTING

| Oil leakage form gaskets and seals                                |                                                                                                                                                                                      |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Prolonged functioning at high temperature of the oil              | Replace the gasket or seal and matching surface if damaged.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals                           |
| Oil gasket assembled incorrectly                                  |                                                                                                                                                                                      |
| Seal lip damaged                                                  |                                                                                                                                                                                      |
| Contaminated oil                                                  |                                                                                                                                                                                      |
| Excessive wearing out of input flange spline                      |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace the flange.                                                                                                                                                                  |
| Pinion nut loosened                                               | Check that the pinion spline is not excessively worn out.<br>Replace bevel gear set if required.                                                                                     |
| Pinion axle backlash                                              |                                                                                                                                                                                      |
| Fatigue failure of pinion teeth                                   |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace bevel gear set                                                                                                                                                               |
| Continuous overload                                               |                                                                                                                                                                                      |
| Pinion and ring teeth breakage                                    |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Crash load of differential components                             | Check and/or replace other differential components                                                                                                                                   |
| Side gear spline worn out                                         |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace differential gear group.<br>Replace halfshaft if required                                                                                                                    |
| Thrust washer surface worn out or scratched                       |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Insufficient lubrication; contaminated oil; incorrect lubrication | Replace all scratched washers and those with 0.1mm thickness lower than the new ones.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals |
| Inner diameter of tapered roller bearing worn out                 |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace bearing.                                                                                                                                                                     |
| Excessive pinion axial backlash                                   | Check pinion axial backlash.                                                                                                                                                         |
| Insufficient lubrication; contaminated oil                        | Use correct lubrication, fill up to the right level and substitute at recommended intervals                                                                                          |
| Bent or broken halfshaft or halfshaft broken at wheel side        |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Vehicle intensively operated or overloaded                        | Replace the axle shaft                                                                                                                                                               |
| Wheel support loosened                                            | Check beam body distortion.                                                                                                                                                          |
| Beam body bent                                                    | Check wheel bearing and replace if necessary.                                                                                                                                        |

**REAR AXLE TROUBLESHOOTING**

| <b>Wheel vibration; front tyre resistance; halfshaft breakage</b> |                                                                                              |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                     | <b>REMEDY</b>                                                                                |
| Incorrect installation                                            | Correct installation                                                                         |
| Defective axle                                                    | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                                    | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                            | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Bent halfshaft                                                    | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>Steering is difficult; vehicle goes straight while its turning.</b> |                                                                                              |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                          | <b>REMEDY</b>                                                                                |
| Incorrect installation                                                 | Correct installation                                                                         |
| Defective axle                                                         | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                                         | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                                 | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Broken halfshaft                                                       | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>No differential action; jamming while steering.</b> |                                                                                              |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                          | <b>REMEDY</b>                                                                                |
| Incorrect installation                                 | Correct installation                                                                         |
| Defective axle                                         | Replace the differential in case it does not survive any one of the test phases              |
| Overloading/ incorrect weight distribution             | Remove excessive weight and redistribute load, following instructions related to the vehicle |

| <b>Excess of noise</b>                                       |                                                                                              |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>CAUSES</b>                                                | <b>REMEDY</b>                                                                                |
| Incorrect installation                                       | Correct installation                                                                         |
| Defective axle                                               | Replace the differential in case it does not survive any one of the test phases              |
| Bent halfshaft                                               | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres                       | Replace the tyre or adjust pressure to have same radius on both tyre                         |
| Overloading/ incorrect weight distribution                   | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Incorrect wheel adjustment                                   | Verify group integrity and wheel side bearings.                                              |
| Contamination in the axle box or incorrect assembly of parts | Look for foreign particles. Check assembly of the various parts of the axle.                 |

## TESTING AND ADJUSTMENTS

## TROUBLESHOOTING

| Uneven wear of tyre                                                                                                                                                                                                                                                                          |                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                                                                                                                                                                                                                                                       | REMEDY                                                                                                                                                                              |
| Incorrect installation                                                                                                                                                                                                                                                                       | Correct installation                                                                                                                                                                |
| Defective axle                                                                                                                                                                                                                                                                               | Replace the differential in case it does not survive any one of the test phases                                                                                                     |
| Bent halfshaft                                                                                                                                                                                                                                                                               | Remove excessive weight and redistribute load, following instructions related to the vehicle                                                                                        |
| Different rotation radius of the tyres                                                                                                                                                                                                                                                       | Replace the tyre or adjust pressure to have same radius on both tyre                                                                                                                |
| Overloading/ incorrect weight distribution                                                                                                                                                                                                                                                   | Remove excessive weight and redistribute load, following instructions related to the vehicle                                                                                        |
| Blocked halfshaft: <ul style="list-style-type: none"> <li>Abnormal functioning of the differential or breakage/blockage of command device.</li> <li>Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns.</li> </ul> | <ul style="list-style-type: none"> <li>Verify assembly and all components.</li> <li>Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.</li> </ul> |
| Incorrect wheel adjustment                                                                                                                                                                                                                                                                   | Verify group integrity and wheel side bearings.                                                                                                                                     |

| Friction noise                                                                                                  |                                                                                              |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| CAUSES                                                                                                          | REMEDY                                                                                       |
| Incorrect installation                                                                                          | Correct installation                                                                         |
| Defective axle                                                                                                  | Replace the differential in case it does not survive any one of the test phases              |
| Overloading/ incorrect weight distribution                                                                      | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Spoiled or worn out axle parts                                                                                  | Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.    |
| Contamination in the axle box or incorrect assembly of parts                                                    | Look for foreign particles. Check assembly of the various parts of the axle.                 |
| Incorrect adjustment of bevel gearset: Parts of the transmission worn out. (transmission gears, U joints, etc.) | Replace or adjust as required.                                                               |

| Vibration during forward drive, intermittent noise |                                                                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------------|
| CAUSES                                             | REMEDY                                                                                       |
| Incorrect installation                             | Correct installation                                                                         |
| Defective axle                                     | Replace the differential in case it does not survive any one of the test phases              |
| Overloading/ incorrect weight distribution         | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Bent halfshaft                                     | Remove excessive weight and redistribute load, following instructions related to the vehicle |
| Different rotation radius of the tyres             | Replace the tyre or adjust pressure to have same radius on both tyre                         |

**TESTING AND ADJUSTMENTS**
**TROUBLESHOOTING**

| <b>Noise while driving</b>                      |               |
|-------------------------------------------------|---------------|
| <b>CAUSES</b>                                   | <b>REMEDY</b> |
| Excessive backlash between pinion and ring gear | Replace       |
| Worn out pinion and gear ring                   | Replace       |
| Worn out pinion bearings                        | Replace       |
| Pinion bearings loosened                        | Replace       |
| Excessive pinion axial backlash                 | Replace       |
| Worn out differential bearings                  | Replace       |
| Differential bearings loosened                  | Replace       |
| Ring gear out of roundness                      | Replace       |
| Low lubricant level                             | Top up        |
| Poor or wrong lubricant                         | Replace       |
| Bent halfshaft                                  | Replace       |

| <b>Noise while driving in neutral</b>                                                                             |                               |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>CAUSES</b>                                                                                                     | <b>REMEDY</b>                 |
| Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud.                     | Replace or adjust (see above) |
| Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed) | Replace                       |
| Pinion or input flange worn out                                                                                   | Replace                       |

| <b>Intermittent noise</b>       |                        |
|---------------------------------|------------------------|
| <b>CAUSES</b>                   | <b>REMEDY</b>          |
| Ring gear damaged               | Replace bevel gear set |
| Differential box bolts loosened | Tighten to torque      |

| <b>Constant noise</b>             |                        |
|-----------------------------------|------------------------|
| <b>CAUSES</b>                     | <b>REMEDY</b>          |
| Ring gear teeth or pinion damaged | Replace bevel gear set |
| Worn out bearings                 | Replace                |
| Pinion spline worn out            | Replace                |
| Bent halfshaft                    | Replace                |

| <b>Noise while steering</b>          |               |
|--------------------------------------|---------------|
| <b>CAUSES</b>                        | <b>REMEDY</b> |
| Worn out differential gears          | Replace       |
| Worn out differential box or spider  | Replace       |
| Differential thrust washers worn out | Replace       |
| Half shaft spline worn out           | Replace       |



## REAR AXLE CHECKING AND TROUBLESHOOTING

| Ring gear tooth broken at the outer side                                                   |                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Excessive gear load compared to the one foreseen                                           | Replace bevel gear set<br>Adjust bevel gear set freebacklash                                                                                                                                                                    |
| Incorrect gear adjustment (excessive backlash)                                             |                                                                                                                                                                                                                                 |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                 |
| Ring gear tooth broken side                                                                |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Load bump                                                                                  | Replace bevel gear set<br>Adjust bevel gear set freebacklash                                                                                                                                                                    |
| Incorrect gear adjustment (insufficient backlash)                                          |                                                                                                                                                                                                                                 |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                 |
| Pinion or ring gear teeth or worn                                                          |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Insufficient lubrication; contaminated oil;<br>incorrect lubrication or depleted additives | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals<br>Use correct lubricants, fill up to the right levels and replace according to the recommended program. |
| Worn out pinion bearings                                                                   |                                                                                                                                                                                                                                 |
| Overheated ring and pinion teeth                                                           |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Prolong ed functioning at high temperatures                                                | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals                                                                                                          |
| Insufficient lubrication; contaminated oil;<br>incorrect lubrication                       |                                                                                                                                                                                                                                 |
| Pinion teeth pitting                                                                       |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Excessive use axial pinion                                                                 | Replace bevel gear set.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals                                                                                                          |
| Insufficient lubrication                                                                   |                                                                                                                                                                                                                                 |
| Axle beam body bent                                                                        |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Vehicle over loaded                                                                        | Replace axle beam body                                                                                                                                                                                                          |
| Vehicle's accident                                                                         |                                                                                                                                                                                                                                 |
| Load bump                                                                                  |                                                                                                                                                                                                                                 |
| Worn out or pitted bearings                                                                |                                                                                                                                                                                                                                 |
| CAUSES                                                                                     | REMEDY                                                                                                                                                                                                                          |
| Insufficient lubrication; contaminated oil                                                 | Replace bearings.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals                                                                                                                |
| Excessive use axial pinion                                                                 |                                                                                                                                                                                                                                 |
| Normal wear out                                                                            |                                                                                                                                                                                                                                 |
| Pinion nut loosened                                                                        |                                                                                                                                                                                                                                 |

## TESTING AND ADJUSTMENTS

## TROUBLESHOOTING

| Oil leakage form gaskets and seals                                |                                                                                                                                                                                      |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Prolonged functioning at high temperature of the oil              | Replace the gasket or seal and matching surface if damaged.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals                           |
| Oil gasket assembled incorrectly                                  |                                                                                                                                                                                      |
| Seal lip damaged                                                  |                                                                                                                                                                                      |
| Contaminated oil                                                  |                                                                                                                                                                                      |
| Excessive wearing out of input flange spline                      |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace the flange.                                                                                                                                                                  |
| Pinion nut loosened                                               | Check that the pinion spline is not excessively worn out.                                                                                                                            |
| Pinion axle backlash                                              | Replace bevel gear set if required.                                                                                                                                                  |
| Fatigue failure of pinion teeth                                   |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace bevel gear set                                                                                                                                                               |
| Continuous overload                                               |                                                                                                                                                                                      |
| Pinion and ring teeth breakage                                    |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Crash load of differential components                             | Check and/or replace other differential components                                                                                                                                   |
| Side gear spline worn out                                         |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace differential gear group.<br>Replace halfshaft if required                                                                                                                    |
| Thrust washer surface worn out or scratched                       |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Insufficient lubrication; contaminated oil; incorrect lubrication | Replace all scratched washers and those with 0.1mm thickness lower than the new ones.<br>Use correct lubrication, fill up to the right level and substitute at recommended intervals |
| Inner diameter of tapered roller bearing worn out                 |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Excessive use axial pinion                                        | Replace bearing.                                                                                                                                                                     |
| Excessive pinion axial backlash                                   | Check pinion axial backlash.                                                                                                                                                         |
| Insufficient lubrication; contaminated oil                        | Use correct lubrication, fill up to the right level and substitute at recommended intervals                                                                                          |
| Bent or broken halfshaft or halfshaft broken at wheel side        |                                                                                                                                                                                      |
| CAUSES                                                            | REMEDY                                                                                                                                                                               |
| Vehicle intensively operated or overloaded                        | Replace the axle shaft                                                                                                                                                               |
| Wheel support loosened                                            | Check beam body distortion.                                                                                                                                                          |
| Beam body bent                                                    | Check wheel bearing and replace if necessary.                                                                                                                                        |

**TRANSMISSION TROUBLESHOOTING**

| <b>Vehicle does not move</b>                                 |                                                                        |
|--------------------------------------------------------------|------------------------------------------------------------------------|
| <b>CAUSES</b>                                                | <b>REMEDY</b>                                                          |
| Faulty supply to solenoid valves                             | Check/Replace                                                          |
| Damaged wiring connections between transmission and vehicle  | Repair/Replace                                                         |
| Oxidised contacts in electrical wiring                       | Clean                                                                  |
| Break in electric cable                                      | Replace                                                                |
| Damaged solenoids                                            | Replace                                                                |
| Damaged sensors                                              | Replace                                                                |
| Short circuits or false contacts                             | Check/replace fuses                                                    |
| Gear selector and direction of movement selector malfunction | Replace selector                                                       |
| Shift electronic control malfunction                         | Replace                                                                |
| Incorrect oil level                                          | Top up                                                                 |
| Check for leaks                                              | Repair/Top up                                                          |
| Blocked intake filter                                        | Clean                                                                  |
| Damaged oil pump                                             | Replace                                                                |
| Damaged oil pump relief valve                                | Replace oil pump                                                       |
| Blocked/damaged transmission filter                          | Replace                                                                |
| Damaged/jammed control valve                                 | Replace                                                                |
| Damaged converter                                            | Replace                                                                |
| Oil temperature below 0°C                                    | Wait for oil to reach working temperature (stall test)                 |
| Damaged rotary seals                                         | Replace                                                                |
| Reverser locking                                             | Repair                                                                 |
| Worn clutch unit                                             | Replace/Repair clutch unit                                             |
| No drive transmission (broken gears, shafts, bearings, etc.) | Check/Repair/Replace                                                   |
| <b>Vehicle has reduced power transmission</b>                |                                                                        |
| <b>CAUSES</b>                                                | <b>REMEDY</b>                                                          |
| Incorrect oil temperature                                    | Wait for oil to reach working temperature (stall test)                 |
| Transmission oil overheating                                 | Restore acceptable temperature values                                  |
| Incorrect operating pressure                                 | Check hydraulic circuit and replace (oil pump, filters, control valve) |
| Damaged converter                                            | Replace                                                                |
| Incorrect oil level                                          | Top up                                                                 |
| Worn clutch unit                                             | Replace/Repair                                                         |
| 4WD clutch failure                                           | Repair/Replace 4WD shaft group                                         |
| Overheated solenoids/solenoid valves                         | Replace                                                                |
| Damaged wiring connections between transmission and vehicle  | Repair/Replace                                                         |
| Damage to shift electronic control logic                     | Replace                                                                |
| Damaged sensors                                              | Replace                                                                |

## TESTING AND ADJUSTMENTS

## TROUBLESHOOTING

| Overheating                                                  |                      |
|--------------------------------------------------------------|----------------------|
| CAUSES                                                       | REMEDY               |
| Damaged hydraulic cooling system                             | Repair               |
| Dirty heat exchanger                                         | Clean                |
| Parking brake inadvertently activated                        | Release              |
| Excessive dirt on axle wheel hubs                            | Clean                |
| Seizing (broken gears, shafts, bearings, etc.)               | Check/Repair/Replace |
| Braking force outside transmission: irregular axle operation | Check/Repair axle    |
| Clutch plate drag                                            | Repair/Replace       |
| Damaged converter                                            | Replace              |
| Damaged oil thermostat                                       | Replace              |
| Incorrect oil level                                          | Top up               |
| Worn oil pump                                                | Replace              |

| Wheels rotate when vehicle is raised     |                                                        |
|------------------------------------------|--------------------------------------------------------|
| CAUSES                                   | REMEDY                                                 |
| Clutch plate drag                        | Repair/Replace                                         |
| Low oil temperature (high oil viscosity) | Wait for oil to reach working temperature (stall test) |
| Incorrect oil specifications             | Replace oil and filters                                |
| Damaged control valve                    | Replace                                                |
| Faulty reverser locking                  | Repair/Replace                                         |

| Noise                                          |                                            |
|------------------------------------------------|--------------------------------------------|
| CAUSES                                         | REMEDY                                     |
| Damaged converter                              | Replace                                    |
| Damaged oil pump                               | Replace                                    |
| Aeration/Cavitation                            | Check oil level / Check oil specifications |
| Seizing (broken gears, shafts, bearings, etc.) | Check/Repair/Replace                       |
| Worn clutch plates                             | Replace                                    |

| Irregular actuation                                         |                                                        |
|-------------------------------------------------------------|--------------------------------------------------------|
| CAUSES                                                      | REMEDY                                                 |
| Damaged control valve                                       | Replace                                                |
| Electrical system fault                                     | Repair/Replace                                         |
| Worn clutch plates                                          | Replace                                                |
| Damaged converter                                           | Replace                                                |
| Low oil temperature (high oil viscosity)                    | Wait for oil to reach working temperature (stall test) |
| Overheating                                                 | See "overheating"                                      |
| Gear selector or direction of movement selector malfunction | Replace                                                |
| Control module malfunction                                  | Replace                                                |
| Shift electronic control malfunction                        | Replace                                                |
| Damaged hydraulic system                                    | Repair/Replace                                         |

**TESTING AND ADJUSTMENTS**
**TROUBLESHOOTING**

| <b>Gear remains engaged</b>          |                |
|--------------------------------------|----------------|
| <b>CAUSES</b>                        | <b>REMEDY</b>  |
| Damaged/jammed shuttleshaft lever    | Repair/Replace |
| Electrical system fault              | Repair/Replace |
| Damaged control valve                | Replace        |
| Damaged hydraulic system             | Repair/Replace |
| Damaged clutch unit                  | Repair/Replace |
| Selector malfunction                 | Replace        |
| Control module malfunction           | Replace        |
| Shift electronic control malfunction | Replace        |

| <b>No 4WD power transmission</b>     |                |
|--------------------------------------|----------------|
| <b>CAUSES</b>                        | <b>REMEDY</b>  |
| Damaged 4WD clutch                   | Replace        |
| Hydraulic system fault               | Repair/Replace |
| Damaged control valve                | Replace        |
| Faulty brake sensor                  | Check/Replace  |
| Electrical system fault              | Repair/Replace |
| Selector malfunction                 | Replace        |
| Control module malfunction           | Replace        |
| Shift electronic control malfunction | Replace        |

| <b>Gear shift won't engage</b>       |                |
|--------------------------------------|----------------|
| <b>CAUSES</b>                        | <b>REMEDY</b>  |
| Damage to clutch engagement assembly | Repair/Replace |
| Damaged hydraulic system             | Repair/Replace |
| Damaged control valve                | Replace        |
| Damage to pressure sensors           | Check/Replace  |
| Electrical system fault              | Repair/Replace |
| Selector malfunction                 | Replace        |
| Control module malfunction           | Replace        |
| Shift electronic control malfunction | Replace        |



# 30 REMOVAL AND INSTALLATION

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## HOW TO READ THE MANUAL

### 1. Removal and Installation of the groups

- (1) The procedures and information needed to carry out the work of removing or Installing units or groups are given in the removal procedure. The sequence of operations is not repeated in the installation procedure.
- (2) Information needed for installation is marked with the symbol [\*1]; The same symbol is repeated at the end of each removal procedure for the same item, to indicate to which installation item it refers.

(Example)

REMOVAL OF THE GROUP ●●●: ..... Title of operation



..... Safety precautions to be followed when carrying out the operation.

1 - Remove XXXX (1): ..... Step in removal procedure

★: ..... Technique or important point to remember when removing XXXX (1)

2 - ▲▲▲ (2): ..... [\*1] This sign means that information is given for the installation procedure

3 - Remove ■■■ (3):



ℓ: ..... Recovery of oil or water, and the quantity to be recovered.

INSTALLATION OF THE GROUP ●●●: ..... Title of operation

● To install, reverse removal procedure.

[\*1]: ..... Technique to be used for installation

★: ..... Technique or important point to remember when installing ▲▲▲ (2)

● Addition of water or oil: ..... Step in removal procedure

★: Point to remember when adding water or oil.

2. To the precautions to be taken during the removal or installation of the groups, must be added the specific "PRECAUTIONS TO BE TAKEN WHILE WORKING". Always make sure that these precautions are taken.

### 3. List of special tools

- (1) For details of the descriptions, codes and quantities of each tool (A1; A2 etc.) mentioned in the operational procedures, see the list "SPECIAL TOOLS" supplied in this section.

### 4. List of the tightening torques and weights, and the quantities oil, liquids or grease needed to fill tanks and containers

- (1) In the operating procedures, you will find the symbols , , , , ; in the following order, these represent the values of «TIGHTENING TORQUES», «WEIGHT OF PARTS OR GROUPS», «QUANTITIES OF OIL OR LIQUIDS TO BE INTRODUCED», «SCREW LOCKING MATERIAL, SEALANTS AND LUBRICATION», «LUBRICATING GREASE».

#### NOTE

If no symbol is indicated, the values to be used are those given in the introductory sections of this manual.

## PRECAUTIONS TO BE TAKEN WHILE WORKING

★ When dismantling or installing a part, always take the following general precautions.

### 1. Precautions for removal operations

- If not otherwise indicated, lower the work equipment until it rests on the ground.
- Always use the safety devices when working with the working equipment raised.
- If the coolant liquid contains an anti-freeze substance, follow the instructions given for drainage.
- After having removed flanges and tubes, insert plugs to prevent impurities from entering.
- Before removing a cylinder, fully retract the piston and tie it with wire.
- Use a sufficiently large container to collect the oil.
- Use a receptacle of adequate capacity to collect the oil.
- Before removing a part from the machine, check the alignment reference marks which show the correct installation position. If necessary add further marks to avoid incorrect installation.
- While dismantling the connectors, always grasp them firmly to avoid undue strain on the wiring.
- If necessary, attach markers to the wires and tubes to avoid muddling them up during installation.
- Check the number and height of the adjustments to a given clearance and store them in a safe place.
- When raising the machine or some parts of it, use adequate equipment for the weight of the part concerned.
- When using screws or eyebolts to remove items of the machinery, screw them alternately, and as deeply as they will go.
- Before removing a piece, clean the surrounding area and, after removal, cover the area to prevent dirt or dust from gaining entrance.

### 2. Precautions to be taken during installation

- Tighten nuts and screws with the specified tightening torques.
- Install the flexible hoses, taking care not to entangle or twist them.
- Replace the O-rings, cotter pins and stop rings with new ones.
- Bend the cotter pins and stops in such a way as to secure them.
- When coating the threads with adhesives, clean the piece to remove oil and grease, then apply just enough adhesive to cover the threading in a uniform manner.
- When applying a liquid sealant, clean the surface involved, remove residual oil and grease, check that there are no dents or dirt, then apply the liquid sealant in a uniform manner.
- Clean all the parts, remove dirt, rust, burrs, or dents.
- Apply a film of engine oil over all the moving parts.
- Apply a film of anti-friction grease (ASL800040) over all surfaces assembled with pressure, to avoid sticking.
- After having mounted the snap-rings, check that they are firmly positioned in their seatings.
- When installing electrical system jacks, remove any oil, dust or water that may have penetrated into them, then connect them firmly.
- If using eyebolts, check that they are not distorted, screw them in fully, and then align the eye with the hoisting hook.
- Mount the flanges in a uniform manner, and tighten the screws in criss-cross sequence, to avoid excessive pull on one side only.

### 3. Precautions to be taken on completion of removal and installation operations.

- If the coolant liquid has been drained away, close the drainage plug and add new liquid up to normal level. Start the engine to circulate the liquid throughout the cooling system and then top up the level once more.
  - When the hydraulic equipment has been dismantled, add engine oil to the indicated level. Start up the engine to circulate the oil in the hydraulic circuits, and then top up to the indicated level.
  - Fill with lubricant when installing mechanical assemblies.
  - If hoses or hydraulic equipment, such as hydraulic cylinders, pumps, motors, solenoid valves and valves, are removed for repairs or substitution, bleed air from the hydraulic circuits after having re-assembled the machine.
- ★ For details, see «20. TESTING AND ADJUSTMENTS».
- After having re-assembled cylinder joints or cylinders, or work equipment articulations, lubricate thoroughly.

## SPECIAL TOOLS

| Nature of work                       | Symbol |    | Code     | Name                      | Q.ty |
|--------------------------------------|--------|----|----------|---------------------------|------|
| Removal of piston pump               | B      | 1  |          | Pump support tool         | 1    |
| Removal of transmission              |        | 2  |          | Transmission support tool | 1    |
| Disassembly - assembly<br>front axle | D      | 1  | CA715655 | Plunger                   | 1    |
|                                      |        | 2  | CA119097 | Plunger                   | 1    |
|                                      |        | 3  | CA715360 | Plunger                   | 1    |
|                                      |        | 4  | CA715035 | Plunger                   | 1    |
|                                      |        | 5  | CA715026 | Plunger                   | 1    |
|                                      |        | 6  | CA715077 | Plunger                   | 1    |
|                                      |        | 7  | CA715034 | Plunger                   | 1    |
|                                      |        | 8  | CA715163 | Plunger                   | 1    |
|                                      |        | 9  | CA119043 | Plunger                   | 1    |
|                                      |        | 10 | CA715779 | Plunger                   | 1    |
|                                      |        | 11 | CA715164 | Plunger                   | 1    |
|                                      |        | 12 | CA119030 | Ring nut spanner wrench   | 1    |
|                                      |        | 13 | CA119230 | Plunger                   | 1    |
|                                      |        | 14 | CA119099 | Closed end wrench         | 1    |
|                                      |        | 15 | CA715170 | Closed end wrench         | 1    |
|                                      |        | 16 | CA119225 | Plunger                   | 1    |
|                                      |        | 17 | CA715023 | False pinion              | 1    |
|                                      |        | 18 | CA119182 | False differential box    | 1    |
|                                      |        | 19 | CA119206 | False differential box    | 1    |
|                                      |        | 20 | CA715179 | Plunger                   | 1    |
|                                      |        | 21 | CA715701 | Plunger                   | 1    |

**REMOVAL AND INSTALLATION****SPECIAL TOOLS**

| Nature of work                   | Symbol |    | Code     | Name                                            | Q.ty |
|----------------------------------|--------|----|----------|-------------------------------------------------|------|
| Disassembly - assembly rear axle | E      | 1  | CA715550 | Plunger                                         | 1    |
|                                  |        | 2  | CA715902 | Removal/installation tool self adjusting kit    | 1    |
|                                  |        | 3  | CA715167 | Plunger                                         | 1    |
|                                  |        | 4  | CA715901 | Bushing                                         | 1    |
|                                  |        | 5  | CA715026 | Plunger                                         | 1    |
|                                  |        | 6  | CA715477 | Plunger                                         | 1    |
|                                  |        | 7  | CA715900 | Removal/installation tool differential ring nut | 1    |
|                                  |        | 8  | CA715391 | Plunger                                         | 1    |
|                                  |        | 9  | CA715170 | Closed end wrench                               | 1    |
|                                  |        | 10 | CA119099 | Closed end wrench                               | 1    |
|                                  |        | 11 | CA715092 | Outer ring installation tool pinion bearing     | 1    |
|                                  |        | 12 | CA119225 | Outer ring installation tool pinion bearing     | 1    |
|                                  |        | 13 | CA715128 | False pinion                                    | 1    |
|                                  |        | 14 | CA119198 | False differential box                          | 1    |

**REMOVAL AND INSTALLATION**
**SPECIAL TOOLS**

| Nature of work                             | Symbol   | Code      | Name                                         | Q.ty |
|--------------------------------------------|----------|-----------|----------------------------------------------|------|
| <b>Disassembly - assembly transmission</b> | <b>F</b> | <b>1</b>  | CA715409 Plunger                             | 1    |
|                                            |          | <b>2</b>  | CA715004 Plunger                             | 1    |
|                                            |          | <b>3</b>  | CA715623 Plunger                             | 1    |
|                                            |          | <b>4</b>  | CA715494 Control                             | 1    |
|                                            |          | <b>5</b>  | CA715495 Protection + shims                  | 1    |
|                                            |          | <b>6</b>  | CA715497 Plunger                             | 1    |
|                                            |          | <b>7</b>  | CA715356 Calibrator                          | 1    |
|                                            |          | <b>8</b>  | CA715501 Plunger                             | 1    |
|                                            |          | <b>9</b>  | CA715358 Installation/assembly tool clutches | 1    |
|                                            |          | <b>10</b> | CA715499 Protection                          | 1    |
|                                            |          | <b>11</b> | CA715046 Plunger                             | 1    |
|                                            |          | <b>12</b> | CA715743 Protection + shims                  | 1    |
|                                            |          | <b>13</b> | CA715746 Plunger                             | 1    |
|                                            |          | <b>14</b> | CA715745 Calibrator                          | 1    |
|                                            |          | <b>15</b> | CA715732 Lifting of B, C, and E shafts       | 1    |
|                                            |          | <b>16</b> | CA715149 Plunger                             | 1    |
|                                            |          | <b>17</b> | CA715744 Protection + shims                  | 1    |
|                                            |          | <b>18</b> | CA715747 Calibrator                          | 1    |
|                                            |          | <b>19</b> | CA715748 Plunger                             | 1    |
|                                            |          | <b>20</b> | CA716009 Calibrator                          | 1    |
|                                            |          | <b>21</b> | CA716010 Protection                          | 1    |
|                                            |          | <b>22</b> | CA716018 Protection + shims                  | 1    |
|                                            |          | <b>23</b> | CA716019 Plunger                             | 1    |
|                                            |          | <b>24</b> | CA716020 Calibrator                          | 1    |
|                                            |          | <b>25</b> | CA716021 Extractor                           | 1    |

**REMOVAL AND INSTALLATION**
**SPECIAL TOOLS**

| Nature of work                  | Symbol |   | Code         | Name                                           | Q.ty |
|---------------------------------|--------|---|--------------|------------------------------------------------|------|
| Disassembly - assembly cylinder | U      | 1 | 790-502-1003 | Equipment                                      | 1    |
|                                 |        |   | 790-101-1102 | Pump                                           | 1    |
|                                 |        | 2 | 790-102-3802 | Key                                            | 1    |
|                                 |        | 3 | 790-302-1310 | Key 65 mm                                      | 1    |
|                                 |        |   | 790-302-1280 | Key 55 mm                                      | 1    |
|                                 |        |   | 790-302-1270 | Key 50 mm                                      | 1    |
|                                 |        |   | 790-302-1390 | Key 46 mm                                      | 1    |
|                                 |        | 4 | 790-102-4300 | Expander                                       | 1    |
|                                 |        | 5 | 796-720-1670 | Calibrator for boom cylinder                   | 1    |
|                                 |        |   | 07281-01279  |                                                |      |
|                                 |        |   | 796-720-1660 | Calibrator for arm and swing cylinders         | 1    |
|                                 |        |   | 07281-01159  |                                                |      |
|                                 |        |   | 796-720-1650 | Calibrator for bucket and shovel arm cylinders | 1    |
|                                 |        |   | 07281-01029  |                                                |      |
|                                 |        |   | 796-720-1640 | Calibrator for outriggers and shovel cylinders | 1    |
|                                 |        |   | 07281-00909  |                                                |      |
|                                 |        | 6 | 790-201-1702 | Driver kit                                     | 1    |
|                                 |        |   | 790-101-5021 | . Handle                                       | 1    |
|                                 |        |   | 01010-50816  | . Screw                                        | 1    |
|                                 |        |   | 790-201-1781 | . Driver for boom cylinder                     | 1    |
|                                 |        |   | 790-201-1771 | . Driver for bucket cylinder                   | 1    |
|                                 |        |   | 790-201-1761 | . Driver for swing and shovel arm cylinder     | 1    |
|                                 |        |   | 790-201-1751 | . Driver for shovel cylinder                   | 1    |
|                                 |        |   | 790-201-1741 | . Driver for outrigger cylinder                | 1    |
|                                 |        | 7 | 790-201-1500 | Driver kit                                     | 1    |
|                                 |        |   | 790-101-5021 | . Handle                                       | 1    |
|                                 |        |   | 01010-50816  | . Screw                                        | 1    |
|                                 |        |   | 790-201-1590 | . Driver for boom cylinder                     | 1    |
|                                 |        |   | 790-201-1580 | . Driver for bucket cylinder                   | 1    |
|                                 |        |   | 790-201-1570 | . Driver for swing and shovel arm cylinder     | 1    |
|                                 |        |   | 790-201-1560 | . Driver for shovel cylinder                   | 1    |
|                                 |        |   | 790-201-1550 | . Driver for outrigger cylinder                | 1    |
|                                 |        | 8 | 790-102-4300 | Key                                            | 1    |
|                                 |        |   | 790-102-4310 | Pin                                            | 2    |

## ENGINE HOOD

### Removal

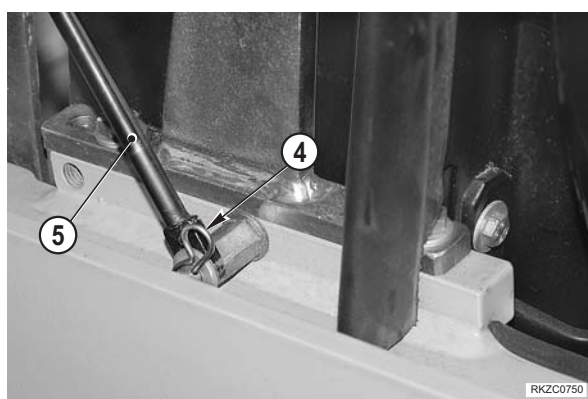
**⚠** Lower the working equipment completely until it is resting on the ground.

Stop the engine and remove the ignition key.

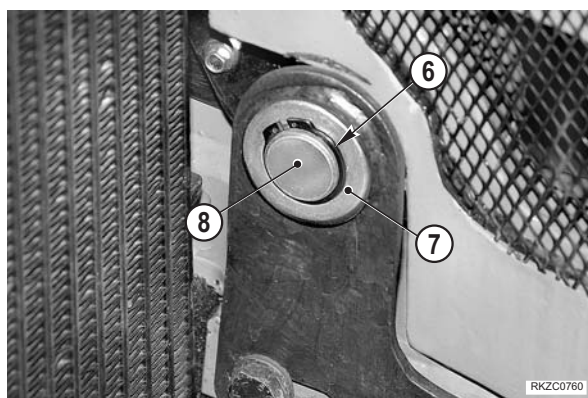
- 1 -Loosen and remove the screws (1) and washers and remove the front grille (2).



- 2 -Fully raise the engine hood (3), remove the safety pins (4) and disconnect the gas springs (5) from the chassis.



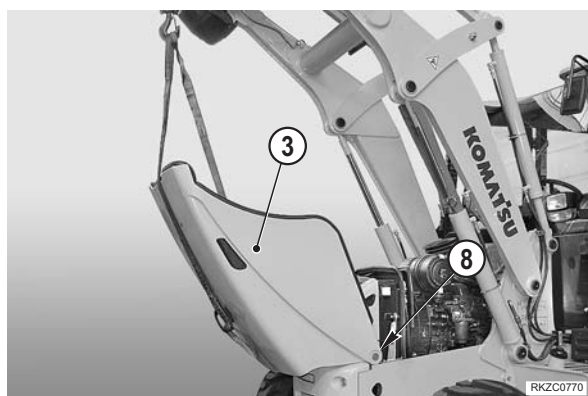
- 3 -Remove the snap rings (6) and washers (7).



- 4 -Attach lifting equipment to engine hood (3); pull out fulcrum pins (8) and remove hood (3).

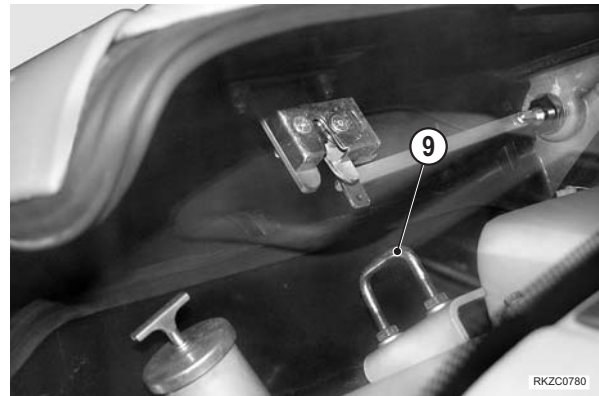


Engine hood: 32 kg



## Installation

- To install, reverse removal procedure.
- ★ Check catch (9) for proper centring.





## FRONT GUARD

### Removal

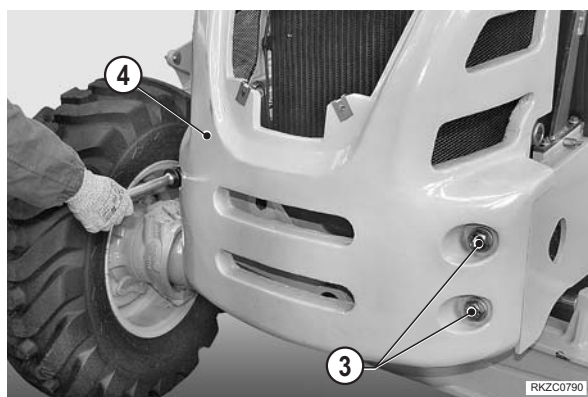
**⚠** Lower the working equipment completely until it is resting on the ground.

Stop the engine and remove the ignition key.

- 1 -Loosen and remove the screws (1) and washers and remove the front grille (2).

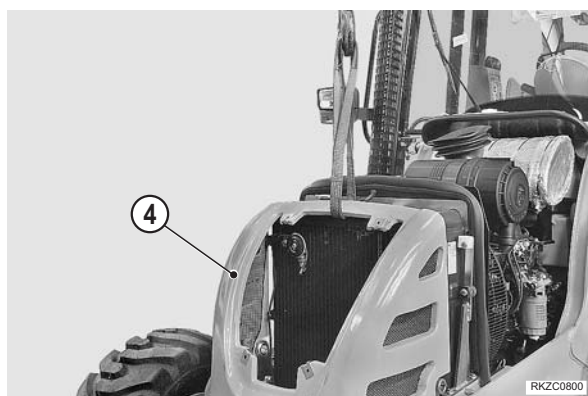


- 2 -Loosen the screws (3) retaining the guard (4) to eliminate torque. [\*1]



- 3 -Connect the guard (4) to the lifting equipment and slightly tension the rope.

- 4 -Take out the screws (1) and remove the protection (4).



### Installation

- To install, reverse removal procedure.

[\*1]

 Screw: Loctite 242

 Screw: 300 Nm

## RADIATOR GROUP

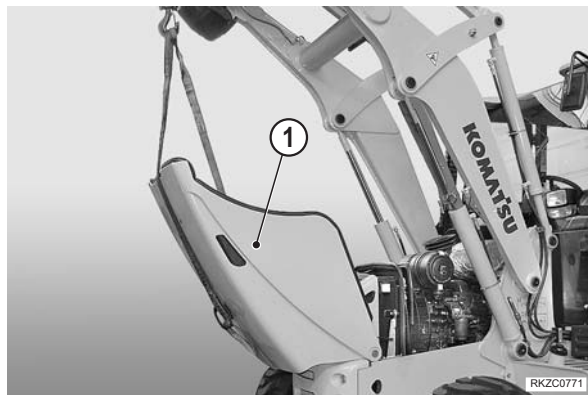
### Removal

**!** Fully raise the front working equipment and engage the safety stop.

Also place the backhoe in its secure position.

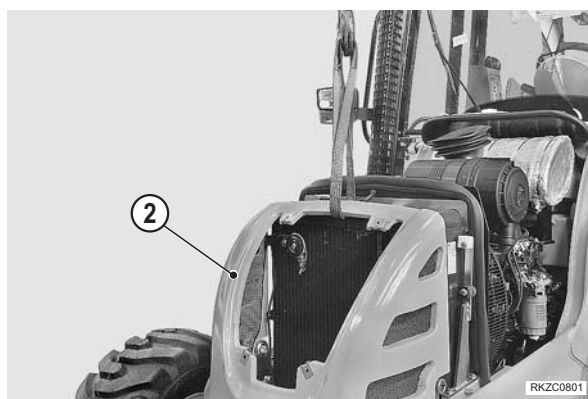
**!** Remove the ignition key.

- 1 - Remove the engine hood (1).  
(For details see "ENGINE HOOD").



- 2 - Remove the front guard (2).  
(For details see "FRONT GUARD").

**!** Release all residual pressure in all circuits.



- 3 - Open the cock (3) and drain the coolant liquid. [\*1]

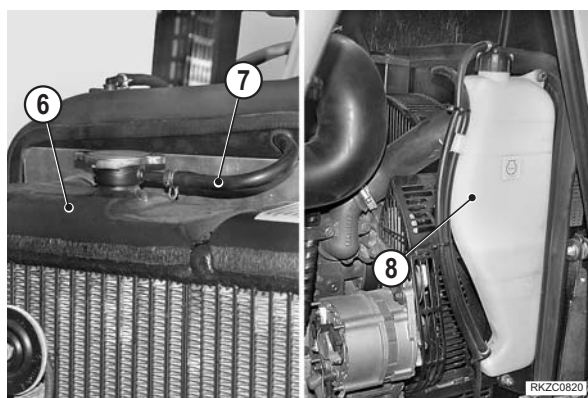
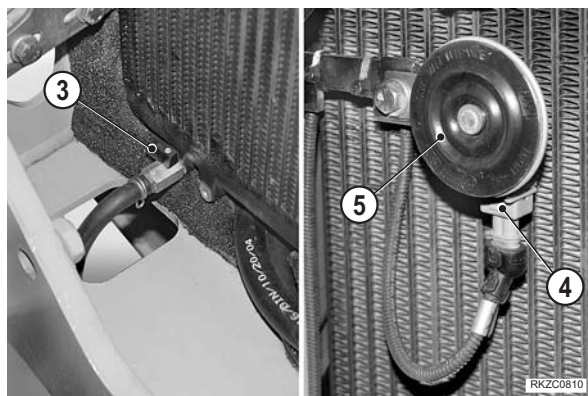


Coolant liquid: approx. 15 ℓ

**For machines equipped with an air-conditioning unit.**

- 4- Drain the air conditioning unit.  
(For details see "20 TESTING AND ADJUSTMENTS").  
[\*2]

- 5 - Disconnect the connector (4) and remove the horn (5).

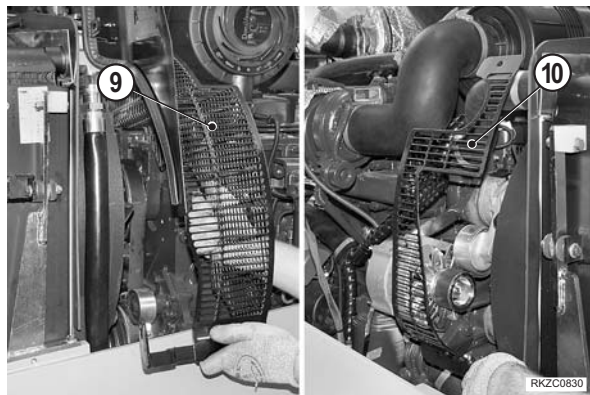


- 6 - Disconnect hose (7) from radiator (6) and remove surge tank (8).

## REMOVAL AND INSTALLATION

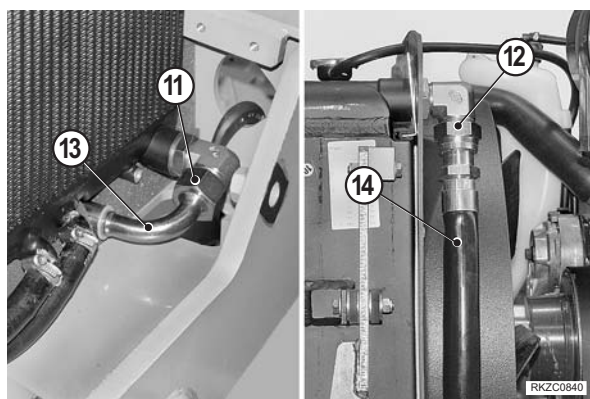
## RADIATOR GROUP

- 7 -Loosen and remove four screws and fan guards (9) and (10).



- 8 -Partly loosen fittings (11) and (12) to drain the hydraulic oil from the oil cooler; once the oil is drained, fully disconnect hoses (13), (14) and plug them to prevent contamination. [\*3]

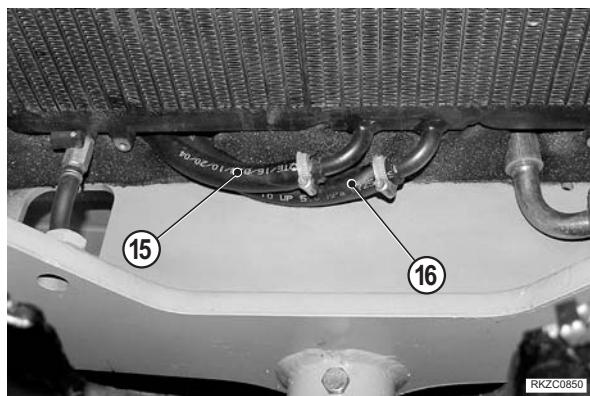
 Hydraulic oil: 40 ℓ



- 9 -Disconnect gearbox oil hoses (15) and (16) from the oil cooler and plug them to prevent contamination.

 Mark the hoses and their respective positions for connection.

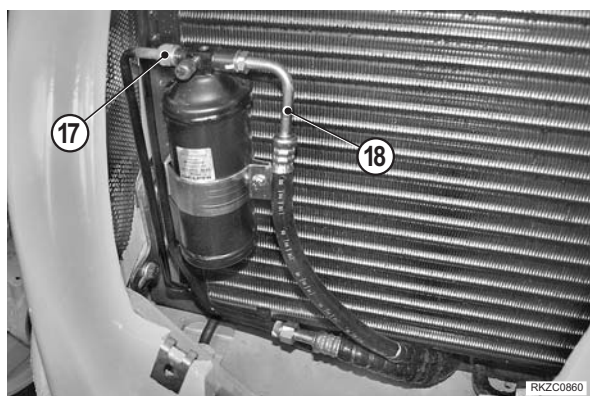
[\*4]



**For machines equipped with an air-conditioning unit.**

- 10 -Disconnect the tubes (17) and (18).

★ Immediately plug the tubes and the orifices to prevent to prevent moisture from entering into the circuit.

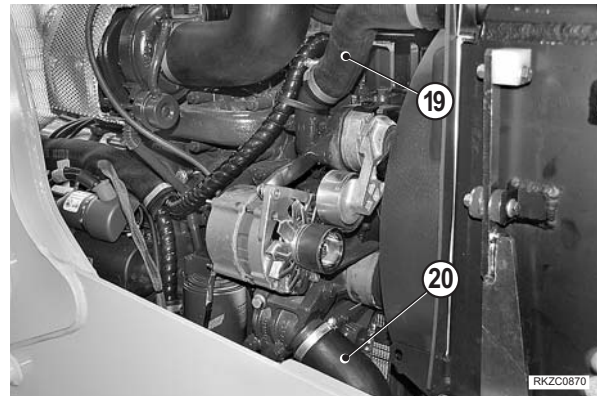




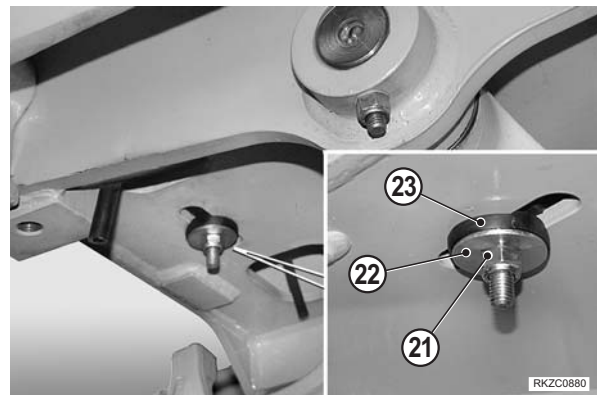
## REMOVAL AND INSTALLATION

## RADIATOR GROUP

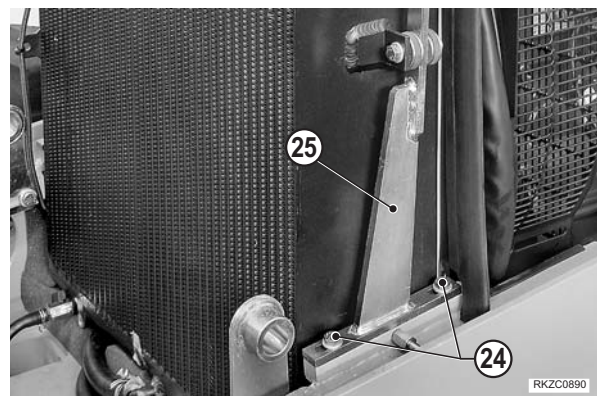
11 - Disconnect the tubes (19) and (20).



12 - Loosen and remove the self-locking nuts (21) (n°2), washers (22) and anti-vibration dampers (23).



13 - Loosen and remove the screws (24) retaining the holders (25).



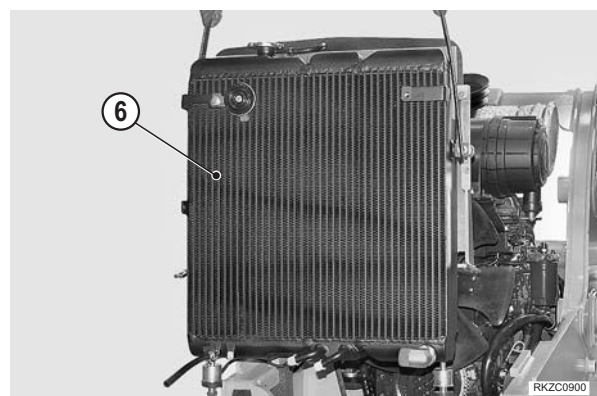
14 - Move the radiator group (6) to the front of the machine so as to disengage it from the cooling fan.

[\*5]

15 - Attach lifting equipment to the group (6) and remove the group.



Radiator group: 37 kg



## Installation

- ★ To install, reverse removal procedure.

[\*1]

- ★ Refill the coolant liquid circuit.



Coolant liquid: 15 ℓ

[\*2]

- ★ Refill the air-conditioning unit.



Quantity of fluid (R134a): 2250 ±150 g

Quantity of oil: see the amount recovered.

[\*3]

- ★ Fill the tank with hydraulic oil up to maximum level.



Hydraulic oil: 40 ℓ

[\*4]

- ★ Ensure that the level of transmission oil is at maximum.

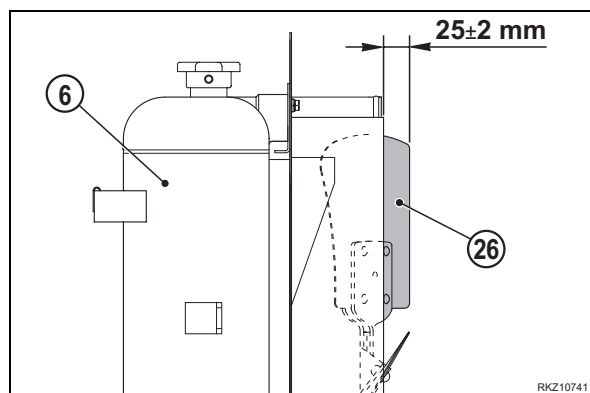
1 -Start the engine at low idling to circulate all the fluids and to fill up the systems.

2 -Accelerate gradually up to 1700 rpm; after about one minute, stop the engine and check or top up the level.

- ★ After about one minute, stop the engine and top up all levels.

[\*5]

- ★ Align radiator (6) with fan (26), making sure the fan protrudes from fan shroud by 25±2 mm.



## REMOVAL AND INSTALLATION

## CONDENSER (For machines equipped with an air-conditioning unit)

# CONDENSER (For machines equipped with an air-conditioning unit)

### Removal

- ⚠ Fully raise the front working equipment and engage the safety stop.

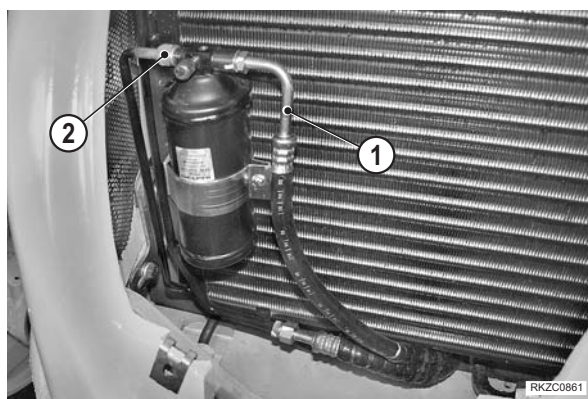
Also place the backhoe in its secure position.

- 1 - Drain the air conditioning unit.  
(For details see "20 TESTING AND ADJUSTMENTS").

- 2 - Remove the front grille and the front guard  
(For details see "FRONT GUARD").

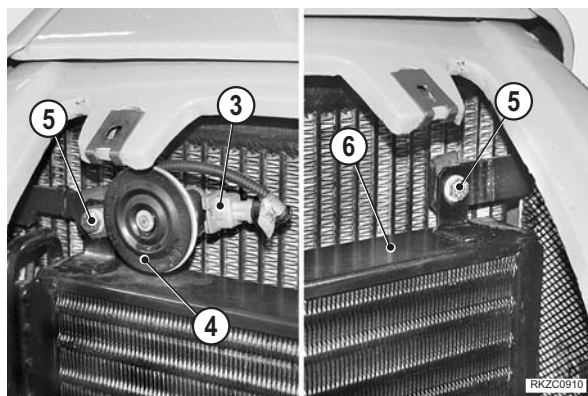
- 3 - Disconnect the tubes (1) and (2).

- ★ Immediately plug the tubes and the condenser tightly to prevent moisture from entering into the air-conditioning circuit.



- 4 - Disconnect the connector (3) and remove the horn (4).

- 5 - Loosen and remove four screws (5) and washers, and remove condenser (6) together with dehydrating filter.



### Installation

- To install, reverse removal procedure.

- 1 - Refill the air-conditioning unit. (For details, see "20 TESTING AND ADJUSTMENTS").

## MUFFLER

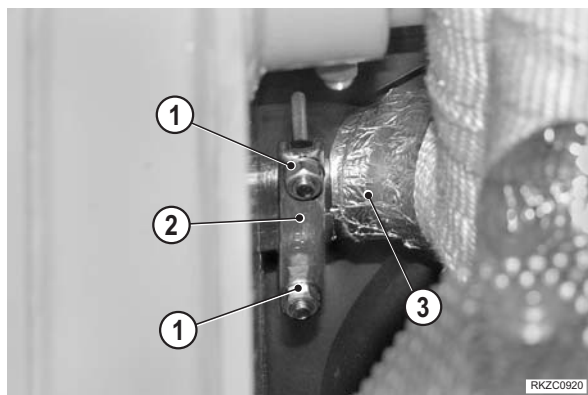
### Removal

**⚠** Fully raise the front working equipment and engage the safety stop.

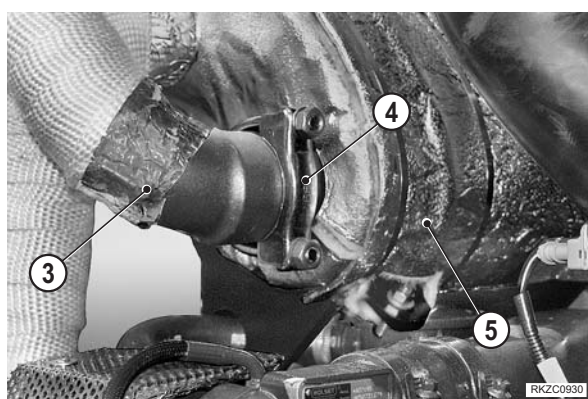
Also place the backhoe in its secure position.

**⚠** Remove the ignition key and fully raise the engine hood.

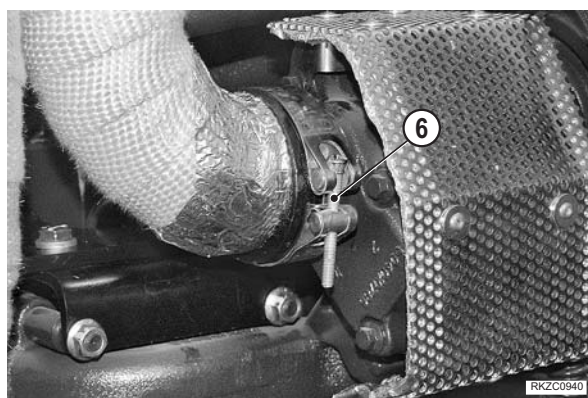
1 -Loosen the nuts (1) on the jumper pin (2) retaining the muffler pipe (3) to the exhaust pipe.



2 -Loosen the jumper pin (4), disconnect the pipe (3) from the muffler (5) and remove pipe.

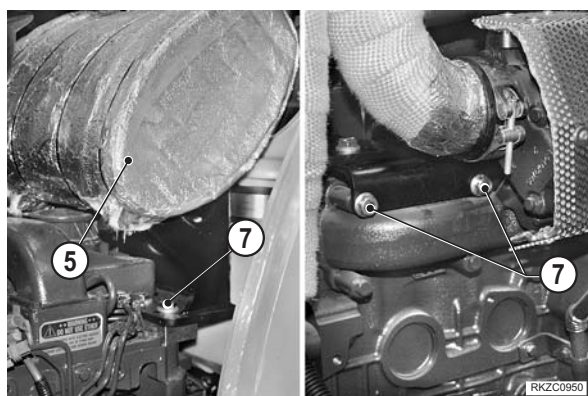


3 -Loosen the tie strap (6) retaining the muffler pipe to the turbocharger.



4 -Loosen and remove the four screws (7) and washers.

5 -Remove the muffler (5).



### Installation

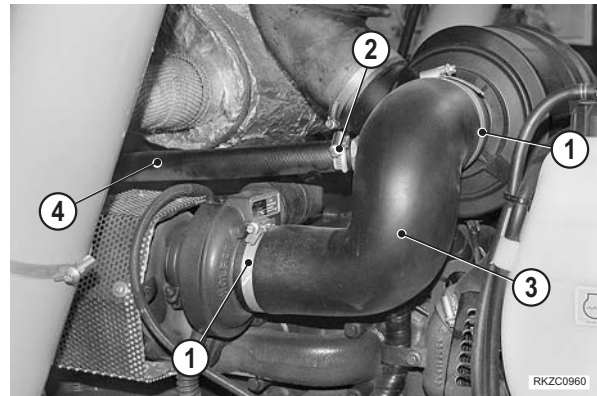
- To install, reverse removal procedure.



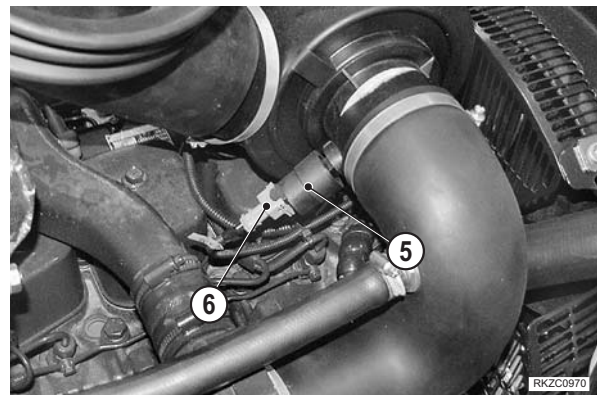
## AIR FILTER

### Removal

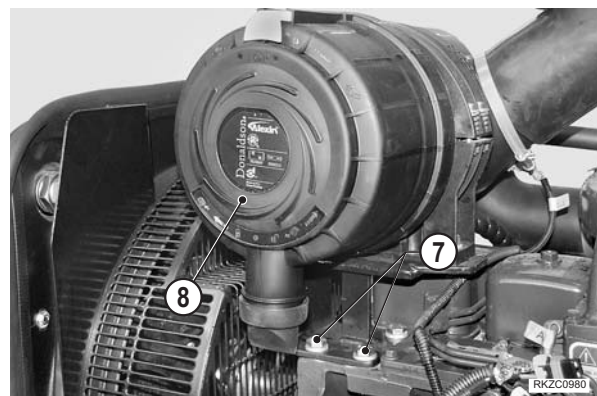
- 1 -Park the machine on hard, level ground, apply the parking brake, stop the engine and remove the ignition key.
- 2 -Fully open engine hood, loosen straps (1) and (2), and disconnect pipes (3) and (4).



- 3 -Disconnect connector (6) from filter clogging sensor (5).



- 4 -Loosen and remove the screws (7) and remove the filter (8) together with the filter holder.



### Installation

- To install, reverse removal procedure.



## TURBOCHARGER

### Removal

**⚠** Fully raise the front working equipment and engage the safety stop.

Also place the backhoe in its secure position.

**⚠** Remove the ignition key.

1 -Disconnect the vapour recovery pipe (2) from the suction pipe (1).

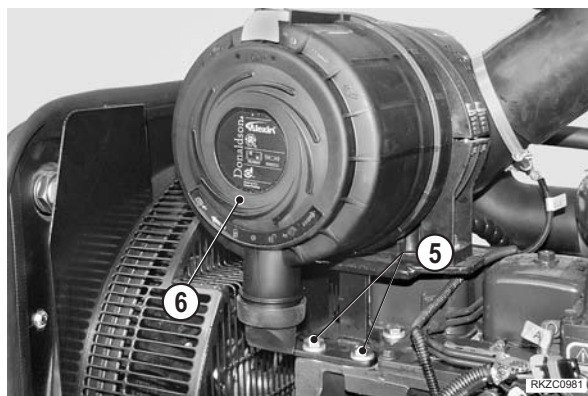
2 -Disconnect the suction pipe (1) from the turbocharger (3).



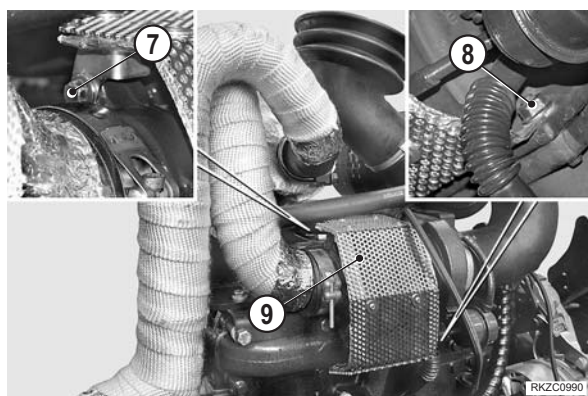
3 -Disconnect the connector (4) from the filter clogging lamp.



4 -Loosen and remove the screws (5) and the air filter (6).



5 -Loosen and remove screw (7) and nut (8), and remove heat guard (9).



## REMOVAL AND INSTALLATION

## TURBOCHARGER

- 6 -Remove the muffler (10)  
(For details see "MUFFLER").



- 7 -Remove the turbocharger (3) according to the instructions provided in the engine manual (manual code WHBMNEF000).



## Installation

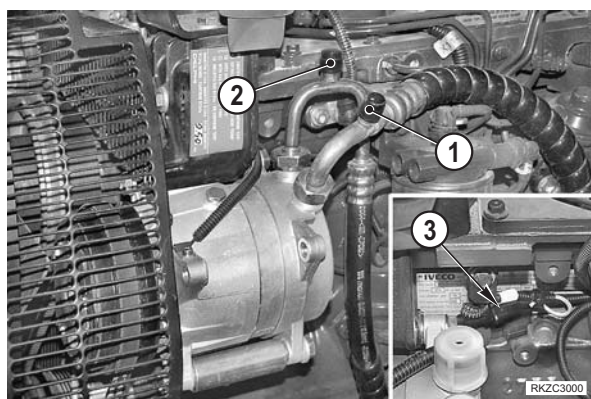
- To install, reverse removal procedure.

## AIR-CONDITIONING UNIT COMPRESSOR

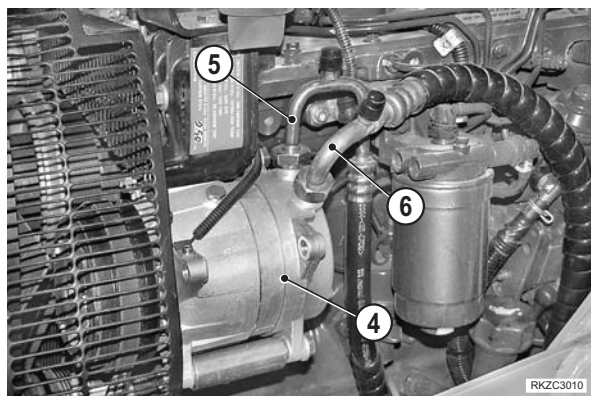
### Removal

-  Fully raise the front working equipment and engage the safety stop.  
Also place the backhoe in its secure position.
-  Remove the ignition key.

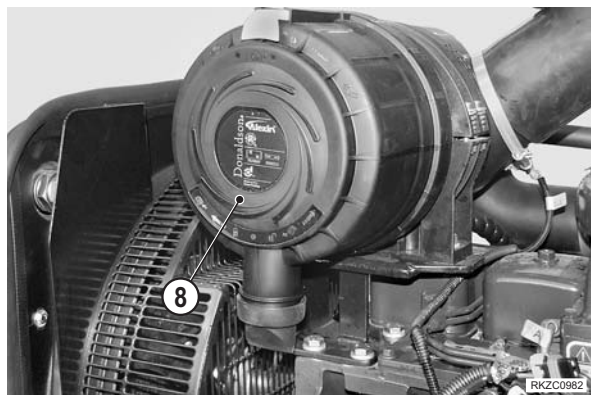
- 1 -Connect the outlets (1) and (2) to the maintenance station for air-conditioning units and drain the cooling fluid.  
(For details see "20 TESTING AND ADJUSTMENTS").
- 2 -Release the tie strap and disconnect the connector (3).



- 3 -Disconnect fluid delivery and return pipes (5), (6) from compressor (4).  
[\*1]
- ★ Collect the O-rings.



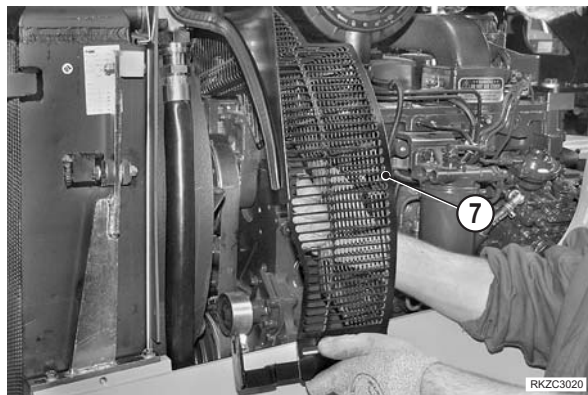
- 4 -Remove the air filter (8).



## REMOVAL AND INSTALLATION

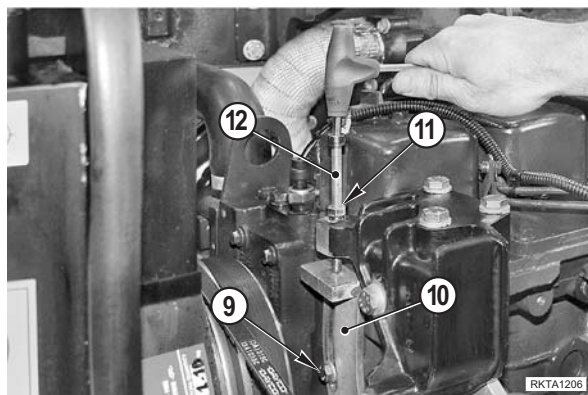
## AIR-CONDITIONING UNIT COMPRESSOR

5 -Remove the left fan guard (7).



6 -Loosen the screw (9) retaining the tensioner (10).

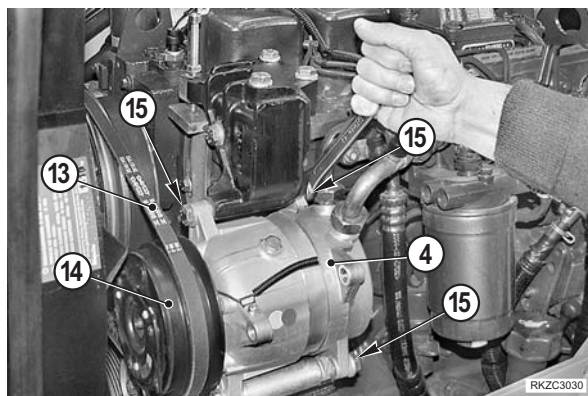
7 -Loosen the nut (11) and turn the screw (12) to loosen the belt.



8 -Disengage belt (13) from pulley (14).

9 -Loosen the screws (15) retaining the compressor (4).

10 -Take out the screws (15) and remove the compressor (4).



### Installation

- To install, reverse removal procedure.

[\*1]

★ Check O-rings for damage.

 O-rings and fittings: coolant oil

1 -Tension the compressor belt.

(For details see "AIR-CONDITIONING UNIT COMPRESSOR BELT").

2 -Connect the unit to the maintenance station and refill it.

(For details see "20 TESTING AND ADJUSTMENTS").



## AIR-CONDITIONING UNIT COMPRESSOR BELT

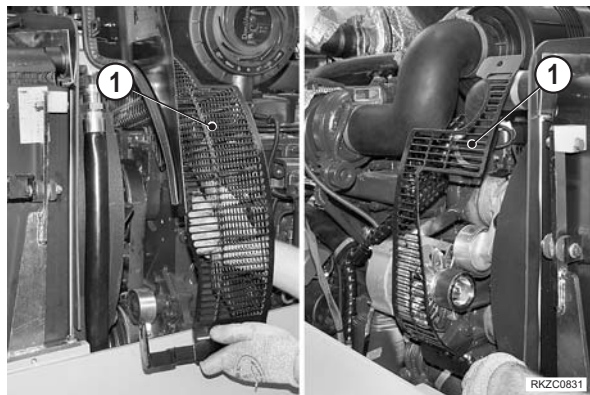
### Removal

⚠ Fully raise the front working equipment and engage the safety stop.

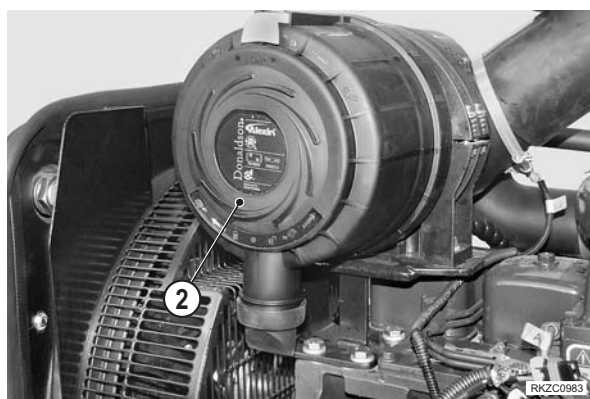
Also place the backhoe in its secure position.

⚠ Remove the ignition key.

1 -Take out the screws and remove the fan guards (1).

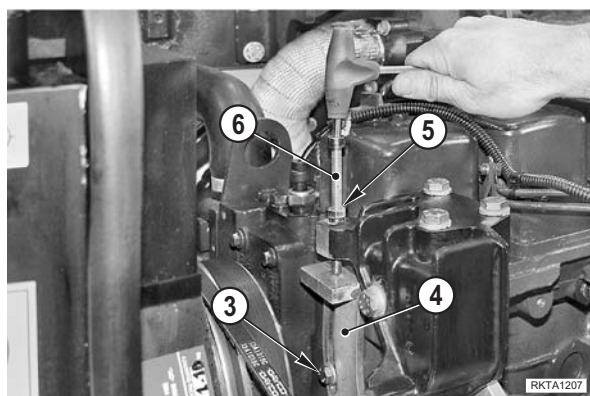


2 -Remove the air filter (2).

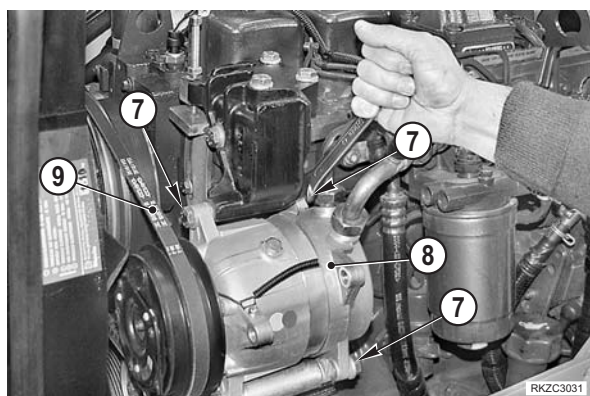


3 -Loosen the screw (3) retaining the tensioner bracket (4).

4 -Loosen nut (5) and screw (6) for belt tension.



5 -Loosen the screws (7) retaining the compressor (8) and remove the belt (9).



## **Installation**

- To install, reverse removal procedure.

[\*1]

 Bracket lock nut: 117.6 Nm

[\*2]

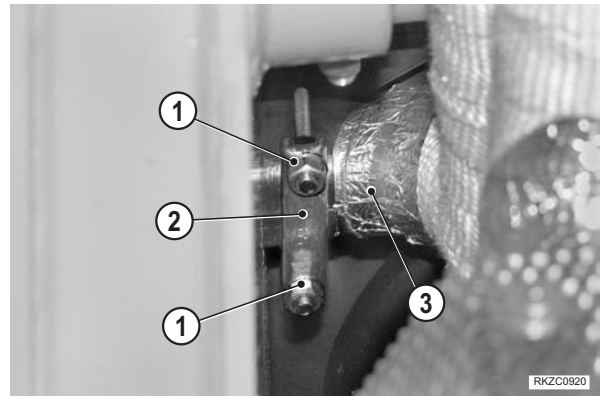
 Fan fastening nuts: 42 Nm

- 1 -Carry out the belt tensioning procedure.  
(For details see "20 TESTING AND ADJUSTMENTS").

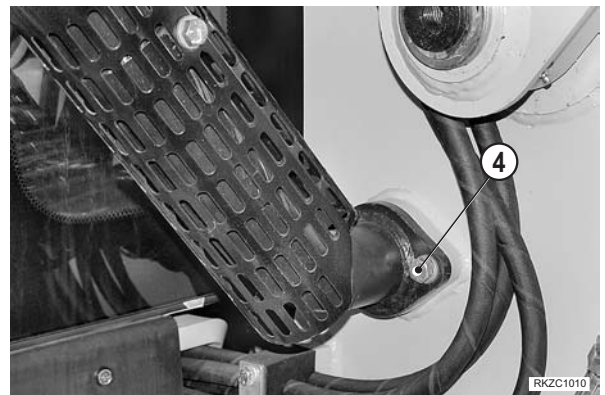
## EXHAUST PIPE

### Removal

- 1 -Loosen the nuts (1) on the jumper pin (2) retaining the muffler pipe (3) to the exhaust pipe.

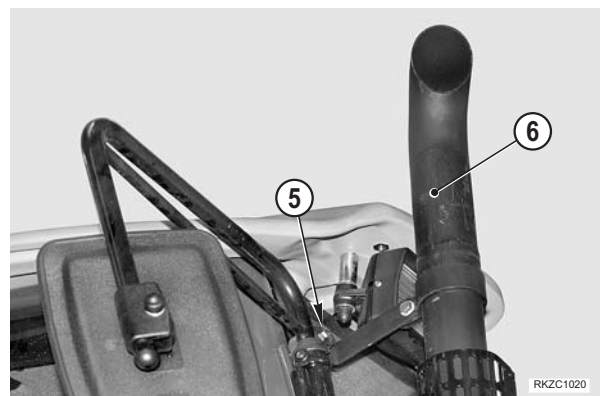


- 2 -Loosen the screws (4) on the attachment flange; remove one screw but leave the second screw in place for added safety.



- 3 -Remove the screw (5) and washer from the upper vibration damper.

- 4 -Remove the second screw (4) and remove the exhaust pipe (6).



### Installation

- To install, reverse removal procedure.

## FAN AND HEATING GROUP

### Removal

**NOTE** If no air-conditioning unit is included, perform only those operations relating to the heating unit.

⚠ Lower the working equipment completely until it rests on the ground, and stop the engine.

⚠ Disconnect the cable from battery negative terminal (-). (For details see "BATTERY").

★ Drain the engine cooling liquid.

 Coolant liquid: 15 ℓ

★ Drain the air conditioning unit. (For details see "20 TESTING AND ADJUSTMENTS").

1 - Remove the floor-mat (1); disconnect the connector (2) and remove the seat (3).

2 - Take out the screws (4) and remove the control unit protection (5).

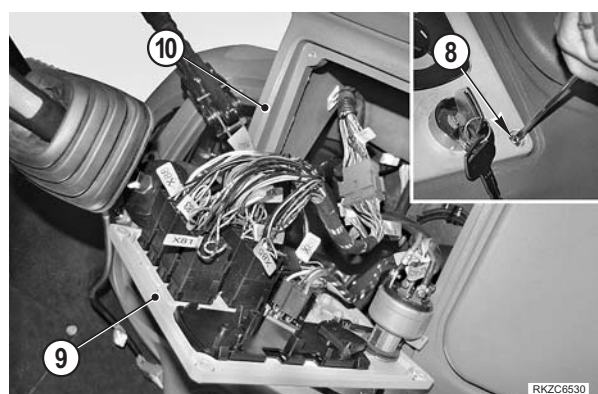
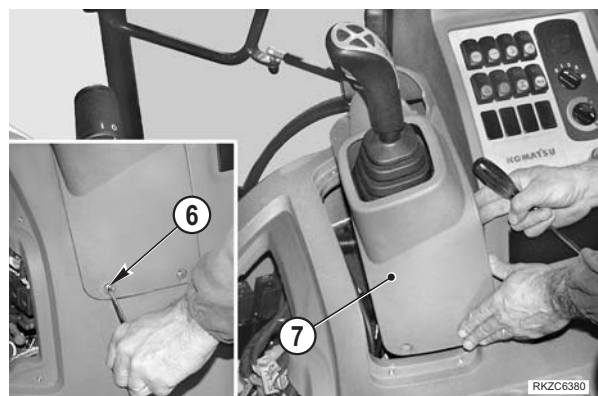
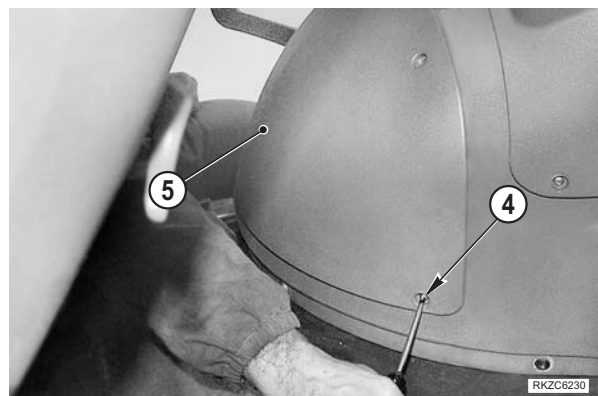
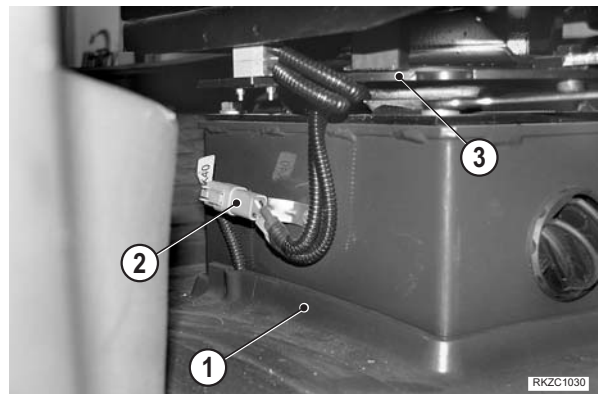
3 - Remove four screws (6) and remove PPC valve and parking brake casing (7).

4 - Remove four screw covers and screws (8).

5 - Remove the lower side instrument board (9).

★ Cut the wiring harness strap and position the instrument board (9) inside the RH case (10).

• To install, reverse removal procedure.





## REMOVAL AND INSTALLATION

## FAN AND HEATING GROUP

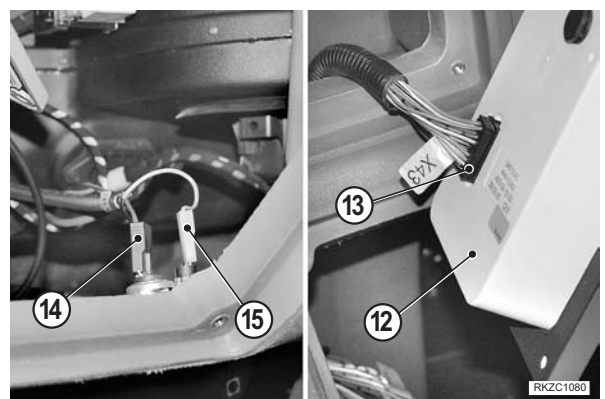
6 -Remove four screw covers and screws (11).

7 -Remove the upper side instrument board (12).



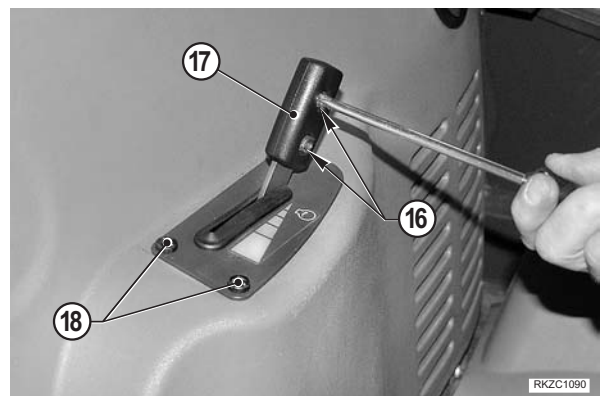
8 -Disconnect the connector (13) from the instrument board (12).

9 -Disconnect connectors (14) and (15) from the lighter.

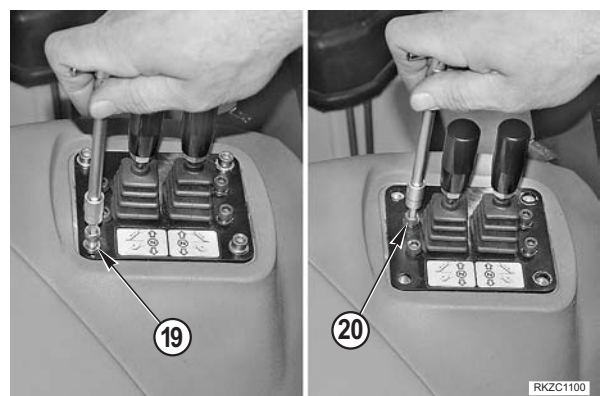


10 -Extract screws (16) and remove the hand accelerator handle (17).

11 -Remove screws (18) from the accelerator lever assembly.



12 -Loosen and remove the screws (19) and (20).

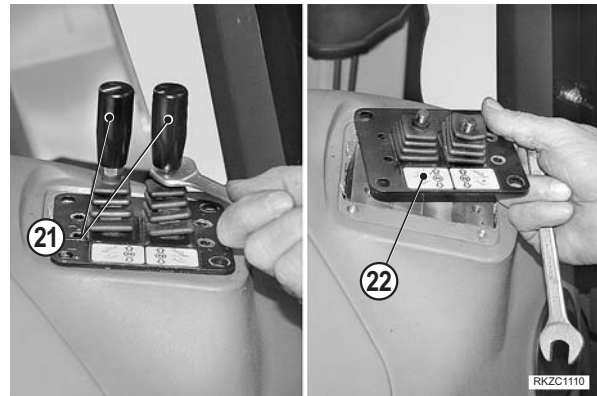


## REMOVAL AND INSTALLATION

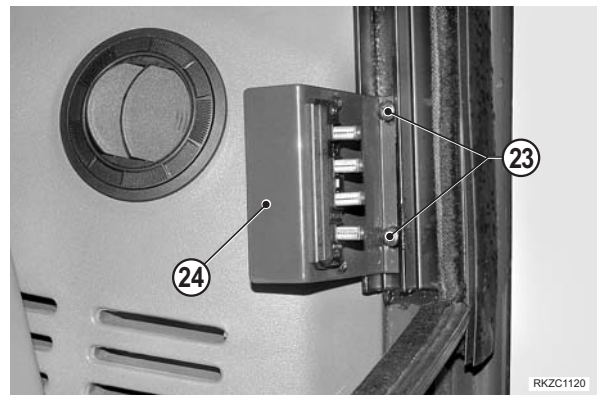
## FAN AND HEATING GROUP

13 -Loosen nuts and remove knobs (21) from outrigger PPC valves.

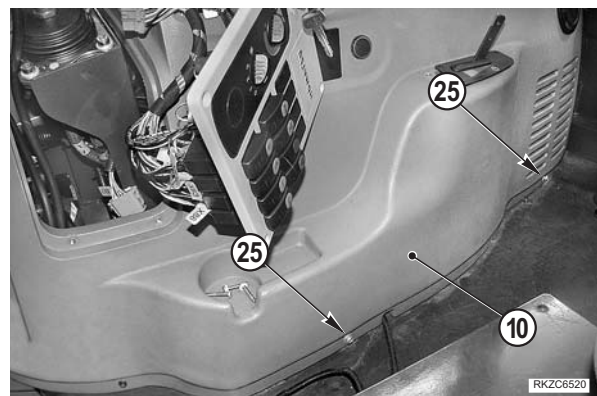
14 -Remove PPC valve mounting plate (22).



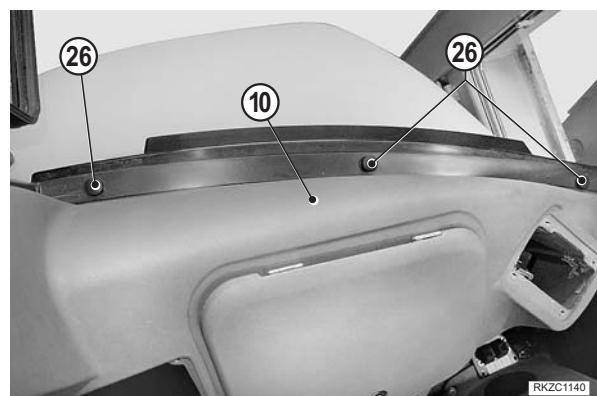
15 -Extract screws (23) and remove contact carrier plate (24) for rear wiper.



16 -Extract the lower screws (25) retaining the right hand case (10).



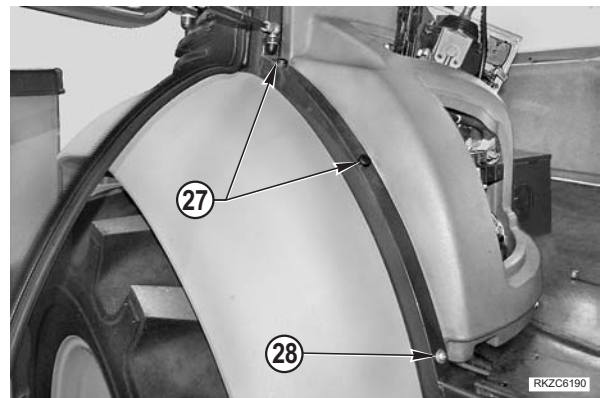
17 -Extract three screw covers (26) and screws retaining the right hand case (10) at the rear.



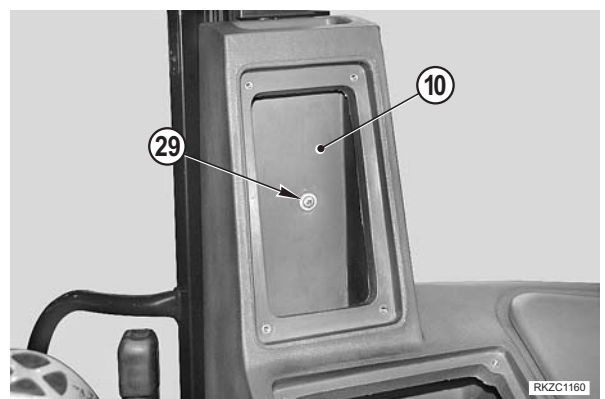
## REMOVAL AND INSTALLATION

## FAN AND HEATING GROUP

- 18 -Extract two screw covers (27) and screws; extract the lower screw (28) and washer.

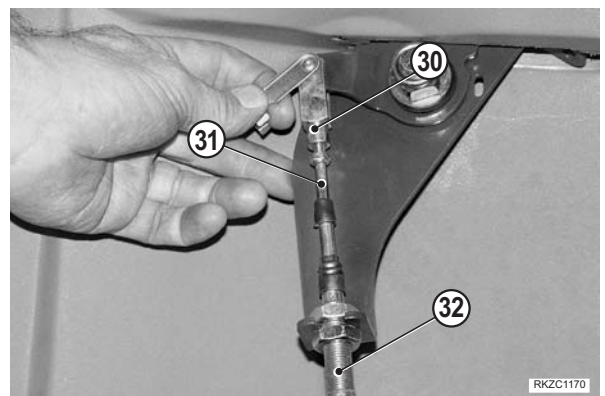


- 19 -Extract the upper screw (29) retaining the right hand case (10) and its washer.

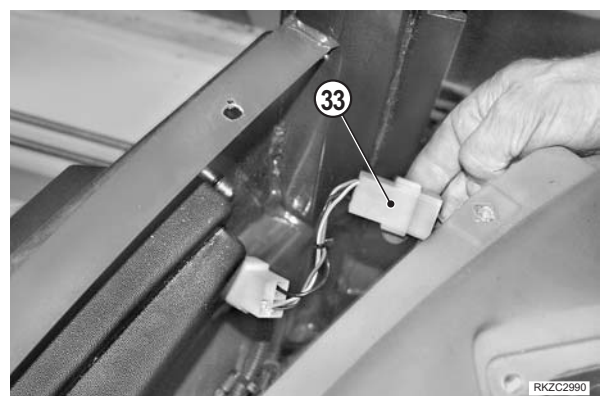


- 20 -Move the rear of the right hand case (10) towards the middle of the cab, remove pin (30), and disconnect hand accelerator cable (31).

- 21 -Loosen nut and disconnect sheath (32).



- 22 -Disconnect the contact carrier plate connector (33).

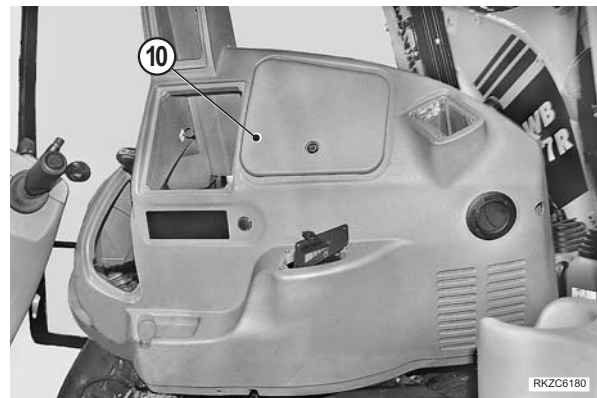


## REMOVAL AND INSTALLATION

## FAN AND HEATING GROUP

24 - Engage the parking brake.

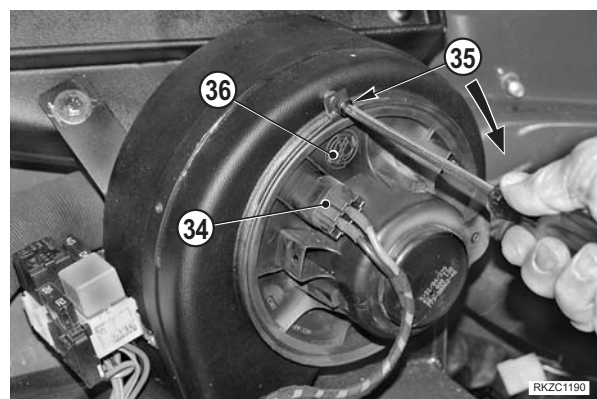
25 - Raise right hand case (10) until PPC valve control and parking brake lever are disengaged; fully remove the case.



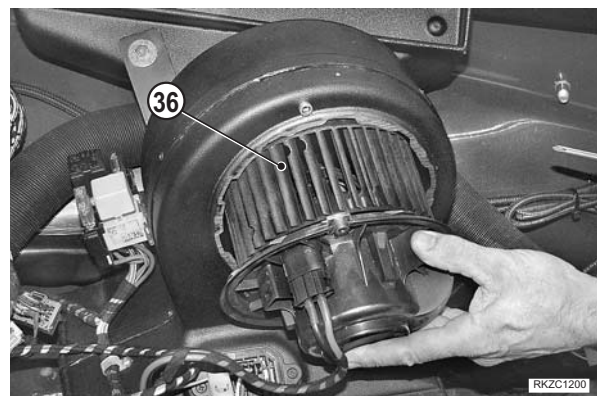
### FAN

26 - Disconnect the connector (34).

27 - Remove screw (35), then rotate fan group (36) counterclockwise.

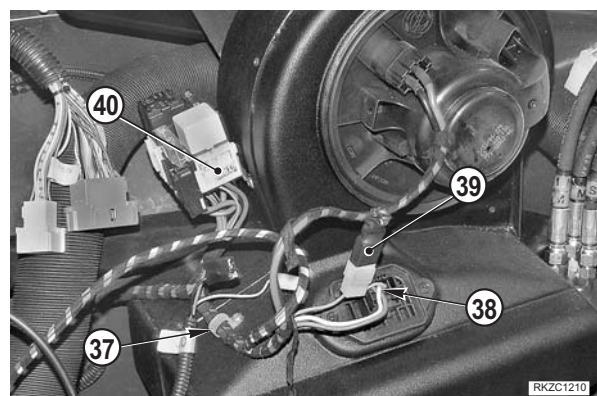


28 - Extract the fan group (36).



29 - Remove the clamp (37).

30 - Disconnect connectors (38) and (39); slide off and move to one side the fuse and relay group (40).

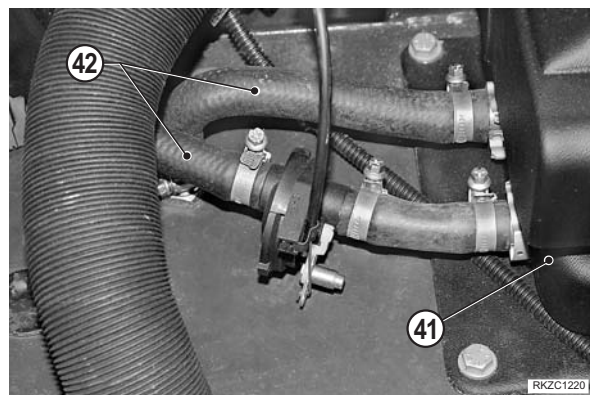




## REMOVAL AND INSTALLATION

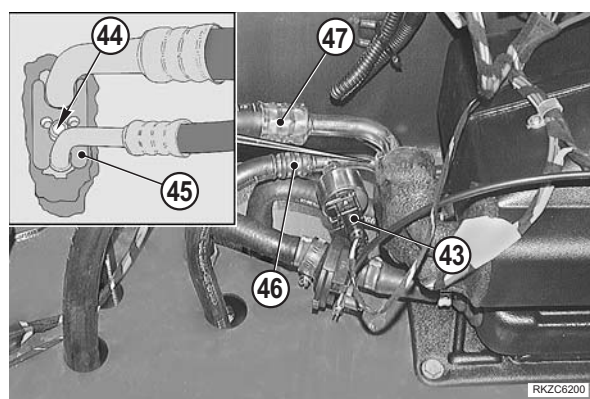
## FAN AND HEATING GROUP

- 31 -Disconnect the heating system liquid inlet and outlet pipes (42) from the oil cooler (41).



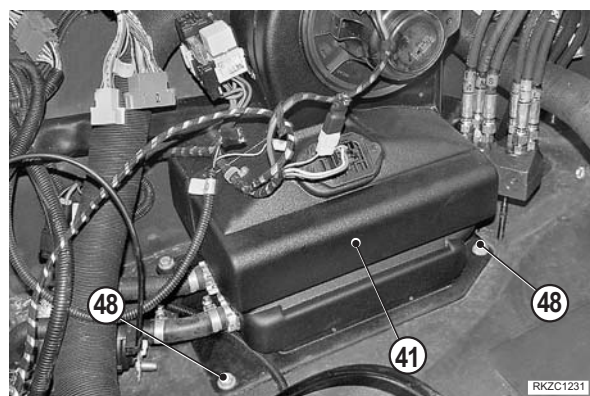
- 32 -Only for machines with air-conditioning.  
Disconnect the pressure switch connector (43).  
Remove the screw (44), the washer and the plate (45);  
disconnect delivery and return hoses (46), (47).

★ Collect the O-rings.



## OIL COOLER GROUP

- 33 -Loosen and remove the four screws (48) and remove the group (41).



## Installation

- 1 - Refill the coolant liquid.



Coolant liquid: approx. 15 ℓ

- 2 -Drain and refill the air-conditioning unit.



Quantity of fluid (R134a): 2250 ±150 g  
Quantity of oil: see the amount recovered.

- 3 -Start the engine and use a leak detector to check the leaktightness of the air-conditioning unit.

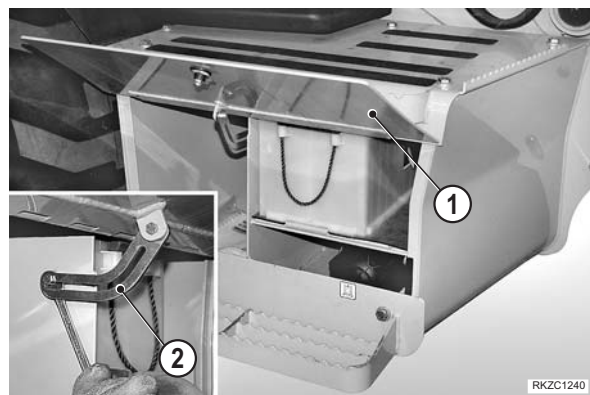
- 4 -Complete installation by reversing the removal procedure.

## BATTERY

### Removal

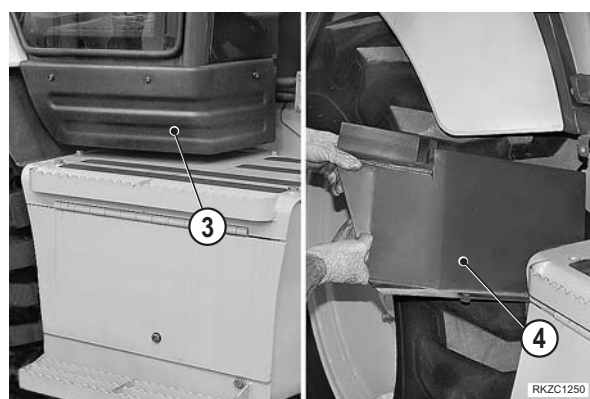
- !** Lower the working equipment completely until it is resting on the ground.  
Engage the parking brake, stop the engine and remove the ignition key.

1 -Lift the door (1) and disconnect the catch (2).

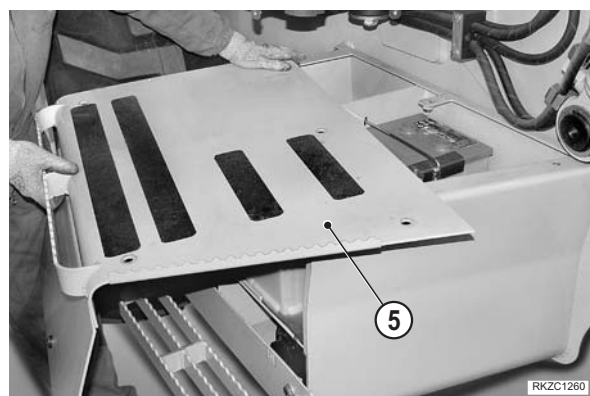


2 -Remove the lower right-hand guard (3) of the cab.

3 -Remove the protection (4).

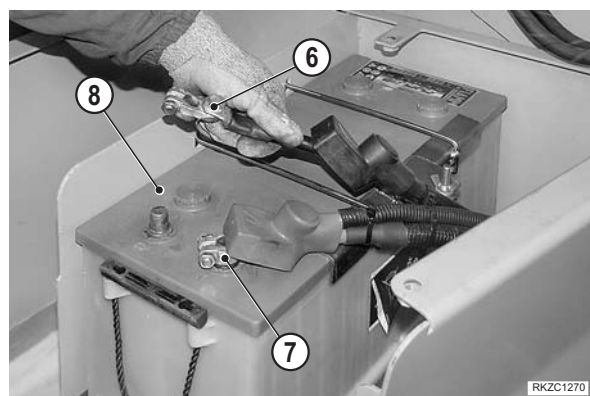


4 -Take out the screws and remove the platform (5) and door.



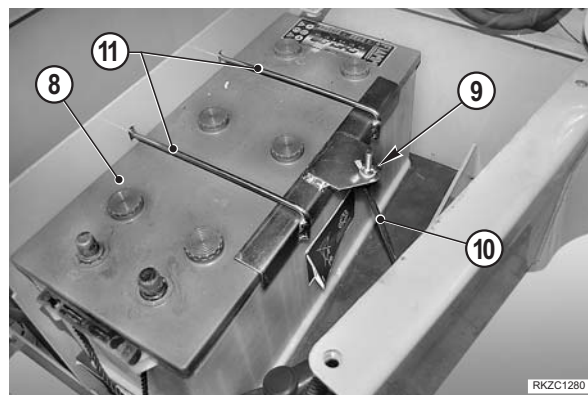
5 -Disengage battery negative (–) terminal (6) from shield and disconnect from battery (7).

6 -Use the same procedure as above to disconnect the battery positive terminal (8).  
[\*1]



7 -Loosen wing nut (9) and remove tie rod (10) and bracket (11).

8 -Remove the battery (8).



## Installation

- To install, reverse removal procedure.

[\*1]



Connect the battery positive (+) cable first, and then the battery negative (–) cable.

## FUEL TANK

### Removal

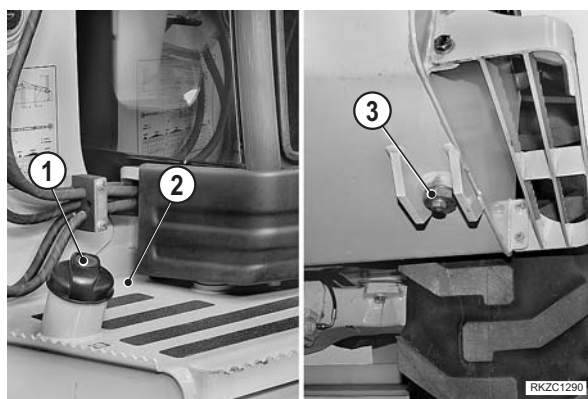
- !** Lower the working equipment completely until it is resting on the ground.  
Engage the parking brake, stop the engine and remove the ignition key.

- 1 - Take the cap (2) off the filling inlet of the fuel tank (3) and remove also the bottom plug in order to drain the fuel.

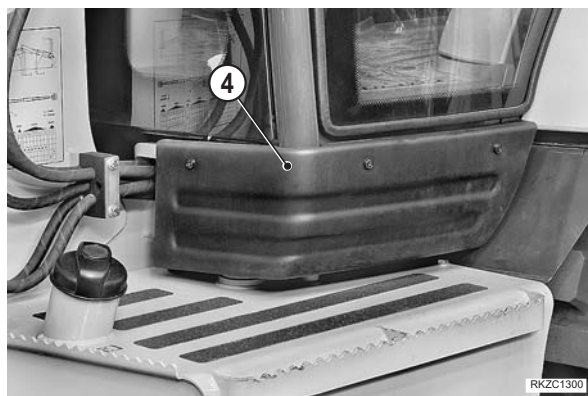


Fuel: max. 150 ℓ

- 2 - Reinstall the fill plug (1) and the drain plug (3).



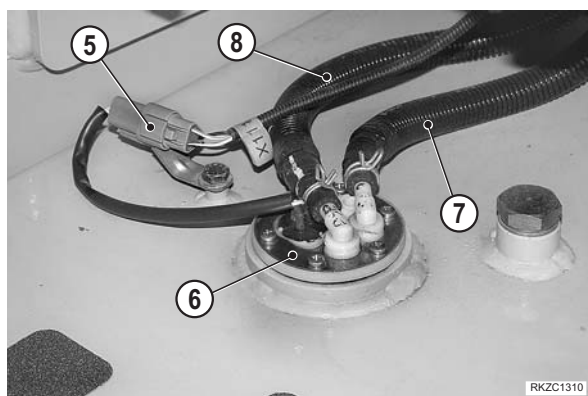
- 3 - Remove the lower left-hand guard (4) of the cab.



- 4 - Disconnect the connector (5) from the level gauge (6).

- 5 - Mark and disconnect the fuel inlet and return hoses (7), (8).

★ Plug all pipes/hoses to prevent contamination.





## REMOVAL AND INSTALLATION

## FUEL TANK

- 6 -Place a hoist under the fuel tank (2); remove four retaining screws (9) and washers, and remove the tank.  
[\*1]



Fuel tank: 68 kg



### Installation

- To install, reverse removal procedure.

[\*1]



Tank retaining screws: 120 Nm

- 1 -Refill the fuel tank.



Fuel: max. 150 ℓ

- 2 -Bleed the air from the fuel circuit.

- 3 -Start the engine.

## STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP

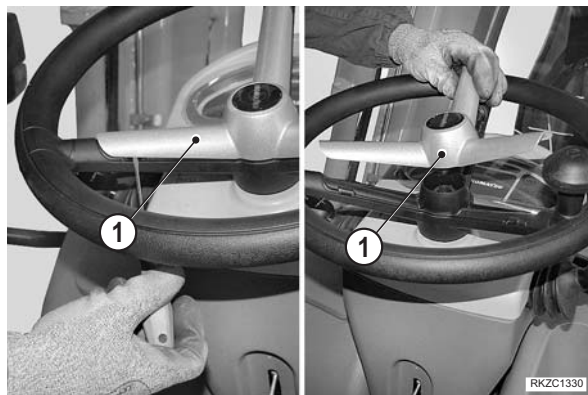
### Removal

**!** Lower the working equipment completely until it rests on the ground.

Engage the parking brake and stop the engine.

**!** Disconnect the cable from battery negative terminal (-). (For details see "BATTERY").

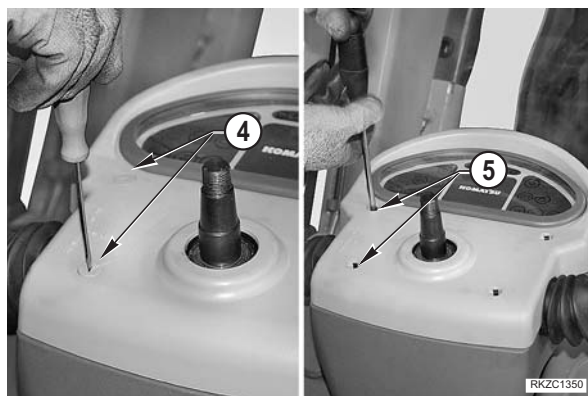
1 - Use a thin bladed screwdriver placed under each spoke of the steering wheel to pry away the cover (1).



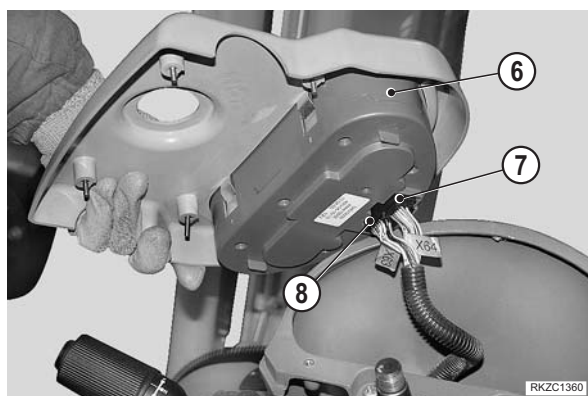
2 - Loosen and remove the retaining nut (2) and remove the steering wheel (3).



3 - Remove four screw covers (4) and loosen four screws (5) retaining the instrument panel.



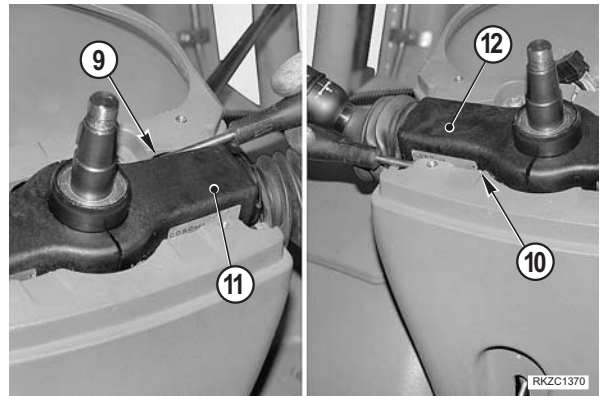
4 - Slide off instrument panel (6) from steering column; disconnect connectors (7) and (8), and remove instrument panel.



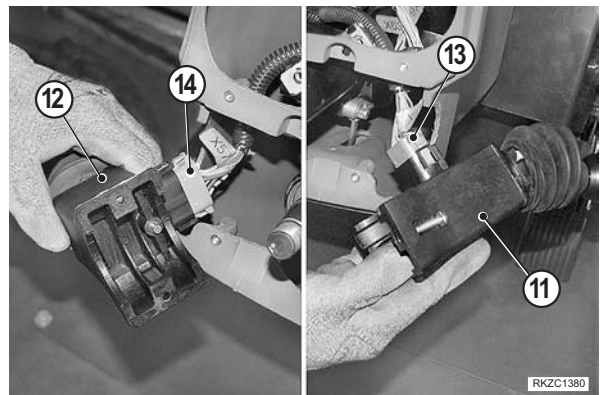
## REMOVAL AND INSTALLATION

## STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION

- 5 -Loosen and remove screws (9) and (10) and release direction indicator group (11) and transmission reverse control group (12).



- 6 -Disconnect connectors (13) and (14) and remove groups (11) and (12). [\*1]

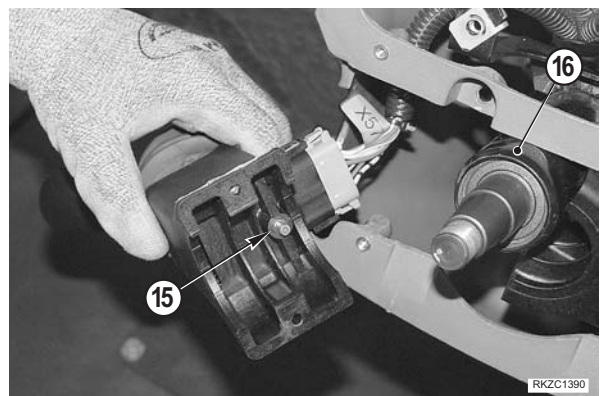


### Installation

- To install, reverse removal procedure.

[\*1]

- ★ Before attempting to tighten the screws, check the antirotation stake (15) for proper engagement into the steering column (16).

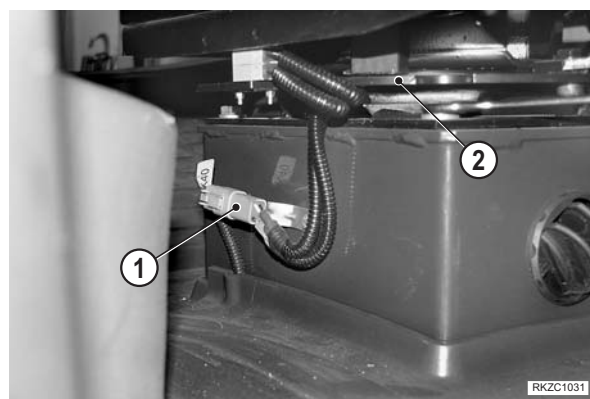


## WORKING BRAKE PUMP GROUP

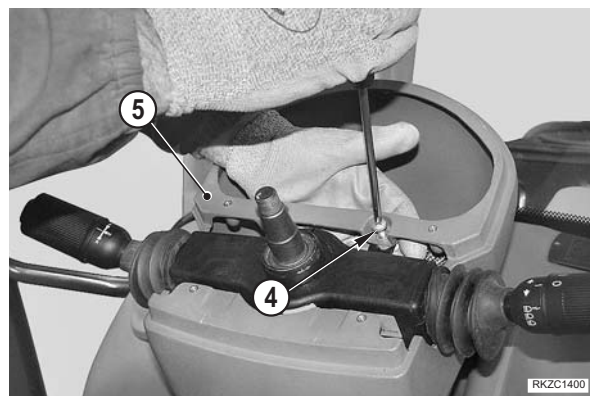
### Removal

- !** Lower the working equipment completely until it rests on the ground.  
Engage the parking brake, stop the engine and remove the ignition key.

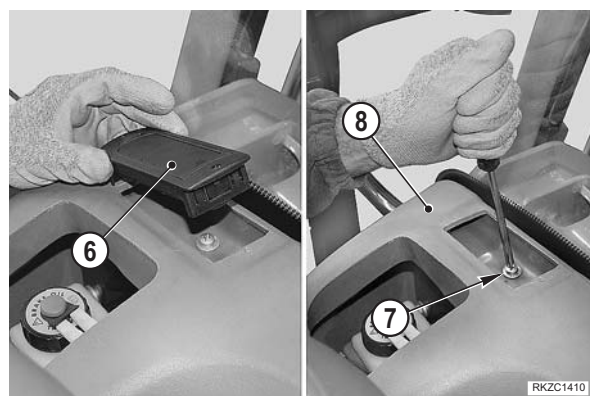
- 1 - Remove the steering wheel and the direction indicator and transmission reverse control groups  
(For details, see "STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP").
- 2 - Disconnect the connector (1) and remove the seat (2).
- 3 - Remove the front mat (3).



- 4 - Loosen and remove the upper screws (4) retaining the instrument panel holder (5).



- 5 - Remove the guards (6) and extract the upper screws (7) retaining the front trim cover (8).

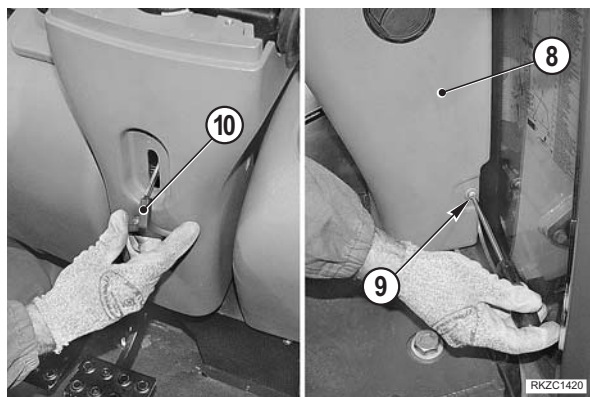


## REMOVAL AND INSTALLATION

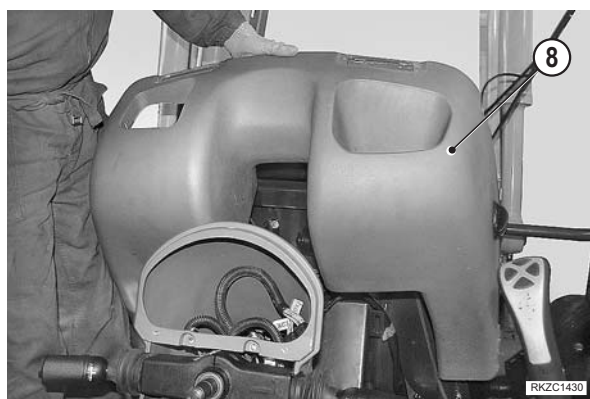
## WORKING BRAKE PUMP GROUP

6 -Loosen and remove the lower screws (9) retaining the front trim cover (8).

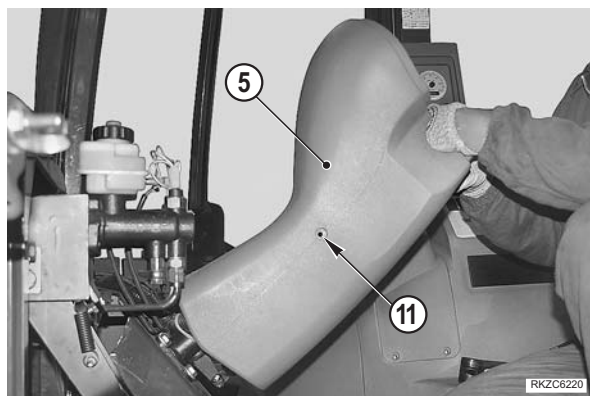
7 -Fully lower the steering column; extract the knob (10).



8 -Slide the front trim cover (8) up to remove it.



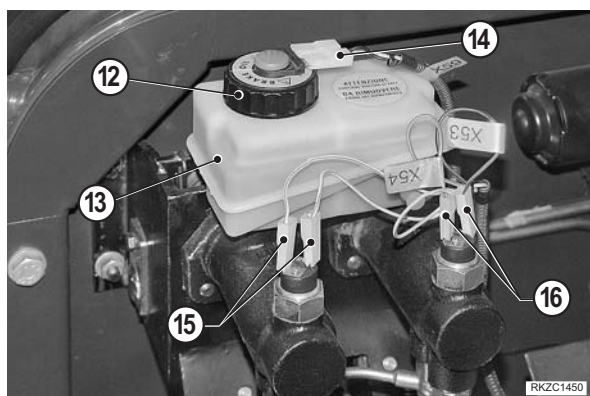
9 -Take out the lower screws (11) and remove the instrument panel holder (5).



10 -Remove the plug and (12) and draw oil from the tank (13).

11 -Reinstall the plug and disconnect connectors (14) and pressure switch connectors (15) and (16).

12 -Remove the tank (13).





## REMOVAL AND INSTALLATION

## WORKING BRAKE PUMP GROUP

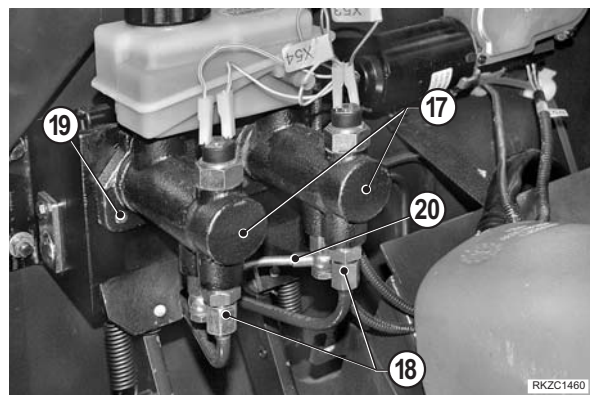
13 - Disconnect the delivery pipes (18) from the pumps (17).  
[\*1]

- ★ Plug all pipes/hoses to prevent contamination.

14 - Take out four screws (19) and remove the pump group.  
[\*2]

- ★ If only one pump is to be removed, also disconnect the pressure equalizing pipe (20).

[\*3]



## Installation

- To install, reverse removal procedure.

[\*1]

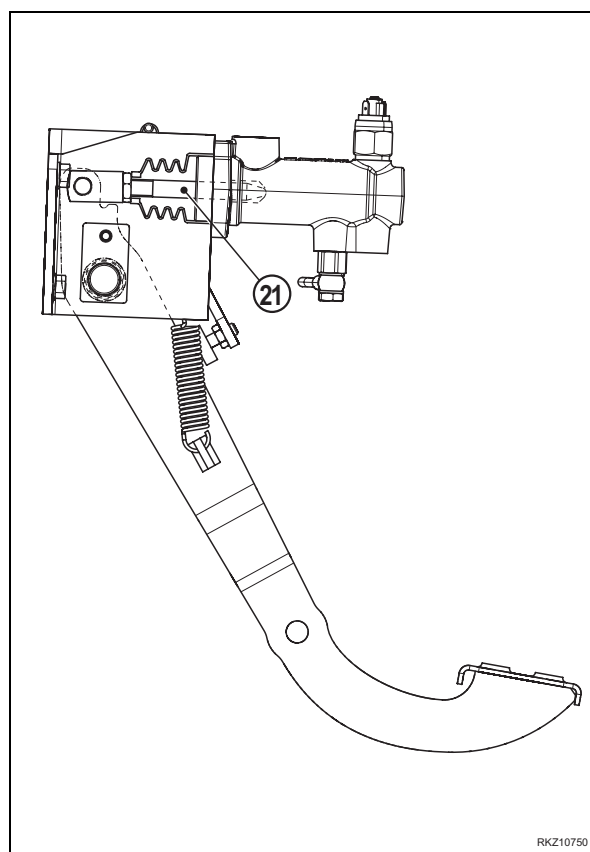
- ★ Bleed the air from the braking circuit.  
(For details, see "20 TESTING AND ADJUSTMENTS").

[\*2]

- ★ Make sure that the push-rods (21) center the seating of the pistons.
- ★ When installation is complete, inspect for proper brake pedal pre-travel and alignment.  
(For details, see "20 TESTING AND ADJUSTMENTS").

[\*3]

 Union: 20 Nm



## STEERING UNIT

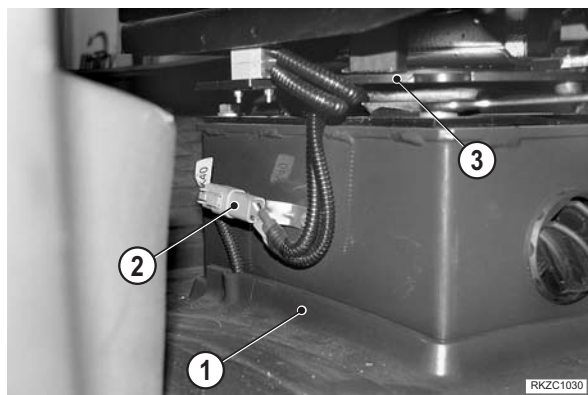
### Removal

**⚠** Lower the working equipment completely until it rests on the ground.  
Engage the parking brake, stop the engine and remove the ignition key.

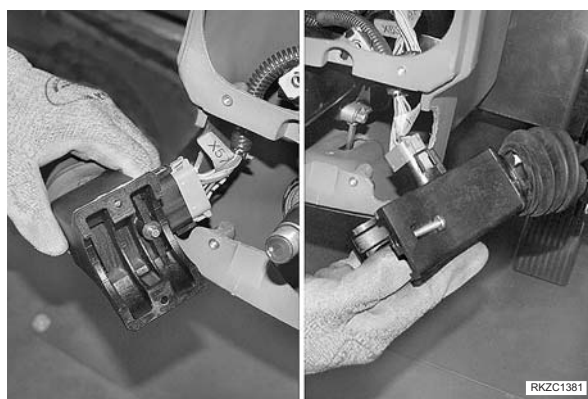
**⚠** Eliminate residual pressure from all circuits by moving all control levers in all directions.

1 -Remove the front mat (1).

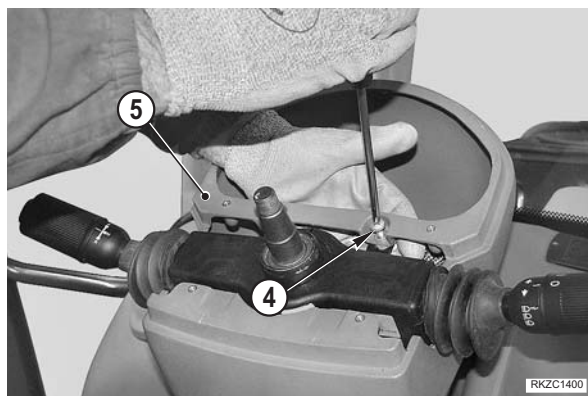
2 -Disconnect the connector (2) and remove the seat (3).



3 -Remove the steering wheel and the direction indicator, transmission reverse and headlight dipper beam control groups  
(For details, see "STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP").

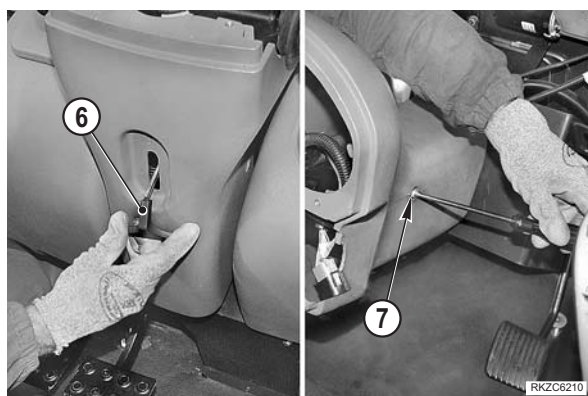


4 -Loosen and remove the upper screws (4) retaining the instrument panel holder (5).



5 -Remove the steering column lock knob (6).

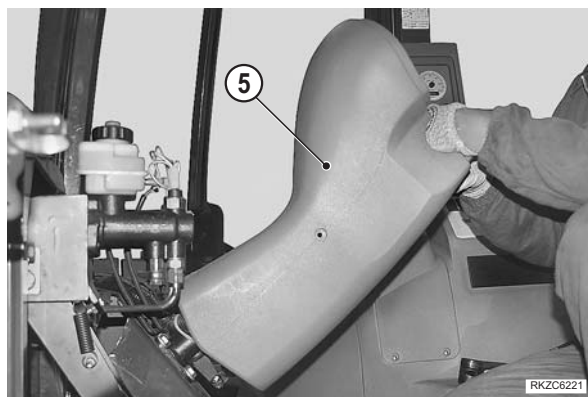
6 -Remove the screws (7) retaining the side of the instrument panel holder.



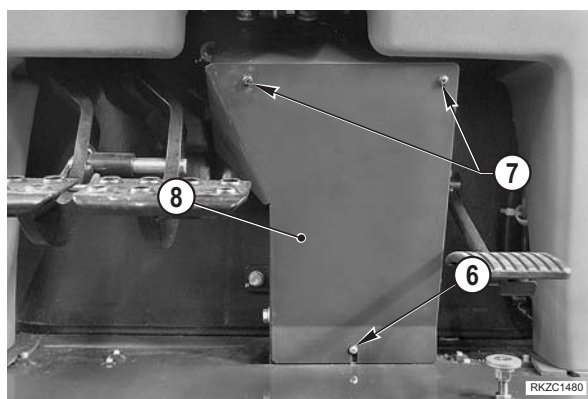
## REMOVAL AND INSTALLATION

## STEERING UNIT

7 - Slide the instrument panel holder (5) up to remove it.



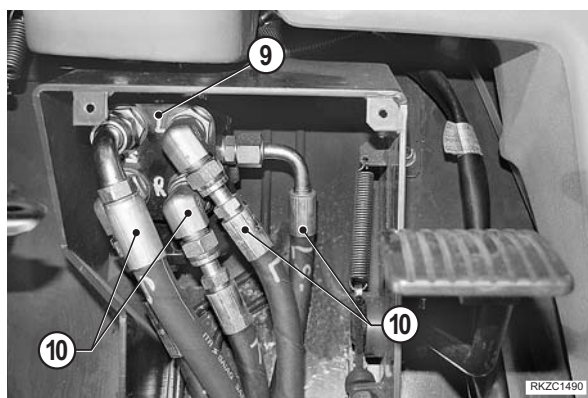
8 - Loosen screw (6) and remove two screws (7); remove the front guard (8).



9 - Mark the respective positions of and disconnect five pipes (10) from steering unit.

★ Plug all pipes to prevent contamination.

[\*1]



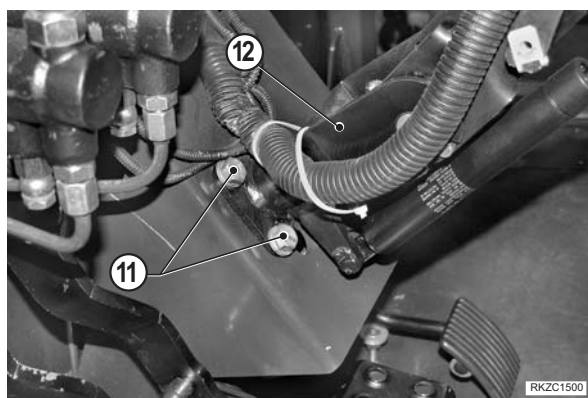
10 - Loosen the screws (11) fastening the column (12) and steering unit (9); remove the steering unit.

### Installation

- To install, reverse removal procedure.

[\*1]

- ★ Start the engine and perform several complete steering manoeuvres in both directions, to bleed the air out of the steering system.





## CAB

### Removal

⚠ Lower the working equipment completely until it rests on the ground.

Engage the parking brake and stop the engine.

⚠ Disconnect the cable from battery negative terminal (-).  
(For details see "BATTERY").

⚠ Release all residual pressure in all circuits.

★ Drain the engine cooling liquid.



Coolant liquid: 15 ℓ

★ **Only for machines equipped with an air-conditioning unit.**

Drain the air conditioning unit.

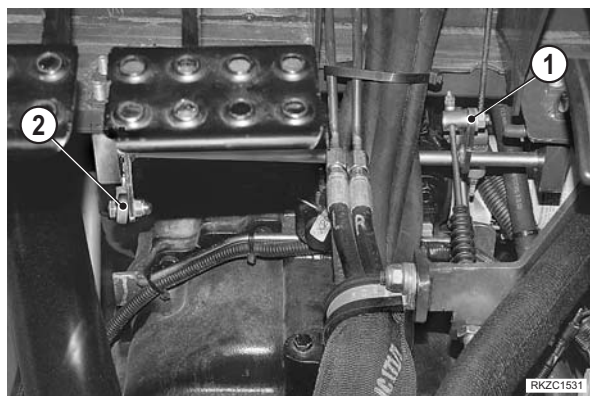
(For details see "20 TESTING AND ADJUSTMENTS").

[\*1]

1 -Remove the exhaust pipe.

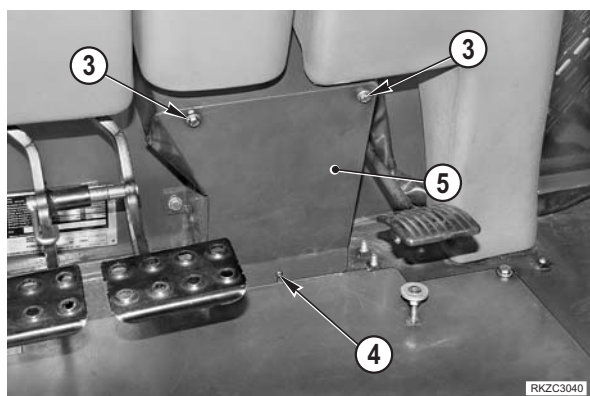
(For details see "EXHAUST PIPE").

2 -Disconnect the injection pump control rod (2) from the pitman arm (1).



3 -Remove the front mat, remove screws (3) and loosen screw (4).

4 -Remove the steering unit guard (5).

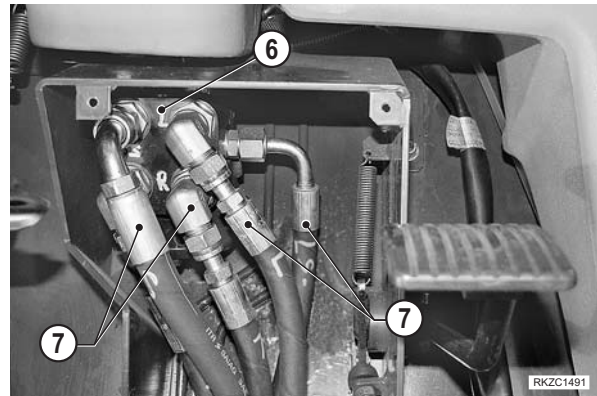


## REMOVAL AND INSTALLATION

CAB

5 - Disconnect pipes (7) from steering unit. [\*2]

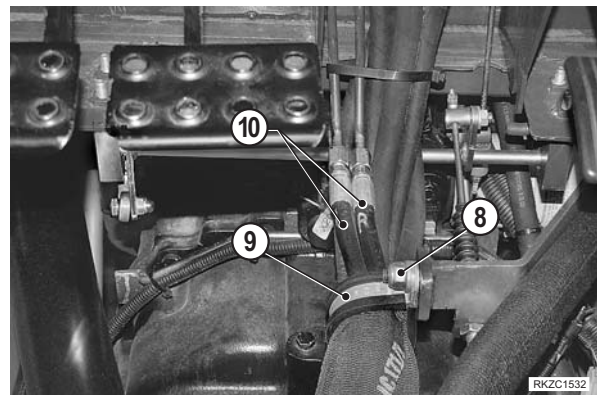
- ★ Mark the positions of the pipes to prevent exchanging positions when reconnecting.
- ★ Plug the pipes and pipe-fittings to prevent entry of impurities.



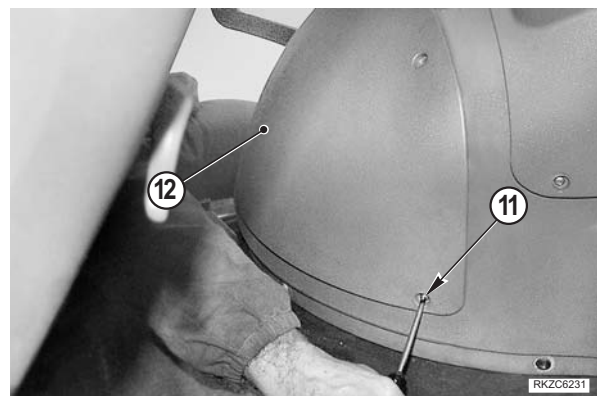
6 - Remove nut (8) and disconnect strap (9) from frame.

7 - Disconnect the tubes (10) and (3). [\*3]

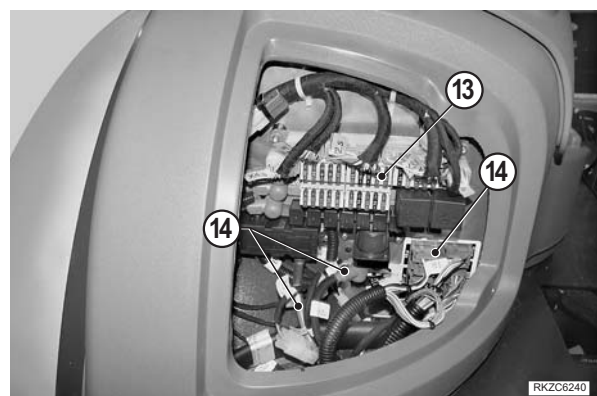
- ★ Plug the pipes and pipe-fittings to prevent entry of impurities.



8 - Take out the screws (11) and remove the hood (12).



9 - Disconnect lower frame harness connectors (14) from fuse block (13).



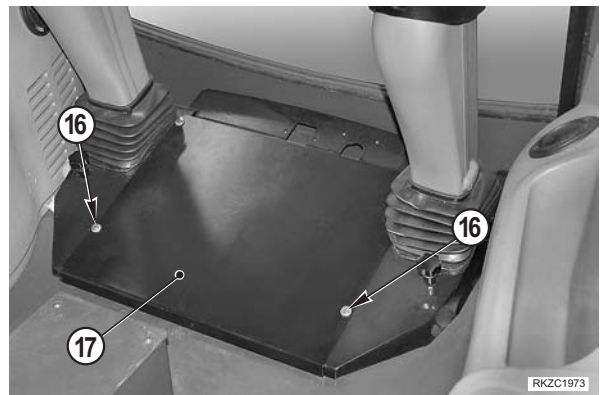
## REMOVAL AND INSTALLATION

## CAB

10 -Lift rear window (15) to the top and remove the rear mat.



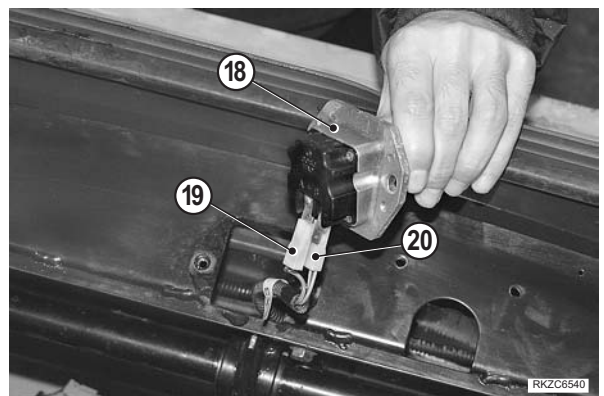
11 -Take out the screws (16) and remove the platform (17).



12 -**Only if equipped.**

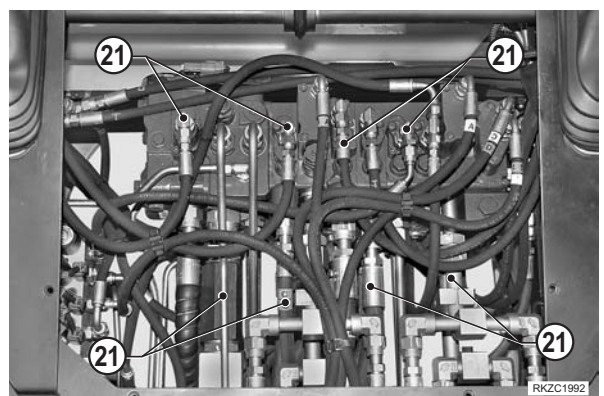
Disconnect connectors (19) and (20) from foot button (18).

- ★ Mark the position of connectors to avoid mixing them during installation.



13 -Disconnect the servocontrols upper and lower pipes (21) from the control valve. [\*4]

- ★ Check that all the hoses are marked and note down the bends and routing patterns.
- ★ Cap pipes, hoses and holes to prevent contamination.
- ★ Lay the hoses inside the cab to gain access to the feed and exhaust hoses.

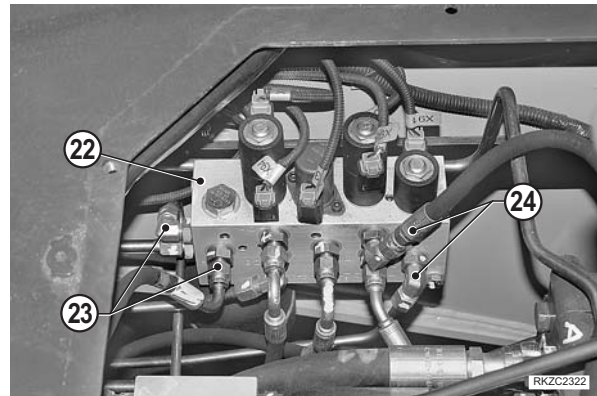


## REMOVAL AND INSTALLATION

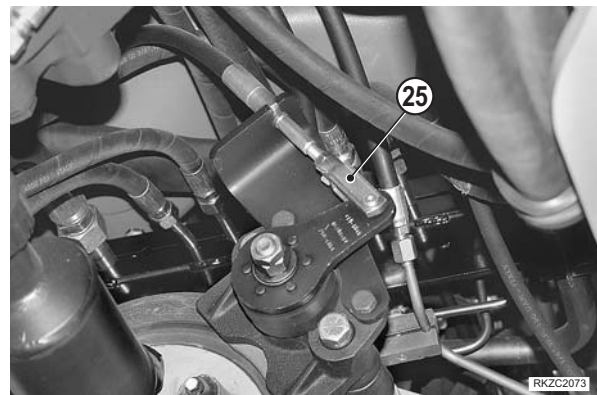
CAB

14 -Disconnect servocontrol supply hoses (23) and (24) from solenoid valve group (22).

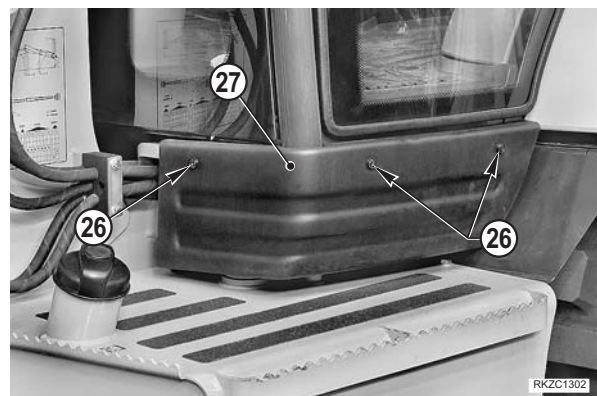
- ★ Mark the pipes to avoid exchanging them during installation.
- ★ Cap pipes, hoses and holes to prevent contamination.



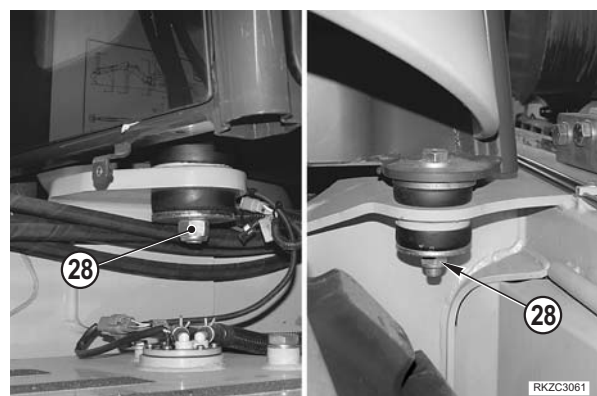
15 -Disconnect parking brake cable (25) from brake caliper.  
[\*5]



16 -Take out the screws (26) and remove the protection (27).



17 -Remove nuts (28) as well as front and rear screws.  
[\*6]

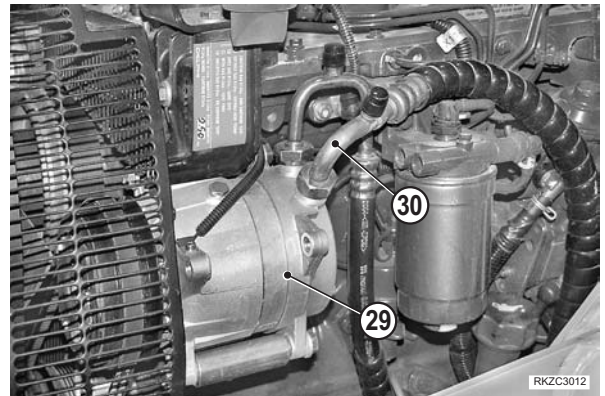




- **Version with air-conditioning unit**

18 -Disconnect the suction pipe (30) from the compressor (29). [<sup>\*</sup>7]

- ★ Cap the hose and hole to ward off humidity.
- ★ Release the hose and route it under the cab.



19 -Take out the screws (31) and remove the protection (32).



20 -Disconnect hose (34) from condenser (33). [<sup>\*</sup>8]

- ★ Cap the hose and hole to ward off humidity.
- ★ Release the hose and route it under the cab.



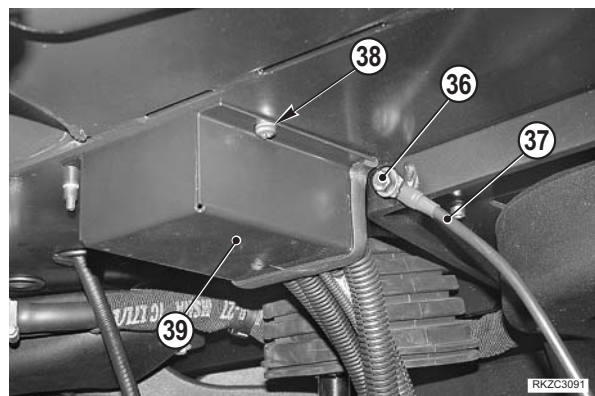
## REMOVAL AND INSTALLATION

## CAB

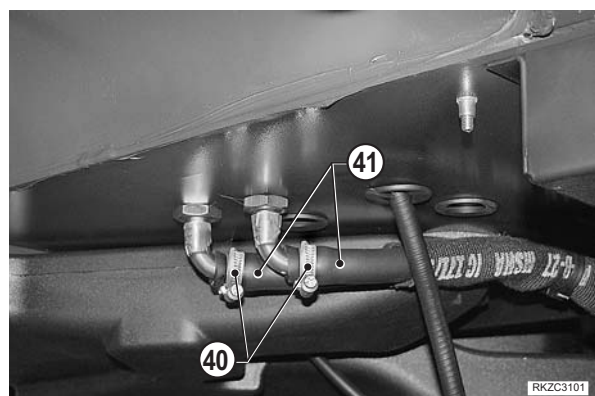
- 21 - Remove the hole plugs and tighten two lifting eyes into the lifting holes provided.  
Connect the cab (35) to the lifting equipment and apply light tension.
- 22 - Lift the cab by about 30 cm and place some safety blocks "A" under it.



- 23 - Remove the screw (36) and disconnect the ground wire (37).
- 24 - Pull out screws (38) and remove cable guard (39).



- 25 - Loosen straps (40) and disconnect heating hoses (41).
- ★ Mark the pipes to avoid exchanging them during installation.
  - ★ Cap pipes, hoses and holes to prevent contamination.
- 26 - Ensure that all hoses, harnesses and wires are free, and remove the cab.



## Installation

- To install, reverse removal procedure.

[\*1]

- ★ Drain and refill the air-conditioning unit



Quantity of fluid (R134a): 2250 ±150 g  
Quantity of oil: see the amount recovered.

[\*2]

- ★ Bleed the air from the steering circuit. (For details, see "20 TESTING AND ADJUSTMENTS").

[\*3]

- ★ Bleed the air from the braking circuit.  
(For details, see "20 TESTING AND ADJUSTMENTS").

[\*4]

- ★ Perform all possible backhoe movements to bleed the servocontrol system.

[\*5]

- ★ Adjust the stroke of the parking brake lever. (For details, see "20 TESTING AND ADJUSTMENTS").

[\*6]



Cab retaining screws: 200 Nm

[\*7]



Suction pipe union: \_\_\_\_\_ Nm

[\*8]



Union (34): 16 Nm

- 1 - Refill the coolant liquid.



Coolant liquid: approx. 15 ℓ

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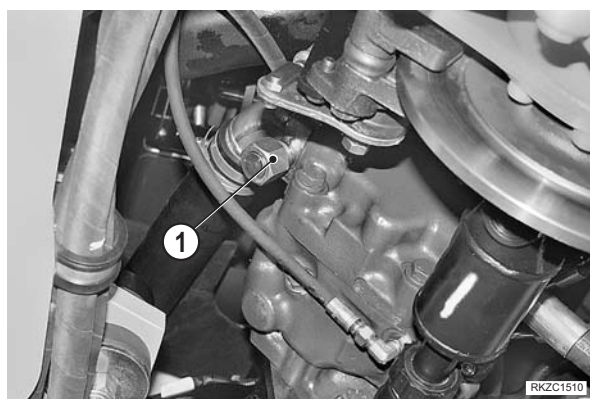
## HYDRAULIC OIL TANK

### Removal

-  Lower the working equipment completely until it rests on the ground.  
Engage the parking brake, stop the engine and remove the ignition key.
-  Eliminate residual pressure from all circuits by moving all control levers in all directions.
-  Disconnect the cable from battery negative terminal (-).  
(For details, see "BATTERY").

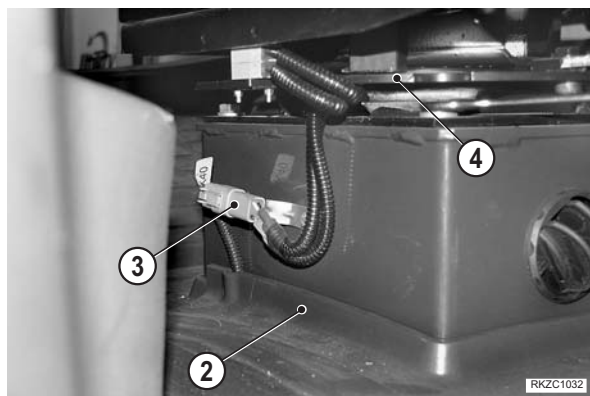
1 - Remove the plug (1) and drain the hydraulic oil.

 Hydraulic oil: approx. 40 ℓ

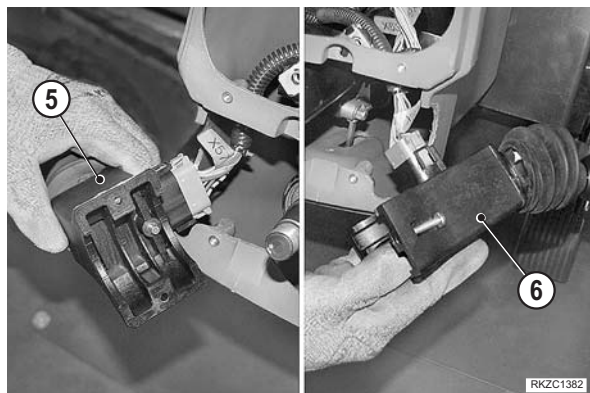


2 - Remove the front mat (2).

3 - Disconnect the connector (3) and remove the seat (4).



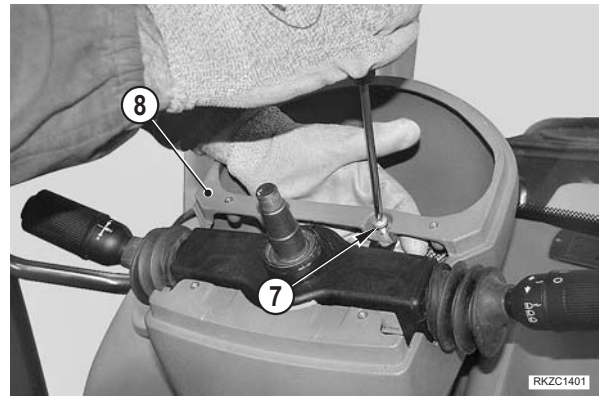
4 - Remove the steering wheel and remove the transmission reverse control group (5) and the direction indicator and headlight dipper beam control group (6) (For details, see "STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP").



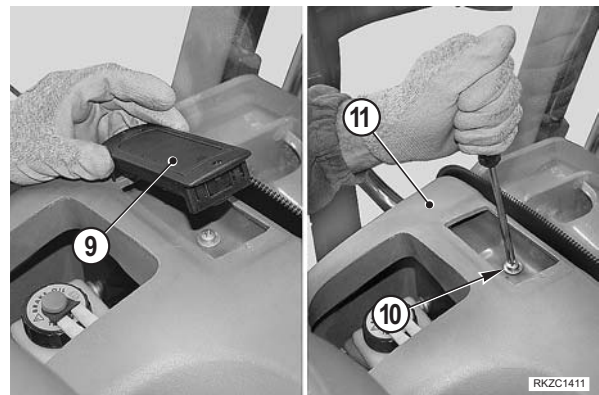
## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

5 -Loosen and remove the upper screws (7) retaining the instrument panel holder (8).

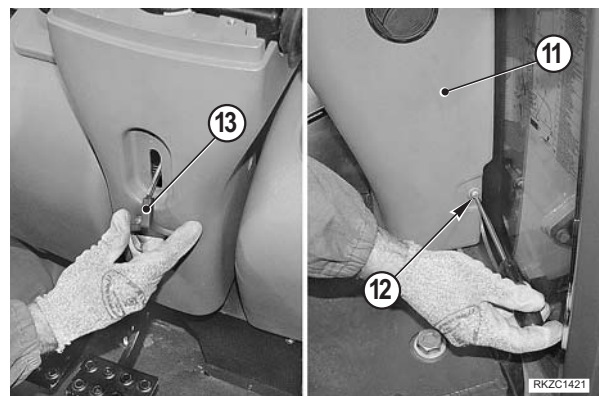


6 -Remove the guards (9) and extract the upper screws (10) retaining the front trim cover (11).

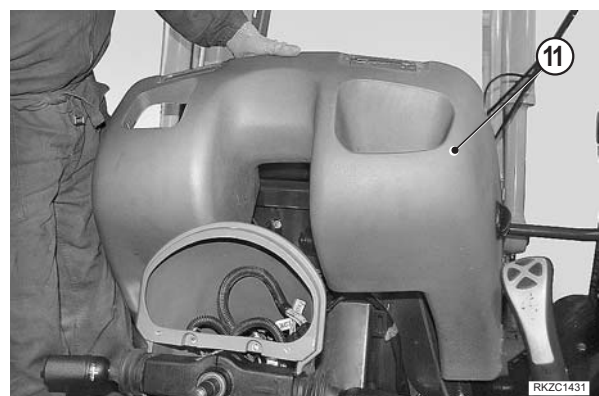


7 -Loosen and remove the lower screws (12) retaining the front trim cover (11).

8 -Fully lower the steering column; extract the knob (13).



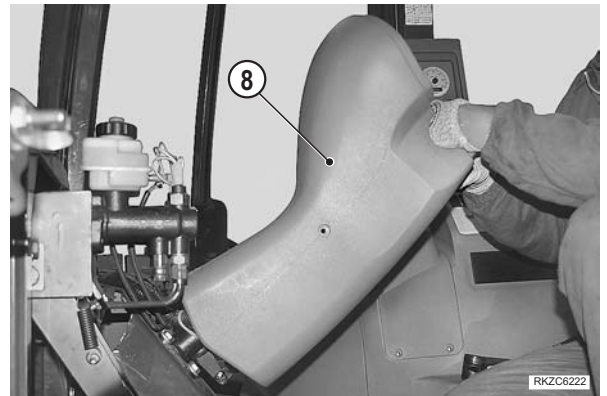
9 -Slide the front trim cover (11) up to remove it.



## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

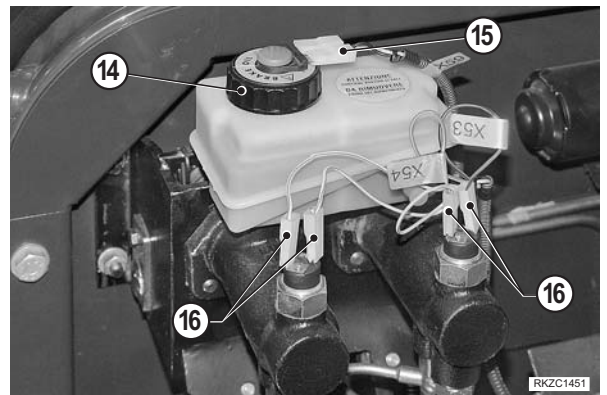
- 10 -Take out the lower screws and remove the instrument panel holder (8).



- 11 -Remove the fill plug (14) and draw the brake fluid.

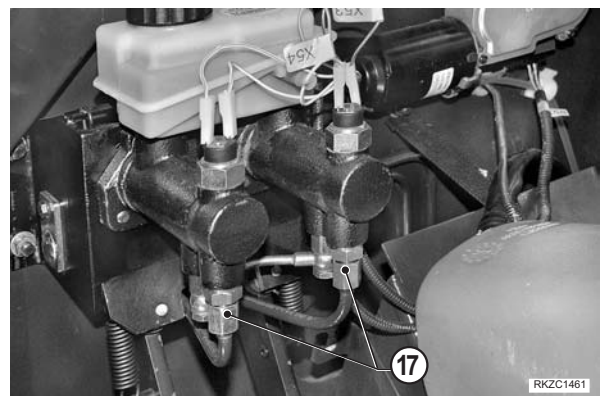
★ Replace plug to prevent contamination.

- 12 -Disconnect oil level and pressure switch connectors (15) and (16).



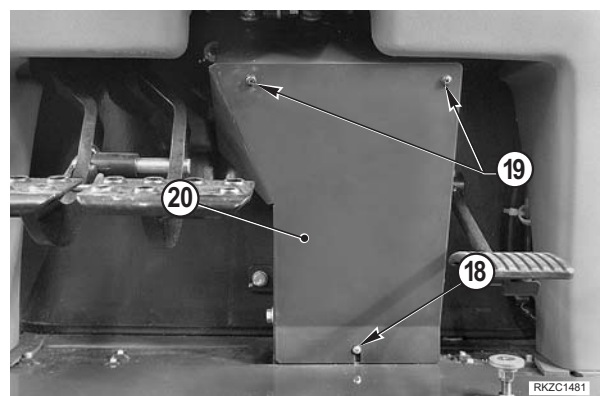
- 13 -Disconnect the brake fluid delivery tubes (17). [\*1]

★ Plug all pipes/hoses to prevent contamination.



- 14 -Loosen mounting bolt (18).

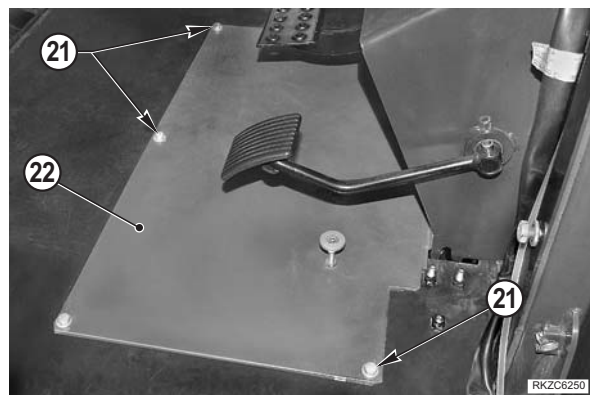
- 15 -Pull out the screws (19) and remove the protection (20).



## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

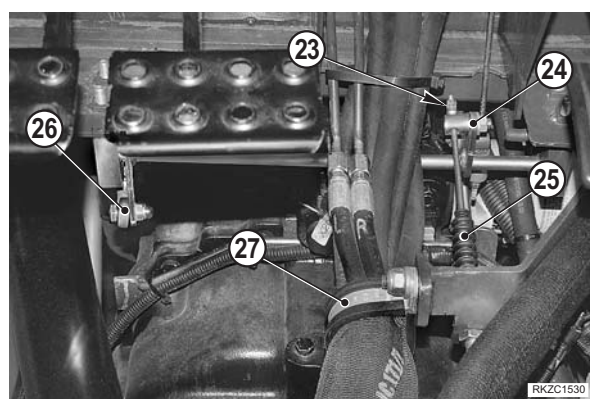
- 16 -Loosen and remove five screws (21) and remove the metal sheet (22) closing off the cab floor.



- 17 -Loosen and remove nuts (23) and disconnect the hand accelerator cable (25) from the relay rod (24). [\*2]

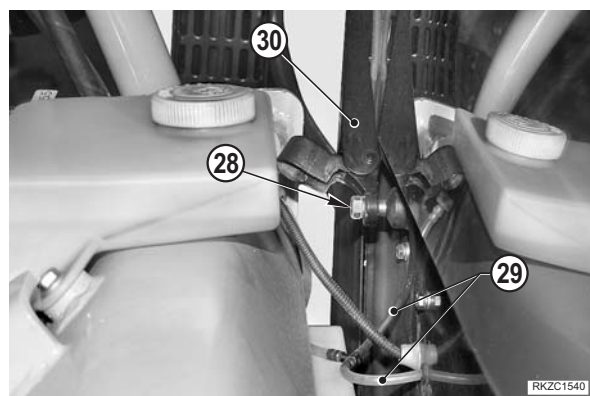
- 18 -Disconnect the injection pump rod (26) from the relay rod (24).

- 19 -Disconnect the strap (27) holding the steering unit and working brake hoses.

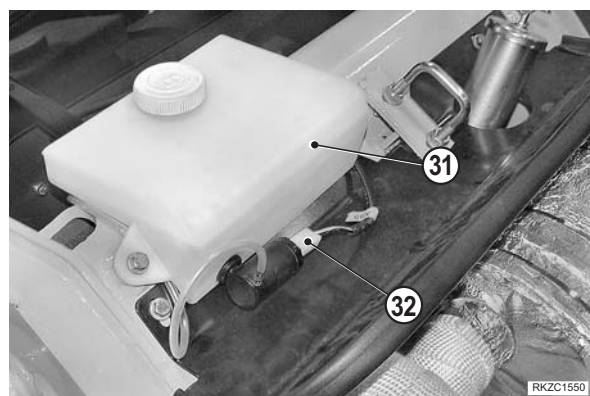


- 20 -Loosen and remove nut (28) and washer.

- 21 -Disconnect the washer hoses (29) and remove the complete wiper arm (30).



- 22 -Disconnect connector (32) from washer pump (31).

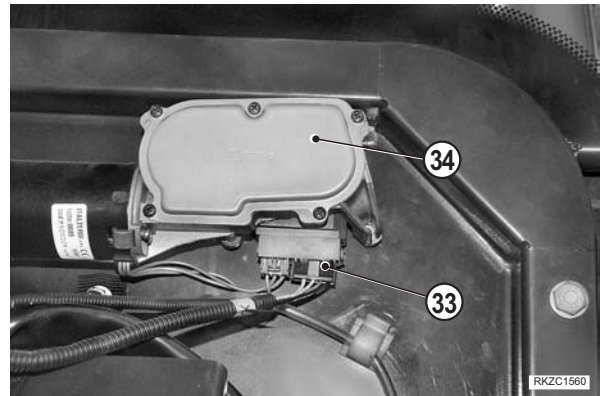




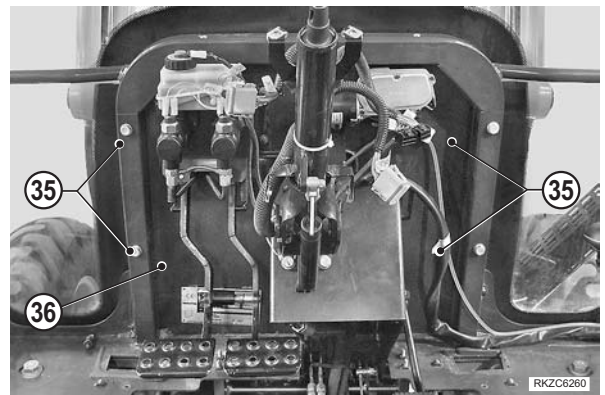
## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

23 -Disconnect connector (33) from wiper (34).



24 -Loosen and remove screws (35) and washers.  
Remove the complete bulkhead (36) and move it to the rear of the machine.

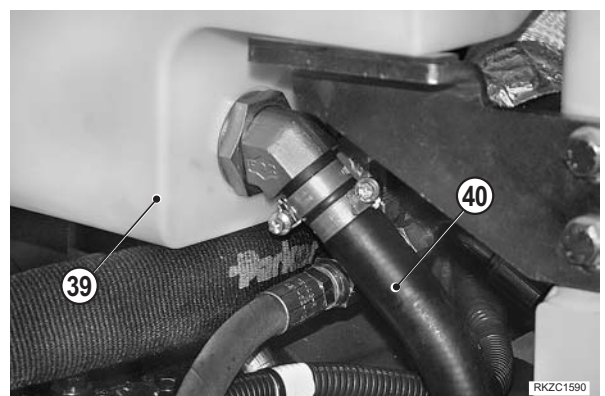


25 -Take out the screws (37) and remove the conveyor (38).



26 -Lift the rubber bulkhead and disconnect the discharge hose (40) from the tank (39).

★ Plug the pipe to prevent contamination.

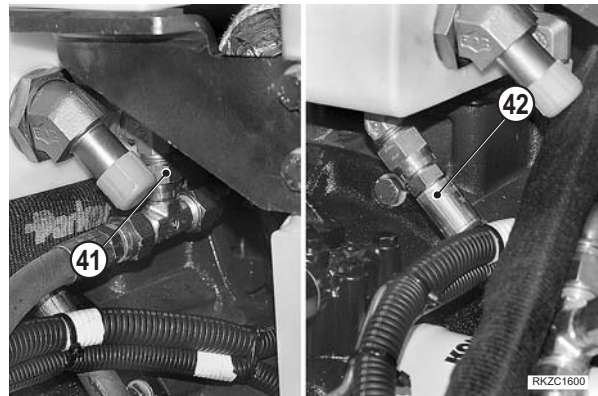


## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

27 -Disconnect the draining union (41) and pipe (42).

- ★ Plug the union to prevent contamination.



28 -Disconnect the pump suction pipe (43).

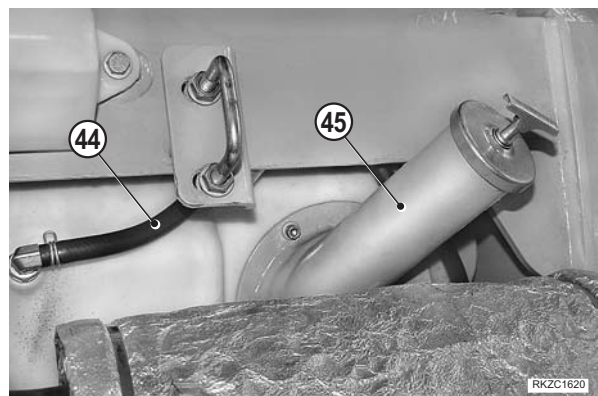
- ★ Plug the pipe to prevent contamination.



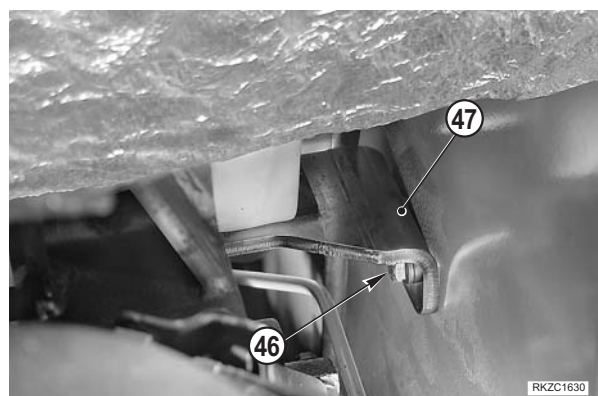
29 -Disconnect the vent hose (44) and filter and remove.

30 -Remove the screws and remove the fill sleeve (45).

- ★ Collect the O-ring.



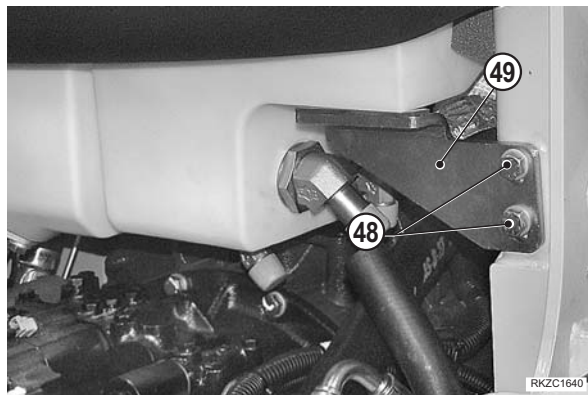
31 -Remove screws (46) and washers and remove the tank's front holder (47).



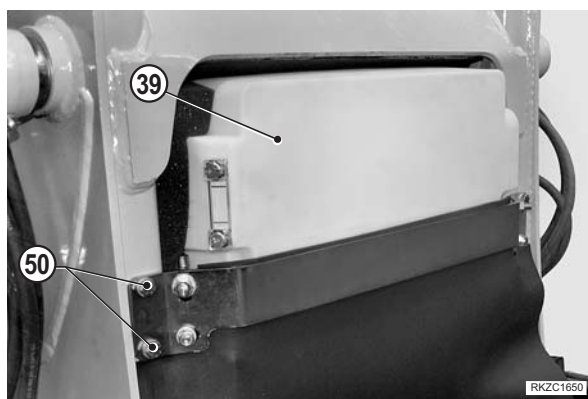
## REMOVAL AND INSTALLATION

## HYDRAULIC OIL TANK

32 -Remove screws (48) and washers and remove the tank's rear holder (49).



33 -Remove two screws (50) and washers to release the complete tank (39).



34 -Extract the tank (39).



## Installation

- To install, reverse removal procedure.

[\*1]

- ★ Bleed the air from the braking circuit. (For details, see "20 TESTING AND ADJUSTMENTS").

[\*2]

- ★ Check and adjust the stroke of the hand accelerator.

1 -Refill the hydraulic oil.



Hydraulic oil: approx. 40 ℓ

2 -Start the engine and check for leaks.

3 -Bleed the air from the cylinders. (For details, see "20 TESTING AND ADJUSTMENTS").

4 -Stop the engine, check the oil level in the tank and, if necessary, top it up.

## PISTON PUMP

### Removal

⚠ Lower the working equipment completely until it rests on the ground.

Stop the engine and remove the ignition key.

⚠ Eliminate all residual pressure from all circuits by moving all hydraulic controls in all directions.

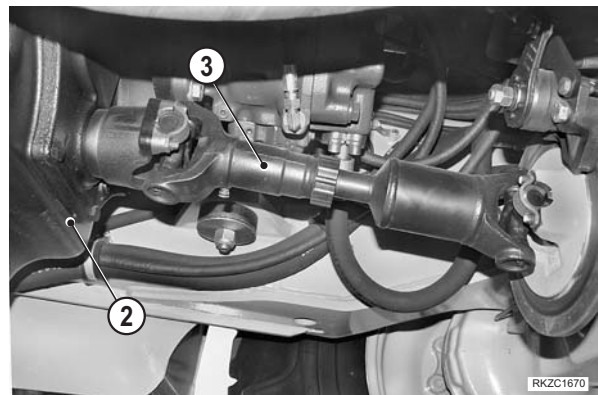
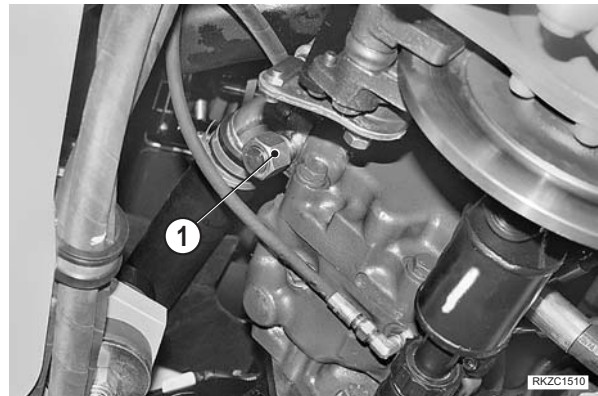
1 - Remove the plug (1) and drain the hydraulic oil.



Hydraulic oil: approx. 40 ℓ

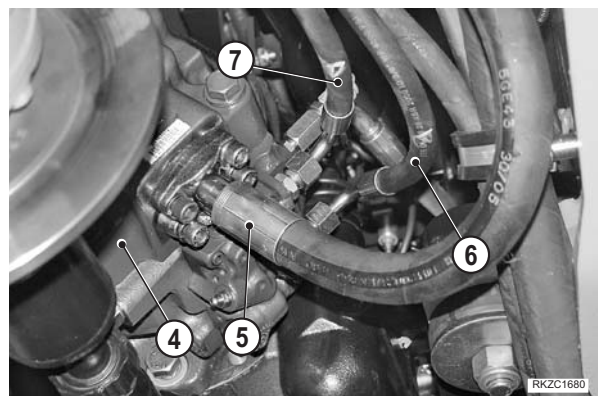
★ Replace plug to prevent contamination.

2 - Disconnect rear cardan shaft (3) from transmission (2).  
[\*1]



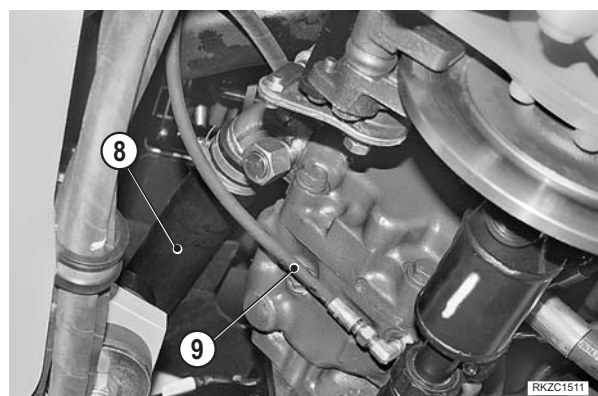
3 - Disconnect the delivery hose (5) and the LS and pump delivery pressure control hoses (6) and (7) from the pump (4).

★ Cap pipes, hoses and holes to prevent contamination.



4 - Disconnect the suction pipe (8) and the draining hose (9) from the pump.

★ Cap pipes, hoses and holes to prevent contamination.





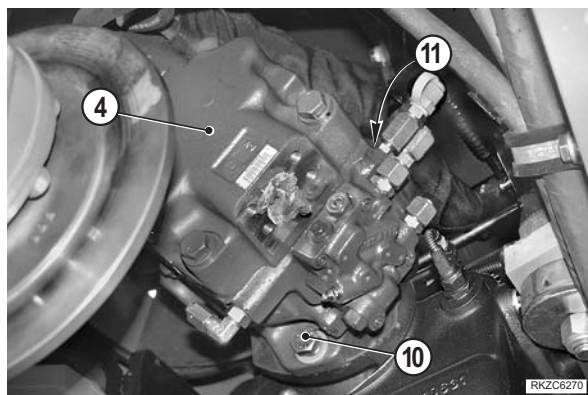
## REMOVAL AND INSTALLATION

## PISTON PUMP

5 -Loosen and remove the lower screw (10) retaining the pump (4) and its washer.

6 -Loosen upper screw (11) but leave it in place.

★ Do not remove the screw at this stage. [\*2]



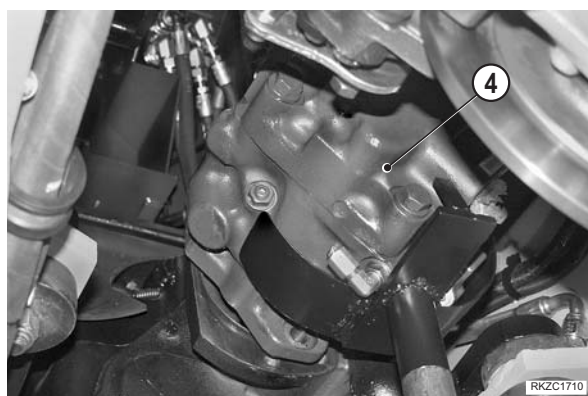
7 -Install pump holding tool “B1” to a hydraulic jack.

8 -Place tool “B1” under the pump until the pump fully supported.



9 -Take out the upper screw (11) and remove the pump (4).

 Piston pump: 36.8 kg



### Installation

- To install, reverse removal procedure.

[\*1]

 Screw: 38±1 Nm

[\*2]

 Pump screws: 220 Nm

1 -Refill the hydraulic oil.

 Hydraulic oil: approx. 40 ℓ

2 -Start the engine and run it at MIN. to bleed any air.

3 -Stop the engine and check the oil level in the tank.

## TRANSMISSION

### Removal

**!** Lower the working equipment completely until it rests on the ground.

Stop the engine and remove the ignition key.

**!** Eliminate all residual pressure from all circuits by moving all hydraulic controls in all directions.

**!** Disconnect the cable from battery negative terminal (-).

★ Drain the hydraulic oil.

 Hydraulic oil: approx. 40 ℓ

★ Drain the oil from the gearbox.

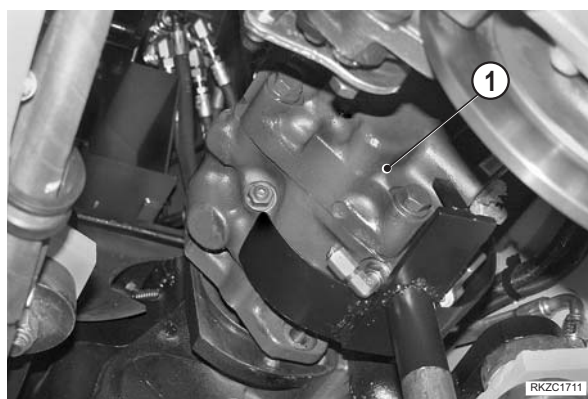
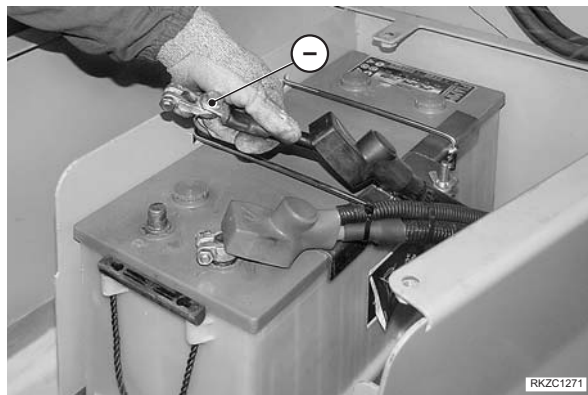
 Hydraulic oil: approx. 20 ℓ

[\*1]

1 - Remove the piston pump (1).

(For details see "PISTON PUMP").

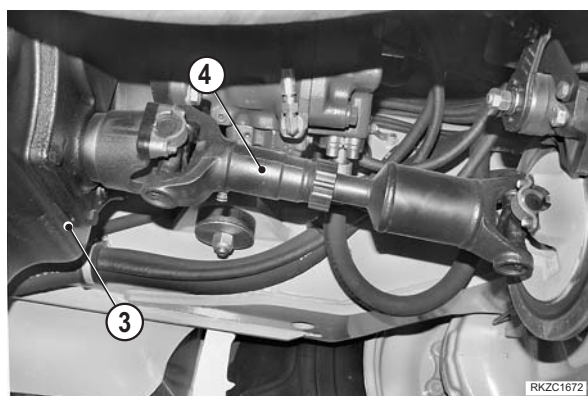
[\*2]



2 - Remove the front mat and remove the metal sheet (2) closing off the cab floor.



3 - Disconnect rear cardan shaft (4) from transmission (3).  
[\*4]

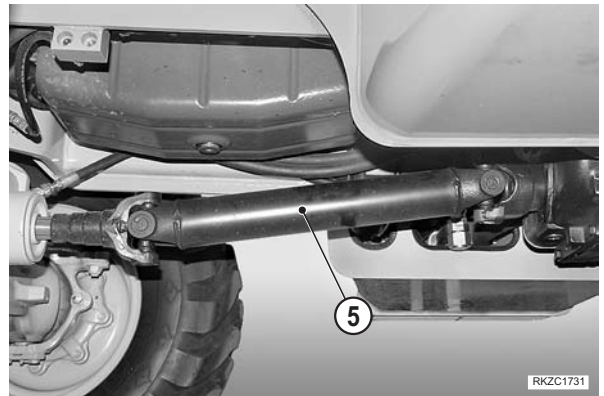


## REMOVAL AND INSTALLATION

## TRANSMISSION

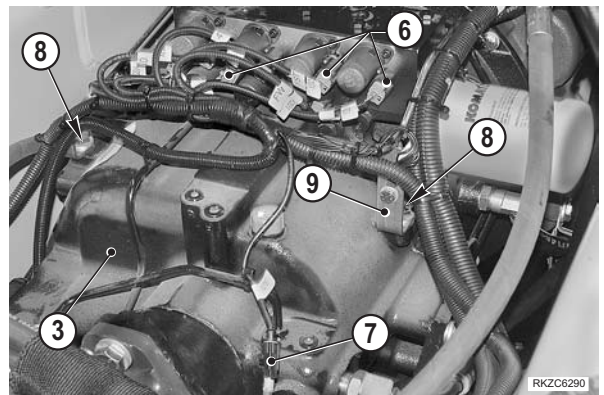
4 -Remove front cardan shaft (5).

[\*4]

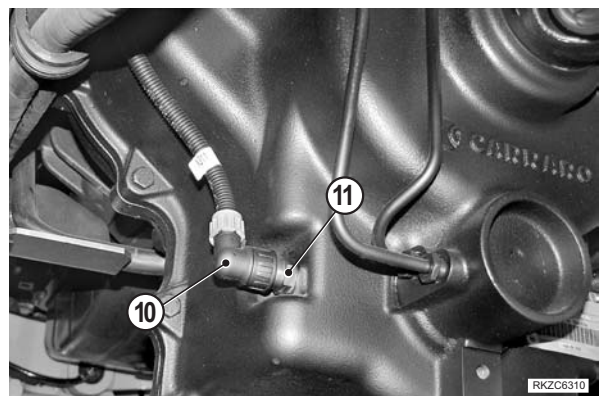


5 -Disconnect seven solenoid valve connectors (6) and shift oil temperature sensor connector (7) from gearshift (3).

6 -Take out the screws (8) and remove the harness holder (9).

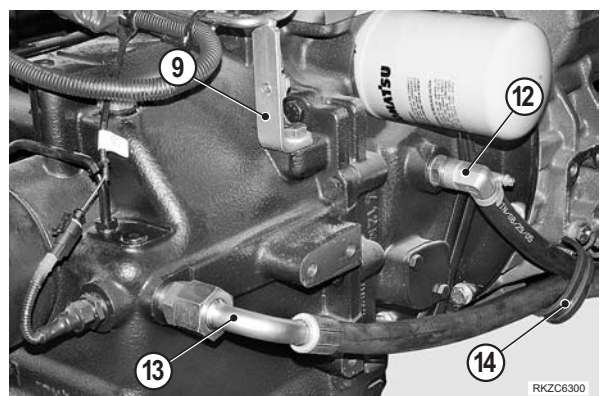


7 -Disconnect the connector (10) from the rev sensor (11).



8 -Disconnect delivery hose (12) to oil cooler and return hose (13) from gearbox (3).

9 -Remove the clamp (14).



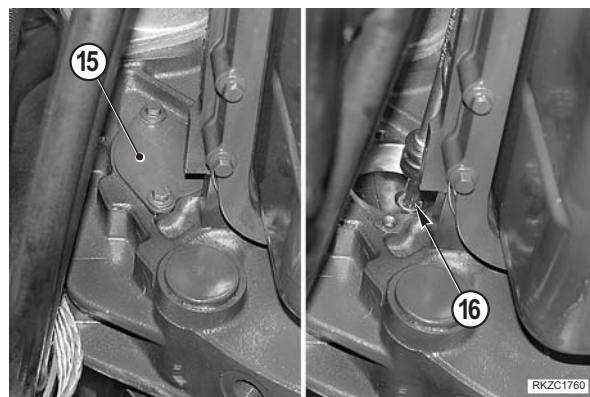


## REMOVAL AND INSTALLATION

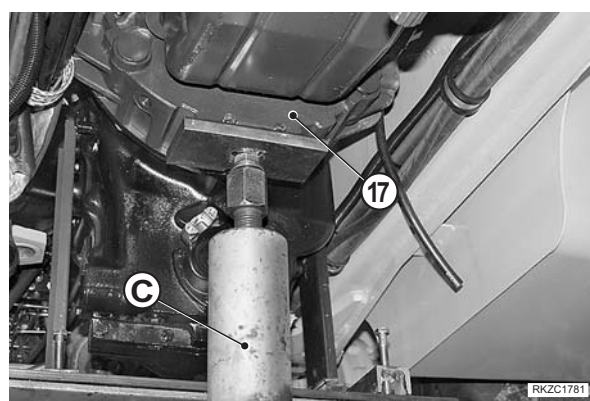
## TRANSMISSION

10 -Remove the screws and remove the cover (15) giving access to the converter coupling flange.

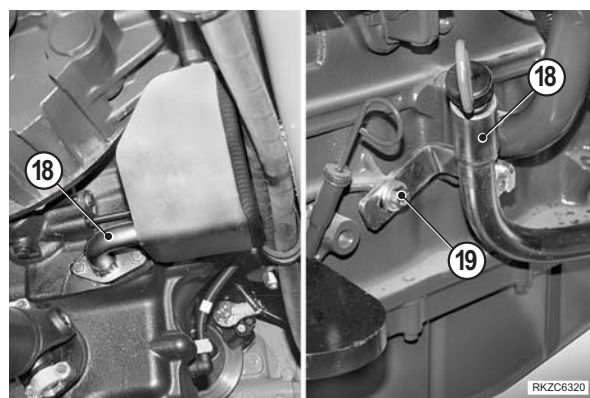
11 -Slowly rotate the engine flywheel until the converter retaining screws (16) are centred in the hole; remove the four screws. [\*5]



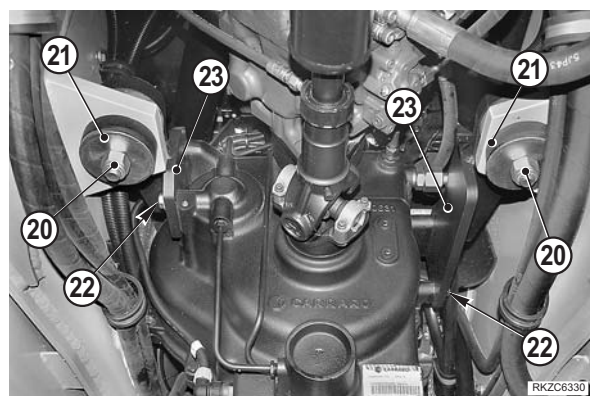
12 -Procure to support the engine (17) with a stand “C” placed under the flywheel bell.



13 -Disconnect the gearbox oil load and oil level control pipe (18), remove the screw (19) and remove the complete pipe (18).



14 -Remove the nuts (20) on the vibration dampers (21), the screws (22) and remove the gearbox supports (23). [\*6] [\*7]



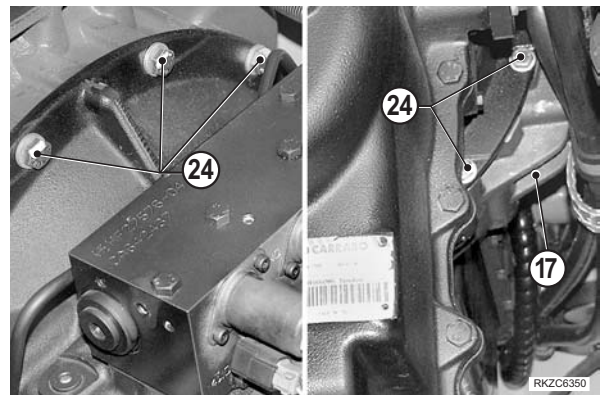
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 15 -Install the gearbox holding tool “**B2**” to a stand that is capable of descending by about 60 cm.  
Using the holes on the supports, secure the tool “**B2**” to the gearbox.

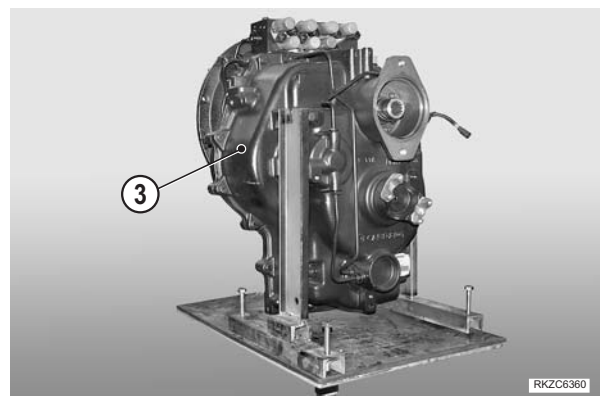


- 16 -Loosen and remove the two screws (24) retaining the gearbox (3) to the engine (17).  
[\*8]



- 17 -Move the gearbox group (3) towards the rear of the machine and extract the group.

 Transmission: 254 kg



## Installation

- To install, reverse removal procedure.

[\*1]



Hydraulic oil: approx. 20 ℓ

[\*2]



Hydraulic oil: approx. 40 ℓ

[\*3]



Screw: 120 Nm

[\*4]



Cardan shaft screws: 38 Nm

[\*5]



Screw: Loctite 242



Screw: 64 Nm

[\*6]



Anti-vibration nuts: 195±20 Nm

[\*7]



Support screws: Loctite 262



Support screws: 90±5 Nm

[\*8]



Engine-gearbox screws: Loctite 262



Engine-gearbox screws: 50±5 Nm

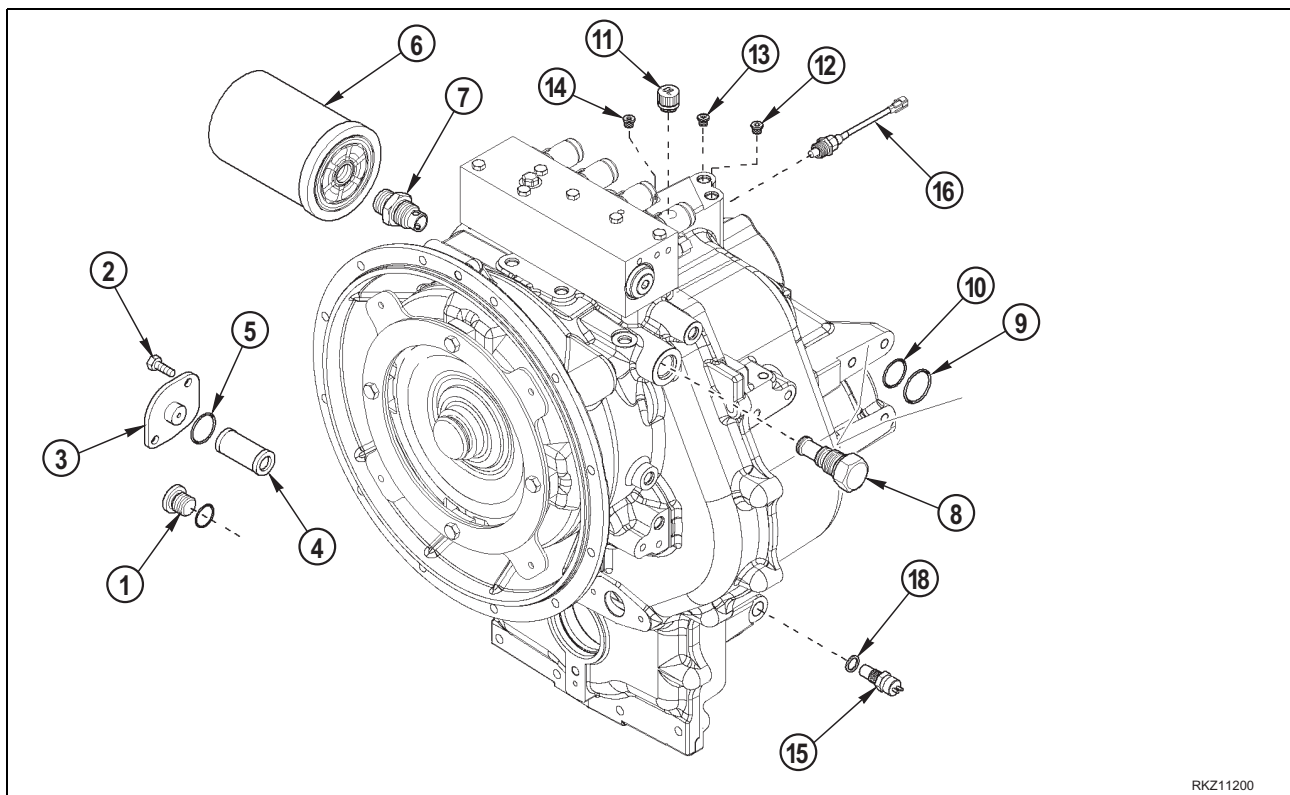
- ★ Tighten the screws using the alternating crosswise method.

- 1 -Start the engine to circulate the oil. Check that there are no leaks.
- 2 -Bleed the air from the working equipment circuits.  
(For details see "20 TESTING AND ADJUSTMENTS").
- 3 -Stop the engine, check the levels and, if necessary, top them up.

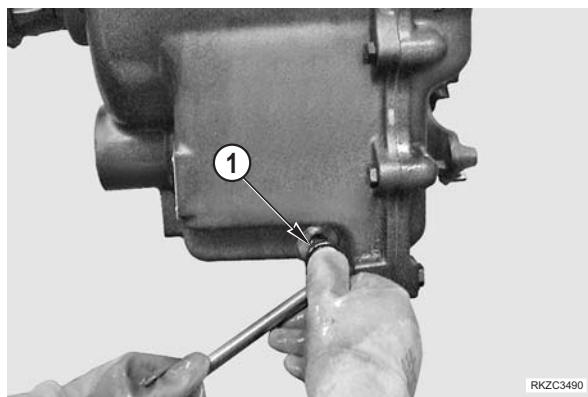
## Disassembly and assembly

### 1. Plugs and filters

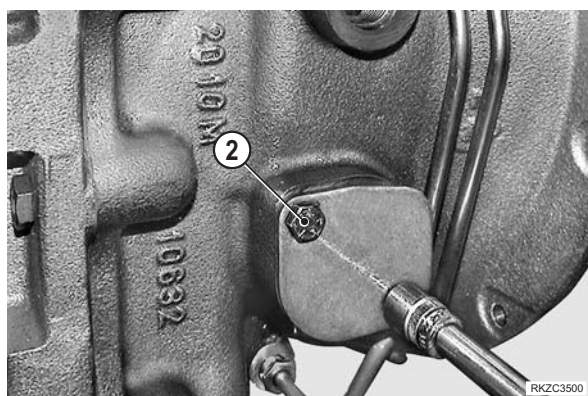
#### 1.1 Disassembly



1 -Remove the drain plug (1) and drain the oil from the transmission.



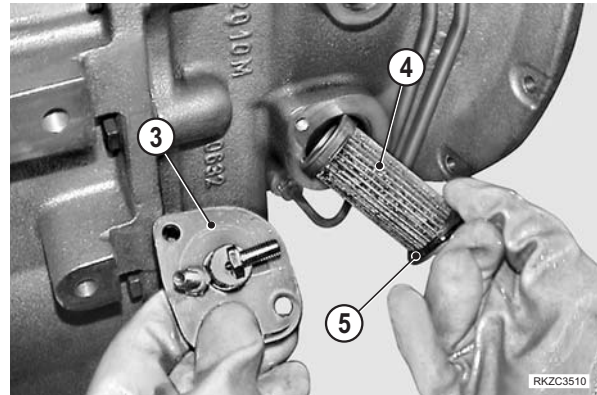
2 -Remove the two cap screws (2) which fasten the cover for the oil screen.



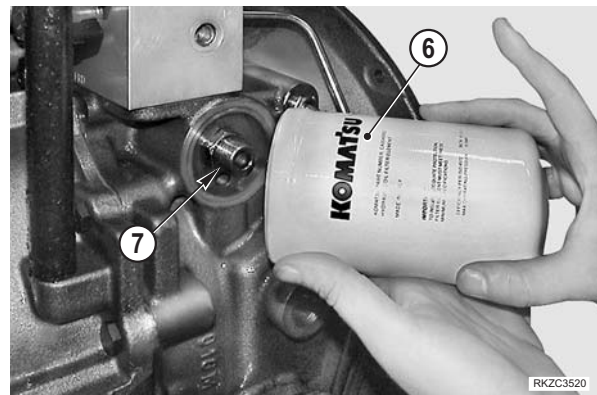
## REMOVAL AND INSTALLATION

## TRANSMISSION

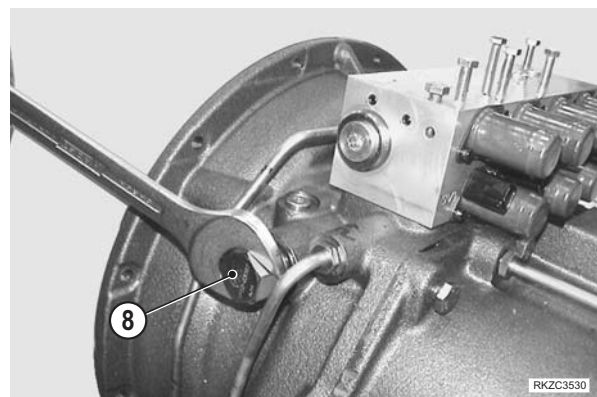
3 - Remove the cover (3), the oil screen (4) and the ring (5).



4 - Unscrew the oil filter (6).  
If necessary, remove the connector (7) for the oil filter (6).

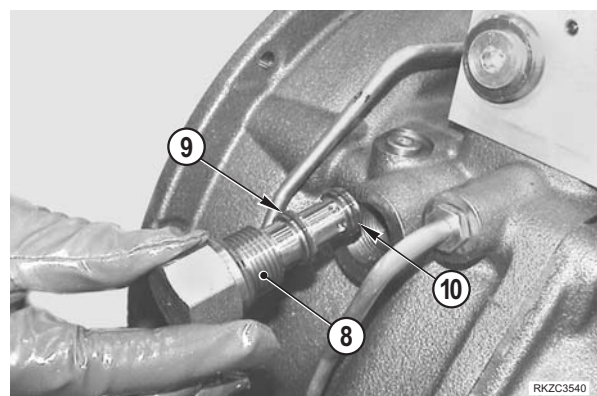


5 - Unscrew and remove the oil filter protection valve (8).



6 - Check the valve (8) condition.

- ★ Clean with care the valve and replace the O-ring (9) and (10) if necessary.

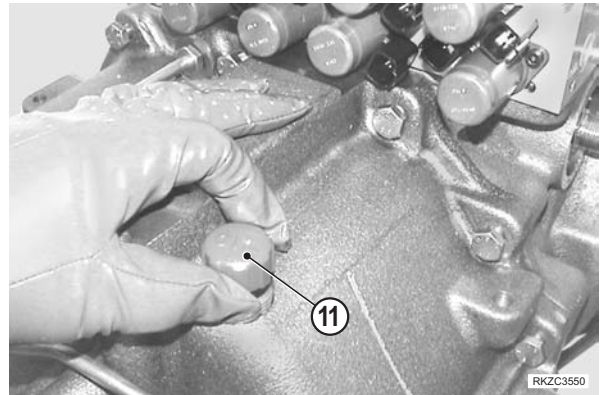




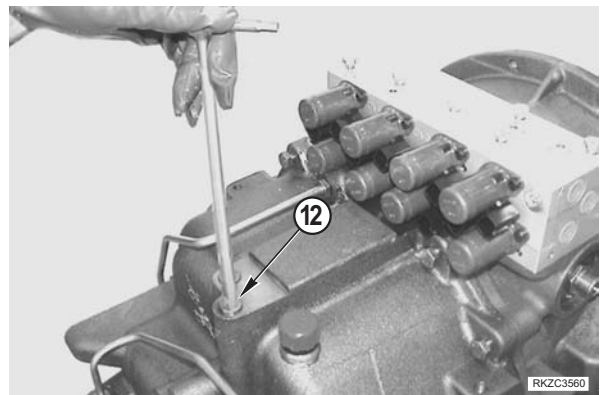
## REMOVAL AND INSTALLATION

## TRANSMISSION

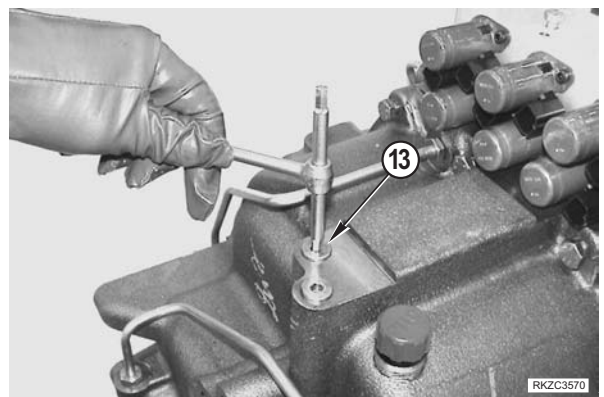
- 7 -Remove the breather (11) from the transmission housing only if this part is leaking or damaged.



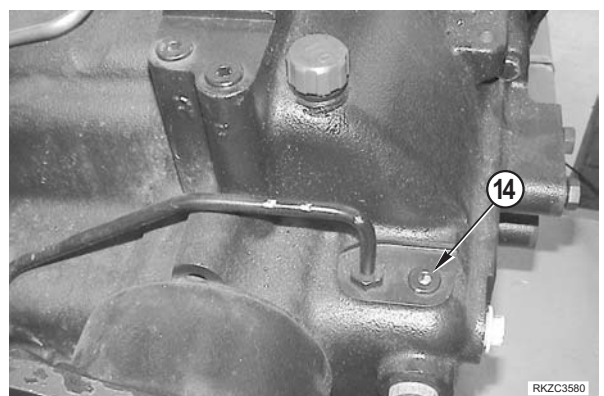
- 8 -To check the FORWARD clutch pressure, remove the plug (12).



- 9 -To check the REVERSE clutch pressure, remove the plug (13).



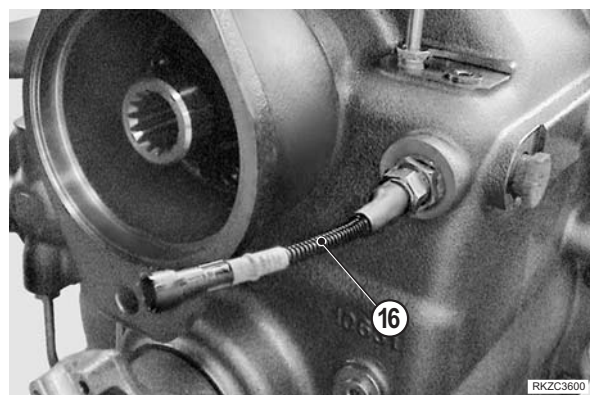
- 10 -To check the lubrication pressure, remove the plug (14).



11 -Remove the speed sensor (15).



12 -Rimuovere il termostato olio (16).



## 1.2 Assembly

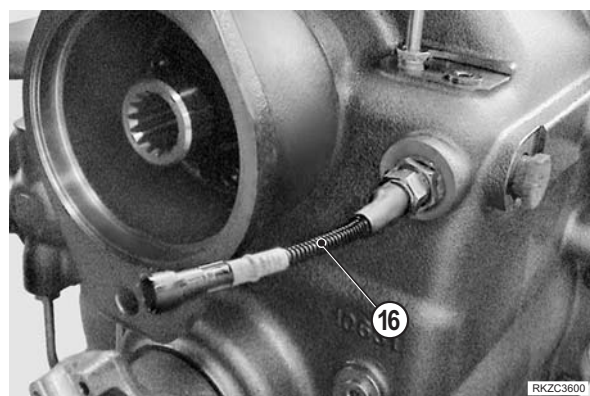
1 -Assemble the speed sensor (15) to the prescribed torque

 Sensor: 50 Nm



2 -Assemble the thermostat (16) to the prescribed torque.

 Thermostat: 30 Nm

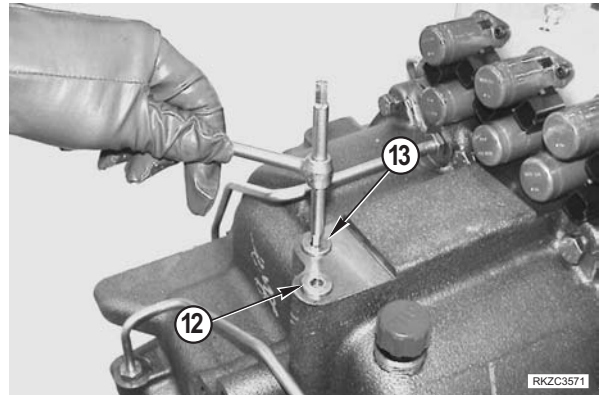


## REMOVAL AND INSTALLATION

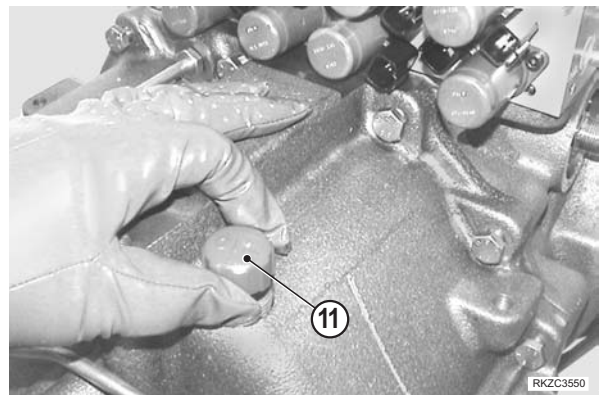
## TRANSMISSION

- 3 - Assemble the plugs (12), (13) and (14) to the prescribed torque after the pressure check.

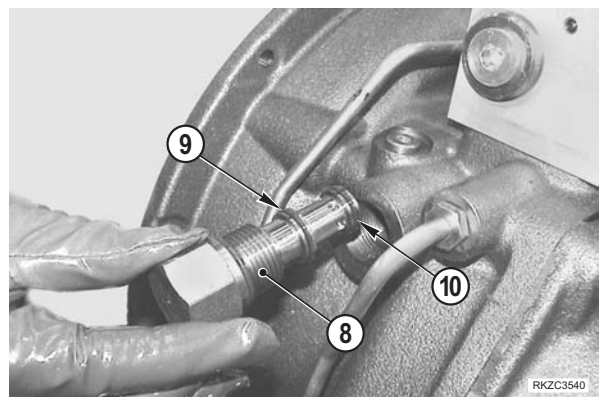
 Caps: 30 Nm



- 4 - Assemble by hand the breather (11) to the transmission housing and tighten it strongly.

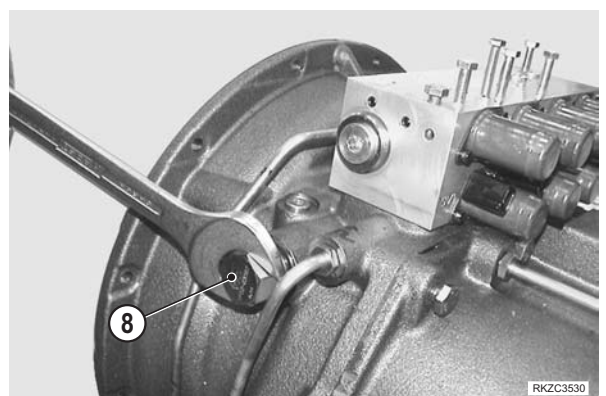


- 5 - Clean with care the oil filter protection valve (8).  
Assemble the new O-ring (9) and (10).



- 6 - Assemble the oil filter protection valves (8).  
Tighten the valve (8) to the prescribed torque

 Valve: 23 Nm



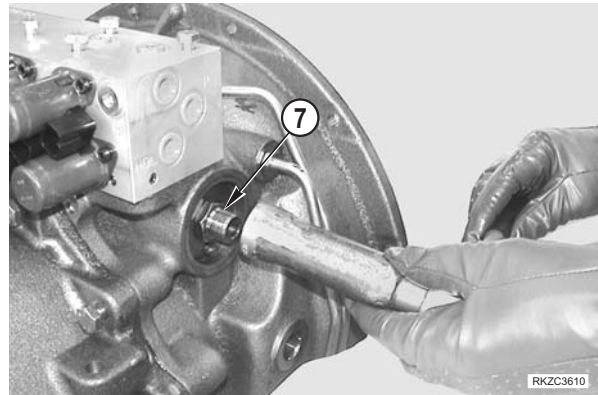


## REMOVAL AND INSTALLATION

## TRANSMISSION

- 7 - Assemble the connector (7) for the oil filter (6) then tighten it to the prescribed torque.

 Union: 50 Nm

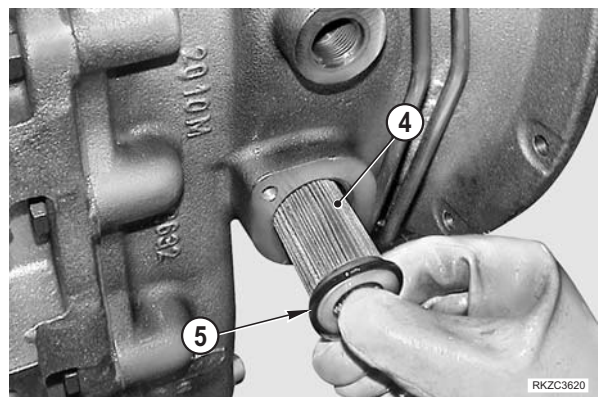


- 8 - Assemble new oil filter (6).

- ★ Put a thin coat of oil or grease on the filter gasket, turn clockwise until the gasket makes contact with the base, continue to turn the filter 2/3 turn.

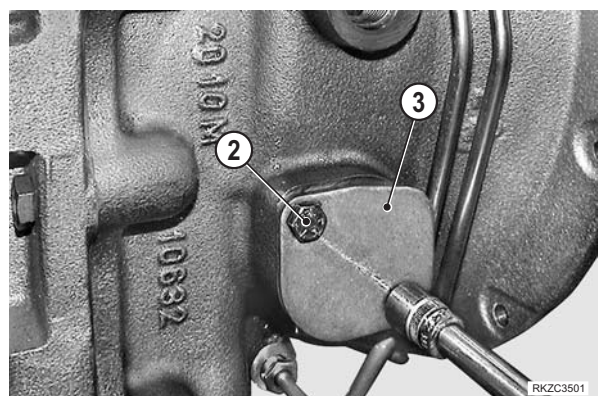


- 9 - Assemble new O-ring (5) to the filter (4).  
Insert the filter (4) with O-ring (5) and assemble the cover (3).



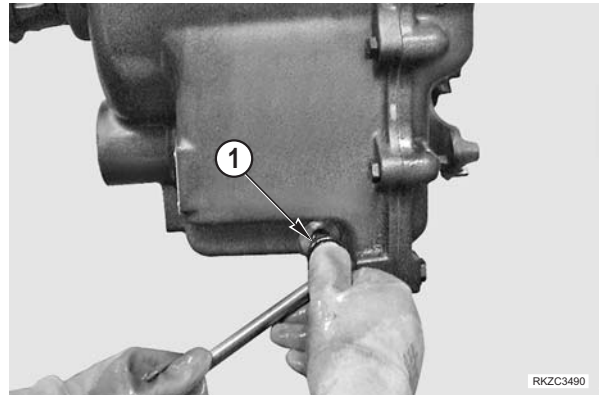
- 10 - Assemble the two cap screws (2) at prescribed torque to fasten the cover (3).

 Screw: 23 Nm



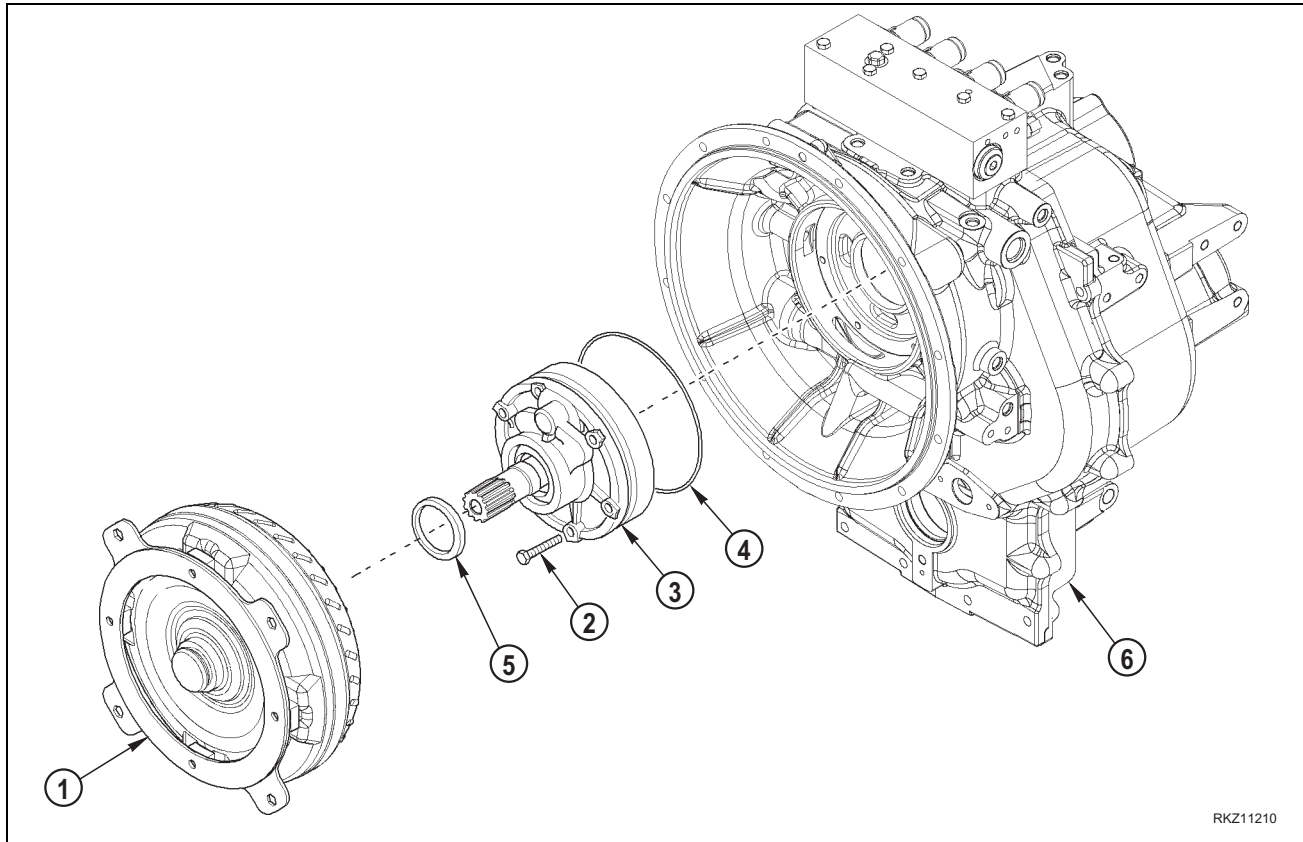
11 -Assemble the drain plug (1) to the prescribed torque.

 Plug: 80 Nm

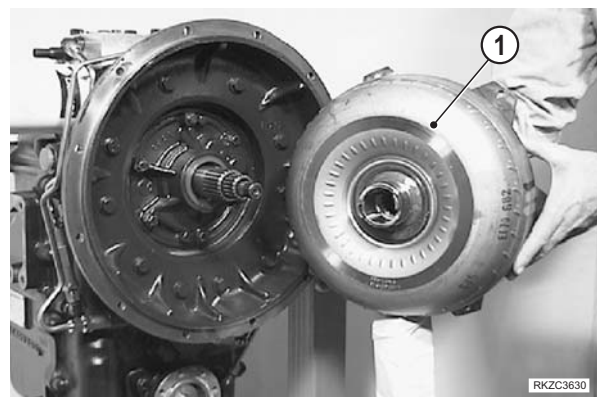


## 2. Torque converter and oil pump

## 2.1 Disassembly

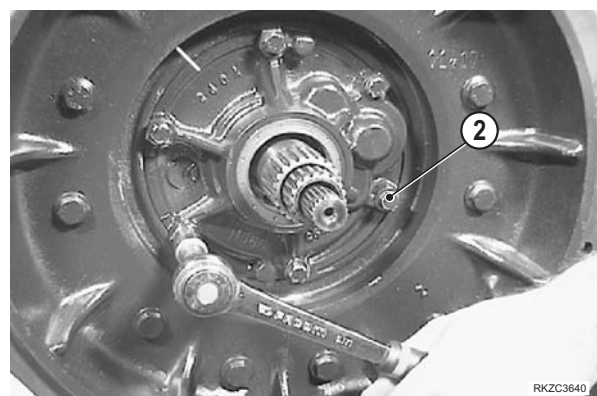


1 -Remove torque converter (1).  
(For details see "CONVERTOR").

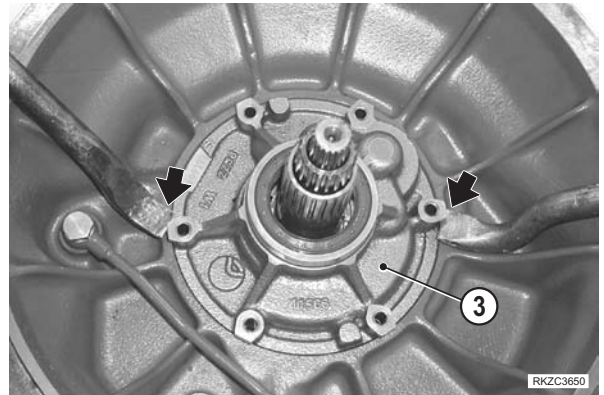


2 -Remove screws (2).

- ★ Make reference mark on the pump and bell housing before untightening the screws.



3 -Extract the pump (3) by means of two levers.



4 -Remove the oil pump (3).

⚠ Do not disassemble the oil pump (3)



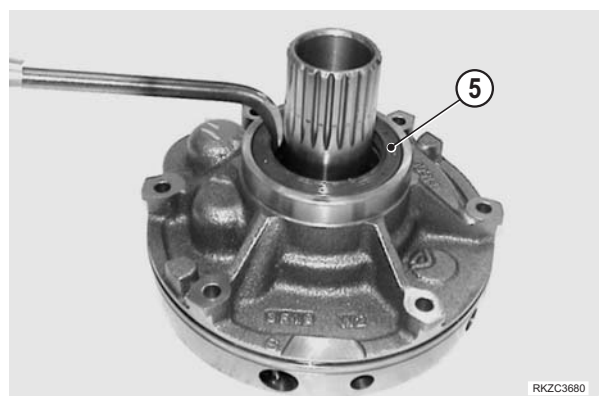
5 -Remove O-ring (4).

★ Replace the O-ring at each disassembly.



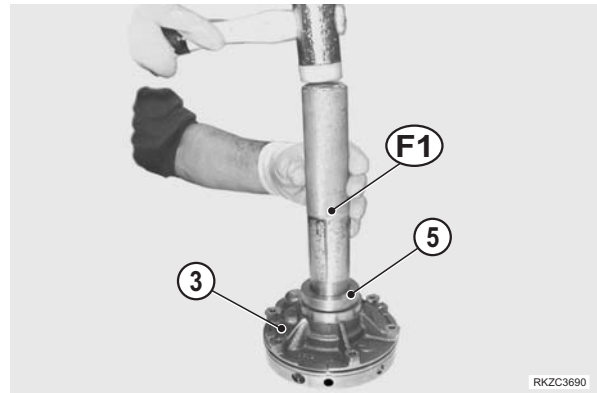
6 -If replacement is necessary, remove the seal ring (5).

★ This is a destructive operation for the seal ring.



## 2.2 Assembly

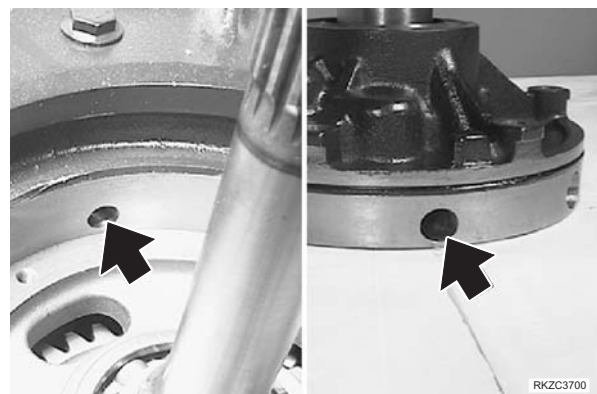
- 1 - Assemble new seal ring (5) on the oil pump (3).  
Use tool F1.



- 2 - Assemble new O-ring (4).



- ★ If the oil pump is being replaced, verify that the oil passage holes between the pump and the half housing, and the marks on the side in view match.



- 3 - Grease the ring (5) to keep it centred/coaxial with respect to the shaft slot centre line and to make the introduction onto the pump easier.

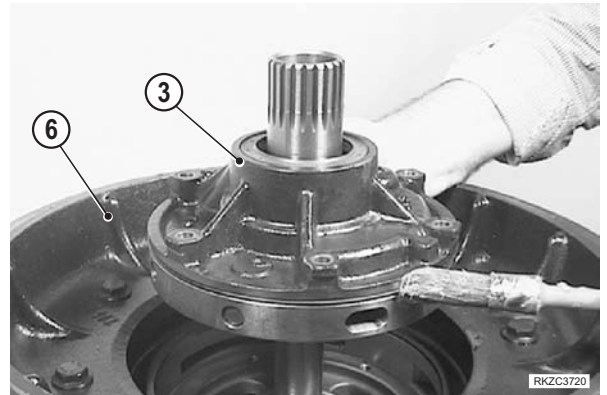




## REMOVAL AND INSTALLATION

## TRANSMISSION

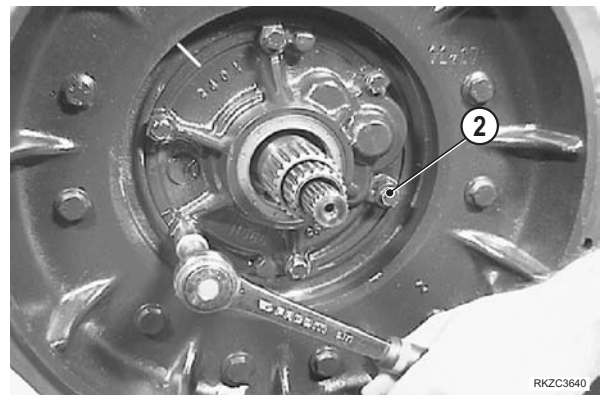
- 4 -Apply a thin film of grease on the coupling seat with the transmission housing (6). Assemble the oil pump (3).



- 5 -Assemble the screws (2) to prescribed torque.

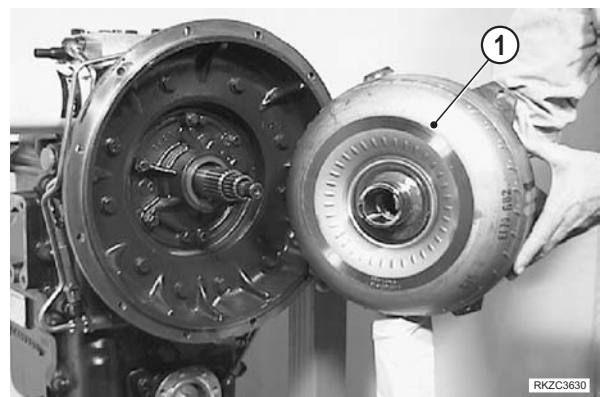
 Screw: 23 Nm

- ★ Check that reference marks made on the oil pump and on the bell housing coincide.



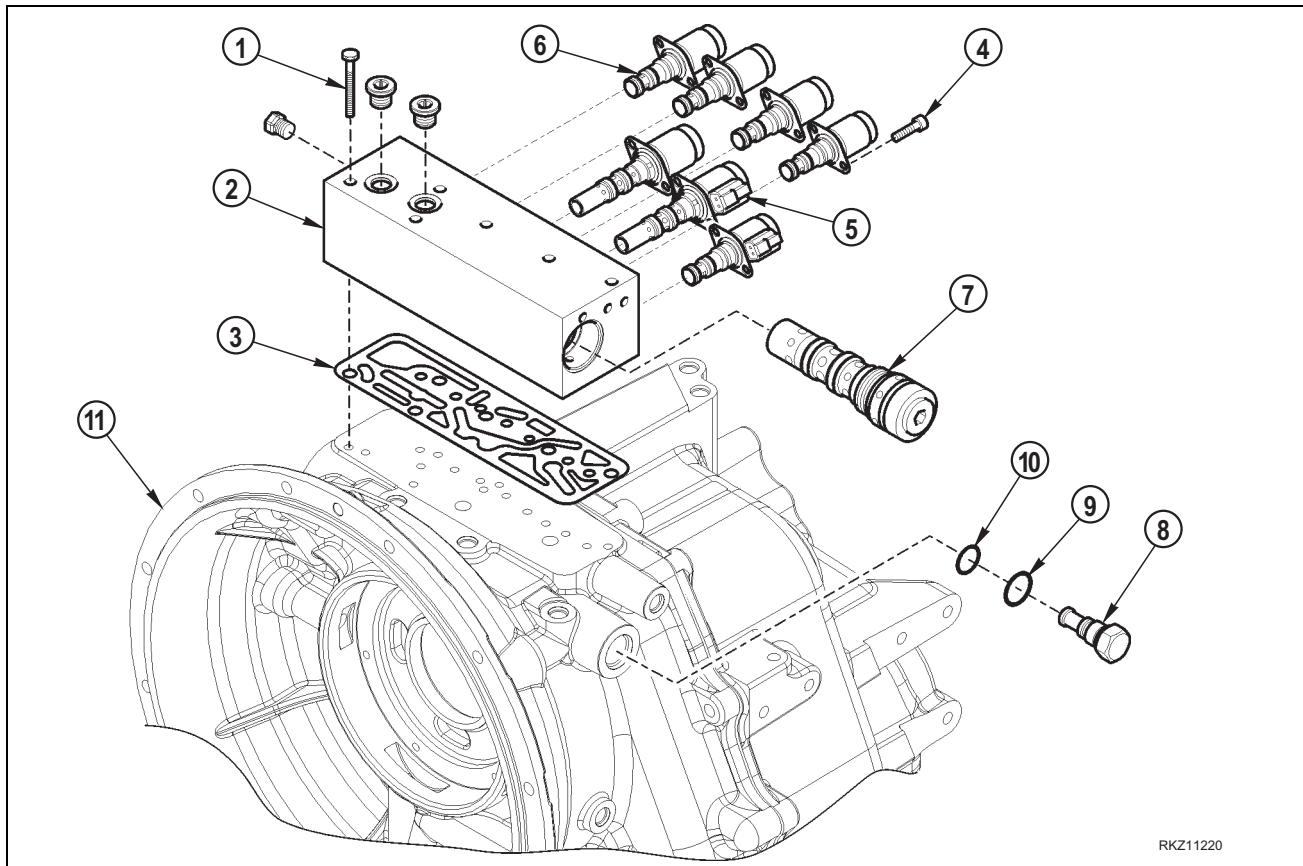
- 6 -To prevent damage to the pump sealing ring, install the converter to the transmission by hand. The two teeth on the converter that are responsible for driving the pump can cut the lip of the sealing ring.

- 7 -Couple transmission and converter to the engine flywheel with the screws of the bell converter drive plate.



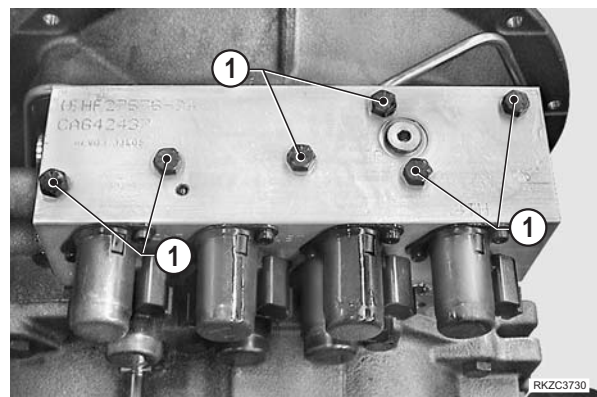
### 3. Hydraulic control valve

#### 3.1 Disassembly



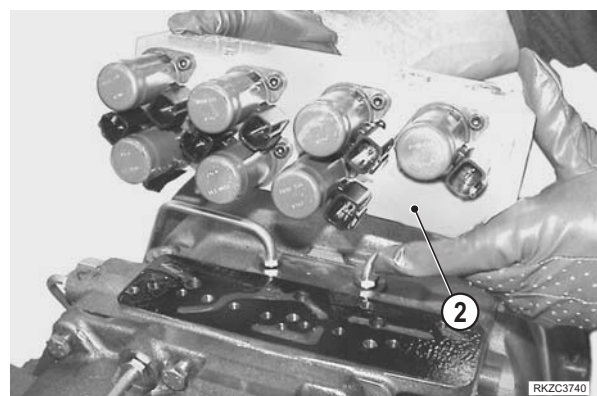
RKZ11220

1 - Drain oil from transmission hydraulic circuit, disconnect all electrical connections.  
Remove screws (1).



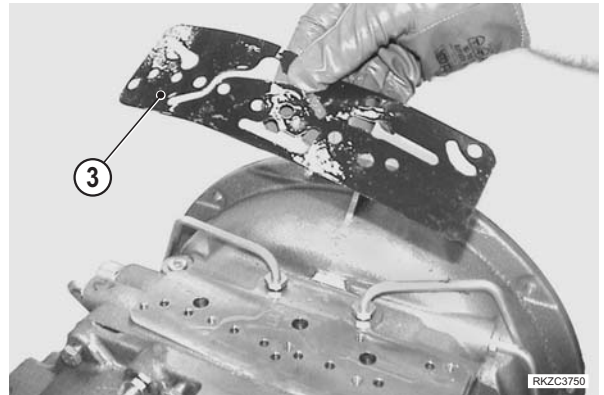
RKZC3730

2 - Lift control valve (2).

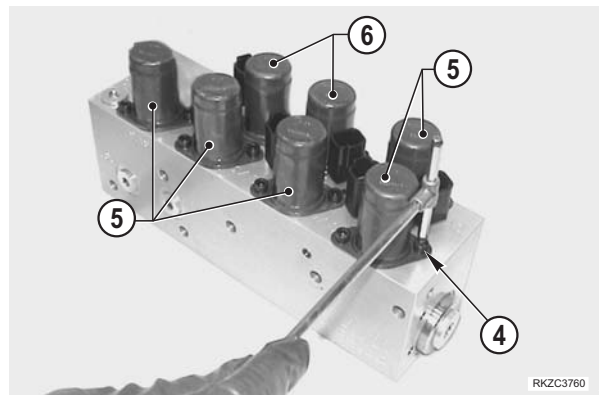


RKZC3740

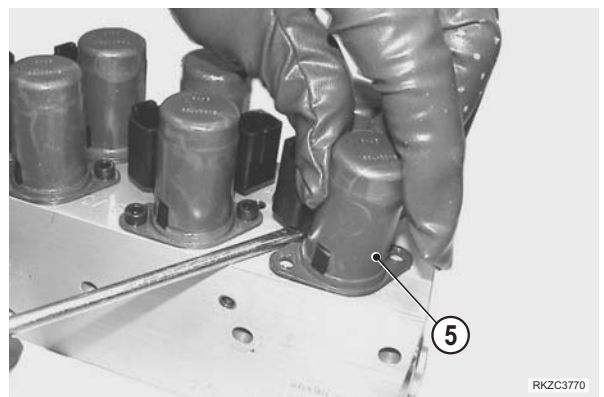
3 -Remove the gasket (3).



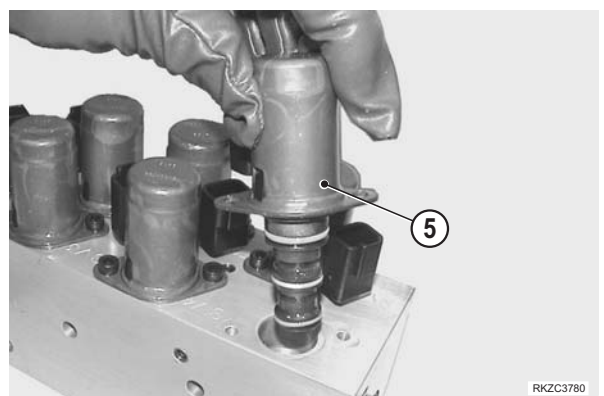
4 -Place the control valve unit on a clean workbench.  
Remove fastening screws (4) from the valves (5) and (6).



5 -Extract with care the valves (5) and (6) with a screwdriver.



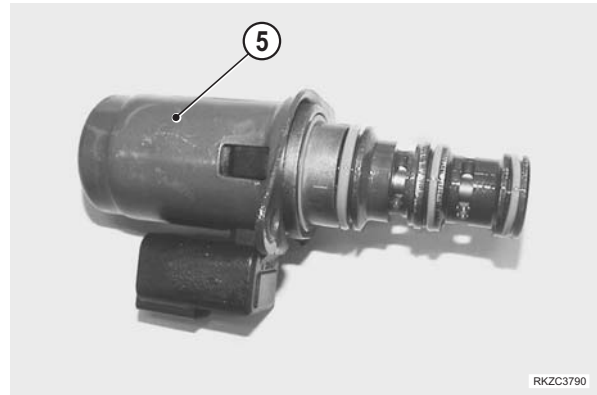
6 -Remove the valves (5) and (6).



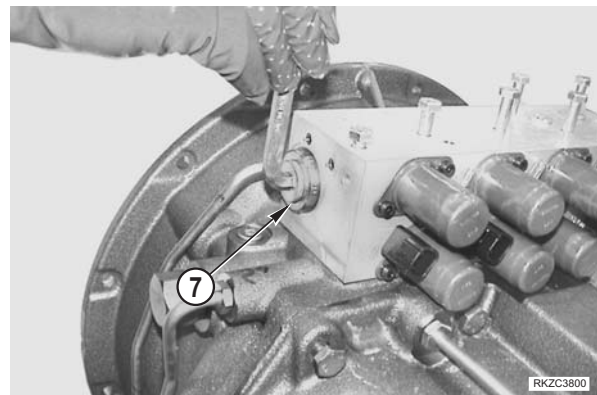
## REMOVAL AND INSTALLATION

## TRANSMISSION

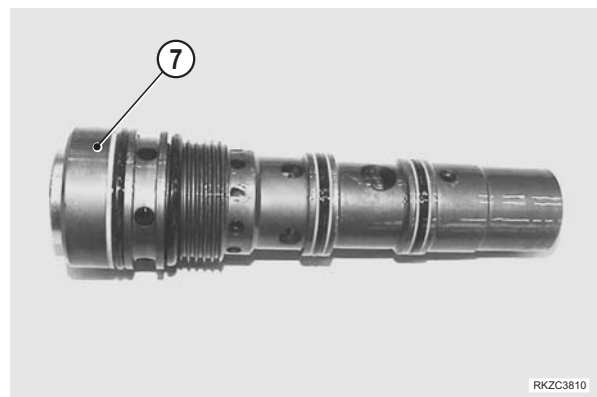
7 -Check the valves (5) and (6) condition.



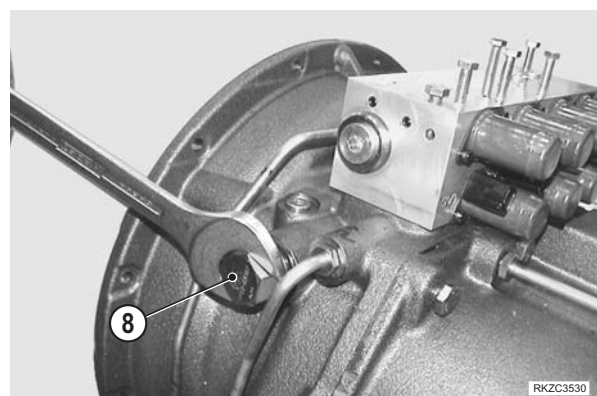
8 -Unscrew and remove the valve (7).



9 -Check the valve (7) condition.



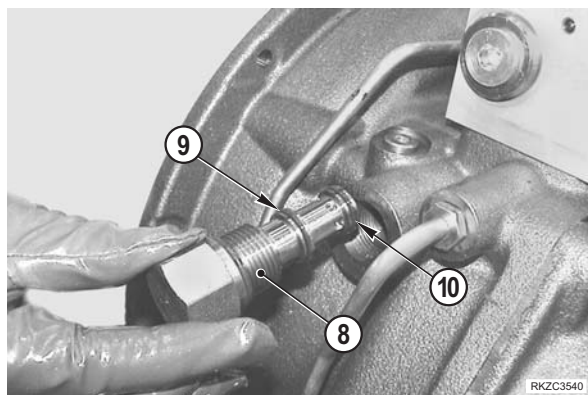
10 -Unscrew and remove the oil filter protection valve (8).



## REMOVAL AND INSTALLATION

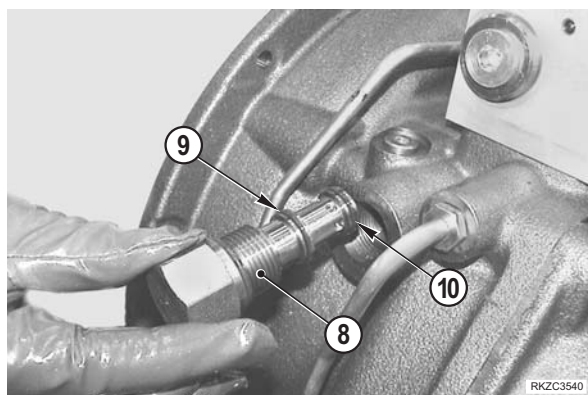
## TRANSMISSION

- 11 -Check the valve (8) condition.  
Clean with care the valve and replace the O-ring (9) and (10) if necessary.



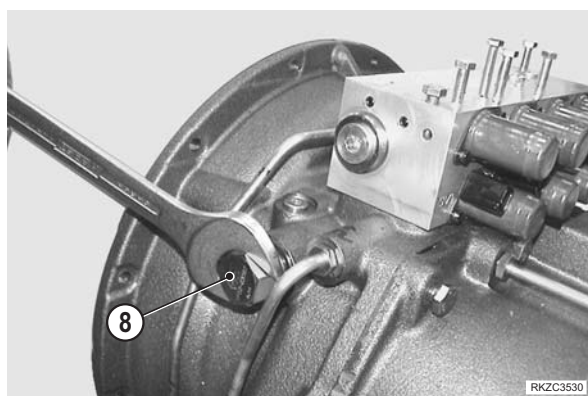
### 3.2 Assembly

- 1 -Clean with care the oil filter protection valve (8) and assemble the new O-ring (9) and (10).

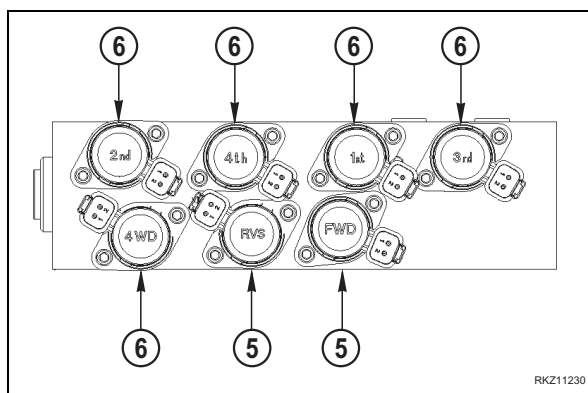


- 2 -Assemble the oil filter protection valves (8).  
Tighten the valve (8) to the prescribed torque

 Valve: 23 Nm



- 3 -Assemble the ON/OFF (6) and proportional (5) valves using the locations shown on the side.





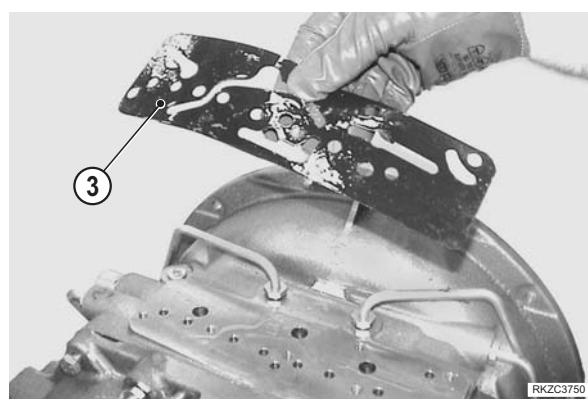
## REMOVAL AND INSTALLATION

## TRANSMISSION

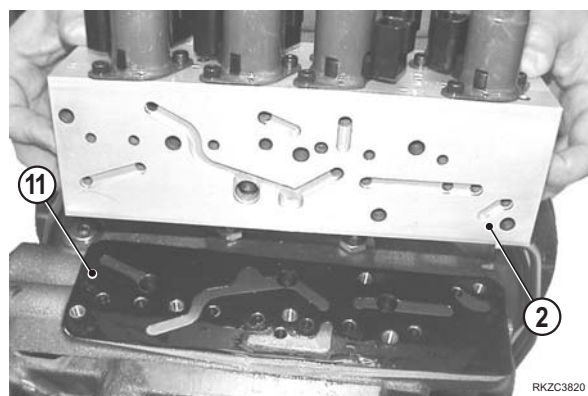
4 - Assemble the valve mounting screws (4).



6 - Assemble the new gasket (3).

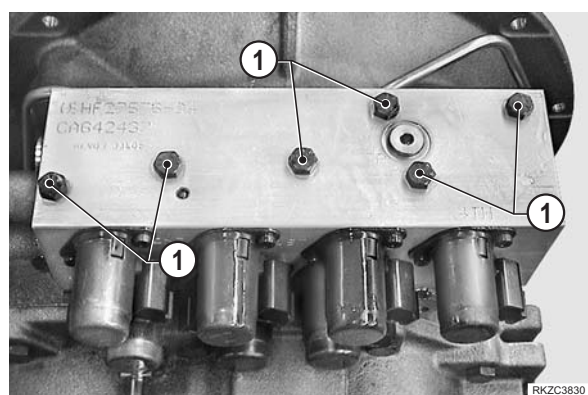


7 - Assemble the control valve unit (2) to the transmission (11).



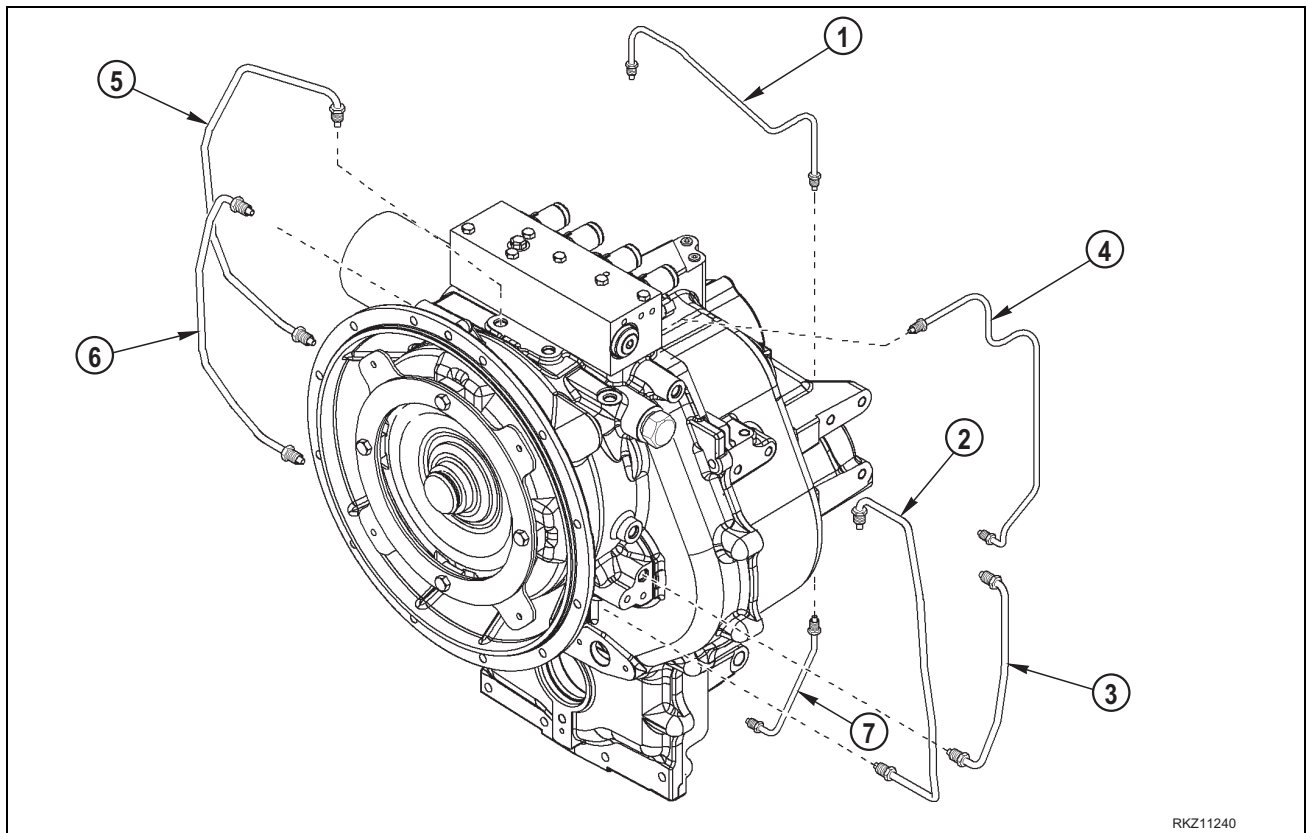
8 - Tighten the bolts (1) to the prescribed torque.

 Screws: 23 Nm



## 4. Hydraulic system lines

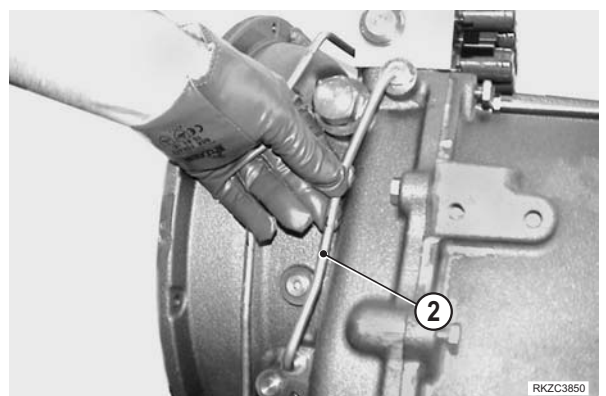
### 4.1 Disassembly



- 1 - Drain oil from transmission hydraulic circuit.  
Unscrew the connections of pipe (1) (shaft lubrication) and remove the pipe (1).



- 2 - Remove the pipe (2) (2nd speed) unscrewing related connections.

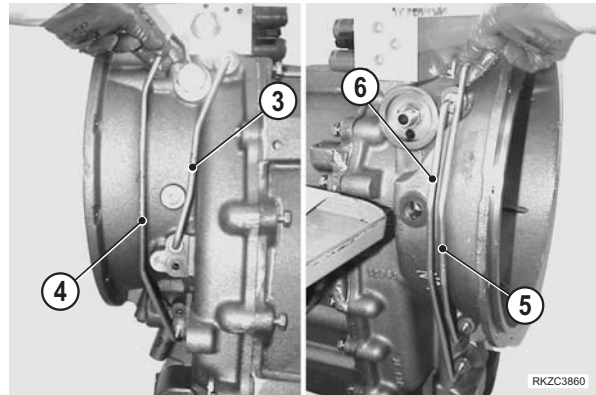


## REMOVAL AND INSTALLATION

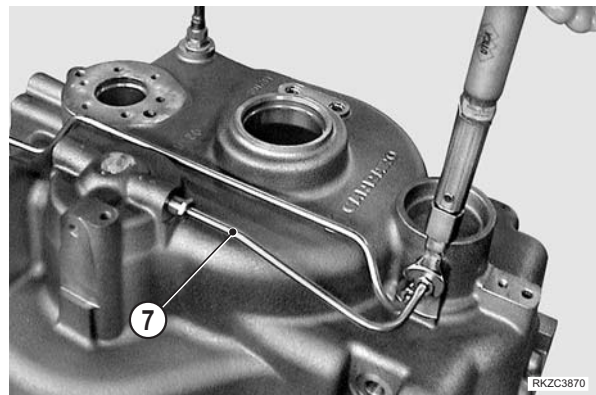
## TRANSMISSION

3 - Remove the pipes (3) (4th speed), (4) (4WD), (5) (1st speed) and (6) (3rd speed) unscrewing related connections.

★ Collect connection gaskets.



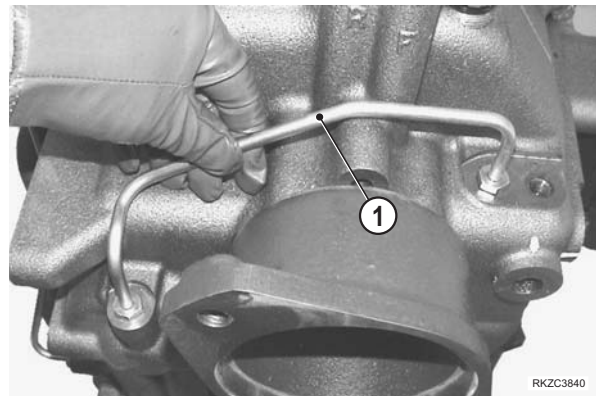
4 - Remove the pipe (7) (shaft lubrication) unscrewing related connections.



### 4.1 Assembly

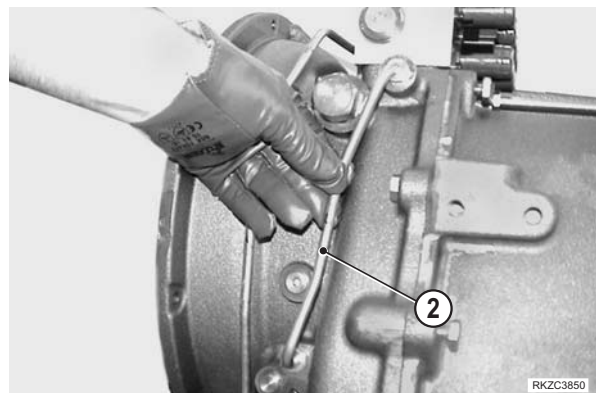
1 - Assemble the pipe (1) tightening the connections to the prescribed torque.

 Unions: 30 Nm



2 - Assemble the pipe (2) tightening torques the connections to the prescribed torque.

 Unions: 30 Nm



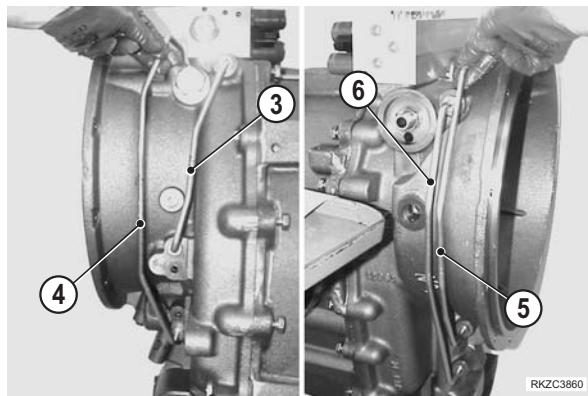


## REMOVAL AND INSTALLATION

## TRANSMISSION

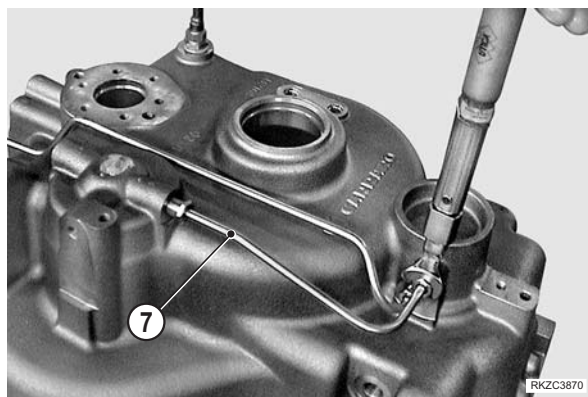
- 3 - Assemble the pipes (3), (4), (5) and (6) then tighten related connections to the prescribed torque.

 Unions: 30 Nm



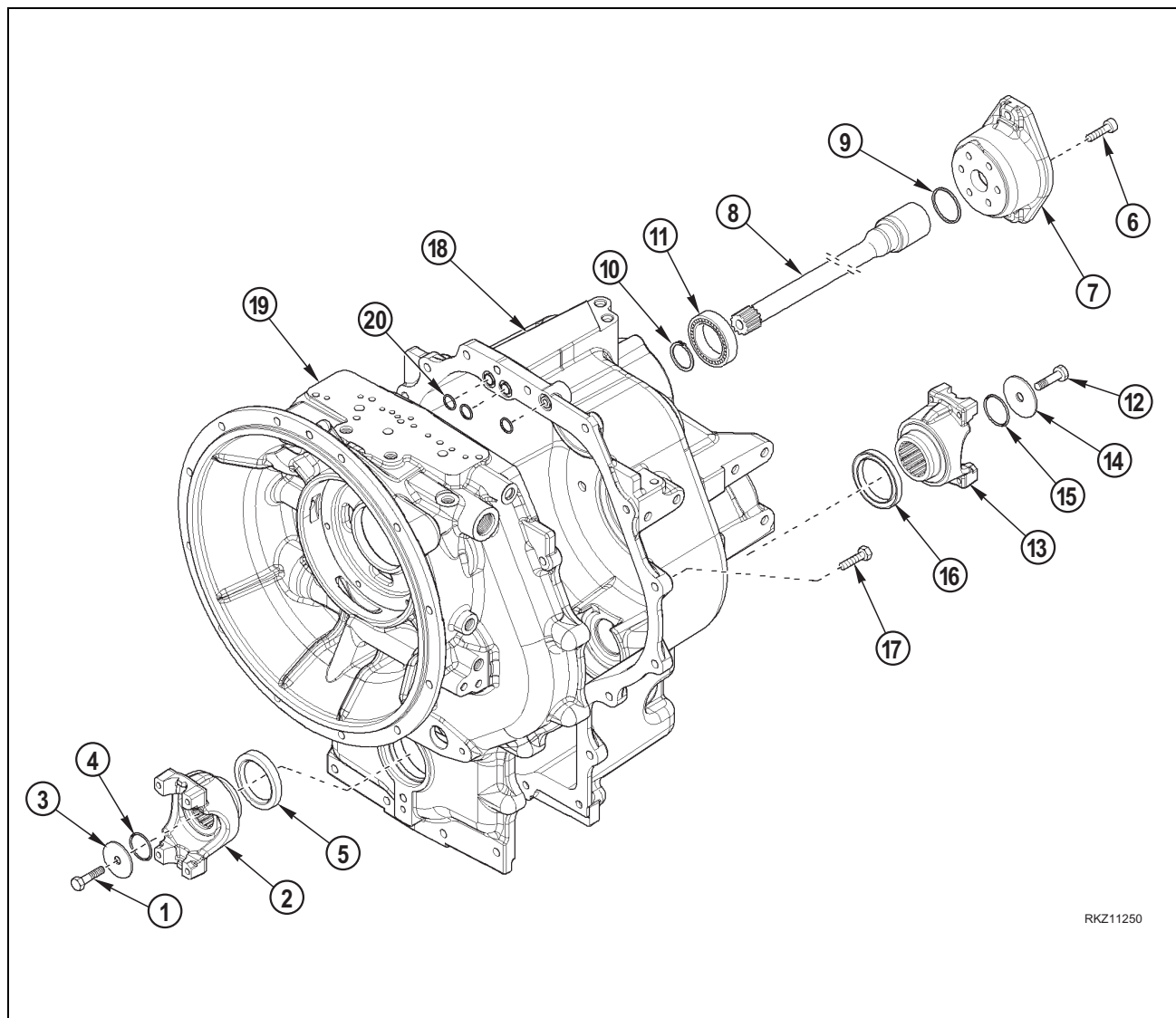
- 4 - Assemble the pipe (7) tightening torques the connections to the prescribed torque.

 Unions: 30 Nm

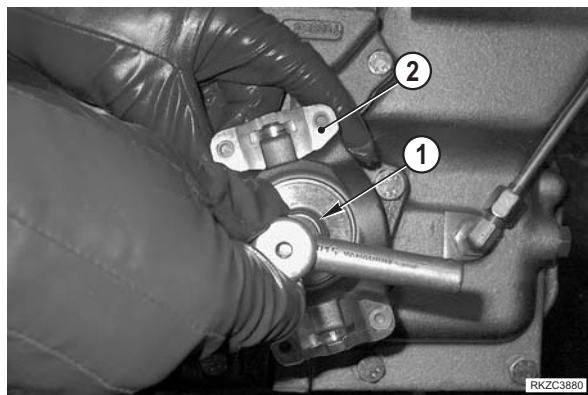


## 5. Transmission housing

## 5.1 Disassembly



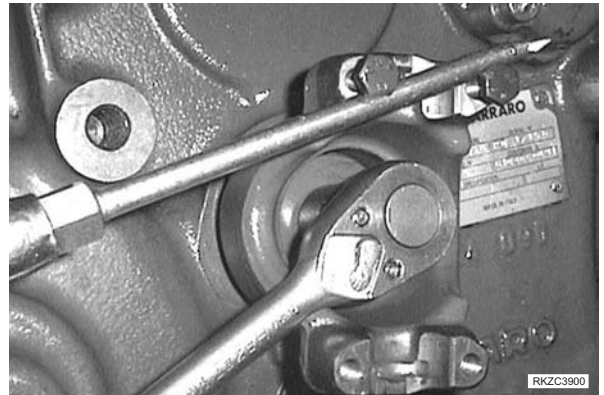
1 -Drain oil from transmission.  
Unscrew flange (2) fastening bolt (1).



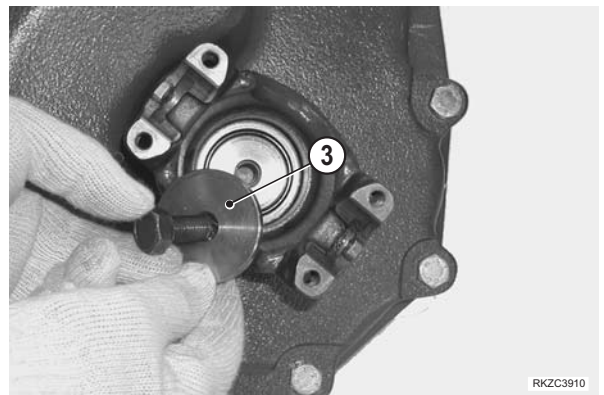
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 2 -If necessary use a screwdriver and two screws to stop flange rotation.

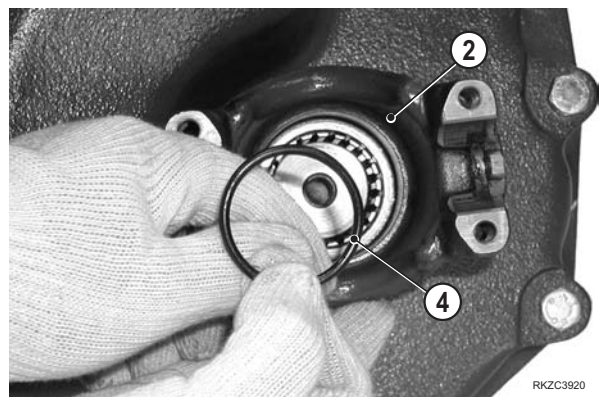


- 3 -Collect the washer (3).



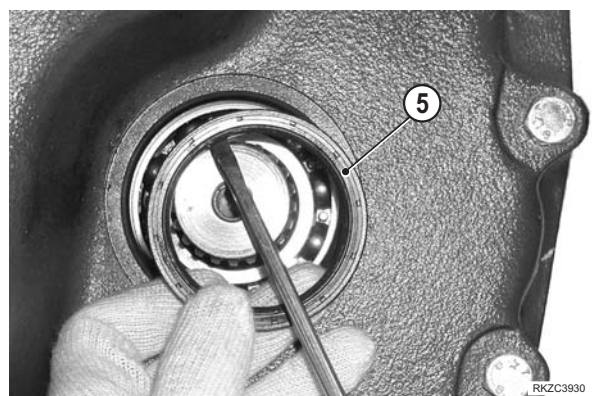
- 4 -Remove flange (2) and O-ring (4).

- ★ Replace the O-ring at each disassembly.



- 5 -Remove seal ring (5).

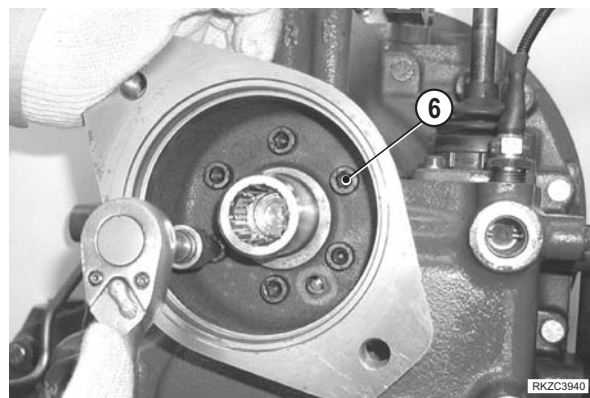
- ★ This is a destructive operation for the seal ring.



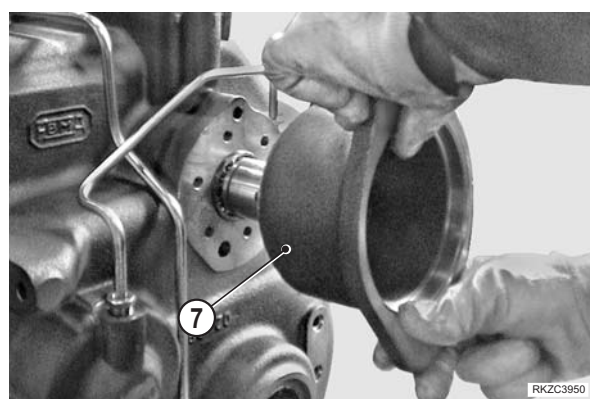
## REMOVAL AND INSTALLATION

## TRANSMISSION

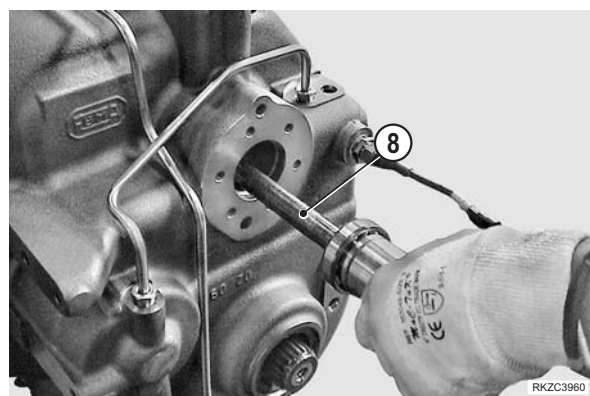
6 - Remove the fastening screws (6) from the flange (7).



7 - Remove flange (7).

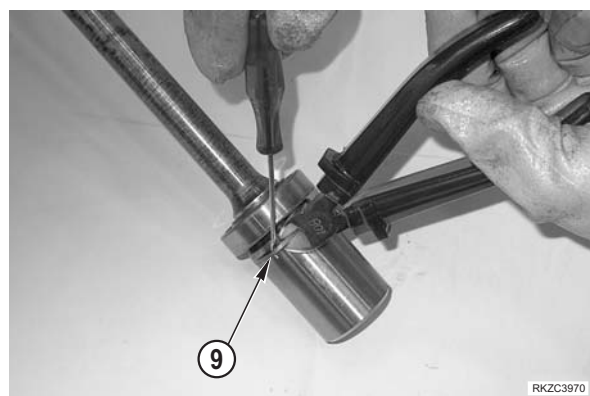


8 - Extract transmission shaft PTO (8).



9 - If to be replaced, remove teflon seal ring (9) by cutting it.

★ This is a destructive operation for the seal ring.

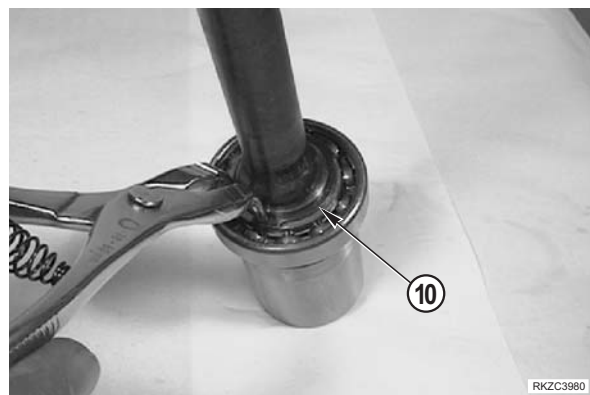




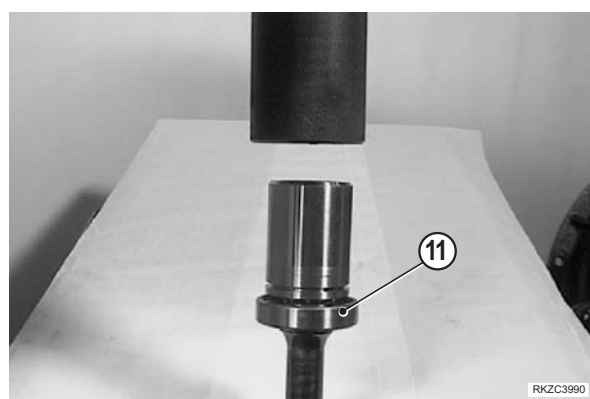
## REMOVAL AND INSTALLATION

## TRANSMISSION

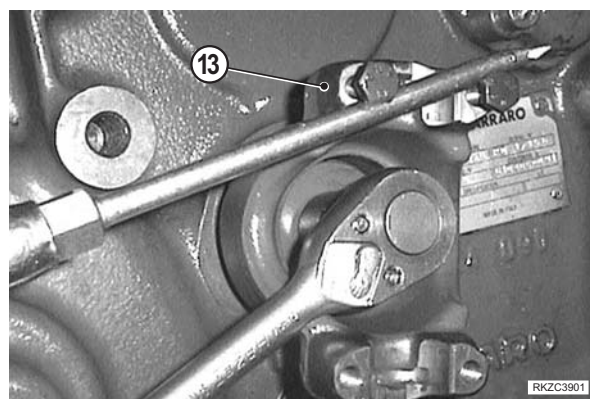
10 -Remove snap ring (10).



11 -Extract bearing (11) with tool **F2**.



12 -Unscrew flange (13) fastening bolt (12).  
Use a screwdriver and two screws to stop flange rotation.



13 -Remove the bolt (12) and washer (14).

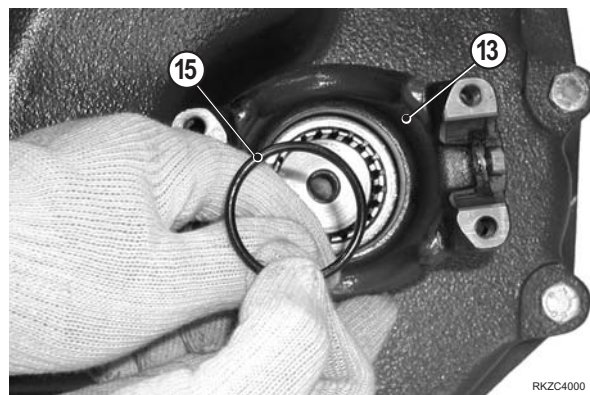


## REMOVAL AND INSTALLATION

## TRANSMISSION

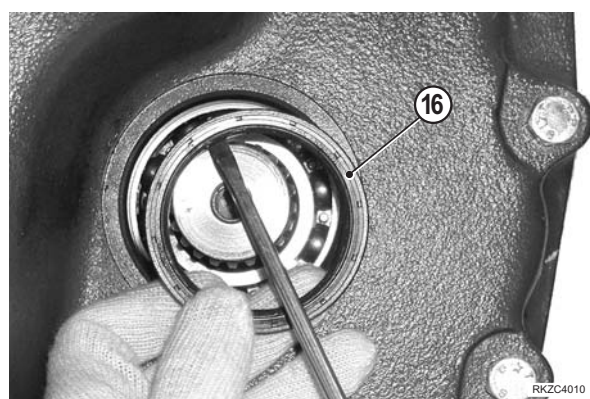
14 -Remove flange (13) and O-ring (15).

- ★ Replace the O-ring at each disassembly.

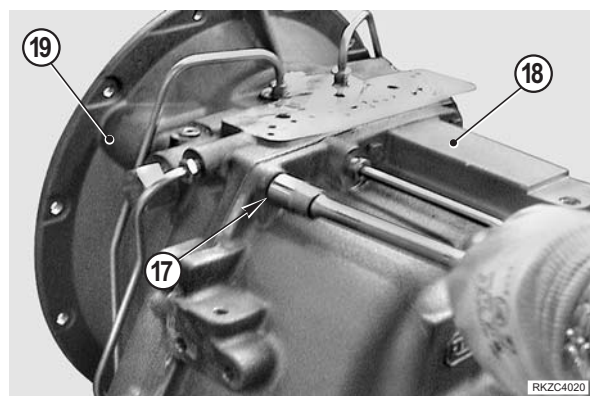


15 -Remove seal ring (16).

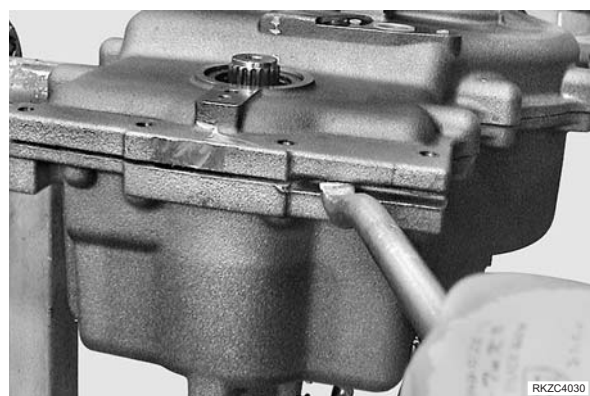
- ★ This is a destructive operation for the seal ring.



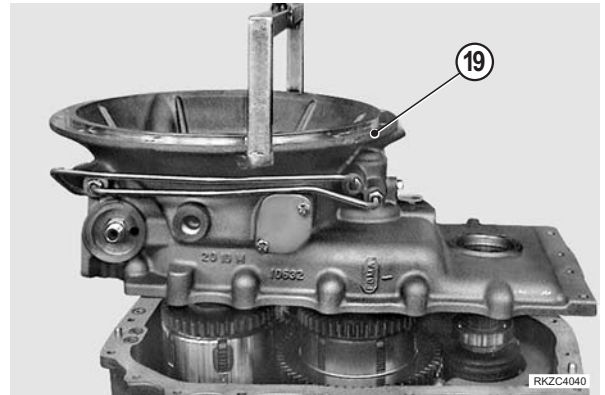
16 -Remove fastening bolts (17) from the rear (18) and front (19) half housings.



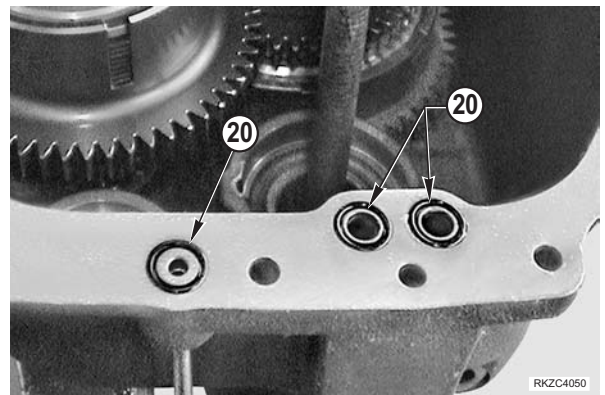
17 -Insert a lever in the special slot to detach the cover.



18 -Lift the front half housing (19) by means of two hooks.



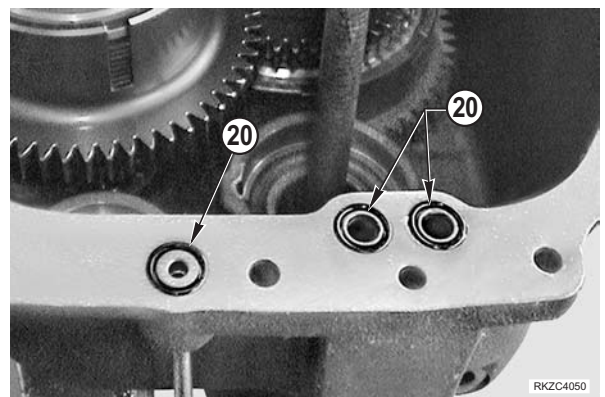
19 -Remove the three O-rings (20).



## 5.2 Assembly

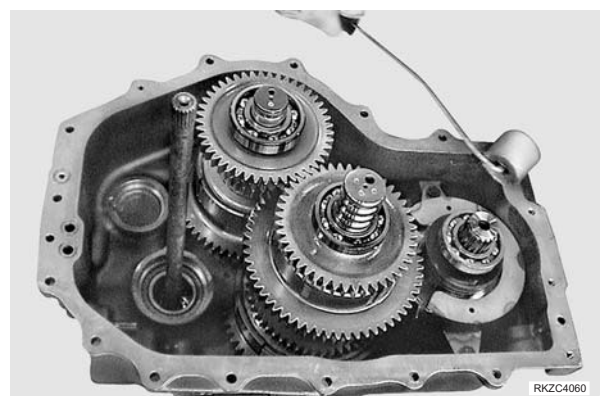
1 -Assemble three new O-rings (20) to the rear half housings (18).

- ★ Accurately remove from mating surfaces any residual of sealant and clean them with a detergent.



2 -Assemble all the transmission internal parts.  
Apply a thin film of prescribed sealant on the edge of the rear half-housing.

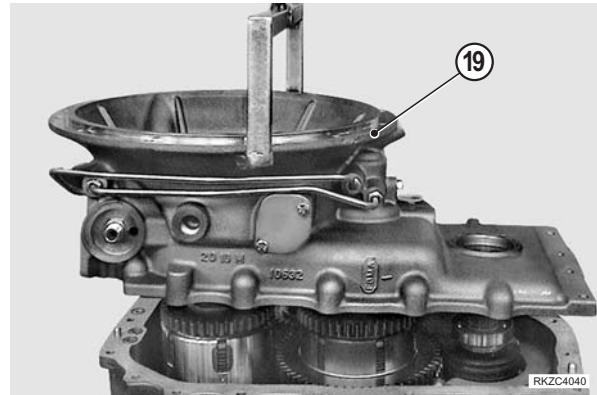
 Loctite 510



## REMOVAL AND INSTALLATION

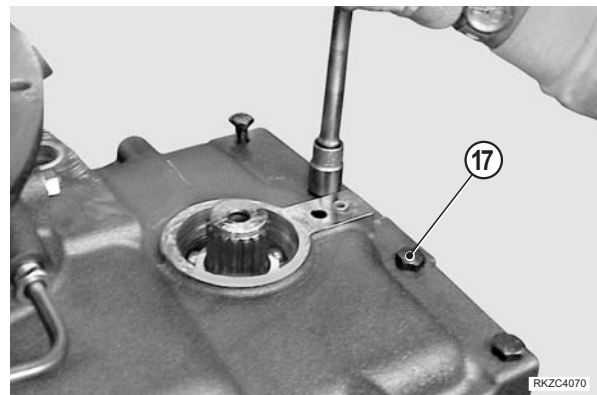
## TRANSMISSION

- 3 - Install front half housing (19) to rear half housing. Make sure that the bearings on the shafts go straight into the bores in the front half housing. Push the front half housing all the way down on the rear half housing.

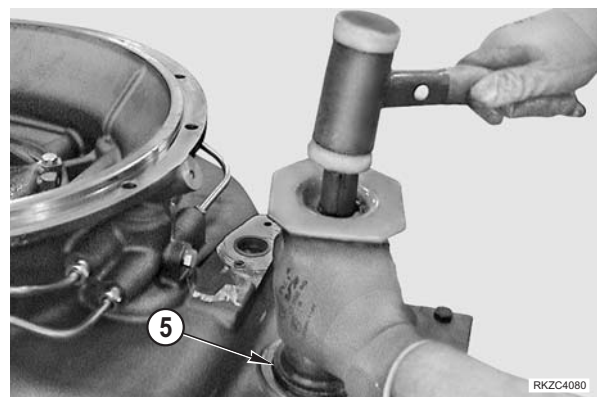


- 4 - Assemble fastening bolts (17) to the rear (18) and front (19) half housings. Tighten the bolts to the prescribed torque.

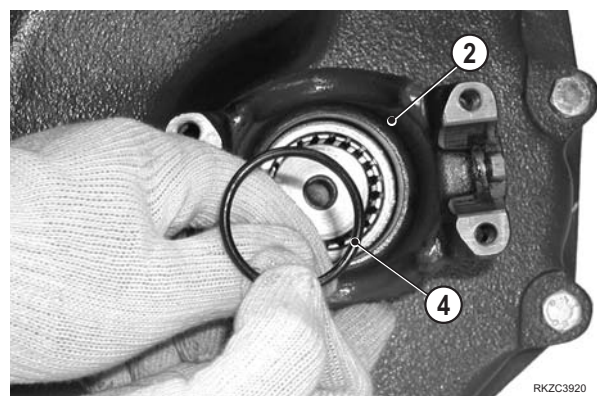
 Screws: 50 Nm



- 5 - Assemble seal ring (5) on front shaft output. Use tool F8.



- 6 - Assemble flange (2) and a new O-ring (4).

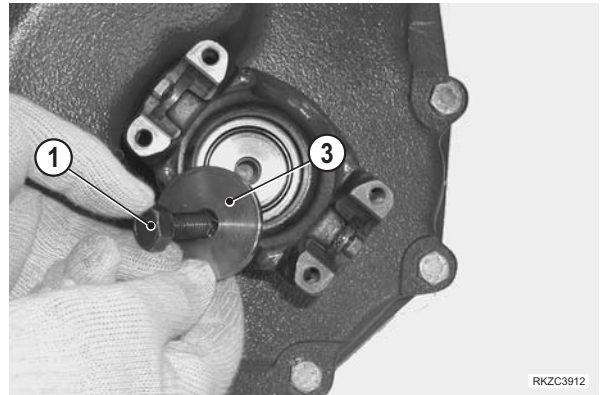




## REMOVAL AND INSTALLATION

## TRANSMISSION

7 -Assemble the washer (3) and bolt (1).



8 -Tighten the bolt (1) to the prescribed torque.  
Use screwdriver and two screws to stop flange rotation.

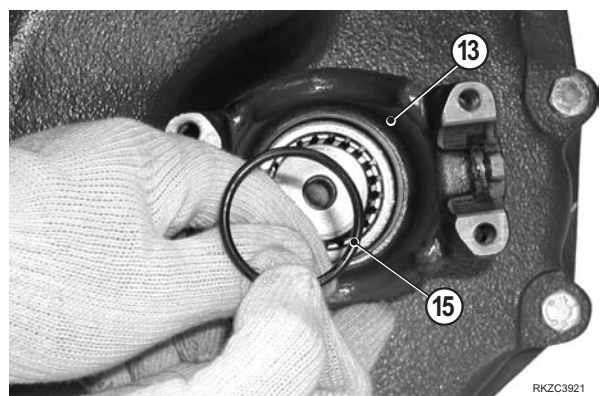
 Screws: 139 Nm



9 -Assemble seal ring (16) on rear shaft output.  
Use tool **F8**.



10 -Assemble flange (13) and a new O-ring (15).



## REMOVAL AND INSTALLATION

## TRANSMISSION

11 - Assemble the washer (14) and bolt (12).

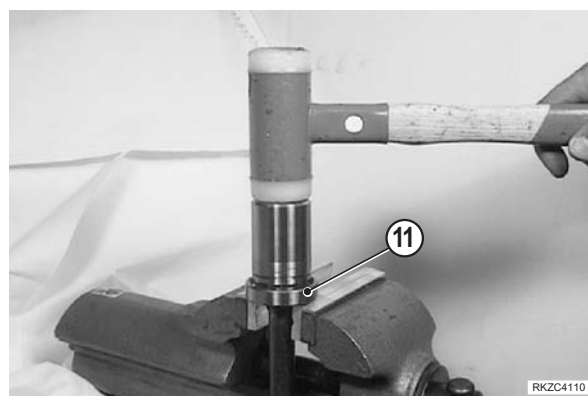


12 - Tighten the bolt (12) to the prescribed torque.  
Use screwdriver and two screws to stop flange rotation.

 Screws: 139 Nm



13 - Assemble bearing (11) on transmission shaft PTO (8).



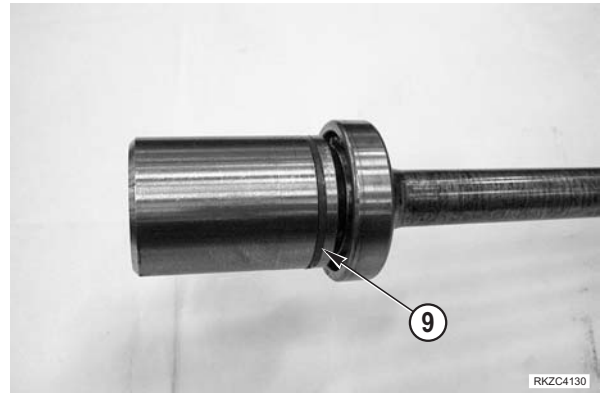
14 - Assemble snap ring (10).



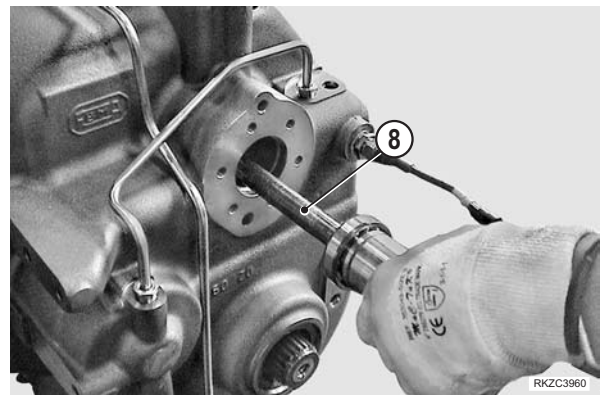
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 15 -Install the Teflon sealing ring (9) according to steps 21 to 25 of the procedure described in paragraph "6.2 Assembly", using tools **F5 - F6 - F7**.



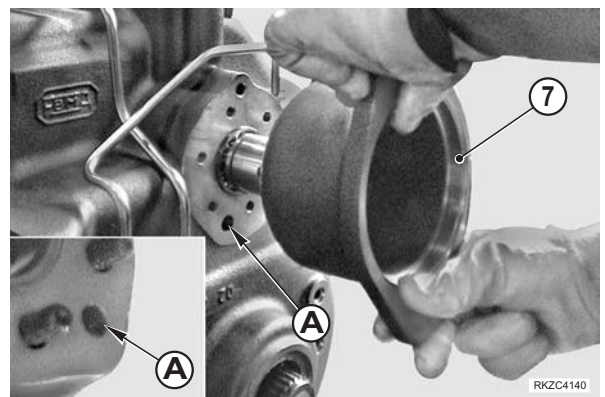
- 16 -Insert transmission shaft PTO (8) to the stroke.



- 17 -Apply a thin film of sealant to the flange (7).

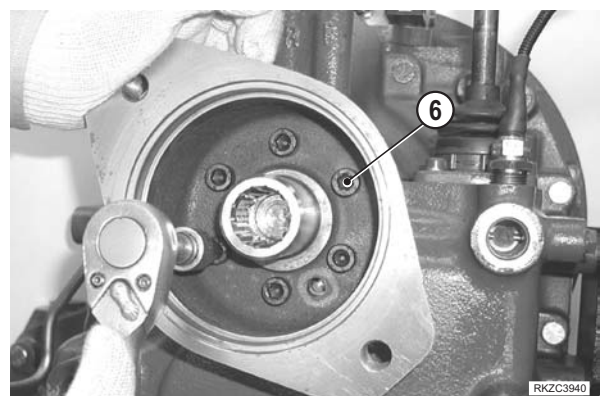
 Loctite 510

- ★ Verify that the two holes for oil passage (A) match.



- 18 -Assemble the screws (6) to prescribed torque.

 Screw: 50 Nm

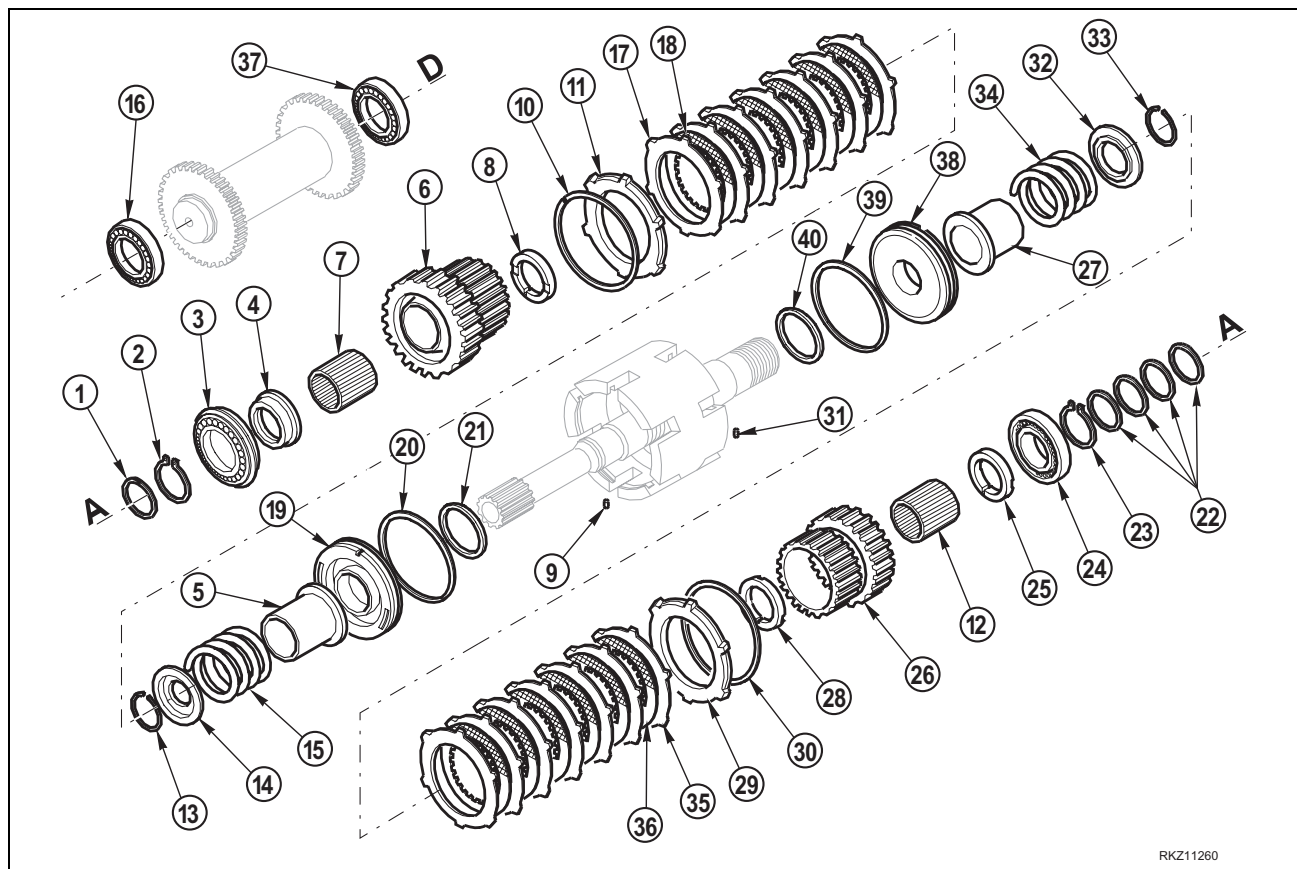


## REMOVAL AND INSTALLATION

## TRANSMISSION

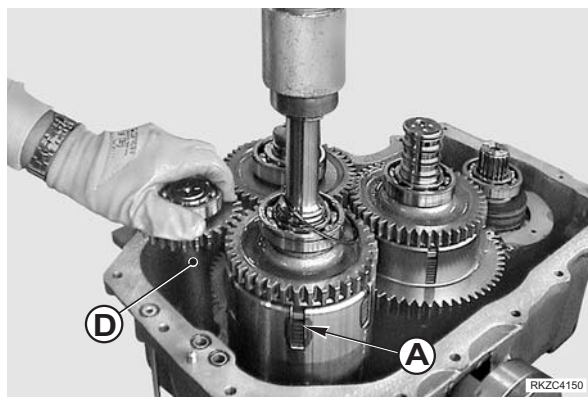
### 6. Shafts A - D

#### 6.1 Disassembly



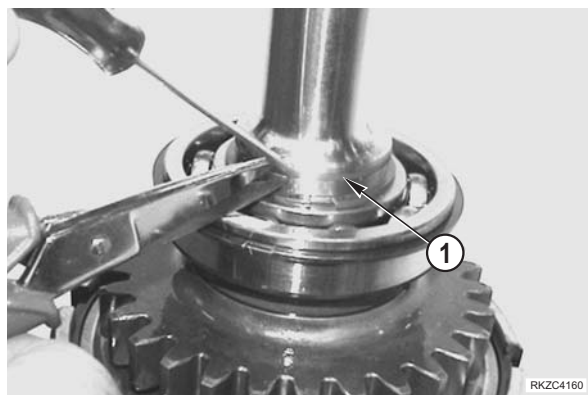
RKZ11260

1 - Grasp with pliers the input shaft assembly **A** . Remove with shaft assembly **D** and lift.



RKZC4150

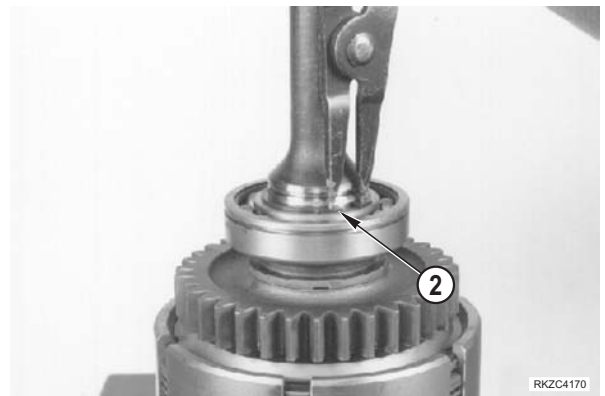
2 - If to be replaced, remove the teflon seal ring (1).



RKZC4160



3 -Remove the snap ring (2).



4 -Install a bearing separator under the gear.  
Use a puller on the bearing separator and insert a shaft protector between the puller and the end of the input shaft.  
Operate with the puller between bearing separator and shaft protector and pull only until the bearing is free. Pulling any farther can damage the parts.

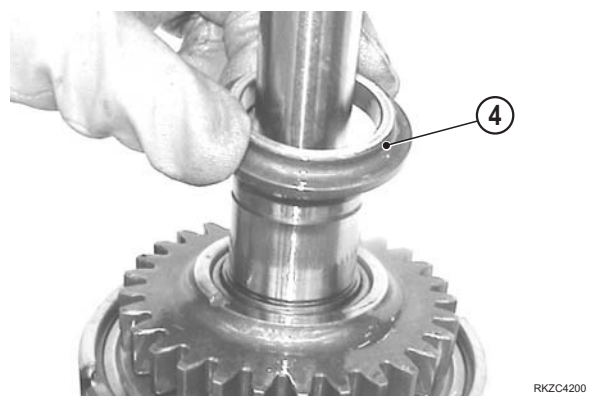
 Do not install the separator between gear and bearing.



5 -Remove bearing (3).



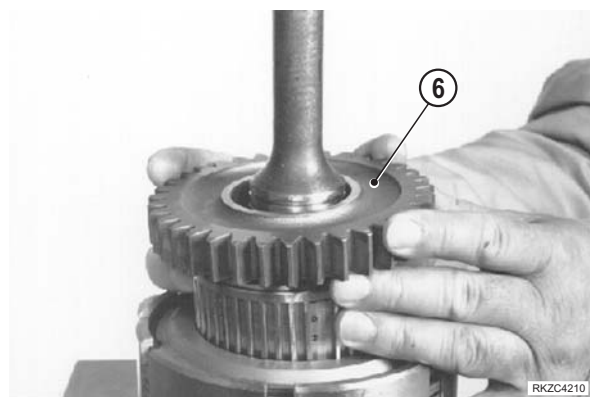
6 -Remove spacer (4).



## REMOVAL AND INSTALLATION

## TRANSMISSION

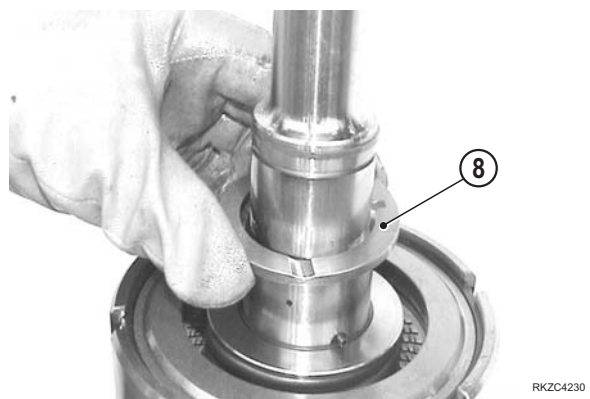
7 -Remove gear (6).



8 -Remove needle cage (7).



9 -Remove spacer (8).



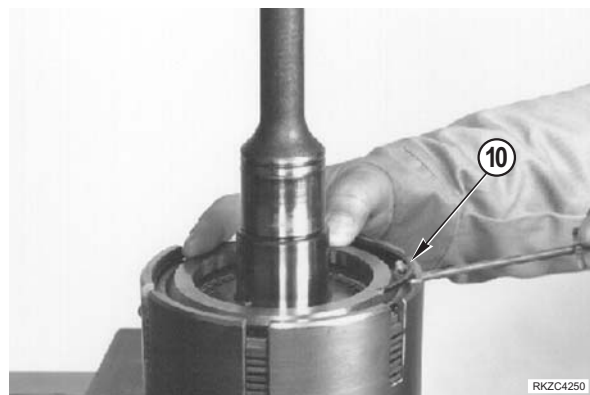
10 -Remove split pin (9).



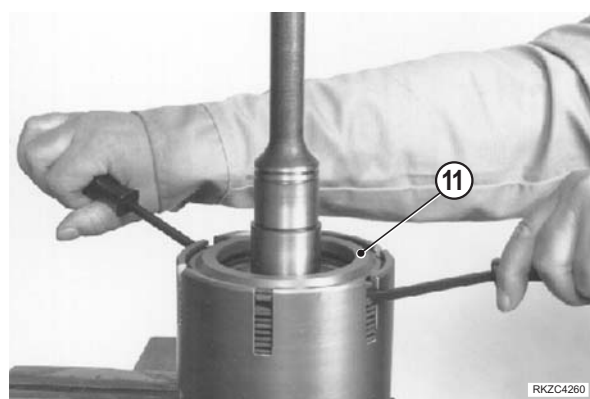
## REMOVAL AND INSTALLATION

## TRANSMISSION

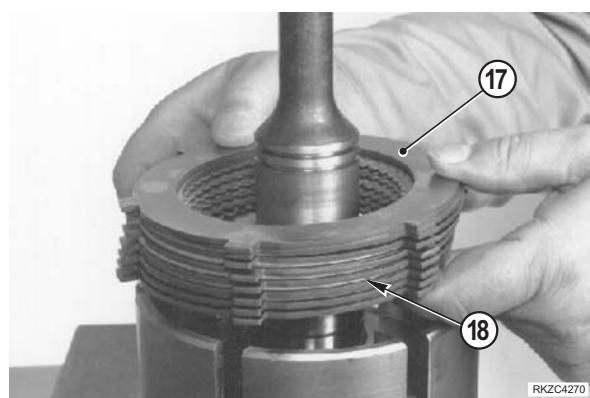
11 -Remove the snap ring (10).



12 -Use prybars to lift and to remove the thrust plate lock ring (11) evenly.



13 -Remove the clutch plates (18) and the clutch drive plates (17).



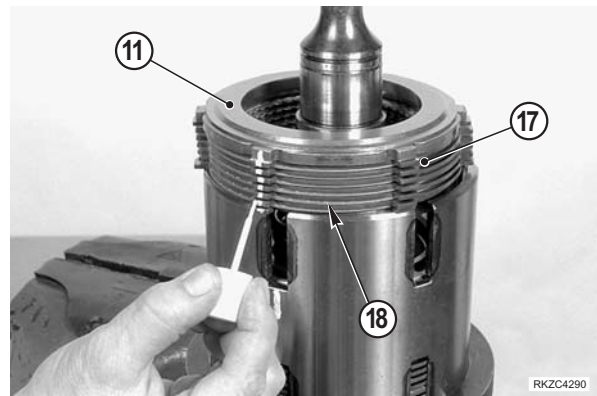
14 -Place a mark below the groove on the friction bell.



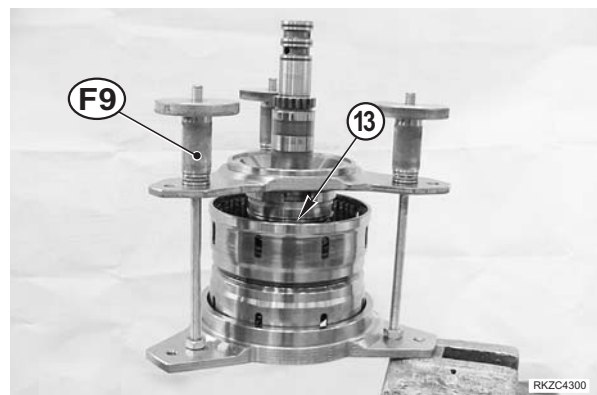
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 15 - Place a mark on each thrust plate lock ring (11), clutch plate (18) and clutch drive plate (17).  
These marks will be used for reference during the reassembly procedure.



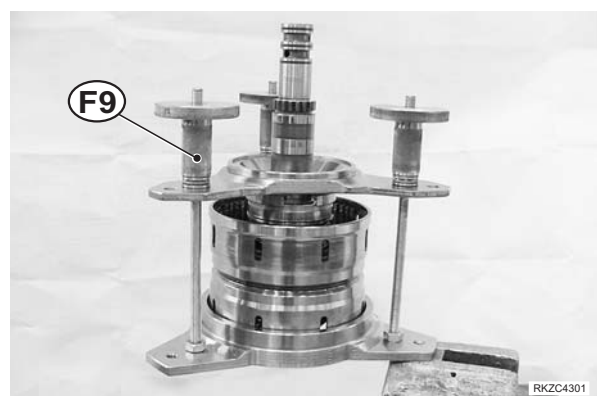
- Lower the spring (15) lock washer (13).  
Use tool **F9**.



- 17 - Remove snap ring (14).



- 18 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.

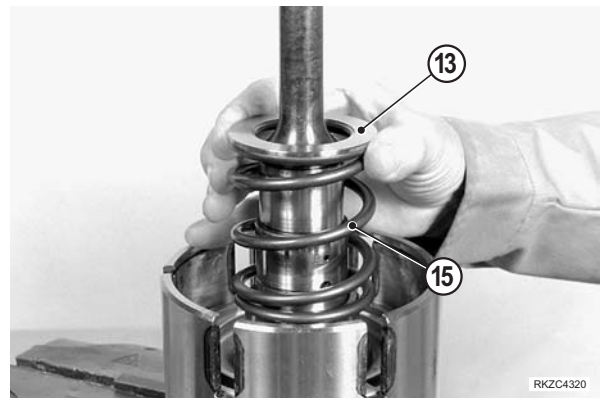




## REMOVAL AND INSTALLATION

## TRANSMISSION

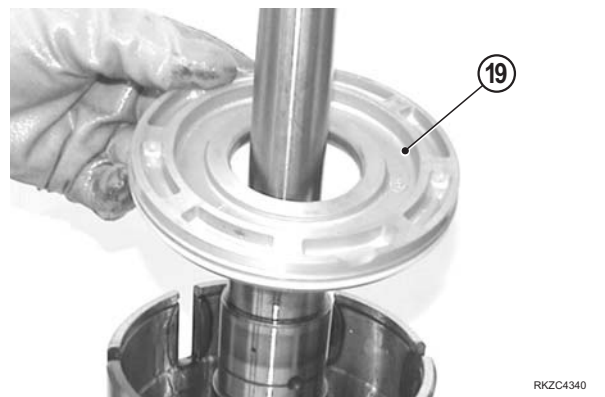
19 -Remove lock spring cover (13) and spring (15).



20 -Remove sleeve (5).



21 -Remove clutch piston (19) by blowing in compressed air through the delivery hole.



22 -If to be replaced, remove teflon seal ring (20) and relevant inner O-ring (20) from outer seat of piston and teflon seal rings (21) and relevant inner O-ring (21) from inner of piston. To remove the rings it is necessary to cut them.

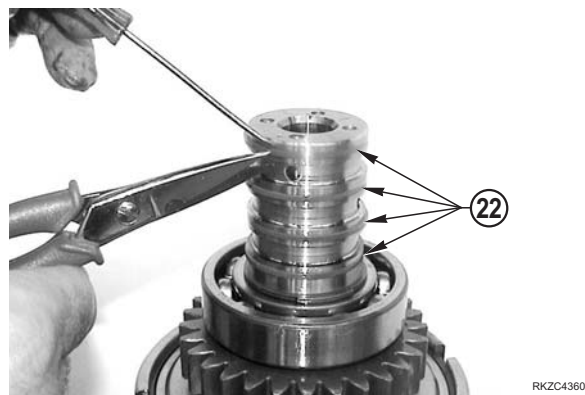


## REMOVAL AND INSTALLATION

## TRANSMISSION

23 - Turn the shaft.

If Teflon seal rings (22) are to be replaced, remove the rings by cutting them.



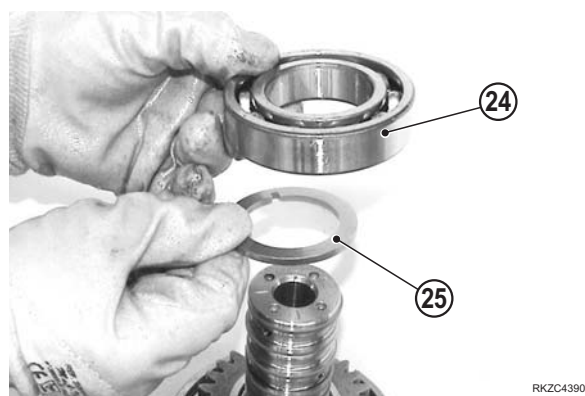
24 - Remove snap ring (23).



25 - Remove bearing (24) by means of an extractor.



26 - Remove bearing (24) and thrust washer (25).



## REMOVAL AND INSTALLATION

## TRANSMISSION

27 -Remove gear (26) and needle cage (12).

28 -Repeat steps 9 to 22 in this section to disinstall the other components.

29 -Check:

- the sealing ring grooves (large and small) for wear and damage if necessary.
- on the output shaft for wear and damage.
- oil passages in the output shaft to be sure that the passages are open and free of foreign material.
- ball bearings and roller bearings for smooth areas, pits or other damage.

Use new parts as required.

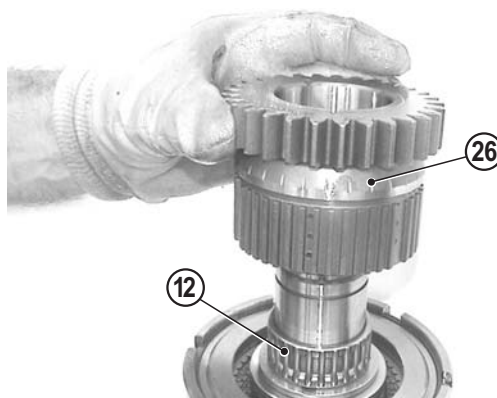
30 -If the clutch discs are to be used again, keep the clutch packs in the same previous assembly order separate and record which clutch pack goes with each clutch.

31 -At each disassembly, use a gauge bar to check that total thickness of clutch unit is within the permissible wear limit. If it is not, replace the clutch unit (18) with a new one.

Check all clutch plates for burns and inspect the friction material for damage. Inspect the grooves in the friction material for being well traced.

Verify also that all the clutch drive plates (17) are perfectly plane and inspect for pitting or scoring.

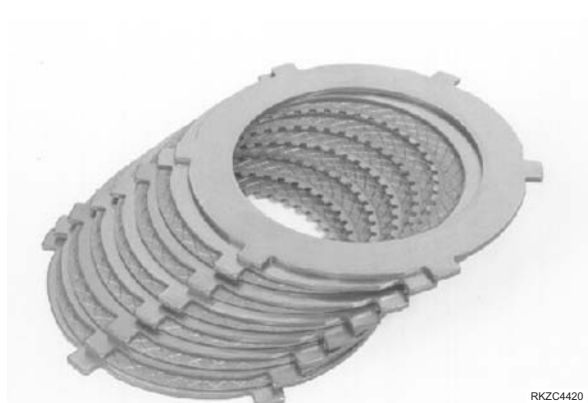
In the case that at least one of the above problems occurs, replace the complete clutch kit with a new one. If using a new clutch kit soak the clutch plates in clean transmission oil for at least an hour before assembly. Lubricate the contact surfaces of clutch drive plates with clean transmission oil before assembly.



RKZC4400



RKZC4410



RKZC4420



RKZC4430

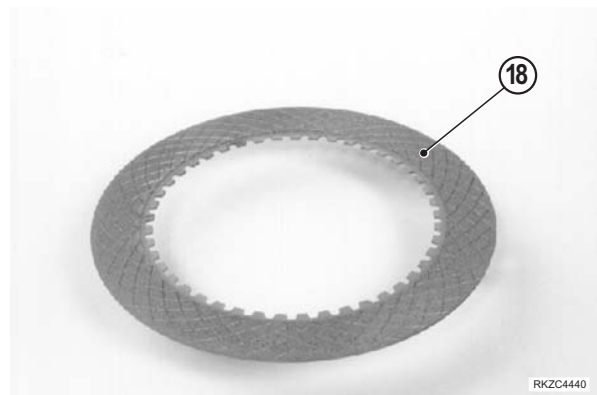
|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plates (each side)   | 6              |
| Number clutch steel plate (each side) | 6              |
| Nominal clutch plate thickness        | 2.40±0.05 mm   |
| Nominal clutch kit thickness          | * 29.0-29.2 mm |
| Maximum clutch plate wear (each side) | 0.25 mm        |
| Maximum clutch kit wear               | 1.5 mm         |

\* Under load of 163 kg

## REMOVAL AND INSTALLATION

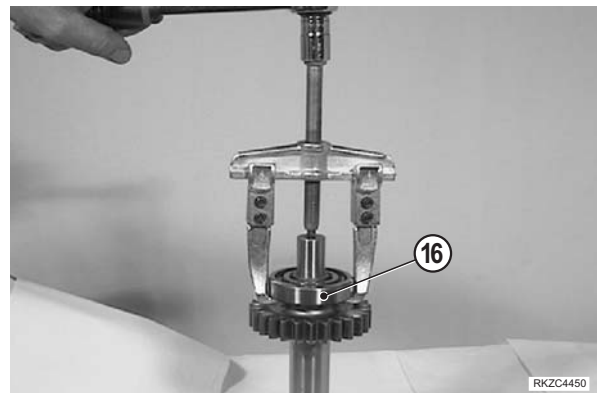
## TRANSMISSION

- 32 -Inspect the bore of the shaft in the input shaft housing for damage that will cause leakage when the clutch is assembled.  
Check the slots in the side of the input shaft housing for damage from the tangs on the steel discs.  
Use new parts as required during assembly.



### SHAFT D

- 1 -Remove bearing (16) of shaft **D** by means of an extractor.



- 2 -Remove bearing (37) of shaft **D** by means of an extractor.



### 6.2 Assembly

#### SHAFT A

- 1 - Assemble new teflon ring (20) and relevant inner O-rings (20), new teflon ring (21) and relevant inner O-rings (21) respectively into the piston outer and inner seats.



## REMOVAL AND INSTALLATION

## TRANSMISSION

- 2 - Apply a thin film of grease on the sealing rings just inserted.



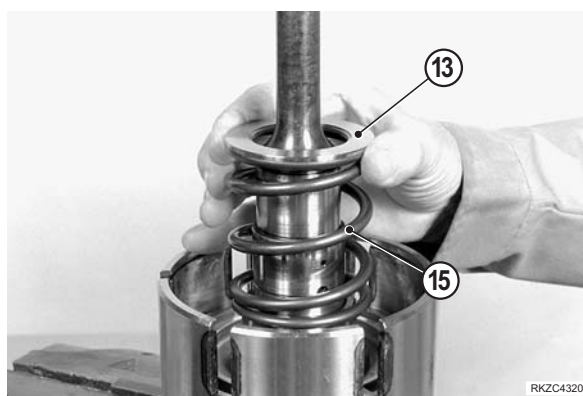
- 3 -Insert clutch piston (19) with special tool **F10** as protection of seal rings (21).



- 4 -Assemble sleeve (5).



- 5 -Assemble spring (15) and washer (13).

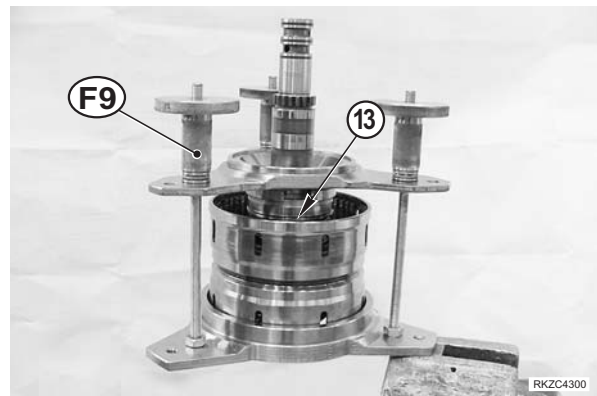




## REMOVAL AND INSTALLATION

## TRANSMISSION

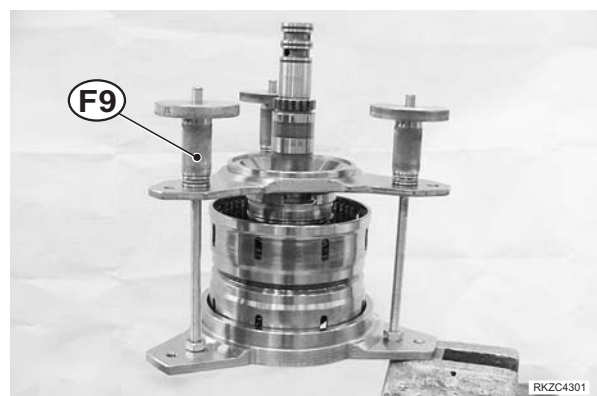
- 6 - Lower the spring (15) lock washer (13).  
Use tool **F9**.



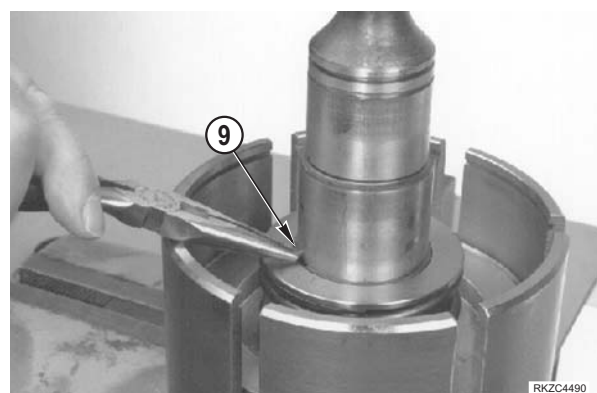
- 7 - Insert snap ring (14).  
★ Ensure that the snap ring (14) is well fitted.



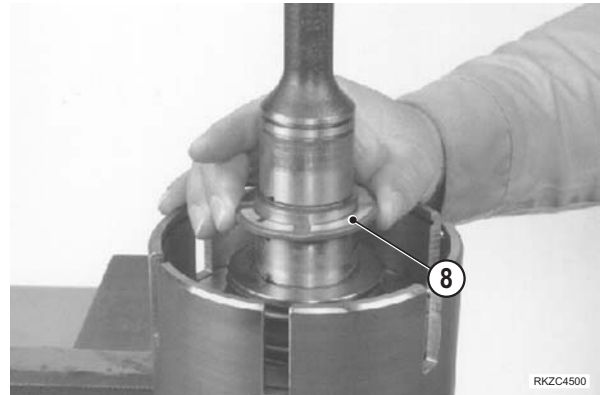
- 8 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



- 9 - Remove tool **F9** and assemble split pin (9).



10 -Insert thrust washer (8)

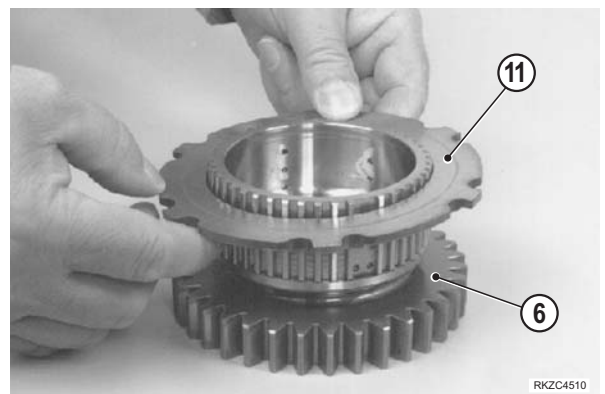


11 -Insert needle cage (7).



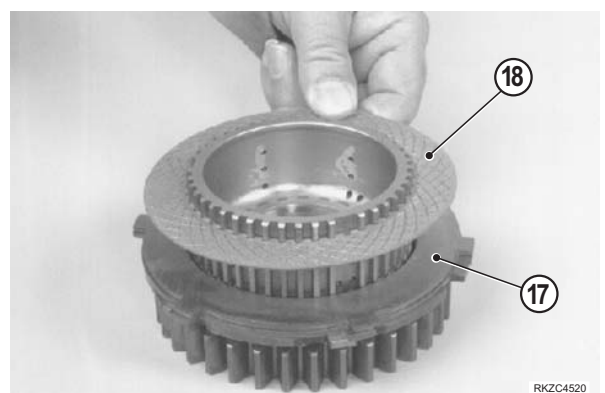
12 -To assemble the clutch pack start with the gear (6) on the bench.

Install the thrust plate (11) so that the reference mark on top of the plate made during disassembly is facing towards the gear.



13 -Assemble clutch plates (18) and clutch drive plates (17) on the gear (6).

The assembled clutch pack must contain seven clutch drive plates and six clutch plates.



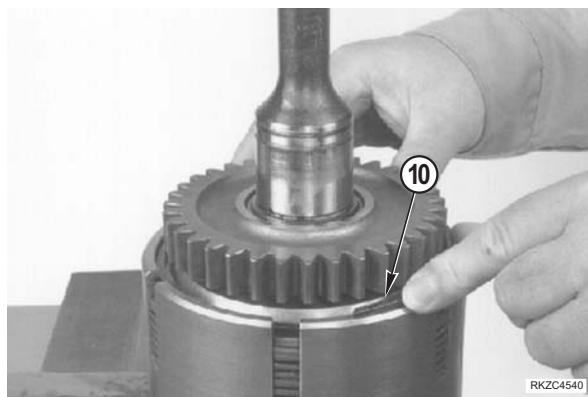
## REMOVAL AND INSTALLATION

## TRANSMISSION

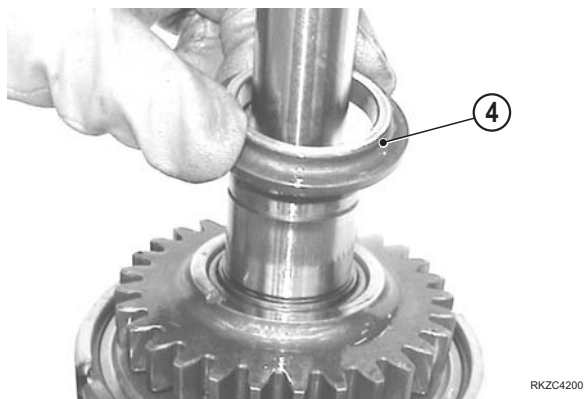
14 -Locate the pack assembly by means of two screwdrivers.



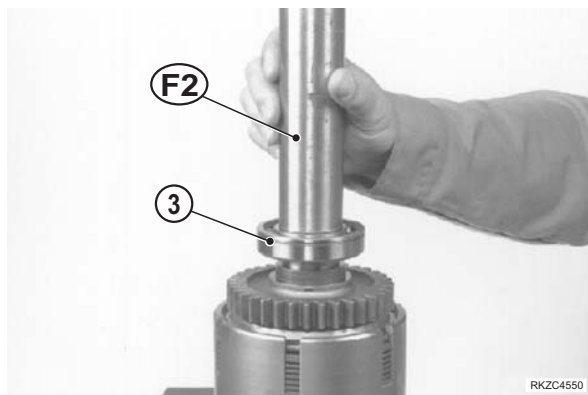
15 -Assemble snap ring (10).



16 -Assemble washer (4).



17 -Heat the bearing (3) to 80÷100 °C (176° to 212 °F).  
Assemble bearing (3).  
Use tool **F2**.





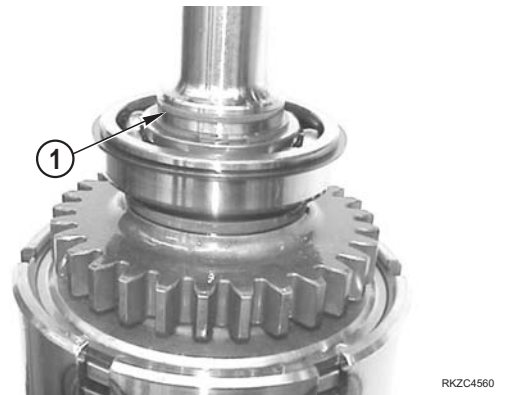
18 -Install the snap ring (2).

**NOTA .**

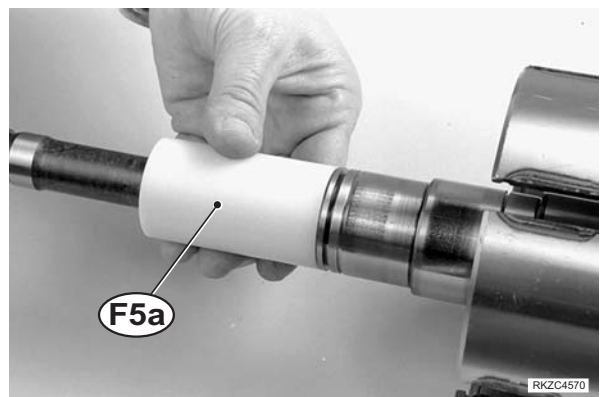
**For clarity of the Teflon sealing ring installation procedure the following photos do not show the clutch pack, gear, spacer, bearing, and snap ring installed on the input shaft.**



19 -Insert the teflon seal ring (1) as follows.



20 -Install the **F5a** spacer onto the input shaft with the chamfered end facing in.



21 -Slide the **F5b** expander/protector onto the input shaft and on the spacer.  
The expander/protector will stop in the correct position to install the seal ring in the groove.



## REMOVAL AND INSTALLATION

## TRANSMISSION

- 22 - Heat the Teflon seal ring to 60°-80°C (140°-176° F) for 5 minutes.

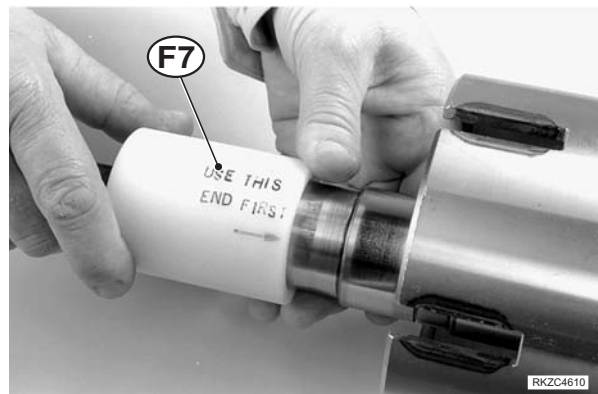
Install the teflon seal ring onto the expander/protector.



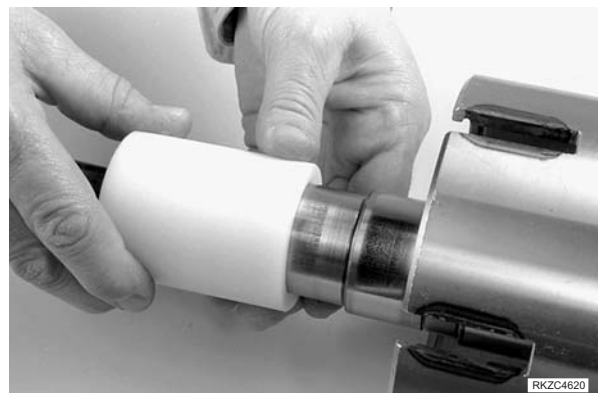
- 23 - Install the **F6** pusher over the expander/protector and slide the seal ring until it reaches the groove in the shaft. Remove the pusher, expander/protector, and spacer from the shaft.



- 24 - Install the end of the **F7** seal compressor with the deep chamfer onto the shaft and over the sealing ring. Use a back and forth twisting motion to allow the seal compressor to slip over the top of the sealing ring and seat the sealing ring into the groove. Be careful not to damage the seal ring. After the sealing ring is seated in the groove, remove the seal compressor from the shaft.



- 25 - Turn the seal compressor around and slide the end with the narrow chamfer over the shaft and over the seal ring. Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove. After the seal ring has cooled, remove the seal compressor from the shaft.



## REMOVAL AND INSTALLATION

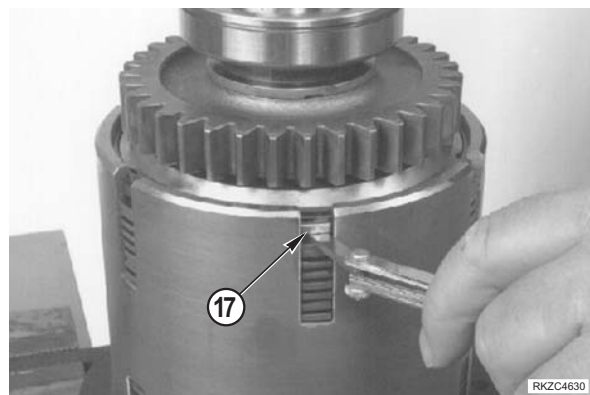
## TRANSMISSION

26 -Measure the clutch discs clearance for each clutch assembly.

The thrust plate lock ring must be all the way up against the lock ring.

Use a feeler gauge to measure the distance between the thrust plate lock ring and the first clutch drive plate (17).

- ★ Distance: 1.60-2.45 mm.
- ★ If the distance is not within specification, the clutch is probably assembled wrong.

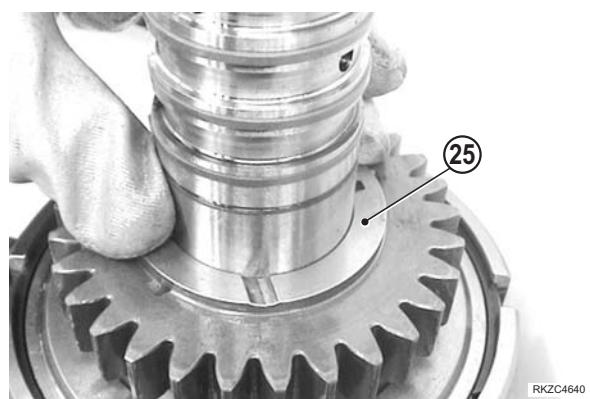


27 -Turn shaft upside down and carry out steps from 1 to 15 in this section .

Lubricate the washer (25) with transmission oil.

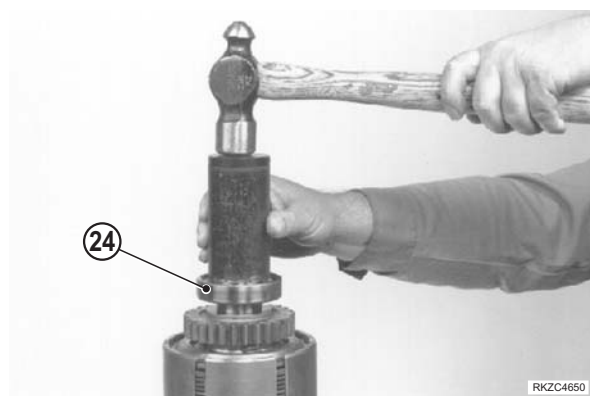
Install the thrust washer ensuring that the notch on the inner edge goes onto the pin.

Make sure that the side with the holes in it for oil passage is at the bottom.

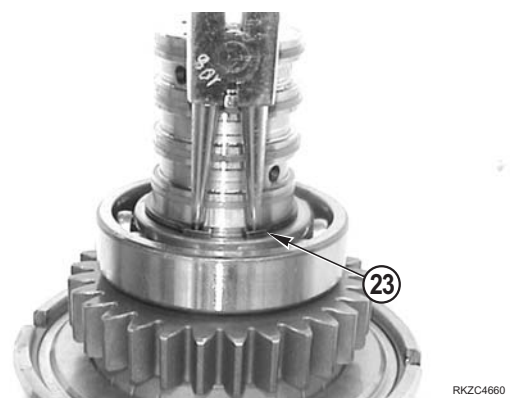


27 -Heat the bearing (24) to 80÷100 °C (176° to 212 °F)

Use driver **F11** to drive the bearing (24) onto the input shaft until the bearing makes contact with the thrust washer.



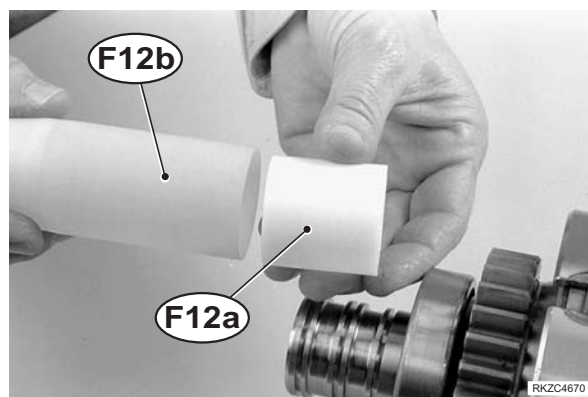
28 -Assemble snap ring (23).



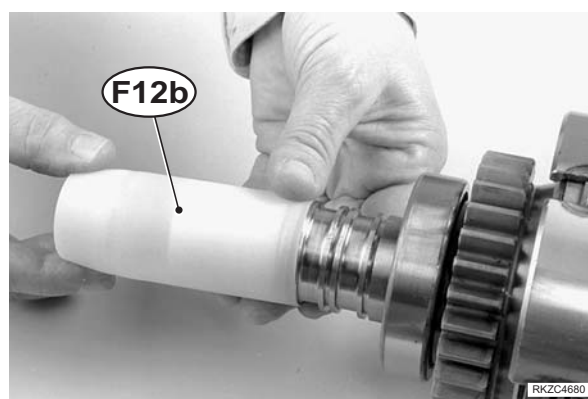
## REMOVAL AND INSTALLATION

## TRANSMISSION

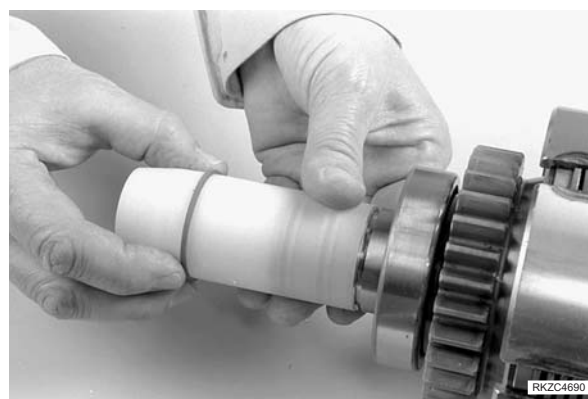
- 29 - Assemble the teflon seal rings (22) as follows: place the **F12a** spacer into the **F12b** expander/protector.



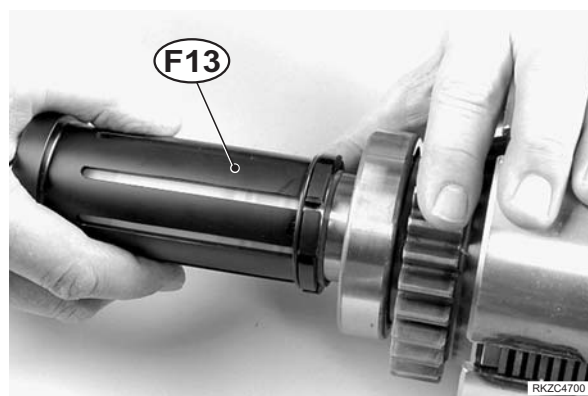
- 30 - Slide the **F12** expander/protector and the spacer onto the shaft.  
The expander/protector will stop in the correct position to install the seal ring in the groove.



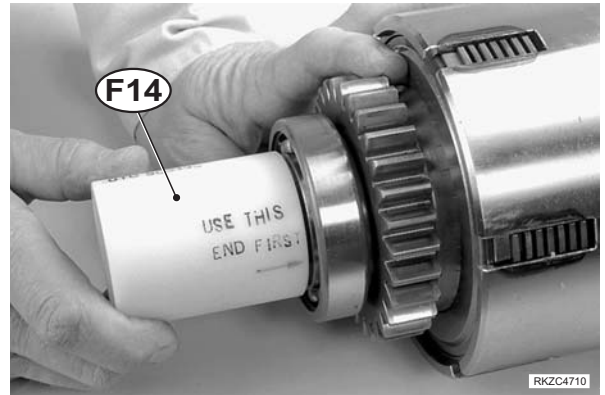
- 31 - Heat the Teflon seal ring to 60°-80°C (140°-176° F) for 5 minutes.  
Install the teflon seal ring onto the expander/protector.



- 32 - Install the **F13** pusher over the expander/protector and slide the seal ring until it reaches the groove in the shaft. Remove the pusher, expander/protector, and spacer from the shaft.



- 33 - Install the end of the **F14** seal compressor with the deep chamfer onto the shaft and over the sealing ring. Use a back and forth twisting motion to allow the seal compressor to slip over the top of the sealing ring and seat the sealing ring into the groove. Be careful not to damage the seal ring. After the sealing ring is seated in the groove, remove the seal compressor from the shaft.

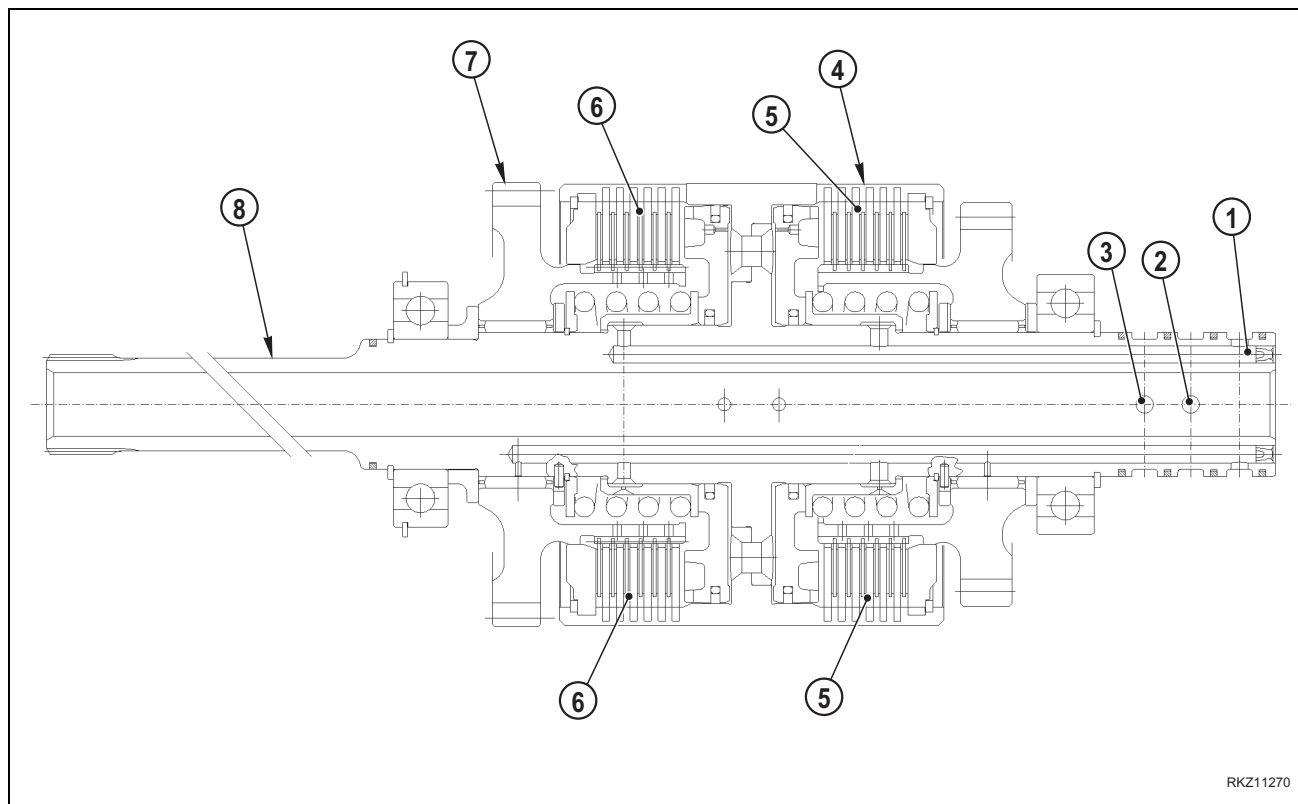


- 34 - Turn the seal compressor around and slide the end with the narrow chamfer over the shaft and over the seal ring. Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove. Once the sealing ring has cooled, remove the seal compressor from the shaft. To install the three Teflon rings remaining, carry out steps 29 to 33 in this section using the other spacers of tool **F12**.



## REMOVAL AND INSTALLATION

## TRANSMISSION



1. Lubrication oil passage
2. Forward clutch oil passage
3. Reverse clutch oil passage
4. Forward gear
5. Forward clutch pack
6. Reverse clutch pack
7. Reverse gear
8. Input shaft

36 -Apply compressed air at about 6 bar for forward gear clutch passage.

Feel the forward gear piston move to lock its respective clutch pack. Try to move the forward gear. The forward gear must not turn on the input shaft. Try to move the reverse gear. The reverse gear must turn freely on the input shaft. If the clutches do not work correctly, disassemble the clutches to find the problem.

37 -Apply compressed air at about 6 bar for reverse gear clutch passage.

Feel the reverse gear piston move to lock its respective clutch pack. Try to move the reverse gear. The forward gear must not turn on the input shaft. Try to move the forward gear. The reverse gear must turn freely on the input shaft. If the clutches do not work correctly, disassemble the clutches to find the problem.



## SHAFT D

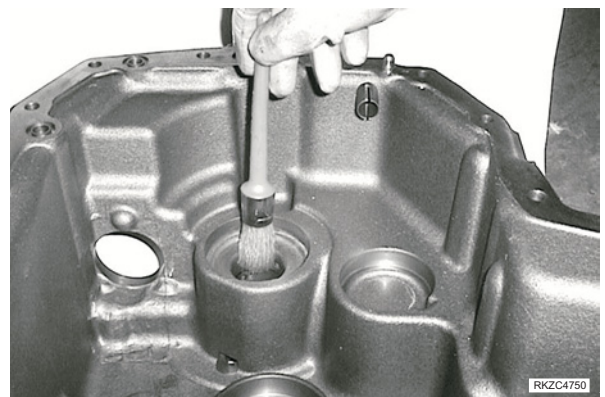
38 -Assemble **D** shaft bearing (16).  
Use tool **F3**.



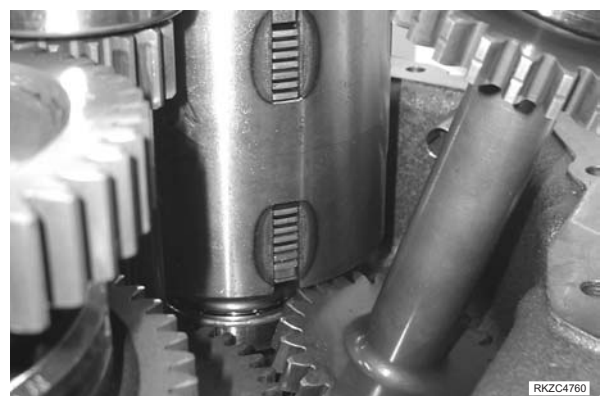
39 -Assemble **D** shaft bearing (37).  
Use tool **F3**.



40 -Lubricate with oil the shaft seat **A.A**.

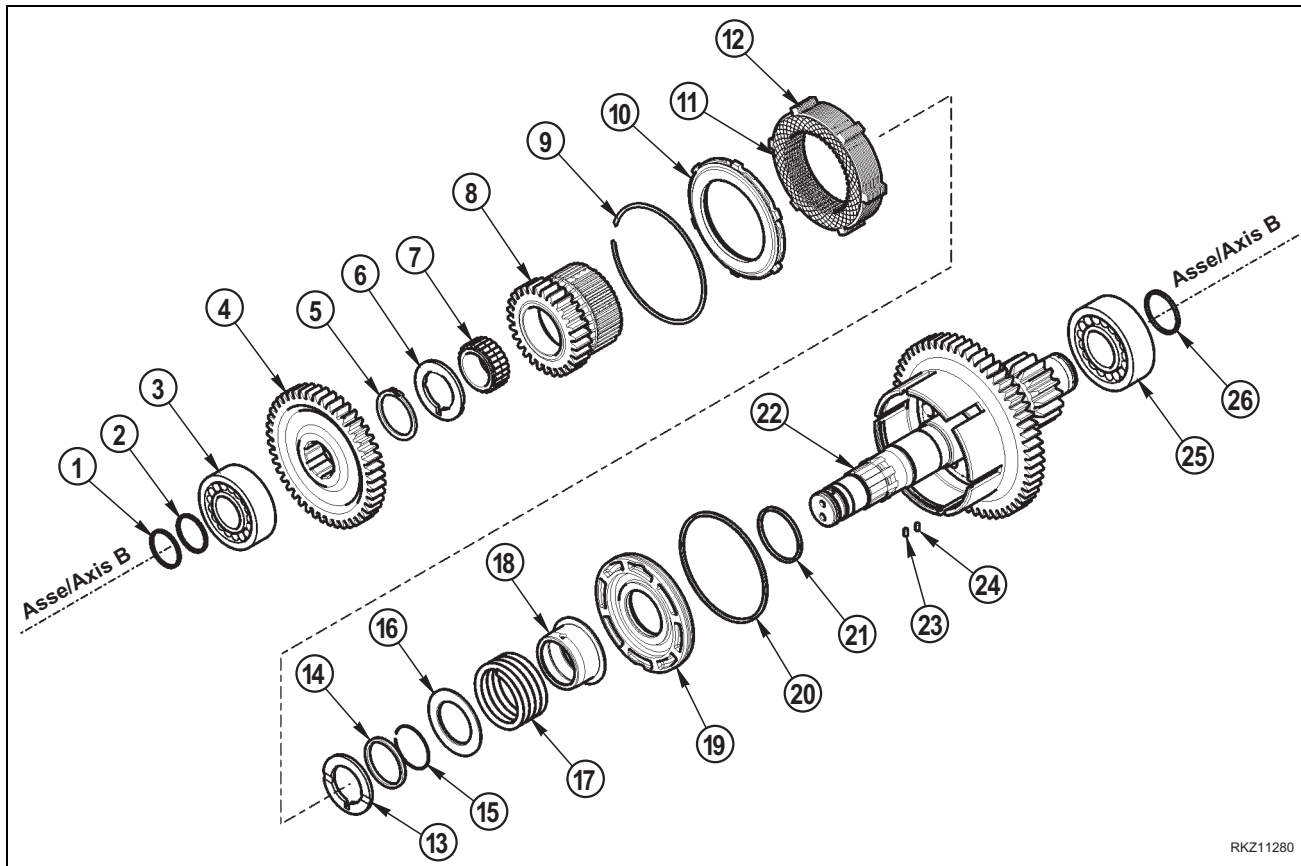


41 -Fit shaft assembly **D** and shaft assembly **A**.  
The operation is correct only if the two shafts are fitted at the same time.

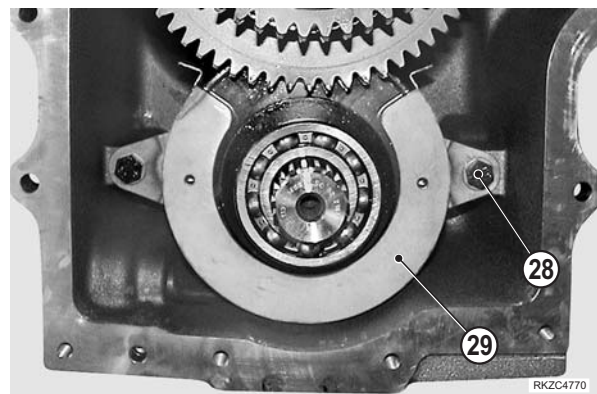


## 7. AXIS B

### 7.1 Disassembly



1 - Remove screws (28) and protection (29).



2 - Lift the three shafts B-C-E, at the same time **B-C-E**.  
Use tool **F15**.



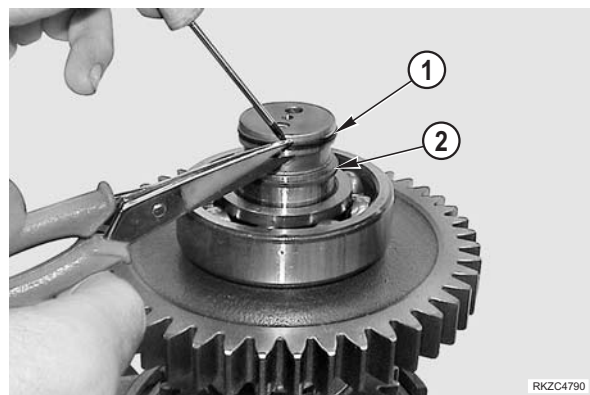


## REMOVAL AND INSTALLATION

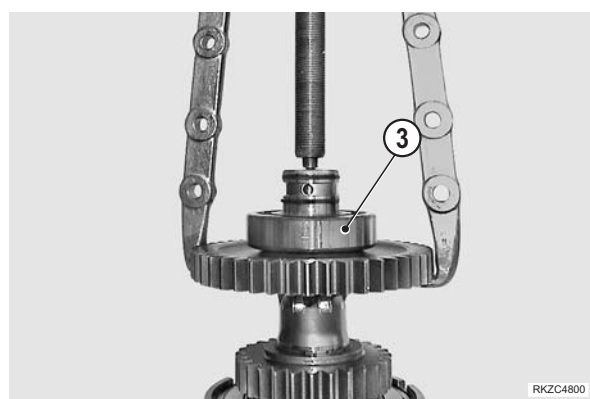
## TRANSMISSION

3 -Remove seals (1) and (2).

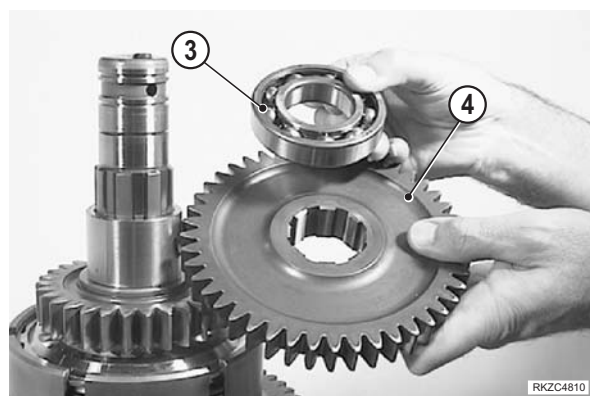
★ This is a destructive operation for the seal rings.



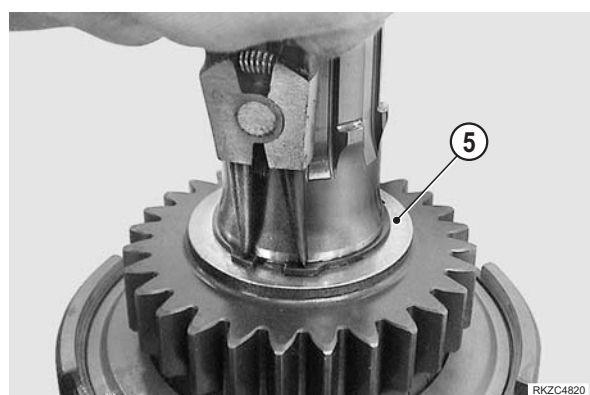
4 -By means of an extractor remove bearing (3) and gear (4).



5 -Remove The bearing (3) and the gear (4).



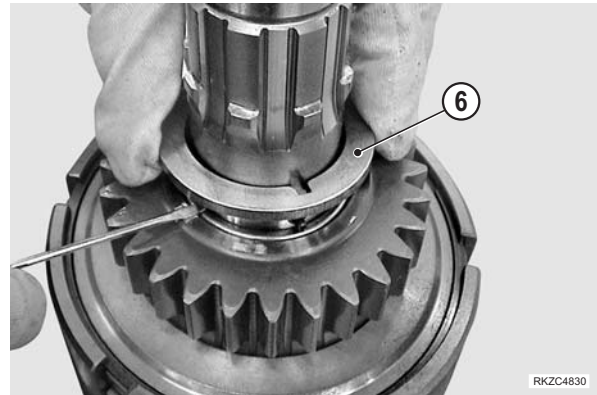
6 -Remove snap ring (5).



## REMOVAL AND INSTALLATION

## TRANSMISSION

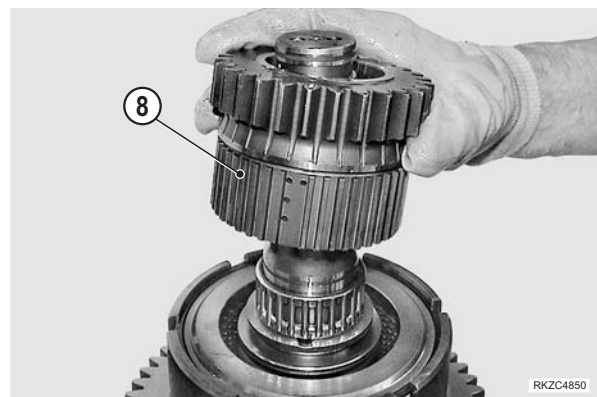
7 - Remove spacer (6).



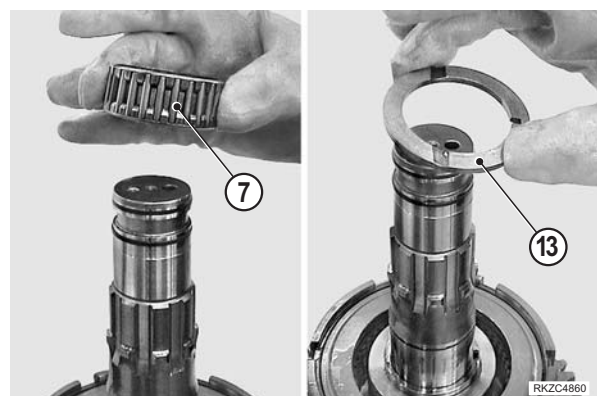
8 - Remove the spring pin (23).



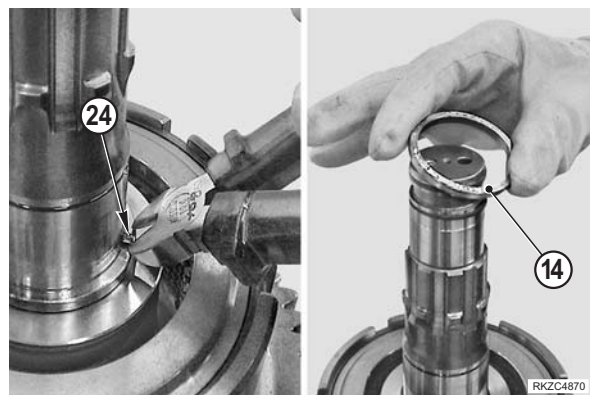
9 - Remove gear (8).



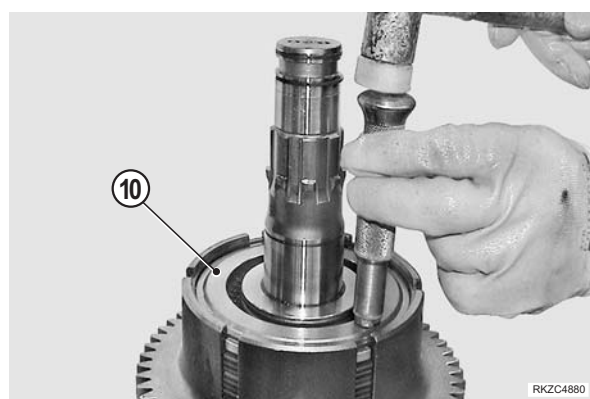
10 - Remove roller retainers (7) and washer (13).



11 -Remove spring pin (24) and spacer (14).



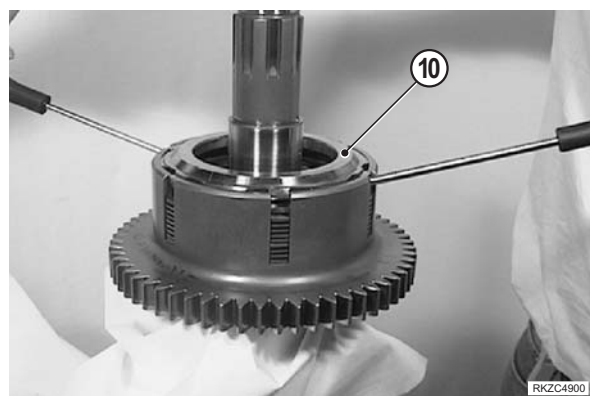
12 -Slightly press thrust plate (10).



13 -Remove snap ring (9).



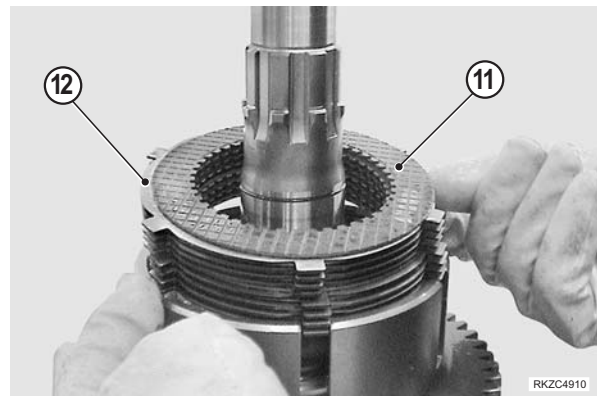
14 -Remove thrust plate (10) by means of two screwdrivers.



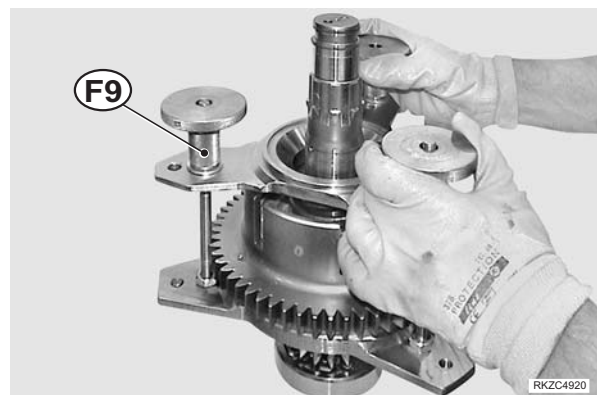
## REMOVAL AND INSTALLATION

## TRANSMISSION

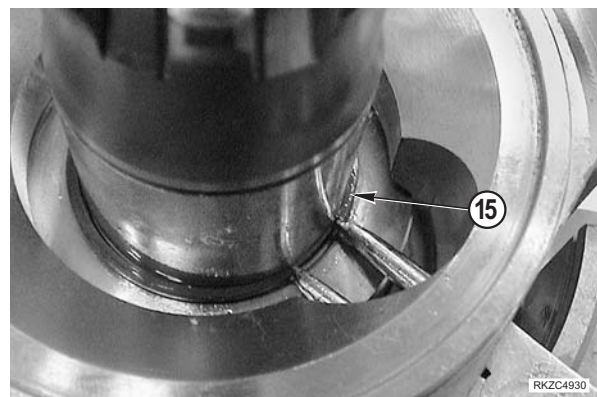
15 - Remove disc (11) and counterdiscs (12) pack.



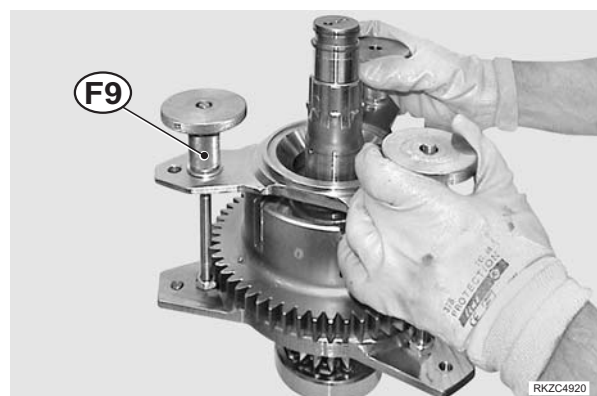
16 - Lower the spring (17) retaining washer (16).  
Use tool **F9**.



17 - Remove snap ring (15).



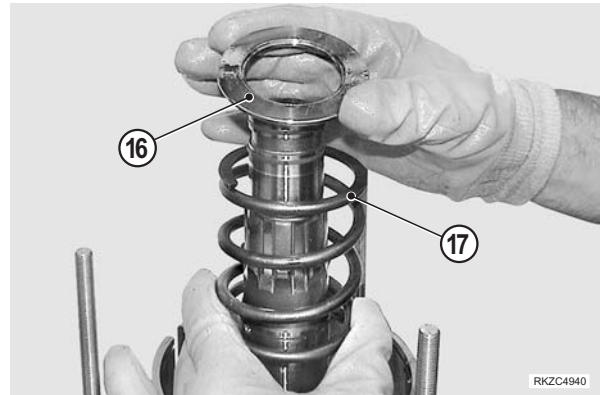
18 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



## REMOVAL AND INSTALLATION

## TRANSMISSION

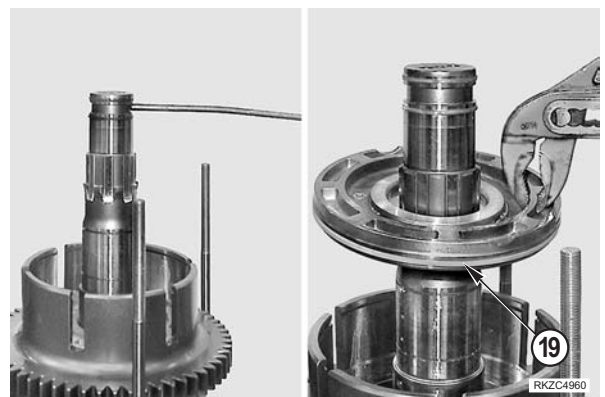
19 -Remove the washer (16) and spring (17).



20 -Remove sleeve (18).



21 -Remove clutch piston (19) by blowing in compressed air through the delivery hole.



22 -If to be replaced, remove teflon seal ring (20) and relevant inner O-ring from outer seat of piston and teflon seal rings (21) and relevant inner O-ring from inner of piston. To remove the rings it is necessary to cut them.





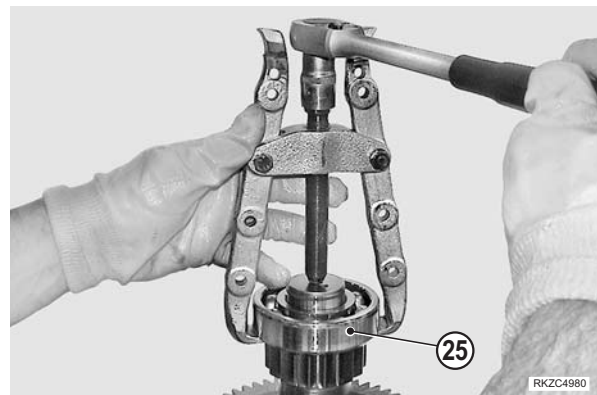
## REMOVAL AND INSTALLATION

## TRANSMISSION

23 - Remove the teflon seal ring (26).



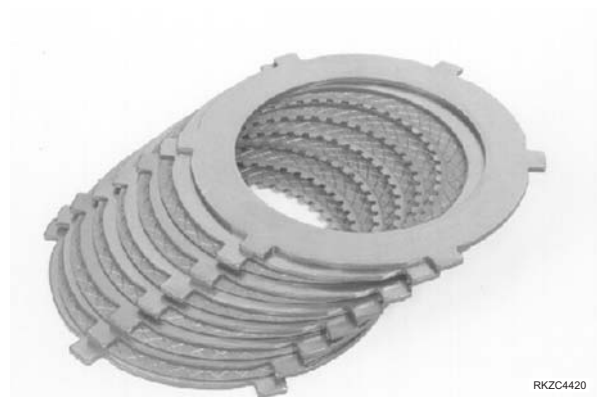
24 - Remove bearing (25) by means of an extractor.



25 - Check:

- the sealing ring grooves (large and small) for wear and damage if necessary.
  - on the output shaft for wear and damage.
  - the oil passages in the output shaft to be sure that the passages are open and free of foreign material.
  - the ball bearings and the needle bearings for flat areas, pitting, and other damage.
- Use new parts as required.

26 - If the clutch discs are to be used again, keep the clutch packs in the same previous assembly order separate and record which clutch pack goes with each clutch.



## 27 -At each disassembly:

- verify with a caliper that the total thickness of the clutch kit is within the wear limit.
  - Verify that all the clutch plates do not appear burned or that the friction material it is not damaged and that splines are well traced.
  - Verify also that all the clutch drive plates (12) are perfectly plane and inspect for pitting or scoring.
- In the case that at least one of the above problems occurs, replace the complete clutch kit with a new one. If using a new clutch kit soak the clutch plates in clean transmission oil for at least an hour before assembly. In any case lubricate the contact surfaces of clutch drive plates with clean transmission oil before assembly.

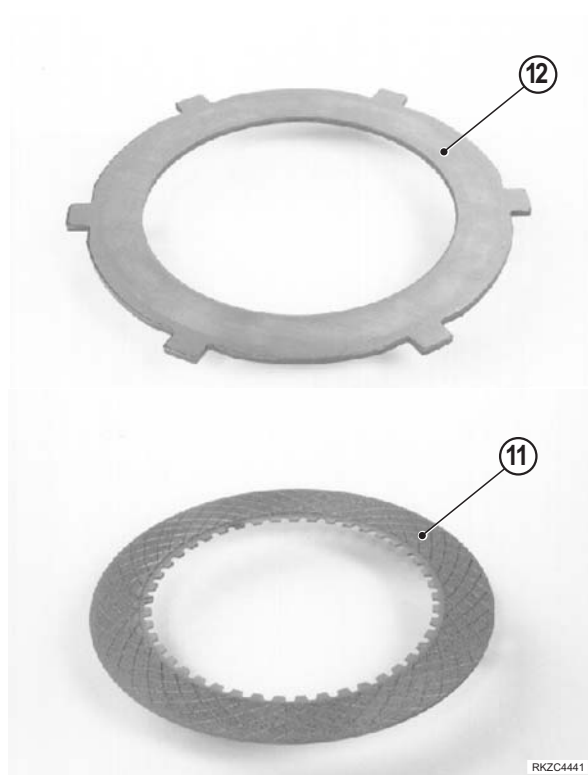
|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plate                | 8              |
| Number clutch steel plate             | 8              |
| Nominal clutch plate thickness        | 2.00±0.05 mm   |
| Nominal clutch kit thickness          | * 30.5-30.7 mm |
| Maximum clutch plate wear (each side) | 0.20 mm        |
| Maximum clutch kit wear               | 1.6 mm         |

\* Under load of 163 kg

## 28 -Inspect the bore of the shaft in the input shaft housing for damage that will cause leakage when the clutch is assembled.

Check the slots in the side of the input shaft housing for damage from the tangs on the steel discs.

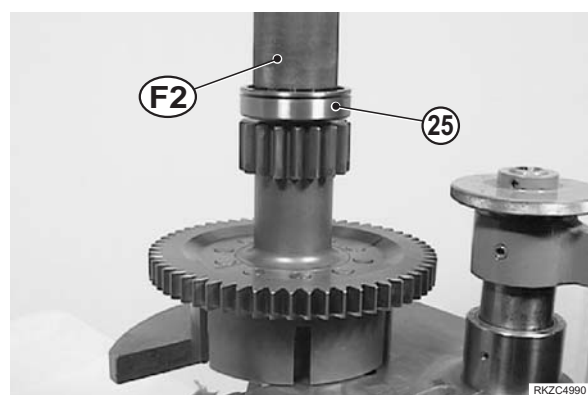
Use new parts as required during assembly.



## 7.2 Assembly

## 1 -Assemble bearing (25).

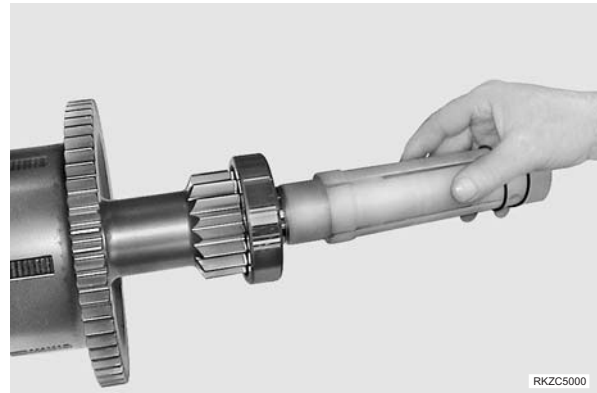
Use tool F2.



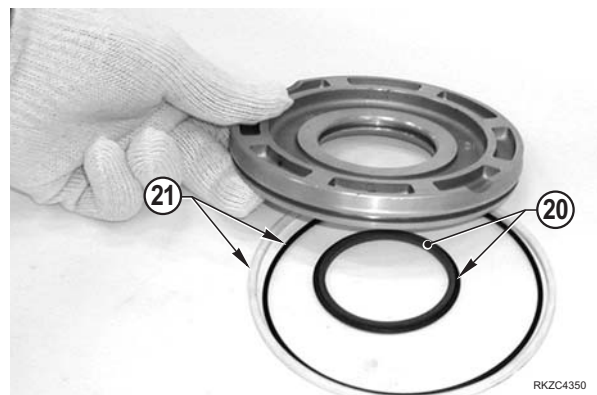
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 2 - Assemble a new Teflon sealing ring (**26**).  
To install the ring (**26**), repeat steps 29 to 34 in section "6.2 Assembly" using tool **F5**.



- 3 - Assemble new teflon ring (20) and relevant inner O-ring, new teflon ring (21) and relevant inner O-rings respectively into the piston outer and inner seats.



- 4 - Apply a thin film of grease on the sealing rings just inserted.



- 5 - Insert clutch piston (19) with special tool **F10** as protection of seal rings (21).

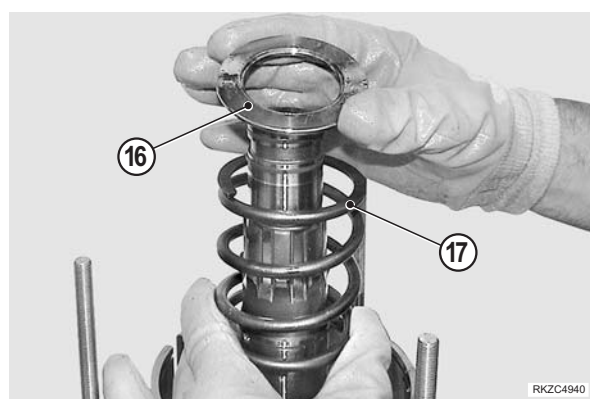




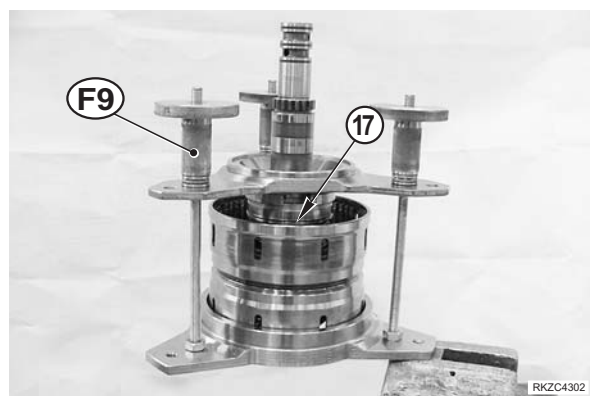
6 -Assemble sleeve (18).



7 -Assemble spring (17) and washer (16).



8 -Lower the spring (16) lock washer (17).  
Use tool **F9**.



9 -Insert snap ring (15).

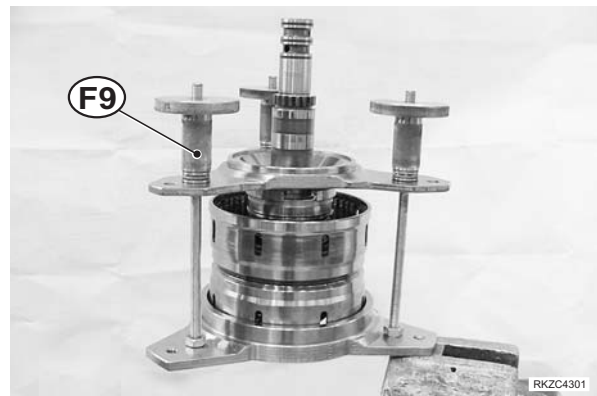
★ Ensure that the snap ring (15) is well fitted.



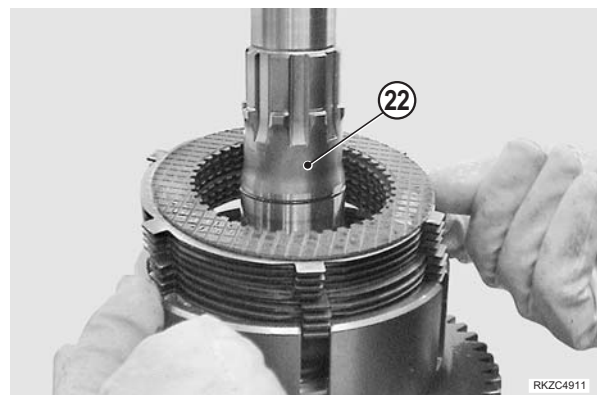
## REMOVAL AND INSTALLATION

## TRANSMISSION

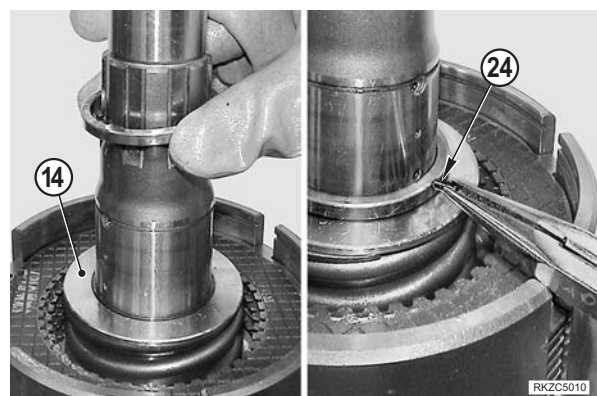
- 10 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



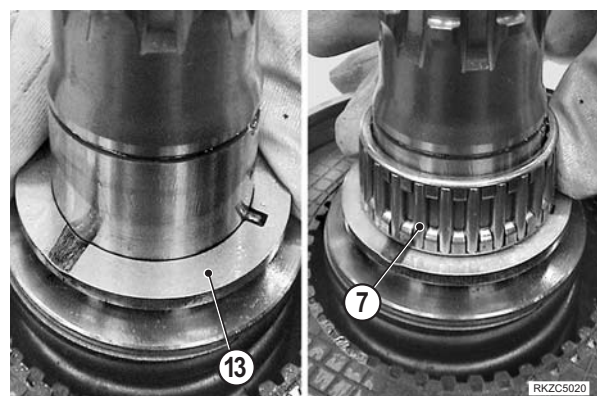
- 11 - Assemble clutch pack to shaft (22).



- 12 - Assemble spacer (14) and spring pin (24).



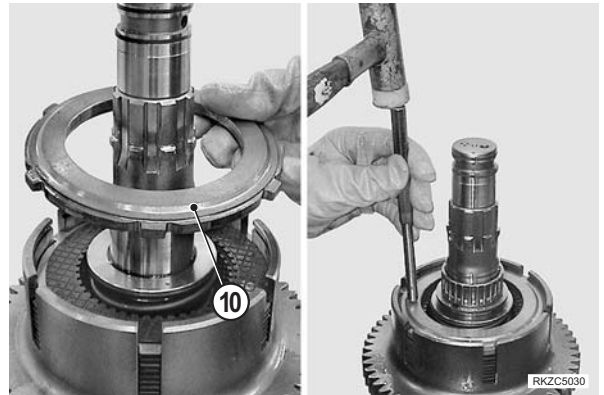
- 13 - Insert washer (13) and roller bearing (7).



## REMOVAL AND INSTALLATION

## TRANSMISSION

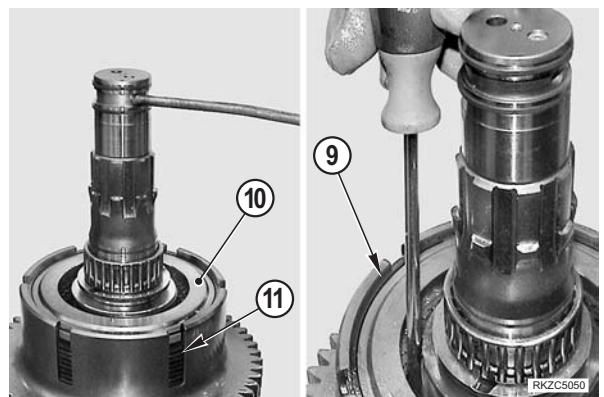
14 -Assemble thrust plate (10) and press it against the clutch pack.



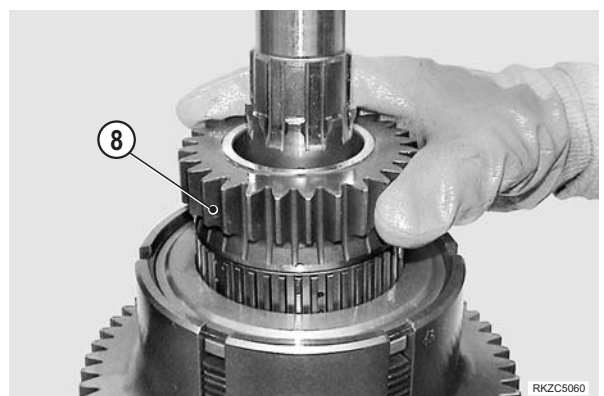
15 -Assemble snap ring (9).



16 -Apply compressed air at low pressure in hole in order to push the thrust plate (10) against the retaining ring (9), then align the clutch plate (11) spline.



17 -Assemble gear (8) paying attention it completely fit in its seat.



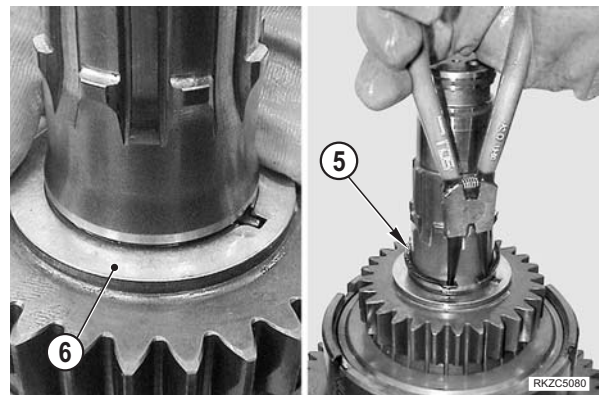
## REMOVAL AND INSTALLATION

## TRANSMISSION

18 -Assemble spring pin (23).



19 -Assemble the washer (6) and lock ring (5).



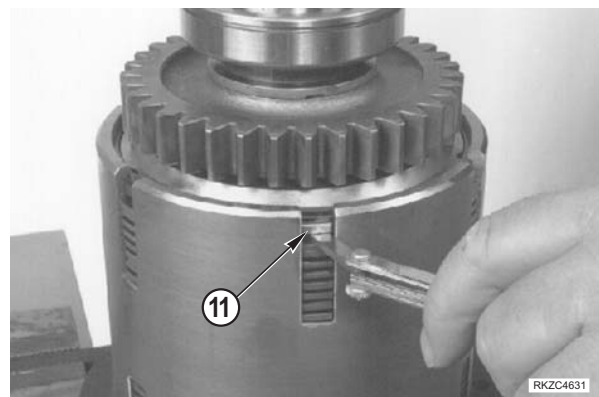
20 -Measure the clutch discs clearance for each clutch assembly.

The clutch plate lock ring must be all the way up against the lock ring.

Use a feeler gauge to measure the distance between the clutch plate lock ring and the first clutch plate (11).

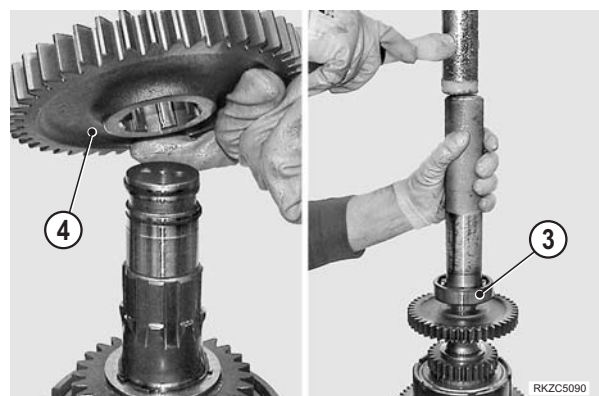
★ Distance: 2.20-3.05 mm.

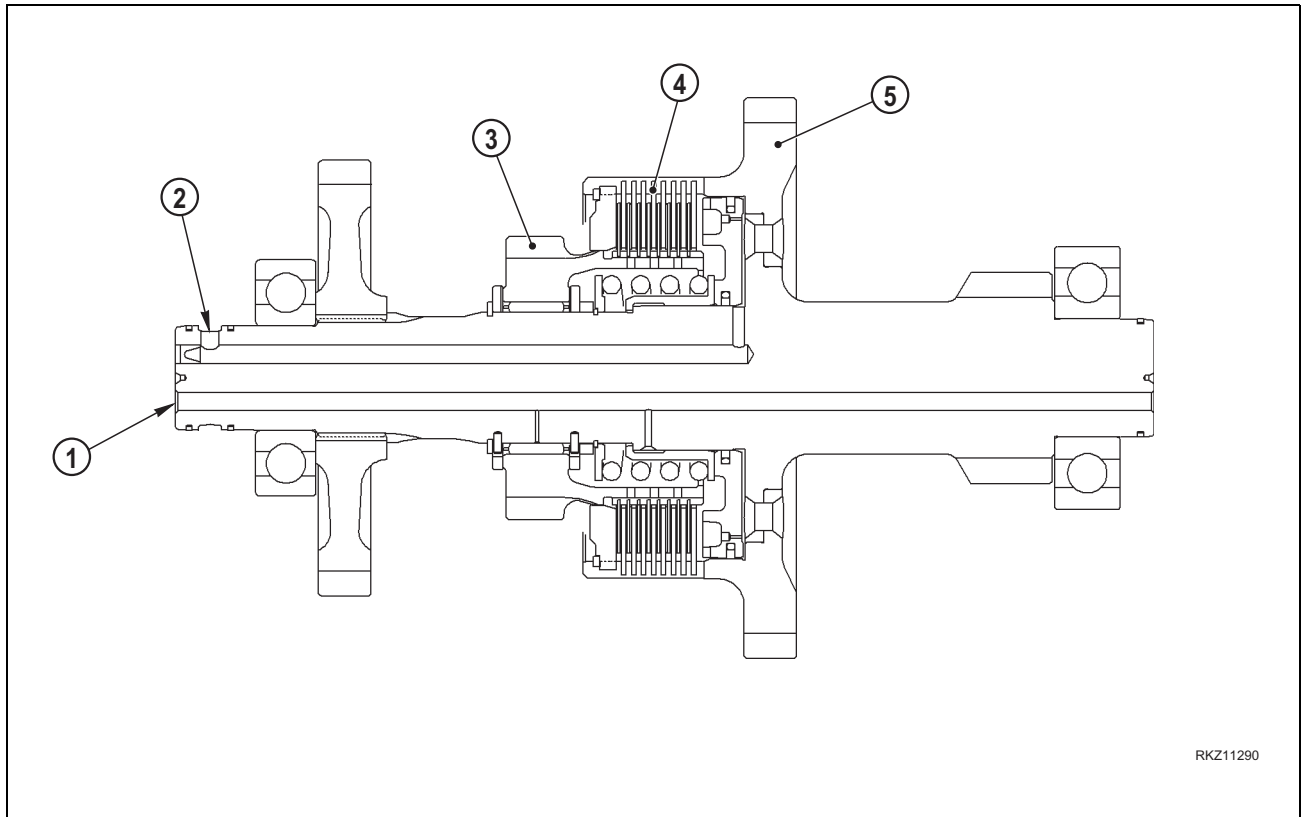
★ If the distance is not within specification, the clutch is probably assembled wrong.



21 -Assemble gear (4) taking care to orientate the shelf facing the clutch and bearing (3).

Use tool **F16**.





RKZ11290

1. Lubrication oil passage
2. 2nd speed clutch oil passage
3. 2nd speed gear
4. 2nd speed clutch pack
5. Input shaft

22 -Try to rotate the 2nd speed gear. The 2nd speed gear must turn freely on the input shaft.

Apply compressed air of approximately 6 bar to the 2nd speed gear clutch passage.

Hear the 2nd speed gear piston moving to lock the 2nd speed gear clutch pack. Try to move the 2nd speed gear. The 2nd speed gear must not turn on the input shaft.

If the clutch does not work correctly, disassemble the clutch to find the problem.

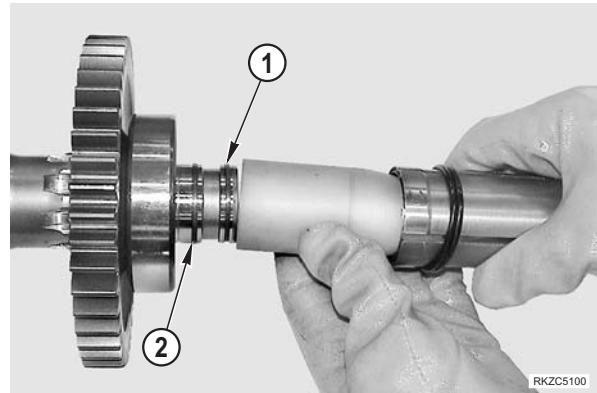


## REMOVAL AND INSTALLATION

## TRANSMISSION

23 -Assemble Teflon sealing rings (1) and (2).

To install the sealing rings, repeat steps 29 to 34 in section "6.2 Assembly" using the spacer rings of tool F17.

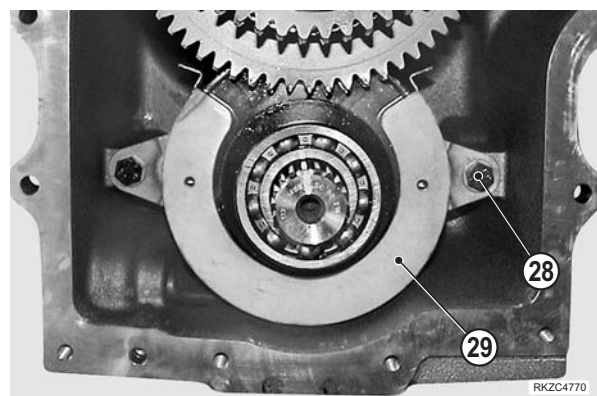


24 -Lift the three shafts **B-C-E** at the same time and insert into the half-housing.  
Use tool F15.



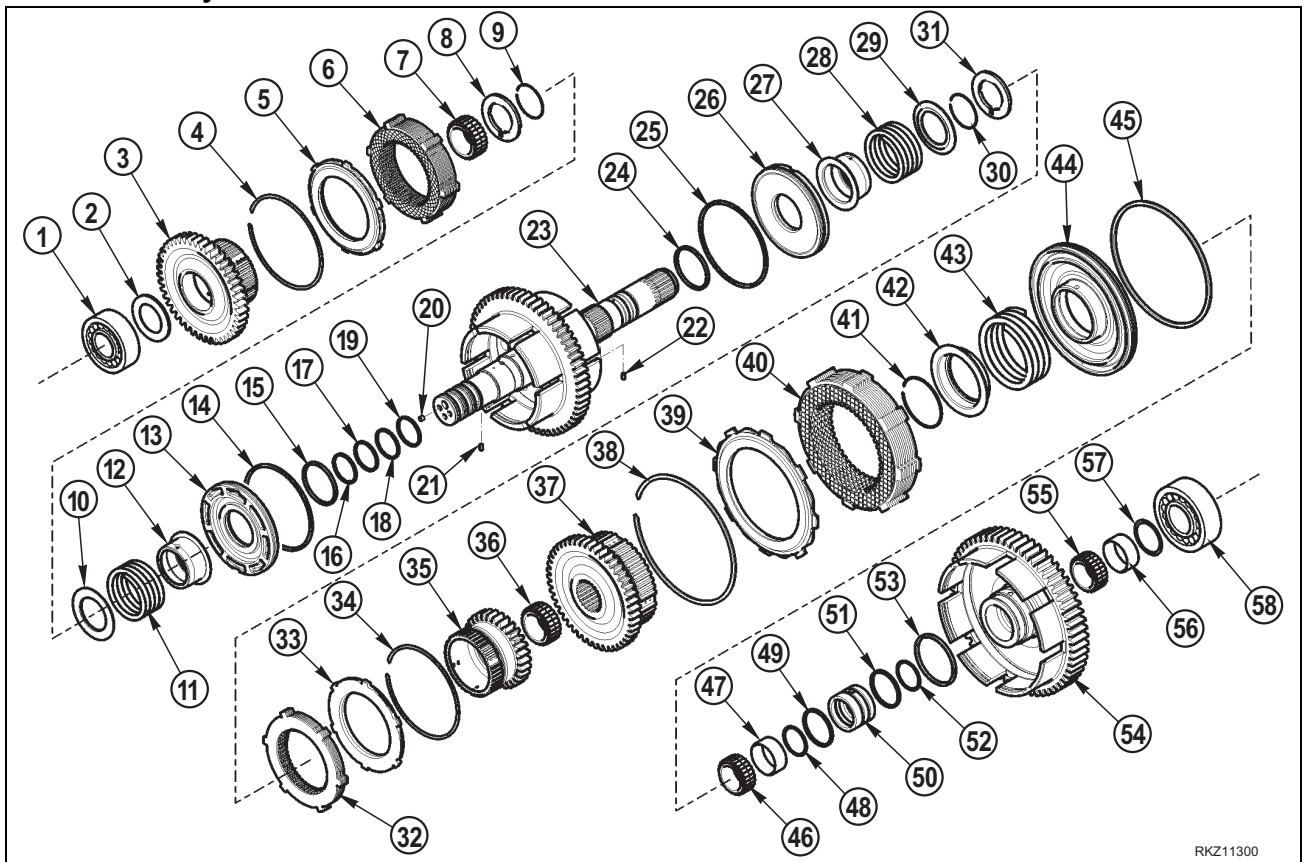
25 -Assemble protection (29) and tighten screws (28) to the prescribed torque.

 Screw: 50 Nm

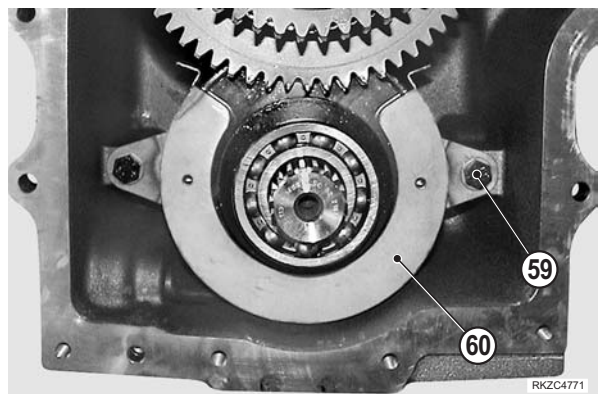


## 8. AXIS C

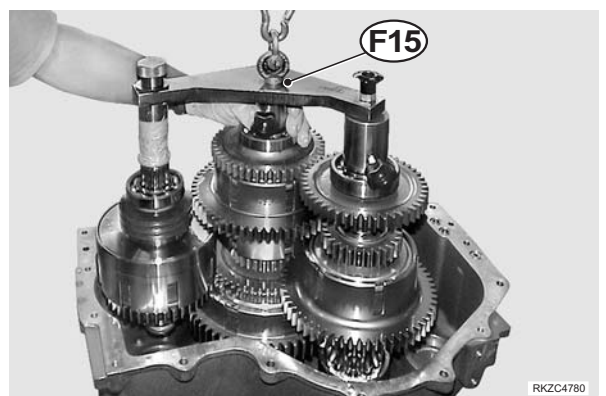
### 8.1 Disassembly



1 -Remove screws (59) and protection (60).



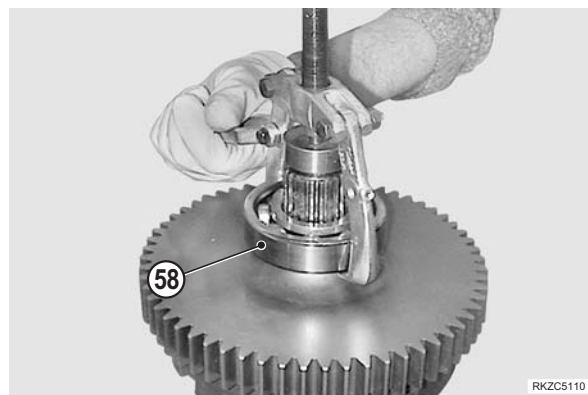
2 -Lift the three shafts B-C-E, at the same time **B-C-E**.  
Use tool **F15**.



## REMOVAL AND INSTALLATION

## TRANSMISSION

3 -By means of an extractor remove bearing (58).



4 -Remove the spacer (57).



5 -Remove the gear (54) with its inner parts.



6 -Overturn the group.  
Push down the thrust plate (39).





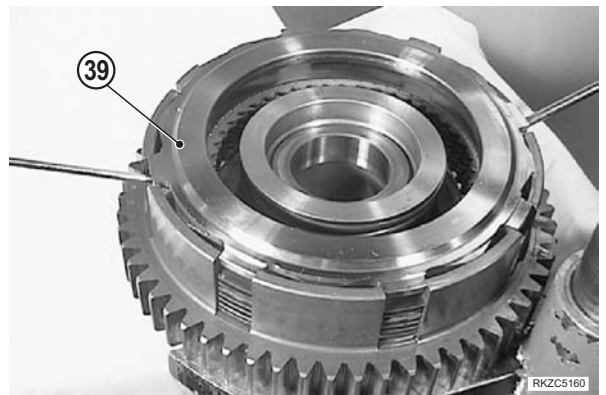
## REMOVAL AND INSTALLATION

## TRANSMISSION

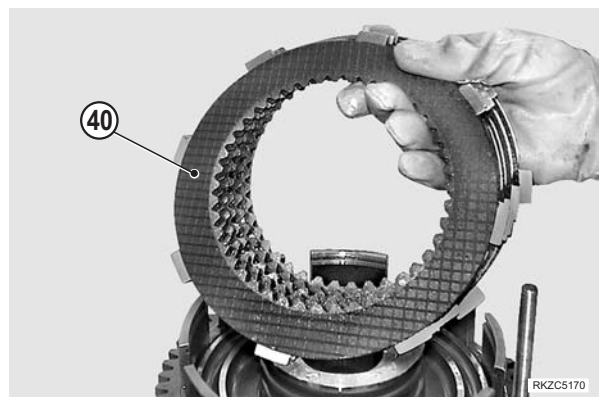
7 -Remove snap ring (38).



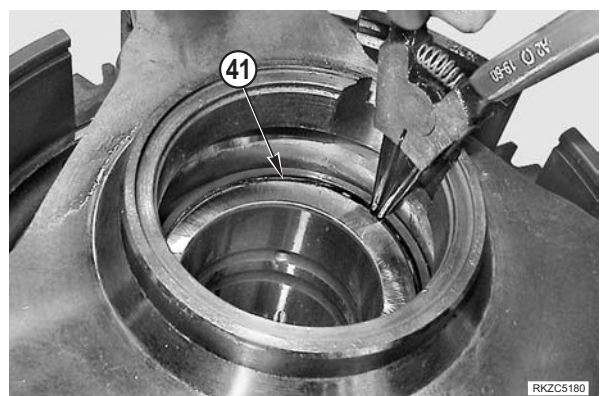
8 -Remove the thrust plate (39) by means of two screwdrivers.



9 -Remove clutch kit (40).



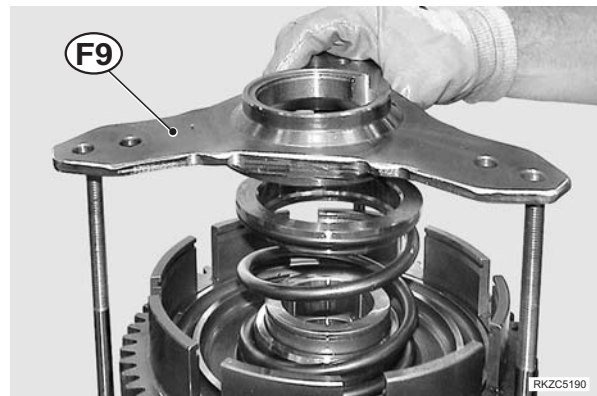
10 -Push down the thrust washer (42) to allow lock ring removal (41).  
Use the special tool **F9**.



## REMOVAL AND INSTALLATION

## TRANSMISSION

- 11 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



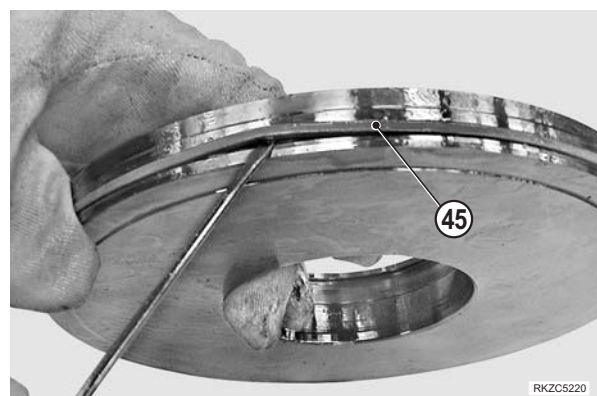
- 12 - Remove the lock ring (41), the thrust washer (42) and spring (43).



- 13 - Remove clutch piston (44) by blowing in compressed air through the delivery hole.



- 14 - If to be replaced, remove teflon seal ring (45) and relevant timer O-ring from outer seat of piston (44).



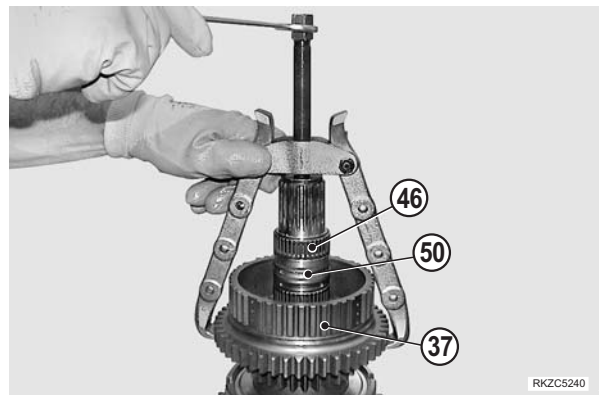
## REMOVAL AND INSTALLATION

## TRANSMISSION

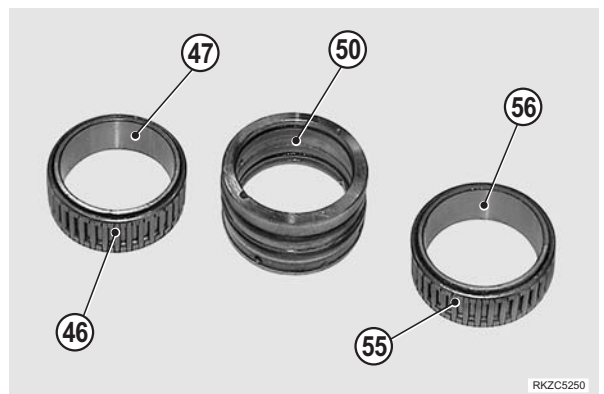
- 15 -If to be replaced, remove the teflon sealving (53) and relevant inner O-ring from seat of gear (54).



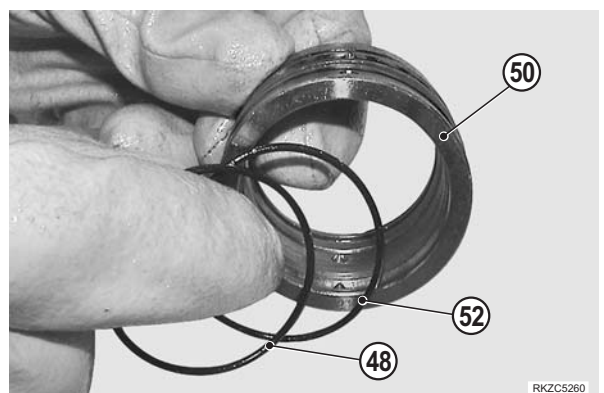
- 16 -Remove gear (37) with an extractor.  
Remove bushing (47) and (56), roller bearing (46) and (55) and spacer (50).



- 17 -Check the condition of removed parts (46), (47), (50), (55) and (56).



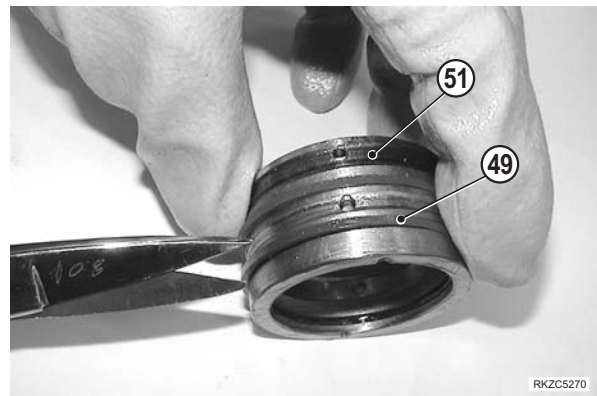
- 18 -Remove the O-rings (48) and (52) from the bush (50).  
destructive operation for the seal rings



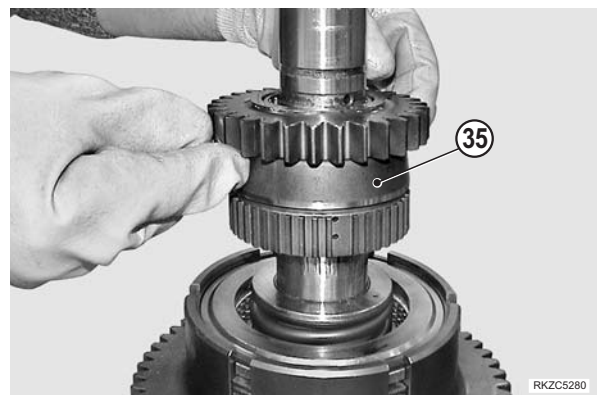
## REMOVAL AND INSTALLATION

## TRANSMISSION

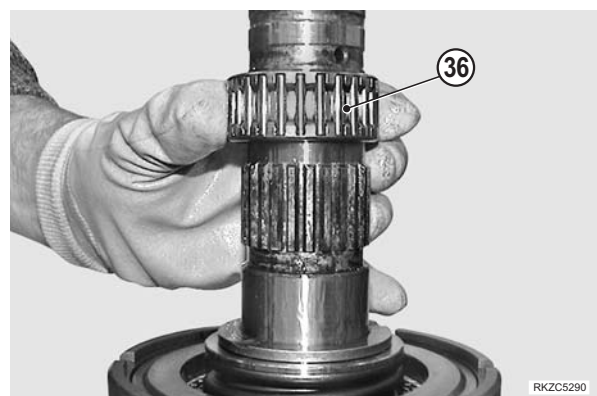
- 19 -Check the wear condition of the teflon seal rings (49) and (51).  
If replacement is necessary, cut the teflon seal rings (49) and (51) to remove them from the bush (50).  
destructive operation for the seal rings



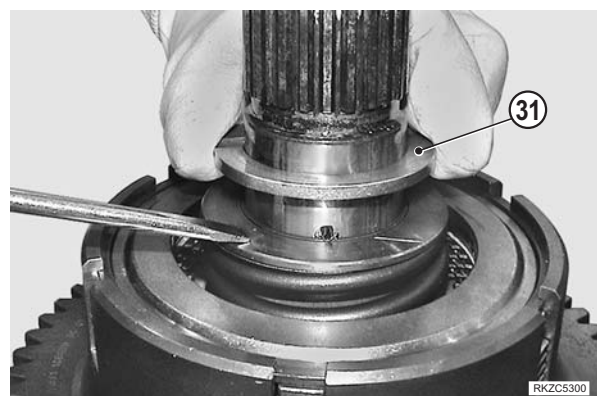
- 20 -Remove gear (35).



- 21 -Remove roller retainer (36).



- 22 -Remove spacer (31).

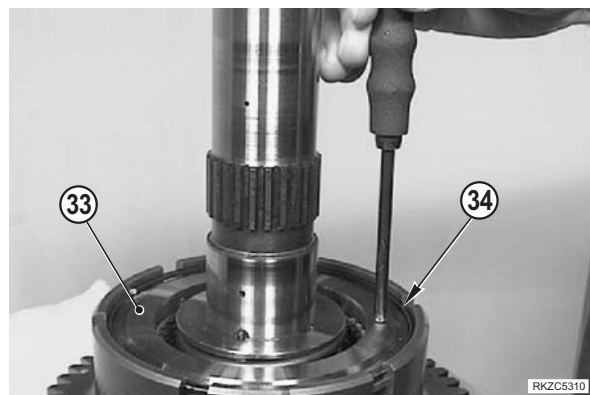




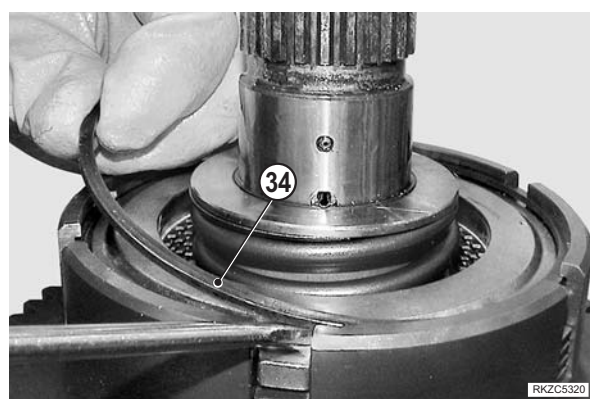
## REMOVAL AND INSTALLATION

## TRANSMISSION

23 -Push down the counterdisk (33) to set free the lock ring (34).



24 -Remove snap ring (34).



25 -Remove the thrust plate (33) by means of two screwdrivers.



26 -Remove clutch kit (32).



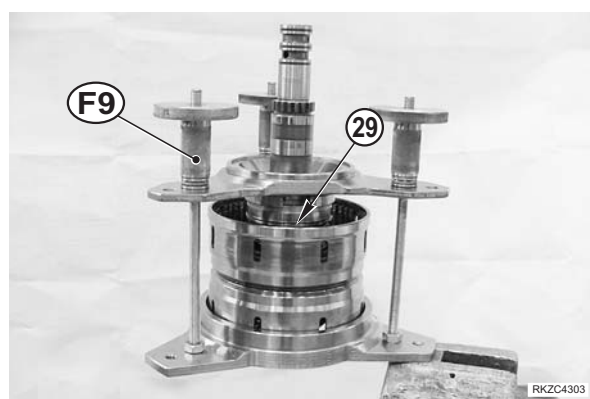
## REMOVAL AND INSTALLATION

## TRANSMISSION

27 -Remove the spring pin (22).



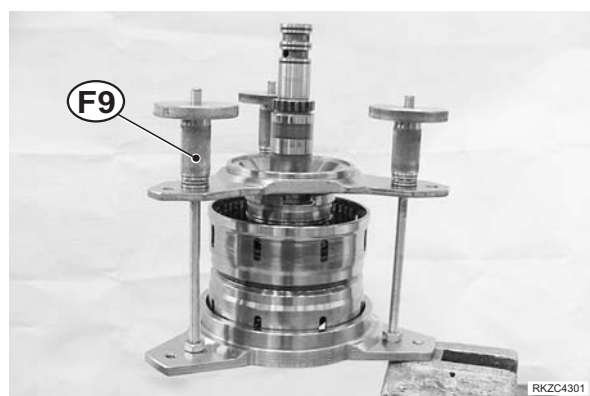
28 -Lower the spring (28) lock washer (29).  
Use tool **F9**.



29 -Remove snap ring (30).



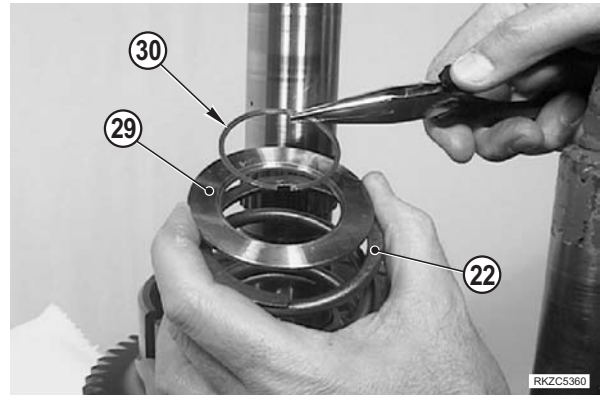
30 -Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



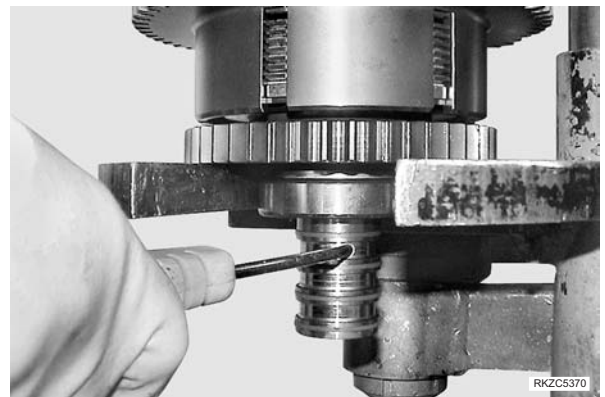
## REMOVAL AND INSTALLATION

## TRANSMISSION

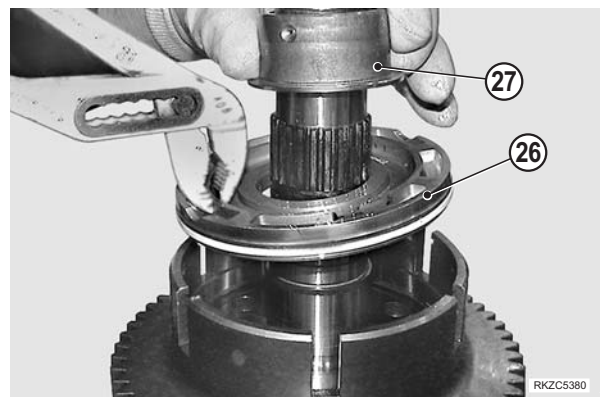
31 -Remove the lock ring (30), the thrust washer (29) and spring (28).



32 -Extract clutch piston (26) from its seat by blowing in compressed air through the delivery hole.



33 -Remove the bush (27) and clutch piston (26).



34 -If to be replaced, remove teflon seal ring (25) and relevant inner O-ring from outer seat of piston and teflon seal rings (24) and relevant inner O-ring from inner of piston.  
To remove the rings it is necessary to cut them.

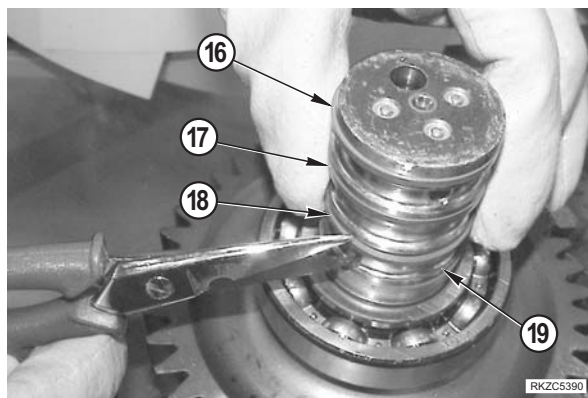




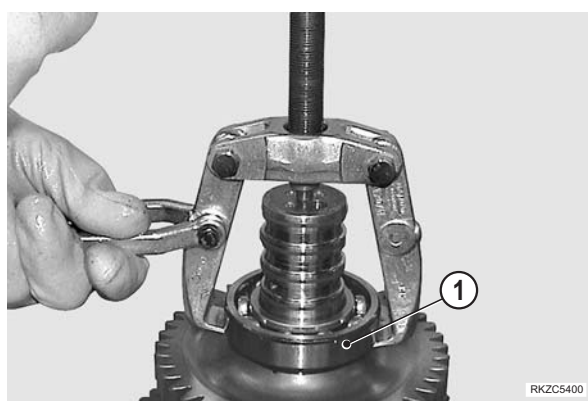
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 35 -Overturn the shaft (23).  
Cut and remove the seal rings (16), (17), (18) and (19).



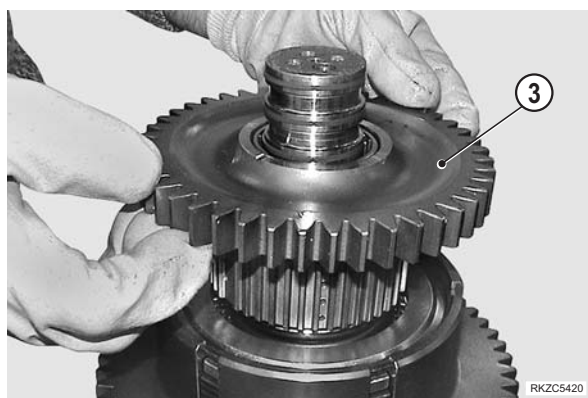
- 36 -By means of an extractor remove bearing (1).



- 37 -Remove spacer (2).



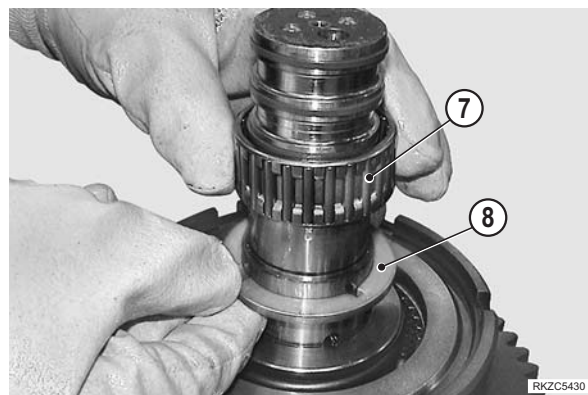
- 38 -Remove gear (3).



## REMOVAL AND INSTALLATION

## TRANSMISSION

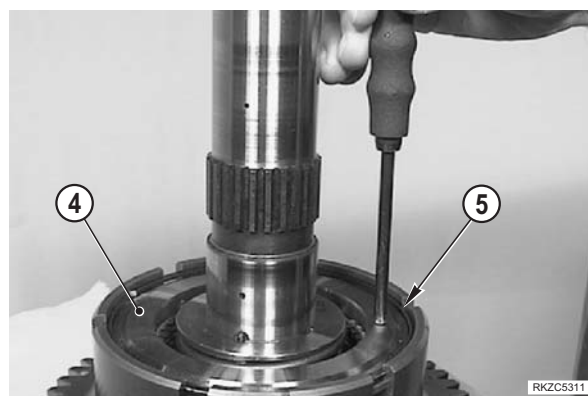
39 -Remove roller retainers (7) and washer (8).



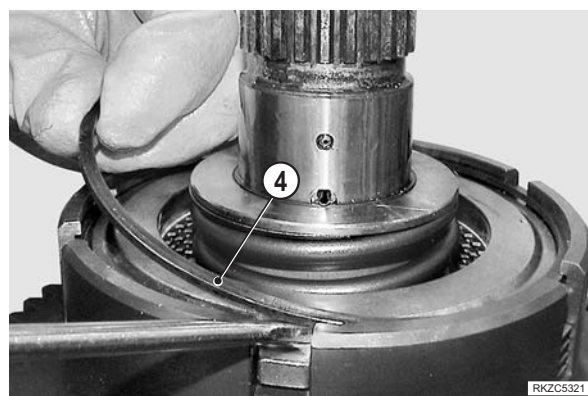
40 -Remove the spring pin (21).



41 -Push down the thrust plate (5) to set free the lock ring (4).



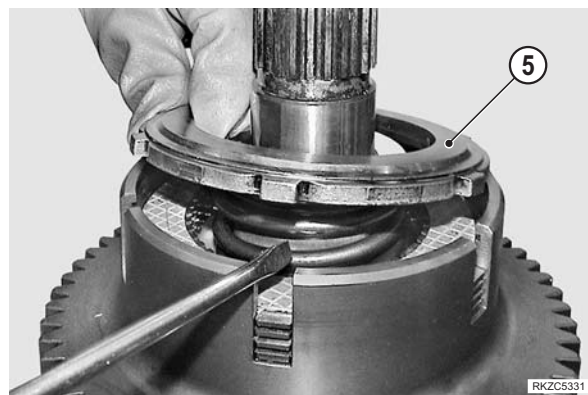
42 -Remove snap ring (4).



## REMOVAL AND INSTALLATION

## TRANSMISSION

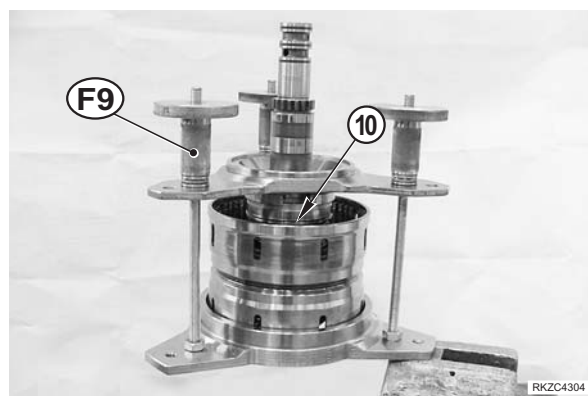
43 -Remove the thrust plate (5) by means of two screwdrivers.



44 -Remove clutch kit (6).



45 -Lower the spring (11) lock washer (10).  
Use tool **F9**.



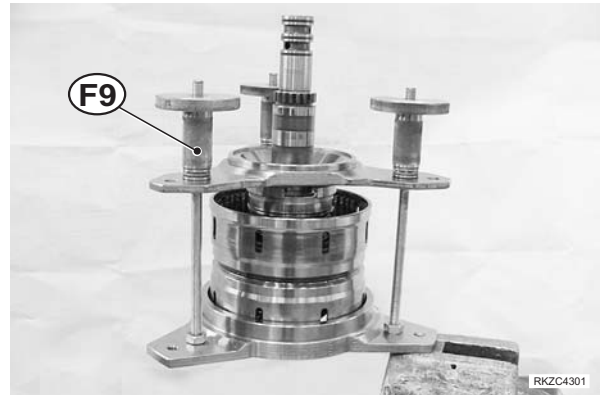
46 -Remove snap ring (9).



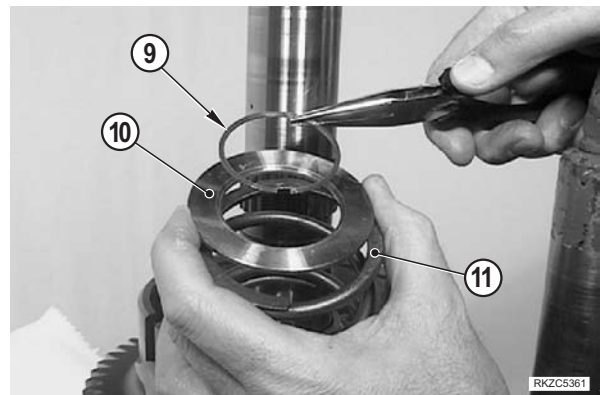
## REMOVAL AND INSTALLATION

## TRANSMISSION

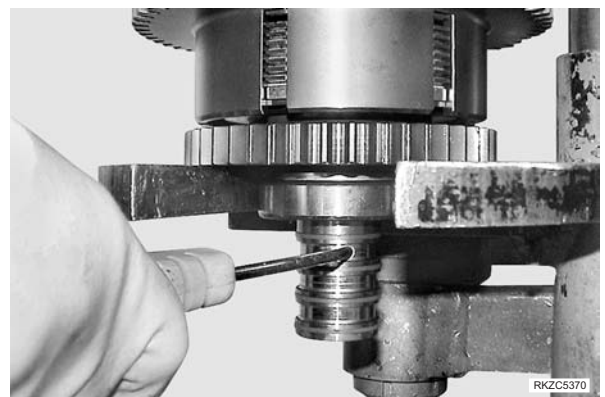
- 47 -Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



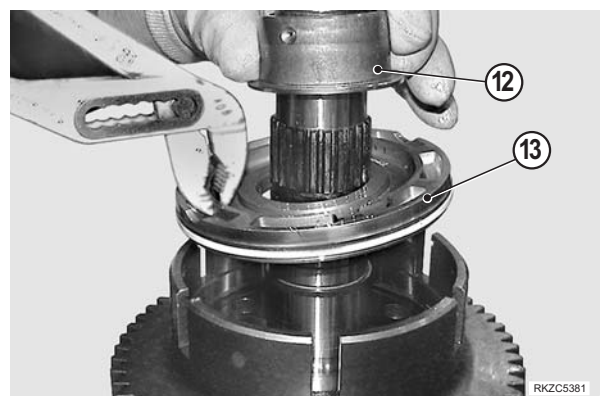
- 48 -Remove the lock ring (9), the thrust washer (10) and spring (11).



- 49 -Extract clutch piston (13) from its seat by blowing in compressed air through the delivery hole.



- 50 -Remove the bush (12) and clutch piston (13).

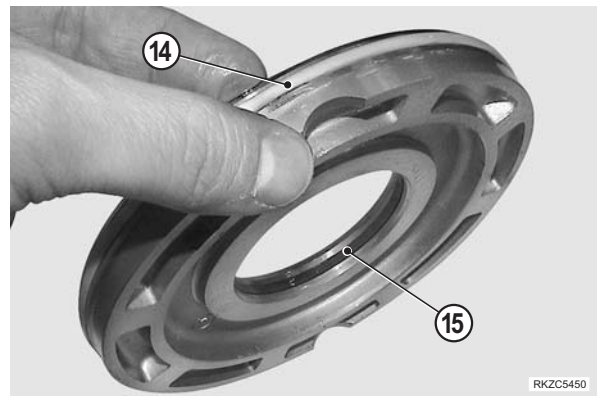


## REMOVAL AND INSTALLATION

## TRANSMISSION

51 -If to be replaced, remove teflon seal ring (15) and relevant inner O-ring from outer seat of piston and teflon seal rings (14) and relevant inner O-ring from inner of piston.

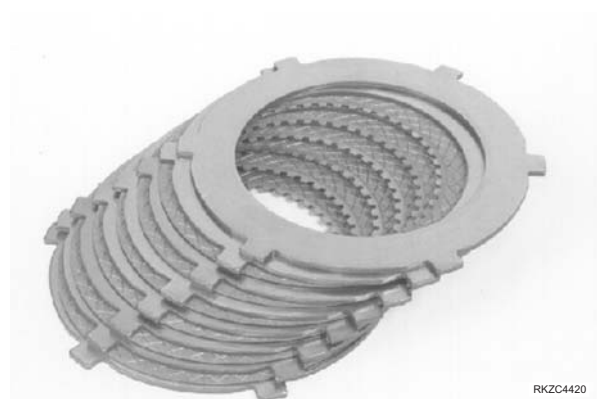
To remove the rings it is necessary to cut them.



52 -Check:

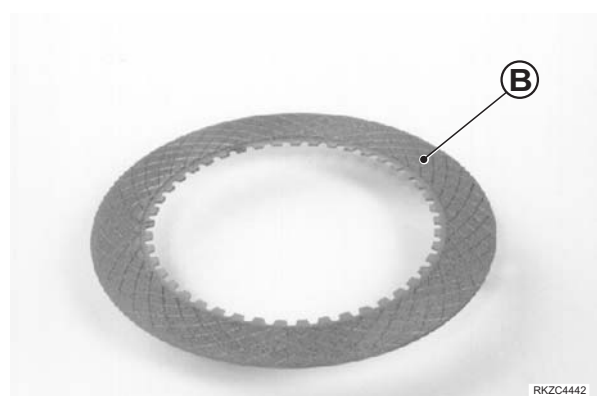
- the sealing ring grooves (large and small) for wear and damage if necessary.
  - on the output shaft for wear and damage.
  - the oil passages in the output shaft for restrictions or foreign matter.
  - the ball bearings and the needle bearings for flat areas, pitting, and other damage.
- Use new parts as required.

53 -If the clutch discs are to be used again, keep the clutch packs in the same previous assembly order separate and record which clutch pack goes with each clutch.



54 -At each disassembly:

- verify with a caliper that the total thickness of the clutch kit is within the wear limit.
  - Verify that all the clutch plates do not appear burned or that the friction material it is not damaged and that splines are well traced.
  - Verify also that all the clutch drive plates (A) are perfectly plane and inspect for pitting or scoring.
- In the case that at least one of the above problems occurs, replace the complete clutch kit with a new one. If using a new clutch kit soak the clutch plates (B) in clean transmission oil for at least an hour before assembly. In any case lubricate the contact surfaces of clutch drive plates with clean transmission oil before assembly.





**REMOVAL AND INSTALLATION****TRANSMISSION****1st GEAR CLUTCH**

|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plate                | 6              |
| Number clutch steel plate             | 6              |
| Nominal clutch plate thickness        | 2.20±0.05 mm   |
| Nominal clutch kit thickness          | * 27.5-27.7 mm |
| Maximum clutch plate wear (each side) | 0.15 mm        |
| Maximum clutch kit wear               | 0.9 mm         |

\* Under load of 163 kg

**3rd GEAR CLUTCH**

|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plate                | 6              |
| Number clutch steel plate             | 6              |
| Nominal clutch plate thickness        | 2.00±0.05 mm   |
| Nominal clutch kit thickness          | * 30.5-30.7 mm |
| Maximum clutch plate wear (each side) | 0.20 mm        |
| Maximum clutch kit wear               | 1.6 mm         |

\* Under load of 163 kg

**4th GEAR CLUTCH**

|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plate                | 6              |
| Number clutch steel plate             | 6              |
| Nominal clutch plate thickness        | 2.00±0.05 mm   |
| Nominal clutch kit thickness          | * 15.9-16.1 mm |
| Maximum clutch plate wear (each side) | 0.2 mm         |
| Maximum clutch kit wear               | 0.8 mm         |

\* Under load of 163 kg

55 - Inspect the bore of the shaft in the input shaft housing for damage that will cause leakage when the clutch is assembled.

Check the slots in the side of the input shaft housing for damage from the tangs on the steel discs.

Use new parts as required during assembly.

## 8.2 Assembly

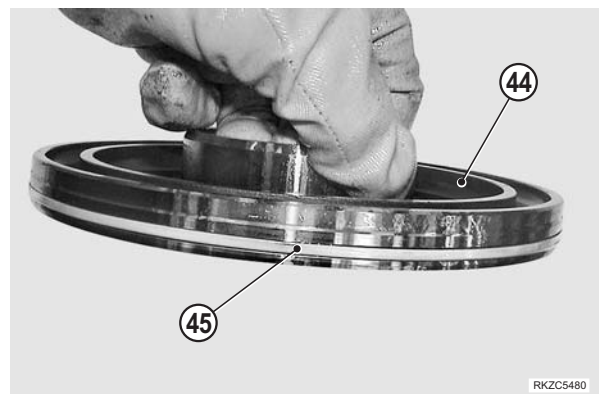
- 1 - Assemble new teflon ring (53) and relevant inner O-Ring on gear (54) using special tool **F21**.  
. Assemble the O-Ring (52).



- 2 - Calibrate the teflon ring (53) using special tool **F20**.



- 3 - Assemble new teflon ring (45) with relative O-ring on clutch piston (44).



- 4 - Apply a thin film of grease on the outer edge and in the inner part of clutch piston (44) and assemble in gear (54).

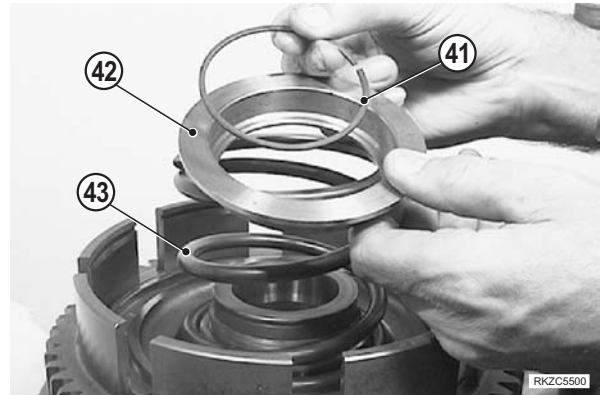




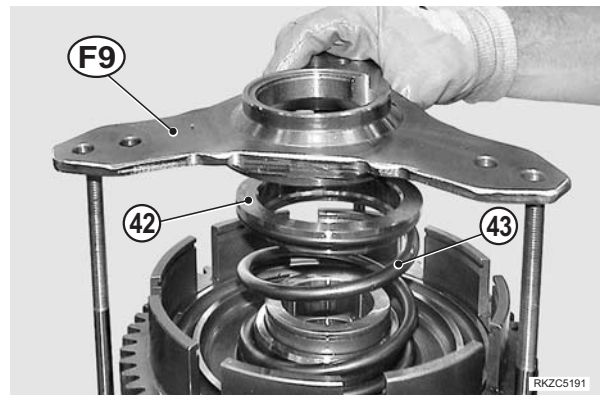
## REMOVAL AND INSTALLATION

## TRANSMISSION

5 -Insert spring (43), thrust washer (42) and snap ring (41).

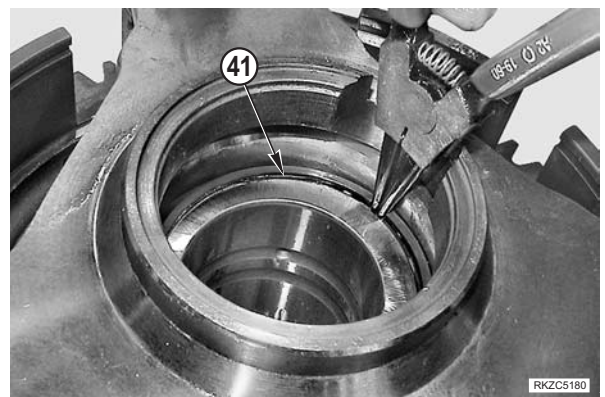


6 -Lower the spring (43) lock washer (42).  
Use tool **F9**.

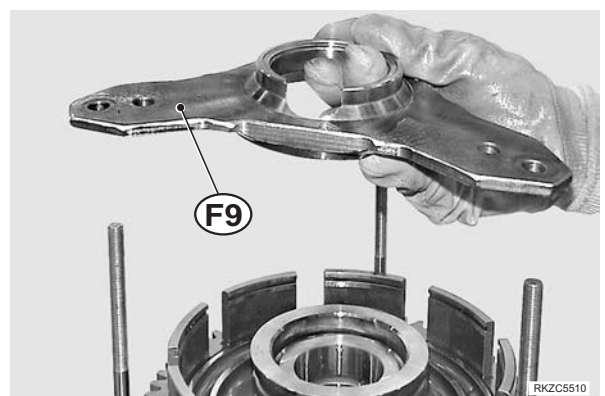


7 -Insert snap ring (41).

★ Ensure that the snap ring (41) is well fitted.



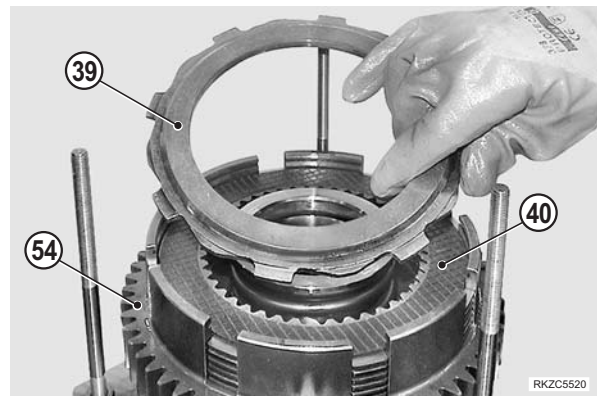
8 -Loosen the handles of the threaded rods to release the tension from the spring. Remove the top piece of the **F9** special tool.



## REMOVAL AND INSTALLATION

## TRANSMISSION

9 -Insert clutch kit (40) and thrust plate (39) into the gear (54).



10 -Assemble retaining ring (38) making sure it is correctly seated.



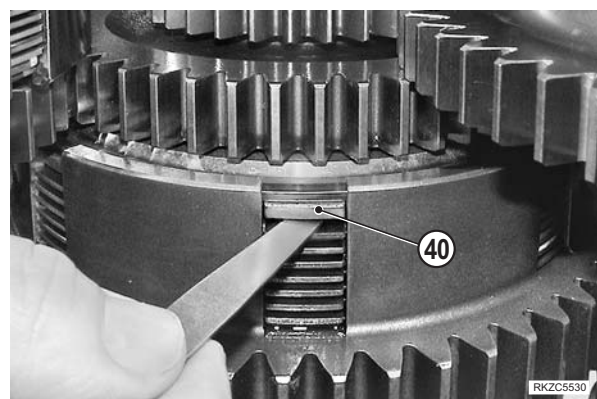
11 -Measure the clutch discs clearance for each clutch assembly.

The clutch plate lock ring must be all the way up against the lock ring.

Use a feeler gauge to measure the distance between the clutch plate lock ring and the first clutch plate (40).

★ Distance: 1.725-2.375 mm.

★ If the distance is not within specification, the clutch is probably assembled wrong.



12 -Assemble new teflon ring (25) and relevant inner O-ring, new teflon ring (24) and relevant inner O-rings respectively into the piston (26) outer and inner seats.



## REMOVAL AND INSTALLATION

## TRANSMISSION

- 13 -Apply a thin film of grease on the sealing rings just inserted.



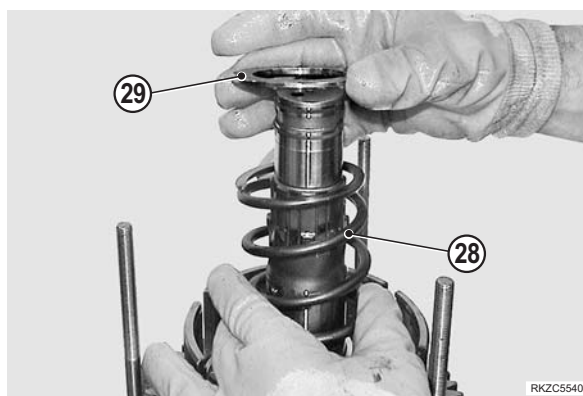
- 14 -Insert clutch piston (26) with special tool **F10** as protection of seal rings (24).



- 15 -Assemble sleeve (27).



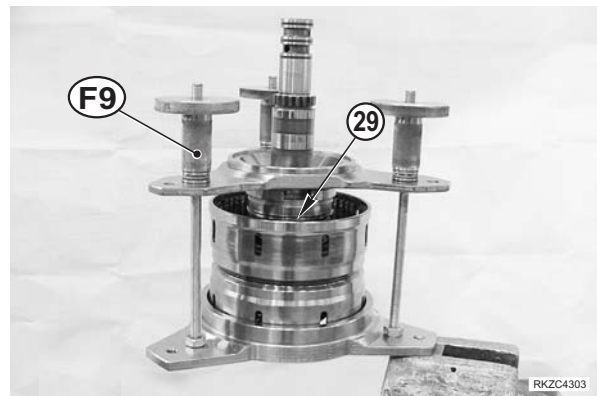
- 16 -Assemble spring (28) and retainer washer (29).



## REMOVAL AND INSTALLATION

## TRANSMISSION

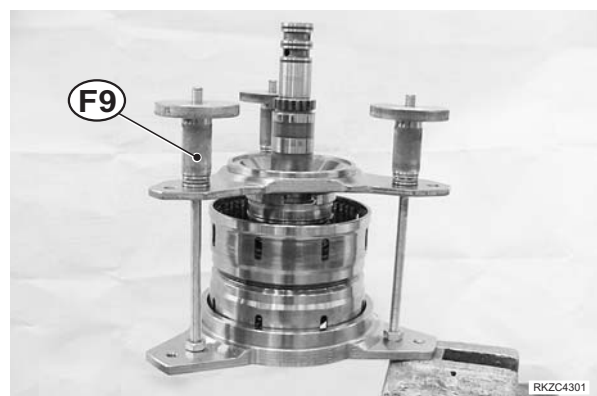
- 17 - Lower the spring (28) lock washer (29).  
Use tool **F9**.



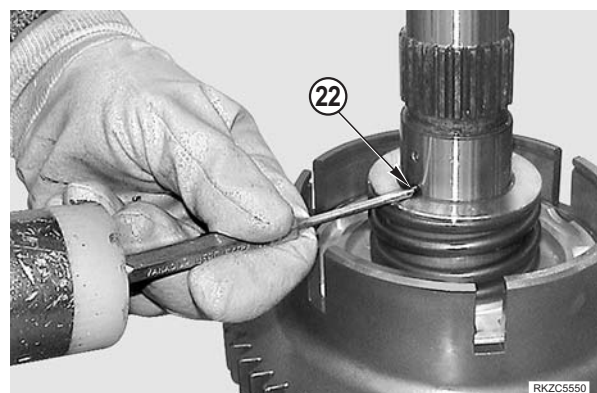
- 18 - Insert snap ring (30).  
★ Ensure that the snap ring (30) is well fitted.



- 19 - Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



- 20 - Remove tool **F9** and assemble spring pin (22).

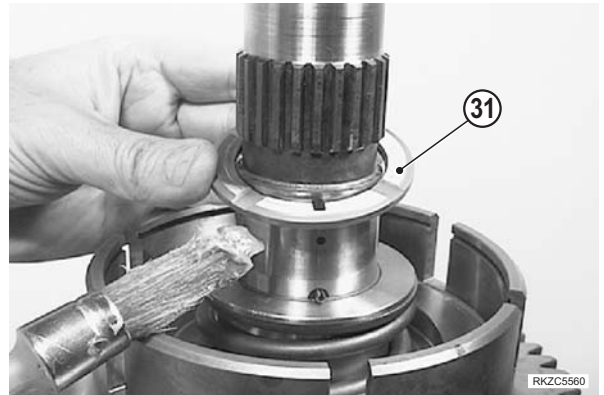




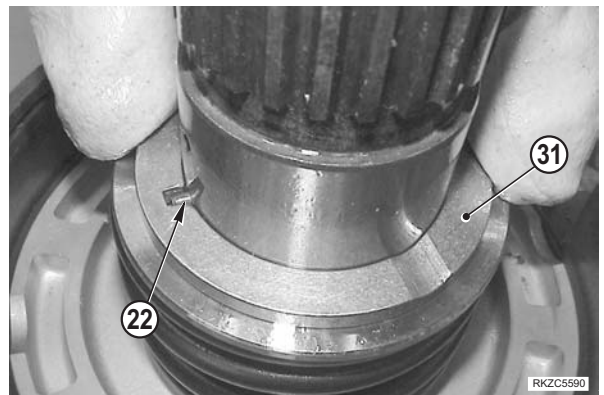
## REMOVAL AND INSTALLATION

## TRANSMISSION

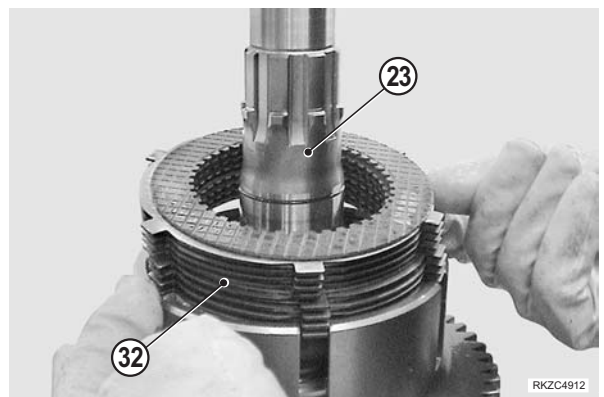
- 21 -Insert the thrust washer (31) into the shaft (23).  
Apply a thin film of grease under washer (31) to avoid its falling when overturning the shaft.



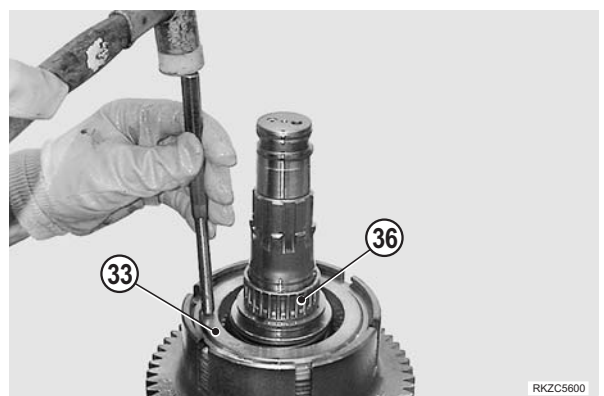
- 22 -Assemble the washer (31) on the pin (22).



- 23 -Insert clutch kit (32) on main shaft (23).



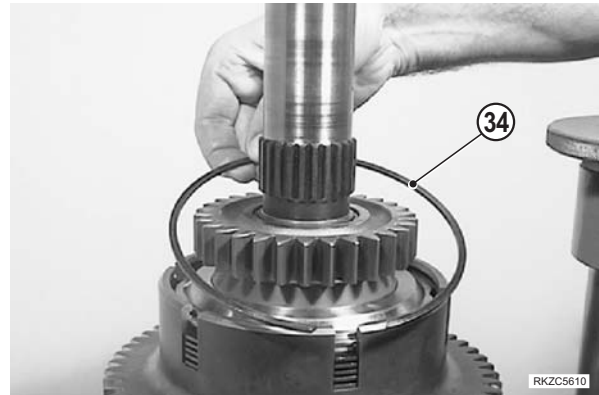
- 24 -Insert the roller bearing (36) and thrust plate (33).



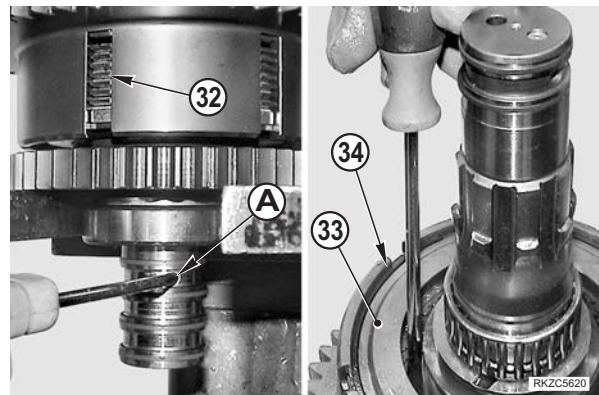
## REMOVAL AND INSTALLATION

## TRANSMISSION

25 -Assemble snap ring (34).



26 -Apply compressed air at low pressure in hole (a) in order to push the thrust plate (33) against retaining ring (34), then align the clutch plate (32) spline.

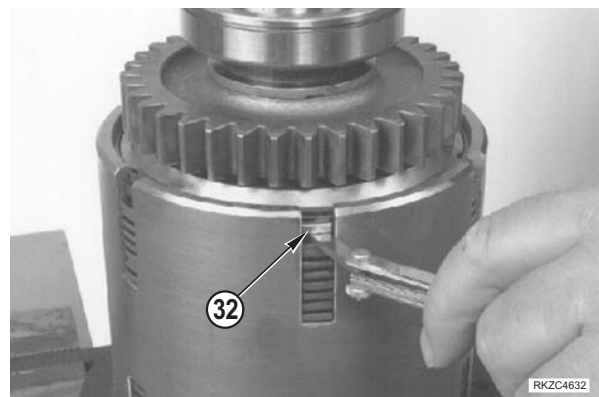


27 -Measure the clutch discs clearance for each clutch assembly.

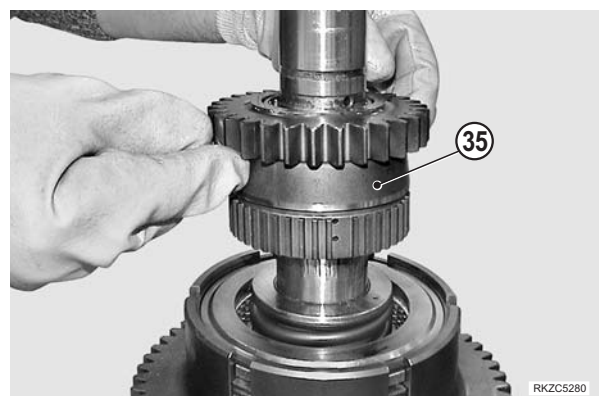
The clutch plate lock ring must be all the way up against the lock ring.

Use a feeler gauge to measure the distance between the clutch plate lock ring and the first clutch plate (32).

- ★ Distance: 1.50-1.95 mm.
- ★ If the distance is not within specification, the clutch is probably assembled wrong.



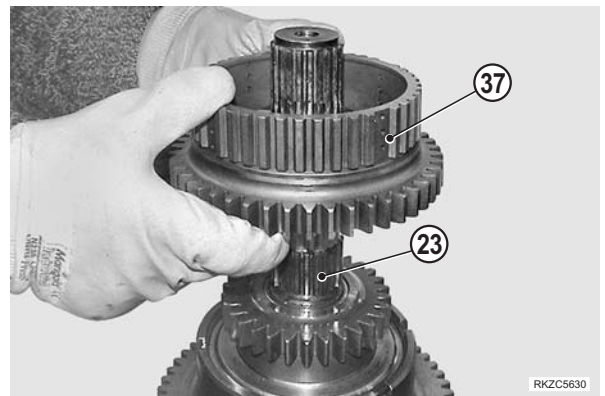
28 -Insert gear (35) paying attention it completely fit in its seat.



## REMOVAL AND INSTALLATION

## TRANSMISSION

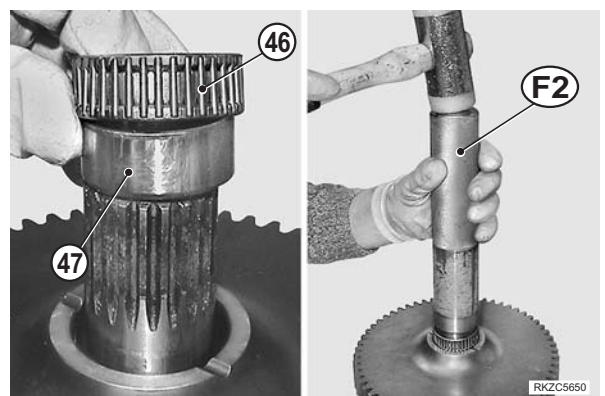
29 -Insert gear (37) on the shaft (23) by side shown in figure.



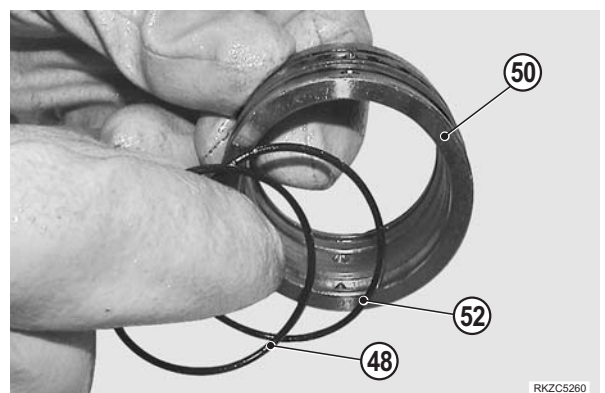
30 -Assemble the gear assembly (54) on main shaft (23).



31 -Assemble the bush (47) and needle bearing (46) with special tool **F2**.



32 -Assemble the new O-rings (48) and (52) to the bush (50).

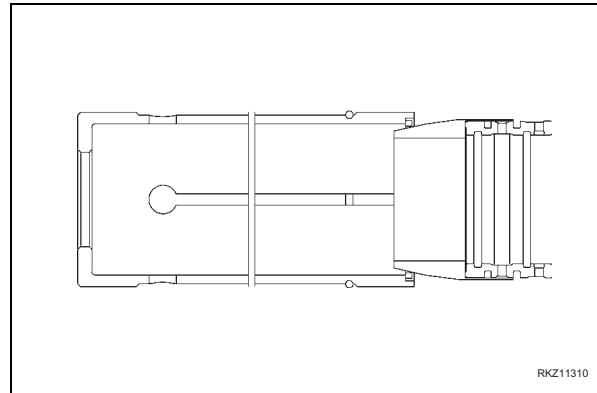




## REMOVAL AND INSTALLATION

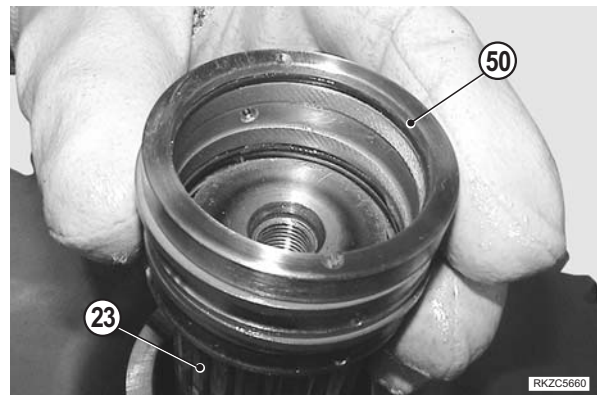
## TRANSMISSION

33 -Install new sealing rings (49) and (51) to bushing (50) using tools **F22**, **F23** and **F24**. Carry out steps 29 to 34 in section "6.2 Assembly" to install.

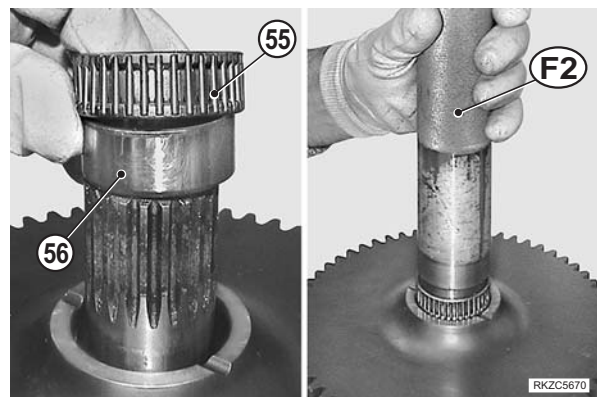


35 -Assemble the bush (50) on main shaft (23) with special tool **F2**.

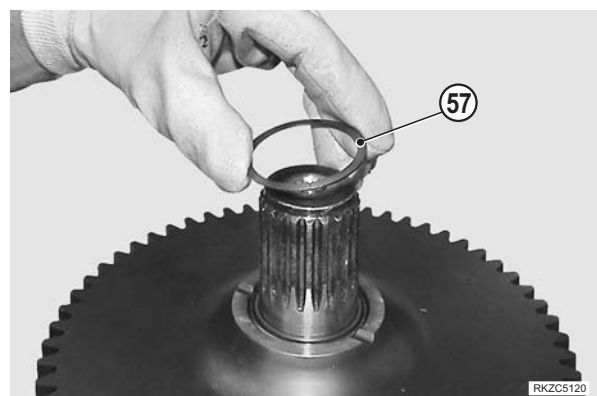
**!** The reference mark must be on the top surface



36 -Assemble the bush (56) and needle bearing (55) with special tool **F2**.



36 -Assemble the spacer (57).



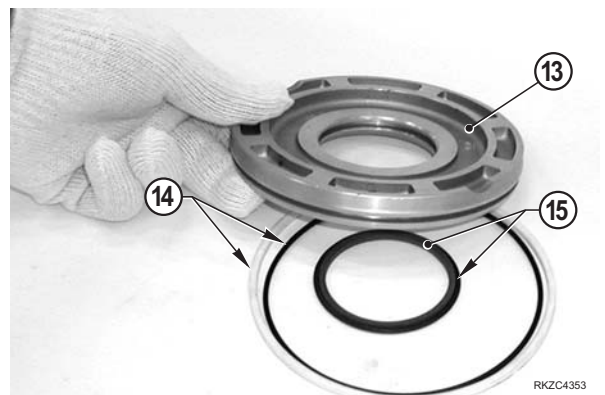
## REMOVAL AND INSTALLATION

## TRANSMISSION

- 37 -Assemble bearing (58).  
Use tool **F2**.



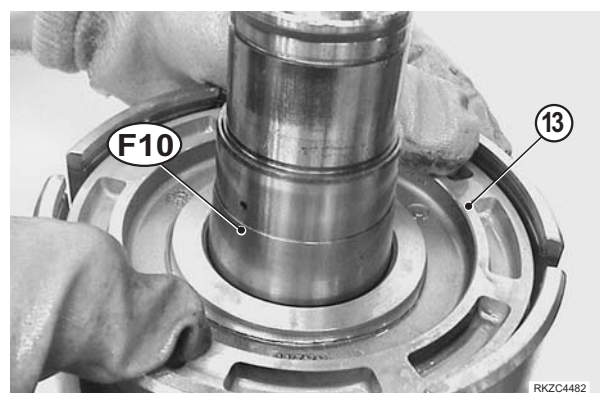
- 38 -Turn the shaft.  
Assemble new O-ring with relative teflon ring (14) into the piston (13) outer seat.  
Assemble new O-ring with relative teflon ring (15) into the piston (13) inner seat.



- 39 -Apply a thin film of grease on the sealing rings just inserted.



- 40 -Insert the clutch piston (13) with the special tool **F10** as protection of seal rings (15).



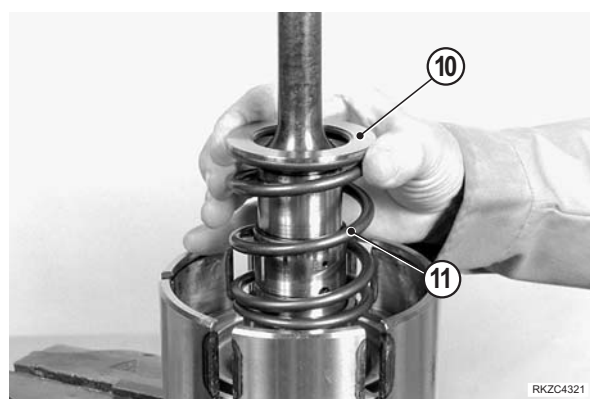
## REMOVAL AND INSTALLATION

## TRANSMISSION

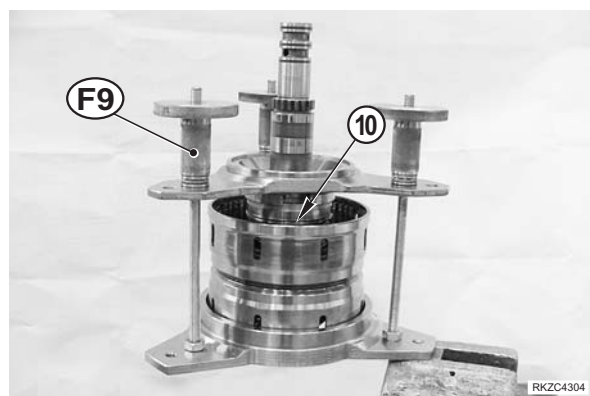
41 -Assemble sleeve (12).



42 -Assemble spring (11) and washer (10).



43 -Lower the spring (11) lock washer (10).  
Use tool **F9**.



44 -Insert snap ring (9).

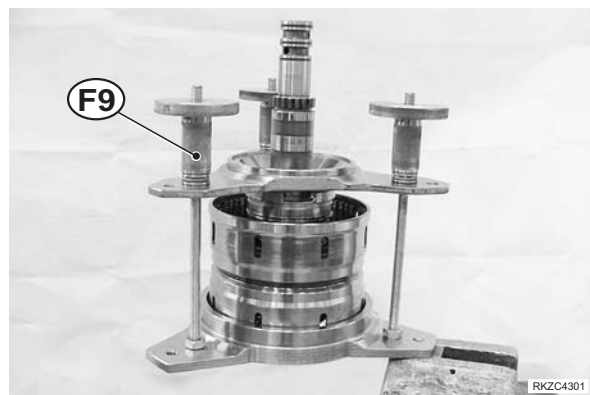
★ Ensure that the snap ring (9) is well fitted.



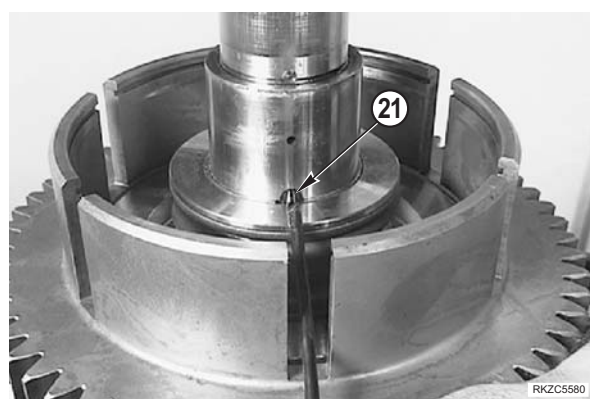
## REMOVAL AND INSTALLATION

## TRANSMISSION

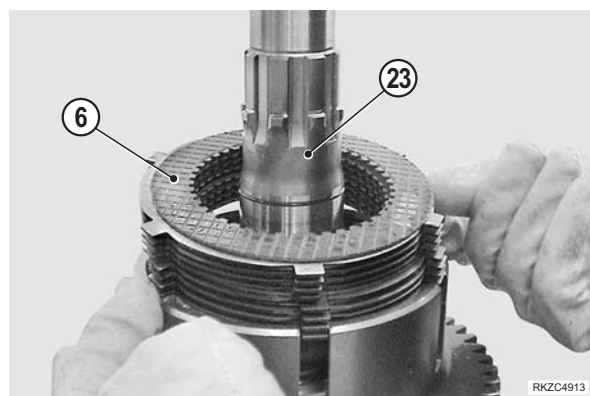
- 45 -Loosen the handles of the threaded rods to release the tension from the spring.  
Remove the top piece of the **F9** special tool.



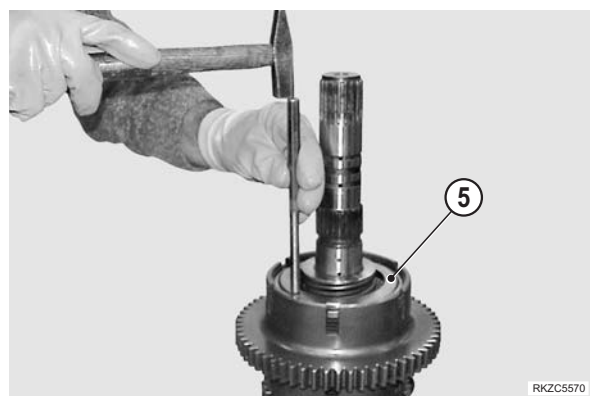
- 46 -Assemble spring pin (21).



- 47 -Insert clutch kit (6) on main shaft (23).



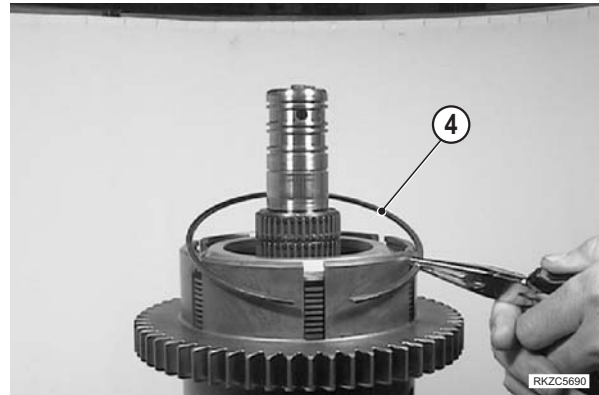
- 48 -Assemble thrust plate (5).



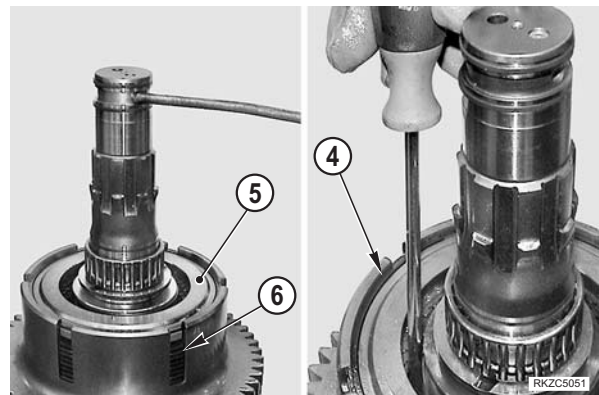
## REMOVAL AND INSTALLATION

## TRANSMISSION

49 -Assemble snap ring (4).



50 -Apply compressed air at low pressure in hole in order to push the thrust plate (5) against the retaining ring (4), then align the clutch plate (6) spline.

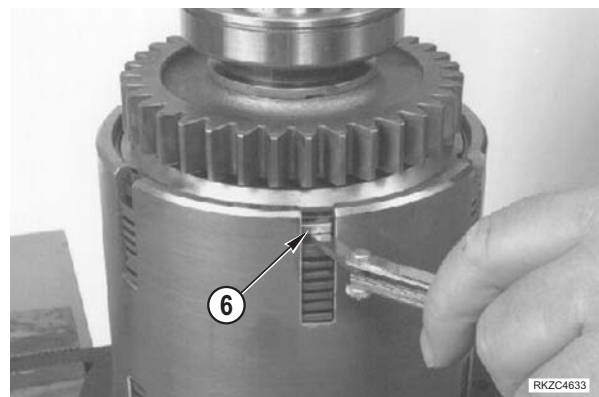


51 -Measure the clutch discs clearance for each clutch assembly.

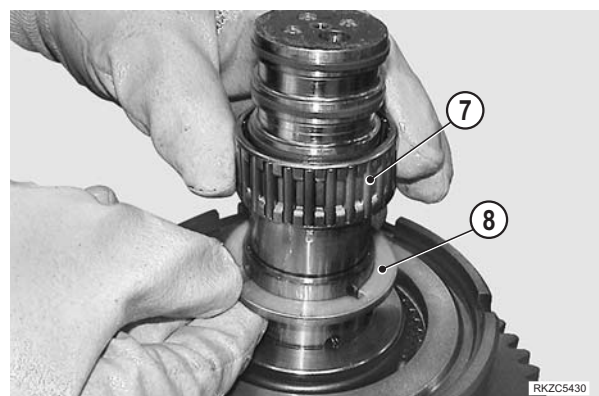
The clutch plate lock ring must be all the way up against the lock ring.

Use a feeler gauge to measure the distance between the clutch plate lock ring and the first clutch plate (6).

- ★ Distance: 2.20-3.05 mm.
- ★ If the distance is not within specification, the clutch is probably assembled wrong.

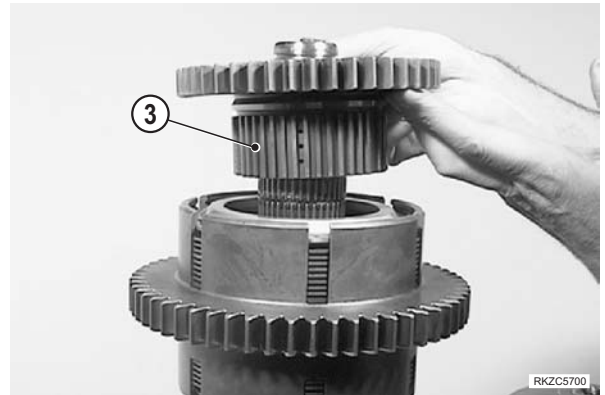


52 -Assemble the thrust washer (8) and roller bearing (7).





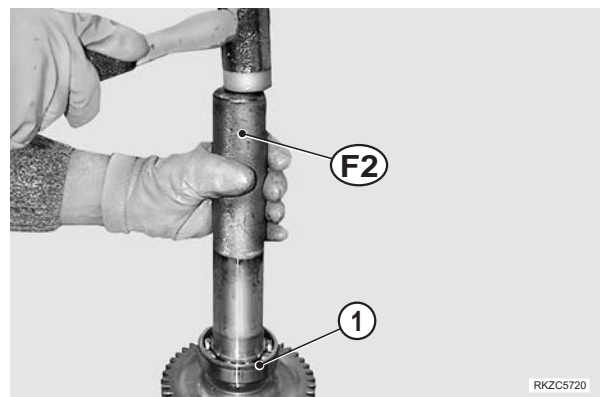
53 -Assemble the gear (3).



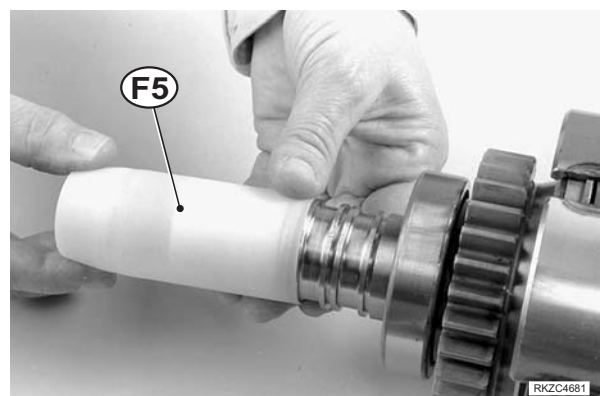
54 -Assemble the thrust washer (2).



55 -Assemble bearing (1) with the special tool **F2**.

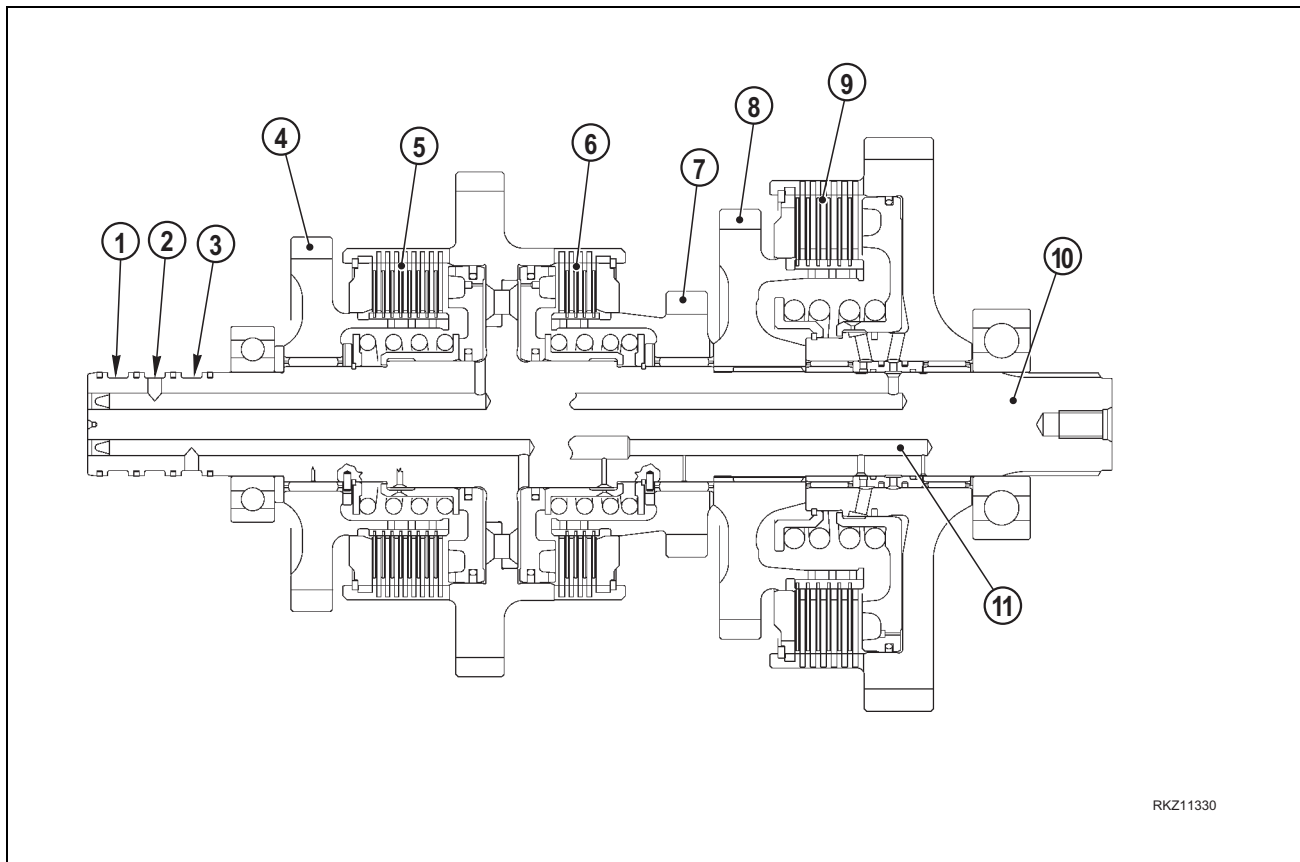


56 -Install Teflon sealing rings (16), (17), (18) and (19).  
Use special tool **F5** and carry out steps 29 to 34 in  
section "6.2 Assembly" to install.



## REMOVAL AND INSTALLATION

## TRANSMISSION



1. 1st clutch oil passage
2. 3rd clutch oil passage
3. 4th clutch oil passage
4. 3rd gear
5. 3rd gear clutch pack
6. 4th gear clutch pack
7. 4th gear
8. 1st gear
9. 1st gear clutch pack
10. Main shaft
11. Lubrication oil passage

57 - Verify that all the gears can freely rotate on the main shaft.

Apply compressed air of approximately 6 bar to the 1st speed gear clutch passage.

Hear the 1st speed gear piston moving to lock the 1st speed gear clutch pack. Try to move the 1st speed gear. The 1st speed gear must not turn on the input shaft.

If the clutch does not work correctly, disassemble the clutch to find the problem.

Apply compressed air of approximately 6 bar to the 3rd speed gear clutch passage.

Hear the 3rd speed gear piston moving to lock the

3rd speed gear clutch pack. Try to move the 3rd speed gear. The 3rd speed gear must not turn on the input shaft.

If the clutch does not work correctly, disassemble the clutch to find the problem.

Apply compressed air of approximately 6 bar to the 4th speed gear clutch passage.

Hear the 4th speed gear piston moving to lock the 4th speed gear clutch pack. Try to move the 4th speed gear. The 4th speed gear must not turn on the input shaft.

If the clutch does not work correctly, disassemble the clutch to find the problem.



## REMOVAL AND INSTALLATION

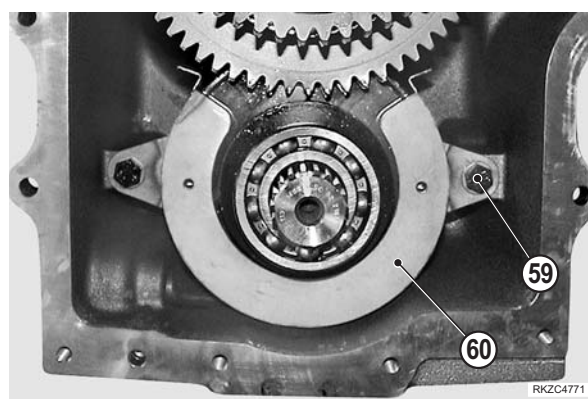
## TRANSMISSION

- 58 -Hook the three shafts **B-C-E** using the special tool **F15**.  
Lift the shafts **B-C-E** at the same time and insert the unit into the half-housing.  
Use tool **F15**.



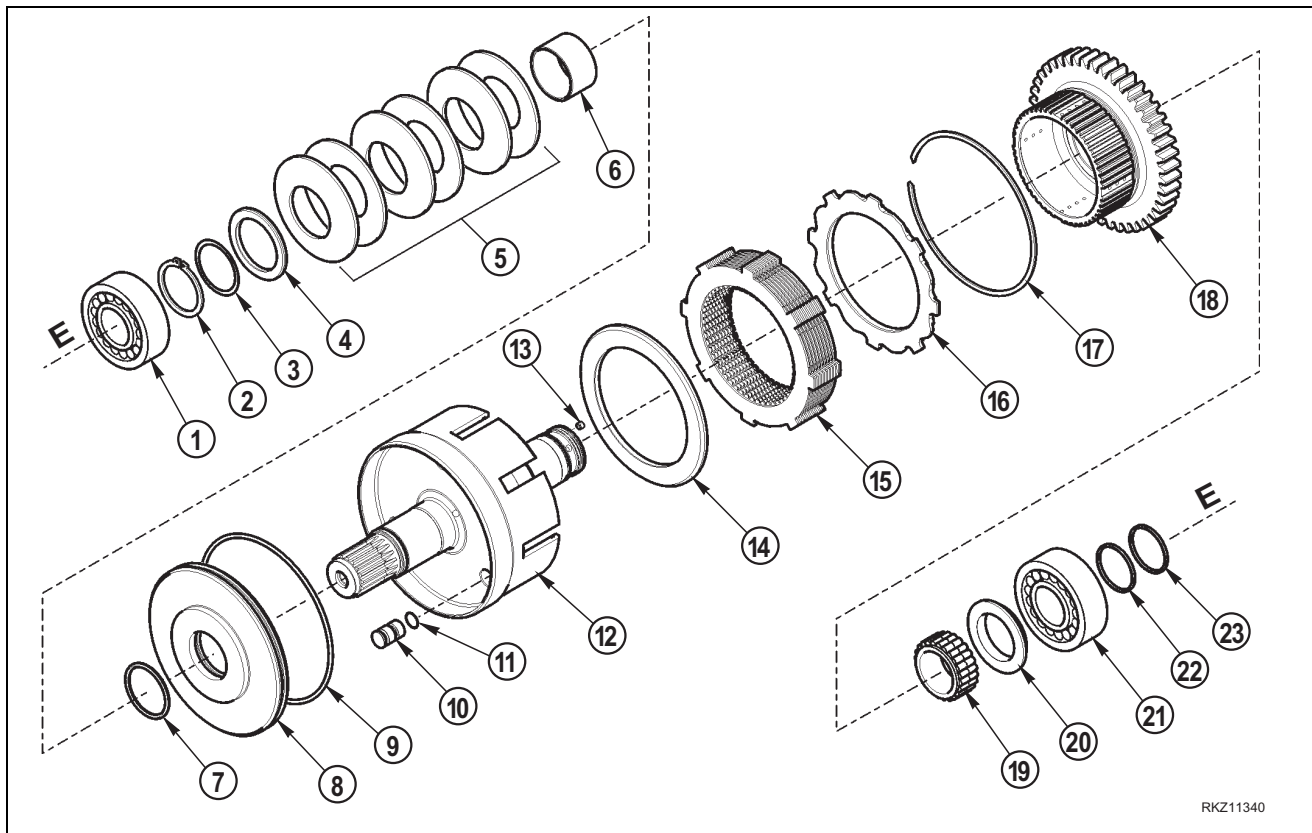
- 59 -Assemble protection (60) and tighten screws (59) to the prescribed torque.

 Screw: 50 Nm

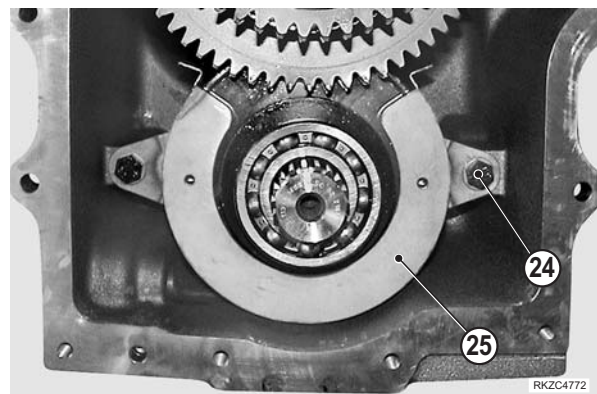


## 9. AXIS E

### 9.1 Disassembly



1 - Remove screws (24) and protection (25).



2 - Lift the three shafts **B-C-E** at the same time.  
Use tool **F15**.

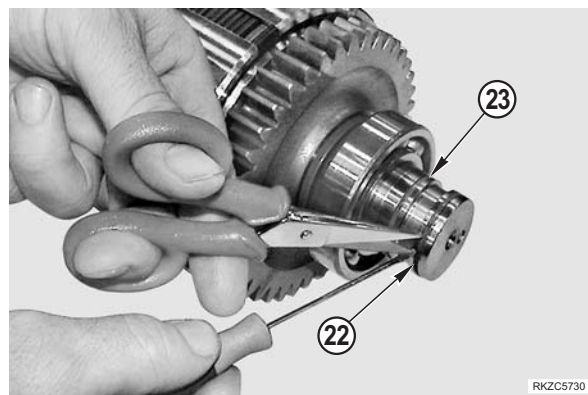


## REMOVAL AND INSTALLATION

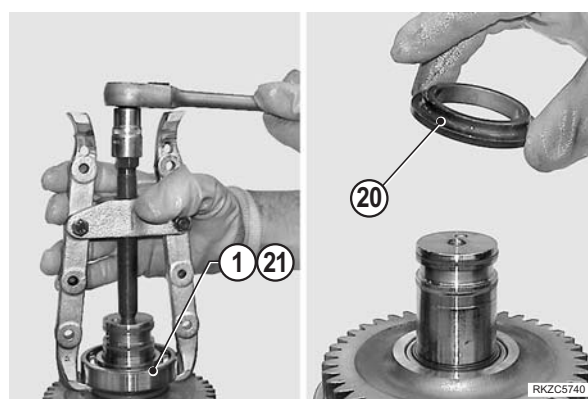
## TRANSMISSION

3 -Remove seals (22) and (23).

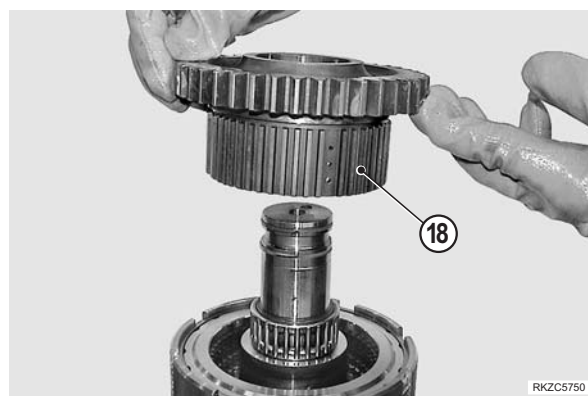
★ This is a destructive operation for the seal rings.



4 -By means of an extractor, remove bearings (21) and (1).  
Remove spacer (20).



5 -Assemble the gear (18).



6 -Remove roller bearing (19).



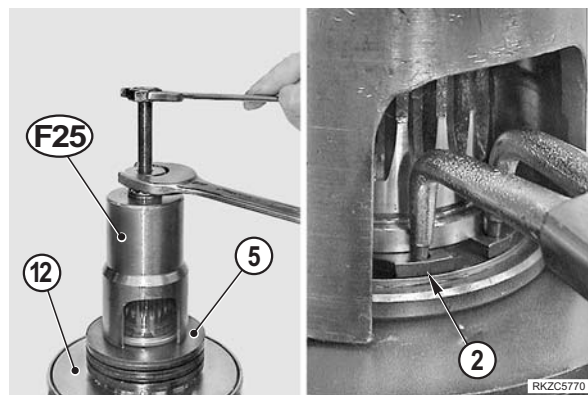
## REMOVAL AND INSTALLATION

## TRANSMISSION

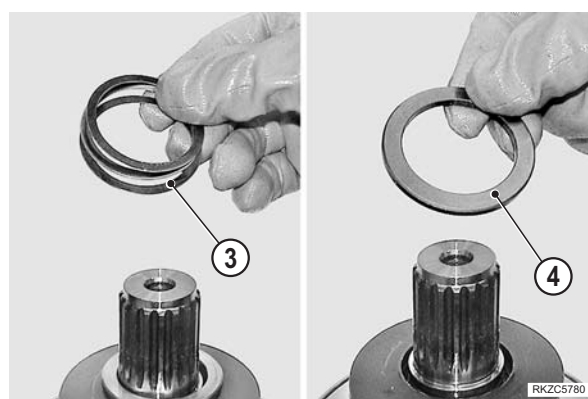
### 7 -Overturn the shaft (12).

Press the Belleville washers (5) and remove retaining ring (2).

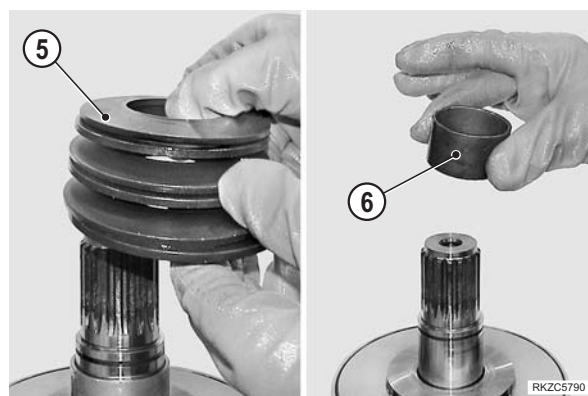
Use tool **F25**.



### 8 -Remove the shim (3) and washers (4).



### 9 -Remove the Belleville washers (5) and spacer (6).



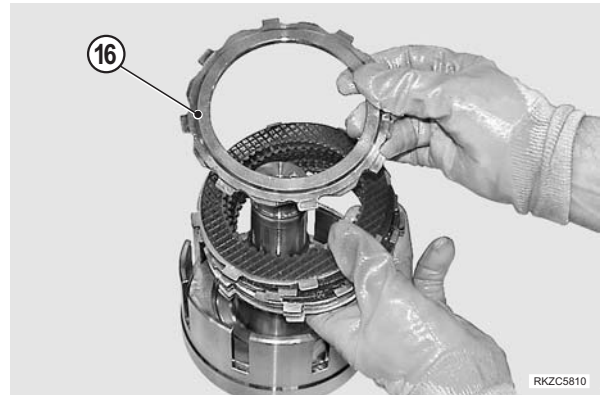
### 10 -Remove snap ring (17).



## REMOVAL AND INSTALLATION

## TRANSMISSION

11 -Remove the thrust plate (16) and clutch kit (15).



12 -Remove brake counter disk (14).



13 -Extract piston (8) using pins (10) as pusher.



14 -Remove the O-rings, inner (7) and outer (9).

★ Replace the O-rings at each disassembly.



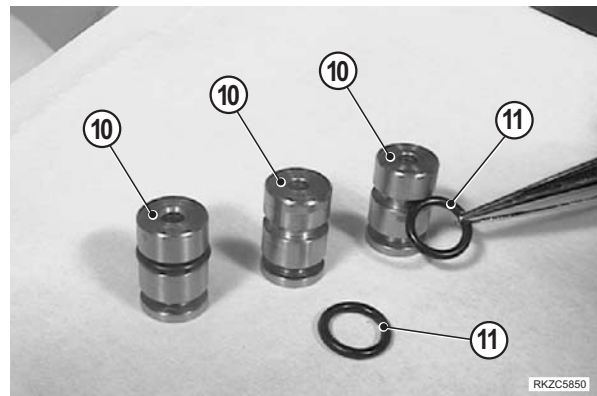


## REMOVAL AND INSTALLATION

## TRANSMISSION

15 -Remove the O-rings (11) from pins (10).

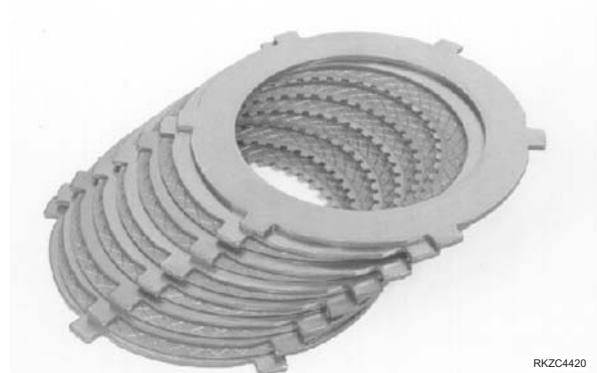
★ Replace the O-rings at each disassembly.



16 -If the clutch discs are to be used again, keep the clutch packs in the same previous assembly order separate and record which clutch pack goes with each clutch.

17 -At each disassembly:

- verify with a caliper that the total thickness of the clutch kit is within the wear limit.
  - verify that all the clutch plates do not appear burned or that the friction material it is not damaged and that splines are well traced.
  - verify also that all the clutch drive plates (12) are perfectly plane and inspect for pitting or scoring.
- In the case that at least one of the above problems occurs, replace the complete clutch kit with a new one. If using a new clutch kit soak the clutch plates in clean transmission oil for at least an hour before assembly. In any case lubricate the contact surfaces of clutch drive plates with clean transmission oil before assembly.



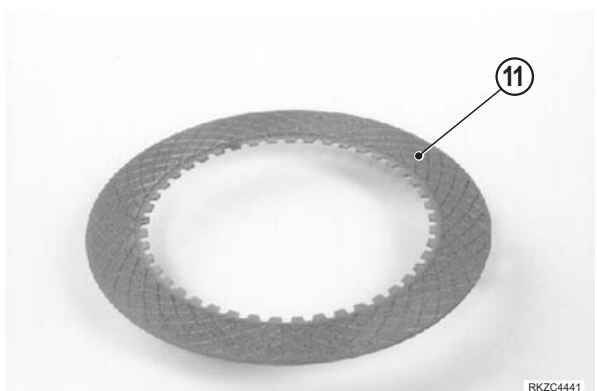
18 -Inspect the bore of the shaft in the input shaft housing for damage that will cause leakage when the clutch is assembled.

Check the slots in the side of the input shaft housing for damage from the tangs on the steel discs.

Use new parts as required during assembly.

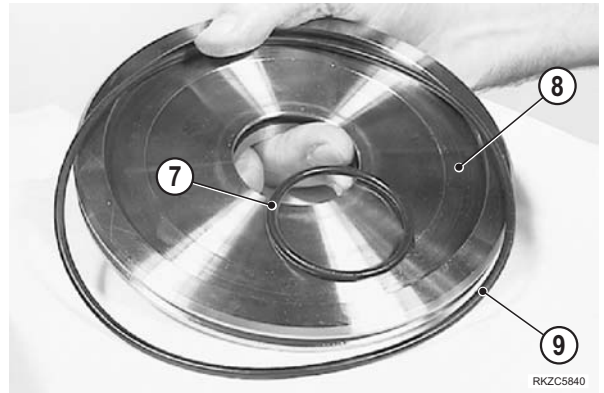
|                                       |                |
|---------------------------------------|----------------|
| Number of clutch plate                | 9              |
| Number clutch steel plate             | 9              |
| Nominal clutch plate thickness        | 2.00±0.05 mm   |
| Nominal clutch kit thickness          | * 33.8-34.0 mm |
| Maximum clutch plate wear (each side) | 0.15 mm        |
| Maximum clutch kit wear               | 1.35 mm        |

\* Under load of 163 kg

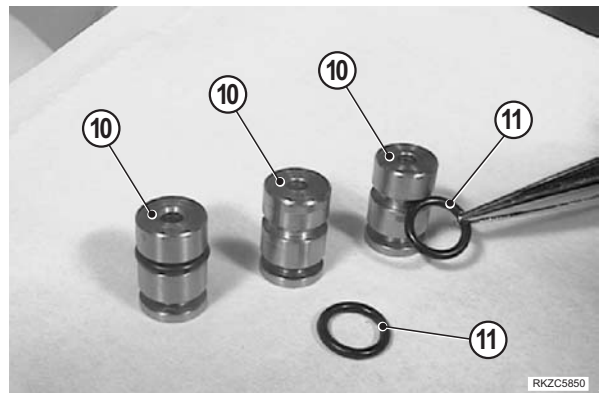


## 9.2 Assembly

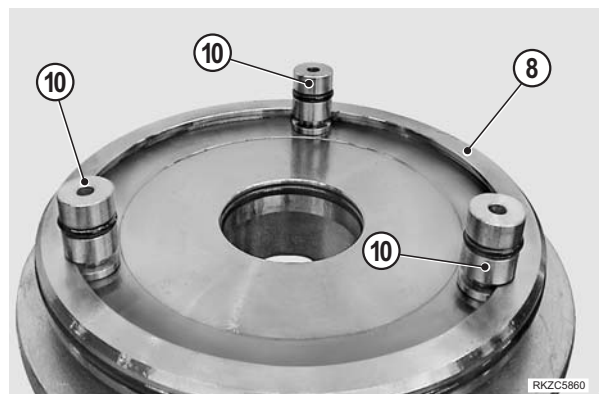
1 -Insert inner (7) and outer (9) O-rings on clutch piston (8).



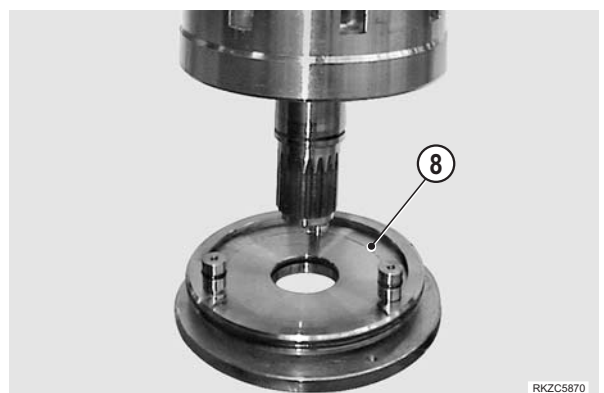
2 -Insert O-rings (11) on the relative pins (10).



3 -Insert pins (10) on clutch piston (8).



4 -Apply a thin film of grease on O-Rings and position the pins on clutch piston (8) in correspondence with the holes on output shaft.

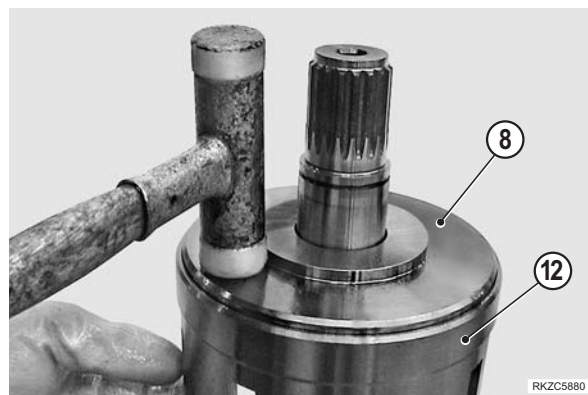




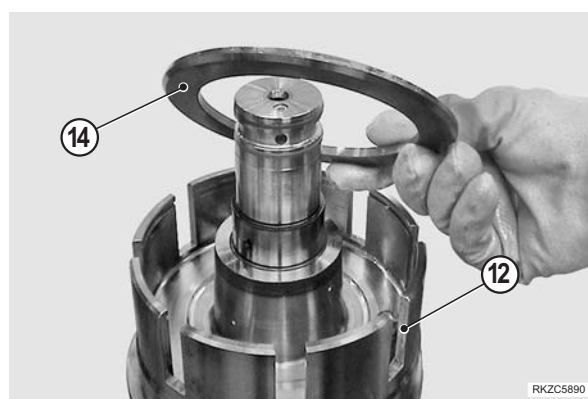
## REMOVAL AND INSTALLATION

## TRANSMISSION

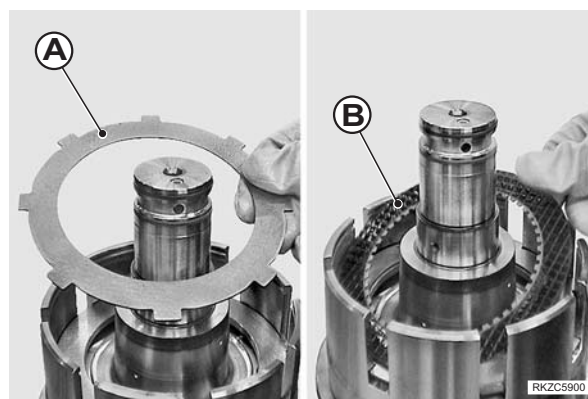
- 5 -Overturn the shaft (12) and fully insert the clutch piston (8).



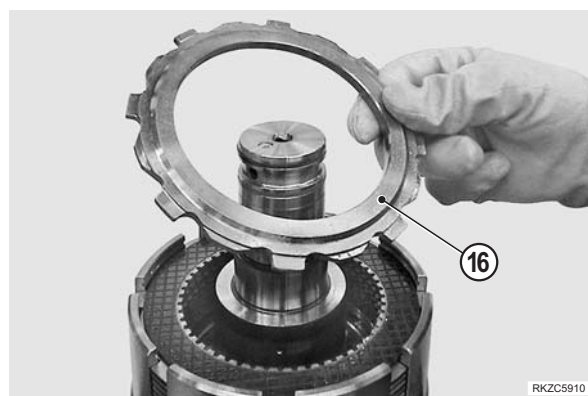
- 6 -Insert brake counter disk (14) on shaft (12) with tapered edge facing down.



- 7 -Mount the clutch kit (15) starting with a drive plate (A) followed by a clutch plate (B).



- 8 -Mount thrust plate (16) on shaft (12).



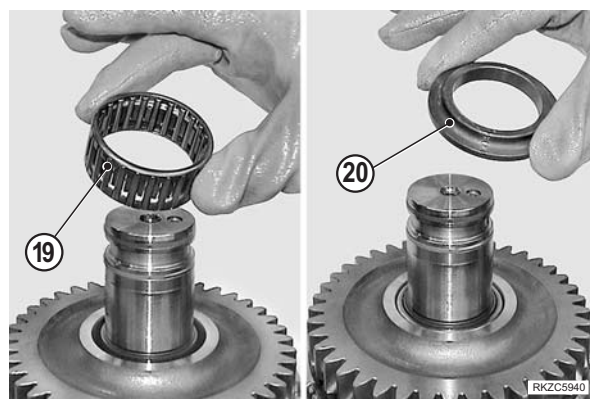
9 -Assemble retaining ring (17).



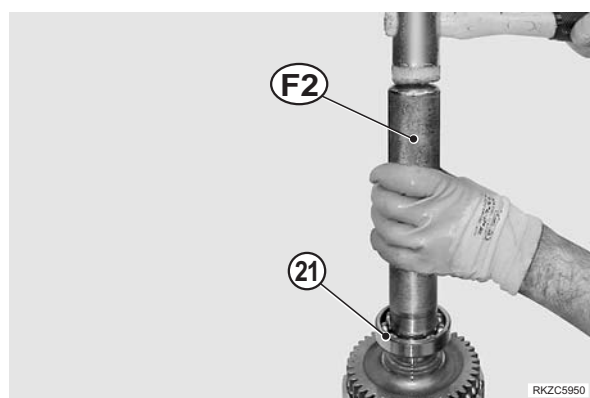
10 -Assemble gear (18).



11 -Assemble roller bearing (19) and spacer (20).



12 -Assemble bearing (21) using special tool **F2**.



## REMOVAL AND INSTALLATION

## TRANSMISSION

- 13 -Turn shaft (12). Make sure that the disk/counterdisk pack and the piston are correctly seated.

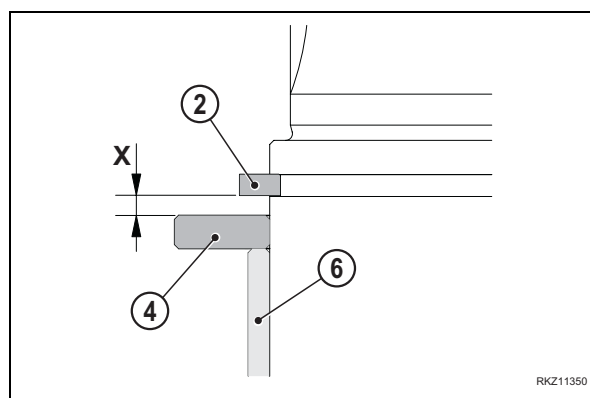


- 14 -Preassemble spacer (6), washer (4) and lock ring (2).



- 15 -Using a thickness gauge measure quote **X** between washer (4) and lock ring (2). Subtract from quote **X** fixed quote **S1** (S1=1.80mm). The result S is the thickness of shims (3) which has to be inser to between washer (4) and locking (2).

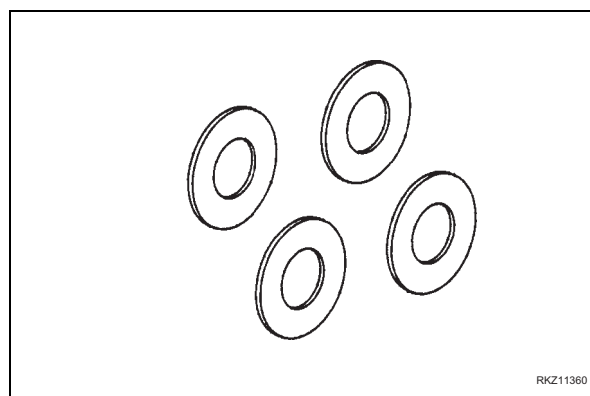
$$S = X - S1 = X - 1.80\text{mm}$$



- 16 -Pick the (**S**) shim (3) from the range of shims available.

- ★ Choose a shim that will provide a piston travel of 1.70-1.90 mm.

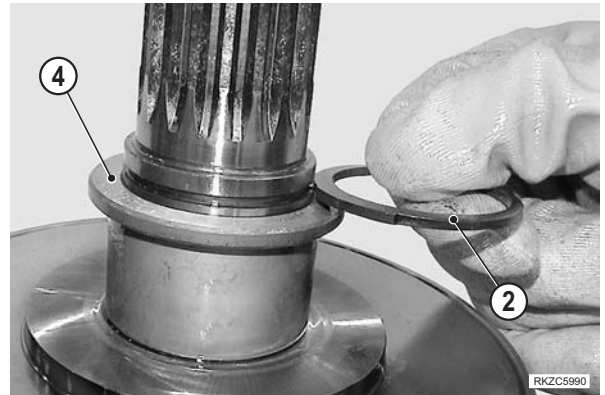
| SHIM RANGE |     |     |     |
|------------|-----|-----|-----|
| Shim (mm)  | 0.1 | 0.3 | 0.5 |



## REMOVAL AND INSTALLATION

## TRANSMISSION

17 -Disassemble the washer (4) and lock ring (2).

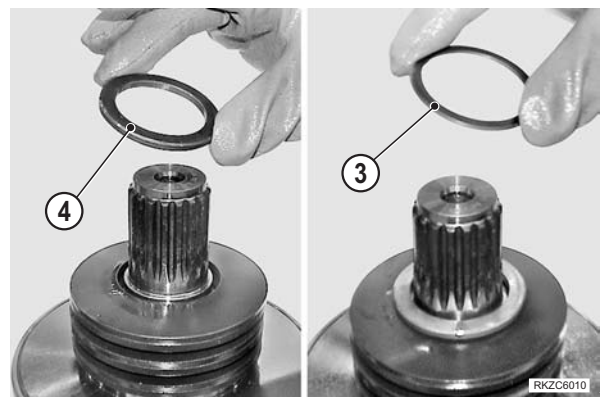


18 -Insert Belleville washer (5).

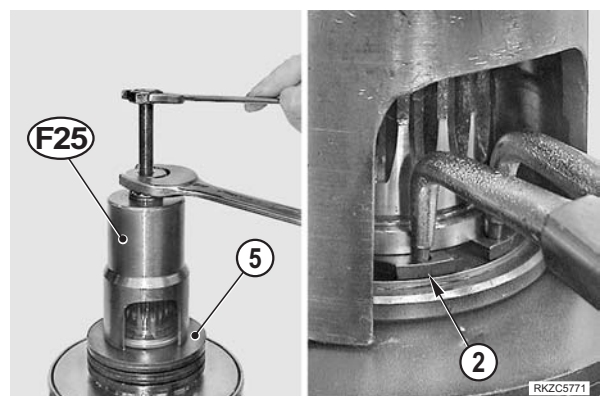
★ Check the Belleville washer (5) orientation.



19 -Mount washer (4) and shims (3) with thickness **S** defined at sequence 14.



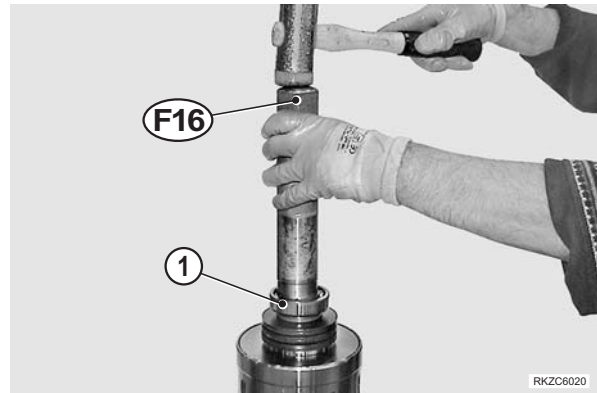
20 -Lower Belleville washers (5) and assemble retaining ring (2). Use tool **F25**.



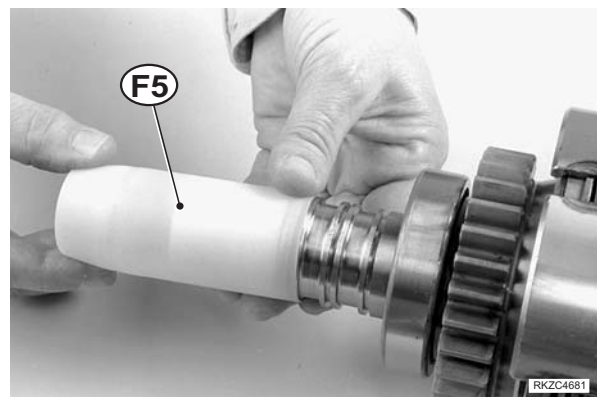
## REMOVAL AND INSTALLATION

## TRANSMISSION

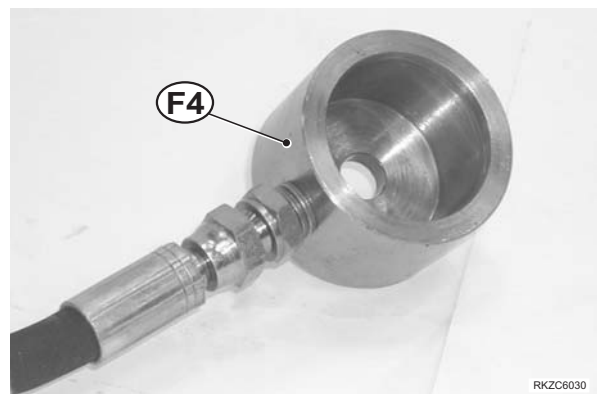
21 -Assemble bearing (1) using tool **F16**.



22 -Install Teflon sealing rings (22) and (23).  
Use special tool **F5** and carry out steps 29 to 34 in section "6.2 Assembly" to install.

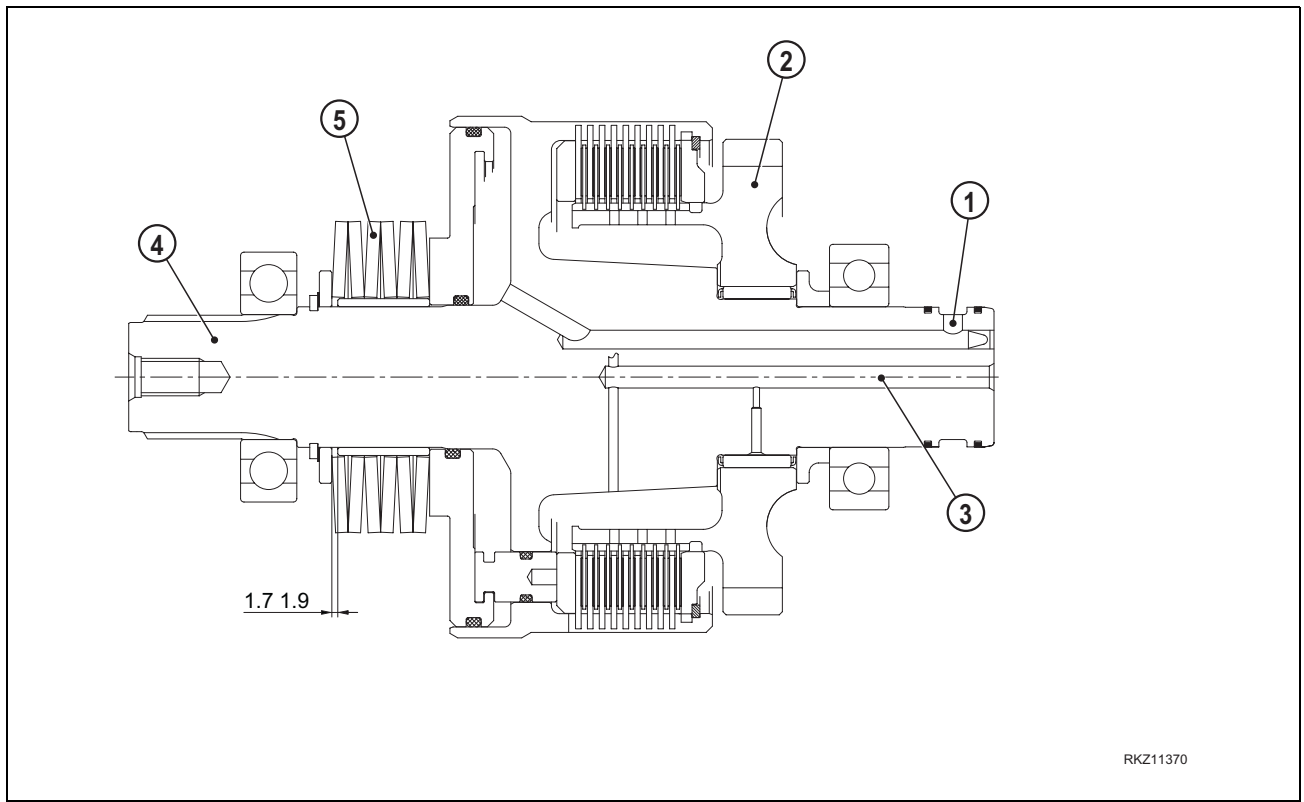


23 -Use tool **F4** for piston operation check and correct adjustment check.



24 -In order to verify the seal of rings (7) and (9) feed the piston chamber with oil at 10 bar and check with a dial gauge located as shown in the photo if the real stroke is included between 1.7 and 1.9 mm.





- 1. 4WD oil passage.
- 2. 4WD drive gear.
- 3. 4WD lubricant oil passage.
- 4. Shaft
- 5. Belleville washers.

25 -Apply compressed oil pressure of approximately 10 bar to the 4WD clutch passage.  
Listen to hear the piston moving to unlock the clutch pack. The belleville washers compressing.  
Try to move the 4WD gear.  
The 4WD gear must turn freely on the 4WD shaft.  
If the clutches do not work correctly, disassemble the clutches to find the problem.



## REMOVAL AND INSTALLATION

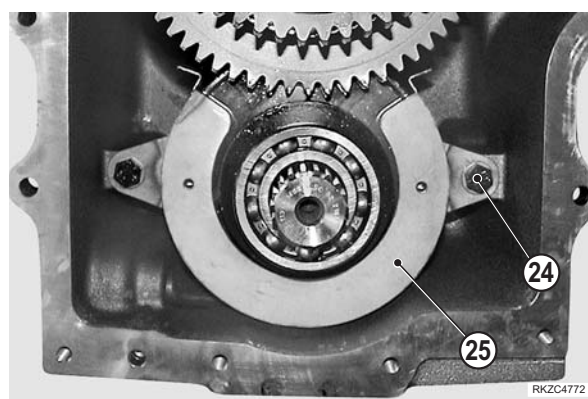
## TRANSMISSION

26 - Lift the three shafts **B-C-E** at the same time and insert into the half-housing.  
Use tool **F15**.



26 - Assemble protection (**25**) and tighten screws (**24**) to the prescribed torque.

 Screw: 50 Nm





## CONVERTOR

### Removal

**!** Lower the working equipment completely until it rests on the ground.

Stop the engine and remove the ignition key.

**!** Eliminate all residual pressure from all circuits by moving the hydraulic controls in all directions.

★ Drain the hydraulic oil.



Hydraulic oil: approx. 40 ℓ

★ Drain the oil from the gearbox.



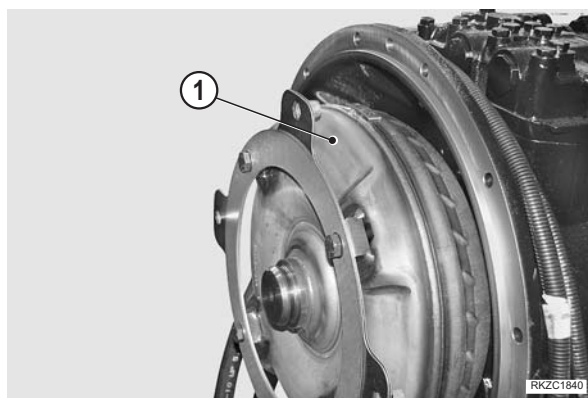
Gearbox oil: approx. 20 ℓ

1 -Remove the piston pump.  
(For details see "PISTON PUMP").

2 -Remove the engine hood.  
(For details see "TRANSMISSION").

3 -Remove the converter (1).

[\*1]



### Installation

• To install, reverse removal procedure.

★ Ensure that the mating surfaces are clean and free of dents.

[\*1]

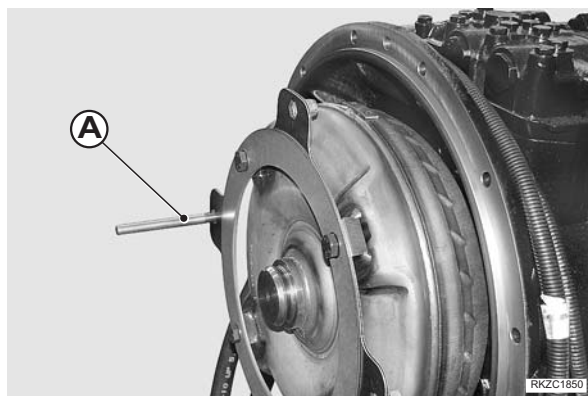
★ To aid in mating flywheel and joint, before mating engine and transmission, tighten a threaded shank "A" as guide to the joint:



Screw: Loctite 262



Screw: 39 Nm



## ENGINE

### Removal

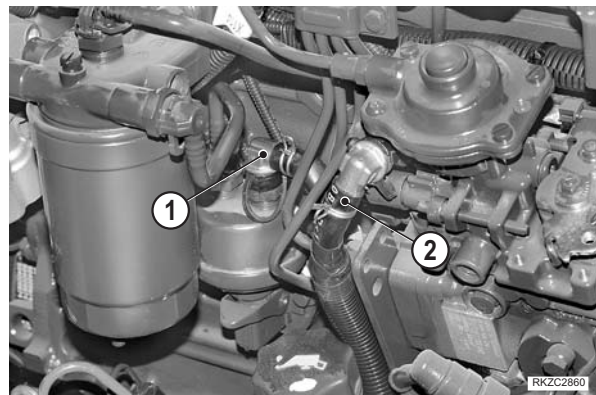
1 -Remove:

- ENGINE HOOD
- FRONT GUARD
- FRONT COUNTERWEIGHT
- RADIATOR GROUP
- CONDENSER (For machines equipped with an air-conditioning unit)
- MUFFLER
- AIR FILTER
- PISTON PUMP
- TRANSMISSION

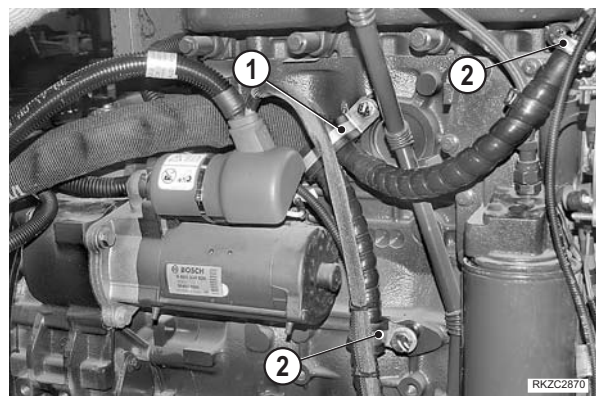
For details, see the individual removal procedures.

2 -Disconnect the fuel inlet and return pipes (1) and (2), release them from the tie straps and position them aside.

- ★ Cap pipes, hoses and holes to prevent contamination.

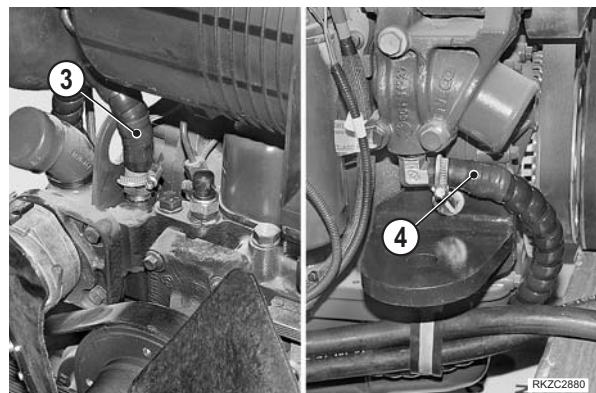


3 -Remove the screws and release the straps (1) and (2) retaining the heating system hoses.



4 -Disconnect the heating system hoses (3) and (4) and remove the tie strap (5) retaining the gearbox oil hoses.

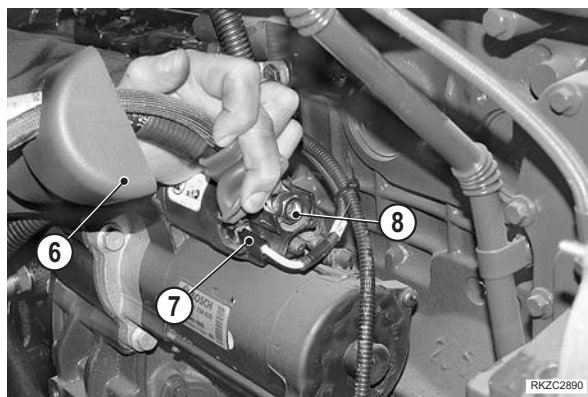
- ★ Cap pipes, hoses and holes to prevent contamination.



## REMOVAL AND INSTALLATION

## ENGINE

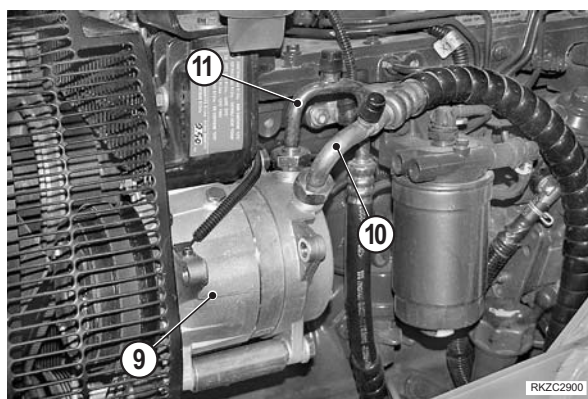
- 5 -Lift the cover (6) and disconnect wiring harnesses (7) and (8) from starter.



### Only if equipped

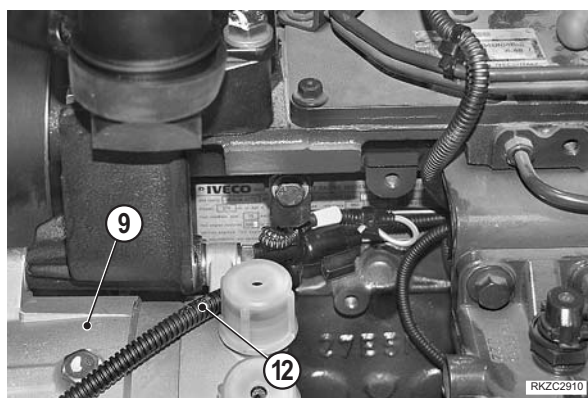
- 6 -Disconnect suction and delivery hoses (10) and (11) from air-conditioning group compressor (9).

★ Cap the hoses and holes to prevent contamination.

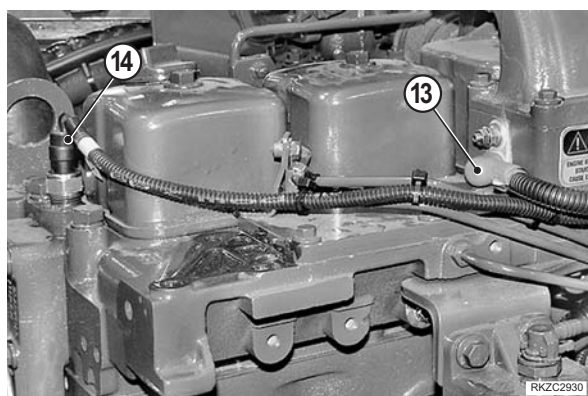


### Only if equipped

- 7 -Release the wiring harness (12) to the compressor (9) from the tie straps and disconnect.



- 8 -Disconnect wiring harness (13) from thermal starter and disconnect connector (14) from the coolant liquid temperature sensor.

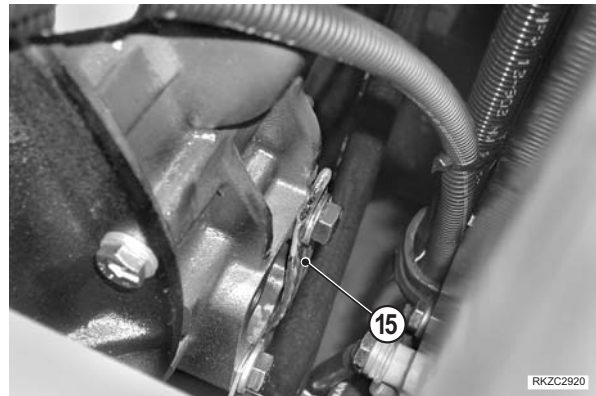




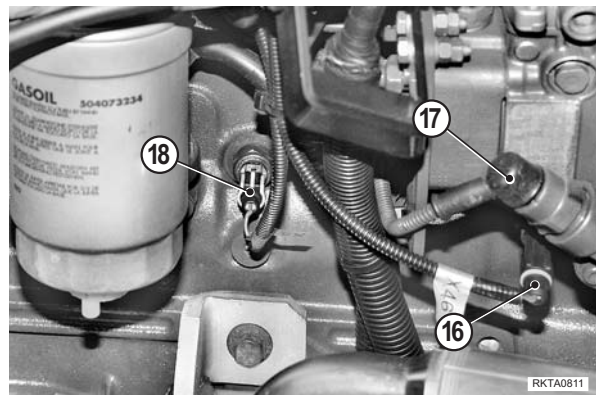
## REMOVAL AND INSTALLATION

## ENGINE

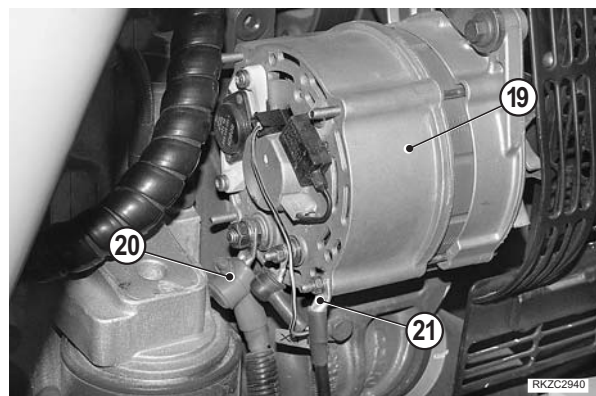
9 -Disconnect the ground plait (15) from the engine.



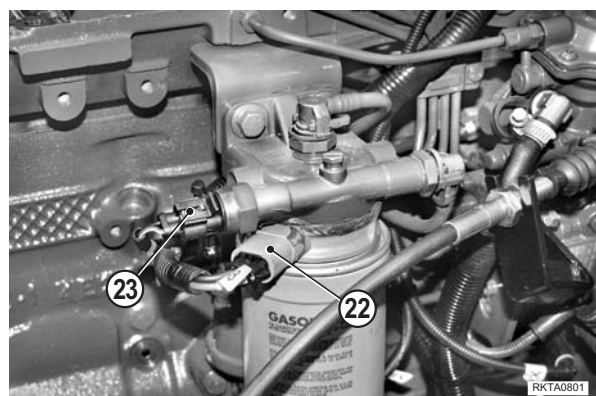
10 -Disconnect connector (16) from the engine stop solenoid valve, disconnect connector (17) from the engine oil temperature sensor (17), and disconnect connector (18) from the oil pressure sensor.



11 -Disconnect wiring harness (20) and ground wire (21) from generator (19).



12 -Disconnect heating system connector and fuel temperature sensor connector (22) and (23) from the filter holder.

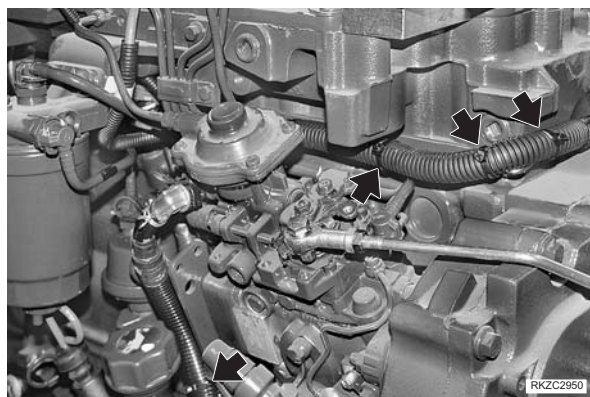


## REMOVAL AND INSTALLATION

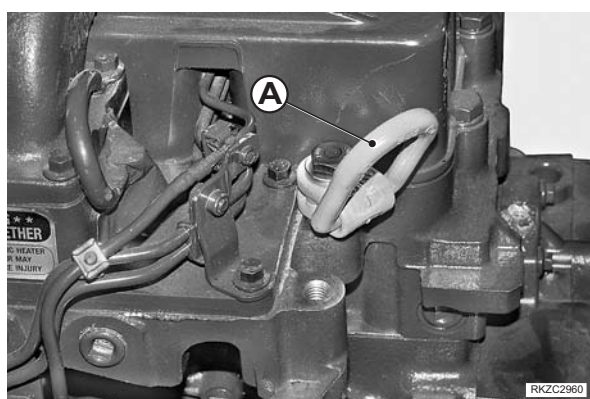
## ENGINE

13 -Release the entire engine harness from the tie straps and route the harness down, and use some straps on the inner sides of the frame to let the wiring hang temporarily.

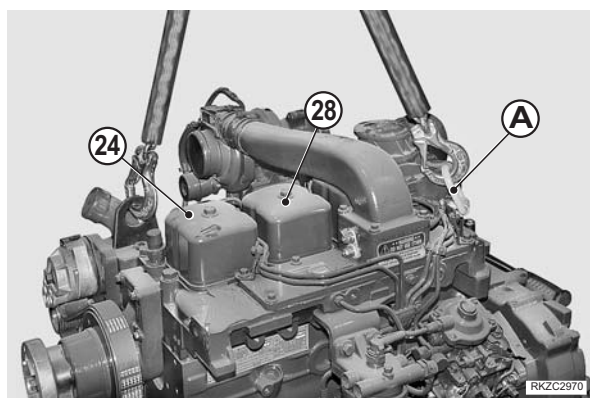
14 -Check to ensure that all hoses to the engine are released from straps or ties.



15 -Tighten a revolving lifting eye "A" to the muffler inner mounting hole.



16 -Attach a lifting device to lifting eye "A" and to engine front bracket (24), and apply a slight tension to the chains or cables.

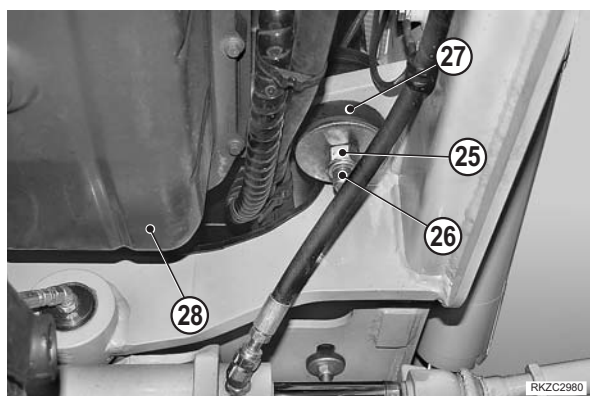


17 -Loosen and remove nuts (25), screws (26) and vibration dampers (27) from front engine mounts. [\*1]

18 -Remove the engine (28).



Engine: approx. 370 kg



## Installation

- To install, reverse removal procedure.

[\*1]

 Nuts: 200 Nm

- ★ Check transmission oil level before starting the engine.
- ★ Thoroughly check the connectors to ensure that they are properly connected.

1 -Start the engine and let it idle for a couple of minutes.

2 -Stop the engine and check all levels.

## CONTROL VALVE

### Removal

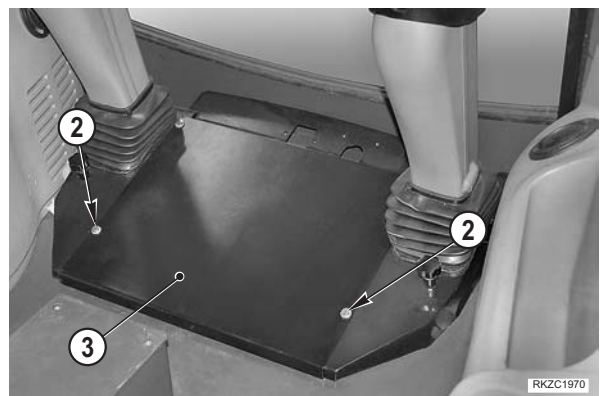
- 1 -Move backhoe fully to the right and swing the boom by about 45° to the right leaving the backhoe plate unlocked.
- 2 -Lower the outriggers to the ground, curl the bucket and allow it to rest on the ground on its back.  
Apply the parking brakes, stop the engine.
- 3 -Release all residual pressure.  
(For details see "20 TESTING AND ADJUSTMENTS").



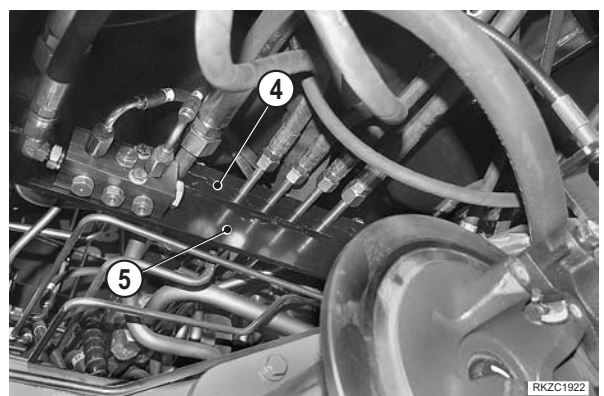
- 4 -Lift rear window (1) to the top and remove the rear mat.



- 5 -Take out the screws (2) and remove the platform (3).



- 6 -Loosen the clamp (4) on the control valve support frame (5) (4 screws).



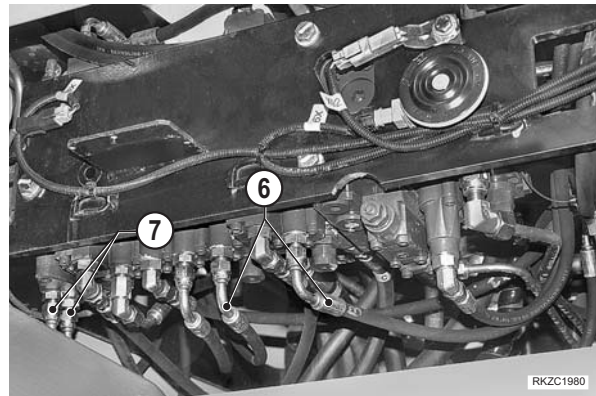


## REMOVAL AND INSTALLATION

## CONTROL VALVE

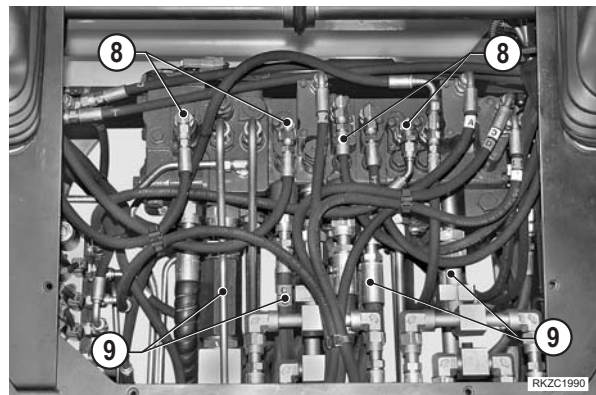
7 -Disconnect lower servocontrol and actuator hoses (6) together with all accessible side hoses (7) from control valve.

- ★ Check that all the hoses are marked and note down the bends and routing patterns.
- ★ Cap pipes, hoses and holes to prevent contamination.

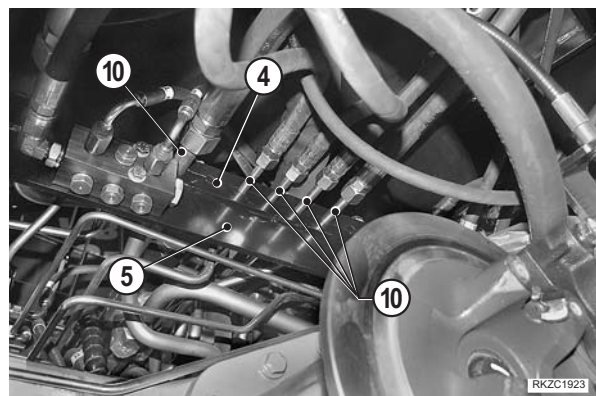


8 -Disconnect upper servocontrol hoses (8) and actuator hoses (9) from control valve.

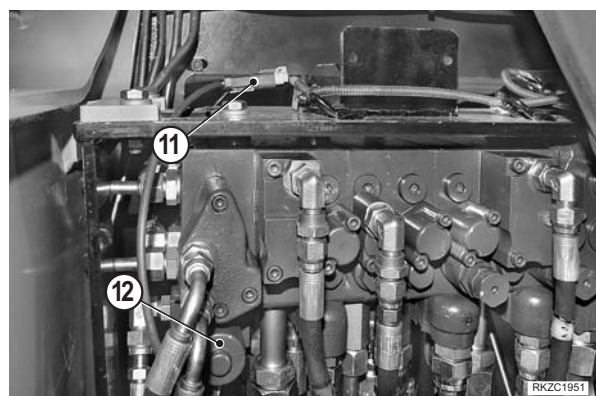
- ★ Check that all the hoses are marked and note down the bends and routing patterns.
- ★ Cap pipes, hoses and holes to prevent contamination.
- ★ Lay the servocontrol hoses inside the cab to gain access to the delivery, exhaust, and actuator hoses.



9 -Turn the tubes (10) that provide direct connection away from control valve and retain their position by temporarily tightening clamp (4) on frame (5).



10 -Disconnect connector (11) from backhoe plate lockout solenoid valve (12).



## REMOVAL AND INSTALLATION

## CONTROL VALVE

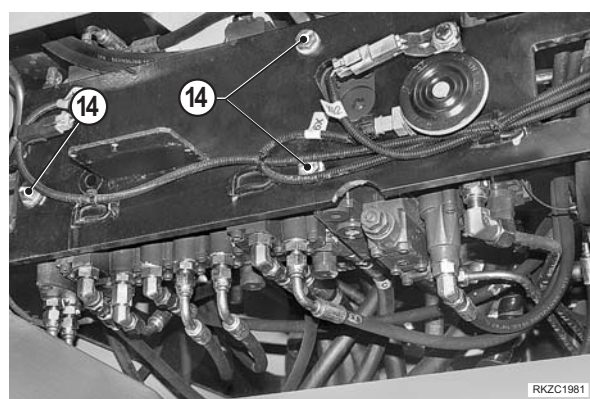
11 -Support control valve (13) by means of two ropes connected to a lift arm to be introduced through the cab opening.

Apply a slight tension to the ropes.

- ★ Pay special attention to rope routing to prevent damaging the unions.



12 -Loosen and remove the four screws (14) (n° 3) and the relative washers.



13 -Lower the control valve (13) onto a lift.

[\*1]

 8-spool control valve: \_\_\_\_\_ kg

 10-spool control valve: \_\_\_\_\_ kg



## Installation

- To install, reverse removal procedure.

[\*1]

- ★ Install control valve from top.

- 1 -Start the machine to circulate the oil; check to ensure that there are no leaks.
- 2 -Bleed the air from the working equipment circuits.  
(For details see "20 TESTING AND ADJUSTMENTS").
- 3 -Stop the engine, check the hydraulic oil level and top up as necessary.

## FRONT AXLE

### Removal

- 1- Start the engine and force the shovel downwards in order to raise the machine and the front wheels.
- 2 -Place two stands "A" and some blocks beneath the chassis.
- 3 -Slowly lower the machine onto the blocks, checking that the wheels remain at least 5 cm above the ground.

**!** Fully raise the front working equipment and engage the safety stop.  
Also place the backhoe in its secure position.



- 4 -Engage the parking brake.
- 5 -Stop the engine and eliminate residual pressure from all circuits.  
(For details see "20 TESTING AND ADJUSTMENTS").  
Remove the ignition key.
- 6 -Remove the engine hood (1) and the front guard (2).  
(For details, see "ENGINE HOOD" and "FRONT GUARD").
- 7 -If equipped, remove the front counterweight.

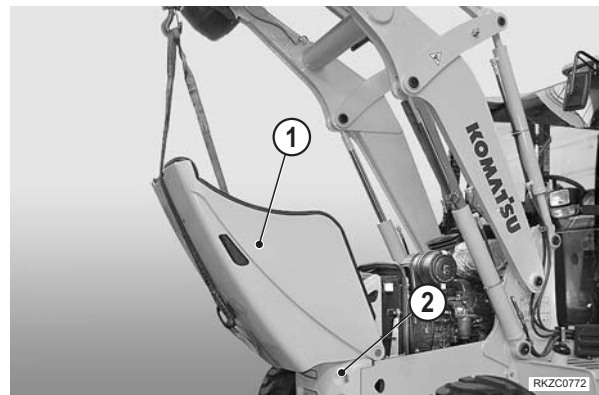
[\*1]

 Counterweight: 372 kg

- 8 -Remove the front wheels.

[\*2]

 Wheel: \_\_\_\_\_ kg



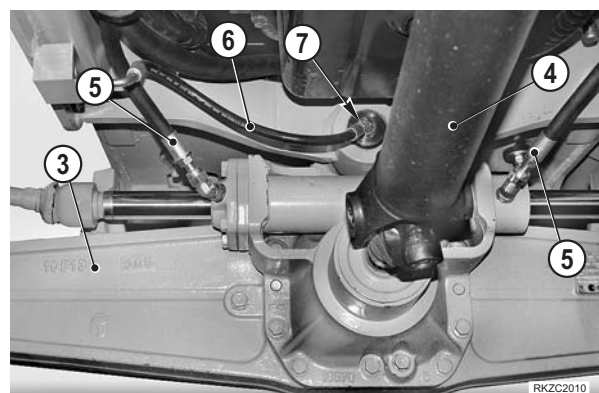
- 9 -Disconnect the cardan shaft (4) from the axle (3).

[\*3]

- 10 -Disconnect the lines (5) from the steering cylinder and plug them to prevent entry of impurities.

[\*4]

- 11 -Disconnect the lubrication tube (6) for the axle oscillation pin (7).

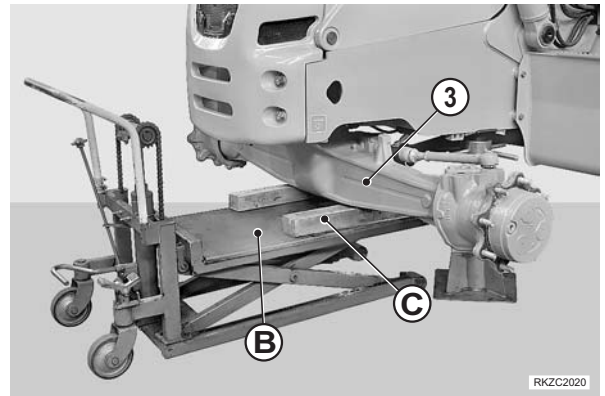


## REMOVAL AND INSTALLATION

## FRONT AXLE

12 -Position a jack "B" and some blocks "C" beneath the axle. Raise the jack until the blocks can be forced under the axle arms (3).

- ★ It should be possible to lower the jack 10 cm in order to disengage the axle from the fulcrum supports.



13 -Take out the nut and remove the retaining screw (8) of the axle oscillation pin (7).

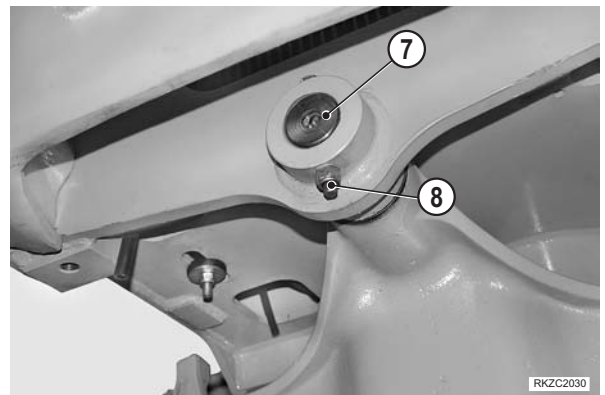
14 -Tighten a hammer puller into the central hole of the axle oscillation pin (7); pull out the axle oscillation pin. [\*5]

15 -Lower the jack until the axle is disengaged.

16 -Extract the entire axle (3).



Front axle: 295 kg



## Installation

- To install, reverse removal procedure.

[\*1]



Nuts for front wheels: 370 Nm

[\*2]



Front closing screws: 300 Nm

[\*3]



Screws on gearbox side: 38 Nm

[\*4]

- ★ Bleed the air from the Load Sensing circuit.  
(For details, see "20 TESTING AND ADJUSTMENTS").

[\*5]



Axle oscillation pin - bushings: ASL800050

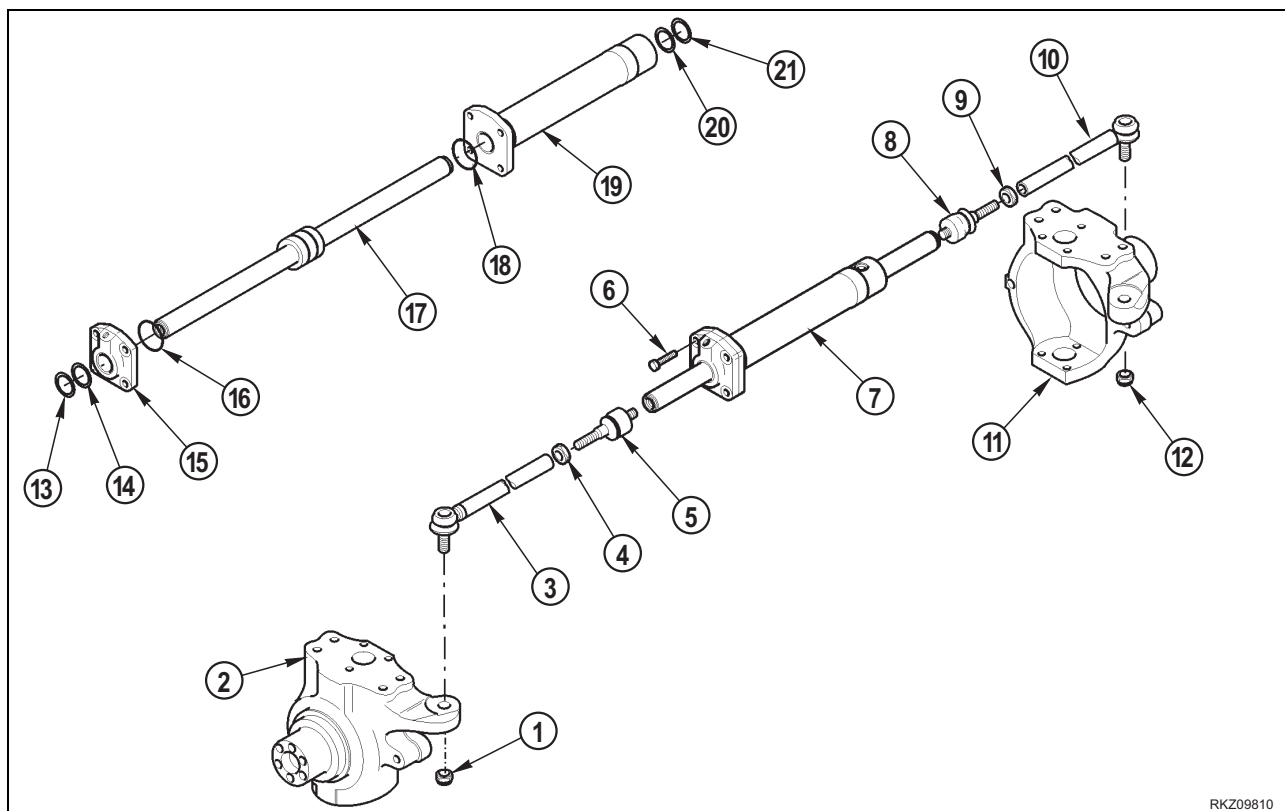
- 1 -Check the oil level in the tank and start the engine.
- 2 -Perform a few complete steering manoeuvres in both directions to bleed the air from the steering circuit.



## Disassembly and assembly

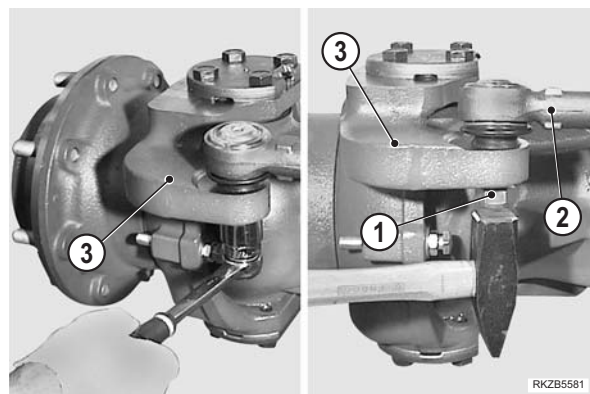
### 1. CYLINDER GROUP DISASSEMBLY

#### 1.1 Disassembly



- 1 -Unloose the guide rod (2) locknut (1) of some turns till it is over the end of the threaded pin.  
Beat on the nut (1) with a hammer in order to disjoin the guide rod (2) from the swivel housing (3).

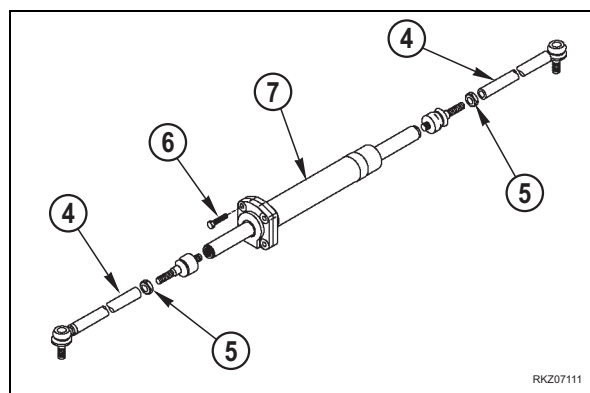
- ★ Don't beat on the end of the threaded pin.
- ★ This is a destructive operation for the nut (1).



- 2 -Loosen the nuts (4) and (9) and remove the tie rods (3) and (10).

- 3 -Remove the fastening screws (6) of the cylinder, then take the cylinder (7) out of its housing using a rubber hammer.

- ★ Remove only those parts that need to be overhauled and/or replaced.



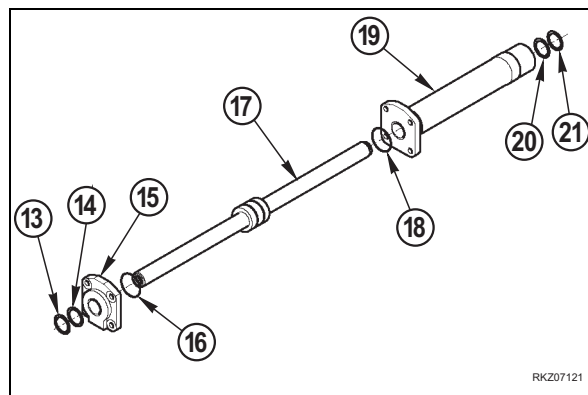
## REMOVAL AND INSTALLATION

## FRONT AXLE

- 4 -Detach the cylinder head (15) from the cylinder case (19).

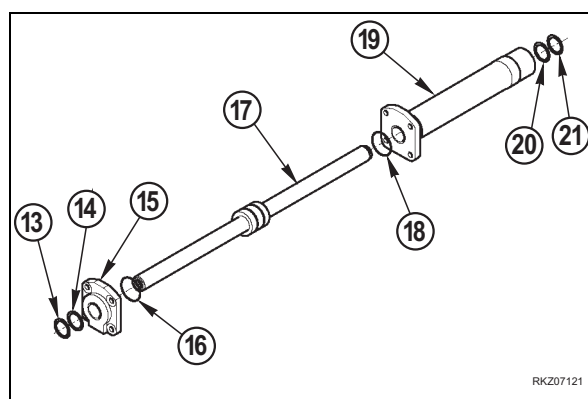
Remove off the cylinder head and the rod (17) from the cylinder case (19).

- 5 -Recover all sealing rings (16) and (18), O-rings (14) and (20), and scrapers (21) and (13) from cylinder body (19) and rod (17).

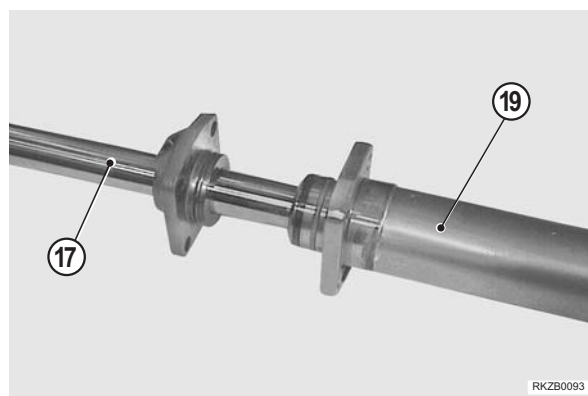


### 1.2 Assembly

- 1 -Install new sealing rings (16) and (18), O-rings (14) and (20), and scrapers (21) and (13) to cylinder head (15), to rod piston (17) and into cylinder body (19).

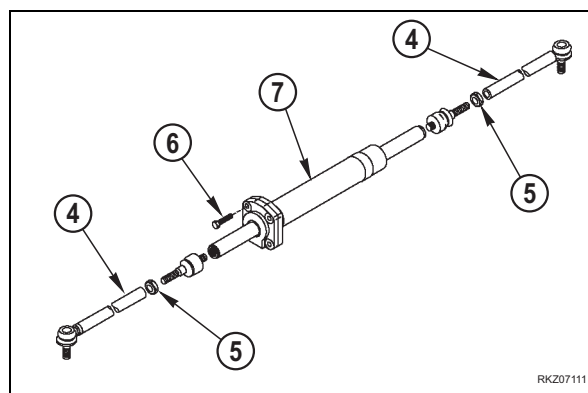


- 2 -Slide pre-assembled (17) rod into the cylinder body (19).



- 3 -Install ball joints (5) and (8), nuts (4) and (9) and tie rods (3) and (10) at the rod (17) ends and tighten.

 Tie rods: 300 Nm





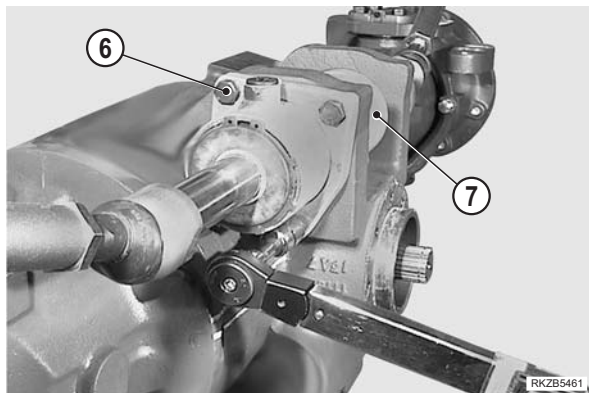
## REMOVAL AND INSTALLATION

## FRONT AXLE

4 -Install steering cylinder to centre body (7) together with tie rods.

5 -Assemble and tighten the steering cylinder fastening screws (6) with torque wrench.

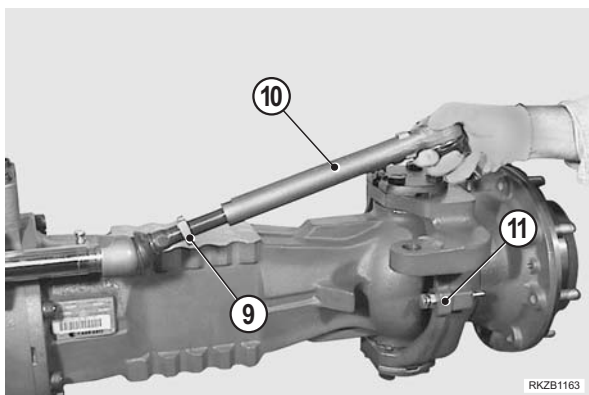
 Screw: 120 Nm



6 -Align the swivel housing with the axle (parallel wheel hub).

Screw the guide rod (5) so that the ball joint can be inserted into the swivel housing arm.

★ It is important to unscrew the locking nut (9) to carry out this operation.

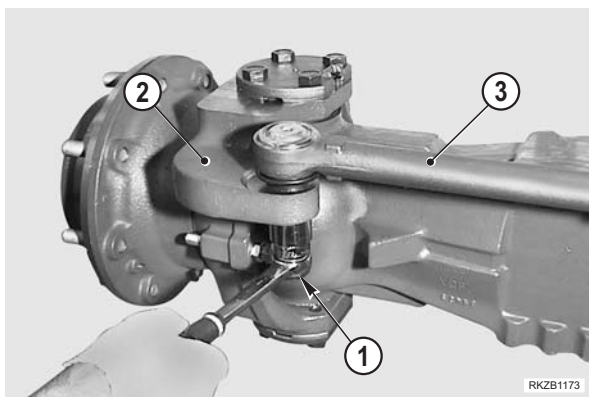


7 -Insert the ball joint (8) (into its own housing on the swivel housing).

Assemble and tighten the lock nut (1) with dynamometric wrench.

 Nut: 220 Nm

8 -Repeat the operation for the opposite side.



9 -Screw in the lock nuts (4) and (9) of the tie rods (3) and (10) only when the toe-in adjustment has been carried out.

## REMOVAL AND INSTALLATION

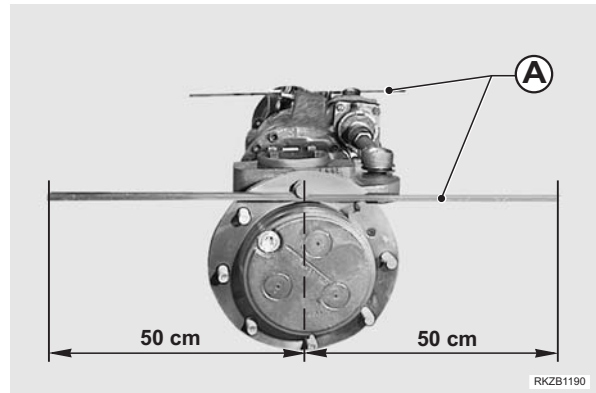
## FRONT AXLE

### Toe-in adjustment

1 -Put two equal one-meter-long linear bars "**A**" on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

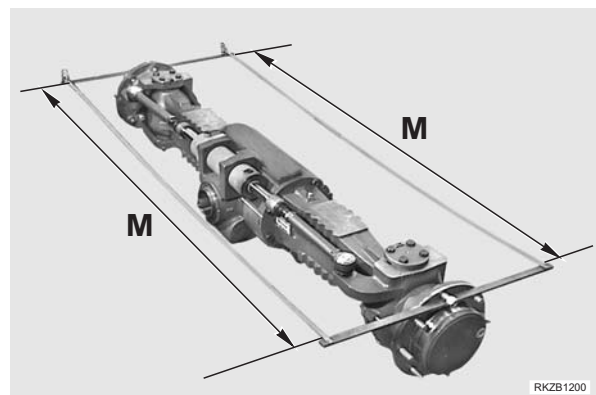
★ The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis.

★ Align the two bars.



2- Using a measuring tape, measure the distance in mm "**M**" from the farthest bar ends, and tighten or loosen the guide rods until the distance is the same on both sides.

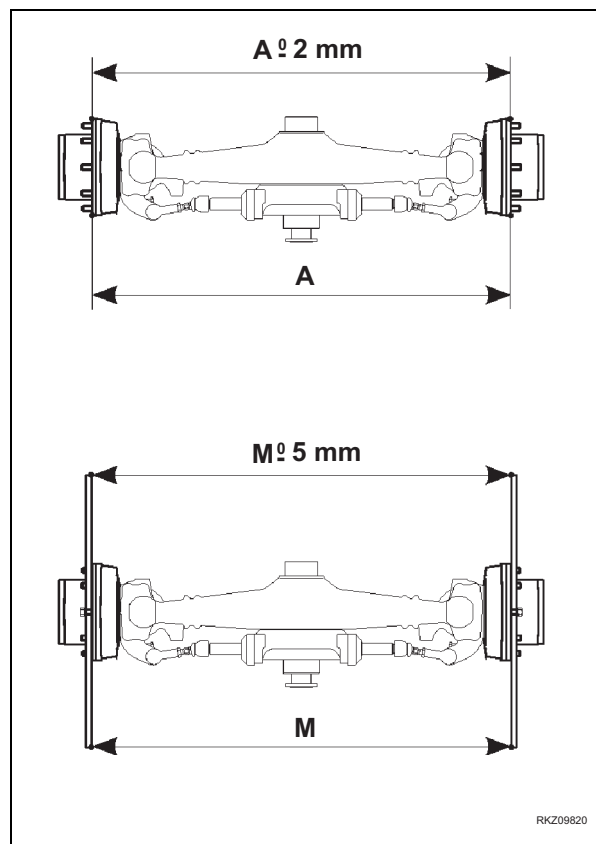
★ Keep the minimum value, swinging the measurement point.



3 - Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.

The nominal toe-in (**A**) value is referred to the external diameter of the wheel hubs flange, therefore the measured toe-in value (**M**) at the bars ends must be related to the ratio between length of the bar and flange diameter.

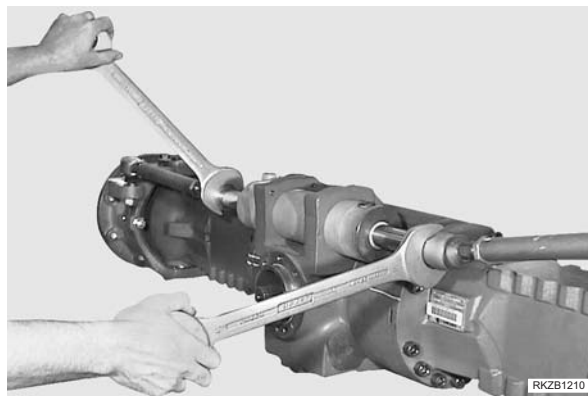
**nominal toe-in** =  $A \pm 2 \text{ mm}$   
**measured toe-in** =  $M \pm 5 \text{ mm}$



## REMOVAL AND INSTALLATION

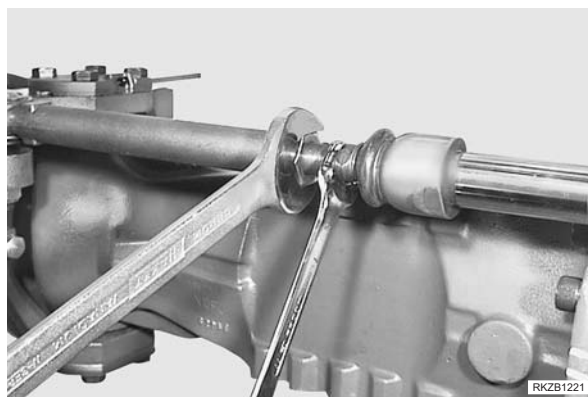
## FRONT AXLE

- 4- If toe-in is incorrect, operate with two wrenches on the guide rods screwing in and out the two joint tie rods equally till the toe-in is within the required tolerance.



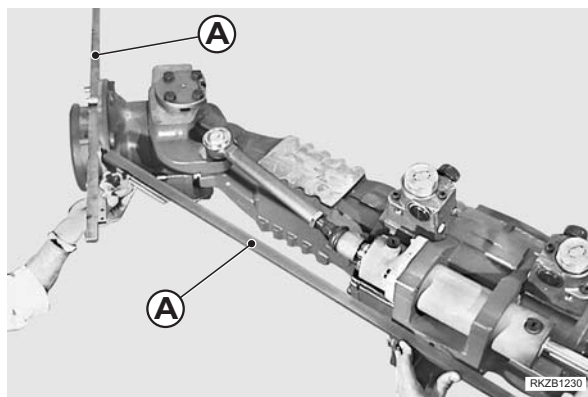
- 5 -Once adjustment is complete, tighten the retaining nuts on the guide tie rods.

 Nuts: 250 Nm

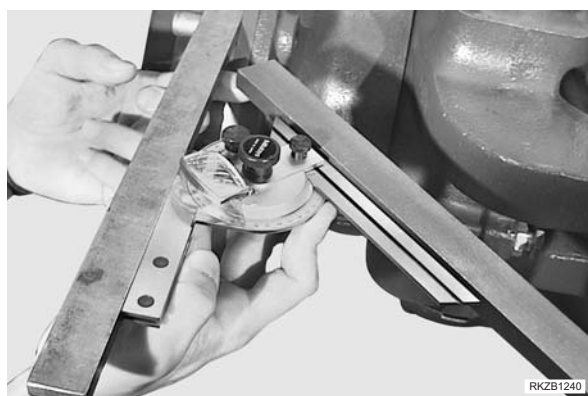


### Steering angle adjustment

- 1 -Use the same bars "A" assembled for the toe-in adjustment and a long bar perfectly leant over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.



- 2 -Adjust a goniometer to the angle of 65° and position it on the long bar.  
Move a wheel side till it forms, with the two bars, the angle fixed by the goniometer.



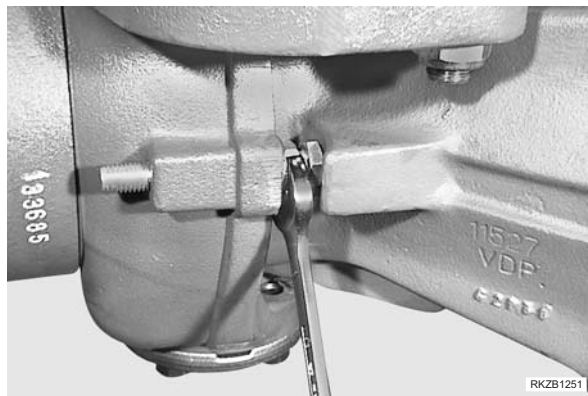
## REMOVAL AND INSTALLATION

## FRONT AXLE

- 3 -Adjust the steering mechanical retainer, screwing in or out the special screws (1) on the bar body, locking them with a locknut (2).

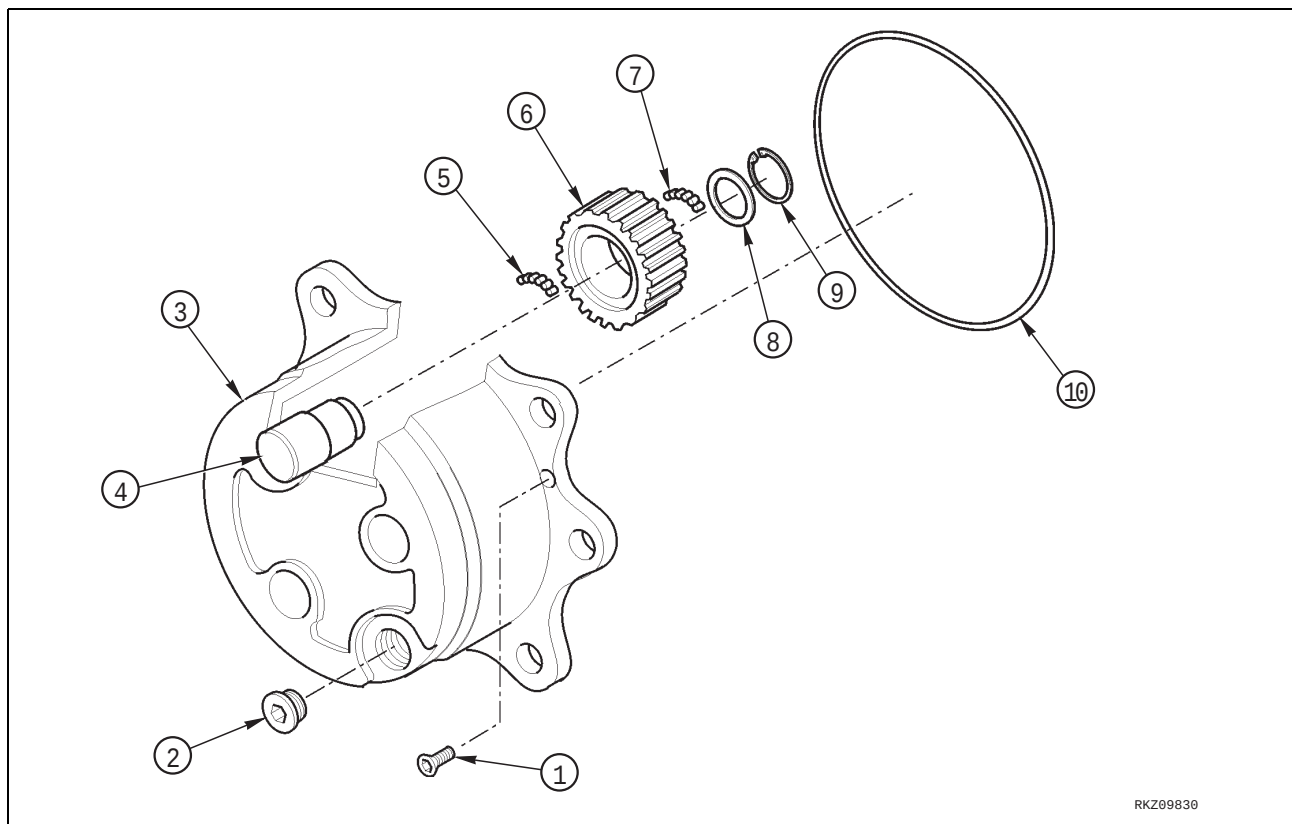
 Lock nut: 150 Nm

Steer completely towards the other side and repeat the same operations.

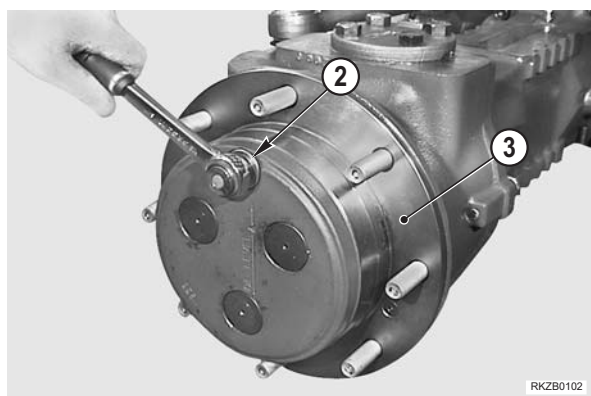


## 2. EPICYCLIC REDUCTION GEAR

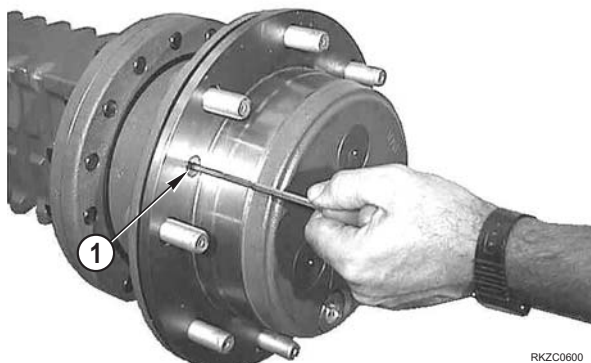
### 2.1 Disassembly



**⚠** Before draining the oil, position the epicyclic reduction gear (3) with the plug (2) on the upper part and loosen it of some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the hub upside-down till the hole is in the lowest point. Drain the oil completely.



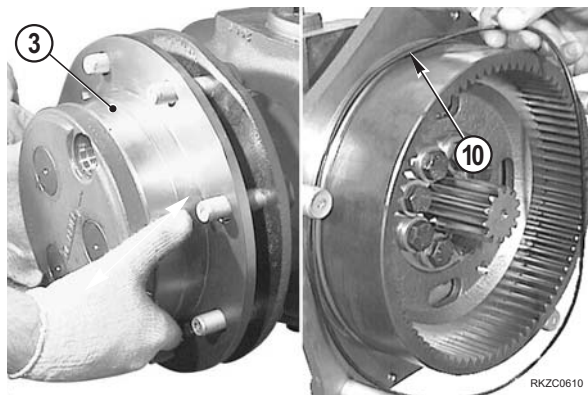
1 -Remove the fastening screws (1).



## REMOVAL AND INSTALLATION

## FRONT AXLE

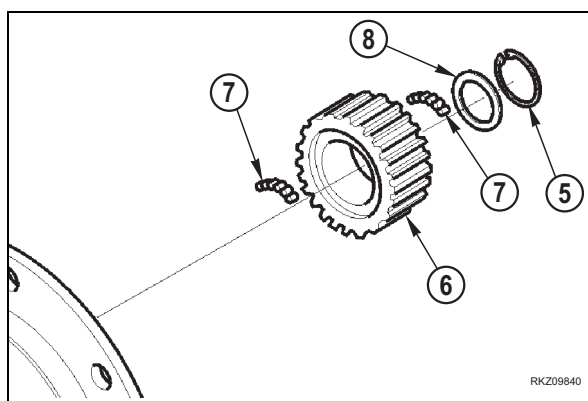
- 2 -Remove the planetary carrier (3) from the epicyclic reduction gear and remove the O-ring (10).



### • Replacements of the planetary gears (if necessary)

- 1 -Remove stop ring (9) from each pin (4).
- 2 -Remove the gears (6) out of the pins.
- 3 -Recover rollers (7) and (5) and inspect their condition.
- 4 -Remove the thrust washers (8).

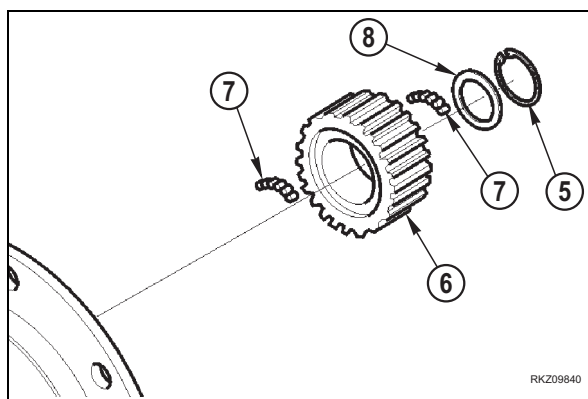
- ★ With new planetary gears is advisable to assembly new roller bearings.



### 2.2 Assembly

- 1 -Recover all epicyclic reduction gear components: the planetary gears carrier (3), the gears (6), the needle bearings (5) and (7), washer (8) and the snap rings (9) of every pin (4).

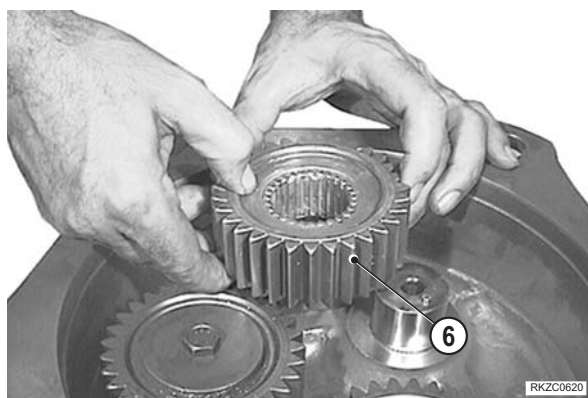
- ★ With new gears, it is advisable to install new needle rollers.



- 2 -Insert the needles (5) and (7) into the gears (6).

- ★ Grease well the needles (5) and (7).

Insert the gears (6) with assembled needles in the planetary carrier pins.

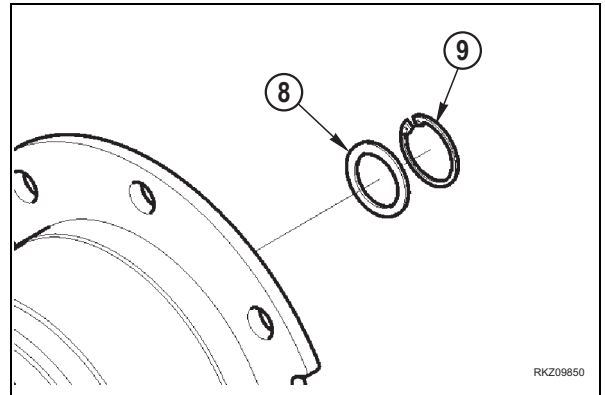




## REMOVAL AND INSTALLATION

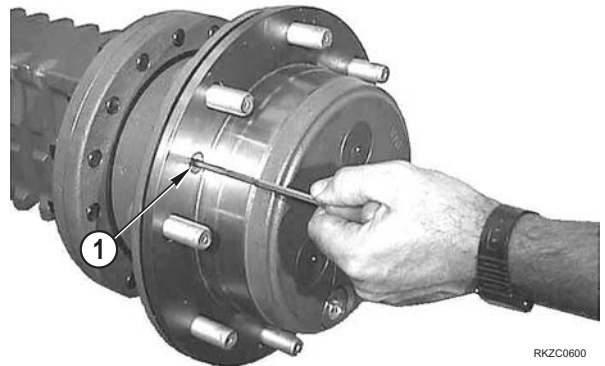
## FRONT AXLE

- 3 - Assemble the washer (8) and snap ring (9) on every pin (4).



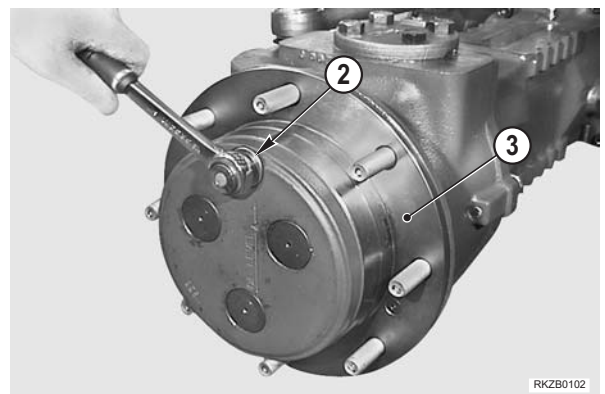
- 4 - Install a new O-ring (10).  
Install planetary gear carrier (3) to epicyclic reduction gear.  
Install retaining screws (1).

 Screws: 25 Nm



- 5 - Use recommended oil in epicyclic reduction gear and axle body.  
Install plug (2) to epicyclic reduction gear.

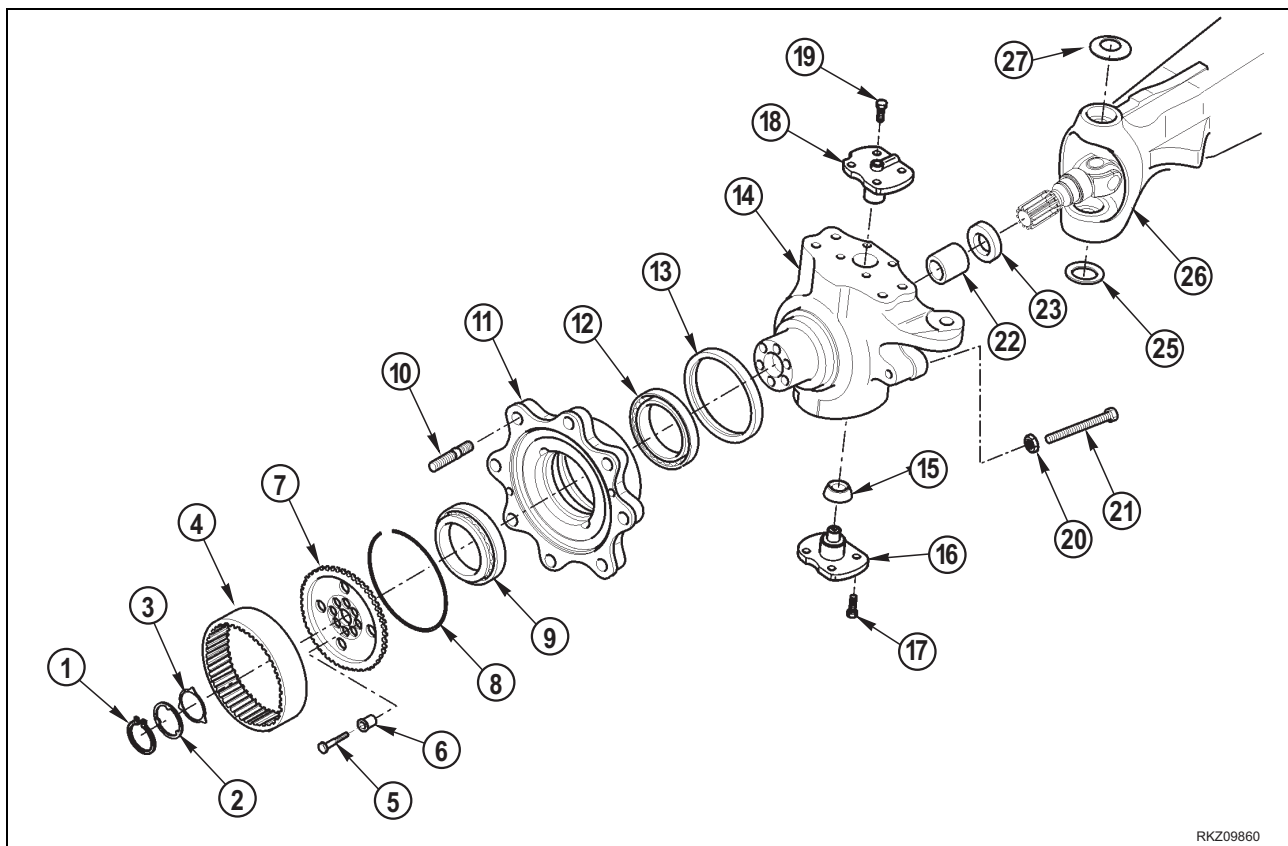
 Plug: 80 Nm





### 3. WHEEL HUB GROUP

#### 3.1 Disassembly

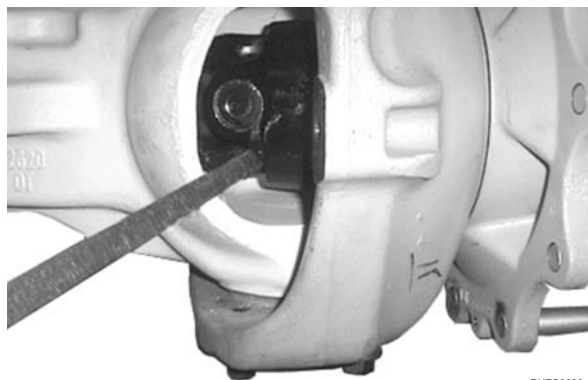


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**!** Before disassembling the wheel hub, it is advisable to secure it with a belt or a rope on a hoist or any other supporting device, in order to avoid its accidental fall that could damage either the operator or the wheel hub group.

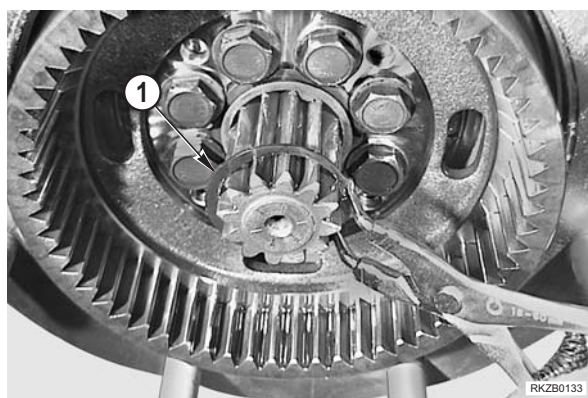
- 1 - Insert a lever between the swivel housing (14) and the axle beam and fit it into the double U-Joint. With the lever push the double U-Joint in the direction of the wheel hub to allow the lock ring (1) removal.

★ Do not damage the double U-Joint.



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- 2 - Remove the lock ring (1) from the double U-Joint shaft and collect the washers (2), (3).

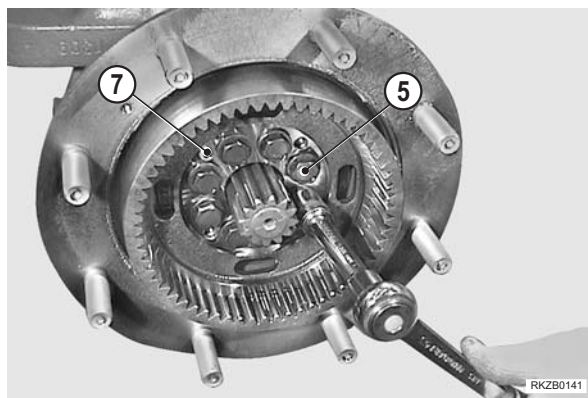


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## REMOVAL AND INSTALLATION

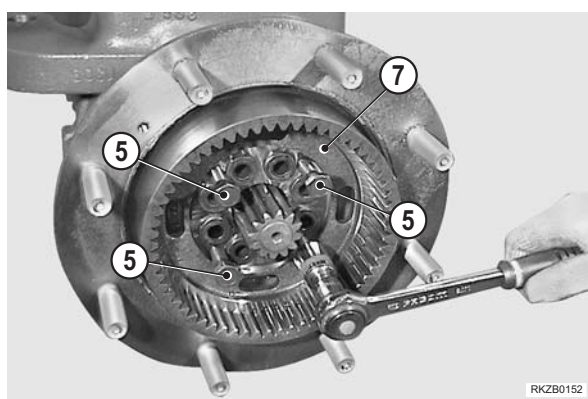
## FRONT AXLE

- 3 -Unscrew and remove the fastening screws (5) from the wheel carrier (7) group.



- 4 -In order to remove the wheel carrier group (7) from its housing, screw (5) at least two of the just removed screws in the threaded extraction holes.

- 5 -Extract and remove the hub-lock ring gear (7) together with the epicyclic ring gear (4).

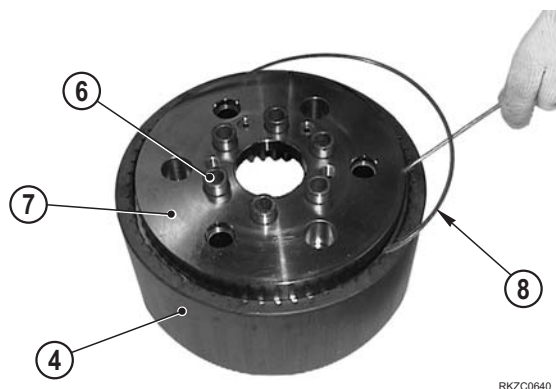


- 6 -Remove the stop ring (4) and disjoin the hub-lock ring gear (7) from the epicyclic ring gear (3).

★ Check the wear conditions of the components.

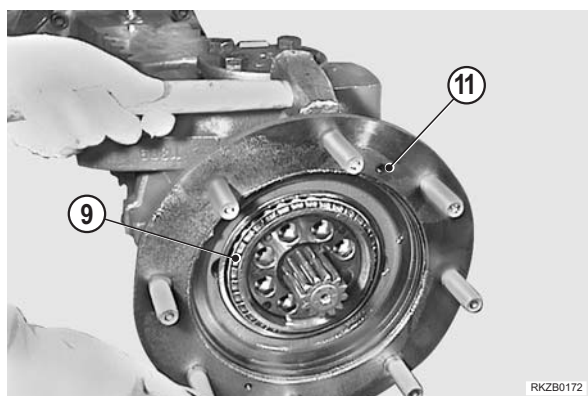
### Only if necessary

- 7 -Remove the centering bushes (6) of the hub lock ring gear with a hammer and the special tool D1.



- 8 -Remove the hub (11), using levers and a hammer to facilitate the operation.

★ Collect the bearing (9) cone.



## REMOVAL AND INSTALLATION

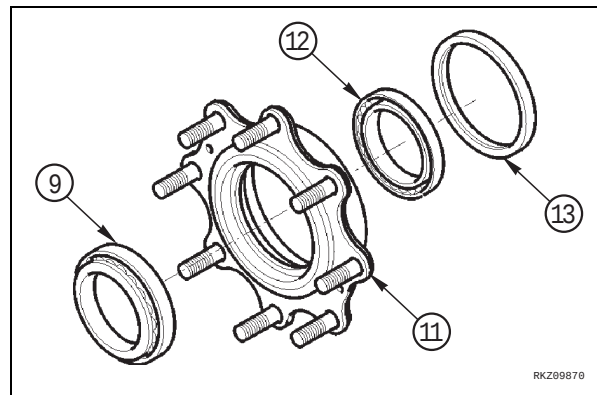
## FRONT AXLE

9 -Position on a flat surface the hub and take the seal ring out (13) with a lever.

★ This is a destructive operation for the seal ring.

10 -Take the bearing cups out (9) and (12), on both sides of the hub, using a hammer and a suitable tool to be beaten.

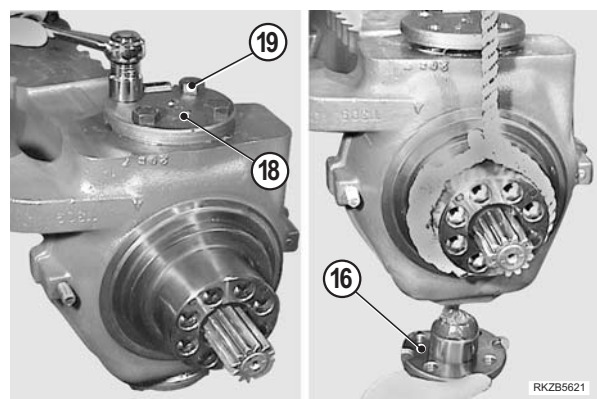
11 -Remove the bearing cone (12) from the swivel housing using a suitable, commercially available puller.



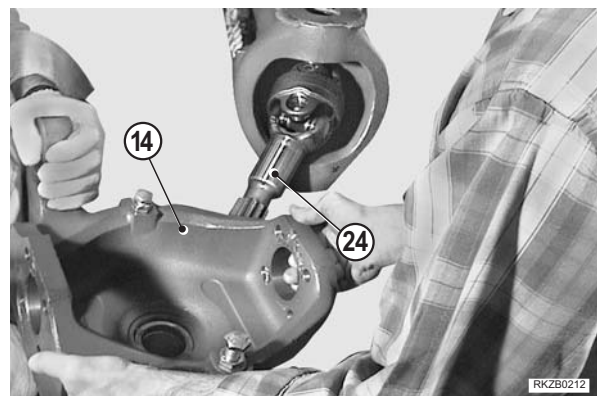
12 -Unscrew and remove the fastening screws (19) from the upper (18) and (17) lower (16) king pin.

⚠ Before removing the king pins, secure the swivel housing with a belt or a rope to a hoist or any other supporting device.

13 -Remove the king pins (18) and (16) and collect the belleville washers (25), (27).



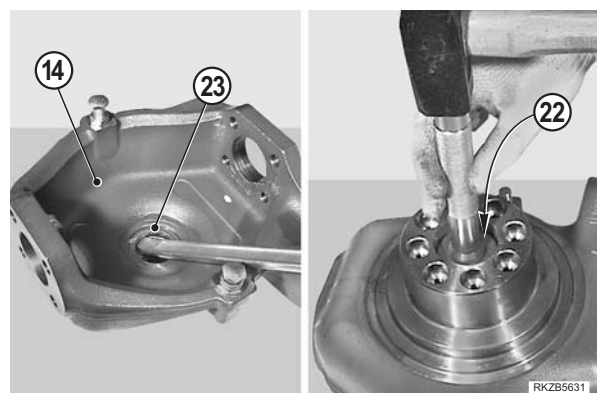
14 -Remove the swivel housing (14) from the axle beam and from the shaft (24).



15 -Position the swivel housing (14) on a flat surface and take the seal ring (23) out with a lever.

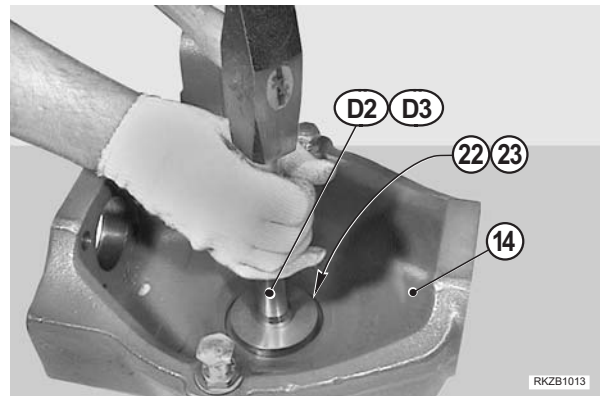
★ This is a destructive operation for the seal ring.

16 -Turn the swivel housing (14) and take the bush (22) out, using a driver and a hammer.

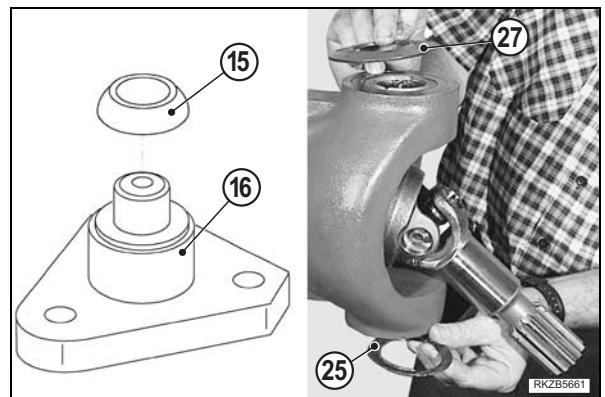


### 3.2 Assembly

- 1 -Force the bush (22) into the swivel housing (14) with the special tool **D2**. and a hammer or a press.
- 2 -Assemble the seal ring (23) on the swivel housing (14) with the special tool **D3**. and a hammer. Lubricate the ring with grease ASL800050.



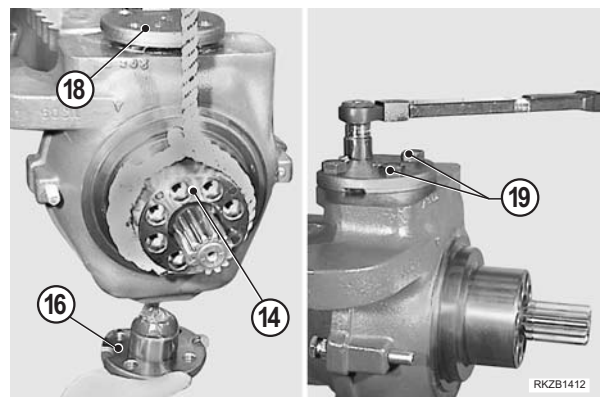
- 3 -Position the lower king pin (16) on a workbench and assemble the cone of the spherical joint (15) with the special tool **D4** under a press. Grease well the king pin housings with grease ASL800050.
- 4 -Position the Belleville washers (25) and (27) on the king pin housings (16) and (18).



- 5 -Secure the swivel housing (7) group with a rope. Lubricate the seal ring lip and protect the splined end of the axle shaft by winding it with thin adhesive tape to avoid damage to the seal ring. After assembly, remove completely the adhesive tape. Assemble the swivel housing on the axle beam.
- 6 -Assemble the two king pins, the upper (16) and the lower (18), and tighten the retaining screws (17) and (19).

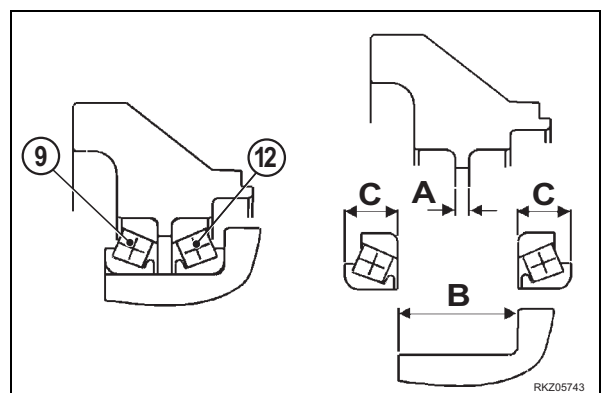
 Screw: 190 Nm

- ★ Make sure that the Belleville washers (25) and (27) remain in their position.



- 7 -If bearings (9) and (12) need to be replaced, make sure that distances "A", "B" and "C" are within the permissible range.

**A = 5.900 – 5.905 mm**  
**B = 52.229 – 52.279 mm**  
**C = 23.072 – 23.173 mm**



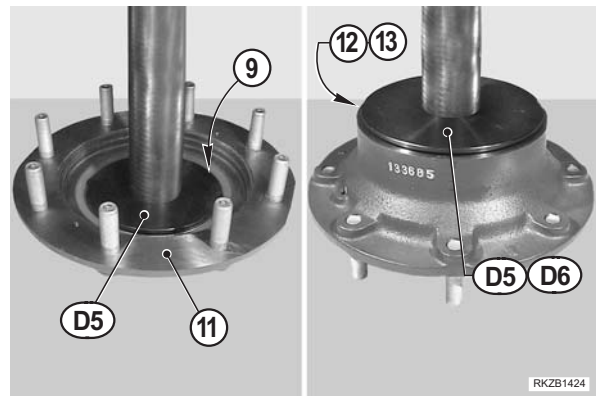


## REMOVAL AND INSTALLATION

## FRONT AXLE

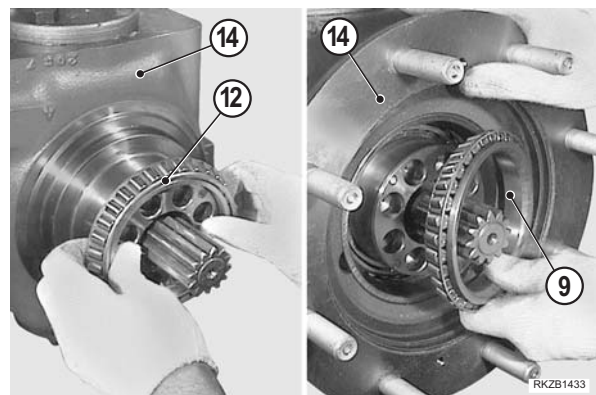
8 -Position the wheel hub (11) on a workbench and force both cups of the taper roller bearings (9) e (12) in position with the special tool **D5** under a press or with a hammer.

9 -Insert the seal ring (13) into the wheel hub (11) with the special tool **D6** and a hammer.



10 -Assemble the cone of the taper roller bearing (12) on the swivel housing end (14).

11 -Assemble the wheel hub (11) on the swivel housing (14) and fit the other cone of the taper roller bearing (9) in position.

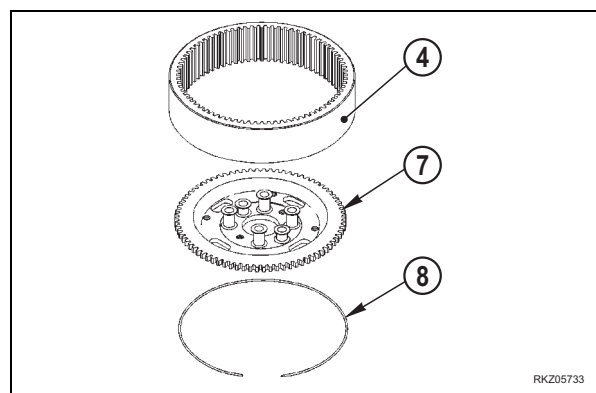


12 -Position the wheel carrier (7) on a workbench and force the bushes (6) to the carrier surface level with the special tool **D1**.

At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



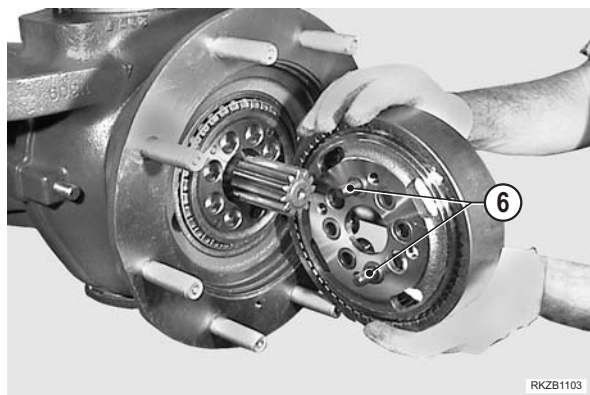
13 -Preassemble the wheel carrier - (7) epicyclic ring gear group (7) and (4) with the special locking ring (8) shown in figure.



## REMOVAL AND INSTALLATION

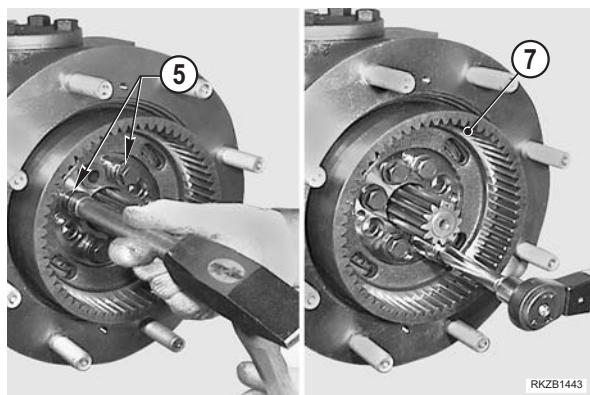
## FRONT AXLE

- 14 - Assemble the wheel carrier group on the wheel hub using the two projecting bushes (6) as dowel pins. Screw the relative screws (5) in order to put in contact the ring bevel gear with the wheel hub.

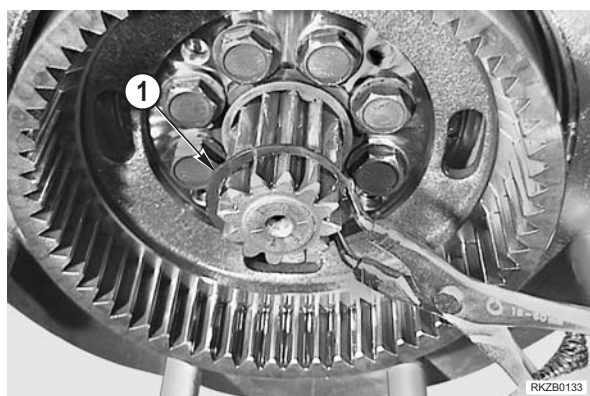


- 15 - Force all the hub dowel bushes completely with the special tool **D1** and a hammer. Assemble the wheel carrier (7) fastening screws (5) and tighten.

 Screw: 120 Nm

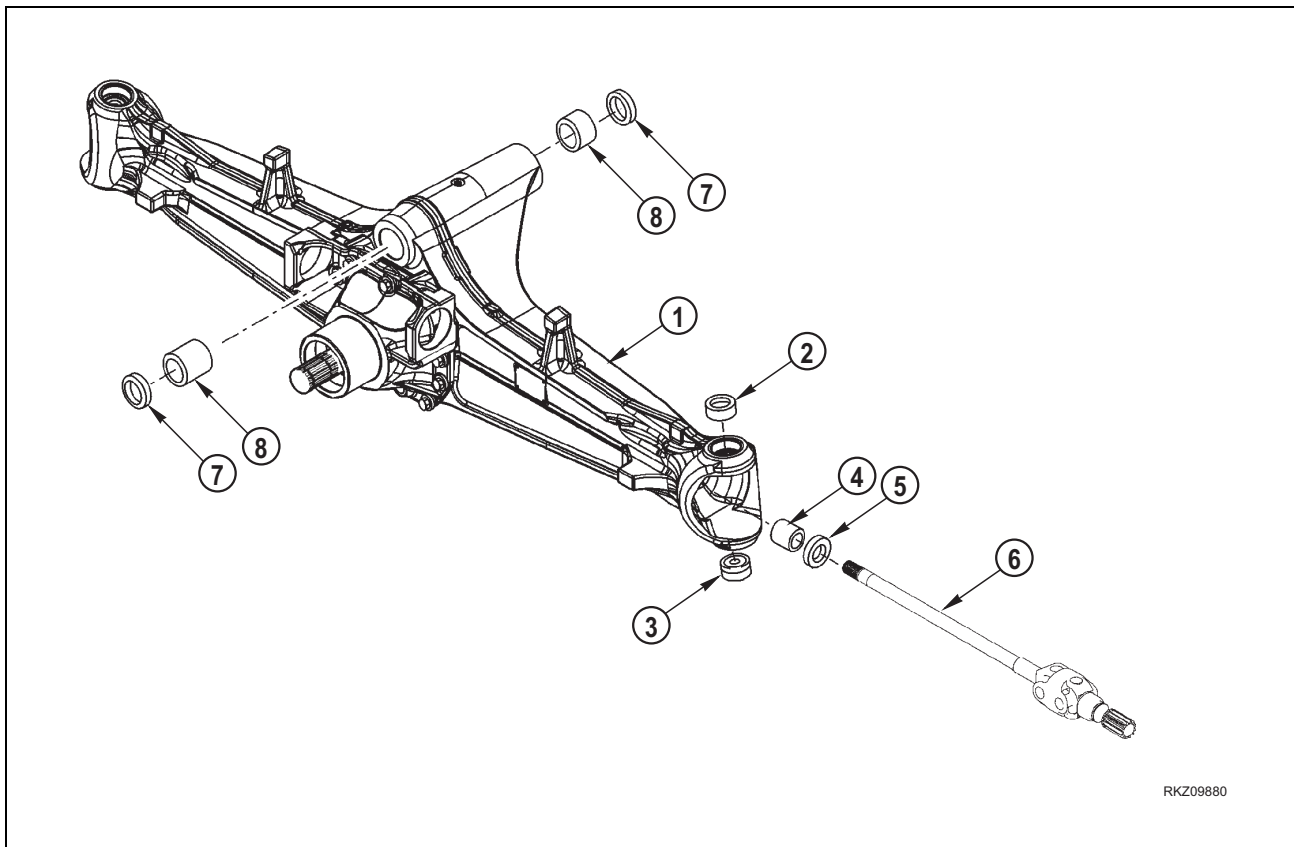


- 16 - Install washers (2) and (3) to the axle shaft and install the stop ring (1) by pushing it from the end of the serrated hub to its seat while counteracting with a lever inserted between beam and swivel housing and engaged onto the double U joint.

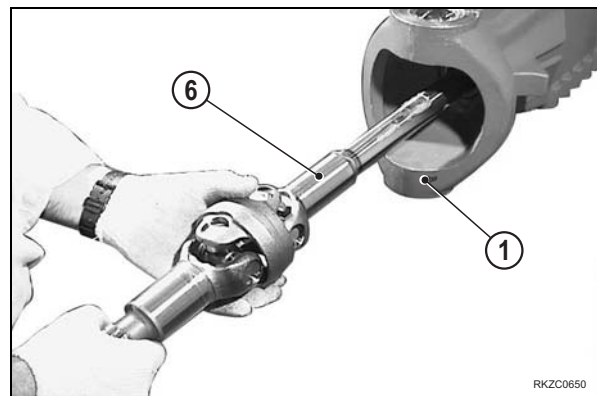


## 4. AXLE BEAM GROUP

### 4.1 Disassembly



1 - Remove the U-Joint (6) from the axle beam (1).

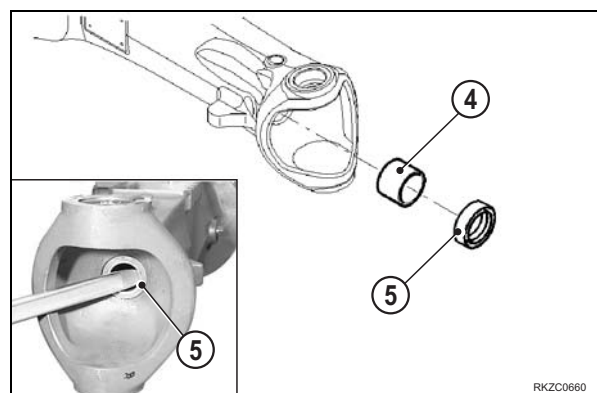


2 - Take the seal ring (5) out of the axle (1) beam with a lever.

★ This is a destructive operation for the seal rings.

3 - Remove the bush (3) from the beam with a suitable extractor.

★ Examine the bush before the removal and replace it only if the wear conditions require this.



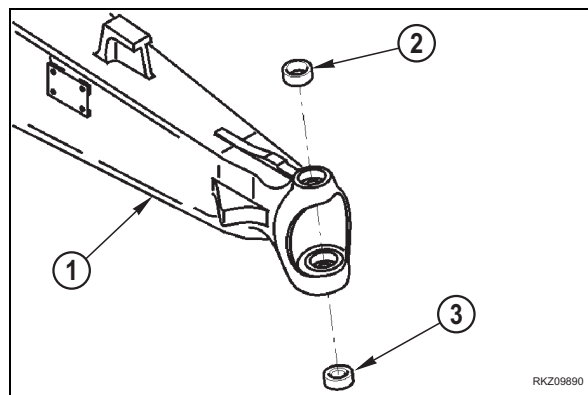


## REMOVAL AND INSTALLATION

## FRONT AXLE

- 4 -Extract the upper bushings (2) and cup (3) from the king pin housings.

★ Examine the bushing and housing before removal and replace depending on wear conditions.

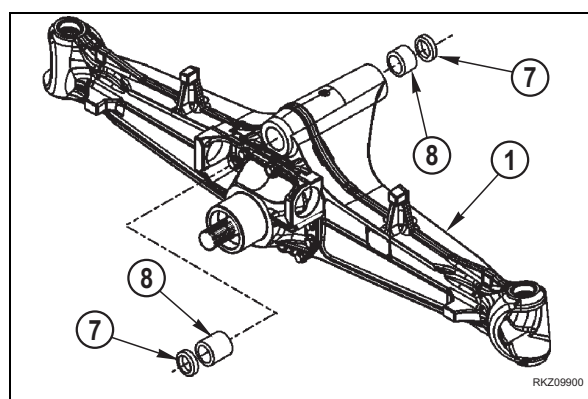


- 5 -Take the seal ring (7) out of the axle (1) beam with a suitable tool.

★ This is a destructive operation for the seal rings.

Only if necessary, remove the bushings with a standard three-gripping point extractor or a suitable driver and a hammer.

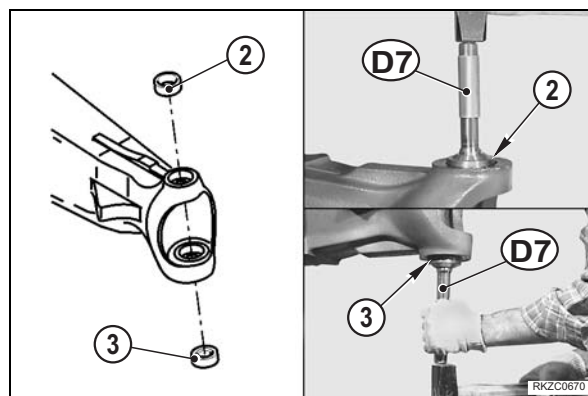
★ Do not damage the bushing housing.



### 4.2 Assembly

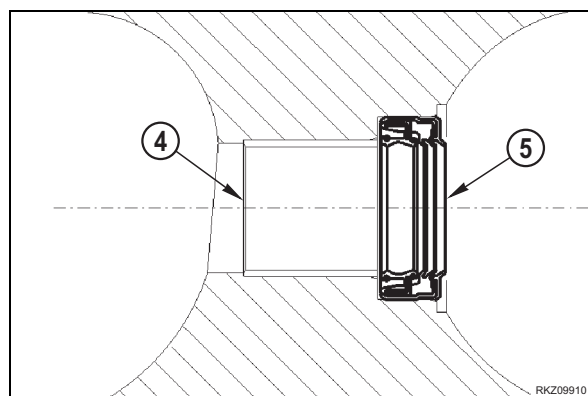
- 1 -Using tool **D7** and a hammer, install bushing (2) and cup (3).

★ To make installation easier, allow the bushings and cups to cool in liquid nitrogen at less than -100°C (-148°F)



- 2 -Assemble the bush (4) on the axle beam with the special tool **D9** and a hammer.

- 3 -Assemble the seal ring (5) on the beam with the special tool **D10** and a hammer.  
Fill 3/4 of the seal ring cavity with grease ASL800050.

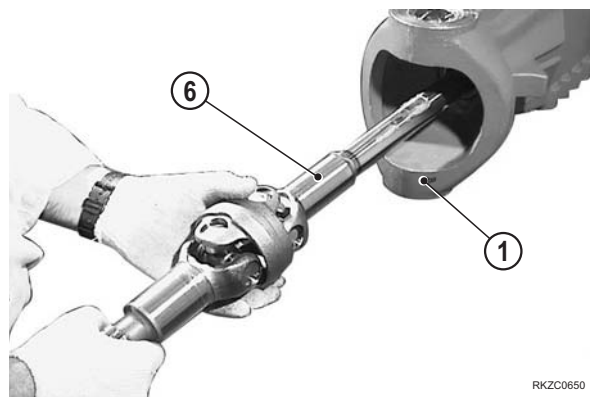


## REMOVAL AND INSTALLATION

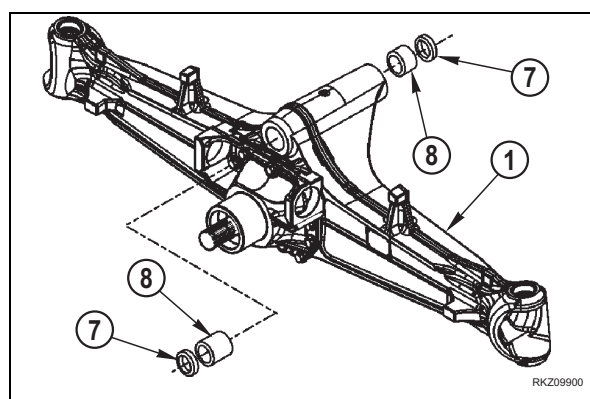
## FRONT AXLE

4 - Lubricate the bush (5) and the seal ring lip (6). Insert the U-Joint (7) inside the axle beam.

★ Take care not to damage the sealing ring.

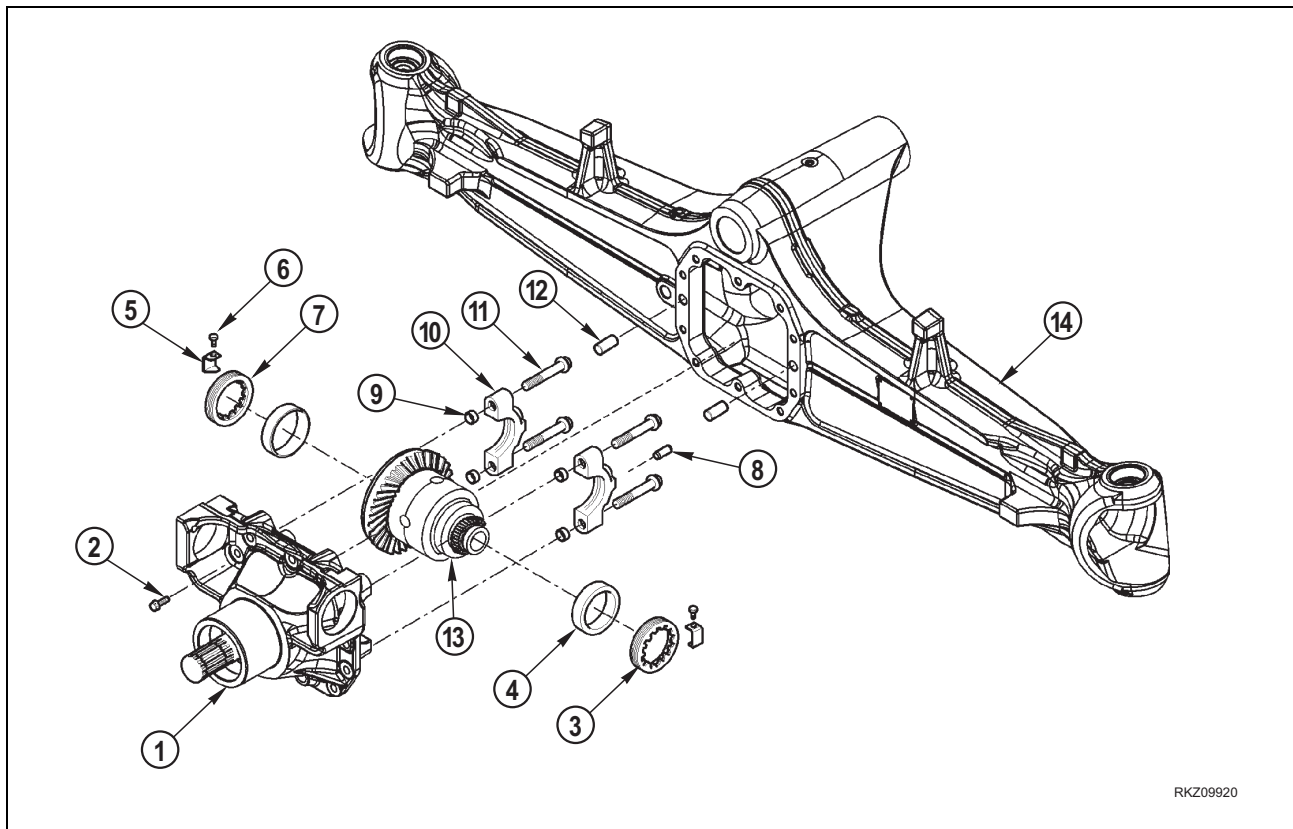


5 - Assemble two new bushings (8) respectively and two new seal rings (7) in the central unit (1) pivot by using special tools **D8** and **D11**.



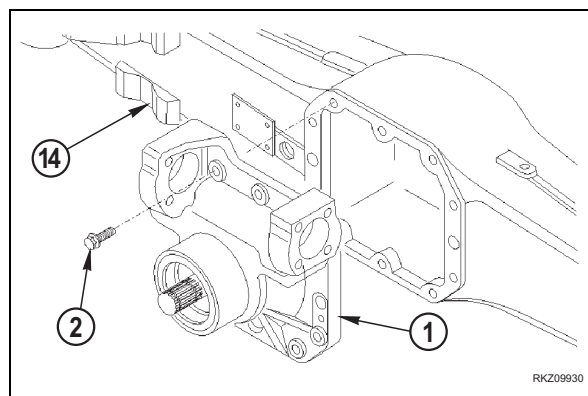
## 5. DIFFERENTIAL SUPPORT

### 5.1 Disassembly

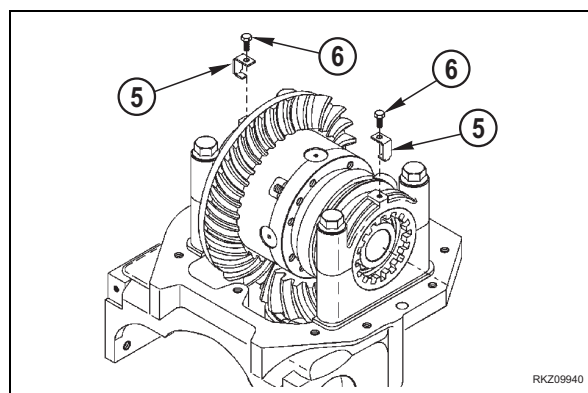


1 -Loosen and remove the screws (2) on the differential support (1). Remove the differential support (1) from the axle beam (14).

**!** Support the differential carrier with a rope or other appropriate means.



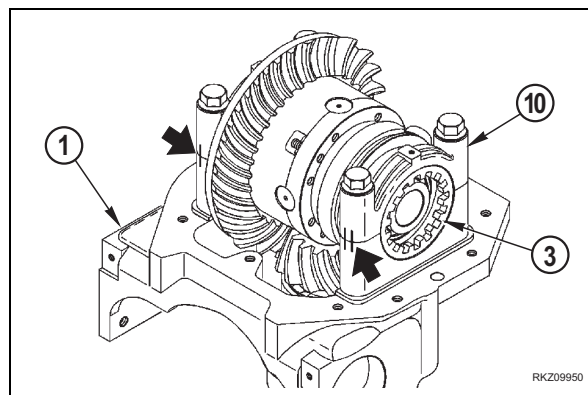
2 -Loosen and remove the screws (6) to remove the two ring nut retainers (5).



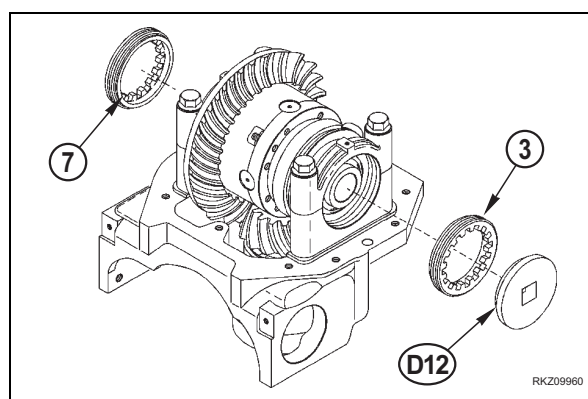
## REMOVAL AND INSTALLATION

## FRONT AXLE

- 3 - Before removing bolts, mark halfbridles (10) and the differential carrier with permanent reference marks to avoid inverting them when re-assembling the unit. Mark the area between the ring (3), (7) butts and the differential (1) carrier as well.

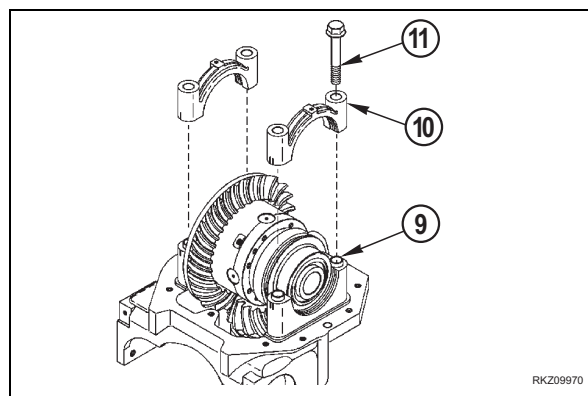


- 4 - Unscrew the adjuster ring nuts (3), (7) using tool **D12** and a wrench.



- 5 - Loosen and remove the 4 screws (11) and remove the 2 half-collar (10).

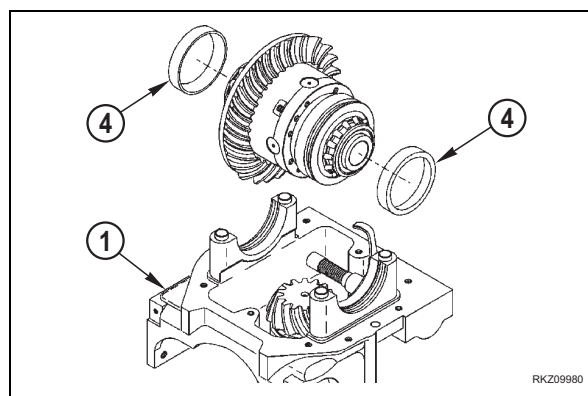
★ Ensure that the centre bushings (9) remain seated.



- 6 - Take out the differential case (13).

★ Take care not to loose the cups bearing (13) that are removed together with the differential case (1).

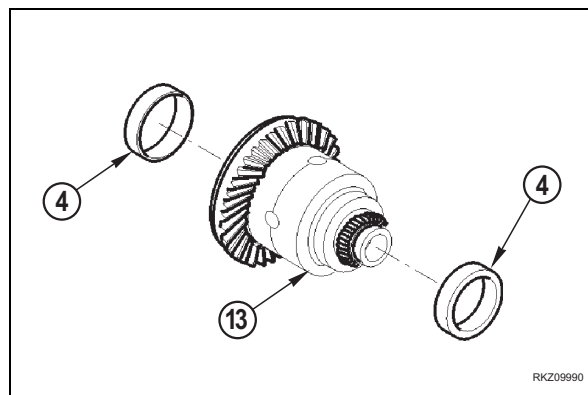
★ Do not mismatch the cups of the bearings (4) if bearings are not to be replaced.



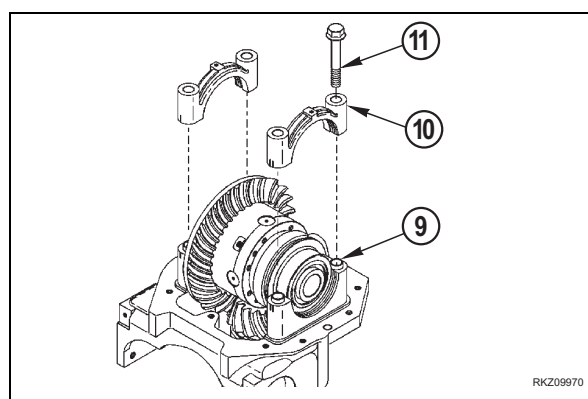
## 5.2 Assembly

- 1 -Position the complete differential box (13), with the outer cups (4) of the tapered roller bearings already assembled, on the differential carrier (1).

**!** Take care not to invert the outer races of the tapered roller bearings and check you are working on the right side of the bevel crown assembly.

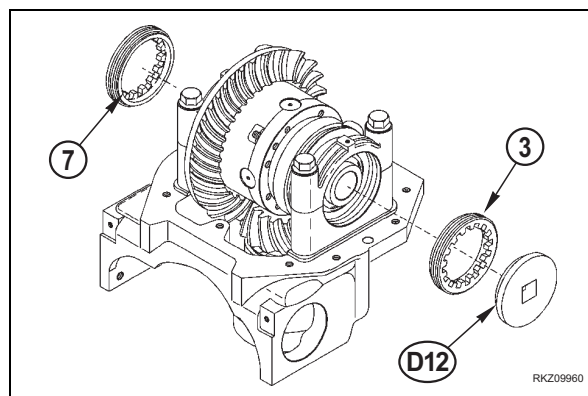


- 2 -Place the differential (1) group and the two halfbridles (3) and bolts in their seat. Check the positions of the bushings and halfbridles using the reference marks on them and on the differential support (1). Install the halfbridles and secure with their respective screws (11).

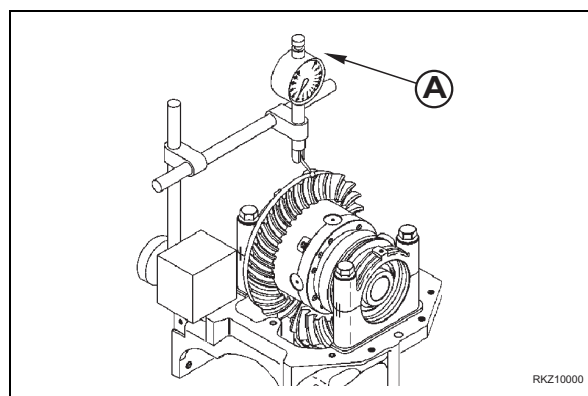


- 3 -Assemble and tighten the two adjustment ring nuts (3) (7) in the differential support with tool **D12**, so as to preload the differential bearings slightly. Knock lightly with a soft hammer in order to properly set the bearings in position.

★ Take care not to reverse the ring nuts; align the previously-traced reference marks.



- 4 -Install a magnetic comparator "A" to the differential support so that the checkhead is at right angles with the side of a tooth from the ring gear.



## REMOVAL AND INSTALLATION

## FRONT AXLE

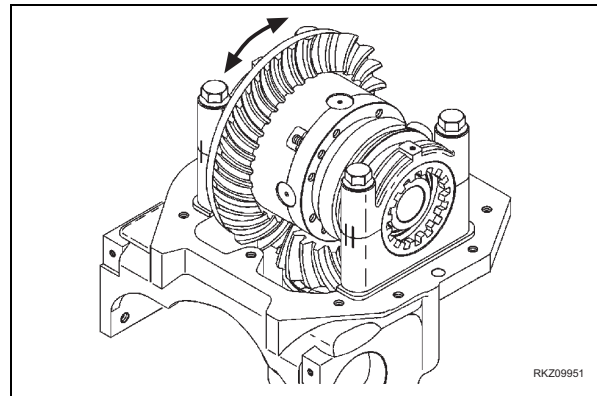
- 5 - Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.

Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.

Check if the measured backlash value is within the requested range:

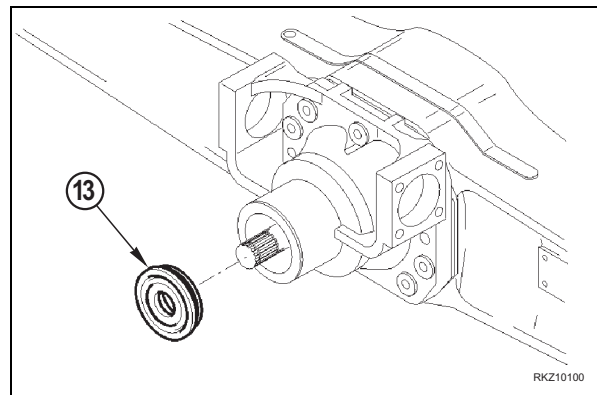
**0.18 – 0.28 mm**

Adjust by operating the ring nuts (3), (7) by means of tool **D12**.

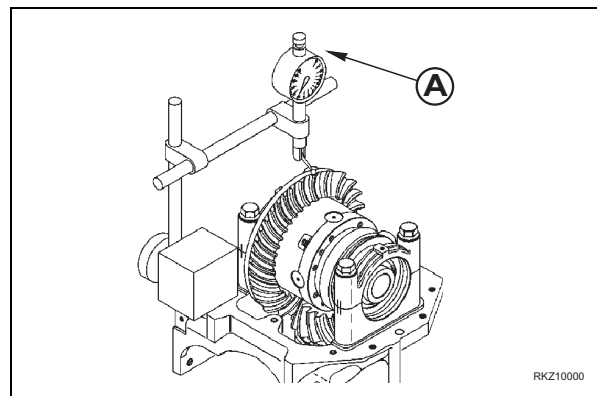


- 6 -If **the measured backlash is lesser** than the given tolerance range, screw the ring nut (7) from the side opposite to the ring gear and unscrew (3) the opposite one of the same measure.

- 6a -If **the measured backlash is higher** than the given tolerance range, screw the ring nut (3) from the side of the ring gear and unscrew the opposite (7) one of the same measure.



- 7 -Make sure that the bearings are slightly preloaded; if necessary, repeat previous adjustment until the specified conditions are reached.

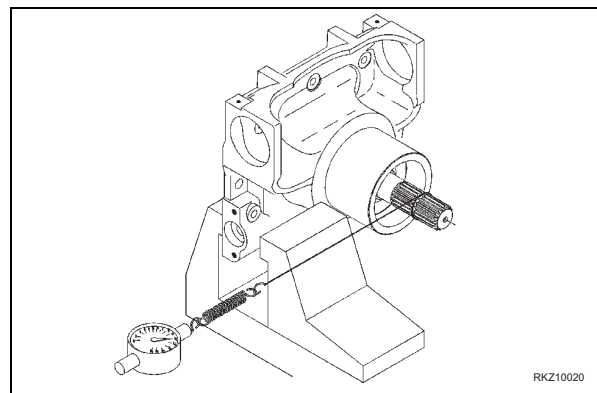


- 8 -Once pinion/ring gear backlash is determined, measure total bearing preload (**T**) (pinion/ring gear system) using a force gauge with the cable wound around the splined pinion end. The reading should be within the following values:

$$T = (P + 3.75) - (P + 5.75) \text{ daN}$$

where **P** is the effectively measured pinion preloading (For details, see "6. DIFFERENTIAL GROUP")

- ★ All preloadings should be measured without the seal ring.

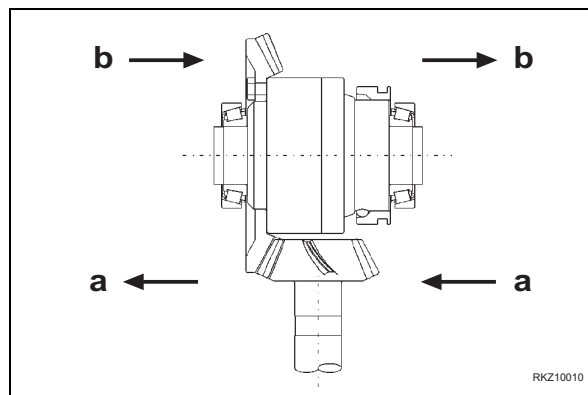


## REMOVAL AND INSTALLATION

## FRONT AXLE

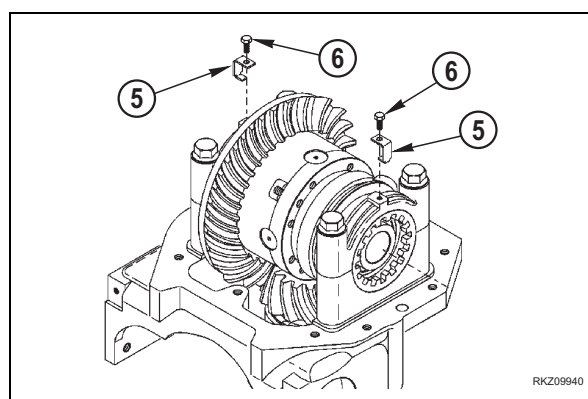
9 -If the measurement is not within the requested range, check well the assembly of each component and operate on the adjuster ring nuts (3) and (7) of the differential support:

- a - if **total preload is less** than the specified values, tighten the adjuster ring nuts (3) and (7) by the same amount, while keeping the pinion/ring gear backlash unchanged;
- b - if **total preload is greater** than the specified values, loosen the adjuster ring nuts (3) and (7) by the same amount, while keeping the pinion/ring gear backlash unchanged;



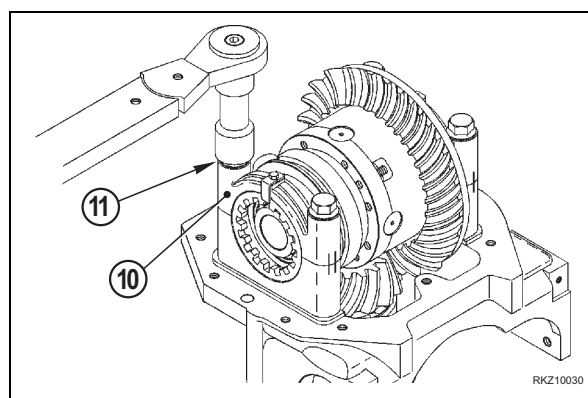
10 -When all adjustments are complete, install the ring nut retainers (5) and their respective screws (6), and tighten to the specified torque.

 Screw: 266 Nm



11 -Tighten the screws (11) the 2 half-collar (10).

 Screw: 266 Nm

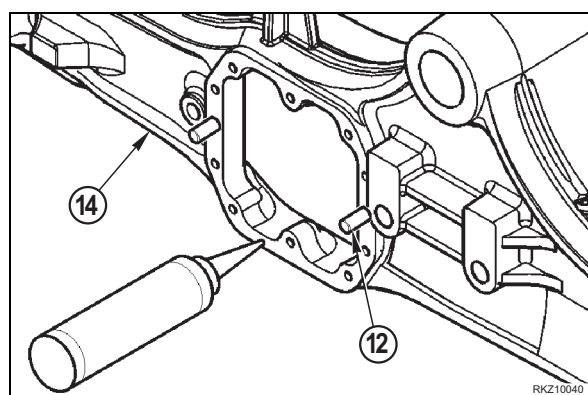


12 -Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.

Spread a film of adhesive on the contact surface between the axle beam (14) and the differential carrier (1).

 Loctite: 510

★ check that two dowel pins (12), (8) are in their seats.





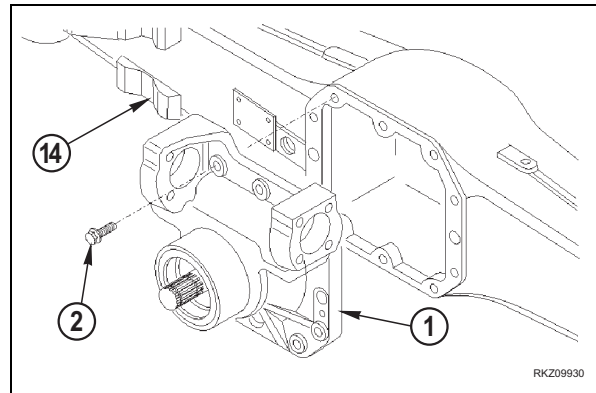
## REMOVAL AND INSTALLATION

## FRONT AXLE

- 13 - Assemble the differential support (1) to the axle housing (14), and tighten the retaining bolts (2) to the requested torque.

Refill the tank with oil.

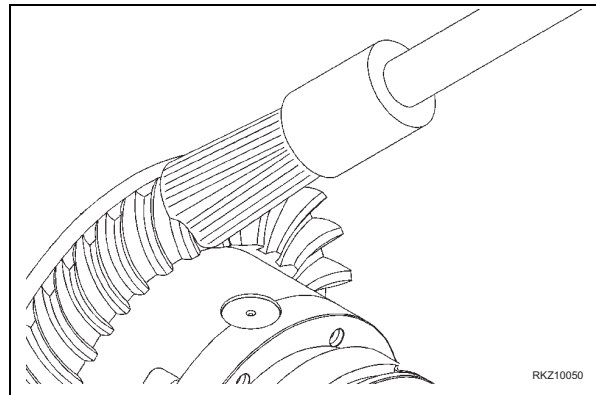
 Screw: 169 Nm



### • Bevel gear marking test

- 1 - To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.

The marking test should be always carried out on the ring bevel gear teeth and on both sides.



- 2 - **OK** - Correct contact:

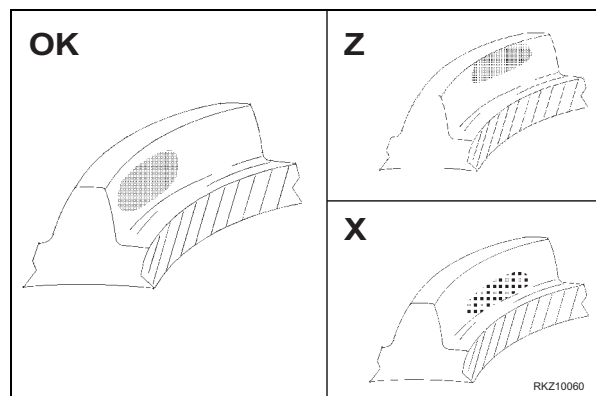
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

**Z** - Excessive contact on the tooth tip:

Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.

**X** - Excessive contact at the tooth base:

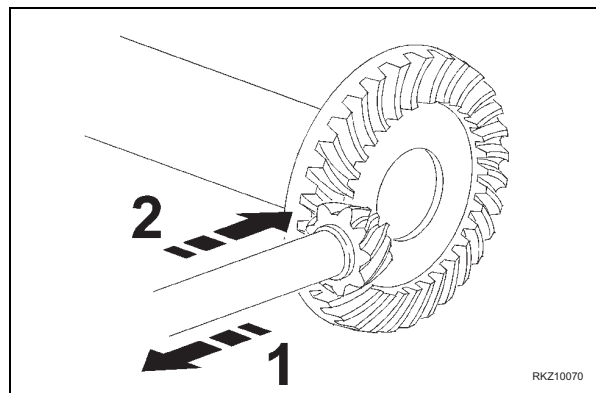
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.



- 3 - Movements to correct:

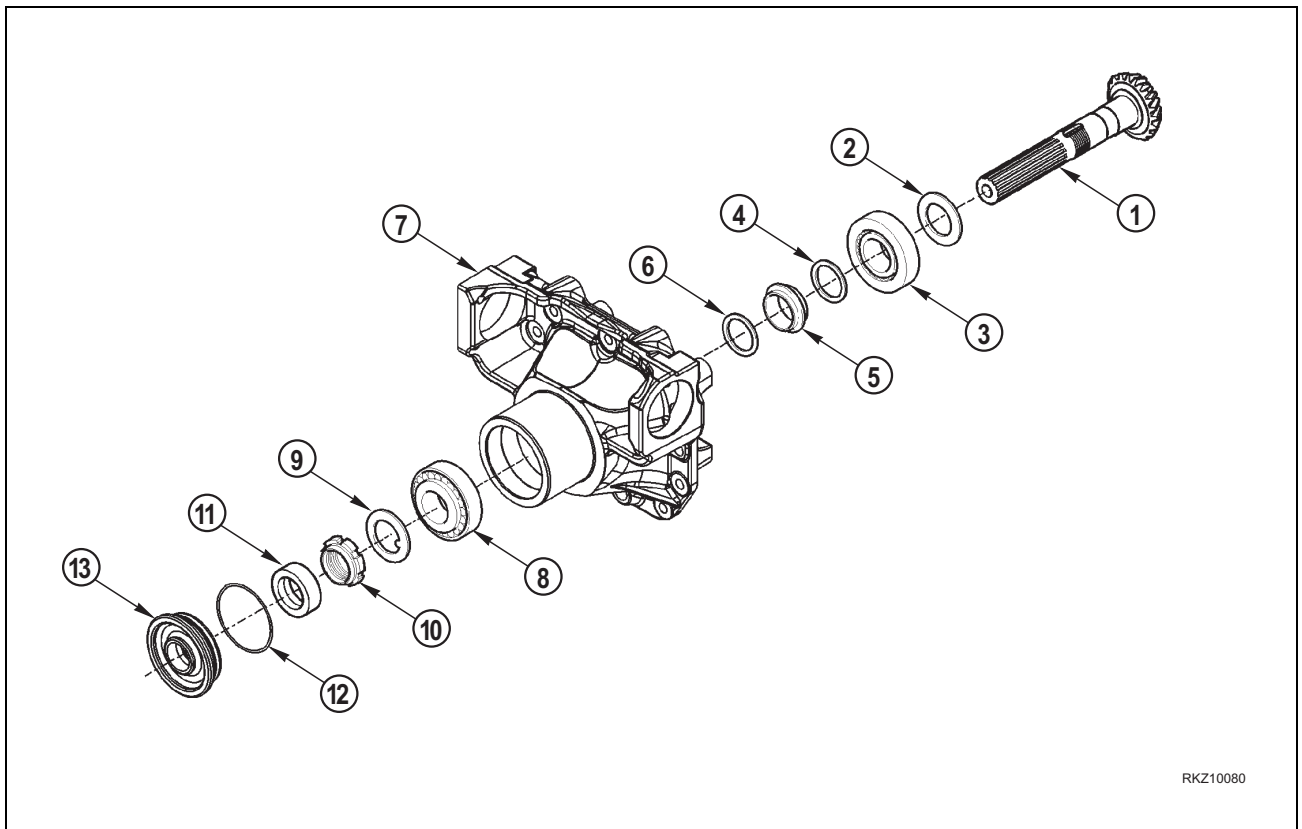
1 - move the pinion for type X contact adjustment **X**.

2 - move the pinion for type Z contact adjustment **Z**.

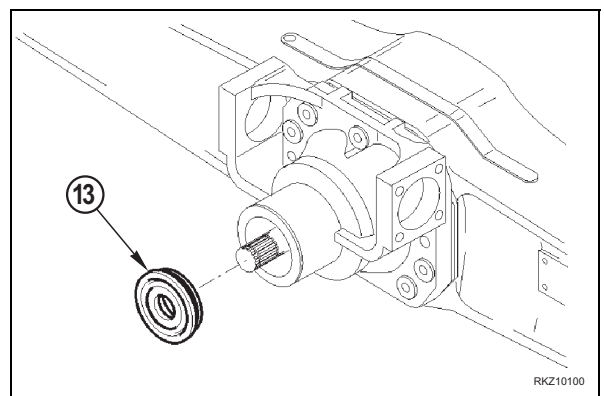


## 6. DIFFERENTIAL GROUP

### 6.1 Disassembly

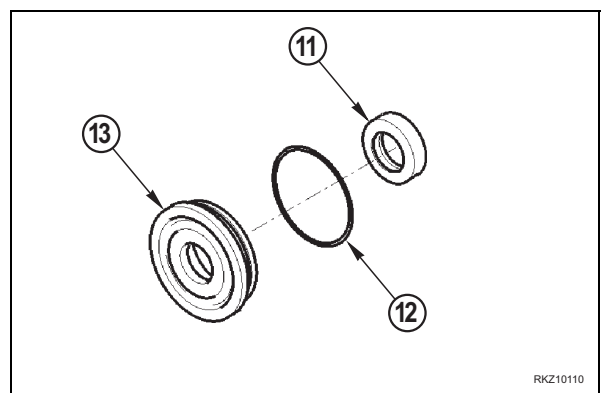


1 -Pry the cover (13) away from the differential support using a lever.



2 -Remove the seal rings (12) and (11) from the cover (13).

★ This is a destructive operation for the seal rings.

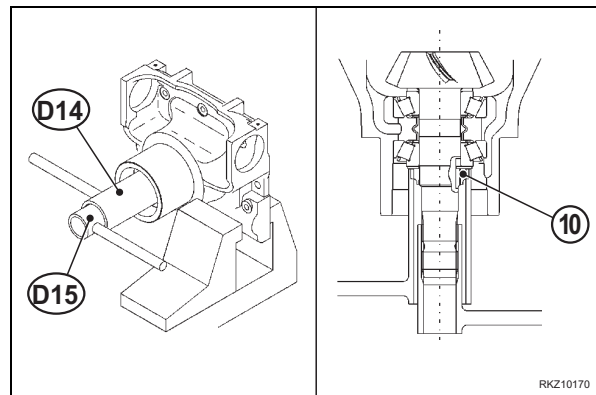


## REMOVAL AND INSTALLATION

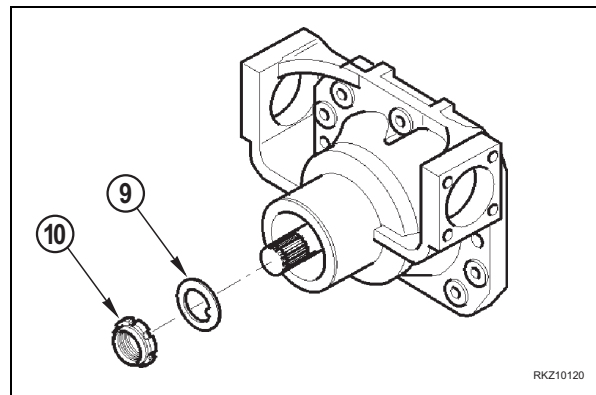
## FRONT AXLE

- 3 - Fit the differential carrier (1) in a vise.  
Unscrew the lock nut (10) using special tools **D14-D15**.

★ This operation will irretrievably damage the ring nut (10).



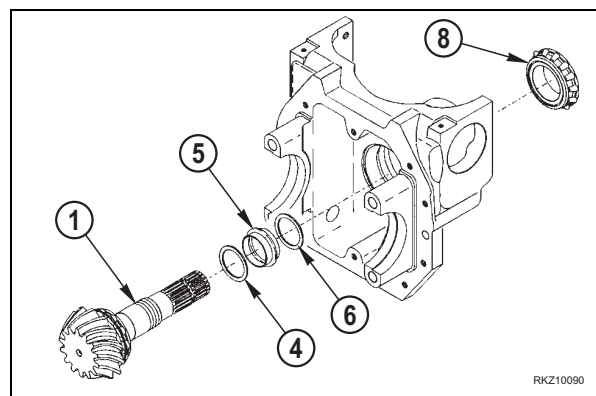
- 4 - Remove the ring nut (10) and collect its retaining washer (9).



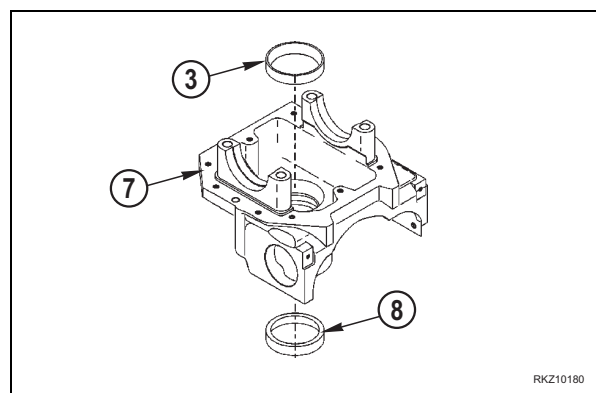
- 5 - Tap the shaft with a soft hammer to remove the bevel pinion (1).

★ Take care not to drop the bevel pinion (1).

Recover washers (4) and (6), collapsible spacer (5) and bearing cone (8).



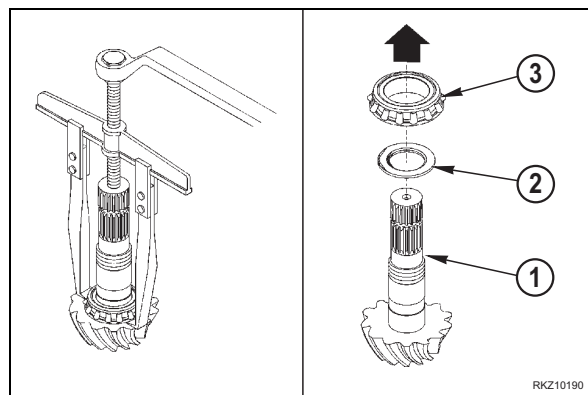
- 6 - Place differential support (7) on a firm flat surface and extract bearing outer rings (3) and (8).



## REMOVAL AND INSTALLATION

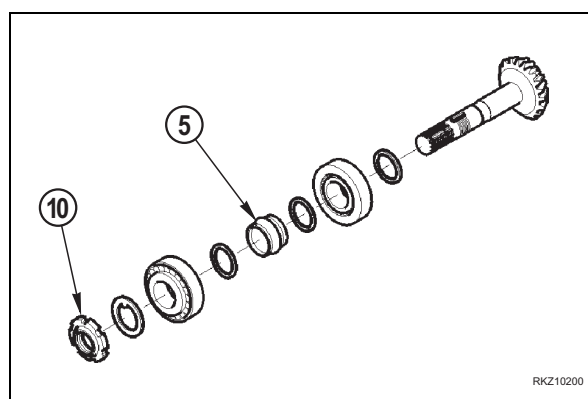
## FRONT AXLE

- 7 -To remove bearing inner ring (3) from bevel pinion (1), use a commercially available grip puller. Recover bearing inner ring (3) and the shim (2) under it.



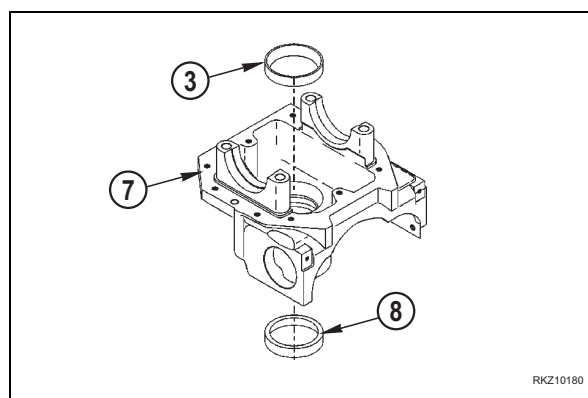
- 8 -Check all pinion components for wear.

- ★ The ring nut (10) and the snap spacer (5) must be replaced when reassembling the unit.

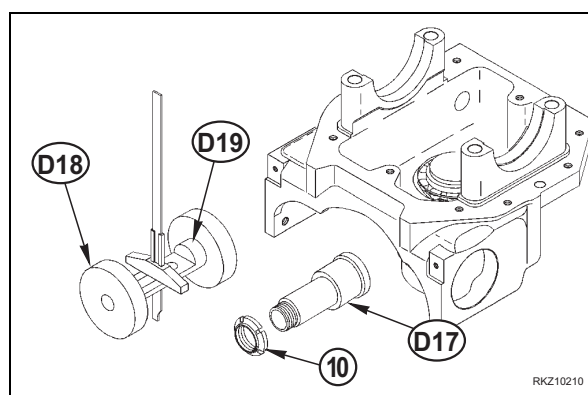


### 6.2 Assembly

- 1 -Place differential support (7) on a work bench. Force bearing outer rings (3) and (8) into it using special tool **D16** and a hammer.



- 2 -Use the kit consisting of the special tools called “false pinion” **D17** and “false differential box **D18** and **D19** and a deep gauge.



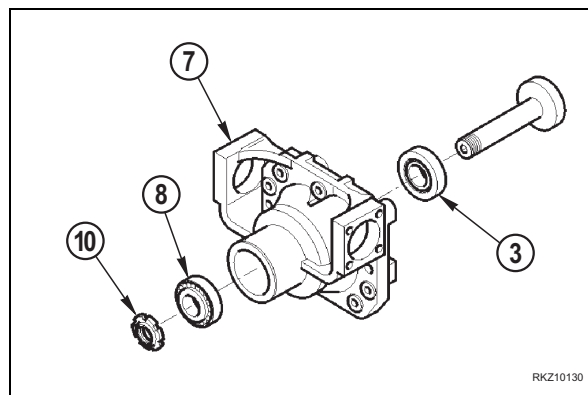
## REMOVAL AND INSTALLATION

## FRONT AXLE

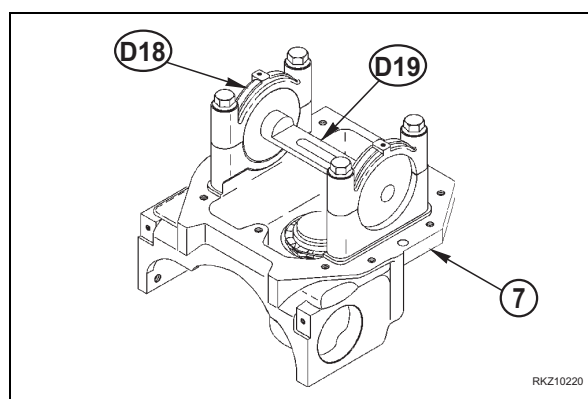
3 -Introduce bearing rings (3) and (8) to their respective seats.

Assemble the “false pinion” and ring nut (10).

Tighten ring nut – but do not overtighten – until backlash is eliminated.

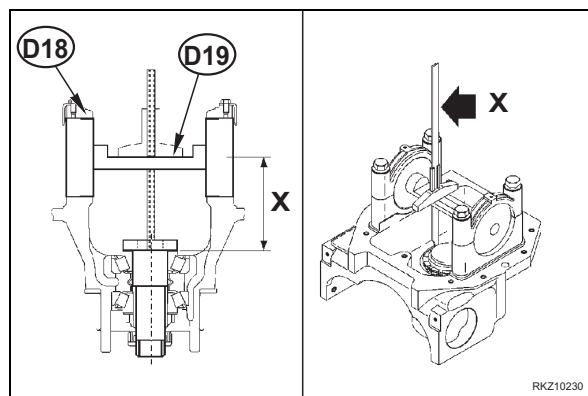


4 -Install tool **D18**, **D19** to bearing seats in differential support (7) and retain with halfbridles.



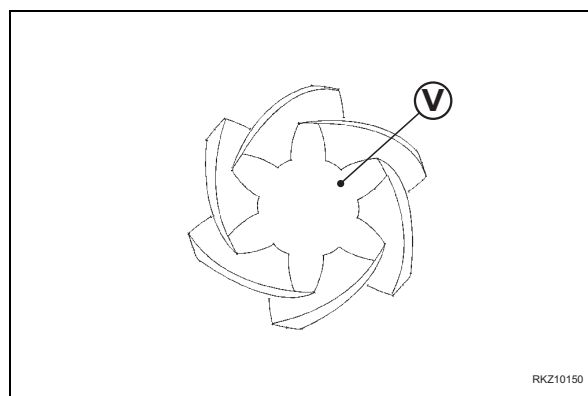
5 -Installation method **D18**, **D19**.

Use a depth gauge to measure distance “**X**” (distance between the axis of the differential bearings and the point at which the pinion head, or base of bearing, is supported).



6 -In order to determine the thickness (**S**) required between the pinion and the bearing, subtract the value (**V**), stamped on the pinion head (**V**=requested bevel distance), from the measured value (**X**).

$$S=X-V \text{ mm}$$

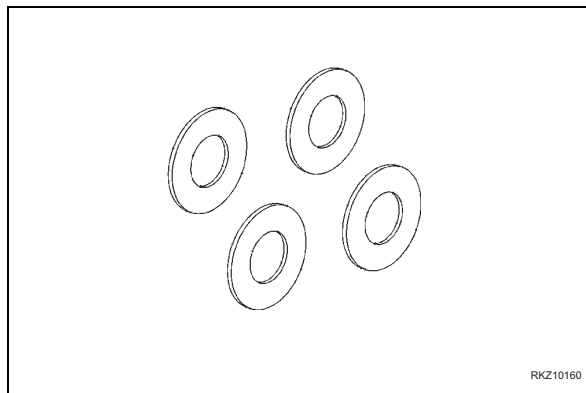


## REMOVAL AND INSTALLATION

## FRONT AXLE

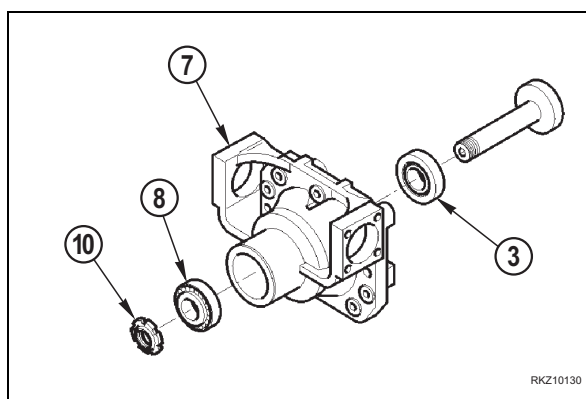
7 -Pick the **(S)** shim (2) from the range of shims available.

| SHIM RANGE |     |     |     |     |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Shims      | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 |



RKZ10160

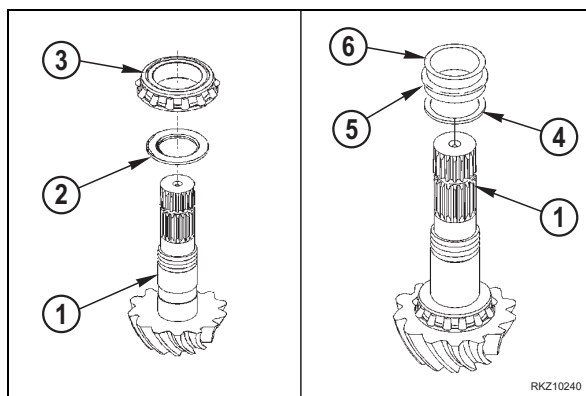
8 -Remove special tool **D18**, **D19** from differential support.  
Remove ring nut (10), false pinion, and bearing cones (3) and (8).



RKZ10130

9 -Install the selected shim (2) to the pinion shaft (1) with the chamfer facing the gear.  
Force bearing (3) onto the pinion shaft (1) using a press and driver **D20**, and ensure that the bearing is fully locked into position.  
Install shims (4) and (6), and a new collapsible spacer (5).

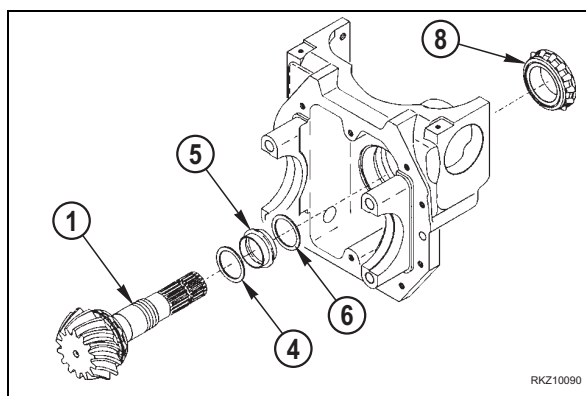
★ Use only one new spacer at any time.



RKZ10240

10 -Install preassembled bevel pinion group (1) to the differential support (7), and install bearing inner ring (8) to pinion end as shown.  
To force bearing (8), use driver **D20** and a hammer.

★ Oppose a resistance to the striking force (e.g. a sledge hammer).

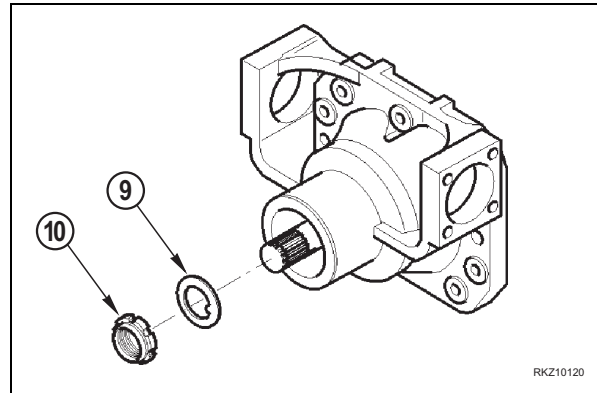


RKZ10090

## REMOVAL AND INSTALLATION

## FRONT AXLE

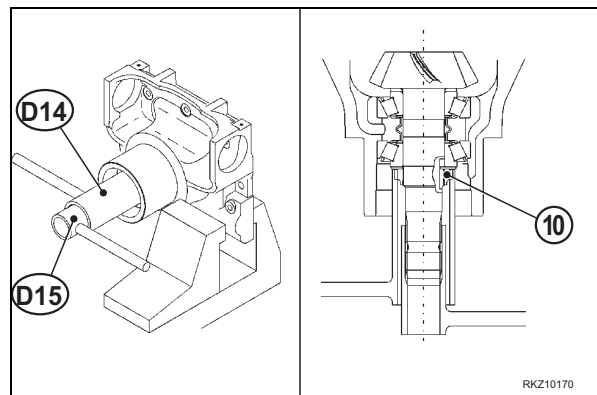
- 11 - Insert a ring nut washer (9) and screw a new lock ring nut (10) on the pinion end.



- 12 - Screw the ring nut in (10), using the wrench for ring nut **D14** and for pinion retainer **D15**.

- ★ The torque setting is given by the preloading measurement on bearings (3) and (8); Tighten the ring nut (10) step by step.
- ★ If it is tightened too much, the elastic spacer (5) should be replaced and the procedure repeated.

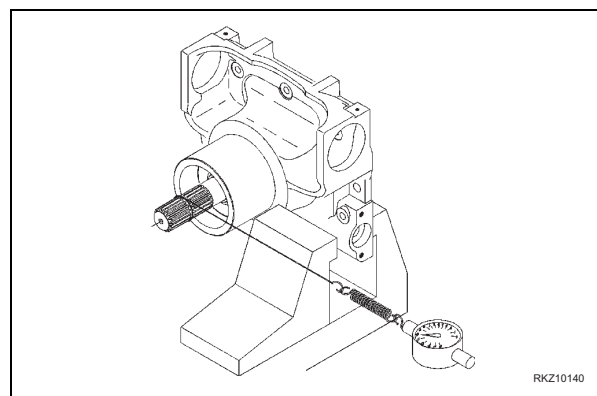
When you check the preloading, it is advisable to beat slightly both pinion (1) ends with a soft hammer, so as to help setting the bearings (3) and (8).



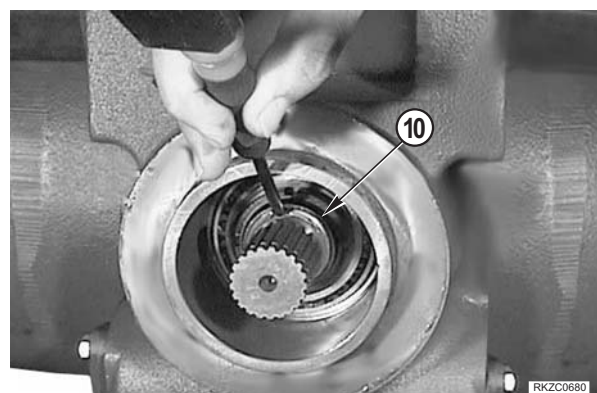
- 13 - Measure preload **P** of tapered bearings (3) and (8) using a force gauge with the string wound around the splined end of pinion (1). Adjustment is carried out by gradually increasing the tightening torque of the ring nut (10), paying attention not to overtighten.

- ★ All preloadings should be measured without the seal ring.

$$P=9.2-13.7 \text{ daN}$$



- 14 - Once you got the requested preloading value, caulk the ring nut (10).



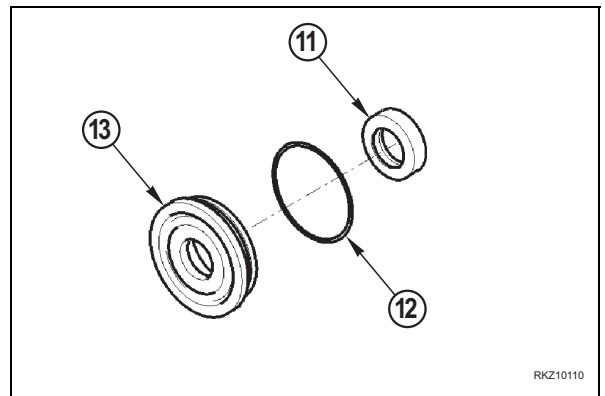


## REMOVAL AND INSTALLATION

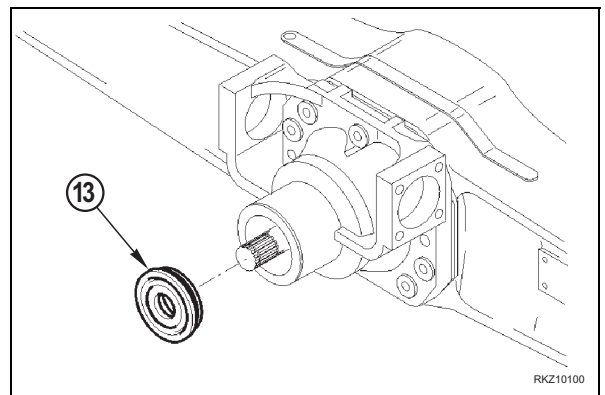
## FRONT AXLE

- ★ Do not carry out the steps below until you have completed the adjustment of preload **T**.

15 - Assemble sealing ring (11) to cover (13) using tool D21 and a hammer.  
Install a new O-ring (12) to cover (13).  
Lubricate O-ring (12) and sealing ring (11).

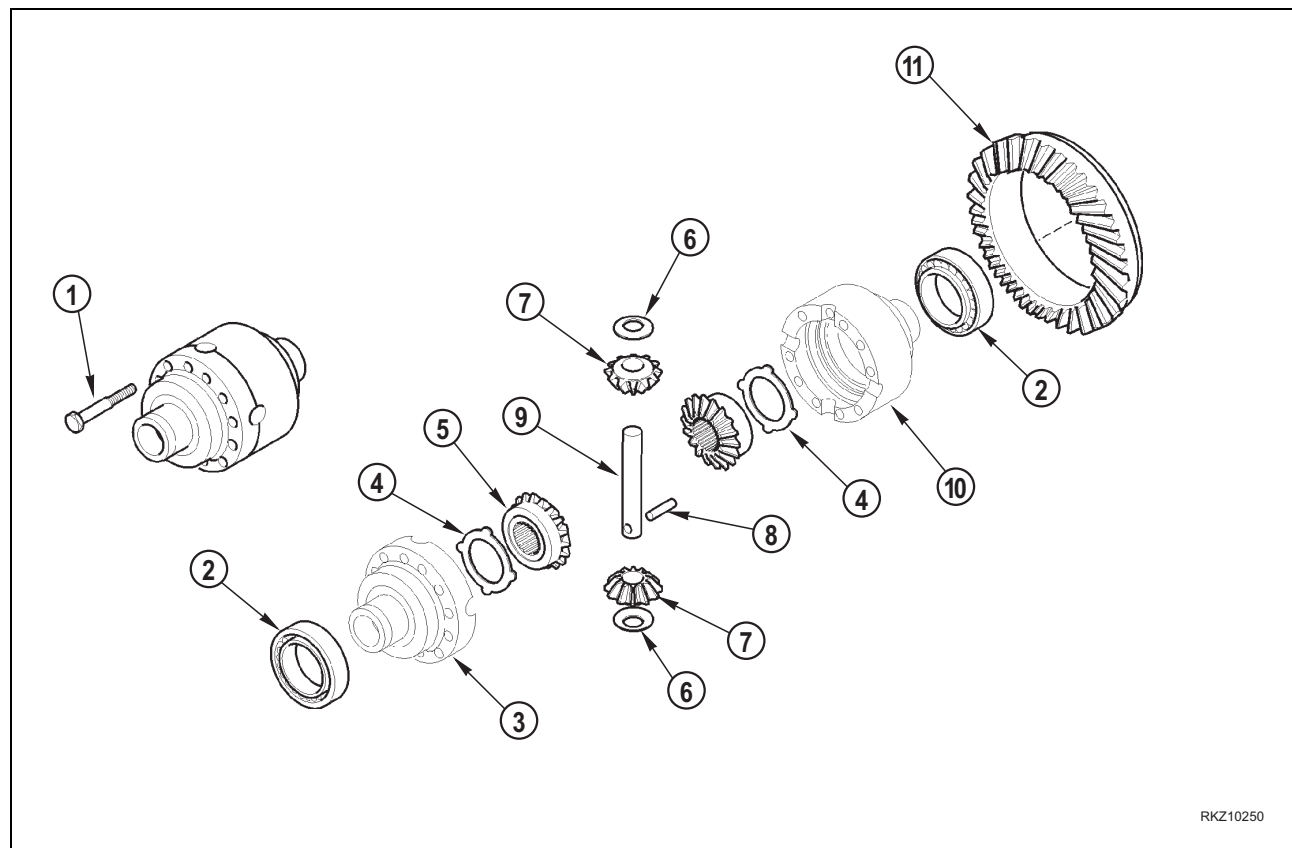


16 - Install cover (13) to differential support.



## 7. DIFFERENTIAL GROUP

### 7.1 Disassembly

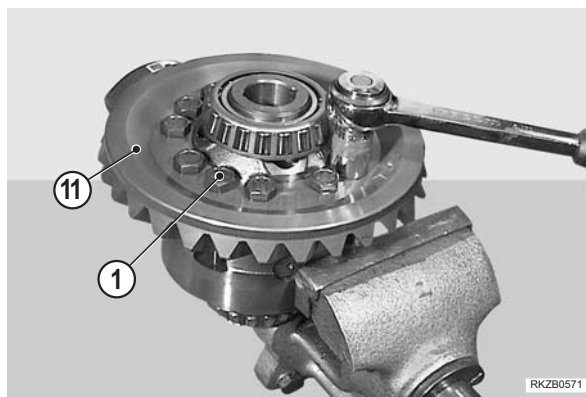


1 Lock the differential in a clamp.

2 -Unscrew all the fastening screws (1) on ring bevel gear (11).

★ This will make both differential half boxes (3), (10) free, so take care not to drop the internal components.

3 -Remove the bevel gear crown (11).

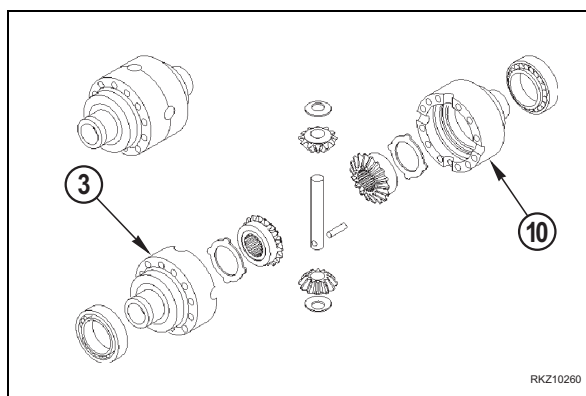


4 -Disassemble the differential box in two half boxes (3), (10) complete with the relevant components.

★ Scribble some match marks before separating the two half housings.

5 -Recover the components from both half boxes.

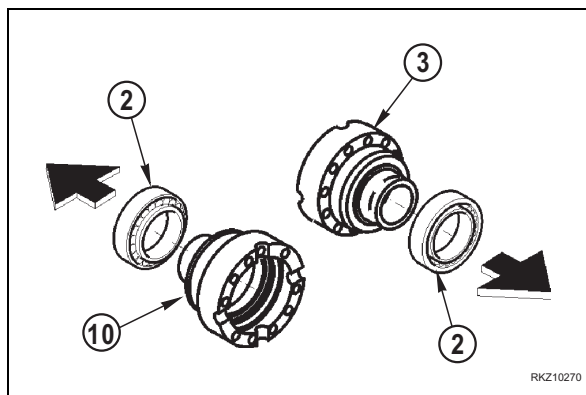
6 -heck the operating and wear conditions of the components.



## REMOVAL AND INSTALLATION

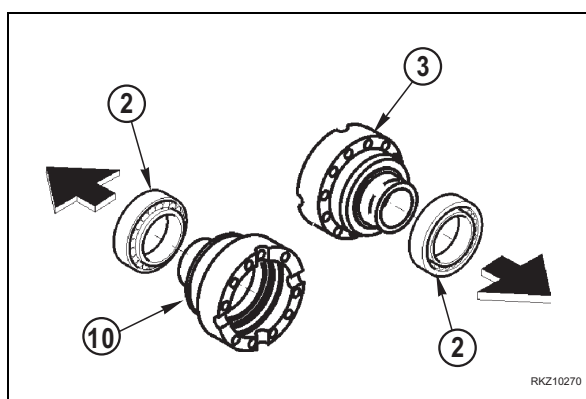
## FRONT AXLE

- 7 - Take the bearing (2) out of the differential half box (3) e (10), using two levers or a three-throw extractor.

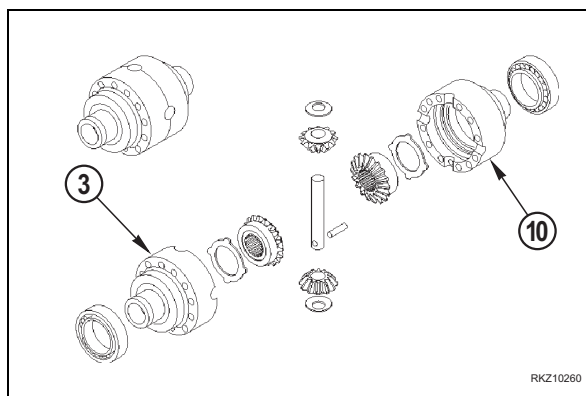


### 7.2 Assembly

- 1 - Assemble the cones of the new taper roller bearings (2) on the half boxes (3), (10) using the special tool **D13** and a hammer.



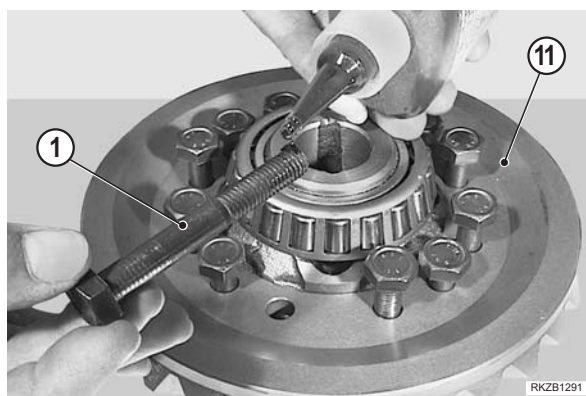
- 2 - Position a half housing (3) on a workbench and assemble all inner components: locking differential counterdiscs (4), sun gears (5), spider (9), spider gears (7), thrust washers (6), pin (8), as shown in figure. Join the two half boxes, aligning the reference marks made during disassembly.



- 3 - Position the ring bevel gear (3) and then fix the whole by tightening the screws (4).

 Screw: 95 Nm

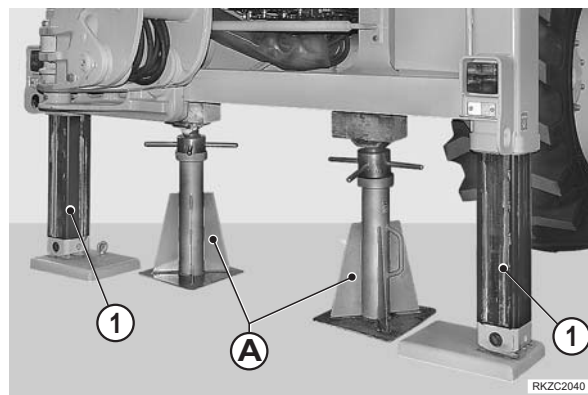
 Screw: Loctite 270



## REAR AXLE

### Removal

- 1 -Lower the backhoe outriggers (1) and force them downwards in order to raise the rear wheels.
- 2 -Place jacks or stands "A" under backhoe frame with non slip blocks that are 50–52 cm high.
- 3 -Start the engine and slowly retract the outriggers until the machine rests on jacks "A", then move frame back to its horizontal position.



- 4 -For added safety, place the backhoe bucket with its back on the ground while holding the arm in its upright position.  
Lower shovel to the ground as well.

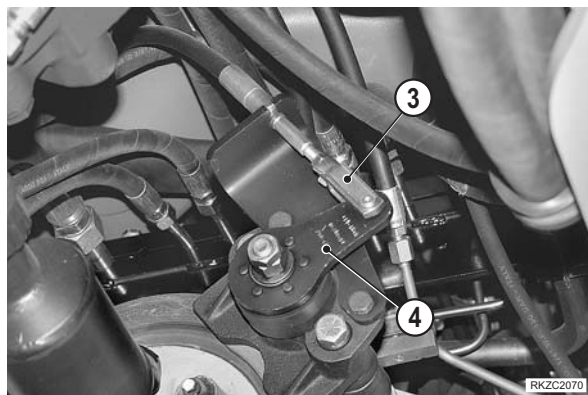


- 5 -Remove the rear wheels (2). [<sup>\*1</sup>]

- 6 -Stop the engine and completely release residual pressures from all the circuits.  
(For details, see "20 TESTING AND ADJUSTMENTS").



- 7 -Disconnect cable (3) from parking brake (4). [<sup>\*2</sup>]

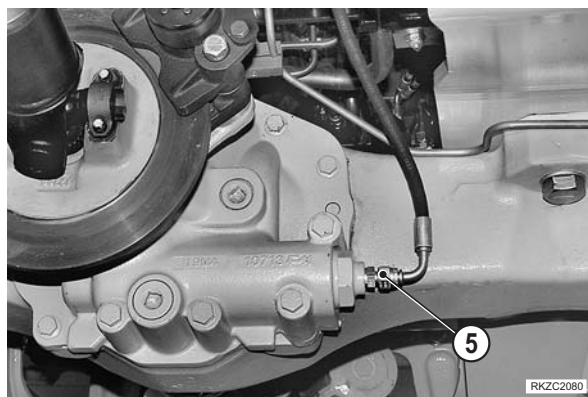


## REMOVAL AND INSTALLATION

## REAR AXLE

8 -Disconnect differential lock hose (5).

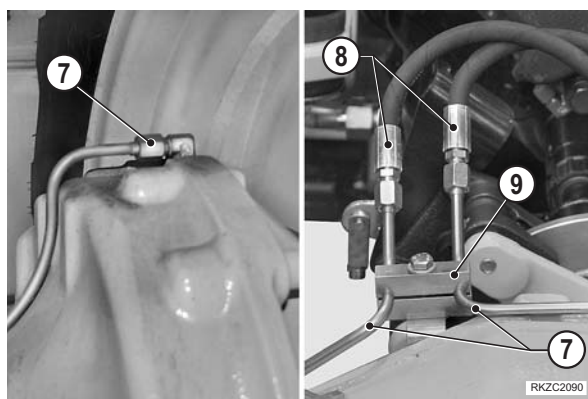
- ★ Cap the hose and hole to prevent contamination.



9 -Disconnect service brake pipes (7) from axle (6).

[\*3]

- ★ Disconnect pipes (7) from hoses (8); loosen and remove clamp (9) and pipes (7).
- ★ Cap pipes, hoses and holes to prevent contamination.



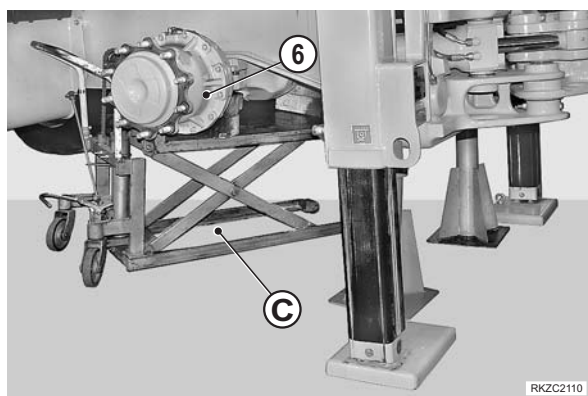
10 -Disconnect the cardan shaft (10) from the rear axle.

[\*4]



11 -Position a jack "C" and some blocks beneath the axle (6). Raise the jack until the blocks can be forced under the axle arms.

- ★ It should be possible to lower the jack by approx. 20 cm.



## REMOVAL AND INSTALLATION

## REAR AXLE

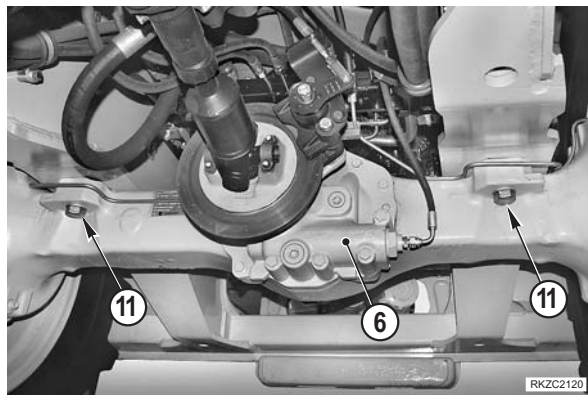
12 -Loosen and remove the screws (11) and (4). [\*5]

13 -Lower the jack until the axle (6) is disengaged from the chassis.

14 -Extract the entire axle.



Rear axle: 435 kg



## Installation

- To install, reverse removal procedure.

[\*1]



Wheel nuts: 500±9.8 Nm

[\*2]

- ★ Bleed the air from the braking circuits. (For details, see "20 TESTING AND ADJUSTMENTS").

[\*3]

- ★ Adjust the stroke of the parking brake lever. (For details, see "20 TESTING AND ADJUSTMENTS").

[\*4]



Cardan shaft screws: 38 Nm

[\*5]



Axle retaining screws: 1000 Nm



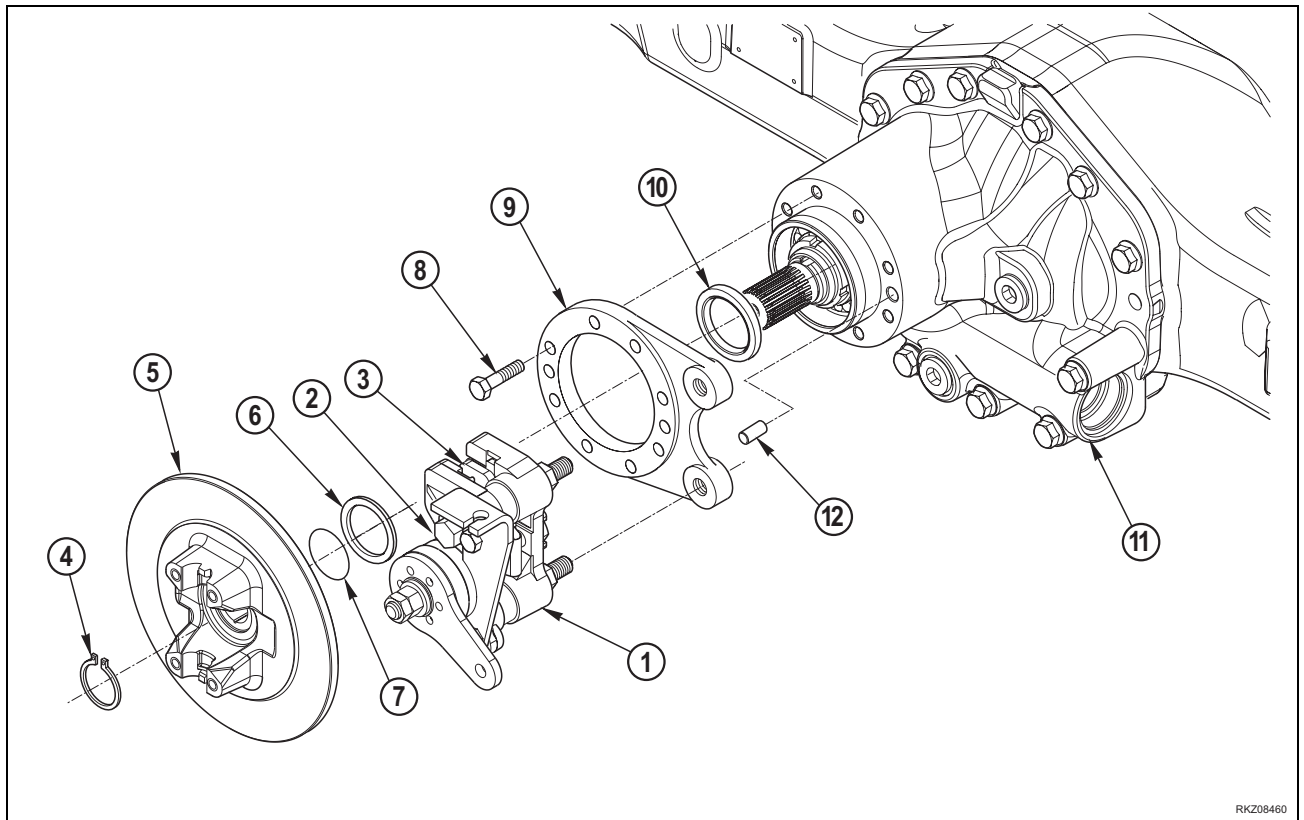
Axle retaining screws: Loctite 262



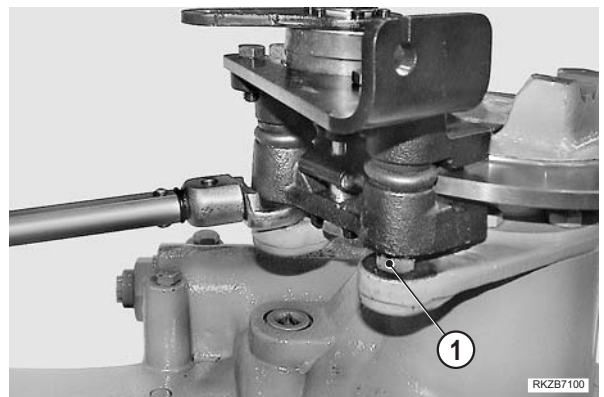
## Disassembly and assembly

### 1. PARKING BRAKE GROUP

#### 1.1 Disassembly



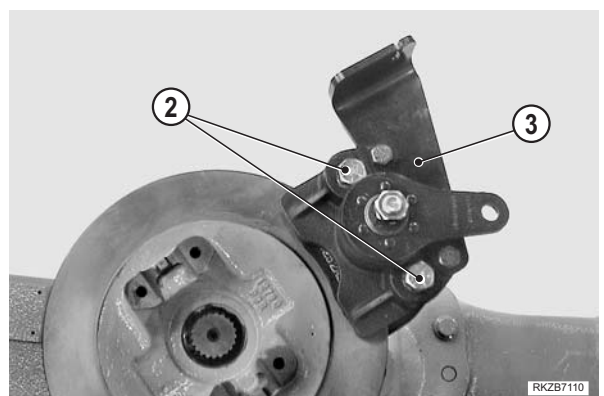
1 -Loosen nut (1) (n°2).



2 -Loosen and remove the screws (2) (n°2).

★ Proceed with care, in order to avoid damaging the brake pads.

3 -Remove the brake caliper (3).



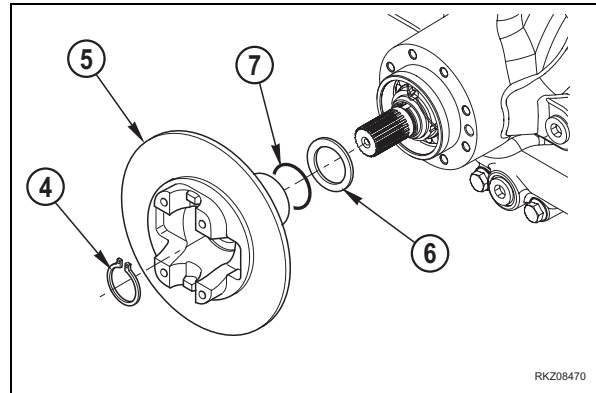


## REMOVAL AND INSTALLATION

## REAR AXLE

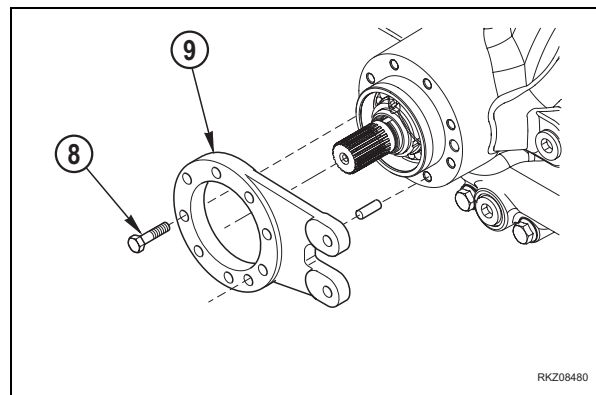
4 -Remove the snap ring (4) and the input flange (5).

★ Collect the shim (6) and the O-ring (7).



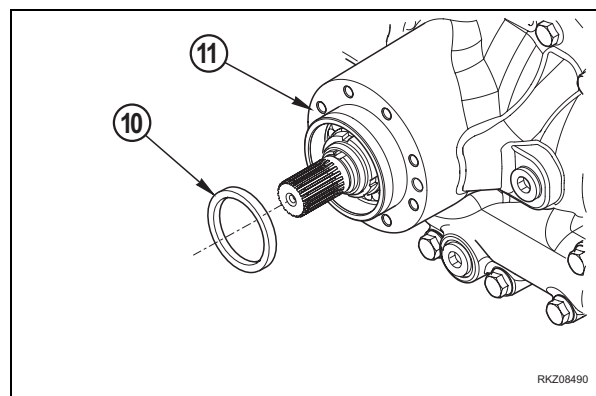
5 -Loosen and remove the screws (8) retaining the brake caliper support (9).

6 -Remove the support (9) from the centre body.



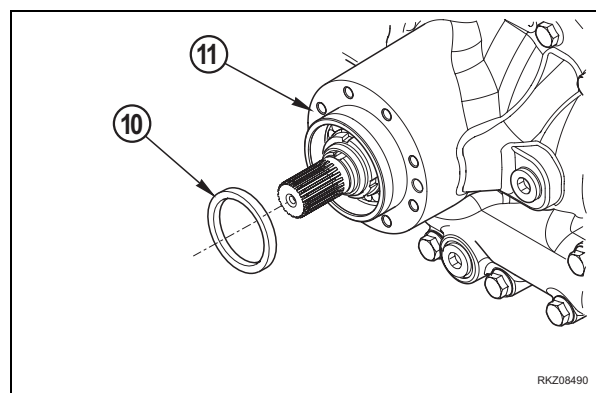
7 -Remove the seal ring (10) from the central housing (11) with a puller.

★ This is a destructive operation for the seal ring.



### 1.2 Assembly

1 -Introduce a new seal (10) into in the central body using special tool E1.

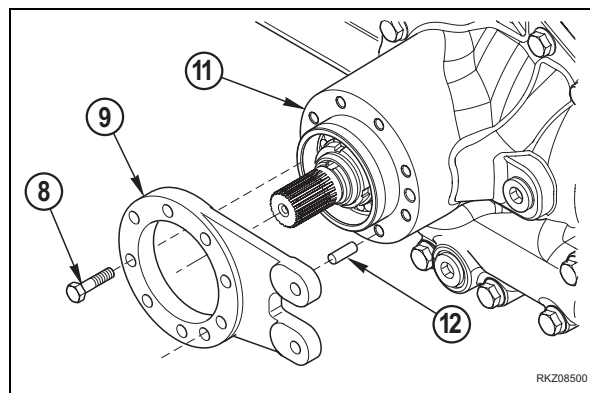


## REMOVAL AND INSTALLATION

## REAR AXLE

- 2 -Insert the dowel pin (10) and the brake caliper support (7) on the central body (9).  
Screw in and tighten the fastening screws (8).

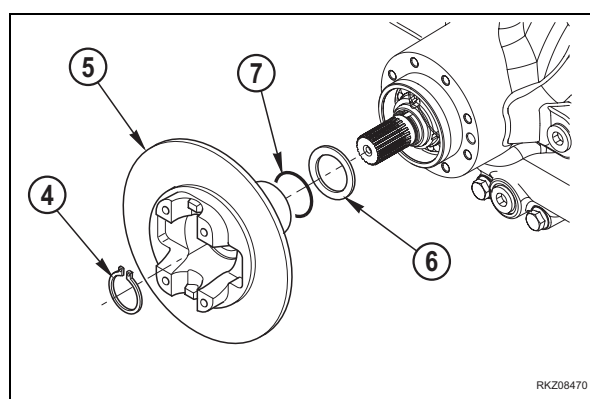
 Support screws: 80 Nm



- 3 -Lubricate O-ring (7).

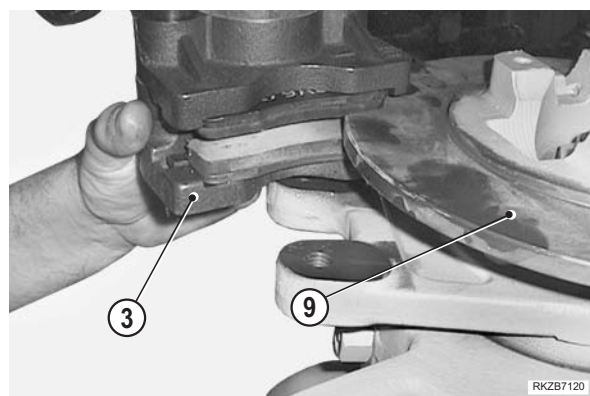
 O-ring: ASL800050

- 4 -Insert the thickness (6) on the splined pinion end, a new O-Ring (7), the input flange (5) and the lock ring (4).



- 5 -Position the brake caliper (3) on the flange disc (9).

★ Be careful to avoid damaging the brake pads.

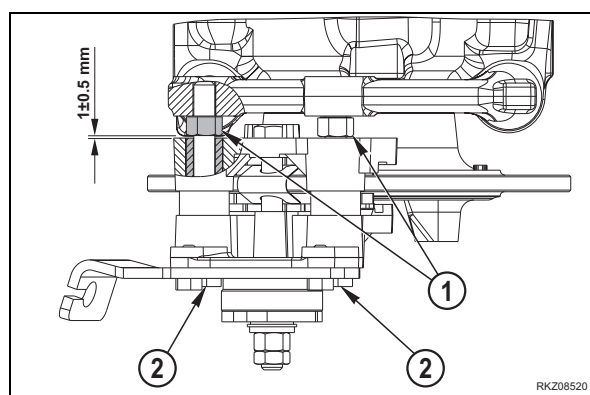


- 6 -Screw in the bolts (2) and tighten the nuts (1) to the prescribed torque.

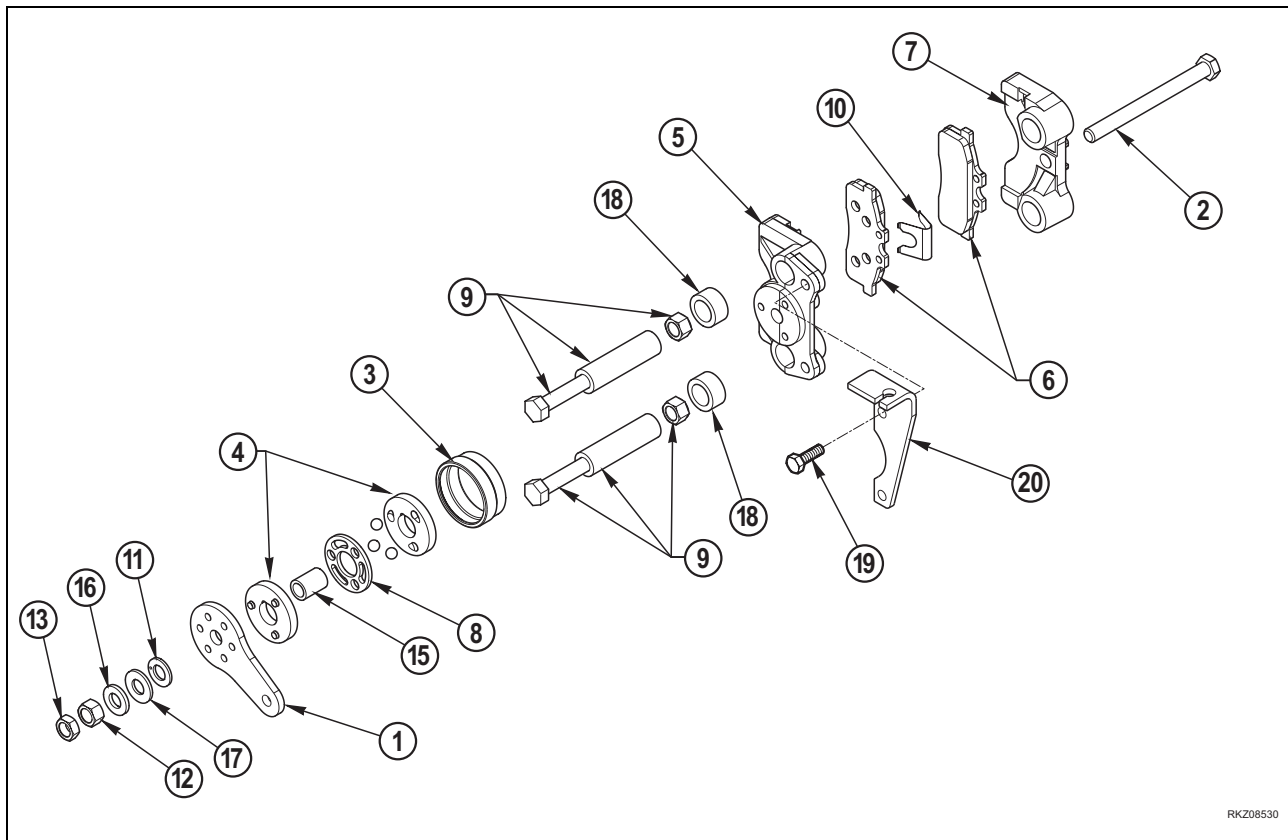
★ Once the nuts are tightened, check to make sure that a  $1 \pm 0.5$  mm gap remains between nuts (1) and the spacers shown.

 Nuts: 115 Nm

 Screw: 45 Nm



## 1.3 Maintenance



RKZ08530

1 - Insert mounting bolts through sleeves (9) and thread brake mounting locking nuts as far as possible on mounting bolts. This is not required if brake assembly comes with the sleeve/bolt sub-assy. Position the brake over disc align with mounting holes in mounting bracket.

2 - Thread mounting bolts (9) into mounting bracket, adjusting bolts until a 0.5 – 1.5 mm exists between the Sleeves and the Locking Nuts. Tighten the Locking Nuts to 115 Nm of torque against the bracket.

3 - Refer to Adjustment Procedure to set backlash of installed brake assembly.

**Brake pad looseness adjustment procedure**

1 - Loosen adjustment nuts (12, 13).

2 - Tighten inner Adjustment Nut (12) until firm contact is made with the disc by the linings. Torque to 160± 170 Nm.

Ensure that the control lever is in the brake apply position.

3 - Back off inner Adjustment nut (12) 4 to 6 turns and check that disc is free to move.

4 - Tighten outer Locking Nut (13) against inner Adjustment Nut (12) to lock Adjustment Bolt (2) in place. Tighten at 62 – 76 Nm.

**Ball and Cam Replacement**

1 - Remove both Adjustment Locking Nuts (12, 13), Thrust, stainless steel and Hardened Washer (11, 16, 17), Lever (11), and Boot (3) from Adjustment Bolt (2).

2 - Remove outer cam (4) and Ball Assembly (8) from Adjustment Bolt (2).

3 - Use a screwdriver, or similar tool, to gently pry inner Cam (4) protrusions on back of cam, loose from Torque Plate (5), and remove from Adjustment Bolt (2). Remove Seal (15) from Adjustment Bolt (2).

4 - Install new Seal (15) on Adjusting Bolt (2), inserting through inner Cam (4) until Seal (15) bottoms out on Torque plate.

★ We recommend lubricating the cams' thrust surfaces before installing the cams (4).

 Cam surface: ASL800050

## REMOVAL AND INSTALLATION

## REAR AXLE

- 5 -Install new Cam (4) on Adjustment Bolt (2), taking care to orient protrusions into Holes in Torque Plates (5).
- 6 -Install Ball Assembly (8) onto Adjusting Bolt (2), orienting balls into pockets of Inner Cam (4). Install outer Cam (4) onto Adjustment Bolt (2), orienting pockets onto Balls of Balls Assembly (8). Install boot (3) over cam assembly.
- 7 -Install Lever (1), using protrusions on back of outer Cam (4) and holes in Lever (1) to orient lever to proper operating position.
- 8 -Install remaining washer and nuts and follow adjustment procedure at paragraph 1.2.
  - ★ Check to ensure that the coated side of shim (11) is oriented towards the steel washer (17).

### Lining Replacement

- 1 -Loosen two adjustment Locking Nuts (12, 13) enough to remove each Torque Plate (5, 7) away from disc far enough to provide backlash to remove old carrier and lining assemblies and install new ones. (It may be necessary to remove one or both Nuts)
- 2 -Collapse the two Lining retraction Springs (10) and remove them from brake Head Assembly.
- 3 -Remove Torque Plates (5, 7) away from disc, move Carrier and Lining Assemblies (6) out of pockets, and remove from the Brake Head Assembly from the side.
- 4 -Before installing new pads, it is necessary to introduce grease between bushings (9) and pad supports (5, 7).
  -  Bushings: ASL800050
  - ★ Once grease has been applied, slide the supports onto the bushings so as to distribute grease evenly.
- 5 -Install new Carrier and Lining Assemblies (6) in each Torque Plate (5, 7).
- 6 -Install the two Lining Retention springs (10) into Brake Head Assembly. Be sure spring's "feet" are positioned properly in holes in both Lining Carrier Assemblies (6).
- 7 -Adjust brake at paragraph 1.2.

### Sleeve seal replacement

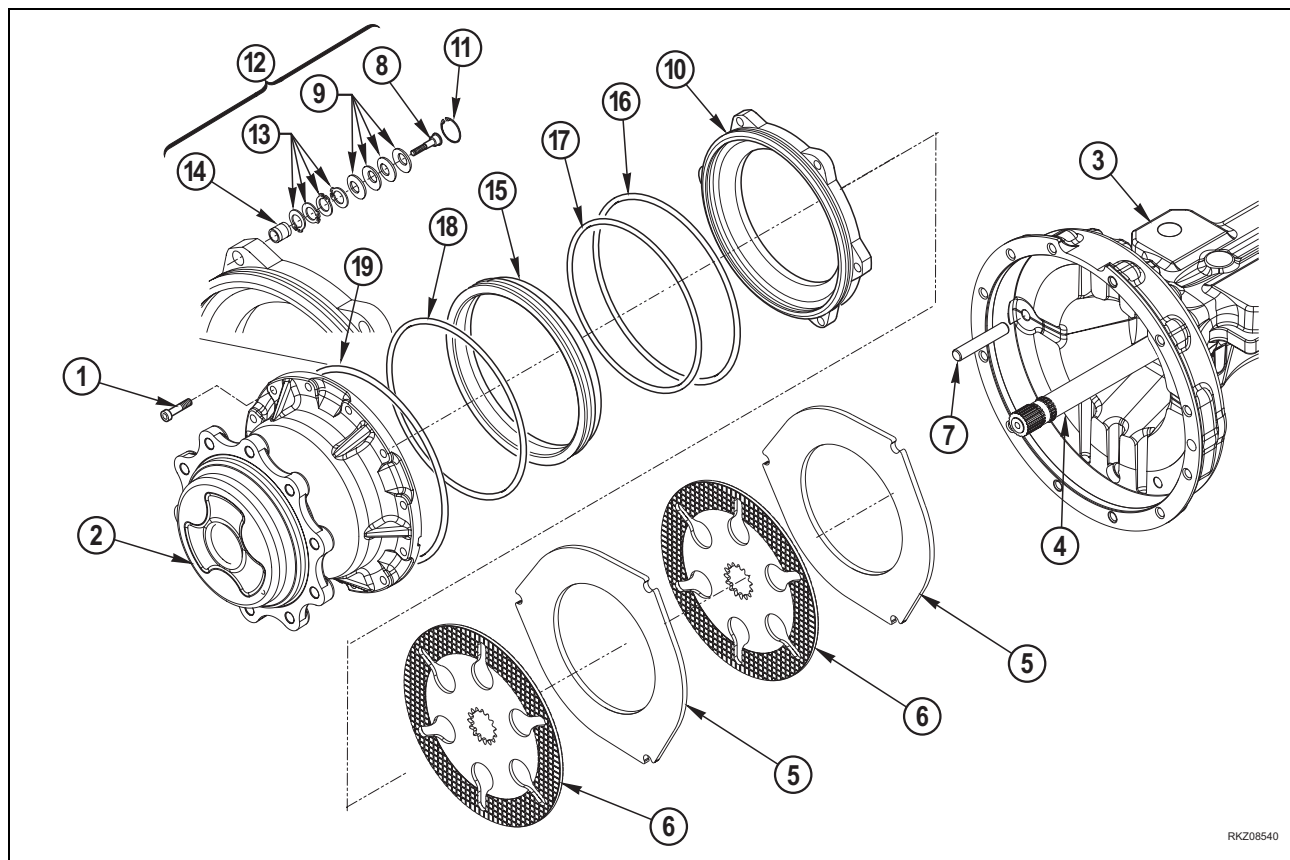
- 1 -Loosen the two locking nuts on the mounting bolts and remove the mounting bolt/sleeve assembly (9) from the brake.
- 2 -Insert sleeve seals (18) between the torque (5, 7) and align with the sleeve bores.
  - ★ Lubricate the mounting bolt/sleeve fit before installing
  -  Bushings: ASL800050.
- 3 -Install the mounting bolt / sleeve assembly through the front pad support (5), the sleeve seals (18) and the rear pad support (7).
- 4 -Mount brake per paragraph 1.1 and adjust per section 1.2.

### Replacing the cable attachment bracket

- 1 -Remove the screws (19) of the bracket (20) from pad support (5).  
Remove the bracket (20).
- 2 -Position the bracket (20) in correspondence with the threaded holes of the pad support (5).  
Fix the bracket (20) to the front torque plate (5) with the appropriate screws (19).
  -  Screw: 63 Nm

## 2. SERVICE BRAKE GROUP

### 2.1 Disassembly

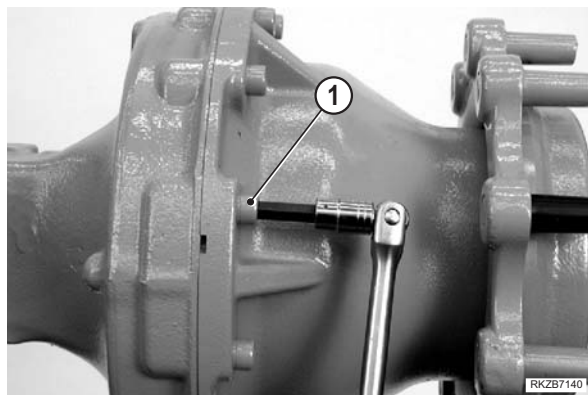


1 - Drain the oil completely from the differential.

 Differential oil: approx. 15 ℓ.



2 - Remove all but two of the cap screws (1).

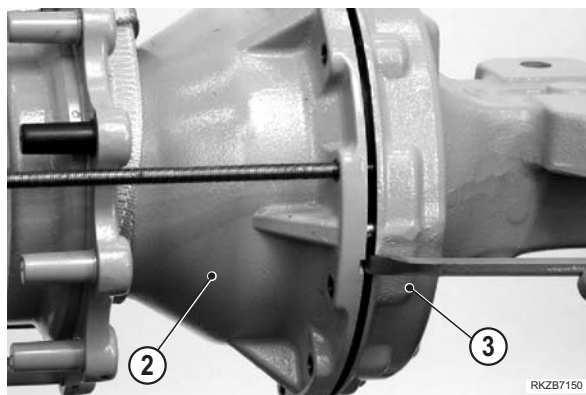


## REMOVAL AND INSTALLATION

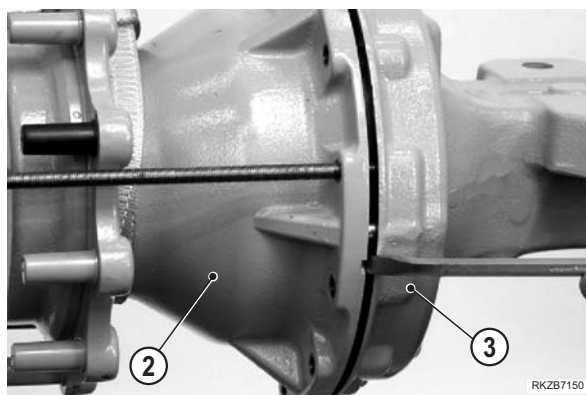
## REAR AXLE

3 -Connect the hub (2) to a lifting device and tension the rope.

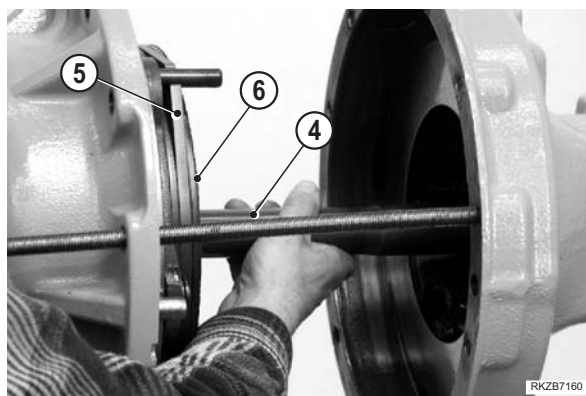
★ insert two dowel rod to enable removal.



4 -Remove last two cap screws (1) and separate the hub (2) from the axle (3).



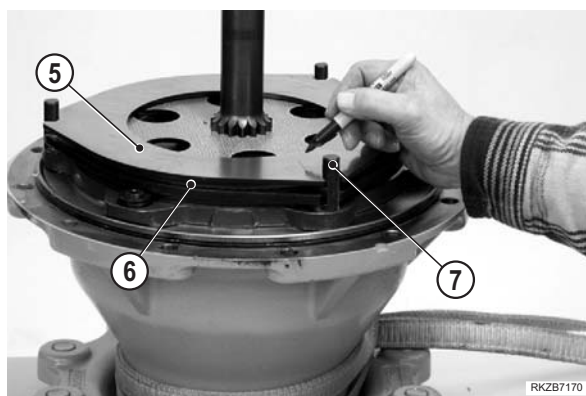
5 -Slowly pull hub (2) away from axle and the half shaft (4), make sure that brake disks (5) and plates (6) stay with the hub.



6 -Stand the hub up, mark the reaction plat (5) that was against the axle housing (3). Remove the reaction (6) and brake disks (5) and pins (7).

★ Check friction plate and brake separator thickness. For details, see ("40MAINTENANCE STANDARD")

★ If brake discs are to be replaced, soak the new discs (for each differential) in oil for at least 24 hours

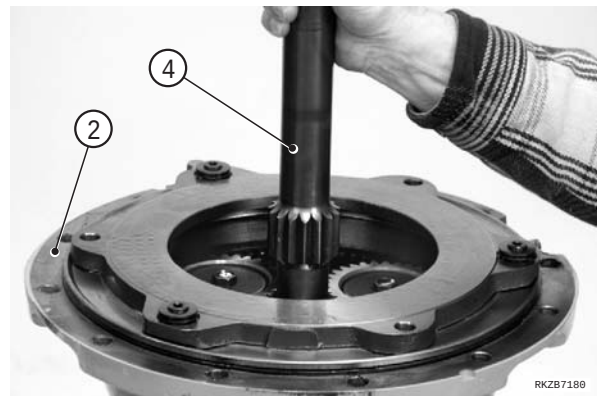




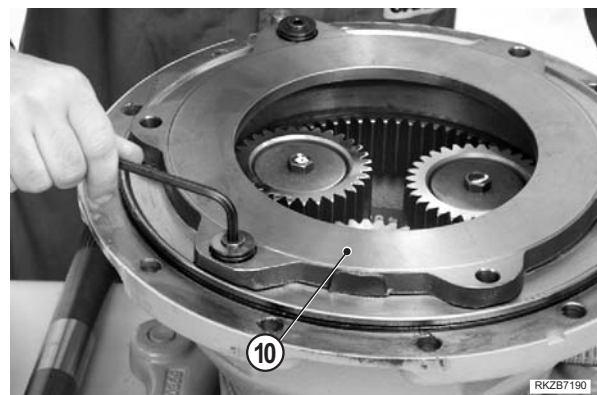
## REMOVAL AND INSTALLATION

## REAR AXLE

7 - Remove axle shaft (4) from wheel hub assembly (2).

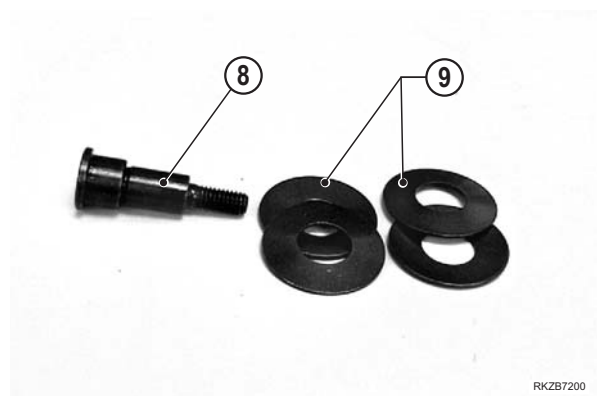


8 - Remove screws (8) and Belleville washers (9) from brake cylinder (10).

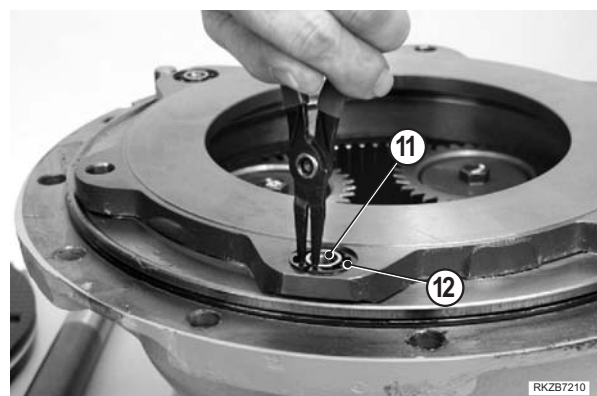


9 - Check to ensure that screws (8) and Belleville washers (9) are not damaged.

- ★ If brake discs are being replaced, replace screws and washers with the new kit.



10- Remove the lock ring (11) and remove the self adjuster (12).

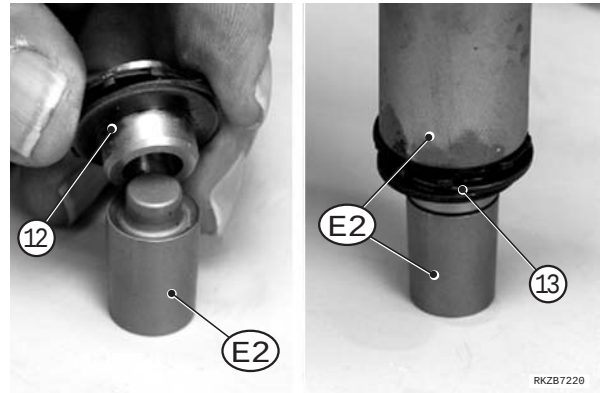




## REMOVAL AND INSTALLATION

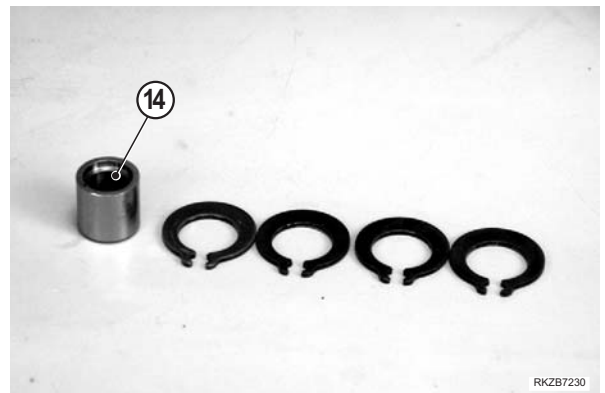
## REAR AXLE

- 11 -Place self adjuster (12) onto special tool **E2** and drive out the spring clips (13) from the adjuster.

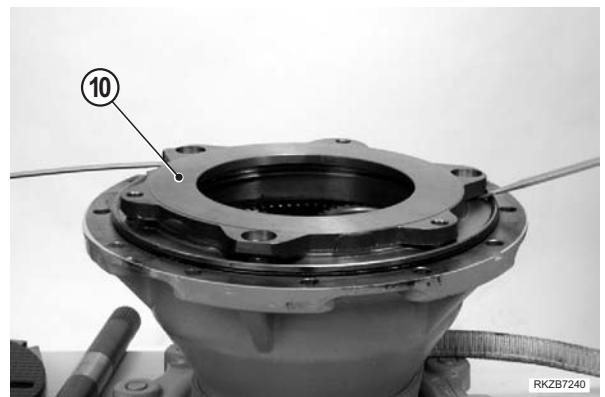


- 12 -Inspect adjuster bushing (14) for wear.

★ Repeat procedure for the remaining 2 kit self adjust.



- 13 -Use an acceptable flat bars and pry the brake piston (10) up from the hub.



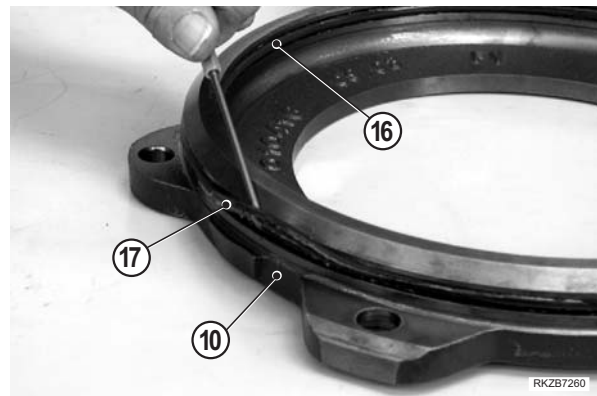
- 14 -Remove from the brake complete piston (10) the inner cylinder (15).



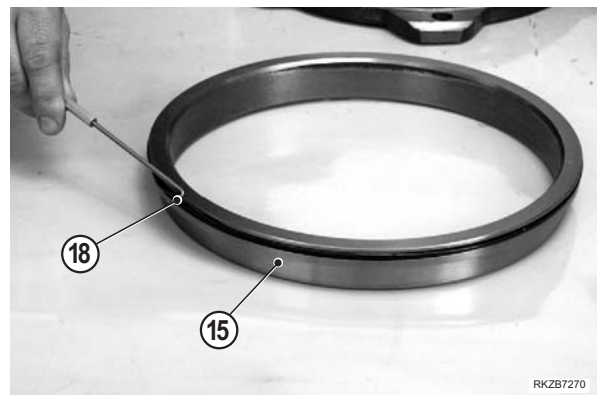
## REMOVAL AND INSTALLATION

## REAR AXLE

15 -Remove O-rings (16) and (17) from the brake piston (10).



16 -Remove O-ring (18) from inner cylinder (15).



17 -Remove and replace O-Ring (19).

★ This is a destructive operation for the O-ring.



### 2.2 Assembly

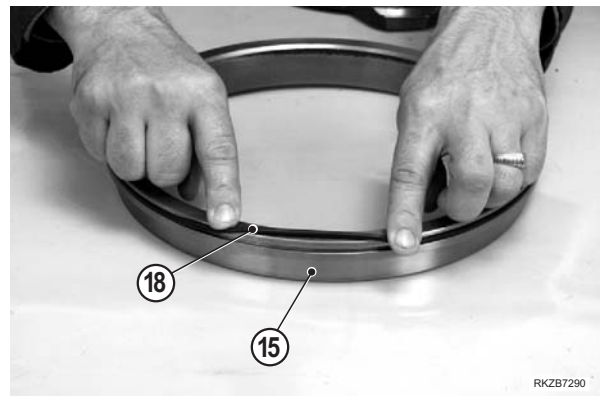
1 -Install a new O-Ring (19) onto hub (2).



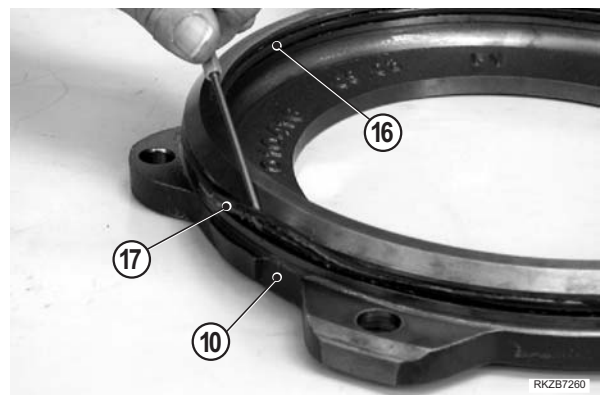
## REMOVAL AND INSTALLATION

## REAR AXLE

2 -Install O-ring (18) onto inner cylinder (15).

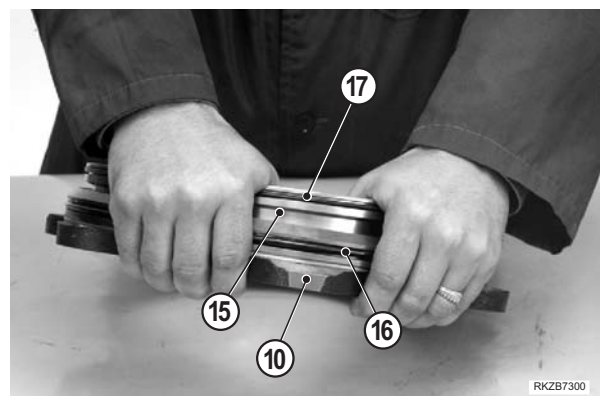


3 -Install O-rings (16) and (17) onto brake piston (10).



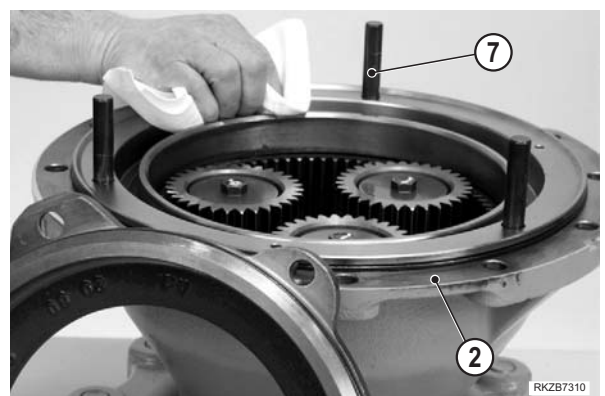
4 - Lubricate O-rings (16), (17) and (18), and install complete piston (15) to brake cylinder (10)

 O-ring: ASL800050



5 -Use hydraulic oil to lubricate the brake cavity of the hub housing (2) and mount pins (7).

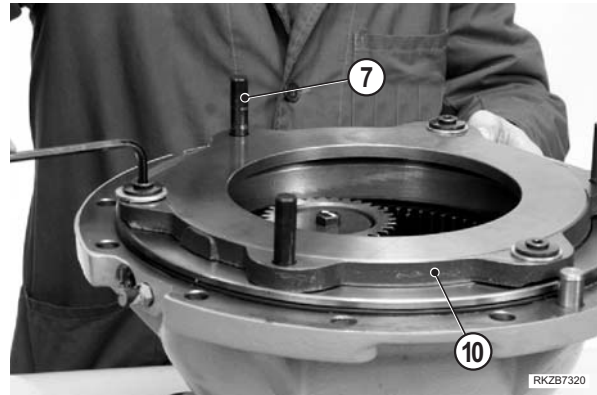
 Cylinder cavity: ASL800050



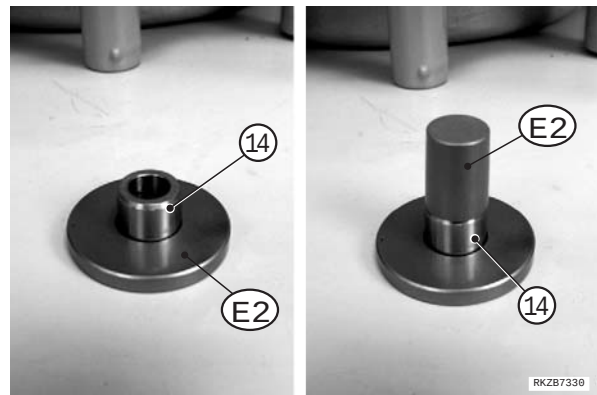
## REMOVAL AND INSTALLATION

## REAR AXLE

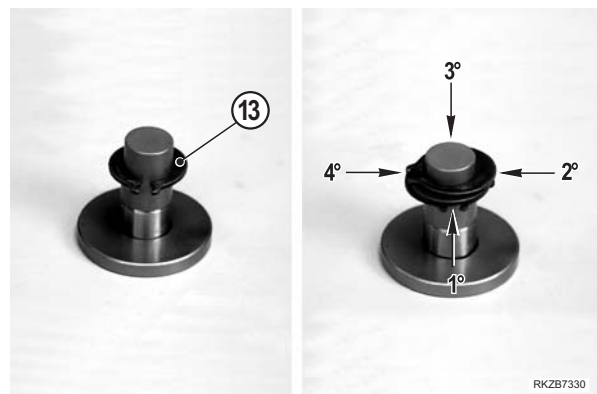
6 - Install the complete brake cylinder (10) and remove pins (7).



7 - Place bushing (14) inside calibrated ring **E2** with the chamfer facing upwards.  
Place pin **E2** into brake adjuster (14).

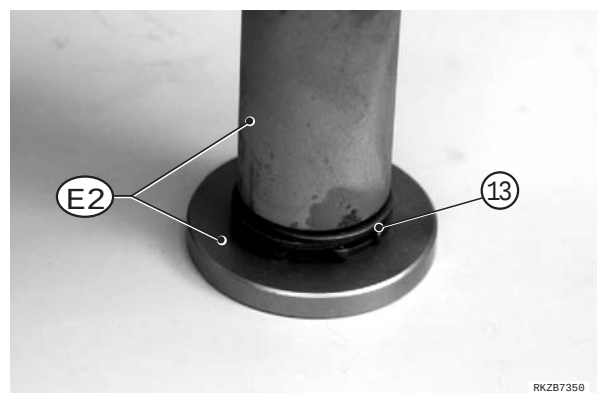


8 - Mount spring clips (13) taking care to rotate them 90° clockwise respect to the one mounted before.



9 - Using driver **E2**, push the rings (13) until solid contact against calibrated ring **E2** is obtained.

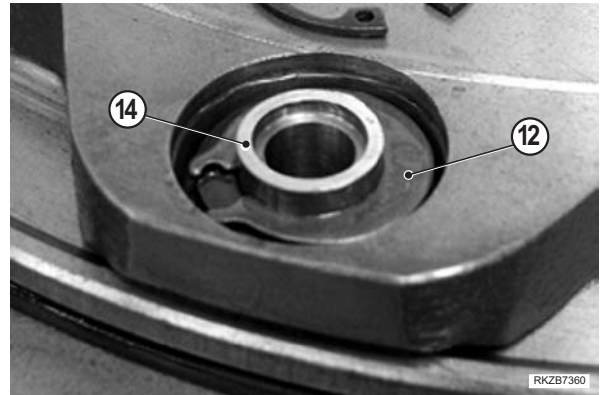
★ Repeat procedure for the remaining 2 self adjust.



## REMOVAL AND INSTALLATION

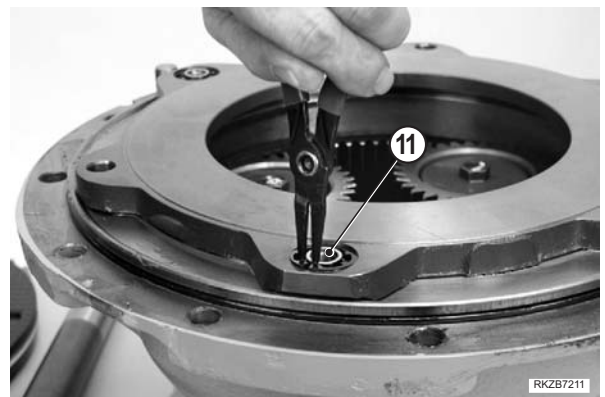
## REAR AXLE

10 -Insert the adjuster (12) into the brake piston, make sure that the chaffered side is up.

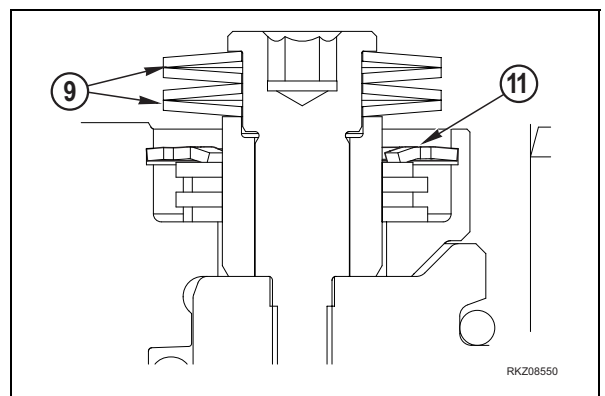


11 -Install the snap rings (11) into the self adjuster bore.

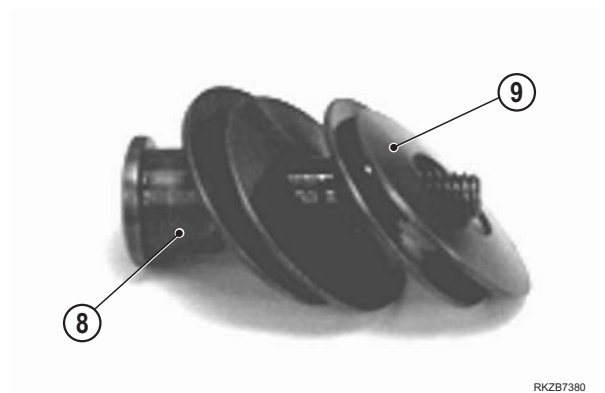
- ★ Check to ensure that spring ring teeth are facing the self adjust kit as shown in the following illustration.



12 -Snap ring (11) orientation and Belleville washers (9).



13 - Install Belleville washers (9) to screws (8) taking care to orient them as shown in the previous illustration.



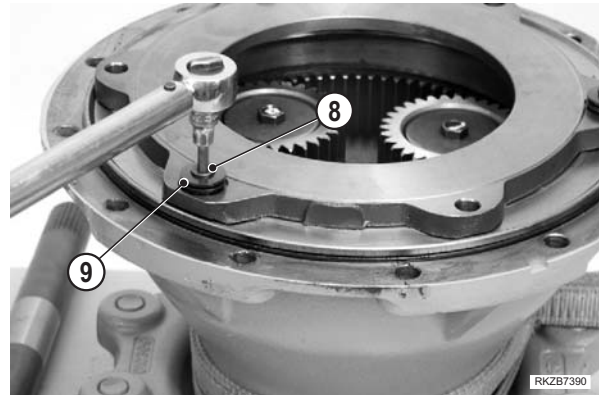


## REMOVAL AND INSTALLATION

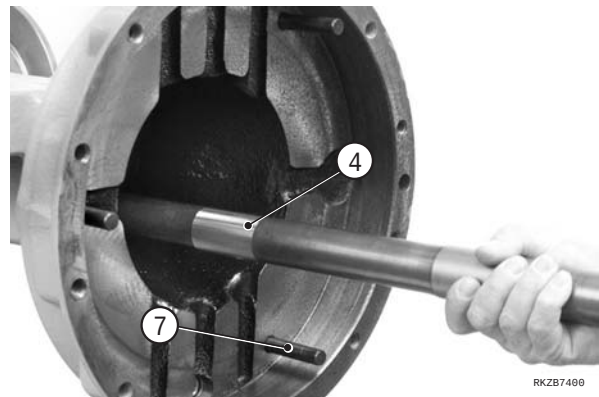
## REAR AXLE

- 14 - Mount the shouldered bolts (8) and spring washers (9) and tighten to the requested torque

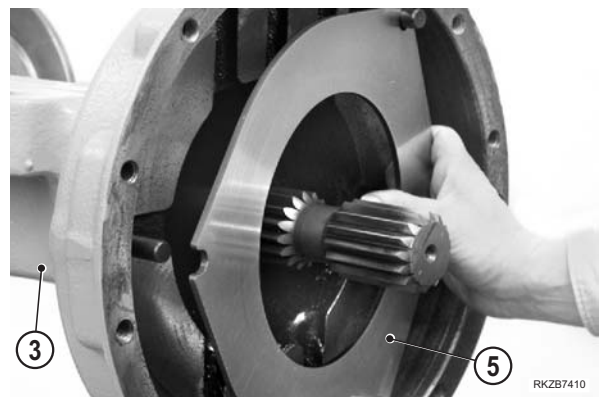
 Screw: 16 Nm



- 15 - Put the half shaft (4) and brake separator plate pins (7) into the axle housing.

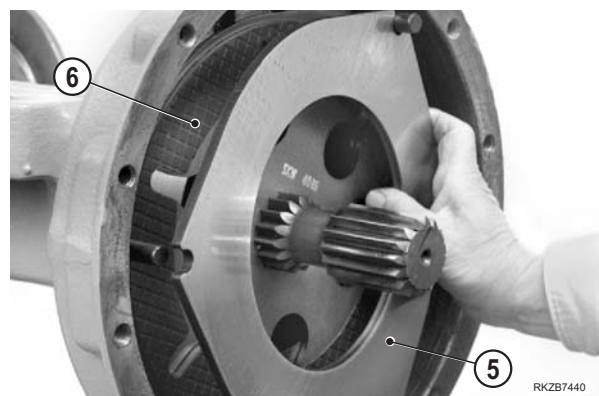


- 16 - Using the reference mark made during disassembly, place the inner brake separator plate (5) into the axle housing (3).



- 17 - Place the inner brake disk (6) and the second brake separator (5).

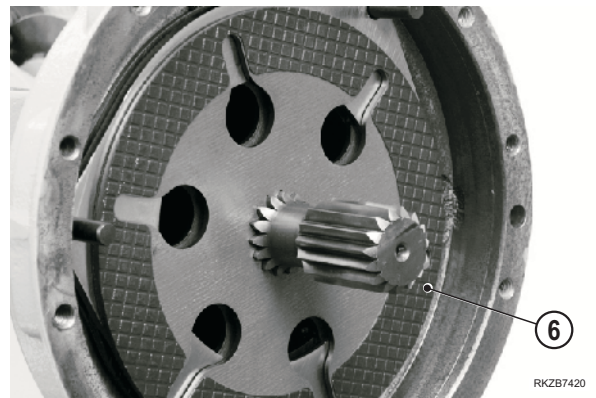
★ If brake discs (6) are replaced, soak discs (for each differential) in oil at least 24 hours prior to installation.



## REMOVAL AND INSTALLATION

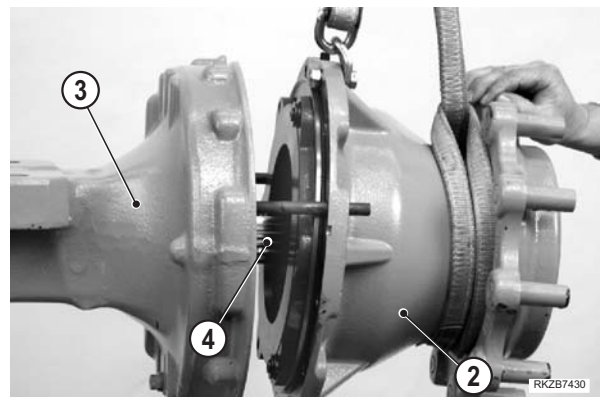
## REAR AXLE

- 18 -Place the outer brake disk (6) and make sure the slots of the inner and outer brake disks are aligned with each other.



- 19 -Attach lifting equipment to hub assembly (2) and guide onto the axle (3).

- ★ Use a piece of rope and lift and rotate the half shaft while pushing the hub onto the axle.

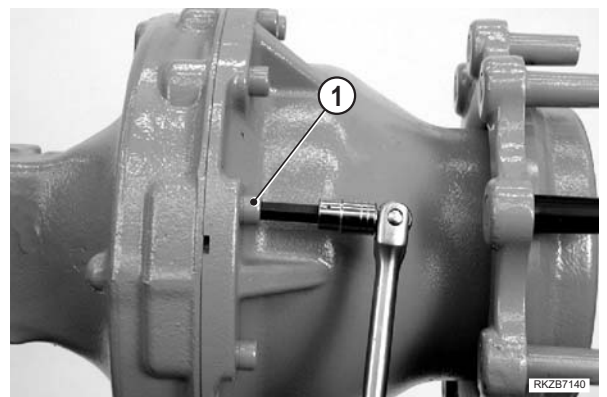


- 20 -Install screws (1) tighten to the required torque

 Screw: Loctite 270

 Screw: 226 Nm

- ★ Tighten using the alternating crosswise method.



- 21 -Fill axle with oil.



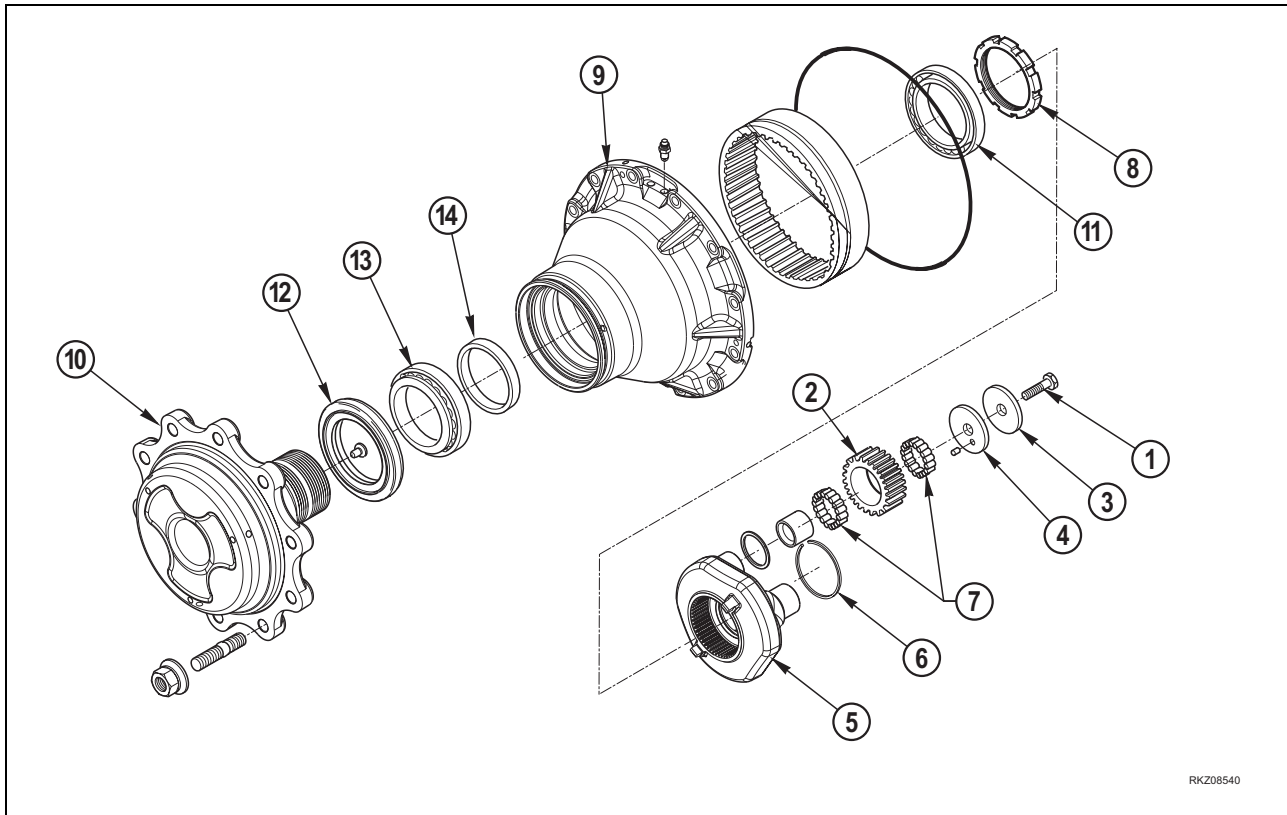
Differential oil: approx. 15 ℓ





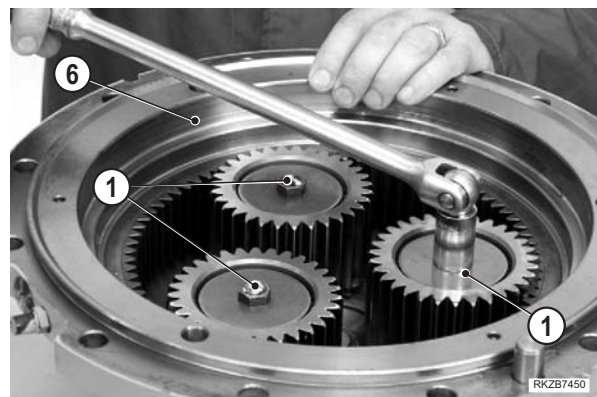
### 3. WHEEL HUB

#### 3.1 Disassembly



1 -Loosen the screws (1).

★ replace screw with a new set.



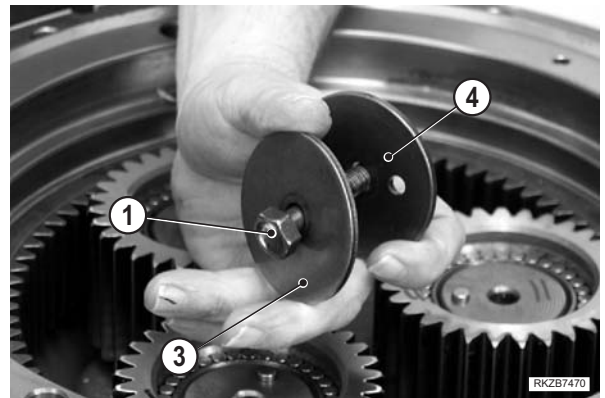
2 -Mark side gears (2), retaining washer (3) and indexed washer (4).



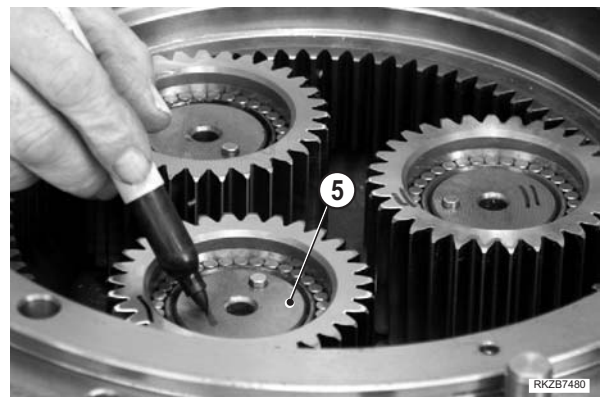
## REMOVAL AND INSTALLATION

## REAR AXLE

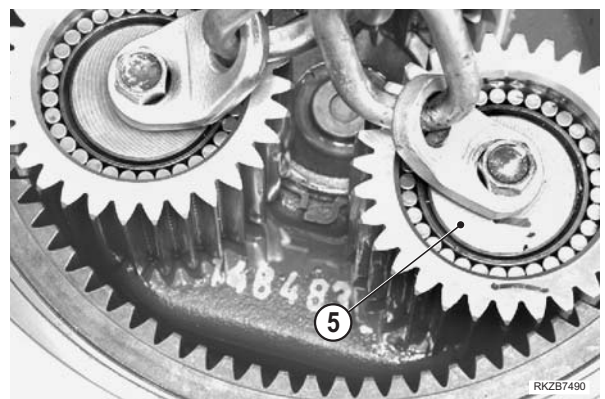
3 -Remove screws (1), retaining washer (3) and indexed washer (4).



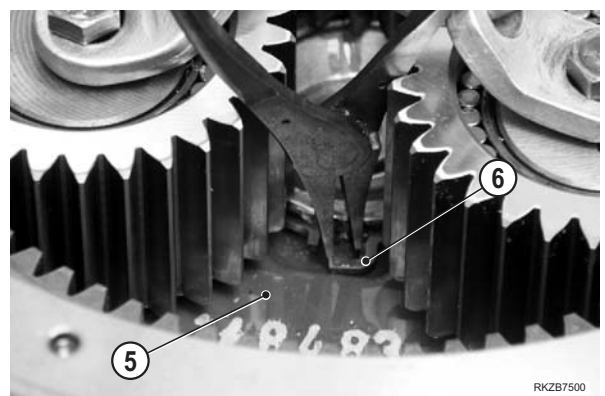
4 -Mark the mounting position of retaining washer (3) and indexed washer (4) on the planetary carrier (5).



5 -Attach lifting equipment to planetary carrier (5).



6 -Locate the snap ring (6) slot and open it while raising the planetary carrier (5).

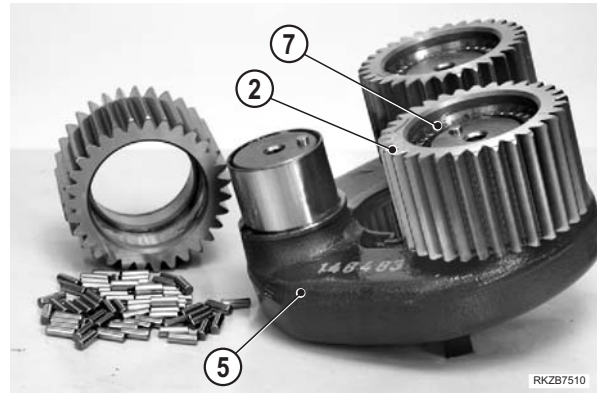


## REMOVAL AND INSTALLATION

## REAR AXLE

7 -Only if necessary: only if necessary, remove from the planetary carrier (5) the side gears (2) and their related rollers (7) (n° 66 per gear).

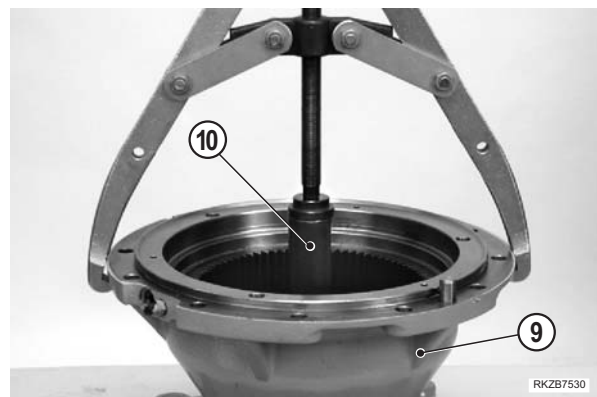
- ★ stock all the components of each gear together as a set.



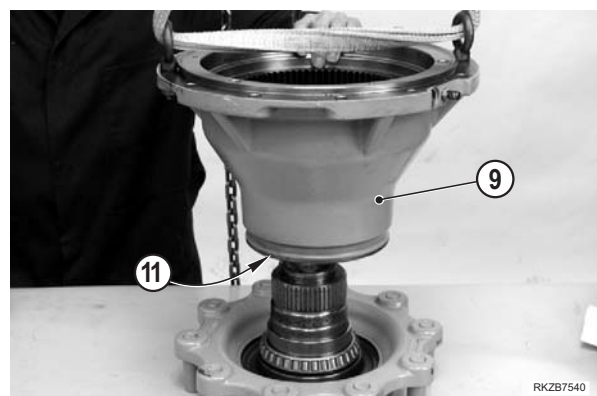
8 -Using spanner **E4**, loosen and remove the ring nut (8).



9 -Use suitable puller and separate hub housing (9) from wheel flange (10)



10 -Attach lifting equipment to hub housing (9) and remove from the wheel flange (10).  
Collect the bearing cone (11)



## REMOVAL AND INSTALLATION

## REAR AXLE

- 11 -Remove from hub housing (9) the outer race of the bearing (11).

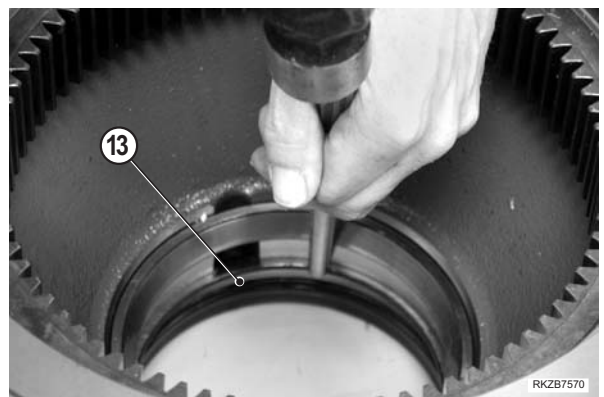


- 12 -Remove from hub housing (9) the outer race of the bearing (12).

★ This is a destructive operation for the seal ring.



- 13 -Remove from hub housing (9) the outer race of the bearing (13).



- 14 -Remove from wheel flange (10) spacer (14).





## REMOVAL AND INSTALLATION

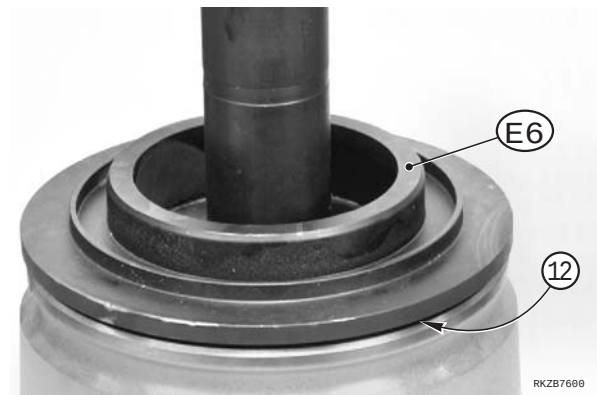
## REAR AXLE

- 15 - Using an angle grinder, cut the cage and etch the bearing ring (13).  
Use a chisel to cut and remove bearing inner race (13).



### 3.2 Assembly

- 1 - Install bearing outer races (13) and (11) to hub (9) using special tool **E5** and a press. Using special tool **E6** install the hub seal (12).



- 2 - Install bearing inner race (13) to wheel flange (10) using a suitable driver and a press.



- 3 - Install spacer (14) on wheel flange (10)

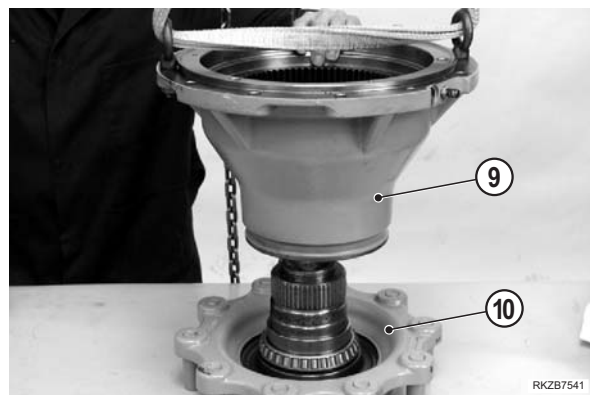


## REMOVAL AND INSTALLATION

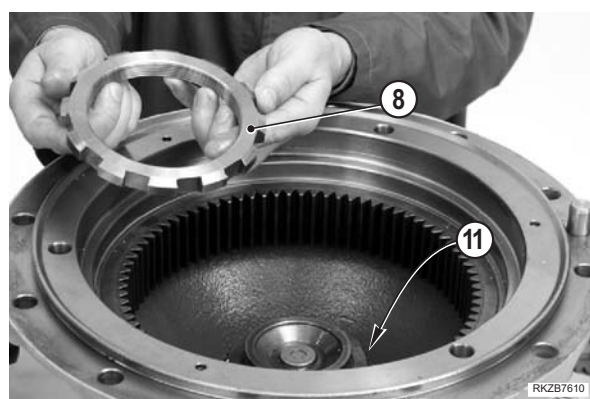
## REAR AXLE

4 -Attach lifting equipment to hub (9) and carefully install onto wheel flange (10).

- ★ Clean accurately all sealing surfaces.
- ★ Take care not to damage the hub seal (12).

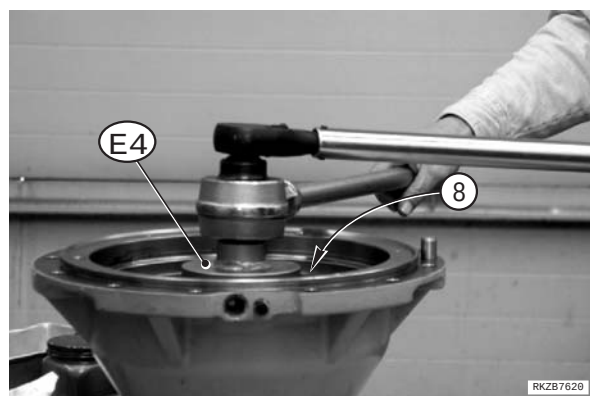


5 -Install bearing inner race (11) using a suitable driver and a hammer.  
Install ring nut (8).



6 -Using spanner **E4**, tighten ring nut (8) to the required torque.

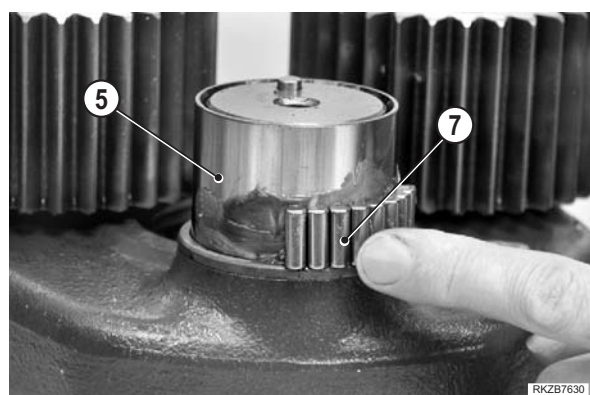
 Ring nut: 1000 Nm



7 -Apply a light coat of Lithium based grease to the planetary carrier (5) stud to hold the needle bearings (7) (n° 33) in place.

 Grease: ASL 800050

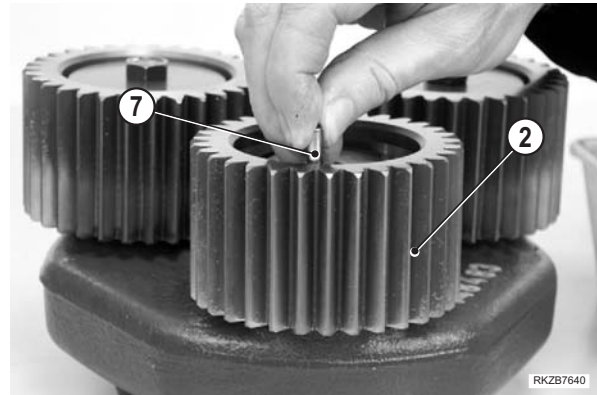
- ★ Use all the components corresponding to the marks made during disassembly.



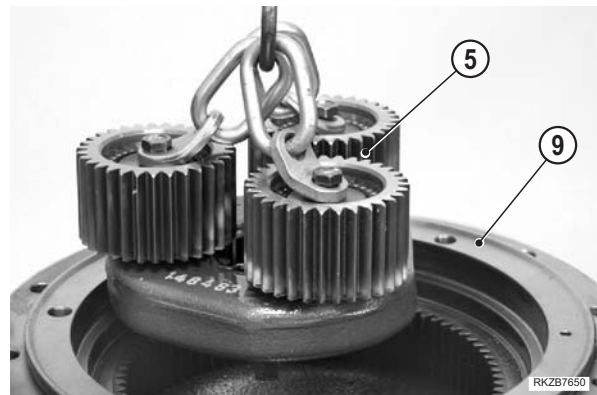
## REMOVAL AND INSTALLATION

## REAR AXLE

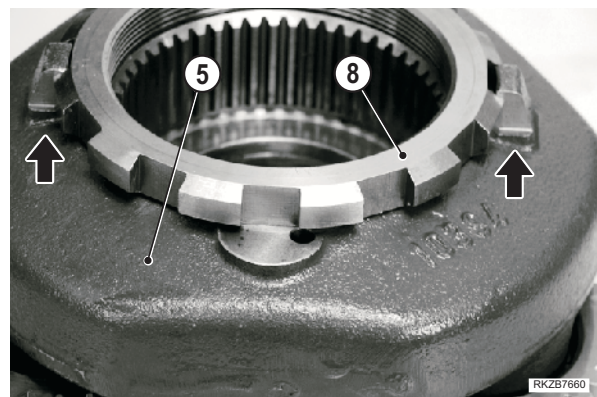
8 - Install the side gear (2) and the remaining needle rollers (7) (N° 33) into the side gear.



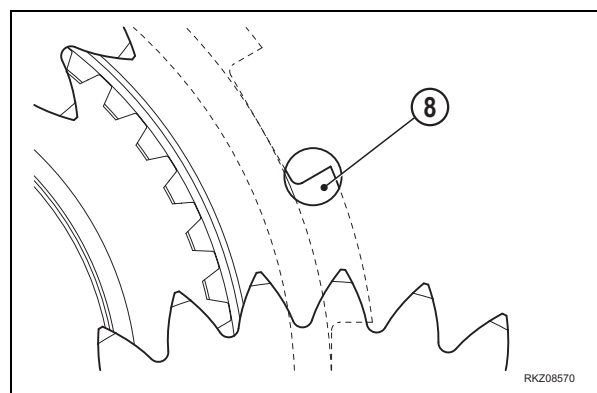
9 - Attach lifting equipment to planetary carrier (5) and lower into hub (9).



10 - During installation the locking ears of the planetary carrier (5) must engage the ring nut (8) as shown in figure and in next one.



11 - In order to simplify the installation, align the hole on the planetary carrier (5) with the ring nut (8) as shown.

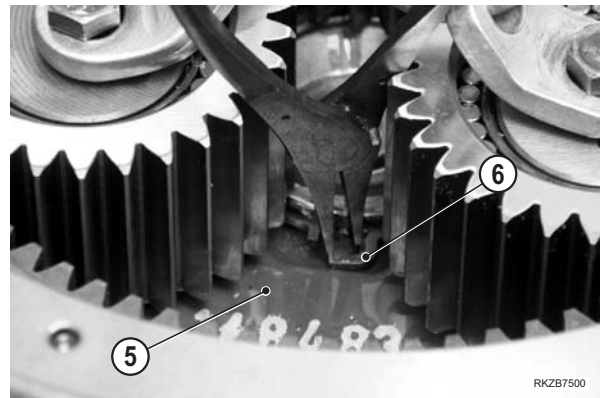




## REMOVAL AND INSTALLATION

## REAR AXLE

- 12 -Open the snap ring (6) and slowly lower the planetary carrier (5).

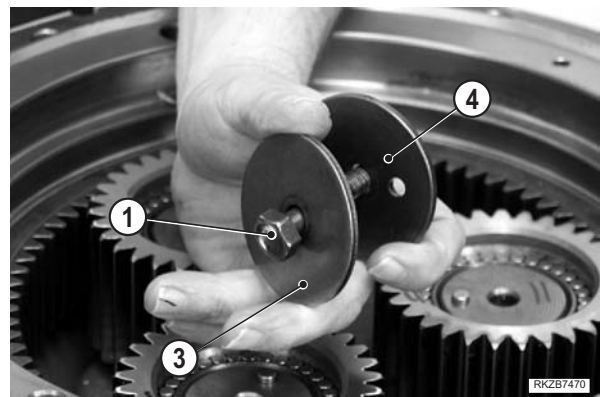


- 13 -Install washers (3) and (4) and tighten screws (1); apply the specified sealant and tighten to the required torque.

★ Replace bolts with new ones.

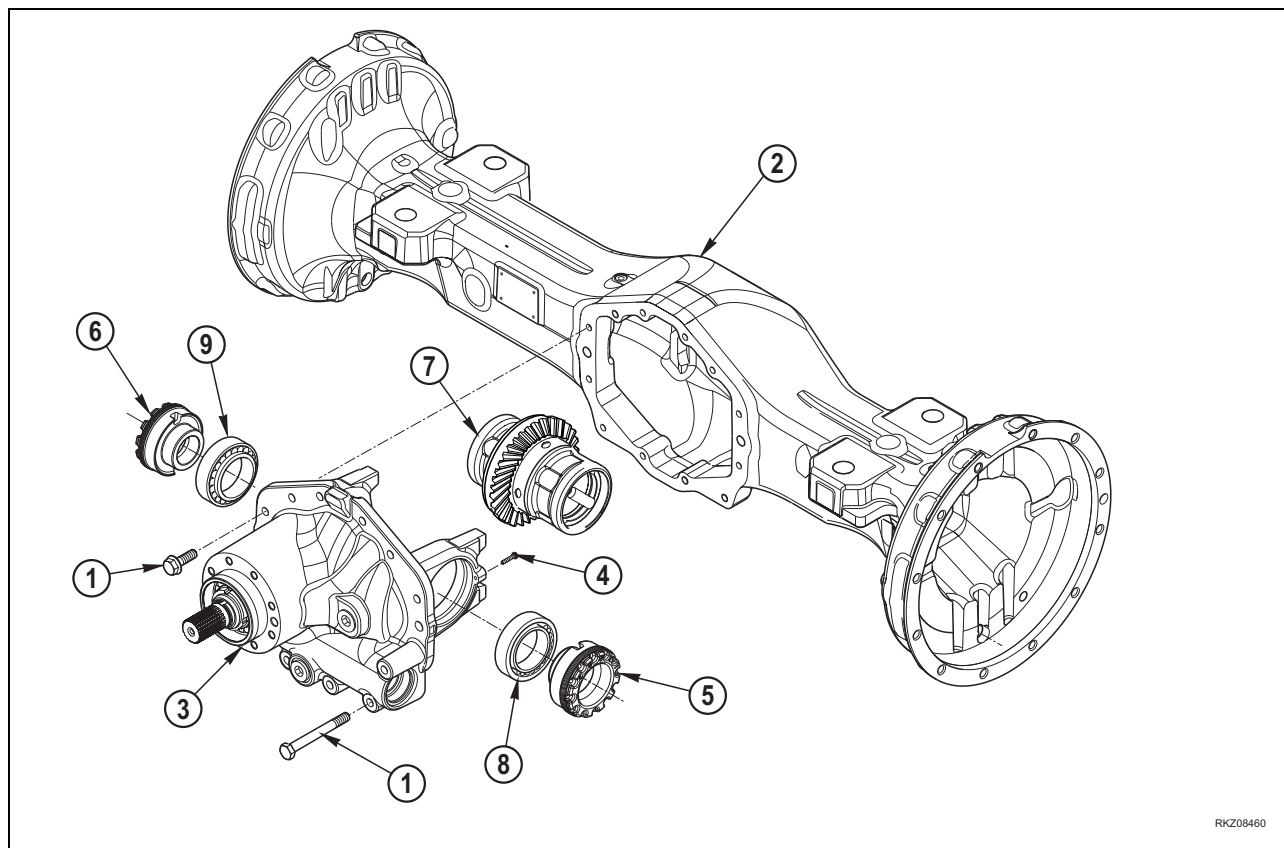
 Screw: Loctite 270

 Screw: 79 Nm



## 4. DIFFERENTIAL SUPPORT GROUP

### 4.1 Disassembly



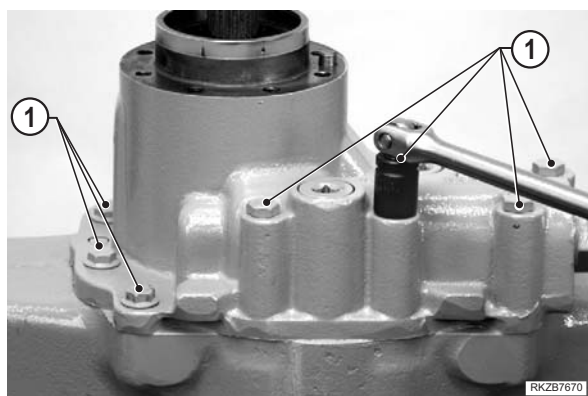
1 - Drain the oil completely from the differential.



Differential oil: approx. 15 ℓ



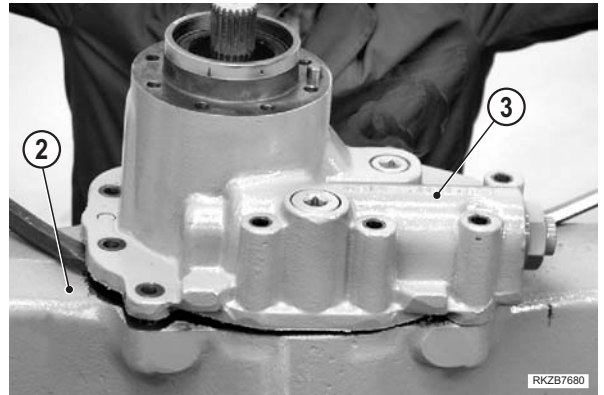
2 - Remove the all screws (1).



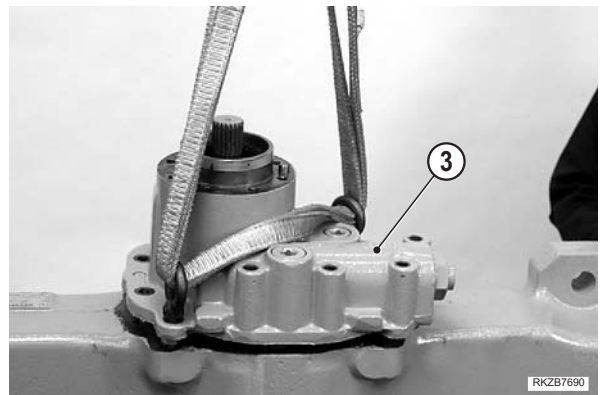
## REMOVAL AND INSTALLATION

## REAR AXLE

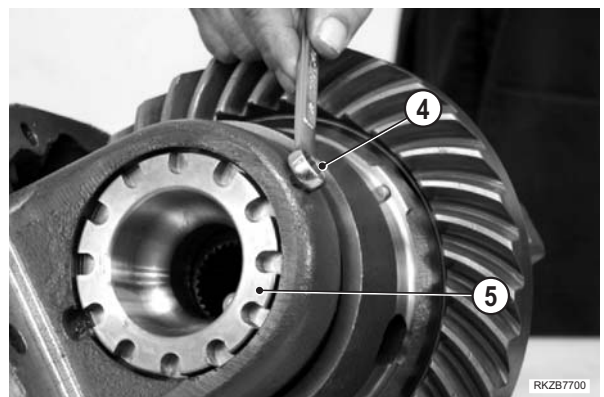
3 -Separate from axle (2) the differential housing (3) using pry bars in slots.



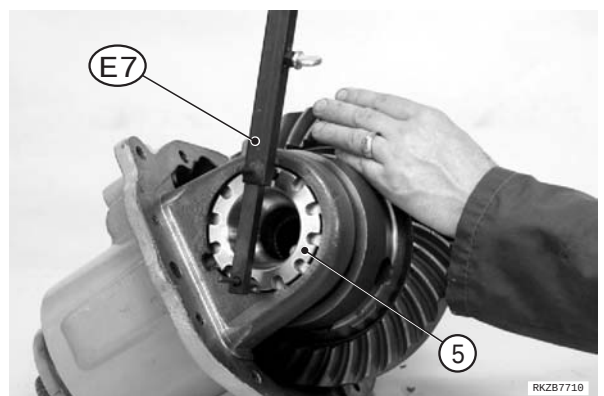
4 -Attach lifting eyes to differential housing (3) and remove it.



5 -Remove the bolts (4) securing the ring nuts (5) and (6).



6 -Use the tool **E7**, unscrew the adjuster ring nuts (5) e (6).

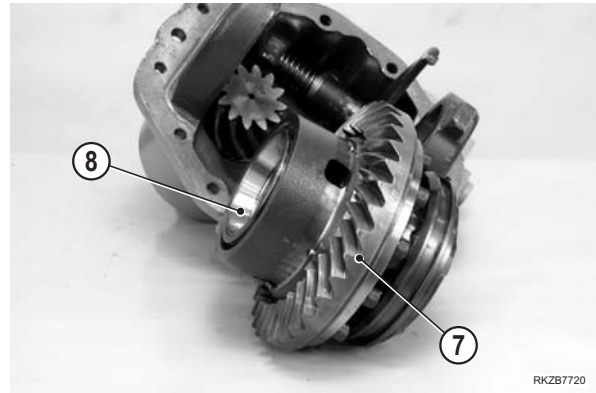


## REMOVAL AND INSTALLATION

## REAR AXLE

7 - Remove out the differential case (7). The external rings (8) and (9) are removed together with the differential housing.

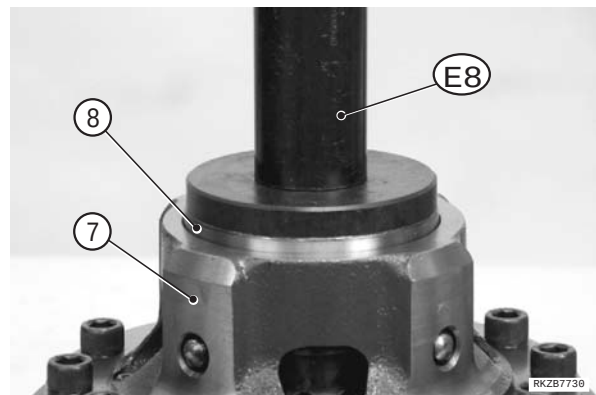
- ★ Try not to mismatch bearings if bearings are not to be replaced.



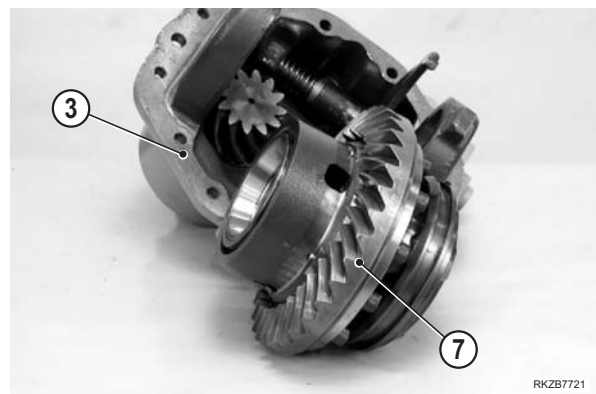
### 4.2 Assembly

1 - Using driver **E8**, install bearing outer races (8) and (9) to differential housing (7).

- ★ Try not to mismatch bearings if bearings are not to be replaced.

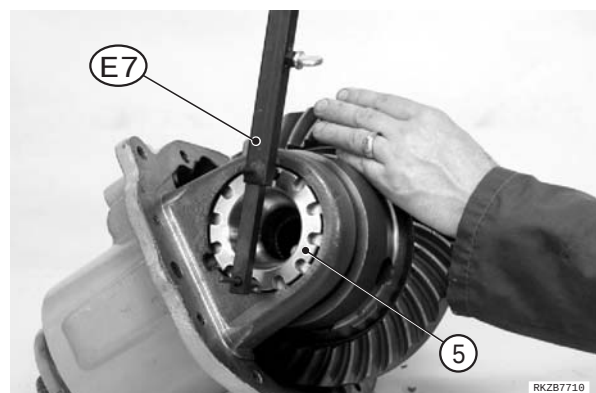


2 - Position the complete differential box (7) with bearings on the differential carrier (3).



3 - Insert and tighten adjustment ring nuts (5) and (6) in the differential support with tool **E7**, so as to pre-load the differential bearings slightly.

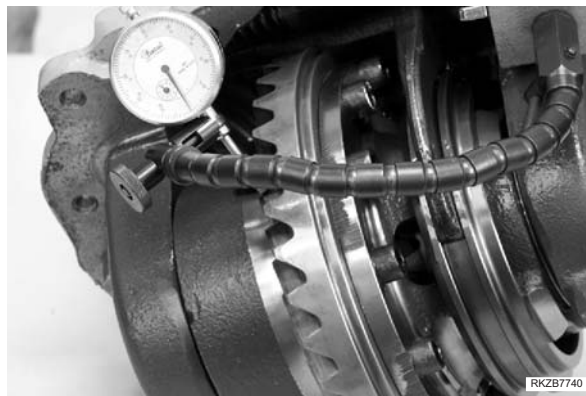
- ★ Knock lightly with a soft hammer in order to properly set the bearings in position.



## REMOVAL AND INSTALLATION

## REAR AXLE

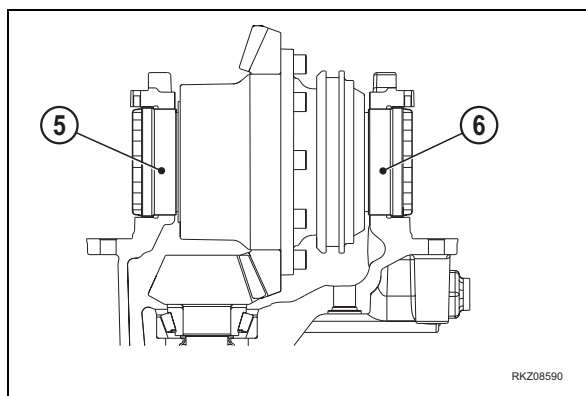
- 4 -Place a magnetic comparator the differential support so that the checkhead is at right angles with the side of a tooth from the ring gear.



- 5 -Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.  
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.  
Check if the measured backlash value is within the requested range:  
**0.21–0.29 mm**  
Adjust by operating the adjuster ring nuts. (5) and (6), using tool **E7**.



- 6 -Adjust the ring nuts (5) and (6) remembering that:
- a - **if the measured backlash is less** than the given tolerance range, unscrew the adjuster ring nut (6) and screw in the adjuster ring nut (5) by the same measure;
  - a - **if the measured backlash is greater** than the given tolerance range, unscrew the adjuster ring nut (5) and screw in the adjuster ring nut (6) by the same measure.



- 7 -Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.





## REMOVAL AND INSTALLATION

## REAR AXLE

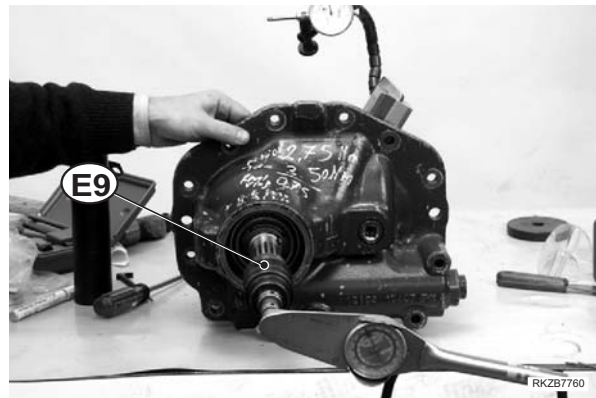
8 -Once the pinion-ring gear backlash has been established, measure the total rolling torque **Tr** of the bearings (pinion-crown bevel gear system), using a torque wrench and special tool **E9**.

- ★ Total rolling torque should be measured without pinion retaining ring.

Rolling torque **Tr** must be within the following range:

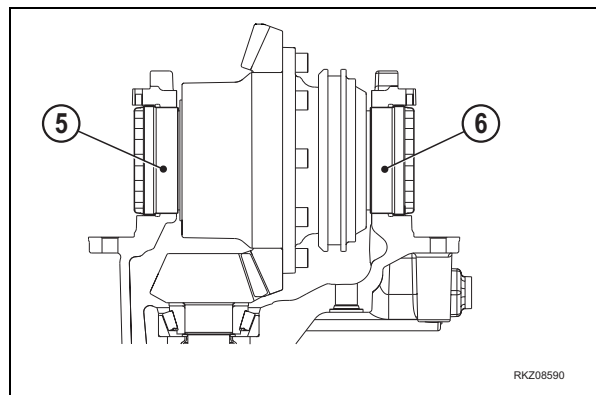
$$\mathbf{Tr = (Pr+0.58) - (Pr+0.87) \text{ Nm}}$$

where **Pr** is the actual rolling torque of pinion alone.



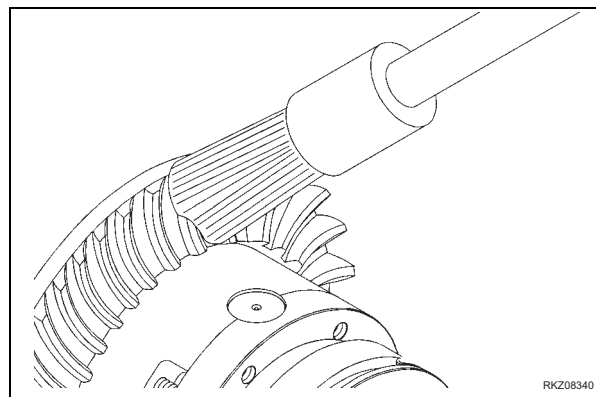
9 -If the reading is not within the requested range, thoroughly check the assembly of each component and operate the adjuster ring nuts (5) and (6) of the differential support:

- a - **if total preload is less** than the specified value, tighten the adjuster ring nuts (5) and (6) by the same amount, while keeping the pinion/ring gear backlash value unchanged;
- b - **if total preload is greater** than the specified value, loosen the adjuster ring nuts (5) and (6) by the same amount, while keeping the pinion/ring gear backlash value unchanged;



10 -To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.

The marking test should be **always** carried out on the ring bevel gear teeth and on both sides.



11 -Contact:

**OK-Correct contact:**

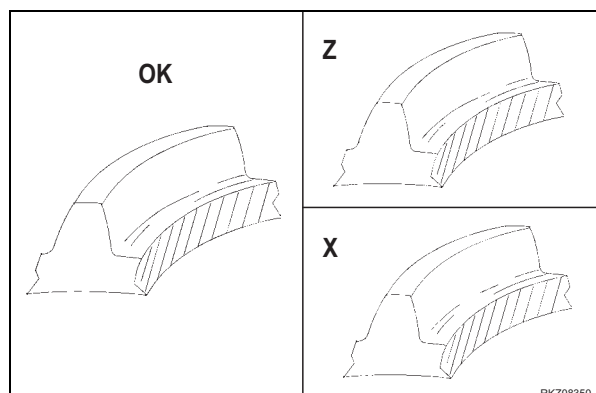
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

**Z - Excessive contact on the tooth tip:**

Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.

**X - Excessive contact at the tooth base:**

Move the pinion away from the ring bevel gear and



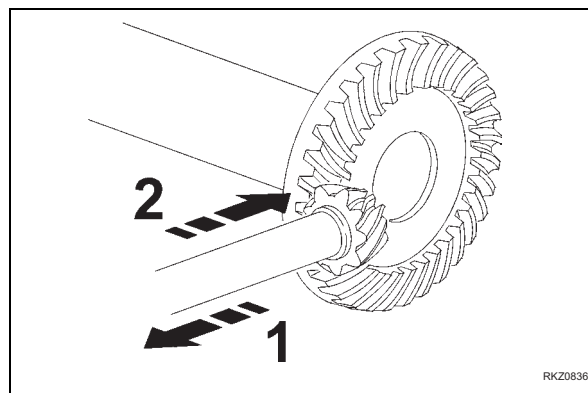
## REMOVAL AND INSTALLATION

## REAR AXLE

then approach the ring bevel gear to the pinion in order to adjust the backlash.

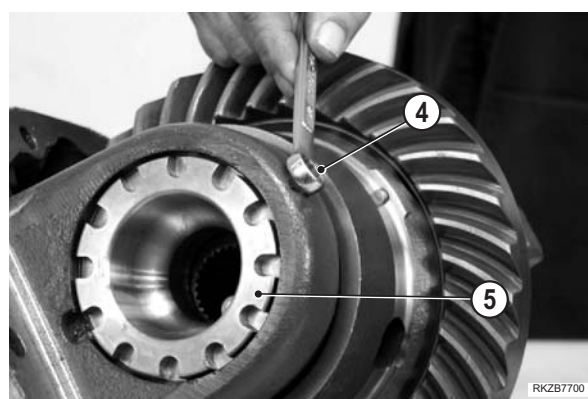
### 12 -Movements to correct:

- 1 - move the pinion for type X contact adjustment.
- 2 - move the pinion for type Z contact adjustment.



- 13 -When all adjustment procedures are complete, lock adjuster ring nuts (5) and (6) into position with screws (4). Tighten screws (4) to the required torque.

 Screw: 10Nm

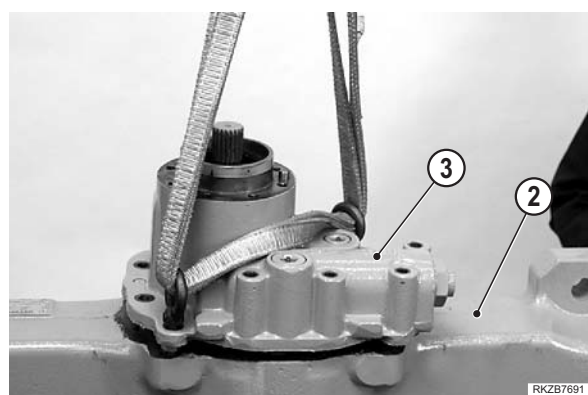


- 14 -Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents. Spread a film of adhesive on the contact surface between the axle beam (2) and the differential carrier (3).

 Contact surfaces: Loctite 510



- 15 - Assemble the differential support (3) to the axle housing (2).





## REMOVAL AND INSTALLATION

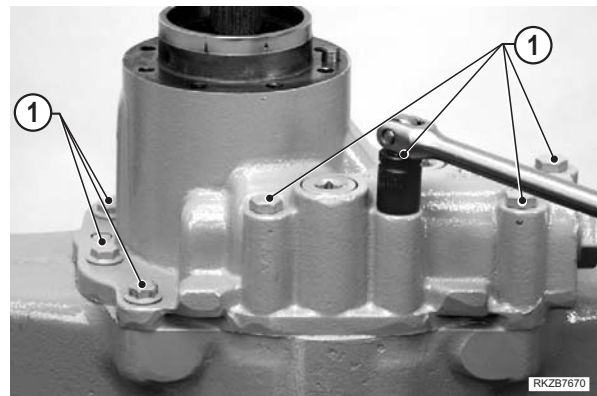
## REAR AXLE

16 - Tighten all screws (1) to the required torque.

 Screw: 169 Nm

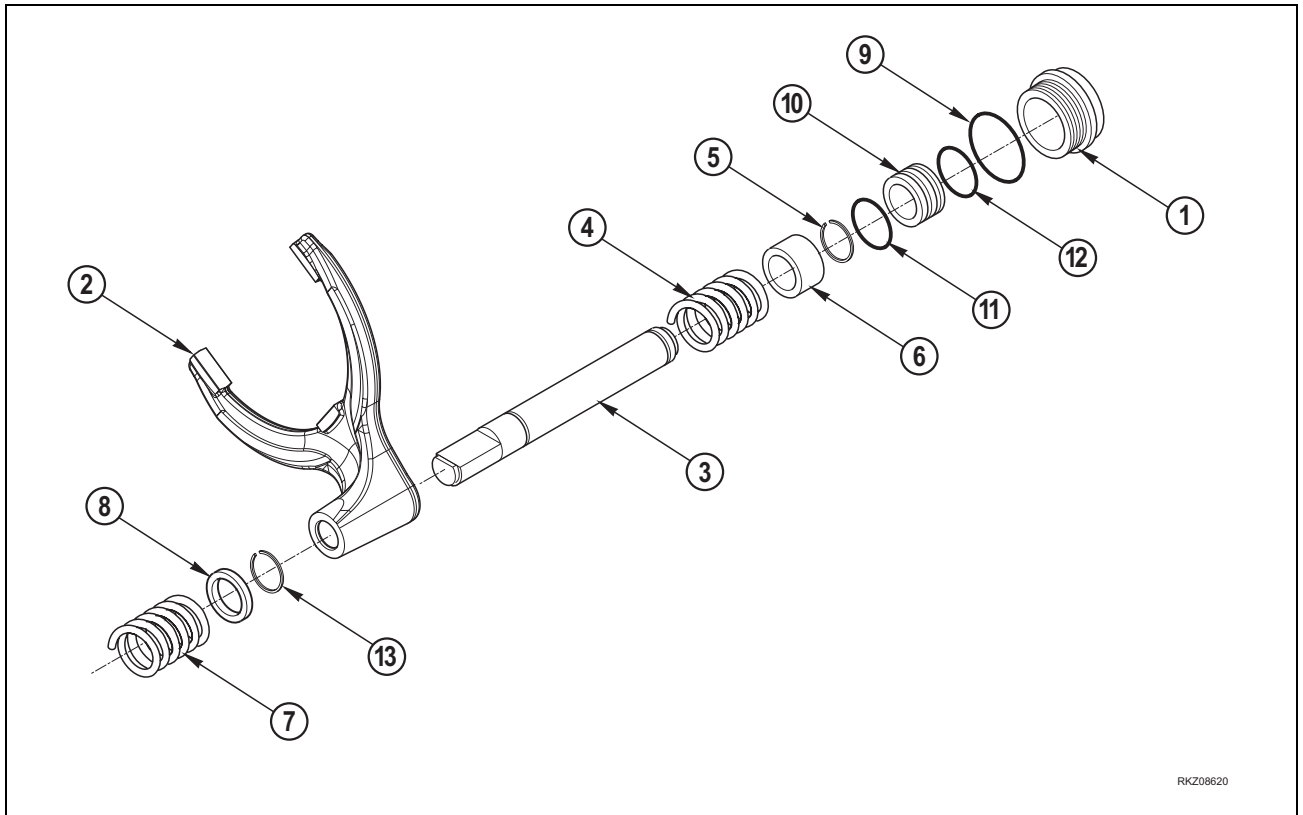
17 - Refill the hydraulic oil.

 Differential oil: approx. 15 ℓ

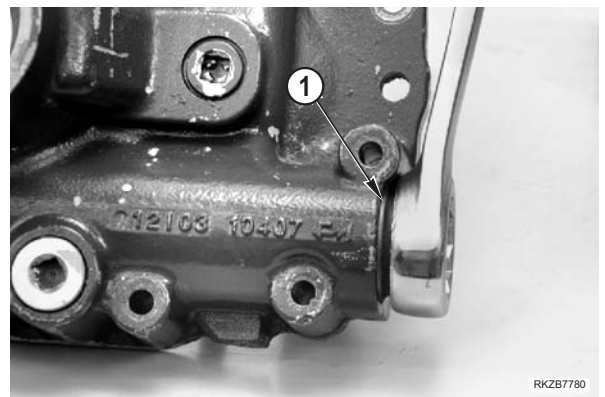


## 5. DIFFERENTIAL LOCKING GROUP

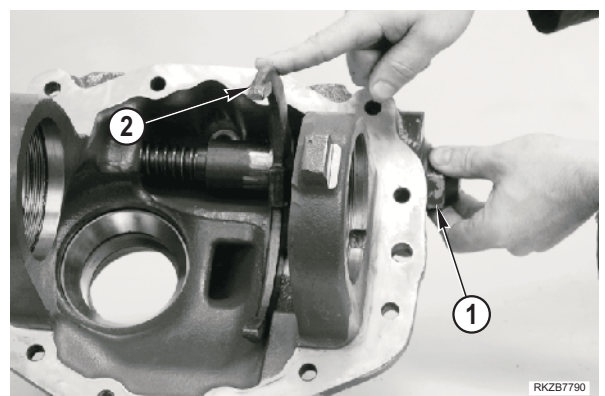
### 5.1 Disassembly



1 -Loose plug (1) but do not remove it.



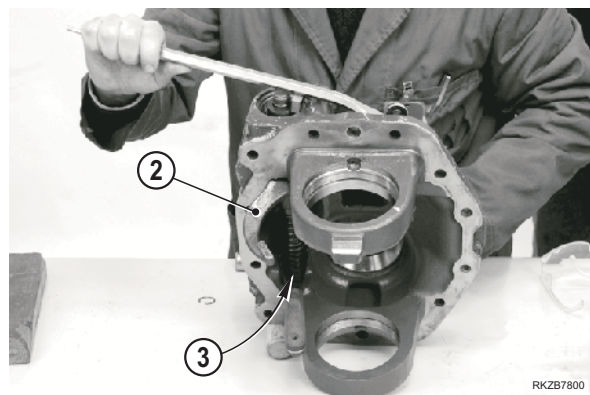
2 -Hold the differential lock fork (2) down to catch a block inside of the housing, remove the plug (1).



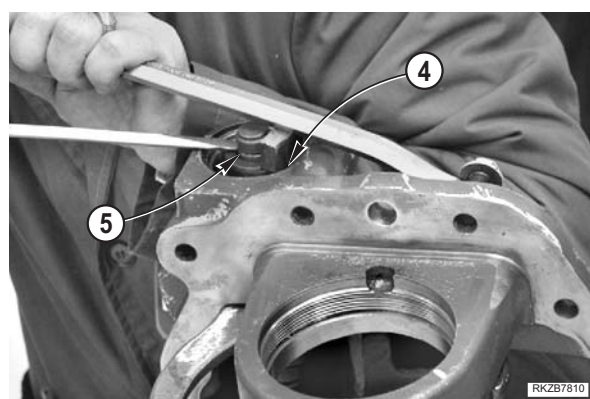
## REMOVAL AND INSTALLATION

## REAR AXLE

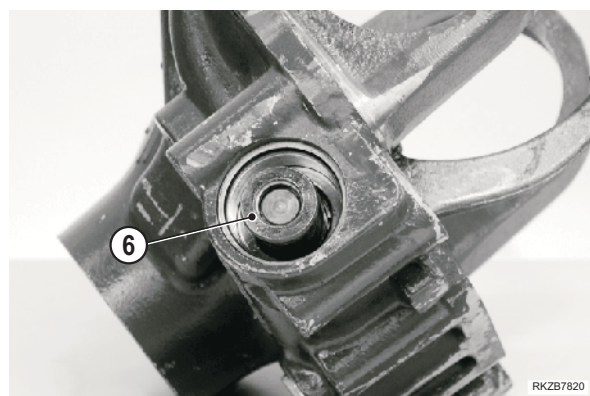
3 -Pull the differential lock fork (2) up, place a flat piece of steel under the shaft (3) to keep it from moving down.



4 -Compress spring (4) until snap ring (5) is released. Remove snap ring (5).



5 -Remove the bushing (6).



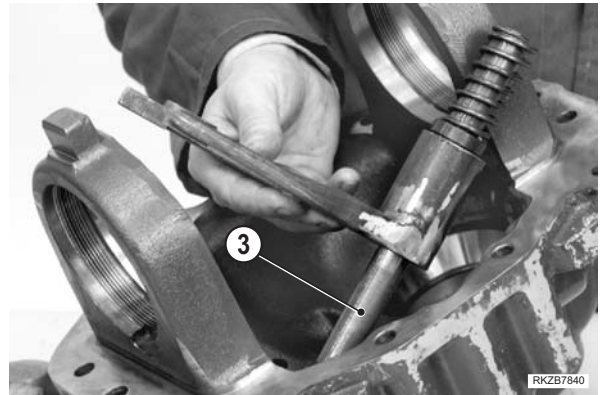
6 -Remove the spring (4).



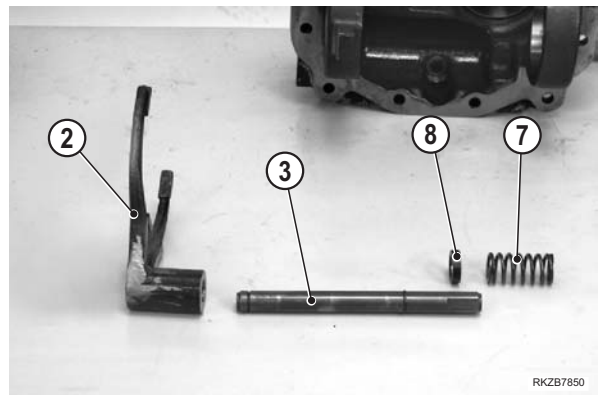
## REMOVAL AND INSTALLATION

## REAR AXLE

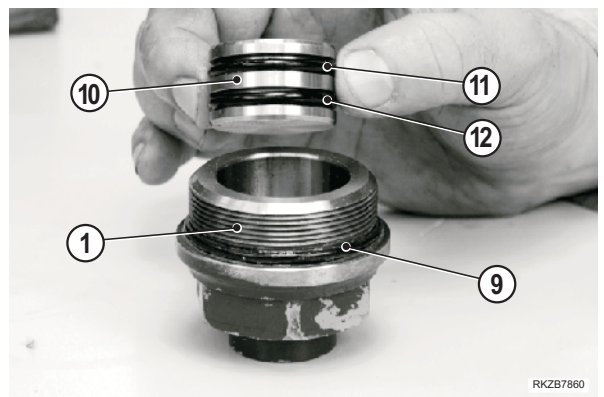
7 -Remove the shaft (3) from differential housing.



8 -Remove the fork (2), spring (7) and bushing (8) from the shaft (3).

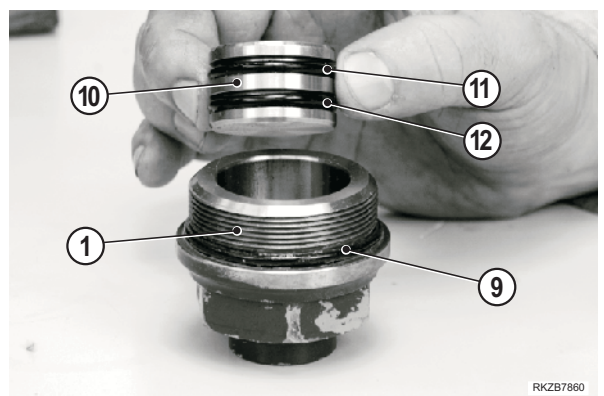


9 -Remove O-Ring (9) from plug (1) and O-rings (11) and (12) from the piston (10).



### 5.2 Assembly

1 -Install new O-rings (11) and (12) on the piston (10) and O-Ring (9) on plug (1). Lubricate the O-rings.

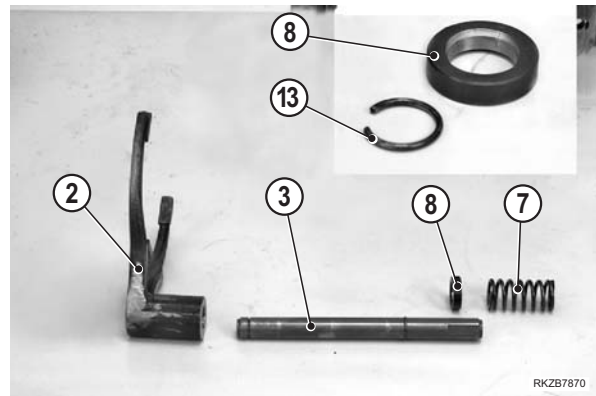


## REMOVAL AND INSTALLATION

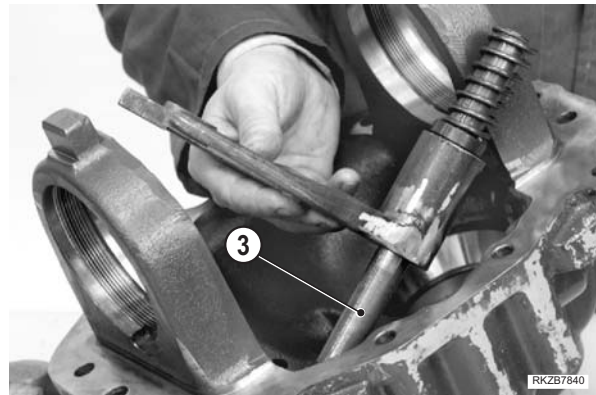
## REAR AXLE

2 -Lubricate the shaft (3) with clean hydraulic oil.  
Install the fork (2) on the shaft (3) like shown in figure.  
Install bushing (8) and spring (7) onto shaft.

★ Mount the spacer (8) with the chamfer towards the snap ring (13).



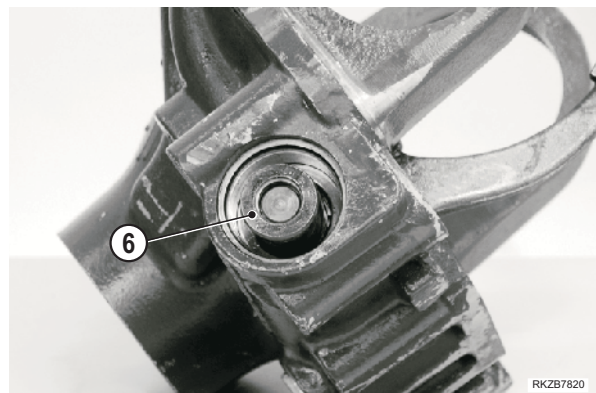
3 -Insert in the differential housing the shaft (3) complete.



4 -Mount the spring (4).



5 -Place the bushing (6) on the shaft, make sure the chamfer in the bushing is facing out.

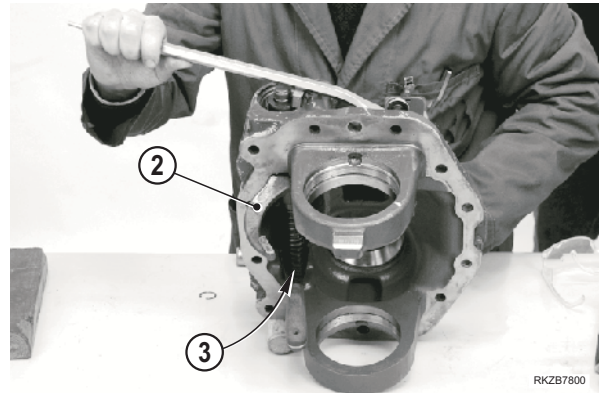




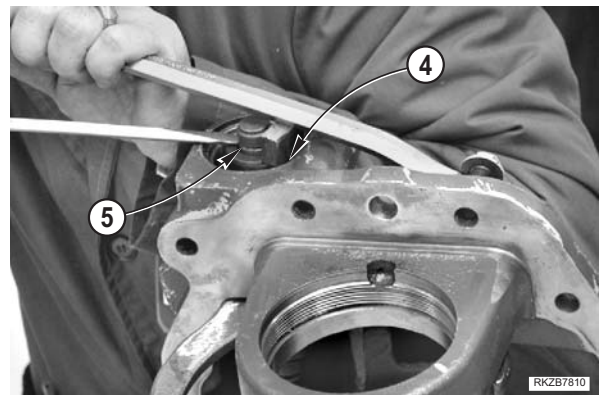
## REMOVAL AND INSTALLATION

## REAR AXLE

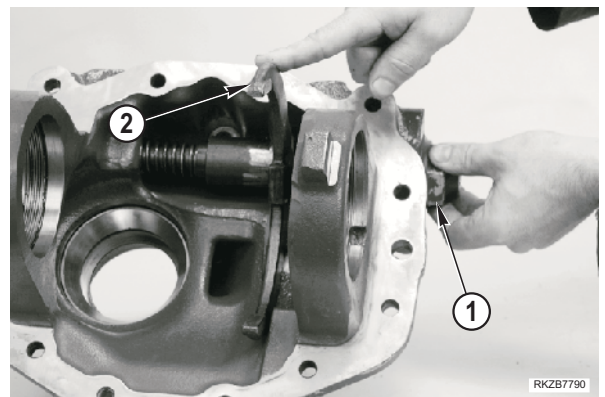
- 6 - Pull the differential lock fork (2) up, place a flat piece of steel under the shaft (3) to keep it from moving down.



- 7 - Compress the spring (4) using a proper tool and install the snap ring (5).  
Remove the piece of steel under the shaft (3).

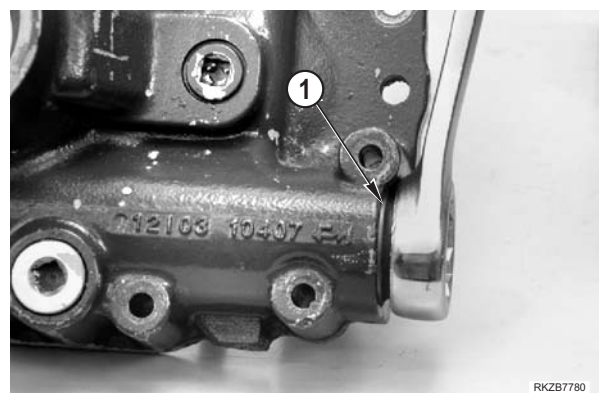


- 8 - Hold the differential lock fork (2) down to catch a block inside of the housing, remove the plug (1).  
Hand screw the plug (1).



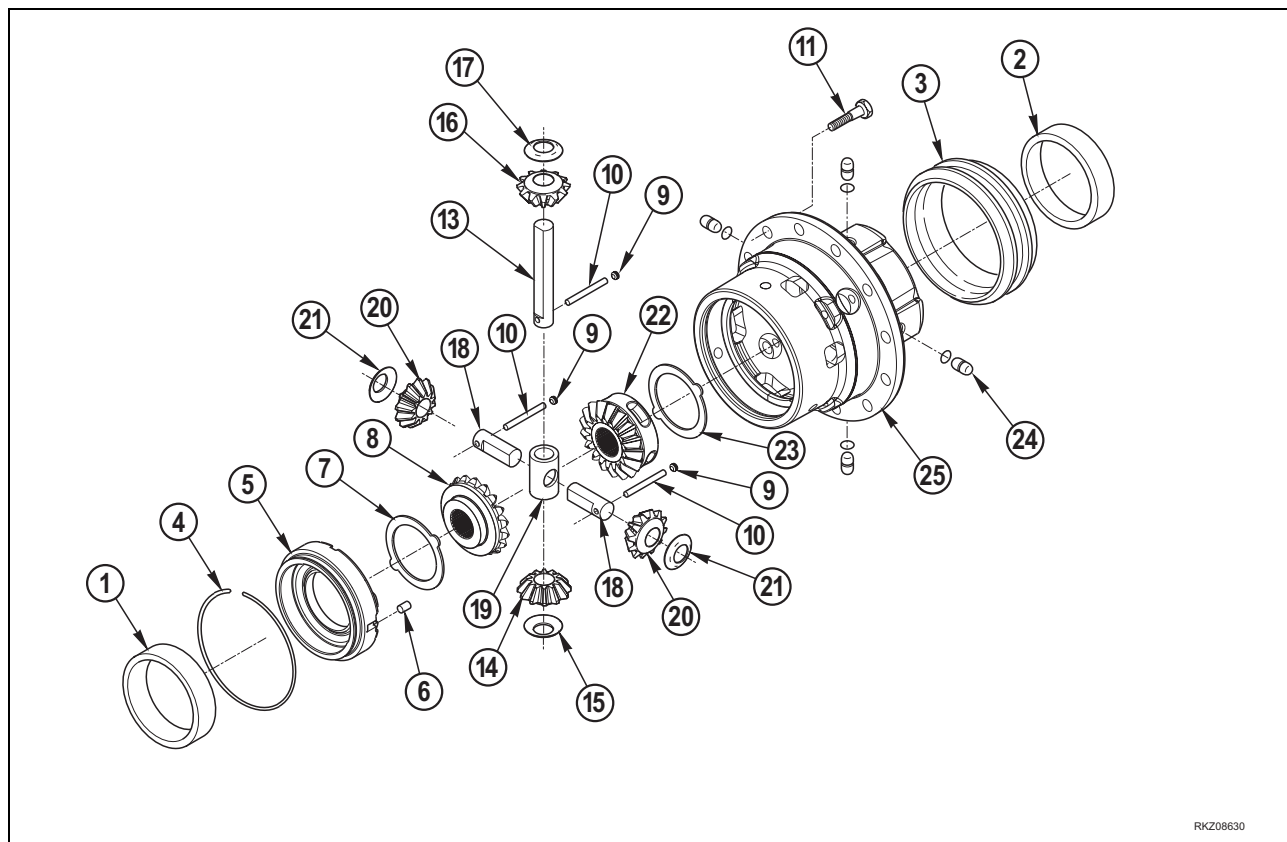
- 9 - Tighten plug (1) to the requested torque.

 Plug: 180 Nm



## 6. DIFFERENTIAL

### 6.1 Disassembly



RKZ08630

1 -If differential bearings are to be replaced, remove bearing outer rings (1) and (2). Remove sleeve (3).



RKZB7890

2 -Remove snap ring (4).



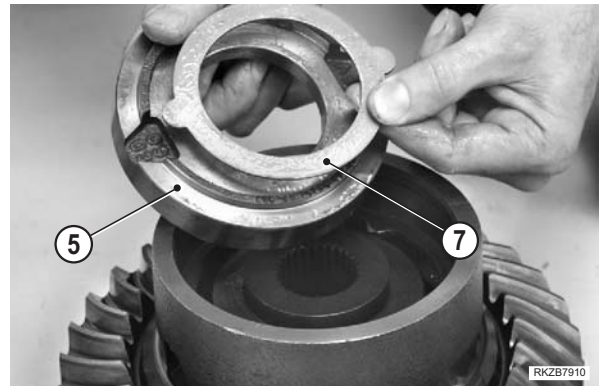
RKZB7900



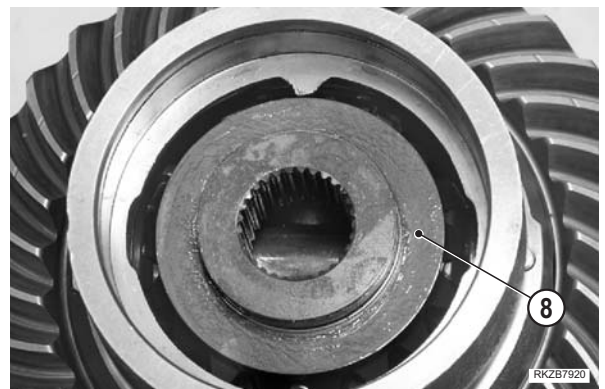
## REMOVAL AND INSTALLATION

## REAR AXLE

- 3 -Remove the differential housing cover (5), remove the anti rotation pin (6) and the thrust washer (7).



- 4 -Remove the side gear (8).



- 5 -Remove three plugs (9) from the differential.



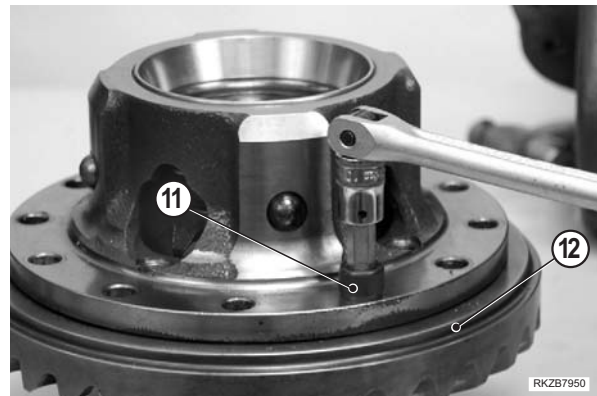
- 6 -Remove the three pins (10) securing the spider pins in the differential.



## REMOVAL AND INSTALLATION

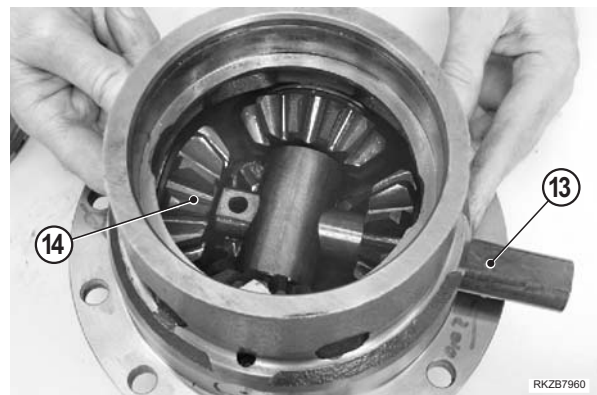
## REAR AXLE

7 - Remove the ring gear cap screws (11), remove the ring gear (12).

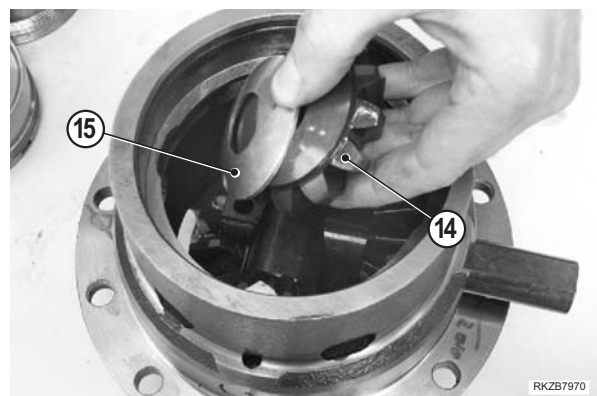


8 - Push the pin (13) towards the flat surface side (14).

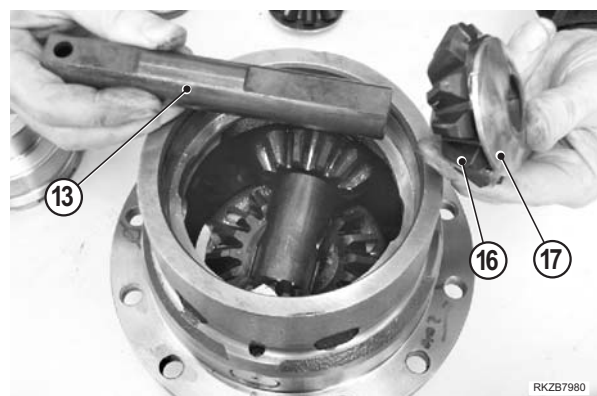
★ the pin can be pushed in only one direction.



9 - Remove the planetary gear (14) and thrust washer (15).



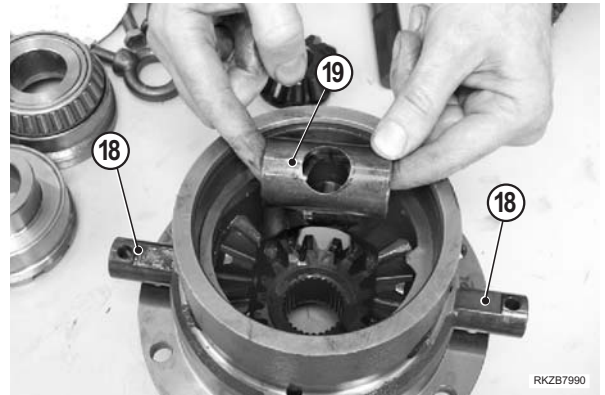
10 - Push the pin (13) out of the housing and remove the planetary gear (16) and thrust washer (17).



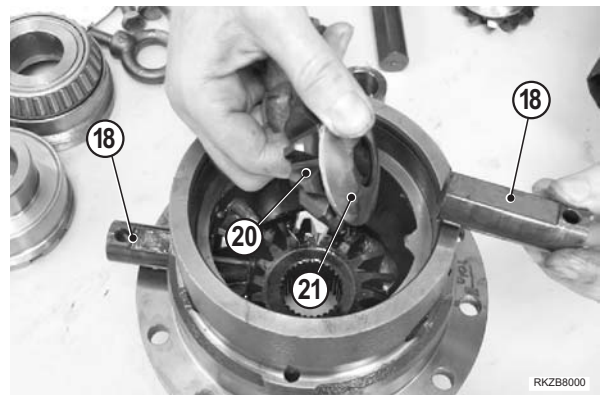
## REMOVAL AND INSTALLATION

## REAR AXLE

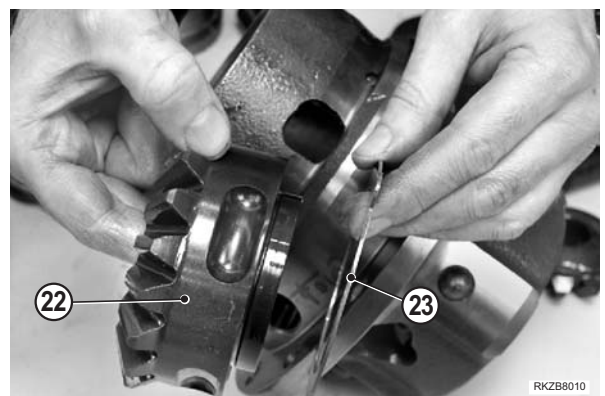
- 11 -Push the short spider pins (18) out of the spacer (19) by pushing them through the hole in the spacer (19).



- 12 -Remove pins (18), spider gears (20) and thrust washers (21).



- 13 -Remove side gear (22) and thrust washer (23) from the housing.



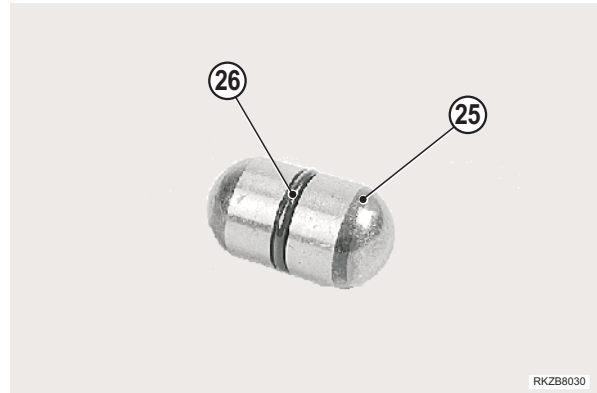
- 14 -Remove the differential locking pins (25) from the housing (24).



## 6.2 Assembly

1 - Install and lubricate new O-rings (26) on the pins (25).

 Gaskets O-ring: ASL800050

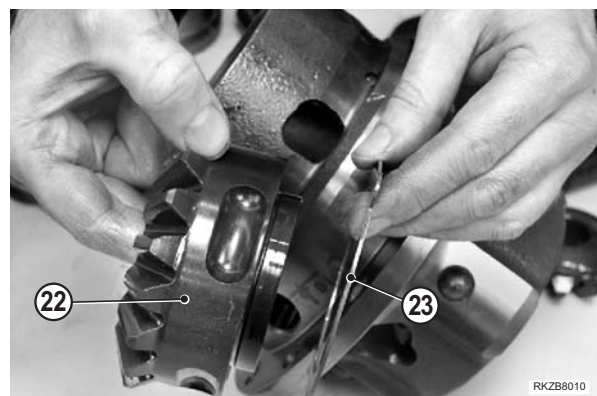


2 - Install the pins (25) in the differential housing (24).



3 - Lubricate and install sun gear (22) and thrust washer (23).

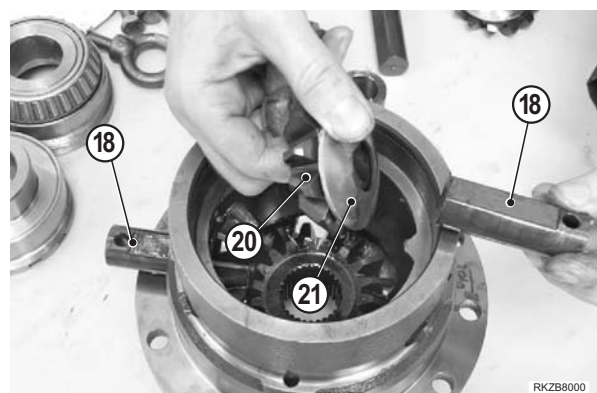
 Gear: differential oil



4 - Lubricate and install planetary gear (20) and its respective thrust washer (21) and introduce the pins (18) forward enough to support them.

★ Orientate the flats on the pins facing up.

 Gear and pin: differential oil

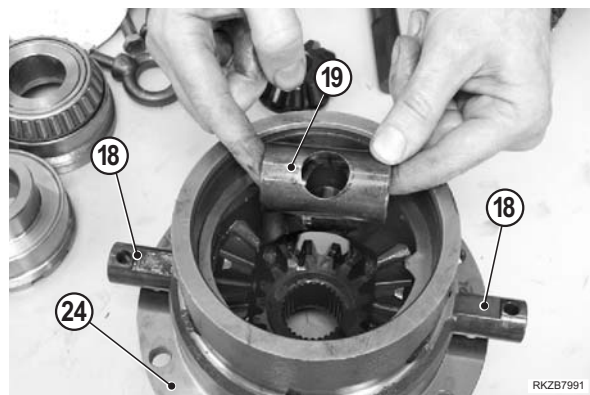




## REMOVAL AND INSTALLATION

## REAR AXLE

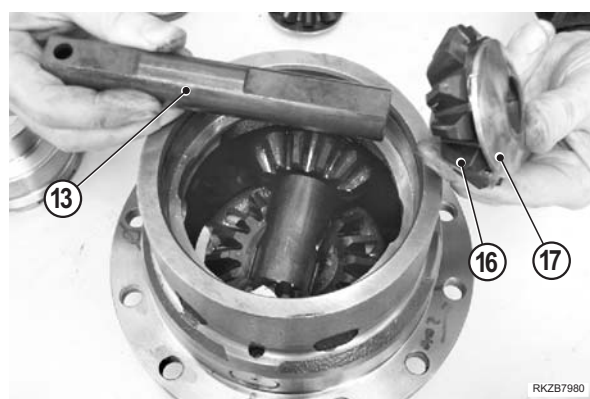
- 5 - Install spacer (19) and introduce pins (18), taking care to align the holes with those on the differential housing (24).



- 6 - Lubricate and install the sun gear (16) and thrust washer (17).  
Introduce the pin (13) as far as it will go.

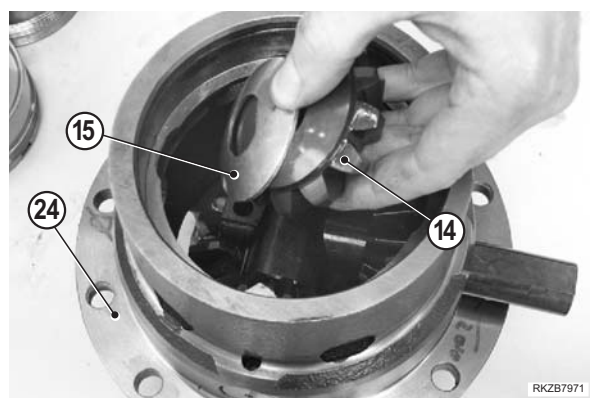
★ Orient pin (13) with the flats on the pin facing up.

 Gear and pin: differential oil



- 7 - Lubricate and install the planetary gear (14) and thrust washer (15) and introduce the pin (13). Orient the hole so as to align with the hole on the differential housing (24).

 Gear and thrust washer: differential oil



- 8 - Install the differential ring gear (12), apply sealant and tighten screws (11) to the required torque.

 Screw: Loctite 270

 Screw: 155 Nm



## REMOVAL AND INSTALLATION

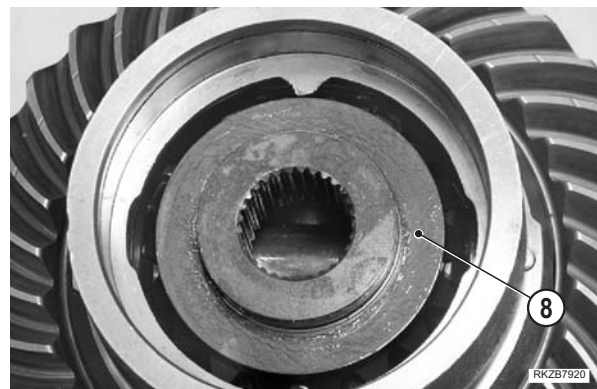
## REAR AXLE

9 - Install pins (10) and tighten caps (9) to the prescribed torque.

 Caps: 25 Nm

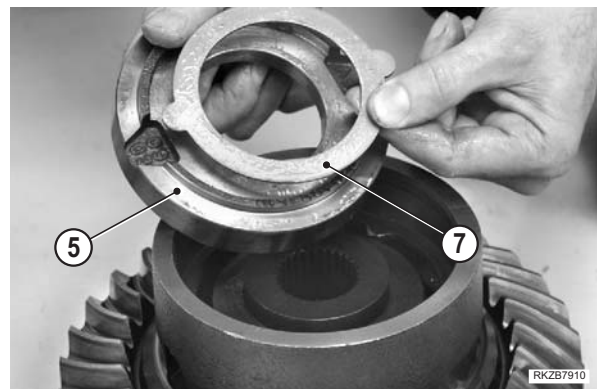


10 - Install the planetary gear (8).



11 - Apply a thin coat of grease to the cover (5) and install the shoulder ring (7).

 Cover: ASL800050



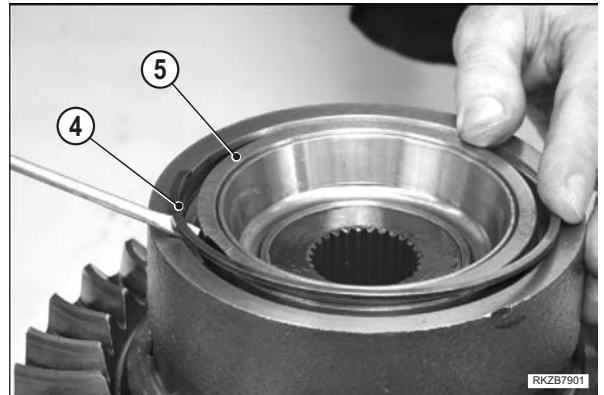
12 - Install antirotation pin (6) to cover (5) and install cover (5) to differential housing.



## REMOVAL AND INSTALLATION

## REAR AXLE

13 -Lock cover (5) into position with snap ring (4).



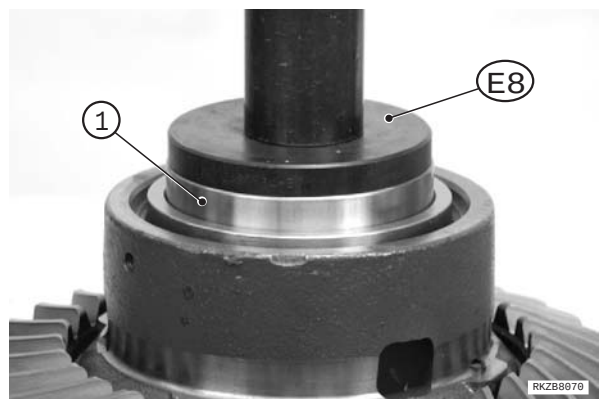
14 -Install sleeve (3) and make sure that sleeve fits snugly into position.

- ★ To make installation easier, rotate the side gear (22).



15 -Install bearing outer rings (1) and (2) using driver E8.

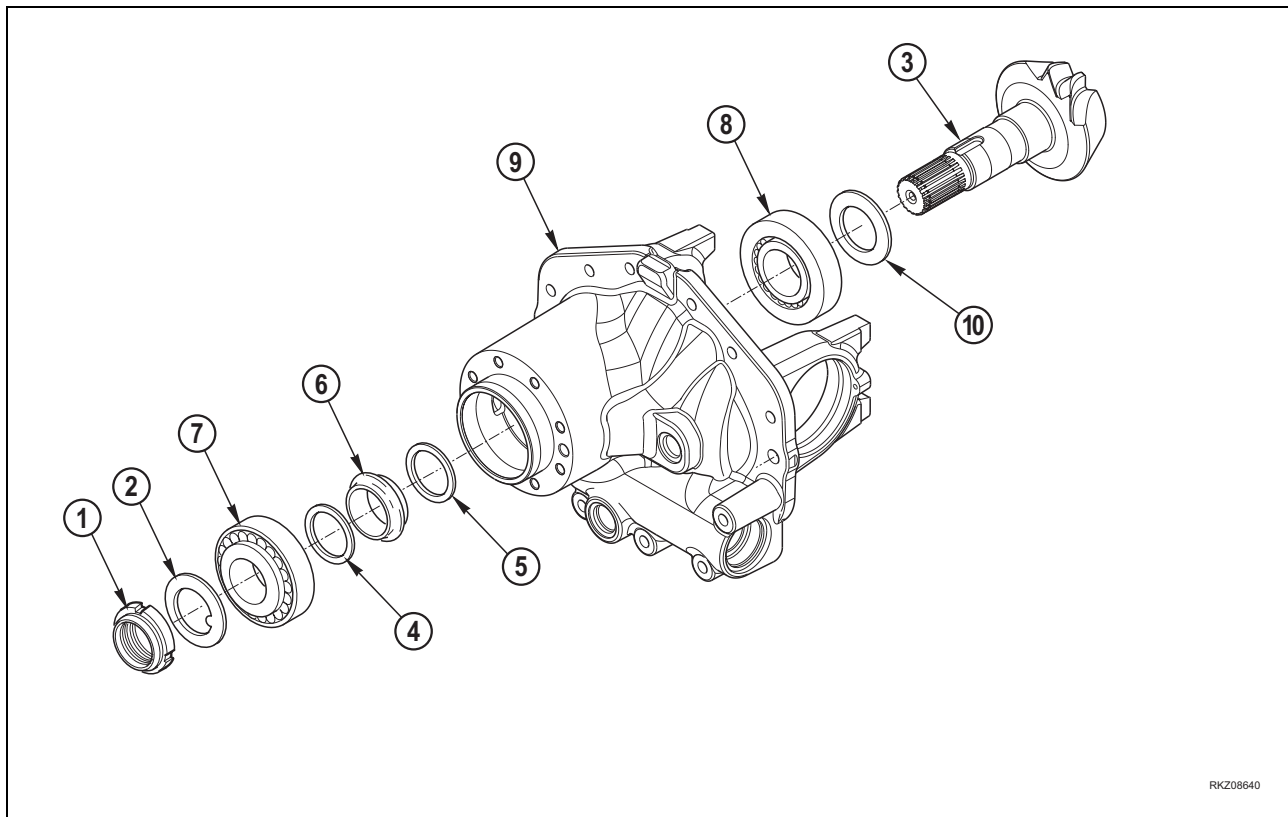
- ★ Do not invert bearings.





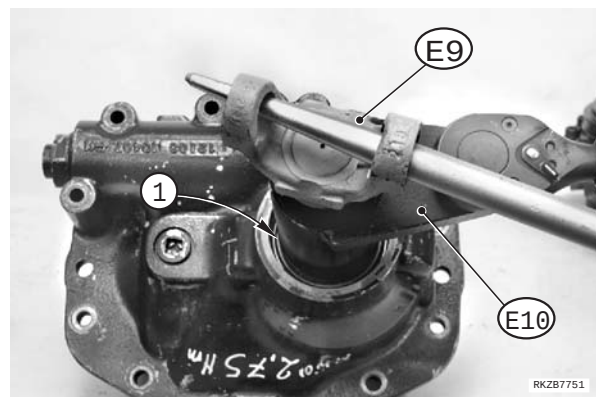
## 7. DIFFERENTIAL GROUP

### 7.1 Disassembly



1 -Fit the differential carrier (1) in a vise.  
Unscrew the lock nut (1) using special tools **E9 - E10**.

★ This operation will irretrievably damage the ring nut (1).



2 -Remove the ring nut (1) and collect its retaining washer (2).



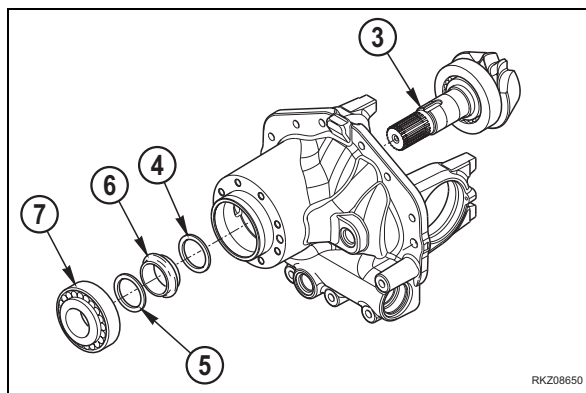
## REMOVAL AND INSTALLATION

## REAR AXLE

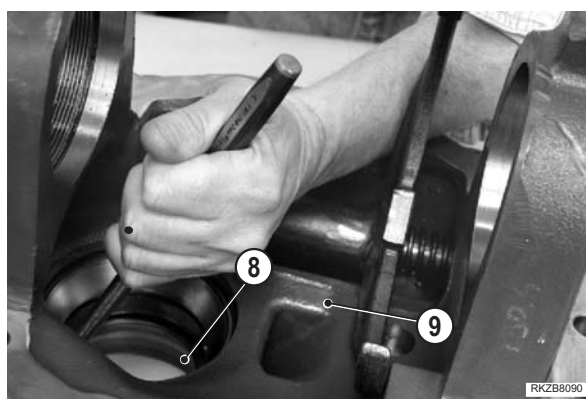
3 - Tap the shaft with a soft hammer to remove the bevel pinion (3).

★ Take care not to drop the bevel pinion (3).

Recover washers (4) and (5), collapsible spacer (6) and bearing inner ring (7).



4 - Remove bearing outer rings (7) and (8) from differential support (9) using a driver and a hammer.

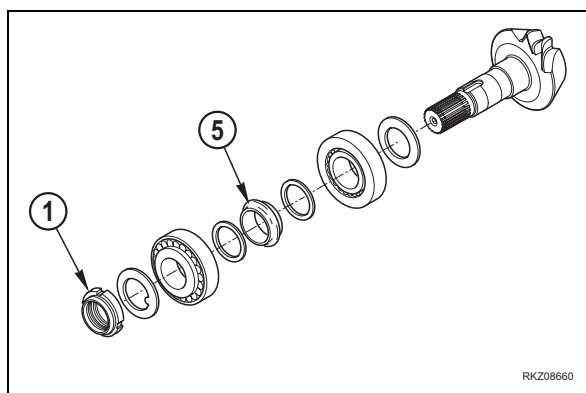


5 - To remove bearing inner ring (8) from bevel pinion (3), use a commercially available grip puller. Recover bearing inner ring (8) and the shim (10) under it.



6 - Check all pinion components for wear.

★ The ring nut (1) and the snap spacer (6) must be replaced.

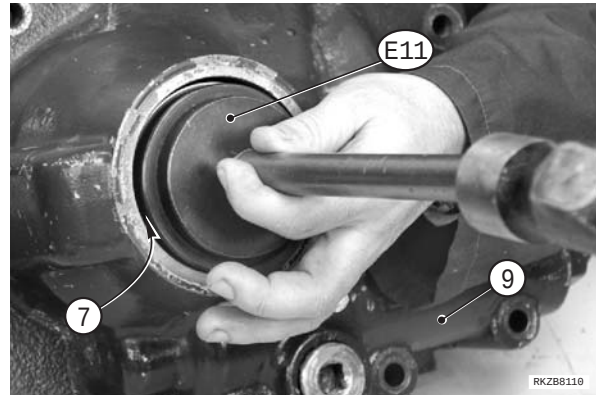


## REMOVAL AND INSTALLATION

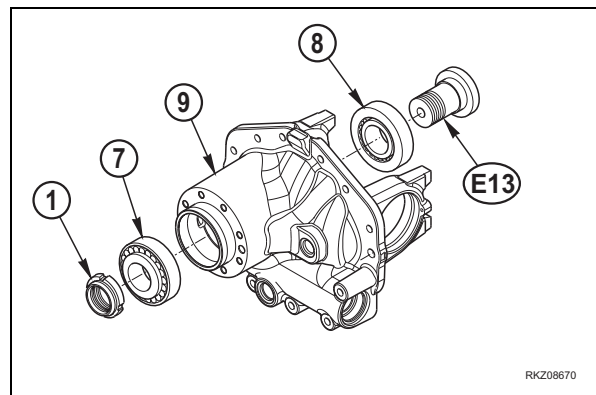
## REAR AXLE

### 7.2 Assembly

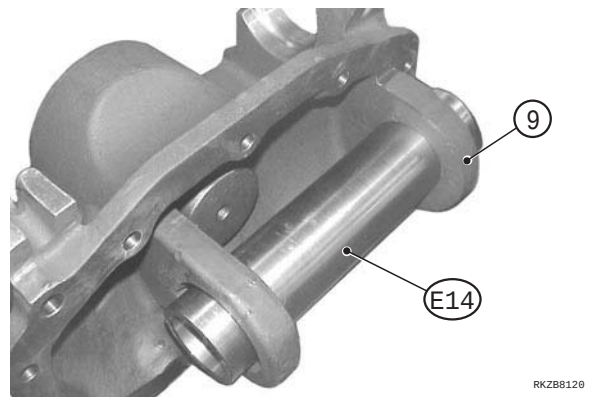
- 1 - Place the differential support (9) on a workbench. Introduce bearing outer rings (7) and (8) using special tools **E11** - **E12** and a hammer.



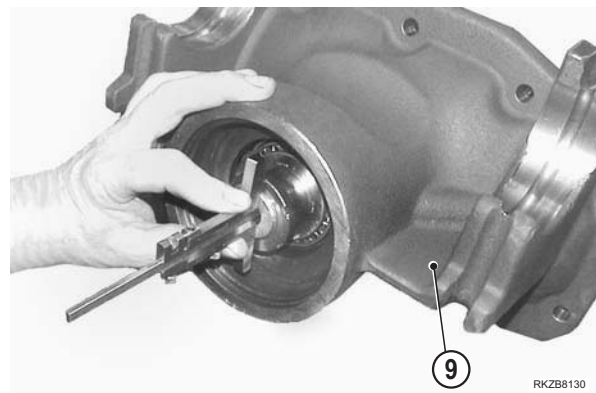
- 2 - Insert inner rings (7) and (8) in their housings. Assemble the false pinion **E13** and its ring nut (1). Tighten without exceeding the ring nut, till the backlash is eliminated.



- 3 - Install special tool **E14** to the differential group supports (9).



- 4 - Use a depth gauge to measure distance "X" (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).



## REMOVAL AND INSTALLATION

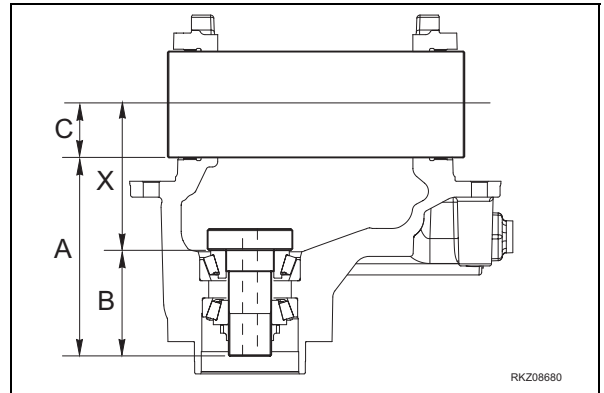
## REAR AXLE

- 5 -To adjust bevel gear/pinion measure the distance “A” with a depth gauge.

Calculate the value “X” as follows:

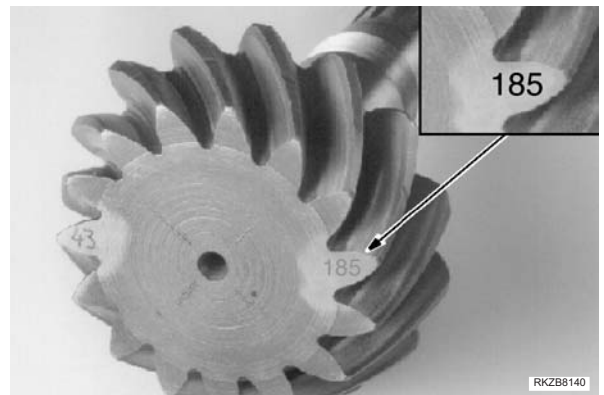
$$X = (A + C) - B \text{ mm}$$

where “B” and “C” are known.



- 6 -In order to determine the necessary thickness value (S) between the pinion and the bearing, subtract the value (V), stamped on the pinion head (V=requested distance), from the measured value (X).

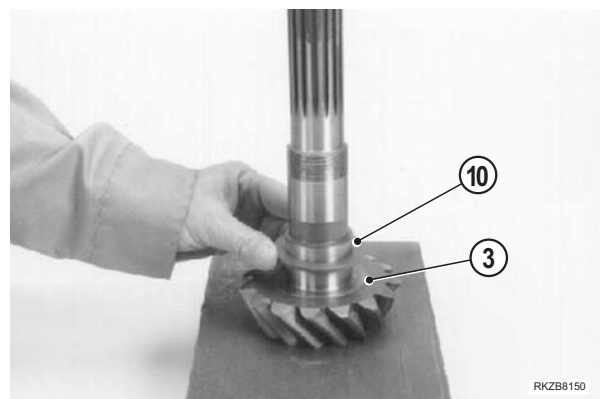
$$S = (X - V) \text{ mm}$$



- 7 -Select the shim with the thickness value (S) among the range of available shims (10), and fit to shaft under the pinion head.

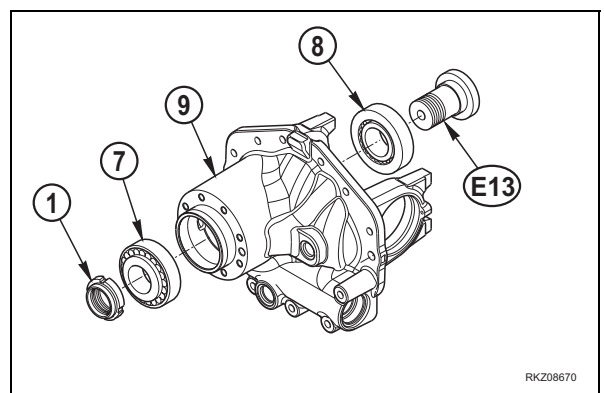
- ★ The chamfer on the ID of the shim (10) must be toward the pinion gear (3).

| SHIM RANGE |     |     |     |     |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Shims      | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 |



- 8 -Remove the special tool E14 to the differential group supports (9).

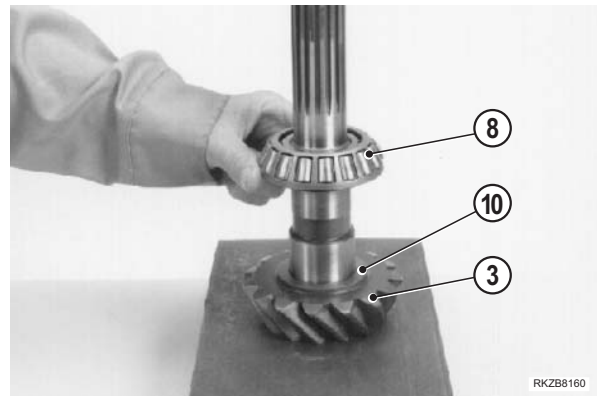
Remove the ring nut (10), the false pinion E13 and the bearing cones (7) and (8).



## REMOVAL AND INSTALLATION

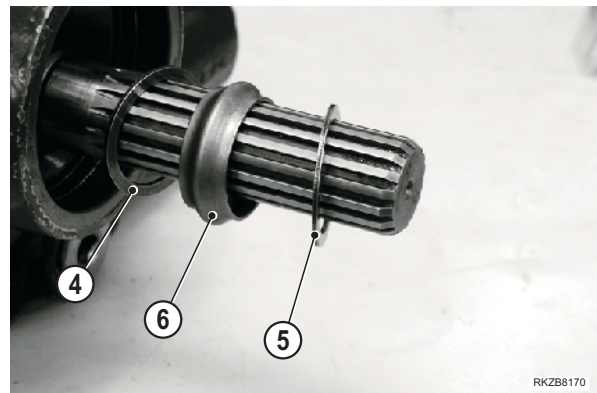
## REAR AXLE

- 9 - Select a suitable shim (10) and install **with the chamfer facing the gear**, then install bearing inner ring (8) to pinion (3) with the help of a press and tool **E3**, and check to ensure that it fits snugly in place.

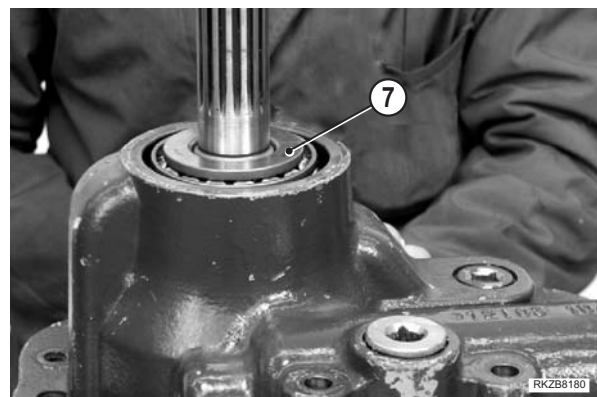


- 10 - Install the washers (4) and (9) and a new collapsible spacer (6) on the pinion gear (3).

★ Use always a new collapsible spacer (6).



- 11 - Install bearing outer ring (7) to pinion end.  
To install bearing (8), use special tool **E3** and a hammer.



- 12 - Insert a ring nut washer (2) and screw a new lock ring nut (1) on the pinion end.



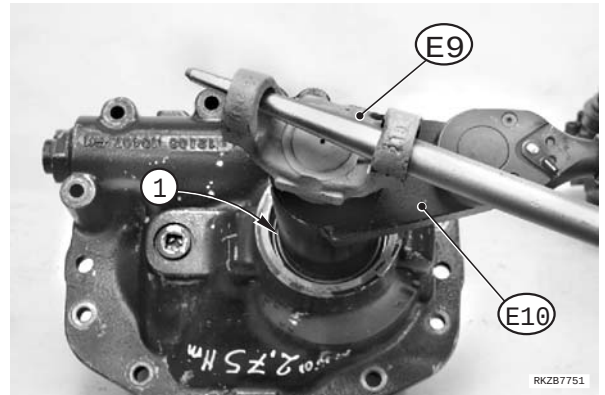


## REMOVAL AND INSTALLATION

## REAR AXLE

13 -Screw the ring nut in (1), using the wrench for ring nut **E10** and for pinion retainer **E9**.

- ★ The torque setting is given by the preloading measurement on bearings (7) and (8); Tighten the ring nut (1) step by step.
- ★ If it is tightened too much, the elastic spacer (6) should be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion (3) ends with a soft hammer, so as to help setting the bearings (7) and (8).



14 -To measure the rolling torque (Pr) of tapered bearings (7) and (8), use a torque wrench and tool **E9**. Adjustment is carried out by gradually increasing the tightening torque of ring nut (1), paying attention not to overtighten.

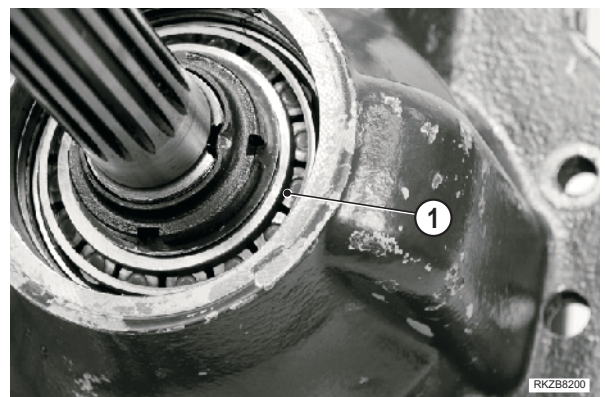
- ★ All preloadings should be measured without the seal rings.

Rolling torque should be within the following range:

**Pr = 2.0–2.4 Nm**



15 -Once you got the requested preloading value, caulk the ring nut (1).



**PAGE INTENTIONALLY  
LEFT BLANK**



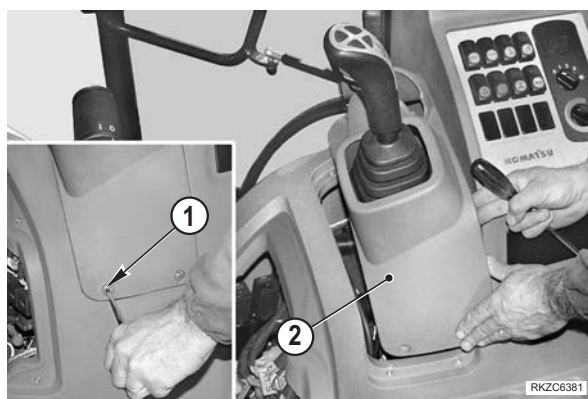
## SHOVEL PPC VALVE

### Removal

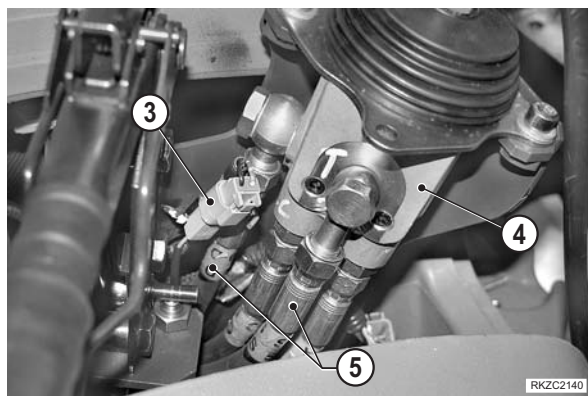
-  Lower the working equipment completely until it rests on the ground; engage the parking brake, stop the engine and remove the ignition key.
-  Release all residual pressure from all circuits. (For details, see "20 TESTING AND ADJUSTMENTS").



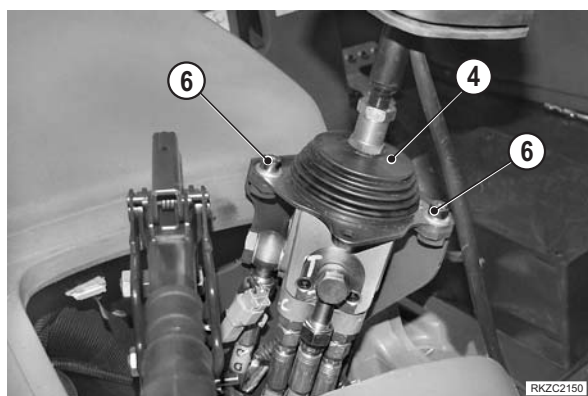
- 1 -Remove four screws (1) and remove PPC valve and parking brake casing (2).



- 2 -Disconnect the connector (3).
- 3 -Disconnect five hoses (5) from PPC valve (4).
  - ★ Check to ensure that hoses are marked; scribble match marks if necessary. [\*1]
  - ★ Cap the hoses and holes to prevent contamination.



- 4 -Loosen and remove screws (6) and remove the complete PPC valve (4).



## REMOVAL AND INSTALLATION

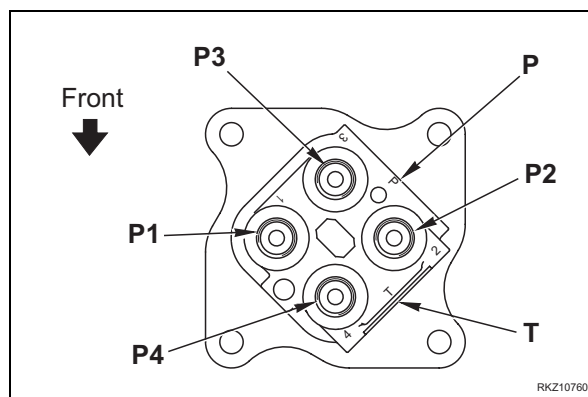
## SHOVEL PPC VALVE

### Installation

- To install, reverse removal procedure.

[\*1]

- ★ Carefully inspect the hoses for the proper position when connecting them.  
(For details, see "10 STRUCTURE AND FUNCTION").

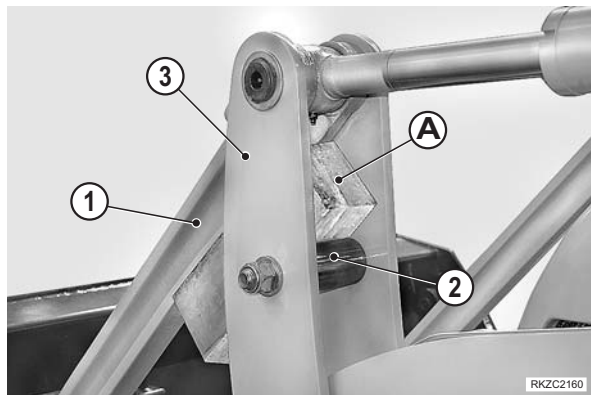


## SHOVEL LIFT CYLINDERS

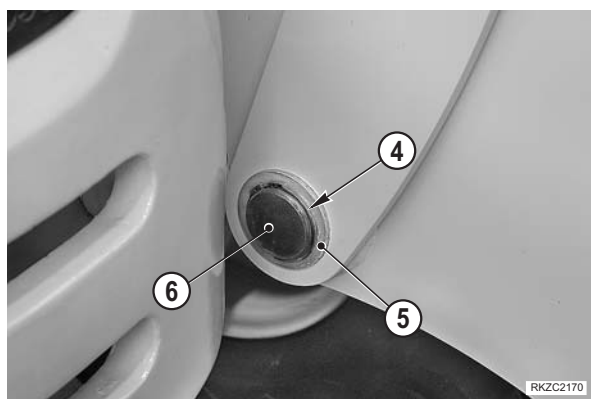
### Removal

**⚠** Fully lower the front working equipment until it rests on the ground; apply the parking brake, and stop the engine.

1 -Introduce non-slip blocks “A” between the shovel dump tie bar (1) and the spacer (2) of the fulcrum lever (3) on removal side.



2 -Take off the snap-ring (4) and the internal retaining spacer (5) for the piston attachment pin (6).



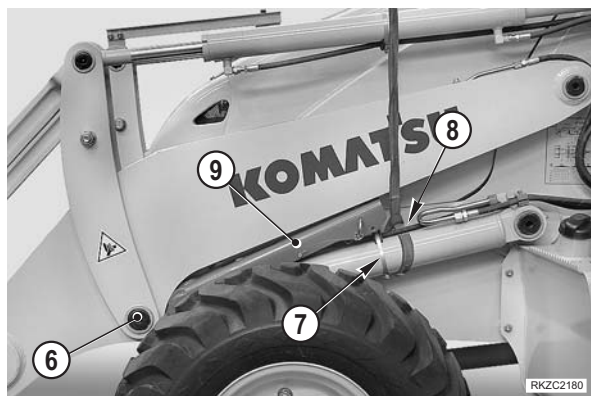
3 -Remove the tie strap (7) retaining the piston return hose (8).

4 -Place a sling around the cylinder and connect it to a hoisting device.

★ Do not engage the piston return hose with the sling.

5 -Extract pin (6) to expose piston eye and safety rod (9).

6 -Remove rod.

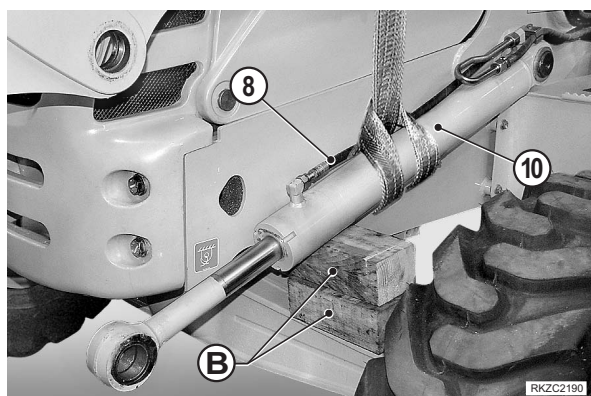


7 -Lower cylinder (10) until it rests on blocks “B”.

8 -Start the engine to retract the piston.

[\*1] [\*2]

**⚠** Stop the engine and eliminate residual pressure.



## REMOVAL AND INSTALLATION

## SHOVEL LIFT CYLINDERS

8 -Remove hoses (8) and (11), and remove hose clamp (12).

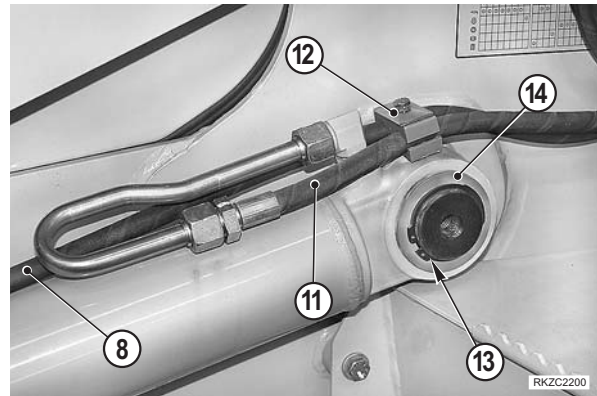
★ Cap pipes, hoses and holes to prevent contamination.

9 -Remove the snap-ring (13) and the spacer (14).

10 -Remove cylinder (10).



Cylinder: approx. 46 kg



### Installation

- To install, reverse removal procedure.

[\*1]



When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

★ After bleeding the air, check the oil level in the tank.

## SHOVEL DUMP CYLINDERS

### Removal

**⚠** Fully lower the working equipment to the ground; apply the parking brake, and stop the engine.

- 1 - Remove the strap retaining the piston return hose (1).

#### For the right-hand cylinder only

★ If installed, disconnect the return-to-dig sensor, mark its location, and then remove the lift bracket.

- 2 - Remove shovel position rod (2).

- 3 - Place a sling round the cylinder (3) and insert a block "A" between the spacer (4) of the piston fulcrum lever (5) and the link (6).

★ Do not engage the piston return hose with the sling.

- 4 - Take off the snap-ring (7) and the internal retaining spacer (8) for the piston attachment pin (9).

- 5 - Extract pin (9) to expose piston eye.

- 6 - Start the engine to retract the piston (10).

[\*1] [\*2]

**⚠** Stop the engine and eliminate completely residual pressure from all circuits.

- 7 - Remove hoses (1) and (11), and remove hose clamp (12).

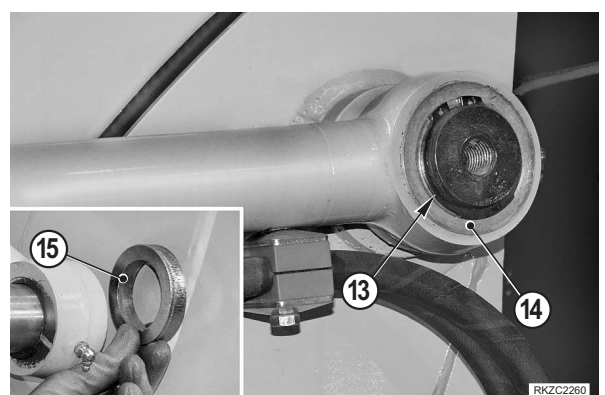
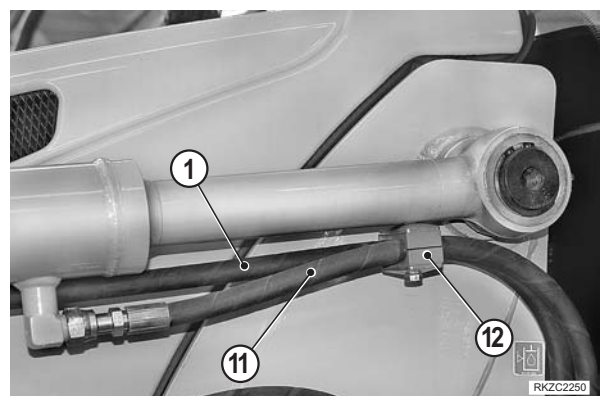
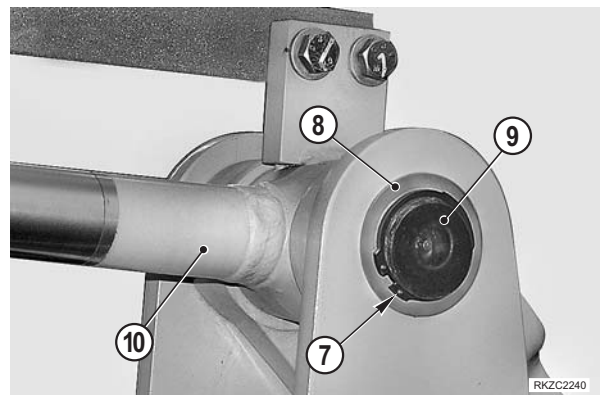
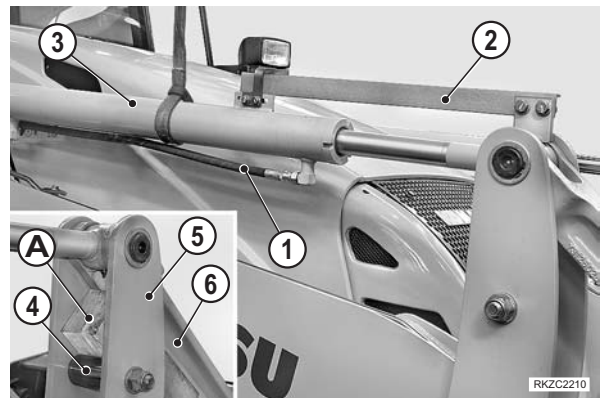
★ Cap the hoses and holes to prevent contamination.

- 8 - Remove the snap-ring (13) and the spacer (14).

- 9 - Remove cylinder (3).

 Tilt cylinder; approx 35 kg

★ Recover spacer (15) between frame and cylinder.



## Installation

- To install, reverse removal procedure.

[\*1]



When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

- 1 - Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

- ★ After bleeding the air, check the oil level in the tank.

### Machines equipped with return-to-dig only

- 2 - Check sensor position and adjust as necessary.  
(For details, see "20 TESTING AND ADJUSTMENTS").



## SHOVEL

### Removal

**⚠** Lower the shovel to the ground, resting on its back, but without forcing it downwards.

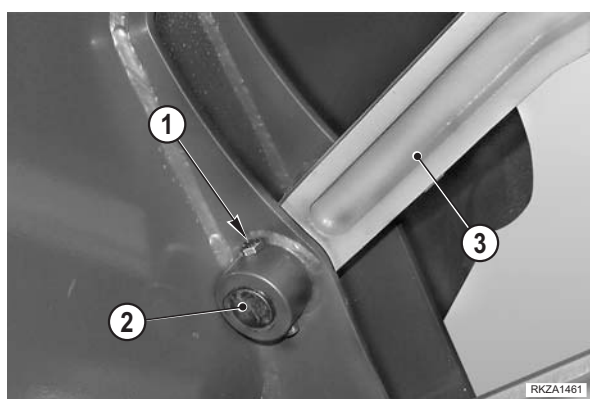
1 -Stop the engine and release residual pressures.



2 -Take out the screws (1) and remove the pins (2) of the lever (3).

Rest the lever (3) on the boom.

[\*1] [\*2]



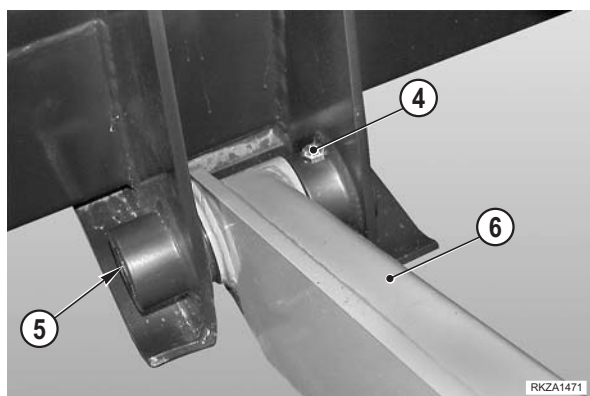
3 -Take out the screws (4) and remove the pins (5) of the shovel fulcrum.

[\*1] [\*2]

4 -Start the engine and put the machine into reverse gear in order to disengage the boom (6).



Shovel: 436 kg



### Installation

- To install, reverse removal procedure.

[\*1]

**⚠** When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050



## FRONT WORKING EQUIPMENT

### Removal

⚠ Lower the working equipment completely until it rests on the ground stop the engine and remove the ignition wrench.

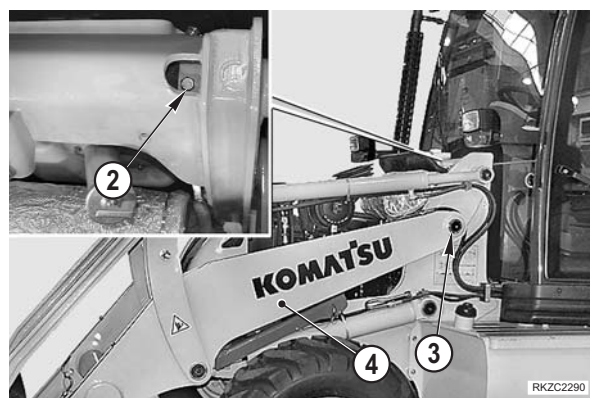
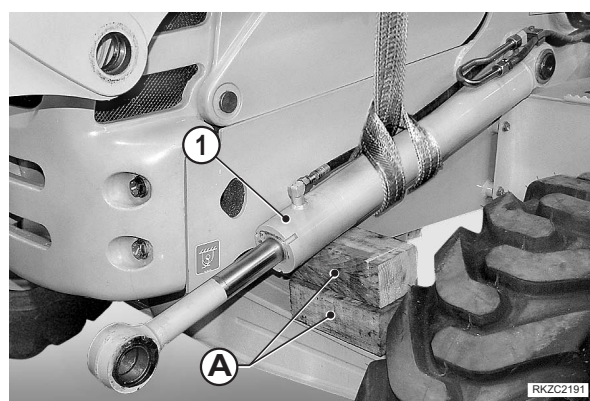
⚠ Release all residual pressure in all circuits.  
(For details, see "20 TESTING AND ADJUSTMENTS").

1 - Remove the tilt cylinders. (See "SHOVEL DUMP CYLINDERS").

2 - Disconnect the cylinders from the boom (1) and rest them on wooden blocks «A» placed on the front axle.  
(See "SHOVEL LIFT CYLINDERS").

3 - Open the front hood and take out the screws (2) that lock the axle oscillation pins (3) of the boom (4).  
Close the front hood.

4 - Put a sling round the boom (4) as shown in the figure, and attach it to the hoisting tackle. Apply a slight tension to the cables.



## REMOVAL AND INSTALLATION

## FRONT WORKING EQUIPMENT

- 5 -Using a puller, remove the oscillation pins (5) of the arm (4) together with snap ring and spacer.

[\*1] [\*2]

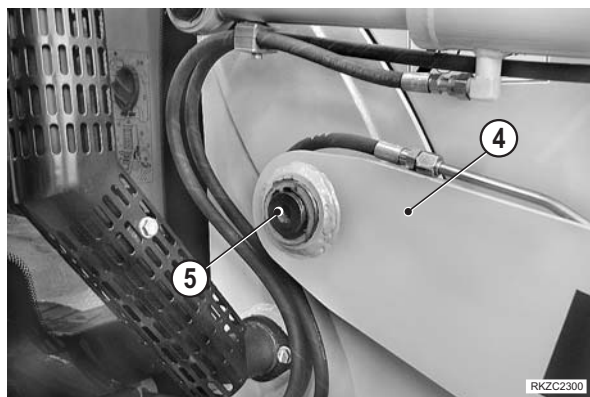
- 6 -Start the engine and put the machine into reverse gear travel until the boom is disengaged.

- ★ If the working equipment is to be detached while the engine or gearshift is out of order and the machine cannot travel automatically, it can be towed using the towing hooks of the backhoe.

- 7 -Place two stands in position and lower the boom until it is resting on them.



Front equipment: approx. 1100 kg



## Installation

- To install, reverse the removal procedure, if necessary using the front towing hook.

[\*1]



When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

- Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").
- ★ After bleeding the air, check the oil level in the tank.

## BACKHOE PPC VALVES

### Removal

**!** The following removal procedure applies to both PPC valves.

1 -Lower the outriggers to the ground: fold the bucket and rest the arm on an "A" block, keeping it at right angles with the ground.

2 -Release the backhoe plate and stop the engine.

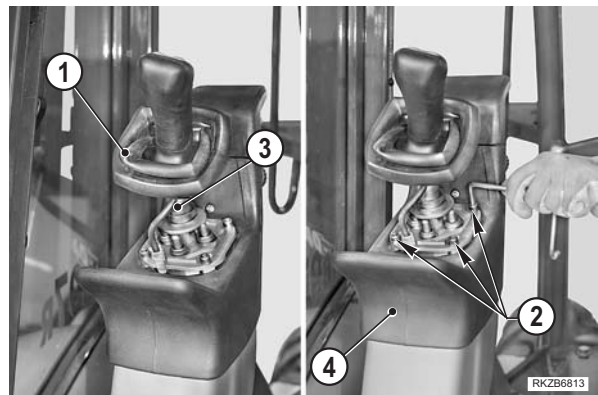
**!** Release all residual pressure in all circuits. (For details, see "20 TESTING AND ADJUSTMENTS").

3 -Lift cab rear window up to the top.



4 -Fully raise the boot (1).

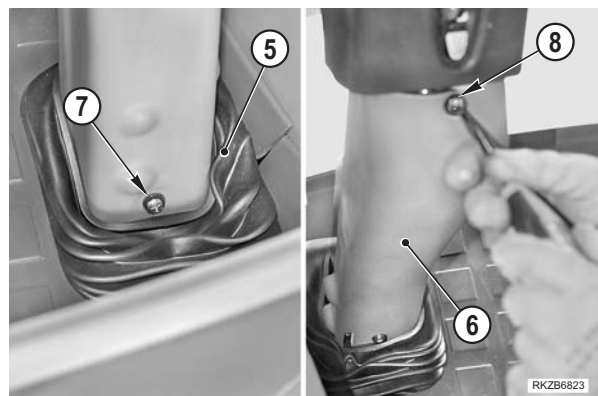
5 -Loosen and remove the screws (2) retaining the PPC valve (3) and armrest (4).



6 -Raise the armrest from the rear side and remove the screw (5) retaining the rear guard (6).

7 -Cut the retaining clamp and lower the lower boot (7).

8 -Loosen and remove screw (8), and remove rear guard (6).

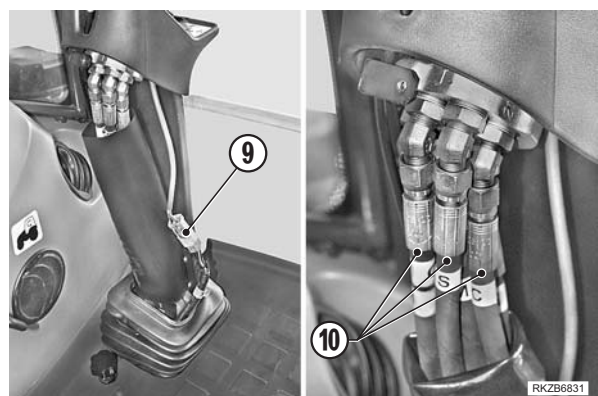


9 -Disconnect the connector (9).

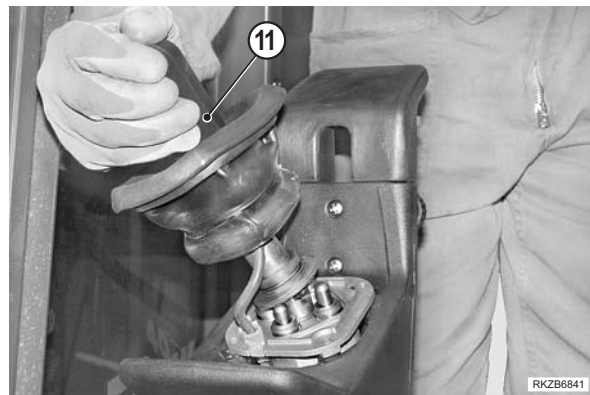
10 -Ensure that the hoses are marked (10), then disconnect the hoses from the PPC valve. [\*1]

★ Mark the hoses, if necessary.

★ Plug all pipes/hoses to prevent contamination.



11 -Remove the PPC valve (11).



### **Installation**

- To install, reverse removal procedure.
  - ★ Carefully inspect the hoses for the proper position when connecting them. (For details, see "10 STRUCTURE AND FUNCTION").

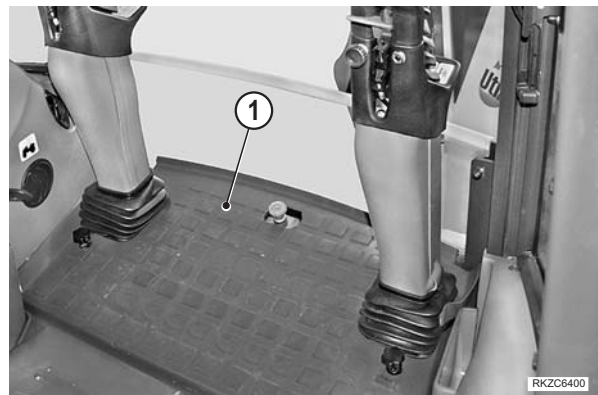
## PPC VALVE SUPPORT RELEASE CABLES

### Removal

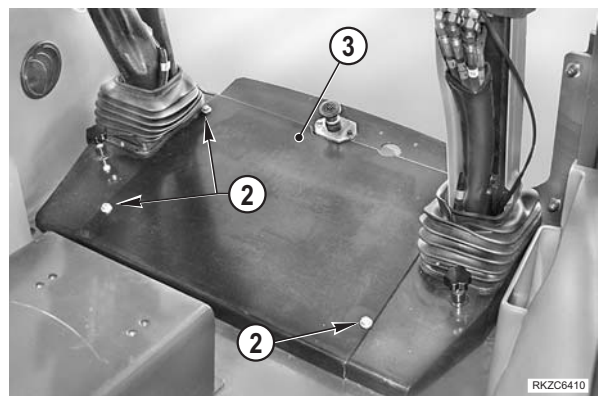
- 1 - Lower the outriggers and the equipment to the ground; stop the engine.



- 2 - Remove the rear mat (1).

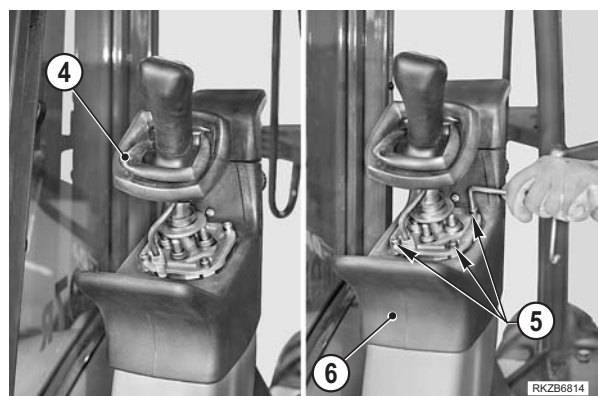


- 3 - Take out the screws (2) and remove the platform (3).



- 4 - Fully raise the boot (4).

- 5 - Loosen and remove the screws (5) that retain the PPC valve and armrest (6).





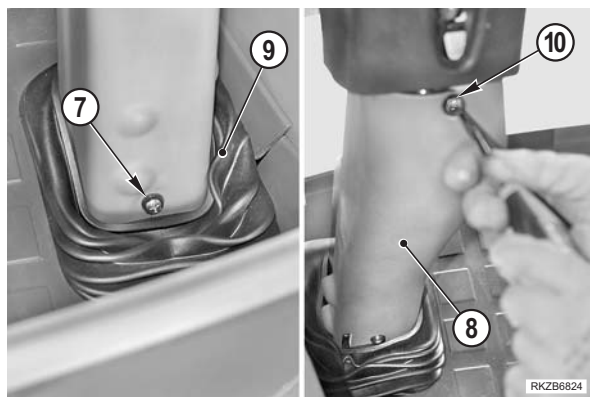
## REMOVAL AND INSTALLATION

## PPC VALVE SUPPORT RELEASE CABLES

6 -Raise the armrest from the rear side and remove the screw (7) retaining the rear guard (8).

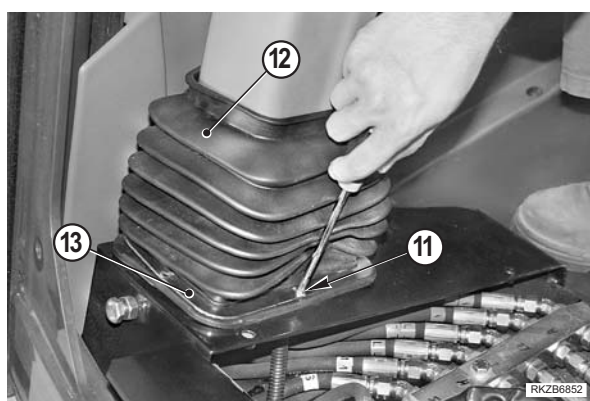
7 -Cut the retaining clamp and release the lower boot (9).

8 -Loosen and remove the screws (10) and remove the rear guard (8).



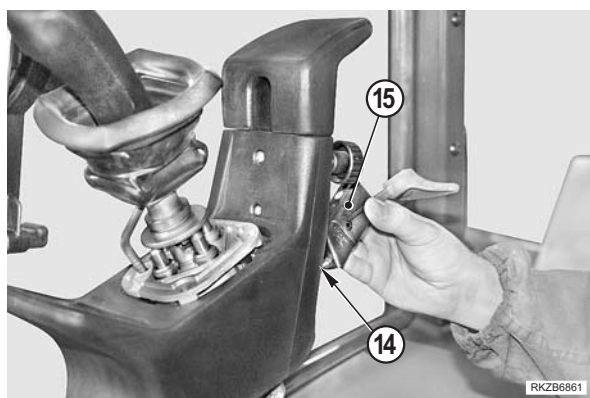
9 -Loosen and remove the screws (11) and raise the boot (12) and the retaining edge (13).

★ Raise until the lower fulcrum and locking assembly become fully disengaged.



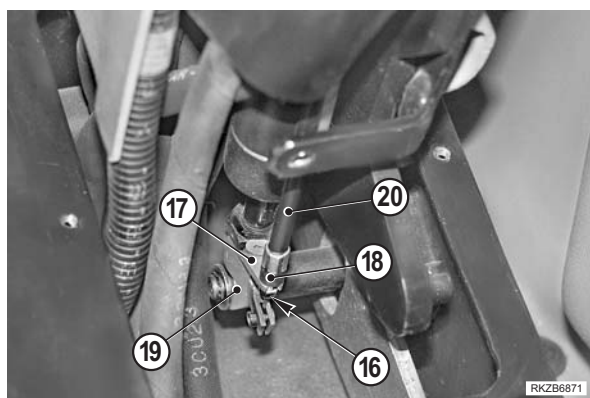
10 -Remove the retaining screws (14) from the lock-actuating lever assembly (15).

11 -Remove the entire lever assembly (15).



12 -Loosen the nut (16) and disengage the sheath (18) from the support (17).

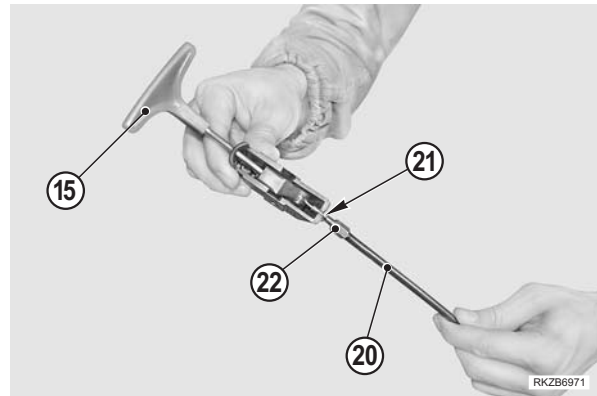
13 -Disconnect the cable (20) from the lower locking lever (19).



## REMOVAL AND INSTALLATION

## PPC VALVE SUPPORT RELEASE CABLES

- 14 -Loosen the nut (21) and unscrew the tensioner (22); disengage the control cable (20) from the release control lever (15).



### Installation and adjusting

- To install, reverse removal procedure.
- 1 -Using the tensioner (22), adjust cable tension to obtain safe locking and friction-free unlocking of the column.
  - 2 -Lock the nut while holding the tensioner into position (21).





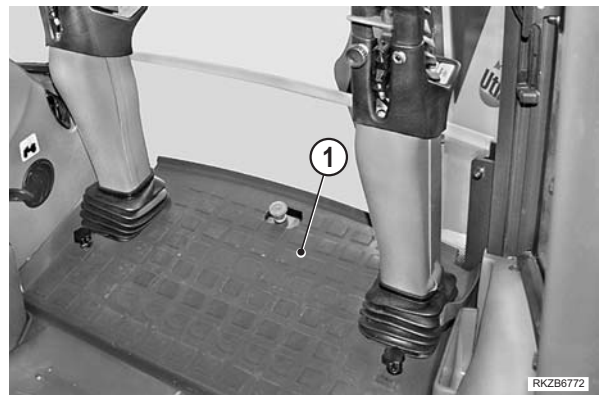
## PPC VALVE SUPPORT RETURN GAS SPRING

### Removal

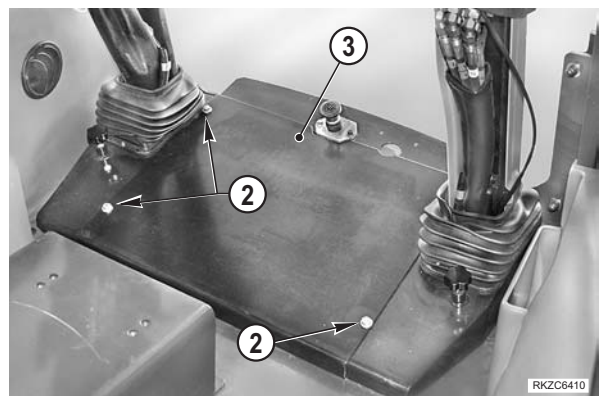
- 1 - Lower the outriggers and the equipment to the ground; stop the engine.



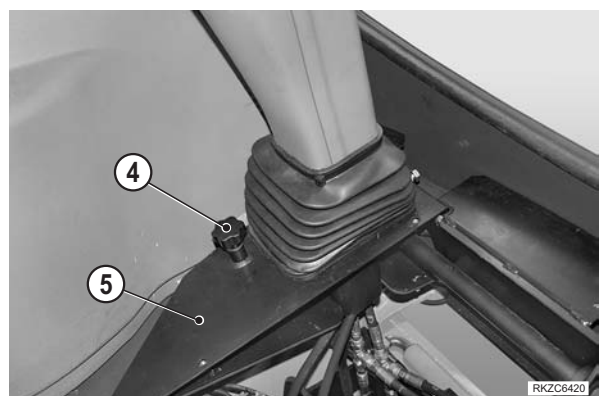
- 2 - Remove the rear mat (1).



- 3 - Take out the screws (2) and remove the platform (3).



- 4 - Fully loosen the stop knob (4) of the PPC valve support (5) you are working on.

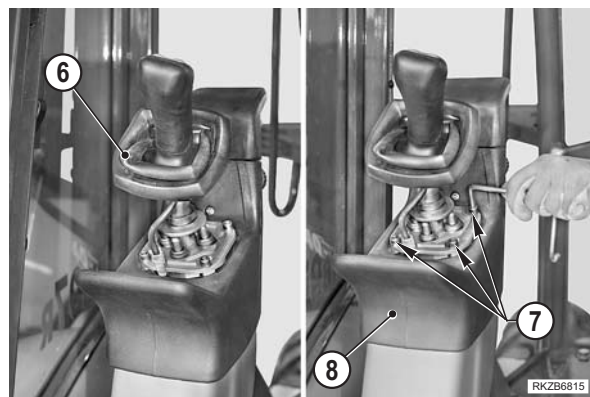


## REMOVAL AND INSTALLATION

## PPC VALVE SUPPORT RETURN GAS SPRING

5 -Fully raise the boot (6).

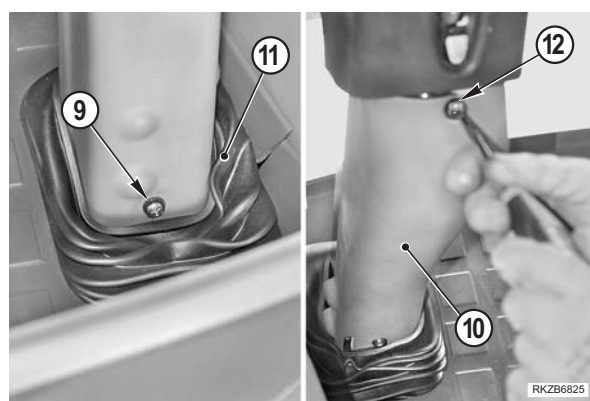
6 -Loosen and remove the screws (7) that retain the PPC valve and armrest (8).



7 -Raise the armrest from the rear side and remove the screw (9) retaining the rear guard (10).

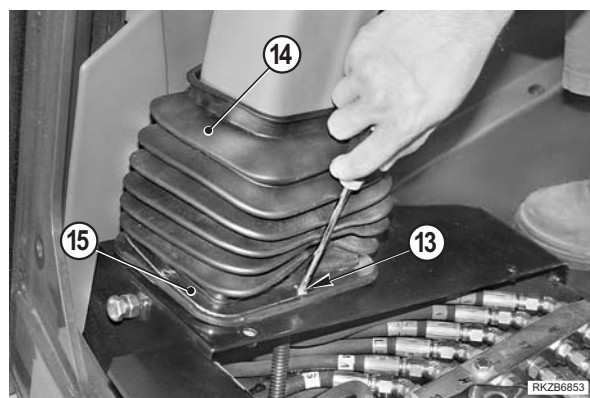
8 -Cut the retaining clamp and release the lower boot (11).

9 -Loosen and remove screw (12), and remove rear guard (10).



10 -Loosen and remove the screws (13) and raise the boot (14) and the retaining edge (15).

★ Raise until the gas spring (16) becomes fully disengaged.

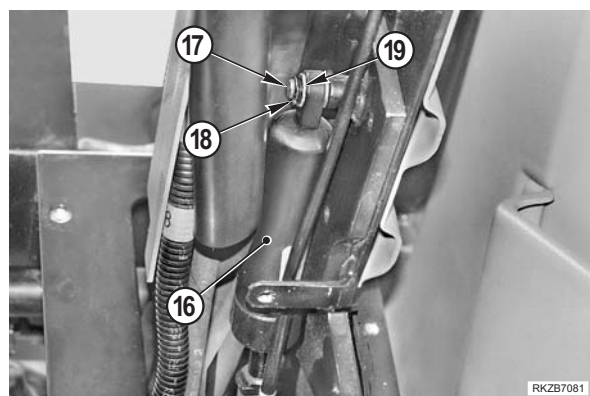


11- Loosen the nut (17) and remove the snap ring (18) and washer (19).

12- Disconnect the gas spring (16) and remove it.

### Installation

- To install, reverse removal procedure.



## SOLENOID VALVE GROUP (servocontrol and optional attachment)

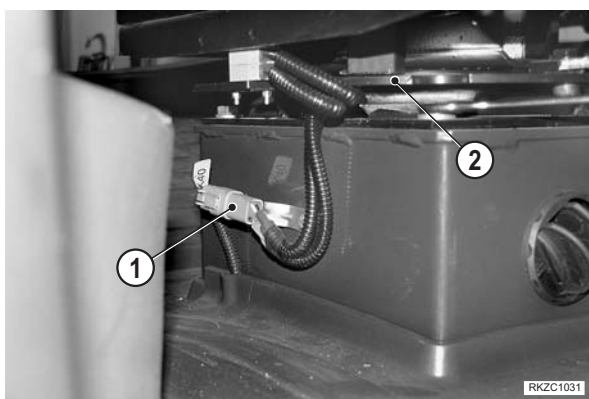
### Removal

- 1 -Lower the outriggers and the equipment to the ground; engage the parking brake, stop the engine and extract the ignition key.

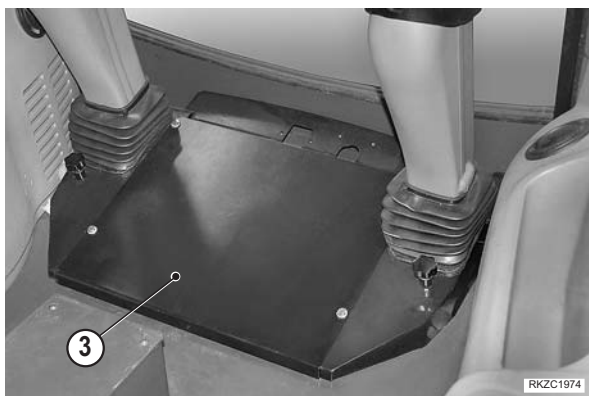
 Release residual pressure from all circuits by moving all control levers in all directions.



- 2 -Disconnect the connector (1) and remove the seat (2).



- 3 -Remove the rear mat and remove the metal sheet (3) closing off the floor.



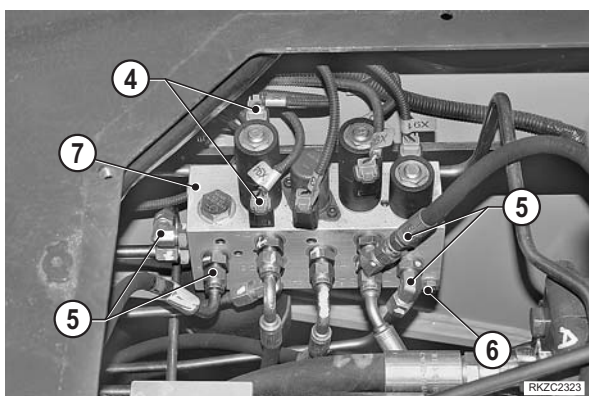
- 4 -Disconnect all connectors (4) from the solenoid valves .

★ Check to ensure that all connectors have marks scribbled on, and note down their plugging positions.

- 5 -Mark and disconnect all hoses (5).

★ Cap pipes, hoses and holes to prevent contamination.

- 6 -Loosen and remove two screws (6) and washers; remove the solenoid valve group (7) together with the accumulator.



## **REMOVAL AND INSTALLATION**

## **SOLENOID VALVE GROUP (servocontrol and optional attachment)**

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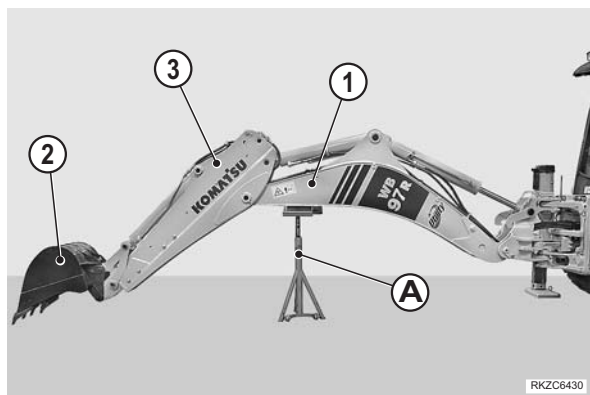
### **Installation**

- To install, reverse removal procedure.
- 1 - Start the engine and perform all possible manoeuvres to eliminate the air from all circuits.

## BACKHOE BOOM CYLINDER

### Removal

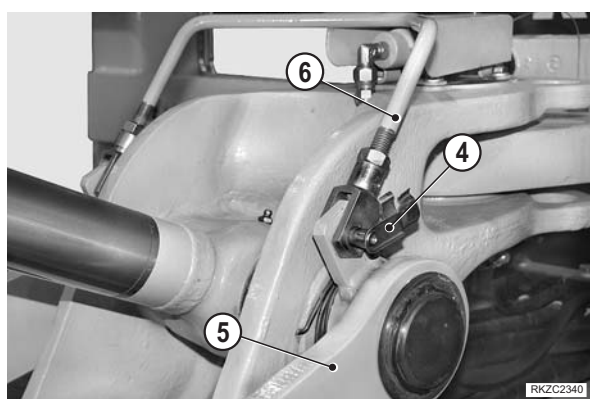
- 1 -Fully extend the arm (1) and fully open the bucket (2).  
Manoeuvre the boom until the outer end of the boom is in a level position.
- 2 -Place and force a jack stand "A" and a non-slip block under the boom.
- 3 -Lower the arm until the bucket teeth touch the ground.



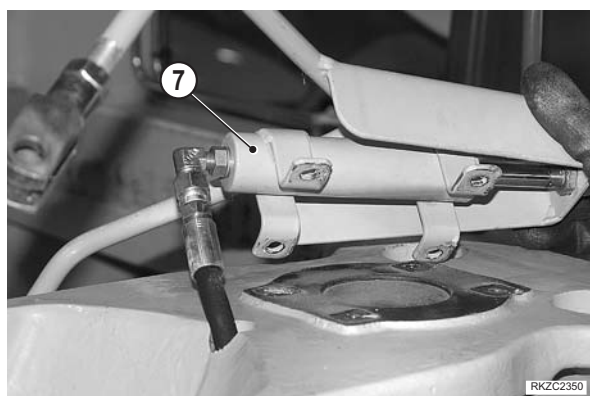
- 4 -Lower the outriggers to the ground, apply the parking brake, and stop the engine.

**!** Release residual pressure from all circuits by operating the control levers in all directions.

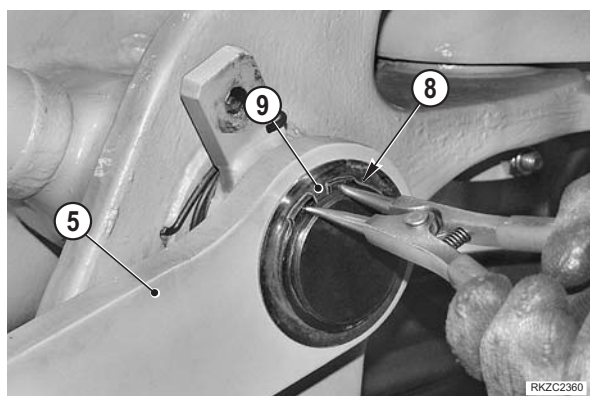
- 5 -Remove pins (4) and disconnect tie rod (6) from boom retaining lever (5).



- 6 -Loosen and remove the screws, remove the group (7) controlling the levers (5) and position it aside.



- 7 -Remove snap rings (8), shims (9), and levers (5).

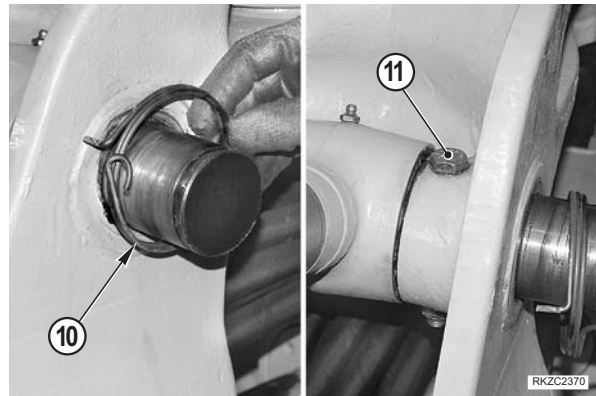




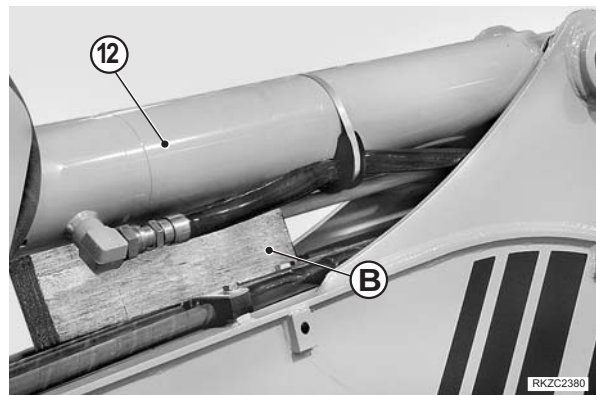
## REMOVAL AND INSTALLATION

## BACKHOE BOOM CYLINDER

- 8 -Remove springs (10), and remove the nut and screw (11) retaining the piston attachment pin.



- 9 -Place a safety block "B" under the cylinder (12) controlling the arm.

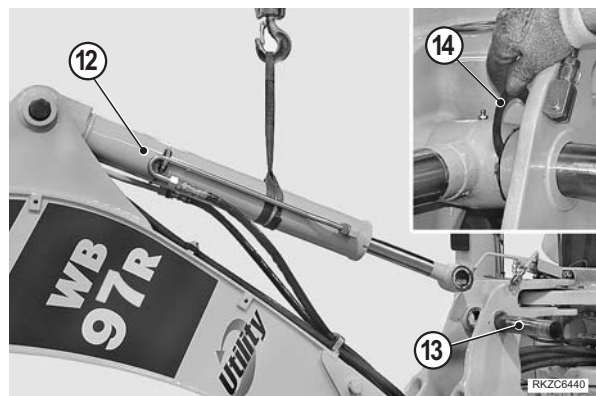


- 10 -Sling the cylinder (12) in a band and connect it to a hoisting device; apply a slight tension.

★ Do not engage the hoses with the band.

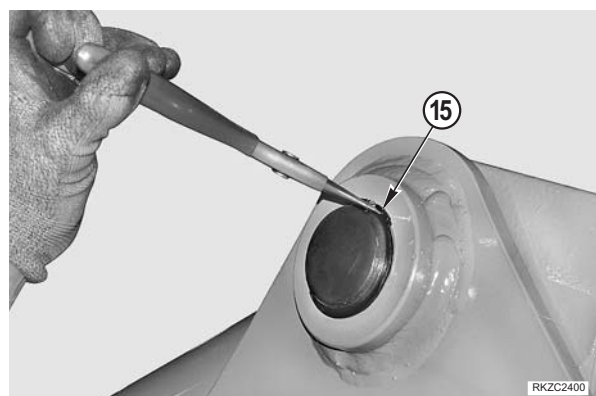
- 11 -Pull out pin (13) and recover spacers (14).

[\*1] [\*2]



- 12 -Start the engine and retract the piston.  
Stop the engine and release residual pressures.

- 13 -Remove snap ring (15).

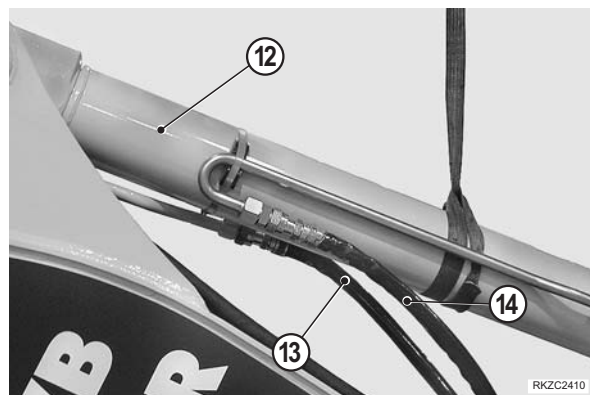


## REMOVAL AND INSTALLATION

## BACKHOE BOOM CYLINDER

14 -Disconnect hoses (13) and (14) from cylinder (12).

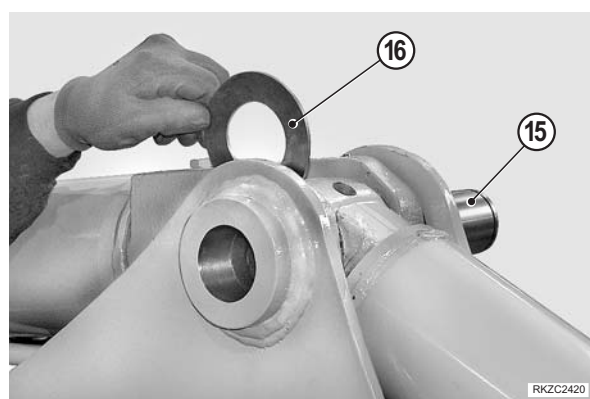
- ★ Cap pipes, hoses and holes to prevent contamination.



15 -Pull out pin (15) and remove cylinder (12).

- ★ Recover shims (16) and note down their position of installation between boom and cylinder and between boom and arm. [\*1] [\*2]

 Cylinder: 87.5 kg



## Installation

- To install, reverse removal procedure.

[\*1]

- ⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]

 Internal bushing: ASL800050

- 1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

- ★ After bleeding the air, check the oil level in the tank.



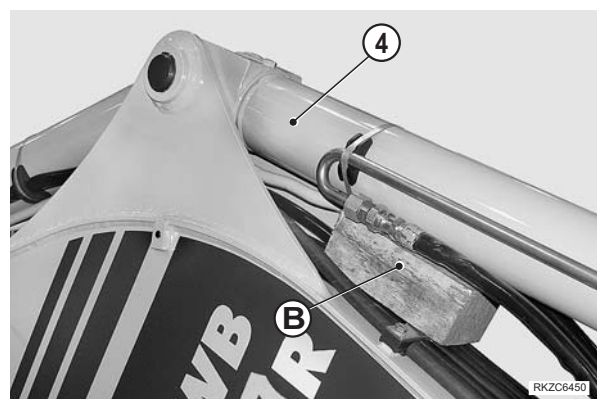
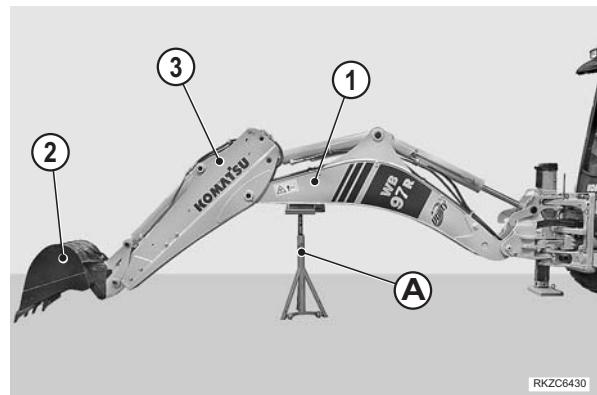
## ARM CYLINDER

### Removal

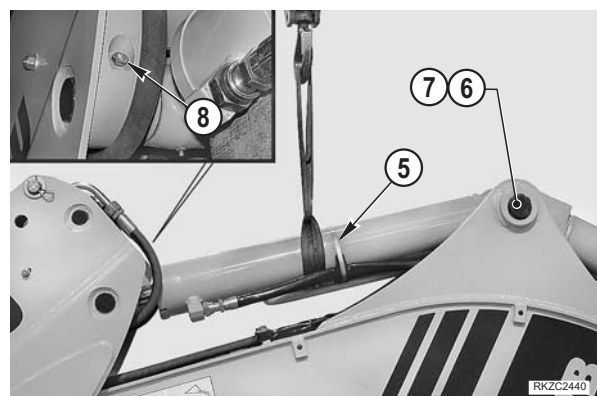
- 1 -Fully extend the arm (1) and fully open the bucket (2).  
Manoeuvre the boom until the outer end of the boom is in a level position.
- 2 -Place and force a jack stand "A" and a non-slip block under the boom.
- 3 -Lower arm (3) until bucket teeth touch the ground.
- 4 -Lower the outriggers to the ground, apply the parking brake, and stop the engine.

**!** Release residual pressure from all circuits by operating all hydraulic controls in all directions.

- 5 -Force a block "B" under the boom cylinder (4).

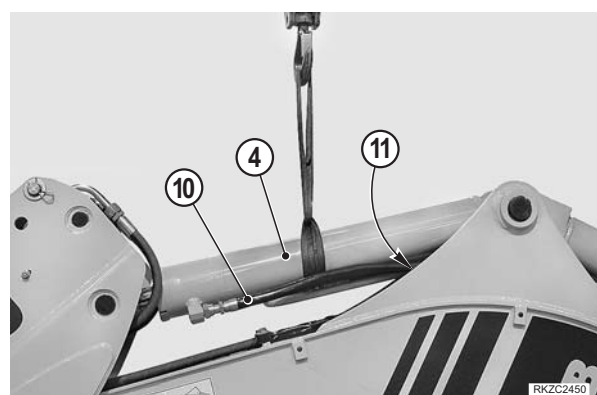


- 6 -Remove the strap (5) retaining the hoses.
- 7 -Sling the cylinder (4) in a band and connect it to a hoisting device; apply a slight tension.  
★ Do not engage the hoses with the band.
- 8 -Remove the snap ring (6) retaining the cylinder fulcrum pin (7) and the screw (8) retaining the piston pin (9).



- 9 -Disconnect hoses (10) and (11) from cylinder (4).

★ Cap pipes, hoses and holes to prevent contamination.

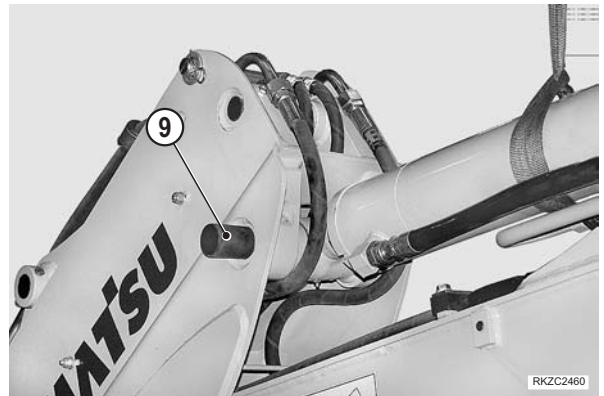


## REMOVAL AND INSTALLATION

## ARM CYLINDER

10 -Pull out the piston attachment pin (9).

[\*1] [\*2]



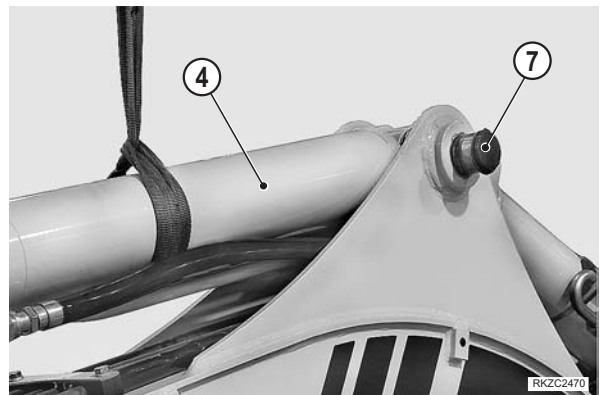
11 -Pull out the cylinder attachment pin (7) until the eye of cylinder (4) is exposed.

[\*1] [\*2]

12 -Remove cylinder (4) and recover shims (if any).



Arm cylinders: 67 kg



## Installation

- To install, reverse removal procedure.

[\*1]



When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

- 1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

★ After bleeding the air, check the oil level in the tank.

## JIG ARM CYLINDER

### Removal

**!** Open the arm (1) completely and lower it until it rests on a trestle "A" that is roughly 40 cm high. Extend the jig arm (2) until it rests on a block "B", and let the bucket teeth rest on the ground.

1 - Stop the engine and release the cylinder (3) pressures, by moving the command pedal several times.

2 - Place a sling around the cylinder (3).

3 - Take off the snap ring and remove the pin (4).  
[\*1] [\*2]

4 - Start the engine to retract the piston.

5 - Stop the engine and release residual hydraulic pressure from all circuits by operating the control levers in all directions.

6 - Take out the safety pin (5).

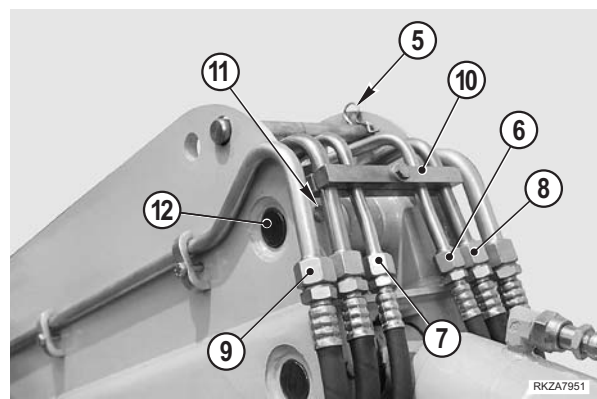
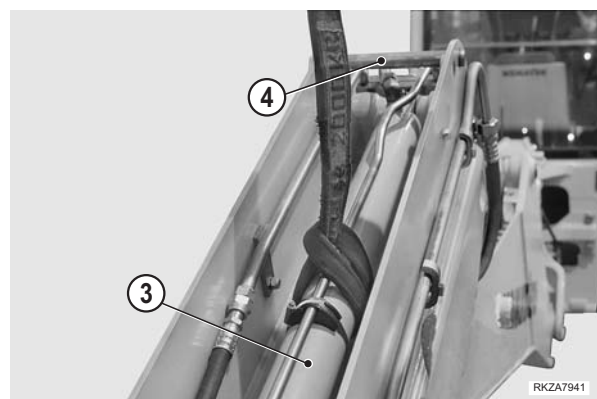
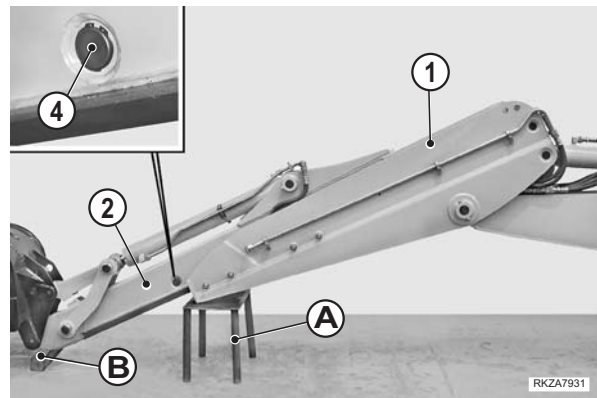
7 - Disconnect the tubes (6), (7), (8) and (9).

★ Cap pipes, hoses and holes to prevent contamination.

8 - Remove the clamp (10).

9 - Remove the screws (11) and the pin (12).  
[\*1] [\*2]

10 - Remove cylinder (3).



### Installation

• To install, reverse removal procedure.

[\*1]

**!** When aligning the positions between the hole and the pin, turn the engine over at low idling speed. Do not insert fingers into the holes to check alignment.

[\*2]

 Internal bushing: ASL800050

1 - Start the engine and bleed the air from the cylinders. (For details, see "20 TESTING AND ADJUSTMENTS").

★ After bleeding the air, check the oil level in the tank.

## OUTRIGGER CYLINDER

### Removal

**⚠** Set the backhoe with the centered attachments with the arm in vertical position and the bucket leaned on the back at level ground.

1 -Extend the outriggers (1) of about 15 cm, stop the engine and release the cylinders pressures.



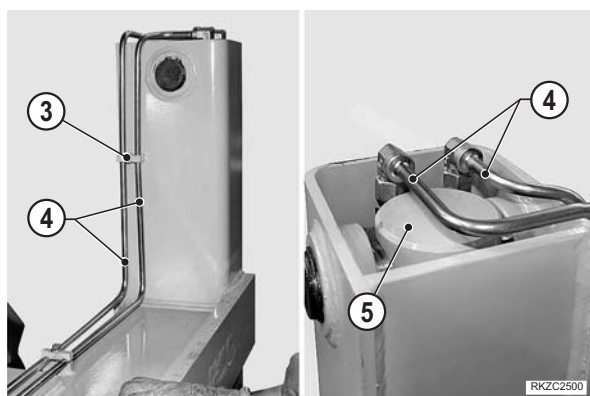
2 -Place a lifting platform "A" beneath outrigger (2) of cylinder to be remove.  
Raise this until it is forced up against the outrigger.



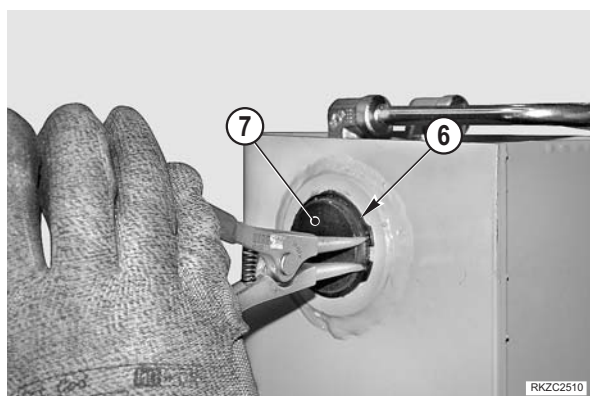
3 -Remove the clamps (3) retaining the pipes (4).

4 -Disconnect from cylinder (5) the pipes (4) and plug them to avoid impurity entry.

★ Plug also the union to avoid the movement of piston.



5 -Take off snap ring (6) and slide pin (7) out until cylinder (5) is disengaged.  
[\*1] [\*2]



## REMOVAL AND INSTALLATION

## OUTRIGGER CYLINDER

- 6 - Raise the lifting platform "A" to disengage the cylinder head (5) from frame.  
Place a sling round the cylinder (5) and apply slight tension to the cables.

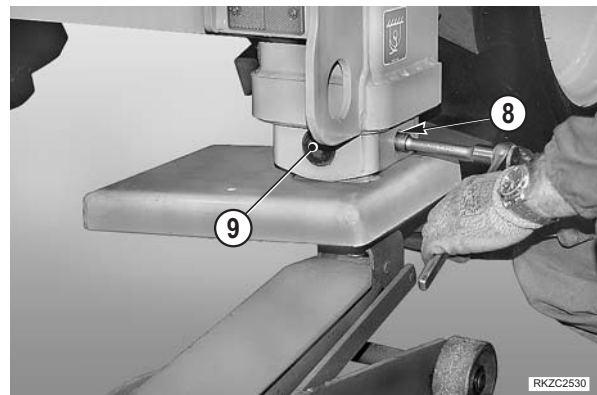


- 7 - Take out the screws and remove the pin (10).  
[\*1] [\*2]

- 8 - Remove the cylinder(5).



Cylinder: approx. 27.5 kg



## Installation

- To install, reverse removal procedure.

[\*1]

 Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

- 1 - Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

- ★ After bleeding the air, check the oil level in the tank.



## BACKHOE SWING CYLINDERS

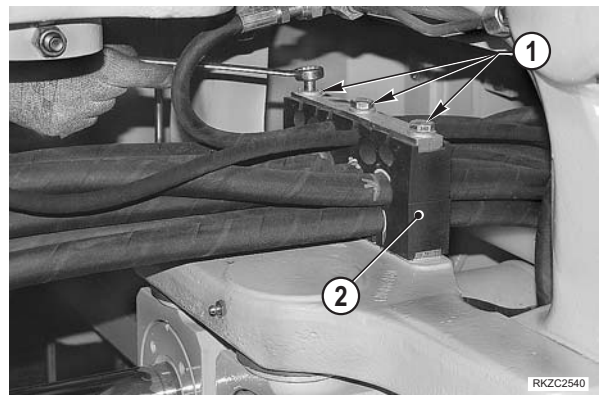
### Removal

**⚠** Set the backhoe with the centered attachments with the arm in vertical position and the bucket leaned on the back at level ground.

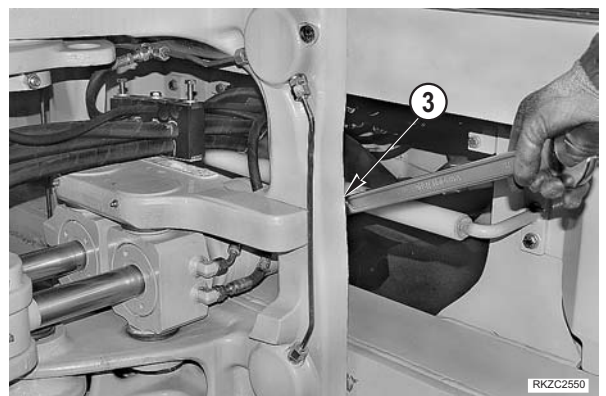
1 -Stop the engine and release all cylinder pressure by moving the lockout control several times.



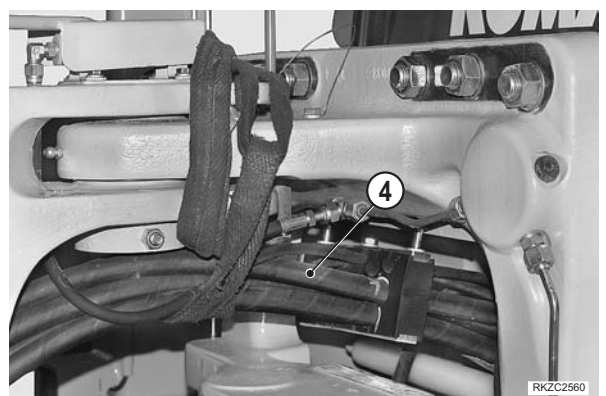
2 -Loosen and remove screws (1) and release hose clamp (2).



3 -Loosen and remove the four screws (3) and washers. [\*1]



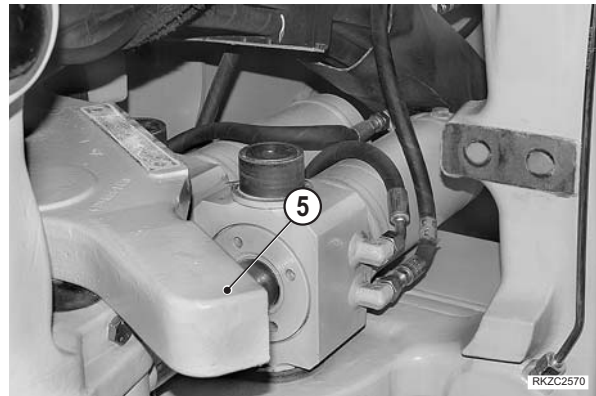
4 -Lift the hoses (4) to the backhoe cylinders and retain them in position with a band.



## REMOVAL AND INSTALLATION

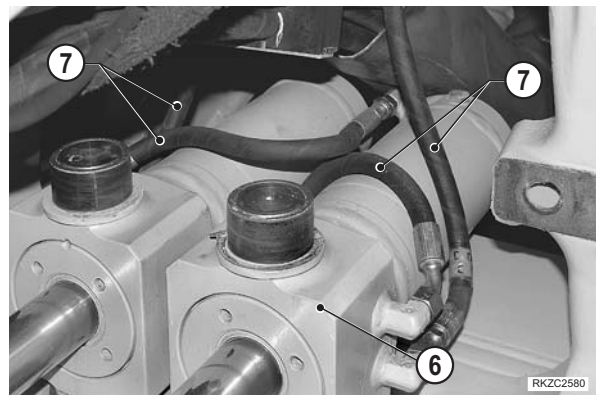
## BACKHOE SWING CYLINDERS

- 5 - Remove the upper support (5) with a vertical movement.  
[\*3]



- 6 - Disconnect four tubes (6) from cylinders (7).

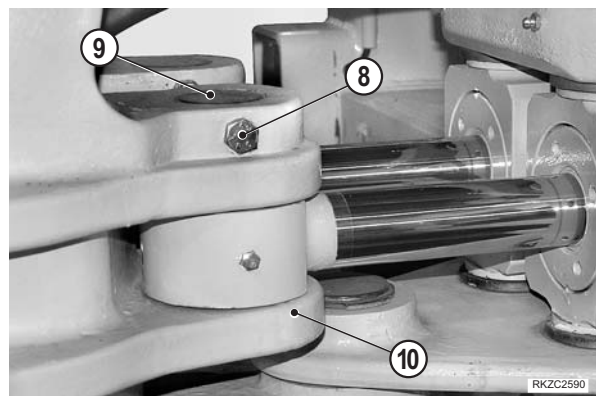
★ Cap pipes, hoses and holes to prevent contamination.



- 7 - Take out the screws (8) and remove the pins (9).

- 8 - Rotate the cylinders to disengage the piston heads from the swing bracket (10) and remove the cylinders (6).

 Cylinder: approx. 34 kg





## REMOVAL AND INSTALLATION

## BACKHOE SWING CYLINDERS

### Installation

- 1 -Mount the cylinders (6) and the upper cylinder fulcrum support (2). Secure the support with the four screws (3).

[\*1]

 Support screws: Loctite 262

 Support screws: 981±98 Nm

- 2 -Connect the four tubes (7) to the cylinders.
- 3 -Start the engine and swing the boom in order to center one of two pins (6). Secure the 1st pin with the screw. Perform the same operation for the other pin.

[\*2]

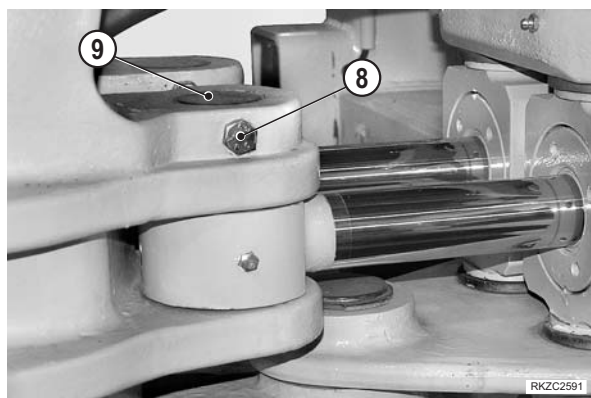
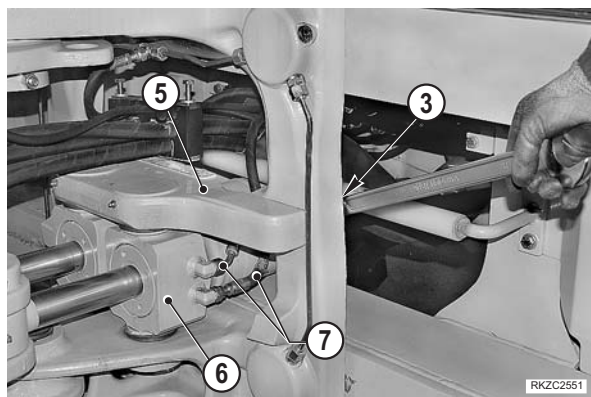
-  When aligning the positions between the hole and the pin, turn the engine over at low idling speed. Do not insert fingers into the holes to check alignment.

[\*3]

 Internal bushing: ASL800050

- 4 -Bleed the air from the cylinders. (For details, see "20 TESTING AND ADJUSTMENTS").

★ After bleeding the air, check the oil level in the tank.



## BACKHOE BUCKET CYLINDER

### Removal

- 1 -Extend the arm (1).
- 2 -Operate the boom (2) and bucket (3) until bottom of bucket sits level.
- 3 -Lower the outriggers to the ground, apply the parking brake, and stop the engine.

**!** Release residual pressure from all circuits by operating the control levers in all directions.

- 4 -Sling the cylinder (4) in a band and connect it to a hoisting device; apply a slight tension.

★ Do not engage the hoses with the band.

- 5 - Take out the lock-nut (5) and the washer and remove the pin (6).  
[\*1] [\*2] [\*3]

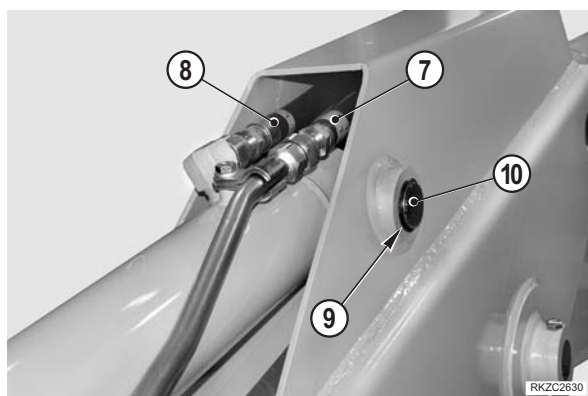
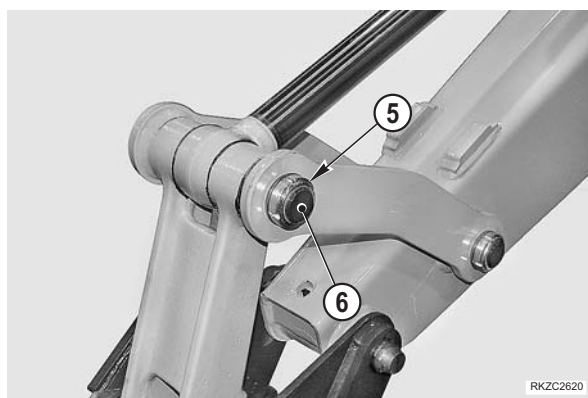
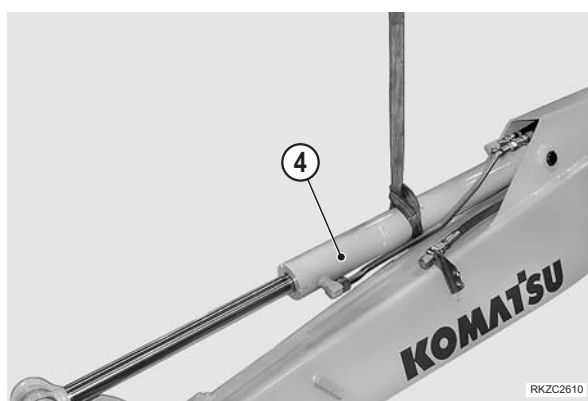
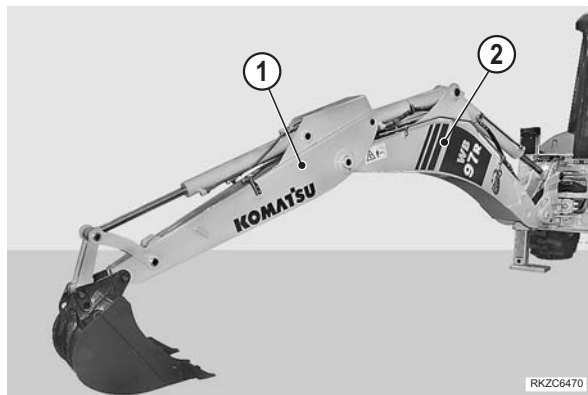
- 6 -Start the engine and retract the piston.

**!** Stop the engine and release residual pressures.

- 7 -Disconnect the tubes (7) and (8).

★ Cap pipes, hoses and holes to prevent contamination.

- 8 -Take off the snap ring (9) and remove the pin (10).  
[\*1] [\*2]



## REMOVAL AND INSTALLATION

## BACKHOE BUCKET CYLINDER

### Versions with jig arm only

9 -Disconnect the tubes (11) and (12).

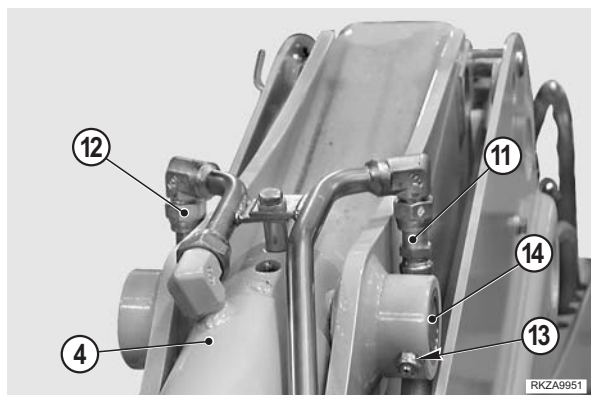
10 -Take out screw (13) and remove pin (14).

[\*1] [\*2]

11 -Remove cylinder (4).



Standard cylinder: approx. 52.5 kg



### Installation

- To install, reverse removal procedure.

[\*1]



When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

[\*3]

- ★ Tighten the locknut completely, then release it half a turn.

1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

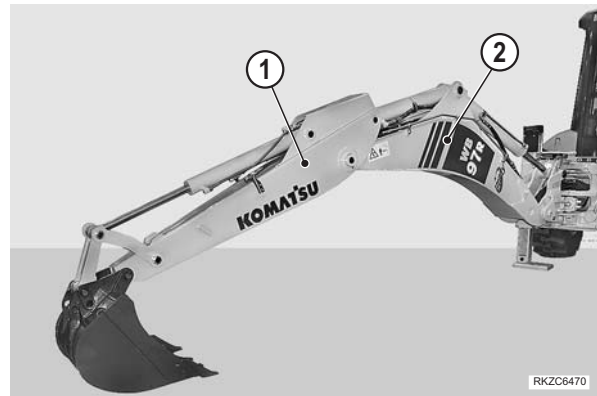
- ★ After bleeding the air, check the oil level in the tank.

## BACKHOE BOOM SAFETY CYLINDER

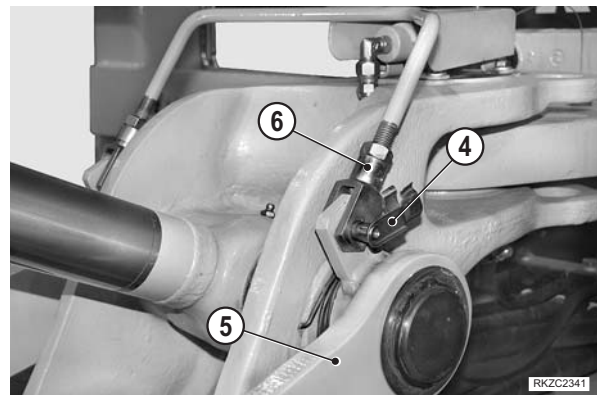
### Removal

- 1 -Extend the arm (1).
- 2 -Operate the boom (2) and bucket (3) until bottom of bucket sits level.
- 3 -Lower the outriggers to the ground, apply the parking brake, and stop the engine.

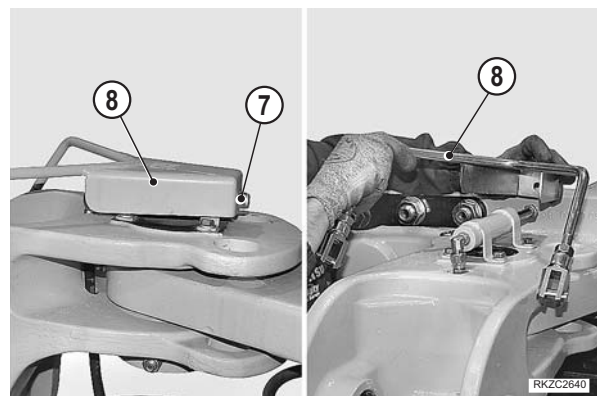
**!** Release residual pressure from all circuits by operating the control levers in all directions.



- 4 -Remove pins (4) and disconnect yokes (6) from boom retaining levers (5).



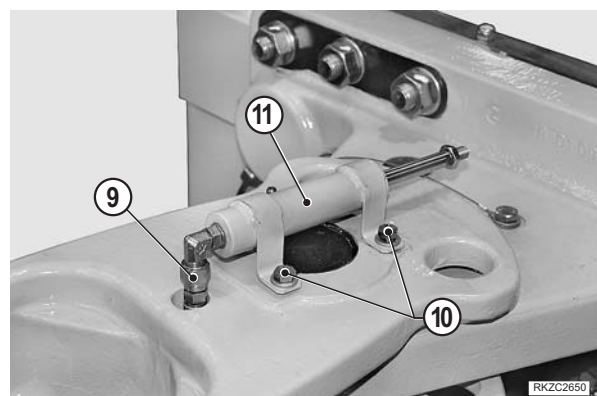
- 5 -Loosen and remove nut (7) and remove tie rod (8).



- 6 -Disconnect feed hose (9).

★ Cap the hose and hole to prevent contamination.

- 7 -Loosen and remove the screws (10) and the cylinder (11).



## **Installation**

- To install, reverse removal procedure.
- 1 -Start the engine and operate the cylinder several times to eliminate the air from the circuit.
- 2 -Lift the boom and check to ensure that the safety connection is correct.

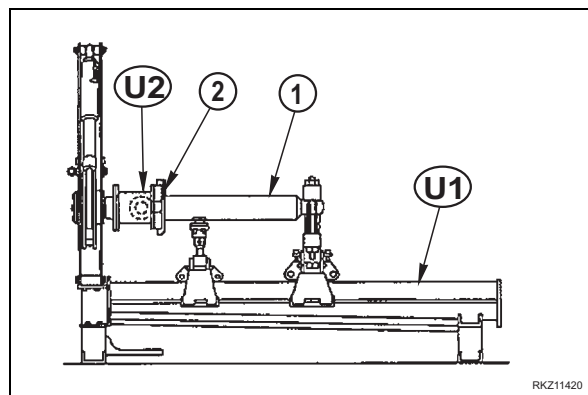
## CYLINDER

### SHOVEL ARM, SHOVEL, BOOM, ARM, BUCKET, OUTRIGGERS

#### Disassembly

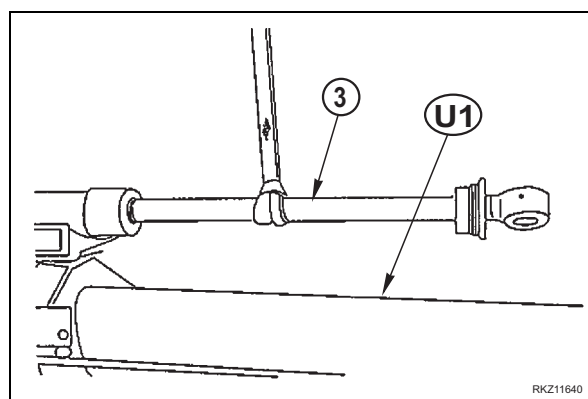
1 -Position cylinder to be disassembled (1) to equipment **U1**.

2 -Using wrench **U2** with torque amplifier, fully unscrew the head (2).



3 -Extract the complete piston (3).

★ Place a receptacle to collect the oil.

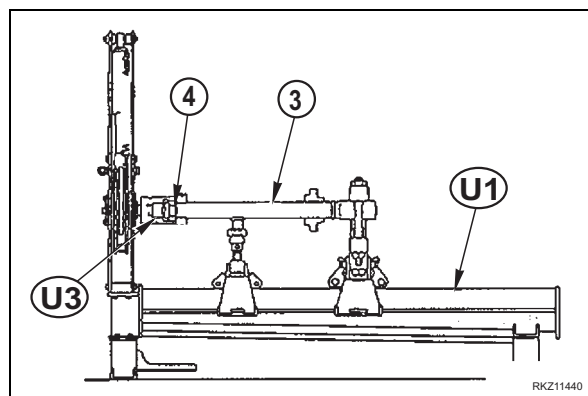


4 -Position the complete piston (3) to equipment **U1**.

5 -Using a wrench **U3** with torque amplifier, remove the nut (4) retaining the piston (5) from the following cylinders:

- Shovel raise: Key 55 mm
- Shovel dump: Key 55 mm
- Boom: Key 65 mm ●
- Arm: Key 65 mm
- Bucket: Key 55 mm
- Outriggers: Key 46 mm
- Jig arm: Key 46 mm ○

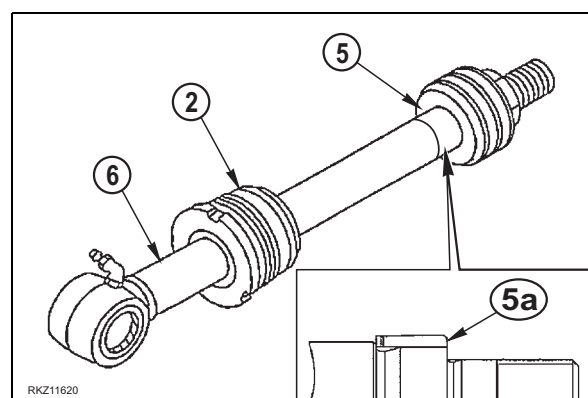
- Remove safety dowel first
- Lift calking first



6 -Slide piston (6) and head (2) off rod (5).

★ **Arm only:**

Note down direction of installation of brake bushing (5a).



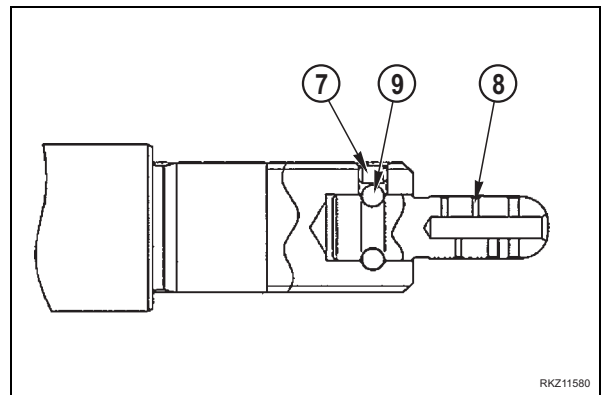
## REMOVAL AND INSTALLATION

## CYLINDER

### 7 -Boom cylinder rod only.

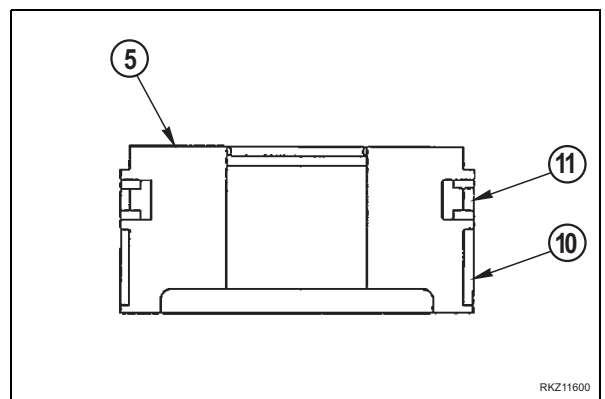
Remove plug (7) and rotate end (8) to let the balls (9) out.

8 -Remove end (8).



### 9 -All cylinders.

Remove guide ring (10) and seal (11) from piston (5).



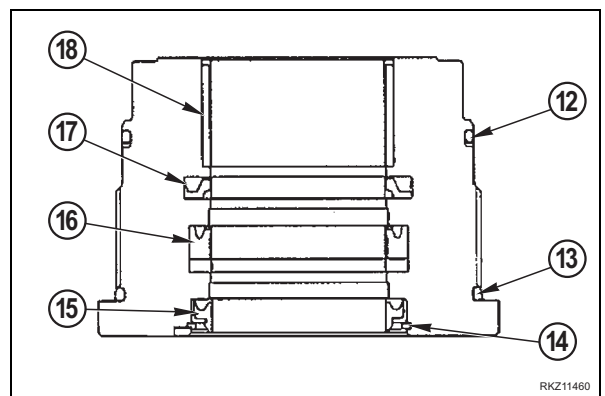
10 -Remove O-ring (12) with anti-extrusion ring, O-ring (13), snap ring (14) and scraper ring (15) from head.

11 -Remove gaskets (16) and (17).

★ Note down direction fo installation of anti-extrusion ring and position of ring (12).

### 12 -Boom head

Remove bushing (18).





## REMOVAL AND INSTALLATION

## CYLINDER

### Assembly

- ★ Lubricate surfaces to prevent damage to the gaskets, seals, O-rings, scraper, etc.

 Surface: engine oil

- ★ Do not force sealing rings into place; heat them instead in hot water at 50-60°C before installing.

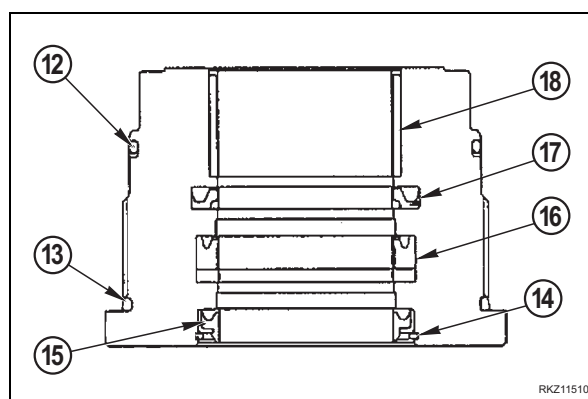
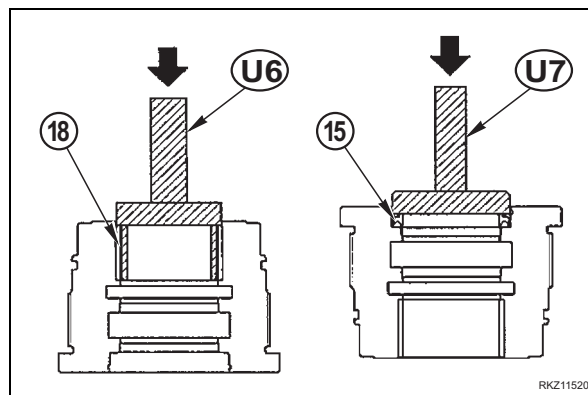
### Boom head only

- 1 -Using tool **U6**, install bushing (18).

### All cylinders

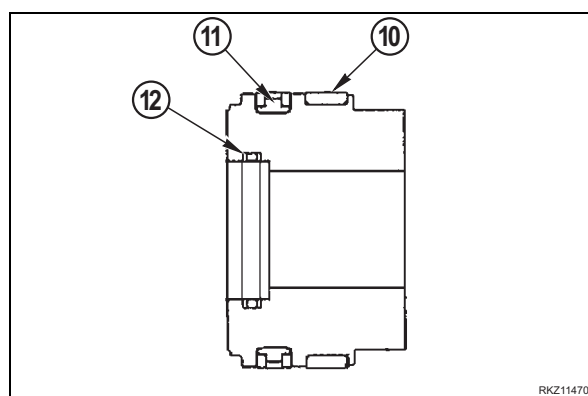
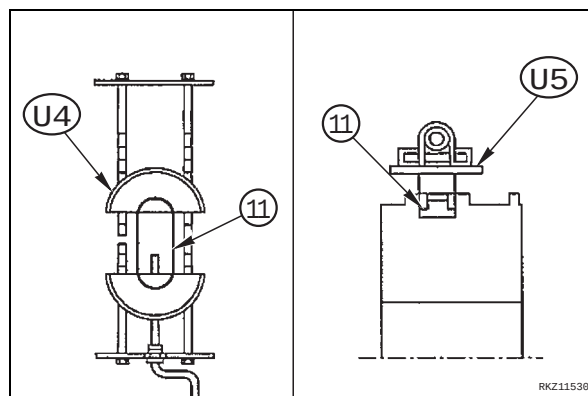
- 2 -Using tool **U7**, install scraper ring (15) and snap ring (14).
- 3 -Assemble seals (16) and (17).

- ★ Check direction of installation.



### Assembly piston

- 1 -Using tool **U4** expand seal (11) and fit it on the piston.
- 2 -Calibrate seal (11) using calibrator **U5**.
- 3 -**Boom cylinder only.**  
Install anti-extrusion rings and O-ring (12).
- 4 -Assemble the guide ring (10).



## REMOVAL AND INSTALLATION

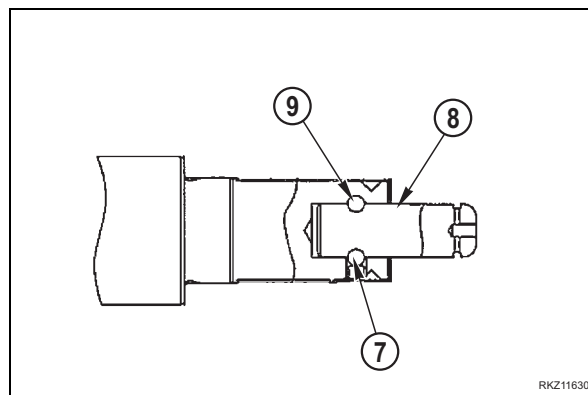
## CYLINDER

### 5 -Boom cylinder only.

Introduce rod (6), end (8), and ten balls (9); install plug (7).

 Plug: Loctite 262

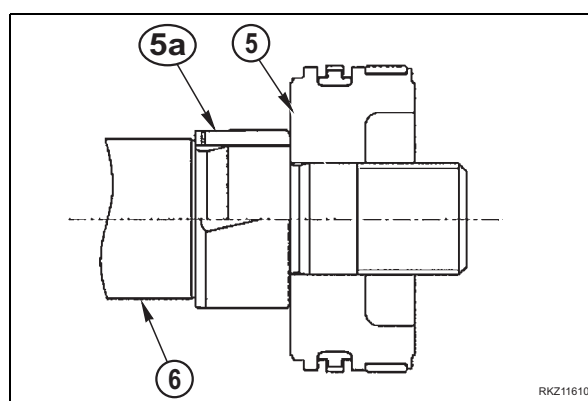
 Plug: 23±2 Nm



### 6 -Install piston (5) to rod (6).

#### ★ Arm cylinder only.

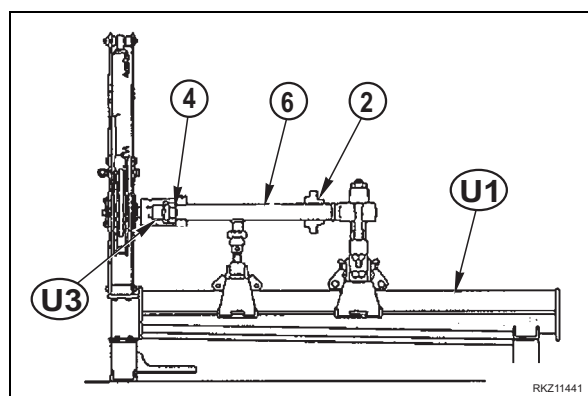
Check orientation of brake bushing (5a).



### Assembly complete piston

#### 1 -Install rod (6) to equipment U1.

#### 2 -Remove any existing dirt from the rod and install the head (2).



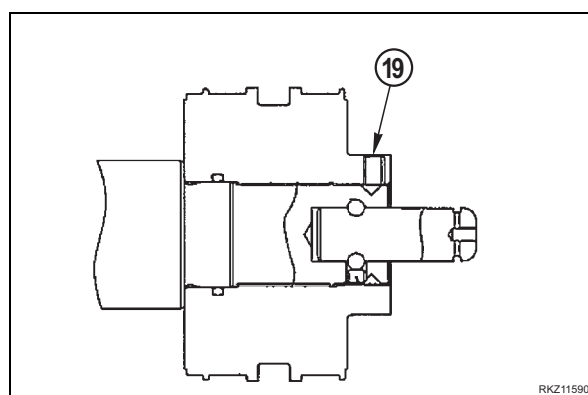
### 3 -Boom cylinder only.

Thread piston (5) onto rod (6) and lock into position with a wrench U3 with torque amplifier.

 Piston: 280–290 kgm

#### 4 -Install safety dowel (19) and tighten until snug.

 Dowel: Loctite 542



## REMOVAL AND INSTALLATION

## CYLINDER

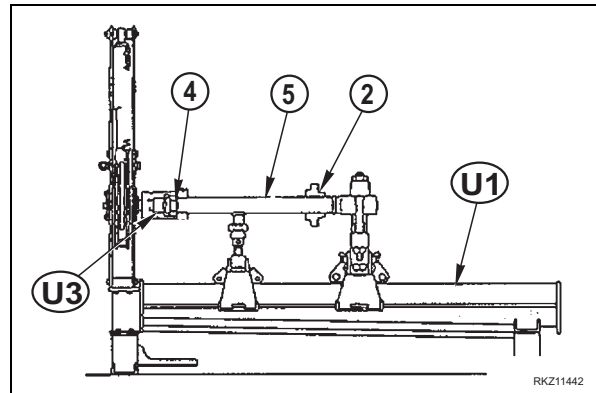
5 -**All cylinders:** install head (2) and piston (5); coat piston thread with sealant.

 Piston: Loctite 262

6 -Install nut (4) and, using wrench **U3** with torque amplifier, lock piston in place using the following torques:

 Shovel raise:  $170 \pm 17$  kgm  
Shovel dump:  $127 \pm 12.7$  kgm  
Arm backhoe  $170 \pm 17$  kgm  
Bucket:  $170 \pm 17$  mm  
Outriggers:  $93 \pm 9.3$  kgm  
Jig arm:  $110 \pm 11$  kgm ○

○ Calk after tightening.



### Final assembly

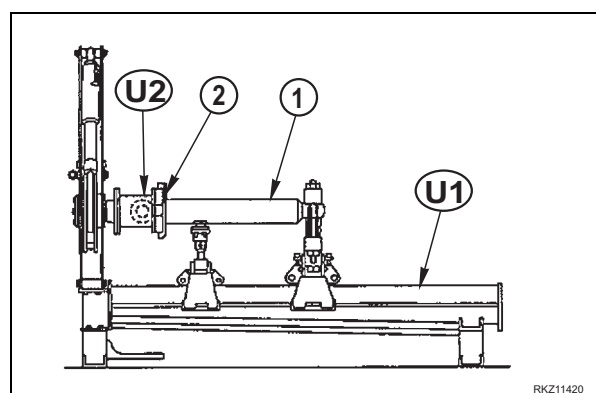
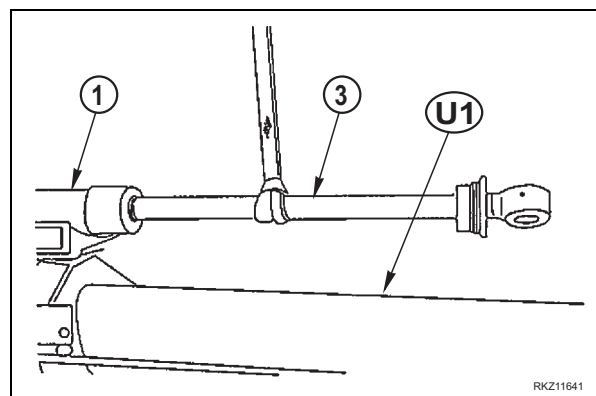
1 -Lubricate piston seals (5) and head gaskets (2) and introduce piston into cylinder (1).

2 -Position cylinder (1) to equipment **U1** and tighten head (2) using tool **U2**; tighten to the following torque:

 Shovel raise:  $69 \pm 6.9$  kgm  
Shovel dump:  $55 \pm 5.5$  kgm  
arm:  $98 \pm 9$  kgm  
Bucket:  $120 \pm 140$  kgm △  
Outriggers:  $55 \pm 6.5$  kgmm  
Jig arm:  $55 \pm 5.5$  kgm  
Boom:  $100 \pm 10$  kgm

△ Loosen down to 0 kg, tighten up to 40 kgm, and then tighten angle-wise for 3.5–4.5 mm

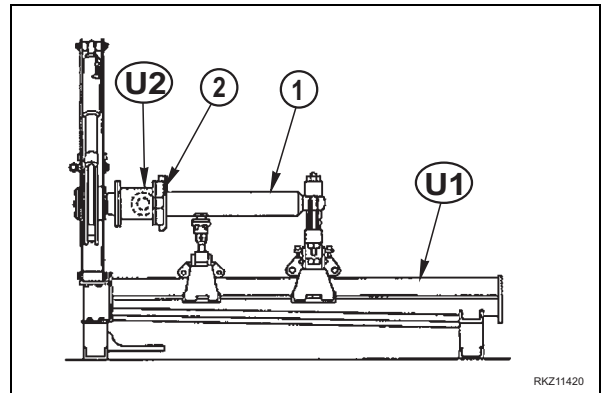
3 -When assembly is complete, plug union fitting holes to prevent contamination.



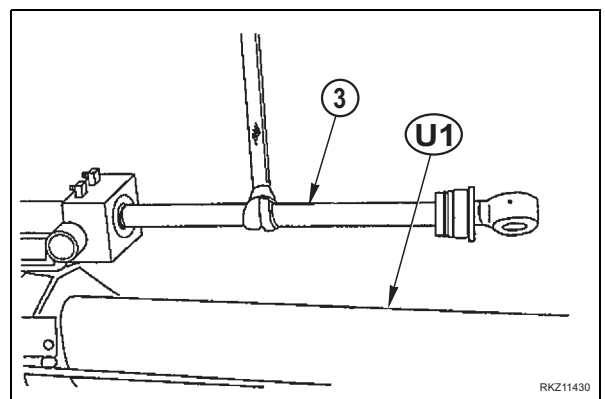
## BACKHOE SWING CYLINDERS

### Disassembly

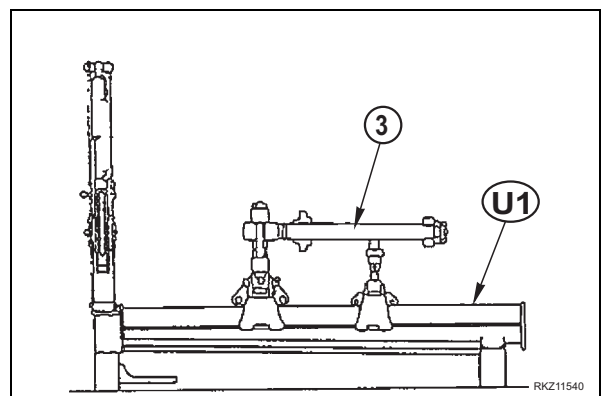
- 1 -Position cylinder (1) to equipment **U1**.
- 2 -Using wrench **U2** with torque amplifier, fully unscrew the head (2).



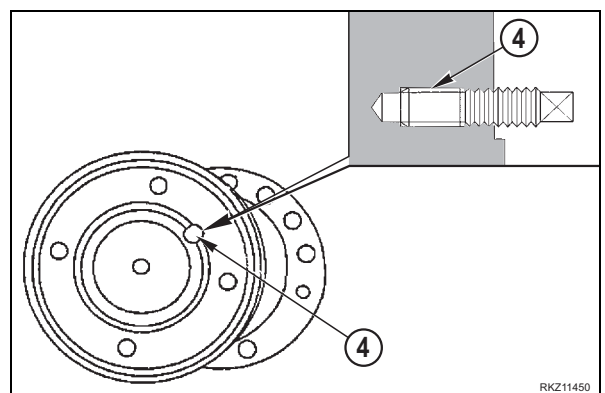
- 3 -Extract the complete piston (3).
- ★ Place a receptacle to collect the oil.



- 4 -Position the complete piston (3) to equipment **U1**.



- 5 -Remove safety screw (4) (M8x1.25).
- ★ If removal is awkward, tighten screw until snug and work thread with a tap.

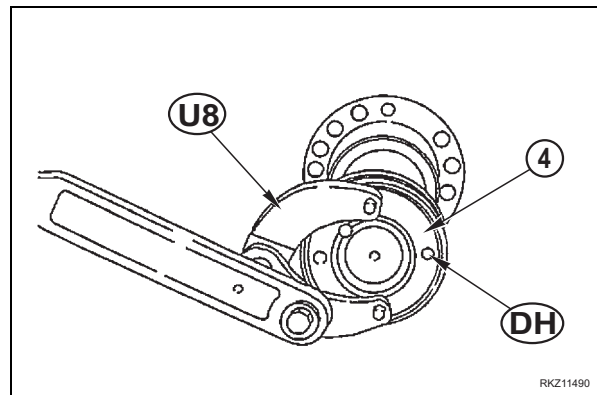


## REMOVAL AND INSTALLATION

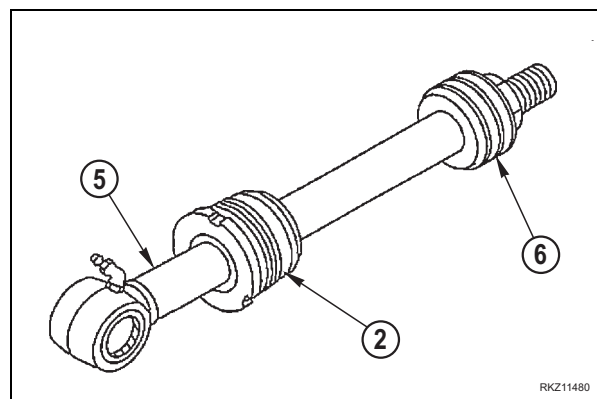
## CYLINDER

6 -Using a wrench **U8**, remove the complete piston (6).

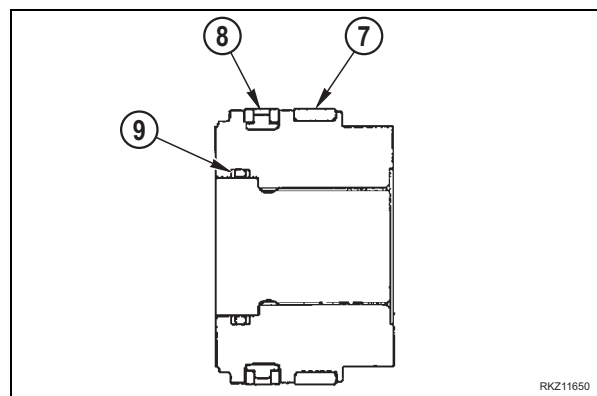
- ★ If no **U8** tool is used, drill 4 holes (Ø 10) and loosen the complete piston.



7 -Slide piston (6) and head (2) off rod (5).

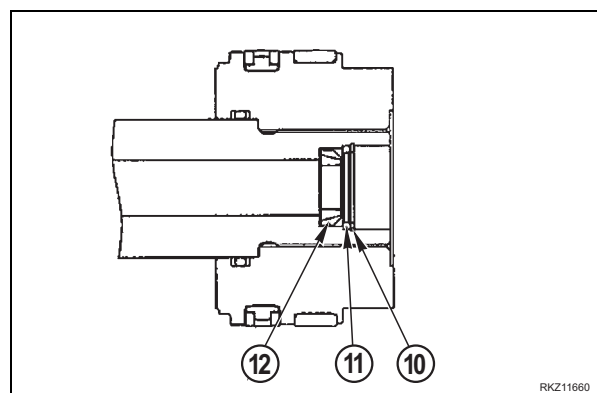


8 -Remove guide ring (7), seal (8), O-ring (9) and their respective anti-extrusion rings from piston.



9 -Remove the snap-ring (10), the spacer (11) and the ring (12).

- ★ Note down orientation of ring (12) and position of spacer (11).



## REMOVAL AND INSTALLATION

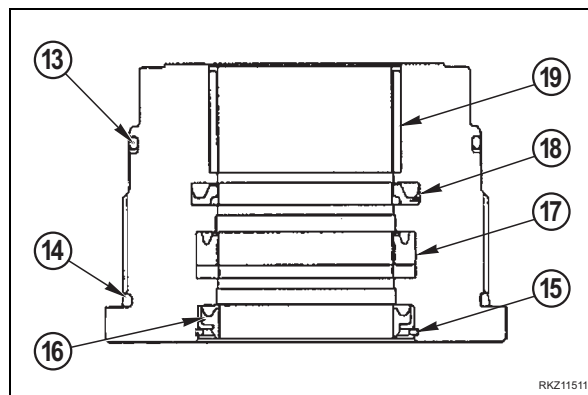
## CYLINDER

10 -Remove O-ring (13) with anti-extrusion ring, O-ring (14), snap ring (15) and scraper ring (16) from head.

11 -Remove gaskets (17) and (18).

★ Note down direction fo installation of anti-extrusion ring and position of ring (13).

12 -Remove the bushing (19).



## REMOVAL AND INSTALLATION

## CYLINDER

### Assembly

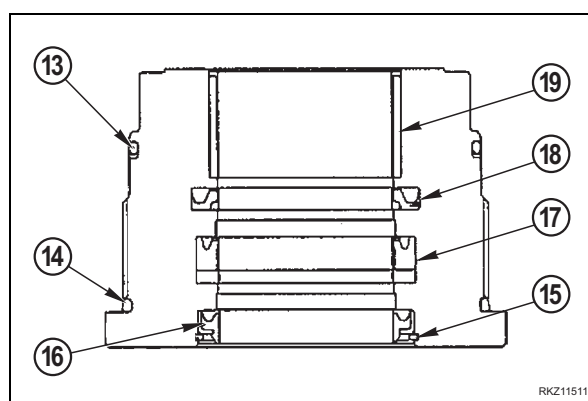
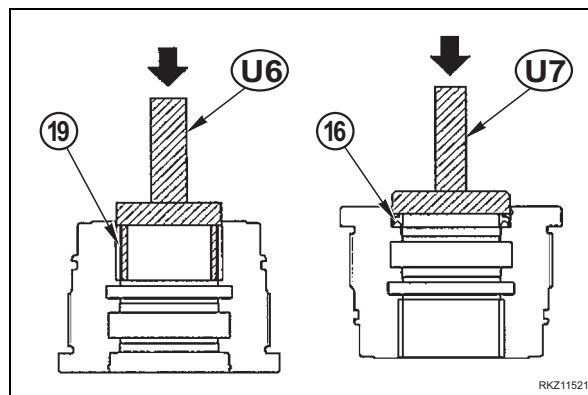
- ★ Lubricate surfaces to prevent damage to the gaskets, seals, O-rings, scraper, etc.

 Surface: engine oil

- ★ Do not force sealing rings into place; heat them in hot water at 50-60°C before installing.

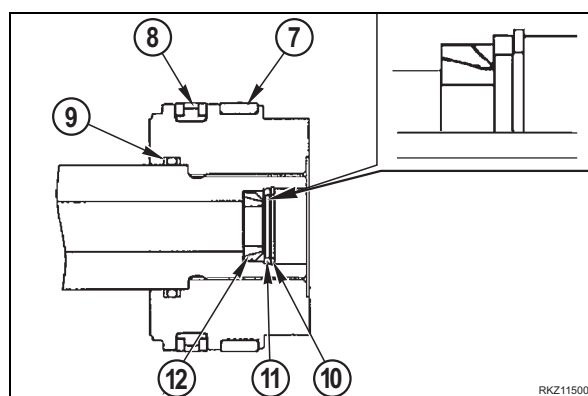
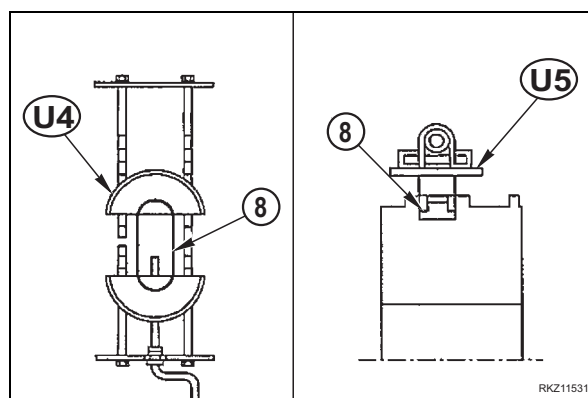
### Assembling the head

- 1 -Using tool **U6**, install bushing (19).
- 2 -Assemble seals (17) and (18).
  - ★ Check direction of installation.
- 3 -Using tool **U7**, install scraper ring (16) and snap ring (15).
- 4 -Assemble O-ring (14).
- 5 -Install anti-extrusion ring and O-ring (13).



### Assembly piston

- 1 -Using tool **U4** expand seal (8) and fit it on the piston.
- 2 -Calibrate seal (8) using calibrator **U5**.
- 3 -Install anti-extrusion rings and O-ring (9).
- 4 -Assemble the guide ring (7).
- 5 -Install ring (12), spacer (11) and snap ring (10) to rod (5).
  - ★ Pay attention to the orientation of ring (12).





### Assembly complete piston

- 1 -Install rod (5) to equipment **U1**.
- 2 -Remove any existing dirt from the rod and install the head (2).
- 3a - **With original parts only:**  
Thread piston (6), and tighten with wrench **U8** until threaded hole **H** of safety screw (4) is perfectly aligned.

#### 3b -With new parts:

- a - Thread the piston (6) in, ensure it contacts the rod (5), and then tighten.

 Piston: 734±49 Nm

- b - Drill hole **H** for safety screw (4) on the seam of thread between rod and piston.

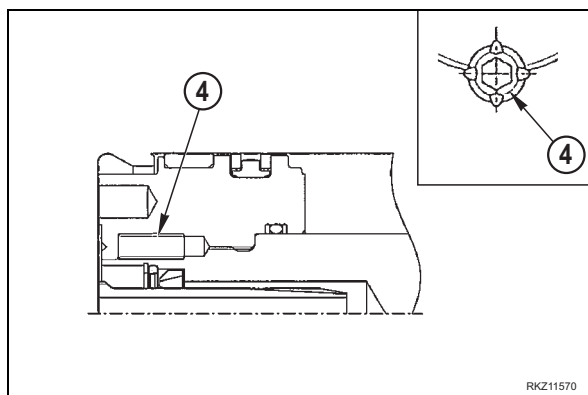
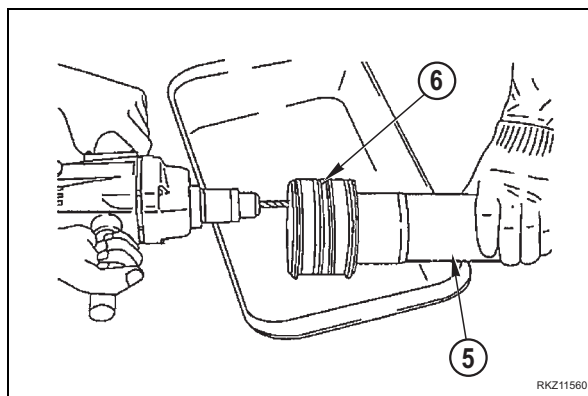
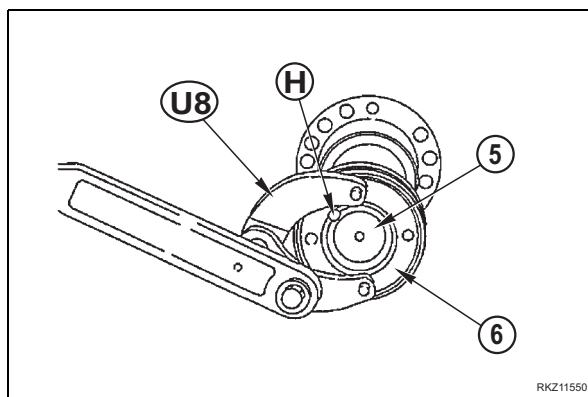
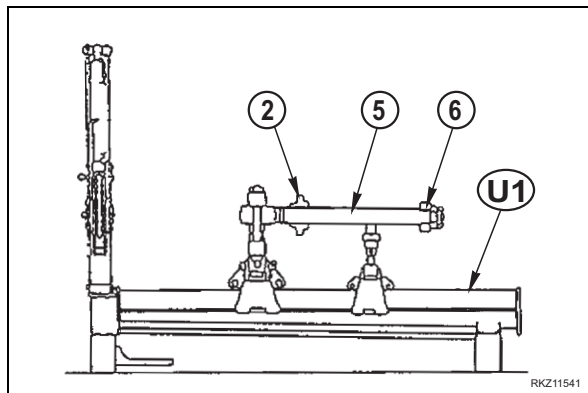
★ Hole Ø 6.8 – depth 31 mm  
Thread: M8x1.25 - depth 25 mm

- 4 -Remove any dirt or shaving and install the safety screw (4).

 Screw: Loctite 262

 Screw: 13.25±1.45 Nm

- 5 -Calk screw (4) in four locations.



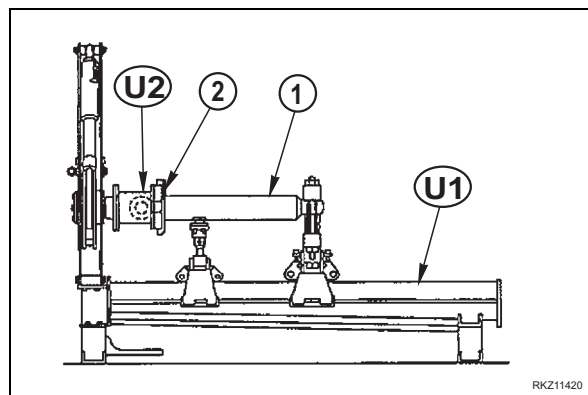
### Final assembly

1 -Lubricate piston seal (6) and head gasket (2) and introduce piston into cylinder (1).

2 -Position cylinder (1) to equipment **U1** and tighten head (2) using tool **U2**; tighten to torque.

 Head: 785±78.5 Nm

★ When assembly is complete, plug cylinder union fittings to prevent contamination.



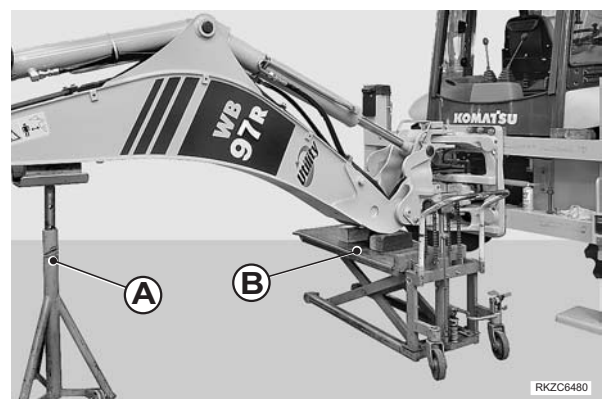
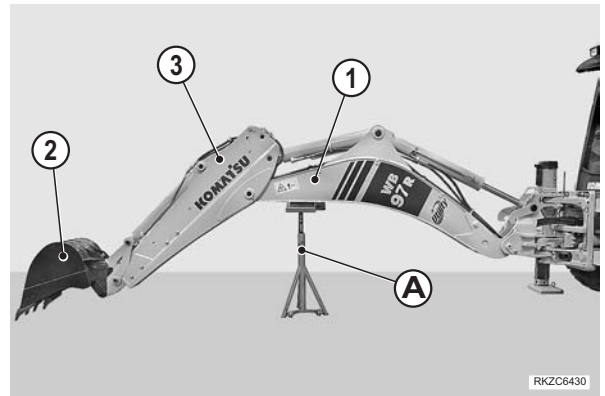
## BACKHOE WORKING EQUIPMENT

### Removal

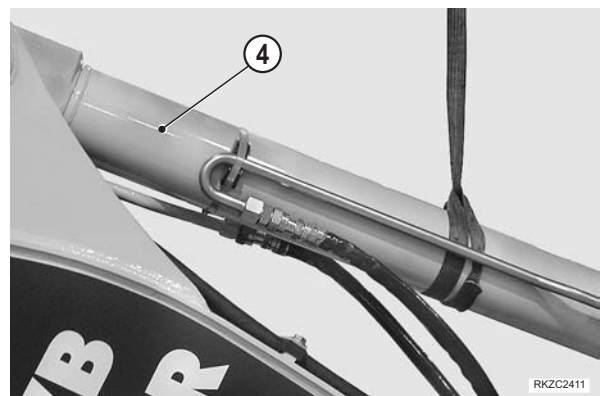
- 1 -Fully extend the arm (1) and fully open the bucket (2); operate the boom (3) until the outer end of the boom is in a horizontal position.
- 2 -Place and force a jack stand "A" and a non-slip block under the boom (3).
- 3 -Lower the arm until the bucket teeth touch the ground.
- 4 -Lower the outriggers to the ground, apply the parking brake, and stop the engine.

**!** Release residual pressure from all circuits by operating all hydraulic controls in all directions.

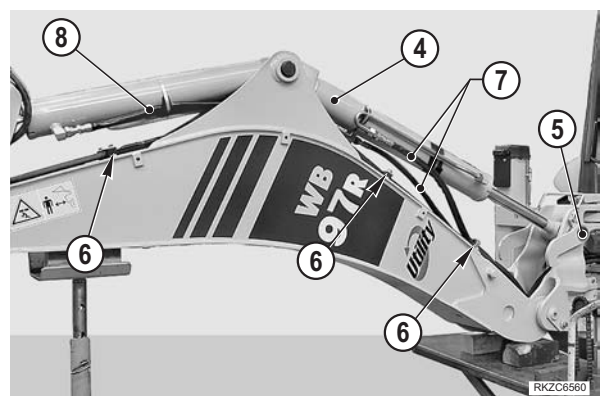
- 5 -Position a lift "B" and some non-slip blocks under boom fulcrum.



- 6 -Place a sling around the boom lift cylinder (4), connect it to a hoisting device and apply a slight tension to the cable.



- 7 -Pull out the piston attachment pin (5).
- 8 -Release boom and arm cylinder hoses and bucket cylinder hoses from the three hose clamps (6).
- 9 -Disconnect hoses (7) and (8) from boom and arm cylinder.
  - ★ Mark the pipes to avoid exchanging them during installation.
  - ★ Plug all pipes/hoses to prevent contamination.



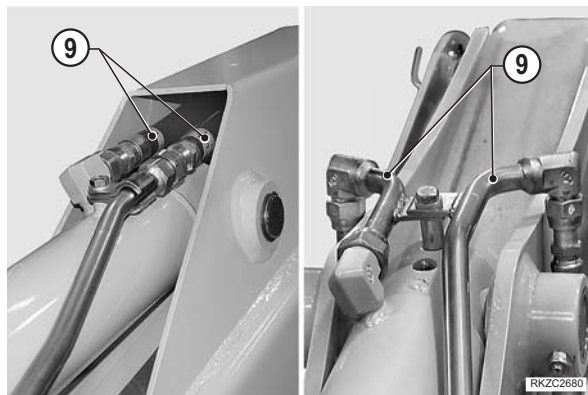
## REMOVAL AND INSTALLATION

## BACKHOE WORKING EQUIPMENT

9 - Disconnect hoses (9) from bucket cylinder.

- ★ Cap pipes, hoses and holes to prevent contamination.
- ★ Mark the pipes to avoid exchanging them during installation.

10 - Slide all hoses off and place them aside.



11 - Position a non-slip block "C" under the boom lift cylinder and disconnect the hoisting device



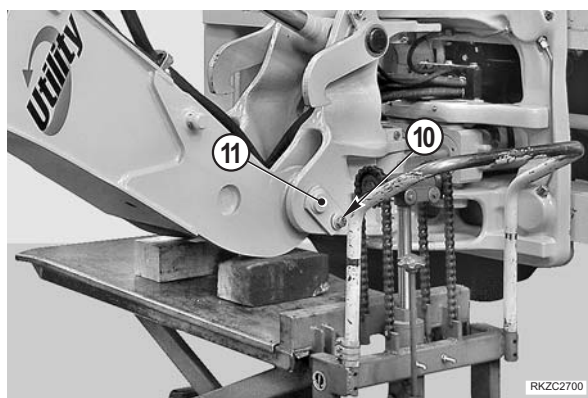
12 - Remove the screw (10) and the pin (11).

13 - Start the engine, draw in the outriggers and move the machine rearward.

- ★ Recover the shims between boom and swing bracket.



Backhoe working equipment  
with standard arm: 850 kg



## Installation

- To install, reverse removal procedure.

- 1 - Start the engine and bleed the air from all circuits.  
(For details, see "20 TESTING AND ADJUSTMENTS").
- 2 - Stop the engine, check the level in the tank and, if necessary, top it up.

## BACKHOE BUCKET

### Removal

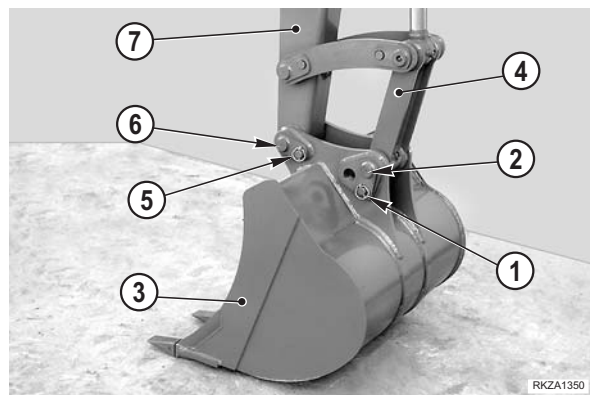
**⚠** Place the bucket on a level surface, resting on its back.

- 1 - Take out the safety pin (1) and remove the connecting pin (2) between bucket (3) and tie-rods (4). [\*1] [\*2]
- 2 - Take out the safety pin (5) and remove the pin (6) that attaches the bucket to the arm (7).

[\*1] [\*2]



Bucket: 158 kg



### Installation

- To install, reverse removal procedure.

[\*1]

**⚠** When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

[\*2]



Internal bushing: ASL800050

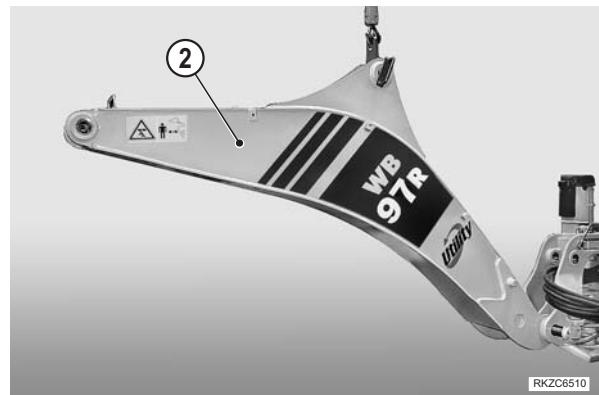
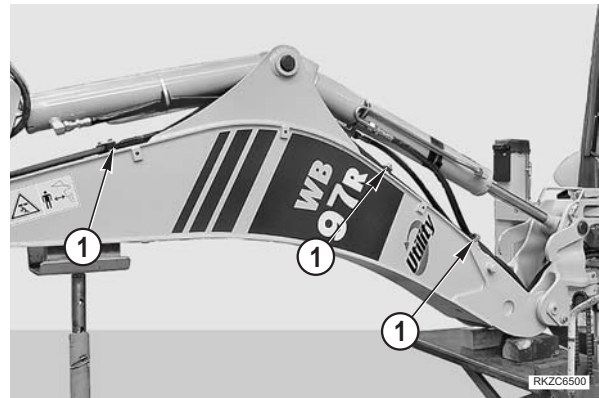
## BACKHOE BOOM CYLINDER

### Removal

- 1 -Remove the arm cylinder.  
(For details see "ARM CYLINDER").
- 2 -Remove the arm.  
(For details see "ARM").
- 3 -Start the engine and rest the boom on the ground.
- 4 -Remove the boom cylinder.  
(For details see "BACKHOE BOOM CYLINDER").
- 5 -Remove the hose clamps (1) retaining the boom, arm and bucket hoses.  
★ Mark the tubes to prevent exchanging positions during re-connection.
- 6 -Hook the boom (2).
- 7 -Take out the retaining screw and remove the pin (3).  
[\*1] [\*2]
- ★ Recover the shims (4) between boom and swing bracket.
- 8 -Remove the boom (2).

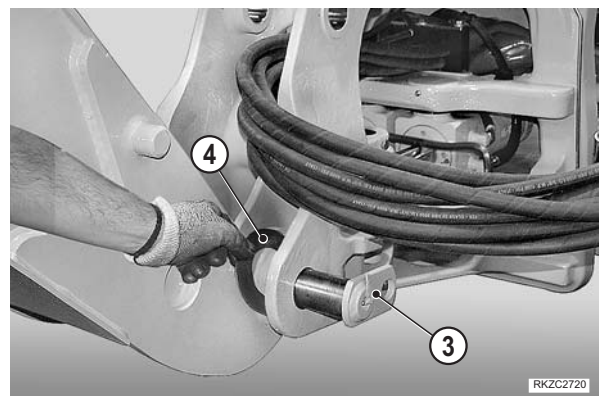


Boom: 248 kg



### Installation

- To install, reverse removal procedure.
- [\*1]
- ⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.
- [\*2]
-  Internal bushing: ASL800050
- 1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").
  - ★ After bleeding the air, check the oil level in the tank.

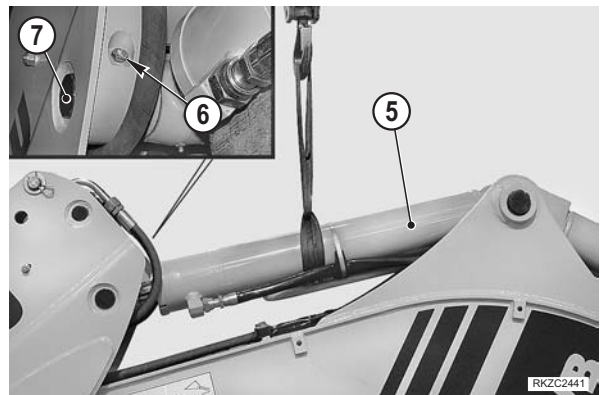
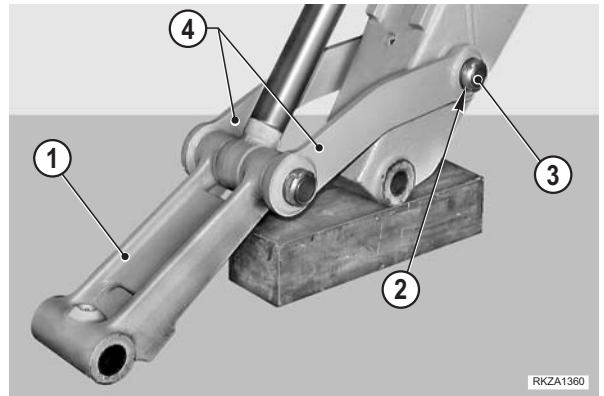




## ARM

### Removal

- 1 -Remove the bucket.  
(For details see "BACKHOE BUCKET").
- 2 -Remove the bucket cylinder and the link (1).  
(For details, see "BACKHOE BUCKET CYLINDER").
- 3 -Take out the lock nut (2), and the washer and remove the pin (3) and the links (4).  
[\*1] [\*2]
- 4 -Start the engine, bring the arm into a vertical position and lower it to the ground.
- 5 -Stop the engine and release residual pressures from the cylinder.
- 6 -Put a sling around the arm cylinder (5), remove the screws (6) and remove the pin (7).  
[\*2] [\*3]
- 7 -Start the engine and retract the piston completely.
- 8 -Rest cylinder (5) on a block "A" and disconnect from the hoisting device.
- 9 -Stop the engine.
- 10 -Connect the arm (8) to the hoisting device and apply a slight tension to the cable.

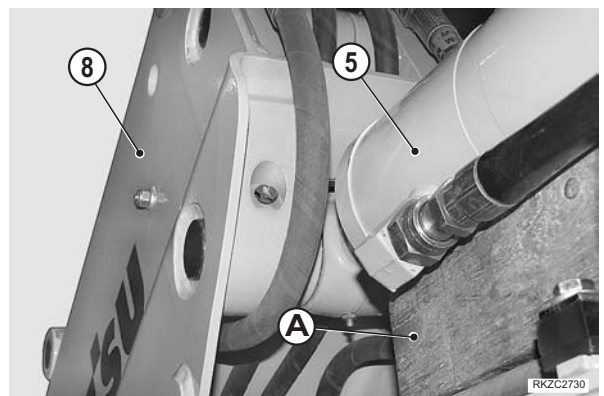


- 11 -Take out the screws (9) and remove the pin (10).  
[\*1] [\*2]

★ Recover the shims.

- 12 -Remove the arm (8).

 Arm: \_\_\_\_\_ kg



### Installation

- To install, reverse removal procedure.

[\*1]

 When aligning the positions between hole and pin, do not insert fingers into the holes to check on alignment.

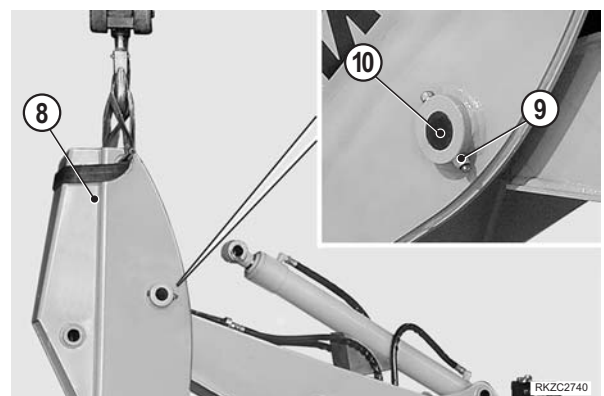
[\*2]

 Internal bushing: ASL800050

- ★ Tighten the locknut completely, then release it half a turn.

[\*3]

 When aligning the positions between the hole and the pin, turn the engine over at low idling speed.  
Do not insert fingers into the holes to check alignment.

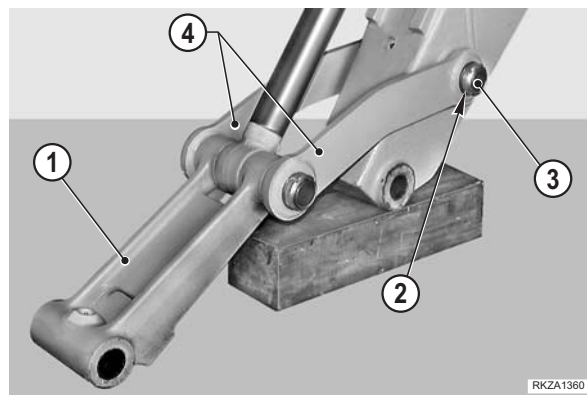




## JIG ARM

### Removal

- 1 - Remove the bucket.  
(For details see "BACKHOE BUCKET").
- 2 - Remove the bucket cylinder and the link (1).  
(For details, see "BACKHOE BUCKET CYLINDER").
- 3 - Take out the lock nut (2), and the washer and remove the pin (3) and the links (4).  
[\*1] [\*2]



- 4 - Disconnect the jig arm hoses (5) and (6), the bucket cylinder hoses (7) and (8), and the hoses of the auxiliary equipment (9) and (10).

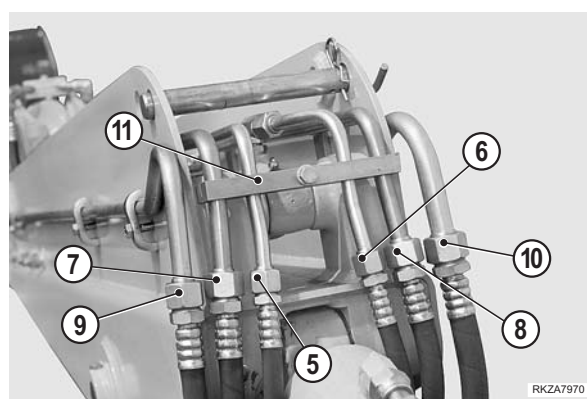
★ Mark the hoses to avoid exchanging them during INSTALLATION.

- 5 - Remove the clamp (11).

- 6 - Proceed with the removal as for the arm.  
(See "ARM").



Jig arm cylinder: 460 kg



### Installation

- To install, reverse removal procedure.

[\*1]

⚠ When aligning the positions between hole and pin, do not insert fingers into the holes to check on alignment.

[\*2]



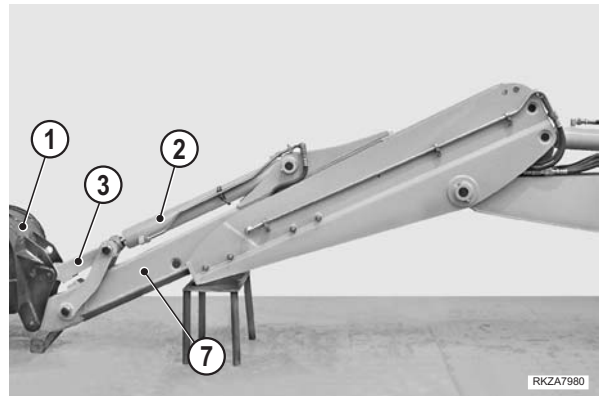
Internal bushing: ASL800050

- ★ Tighten the locknut completely, then release it half a turn.

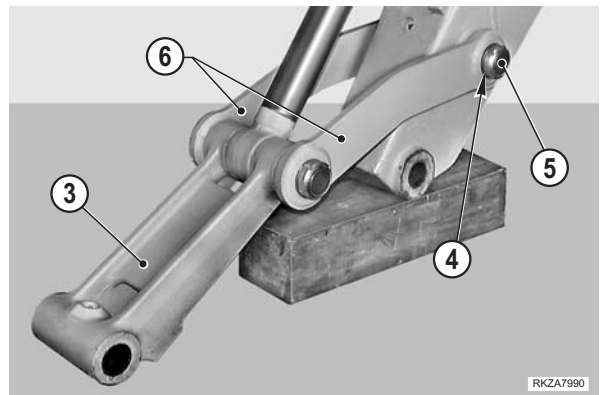
## 2nd ARM

### Removal

- 1 -Remove the bucket (1).  
(For details see "BACKHOE BUCKET").
  - 2 -Remove the bucket cylinder (2) and the link (3).  
(For details, see "BACKHOE BUCKET CYLINDER").
  - 3 -Remove the 2nd arm cylinder.  
(For details see "JIG ARM CYLINDER").
- ★ For safety, tightly plug all the disconnected hoses.

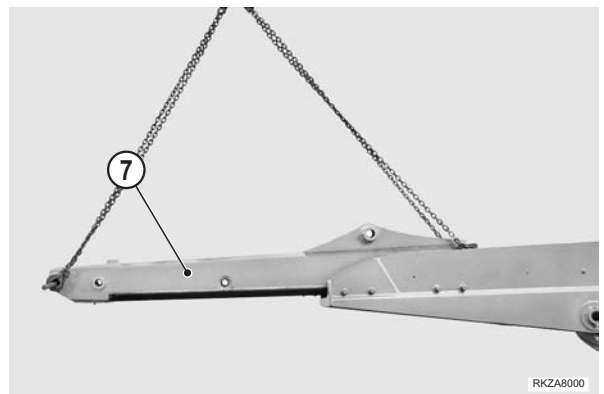


- 4 -Take out the lock nut (4), and the washer and remove the pin (5) and the links (6). [<sup>[\*1]</sup>] [<sup>[\*2]</sup>] [<sup>[\*3]</sup>]
  - 5 -Connect the 2nd arm (7) to some hoisting tackle.
- ★ Use the bucket pin hole and the safety pin holes.
- 6 -Start the engine and, maintaining constant tension on the section of cable or chain connected to the bucket coupling, slowly raise the boom until both sections of cable or chain are under slight tension.



- 7 -Stop the engine and loosen by several turns the gib adjustment screws.
- ★ Loosen the screws on both sides.
- 8 -Slide out the 2nd arm (7).

 2nd arm: \_\_\_\_\_ kg



### Installation

- To install, reverse removal procedure.

[<sup>[\*1]</sup>]



When aligning the positions between hole and pin, do not insert fingers into the holes to check on alignment.

[<sup>[\*2]</sup>]



Internal bushing: ASL800050

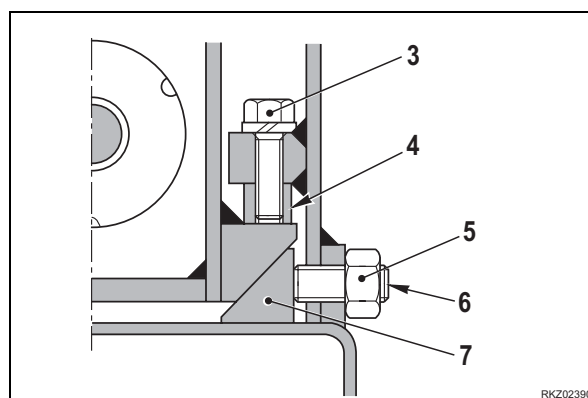
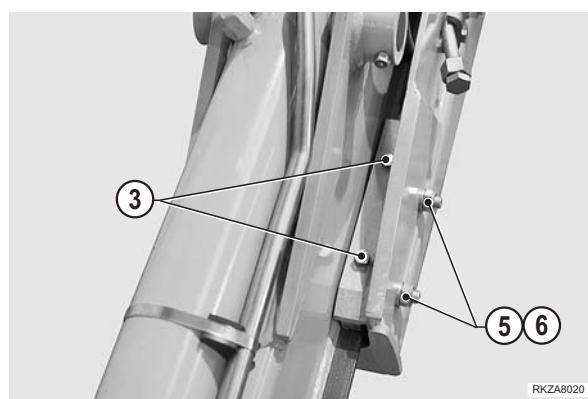
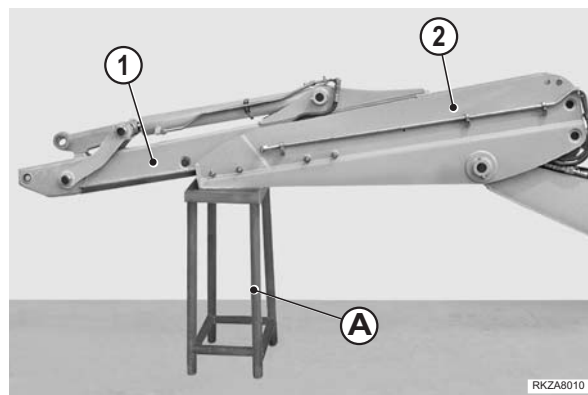
[<sup>[\*3]</sup>]

- ★ Tighten the locknut completely, then release it half a turn.

## 2nd ARM GUIDES

### Removal

- 1 -Remove the bucket.  
(For details see "BACKHOE BUCKET").
- 2 -Partially extend the 2nd arm (1).
- 3 -Rest the arm (2) on a trestle "A" about 80 cm high.
- 4 -Loosen and remove the screws (3), the spring washers and remove the upper guides (4). [\*1]
- 5 -Connect the 2nd arm (1) to some hoisting tackle.  
★ Use the bucket pin hole and the safety pin holes.
- 6 -Slowly raise the 2nd arm (1) until it rests on the supporting surfaces of the upper guides.
- 7 -Loosen the nuts (5) and remove the adjustment dowel bolts (6).
- 8 -Raise the lower guides (7) and slide them out. [\*1]



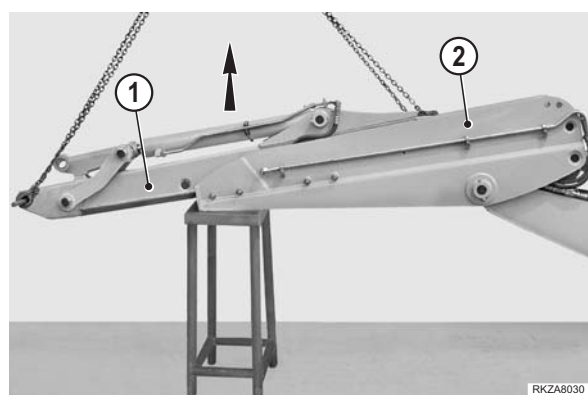
### Installation

- To install, reverse removal procedure.

[\*1]

 Guides and 2nd arm guides: ASL800040

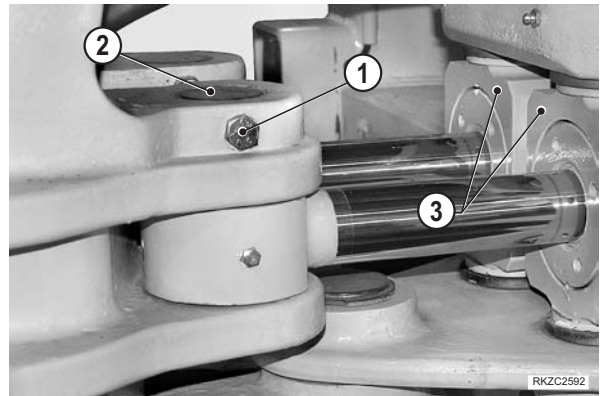
- 1 -Adjust the clearances, keeping the jig arm (1) aligned with respect to the 2nd arm (2).  
(For details, see "20 TESTING AND ADJUSTMENTS").



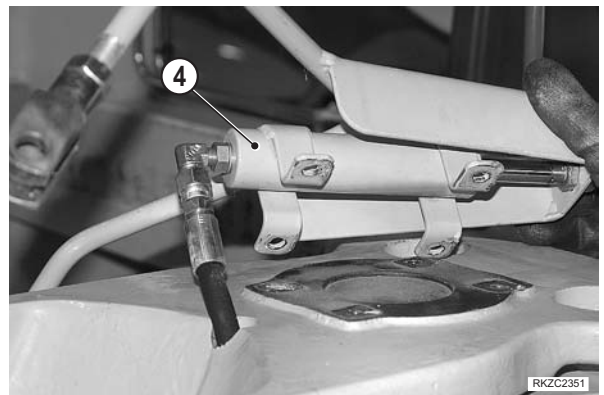
## BACKHOE SWING BRACKET

### Removal

- 1 -Remove the equipment. (For details see "BACKHOE WORKING EQUIPMENT").
- 2 -Take out the screws (1) and remove the pins (2) that connect the swing cylinders (3). [\*1] [\*2]
- 3 -Remove boom safety cylinder (4). (For details see "BACKHOE BOOM SAFETY CYLINDER").



- 4 -Sling the swing bracket (5)
- 5 -Take out screws (6) and (7) and remove pins (8) and (9) from swing bracket. [\*1] [\*2]
- 6 -Remove swing bracket (5) and shims (10) and slide the hoses off. [\*3]



 Bracket: 162.5 kg

### Installation

- To install, reverse removal procedure.

[\*1]

-  When aligning the positions between the hole and the pin, turn the engine over at low idling speed. Do not insert fingers into the holes to check alignment.

[\*2]

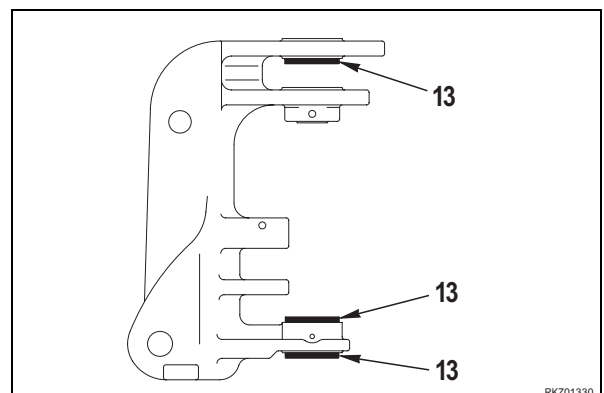
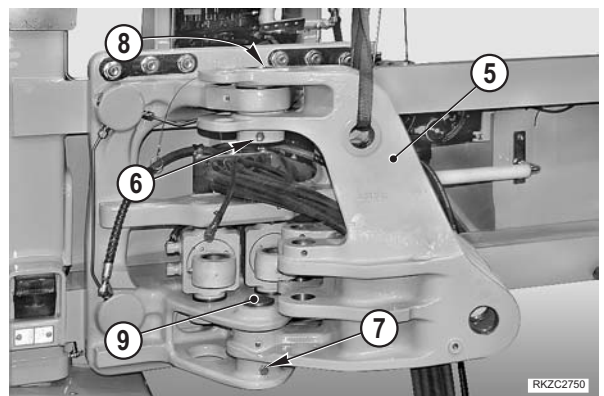
 Internal bushing: ASL800050

[\*3]

- ★ Insert the shims.

- 1 -Start the engine and bleed the air from the cylinders. (For details, see "20 TESTING AND ADJUSTMENTS").

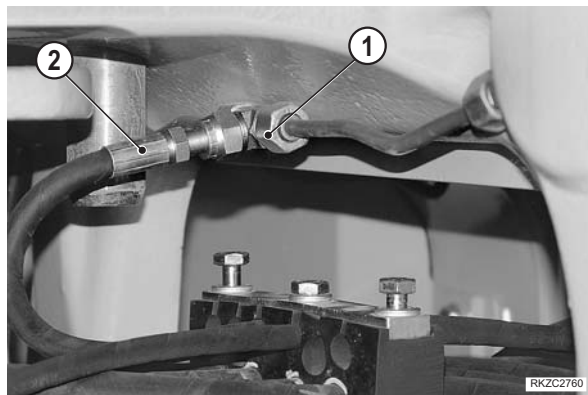
- ★ After bleeding the air, check the oil level in the tank.



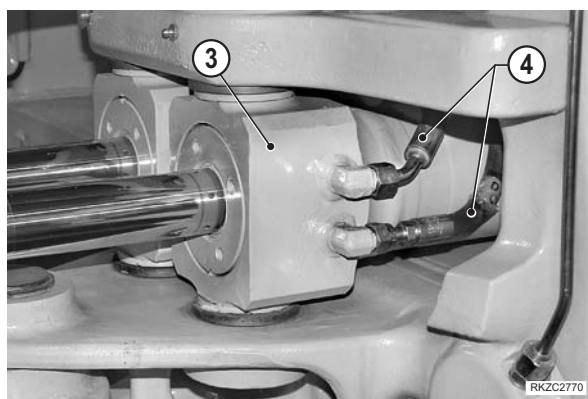
## COMPLETE BACKHOE BACKFRAME

### Removal

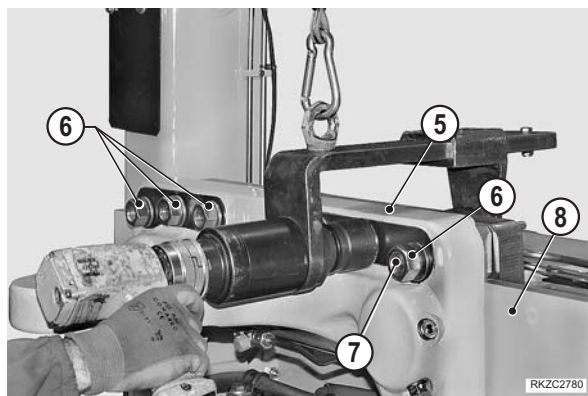
- 1 -Remove the equipment.  
(For details see "BACKHOE WORKING EQUIPMENT").
- 2 -Remove the swing bracket.  
(For details see "BACKHOE SWING BRACKET").
- 3 -Disconnect the backhoe backframe lock piston feeding hose (2) from union (1); plug hose and union to prevent contamination.



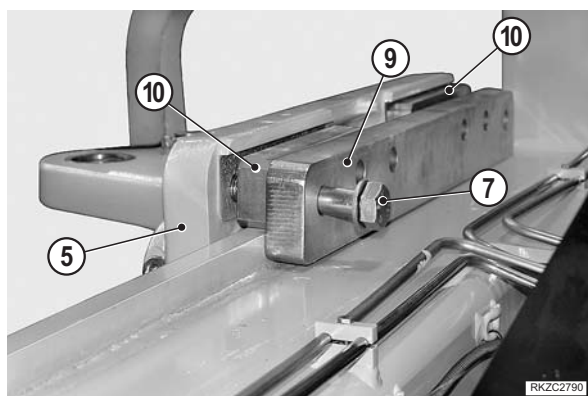
- 4 -Disconnect feed hoses (4) from swing cylinders (3).



- 5 -Connect the backframe (5) to a hoisting device.
- 6 -Loosen nuts (6) and remove washers and four screws (7).  
Loose partially lateral nuts (4) to remove backframe (3) from frame (8).  
[\*1]



- 7 -Put a sling round the backframe (5) and apply slight tension to the cables.
- 8 -Remove external nuts (6), washers and screws (7).  
[\*1]
- 9 -Remove slide block (9) and spacers (10).



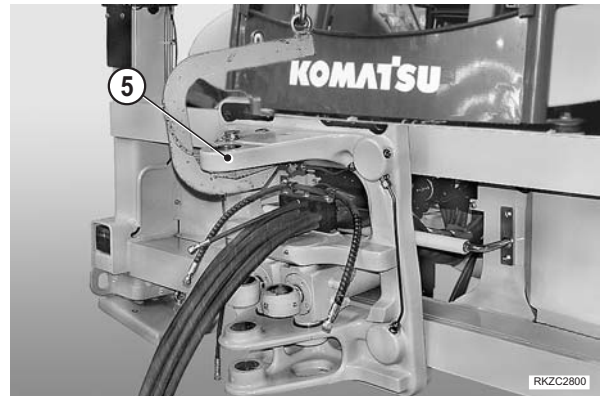
## REMOVAL AND INSTALLATION

## COMPLETE BACKHOE BACKFRAME

- 10 -Lower backframe (5) and remove backframe together with swing cylinders.



Complete backframe: approx. 246 kg



### Installation

- To install, reverse removal procedure.

[\*1]



Nuts: Loctite 262



Nuts: 980±98 Nm

- 1 -Start the engine and bleed the air from the cylinders.  
(For details, see "20 TESTING AND ADJUSTMENTS").

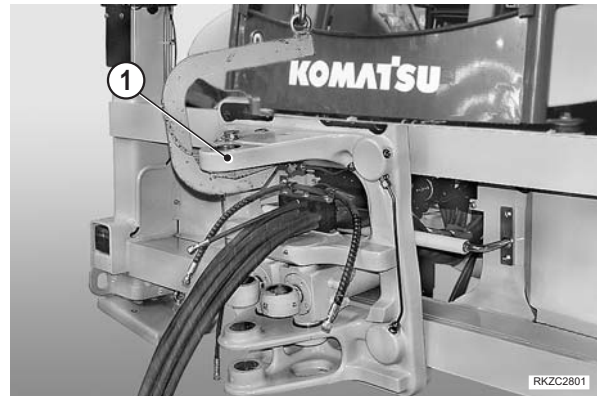
- ★ After bleeding the air, check the oil level in the tank.



## BACKFRAME LOCK PISTONS

### Removal

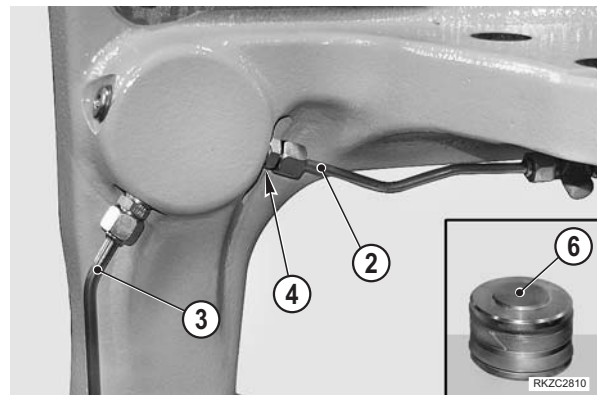
- 1 - Remove the complete backframe (1).  
(For details see "COMPLETE BACKHOE BACKFRAME").



### UPPER PISTON

- 1 - Remove two pipes (2) and (3).
- 2 - Plug the horizontal union (4).
- 3 - Introduce compressed air at low pressure (max. 2 bar) through lower union (5) and recover piston (6).

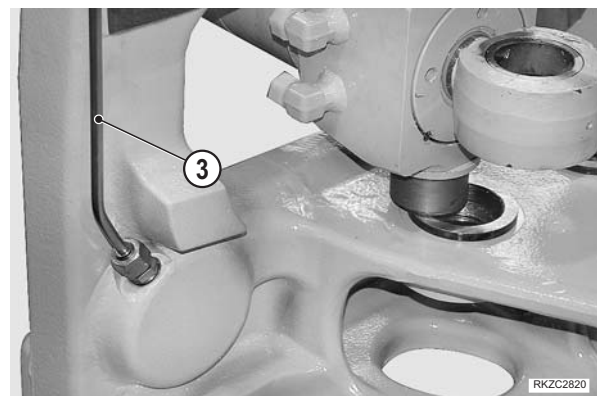
**!** Be aware that the piston may be ejected rapidly. Use a rag or non-slip gloves to accompany the piston as it is being ejected.



### LOWER PISTON

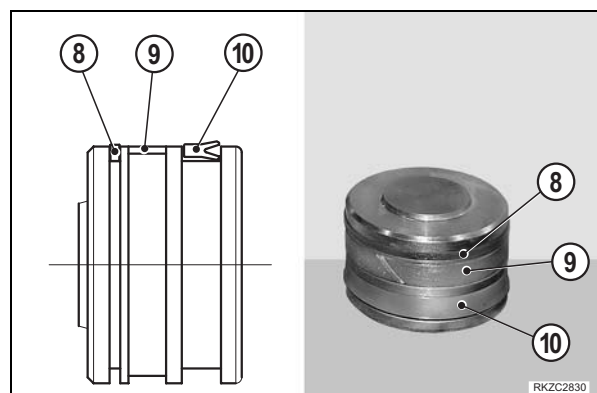
- 1 - Remove pipe (3).
- 2 - Introduce compressed air at low pressure (max. 2 bar) through union (7) and recover piston (6).

**!** Be aware that the piston may be ejected rapidly. Use a rag or non-slip gloves to accompany the piston as it is being ejected.



### REPLACING SEALS

- 1 - Remove seal (8), guide ring (9), and seal (10).
- ★ Note down direction of installation of seal (10).





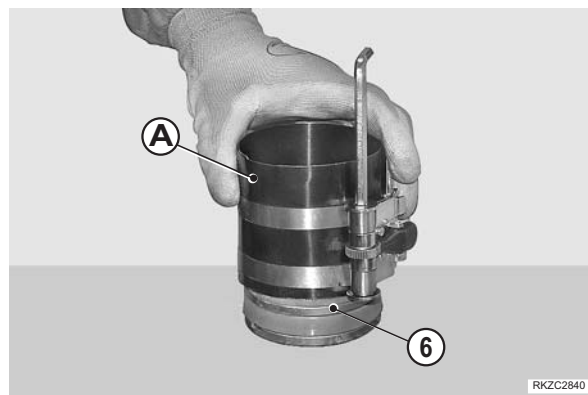
## REMOVAL AND INSTALLATION

## BACKFRAME LOCK PISTONS

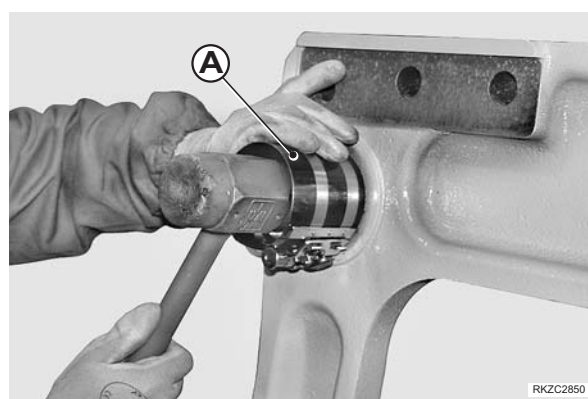
2 - Thoroughly clean the seats and install new seals and the guide ring.

3 - Lubricate the seals, guide ring, and piston seat.

 Seal and seat: Hydraulic oil:



4 - Apply a band "A" for seal compression and install piston (6).



### Installation

- To install, reverse removal procedure.



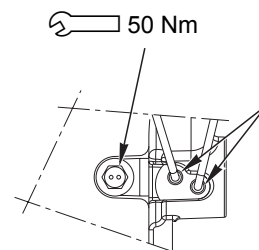
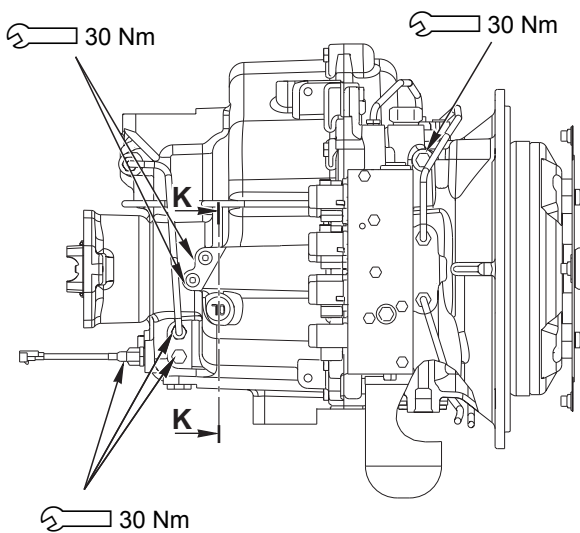
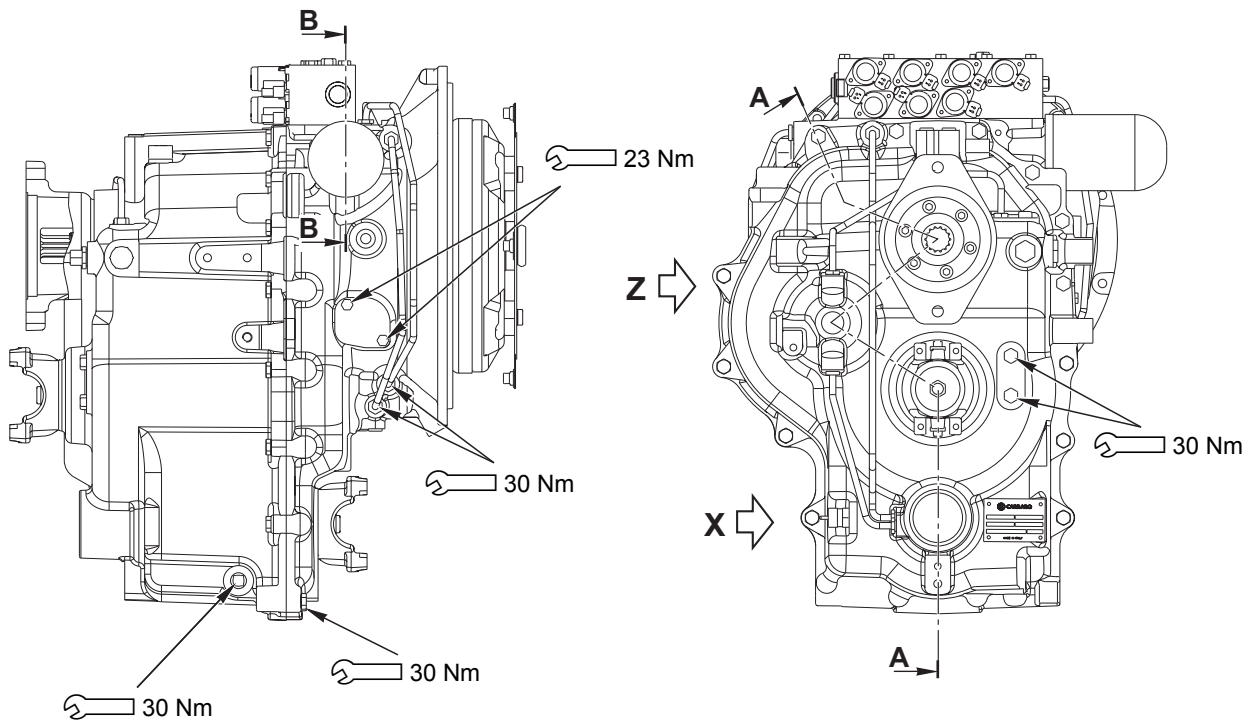
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# 40 STANDARD MAINTENANCE

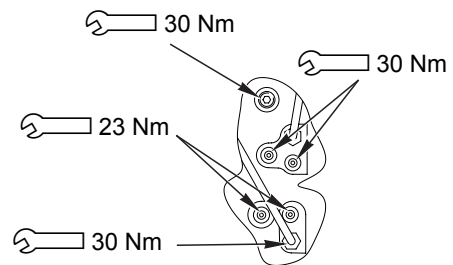
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|                      |    |                                 |    |
|----------------------|----|---------------------------------|----|
| TRANSMISSION.....    | 2  | SHOVEL CYLINDERS .....          | 34 |
| FRONT AXLE.....      | 5  | BACKHOE CYLINDERS .....         | 36 |
| REAR AXLE .....      | 9  | FRONT WORKING EQUIPMENT .....   | 40 |
| HYDRAULIC PUMP ..... | 13 | SWING BRACKET .....             | 42 |
| CONTROL VALVE .....  | 16 | BACKHOE WORKING EQUIPMENT ..... | 44 |
| PPC VALVES.....      | 32 |                                 |    |

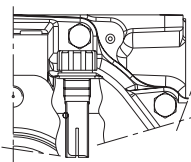
# TRANSMISSION



View X

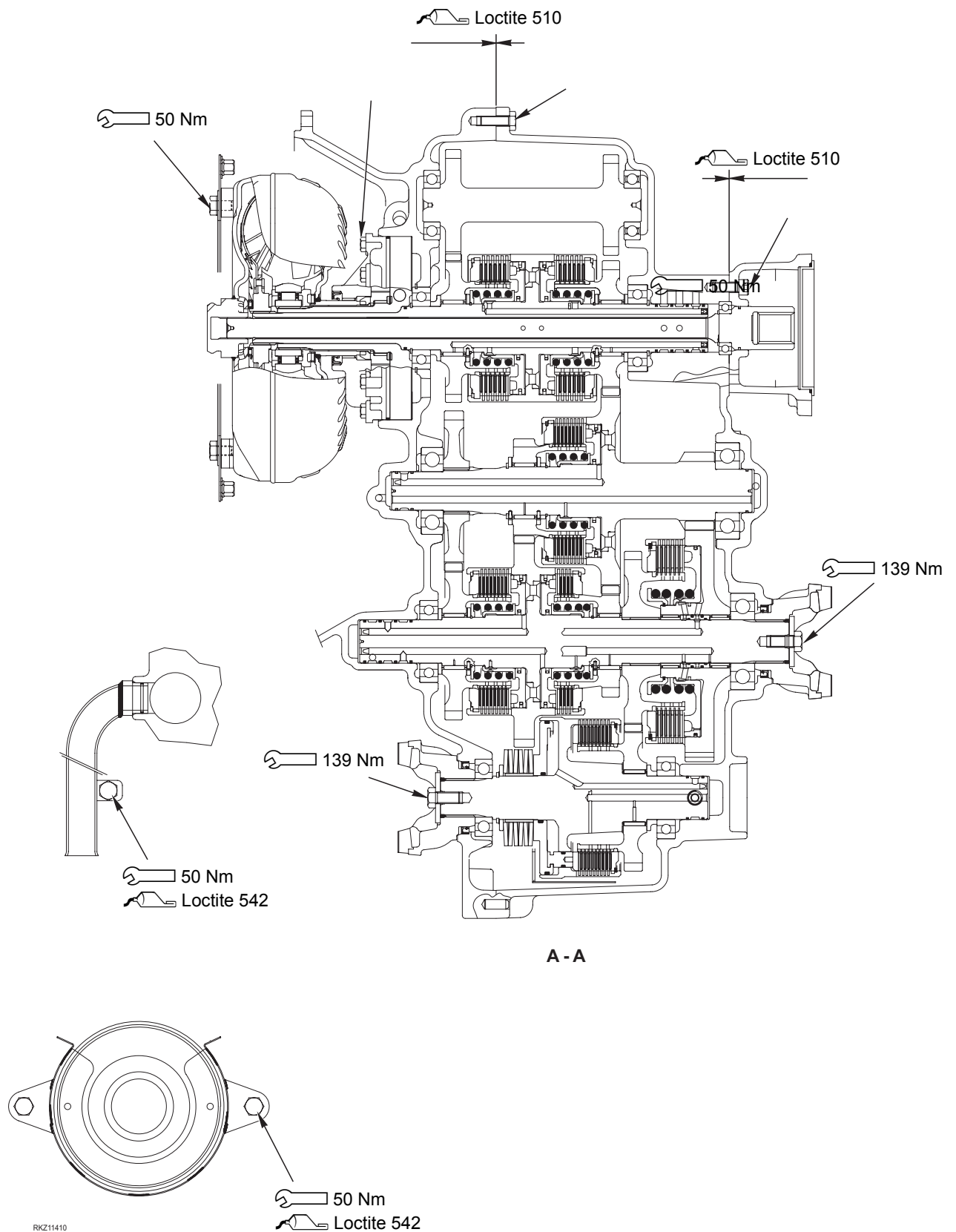


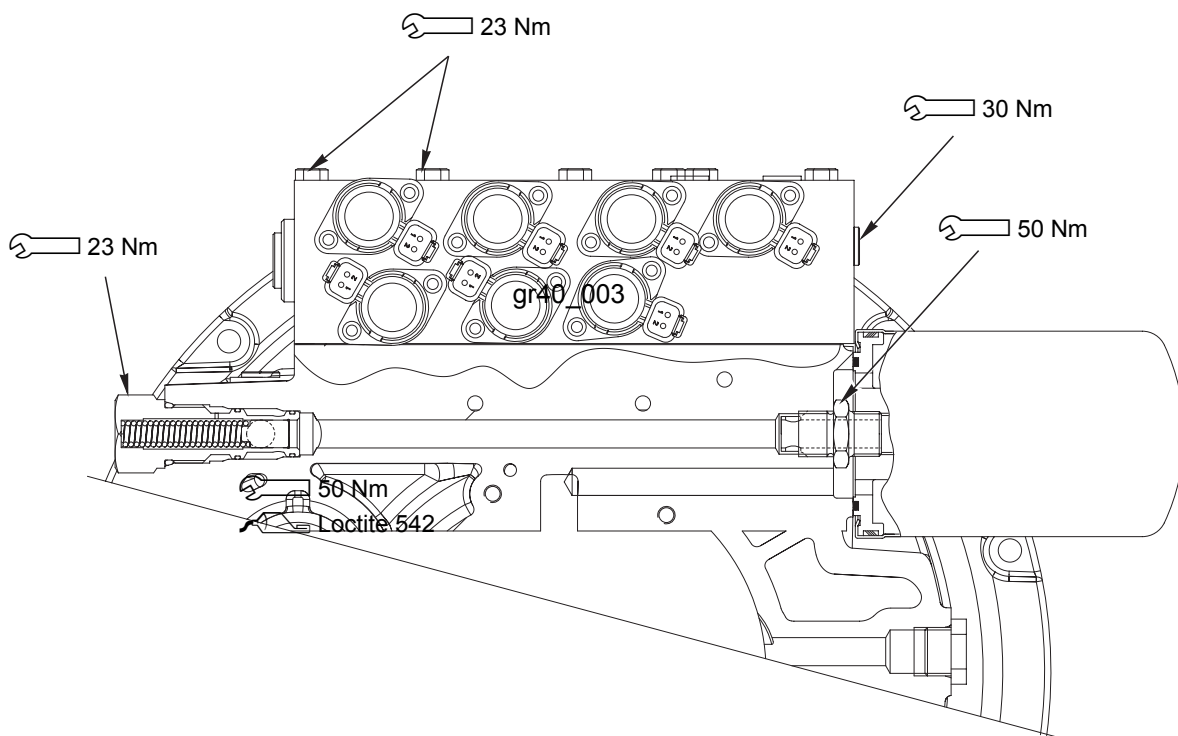
View Z



K - K

RKZ11670



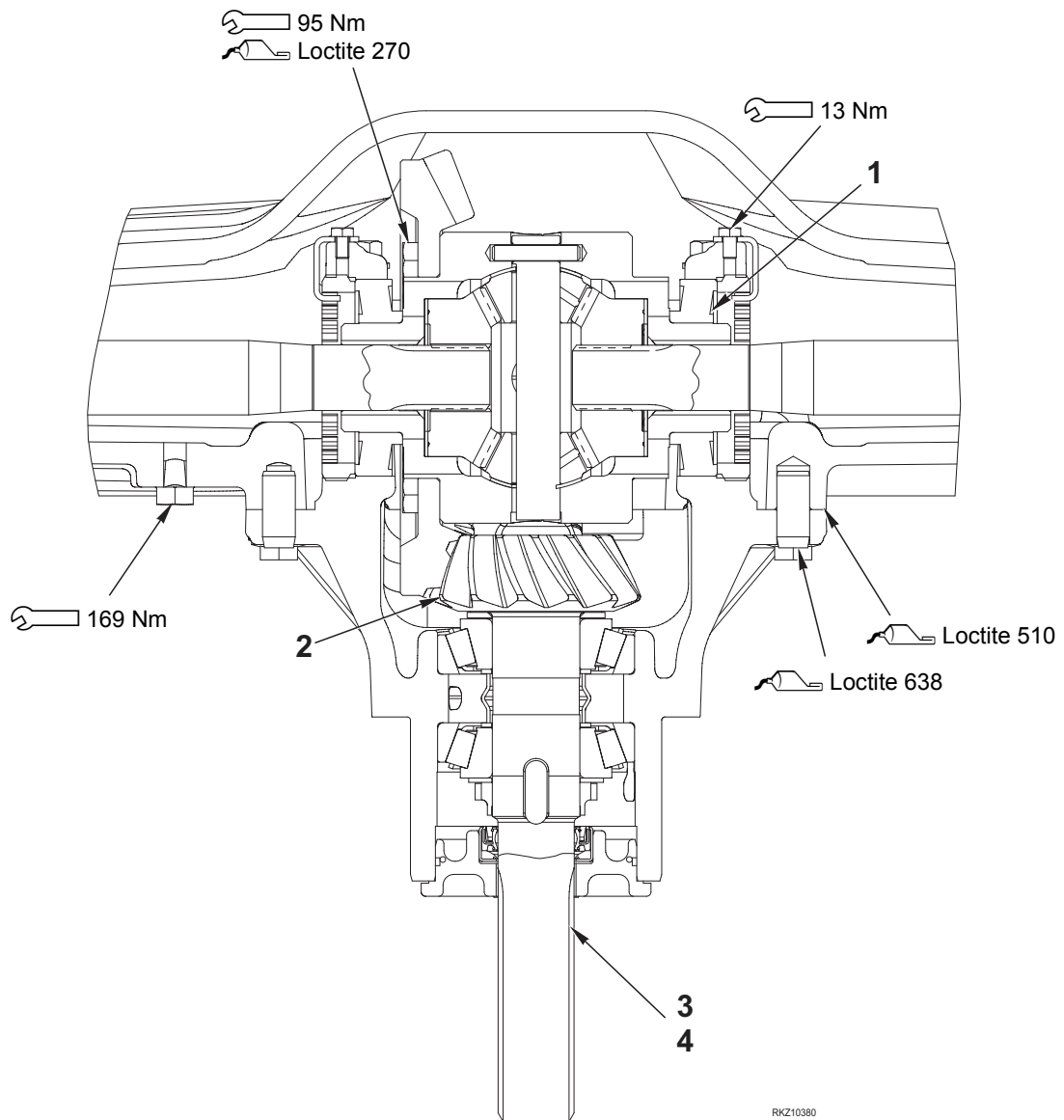


B - B

RKZ11680

## FRONT AXLE

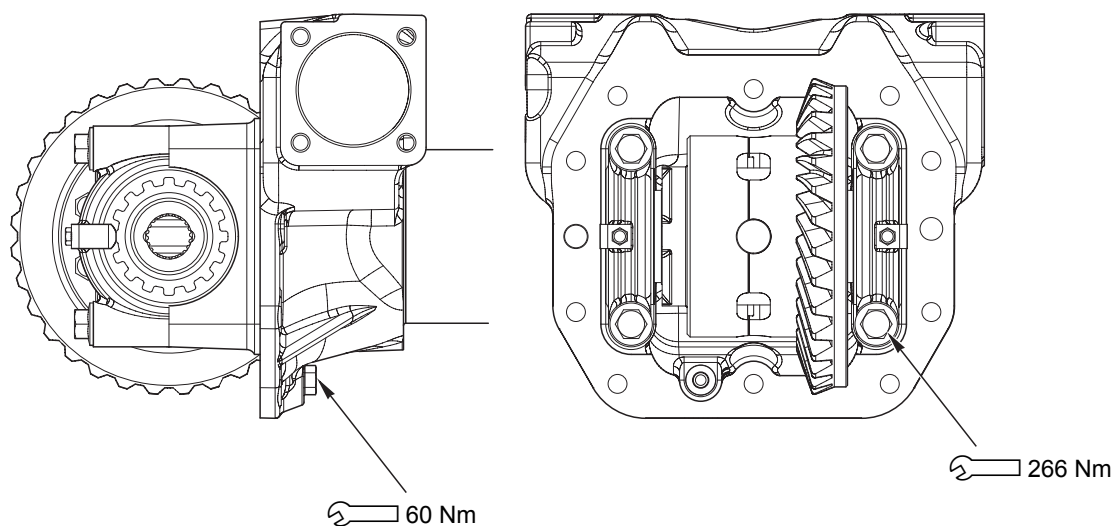
### Differential





## STANDARD MAINTENANCE

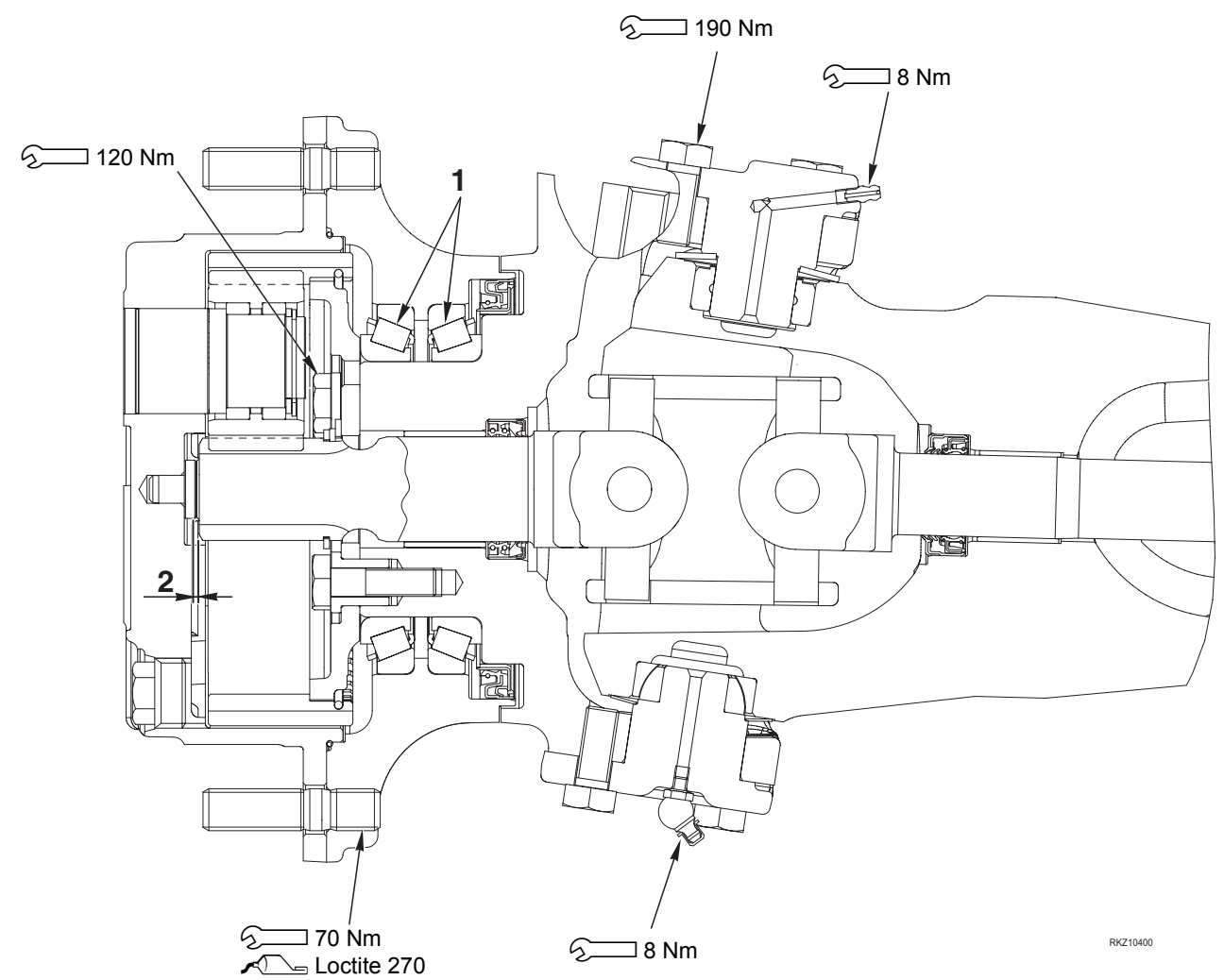
## FRONT AXLE



Unit: mm

| No. | Check item                                                                            | Criteria           |                 | Remedy |
|-----|---------------------------------------------------------------------------------------|--------------------|-----------------|--------|
| 1   | Axle clearance                                                                        | Standard clearance | Clearance limit | Adjust |
|     |                                                                                       | —                  | —               |        |
| 2   | Backlash of crown wheel and pinion                                                    | 0.18–0.28          | 0.28            |        |
| 3   | Pinion rotation force<br>(without sealing ring)<br>As measured on pinion Ø 34.8       | 92-137 Nm          |                 |        |
| 4   | Pinion-crown rotation force<br>(without sealing ring)<br>As measured on pinion Ø 34.8 | 129.5-194.5 Nm     |                 |        |

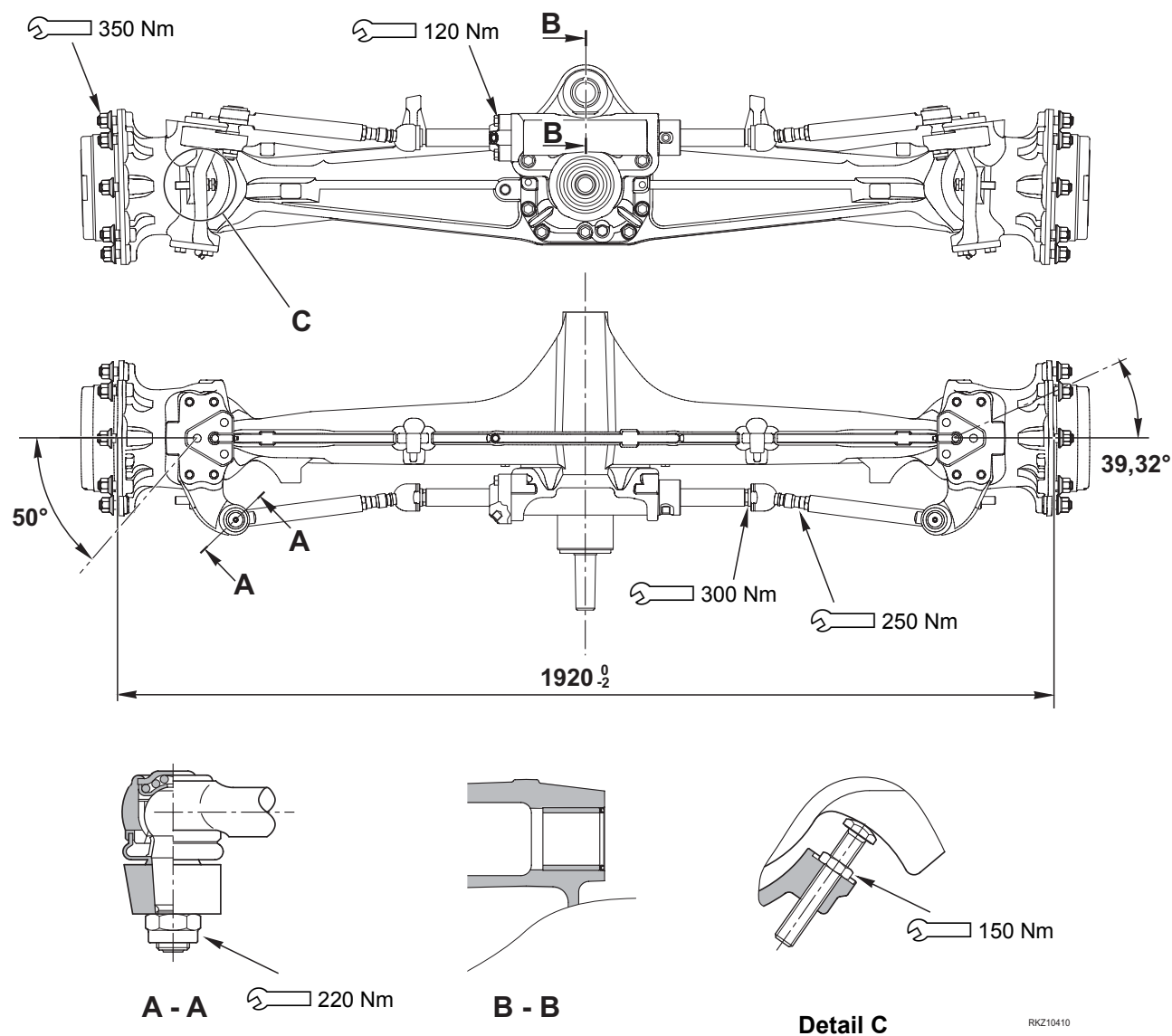
Planetary - Joint



Unit: mm

| No. | Check item                 | Criteria | Remedy  |
|-----|----------------------------|----------|---------|
| 1   | Hub rotation torque        | —        | Adjust  |
| 2   | Drive shaft axle clearance | —        | Replace |

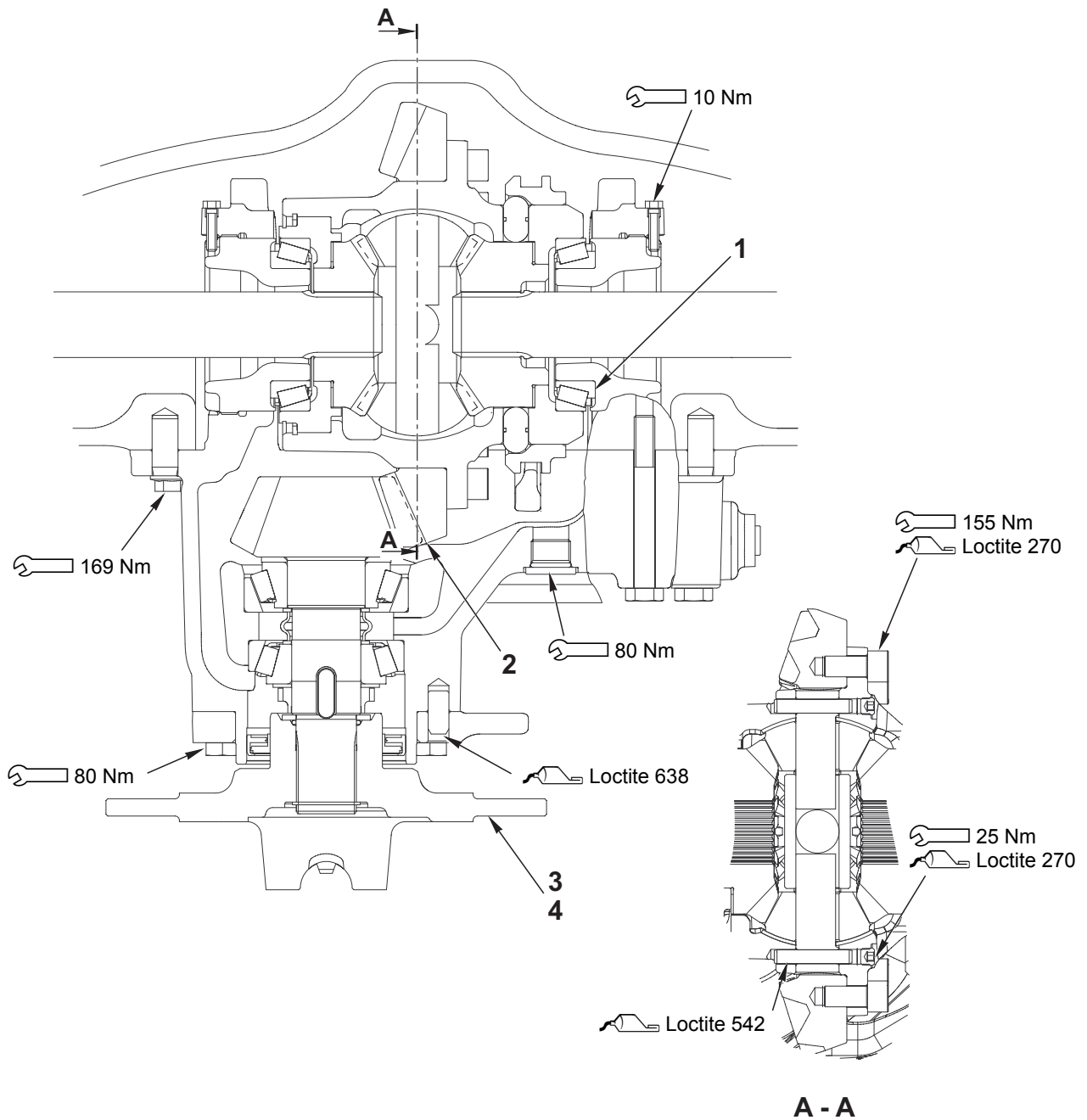
Steering unit cylinder



| Unit: mm |                                   |               |           |                                     |                    |                 |                         |
|----------|-----------------------------------|---------------|-----------|-------------------------------------|--------------------|-----------------|-------------------------|
| No.      | Check item                        | Criteria      |           |                                     |                    |                 | Remedy                  |
| 1        | Clearance between bushing and pin | Standard size | Tolerance |                                     | Standard clearance | Clearance limit | Replace bushing and pin |
|          |                                   |               | Shaft     | Hole                                |                    |                 |                         |
|          |                                   | 50            | —         | 50.19 <sup>+0.04</sup> <sub>0</sub> | —                  | —               |                         |

## REAR AXLE

### Differential

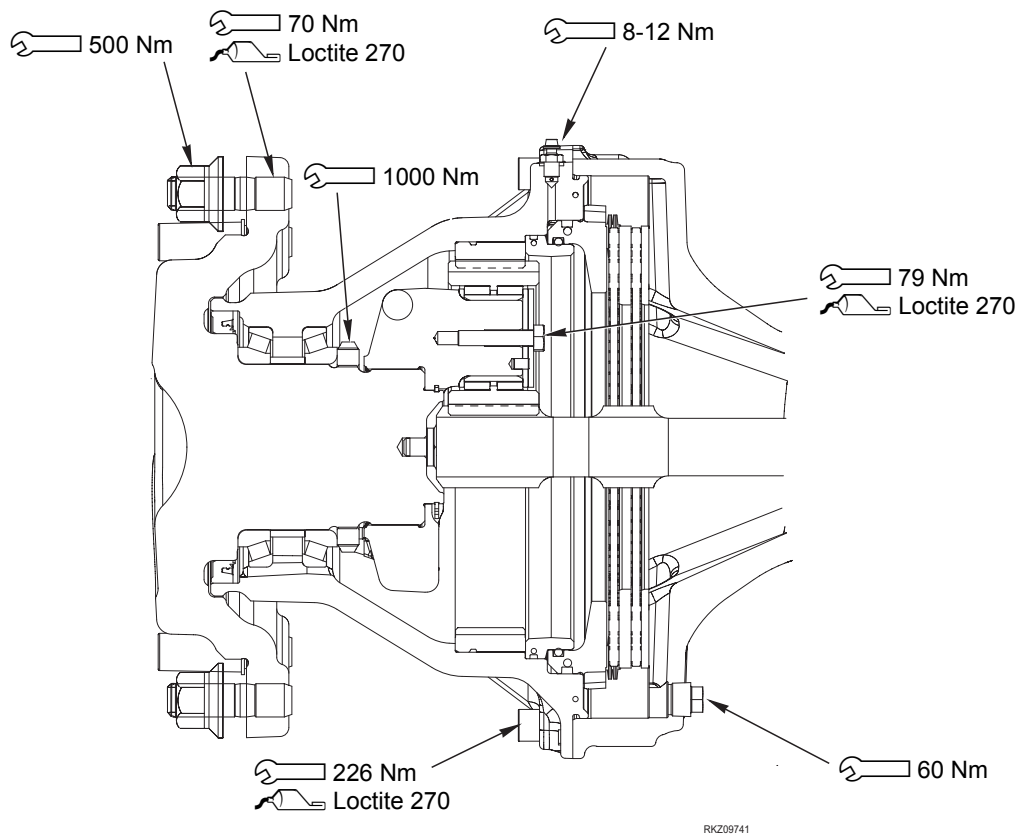


RKZ10420

Unit: mm

| No. | Check item                                                                         | Criteria           |                 | Remedy |
|-----|------------------------------------------------------------------------------------|--------------------|-----------------|--------|
| 1   | Axle clearance                                                                     | Standard clearance | Clearance limit | Adjust |
|     |                                                                                    | —                  | —               |        |
| 2   | Backlash of crown wheel and pinion                                                 | 0.21–0.29          | 0.29            |        |
| 3   | Pinion rotation force (without sealing ring)<br>As measured on pinion Ø 34.8       | 115-138 Nm         |                 |        |
| 4   | Pinion-crown rotation force (without sealing ring)<br>As measured on pinion Ø 34.8 | 148-188 Nm         |                 |        |

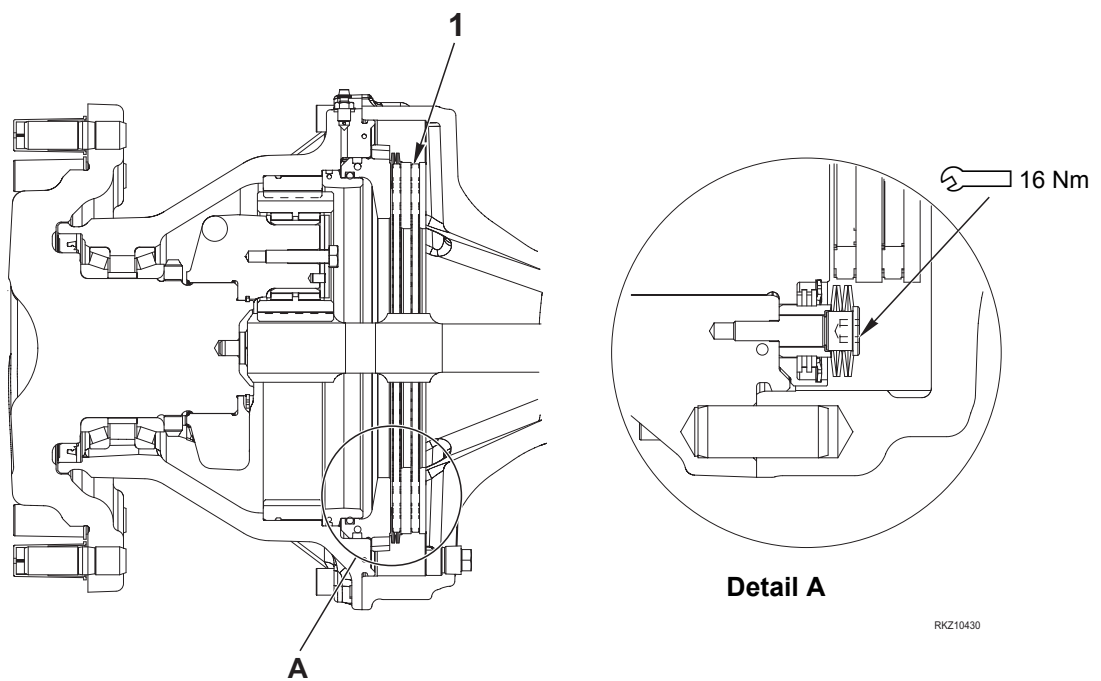
## Planetary



Unit: mm

| No. | Check item                 | Criteria | Remedy  |
|-----|----------------------------|----------|---------|
| 1   | Hub rotation torque        | —        | Adjust  |
| 2   | Drive shaft axle clearance | —        | Replace |

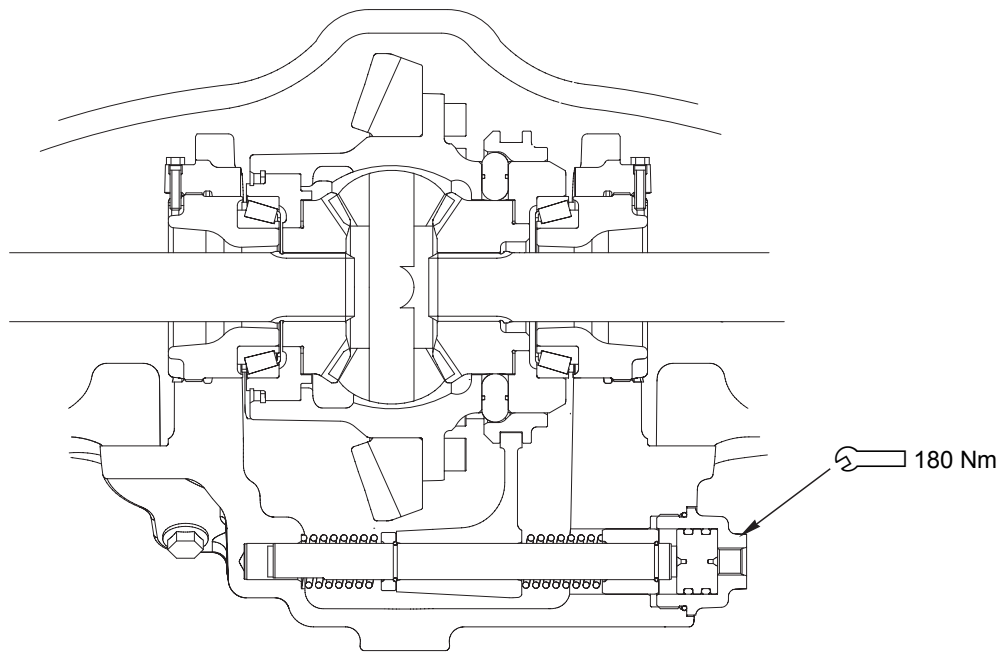
## Brakes



Unit: mm

| No. | Check item     | Criteria           |                | Remedy  |
|-----|----------------|--------------------|----------------|---------|
|     |                | Standard thickness | Min. thickness |         |
| 1   | Disc thickness | 6.73 $\pm$ 0.1     | 5.8            | Replace |

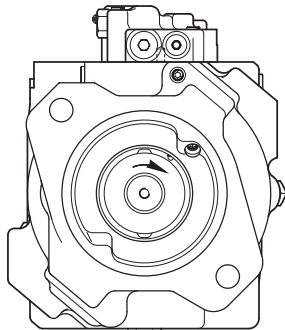
Differential lock



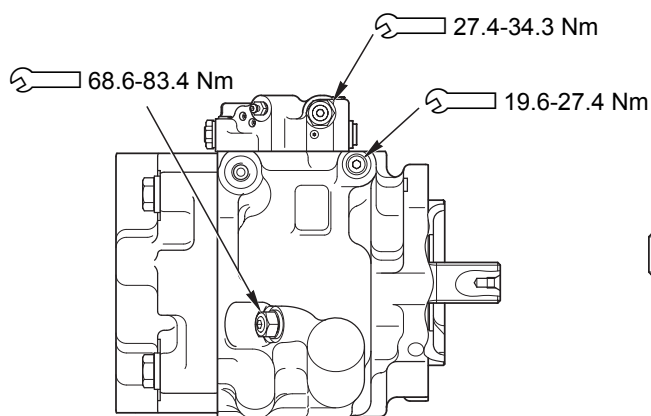
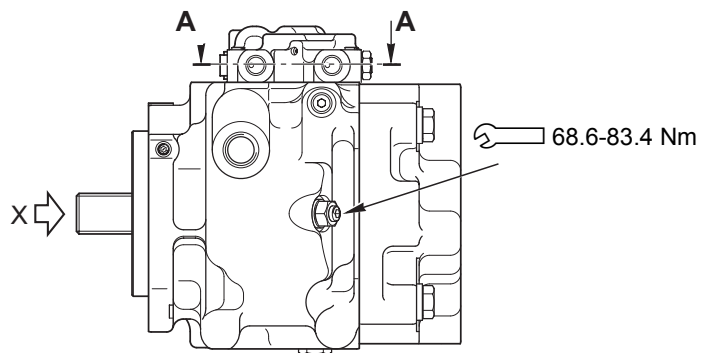
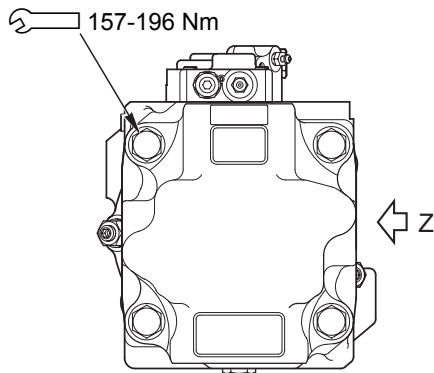
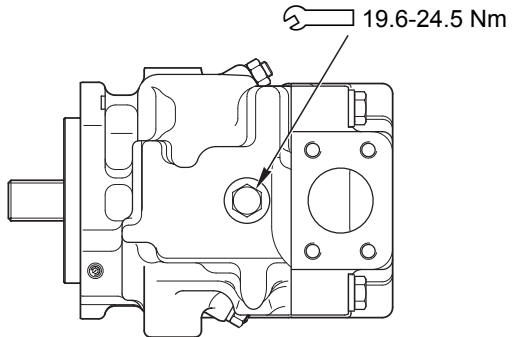
RKZ09761



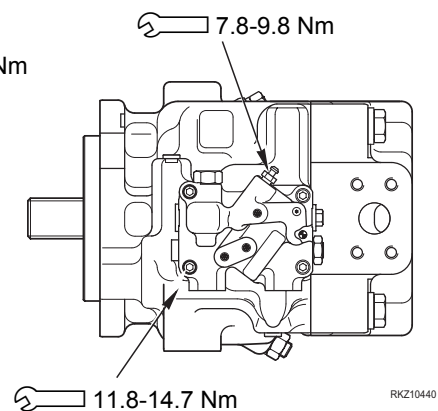
# HYDRAULIC PUMP



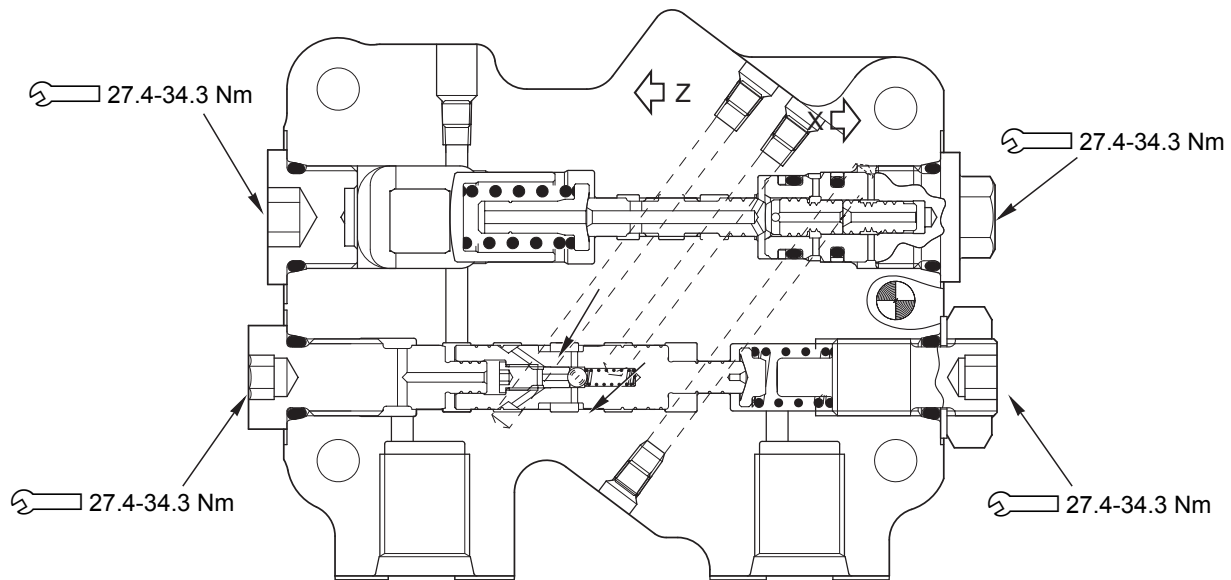
View X



View Z



RKZ10440



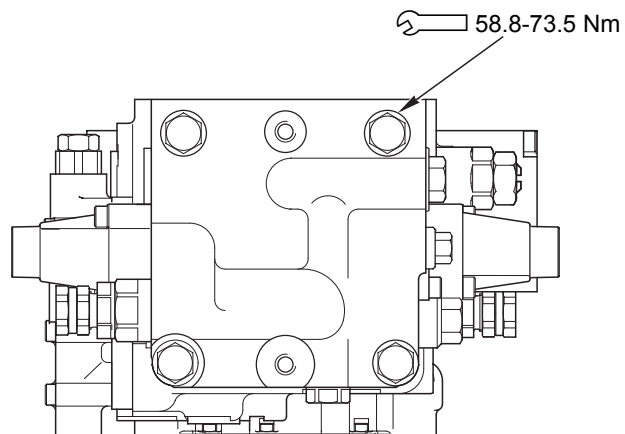
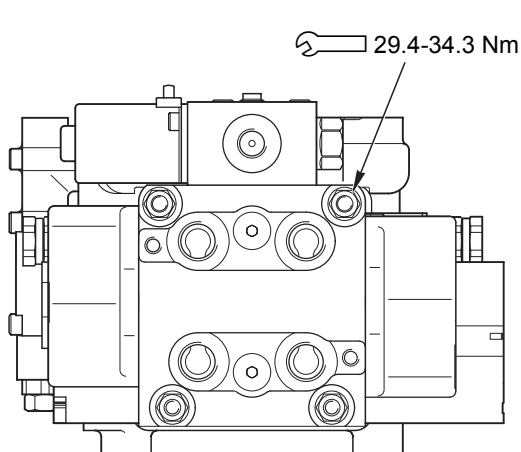
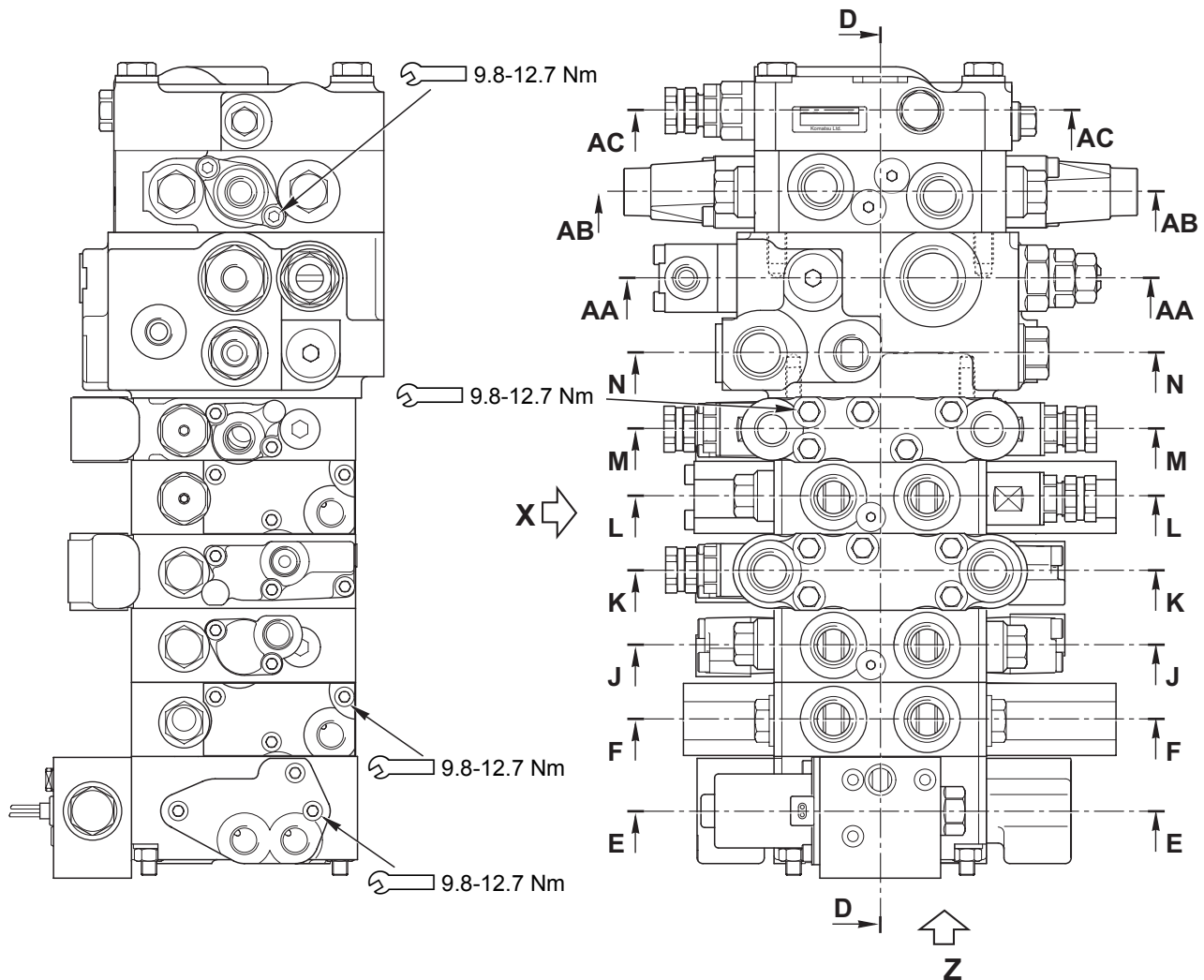
A - A

RKZ10450

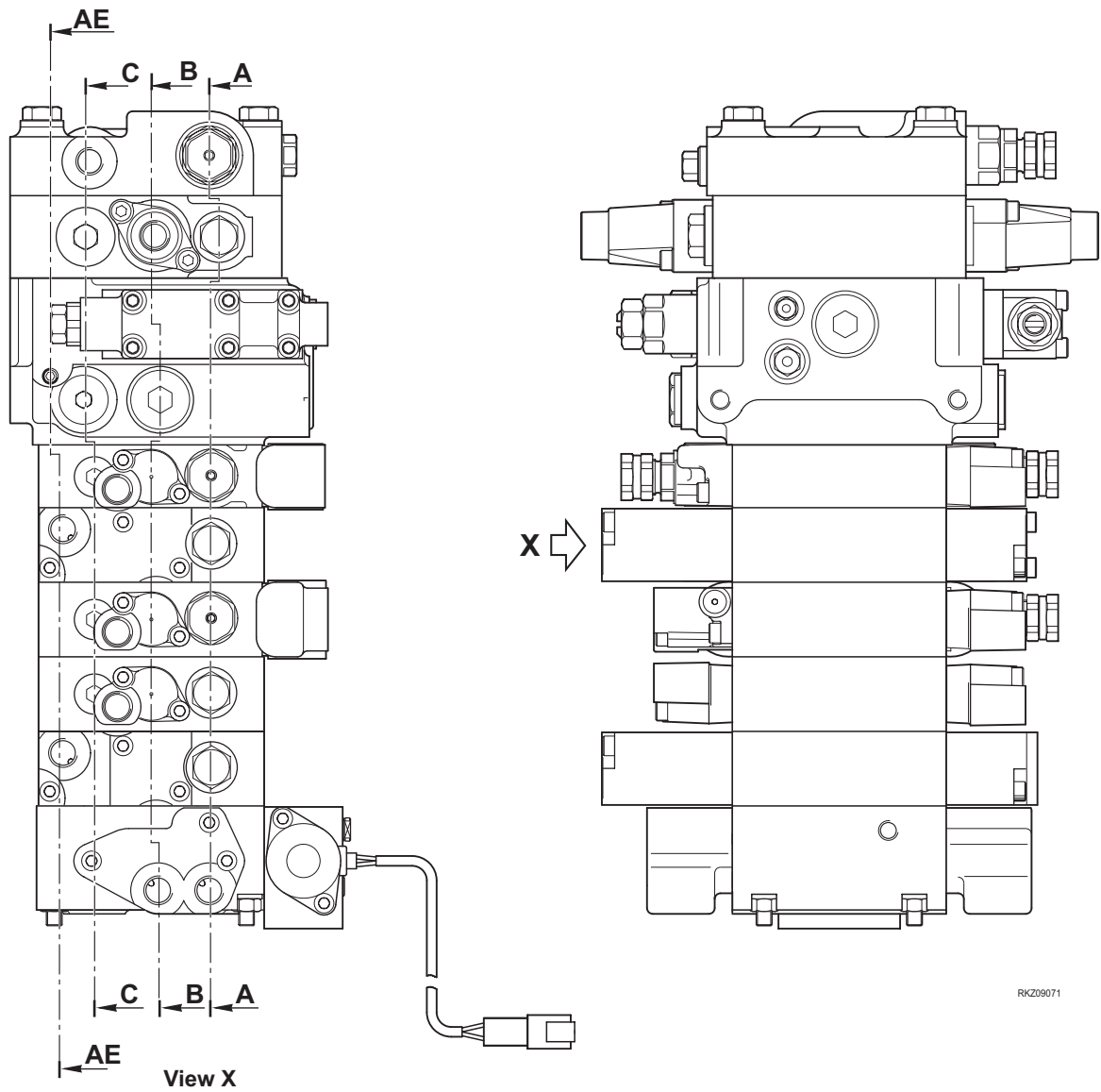
**PAGE INTENTIONALLY  
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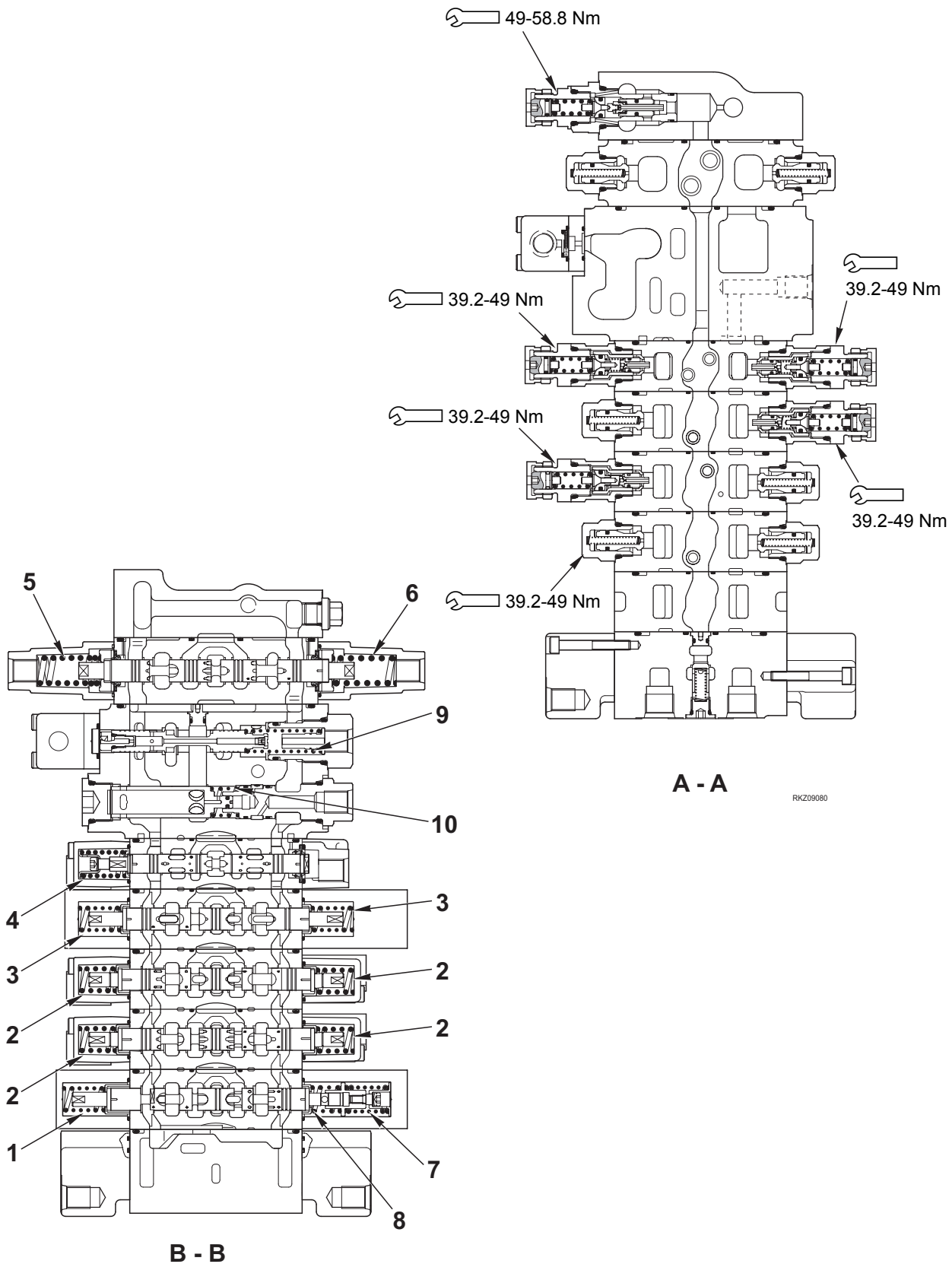
# CONTROL VALVE

## 8-SPOOL VERSION



RKZ09062





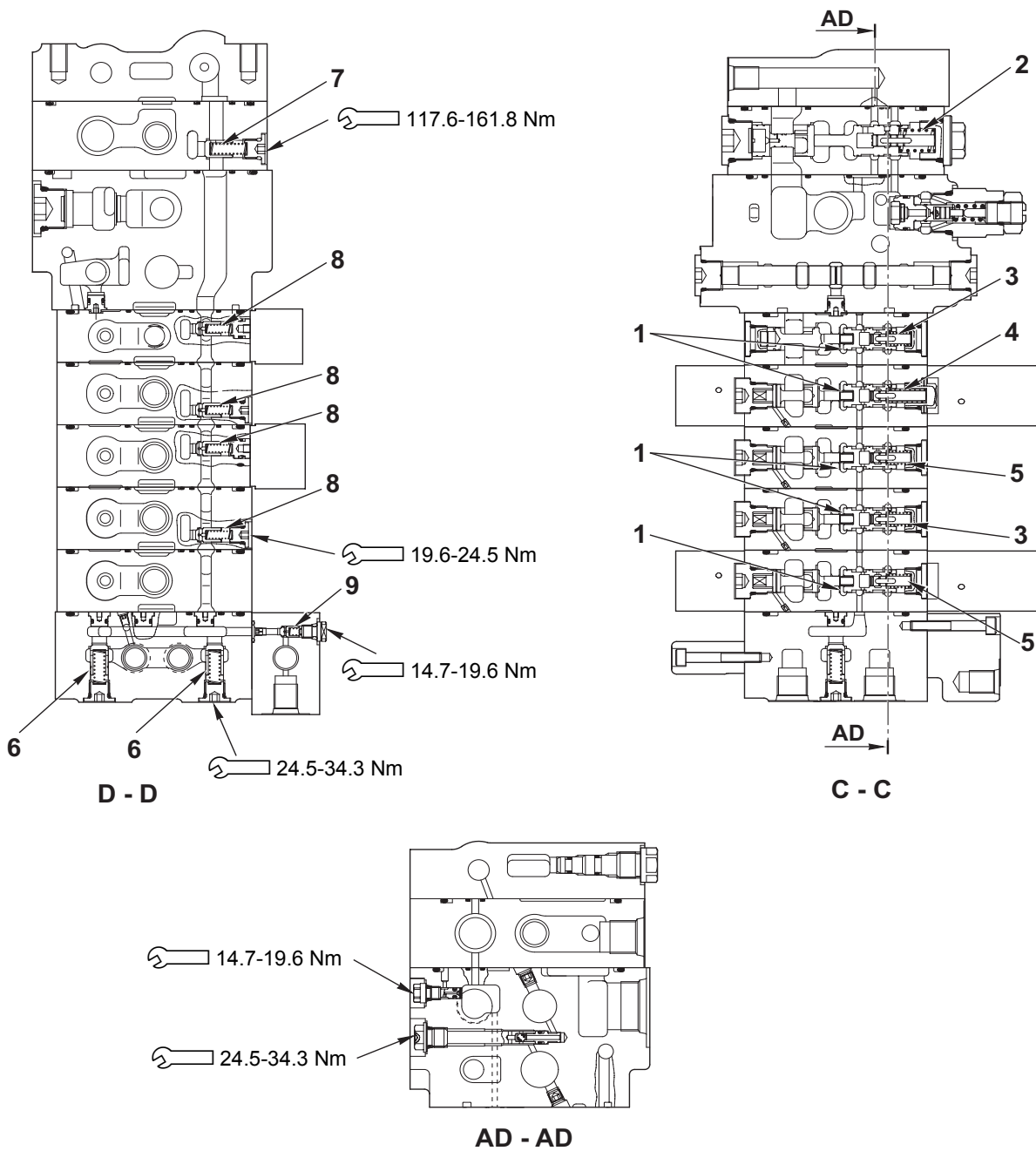
## STANDARD MAINTENANCE

## CONTROL VALVE

Unit: mm

| No. | Check item                                        | Criteria               |                  |                |                |                | Remedy         |
|-----|---------------------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                                   | Standard size          |                  |                | Repair limit   |                | Replace spring |
|     |                                                   | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Spool return spring (shovel arm raise control)    | 27.1x16.2              | 26.7             | 14.7N          | —              | 11.8N          |                |
| 2   | Spool return spring (in arm control)              | 41.1x19.3              | 40.5             | 34.3N          | —              | 27.4N          |                |
| 3   | Spool return spring (out arm control)             | 42.3x19.2              | 40.5             | 54.9N          | —              | 43.9N          |                |
| 4   | Spool return spring (boom swing control)          | 29x17.5                | 28.5             | 22.5N          | —              | 18N            |                |
| 5   | Spool return spring (shovel control)              | 27.2x16.6              | 26.7             | 30.38N         | —              | 24.3N          |                |
| 6   | Spool return spring (backhoe bucket boom control) | 24.2x16.7              | 23.7             | 30.4N          | —              | 24.3N          |                |
| 7   | Spool return spring (shovel arm float control)    | 19.4x17.6              | 19               | 14.7N          | —              | 11.8N          |                |
| 8   | Spool return spring (shovel arm lower control)    | 38.7x18                | 27.6             | 355.7N         | —              | 284.6N         |                |
| 9   | Priority valve spring                             | 56.8x15.2              | 48.5             | 29.6N          | —              | 23.7N          |                |
| 10  | Unloading valve spring                            | 25.5x19.3              | 18               | 121.5N         | —              | 97.2N          |                |





RK208341

## STANDARD MAINTENANCE

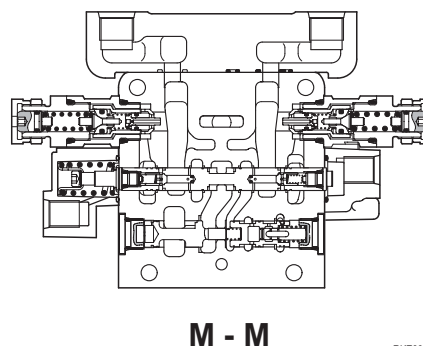
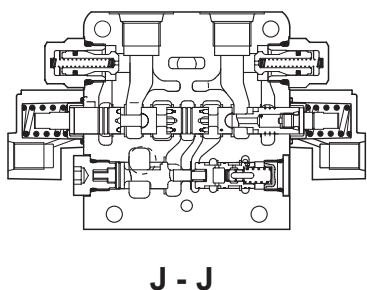
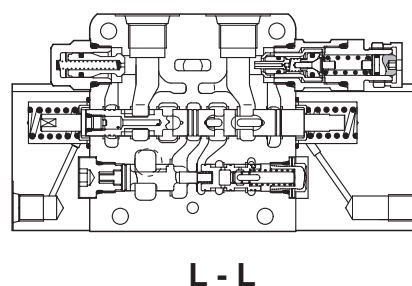
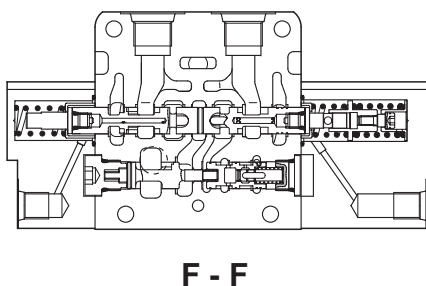
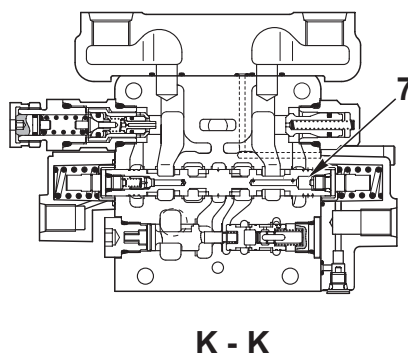
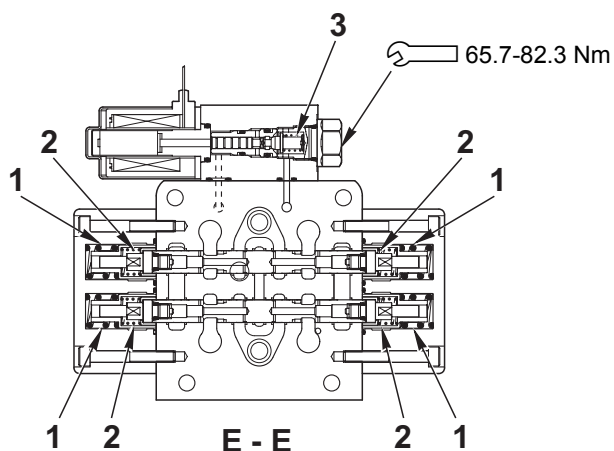
## CONTROL VALVE

Unit: mm

| No. | Check item                                                                                   | Criteria               |                  |                |                |                | Remedy         |
|-----|----------------------------------------------------------------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                                                                              | Standard size          |                  |                | Repair limit   |                | Replace spring |
|     |                                                                                              | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Pressure compensation valve spring<br>(Shovel arm, backhoe bucket, boom, shovel, boom swing) | 15.4x6                 | 8                | 7.44N          | —              | 5.96N          |                |
| 2   | Pressure compensation valve spring (arm)                                                     | 31.4x14.4              | 21.8             | 63.7N          | —              | 51.0N          |                |
| 3   | Pressure compensation valve spring.<br>(Boom swing, backhoe bucket)                          | 18.9x8.4               | 15               | 15.7N          | —              | 12.5N          |                |
| 4   | Pressure compensation valve spring.<br>(Front bucket)                                        | 37.1x8.6               | 24               | 34.3N          | —              | 27.4N          |                |
| 5   | Pressure compensation valve spring.<br>(Boom, shovel arm)                                    | 20x8.4                 | 15               | 4.32N          | —              | 3.45N          |                |
| 6   | Check valve spring                                                                           | 27.2x6.9               | 21               | 4.70N          | —              | 3.76N          |                |
| 7   | Check valve spring                                                                           | 27.2x6.9               | 22               | 3.92N          | —              | 3.14N          |                |
| 8   | Check valve spring                                                                           | 21.9x5                 | 15.8             | 1.96N          | —              | 1.57N          |                |
| 9   | Check valve spring                                                                           | 11.3x4.3               | 7.5              | 1.72N          | —              | 1.38N          |                |

# STANDARD MAINTENANCE

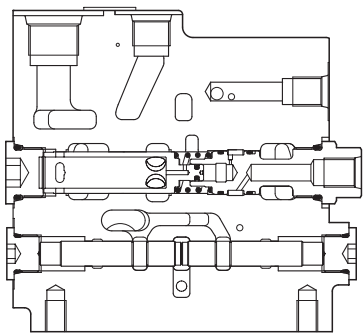
# CONTROL VALVE



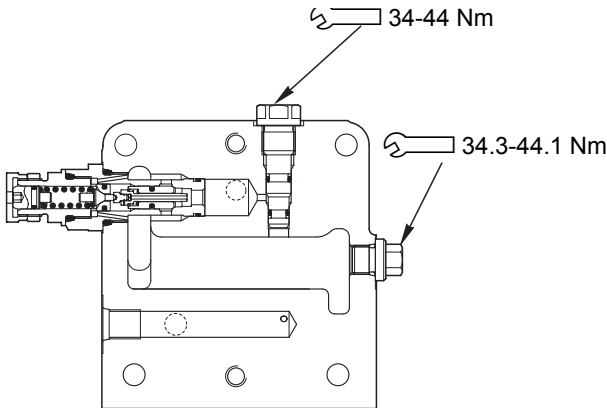
RIKZ09102

Unit: mm

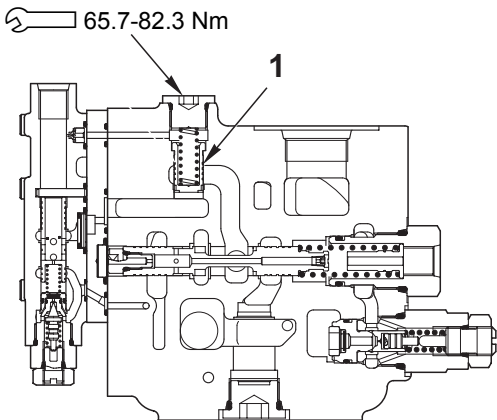
| No. | Check item                              | Criteria               |                  |                |                |                | Remedy         |
|-----|-----------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                         | Standard size          |                  |                | Repair limit   |                |                |
|     |                                         | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Spool return spring (Outrigger control) | 18.0x18                | 17.5             | 39.2N          | —              | 31.4N          | Replace spring |
| 2   | Spool return spring (Outrigger control  | 20.2x14.2              | 10.4             | 30.4N          | —              | 24.3N          |                |
| 3   | Control valve spring plate lock         | 13.0x8.8               | 11               | 3.92N          | —              | 3.1N           |                |



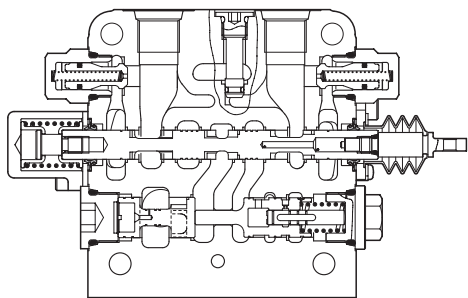
N - N



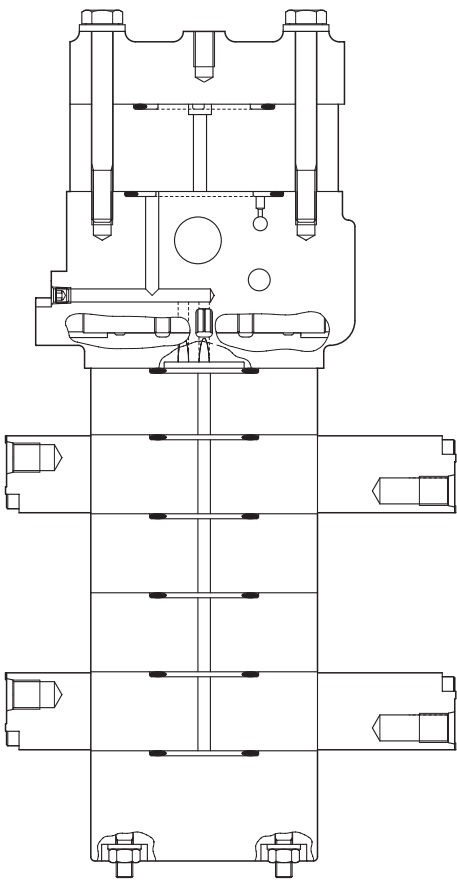
AC - AC



AA - AA



AB - AB



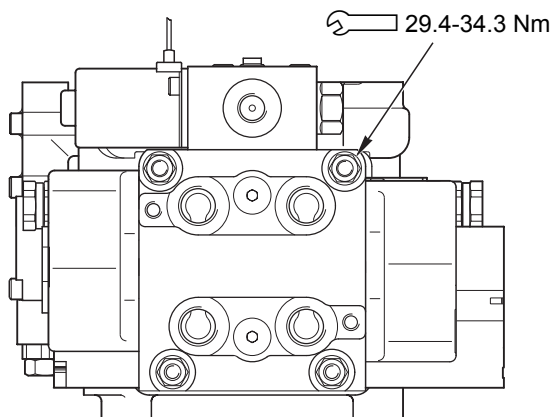
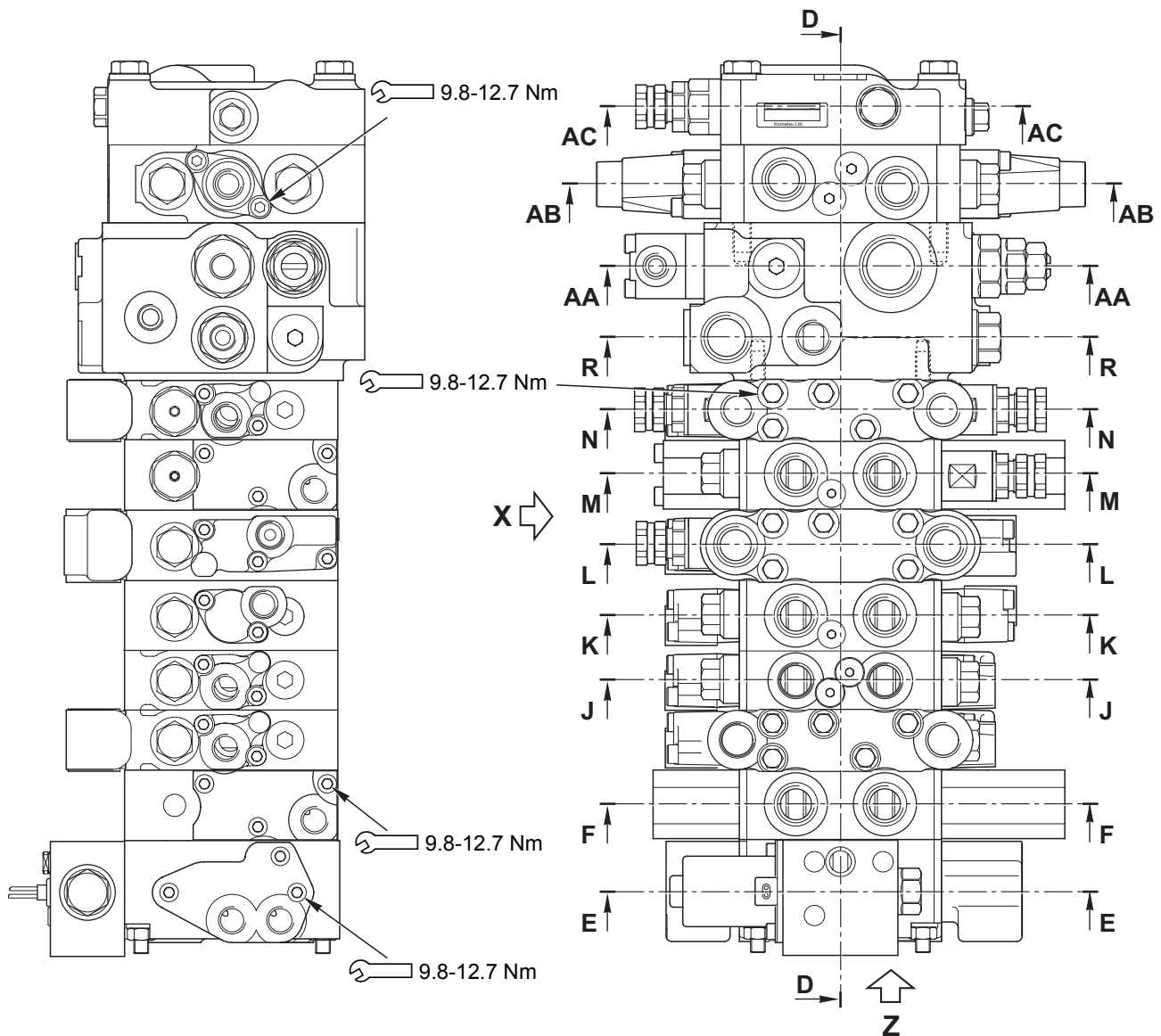
AE - AE

RKZ08892

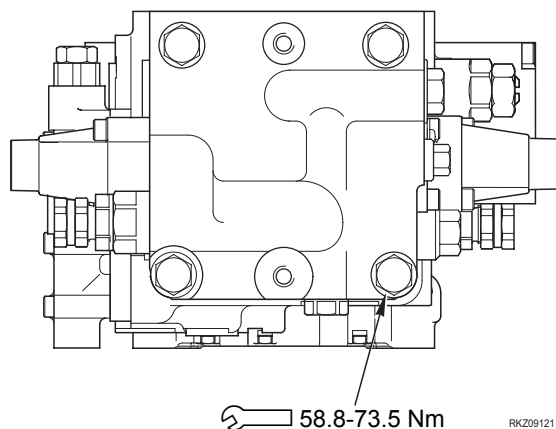
Unit: mm

| No. | Check item                             | Criteria                  |                     |                   |                   |                   | Remedy            |
|-----|----------------------------------------|---------------------------|---------------------|-------------------|-------------------|-------------------|-------------------|
|     |                                        | Standard size             |                     |                   | Repair limit      |                   | Replace<br>spring |
|     |                                        | Free<br>installed<br>x Øe | Installed<br>length | Installed<br>load | Free<br>installed | Installed<br>load |                   |
| 1   | Pressure compensation<br>valve spring. | 31.7x9.2                  | 27.5                | 43.1N             | —                 | 34.5N             |                   |

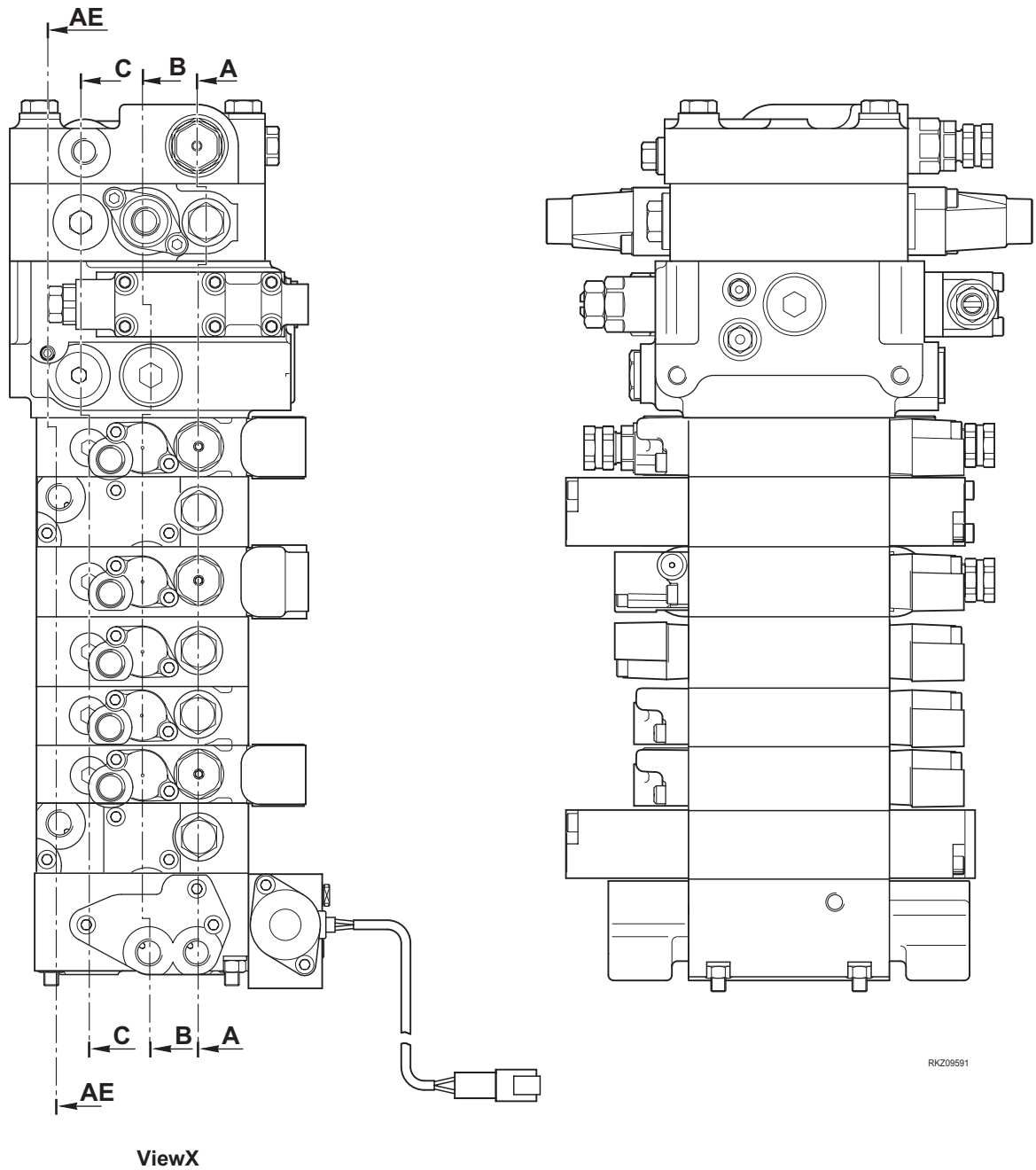
10-SPOOL VERSION

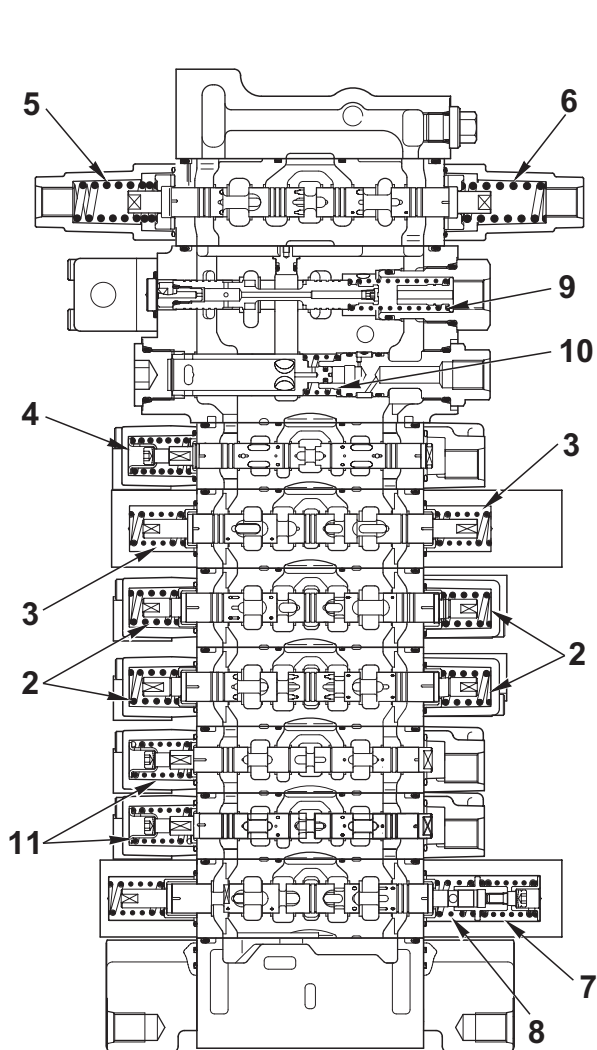


ViewZ

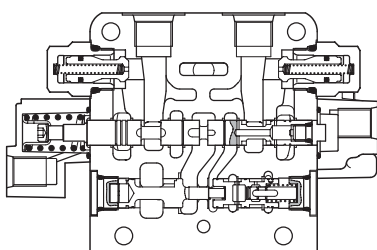


RKZ09121

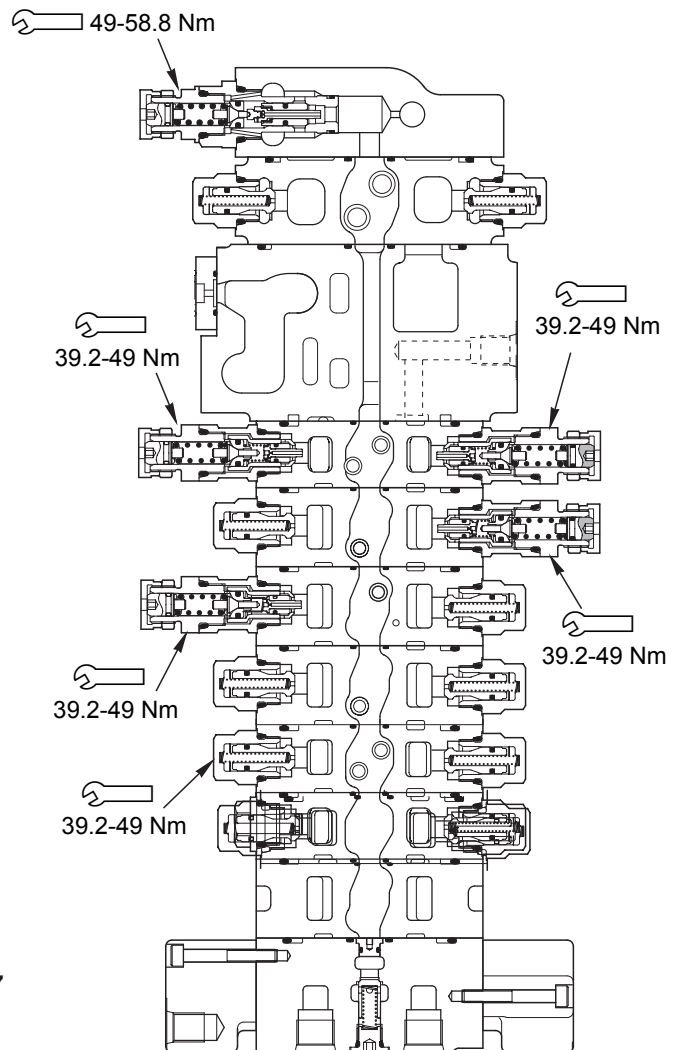




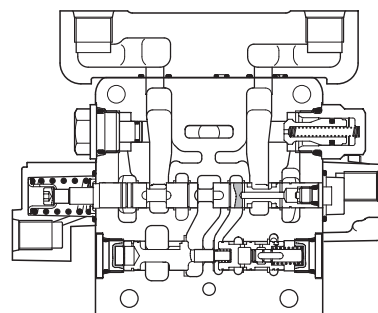
B - B



K - K



A - A



J - J

RK209131

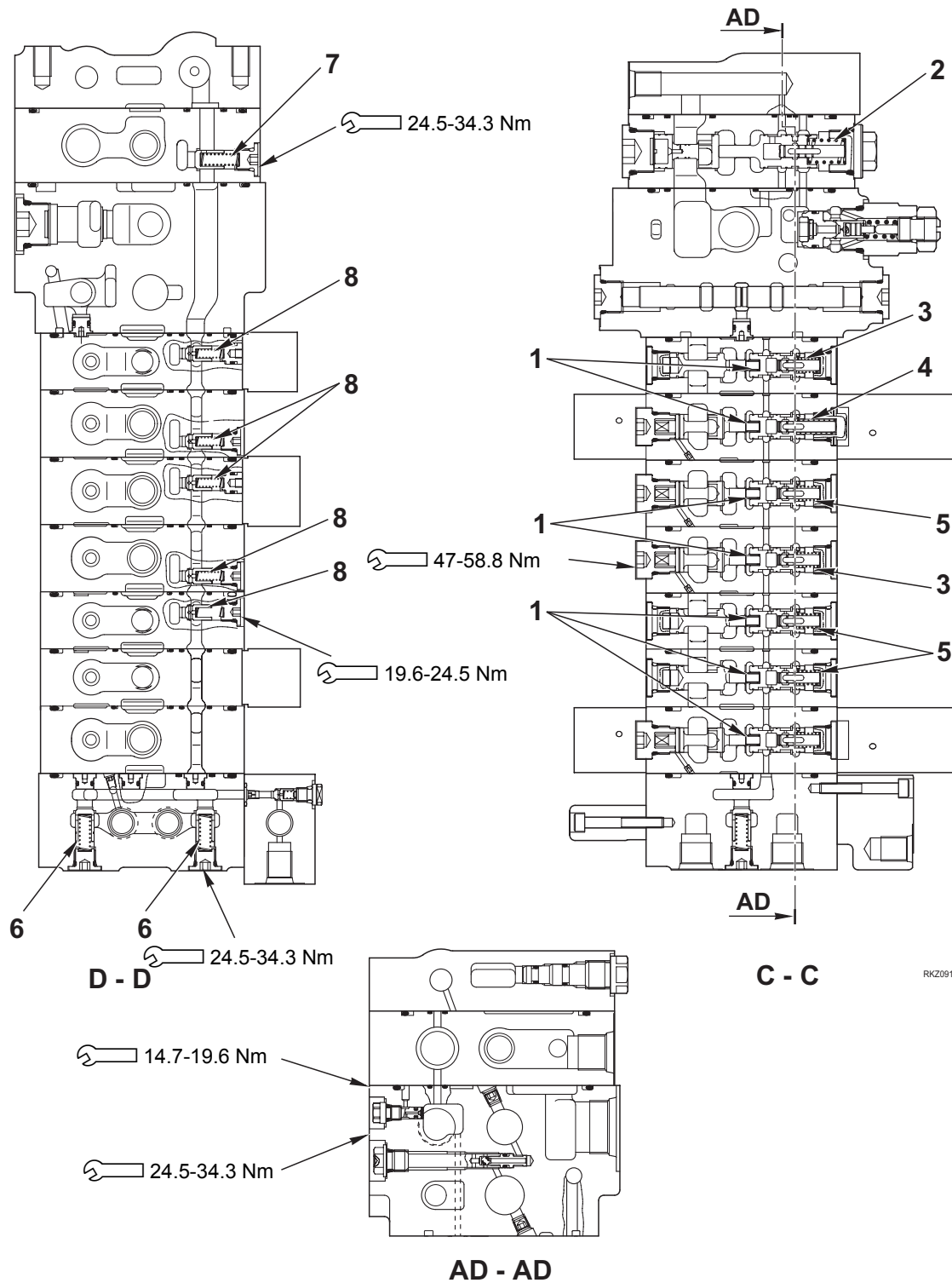


## STANDARD MAINTENANCE

## CONTROL VALVE

Unit: mm

| No. | Check item                                                   | Criteria               |                  |                |                |                | Remedy         |
|-----|--------------------------------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                                              | Standard size          |                  |                | Repair limit   |                | Replace spring |
|     |                                                              | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Spool return spring (shovel arm raise control)               | 27.1x16.2              | 26.7             | 14.7N          | —              | 11.8N          |                |
| 2   | Spool return spring (in arm control)                         | 41.1x19.3              | 40.5             | 34.3N          | —              | 27.4N          |                |
| 3   | Spool return spring (out arm control)                        | 42.3x19.2              | 40.5             | 54.9N          | —              | 43.9N          |                |
| 4   | Spool return spring (boom swing control)                     | 29x17.5                | 28.5             | 22.5N          | —              | 18N            |                |
| 5   | Spool return spring (shovel control)                         | 27.2x16.6              | 26.7             | 30.38N         | —              | 24.3N          |                |
| 6   | Spool return spring (backhoe bucket boom control)            | 24.2x16.7              | 23.7             | 30.4N          | —              | 24.3N          |                |
| 7   | Spool return spring (shovel arm float control)               | 19.4x17.6              | 19               | 14.7N          | —              | 11.8N          |                |
| 8   | Spool return spring (shovel arm lower control)               | 38.7x18                | 27.6             | 355.7N         | —              | 284.6N         |                |
| 9   | Priority valve spring                                        | 56.8x15.2              | 48.5             | 29.6N          | —              | 23.7N          |                |
| 10  | Unloading valve spring                                       | 25.5x19.3              | 18               | 121.5N         | —              | 97.2N          |                |
| 11  | Spool return spring (jig arm control, 4 in 1 bucket control) | 29x17.5                | 28.5             | 22.5N          |                | 18.0N          |                |



RKZ09141

# STANDARD MAINTENANCE

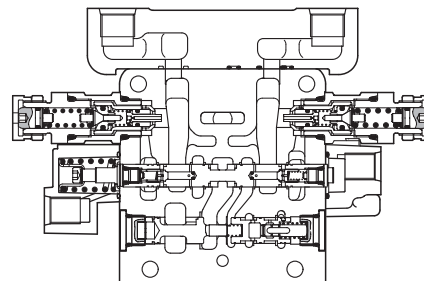
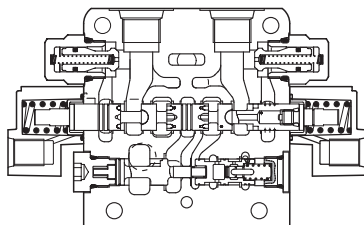
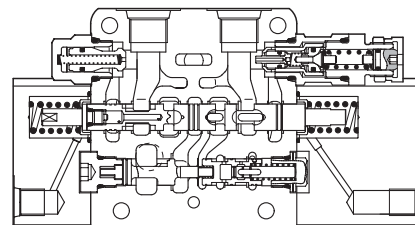
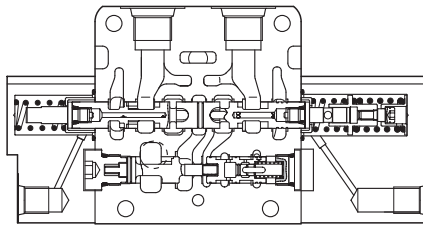
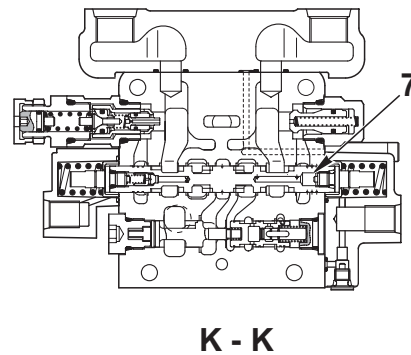
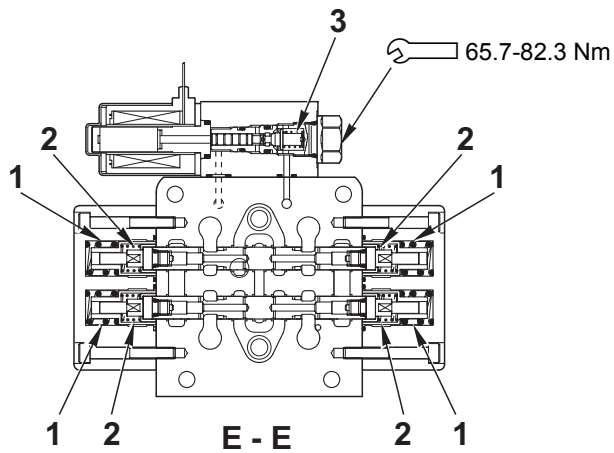
# CONTROL VALVE

Unit: mm

| No. | Check item                                                                                                           | Criteria            |                  |                |                |                | Remedy         |
|-----|----------------------------------------------------------------------------------------------------------------------|---------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                                                                                                      | Standard size       |                  |                | Repair limit   |                | Replace spring |
|     |                                                                                                                      | Free installed x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Pressure compensation valve spring<br>(Shovel arm, backhoe bucket, boom, shovel, boom swing, jig arm, 4 in 1 bucket) | 15.4x6              | 8                | 7.44N          | —              | 5.96N          |                |
| 2   | Pressure compensation valve spring (arm)                                                                             | 31.4x14.4           | 21.8             | 63.7N          | —              | 51.0N          |                |
| 3   | Pressure compensation valve spring.<br>(Boom swing, backhoe bucket)                                                  | 18.9x8.4            | 15               | 15.7N          | —              | 12.5N          |                |
| 4   | Pressure compensation valve spring.<br>(Front bucket)                                                                | 37.1x8.6            | 24               | 34.3N          | —              | 27.4N          |                |
| 5   | Pressure compensation valve spring.<br>(Boom, shovel arm jig arm, 4 in 1 bucket)                                     | 20x8.4              | 15               | 4.32N          | —              | 3.45N          |                |
| 6   | Check valve spring                                                                                                   | 27.2x6.9            | 21               | 4.70N          | —              | 3.76N          |                |
| 7   | Check valve spring                                                                                                   | 27.2x6.9            | 22               | 3.92N          | —              | 3.14N          |                |
| 8   | Check valve spring                                                                                                   | 21.9x5              | 15.8             | 1.96N          | —              | 1.57N          |                |
| 9   | Check valve spring                                                                                                   | 11.3x4.3            | 7.5              | 1.72N          | —              | 1.38N          |                |

## STANDARD MAINTENANCE

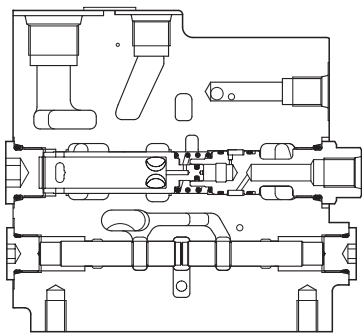
## CONTROL VALVE



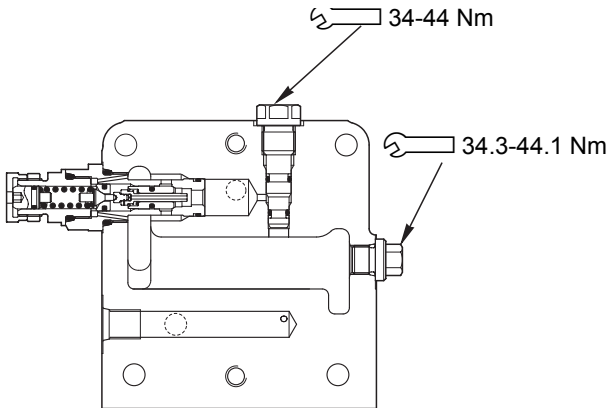
RKZ09102

Unit: mm

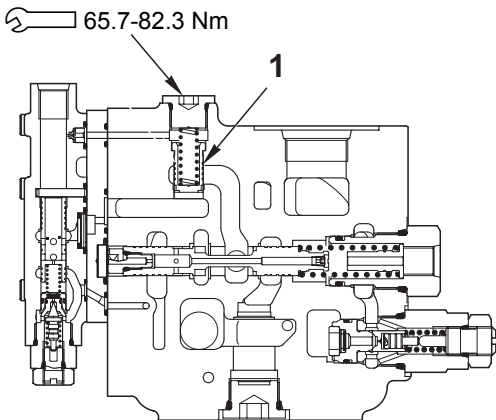
| No. | Check item                              | Criteria               |                  |                |                |                | Remedy         |
|-----|-----------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                         | Standard size          |                  |                | Repair limit   |                |                |
|     |                                         | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Spool return spring (Outrigger control) | 18.0x18                | 17.5             | 39.2N          | —              | 31.4N          | Replace spring |
| 2   | Spool return spring (Outrigger control) | 20.2x14.2              | 10.4             | 30.4N          | —              | 24.3N          |                |
| 3   | Control valve spring plate lock         | 13.0x8.8               | 11               | 3.92N          | —              | 3.1N           |                |



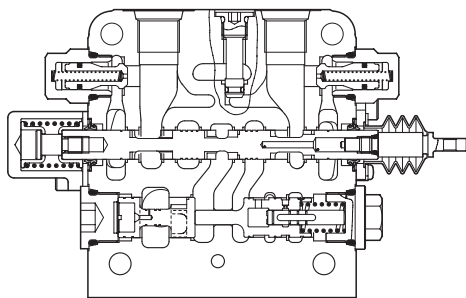
N - N



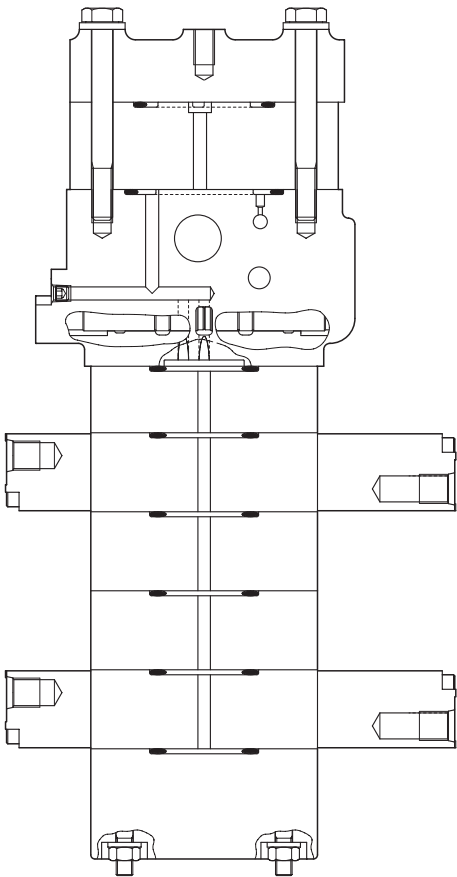
AC - AC



AA - AA



AB - AB



AE - AE

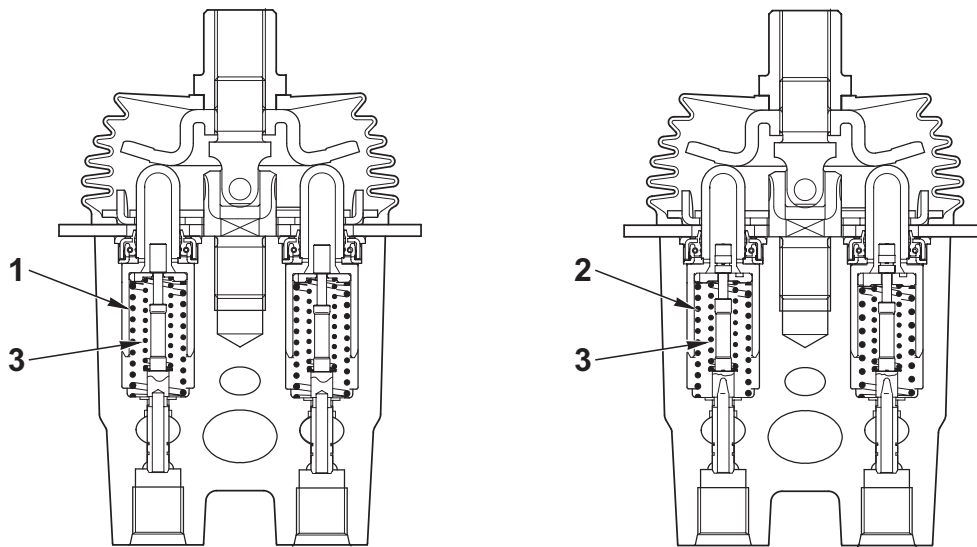
RKZ08892

Unit: mm

| No. | Check item                          | Criteria               |                  |                |                |                | Remedy         |
|-----|-------------------------------------|------------------------|------------------|----------------|----------------|----------------|----------------|
|     |                                     | Standard size          |                  |                | Repair limit   |                | Replace spring |
|     |                                     | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |                |
| 1   | Pressure compensation valve spring. | 31.7x9.2               | 27.5             | 43.1N          | —              | 34.5N          |                |

## PPC VALVES

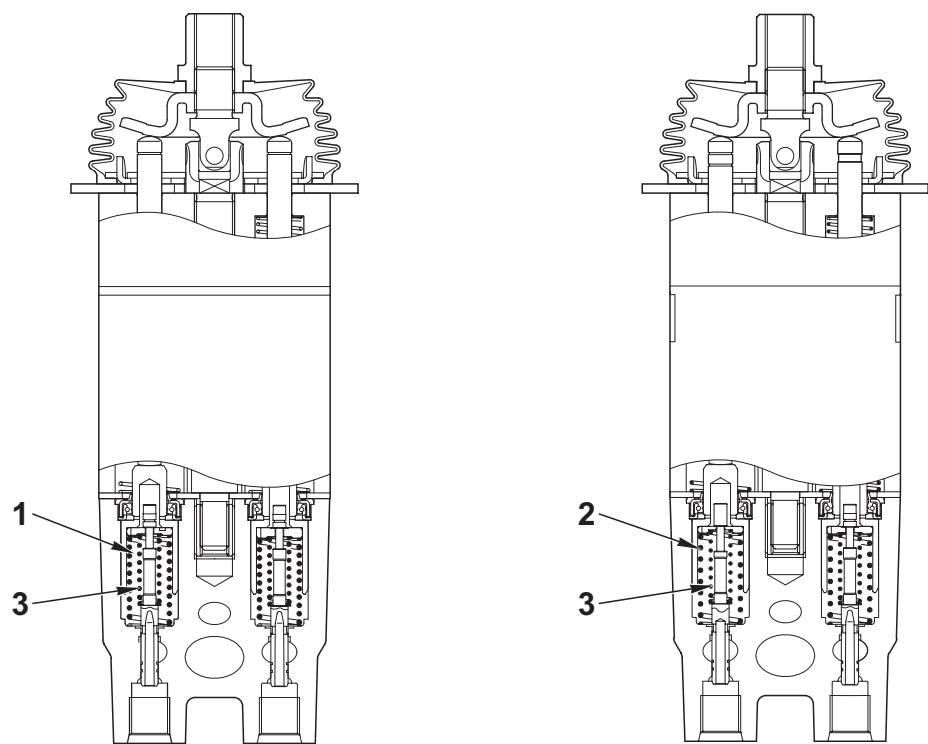
### SHOVEL CONTROL



RKZ10460

Unit: mm

| No. | Check item                                     | Criteria               |                  |                |                |                | Remedy  |
|-----|------------------------------------------------|------------------------|------------------|----------------|----------------|----------------|---------|
|     |                                                | Standard size          |                  |                | Repair limit   |                |         |
|     |                                                | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |         |
| 1   | Return spring (outer)<br>(for ports P1 and P2) |                        |                  |                |                |                | Replace |
| 2   | Return spring (outer)<br>(for ports P3 and P4) |                        |                  |                |                |                |         |
| 3   | Adjusting screw (inner)                        |                        |                  |                |                |                |         |



RKZ10470

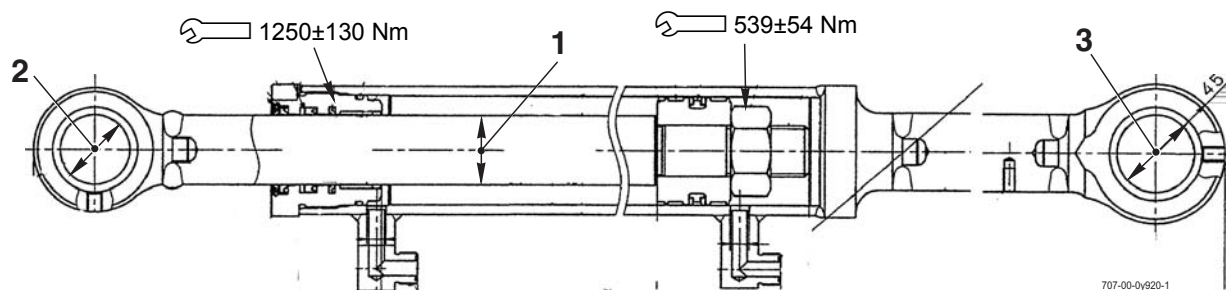
Unit: mm

| No. | Check item                                     | Criteria               |                  |                |                |                | Remedy  |
|-----|------------------------------------------------|------------------------|------------------|----------------|----------------|----------------|---------|
|     |                                                | Standard size          |                  |                | Repair limit   |                | Replace |
|     |                                                | Free installed<br>x Øe | Installed length | Installed load | Free installed | Installed load |         |
| 1   | Return spring (outer)<br>(for ports P1 and P2) |                        |                  |                |                |                |         |
| 2   | Return spring (outer)<br>(for ports P3 and P4) |                        |                  |                |                |                |         |
| 3   | Adjusting screw (inner)                        |                        |                  |                |                |                |         |

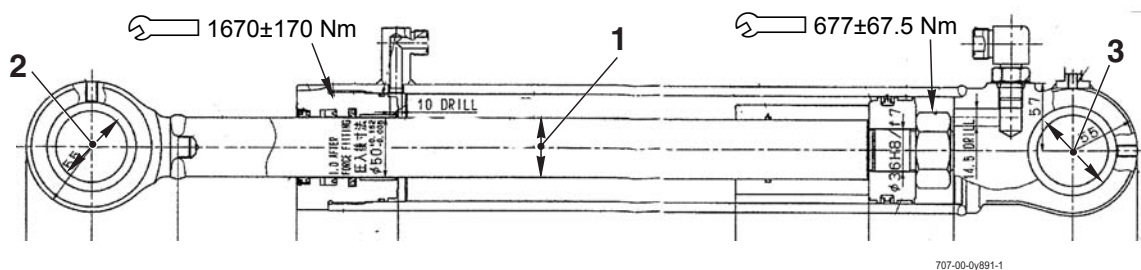


## SHOVEL CYLINDERS

## DUMP CYLINDER



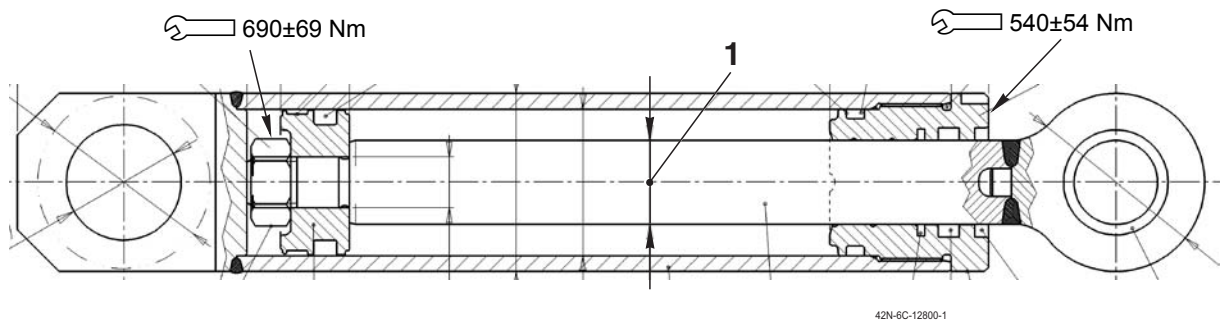
## RAISE CYLINDER



Unit: mm

| No. | Check item                                             | Cylinder | Criteria      |                  |                    |                    |                 | Remedy                  |
|-----|--------------------------------------------------------|----------|---------------|------------------|--------------------|--------------------|-----------------|-------------------------|
|     |                                                        |          | Standard size | Tolerance        |                    | Standard clearance | Clearance limit |                         |
|     |                                                        |          |               | Shaft            | Hole               |                    |                 |                         |
| 1   | Tolerance between piston rod and head                  | Lifting  | 50            | -0.030<br>-0.076 | + 0.162<br>+ 0.005 | 0.035              | 0.238           | Replace                 |
|     |                                                        | Dump     | 45            | -0.025<br>-0.064 | + 0.141<br>+ 0.004 | 0.029              | 0.205           |                         |
| 2   | Tolerance between bushing and piston head mounting pin | Lifting  | 60            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           | Replace pin and bushing |
|     |                                                        | Dump     | 45            | -0.050<br>-0.089 | + 0.142<br>+ 0.080 | 0.130              | 0.231           |                         |
| 3   | Tolerance between bushingn and cylin der mounting pin  | Lifting  | 60            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           |                         |
|     |                                                        | Dump     | 50            | -0.050<br>-0.089 | + 0.142<br>+ 0.080 | 0.130              | 0.231           |                         |

## 4 IN 1 BUCKET

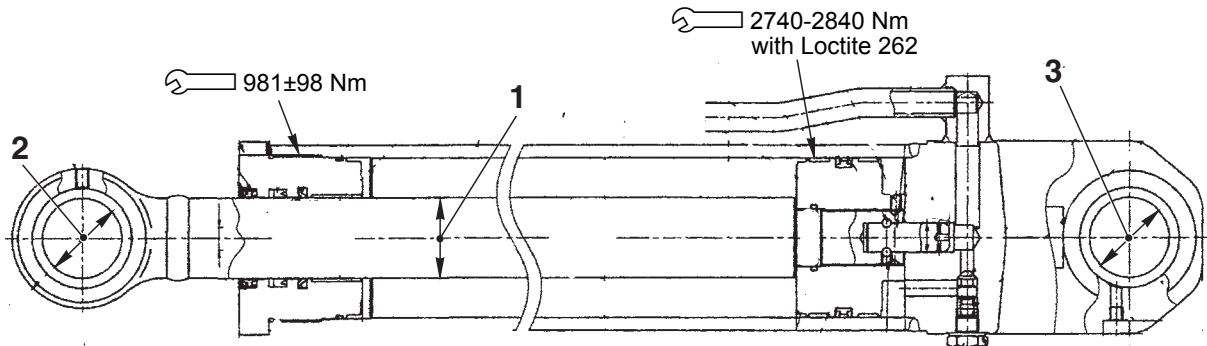


Unit: mm

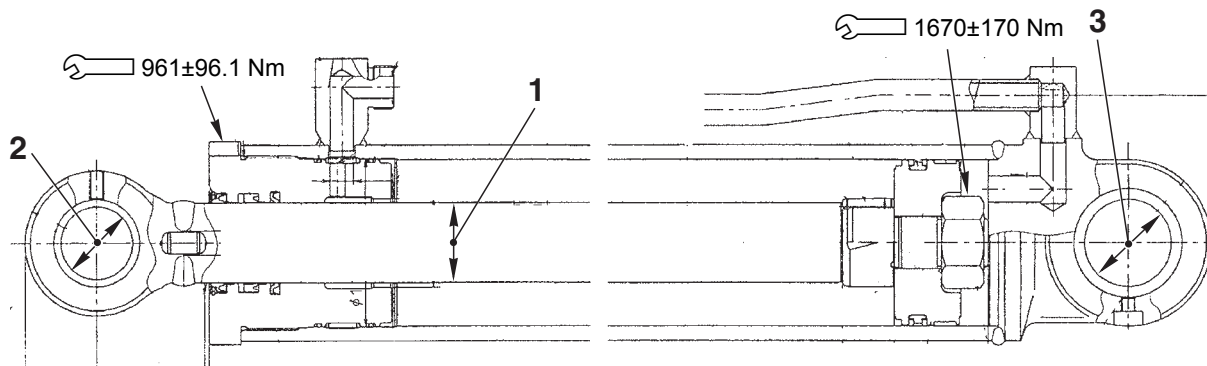
| No. | Check item                                             | Criteria               |                  |                    |                |                | Remedy  |
|-----|--------------------------------------------------------|------------------------|------------------|--------------------|----------------|----------------|---------|
|     |                                                        | Standard size          |                  |                    | Repair limit   |                |         |
|     |                                                        | Free installed<br>x Øe | Installed length | Installed load     | Free installed | Installed load |         |
| 1   | Tolerance between piston rod and head                  | 40                     | −0.025<br>−0.050 | + 0.064<br>+ 0.025 | 0.05           | 0.114          | Replace |
| 2   | Tolerance between bushing and piston head mounting pin | 40                     | ±0.150           |                    |                |                |         |

## BACKHOE CYLINDERS

### BOOM

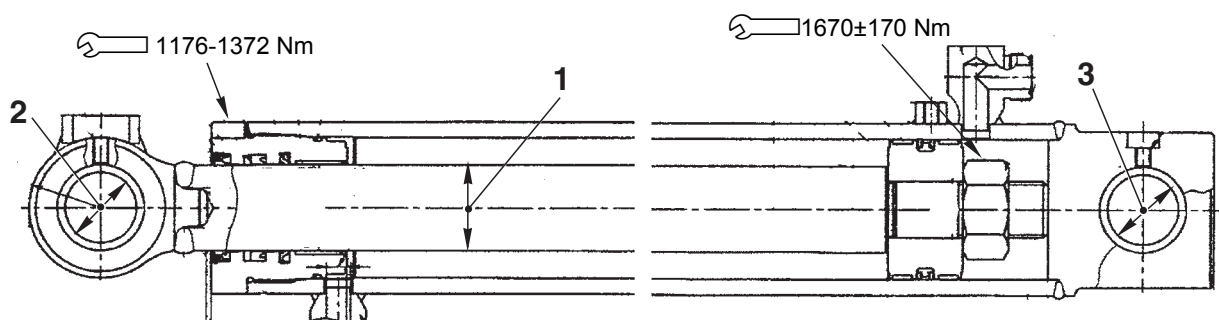


### ARM



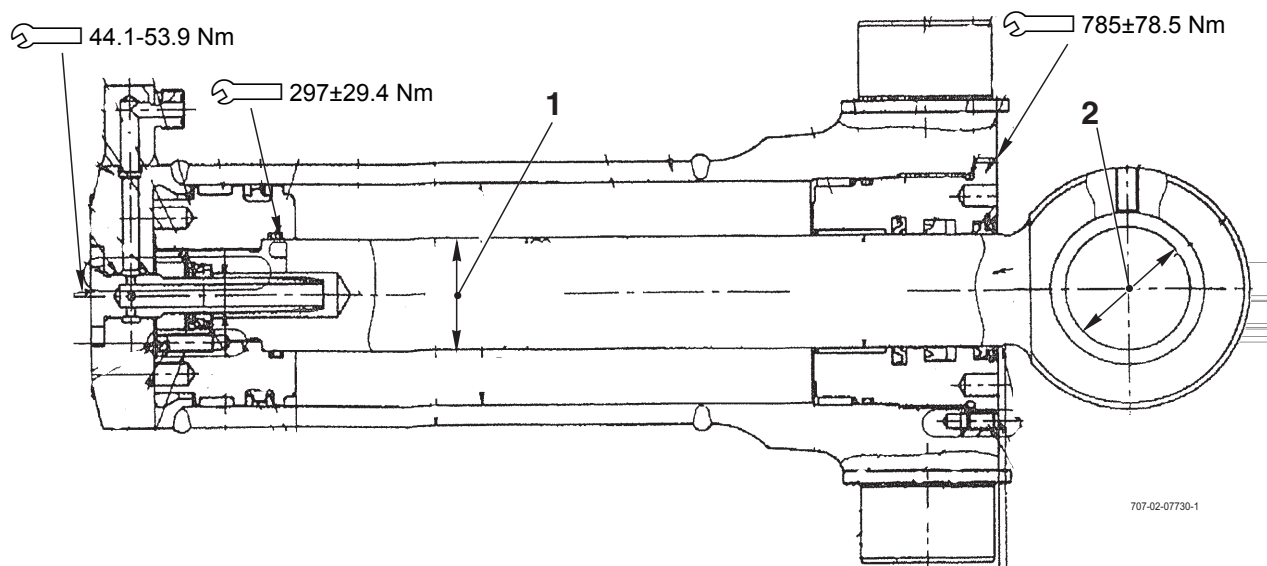
707-00-0y871-1

### BUCKET



707-00-0y901-1

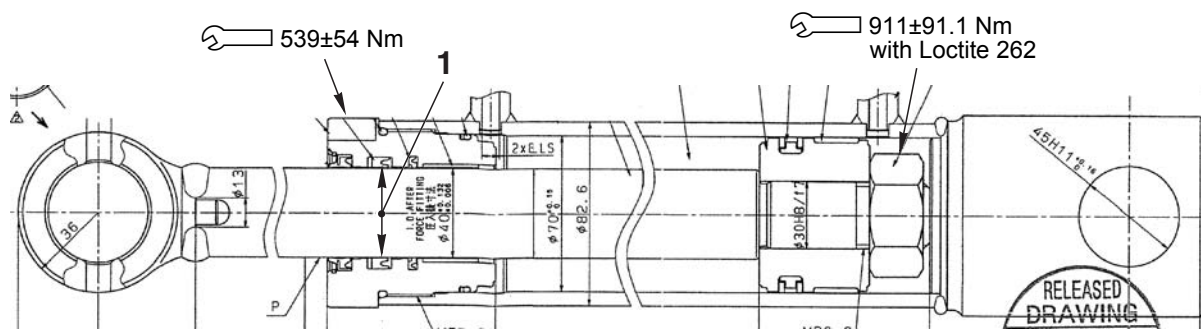
## BOOM SWING



Unit: mm

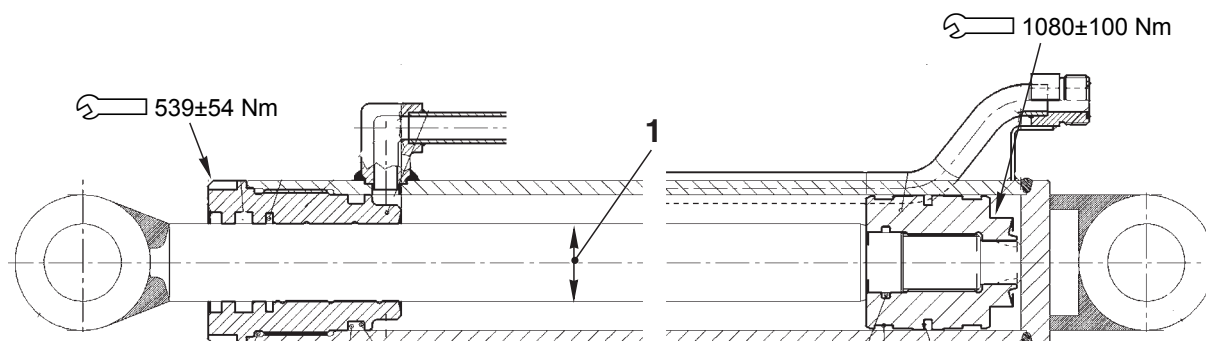
| No. | Check item                                             | Cylinder   | Criteria      |                  |                    |                    |                 | Remedy                  |
|-----|--------------------------------------------------------|------------|---------------|------------------|--------------------|--------------------|-----------------|-------------------------|
|     |                                                        |            | Standard size | Tolerance        |                    | Standard clearance | Clearance limit |                         |
|     |                                                        |            |               | Shaft            | Hole               |                    |                 |                         |
| 1   | Clearance between piston rod and head                  | Boom       | 60            | -0.030<br>-0.076 | + 0.051<br>+ 0.005 | 0.035              | 0.227           | Replace                 |
|     |                                                        | Arm        | 55            | -0.030<br>-0.076 | + 0.046<br>0       | 0.030              | 0.132           |                         |
|     |                                                        | Bucket     | 55            | -0.030<br>-0.076 | + 0.051<br>+ 0.005 | 0.035              | 0.227           |                         |
|     |                                                        | Boom swing | 50            | -0.030<br>-0.076 | + 0.164<br>+ 0.007 | 0.037              | 0.240           |                         |
| 2   | Tolerance between bushing and piston head mounting pin | Boom       | 60            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           | Replace pin and bushing |
|     |                                                        | Arm        | 50            | -0.050<br>-0.089 | + 0.142<br>+ 0.080 | 0.130              | 0.231           |                         |
|     |                                                        | Bucket     | 45            | -0.050<br>-0.089 | + 0.142<br>+ 0.080 | 0.130              | 0.231           |                         |
|     |                                                        | Boom swing | 55            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           |                         |
| 3   | Tolerance between bushing and cylinder mounting pin    | Boom       | 60            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           |                         |
|     |                                                        | Arm        | 60            | -0.060<br>-0.106 | + 0.174<br>+ 0.100 | 0.160              | 0.280           |                         |
|     |                                                        | Bucket     | 45            | -0.050<br>-0.089 | + 0.142<br>+ 0.080 | 0.130              | 0.231           |                         |

## OUTRIGGERS



707-00-0Y0910-1

## JIG ARM



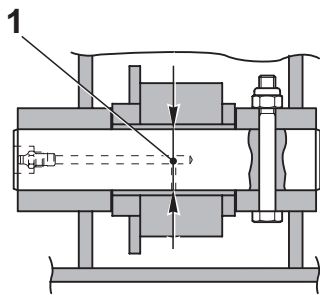
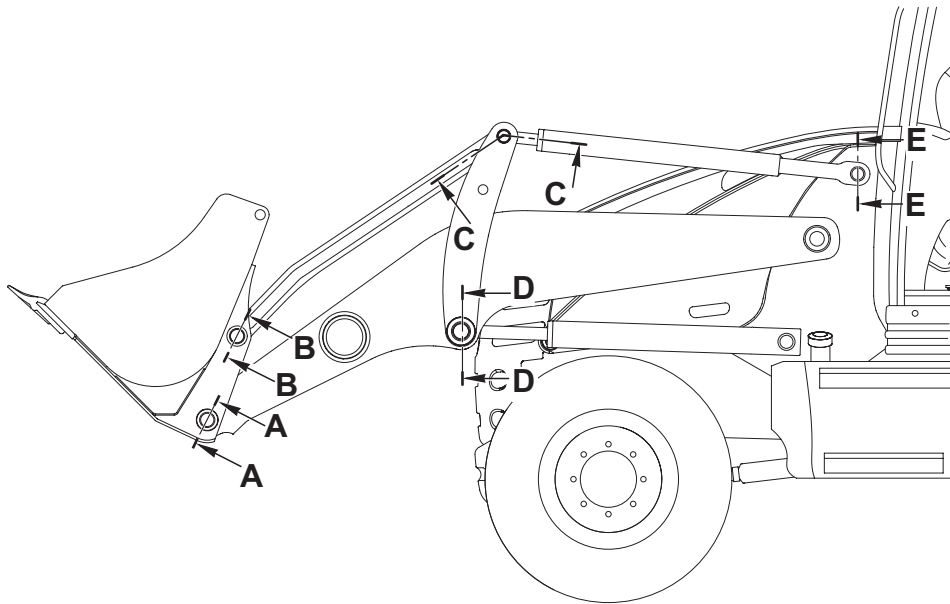
42N-6C-13301-1

Unit: mm

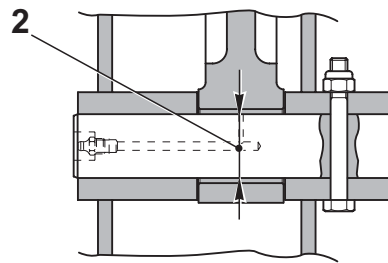
| No. | Check item                            | Cylinder   | Criteria      |                  |                    |                    |                 | Remedy  |
|-----|---------------------------------------|------------|---------------|------------------|--------------------|--------------------|-----------------|---------|
|     |                                       |            | Standard size | Tolerance        |                    | Standard clearance | Clearance limit |         |
|     |                                       |            |               | Shaft            | Hole               |                    |                 |         |
| 1   | Clearance between piston rod and head | Outriggers | 40            | -0.025<br>-0.064 | + 0.132<br>+ 0.006 | 0.031              | 0.196           | Replace |
|     |                                       | Jig arm    | 40            | -0.025<br>-0.050 | + 0.064<br>+ 0.025 | 0.050              | 0.114           |         |

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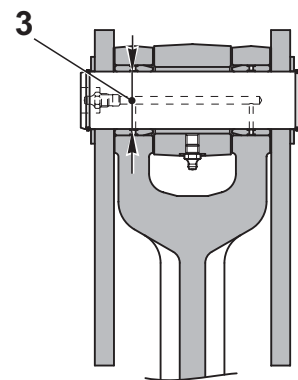
## FRONT WORKING EQUIPMENT



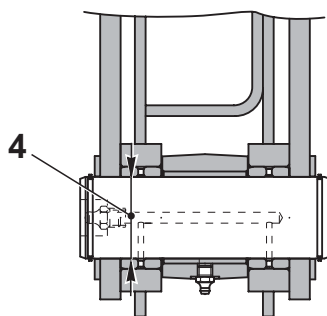
A - A



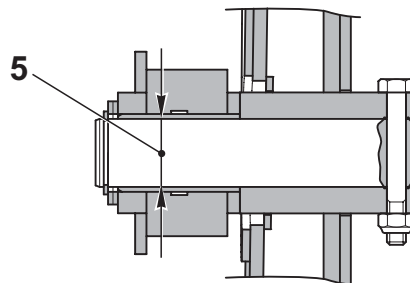
B - B



C - C



D - D



E - E

RKZ10480



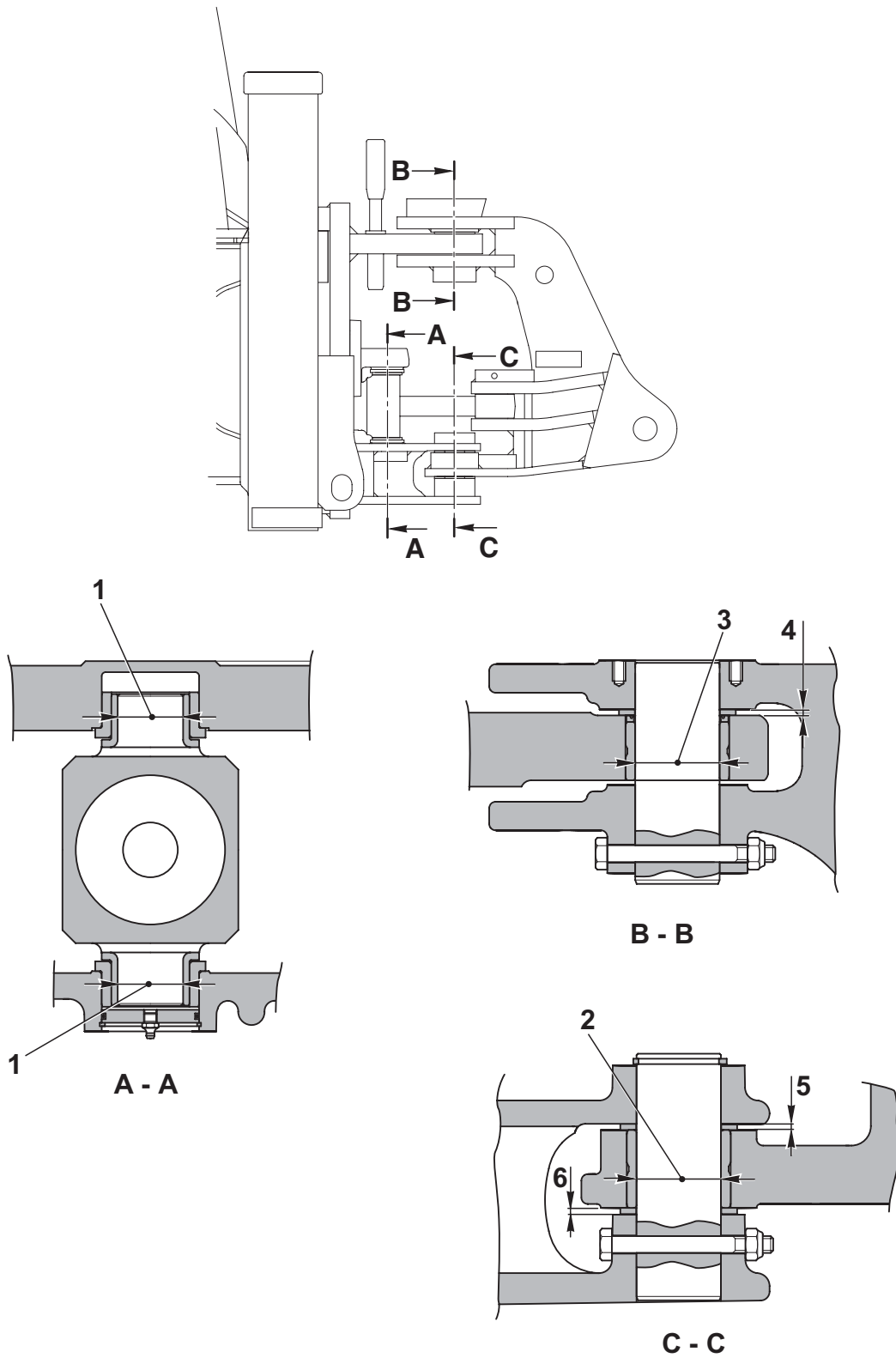
## STANDARD MAINTENANCE

## FRONT WORKING EQUIPMENT

Unit: mm

| No. | Check item                                              | Criteria      |                  |                    |                    |                 | Remedy  |
|-----|---------------------------------------------------------|---------------|------------------|--------------------|--------------------|-----------------|---------|
|     |                                                         | Standard size | Tolerance        |                    | Standard clearance | Clearance limit |         |
|     |                                                         |               | Shaft            | Hole               |                    |                 |         |
| 1   | Clearance between bushings and bucket mounting pin      | 45            | −0.050<br>−0.089 | + 0.080<br>+ 0.240 | 0.130–0.329        |                 | Replace |
| 2   | Clearance between bushing and link mounting pin         | 45            | −0.050<br>−0.089 | + 0.080<br>+ 0.240 | 0.130–0.329        |                 |         |
| 3   | Clearance between bushing and fulcrum link mounting pin | 45            | −0.050<br>−0.089 | + 0.080<br>+ 0.119 | 0.130–0.208        |                 |         |
| 4   | Clearance between bushing and link mounting pin         | 60            | −0.060<br>−0.106 | + 0.137<br>+ 0.197 | 0.143–0.303        |                 |         |
| 5   | Clearance between bushing and boom mounting pin         | 50            | −0.050<br>−0.089 |                    |                    |                 |         |

## SWING BRACKET



RKZ10490

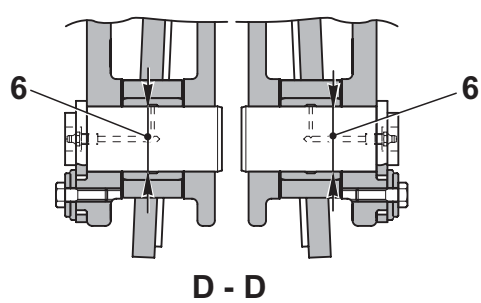
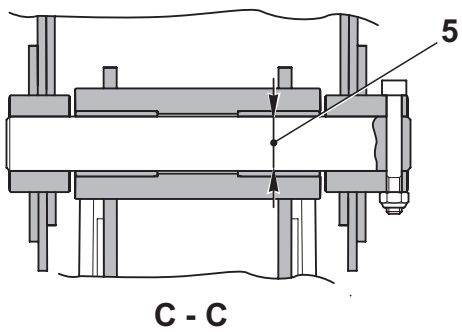
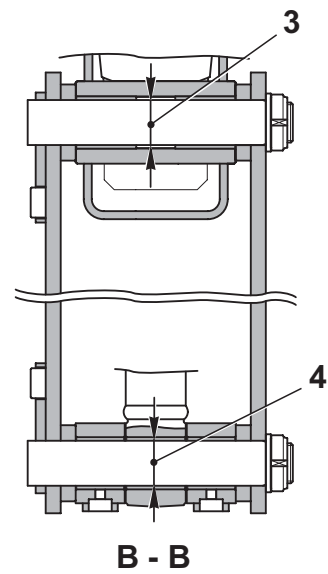
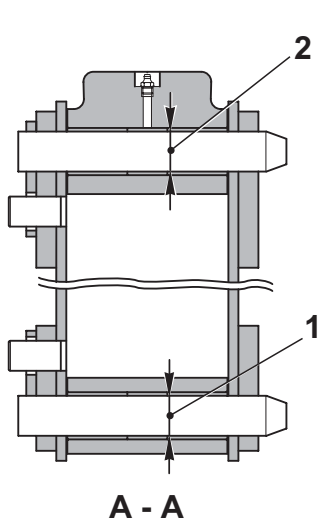
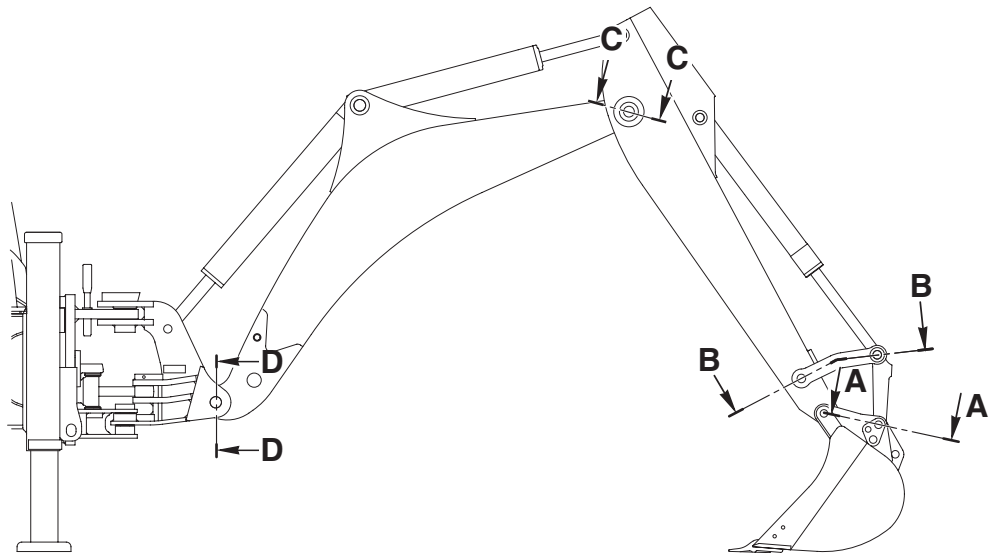
## STANDARD MAINTENANCE

## SWING BRACKET

Unit: mm

| No. | Check item                                                         | Criteria              |                  |                    |                    |                 | Remedy                  |
|-----|--------------------------------------------------------------------|-----------------------|------------------|--------------------|--------------------|-----------------|-------------------------|
|     |                                                                    | Standard size         | Tolerance        |                    | Standard clearance | Clearance limit |                         |
|     |                                                                    |                       | Shaft            | Hole               |                    |                 |                         |
| 1   | Clearance between rotating bushing and boom swing cylinder bushing | 60                    | −0.010<br>−0.085 | + 0.090<br>+ 0.060 | 0.070–0.175        |                 | Replace bushing and pin |
| 2   | Clearance between bushing and (lower) swing bracketrotating pin    | 65                    | −0.060<br>−0.106 | + 0.190<br>+ 0.264 | 0.250–0.370        |                 |                         |
| 3   | Clearance between bushing and (upper) swing bracketrotating pin    | 65                    | −0.060<br>−0.106 | + 0.190<br>+ 0.264 | 0.250–0.370        |                 |                         |
| 4   | Upper shim thickness                                               | Standard size         |                  |                    | Limit size         |                 |                         |
|     |                                                                    | 2.50 <sup>±</sup> 0.1 |                  |                    |                    |                 |                         |
| 5   | Central shim thickness                                             | 4.75 <sup>±</sup> 0.1 |                  |                    |                    |                 |                         |
| 6   | Lower shim thickness                                               | 4.75 <sup>±</sup> 0.1 |                  |                    |                    |                 |                         |

## BACKHOE WORKING EQUIPMENT



RKZ10500

## STANDARD MAINTENANCE

## BACKHOE WORKING EQUIPMENT

Unit: mm

| No. | Check item                                              | Criteria      |                  |                  |                   |                 | Remedy  |
|-----|---------------------------------------------------------|---------------|------------------|------------------|-------------------|-----------------|---------|
|     |                                                         | Standard size | Tolerance        |                  | Minimum clearance | Clearance limit |         |
|     |                                                         |               | Shaft            | Hole             |                   |                 |         |
| 1   | Clearance between link bushings and bucket mounting pin | 45            | −0.050<br>−0.089 | −0.080<br>−0.240 | 0.130–0.329       |                 | Replace |
| 2   | Clearance between arm bushings and bucket mounting pin  | 45            | −0.050<br>−0.089 | −0.080<br>−0.240 | 0.130–0.329       |                 |         |
| 3   | Clearance between arm bushings and lever mounting pin   | 45            | −0.050<br>−0.089 | −0.080<br>−0.240 | 0.130–0.329       |                 |         |
| 4   | Clearance between bushings and tilt lever mounting pin  | 45            | −0.050<br>−0.089 | −0.080<br>−0.240 | 0.130–0.329       |                 |         |
| 5   | Clearance between bushings and arm mounting pin         | 50            | −0.050<br>−0.089 | −0.080<br>−0.119 | 0.130–0.208       |                 |         |
| 6   | Clearance between bushings and boom mounting pin        | 60            | −0.060<br>−0.106 | −0.137<br>−0.197 | 0.197–0.303       |                 |         |



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# 90 VARIE

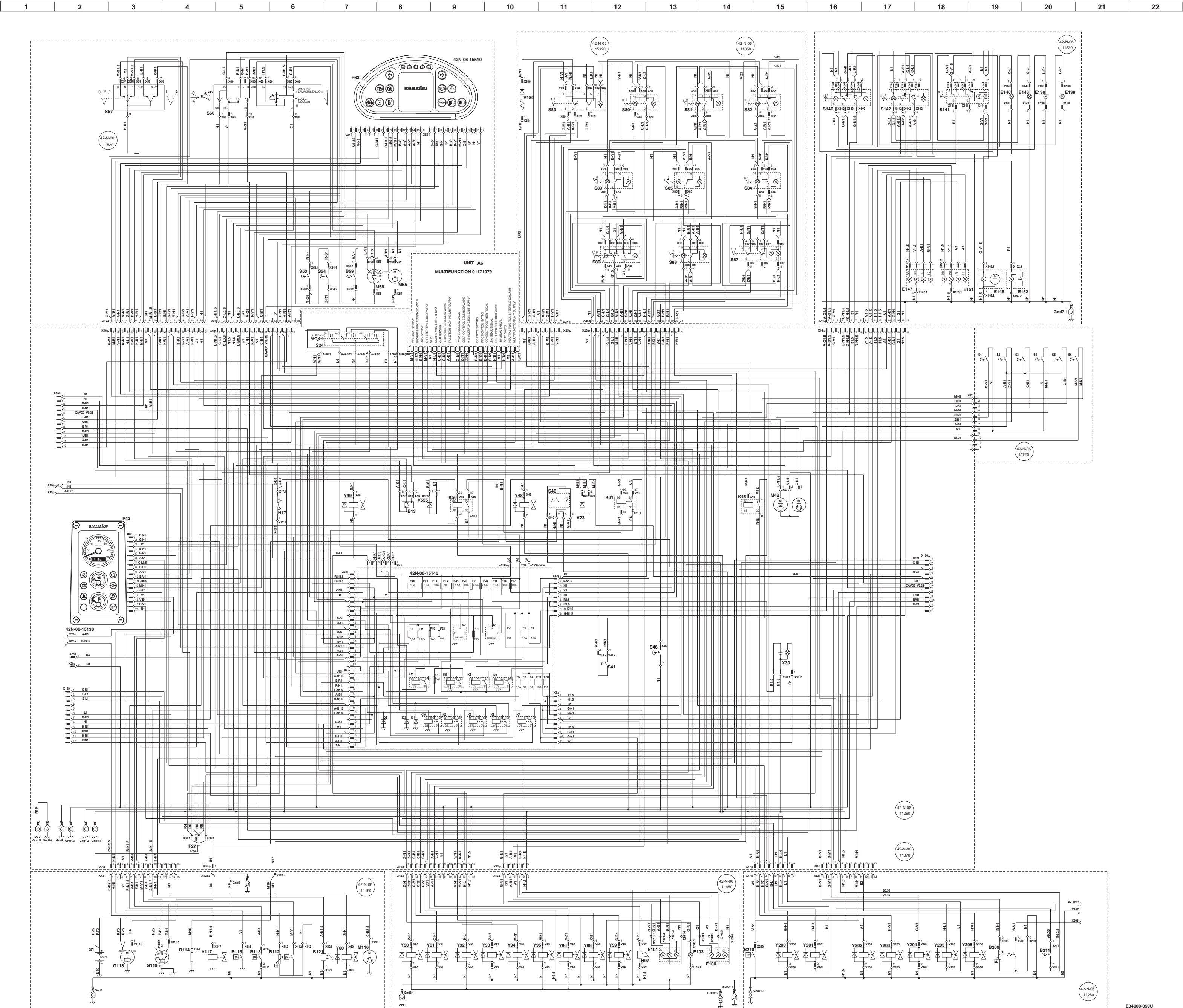
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SCHEMA ELETTRICO (VERSIONE STANDARD) ... 3





ELECTRICAL DIAGRAM (STANDARD VERSION)



| Nome/Item | Descrizione           | Description           | KUE P/N |
|-----------|-----------------------|-----------------------|---------|
| 1         | FUNCTION MACHINE UNIT | FUNCTION MACHINE UNIT |         |
| 2         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 3         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 4         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 5         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 6         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 7         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 8         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 9         | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 10        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 11        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 12        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 13        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 14        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 15        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 16        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 17        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 18        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 19        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 20        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 21        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |
| 22        | RETURN TO FUSE BINDER | RETURN TO FUSE BINDER |         |





