WEBM005800

SHOP MANUAL

WB93R-5

BACKHOE-LOADER

SERIAL NUMBER

WB93R-5 F50003 and up

KOMATSU

Utility

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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 suck 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 in 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 particulary 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.

FOREWORD

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 sections 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.

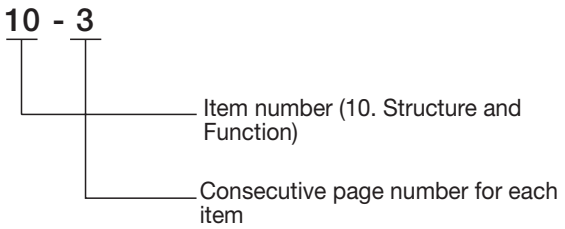
HOW TO READ THE SHOP MANUAL

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

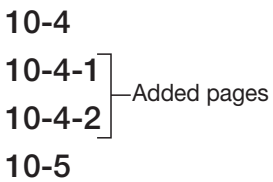
DISTRIBUTION AND UPDATING
Any additions, amendments or other changes will be sent to Komatsu distributors.
Get the most up-to-date information before you start any work.

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:



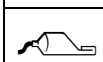
3. Additional pages: additional pages are indicated by a hyphen (–) and number after the page number. FIe as in the example.
   Example:



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 chelpful, 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

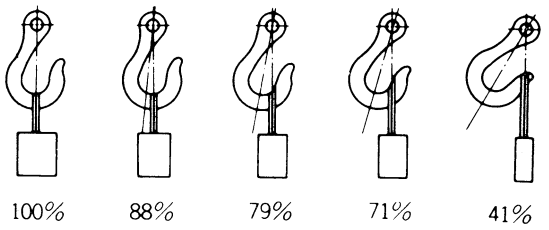
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

WIRE ROPES (Standard «S» or «Z» twist ropes 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.

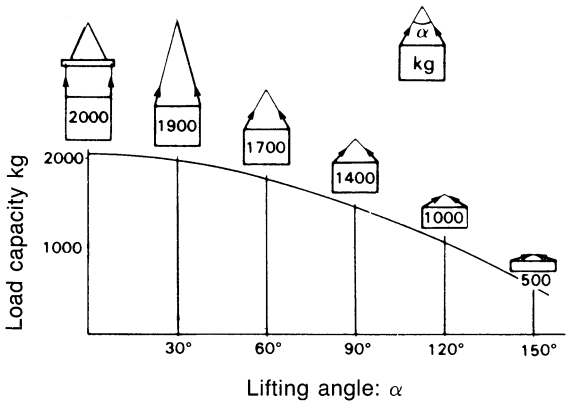
Hooks have maximum strength at the middle portion.



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 handing 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».

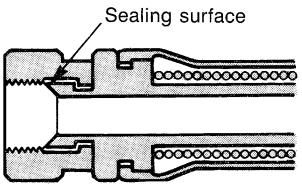
1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUT

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.

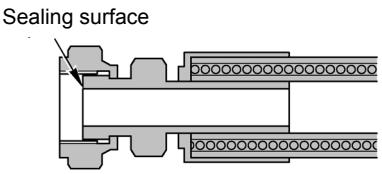
★ **Nm (newton meter): 1 Nm = 0.102 kgm**

2. TIGHTENING TORQUE FOR NUTS OF FLARED

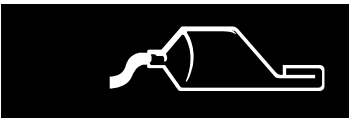


Use these torques for nut part of flared.

Thread diameter of nut part (mm)	Width across flats of nut part (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 of nut part (mm)	Width across flats of nut part (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 (Clearance between surfaces within 0.2 mm)
	Loctite 518	Used by itself on mounting flat surface (Clearance between surfaces within 0.5 mm
Antifriction compound (Lubricant including Molybdenum disulfide)	ASL800040	Applied to bearings and taper shaft to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (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	WB93R-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	232
Front axle	295
Rear axle	435
Front wheel Rear wheel	
Work equipment • Boom • Shovel • Fulcrum lever • Tilt lever • Raise cylinder • Tilt cylinder	1100 313 436 13x4 32.5x2 46x2 35x2
Work equipment • with standard arm • with long arm • with jig arm	 850 885 1030
Boom	248
Arm	
Long arm	
Boom swing bracket	162.5
Backframe	246
Control valve (8-spool)	
Control valve (10-spool)	
Control valve (8-spool)	460
Jig arm	39x2
Outriggers	87.5
Boom cylinder	67
Arm cylinder	52.5
Bucket cylinder	27.5x2
Outriggers cylinder	34x2
Swing cylinder	158

TABLE OF OIL AND COOLANT QUANTITIES

TANK / RESERVOIR	FLUID	AMBIENT TEMPERATURE -30 -20 -10 0 10 20 30 40 50 °C	CAPACITY (l)	
			1st filling	Change
Engine oil pan	OIL ACEA E5 - E4	SAE 5W-30	13	13
	OIL API CI-4 ACEA E7	SAE 15W-40		
Hydraulic system	OIL API CF - CF2 - CD	SAE 10W-30	98	40
Hydraulic system with biodegradable oil			98	40
Front axle: Differential	OIL 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 DEXRON® II D (DEXRON® is a registered trademark of General Motors Corporation)		20	20
Braking system			0.8	0.8
Fuel tank	DIESEL OIL	★ ASTM D975 N. 2	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%).

ASTM: America Society of Testing and Materials
SAE: Society of Automotive Engineers
API: American Petroleum Institute
MIL: Military Specification
CCMC: Common Market Constructors Committe

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 then 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 Ⓐ, then drow a horizontal line from Ⓐ.

2 - Locate the number 5 in the row across the top, take this as , then draw a perpendicular line down from Ⓑ.

3 - Take the point where the two lines cross as Ⓒ. This point Ⓒ 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

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

From liter to U.S. Gall.

1 ℓ = 0.2642 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 ℓ = 0.21997 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	7.969	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	12.257	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

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	82.645	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

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

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

From bar to psi (lb/in^2)

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

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.

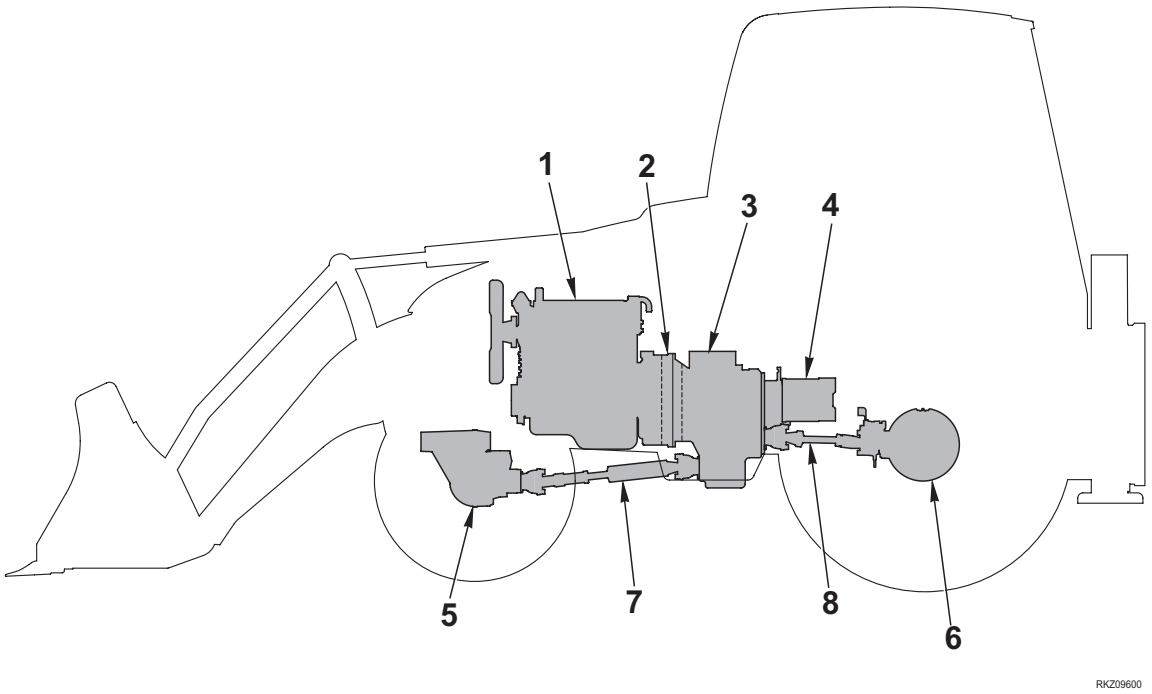
1 °C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
–40.4	**–40**	–40.0	–11.7	**11**	51.8	7.8	**46**	144.8	27.2	**81**	117.8
–37.2	**–35**	–31.0	–11.1	**12**	53.6	8.3	**47**	116.6	27.8	**82**	179.6
–34.4	**–30**	–22.0	–10.6	**13**	55.4	8.9	**48**	118.4	28.3	**83**	181.4
–31.7	**–25**	–13.0	–10.0	**14**	57.2	9.4	**49**	120.2	28.9	**84**	183.2
–28.9	**–20**	–4.0	–9.4	**15**	59.0	10.0	**50**	122.0	29.4	**85**	185.0
–28.3	**–19**	–2.2	–8.9	**16**	60.8	10.6	**51**	123.8	30.0	**86**	186.8
–27.8	**–18**	–0.4	–8.3	**17**	62.6	11.1	**52**	125.6	30.6	**87**	188.6
–27.2	**–17**	1.4	–7.8	**18**	64.4	11.7	**53**	127.4	31.1	**88**	190.4
–26.7	**–16**	3.2	–7.2	**19**	66.2	12.2	**54**	129.2	31.7	**89**	192.2
–26.1	**–15**	5.0	–6.7	**20**	68.0	12.8	**55**	131.0	32.2	**90**	194.0
–25.6	**–14**	6.8	–6.1	**21**	69.8	13.3	**56**	132.8	32.8	**91**	195.8
–25.0	**–13**	8.6	–5.6	**22**	71.6	13.9	**57**	134.6	33.3	**92**	197.6
–24.4	**–12**	10.4	–5.0	**23**	73.4	14.4	**58**	136.4	33.9	**93**	199.4
–23.9	**–11**	12.2	–4.4	**24**	75.2	15.0	**59**	138.2	34.4	**94**	201.2
–23.3	**–10**	14.0	–3.9	**25**	77.0	15.6	**60**	140.0	35.0	**95**	203.0
–22.8	**–9**	15.8	–3.3	**26**	78.8	16.1	**61**	141.8	35.6	**96**	204.8
–22.2	**–8**	17.6	–2.8	**27**	80.6	16.7	**62**	143.6	36.1	**97**	206.6
–21.7	**–7**	19.4	–2.2	**28**	72.4	17.2	**63**	145.4	36.7	**98**	208.4
–21.1	**–6**	21.2	–1.7	**29**	84.2	17.8	**64**	147.2	37.2	**99**	210.2
–20.6	**–5**	23.0	–1.1	**30**	86.0	18.3	**65**	149.0	37.8	**100**	212.0
–20.0	**–4**	24.8	–0.6	**31**	87.8	18.9	**66**	150.8	40.6	**105**	221.0
–19.4	**–3**	26.6	0.0	**32**	89.6	19.4	**67**	152.6	43.3	**110**	230.0
–18.9	**–2**	28.4	0.6	**33**	91.4	20.0	**68**	154.4	46.1	**115**	239.0
–18.3	**–1**	30.2	1.1	**34**	93.2	20.6	**69**	156.2	48.9	**120**	248.0
–17.8	**0**	32.0	1.7	**35**	95.0	21.1	**70**	158.0	51.7	**125**	257.0
–17.2	**1**	33.8	2.2	**36**	96.8	21.7	**71**	159.8	54.4	**130**	266.0
–16.7	**2**	35.6	2.8	**37**	98.6	22.2	**72**	161.6	57.2	**135**	275.0
–16.1	**3**	37.4	3.3	**38**	100.4	22.8	**73**	163.4	60.0	**140**	284.0
–15.6	**4**	39.2	3.9	**39**	102.2	23.3	**74**	165.2	62.7	**145**	2930
–15.0	**5**	41.0	4.4	**40**	104.0	23.9	**75**	167.0	65.6	**150**	302.0
–14.4	**6**	42.8	5.0	**41**	105.8	24.4	**76**	168.8	68.3	**155**	311.0
–13.9	**7**	44.6	5.6	**42**	107.6	25.0	**77**	170.6	71.1	**160**	320.0
–13.3	**8**	46.4	6.1	**43**	109.4	25.6	**78**	172.4	73.9	**165**	329.0
–12.8	**9**	48.2	6.7	**44**	111.2	26.1	**79**	174.2	76.7	**170**	338.0
–12.2	**10**	50.0	7.2	**45**	113.0	26.7	**80**	176.0	79.4	**175**	347.0

10 STRUCTURE AND FUNCTION

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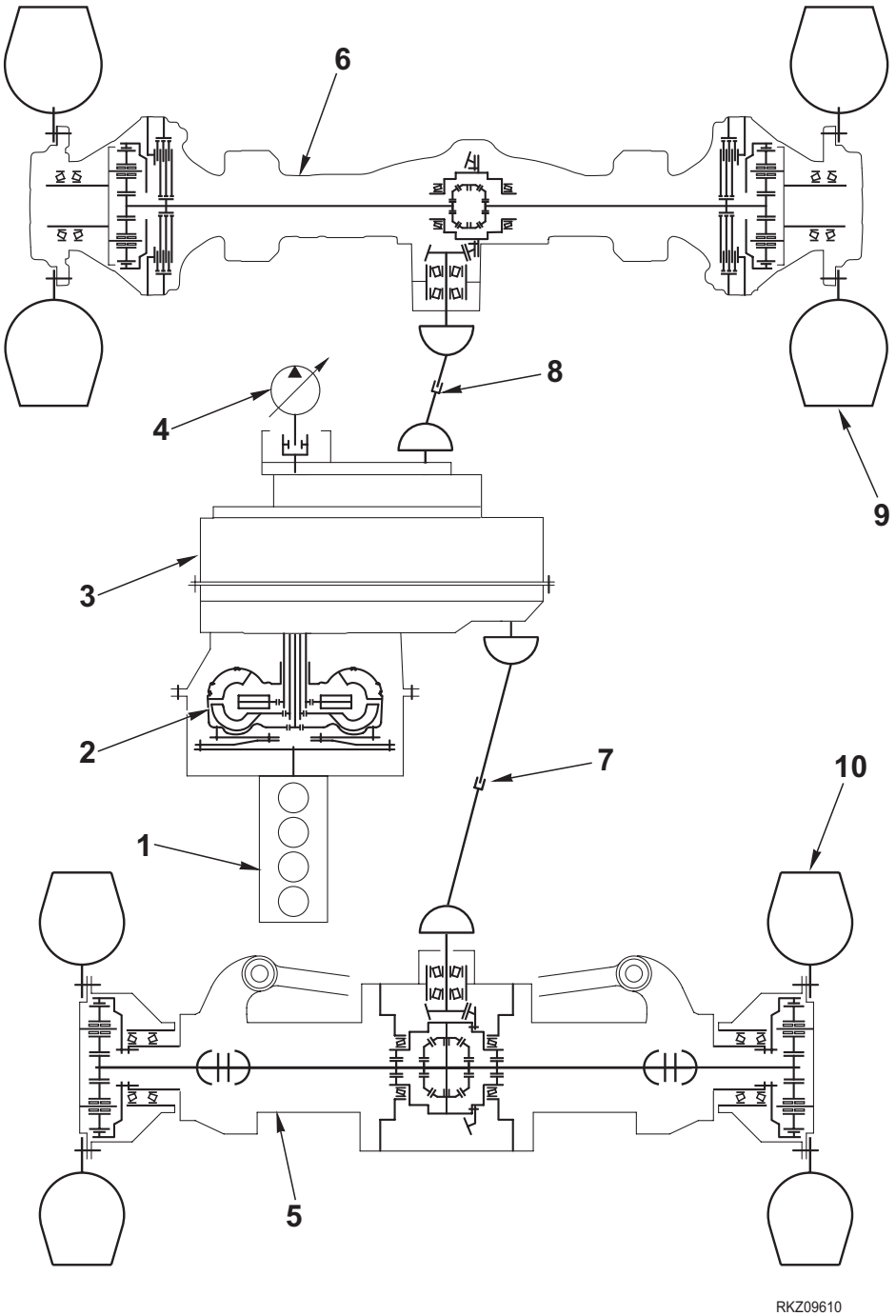
POWER TRAIN



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) has two hydraulically-activated clutches that can be selected by an electrically-controlled gear selector.
  It also has manual gear selection (four forward gears and four reverse gears).
- The driving power is transmitted from the transmission flanges (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.

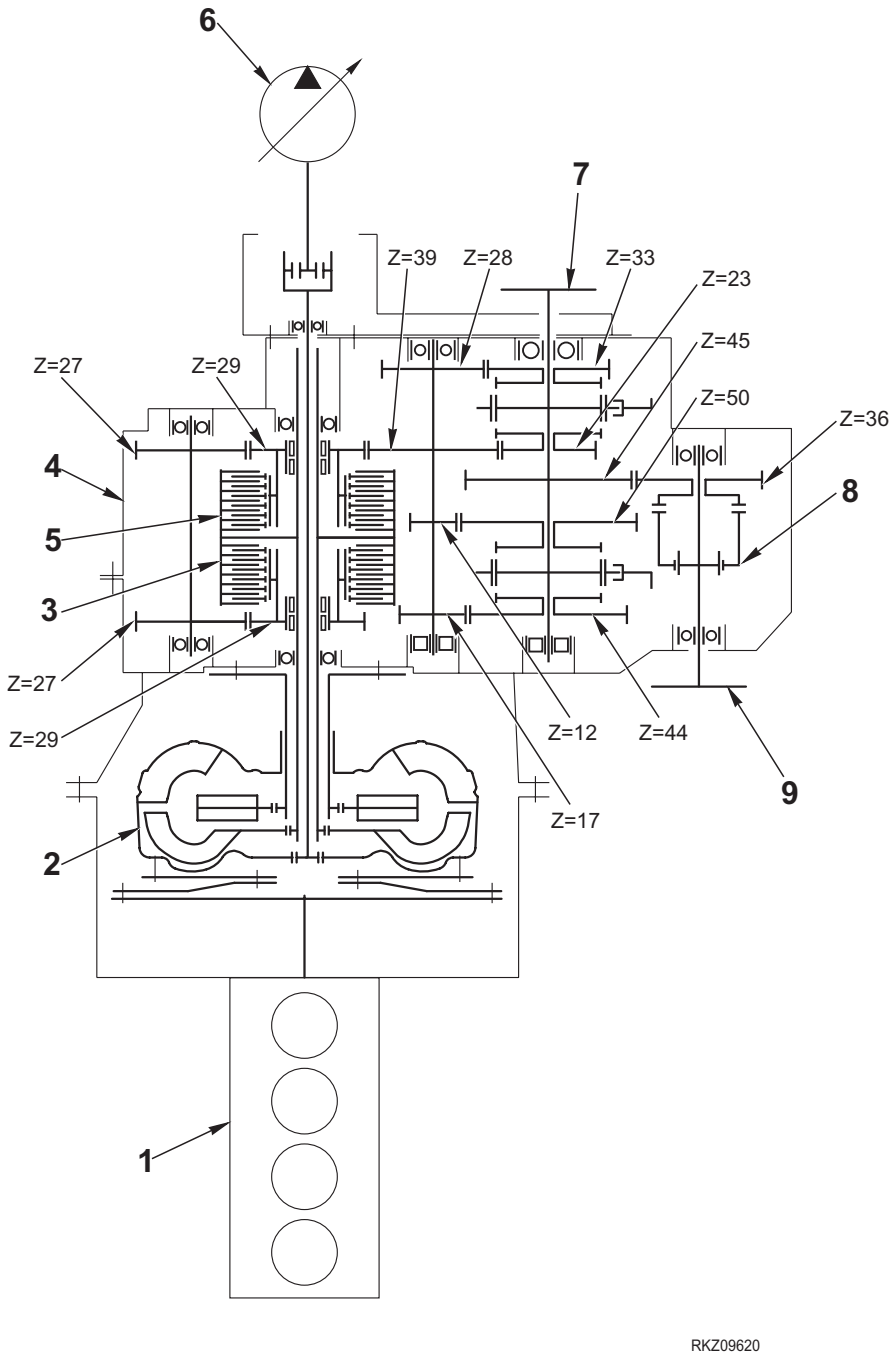
Gears	Front axle				Rear axle			
	Transmission	Differential	Planetary	Total	Transmission	Differential	Planetary	Total
1st gear	5.533	2.462	6.00	81.722	5.533	2.75	6.40	97.338
2nd gear	3.360			49.627	3.360			59.136
3rd gear	1.532			22.627	1.532			26.963
4th gear	0.810			11.963	0.810			14.256



1. Diesel engine
2. Convertor
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

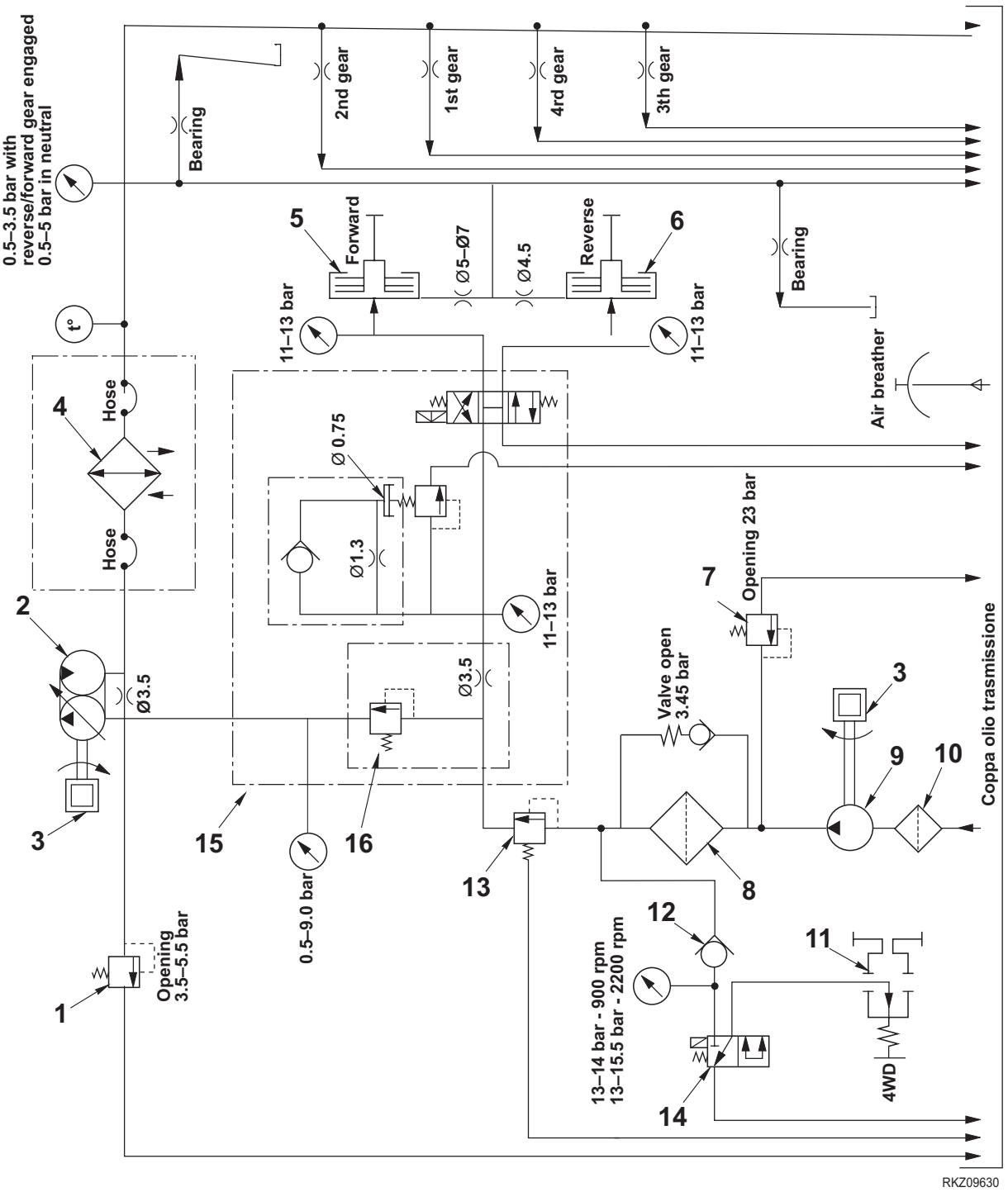
TRANSMISSION (4WD)

Diagram of the power train



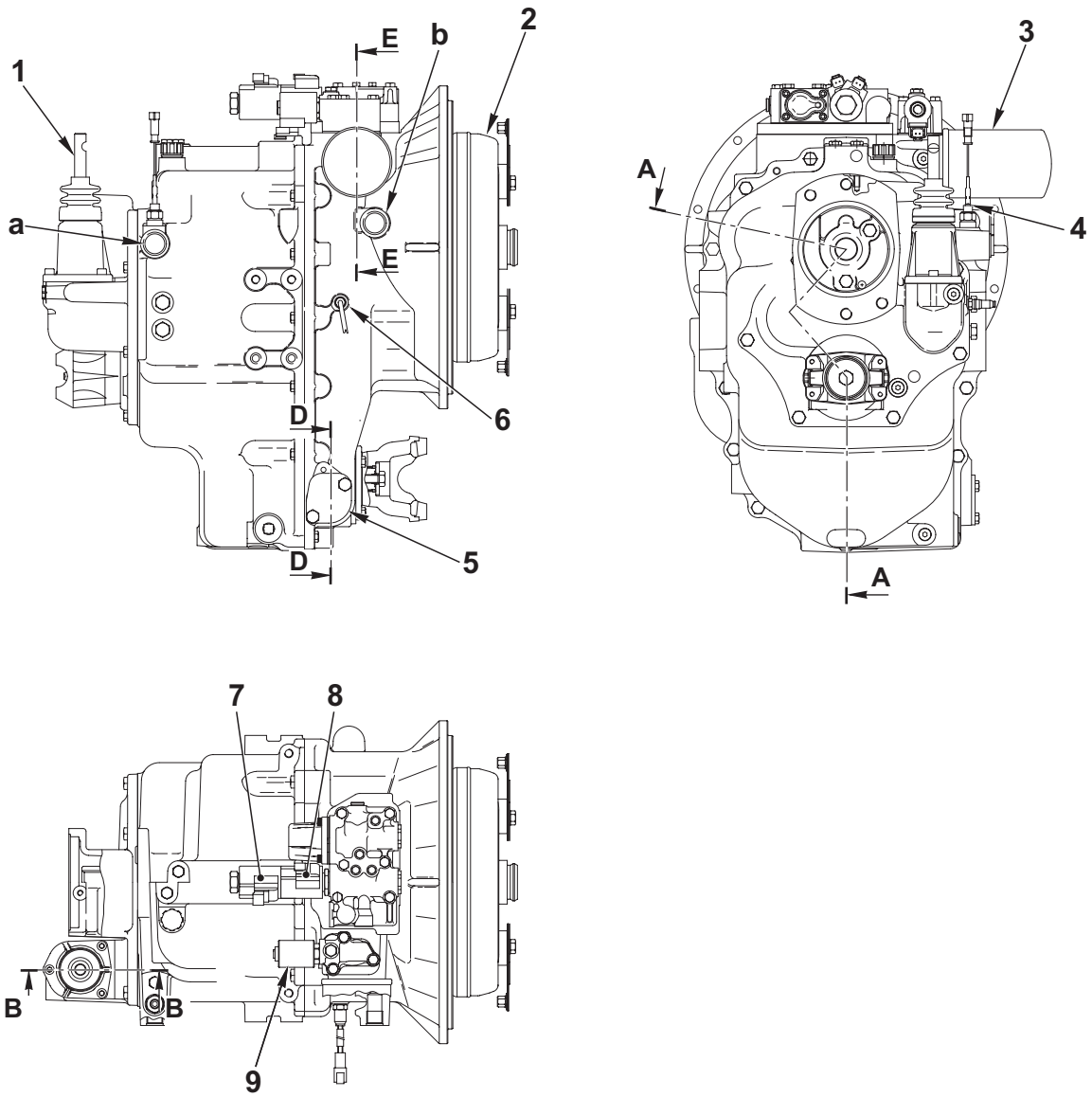
1. Diesel engine
2. Convertor
3. Forward clutch
4. Transmission
5. Reverse clutch
6. Hydraulic pump
7. Rear flange
8. 4WD engagement device
9. Front flange

Hydraulic convertor-transmission circuit diagram



1. Convertor pressurization valve
2. Convertor
3. Diesel engine
4. Oil cooler
5. Forward clutch
6. Reverse clutch
7. Max. pressure valve: calib. 23 bar
8. Spin-on filter (10 µm)
9. Pump
10. Suction filter (250 µm)
11. 4WD engagement device
12. Check valve
13. Pressure control
14. 4WD engagement solenoid
15. Control valve group
16. Oil flow divider/pressure regulator valve

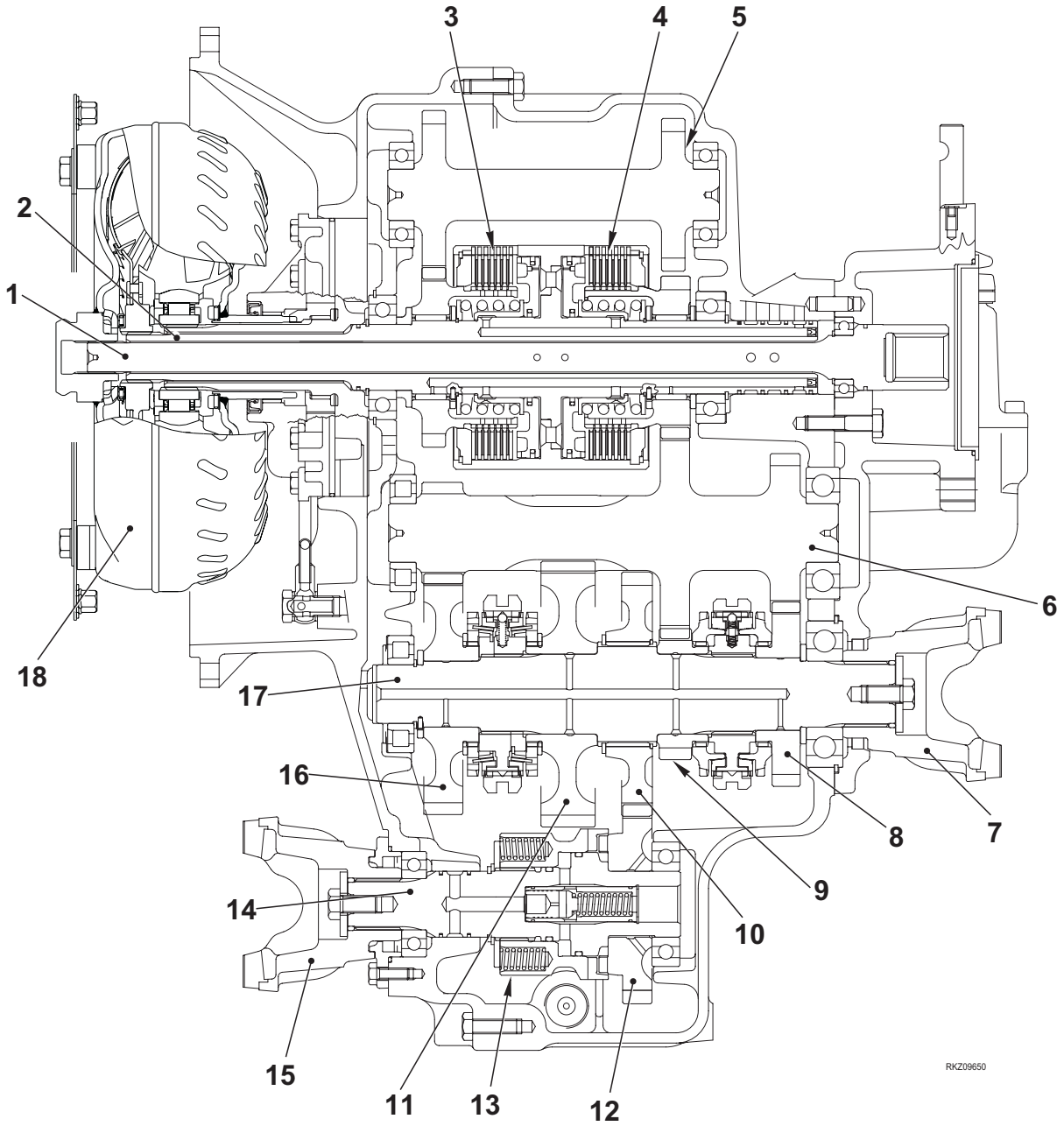
TRANSMISSION



RKZ09640

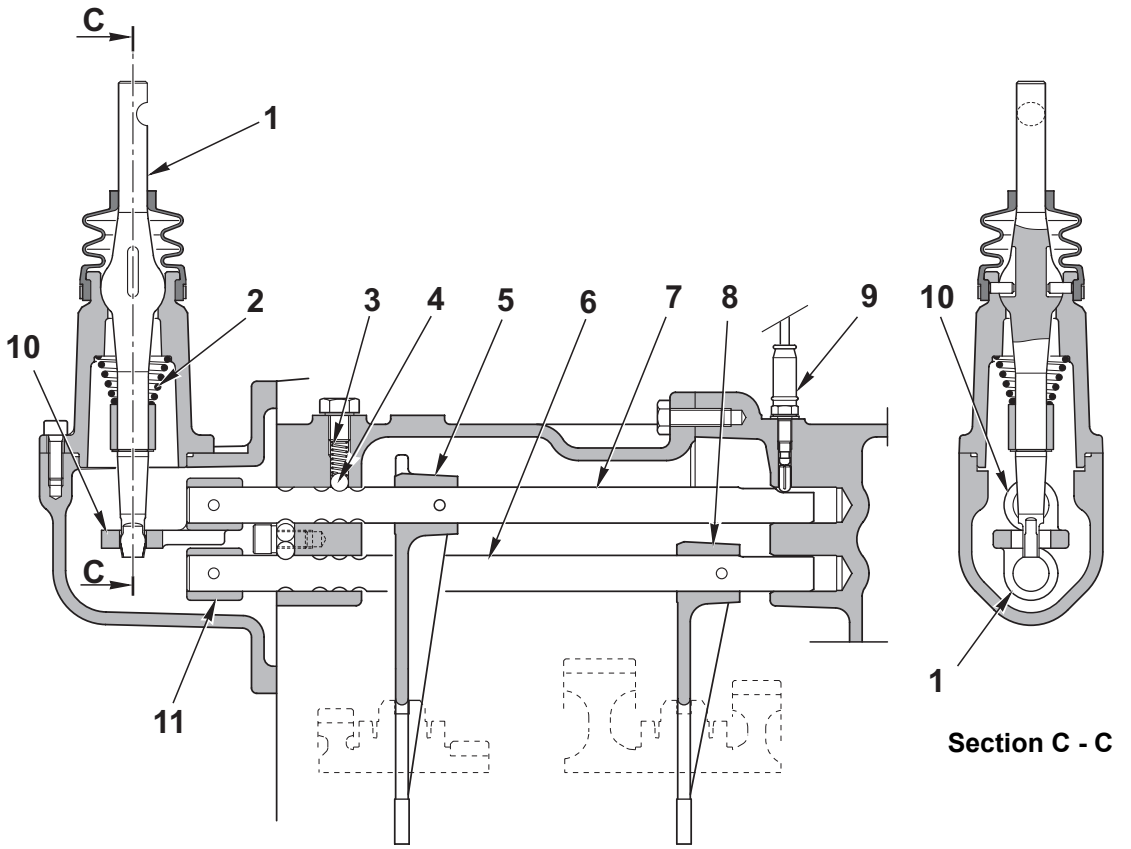
a. From the oil cooler
b. To the oil cooler

1. Gear lever
2. Convertor
3. Filter
4. Oil temperature sensor
5. Suction filter
6. 4th gear selecting sensor
7. Y203 Reverse gears command solenoid valve
8. Y108 Forward gears command solenoid valve
9. Y106 4WD engagement solenoid valve



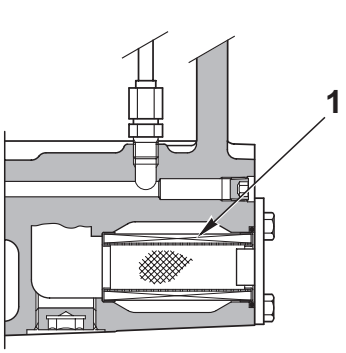
Section A - A

1. Hydraulic pump drive shaft
2. Transmission drive shaft
3. Reverse clutch
4. Forward clutch
5. Reverse gears idler shaft
6. Drive shaft
7. Flange
8. 3rd gear driven gear
9. 4th gear driven gear
10. 4WD drive gear
11. 1st gear driven gear
12. 4WD driven gear
13. 4WD engagement device
14. Front output shaft
15. Flange
16. 2nd gear driven gear
17. Rear output shaft
18. Convertor

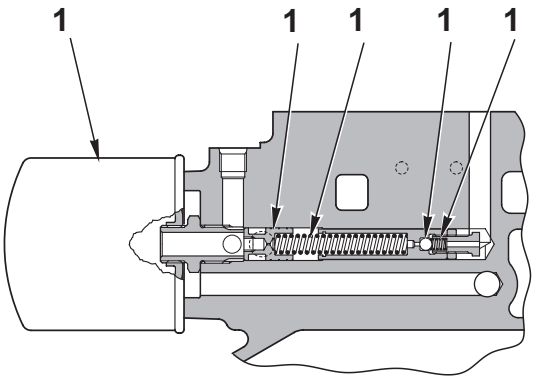


Section B - B

Section C - C



Section D - D



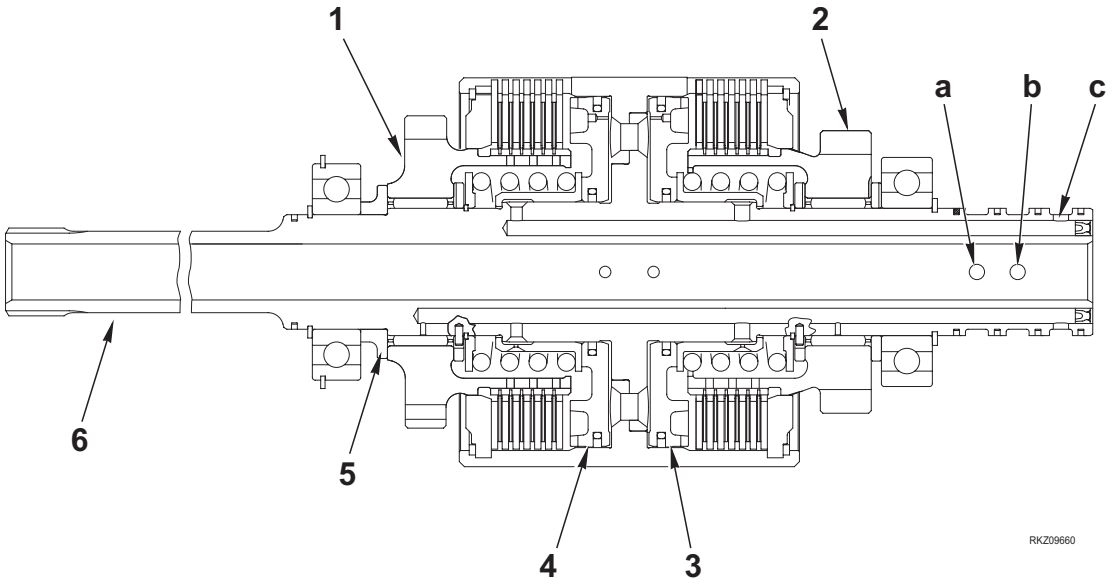
Section E - E

RKZ00991

1. Gear-shift piston
2. Spring
3. Spring
4. Ball
5. 3rd and 4th gear selecting fork
6. 1st and 2nd gear selector piston
7. 3rd and 4th gear selector piston
8 1st and 2nd gear selecting fork
9. 4th gear selecting sensor
10. 3rd and 4th gear selecting fork
11. 1st and 2nd gear selecting fork
12. Suction filter (250 μm)
13. Spin-on filter (10 μm)
14. Valve
15. Spring
16. Ball
17. Spring

DRIVE SHAFTS

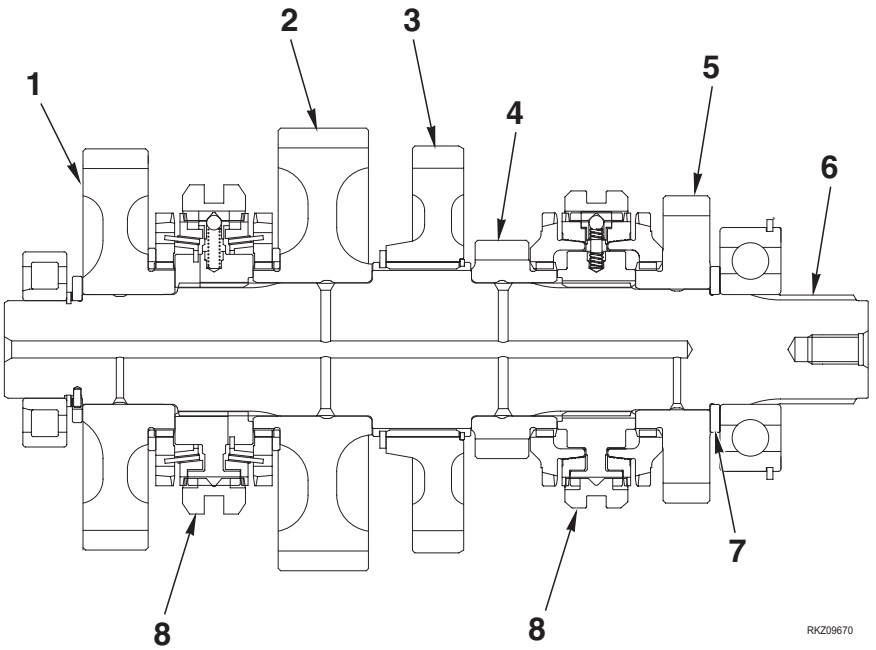
Drive shaft for forward and reverse movement



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

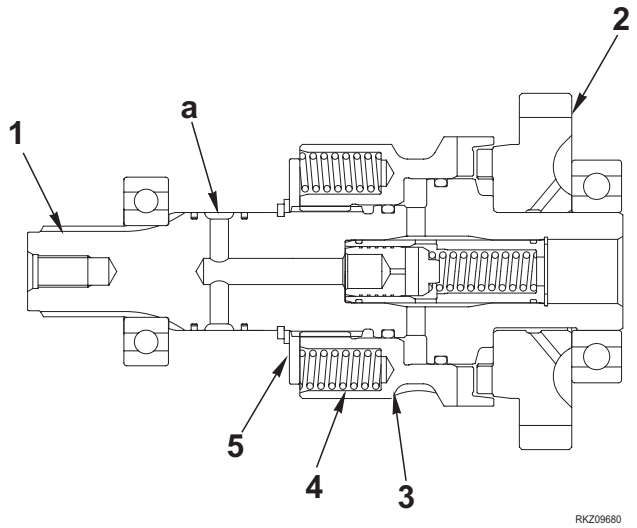
1. Reverse gear clutch (Z=29)
2. Forward gear clutch (Z=29)
3. Forward clutch piston
4. Reverse clutch piston
5. Shoulder ring
6. Driven shaft

Driven gear shaft



1. 2nd gear driven gear (Z=44)
2. 1st gear driven gear (Z=50)
3. 4WD drive gear (Z=45)
4. 4th gear driven gear (Z=23)
5. 3rd gear driven gear (Z=33)
6. Rear output shaft
7. Shoulder ring
8. Synchronizer

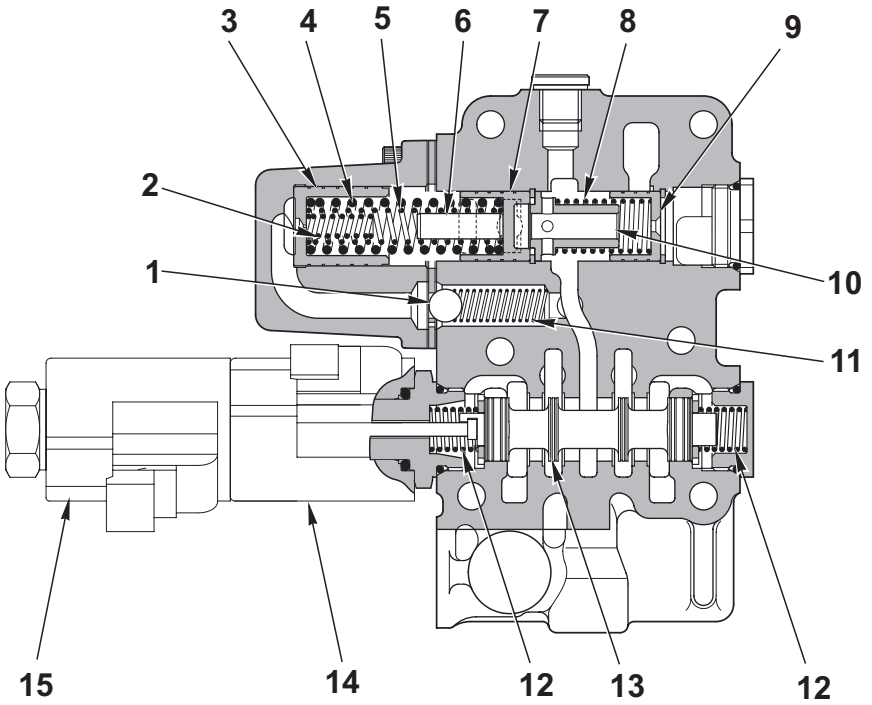
4WD driven shaft



a. 4WD disengagement command port

1. Front output shaft
2. 4WD gear driven (Z=36)
3. Cylinder
4. Spring
5. Disk

CONTROL VALVE BLOCK



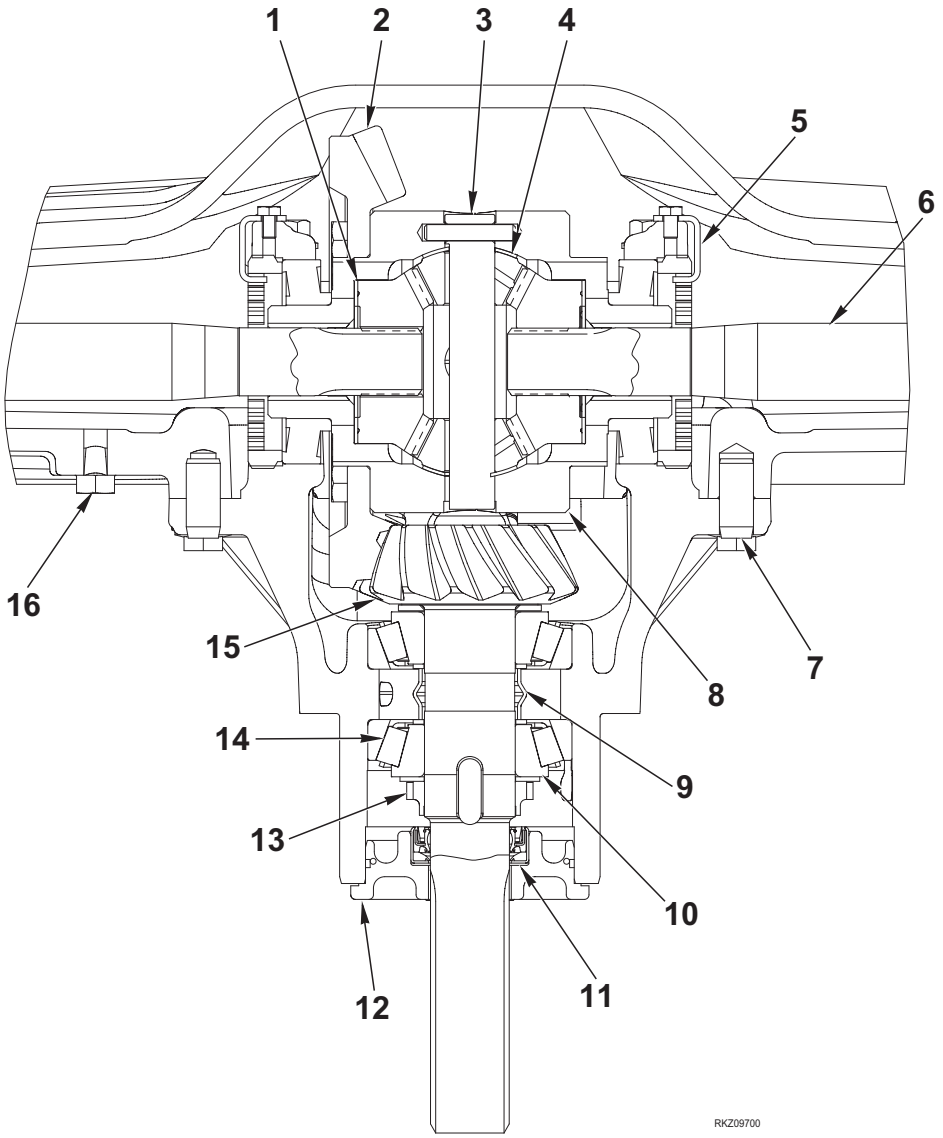
Section F - F

RKZ09690

1. Ball
2. Spring
3. Piston
4. Spring
5. Spring
6. Spring-guide pin
7. Valve
8. Spring
9. Valve
10. Piston rod
11. Spring
12. Spool return spring
13. Spool
14. Forward gear command solenoid
15. Reverse gear command solenoid

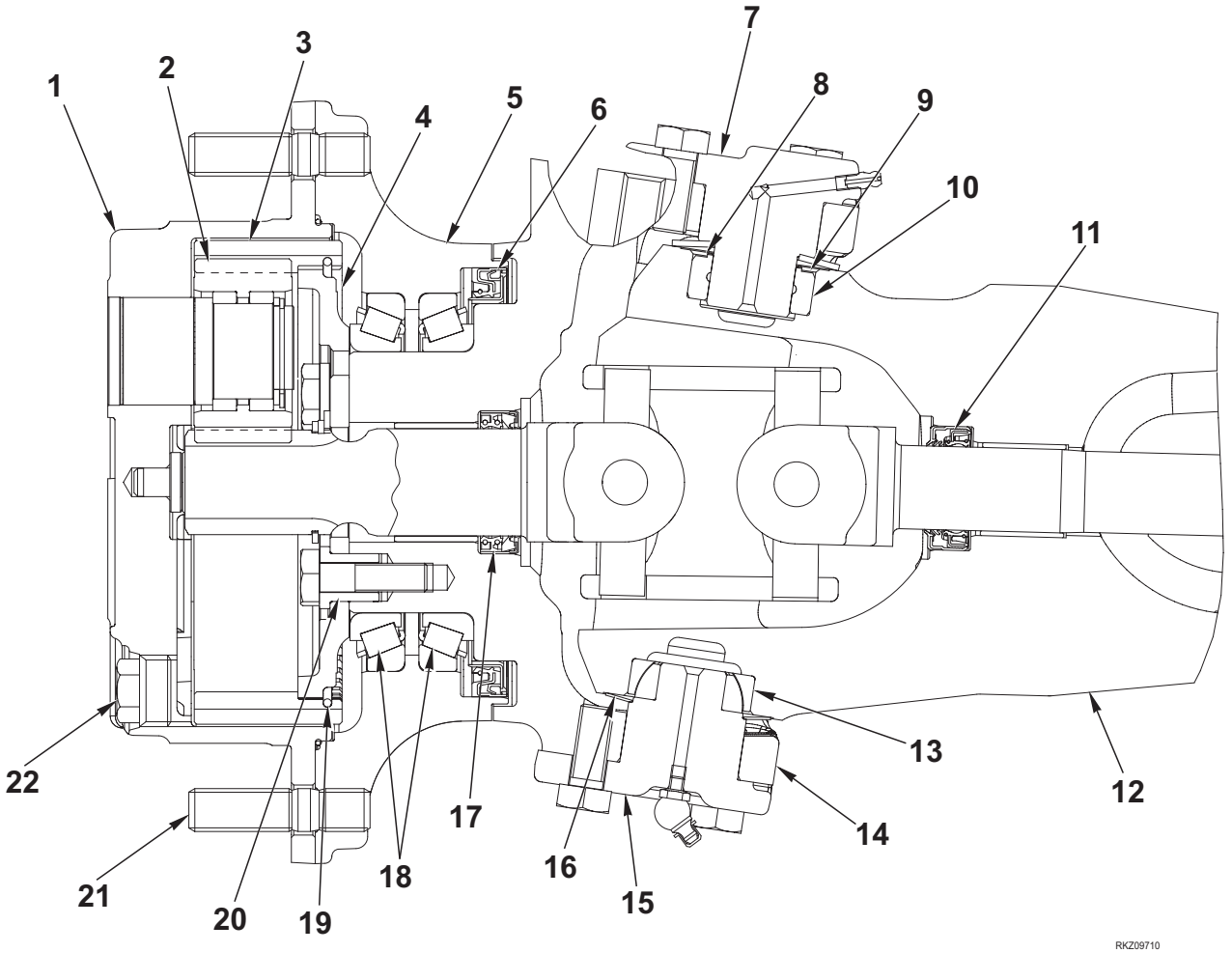
FRONT AXLE

Differential



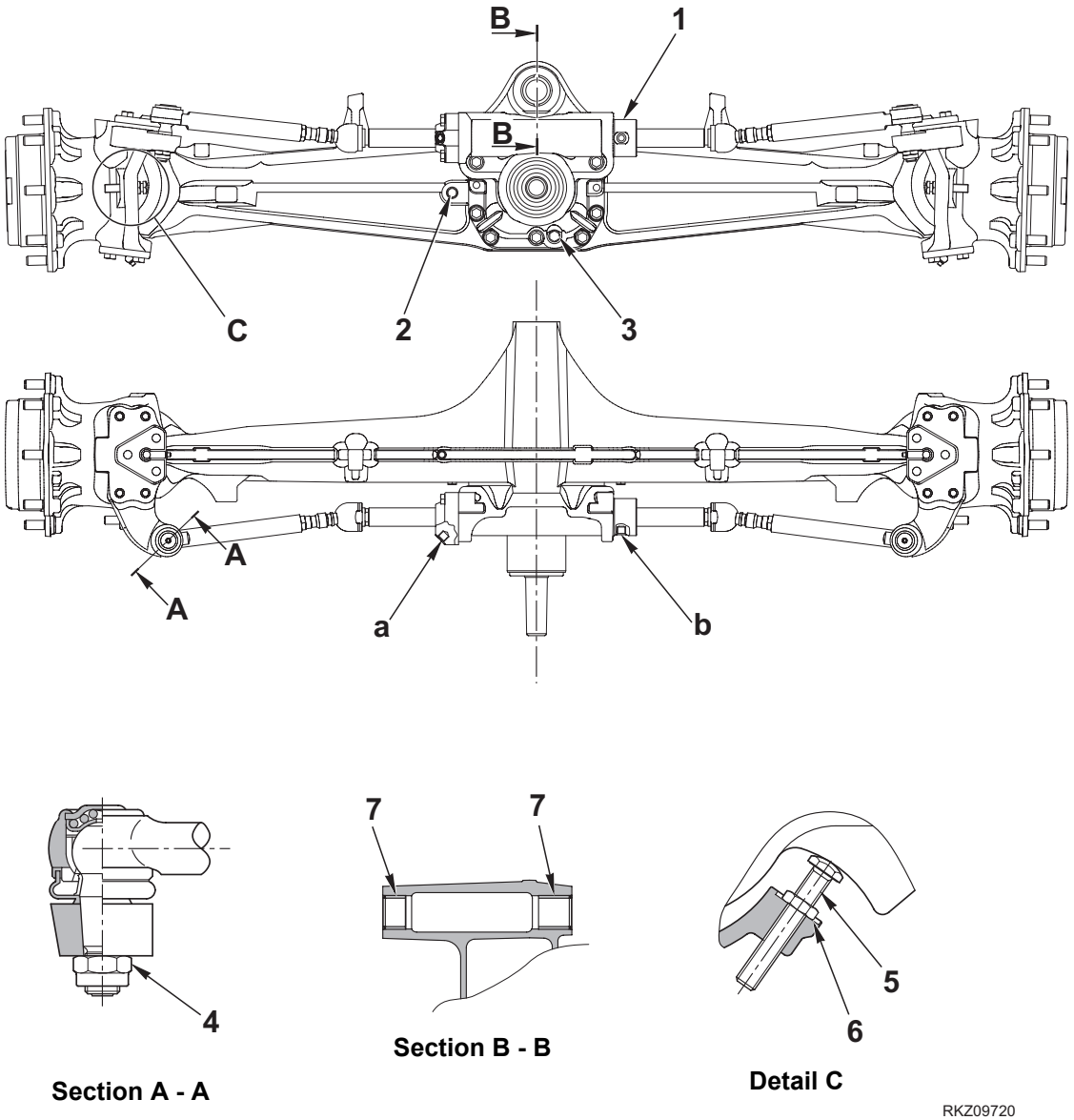
1. Planetary gear
2. Ring gear (Z=32)
3. Pin
4. Planetary gear
5. Ring nut
6. Half-axle
7. Pin
8. Differential housing
9. Spacer
10. Bearing
11. Gasket
12. Cover
13. Ring nut
14. Bearing
15. Bevel pinion (Z=13)
16. Oil refilling plug

Final reduction gear - Joint



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

Steering unit cylinder

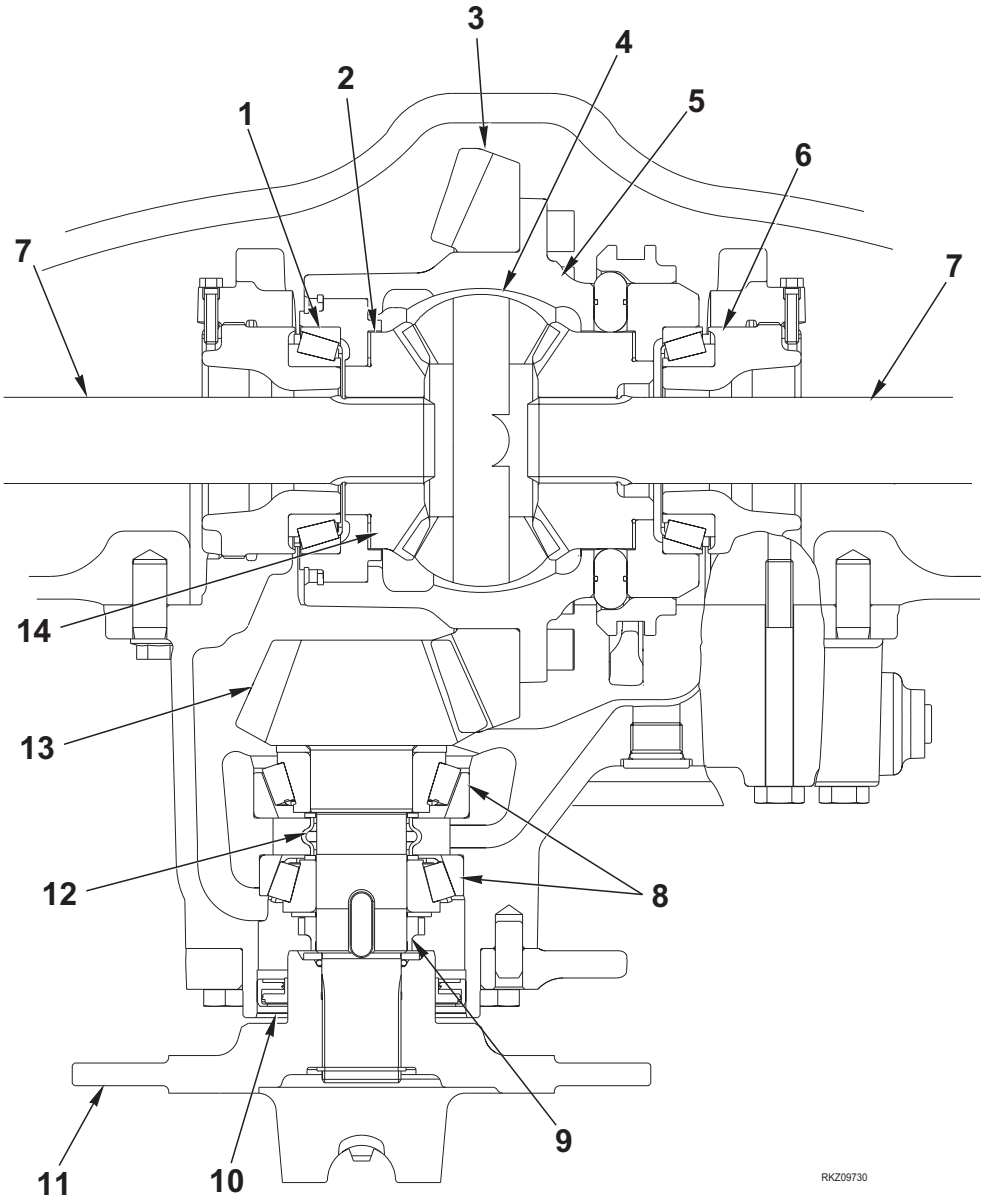


1. Steering cylinder
2. Oil refilling plug
3. Oil drain plug
4. Nut
5. Adjusting screw
6. Nut
7. Bushing

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

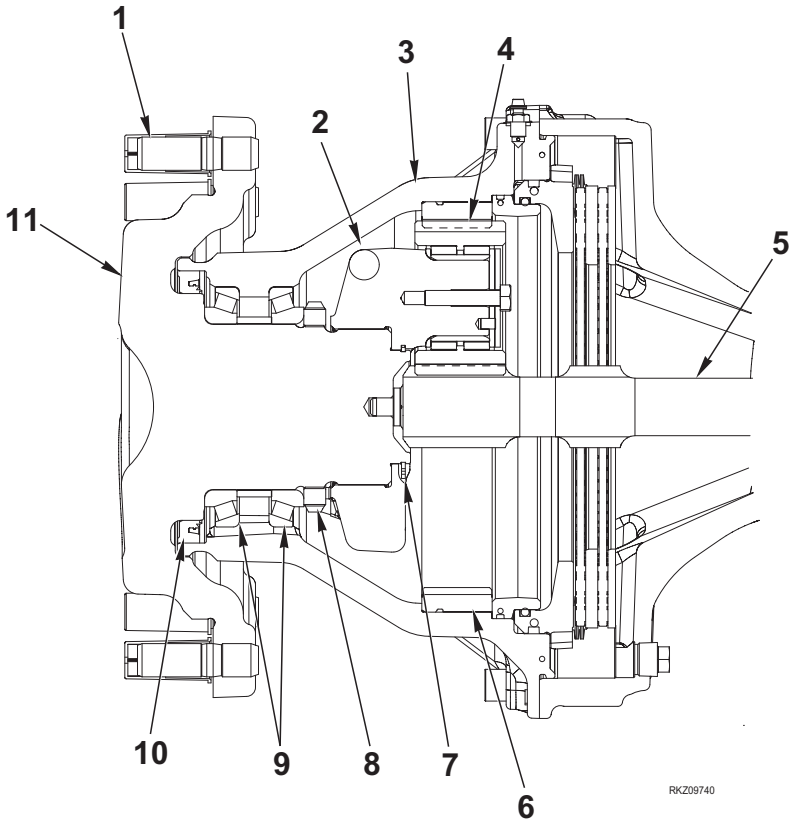
REAR AXLE

Differential



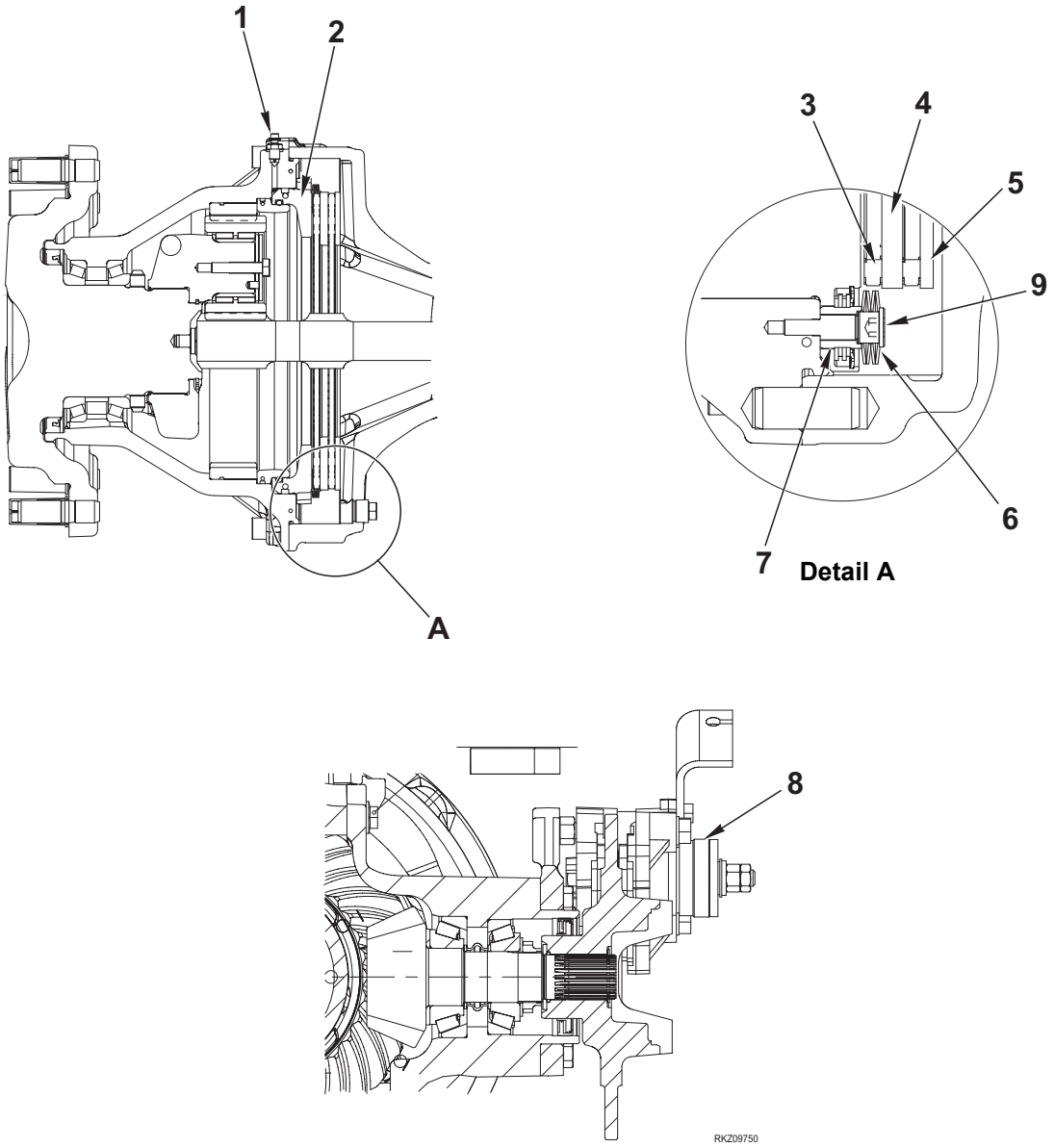
1. Bearing
2. Planetary gear
3. Ring gear (Z=32)
4. Planetary gear
5. Differential housing
6. Ring nut
7. Half-axle
8. Bearing
9. Ring nut
10. Gasket
11. Flange
12. Spacer
13. Bevel pinion (Z=13)
14. Differential housing

Final reduction gear



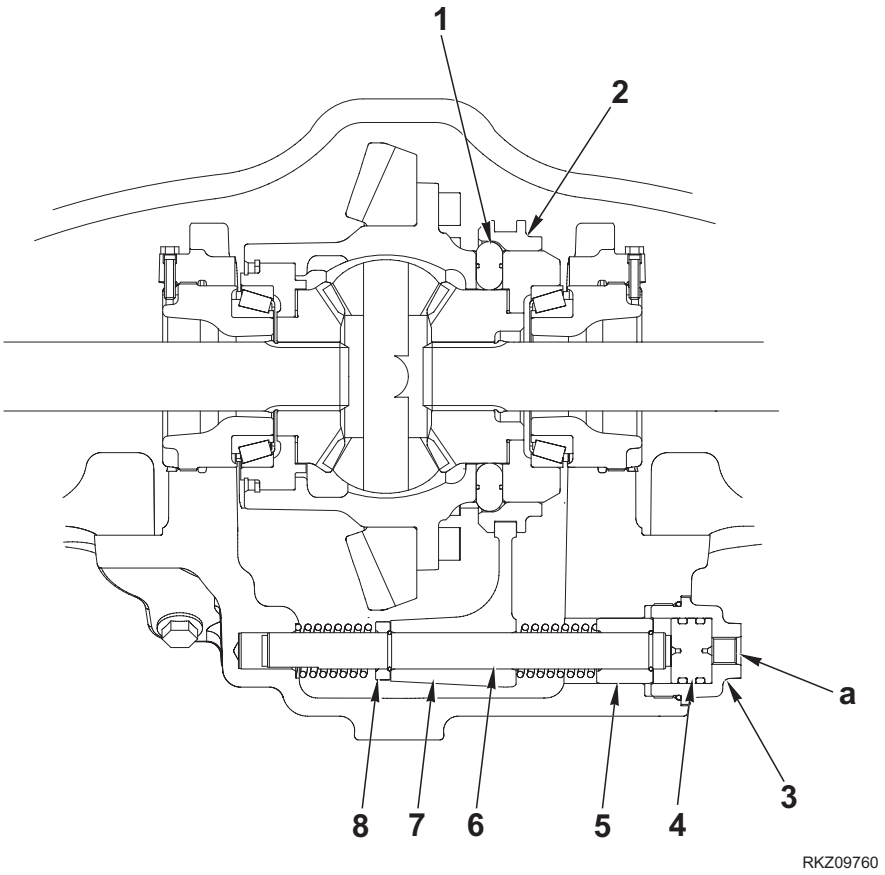
1. Stud bolt
2. Planetary gear
3. Wheel hub
4. Planetary gear
5. Half-axle (Z=15)
6. Ring gear (Z=32)
7. Snap ring
8. Ring nut
9. Bearing
10. Gasket
11. Flange

Brakes



1. Bleed screw
2. Piston
3. Brake disk
4. Intermediate disk
5. Pressure disk
6. Pressure disk
7. Bushing
8. Parking brake control caliper
9. Screw

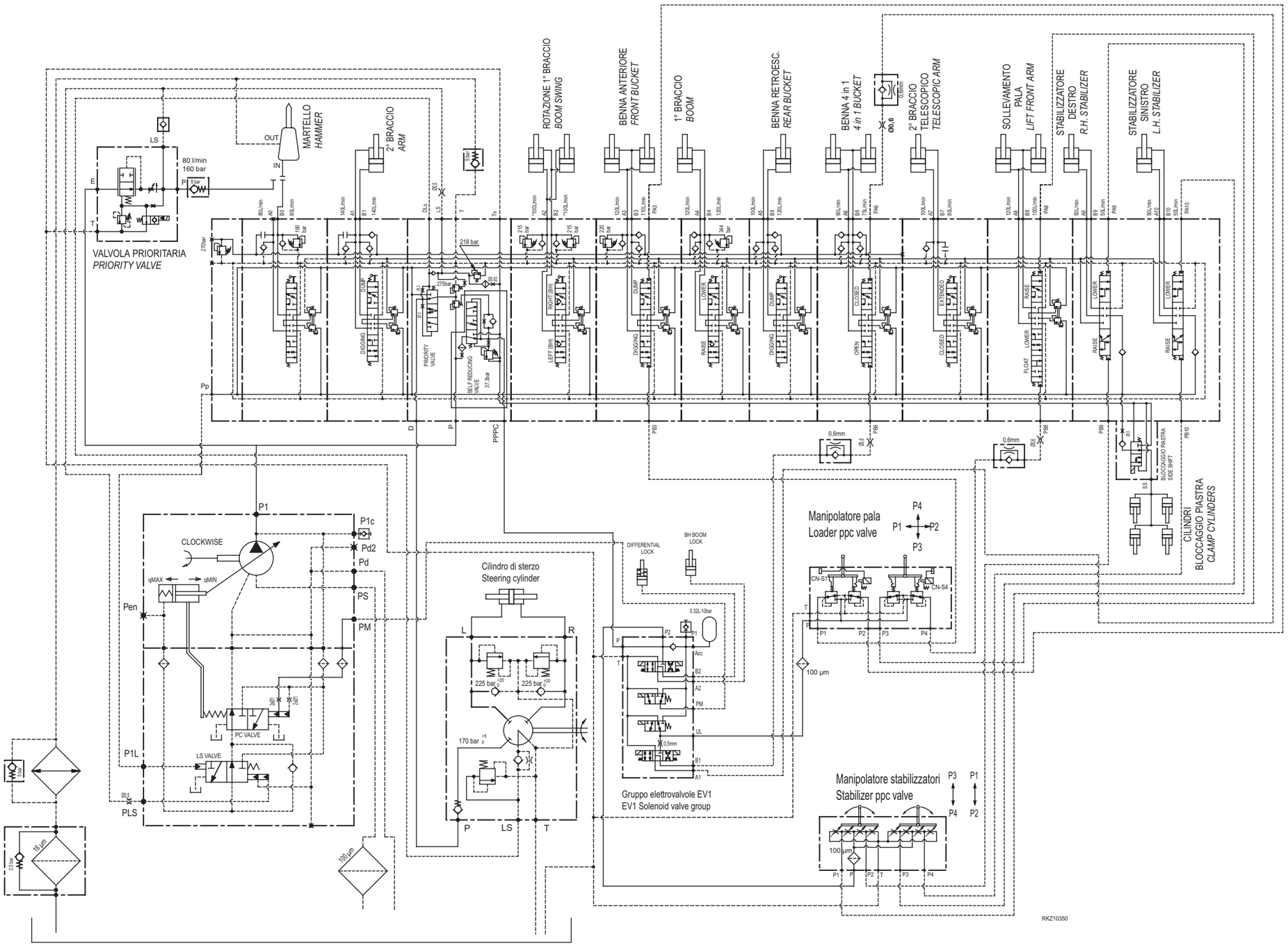
Differential lock



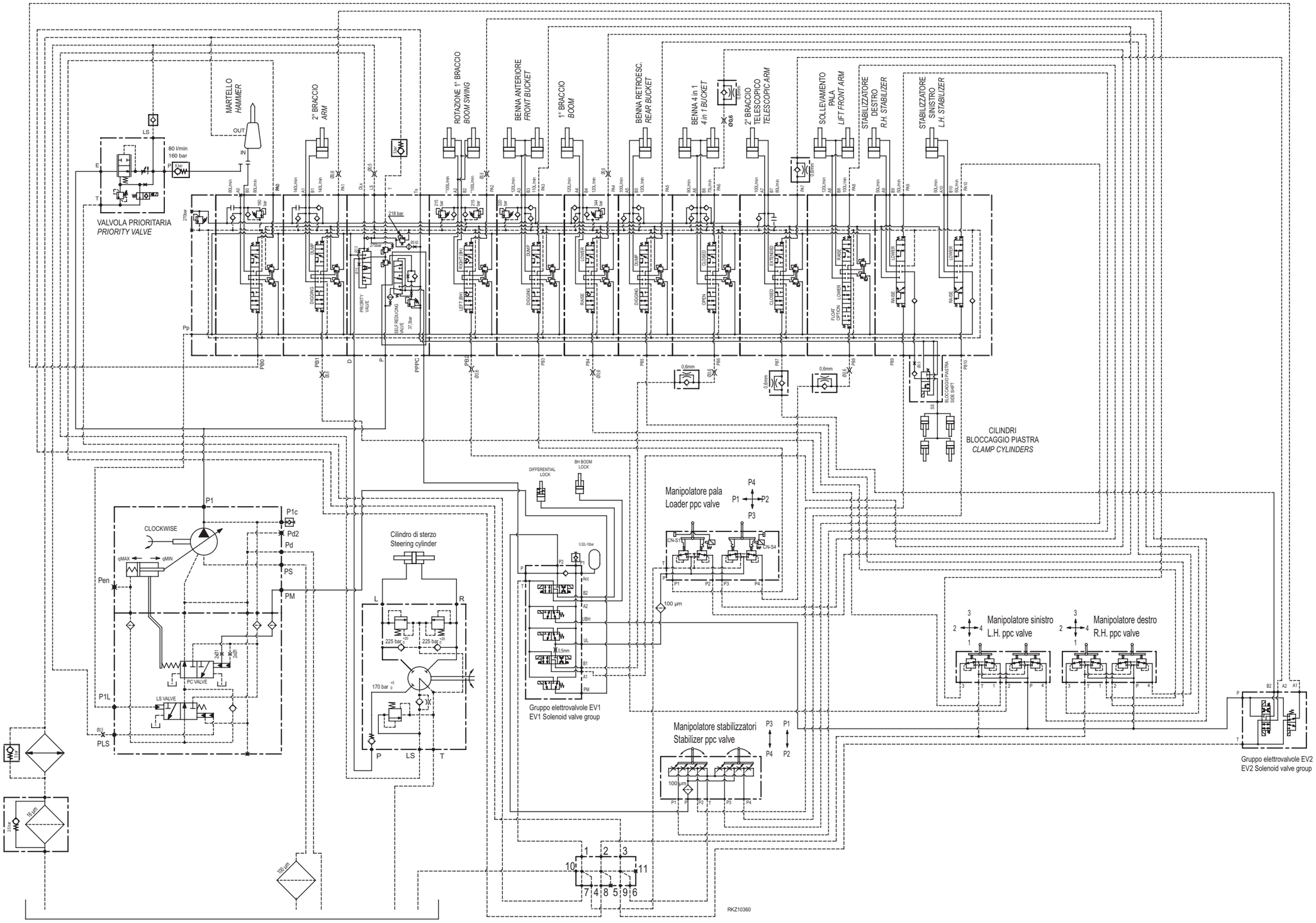
a. From servocontrol solenoid valve group EV1 (Port B2)

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

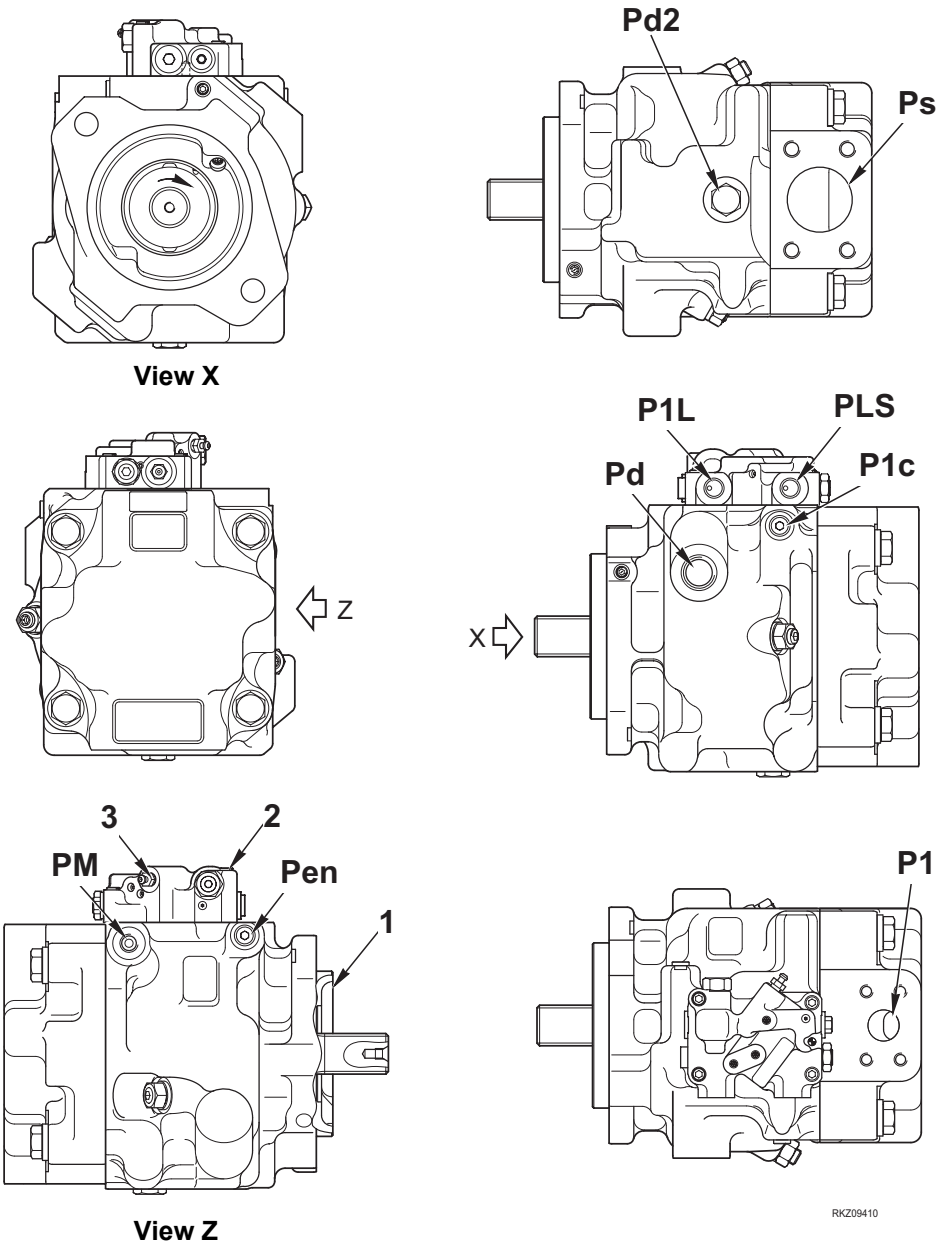
HYDRAULIC CIRCUIT (WITH MECHANICAL CONTROL)



HYDRAULIC CIRCUIT (WITH SERVOCONTROL)



HYDRAULIC PUMP



COMPONENTS

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

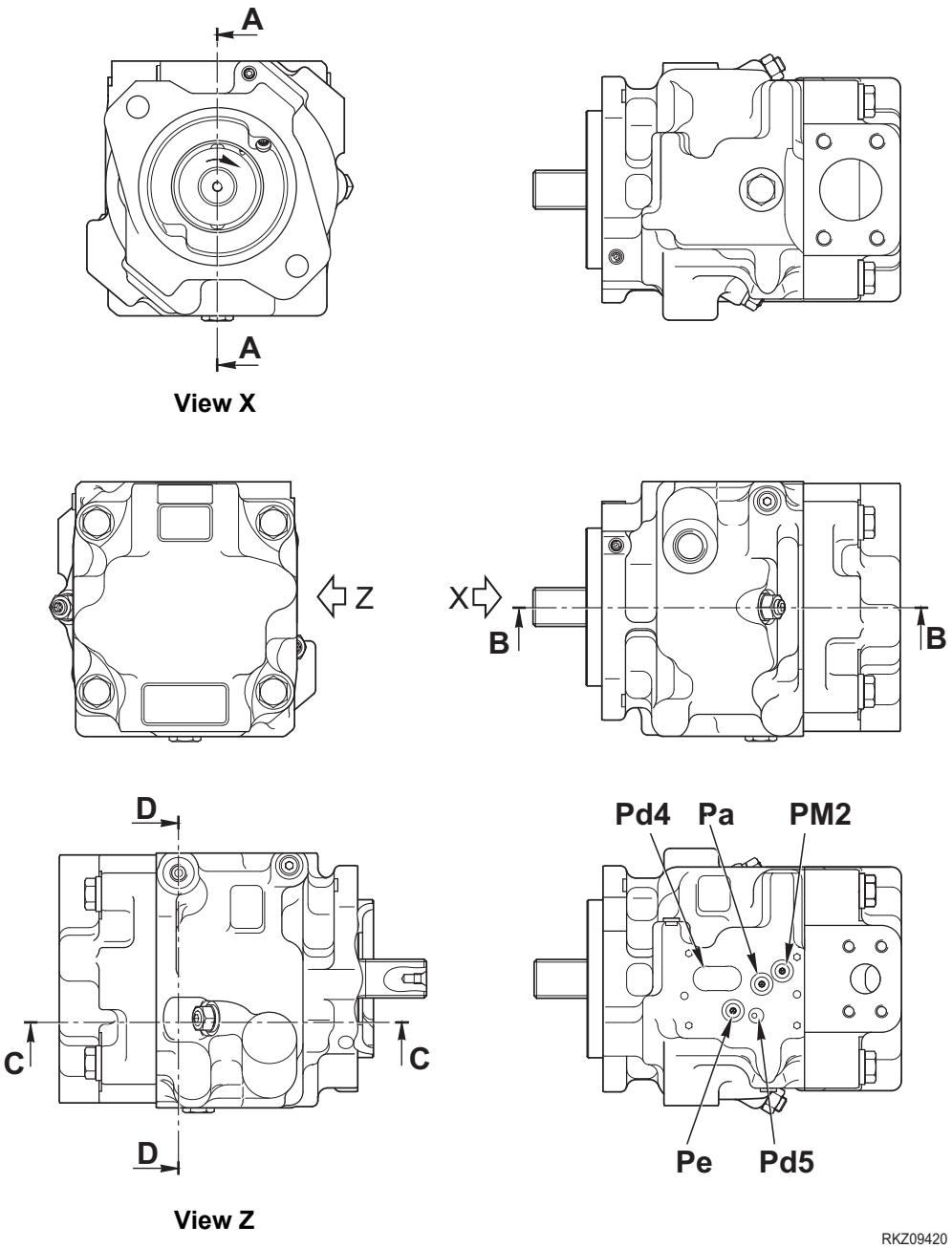
CONNECTIONS

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

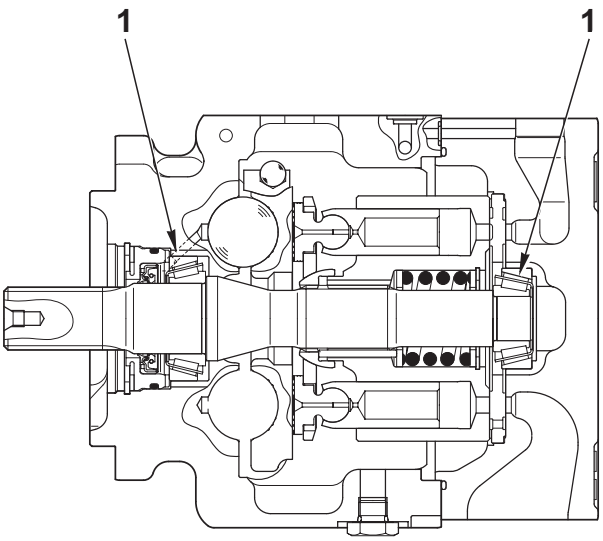
Port P1 - Pump delivery
Port Pd - Drain
Port Ps - Intake of oil
Port P1L - Pump delivery pressure input
Port P1C - Quick connect for pump delivery pressure
Port Pd2 - Drain plug
Pen port - Delivery control pressure check
Port PLS - Load Sensing signal input
Port PM - Operating mode control signal input

1. MAIN PUMP

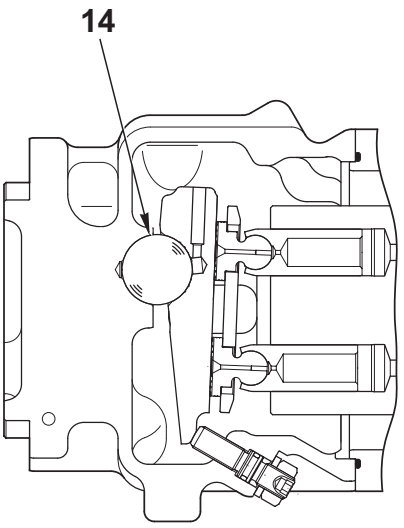


PORT FUNCTIONS

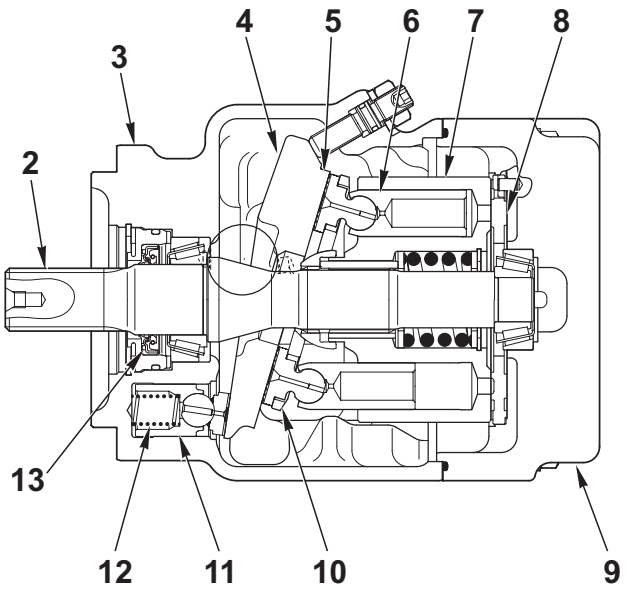
Port Pa - Delivery control group feed
Port Pe - Delivery control signal
Port Pd4 - Drain
Port Pd5 - Drain
Port PM2 - Operating mode signal



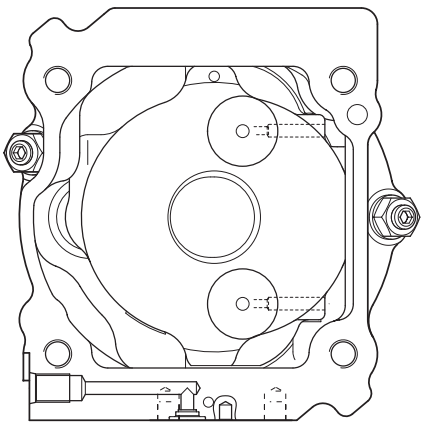
Section A - A



Section C - C



Section B - B



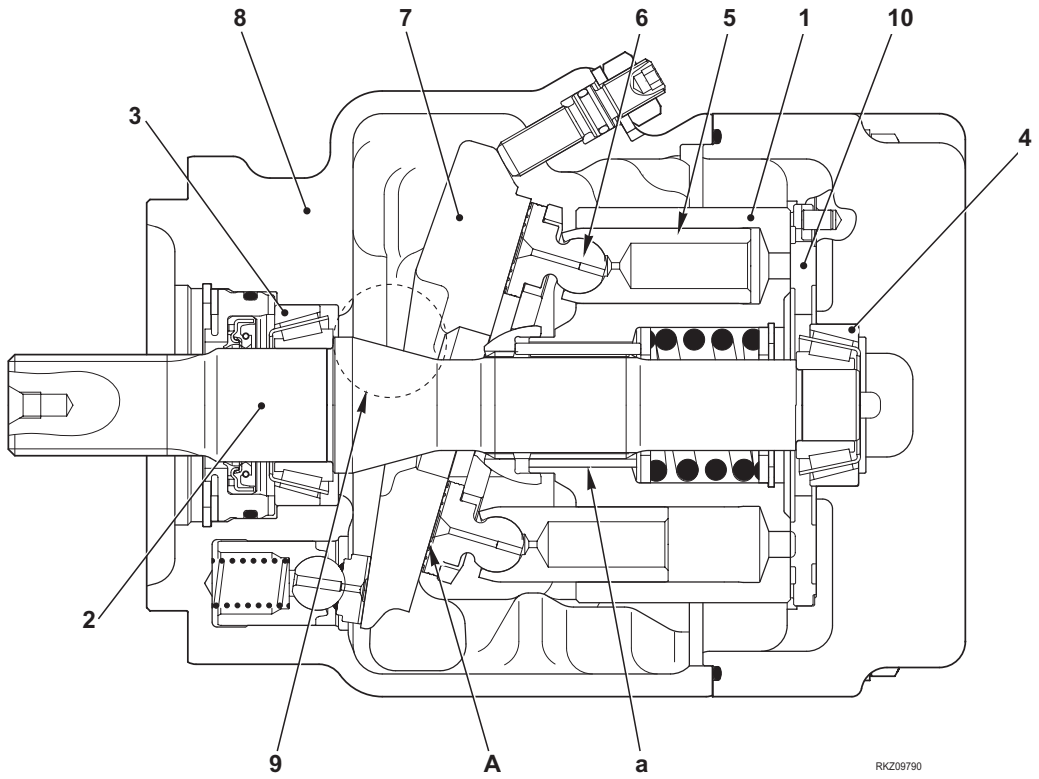
Section D - D

RKZ09520

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

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

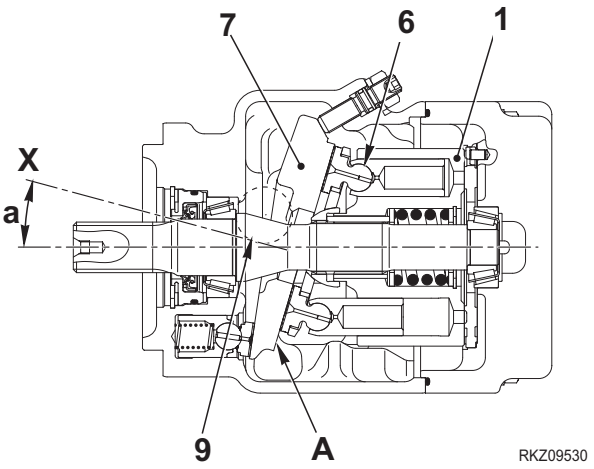
1. Pump operation

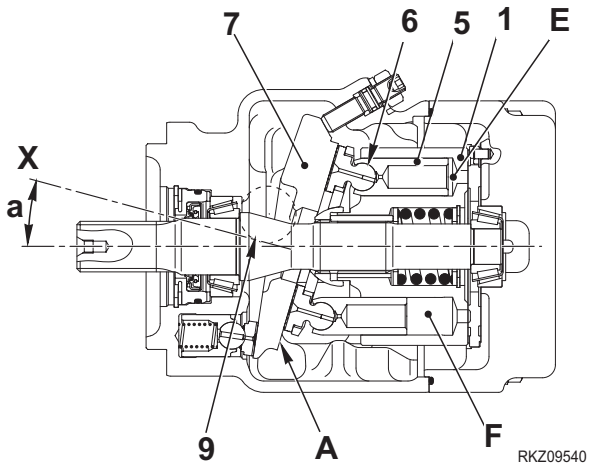
1 - The cylinder block (1) rotates with the shaft (2), and the shoe (6) slides on the flat surface **A**.
When this happens, the swash plate (7) rotates on the ball (9), and the angle **a** between the axis of the cylinder block (1) and the axis **X** of the swash plate (3) changes. The angle **a** is known as the swash plate angle.

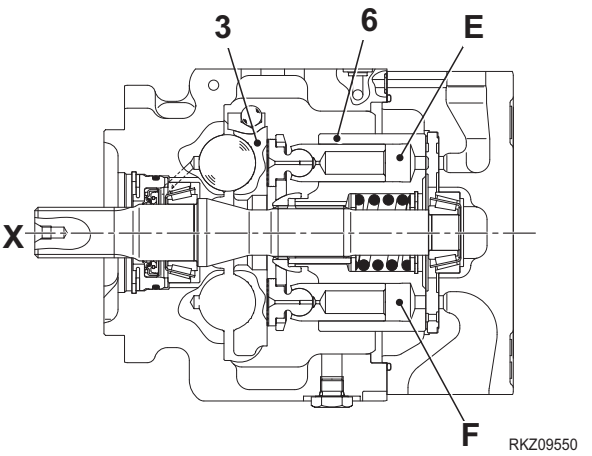
2 - When the axis **X** of the swash plate (7) retains the angle **a** in relation to the axis of the cylinder block (1), flat surface **A** acts as a cam for the shoe (6). This is why the piston (5) slides inside the cylinder block (1), creating a difference between volumes **E** and **F** and therefore causing the suction and delivery of oil in a quantity that is equivalent to the difference between those volumes (**F**–**E** = 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.



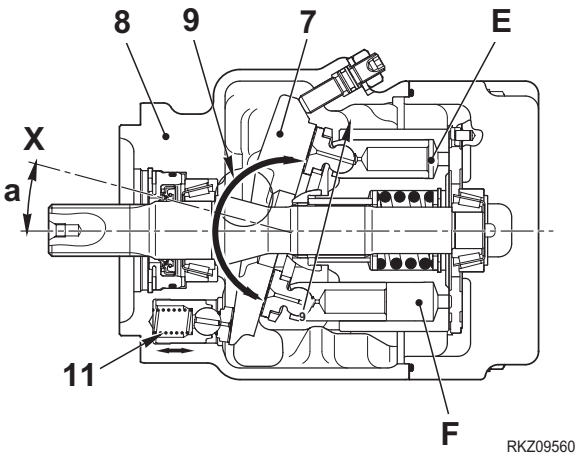




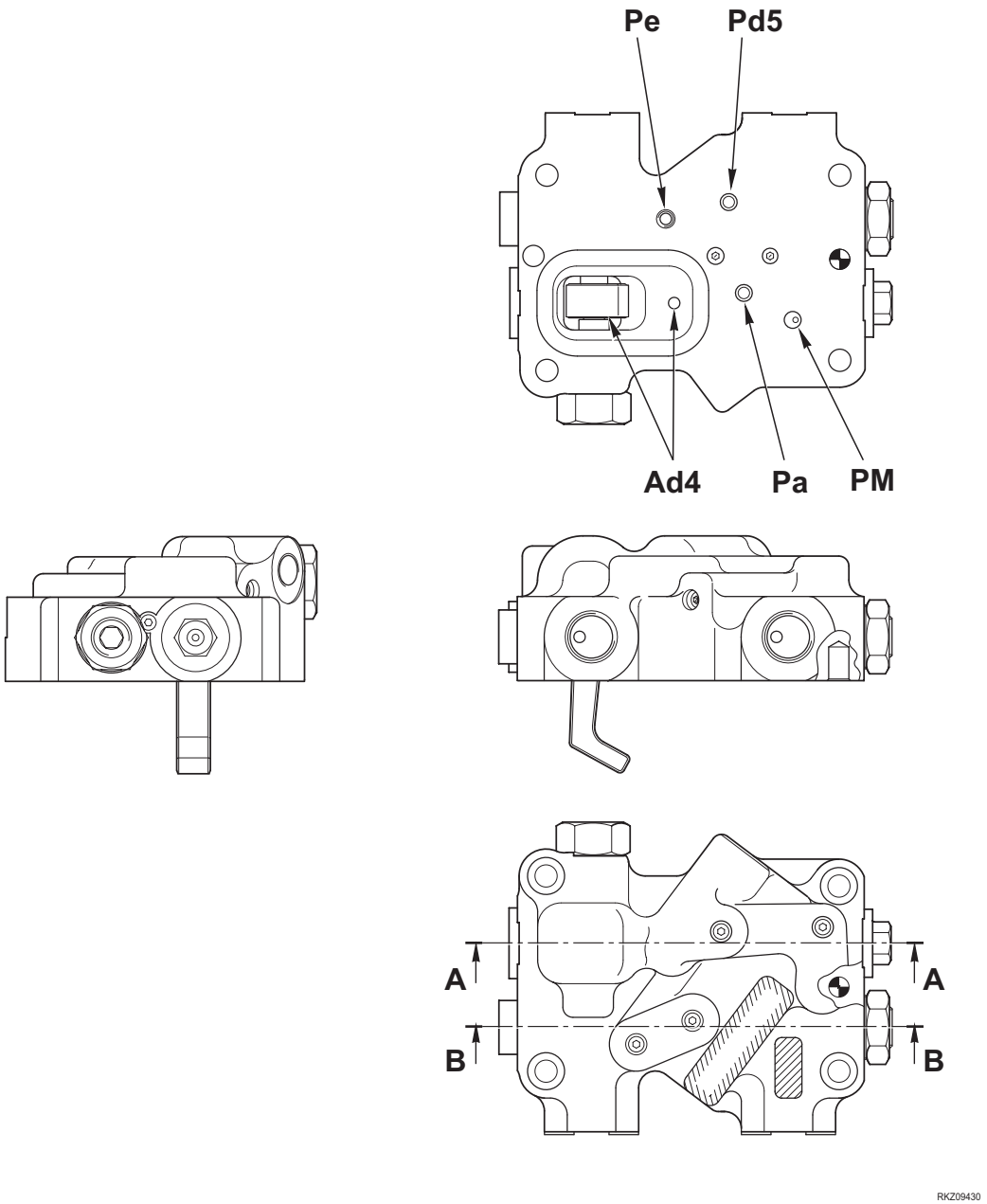
2. Control of Delivery

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.



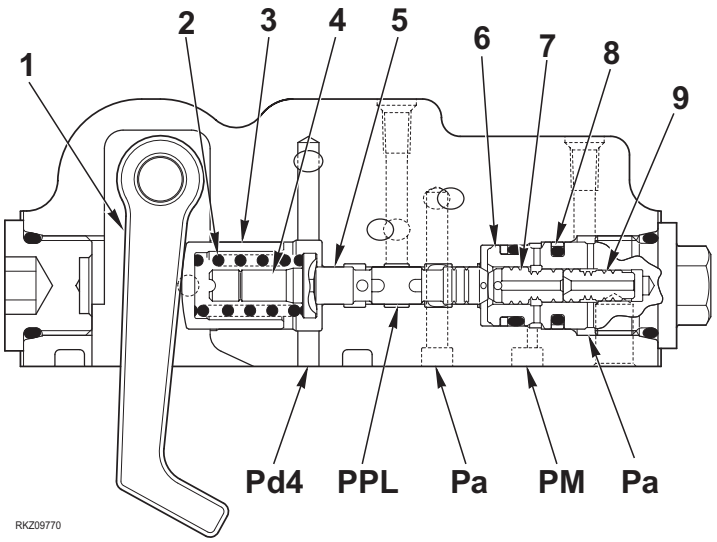
2. DELIVERY CONTROL VALVE



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

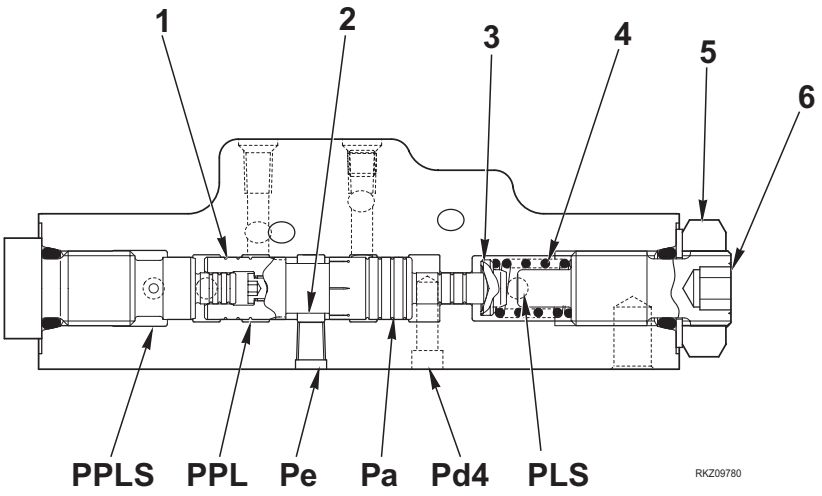
COMPONENTS

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

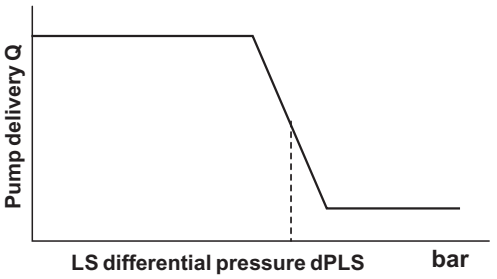
1. Spool
2. Plug
3. Seat
4. Spring
5. Nut
6. Plug

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

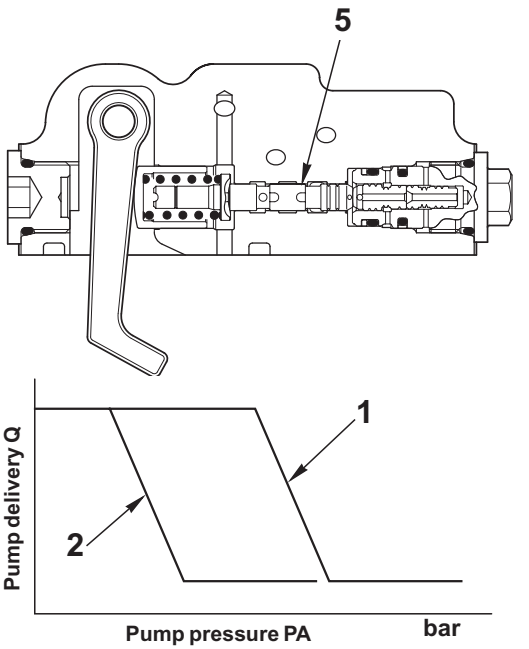
- The LS valve controls the pump delivery according to the stroke of the control valve lever, i.e., in function of the delivery demands made by the actuators.
- The LS valve detects the actuator's delivery needs by means of the differential pressure DPLS existing between pressure PPLS (control valve 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 switched 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**".



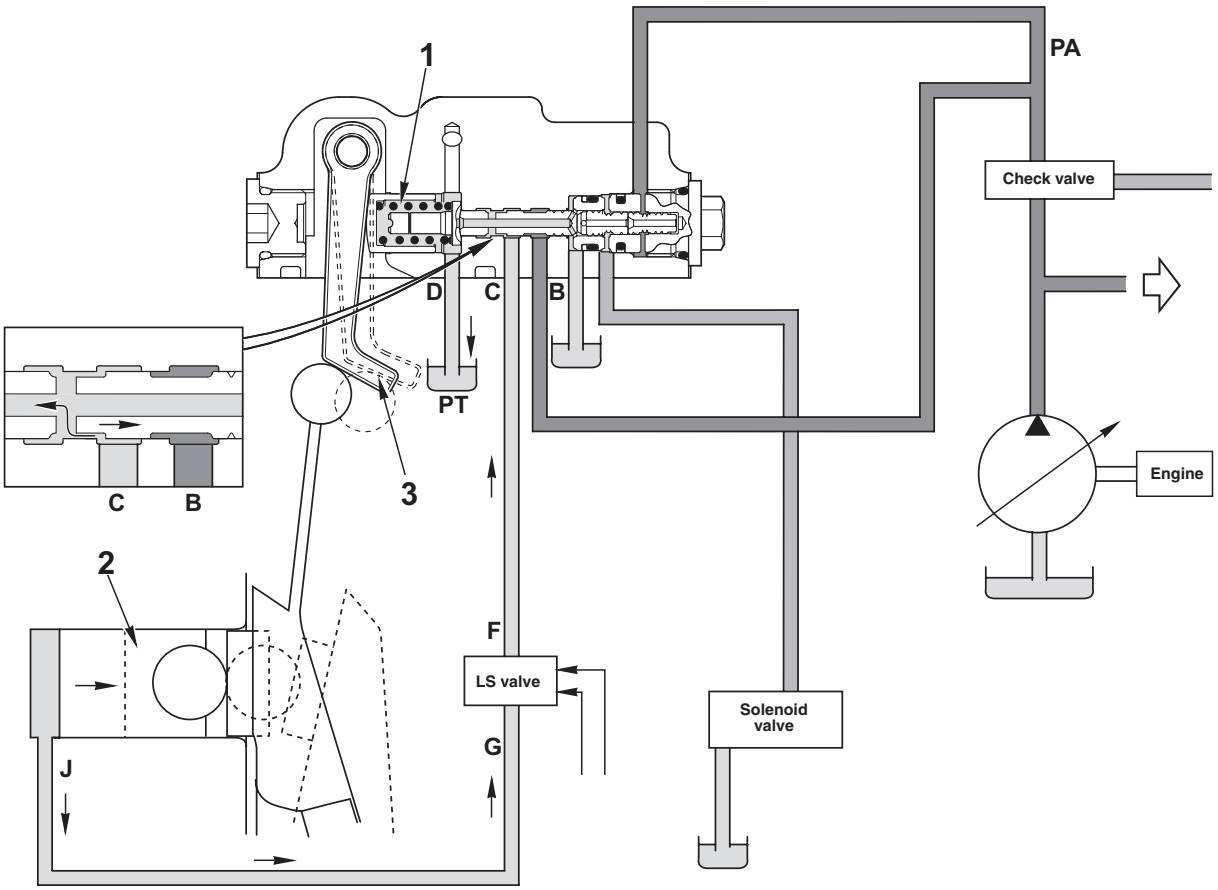
RKZ09580

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.

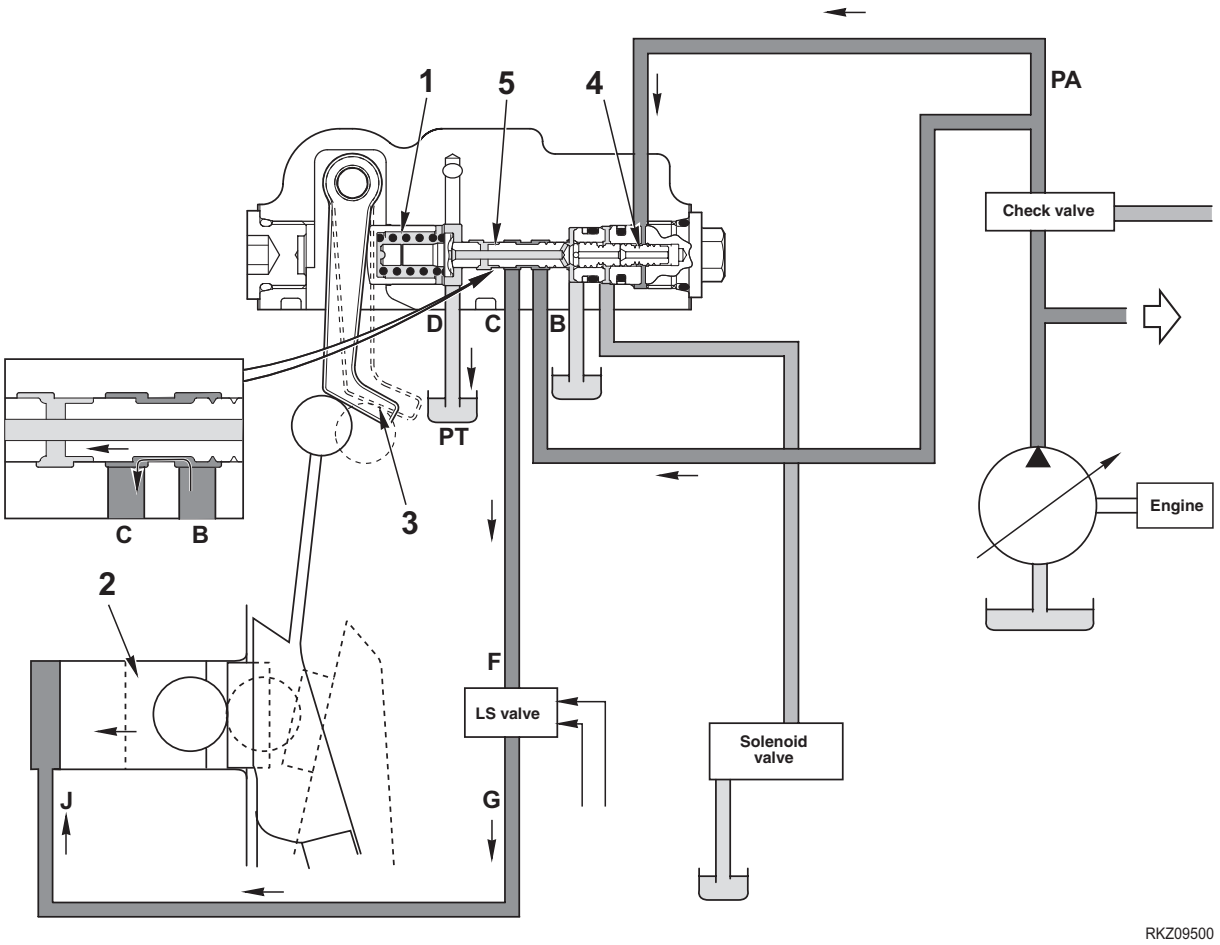
2. When pump pressure PA is low



RKZ09490

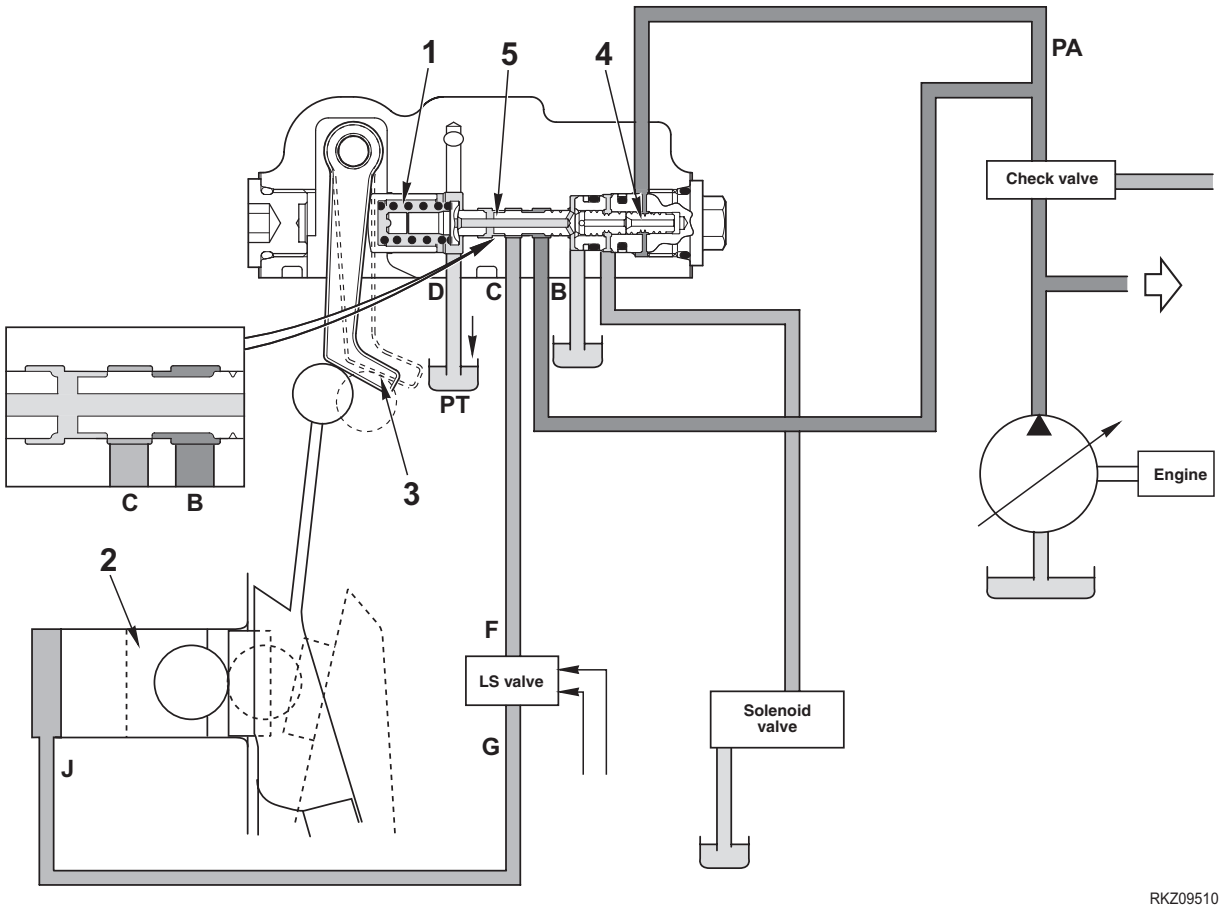
- The force applied by the pressure against the spool (4) decreases, and the spool (5) shifts slightly to the right.
  At the same time, a connection opens between ports **C** and **D**, and pressurised oil from valve LS is sent for discharge (PT).
- Simultaneously, ports **F** and **G** on valve LS are interconnected, and pressure at port **J** is sent for relief (PT); 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 ports **C** and **D**, and a passage opens between ports **B** and **C**.
- As a result of that, the pressure at port **C** increases, and the control piston (2) stops.

3. When pump pressure PA is high



- 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 between ports **C** and **B**, and the pressure of the oil sent to valve LS becomes equivalent to the pump's delivery pressure (PA).
- Simultaneously, ports **F** and **G** on 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 between ports **C** and **B**, and a passage opens between ports **D** and **C**.
- As a result of that, the pressure at port **C** decreases, and the control piston (2) stops.

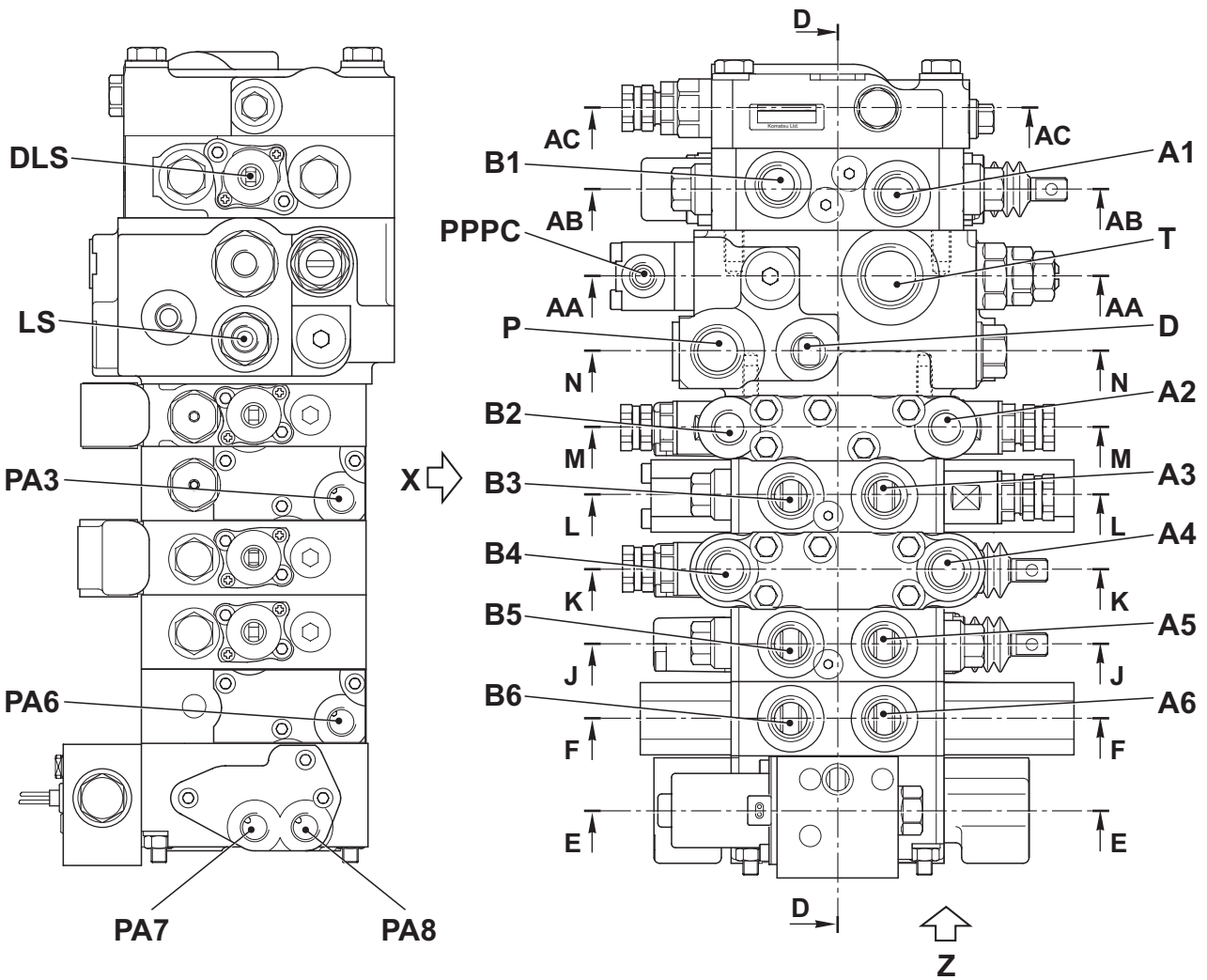
4. When equilibrium has been reached

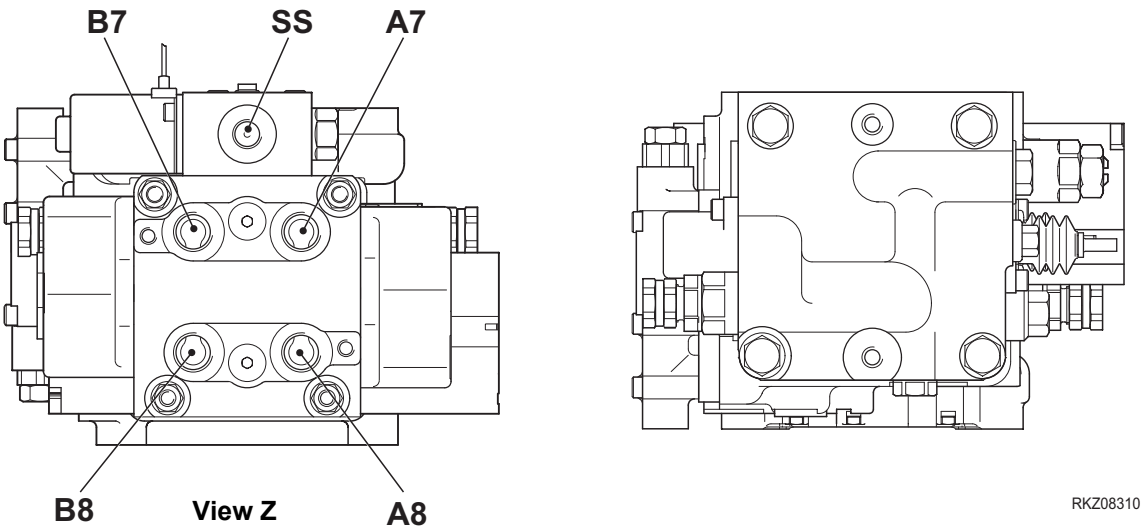


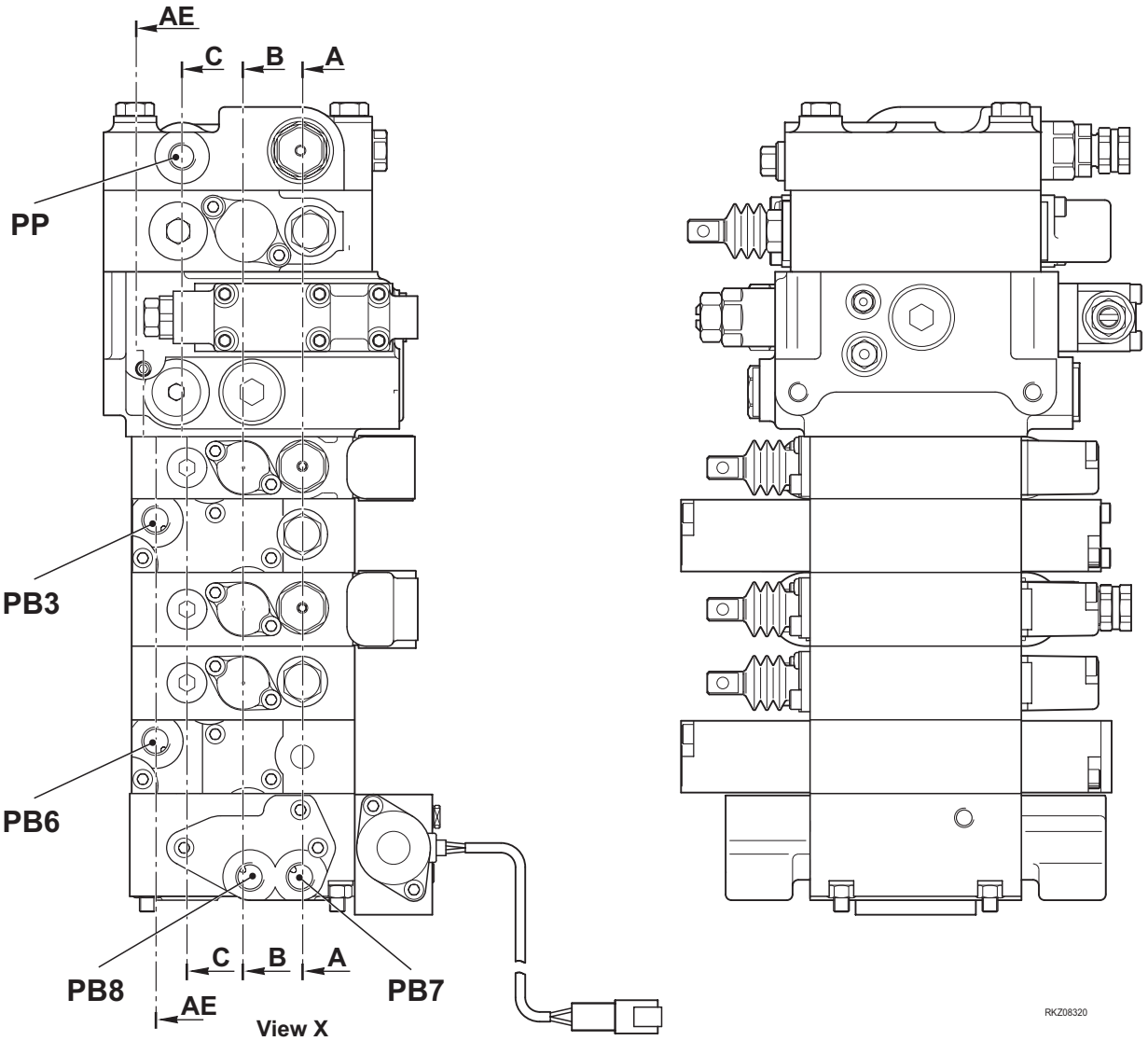
- The equilibrium between the force applied by pressure PA against spool (4) and the force applied by spring (1) against spool (5) is what determines the position at which the control piston (2) (hence pump delivery) stops.

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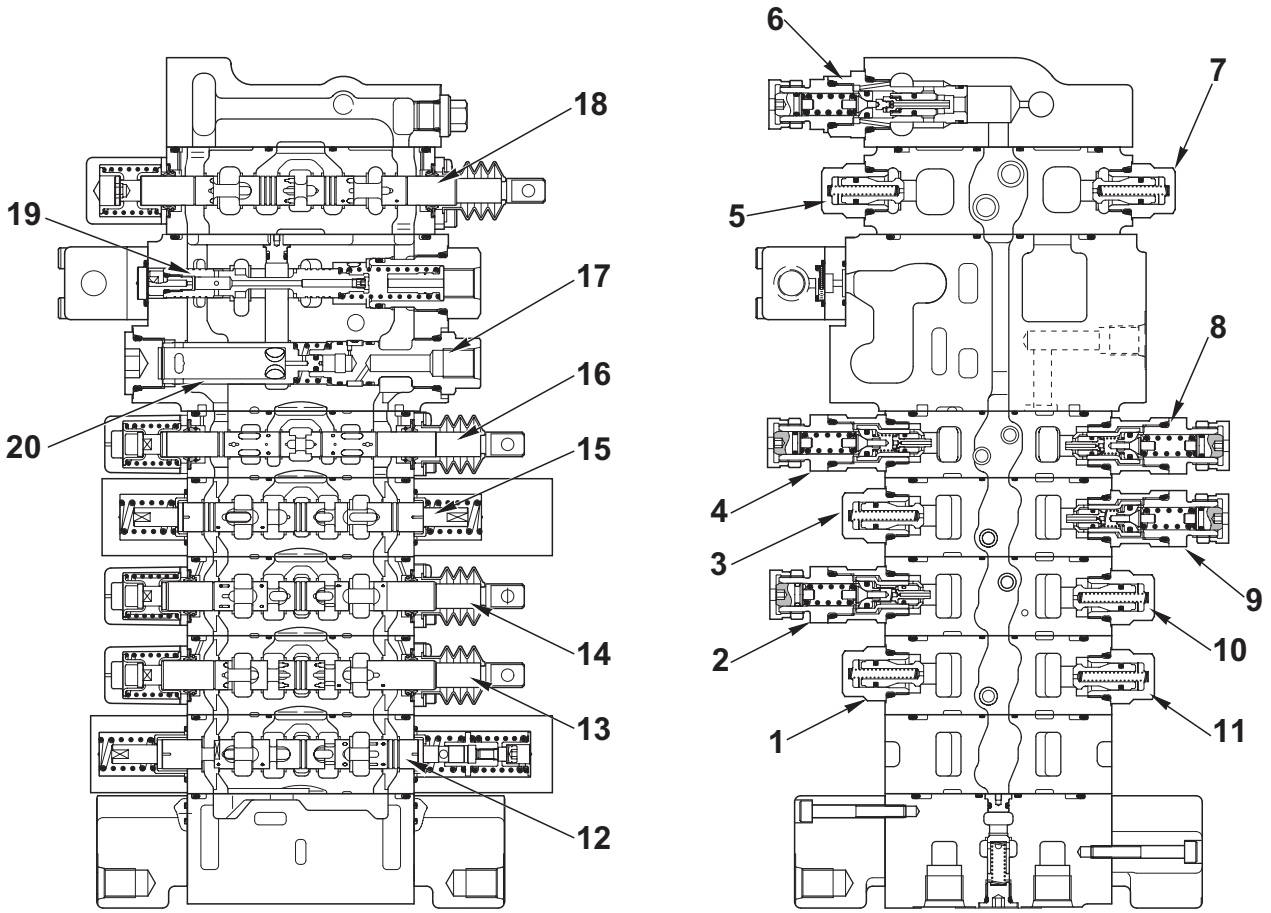
8-SPOOL CONTROL VALVE (WITH MECHANICAL CONTROL)



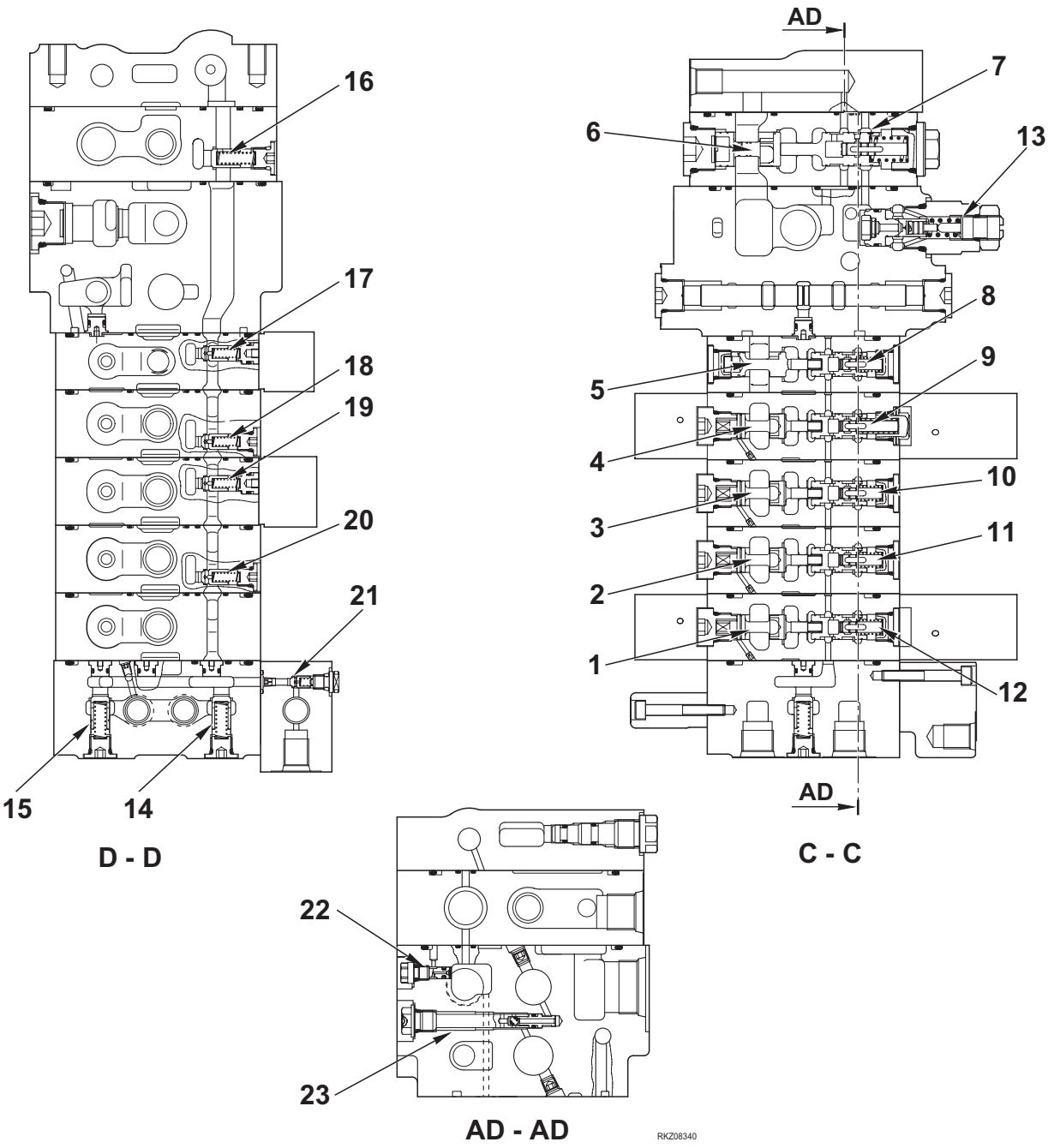




A1 - To the arm cylinder (Head side)
A2 - To the boom (LH-RH) swing cylinder (Bottom side)
A3 - To the shovel cylinders (Bottom side)
A4 - To the boom cylinder (Bottom side)
A5 - To the backhoe bucket cylinder (Head side)
A6 - To the shovel arm raise cylinder (Bottom side)
A7 - To the RH outrigger cylinder (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
PA3 - From the shovel PPC valve (P2 port)
PA6 - From the shovel PPC valve (P3 port)
PA7 - From the outriggers PPC valve (P1 port)
PA8 - From the outriggers PPC valve (P3 port)
PB3 - From the shovel PPC valve (P1 port)
PB6 - From the shovel PPC valve (P4 port)
PB7 - From the outriggers PPC valve (P2 port)
PB8 - From the outriggers PPC valve (P4 port)



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

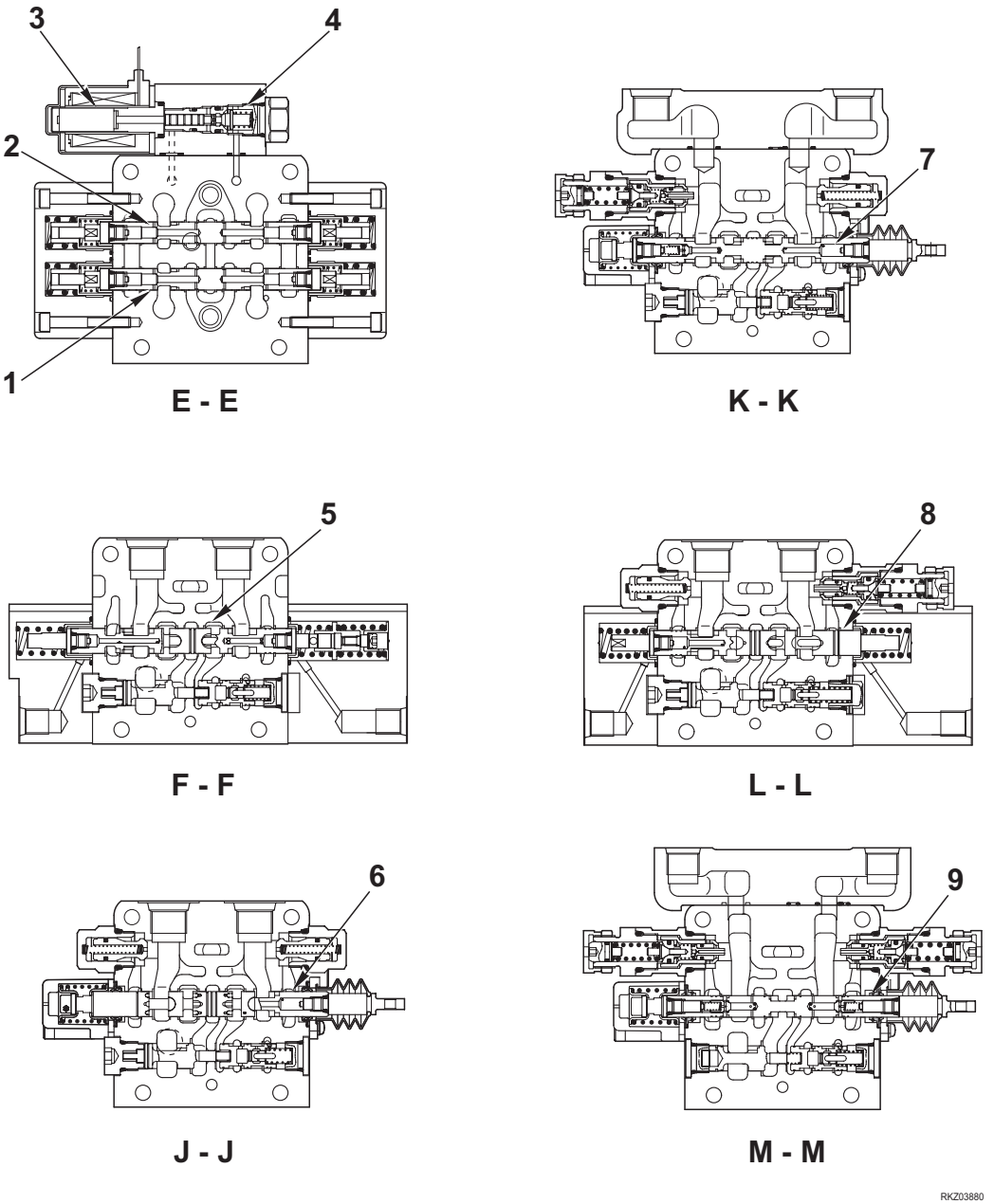


PRESSURE REDUCING VALVE

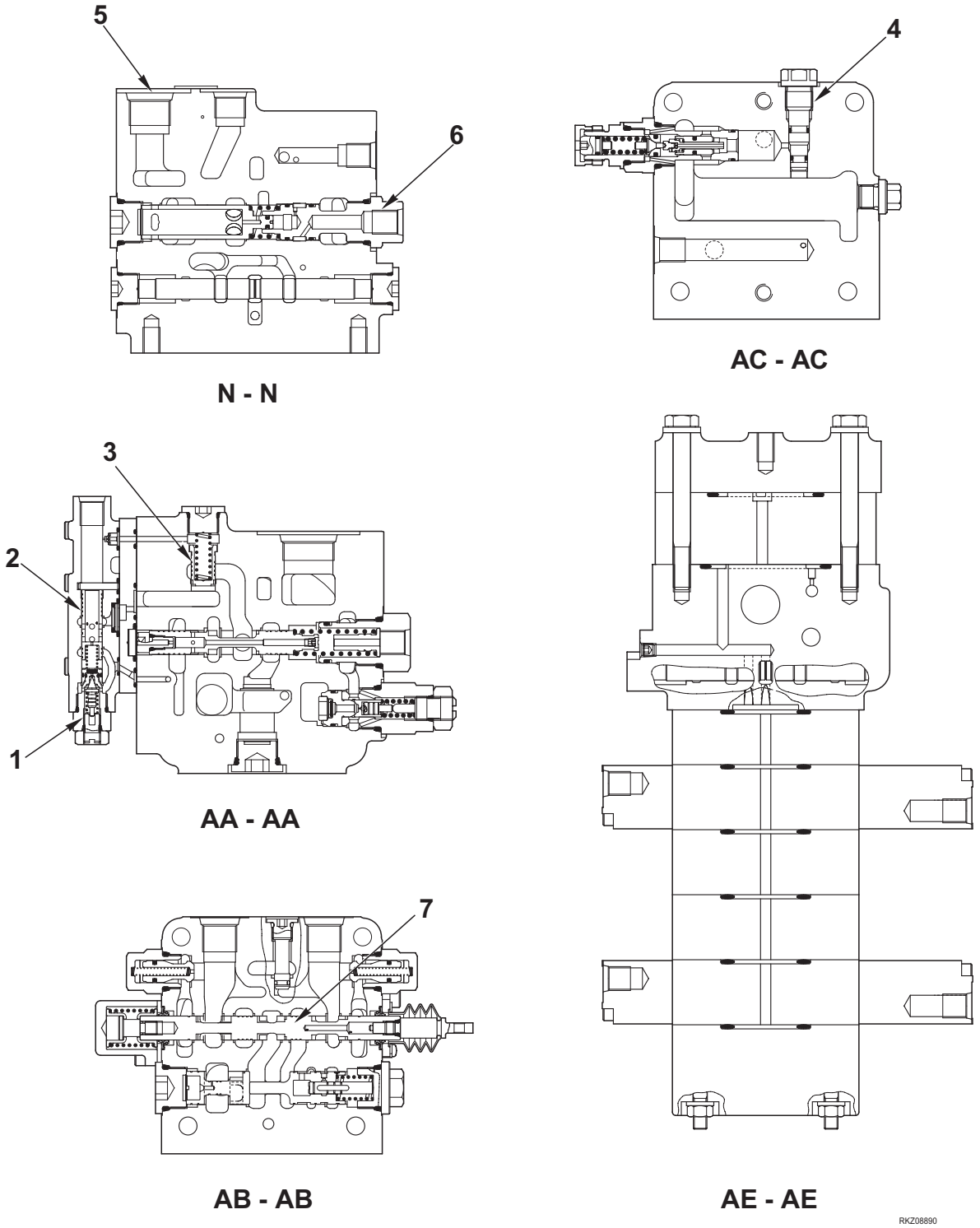
1. Shovel arm
2. Backhoe bucket
3. Boom
4. Front bucket
5. Boom swing
6. Arm

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

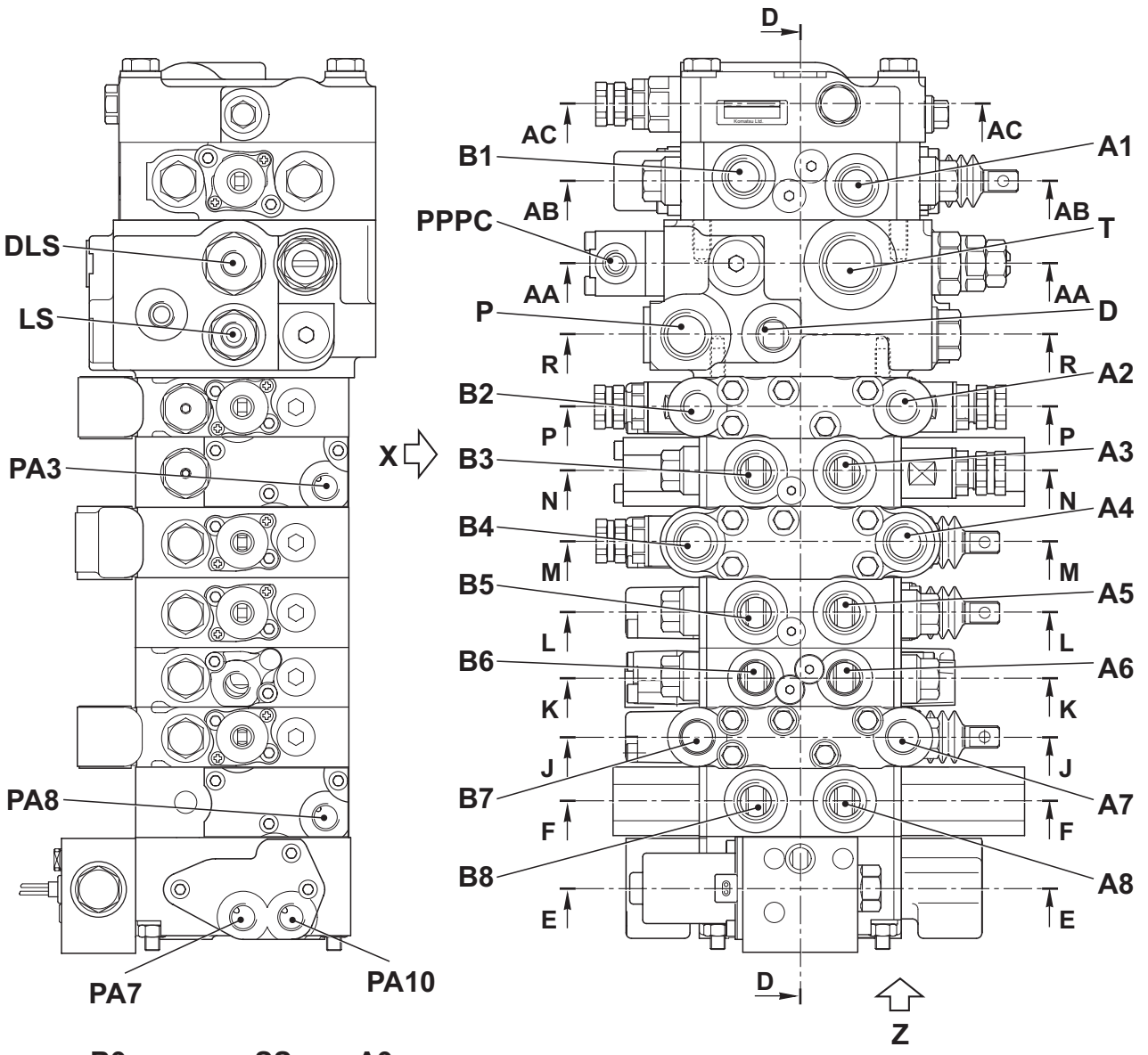


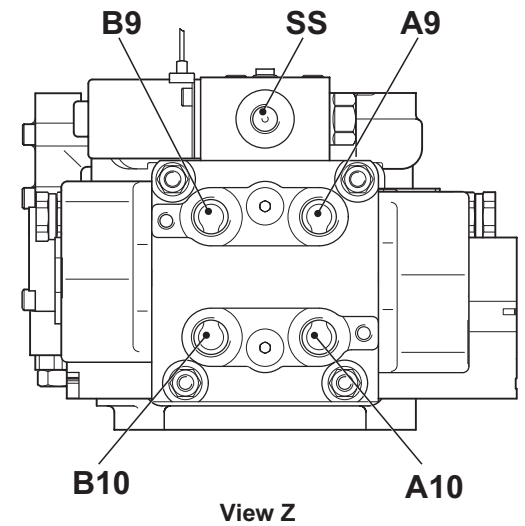
1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)



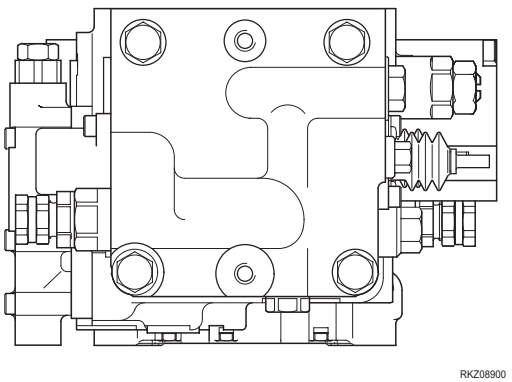
1. Servocontrol max. pressure valve
2. Max. pressure valve spool
3. Sequential reducing valve
4. Blow out plug
5. Unloading valve
6. LS by-pass plug
7. Spool (Arm control)

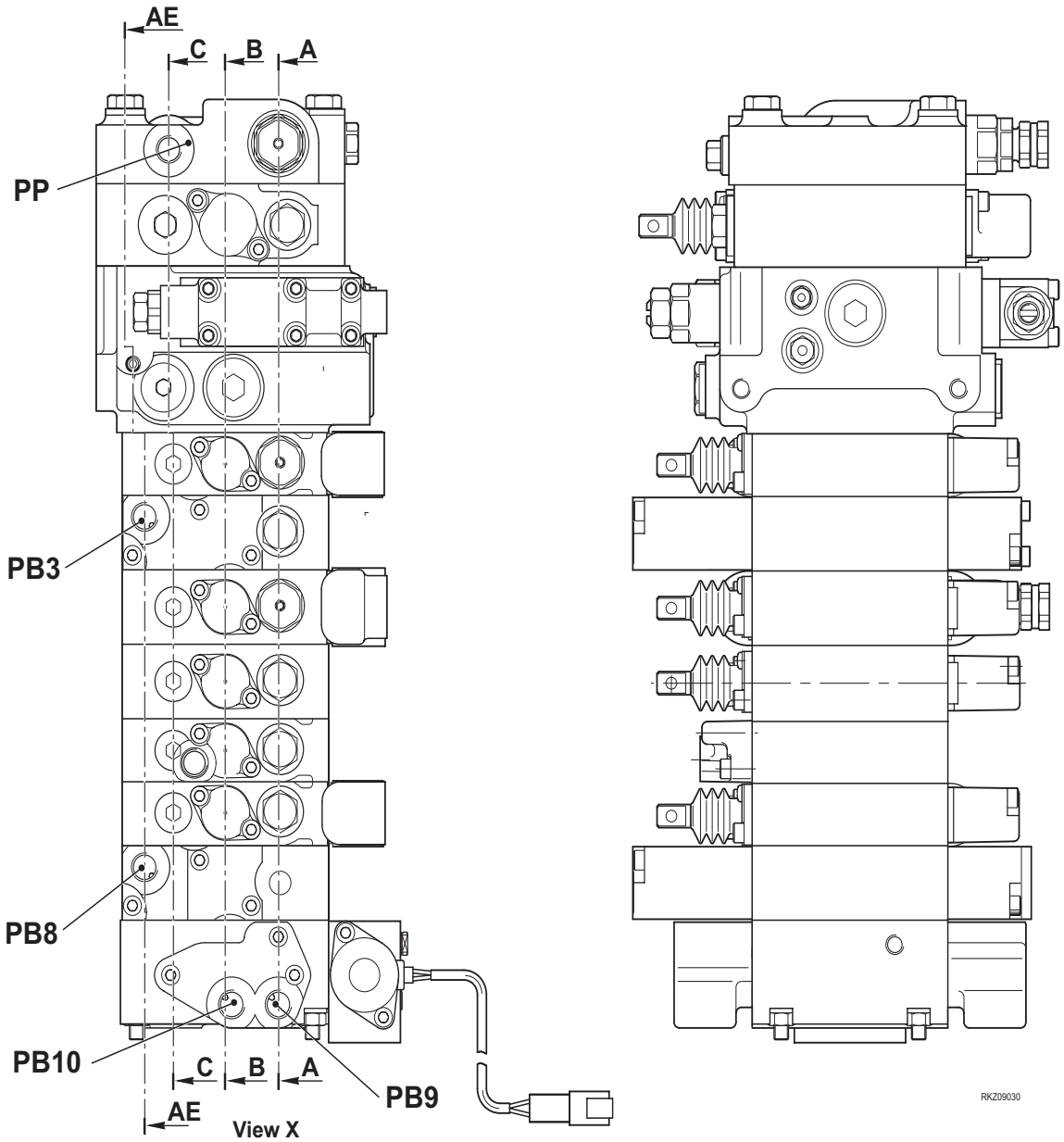
10-SPOOL CONTROL VALVE (WITH MECHANICAL CONTROL)



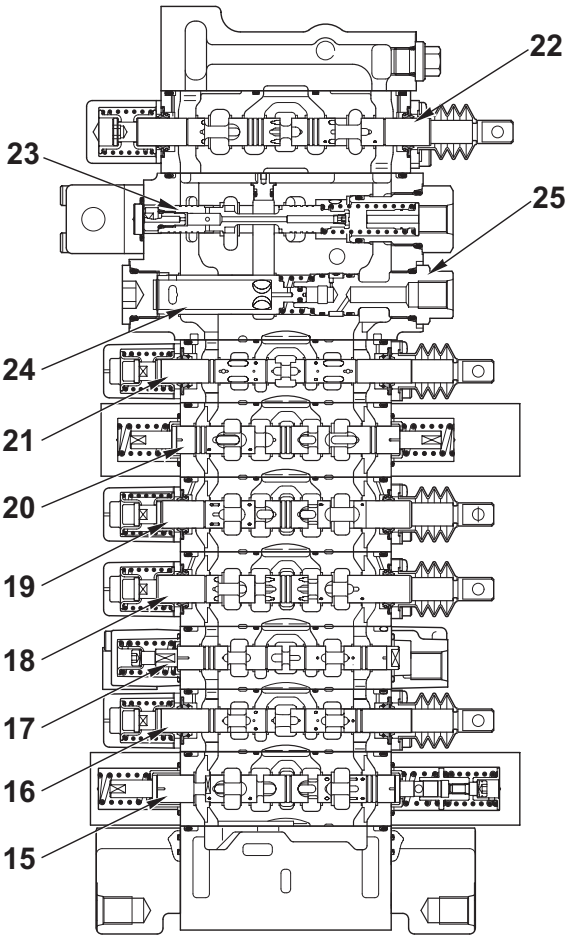


View Z

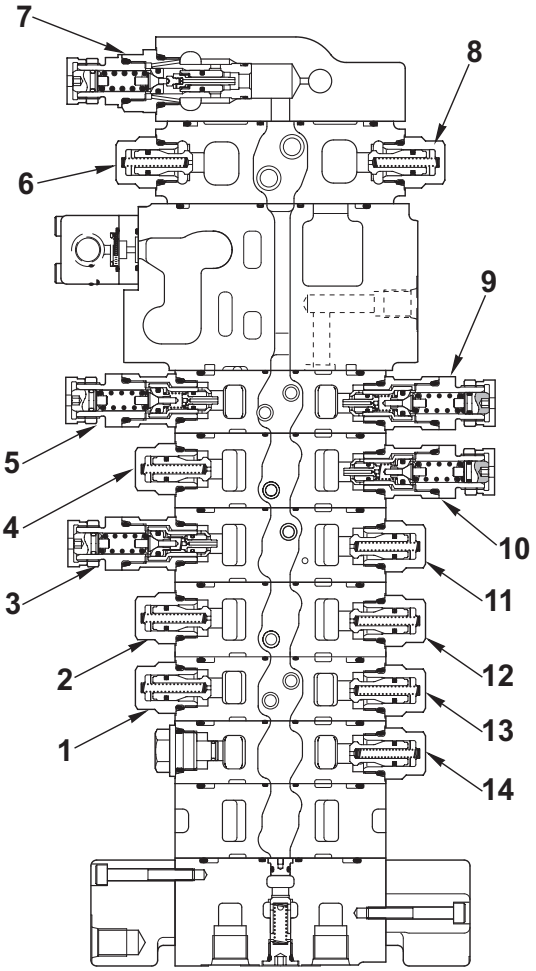




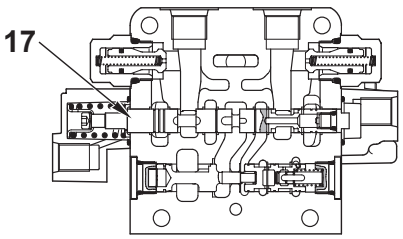
A1 - To the arm cylinder (Head side)
A2 - To the boom (LH-RH) swing cylinder (Bottom side)
A3 - To the shovel cylinders (Bottom side)
A4 - To the boom cylinder (Bottom side)
A5 - To the backhoe bucket cylinder (Head side)
A6 - To the 4 in 1 bucket cylinder (Bottom side)
A7 - To the jig arm cylinder (Bottom 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
PA3 -From the shovel PPC valve (P2 port)
PA6 -From solenoid valve group EV1 (A1 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)
PB3 -From the shovel PPC valve (P1 port)
PB6 -From solenoid valve group EV1 (B1 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)



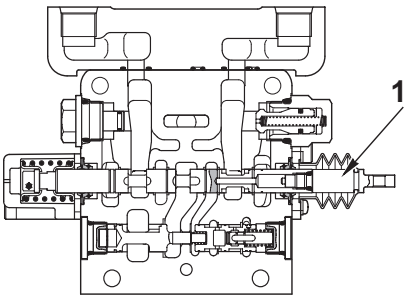
B - B



A - A



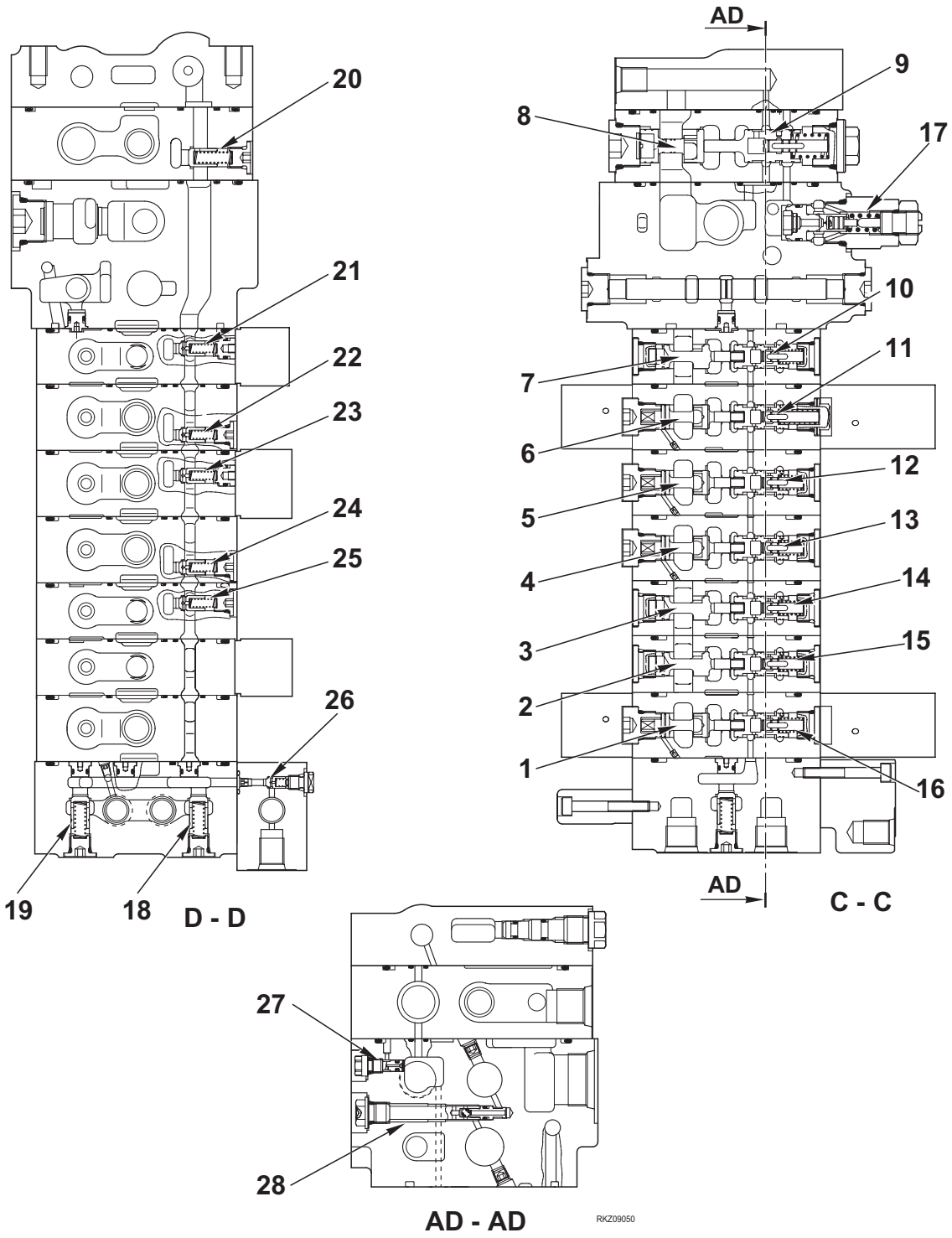
K - K



J - J

RKZ09040

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

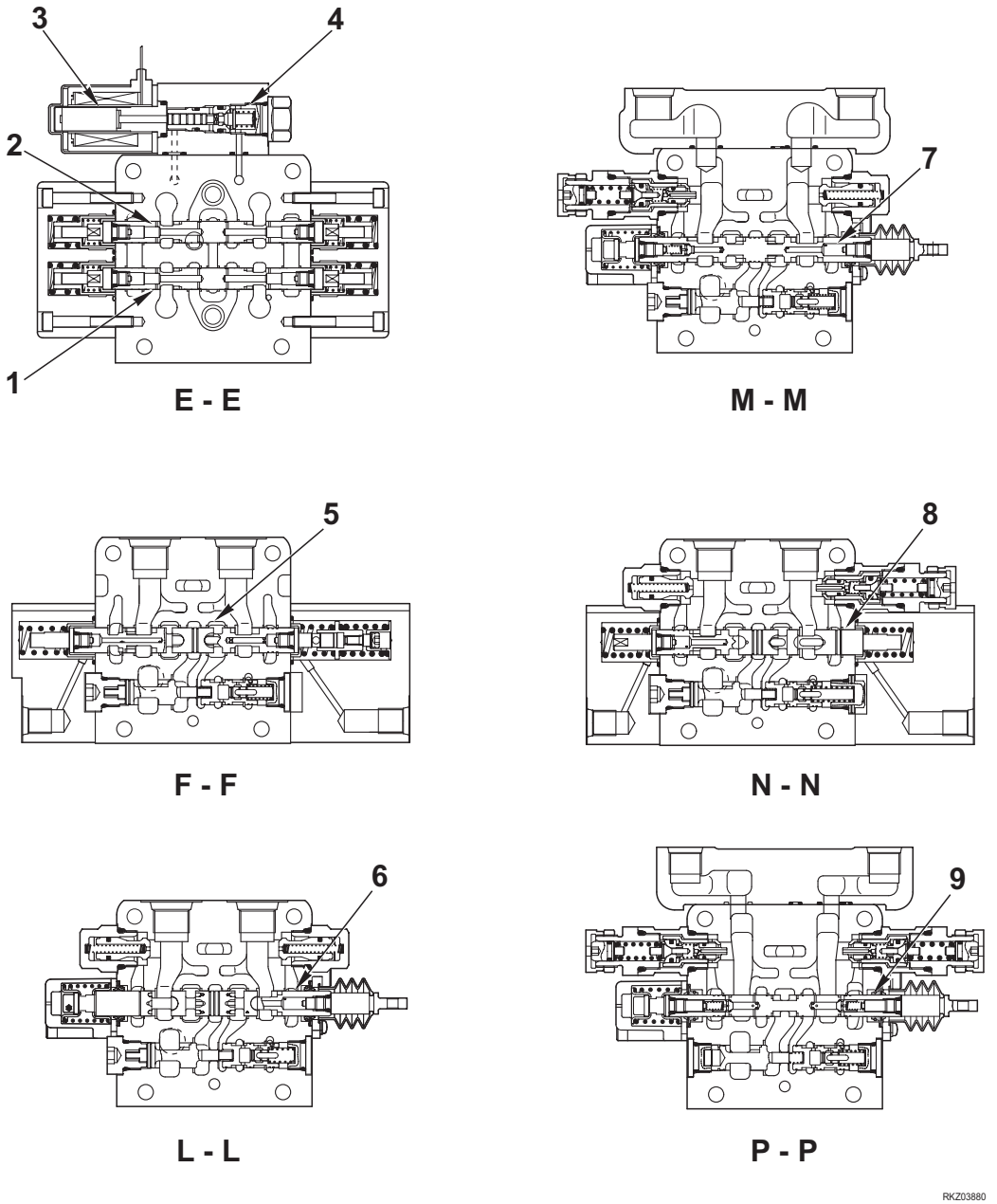


PRESSURE REDUCING VALVE

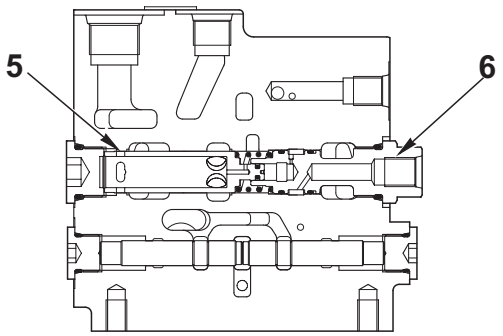
1. Shovel arm
2. Jig arm
3. 4 in 1 bucket
4. Backhoe bucket
5. Boom
6. Front bucket
7. Boom swing
8. Arm

DELIVERY CONTROL VALVE

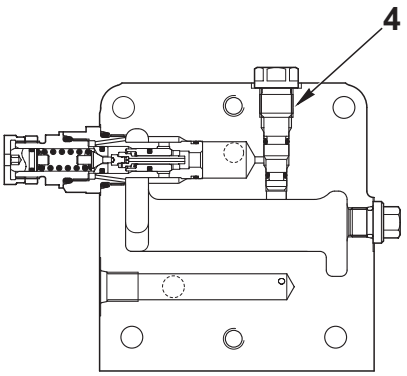
9. Arm
10. Boom swing
11. Front bucket
12. Boom
13. Backhoe bucket
14. 4 in 1 bucket
15. Jig arm
16. Shovel arm
17. Max. pressure valve
18. Check valve
19. Check valve
20. Check valve
21. Check valve
22. Check valve
23. Check valve
24. Check valve
25. Check valve
26. Check valve
27. LS, DLS pressure check valve
28. LS by-pass plug



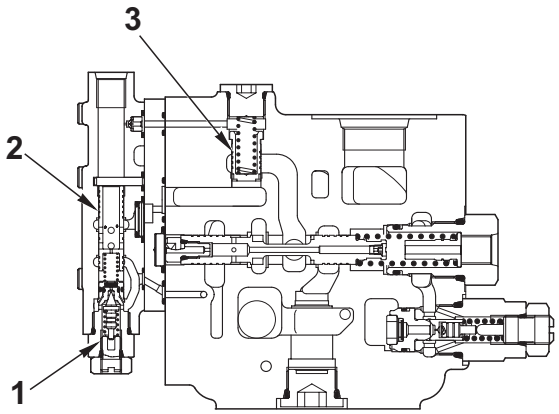
1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)



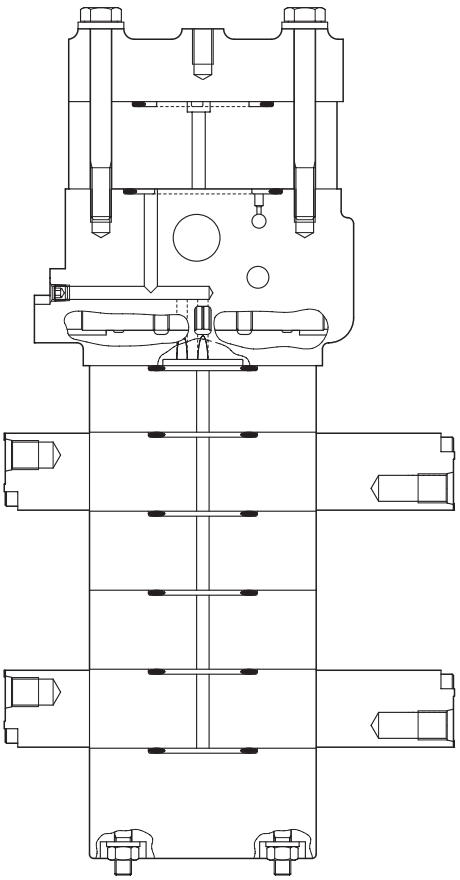
R - R



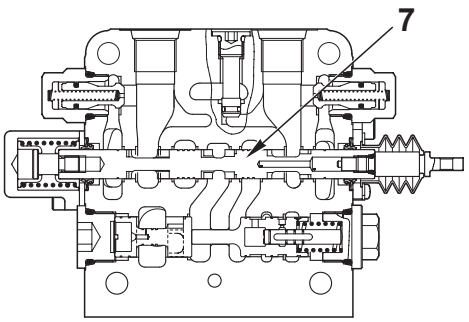
AC - AC



AA - AA



AE - AE

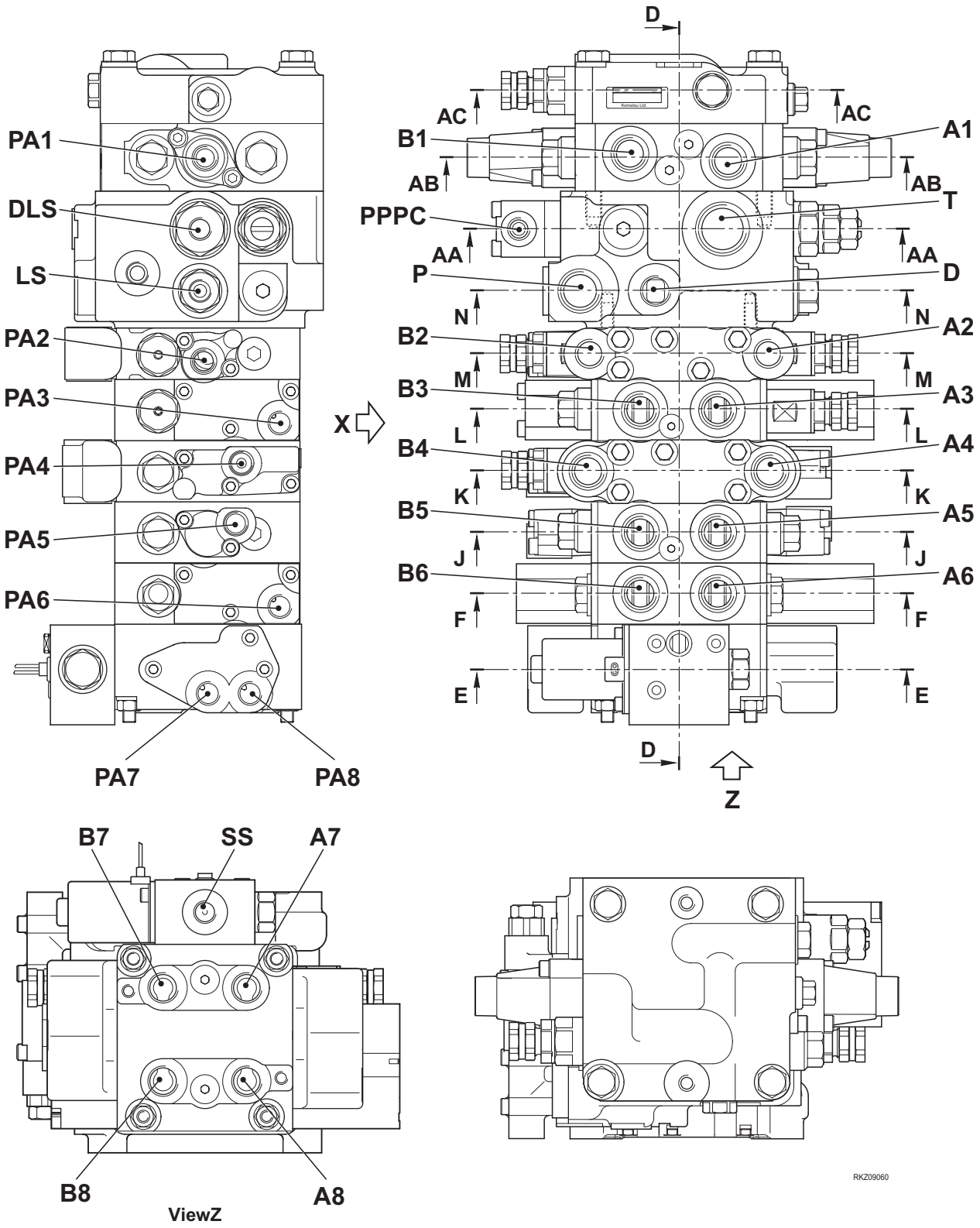


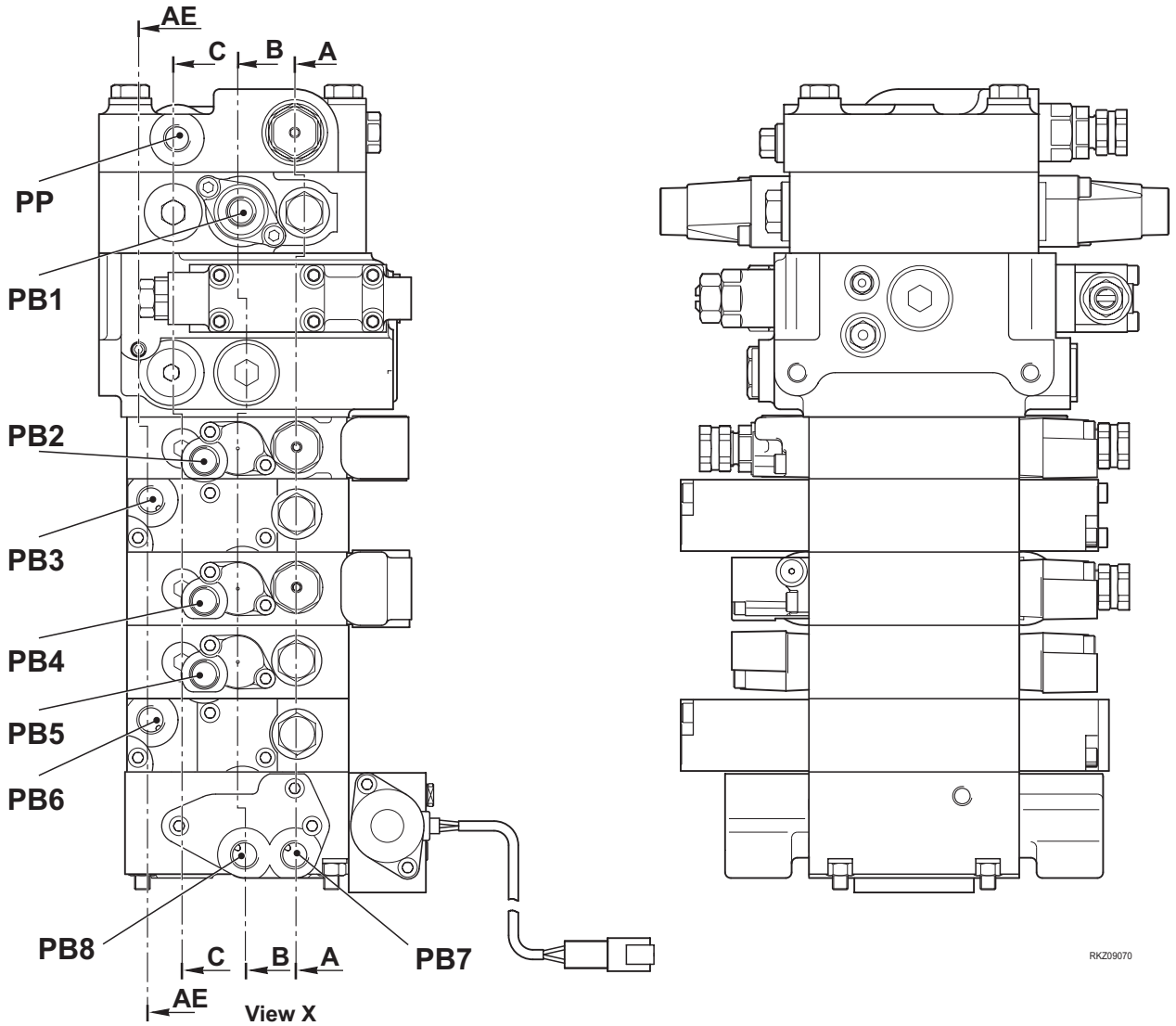
AD - AD

RKZ08891

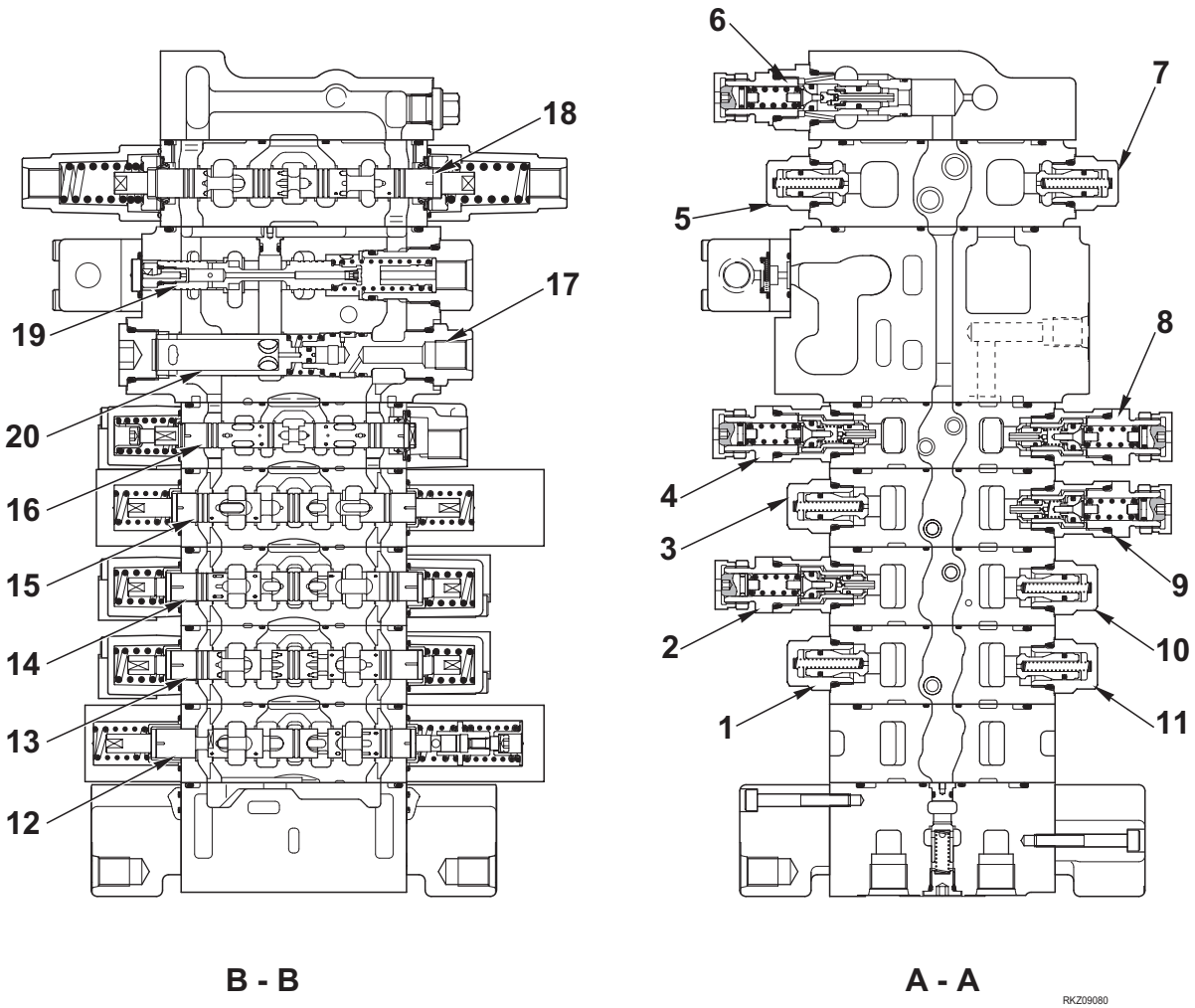
1. Servocontrol max. pressure valve
2. Max. pressure valve spool
3. Sequential reducing valve
4. Blow out plug
5. Unloading valve
7. LS by-pass plug
8. Spool (Arm control)

8-SPOOL CONTROL VALVE (WITH SERVOCONTROL)

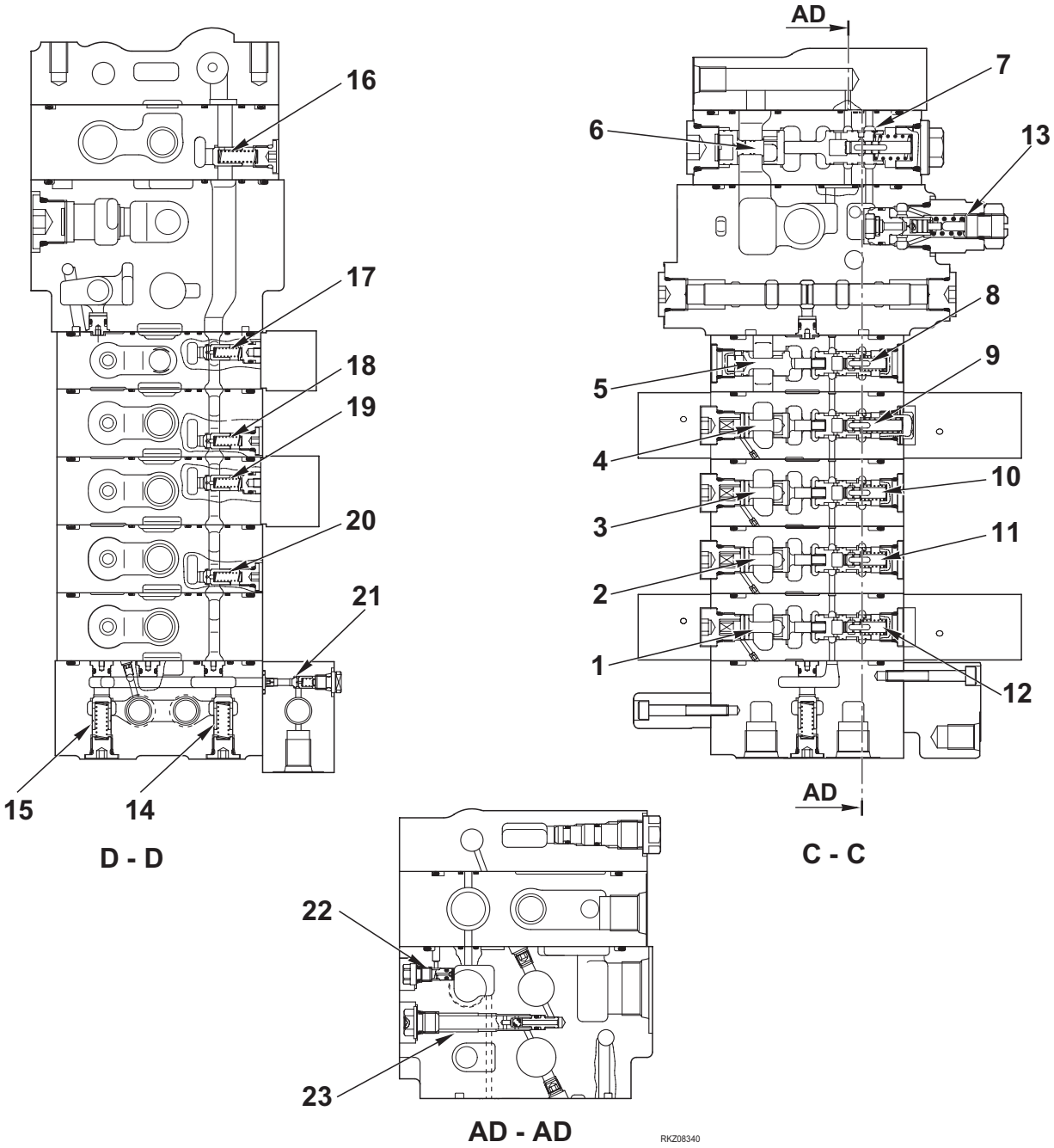




A1 - To the arm cylinder (Head side)
A2 - To the boom (LH-RH) swing cylinder (Bottom side)
A3 - To the shovel cylinders (Bottom side)
A4 - To the boom cylinder (Bottom side)
A5 - To the backhoe bucket cylinder (Head side)
A6 - To the shovel arm raise cylinder (Bottom side)
A7 - To the RH outrigger cylinder (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)



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

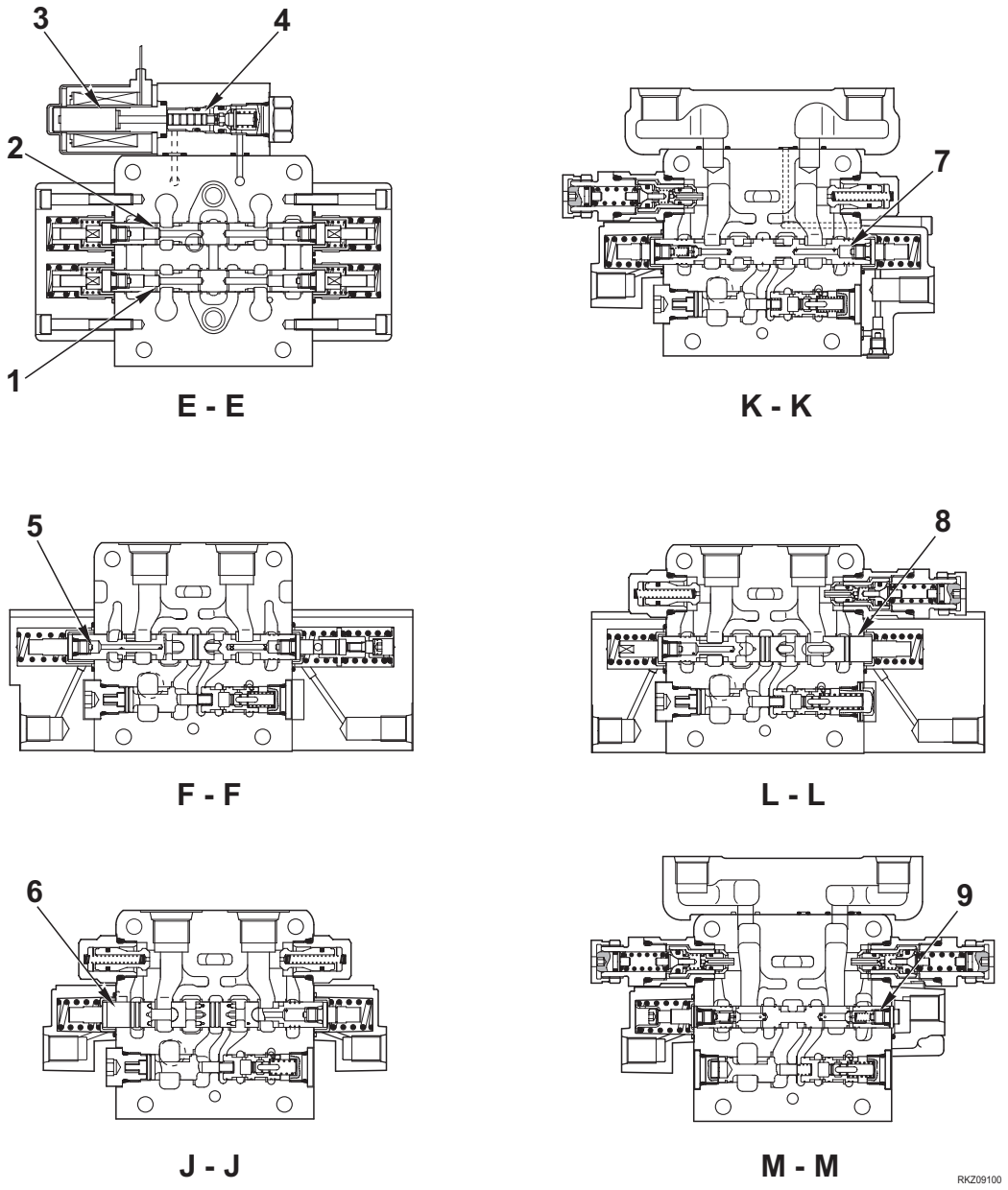


PRESSURE REDUCING VALVE

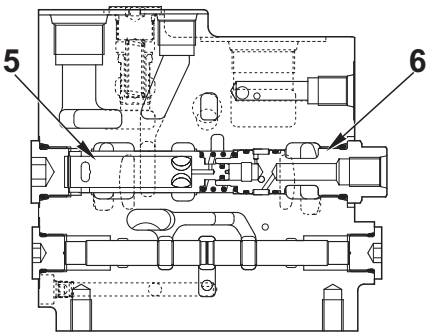
1. Shovel arm
2. Backhoe bucket
3. Boom
4. Front bucket
5. Boom swing
6. Arm

DELIVERY CONTROL VALVE

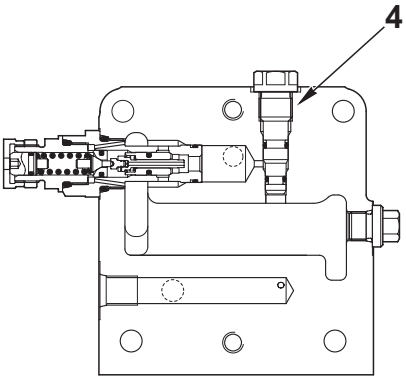
7. Arm
8. Boom swing
9. Front bucket
10. Boom
11. Backhoe bucket
12. Shovel arm
13. Max. pressure valve
14. Check valve
15. Check valve
16. Check valve
17. Check valve
18. Check valve
19. Check valve
20. Check valve
21. Check valve
22. LS, DLS pressure check valve
23. LS by-pass plug



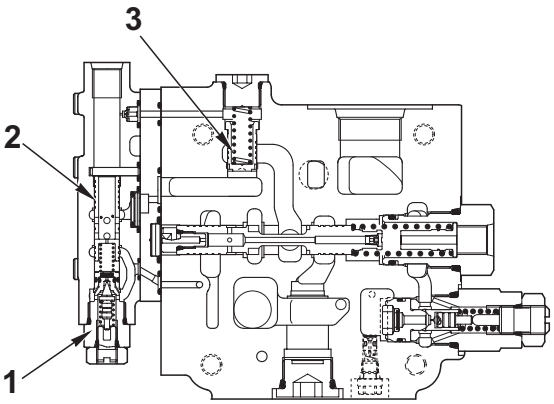
1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)



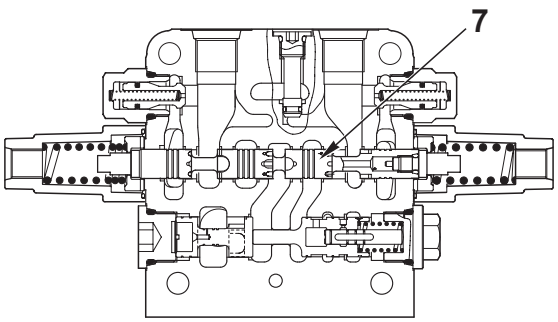
N - N



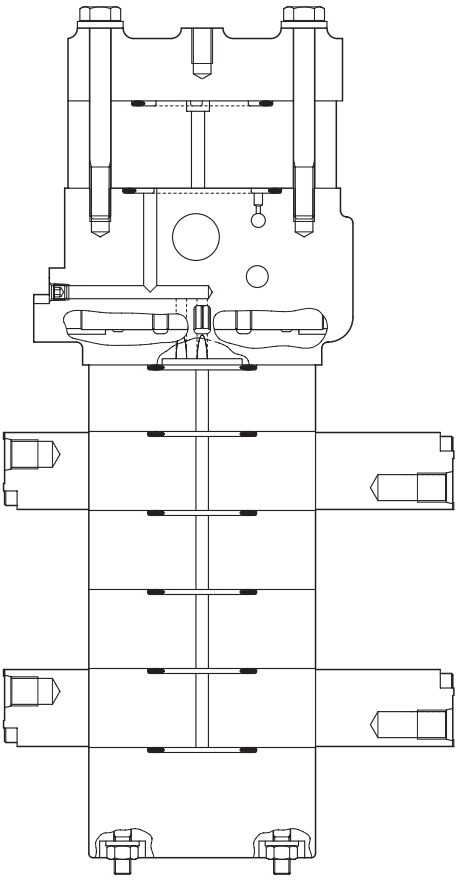
AC - AC



AA - AA



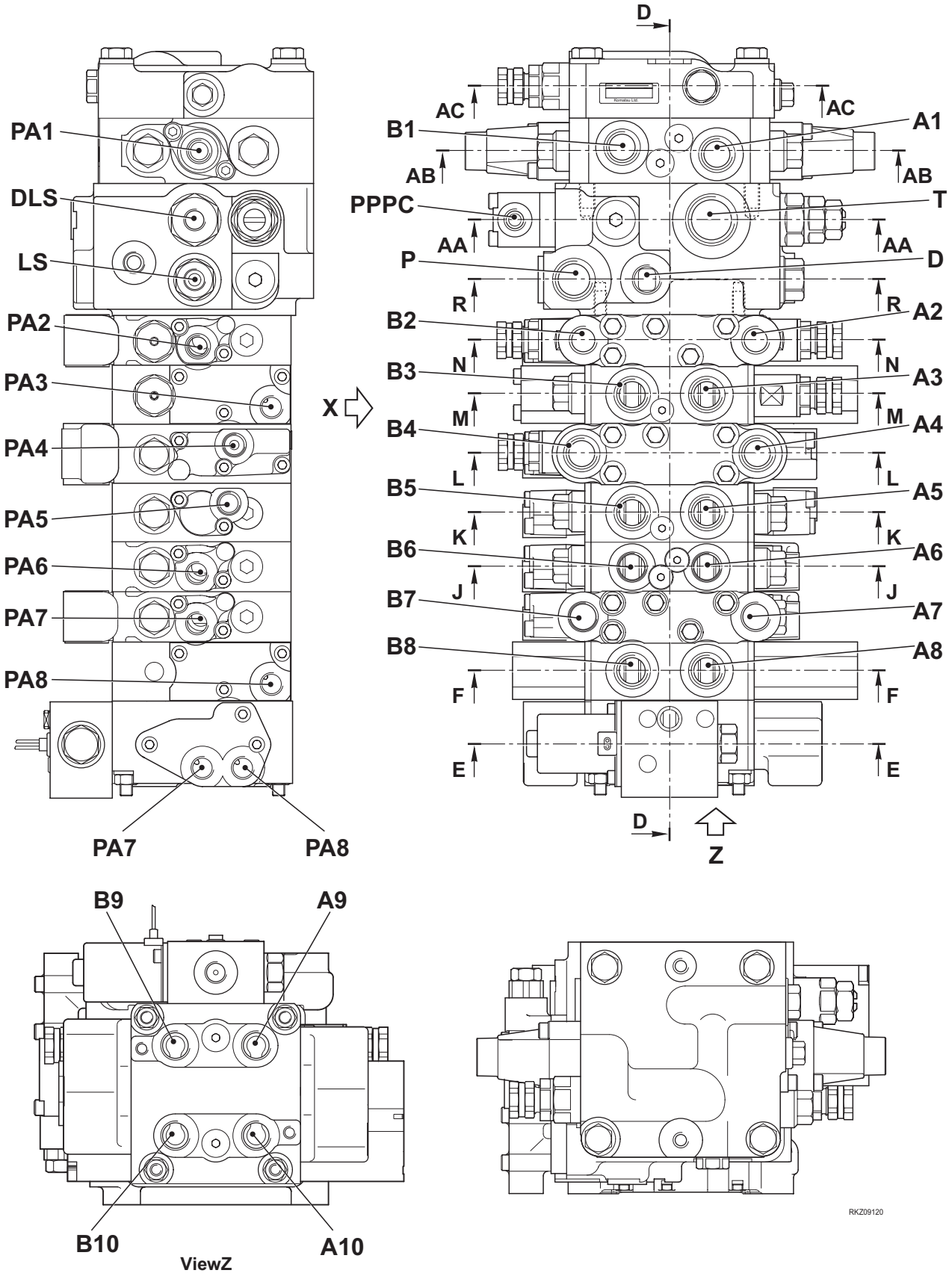
AB - AB

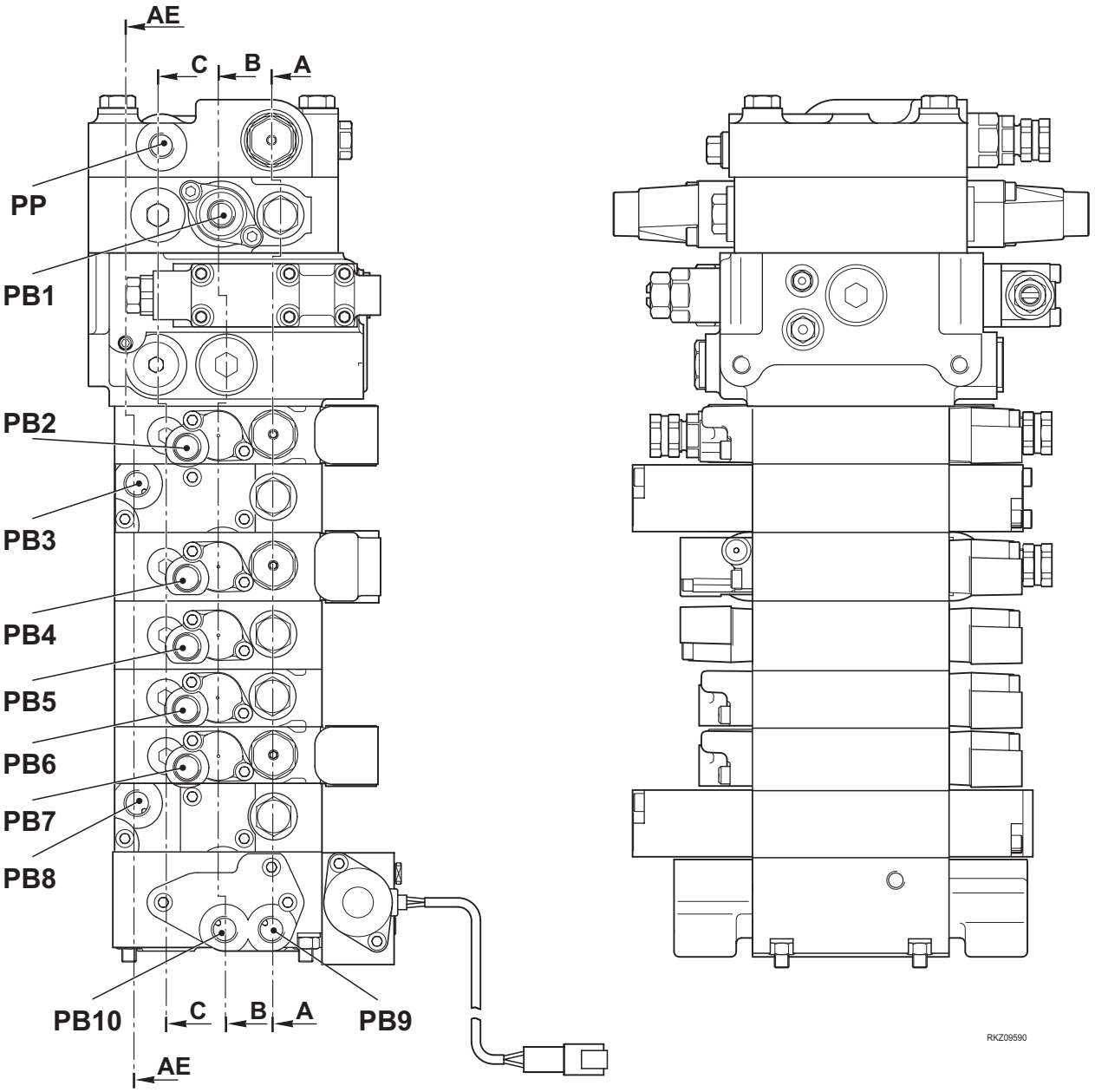


AE - AE

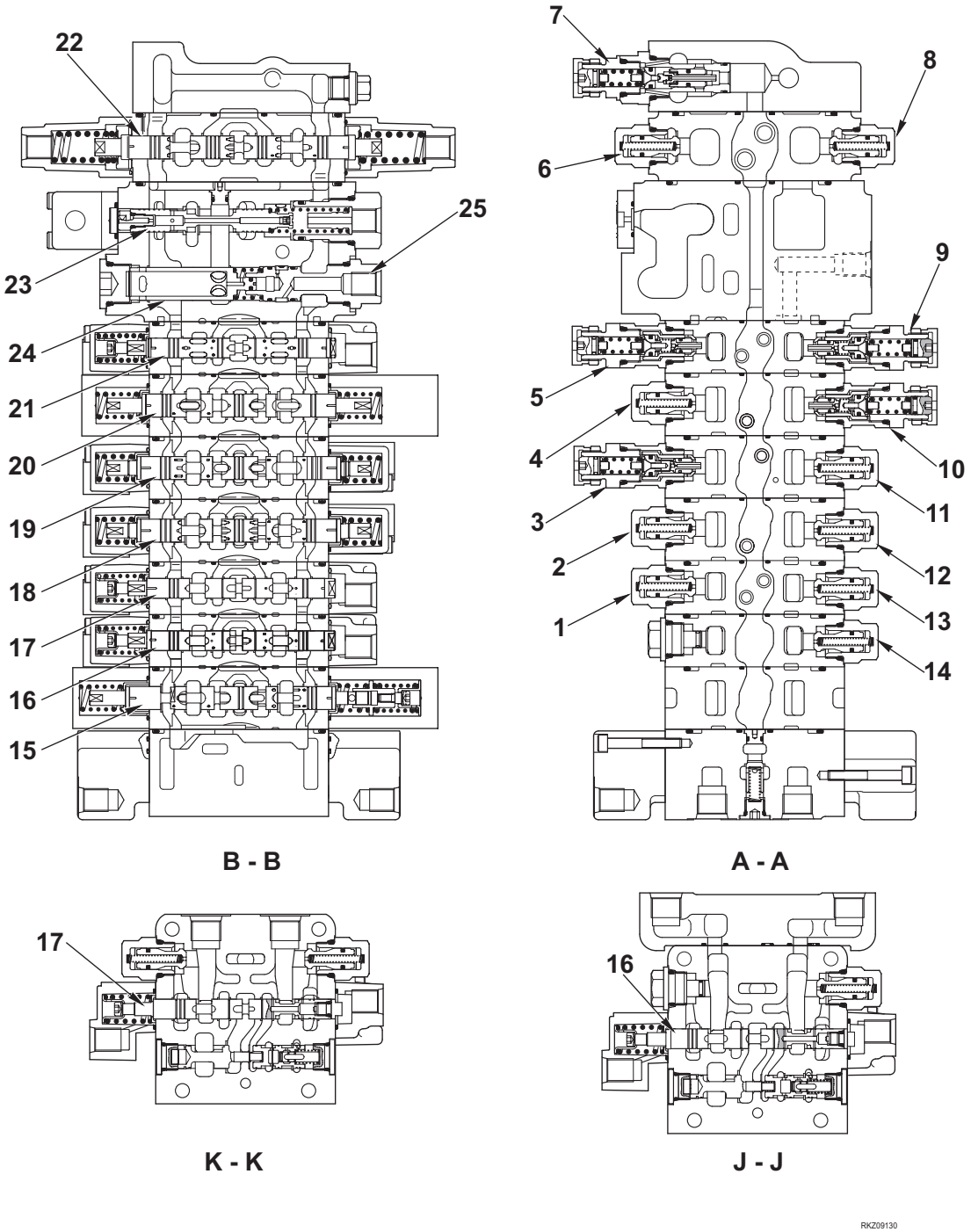
1. Servocontrol max. pressure valve
2. Max. pressure valve spool
3. Sequential reducing valve
4. Blow out plug
5. Unloading valve
6. LS by-pass plug
7. Spool (Arm control)

10-SPOOL CONTROL VALVE (WITH SERVOCONTROL)

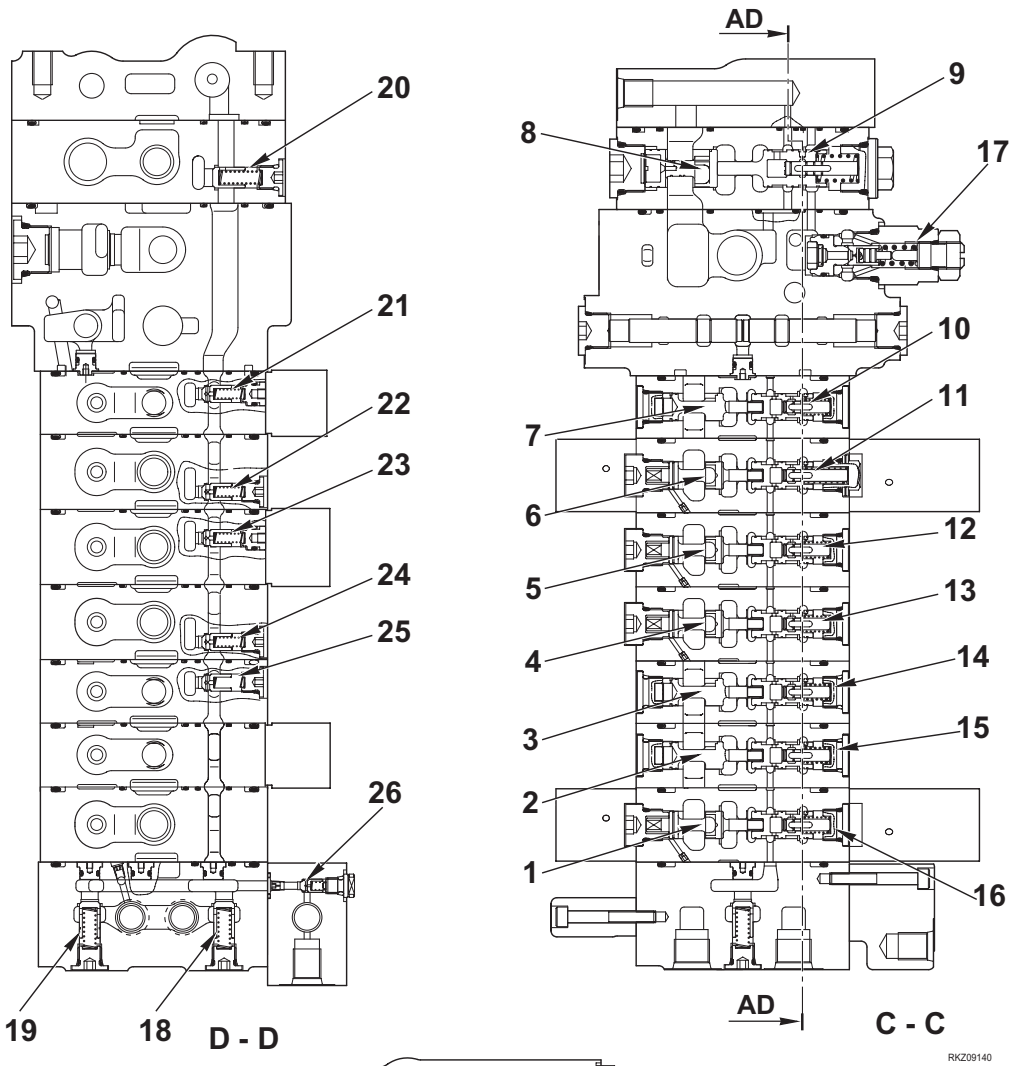


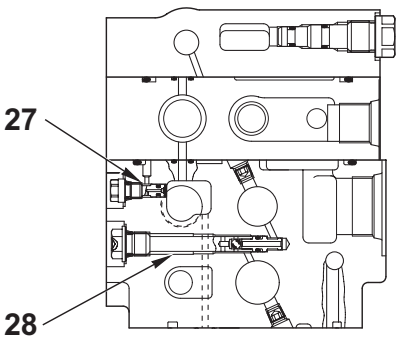

AE
C
B
A
PP
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB10
C
B
A
PB9
AE
RKZ09590

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)



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





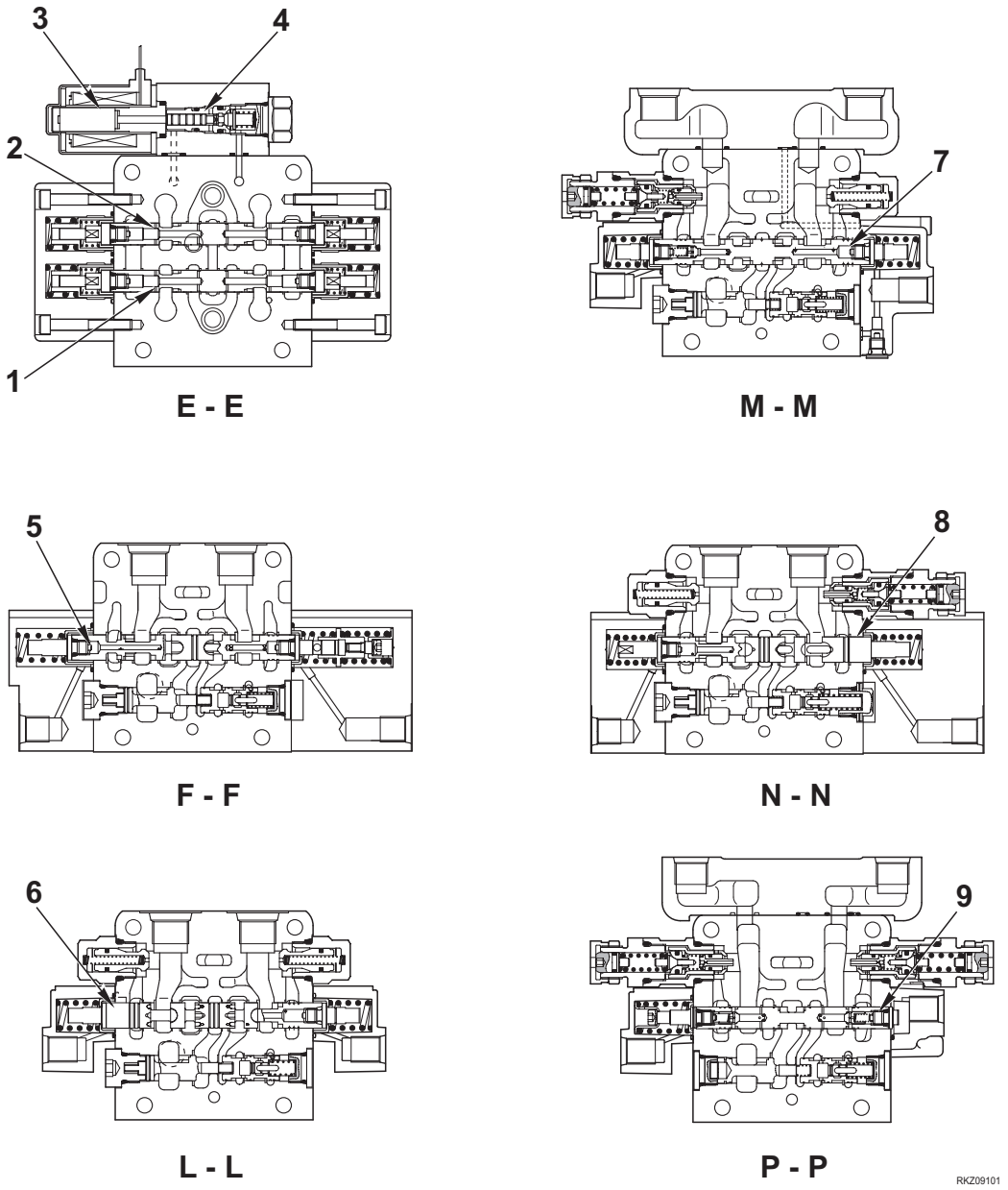
AD - AD

PRESSURE REDUCING VALVE

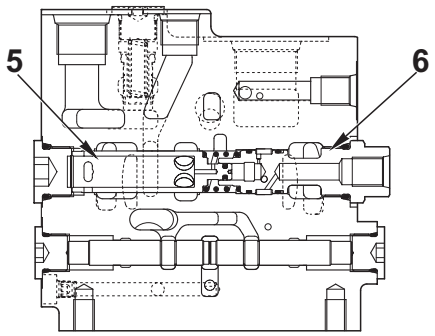
1. Shovel arm
2. Jig arm
3. 4 in 1 bucket
4. Backhoe bucket
5. Boom
6. Front bucket
7. Boom swing
8. Arm

DELIVERY CONTROL VALVE

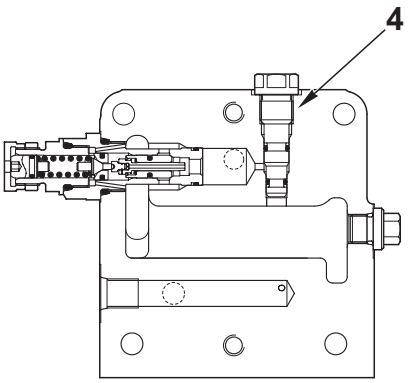
9. Arm
10. Boom swing
11. Front bucket
12. Boom
13. Backhoe bucket
14. 4 in 1 bucket
15. Jig arm
16. Shovel arm
17. Max. pressure valve
18. Check valve
19. Check valve
20. Check valve
21. Check valve
22. Check valve
23. Check valve
24. Check valve
25. Check valve
26. Check valve
27. LS, DLS pressure check valve
28. LS by-pass plug



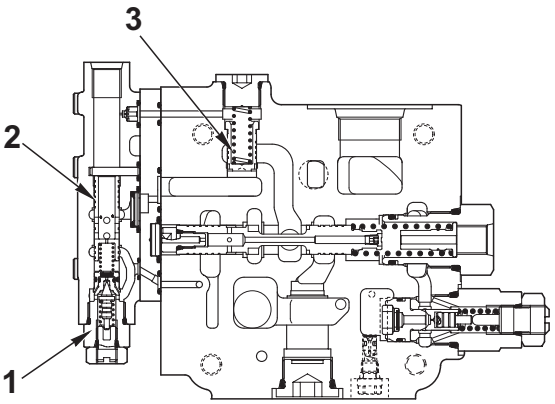
1. Spool (right outrigger control)
2. Spool (left outrigger control)
3. Backhoe plate lock solenoid valve
4. Backhoe plate lock valve
5. Spool (shovel arm control)
6. Spool (backhoe bucket control)
7. Spool (Boom control)
8. Spool (front bucket control)
9. Spool (boom swing control)



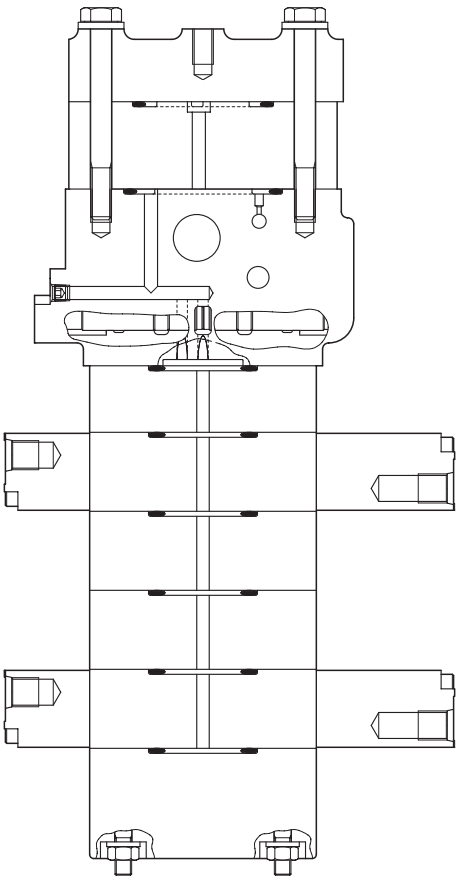
R - R

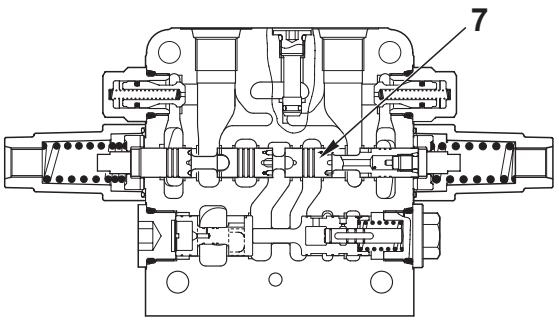


AC - AC



AA - AA





AB - AB

RKZ09111

AE - AE

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

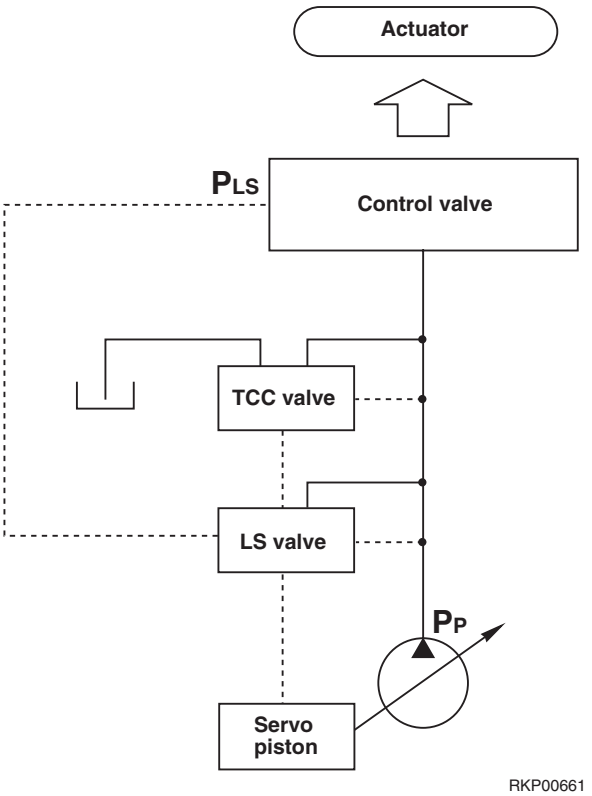
1.1 CHARACTERISTICS

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

a) High precision control that is independent of the load applied to the movement;
b) High precision control of digging action even during delicate manoeuvres;
c) Ability to perform complex operations, guaranteed by control of oil flow in function of the aperture surfaces of the shuttles;
d) 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.

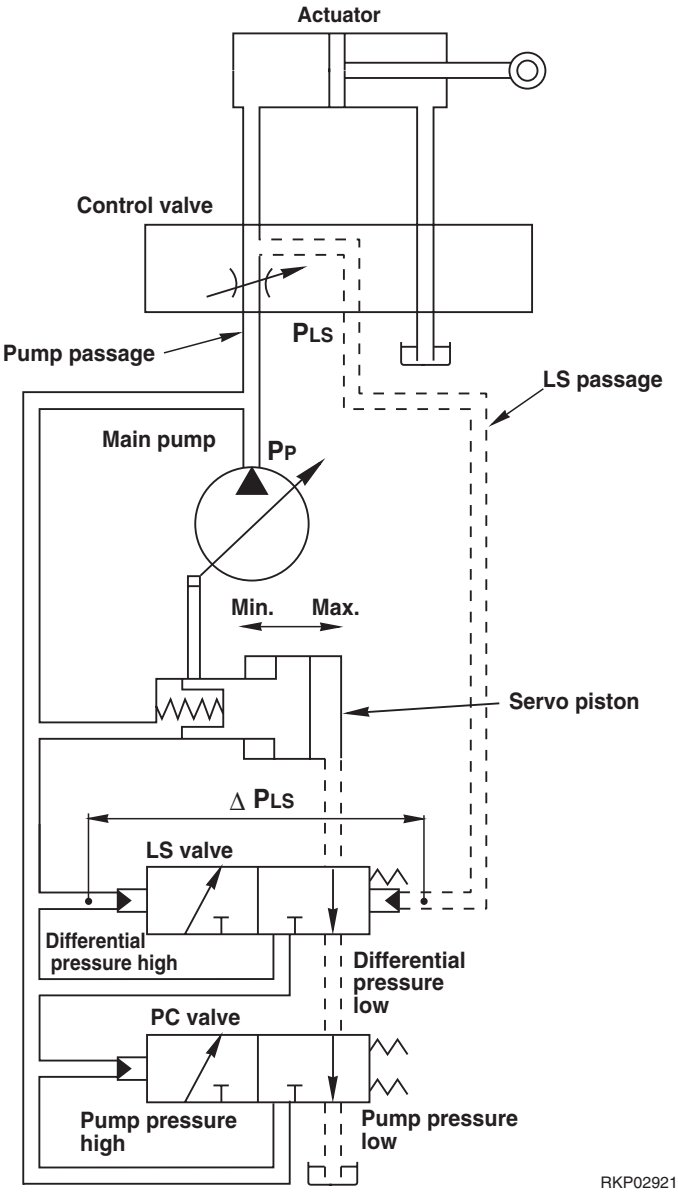


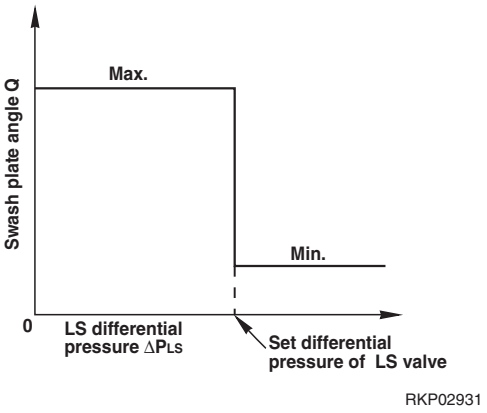
2. OPERATING PRINCIPLES

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.

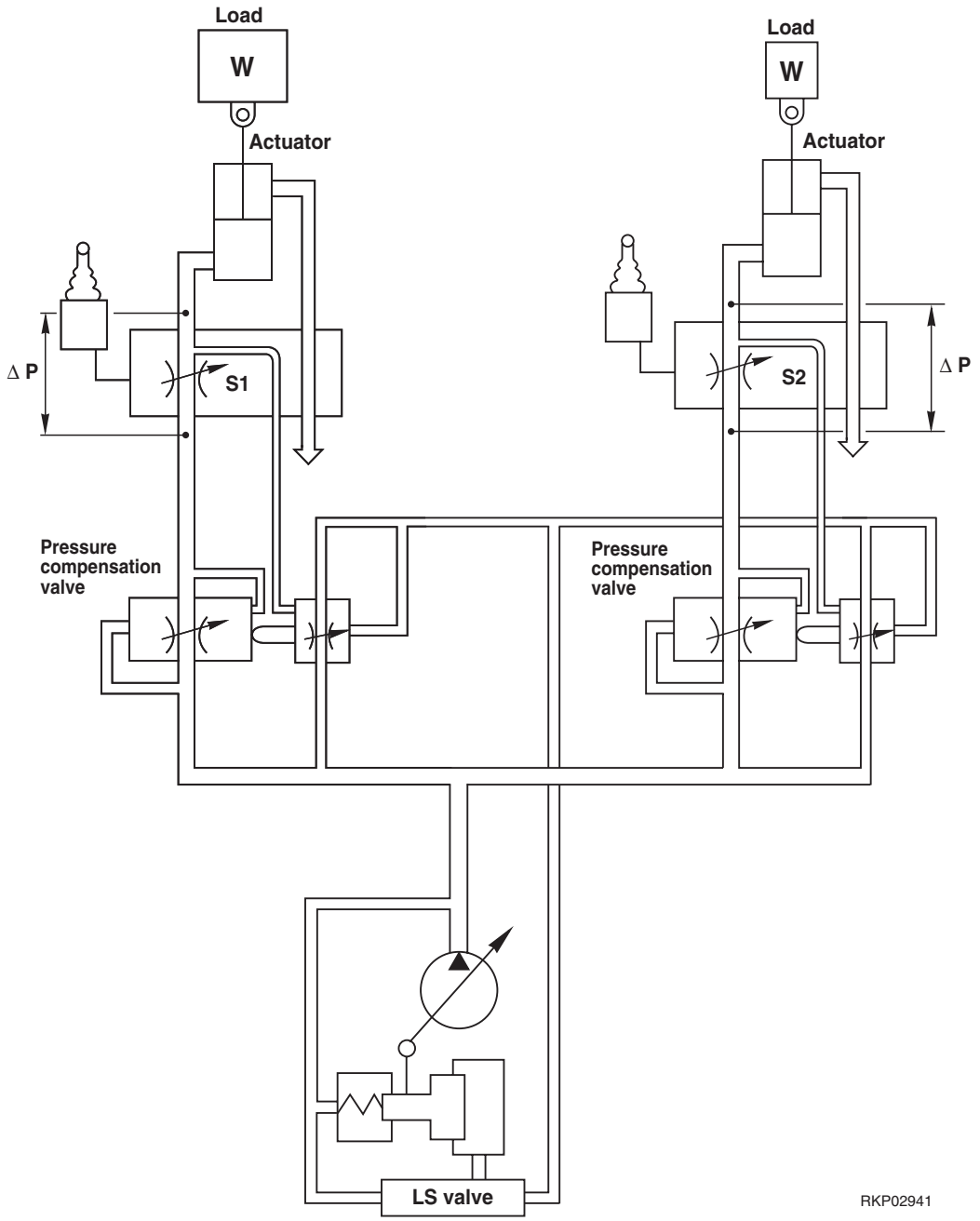
★ For details about this movement, see the description of the "HYDRAULIC PUMP".





2.2 PRESSURE COMPENSATION CONTROL

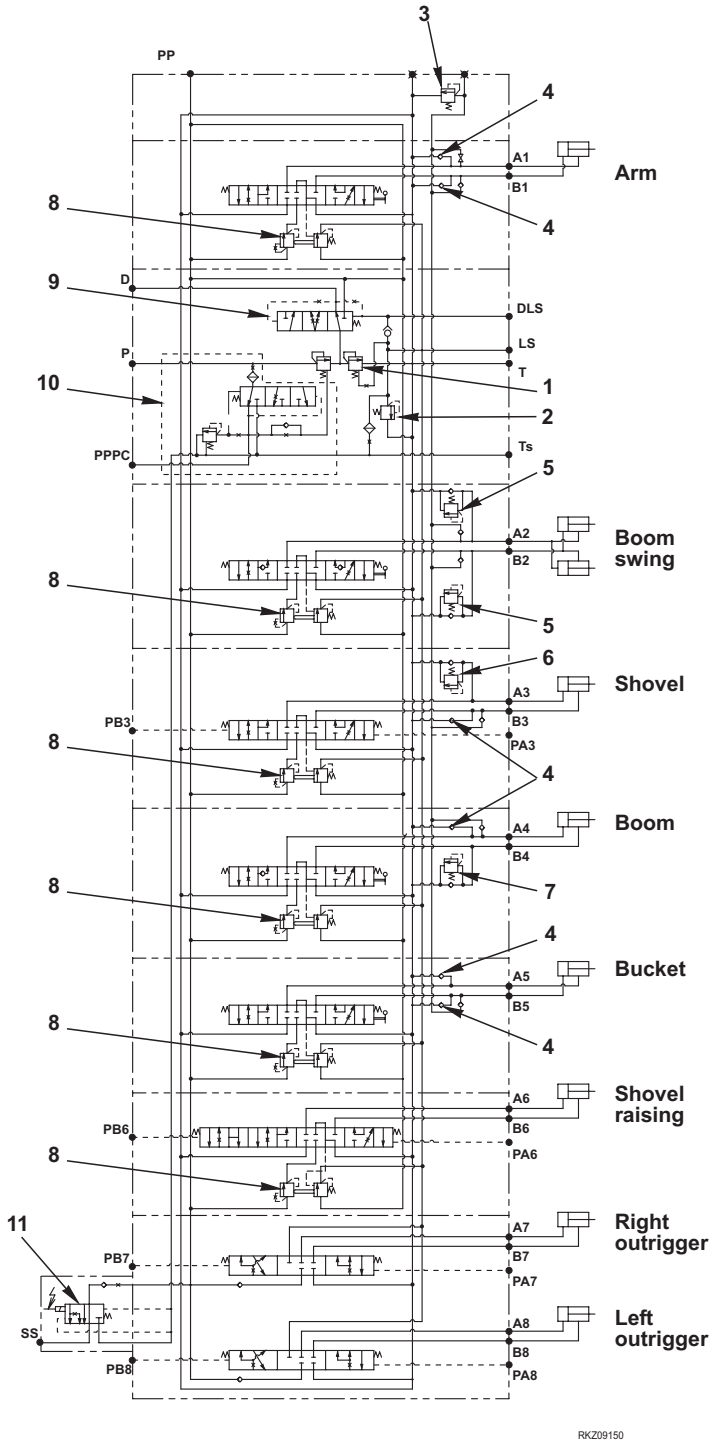
- The pressure compensation valves are installed downstream from the control valve in order to balance the differential pressure between the loads.
  When two or more movements (cylinders) are activated simultaneously, the pressure differences **DP** between the delivery at the control valve inlet and 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.



3. OPERATION FOR EACH CIRCUIT AND VALVE

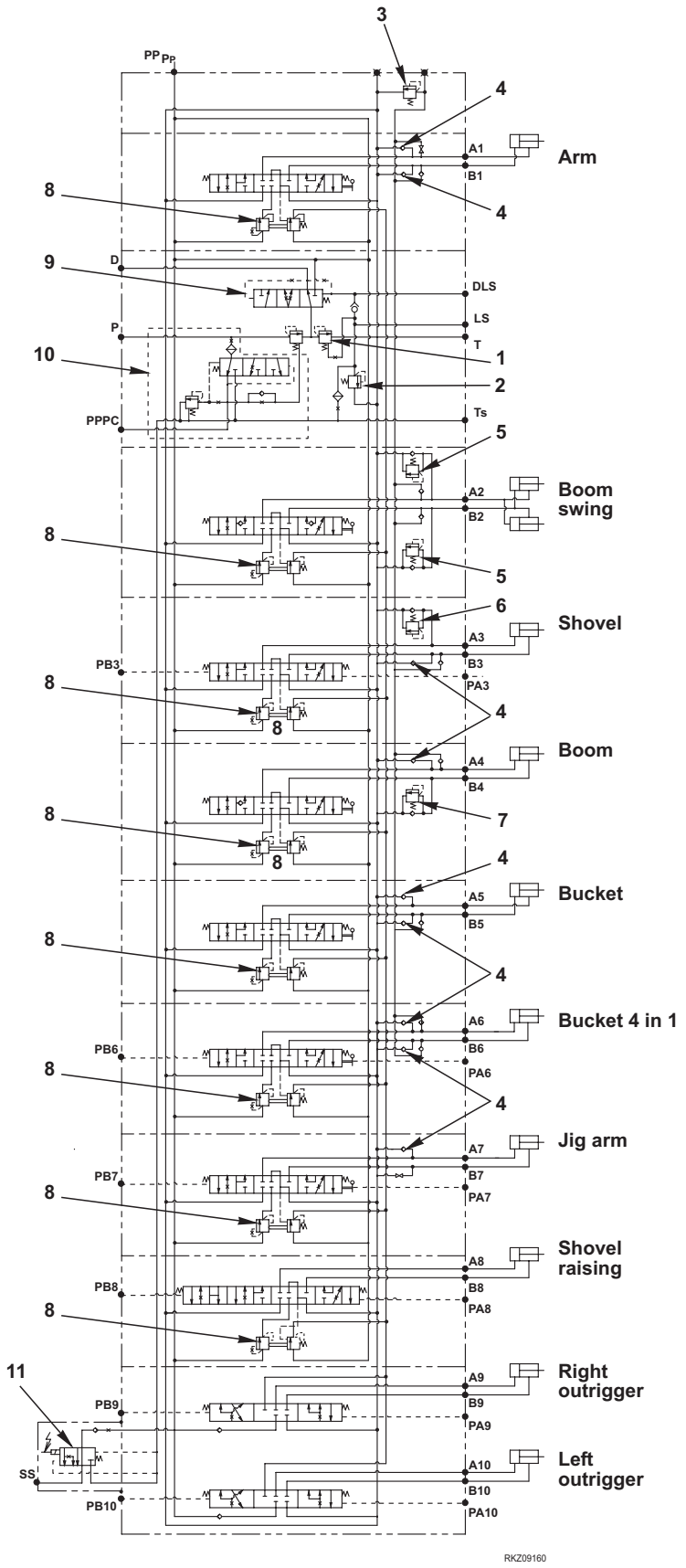
3.1 HYDRAULIC CIRCUIT DIAGRAM AND NAMES OF VALVES

3.1.1 8-spool control valve (with mechanical control)



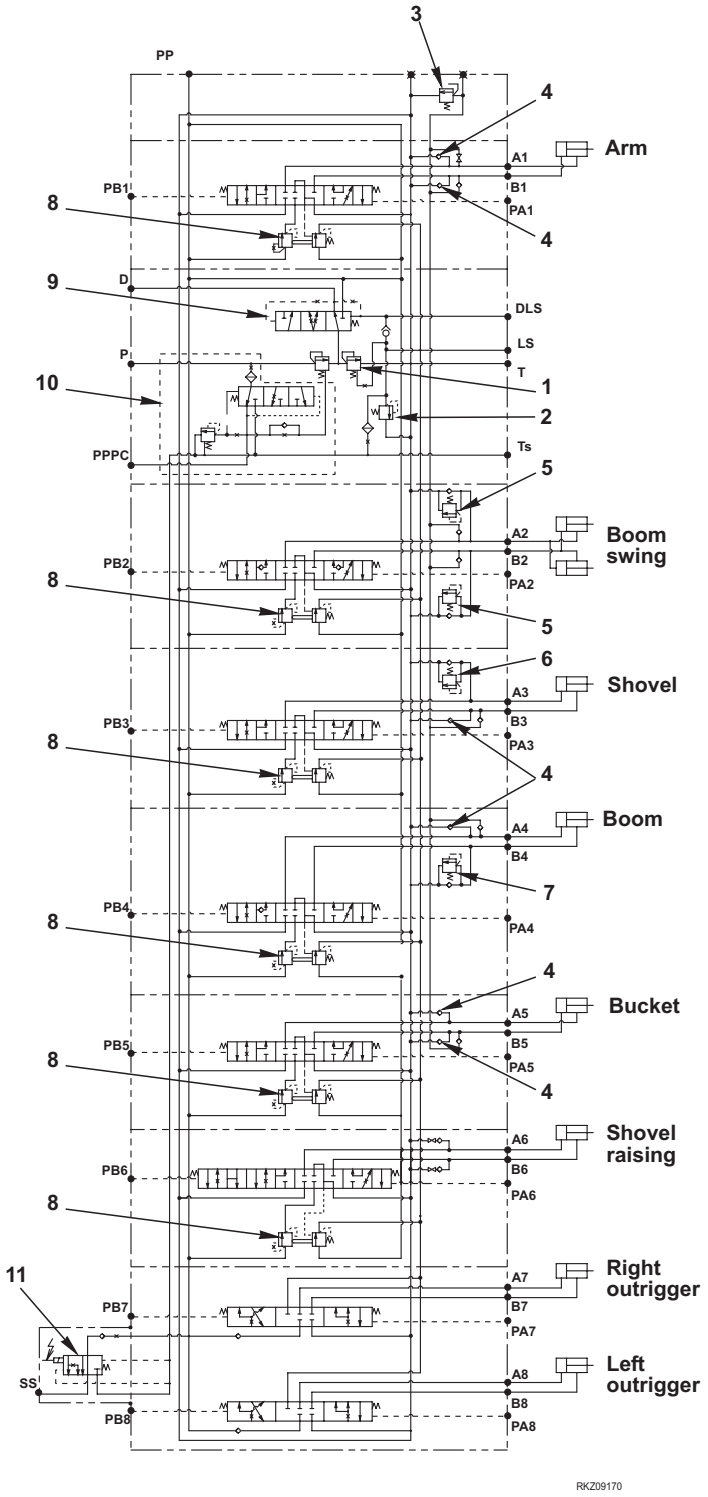
1. Unloading valve: pressure LS + 27.5 bar
2. Max. pressure valve: 218 bar
3. Safety valve: 270 bar
4. Check valve
5. Anti-shock/anticavitation valve: 215 bar
6. Anti-shock/anticavitation valve: 220 bar
7. Anti-shock/anticavitation valve: 350 bar
8. Pressure compensation valves
9. Priority valve
10.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

3.1.1 10-spool mechanical control valve (with mechanical control)



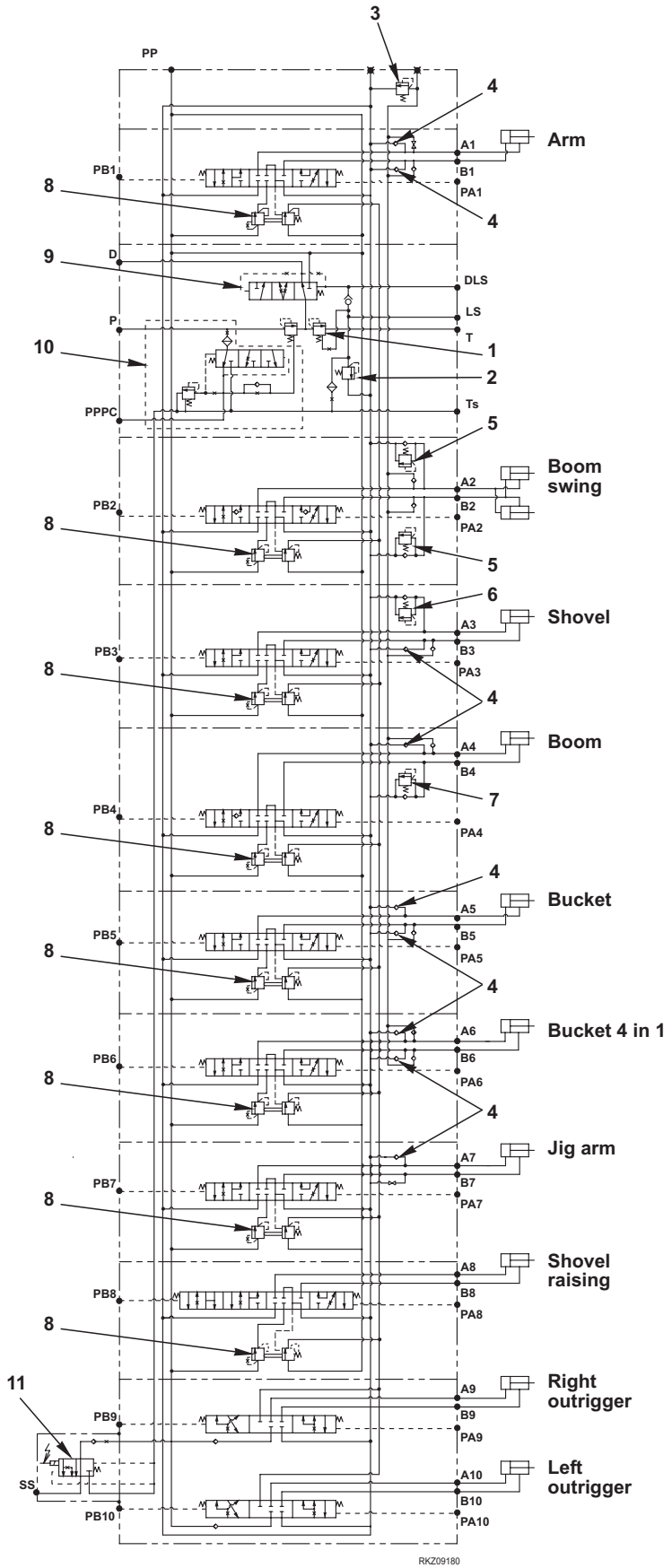
1. Unloading valve: pressure LS + 27.5 bar
2. Max. pressure valve: 218 bar
3. Safety valve: 270 bar
4. Check valve
5. Anti-shock/anticavitation valve: 215 bar
6. Anti-shock/anticavitation valve: 220 bar
7. Anti-shock/anticavitation valve: 350 bar
8. Pressure compensation valves
9. Priority valve
10.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

3.1.1 8-spool control valve (with servocontrol)



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

3.1.4 10-spool control valve (with servocontrol)



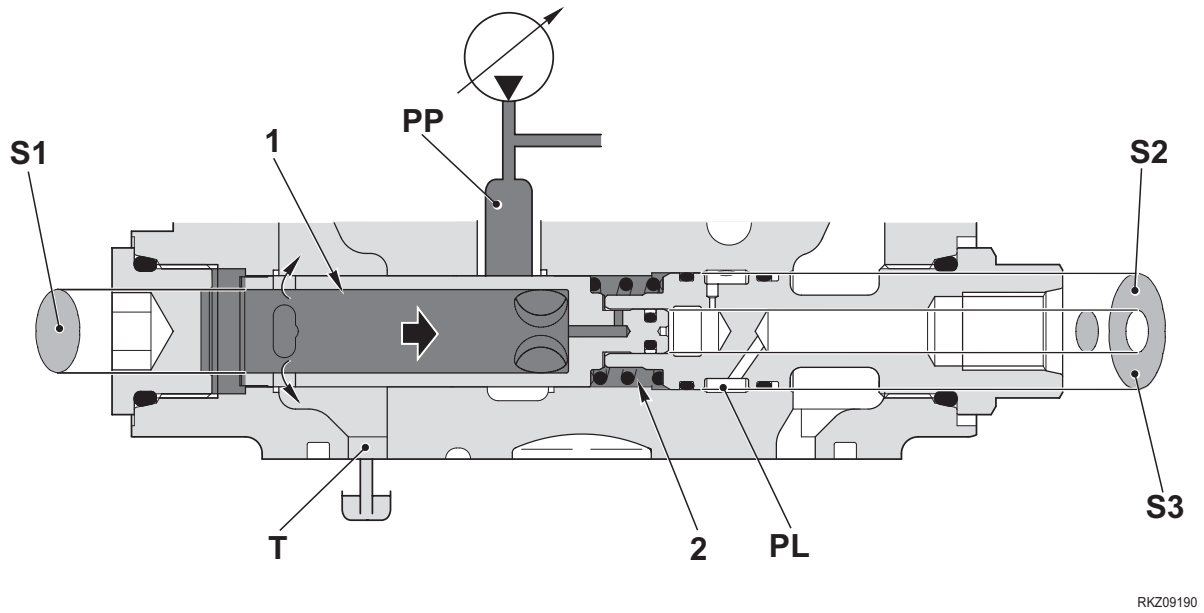
1. Unloading valve: pressure LS + 27.5 bar
2. Max. pressure valve: 218 bar
3. Safety valve: 270 bar
4. Check valve
5. Anti-shock/anticavitation valve: 215 bar
6. Anti-shock/anticavitation valve: 220 bar
7. Anti-shock/anticavitation valve: 350 bar
8. Pressure compensation valves
9. Priority valve
10.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

3.2 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^2) by means of the spring (2) inside the valve.
  (**LS** signal with **PLS** pressure=0 bar (0 kg/cm^2)



Functioning

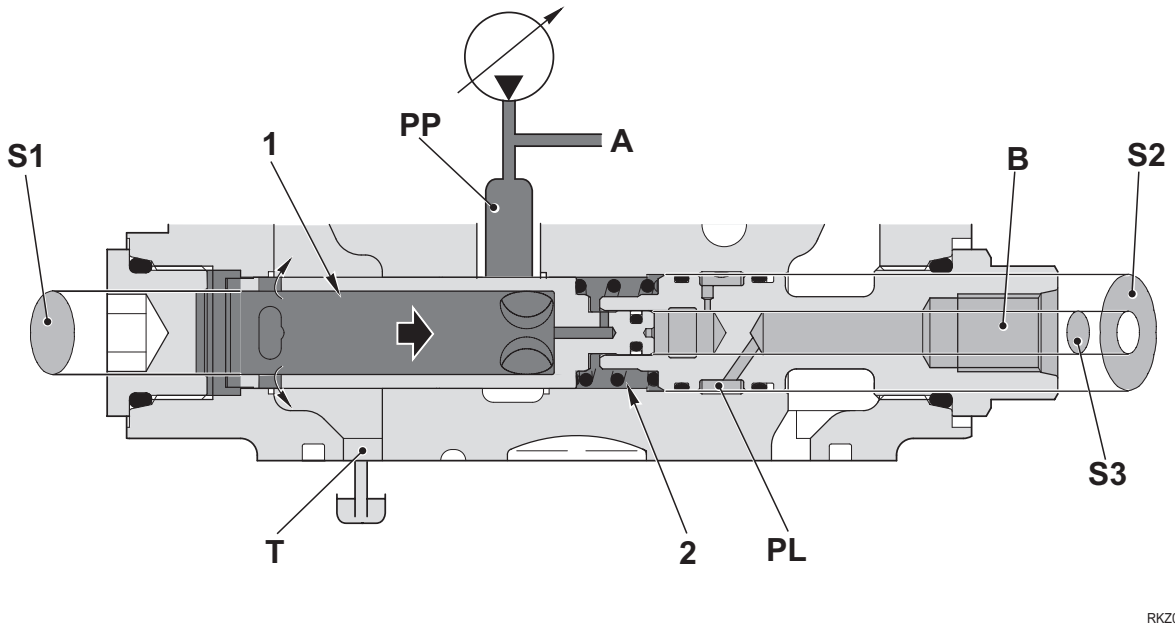
- Pump pressure **PP** acts on spool (1) – left, on surface **S1**, and right, on surface **S2** – whereas Load Sensing pressure **PLS** acts on surface **S2**.
- Since no **LS** signal with **PLS** pressure is generated when the control valve is in “NEUTRAL” position, the only pressure acting on spool (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^2).

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^2). 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^2)), the differential pressure **DPLS** becomes 27.5 bar (28 kg/cm^2).



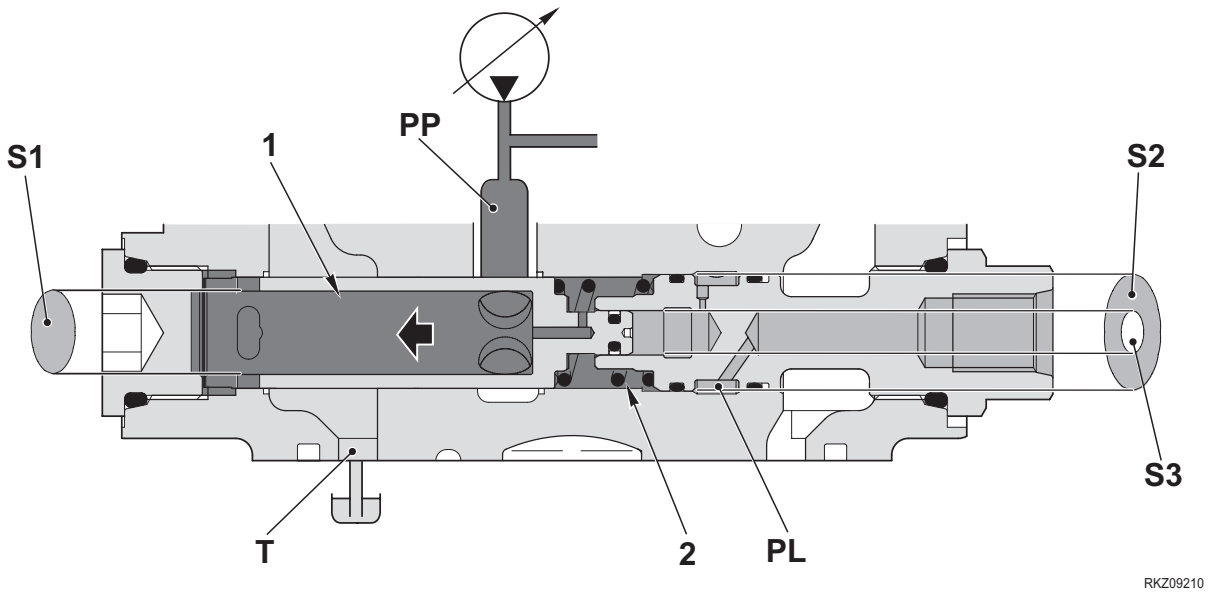
Functioning

- 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^2)), 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^2)) and the pressure **PLS** of the **LS**, i.e. when the differential pressure **DPLS** reaches a value of 27.5 bar (28 kg/cm^2).

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.



Functioning

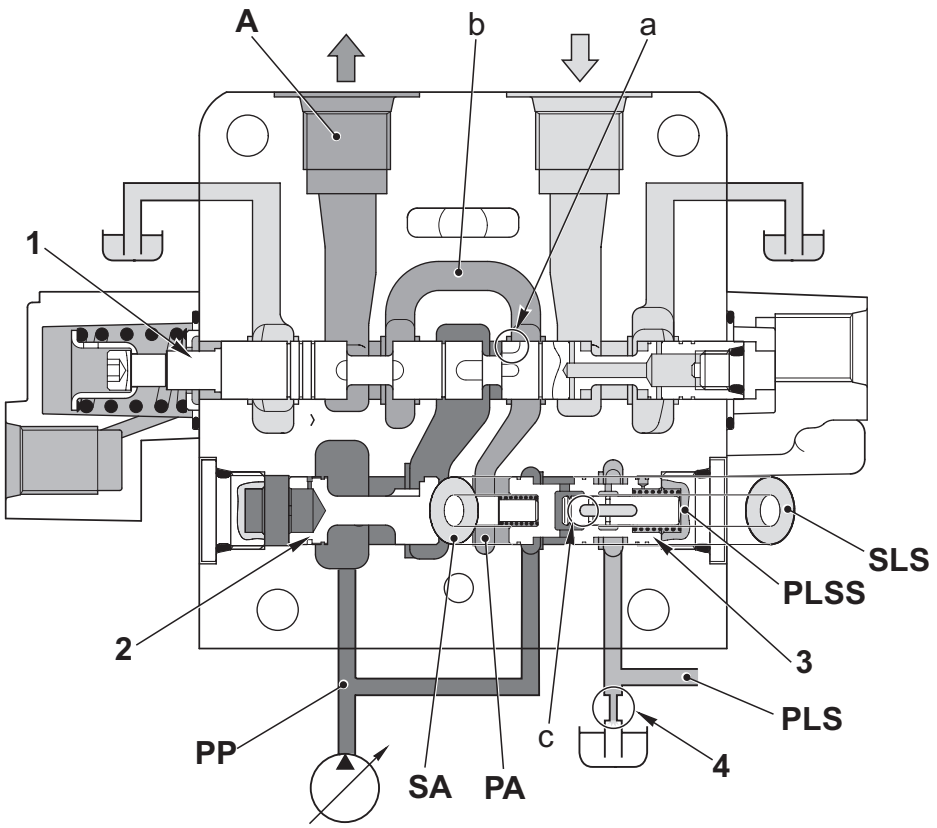
- When the control valve spool is caused to perform a longer travel, this generates a pressure **PLS** of the **LS**, which acts on the right hand side of the spool (1). Since the control valve passage is wide, the difference between the pressure **PLS** of the **LS** and the pump's delivery pressure **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^2), 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).

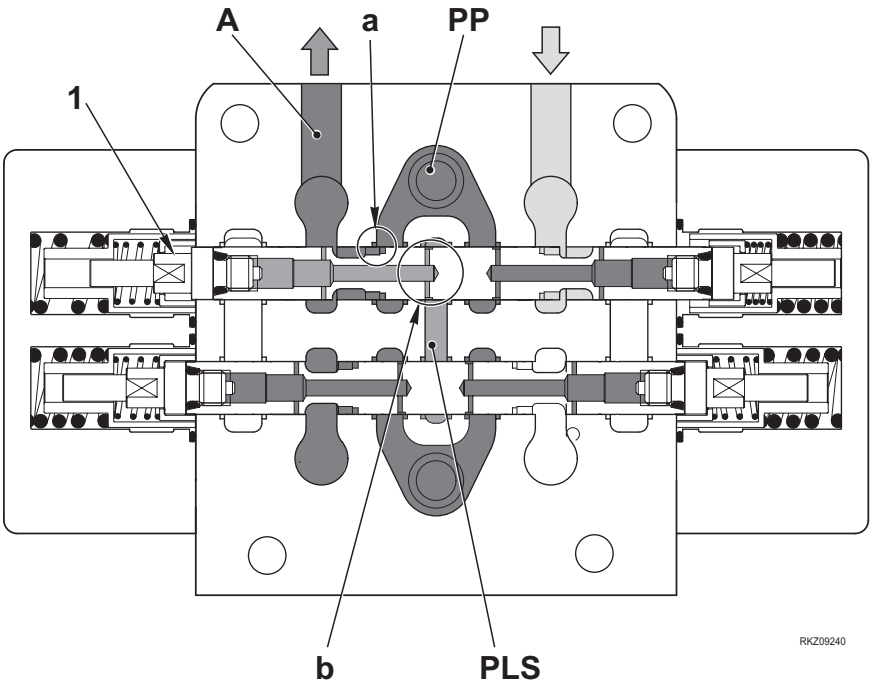


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Functioning

- 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

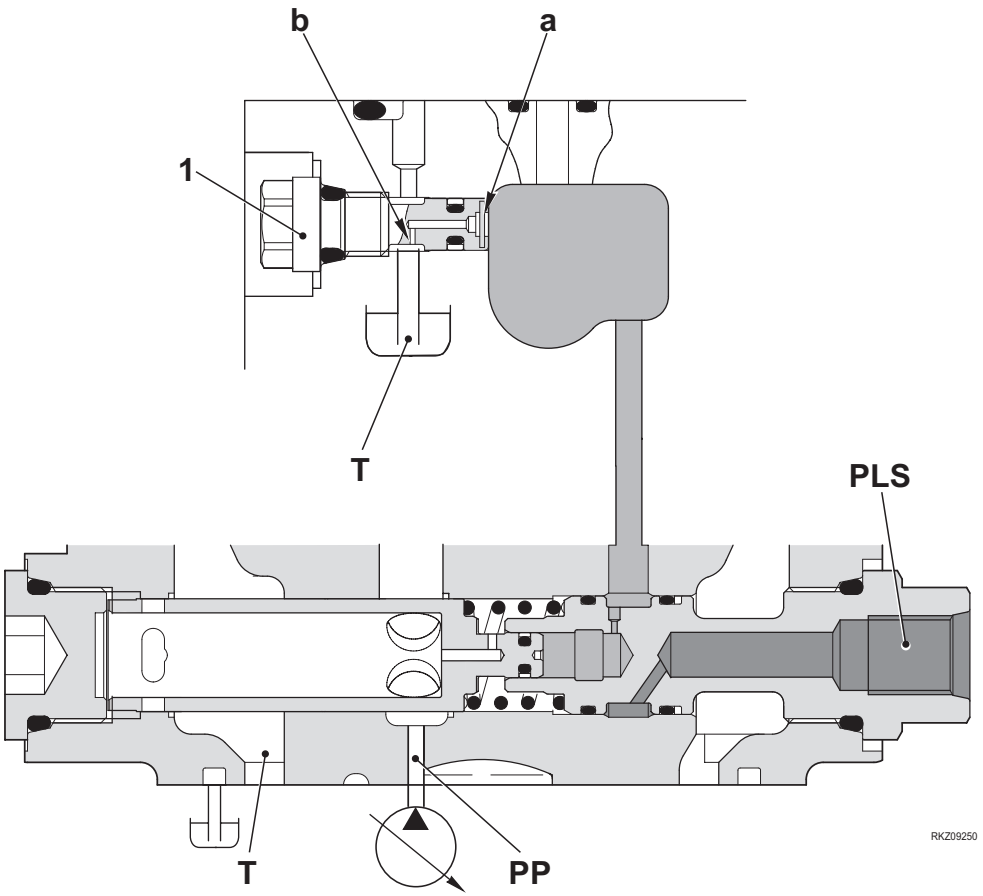
- When the spool (1) is operated, pump pressure **PP** starts flowing into the circuit of actuator **A** through the duct **a**.
- At the same time, pressurised oil is introduced into the **PLS** circuit of the **LS** through holes **b**.

★ 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

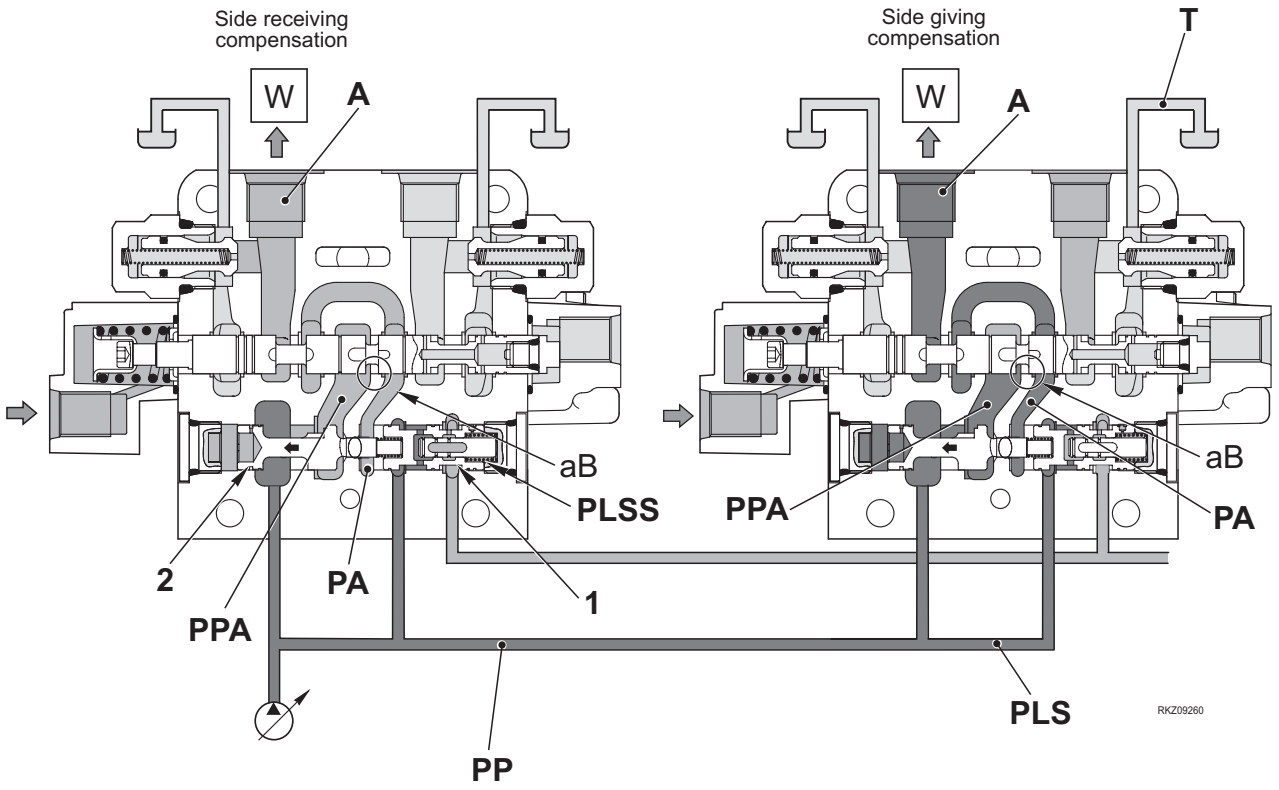
- Pressurised oil in the Load Sensing **PLS** circuit flows through filter **a**, through orifice **b** and into the tank circuit **T**.

PP = Pump circuit
PLS = Load Sensing circuit
T = Drain circuit

3.5 PRESSURE COMPENSATION VALVES

Function

- Pressure compensation occurs during simultaneous operation of several movements, specifically when the pressure of an actuator becomes lower than the pressure of the actuator on the opposite side, and pump delivery is on the verge of being increased.
  In this specific case, the RH actuator withstands a higher pressure than the LH actuator.



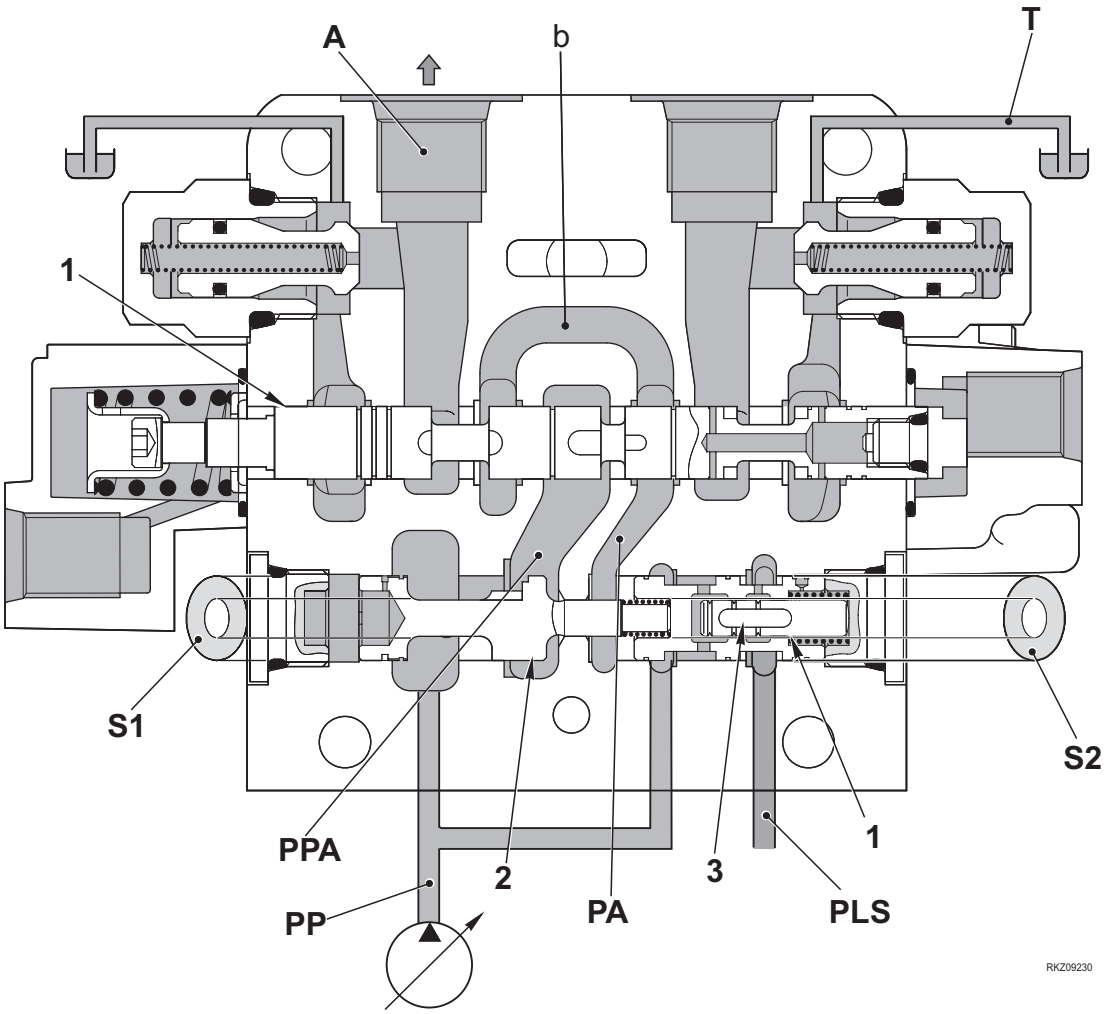
Functioning

- During simultaneous operation, when RH actuator pressure increases, delivery in circuit **A** of the LH actuator tends to increase.
- In this case, the **PLS** pressure of the **LS** for the RH actuator acts on chamber **PLS1** of the spring and pushes the pressure reducing valve (1) and the delivery control valve (2) to the left.
- The delivery control valve (2) produces a bottleneck between the pump's delivery **PP** circuit and the **PPA** circuit upstream of the control valve spool.
  This bottleneck generates a pressure loss between circuits **PP** and **PPA**.
- The delivery control valve (2) and the pressure reducing valve (1) are balanced out at a point where the differential pressure between **PA** and **PLS** (these two acting on both surfaces of the pressure reducing valve (1)), equals the loss of pressure between **PP** and **PPA** (these two acting on both surfaces of the delivery control valve (1)).
- The differential pressure between the upstream pressure **PPA** and the downstream pressure of both spools in the control valves concerned in the simultaneous movements are equalised, and pump delivery is distributed proportionally to the sections **a** that are responsible for opening the notches of each spool.

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).



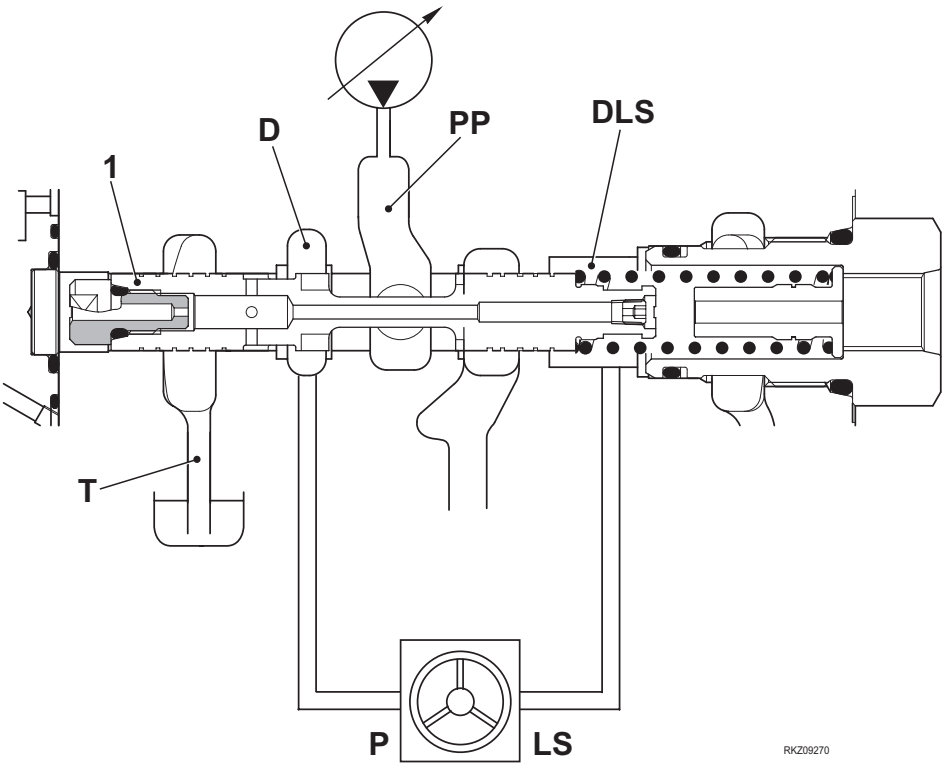
Surface ratio (S1:S2) and compensation characteristics

- When the ratio is 1.00 :
  [Pump pressure **PP** – Pressure **PPA** upstream of spool] ≒ [Load Sensing **PLS** pressure – Actuator **PA** 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.



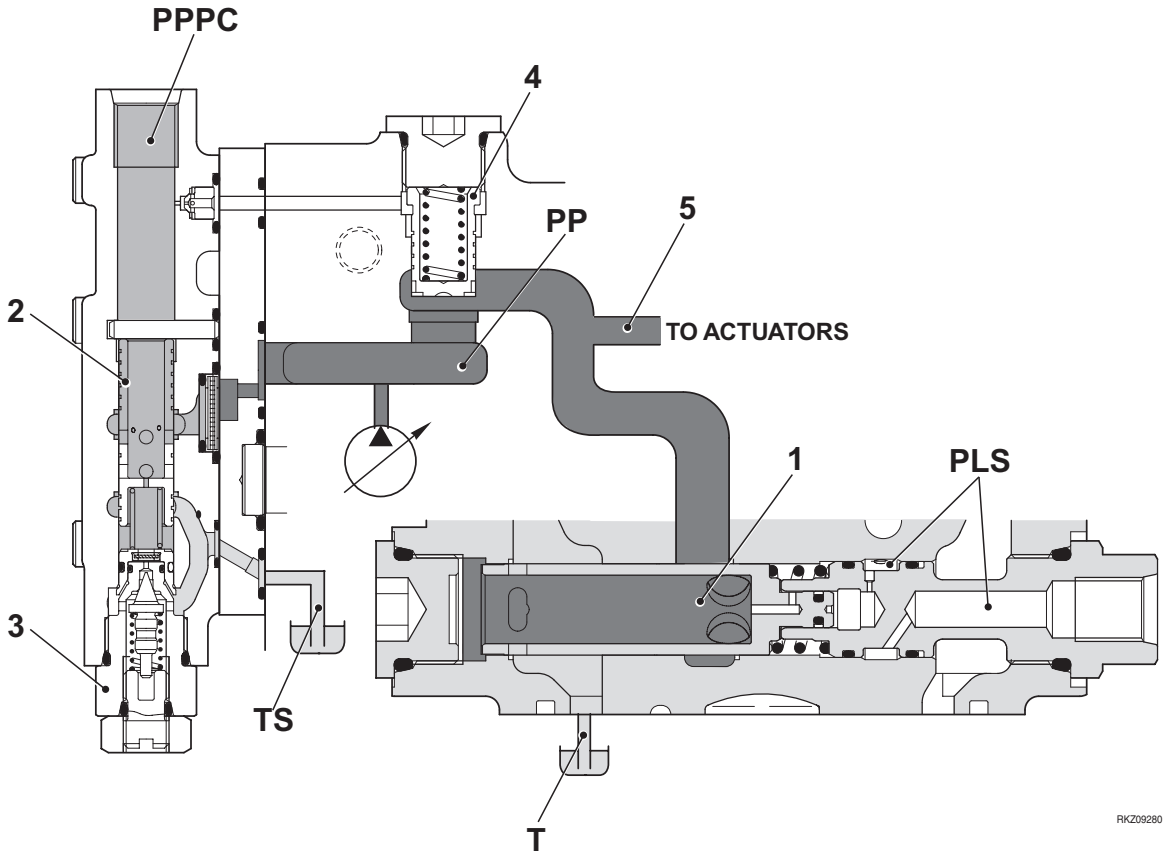
1= Priority valve spool
PP = Pump circuit
D = Steering unit feed circuit
DLS = Steering unit LS signal

3.8 SERVOCONTROLS REDUCING VALVE

Function

- This valve regulates the servocontrol feed pressure at 29 bar (30 kg/cm^2).
- 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.

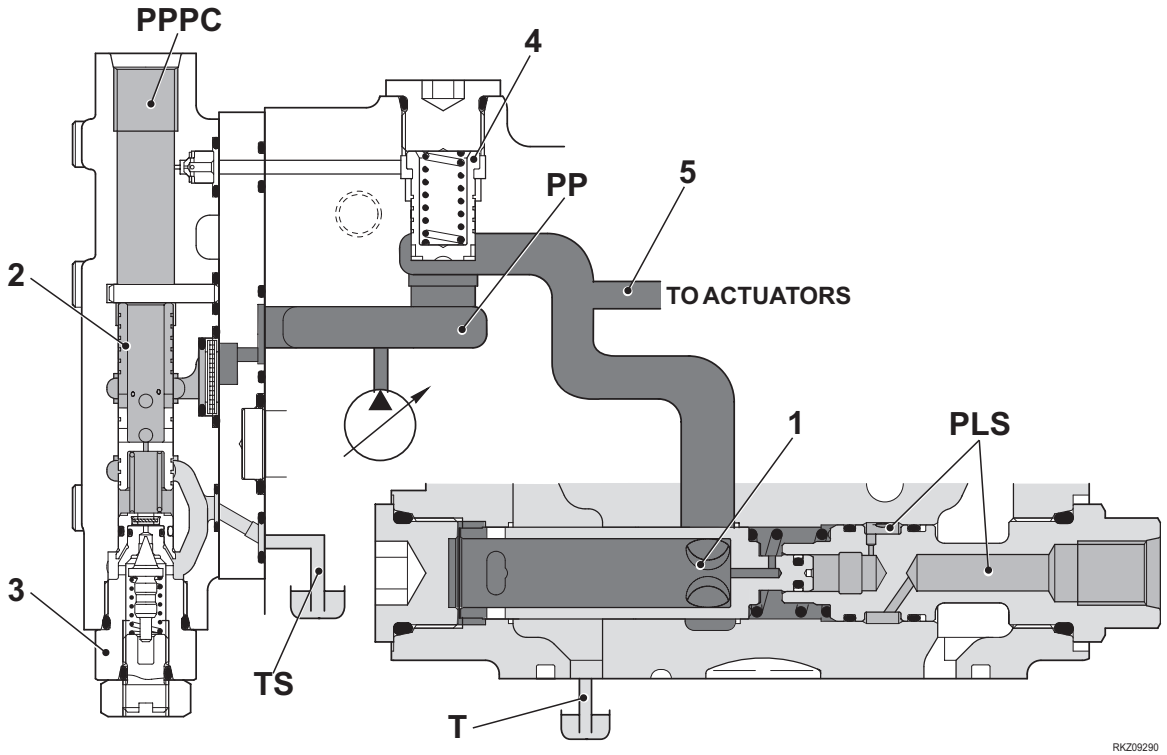
3.8.1 When all actuators are in a neutral condition



Functioning

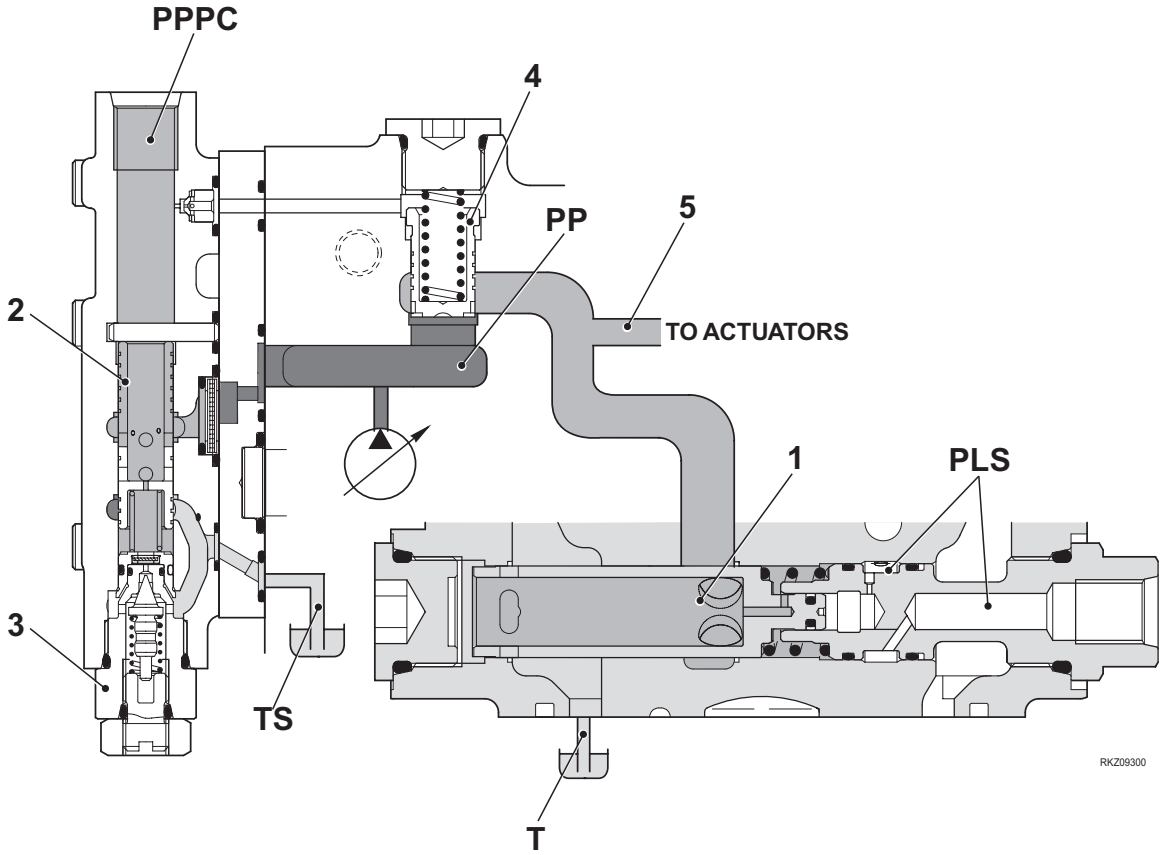
- The spool (1) of the unloading valve moves, and delivery pressure is regulated at 29 bar (30 kg/cm^2). (For details, see 3.2 UNLOADING VALVE).
- The spool (2) and valve (3) reduce the pump's delivery pressure **PP** to 29 bar (30 kg/cm^2) . Pressure is then sent to the servocontrols via port **PC**.

3.8.2 When the control valve is operated



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^2), valves (2) and (3) reduce pressure **PP** to 29 bar (30 kg/cm^2).
  The reduced pressure is then sent to the servocontrols via port **PC**.
- When this occurs, the sequential reducing valve (4) stays open.



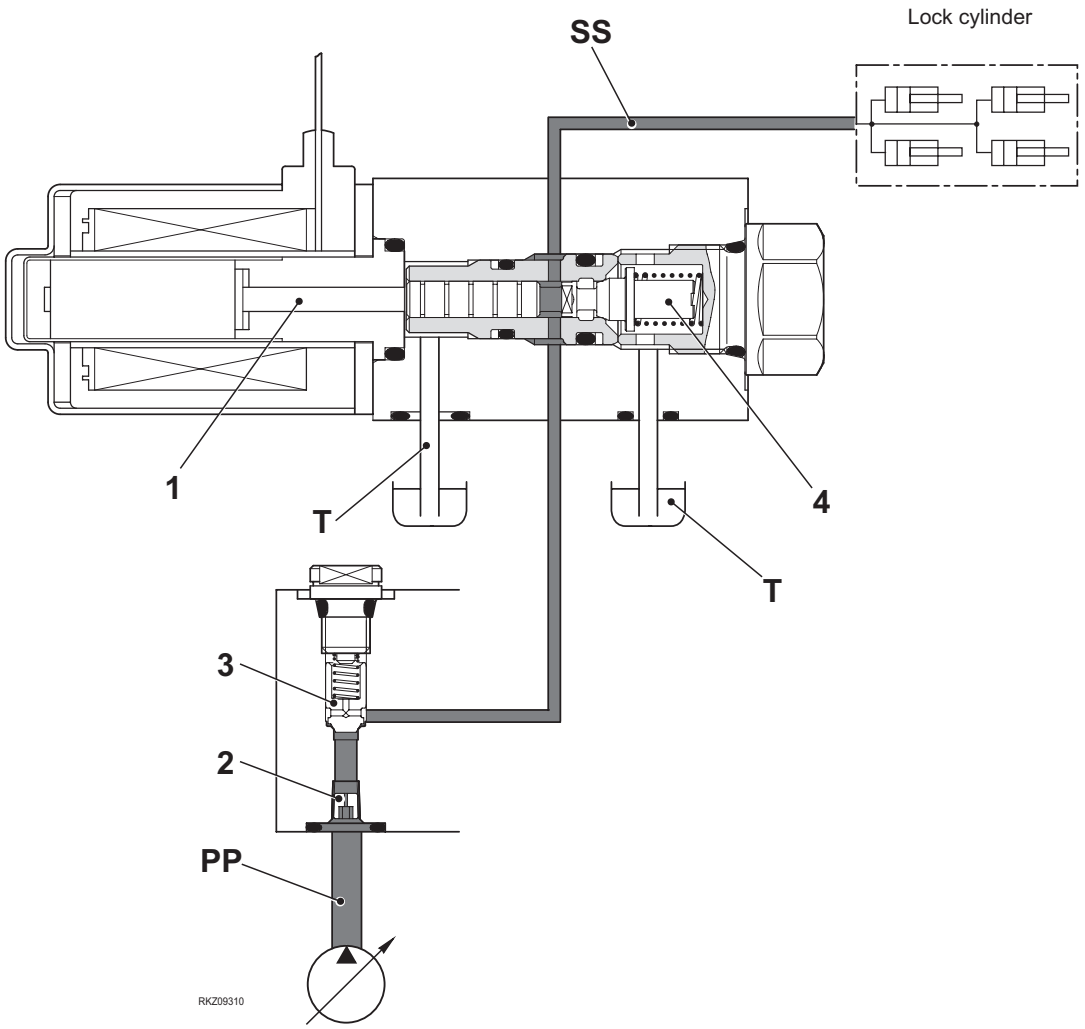
- When the pump's delivery pressure **PP** is lower than 29 bar (30 kg/cm^2), the sequential reducing valve shifts to the right, thereby reducing the flow of the **PP** pressure to the actuator circuit (5).
  This generates a pressure gap between **PP** pressure and actuator pressure.
  PP pressure is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

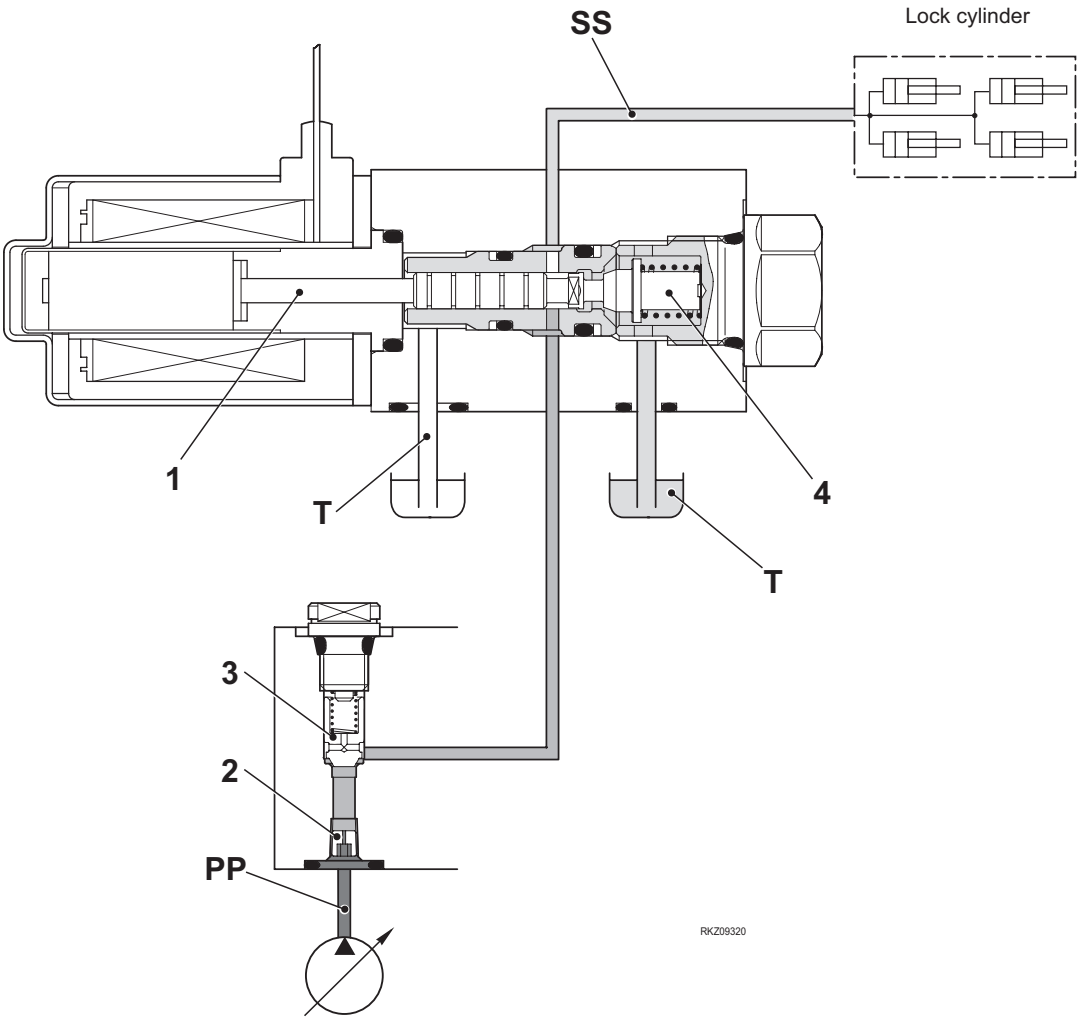
3.9.1 When the solenoid valve is deenergized



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.

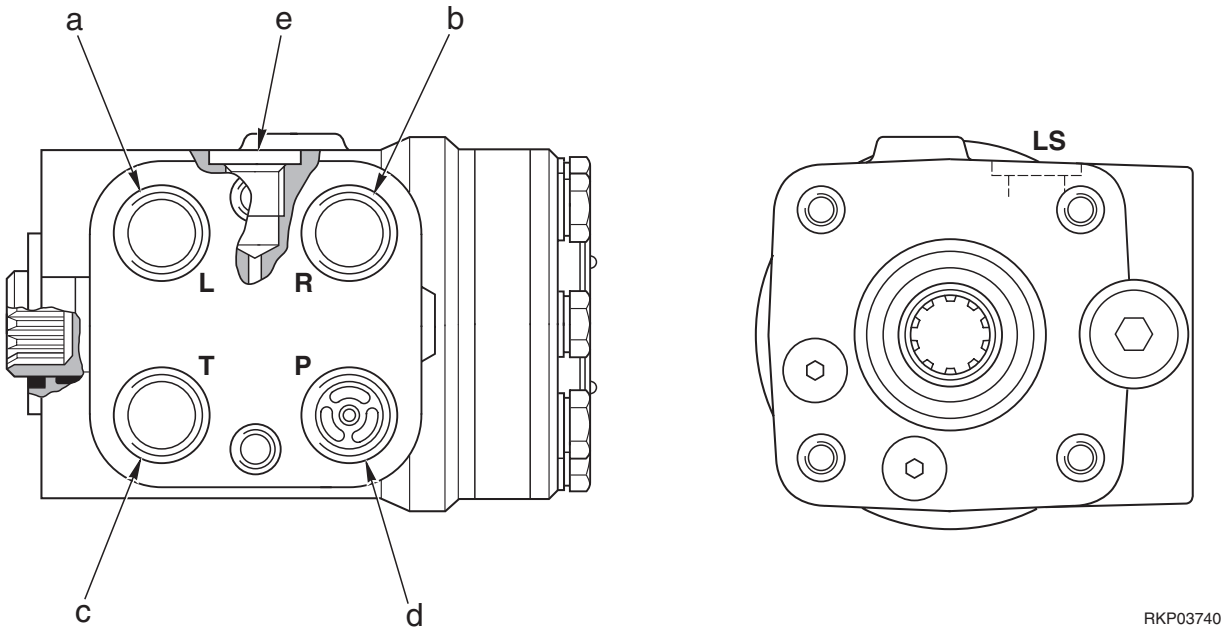
3.9.2 When the solenoid valve is energized



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



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

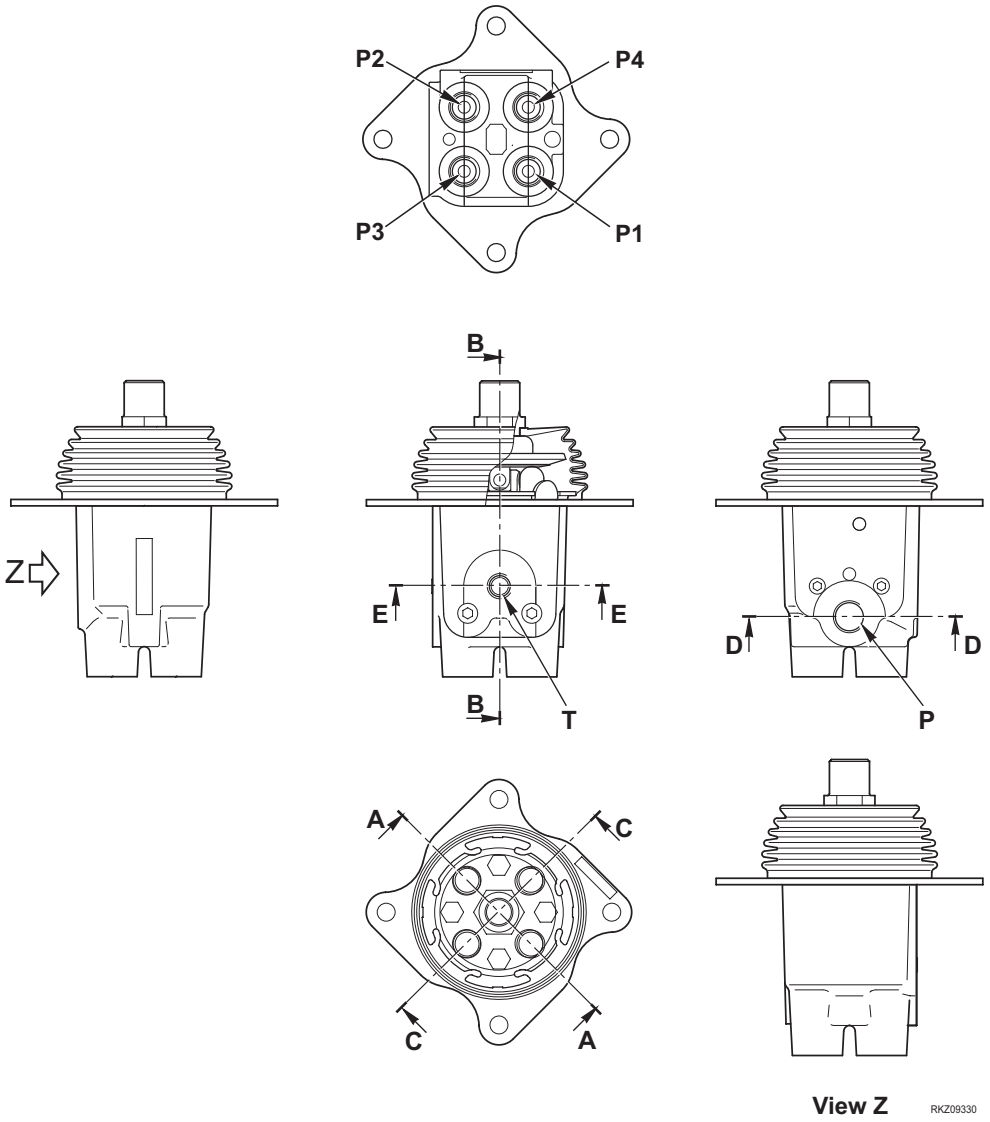
Steering unit type: OSPC200LS
Nominal flow: 20 ℓ

OPERATION

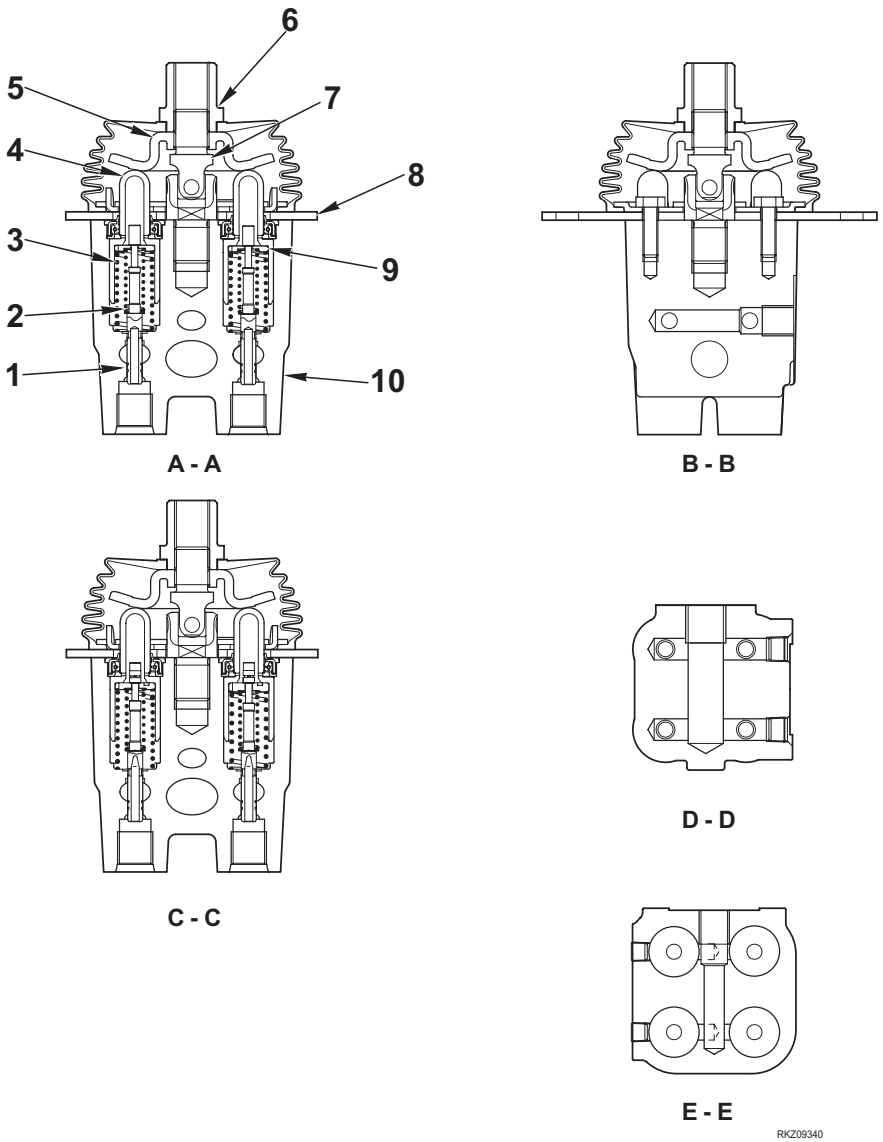
- The steering unit is composed of a control valve and a rotating oil dispenser, and is of the hydrostatic type.
- When the steering wheel is turned, the control valve sends oil from the pump (by means of the rotating oil dispenser) to one of the sides of the steering cylinder. The rotating dispenser 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

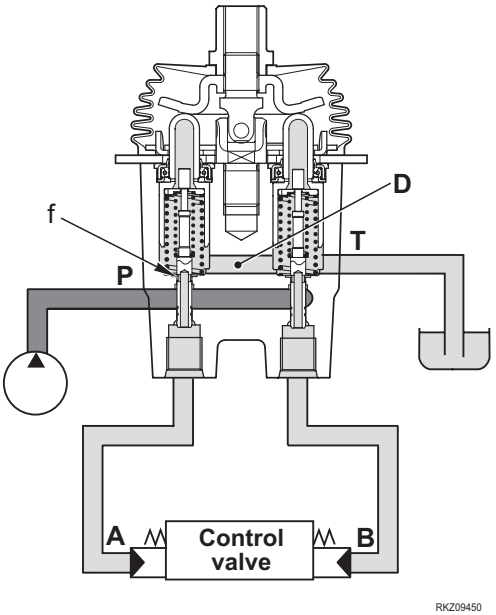


1. Spool
2. Adjusting screw (inner)
3. Adjusting screw (outer)
4. Piston
5. Disk
6. Nut
7. Joint
8. Cover
9. Retainer
10. Body

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).



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).

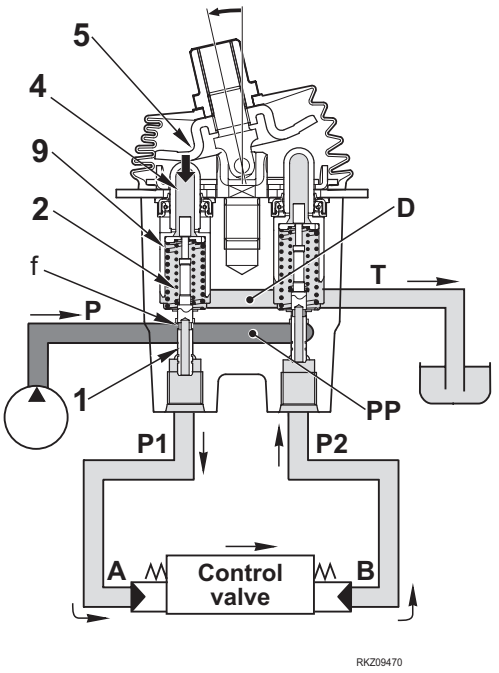
The spring (2) is compressed proportionally to the movement of the disk (5) and therefore, pressure at **P1** increases in proportion to the travel of the disk (5).

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

a) as long as pressures at ports **A** and **P1** are perfectly balanced;

b) 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.



3. During fine control
(Actuator→ NEUTRAL)

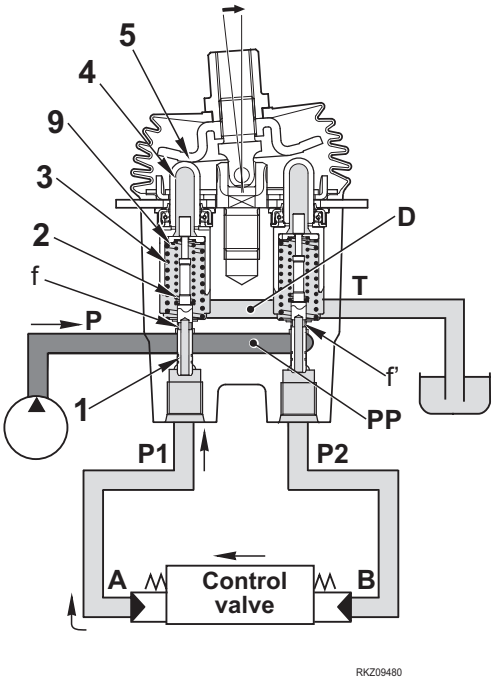
When the disk (5) is released and moved to neutral position, the piston (4) is pushed upwards by the spring (3) acting on the retainer (9), and spool (1) is thrusted upwards both by the force of spring (2) and by the force that the pressure in section **A-P1** applies against the stem.

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.

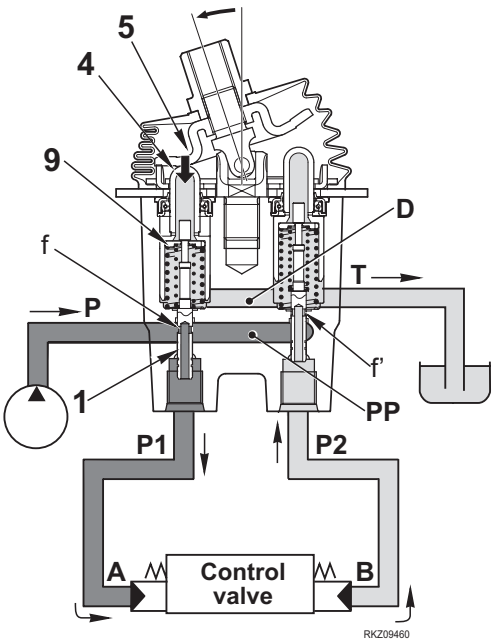
Oil flows through duct **P2** and into chamber **B** to ensure it is filled properly.



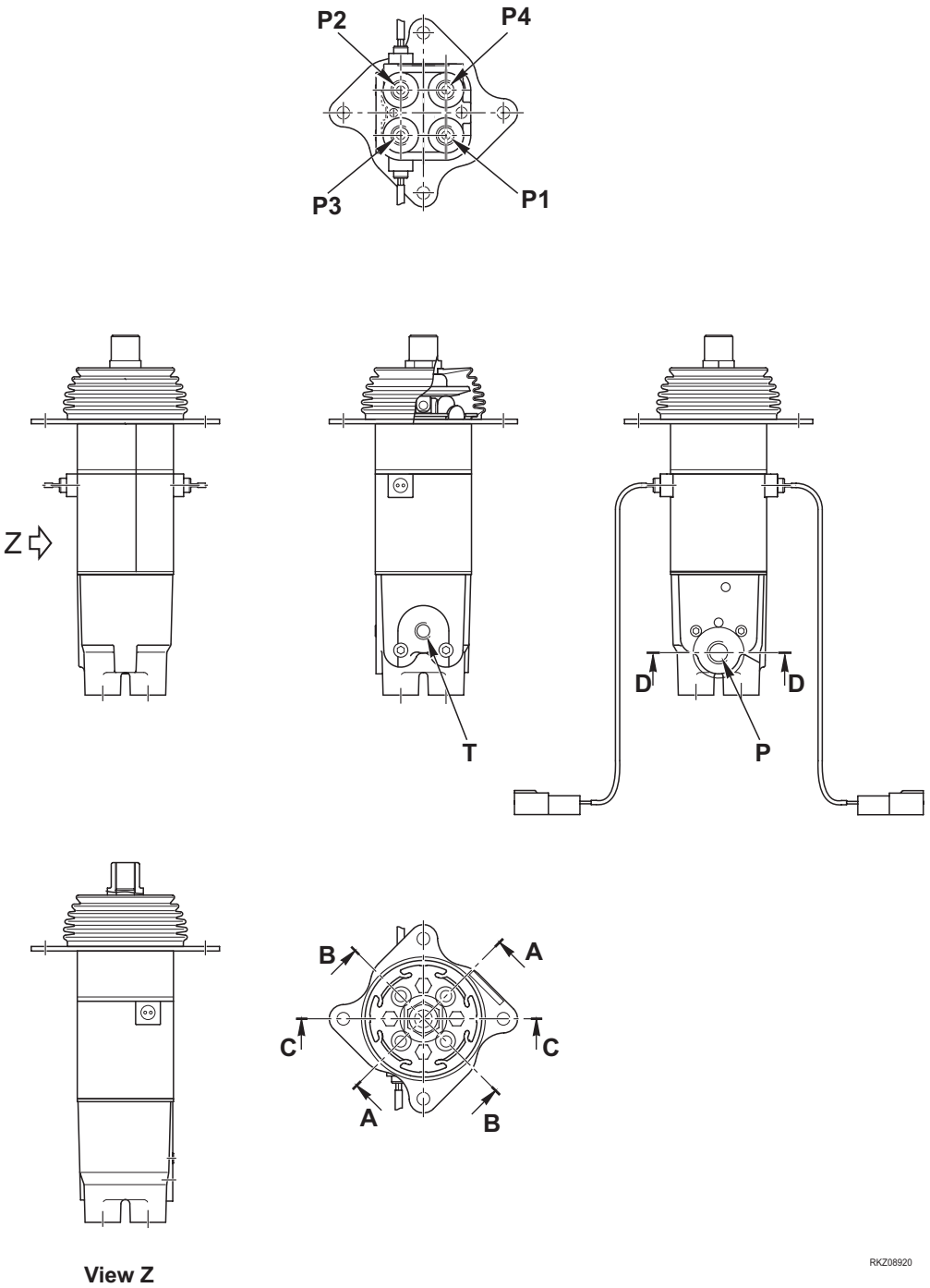
4. During fine control
(NEUTRAL → Full stroke)

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**.

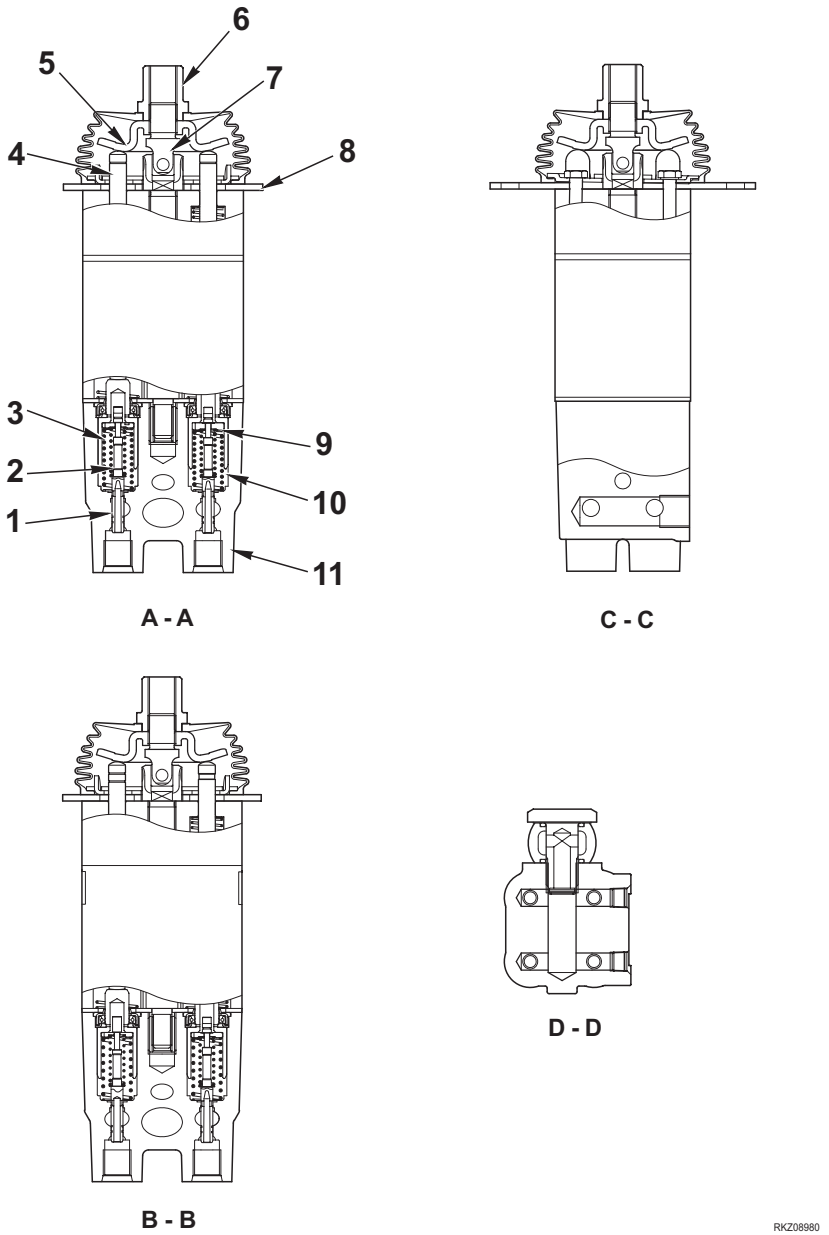


SHOVEL PPC VALVE (FLOAT + RETURN TO DIG)



View Z

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

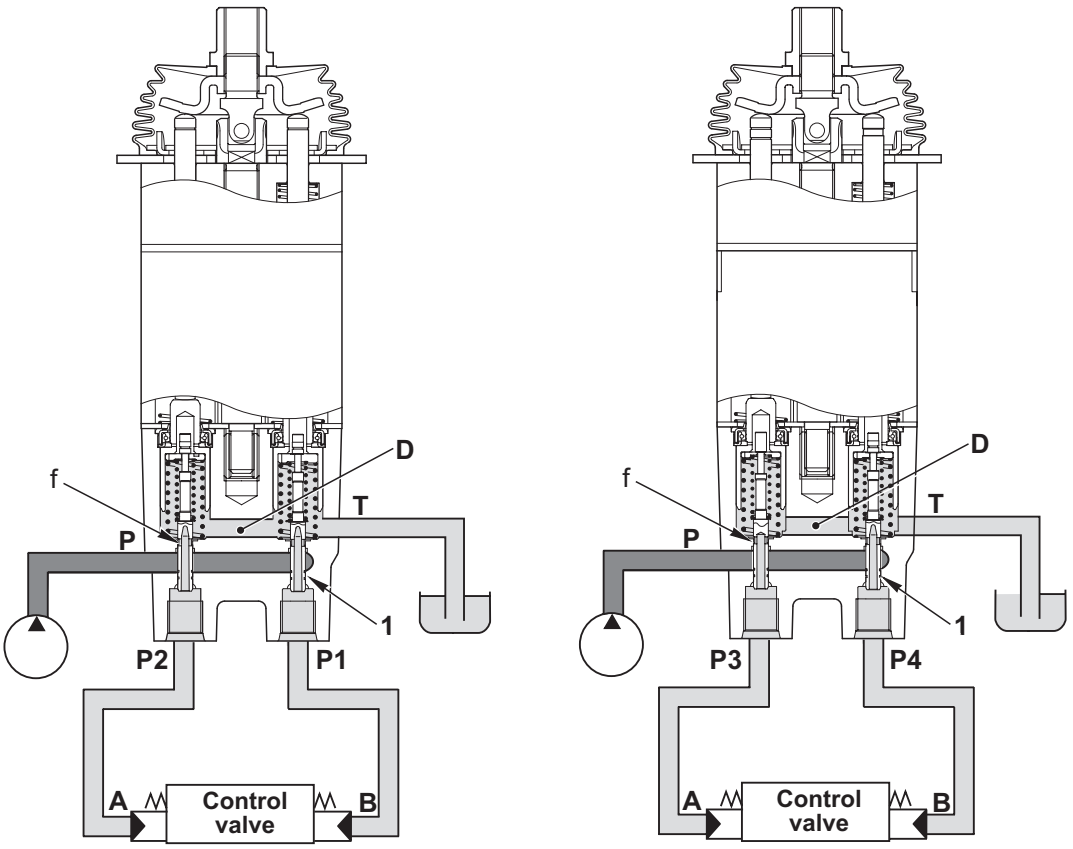


1. Spool
2. Adjusting screw (inner)
3. Adjusting screw (outer)
4. Piston
5. Disk
6. Disk
7. Joint
8. Cover
9. Retainer
10. Piston
11. Body

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).

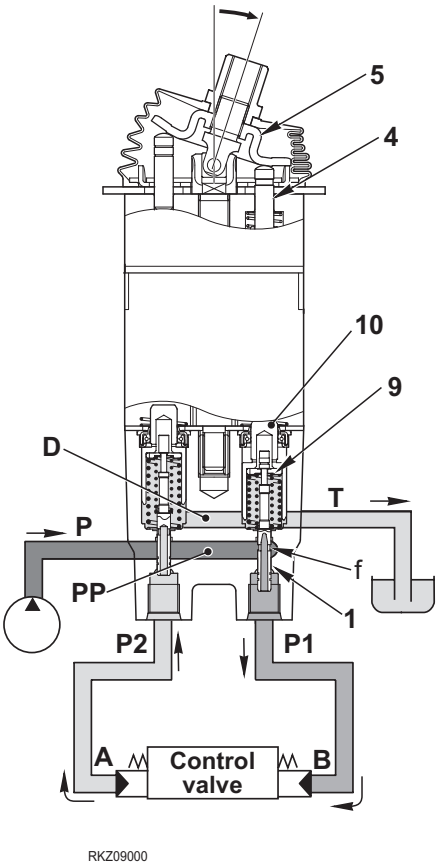
The spring (2) is compressed proportionally to the movement of the disk (5) and therefore, pressure at **P1** increases in proportion to the travel of the disk (5).

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

a) as long as pressures at ports **B** and **P1** are perfectly balanced;

b) 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.



3. During fine control (Actuator→ NEUTRAL)

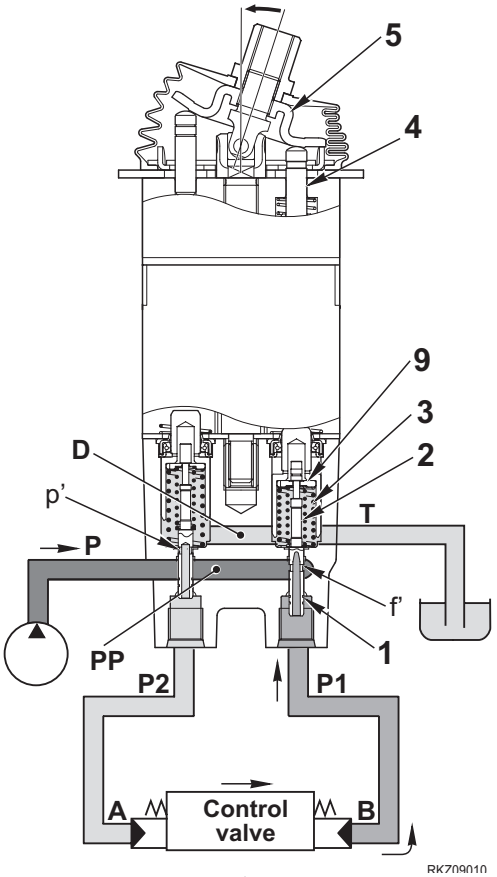
When the disk (5) is released and moved to neutral position, the piston (4) is pushed upwards by the spring (3) acting on the retainer (9), and spool (1) is thrusted upwards both by the force of spring (2) and by the force that the pressure in section **B-P1** applies against the stem.

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.

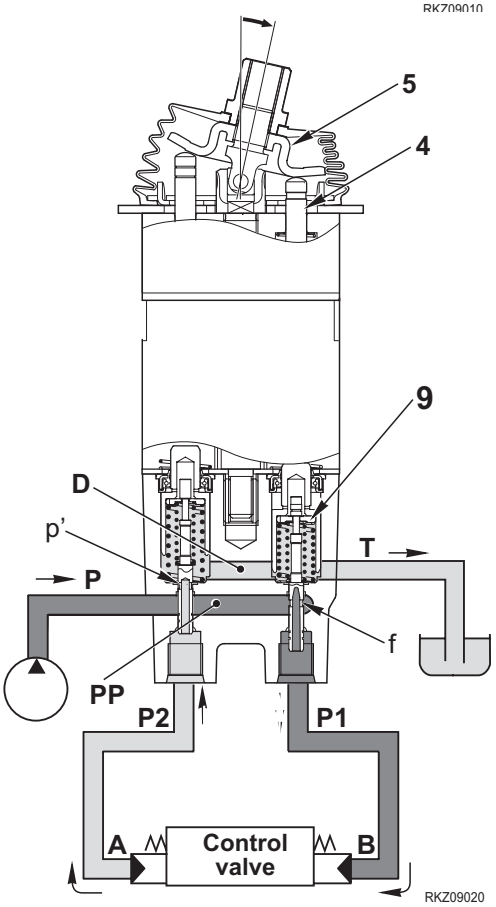
Oil flows through duct **P2** and into chamber **B** to ensure it is filled properly.



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.

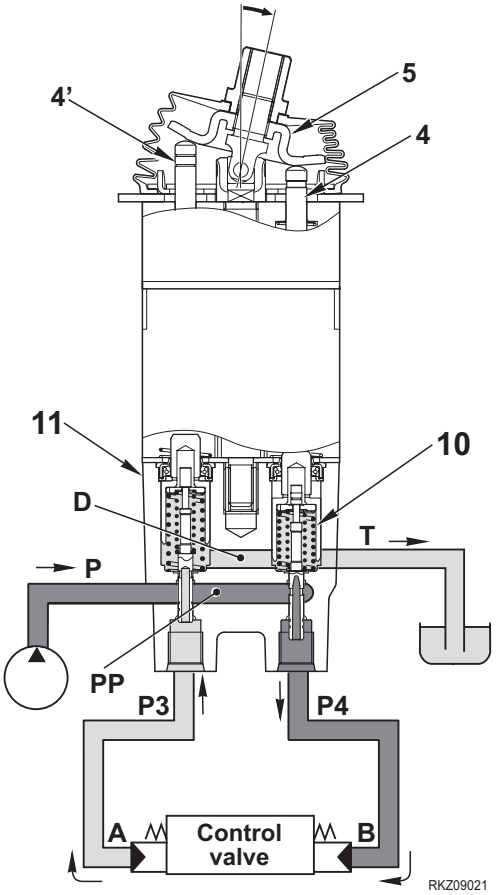
If piston (4') is pushed upwards and the solenoid in the PPC valve is energized, the force generated by the solenoid will retain the piston (4') in place and the arm float condition will be retained – even if the lever is released.

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

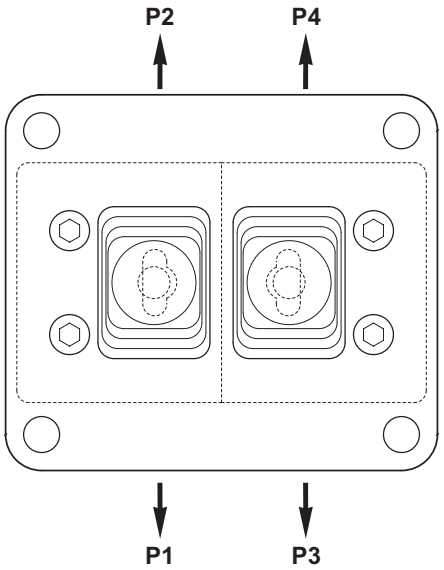
6. When control lever is moved from float back to neutral position

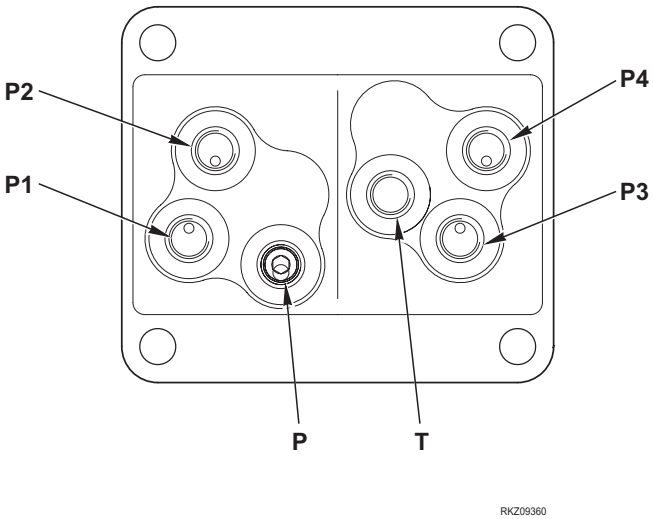
The disk (5) can be moved back to neutral position by applying a force that exceeds the force applied by the solenoid.

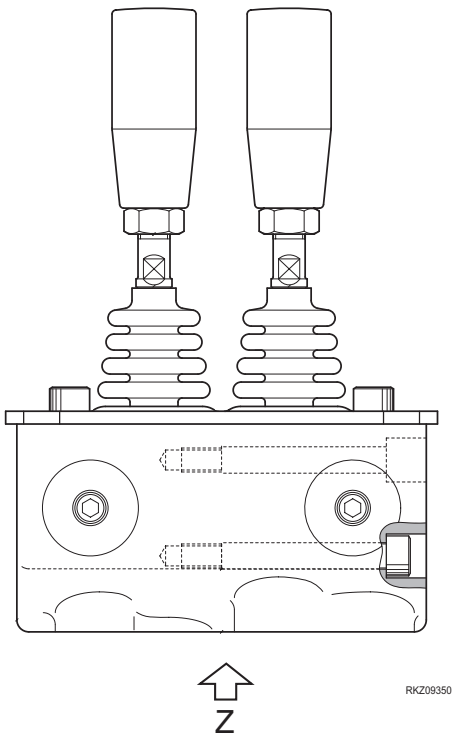
The floating state can also be cancelled, and the lever can move back to neutral position, denergizing the solenoid.



OUTRIGGERS PPC VALVE







P1 port - To control valve (8 spools) (PA7 port)
To control valve (10 spools) (PA9 port)

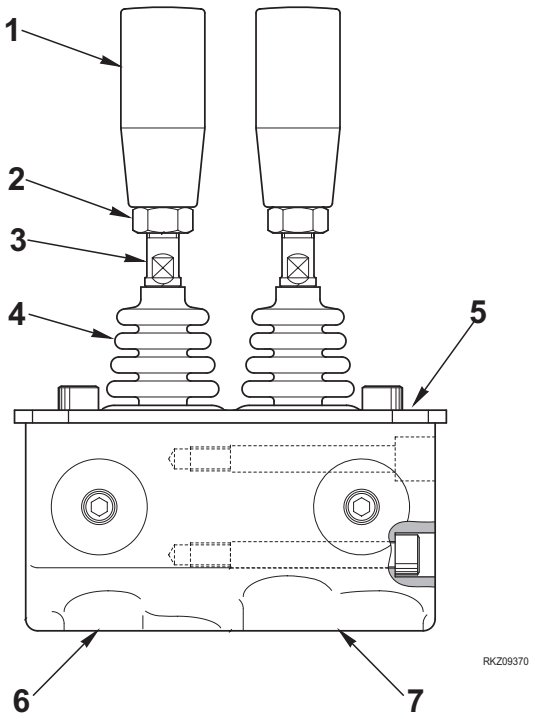
P2 port - To control valve (8 spools) (PB7 port)
To control valve (10 spools) (PB9 port)

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)

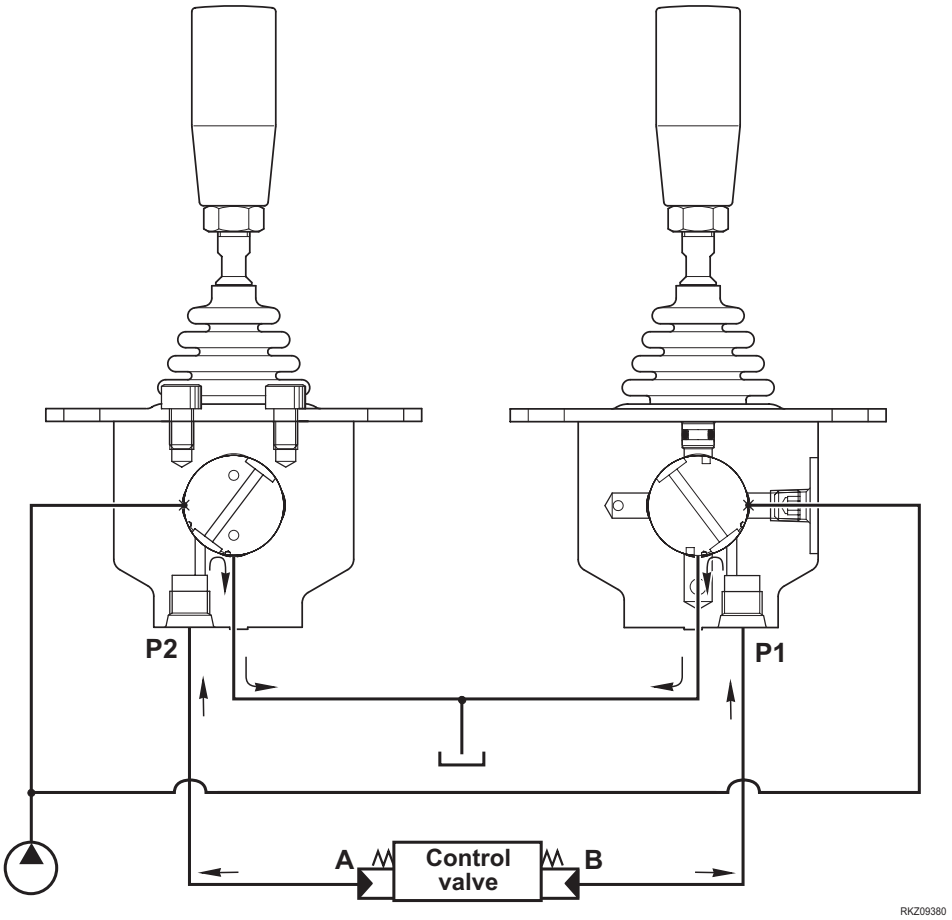
Port T - To hydraulic tank



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

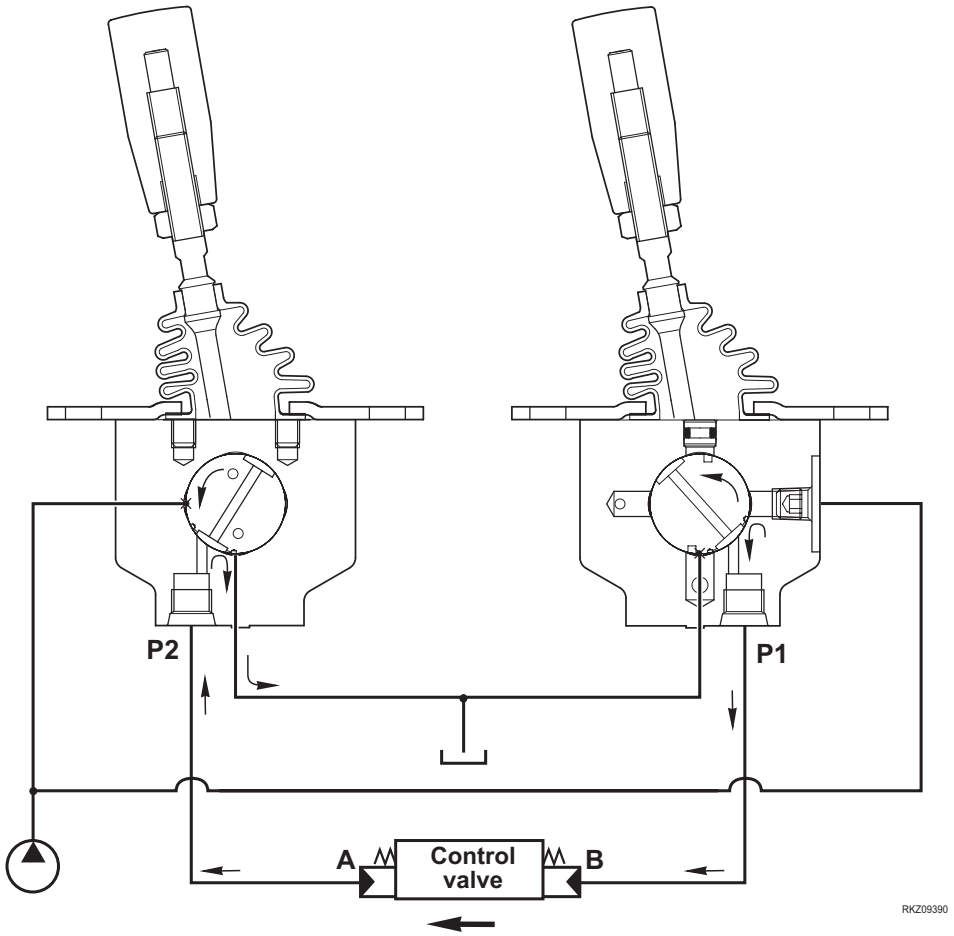
OPERATION

1. Control lever in neutral position



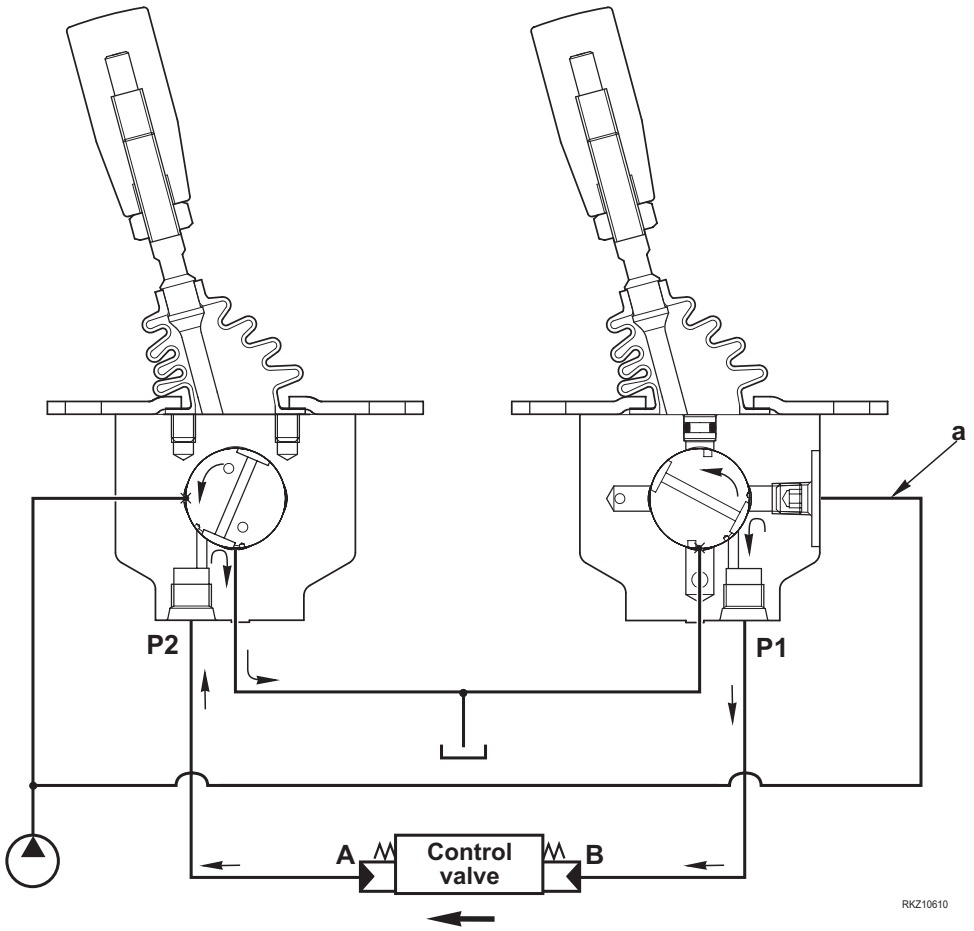
- Ports **A** and **B** of control valve and ports **P1** and **P2** of PPC valves are connected to the tank circuit.
- Hence, the spool is in neutral position.

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 conected 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).

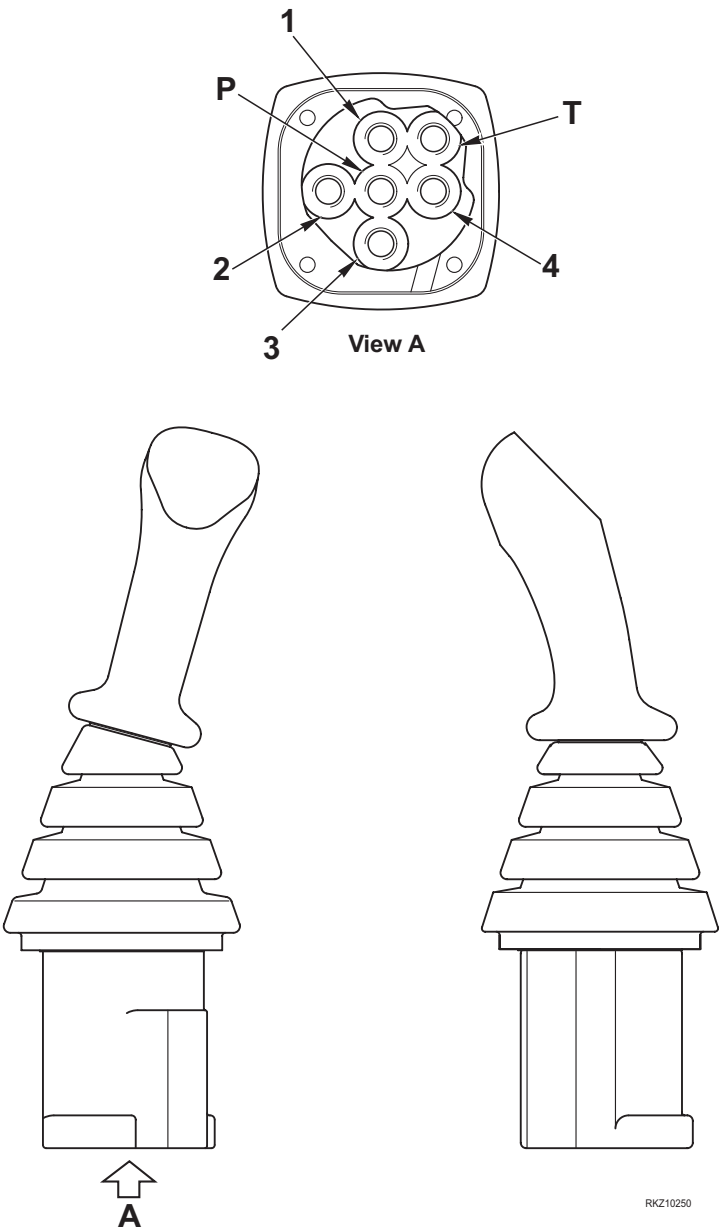
3. Control lever at full stroke (Actuator → NEUTRAL)



- 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.

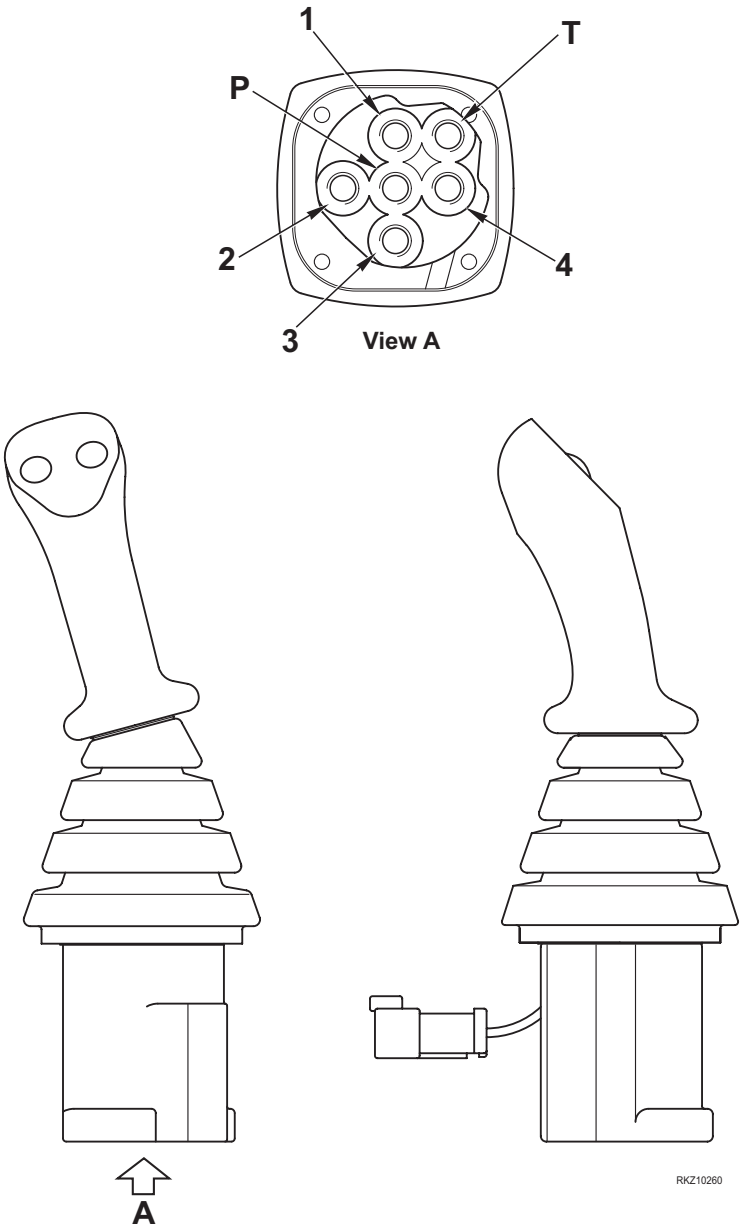
PPC VALVE (SERVOCONTROL VERSION)

L.H. 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)

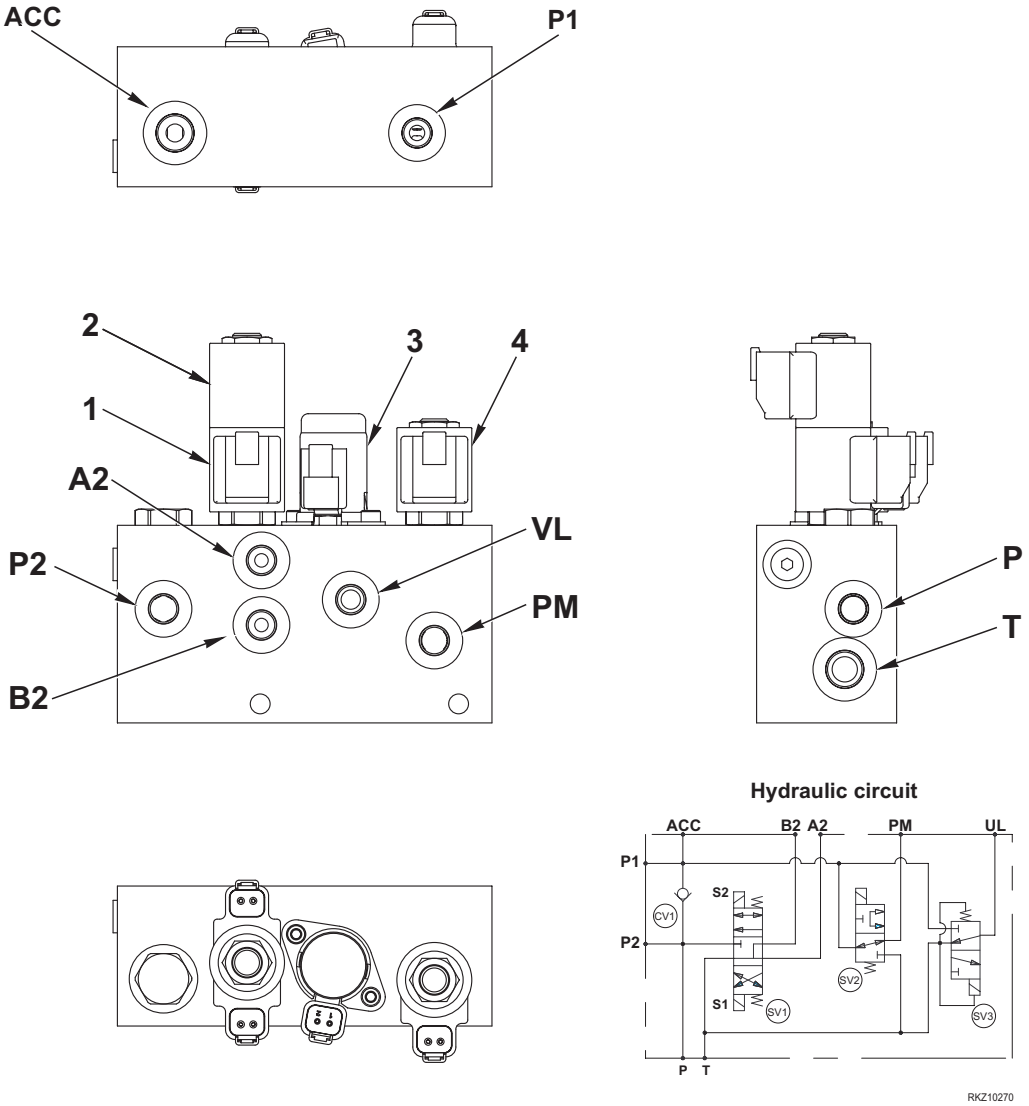
R.H. PPC VALVE



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)

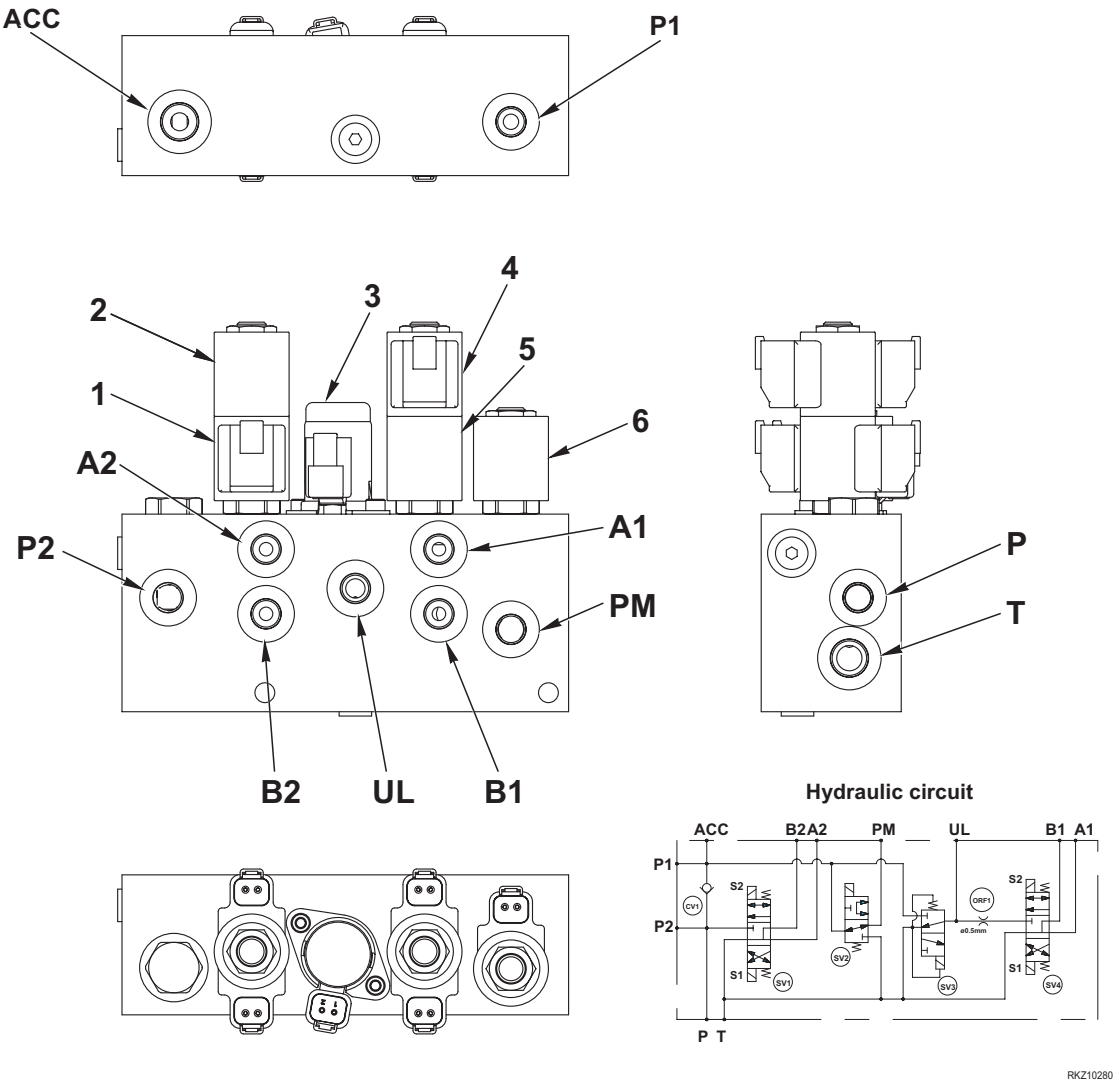
BACKHOE VERSION WITH MECHANICAL CONTROLS WITHOUT 4 IN 1 BUCKET



1. Y94 - Differential lock solenoid valve
2. Y95 - Boom unlock solenoid valve
3. Y93 - PPC solenoid valve
4. 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 VL -	To shovel PPC valve (Port P)
Port PM -	To hydraulic pump (Port PM)
Port P -	From control valve (Port PPPC)
Port T -	To hydraulic tank

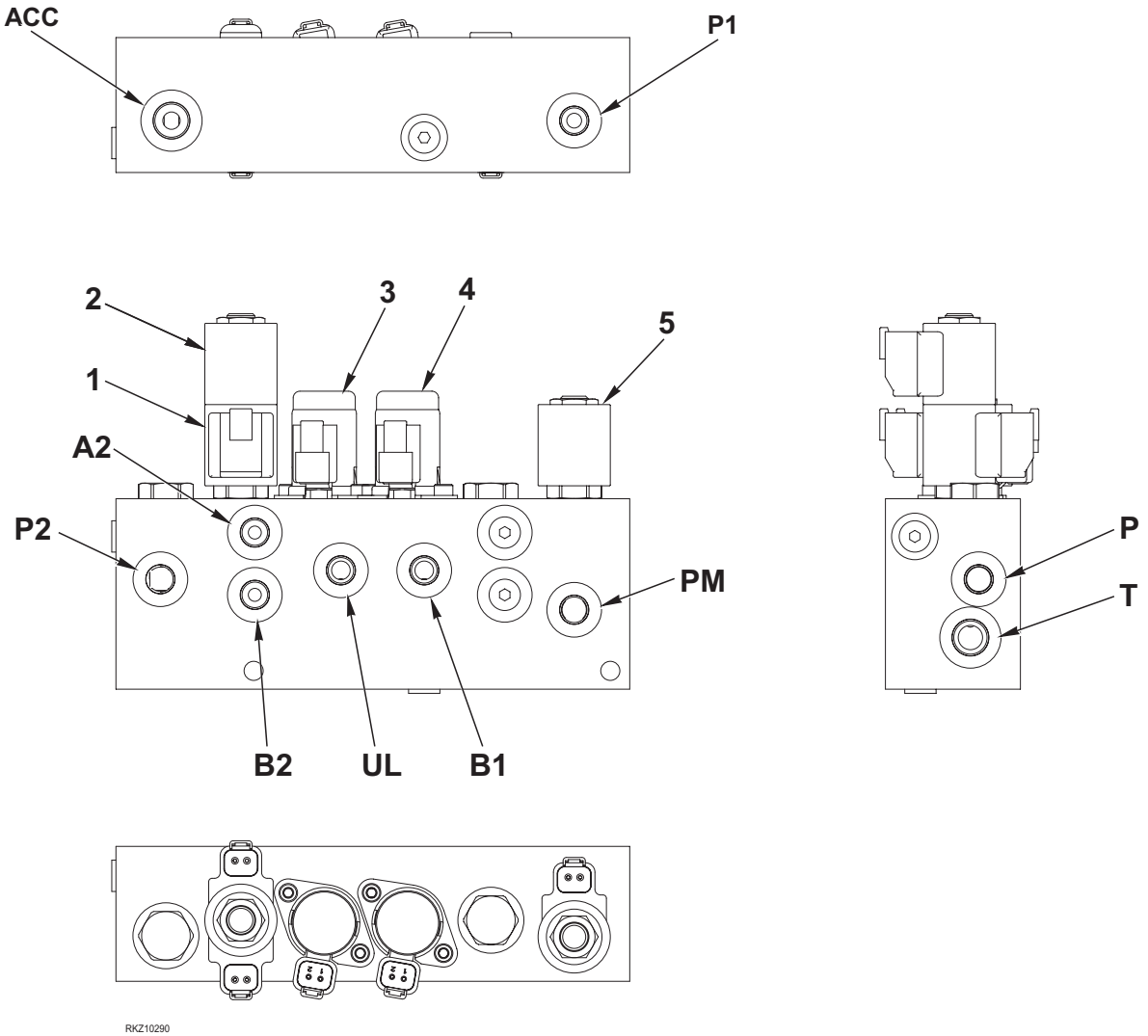
BACKHOE VERSION WITH MECHANICAL CONTROLS WITH 4 IN 1 BUCKET



1. Y94 - Differential lock solenoid valve
2. Y95 - Boom unlock solenoid valve
3. Y93 - PPC solenoid valve
4. Y98 - Bucket curl solenoid valve
5. 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 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

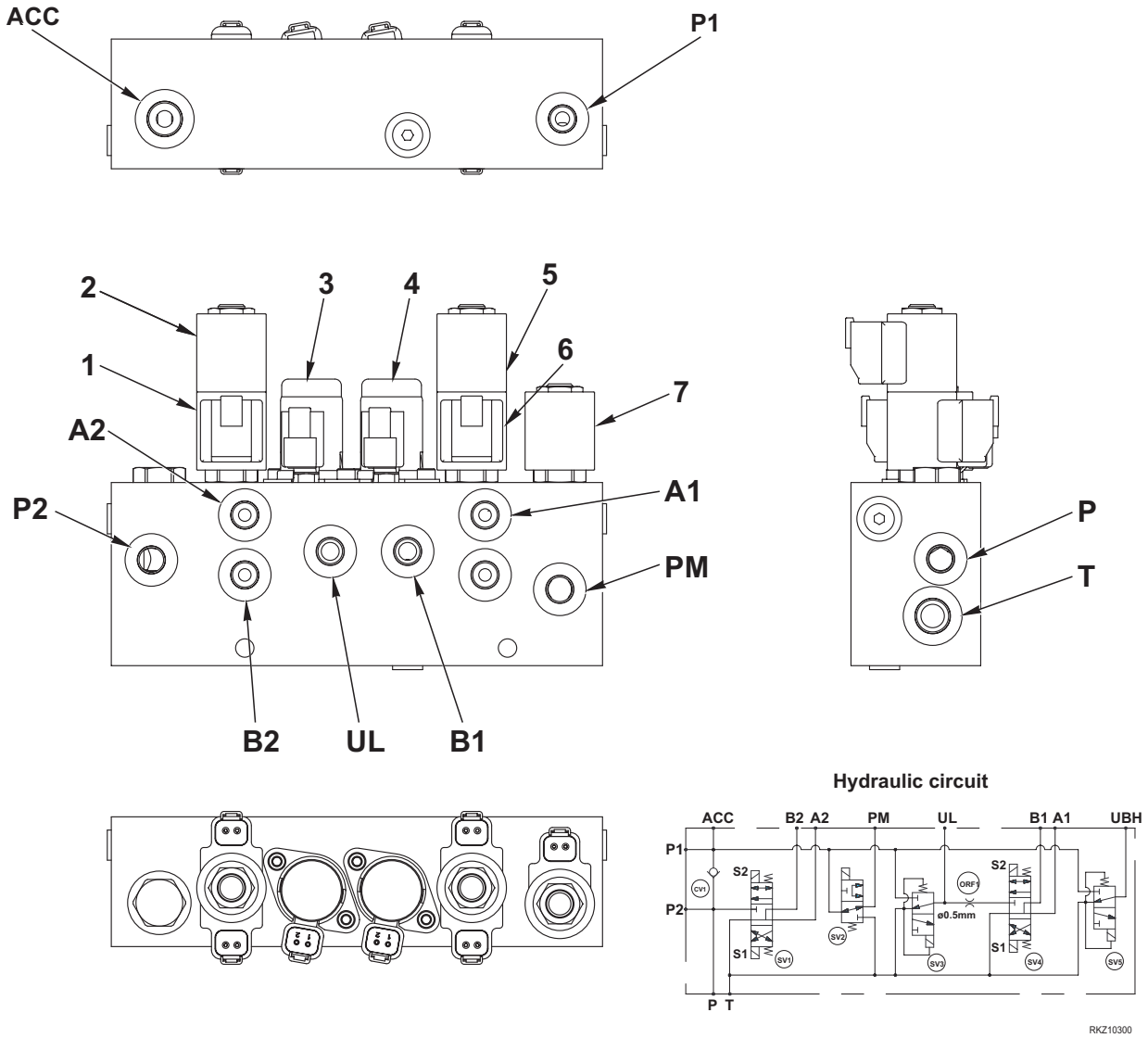
BACKHOE VERSION WITH HYDRAULIC CONTROLS WITHOUT 4 IN 1 BUCKET



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 PPPC)
Port T -	To hydraulic tank

BACKHOE VERSION WITH HYDRAULIC CONTROLS WITH 4 IN 1 BUCKET

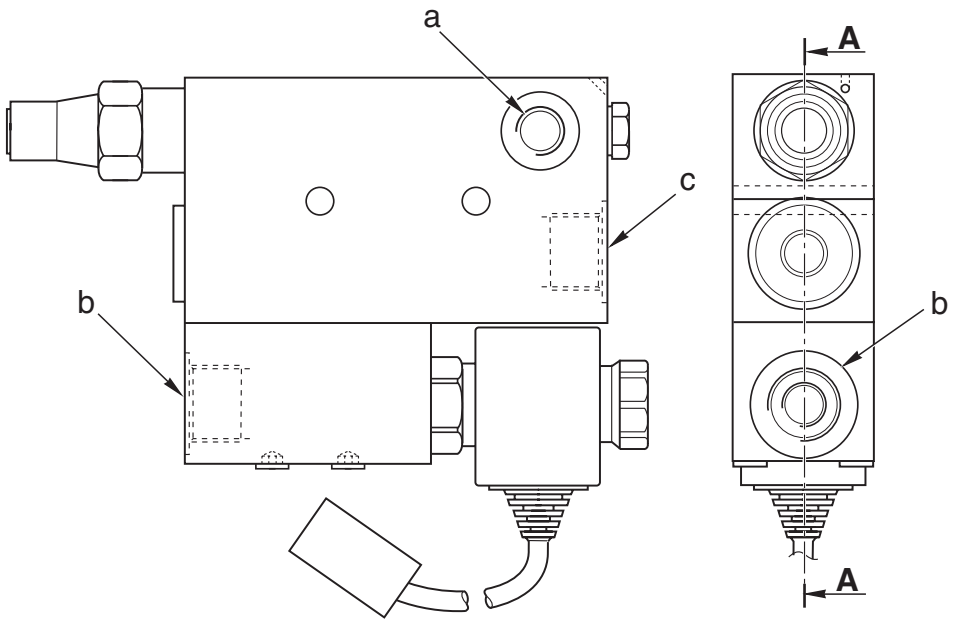


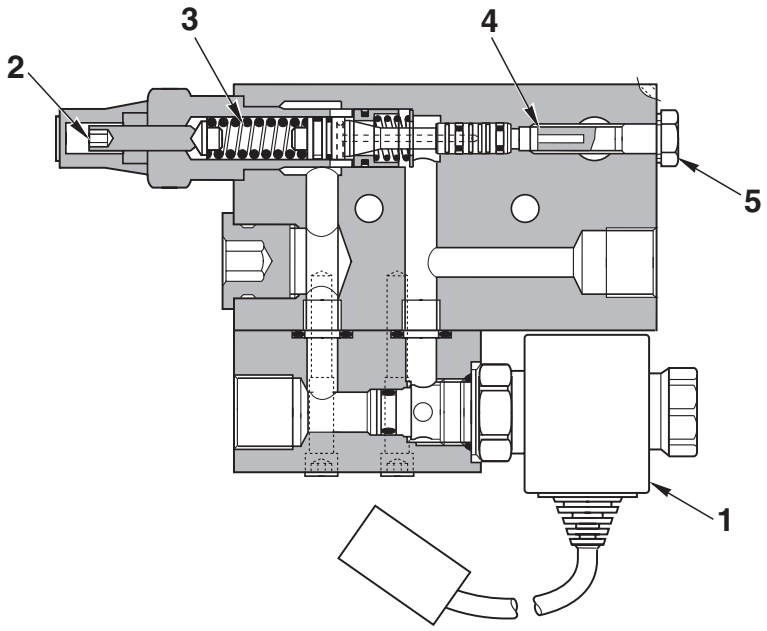
1. Y94 - Differential lock solenoid valve
2. Y95 - Boom unlock solenoid valve
3. Y90 - Backhoe PPC solenoid valve
4. Y93 - PPC solenoid valve
5. Y98 - Bucket curl solenoid valve
6. Y99 - Bucket dump solenoid valve
6. Y91 - Ecopower solenoid valve

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

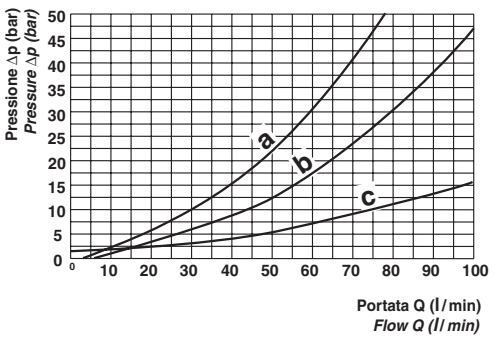
SHOVEL RAISE





RKZ08040

Sezione 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)

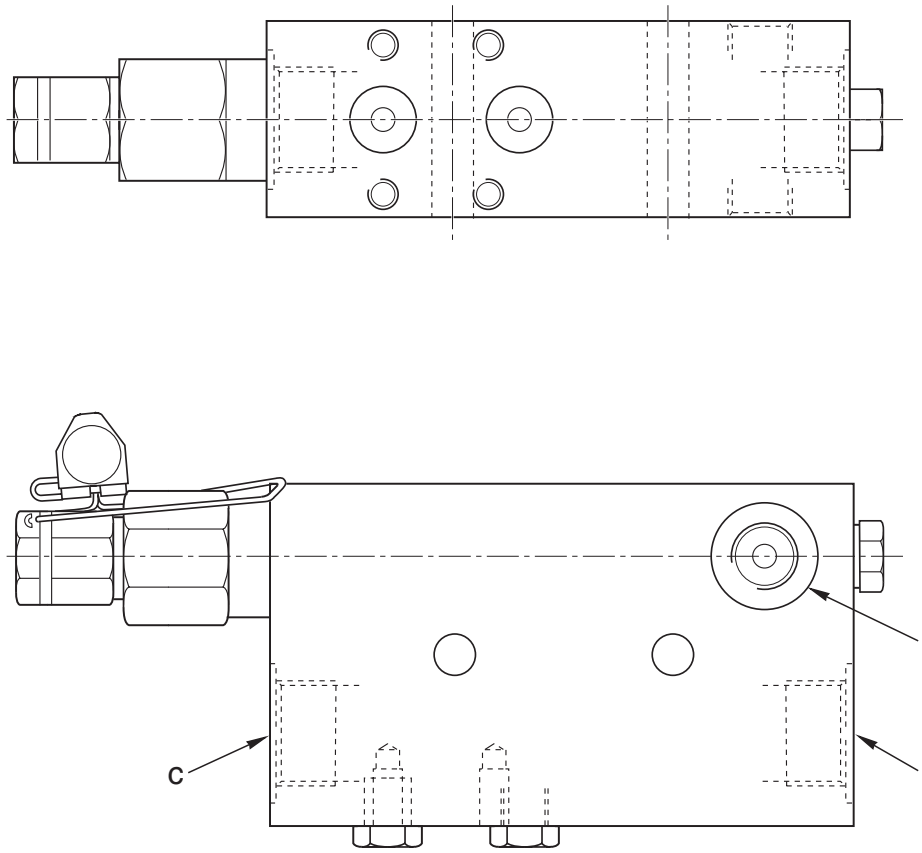
COMPONENTS

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

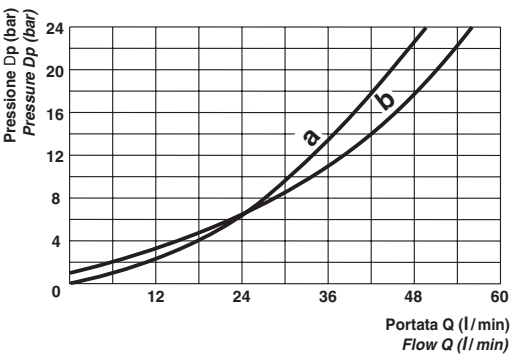
CHARACTERISTICS

Safety valve calibration: 220 $^{0}_{+10}$ bar

SHOVEL DUMP



RKZ08060

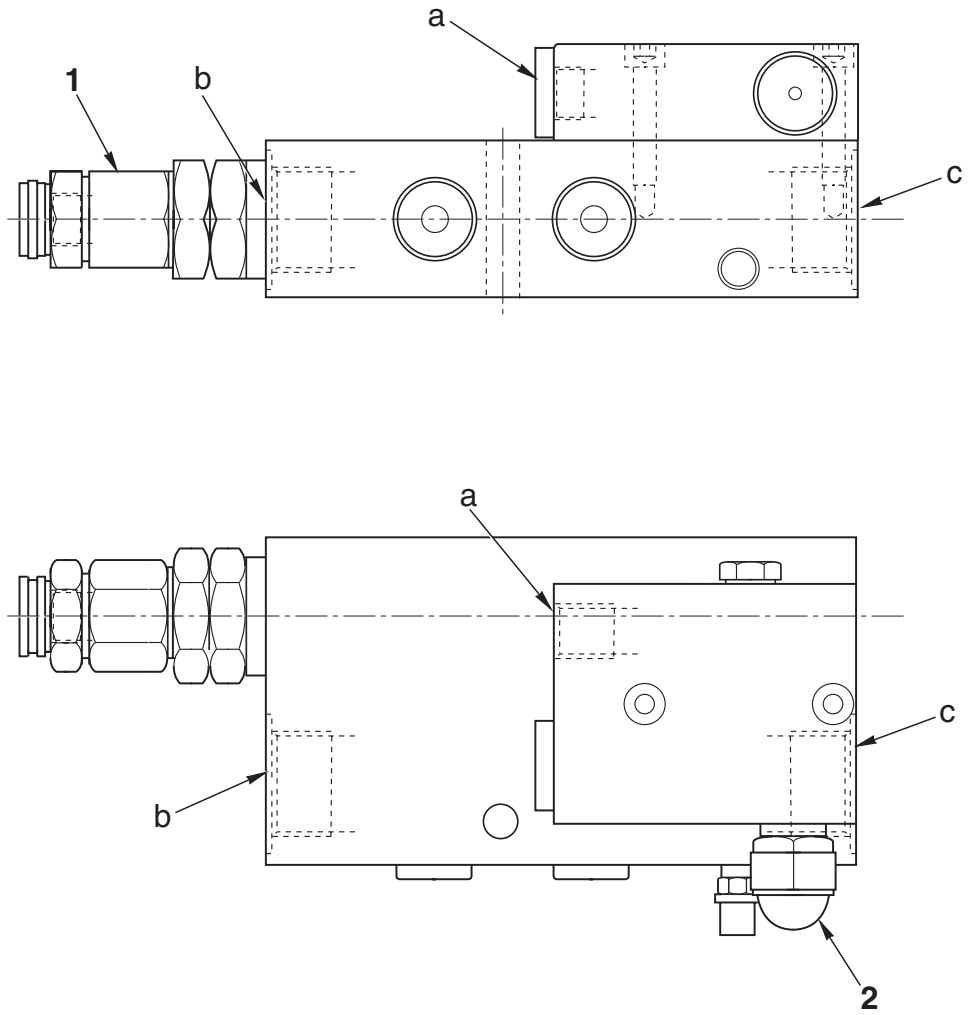


RKZ08070

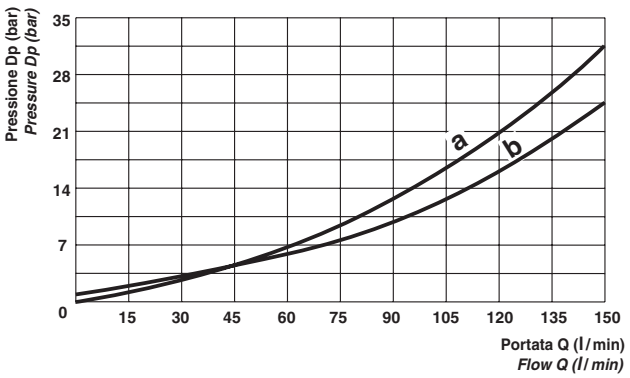
a. Port PiL - To the dump cylinder (Bottom side)
b. Port C2 - To the dump cylinder (Head side)
b. Port V2 - From control valve (8-spool) (B3 port)

CHARACTERISTICS
Safety valve calibration: 220 0 -10 bar

BOOM



RKZ08080

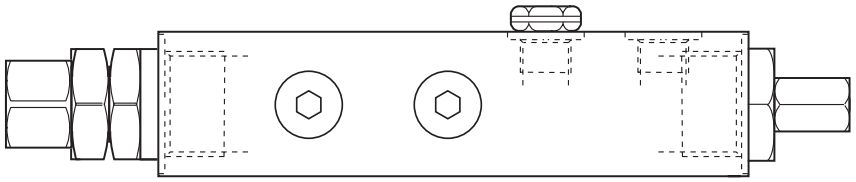


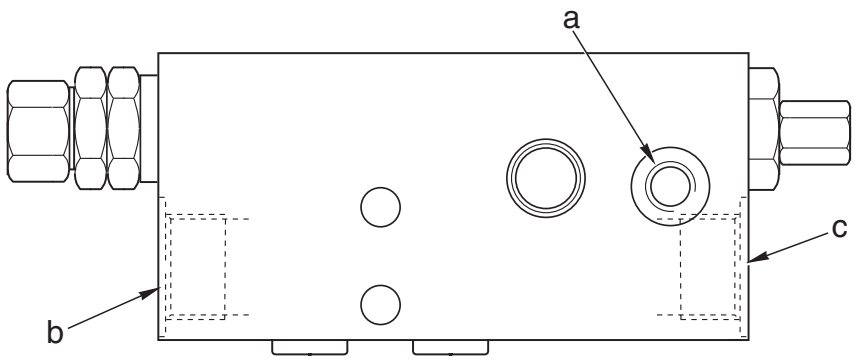
RKZ08090

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)

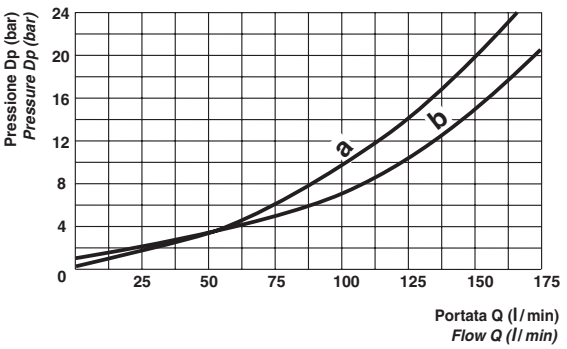
CHARACTERISTICS
Safety valve calibration 1: 250 0 +15 bar
Safety valve calibration 2: 200 0 +20 bar

ARM





RKZ08100



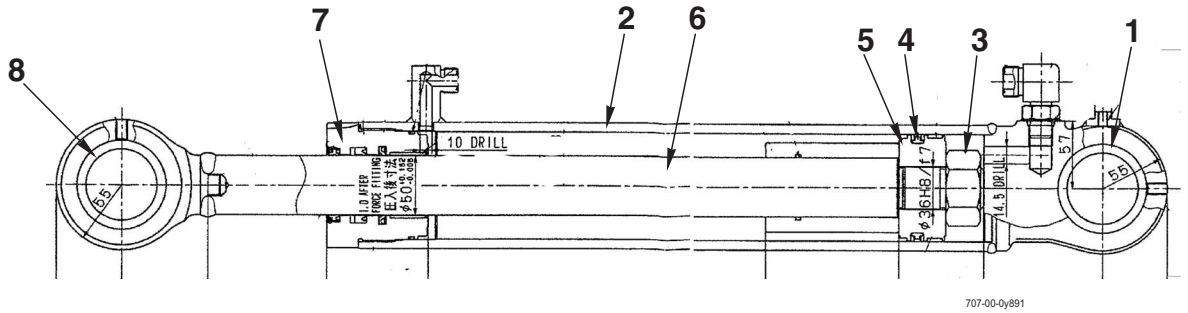
RKZ08110

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 $^{0}_{+10}$ bar

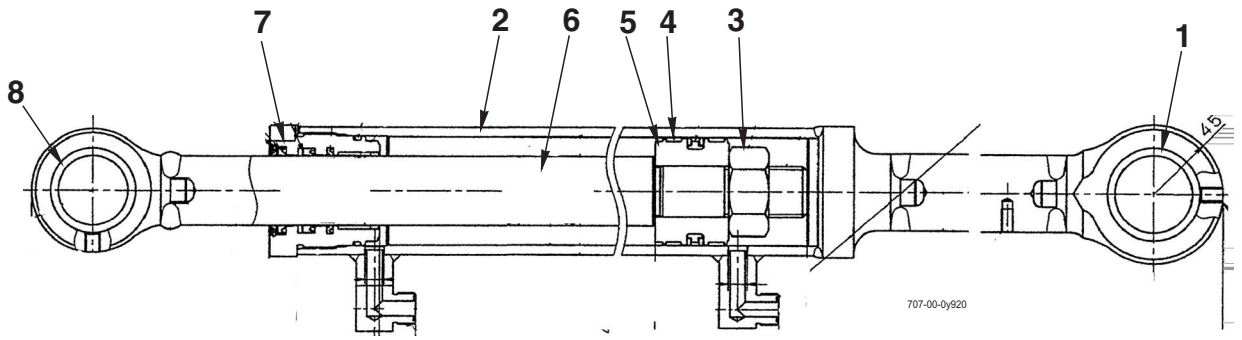
SHOVEL CYLINDERS

RAISING CYLINDER



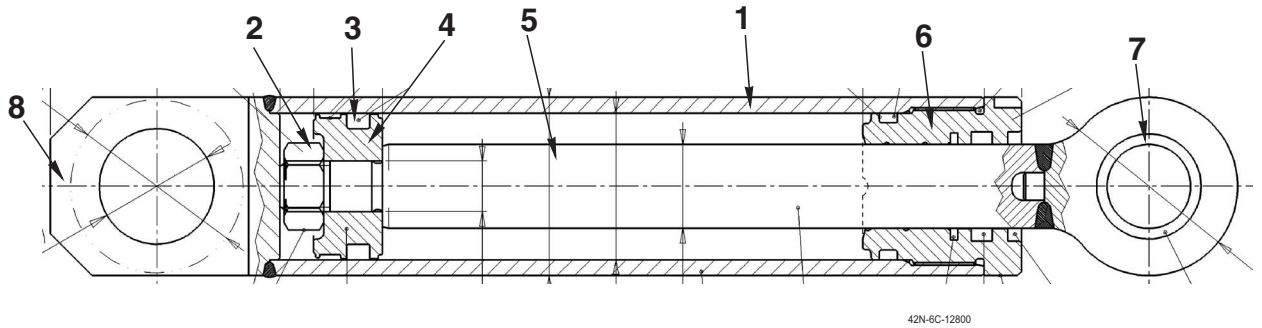
1. Bottom bushing
2. Cylinder
3. Nut
4. Gasket
5. Piston
6. Stem
7. Head
8. Head bushing

DUMPING CYLINDER



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

4 IN 1 BUCKET



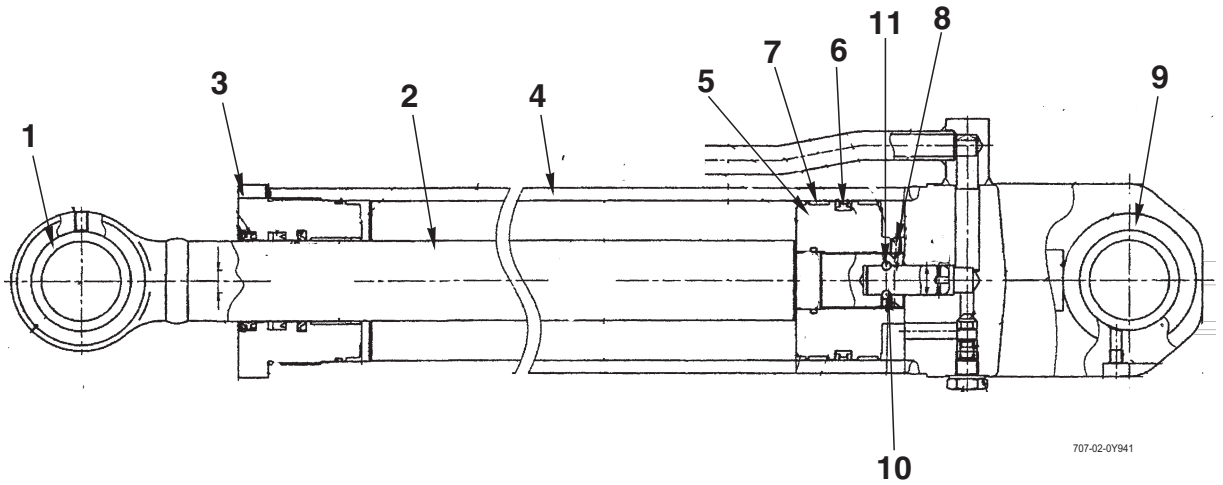
1. Cylinder
2. Nut
3. Gasket
4. Piston
5. Stem
6. Head
7. Head bushing

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

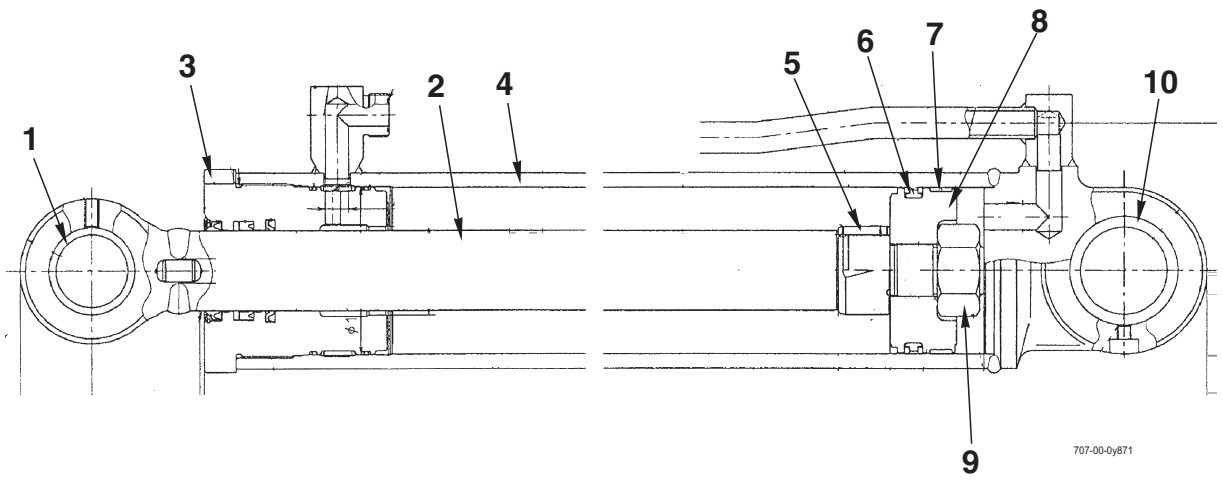
BACKHOE CYLINDERS

BOOM CYLINDER



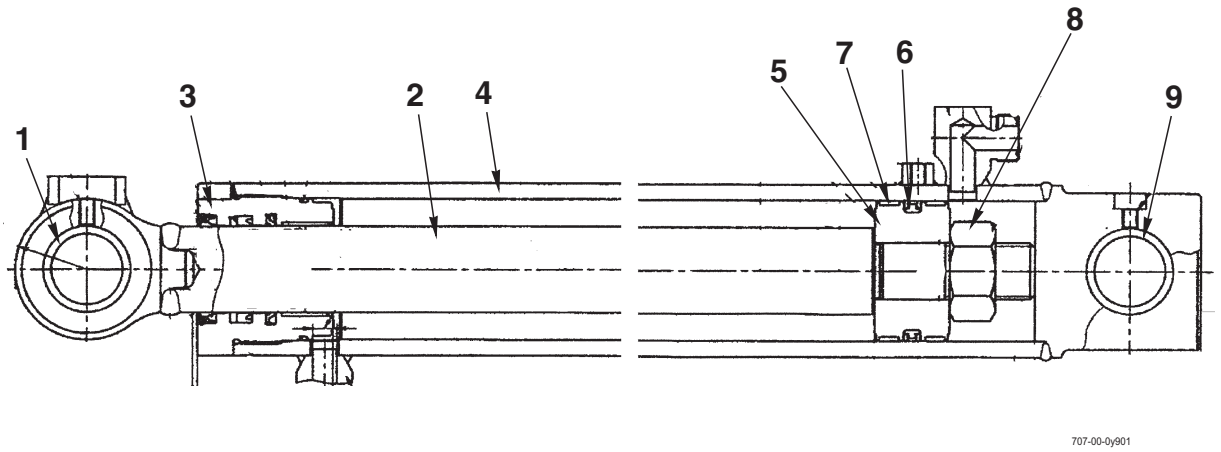
1. Bottom bushing
2. Stem
3. Head
4. Cylinder
5. Piston
6. Gasket
7. Guide ring
8. Cushion plunger
9. Bottom bushing
10. Dowel
11. Ball-bearings (no. 10)

ARM



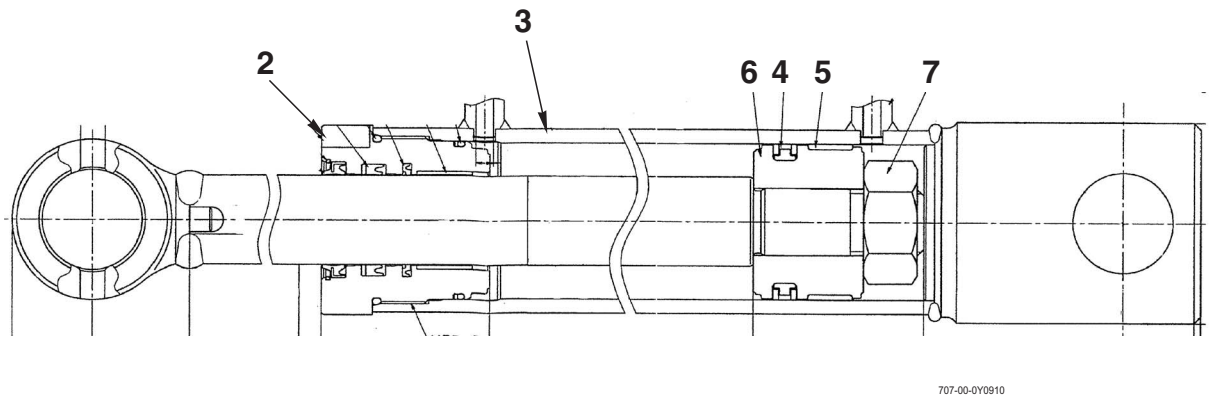
1. Bottom bushing
2. Stem
3. Head
4. Cylinder
5. Brake bushing
6. Gasket
7. Guide ring
8. Piston
9. Nut
10. Bottom bushing

BUCKET CYLINDER



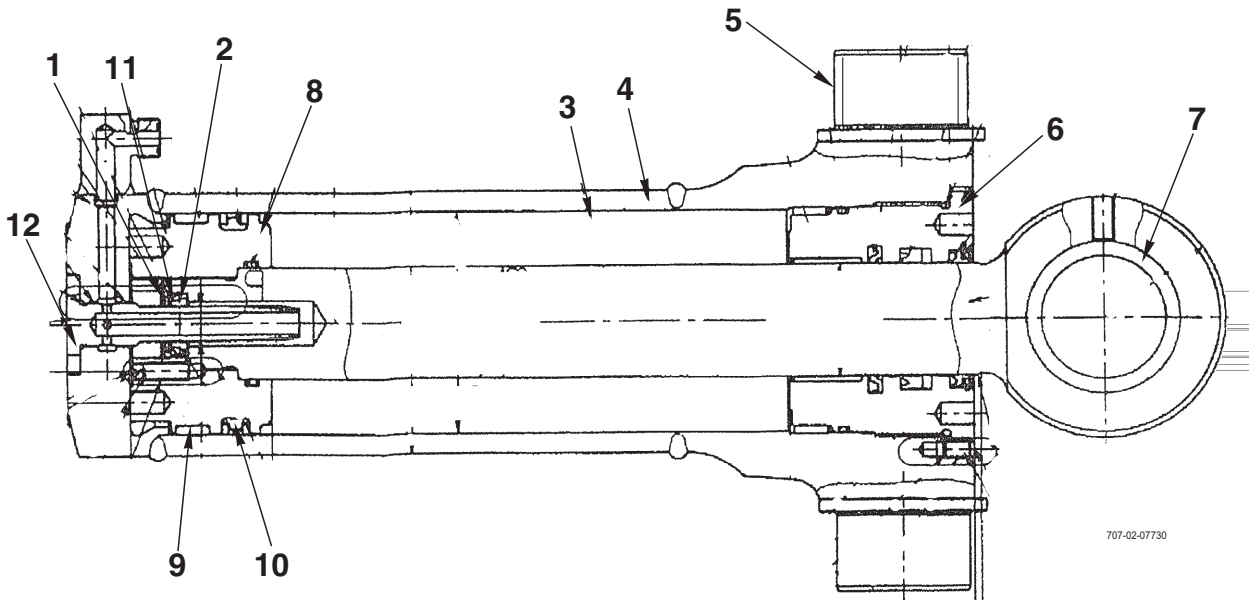
1. Bottom bushing
2. Stem
3. Head
4. Cylinder
5. Piston
6. Gasket
7. Guide ring
8. Nut
9. Bottom bushing

OUTRIGGER CYLINDER



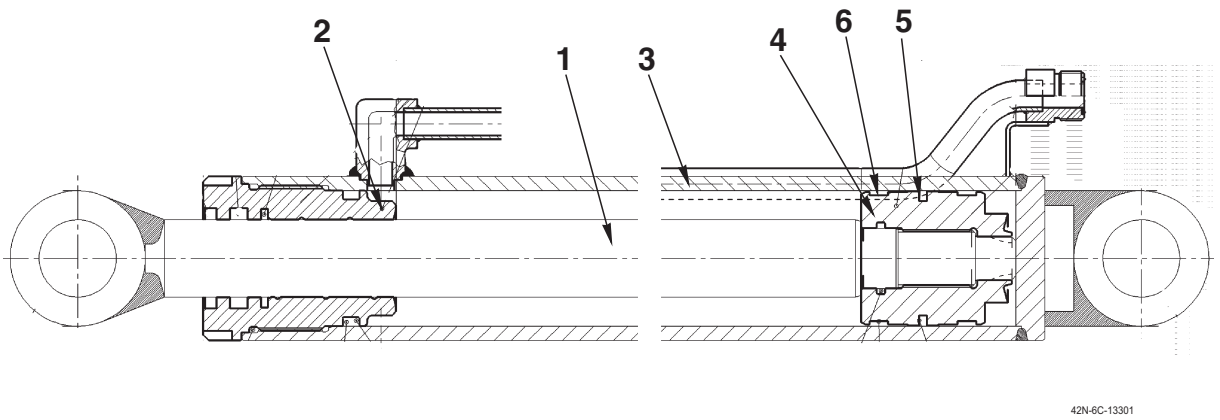
1. Stem
2. Head
3. Cylinder
4. Gasket
5. Guide ring
6. Piston
7. Nut

BOOM SWING CYLINDER



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

JIG ARM CYLINDER



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

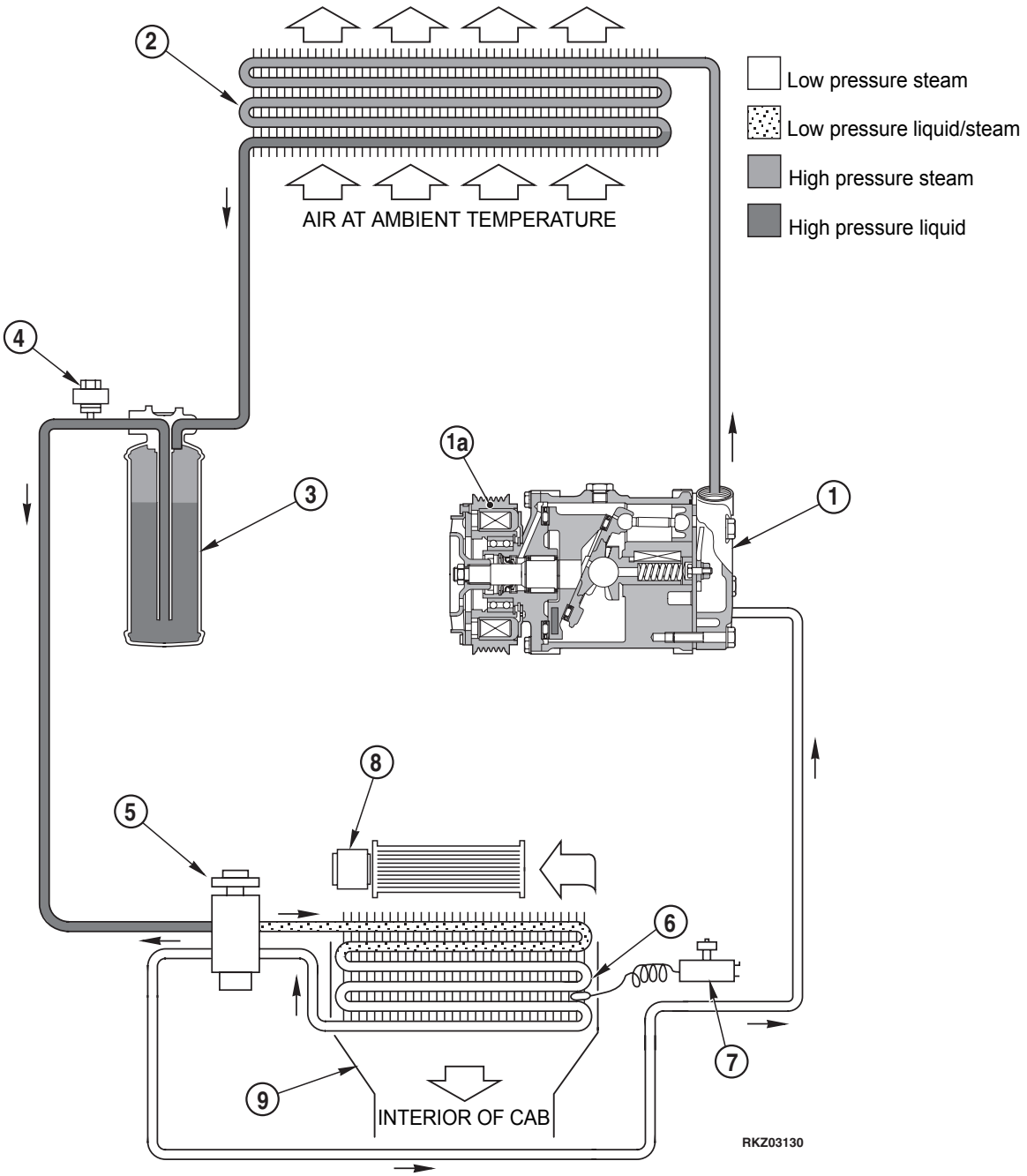
CHARACTERISTICS

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. Drying-filter tank
4. Safety pressure
5. Expansion valve
6. Evaporator
7. Thermostatic clutch control sensor
8. Air-circulation fan in cab
9. Air conveyor

TECHNICAL DATA

- Operating pressure in circuit with engine at 2500 rpm and ambient temperature at 25–30°C:
- Normal pressure: 15 –17 bar
- Low pressure: 1.6 –1.8 bar
- Safety pressures:
- High pressure: 26 bar
- Low pressure: 2.5 bar
- Coolant fluid: R134a
- Quantity of coolant: 2250 ±150 g

HOW THE AIR-CONDITIONING UNIT FUNCTIONS

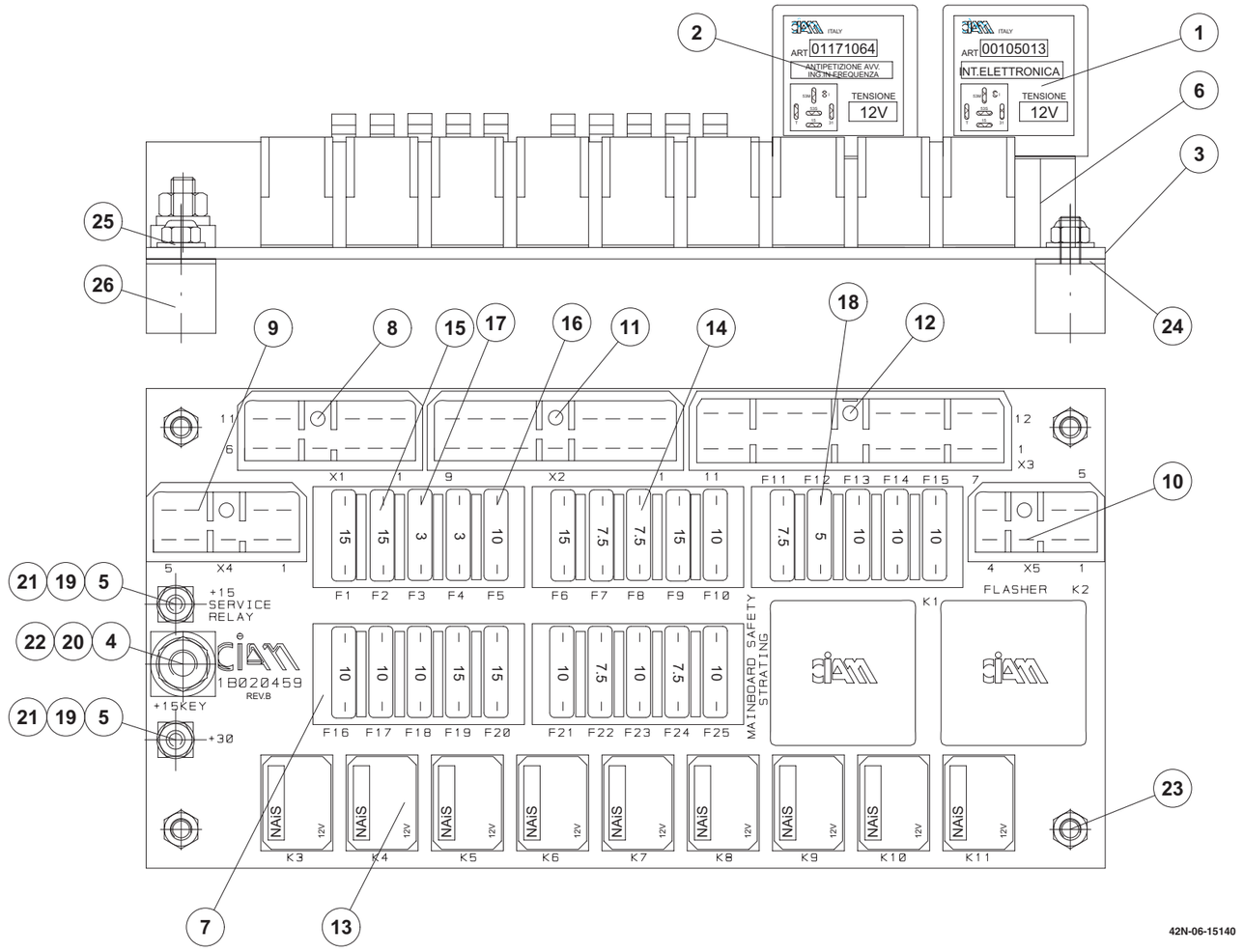
The compressor (1) is driven directly by the engine shaft by means of a belt, and made to rotat by a pulley fitted with an electromagnetically-engaged clutch (1a).
A thermostatic sensor (7) controls the engagement and disengagement of the clutch. It disengages the clutch when the evaporator reaches the lower temperature limit and engages the clutch when the evaporator reaches the upper temperature limit.
The coolant fluid (in gaseous phase) is drawn into the compressor where it is subjected to compression and an intense heating process. In these conditions the fluid is then sent into the condenser (2) where, due to the heat extracted by ambient temperature air flowing over fins, it reaches condensation temperature, and passes into a high-pressure liquid state.
Subsequently the coolant passes into the drying-filter group (3) which performs three functions: it filters out impurities, absorbs any moisture present in 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°C.
The flow of air generated by centrifugal fan (8) which passes through the evaporator (6) at ambient temperature is considerably warmer than – 8°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 commences.
The yielding of heat from the atmosphere in which the evaporator is positioned 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°C is not maintained, it freezes and inhibits the functioning of the evaporator.
The task of keeping the temperature of the evaporator above 0°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 discharged 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 unit. A percentage of this oil circulates constantly throughout the unit in nebulized 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 unit in the case of a lack of coolant fluid or if the quantity becomes insufficient due to leakages. This switch will inhibit the engagement of the electromagnetic clutch and hence the functioning of the air-conditioning unit.

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FUSE AND RELAY CENTRE

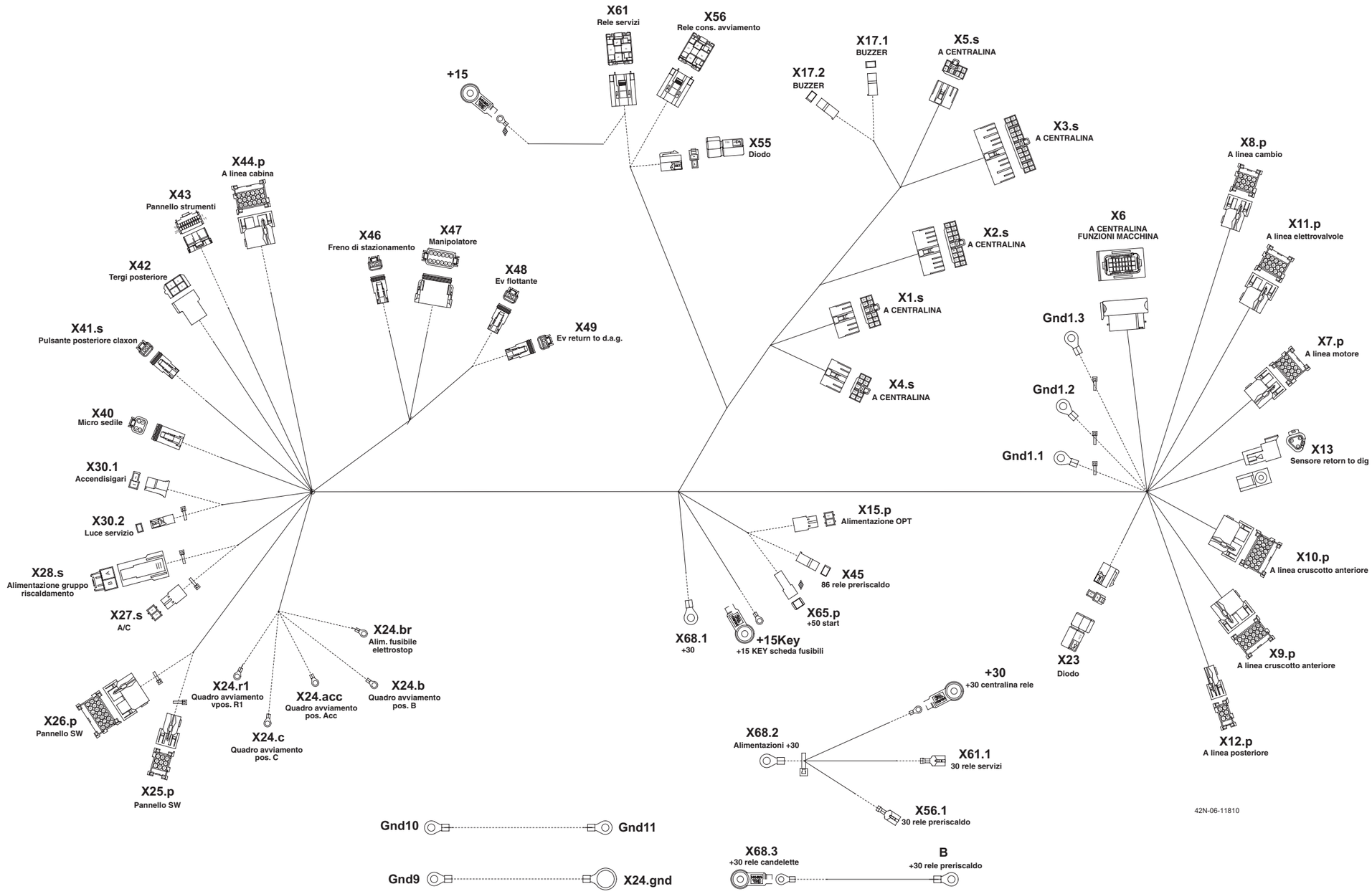
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

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



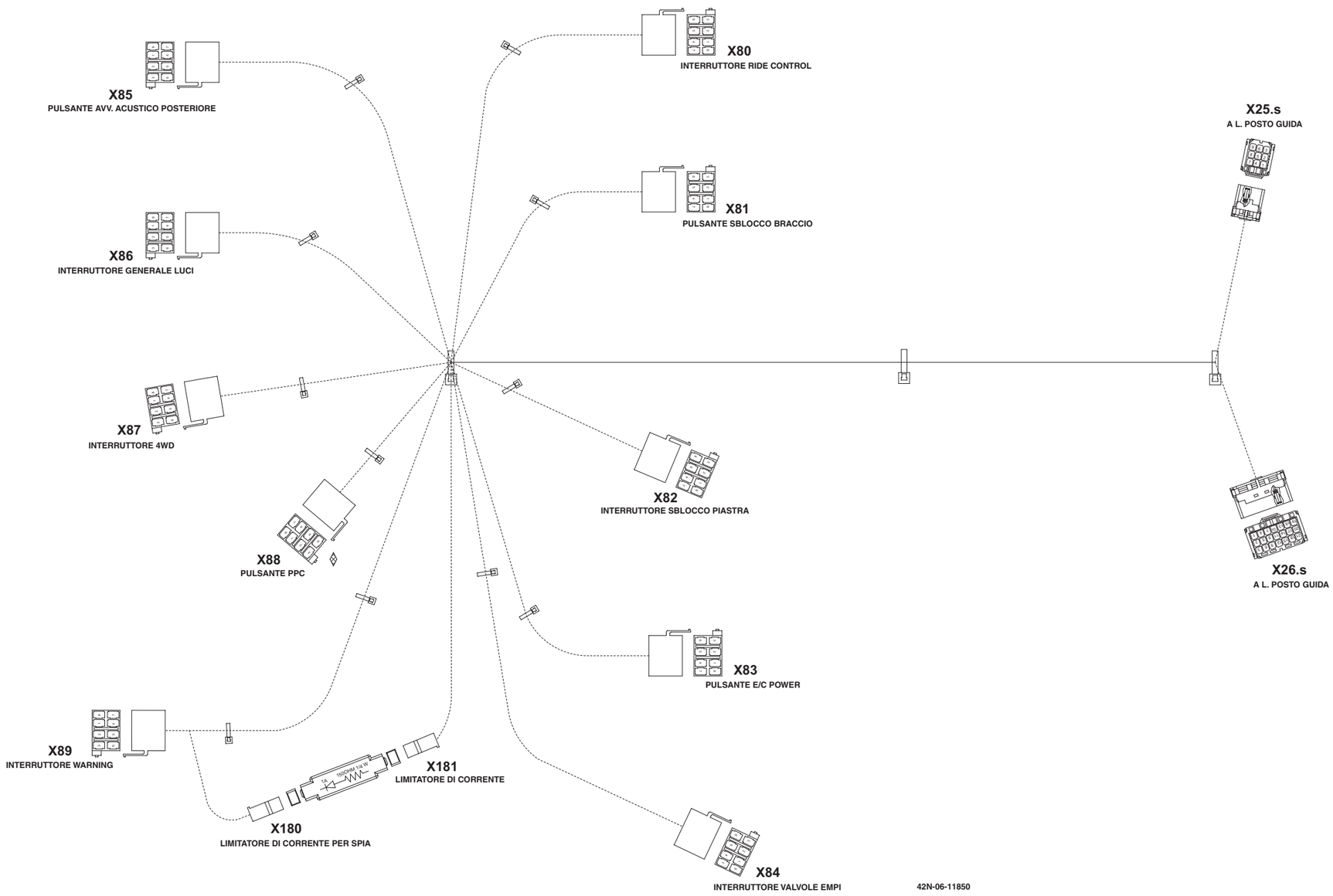
DRIVER SEAT WIRING

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



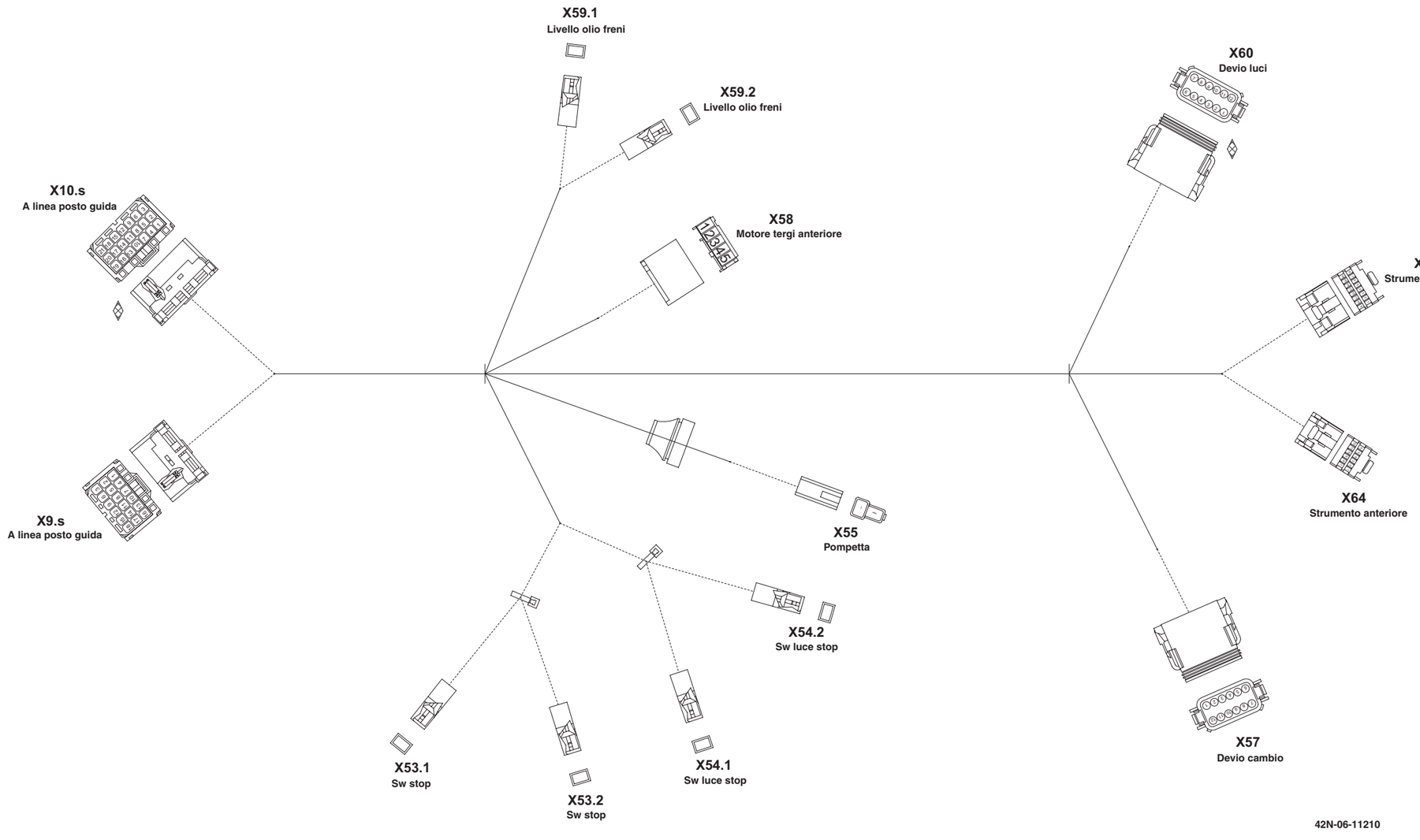
SWITCH PANEL WIRING

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



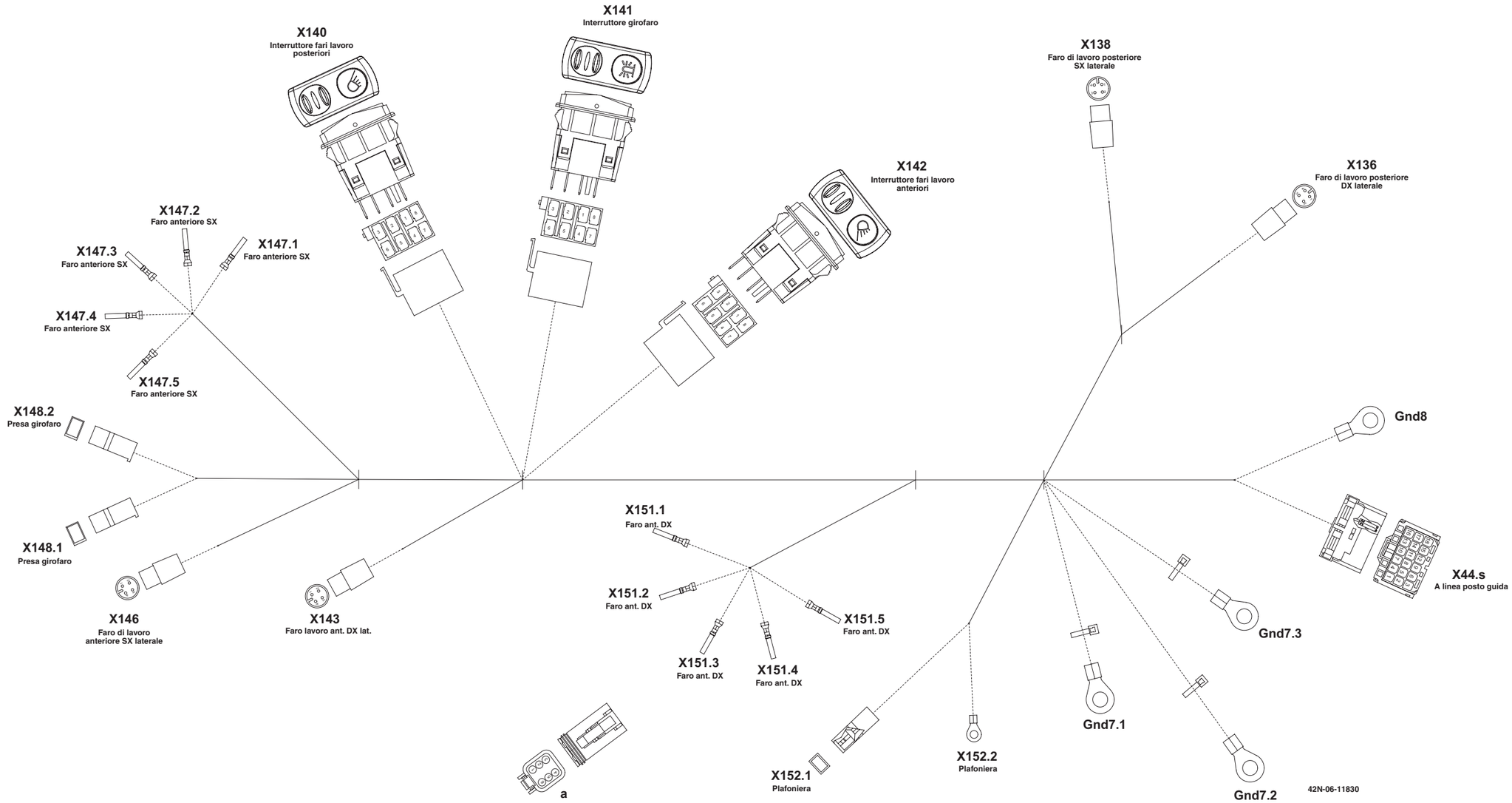
FRONT DASH WIRING

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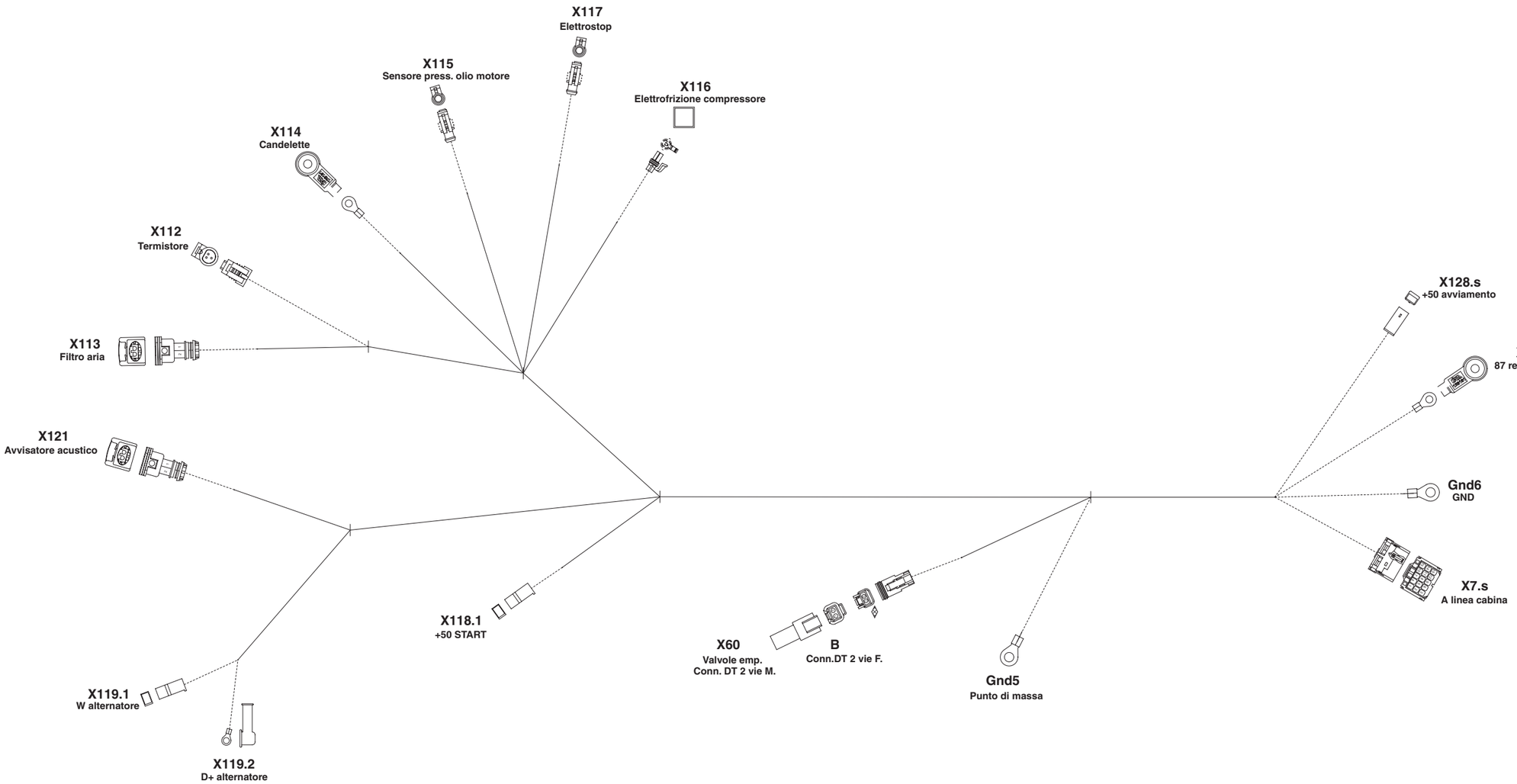
ROOF WIRING

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ENGINE WIRING

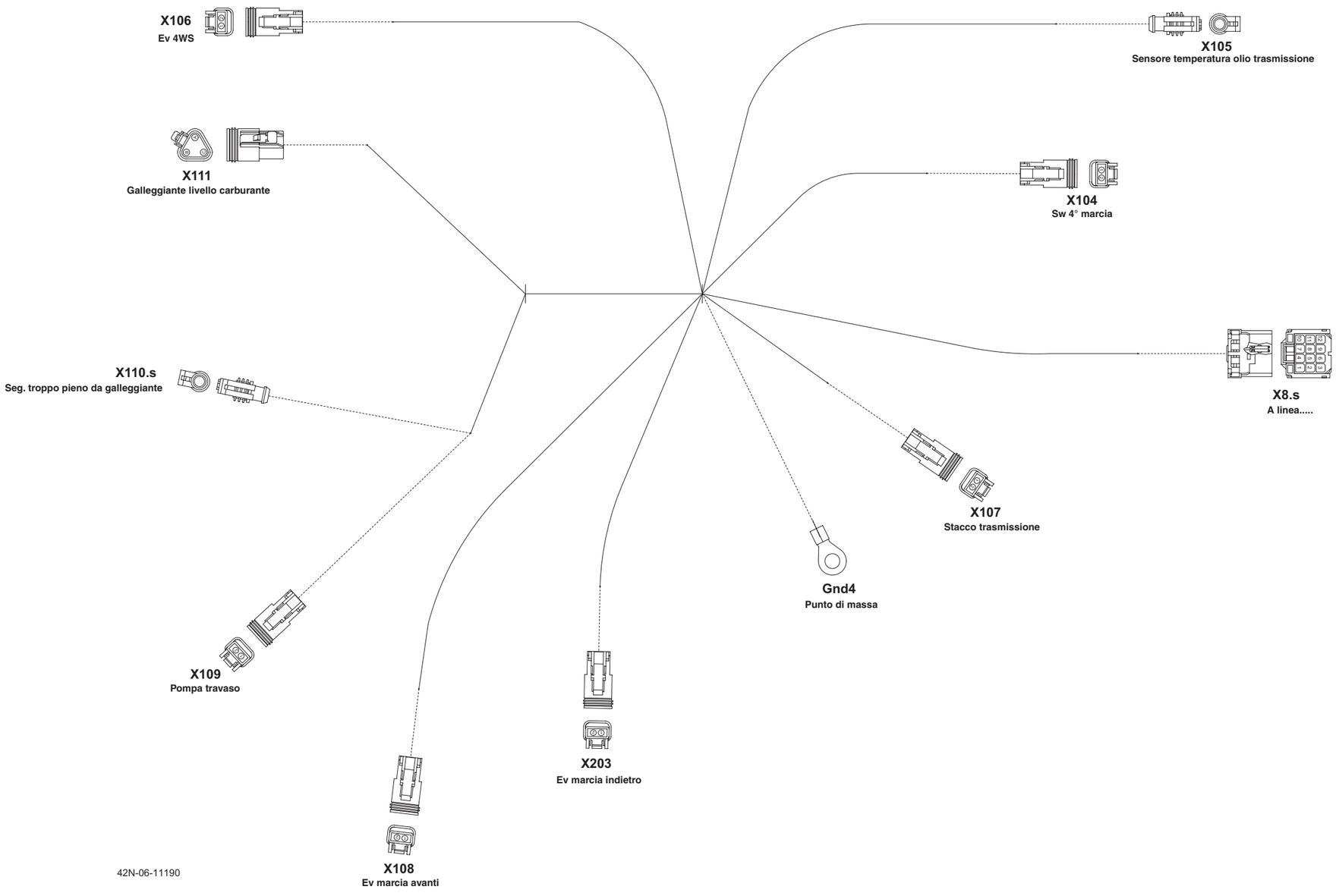
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42N-06-11160

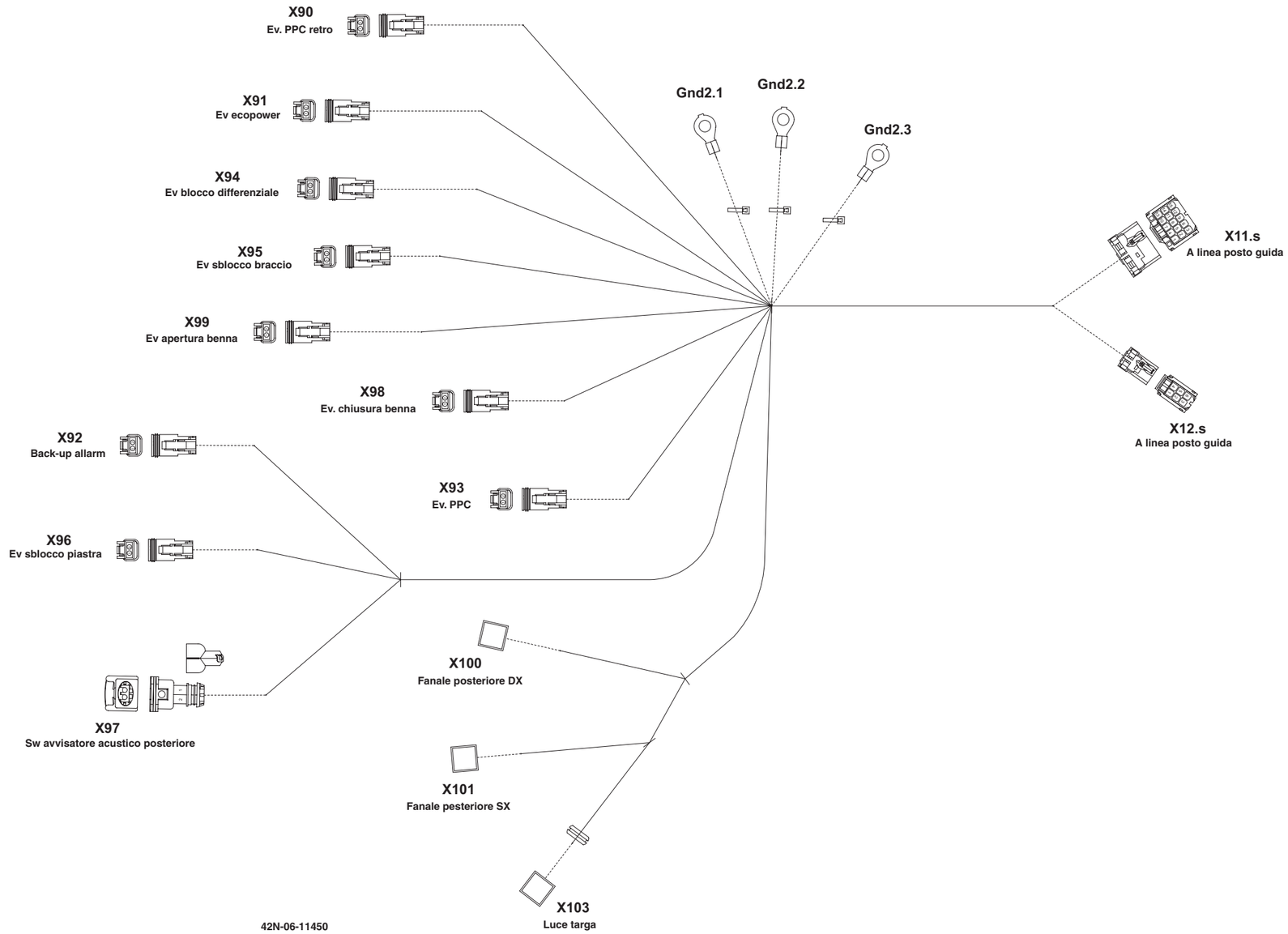
SPEED SELECTOR WIRING

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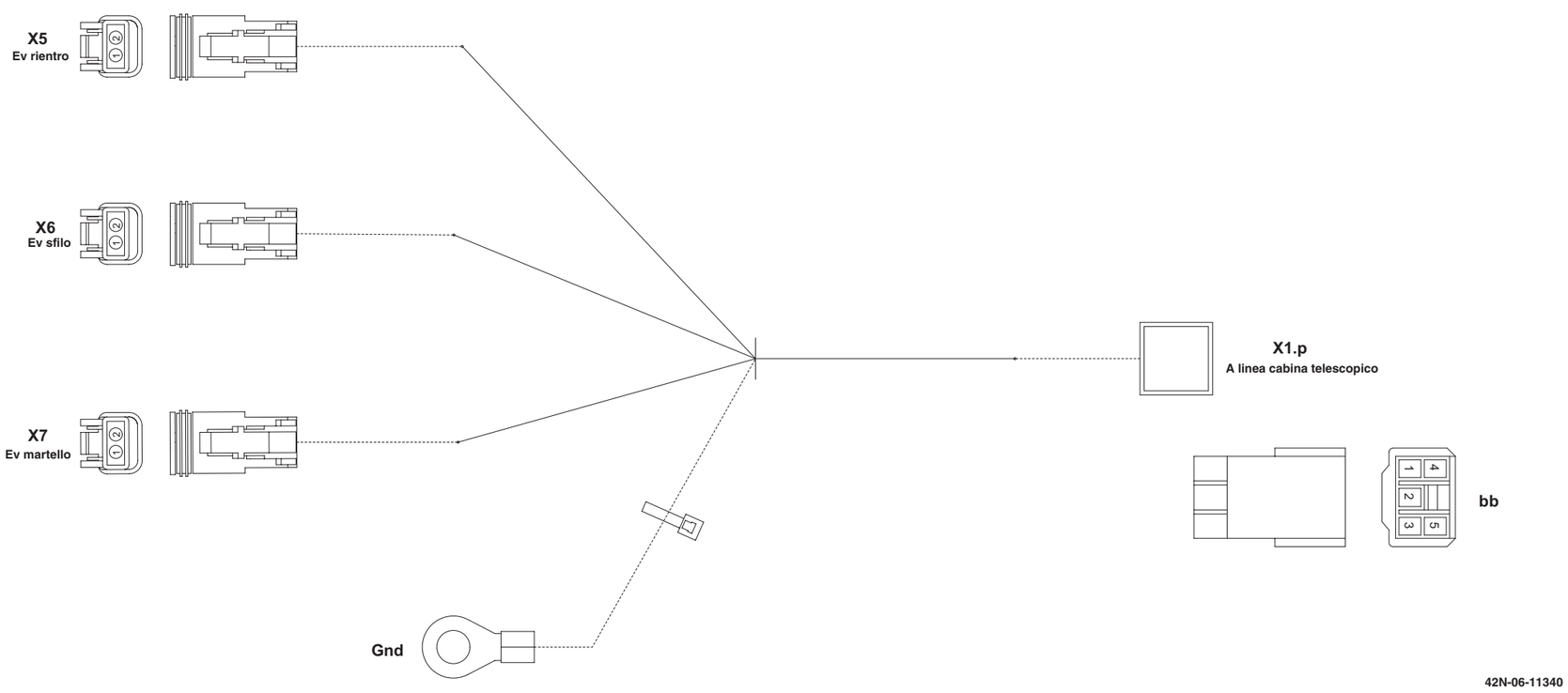
BACKHOE WIRING

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

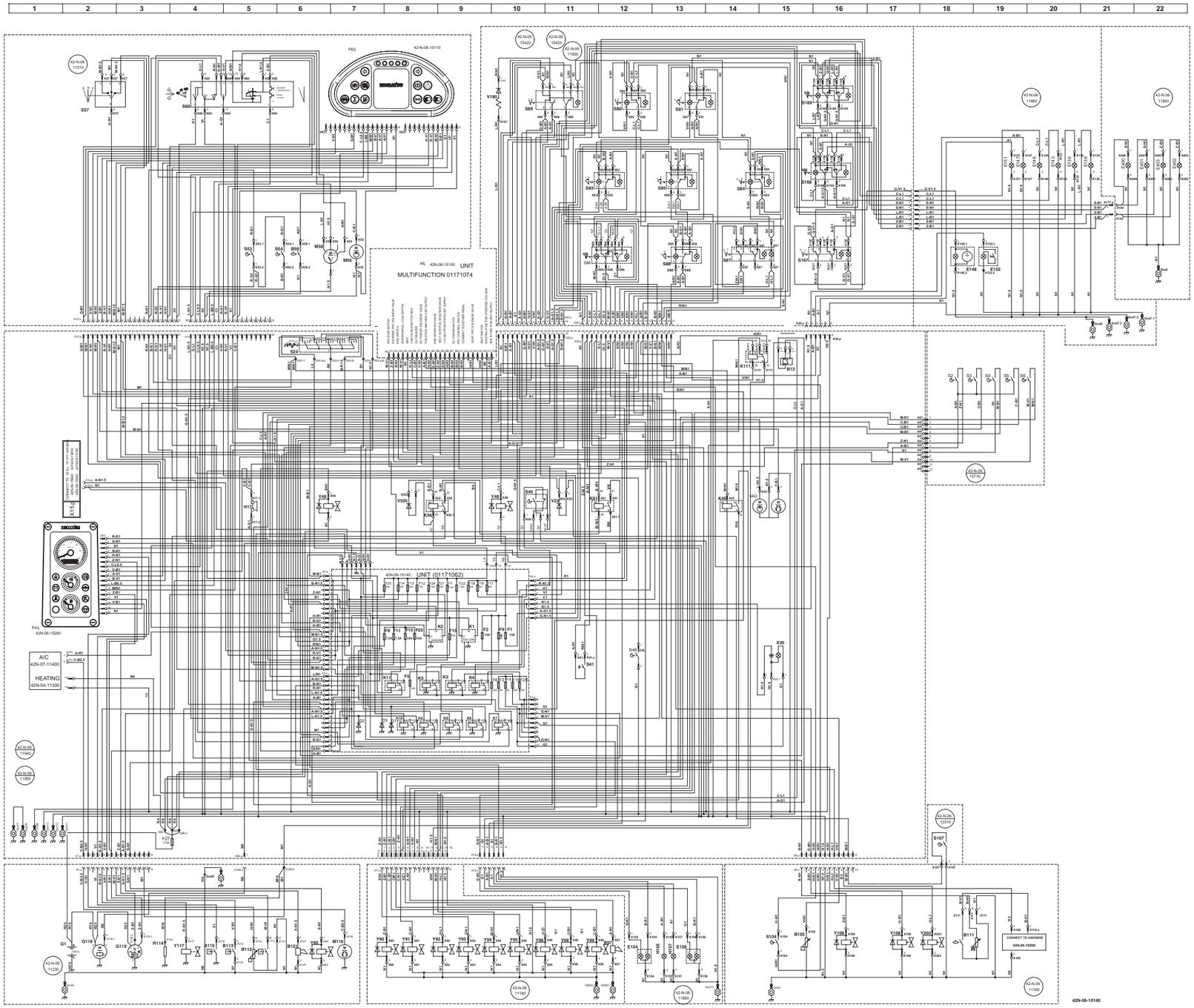


JIG ARM WIRING

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



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



Name/Item	Descrizione	Description	KUE P/N
A6	CENTRALINA FUNZIONI MACCHINA	Function machine unit	
B1	Batteria 12V 180Ah 1000A	Battery 12V 180Ah 1000A	
B30	Usetto stop front	Brake oil low level switch	
B37	AVVISATORE ACUSTICO POSTERIORE	Rear horn switch	
B108	Sensore temperatura olio trasmissione	Transmission oil temperature sender	
B111	Galleggiante livello carburante	Fuel level sender	
B112	Termistore	Thermistor	
B113	Sensore pressione	Pressure switch	
B115	Sensore press. olio motore	Engine oil pressure switch	
B121	Avvisatore acustico	Horn	
E156	Fanale posteriore DX	Rear right light	
E154	Fanale posteriore SX	Rear left light	
E155	LUCE DIREZIONALE SX	LEFT INDICATOR LIGHT	
E165	LUCE DIREZIONALE DX	RIGHT INDICATOR LIGHT	
E136	Faro di lavoro posteriore SX laterale	Lateral rear right working light	
E137	Faro di lavoro posteriore DX laterale	Lateral rear left working light	
E143	Faro lavoro ant. SX lat.	Lateral front right working light	
E140	Faro di lavoro anteriore SX laterale	Lateral front left working light	
E147	Luce di direzione SX	Left indicator	
E148	Presa girofaro	Beacon lamp intake	
E167	Luce d'ingombro DX	Right indicator	
E152	Fanalino	Cabin lamp	
E401	Faro di lavoro anteriore DX	Front right working light	
E403	Faro lavoro ant. SX esterno	Front left working light	
E402	Faro di lavoro posteriore DX centrale	Rear left working light	
E403	Faro di lavoro posteriore DX centrale	Rear right working light	
F1	FUSIBILE FARI LAVORO ANTERIORI CENTRALI 15A	Central front working light fuse 15A	
F2	FUSIBILE FARI LAVORO POSTERIORI CENTRALI 15A	Central rear working light fuse 15A	
F3	FUSIBILE LUCE POSIZIONE DX 3A	Right position light fuse 3A	
F4	FUSIBILE LUCE POSIZIONE SX 3A	Left position light fuse 3A	
F5	FUSIBILE AVVISATORE ACUSTICO 10A	Horn fuse 10A	
F6	FUSIBILE FARI LAVORO POSTERIORI LATERALI 10A	Lateral rear working light fuse 10A	
F7	FUSIBILE 7.5VDD POSTERIORE + AVVISATORE ACUSTICO POSTERIORE 7.5A	Windshield wiper+washer + rear horn fuse 7.5A	
F8	FUSIBILE SWITCH LUCI STOP 7.5A	Stop light switch fuse 7.5A	
F9	FUSIBILE FARI LAVORO ANTERIORI LATERALI 15A	Lateral front working light fuse 15A	
F10	FUSIBILE ALIM. STRUMENTAZIONE 10A	Front windshield wiper supply fuse 10A	
F11	FUSIBILE OPTIONAL 7.5A	Optional fuse 7.5A	
F12	FUSIBILE SCUDERIA DX ANTERIORE+STR LATERALE 5A	Front and lateral instruments supply+ trasher fuse 5A	
F13	FUSIBILE ALIM. MANIPOLATORE 10A	Lever grip supply fuse 10A	
F14	FUSIBILE LAMPADE SWITCH + SWITCH OPTIONAL 10A	Light switch + servizi optional fuse 10A	
F15	FUSIBILE CENTRALINA	Elettrostop + Safety starter fuse 10A	
F16	FUSIBILE GIROFARO 10A	Beacon light fuse 10A	
F17	FUSIBILE ALIM. CENTRALINA 01171062 10A	Warning servizi fuse 10A	
F18	FUSIBILE PLAFONIERA/ACCENDISIGARI 15A	Cabin lamp+cigarette lighter fuse 15A	
F19	Luce fanali ingombro 15A	Low beam light fuse 15A	
F20	FUSIBILE ABBAG.WARN 15A	Main beam light fuse 15A	
F21	FUSIBILE ALIM. SENSORE RETURN + DIG.10A	Return to Dig.sensor supply fuse 10A	
F22	FUSIBILE EC POWER 7.5A	EC POWER fuse 7.5A	
F23	FUSIBILE +15 CENTRALINA STERZATURA 10A	+15 Steering unit fuse 10A	
F24	FUSIBILE ALIM. INTERRUTTORE 7.5A	Washer fuse 10A	
F25	FUSIBILE ALIM. CENTRALINA + ALIM SERVO 10A	Transmission unit+shift/reverse brasket fuse 10A	
F27	+30 rele Lavaggio	Service fuse 115A	
G1	BATTERIA	Battery	
G118	Motorino avviamento	Starter motor	
G119	Gr. alternatore	Generator	
H17	BUZZER	Buzzer	
K1	CENTRALINA ANTIPROTEZIONE AVVIAMENTO	Antiprotection starting unit	
K2	RELE' RISCALDO	Heater relay	
K3	RELE' LAMPEGGIO LUCI	Low beam light relay	
K4	RELE' ABBAGLIANTI	Main beam light relay	
K5	RELE' LAMPEGGIO LUCI	Front horn relay	
K6	RELE' ELETTROVALVOLA RETURN TO DIG	Return to DIG solenoid valve relay	
K7	RELE' LAMPEGGIO LUCI	Stop Light relay	
K8	RELE' STARTING/ AVVIAMENTO	Start relay	
K9	RELE' MARCIA AVANTI	Forward speed relay	
K10	RELE' MARCIA INDIETRO	Reverse speed relay	
K11	RELE' STACCO TRASMISSIONE	De-clutch relay	
K45	+15 rele preriscaldo	Preheating relay	
K46	30 rele preriscalde	Safety start relay	
K51	30 rele avvisi	Services relay	
M44	Tergi posteriore	Rear windshield wiper	
M45	Tergi proiettore	Rear windshield wiper	
M55	Proiettore	Windshield+Washer pump	
M56	Motore tergi anteriore	Front windshield wiper	
M116	Elettroriduttore compressore	Compressor Electronic clutch	
M117	Condensatore	Preheater	
P1	INTERRUTTORE 45-0-TECNOVALVOLA EC- POWER	SWITCH 45-0-EC POWER	
P4	Interruttore luci cruscotto	Instrument panel light switch	
P5	STACCO TRASMISSIONE	DECLUTCH SWITCH	
P6	BENNA APRE INTERRUTTORE	OPEN GRAB SWITCH	
P7	BLOC.CAGGIO DIFFERENZIALE	DIFFERENTIAL LOCKING SWITCH	
P8	Quadro portalampada pos. B1	Starting Switch	
P40	Micro aperto	Seat Switch	
P41	FULSANTE POSTERIORE CLAXON	Rear horn switch	
P45	Freno di stazionamento	Parking brake switch	
P50	INTERRUTTORE LUCI STOP	Stop light Switch	
P54	INTERRUTTORE STOP AWD	Stop AWD Switch	
P57	Sterzo ussino	Steering column gear shift	
P59	Interruttore luci cruscotto	Instrument panel light switch	
P60	INTERRUTTORE RIDE CONTROL	Ride control switch	
P61	PULSANTE SBLOCCO BRACCIO	Arm unlock switch	
P63	PULSANTE EC POWER	EC Power Switch	
P64	INTERRUTTORE VALVOLE EMPI	EMPI solenoid valve switch	
P65	PULSANTE AVV. ACUSTICO POSTERIORE	Rear horn switch	
P66	Interruttore luci cruscotto	Electric switch	
P67	INTERRUTTORE GENERALE LUCI	Head light switch	
P69	INTERRUTTORE 4WD	4WD Switch	
P70	PULSANTE PTO	PTO switch	
P89	INTERRUTTORE WARNING	WARNING switch	
P97	AVVISATORE ACUSTICO POSTERIORE	Rear horn switch	
S104	Sw.4° marcia	4th speed switch	
S105	INTERRUTTORE FARO DI LAVORO ANTERIORE	Front working light switch	
S106	Interruttore luci cruscotto	Beacon light switch	
S107	INTERRUTTORE FARI LAVORO POSTERIORI	Rear working light switch	
S30	ACCENDISIGARI	Cigarette lighter	
V.66	Ev.flottante	Float solenoid valve	
V.49	Ev.ritorno in d.p.g.	Return to DIG solenoid valve	
V.60	Valvola ossu	EMPI Solenoid Valve	
V.62	Ev. 4th velocità	4th speed solenoid valve	
V.63	Ev. EC power	EC power solenoid valve	
V.70	Retro-up allarm	Back-up alarm	
V.93	Ev. PPC	PPC solenoid valve	
V.94	Ev.blocco differenziale	Differential lock solenoid valve	
V.95	Ev.ritenuta braccio	Arm unlock solenoid valve	
V.96	Ev.sblocco pistone	Piste unlock solenoid valve	
V.98	Ev.chiusura benna	Grab close solenoid valve	
V.99	Ev.apertura benna	Grab open solenoid valve	
V.102	30 4WD	4WD Solenoid valve	
V.108	Ev.marcia avanti	Forward solenoid valve	
V.111	Elettrostop	Elettrostop	
V.203	Ev.marcia indietro	Reverse speed solenoid valve	
A.12.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.12.B	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.100.A	CONNETTORE A LINEA INTERRUTTORI	TO SWITCH HARNESS CONNECTOR	
A.117.R	CONNETTORE A LINEA FARI LAVORO	TO WORKING LIGHT HARNESS CONNECTOR	
A.9.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.12.B.a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.7.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.1.A	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
A.10.A	CONNETTORE A LINEA CRUSCOTTO ANTERIORE	TO FRONT DASHBOARD HARNESS CONNECTOR	
A.12.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A.11.A	CONNETTORE A LINEA FANALI POSTERIORI	TO CHASSIS HARNESS CONNECTOR	
A.7.A	CONNETTORE A LINEA OPTIONAL	TO OPTIONAL HARNESS CONNECTOR	
A.2.A	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
A.26.A	CONNETTORE A LINEA PANNELLO INTERRUTTORI	TO SWITCHES PANEL HARNESS CONNECTOR	
A.26.A	CONNETTORE A LINEA PANNELLO INTERRUTTORI	TO SWITCHES PANEL HARNESS CONNECTOR	
A.28	CONNETTORE MOTORE 6HK1/4HK1/6TD	HEATING CONNECTOR	
A.2.A	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
A.2.A	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
A.44.A	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	
A.5.A	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
A24.A	CONNETTORE A LINEA MOTORE	TO MOTOR HARNESS CONNECTOR	
A7.J	CONNETTORE A LINEA MOTORE	TO MOTOR HARNESS CONNECTOR	
A9.J	CONNETTORE A LINEA CAMBIO SHUTTLE	TO GEAR HARNESS CONNECTOR	
A10.A	CONNETTORE A LINEA CRUSCOTTO ANTERIORE	TO FRONT DASHBOARD HARNESS CONNECTOR	
A12.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A26.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A10.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A9.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A44.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
A11.A	CONNETTORE A LINEA FANALI POSTERIORI	TO CHASSIS HARNESS CONNECTOR	
A12.A	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
P43	PANNELLO STRUMENTI	INSTRUMENTS PANEL	
P63	PANNELLO ANTERIORE	FRONT CONTROL PANEL	
A.14D	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	
A.14D	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	

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NORMAL OR STANDARD TECHNICAL DATA

Machine model			WB93R-5	
Check item	Test conditions	Unit:	Standard value	Normal value
Engine speed (without load):	High idling Low idling Calibration speed	rpm rpm rpm	2400±50 1050±50 –	2350–2450 1000–1100 –
Exhaust gas colour	Sudden acceleration At high idling speed	Bosch index	– <1.5	<3.0 <3.0
Valve clearance	Intake valve (20°C) Exhaust (20°C)	mm mm	0.30±0.05 0.55±0.05	0.30±0.05 0.55±0.05
Compression pressure (SAE30 oil)	Oil temperature: 69–72°C (Engine speed)	bar rpm	34.3±1 250	27.5±1 250
Engine oil pressure (SAE30 oil)	With blow-by Free exhaust	mm H_2O	5–10 50.0	5–10 50.0
Engine oil pressure	At high idling speed At Low idling	bar (kPa) bar (kPa)	3.5 (350) 0.7 (70)	–
Engine oil temperature	Entire speed range	°C	Max. 120	Max. 120
Fuel injectiontiming	B.T.D.C.	mm	1.00	1.00±0.05

• MACHINE WITH BACKHOE MECHANICAL CONTROLS

Machine model						WB93R-5							
Classification	Check item	Test conditions			Unit:	Standard value				Normal value:			
Engine speed	Accelerator pedal	• Hydraulic oil temperature: 45–55 °C • Converter oil temperature: 80 °C • Engine oil temperature cooling circuit: in the limits • Measurement taken on drive shaft pulley with stroboscopic rev counter.	Max.		rpm	2400±50				2350–2450			
			Min.			1050±50				1000–1100			
	Accelerator fuel	• Hydraulic oil temperature: 45–55 °C • Converter oil temperature: 80 °C • Engine oil temperature cooling circuit: in the limits • Measurement taken on drive shaft pulley with stroboscopic rev counter.	Max.			1900±50				1850–1950			
			Min.			1050±50				1000–1100			
Control valve					mm	ℓ	a	b	c	ℓ	a	b	c
	Boom swing, 4 in 1 bucket, jig arm, outriggers	• See Fig. A				45	6	6	–	–	–	–	–
	Arm, shovel, boom, bucket					45	6.5	6.5	–	–	–	–	–
	Shovel arm command only	• See Fig. B				–	6	5.5	2	–	–	–	–
Travel of levers and pedals	Shovel arm control lever	• Engine stopped • Knob lever: at the center and at 90° from the lever • Value reading at the end of working stroke plus half measured backlash • Attachments on the ground • Instrument metre w/ millimetre divisions	Neutral →	Raise	mm	95				80–110			
				Lower		95				80–110			
	Shovel control lever		Neutral →	Dump		95				80–110			
				Curl		95				80–110			
	Boom backhoe controllever		Neutral →	Raise		100				85–115			
				Lower		100				85–115			
	Arm backhoe control lever		Neutral →	Opening		100				85–115			
				Closing		100				85–115			
	Bucket backhoe control lever		Neutral →	Opening		100				85–115			
				Curl		100				85–115			
	Boom swing backhoe control lever		Neutral →	Right		100				85–115			
				Left		100				85–115			
	Outriggers control lever		Neutral →	Up		35				25–45			
				Down		35				25–45			
	Fuel control lever		Min. →	Max.		40				30–50			
	Pedale comando telescopico		Neutral →	Out		15				10–20			
				In		15				10–20			
	Hammer and side digging boom control pedal		Neutral →	Right		15				10–20			
				Left		15				10–20			

MACHINE WITH BACKHOE MECHANICAL CONTROLS

Machine model					WB93R-5	
Classification	Check item	Test conditions		Unit	Standard value	Normal value:
Travel of levers and pedals	Accelerator pedal	• Engine stopped • Knob lever: at the center and at 90° from the lever • Value reading at the endof working stroke • Attachments on the ground • Instrument:	Min. → Max.	mm	80	65–95
	Wheel swing		Right →Left Left → Right	rev.	3.5 3.5	3.1–3.9 3.1–3.9
Force for lever, pedal and steering wheel operation	Shovel arm control lever	• Engine speed: min. • Oil temperature: 45–55 °C • Tool connection at centre of knob and 80 mm away from handle base (see Fig. C) • Value reading at the 10 mm before end of working stroke. • Instrument force gauge. • Ambient temperature: 15-35 °C		kg	1.5	1.0–2.0
	Shovel control lever				1.5	1.0–2.0
	Control lever Boom	• Engine speed: min. • Oil temperature: 45-55 °C • Tool connection at the centre of knob and at 90° from the lever. • Tool connection on edge (for pedals) • Value reading at the 10 mm before end of working stroke. • Instrument force gauge. • Ambient temperature: 15-35 °C			1.5	1.0–2.0
	Arm control lever				1.5	1.0–2.0
	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
	Jig arm control pedal		Input		3.5	2.5–4.5
			Out		5.0	4.0–6.0
	Hammer control pedal				3.5	2.5–4.5
	Accelerator pedal				4.0	2.5–5.5
	Steering wheel	• 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.			–	–

MACHINE WITH BACKHOE MECHANICAL CONTROLS

Machine model				WB93R-5	
Classification	Check item	Test conditions	Unit	Standard value	Normal value
Main valve pressure	Control valve	• Engine speed: 2200 rpm • Oil temperature: 45-55 °C • Move arm cylinder to end of stroke and measure the pressure • Instrument: 0-600 bar pressure gauge mounted on adapters at port “P1C”. • Working mode switch: POWER	bar	245	235–260
	Steering unit	• Engine speed: 1500±50 rpm		175	170–185
Pressures of secondary valves circuits	Shovel (curled)	• Engine speed: min. • Oil temperature: 45-55 °C • Check one circuit at the time • Instrument: 0-600 bar pressure gauge mounted on adapters at port “P1C”. • Working mode switch: POWER	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

MACHINE WITH BACKHOE MECHANICAL CONTROLS

Machine model				WB93R-5	
Classification	Check item	Test conditions	Unit	Standard value	Normal value
Engine speed (with load) - Converter	With converter	• Engine speed (without load): 2400±50 • Hydraulic oil temperature: 45-55 °C • Machine in 3rd gear • Working brakes: engaged. • Working mode switch: POWER	rpm	2175±50	2125–2225
	With converter and hydraulic circuit	• Engine speed (without load): 2400±50 • Hydraulic oil temperature: 45-55 °C • Machine in 3rd gear • Working brakes: engaged. • Shovel raise bottom of stroke • Steering held at the end of stroke • Working mode switch: POWER		2075±50	2025–2125
	Hydraulic circuit at Low idling	• Engine speed: 1050±50 • Hydraulic oil temperature: 45-55 °C • Vehicle in neutral • Parking brake: applied • Bucket dump bottom of stroke • Working mode switch: POWER		600	Min. 600

★ 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 WITH BACKHOE MECHANICAL CONTROLS

Machine model					WB93R-5	
Classification		Check item	Test conditions	Unit	Standard value	Normal value
Hydraulic drift working equipment	Shovel	Complete working equipment (Shovel teeth tip lower)	Measuring posture: see Fig. D • In this position check in feedback of each cylinder and the leakage with applied load on the tip of shovel teeth. • On level ground. • Shovel: load 1800 Kg 4 in 1 bucket: load 1550 kg • Engine stopped • Oil temperature: 45-55 °C • Check measures as soon as engine stops. • Check changes every 5 min. and the total change in 15 min.	mm	150	300
		Raise cylinder (Cylinder in)			12	20
		Shovel cylinder (Cylinder out)			35	50
	Backhoe	Complete working equipment (Bucket teeth tip lower)	Measuring posture: see Fig. E • In this position check the extension of each cylinder and the leakage with normal load on the bucket. • On level ground. • Bucket: load with standard arm: 340 kg Bucket load with jig arm: 0 kg Fully extend jig arm • Engine stopped • Oil temperature: 45-55 °C • Check measures as soon as engine stops. • Check changes every 5 min. and the total change in 15 min.	mm	200	350
		Boom cylinders (Cylinder out)			10	20
		Arm cylinders (Cylinder out)			10	20
		Bucket cylinder (Cylinder in)			8	15

★ 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 WITH BACKHOE MECHANICAL CONTROLS

Machine model					WB93R-5	
Classification	Check item		Test conditions	Unit	Standard value	Normal value
Hydraulic drift working equipment	Backhoe	Boom swing	Measuring posture: see Fig. F • Oil temperature: 45-55 °C • Backhoe balanced on the guides bucket in transport condition. • 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. • Move the machine on a slope of 15° and apply the parking brake. • Stop the engine and, after 1 minute, check the inner cylinder feed back opposite to the boom every 5 min. for a total of 15 minutes.	mm	15	15
		Outriggers	Measuring posture: see Fig. G • Oil temperature: 45-55 °C • Backhoe balanced. • Boom and arm cylinders in, bucket cylinder out • Outriggers at maximum extension. • Engine stopped • 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 • Oil temperature: 45-55 °C • Leaking check: on the cylinder opposite side to the pressure one. • Check 1 cylinder at a time. • For arm shovel, shovel and for swing, check the two cylinders separately.	cm³/min	2.0 (each cylinder)	Max. 8.0
		Shovel			1.6 (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

★ 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 WITH BACKHOE MECHANICAL CONTROLS

Machine model						WB93R-5	
Classification	Check item		Test conditions		Unit	Standard value	Normal value
Work equipment speed	Shovel	Arm shovel Cylinders fully out ↕ Shovel at the ground	Measuring posture: see Fig. H • Engine speed: max. • Oil temperature: 45-55 °C • Shovel speed button: applied	Lifting	sec.	3.6	3.1–4.1
				Lowering		2.6	2.2–3.0
		Shovel Cylinders fully out ↕ Cylinders fully in	Measuring posture: see Fig. J • Engine speed: max. • Oil temperature: 45–55 °C • Shovel speed button: applied	Curl		2.3	2.0–2.6
				Dump		2.8	2.4–3.2
	Backhoe	Boom Cylinders fully in ↕ Teeth bucket on level ground	Measuring posture: see Fig. K • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Lifting ●		2.7	2.3–3.1
				Lowering		2.0	1.7–2.3
		Arm Cylinders fully in ↕ Cylinders fully out	Measuring posture: see Fig. L • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Opening		3.8	3.2–4.3
				Closing ●		4.4	3.7–5.1
		Bucket Cylinders fully in ↕ Cylinders fully out	Measuring posture: see Fig. M • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Dump		2.4	2.0–2.8
				Curl		3.1	2.6–3.6

★ 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 WITH BACKHOE MECHANICAL CONTROLS

Machine model						WB93R-5	
Classification	Check item		Test conditions		Unit	Standard value	Normal value
Work equipment speed	Backhoe	Boom swing Right end travel ↕ Left end travel	Measuring posture: see Fig. N • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Arm vertical • Power mode ON	Right ●	sec.	3.2	2.7–3.7
				Left ●		3.2	2.7–3.7

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

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

★ 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 WITH BACKHOE MECHANICAL CONTROLS

Machine model					WB93R-5	
Classification	Check item		Test conditions	Unit	Standard value	Normal value
Work equipment	Time lags	Arm shovel	Measuring posture: see Fig. P • Engine speed: Min. • Oil temperature: 45-55 °C • Check the time necessary to lift shovel from level ground.	sec.	0	Max. 2
		Boom	Measuring posture: see Fig. Q • Engine speed: Min. • Oil temperature: 45-55 °C • 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	Measuring posture: see Fig. R • Engine speed: Min. • Oil temperature: 45-55 °C • 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	Measuring posture: see Fig. S • Engine speed: Min. • Oil temperature: 45-55 °C • Put arm in horizontal position. Tilt back bucket cylinder an then extend it. Check the time passing between bucket stop at dead centre and the restart movement.		0	Max. 2
		Outriggers	Measuring posture: see Fig. T • Engine speed: Min. • Oil temperature: 45-55 °C • Boom, arm and bucket fully retracted and putted in machine centre position. • Check the time necessary for outriggers to raise the machine from when they lean on level ground. • Check each outrigger at a time.		0	Max. 2

• VEHICLE WITH SERVOCONTROLS

Machine model					WB93R-5							
Classification	Check item	Test conditions		Unit	Standard value				Normal value			
Engine speed	Accelerator pedal	• Hydraulic oil temperature: 45-55 °C • Converter oil temperature: 80 °C • Engine oil temperature cooling circuit: in the limits • Measurement taken on drive shaft pulley with stroboscopic rev counter.	Max.	rpm	2400±50				2350–2450			
			Min.		1050±50				1000–1100			
	Accelerator fuel	• Hydraulic oil temperature: 45-55 °C • Converter oil temperature: 80 °C • Engine oil temperature cooling circuit: in the limits • Measurement taken on drive shaft pulley with stroboscopic rev counter.	Max.		1900±50				1850–1950			
			Min.		1050±50				1000–1100			
Control valve				mm	ℓ	a	b	c	ℓ	a	b	c
	Boom swing, 4 in 1 bucket, jig arm, outriggers	• See Fig. A			45	6	6	–	–	–	–	–
	Arm, shovel, boom, bucket				45	6.5	6.5	–	–	–	–	–
	Shovel arm command only	• See Fig. B			–	6	5.5	2	–	–	–	–
Travel of levers and pedals	Shovel arm control lever	• Engine stopped • Knob lever: at the center and at 90° from the lever • Value reading at the end of working stroke plus half measured backlash • Attachments on the ground • Instrument metre w/ millimetre divisions	Neutral → Raise Neutral → Lower	mm	95 95				80–110 80–110			
	Shovel control lever		Neutral → Dump Neutral → Curl		95 95				80–110 80–110			
	Boom backhoe controllever		Neutral → Raise Neutral → Lower		50 50				40–60 40–60			
	Arm backhoe control lever		Neutral → Opening Neutral → Closing		50 50				40–60 40–60			
	Bucket backhoe control lever		Neutral → Opening Neutral → Curl		50 50				40–60 40–60			
	Boom swing backhoe control lever		Neutral → Right Neutral → Left		50 50				40–60 40–60			
	Outriggers control lever		Neutral → Up Neutral → Down		35 35				25–45 25–45			
	Fuel control lever		Min. → Max.		40				30–50			

VEHICLE WITH SERVOCONTROLS

Machine model				WB93R-5	
Classification	Check item	Test conditions	Unit	Standard value	Normal value
Travel of levers and pedals	Accelerator pedal	• Engine stopped • Knob lever: at the center and at 90° from the lever • Value reading at the end of working stroke • Attachments on the ground • Instrument: Min. → Max.	mm	80	65–95
	Wheel swing	Right → Left Left → Right	rev.	3.5 3.5	3.1–3.9 3.1–3.9
Force for lever, pedal and steering wheel operation	Shovel arm control lever	• Engine speed: min. • Oil temperature: 45-55 °C • Tool connection at centre of knob and 80 mm away from handle base (see Fig. C) • Value reading at the 10 mm before end of working stroke. • Instrument force gauge. • Ambient temperature: 15-35 °C	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	• 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.		–	–

VEHICLE WITH SERVOCONTROLS

Machine model				WB93R-5	
Classification	Check item	Test conditions	Unit	Standard value	Normal value
Main valve pressure	Control valve	• Engine speed: 2200 rpm • Oil temperature: 45-55 °C • Move arm cylinder to end of stroke and measure the pressure • Instrument: 0-600 bar pressure gauge mounted on adapters at port “P1C”. • Working mode switch: POWER	bar	245	235–260
	Steering unit	• Engine speed: 1500±50 rpm		175	170–185
Pressures of secondary valves circuits	Shovel (curled)	• Engine speed: min. • Oil temperature: 45-55 °C • Check one circuit at the time • Instrument: 0-600 bar pressure gauge mounted on adapters at port “P1C”. • Working mode switch: POWER	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

VEHICLE WITH SERVOCONTROLS

Machine model				WB93R-5	
Classification	Check item	Test conditions	Unit	Standard value	Normal value
Engine speed (with load) - Converter	With converter	• Engine speed (without load): 2400±50 • Hydraulic oil temperature: 45-55 °C • Machine in 3rd gear • Working brakes: engaged. • Working mode switch: POWER	rpm	2175±50	2125–2225
	With converter and hydraulic circuit	• Engine speed (without load): 2400±50 • Hydraulic oil temperature: 45-55 °C • Machine in 3rd gear • Working brakes: engaged. • Shovel raise bottom of stroke • Steering held at the end of stroke • Working mode switch: POWER		2075±50	2025–2125
	Hydraulic circuit at Low idling	• Engine speed: 1050±50 • Hydraulic oil temperature: 45-55 °C • Vehicle in neutral • Parking brake: applied • Bucket dump bottom of stroke • Working mode switch: POWER		600	Min. 600

★ 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.

VEHICLE WITH SERVOCONTROLS

Machine model					WB93R-5	
Classification	Check item		Test conditions	Unit	Standard value	Normal value
Hydraulic drift working equipment	Shovel	Complete working equipment (Shovel teeth tip lower)	Measuring posture: see Fig. D • In this position check in feedback of each cylinder and the leakage with applied load on the tip of shovel teeth. • On level ground. • Shovel: load 1800 Kg 4 in 1 bucket: load 1550 kg • Engine stopped • Oil temperature: 45-55 °C • Check measures as soon as engine stops. • Check changes every 5 min. and the total change in 15 min.	mm	150	300
		Raise cylinder (Cylinder in)			12	20
		Shovel cylinder (Cylinder out)			35	50
	Backhoe	Complete working equipment (Bucket teeth tip lower)	Measuring posture: see Fig. E • In this position check the extension of each cylinder and the leakage with normal load on the bucket. • On level ground. • Bucket: load with standard arm: 340 kg Bucket load with jig arm: 0 kg Fully extend jig arm • Engine stopped • Oil temperature: 45-55 °C • Check measures as soon as engine stops. • Check changes every 5 min. and the total change in 15 min.	mm	200	350
		Boom cylinders (Cylinder out)			10	20
		Arm cylinders (Cylinder out)			10	20
		Bucket cylinder (Cylinder in)			8	15

★ 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.

VEHICLE WITH SERVOCONTROLS

Machine model					WB93R-5	
Classification	Check item		Test conditions	Unit	Standard value	Normal value
Hydraulic drift working equipment	Backhoe	Boom swing	Measuring posture: see Fig. F • Oil temperature: 45-55 °C • Backhoe balanced on the guides bucket in transport condition. • 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. • Move the machine on a slope of 15° and apply the parking brake. • Stop the engine and, after 1 minute, check the inner cylinder feed back opposite to the boom every 5 min. for a total of 15 minutes.	mm	15	25
		Outriggers	Measuring posture: see Fig. G • Oil temperature: 45-55 °C • Backhoe balanced. • Boom and arm cylinders in, bucket cylinder out • Outriggers at maximum extension. • Engine stopped • 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 • Oil temperature: 45-55 °C • Leaking check: on the cylinder opposite side to the pressure one. • Check 1 cylinder at a time. • For arm shovel, shovel and for swing, check the two cylinders separately.	cm³/min	2.0 (each cylinder)	Max. 8.0
		Shovel			1.6 (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

★ 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.

VEHICLE WITH SERVOCONTROLS

Machine model						WB93R-5	
Classification	Check item		Test conditions		Unit	Standard value	Normal value
Work equipment speed	Shovel	Arm shovel Cylinders fully out ↕ Shovel at the ground	Measuring posture: see Fig. H • Engine speed: max. • Oil temperature: 45-55 °C • Shovel speed button: applied	Lifting	sec.	3.6	3.1–4.1
				Lowering		2.6	2.2–3.0
		shovel Cylinders fully out ↕ Cylinders fully in	Measuring posture: see Fig. J • Engine speed: max. • Oil temperature: 45–55 °C • Shovel speed button: applied	Curl		2.3	2.0–2.6
				Dump		2.8	2.4–3.2
	Backhoe	Boom Cylinders fully in ↕ Teeth bucket on level ground	Measuring posture: see Fig. K • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Lifting ●		2.7	2.3–3.1
				Lowering		2.0	1.7–2.3
		Arm Cylinders fully in ↕ Cylinders fully out	Measuring posture: see Fig. L • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Opening		3.8	3.2–4.3
				Closing ●		4.4	3.7–5.1
		Bucket Cylinders fully in ↕ Cylinders fully out	Measuring posture: see Fig. M • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Backhoe balanced • Power mode ON	Dump		2.4	2.0–2.8
				Curl		3.1	2.6–3.6

★ 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.

VEHICLE WITH SERVOCONTROLS

Machine model						WB93R-5	
Classification	Check item		Test conditions		Unit	Standard value	Normal value
Work equipment speed	Backhoe	Boom swing Right end travel ↕ Left end travel	Measuring posture: see Fig. N • Engine speed: 1700 ± 50 rpm • Oil temperature: 45-55 °C • Arm vertical • Power mode ON	Right ●	sec.	3.2	2.7–3.7
				Left ●		3.2	2.7–3.7

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

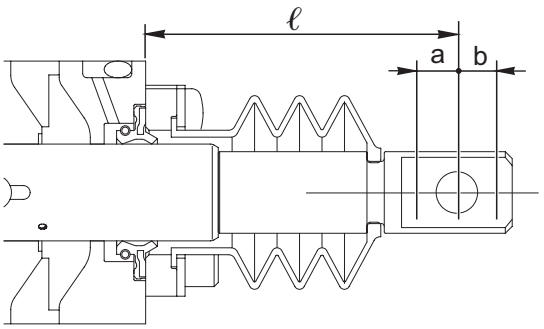
NOTE. The engine speed (1700 ± 50 rpm) has to be checked with the procedure described at paragraph «MEASURING ENGINE SPEED» in this section.

★ 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.

VEHICLE WITH SERVOCONTROLS

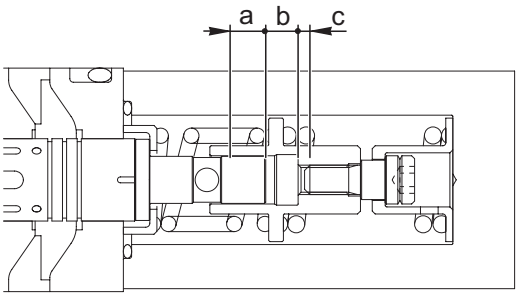
Machine model					WB93R-5	
Classification	Check item		Test conditions	Unit	Standard value	Normal value
Work equipment	Time lags	Arm shovel	Measuring posture: see Fig. P • Engine speed: Min. • Oil temperature: 45-55 °C • Check the time necessary to lift shovel from level ground.	sec.	0	Max. 2
		Boom	Measuring posture: see Fig. Q • Engine speed: Min. • Oil temperature: 45-55 °C • 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	Measuring posture: see Fig. R • Engine speed: Min. • Oil temperature: 45-55 °C • 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	Measuring posture: see Fig. S • Engine speed: Min. • Oil temperature: 45-55 °C • Put arm in horizontal position. Tilt back bucket cylinder an then extend it. Check the time passing between bucket stop at dead centre and the restart movement.		0	Max. 2
		Outriggers	Measuring posture: see Fig. T • Engine speed: Min. • Oil temperature: 45-55 °C • Boom, arm and bucket fully retracted and putted in machine centre position. • Check the time necessary for outriggers to raise the machine from when they lean on level ground. • Check each outrigger at a time.		0	Max. 2

Fig. A



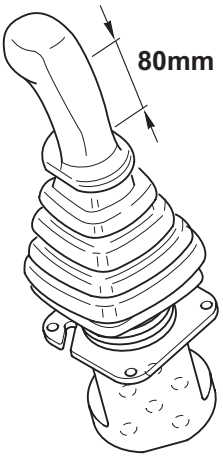
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Fig. B



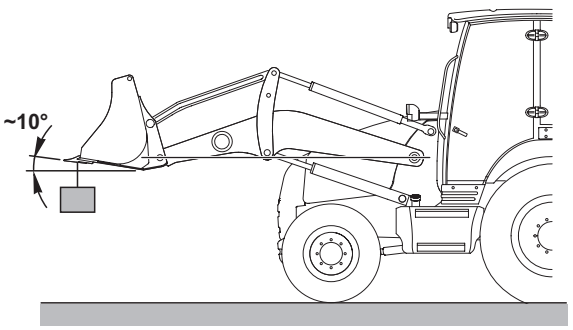
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Fig. C



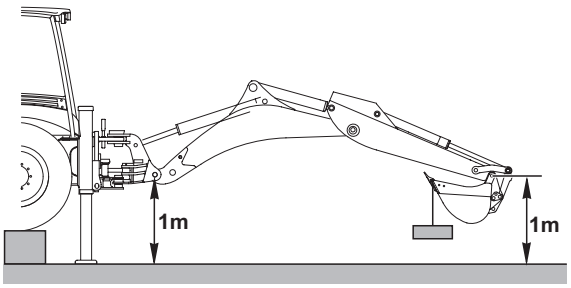
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Fig. D



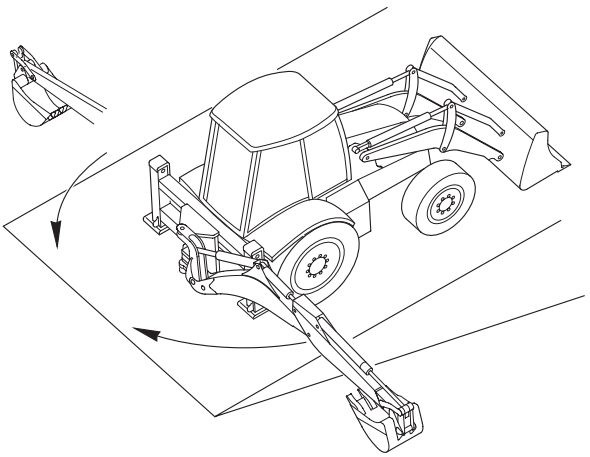
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Fig. E



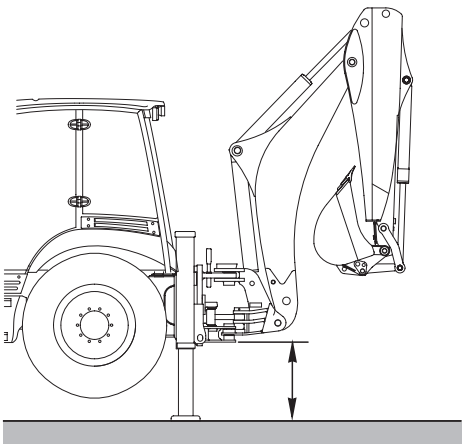
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Fig. F



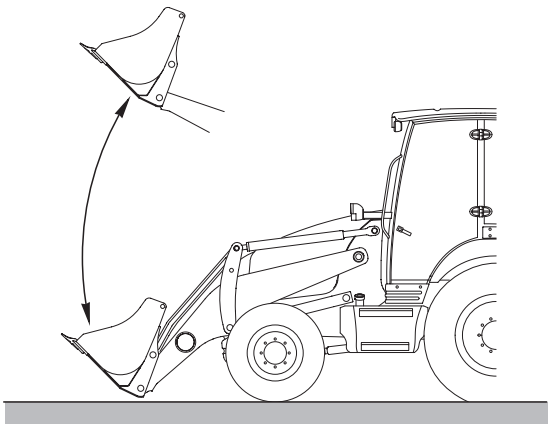
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Fig. G



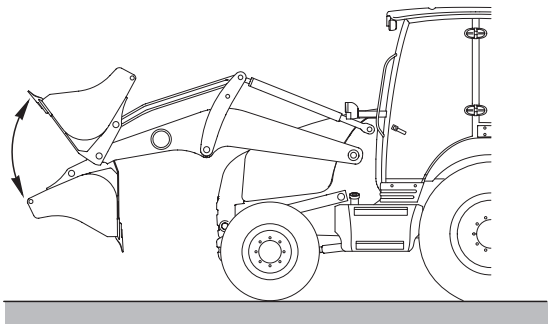
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Fig. H



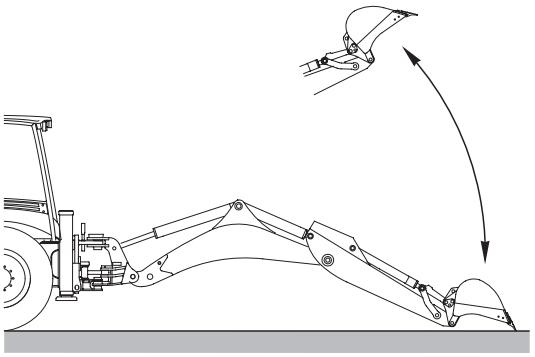
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Fig. J



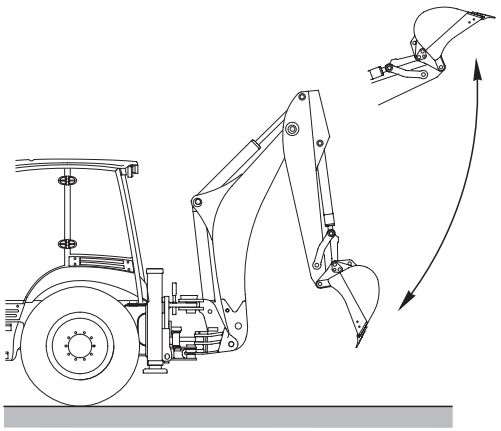
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Fig. K



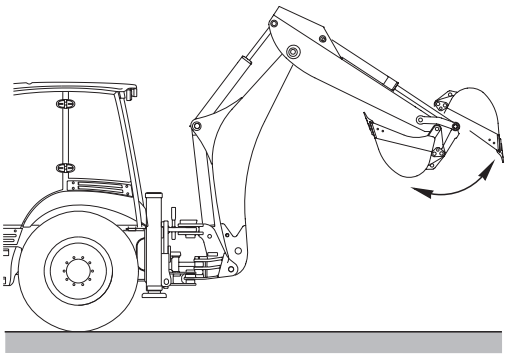
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Fig. L



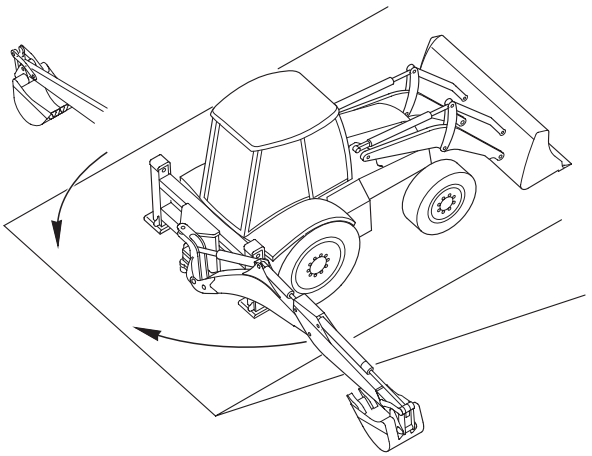
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Fig. M



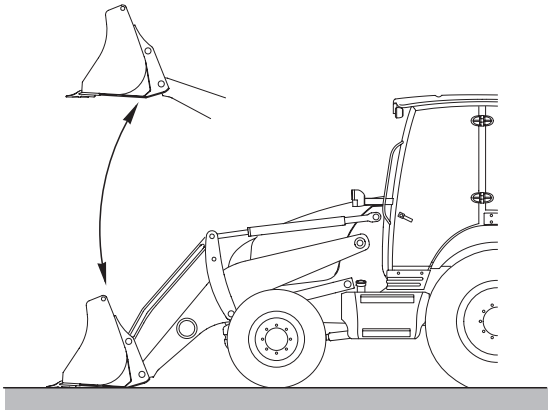
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Fig. N



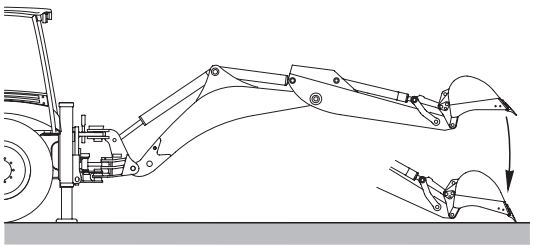
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Fig. P



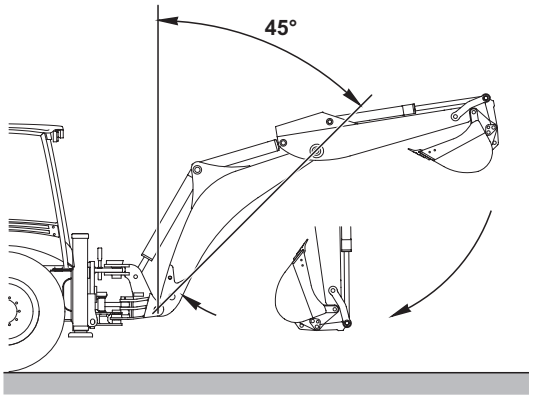
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Fig. Q



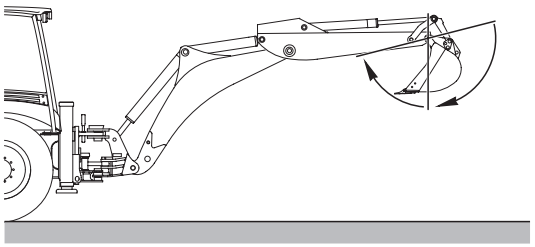
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Fig. R



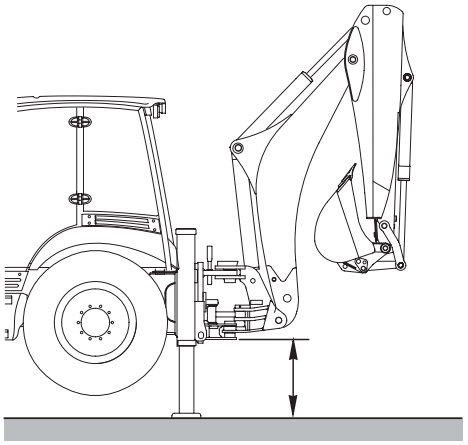
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Fig. S



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Fig. T



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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**	Commerciallyavailable	Pressure gauge	2	Full scale 60 bar
		2	Commerciallyavailable	Pressure gauge	1	Full scale 250 bar
		3	Commerciallyavailable	Pressure gauge	1	Full scale 400 bar
		4	Commerciallyavailable	Pressure gauge	1	Full scale 600 bar
		5	ATR800200	Servocontrol kit 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**	Commerciallyavailable	Maintenance station	1	For coolant R134a
		2	Commerciallyavailable	Thermometer-hygrometer	1	Sampling every 15 seconds
		3	Commerciallyavailable	Leak detector	1	For coolant R134a

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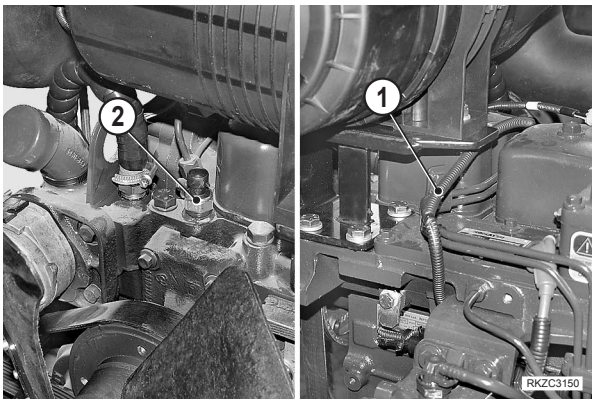
ADJUSTING VALVE CLEARANCE

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 RIMOZIONI ED INSTALLAZIONI").

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

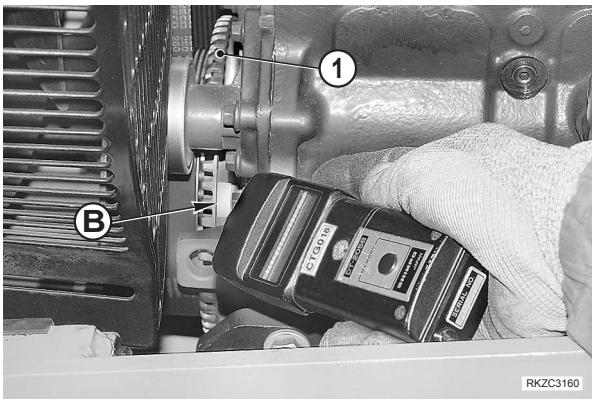
⚠ When checking engine speeds, be careful not to touch high temperature parts and not to get caught in rotating parts.

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±5°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±50 rpm

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

- Maximum speed: 2400±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 red 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

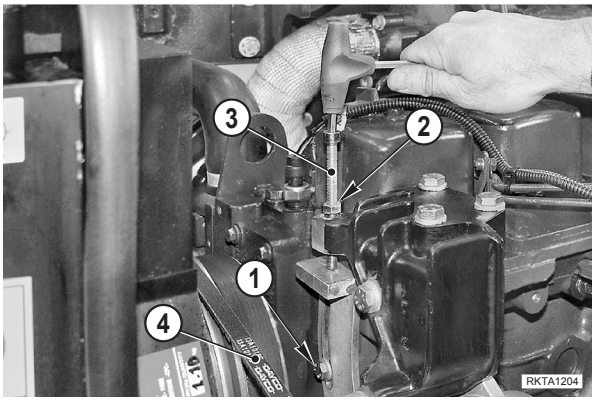
1 - If readings are not within the required interval, check the engine according to the instructions provided in manual code WHBMNEF000.

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).

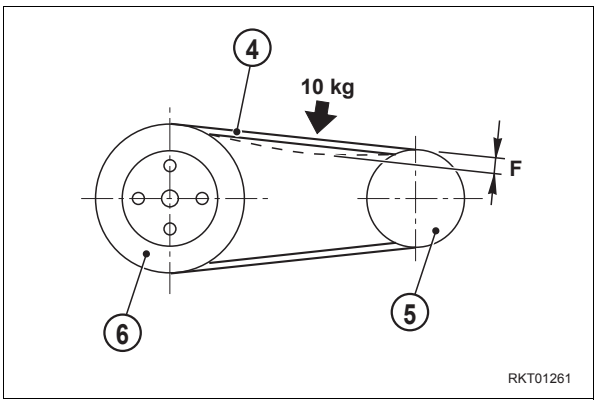


3 - Apply a 10 kg force halfway between compressor pulley (5) and engine pulley (6).

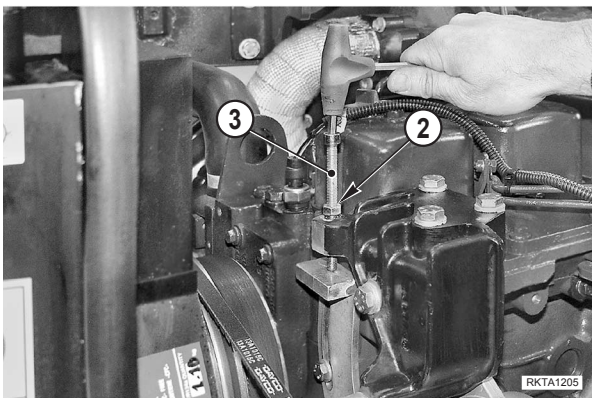
4 - Check the resulting arrow "**F**".

★ **F** = 4-6 mm normal tensioning
F = 3 mm new belt

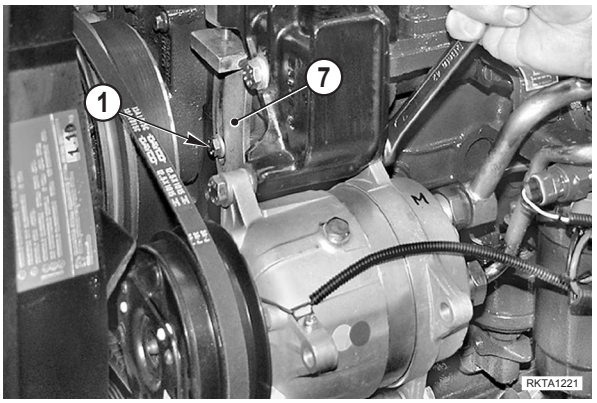
⚠ Check belt tension again after 15 minutes of operation.



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.

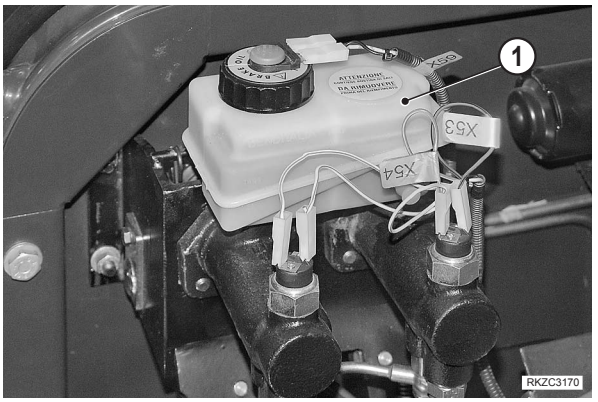
5 - Repeat steps (from Step 2) for all cylinders, frequently checking the oil level in the tank.

• 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.

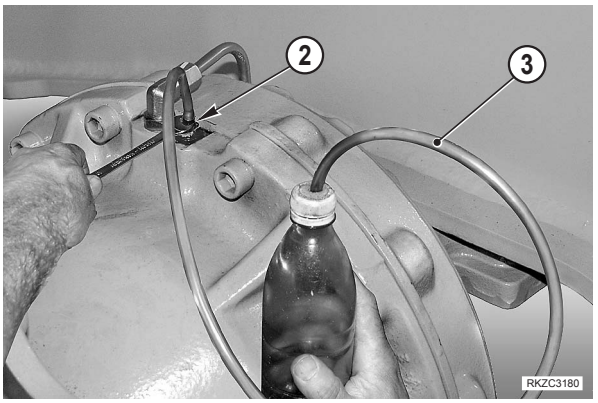
1 - Make sure that oil in brake system tank (1) is at maximum level.



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).

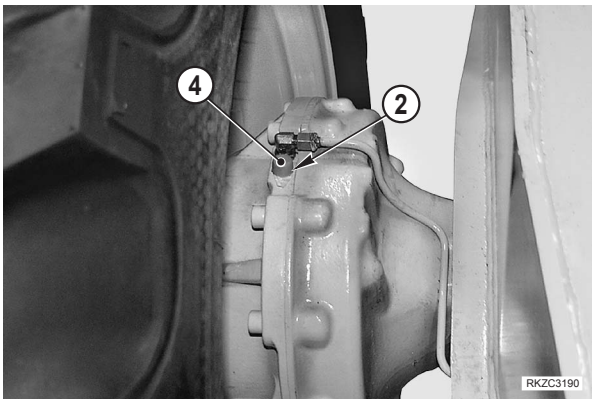


5 - Release brake pedal, wait for few seconds and repeat above operations two or three times until from bleeding screw, oil flows out without air bubbles.

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.

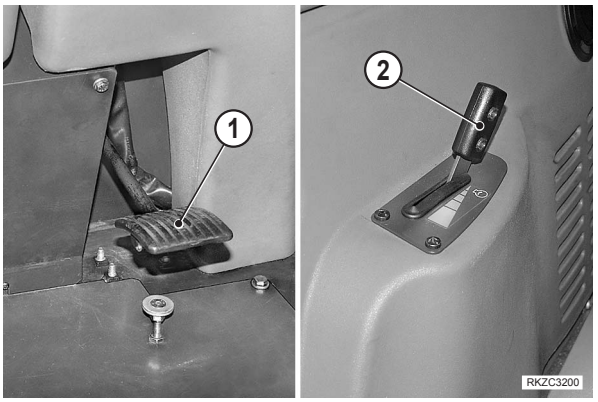
ADJUSTING ACCELERATOR PEDAL TRAVEL AND ACCELERATOR LEVER

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

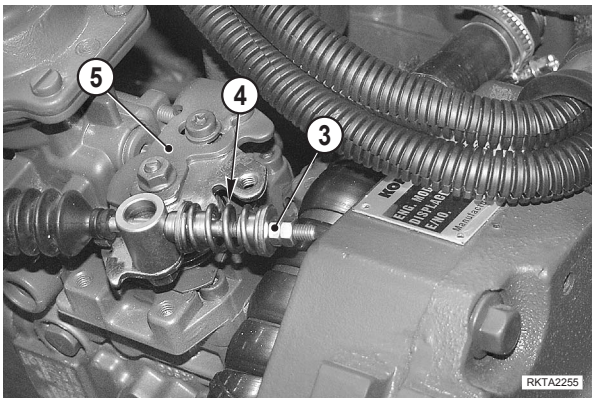
★ In order to check high speed engine idling, push the accelerator pedal (1) manually.

• Accelerator pedal travel adjusting

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



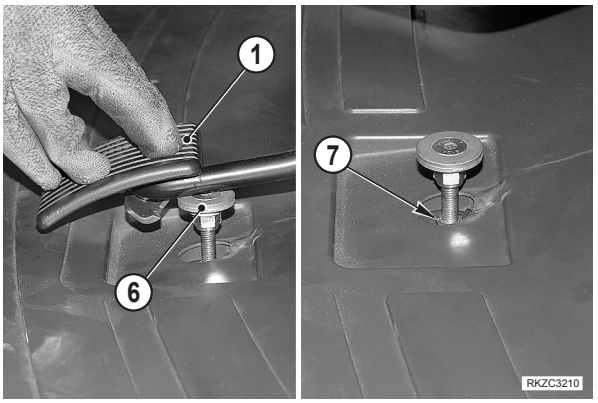
2 - Tighten the nut (3) until spring slack is eliminated (4) and spring is preloaded to about 1 mm.



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).

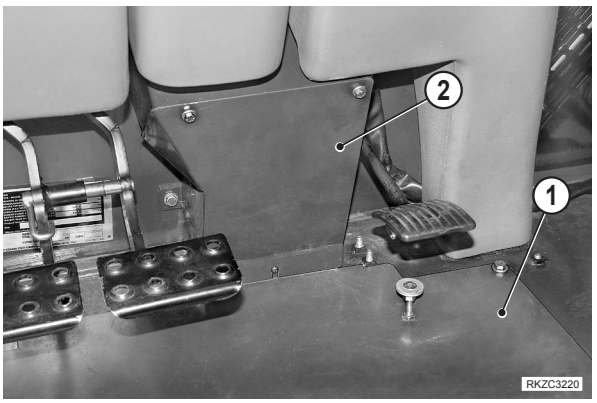
5 - Release the accelerator pedal (1).



- **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.

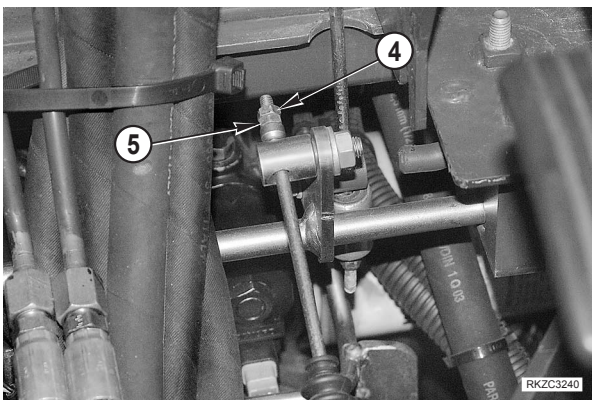
4 - Loosen and unscrew the locking nut (4).



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±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

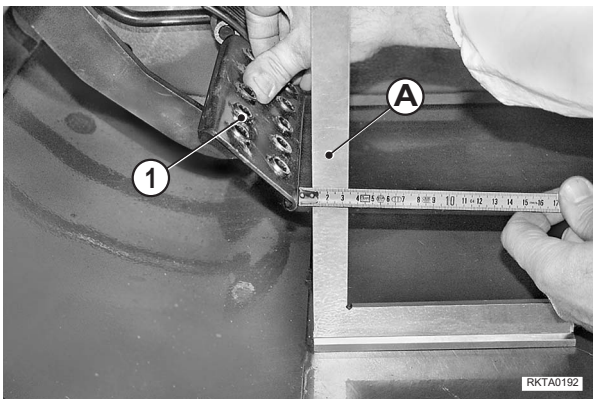
★ Working condition:
- Set the machine on level surface with attachments on ground level
- Apply the parking brake and remove the ignition key



1 - Place a square "**A**" to the cab floor and move the square close to the edge of the brake pedal (1).

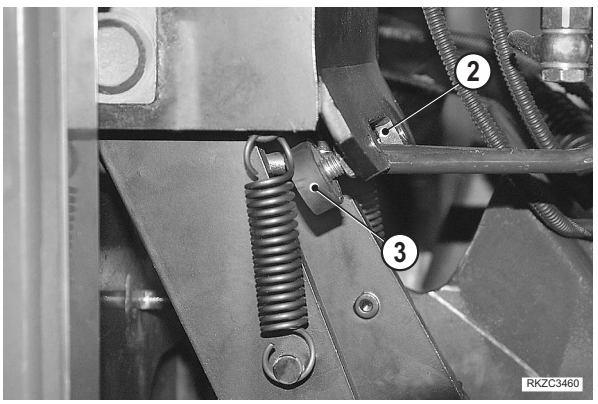
2 - Press the brake pedal by hand and check pre-travel.

★ Standard clearance "**G**": 3-8 mm

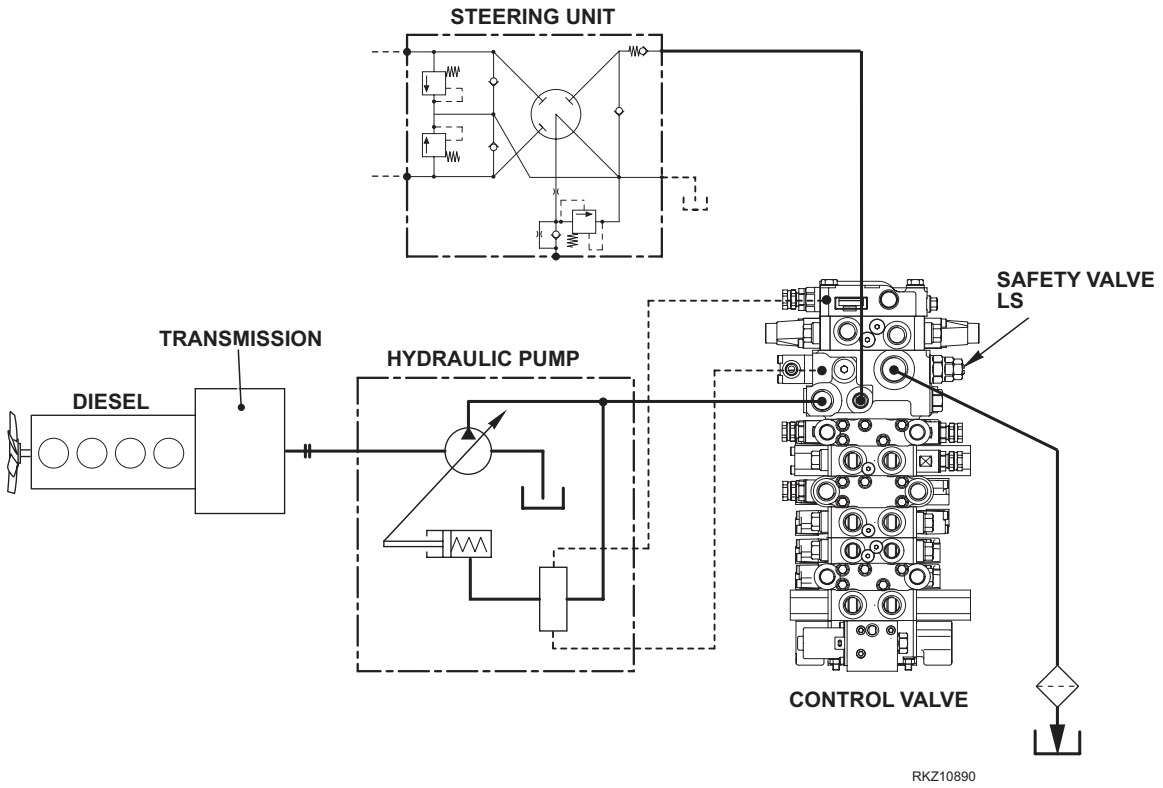


3 - If necessary, adjust the pedal clearance loosen the nut (2).

4 - When adjustment is complete, lock the pad (3) with the nut.



CHECKING AND SETTING PRESSURE IN THE ATTACHMENTS HYDRAULIC CIRCUIT



NOTE
Shown in this section is the servocontrolled (optional) version of the control valve.
Functions are the same as on the standard version with mechanical control.

- **Introduction**

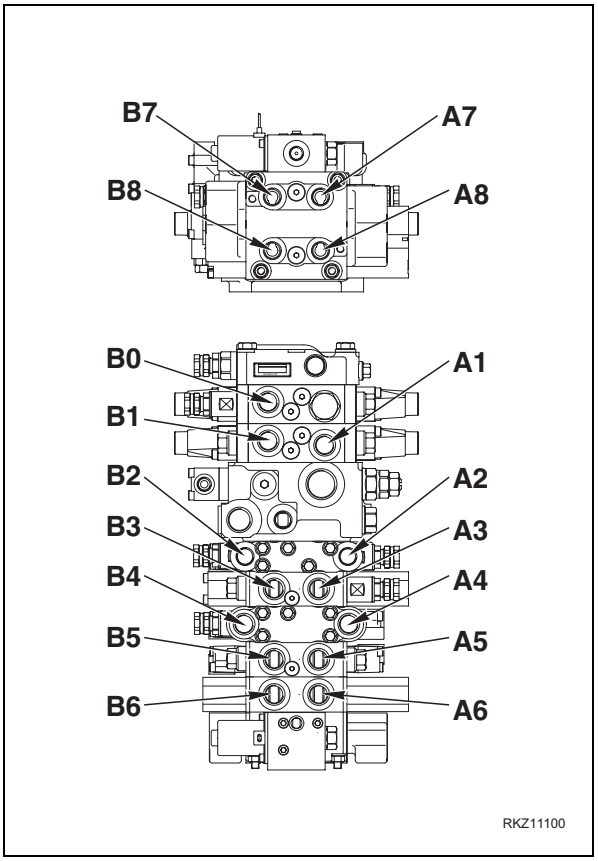
1 - The machine is equipped with a single control valve with mechanically and/or hydraulically controlled spools. The control valve is protected against overpressure by a single upper valve (or main valve, referred to as "LS safety valve") with adjustable pressure setting.

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 unit is used for a steering manoeuvre.

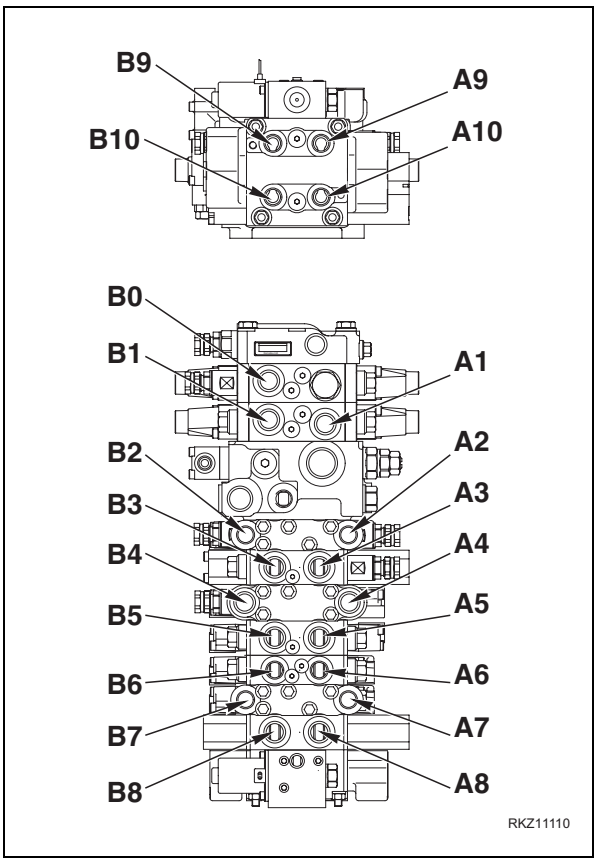
- **8-spool control valve + Hammer**

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	–



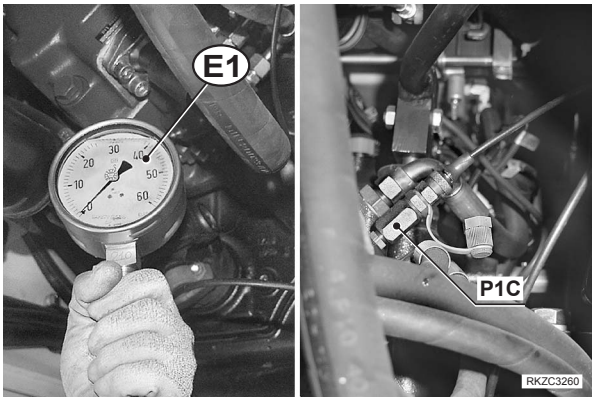
- **10-spool control valve + Hammer**

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.

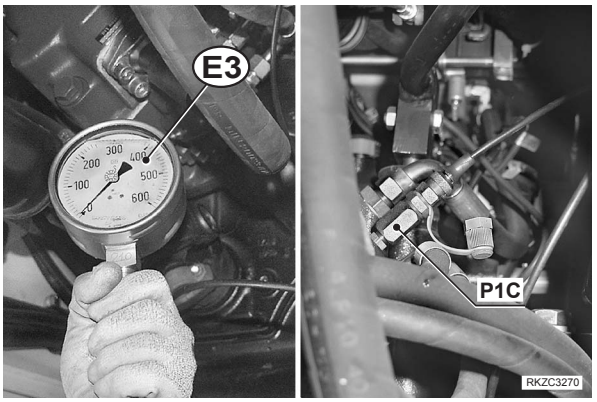
2 - Start the engine and run the engine at low idling with all levers in neutral position.

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

★ Normal pressure: 41±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 °C
- Working brakes applied

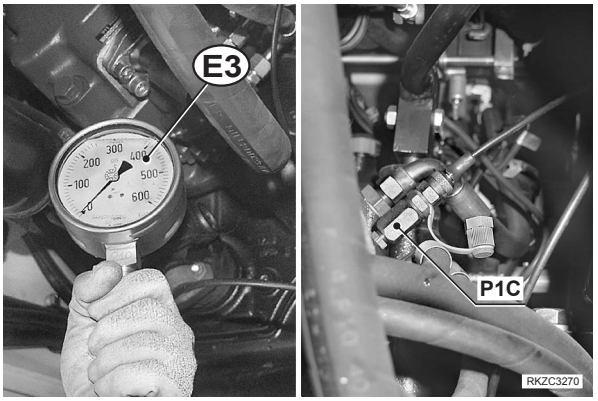
1 - Connect a pressure gauge **E3** (600 bar) to pressure tap **P1C** of the pump.

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:

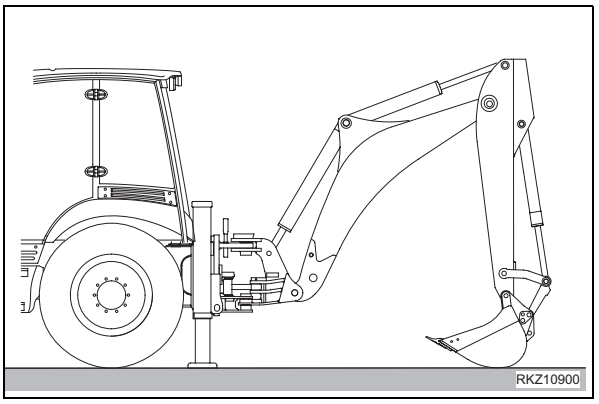
Cylinder and movement		**Set (bar)**
Hammer		180–210
Boom swing	Right	225–250
	Left	225–250
Shovel	Dump	235–260

- **Checking secondary valve setting (for boom raise movement)**

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

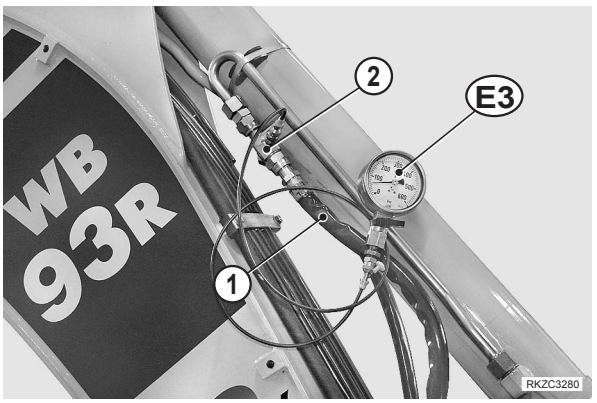
1 - Set the machine with arm in vertical position and with bucket on level ground leaned on the side.

2 - Stop the engine and release residual hydraulic pressures.

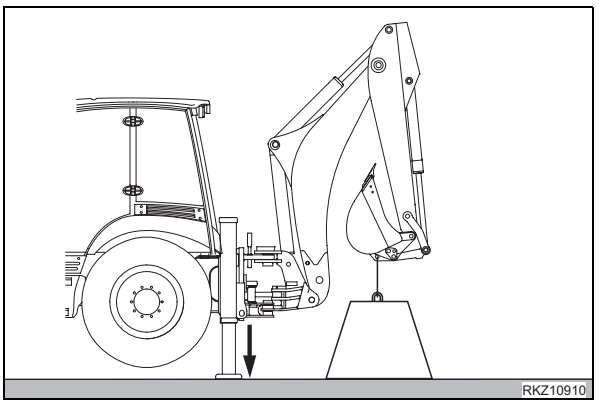


3 - Disconnect the hose (1) and connect a tee fitting (2) with adapter.

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

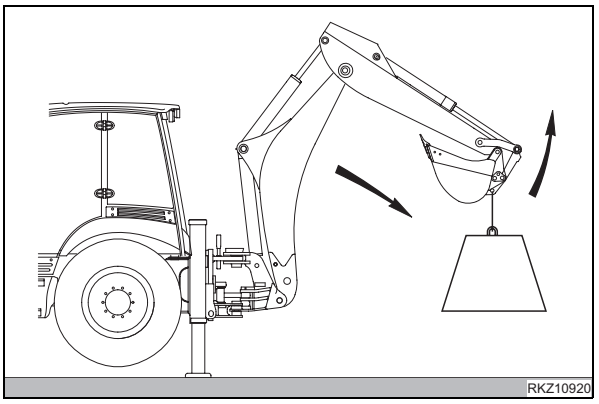


5 - Start the engine, connect a weight of approx. 1500 kg to the bucket, and fully lower the outriggers.



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

★ Normal pressure: 320-360 bar



- **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.

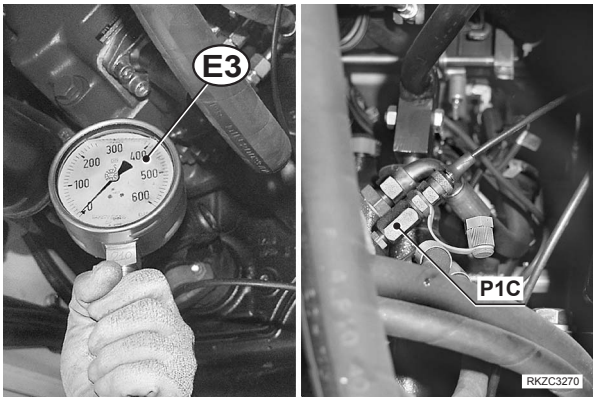
★ Move piston to the end of stroke to check the pressure of the working equipment.

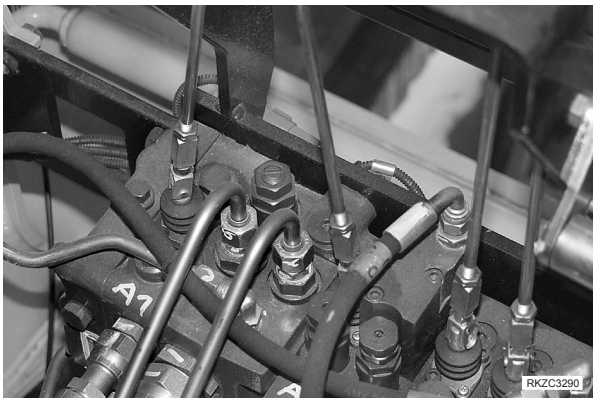
★ Normal pressure values:

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.

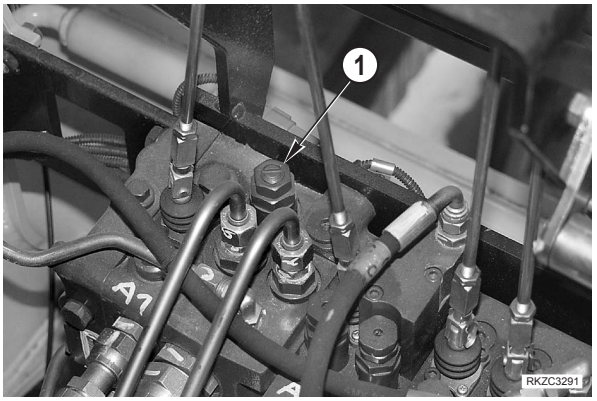




SETTING THE MAIN RELIEF VALVES AND THE REDUCING VALVES

- **Setting the main relief valve**

1 - Loosen lock nut (1).

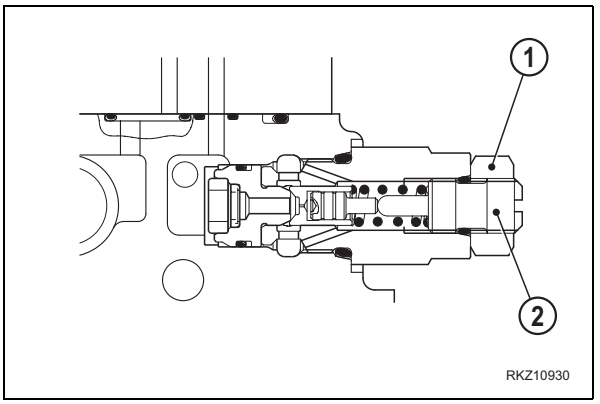


2 - Adjust the pressure using the screw (2).
   - To INCREASE pressure turn in CLOCKWISE direction.
   - To DECREASE pressure turn in COUNTERCLOCKWISE direction.

3 - Lock the nut (1).

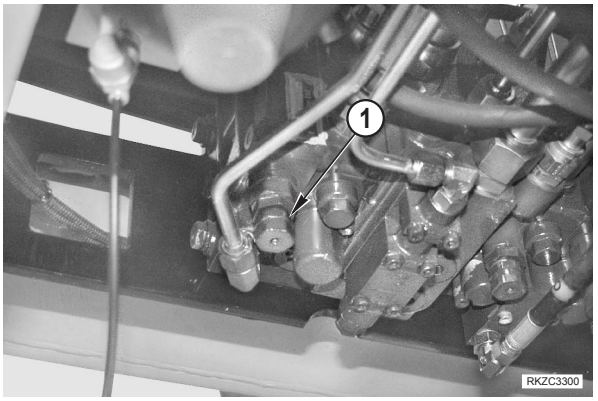
   Nut: 29.4-39.2 Nm

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



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

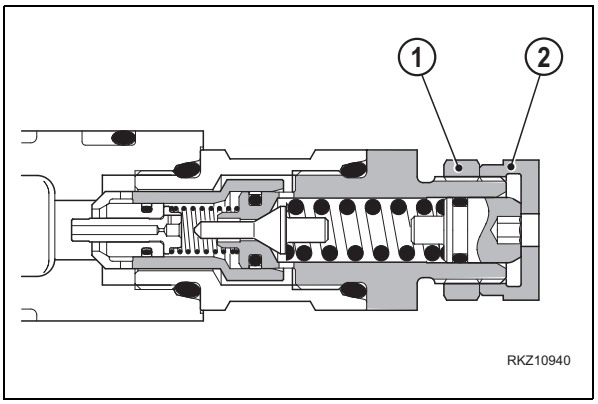
1 -Loosen nut (1)



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).

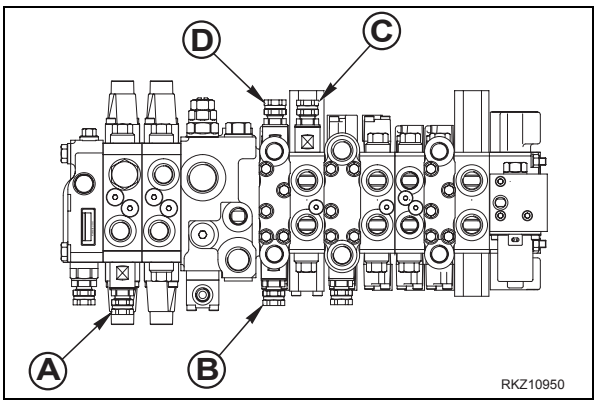
Nut (1): 39-49 Nm



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

1 -Loosen nut (1).

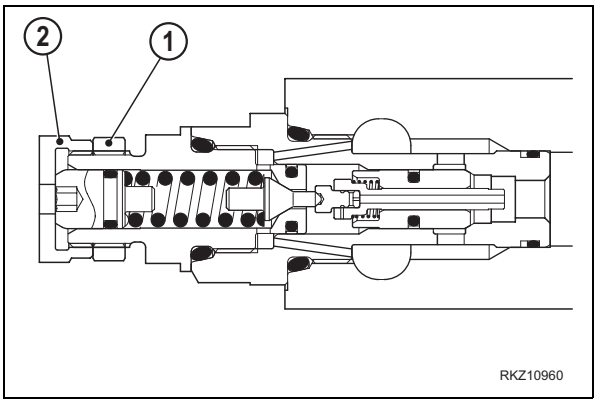
A = hammer secondary valve
B = LH swing secondary valve
C = shovel dump secondary valve
D = RH swing secondary valve



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

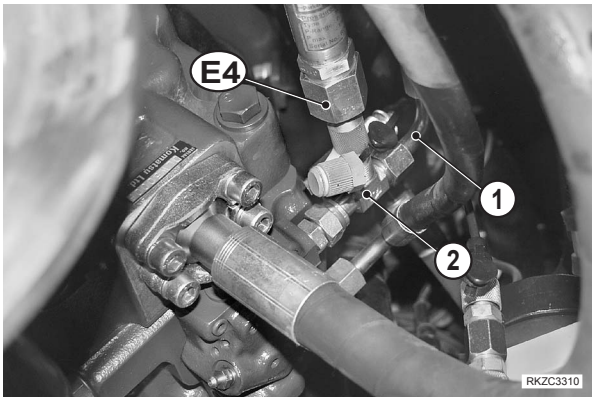


CHECKING AND ADJUSTING THE LS DIFFERENTIAL PRESSURE. ADJUSTING THE LS VALVE

- **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).

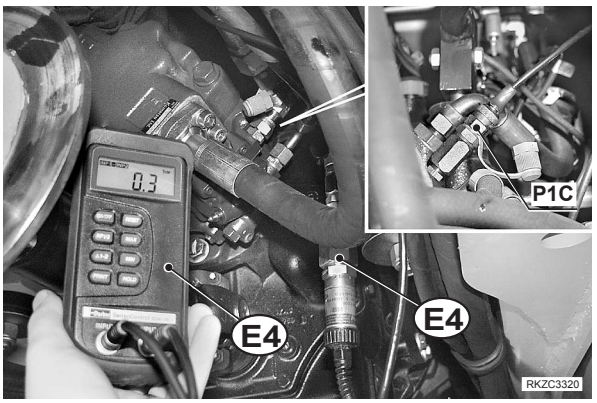


2 - Connect a differential pressure gauge **E4** to adaptor (2) and to pressure tap **P1C** of the pump.

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:

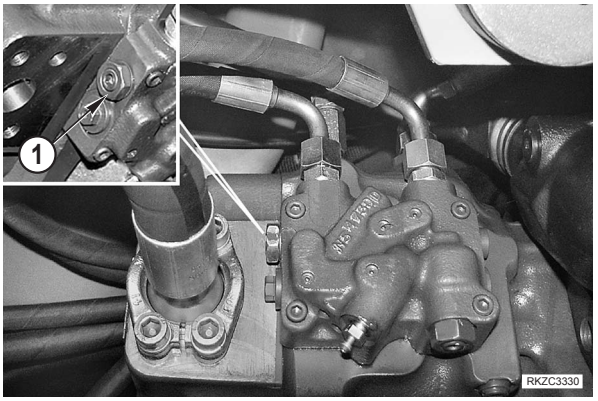
1 - Loosen the retaining nut (1) and turn the adjustment screw (2).
- To INCREASE pressure turn in CLOCKWISE direction.
- To DECREASE pressure turn in COUNTERCLOCKWISE direction.

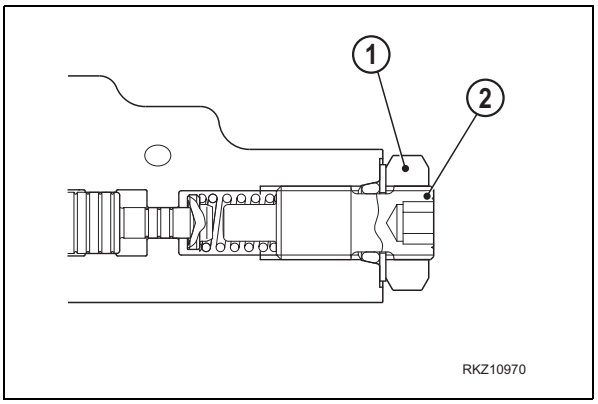
★ Each turn of the adjustment screw (2) will change the pressure by approx. 13 bar (13.2 kg/sq cm;).

2 - Lock the nut (3).

Nut: 27.4-34.3 Nm

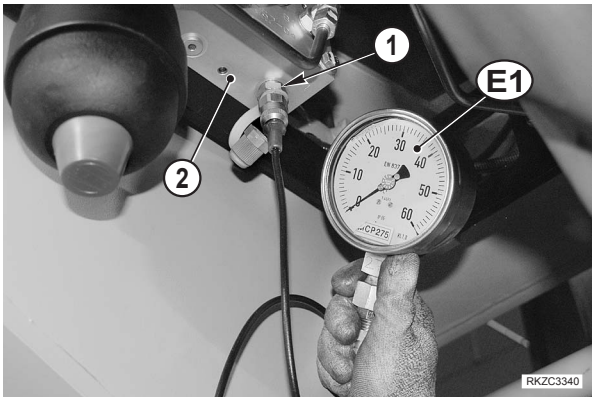
3 - When adjustment is complete, check the setting of the LS valve (1) using the procedures used for checking.





CHECKING AND ADJUSTING SERVOCONTROLS SUPPLY PRESSURE

- **Checking servocontrols supply pressure**



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

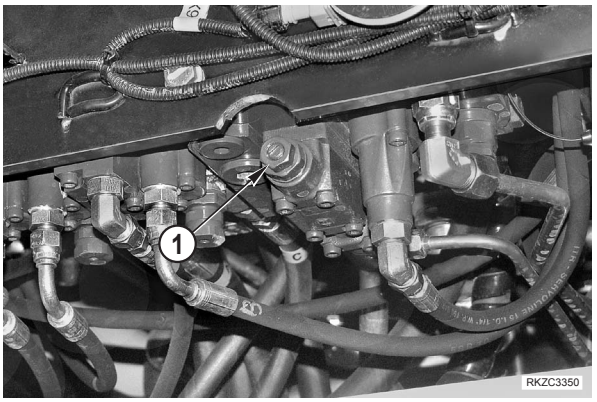
1 - Connect a pressure gauge **E1** (60 bar) to the pressure tap (1) of the solenoid valve group (2).

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**



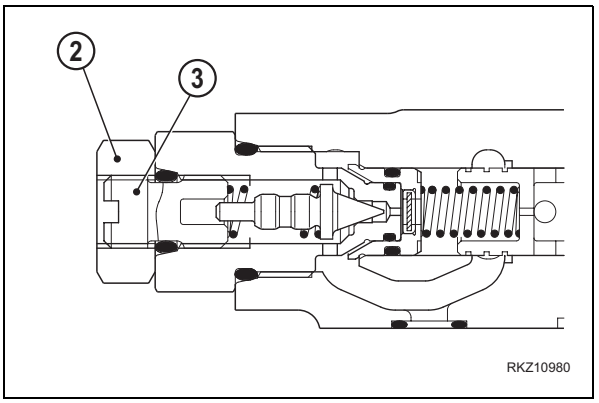
★ If the pressure value is not within the tolerance range, adjust the valve (1) as follows:

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

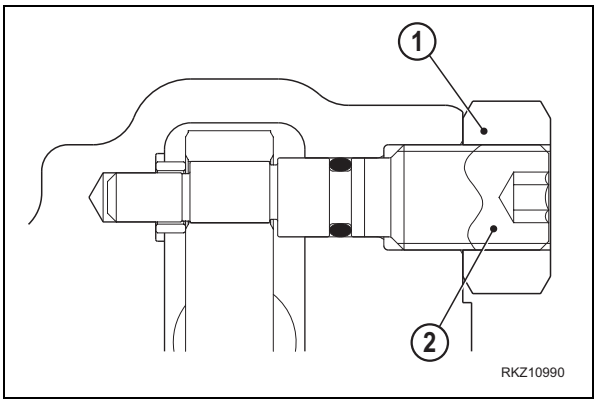
★ To increase the pump's torque absorption (i.e. to increase the speed of working equipment) turn the adjustment screw (2) clockwise.

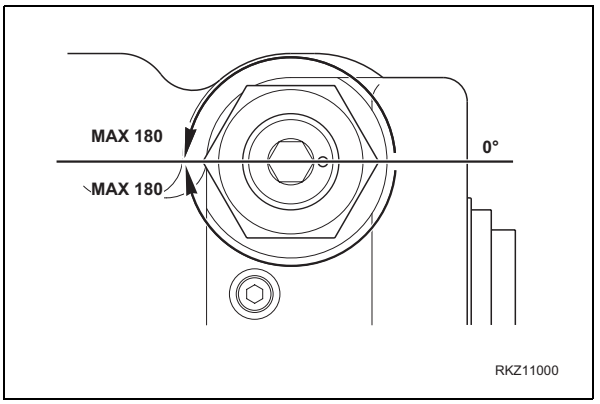
★ Turn the adjustment screw by not more than 180° in relation to the 0° line, in both directions

★ 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

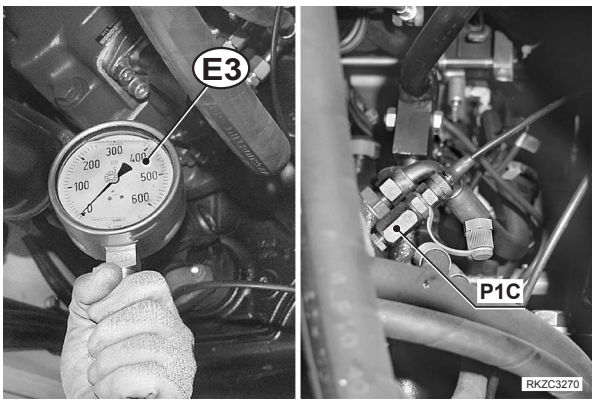
1 - Connect a pressure gauge **E3** (600 bar) to the pressure tap **P1C** on the backhoe control valve.

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

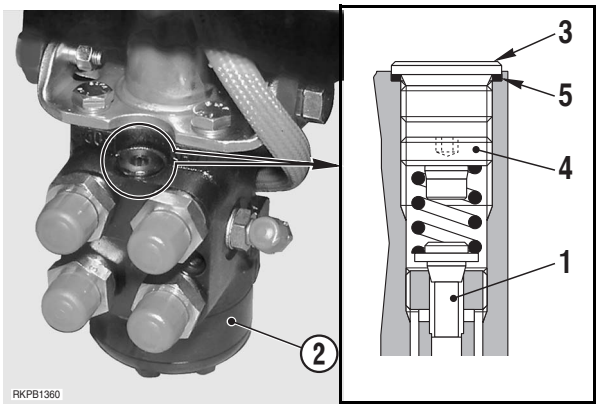
★ If pressure is not within permissible value, carry out setting acting on upper valve (1) of the steering unit (2).

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.

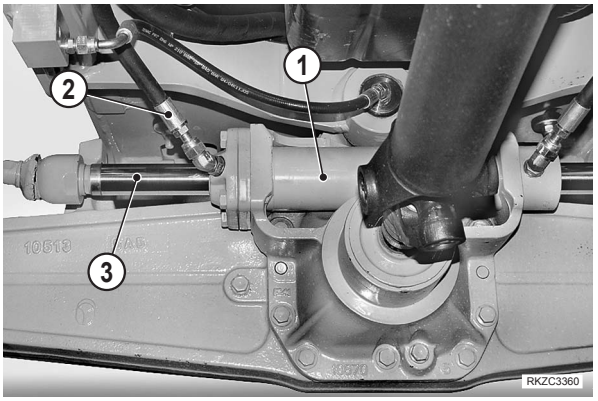
6 - Force the steering wheel to the end of its travel and retain the position for 30 seconds; measure any leak during the following minute.

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.



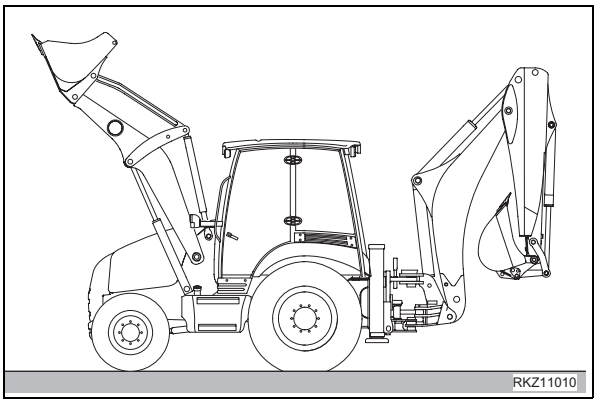
TESTING PRESSURES IN THE POWER TRAIN GROUP

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.



- **Converter oil pressure**

1 - Remove the plug (P22) 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±5 °C.

3 - With the engine at MIN, check the pressure on the pressure gauge **E6**.

★ Normal pressure: Min. 0.5 bar

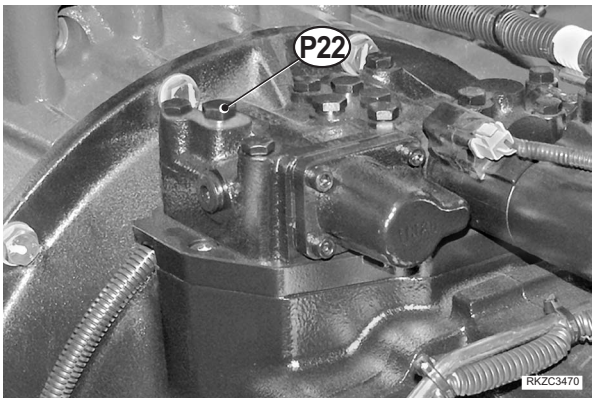
4 - Gradually increase engine speed to 2200 rpm; take a new reading on pressure gauge **E6**.

★ Normal pressure: Max. 9 bar

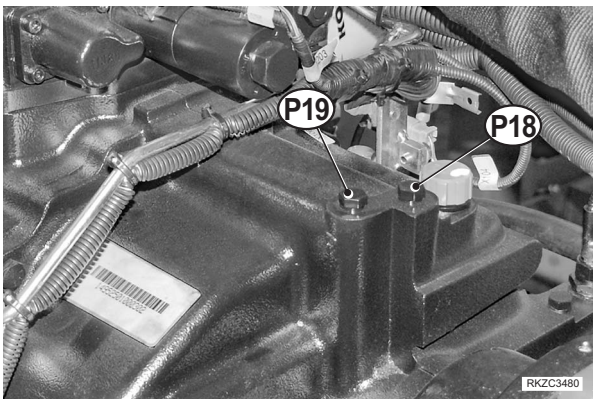
5 - Bring the engine back to MIN and compare the pressure with the normal value.

★ Normal pressure: Min. 0.5 bar

★ If the maximum pressure value drops to below the permissible lower limit, the power train pump needs an replacement.



- **Clutch engagement pressure**



1 - Remove the cab floor.

2 - Remove the plug (P19) and connect the pressure gauge **E6**.

3 - 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±5 °C.

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

★ Normal pressure: Max. 0.3 bar

5 - Insert REVERSE gear and gradually increase the rev speed up to MAX. Take a new reading from the pressure gauge **E6**.

★ Normal pressure: 11-13 bar

6 - 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

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

Plug: 23 Nm

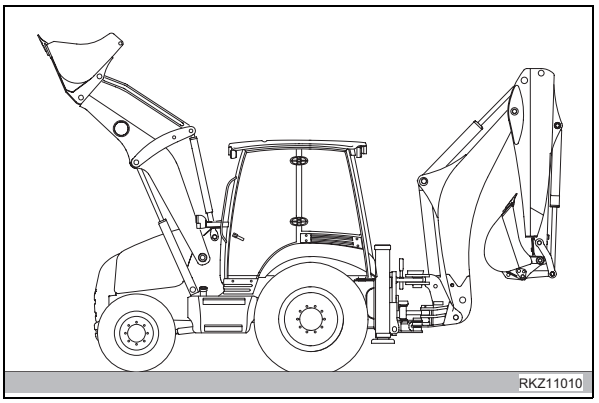
8 - Repeat the same test for the FORWARD gear, reading the pressure from the orifice protected by the plug (P18).

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

TESTING THE CORRECT FUNCTIONING OF THE POWER TRAINCLUTCHES

★ 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

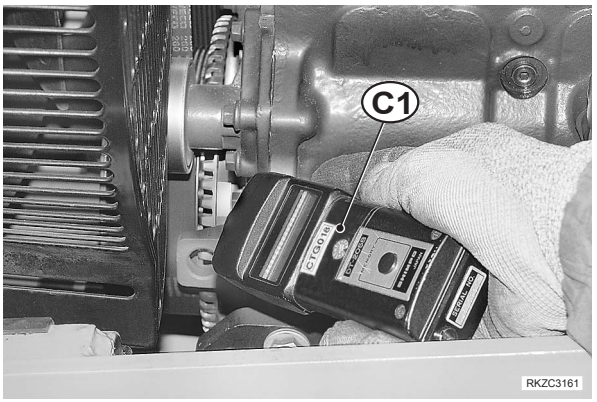
1 - Prepare a rev. counter **C1** to measure the engine rpm.

⚠ 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 RIMOZIONI ED INSTALLAZIONI").



• 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±5 °C.

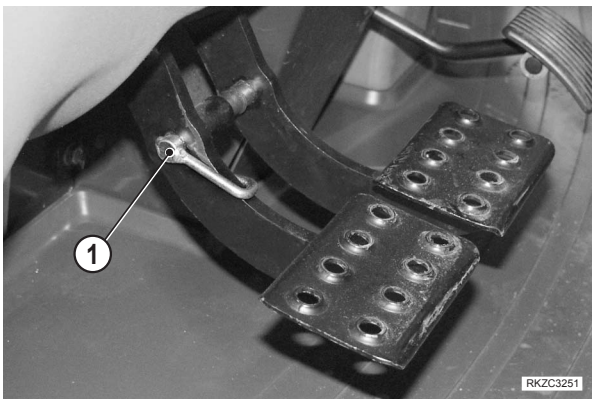
2 - With the engine in idling condition, accelerate to MAX. and check that in this condition the revs remain within permissible limits.
(See "ENGINE SPEED TESTS").

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

• Testing of front bucket lifting

1 - Put the machine with bucket teeth on blocks **A** of about 10 cm and in vertical position compared to 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 retract the bucket until to bring the teeth in tilt position of about 10°.

6 - Stop the engine and check bucket 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:

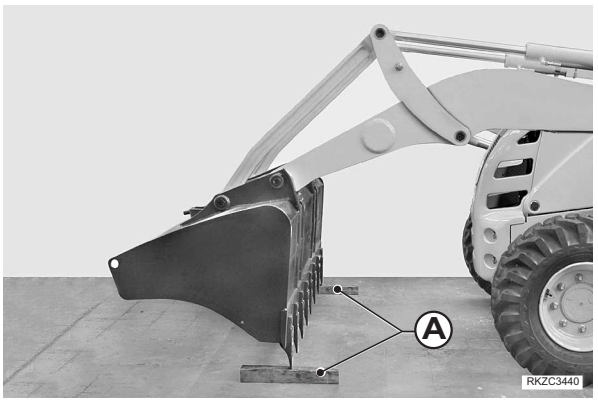
7 - Carry out with bucket a dump movement to let teeth lean on ground in vertical position.

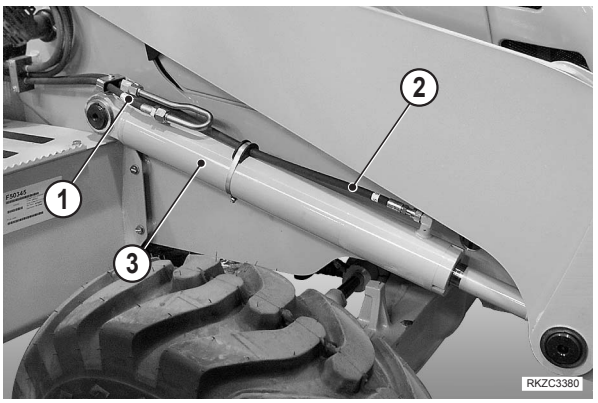
8 - Remove from one of the cylinders the plug fitted on the cylinder bottom side in Phase 4.

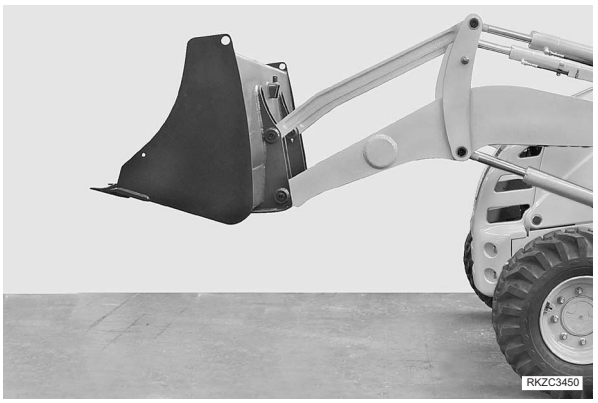
9 - Start the engine and retract the bucket until to bring the teeth in tilt position of about 10° towards upper.

10 - Stop the engine and check the bucket position for 5 minutes.
- If bucket 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.

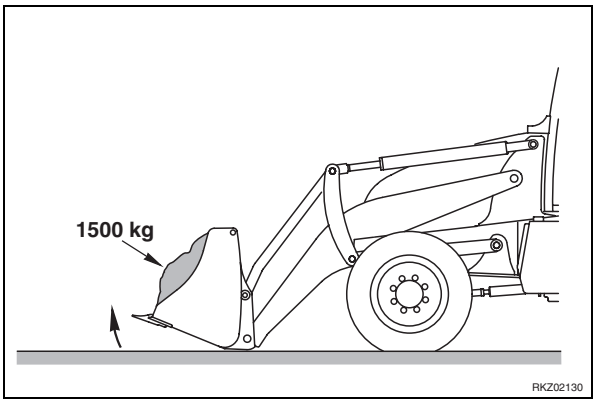






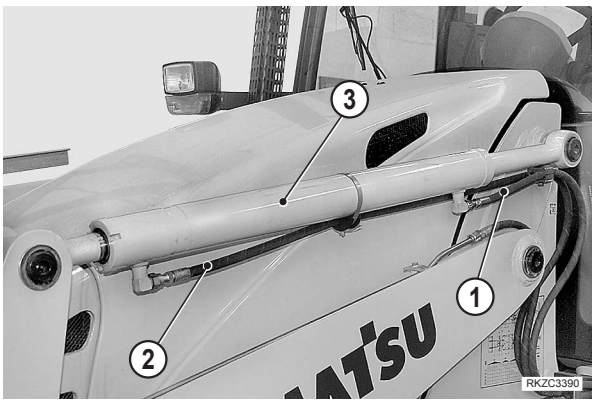
- **Testing of front bucket dumping**

1 - Put the machine with bucket 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 bucket up to the alignment of the bucket hinge and shovel arm hinge.

5 - Stop the engine and check the position of the bucket teeth for 5 minutes.
- If bucket has no swing movement, drift is due to control valve.

To test the individual cylinders, proceed as follows:

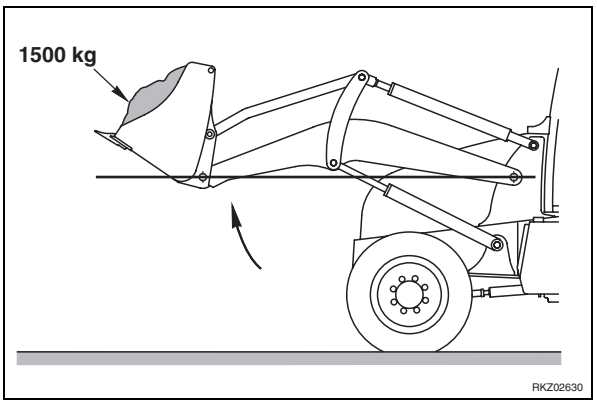
6 - Lower the bucket to the ground.

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 bucket as indicated in phase 4.

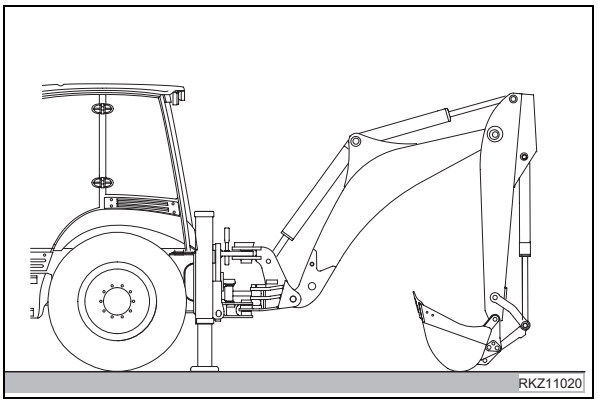
9 - Stop the engine and check the position of the bucket teeth for 5 minutes.
- If the bucket teeth turn, the drift is due to the gasket seals of the plugged cylinder.

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.

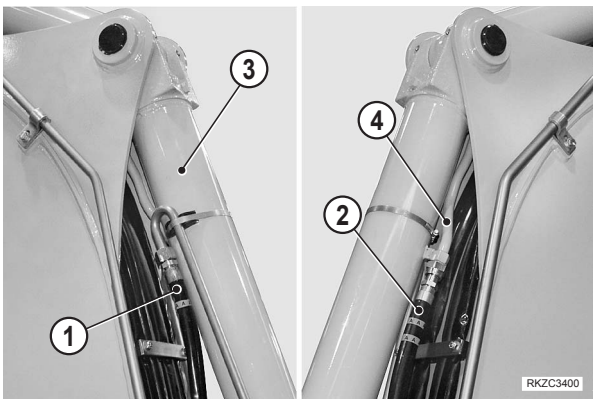
2 - Stop the engine and release residual hydraulic pressures.

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

4 - Plug the two hoses to avoid impurity inlet.

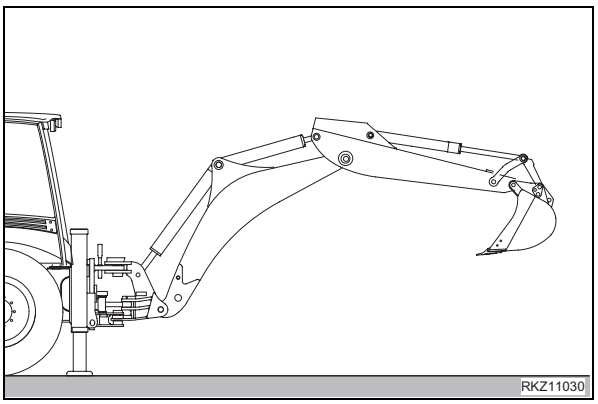
5 - Plug the cylinder head side.

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



7 - Start the engine and extend completely the arm.

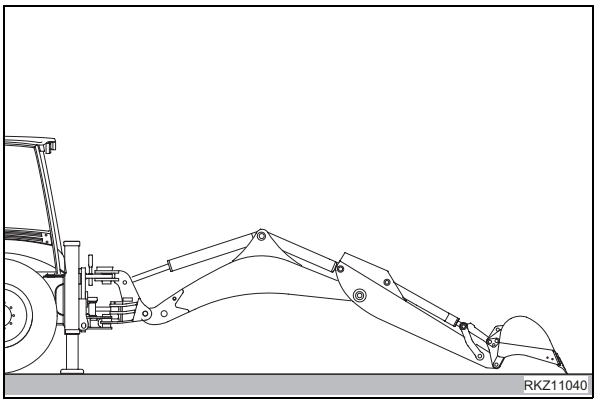
8 - Stop the engine and check the boom position for 5 minutes.
- If boom has a lowering movement, drift is due to cylinder gaskets.
- If boom has no lowering movement, drift is due to control valve.



• Arm testing

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

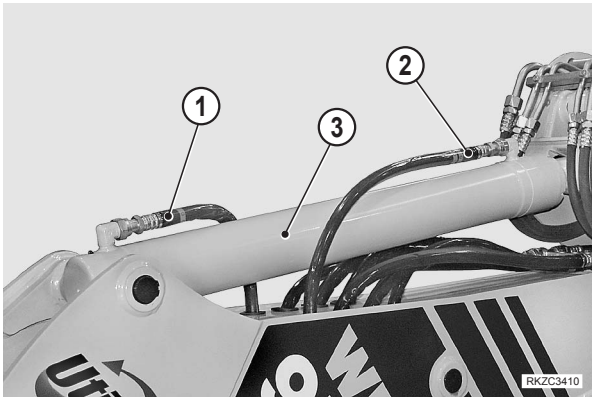
2 - Stop the engine and release residual hydraulic pressures.



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.

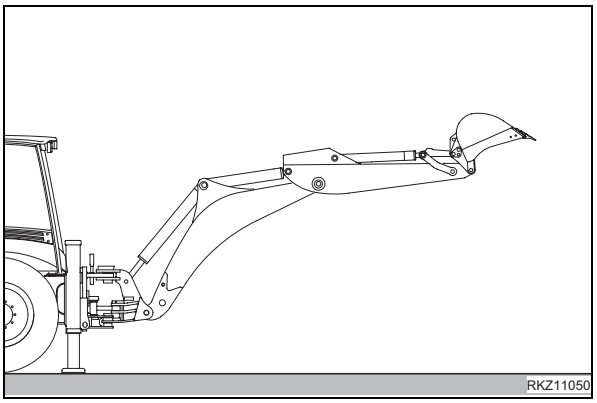
4 - Plug arm cylinder hole on head side and fit a temporary pipe on base side to catch possible oil leakage.



5 - Start the engine and raise the boom.

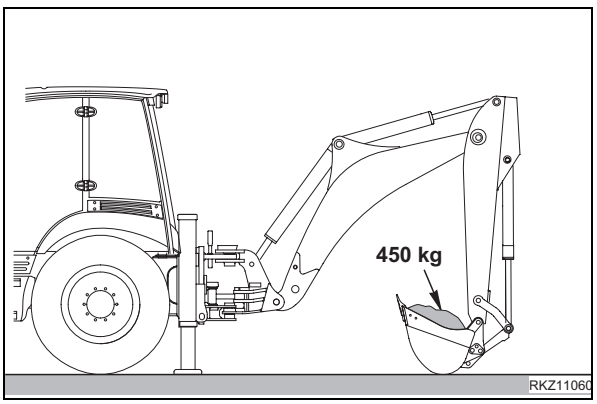
6 - Stop the engine and check the arm position for 5 minutes.

- 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

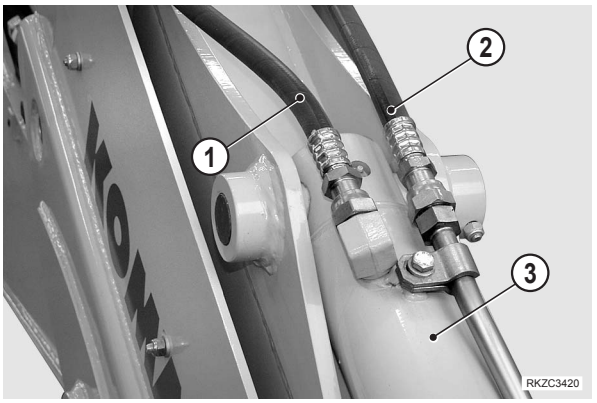
1 - Set the machine with vertical arm and horizontal bucket leaned at level ground on the side.
Put in the bucket a weight of 450 kg or fill it with earth.



2 - Stop the engine and release residual hydraulic pressures.

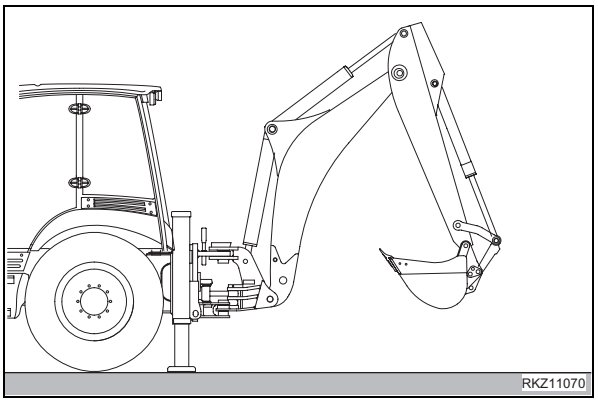
3 - Disconnect bucket cylinders (3) pipes (1) and (2) and plug them to avoid impurity inlet.

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



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.

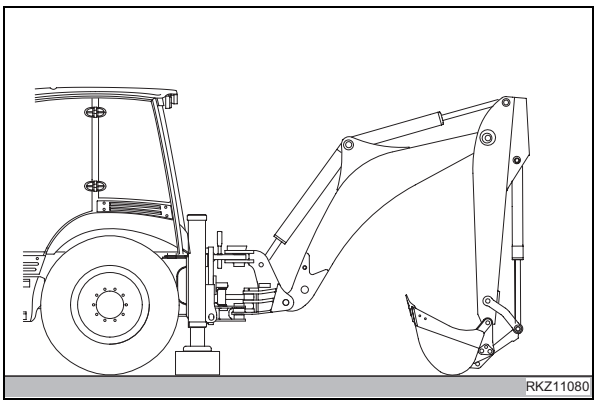


• Outriggers testing

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.

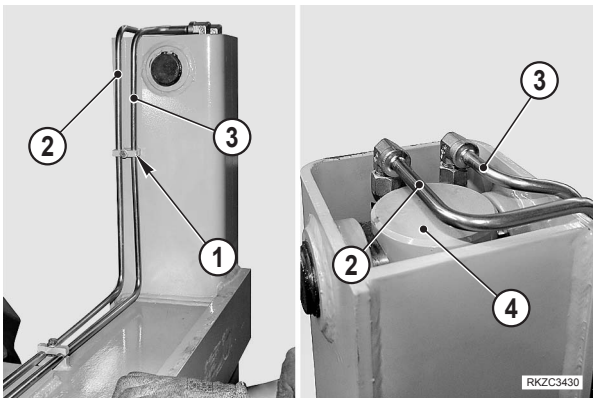


4 - Stop the engine and release residual hydraulic pressures.

5 - Remove clamp (1) and disconnect from cylinders (4) the pipes (2) and (3).

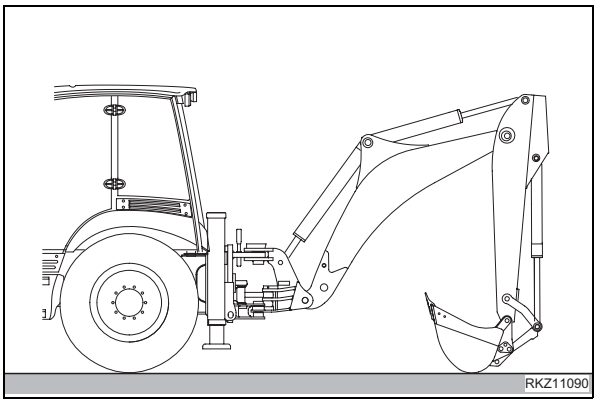
6 - Plug cylinders pipes (2) base side and apply on head sides temporary pipes to catch possible oil leakage.

7 - Start the engine, use force on the boom to raise the machine, and remove the trestles supporting the outriggers.



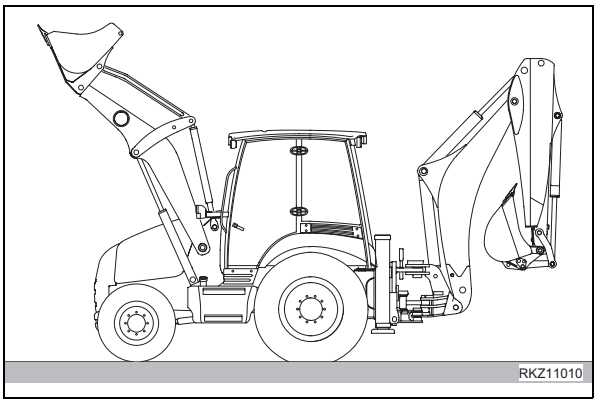
8 - Lower the machine and stop the engine.

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.

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/cm²)		H.P. (kg/cm²)	
	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:

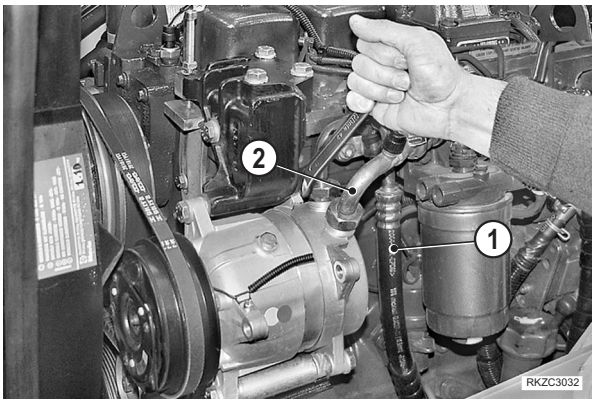
Conditions	Causes - Faults
L.P. high - H.P. normal or low	• Electromagnetic pulley that slips or does not engage correctly • Expansion valve blocked in open position • Compressor damaged
L.P. low - A.P. high or normal	• Expansion valve blocked in closed position or obstructed • Filter saturated with moisture • Obstruction in the L.P. line or in the H.P. line between the filter and the evaporator L.P.
L.P.normal - H.P. normal	• Infiltration of hot air into the evaporator group, the pipes or the cab • Hot air circulating in the heating group • Formation of ice on the evaporator
L.P. high - H.P. high	• Normal condition with very high ambient temperature (higher than 43°C) • Excess coolant (30 – 35% more) • Overheating of condenser • Air present in the unit • Obstruction in the H.P. line between the compressor and the condenser-filter tube, behind the measurement point of the H.P
L.P. normal or low - H.P. low	• Normal condition with very low temperature (lower than 5°C) • Lack of coolant (70 - 75% less) (probable leakages) • Obstruction in the H.P. line between the compressor and the condenser-filter tube, before the measurement point of the H.P. • Compressor damaged
L.P. roughly equal to H.P.	• Compressor belt missing • Electromagnetic pulley that slips or does not engage • Compressor damaged

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

Wheel vibration; front tyre resistance; halfshaft breakage	
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
Bent halfshaft	Remove excessive weight and redistribute load, following instructions related to the vehicle

Steering is difficult; vehicle goes straight while its turning.	
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
Broken halfshaft	Remove excessive weight and redistribute load, following instructions related to the vehicle

No differential action; jamming while steering.	
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

Excess of 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
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 assemblyof parts	Look for foreign particles. Check assembly of the various parts of the axle.

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: • Abnormal functioning of the differential or breakage/blockage of command device. • Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns.	Blocked halfshaft: • Verify assembly and all components • Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.
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 assemblyof 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
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

Noise while driving	
CAUSES	**REMEDY**
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

Noise while driving in neutral	
CAUSES	**REMEDY**
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

Intermittent noise	
CAUSES	**REMEDY**
Ring gear damaged	Replace bevel gear set
Differential box bolts loosened	Tighten to torque

Constant noise	
CAUSES	**REMEDY**
Ring gear teeth or pinion damaged	Replace bevel gear set
Worn out bearings	Replace
Pinion spline worn out	Replace
Bent halfshaft	Replace

Noise while steering	
CAUSES	**REMEDY**
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 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 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;incorrect lubrication or depleted additives	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals 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. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Insufficient lubrication; contaminated oil;incorrect lubrication	

Pinion teeth pitting	
CAUSES	**REMEDY**
Excessive use axial pinion	Replace bevel gear set. 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. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Excessive use axial pinion	
Normal wear out	
Pinion nut loosened	

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. 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. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.
Pinion nut loosened	
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. 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. 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. Check pinion axial backlash. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Excessive pinion axial backlash	
Insufficient lubrication; contaminated oil	

Bent or broken halfshaft or halfshaft broken at wheel side	
CAUSES	**REMEDY**
Vehicle intensively operated or overloaded	Replace the axle shaft Check beam body distortion. Check wheel bearing and replace if necessary.
Wheel support loosened	
Beam body bent	

REAR AXLE TROUBLESHOOTING

Wheel vibration; front tyre resistance; halfshaft breakage	
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
Bent halfshaft	Remove excessive weight and redistribute load, following instructions related to the vehicle

Steering is difficult; vehicle goes straight while its turning.	
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
Broken halfshaft	Remove excessive weight and redistribute load, following instructions related to the vehicle

No differential action; jamming while steering.	
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

Excess of 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
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 assemblyof parts	Look for foreign particles. Check assembly of the various parts of the axle.

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: • Abnormal functioning of the differential or breakage/blockage of command device. • Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns.	• Verify assembly and all components. • Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.
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 assemblyof 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

Noise while driving	
CAUSES	**REMEDY**
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

Noise while driving in neutral	
CAUSES	**REMEDY**
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

Intermittent noise	
CAUSES	**REMEDY**
Ring gear damaged	Replace bevel gear set
Differential box bolts loosened	Tighten to torque

Constant noise	
CAUSES	**REMEDY**
Ring gear teeth or pinion damaged	Replace bevel gear set
Worn out bearings	Replace
Pinion spline worn out	Replace
Bent halfshaft	Replace

Noise while steering	
CAUSES	**REMEDY**
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 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 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;incorrect lubrication or depleted additives	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals 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. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Insufficient lubrication; contaminated oil;incorrect lubrication	

Pinion teeth pitting	
CAUSES	**REMEDY**
Excessive use axial pinion	Replace bevel gear set. 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. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Excessive use axial pinion	
Normal wear out	
Pinion nut loosened	

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. 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. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.
Pinion nut loosened	
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. 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. 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. Check pinion axial backlash. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Excessive pinion axial backlash	
Insufficient lubrication; contaminated oil	

Bent or broken halfshaft or halfshaft broken at wheel side	
CAUSES	**REMEDY**
Vehicle intensively operated or overloaded	Replace the axle shaft Check beam body distortion. Check wheel bearing and replace if necessary.
Wheel support loosened	
Beam body bent	

TRANSMISSION TROUBLESHOOTING

Vehicle does not move	
CAUSES	**REMEDY**
Faulty supply to solenoid valves	Check/Replace
Damaged wiring connections betweentransmission 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
Damaged synchroniser	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 0ûC	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

Vehicle has reduced power transmission	
CAUSES	**REMEDY**
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 sensors	Replace

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
Worn synchronizer clutch	Replace
Worn 4WD clutch	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"
Damaged hydraulic system	Repair/Replace
Gear remains engaged	
CAUSES	**REMEDY**
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
Damaged gear lever rod	Replace
Damaged synchroniser	Replace
No 4WD power transmission	
CAUSES	**REMEDY**
Damaged 4WD clutch	Replace
Hydraulic system fault	Repair/Replace
Damaged control valve	Replace
Faulty brake sensor	Check/Replace
Electrical system fault	Repair/Replace

Gear shift won't engage	
CAUSES	**REMEDY**
Damaged shifter	Replace
Damaged synchroniser	Replace

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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 carryingout the operation.

1 - Remove XXXX (1): ..... Step in removal procedure
★: ..... Technique or important point to remember whenremoving XXXX (1)

2 - ▲▲▲ (2): ..... [*1] This sign means that information is given\line 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 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

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

Nature of work	Symbol		Code	Name	Q.ty
Disassembly - assembly transmission	**F**	**1**	CA715409	Plunger	1
		2	CA715004	Plunger	1
		3	CA715623	Plunger	1
		4	CA715354	Plunger	1
		5	CA715495	Protection + shims	1
		6	CA715497	Plunger	1
		7	CA715356	Calibrator	1
		8	CA715501	Plunger	1
		9	CA715358	Installation/assembly tool clutches	1
		10	CA715499	Protection	1
		11	CA715046	Plunger	1
		12	CA715743	Protection + shims	1
		13	CA715746	Plunger	1
		14	CA715745	Calibrator	1
		15	CA715496	Latch for B and C shafts	1
		16	CA715149	Plunger	1
		17	CA715493	Removal/installation tool stop ring	1
		18	CA715257	Protection	1
		19	CA715263	Protection	1

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ENGINE HOOD

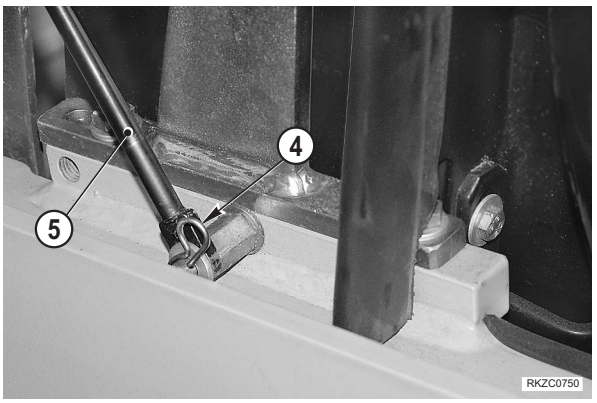
Removal

⚠ Lower the working equipment completely until it is resting on the ground.
Stop the engine and remove the ignition key.

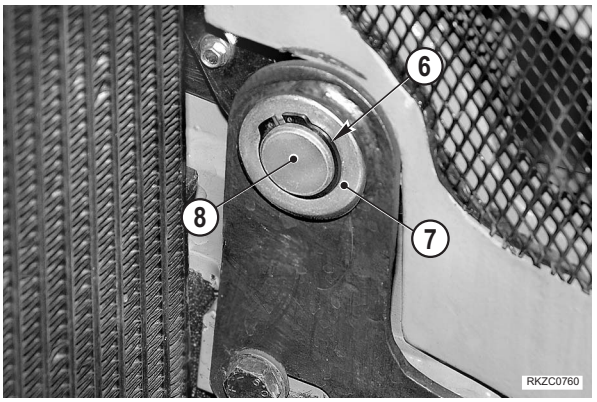
1 - Loosen and remove the screws (1) and washers and remove the front grille (2).



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

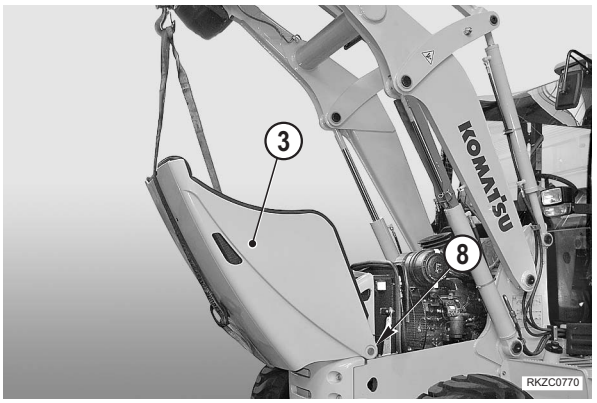


3 - Remove the snap rings (6) and washers (7).



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

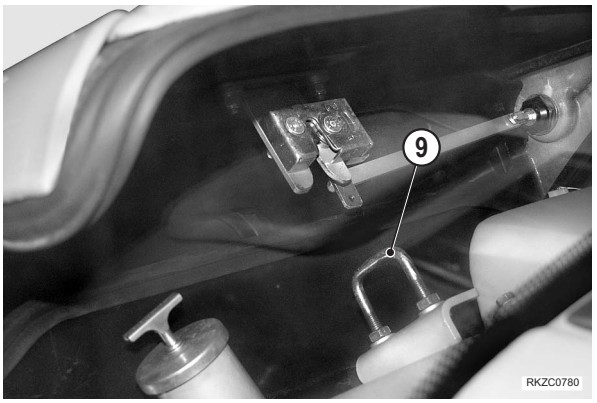
Engine hood: 32 kg



Installation

- To install, reverse removal procedure.

★ Check catch (9) for proper centring.



FRONT GUARD

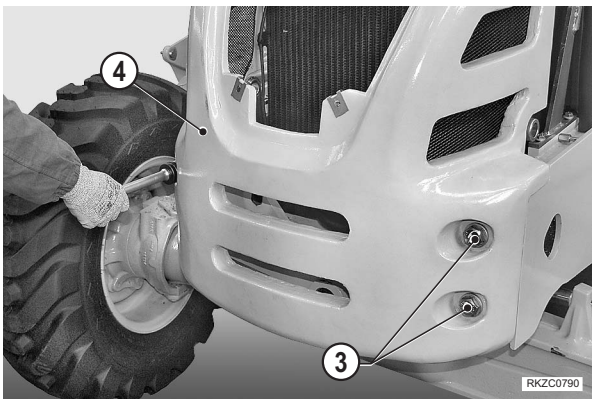
Removal

⚠ 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).

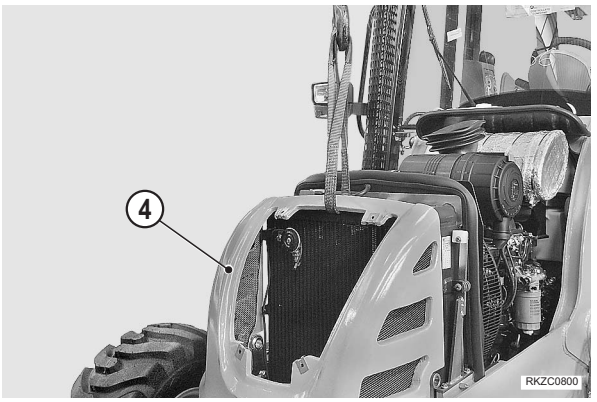


2 - Loosen the screws (3) retaining the guard (4) to eliminate torque. [*1]



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

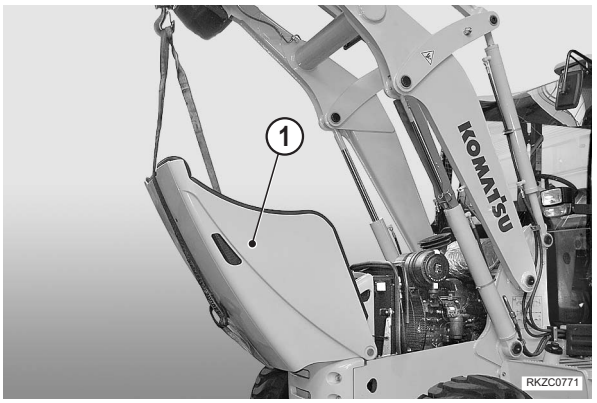
RADIATOR GROUP

Removal

⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

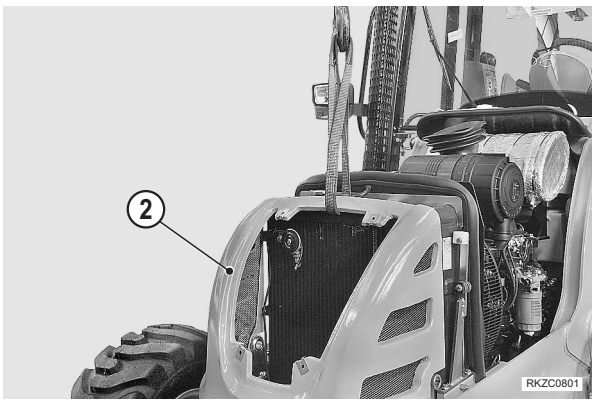
⚠ Remove the ignition key.

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.



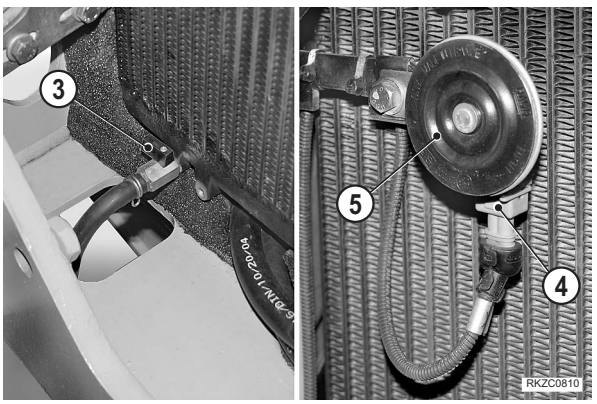
3 - Open the cock (3) and drain the coolant liquid. [*1]

Coolant liquid: approx. 15 ℓ

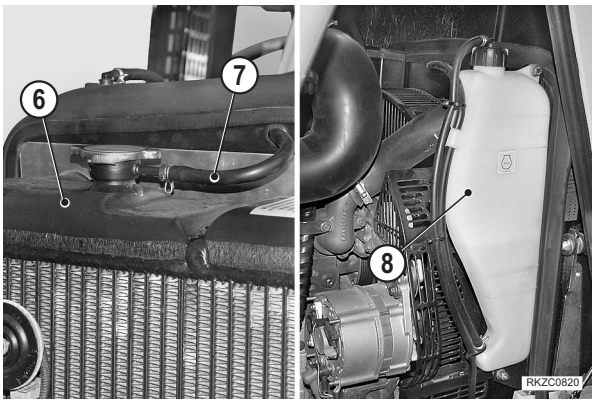
For machines equipped with an air-conditioning unit.

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

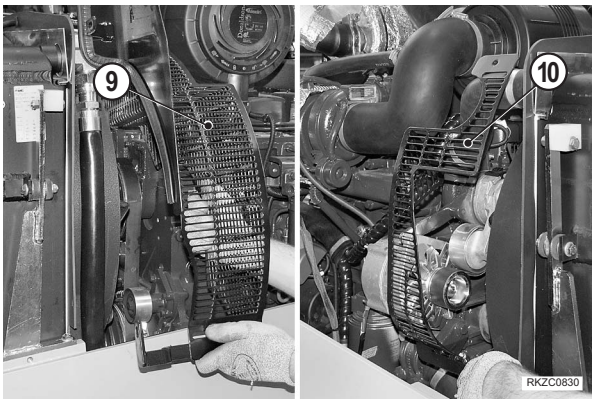
5 - Disconnect the connector (4) and remove the horn (5).



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

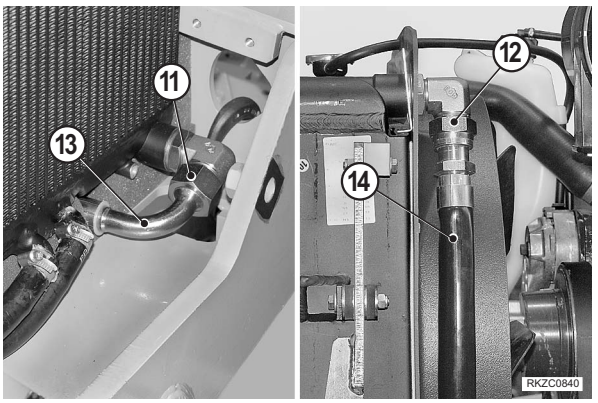


7 -Loosen and remove four screws and fan guards (9) and (10).



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]

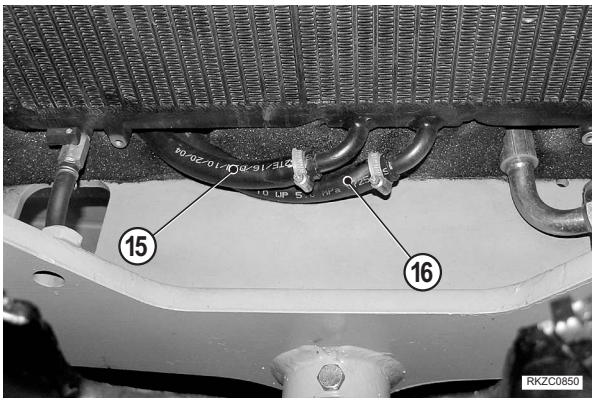
Hydraulic oil: 40 ℓ



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.

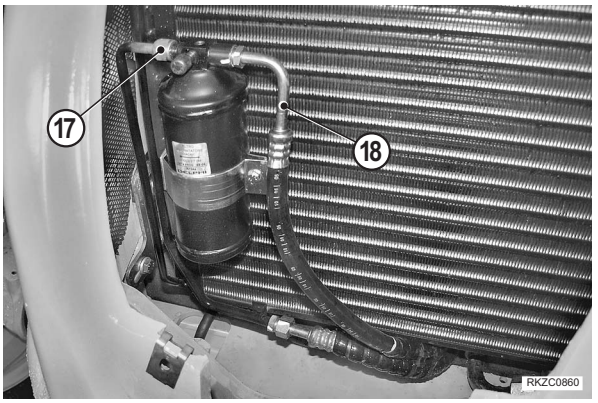
[*4]



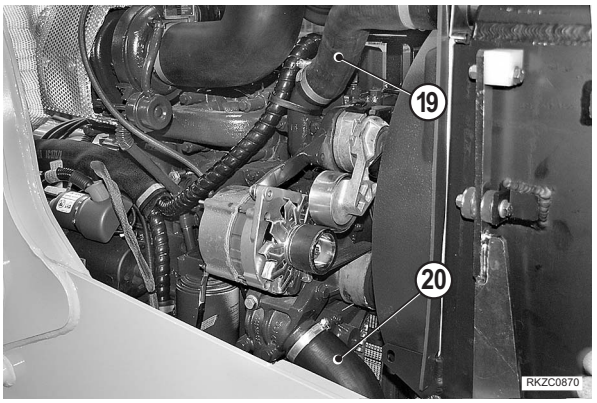
For machines equipped with an air-conditioning unit.

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

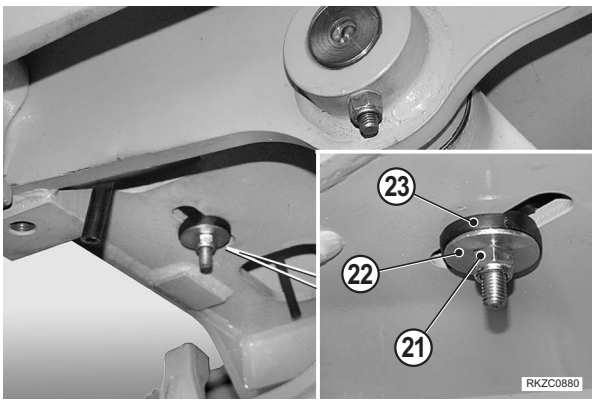
★ Immediately plug the tubes and the orifices to prevent to prevent moisture from entering into the circuit.



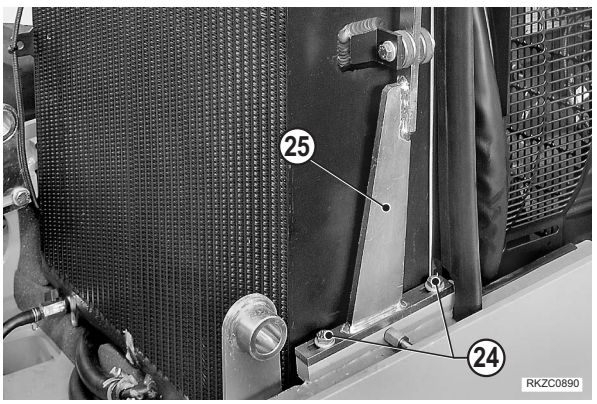
11 - Disconnect the tubes (19) and (20).



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).

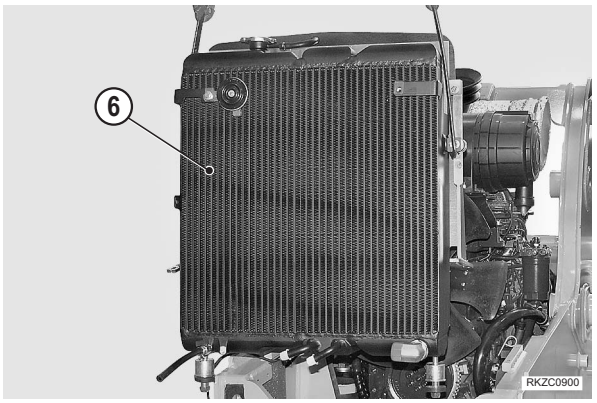


14 - Move the radiator group (6) to the front of the machine so as to disengage it from the cooling fan.

[*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.

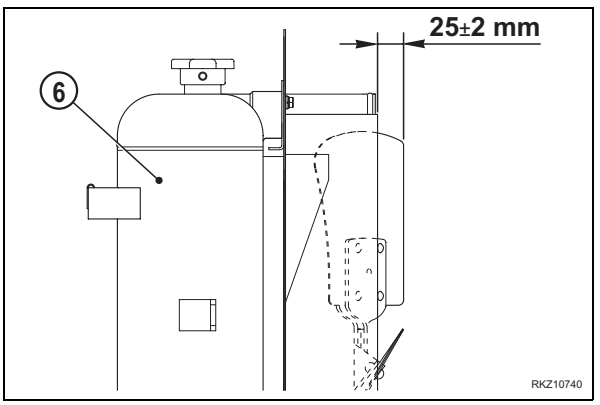
1 - Start the engine at low idling to circulate all the fluids and to fill up the systems.

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, making sure the fan protrudes from fan shroud by 25±2 mm.



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

Removal

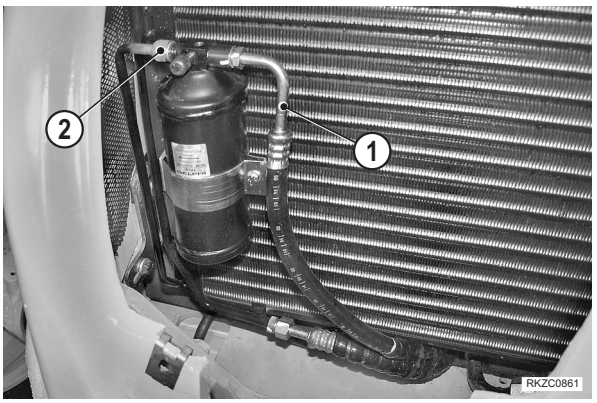
⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

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").

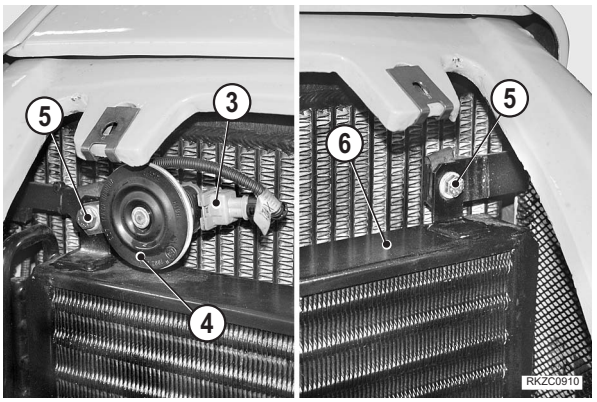
3 - Disconnect the tubes (1) and (2).

★ 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").

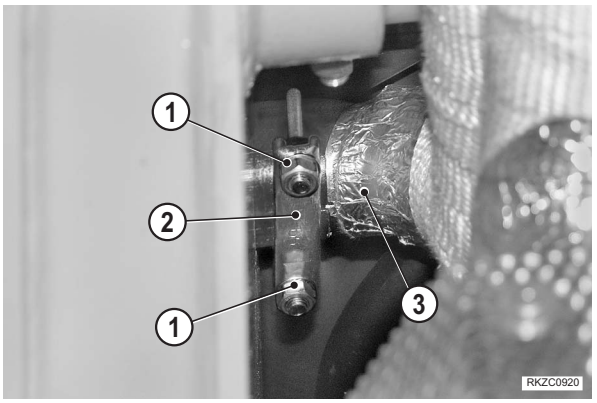
MUFFLER

Removal

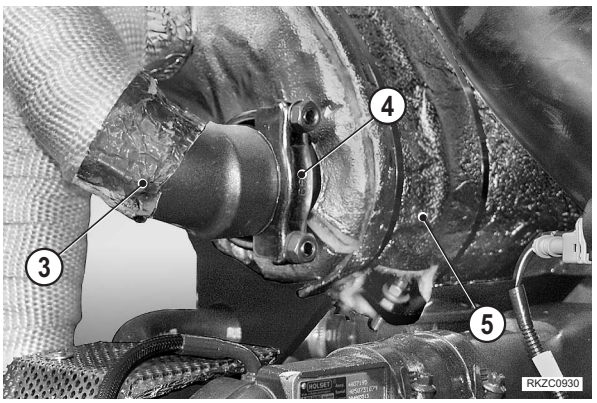
⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

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

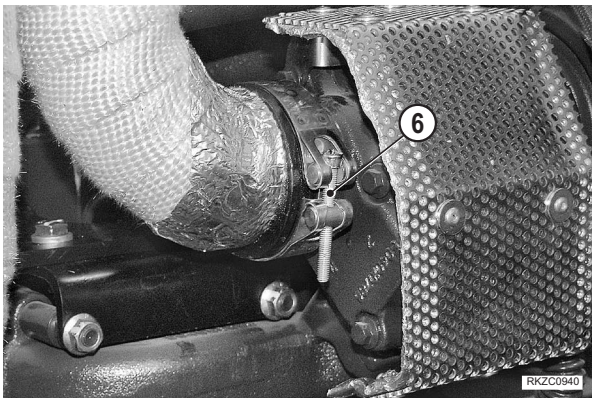
1 -Loosen the nuts (1) on the jumper pin (2) retaining the muffler pipe (3) to the exhaust pipe.



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

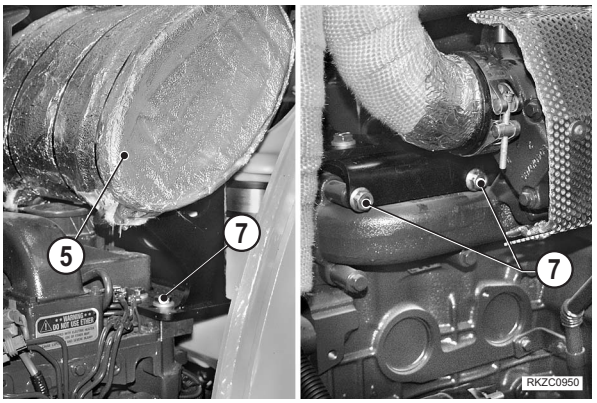


3 -Loosen the tie strap (6) retaining the muffler pipe to the turbocharger.



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

5 -Remove the muffler (5).



Installation

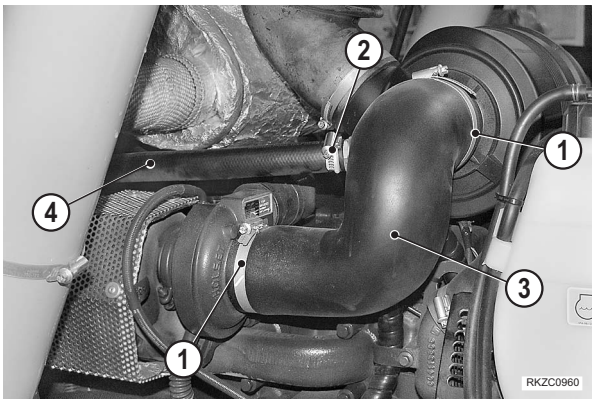
- To install, reverse removal procedure.

AIR FILTER

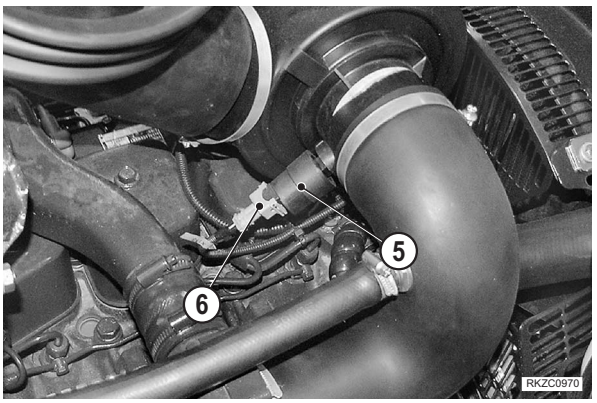
Removal

1 - Park the machine on hard, level ground, apply the parking brake, stop the engine and remove the ignition key.

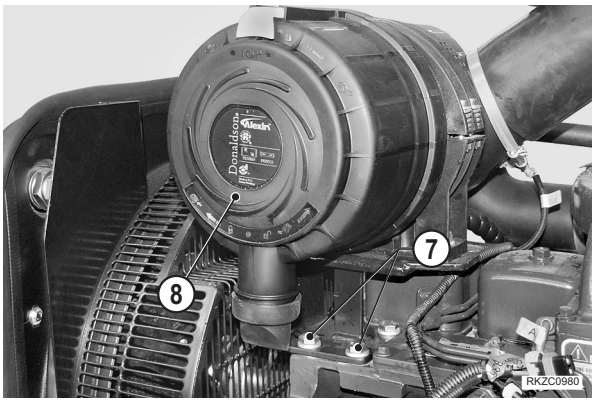
2 - Fully open engine hood, loosen straps (1) and (2), and disconnect pipes (3) and (4).



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

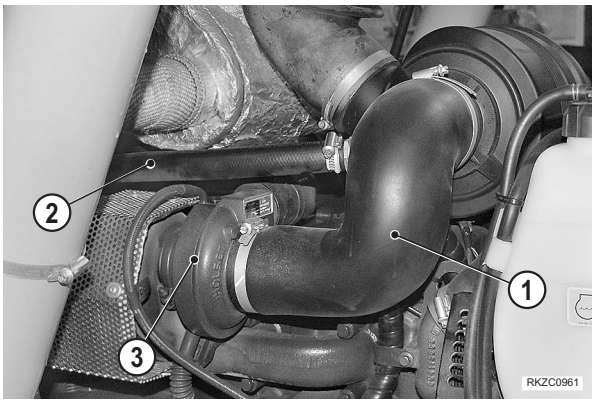
Removal

⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

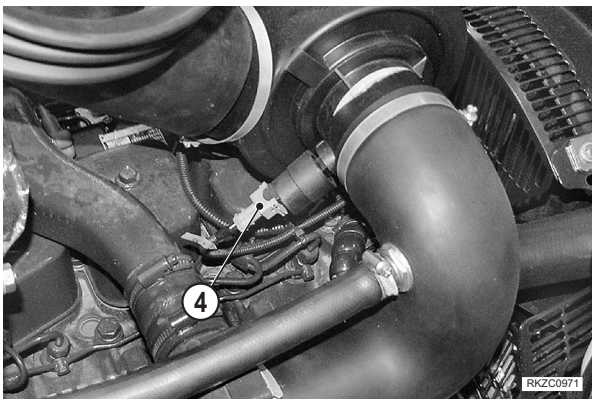
⚠ Remove the ignition key.

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

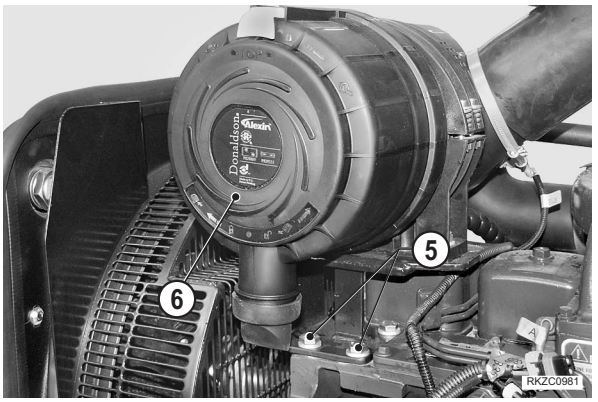
2 - Disconnect the suction pipe (1) from the turbocharger (3).



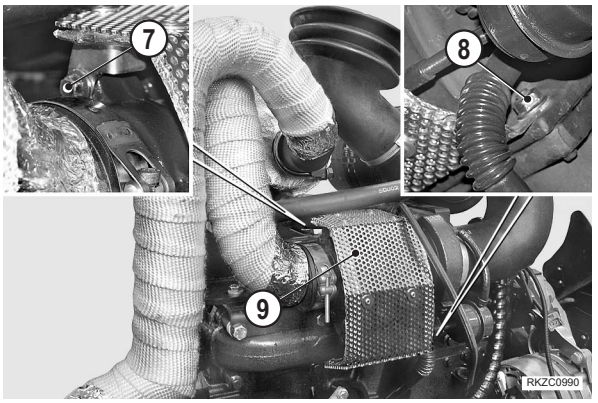
3 - Disconnect the connector (4) from the filter clogging lamp.



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



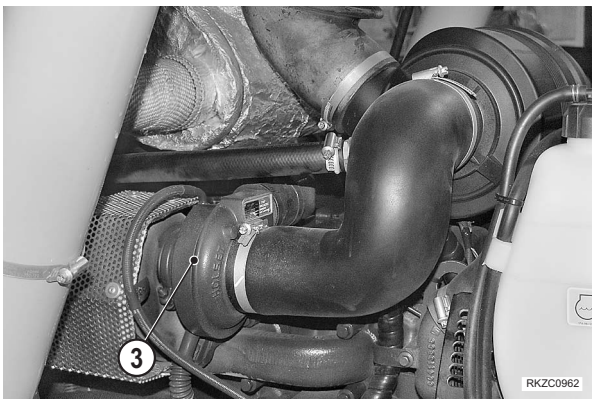
5 - Loosen and remove screw (7) and nut (8), and remove heat guard (9).



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

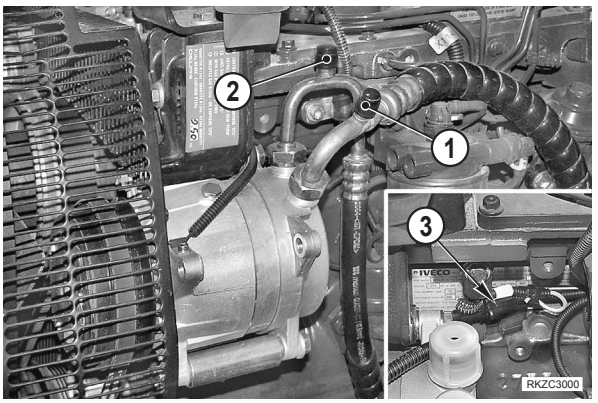
Removal

⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

⚠ Remove the ignition key.

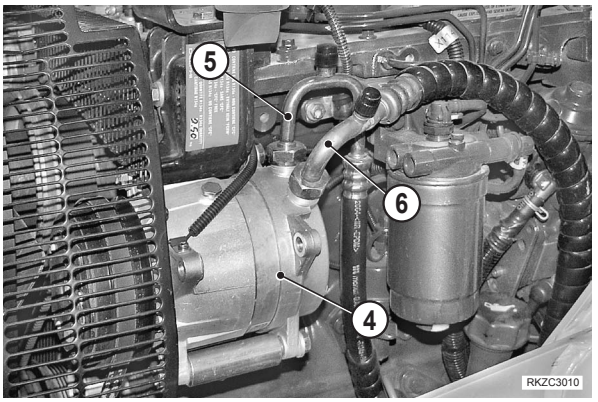
1 - Connect the outlets (1) and (2) to the maintenance station for air-conditioning units and drain the cooling fluid.
(For details see "20 TESTING AND ADJUSTMENTS").

2 - Release the tie strap and disconnect the connector (3).

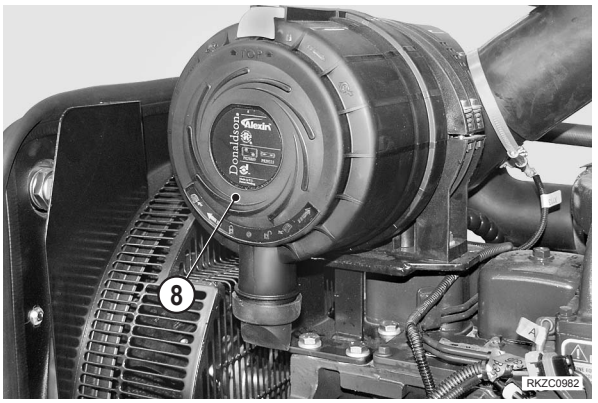


3 - Disconnect fluid delivery and return pipes (5), (6) from compressor (4). [*1]

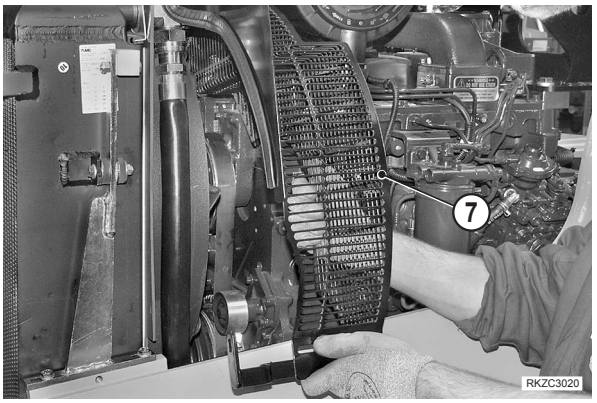
★ Collect the O-rings.



4 - Remove the air filter (8).

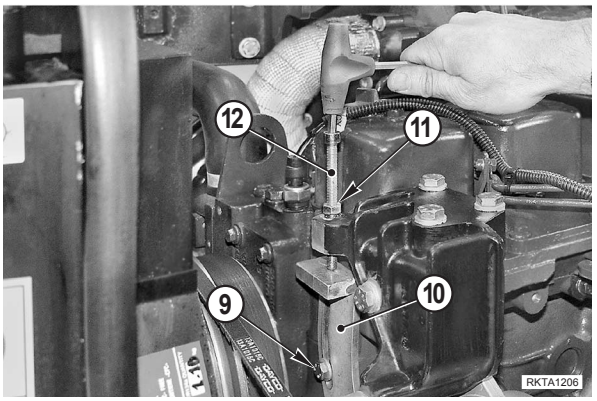


5 - Remove the left fan guard (7).



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

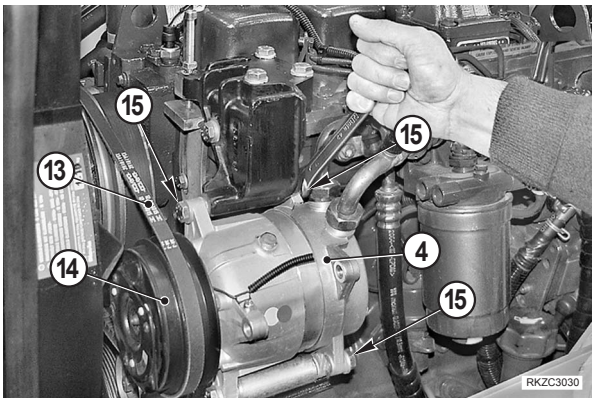
7 - Loosen the nut (11) and turn the screw (12) to loosen the belt.



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").

2 - Connect the unit to the maintenance station and refill it.
(For details see "20 TESTING AND ADJUSTMENTS").

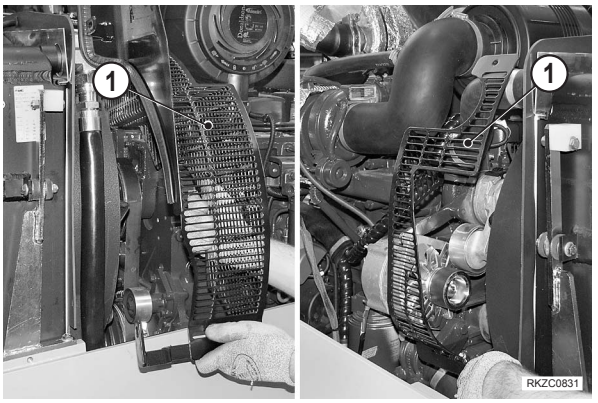
AIR-CONDITIONING UNIT COMPRESSOR BELT

Removal

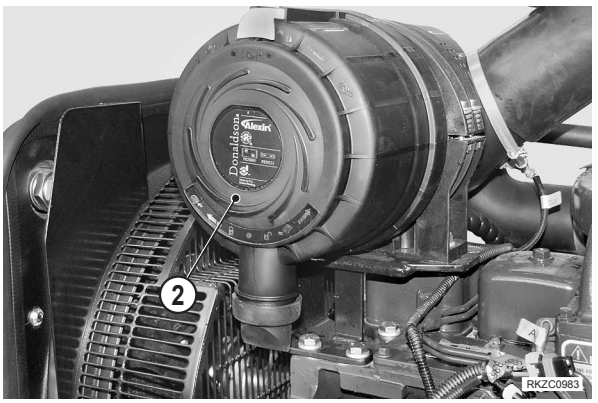
⚠ Fully raise the front working equipment and engage the safety stop.
Also place the backhoe in its secure position.

⚠ Remove the ignition key.

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

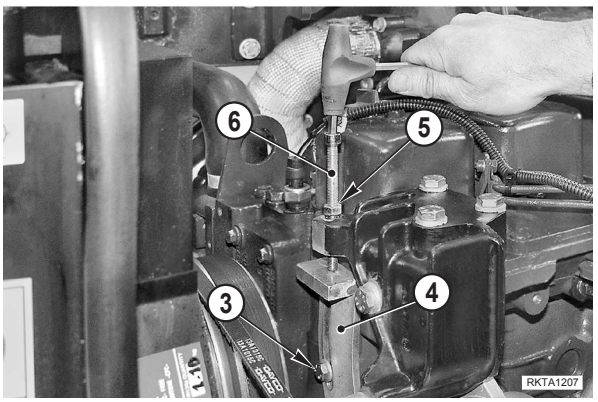


2 -Remove the air filter (2).

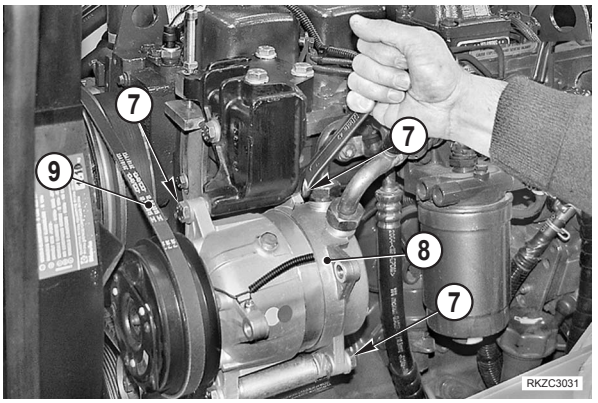


3 -Loosen the screw (3) retaining the tensioner bracket (4).

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]

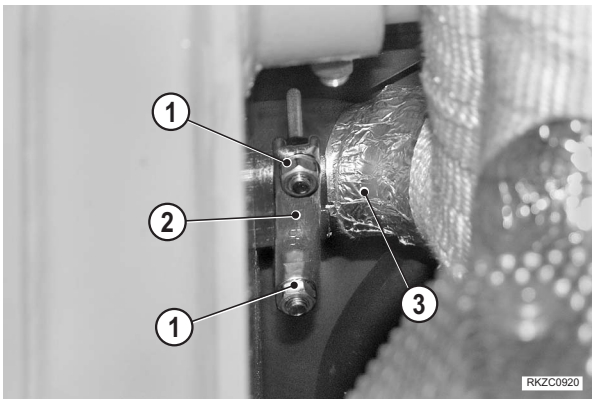
Fan fastening nuts: 42 Nm

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

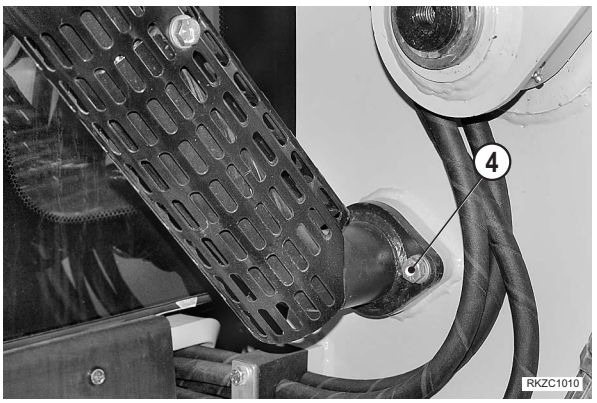
EXHAUST PIPE

Removal

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

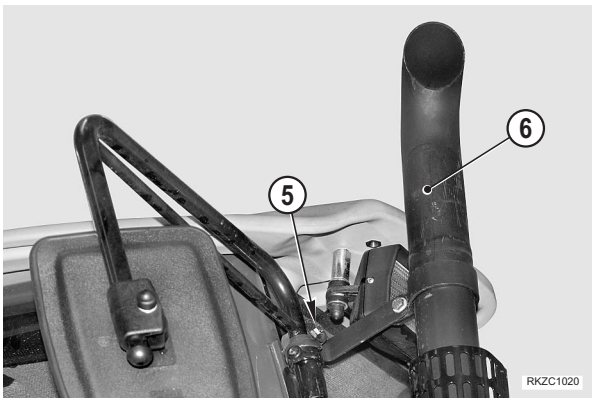


2 - Loosen the screws (4) on the attachment flange; remove one screw but leave the second screw in place for added safety.



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

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

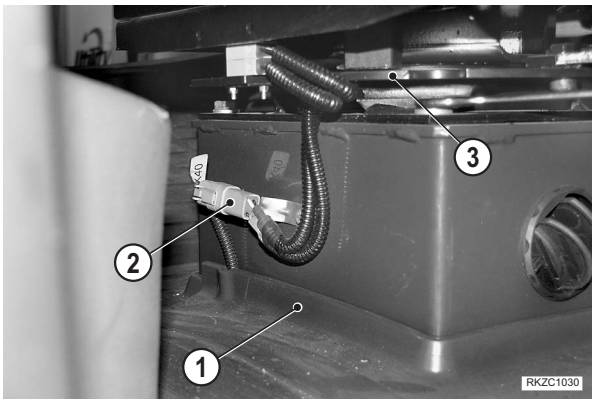
⚠ Lower the working equipment completely until it rests on the ground, and stop the engine.

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

★ Drain the engine cooling liquid.

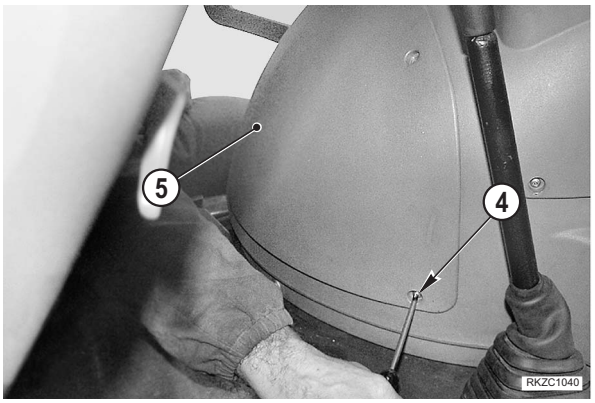
Coolant liquid: 15 ℓ

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

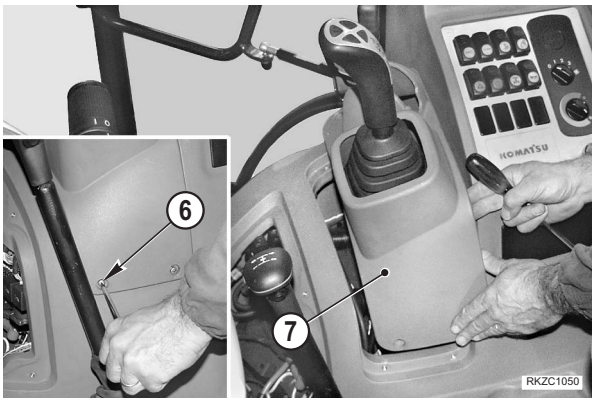


1 - Remove the floor-mat (1); disconnect the connector (2) and remove the seat (3).

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



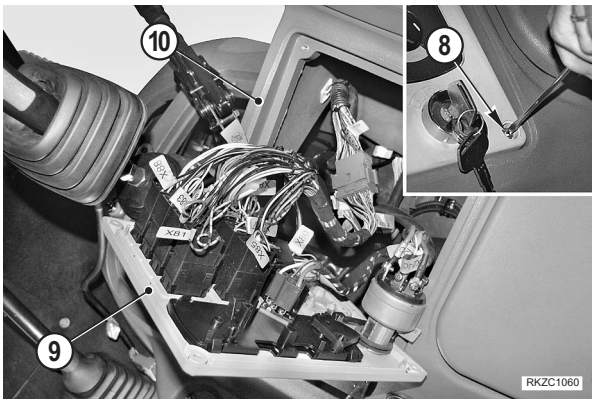
3 - Remove four screws (6) and remove PPC valve and parking brake casing (7).



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.

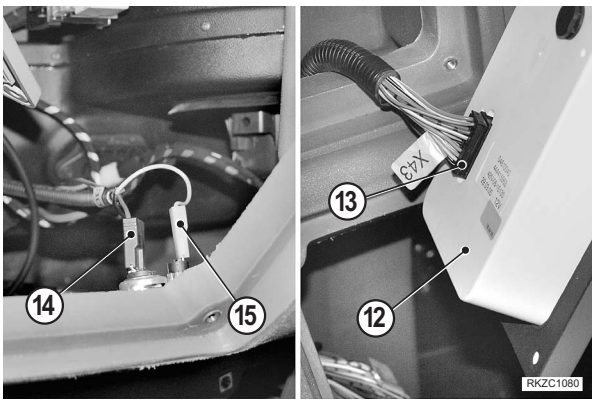
6 - Remove four screw covers and screws (11).

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



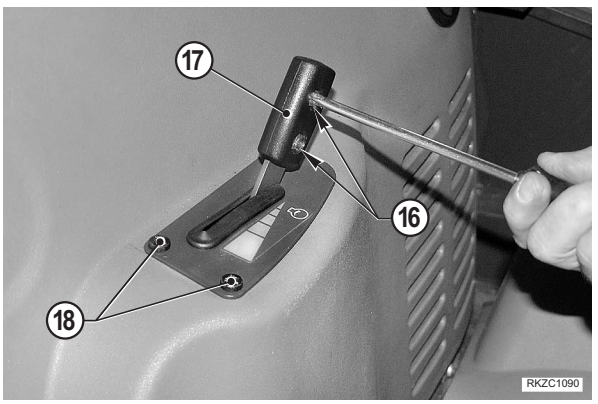
8 - Disconnect the connector (13) from the instrument board (12).

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

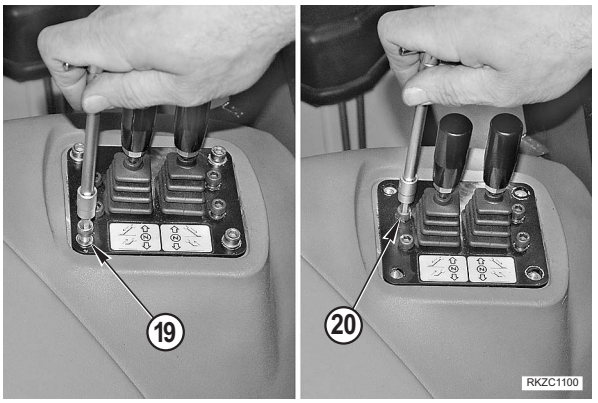


10 - Extract screws (16) and remove the hand accelerator handle (17).

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

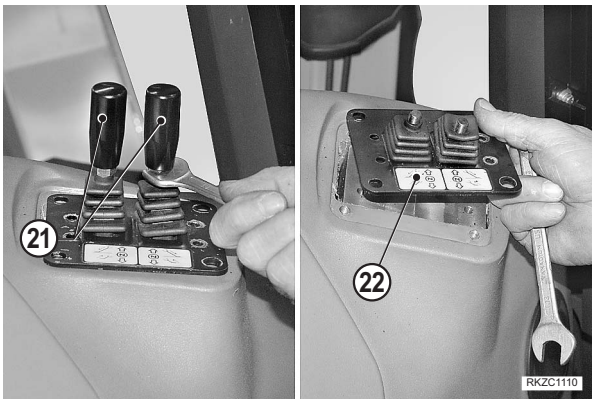


12 - Loosen and remove the screws (19) and (20).

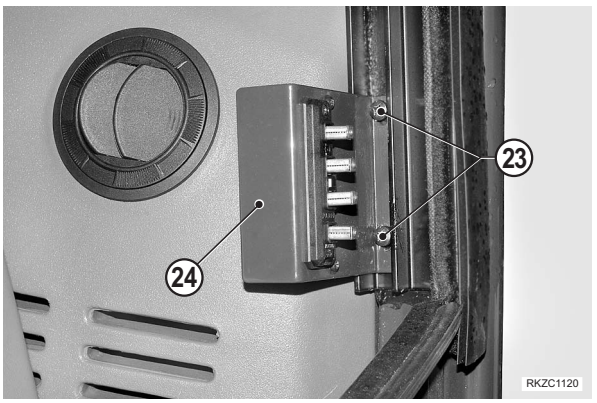


13 - Loosen nuts and remove knobs (21) from outrigger PPC valves.

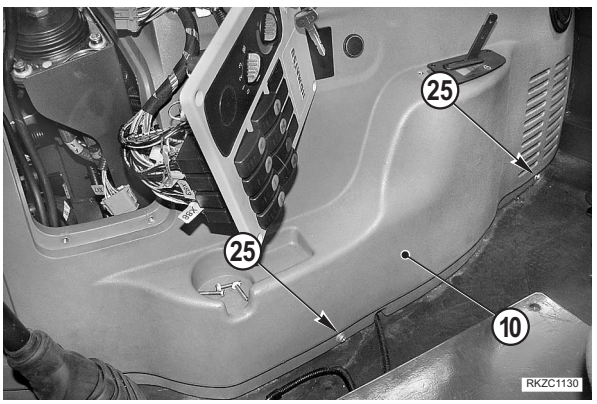
14 - Remove PPC valve mounting plate (22).



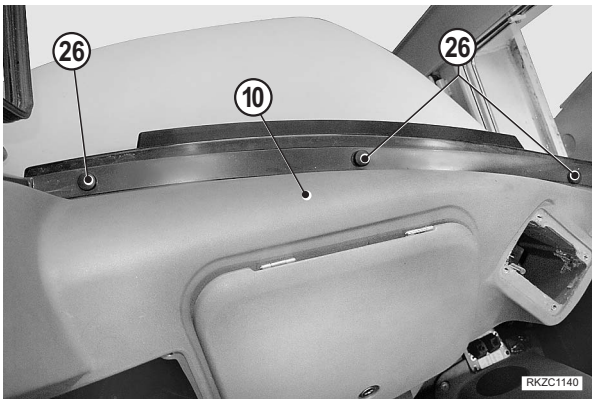
15 - Extract screws (23) and remove contact carrier plate (24) for rear wiper.



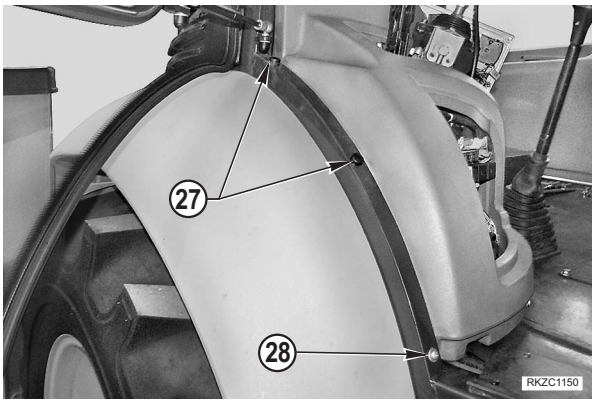
16 - Extract the lower screws (25) retaining the right hand case (10).



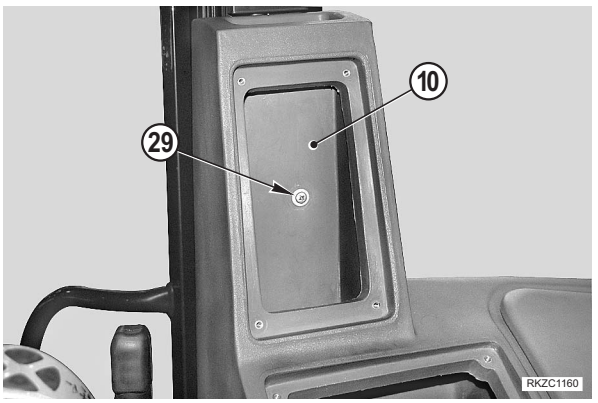
17 - Extract three screw covers (26) and screws retaining the right hand case (10) at the rear.



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

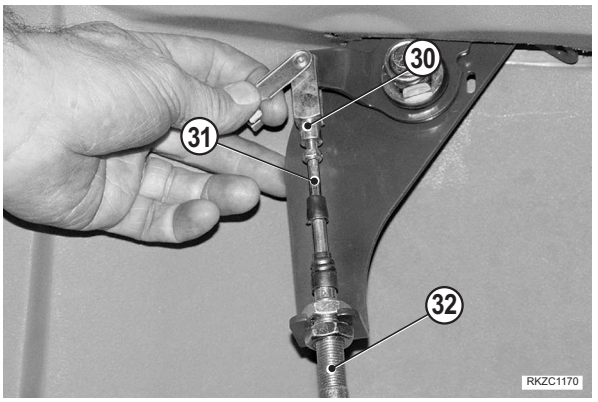


19 - Extract the upper screw (29) retaining the right hand case (10) and its washer.

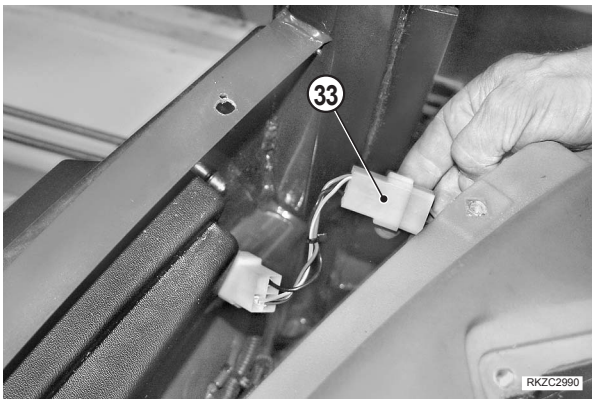


20 - Move the rear of the right hand case (10) towards the middle of the cab, remove pin (30), and disconnect hand accelerator cable (31).

21 - Loosen nut and disconnect sheath (32).

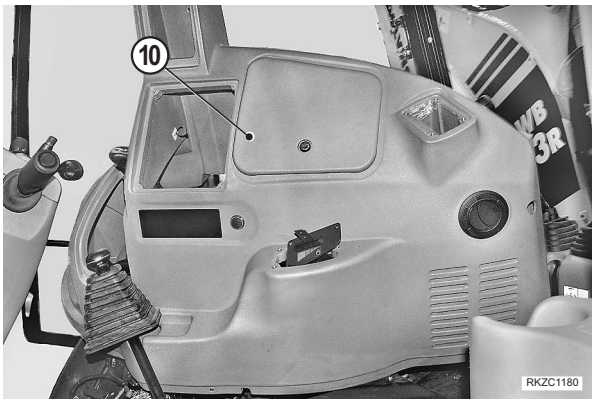


22 - Disconnect the contact carrier plate connector (33).



24 - Engage the parking brake.

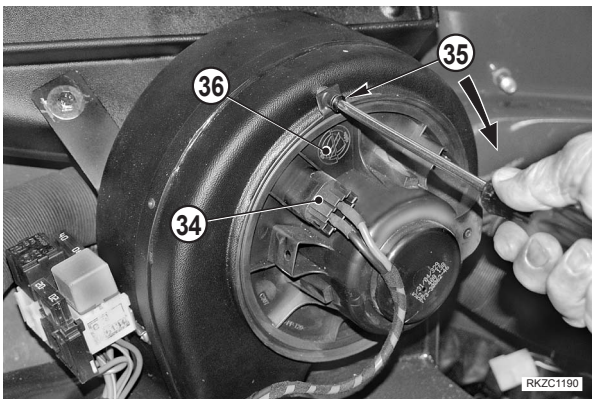
25 - Raise right hand case (10) until PPC valve control and parking brake lever are disengaged; fully remove the case.



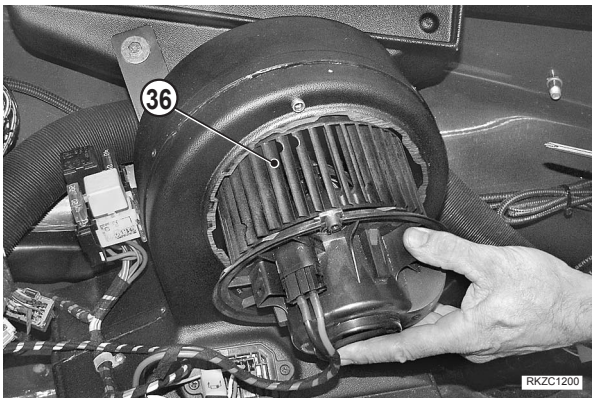
FAN

26 - Disconnect the connector (34).

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

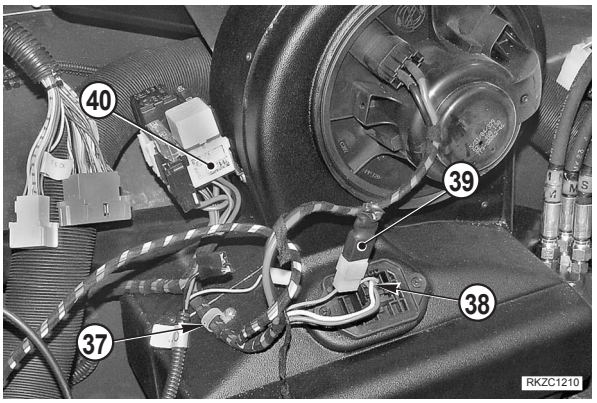


28 - Extract the fan group (36).

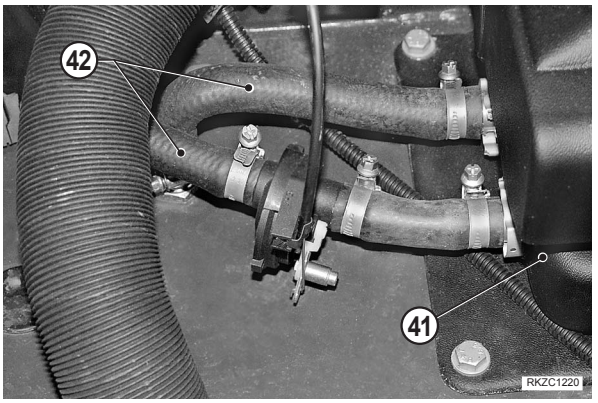


29 - Remove the clamp (37).

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

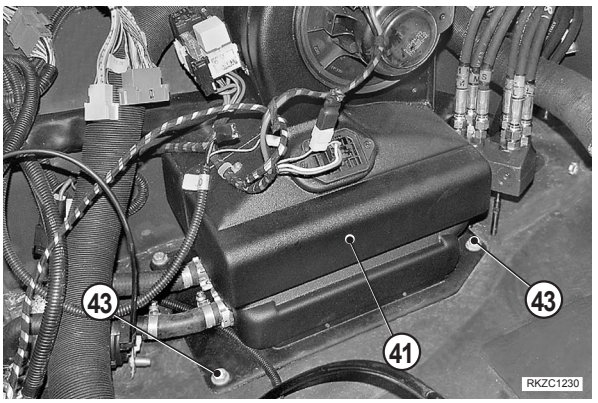


31 - Disconnect the heating system liquid inlet and outlet pipes (42) from the oil cooler (41).



OIL COOLER GROUP

32 - Loosen and remove the four screws (43) and remove the group.



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.

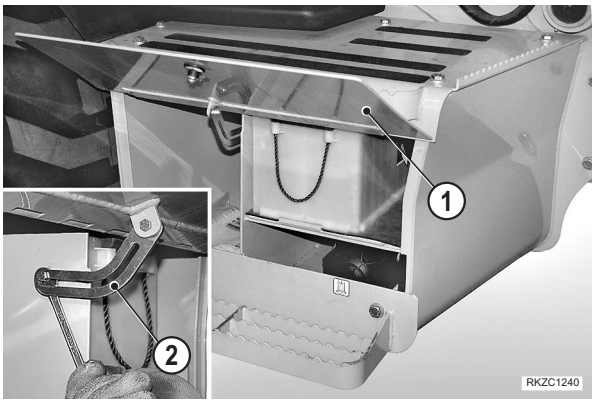
4 - Complete installation by reversing the removal procedure.

BATTERY

Removal

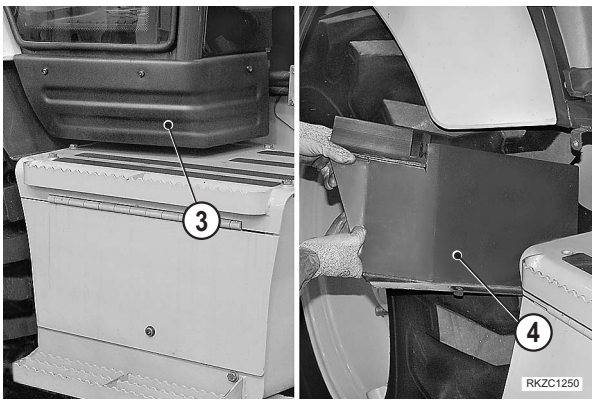
⚠ Lower the working equipment completely until it is resting on the ground.
Engage the parking brake, stop the engine and remove the ignition key.

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

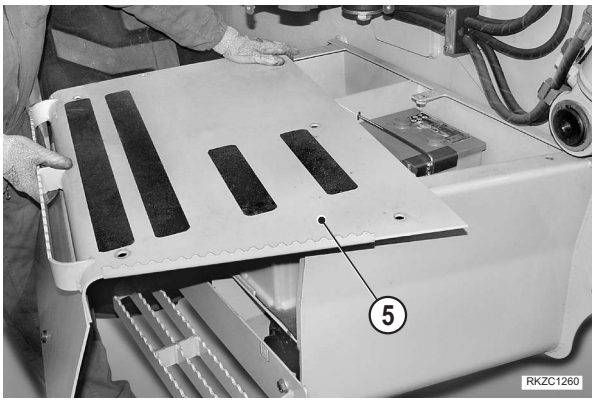


2 -Remove the lower right-hand guard (3) of the cab.

3 -Remove the protection (4).

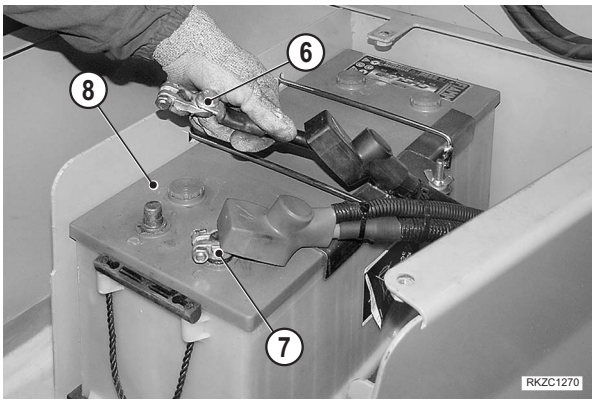


4 -Take out the screws and remove the platform (5) and door.



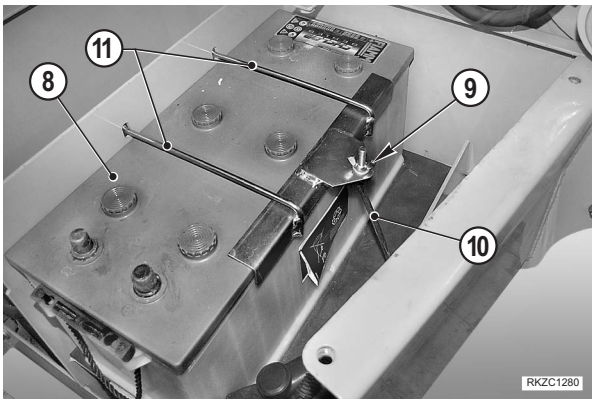
5 -Disengage battery negative (–) terminal (6) from shield and disconnect from battery (7).

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

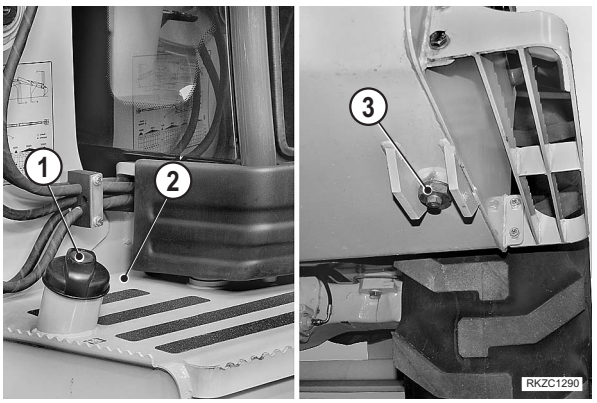
Removal

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

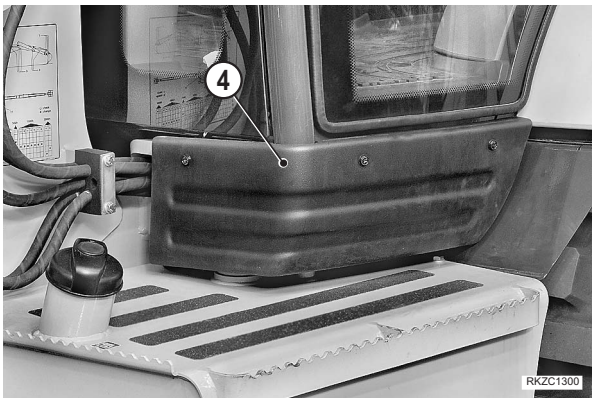
1 - Take the cap (2) off the filling inlet of the fuel tank (3) and remove also the bottom plug in order to drain the fuel.

Fuel: max. 150 ℓ

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



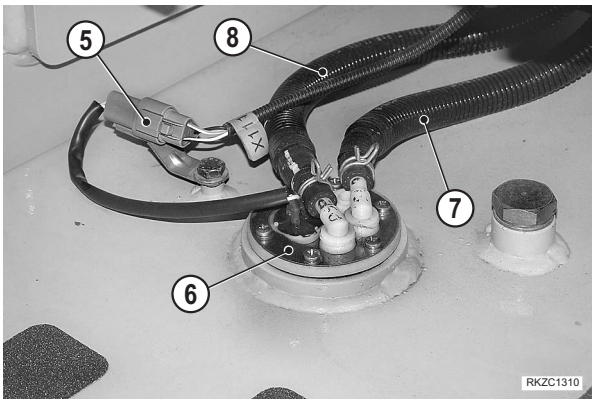
3 - Remove the lower left-hand guard (4) of the cab.



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.



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.

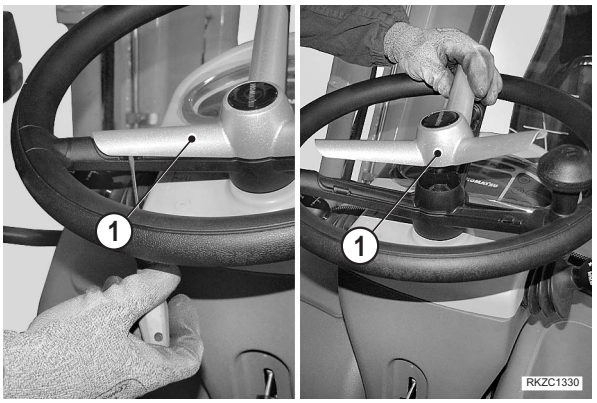
STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP

Removal

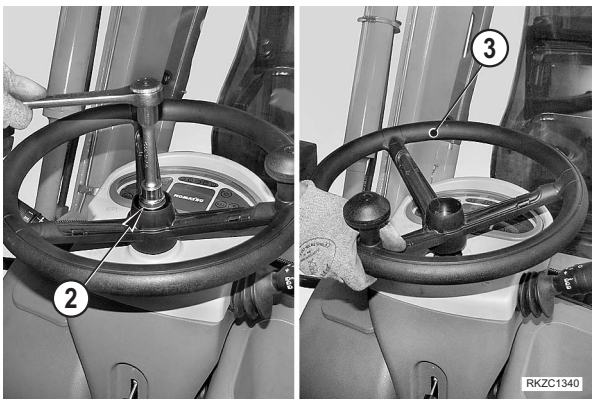
⚠ Lower the working equipment completely until it rests on the ground.
Engage the parking brake and stop the engine.

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

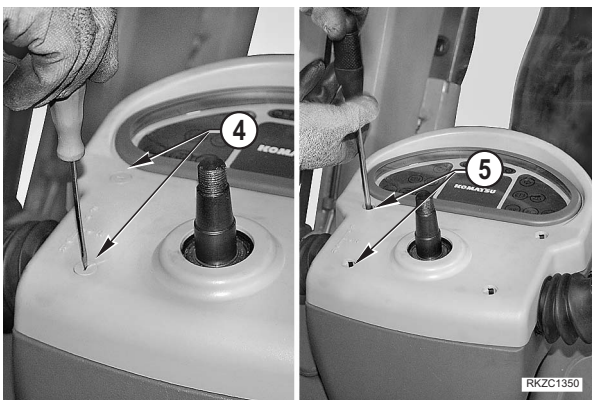
1 - Use a thin bladed screwdriver placed under each spoke of the steering wheel to pry away the cover (1).



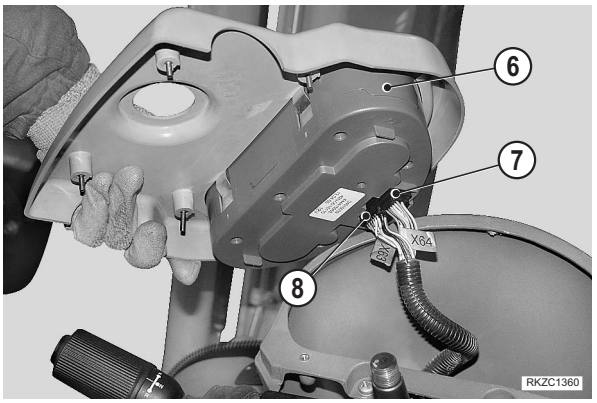
2 - Loosen and remove the retaining nut (2) and remove the steering wheel (3).



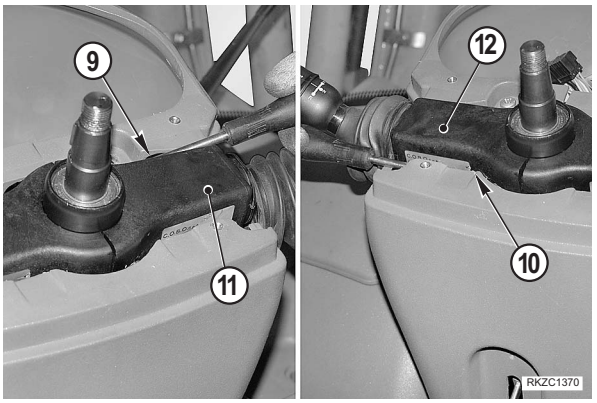
3 - Remove four screw covers (4) and loosen four screws (5) retaining the instrument panel.



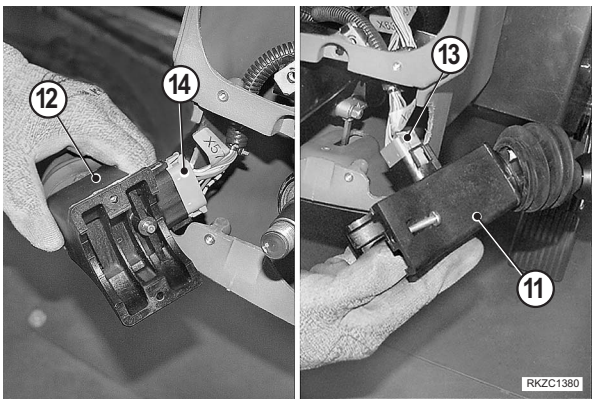
4 - Slide off instrument panel (6) from steering column; disconnect connectors (7) and (8), and remove instrument panel.



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]

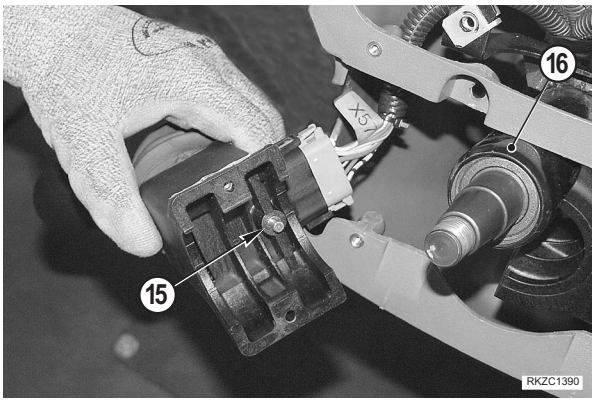


Installation

- 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

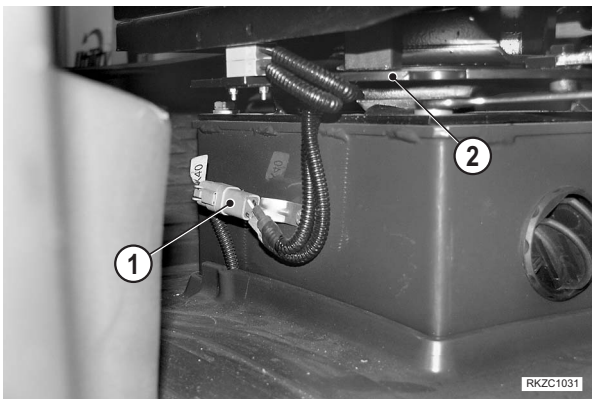
Removal

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

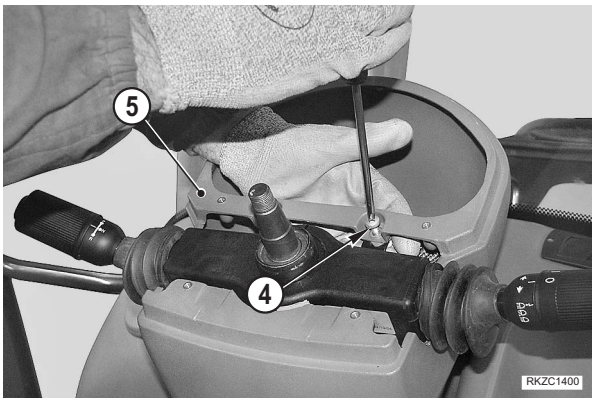
1 - Remove the steering wheel and the direction indicator and transmission reverse control groups
(For details, see "STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP").

2 - Disconnect the connector (1) and remove the seat (2).

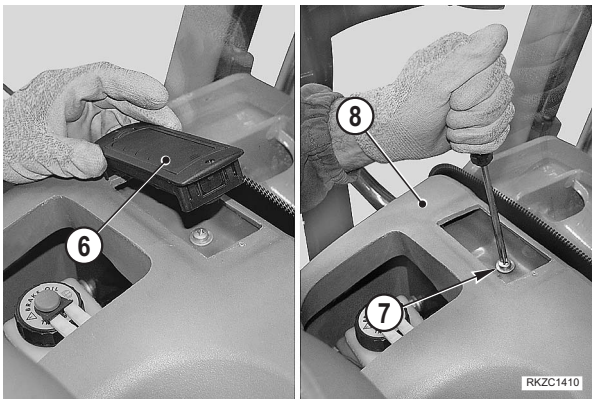
3 - Remove the front mat (3).



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

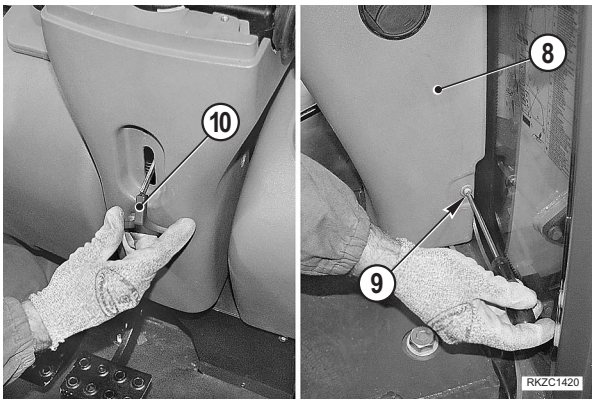


5 - Remove the guards (6) and extract the upper screws (7) retaining the front trim cover (8).

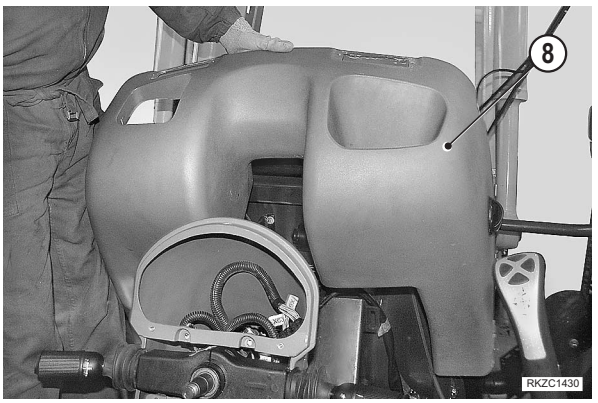


6 - Loosen and remove the lower screws (9) retaining the front trim cover (8).

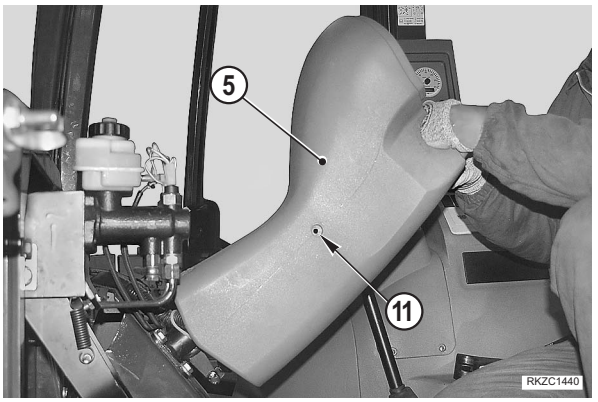
7 - Fully lower the steering column; extract the knob (10).



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



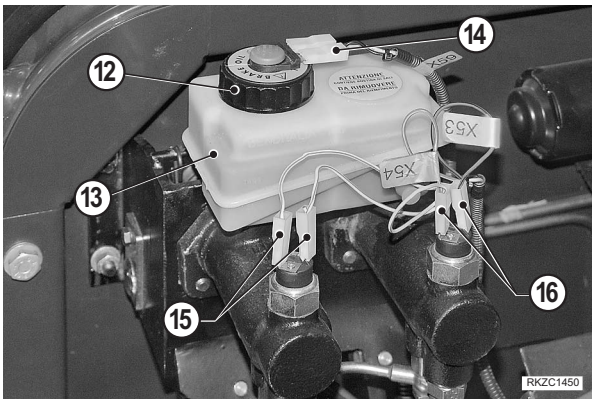
9 - Take out the lower screws (11) and remove the instrument panel holder (5).



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).

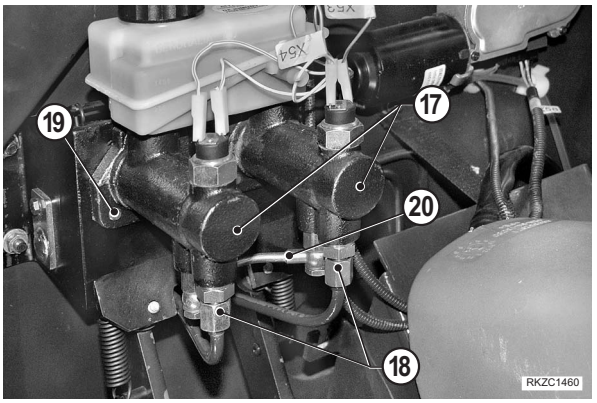


13 - Disconnect the delivery pipes (18) from the pumps (17). [*1]

★ 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").

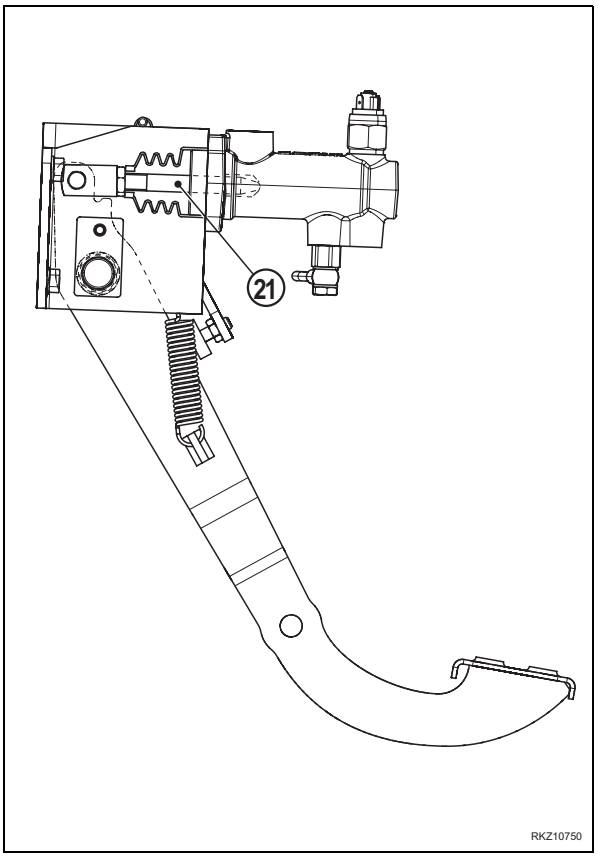
[*2]

★ 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

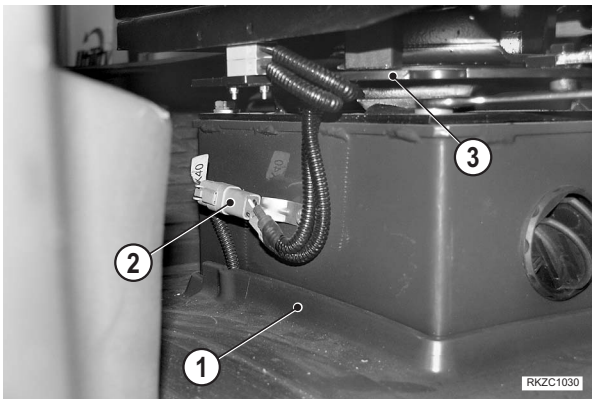
Removal

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

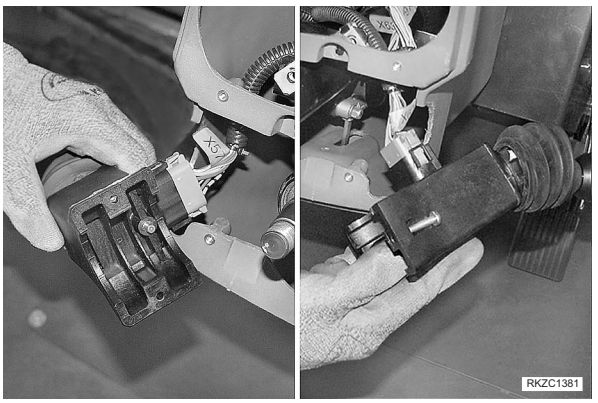
⚠ Eliminate residual pressure from all circuits by moving all control levers in all directions.

1 - Remove the front mat (1).

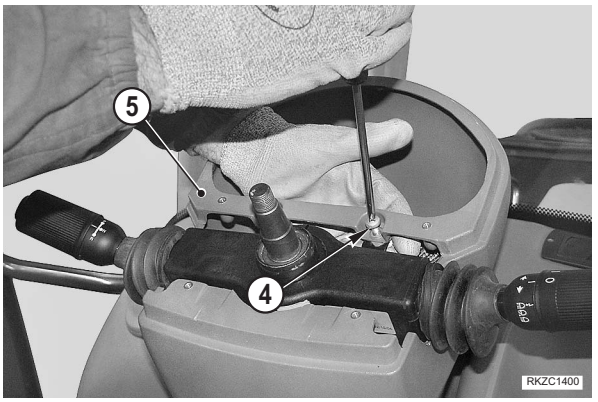
2 - Disconnect the connector (2) and remove the seat (3).



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").

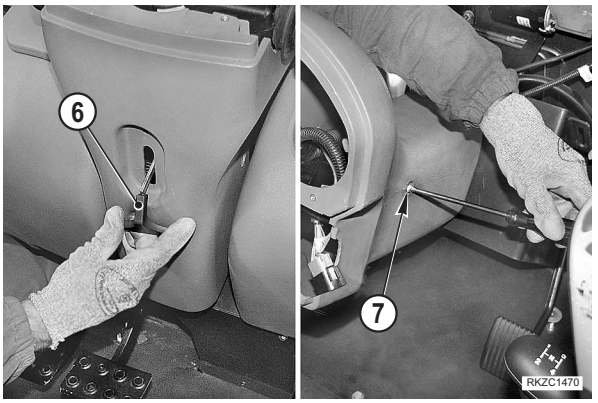


4 - Loosen and remove the upper screws (4) retaining the instrument panel holder (5).

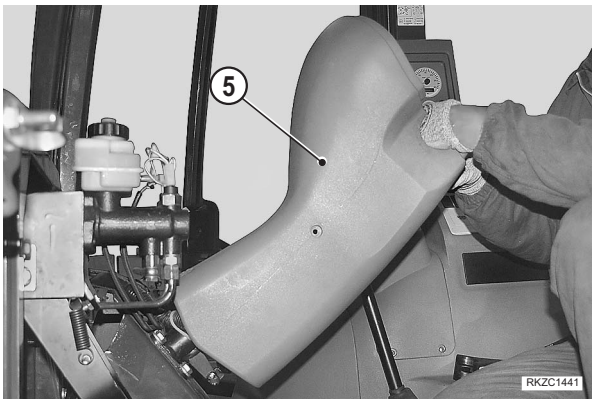


5 - Remove the steering column lock knob (6).

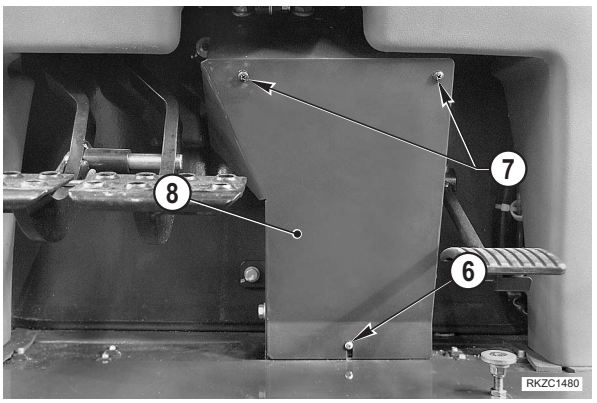
6 - Remove the screws (7) retaining the side of the instrument panel holder.



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



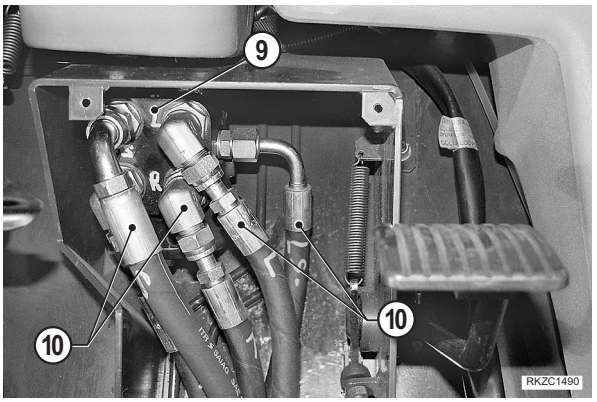
8 - Loosen screw (6) and remove two screws (7); remove the front guard (8).



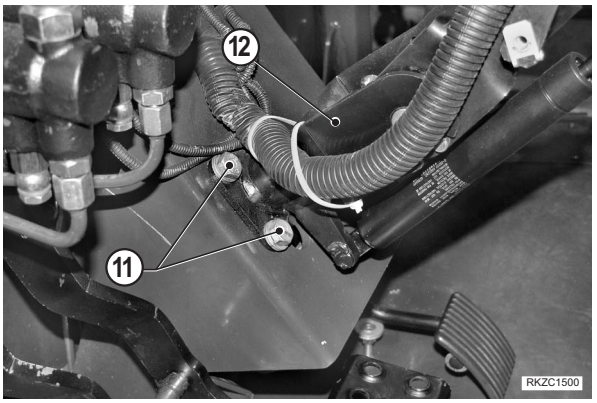
9 - Mark the respective positions of and disconnect five pipes (10) from steering unit.

★ 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.

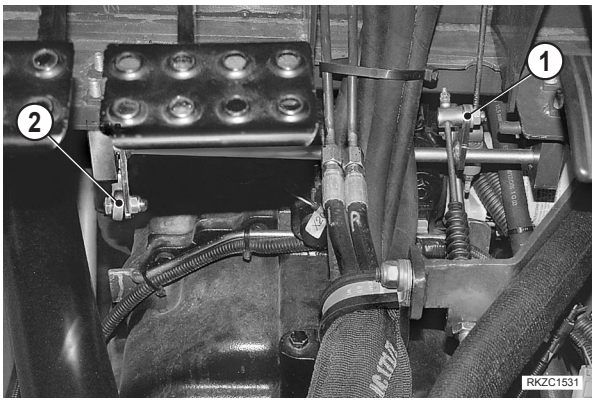
★ Drain the engine cooling liquid.

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]

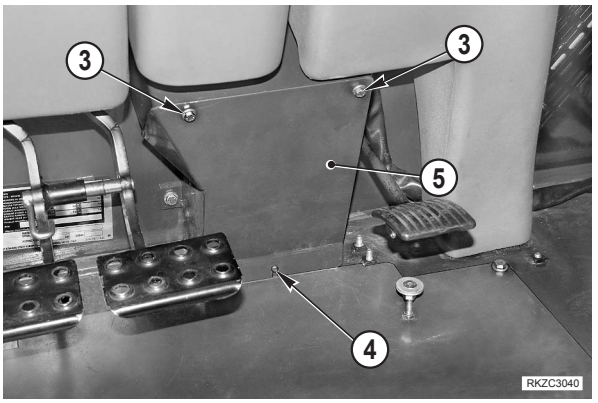
1 - Remove the exhaust pipe.
(For details see "EXHAUST PIPE").

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).

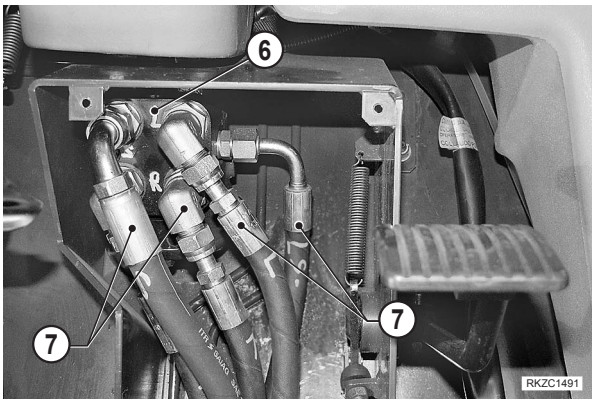
4 - Remove the steering unit guard (5).



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

★ Mark the positions of the pipes to prevent exchanging positions when reconnecting.

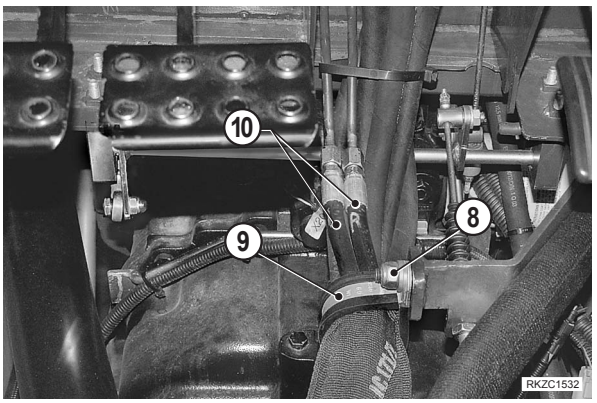
★ Plug the pipes and pipe-fittings to prevent entry of impurities.



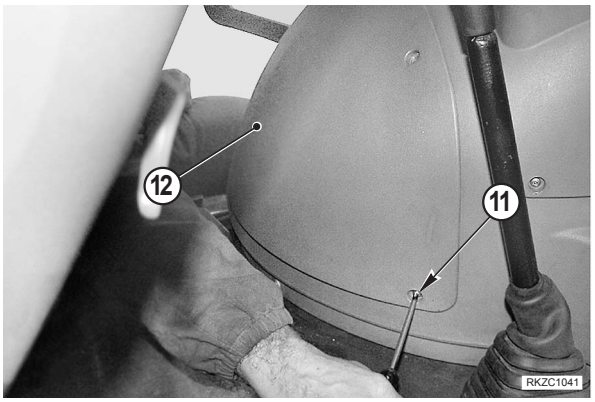
6 - Remove nut (8) and disconnect strap (9) from frame.

7 - Disconnect the tubes (10) and (3). [*3]

★ Plug the pipes and pipe-fittings to prevent entry of impurities.

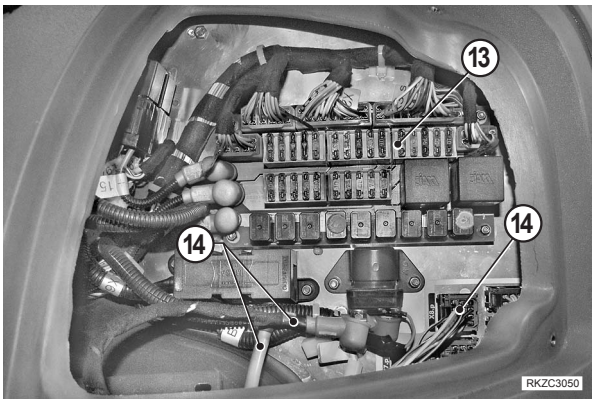


8 - Take out the screws (11) and remove the hood (12).



9 - Disconnect connectors (14) from fuseblock (13).

★ Disconnect connectors marked:
X7 - X8 - X11 - X12 - X126 - X128 - X153 - GND6

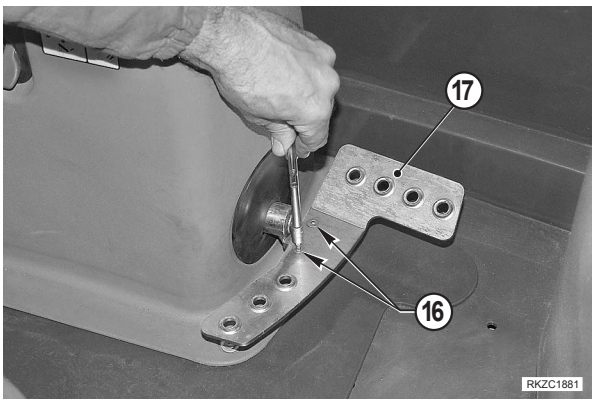


10 - Lift rear window (15) to the top and remove the rear mat.

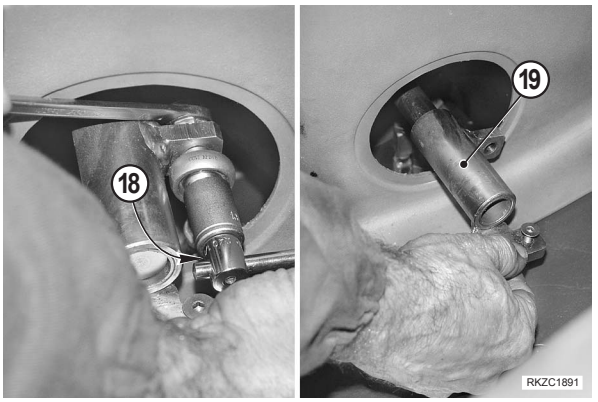


- **For standard version**

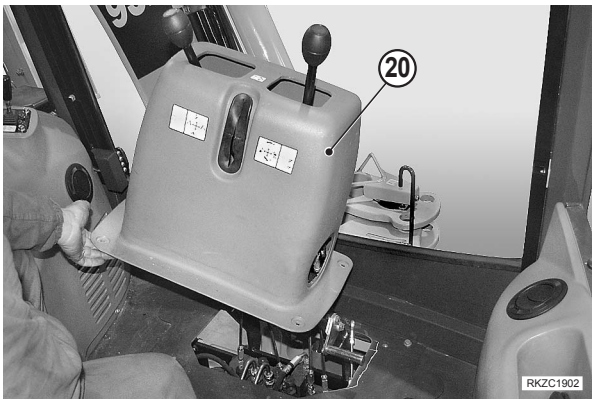
11 - **Only if equipped**
Remove screws (16) and remove control pedals (17) for jig arm and hammer.



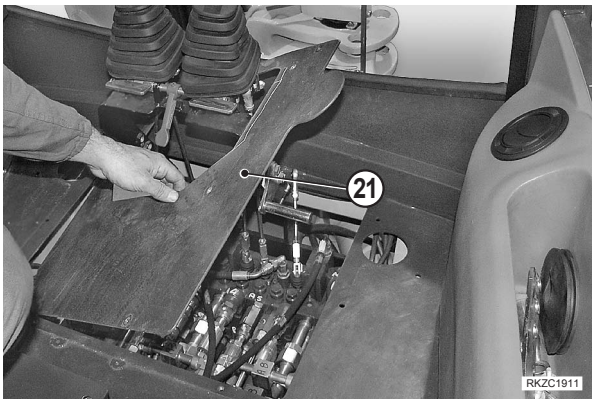
12 - Loosen and remove the screws (18) and the pedal support (19).



13 - Take out the screws (no. 4) and remove the hood (20).

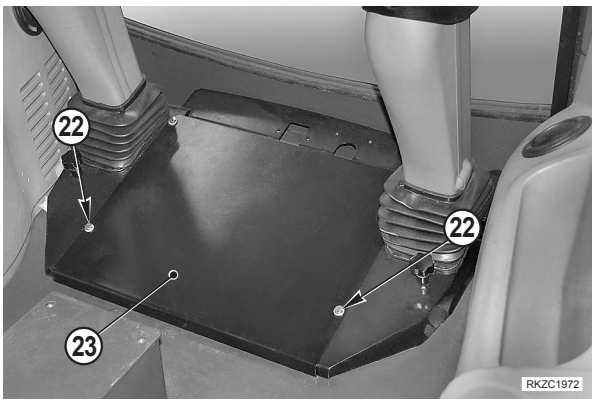


14 - Take out four screws and remove the metal sheet (21) closing off the floor.



- **Version with servocontrols**

15 - Pull out the screws (22) and remove the platform (23).



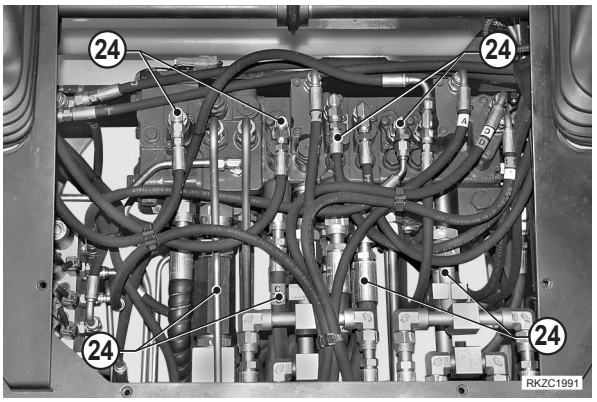
- **For all versions**

16 - Disconnect the servocontrols upper and lower pipes (24) 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.

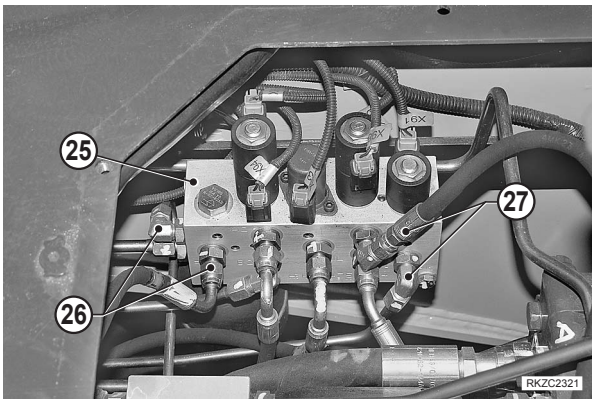
★ Lay the hoses inside the cab to gain access to the feed and exhaust hoses.



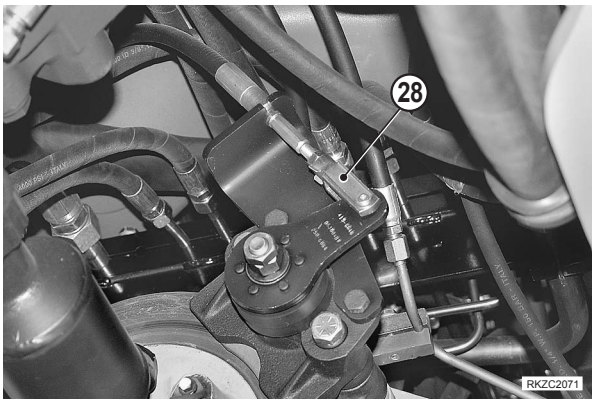
17 - Disconnect servocontrol supply hoses (26) and (27) from solenoid valve group (25).

★ Mark the pipes to avoid exchanging them during installation.

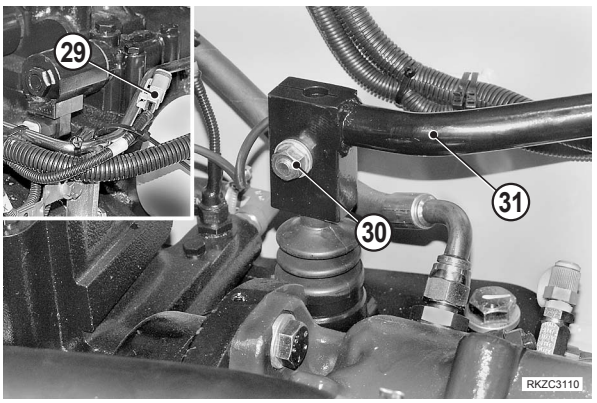
★ Cap pipes, hoses and holes to prevent contamination.



18 - Disconnect parking brake cable (28) from brake caliper. [*5]



19 - Disconnect connector (29); remove screw (30), and disconnect gear lever (31).



20 - Take out the screws (32) and remove the protection (33).

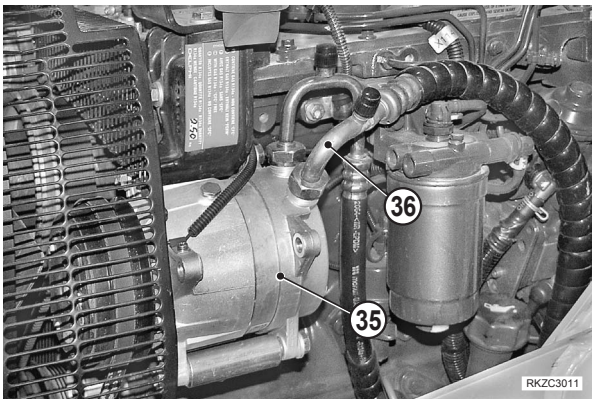


21 - Remove nuts (34) as well as front and rear screws. [*6]



- **Version with air-conditioning unit**

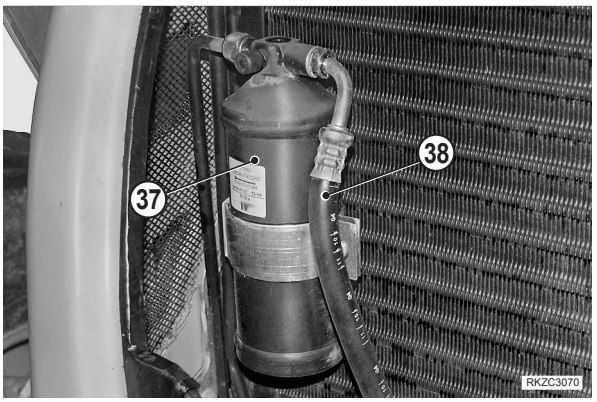
22 - Disconnect the suction pipe (36) from the compressor (35). [*7]



23 - Take out the screws (39) and remove the protection (40).



24 - Disconnect hose (38) from condenser (37). [*8]



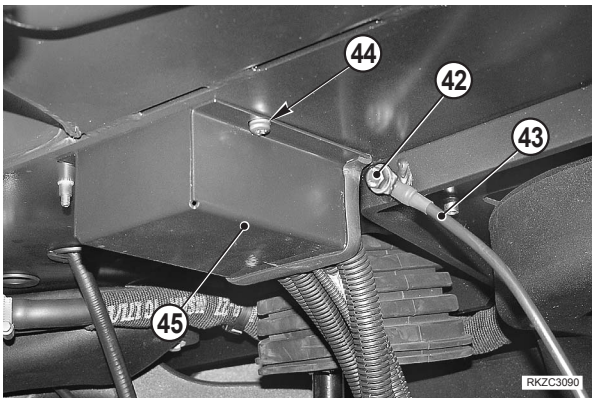
25 - Remove the hole plugs and tighten two lifting eyes into the lifting holes provided.
Connect the cab (41) to the lifting equipment and apply light tension.

26 - Lift the cab by about 30 cm and place some safety blocks "**A**" under it.



27 - Remove the screw (42) and disconnect the ground wire (43).

28 - Pull out screws (44) and remove cable guard (45).



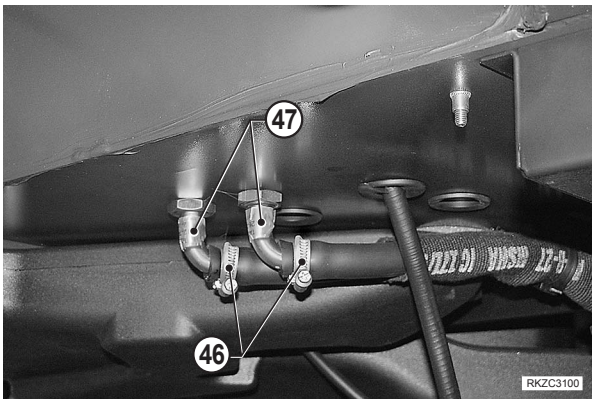
29 - Loosen straps (46) and disconnect heating hoses.

★ Mark the pipes to avoid exchanging them during installation.

★ Cap pipes, hoses and holes to prevent contamination.

30 - Remove the cab.

Cabin: _____ kg



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: 16 Nm

1 - Refill the coolant liquid.



Coolant liquid: approx. 15 ℓ

HYDRAULIC OIL TANK

Removal

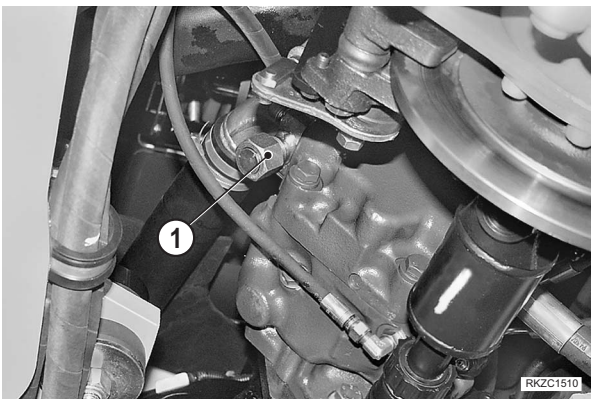
⚠ Lower the working equipment completely until it rests on the ground.
Engage the parking brake, stop the engine and remove the ignition key.

⚠ 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").

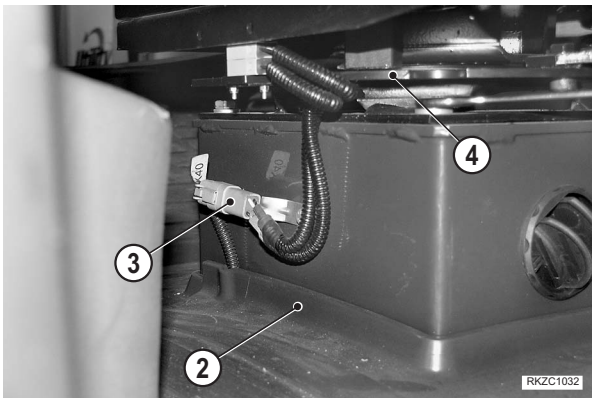
1 - Remove the plug (1) and drain the hydraulic oil.

Hydraulic oil: approx. 40 ℓ

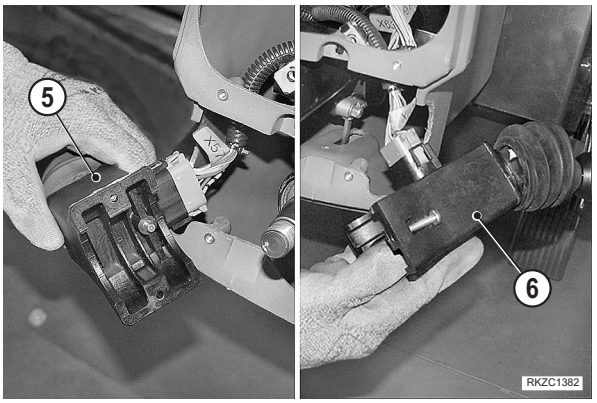


2 - Remove the front mat (2).

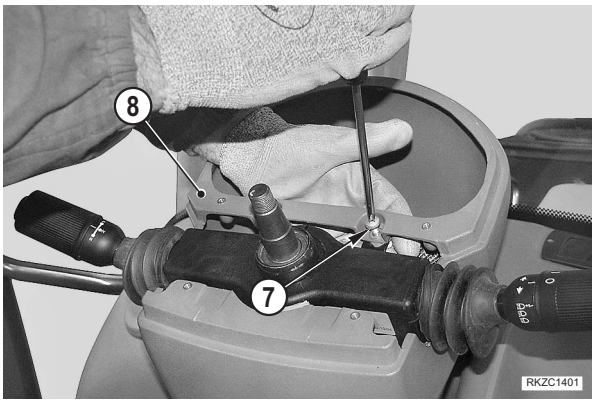
3 - Disconnect the connector (3) and remove the seat (4).



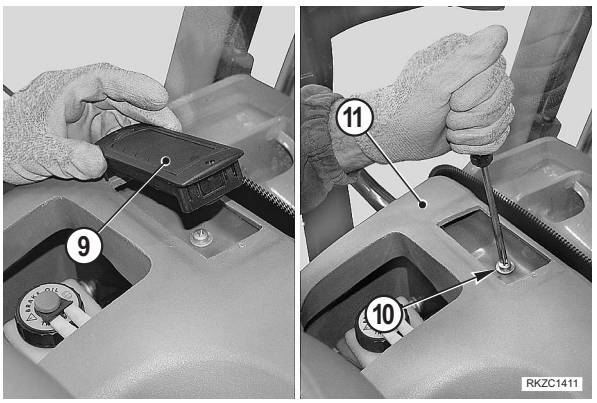
4 - Remove the steering wheel and remove the transmission reverse control group (5) and the direction indicator and headlight dipper beam control group (6) (For details, see "STEERING WHEEL AND TRANSMISSION-REVERSE, DIRECTION INDICATOR AND HEADLIGHT DIPPER BEAM CONTROL GROUP").



5 - Loosen and remove the upper screws (7) retaining the instrument panel holder (8).

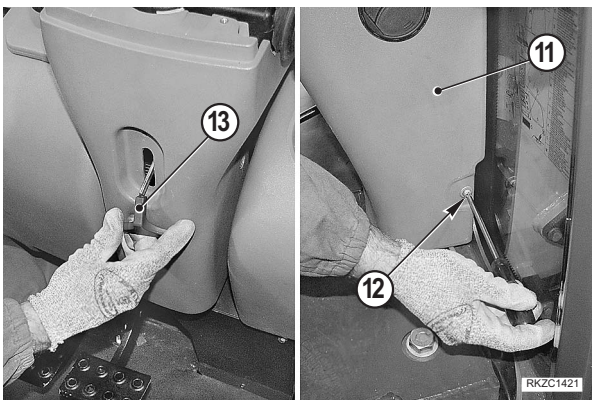


6 - Remove the guards (9) and extract the upper screws (10) retaining the front trim cover (11).

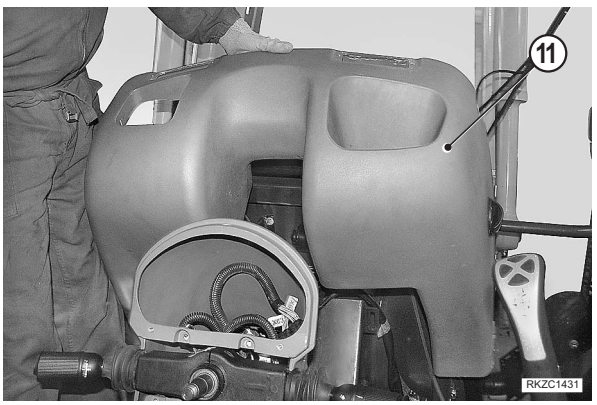


7 - Loosen and remove the lower screws (12) retaining the front trim cover (11).

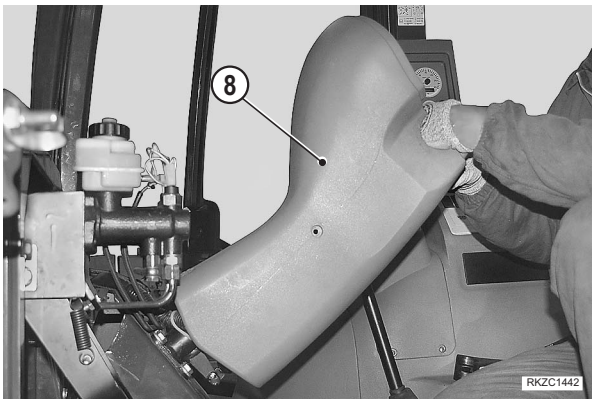
8 - Fully lower the steering column; extract the knob (13).



9 - Slide the front trim cover (11) up to remove it.



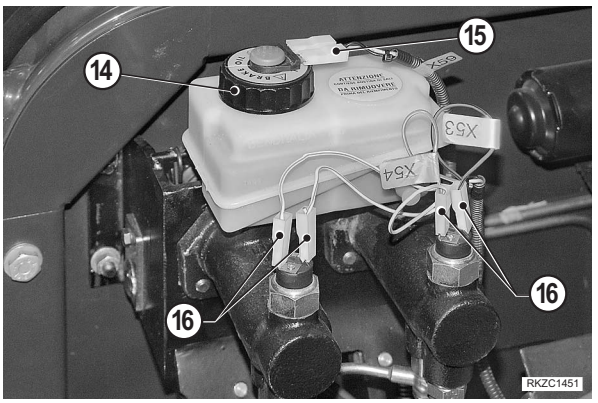
10 - Take out the lower screws and remove the instrument panel holder (8).



11 - Remove the fill plug (14) and draw the brake fluid.

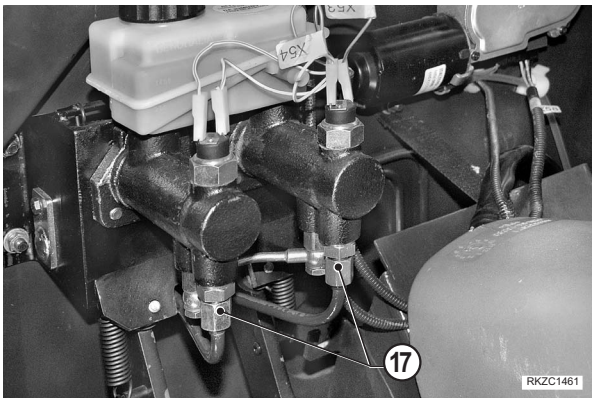
★ Replace plug to prevent contamination.

12 - Disconnect oil level and pressure switch connectors (15) and (16).



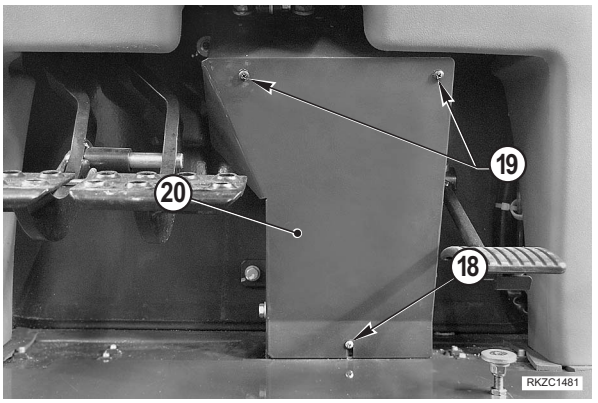
13 - Disconnect the brake fluid delivery tubes (17). [*1]

★ Plug all pipes/hoses to prevent contamination.

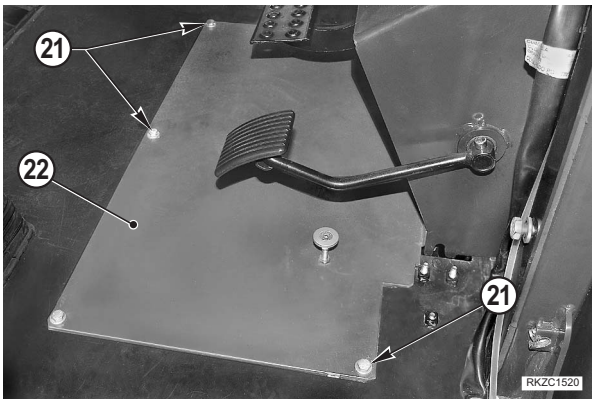


14 - Loosen mounting bolt (18).

15 - Pull out the screws (19) and remove the protection (20).



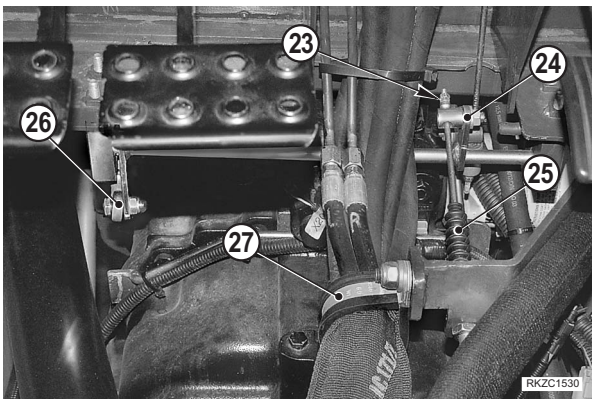
16 - Loosen and remove five screws (21) and remove the metal sheet (22) closing off the cab floor.



17 - Loosen and remove nuts (23) and disconnect the hand accelerator cable (25) from the relay rod (24). [*2]

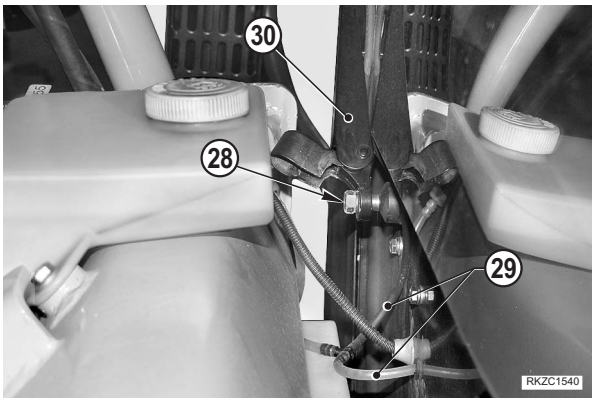
18 - Disconnect the injection pump rod (26) from the relay rod (24).

19 - Disconnect the strap (27) holding the steering unit and working brake hoses.

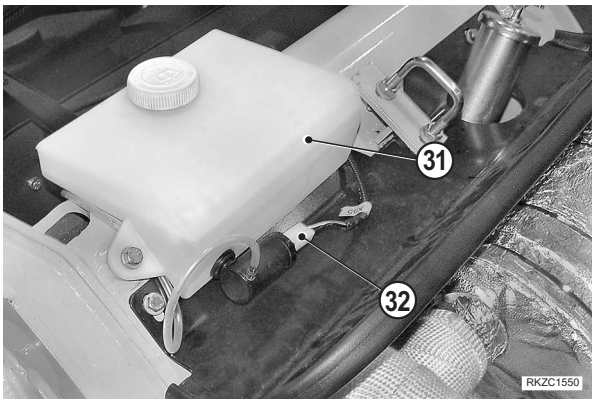


20 - Loosen and remove nut (28) and washer.

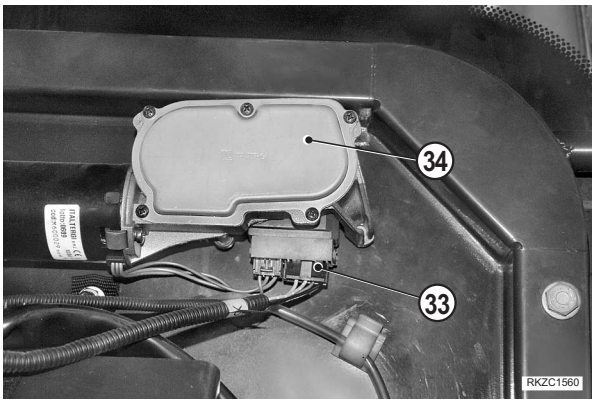
21 - Disconnect the washer hoses (29) and remove the complete wiper arm (30).



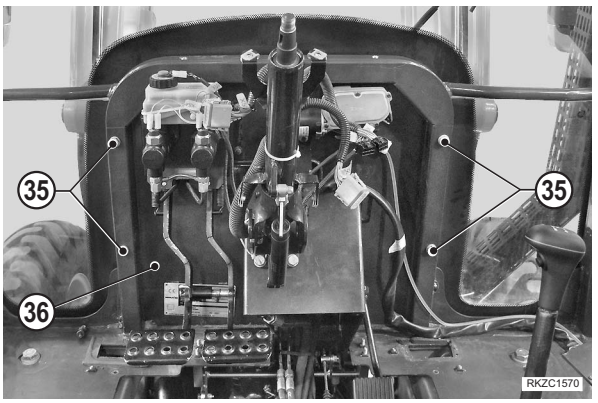
22 - Disconnect connector (32) from washer pump (31).



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.

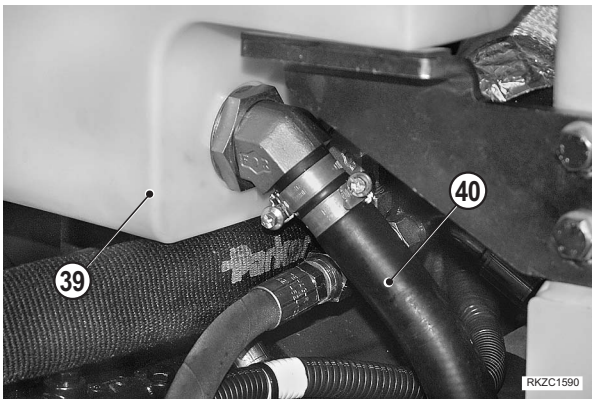


25 - Take out the screws (37) and remove the conveyor (38).



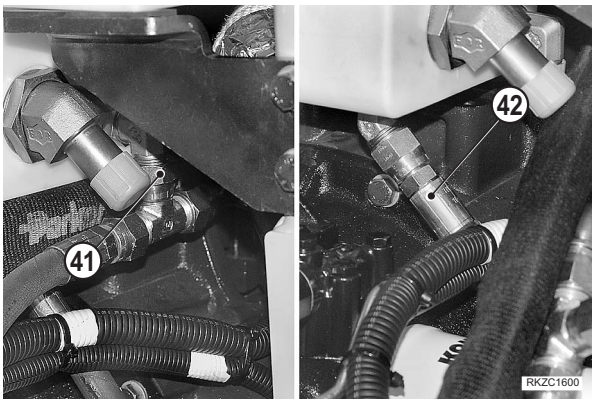
26 - Lift the rubber bulkhead and disconnect the discharge hose (40) from the tank (39).

★ Plug the pipe to prevent contamination.



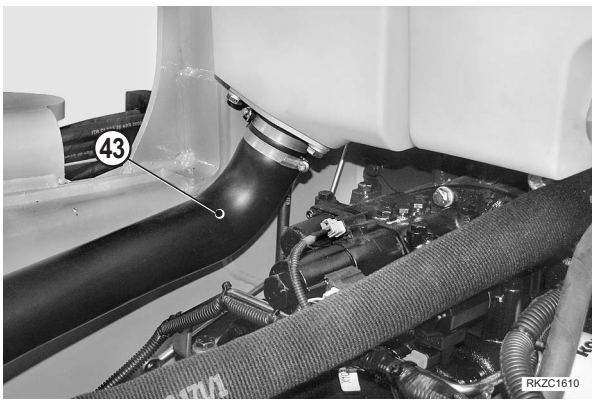
27 - Disconnect the draining union (41) and pipe (42).

★ Plug the union to prevent contamination.



28 - Disconnect the pump suction pipe (43).

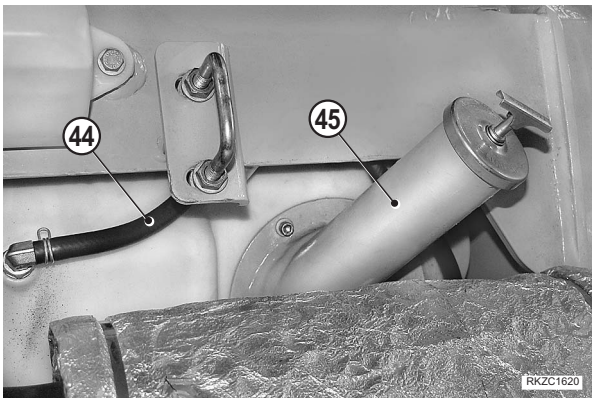
★ Plug the pipe to prevent contamination.



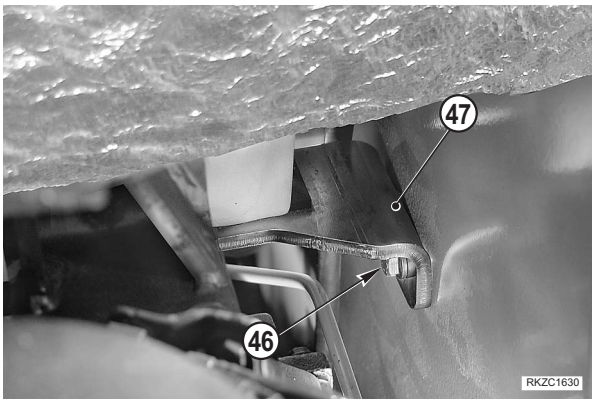
29 - Disconnect the vent hose (44) and filter and remove.

30 - Remove the screws and remove the fill sleeve (45).

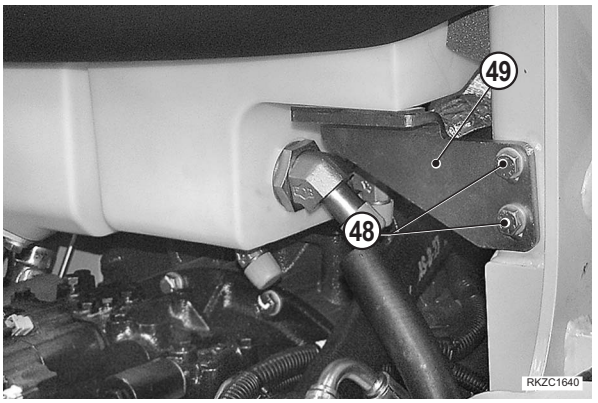
★ Collect the O-ring.



31 - Remove screws (46) and washers and remove the tank's front holder (47).



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

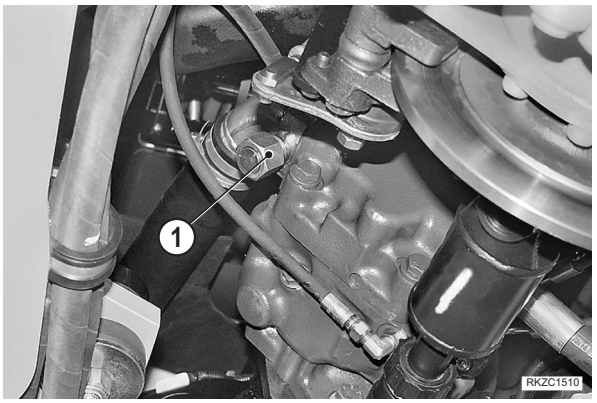
⚠ Lower the working equipment completely until it rests on the ground.
Stop the engine and remove the ignition key.

⚠ Eliminate all residual pressure from all circuits by moving all hydraulic controls in all directions.

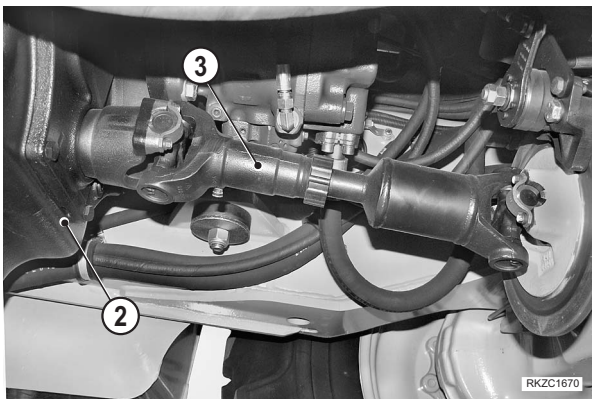
1 - Remove the plug (1) and drain the hydraulic oil.

Hydraulic oil: approx. 40 ℓ

★ Replace plug to prevent contamination.

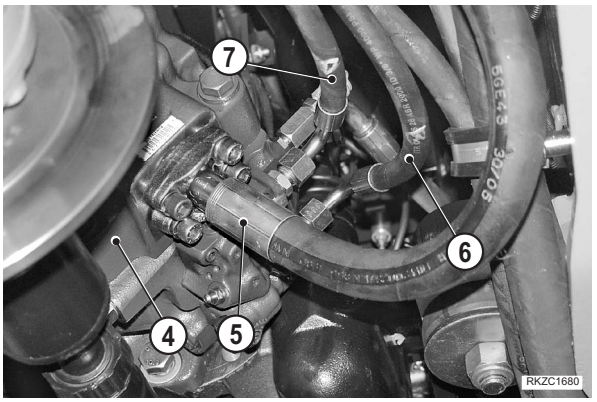


2 - Disconnect rear cardan shaft (3) from transmission (2). [*1]



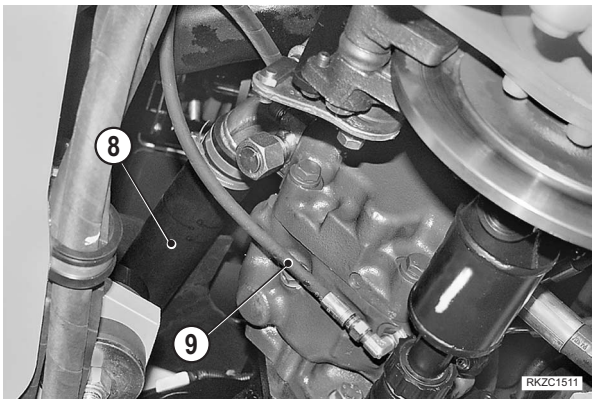
3 - Disconnect the delivery hose (5) and the LS and pump delivery pressure control hoses (6) and (7) from the pump (4).

★ Cap pipes, hoses and holes to prevent contamination.



4 - Disconnect the suction pipe (8) and the draining hose (9) from the pump.

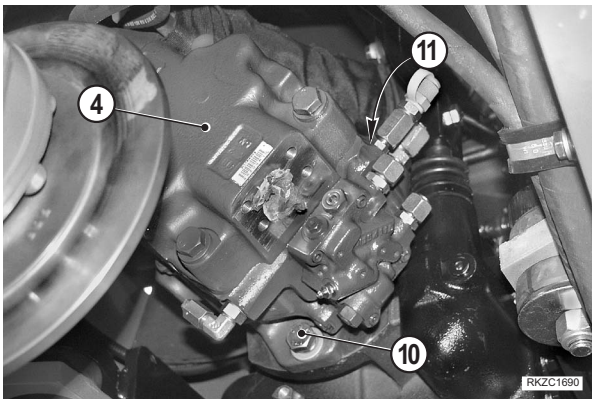
★ Cap pipes, hoses and holes to prevent contamination.



5 -Loosen and remove the lower screw (10) retaining the pump (4) and its washer.

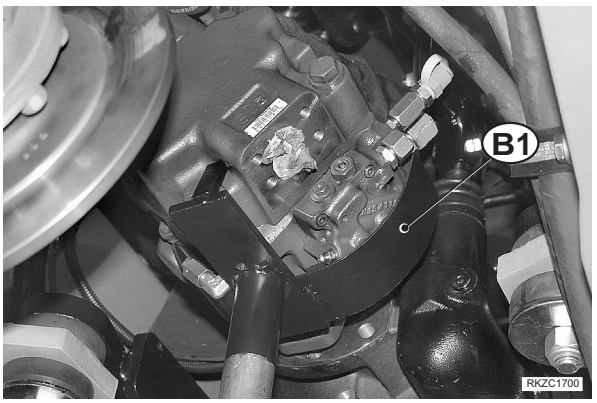
6 -Loosen upper screw (11) but leave it in place.

★ Do not remove the screw at this stage. [*2]



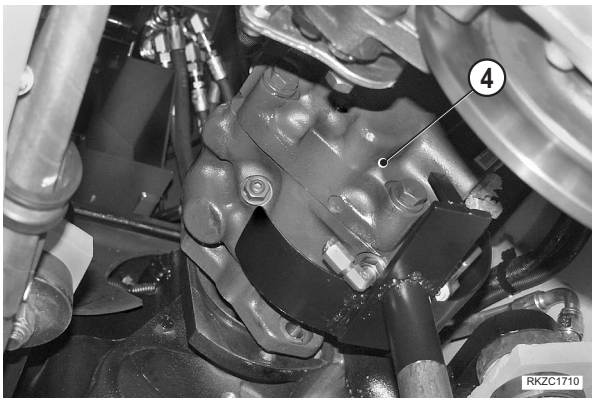
7 -Install pump holding tool "**B1**" to a hydraulic jack.

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 (–).

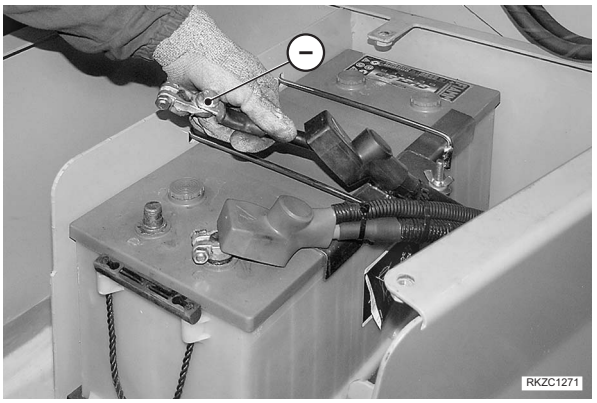
★ Drain the hydraulic oil.

Hydraulic oil: approx. 40 ℓ

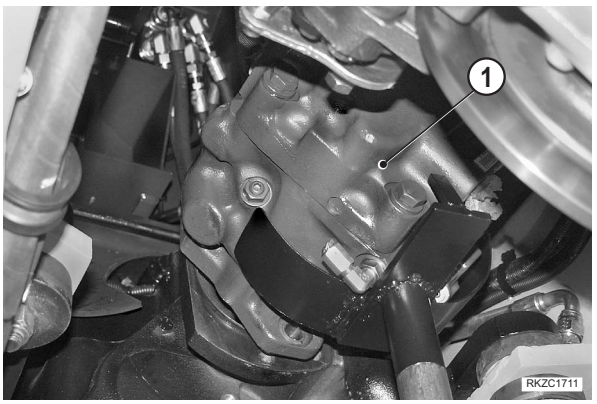
★ Drain the oil from the gearbox.

Hydraulic oil: approx. 20 ℓ

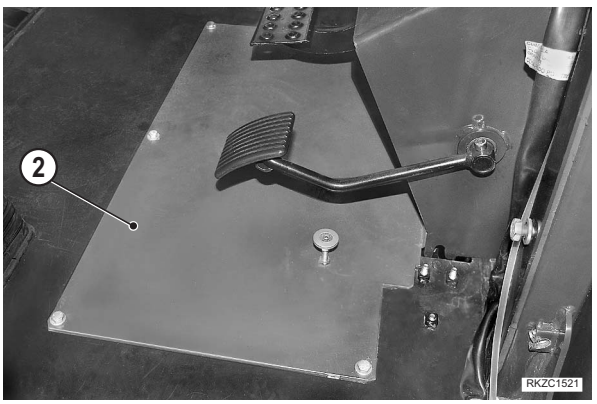
[*1]



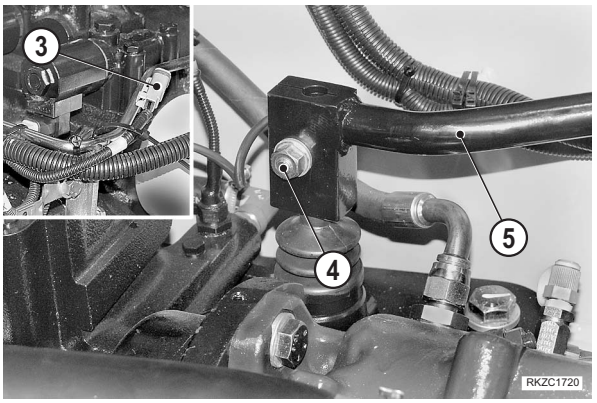
1 - Remove the piston pump (1).
(For details see "PISTON PUMP"). [*2]



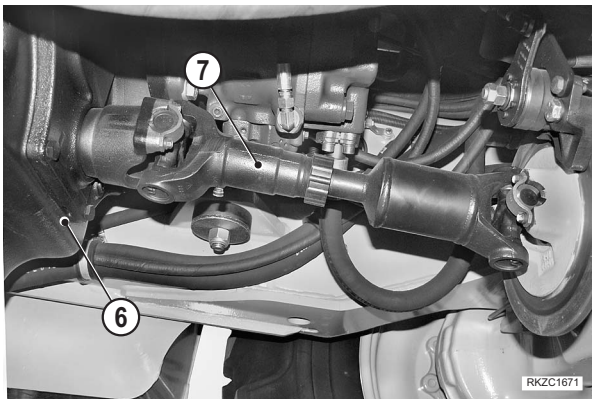
2 - Remove the front mat and remove the metal sheet (2) closing off the cab floor.



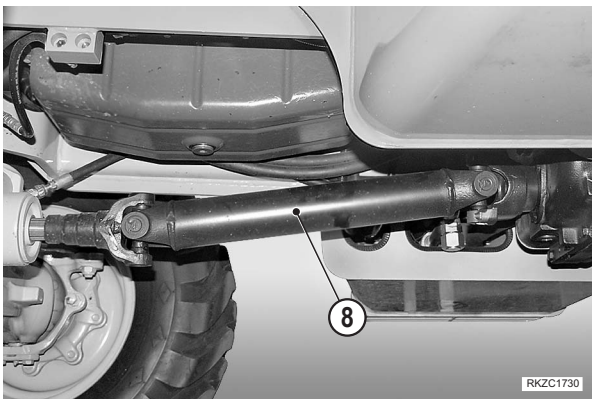
3 - Disconnect the connector (3) of the transmission disengagement button, remove the screw (4) and remove the control lever (5). [*3]



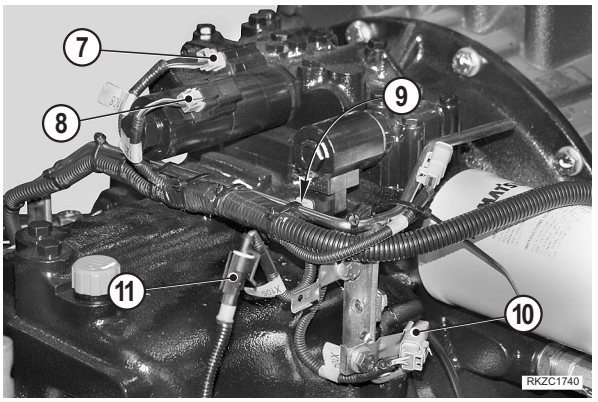
4 - Disconnect rear cardan shaft (7) from transmission (6). [*4]



5 - Remove front cardan shaft (8). [*4]

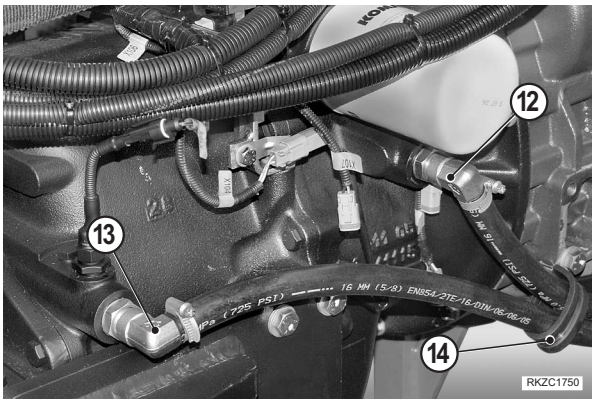


6 - Disconnect solenoid valve connectors (7), (8), (9), 4th gear sensor connector (10), and gearbox oil temperature sensor connector (11) from gearbox (6).



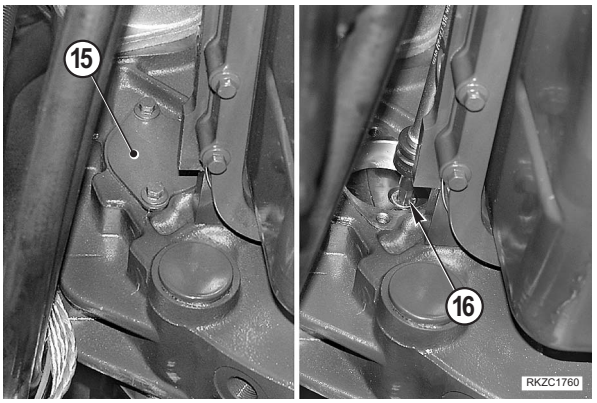
7 - Disconnect delivery hose (12) to oil cooler and return hose (13) from gearbox.

8 - Remove the clamp (14).

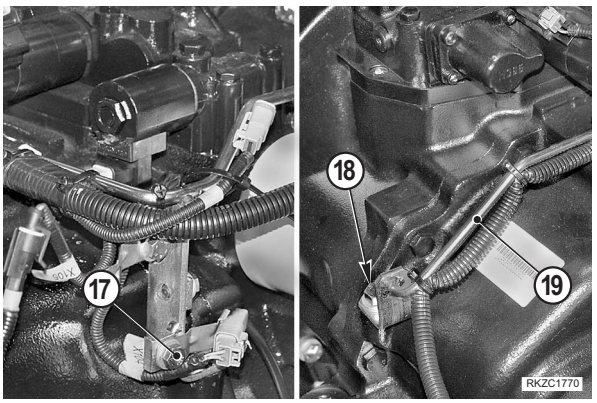


9 - Remove the screws and remove the cover (15) giving access to the converter coupling flange.

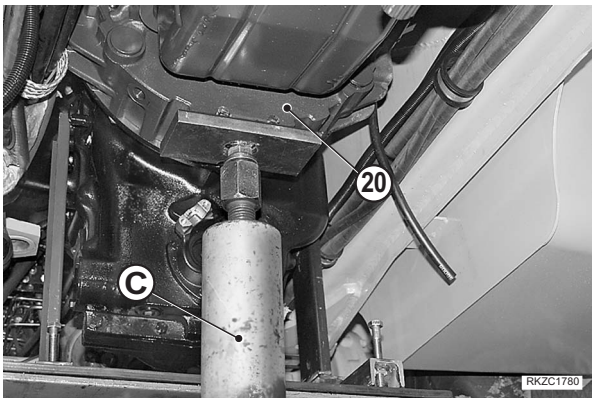
10 - Slowly rotate the engine flywheel until the converter retaining screws (16) are centred in the hole; remove the four screws. [*5]



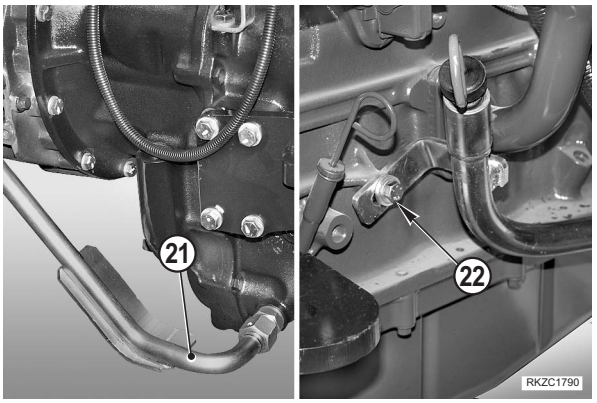
11 - Remove the screws (17), (18) retaining the wiring harness brace (19).



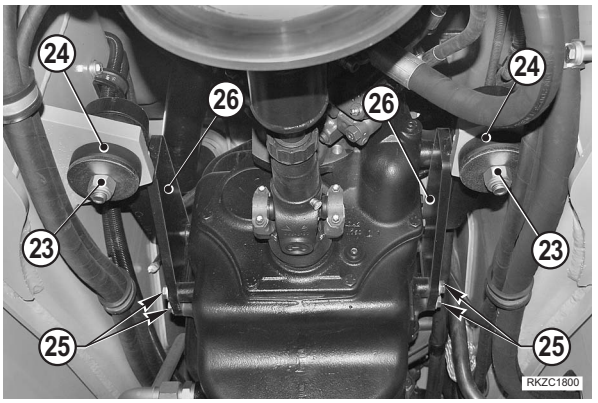
12 - Procure to support the engine (20) with a stand "**C**" placed under the flywheel bell.



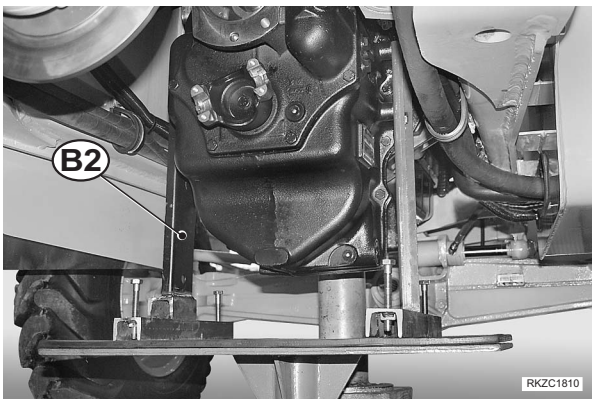
13 - Disconnect the gearbox oil load and oil level control pipe (21), remove the screw (22) and remove the complete pipe (21).



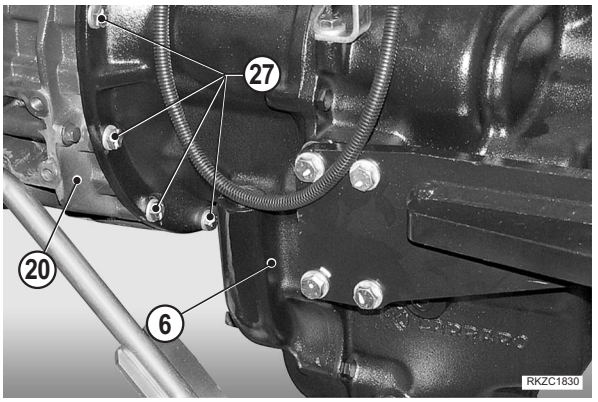
14 - Remove the nuts (23) on the vibration dampers (24), the screws (25) and remove the gearbox supports (26). [*6] [*7]



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.

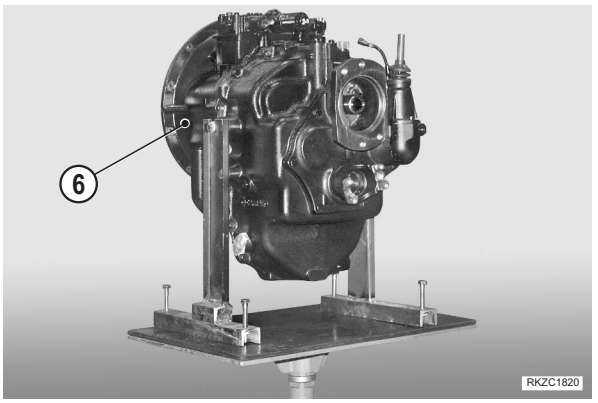


16 - Loosen and remove the two screws (27) retaining the gearbox (6) to the engine (20). [*8]



17 - Move the gearbox group (6) towards the rear of the machine and extract the group.

Transmission: 232 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.

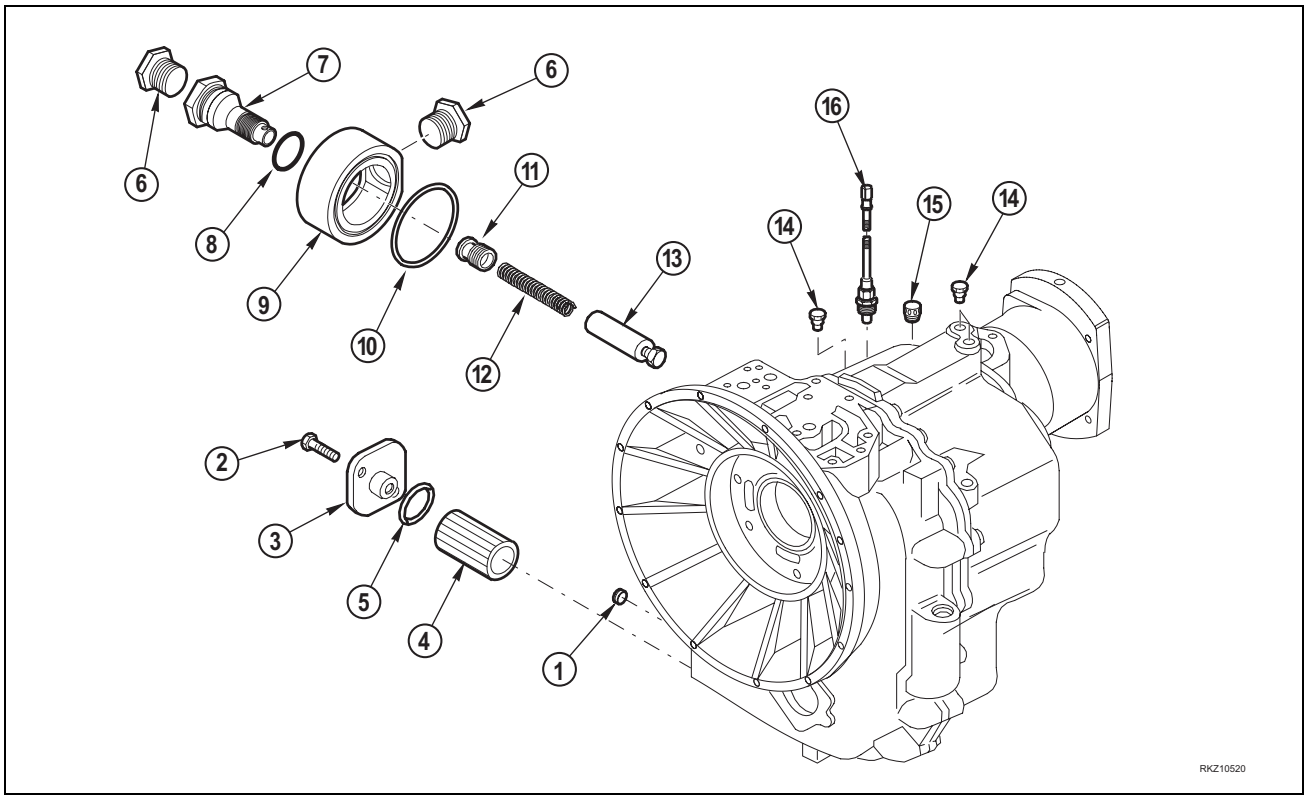
2 - Bleed the air from the working equipment circuits. (For details see "20 TESTING AND ADJUSTMENTS").

3 - Stop the engine, check the levels and, if necessary, top them up.

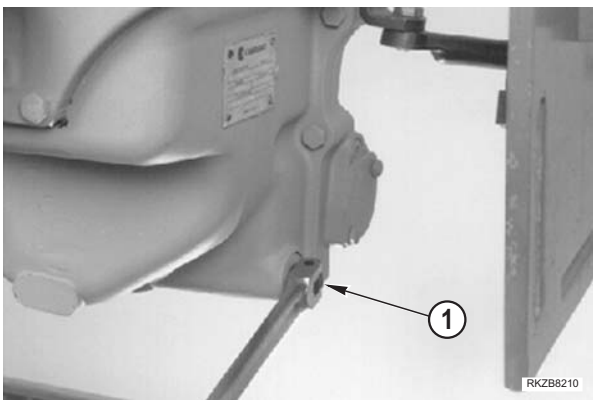
Disassembly and assembly

1. Plugs and filters

1.1 Disassembly

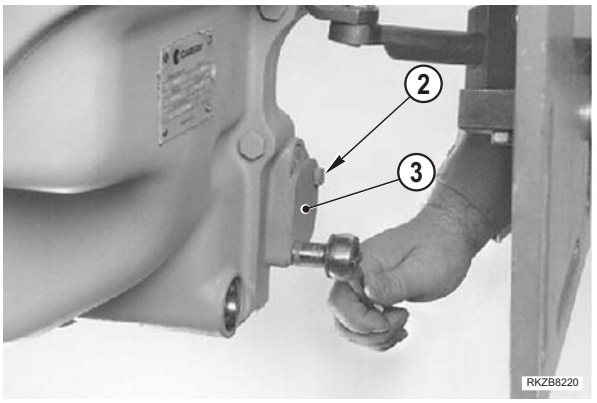


1 - Remove the drain plug (1) and drain the oil from the transmission.

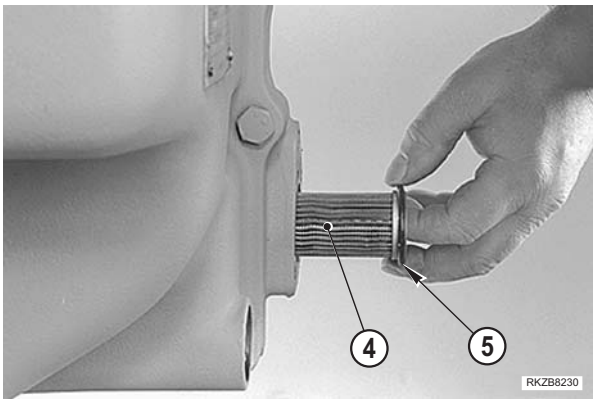


2 - Remove the two cap screws (2) which fasten the cover for the oil screen.

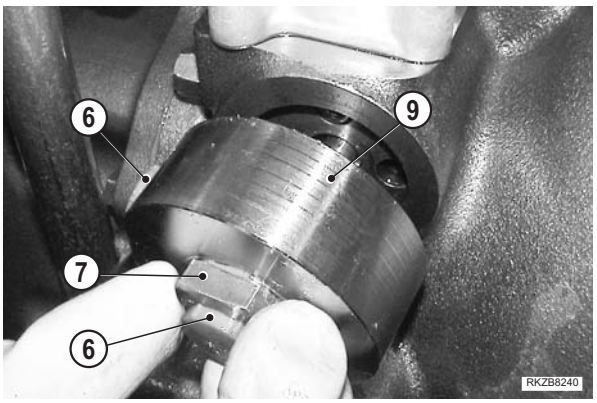
3 - Remove the cover (3).



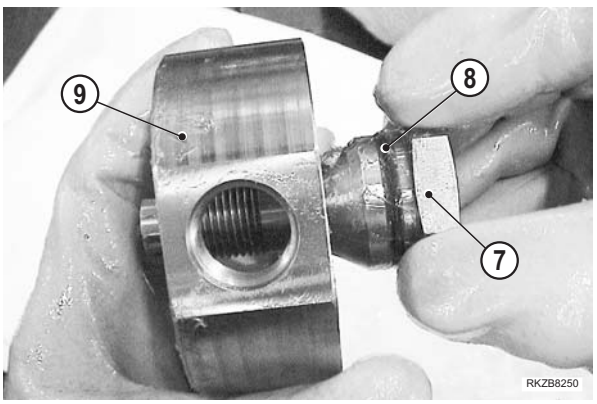
4 - Remove the oil screen (4) and the O-ring (5).



5 - Remove the connector for the oil filter (7) and its elements: plugs (6) and cover (9).



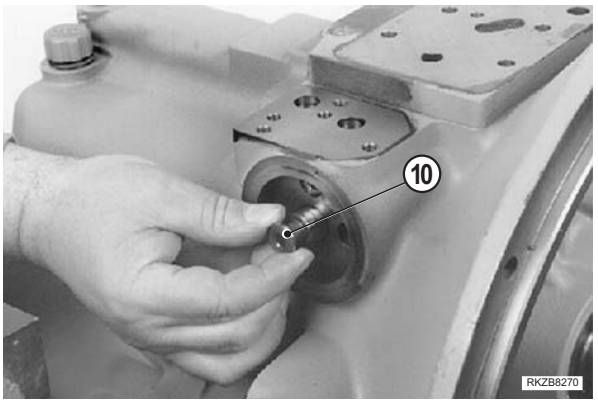
6 - Remove the connector (7) from the cover (9). Remove the O-Ring (8).



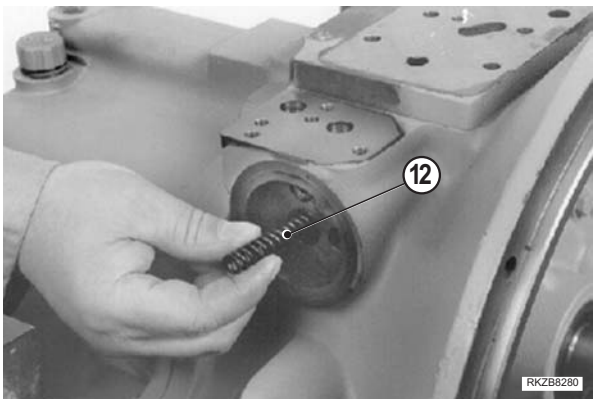
7 - Remove O-Ring (10) from cover (9).



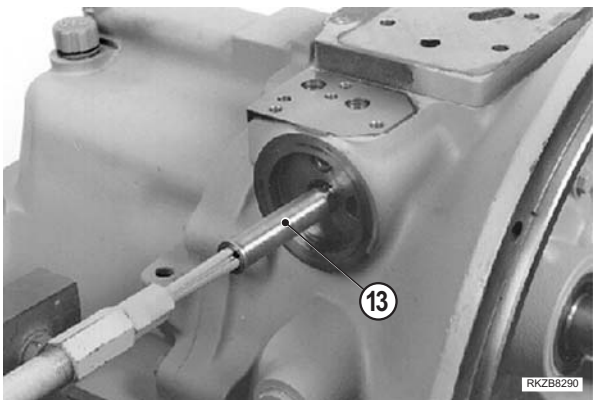
8 -Remove the spool (11).



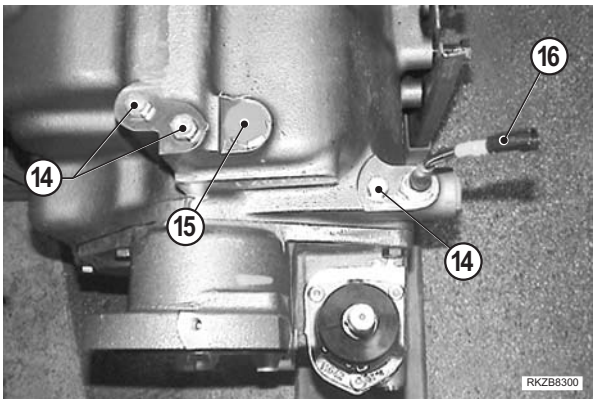
9 -Remove the spring (12).



10 -Using a puller, remove the 4WD priority valve (13).
Do not remove or adjust the valve (13).
If valve is already damaged, replace it with a new one.



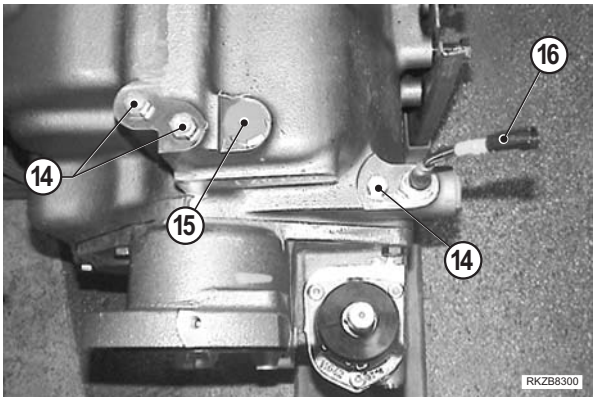
11 -It is not necessary to remove the port plugs (14), the breather (15), or the oil temperature sensor (16).



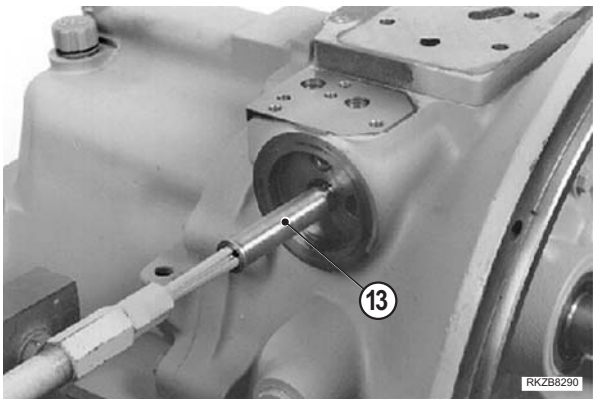
1.2 Assembly

1 - Assemble the port plugs (14), the breather (15) and the oil temperature sensor (16).

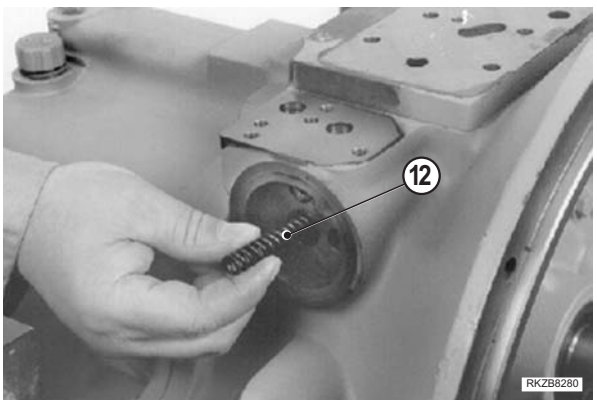
Sensor: 30 Nm



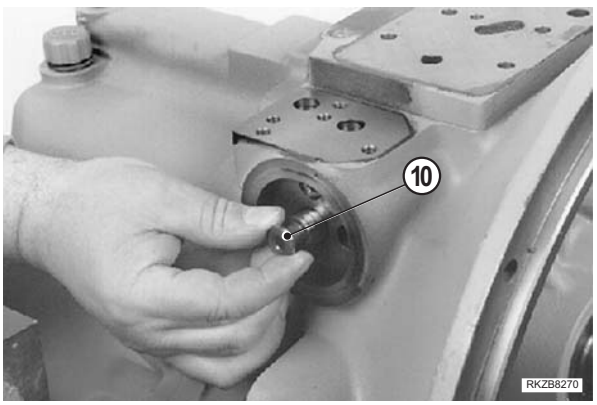
2 - Assemble valve (13).



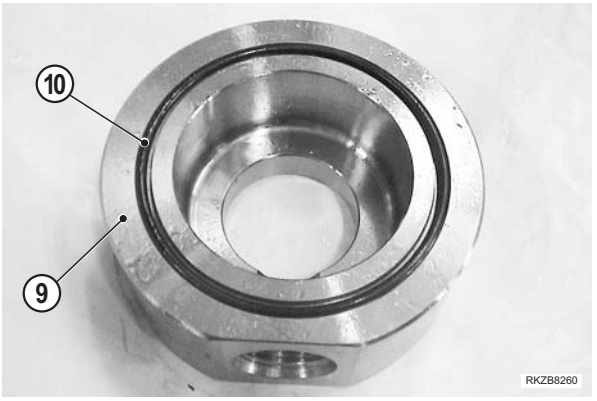
3 - Mount the spring (12).



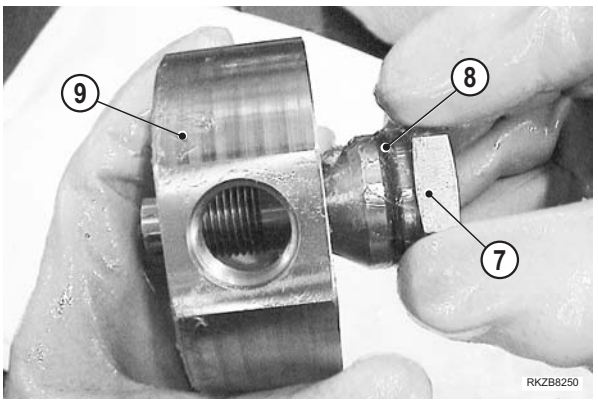
4 - Mount the spool (11).



5 -Assemble O-Ring (10) on the cover (9).

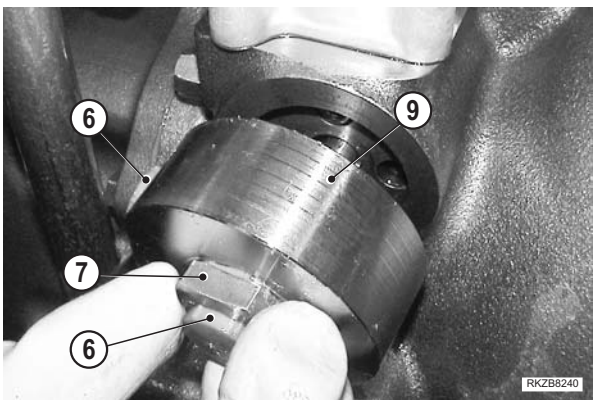


6 -Assemble O-Ring (8) on the connector (7), and the connector on the cover (9).

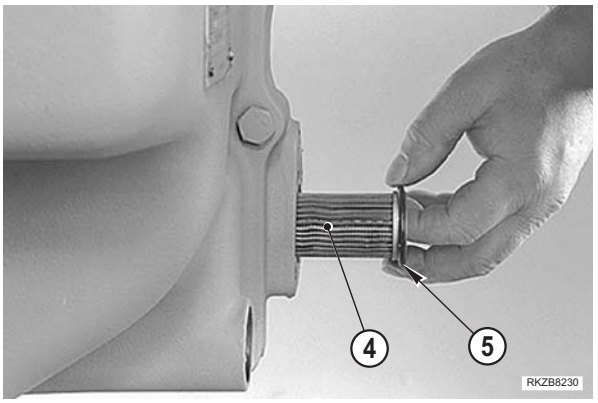


7 -Assemble the connector (7) and plugs (6).

Union: 50 Nm

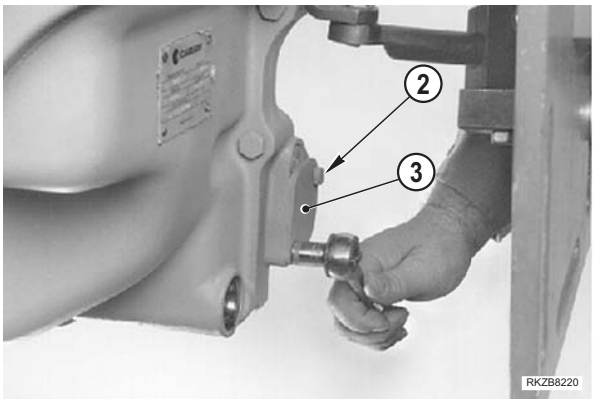


8 -Assemble filter (4) and O-ring (5) after having washed or replaced it.

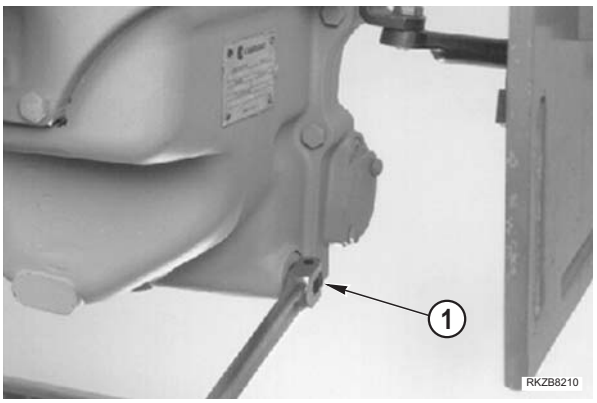


9 -Assemble cover (3) and screws (2).

Screw: 23 Nm

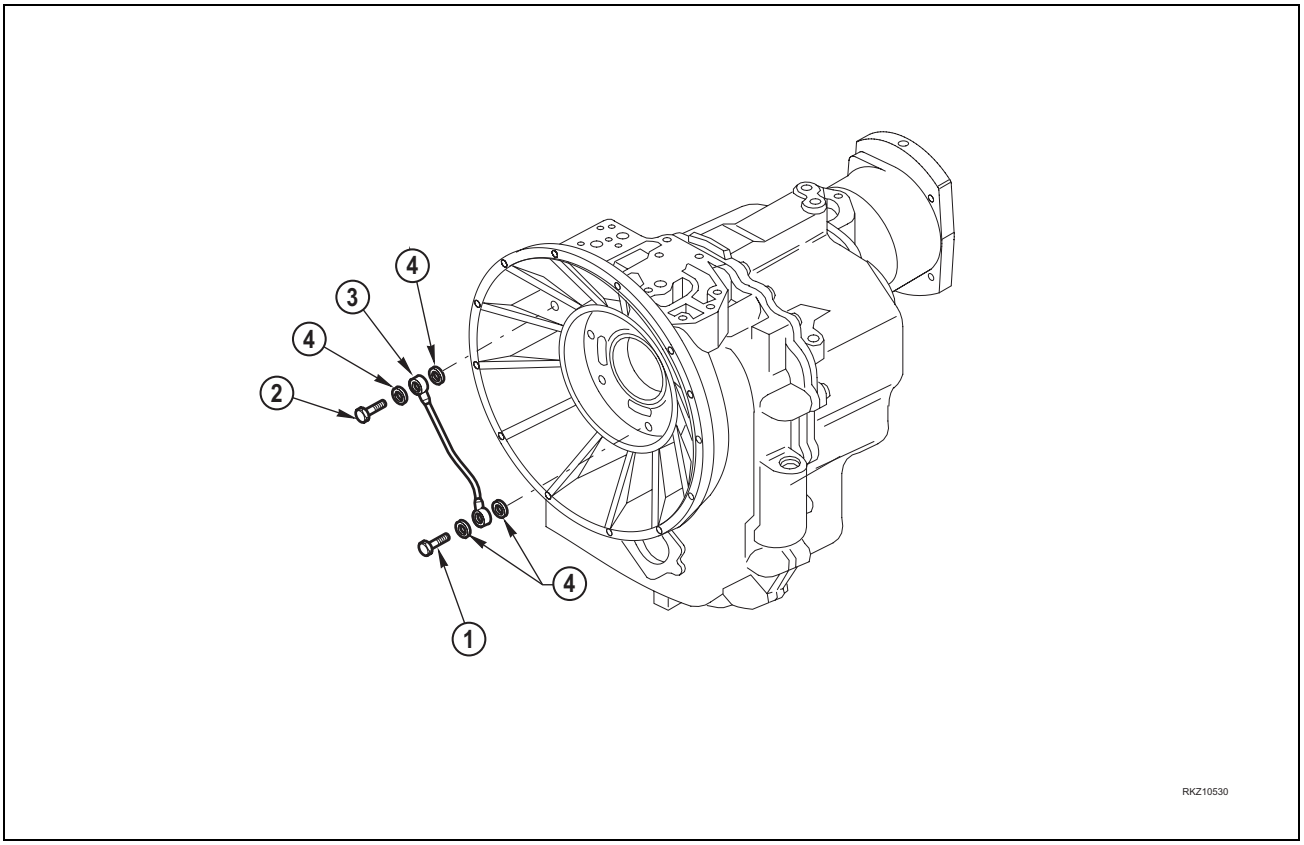


10 -Mount the plug (1).



2. OIL PUMP

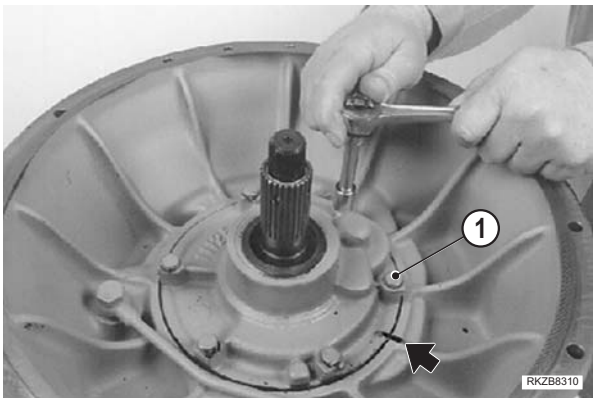
2.1 Disassembly



1 - Remove the drain plug (1) and drain the oil from the transmission.

2 - Remove the screws (1).

★ Make reference mark on the pump and bell housing before untightening the screws.



3 - Remove the pump (2) by means of two levers.

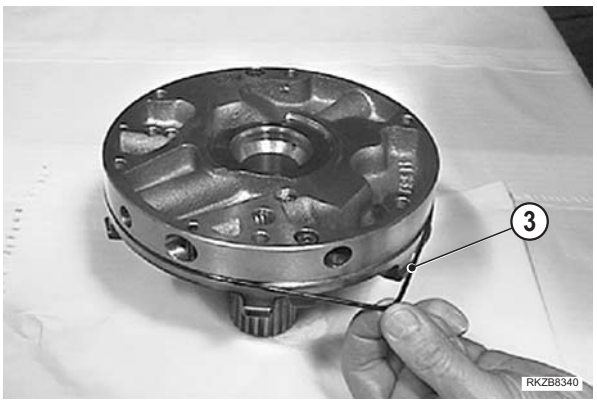


3 -Remove the oil pump (2).



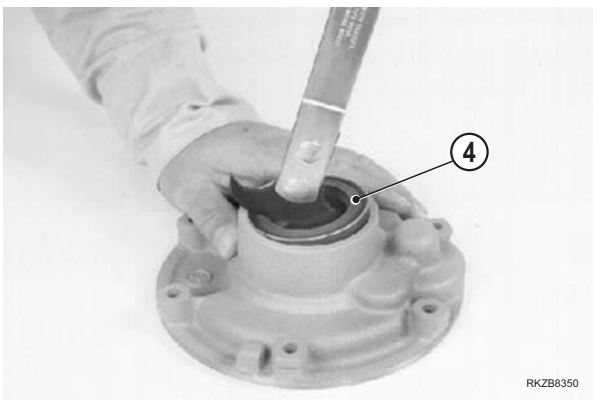
4 -Remove O-ring (3).

★ Inspect the condition of the O-ring (3) and replace if necessary.



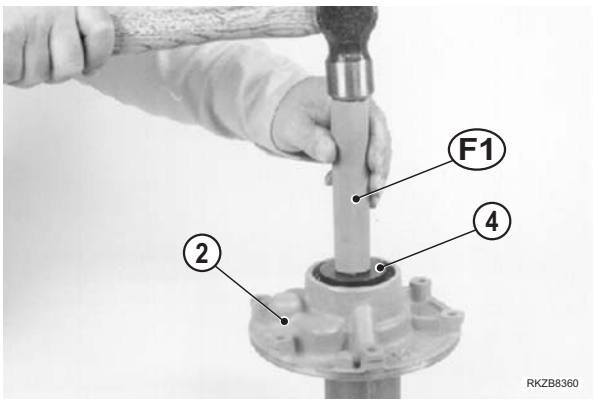
5 -Remove O-ring (4).

★ Inspect the condition of the sealing ring (4) and replace if necessary.

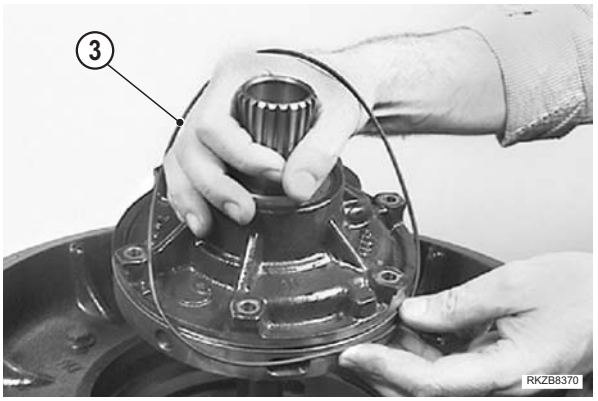


2.2 Assembly

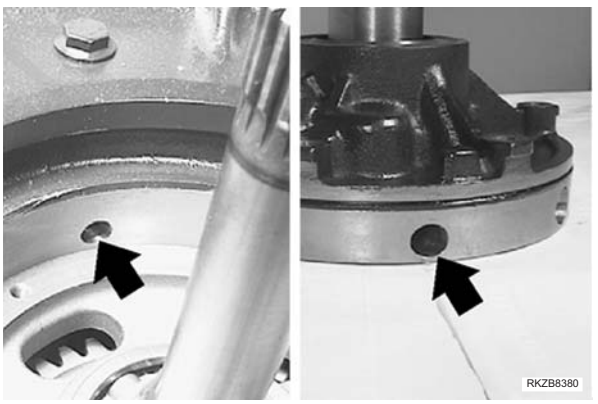
1 - Use the tool **F1,**Assemble the seal ring (2) on the oil pump (2).



2 - Assemble O-ring (3).



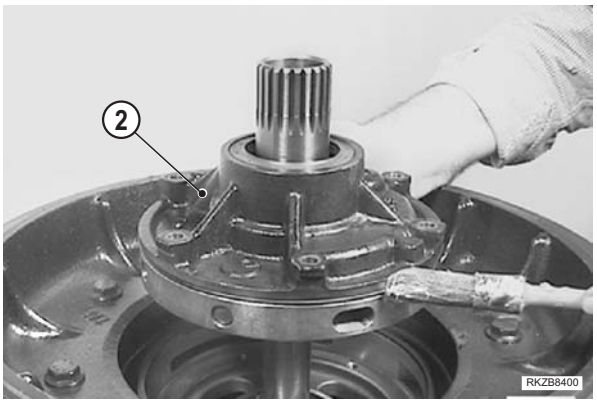
3 - Check that oil passage holes between pump (2) and half-case or the visual marks aligned.



4 - Grease the ring to the half boxes to keep it centred/ coaxial with respect to the shaft slot centre line and to make the introduction onto the pump easier.

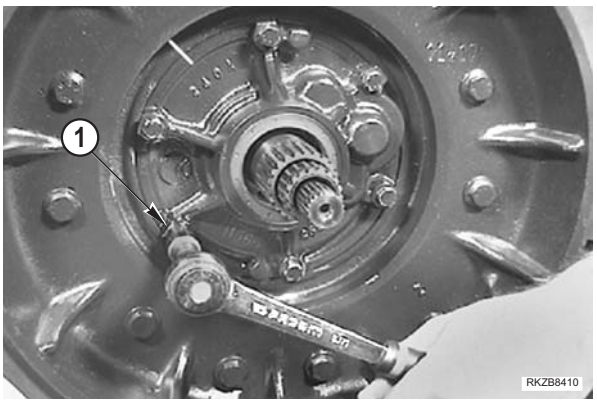


5 - Apply a thin coat of grease to the seat of the oil pump (2) and install.



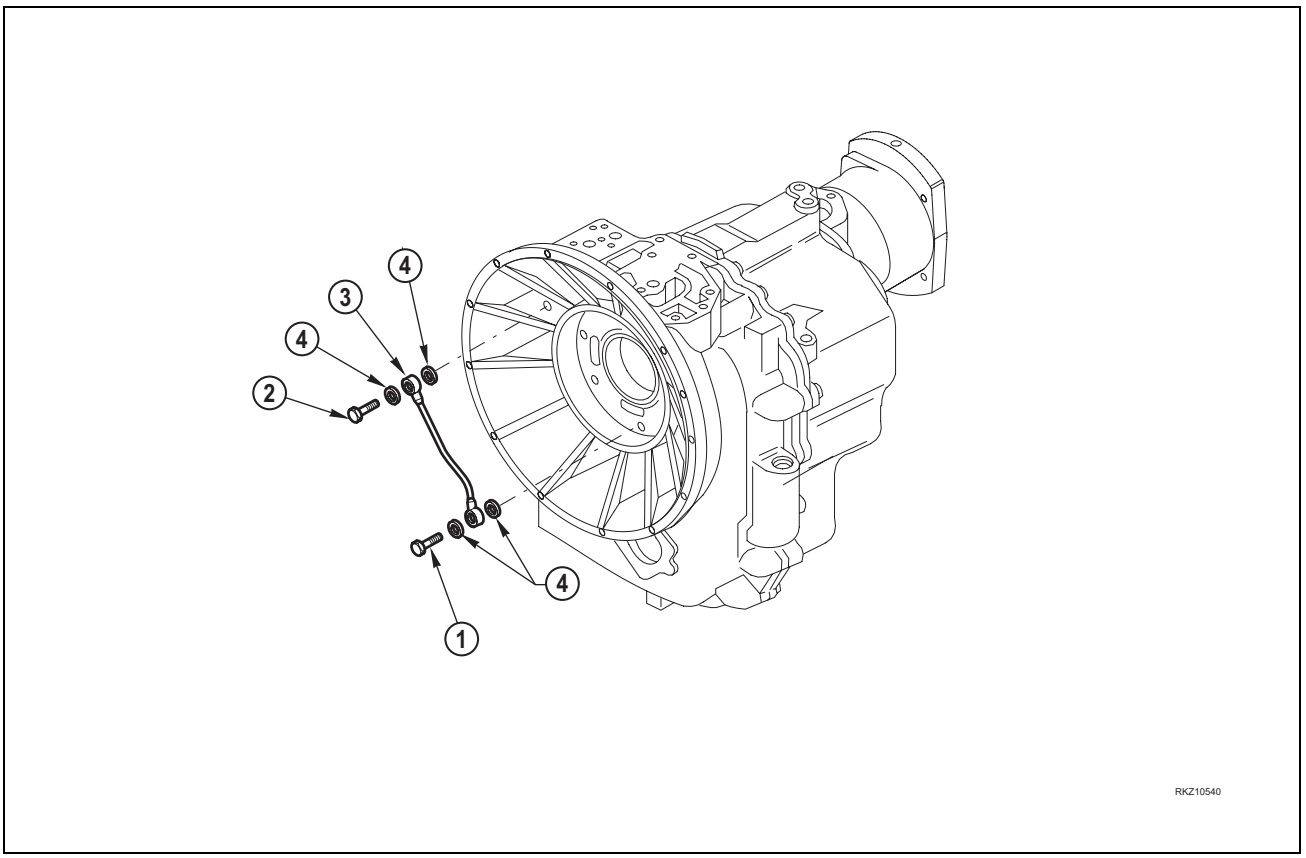
6 - Mount the screws (1).

Screw: 23 Nm



3. PARKING BRAKE GROUP

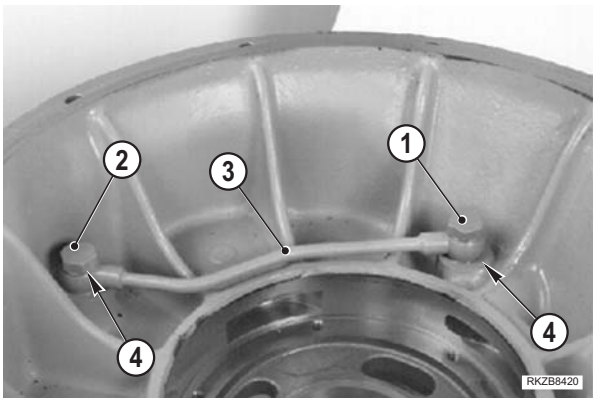
3.1 Disassembly



1 - Remove the drain plug (1) and drain the oil from the transmission.

2 - Remove the fittings (1) and (2) and remove the pipe (3)

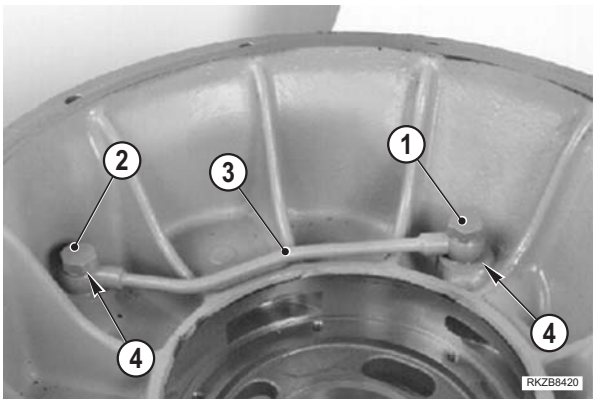
★ Replace the seals (4) at each disassembly.



3.2 Assembly

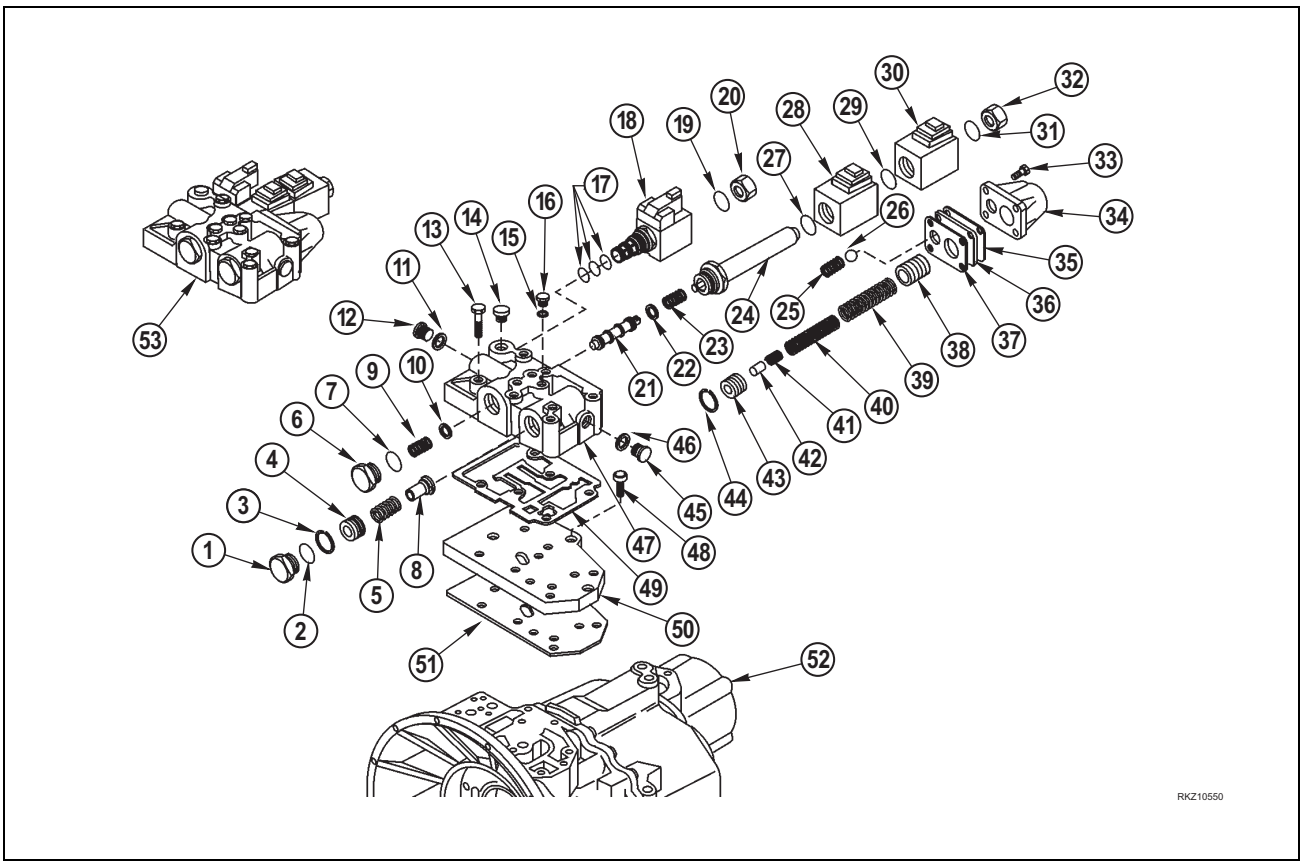
1 - Mount the clutch pipe (3) and the fittings (1) and (2).

Screw: 40 Nm



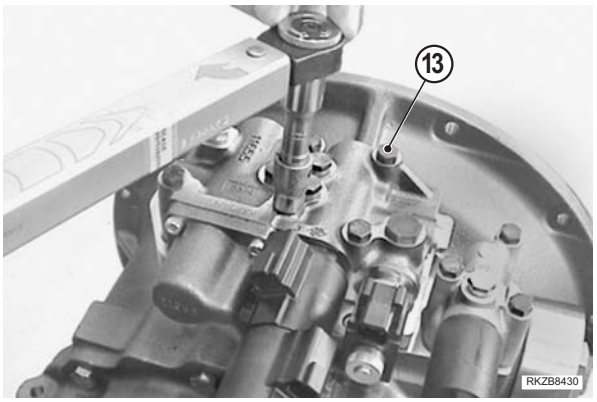
4. Hydraulic control valve

4.1 Disassembly

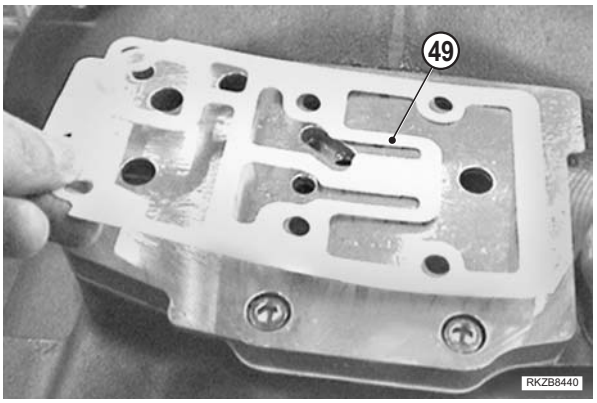


1 - Remove the drain plug (1) and drain the oil from the transmission.

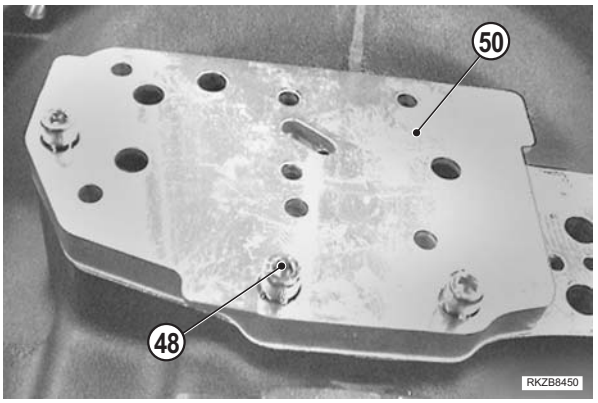
2 - Take out the screws (13) and remove the distributor (53)



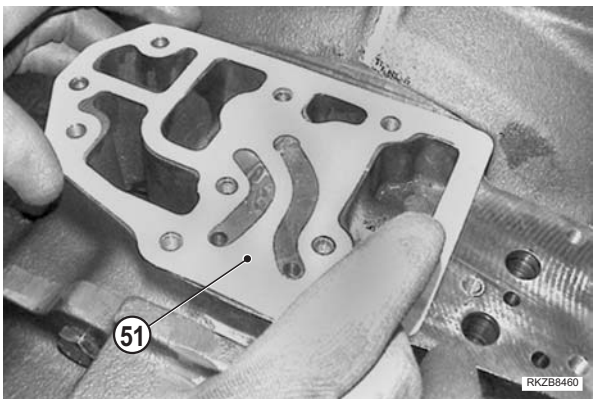
3 - Remove the gasket (49).



3 -Take out the screws (48) and remove the plate (50).

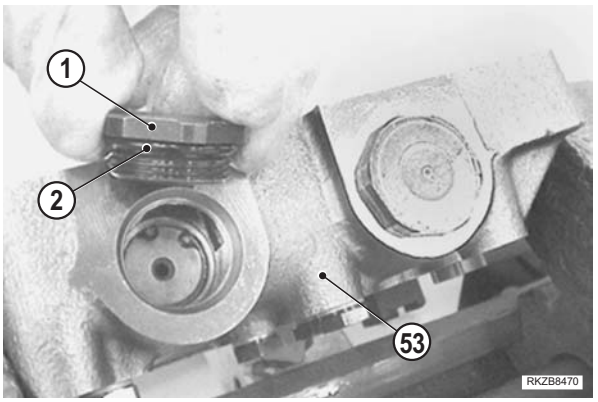


4 -Remove the gasket (51).

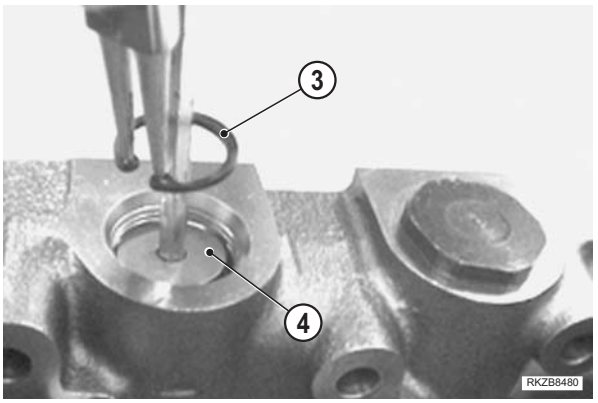


5 Clamp the control valve (53) in a vise.

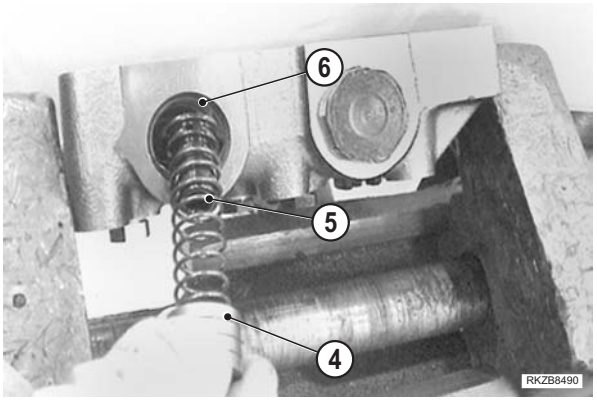
6 -Remove plug (1) and collect the O-ring (2);



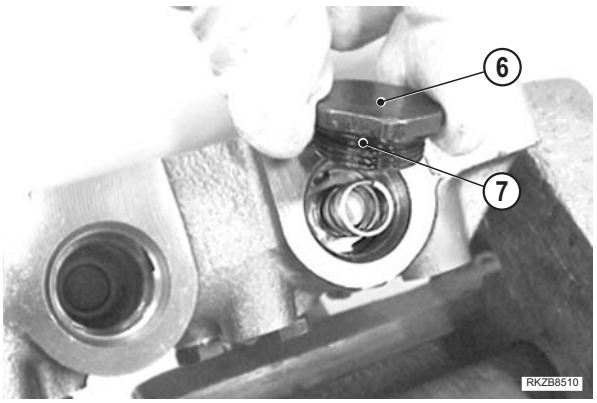
7 -Push down the piston (4) then remove the snap ring (3).



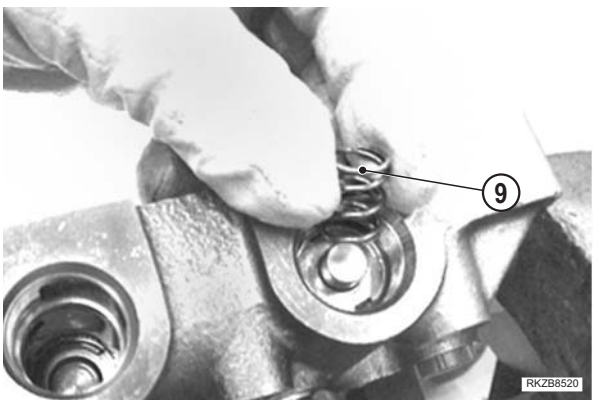
8 - Remove the piston (4), the spring (5) and the bush (6) and check the wear conditions of the components.



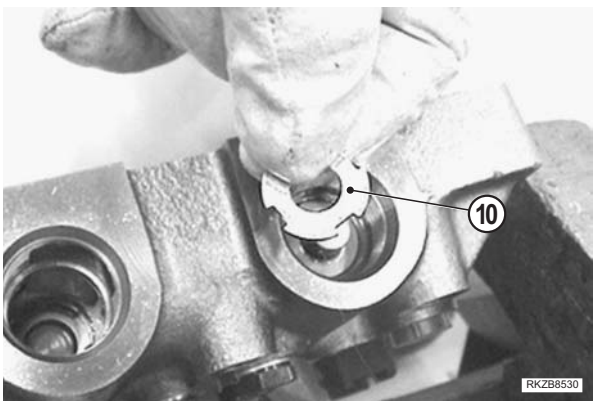
9 - Remove plug (6) and collect the O-ring (7);



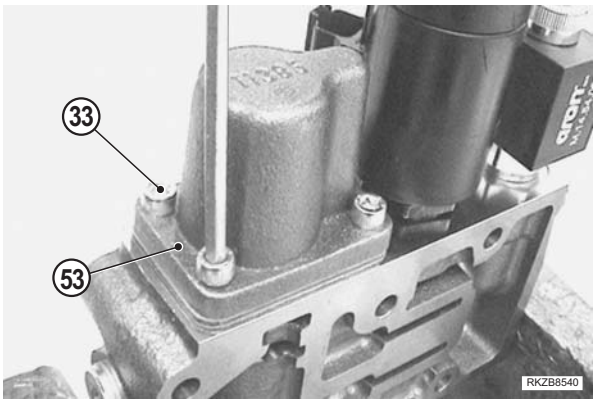
9 - Remove the spring (9).



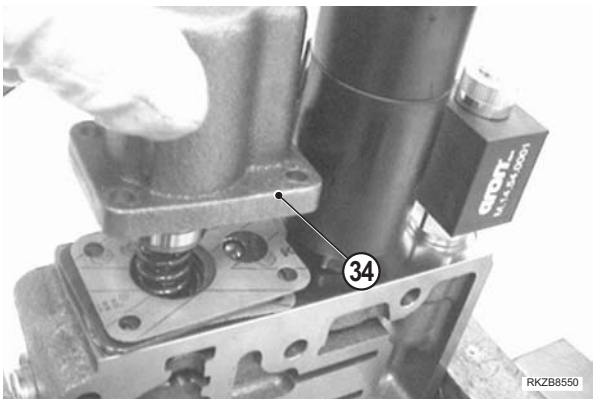
10 - Remove the washer (10).



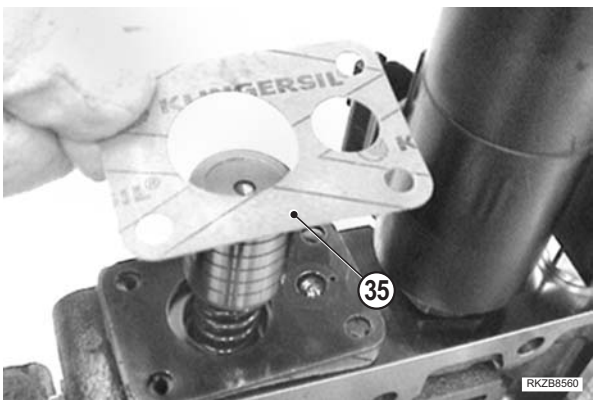
11 -Turn the control valve (53) and remove the screws (33).



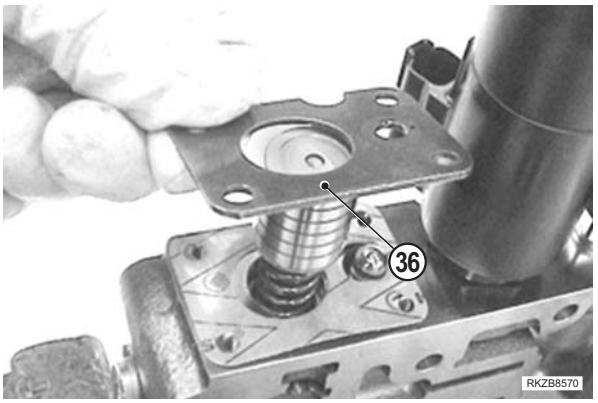
12 -Remove the valve cover (34).



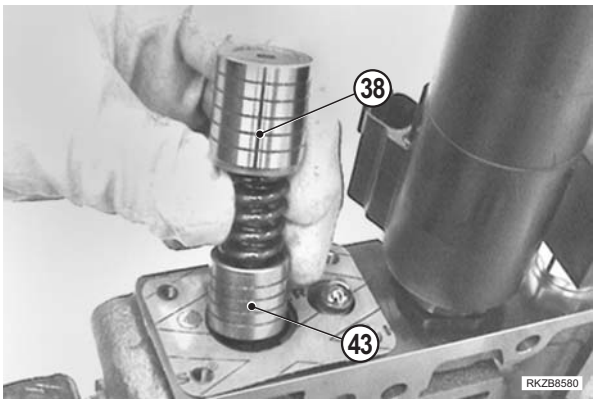
13 -Remove the plate gasket (35).



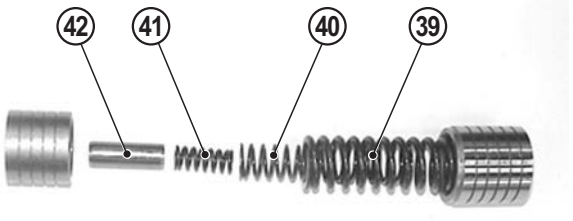
14 -Remove the plate (36).



15 - Remove the outward piston (38), the springs (39,40,41), the pin (42) and the inward piston (43).

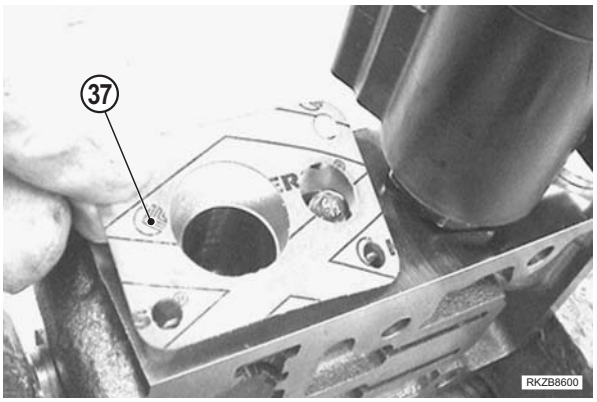


16 - Check the wear conditions of removed parts.

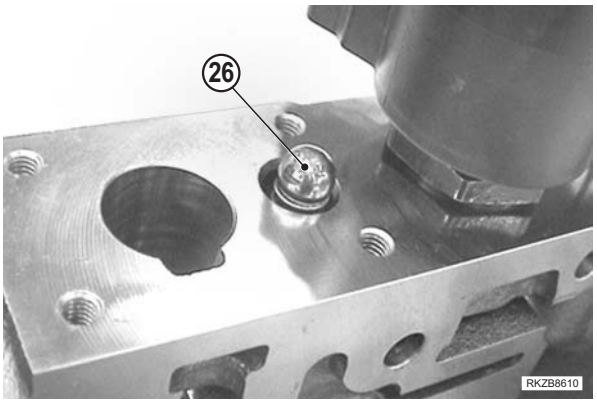


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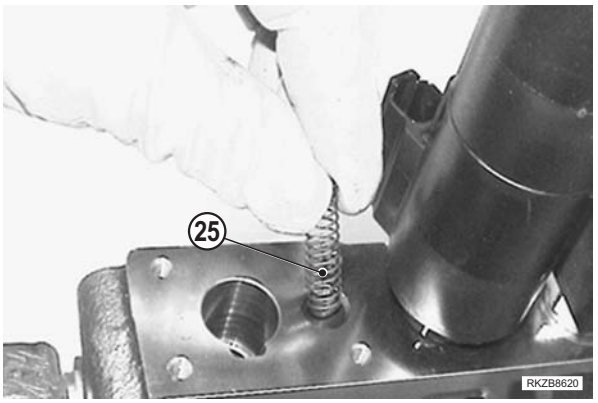
17 - Remove the plate gasket (37).



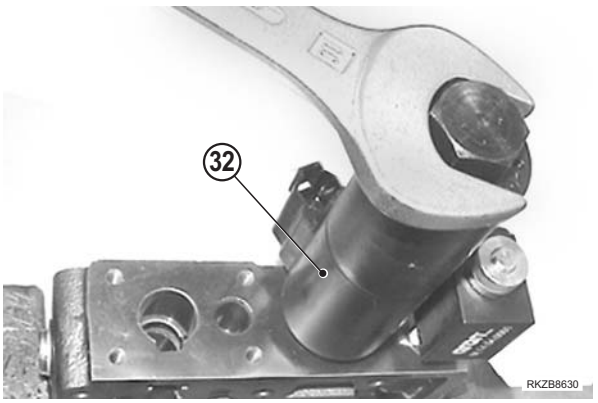
18 - Remove the ball (26).



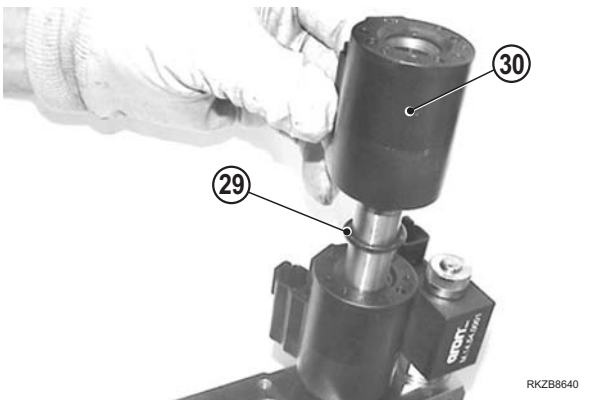
19 -Remove the spring (25).



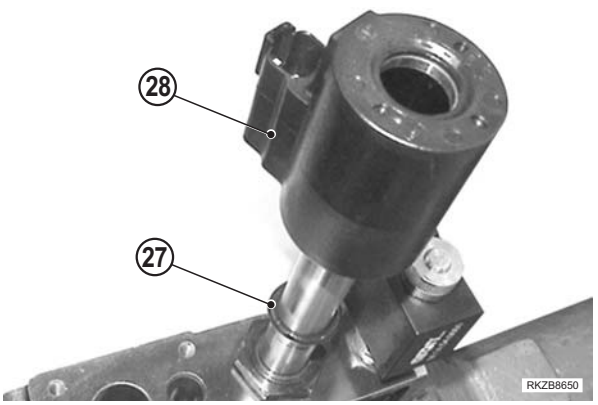
20 -Remove the nut (32) and the O-ring (31);



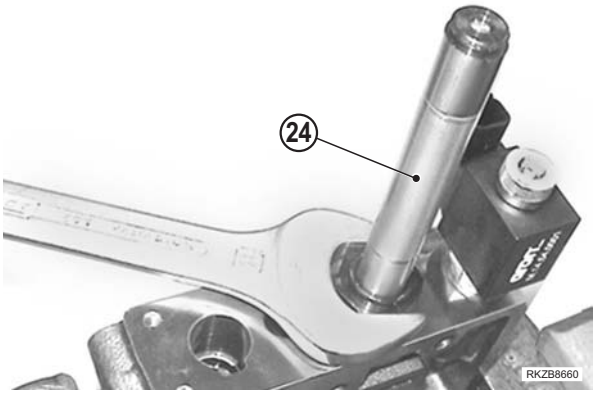
21 -Remove the solenoid (30) and remove the O-Ring (29);



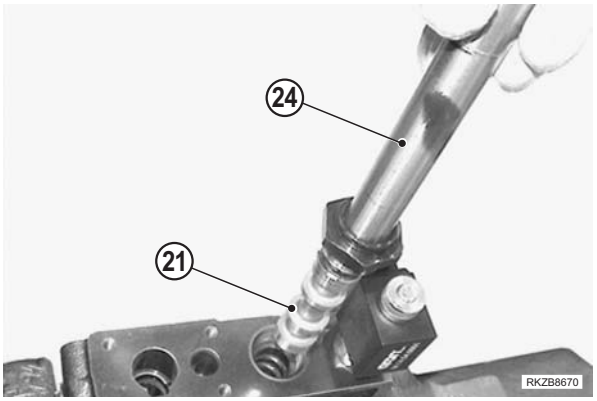
22 -Remove the solenoid (28) and remove the O-Ring (27);



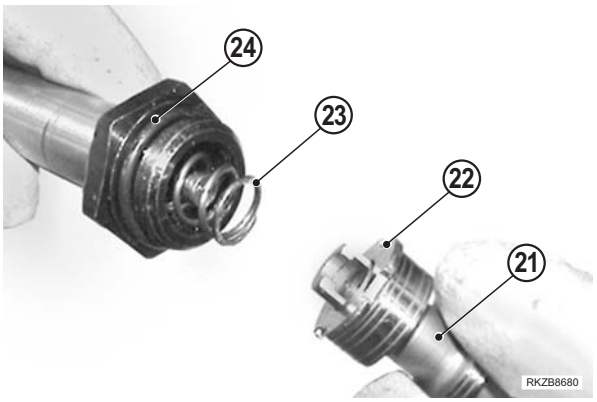
23 - Unscrew the solenoid tube (24).



24 - Remove the cartridge (24) and spool (21).

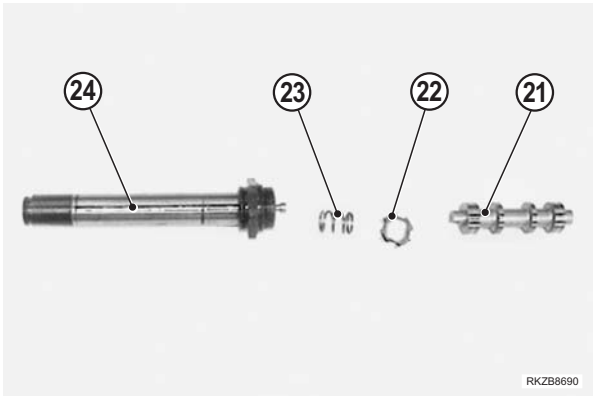


25 - Disassemble the spool (21) from the cartridge (24)

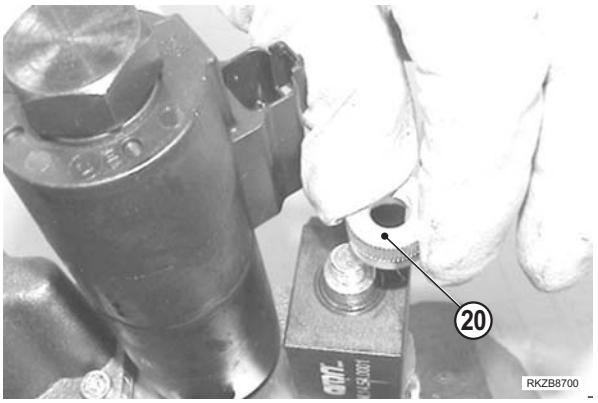


26 - Remove the spring (23) and the washer (22).

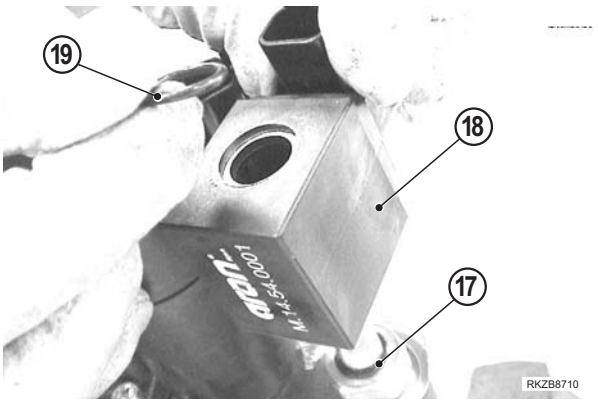
★ Check the wear conditions of removed parts.



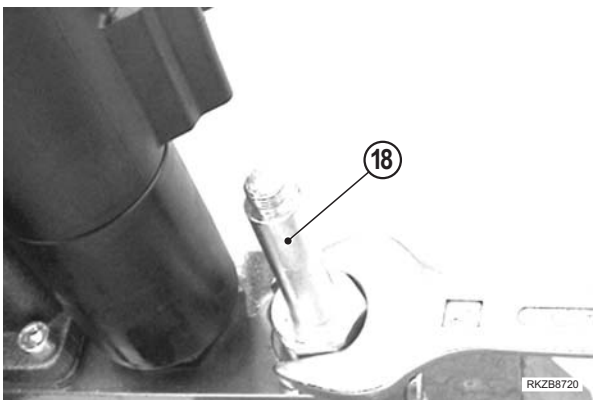
27 -Remove the nut (20).



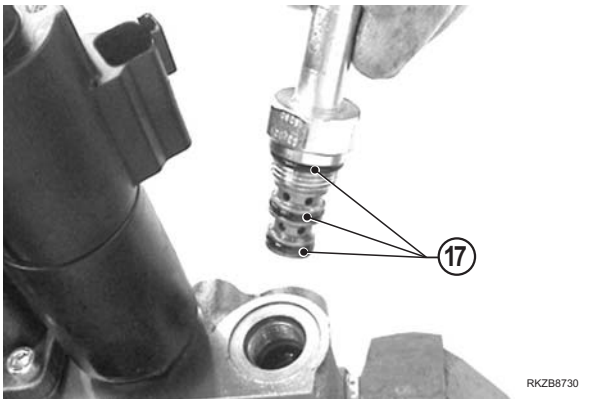
28 -Remove the O-ring (19), the solenoid valve (18) and the O-ring (17);



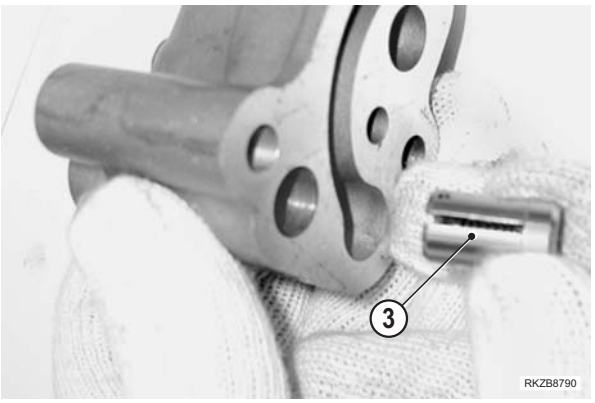
29 -Loosen the cartridge (18).



30 -Remove the O-Rings (17);

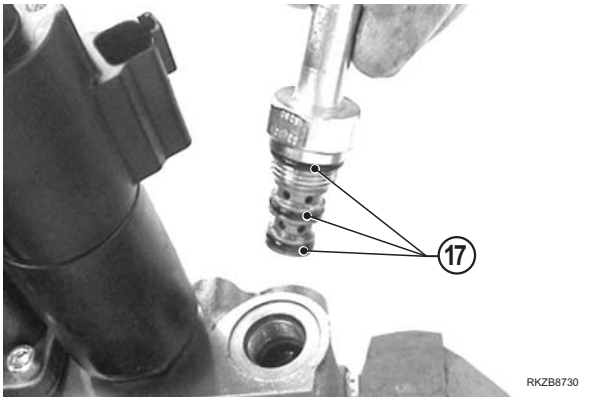


31 - Check the wear conditions of removed parts.



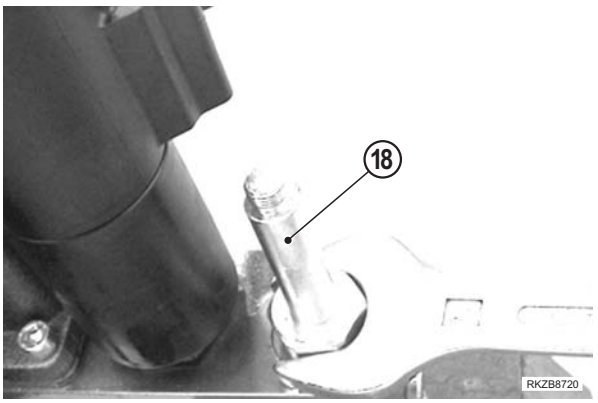
4.2 Assembly

1 -Assemble the O-Rings (17);

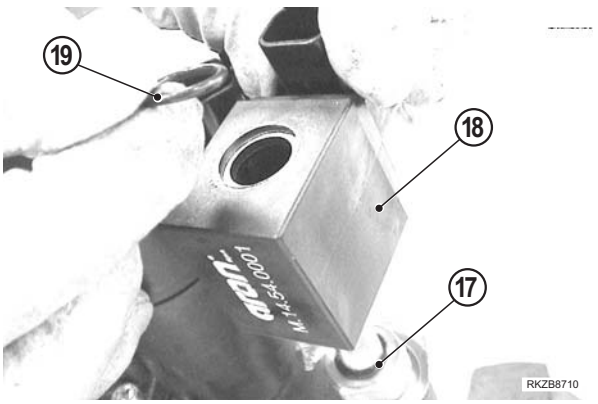


2 -Install the cartridge (18).

Cartridge: 25-30 Nm

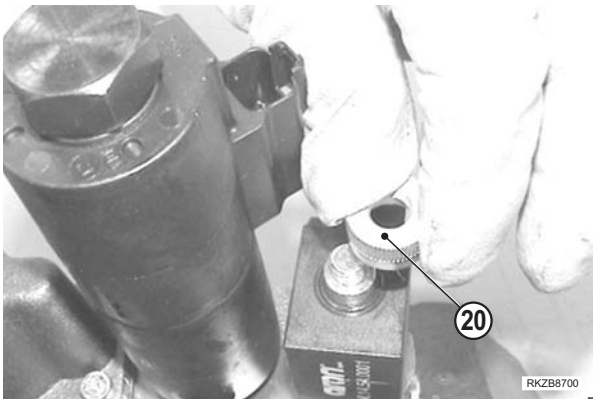


3 -Assemble the O-Ring (17), the solenoid (18) and assemble the O-Ring (19);

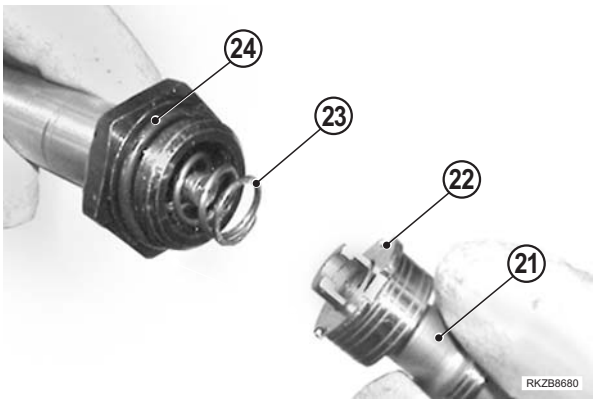


4 -Install the nut (20).

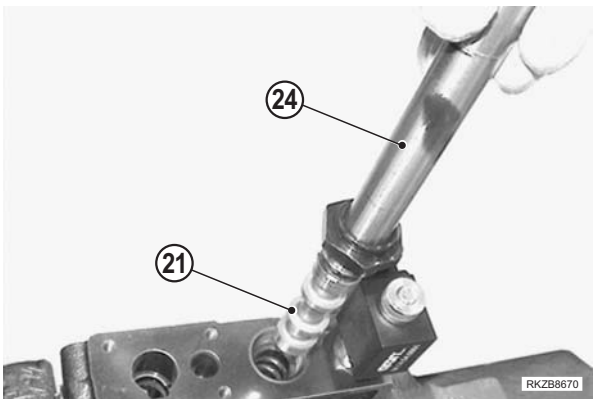
Nut: 5-7 Nm



5 - Install the cartridge (24) and spring (23) to spool (21), and the washer (22).

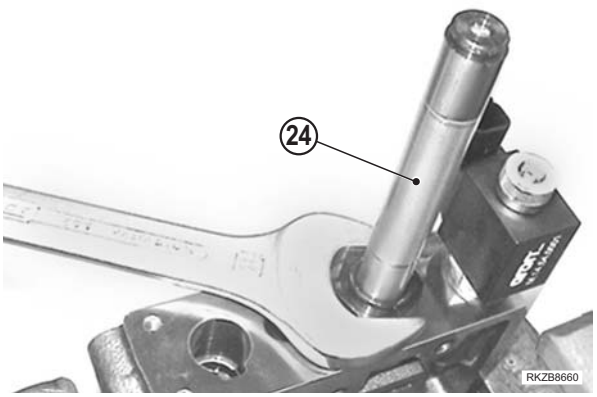


6 - Install the cartridge (24) and spool (21) to control valve.

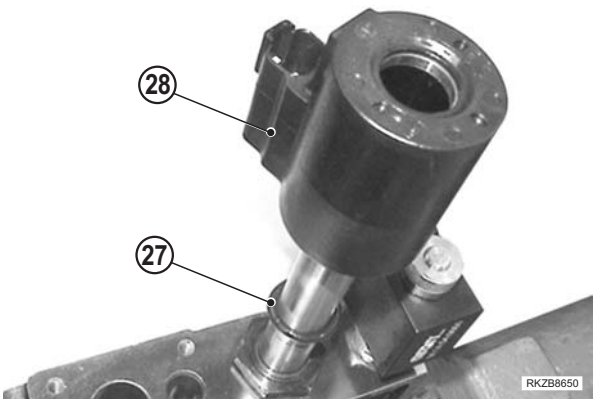


7 - Tighten the cartridge (24).

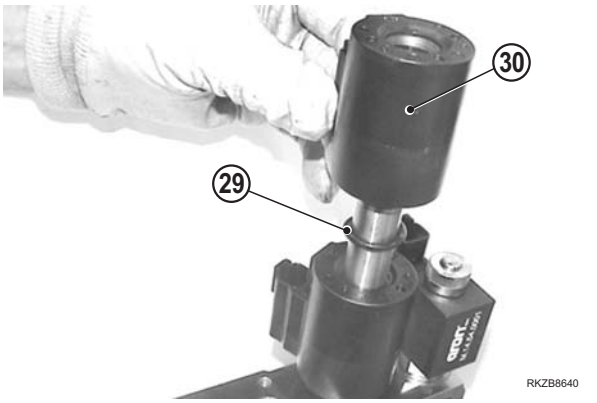
Cartridge: 21.5-24.5 Nm



8 - Assemble O-Ring (27) and the solenoid (28).



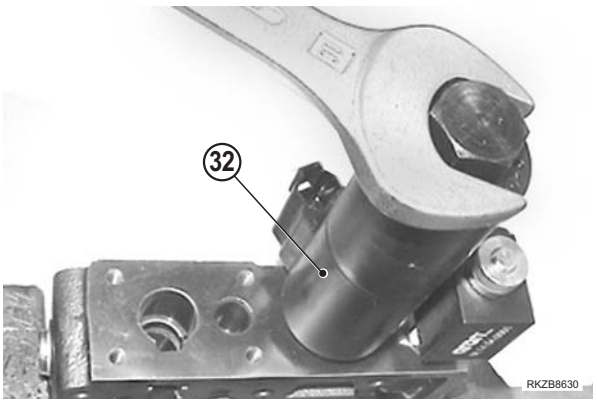
9 -Assemble O-Ring (29) and the solenoid (30).



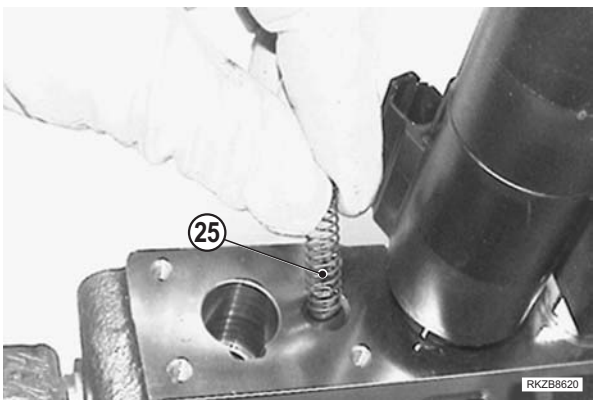
10 -Assemble O-ring (31) on the plug.

11 -Screw the nut (32).

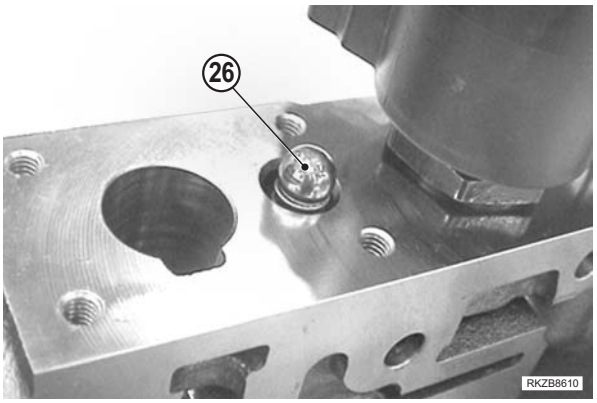
Nut: 7-10 Nm



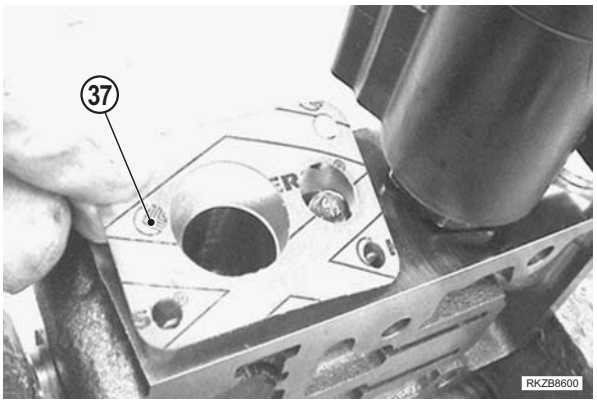
12 -Mount the spring (25).



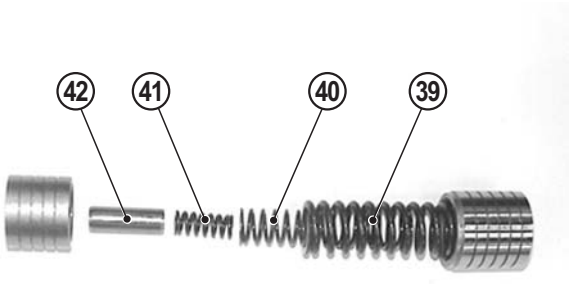
13 -Install the ball (26).



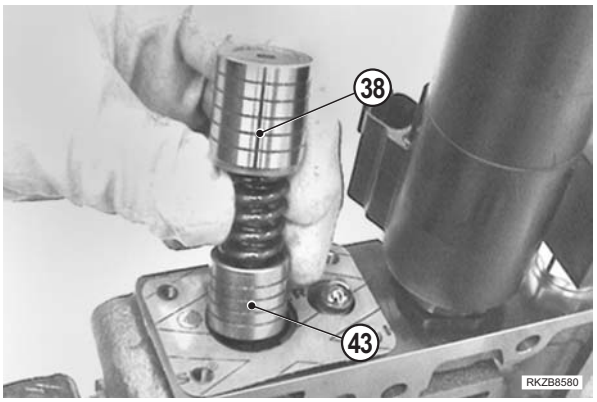
14 - Assemble the gasket (37).



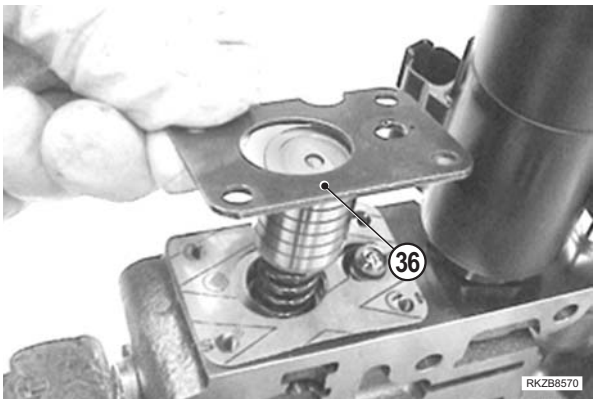
15 - Preassemble the components.



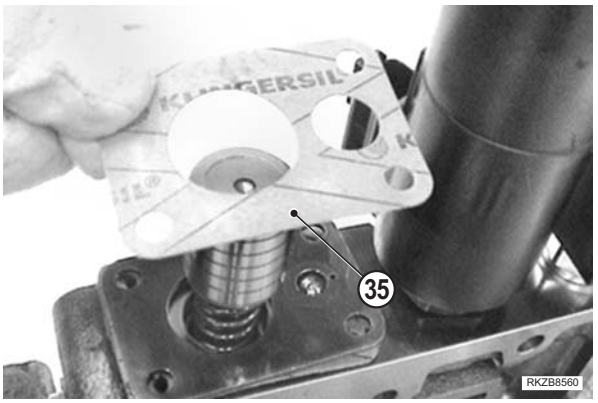
16 - Mount the outward piston (38), the springs (39,40,41), the pin (42) and the inward piston (43).



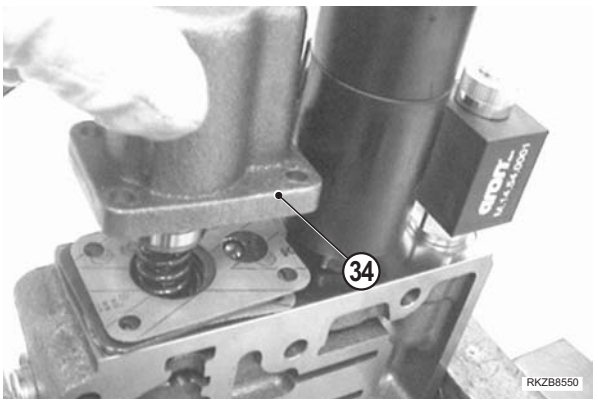
17 - Mount the plate (36).



18 -Mount the gasket (35).

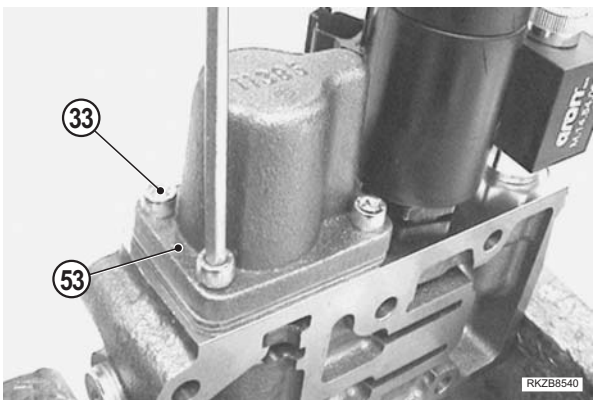


19 -Assemble the valve cover (34).



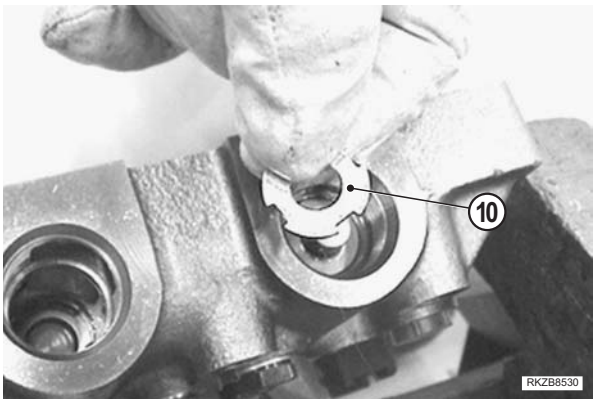
20 -Mount the screws (33).

Screw: 9.8-11.8 Nm

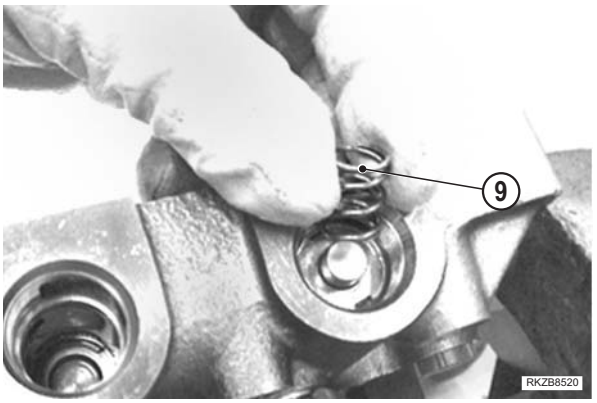


21 -Turn the control valve (53).

22 -Assemble the washer (10).

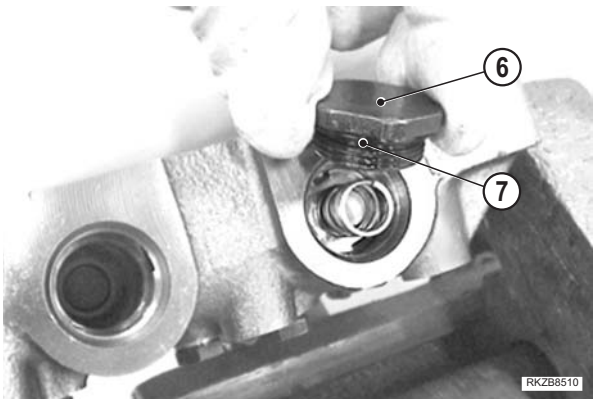


23 - Assemble the spring (9).

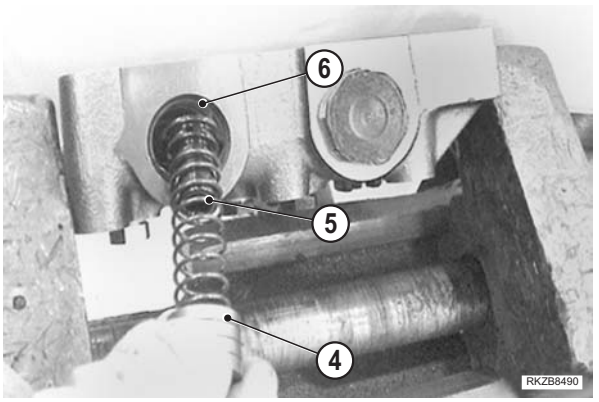


24 - Assemble O-ring (7) on the plug.

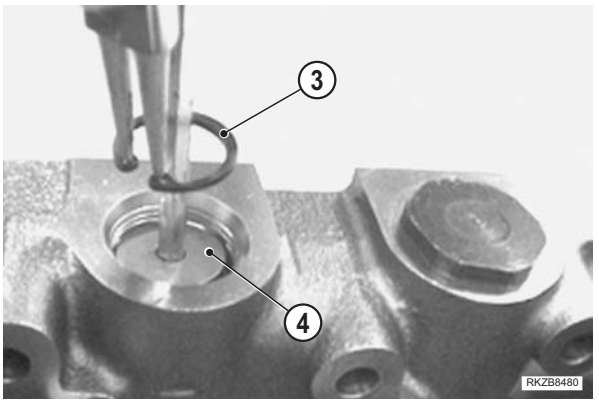
25 - Assemble the plug (6).



26 - Assemble the piston (4), the spring (5) and the bush (6).

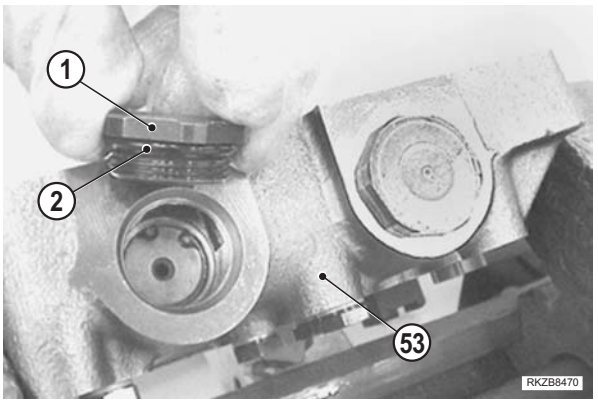


27 - Push down the piston (4) then assemble the snap ring (3) in its seat.

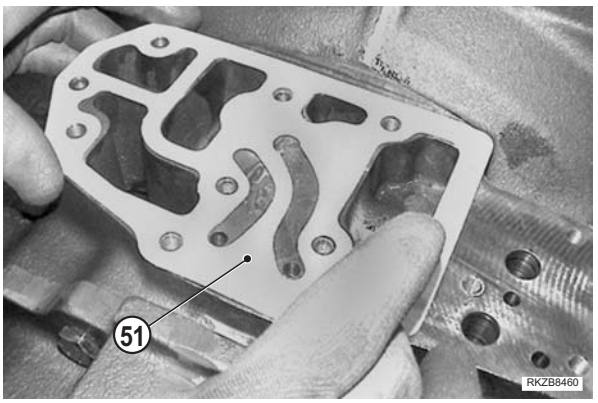


28 -Assemble the O-ring (2) on the plug.

29 -Assemble the plug (1).

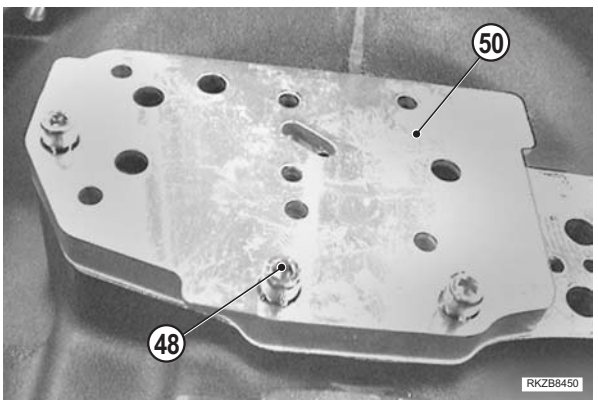


30 -Assemble the gasket (51) on the transmission (52).

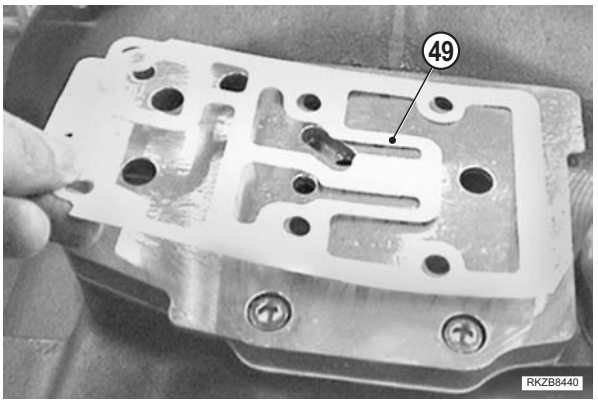


31 -Assemble the plate (50) and the screws (48).

Screw: 23Nm

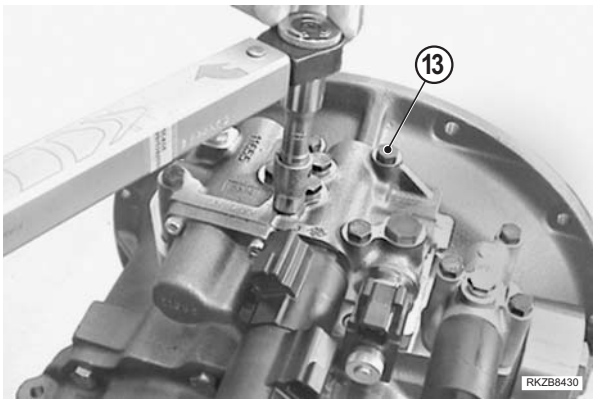


32 -Mount the gasket (49).



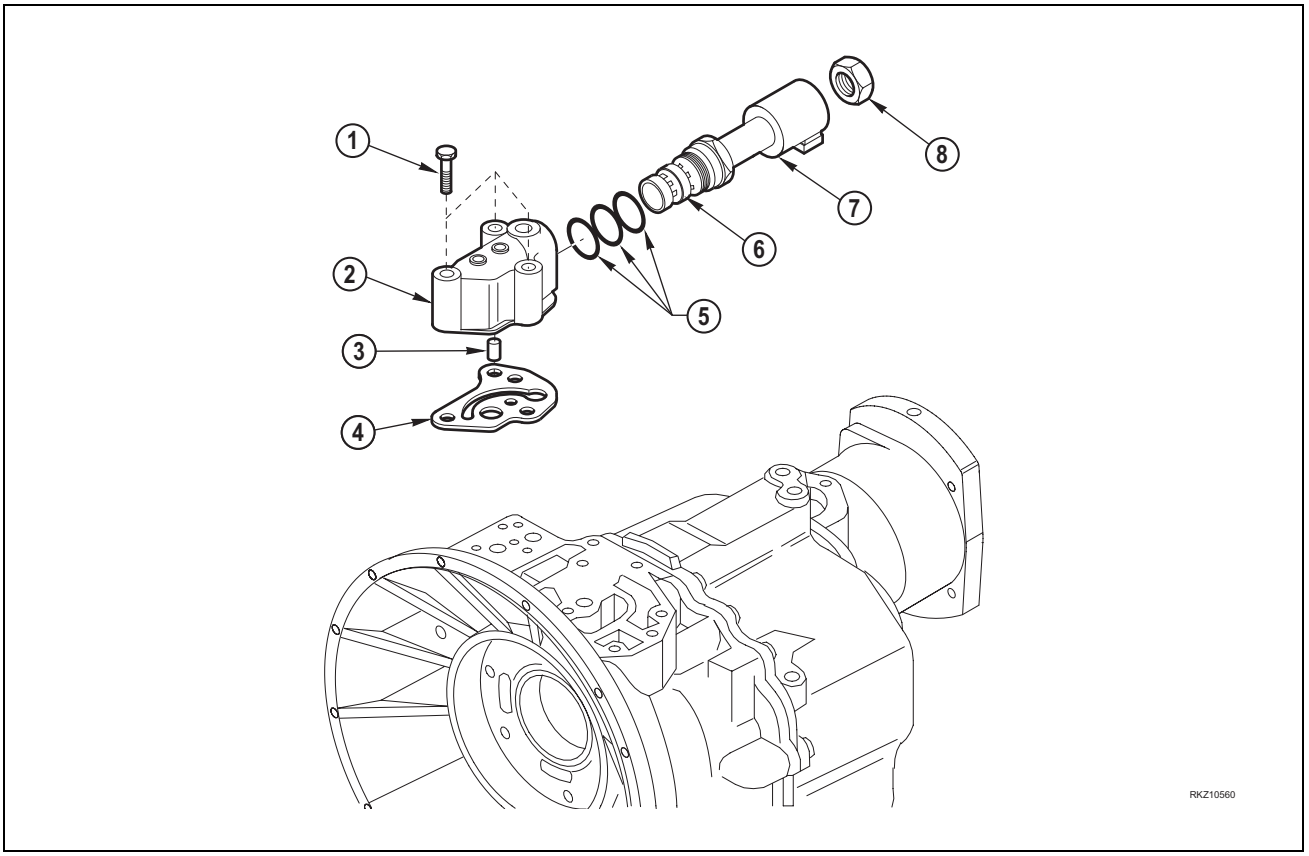
33 - Assemble the control valve (53) and the screws (13).

Screw: 23Nm



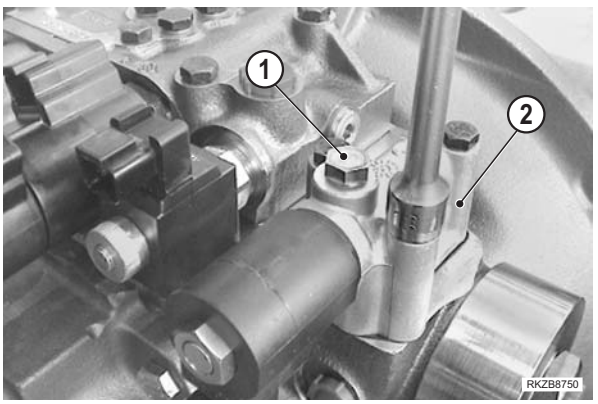
5. 4WD Solenoid valve

5.1 Disassembly



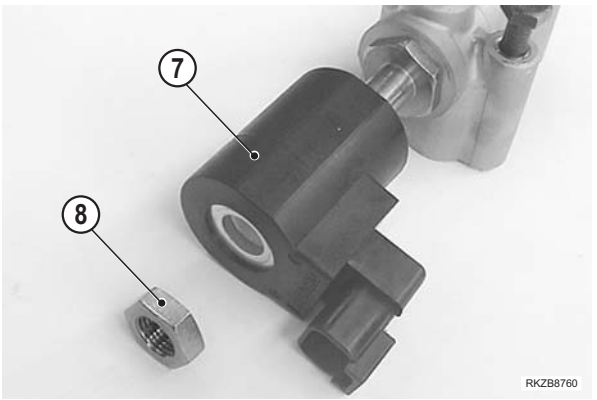
1 - Remove the drain plug (1) and drain the oil from the transmission.

2 - Remove the screws (1) and remove the solenoid valve housing (2).



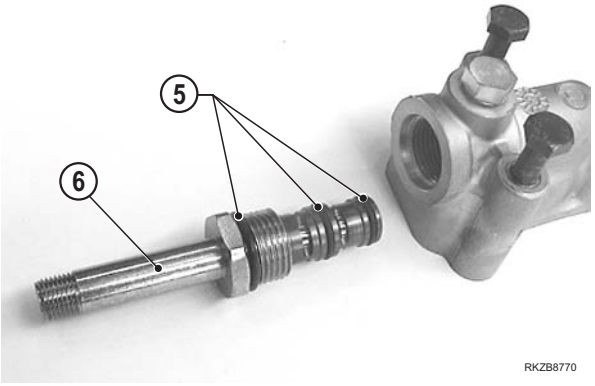
3 - Remove the nut (8).

4 - Remove the solenoid (7).

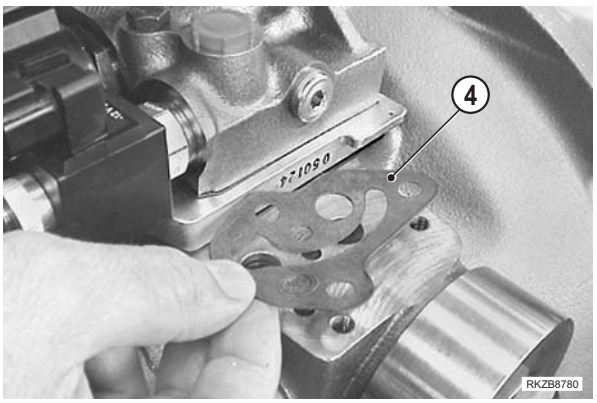


5 - Remove cartridge (6) from housing.

6 - Remove O-rings (5) from the cartridge.

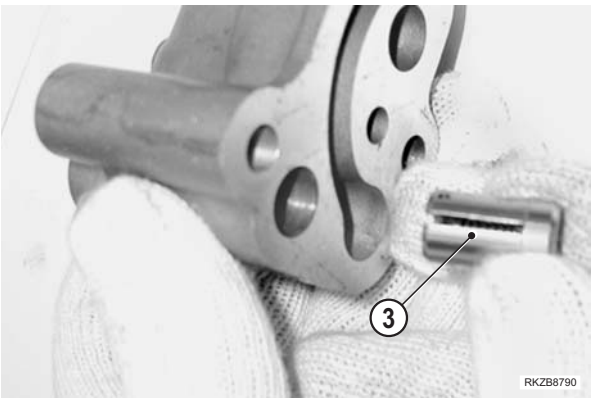


7 - Remove the gasket (4).



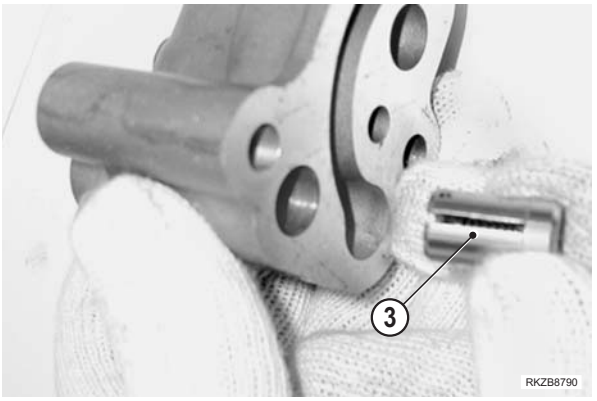
8 - Remove the valve (3).

9 - DO NOT try to disassemble the valve (3).
If valve is already damaged, replace it with a new one.



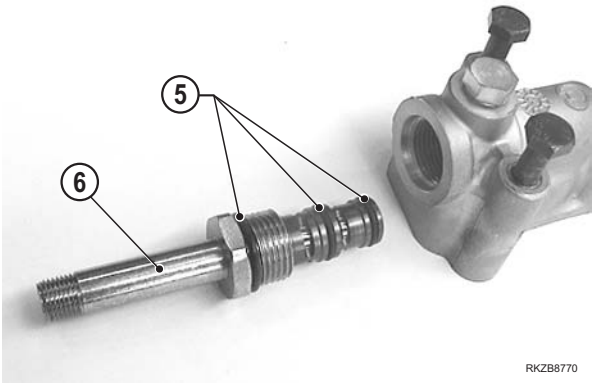
5.2 Assembly

1 -Assemble valve (3) to the housing.



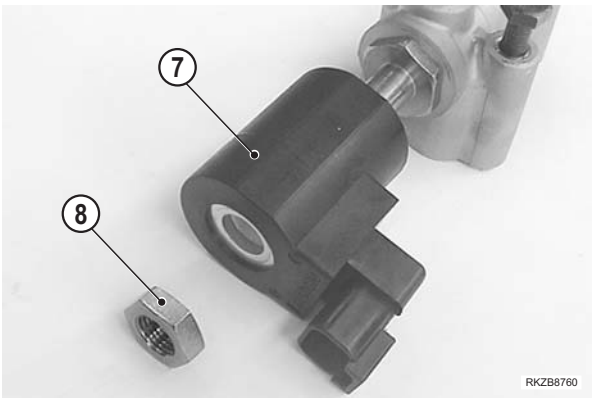
2 -Assemble O-rings (5) into the cartridge (6) and cartridge (6) in the housing.

Cartridge: 22 Nm

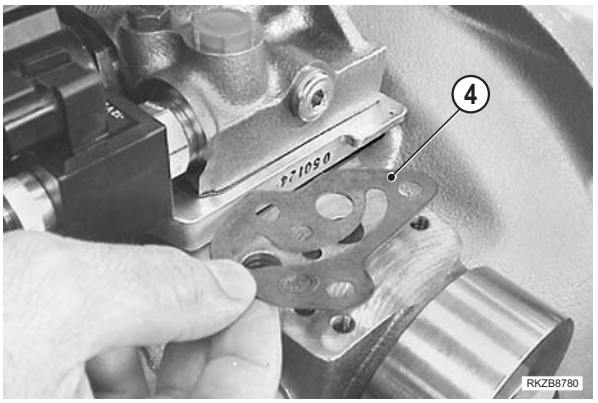


3 -Assemble the 4WD solenoid valve (7) and the nut (8).

Nut: 5-8 Nm

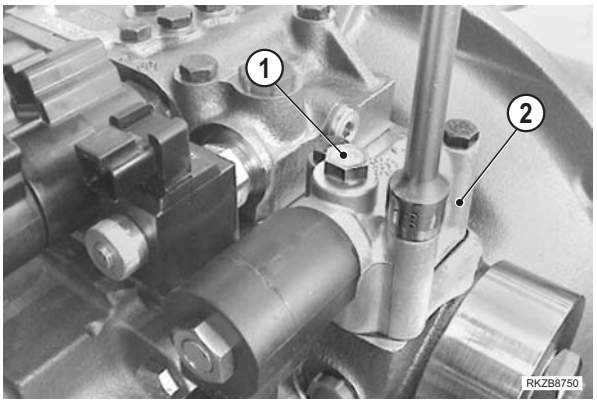


4 -Assemble new gasket (4).



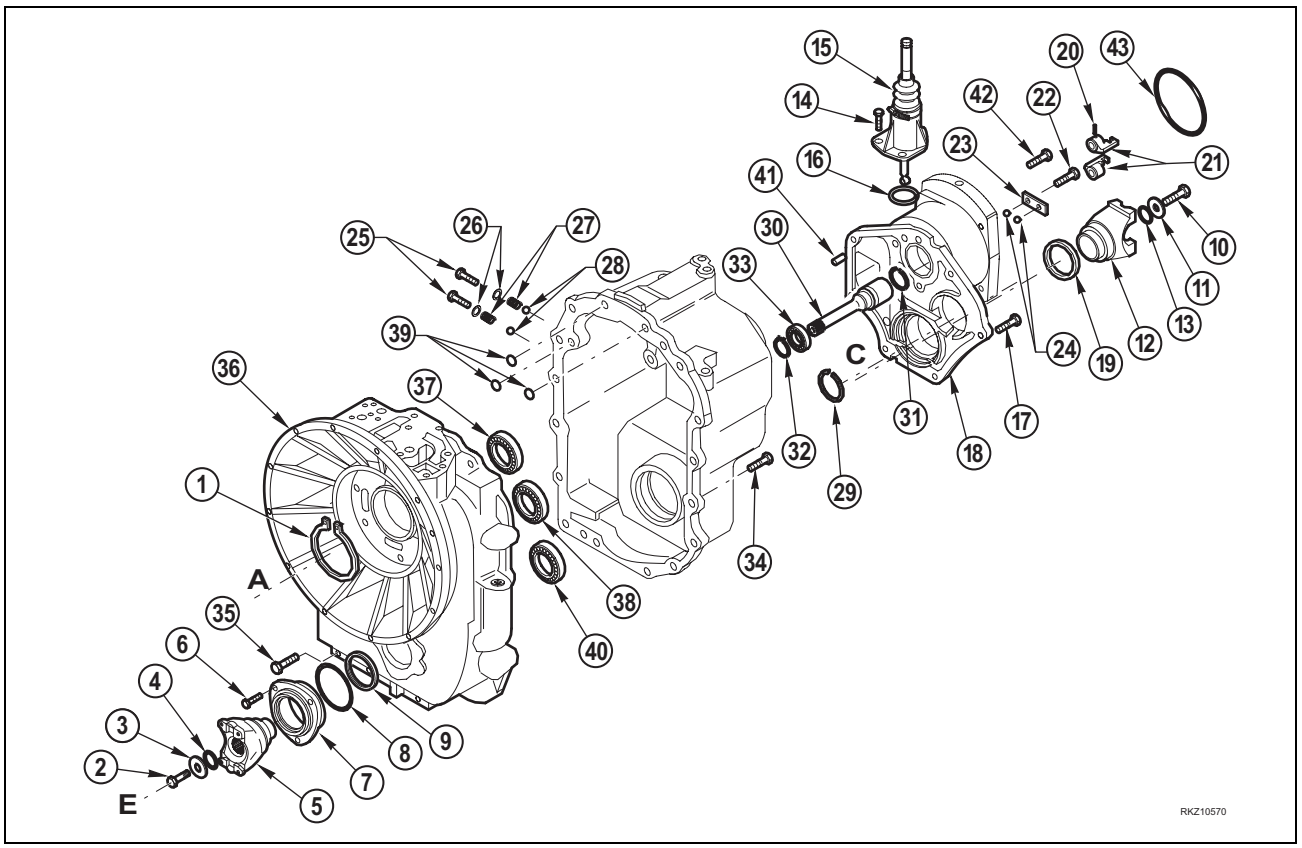
5 -Assemble the housing (2) and screws (1).

Screw: 23Nm

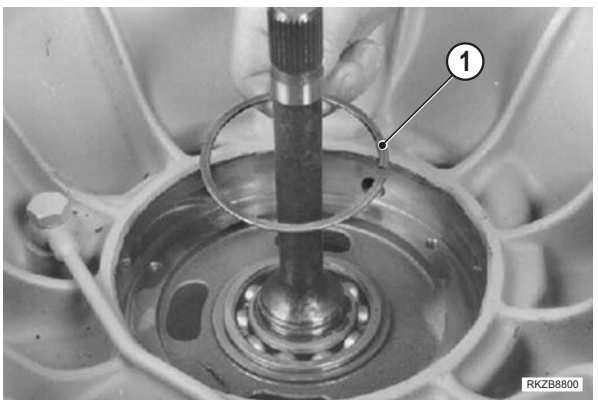


6. Transmission housing

6.1 Disassembly

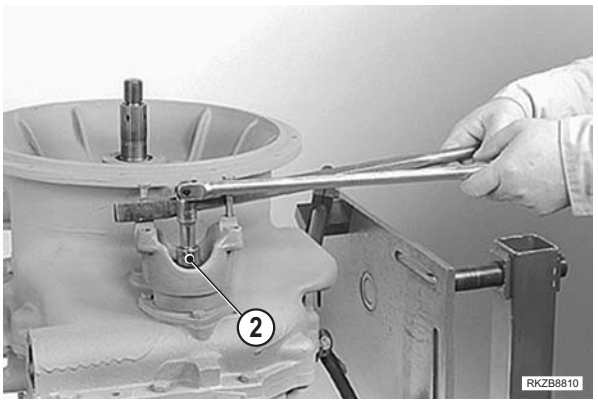


1 - Remove bearing snap ring (1).

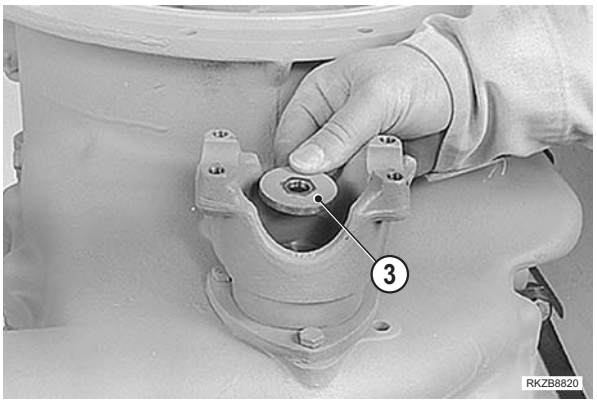


2 - Untighten and remove flange retaining screw (2).

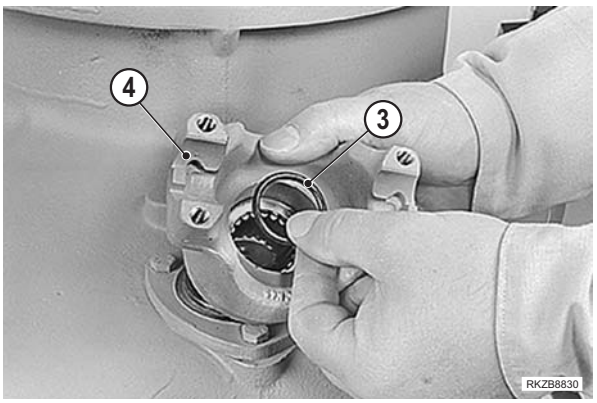
3 - Use a screwdriver and two screws to avoid flange rotation.



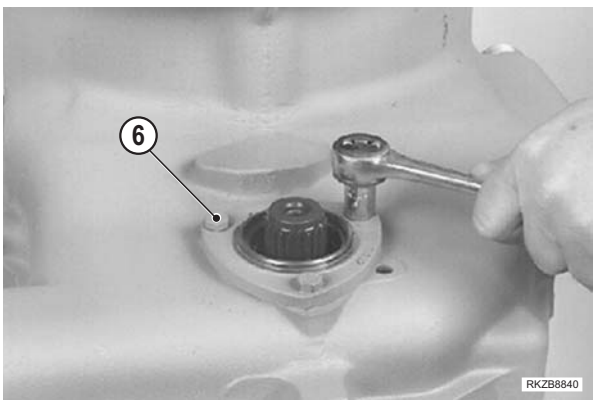
4 -Remove the washer (3).



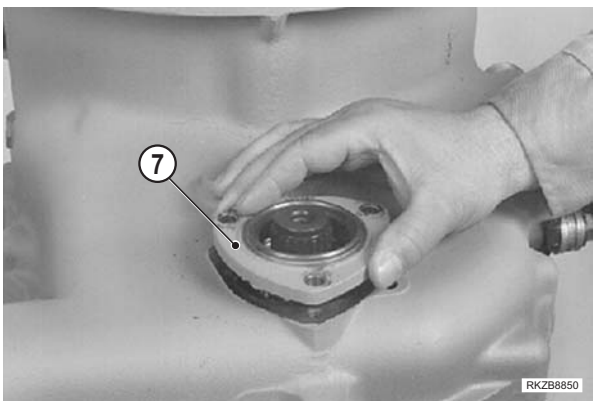
5 -Remove flange (5) and O-ring (4).



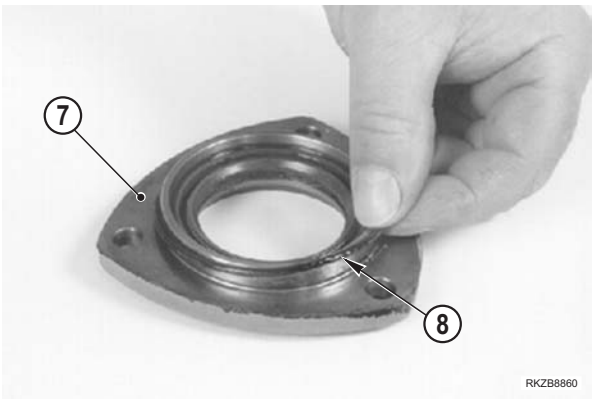
6 -Take out the screws (6) (n°3).



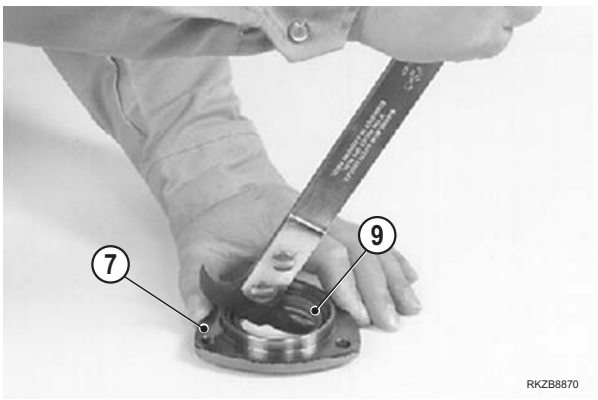
7 -Remove the cover (7).



8 - Remove O-Ring (8) from cover (7).

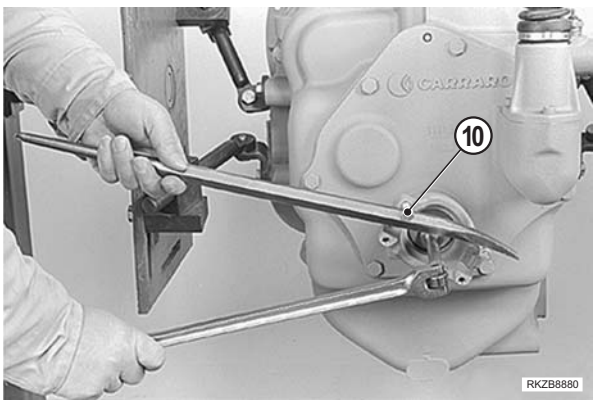


9 - Remove the seal (9) from the cover (7).

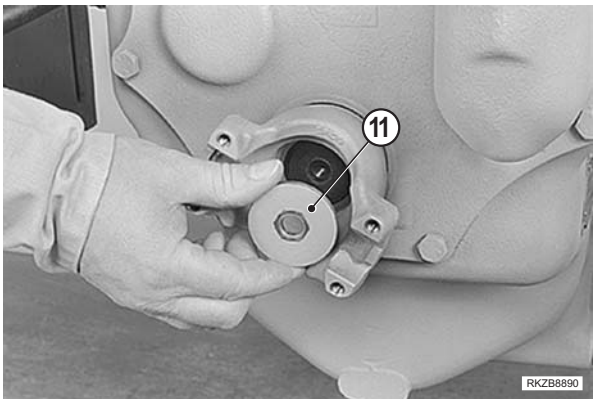


10 - Untighten and remove flange retaining screw (10).

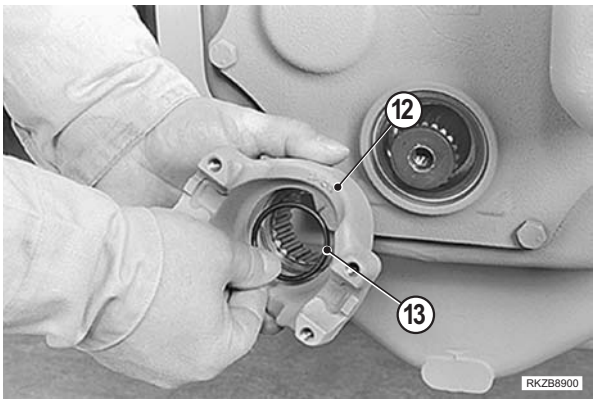
11 - Use a screwdriver and two screws to avoid flange rotation.



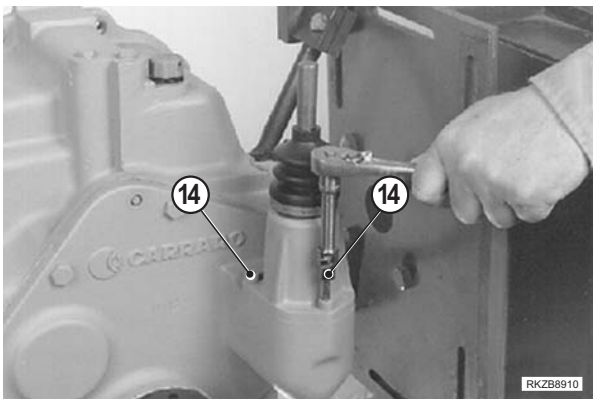
12 - Remove the washer (11).



13 - Remove flange (12) and O-ring (13).

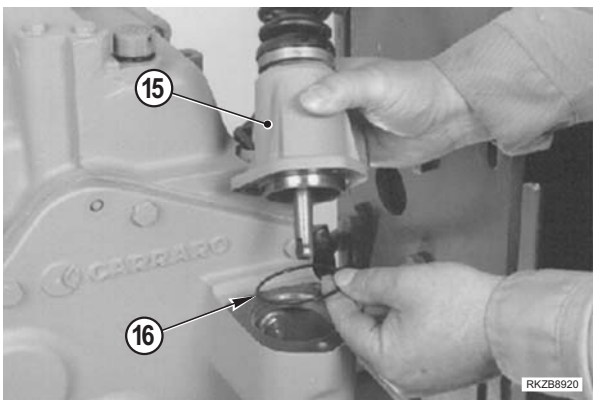


14 - Remove out the screws (14) (n°3).



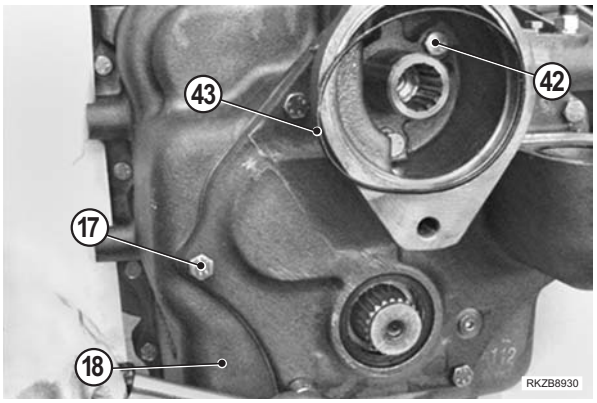
15 - Remove the shift tower assembly (15) and the O-ring (16).

16 - Replace the O-ring (16) with a new one at each disassembly.

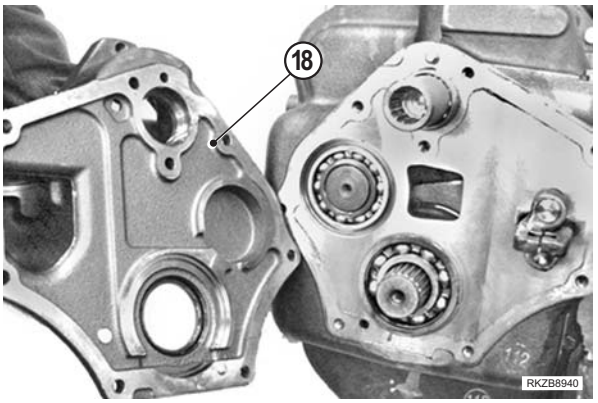


17 - Remove O-ring (43).

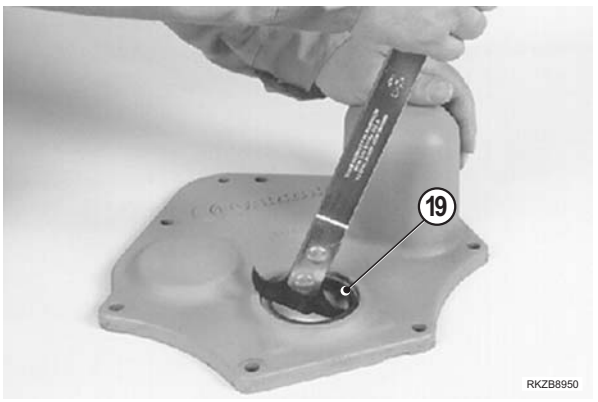
18 - Remove the six cap screws (17) and the two capscrews (42) which fasten the rear cover (18) to the rear half housing.



19 - Use a prybar to separate the rear cover from the housing.
Remove the rear cover (18).

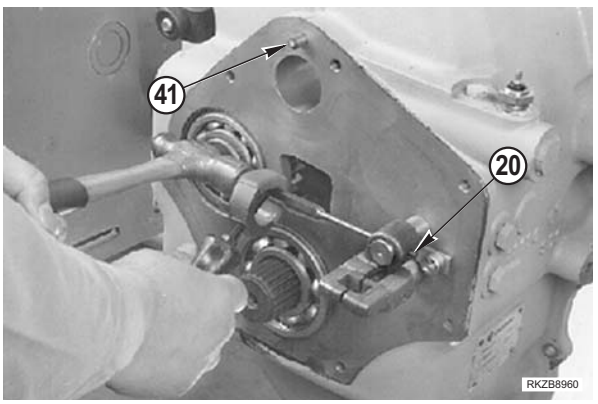


20 - Remove the seal (19) from the rear cover.

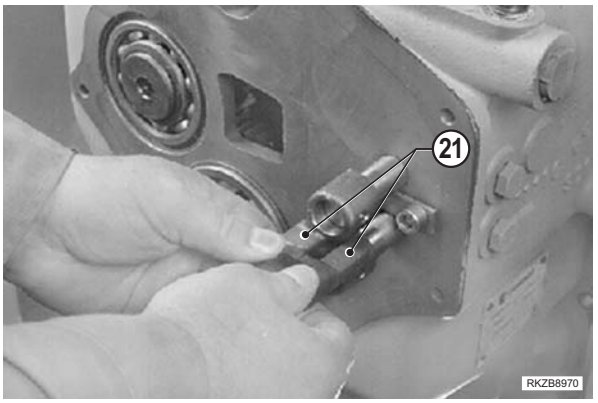


21 - Use a punch to remove the pins (20) which fasten the shift collars to the shift rods.

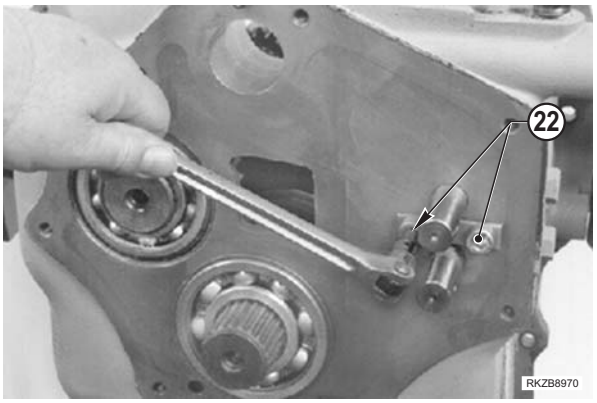
22 - Remove the centering pins (41).



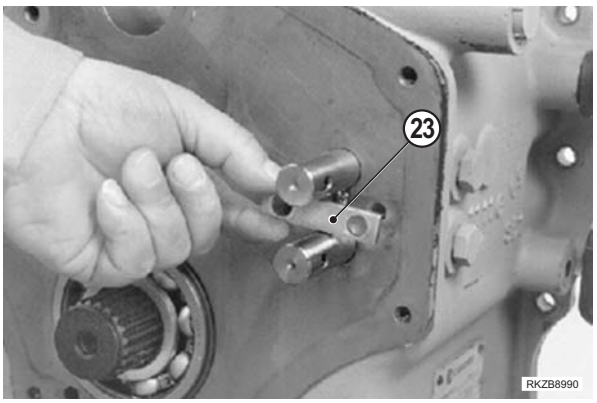
23 - Remove the shift collars (21).



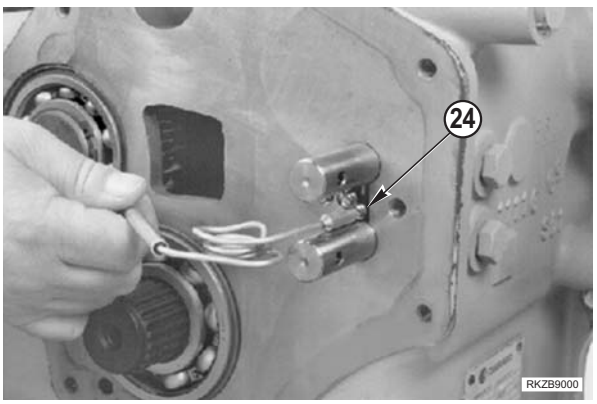
24 - Remove the two screws (22) which hold the plate between the two shift rods.



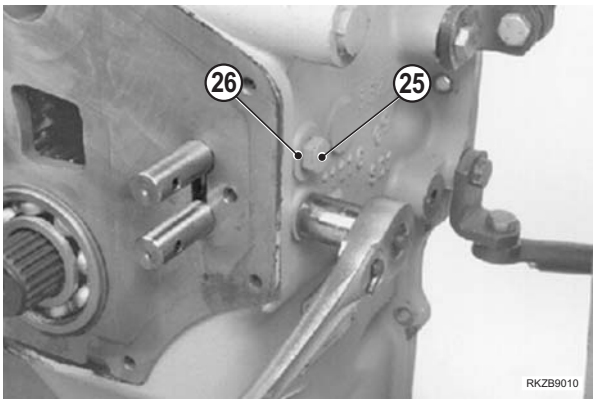
25 - Remove the plate (23).



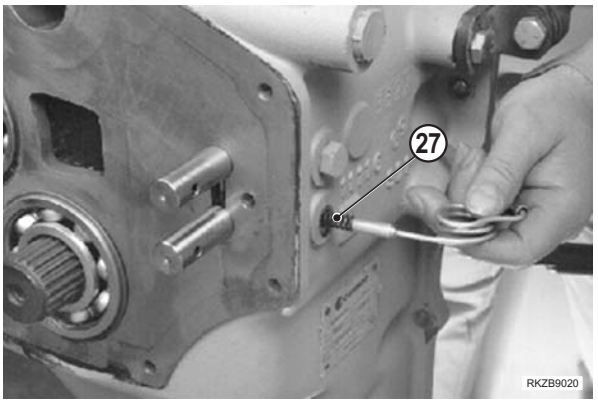
26 - Remove the two detent balls (24) from the groove between the two shift rods.



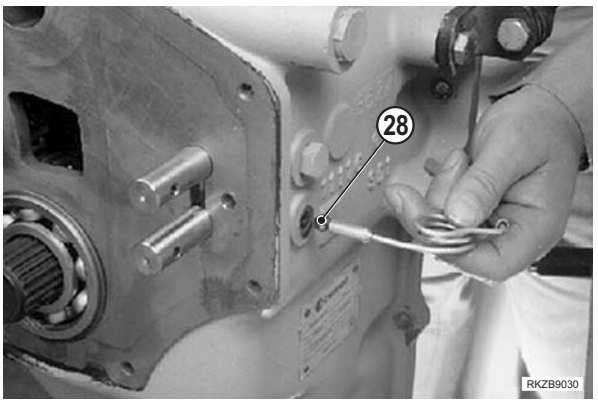
27 - Untighten and remove screws (25) and washers (26).



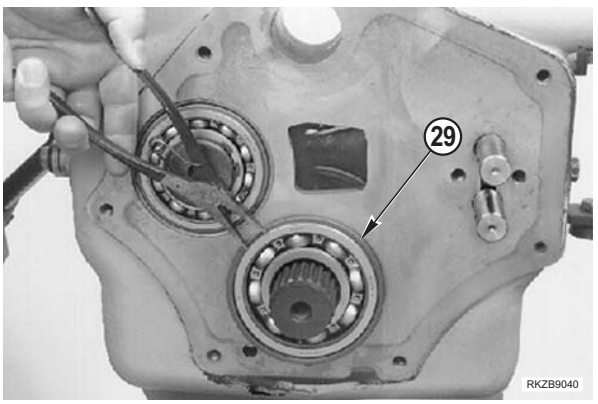
28 -Remove springs (27).



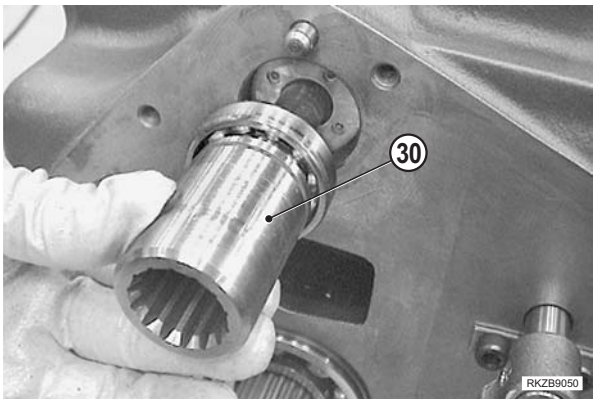
29 -Remove balls (28).



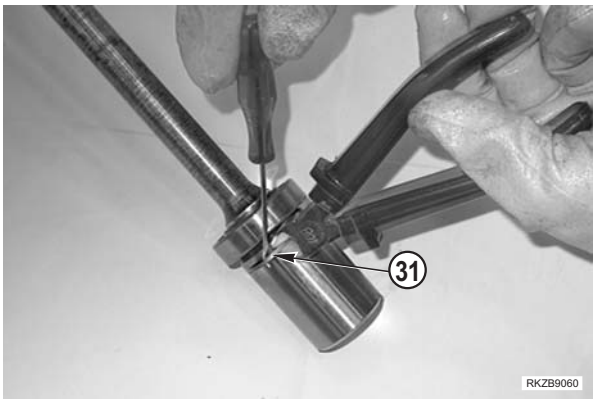
30 -Pull the secondary shaft to the rear so that there is clearance between the snap ring and the rear housing. Remove the snap ring (29).



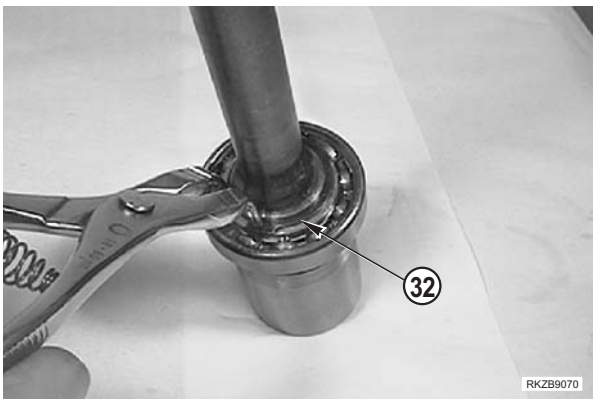
31 -Remove transmission shaft PTO (30) by pushing lightly on the opposite side.



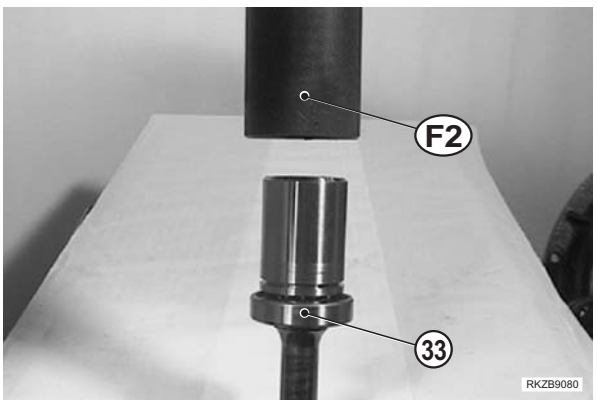
32 - If to replaced, remove teflon seal ring (31) by cutting it.



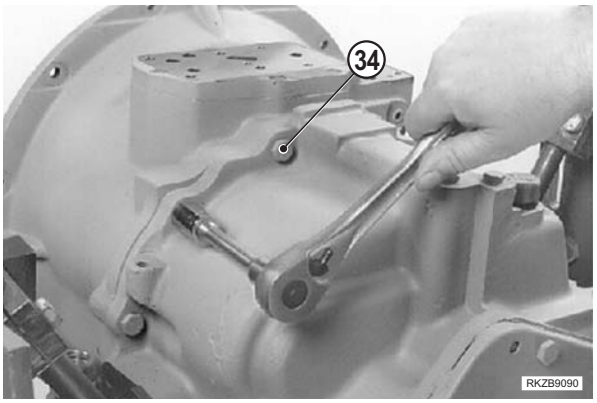
33 - Remove snap ring (32).



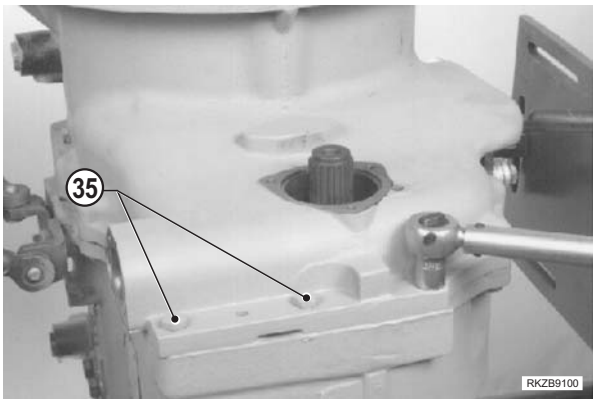
34 - Use the tool **F2** take the bearing (33).



35 - Remove the screws (34).

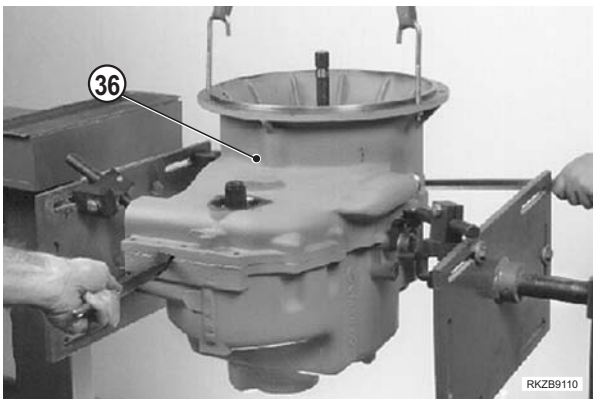


36 -Remove the screws (35).

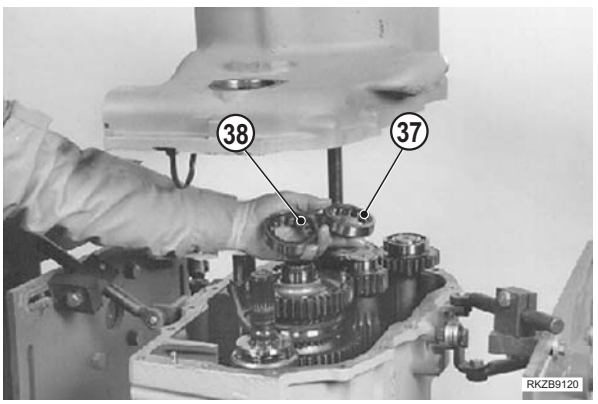


37 -Use lever to remove the front half housing (36).

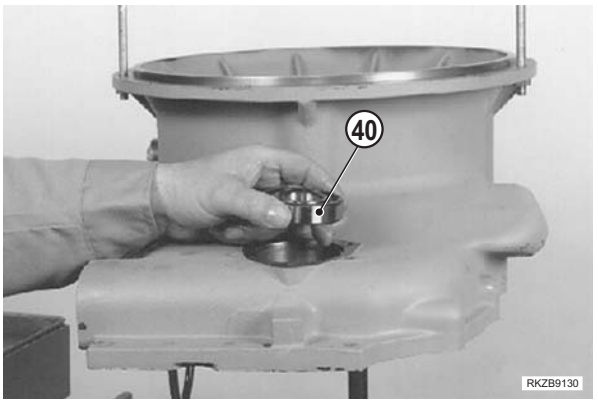
38 -Lift the front half housing by means of two hooks.



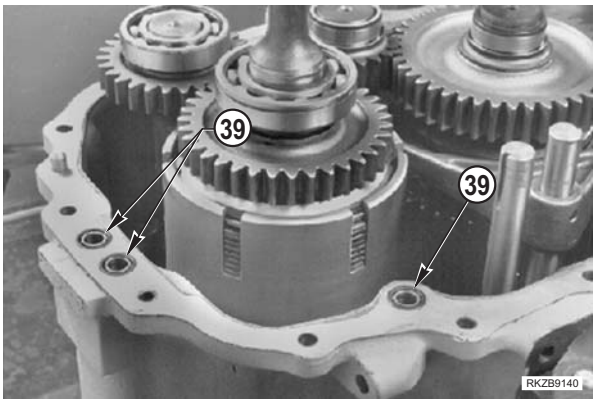
39 -Remove the outer bearing cups (37) and (38).



40 -Remove bearing (40).

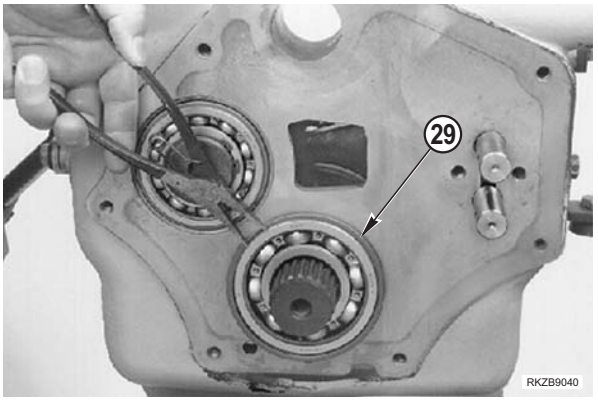


41 - Inspect the condition of the O-rings(39) and replace if necessary.

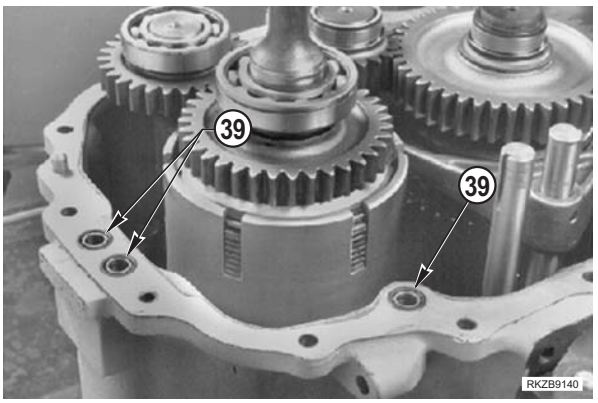


6.2 Assembly

1 - Push the secondary shaft toward the rear of the rear housing so that there is clearance between the snap ring groove and the rear housing.
Install the snap ring (29).

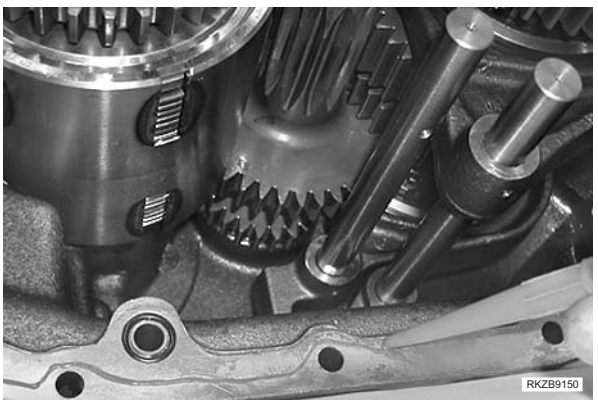


2 -Assemble the O-Rings (39);

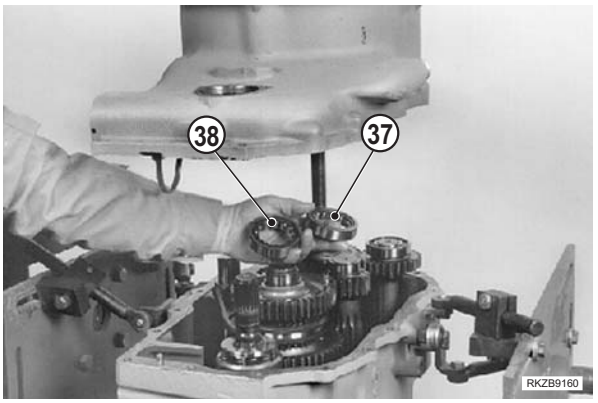


3 -Apply a thin film of sealant on the edge of the rear half-housing.

Contact surface: Loctite 510



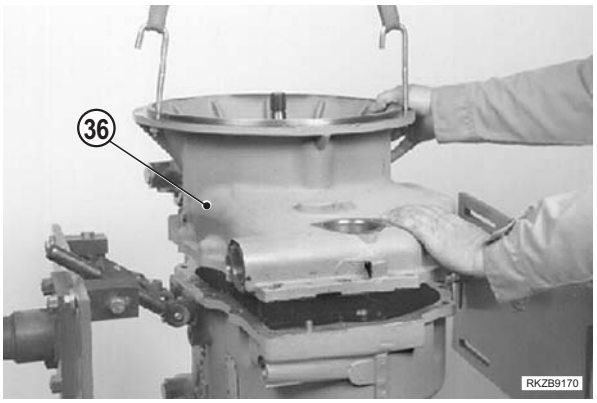
4 -Lubricate the bearings (37) e (38) and mount them on the shaft.



5 - Install front half housing (36) to rear half housing.

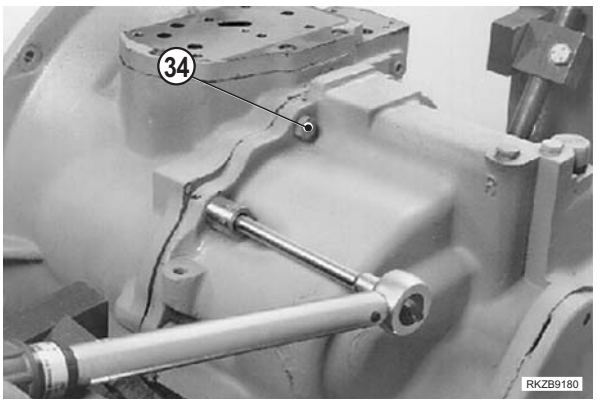
6 - Make sure the bearings on the shafts are correctly positioned in the front half housing.

7 - Press the front half housing onto rear half housing.



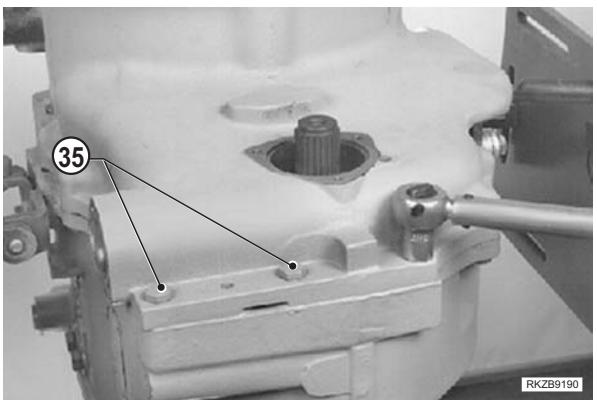
8 - Mount the screws (34).

Screw: 50 Nm

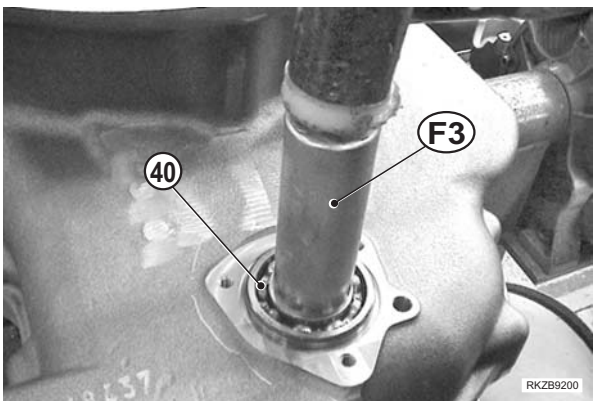


9 - Mount the screws (35).

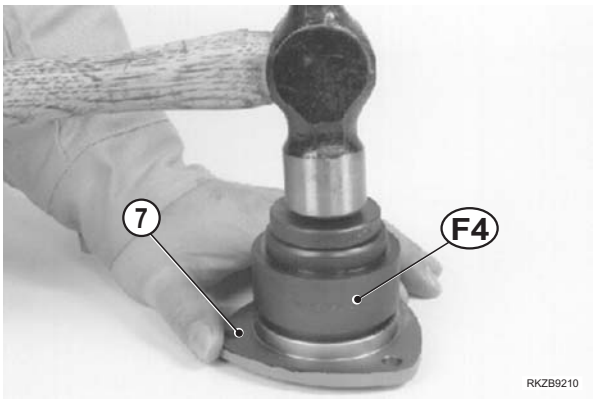
Screw: 50 Nm



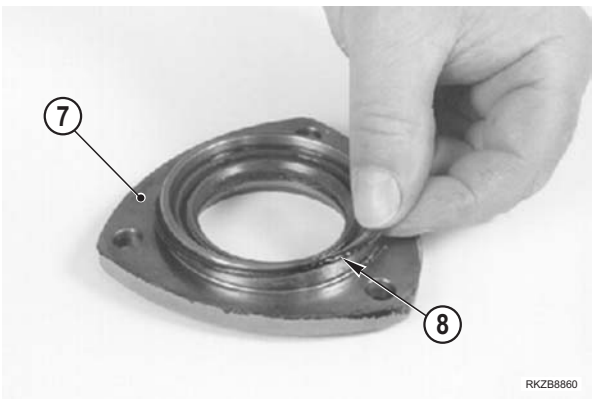
10 - Use clean transmission oil to lubricate the bearing for the 4WD shaft.
Install the bearing (40) on the 4WD shaft.
Use tool**F3**.



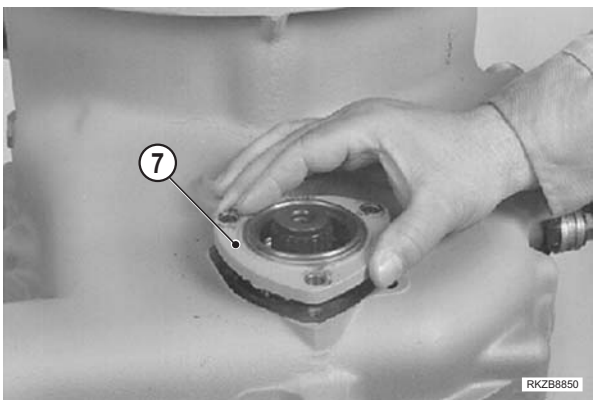
11 - Use the **F4** special tool to install a new seal (9) in the cover (7). Push just until the seal stops moving.
DO NOT use excessive force.
Fill the cavity under the lip of the seal with high temperature wheel bearing grease.



12 - Assemble O-ring (8).

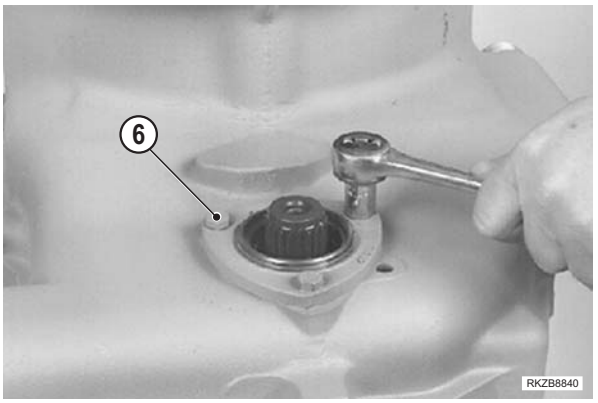


13 - Install the cover (7) in the front housing.

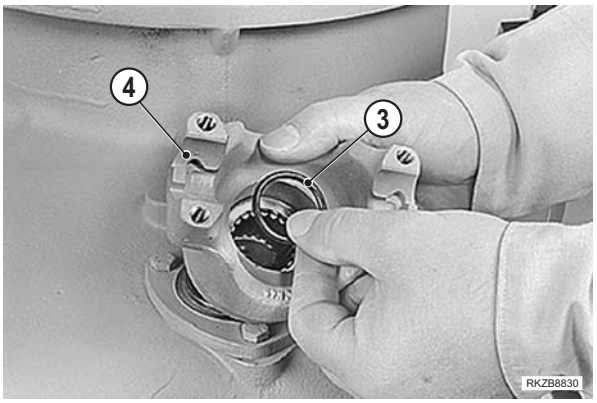


14 - Install the three cap screws (6) which fasten the cover to the front housing.

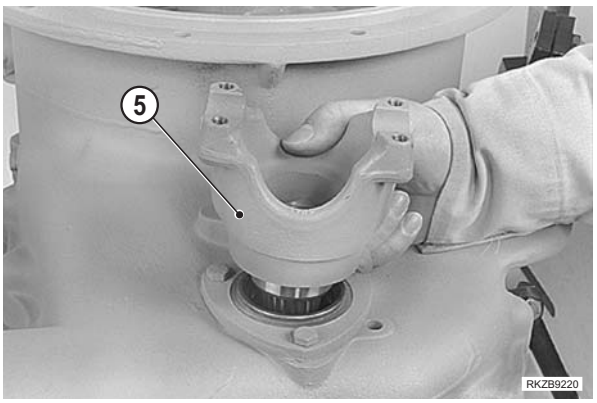
Screw: 23 Nm



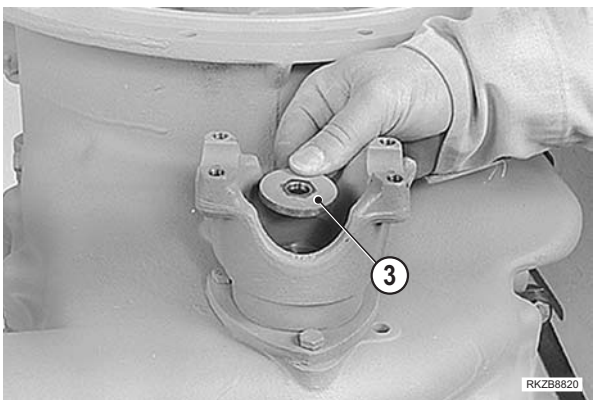
15 - Install a new O-ring (4) in the four-wheel drive flange. Use clean transmission oil to lubricate the O-ring.



16 - Install the four-wheel drive flange (5) on the four-wheel drive shaft.

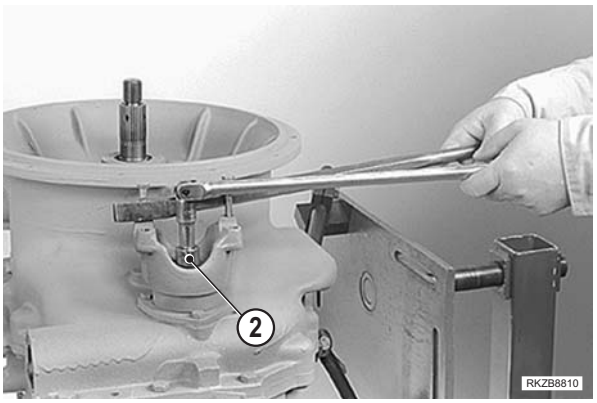


17 - Install the washer (3).

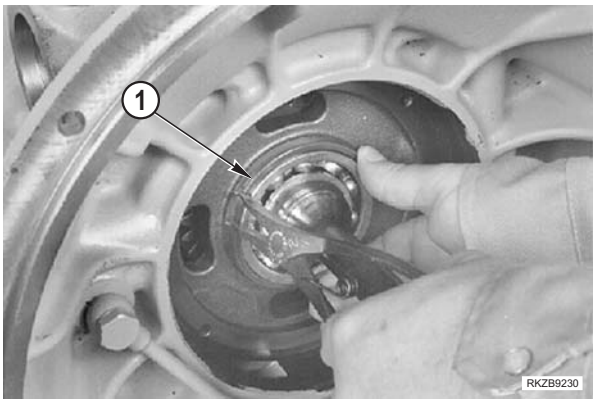


18 - Tighten the screw (2) using a screwdriver to prevent flange rotation.

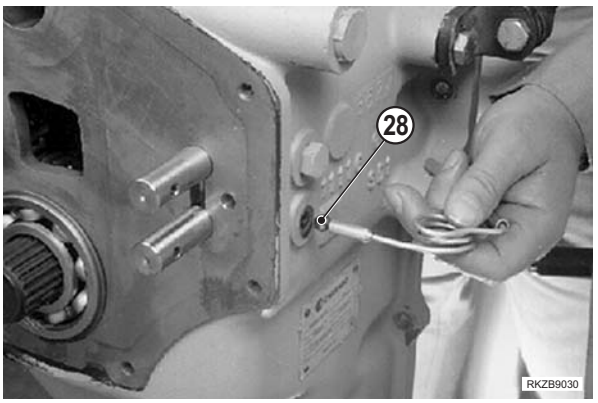
Screw: 139 Nm



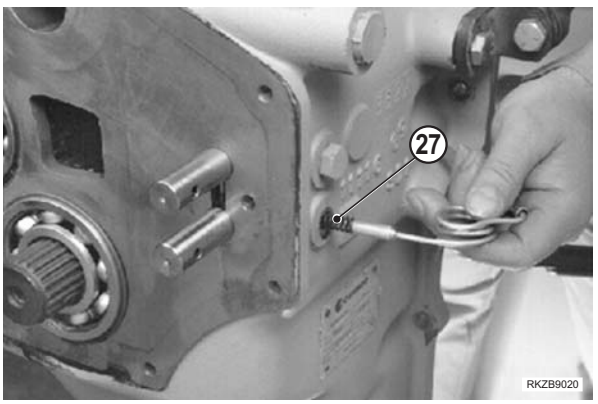
19 -Assemble snap ring (1).



20 -Install the ball (28).

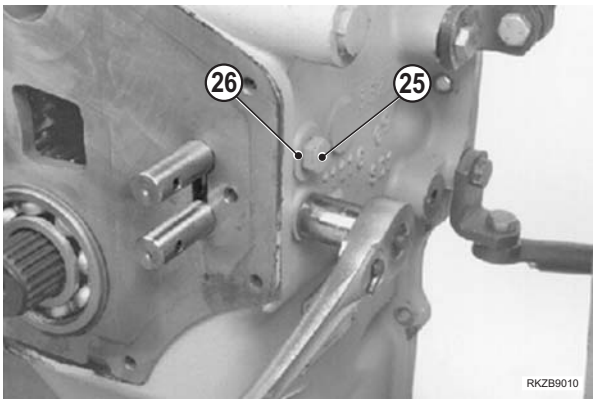


21 -Mount the spring (27).

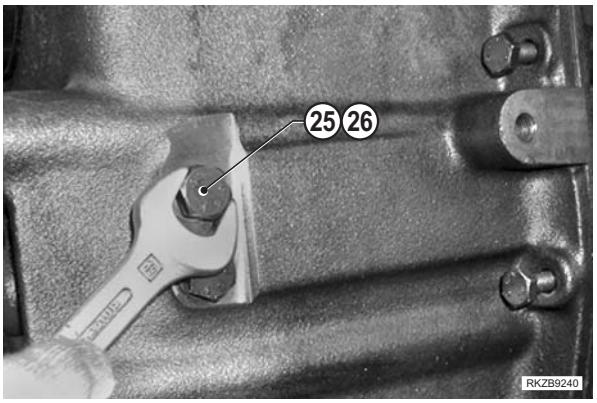


22 -Mount the washer (26) and the screw (25).

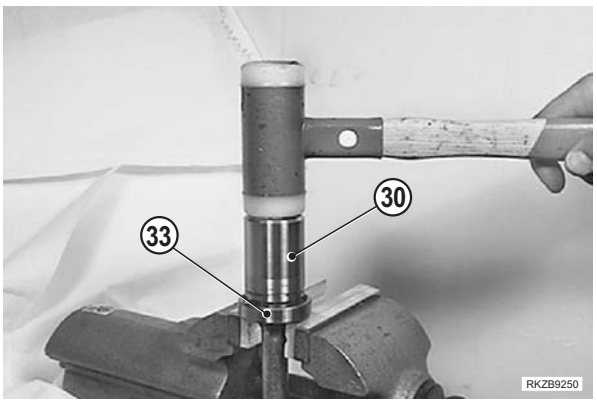
Screw: 80 Nm



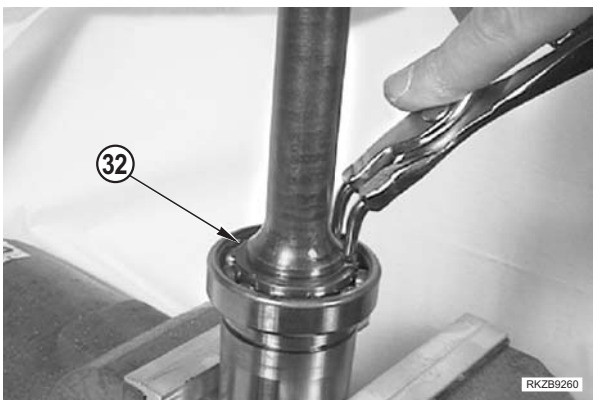
23 - Repeat steps 18 through 20 to install the upper detent ball and spring.



24 - Assemble bearing (33) on transmission shaft PTO (30).

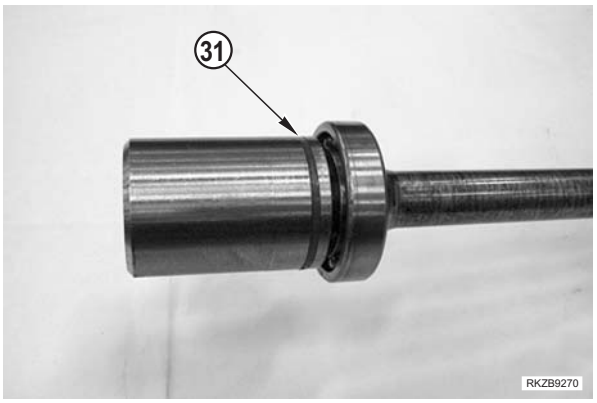


25 - Assemble snap ring (32).

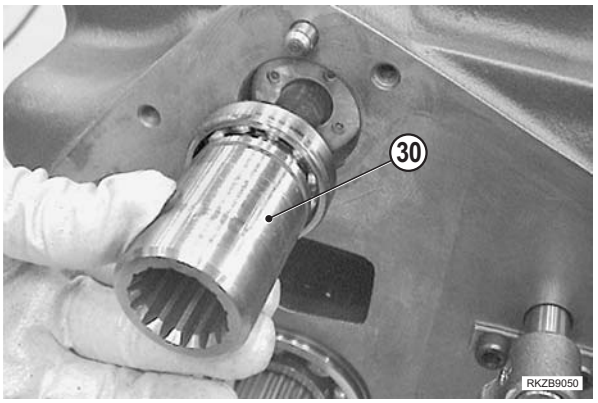


26 - For the assembly of teflon seal ring (31).
(For details see "7. SHAFTS A - D" - "7.2 Assembly" the points 18-22).

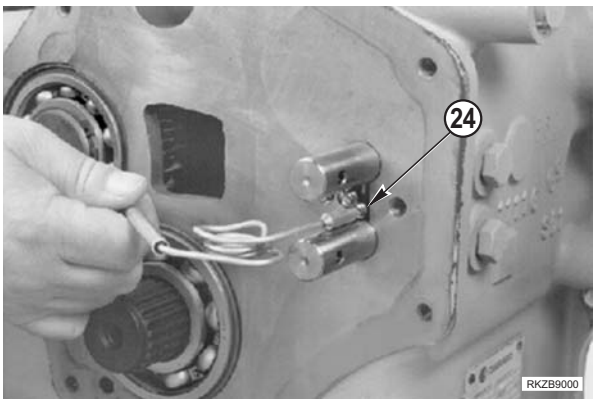
★ Use tools **F5** - **F6** - **F7**.



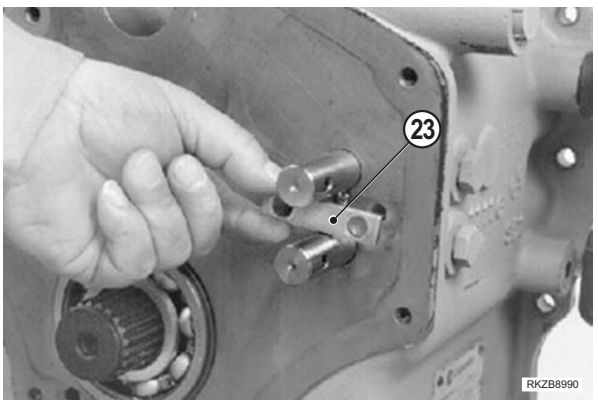
27 - Insert transmission shaft PTO (30) to the stroke.



28 - Grease and mount the two detent balls (24).



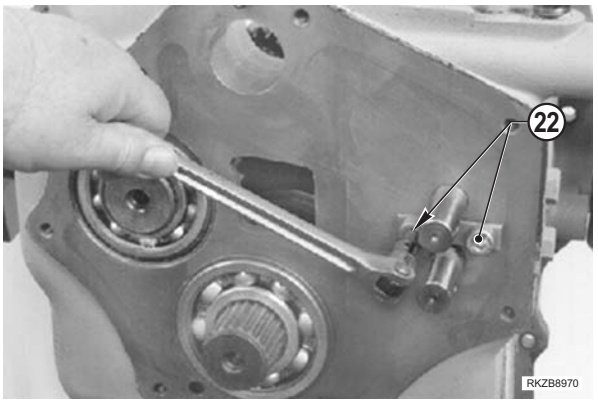
29 - Install the plate (23).



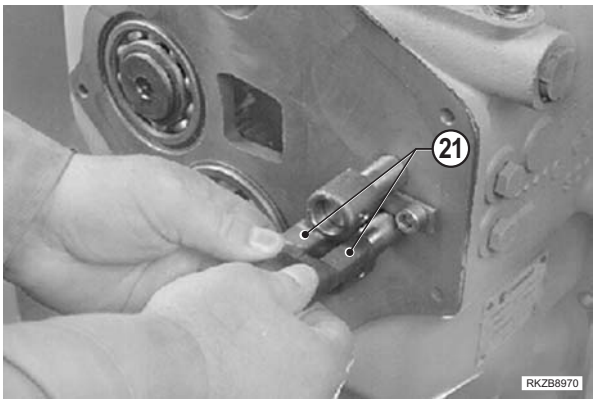
30 - Apply sealant to the threads of the Allen head screws (22) and fix the plate in position.

Screw: Loctite 542

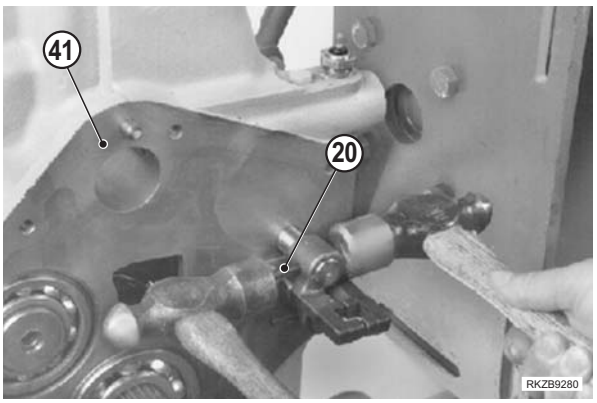
Screw: 50 Nm



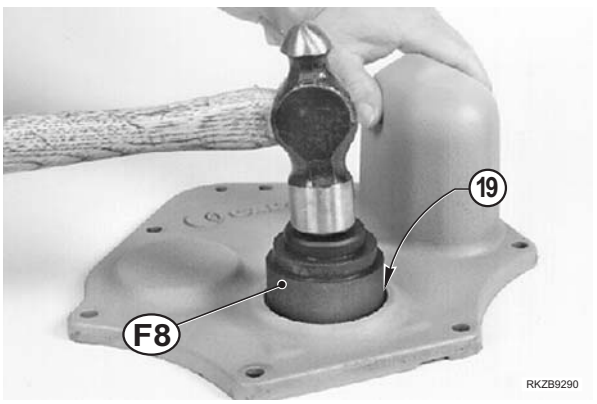
31 - Install shift collars (21) on the shift rods.



32 - Install the pins (20) to fasten the shift collars to the shift rods.
Mount the centering pins (41).



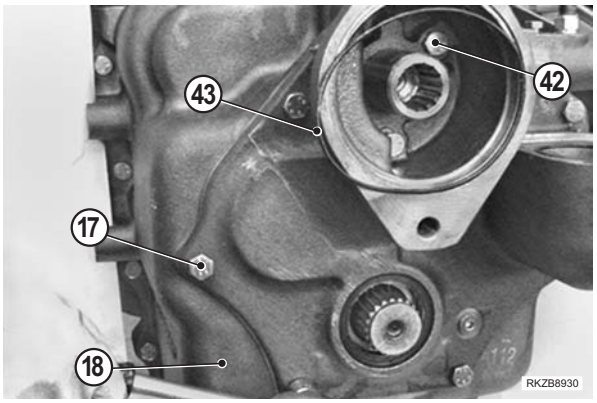
33 - Use the **F8**special tool to install a new seal (19) on rear cover.
Push until the seal touches the lip in the hole.



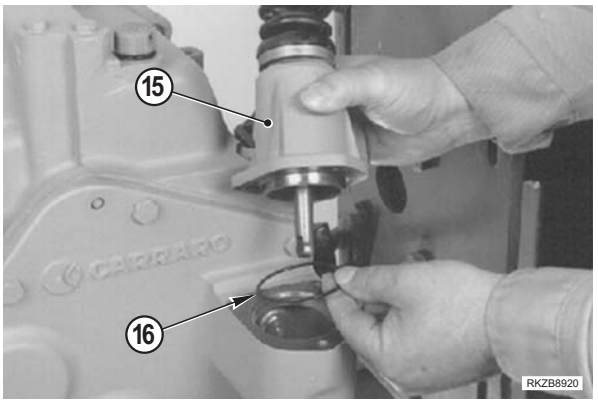
34 - Position the rear cover (18).
Make sure that the pin (41) is correctly installed both in the rear housing and through the hole in the rear cover.
Install the six cap screws (17) and the two cap screws (42) to fasten the cover to the rear half housing.

Screw: 50 Nm

35 - Mount the O-ring (43).

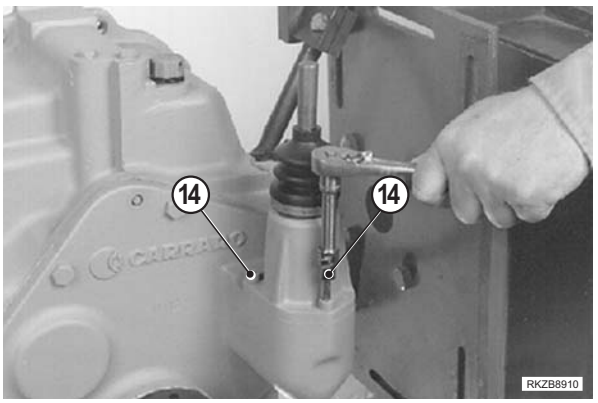


36 - Install a new O-ring (16) on the shift tower assembly (15).
Use clean oil to lubricate the O-ring and assembly it on the rear housing.



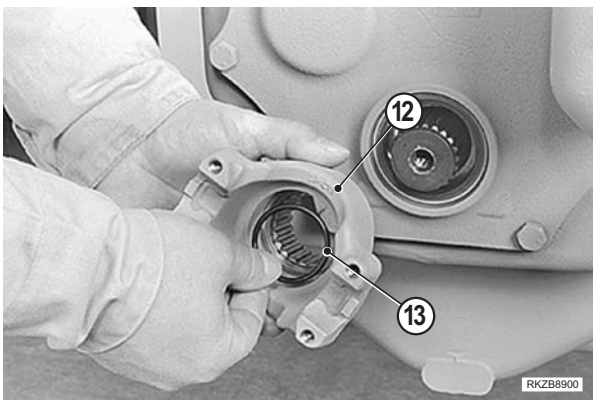
37 - Tighten the bolts (14) to fasten the shift tower assembly to the rear cover.

Screw: 23 Nm

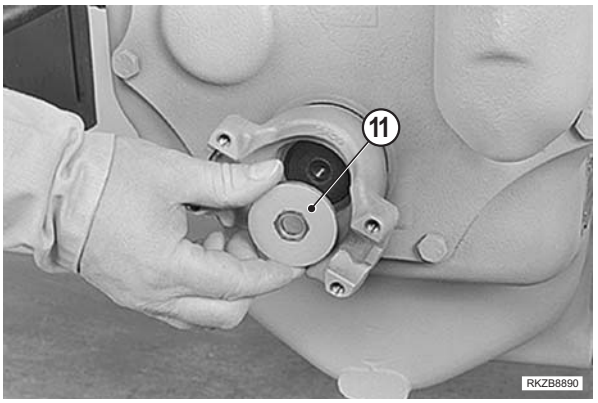


38 - Install a new O-ring (13) in the output flange (12).

39 - Use clean oil to lubricate the O-ring.

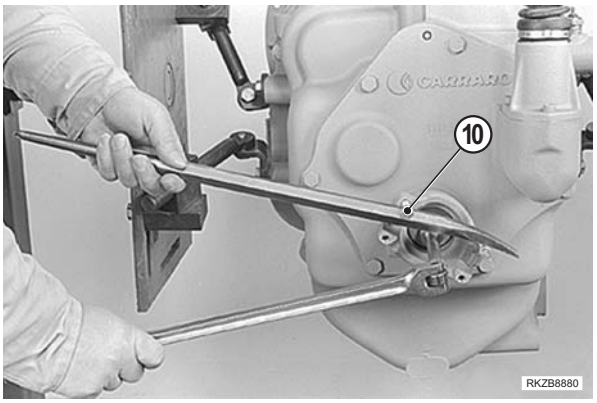


40 - Install the washer (11).



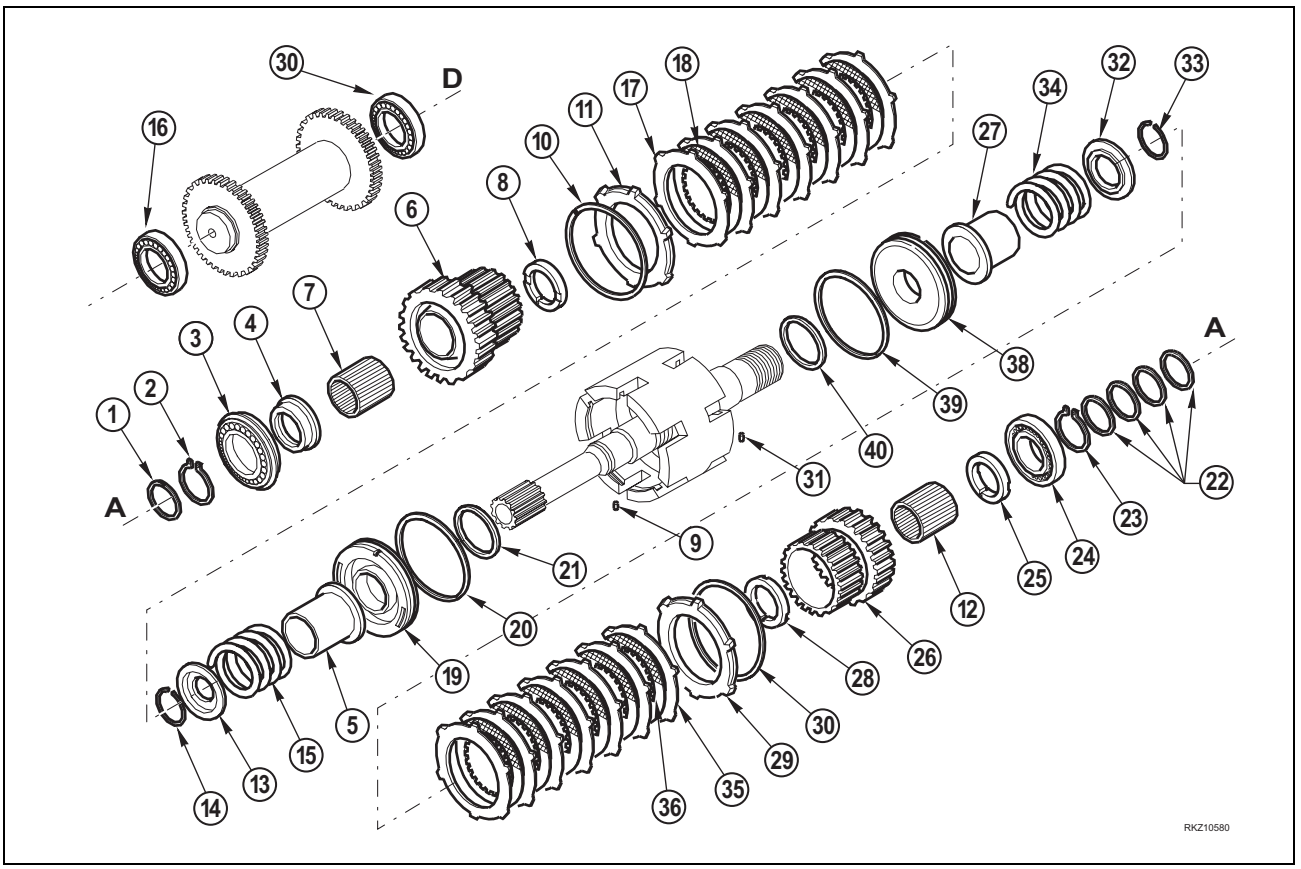
41 - Tighten the screw (10) using a lever to prevent flange rotation.

Screw: 139 Nm

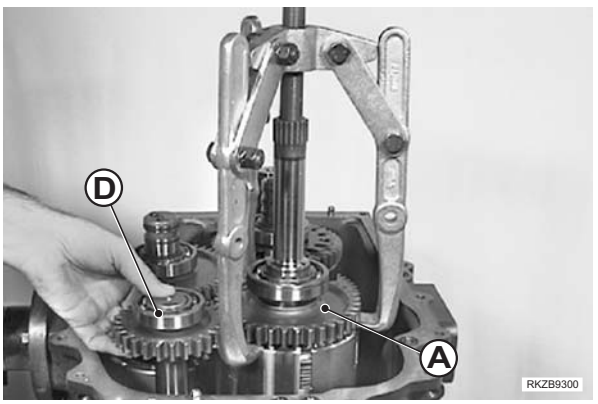


7. SHAFTS A - D

7.1 Disassembly

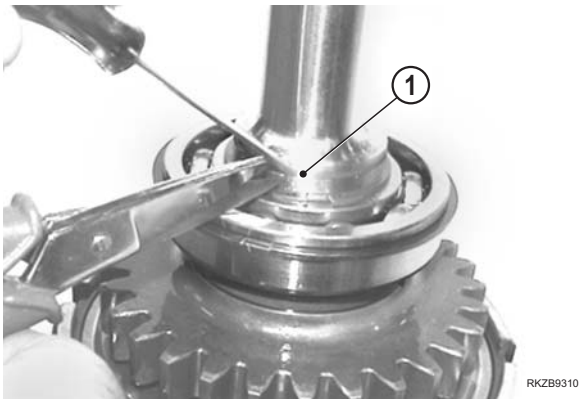


1 - Grab shaft **A** and simultaneously extract shafts **A** and **D**.

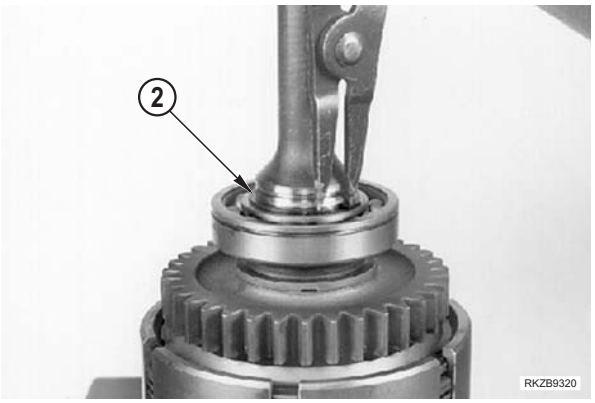


Shaft A

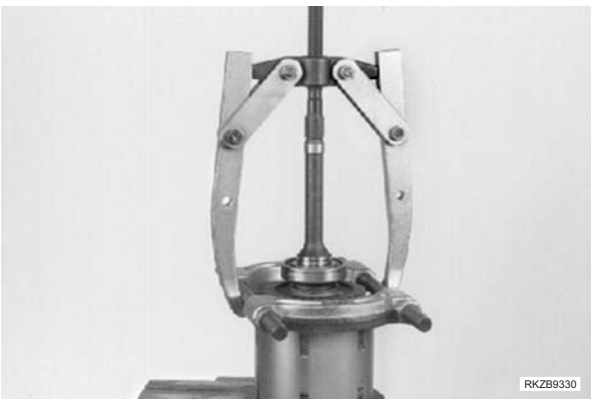
1 - If to be replaced, remove the teflon seal ring (1).



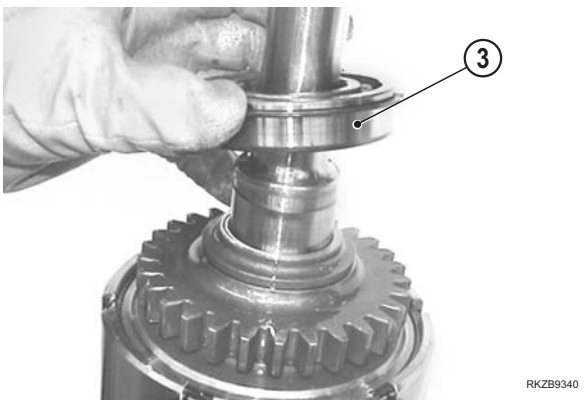
2 - Remove the snap ring (2).



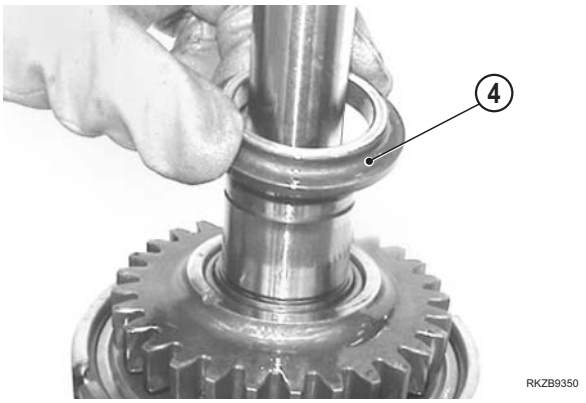
3 - Install a bearing separator under the gear as shown (do not install the bearing separator between the gear and the bearing).
Use a puller on the bearing separator and insert a shaft protector between the puller and the end of the input shaft.
By means of puller which operates between bearing separator and shaft protector pull only until the bearing is free. Pulling anyfarther can damage the parts.



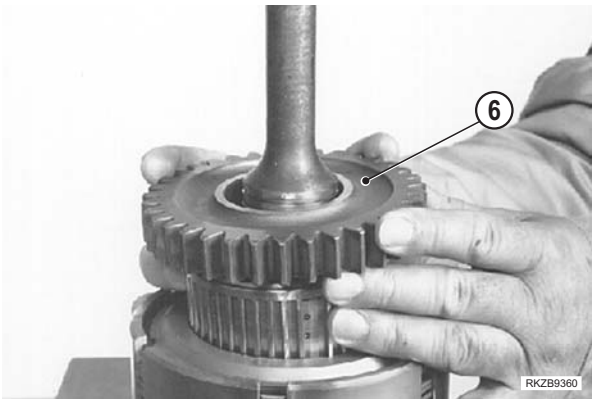
4 - Remove bearing (3).



5 - Remove spacer (4).



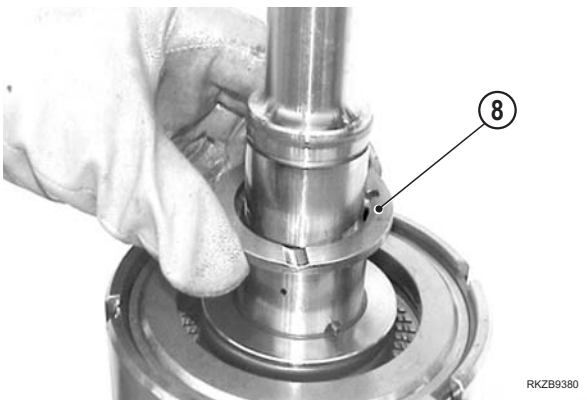
6 -Remove gear (6).



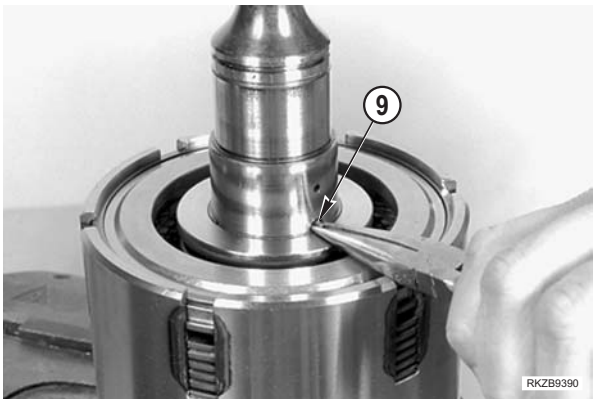
7 -Remove needle cage (7).



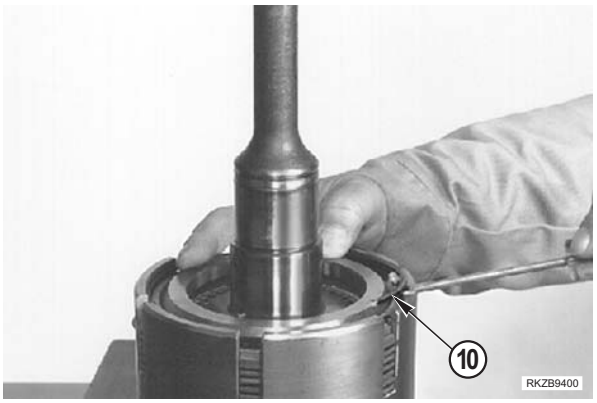
8 -Remove spacer (8).



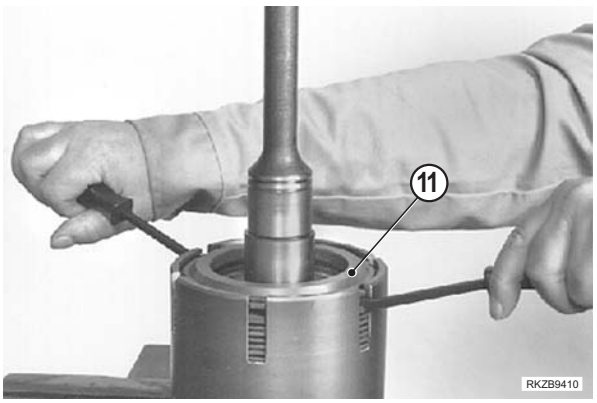
9 -Remove split pin (9).



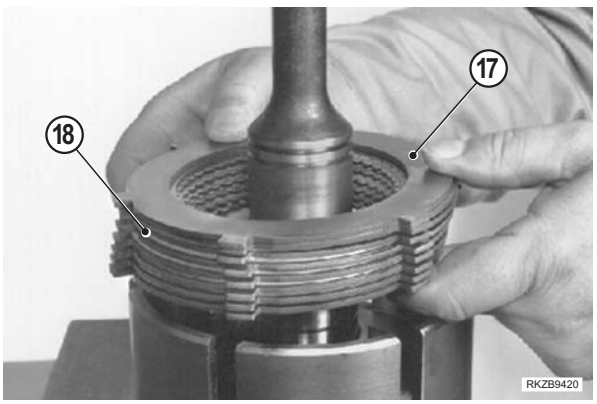
10 - Remove the snap ring (10).



11 - Use prybars to lift and to remove the clutch plate lock ring (11) evenly.



12 - Remove the clutch plates (18) and the clutch drive plates (17).



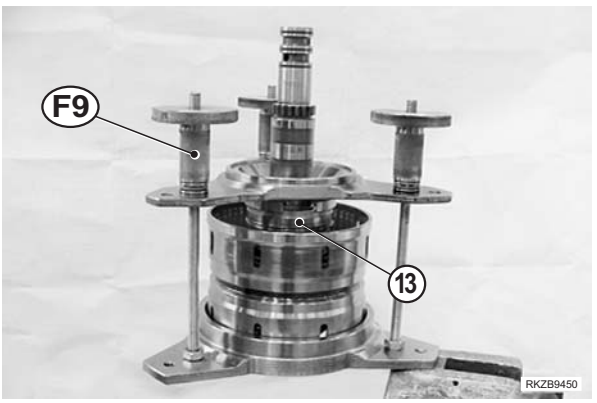
13 - Place a mark below the groove on the friction bell.



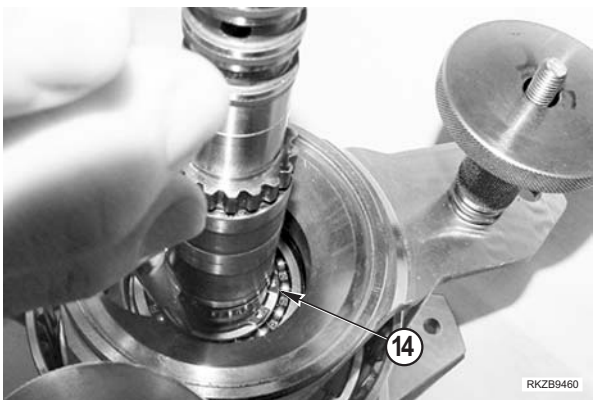
14 -Place a mark on each clutch plate lock ring (11), clutch plate (18) and clutch drive plate (17).
These marks will be used for reference during the reassembly procedure.



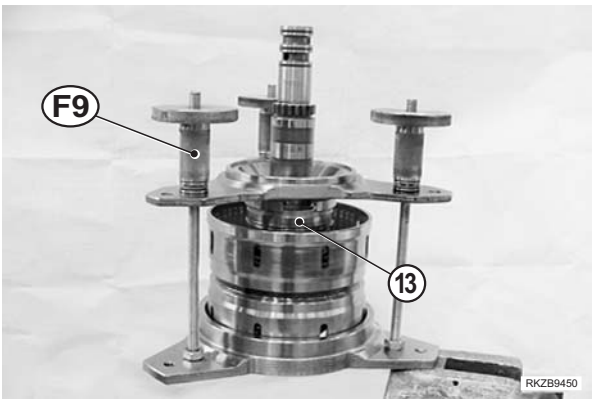
15 -Use the tool **F9** lower lock spring cover (13).



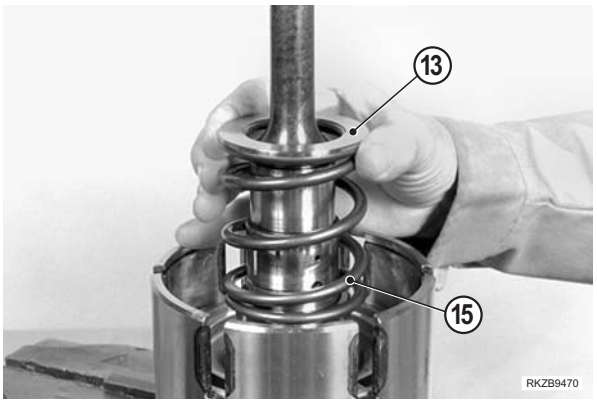
16 -Remove snap ring (14).



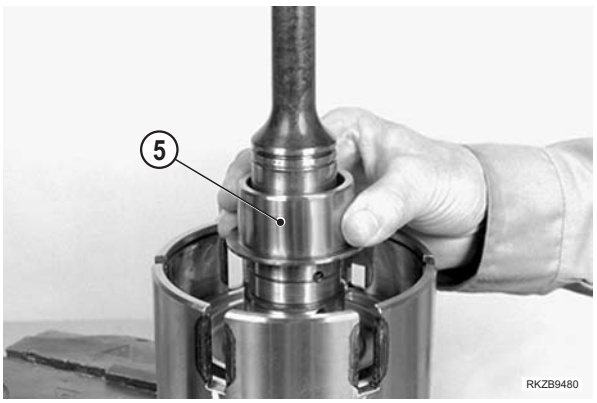
17 -Loosen the handles of the threaded rods to release the tension from the spring.
Remove the top piece of the F9 special tool.



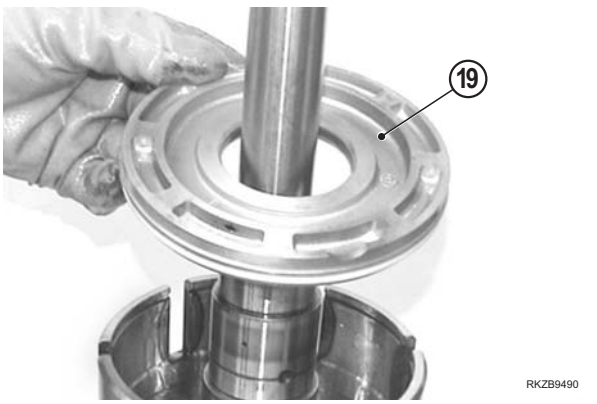
18 - Remove lock spring cover (13) and spring (15).



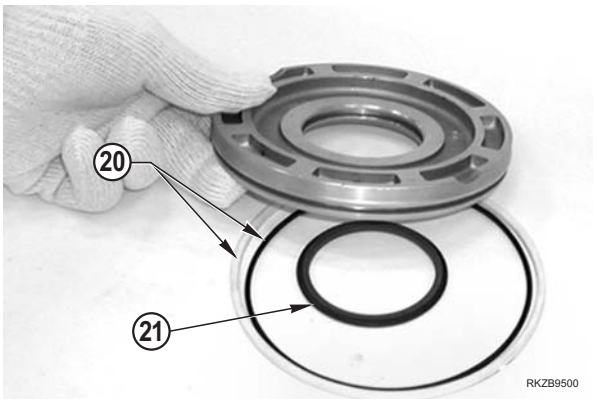
19 - Remove sleeve (5).



20 - Introduce low pressure compressed air into the delivery hole and expel piston (19).

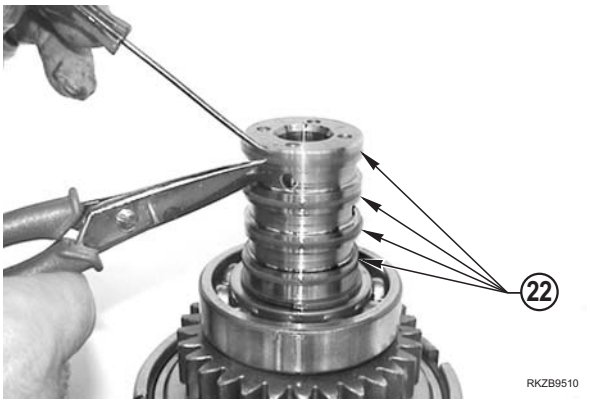


21 - If to be replaced, remove teflon seal ring (20) and relevant inner O-ring (20) from outer seat of piston and teflon seal rings (21) and relevant inner O-ring (21) from inner of piston.
To remove the rings it is necessary to cut them.

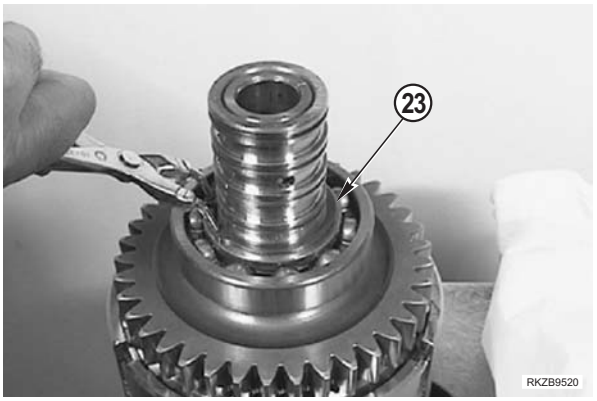


22 -Turn the shaft.

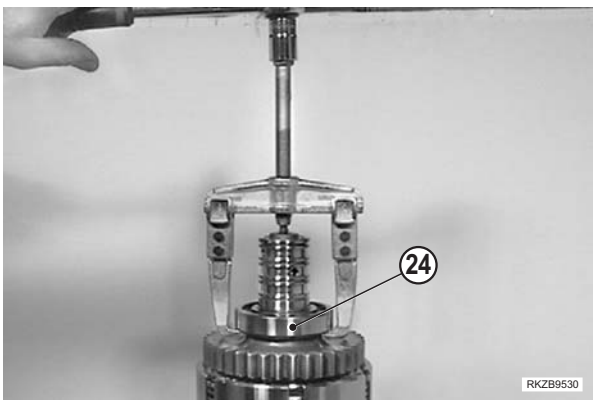
23 -If to be replaced, remove teflon seal rings (22) by cutting them.



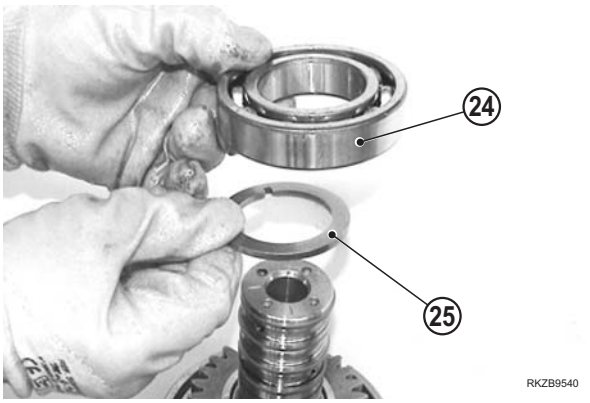
24 -Remove snap ring (23).



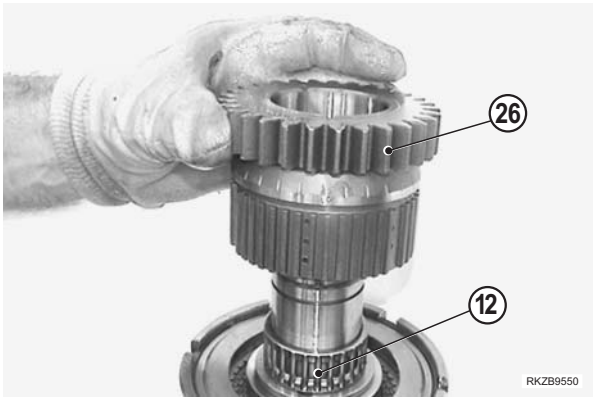
25 -Remove bearing (24) by means of an extractor..



26 -Remove bearing (24) and thrust washer (25).



27 - Remove gear (26) and needle cage (12).

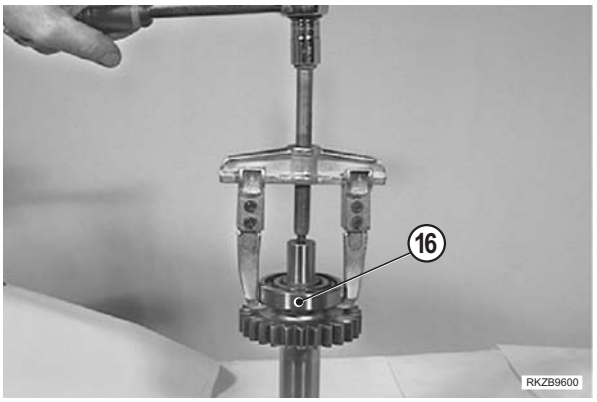


28 - Repeat the procedure described so far to remove the components of this clutch.

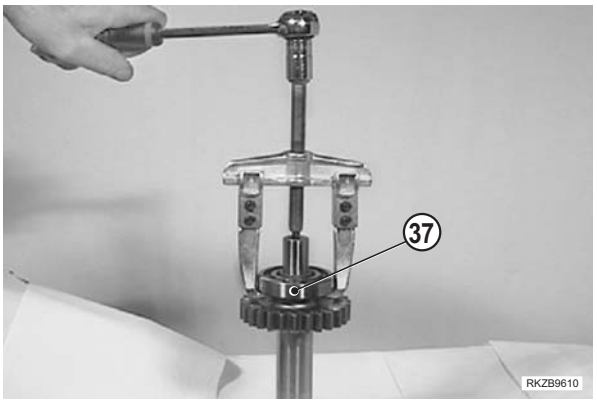


Shaft D

1 - Remove bearing (16) of shaft **D** by means of an extractor.



2 - Remove bearing (37) of shaft **D** by means of an extractor.



Checks and inspections

1 - Inspect grooves on (large and small) sealing rings for wear or damage.
Replace parts if necessary.

2 - Inspect output shaft for wear or damage.
Check oil passages in the output shaft for restrictions or foreing matter.

3 - Check ball bearings and roller bearings for smooth areas, pits or other damage.

4 - If the clutch discs are to be used again, keep the clutch packs in the same previous dismantling order separate and record which clutch pack goes with each clutch.

5 - 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.
Also inspect the clutch drive plates (17) for being perfectly flat, and check them for pits or scratches.
If any of the above conditions exists on any of the plates, replace the clutch unit with a new one.

6 - If a new clutch unit is to be used, leave the unit soaked in transmission oil for at least one hour before installing. In any case, before attempting to install the clutch unit, lubricate the contact surfaces of the clutch drive plates with transmission oil.
Check the hole on the input shaft entering the rear half housing for any damage that may later cause leaks when clutch is installed.
Check the splines on the input shaft for damage caused by steel plates.
Replace parts as necessary during installation.





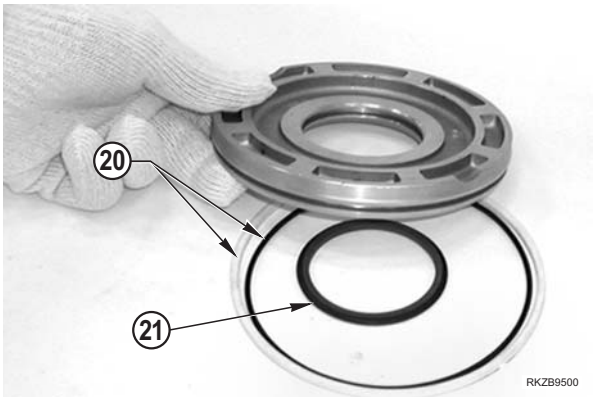


Number of clutch plates (each side)	6
Number clutch steel plate (each side)	7
Nominal clutch drive plate thickness	2.5±0.05 mm
Nominal clutch plate thickness	1.75±0.05 mm
Maximum clutch plate wearing (each side)	0.2 mm

7.2 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.



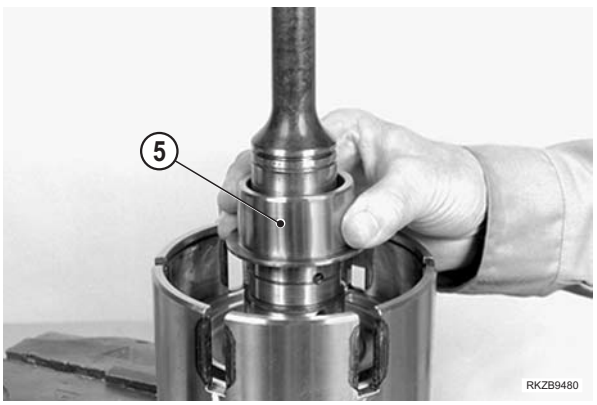
2 - Apply a thin film of grease on the sealing rings just inserted.



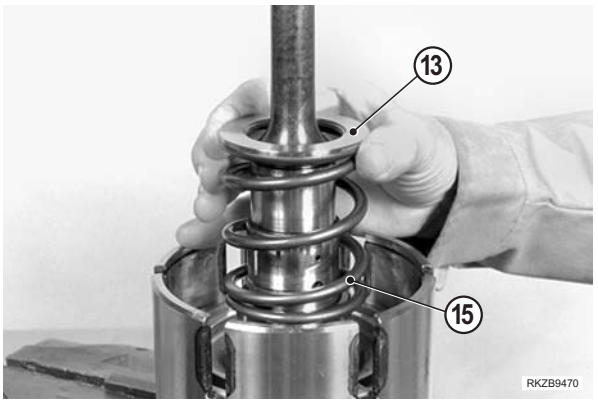
3 - Insert clutch piston (19) with special tool **F10** as protection of seal rings (21).



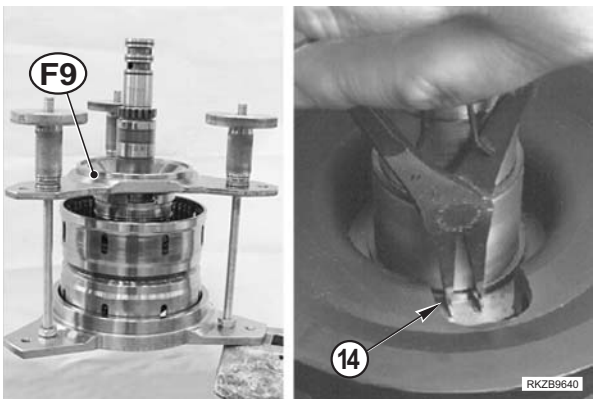
4 - Assemble sleeve (5).



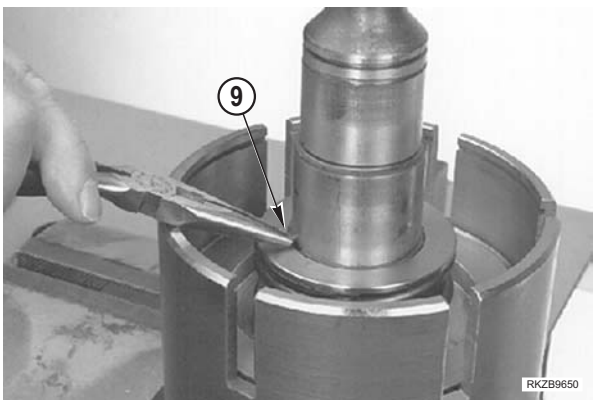
5 -Assemble spring (15) and lock spring cover (13).



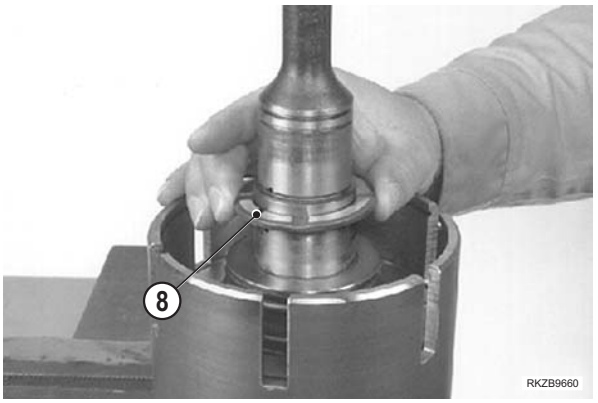
6 -Lower the lock spring cover (13). Insert lock ring (14). Use tool **F9**.



7 -Remove tool **F9** and assemble split pin (9).



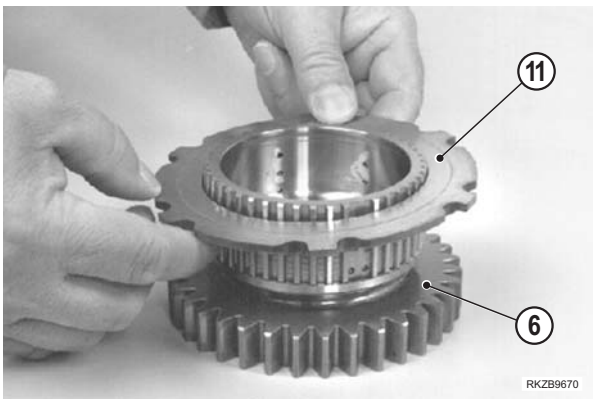
8 -Insert thrust washer (8)



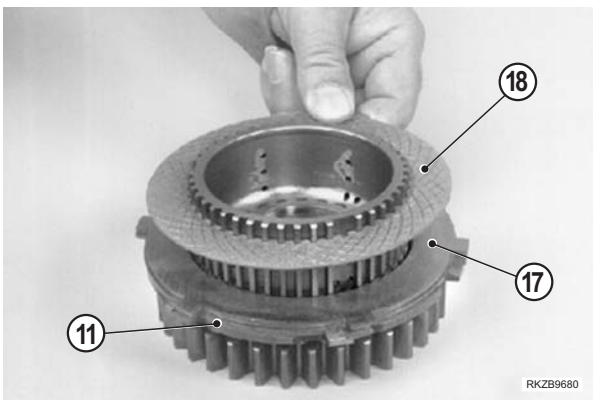
9 - Insert needle cage (7).



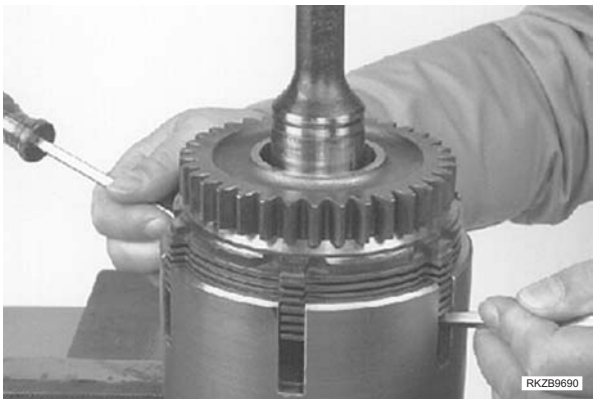
10 - To assemble the clutch pack start with the gear (6) on the bench. Install the clutch plate lock ring (11) so that the reference mark on top of the plate made during disassembly is facing towards the gear.



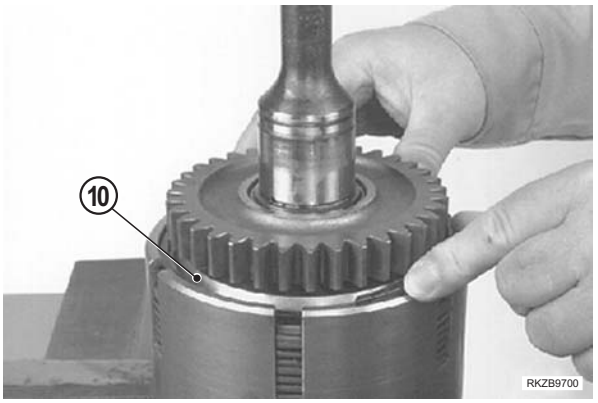
11 - Assemble clutch plates (18) and clutch drive plates (17) on the gear (6). The assembled clutch pack must contain seven clutch drive plates and six clutch plates.



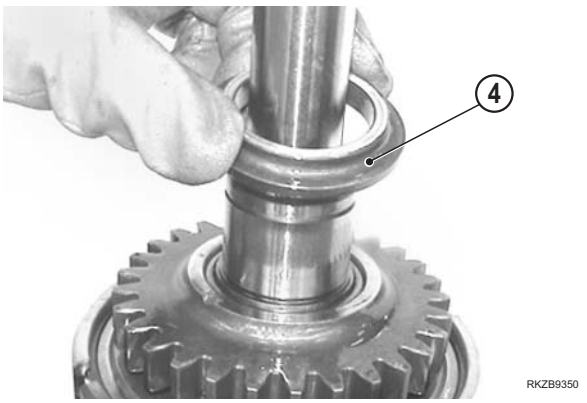
12 - Locate the pack assembly by means of two screwdrivers.



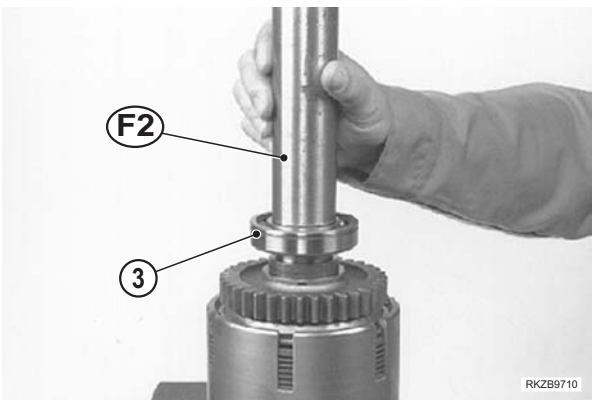
13 -Assemble snap ring (10).



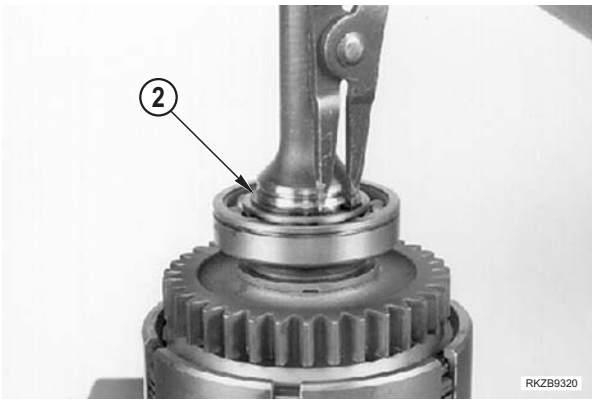
14 -Assemble washer (4).



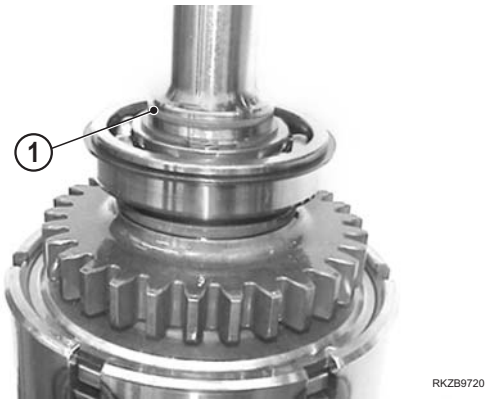
15 -Heat the bearing (3) to 80–100 °C (176 - 212°F) and install using tool **F2**.



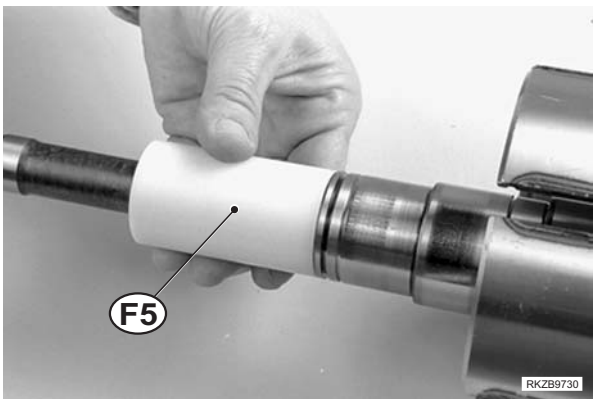
16 -Install the stop ring (2).
Measure clearance between clutch plate lock ring and first clutch drive plate (17).
The clutch plate lock ring must be lifted against the stop ring. Distance must be 2.3–4.3 mm.
If distance is not within the specified range, the likelihood is that the clutch has been installed improperly.
Check clutch for proper operation (for details, see "7.3 Checking clutch functionality").



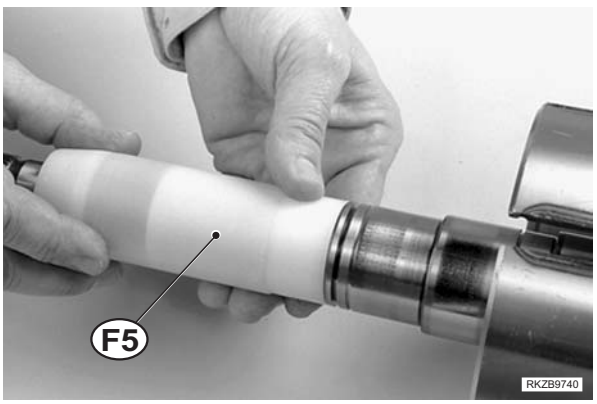
17 - Insert the teflon seal ring (1) as follows.



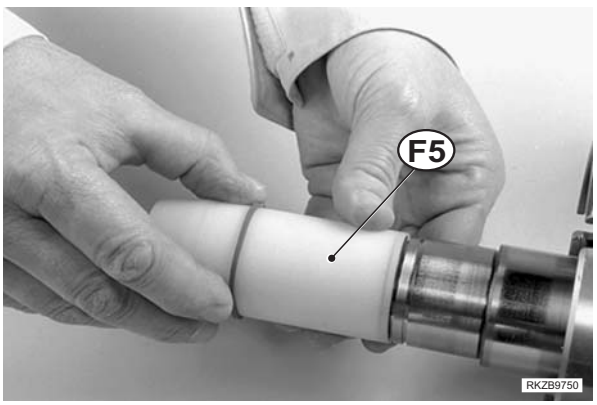
18 - Install the **F5** spacer onto the input shaft with the chamfered end facing in.



19 - Slide the **F5** 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.



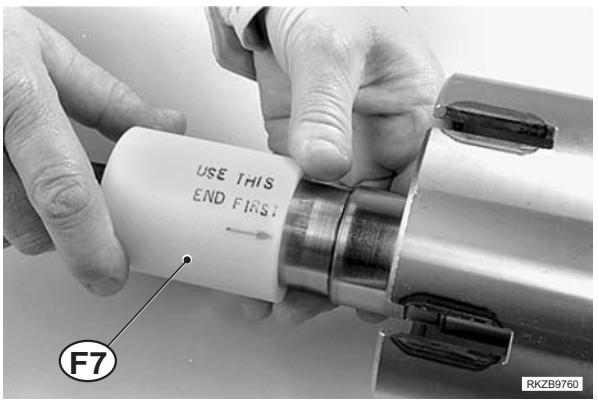
20 - Heat the Teflon seal ring to 60°-80°C (140°-176° F) for 5 minutes.
Install the teflon seal ring onto the expander/protector.



21 - 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.



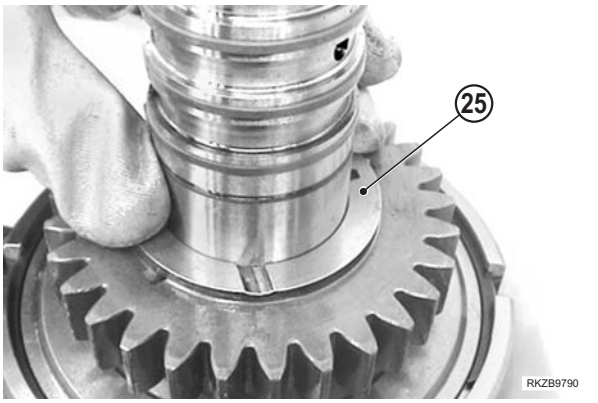
22 - Install the end of the **F7** seal compressor with the deep chamfer onto the shaft and over the sealing ring. Use a back and forth twisting motion to allow the seal compressor to slip over the top of the sealing ring and seat the sealing ring into the groove. Be careful not to damage the seal ring. After the sealing ring is seated in the groove, remove the seal compressor from the shaft.



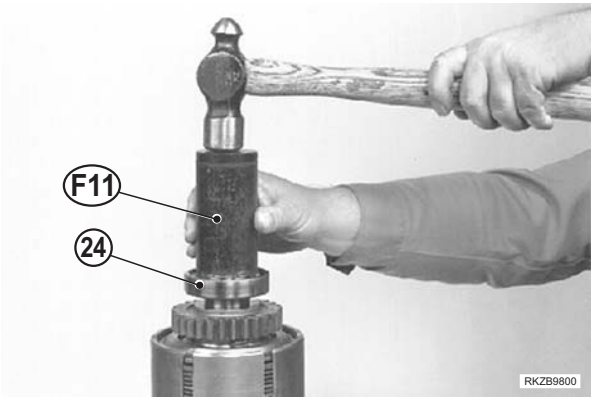
23 - Turn the seal compressor around and slide the end with the narrow chamfer over the shaft and over the seal ring. Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove. After the seal ring has cooled, remove the seal compressor from the shaft.



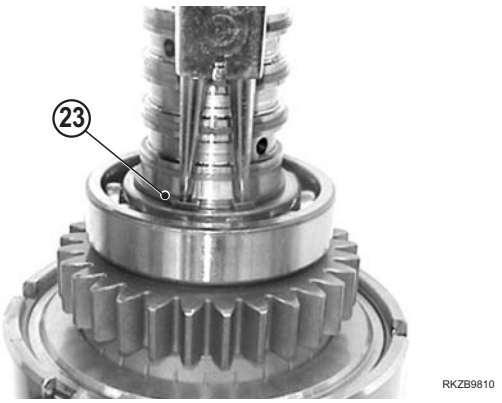
24 - Turn the shaft around and carry out steps 1 - 10 for the other clutch. Lubricate the ring (25) with transmission oil. Install the ring (25) so the notch on the inside rim goes onto the pin. Make sure that the side with the oil grooves is down.



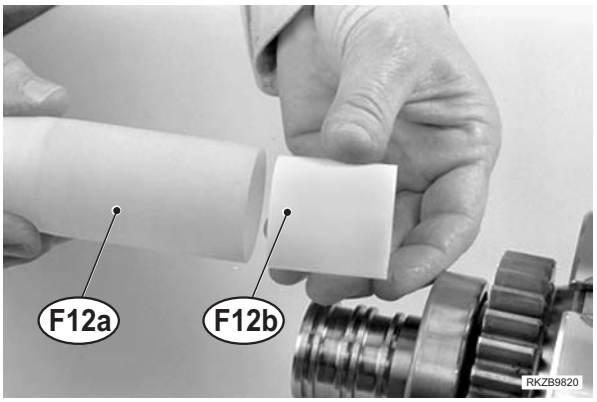
25 - Heat the bearing (24) to 80÷100 °C (176° to 212 °F)
Use driver **F11** to drive the bearing (24) onto the input shaft until the bearing makes contact with the thrust washer.



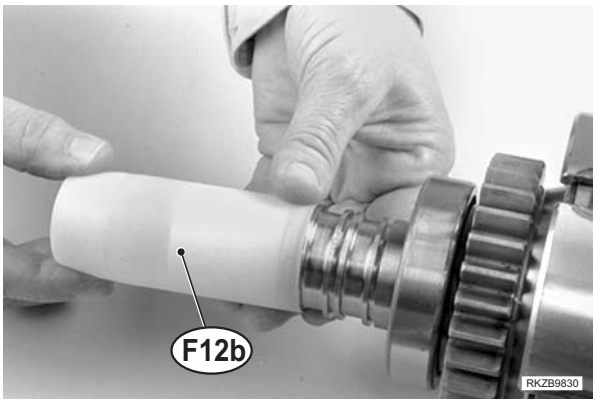
26 - Assemble snap ring (23).



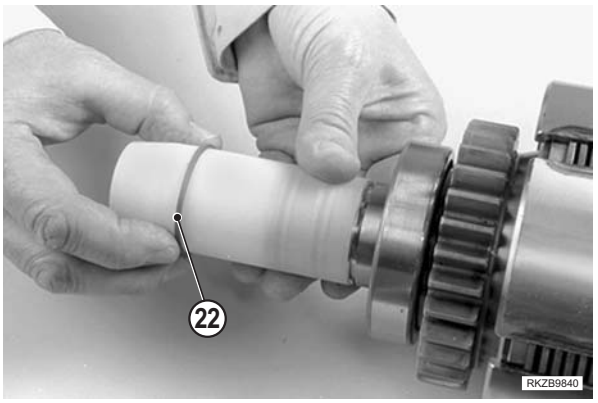
27 - Assemble the teflon seal rings (22) as follows: place the **F12a** spacer into the **F12b** expander/protector.



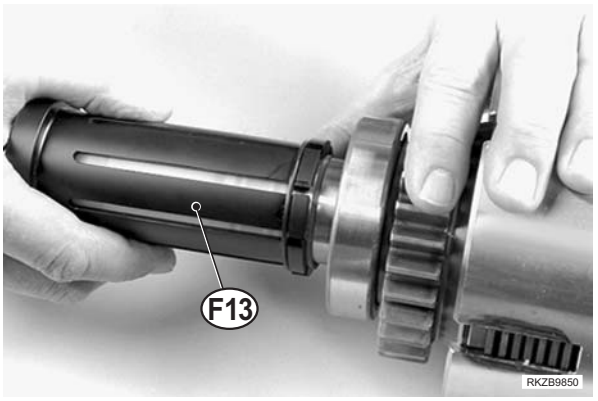
28 - Slide the **F12b** expander/protector and the spacer onto the shaft.
The expander/protector will stop in the correct position to install the seal ring in the groove.



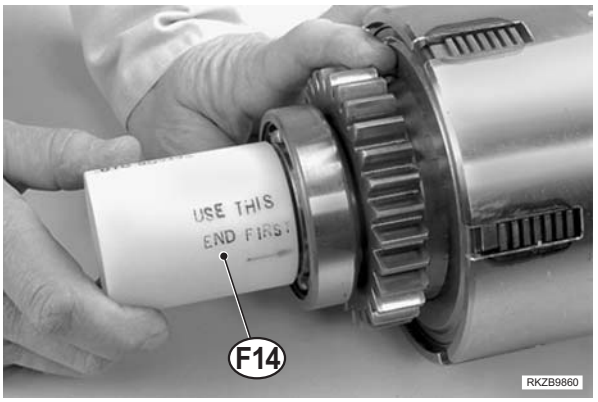
29 - Heat the Teflon seal ring to 60°-80°C (140°-176° F) for 5 minutes.
Install the teflon (22) seal ring onto the expander/ protector.



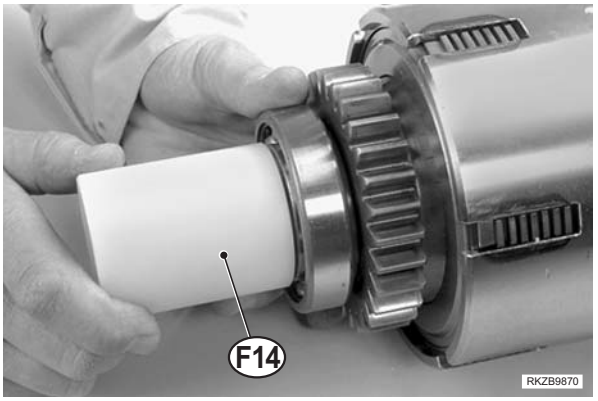
30 - Install the **F13** pusher over the expander/protector and slide the seal ring until it reaches the groove in the shaft. Remove the pusher, expander/protector, and spacer from the shaft.



31 - 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.

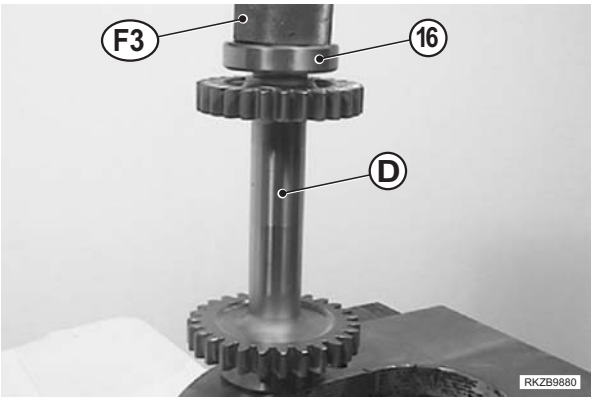


32 - Turn the seal compressor around and slide the end with the narrow chamfer over the shaft and over the seal ring. Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove. After the seal ring has cooled, remove the seal compressor from the shaft.
For the introduction of the other three teflon rings, repeat the operations from sequence 27 to sequence 31, using the following spacer rings:
CA715743/2 for the 2nd teflon ring,
CA715743/3 for the 3rd teflon ring,
CA715743/4 for the 4th teflon ring.

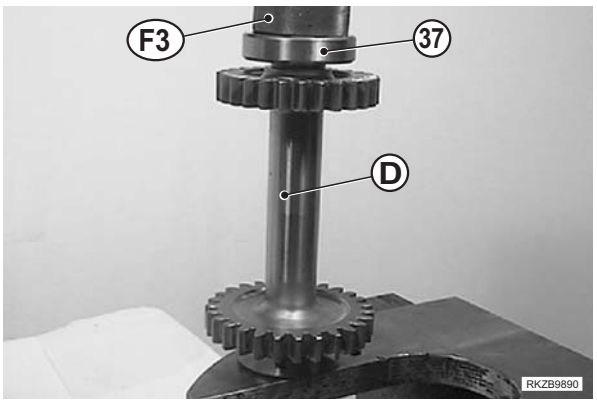


Shaft D

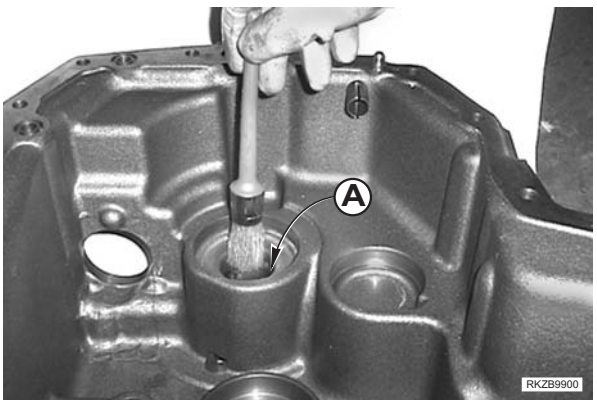
1 - Assemble **D** shaft bearing (16).
Use tool **F3**



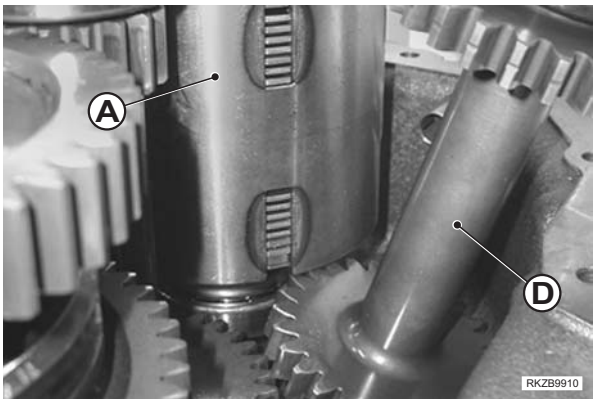
2 - Assemble **D** shaft bearing (37).
Use tool **F3**.



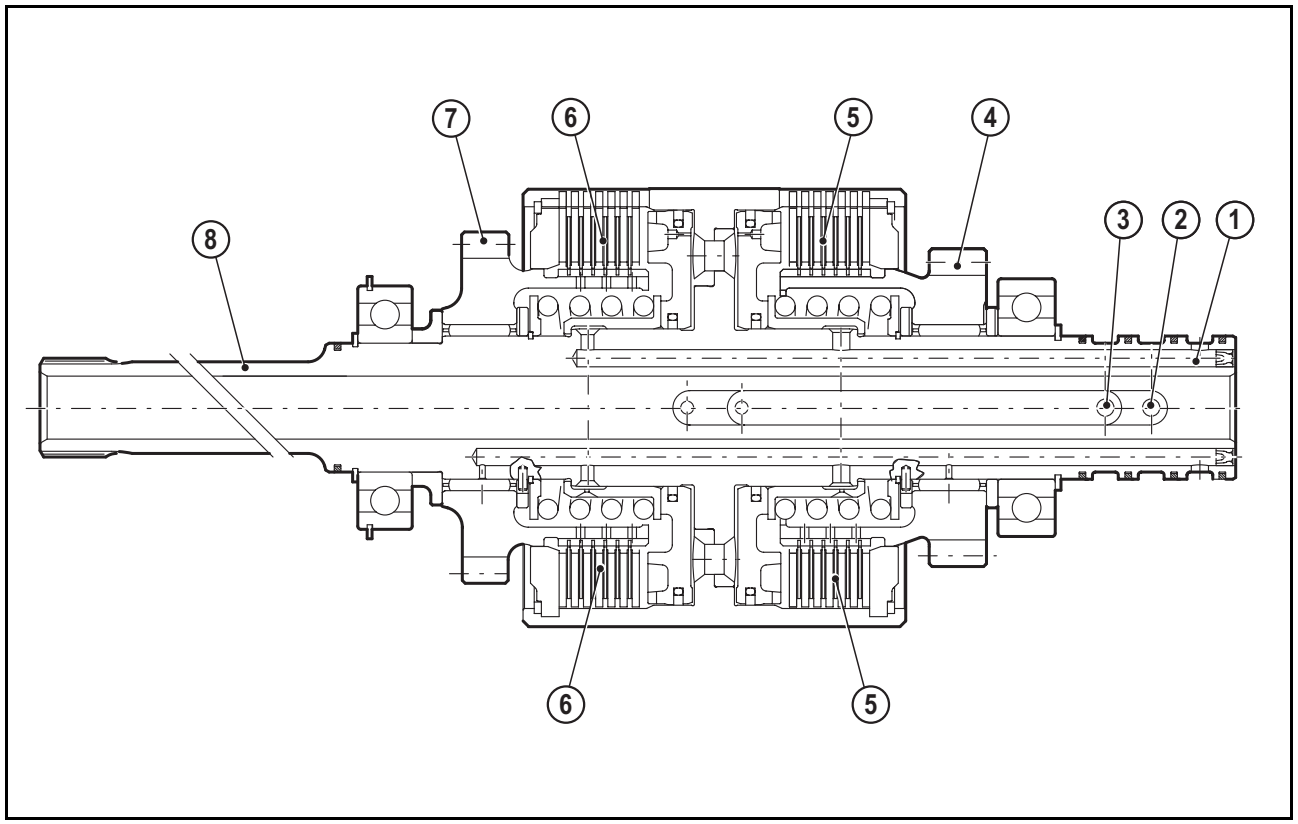
3 - Lubricate with oil the shaft seat A.**A**.



4 - Fit shaft assembly **D** and shaft assembly **A**.
The operation is correct only if the two shafts are fitted at the same time.



7.3 Checking clutch functionality



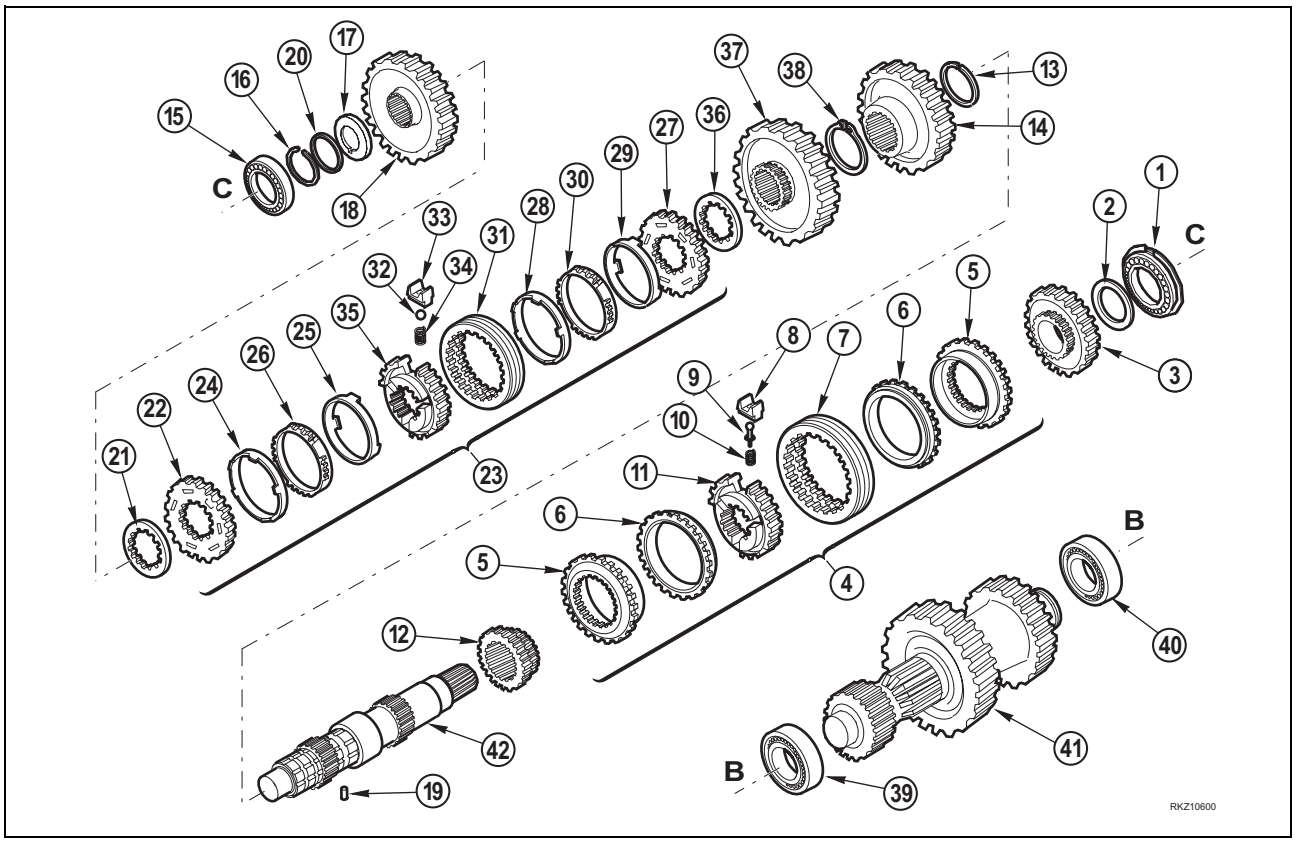
1. Lubrication oil passage
2. Forward clutch passage
3. Reverse clutch passage
4. Forward gear
5. Forward clutch pack
6. Reverse clutch pack
7. Reverse gear
8. Input shaft

1 -Apply compressed air of approximately 6 bar to the forward clutch passage. Listen to hear the forward piston moving to lock the forward 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.

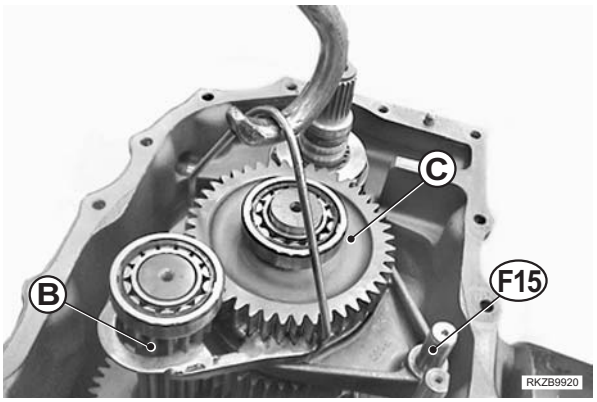
2 - Apply compressed air of approximately 6 bar to the reverse clutch passage. Listen to hear the reverse piston moving to lock the reverse clutch pack. Try to move the reverse gear. The forward gear must not turn on the input shaft. Try to move the forward gear. The reverse gear must turn freely on the input shaft. If the clutches do not work correctly, disassemble the clutches to find the problem.

8. SHAFTS B - C

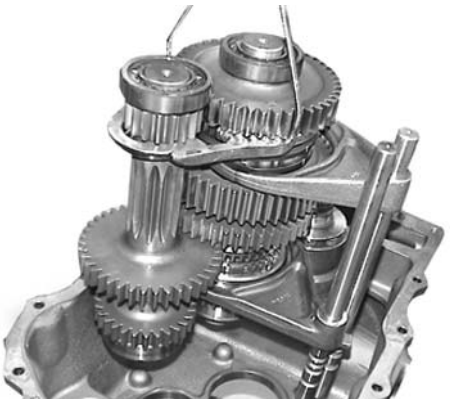
8.1 Disassembly



1 - Remove the shafts **B** and **C** with special tool **F15**.

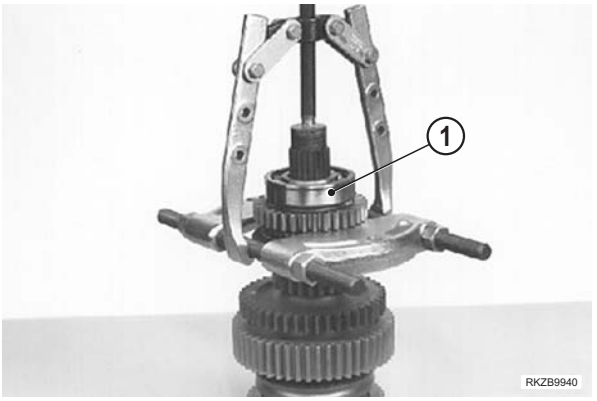


2 - Remove the gear control forks.

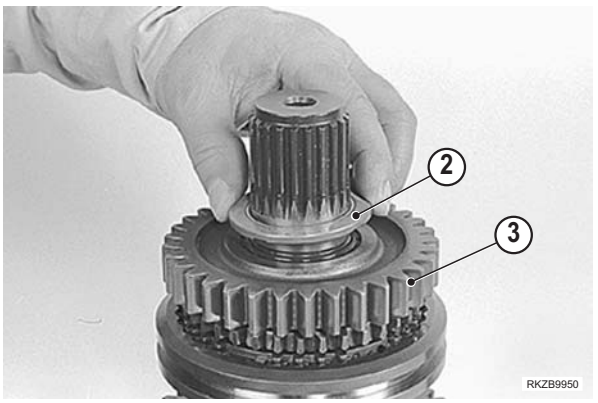


Shaft C

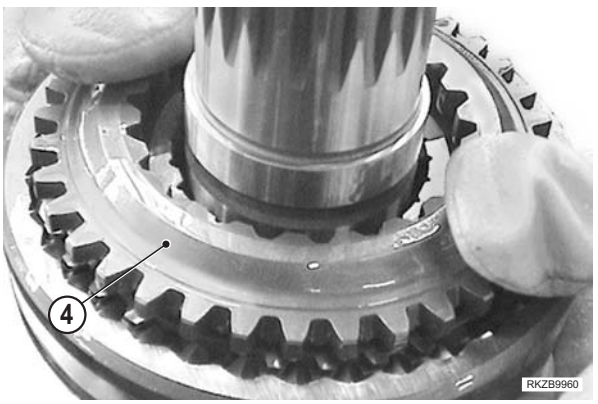
1 -Remove bearing (1) by means of an extractor.



2 -Remove thrust washer (2) and third speed gear (3).



3 -Remove third/fourth speed synchronizer assembly (4).

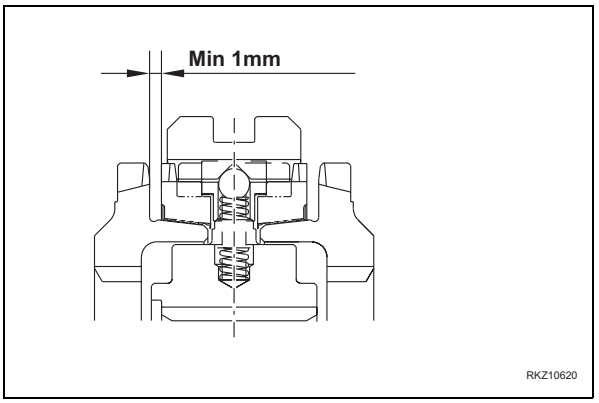


4 -Remove the clutch ring (5) from each side of the synchronizer assembly.
The synchronizer assembly component parts are serviced as a complete unit.
The synchronizer assembly may be disassembled for inspection and cleaning.
If any of the parts are damaged, the entire synchronizer assembly must be replaced.



5 - Use a feeler gauge to measure the clearance between the bottom of the teeth on the synchronizer ring and the edge of the sleeve on the outside of the synchronizer assembly.
This clearance should be approximately 1.0 mm with used parts in good condition.
If clearance is equal to or smaller than 0.5 mm, replace the complete synchronizer.
Inspect both sides of synchronizer for wear.

★ Thickness must be not less than 1 mm.



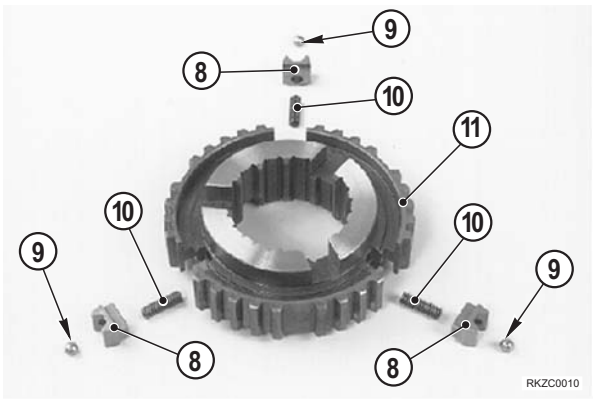
6 - Remove the tapered friction ring (6) from each side of the synchronizer assembly.



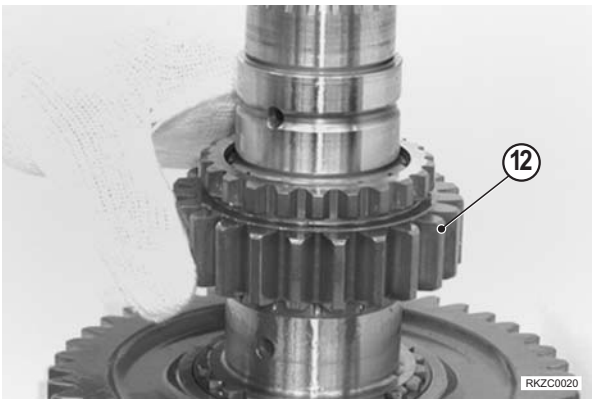
7 - Do not remove the sleeve (7) from synchronizer hub unless it is absolutely necessary.
When removing the sleeve from the hub, be aware that spring plates, hub pins and hub springs are free from the hub and are expelled fast.
Pay attention not to misplace these parts.



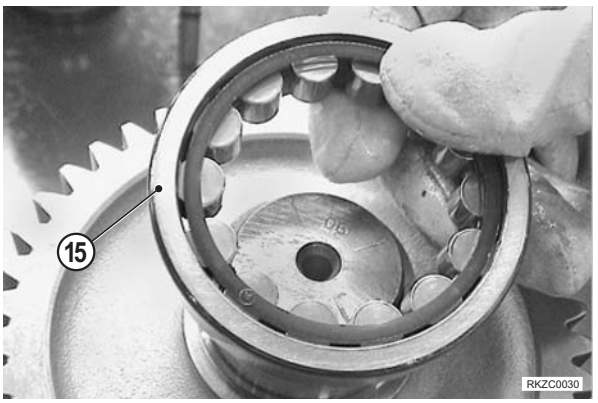
8 - The synchronizer hub contains 3 plates (8), 3 balls (9), and 3 hub springs (10).



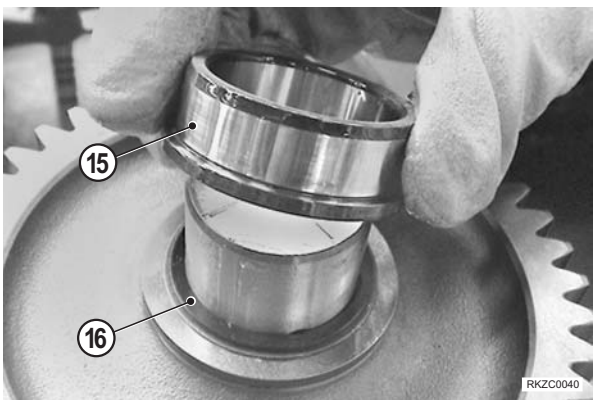
9 -Remove fourth speed gear (12).



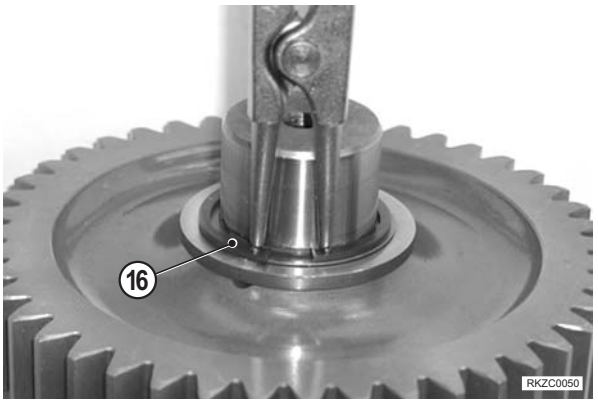
10 -Turn shaft around and remove bearing outer ring (15).



11 -Using a puller, remove bearing inner ring (15).
Do not extract bearing using the gear as a puller. The stop ring (16) will prevent removal.



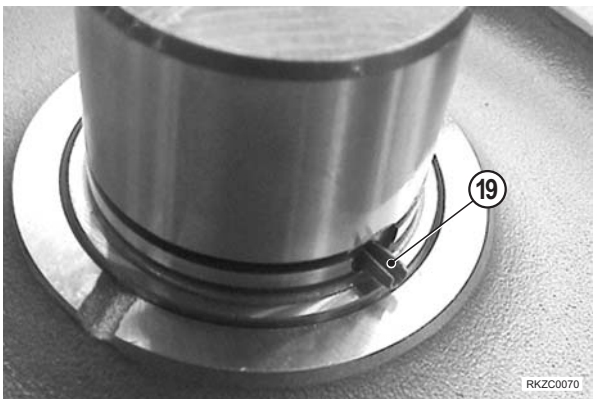
12 -Remove snap ring (16).



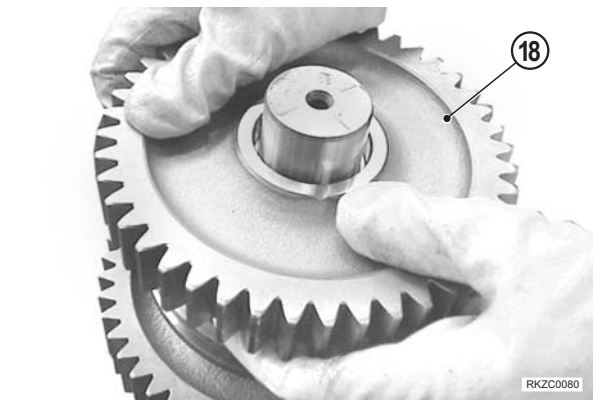
13 -Remove the shims (20) and the thrust washer (17)



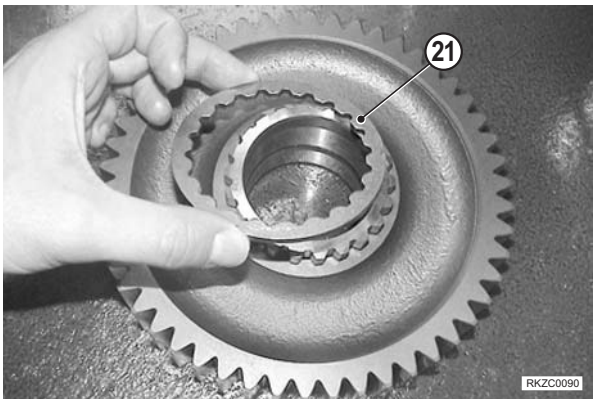
14 -Remove split pin (19).



15 -Remove second speed gear (18).



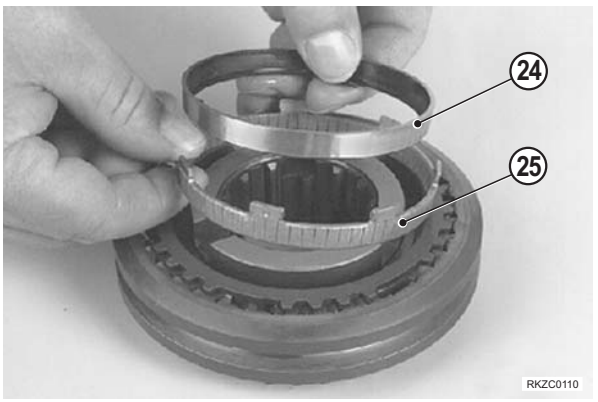
16 -Remove the spacer (21).



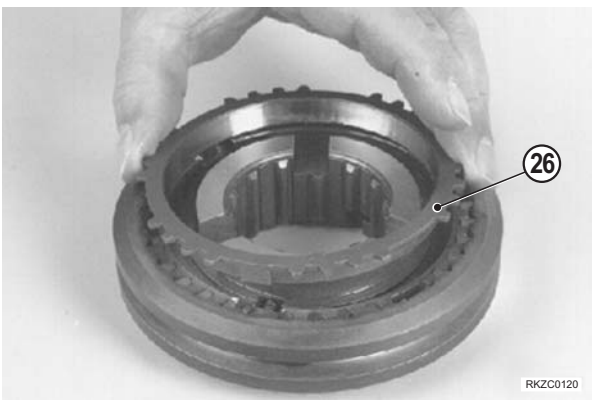
17 - Remove the first/second speed synchronizer assembly (23).
Remove synchronizer ring (22).



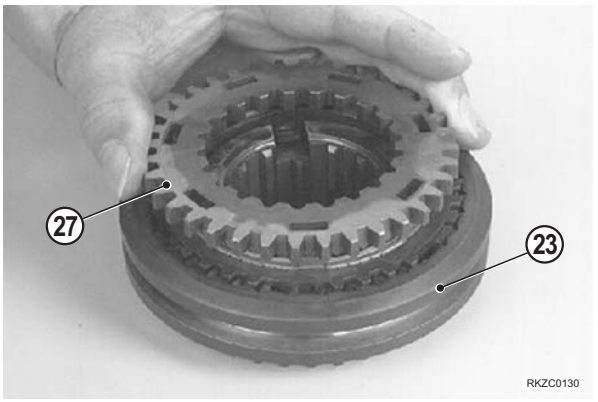
18 - Remove the steel ring (24) and the sintered ring (25).



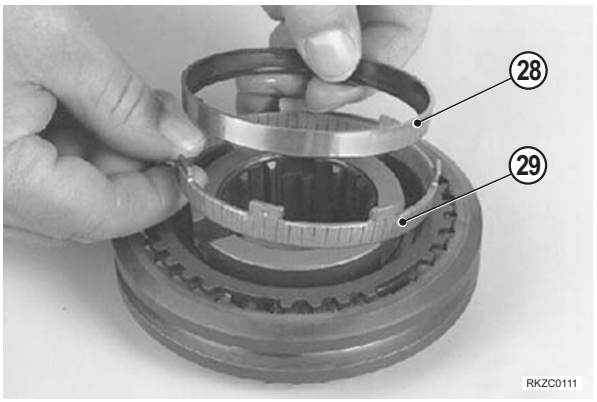
19 - Remove the tapered friction ring (26).



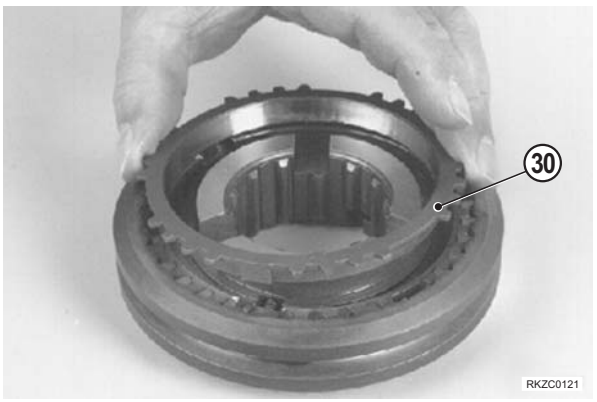
20 - Turn the synchronizer assembly (23) over and remove the synchronizer ring (27) from the other side.



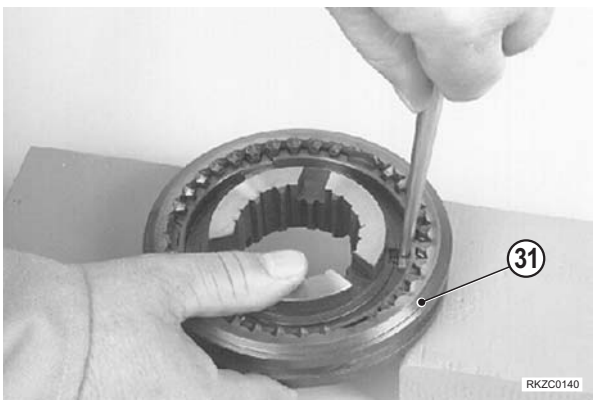
21 - Remove the steel ring (28) and the sintered ring (29).



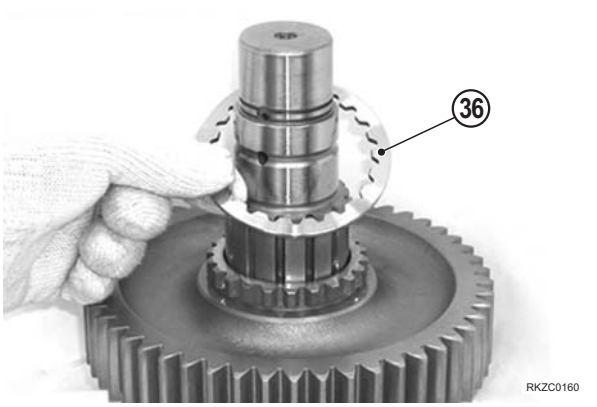
22 - Remove the tapered friction ring (30).



23 - Support the sleeve on blocks.
Push down on the hub while you use a punch to push the detent assemblies out of the sleeve and hub.
Remove the sleeve (31) from the hub.



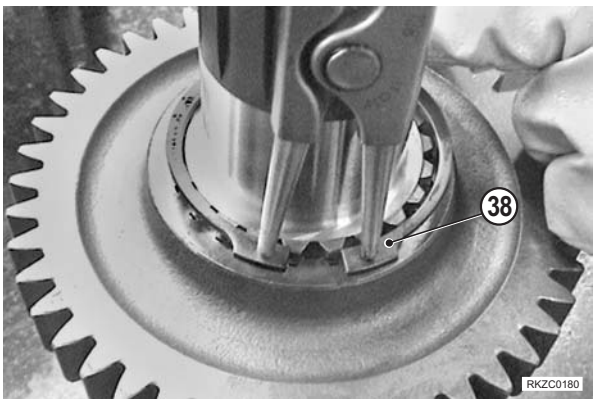
24 - Remove the spacer (36).



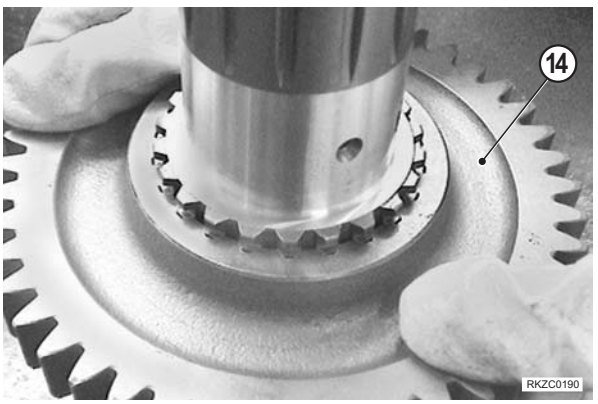
25 -Remove first speed gear (37).



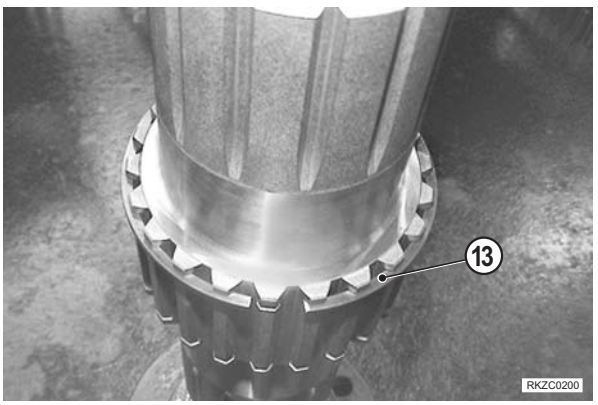
26 -Remove snap ring (38).



27 -Remove the 4WD gear (14).



28 -Remove snap ring (13).



Shaft B

1 - Remove bearing inner race (39) by means of a puller.



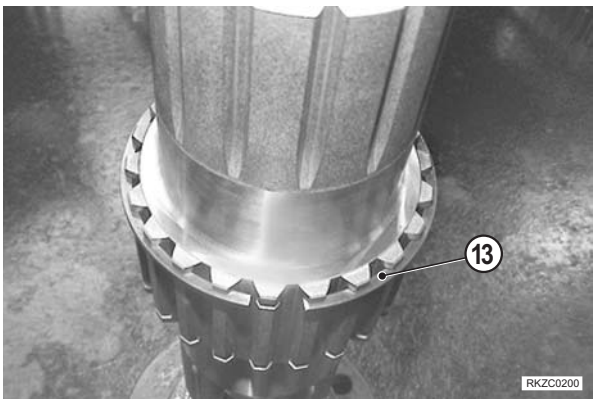
2 - Turn shaft (41) around and remove bearing (40).



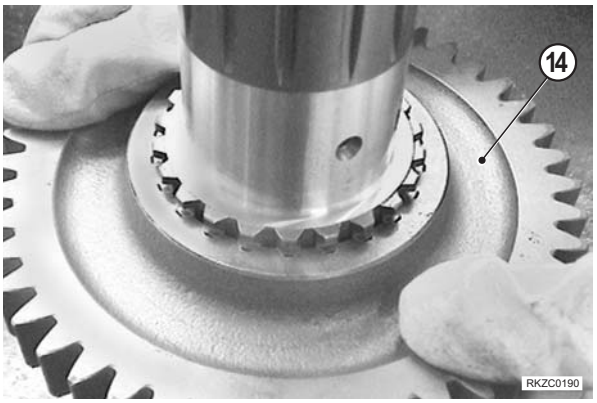
8.2 Assembly

Shaft C

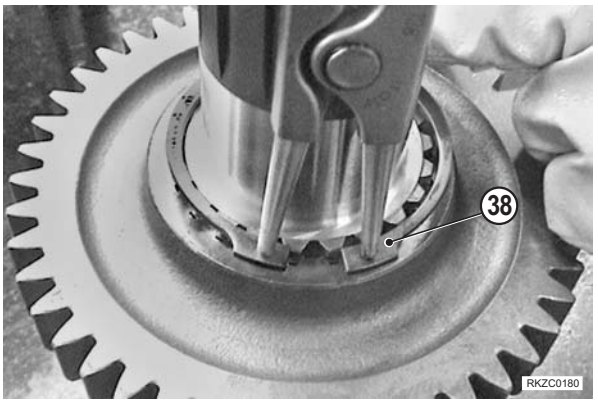
1 - Place shaft on bench so the side with serrated edge is facing upwards.
Install the stop ring (13).



2 - Assemble 4WD gear (14).



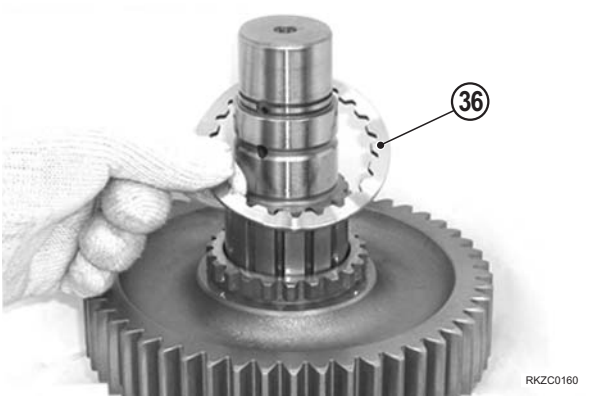
3 -Assemble snap ring (38).



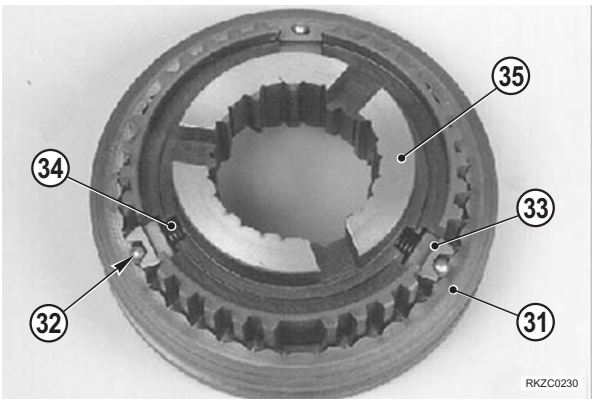
4 -Assemble the first speed gear (37).



5 -Assemble spacer (36).



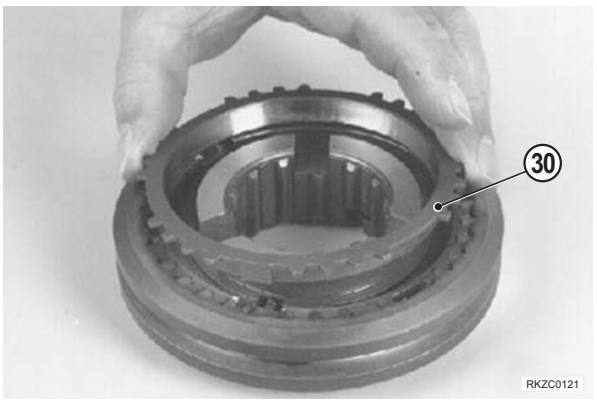
6 -Assemble the first/second speed synchronizer (23). Assemble on the hub (35) the spring (34), the blocks (33), the balls (32), and the sleeve (31).



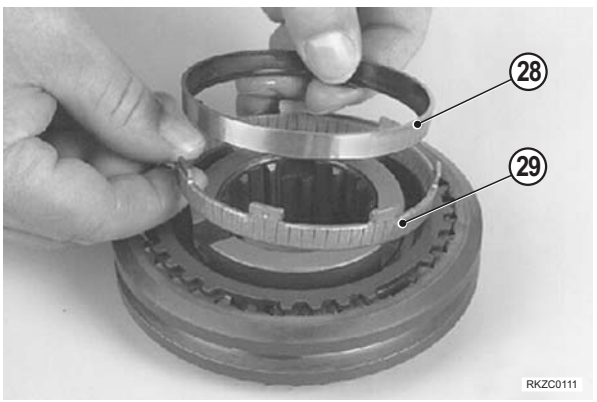
7 - Using a punch or screwdriver push in the balls (32) to complete hub assembly (35).



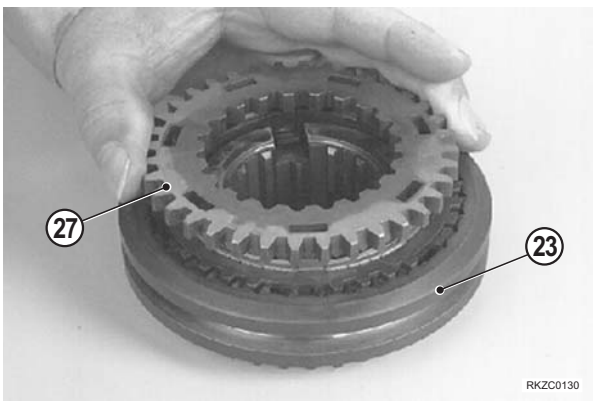
8 - Install the tapered friction ring (30) on the synchronizer assembly.



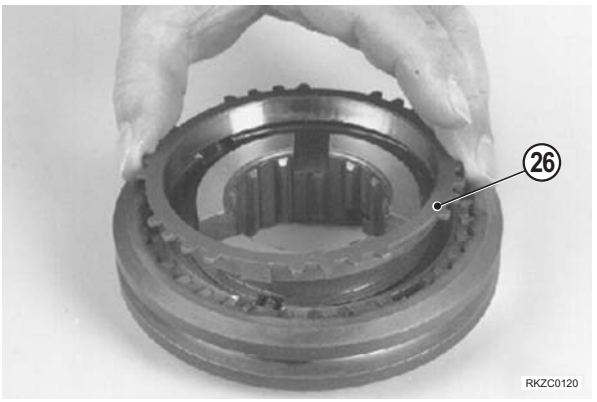
9 - Use clean transmission oil to lubricate the sintered ring (29) and the steel ring (28).



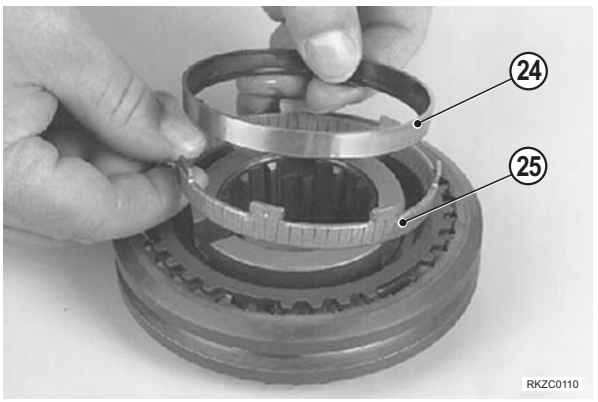
10 - Install the synchronizer ring (27) as shown. The flat sides of the teeth must be up.



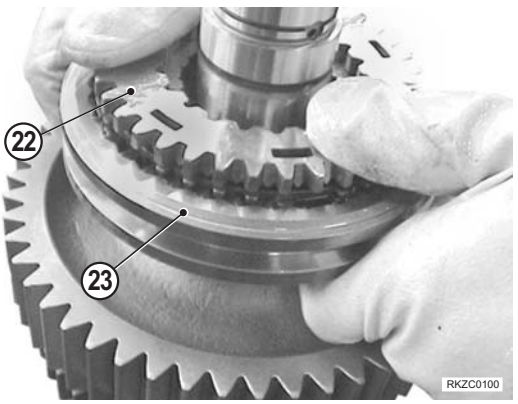
11 - Turn the synchronizer assembly over and install the tapered friction ring (26) on the other side.



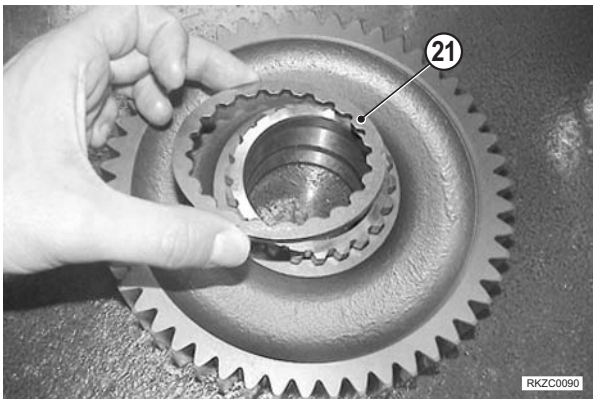
12 - Use clean transmission oil to lubricate the sintered ring (25) and the steel ring (24). Install the sintered ring (25) and the steel ring (24).



13 - Install the upper synchronizer ring (22) so the smooth sides of the teeth are facing upwards.
Install the complete first/second speed synchronizer (23).

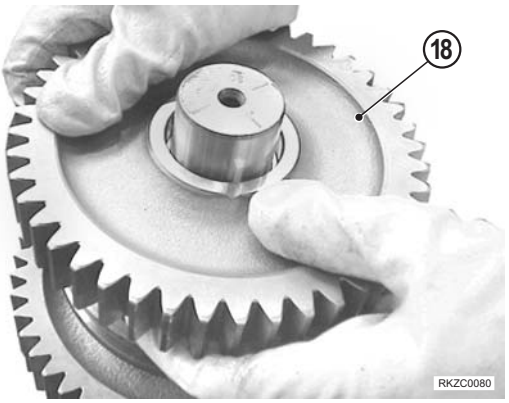


14 - Install the spacer (21) on the second speed gear (18).

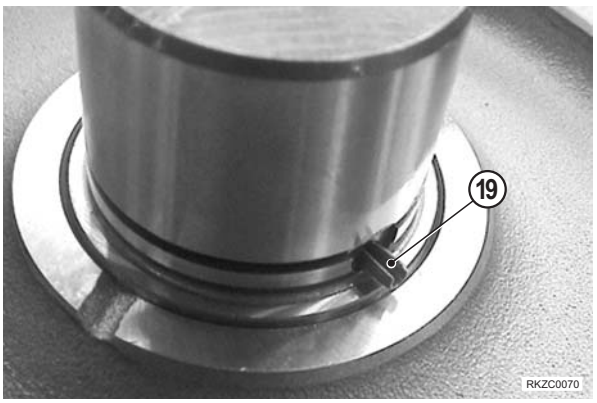


15 - Assemble the second speed gear (18).

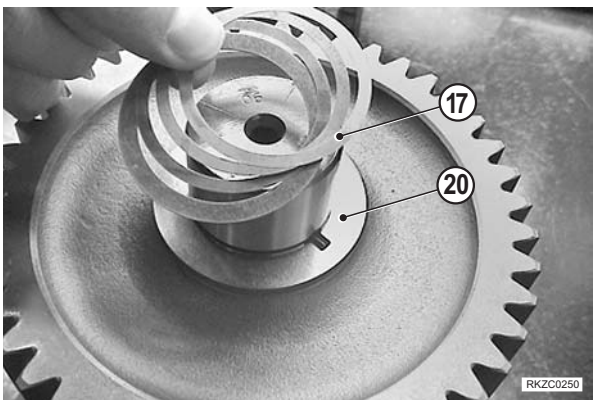
16 - Ensure the spacer (21) and gear (18) make solid contact with the synchronizer (23).



17 - Mount the pin (19).

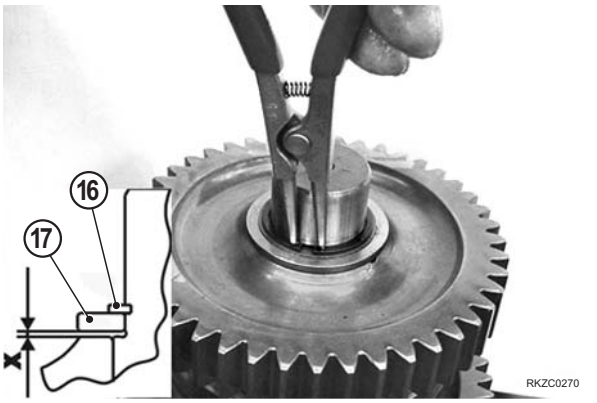


18 - Assemble thrust washer (17) and shims (20).



19 - Install the stop ring (16).
Using a feeler gauge, measure distance **X** between gear (18) and ring (17).

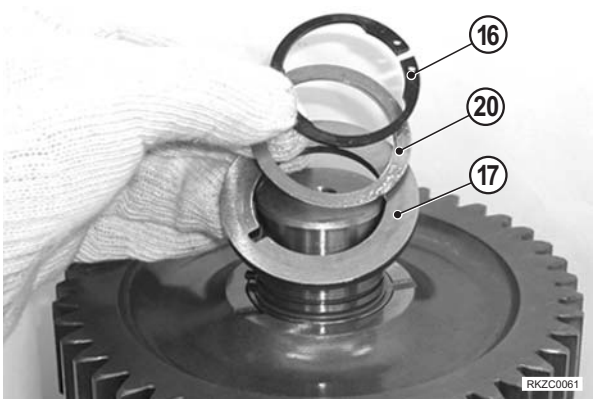
★ Standard clearance: 0.2-0.42 mm.



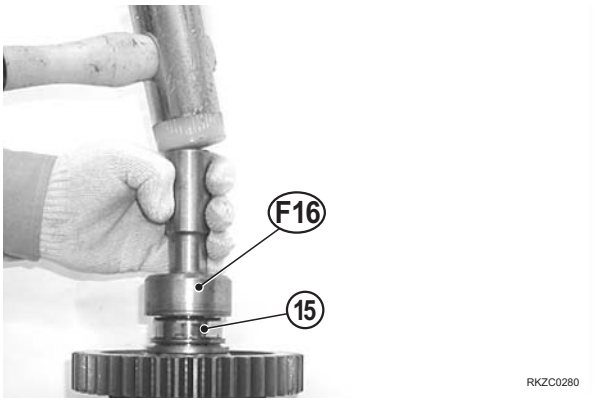
20 - Use a thickness gauge.



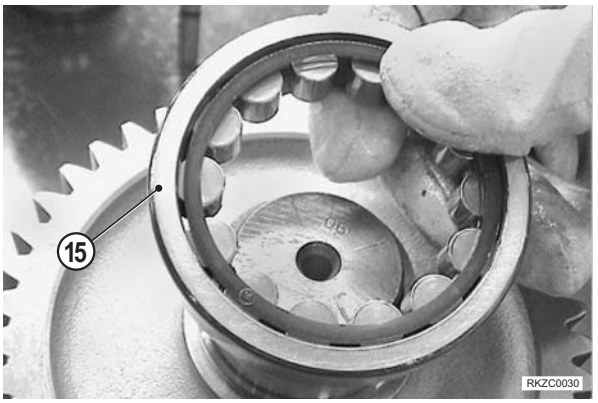
21 - If distance **X** is incorrect, rearrange the shim pack to obtain the specified clearance using the shims available.



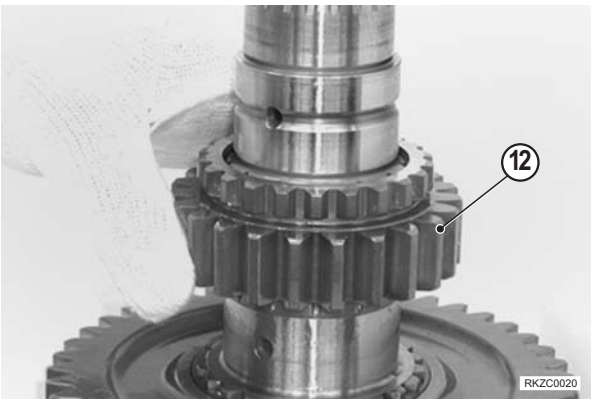
22 - Heat the inner race of the bearing (15) to 80÷100°C (176°÷212°F) and use the tools **F16** mount it on the shaft.



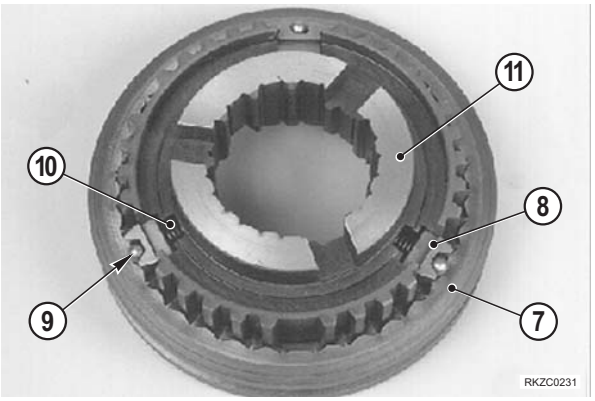
23 - Assemble the outer race of the bearing (15).



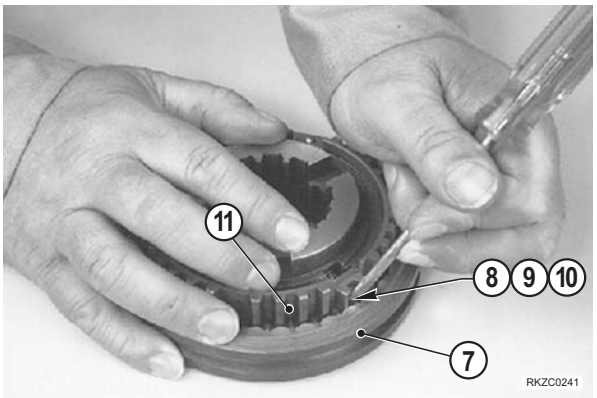
24 - Turn the shaft.
Assemble the fourth speed gear (12).



25 - Assemble the third/fourth speed synchronizer (4).



26 - Install springs (10), blocks (8), balls (9) and sleeve (7) to hub (11).
Using a punch or screwdriver, push in the balls (9) to complete assembly of hub (11).



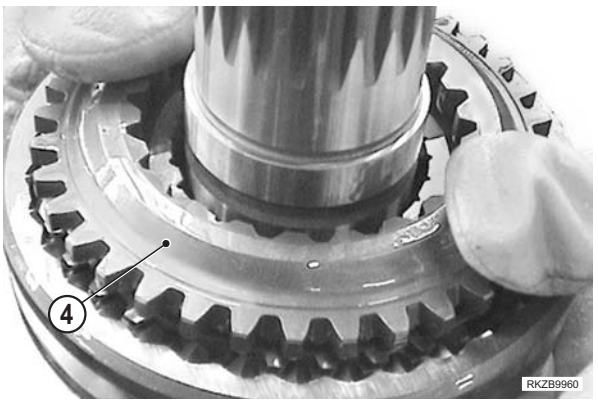
27 - Install the tapered friction ring (6) on each side of the synchronizer assembly.



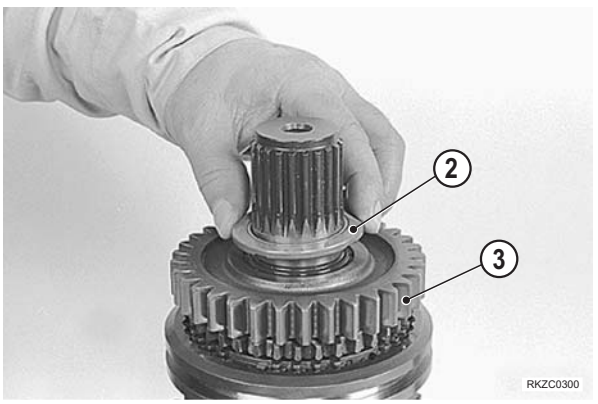
28 - Lubricate clutch ring (5) with transmission oil and install to each side of the synchronizer assembly.



29 - Install the third/fourth speed synchronizer assembly (4) onto the shaft.



30 - Use clean transmission oil to lubricate the thrust washer (2).
Assemble third speed gear (3) and the thrust washer (2) onto the shaft.

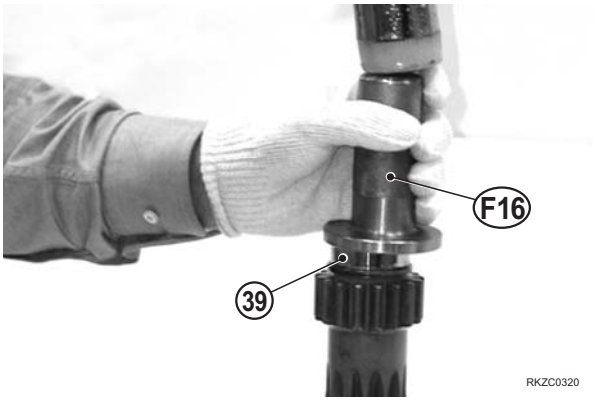


31 - Heat the bearing (1) to 80÷100°C (176°÷212°F).
Use the tool **F2** assemble bearing (1)



Shaft B

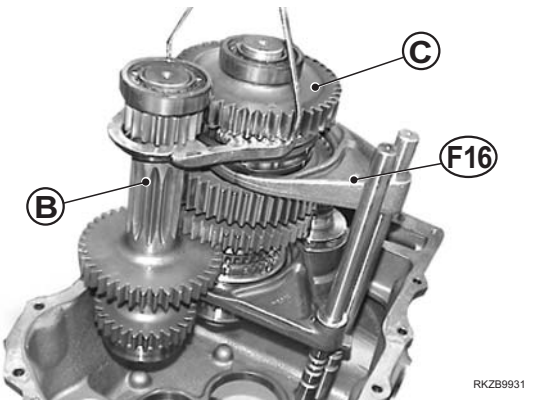
1 - Heat the inner race of the bearing (39) to 80÷100°C (176°÷212°F) and use the tools **F16** mount the ring inside the bearing (39).



2 - Turn the shaft (41).
Heat the bearing to 80÷100°C (176°÷212°F). Use the tool **F2** assemble bearing (40).



3 - Using tool **F16**, position complete shafts B and C to half housing.
Complete shafts should be installed with pins and forks.
Introduce preassembled 3rd and 4th speed forks and 1st and 2nd speed forks as shown.

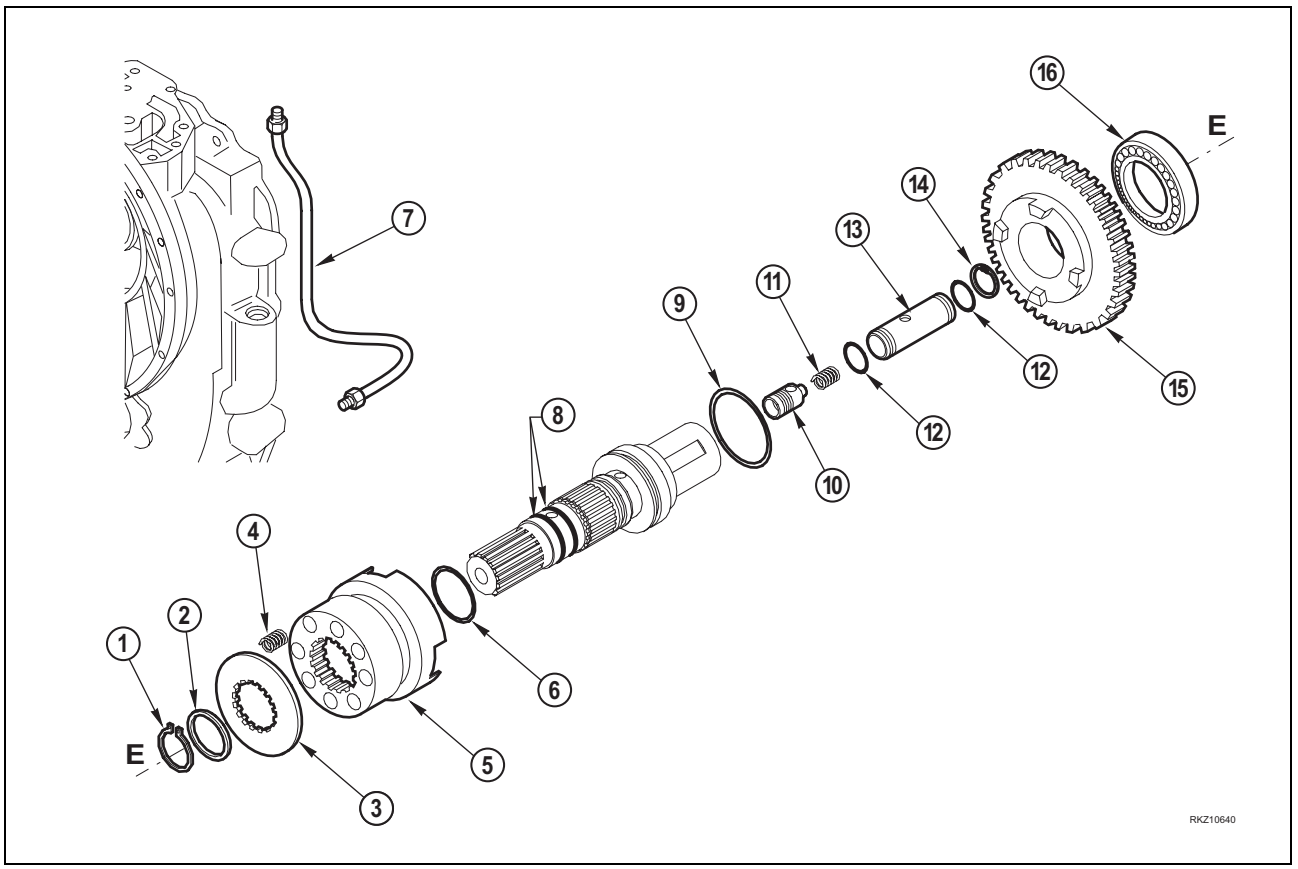


4 - Position the group with care paying attention to the location of fork pins in their seats.

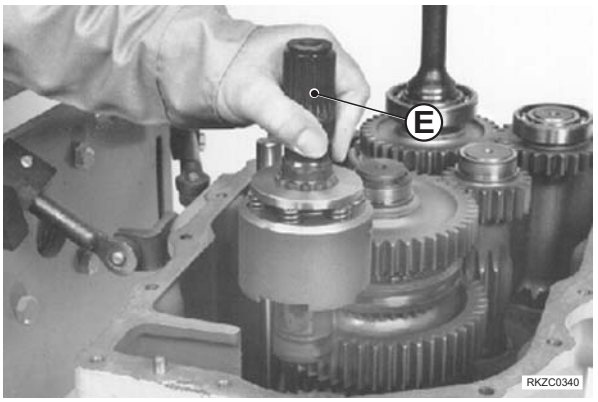


9. SHAFT E

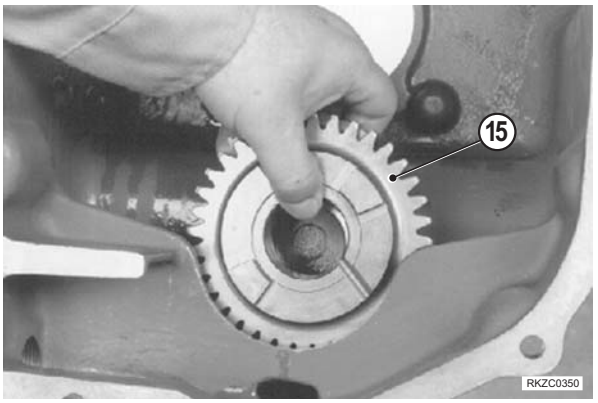
9.1 Disassembly



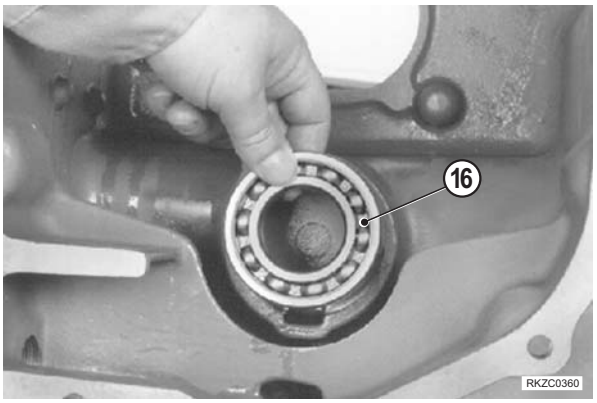
1 -Remove the shaft **E**.



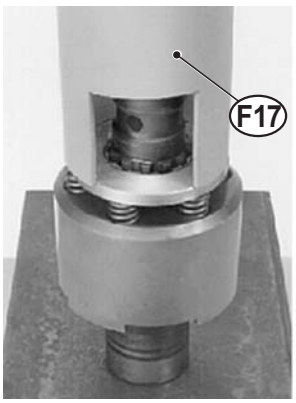
2 -Remove shafts **B** and **C**. Remove the four-wheel drive clutch gear (15).

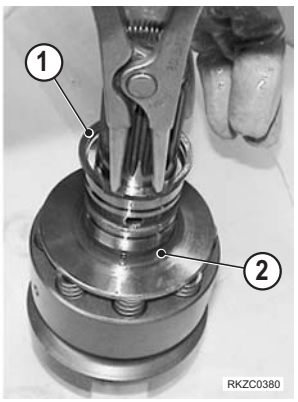


3 - Remove bearing (16).

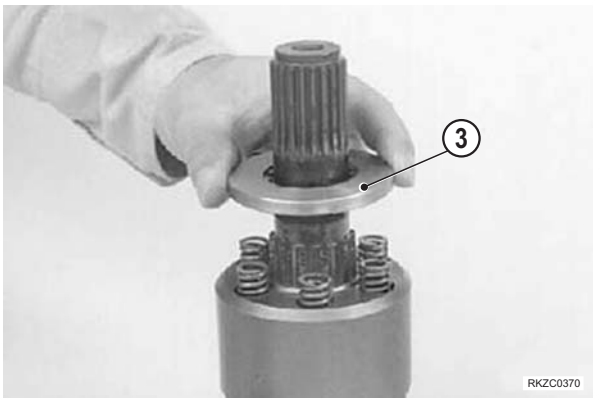


4 - Using tool **F17**, push down on the spring cover until stop ring is exposed (1).
Remove stop ring (1) from its seat and remove tool **F17**, then remove washer (2).

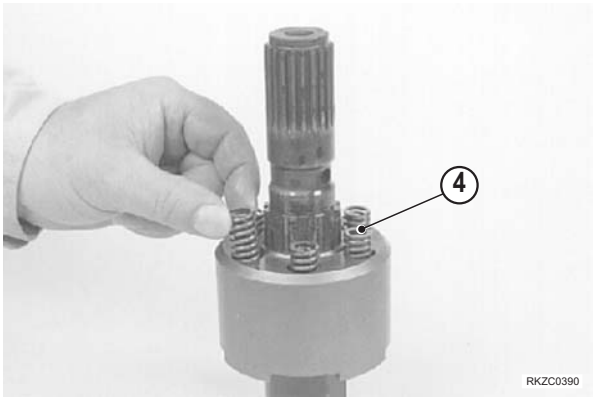




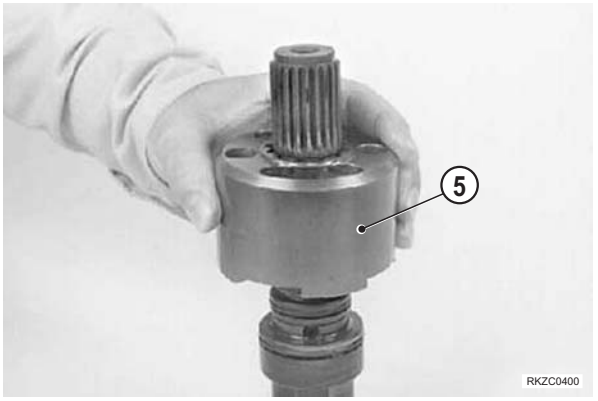
5 - Remove the spacer (3).



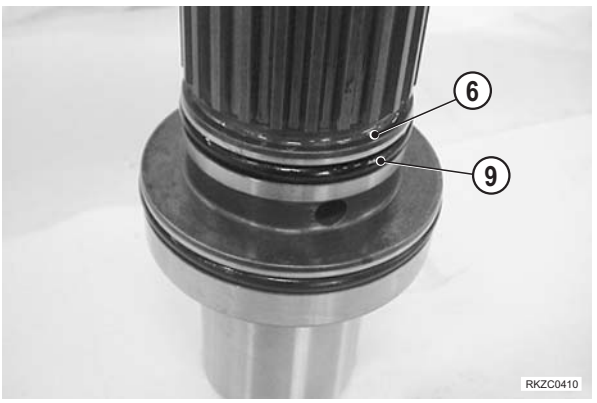
6 - Remove springs (4).



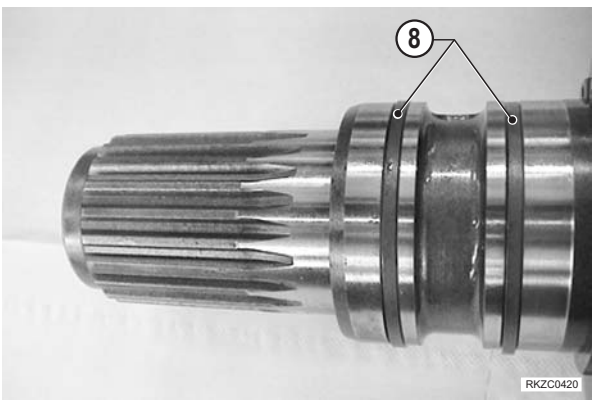
7 -Remove sleeve (5).



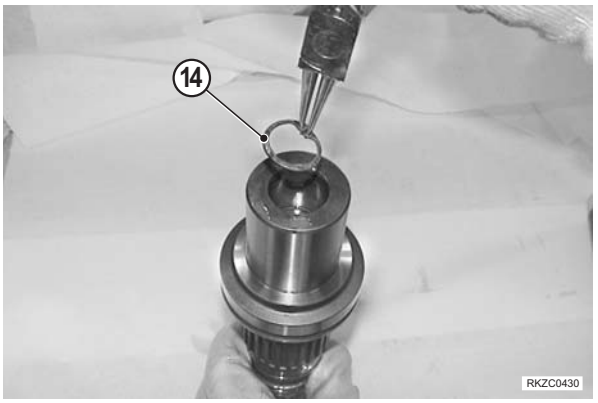
8 -Remove the two O-rings (6) and (9) from the shaft.



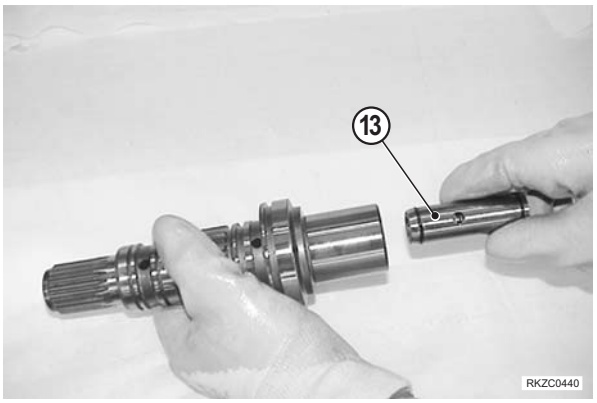
9 -Remove the teflon sealing rings (8) from the shaft.



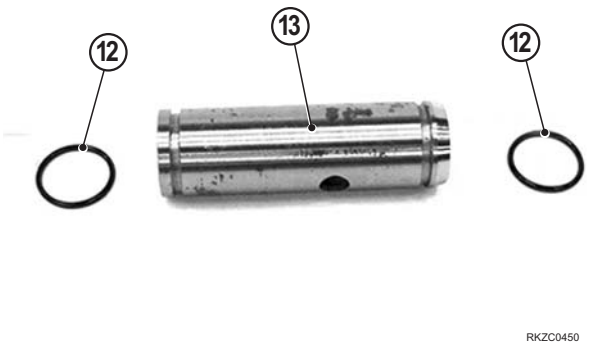
10 -Remove snap ring (14).



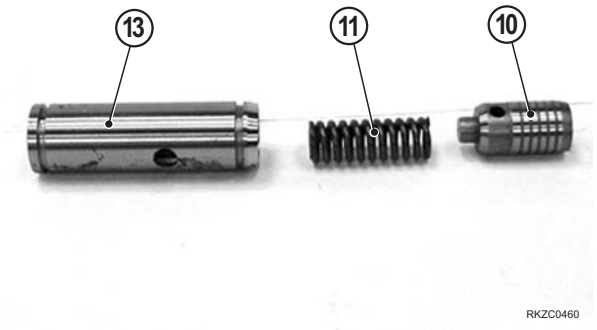
11 - Remove cylinder (13).



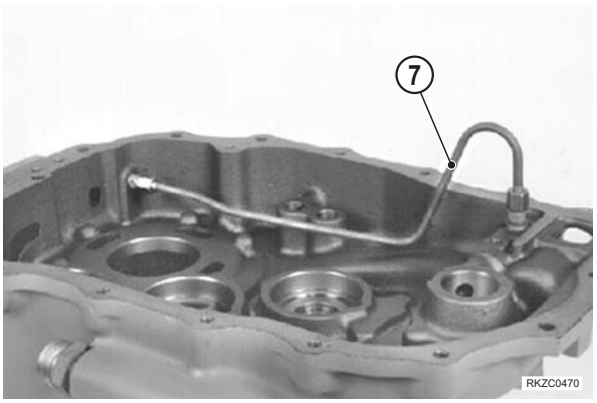
12 - Remove O-rings (12) from cylinder (13).



13 - Remove valve (10) and spring (11) from cylinder (13).

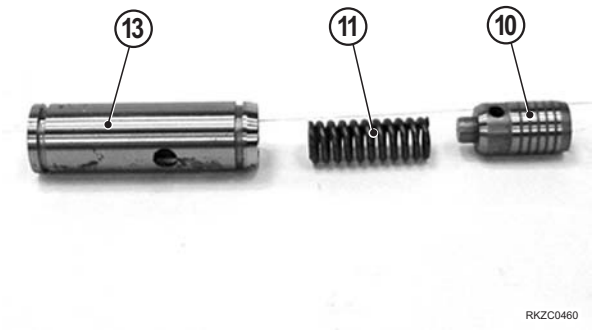


14 - Do not remove 4WD clutch pipe (7) from front housing unless absolutely necessary.

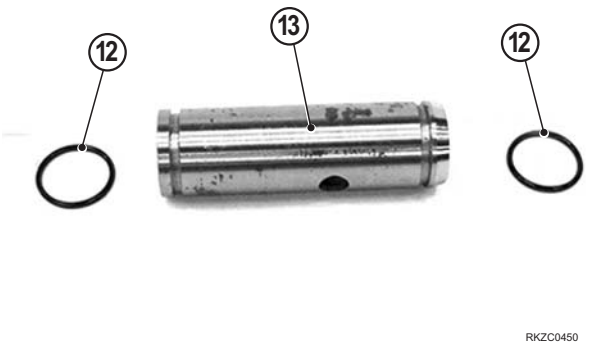


9.2 Assembly

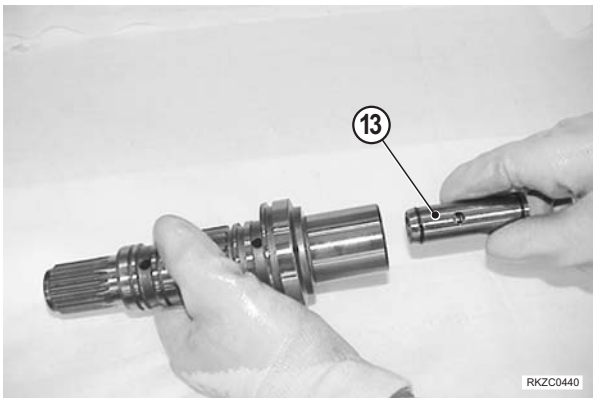
1 -Install spring (11) and valve (10) in cylinder (13).



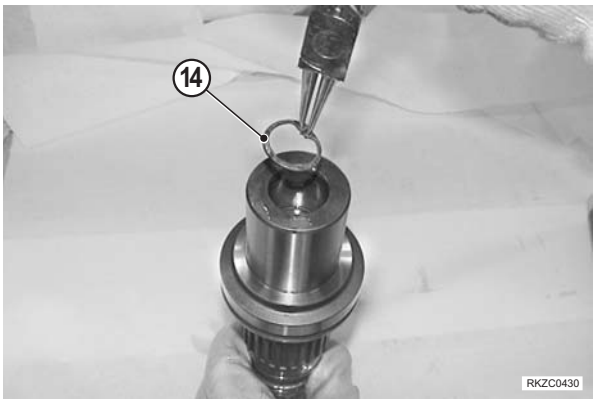
2 -Install O-rings (12) on cylinder (13);



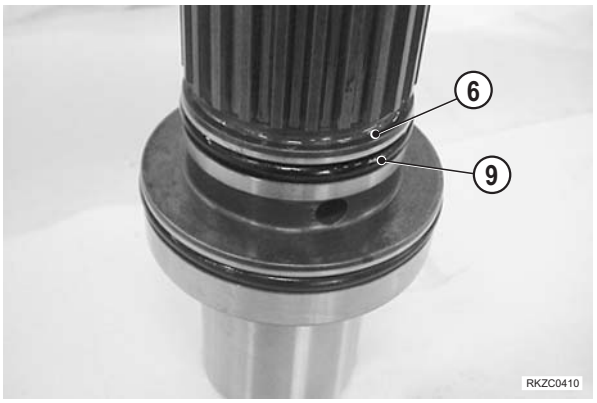
3 -Install cylinder (13) in the shaft



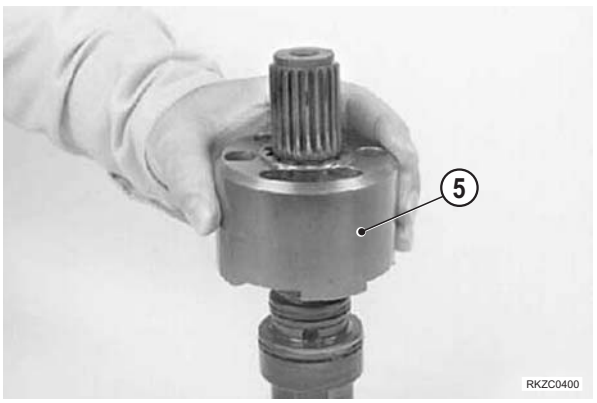
4 -Assemble snap ring (14).



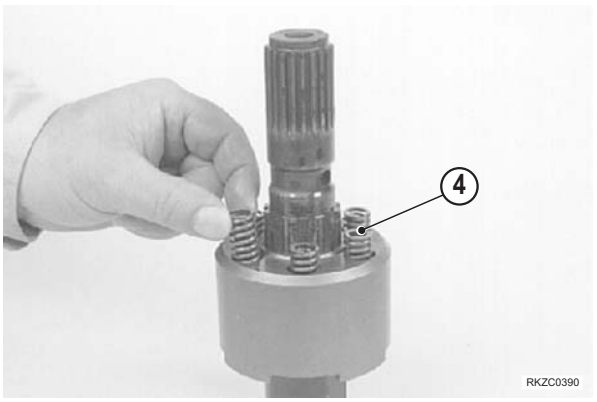
5 -Assemble the O-Rings (6) and (9) on the shaft.



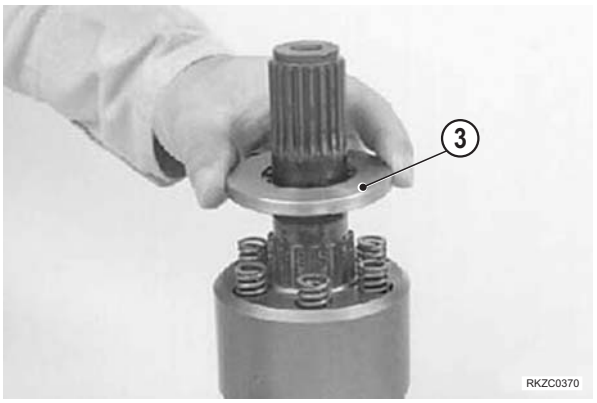
6 -Assemble sleeve (5).



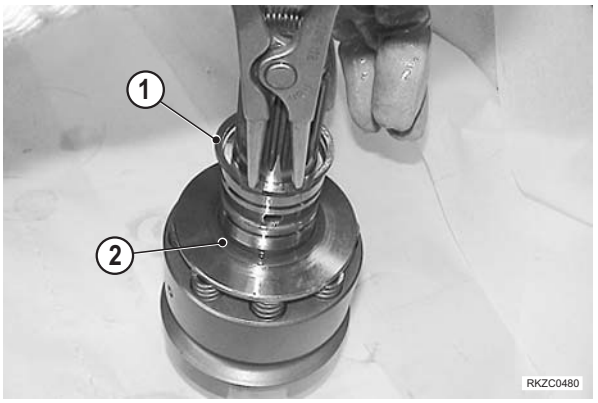
7 -Assemble springs (4).



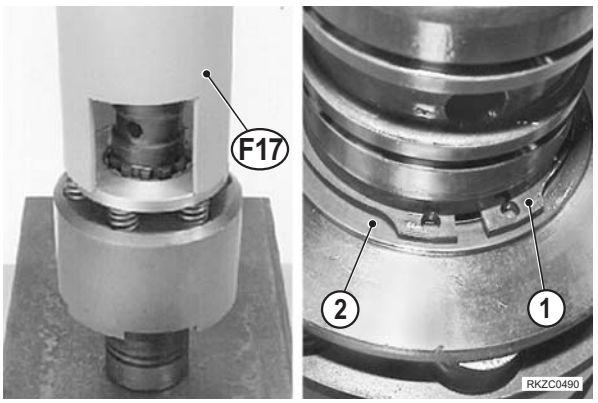
8 -Assemble spacer (3).



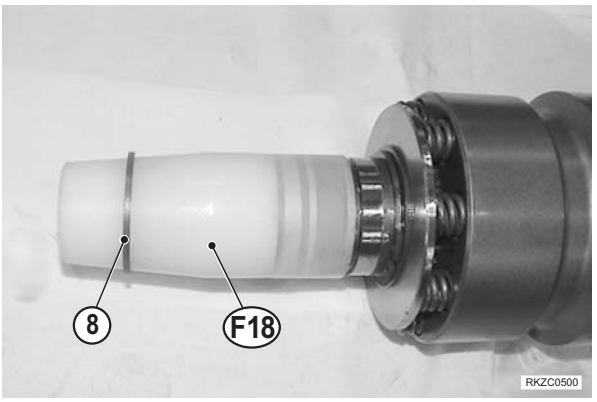
9 - Position washer (2) and snap ring (1).



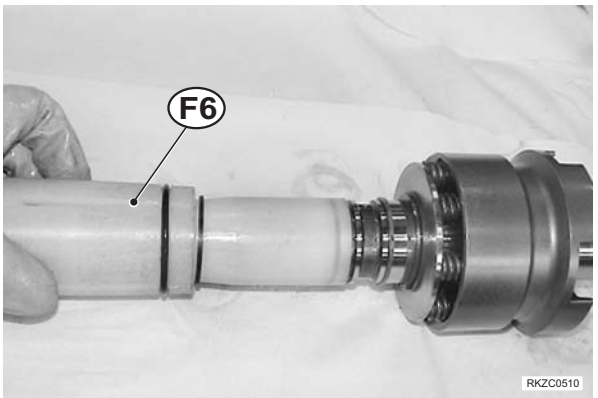
10 - Using tool **F17**, push down on spring cover until the stop ring seat (1) is exposed and complete the assembly of the stop ring (1).
Release tension and remove the tool.
Ensure that the stop ring (1) is correctly positioned in the recess of the spring cover.



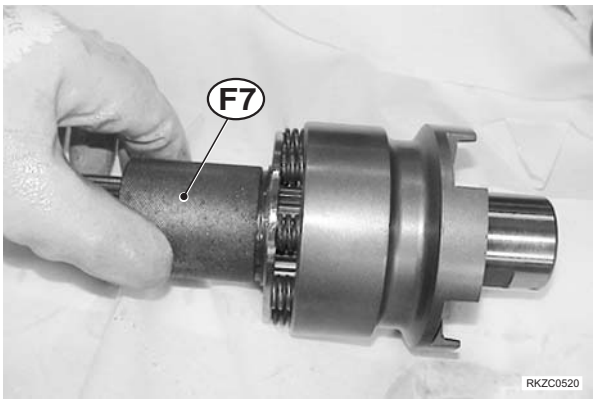
11 - Place the protector **F18** onto the shaft. The expander/protector will stop in the correct position to install the teflon sealing ring in the groove.
Heat the teflon sealing ring (8) to 60-80 °C (140-176 °F).
Install it onto the expander/protector.



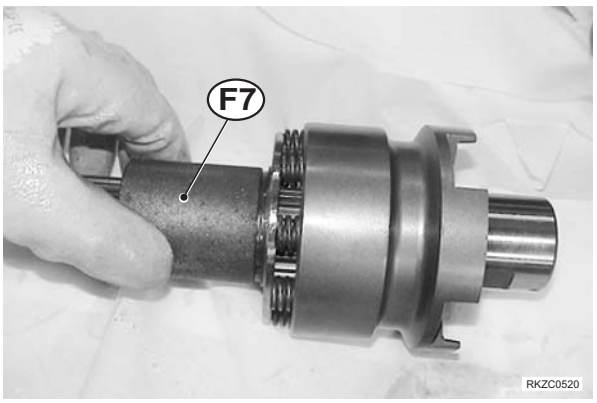
12 - Install the **F6** pusher over the expander/protector and slide the seal ring until it reaches the groove in the shaft.
Remove the pusher, expander/protector, and spacer from the shaft.



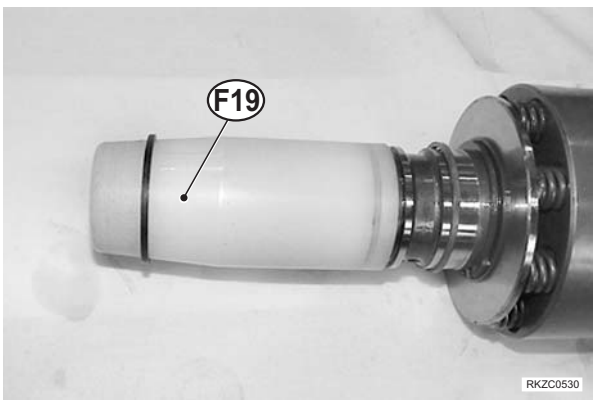
13 - Install the end of the **F7** seal compressor with the deep chamfer onto the shaft and over the sealing ring.
Use a back and forth twisting motion to allow the seal compressor to slip over the top of the sealing ring and seat the sealing ring into the groove.
Be careful not to damage the seal ring.
After the sealing ring is seated in the groove, remove the seal compressor from the shaft.



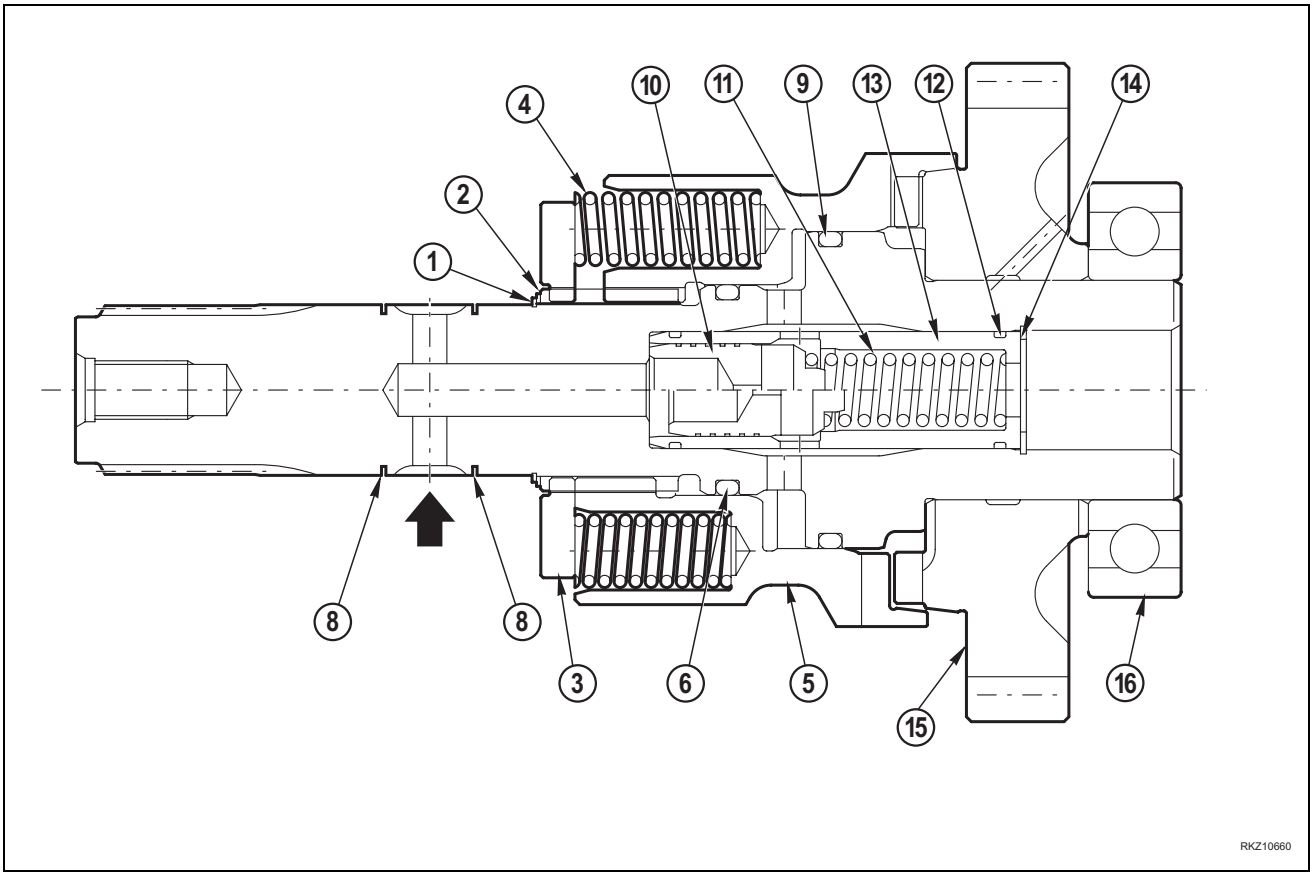
14 - Turn the seal compressor around and slide the end with the narrow chamfer over the shaft and over the seal ring.
Leave the seal compressor in place for 15 minutes until the sealing ring has cooled and is properly sized and seated in the groove.
After the seal ring has cooled, remove the seal compressor from the shaft.



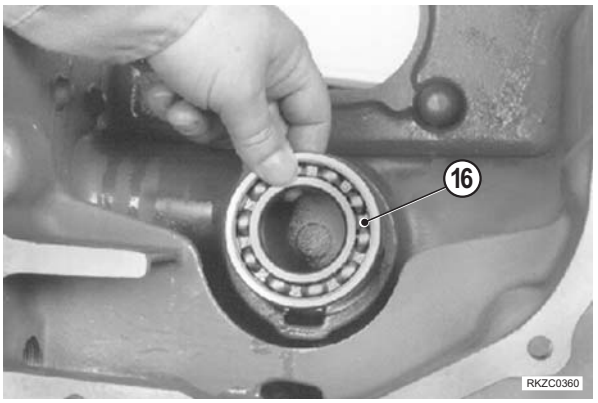
15 - Assemble protector **F19**.
Repeat steps 13 -19 to introduce the second teflon ring.



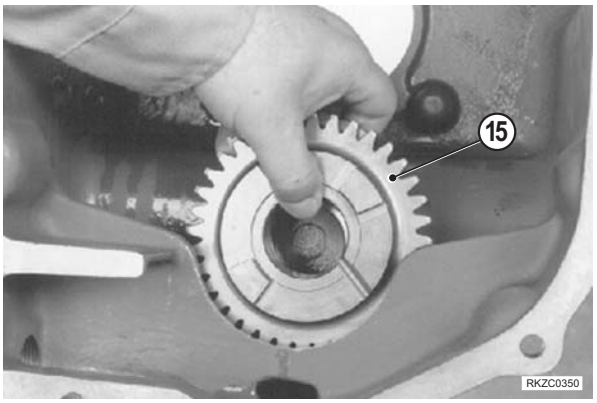
16 -Apply air compressed at about 6 bar to 4WD clutch oil passage (see arrow) by plugging the opposite hole with a finger. The sleeve (5) should be moving when compressing the springs (4).
The 4WD gear (15) should move freely on 4WD shaft. Valve (10), if operating correctly reaches the end of stroke making a noise.
If the operation is incorrect, dismantle to find the problem.



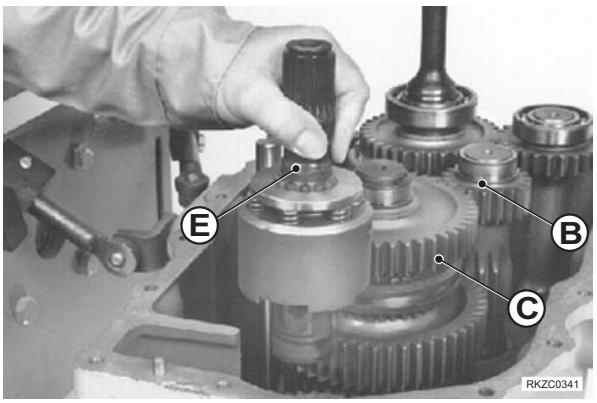
17 -Install bearing (16).



18 - Install gear (15).

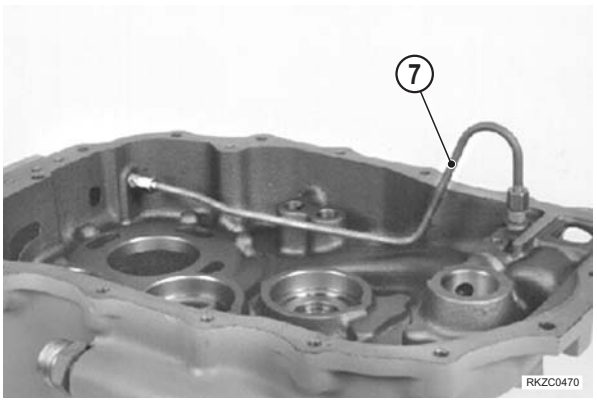


19 - Assemble shafts **B** and **C**. Assemble shaft **E**.



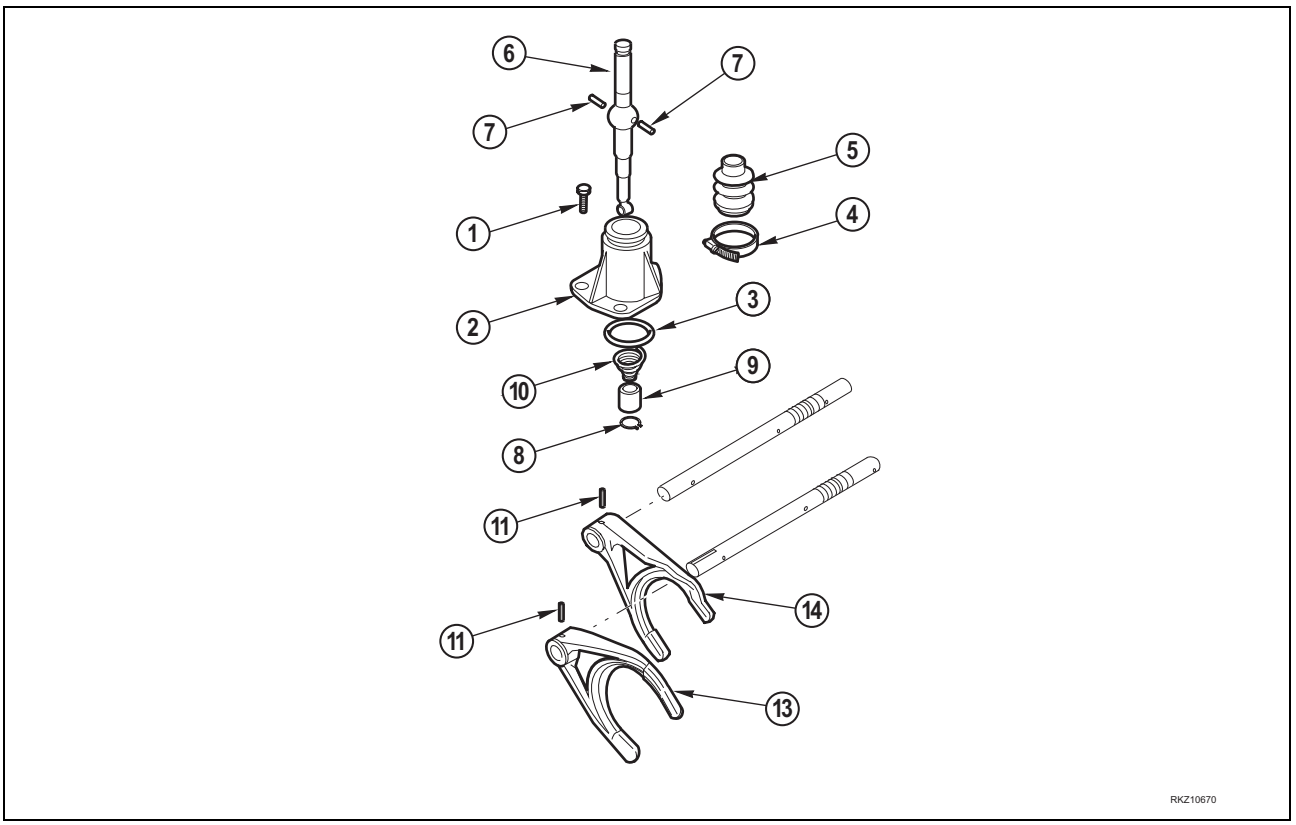
20 - Reinstall the 4WD clutch pipe (7).

Hose (7): 26-30 Nm

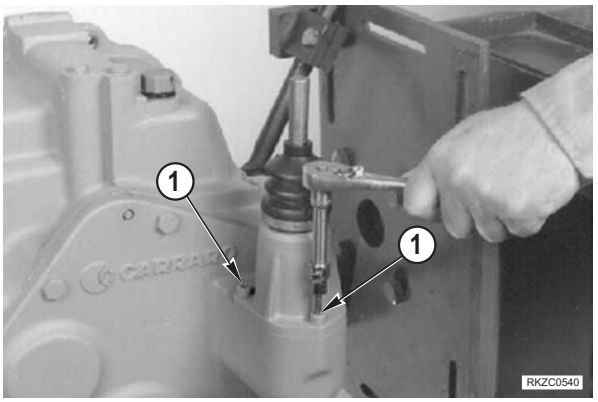


10. SPEED CONTROLS

10.1Disassembly

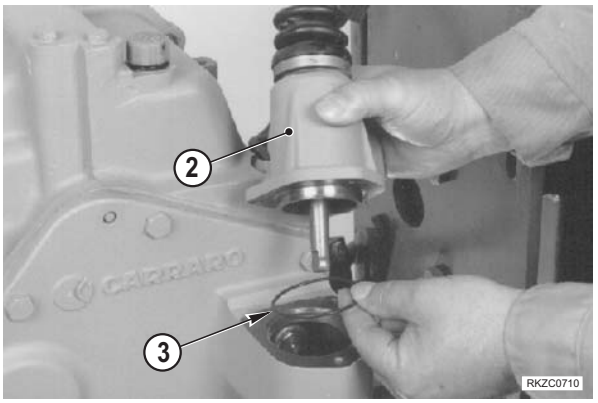


1 - Untighten and remove screws (1).
For the disassembly of the two half boxes it is necessary to remove the shift tower assy.



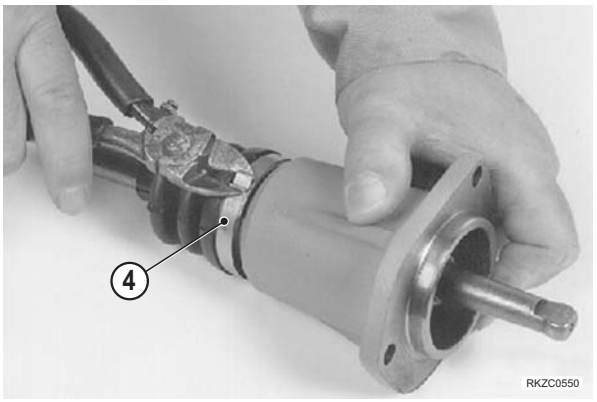
2 - Remove the shift tower assembly (2) and the O-ring (3).

★ This is a destructive operation for the O-ring.

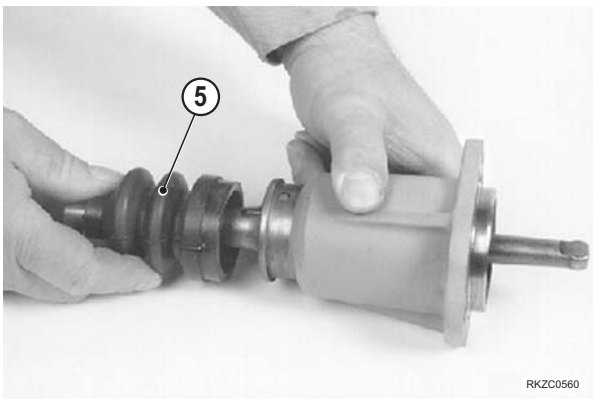


3 -Remove the clamp (4).

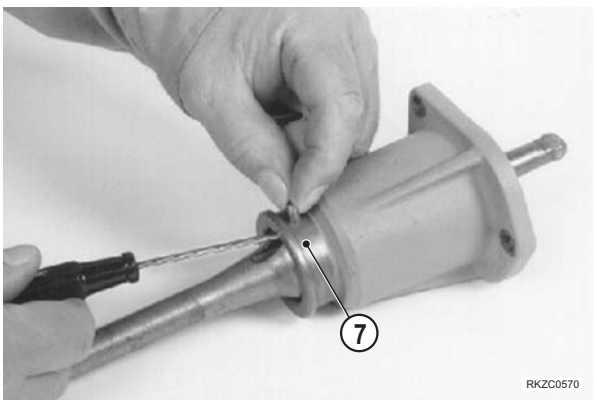
★ Replace the clamp at each disassembly.



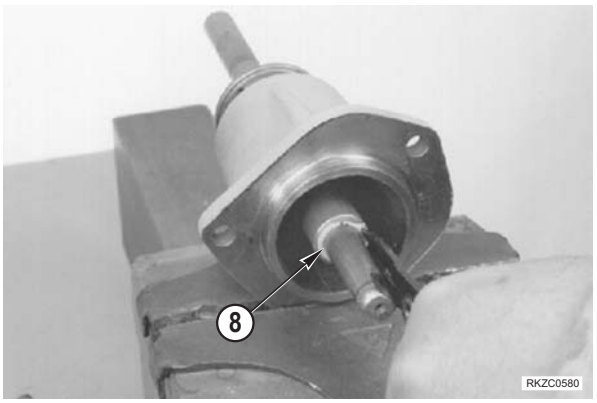
4 -Remove the protective sleeve (5).



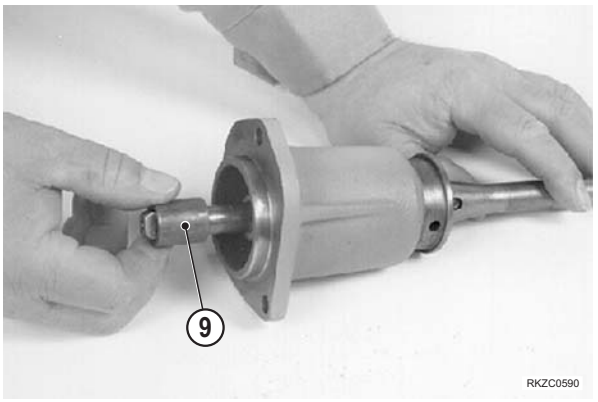
5 -Remove the king pins (7) (n° 2).



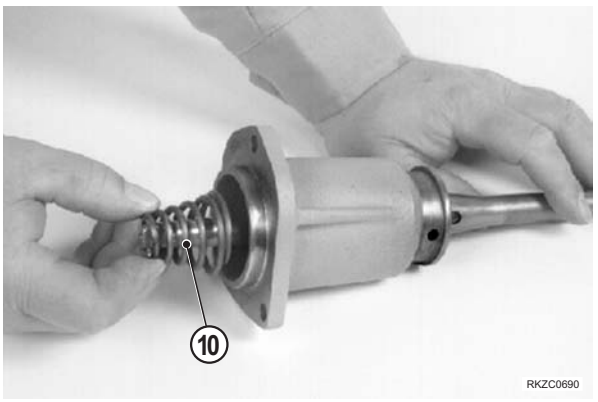
6 -Remove the steel stop ring (8) from transmission lever.



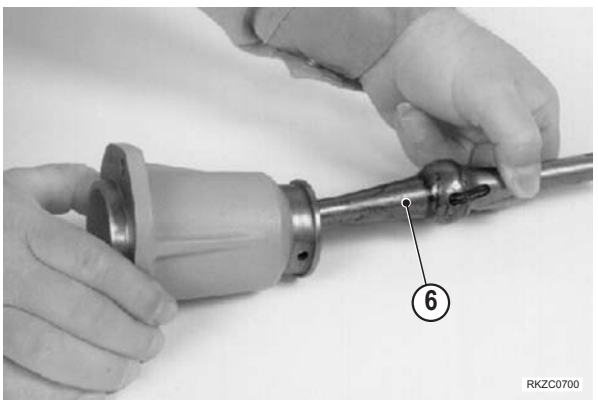
7 -Remove the bushing (9) from transmission lever.



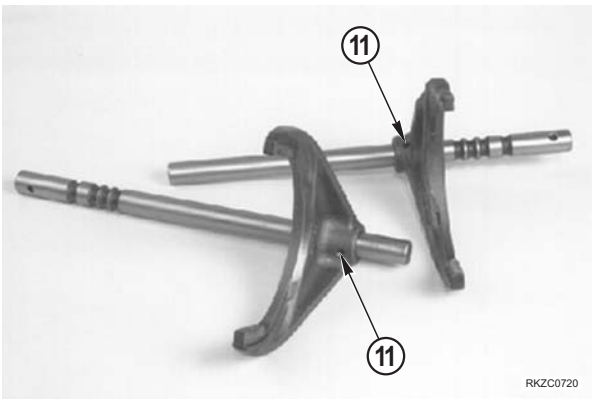
8 -Remove the spring (10).



9 -Slide the gear lever (6) out.

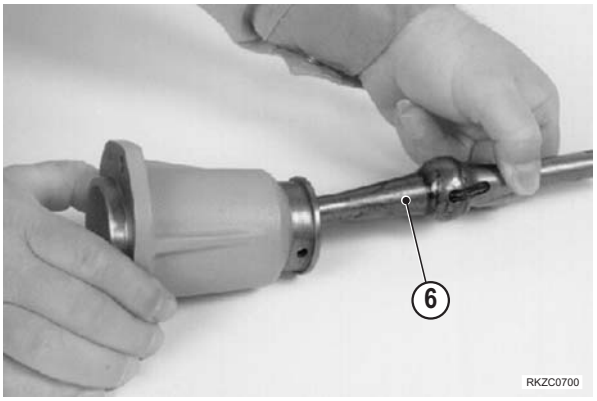


10 -Do not remove pins (11) and do not separate forks from shifters unless it is necessary.
Mark the forks and the shifters to prevent mixing them during installation.

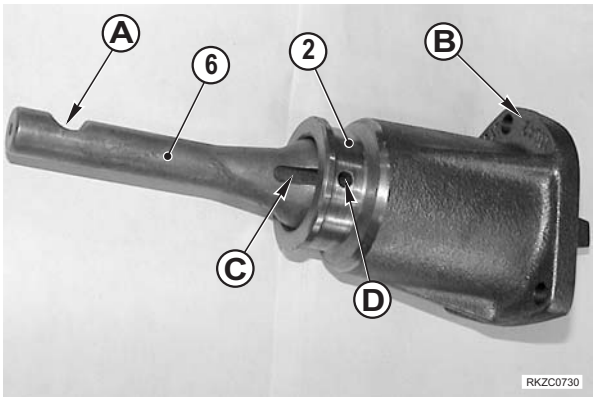


10.2Assembly

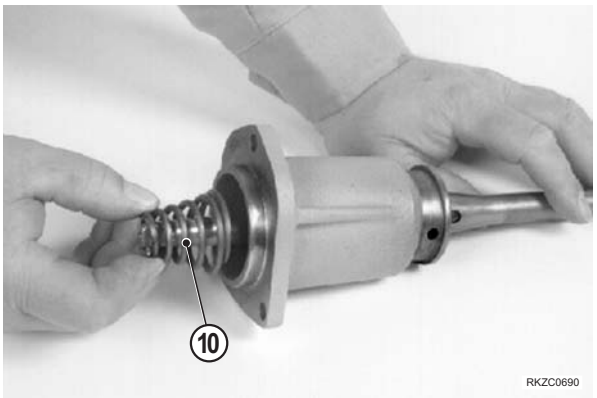
1 - Apply grease to the ball of the shift lever.
Install the shift lever (6) in the cover (2).



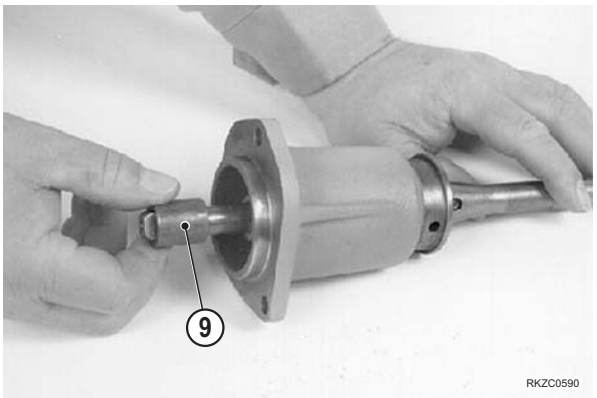
2 - The illustration shows the correct position of the control lever (6) in relation to the gear case (2):
with recess (A) facing curved side (B) of case;
with slots (C) aligned with holes (D) in the case.



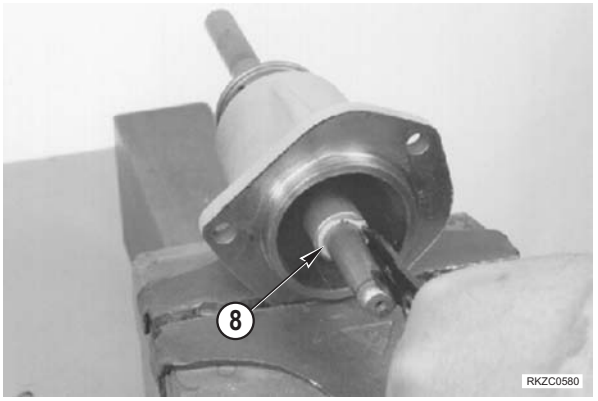
3 - Install the spring (10).



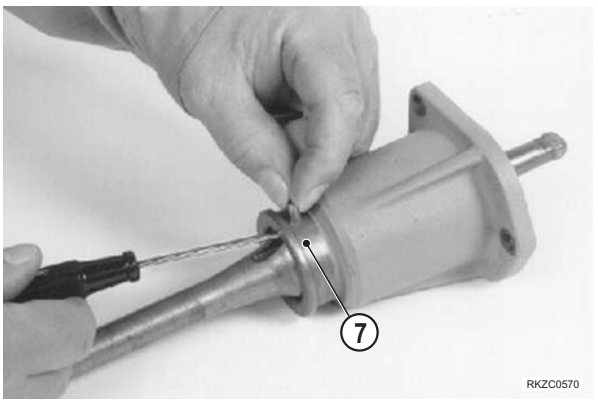
4 - Install the bushing (9).



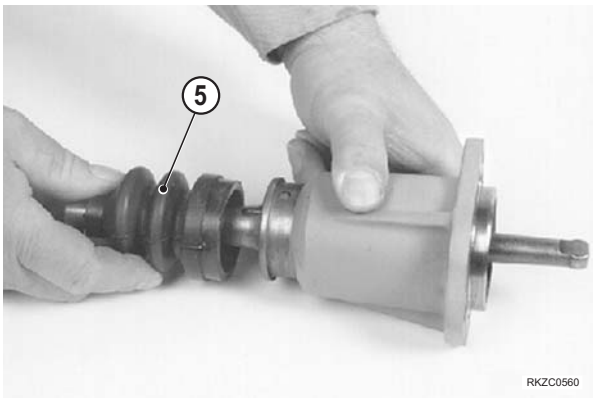
5 - Position the stop ring (8) to the shift lever.



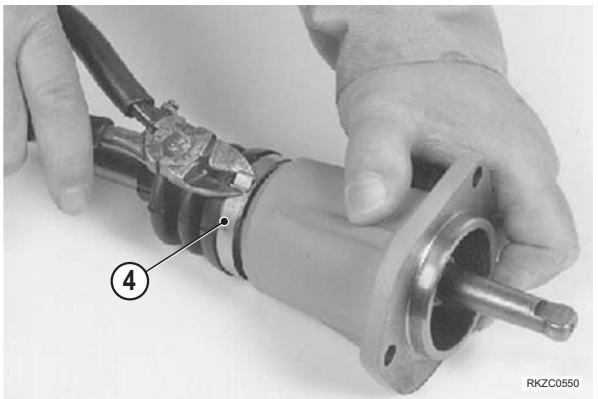
6 - Install pins (7) through the holes in the case flange so they engage into the slots on the shift lever.



7 - Install the boot (5) so that the edge is seated on the pin ends.
Pay attention not to drop the pins.

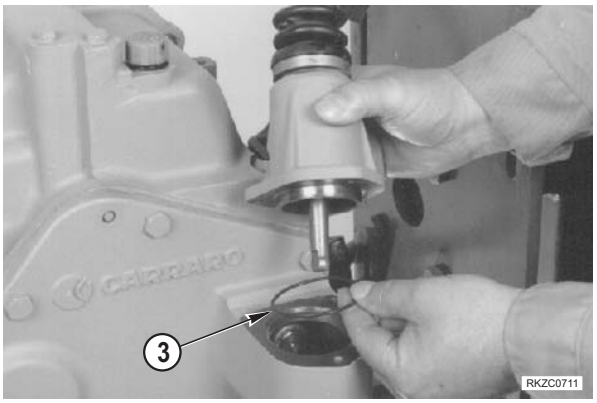


8 - Install a new clamp (4) around the boot (5).



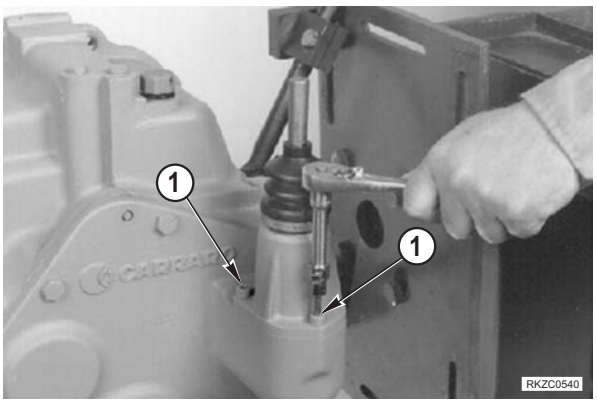
9 - Install a new O-ring (3) to case flange.

O-ring: power train oil.

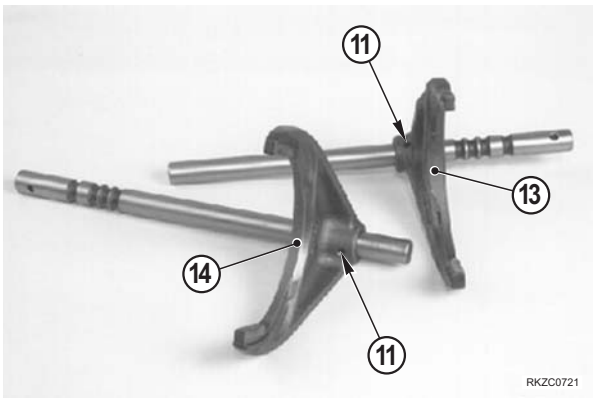


10 - Tighten the screws (1).

Screws (1): 23 Nm



11 - Fit the two pins (11) to lock gear control fork 3rd and 4th speed (13) and gear control 1st and 2nd speed (14).



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

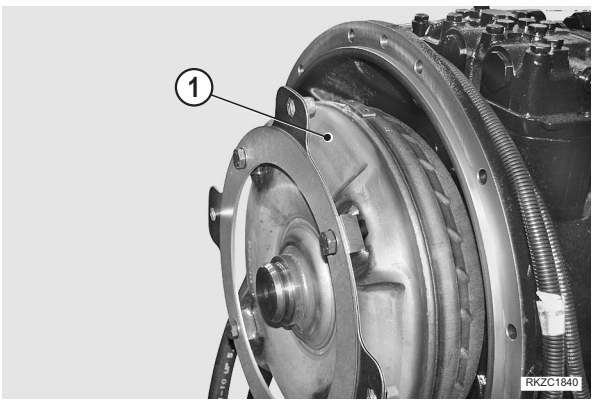
★ Drain the oil from the gearbox.

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.

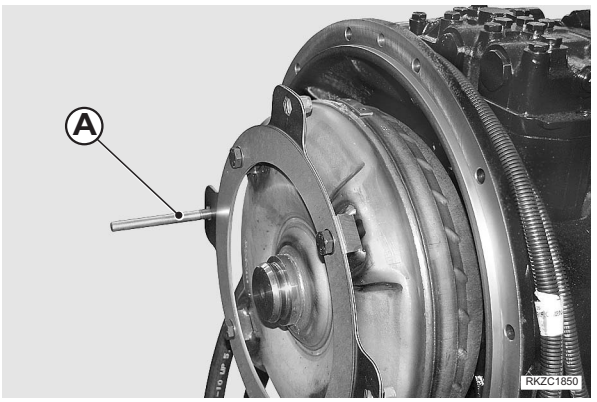
★ Ensure that the mating surfaces are clean and free of dents.

[*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

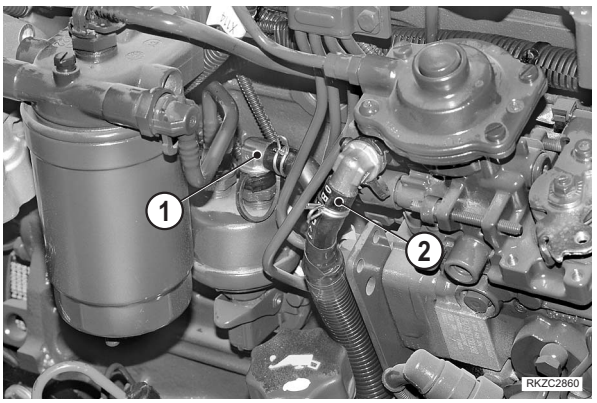
Removal

1 - Remove:
- ENGINE HOOD
- FRONT GUARD
- FRONT COUNTERWEIGHT
- RADIATOR GROUP
- CONDENSER
- MUFFLER
- AIR FILTER
- PISTON PUMP
- TRANSMISSION

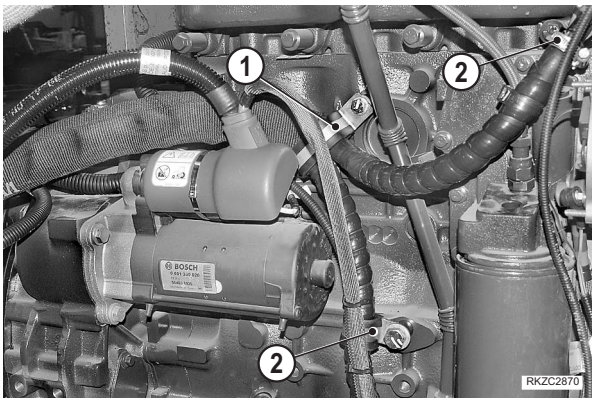
For details, see the individual removal procedures.

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.

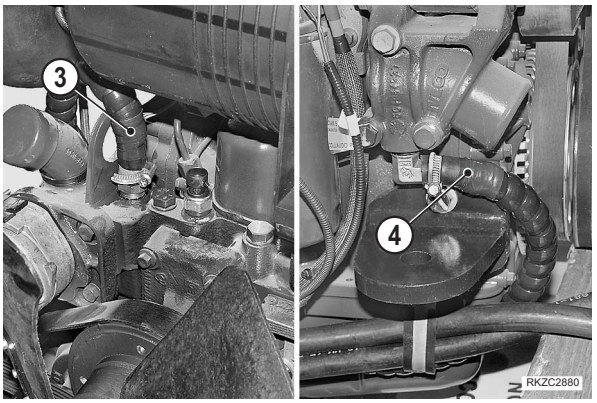


3 - Remove the screws and release the straps (1) and (2) retaining the heating system hoses.

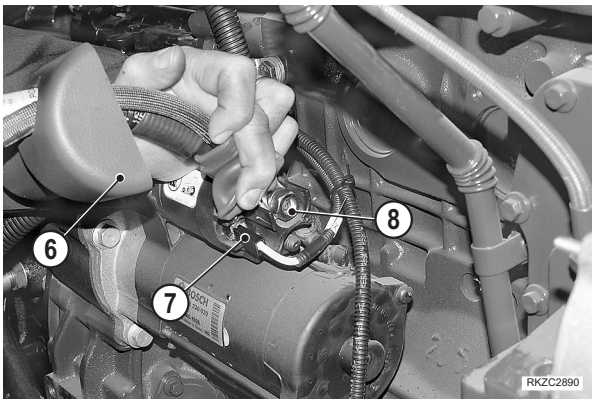


4 - Disconnect the heating system hoses (3) and (4) and remove the tie strap (5) retaining the gearbox oil hoses.

★ Cap pipes, hoses and holes to prevent contamination.



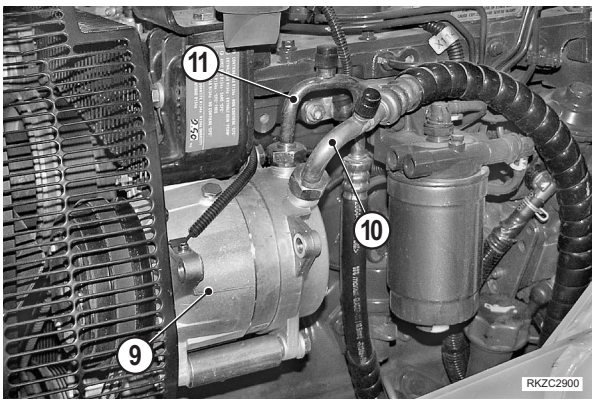
5 - Lift the cover (6) and disconnect wiring harnesses (7) and (8) from starter.



Only if equipped

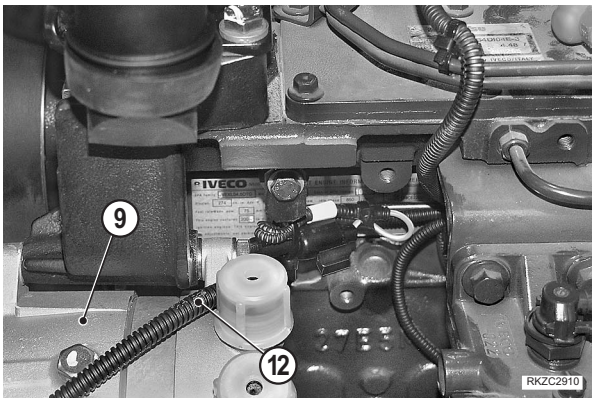
6 - Disconnect suction and delivery hoses (10) and (11) from air-conditioning group compressor (9).

★ Cap the hoses and holes to prevent contamination.

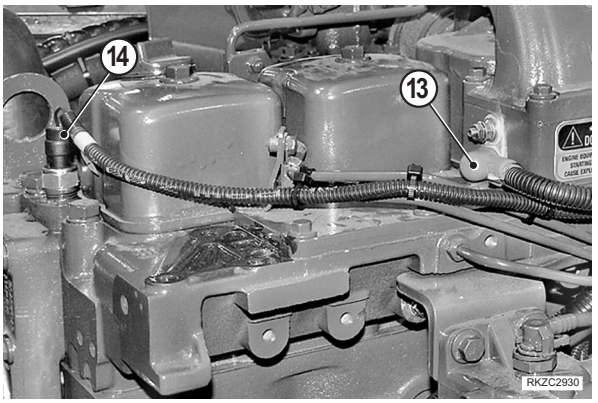


Only if equipped

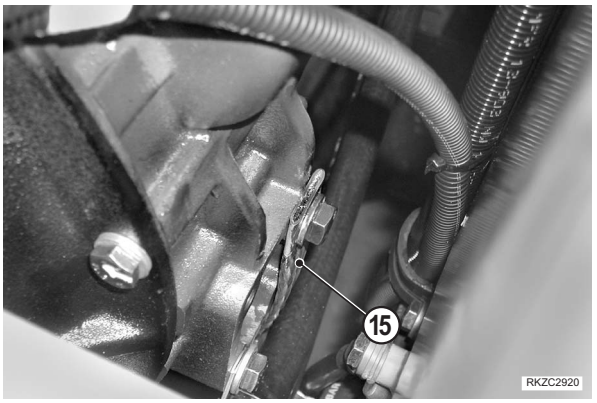
7 - Release the wiring harness (12) to the compressor (9) from the tie straps and disconnect.



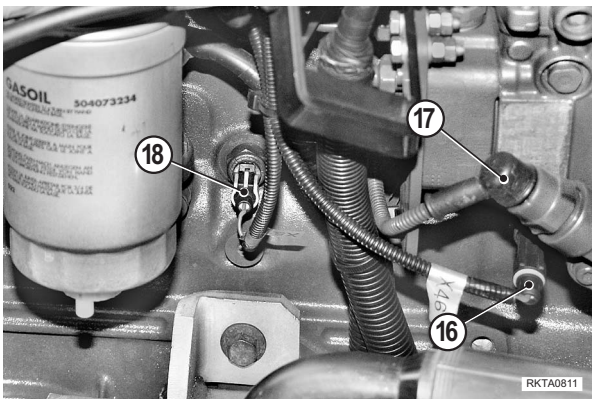
8 - Disconnect wiring harness (13) from thermal starter and disconnect connector (14) from the coolant liquid temperature sensor.



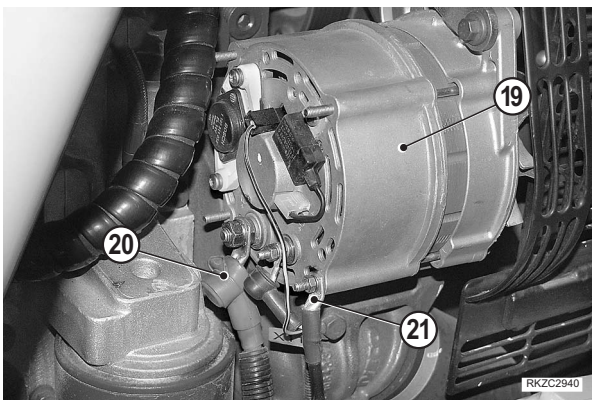
9 - Disconnect the ground plait (15) from the engine.



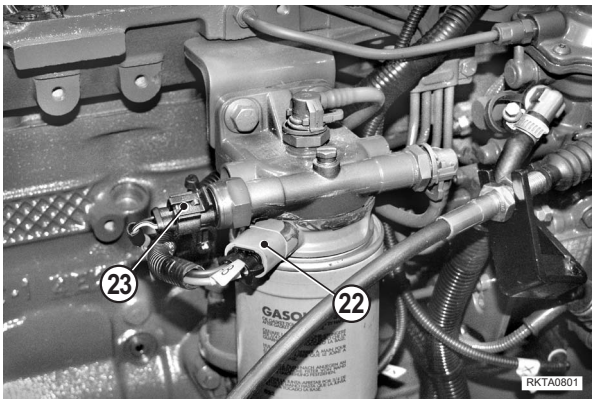
10 - Disconnect connector (16) from the engine stop solenoid valve, disconnect connector (17) from the engine oil temperature sensor (17), and disconnect connector (18) from the oil pressure sensor.



11 - Disconnect wiring harness (20) and ground wire (21) from generator (19).

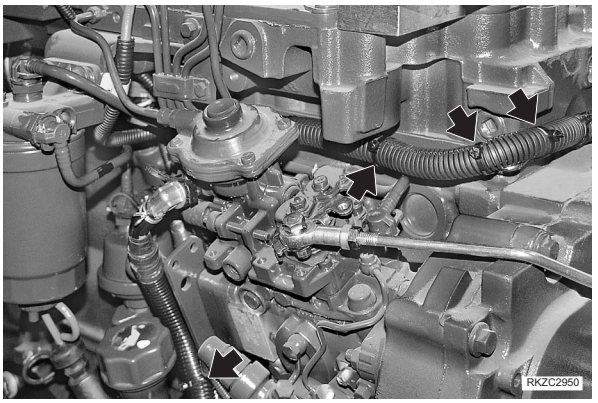


12 - Disconnect heating system connector and fuel temperature sensor connector (22) and (23) from the filter holder.

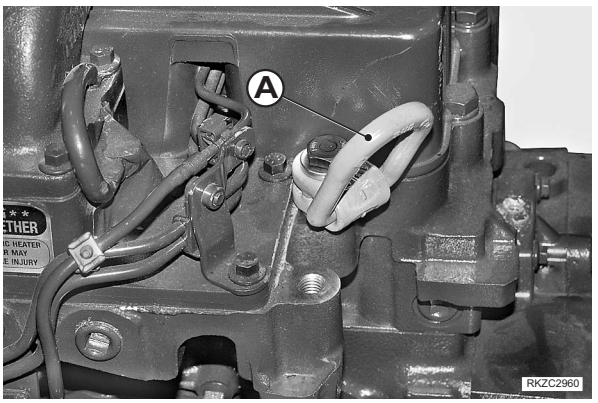


13 - Release the entire engine harness from the tie straps and route the harness down, and use some straps on the inner sides of the frame to let the wiring hang termporarily.

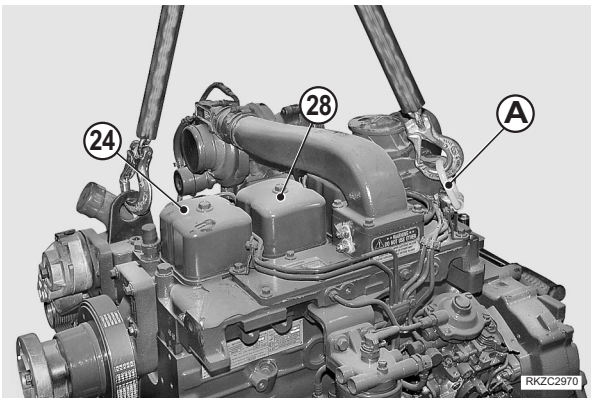
14 - Check to ensure that all hoses to the engine are released from straps or ties.



15 - Tighten a revolving lifting eye "**A**" to the muffler inner mounting hole.



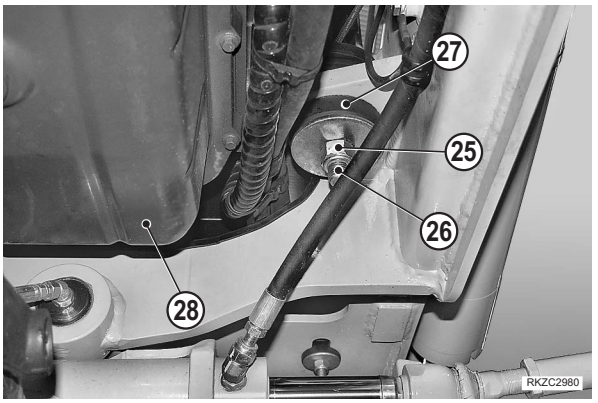
16 - Attach a lifting device to lifting eye "**A**" and to engine front bracket (24), and apply a slight tension to the chains or cables.



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 (Standard version)

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 and remove the ignition key.

3 -Release all residual pressure by operating the hydraulic controls (including any optional device pedals) several times in all directions.

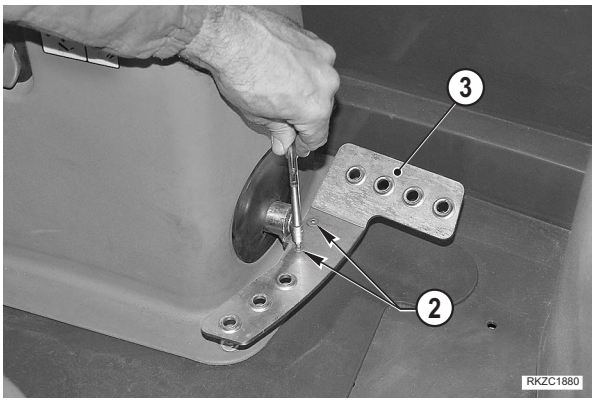


4 -Lift rear window (1) to the top and remove the rear mat.

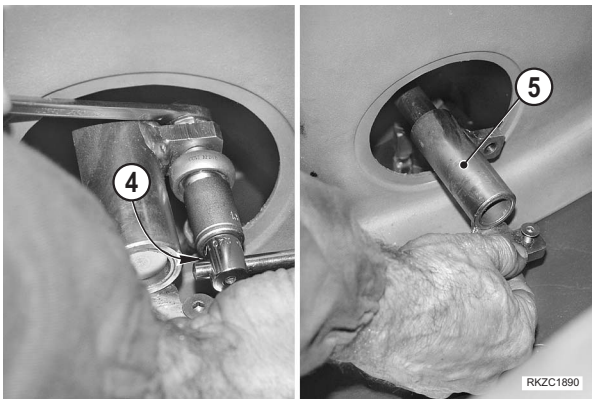


Only if equipped

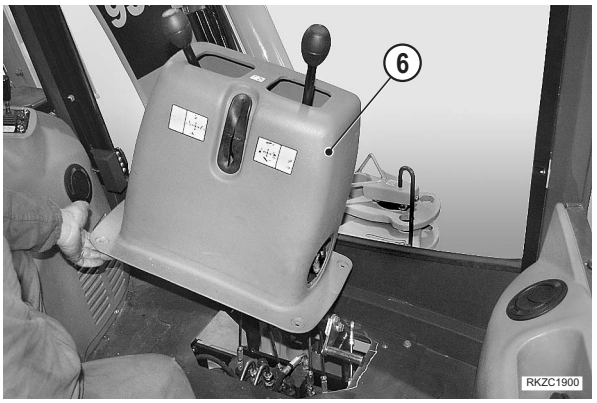
5- Remove screws (2) and remove control pedals (3) for jig arm and hammer.



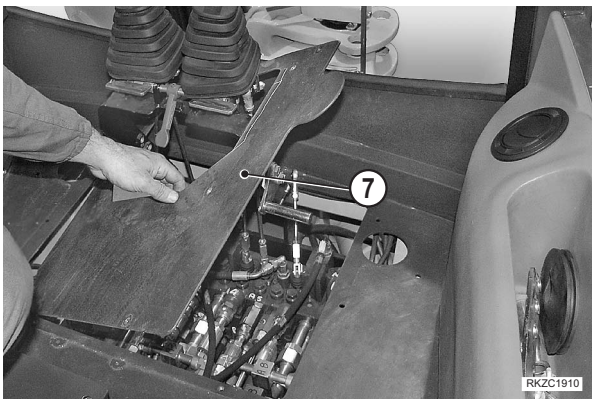
6 -Loosen and remove the screws (4) and the pedal support (5).



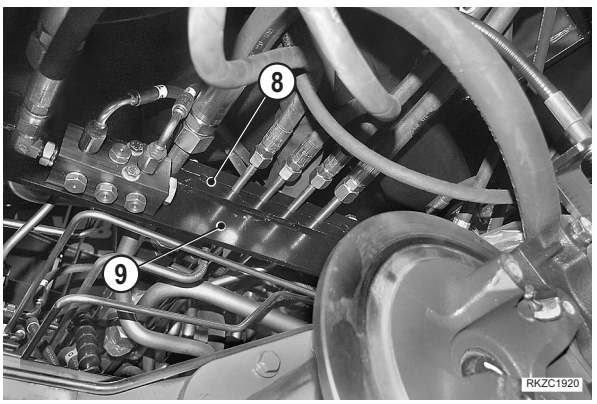
7 - Take out the screws (n°4) and remove the hood (6).



8 - Take out four screws and remove the metal sheet (7) closing off the floor.

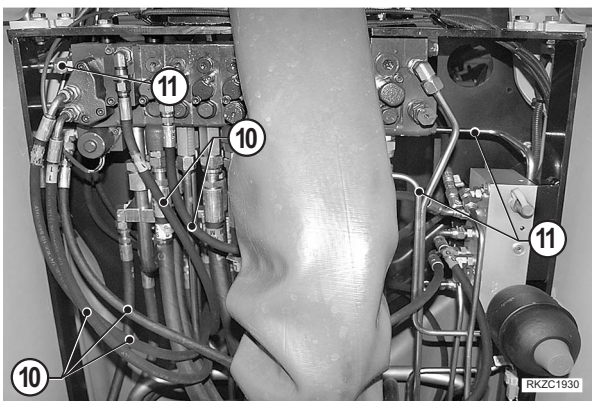


9 - Loosen the clamp (8) on the control valve support frame (9) (4 screws).



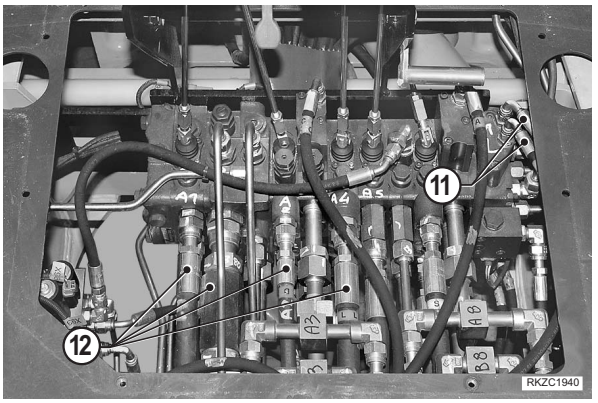
10 - Make sure that all the hoses are marked; disconnect the lower hoses (10), together with all accessible side hoses (11), from the control valve.

★ Cap pipes, hoses and holes to prevent contamination.

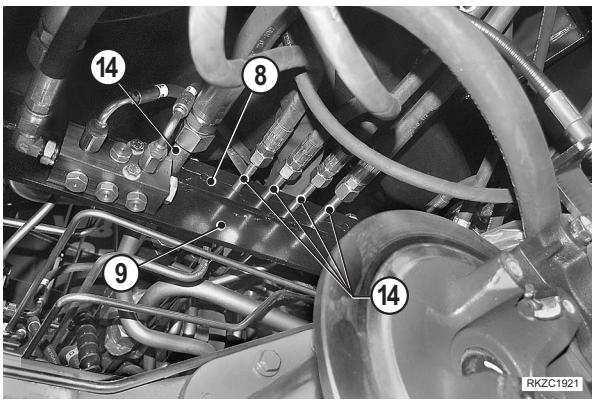


11 - Make sure that all the hoses are marked; disconnect the upper hoses (12), together with all accessible side hoses (13), from the control valve.

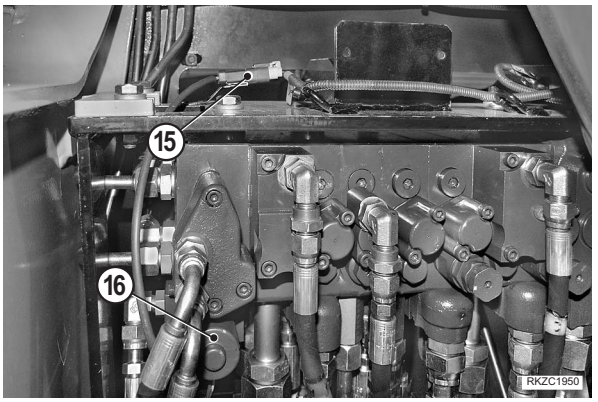
★ Cap pipes, hoses and holes to prevent contamination.



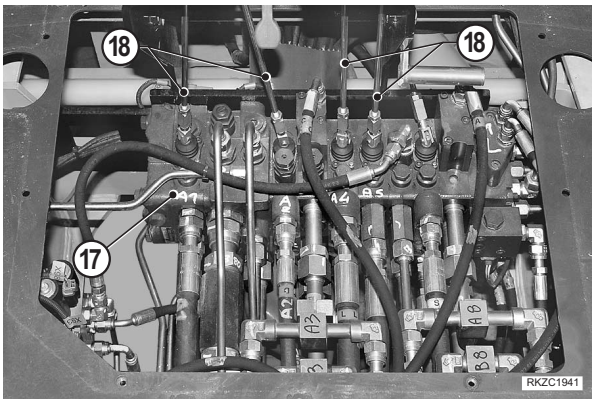
12 - Turn the tubes (14) that provide direct connection away from control valve and retain their position by temporarily tightening clamp (8) on frame (9).



13 - Disconnect connector (15) from backhoe plate lockout solenoid valve.

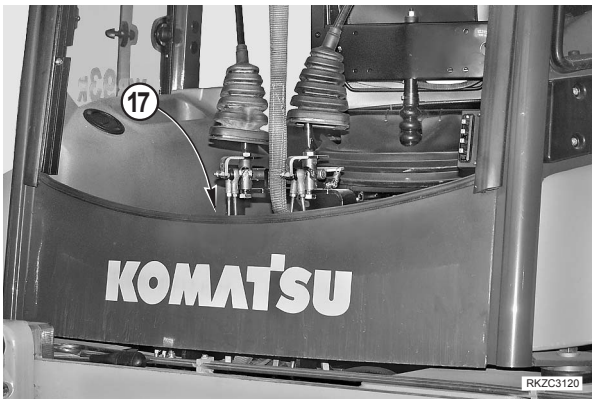


14 - Remove pins and disconnect control tie rods (8) from control valve (7).

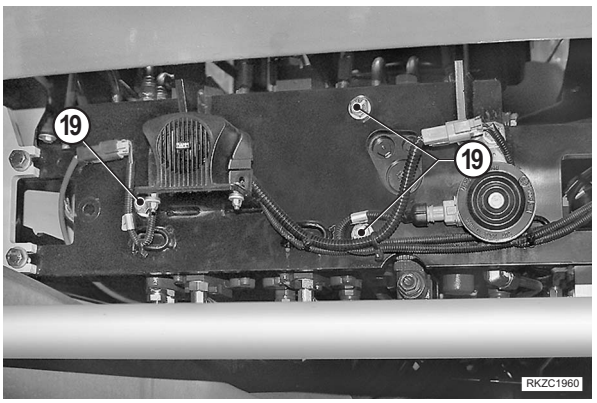


15 - Support control valve (17) by means of two ropes connected to a lift arm to be introduced through the cab opening.
Apply a slight tension to the ropes.

★ Pay special attention to rope routing to prevent damaging the unions.



16 - Loosen and remove the four screws (19) (n° 3) and the relative washers.



17 - Lower the control valve (17) 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.

CONTROL VALVE (version with servocontrol)

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.

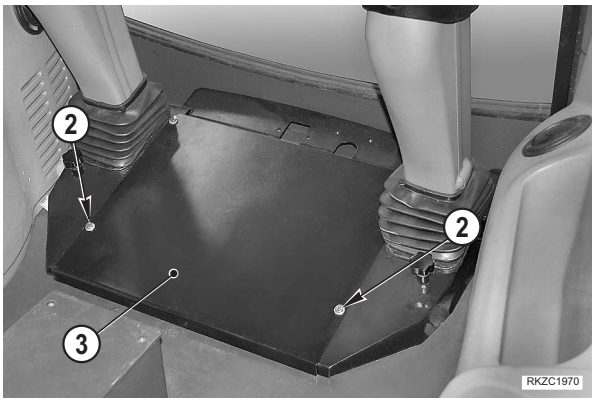
3 -Release all residual pressure.
(For details see "20 TESTING AND ADJUSTMENTS").



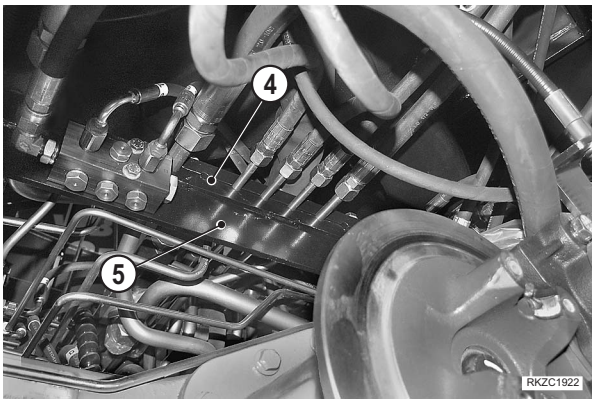
4 -Lift rear window (1) to the top and remove the rear mat.



5 -Take out the screws (2) and remove the platform (3).



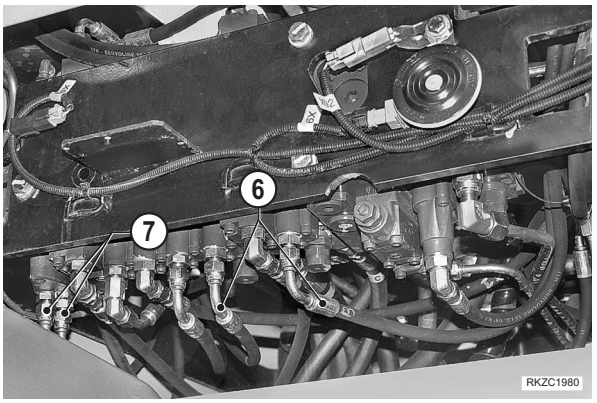
6 -Loosen the clamp (4) on the control valve support frame (5) (4 screws).



7 - Disconnect lower servocontrol and actuator hoses (6) together will 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.

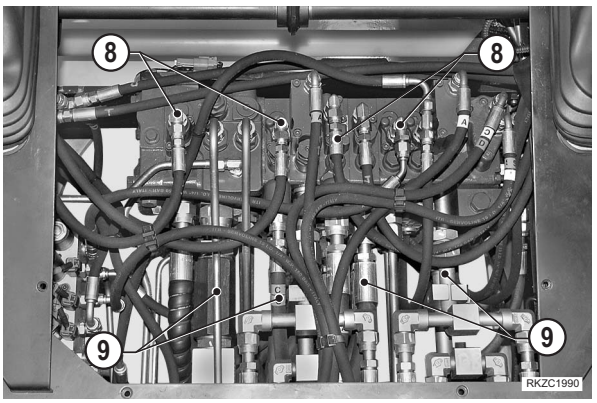


8 - Disconnect upper servocontrol hoses (8) and actuator hoses (9) from control valve.

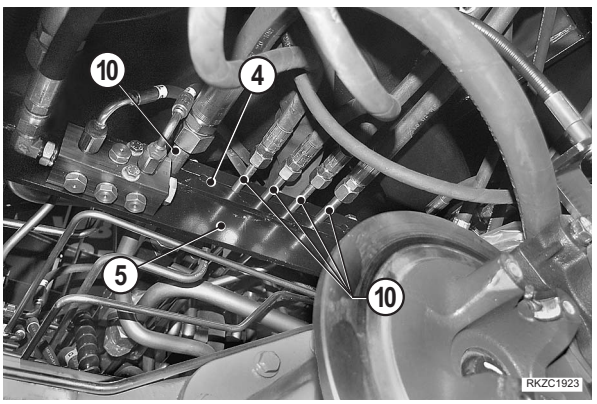
★ Check that all the hoses are marked and note down the bends and routing patterns.

★ Cap pipes, hoses and holes to prevent contamination.

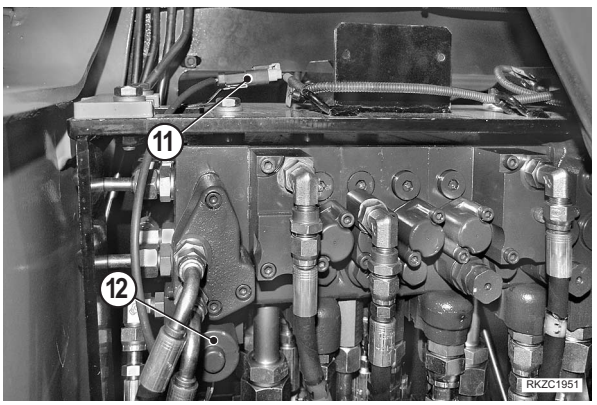
★ Lay the servocontrol hoses inside the cab to gain access to the delivery, exhaust, and actuator hoses.



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).

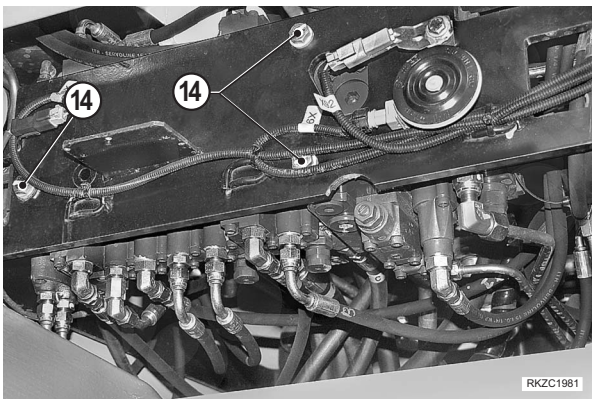


11 - Support control valve (13) by means of two ropes connected to a lift arm to be introduced through the cab opening.
Apply a slight tension to the ropes.

★ 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").

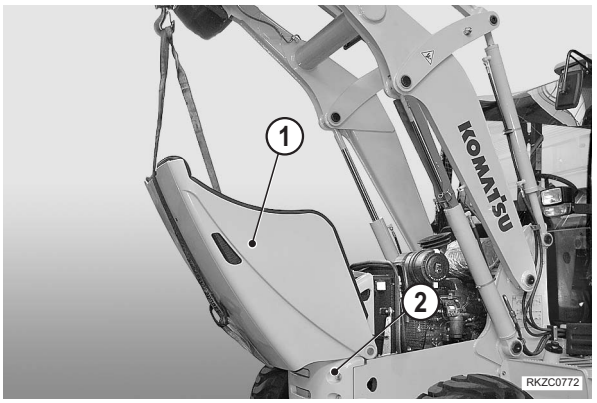
7 - If equipped, remove the front counterweight. [*1]

Counterweight: 372 kg

8 - Remove the front wheels. [*2]

Wheel: _____ kg

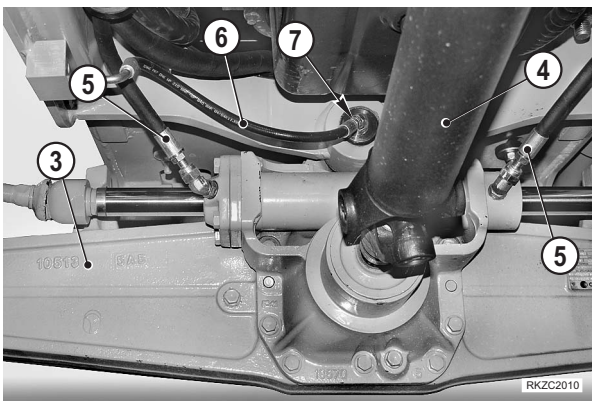




9 - Disconnect the cardan shaft (4) from the axle (3). [*3]

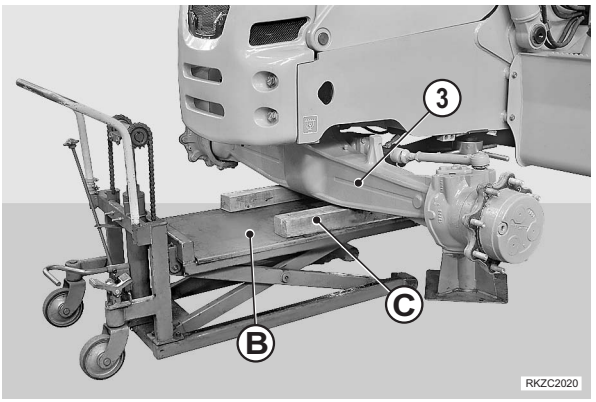
10 - Disconnect the lines (5) from the steering cylinder and plug them to prevent entry of impurities. [*4]

11 - Disconnect the lubrication tube (6) for the axle oscillation pin (7).



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.



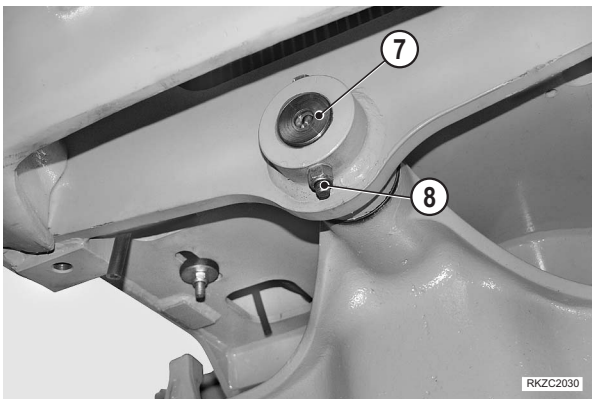
13 - Take out the nut and remove the retaining screw (8) of the axle oscillation pin (7).

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

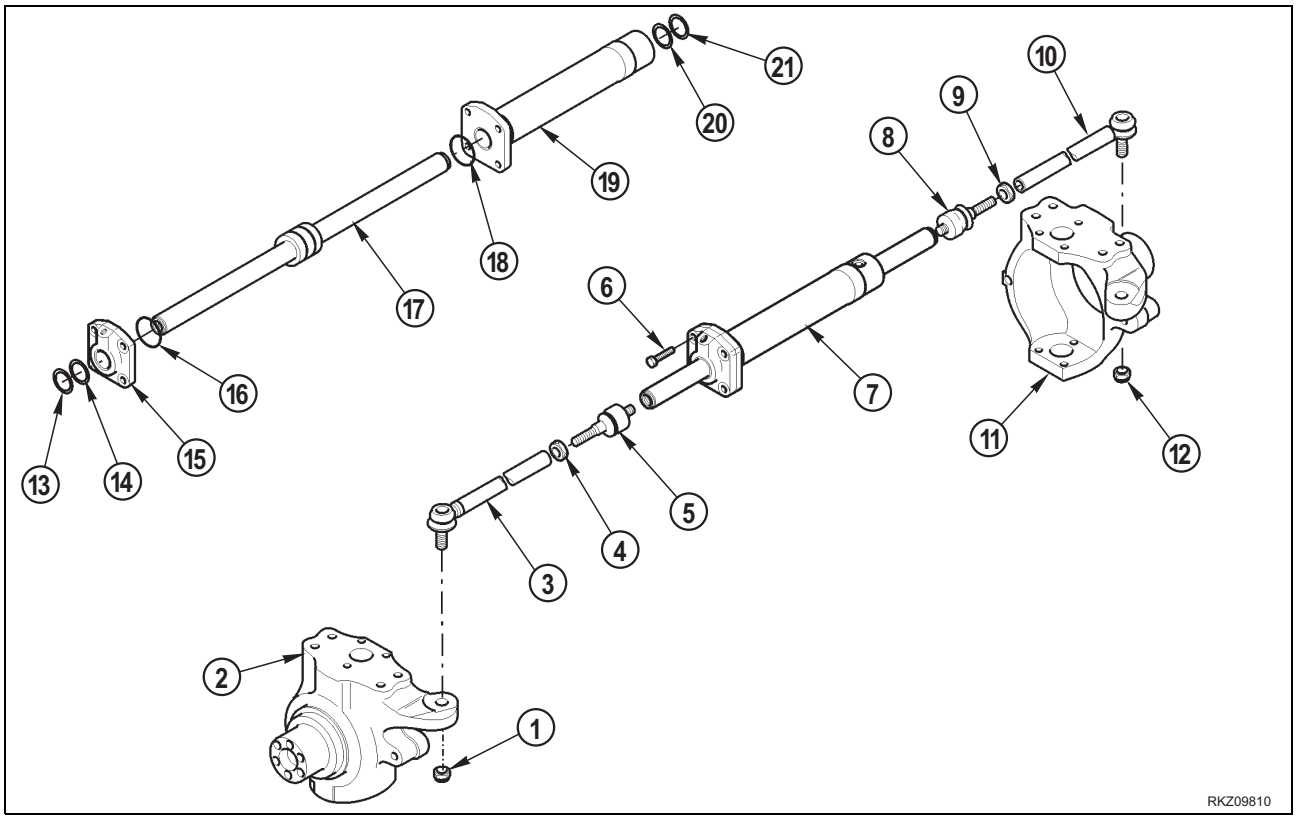
1 - Check the oil level in the tank and start the engine.

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

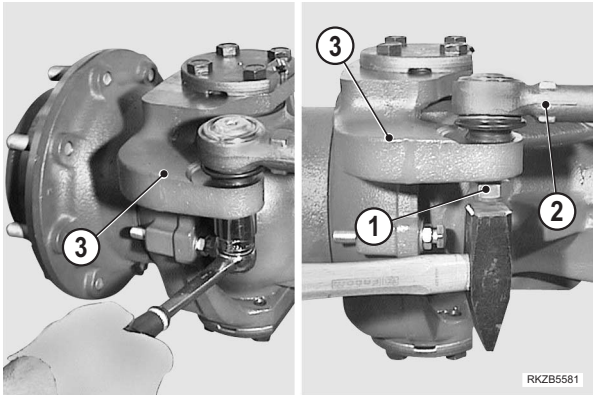
1.1 Disassembly



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.

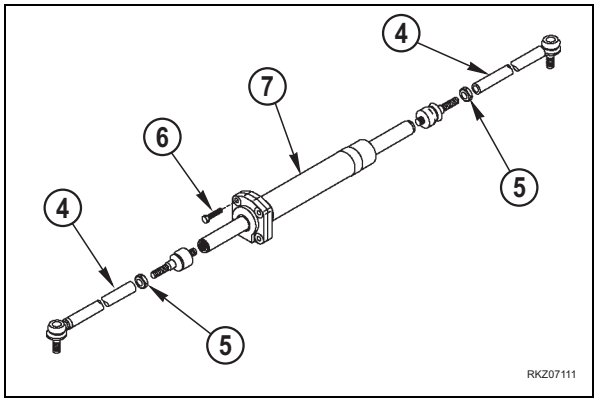
★ This is a destructive operation for the nut (1).



2 - Loosen the nuts (4) and (9) and remove the tie rods (3) and (10).

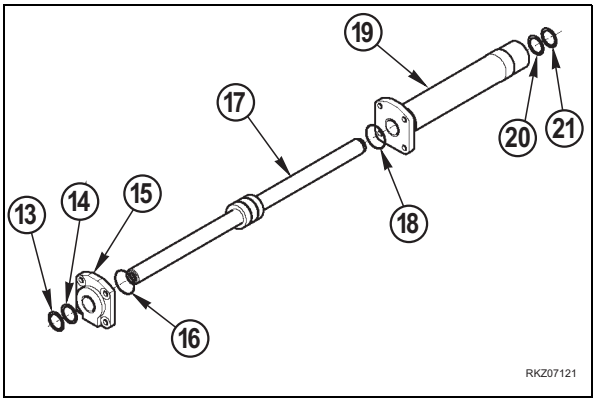
3 - Remove the fastening screws (6) of the cylinder, then take the cylinder (7) out of its housing using a rubber hammer.

★ Remove only those parts that need to be overhauled and/or replaced.



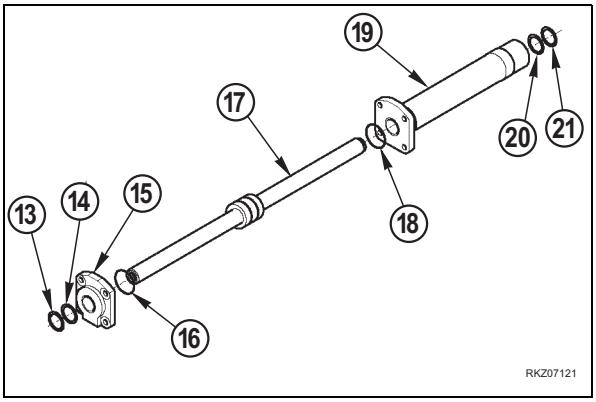
4 - Detach the cylinder head (15) from the cylinder case (19).
Remove off the cylinder head and the rod (17) from the cylinder case (19).

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).

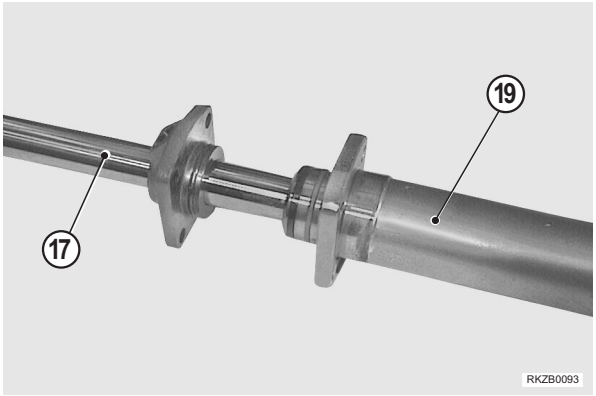


1.2 Assembly

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).

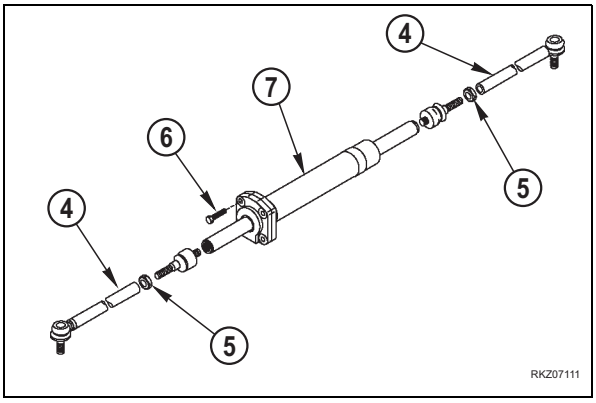


2 - Slide pre-assembled (17) rod into the cylinder body (19).



3 - Install ball joints (5) and (8), nuts (4) and (9) and tie rods (3) and (10) at the rod (17) ends and tighten.

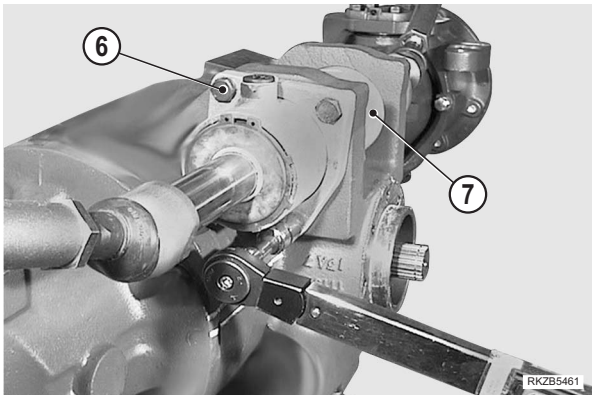
Tie rods: 300 Nm



4 - Install steering cylinder to centre body (7) together with tie rods.

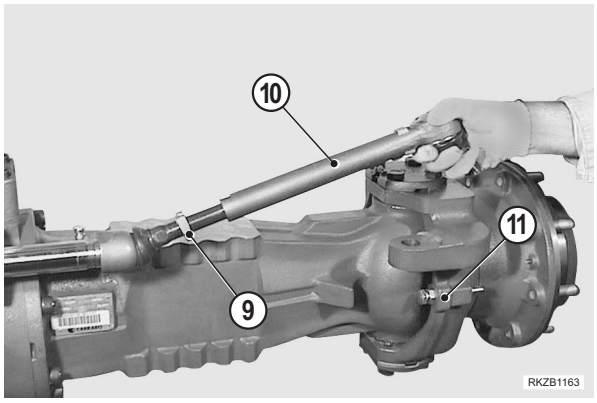
5 - Assemble and tighten the steering cylinder fastening screws (6) with torque wrench.

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.

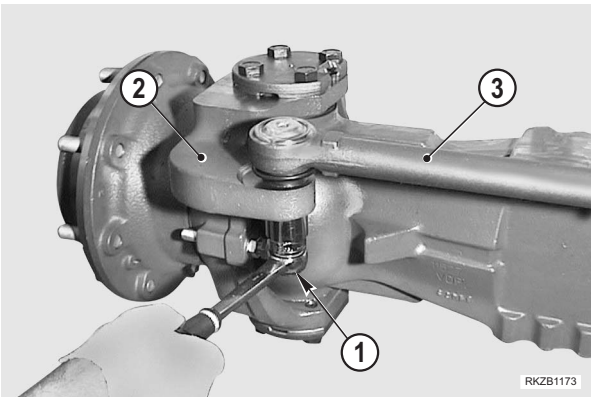
★ It is important to unscrew the locking nut (9) to carry out this operation.



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.



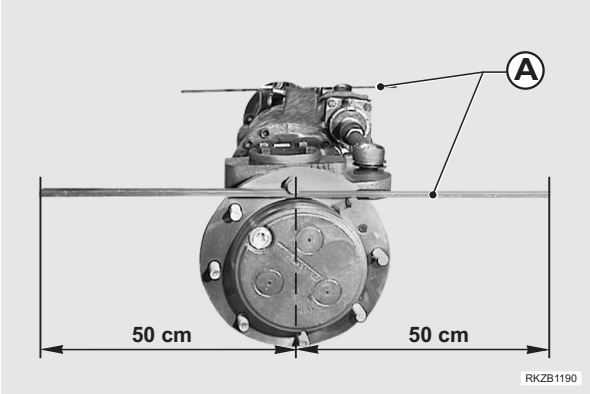
9 - Screw in the lock nuts (4) and (9) of the tie rods (3) and (10) only when the toe-in adjustment has been carried out.

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.

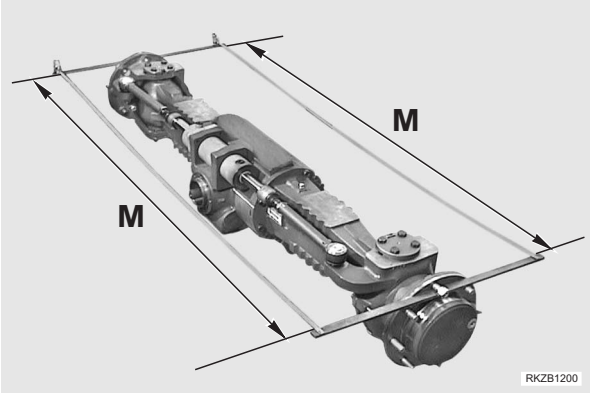
★ The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis.

★ Align the two bars.

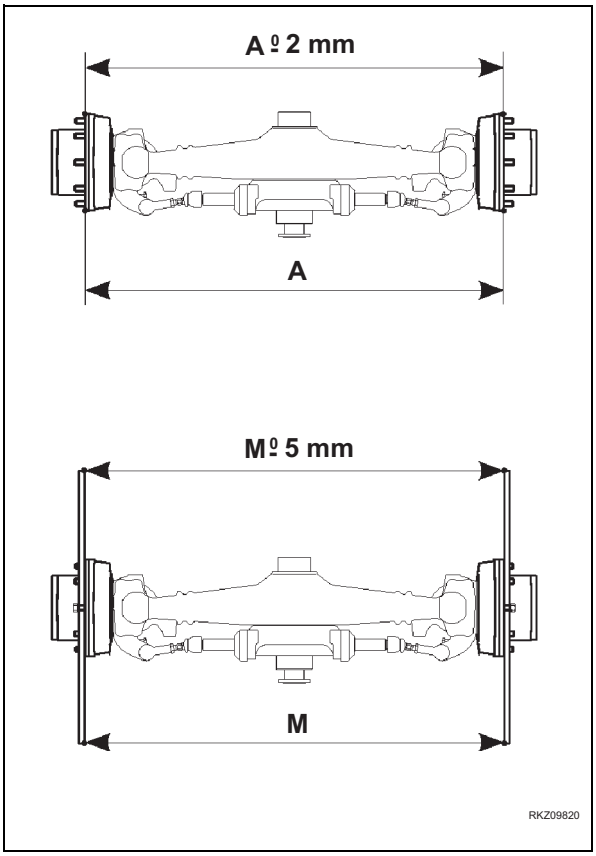


2- Using a measuring tape, measure the distance in mm **"M"** from the farthest bar ends, and tighten or loosen the guide rods until the distance is the same on both sides.

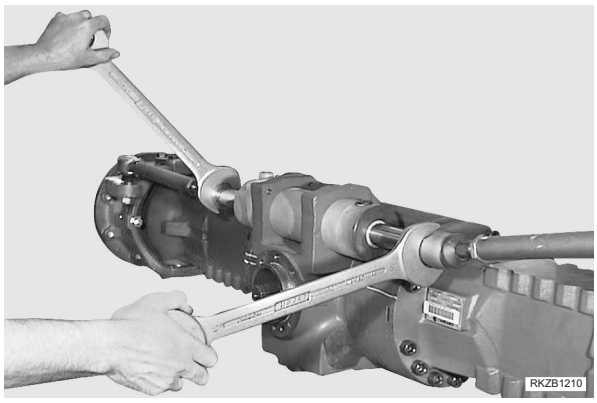
★ Keep the minimum value, swinging the measurement point.



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 º 2 mm
measured toe-in = Mº 5 mm

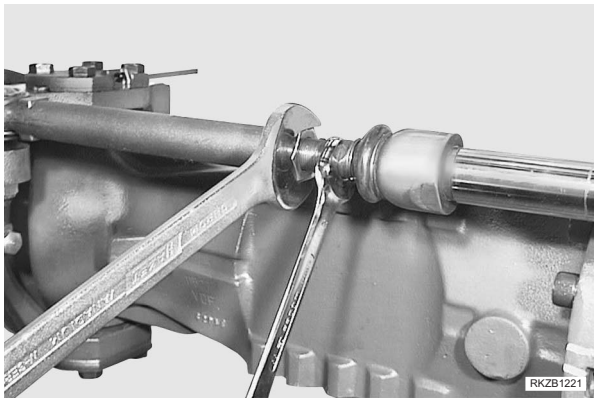


4- If toe-in is incorrect, operate with two wrenches on the guide rods screwing in and out the two joint tie rods equally till the toe-in is within the required tolerance.



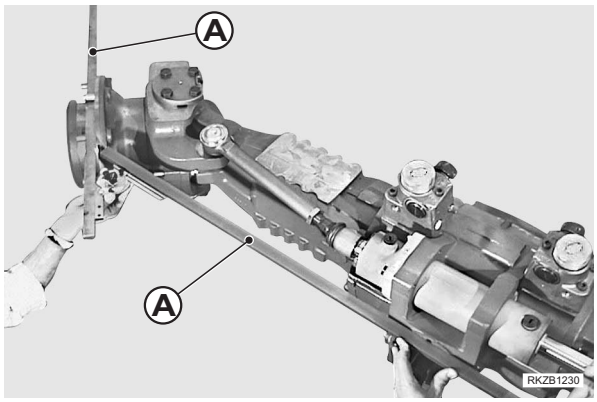
5 - Once adjustment is complete, tighten the retaining nuts on the guide tie rods.

Nuts: 250 Nm

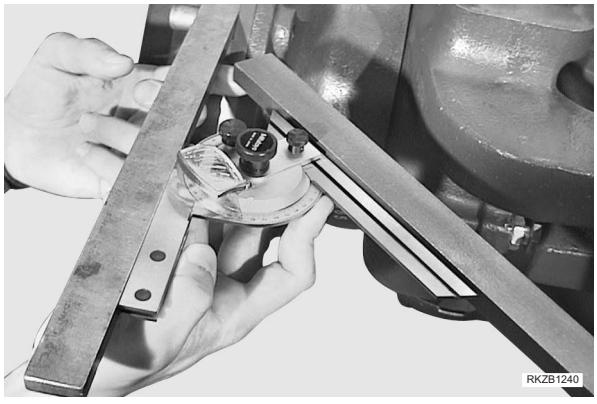


Steering angle adjustment

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.



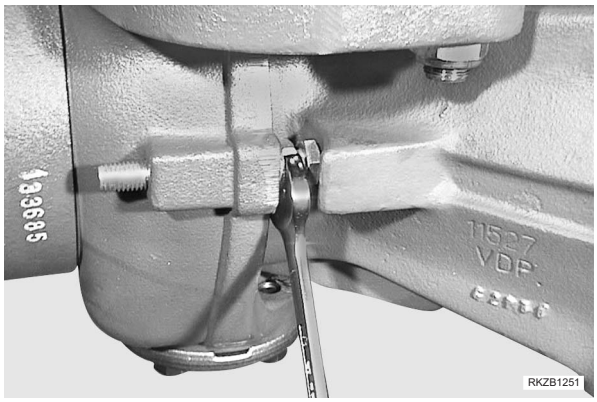
2 - Adjust a goniometer to the angle of 65° and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the goniometer.



3 - Adjust the steering mechanical retainer, screwing in or out the special screws (1) on the bar body, locking them with a locknut (2).

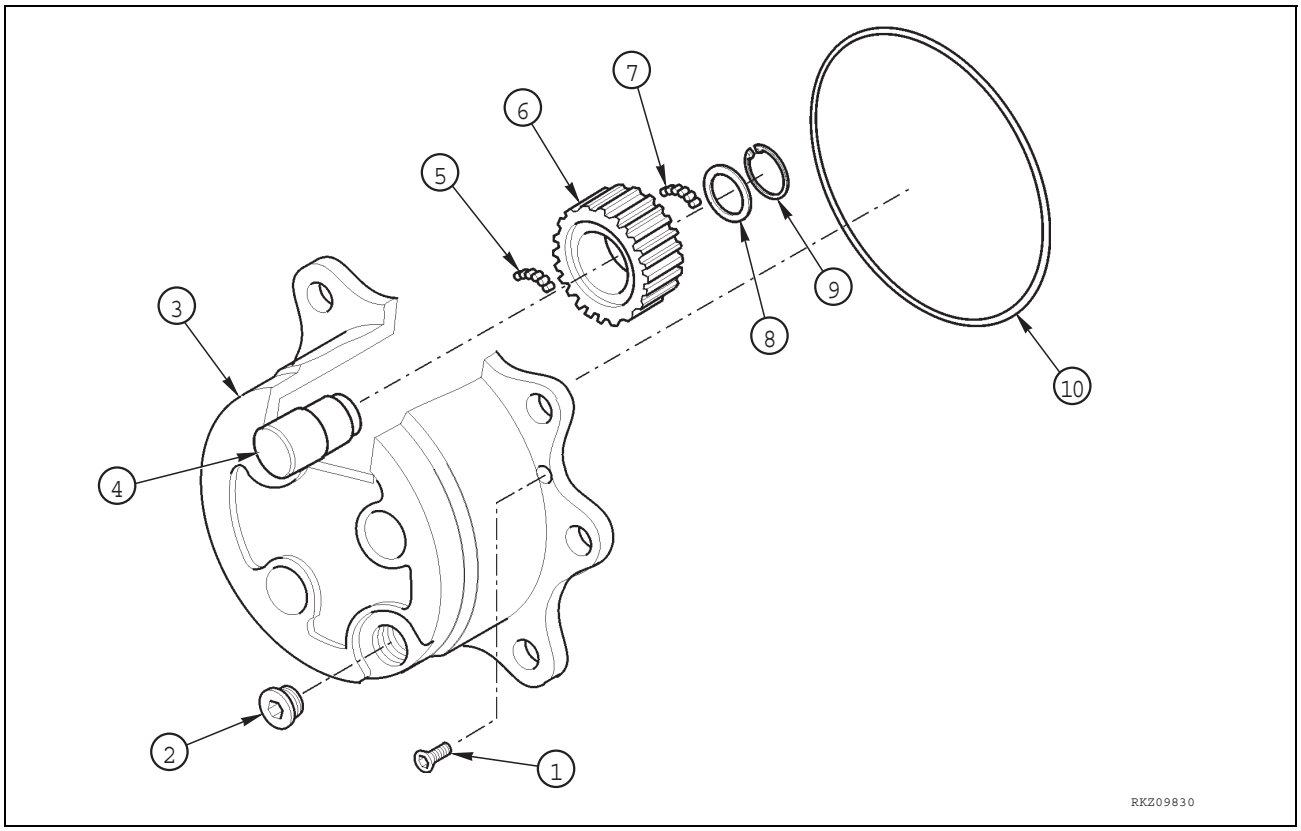
Lock nut: 150 Nm

Steer completely towards the other side and repeat the same operations.

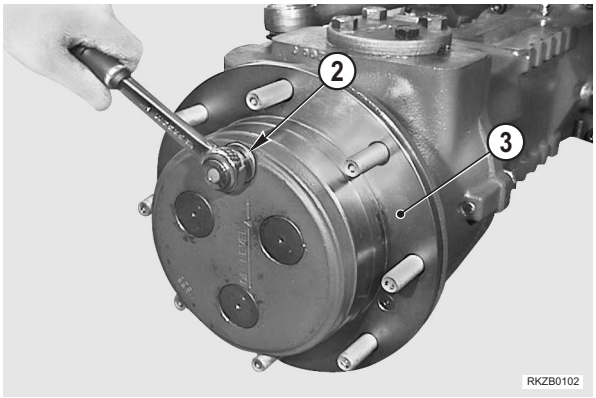


2. EPICYCLIC REDUCTION GEAR

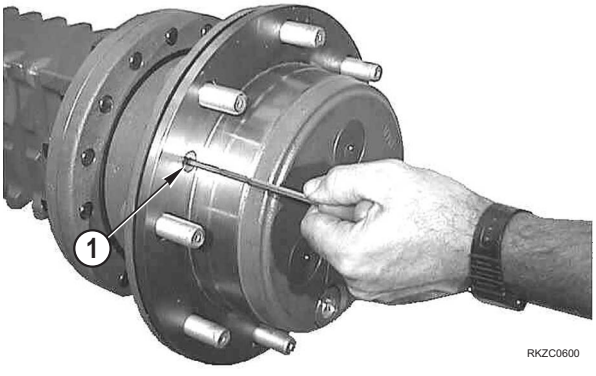
2.1 Disassembly



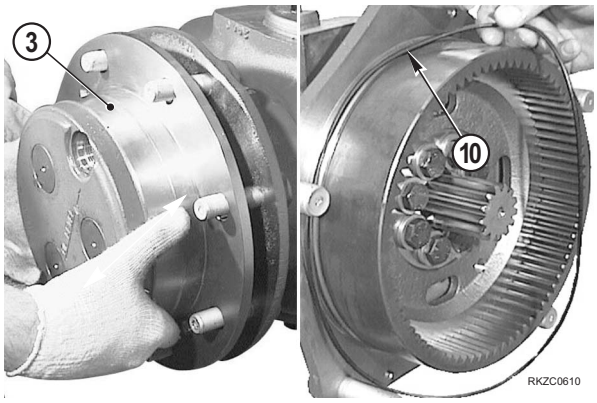
Before draining the oil, position the epicyclic reduction gear (3) with the plug (2) on the upper part and loosen it of some turns in order to eliminate any possible inner pressure, then remove it completely.
Turn the hub upside-down till the hole is in the lowest point.
Drain the oil completely.



1 -Remove the fastening screws (1).



2 - Remove the planetary carrier (3) from the epicyclic reduction gear and remove the O-ring (10).



- **Replacements of the planetary gears (if necessary)**

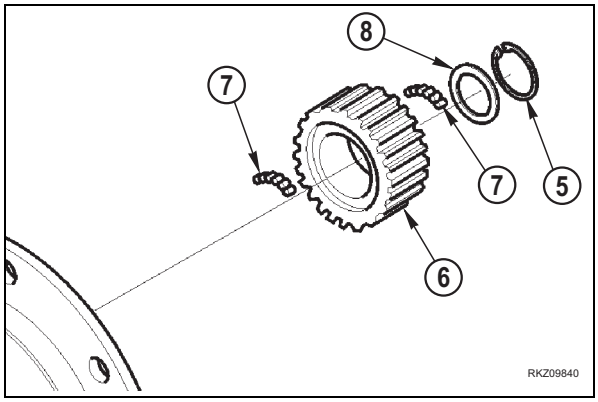
1 - Remove stop ring (9) from each pin (4).

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).

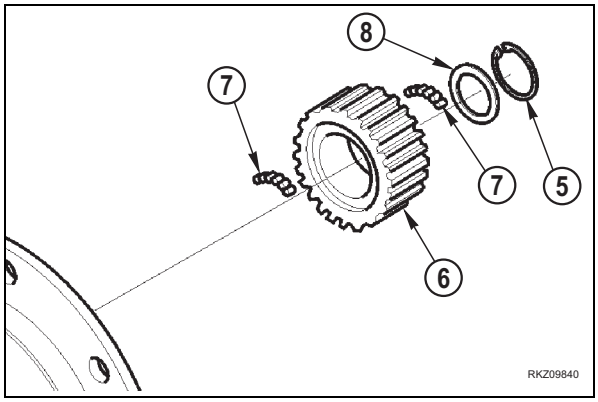
★ With new planetary gears is advisable to assembly new roller bearings.



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).

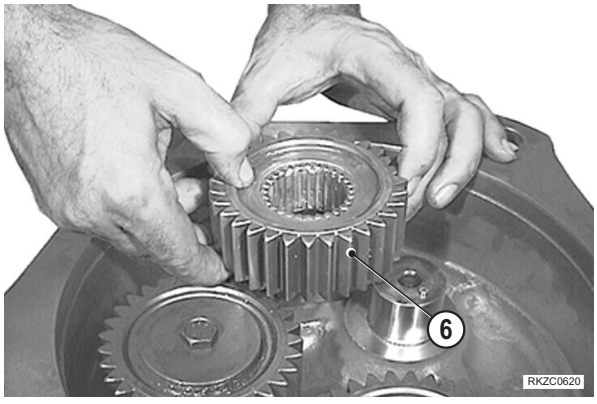
★ With new gears, it is advisable to install new needle rollers.



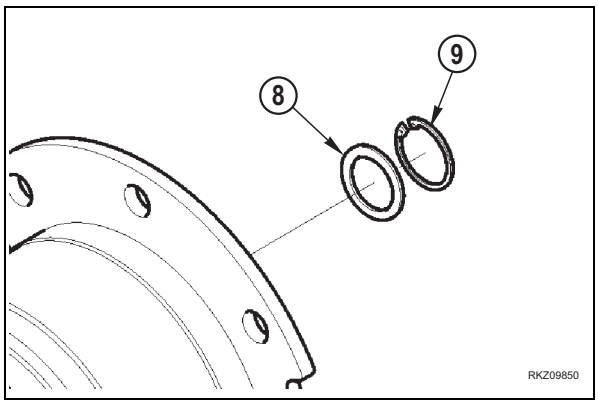
2 - Insert the needles (5) and (7) into the gears (6).

★ Grease well the needles (5) and (7).

Insert the gears (6) with assembled needles in the planetary carrier pins.

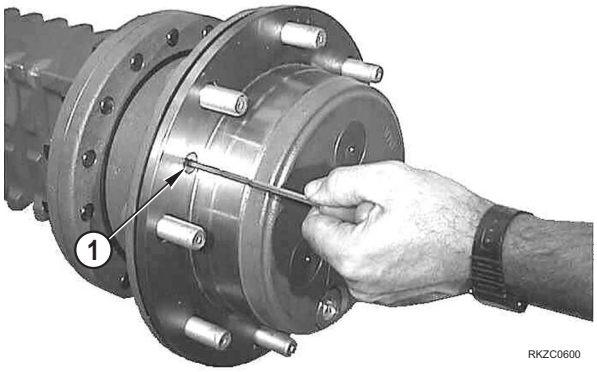


3 -Assemble the washer (8) and snap ring (9) on every pin (4).



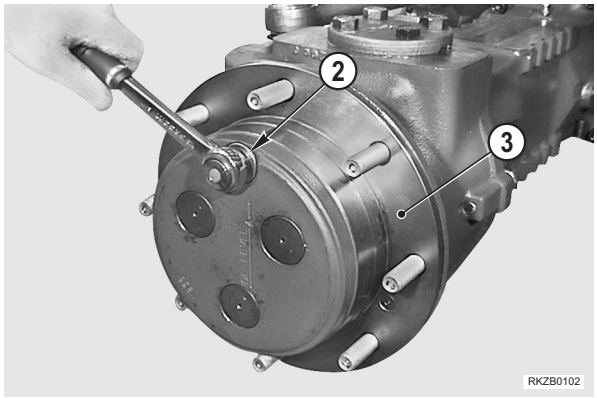
4 -Install a new O-ring (10).
Install planetary gear carrier (3) to epicyclic reduction gear.
Install retaining screws (1).

Screws: 25 Nm



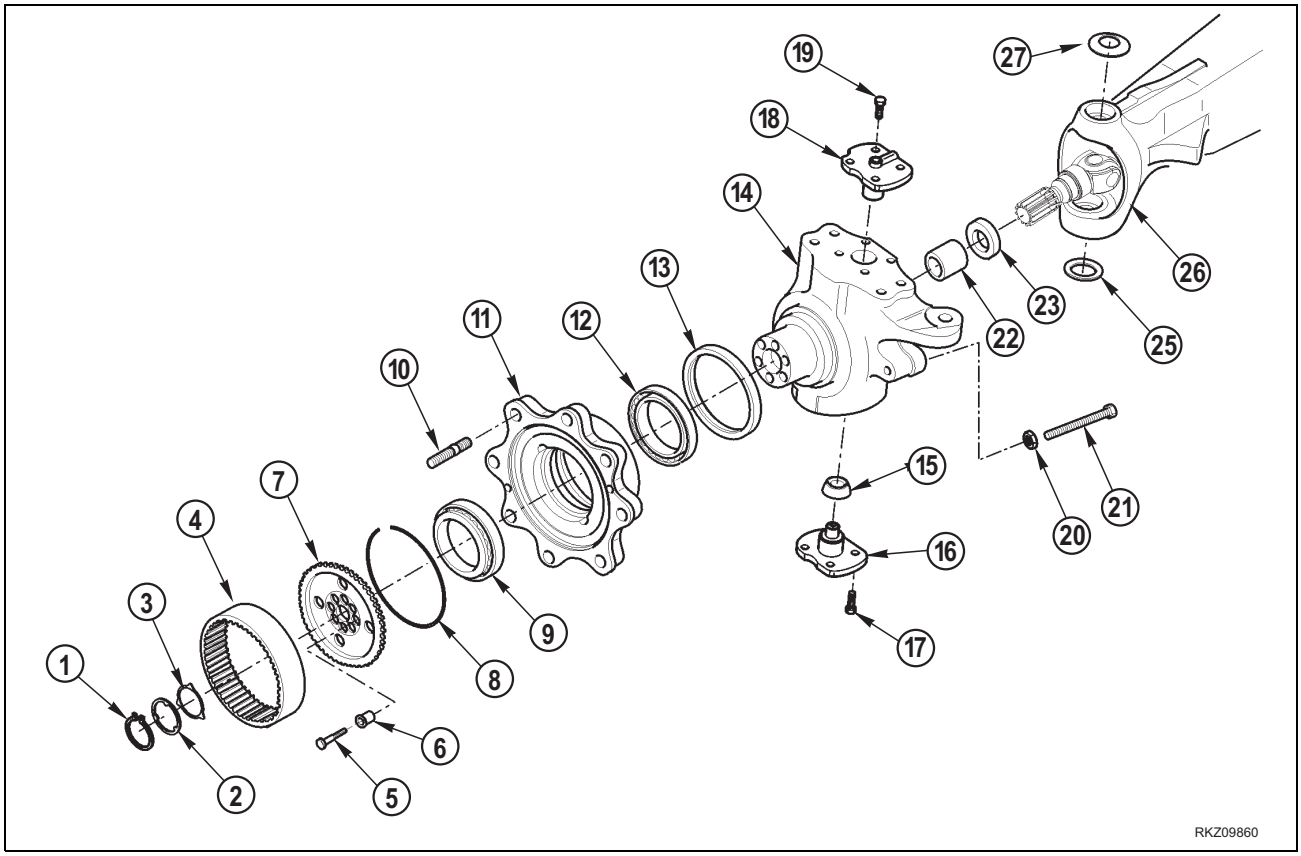
5 -Use recommended oil in epicyclic reduction gear and axle body.
Install plug (2) to epicyclic reduction gear.

Plug: 80 Nm



3. WHEEL HUB GROUP

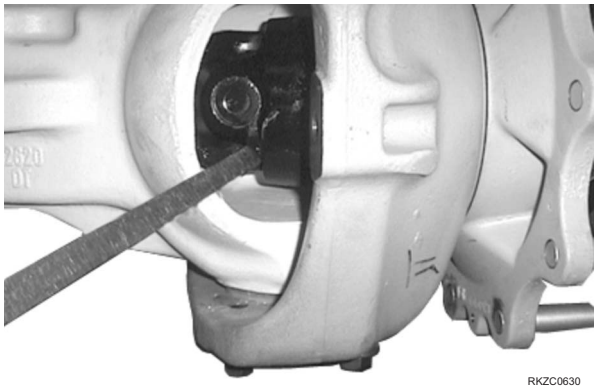
3.1 Disassembly



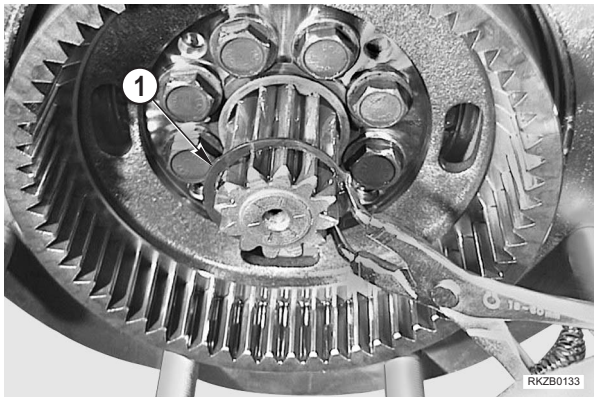
⚠ Before disassembling the wheel hub, it is advisable to secure it with a belt or a rope on a hoist or any other supporting device, in order to avoid its accidental fall that could damage either the operator or the wheel hub group.

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.

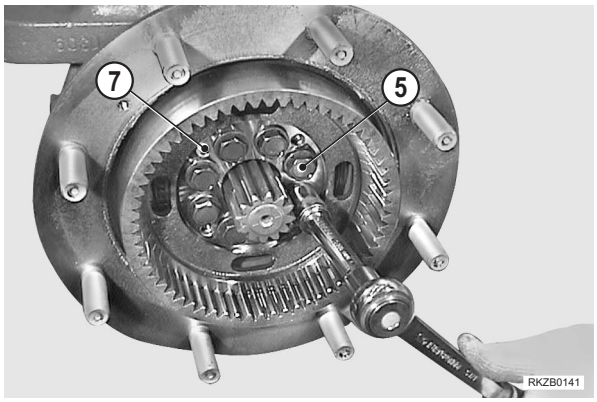
★ Do not damage the double U-Joint.



2 - Remove the lock ring (1) from the double U-Joint shaft and collect the washers (2), (3).

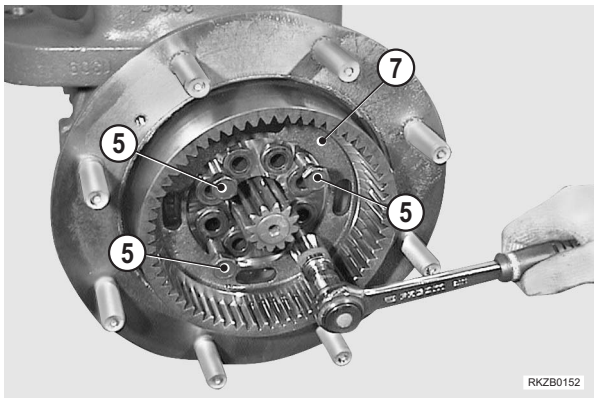


3 - Unscrew and remove the fastening screws (5) from the wheel carrier (7) group.



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).

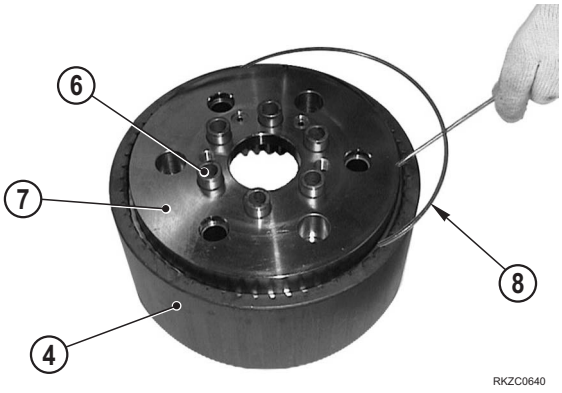


6 - Remove the stop ring (4) and disjoin the hub-lock ring gear (7) from the epicyclic ring gear (3).

★ Check the wear conditions of the components.

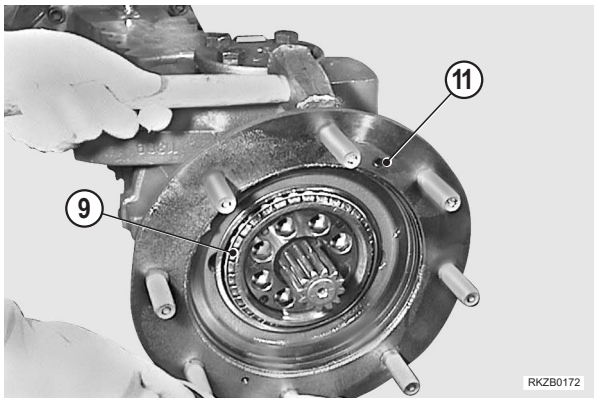
Only if necessary

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.

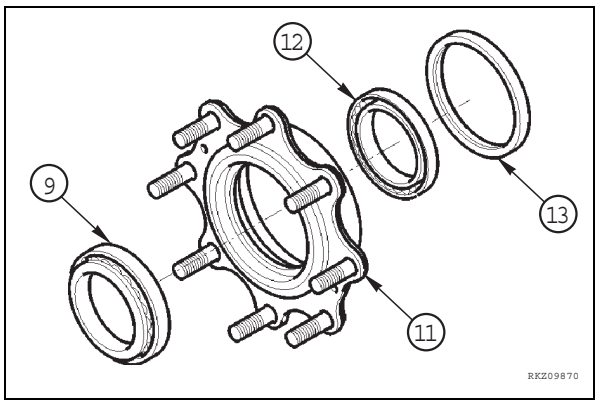


9 - Position on a flat surface the hub and take the seal ring out (13) with a lever.

★ 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.

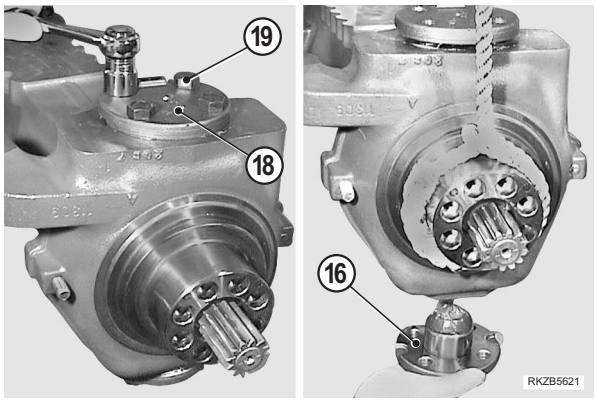
11 - Remove the bearing cone (12) from the swivel housing using a suitable, commercially available puller.



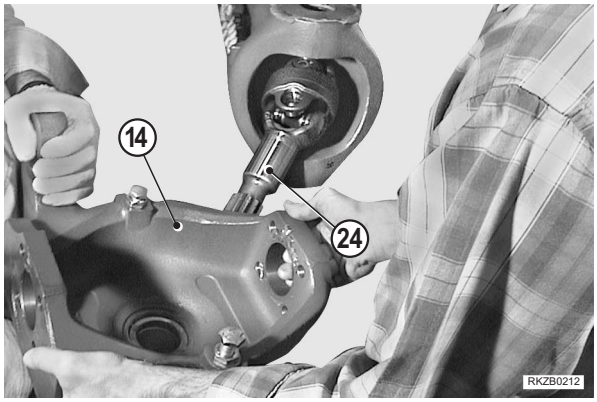
12 - Unscrew and remove the fastening screws (19) from the upper (18) and (17) lower (16) king pin.

⚠ 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 he belleville washers (25), (27).



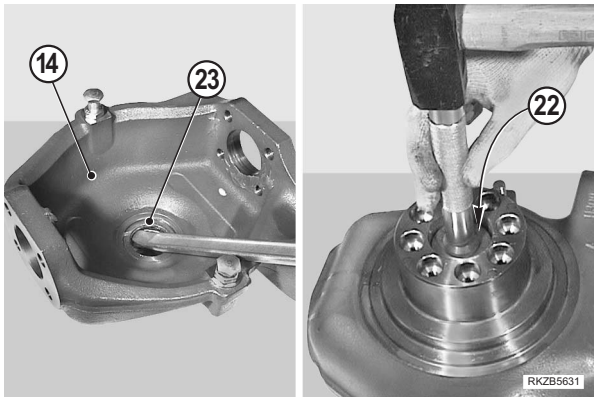
14 - Remove the swivel housing (14) from the axle beam and from the shaft (24).



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.

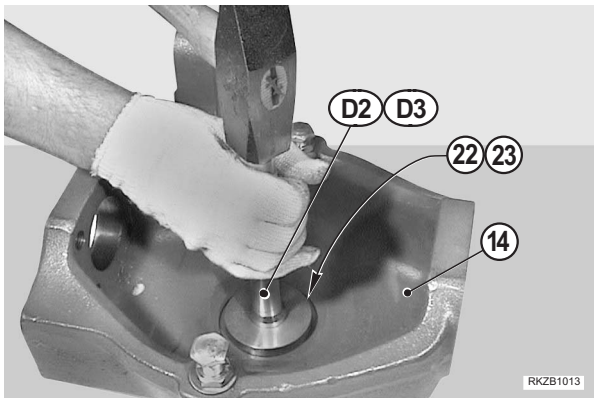
16 - Turn the swivel housing (14) and take the bush (22) out, using a driver and a hammer.



3.2 Assembly

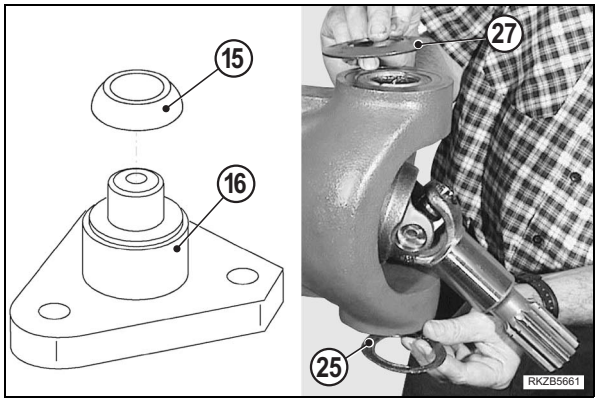
1 -Force the bush (22) into the swivel housing (14) with the special tool **D2**. and a hammer or a press.

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).

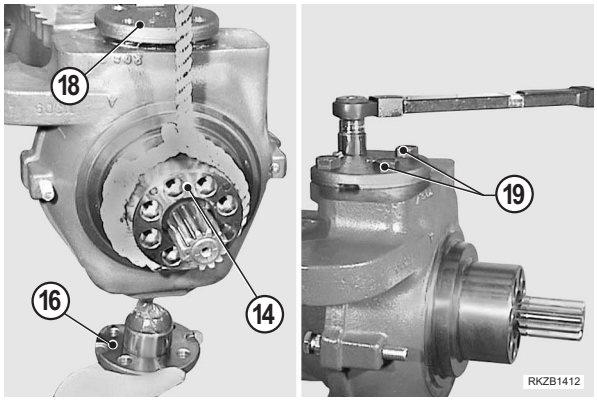


5 -Secure the swivel housing (7) group with a rope. Lubricate the seal ring lip and protect the splined end of the axle shaft by winding it with thin adhesive tape to avoid damage to the seal ring. After assembly, remove completely the adhesive tape. Assemble the swivel housing on the axle beam.

6 -Assemble the two king pins, the upper (16) and the lower (18), and tighten the retaining screws (17) and (19).

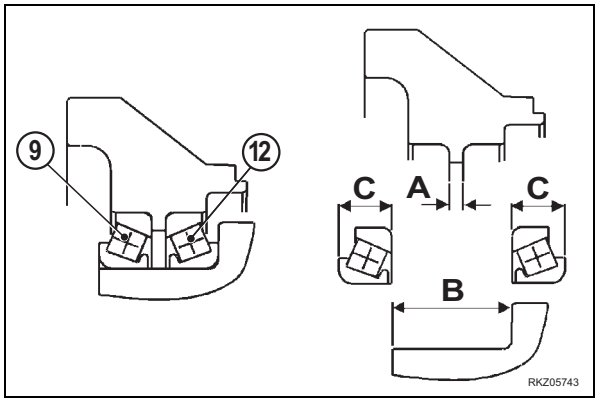
Screw: 190 Nm

★ Make sure that the Belleville washers (25) and (27) remain in their position.



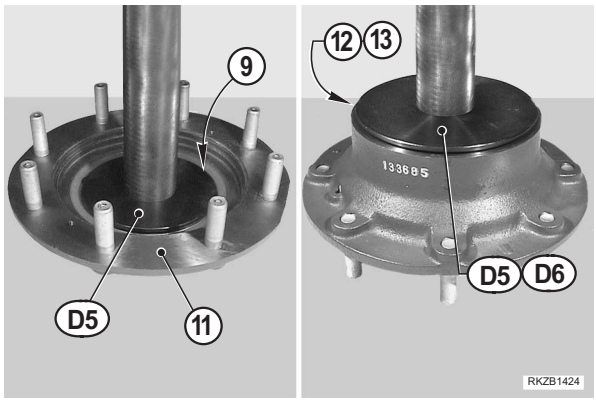
7 -If bearings (9) and (12) need to be replaced, make sure that distances "**A**", "**B**" and "**C**" are within the permissible range.

A = 5.900 – 5.905 mm
B = 52.229 – 52.279 mm
C = 23.072 – 23.173 mm



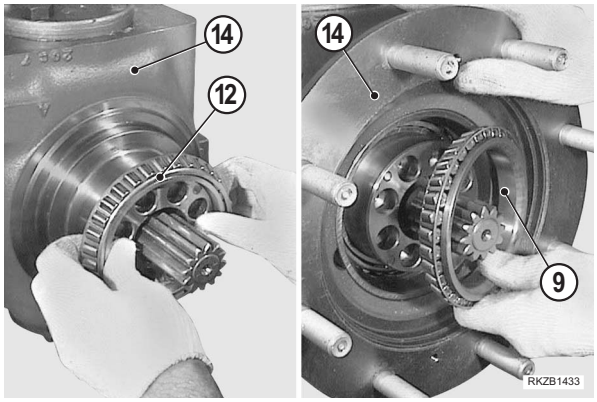
8 - Position the wheel hub (11) on a workbench and force both cups of the taper roller bearings (9) e (12) in position with the special tool **D5** under a press or with a hammer.

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).

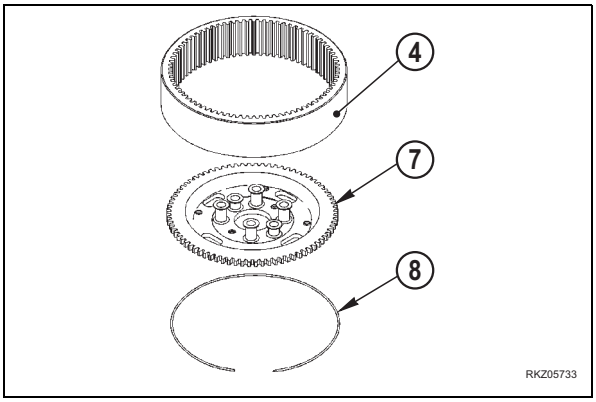
11 - Assemble the wheel hub (11) on the swivel housing (14) and fit the other cone of the taper roller bearing (9) in position.



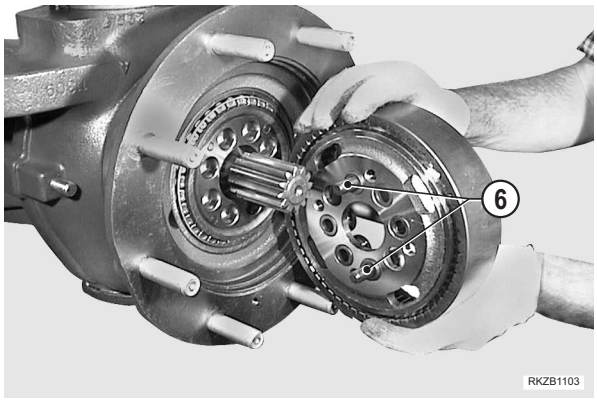
12 - Position the wheel carrier (7) on a workbench and force the bushes (6) to the carrier surface level with the special tool **D1**.
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



13 - Preassemble the wheel carrier - (7) epicyclic ring gear group (7) and (4) with the special locking ring (8) shown in figure.

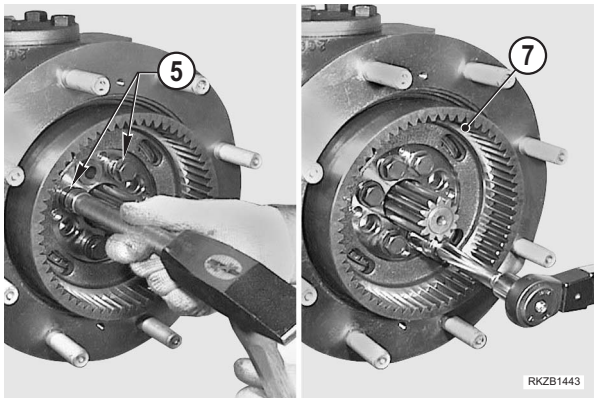


14 - Assemble the wheel carrier group on the wheel hub using the two projecting bushes (6) as dowel pins.
Screw the relative screws (5) in order to put in contact the ring bevel gear with the wheel hub.

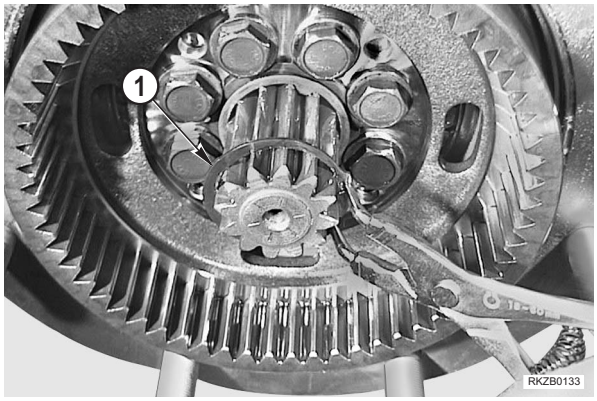


15 - Force all the hub dowel bushes completely with the special tool **D1** and a hammer.
Assemble the wheel carrier (7) fastening screws (5) and tighten.

Screw: 120 Nm

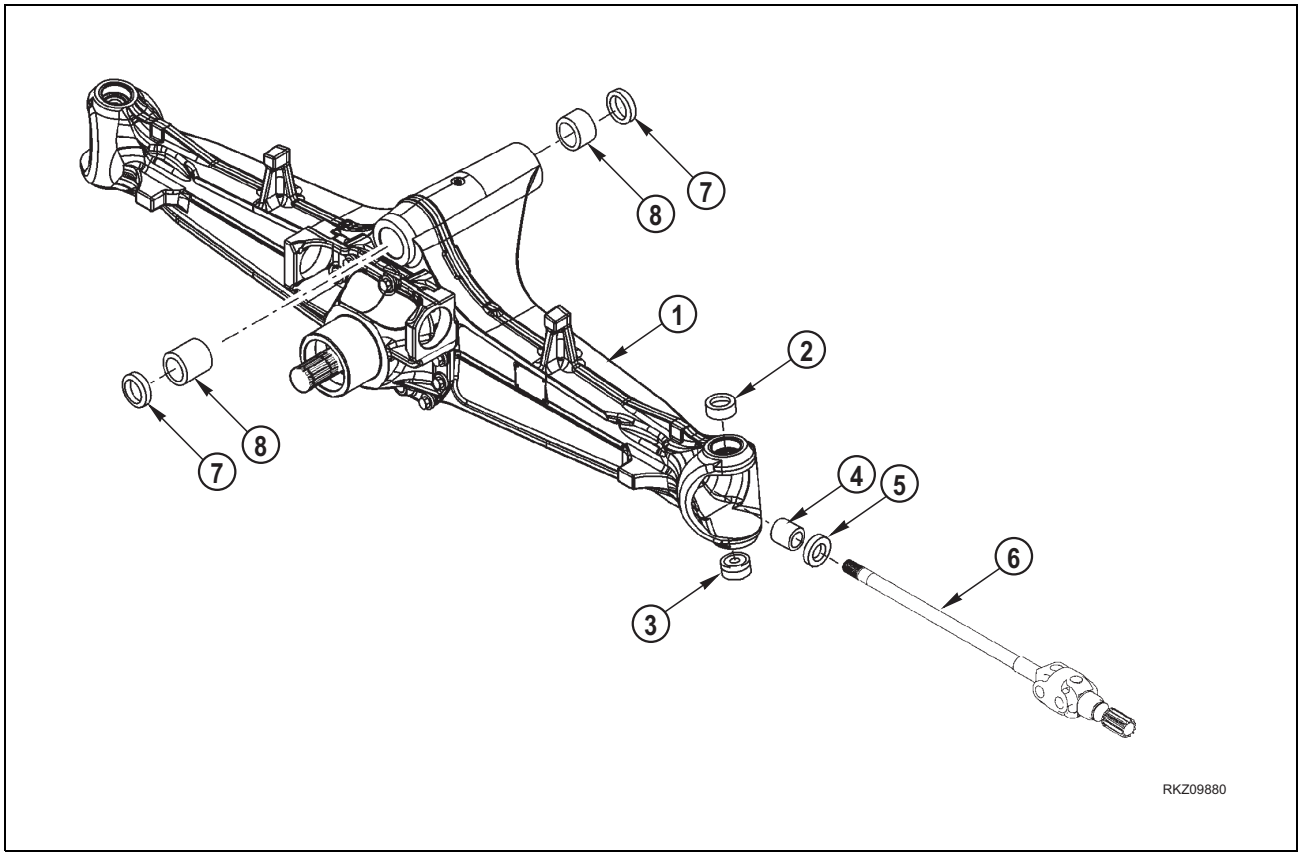


16 - Install washers (2) and (3) to the axle shaft and install the stop ring (1) by pushing it from the end of the serrated hub to its seat while counteracting with a lever inserted between beam and swivel housing and engaged onto the double U joint.

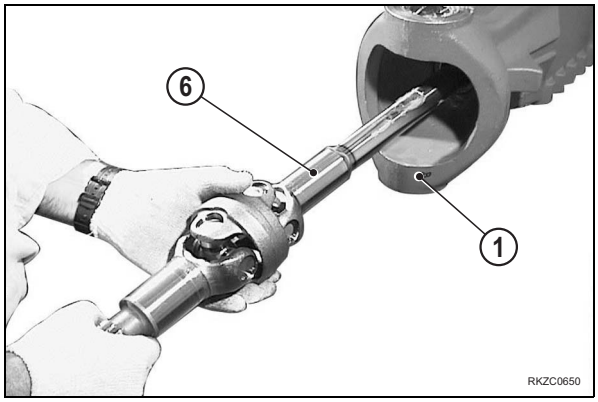


4. AXLE BEAM GROUP

4.1 Disassembly



1 - Remove the U-Joint (6) from the axle beam (1).

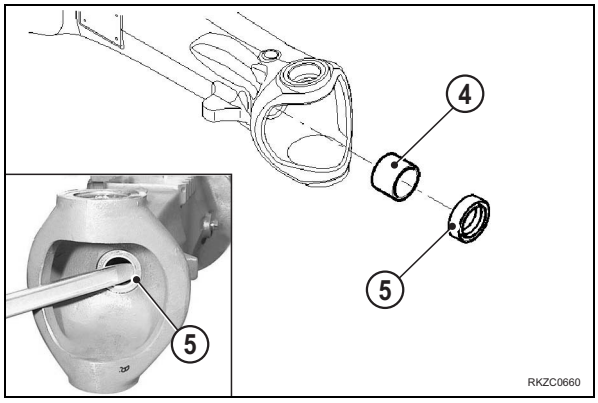


2 - Take the seal ring (5) out of the axle (1) beam with a lever.

★ This is a destructive operation for the seal rings.

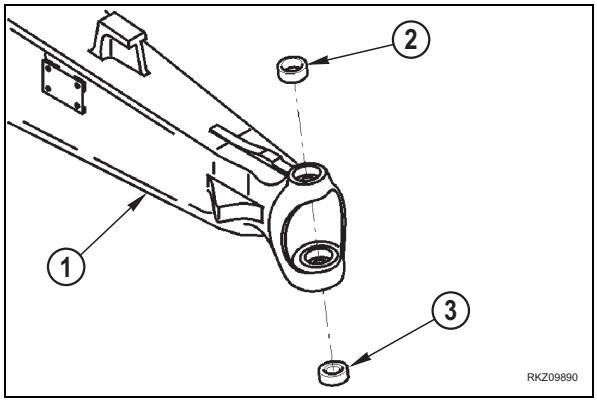
3 - Remove the bush (3) from the beam with a suitable extractor.

★ Examine the bush before the removal and replace it only if the wear conditions require this.



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.

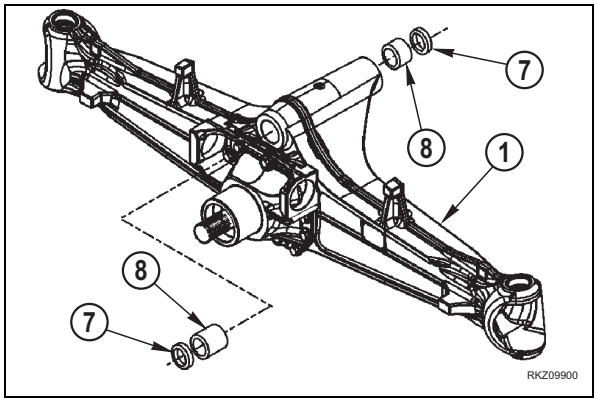


5 - Take the seal ring (7) out of the axle (1) beam with a suitable tool.

★ 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.

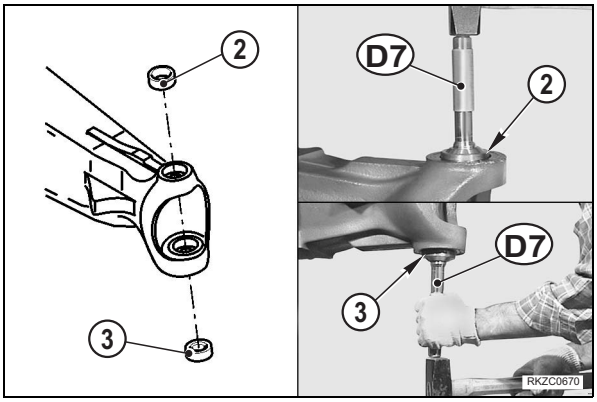
★ Do not damage the bushing housing.



4.2 Assembly

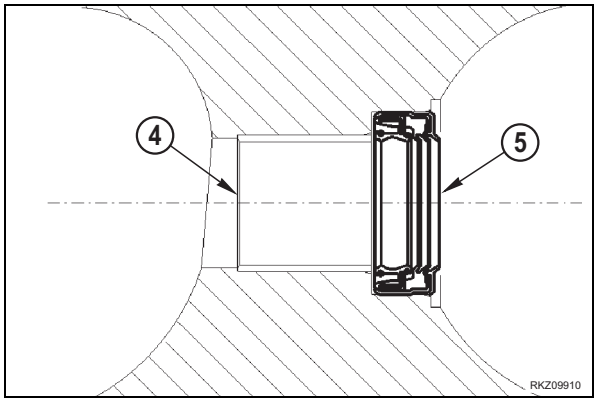
1 - Using tool **D7** and a hammer, install bushing (2) and cup (3).

★ To make installation easier, allow the bushings and cups to cool in liquid nitrogen at less than -100°C (-148°F)



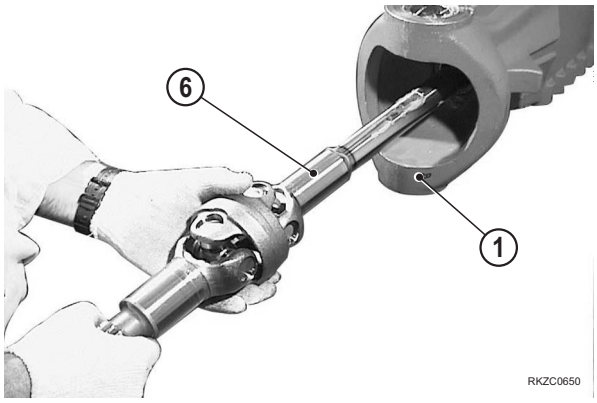
2 - Assemble the bush (4) on the axle beam with the special tool **D9** and a hammer.

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.

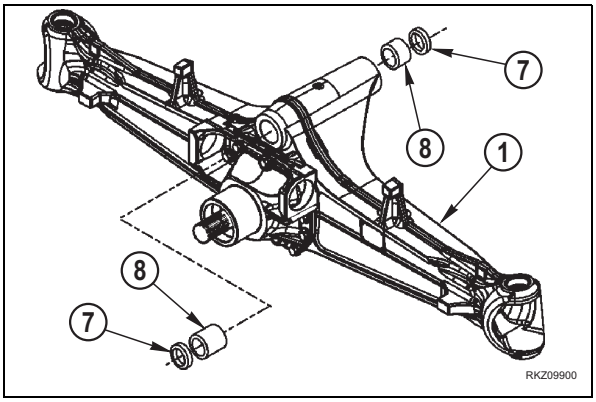


4 - Lubricate the bush (5) and the seal ring lip (6). Insert the U-Joint (7) inside the axle beam.

★ Take care not to damage the sealing ring.

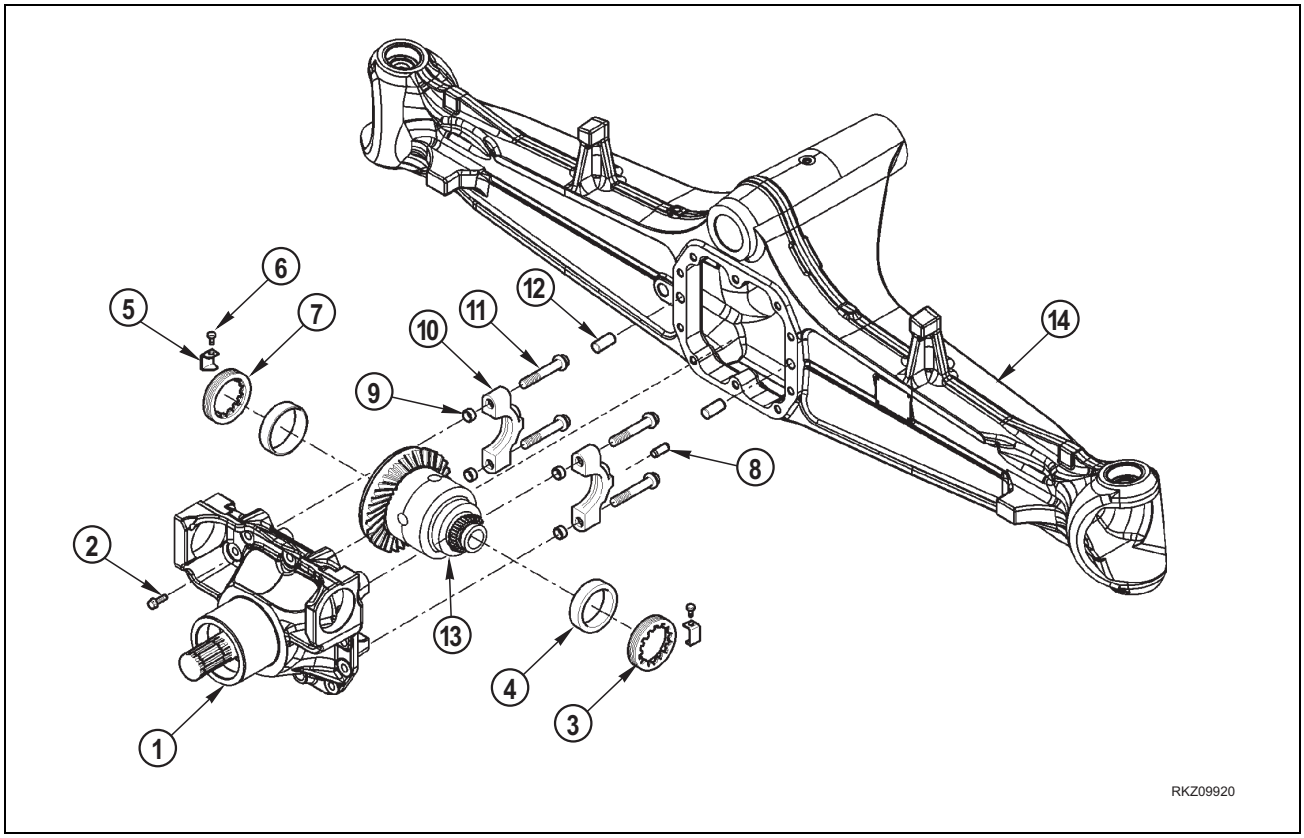


5 - Assemble two new bushings (8) respectively and two new seal rings (7) in the central unit (1) pivot by using special tools **D8** and **D11**.



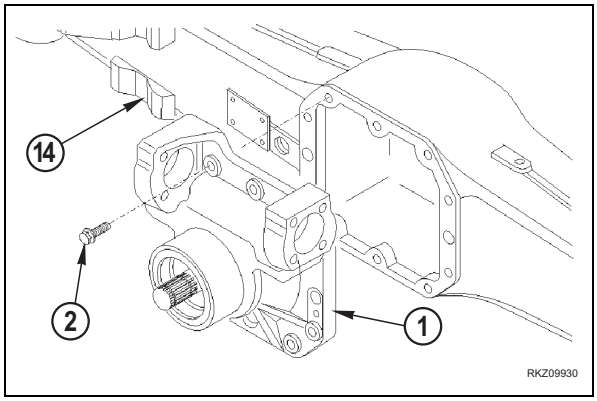
5. DIFFERENTIAL SUPPORT

5.1 Disassembly

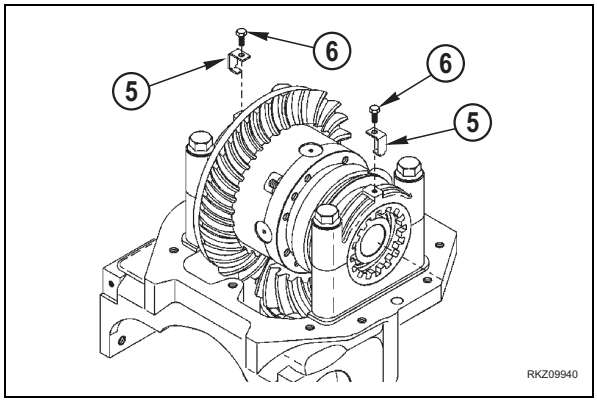


1 -Loosen and remove the screws (2) on the differential support (1). Remove the differential support (1) from the axle beam (14).

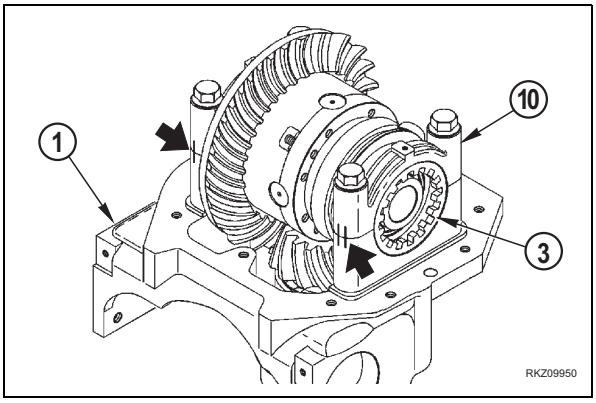
⚠ Support the differential carrier with a rope or other appropriate means.



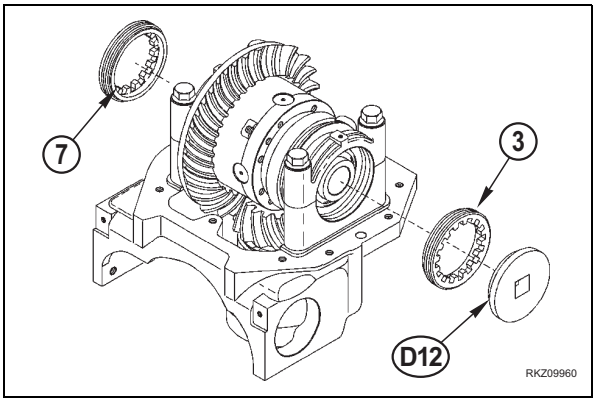
2 -Loosen and remove the screws (6) to remove the two ring nut retainers (5).



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) buts and the differential (1) carrier as well.

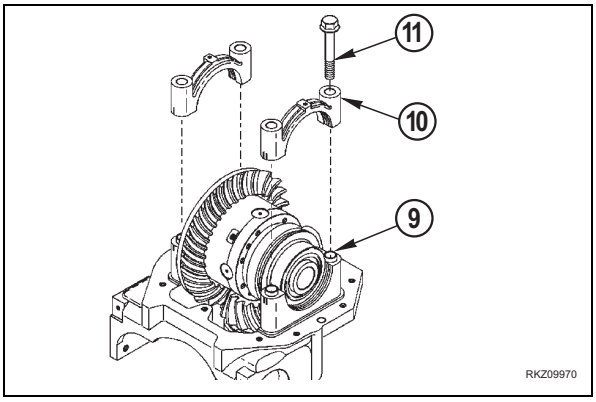


4 - Unscrew the adjuster ring nuts (3), (7) using tool **D12** and a wrench.



5 - Loosen and remove the 4 screws (11) and remove the 2 half-collar (10).

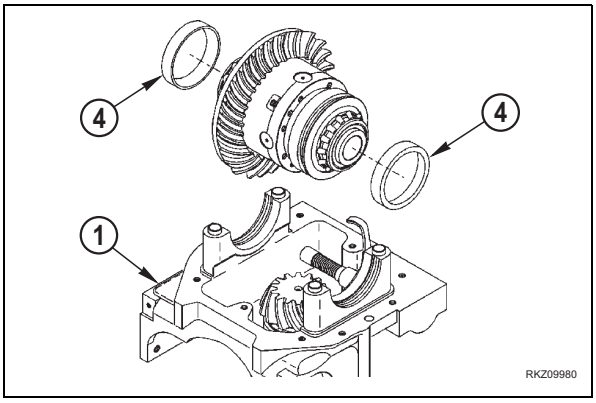
★ Ensure that the centre bushings (9) remain seated.



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).

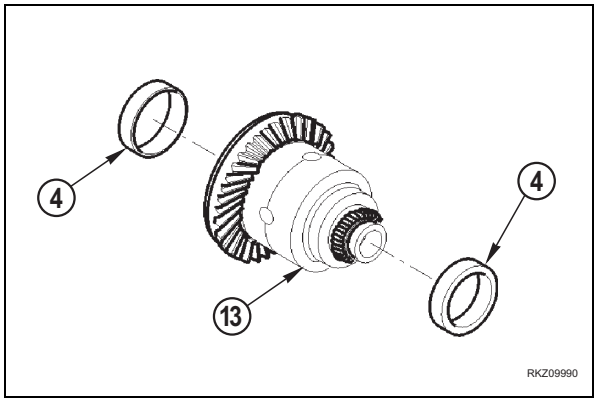
★ Do not mismatch the cups of the bearings (4) if bearings are not to be replaced.



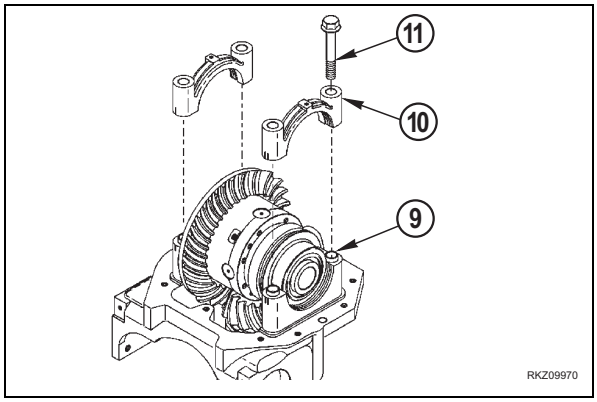
5.2 Assembly

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.

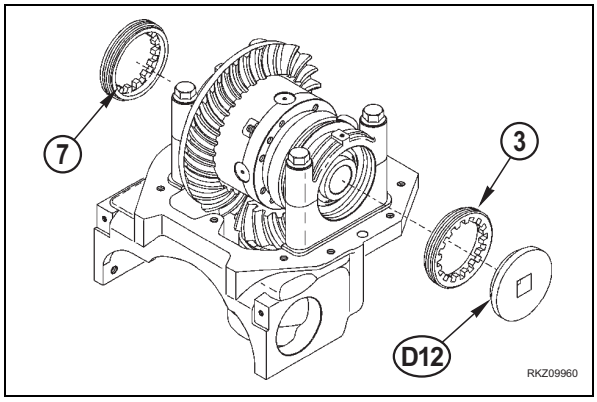


2 - Place the differential (1) group and the two halfbridles (3) and bolts in their seat.
Check the positions of the bushings and halfbridles using the reference marks on them and on the differential support (1).
Install the halfbridles and secure with their respective screws (11).

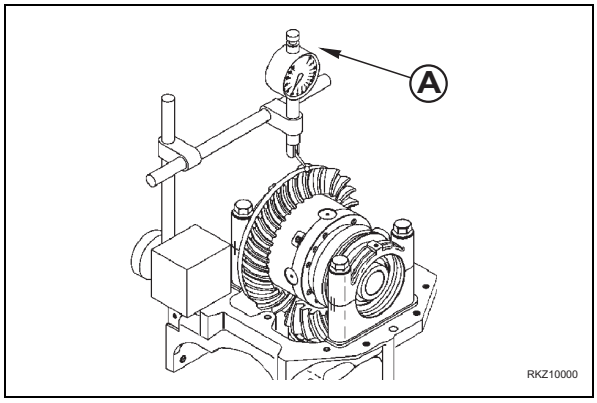


3 - Assemble and tighten the two adjustment ring nuts (3) (7) in the differential support with tool **D12**, so as to pre-load the differential bearings slightly. Knock lightly with a soft hammer in order to properly set the bearings in position.

★ Take care not to reverse the ring nuts; align the previously-traced reference marks.



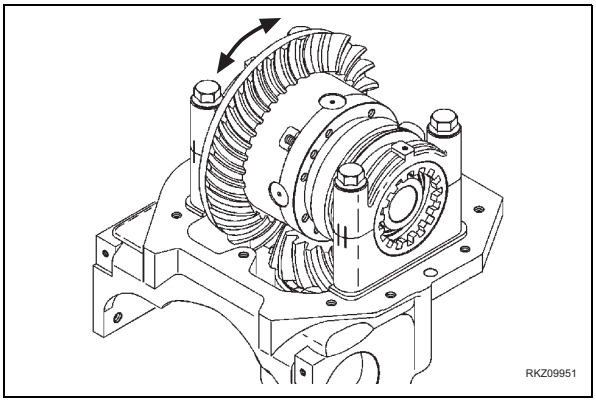
4 - Install a magnetic comparator "**A**" to the differential support so that the checkhead is at right angles with the side of a tooth from the ring gear.



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:

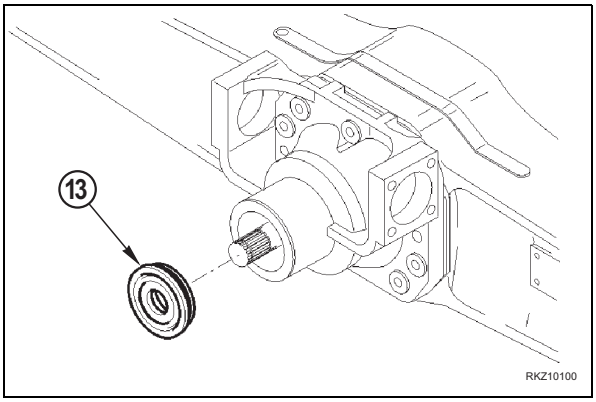
0.18 – 0.28 mm

Adjust by operating the ring nuts (3), (7) by means of tool **D12**.

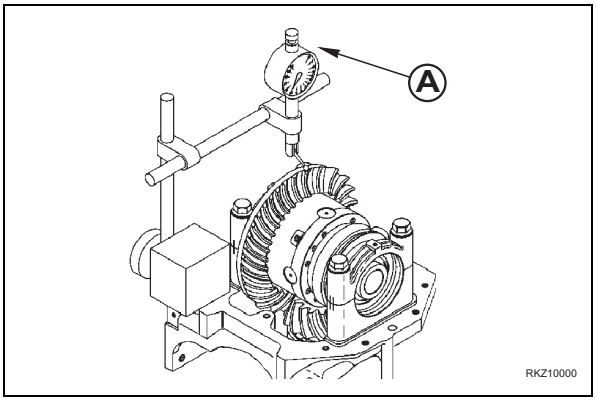


6 - If **the measured backlash is lesser** than the given tolerance range, screw the ring nut (7) from the side opposite to the ring gear and unscrew (3) the opposite one of the same measure.

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.

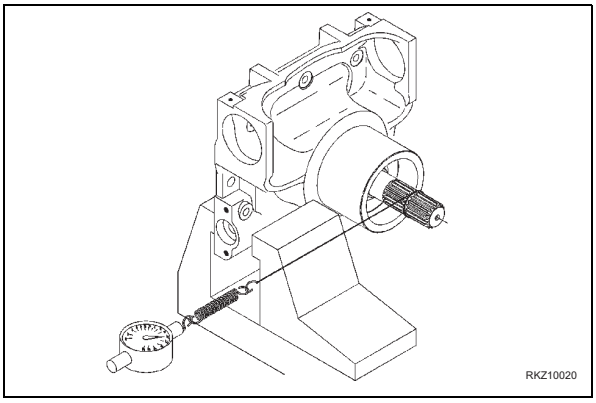


8 - Once pinion/ring gear backlash is determined, measure total bearing preload (**T**) (pinion/ring gear system) using a force gauge with the cable wound around the splined pinion end. The reading should be within the following values:

T=(P+3.75)–(P+5.75) daN

where **P** is the effectively measured pinion preloading (For details, see "6. DIFFERENTIAL GROUP")

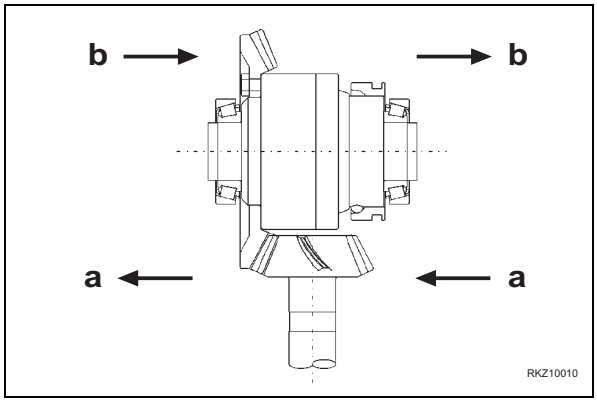
★ All preloadings should be measured without the seal ring.



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:

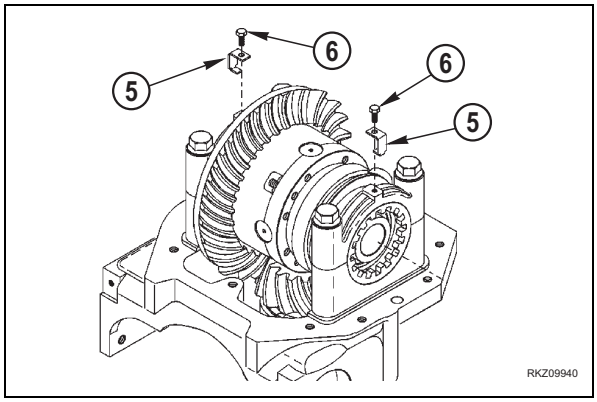
a - if **total preload is less** than the specified values, tighten the adjuster ring nuts (3) and (7) by the same amount, while keeping the pinion/ring gear backlash unchanged;

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;



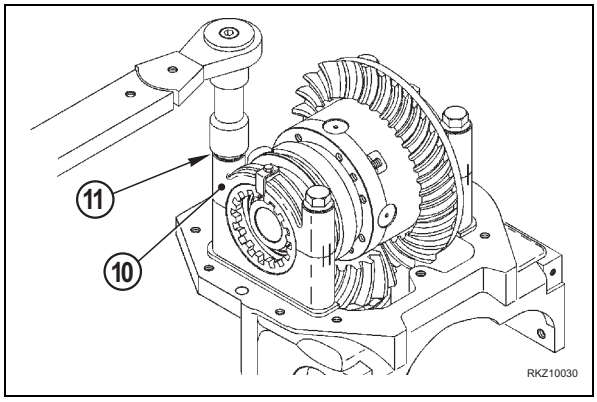
10 -When all adjustments are complete, install the ring nut retainers (5) and their respective screws (6), and tighten to the specified torque.

Screw: 266 Nm



11 -Tighten the screws (11) the 2 half-collar (10).

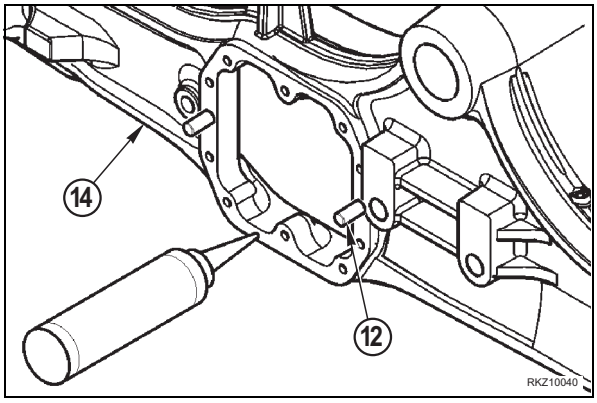
Screw: 266 Nm



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).

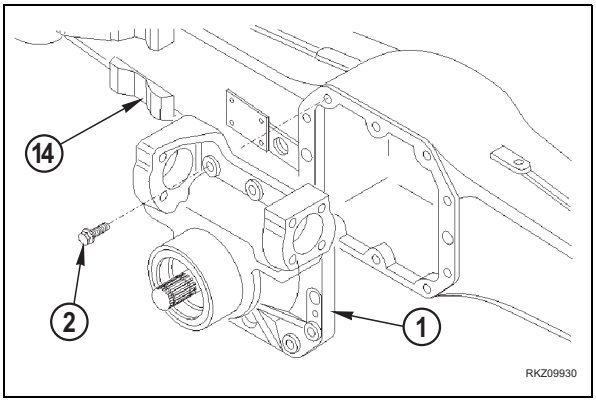
Loctite: 510

★ check that two dowel pins (12), (8) are in their seats.



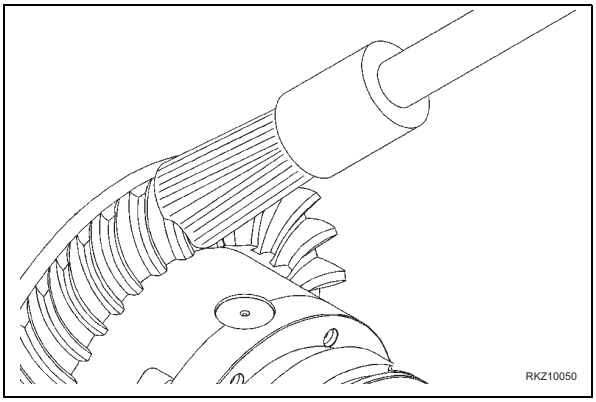
13 - Assemble the differential support (1) to the axle housing (14), and tighten the retaining bolts (2) to the requested torque.
Refill the tank with oil.

Screw: 169 Nm



- **Bevel gear marking test**

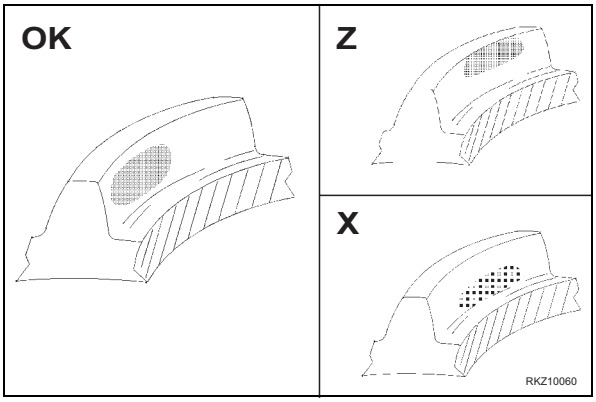
1 - To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should be always carried out on the ring bevel gear teeth and on both sides.



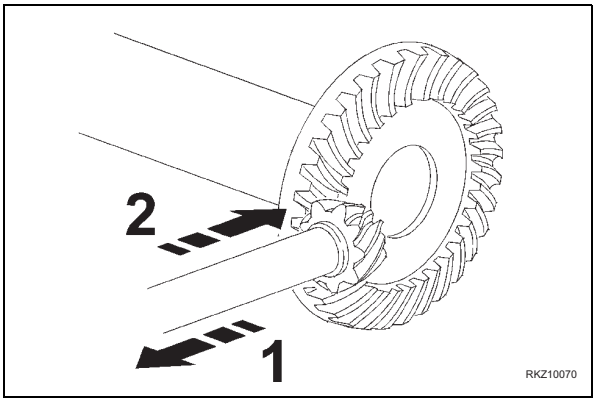
2 - **OK** - Correct contact:
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

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.

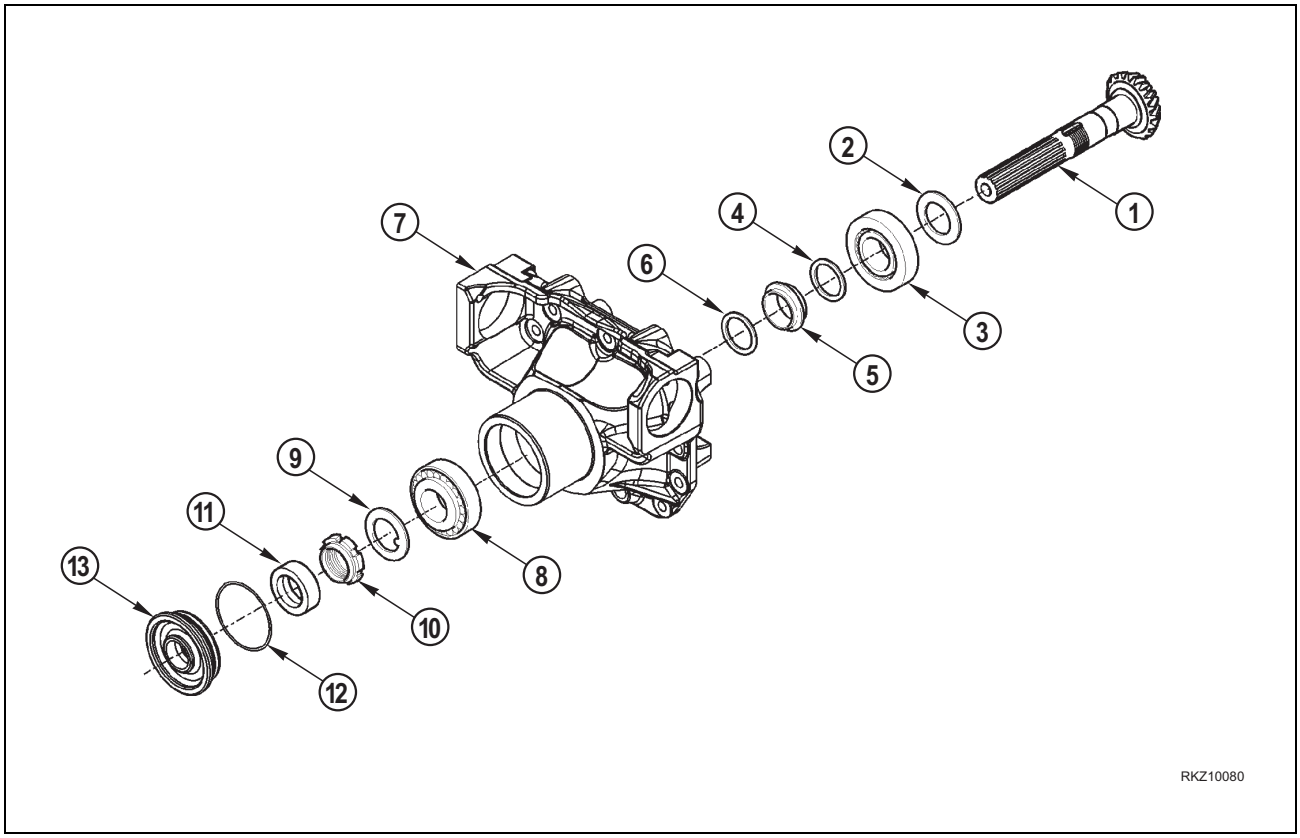


3 - Movements to correct:
1 - move the pinion for type X contact adjustment **X**.
2 - move the pinion for type **Z** contact adjustment.

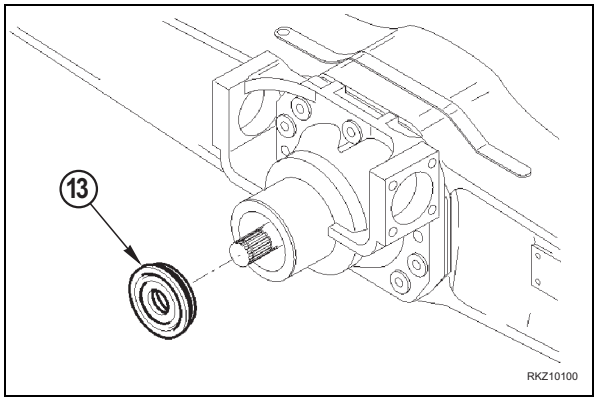


6. DIFFERENTIAL GROUP

6.1 Disassembly

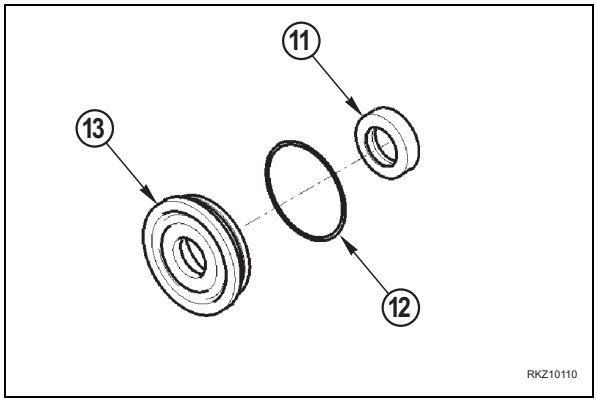


1 -Pry the cover (13) away from the differential support using a lever.



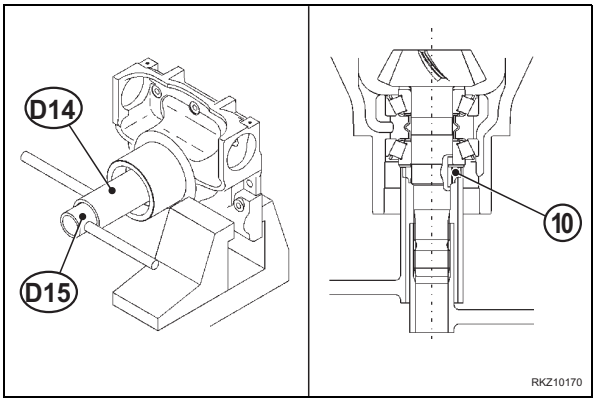
2 -Remove the seal rings (12) and (11) from the cover (13).

★ This is a destructive operation for the seal rings.

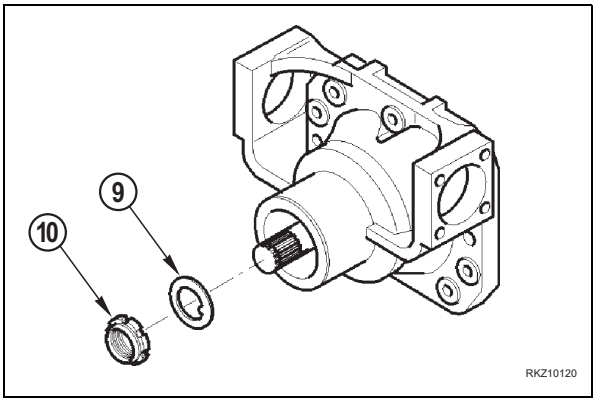


3 - Fit the differential carrier (1) in a vise.
Unscrew the lock nut (10) using special tools **D14-D15**.

★ This operation will irretrievably damage the ring nut (10).



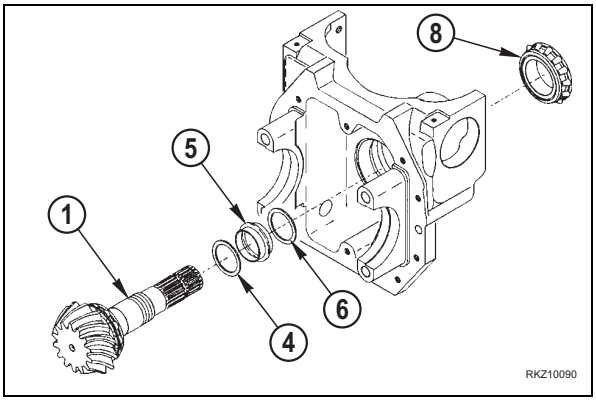
4 - Remove the ring nut (10) and collect its retaining washer (9).



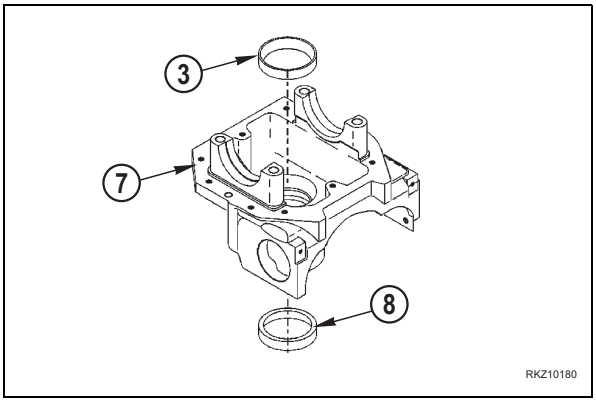
5 - Tap the shaft with a soft hammer to remove the bevel pinion (1).

★ Take care not to drop the bevel pinion (1).

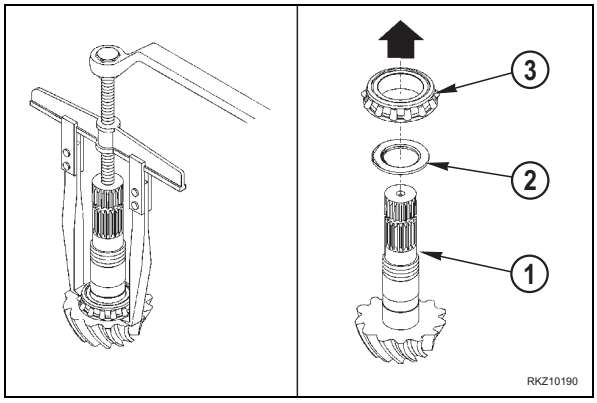
Recover washers (4) and (6), collapsible spacer (5) and bearing cone (8).



6 - Place differential support (7) on a firm flat surface and extract bearing outer rings (3) and (8).

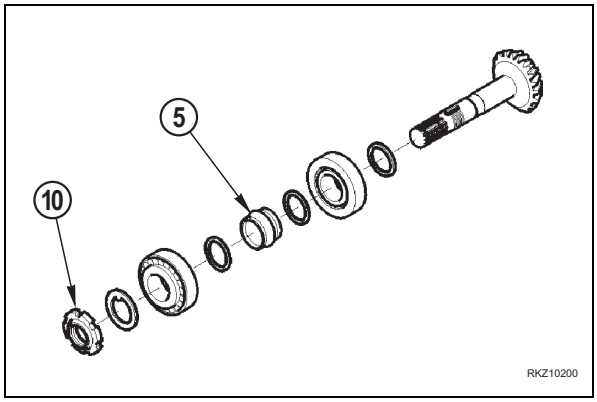


7 - To remove bearing inner ring (3) from bevel pinion (1), use a commercially available grip puller.
Recover bearing inner ring (3) and the shim (2) under it.



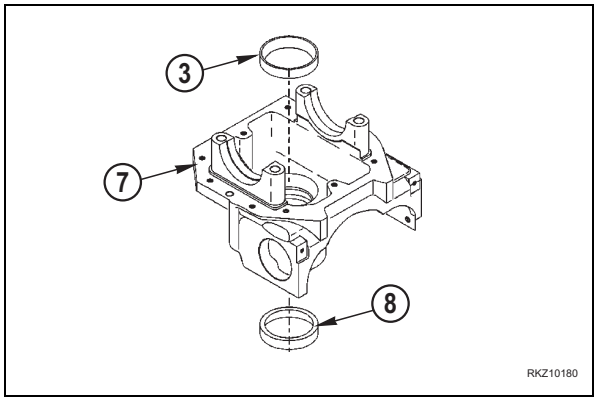
8 - Check all pinion components for wear.

★ The ring nut (10) and the snap spacer (5) must be replaced when reassembling the unit.

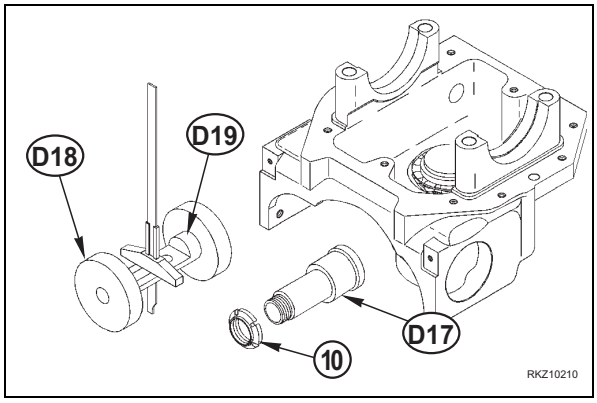


6.2 Assembly

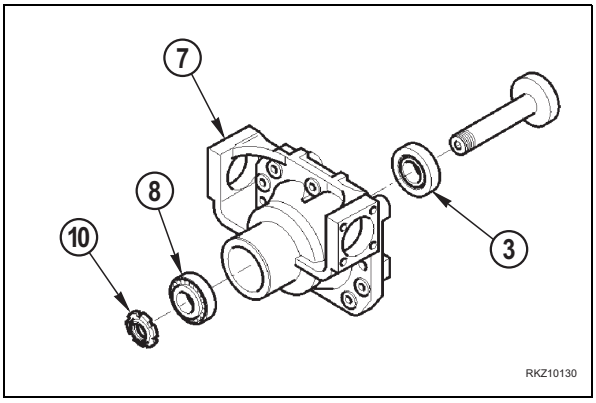
1 - Place differential support (7) on a work bench.
Force bearing outer rings (3) and (8) into it using special tool **D16** and a hammer.



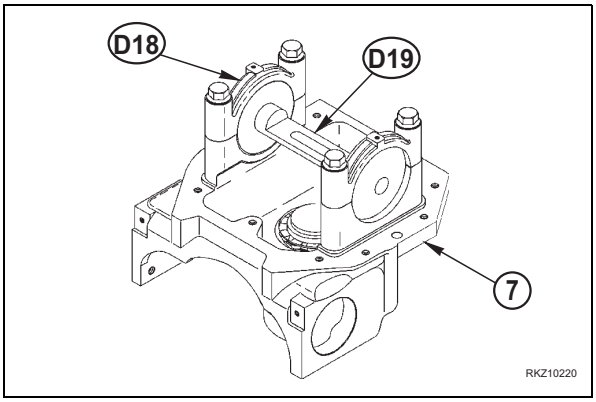
2 - Use the kit consisting of the special tools called “false pinion” **D17** and “false differential box **D18** and **D19** and a deep gauge.



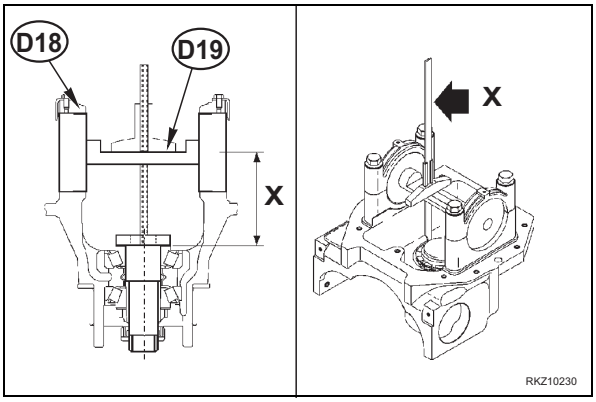
3 - Introduce bearing rings (3) and (8) to their respective seats.
Assemble the “false pinion” and ring nut (10).
Tighten ring nut – but do not overtighten – until backlash is eliminated.



4 - Install tool **D18**, **D19** to bearing seats in differential support (7) and retain with halfbridles.

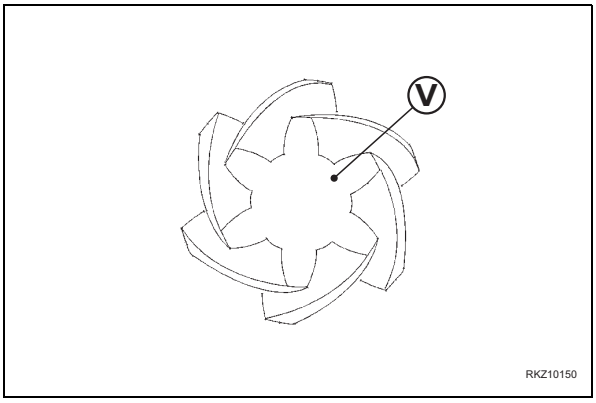


5 - Installation method **D18**, **D19**.
Use a depth gauge to measure distance “**X**” (distance between the axis of the differential bearings and the point at which the pinion head, or base of bearing, is supported).



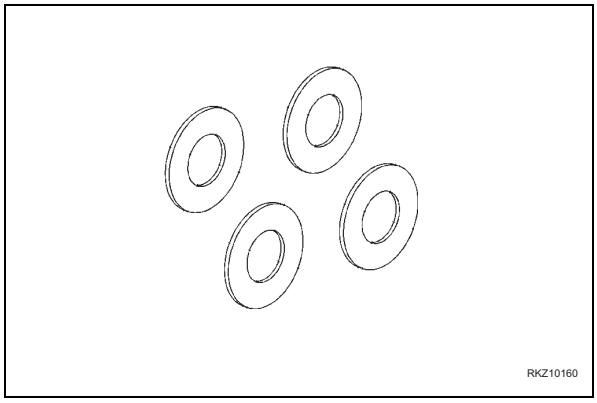
6 - In order to determine the thickness (**S**) required between the pinion and the bearing, subtract the value (**V**), stamped on the pinion head (**V**=requested bevel distance), from the measured value (**X**).

S=X-V mm

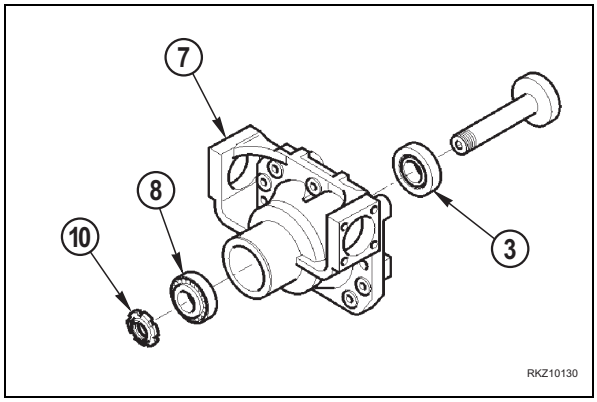


7 - Pick the (**S**) shim (2) from the range of shims available.

SHIM RANGE										
Shims	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4

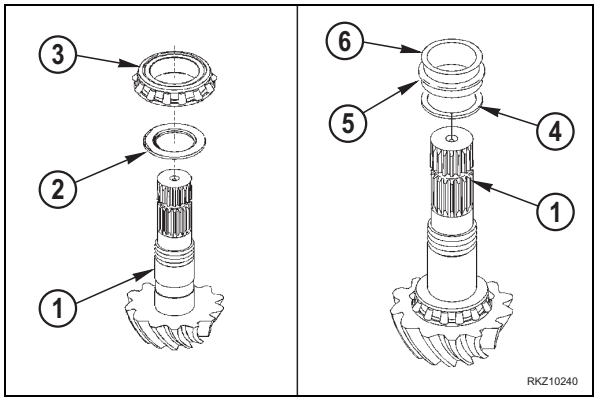


8 - Remove special tool **D18**, **D19** from differential support.
Remove ring nut (10), false pinion, and bearing cones (3) and (8).



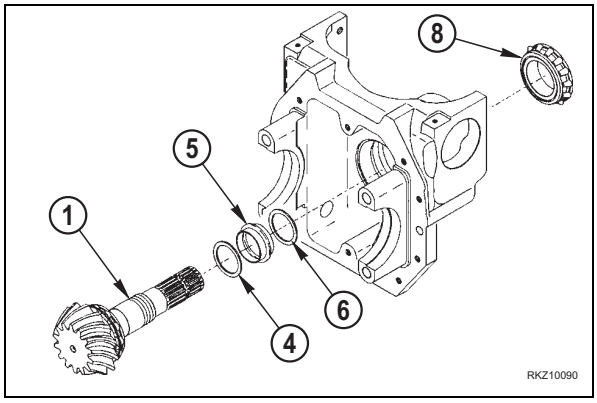
9 - Install the selected shim (2) to the pinion shaft (1) with the chamfer facing the gear.
Force bearing (3) onto the pinion shaft (1) using a press and driver **D20**, and ensure that the bearing is fully locked into position.
Install shims (4) and (6), and a new collapsible spacer (5).

★ Use only one new spacer at any time.

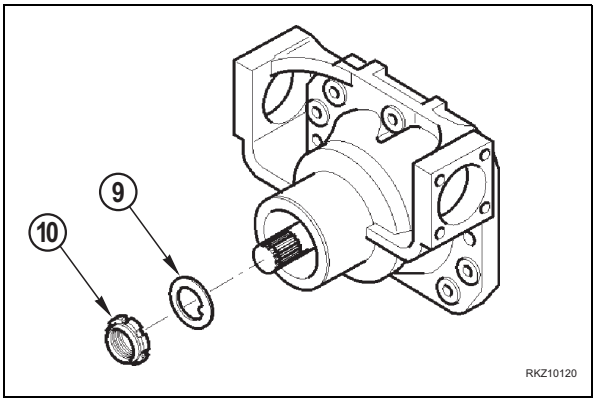


10 - Install preassembled bevel pinion group (1) to the differential support (7), and install bearing inner ring (8) to pinion end as shown.
To force bearing (8), use driver **D20** and a hammer.

★ Oppose a resistance to the striking force (e.g. a sledge hammer).



11 - Insert a ring nut washer (9) and screw a new lock ring nut (10) on the pinion end.

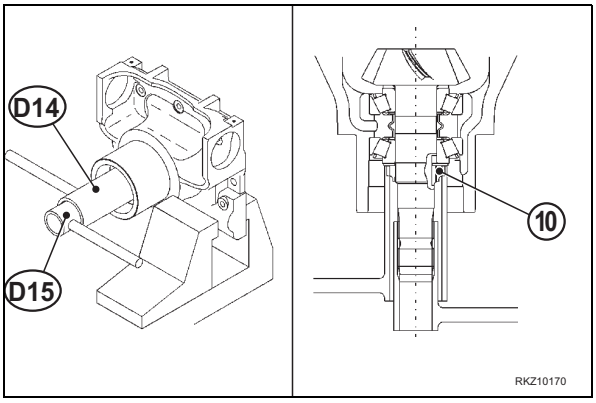


12 - Screw the ring nut in (10), using the wrench for ring nut **D14** and for pinion retainer **D15**.

★ 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.

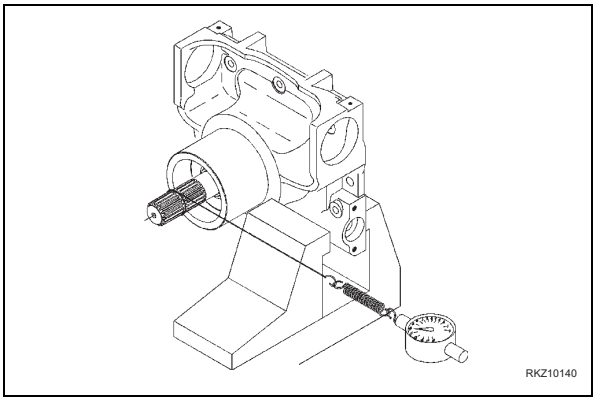
When you check the preloading, it is advisable to beat slightly both pinion (1) ends with a soft hammer, so as to help setting the bearings (3) and (8).



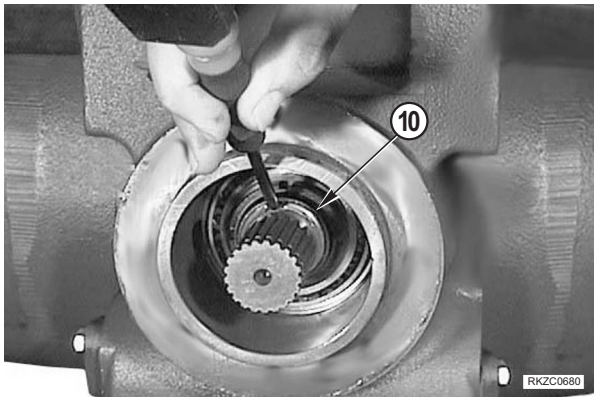
13 - Measure preload **P** of tapered bearings (3) and (8) using a force gauge with the string wound around the splined end of pinion (1).
Adjustment is carried out by gradually increasing the tightening torque of the ring nut (10), paying attention not to overtighten.

★ All preloadings should be measured without the seal ring.

P=9.2-13.7 daN

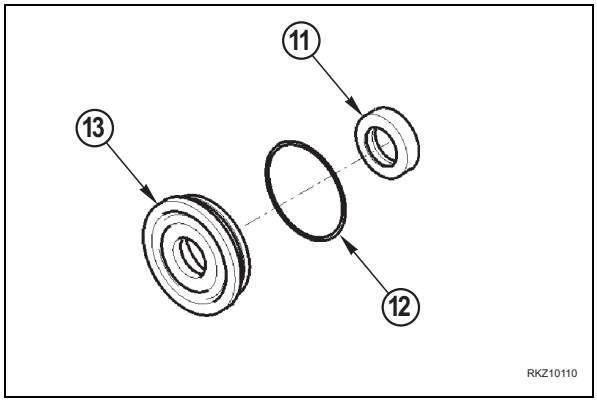


14 - Once you got the requested preloading value, caulk the ring nut (10).

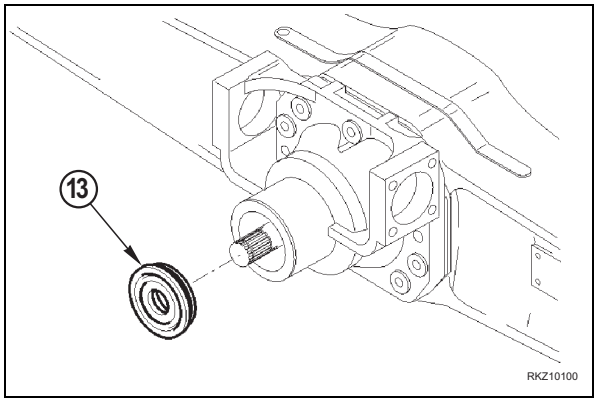


★ Do not carry out the steps below until you have completed the adjustment of preload **T.**

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).

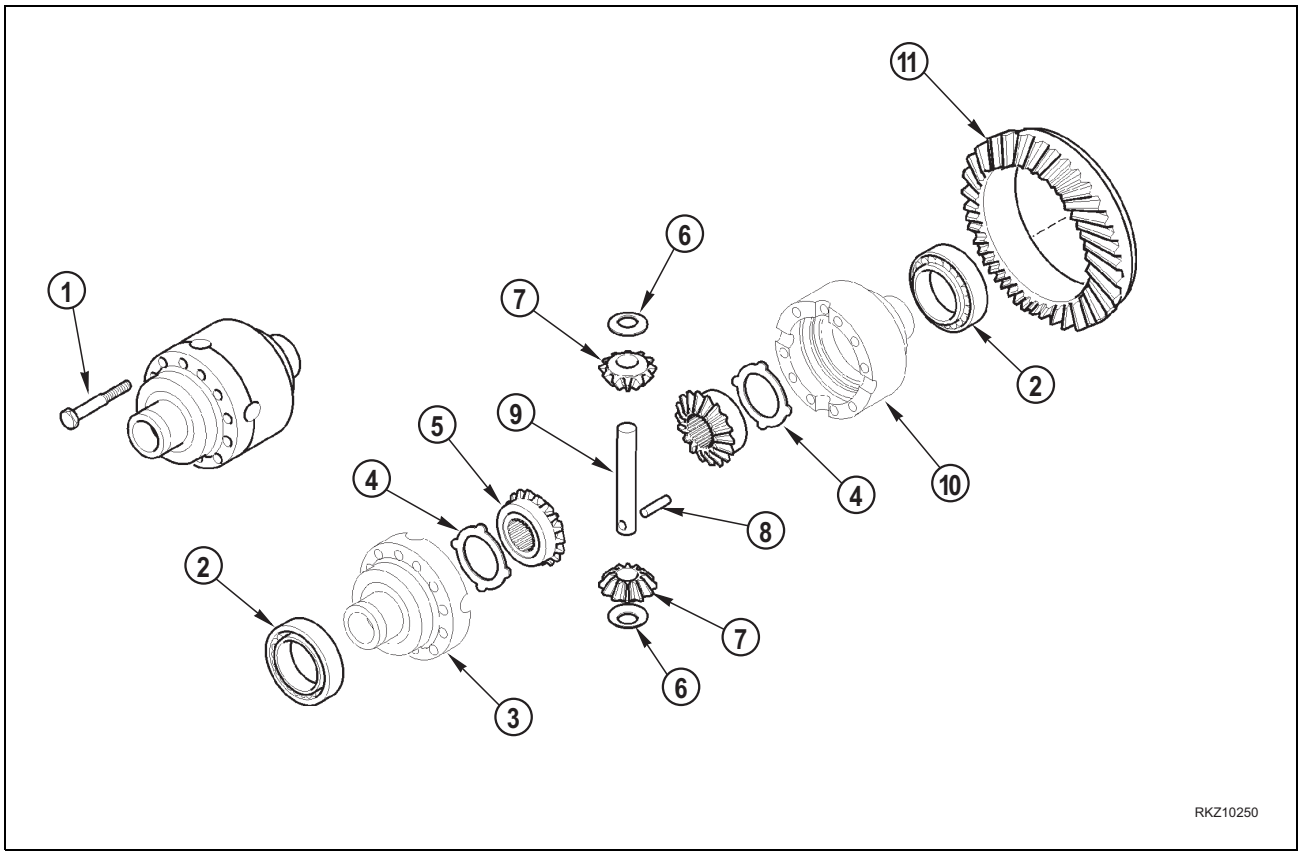


16 - Install cover (13) to differential support.



7. DIFFERENTIAL GROUP

7.1 Disassembly

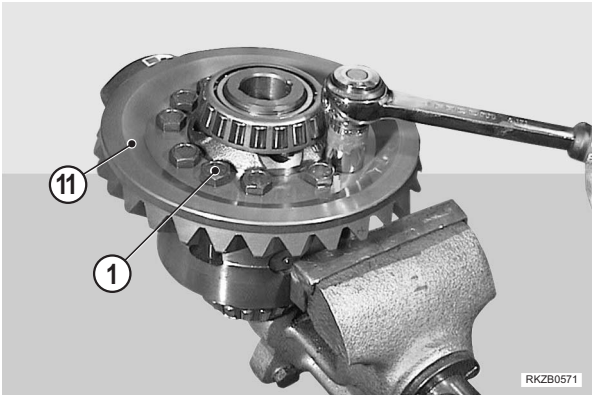


1 Lock the differential in a clamp.

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).

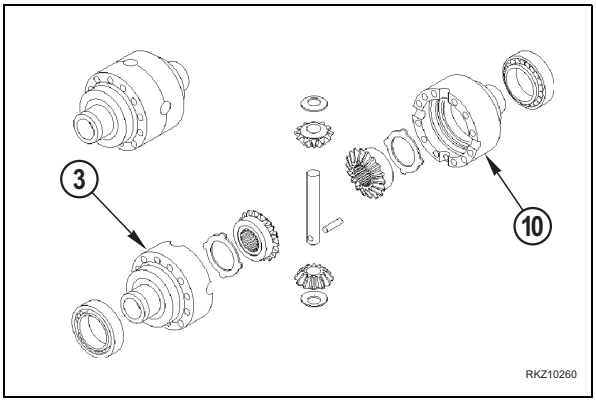


4 - Disassemble the differential box in two half boxes (3), (10) complete with the relevant components.

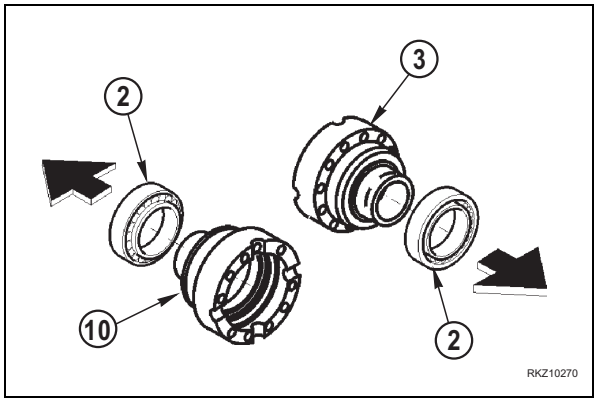
★ Scribble some match marks before separating the two half housings.

5 - Recover the components from both half boxes.

6 - heck the operating and wear conditions of the components.

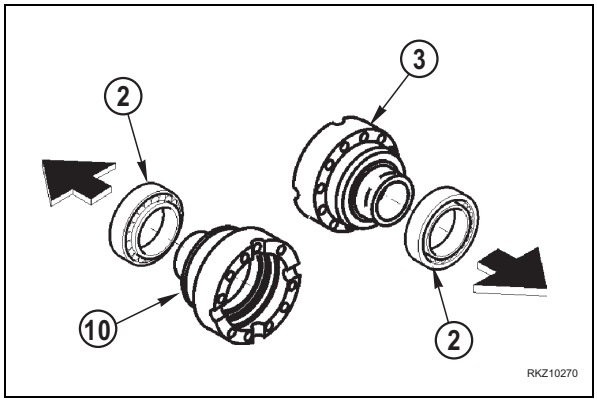


7 - Take the bearing (2) out of the differential half box (3) e (10), using two levers or a three-hold extractor.

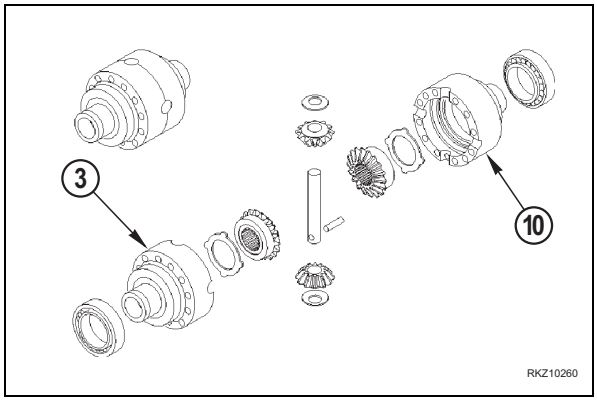


7.2 Assembly

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.



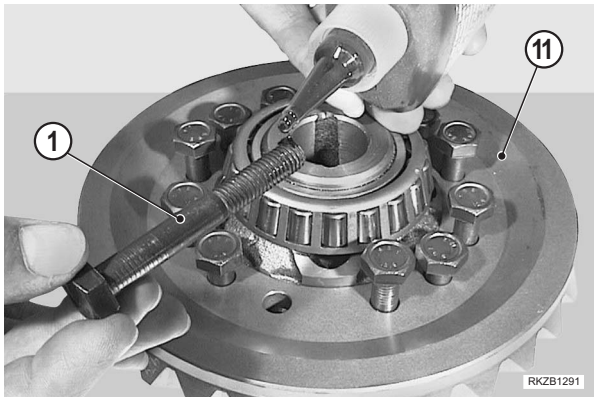
2 - Position a half housing (3) on a workbench and assemble all inner components: locking differential counterdiscs (4), sun gears (5), spider (9), spider gears (7), thrust washers (6), pin (8), as shown in figure.
Join the two half boxes, aligning the reference marks made during disassembly.



3 - Position the ring bevel gear (3) and then fix the whole by tightening the screws (4).

Screw: 95 Nm

Screw: Loctite 270



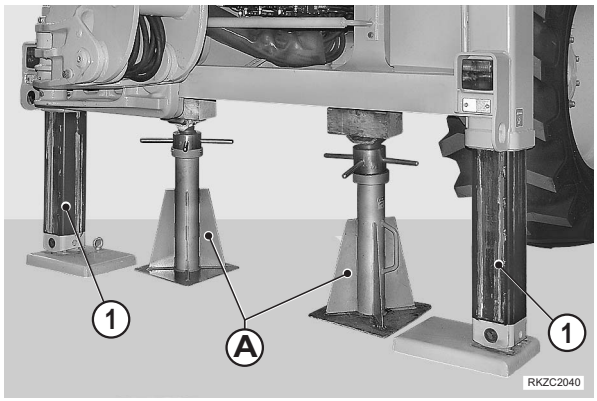
REAR AXLE

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.

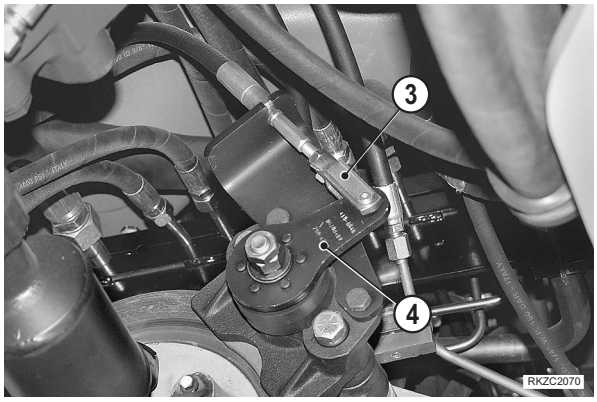


5 - Remove the rear wheels (2). [*1]

6 - Stop the engine and completely release residual pressures from all the circuits.
(For details, see "20 TESTING AND ADJUSTMENTS").

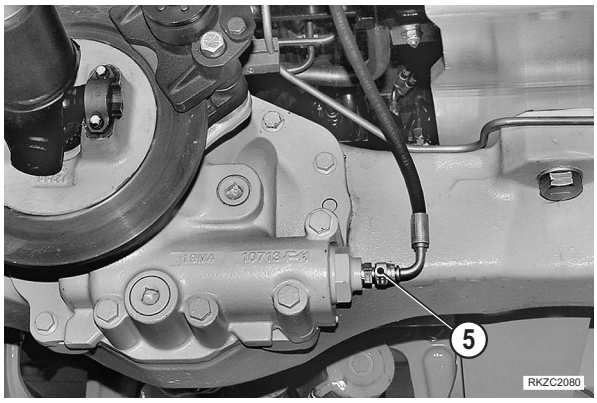


7 - Disconnect cable (3) from parking brake (4). [*2]



8 - Disconnect differential lock hose (5).

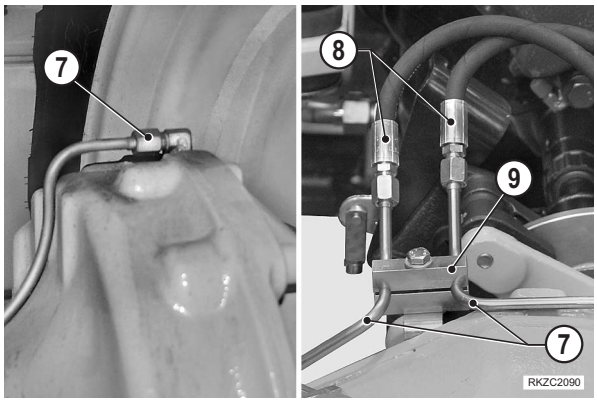
★ Cap the hose and hole to prevent contamination.



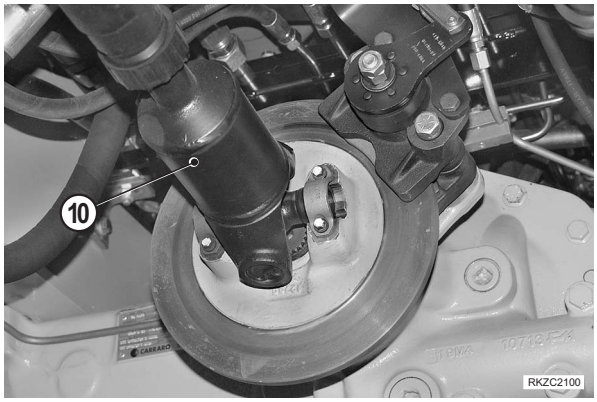
9 - Disconnect service brake pipes (7) from axle (6). [*3]

★ Disconnect pipes (7) from hoses (8); loosen and remove clamp (9) and pipes (7).

★ Cap pipes, hoses and holes to prevent contamination.

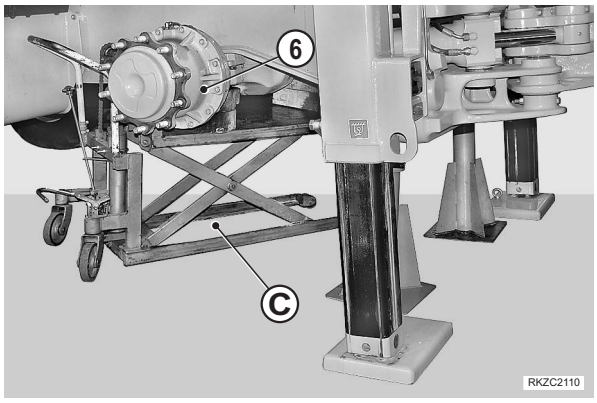


10 - Disconnect the cardan shaft (10) from the rear axle. [*4]



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.

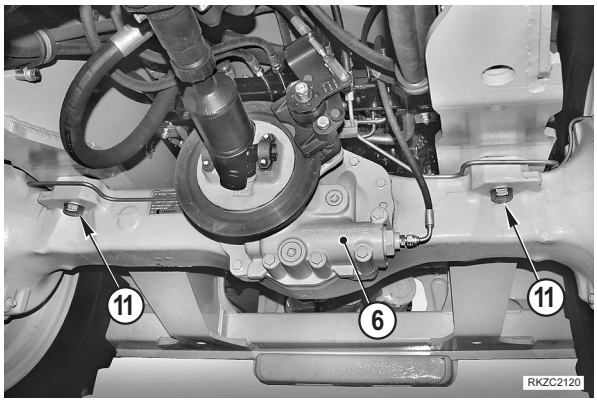


12 - Loosen and remove the screws (11) and (4). [*5]

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]

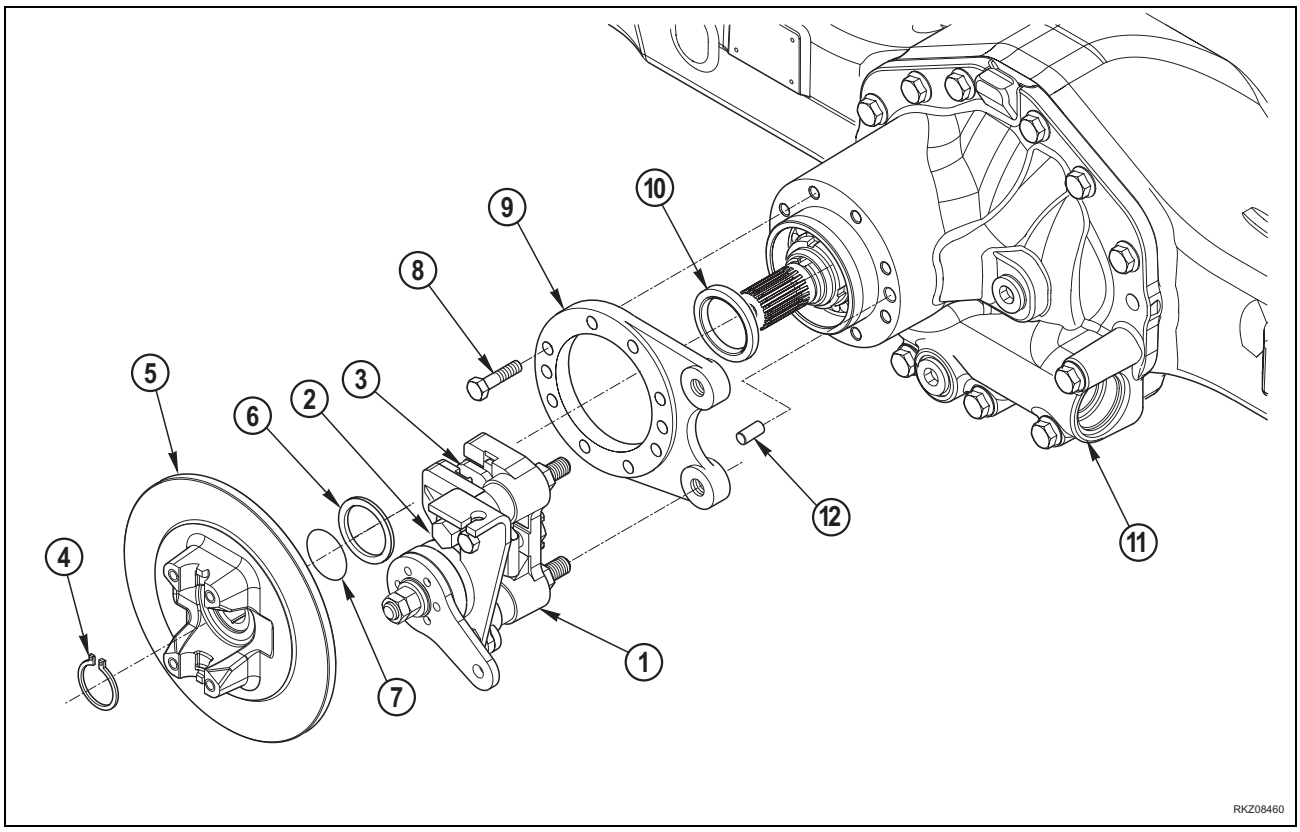
Axle retaining screws: 1000 Nm

Axle retaining screws: Loctite 262

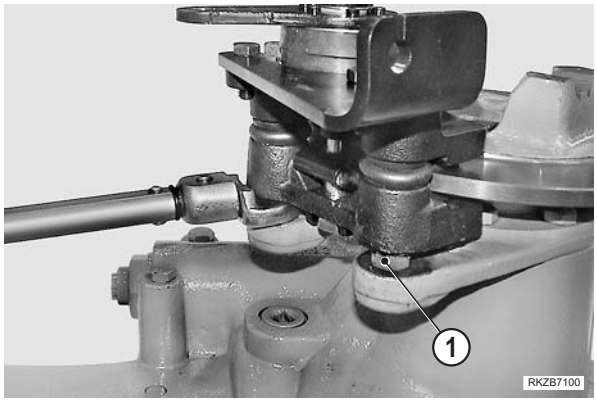
Disassembly and assembly

1. PARKING BRAKE GROUP

1.1 Disassembly



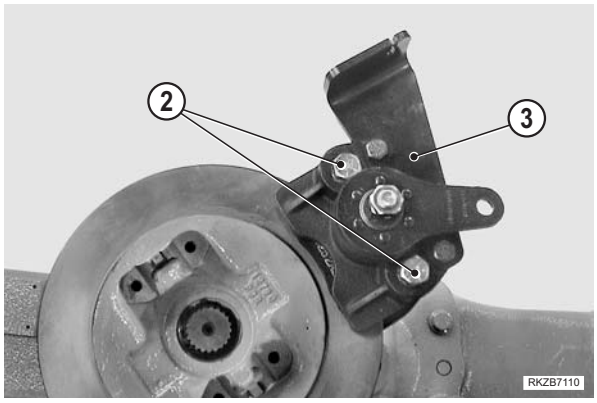
1 -Loosen nut (1) (n°2).



2 -Loosen and remove the screws (2) (n°2).

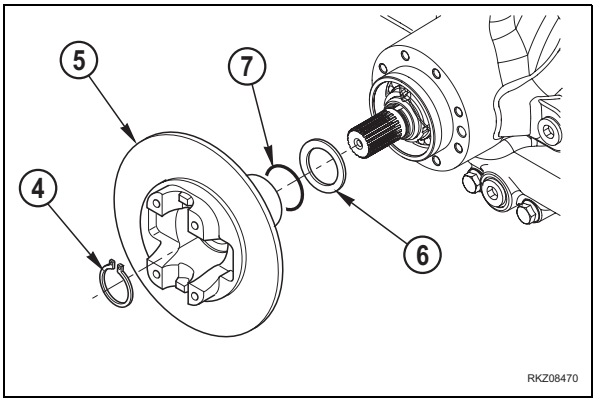
★ Proceed with care, in order to avoid damaging the brake pads.

3 -Remove the brake caliper (3).



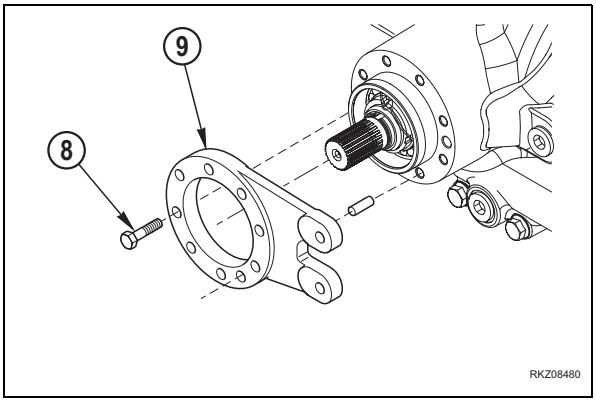
4 - Remove the snap ring (4) and the input flange (5).

★ Collect the shim (6) and the O-ring (7).



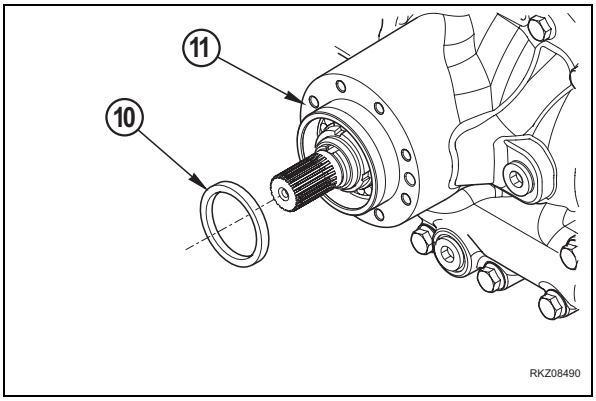
5 - Loosen and remove the screws (8) retaining the brake caliper support (9).

6 - Remove the support (9) from the centre body.



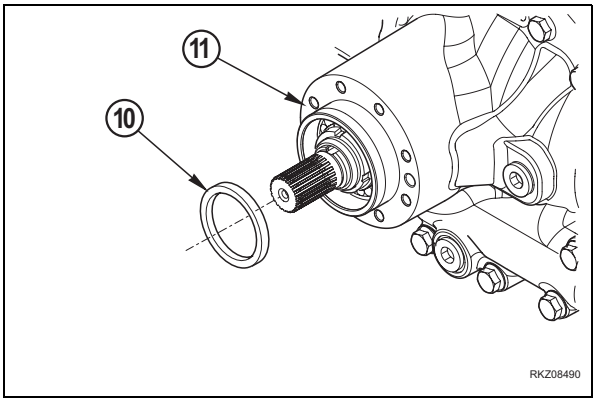
7 - Remove the seal ring (10) from the central housing (11) with a puller.

★ This is a destructive operation for the seal ring.



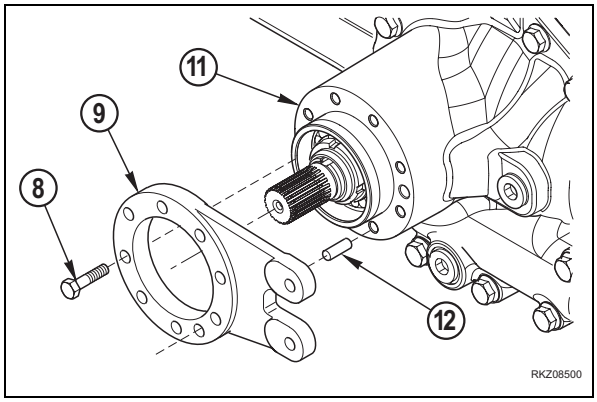
1.2 Assembly

1 - Introduce a new seal (10) into in the central body using special tool **E1**.



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).

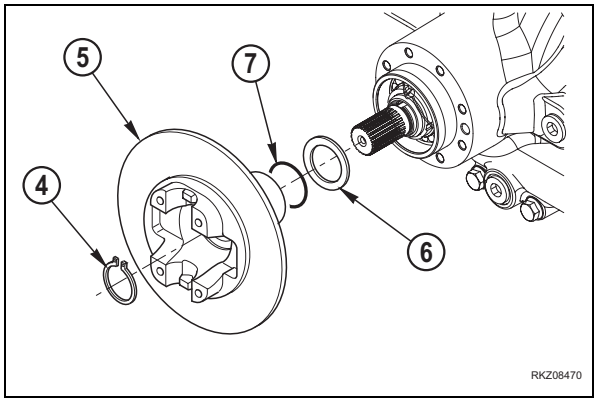
Support screws: 80 Nm



3 - Lubricate O-ring (7).

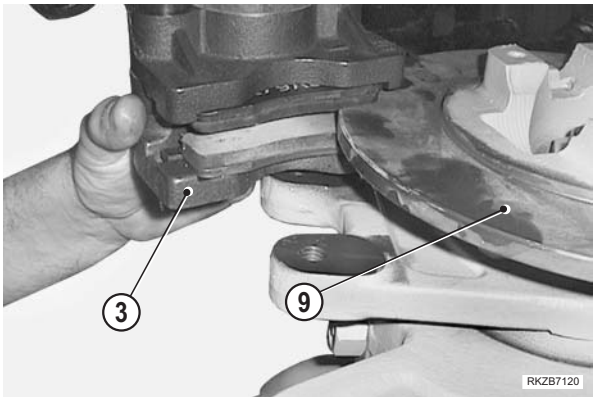
O-ring: ASL800050

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.

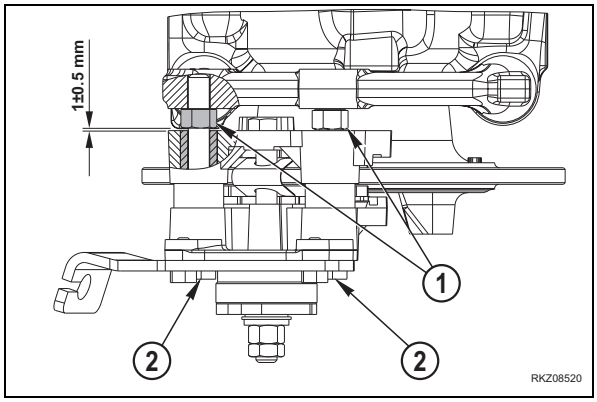


6 - Screw in the bolts (2) and tighten the nuts (1) to the prescribed torque.

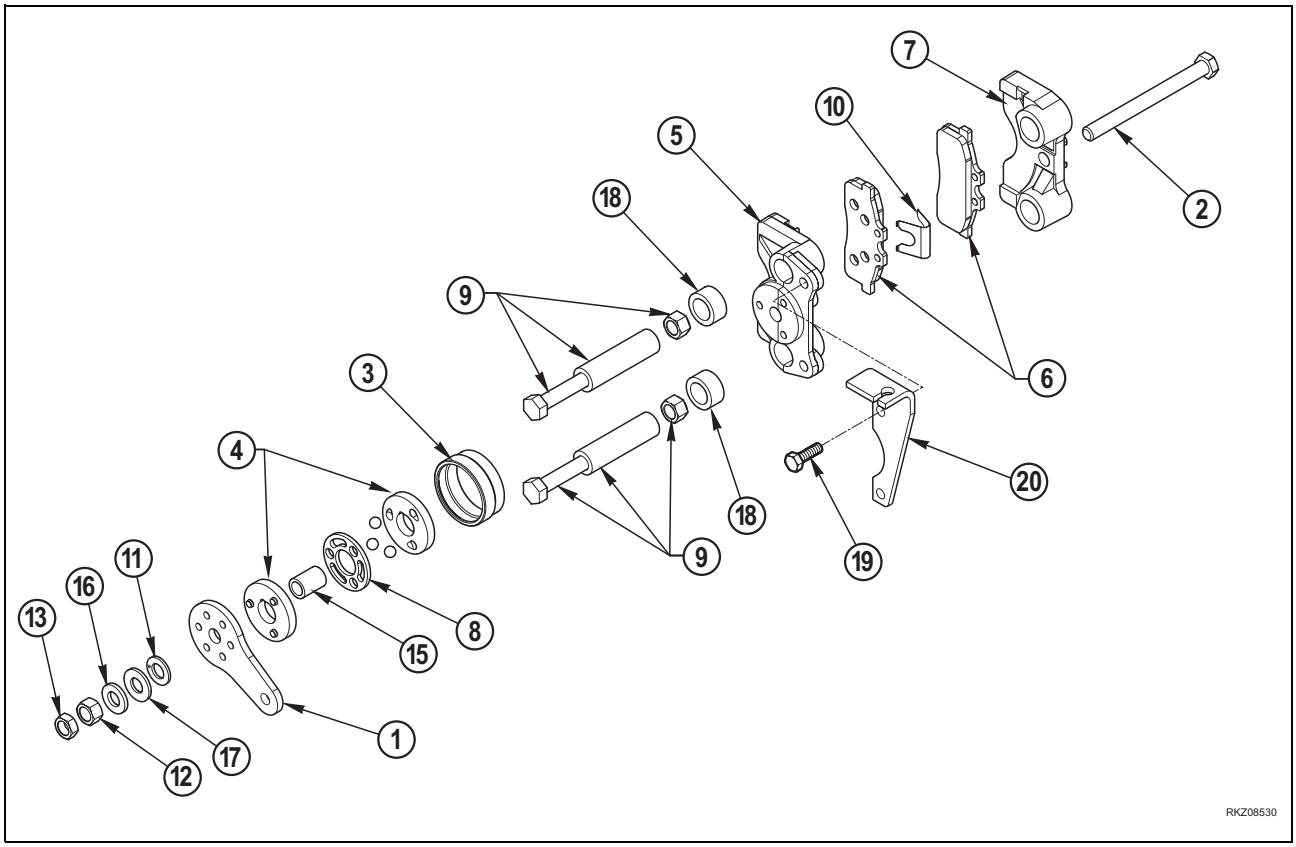
★ Once the nuts are tightened, check to make sure that a 1 ± 0.5 mm gap remains between nuts (1) and the spacers shown.

Nuts: 115 Nm

Screw: 45 Nm



1.3 Maintenance



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

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

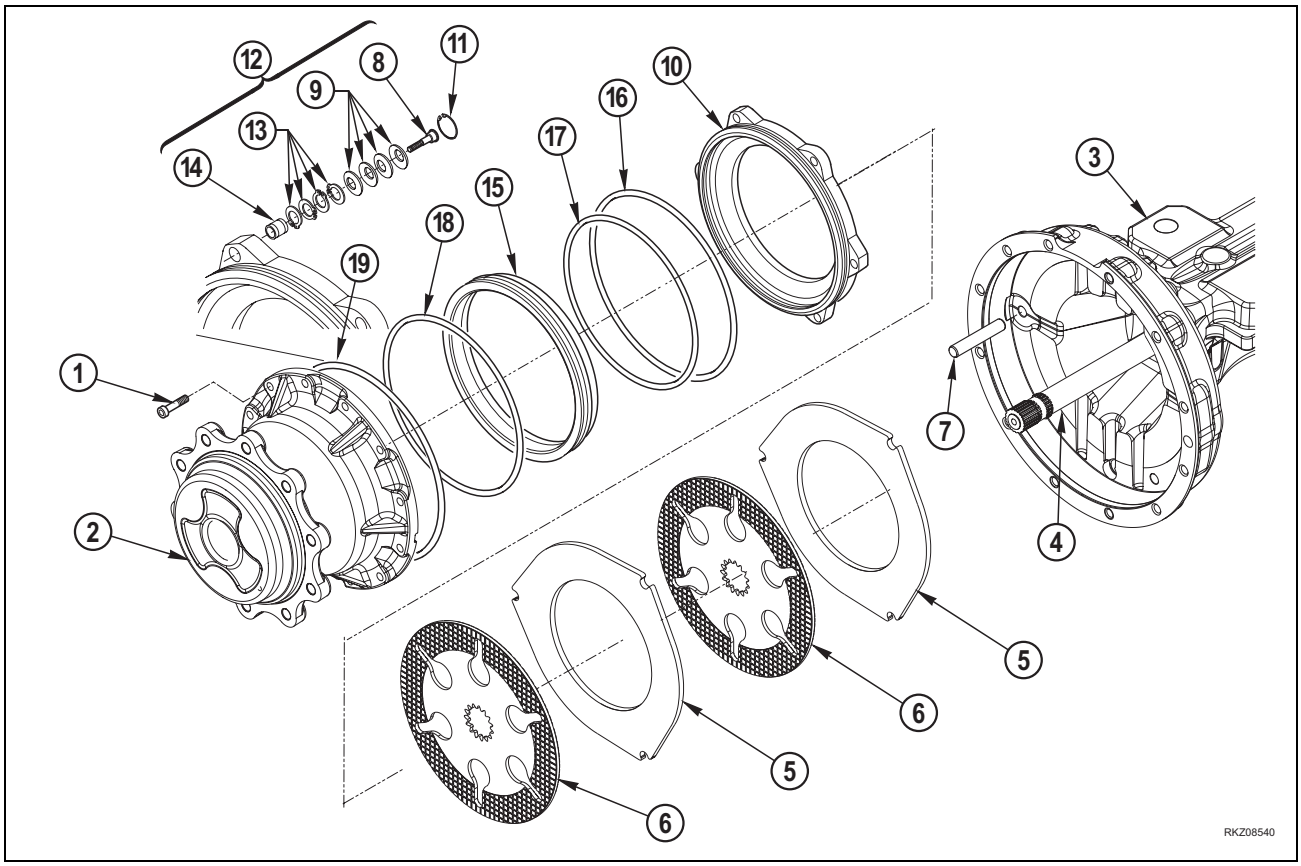
1 - Remove the screws (19) of the bracket (20) from pad support (5).
Remove the bracket (20).

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

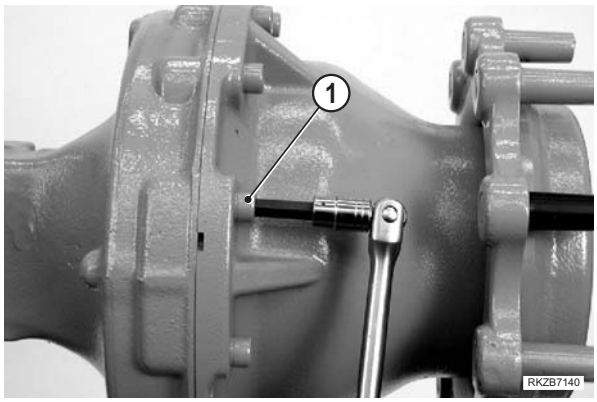


1 - Drain the oil completely from the differential.

Differential oil: approx. 15 ℓ.

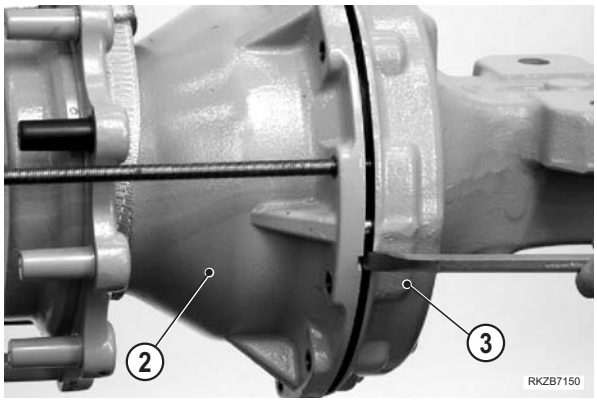


2 - Remove all but two of the cap screws (1).

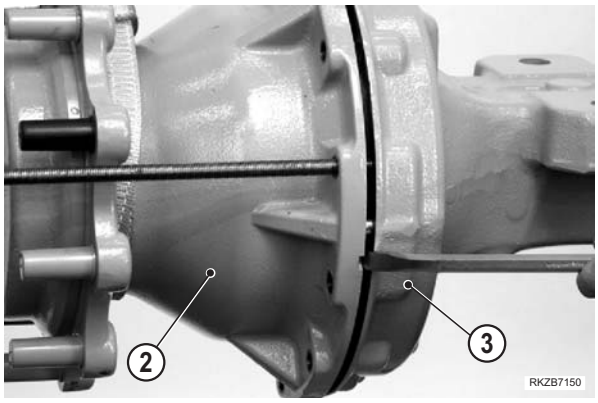


3 - Connect the hub (2) to a lifting device and tension the rope.

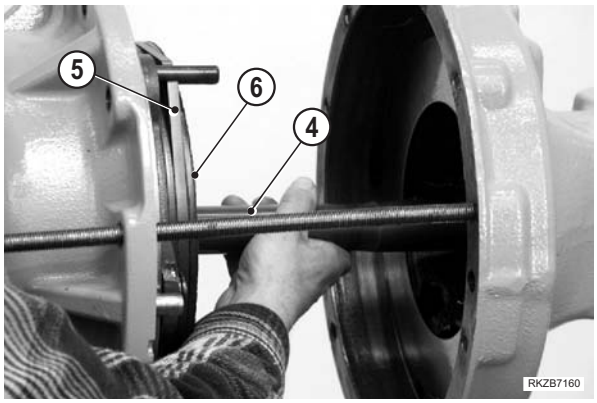
★ insert two dowel rod to enable removal.



4 - Remove last two cap screws (1) and separate the hub (2) from the axle (3).



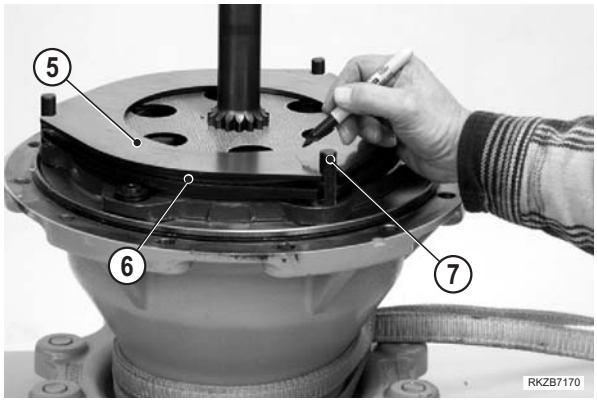
5 - Slowly pull hub (2) away from axle and the half shaft (4), make sure that brake disks (5) and plates (6) stay with the hub.



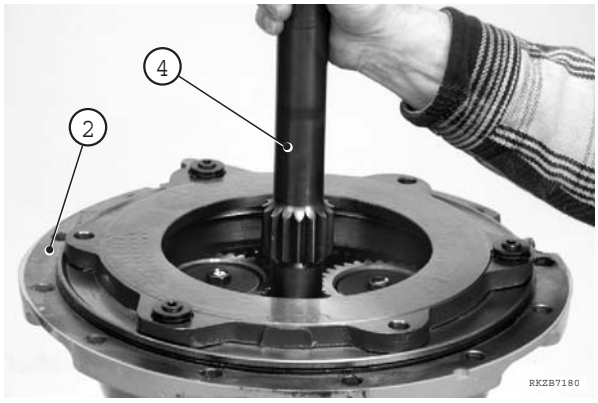
6 - Stand the hub up, mark the reaction plat (5) that was against the axle housing (3). Remove the reaction (6) and brake disks (5) and pins (7).

★ Check friction plate and brake separator thickness. For details, see ("40MAINTENANCE STANDARD")

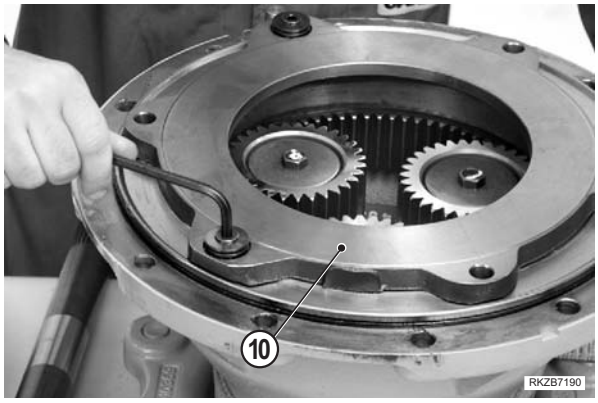
★ If brake discs are to be replaced, soak the new discs (for each differential) in oil for at least 24 hours



7 - Remove axle shaft (4) from wheel hub assembly (2).

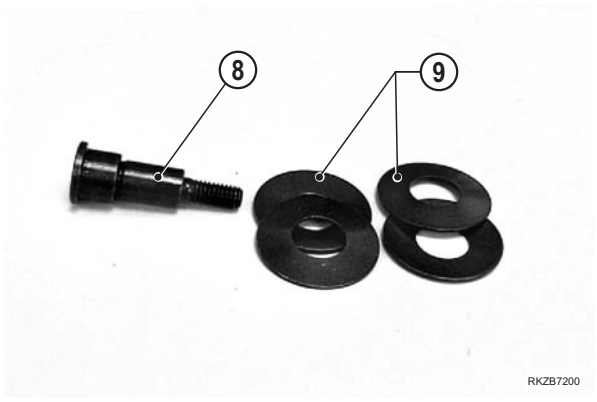


8 - Remove screws (8) and Belleville washers (9) from brake cylinder (10).

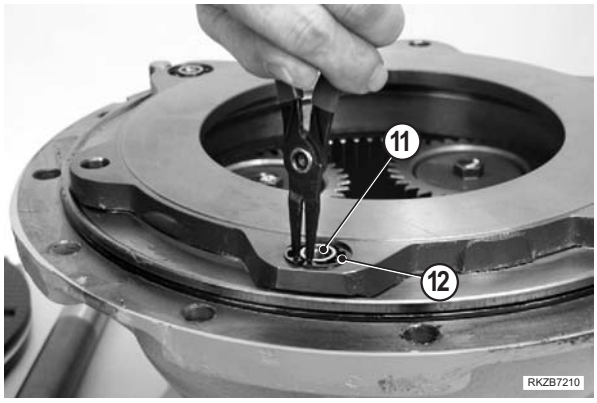


9 - Check to ensure that screws (8) and Belleville washers (9) are not damaged.

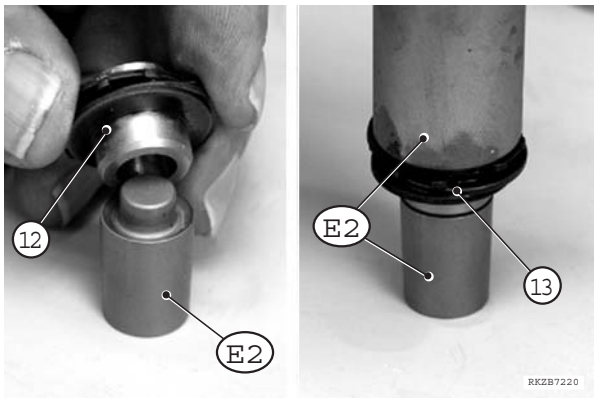
★ If brake discs are being replaced, replace screws and washers with the new kit.



10- Remove the lock ring (11) and remove the self adjuster (12).

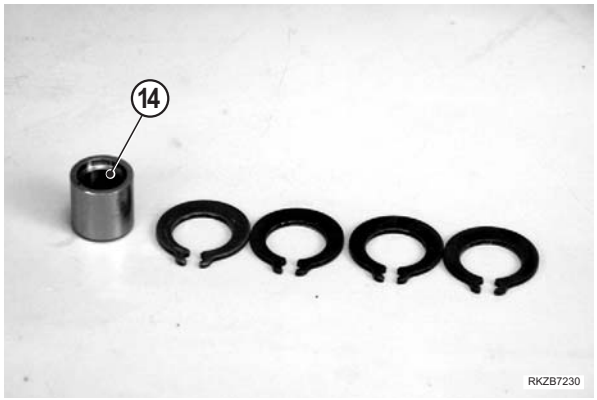


11 -Place self adjuster (12) onto special tool **E2** and drive out the spring clips (13) from the adjuster.

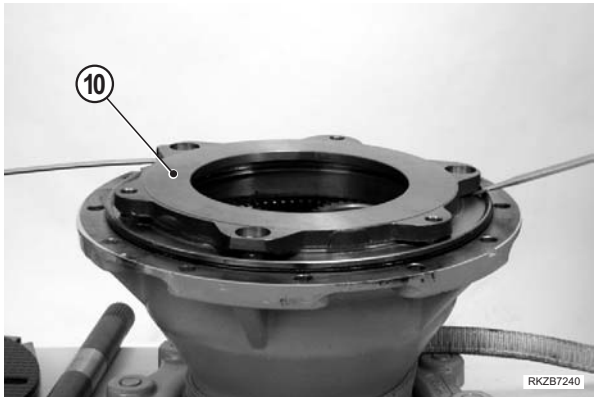


12 -Inspect adjuster bushing (14) for wear.

★ Repeat procedure for the remaining 2 kit self adjust.



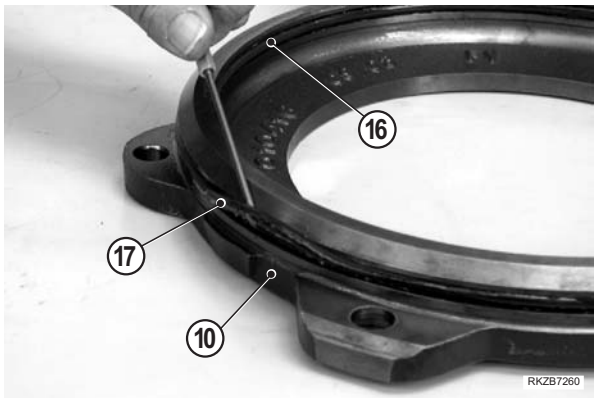
13 -Use an acceptable flat bars and pry the brake piston (10) up from the hub.



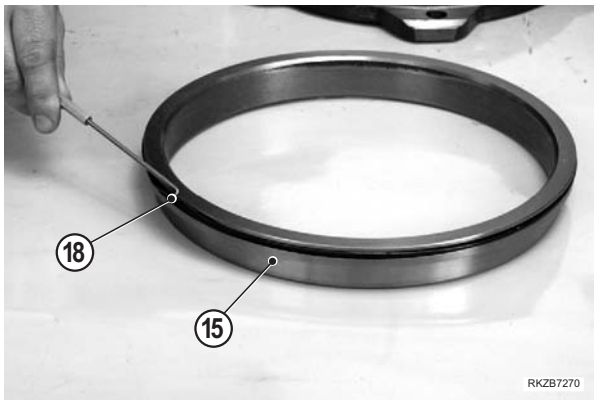
14 -Remove from the brake complete piston (10) the inner cylinder (15).



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.

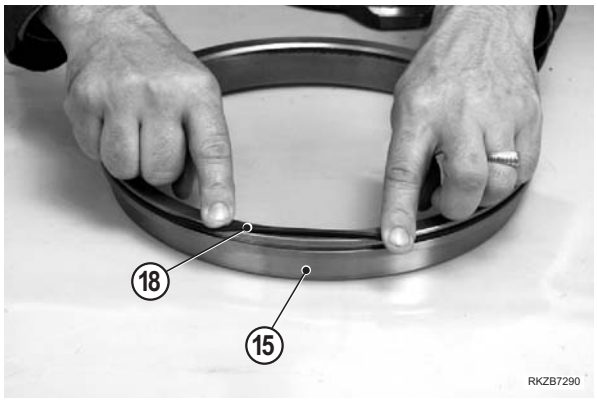


2.2 Assembly

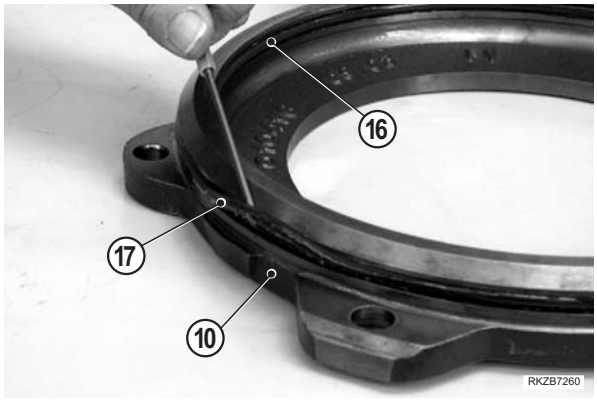
1 - Install a new O-Ring (19) onto hub (2).



2 - Install O-ring (18) onto inner cylinder (15).

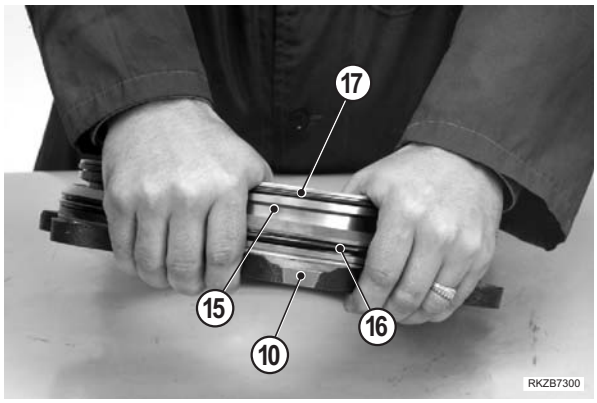


3 - Install O-rings (16) and (17) onto brake piston (10).



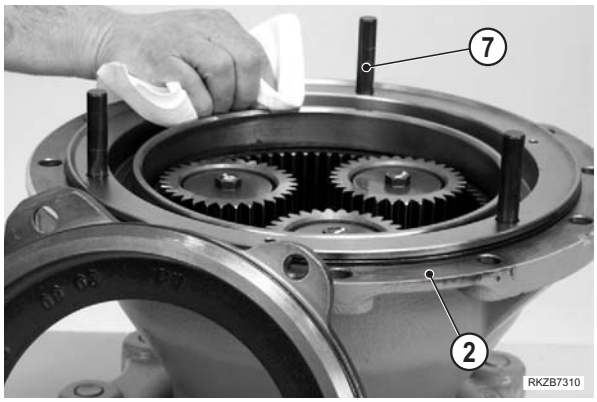
4 - Lubricate O-rings (16), (17) and (18), and install complete piston (15) to brake cylinder (10)

O-ring: ASL800050

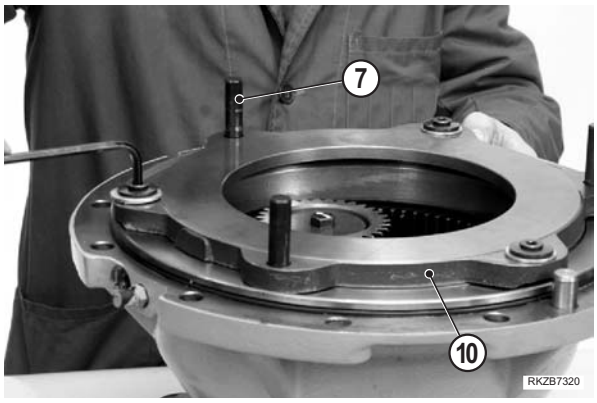


5 - Use hydraulic oil to lubricate the brake cavity of the hub housing (2) and mount pins (7).

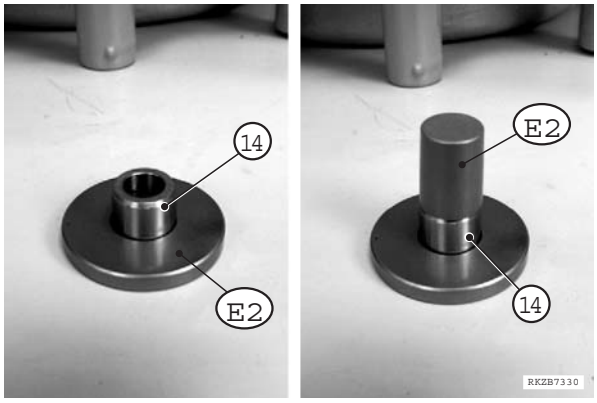
Cylinder cavity: ASL800050



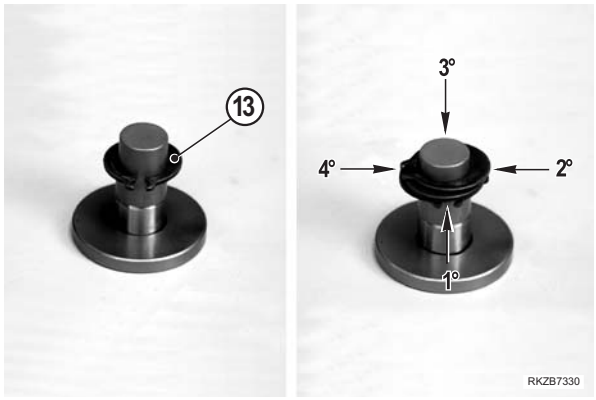
6 - Install the complete brake cylinder (10) and remove pins (7).



7 - Place bushing (14) inside calibrated ring **E2** with the chamfer facing upwards.
Place pin **E2** into brake adjuster (14).

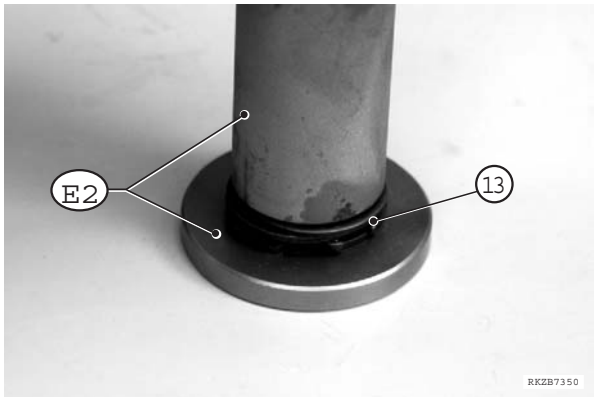


8 - Mount spring clips (13) taking care to rotate them 90° clockwise respect to the one mounted before.

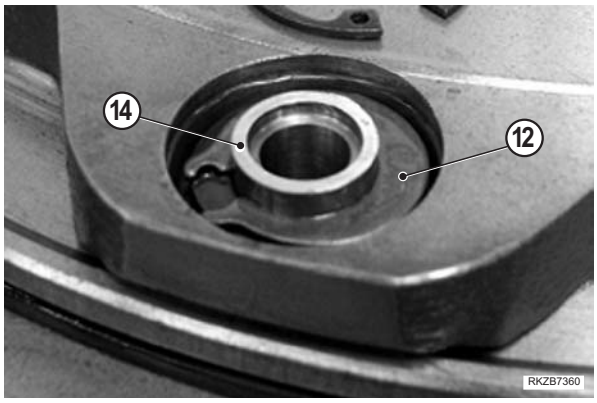


9 - Using driver**E2**, push the rings (13) until solid contact against calibrated ring **E2** is obtained.

★ Repeat procedure for the remaining 2 self adjust.

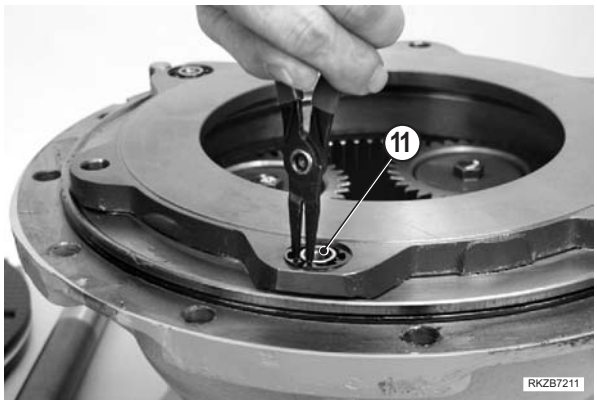


10 - Insert the adjuster (12) into the brake piston, make sure that the chaffered side is up.

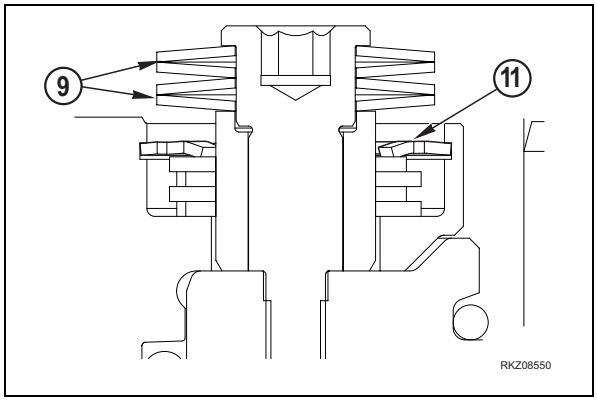


11 - Install the snap rings (11) into the self adjuster bore.

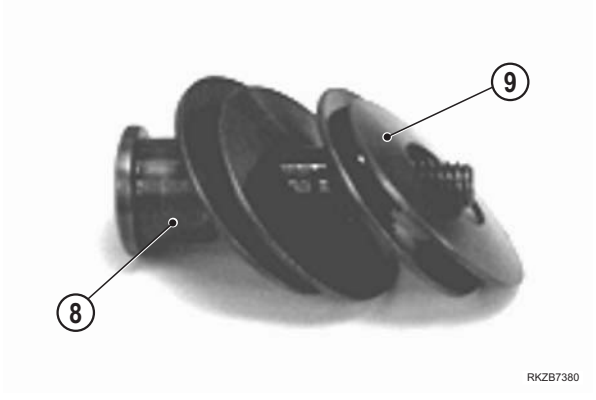
★ Check to ensure that spring ring teeth are facing the self adjust kit as shown in the following illustration.



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.

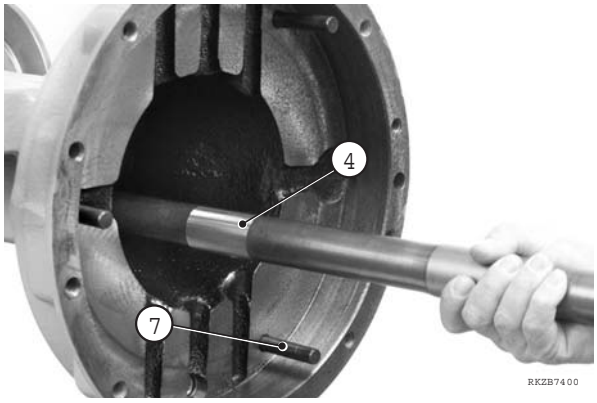


14 - Mount the shouldered bolts (8) and spring washers (9) and tighten to the requested torque

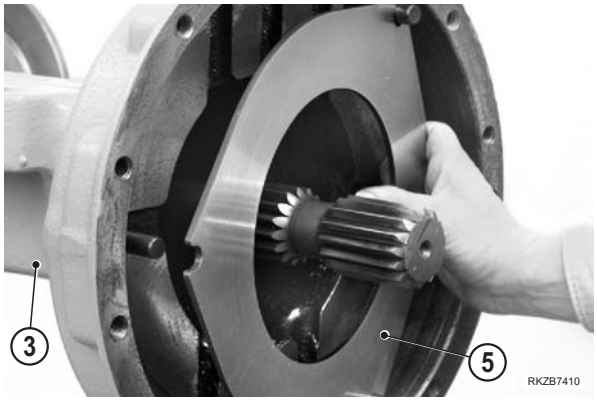
Screw: 16 Nm



15 - Put the half shaft (4) and brake separator plate pins (7) into the axle housing.

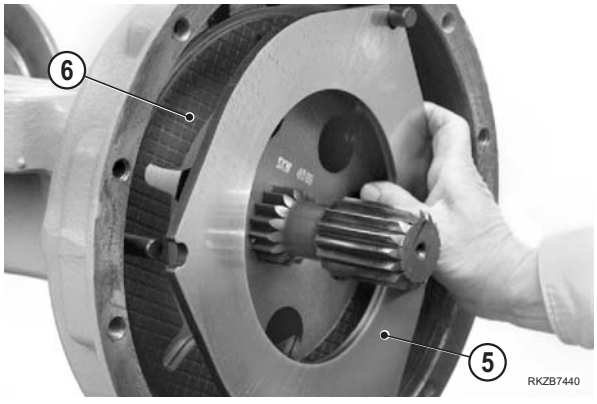


16 - Using the reference mark made during disassembly, place the inner brake separator plate (5) into the axle housing (3).

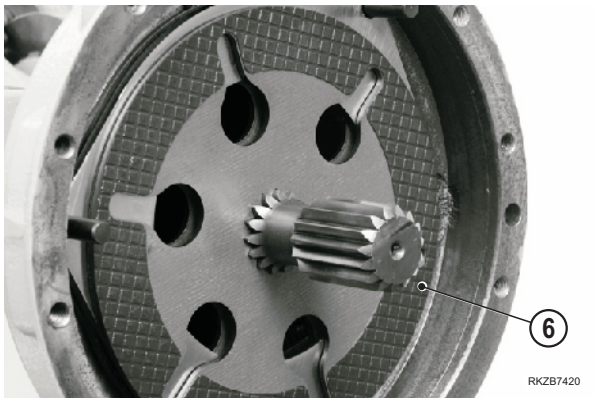


17 - Place the inner brake disk (6) and the second brake separator (5).

★ If brake discs (6) are replaced, soak discs (for each differential) in oil at least 24 hours prior to installation.

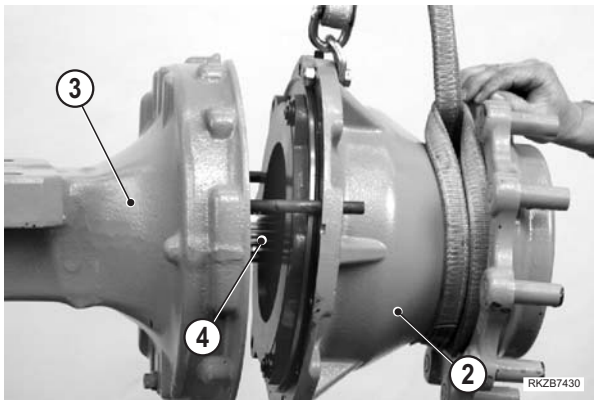


18 - Place the outer brake disk (6) and make sure the slots of the inner and outer brake disks are aligned with each other.



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.

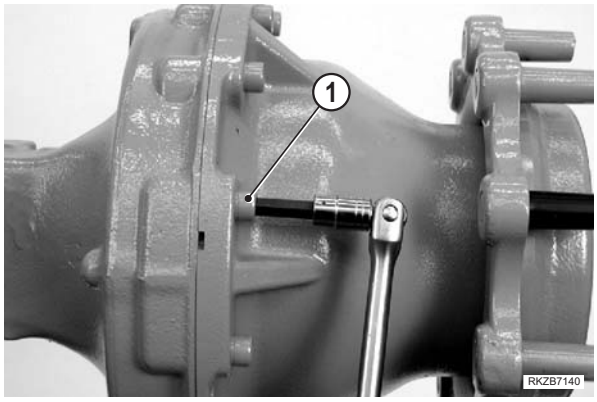


20 - Install screws (1) tighten to the required torque

Screw: Loctite 270

Screw: 226 Nm

★ Tighten using the alternating crosswise method.



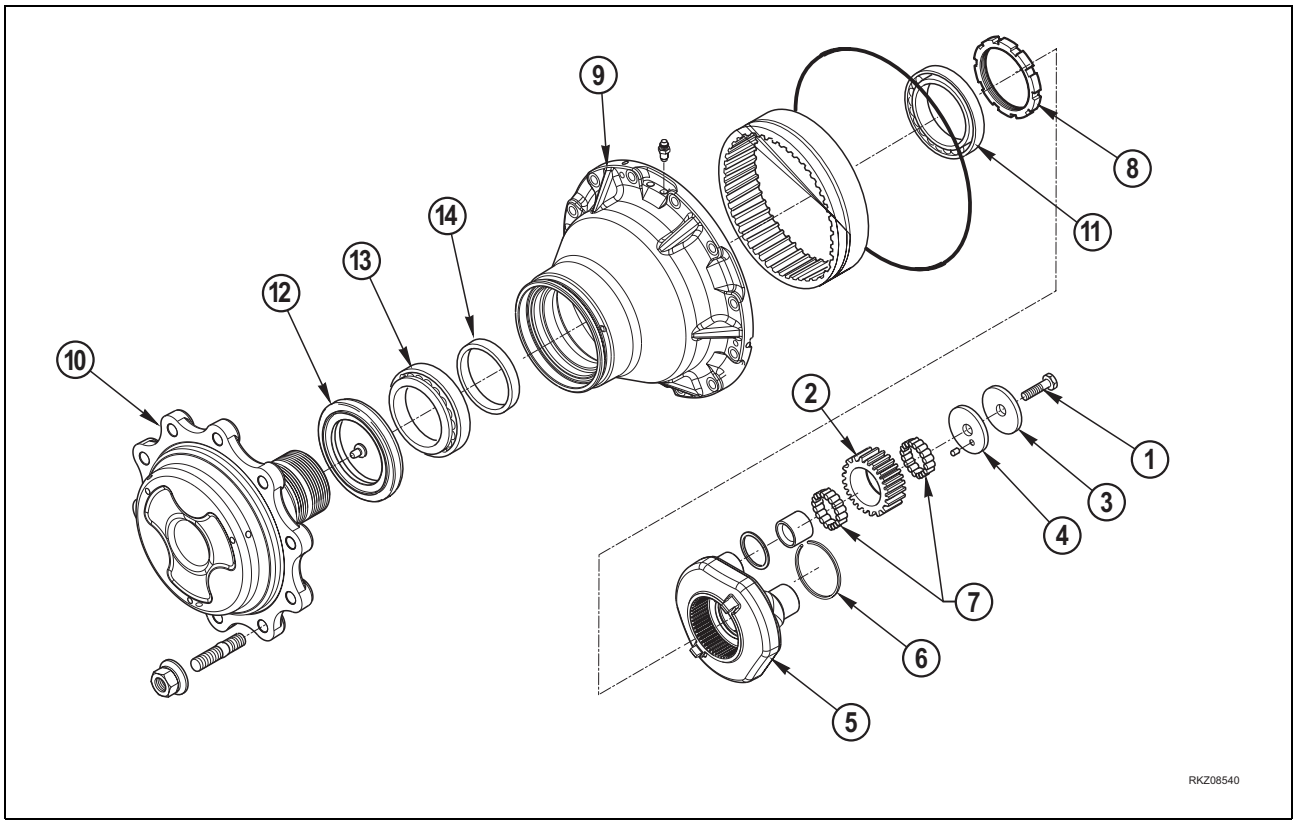
21 - Fill axle with oil.

Differential oil: approx. 15 ℓ



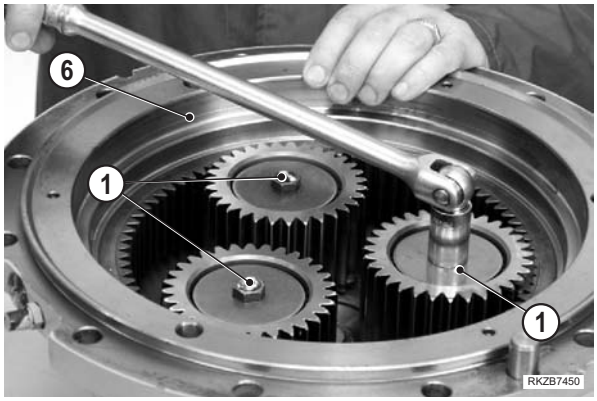
3. WHEEL HUB

3.1 Disassembly

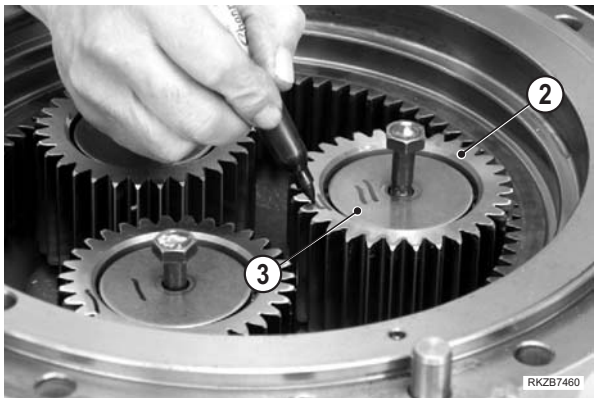


1 -Loosen the screws (1).

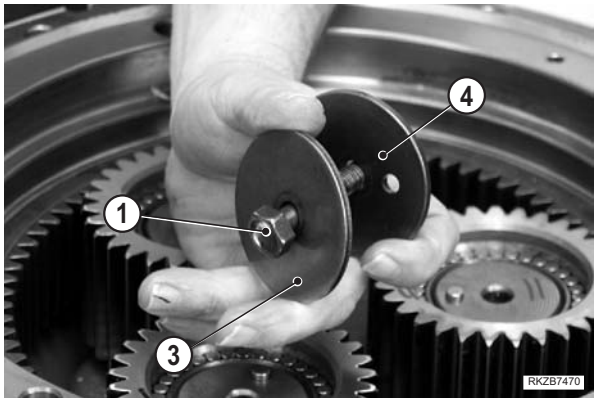
★ replace screw with a new set.



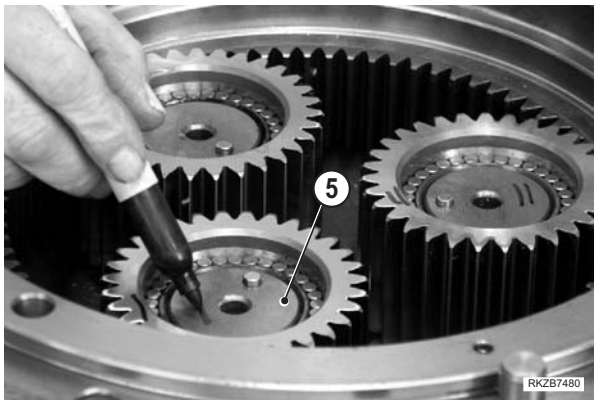
2 -Mark side gears (2), retaining washer (3) and indexed washer (4).



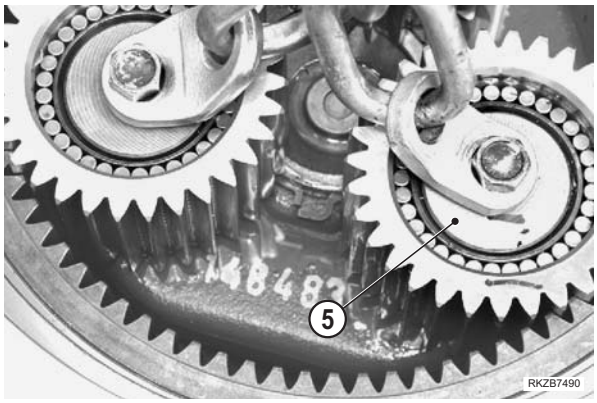
3 -Remove screws (1), retaining washer (3) and indexed washer (4).



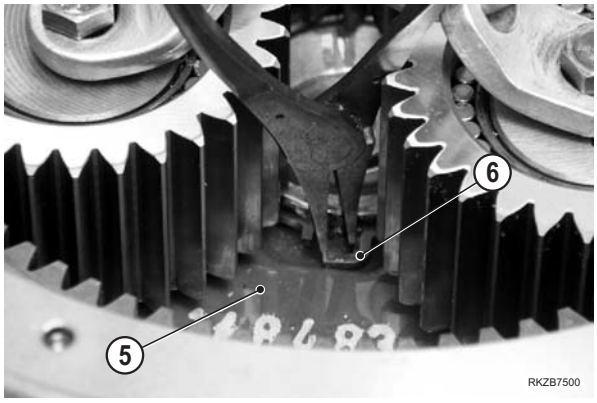
4 -Mark the mounting position of retaining washer (3) and indexed washer (4) on the planetary carrier (5).



5 -Attach lifting equipment to planetary carrier (5).

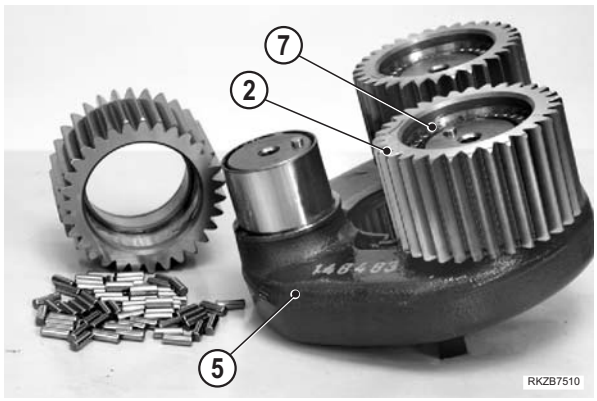


6 -Locate the snap ring (6) slot and open it while raising the planetary carrier (5).

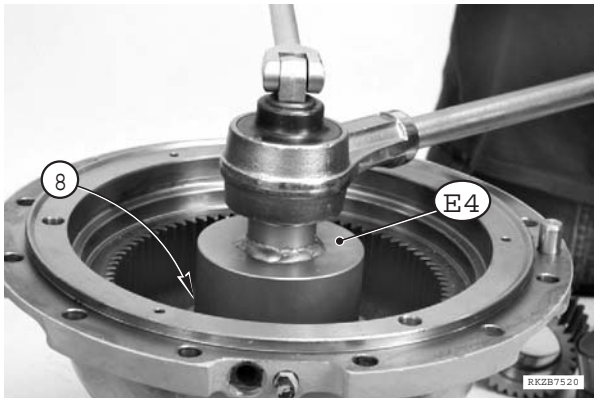


7 - Only if necessary: only if necessary, remove from the planetary carrier (5) the side gears (2) and their related rollers (7) (n° 66 per gear).

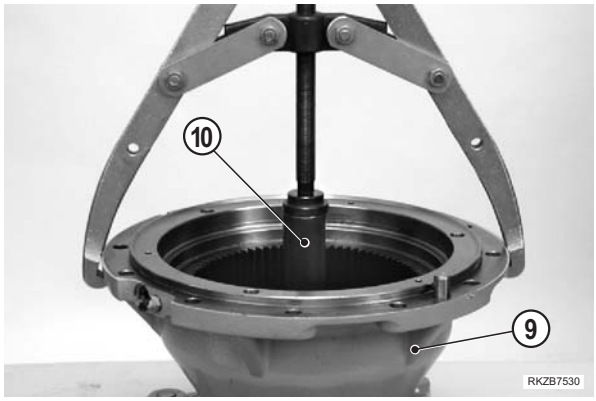
★ stock all the components of each gear together as a set.



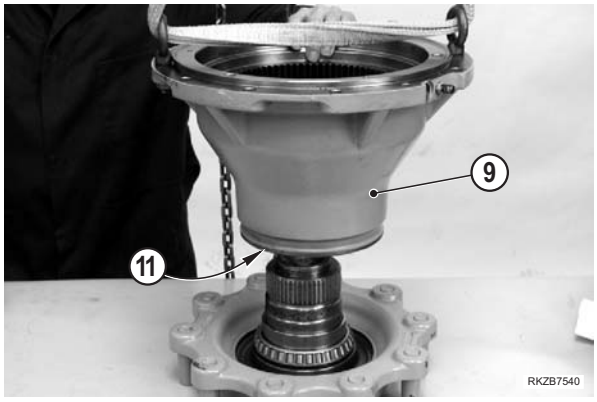
8 - Using spanner **E4**, loosen and remove the ring nut (8).



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)



11 -Remove from hub housing (9) the outer race of the bearing (11).

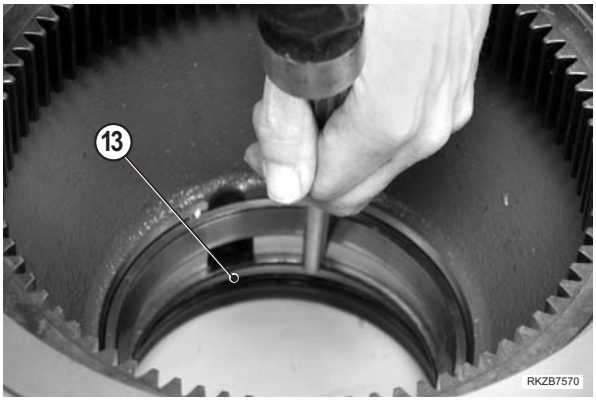


12 -Remove from hub housing (9) the outer race of the bearing (12).

★ 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 whell flange (10) spacer (14).

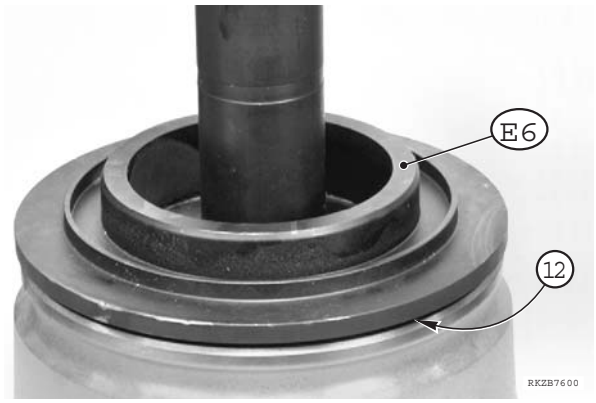


15 - Using an angle grinder, cut the cage and etch the bearing ring (13).
Use a chisel to cut and remove bearing inner race (13).



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.



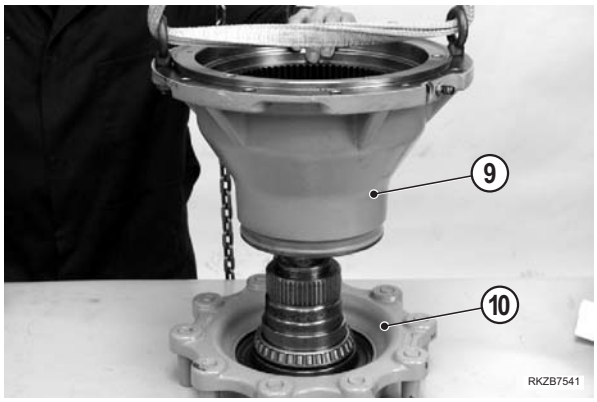
3 - Install spacer (14) on wheel flange (10



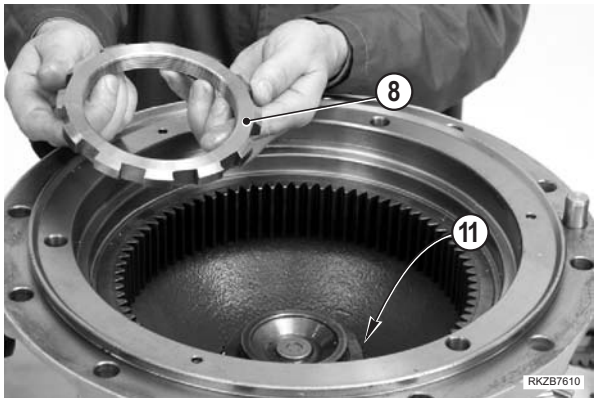
4 - Attach lifting equipment to hub (9) and carefully install onto wheel flange (10).

★ Clean accurately all sealing surfaces.

★ Take care not to damage the hub seal (12).

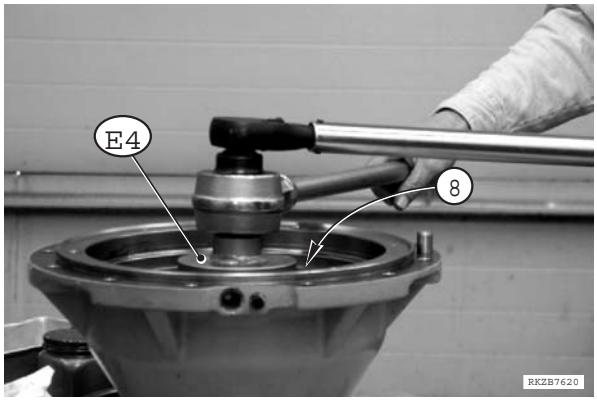


5 - Install bearing inner race (11) using a suitable driver and a hammer.
Install ring nut (8).



6 - Using spanner **E4**, tighten ring nut (8) to the required torque.

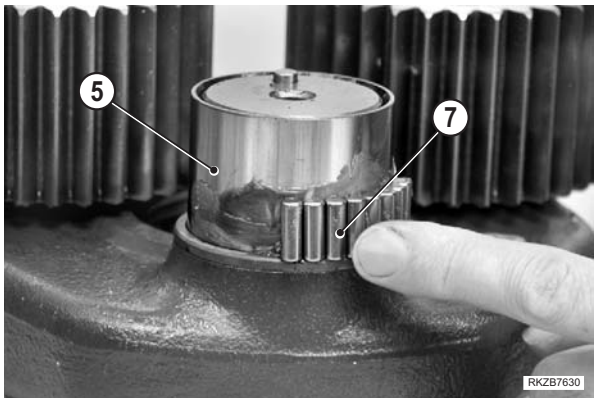
Ring nut: 1000 Nm



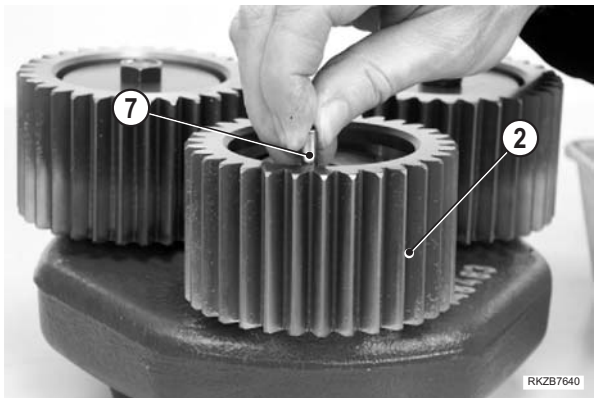
7 - Apply a light coat of Lithium based grease to the planetary carrier (5) stud to hold the needle bearings (7) (n° 33) in place.

Grease: ASL 800050

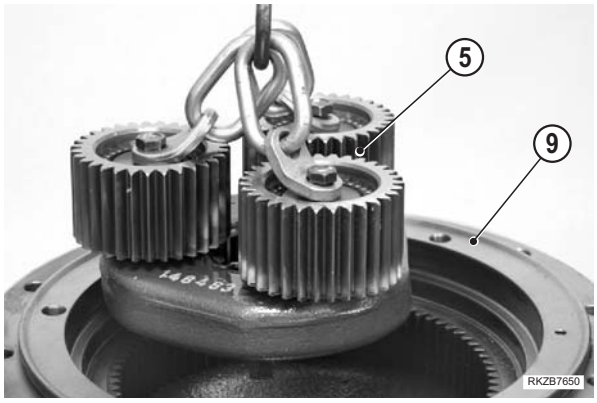
★ Use all the components corresponding to the marks made during disassembly.



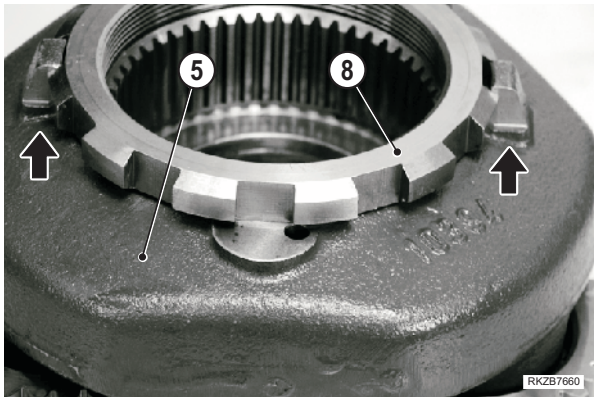
8 - Install the side gear (2) and the remaining needle rollers (7) (N° 33) into the side gear.



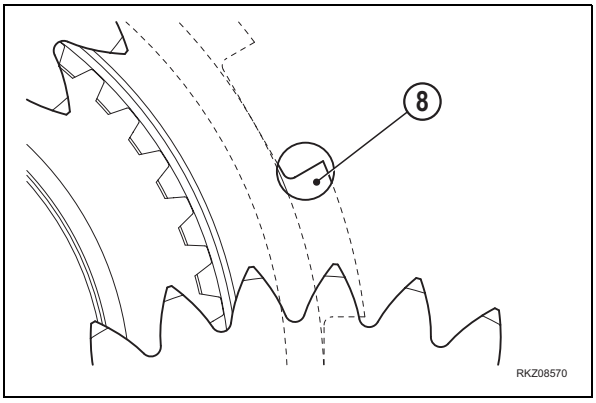
9 - Attach lifting equipment to planetary carrier (5) and lower into hub (9).



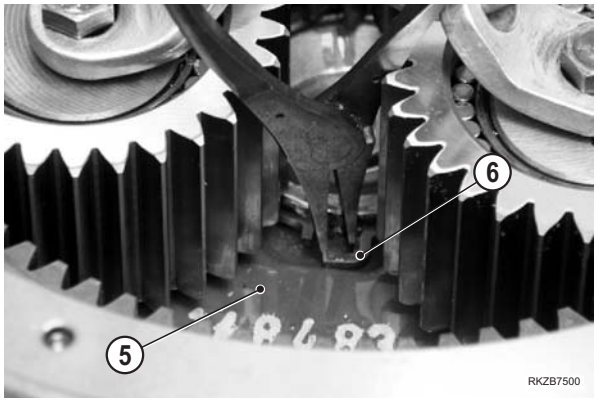
10 - During installation the locking ears of the planetary carrier (5) must engage the ring nut (8) as shown in figure and in next one.



11 - In order to simplify the installation, align the hole on the planetary carrier (5) with the ring nut (8) as shown.



12 - Open the snap ring (6) and slowly lower the planetary carrier (5).

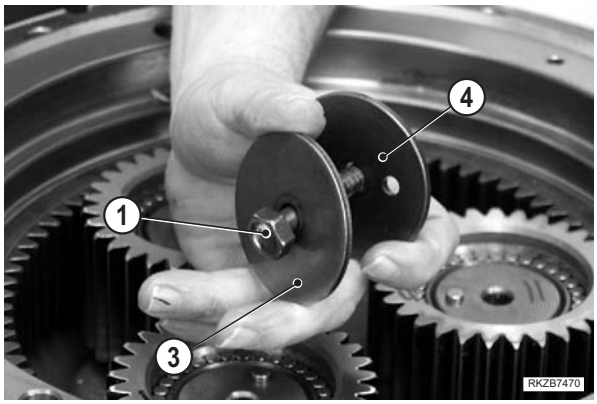


13 - Install washers (3) and (4) and tighten screws (1); apply the specified sealant and tighten to the required torque.

★ Replace bolts with new ones.

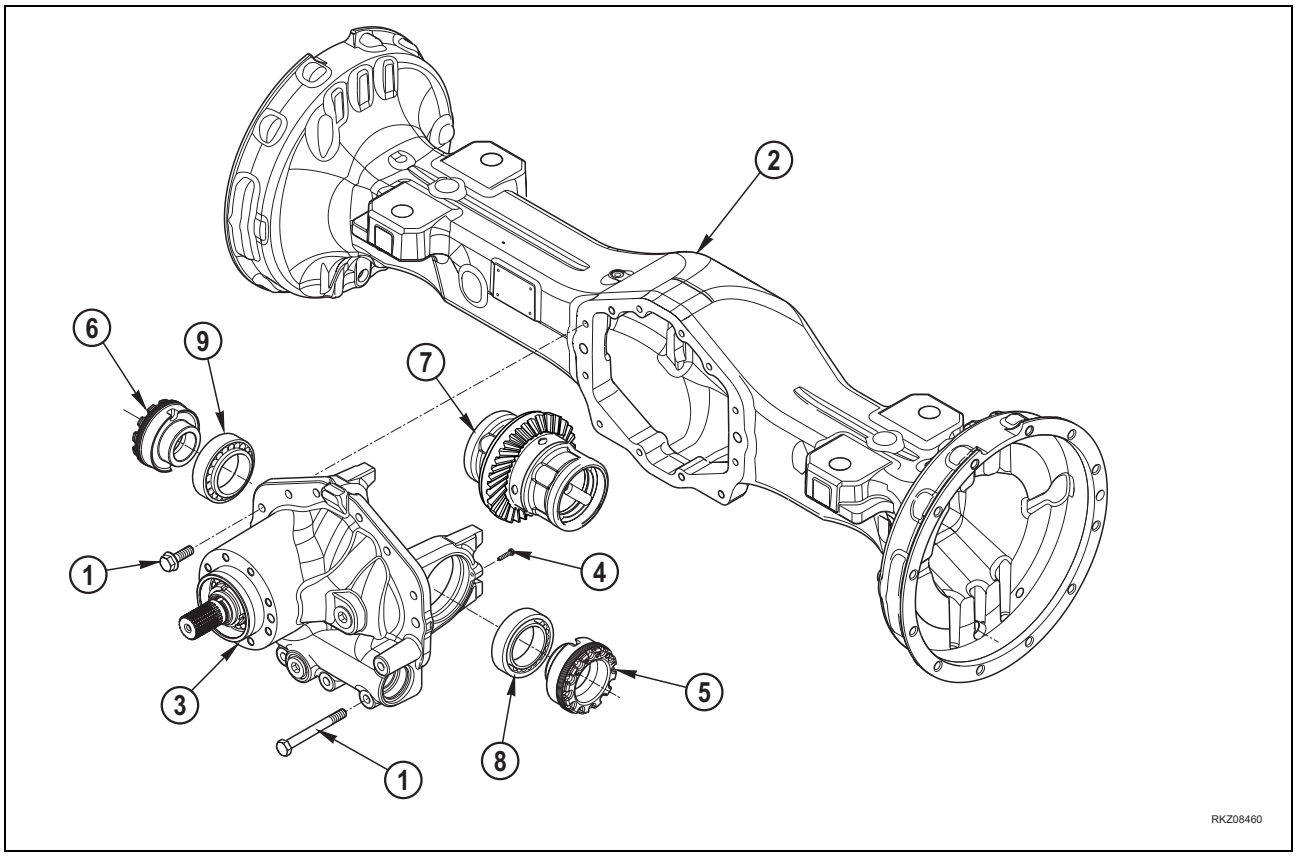
Screw: Loctite 270

Screw: 79 Nm



4. DIFFERENTIAL SUPPORT GROUP

4.1 Disassembly

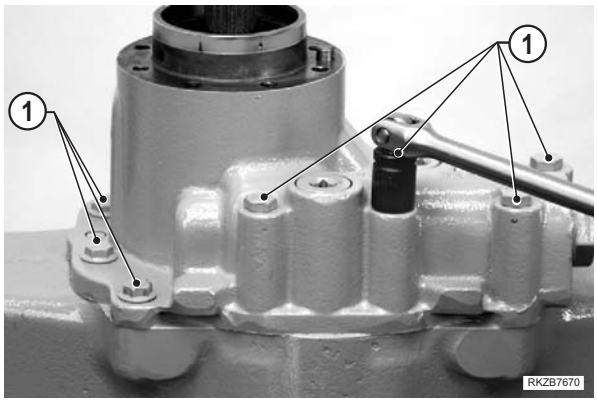


1 - Drain the oil completely from the differential.

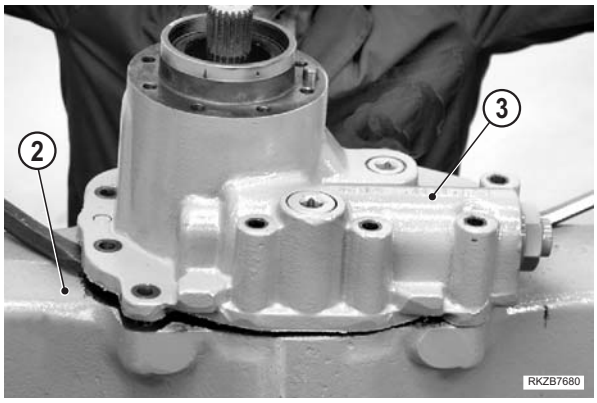
Differential oil: approx. 15 ℓ



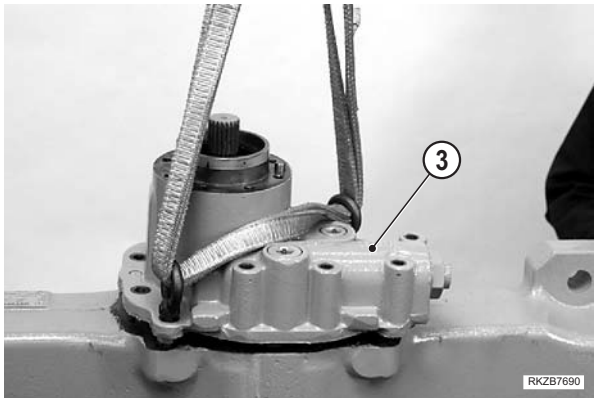
2 - Remove the all screws (1).



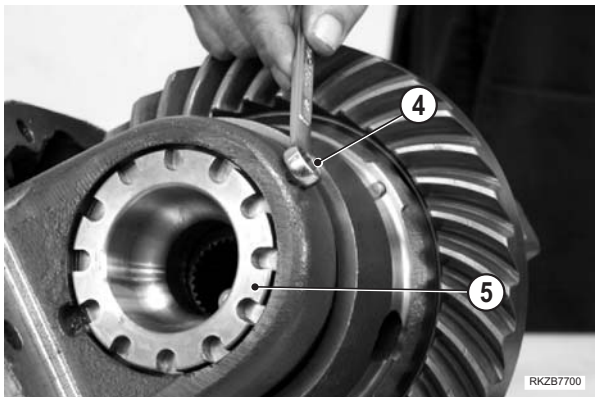
3 - Separate from axle (2) the differential housing (3) using pry bars in slots.



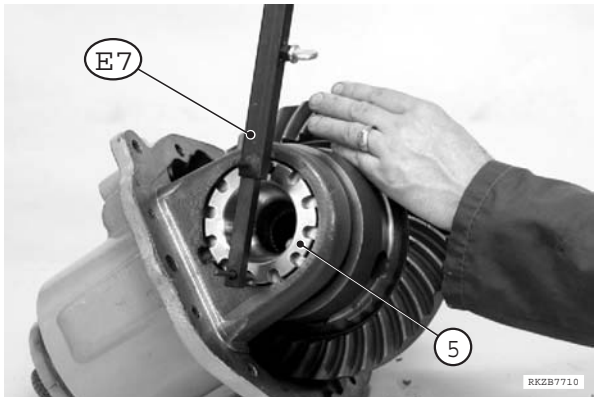
4 - Attach lifting eyes to differential housing (3) and remove it.



5 - Remove the bolts (4) securing the ring nuts (5) and (6).

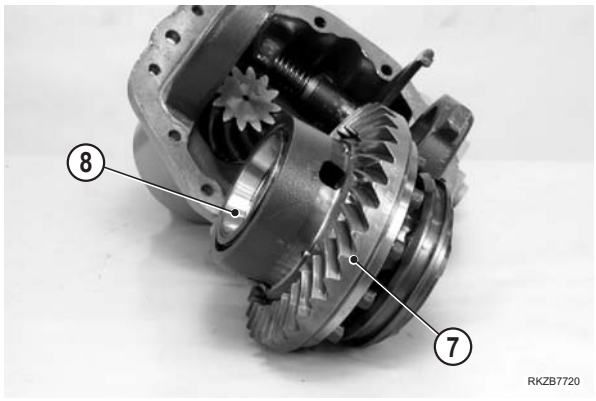


6 - Use the tool **E7**, unscrew the adjuster ring nuts (5) e (6).



7 - Remove out the differential case (7). The external rings (8) and (9) are removed together with the differential housing.

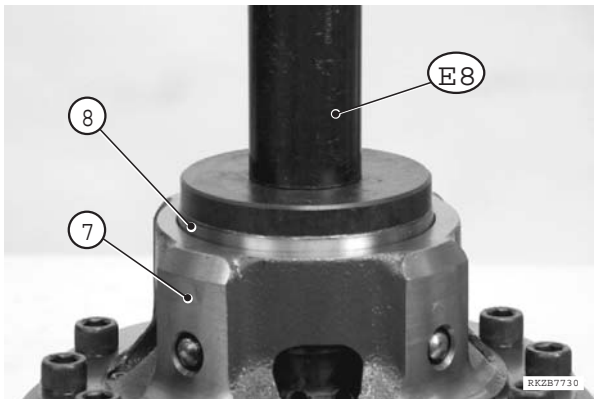
★ Try not to mismatch bearings if bearings are not to be replaced.



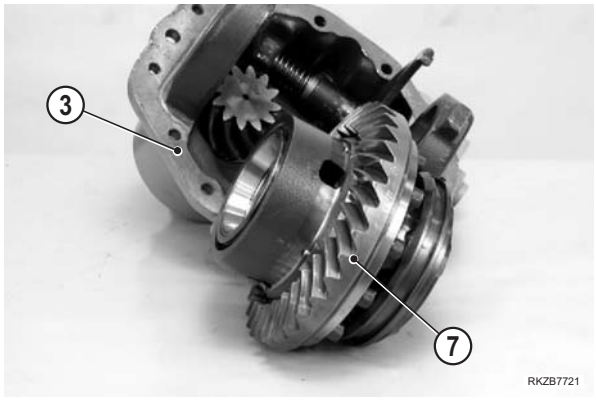
4.2 Assembly

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.

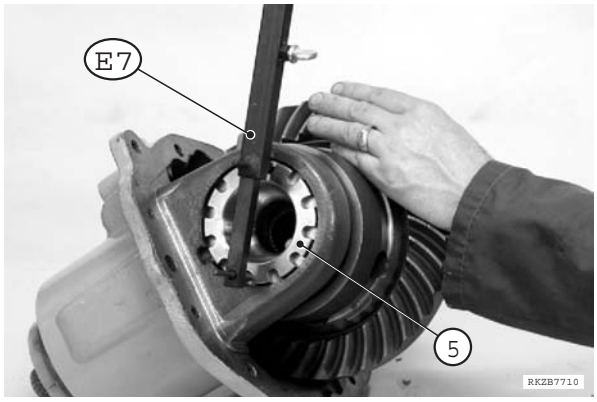


2 - Position the complete differential box (7) with bearings on the differential carrier (3).

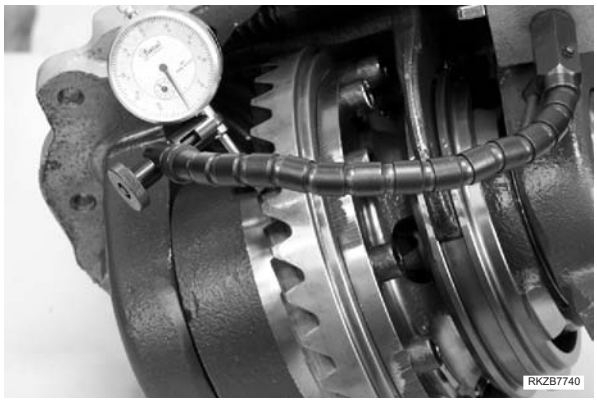


3 - Insert and tighten adjustment ring nuts (5) and (6) in the differential support with tool **E7**, so as to pre-load the differential bearings slightly.

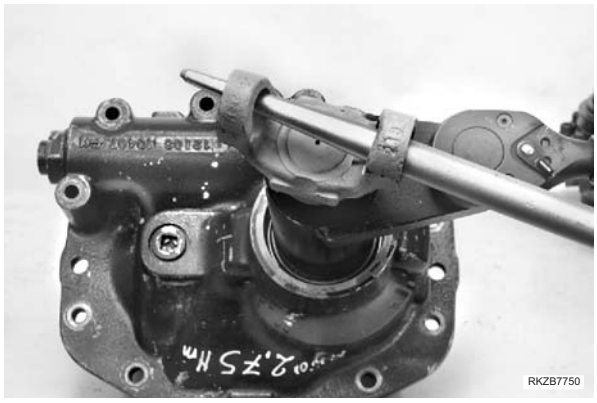
★ Knock lightly with a soft hammer in order to properly set the bearings in position.



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.



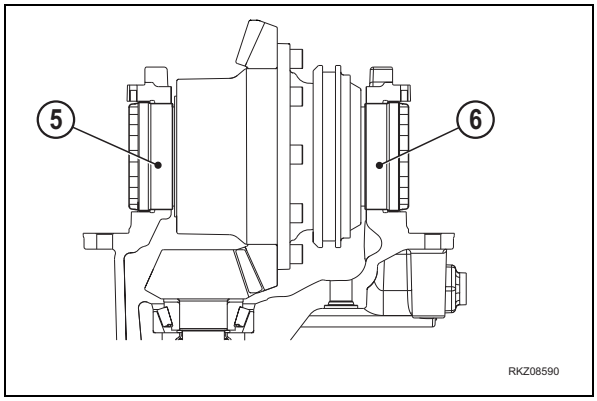
5 -Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.
Check if the measured backlash value is within the requested range:
0.21–0.29 mm
Adjust by operating the adjuster ring nuts. (5) and (6), using tool **E7**.



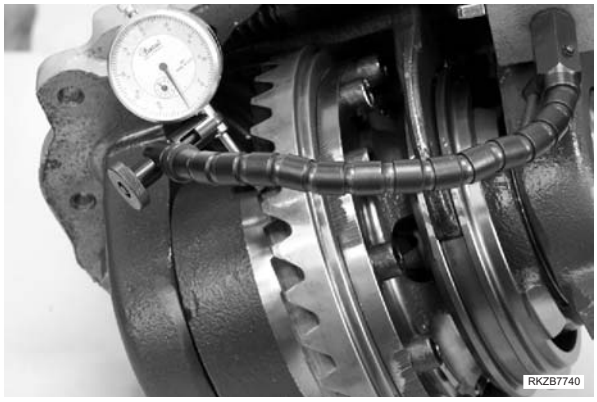
6 -Adjust the ring nuts (5) and (6) remembering that:

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.



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**.

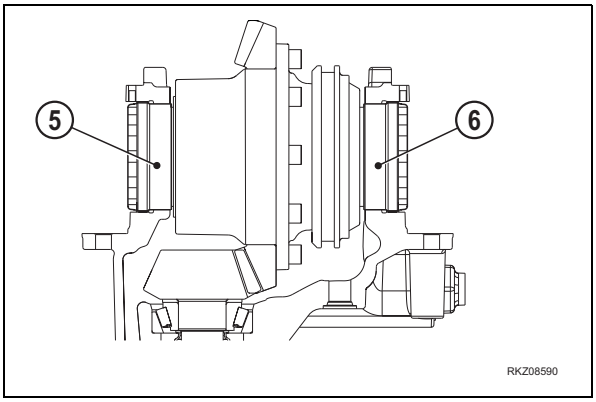
★ Total rolling torque should be measured without pinion retaining ring.
Rolling torque **Tr** must be within the following range:
Tr = (Pr+0.58) – (Pr+0.87) Nm
where **Pr** is the actual rolling torque of pinion alone.



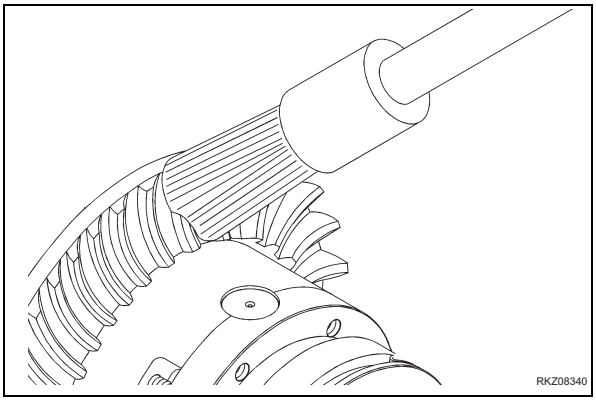
9 - If the reading is not within the requested range, thoroughly check the assembly of each component and operate the adjuster ring nuts (5) and (6) of the differential support:

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.

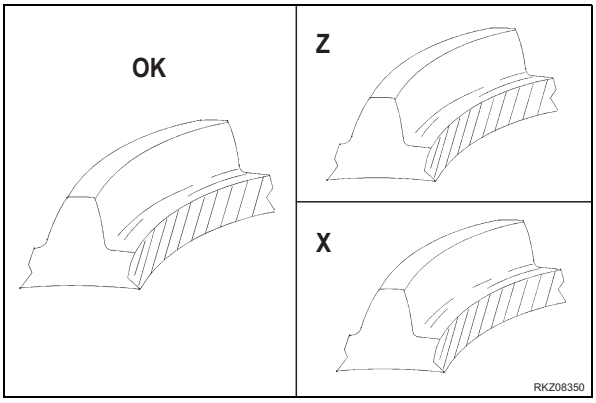


11 - Contact:

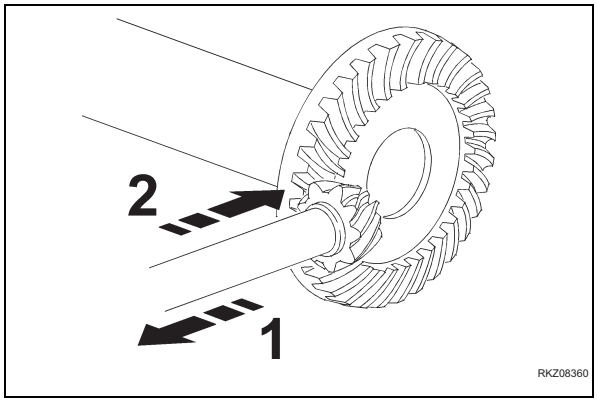
OK-Correct contact:
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.

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 then approach the ring bevel gear to the pinion in order to adjust the backlash.

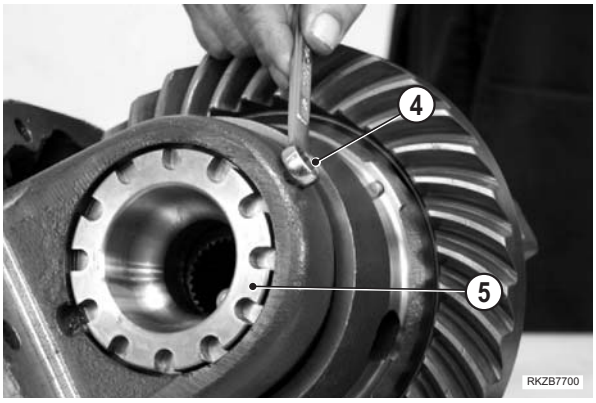


12 -**Movements to correct:**
1 - move the pinion for type X contact adjustment.
2 - move the pinion for type Z contact adjustment.



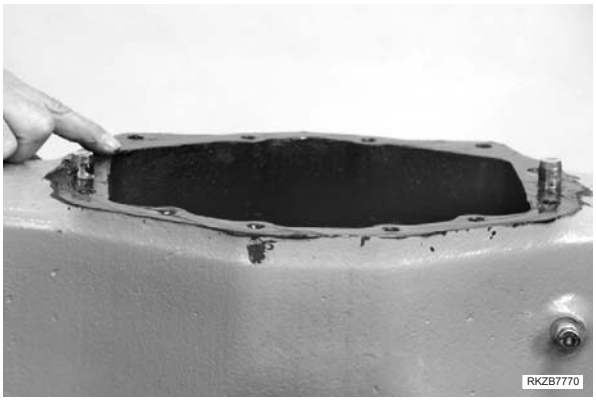
13 -When all adjustment procedures are complete, lock adjuster ring nuts (5) and (6) into position with screws (4). Tighten screws (4) to the required torque.

Screw: 10Nm

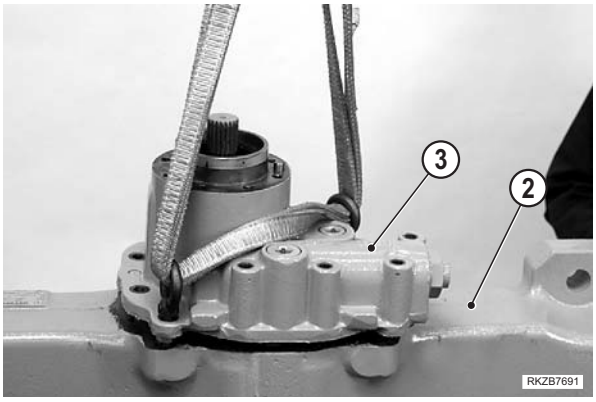


14 -Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents. Spread a film of adhesive on the contact surface between the axle beam (2) and the differential carrier (3).

Contact surfaces: Loctite 510



15 - Assemble the differential support (3) to the axle housing (2).

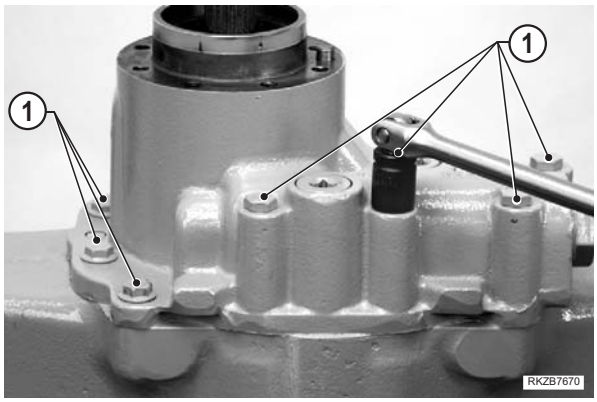


16 - Tighten all screws (1) to the required torque.

Screw: 169 Nm

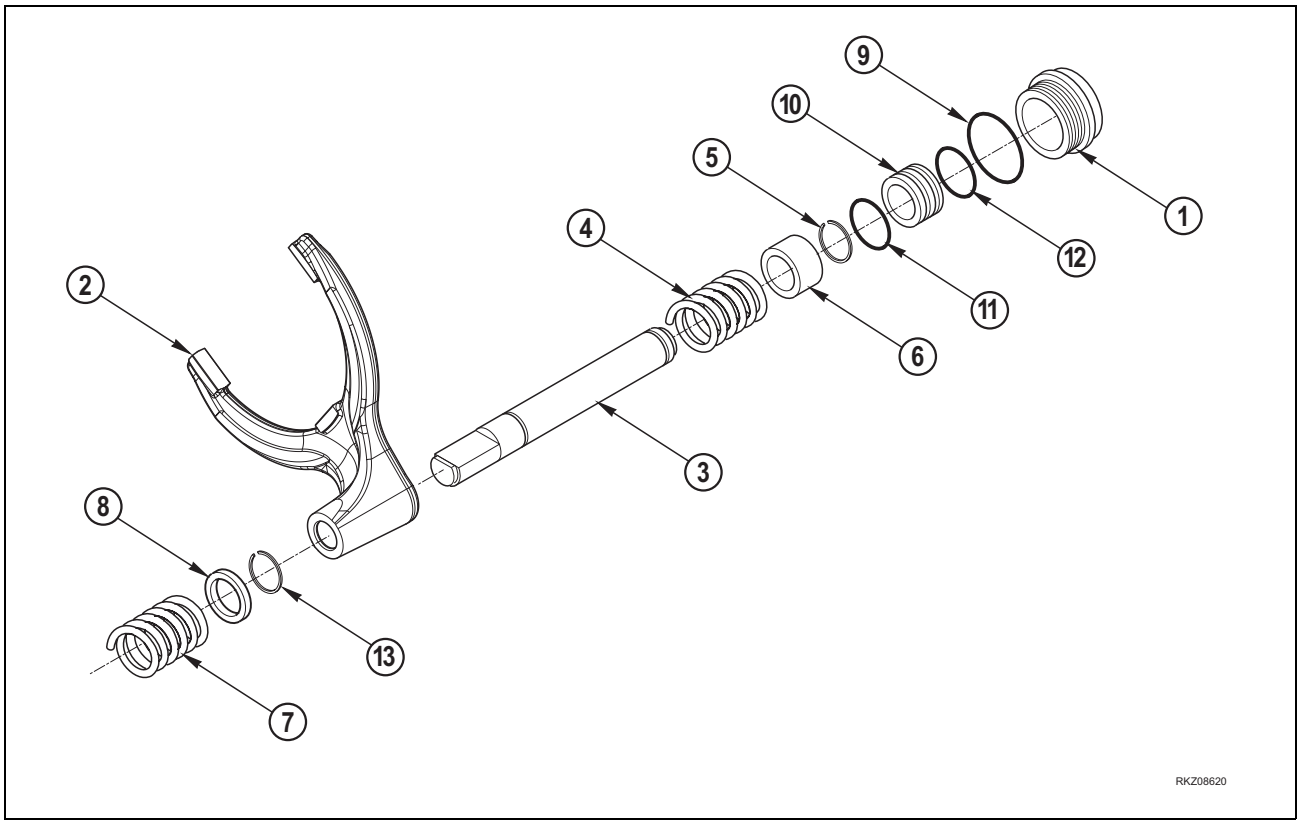
17 - Refill the hydraulic oil.

Differential oil: approx. 15 ℓ

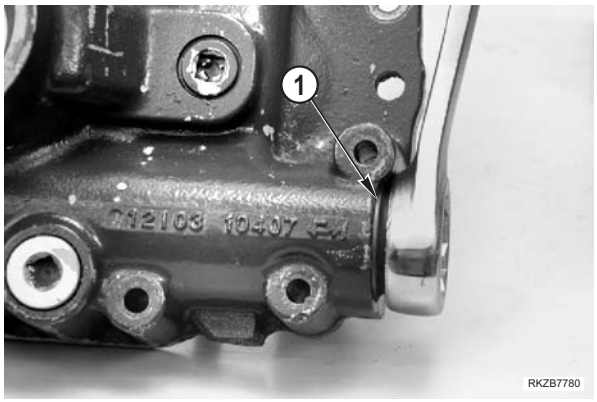


5. DIFFERENTIAL LOCKING GROUP

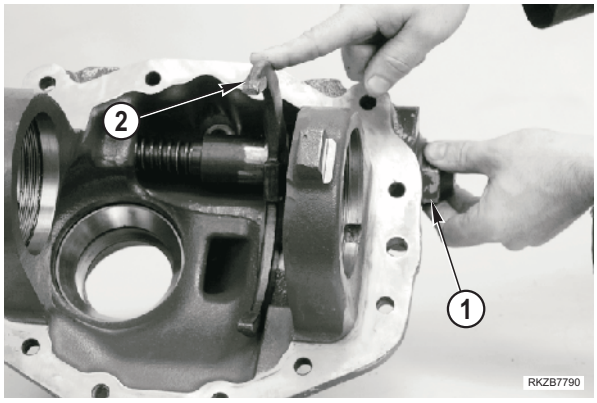
5.1 Disassembly



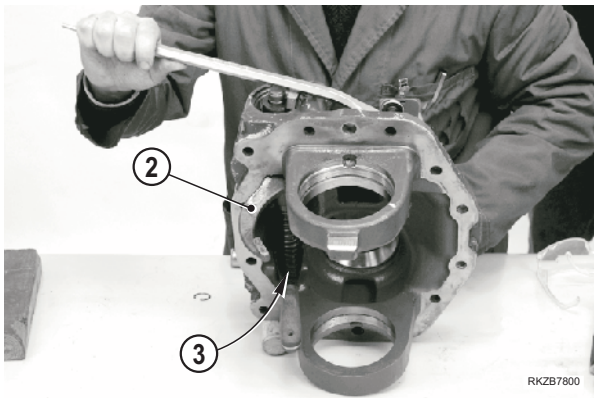
1 -Loose plug (1) but do not remove it.



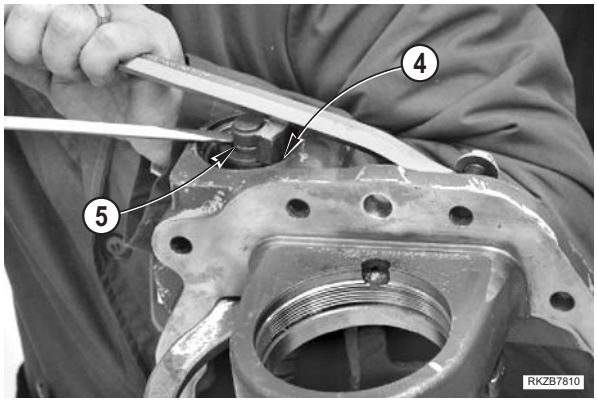
2 -Hold the differential lock fork (2) down to catch a block inside of the housing, remove the plug (1).



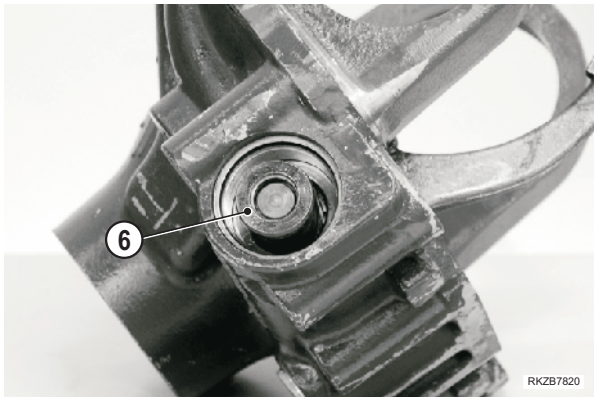
3 - Pull the differential lock fork (2) up, place a flat piece of steel under the shaft (3) to keep it from moving down.



4 - Compress spring (4) until snap ring (5) is released. Remove snap ring (5).



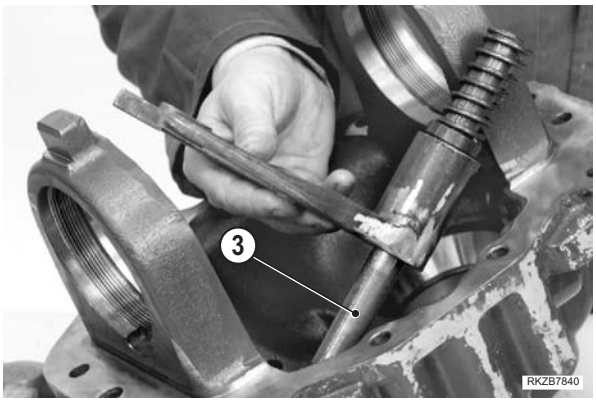
5 - Remove the bushing (6).



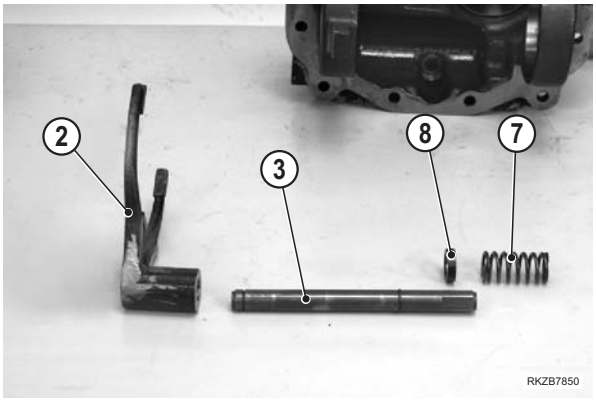
6 - Remove the spring (4).



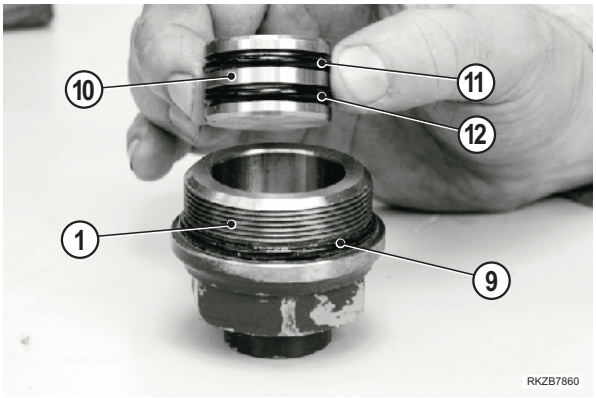
7 -Remove the shaft (3) from differential housing.



8 -Remove the fork (2), spring (7) and bushing (8) from the shaft (3).

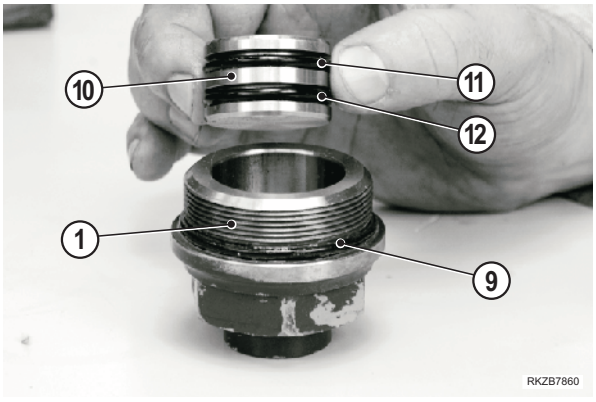


9 -Remove O-Ring (9) from plug (1) and O-rings (11) and (12) from the piston (10).



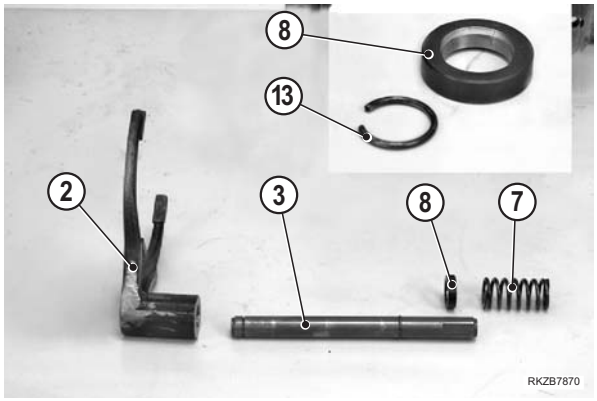
5.2 Assembly

1 -Install new O-rings (11) and (12) on the piston (10) and O-Ring (9) on plug (1). Lubricate the O-rings.

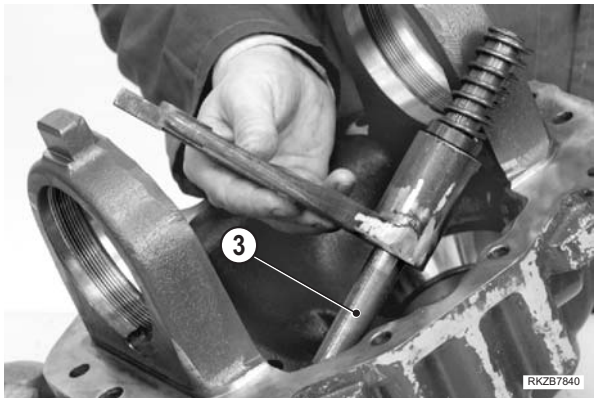


2 - Lubricate the shaft (3) with clean hydraulic oil. Install the fork (2) on the shaft (3) like shown in figure. Install bushing (8) and spring (7) onto shaft.

★ Mount the spacer (8) with the chamfer towards the snap ring (13).



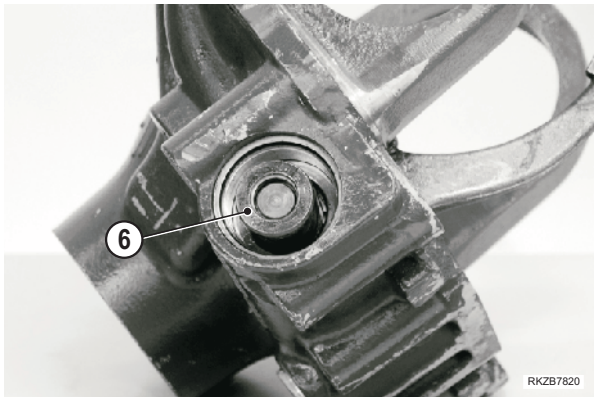
3 - Insert in the differential housing the shaft (3) complete.



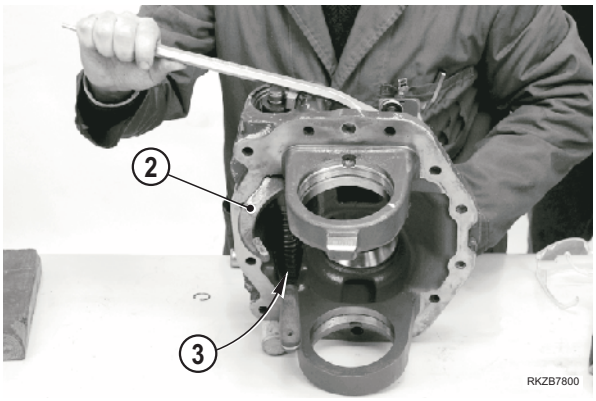
4 - Mount the spring (4).



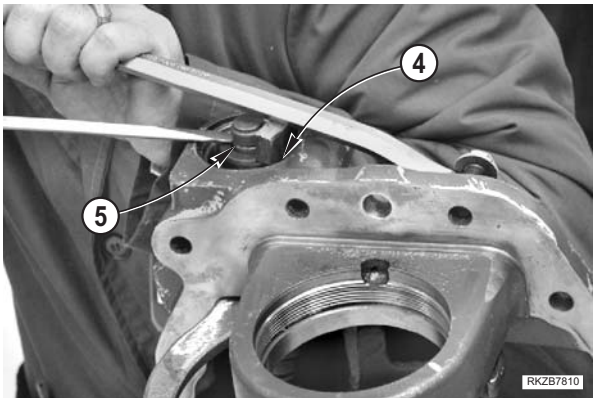
5 - Place the bushing (6) on the shaft, make sure the chamfer in the bushing is facing out.



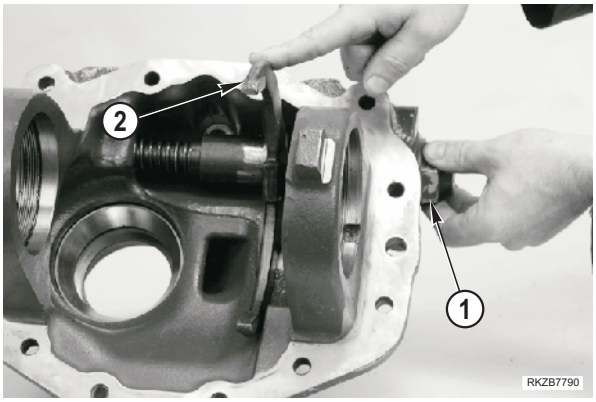
6 - Pull the differential lock fork (2) up, place a flat piece of steel under the shaft (3) to keep it from moving down.



7 - Compress the spring (4) using a proper tool and install the snap ring (5).
Remove the piece of steel under the shaft (3).

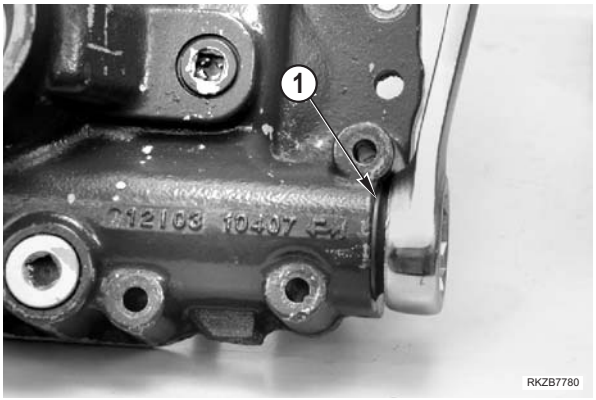


8 - Hold the differential lock fork (2) down to catch a block inside of the housing, remove the plug (1).
Hand screw the plug (1).



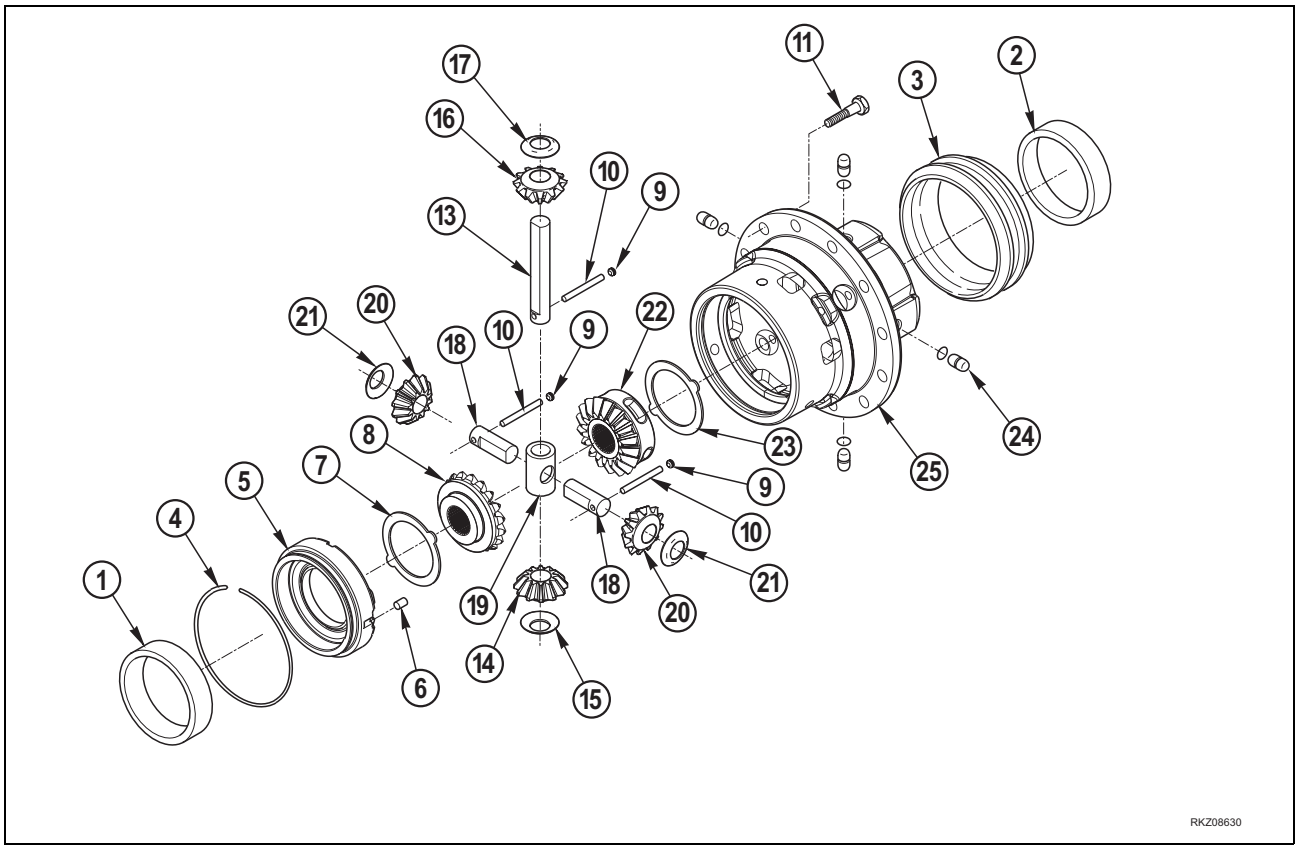
9 - Tighten plug (1) to the requested torque.

Plug: 180 Nm



6. DIFFERENTIAL

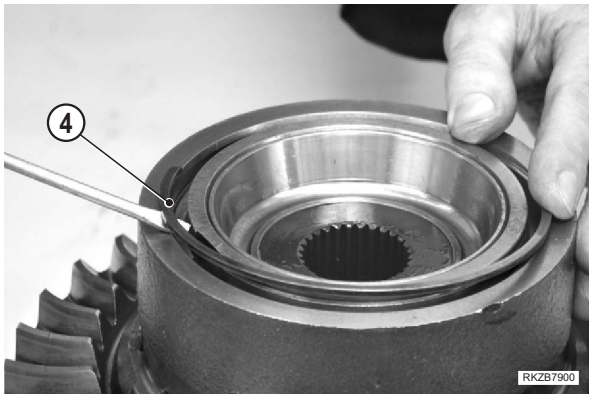
6.1 Disassembly



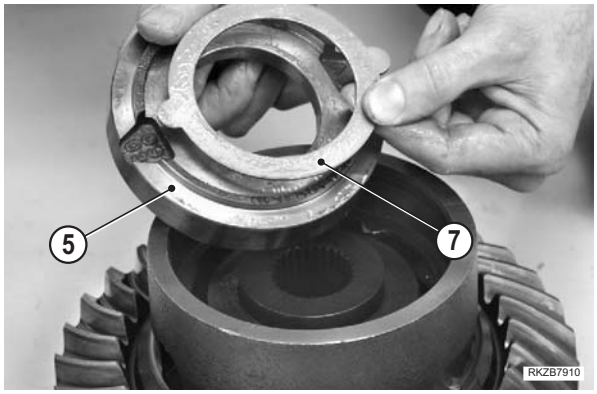
1 - If differential bearings are to be replaced, remove bearing outer rings (1) and (2).
Remove sleeve (3).



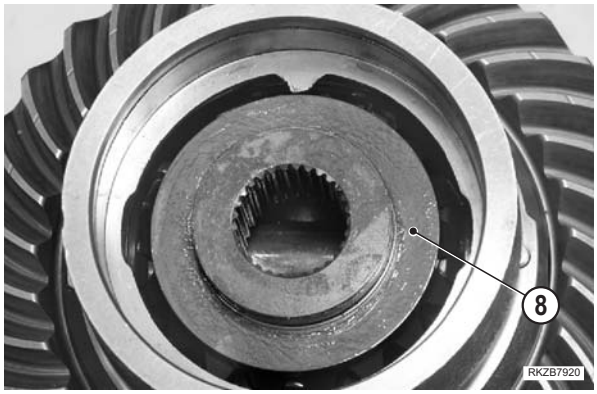
2 - Remove snap ring (4).



3 -Remove the differential housing cover (5), remove the anti rotation pin (6) and the thrust washer (7).



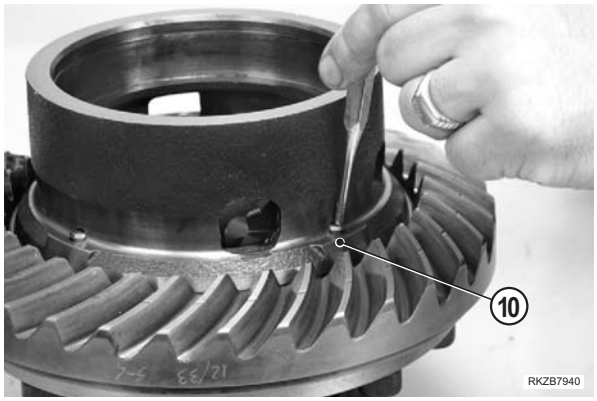
4 -Remove the side gear (8).



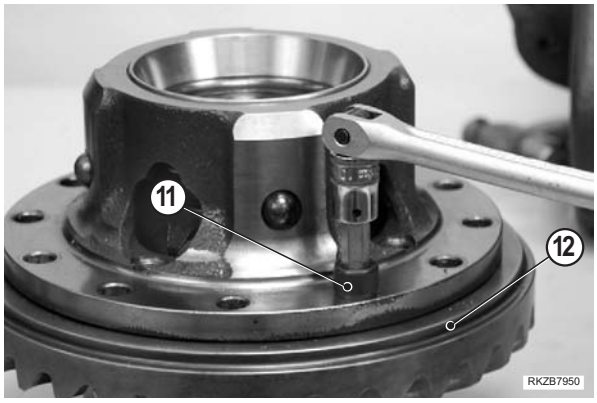
5 -Remove three plugs (9) from the differential.



6 -Remove the three pins (10) securing the spider pins in the differential.

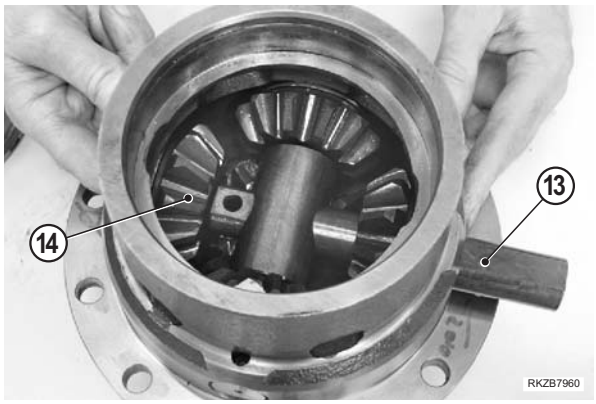


7 - Remove the ring gear cap screws (11), remove the ring gear (12).

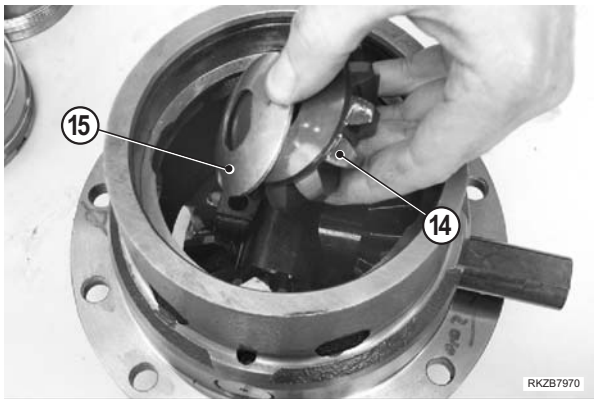


8 - Push the pin (13) towards the flat surface side (14).

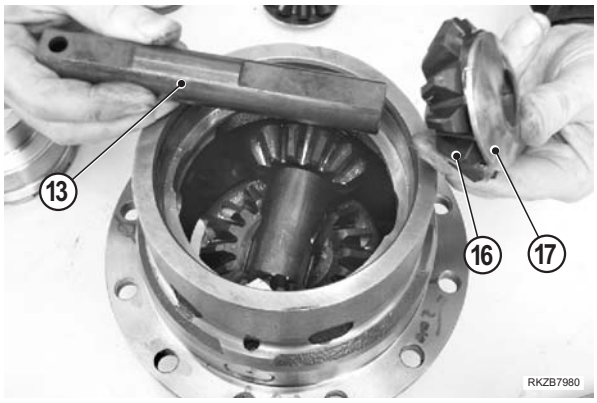
★ the pin can be pushed in only one direction.



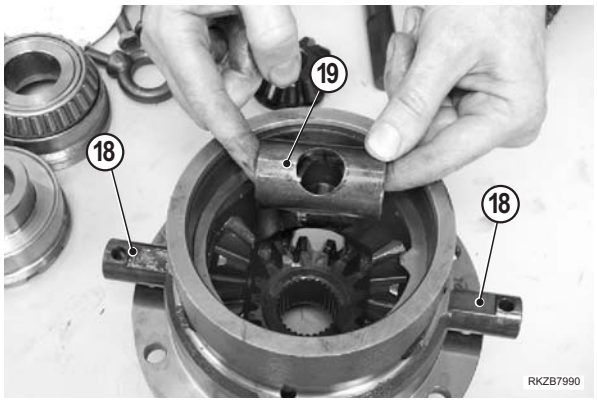
9 - Remove the planetary gear (14) and thrust washer (15).



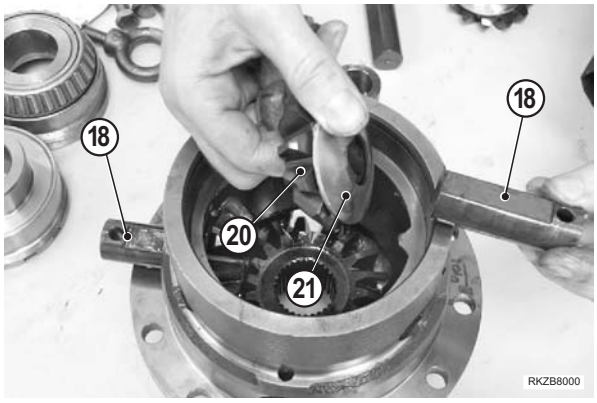
10 - Push the pin (13) out of the housing and remove the planetary gear (16) and thrust washer (17).



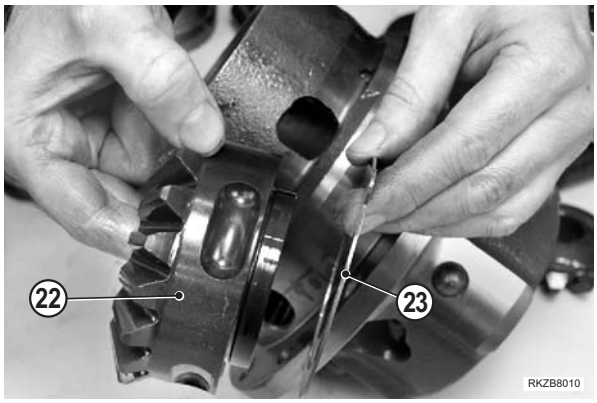
11 - Push the short spider pins (18) out of the spacer (19) by pushing them through the hole in the spacer (19).



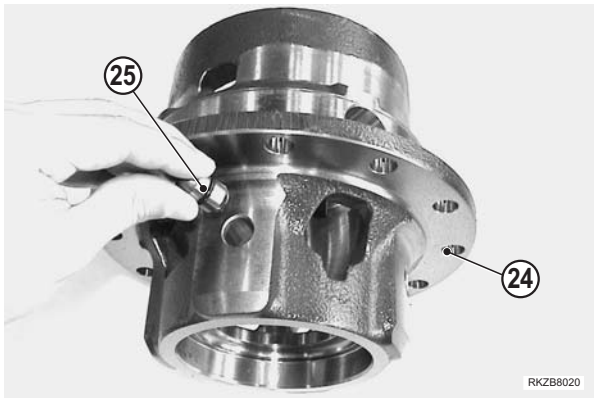
12 - Remove pins (18), spider gears (20) and thrust washers (21).



13 - Remove side gear (22) and thrust washer (23) from the housing.



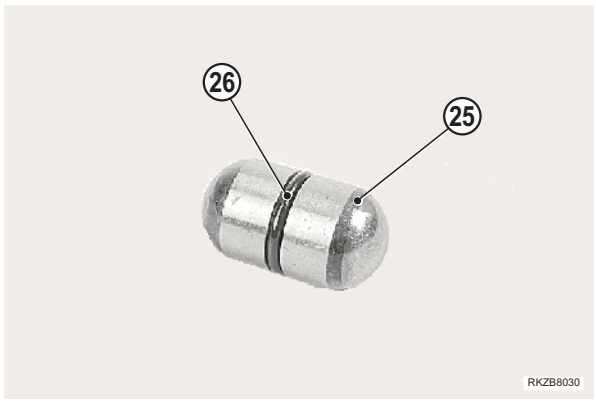
14 - Remove the differential locking pins (25) from the housing (24).



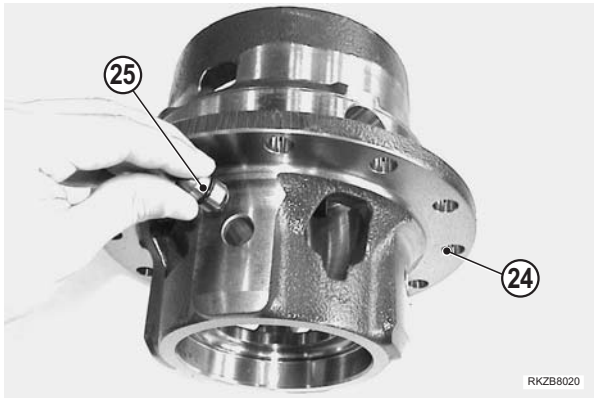
6.2 Assembly

1 - Install and lubricate new O-rings (26) on the pins (25).

Gaskets O-ring: ASL800050

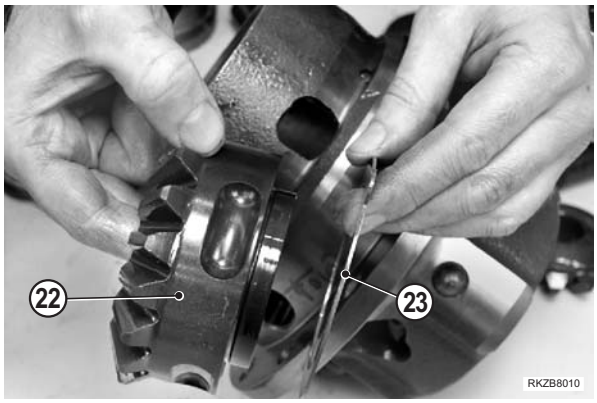


2 - Install the pins (25) in the differential housing (24).



3 - Lubricate and install sun gear (22) and thrust washer (23).

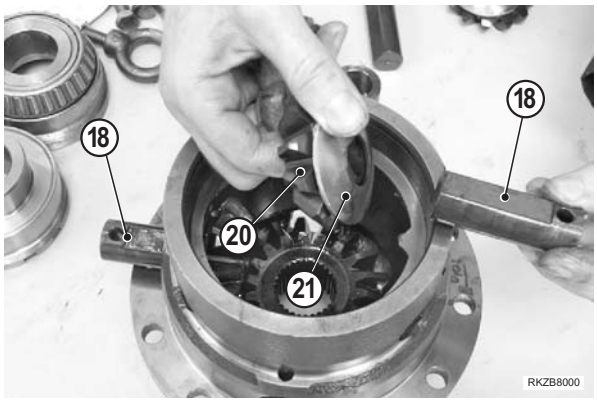
Gear: differential oil



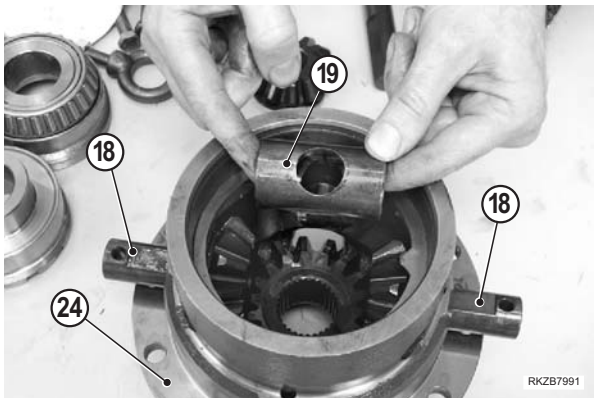
4 - Lubricate and install planetary gear (20) and its respective thrust washer (21) and introduce the pins (18) forward enough to support them.

★ Orientate the flats on the pins facing up.

Gear and pin: differential oil



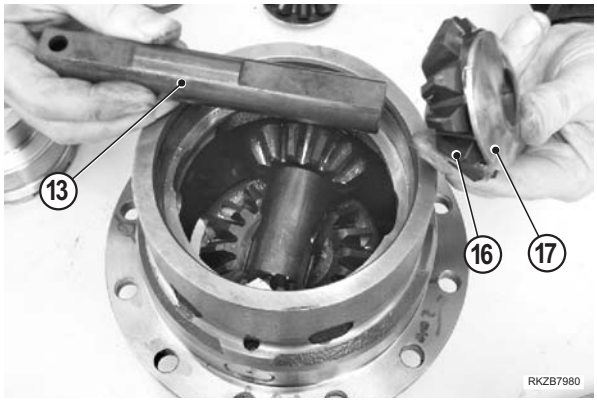
5 - Install spacer (19) and introduce pins (18), taking care to align the holes with those on the differential housing (24).



6 - Lubricate and install the sun gear (16) and thrust washer (17).
Introduce the pin (13) as far as it will go.

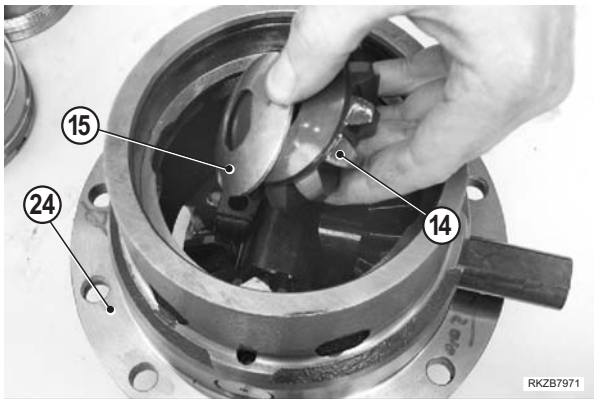
★ Orient pin (13) with the flats on the pin facing up.

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

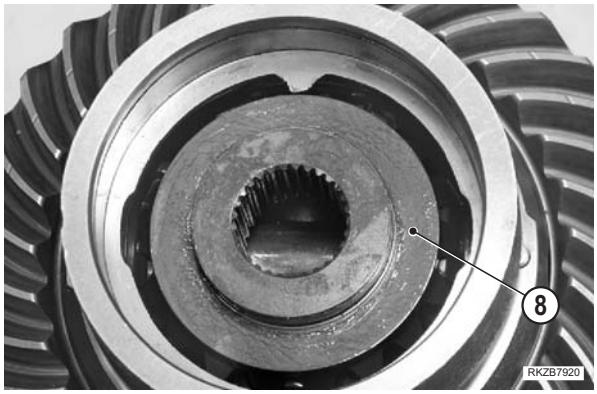


9 - Install pins (10) and tighten caps (9) to the prescribed torque.

Caps: 25 Nm

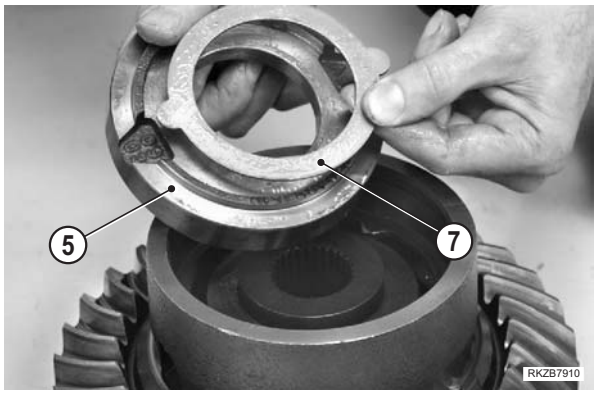


10 - Install the planetary gear (8).

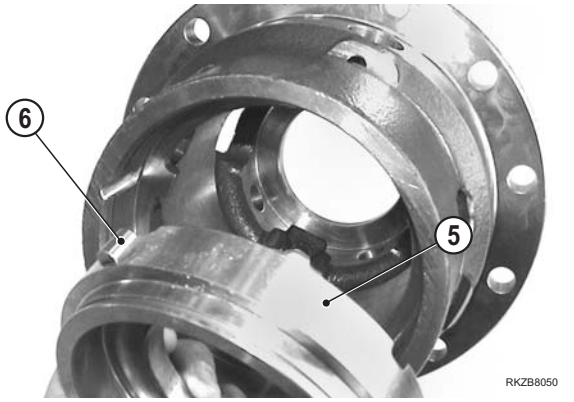


11 - Apply a thin coat of grease to the cover (5) and install the shoulder ring (7).

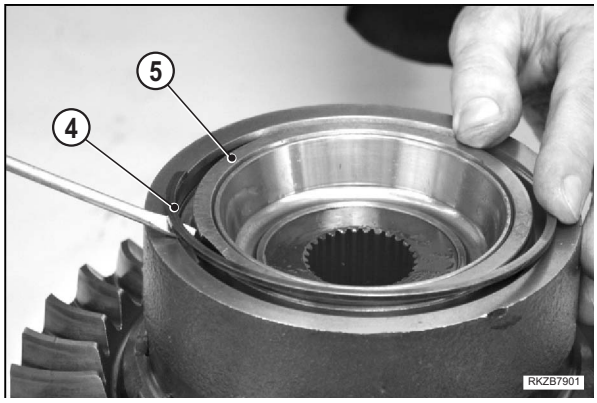
Cover: ASL800050



12 - Install antirotation pin (6) to cover (5) and install cover (5) to differential housing.



13 -Lock cover (5) into position with snap ring (4).



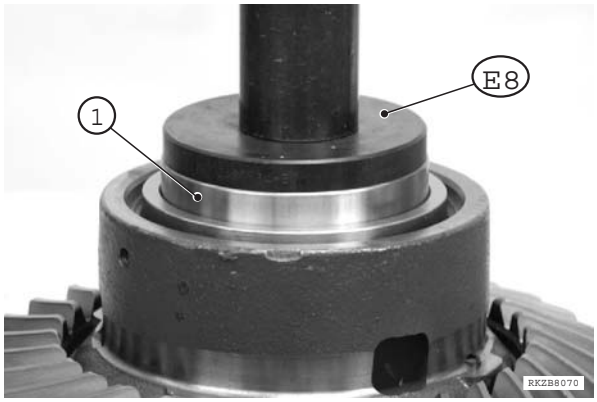
14 -Install sleeve (3) and make sure that sleeve fits snugly into position.

★ To make installation easier, rotate the side gear (22).



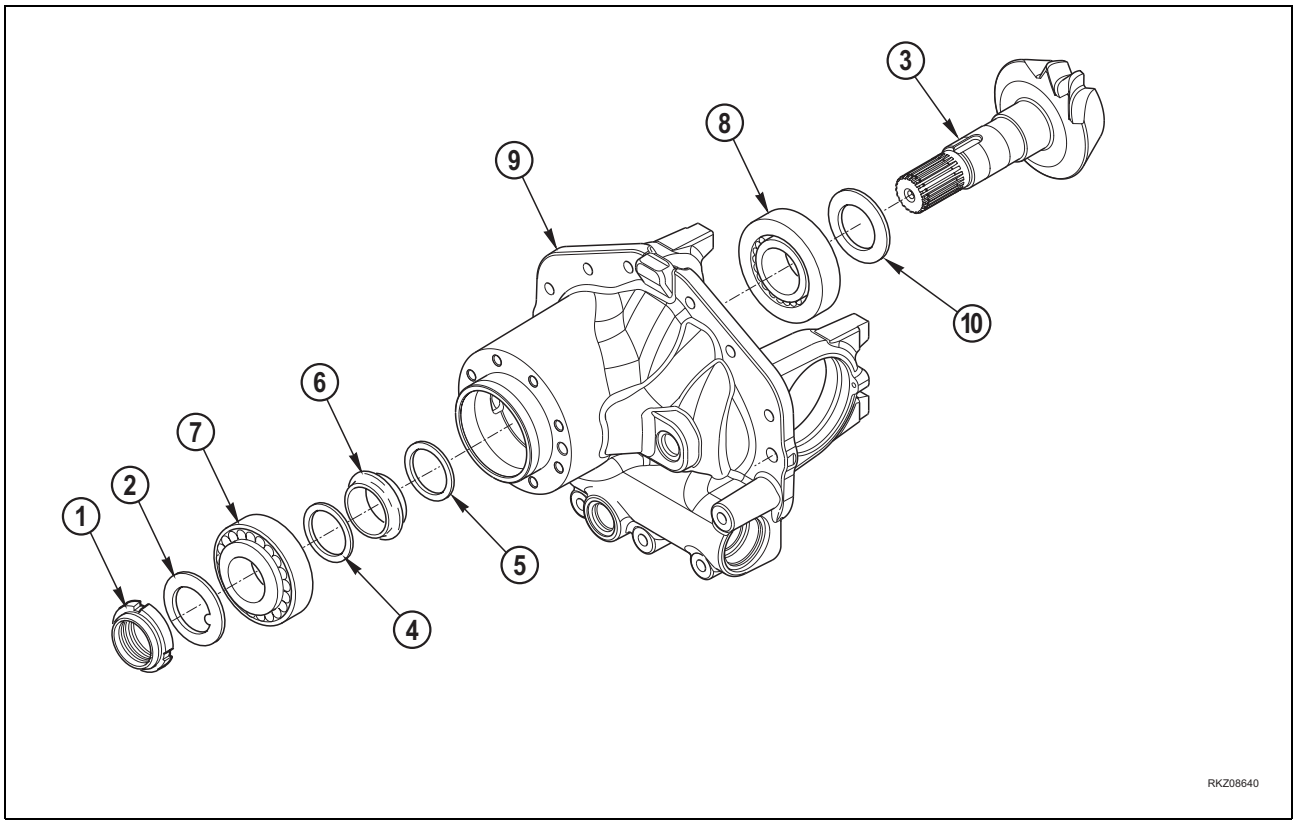
15 -Install bearing outer rings (1) and (2) using driver **E8**.

★ Do not invert bearings.



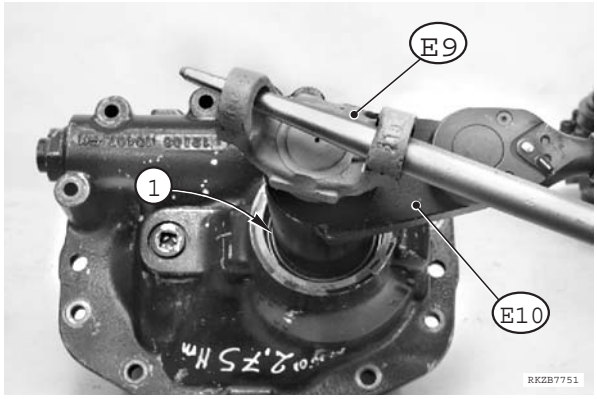
7. DIFFERENTIAL GROUP

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).



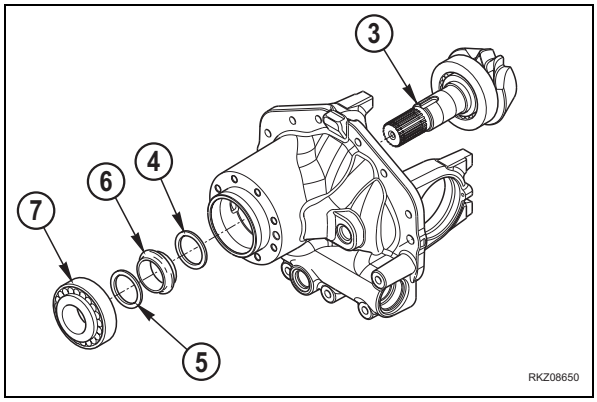
2 - Remove the ring nut (1) and collect its retaining washer (2).



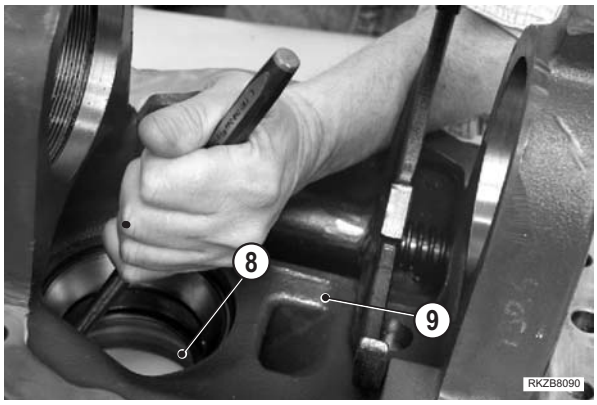
3 - Tap the shaft with a soft hammer to remove the bevel pinion (3).

★ Take care not to drop the bevel pinion (3).

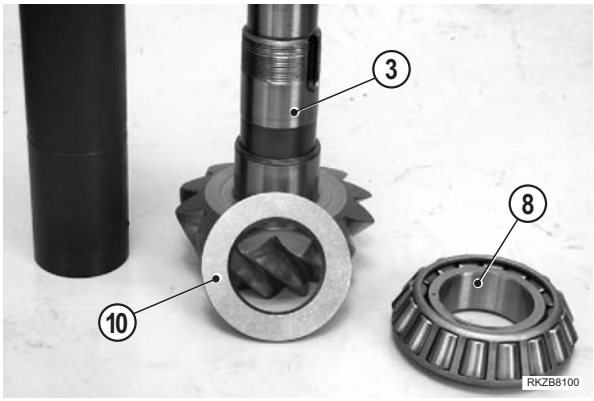
Recover washers (4) and (5), collapsible spacer (6) and bearing inner ring (7).



4 - Remove bearing outer rings (7) and (8) from differential support (9) using a driver and a hammer.

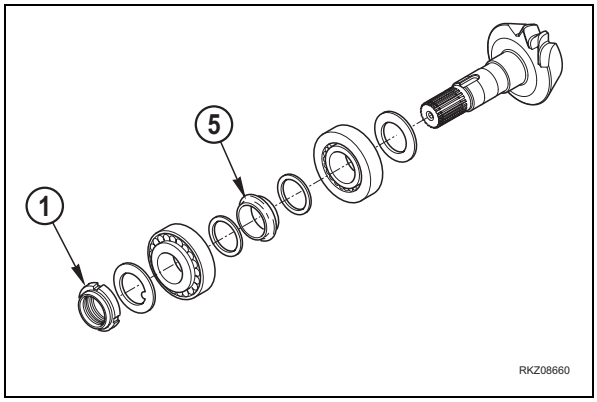


5 - To remove bearing inner ring (8) from bevel pinion (3), use a commercially available grip puller.
Recover bearing inner ring (8) and the shim (10) under it.



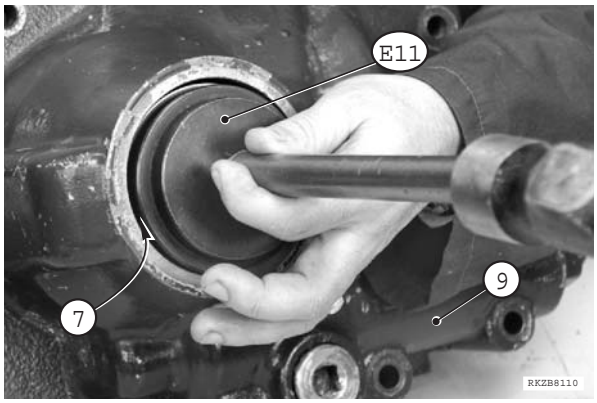
6 - Check all pinion components for wear.

★ The ring nut (1) and the snap spacer (6) must be replaced.

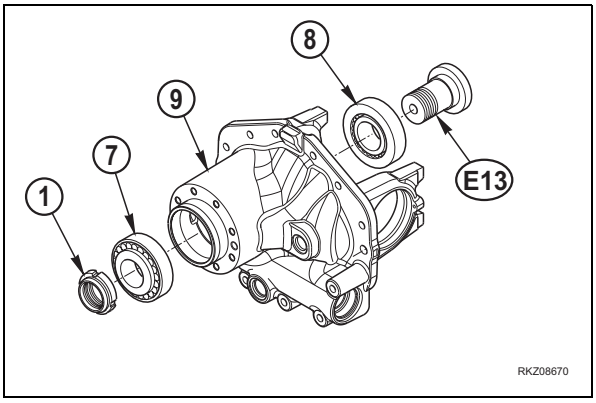


7.2 Assembly

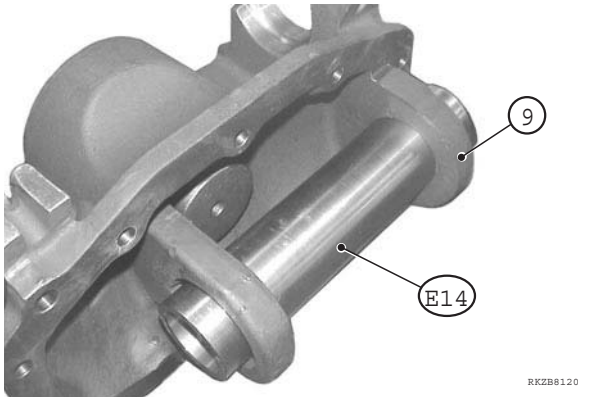
1 - Place the differential support (9) on a workbench. Introduce bearing outer rings (7) and (8) using special tools **E11** - **E12** and a hammer.



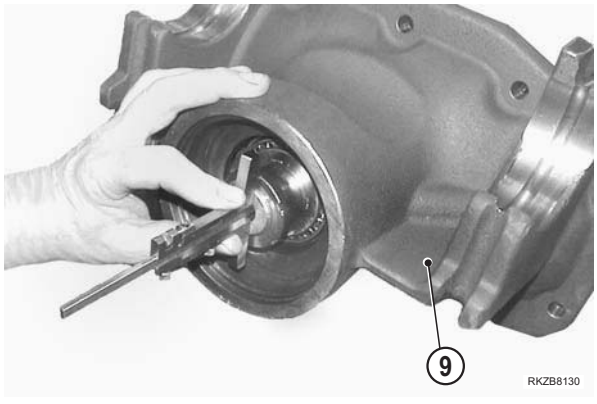
2 - Insert inner rings (7) and (8) in their housings. Assemble the false pinion **E13** and its ring nut (1). Tighten without exceeding the ring nut, till the backlash is eliminated.



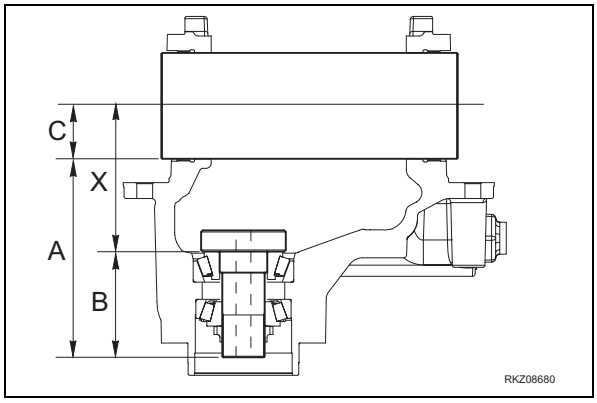
3 - Install special tool **E14** to the differential group supports (9).



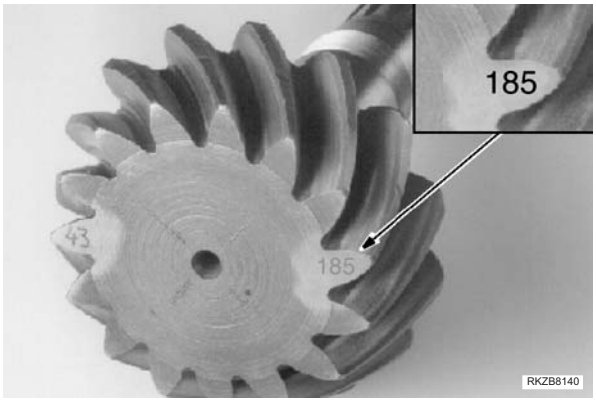
4 - Use a depth gauge to measure distance "**X**" (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).



5 - To adjust bevel gear/pinion measure the distance "**A**" with a depth gauge.
Calculate the value "**X**" as follows:
X =(A+C)-B mm
where "**B**" and "**C**" are known.



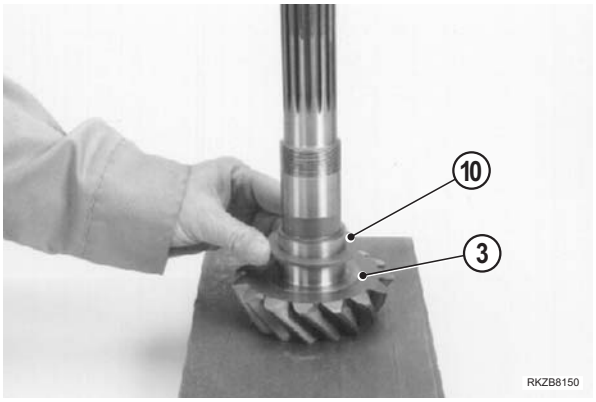
6 - In order to determine the necessary thickness value (**S**) between the pinion and the bearing, subtract the value (**V**), stamped on the pinion head (**V**=requested distance), from the measured value (**X**).
S = (X–V) mm



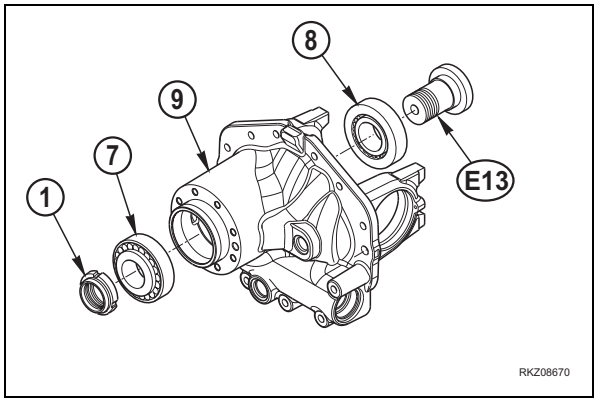
7 - Select the shim with the thickness value (S) among the range of available shims (10), and fit to shaft under the pinion head.

★ The chamfer on the ID of the shim (10) must be toward the pinion gear (3).

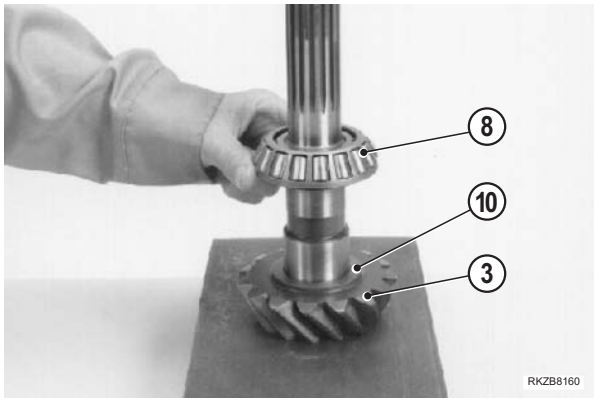
SHIM RANGE										
Shims	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4



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).

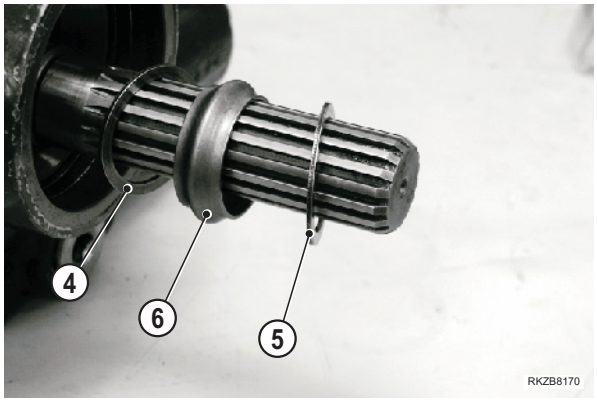


9 - Select a suitable shim (10) and install **with the chamfer facing the gear**, then install bearing inner ring (8) to pinion (3) with the help of a press and tool **E3**, and check to ensure that it fits snugly in place.

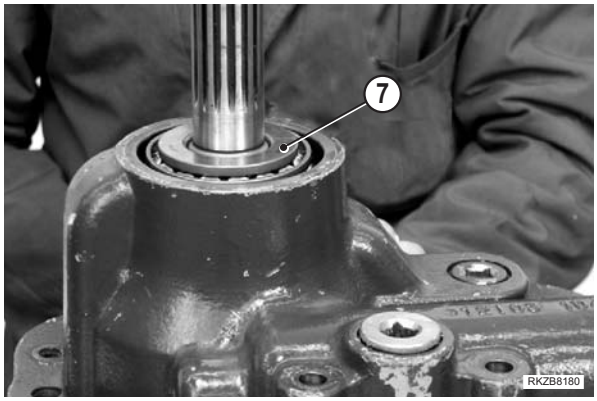


10 - Install the washers (4) and (9) and a new collapsible spacer (6) on the pinion gear (3).

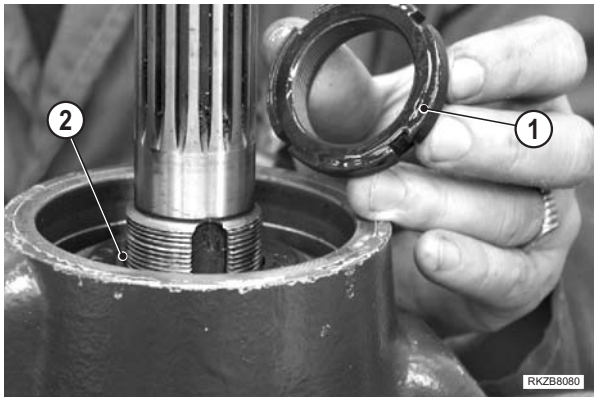
★ Use always a new collapsible spacer (6).



11 - Install bearing outer ring (7) to pinion end.
To install bearing (8), use special tool **E3** and a hammer.



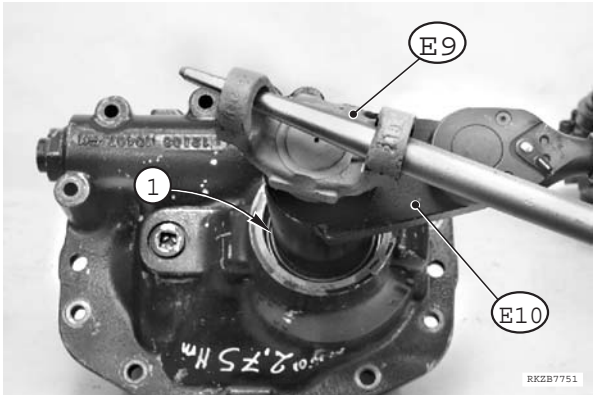
12 - Insert a ring nut washer (2) and screw a new lock ring nut (1) on the pinion end.



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).



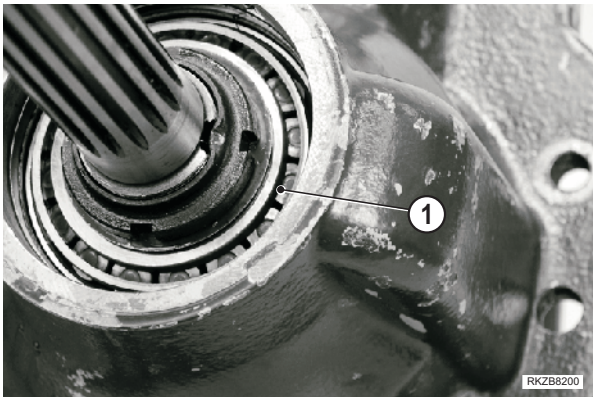
14 - To measure the rolling torque (Pr) of tapered bearings (7) and (8), use a torque wrench and tool **E9**. Adjustment is carried out by gradually increasing the tightening torque of ring nut (1), paying attention not to overtighten.

★ 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).



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SHOVEL PPC VALVE

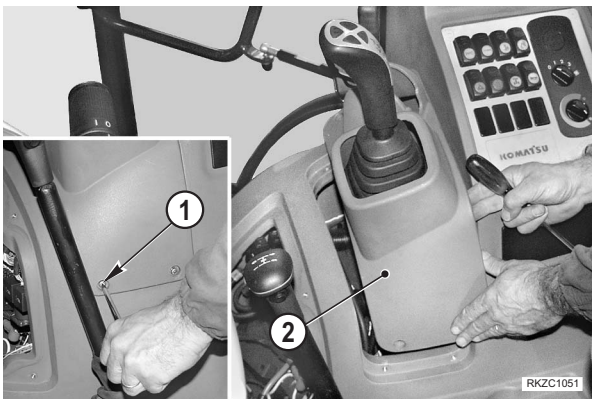
Removal

⚠ 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).

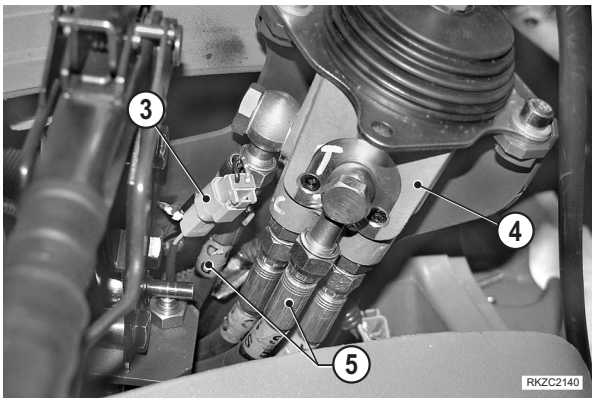


2 - Disconnect the connector (3).

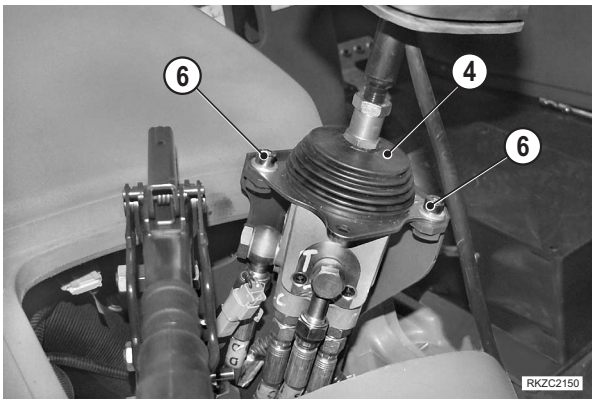
3 - Disconnect five hoses (5) from PPC valve (4).

★ 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).

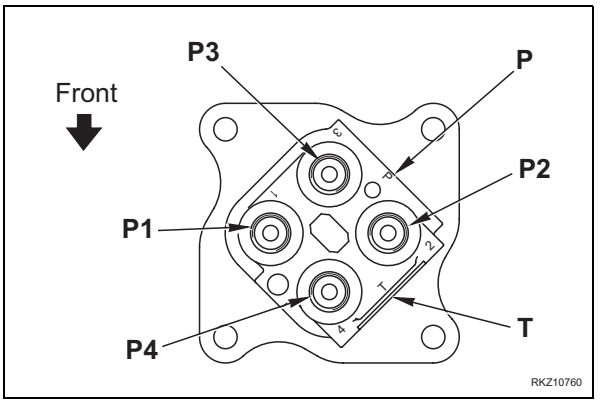


Installation

- To install, reverse removal procedure.

[*1]

★ Carefully inspect the hoses for the proper position when connecting them.
(For details, see "10 STRUCTURE AND FUNCTION").

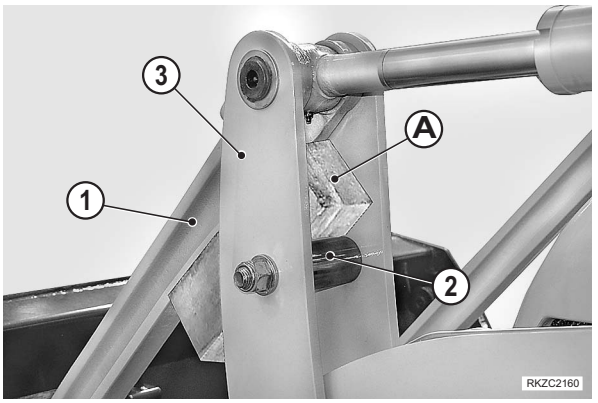


SHOVEL LIFT CYLINDERS

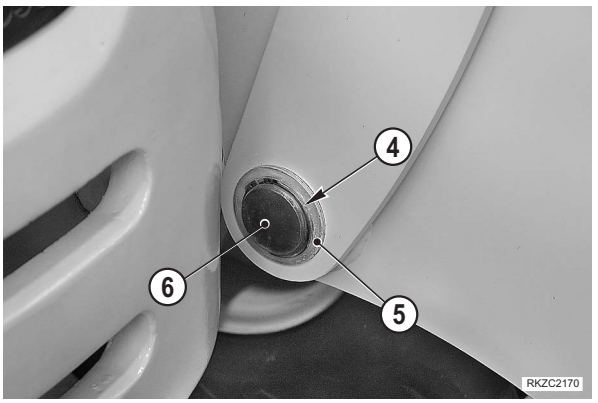
Removal

⚠ 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).



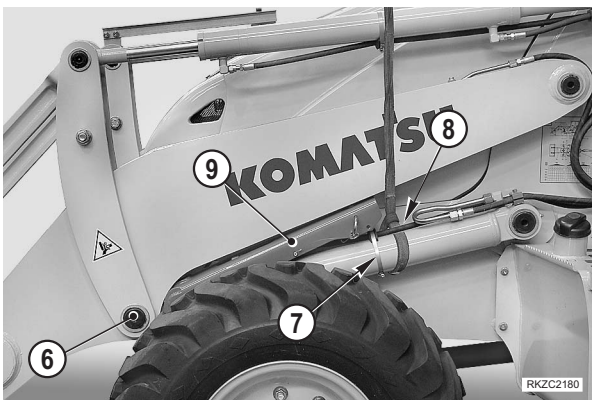
3 - Remove the tie strap (7) retaining the piston return hose (8).

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.

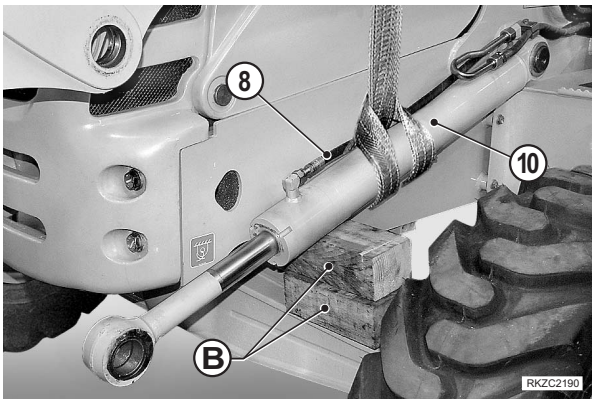


7 - Lower cylinder (10) until it rests on blocks "**B**".

8 - Start the engine to retract the piston.

[*1] [*2]

⚠ Stop the engine and eliminate residual pressure.



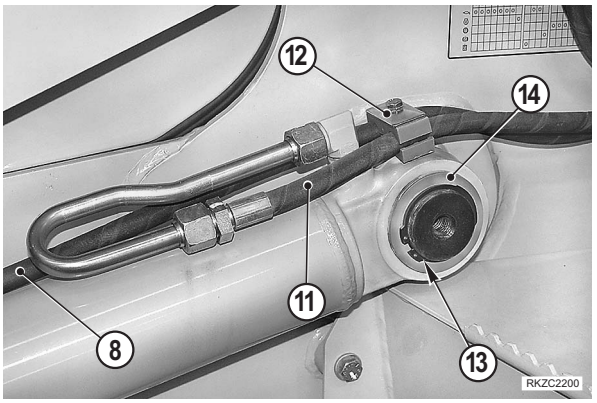
8 - Remove hoses (8) and (11), and remove hose clamp (12).

★ 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).

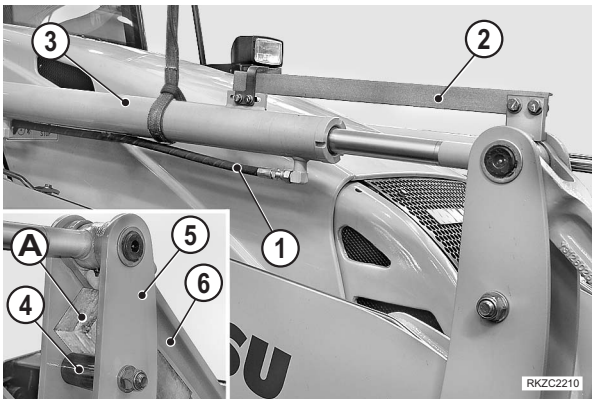
For the right-hand cylinder only

★ 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.



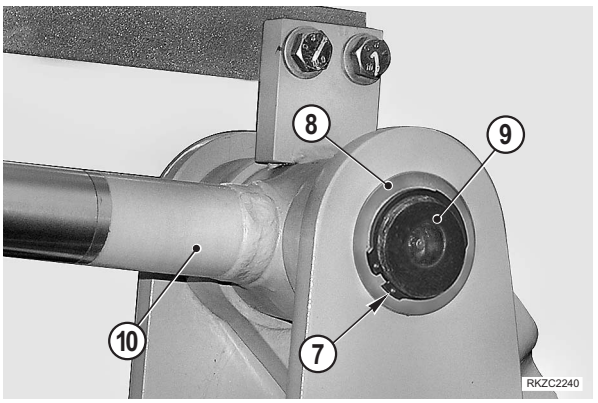
4 - Take off the snap-ring (7) and the internal retaining spacer (8) for the piston attachment pin (9).

5 - Extract pin (9) to expose piston eye.

6 - Start the engine to retract the piston(10).

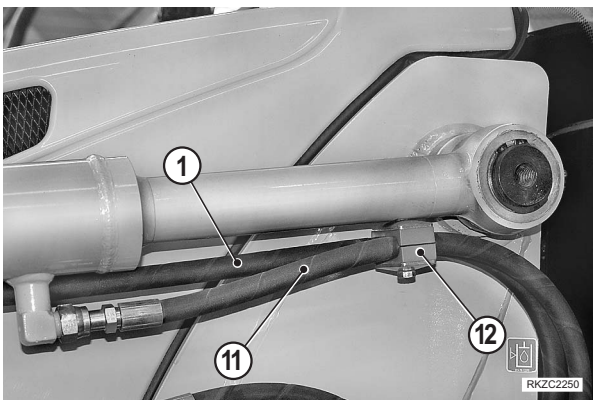
[*1] [*2]

⚠ 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.

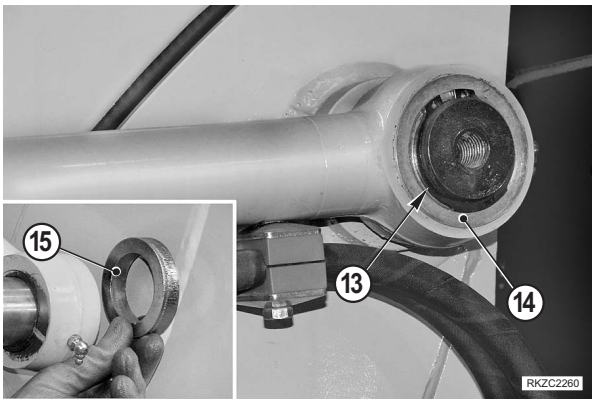


8 - Remove the snap-ring (13) and the spacer (14).

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

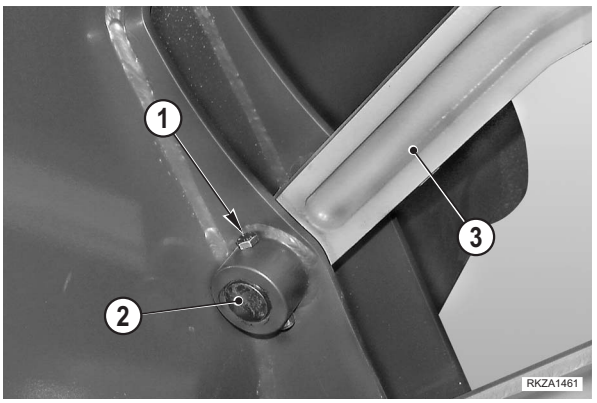
Removal



⚠ Lower the shovel to the ground, resting on its back, but without forcing it downwards.

1 - Stop the engine and release residual pressures.

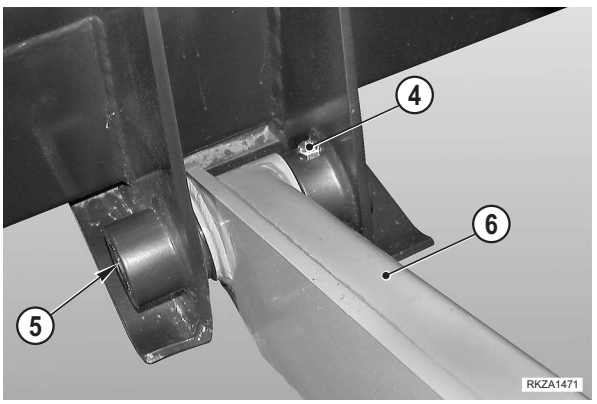
2 - Take out the screws (1) and remove the pins (2) of the lever (3).
Rest the lever (3) on the boom. [*1] [*2]



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

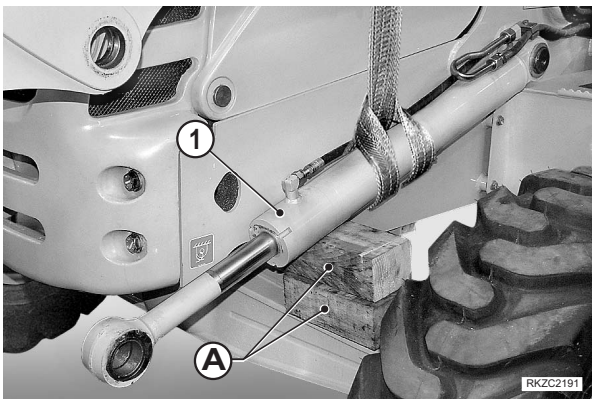
⚠ Lower the working equipment completely until it rests on the ground stop the engine and remove the ignition wrench.

⚠ Release all residual pressure in all circuits.
(For details, see "20 TESTING AND ADJUSTMENTS").

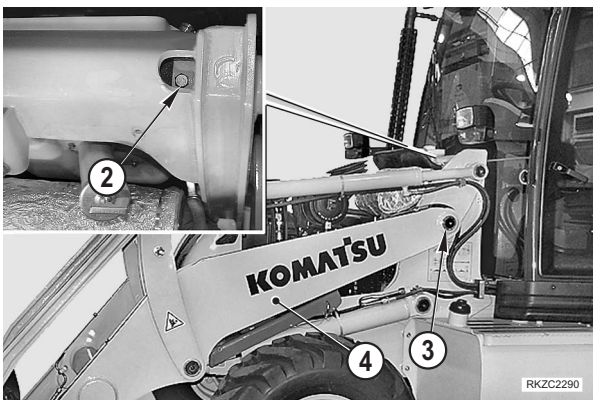
1 - Remove the tilt cylinders. (See "SHOVEL DUMP CYLINDERS").



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.



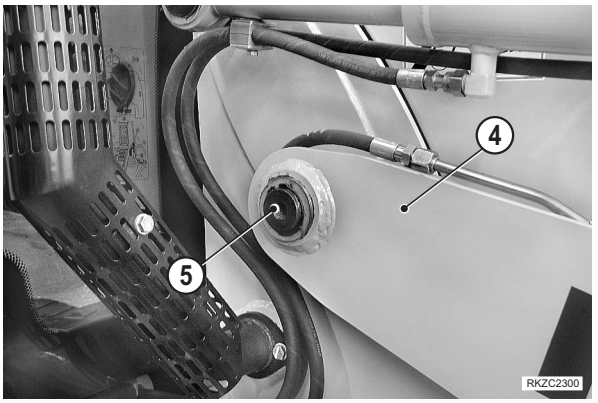
5 - Using a puller, remove the oscillation pins (5) of the arm (4) together with snap ring and spacer.
[*1] [*2]

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 (Optional)

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.

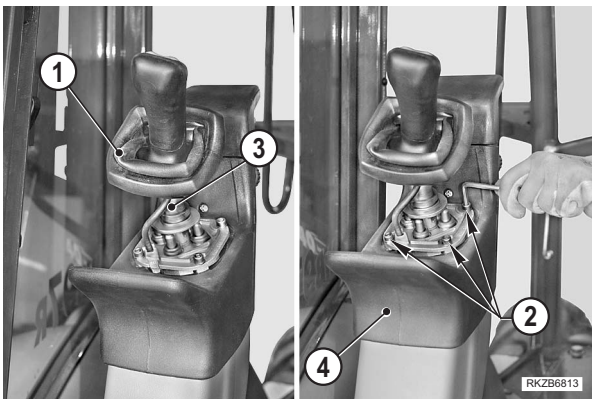
⚠ Release all residual pressure in all circuits. (For details, see "20 TESTING AND ADJUSTMENTS").

3 - Lift cab rear window up to the top.



4 - Fully raise the boot (1).

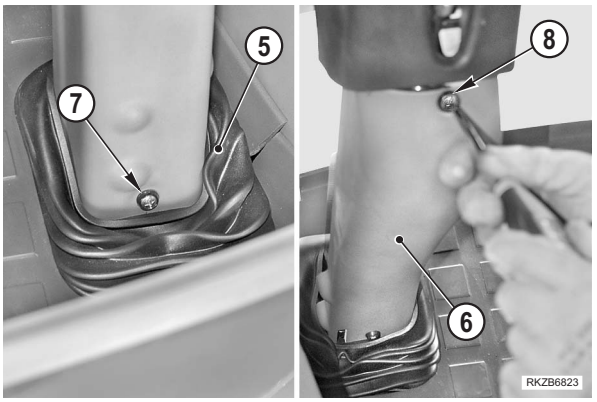
5 - Loosen and remove the screws (2) retaining the PPC valve (3) and armrest (4).



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).

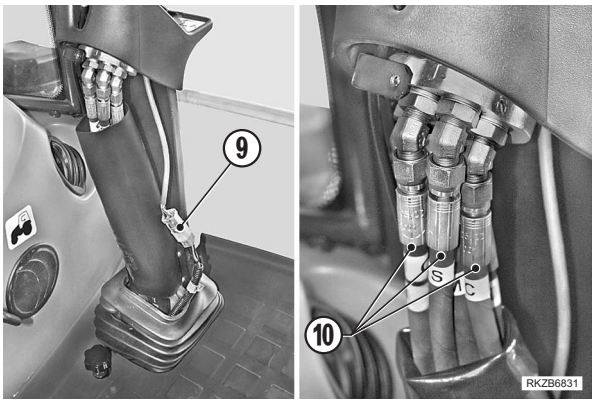


9 - Disconnect the connector (9).

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").

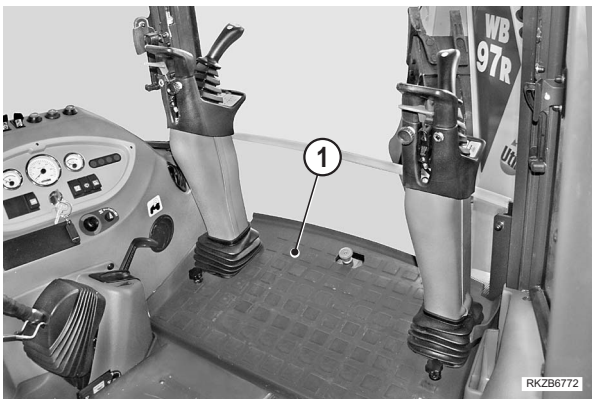
PPC VALVE SUPPORT RELEASE CABLES

Removal

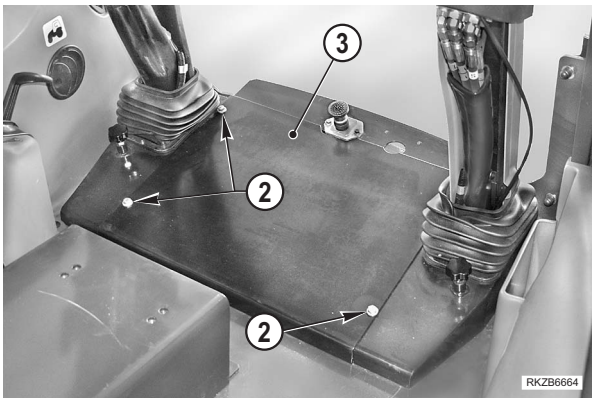
1 - Lower the outriggers and the equipment to the ground; stop the engine.



2 - Remove the rear mat (1).

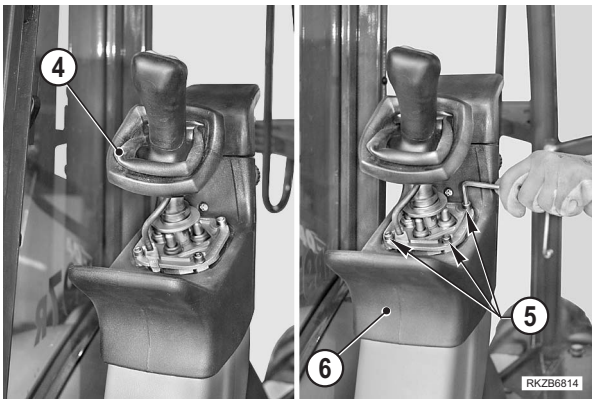


3 - Take out the screws (2) and remove the platform (3).



4 - Fully raise the boot (4).

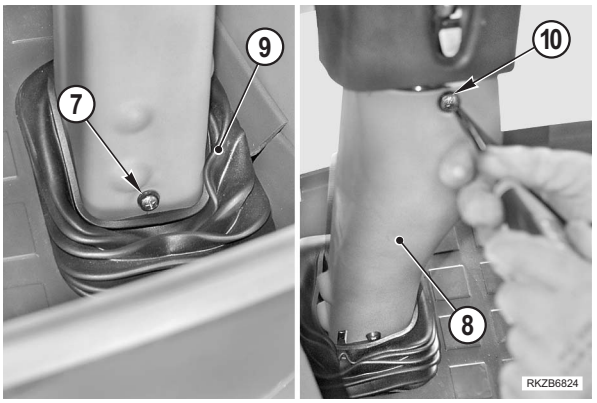
5 - Loosen and remove the screws (5) that retain the PPC valve and armrest (6).



6 - Raise the armrest from the rear side and remove the screw (7) retaining the rear guard (8).

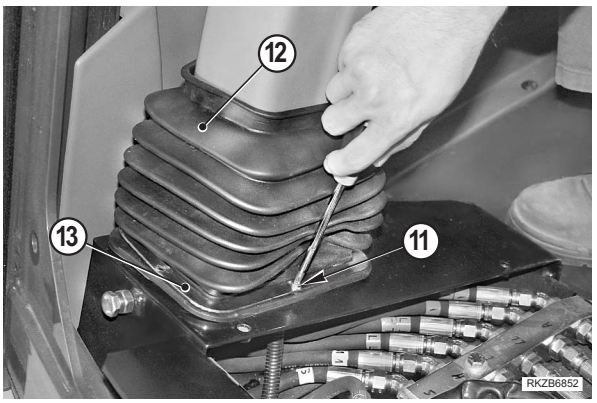
7 - Cut the retaining clamp and release the lower boot (9).

8 - Loosen and remove the screws (10) and remove the rear guard (8).



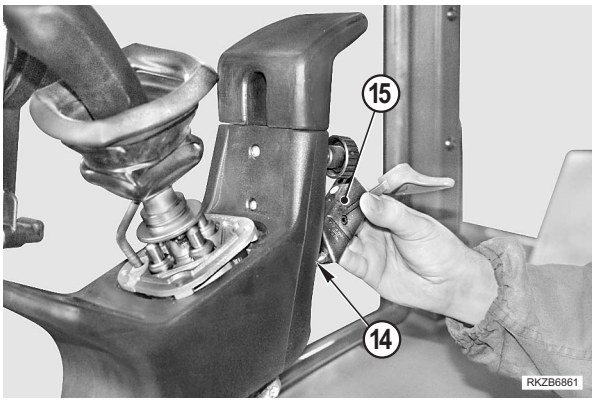
9 - Loosen and remove the screws (11) and raise the boot (12) and the retaining edge (13).

★ Raise until the lower fulcrum and locking assembly become fully disengaged.



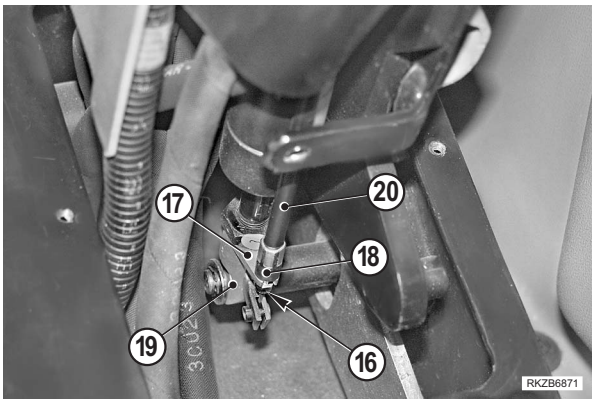
10 - Remove the retaining screws (14) from the lock-actuating lever assembly (15).

11 - Remove the entire lever assembly (15).

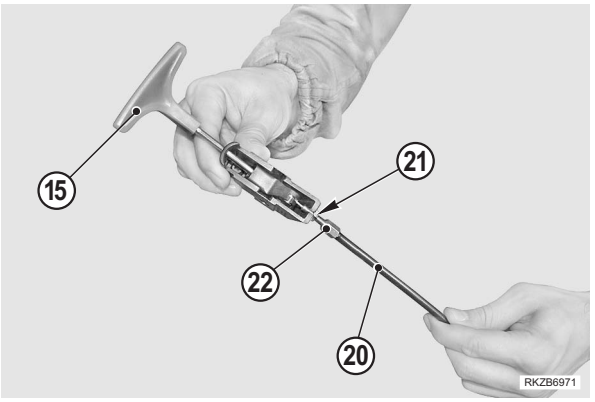


12 - Loosen the nut (16) and disengage the sheath (18) from the support (17).

13 - Disconnect the cable (20) from the lower locking lever (19).



14 - Loosen the nut (21) and unscrew the tensioner (22); disengage the control cable (20) from the release control lever (15).

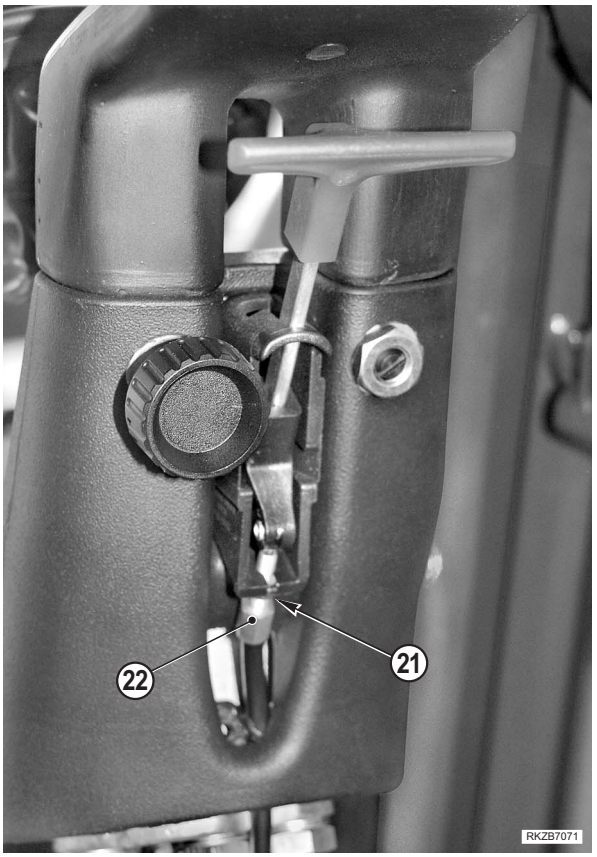


Installation and adjusting

- 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).



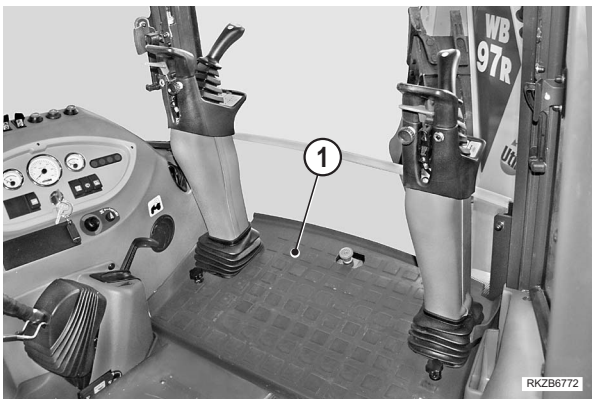
PPC VALVE SUPPORT RETURN GAS SPRING

Removal

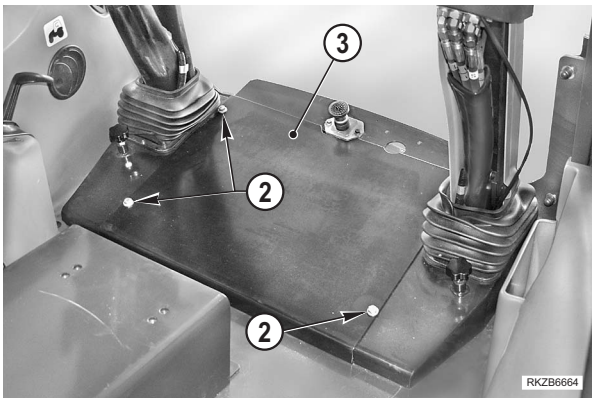
1 - Lower the outriggers and the equipment to the ground; stop the engine.



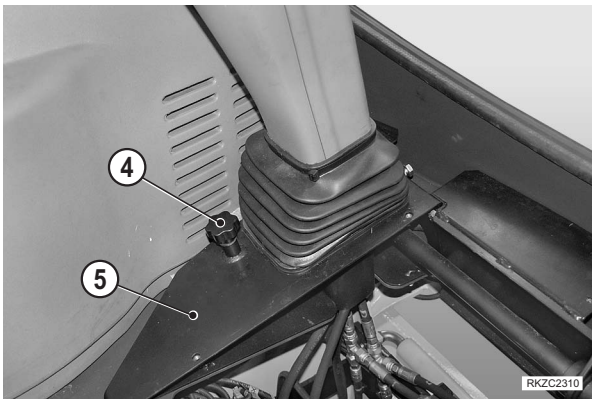
2 -Remove the rear mat (1).



3 -Take out the screws (2) and remove the platform (3).

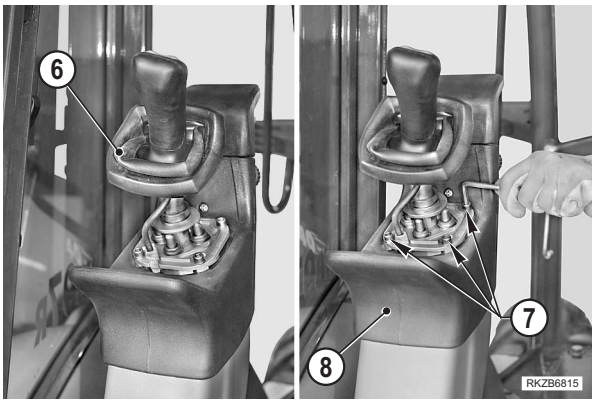


4 -Fully loosen the stop knob (4) of the PPC valve support (5) you are working on.



5 - Fully raise the boot (6).

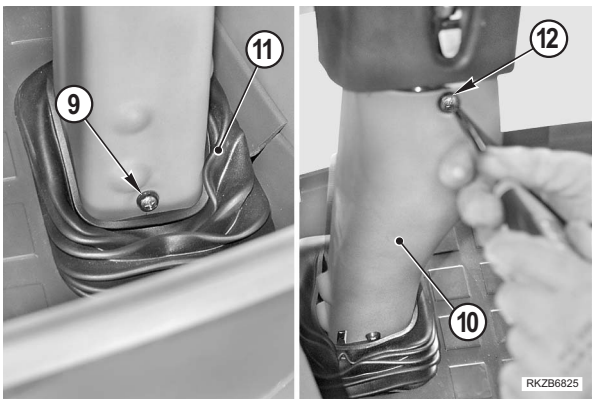
6 - Loosen and remove the screws (7) that retain the PPC valve and armrest (8).



7 - Raise the armrest from the rear side and remove the screw (9) retaining the rear guard (10).

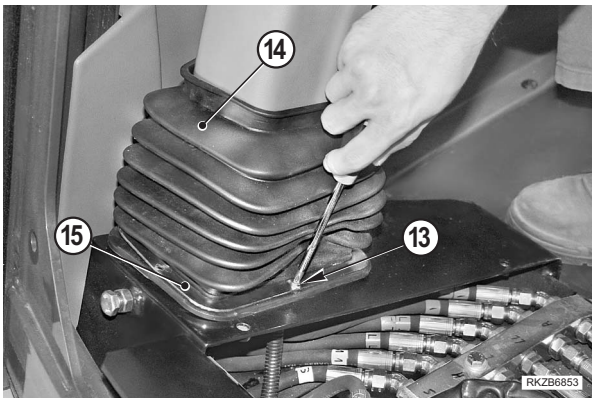
8 - Cut the retaining clamp and release the lower boot (11).

9 - Loosen and remove screw (12), and remove rear guard (10).



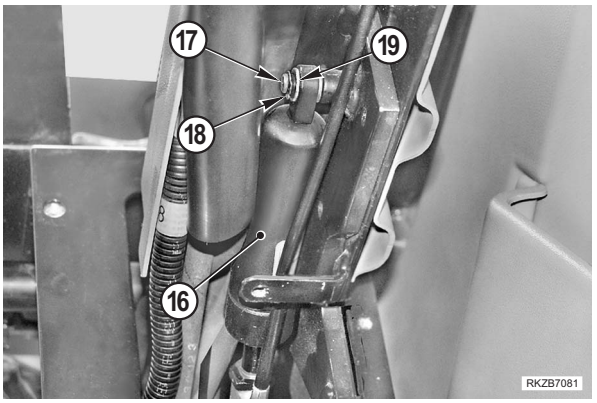
10 - Loosen and remove the screws (13) and raise the boot (14) and the retaining edge (15).

★ 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)

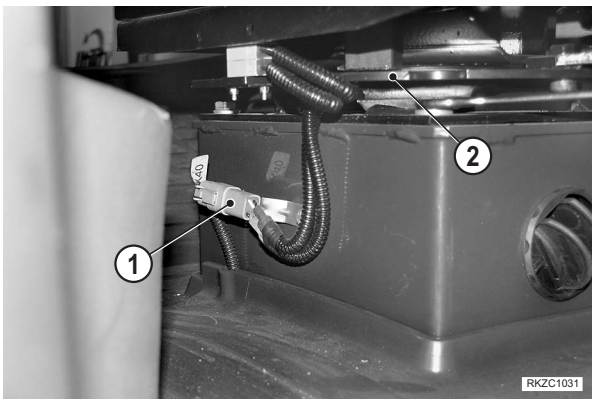
Removal

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.

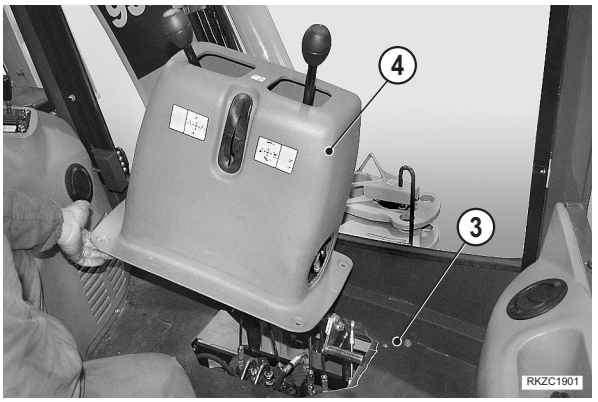


2 - Disconnect the connector (1) and remove the seat (2).



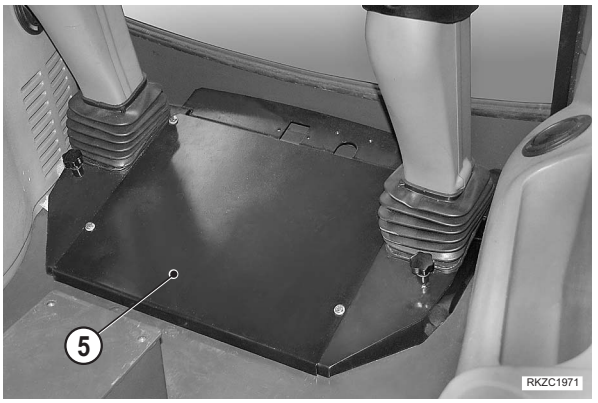
Standard version

3 - Remove rear mat, optional device control pedals (if any), hood (3), and the metal sheet closing off the floor (4).



Version with backhoe servocontrols

3a - Remove the rear mat and remove the metal sheet (5) closing off the floor.



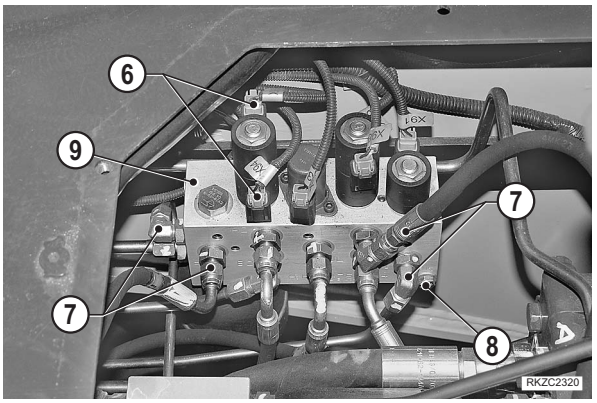
4 - Disconnect all connectors (6) from the solenoid valves .

★ Check to ensure that all connectors have marks scribbled on, and note down their plugging positions.

5 - Mark and disconnnect all hoses (7).

★ Cap pipes, hoses and holes to prevent contamination.

6 - Loosen and remove two screws (8) and washers; remove the solenoid valve group (9) together with the accumulator.



Installation

• To install, reverse removal procedure.

1 - Start the engine and perform all possible manoeuvres to eliminate the air from all circuits.

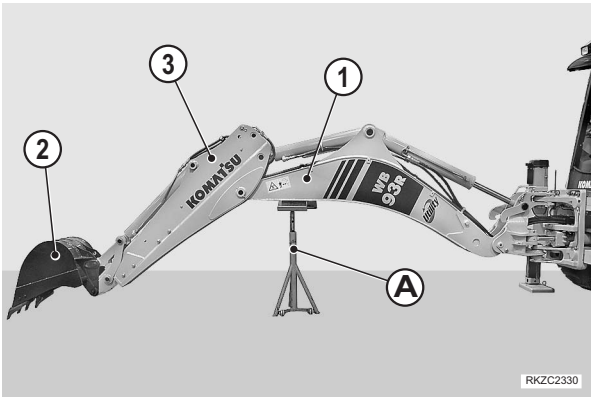
BACKHOE BOOM CYLINDER

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.

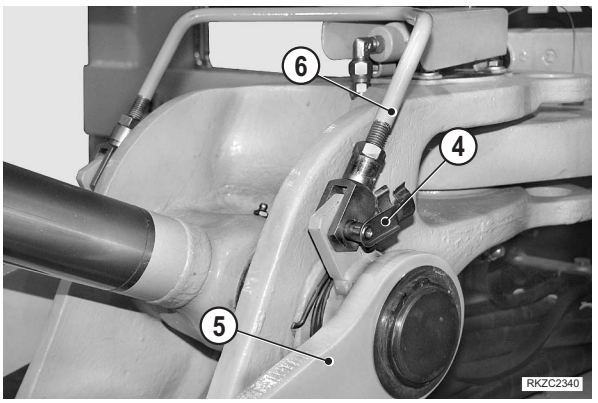
3 - Lower the arm until the bucket teeth touch the ground.



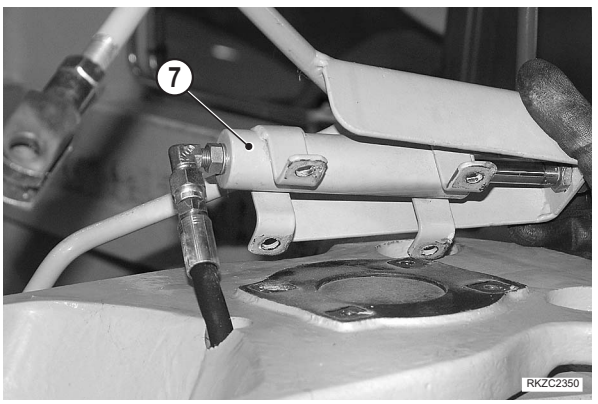
4 - Lower the outriggers to the ground, apply the parking brake, and stop the engine.

⚠ Release residual pressure from all circuits by operating the control levers in all directions.

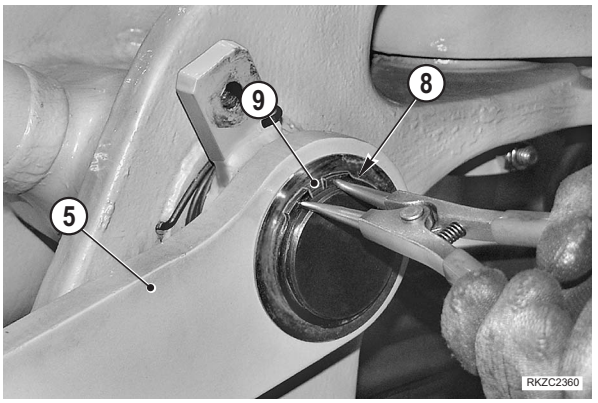
5 - Remove pins (4) and disconnect tie rod (6) from boom retaining lever (5).



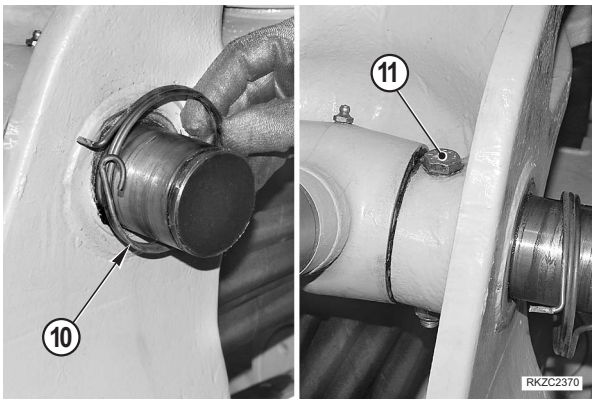
6 - Loosen and remove the screws, remove the group (7) controlling the levers (5) and position it aside.



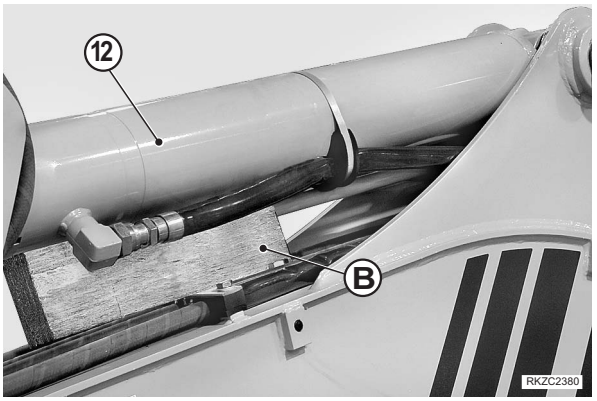
7 - Remove snap rings (8), shims (9), and levers (5).



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.

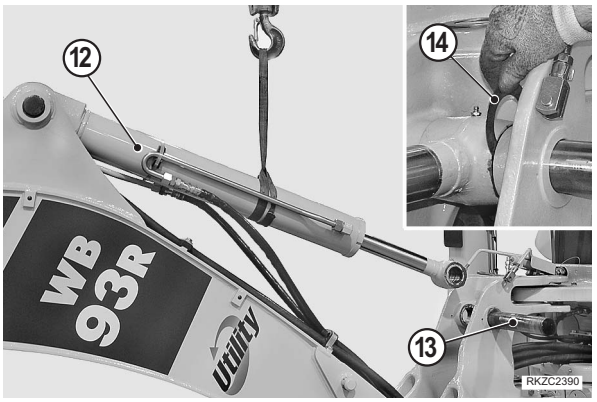


10 - Sling the cylinder (12) in a band and connect it to a hoisting device; apply a slight tension.

★ Do not engage the hoses with the band.

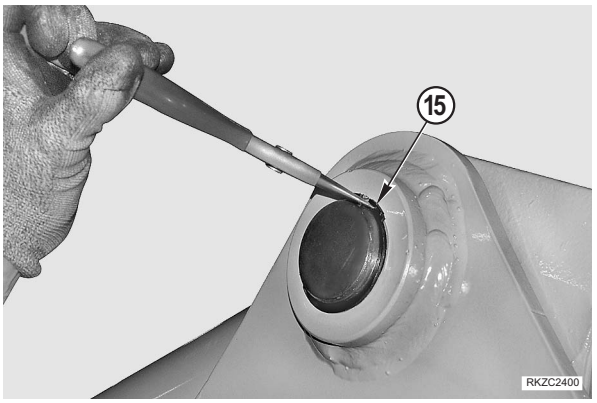
11 - Pull out pin (13) and recover spacers (14).

[*1] [*2]



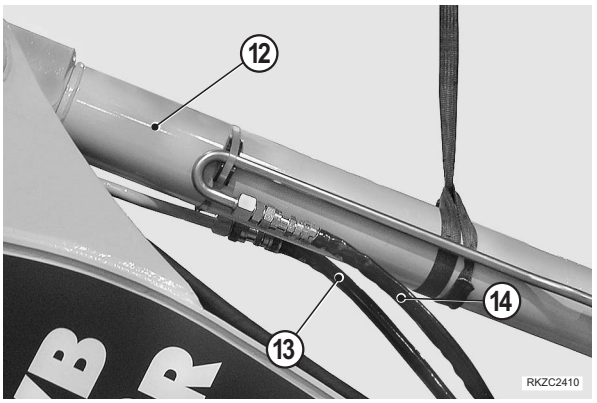
12 - Start the engine and retract the piston.
Stop the engine and release residual pressures.

13 - Remove snap ring (15).



14 - Disconnect hoses (13) and (14) from cylinder (12).

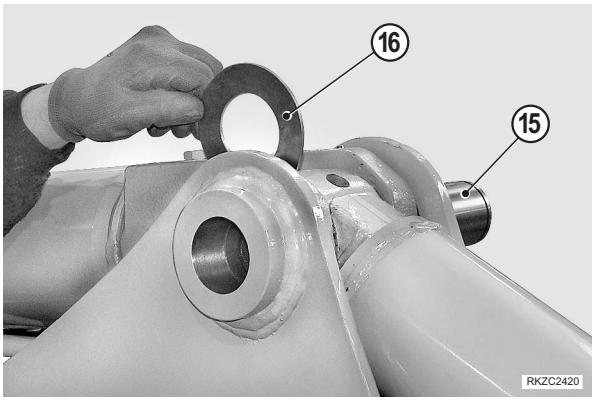
★ Cap pipes, hoses and holes to prevent contamination.



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

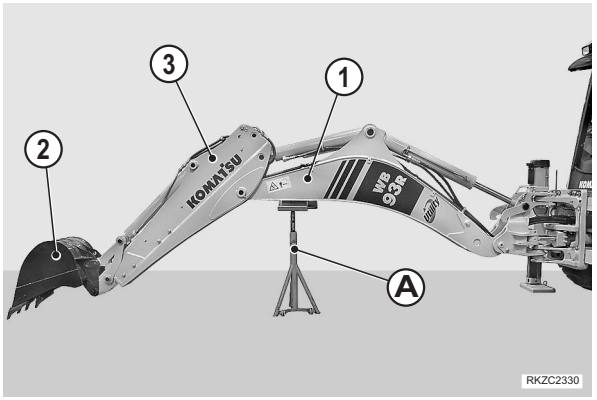
1 - Fully extend the arm (1) and fully open the bucket (2). Manoeuvre the boom until the outer end of the boom is in a level position.

2 - Place and force a jack stand "**A**" and a non-slip block under the boom.

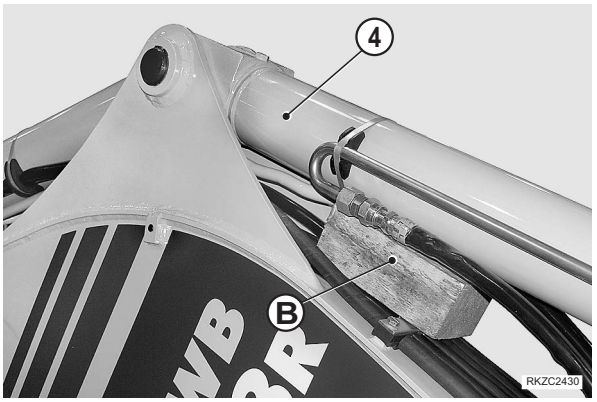
3 - Lower arm (3) until bucket teeth touch the ground.

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).

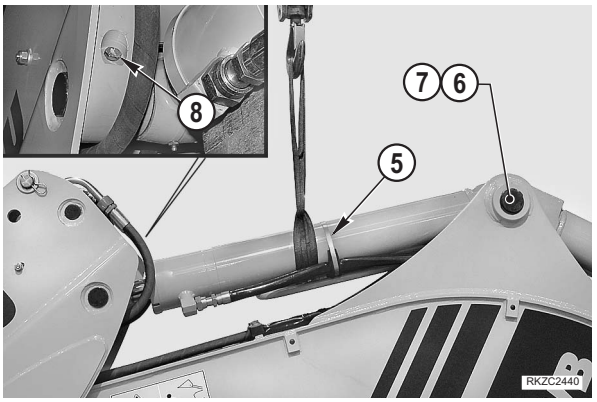


6 - Remove the strap (5) retaining the hoses.

7 - Sling the cylinder (4) in a band and connect it to a hoisting device; apply a slight tension.

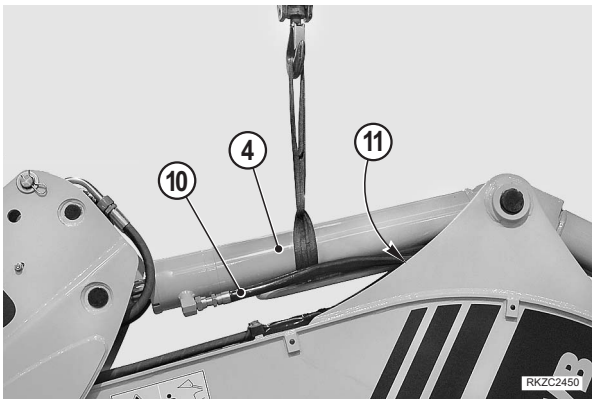
★ Do not engage the hoses with the band.

8 - Remove the snap ring (6) retaining the cylinder fulcrum pin (7) and the screw (8) retaining the piston pin (9).

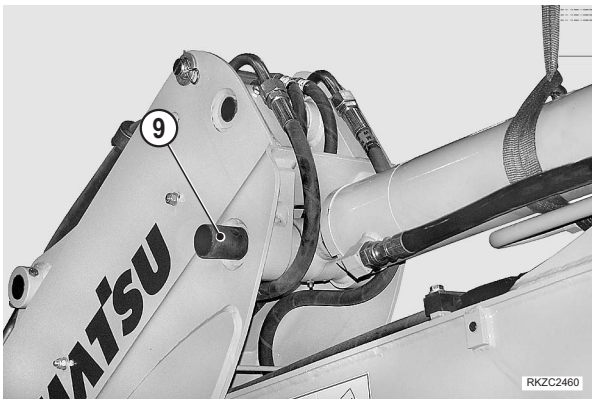


9 - Disconnect hoses (10) and (11) from cylinder (4).

★ Cap pipes, hoses and holes to prevent contamination.



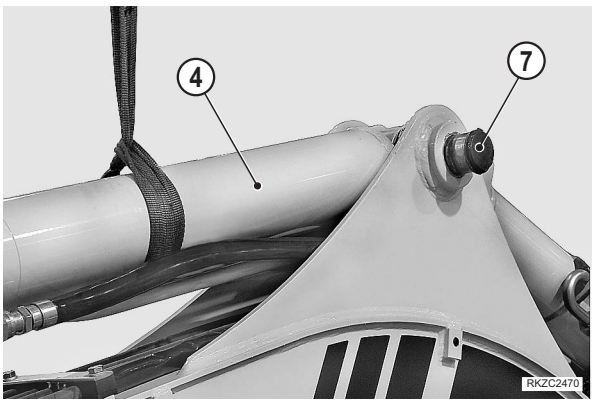
10 - Pull out the piston attachment pin (9). [*1] [*2]



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).

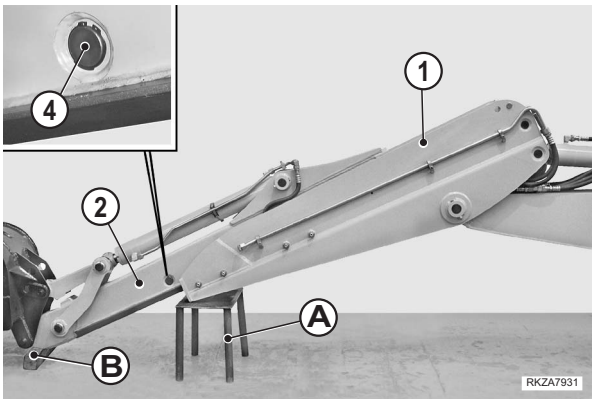
7 - Disconnect the tubes (6), (7), (8) and (9).

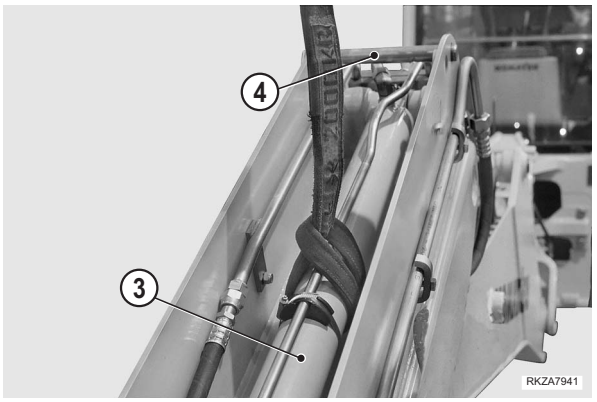
★ Cap pipes, hoses and holes to prevent contamination.

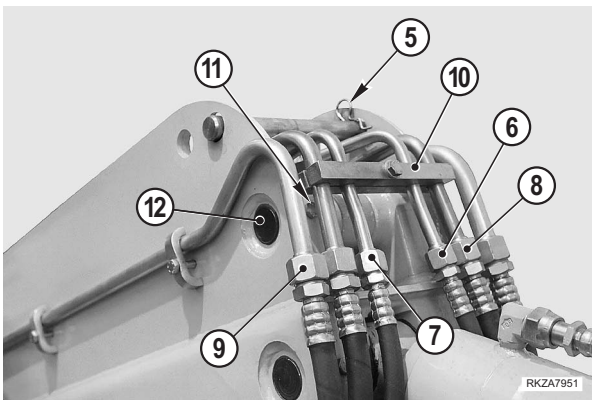
8 - Remove the clamp (10).

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").

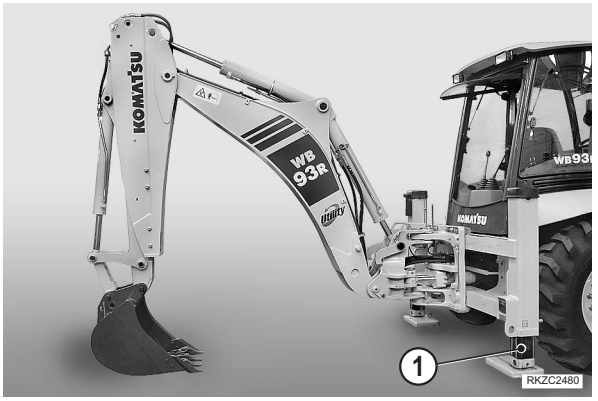
★ After bleeding the air, check the oil level in the tank.

OUTRIGGER CYLINDER

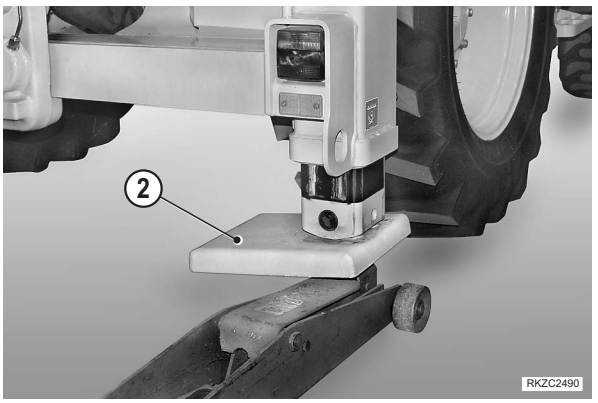
Removal

⚠ 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.



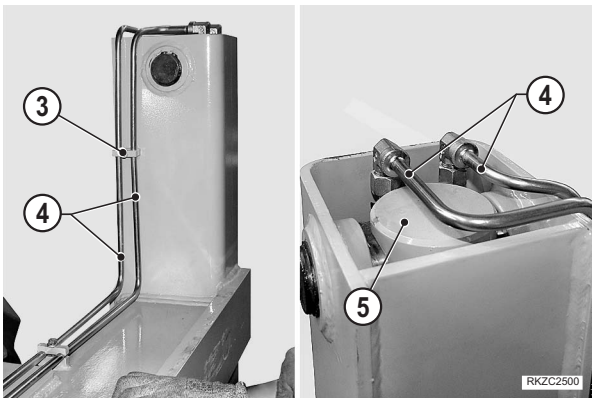
2 - Place a lifting platform "**A**" beneath outrigger (2) of cylinder to be remove.
Raise this until it is forced up against the outrigger.



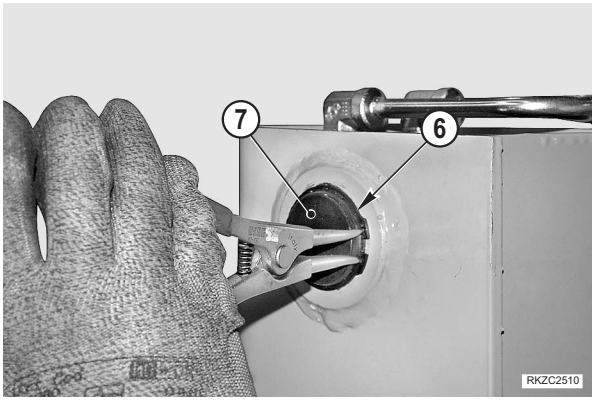
3 - Remove the clamps (3) retaining the pipes (4).

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]



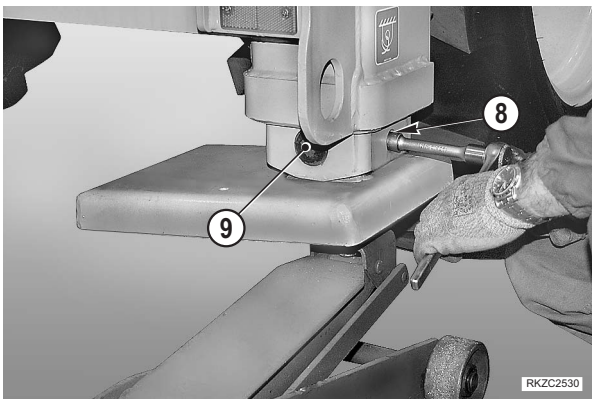
6 - Raise the lifting platform "**A**" to disengage the cylinder head (5) from frame.
Place a sling round the cylinder (5) and apply slight tension to the cables.



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

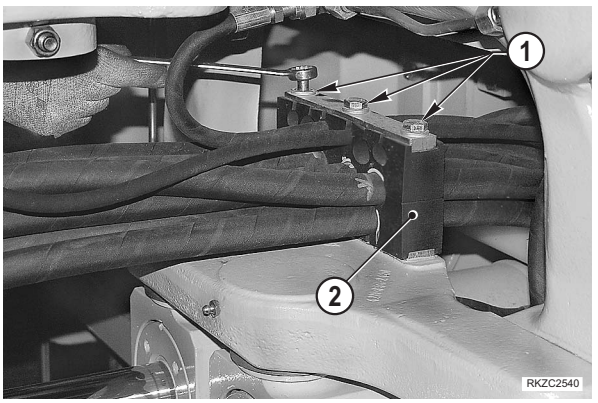
Removal

⚠ Set the backhoe with the centered attachments with the arm in vertical position and the bucket leaned on the back at level ground.

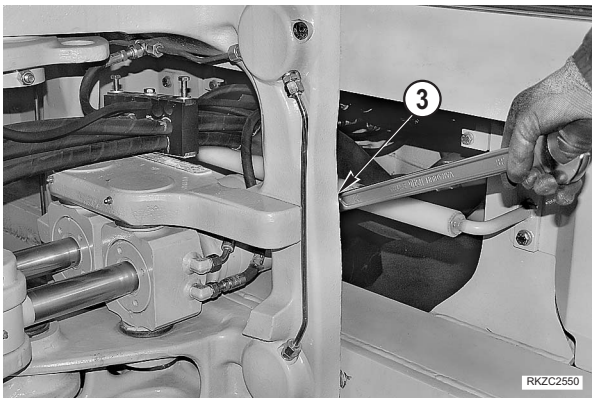
1 -Stop the engine and release all cylinder pressure by moving the lockout control several times.



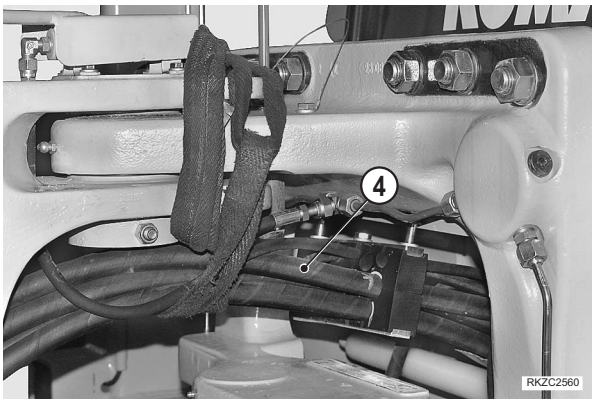
2 -Loosen and remove screws (1) and release hose clamp (2).



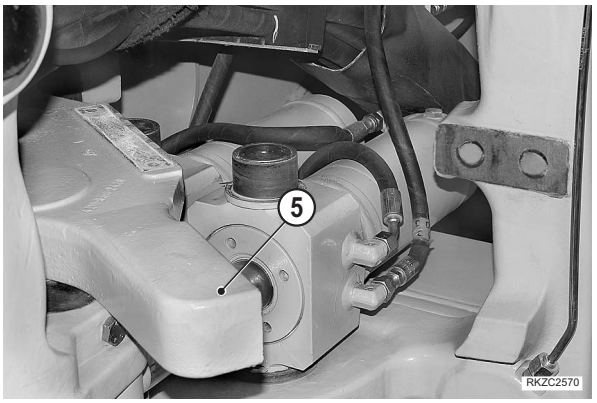
3 -Loosen and remove the four screws (3) and washers. [*1]



4 -Lift the hoses (4) to the backhoe cylinders and retain them in position with a band.

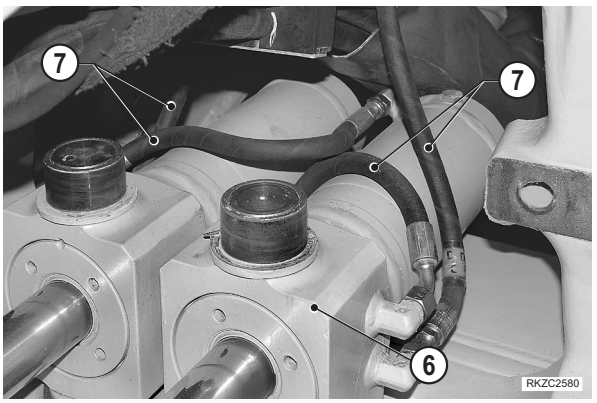


5 - Remove the upper support (5) with a vertical movement. [*3]



6 - Disconnect four tubes (6) from cylinders (7).

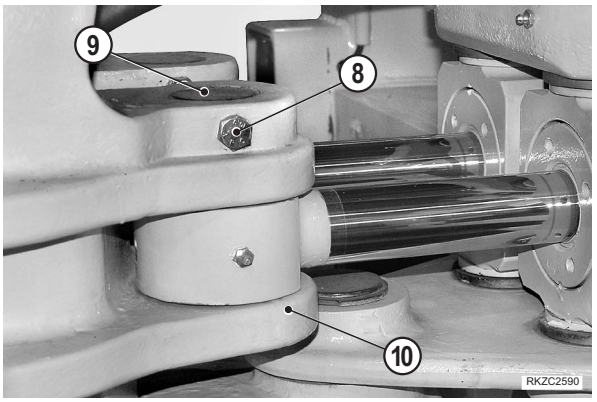
★ Cap pipes, hoses and holes to prevent contamination.



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



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]

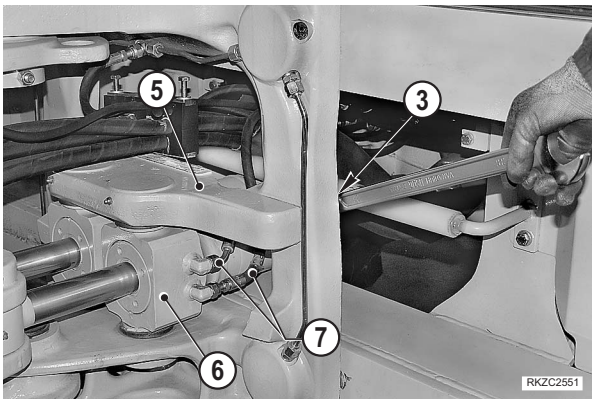
When aligning the positions between the hole and the pin, turn the engine over at low idling speed.
Do not insert fingers into the holes to check alignment.

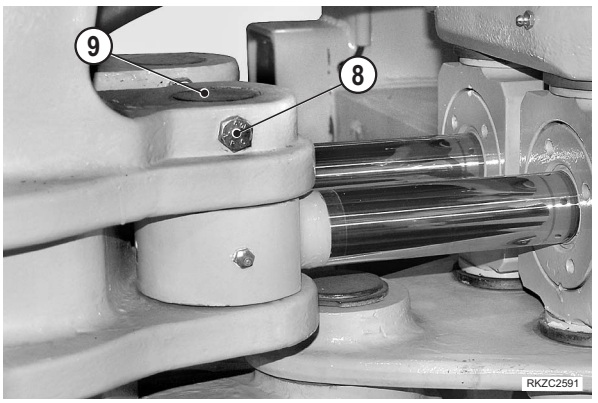
[*3]

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

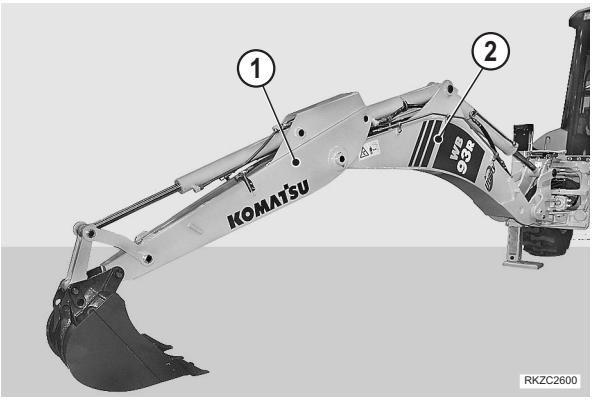
Removal

1 - Extend the arm (1).

2 - Operate the boom (2) and bucket (3) until bottom of bucket sits level.

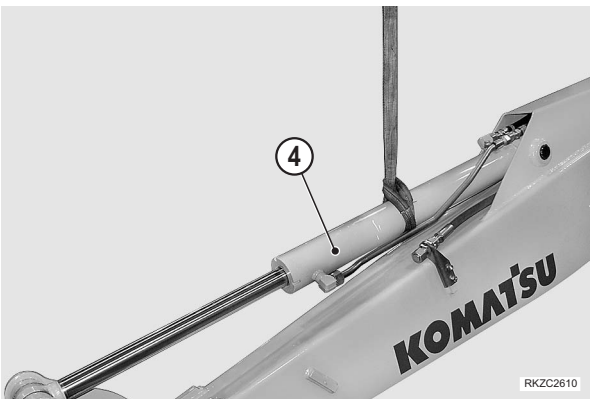
3 - Lower the outriggers to the ground, apply the parking brake, and stop the engine.

⚠ 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.

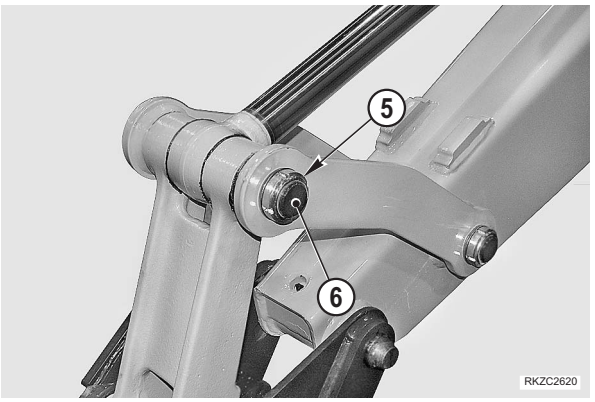
★ Do not engage the hoses with the band.



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.

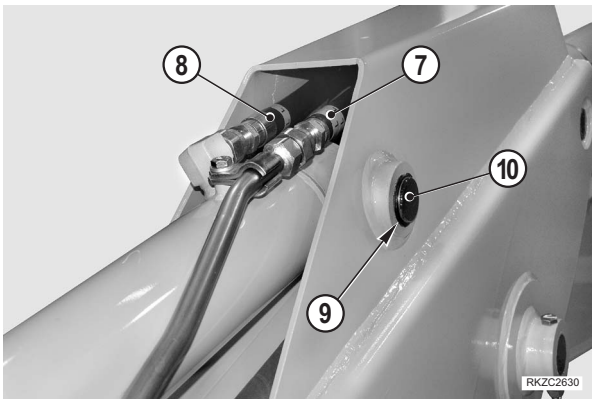
⚠ Stop the engine and release residual pressures.



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]

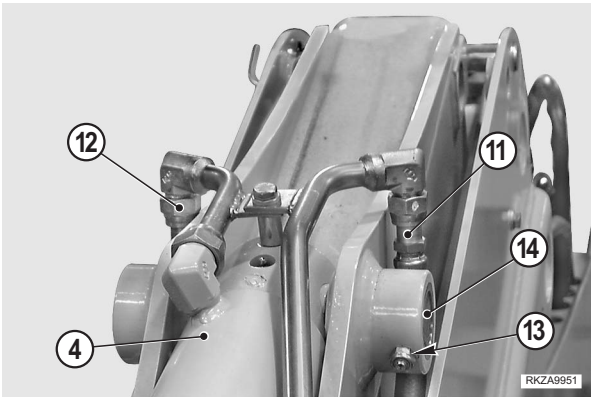


Versions with jig arm only

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

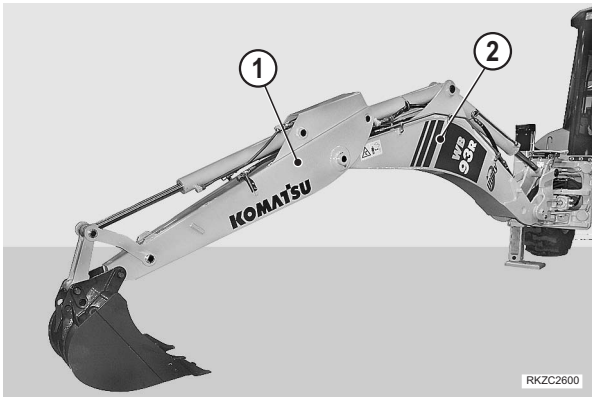
Removal

1 - Extend the arm (1).

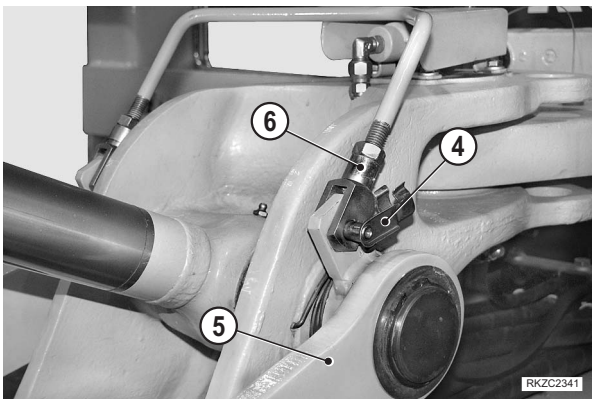
2 - Operate the boom (2) and bucket (3) until bottom of bucket sits level.

3 - Lower the outriggers to the ground, apply the parking brake, and stop the engine.

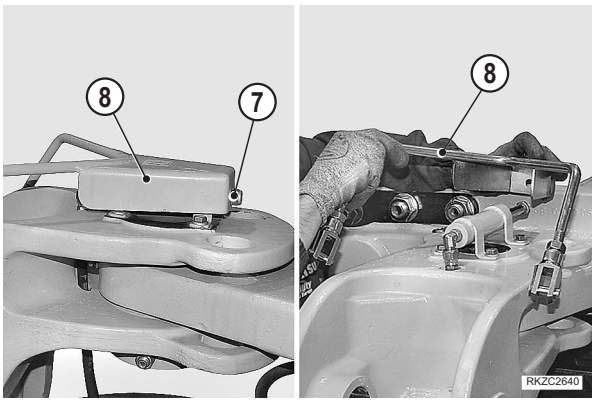
⚠ Release residual pressure from all circuits by operating the control levers in all directions.



4 - Remove pins (4) and disconnect yokes (6) from boom retaining levers (5).



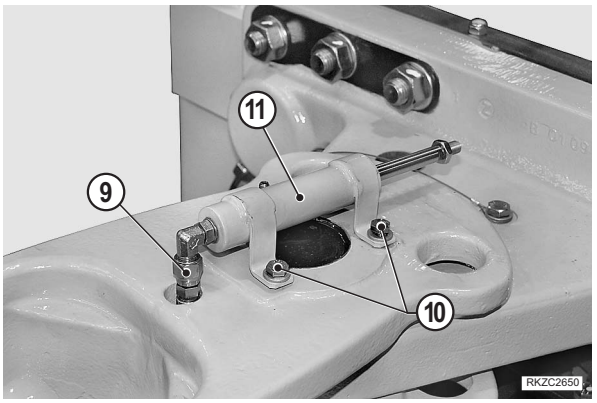
5 - Loosen and remove nut (7) and remove tie rod (8).



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.

BACKHOE WORKING EQUIPMENT

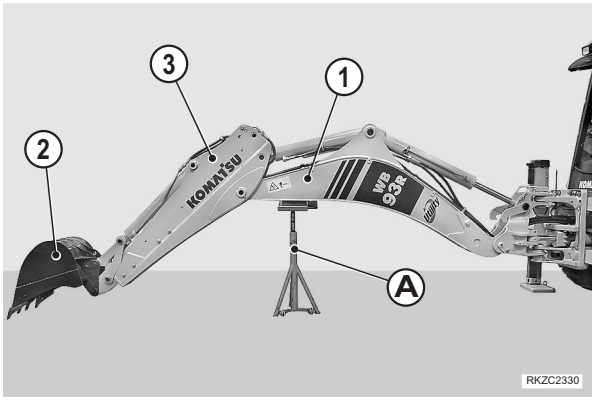
Removal

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).

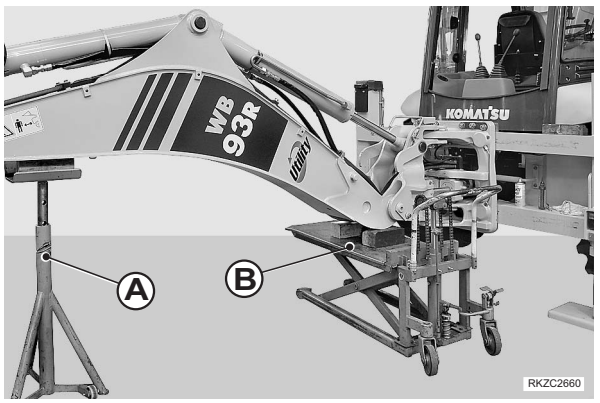
3 - Lower the arm until the bucket teeth touch the ground.

4 - Lower the outriggers to the ground, apply the parking brake, and stop the engine.

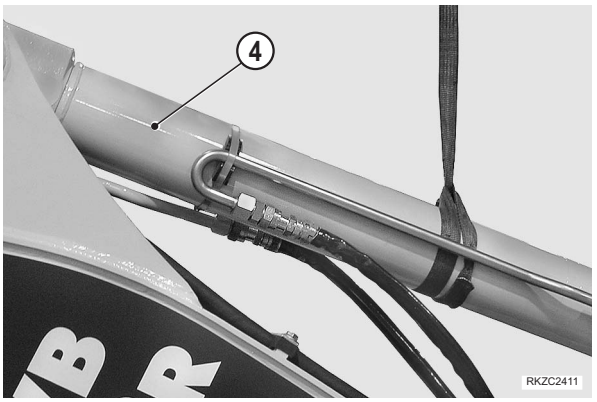


⚠ Release residual pressure from all circuits by operating all hydraulic controls in all directions.

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.



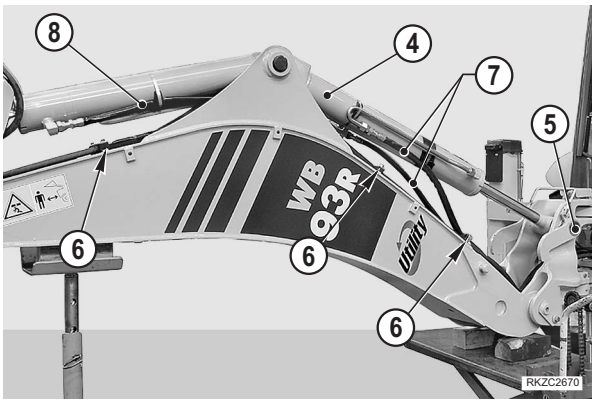
7 - Pull out the piston attachment pin (5).

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.



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

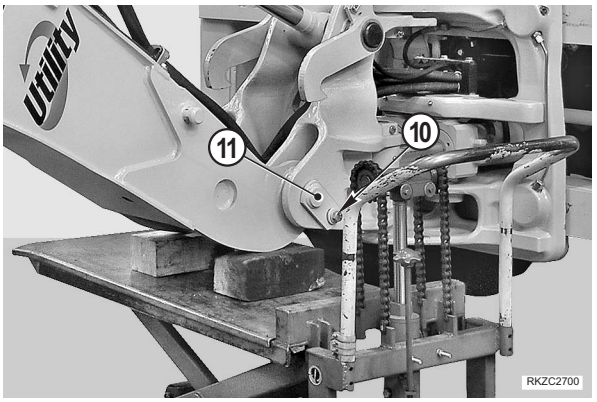


12 - Remove the screw (10) and the pin (11).

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

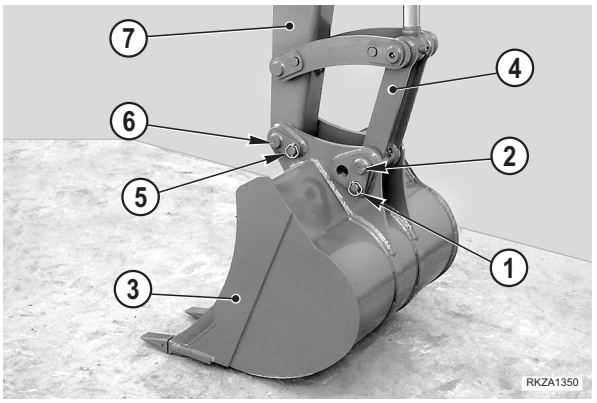
• To install, reverse removal procedure.

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]

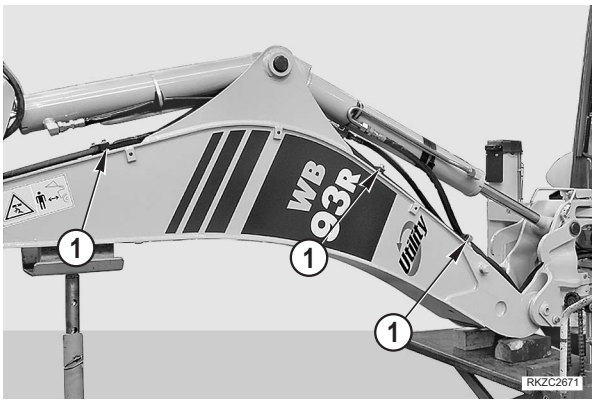
⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling speed.
Do not insert fingers into the holes to check alignment.

[*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.

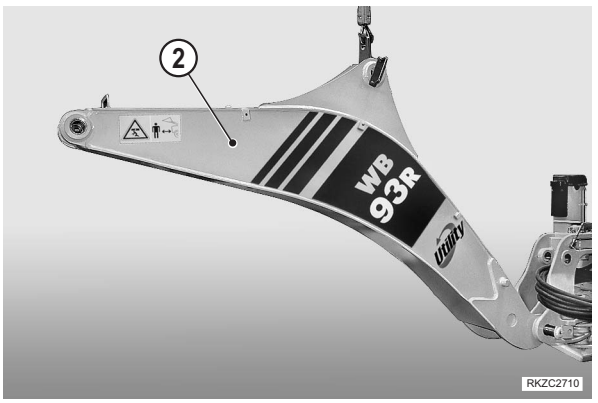
6 - Hook the boom (2).

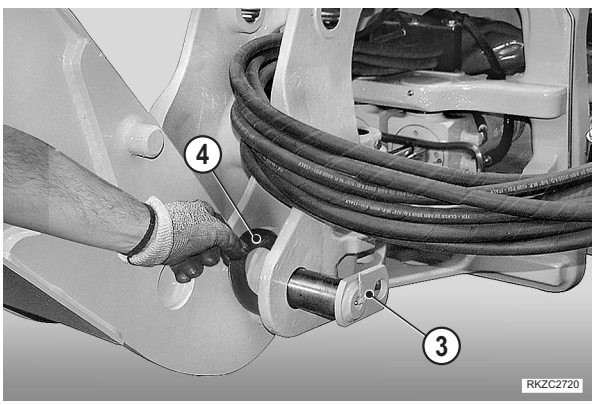
7 - Take out the retaining screw and remove the pin (3). [*1] [*2]

★ 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.

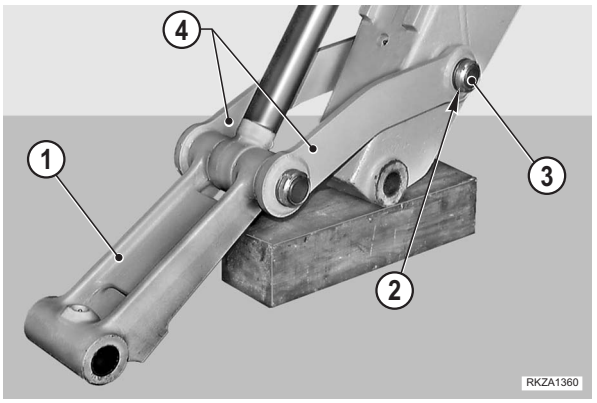
10 - Connect the arm (8) to the hoisting device and apply a slight tension to the cable.

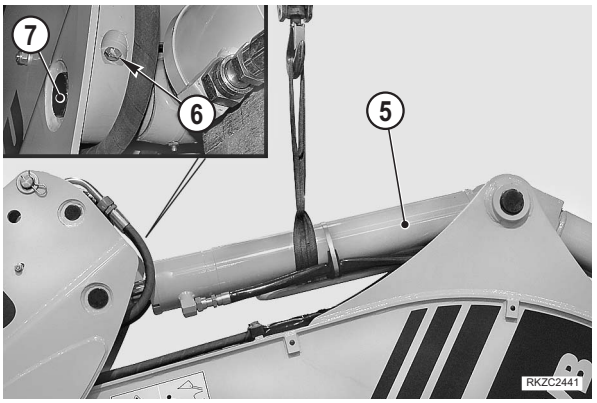
11 - Take out the screws (9) and remove the pin (10). [*1] [*2]

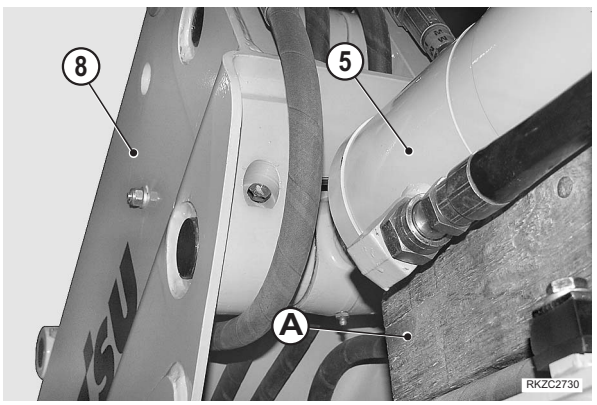
★ Recover the shims.

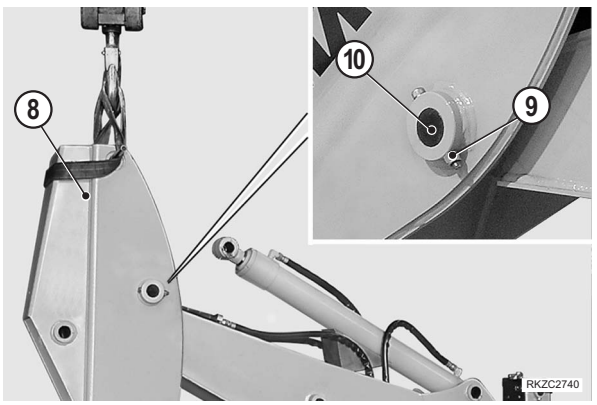
12 - Remove the arm (8).

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.

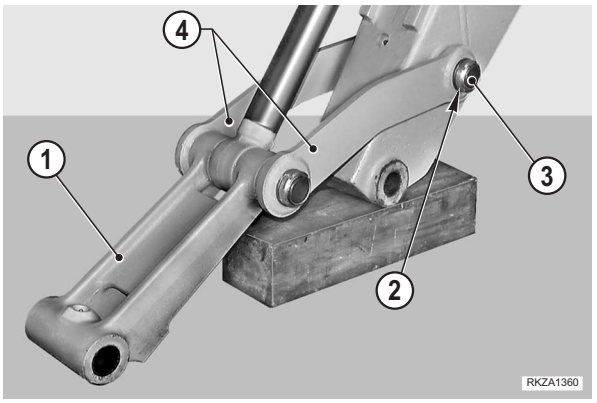
JIG ARM

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]



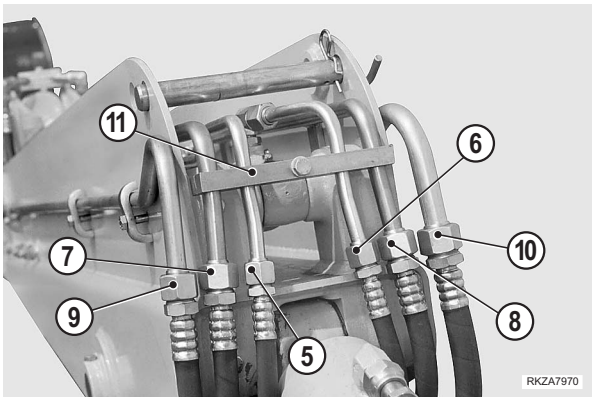
4 - Disconnect the jig arm hoses (5) and (6), the bucket cylinder hoses (7) and (8), and the hoses of the auxiliary equipment (9) and (10).

★ 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). [*1] [*2] [*3]

5 - Connect the 2nd arm (7) to some hoisting tackle.

★ Use the bucket pin hole and the safety pin holes.

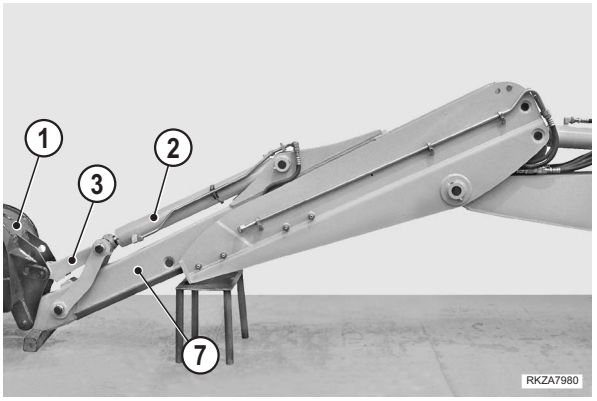
6 - Start the engine and, maintaining constant tension on the section of cable or chain connected to the bucket coupling, slowly raise the boom until both sections of cable or chain are under slight tension.

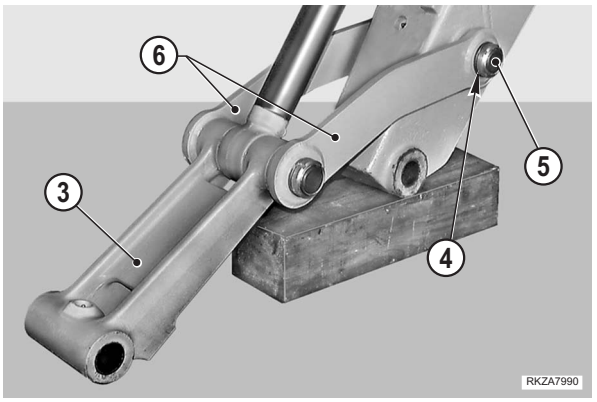
7 - Stop the engine and loosen by several turns the gib adjustment screws.

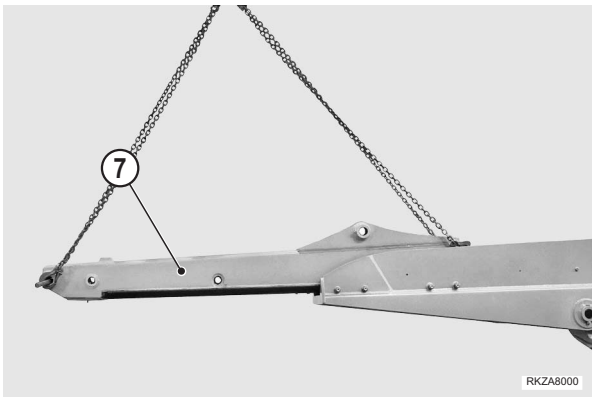
★ Loosen the screws on both sides.

8 - Slide out the 2nd arm (7).

2nd arm: _____ kg







Installation

• To install, reverse removal procedure.

[*1]

When aligning the positions between hole and pin, do not insert fingers into the holes to check on alignment.

[*2]

Internal bushing: ASL800050

[*3]

★ Tighten the locknut completely, then release it half a turn.

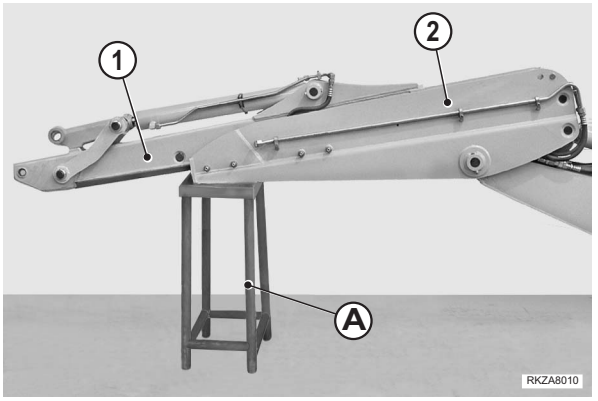
2nd ARM GUIDES

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 (3.5 ft.) high.

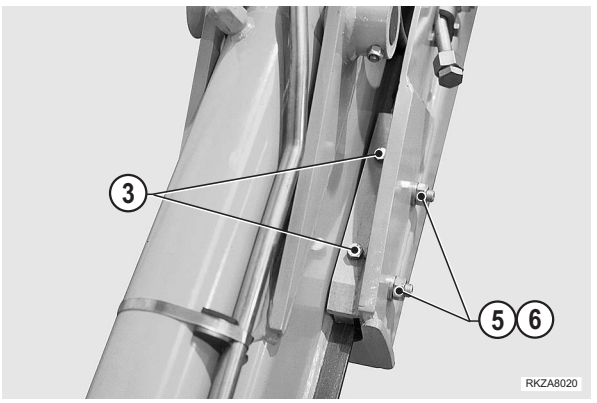


4 -Loosen and remove the screws (3), the spring washers and remove the upper guides (4). [*1]

5 -Connect the 2nd arm (1) to some hoisting tackle.

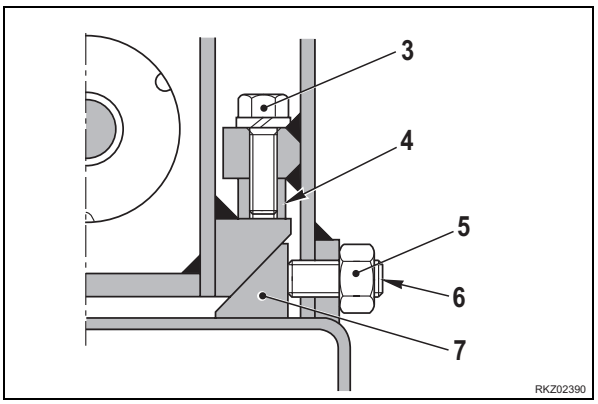
★ Use the bucket pin hole and the safety pin holes.

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]



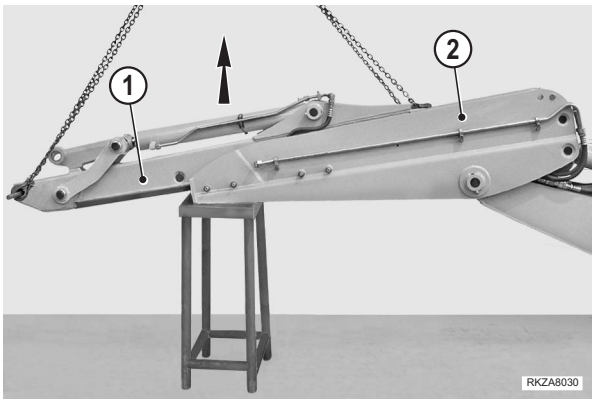
Installation

• 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").



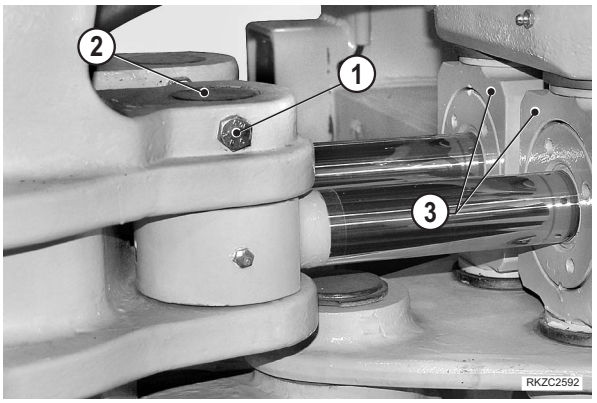
BACKHOE SWING BRACKET

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").

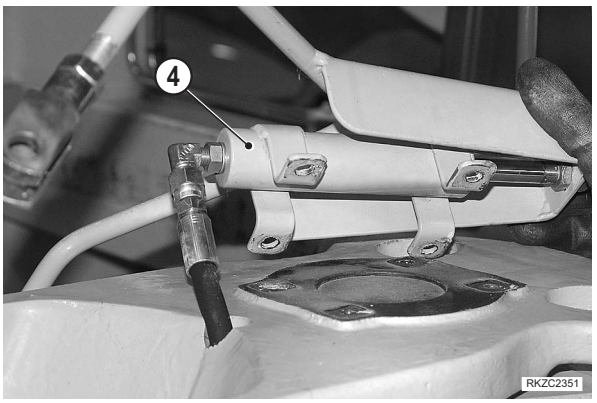


4 - Sling the swing bracket (5)

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]

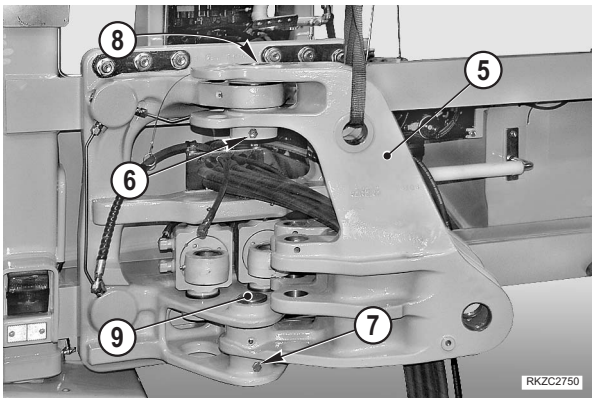
Internal bushing: ASL800050

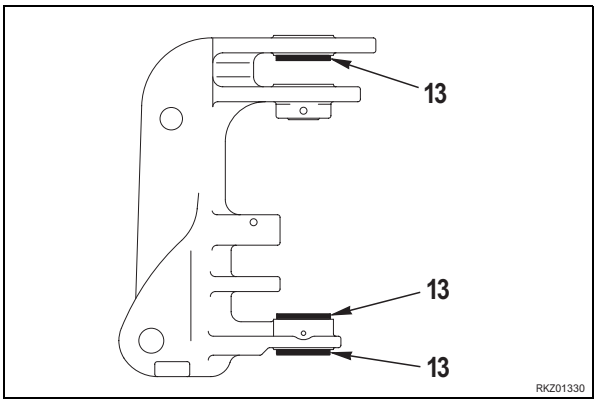
[*3]

★ 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.





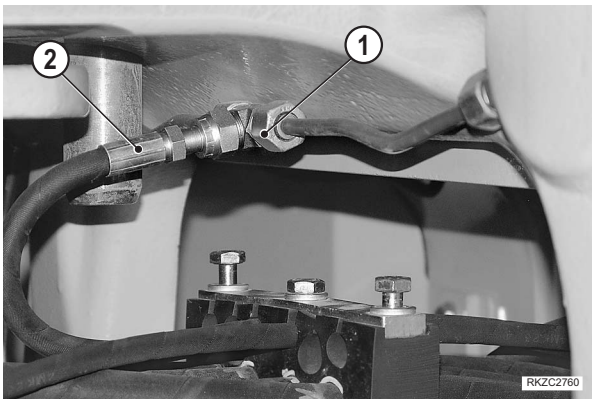
COMPLETE BACKHOE BACKFRAME

Removal

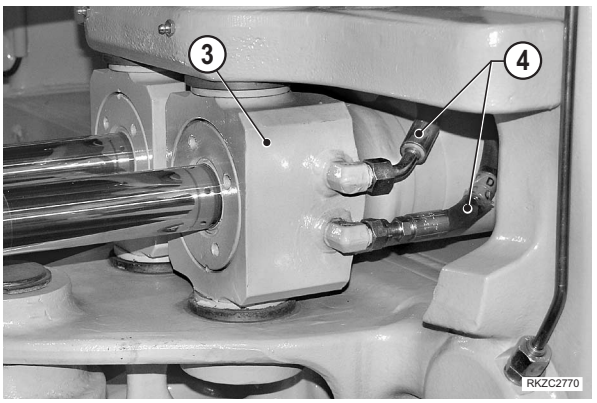
1 - Remove the equipment.
(For details see "BACKHOE WORKING EQUIPMENT").

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.

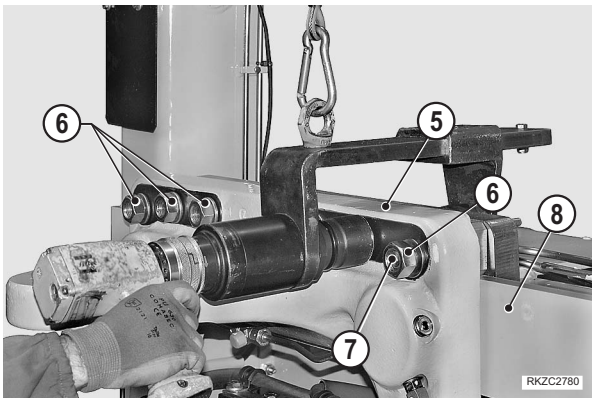


4 - Disconnect feed hoses (4) from swing cylinders (3).



5 - Connect the backframe (5) to a hoisting device.

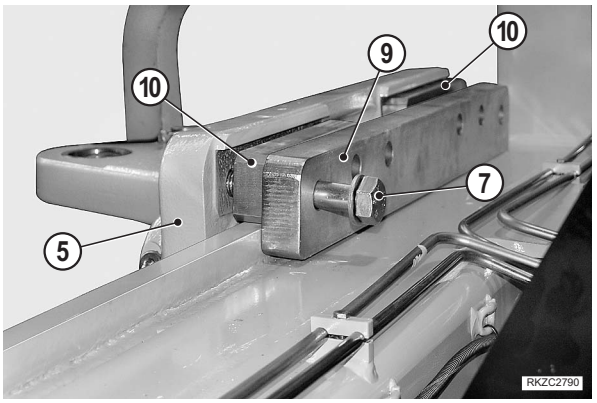
6 - Loosen nuts (6) and remove washers and four screws (7).
Loose partially lateral nuts (4) to remove backframe (3) from frame (8). [*1]



7 - Put a sling round the backframe (5) and apply slight tension to the cables.

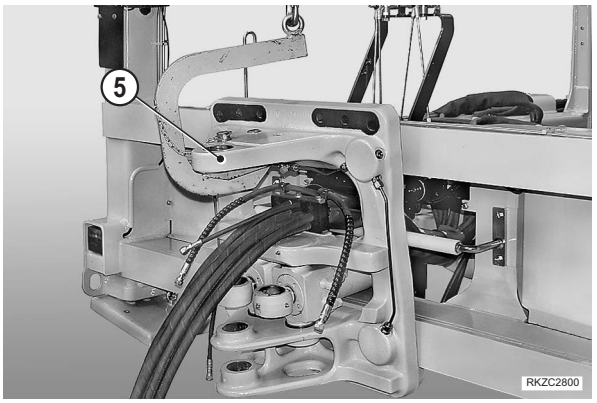
8 - Remove external nuts (6), washers and screws (7). [*1]

9 - Remove slide block (9) and spacers (10).



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

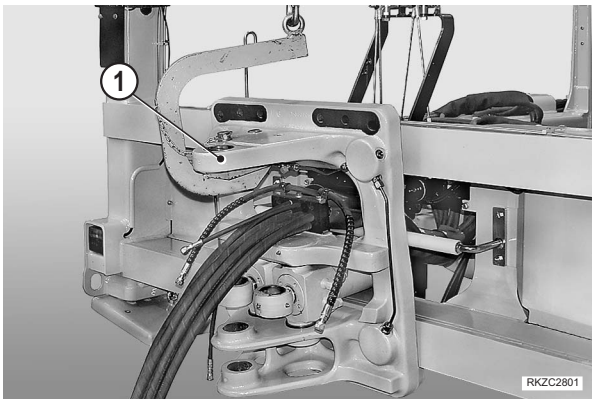
1 - Start the engine and bleed the air from the cylinders. (For details, see "20 TESTING AND ADJUSTMENTS").

★ 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").



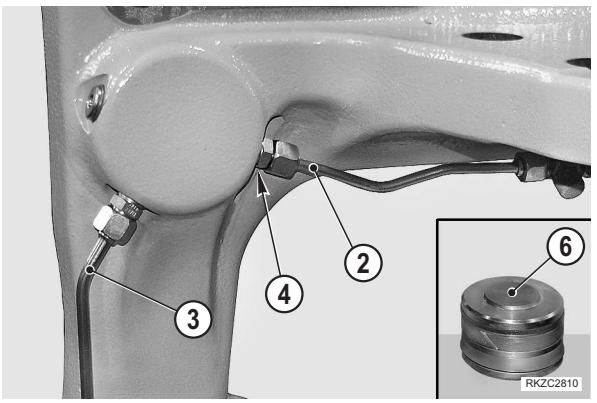
UPPER PISTON

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.

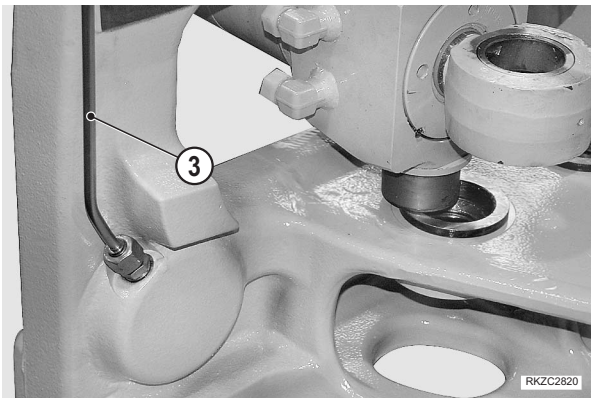


LOWER PISTON

1 -Remove pipe (3).

2 -Introduce compressed air at low pressure (max. 2 bar) through union (7) and recover piston (6).

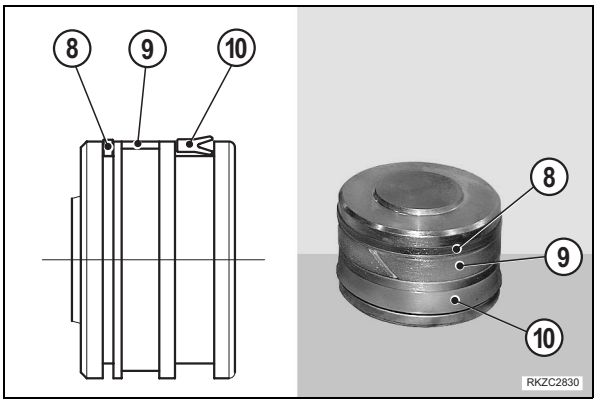
⚠ Be aware that the piston may be ejected rapidly. Use a rag or non-slip gloves to accompany the piston as it is being ejected.



REPLACING SEALS

1 -Remove seal (8), guide ring (9), and seal (10).

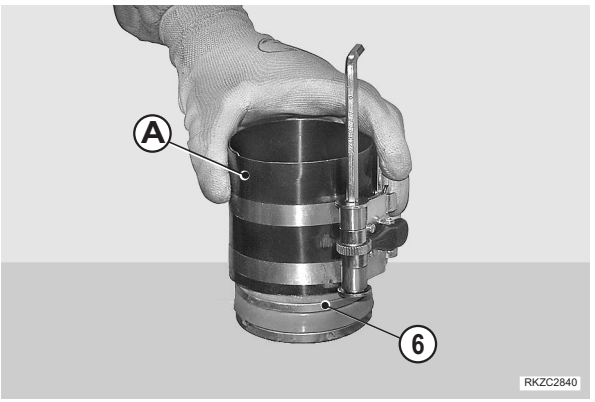
★ Note down direction of installation of seal (10).



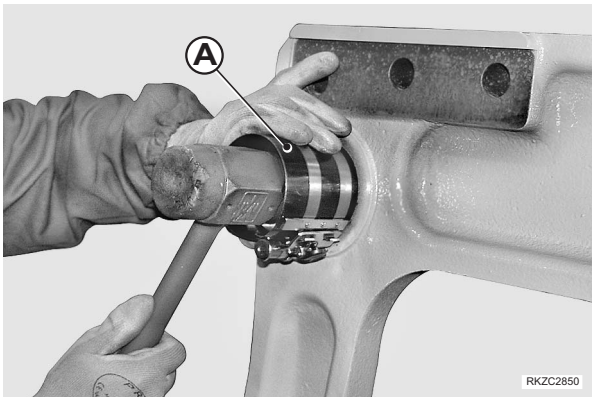
2 - Thoroughly clean the seats and install new seals and the guide ring.

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).



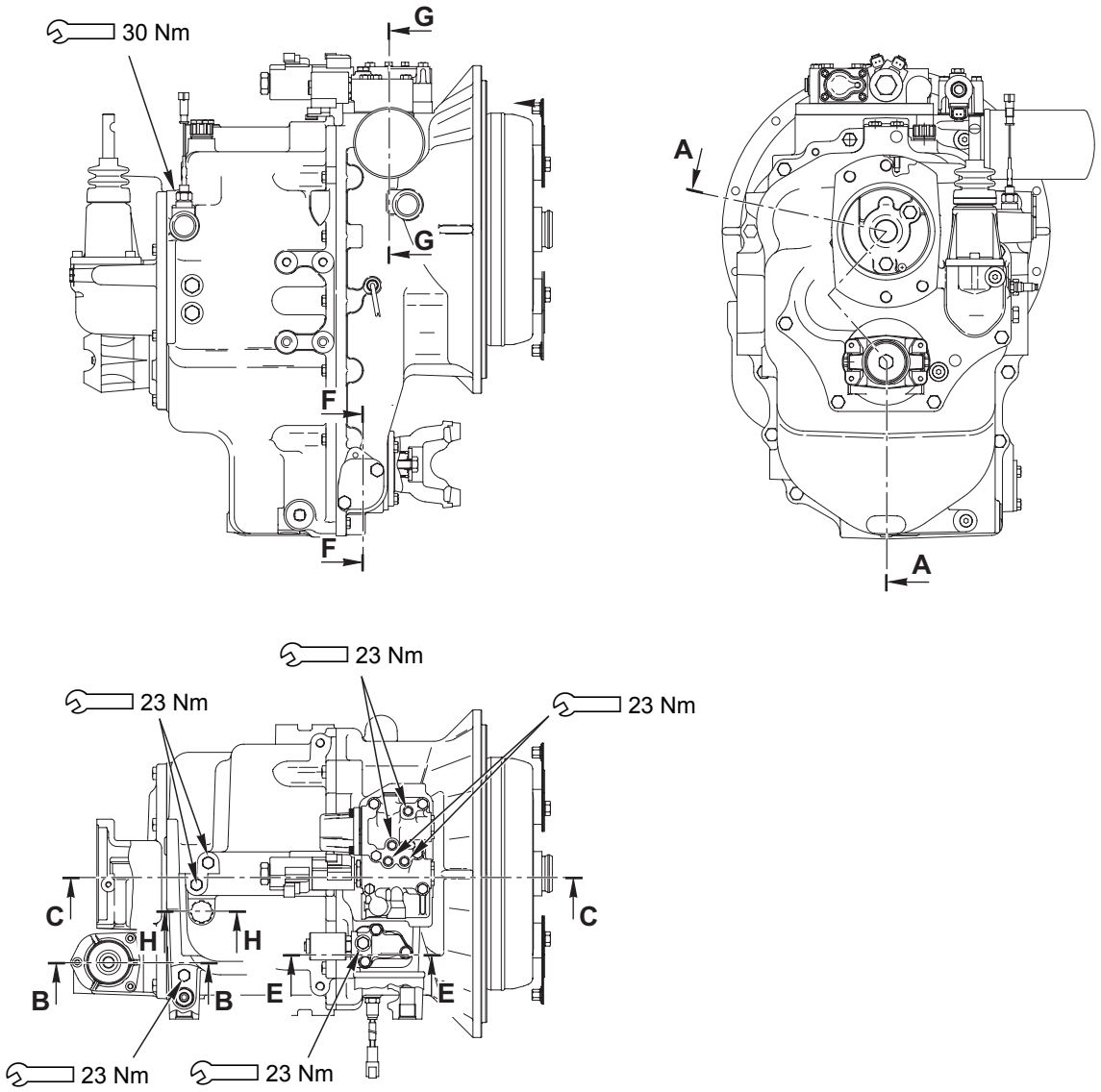
Installation

- To install, reverse removal procedure.

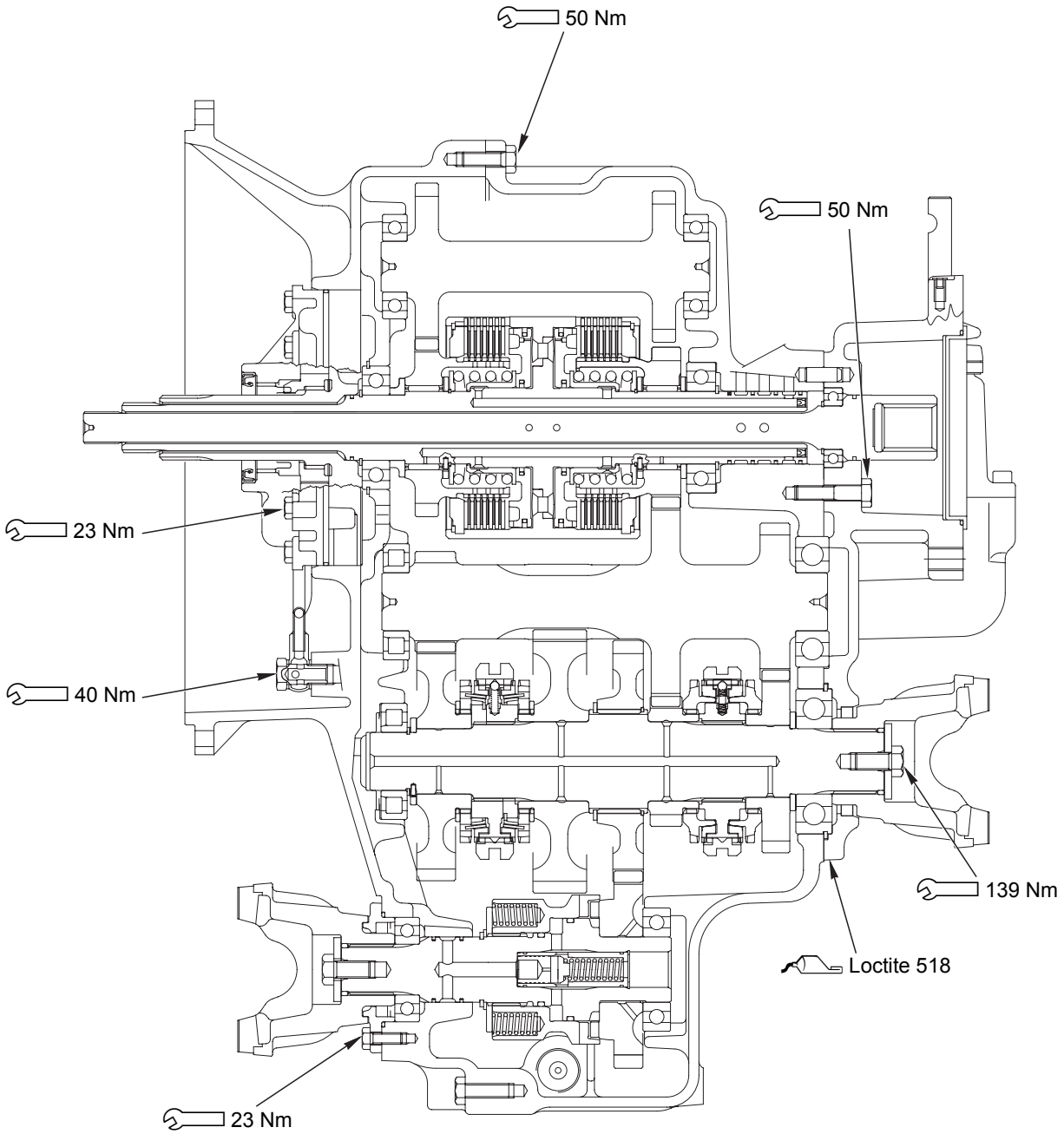
40 STANDARD MAINTENANCE

TRANSMISSION 2
FRONT AXLE 7
REAR AXLE 11
HYDRAULIC PUMP 15
CONTROL VALVE 18
PPC VALVES 50
SHOVEL CYLINDERS 52
BACKHOE CYLINDERS 54
FRONT WORKING EQUIPMENT 58
SWING BRACKET 60
BACKHOE WORKING EQUIPMENT 62

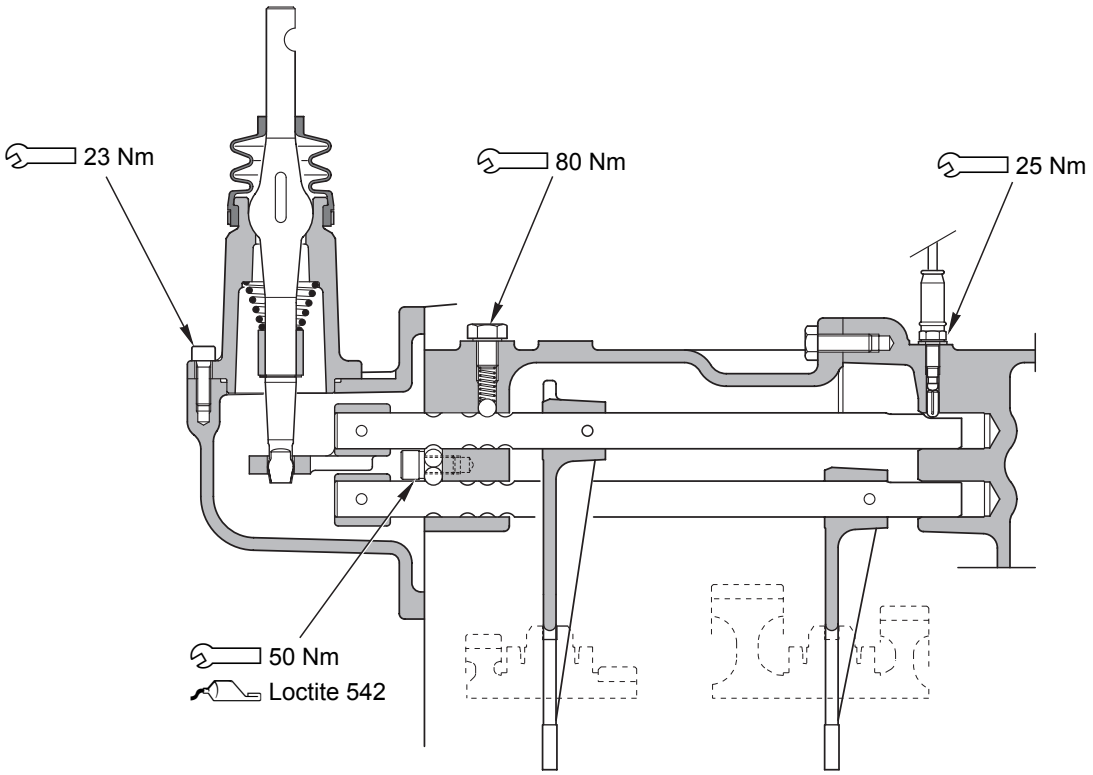
TRANSMISSION



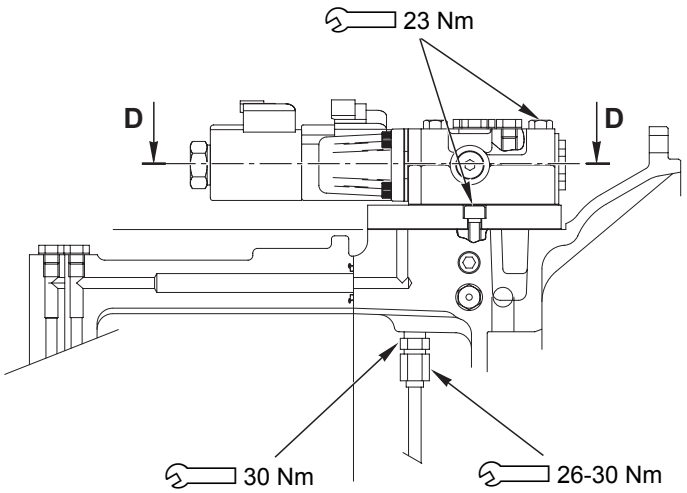
RKZ10310



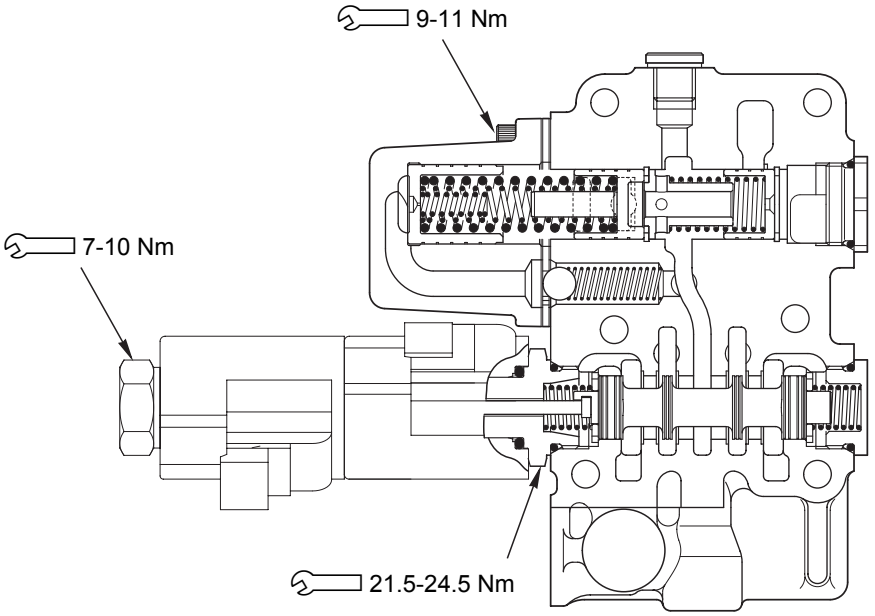
A - A


23 Nm
80 Nm
25 Nm
50 Nm
Loctite 542

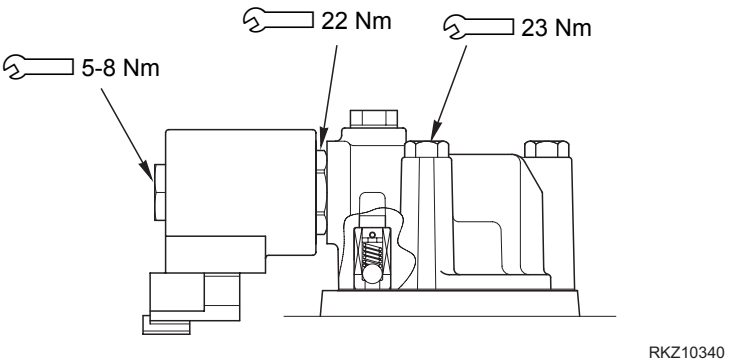
B - B


23 Nm
D
D
30 Nm
26-30 Nm
RKZ10330

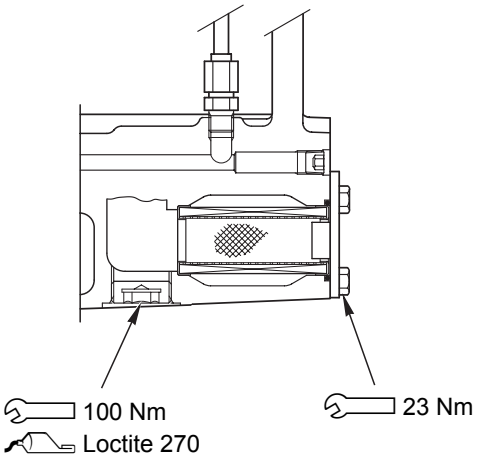
C - C



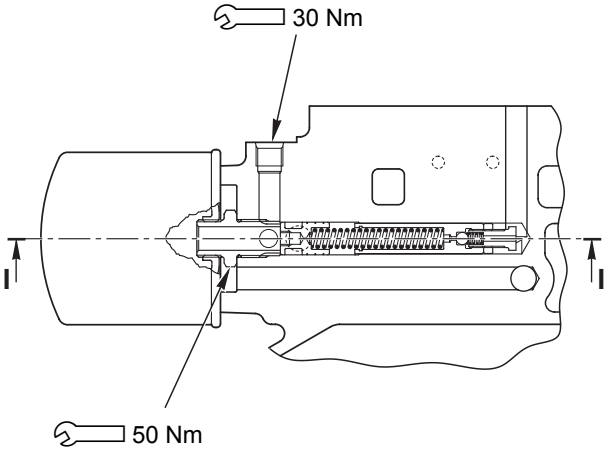
D - D



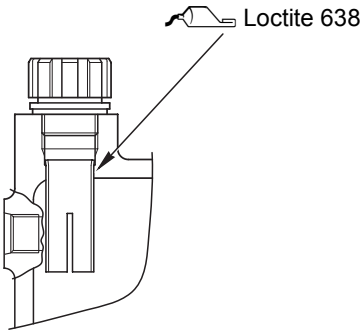
E - E



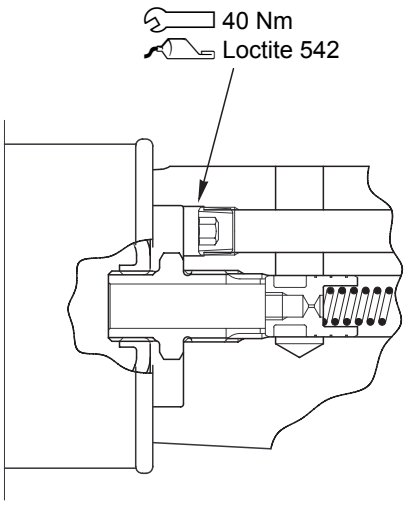
F - F



G - G



H - H

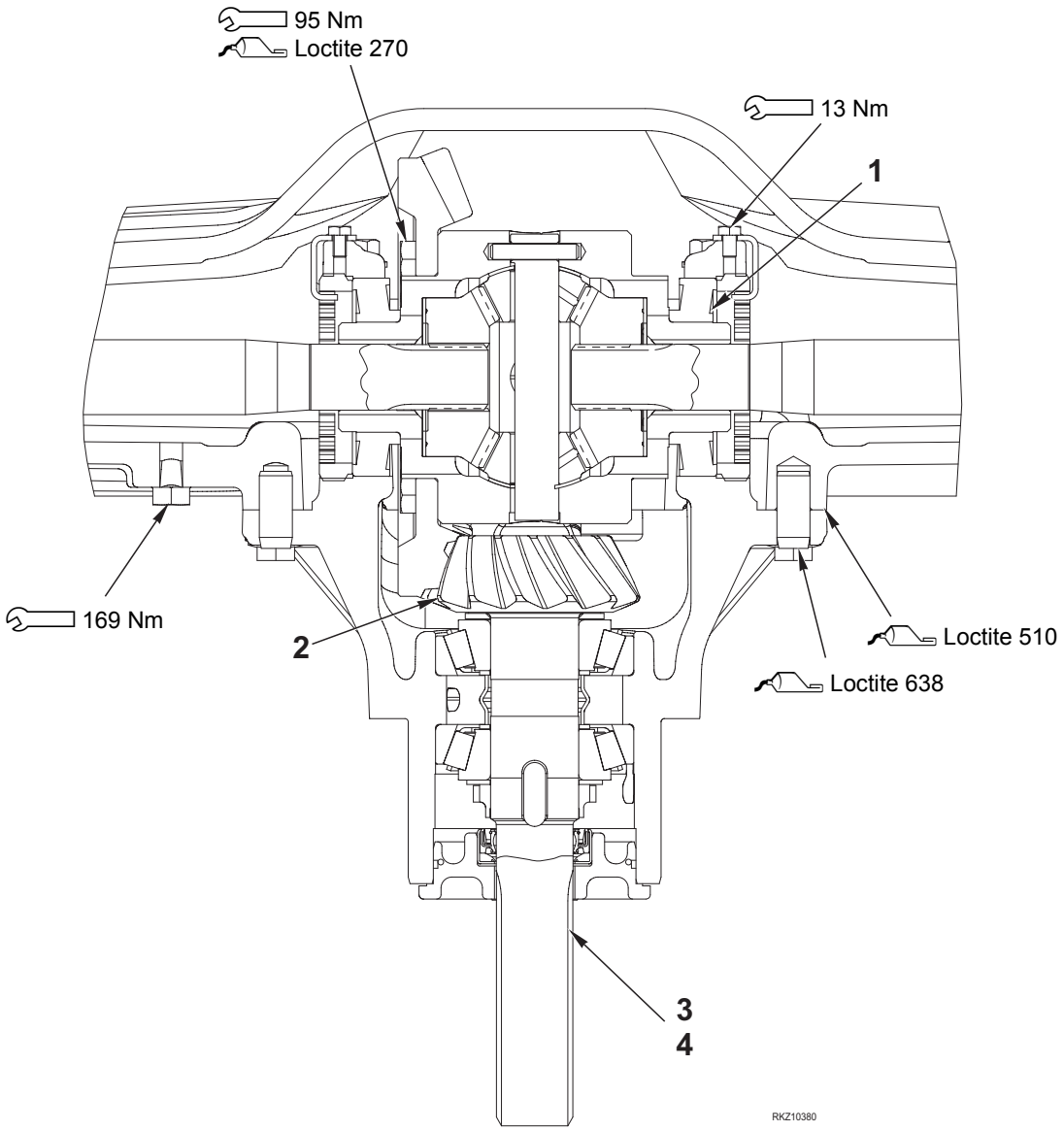


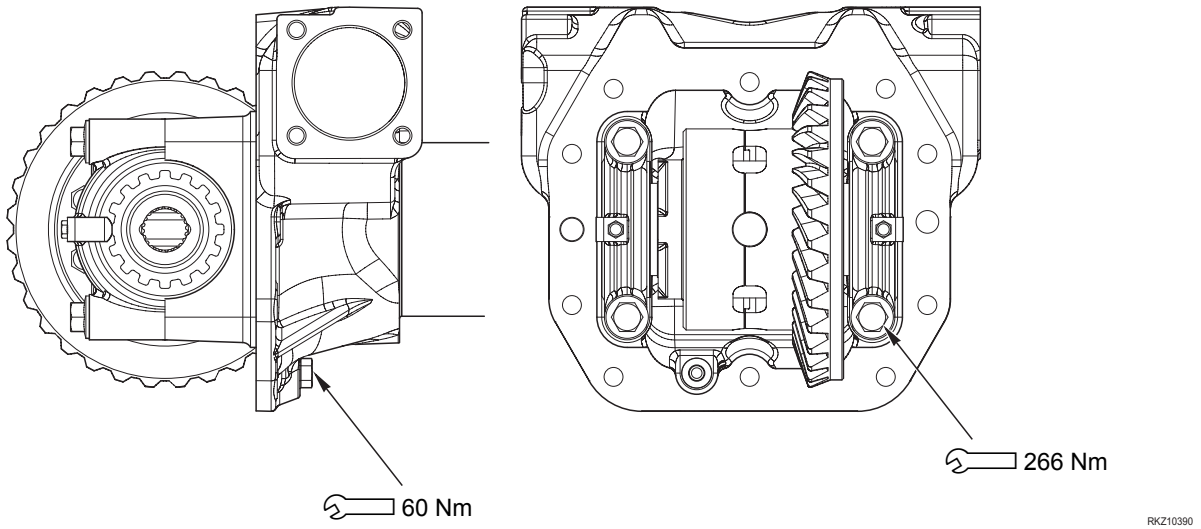
I - I

RKZ10370

FRONT AXLE

Differential

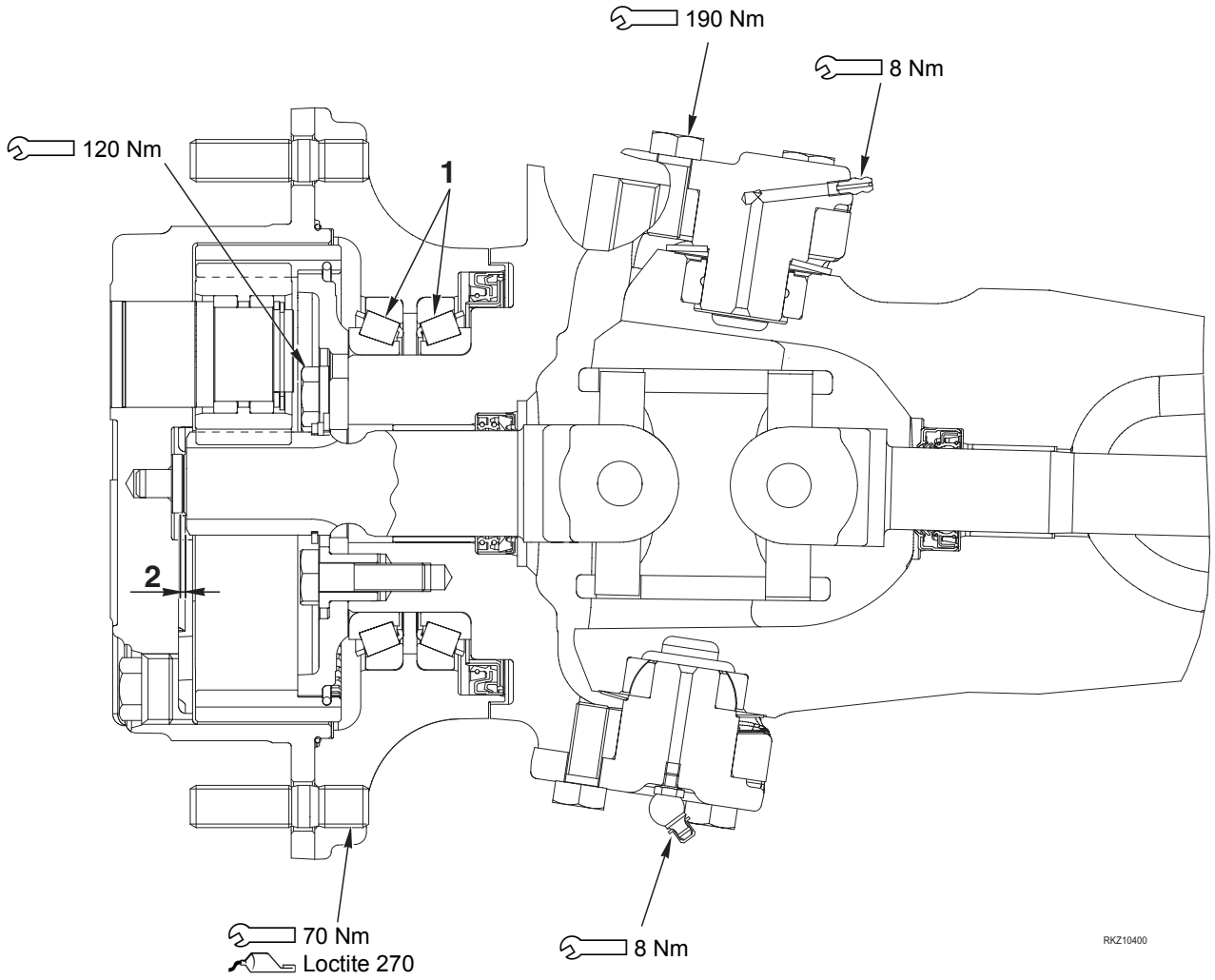




Unit: mm

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 (without sealing ring) As measured on pinion Ø 34.8	92-137 Nm		
4	Pinion-crown rotation force (without sealing ring) As measured on pinion Ø 34.8	129.5-194.5 Nm		

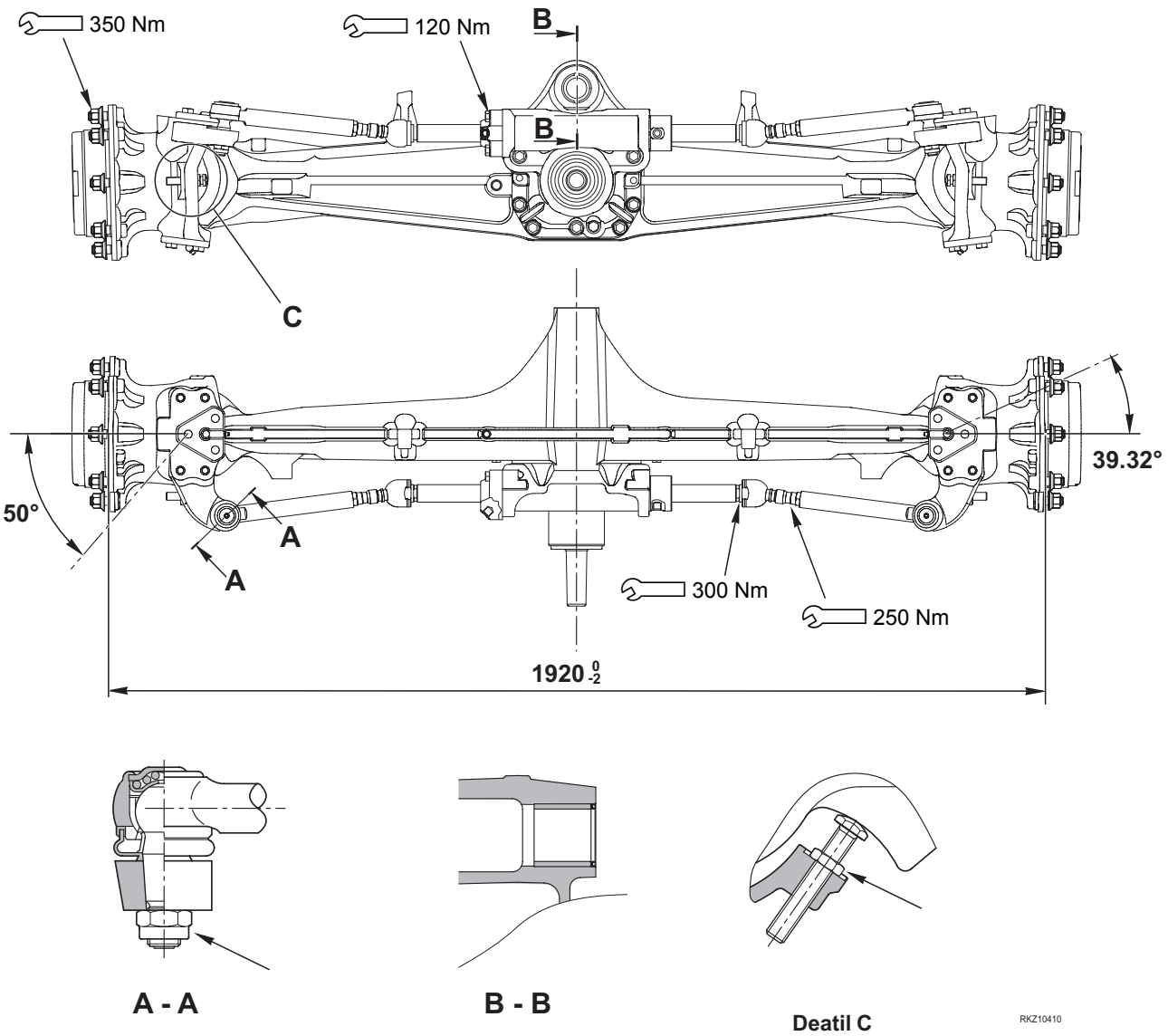
Planetary - Joint



Unit: mm

No.	Check item	Criteria	Remedy
1	Hub rotation torque	—	Adjust
2	Drive shaft axle clearance	—	Replace

Steering unit cylinder

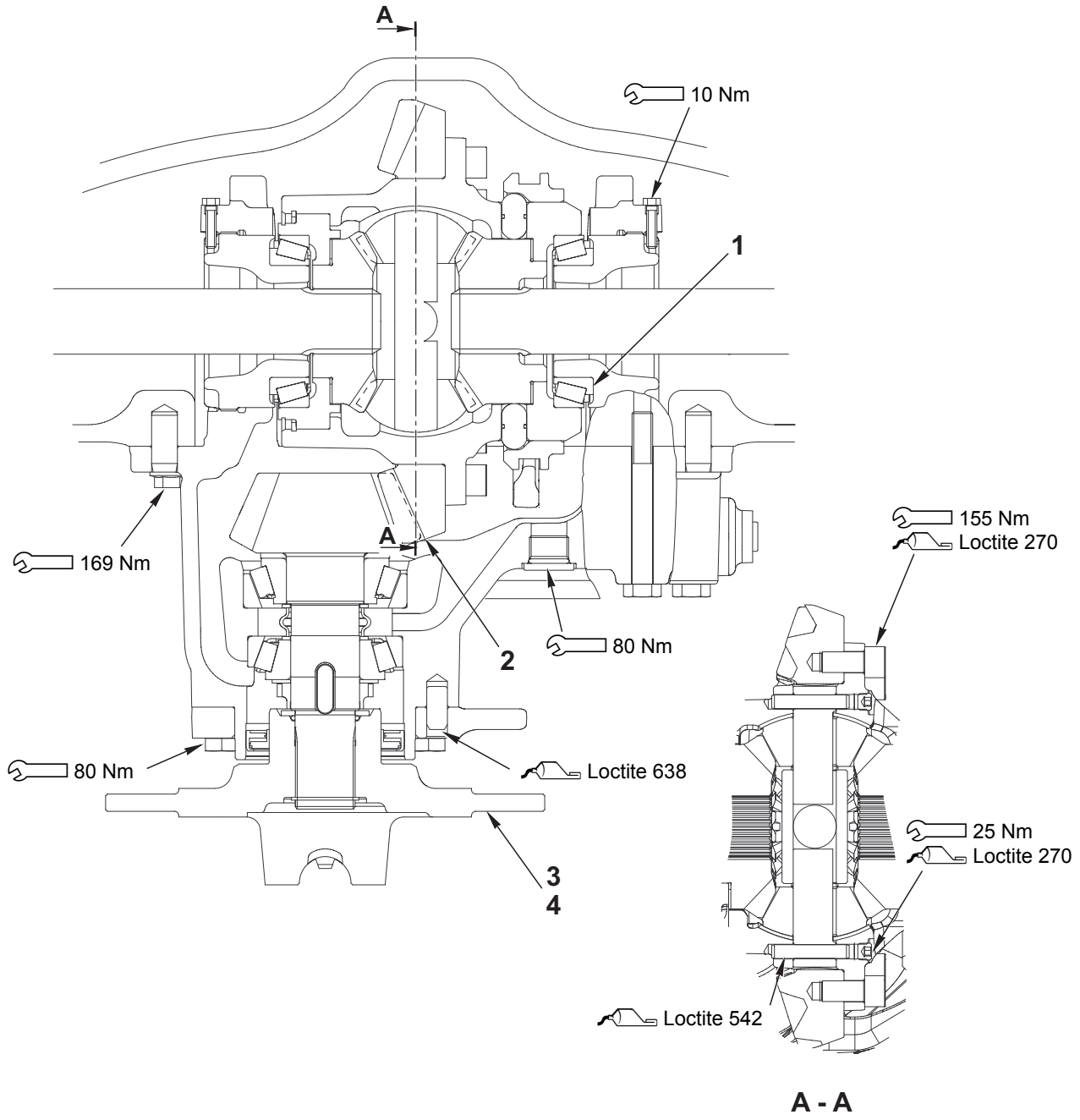


Unit: mm

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	—	$50.19^{+0.04}_{0}$	—	—	

REAR AXLE

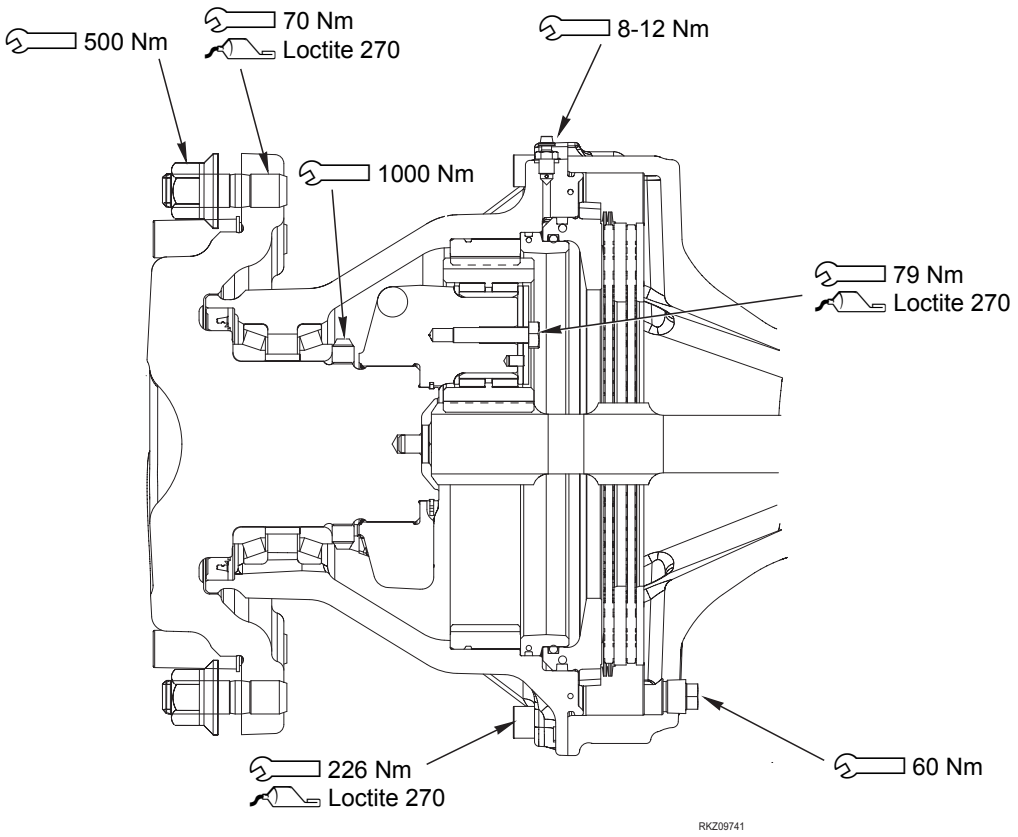
Differential



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) As measured on pinion Ø 34.8	115-138 Nm		
4	Pinion-crown rotation force (without sealing ring) As measured on pinion Ø 34.8	148-188 Nm		

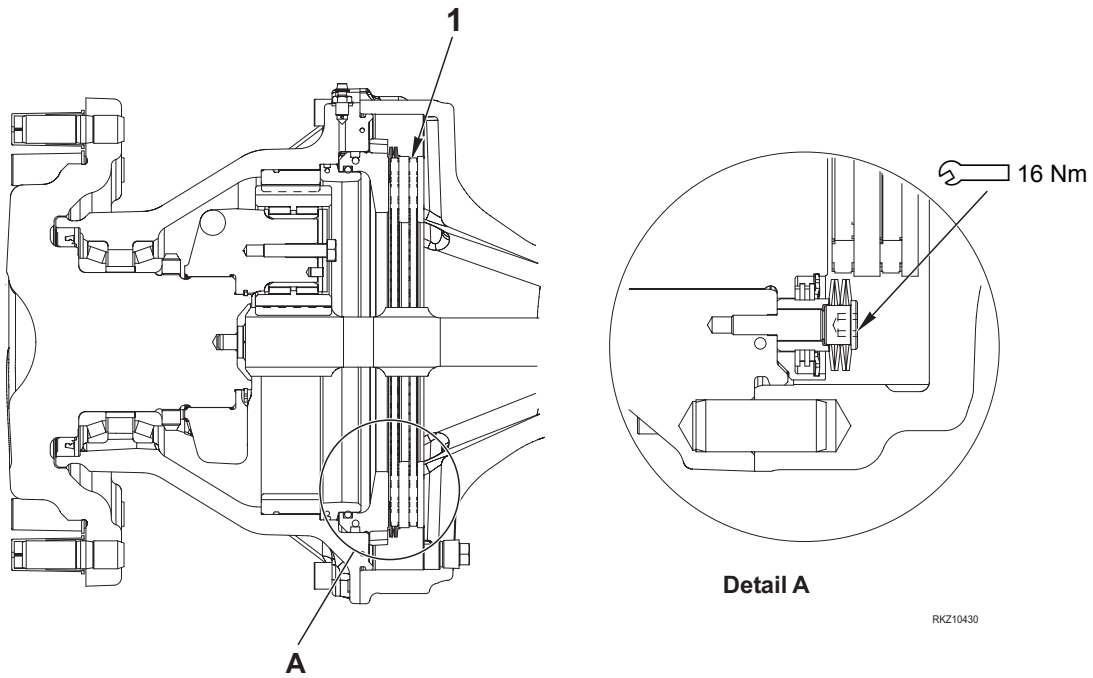
Planetary



Unit: mm

No.	Check item	Criteria	Remedy
1	Hub rotation torque	—	Adjust
2	Drive shaft axle clearance	—	Replace

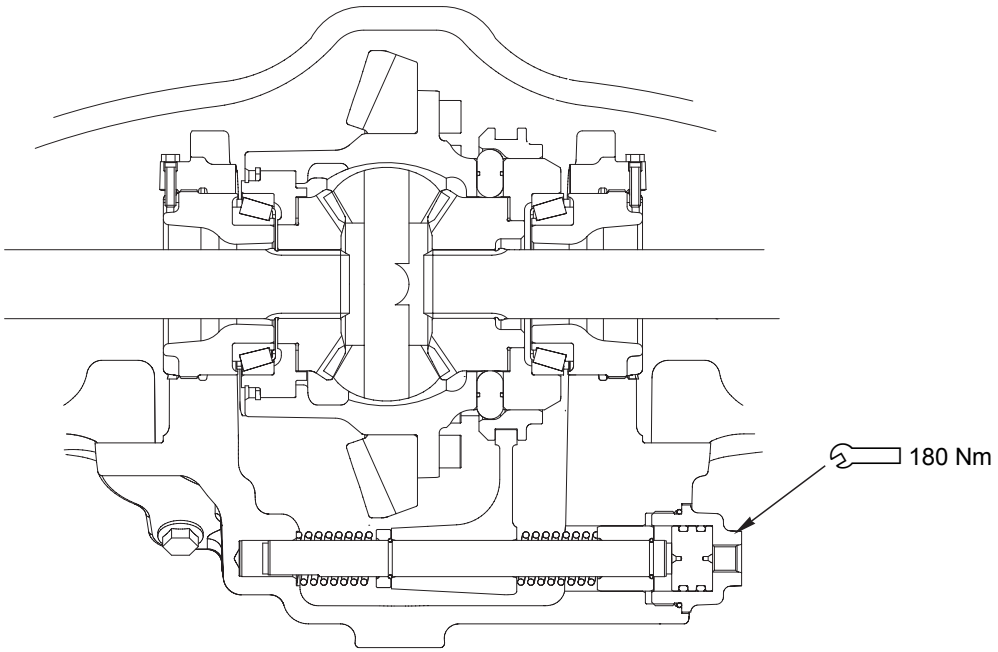
Brakes



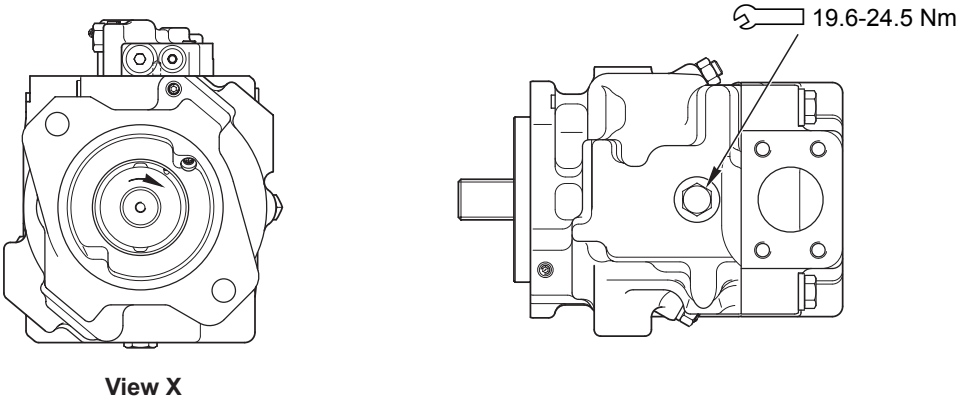
Unit: mm

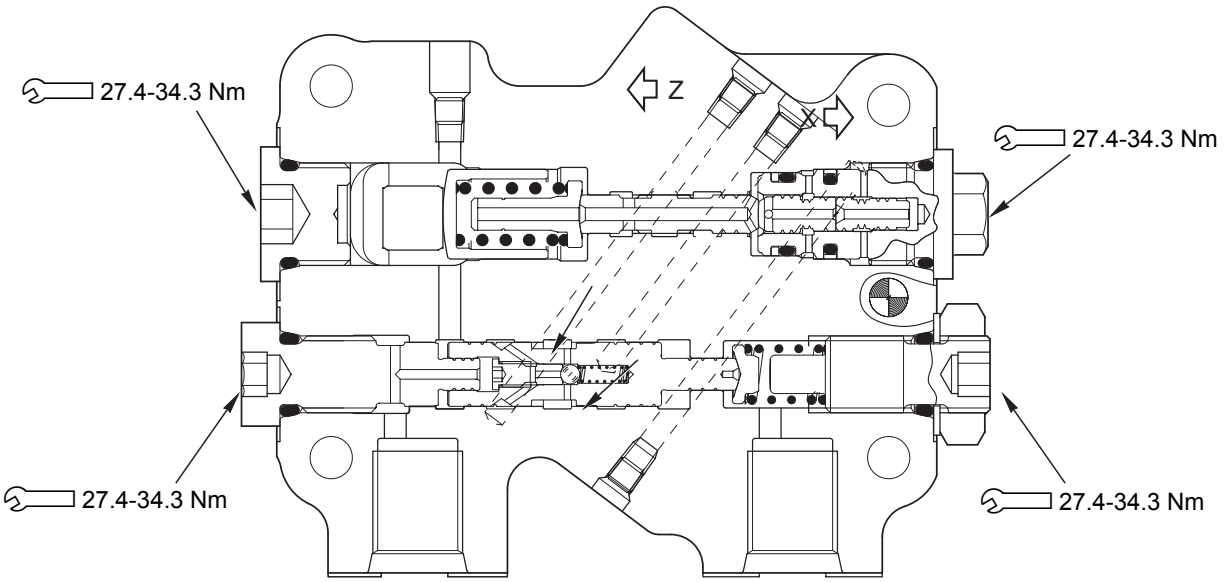
No.	Check item	Criteria		Remedy
1	Disc thickness	Standard thickness	Min. thickness	Replace
		6.73 +0 -0.1	5.8	

Differential lock



HYDRAULIC PUMP



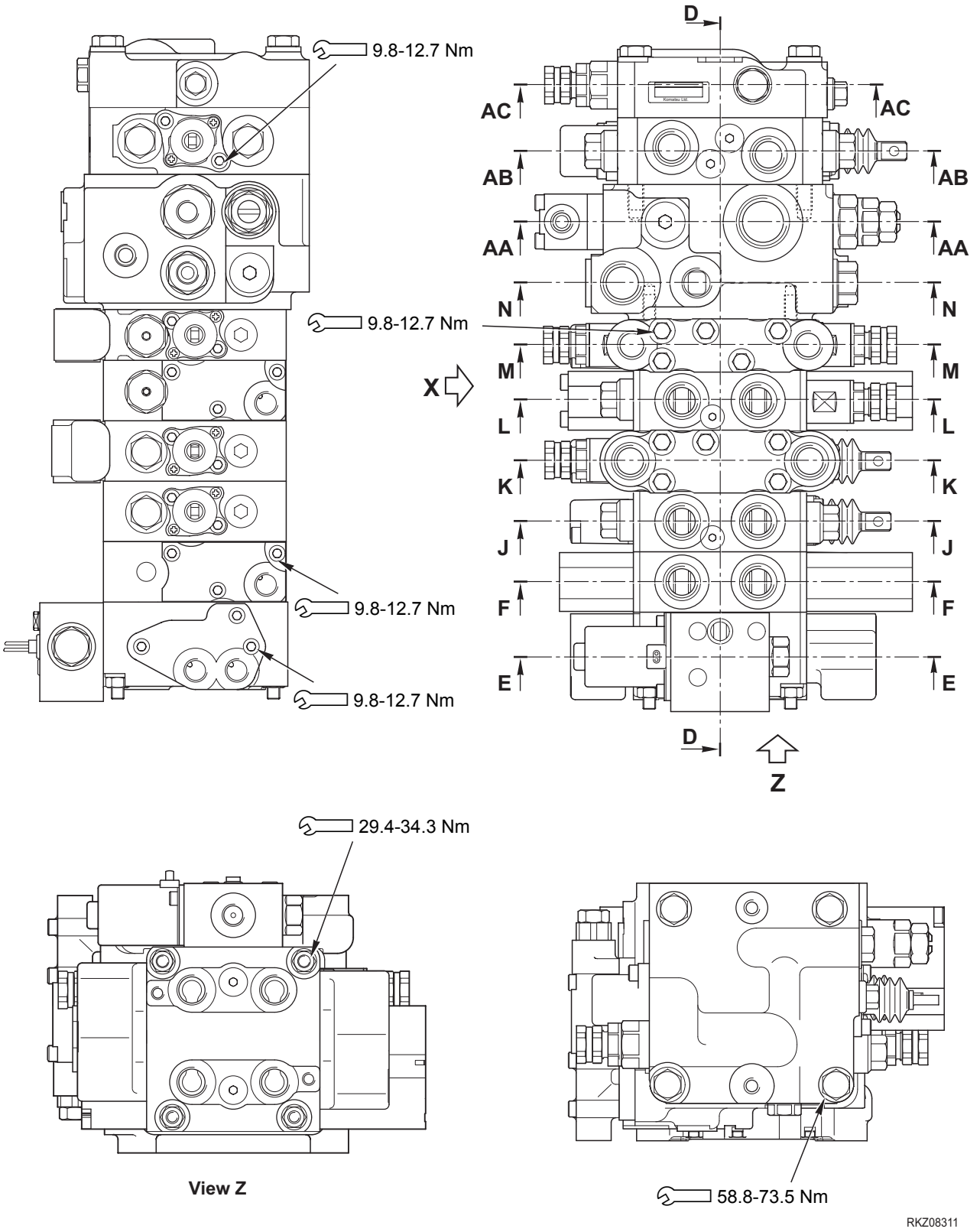


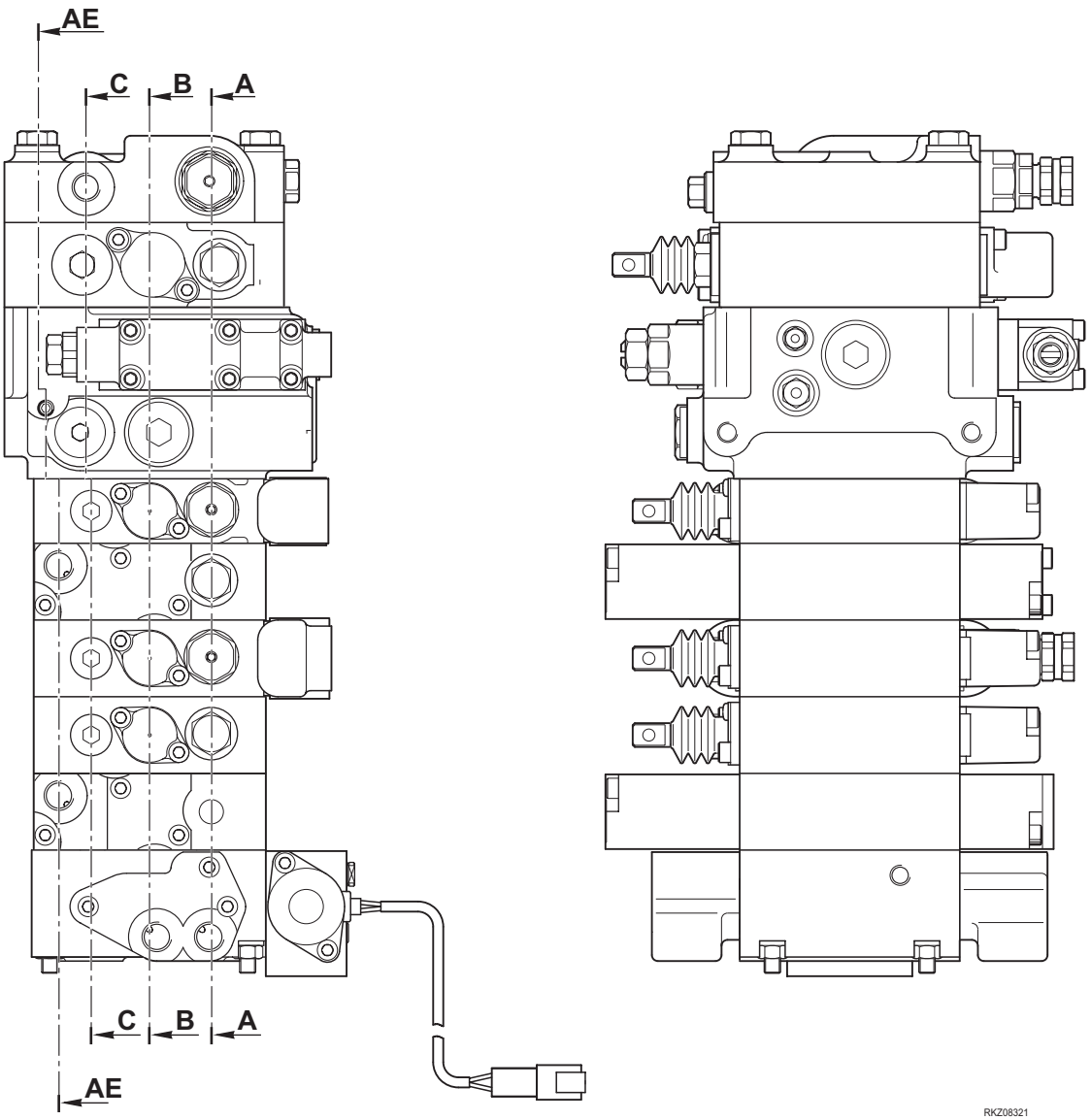
A - A

PAGE INTENTIONALLY
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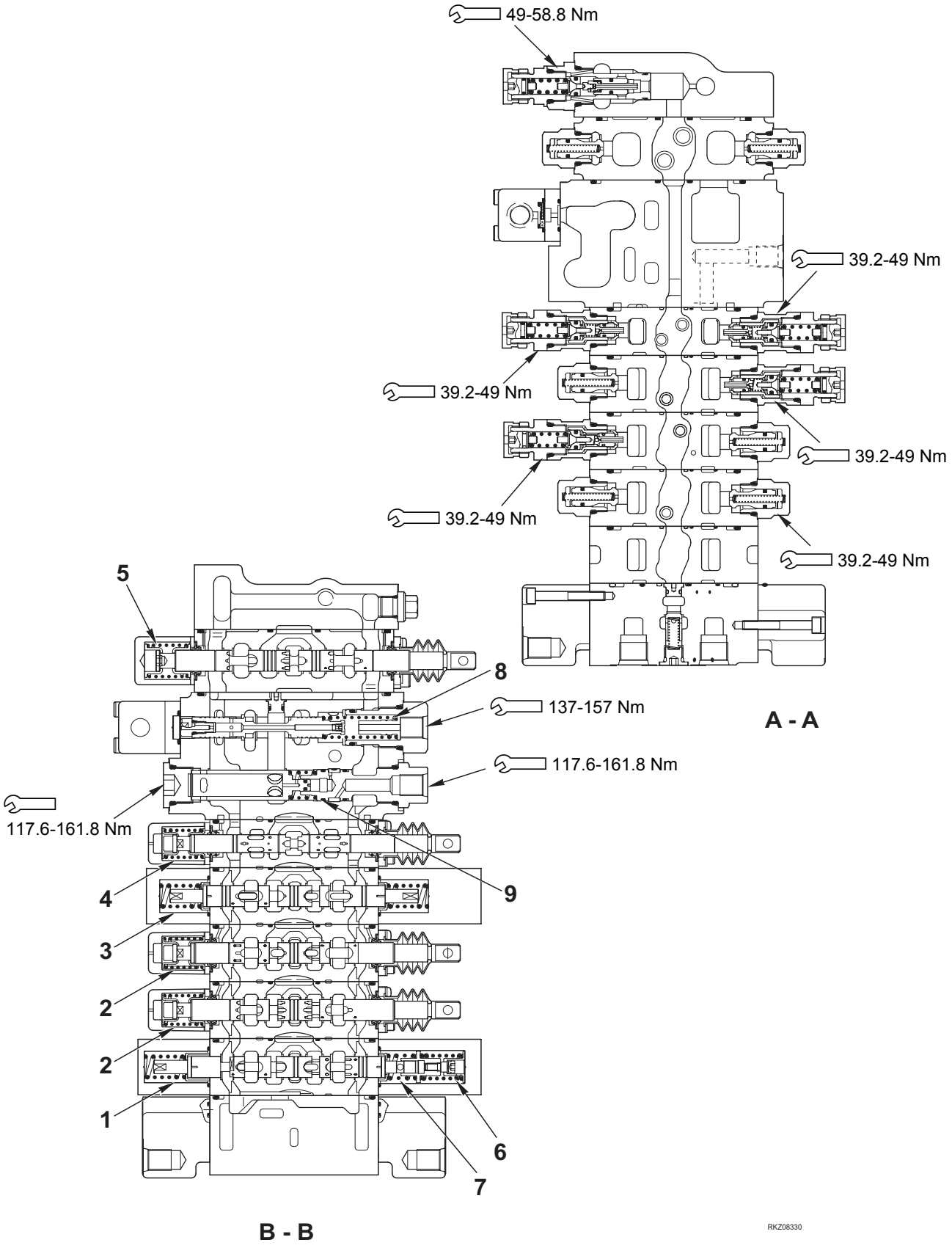
CONTROL VALVE

8-SPOOL VERSION (WITH MECHANICAL CONTROL)



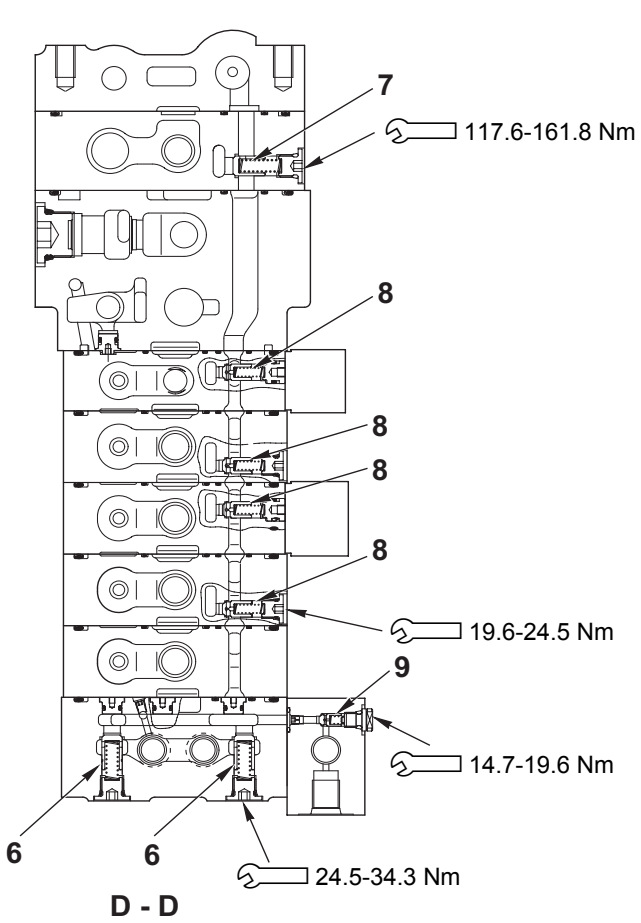


View X

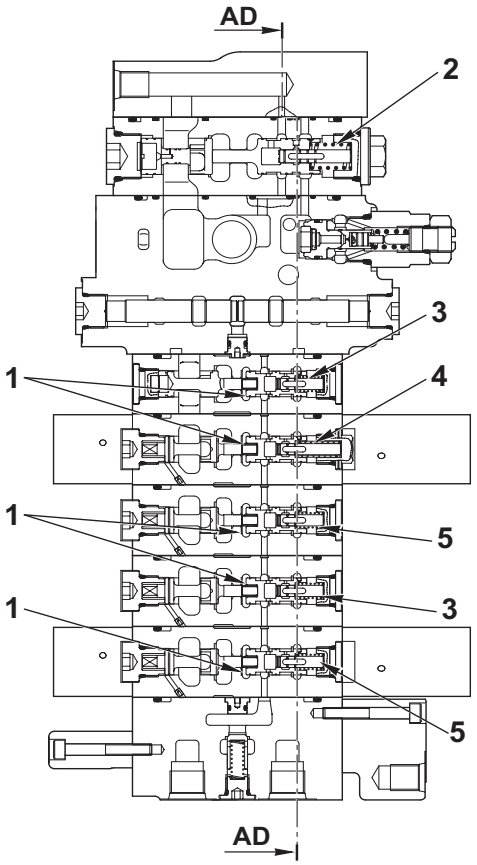

49-58.8 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
A - A
5
8
137-157 Nm
117.6-161.8 Nm
117.6-161.8 Nm
9
4
3
2
2
1
6
7
B - B
RKZ08330

Unit: mm

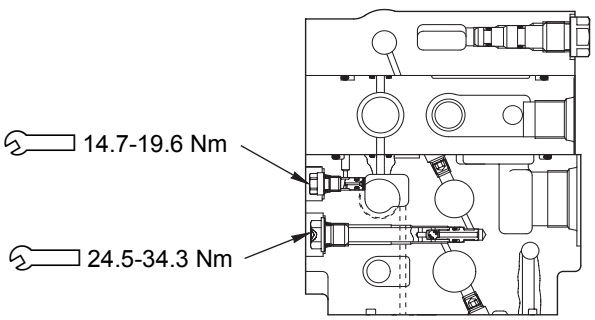
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (shovel arm raise control)	27.1x16.2	26.7	14.4N	–	11.8N	Replace spring
2	Spool return spring (backhoe bucket boom control)	66.5x21.1	25.4	73.5N	–	58.8N	
3	Spool return spring (shovel control)	27.2x16.6	26.7	30.38N	–	34.3N	
4	Spool return spring (boom swing control)	42x20	25.4	75.5N	–	59.6N	
5	Spool return spring (arm control)	65.4x22.1	26.5	73.5N	–	58.8N	
6	Spool return spring (shovel arm float control)	19.4x17.6	19	14.7N	–	11.8N	
7	Spool return spring (shovel arm lower control)	38.7x18	27.6	355.7N	–	284.6N	
6	Priority valve spring	56.8x15.2	48.5	29.6N	–	23.7N	
9	Unloading valve spring	25.5x19.3	18	121.5N	–	97.2N	



D - D



C - C

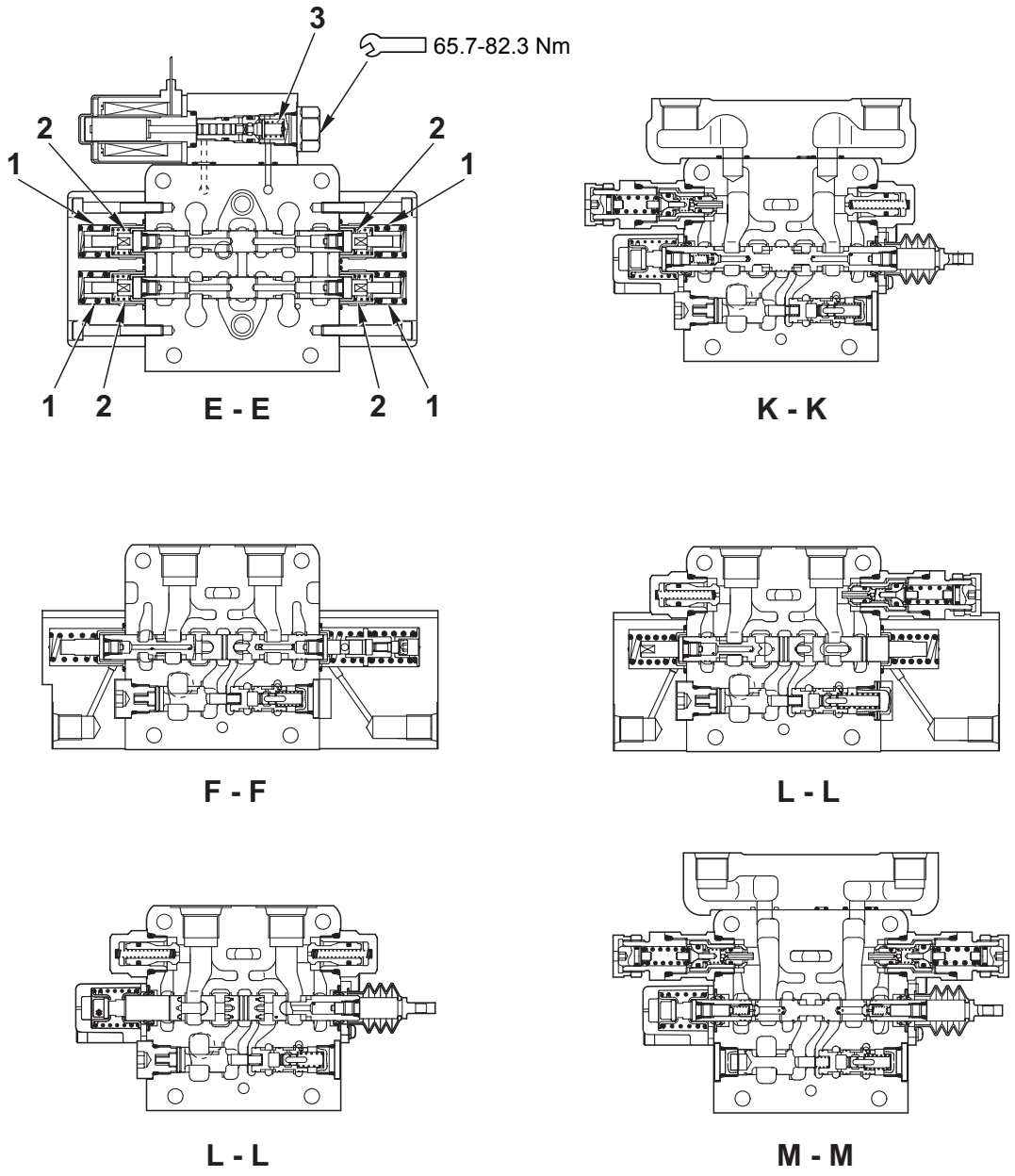


AD - AD

RKZ08341

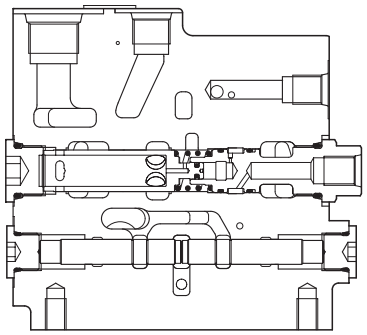
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Pressure compensation valve spring (Shovel arm, backhoe bucket, boom, shovel, boom swing)	15.4x6	8	7.44N	–	5.96N	Replace spring
2	Pressure compensation valve spring (arm)	31.4x14.4	21.8	63.7N	–	51.0N	
3	Pressure compensation valve spring. (Boom swing, backhoe bucket)	18.9x8.4	15	15.7N	–	12.5N	
4	Pressure compensation valve spring. (Front bucket)	37.1x8.6	24	34.3N	–	27.4N	
5	Pressure compensation valve spring. (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	

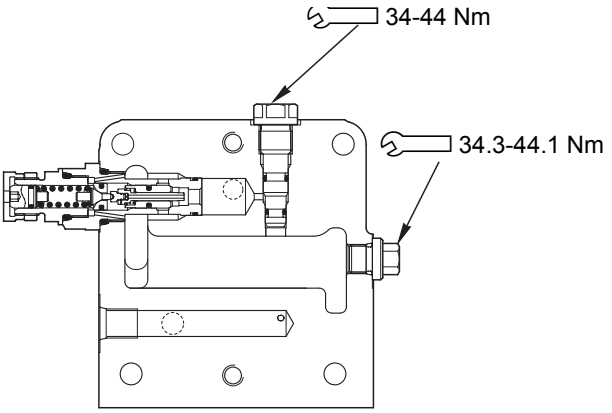


Unit: mm

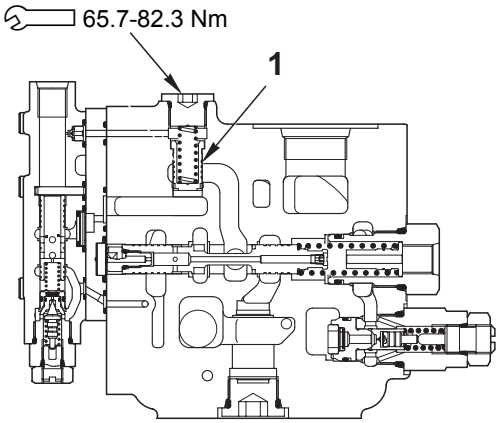
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (Outrigger control)	18.0x18	17.5	39.2N	–	31.4N	Replace spring
2	Spool return spring (Outrigger control	20.2x14.2	10.4	30.4N	–	24.3N	
3	Control valve spring plate lock	13.0x8.8	11	3.92N	–	3.1N	



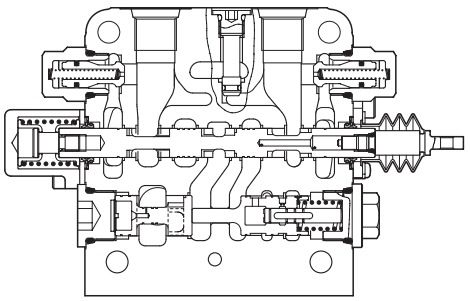
N - N



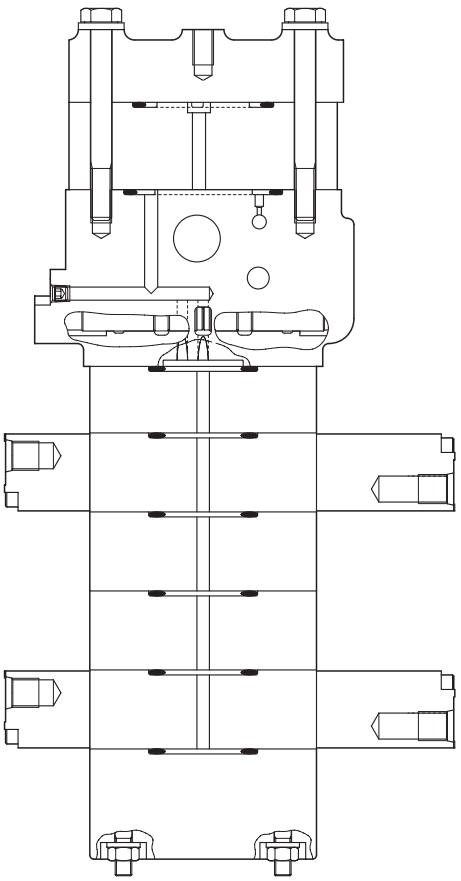
AC - AC



AA - AA



AB - AB



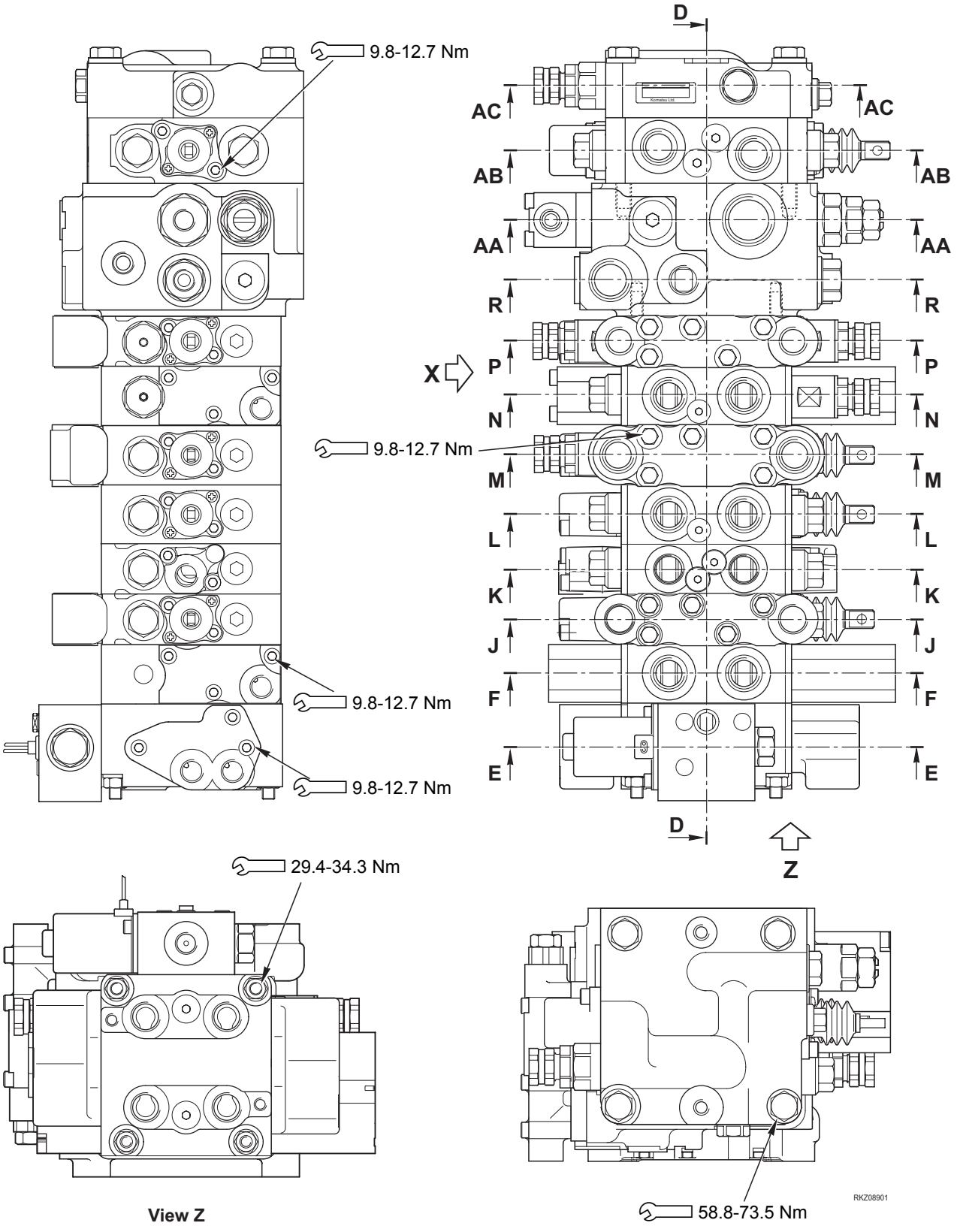
AE - AE

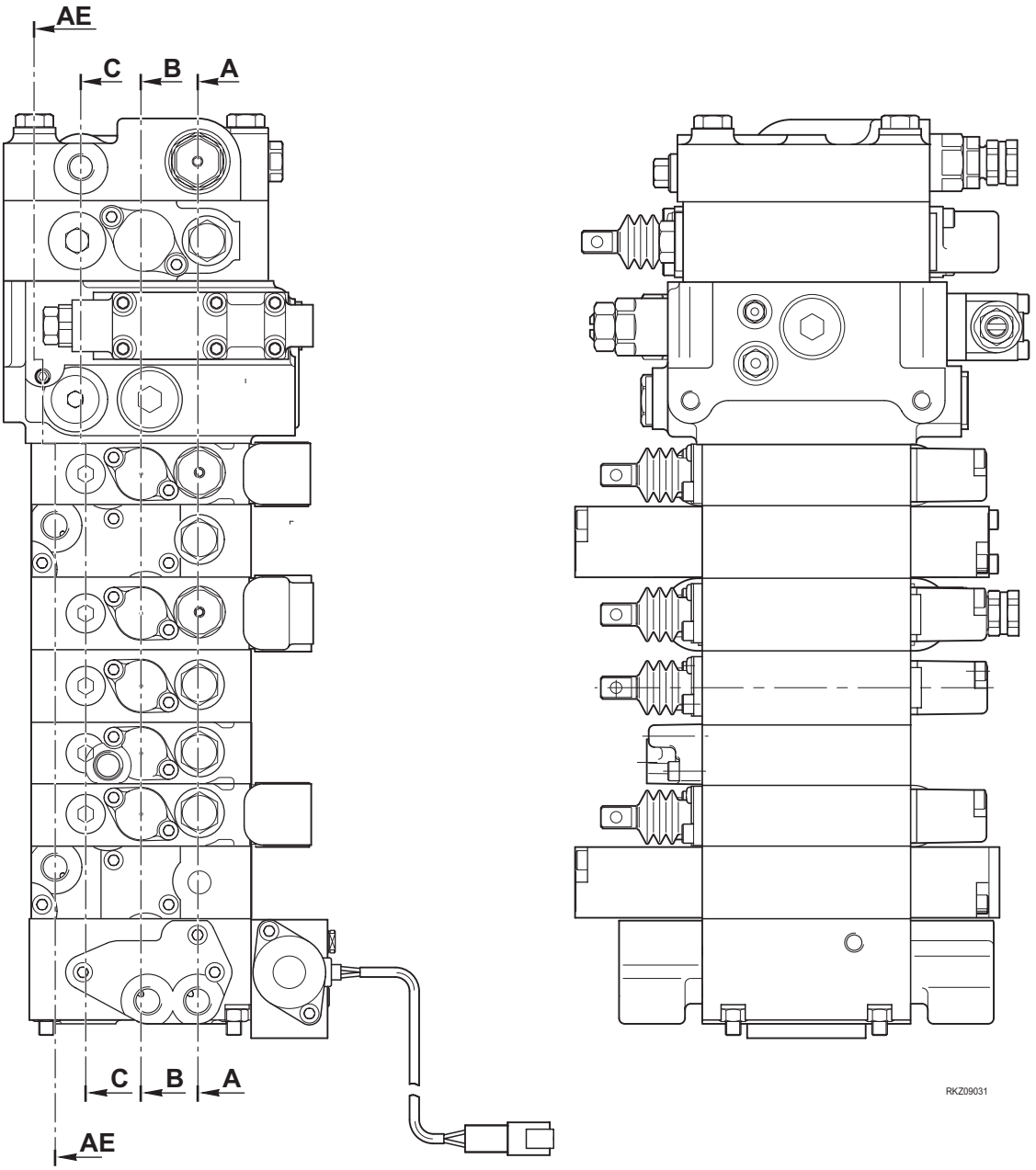
RKZ08892

Unit: mm

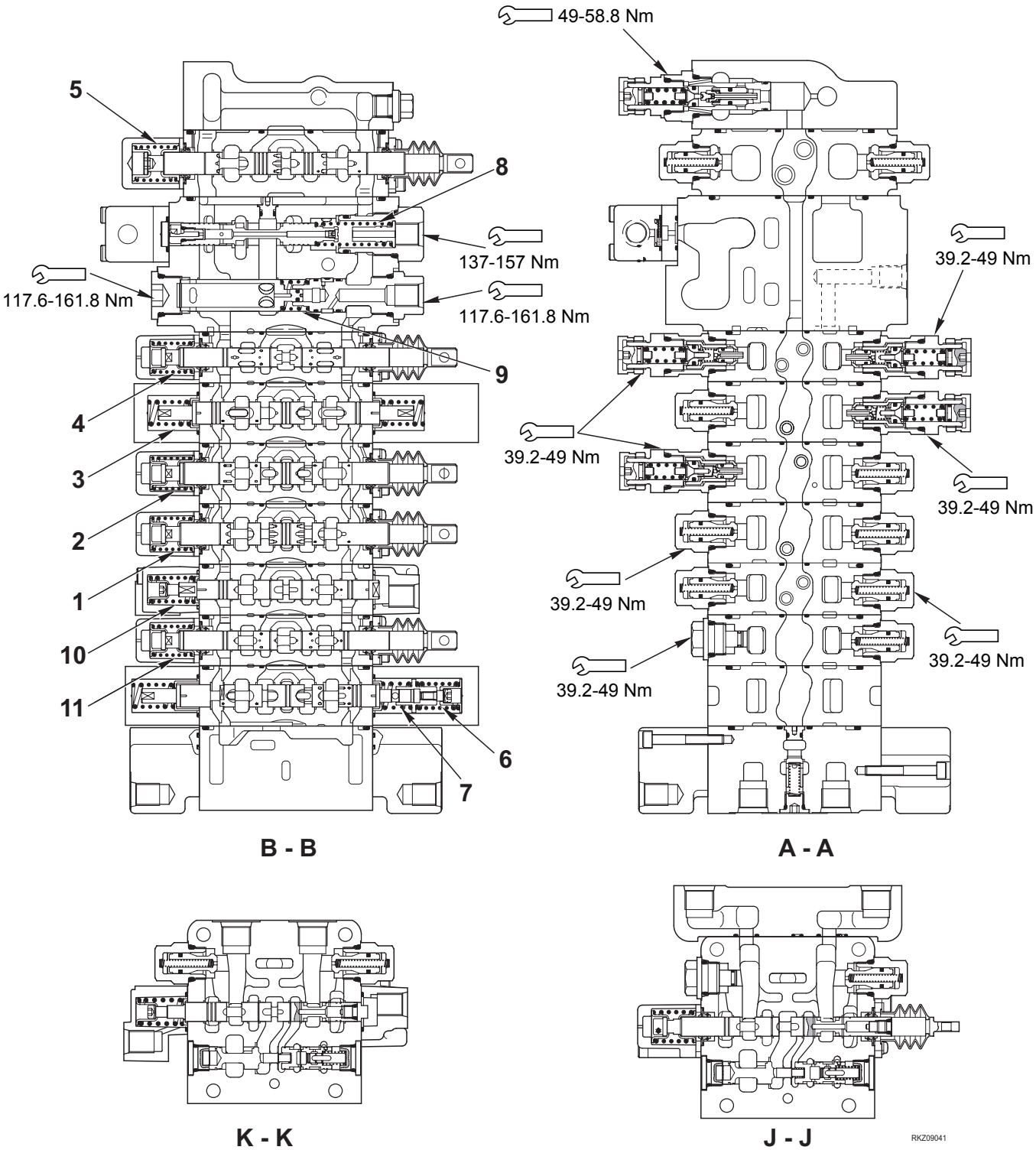
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	Replace spring
1	Pressure compensation valve spring.	31.7x9.2	27.5	43.1N	–	34.5N	

10-SPOOL VERSION (WITH MECHANICAL CONTROL)



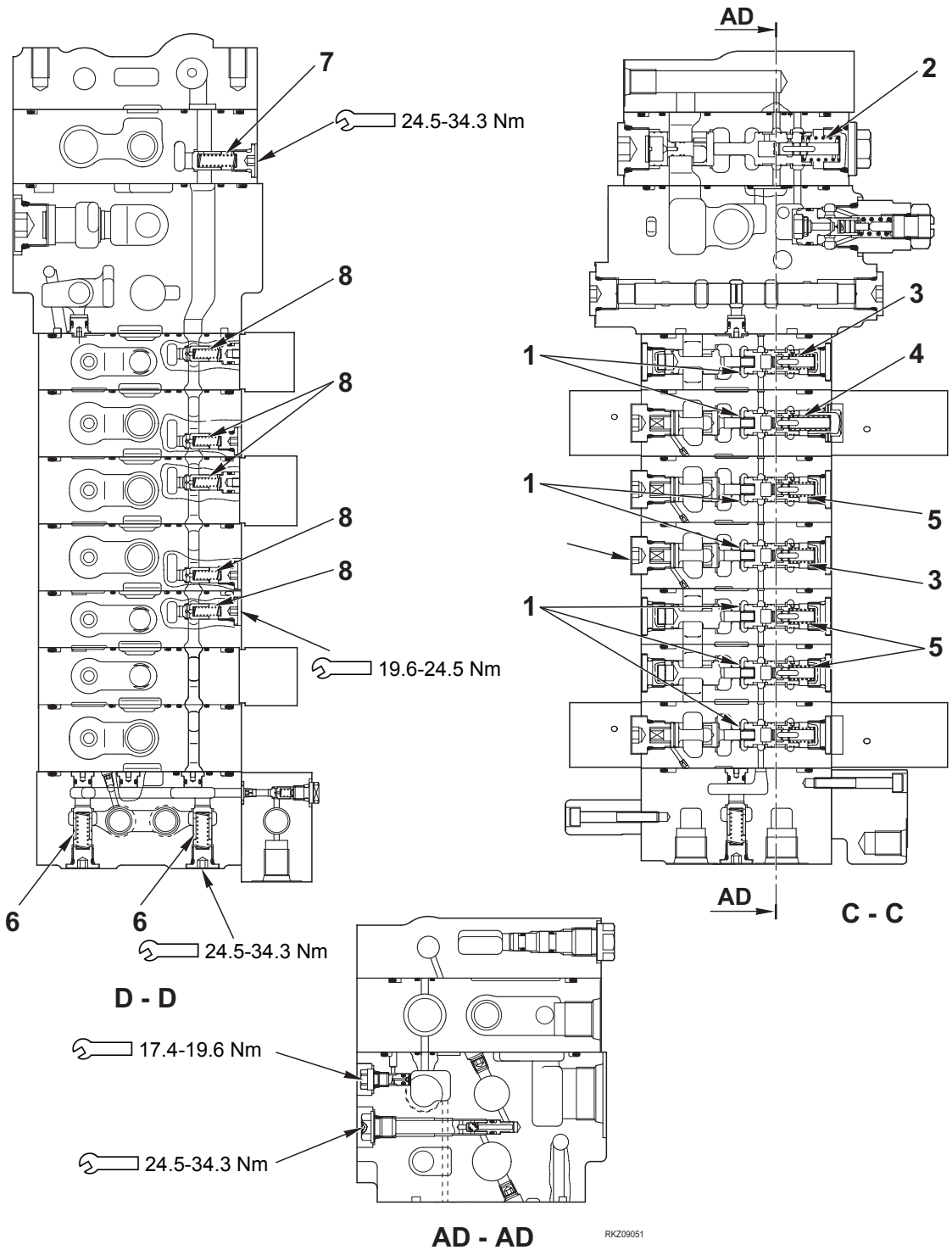


View X


49-58.8 Nm
5
8
137-157 Nm
117.6-161.8 Nm
117.6-161.8 Nm
9
4
3
2
1
10
11
6
7
B - B
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
A - A
K - K
J - J
RKZ09041

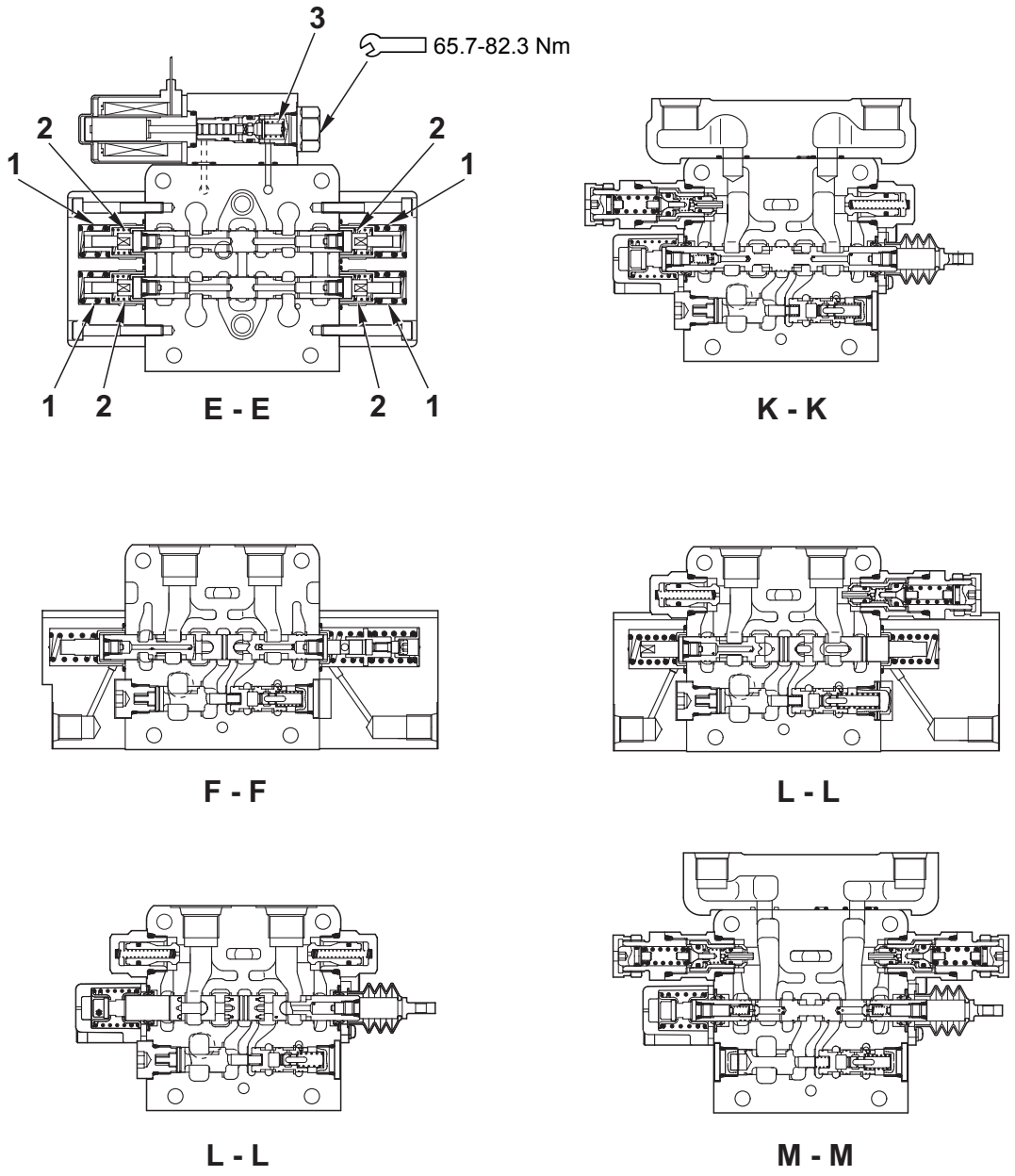
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (shovel arm raise control)	27.1x16.2	26.7	14.4N	–	11.8N	Replace spring
2	Spool return spring (backhoe bucket boom control)	66.5x21.1	25.4	73.5N	–	58.8N	
3	Spool return spring (shovel control)	27.2x16.6	26.7	30.38N	–	34.3N	
4	Spool return spring (boom swing control)	42x20	25.4	75.5N	–	59.6N	
5	Spool return spring (arm control)	65.4x22.1	26.5	73.5N	–	58.8N	
6	Spool return spring (shovel arm float control)	19.4x17.6	19	14.7N	–	11.8N	
7	Spool return spring (shovel arm lower control)	38.7x18	27.6	355.7N	–	284.6N	
8	Priority valve spring	56.8x15.2	48.5	29.6N	–	23.7N	
9	Unloading valve spring	25.5x19.3	18	121.5N	–	97.2N	
10	Spool return spring (Jig arm control)	29x17.5	28.5	22.5N	–	18.0N	
11	Spool return spring (4 in 1 bucket control)	42.2x20	25.4	98.0N	–	78.4N	


AD
7
24.5-34.3 Nm
8
8
8
8
19.6-24.5 Nm
6
6
24.5-34.3 Nm
D - D
2
3
1
4
1
5
3
1
5
AD
C - C
17.4-19.6 Nm
24.5-34.3 Nm
AD - AD
RKZ09051

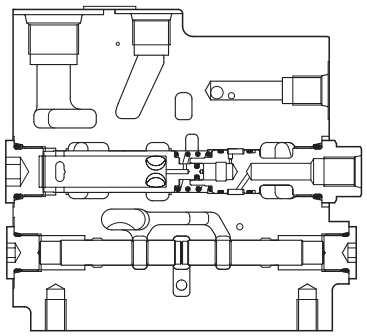
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Pressure compensation valve spring (Shovel arm, backhoe bucket, boom, shovel, boom swing)	15.4x6	8	7.44N	–	5.96N	Replace spring
2	Pressure compensation valve spring (arm)	31.4x14.4	21.8	63.7N	–	51.0N	
3	Pressure compensation valve spring. (Boom swing, backhoe bucket)	18.9x8.4	15	15.7N	–	12.5N	
4	Pressure compensation valve spring. (Front bucket)	37.1x8.6	24	34.3N	–	27.4N	
5	Pressure compensation valve spring. (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	

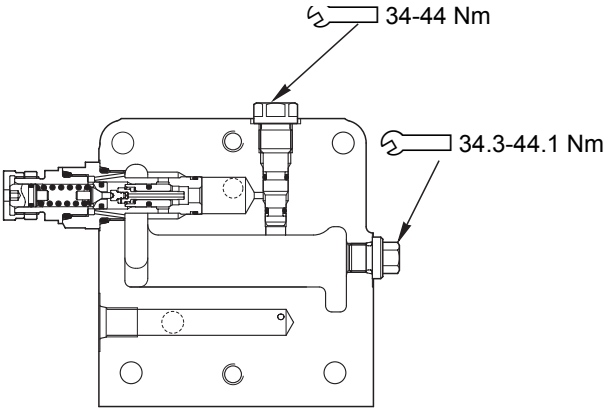


Unit: mm

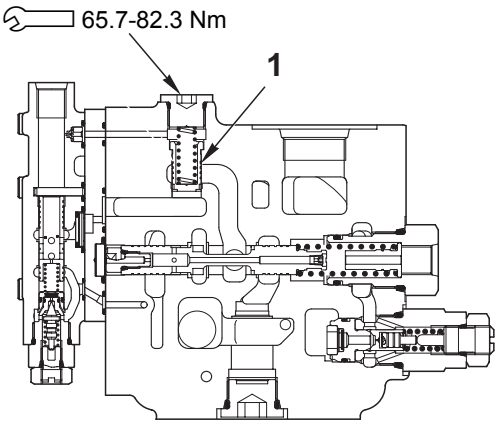
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (Outrigger control)	18.0x18	17.5	39.2N	–	31.4N	Replace spring
2	Spool return spring (Outrigger control	20.2x14.2	10.4	30.4N	–	24.3N	
3	Control valve spring plate lock	13.0x8.8	11	3.92N	–	3.1N	



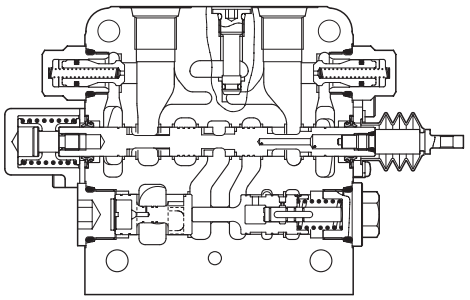
N - N



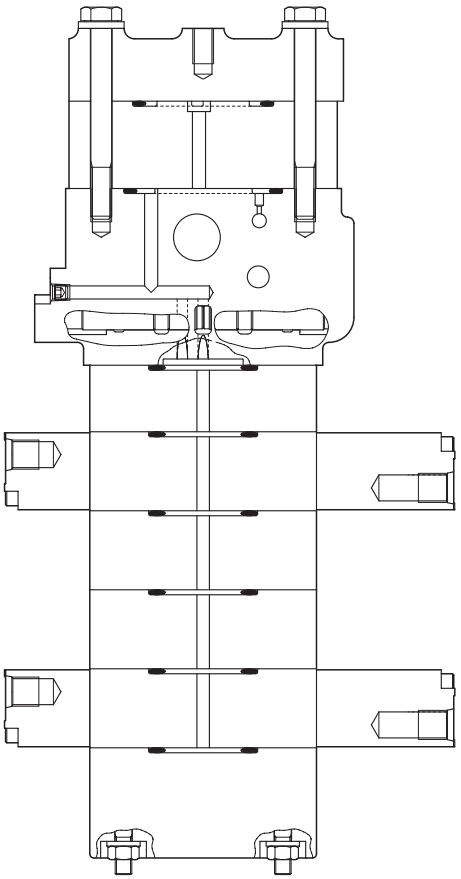
AC - AC



AA - AA



AB - AB



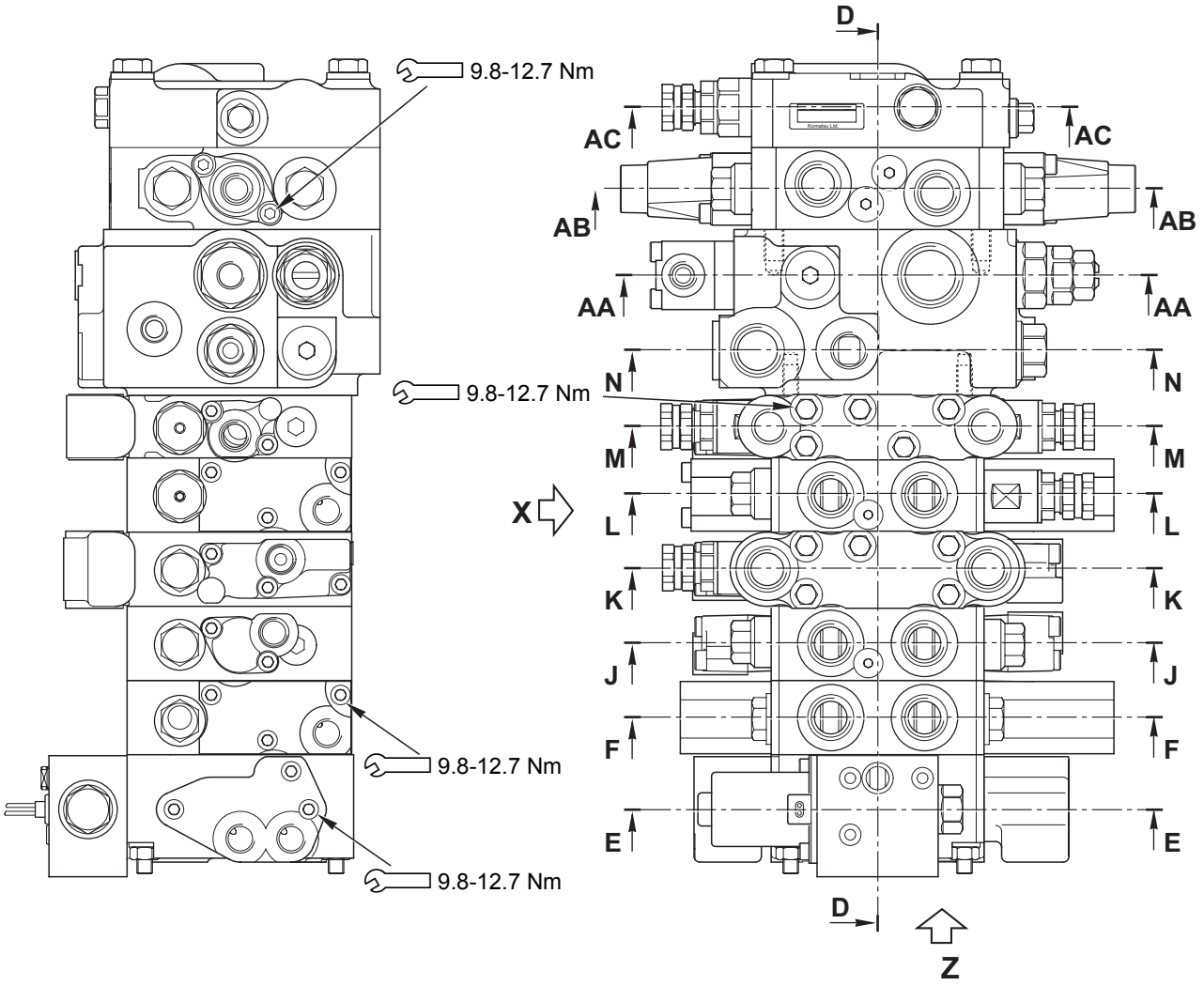
AE - AE

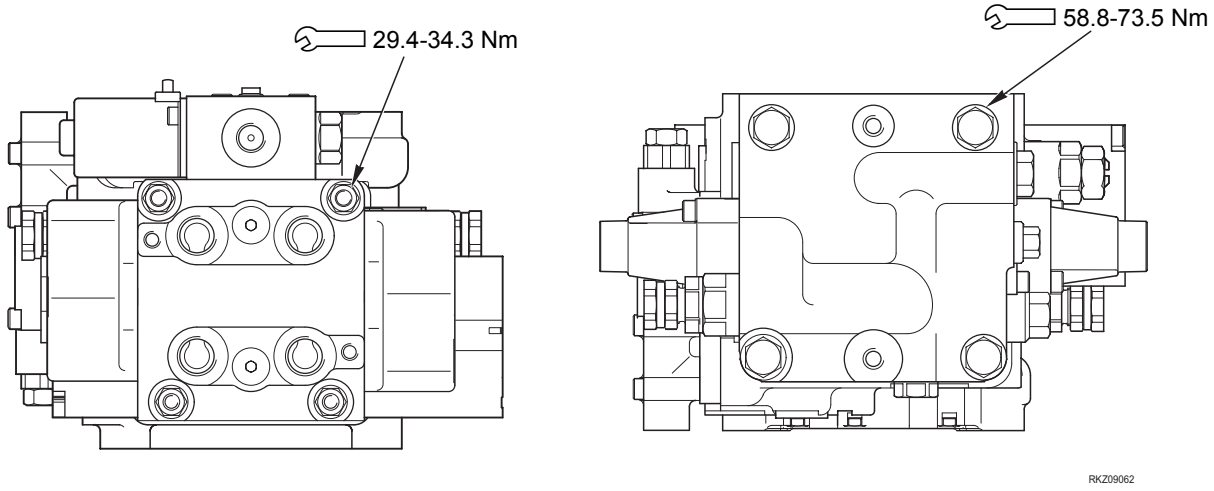
RKZ08892

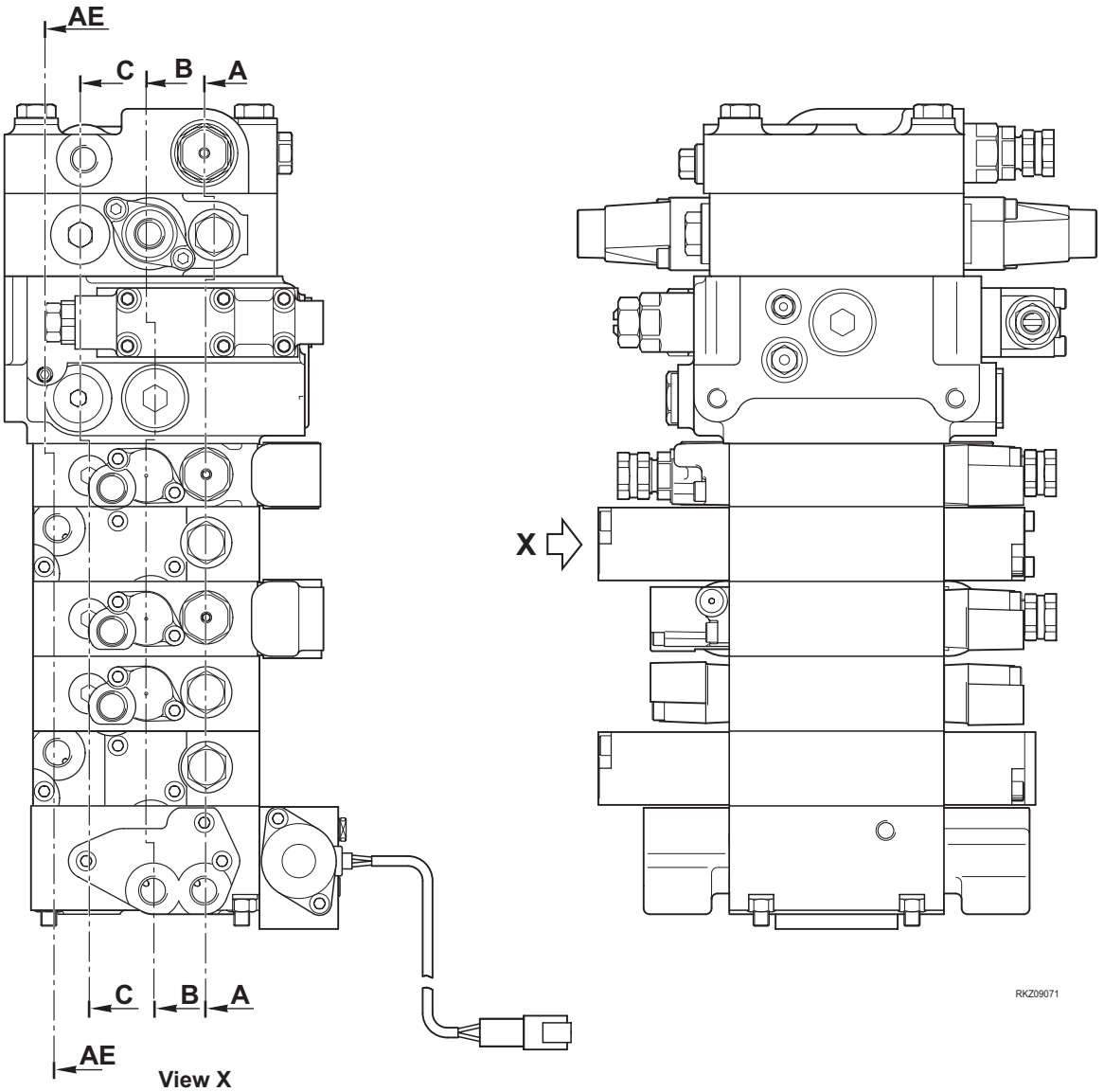
Unit: mm

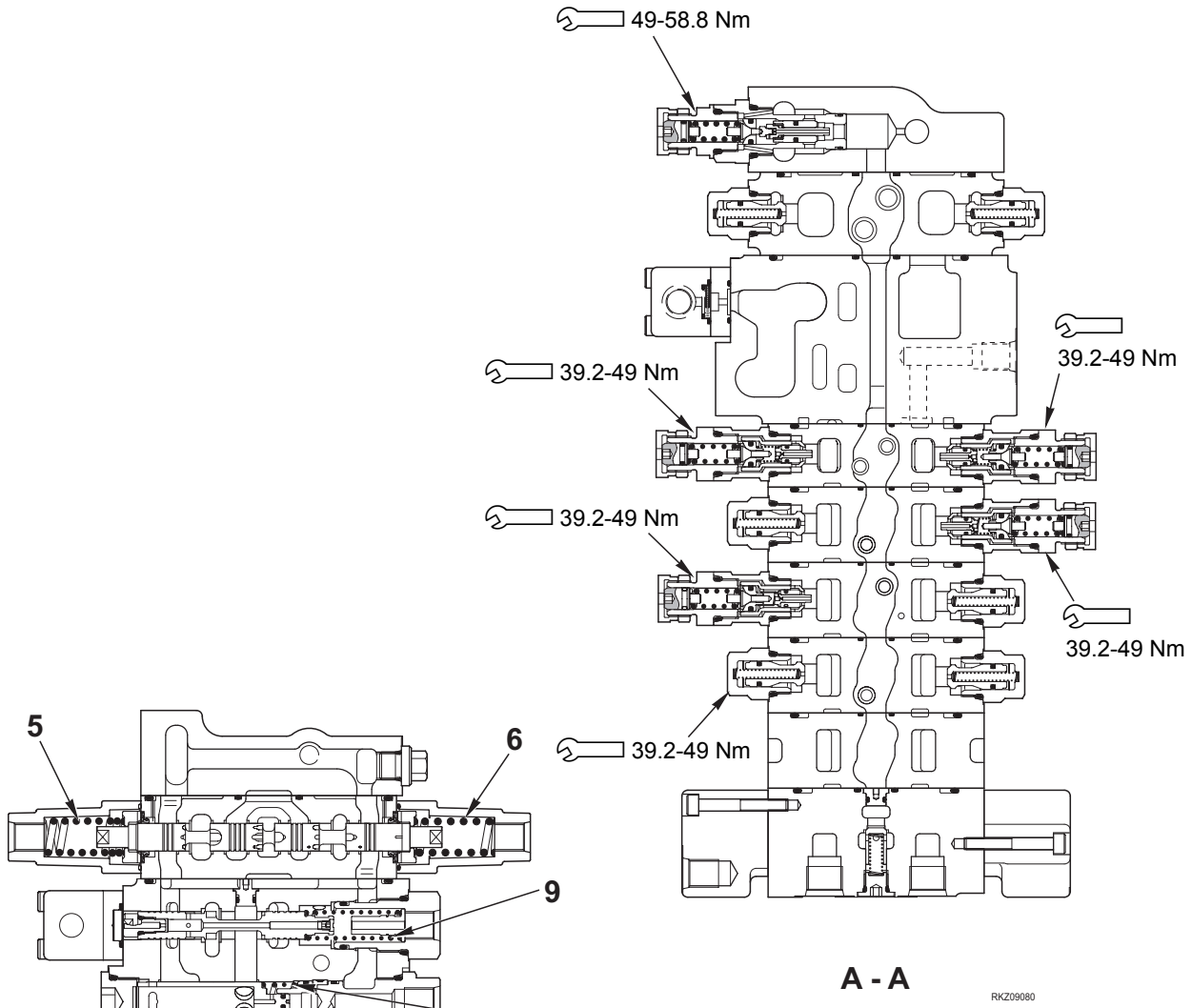
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	Replace spring
1	Pressure compensation valve spring.	31.7x9.2	27.5	43.1N	–	34.5N	

8-SPOOL VERSION (WITH SERVOCONTROL)



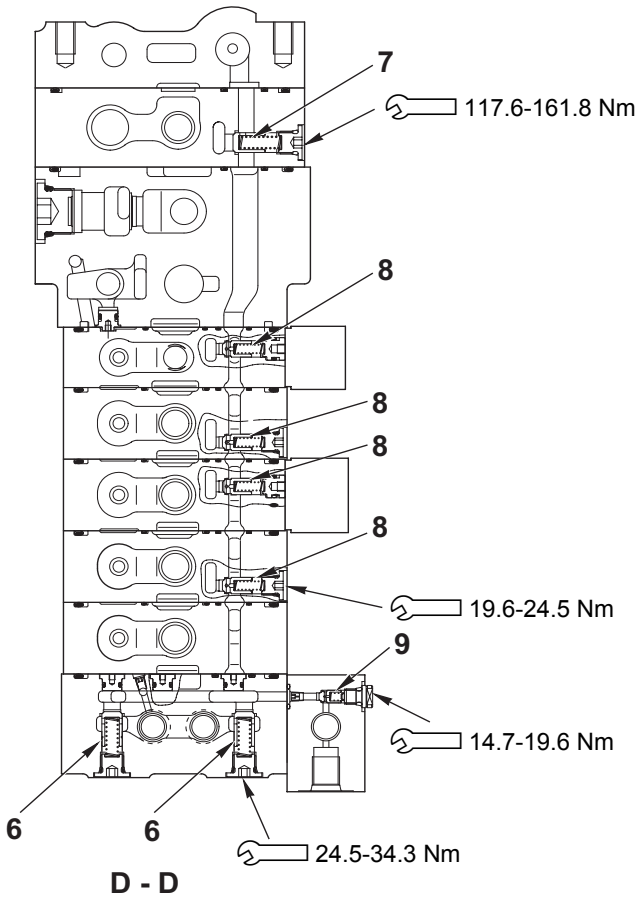



AE
C
B
A
X
C
B
A
AE
View X
RKZ09071

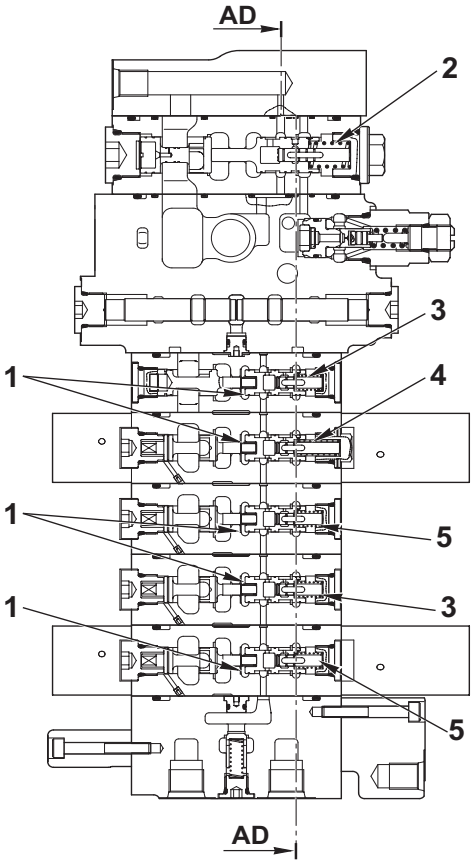

49-58.8 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
A - A
RKZ09080
5
6
9
10
4
3
3
2
2
2
2
1
7
8
B - B

Unit: mm

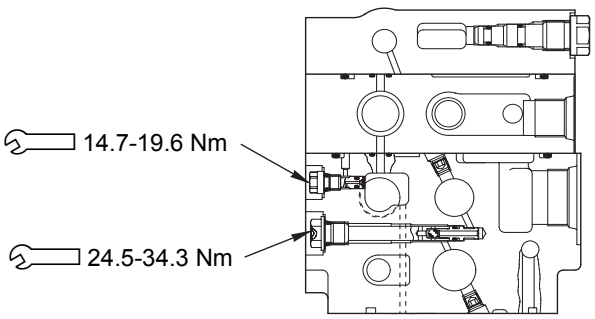
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (shovel arm raise control)	27.1x16.2	26.7	14.7N	–	11.8N	Replace spring
2	Spool return spring (in arm control)	41.1x19.3	40.5	34.3N	–	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	



D - D



C - C

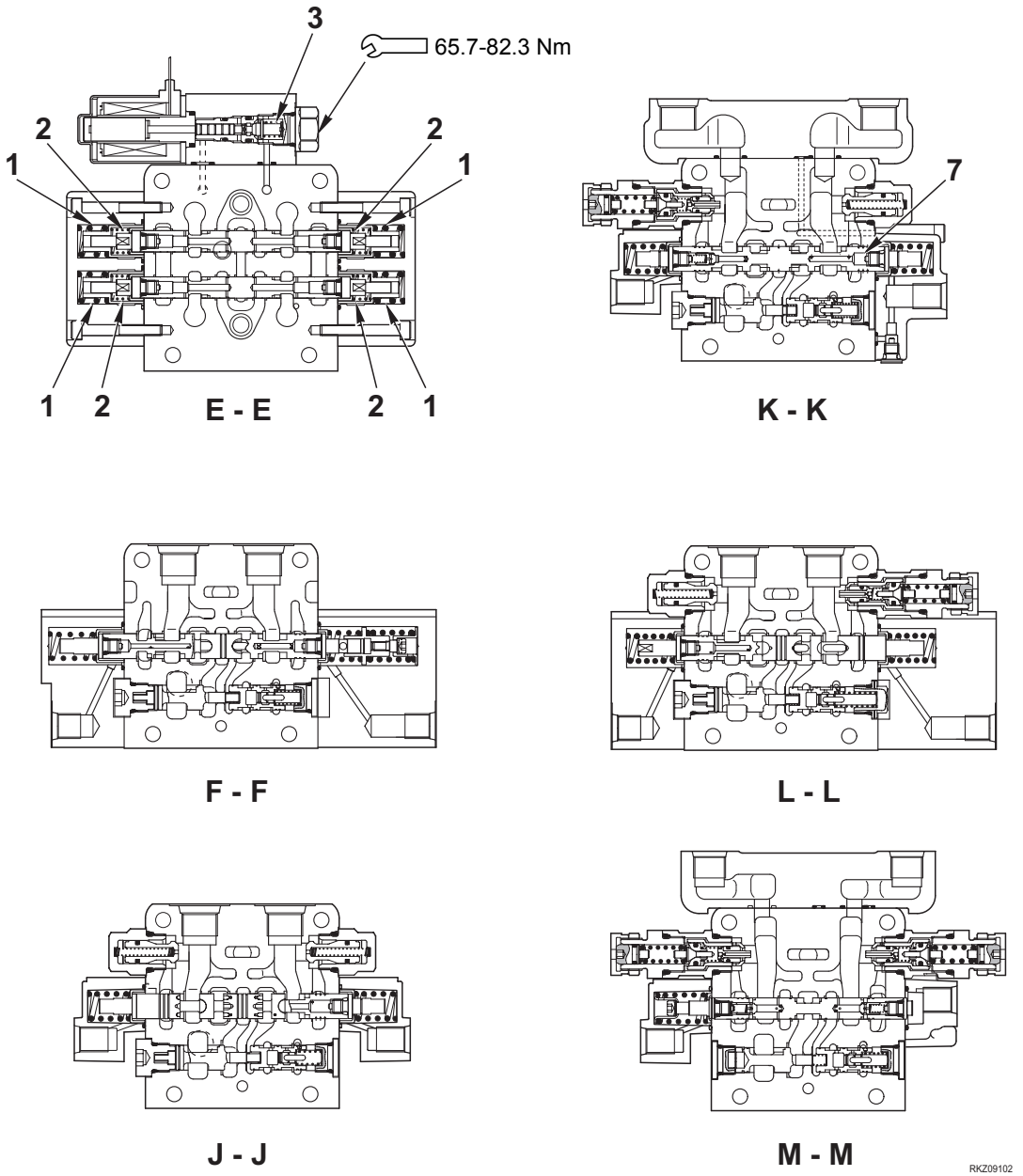


AD - AD

RKZ08341

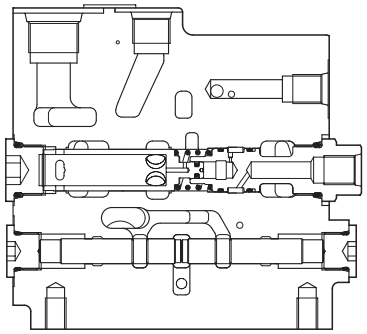
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Pressure compensation valve spring (Shovel arm, backhoe bucket, boom, shovel, boom swing)	15.4x6	8	7.44N	–	5.96N	Replace spring
2	Pressure compensation valve spring (arm)	31.4x14.4	21.8	63.7N	–	51.0N	
3	Pressure compensation valve spring. (Boom swing, backhoe bucket)	18.9x8.4	15	15.7N	–	12.5N	
4	Pressure compensation valve spring. (Front bucket)	37.1x8.6	24	34.3N	–	27.4N	
5	Pressure compensation valve spring. (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	

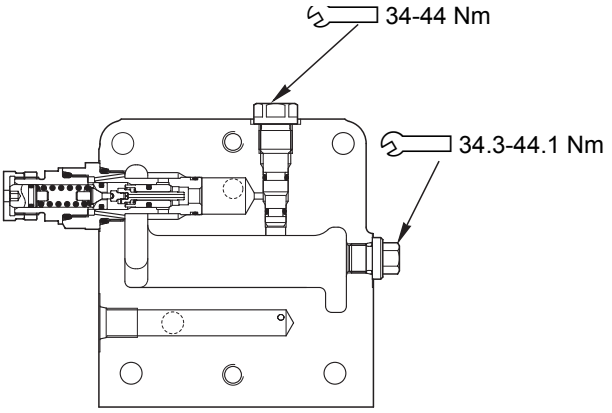


Unit: mm

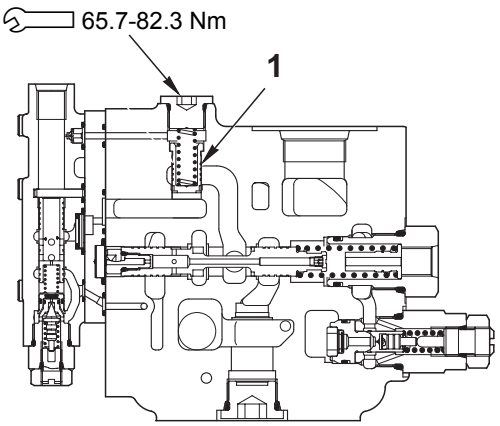
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (Outrigger control)	18.0x18	17.5	39.2N	–	31.4N	Replace spring
2	Spool return spring (Outrigger control	20.2x14.2	10.4	30.4N	–	24.3N	
3	Control valve spring plate lock	13.0x8.8	11	3.92N	–	3.1N	



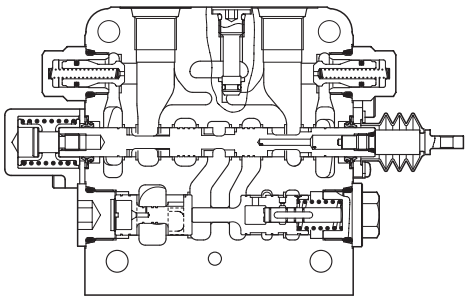
N - N



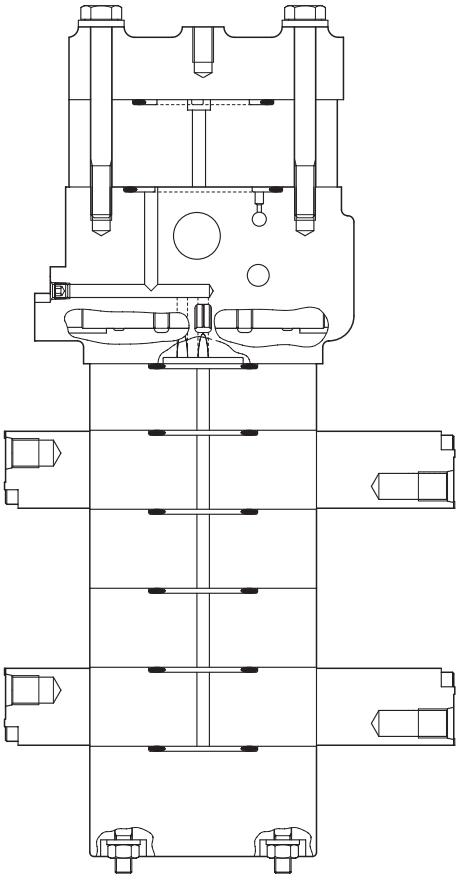
AC - AC



AA - AA



AB - AB



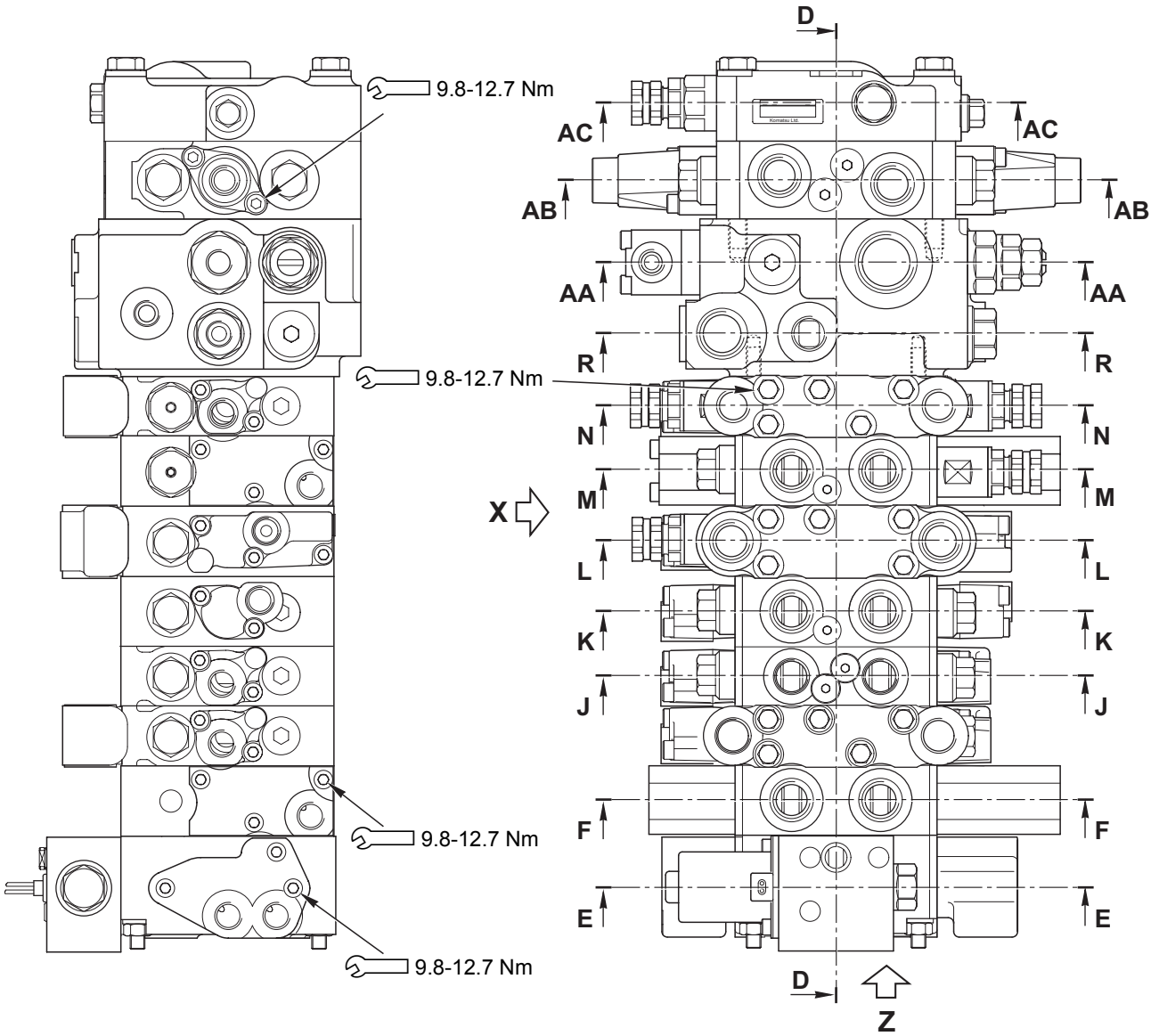
AE - AE

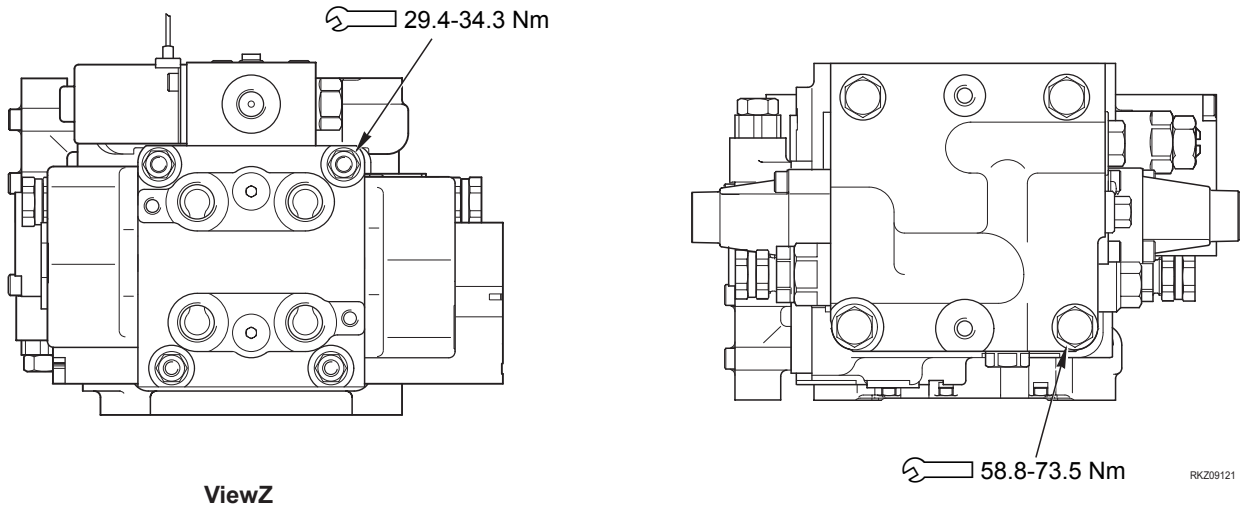
RKZ08892

Unit: mm

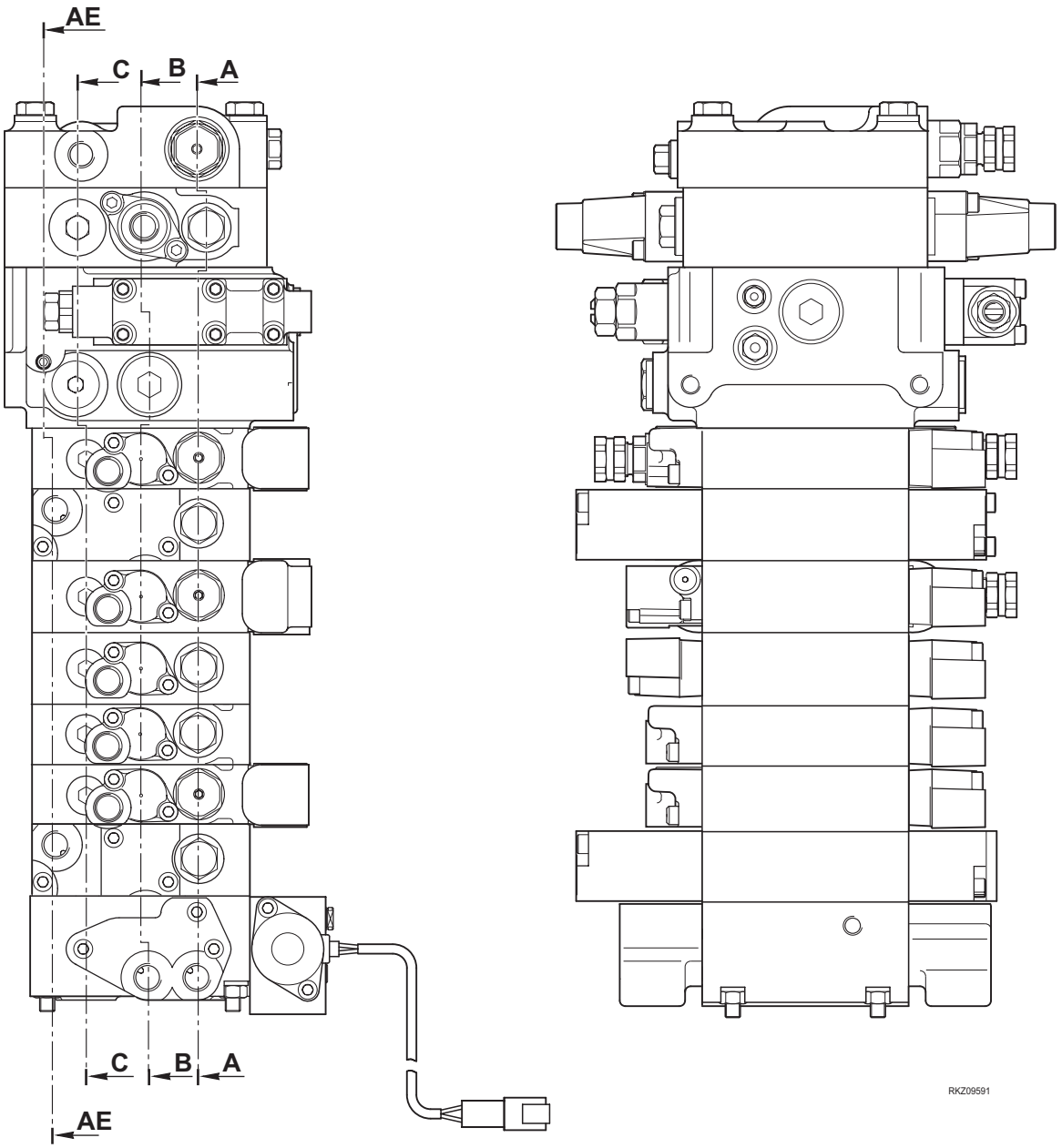
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	Replace spring
1	Pressure compensation valve spring.	31.7x9.2	27.5	43.1N	–	34.5N	

10-SPOOL VERSION (WITH SERVOCONTROL)

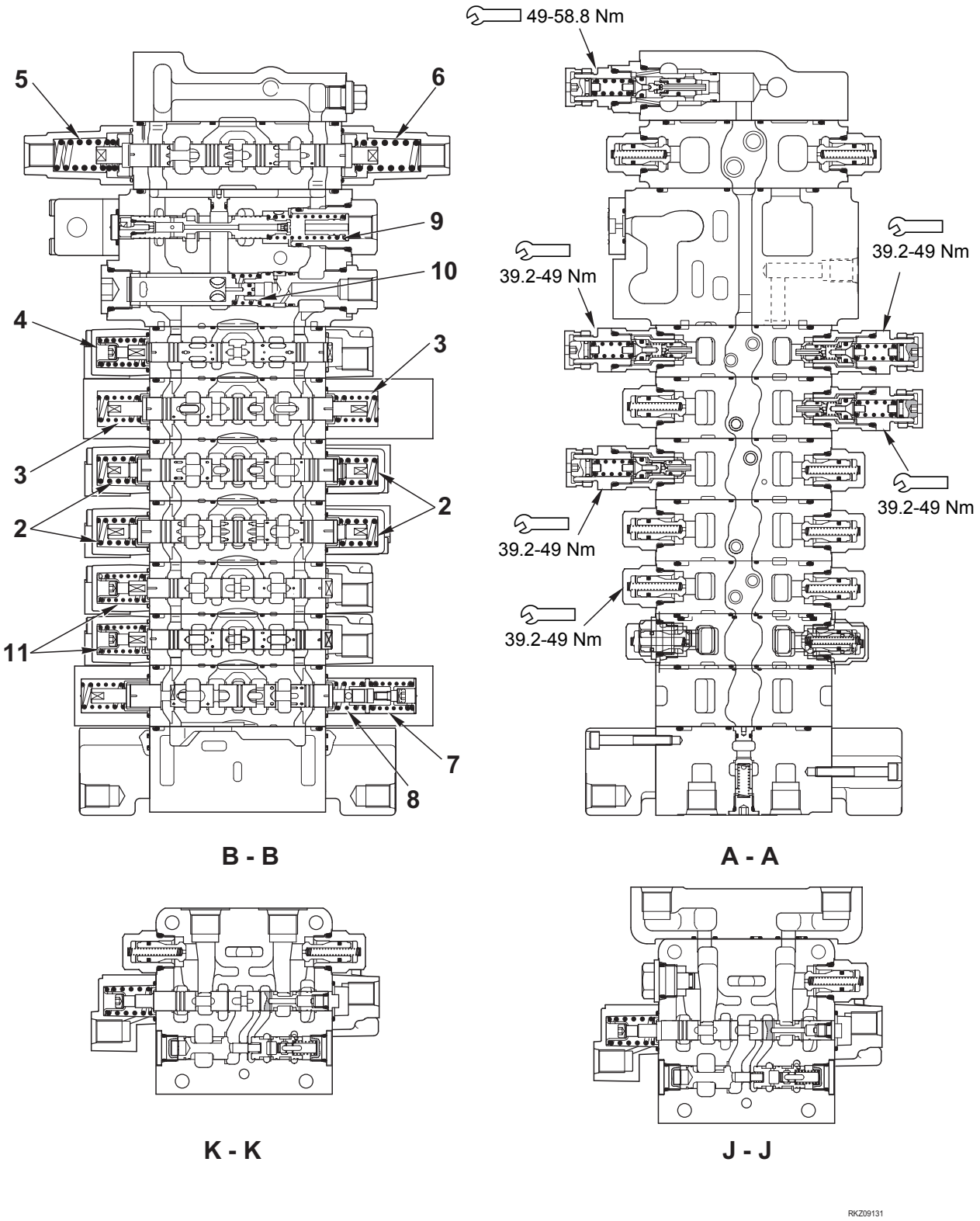




ViewZ

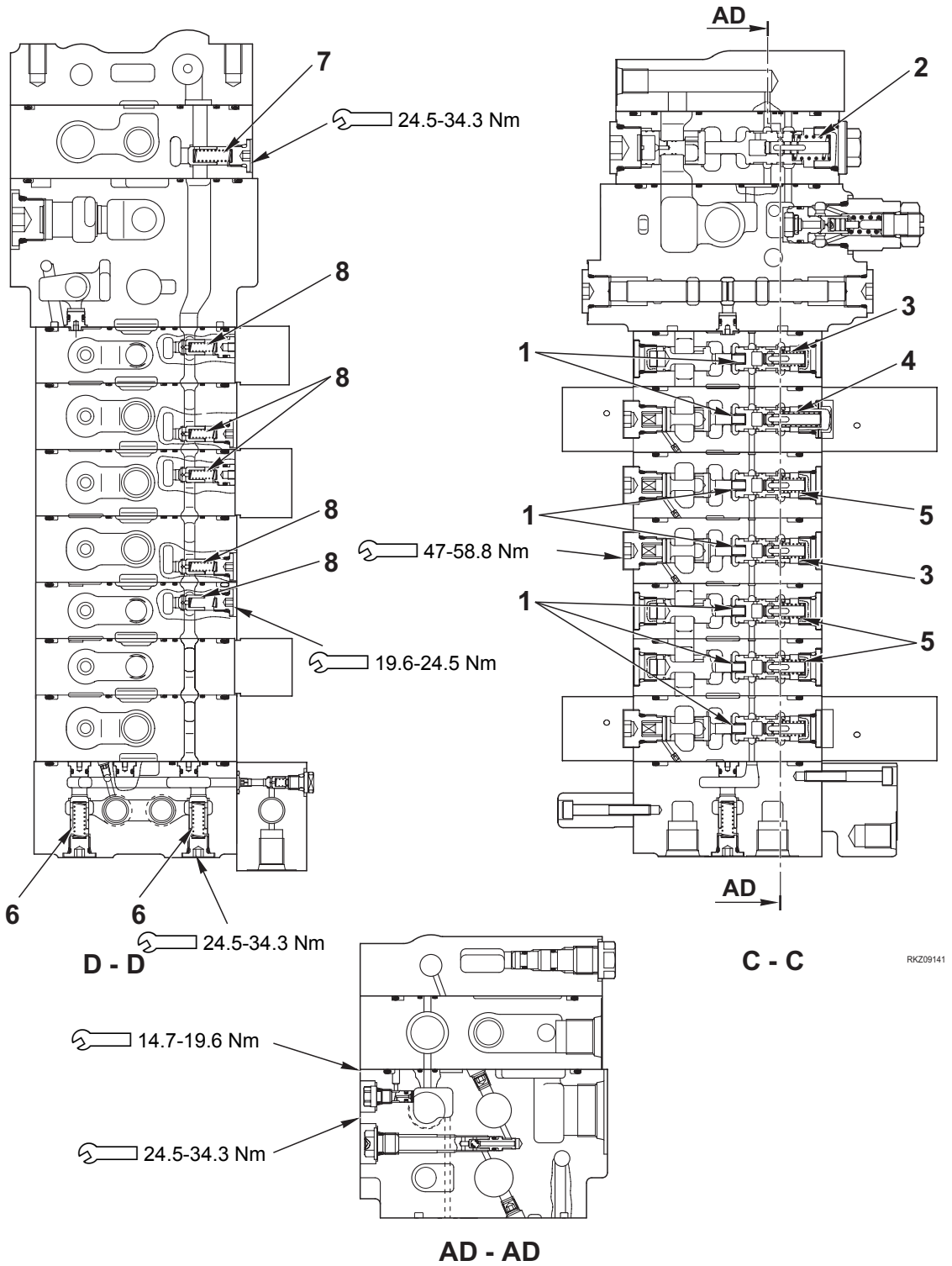


ViewX


49-58.8 Nm
5
6
9
10
4
3
3
2
2
11
7
8
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
39.2-49 Nm
B - B
A - A
K - K
J - J
RKZ09131

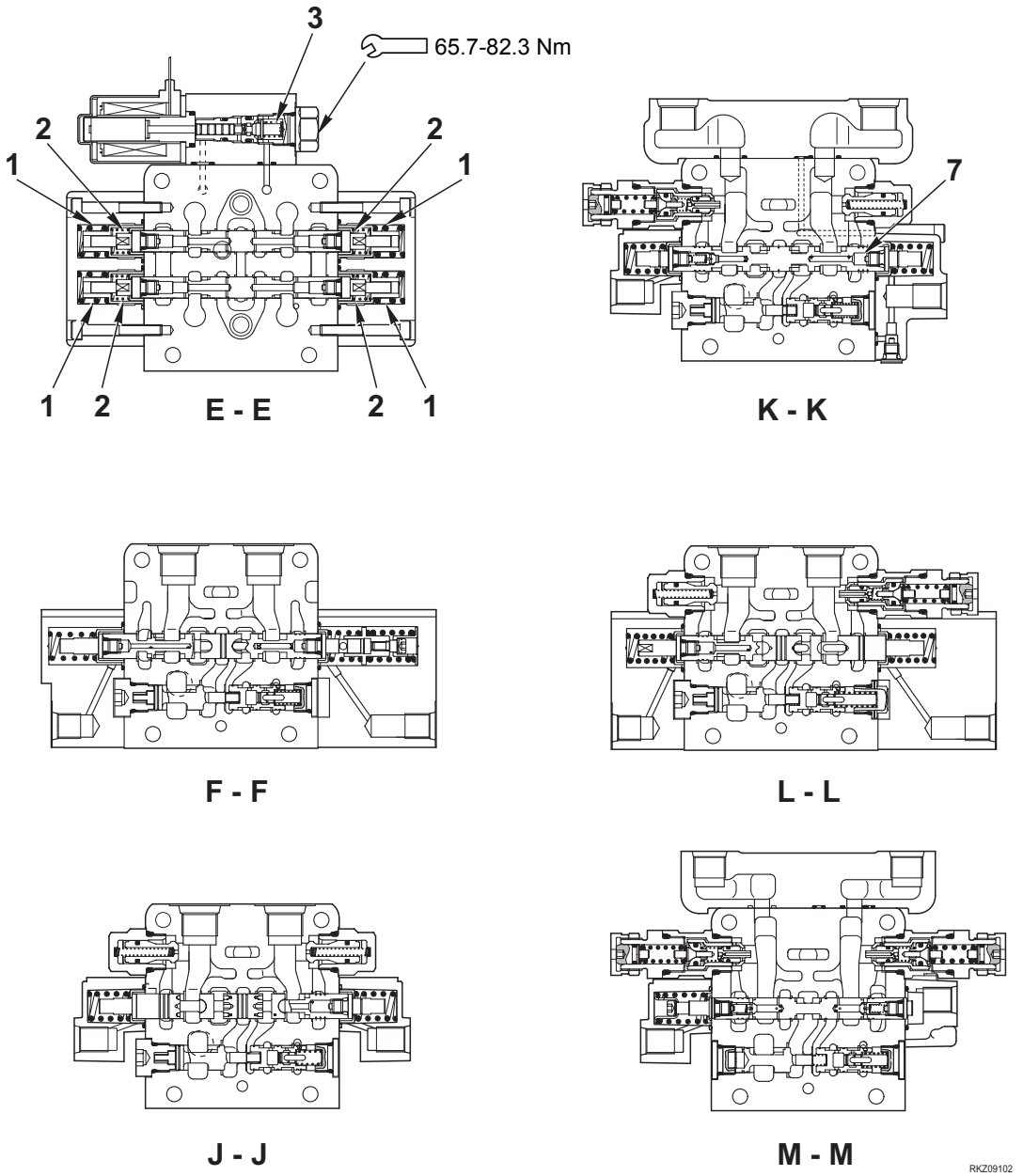
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed 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	Replace spring
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	


AD
7
24.5-34.3 Nm
8
8
8
8
47-58.8 Nm
19.6-24.5 Nm
6
6
24.5-34.3 Nm
D - D
2
3
1
4
1
5
3
1
5
AD
C - C
RKZ09141
14.7-19.6 Nm
24.5-34.3 Nm
AD - AD

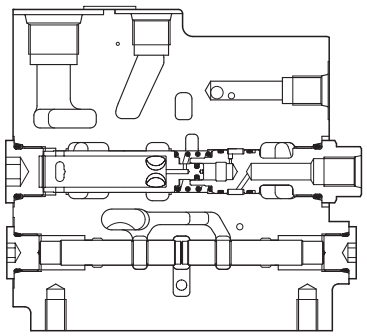
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Pressure compensation valve spring (Shovel arm, backhoe bucket, boom, shovel, boom swing, jig arm, 4 in 1 bucket)	15.4x6	8	7.44N	–	5.96N	Replace spring
2	Pressure compensation valve spring (arm)	31.4x14.4	21.8	63.7N	–	51.0N	
3	Pressure compensation valve spring. (Boom swing, backhoe bucket)	18.9x8.4	15	15.7N	–	12.5N	
4	Pressure compensation valve spring. (Front bucket)	37.1x8.6	24	34.3N	–	27.4N	
5	Pressure compensation valve spring. (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	

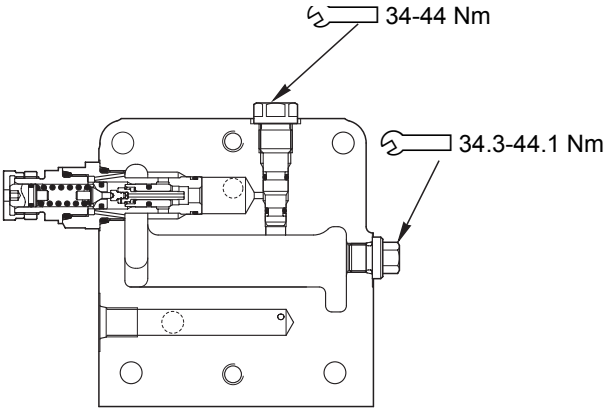


Unit: mm

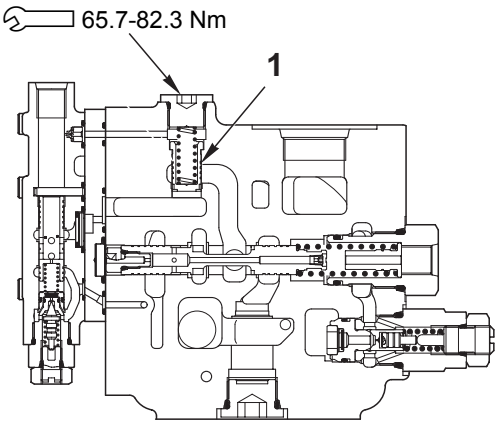
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Spool return spring (Outrigger control)	18.0x18	17.5	39.2N	–	31.4N	Replace spring
2	Spool return spring (Outrigger control	20.2x14.2	10.4	30.4N	–	24.3N	
3	Control valve spring plate lock	13.0x8.8	11	3.92N	–	3.1N	



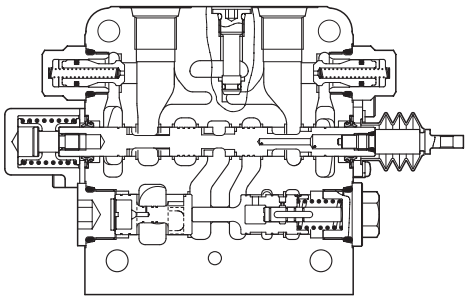
N - N



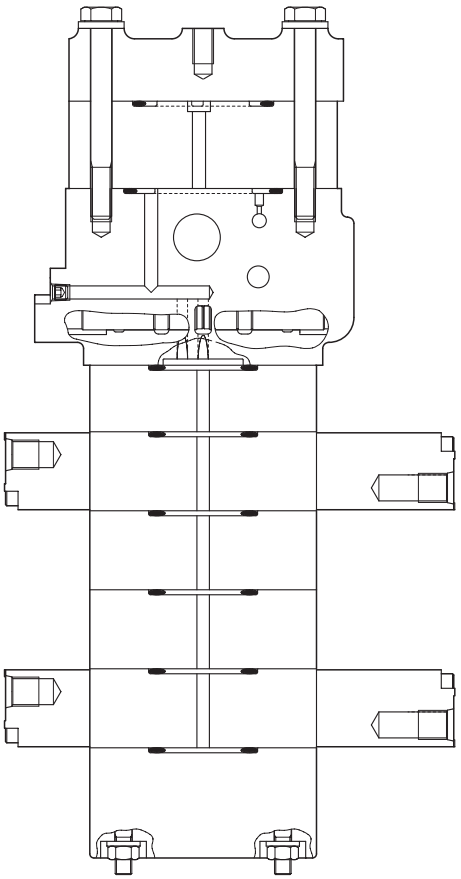
AC - AC



AA - AA



AB - AB



AE - AE

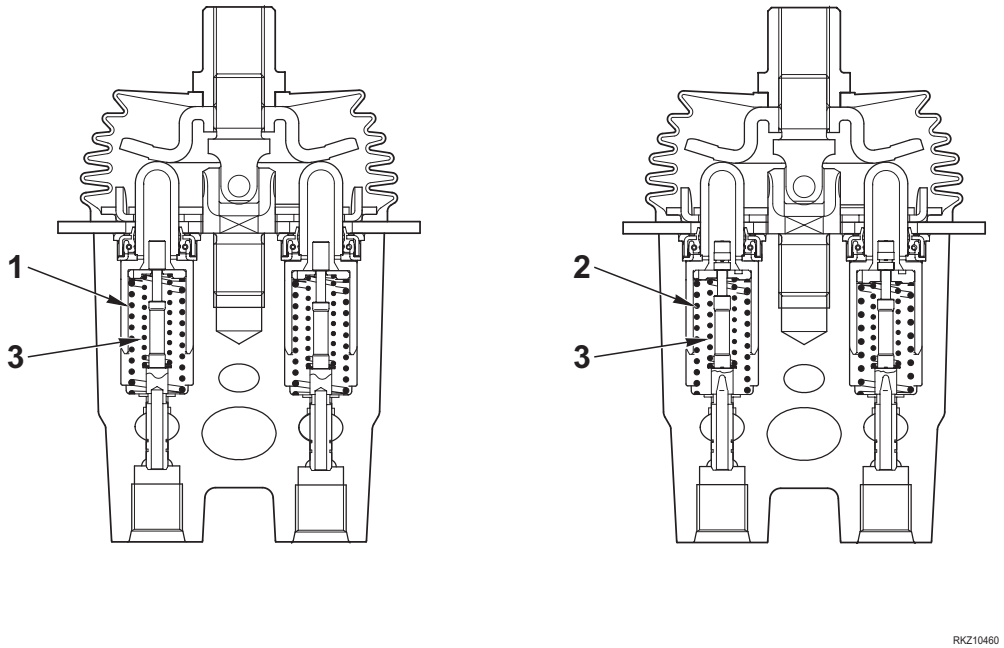
RKZ08892

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	Replace spring
1	Pressure compensation valve spring.	31.7x9.2	27.5	43.1N	–	34.5N	

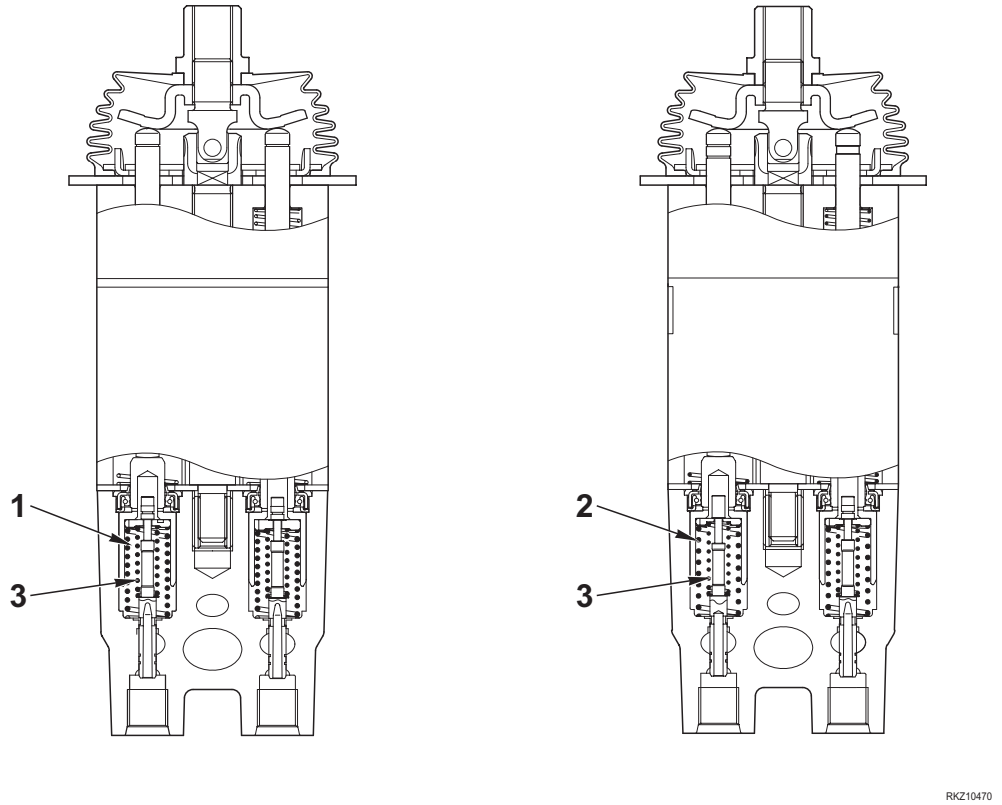
PPC VALVES

SHOVEL CONTROL



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Return spring (outer) (for ports P1 and P2)						Replace
2	Return spring (outer) (for ports P3 and P4)						
3	Adjusting screw (inner)						

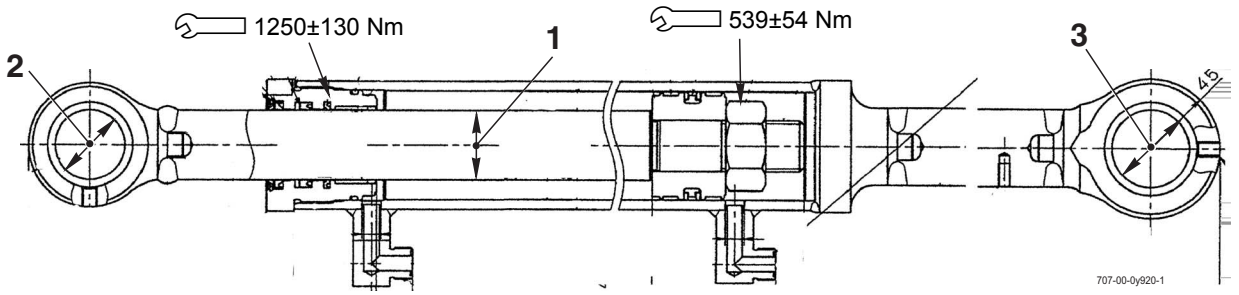


Unit: mm

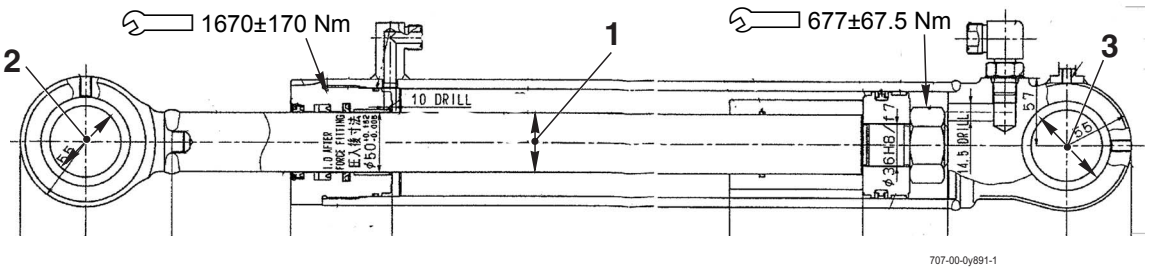
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Return spring (outer) (for ports P1 and P2)						Replace
2	Return spring (outer) (for ports P3 and P4)						
3	Adjusting screw (inner)						

SHOVEL CYLINDERS

DUMP CYLINDER



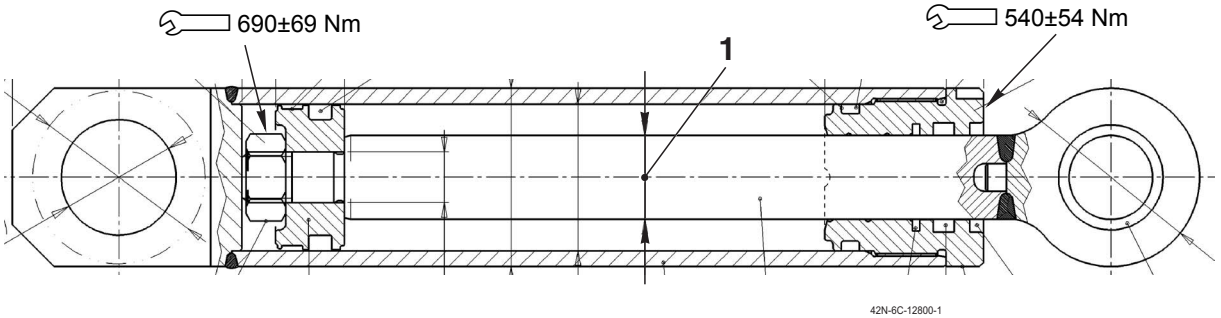
RAISE CYLINDER



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 −0.076	+ 0.162 + 0.005	0.035	0.238	Replace
		Dump	45	−0.025 −0.064	+ 0.141 + 0.004	0.029	0.205	
2	Tolerance between bushing and piston head mounting pin	Lifting	60	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	Replace pin and bushing
		Dump	45	−0.050 −0.089	+ 0.142 + 0.080	0.130	0.231	
3	Tolerance between bushing and cylinder mounting pin	Lifting	60	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	
		Dump	50	−0.050 −0.089	+ 0.142 + 0.080	0.130	0.231	

4 IN 1 BUCKET

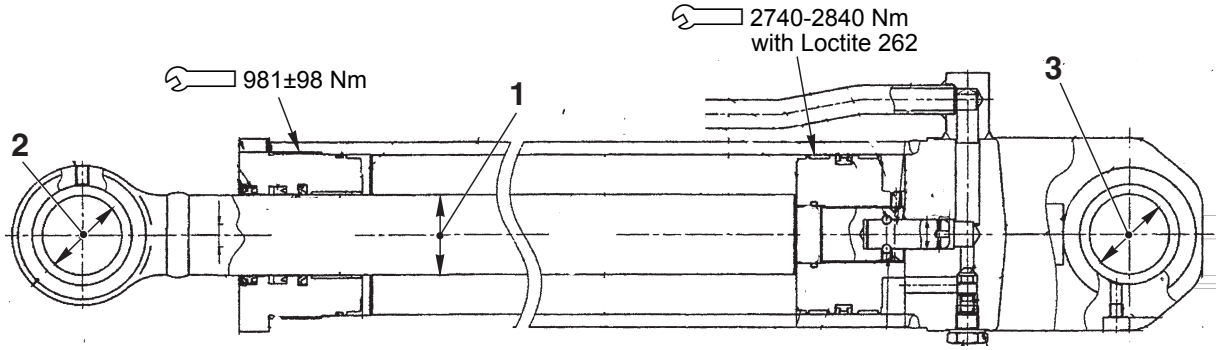


Unit: mm

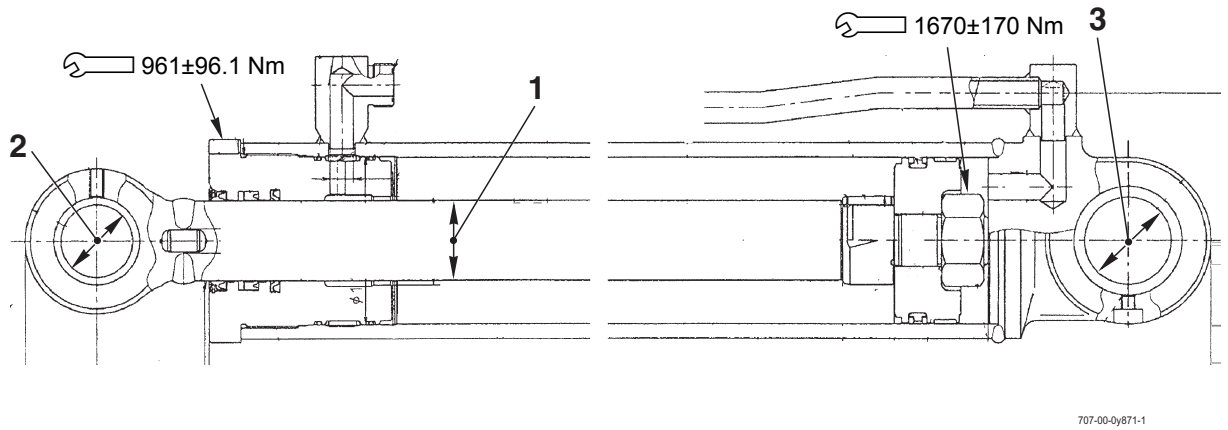
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free installed x Øe	Installed length	Installed load	Free installed	Installed load	
1	Tolerance between piston rod and head	40	−0.025 −0.050	+ 0.064 + 0.025	0.05	0.114	Replace
2	Tolerance between bushing and piston head mounting pin	40	±0.150				

BACKHOE CYLINDERS

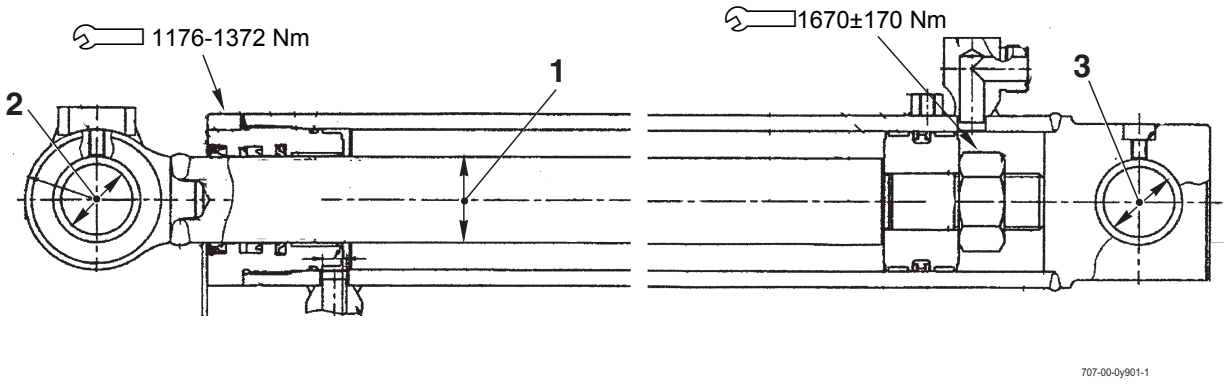
BOOM



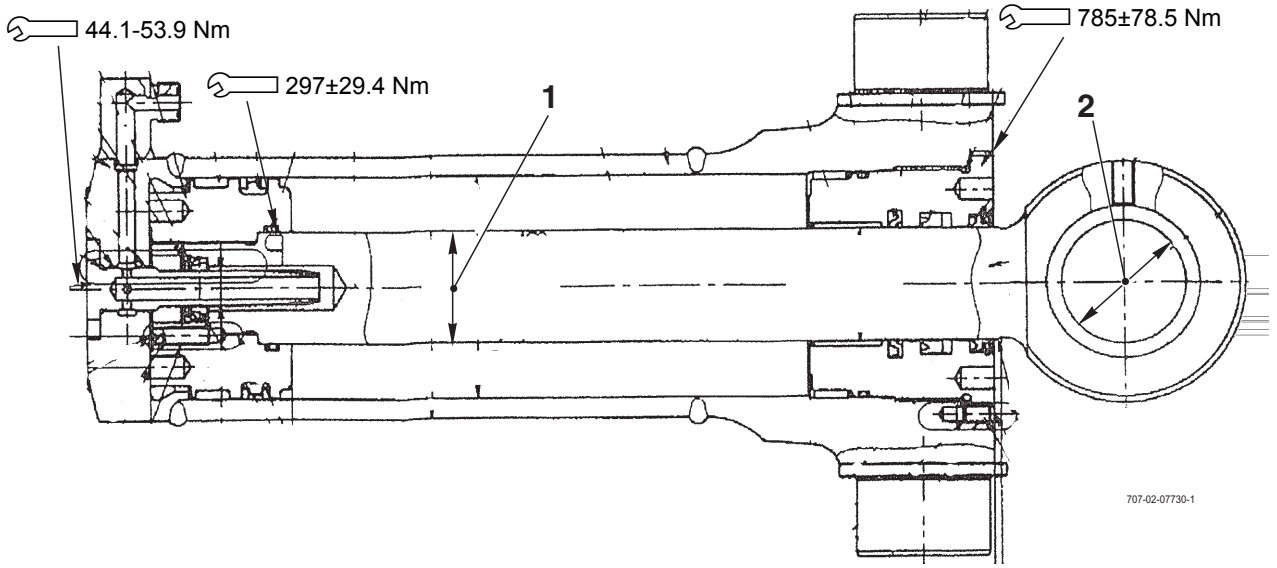
ARM



BUCKET



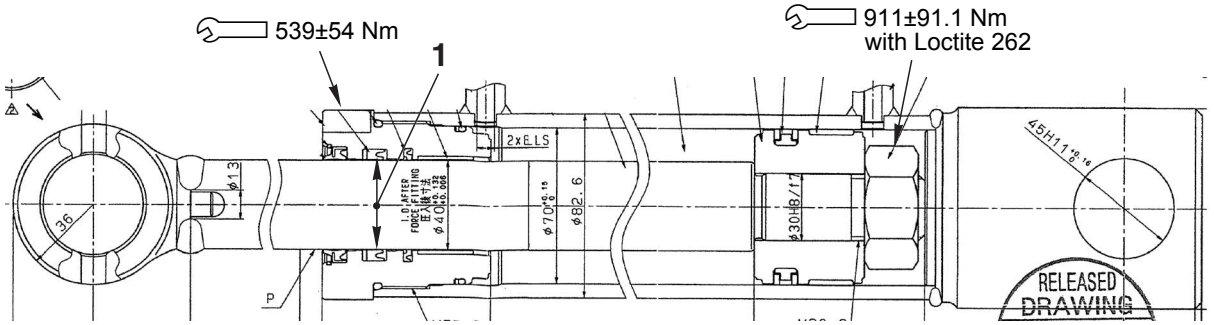
BOOM SWING



Unit: mm

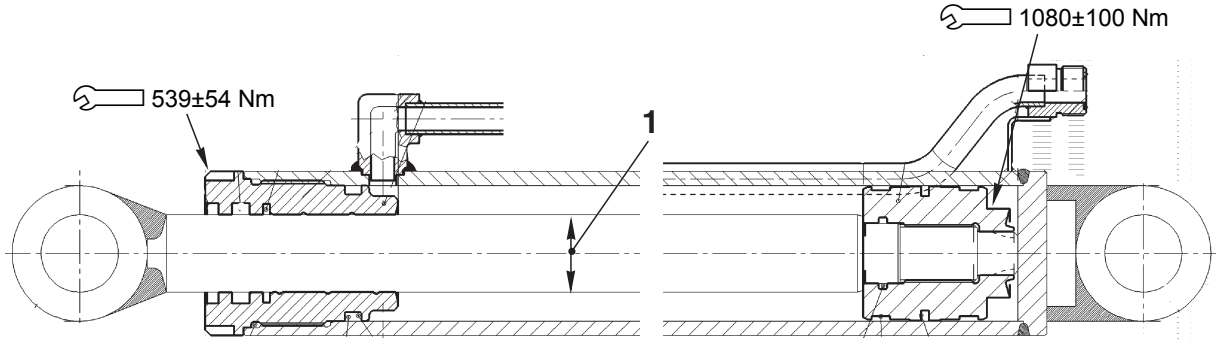
No.	Check item	Cylinder	Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and head	Boom	60	−0.030 −0.076	+ 0.051 + 0.005	0.035	0.227	Replace
		Arm	55	−0.030 −0.076	+ 0.046 0	0.030	0.132	
		Bucket	55	−0.030 −0.076	+ 0.051 + 0.005	0.035	0.227	
		Boom swing	50	-0.030 −0.076	+ 0.164 + 0.007	0.037	0.240	
2	Tolerance between bushing and piston head mounting pin	Boom	60	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	
		Arm	50	−0.050 −0.089	+ 0.142 + 0.080	0.130	0.231	Replace pin and bushing
		Bucket	45	−0.050 −0.089	+ 0.142 + 0.080	0.130	0.231	
		Boom swing	55	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	
3	Tolerance between bushing and cylinder mounting pin	Boom	60	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	
		Arm	60	−0.060 −0.106	+ 0.174 + 0.100	0.160	0.280	
		Bucket	45	−0.050 −0.089	+ 0.142 + 0.080	0.130	0.231	

OUTRIGGERS



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JIG ARM



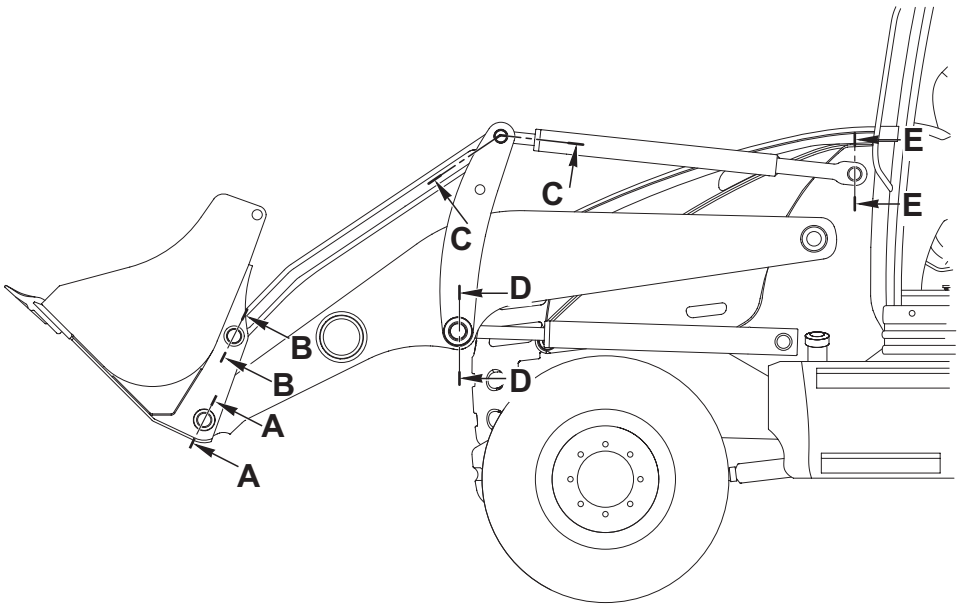
42N-6C-13301-1

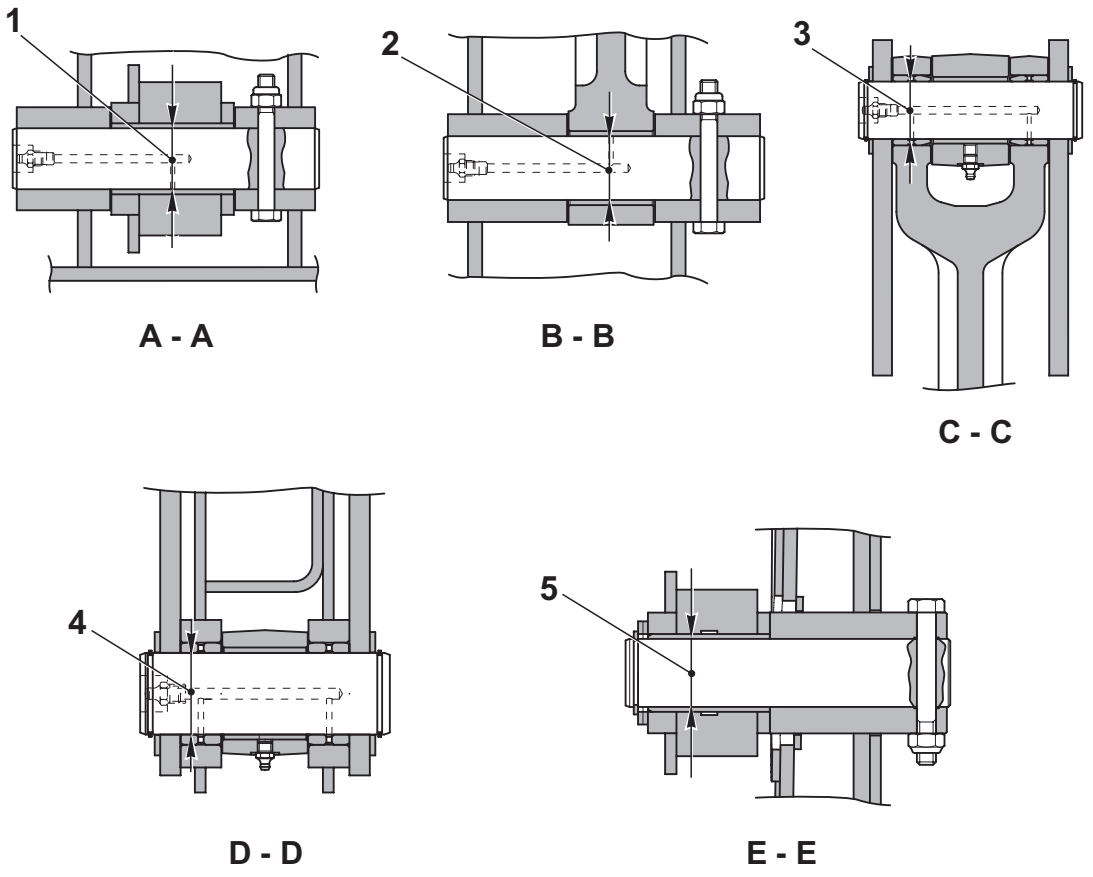
Unit: mm

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 −0.064	+ 0.132 + 0.006	0.031	0.196	Replace
		Jig arm	40	−0.025 −0.050	+ 0.064 + 0.025	0.050	0.114	

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FRONT WORKING EQUIPMENT

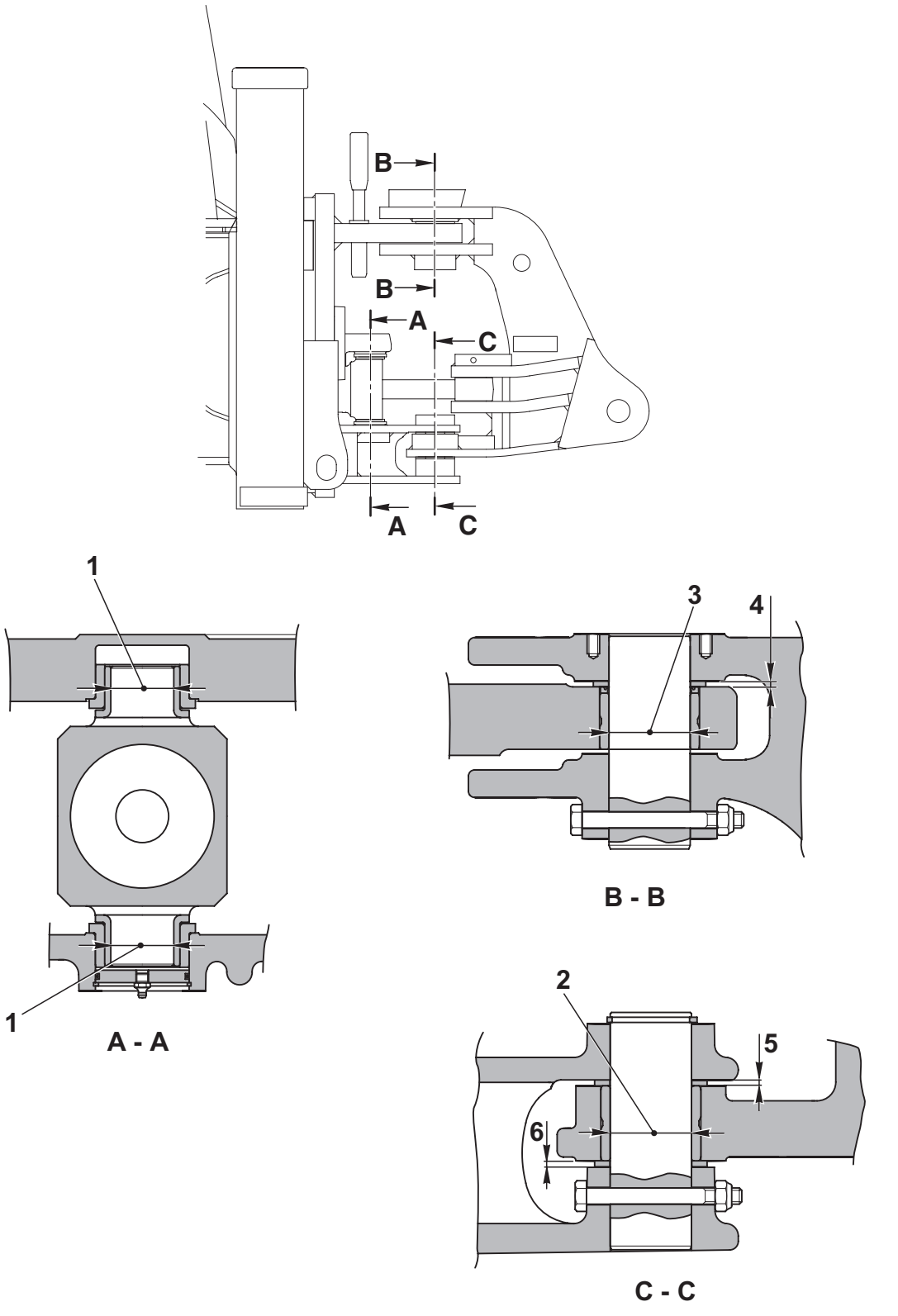




Unit: mm

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 −0.089	+ 0.080 + 0.240	0.130–0.329		Replace
2	Clearance between bushing and link mounting pin	45	−0.050 −0.089	+ 0.080 + 0.240	0.130–0.329		
3	Clearance between bushing and fulcrum link mounting pin	45	−0.050 −0.089	+ 0.080 + 0.119	0.130–0.208		
4	Clearance between bushing and link mounting pin	60	−0.060 −0.106	+ 0.137 + 0.197	0.143–0.303		
5	Clearance between bushing and boom mounting pin	50	−0.050 −0.089				

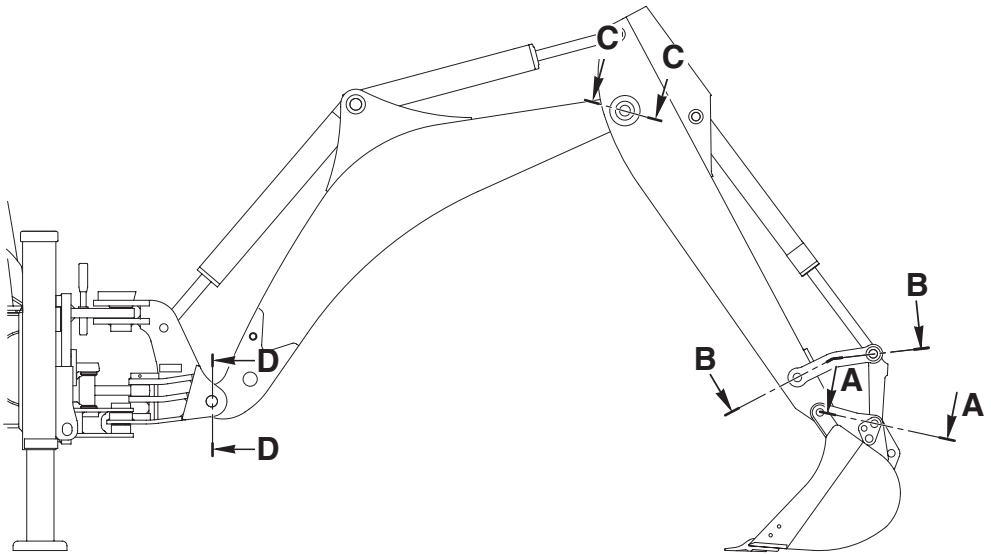
SWING BRACKET

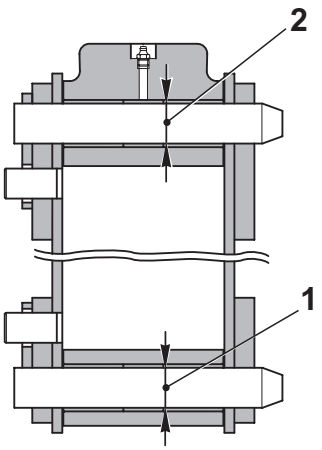


Unit: mm

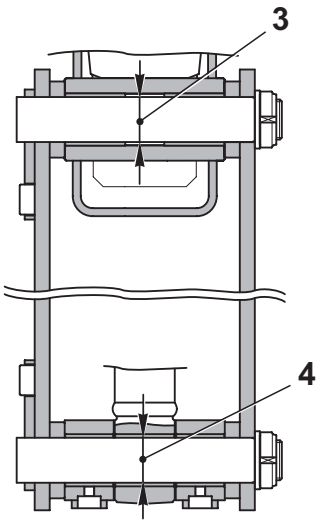
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between rotating bushing and boom swing cylinder bushing	60	−0.010 −0.085	+ 0.090 + 0.060	0.070–0.175		Replace bushing and pin
2	Clearance between bushing and (lower) swing bracketrotating pin	65	−0.060 −0.106	+ 0.190 + 0.264	0.250–0.370		
3	Clearance between bushing and (upper) swing bracketrotating pin	65	−0.060 −0.106	+ 0.190 + 0.264	0.250–0.370		
4	Upper shim thickness	Standard size			Limit size		
		2.50 ±0.1					
5	Central shim thickness	4.75 ±0.1					
6	Lower shim thickness	4.75 ±0.1					

BACKHOE WORKING EQUIPMENT

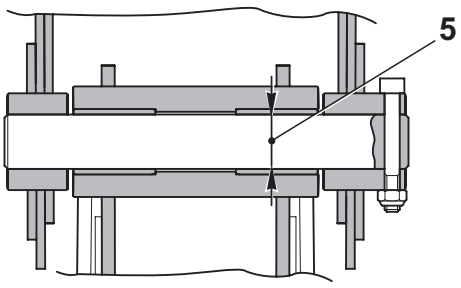




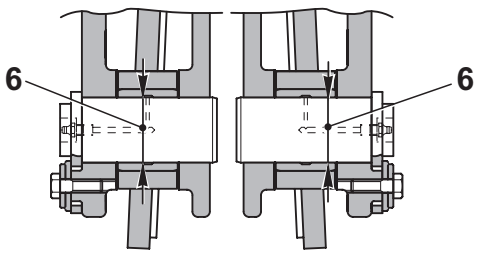
A - A



B - B



C - C



D - D

RKZ10500

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 −0.089	—0.080 —0.240	0.130–0.329		Replace
2	Clearance between arm bushings and bucket mounting pin	45	−0.050 −0.089	—0.080 —0.240	0.130–0.329		
3	Clearance between arm bushings and lever mounting pin	45	−0.050 −0.089	—0.080 —0.240	0.130–0.329		
4	Clearance between bushings and tilt lever mounting pin	45	−0.050 −0.089	—0.080 —0.240	0.130–0.329		
5	Clearance between bushings and arm mounting pin	50	−0.050 −0.089	—0.080 —0.119	0.130–0.208		
6	Clearance between bushings and boom mounting pin	60	−0.060 −0.106	—0.137 —0.197	0.197–0.303		

90 OTHER

ELECTRICAL DIAGRAM (STANDARD VERSION) .. 3

ELECTRICAL DIAGRAM (STANDARD VERSION)

Nome/Item	Descrizione	Description	KUE P/N
A6	CENTRALINA FUNZIONI MACCHINA	Function machine unit	
B13	Sensore ritorno to dig	Return to dig sensor	
B59	Livello olio freni	Brake oil low level switch	
B97	AVVISATORE ACUSTICO POSTERIORE	Rear horn switch	
B105	Sensore temperatura olio trasmissione	Transmission oil temperature sender	
B111	Galleggiante livello carburante	Fuel level sender	
B112	Termostore	Thermistor	
B113	Filtro aria	Air filter switch	
B115	Sensore press. olio motore	Engine oil pressure switch	
B121	Avvisatore acustico	Horn	
E156	Fanale posteriore DX	Rear right light	
E154	Fanale posteriore SX	Rear left light	
E155	LUCE DIREZIONALE SX	LEFT INDICATOR LIGHT	
E155	LUCE DIREZIONALE DX	RIGHT INDICATOR LIGHT	
E136	Faro di lavoro posteriore DX laterale	Lateral rear right working light	
E138	Faro di lavoro posteriore SX laterale	Lateral rear left working light	
E143	Faro lavoro ant. DX lat.	Lateral front right working light	
E146	Faro di lavoro anteriore SX laterale	Lateral front left working light	
E147	Luce di direzione SX	Left indicator	
E148	Presa girofaro	Beacon lamp intake	
E151	Luce direzionale DX	Right indicator	
E152	Plafoniera	Cabin lamp	
E400	Faro di lavoro anteriore DX	Front right working light	
E401	Faro lavoro ant. SX centrale	Front left working light	
E402	Faro di lavoro posteriore SX centrale	Rear left working light	
E403	Faro di lavoro posteriore DX centrale	Rear right working light	
F1	FUSIBILE FARI LAVORO ANTERIORI CENTRALI 15A	Central front working light fuse 15A	
F2	FUSIBILE FARI LAVORO POSTERIORI CENTRALI 15A	Central rear working light fuse 15A	
F3	FUSIBILE LUCI POSIZIONE DX 3A	Right position light fuse 3A	
F4	FUSIBILE LUCE POSIZIONE SX 3A	Left position light fuse 3A	
F5	FUSIBILE AVVISATORE ACUSTICO 10A	Horn fuse 10A	
F6	FUSIBILE FARI LAVORO POSTERIORI LATERALI 15A	Lateral rear working light fuse 15A	
F7	FUSIBILE TERGI POSTERIORE + AVVISATORE ACUSTICO POSTERIORE 7,5A	Windshield wiper-washer + rear horn fuse 7,5A	
F8	FUSIBILE SWITCH LUCI STOP 7,5A	Stop light switch fuse 7,5A	
F9	FUSIBILI FARI LAVORO ANTERIORI LATERALI 15A	Lateral front working light fuse 15A	
F10	FUSIBILE ALIM. TERGI ANTERIORE 10A	Front windshield-wiper supply fuse 10A	
F11	FUSIBILE OPTIONAL 7,5A	Optional fuse 7,5A	
F12	FUSIBILE BUZZER+STR.ANTERIORE+STR.LATERALE 5A	Front and lateral instruments supply+ buzzer fuse 5A	
F13	FUSIBILE ALIM. MANIPOLATORI 15A	Lever grip supply fuse 15A	
F14	FUSIBILE LAMPADE SWITCH + SWITCH OPTIONAL 10A	Light switch + switch optional fuse 15A	
F15	FUSIBILE CENTRALINA	Elettrovalvp + Safety starter fuse 10A	
F16	FUSIBILE GIROFARO 10A	Beacon light fuse 10A	
F17	FUSIBILE SWITCH EMERGENZA 10A	Warning switch fuse 10A	
F18	FUSIBILE PLAFONIERA+ACCENDISIGARI 10A	Cabin lamp + cigarette lighter fuse 10A	
F19	FUSIBILE ANABBAGLIANTI 15A	Low beam light fuse 15A	
F20	FUSIBILE ABBAGLIANTI 15A	Main beam light fuse 15A	
F21	FUSIBILE ALIM. SENSORE RITORNI + DIG 10A	Return to Dig sensor supply fuse 10A	
F22	FUSIBILE EC POWER 7,5A	EC Power fuse 7,5A	
F23	FUSIBILE +15 CENTRALINA SITERZATURA 10A	+15 Steering unit fuse 10A	
F24	FUSIBILE ALIM. INTERMITTENZA 7,5A	Flasher fuse 7,5A	
F25	FUSIBILE SIRENA RETRO + ALIM. CEVIO 10A	Steering column switch+reverse buzzer fuse 10A	
F27	+30 rele candeletta	General fuse 175A	
G1	BATTERIA	Battery	
G118	Motorino avviamento	Starter motor	
G119	Gr alternatore	Generator	
H17	BUZZER	Buzzer	
K1	CENTRALINA ANTIRIPETIZIONE AVVIAMENTO	Antirepetition starting unit	
K2	INTERMITTENZA	Flasher	
K3	RELE' ANABBAGLIANTI	Low beam light relay	
K4	RELE' ABBAGLIANTI	Main beam light relay	
K5	RELE' ANABBAGLIANTI	Front horn relay	
K6	RELE' ELETTROVALVOLA RETURN TO DIG	Return to DIG solenoid valve relay	
K7	RELE' LUCI STOP	Stop Light relay	
K8	RELE' CONSENSO AVVIAMENTO	Start relay	
K9	RELE' MARCIA AVANTI	Forward speed relay	
K10	RELE' MARCIA INDIATRO	Reverse speed relay	
K11	RELE' BLOCCO TRASMISSIONE	De-clutch relay	
K45	+30 rele preriscalda	Preheating relay	
K56	30 rele preriscalda	Safety start relay	
K61	30 rele servizi	Services relay	
K111	Rele deiend retro	Rele deiend retro	
M42	Tergi posteriore	Rear Windshield-Wiper	
M57	Pompetta	Windshield-Washer pump	
M58	Motore tergi anteriore	Front windshield-wiper	
M116	Elettrovalvone compressore	Compresser Electronic cluch	
R114	Candeletta	Preheating	
S2	INTERRUTTORE ELETTROVALVOLA EC. POWER	SOLENOID VALVE E.C. POWER SWITCH	
S3	BENNA CHIUDE	CLOSED GRAB SWITCH	
S4	STACCO TRASMISSIONE	DECLUCH SWITCH	
S5	BENNA APRE INTERRUTTORE	OPEN GRAB SWITCH	
S6	BLOCCAGGIO DIFFERENZIALE	DIFFERENTIAL LOCKING SWITCH	
S24	Quadro avviamento pos. B1	Starting Switch	
S40	Micro sedile	Seat Switch	
S41	PULSANTE POSTERIORE CLAXON	Rear horn switch	
S46	Freno di stazionamento	Parking brake switch	
S53	INTERRUTTORE LUCI STOP	Stop light Switch	
S54	INTERRUTTORE STOP 4WD	Stop 4WD Switch	
S57	Devio cambio	Steering column gear shift	
S60	Devio luci	Steering column light switch	
S80	INTERRUTTORE RIDE CONTROL	Ride control switch	
S81	PULSANTE SBLOCCO BRACCIO	Arm unlock switch	
S83	PULSANTE EC POWER	EC Power Switch	
S84	INTERRUTTORE VALVOLE EMPI	EMPI Solenoid Valve switch	
S85	PULSANTE AVV. ACUSTICO POSTERIORE	Rear horn switch	
S107	Blocco trasmissione	Declutch switch	
S86	INTERRUTTORE GENERALE LUCI	General light switch	
S87	INTERRUTTORE 4WD	4WD Switch	
S89	PULSANTE PPC	PPC switch	
S90	INTERRUTTORE WARNING	WARNING switch	
B97	AVVISATORE ACUSTICO POSTERIORE	Rear horn switch	
S104	Sw 4° marcia	4th speed switch	
S168	INTERRUTTORE FARO DI LAVORO ANTERIORE	Front working light switch	
S167	INETTERRUTORE GIROFARO	Beacon light switch	
S169	INTERRUTTORE FARI LAVORO POSTERIORI	Rear working light switch	
X30	ACCENDISIGARI	Cigarette lighter	
Y48	Ev flottante	Float solenoid valve	
Y49	Ev return to d.i.g.	Return to DIG solenoid valve	
Y60	Valvola empi.	EMPI Solenoid Valve	
Y90	Ev. PPC retro	Rear PPC solenoid valve	
Y91	Ev EC power	EC power Solenoid valve	
Y92	Back-up alarm	Back-up alarm	
Y93	Ev. PPC	PPC solenoid valve	
Y94	Ev blocco differenziale	Differential lock solenoid valve	
Y95	Ev sblocco braccio	Arm unlock solenoid valve	
Y96	Ev sblocco pialtra	Plate unlock solenoid valve	
Y98	Ev. chiusura benna	Grab close solenoid valve	
Y99	Ev apertura benna	Grab open solenoid valve	
Y106	Ev 4WD	4WD Solenoid valve	
Y108	Ev marcia avanti	Forward solenoid valve	
Y117	Elettrostop	Elettrostop	
Y203	Ev marcia indietro	Reverse speed solenoid valve	
X12 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X166 c	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	
X166 p	CONNETTORE A LINEA INTTERRUTTORI	TO SWITCH HARNESS CONNECTOR	
X177 c	CONNETTORE A LINEA FARI LAVORO	TO WORKING LIGHT HARNESS CONNECTOR	
X8 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X128 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X7 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X1 a	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
X10 p	CONNETTORE A LINEA CRUSCOTTO ANTERIORE	TO FRONT DASHBOARD HARNESS CONNECTOR	
X11 p	CONNETTORE A LINEA ELETTROVALVOLE	TO SOLENOID VALVE HARNESS CONNECTOR	
X12 p	CONNETTORE A LINEA FANALI POSTERIORI	TO CHASSIS HARNESS CONNECTOR	
X15 p	CONNETTORE A LINEE OPTIONAL	TO OPTIONAL HARNESS CONNECTOR	
X2 a	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
X25 a	CONNETTORE A LINEA PANNELLO INTERRUTTORI	TO SWITCHES PANEL HARNESS CONNECTOR	
X26 p	CONNETTORE A LINEA PANNELLO INTERRUTTORI	TO SWITCHES PANEL HARNESS CONNECTOR	
X28 a	CONNETTORE RISCALDAMENTO	HEATING CONNECTOR	
X3 a	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
X4 a	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
X44 p	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	
X5 a	CONNETTORE A LINEA CENTRALINA 01171062	TO UNIT 01171062 CONNECTOR	
X65 p	CONNETTORE A LINEA MOTORE	TO MOTOR HARNESS CONNECTOR	
X7 p	CONNETTORE A LINEA MOTORE	TO MOTOR HARNESS CONNECTOR	
X8 p	CONNETTORE A LINEA CAMBIO SHUTTLE	TO GEAR HARNESS CONNECTOR	
X9 p	CONNETTORE A LINEA CRUSCOTTO ANTERIORE	TO FRONT DASHBOARD HARNESS CONNECTOR	
X25 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X26 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X10 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X9 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X44 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X11 a	CONNETTORE A LINEA POSTO GUIDA	TO DRIVER SITE HARNESS CONNECTOR	
X27a	CONNETTORE ARIA CONDIZIONATA	A/C HARNESS CONNECTOR	
P43	PANNELLO STRUMENTI	INSTRUMENTS PANEL	
P63	PANNELLO ANTERIORE	FRONT CONTROL PANEL	
X140	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	
X142	CONNETTORE A LINEA CABINA	TO CABIN HARNESS CONNECTOR	

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