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# TORQUE SPECIFICATIONS

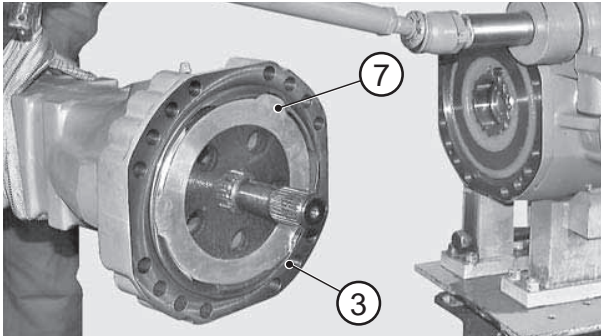
## TORQUE SPECIFICATIONS

### COARSE PITCH

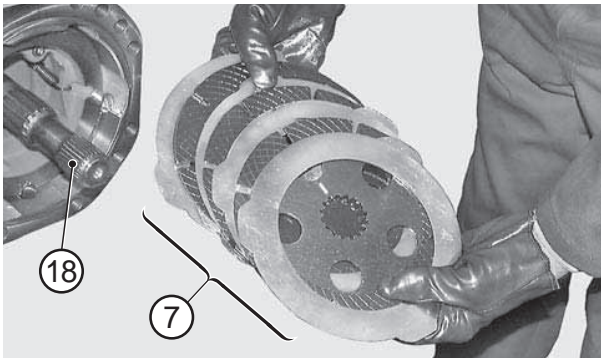
SIZE OF BOLT	TYPE OF BOLT					
	8.8	8.8 + Loctite 270	10.9	10.9 + Loctite 270	12.9	12.9 + Loctite 270
M6 x 1 mm	9,5 – 10,5 N·m	10,5 – 11,5 N·m	14,3 – 15,7 N·m	15,2 – 16,8 N·m	16,2 – 17,8 N·m	18,1 – 20 N·m
M8 x 1,25 mm	23,8 – 26,2 N·m	25,6 – 28,4 N·m	34,2 – 37,8 N·m	36,7 – 40,5 N·m	39 – 43 N·m	43,7 – 48,3 N·m
M10 x 1,5 mm	48 – 53 N·m	52 – 58 N·m	68 – 75 N·m	73 – 81 N·m	80 – 88 N·m	88 – 97 N·m
M12 x 1,75 mm	82 – 91 N·m	90 – 100 N·m	116 – 128 N·m	126 – 139 N·m	139 – 153 N·m	152 – 168 N·m
M14 x 2 mm	129 – 143 N·m	143 – 158 N·m	182 – 202 N·m	200 – 221 N·m	221 – 244 N·m	238 – 263 N·m
M16 x 2 mm	200 – 221 N·m	219 – 242 N·m	283 – 312 N·m	309 – 341 N·m	337 – 373 N·m	371 – 410 N·m
M18 x 2,5 mm	276 – 305 N·m	299 – 331 N·m	390 – 431 N·m	428 – 473 N·m	466 – 515 N·m	509 – 562 N·m
M20 x 2,5 mm	390 – 431 N·m	428 – 473 N·m	553 – 611 N·m	603 – 667 N·m	660 – 730 N·m	722 – 798 N·m
M22 x 2,5 mm	523 – 578 N·m	575 – 635 N·m	746 – 824 N·m	817 – 903 N·m	893 – 987 N·m	974 – 1076 N·m
M24 x 3 mm	675 – 746 N·m	732 – 809 N·m	950 – 1050 N·m	1040 – 1150 N·m	1140 – 1260 N·m	1240 – 1370 N·m
M27 x 3 mm	998 – 1103 N·m	1088 – 1202 N·m	1411 – 1559 N·m	1539 – 1701 N·m	1710 – 1890 N·m	1838 – 2032 N·m
M30 x 3,5 mm	1378 – 1523 N·m	1473 – 1628 N·m	1914 – 2115 N·m	2085 – 2305 N·m	2280 – 2520 N·m	2494 – 2757 N·m

### FINE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	8.8	8.8 + Loctite 270	10.9	10.9 + Loctite 270	12.9	12.9 + Loctite 270
M8 x 1 mm	25,7 – 28,3 N·m	27,5 – 30,5 N·m	36,2 – 39,8 N·m	40 – 44 N·m	42,8 – 47,2 N·m	47,5 – 52,5 N·m
M10 x 1,25 mm	49,4 – 54,6 N·m	55,2 – 61 N·m	71,5 – 78,5 N·m	78 – 86 N·m	86 – 94 N·m	93 – 103 N·m
M12 x 1,25 mm	90 – 100 N·m	98 – 109 N·m	128 – 142 N·m	139 – 154 N·m	152 – 168 N·m	166 – 184 N·m
M12 x 1,5 mm	86 – 95 N·m	94 – 104 N·m	120 – 132 N·m	133 – 147 N·m	143 – 158 N·m	159 – 175 N·m
M14 x 1,5 mm	143 – 158 N·m	157 – 173 N·m	200 – 222 N·m	219 – 242 N·m	238 – 263 N·m	261 – 289 N·m
M16 x 1,5 mm	214 – 236 N·m	233 – 257 N·m	302 – 334 N·m	333 – 368 N·m	361 – 399 N·m	394 – 436 N·m
M18 x 1,5 mm	312 – 345 N·m	342 – 378 N·m	442 – 489 N·m	485 – 536 N·m	527 – 583 N·m	580 – 641 N·m
M20 x 1,5 mm	437 – 483 N·m	475 – 525 N·m	613 – 677 N·m	674 – 745 N·m	736 – 814 N·m	808 – 893 N·m
M22 x 1,5 mm	581 – 642 N·m	637 – 704 N·m	822 – 908 N·m	903 – 998 N·m	998 – 1103 N·m	1078 – 1191 N·m
M24 x 2 mm	741 – 819 N·m	808 – 893 N·m	1045 – 1155 N·m	1140 – 1260 N·m	1235 – 1365 N·m	1363 – 1507 N·m
M27 x 2 mm	1083 – 1197 N·m	1178 – 1302 N·m	1520 – 1680 N·m	1672 – 1848 N·m	1834 – 2027 N·m	2000 – 2210 N·m
M30 x 2 mm	1511 – 1670 N·m	1648 – 1822 N·m	2138 – 2363 N·m	2332 – 2577 N·m	2565 – 2835 N·m	2788 – 3082 N·m



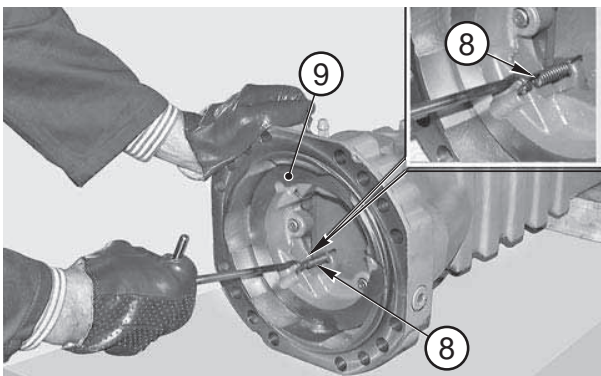
**FIGURE 6:** Remove the arm (3) together with the pack of the braking disks (7). Place the arm on a bench.



**FIGURE 7:** Remove the braking disks (7) and write down their order of assembly.

**NOTE:**

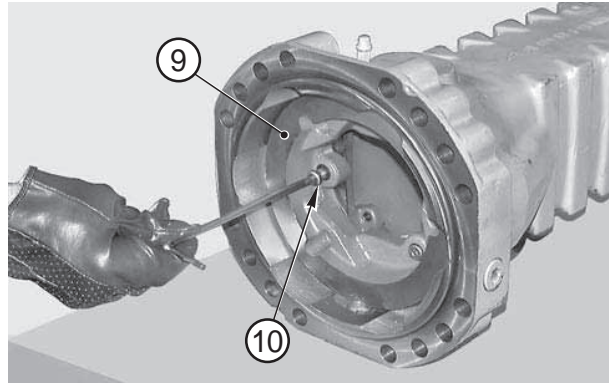
- 1 - If the disks do not need replacing, avoid switching their position.
- 2 - Extract the u-joint (18).



**FIGURE 8:** Remove the reversal springs (8) from the piston (9).

**NOTE:**

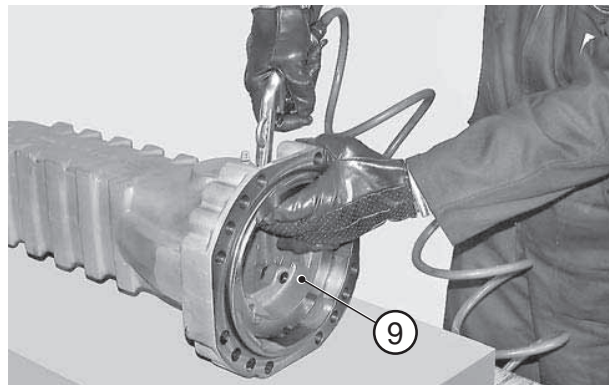
If the springs (8) are weak or deformed they must be replaced.



**FIGURE 9:** Remove the pin screws (10) guiding the piston (9).

**CAUTION**

If the screws are to be replaced, write down the different colors for the different brake gap.

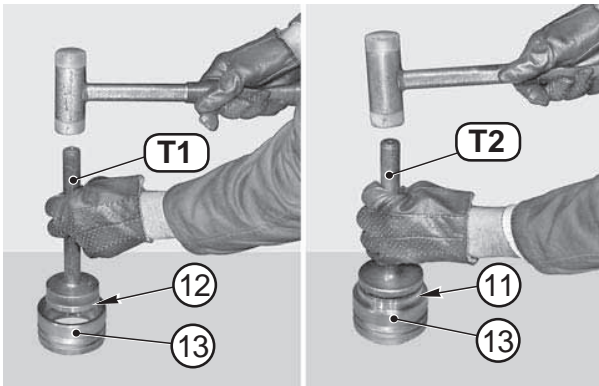


**FIGURE 10:** Slowly introduce compressed air through the connection of the braking circuit in order to extract the entire piston.

**CAUTION**

Hold on to the piston as it may be suddenly ejected and damaged.

## ASSEMBLY



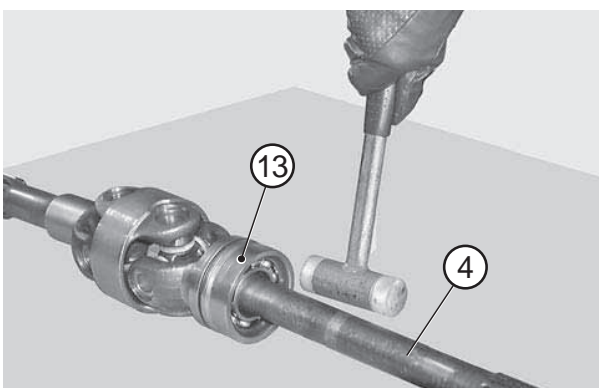
**FIGURE 6:** Using tools T1 (See drawing T1 p. 33) and T2 (See drawing T2 p. 33), insert the sealing ring (12) and the bearing (11) in the bushing (13).

**NOTE:**

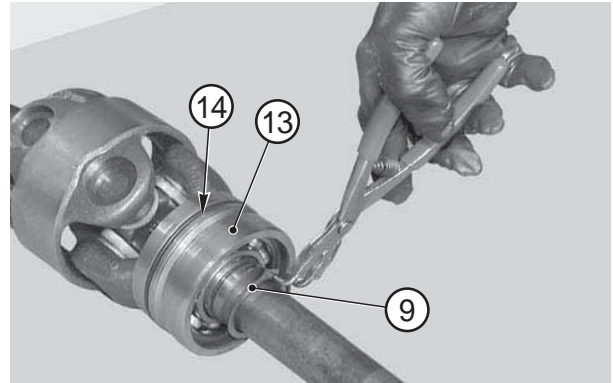
Carefully check the assembly side of the seal (12).



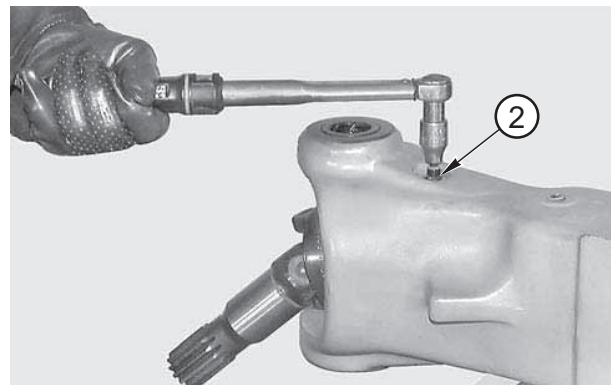
**FIGURE 7:** Fit the snap ring (10) on the bearing (11).



**FIGURE 8:** Heat the bearing in oil at an approximate temperature of 100°C and fit the entire bushing (13) on the u-joint (4).



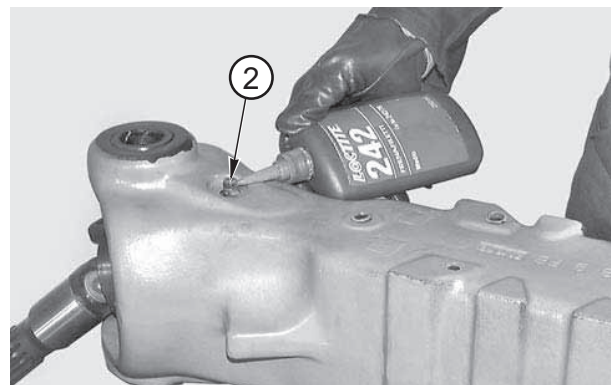
**FIGURE 9:** Fit the check ring (9) on the bushing unit (13); also put the o-ring (14) into position.



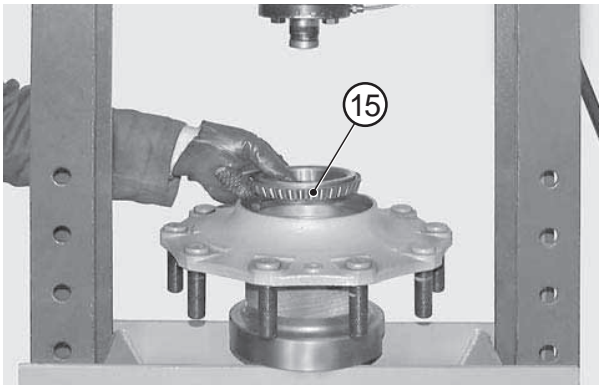
**FIGURE 10:** Insert the u-joint and tighten the top and bottom studs (2).  
Torque wrench setting: maximum 15 N·m.

**NOTE:**

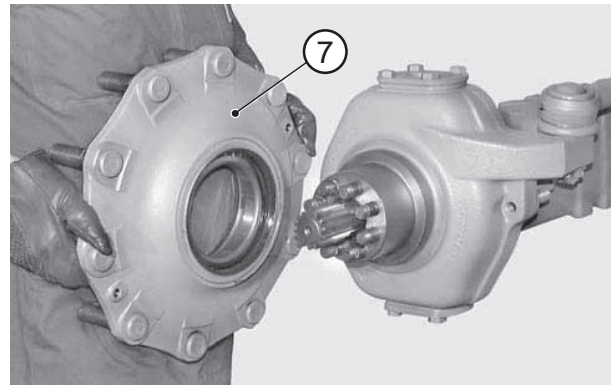
For u-joint coming with a bushing, center the point of the check studs in the slot.



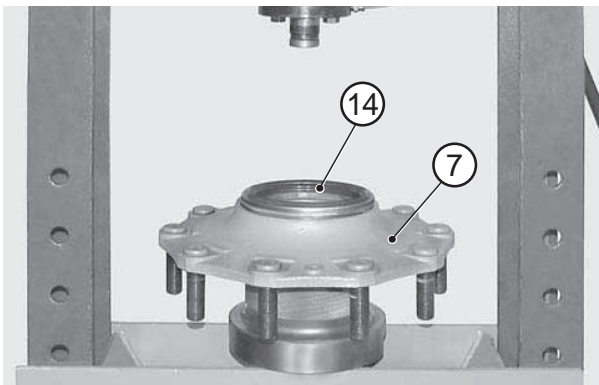
**FIGURE 11:** Apply Loctite 242 to the jutting parts of the studs (2).



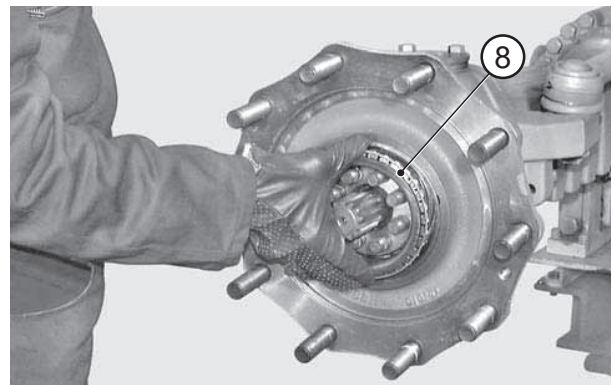
**FIGURE 25:** Fit the bearing (15) into the internal thrust block.



**FIGURE 28:** Install the hub (7).



**FIGURE 26:** Apply a repositionable jointing compound for seals to the outer surface of the sealing ring (14). Position the sealing ring (14) in the hub (7).



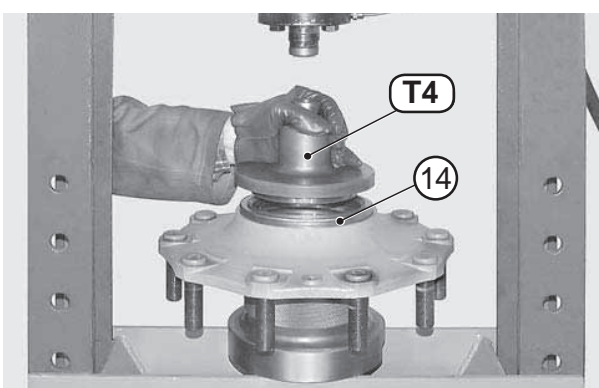
**FIGURE 29:** Install the external bearing (8).

**NOTE:**

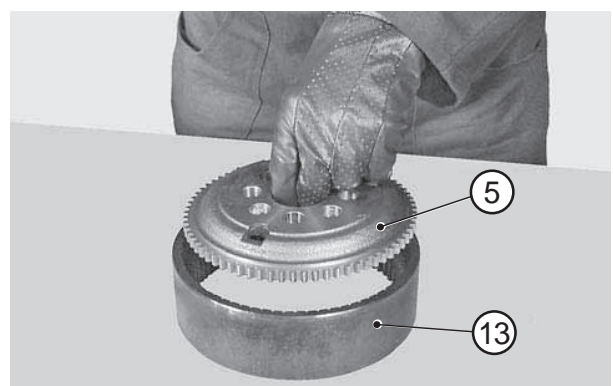
Check that the ring (14) is correctly oriented.

**NOTE:**

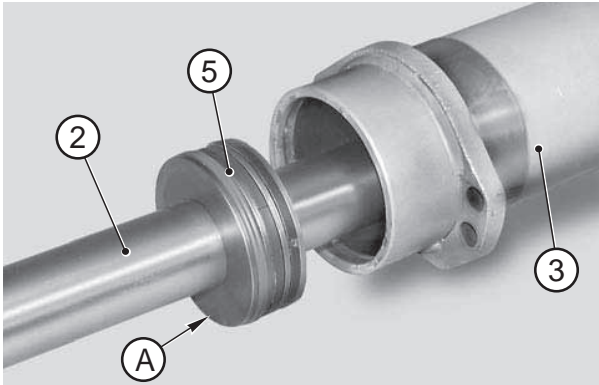
Using a plastic hammer, drive the bearing to the limit stop by lightly hammering around the edge.



**FIGURE 27:** Position tool T4 (See drawing T4 p. 46) and press the sealing ring (14) into its seat.



**FIGURE 30:** Insert the flange (5) in the crown (13).



**FIGURE 13:** Disassemble the cylinder unit (3) by extracting first the head (2), then the piston (5).

### **CAUTION**

Write the assembly side of the piston (5). The beveled part "A" of the piston is oriented towards the head (2).

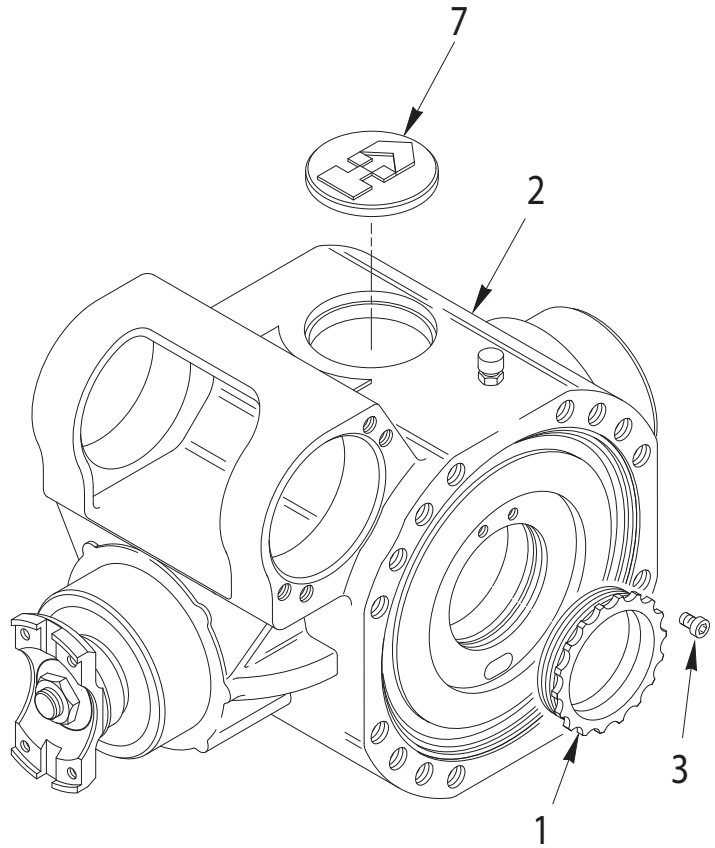
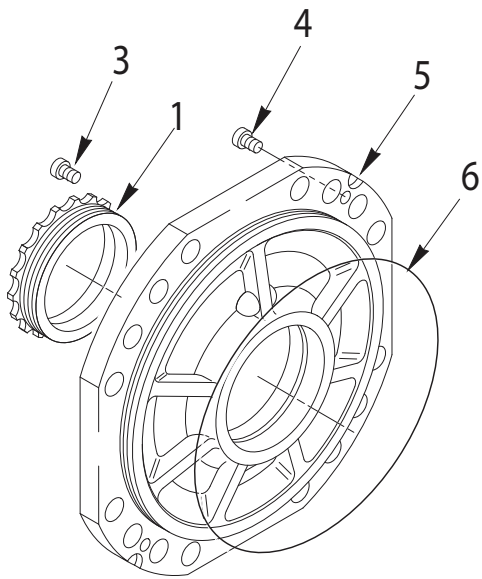
**FIGURE 14:** Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).

#### **NOTE:**

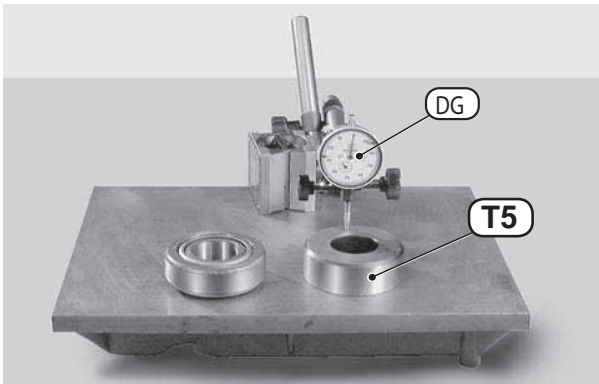
- 1 - All seals must be replaced every time the unit is disassembled.**
- 2 - Particular attention must be paid not to damage the seats of both seals and piston slide.**

# DIFFERENTIAL UNIT

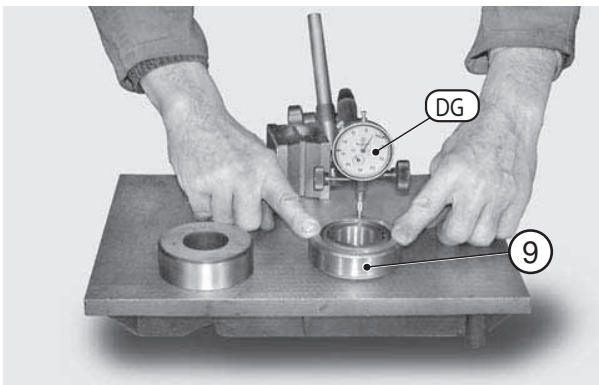
## EXPLODED VIEW



## ASSEMBLY



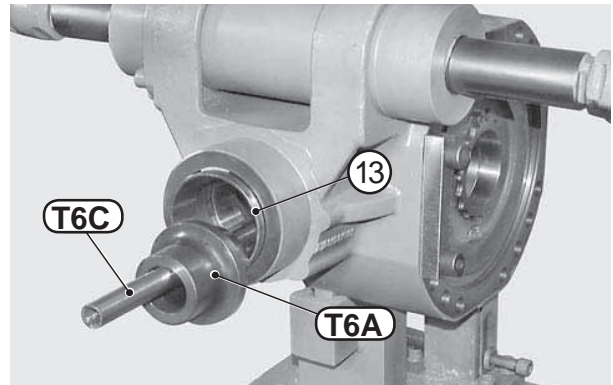
**FIGURE 13:** Using a surface plate, reset a dial indicator "DG" and place it on the measurement ring T5 (See drawing T5 p. 79) (with a thickness of 30.2 mm). Preset the depth gauge to approximately 2 mm.



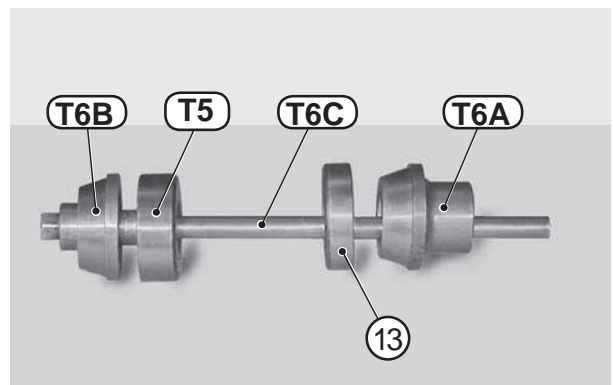
**FIGURE 14:** Bring the internal bearing (9), complete with its thrust block, under dial indicator. Determine overall thickness "D" of the bearing checking the discrepancy between this size and the size of the measurement ring.

### **CAUTION**

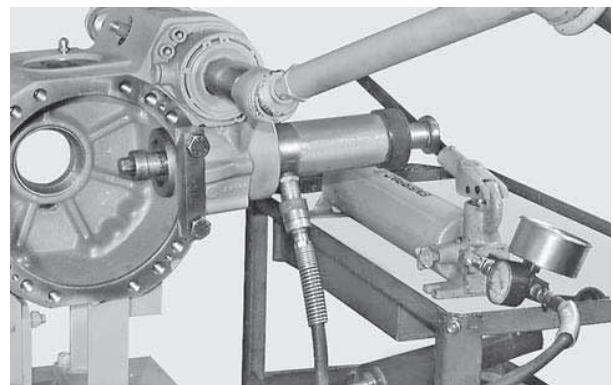
Press the thrust block in the center and take several measurements while rotating the thrust block.



**FIGURE 15:** Partially insert the thrust block of the external bearing (13).



**FIGURE 16:** Install tension rod T6C (See drawing T6 p. 80), measurement ring T5 (See drawing T5 p. 79) and front guide tool T6A (See drawing T6 p. 80) on the thrust block of the external bearing (13).



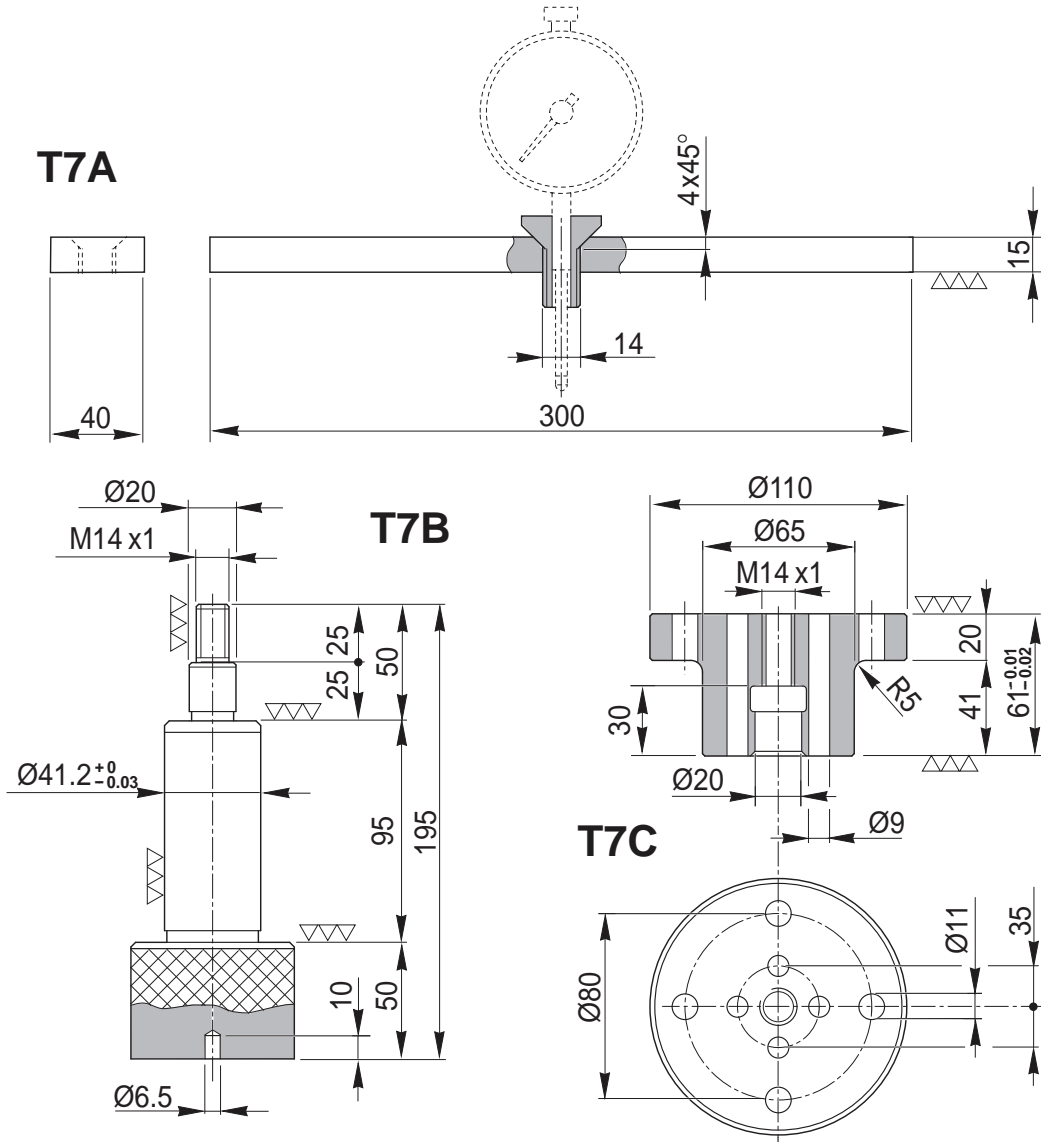
**FIGURE 17:** Connect the tension rod to the press and move the thrust block of the external bearing (13) into its seat. Disconnect the press and remove the tension rod.

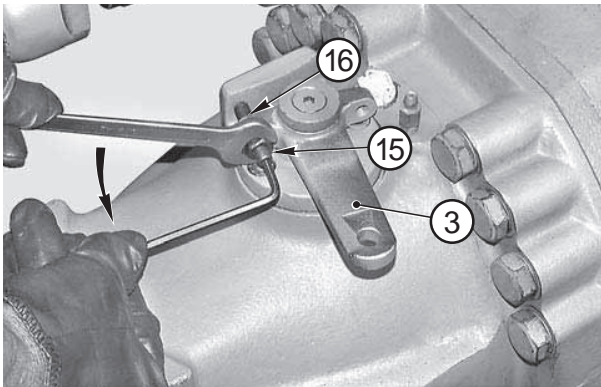
### **NOTE:**

**Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.**

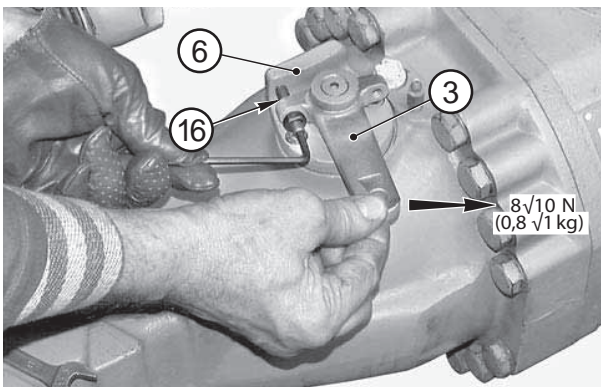
T7

P/N: 2312

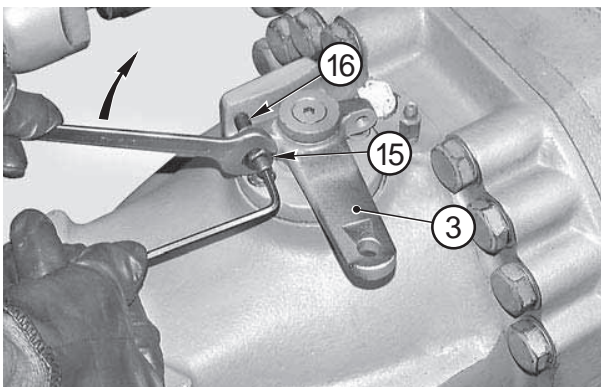




**FIGURE 15:** Connect the braking circuit and apply maximum working pressure to set the disks. Release the pressure, loosen nut (15) and unscrew stud (16) by a few turns.



**FIGURE 16:** Apply a force of 8 - 10 N (0.8 - 1 kg) to lever (3). Direct the force towards the braking direction in order to eliminate the idle stroke. While the force is being applied, tighten stud (16) until it is caused to rest onto bushing (6).

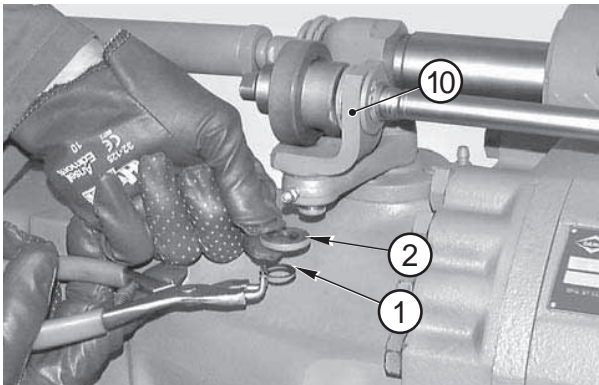


**FIGURE 17:** Lock stud (16) in this position with nut (15). Torque wrench setting: 20 - 25 N-m.

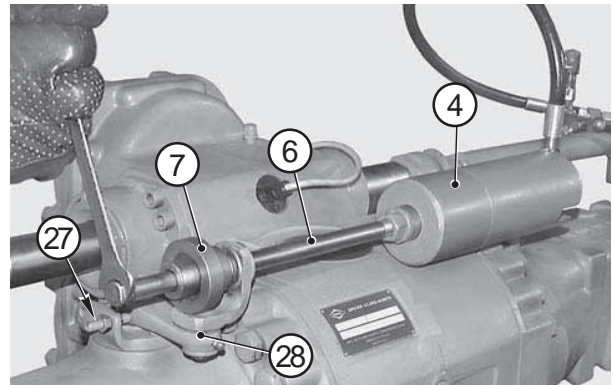
## ⚠ CAUTION

The idle stroke should be eliminated without preloading thrust levers (12) and (13).

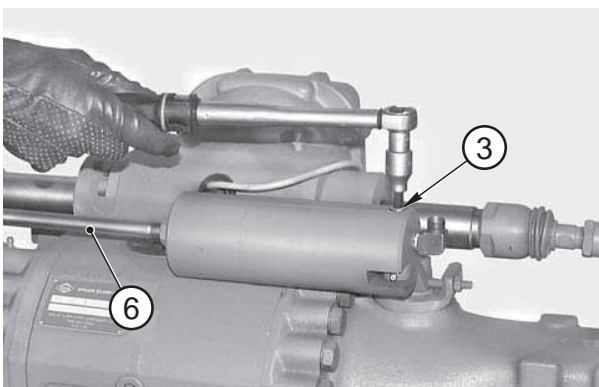
**FIGURE 18:** After connecting the control cable, check that when brakes are released both studs (16) do lean against bushing (6).



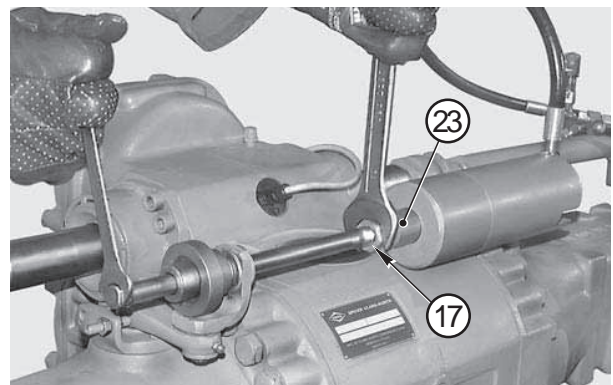
**FIGURE 16:** Fit the spacer (2) and insert the pin of support (10) in the right-hand braking lever. Fit the snap ring (1).



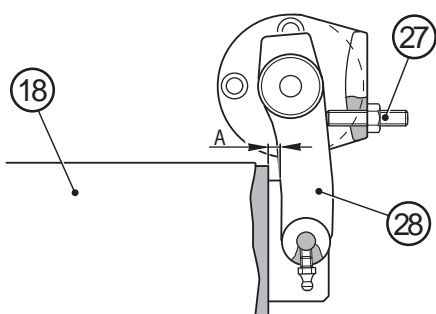
**FIGURE 19:** Introduce pressure into the cylinder (4) and, with the levers (28) resting against the adjustment studs (27), screw rod (6) to engage the quick release (7) in the slot.



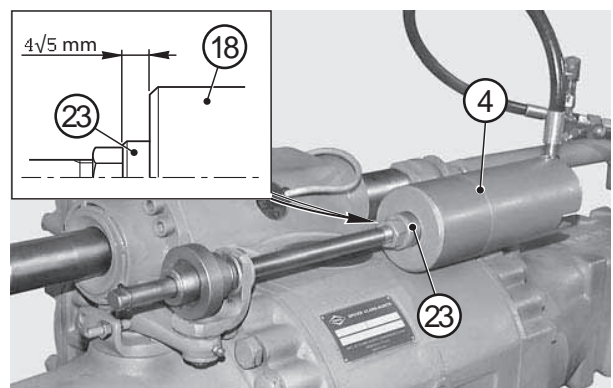
**FIGURE 17:** Rotate stem (6) to center the hole of the fulcrum pin (3). Apply Loctite 242 to the thread of the fulcrum pin (3), screw and tighten pin with a torque wrench set to 25 - 30 N·m.



**FIGURE 20:** Lock nut (17) in position against the stem of the piston (23). Torque wrench setting for the nut: maximum 40 N·m.



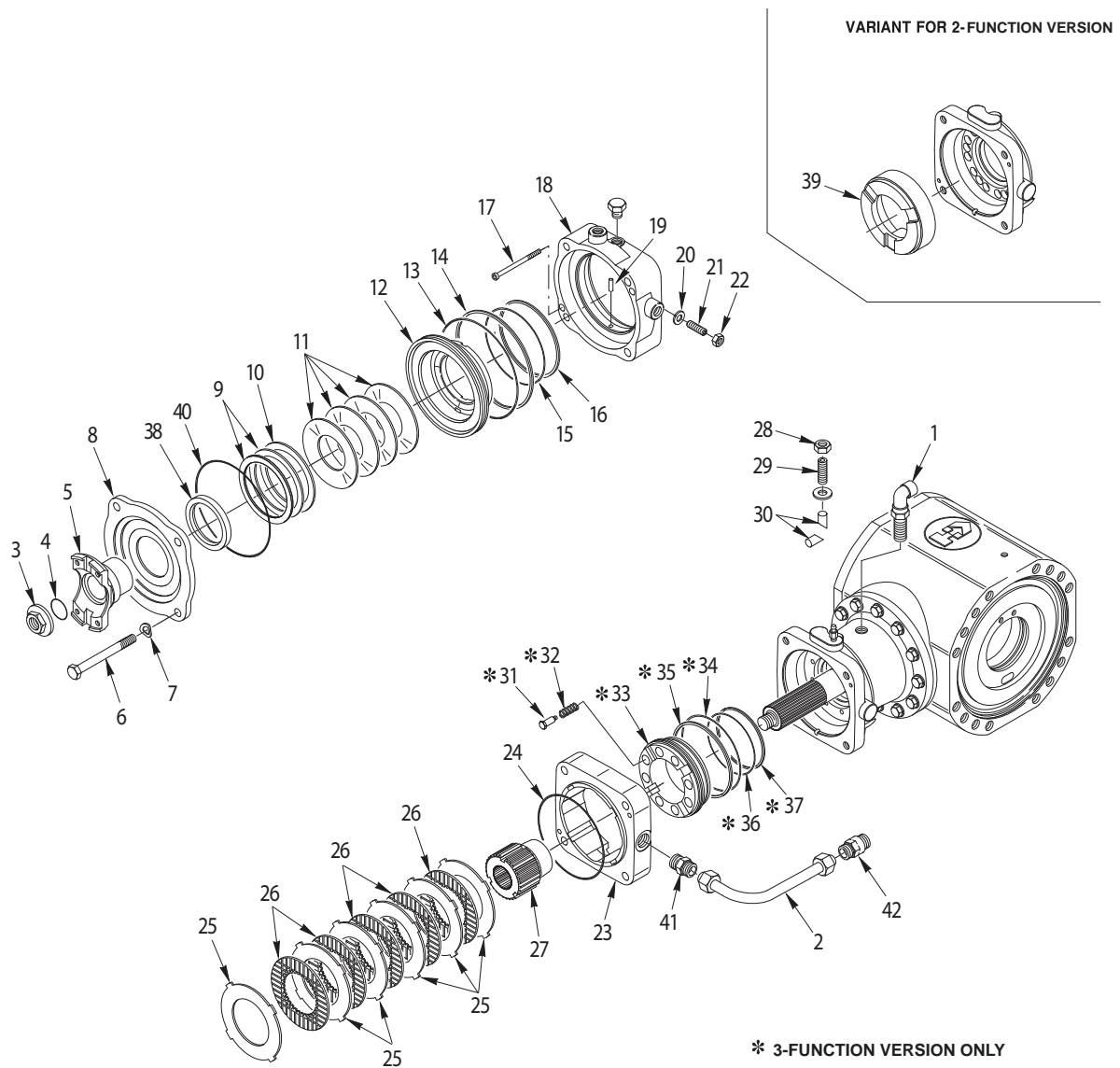
**FIGURE 18:** Check that a clearance "A" is left between the lever (28) on the cylinder side (resting against the adjustment stud) and cylinder (18). If necessary, remove the lever, turn it by one tooth in relation to the spline and repeat idle stroke elimination procedure.

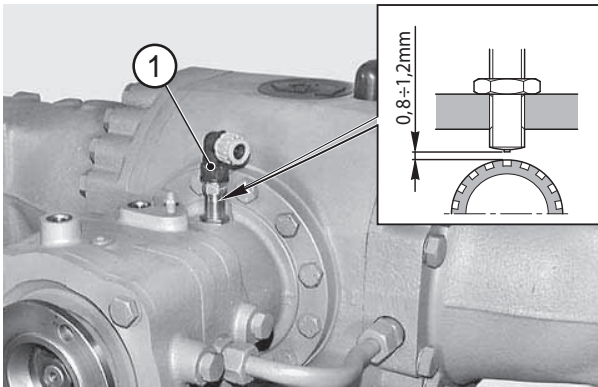


**FIGURE 21:** Release the pressure and check that piston (23) returns and stops in a position where it projects out from the cylinder head (4) by 4 - 5 mm.

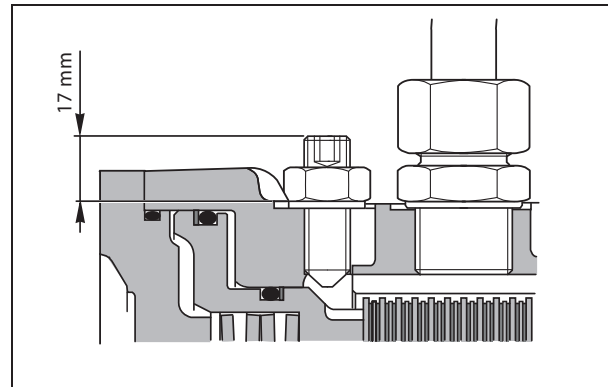
# 4" INCOMING BRAKE (2 AND 3 FUNCTION VERSIONS)

## EXPLODED VIEW





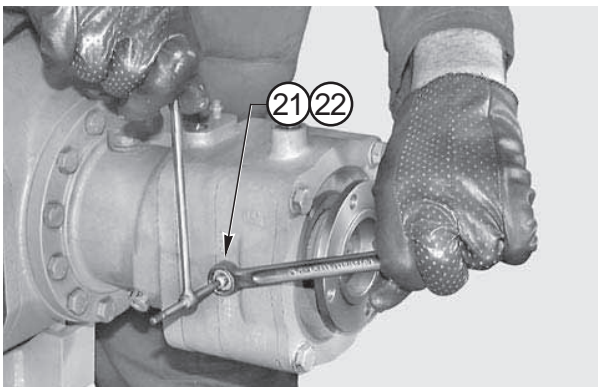
**FIGURE 50:** Fit the electronic sensor (1) and screw it up to the limit stop. Unscrew sensor by 3/4 turn and lock into position with nut. Locking torque: maximum 30 N·m.



**FIGURE 52:** When the emergency is over, loosen the studs in an alternate manner until a 17 mm projection is obtained; lock into position with the nuts (22) tightened to 15 N·m.

## ⚠ CAUTION

Do not exceed the specified torque setting.

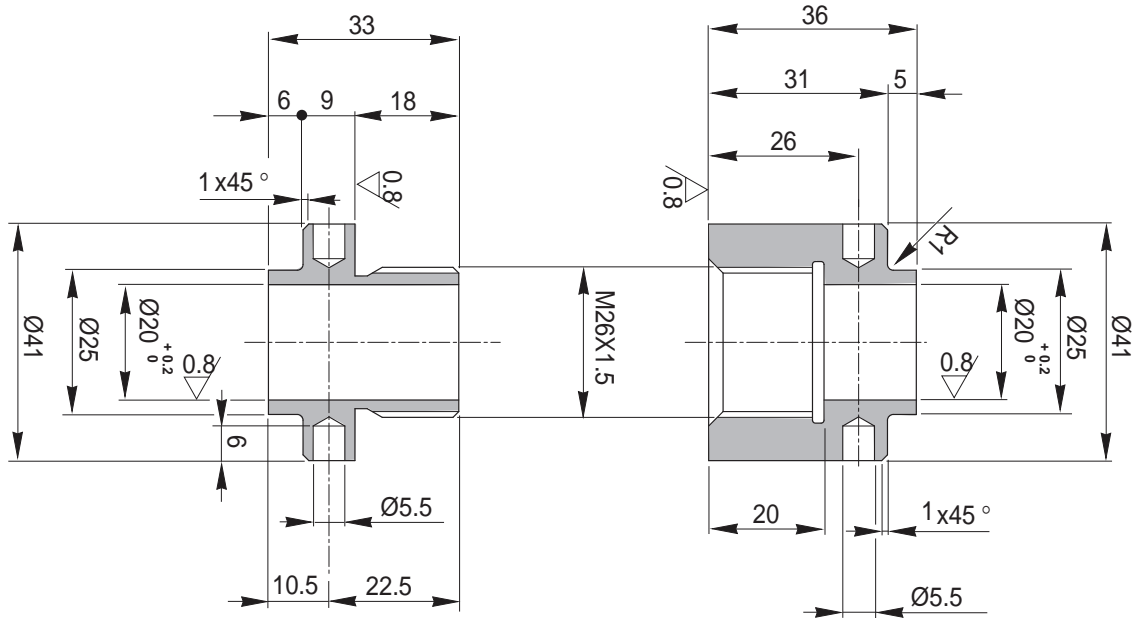


**FIGURE 51:** To release the negative brake during an emergency, (lack of pressure due to vehicle breakdown), loosen nuts (22) and screw studs (21) in an alternate and gradual manner until you notice some preloading; continue by giving another 1.5 turns.

SPECIAL TOOLS

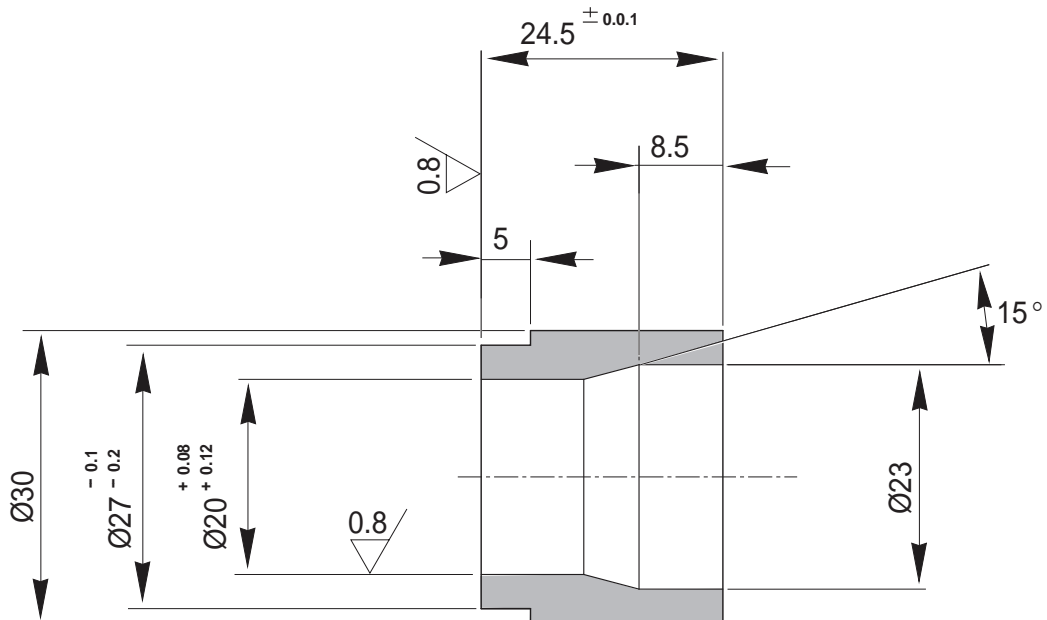
T1

P/N: 3708



T2

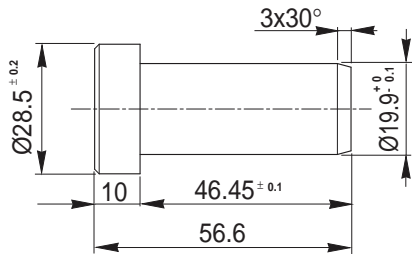
P/N: 3424



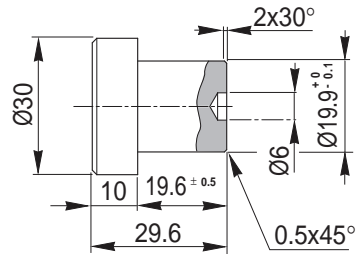
T3

P/N: 2306

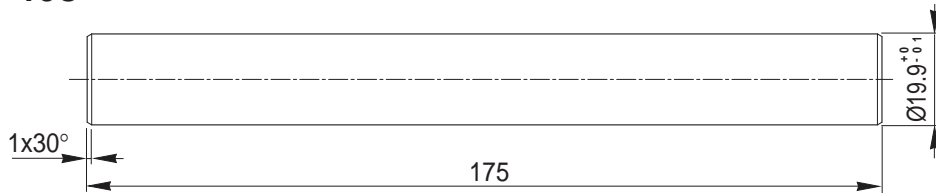
T3A



T3B

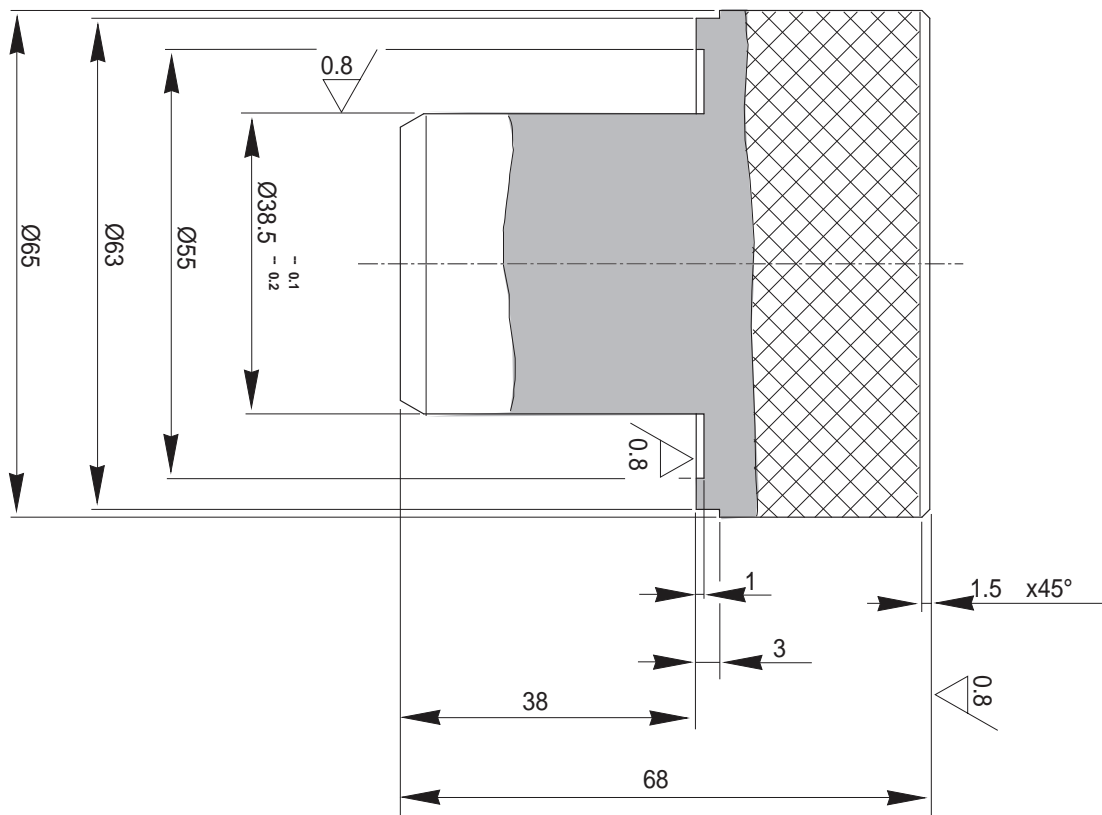


T3C



T4

P/N: 3332





# ELECTRICITY

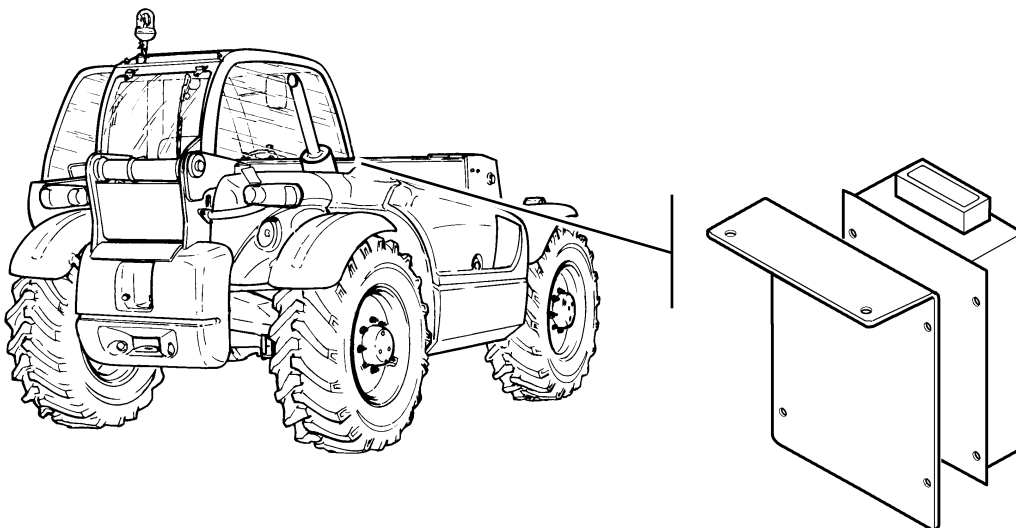
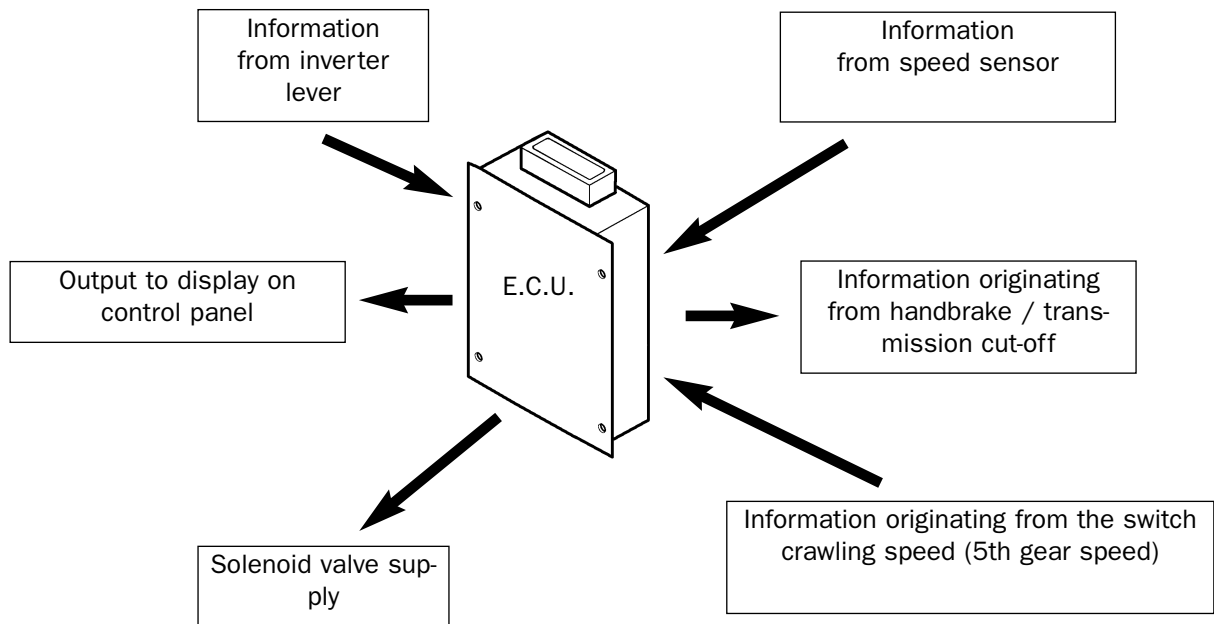
## A - E.C.U.

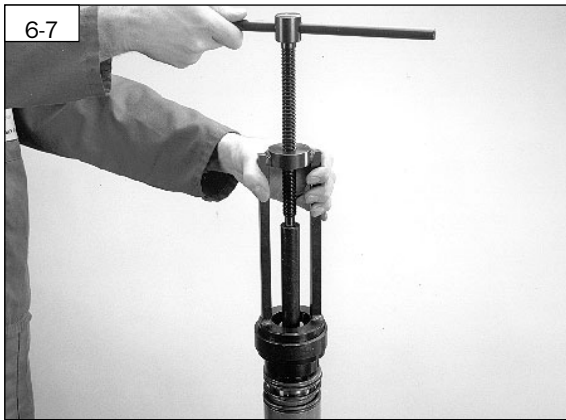
The E.C.U (Electronic Control Unit) controls the transmission. It controls several gearbox functions:

- gear changes
- kickdown function (according to model)
- diagnostics on the harness to the solenoid valves
- diagnostics of inputs.

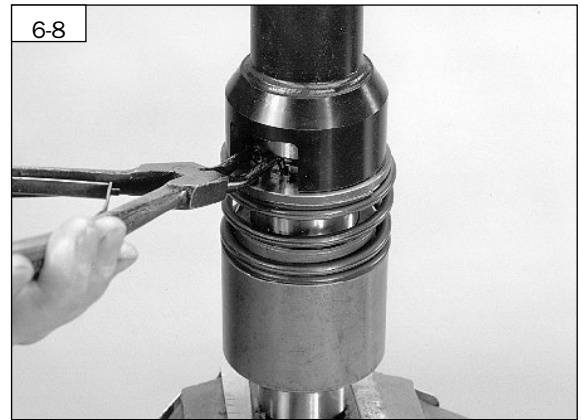
Situated in the cab at the front right of the driver.

E.C.U operating process :





Invert the shaft and using the appropriate bearing puller remove the front bearing.



Using the appropriate tool compress the spring and release the circlip.



Remove the circlip, retainer, and spring.



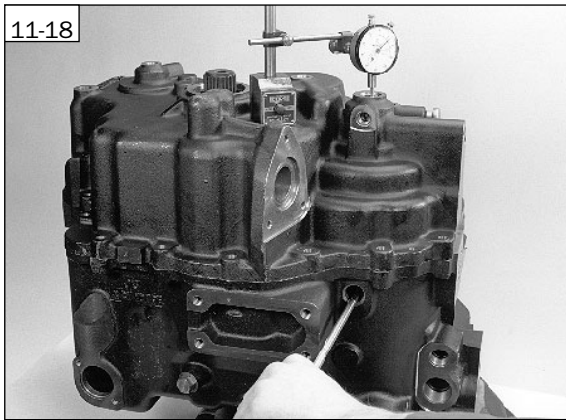
Remove the piston drum assembly.



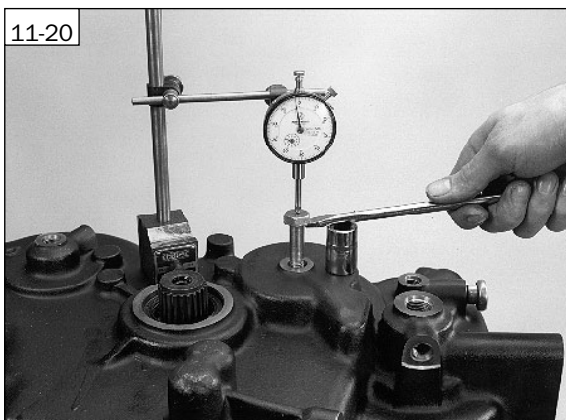
Remove the piston seal and «O»ring from the shaft and discard.



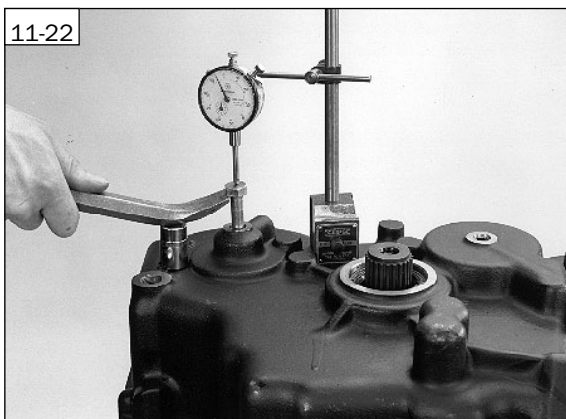
Remove and discard the piston seal and «O»ring from the piston drum.



Position a D.T.I. on the end of the input shaft as shown, and using a suitable pry bar through the side access hole, measure and note the shaft end float.

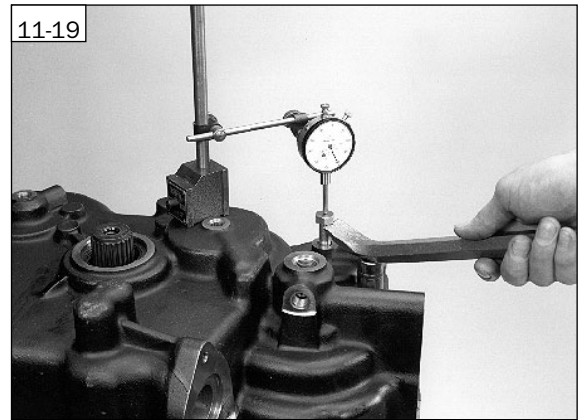


Attach a suitable shimming tool, (with a 12mm thread), to the end of the countershaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float .

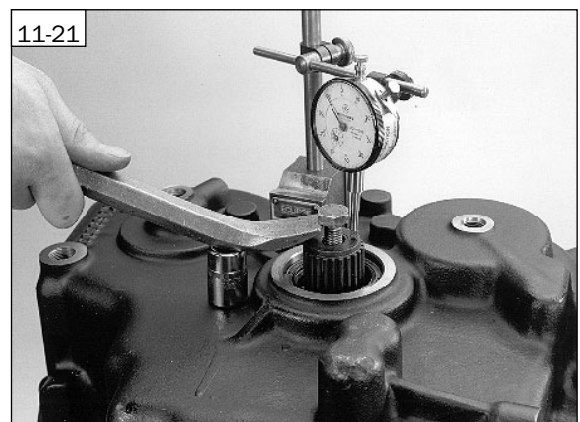


**4WD VERSION :** Attach a suitable shimming tool, (with a 12mm thread), to the end of the 4 wheel drive shaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.

(01/07/2008)



Attach a suitable shimming tool, (with a 12mm thread), to the end of the reverse idler shaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.



Attach a suitable shimming tool, (with a 12 mm thread), to the end of the output shaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.

Remove the rear case and add or remove shims as necessary to give .001» to .003» end float on all shafts. Repeat steps 11.17 to 11.22 until all shaft end floats are correct.

<b>FAULT</b>	<b>POSSIBLE CAUSES</b>
Converter pressure high.	Converter relief valve faulty. Blockage or restriction in oil cooler.
Low 4WD clutch pack pressure.	4WD piston seals leaking. 4WD shaft sealing ring leaking. Leak from 4WD clutch supply pipe. Faulty 4WD Solénoïd. Blockage or restriction in 4WD clutch supply pipe.
High 4WD clutch pack pressure.	Pressure regulator valve faulty.
Low lubrication pressure.	Blockage or restriction in oil cooler. Input shaft front sealing ring leaking.

**FAULT DIAGNOSIS MECHANICAL SYSTEM**

<b>FAULT</b>	<b>POSSIBLE CAUSES</b>
Noise	Vehicle Driveline Problem : Axles, Propshafts, Engine, Engine mounts. Mis-alignment of transmission / engine. Bearings worn or damaged. Gear teeth damaged or brocken. Excessive end float of shafts or gears. Clutch plate failure forward, reverse or 4WD. Incorrect grade of oil in transmission. Low oil level. Gear or thrust washer beginning to seize.
Difficult gear selection.	Shift rods worn or bent. Synchroniser assemblies worn or damaged. Clutch pack not releasing due to mechanical fault. Clutch pack not releasing due to hydraulic fault. Gear shift stub lever worn or damaged. Incorrect grade of oil in transmission. Low oil level.
Jumping out of Gear.	Detent springs worn or broken. Synchroniser or gear dog teeth worn or damaged. Synchroniser assemblies worn or damaged. Shift forks worn, loose or twisted. Restriction or wear in gear linkage or stub lever assy. not allowing gears to be fully selected. Excess end float on output shaft assembly or gears.

## 2 - INPUT SHAFT DISASSEMBLY AND RE-ASSEMBLY (Includes Forward High and Forward Low clutch packs)



Remove and discard the 3 sealing rings.



Using the appropriate bearing puller remove the rear bearing.  
(Tool No. 600744)



Remove the primary gear circlip.



Remove the thrust washer and needle bearing.

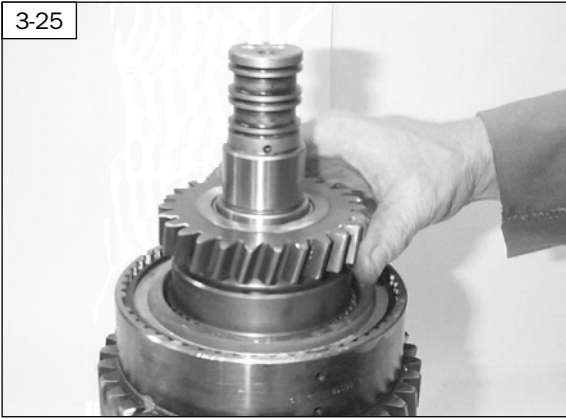


Remove the primary gear.



Remove the two bearings and spacer.  
NOTE : There is no spacer fitted on the forward high side.

3-25



Line up the clutch plate splines and replace the primary gear (see tips).

3-26



Replace the needle bearing and thrust washer as shown. Check gear end float.

NOTE : The needle bearing should be fitted with the closed side of its cage against the gear.

3-27



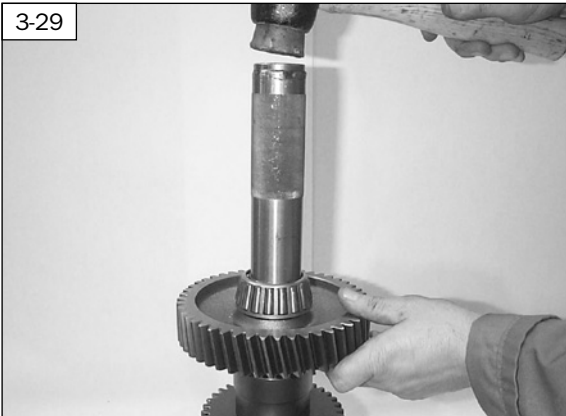
Using an appropriately sized tube replace the bearing as shown.

3-28



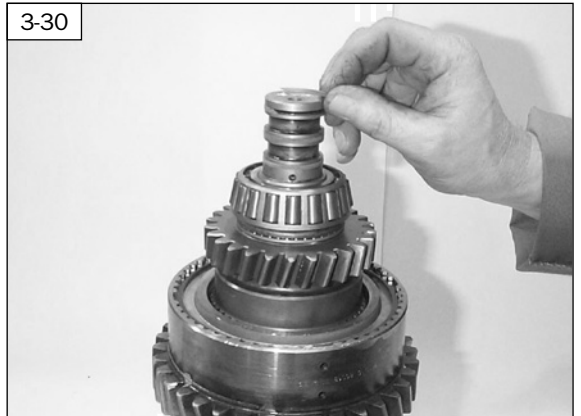
Invert the shaft and repeat steps 3:16 to 3:26. Then refit the drive gear using Loctite 638, or equivalent on the shaft splines.

3-29



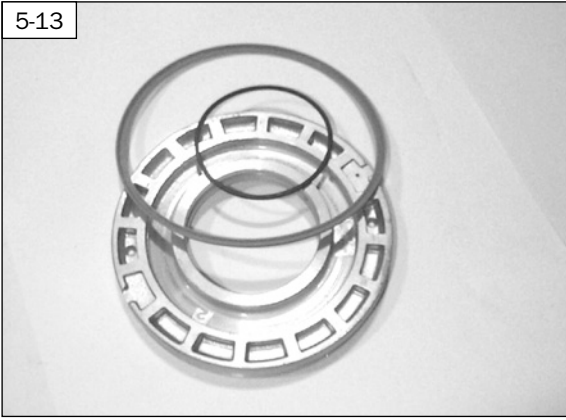
Using an appropriately sized tube replace the rear bearing as shown.

3-30



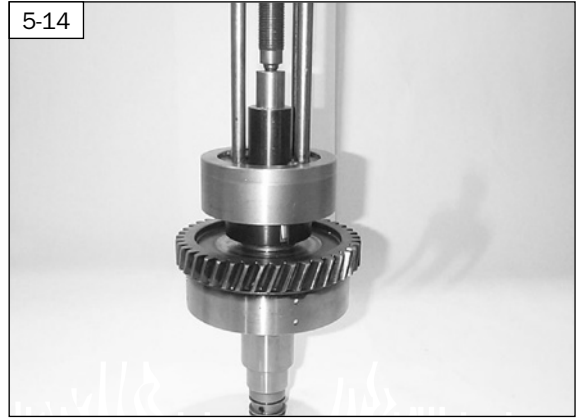
Finally fit 3 new sealing rings to the front of the shaft as shown.

5-13



Remove and discard the piston sealing rings and O rings.

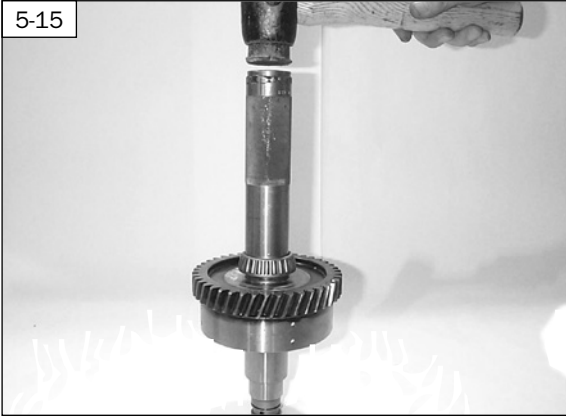
5-14



Invert the shaft and using the appropriate bearing puller remove the front bearing.  
(Tool No. 563390)

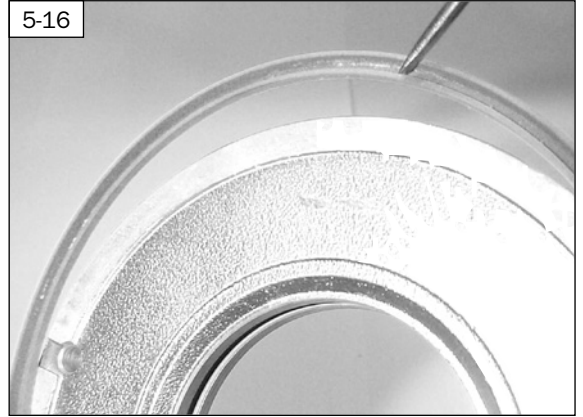
### RE-ASSEMBLY OF THE REVERSE SHAFT

5-15



Using an appropriately sized tube replace the front bearing as shown.

5-16



Re-new the piston sealing rings to assist assembly the seals may be warmed in lukewarm water prior to assembly.

NOTE : The outer seal must be fitted with the open edge facing away from the clutch pack.

5-17

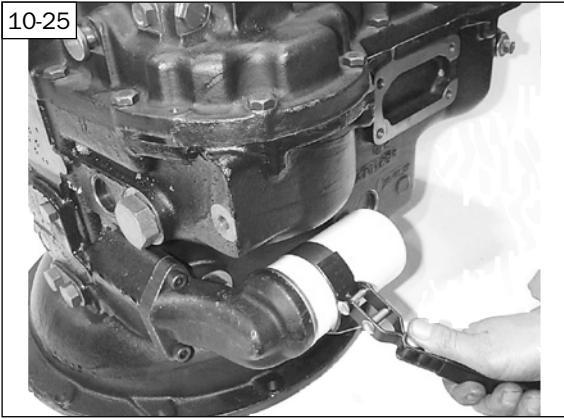


Using transmission fluid to lubricate the seals push the pistons into the sizing ring and leave for approximately 30 minutes.  
(Tool No. 600743)

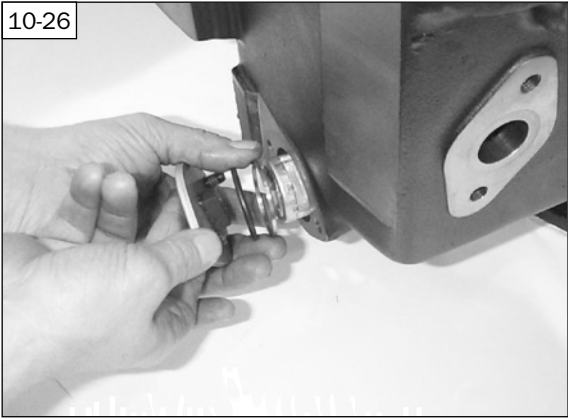
5-18



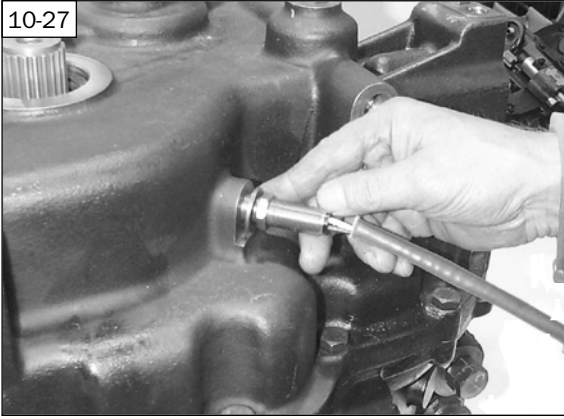
Using transmission fluid to lubricate the seals push the piston into the drum.



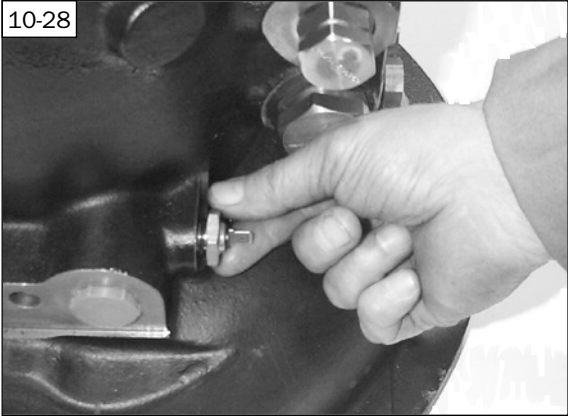
Lubricate the seal with a light grease and screw on a new oil filter. Tighten to a torque of 7 to 10 Nm.



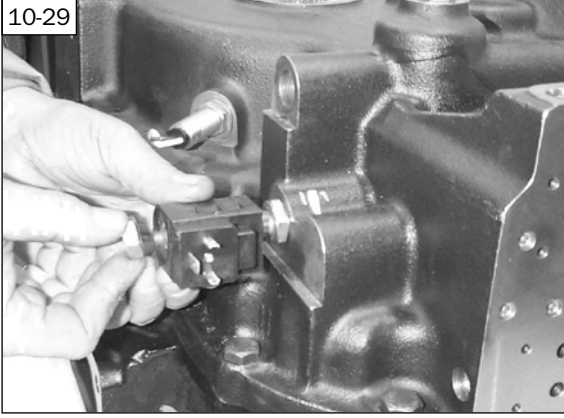
Refit the strainer, spacer, O ring and cover plate. Then tighten the two screws to a torque of 18 to 31 Nm.



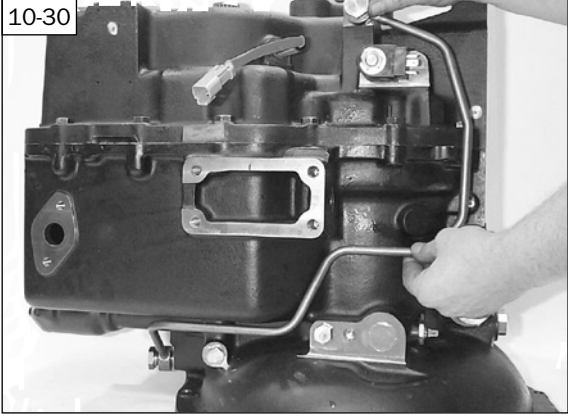
Refit the speed probe, sealing washer and locknut. Adjust. then tighten the locknut to a torque of 25,5 Nm and seal with Loctite 542 (see notes for correct adjustment).



Re-fit the temperature sender. Then tighten to a torque of 20 to 27 Nm.



Lubricate the seals with a light grease and re-fit the Speed Clutch 1 solenoid spool. Tighten to a torque of 26 to 39 Nm. Then refit the solenoid coil and nut. Tighten to a torque of 2,7 to 5,4 Nm.



Refit the external transfer pipe using 4 new copper washers . Then tighten the 2 banjo bolts to a torque of 40 to 46 Nm.

## GEAR BOX (Details)

- 1 – Transmission housing
- 2 – Transmission rear case
- 3 – Screw
- 4 – Washer
- 5 – "O" ring
- 6 – Seal
- 7 – Plug
- 8 – "O" ring
- 9 – Plug
- 10 – Complete pump
- 11 – Seal
- 12 – "O" ring
- 13 – Screw
- 14 – Washer
- 15 – Hollow screw
- 16 – Seal
- 17 – Solenoid - **Clutch N°1 (1)**
- 18 – Pipe (3rd and 4th gear)
- 19 – Pipe (1st gear)
- 20 – Screw
- 21 – Valve - **Clutch N°2 (2) and N°3 (3)**
- 22 – Complete electrical valve control
  - **Forward gear low (LH) and high (FH) speed**
- 23 – Control valve - **Reverse gear (R)**
- 24 – Screw
- 25 – Pipe
- 26 – Hollow screw
- 27 – Seal
- 28 – Screw
- 29 – Screw
- 30 – Drain plug
- 31 – "O" ring
- 32 – Plug
- 33 – Spacer
- 34 – Air breather
- 35 – Coupling flange
- 36 – Valve (pressure regulation)
  - **(LP) converter 6 bar**
- 37 – Plug
- 38 – Over pressure valve
  - **(LP) principal 15 bar**
- 39 – Seal kit
- 40 – Screw
- 41 – Cover
- 42 – "O" ring
- 43 – Washer
- 44 – Suction strainer
- 45 to 48 - Valve start cold 26 bar**
- 45 – Plug
- 46 – Spring
- 47 – Ball
- 48 – "O" ring
- 49 – Sensor
- 50 – Seal
- 51 – "O" ring
- 52 – Plug
- 53 – Screw
- 54 – Stud-bolt
- 55 – Oil temperature sensor
- 56 – "O" ring
- 57 – Brake assy
- 58 – Plug
- 59 – "O" ring
- 60 – Filter housing
- 61 – Oil filter
- 62 – Adaptor
- 63 – Pipe
- 64 – Gauge
- 65 – Connection
- 66 – Fastening plate
- 67 – Screw
- 68 – Wiring harness (gear box)
- 69 – "O" ring
- 70 – Screw
- 71 – Screw
- 72 – Kit (Brake lining + Spring)
- 73 – Kit (Screw + Nut)
- 74 – Kit brake lining
- 75 – Plug
- 90 – Seal kit
- 91 – Valve Kit
- 92 – Pompe kit
- 93 – Seal kit

**PRESSURE READING ON GEAR BOX "TURNER POWERSHIFT"**

MACHINE TYPE and N° : ..... N° of HOURS : .....

GEAR BOX TYPE and N° : .....

FORWARD GEAR	Clutch - forward gear low speed FL (T7)	Clutch - forward gear high speed FH (T9)	Clutch - reverse gear (T8)	Clutch 1 (T6)	Clutch 2 (T10)	Clutch 3 (T4)
1 <sup>st</sup> gear						
2 <sup>nd</sup> gear						
3 <sup>rd</sup> gear						
4 <sup>th</sup> gear						
5 <sup>th</sup> gear						
6 <sup>th</sup> gear						

REVERSE GEAR	Clutch - forward gear low speed FL (T7)	Clutch - forward gear high speed FH (T9)	Clutch - reverse gear (T8)	Clutch 1 (T6)	Clutch 2 (T10)	Clutch 3 (T4)
1 <sup>st</sup> gear						
2 <sup>nd</sup> gear						
3 <sup>rd</sup> gear						

Pump (T3)	
Converter (T1)	
Lubrication (T5)	

**COMMENTS :** .....

.....

.....

\* **BREAKDOWN AT THE ORIGIN :** .....

.....

.....

\* **DETERMINED CAUSE OF THE BREAKDOWN :** .....

.....

.....

.....

.....

.....

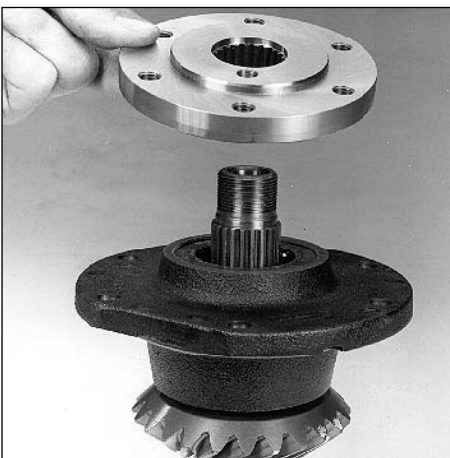
# **CONTROL AND ADJUSTMENT ANGLE GEAR BOX TRANSMISSION**

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ANGLE GEAR BOX MAINTENANCE . . . . .	2
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DISASSEMBLY . . . . .	6
- Main housing	
- Input shaft	
- Output shaft	
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- Input shaft	
- Output shaft	
- Main housing	
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- 21 -

- Remove the o-ring.



- 22 -

- Remove the output flange.



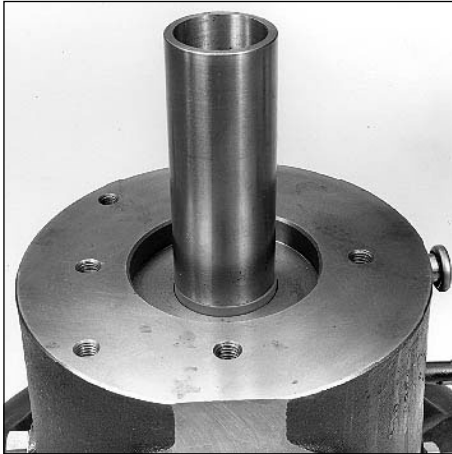
- 23 -

- Remove the housing from the output shaft.



- 24 -

- Remove the gauged strut.



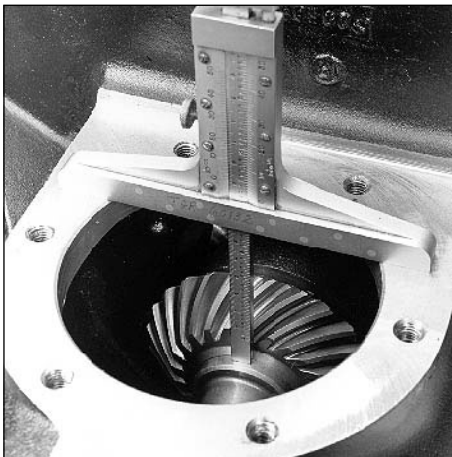
- 60 -

- Refit the output shaft rear oil seal.
- Into the case to a depth of 1.5mm below the housing face using a suitable tool.



- 61 -

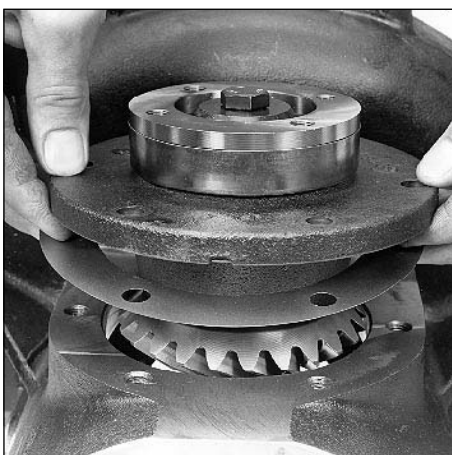
- Refit the output shaft assembly and shim pack into the case.
- Secure with 2 bolts. Do not use any sealant at this stage.



- 62 -

- Measure the distance from the input housing mounting face to the previously measured diameter on the output shaft.

**Measurement E :**



- 63 -

- Remove the output shaft assembly then refit the input shaft assembly and shim pack onto the case.
- Secure with 2 bolts. Do not use any sealant at this stage.

## 1104 Engine Model Views

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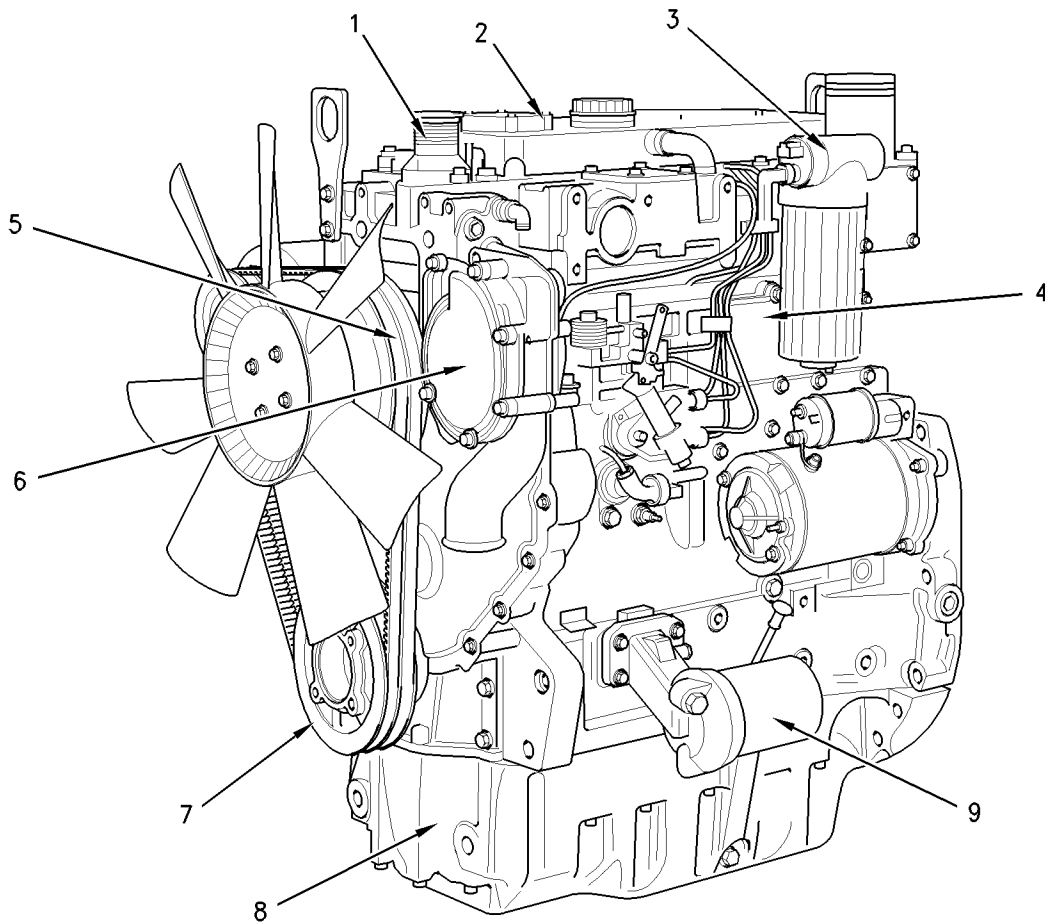


Illustration 3

g00993373

(1) Water temperature regulator housing  
(2) Valve mechanism cover  
(3) Fuel transfer pump and fuel filter

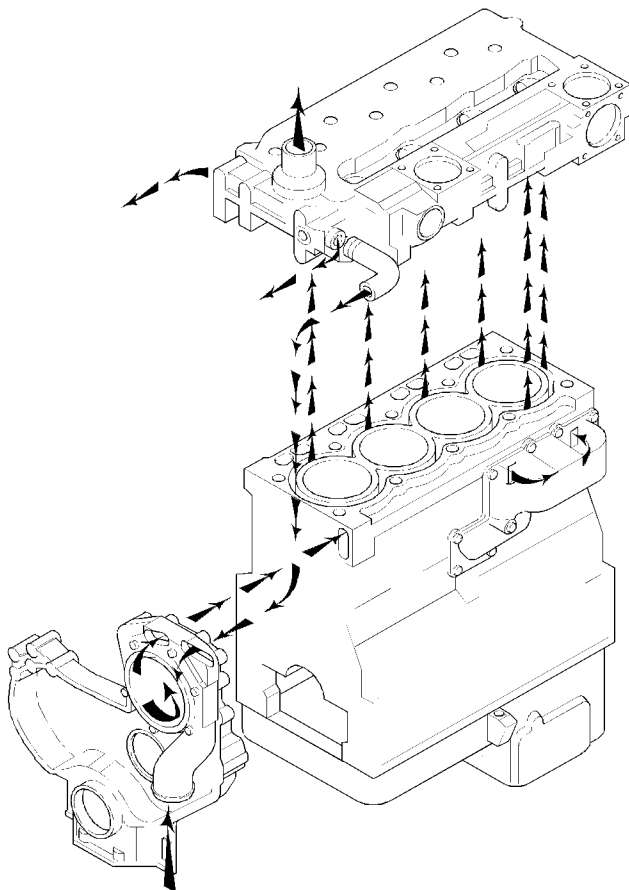
(4) Engine oil cooler  
(5) Fan drive  
(6) Water pump

(7) Crankshaft pulley  
(8) Oil pan  
(9) Engine oil filter

i01958111

## Cooling System

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Illustration 11  
Flow diagram of the cooling system for the 1104 engine

g00985481

4. Remove the plug (1) and the washer from the rear of the fuel injection pump and install 27610248 fuel injection pump timing adapter (2). Install a suitable dial indicator (3) into 27610248 fuel injection pump timing adapter. Set the dial indicator to approximately 3 mm (0.1181 inch).
5. Ensure that the timing pins have been removed from the engine.
6. Rotate the crankshaft counterclockwise when the crankshaft is viewed from the front of the engine. Carefully rotate the crankshaft until the dial indicator (3) indicates that the plunger of the fuel injection pump is at the bottom. Set the dial indicator (3) to zero.
7. Rotate the crankshaft clockwise, until the required lift on the plunger is achieved. Refer to Specifications, "Fuel Injection Pump" for the correct reading.

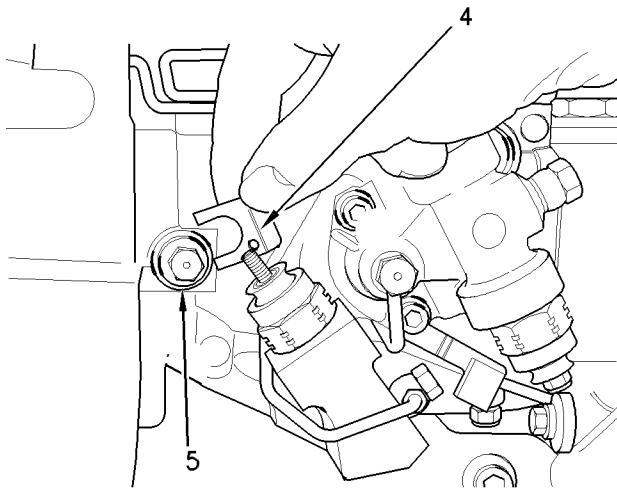


Illustration 22

g00996240

- (4) Washer  
(5) Locking screw

8. Lock the fuel injection pump shaft.  
In order to lock the shaft of the Bosch EPVE fuel injection pump, loosen the locking screw (5) and remove the washer (4). Tighten the locking screw to 31 N·m (23 lb ft). Ensure that the needle of the dial indicator has not moved.
9. Remove the water pump. Refer to Disassembly and Assembly, "Water Pump - Remove and Install".
10. Remove the front cover. Refer to Disassembly and Assembly, "Front Cover - Remove and Install".

11. Remove the fuel injection pump gear. Refer to Disassembly and Assembly, "Fuel Injection pump - Remove".

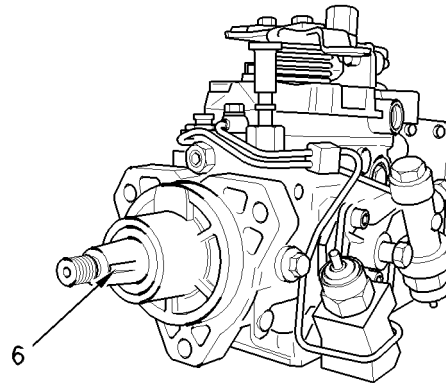


Illustration 23

g00996242

- (6) Keyway

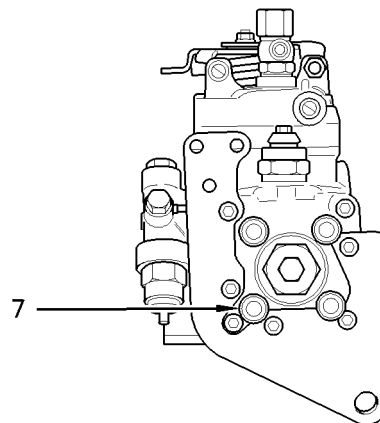


Illustration 24

g00996245

- (7) Outlet

**Note:** A key should not be installed in the keyway (6).

**Note:** If the fuel injection pump is on the correct stroke, the keyway (6) is toward the outlet (7).

12. Set the number one piston at the top center piston on the compression stroke. Refer to Testing and Adjusting, "Finding Top Center Position for the No. 1 Piston" for the procedure.
13. Install the fuel injection pump gear. Refer to Disassembly and Assembly, "Fuel Injection pump - Install".
14. Install the front cover. Refer to Disassembly and Assembly, "Front Cover - Remove and Install".

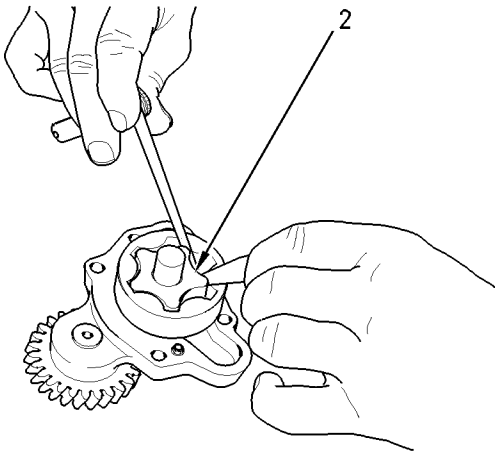


Illustration 32 g00985780

Clearance for the inner rotor

(2) Measure the clearance of the inner rotor to the outer rotor.

4. Measure the clearance of the inner rotor to the outer rotor (2).

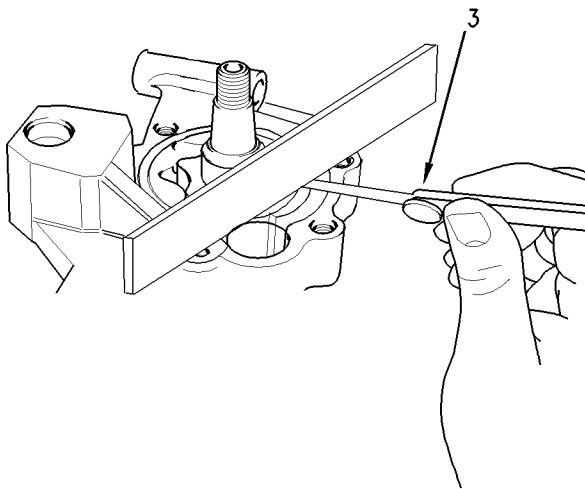


Illustration 33 g00989217

5. Measure the end play of the rotor with a straight edge and a feeler gauge (3).
6. Clean the top face of the oil pump and the bottom face of the cover. Install the cover on the oil pump. Install the oil pump on the engine. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".

## Excessive Bearing Wear - Inspect

When some components of the engine show bearing wear in a short time, the cause can be a restriction in an oil passage.

An engine oil pressure indicator may show that there is enough oil pressure, but a component is worn due to a lack of lubrication. In such a case, look at the passage for the oil supply to the component. A restriction in an oil supply passage will not allow enough lubrication to reach a component. This will result in early wear.

## Excessive Engine Oil Consumption - Inspect

### Engine Oil Leaks on the Outside of the Engine

Check for leakage at the seals at each end of the crankshaft. Look for leakage at the gasket for the engine oil pan and all lubrication system connections. Look for any engine oil that may be leaking from the crankcase breather. This can be caused by combustion gas leakage around the pistons. A dirty crankcase breather will cause high pressure in the crankcase. A dirty crankcase breather will cause the gaskets and the seals to leak.

### Engine Oil Leaks into the Combustion Area of the Cylinders

Engine oil that is leaking into the combustion area of the cylinders can be the cause of blue smoke. There are several possible ways for engine oil to leak into the combustion area of the cylinders:

- Leaks between worn valve guides and valve stems
- Worn components or damaged components (pistons, piston rings, or dirty return holes for the engine oil)
- Incorrect installation of the compression ring and/or the intermediate ring
- Leaks past the seal rings in the turbocharger shaft

The correct piston height must be maintained in order to ensure that the engine conforms to the standards for emissions.

**Note:** The top of the piston should not be machined. If the original piston is installed, be sure that the original piston is assembled to the correct connecting rod and installed in the original cylinder.

Six grades of length of connecting rods determine the piston height above the cylinder block. The grade of length of a connecting rod is identified by a letter or a color. The letter or the color is marked on the side of the connecting rod. Refer to Testing and Adjusting, "Connecting Rod - Inspect" and Specifications, "Connecting Rod" for additional information.

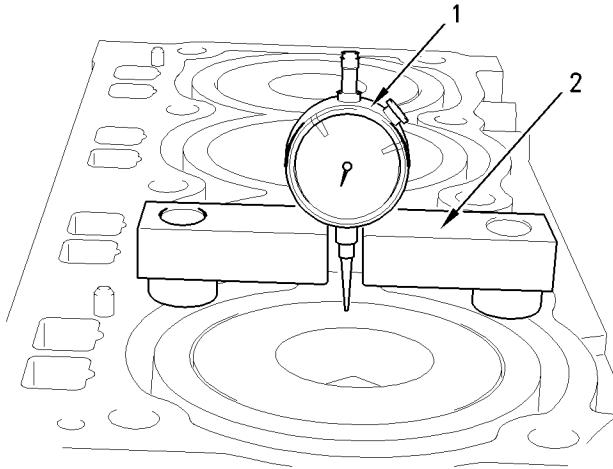


Illustration 40

g00983585

- (1) Dial gauge  
(2) Dial gauge holder

1. Use the dial gauge (1) and the dial gauge holder (2) in order to measure the piston height above the cylinder block. Use the cylinder block face to zero the dial gauge (1).
2. Rotate the crankshaft until the piston is at the approximate top center.
3. Position the dial gauge holder (2) and the dial gauge (1) in order to measure the piston height above the cylinder block. Slowly rotate the crankshaft in order to determine when the piston is at the highest position. Record this dimension. Compare this dimension with the dimensions that are given in Specifications, "Piston and Rings".

i01897548

## Flywheel - Inspect

### Alignment of the Flywheel Face

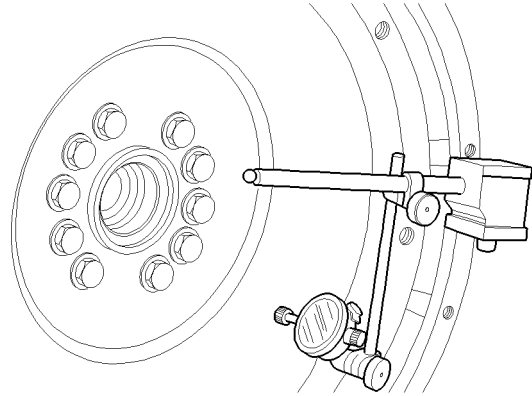


Illustration 41

g00987751

1. Install the dial indicator. Refer to Illustration 41.
2. Set the pointer of the dial indicator to 0 mm (0 inch).
3. Turn the flywheel. Read the dial indicator for every 90 degrees.

**Note:** During the check, keep the crankshaft pressed toward the front of the engine in order to remove any end clearance.

4. Calculate the difference between the lowest measurement and the highest measurement of the four locations. This difference must not be greater than 0.03 mm (0.001 inch) for every 25 mm (1.0 inch) of the radius of the flywheel. The radius of the flywheel is measured from the axis of the crankshaft to the contact point of the dial indicator.

## GENERAL INFORMATION

We recommend that the procedures as outlined in this manual be followed when performing maintenance work on this transmission.

### TOOLS

This transmission can be repaired with ordinary mechanics hand tools however this procedure is not only slow but may damage otherwise serviceable parts. To reduce maintenance costs and vehicle downtime, we recommend that the special tools listed in this manual be procured from a tool manufacturer, as stated.

### CLEANLINESS

Transmission should be steam cleaned externally prior to disassembly. Seal all opening before cleaning to prevent entry of dirt and water which can damage serviceable parts. Dirt is abrasive and will cause premature wear and failure of clutch plates, hydraulic valves and bearings.

\* Due to the nature of operation of the hydraulic system cleanliness is of prime importance and the following guidelines should be observed :

- 1 – Not lint or cotton rags should be used in order to prevent any possible clogging.
- 2 – When fitting new clutch plates they should be soaked in clean new oil as recommended for 3 hours.
- 3 – All parts should be thoroughly cleaned and lubricated with new oil prior to reassembly.

### BEARINGS

When a transmission is removed at relatively low mileage, bearings should be removed with pullers designed for the purpose. Wrap the bearings to keep out dirt.

Clean, inspect and lubricate all bearings just prior to reassembly. If accumulated mileage is over 1500 hours we suggest that all bearings be replaced.

### REPLACEMENT PARTS

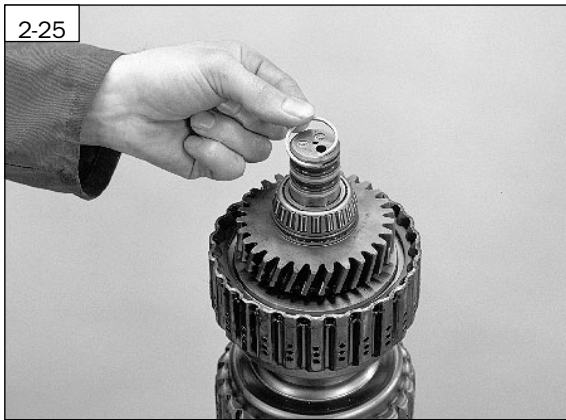
The exploded views of sub-assemblies which are incorporated in this manual are for the mechanic's convenience and show the latest material. The parts are arranged in their correct order and may also be used as a reference for assembly or disassembly of this unit.

### SHIMS

When inserting shim packs, it is essential that the thinnest shims are placed between the thicker shims to prevent any possible damage to the shims.

### SEALS

The seals which have been removed on the disassembly shall be replaced by new on reassembly.



Finally fit 3 new sealing rings to the rear of the shaft as shown.

## ***GEAR BOX AND CONVERTER (DETAILS 4WD VERSION)***

**With brake**

- |                            |                               |
|----------------------------|-------------------------------|
| 1 – Reverse idler gear     | 41 – Synchro assy             |
| 2 – Bearing                | 42 – Output shaft 1st gear    |
| 3 – Shim                   | 43 – Bearing                  |
| 4 – Spacer                 | 44 – Spacer                   |
| 5 – Input shaft            | 45 – Coupling                 |
| 6 – Seal                   | 46 – Out put shaft drive gear |
| 7 – Seal (inner)           | 47 – Seal                     |
| 8 – «O» ring               | 48 – Coupling flange          |
| 9 – Seal (outer)           | 49 – «O» ring                 |
| 10 – «O» ring              | 50 – Washer                   |
| 11 – Piston                | 51 – Screw                    |
| 12 – Clutch disc           | 52 – Out put shaft            |
| 13 – Friction disc         | 54 – Gear (37 teeth)          |
| 14 – Piece                 | 55 – Bearing                  |
| 15 – Circlips              | 56 – Shim                     |
| 16 – Spring                | 57 – Spacer                   |
| 17 – Bushing               | 58 – Spacer                   |
| 18 – Circlips              | 59 – End yoke                 |
| 19 – Thrustwasher          | 60 – 1st and 2nd shift rod    |
| 20 – Forward primary gear  | 61 – 3th and 4th shift rod    |
| 21 – Roller bearing        | 62 – Ball                     |
| 22 – Spacer                | 63 – Spring                   |
| 23 – Bearing               | 64 – Plug                     |
| 24 – Stop washer           | 65 – «O» ring                 |
| 25 – Backward primary gear | 66 – 1st and 2nd shift fork   |
| 26 – Countershaft          | 67 – 3th and 4th shift fork   |
| 27 – Bearing               | 68 – Screw                    |
| 28 – Bearing               |                               |
| 29 – Shim                  |                               |
| 30 – Spacer                |                               |
| 31 – Out put shaft         |                               |
| 32 – 3rd gear              |                               |
| 33 – 2nd gear              |                               |
| 34 – Coupling sleeve       |                               |
| 35 – Synchro assy          |                               |
| 36 – Circlips              |                               |
| 37 – 4th gear              |                               |
| 38 – Washer                |                               |
| 39 – Bearing               |                               |
| 40 – Plug                  |                               |

## ***DESCRIPTION OF THE TRANSMISSION SHAFT HYDRAULIC CIRCUIT***

### CLUTCH CIRCUIT

The oil is sucked into the casing via the suction strainer.

The oil leaving the pump passes into the filter and is directed towards the clutch circuit.

The filter is protected by a cold start valve calibrated to 26 bars.

On the filter outlet, the pressure regulator mark A maintains a pressure of 14 +/- 1 bar in the clutch circuit. The same regulator supplies the converter circuit.

The electrovalves mark B enable the pressure to be directed towards the front and reverse gear clutches, and in neutral gear they enable the clutches to be decompressed towards the casing.

On the 4WD «sprung on» version, the clutch is engaged by a spring. When the 4WD electrovalve mark C is fed, the pressure is applied on the piston which pushes the spring back and frees the 4WD clutch.

### CONVERTER CIRCUIT

The oil passes into the converter circuit through the pressure regulator mark A. The pressure limiter mark D maintains a pressure of 6.5 +/- 1.5 bar in the circuit.

### COOLING AND LUBRICATION CIRCUIT

The oil returning from the converter passes via the inside of the pump's hollow shaft, heads towards the oil cooler and then returns into the transmission shaft to lubricate the gears and the bearings on the inlet shaft.

## MAINTENANCE INSTRUCTIONS - Troubleshooting

Observed problems	Probable cause	Additional verifications	Solutions
Symmetry defect of the control of a proportional function.	Shift of the neutral position of the position sensor.		Adjust the neutral position of the position sensor (page 24).
Oil leak between two proportional control units.	Imperviousness defect of the piping of the pilot circuit between the units.		Change the packing (pages 17, 18, 19).
Oil leak between electro-hydraulic and mechanical interface of the proportional control units.	1. Packing damaged.		Change the packing (page 20).
	2. Pilot pressure too high.	Verify that the supply pressure of the pilot circuit does not exceed 35 bar.	

### 3. FONDAMENTAL RULES

#### 3.1 - General information concerning electrohydraulic actuation module connection

##### Hydraulic

When removing the electrohydraulic actuation module, all openings must be plugged immediately to prevent any contamination of the hydraulic system.

Check the hydraulic installation's oil quality and filtration capacity during all servicing / maintenance operations.

When replacing the electrohydraulic actuation module, remove the plastic plugs from the openings and lines just before making the connections.

Do not tighten connectors to a torque greater than that specified in the assembly instructions.

The use of Teflon tape, hemp and joint filler is prohibited.

Hydraulic lines and connections must not be under any strain whatsoever.

##### Electric

All along the operations, pay attention not to damage the cables and electrical connections.

Check that there is no residual voltage across the cables and electrical connections.

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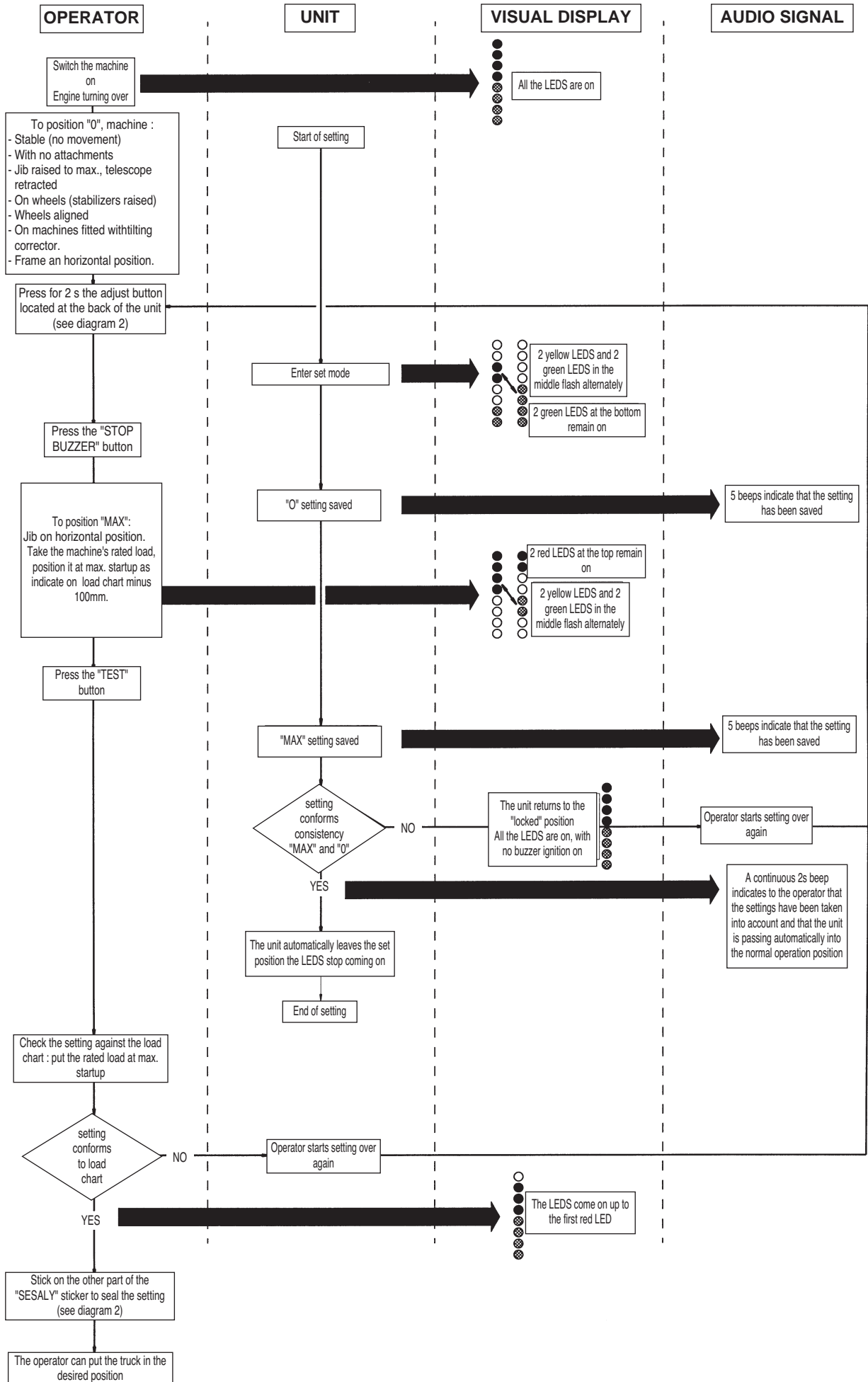
- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: [www.heydownloads.com](http://www.heydownloads.com) by clicking the link below



- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

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# OPERATING AND SETTING OF THE LONGITUDINAL STABILITY ALARM



## 1.4- THE DEHYDRATING FILTER



The dehydrating filter is the only part of the installation which must be changed periodically, at least every 2 years.

The dehydrating filter has 6 very important functions. Remember that it is between the condenser and the expansion valve and is therefore crossed by fluid in liquid form.

### 1<sup>st</sup> FUNCTION :

It provides a **reserve of fluid** in liquid form.

### 2<sup>nd</sup> FUNCTION :

Known as the **damping function** or "**buffer**" function. Indeed, any compressed and liquefied gas has on its liquid surface a gaseous cap which ensures the fluid storage pressure. This naturally compressible gas cap absorbs the shocks generated by the sudden engagement of the compressor, particularly at high engine speeds, thus protecting the installation, above all the expansion valve.

### 3<sup>rd</sup> FUNCTION :

The **microfiltering** provided by synthetic components designed to stop any solid impurities which could have got into the installation during assembly or later operations.

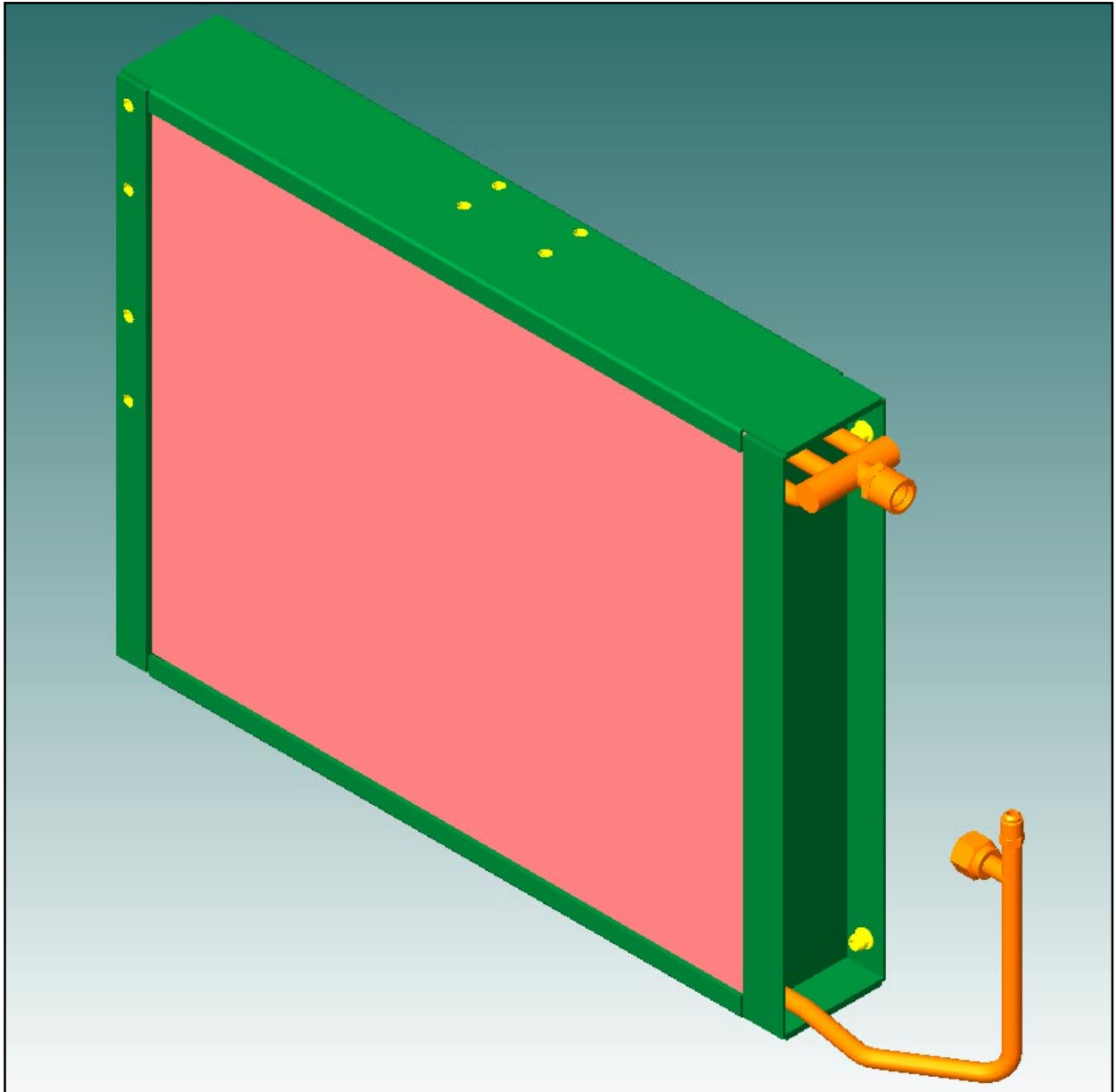
### 4<sup>th</sup> FUNCTION :

**Dehydration.** The filter is crossed by coolant in liquid form. The outer humidity or that produced by the installation penetrates the compressor tubes and ring seal. This humidity can produce hydrochloric and hydrofluoric acid on contact with the coolant. When the humidity is in contact with oil and metals, it can promote corrosion which can damage the compressor, condenser and evaporator. Humidity can also produce so much ice that the expansion valve is blocked, making the installation inefficient. To avoid these problems, humidity absorbing material has been fitted inside the filter through which the refrigerant flows, to absorb it to saturation point. These materials are silica gel, activated aluminium and the molecule trap.

### 5<sup>th</sup> FUNCTION :

**Decantation.** The direction of flow of the fluid is always shown clearly on the filter body because the inner plunger tube stops 20 mm from the bottom of the filter, creating a decantation zone allowing heavy foreign bodies (e.g. welding debris) left over from manufacture to be deposited.

### 1.3- THE CONDENSER



The condenser is a heat exchanger which condenses the coolant. This arrives in the form of a gas at high pressure and temperature, and the condenser liquefies it through the fall in temperature caused by the air passing through it. The condenser is fitted with easily identified input and output connections. The fluid arriving as a gas goes in through the large connection and leaves by the small one in liquid form. The condenser must be supplied with air by the radiator cooling fan which pulses air through it to condense the fluid.

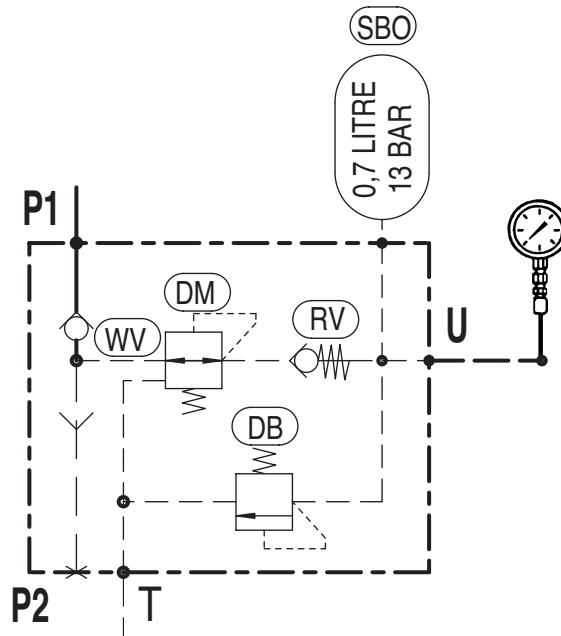


## **Diagnostics and Breakdowns :**

Looking for breakdowns :



Instal a pressure valve on the U line (utilisation)  
The manometer must be at 0-40 bar (see outlines below)



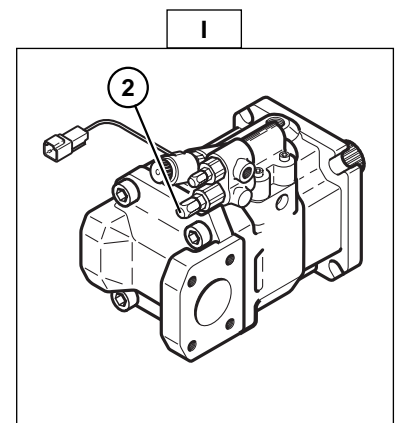
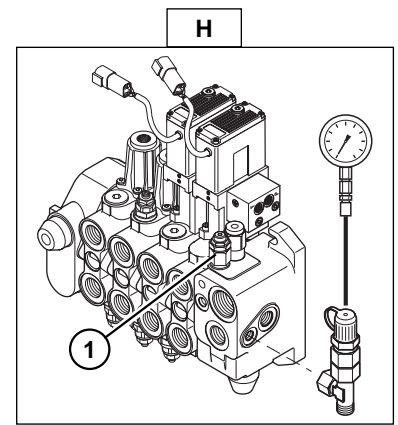
	<b>Procedure</b>	<b>Probable cause</b>
1	1.1-Start up the elevator wagon 1.2-Carry out a steering manoeuvre 1.3-The U pressure must not exceed 35 bar	If pressure < 35 bar - DM spring too weak - DM drawer jammed  If pressure > 35 bar - DM spring too hard - DM drawer jammed
2	2.1-Switch off the engine while retaining the installed pressure valve 2.2- The pressure U must be maintained at 35 bar for sufficient time period	If pressure decrease rapidly -RV leak -DB leak -leak in one of the elements connected to the U line
3	3.1-Carry out 5 depressions on the brake pedal until the end of the run.	After the 5 pedal depressions:  -If the pressure is superior to 0 bar, the accumulator is functioning correctly -If the pressure is inferior to 0 bar, the accumulator must be replaced.

CA	Suction strainer
D3	Driving valve bank 3 positions Position 1 : Steering short Position 2 : Steering front wheel Position 3 : Carbe position
FDAV	Front disk brake
FDAR	Rear disk brake
FR	Return filter
M	I. C. Engine
MC	Master cylinder
N	Level
P	Hydraulic pump
PD	Steering pump
PFR(O)	Trailer braking fitting (Option)
PP	Pressure point
R	Hydraulic tank
RLF	Braking oil tank
SCFR(O)	Trailer braking circuit selector (Option)
VACM(O)	Movements cut-off valve (Option)
VAFR(O)	Trailer braking valve (Option)
VDAR	Rear steering cylinder DE 90x45 C80x2
VDAV	Front steering cylinder DE 90x45 C80x2

## 1-2 Checking pump DR valve (Main pump LS maxi pressure)

Note : in the DDIC system, the maximum pressure limitation of the hydraulic circuit is carried out on the LS pressure control of the SX14 distributor. Do not change the pressure of the DR regulator of the pump.

- Connect the manometer at 0-600 bar the test valve (Fig. H).
- Engine at maximum, activate the push-button (secondary circuit) of the manipulator.
- Tighten the adjustment screw 1 (Fig. H) to increase the pressure of the main control of the distributor..
- You should be reading 290 bar on the manometer.
- If this is not the case, activate the adjustment screw 2 (Fig. 1) of the main pump.
- Tighten to increase the DR, loosen to diminish the DR.  
(For info : 1 turn is equivalent  $\pm 50$  bar)
- At the end of the operation, reset the pressure of the main control of the distributor 1 (Fig. 1) at 270 bar  $\pm 5$ .

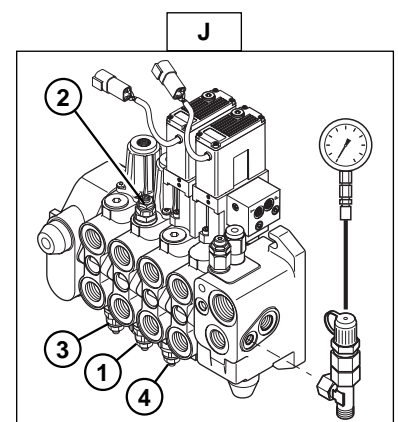


## 1-3 Checking and adjusting the anti-shock valves of the distributor.

- For this operation, it will first be necessary to overset the main pressure relief valve 1 (Fig. H) to 290 bar. Follow instructions as below.
- Connect the 0-600 bar pressure gauge to the test port (Fig. H).
- With the engine at maximum speed, press the manipulator button (attachments circuit).
- Set the pressure to 290 bar by turning the adjusting screw on the main pressure relief valve 1 (Fig. H).
- Tighten to increase the DR and undo to reduce the DR.  
(For info : 1 turn is equivalent  $\pm 50$  bar)

When you have finished oversetting, proceed to check the anti-shock valves.

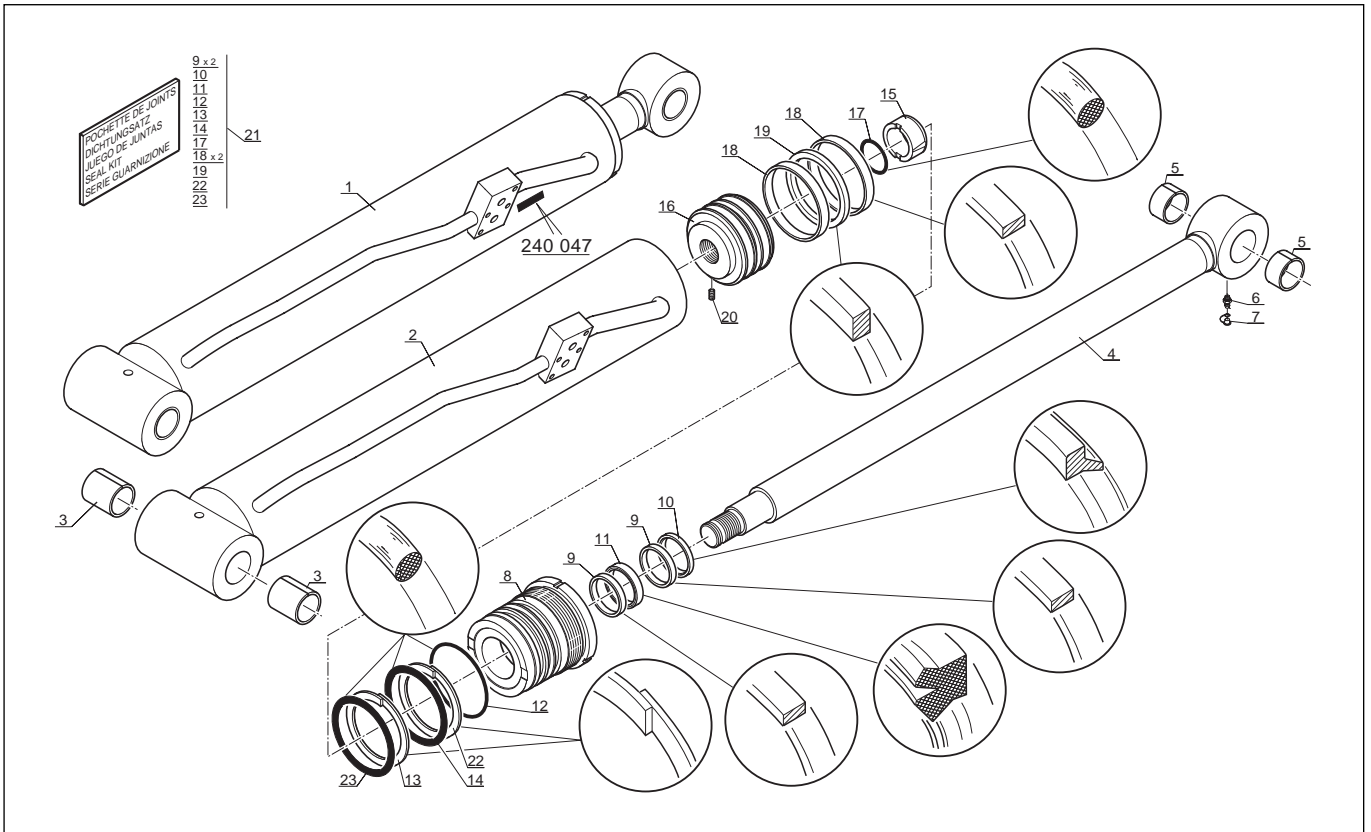
- Engine to 1500 rpm.
- Hold the relevant cylinder at its end of travel and read off the pressure on the pressure gauge (see table of values below).
- If the pressures are not correct, turn the anti-shock valve adjusting screws (Fig. J).
  - 1 - Tilting anti-shock valve on the rod side
  - 2 - Tilting anti-shock valve on the piston side
  - 3 - Lifting anti-shock valve on the piston side
  - 4 - Telescoping anti-shock valve on the piston side



- At the end of setting operations, reset the main pressure relief valve to 270 bar  $\pm 5$ .

# LIFTING CYLINDER

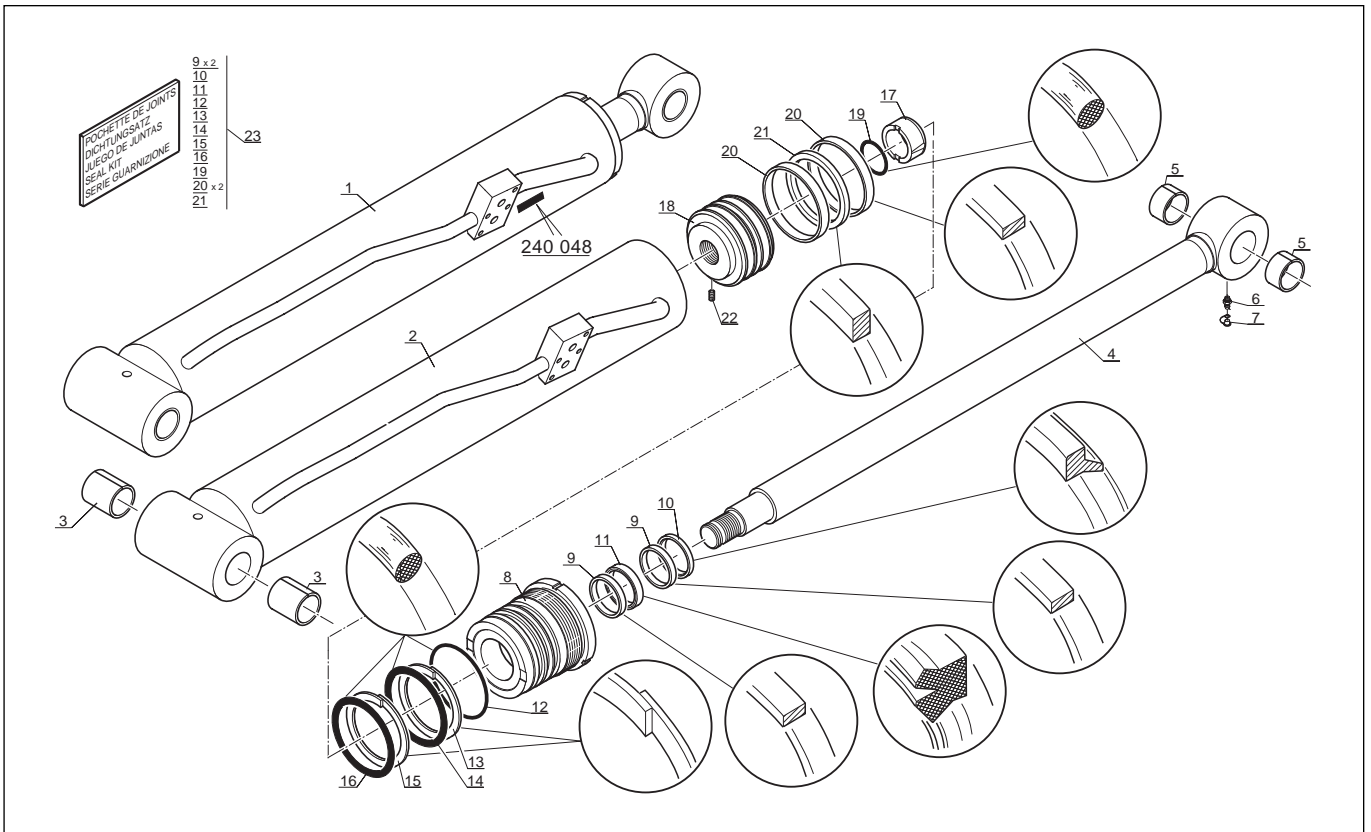
MLT 630 / 634 Série B



# LIFTING CYLINDER

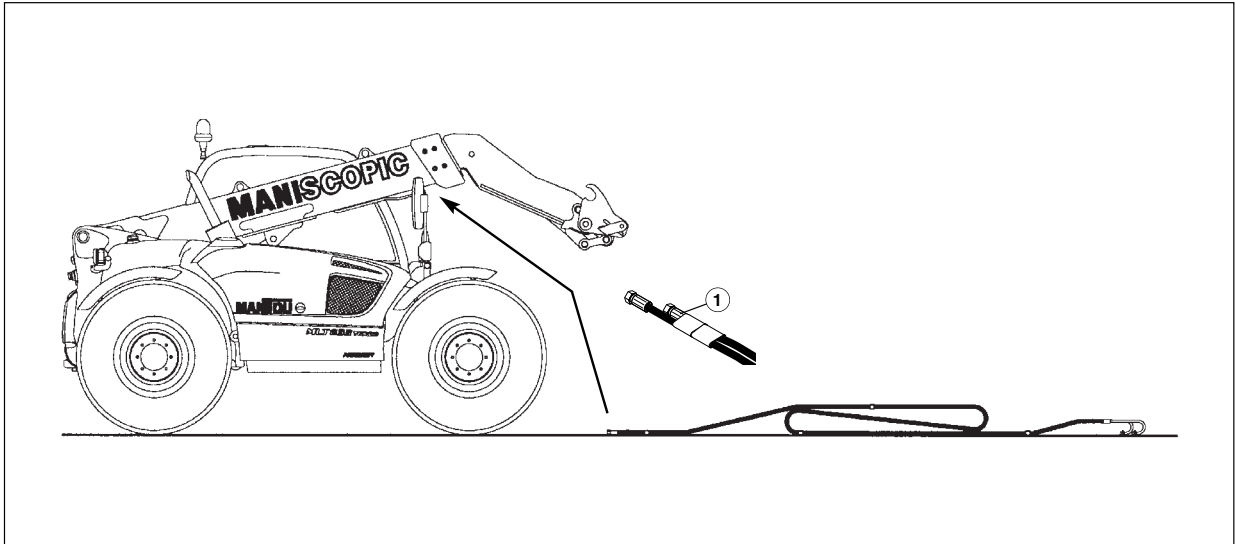
MLT 731 Série B

MT 732 / 932 Série B



## REASSEMBLY OF THE PAIRED HOSES IN THE JIB

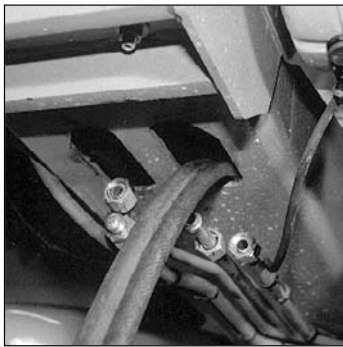
- Reassemble by carrying out in reverse order the operations described in the chapter "REMOVAL OF THE PAIRED HOSES IN THE JIB", also complying with the following instructions.



9

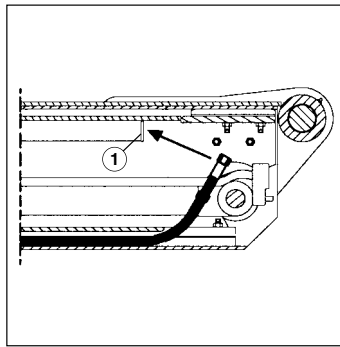
- Place the hoses flat in front of the jib with the crossheads facing down. The longer paired hoses for the attachments circuit and the shorter ones for the tilting circuit.
- Carefully tape the right joint of the paired hoses tightly together with sticky tape.

N.B. : When changing paired hoses, locate the hydraulic connection relating to the old paired hoses.



10

- Engage the paired hoses underneath up to the back of the jib.



11

- Recover the hoses at the back of the jib, slide them into the upper guide 1 and continue to engage them.

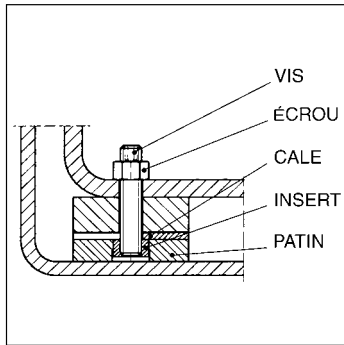


12

- Recover the hoses in the jib head, remove the sticky tape and reconnect them.

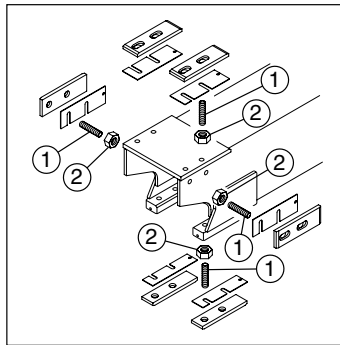
## REASSEMBLY OF THE INNER BOOM

- Reassemble by carrying out in reverse order the operations described in the chapter " REMOVAL OF THE INNER BOOM", also complying with the following instructions.



10

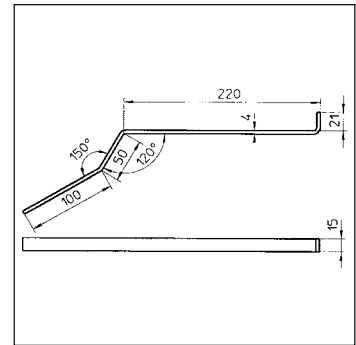
- Cross-section drawing of assembly of all jib wear pads.



11

### REAR WEAR PADS ON THE INNER BOOM

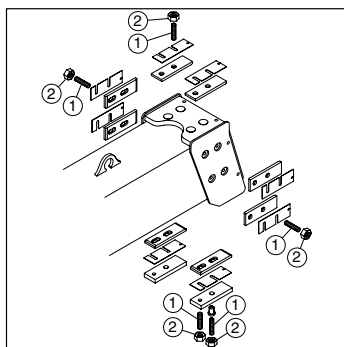
- Apply MANITOU locking compound Ref 187526 on the screw bases 1, then tighten as far as the thread will go.
- Apply MANITOU locking compound Ref 187526 on the nuts, then tighten (tightening torque  $92.6 \text{ N.m} \pm 25 \%$ ).



12

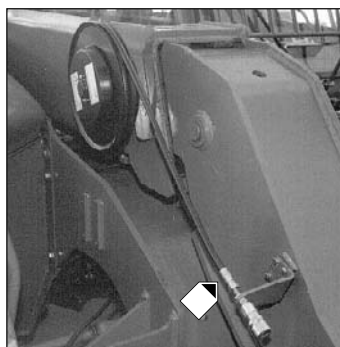
### FRONT WEAR PADS ON THE FOOT OF THE JIB

- For the side wear pads, use the MANITOU tool Ref. 552829



13

- Screw on tight the nuts 1.
- Screw the nuts 2 and tighten (tightening torque  $92.6 \text{ N.m} \pm 25 \%$ ).



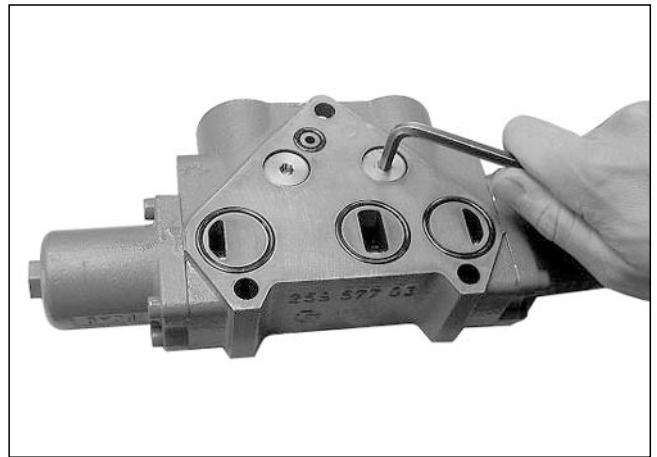
13

- Do a turn and a half pre-load on the reel before reconnecting the leak return hose (Option).

- After re-assembling all the jib components, adjust and secure the jib wear pads and check that the jib is in good working order.

## Disassembling a charge holding valve

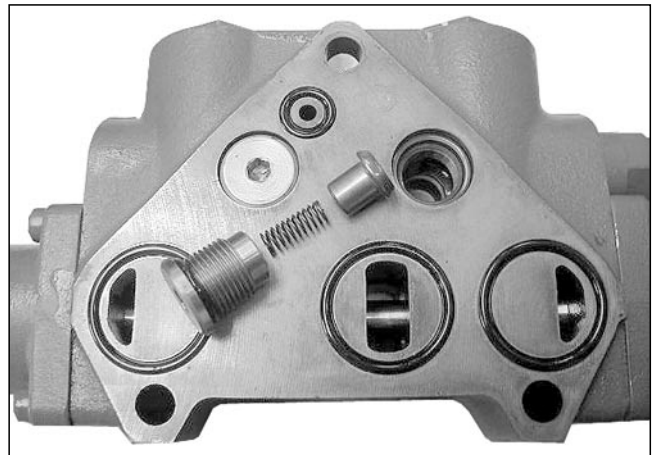
Unscrew the cap with a 5 mm hexagon socket screws key.



- Remove the valve and the spring.
- Visually check the state of the parts.
- If necessary, change the faulty parts.

### *Re-assembly :*

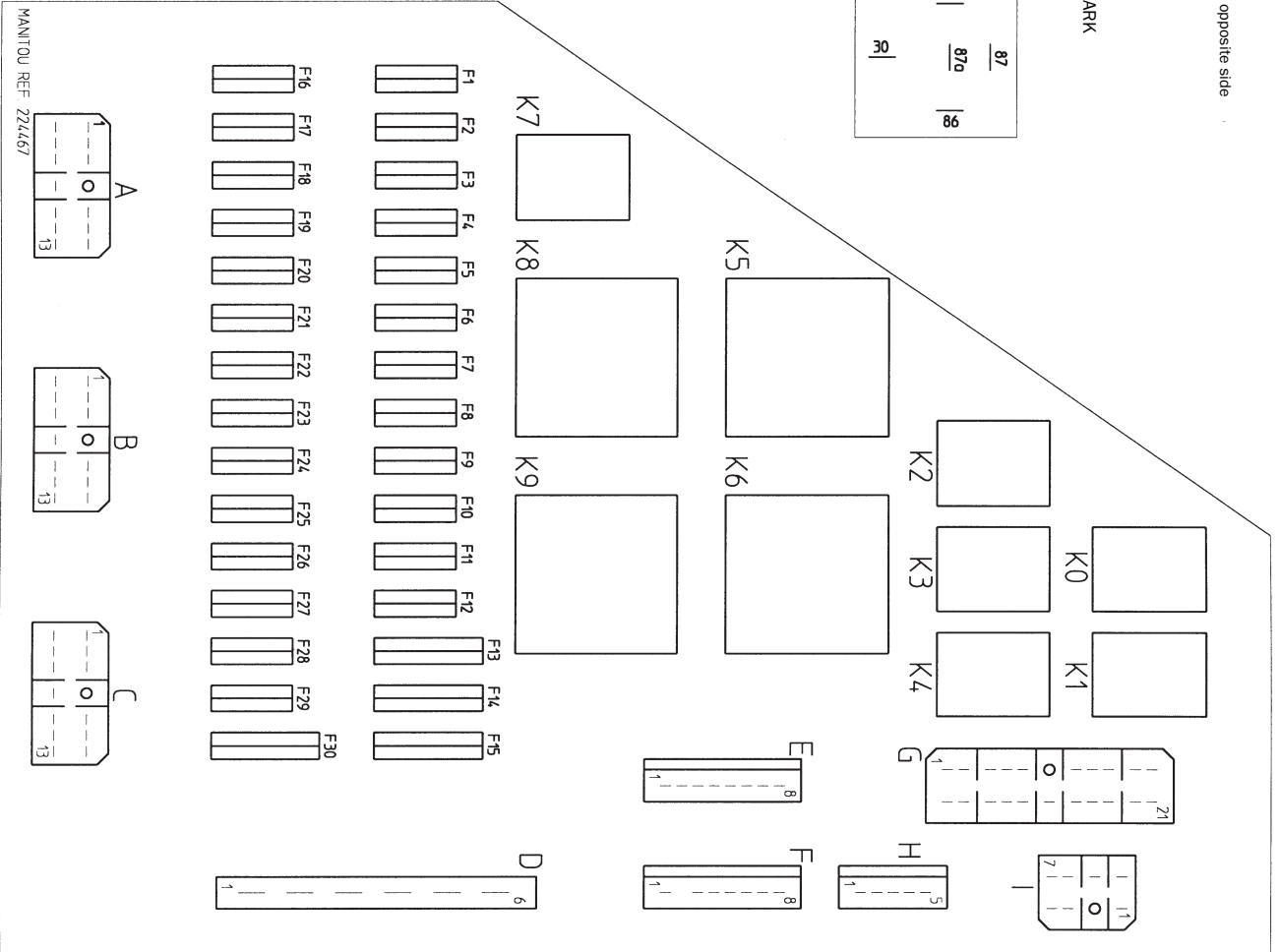
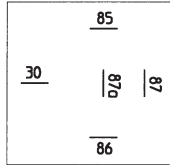
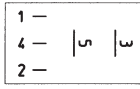
- *Change the O ring on the cap*
- *Tightening torque :  $30 \pm 3$  N.m.*



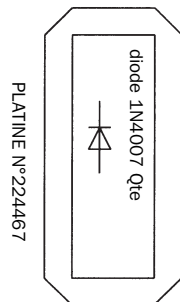
# PLATE ELECTRIC DIAGRAM

- All connectors are seen to opposite side from the weld

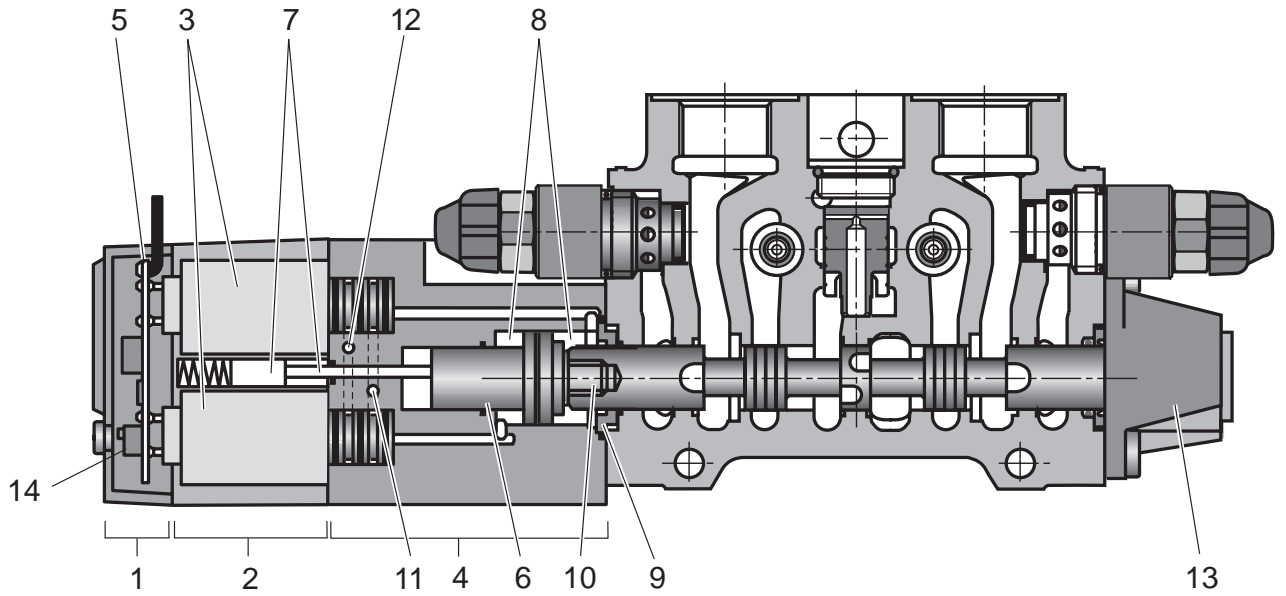
RELAY BRACKET MARK



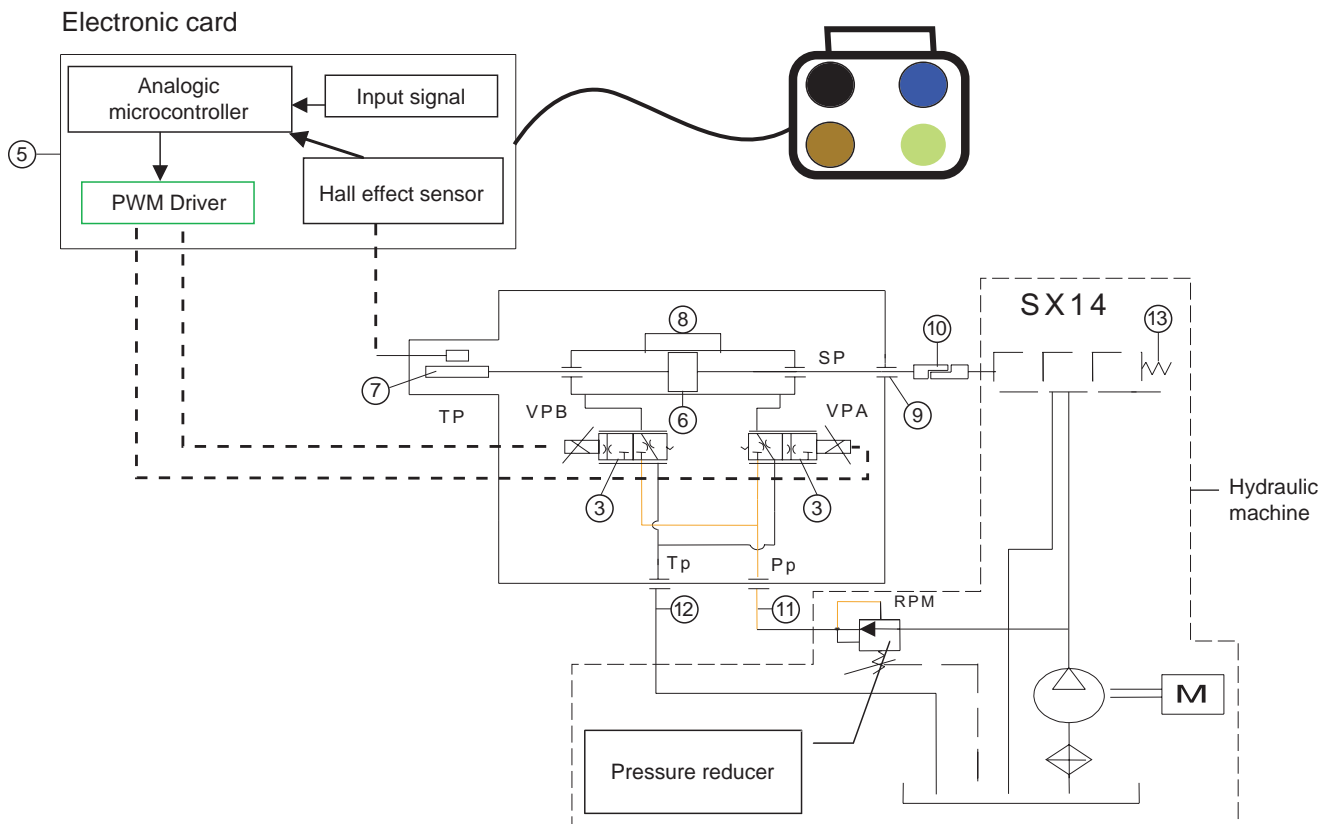
MANNITOU REF 224467

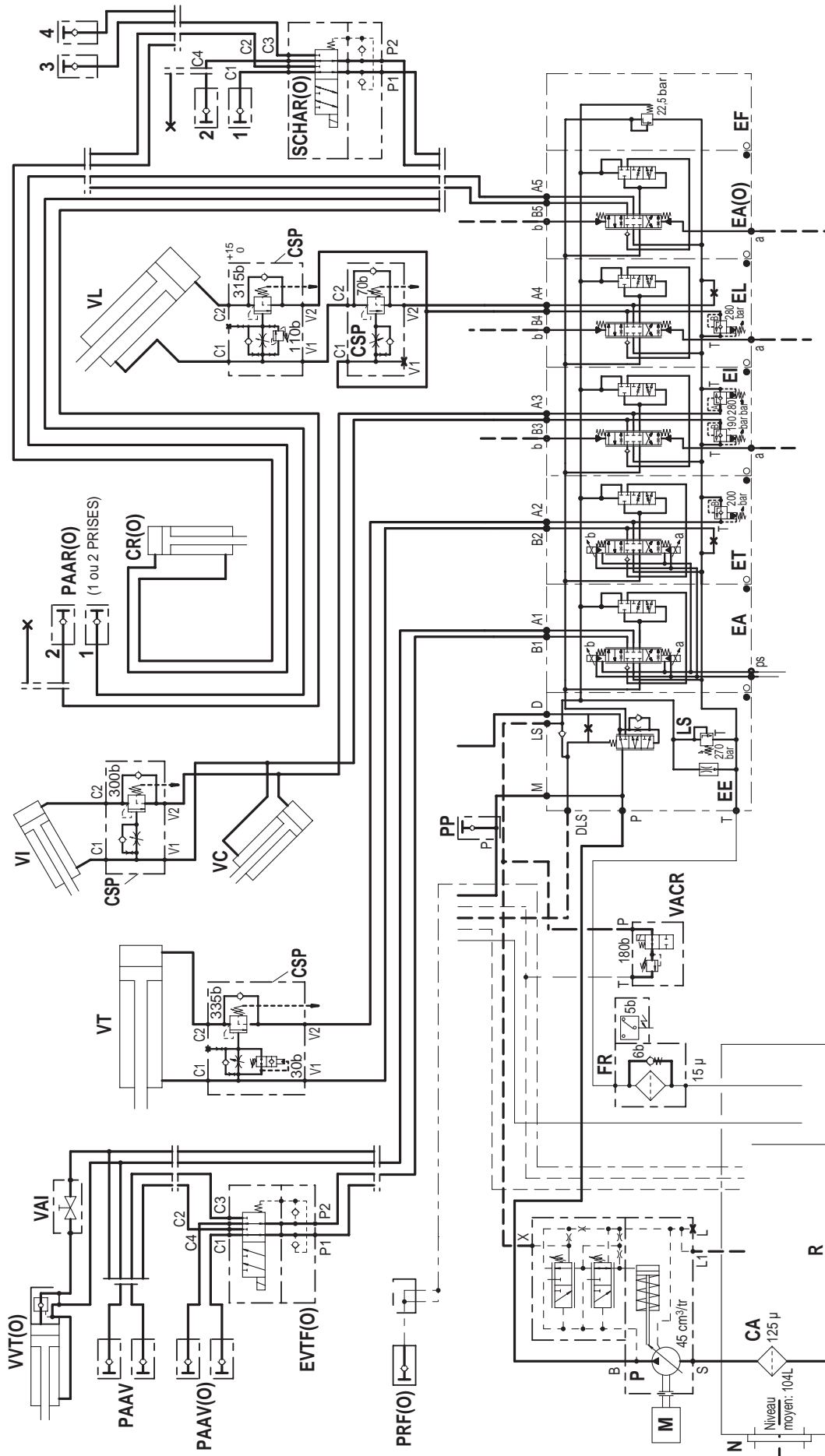


# FUNCTIONAL DESCRIPTION, SECTION



# EMS HYDRAULIC OUTLINE ADAPTED TO THE MACHINE





## B - REMOVAL AND REASSEMBLY OF THE PISTON AND LOCKING RING

### REMOVAL

- Place the stem in a vice fitted with false jaws.
- Tighten so as to stop it turning.
- Loosen nut 5 (Fig. B1) and unscrew it completely using a box wrench. Or depending on the version, remove locking screw 6 (Fig. 1) using a hexagonal wrench.

NOTE : Locking ring 6 (Fig. B1) is fitted using Loctite, then blocked by striking it with a chisel

- Remove piston 4 (Fig. B2) by pulling it out manually or, depending on the version, by unscrewing piston 7 (Fig. B1) using a hook wrench.
- Remove locking ring 2 (Fig. B3) by sliding it along the stem.

### INSPECTION

- Check that the stem is straight over its whole length, using a comparator (Fig. B4).
- Check that the stem is not scaling, corroded or scratched.

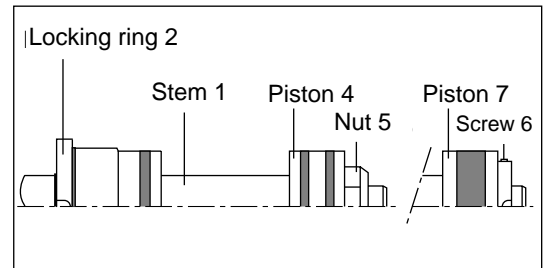
### REASSEMBLY

- Reassemble locking ring 2 (Fig. B5) on stem 1 (Fig. B5).
- Reassemble piston 4 (Fig. B1) on the stem.
- Screw and lock nut 5 (Fig. B1) using a box wrench and a torque wrench. See the table for the tightening torque (Fig. B6). Or, depending on the version, screw piston 7 (Fig. B1) using a spanner wrench (see tightening torque Fig. B6) and block it with locking screw 6 (Fig. B1).

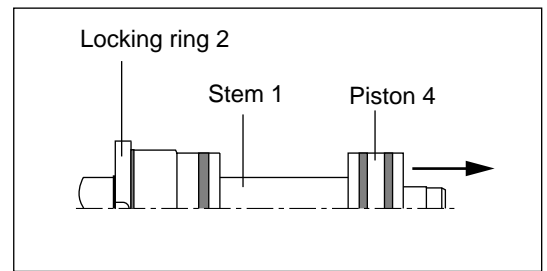
NOTE : • The locking screw should be fitted using Loctite 243, see section E.

- Tightening torque for the screw = 20 Nm.
- Strike with a chisel to drive the screw into the metal.

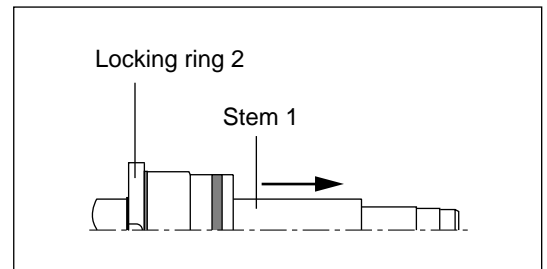
B1



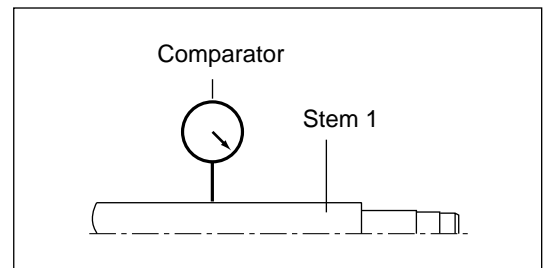
B2



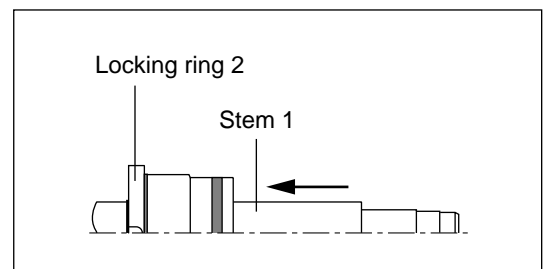
B3



B4



B5



## 2 INSTRUCTIONS FOR STARTING UP THE MANITOU PRODUCTION UNIT

### 2.1- CHECK BEFORE LOADING

Tightening the coolant connections according to the torque table.

CONNECTION	MODULE	TORQUE Nm
COMPRESSOR DISCHARGE	8     ‘’	15.4 Nm
COMPRESSOR SUCTION	10    7/8 ‘’	24.4 Nm
CONDENSER INPUT	8     ‘’	15.4 Nm
DEHYDRATOR OUTPUT	6     5/8 ‘’	15.4 Nm
EVAPORATOR INPUT	6     5/8 ‘’	15.4 Nm
EVAPORATOR OUTPUT	10    7/8 ‘’	24.4 Nm

### 2.2- CHARACTERISTICS OF COOLANT R134a

**WARNING :** *The MANITOU air-conditioning system uses coolant R134a only (Ref. MANITOU 4500421 – 14.5 Kg bottle) and PAG SP20 oil code : 430A08 only.*

#### Characteristics of coolant R134a

* Trade name	: Fluorocarbon 134a
* Use	: Coolant
* Chemical characteristics	: Tetrafluoroethane 134a
* Chemical formula	: CH <sub>2</sub> FCF <sub>3</sub>
* Physical state	: Liquefied gas
* Colour	: Colourless
* Odour	: Slightly of ether
* Boiling point (s/1bar)	: -26.5 °C
* Melting point	: -101°C
* Density at 25°C	: 1.21kg/l
* Critical pressure	: 40.56 bar
* Critical temperature	: +100.6 °C
* Weight as gas	: 5 times heavier than air
* 1 kg in liquid state at 1 bar	: 200 l in gaseous state
* Thermal decomposition	: from 110°C
* Hazardous decomposition products	: hydrogen halides and traces of carbonyl halides
* Dangerous reactions	: With alkaline metals and alkaline-earths of powdered metal salts : Al-Zn-Be...
* Flash point	: No flash point
* Self-ignition temperature	: Over 750°C
* Limit of explosivity	: Below none, above none
* Ozone destruction potential	: Zero (none).

## 5.2- PRECAUTIONS (GB)



5.2.1- Once the A/C system is slowing down, it is losing its efficiency. Contact an approved MANITOU dealer if this is the case with your air conditioner.

**CAUTION : Never repair your air conditioner by yourself. An approved MANITOU dealer will have the technical know-how, all the necessary tools and the spare parts.**

5.2.2- Do not open the A/C system, as it will cause loss of refrigerant. The refrigerant in the A/C system can carry some risks. The R-134a refrigerant is colourless, odourless and denser than the air.

5.2.3- Never loosen the compressor-draining plug, as it will cause loss of the refrigerant. Always check the oil level in the compressor when the A/C system is empty

**2 LOAD**

**Verification of the quantity to use**

**HP loading  
Liquid phase**

**Possible LP complement  
Gas phase**

**HP reading: (Condensation temp.)  
Max.: Ext. temp. + 16°C**

**LP reading: (Evaporation temp.)  
Mini : 0.2 bar**

**3 CHECK USING ELECTRONIC DETECTOR**

**3 CHECK USING ELECTRONIC DETECTOR**

## Installation Procedure

### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

**Note:** The installation procedure is identical for the four cylinder and the three cylinder engines. The illustrations show the four cylinder engine.

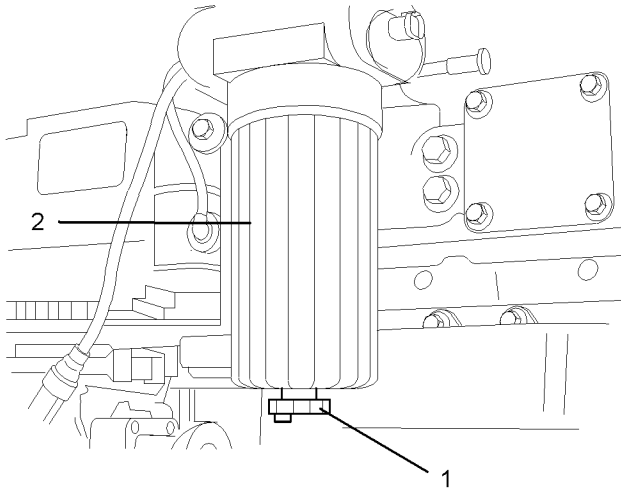


Illustration 5  
Typical example

g01010637

1. Thoroughly clean the inside of the filter case (2) and thoroughly clean the lower face of the filter head (5).
2. Inspect the thread of a new filter element (4) in order to ensure that the thread is not damaged. Inspect the thread of the adapter in the filter head (5) in order to ensure that the thread is not damaged.
3. Inspect the condition of the spring and ensure that the spring is correctly located within the filter case (2).
4. Install the new filter element (4) into the filter case (2). Push the filter element against the spring pressure and rotate the filter element in a clockwise direction in order to secure the filter element within the filter case (2).
5. Lightly lubricate a new O-ring (3) with clean fuel oil. Install the new O-ring (3) into the recess within the filter case (2).
6. Close the drain (1).
7. Remove the air from the fuel system. Refer to the Operations and Maintenance Manual, "Fuel System - Prime". Remove the suitable container and dispose of the fuel that has drained as waste.

i01939856

## Fuel Injection Lines - Remove

### Removal Procedure

#### Start By:

- a. Remove the cover for the fuel injectors. Refer to this Disassembly and Assembly Manual, "Fuel Injector Cover - Remove and Install".

### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

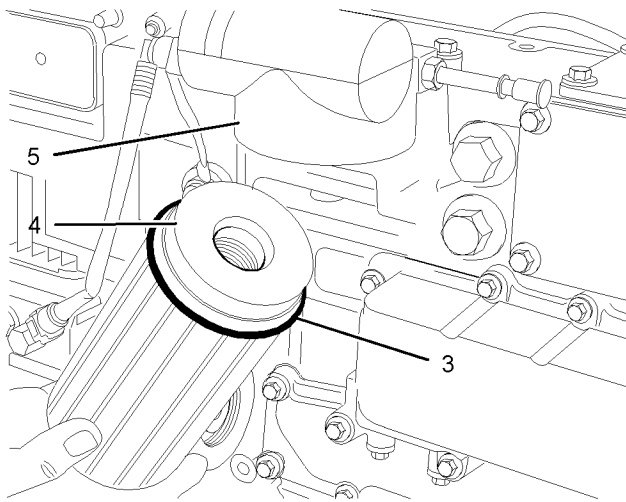


Illustration 6  
Typical example

g01010595

6. Connect the harness assembly to the timing advance solenoid (6).
7. Connect the harness assembly (4).
8. Remove all of the dust caps from the connectors on the fuel injection pump. Remove all of the plugs from the fuel hose assemblies and from the tube assemblies.
9. Connect the fuel line (5) to the fuel injection pump. Connect the fuel return line (3) to the fuel injection pump.

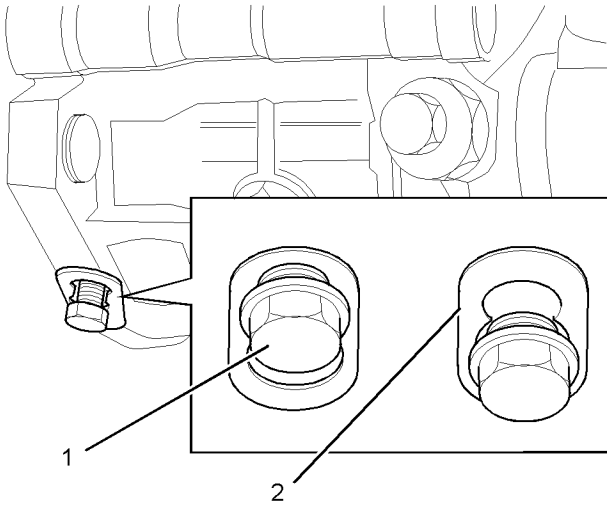


Illustration 29

g01061708

10. Loosen the locking screw (1). Move the spacer (2) in order to prevent the locking screw (1) from tightening against the shaft of the fuel injection pump. Tighten the locking screw (1) to a torque of 12 N·m (8.8 lb ft).

**Note:** The spacer (2) must be correctly positioned and locking screw (1) must be tightened in order to prevent the locking screw from contacting the shaft of the fuel injection pump.

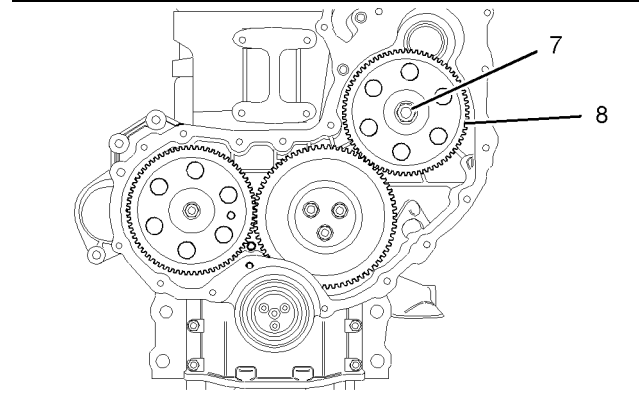


Illustration 30

g01062397

Typical example

11. Tighten the nut (7) to a torque of 88 N·m (65 lb ft).

#### End By:

- a. Install the front cover. Refer to this Disassembly and Assembly Manual, "Front Cover - Remove and Install".
- b. Install the crankshaft pulley. Refer to this Disassembly and Assembly Manual, "Crankshaft Pulley - Remove and Install".
- c. Install the fuel injection lines. Refer to this Disassembly and Assembly Manual, "Fuel Injection Lines - Install".

**NOTICE**

Ensure that the valve spring is compressed squarely or damage to the valve stem may occur.

- b. Compress the valve spring (5) sufficiently in order to open the valve only. Do not compress the valve spring sufficiently so that the valve keepers (3) could be removed from the recess in the valve stem.
- c. Turn the crankshaft until the piston touches the valve.
- d. Continue to turn the crankshaft until the valve stem is at the highest point. The piston is now at top dead center. Release the applied pressure of the valve spring compressor (1) at the top center position.

**NOTICE**

Do not turn the crankshaft while the valve springs are removed.

- 2. Use the valve spring compressor (1) in order to compress the valve spring (5). Remove the valve keepers (3).
- 3. Carefully release the pressure on the valve spring compressor (1). Remove the valve spring retainer (4) and the valve spring (5).

**Note:** If you are replacing all of the valve springs, the procedure can be done on two cylinders at the same time. The procedure can be done on cylinder 1 and cylinder 4, and on cylinder 2 and cylinder 3. Remember that the crankshaft must not be turned while the valve springs are removed. Ensure that all of the valve springs are installed before changing from one pair of cylinders to the other pair of cylinders.

**Installation Procedure**

Table 2

Required Tools		
Part Number	Part Description	Qty
21825666	Valve Spring Compressor	1
27610235	Setscrew	1

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

**WARNING**

**Improper assembly of parts that are spring loaded can cause bodily injury.**

**To prevent possible injury, follow the established assembly procedure and wear protective equipment.**

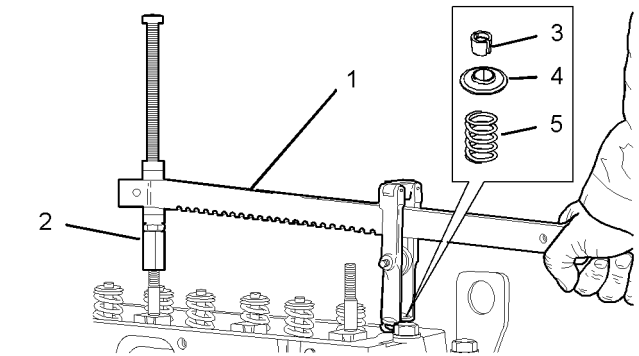


Illustration 50

g01015085

- 1. Place the new valve spring (5) into position.
- 2. Install the valve spring retainer (4).

**NOTICE**

Ensure that the valve spring is compressed squarely or damage to the valve stem may occur.

- 3. Install the valve spring compressor (1) in position on the cylinder head in order to compress the appropriate valve spring (5). Compress the valve spring (5).
- 4. Install the valve keepers (3).

**NOTICE**

Do not turn the crankshaft while the valve springs are removed.

- 5. Carefully release the pressure on the valve spring compressor (1). Remove the valve spring compressor (1). Ensure that all of the valves are secured in place by a valve spring and valve keepers. Rotate the crankshaft through about 45 degrees in order to clear the piston from the valve. Lightly strike the top of the valve with a soft hammer in order to ensure that the valve keepers (3) are properly installed.

**Note:** If you are replacing all of the valve springs the procedure can be done on two cylinders at the same time. The procedure can be done on cylinder 1 and cylinder 4, and on cylinder 2 and cylinder 3.

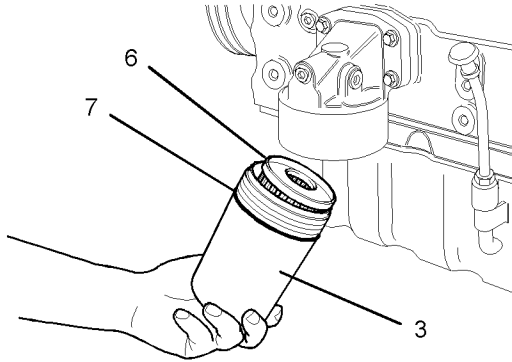


Illustration 64  
Typical example

g01018307

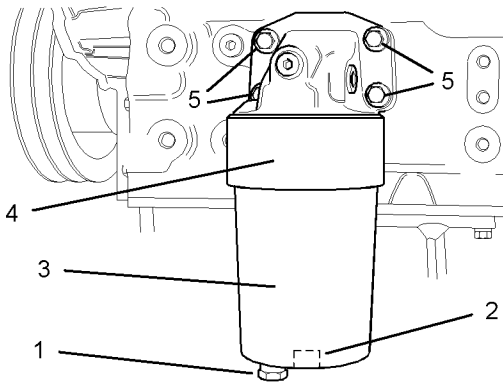


Illustration 65  
Typical example

g01018261

6. Clean the inner surface of the oil filter housing (3). Clean the mating surfaces of the oil filter base (4) and the oil filter housing (3). Install a new O-ring onto the drain plug (1) if the drain plug was removed previously. Install the drain plug (1) into the oil filter housing (3). Tighten the drain plug (1) finger tight.
7. Lubricate a new O-ring (7) with clean engine lubricating oil. Install the new O-ring (7) onto the oil filter housing (3). Install a new oil filter element (6) into the oil filter housing (3). Rotate the oil filter element (6) in order to lock the element in the oil filter housing (3).

**Note:** Add clean engine lubricating oil into the oil filter housing (3) if the oil filter is installed vertically on the engine. Allow sufficient time for the added oil to flow through the oil filter element (6).

8. Screw the oil filter housing (3) into the oil filter base (4) by hand. Install a 1/2 inch square drive into the recess (2) in order to tighten the oil filter housing (3) to a torque of 25 N·m (18 lb ft).

9. Tighten the drain plug (1) to a torque of 12 N·m (9 lb ft).
10. Inspect the O-ring for the drain plug for the engine oil pan. If necessary, replace the O-ring. Install the O-ring onto the drain plug for the engine oil pan and install the drain plug into the engine oil pan. Tighten the drain plug to the correct torque. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install" for the correct torque. Remove the suitable containers beneath the engine oil pan and beneath the oil filter housing.
11. Fill the engine oil to the correct level that is indicated on the engine oil level gauge. Refer to the Operation and Maintenance Manual, "Refill Capacities" for the lubrication system capacity of the engine.

## Removal Procedure for a Spin-On Oil Filter

**Note:** This procedure is for the removal of an oil filter with an oil filter element that has an integral housing.

**Note:** The oil filter can be installed vertically or the oil filter can be installed horizontally.

### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

### NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

1. Remove all dirt, oil, and grease from the engine oil filter assembly and from the drain plug of the engine oil pan. Place a suitable container beneath the drain plug of the engine oil pan.
2. Operate the engine until the engine is warm. Stop the engine.
3. Remove the oil drain plug and the O-ring from the engine oil pan. Drain the engine oil into the container for storage or disposal.

1. Drain the coolant from the cooling system into a suitable container for storage or disposal.
2. Loosen the clamps and remove the hose from the water pump inlet.

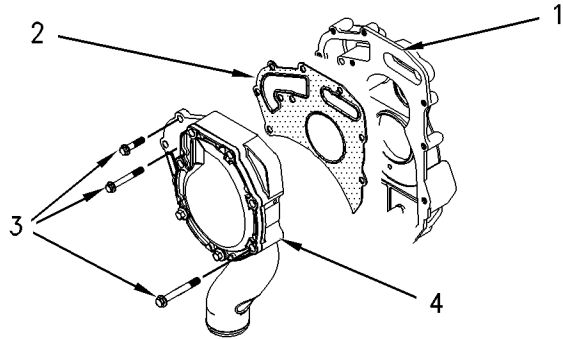


Illustration 84

g00952695

3. Remove the setscrews (3) that fasten the water pump (4) to the front housing (1).
4. If necessary, gently tap the water pump (4) with a soft hammer in order to loosen the water pump.
5. Remove the water pump (4). Remove the joint (2) from the front housing (1) and the water pump (4). Discard the joint (1).

i01962207

## Water Pump - Disassemble

### Disassembly Procedure

#### Start By:

- a. Remove the water pump. Refer to this Disassembly and Assembly Manual, "Water Pump - Remove and Install".

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

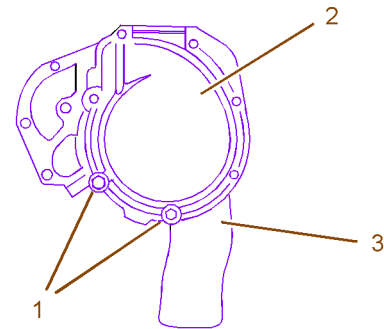


Illustration 85

g01019550

1. Remove the setscrews (1) from the cover (2) of the water pump (3). Remove the joint between the cover (2) and the water pump (3). Discard the joint.

**Note:** All of the other setscrews are removed during the removal of the water pump.

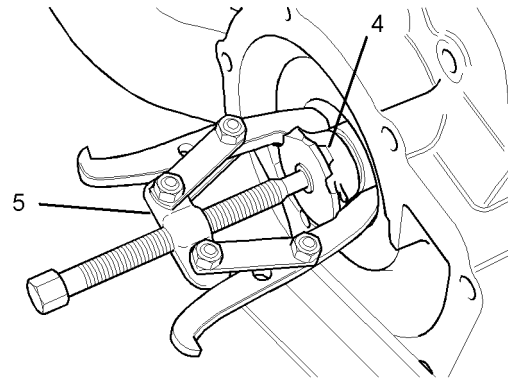


Illustration 86

g01019566

2. Drill twelve 6.35 mm (0.25 inch) holes between the existing holes in the impeller (4). Break pieces from the impeller (4) in order to install a suitable puller (5) with two legs onto the impeller. Remove the impeller (4) with the suitable puller (5).

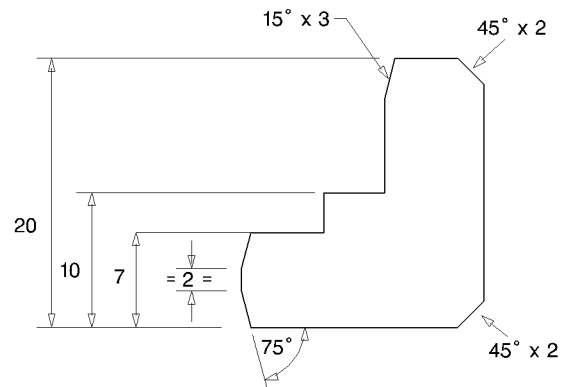
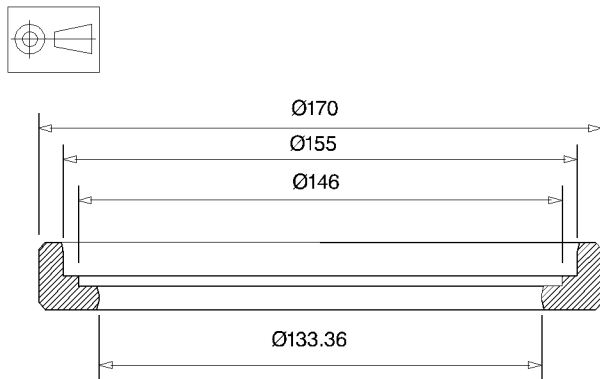


Illustration 112

g00975010

**Note:** The alignment tool (4) is not currently available from Perkins. Refer to the illustration 112 for the required dimensions in order to manufacture an alignment tool (4) locally.

7. Install the alignment tool (4) onto the crankshaft flange (1) and over the assembly of the crankshaft rear seal (3) in order to align the assembly with the crankshaft flange.

9. Remove the alignment tool (4). Tighten the setscrews 8 and 9 to a torque of 22 N·m (16 lb ft). Refer to the illustration 113.

**End By:**

- a. Install the flywheel housing. Refer to this Disassembly and Assembly Manual, "Flywheel Housing - Remove and Install".
- b. Install the flywheel. Refer to this Disassembly and Assembly Manual, "Flywheel - Install".

i01964071

**Crankshaft Wear Sleeve (Rear) - Remove**

**Removal Procedure**

**Start By:**

- a. Remove the crankshaft rear seal. Refer to this Disassembly and Assembly Manual, "Crankshaft Rear Seal - Remove".

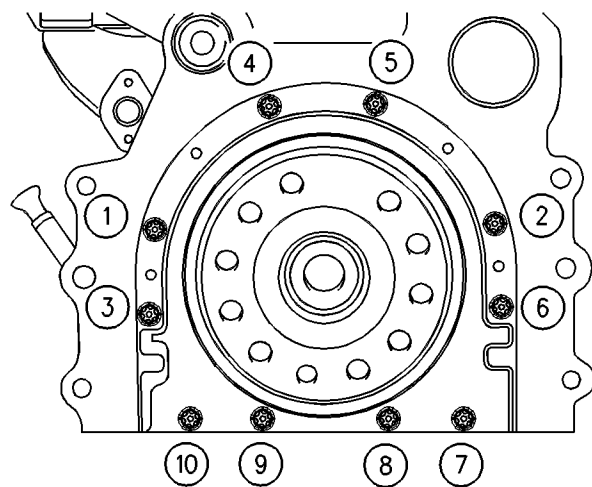


Illustration 113

g00915076

8. Tighten the setscrews (5) in the sequence 1, 2, 3, 4, 5, 6, 7, and 10 to a torque of 22 N·m (16 lb ft). Refer to the illustration 113.

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

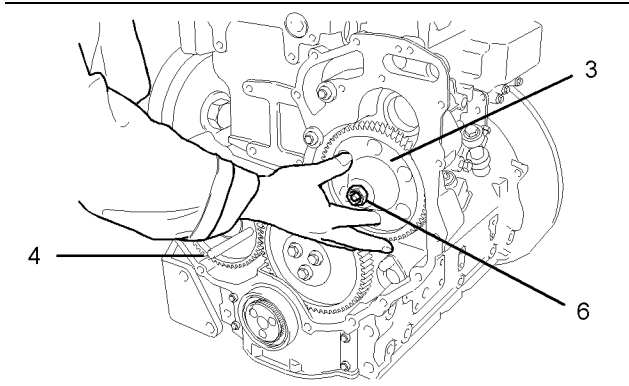


Illustration 133

g01023250

Typical example (Bosch fuel injection pump drive gear)

8. Install the fuel injection pump gear (3) onto the fuel injection pump shaft. Ensure that the mesh of the fuel injection pump gear (3) is correct with the idler gear (2). Install the washer and the nut (6) finger tight.
9. Apply hand pressure to the fuel injection pump gear (3) in a counterclockwise direction in order to remove the backlash in the gears (1), (2), and (3). Tighten the nut (6) to a torque of 24 N·m (18 lb ft).
10. Ensure that all of the timing marks on the gears (1), (2), and (3) are in alignment.

**Note:** The three cylinder engine is equipped with the Delphi DP210 fuel injection pump.

**Note:** The four cylinder engine can be equipped with either the Delphi DP210 or the Bosch EPVE fuel injection pump. The two types of fuel injection pump have a different procedure for unlocking the fuel injection pump shaft.

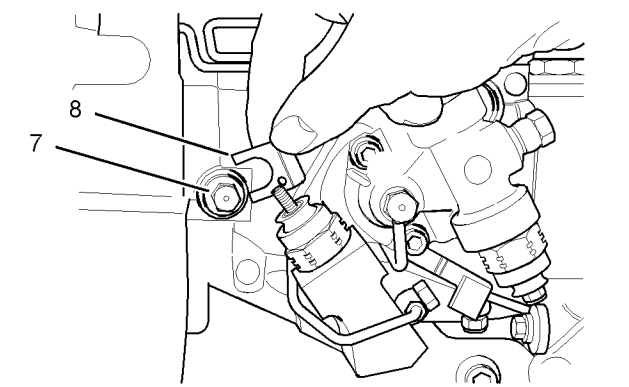


Illustration 134

g01023252

Four cylinder engine only

11. Release the locked fuel injection pump shaft. In order to unlock the Bosch EPVE fuel injection pump shaft, loosen the locking screw (7) and install the washer (8). Tighten the locking screw (7) onto the washer (8) to a torque of 12 N·m (9 lb ft).

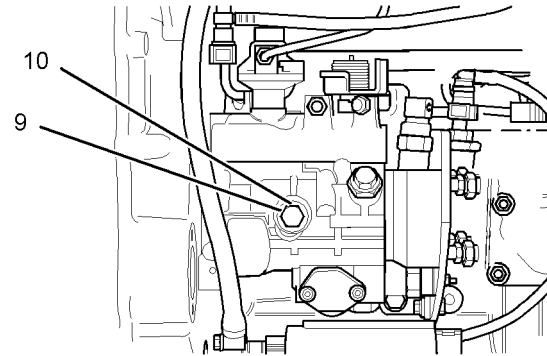


Illustration 135

g01023253

Three cylinder and four cylinder engines

12. In order to unlock the Delphi DP210 fuel injection pump shaft, loosen the locking screw (9) and move the washer (10). Tighten the locking screw (9) onto the washer (10) to a torque of 12 N·m (9 lb ft).
13. Tighten the nut (6) to an increased torque of 90 N·m (66 lb ft). Refer to illustration 133.
14. Remove the timing pins (4) and (5). Refer to illustration 132.
15. Check the backlash value for the fuel injection pump gear (3). Refer to the Specifications Manual, "Gear Group (Front)" for further information.
16. Check the end play of the idler gear (2). Refer to this Disassembly and Assembly Manual, "Idler Gear - Remove and Install" and refer to the Specifications Manual, "Gear Group (Front)" for further information.
17. Check the backlash value for the idler gear (2). Refer to this Disassembly and Assembly Manual, "Idler Gear - Remove and Install" and refer to the Specifications Manual, "Gear Group (Front)" for further information.
18. Check the end play of the camshaft gear (1). Refer to this Disassembly and Assembly Manual, "Camshaft Gear - Remove and Install".
19. Check the backlash value for the camshaft gear (1). Refer to this Disassembly and Assembly Manual, "Camshaft Gear - Remove and Install" and refer to the Specifications Manual, "Gear Group (Front)" for further information.

4. Apply a small continuous bead (14) of 21820603 POWERPART Retainer (oil tolerant) to the outer surface of the bearing (8). Apply a small continuous bead (13) of 21820603 POWERPART Retainer (oil tolerant) to the inner surface of the bearing (8). Ensure that the front face of the inner race of the bearing (9) is still on a suitable support. Press the bearing (8) onto the larger shaft of the gear (7) until the bearing (9) is against the shoulder of the gear. Remove any excess sealant.
5. Install the circlip (5) into the groove in the front housing (6). Ensure that the circlip (5) is correctly positioned in the groove.

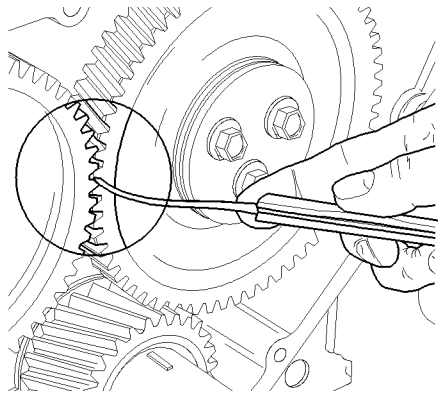


Illustration 163

g00946787

Typical Example

6. Refer to the illustration 163 and check the backlash between the idler gear and gear (7). The backlash should be within 0.11 mm (0.004 inch) to 0.17 mm (0.007 inch).
7. Lightly lubricate a new O-ring (10) with 21820221 POWERPART Red Rubber Grease and install the O-ring into the recess in the front housing (6). Lightly lubricate the bearing (8), the bearing (9), and the gear (7) with clean engine lubricating oil.
8. By using the Allen head screws (3 and 4), install the assembly of the accessory drive to the rear of the front housing (6). Refer to the Torque Specifications Manual, "Standard Torques for Metric Fasteners" for the correct torques.
9. By using the setscrews (1), install the front cover (2). Refer to this Disassembly and Assembly Manual, "Front Cover - Remove and Install."

## Crankcase Breather - Remove and Install

### Removal Procedure for the Diaphragm Valve

**Note:** All naturally aspirated three cylinder and four cylinder engines in the 1100 Series are equipped with a closed breather system. A closed breather system is optional for turbocharged three cylinder and four cylinder engines in the 1100 Series.

**Note:** All of the engines that are equipped with a closed breather system have a diaphragm valve in the valve mechanism cover.

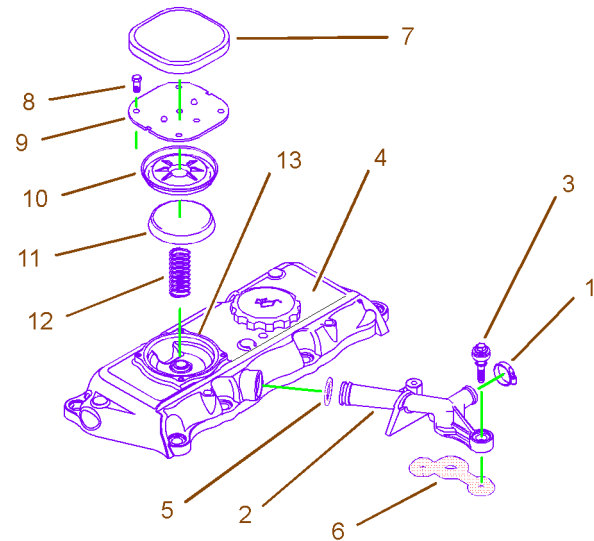


Illustration 164

g01038913

Three cylinder engine

#### 4. Remove the studs (3).

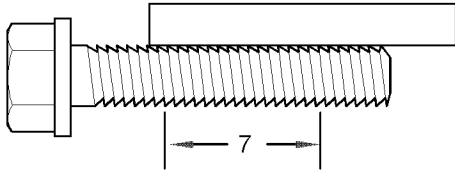


Illustration 187

g01039873

#### 5. Clean the threads of the setscrews (6) for the cylinder head (2). Inspect the setscrews (6) for the cylinder head (2).

**Note:** Do not use the setscrews (6) if there is any visual reduction in the diameter of the threads (7) that have not been engaged with the cylinder block (1). Use a straight edge to check the setscrews (6). Refer to illustration 187.

#### 6. Lubricate the threads and the shoulder of the setscrews (6) for the cylinder head (2) with clean engine oil before installation.

**Note:** There are two different lengths of setscrew (6) for the cylinder head (2).

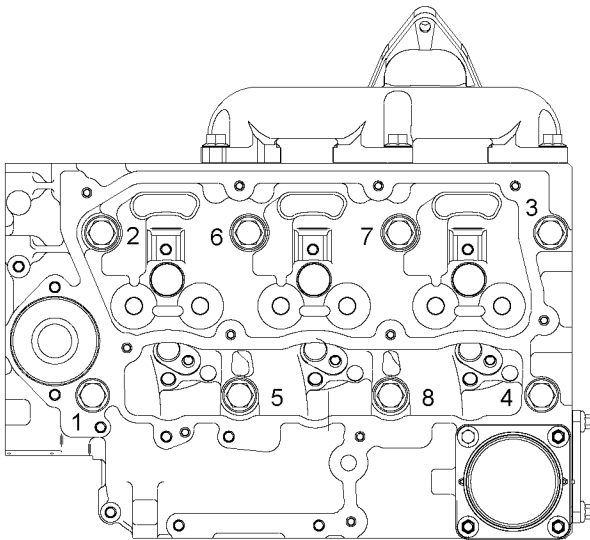


Illustration 188

Three cylinder engine

g01039487

**Note:** For the three cylinder engine, the short setscrews (6) are installed into the holes that are marked 2, 5, 6, 7, and 8. The long setscrews (6) are installed into the holes that are marked 1, 3, and 4. Refer to the illustration 188.

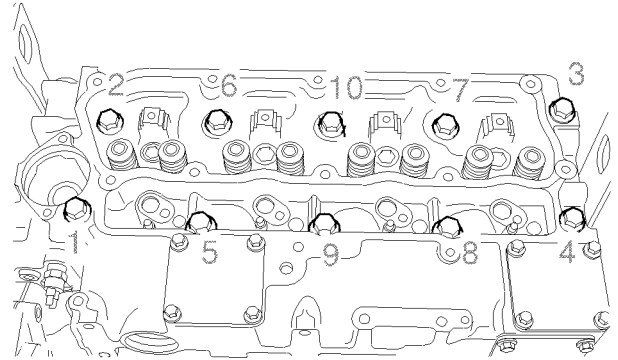


Illustration 189

Four cylinder engine

g01039483

**Note:** For the four cylinder engine, the short setscrews (6) are installed into holes that are marked 2, 5, 6, 7, 8, 9, and 10. The long setscrews (6) are installed into the holes that are marked 1, 3, and 4. Refer to illustration 189.

#### 7. Install the appropriate setscrews (6) into the cylinder head (2).

8. Tighten the setscrews (6) for the cylinder head (2) in numerical order to a torque of 50 N·m (37 lb ft). Refer to the illustration 188 for the three cylinder and refer to illustration 189 for the four cylinder engine.

9. Tighten the setscrews (6) for the cylinder head (2) again in the appropriate numerical order to a torque of 100 N·m (74 lb ft). Refer to the illustration 188 for the three cylinder and the illustration 189 for the four cylinder engine.

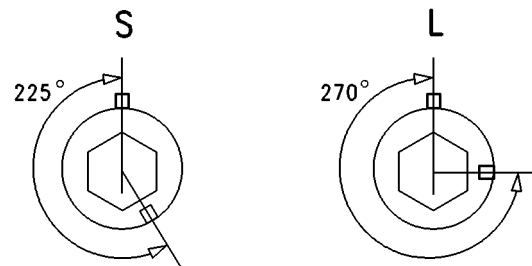


Illustration 190

g00951562

12. Ensure that the No. 1 piston is at top dead center on the compression stroke. Refer to the Testing and Adjusting Manual, "Fuel Injection Timing - Check".

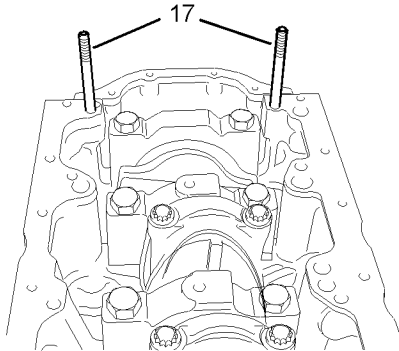


Illustration 210

g01026330

13. Install two temporary studs (17) into the cylinder block.

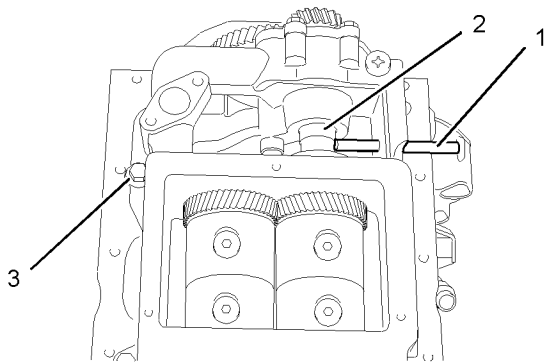


Illustration 211

g01026243

14. Install the 27610225 Timing Pin (1) into the shaft (2).
15. Carefully position the balancer onto the temporary studs (17). Ensure that the teeth of the idler gear (6) and the crankshaft gear are aligned.
16. Install two setscrews (3) into the center of the balancer. Tighten the setscrews (3) to a torque of 54 N·m (40 lb ft).
17. Remove the temporary studs (17) and install the remaining setscrews (3). Tighten the remaining setscrews to a torque of 54 N·m (40 lb ft).
18. Remove the timing pin (1). Rotate the crankshaft in order to ensure that the balancer turns freely.

### End By:

- a. Install the engine oil relief valve. Refer to this Disassembly and Assembly Manual, "Engine Oil Relief Valve - Remove and Install (Balancer Unit for the Engine)".
- b. Install the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".

i01979959

## Piston Cooling Jets - Remove and Install

### Removal Procedure

#### Start By:

- a. Remove the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

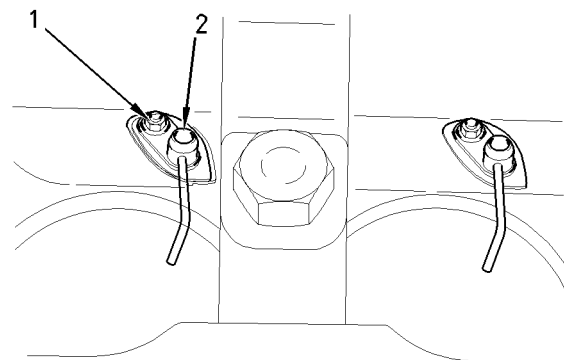


Illustration 212

g00952340

1. Remove the setscrew (1). Remove the piston cooling jet assembly (2) from the cylinder block.

**Note:** The engine crankshaft may be rotated in order to access all of the piston cooling jet assemblies.

11. Lightly lubricate the lower thrust washers (5) with clean engine oil. Install the lower thrust washers (5) onto each side of the appropriate main bearing cap. The grooves on the lower thrust washers (5) must be located against the crankshaft.

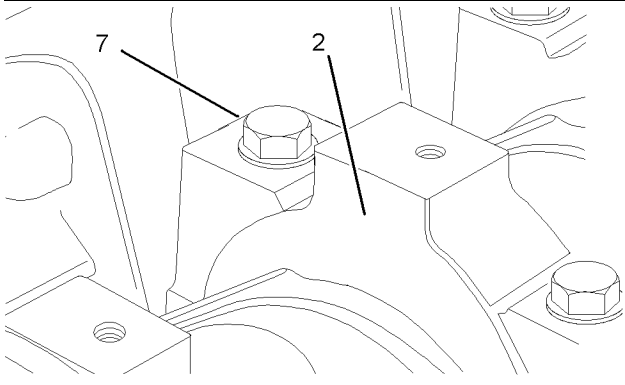


Illustration 235

g01026633

12. Lubricate the threads of the setscrews (7) with clean engine oil.

13. Install the setscrews (7). Tighten the setscrews (7) to a torque of 245 N·m (181 lb ft).

14. Rotate the crankshaft in order to ensure that the crankshaft turns freely.

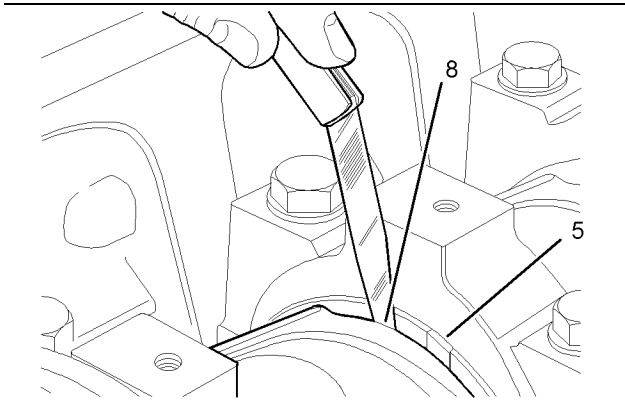


Illustration 236

g01026647

15. Check the crankshaft end play. Use a prybar to move the crankshaft toward the front of the engine. Use a suitable feeler gauge to measure the end play (8) between rear thrust washer (5) and the crankshaft. The maximum permissible crankshaft end play is 0.51 mm (0.020 inch).

#### End By:

- a. Install the rear bridge. Refer to this Disassembly and Assembly Manual, "Crankshaft - Install".

- b. Install the crankshaft rear seal. Refer to this Disassembly and Assembly Manual, "Crankshaft Rear Seal - Install".

- c. Install the flywheel housing. Refer to this Disassembly and Assembly Manual, "Flywheel Housing - Remove and Install".

- d. If the engine is equipped with a balancer and the engine oil pump was removed from the balancer, install the engine oil pump. Install the balancer. Refer to this Disassembly and Assembly Manual, "Balancer - Install".

- e. If the engine is not equipped with a balancer, install the engine oil pump. Refer to this Disassembly and Assembly Manual, "Engine Oil Pump - Install".

- f. Install the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".

i01981186

## Crankshaft - Remove

### Removal Procedure

#### Start By:

- a. Remove the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".
- b. Only if the engine is not equipped with a balancer, remove the engine oil pump. Refer to this Disassembly and Assembly Manual, "Engine Oil Pump - Remove".
- c. If the engine is equipped with a balancer, remove the balancer. Only remove the engine oil pump if it is necessary. Refer to this Disassembly and Assembly Manual, "Balancer - Remove".
- d. Remove the flywheel housing. Refer to this Disassembly and Assembly Manual, "Flywheel Housing - Remove and Install".
- e. Remove the crankshaft rear seal. Refer to this Disassembly and Assembly Manual, "Crankshaft Rear Seal - Remove".
- f. Remove the front housing. Refer to this Disassembly and Assembly Manual, "Housing (Front) - Remove".

**Note:** The removal procedure is identical for the three cylinder and the four cylinder engines. The illustration shows the four cylinder engine.

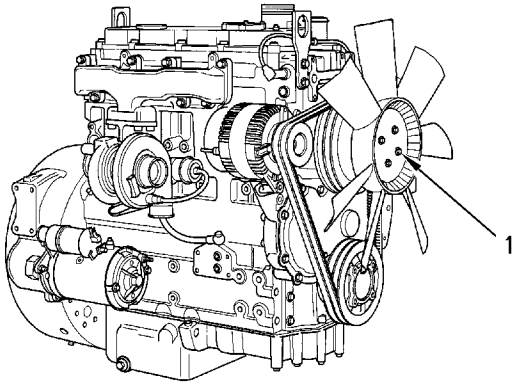


Illustration 261

g00926178

Typical example

1. Remove the setscrews (1).
2. Remove the fan.
3. If equipped, remove the extension for the fan.
4. Remove the fan pulley.

## Installation Procedure

**Note:** The installation procedure is identical for the three cylinder and the four cylinder engines. The illustration shows the four cylinder engine.

1. Inspect the condition of the fan pulley. Replace the fan pulley, if necessary.
2. Install the fan pulley.
3. If the engine is equipped with an extension for the fan, install the extension.
4. Inspect the condition of the fan and replace the fan, if necessary.
5. Install the fan.

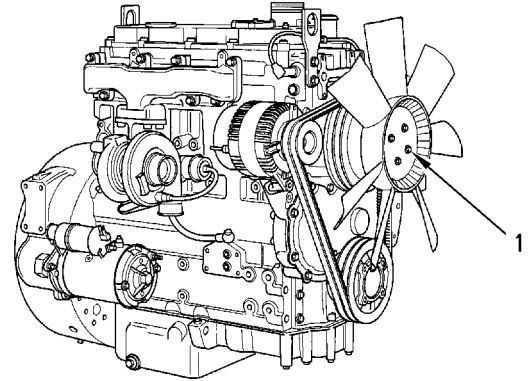


Illustration 262

g00926178

Typical example

6. Install the setscrews (1). Tighten the setscrews (1) to a torque of 12 N·m (9 lb ft).

### End By:

- a. Install the V-Belts. Refer to this Disassembly and Assembly Manual, "V-Belts - Remove and Install".

i02011983

## Fan Drive - Remove and Install

### Removal Procedure

#### Start By:

- a. Remove the fan. Refer to this Disassembly and Assembly Manual, "Fan - Remove and Install".

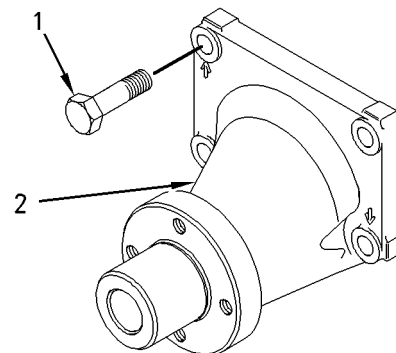


Illustration 263

g00944500

1. Remove the setscrews (1) from the fan drive (2).
2. Remove the fan drive (2).

# Specifications Section

i01957588

## Engine Design

### Four Cylinder Engine

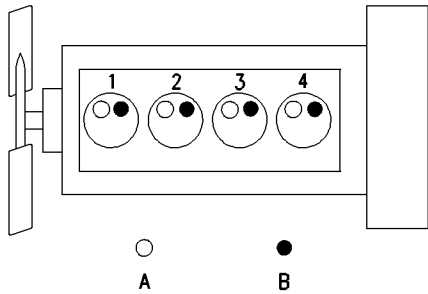


Illustration 1 g00984281

Cylinder and valve location

- (A) Inlet valve
- (B) Exhaust valve

Bore .....	105 mm (4.133 inch)
Stroke .....	127 mm (5.000 inch)
Displacement .....	4.4 L (269 in <sup>3</sup> )
Cylinder arrangement .....	In-line
Type of combustion .....	Direct injection
Compression ratio	
Naturally aspirated engines .....	19.3:1
Turbocharged engines .....	18.2:1
Number of cylinders .....	4
Valves per cylinder .....	2
Valve lash	
Inlet valve .....	0.20 mm (0.008 inch)
Exhaust valve .....	0.45 mm (0.018 inch)
Firing order .....	1, 3, 4, 2

When the crankshaft is viewed from the front of the engine, the crankshaft rotates in the following direction: ..... Clockwise

When the camshaft is viewed from the front of the engine, the camshaft rotates in the following direction: ..... Clockwise

The front of the engine is opposite the flywheel end. The left side and the right side of the engine are viewed from the flywheel end. The No. 1 cylinder is the front cylinder.

### Three Cylinder Engine

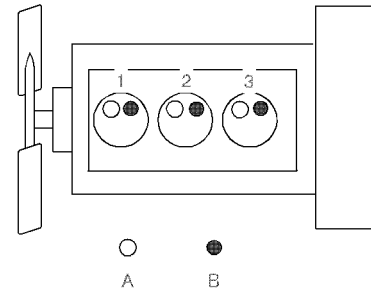


Illustration 2 g01014247

Cylinder and valve location

- (A) Inlet valve
- (B) Exhaust valve

Bore .....	105 mm (4.133 inch)
Stroke .....	127 mm (5.000 inch)
Displacement .....	3.3 L (201 in <sup>3</sup> )
Cylinder arrangement .....	In-line
Type of combustion .....	Direct injection
Compression ratio	
Naturally aspirated engines .....	19.3:1
Turbocharged engines .....	18.2:1
Number of cylinders .....	3
Valves per cylinder .....	2
Valve lash	
Inlet valve .....	0.20 mm (0.008 inch)
Exhaust valve .....	0.45 mm (0.018 inch)
Firing order .....	1, 2, 3

When the crankshaft is viewed from the front of the engine, the crankshaft rotates in the following direction: ..... Clockwise

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## Exhaust Manifold

### Four Cylinder Engine

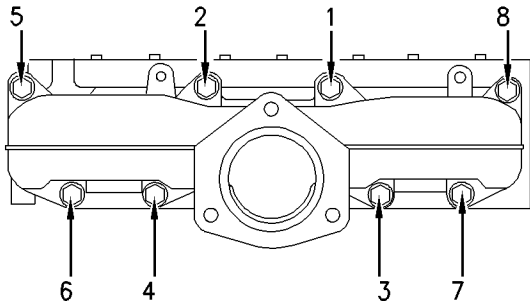


Illustration 25  
Tightening sequence  
g00907527

**Note:** The exhaust manifold must be aligned to the cylinder head. Refer to the Disassembly and Assembly manual.

Tighten the exhaust manifold bolts in the sequence that is shown in illustration 25 to the following torque. .... 33 N·m (24 lb ft)

### Three Cylinder Engine

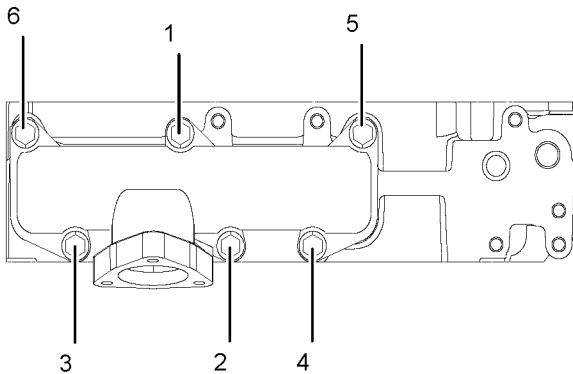


Illustration 26  
g01017009

**Note:** The exhaust manifold must be aligned to the cylinder head. Refer to the Disassembly and Assembly manual.

Tighten the exhaust manifold bolts in the sequence that is shown illustration 26 to the following torque. .... 33 N·m (24 lb ft)

## Camshaft

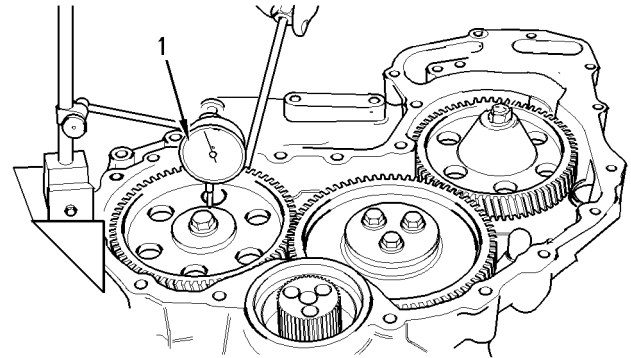


Illustration 27  
Checking the end play of the camshaft  
g00987750

(1) End play of a new camshaft ..... 0.10 to 0.55 mm  
(0.004 to 0.022 inch)

Maximum permissible end play of a worn camshaft ..... 0.60 mm (0.023 inch)

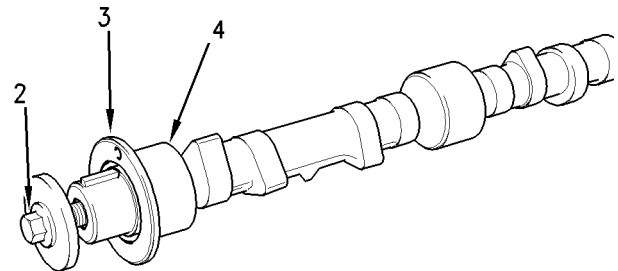


Illustration 28  
Typical camshaft  
g00976195

(2) Bolt  
Tighten the bolt to the following torque. ... 95 N·m  
(70 lb ft)

(3) Camshaft thrust washer  
Thickness of the thrust washer .. 5.49 to 5.54 mm  
(0.216 to 0.218 inch)  
Depth of the recess in the cylinder block for the thrust washer ..... 5.54 to 5.64 mm  
(0.218 to 0.222 inch)

- (4) Main bearings for the four cylinder engine  
 Bore in the cylinder block for the main bearings ..... 80.416 to 80.442 mm  
 (3.1660 to 3.1670 inch)

- (5) Main bearing cap bolts for the four cylinder engine

Use the following procedure in order to install the main bearing cap bolts:

1. Apply clean engine oil to the threads of the main bearing cap bolts.
2. Put the main bearing caps in the correct position that is indicated by a number on the top of the main bearing cap. Install the main bearing caps with the locating tabs in correct alignment with the recess in the cylinder block.
3. Evenly tighten the main bearing cap bolts.

Torque for the main bearing cap bolts. .... 245 N·m  
 (180 lb ft)

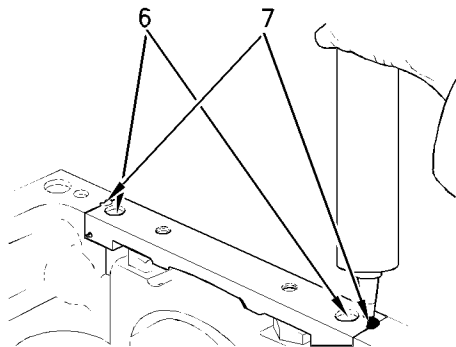


Illustration 57

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Use the following procedure in order to install the Allen head bolts for the bridge.

**Note:** Install the rear seal before sealant is applied.

1. Use a straight edge in order to ensure that the bridge is aligned with the rear face of the cylinder block.
2. Tighten the Allen head bolts (6) for the bridge.  
 Torque for the Allen head bolts .. 16 N·m (12 lb ft)
3. When the bridge is installed on the cylinder block, apply 21826038 POWERPART Silicon Adhesive into groove (7) at each end of the bridge. Apply the sealant into the groove until the sealant is forced through the bottom end of the groove in the bridge.

Total height of the cylinder block between the top and the bottom faces. .... 441.173 to 441.274 mm  
 (17.3689 to 17.3729 inch)

## Three Cylinder Engine

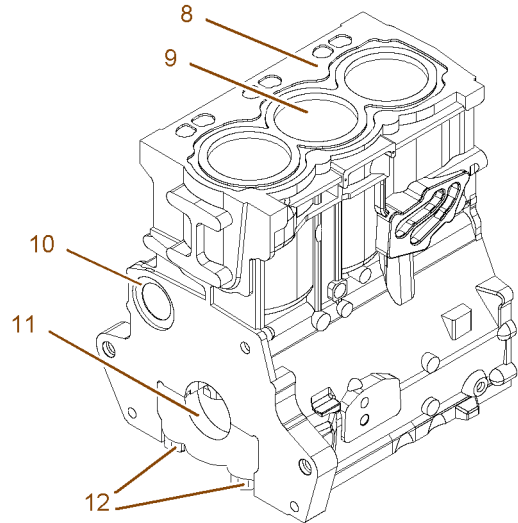


Illustration 58

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- (8) Cylinder block

(9) Cylinder bore ..... 105.000 to 105.025 mm  
 (4.1338 to 4.1348 inch)

The first oversize bore diameter ..... 105.5 to 105.525 mm  
 (4.1535 to 4.1545 inch)

The second oversize bore diameter ..... 106.000 to 106.025 mm  
 (4.1732 to 4.1742 inch)

The maximum permissible wear for the cylinder bore ..... 0 to 0.15 mm (0 to 0.0059 inch)

- (10) Camshaft bearings for the four cylinder engine

Diameter of the bore in the cylinder block for the number 1 camshaft bearing ..... 55.563 to 55.593 mm  
 (2.1875 to 2.1887 inch)

Diameter of the bore in the cylinder block for the number 2 camshaft journal ..... 50.546 to 50.597 mm  
 (1.9900 to 1.9920 inch)

Diameter of the bore in the cylinder block for the number 3 camshaft journal ..... 50.546 to 50.597 mm  
 (1.9900 to 1.9920 inch)

## Piston Cooling Jet Alignment

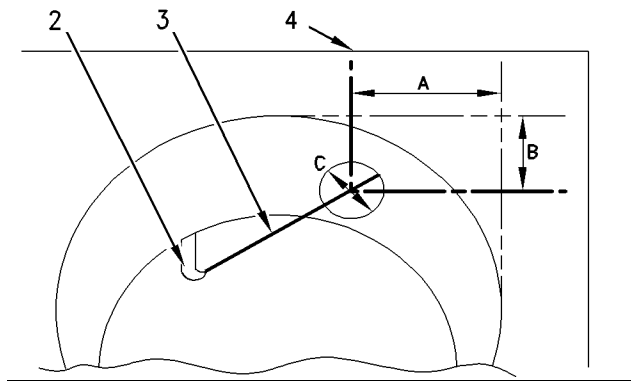


Illustration 71 g01006929

- (2) Piston cooling jet
- (3) Rod
- (4) Cylinder block

Use the following procedure in order to check the alignment of the piston cooling jet.

1. Insert rod (3) into the end of the piston cooling jet (2). Rod (3) has a diameter of 1.70 mm (0.067 inch). Rod (3) must protrude out of the top of the cylinder block.
2. Dimension (A) is 55.25 mm (2.1752 inch) and dimension (B) is 14 mm (0.5512 inch). Dimension (A) and dimension (B) are tangent to the cylinder bore (4).
3. The position of the rod (3) must be within dimension (C). Dimension (C) is 14 mm (0.5512 inch).

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## Front Housing and Covers

The front housing must be aligned to the cylinder block face. .... + 0.05 to minus 0.05 mm  
(+ 0.0020 to minus 0.0020 inch )

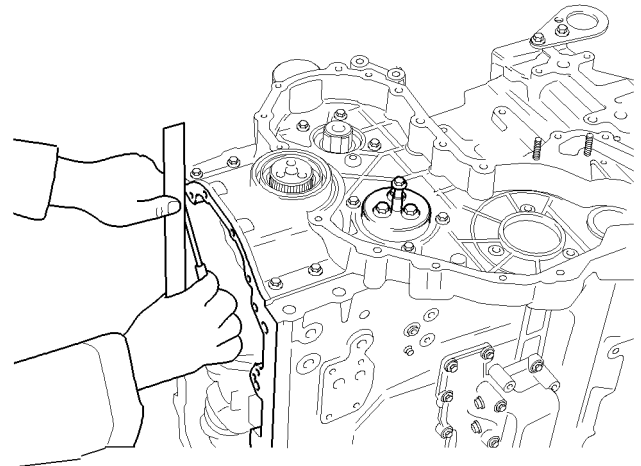


Illustration 72 g00995663  
Alignment

- (1) Tighten the bolts that fasten the front cover to the front housing to the following torque. .... 22 N·m (16 lb ft)

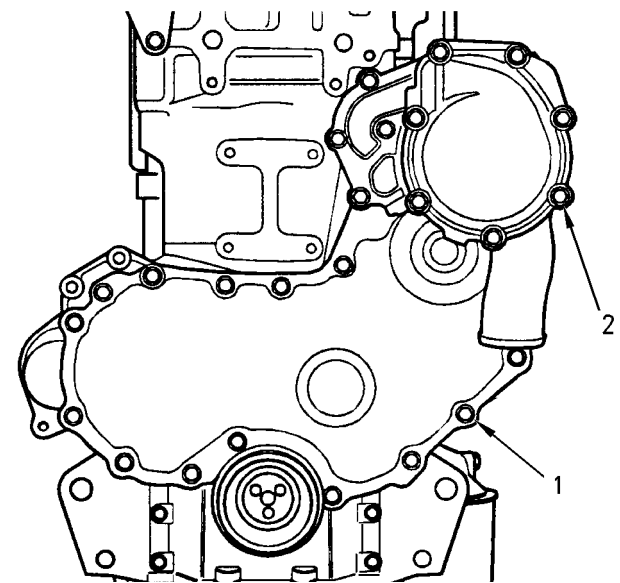
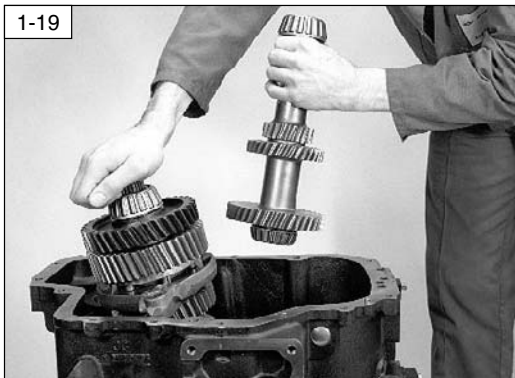


Illustration 73 g00918672  
Front cover

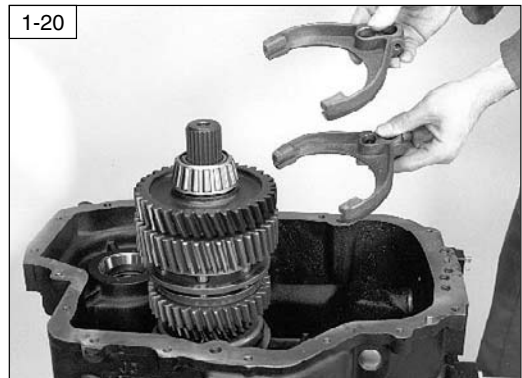
- (2) Tighten the bolts that fasten the water pump to the front housing to the following torque. .... 22 N·m (16 lb ft)

**Note:** Refer to Specifications, "Water Pump" for the correct bolt tightening sequence for the water pump.

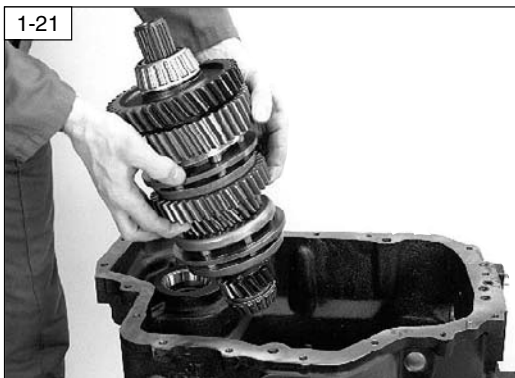




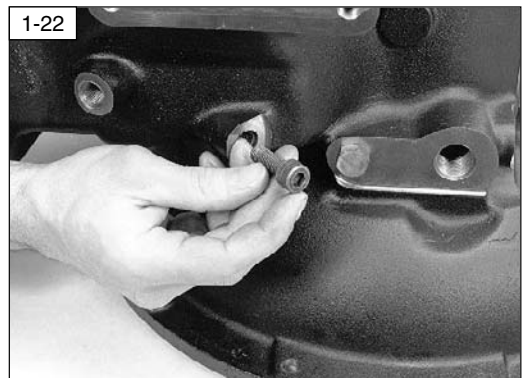
1-19 Remove the counter shaft assembly.



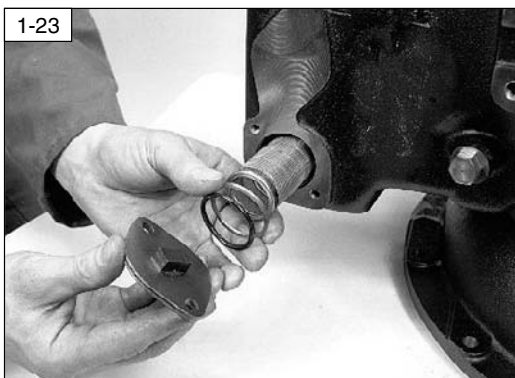
1-20 Remove the 1st / 2nd and 3rd / 4th shift forks.



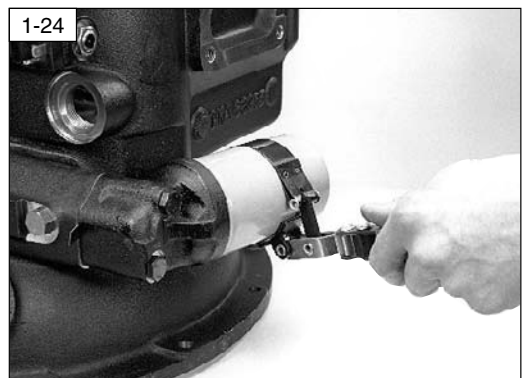
1-21 Remove the output shaft assembly.



1-22 Remove the 4th gear lock out screw. (If fitted).



1-23 Remove 2 screws and withdraw the strainer cover, "O"ring, spacer and strainer.

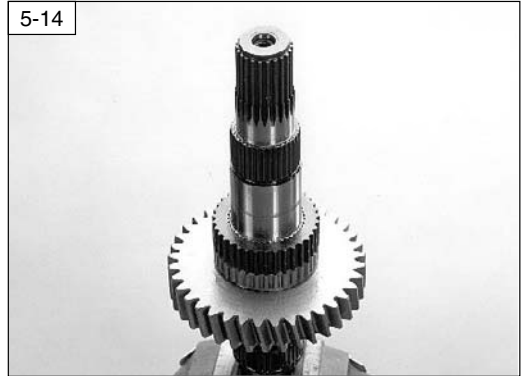


1-24 Using a strap wrench remove and discard the oil filter.



5-13  
Removal of the bearing sleeve, synchro hub and 2nd gear.

RE-ASSEMBLY



5-14  
Replace the 2nd gear and synchro hub.



5-15  
Using an appropriately sized tube refit the 1st gear bearing sleeve.



5-16  
Replace the 1st / 2nd synchroniser assembly.

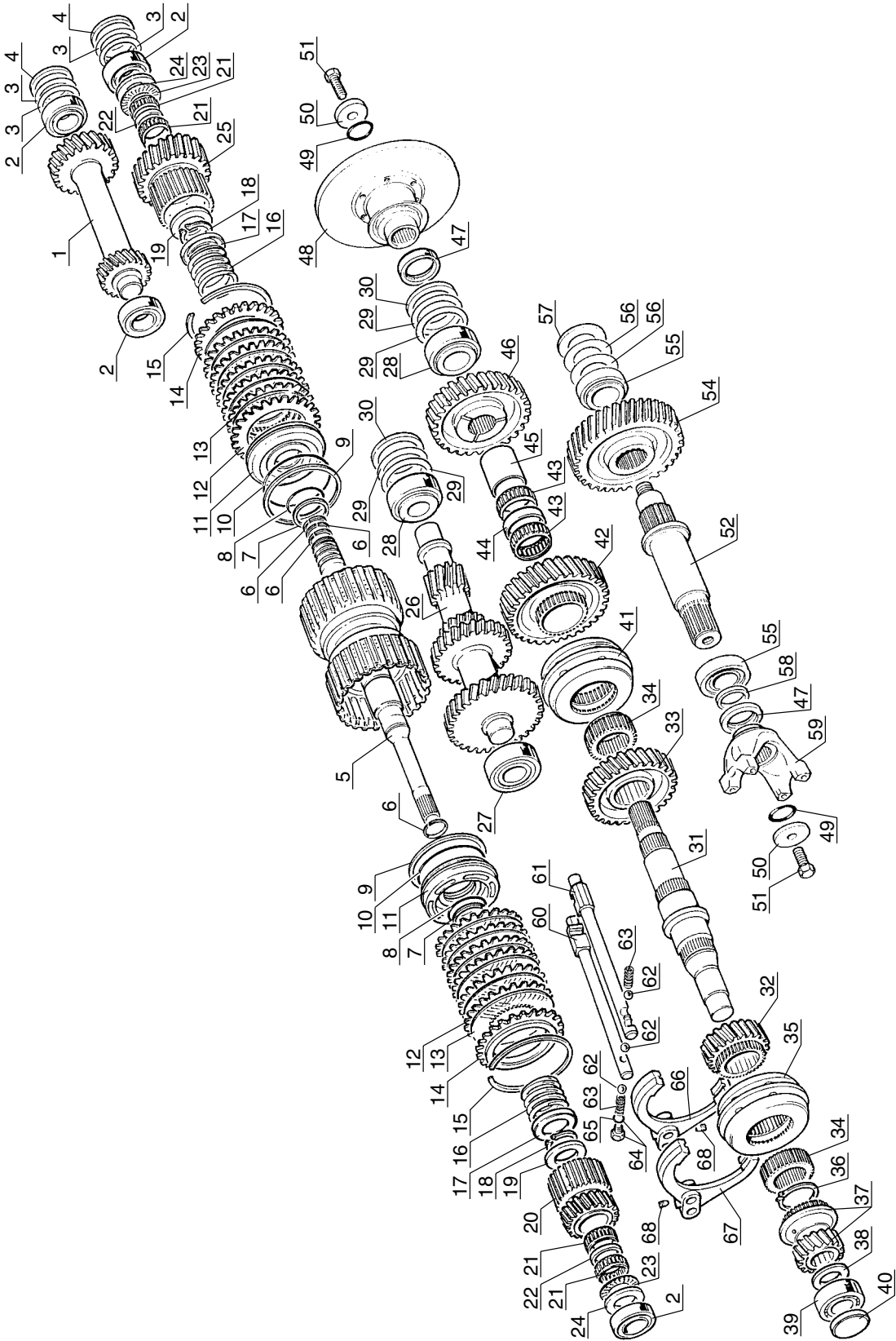


5-17  
Replace the 1st gear needle bearings and spacer as shown.



5-18  
Replace the 1st gear.

# GEAR BOX (mécanism details - gears)



# PRESSURE READING ON GEAR BOX

MACHINE TYPE and N° : ..... N° of HOURS : .....

GEAR BOX TYPE and N° : .....

(To be carried out with gear box oil at 80° mini).

		NEUTRAL	FORWARD GEAR	REVERSE GEAR
PUMP	Mini r.p.m. ....			
	Maxi r.p.m. ....			
CONVERTER	Mini r.p.m. ....			
	Maxi r.p.m. ....			
DRAINAGE	Mini r.p.m. ....			
	Maxi r.p.m. ....			

FORWARD GEAR	Mini r.p.m. ....	
	Maxi r.p.m. ....	

REVERSE GEAR	Mini r.p.m. ....	
	Maxi r.p.m. ....	

4 WD	Mini r.p.m. ....	
	Maxi r.p.m. ....	

**COMMENTS :** .....

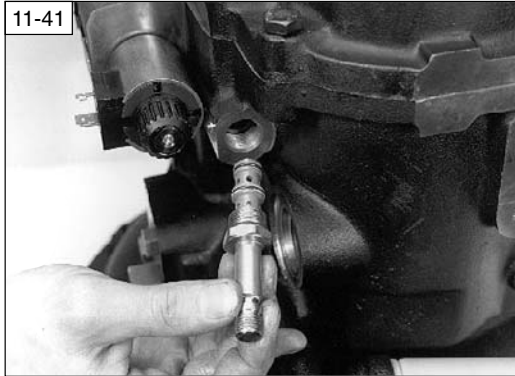
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\* **BREAKDOWN AT THE ORIGIN :** .....

.....

\* **DETERMINED CAUSE OF THE BREAKDOWN :** .....

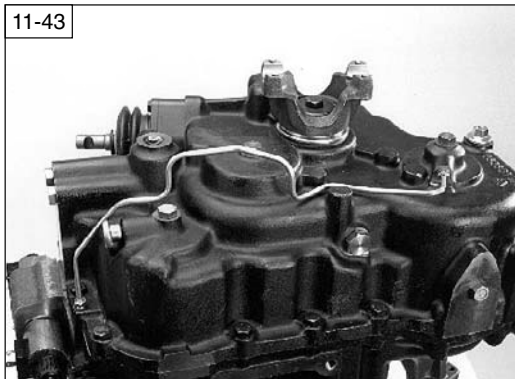
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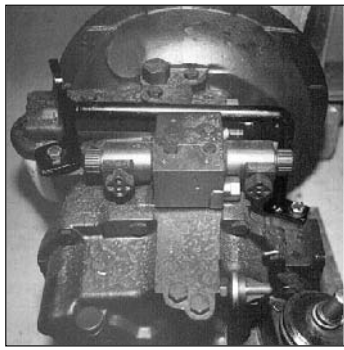
**4WD VERSION** : Lubricate the seals with a light grease and re-fit the 4 wheel drive solenoid spool. Tighten to a torque of 15 to 20 lbs / ft.



**4WD VERSION** : Re-fit the 4 wheel drive solenoid coil and nut. Tighten to a torque of 4 lbs / ft maximum.



**4WD VERSION** : If previously removed re-fit the 4 wheel drive clutch supply pipe, apply air tightness product (P / N° 62175) to threads and tighten nuts to a torque of 5 to 7.5 lbs / ft.



15

- Mount and fix the hook (Fig. 2) as indicated on the gearbox.

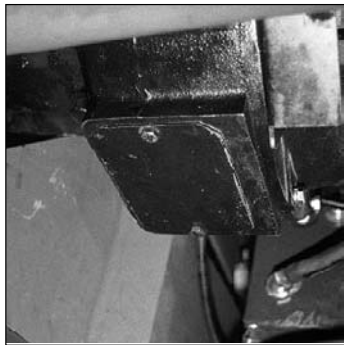


16

- Use a chain pulley and strap to sling the gearbox (See 16 - 17). Bring the pulley under strain to support the gearbox.

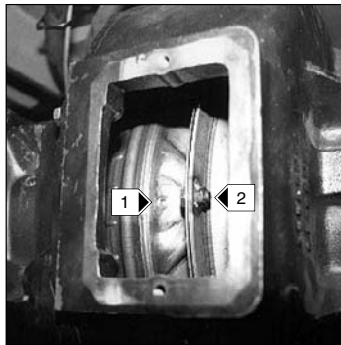


17



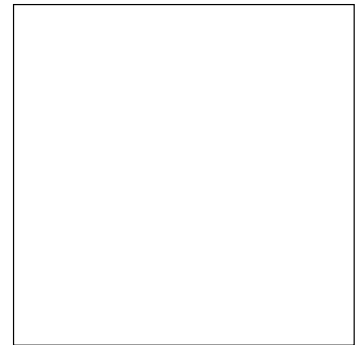
18

- DRAIN THE CONVERTER**
- Disassemble the converter inspection panel.



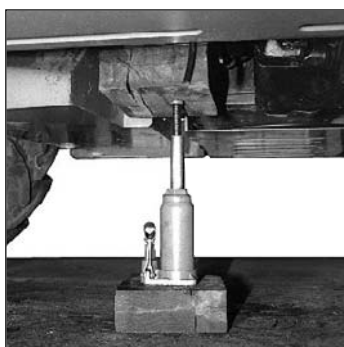
19

- Place a tray under the converter, unscrew the plug 1 and drain.
- Disconnect the converter by removing the six screws 2.



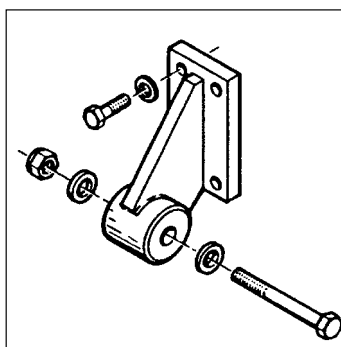
20

- Remove ten of the twelve mounting screws 1 between the gearbox and the bevel gear, leaving one screw on either side to hold the assembly.



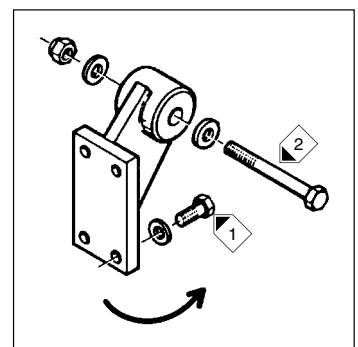
21

- Secure the bevel gear to hold it in place while uncoupling the assembly.



22

- Completely remove the right hand gearbox bracket.



23

- Remove the four mounting screws 1 on the left hand gearbox bracket.
- Loosen the screw 2.
- Swing over the bracket and fasten it to the frame.

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