MANITOU

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MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

REPAIR MANUAL

MANITOU

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REPAIR MANUAL

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GROUP 0

GENERAL POINTS

LIFT TRUCK CHARACTERISTICS

0-1-M116 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
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MH 20-4 Turbo BUGGIE Série 2-E2
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CHARACTERISTICS

I.C. ENGINE

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2	**PERKINS 404C-22 (HP81468U)**
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2	**PERKINS 404C-22 (HP81468U)**
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2	**PERKINS 404C-22 (HP81468U)**
MSI 35 Turbo Série 2-E2	**PERKINS 404C-22T (HR81469U)**
MSI 35 Turbo BUGGIE Série 2-E2	**PERKINS 404C-22T (HR81469U)**
MH 20-4 Turbo BUGGIE Série 2-E2	**PERKINS 404C-22T (HR81469U)**
MH 25-4 Turbo BUGGIE Série 2-E2	**PERKINS 404C-22T (HR81469U)**

	404C-22	**404C-22T**
- Type	4 in line	4 in line
- Number of cylinders	4	4
- Number of strokes	Natural	Turbocharged
- Suction	Indirect	Indirect
- Injection system	1.3.4.2.	1.3.4.2.
- Ignition sequence		
- Clearance of rocker valve (cold)		
. Inlet	0,20 mm	0,20 mm
. Exhaust	0,20 mm	0,20 mm
- Capacity	2216 cm3	2216 cm3
- Bore	84 mm	84 mm
- Stroke	100 mm	100 mm
- Compression ratio	23,3/1	23,3/1
- Nominal rating loaded	2800 rpm	2800 rpm
- Rating slow unladen	900 + 50 rpm	900 ± 25 rpm
- Max. rating unladen	3025 rpm	3000 rpm
- Power ISO/TR 14396	51 cv/37,3 kw	61 cv/44,7 kw
- Maximum torque ISO/TR 14396	143 Nm at 1800 rpm	190 Nm at 1800 rpm
- Air cleaner	Dry 3 µ	Dry 3 µ

COOLING CIRCUIT

	404C-22	**404C-22T**
- Type	By water	By water
- Fan	Blowing	Blowing
. Number of blades	6	7
. Diameter	381 mm (15")	406 mm (16")
- Thermostat		
. Start opening	80°C / 84°C	71°C
. Full opening	95°C	82°C

HYDROSTATIC TRANSMISSION

HYDROSTATIC PUMP	**MANNESMANN REXROTH**
- Type	**A4VG71DA1D7/32R** with variable cubic capacity and with automatic power governor
- Gear reverser	Electromagnetic 12V
. Number of forward gears	1
. Number of reverse gears	1
- Main pump	
. Max./Mini displacement	0 to 71 cm3/r
. Max. flow rate	196 L/mn
. Working pressure	497 Bar
- Boost pump	
. Displacement	. cm3
. Max. flow rate	. L/mn
. Boost pressure Max. R.P.M.	27 Bar (transmission in neutral)
FRONT WHEEL HYDROSTATIC MOTOR	**MANNESMANN REXROTH**
- Type	**A2FE28/61W** with fixed capacity
. Max. displacement	28 cm3/r

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2
MSI 35 Turbo Série 2-E2 - MSI 35 Turbo BUGGIE Série 2-E2

FRONT WHEEL REDUCERS	**BREVINI**
- Type	**CWD 2050/1M**

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

FRONT WHEEL REDUCERS	**BREVINI**
- Type	**CWD 2050.1M/CF.1M**
REAR WHEEL HYDROSTATIC MOTOR	**POCLAIN HYDRAULICS**
- Type	**MS02**
. Max. displacement	398 cm3/tr

BRAKE

- Type	Multidisc brake immersed in oil.
. Number of steel disks	4
. Number of friction disks	5
- Service brakes	Foot pedal. Hydraulic brake acting on front wheels through pressure break.
- Parking brake	Switch. Electro-hydraulic brake acting on front wheels through pressure break.

ELECTRIC CIRCUIT

- Earth	Negative
- Battery	12 V - 110 Ah - 750 A EN
- Alternator	12 V - 55 A
. Type	Magneti Marelli A127
. Tension regulator	Incorporated into the alternator
- Starter	12 V - 2 KW
. Type	Bosch

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
275/70R22,5 RHS 148/145M TUBELESS	9 BAR	FRONT UNLADEN	900 KG	KG/CM2		CM2	
		FRONT LADEN	2500 KG	KG/CM2		CM2	
10.5R20 14PR MPT80 134G TUBELESS	4,4 BAR	FRONT UNLADEN	900 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2500 KG	KG/CM2	KG/CM2	CM2	CM2
8.25X20 CSE SC15	Solid	FRONT UNLADEN	900 KG	3,47 KG/CM2		266 CM2	
		FRONT LADEN	2500 KG	6,61 KG/CM2		375 CM2	
15,5/55R18 14PR SPPG7 TUBELESS	3,3 BAR	FRONT UNLADEN	900 KG	2,61 KG/CM2	1,45 KG/CM2	345 CM2	621 CM2
		FRONT LADEN	2500 KG	3,05 KG/CM2	1,70 KG/CM2	816 CM2	1468 CM2
12.0-18 T86 TUBE TYPE 12PR	3,5 BAR	FRONT UNLADEN	900 KG	6,92 KG/CM2	2,27 KG/CM2	130 CM2	396 CM2
		FRONT LADEN	2600 KG	9,32 KG/CM2	3,16 KG/CM2	279 CM2	824 CM2
275/80R20 XM27 144A2/132B TUBELESS	4,1 BAR	FRONT UNLADEN	900 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2500 KG	KG/CM2	KG/CM2	CM2	CM2
285/70R19,5 XZY 140/137L TUBELESS	6 BAR	FRONT UNLADEN	900 KG	6,62 KG/CM2		136 CM2	
		FRONT LADEN	2500 KG	5,86 KG/CM2		431 CM2	

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
7.00X12 14PR IC40	4,5 BAR	REAR UNLADEN	1050 KG	KG/CM2		CM2	
		REAR LADEN	400 KG	KG/CM2		CM2	
27.10.12 14PR IC12	4,5 BAR	REAR UNLADEN	1050 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	400 KG	KG/CM2	KG/CM2	CM2	CM2
7.00X12 CSE SC10	Solid	REAR UNLADEN	1050 KG	5,85 KG/CM2		178 CM2	
		REAR LADEN	400 KG	3,60 KG/CM2		113 CM2	
195R14C 106/104N SPLT3 TUBELESS	5 BAR	REAR UNLADEN	1050 KG	6,08 KG/CM2	4,94 KG/CM2	173 CM2	213 CM2
		REAR LADEN	400 KG	5,45 KG/CM2	4,21 KG/CM2	73 CM2	94 CM2
7,00R12 XZM 136A5 TUBELESS	3,5 BAR	REAR UNLADEN	1050 KG	3,25 KG/CM2		323 CM2	
		REAR LADEN	400 KG	3,20 KG/CM2		125 CM2	

HYDRAULIC CIRCUIT

- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	140 Bar
Double mast with free-acting lift	140 Bar
Triple mast with free-acting lift	140 Bar
Triple mast without free-acting lift	145 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA **(accordng to standard prEN 12053 : 1995)**	
. Overhead guard	83 dB
. Cab	81 dB
- Level of sound power in the LwA environment **(according to directive 2000/14 CE guaranteed)**	104 dB
- Speed of movement of lift truck in standard configuration on horizontal ground **(except particular conditions)**	
. Forward unladen	20 km/h
. Reverse unladen	20 km/h
- Standard lift height	3300 mm
- Rated capacity with standard mast	2000 kg
- Load center	500 mm
- Weight of forks (each)	43 kg
- Lifting motions with standard mast	
. Unladen lifting	0,60 m/s
. Rated load lifting	0,55 m/s
. Unladen lowering	0,46 m/s
. Rated load lowering	0,47 m/s
- Lift truck weight with standard mast	
. Unladen	3840 kg
. Rated load	5840 kg
- Axle weight with standard mast (transport position)	
. Front unladen	1780 kg
rated load	5020 kg
. Rear unladen	2060 kg
rated load	820 kg
- Tensible strain at coupling hook	
. Unladen	1300 daN
. Rated load	2400 daN
- Maximum ramp negotiable in forward motion	
. Unladen	32 % at 1 km/h
. Rated load	33 % at 1 km/h

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
275/70R22,5 RHS 148/145M TUBELESS	9 BAR	FRONT UNLADEN	900 KG	KG/CM2		CM2	
		FRONT LADEN	2950 KG	KG/CM2		CM2	
10.5R20 14PR MPT80 134G TUBELESS	5,3 BAR	FRONT UNLADEN	900 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2950 KG	KG/CM2	KG/CM2	CM2	CM2
8.25X20 CSE SC15	Solid	FRONT UNLADEN	900 KG	3,47 KG/CM2		266 CM2	
		FRONT LADEN	2950 KG	7,41 KG/CM2		398 CM2	
15,5/55R18 14PR SPPG7 TUBELESS	4 BAR	FRONT UNLADEN	900 KG	3,00 KG/CM2	1,67 KG/CM2	300 CM2	540 CM2
		FRONT LADEN	2950 KG	3,58 KG/CM2	1,99 KG/CM2	822 CM2	1480 CM2
12.0-18 T86 TUBE TYPE 12PR	3,5 BAR	FRONT UNLADEN	900 KG	6,92 KG/CM2	2,27 KG/CM2	130 CM2	396 CM2
		FRONT LADEN	2950 KG	9,69 KG/CM2	3,31 KG/CM2	304 CM2	891 CM2
275/80R20 XM27 144A2/132B TUBELESS	4,1 BAR	FRONT UNLADEN	900 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2950 KG	KG/CM2	KG/CM2	CM2	CM2
285/70R19,5 XZY 140/137L TUBELESS	7 BAR	FRONT UNLADEN	900 KG	6,70 KG/CM2		134 CM2	
		FRONT LADEN	2950 KG	6,21 KG/CM2		476 CM2	

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
7.00X12 14PR IC40	5,3 BAR	REAR UNLADEN	1200 KG	KG/CM2		CM2	
		REAR LADEN	400 KG	KG/CM2		CM2	
27.10.12 14PR IC12	4,5 BAR	REAR UNLADEN	1200 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	400 KG	KG/CM2	KG/CM2	CM2	CM2
7.00X12 CSE SC10	Solid	REAR UNLADEN	1200 KG	6,30 KG/CM2		190 CM2	
		REAR LADEN	400 KG	3,60 KG/CM2		113 CM2	
7,00R12 XZM 136A5 TUBELESS	4 BAR	REAR UNLADEN	1200 KG	KG/CM2		CM2	
		REAR LADEN	400 KG	KG/CM2		CM2	

HYDRAULIC CIRCUIT

- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	170 Bar
Double mast with free-acting lift	170 Bar
Triple mast with free-acting lift	170 Bar
Triple mast without free-acting lift	180 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA (according to standard prEN 12053 : 1995)	
. Overhead guard	83 dB
. Cab	81 dB
- Level of sound power in the LwA environment (according to directive 2000/14 CE guaranteed)	104 dB
- Speed of movement of lift truck in standard configuration on horizontal ground (except particular conditions)	
. Forward unladen	20 km/h
. Reverse unladen	20 km/h
- Standard lift height	3300 mm
- Rated capacity with standard mast	2500 kg
- Load center	500 mm
- Weight of forks (each)	43 kg
- Lifting motions with standard mast	
. Unladen lifting	0,60 m/s
. Rated load lifting	0,55 m/s
. Unladen lowering	0,46 m/s
. Rated load lowering	0,47 m/s
- Lift truck weight with standard mast	
. Unladen	4150 kg
. Rated load	6650 kg
- Axle weight with standard mast (transport position)	
. Front unladen	1760 kg
rated load	5880 kg
. Rear unladen	2390 kg
rated load	770 kg
- Tensible strain at coupling hook	
. Unladen	1300 daN
. Rated load	2400 daN
- Maximum ramp negotiable in forward motion	
. Unladen	29 % at 1 km/h
. Rated load	31 % at 1 km/h

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
275/70R22,5 RHS 148/145M TUBELESS	9 BAR	FRONT UNLADEN	850 KG	KG/CM2		CM2	
		FRONT LADEN	3300 KG	KG/CM2		CM2	
10.5R20 14PR MPT80 134G TUBELESS	5,6 BAR	FRONT UNLADEN	850 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	3300 KG	KG/CM2	KG/CM2	CM2	CM2
8.25X20 CSE SC15	Solid	FRONT UNLADEN	850 KG	3,37 KG/CM2		265 CM2	
		FRONT LADEN	3300 KG	8,02 KG/CM2		411 CM2	
15,5/55R18 14PR SPPG7 TUBELESS	4,5 BAR	FRONT UNLADEN	850 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	3300 KG	KG/CM2	KG/CM2	CM2	CM2
12.0-18 T86 TUBE TYPE 12PR	4,2 BAR	FRONT UNLADEN	850 KG	7,23 KG/CM2	2,40 KG/CM2	117 CM2	353 CM2
		FRONT LADEN	3300 KG	11,05 KG/CM2	3,80 KG/CM2	299 CM2	869 CM2
285/70R19,5 XZY 140/137L TUBELESS	8 BAR	FRONT UNLADEN	850 KG	KG/CM2		CM2	
		FRONT LADEN	3300 KG	KG/CM2		CM2	

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
7.00X12 14PR IC40	6,7 BAR	REAR UNLADEN	1400 KG	KG/CM2		CM2	
		REAR LADEN	450 KG	KG/CM2		CM2	
27.10.12 14PR IC12	4,5 BAR	REAR UNLADEN	1400 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	450 KG	KG/CM2	KG/CM2	CM2	CM2
7.00X12 CSE SC10	Solid	REAR UNLADEN	1400 KG	6,85 KG/CM2		204 CM2	
		REAR LADEN	450 KG	3,80 KG/CM2		119 CM2	
7,00R12 XZM 136A5 TUBELESS	4,75 BAR	REAR UNLADEN	1400 KG	4,73 KG/CM2		296 CM2	
		REAR LADEN	450 KG	3,49 KG/CM2		129 CM2	

HYDRAULIC CIRCUIT

- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	185 Bar
Double mast with free-acting lift	185 Bar
Triple mast with free-acting lift	185 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA (according to standard prEN 12053 : 1995)	
. Overhead guard	83 dB
. Cab	81 dB
- Level of sound power in the LwA environment (according to directive 2000/14 CE guaranteed)	104 dB
- Speed of movement of lift truck in standard configuration on horizontal ground (except particular conditions)	
. Forward unladen	20 km/h
. Reverse unladen	20 km/h
- Standard lift height	3300 mm
- Rated capacity with standard mast	3000 kg
- Load center	500 mm
- Weight of forks (each)	55 kg
- Lifting motions with standard mast	
. Unladen lifting	0,50 m/s
. Rated load lifting	0,46 m/s
. Unladen lowering	0,46 m/s
. Rated load lowering	0,47 m/s
- Lift truck weight with standard mast	
. Unladen	4530 kg
. Rated load	7530 kg
- Axle weight with standard mast (transport position)	
. Front unladen	1710 kg
rated load	6600 kg
. Rear unladen	2810 kg
rated load	930 kg
- Tensible strain at coupling hook	
. Unladen	1300 daN
. Rated load	2400 daN
- Maximum ramp negotiable in forward motion	
. Unladen	28 % at 1 km/h
. Rated load	30 % at 1 km/h

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE HARD GROUND	PRESSURE ON THE CONTACT SURFACE LIGHT GROUND	AREA OF THE CONTACT SURFACE HARD GROUND	AREA OF THE CONTACT SURFACE LIGHT GROUND
275/70R22,5 RHS 148/145M TUBELESS	9 BAR	FRONT UNLADEN	850 KG	KG/CM2		CM2	
		FRONT LADEN	3650 KG	KG/CM2		CM2	
10.5R20 14PR MPT80 134G TUBELESS	6,5 BAR	FRONT UNLADEN	850 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	3650 KG	KG/CM2	KG/CM2	CM2	CM2
8.25X20 CSE SC15	Solid	FRONT UNLADEN	850 KG	3,37 KG/CM2		263 CM2	
		FRONT LADEN	3650 KG	8,63 KG/CM2		424 CM2	
15,5/55R18 14PR SPPG7 TUBELESS	5,5 BAR	FRONT UNLADEN	850 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	3650 KG	KG/CM2	KG/CM2	CM2	CM2
285/70R19,5 XZY 140/137L TUBELESS	9 BAR	FRONT UNLADEN	850 KG	KG/CM2		CM2	
		FRONT LADEN	3650 KG	KG/CM2		CM2	

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE HARD GROUND	PRESSURE ON THE CONTACT SURFACE LIGHT GROUND	AREA OF THE CONTACT SURFACE HARD GROUND	AREA OF THE CONTACT SURFACE LIGHT GROUND
7.00X12 14PR IC40	7,5 BAR	REAR UNLADEN	1500 KG	KG/CM2		CM2	
		REAR LADEN	450 KG	KG/CM2		CM2	
27.10.12 14PR IC12	4,5 BAR	REAR UNLADEN	1500 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	450 KG	KG/CM2	KG/CM2	CM2	CM2
7.00X12 CSE SC10	Solid	REAR UNLADEN	1500 KG	7,11 KG/CM2		211 CM2	
		REAR LADEN	450 KG	3,80 KG/CM2		119 CM2	
7,00R12 XZM 136A5 TUBELESS	7 BAR	REAR UNLADEN	1500 KG	KG/CM2		CM2	
		REAR LADEN	450 KG	KG/CM2		CM2	

HYDRAULIC CIRCUIT

- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	190 Bar
Double mast with free-acting lift	190 Bar
Triple mast with free-acting lift	220 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA	
(accordng to standard prEN 12053 : 1995)	
. Overhead guard	81 dB
. Cab	79 dB
- Level of sound power in the LwA environment	104 dB
(according to directive 2000/14 CE guaranteed)	
- Speed of movement of lift truck in standard configuration on horizontal ground	
(except particular conditions)	
. Forward unladen	20 km/h
. Reverse unladen	20 km/h
- Standard lift height	3300 mm
- Rated capacity with standard mast	3500 kg
- Load center	500 mm
- Weight of forks (each)	68 kg
- Lifting motions with standard mast	
. Unladen lifting	0,51 m/s
. Rated load lifting	0,46 m/s
. Unladen lowering	0,43 m/s
. Rated load lowering	0,47 m/s
- Lift truck weight with standard mast	
. Unladen	4690 kg
. Rated load	8190 kg
- Axle weight with standard mast (transport position)	
. Front unladen	1650 kg
rated load	7330 kg
. Rear unladen	3040 kg
rated load	860 kg
- Tensible strain at coupling hook	
. Unladen	1160 daN
. Rated load	2400 daN
- Maximum ramp negotiable in forward motion	
. Unladen	24 % at 1 km/h
. Rated load	27 % at 1 km/h

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
10.5R20 14PR MPT80 134G TUBELESS	4,4 BAR	FRONT UNLADEN	950 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2600 KG	KG/CM2	KG/CM2	CM2	CM2
15,5/55R18 14PR SPPG7 TUBELESS	3,5 BAR	FRONT UNLADEN	950 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2600 KG	KG/CM2	KG/CM2	CM2	CM2
275/80R20 XM27 144A2/132B TUBELESS	4,1 BAR	FRONT UNLADEN	950 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2600 KG	KG/CM2	KG/CM2	CM2	CM2

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
27.10.12 14PR IC30	7 BAR	REAR UNLADEN	1050 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	450 KG	KG/CM2	KG/CM2	CM2	CM2

HYDRAULIC CIRCUIT

- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	140 Bar
Triple mast with free-acting lift	150 Bar
Triple mast without free-acting lift	145 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA
  (accordng to standard prEN 12053 : 1995)
  - . Overhead guard 82 dB
  - . Cab 80 dB

- Level of sound power in the LwA environment 104 dB
  (according to directive 2000/14 CE guaranteed)

- Speed of movement of lift truck in standard configuration on horizontal ground
  (except particular conditions)
  - . Forward unladen 14 km/h
  - . Reverse unladen 14 km/h

- Standard lift height 3300 mm

- Rated capacity with standard mast 2000 kg

- Load center 500 mm

- Weight of forks (each) 43 kg

- Lifting motions with standard mast
  - . Unladen lifting 0,61 m/s
  - . Rated load lifting 0,55 m/s
  - . Unladen lowering 0,46 m/s
  - . Rated load lowering 0,54 m/s

- Lift truck weight with standard mast
  - . Unladen 4040 kg
  - . Rated load 6040 kg

- Axle weight with standard mast (transport position)
  - . Front unladen 1900 kg
  - rated load 5150 kg
  - . Rear unladen 2140 kg
  - rated load 890 kg

- Tensible strain at coupling hook
  - . Unladen 2300 daN
  - . Rated load 3500 daN

- Maximum ramp negotiable in forward motion
  - . Unladen 52 % at 1 km/h
  - . Rated load 52 % at 1 km/h

FRONT TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
10.5R20 14PR MPT80 134G TUBELESS	5,3 BAR	FRONT UNLADEN	950 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2800 KG	KG/CM2	KG/CM2	CM2	CM2
15,5/55R18 14PR SPPG7 TUBELESS	4 BAR	FRONT UNLADEN	950 KG	3,06 KG/CM2	1,70 KG/CM2	310 CM2	558 CM2
		FRONT LADEN	2800 KG	3,54 KG/CM2	1,97 KG/CM2	784 CM2	1411 CM2
275/80R20 XM27 144A2/132B TUBELESS	4,5 BAR	FRONT UNLADEN	950 KG	KG/CM2	KG/CM2	CM2	CM2
		FRONT LADEN	2800 KG	KG/CM2	KG/CM2	CM2	CM2

REAR TYRES

DIMENSIONS	PRESSURE	TYRE LOAD		PRESSURE ON THE CONTACT SURFACE		AREA OF THE CONTACT SURFACE	
				HARD GROUND	LIGHT GROUND	HARD GROUND	LIGHT GROUND
27.10.12 14PR IC30	7 BAR	REAR UNLADEN	1250 KG	KG/CM2	KG/CM2	CM2	CM2
		REAR LADEN	600 KG	KG/CM2	KG/CM2	CM2	CM2

HYDRAULIC CIRCUIT

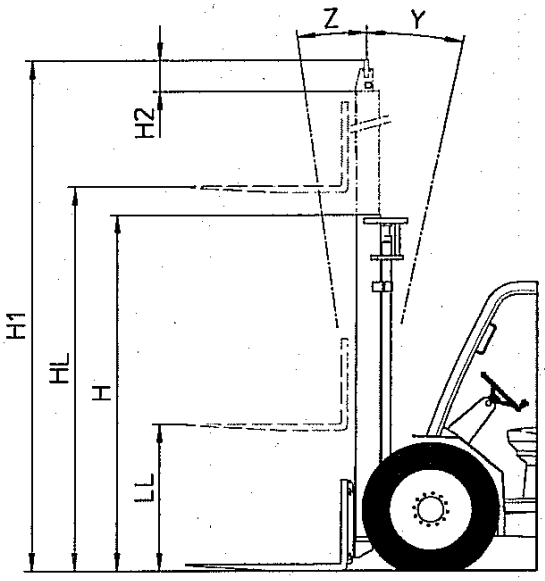
- Type of pump	Gear pump with flow divider
. Capacity	26,4 cm3
. Flow rate at full speed	79 L/mn
. Flow rate at 2800 rpm	74 L/mn
. Flow rate at 2000 rpm	53 L/mn
- Pressure	
. Lifting, tilting, attachment circuit	
Double mast	170 Bar
Triple mast with free-acting lift	180 Bar
Triple mast without free-acting lift	180 Bar
. Steering circuit	125 Bar
- Filtration	
. Return	10 µ
. Suction	100 µ

- Level of sound pressure in the driver's cab LpA (according to standard prEN 12053 : 1995)	
. Overhead guard	82 dB
. Cab	80 dB
- Level of sound power in the LwA environment (according to directive 2000/14 CE guaranteed)	104 dB
- Speed of movement of lift truck in standard configuration on horizontal ground (except particular conditions)	
. Forward unladen	14 km/h
. Reverse unladen	14 km/h
- Standard lift height	3300 mm
- Rated capacity with standard mast	2500 kg
- Load center	500 mm
- Weight of forks (each)	43 kg
- Lifting motions with standard mast	
. Unladen lifting	0,61 m/s
. Rated load lifting	0,55 m/s
. Unladen lowering	0,46 m/s
. Rated load lowering	0,54 m/s
- Lift truck weight with standard mast	
. Unladen	4340 kg
. Rated load	6840 kg
- Axle weight with standard mast (transport position)	
. Front unladen	1870 kg
rated load	5620 kg
. Rear unladen	2470 kg
rated load	1220 kg
- Tensible strain at coupling hook	
. Unladen	2300 daN
. Rated load	3500 daN
- Maximum ramp negotiable in forward motion	
. Unladen	46 % at 1 km/h
. Rated load	52 % at 1 km/h

CHARACTERISTICS OF MASTS WITH ROLLERS

MSI 20 D Série 2-E2 **MSI 20 D BUGGIE Série 2-E2**
MSI 25 D Série 2-E2 **MSI 25 D BUGGIE Série 2-E2**

DOUBLE MAST WITH ALL-ROUND VISION							
MAST	HL	Z	Y	LL	H	H1	H2
2m70	2730	10°	12°	150	2005	3530	236
3m00	3030	10°	12°	150	2155	3830	236
3m30	3330	10°	12°	150	2305	4130	236
3m50	3530	10°	12°	150	2405	4330	236
3m70	3730	10°	12°	150	2565	4530	176
4m00	4030	10°	12°	150	2755	4830	136
4m50	4530	10°	12°	150	3005	5330	136
5m00	5030	6°	6°	150	3255	5830	136
5m50	5530	6°	6°	150	3505	6330	136
6m00	6030	6°	6°	150	3795	6830	136



DOUBLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m00	3040	10°	12°	1400	2155	3800	142
3m30	3340	10°	12°	1550	2305	4100	142
3m50	3540	10°	12°	1650	2405	4300	142
3m70	3740	10°	12°	1810	2565	4500	142
4m00	4040	10°	12°	2000	2755	4800	142
4m50	4540	10°	12°	2250	3005	5300	142

TRIPLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m70	3740	10°	12°	1226	1955	4470	44
4m00	4040	10°	12°	1326	2055	4770	44
4m30	4340	10°	12°	1426	2155	5070	44
4m70	4740	10°	12°	1576	2305	5470	44
5m00	5040	6°	6°	1676	2405	5770	44
5m50	5540	6°	6°	1836	2565	6270	44
6m00	6040	6°	6°	2026	2755	6770	44
6m50	6540	6°	6°	2276	3005	7270	44
7m00	7040	6°	6°	2526	3255	7770	44

TRIPLE MAST WITHOUT FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m30	3340	10°	12°	0	1845	4070	25
3m30	3340	10°	12°	0	1845	4070	25
3m30	3340	10°	12°	0	1830	4070	40

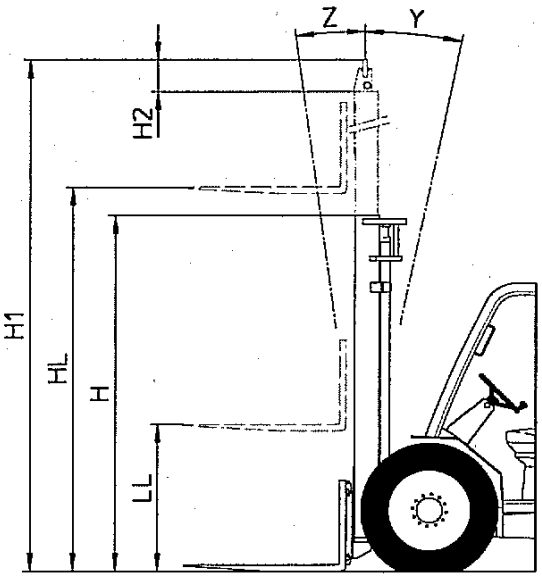
⇨ **MSI 20 D with standard tyres**
⇨ **MSI 25 D with standard tyres**
⇨ **MSI 25 D with tyres 275/80R20 XM27 144A2/132B Tubeless**

HL : Lift height in mm
Z : Forward tilting
Y : Backward tilting
LL : Free-acting lift in mm
H : Overall height with folded mast in mm
H1 : Overall height with spreaded out mast in mm
H2 : Carriage overshooting in mm

CHARACTERISTICS OF MASTS WITH ROLLERS

MSI 30 D Série 2-E2 **MSI 30 D BUGGIE Série 2-E2**
MSI 35 Turbo Série 2-E2 **MSI 35 Turbo BUGGIE Série 2-E2**

DOUBLE MAST WITH ALL-ROUND VISION							
MAST	HL	Z	Y	LL	H	H1	H2
3m00	3035	10°	12°	135	2155	3895	290
3m30	3335	10°	12°	135	2305	4195	290
3m50	3535	10°	12°	135	2405	4395	290
3m70	3735	10°	12°	135	2565	4595	230
4m00	4035	10°	12°	135	2755	4895	190
4m50	4535	10°	12°	135	3005	5395	190
5m00	5035	6°	6°	135	3255	5895	190
5m50	5535	6°	6°	135	3505	6395	190
6m00	6035	6°	6°	135	3795	6895	190



DOUBLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m00	3045	10°	12°	1400	2155	3800	154
3m30	3345	10°	12°	1550	2305	4100	154
3m50	3545	10°	12°	1650	2405	4300	154
3m70	3745	10°	12°	1810	2565	4500	154
4m00	4045	10°	12°	2000	2755	4800	154
4m50	4545	10°	12°	2250	3005	5300	154

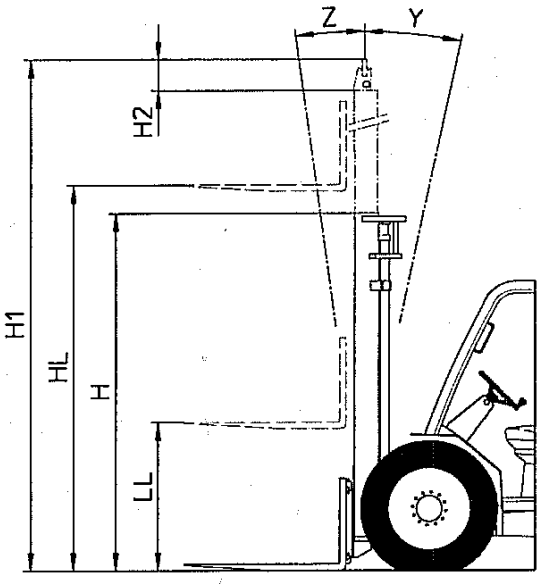
TRIPLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m70	3745	10°	12°	1300	2055	4500	34
4m00	4045	10°	12°	1400	2155	4800	34
4m30	4345	10°	12°	1550	2305	5100	34
4m70	4745	10°	12°	1650	2405	5500	34
5m00	5045	6°	6°	1810	2565	5800	34
5m50	5545	6°	6°	2000	2755	6300	34
6m00	6045	6°	6°	2250	3005	6800	34
6m50	6545	6°	6°	2500	3255	7300	34
7m00	7045	6°	6°	2750	3505	7800	34

HL : Lift height in mm
Z : Forward tilting
Y : Backward tilting
LL : Free-acting lift in mm
H : Overall height with folded mast in mm
H1 : Overall height with spreaded out mast in mm
H2 : Carriage overshooting in mm

CHARACTERISTICS OF MASTS WITH ROLLERS

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

DOUBLE MAST WITH ALL-ROUND VISION							
MAST	HL	Z	Y	LL	H	H1	H2
2m70	2730	10°	12°	150	2005	3530	236
3m00	3030	10°	12°	150	2155	3830	236
3m30	3330	10°	12°	150	2305	4130	236
3m50	3530	10°	12°	150	2405	4330	236
3m70	3730	10°	12°	150	2565	4530	176
4m00	4030	10°	12°	150	2755	4830	136
4m50	4530	10°	12°	150	3005	5330	136
5m00	5030	6°	6°	150	3255	5830	136
5m50	5530	6°	6°	150	3505	6330	136
6m00	6030	6°	6°	150	3795	6830	136



DOUBLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m00	3040	10°	12°	1400	2155	3800	142
3m30	3340	10°	12°	1550	2305	4100	142
3m50	3540	10°	12°	1650	2405	4300	142
3m70	3740	10°	12°	1810	2565	4500	142
4m00	4040	10°	12°	2000	2755	4800	142
4m50	4540	10°	12°	2250	3005	5300	142

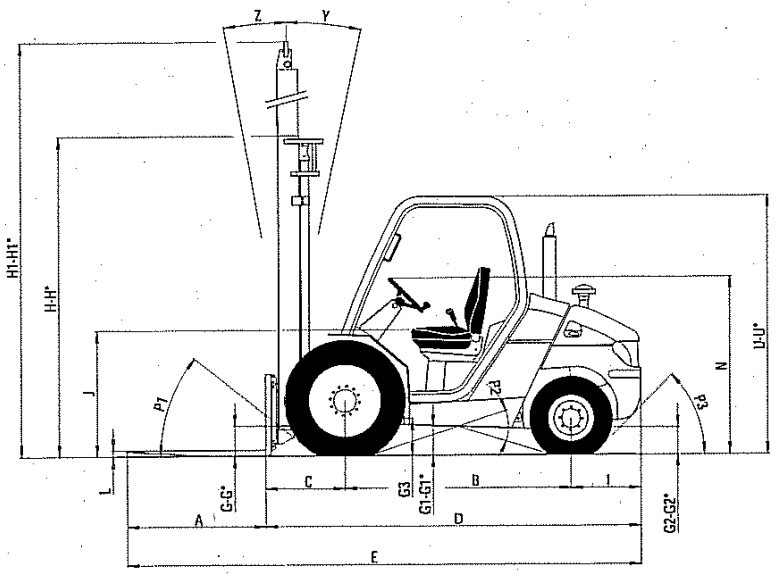
TRIPLE MAST WITH TOTAL FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m70	3740	10°	12°	1226	1955	4470	44
4m00	4040	10°	12°	1326	2055	4770	44
4m30	4340	10°	12°	1426	2155	5070	44
4m70	4740	10°	12°	1576	2305	5470	44
5m00	5040	6°	6°	1676	2405	5770	44
5m50	5540	6°	6°	1836	2565	6270	44
6m00	6040	6°	6°	2026	2755	6770	44
6m50	6540	6°	6°	2276	3005	7270	44
7m00	7040	6°	6°	2526	3255	7770	44

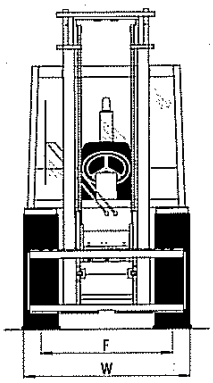
TRIPLE MAST WITHOUT FREE-ACTING LIFT							
MAST	HL	Z	Y	LL	H	H1	H2
3m30	3340	10°	12°	0	1830	4070	40

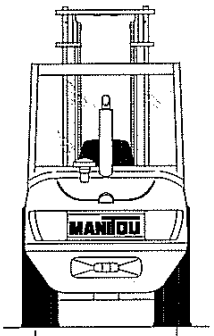
HL : Lift height in mm
Z : Forward tilting
Y : Backward tilting
LL : Free-acting lift in mm
H : Overall height with folded mast in mm
H1 : Overall height with spreaded out mast in mm
H2 : Carriage overshooting in mm

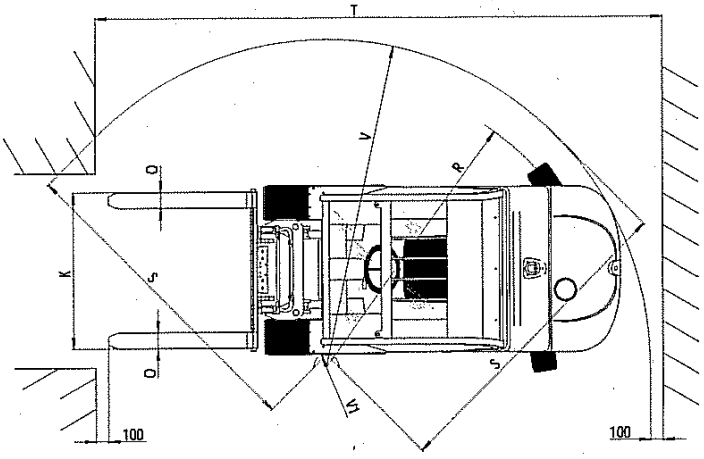
DIMENSIONS AND LOAD CHART

MSI 20 D Série 2-E2 **MSI 20 D BUGGIE Série 2-E2**









RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

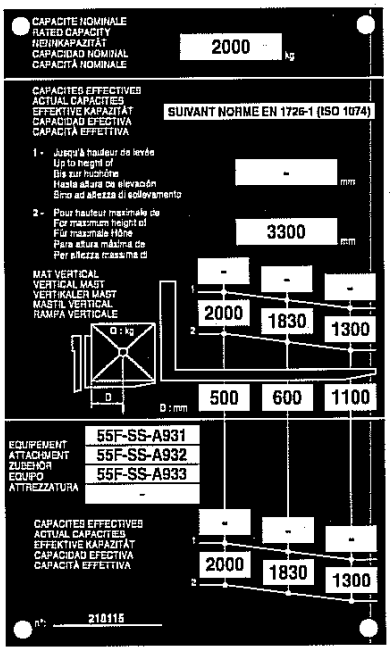
1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

ACTUAL CAPACITIES

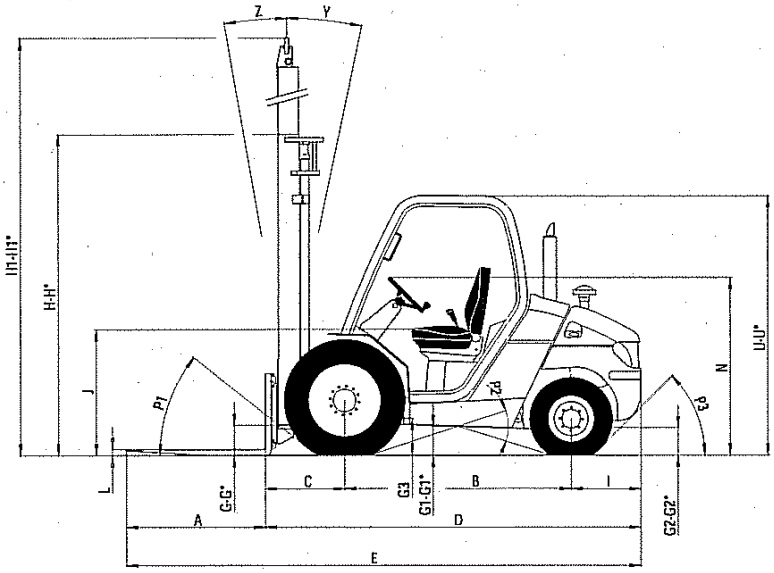


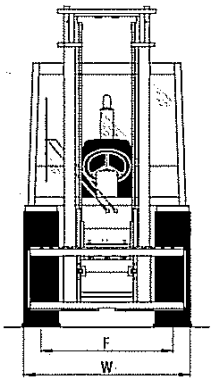
A	1100 mm
B	1800 mm
C	625 mm
D	2945 mm
E	4045 mm
F	1046 mm
F1	1102 mm
G	270 mm
G*	240 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	2300 mm
H*	1950 mm
H1	4131 mm
H1*	4470 mm
I	520 mm
J	1025 mm
K	1260 mm
L	40 mm
N	1450 mm
O	100 mm
P1	49,5 °
P2	40,5 °
P3	44 °
R	2310 mm
S	2545 mm
T	4525 mm
U	2105 mm
U*	1990 mm
V	2600 mm
V1	150 mm
W	1323 mm
Y	12 °
Z	10 °

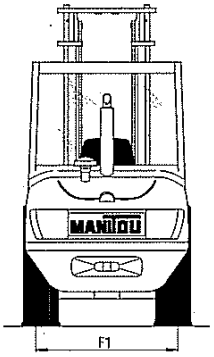
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mastTRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load
U = MSI 20 D Série 2-E2
U* = MSI 20 D BUGGIE Série 2-E2

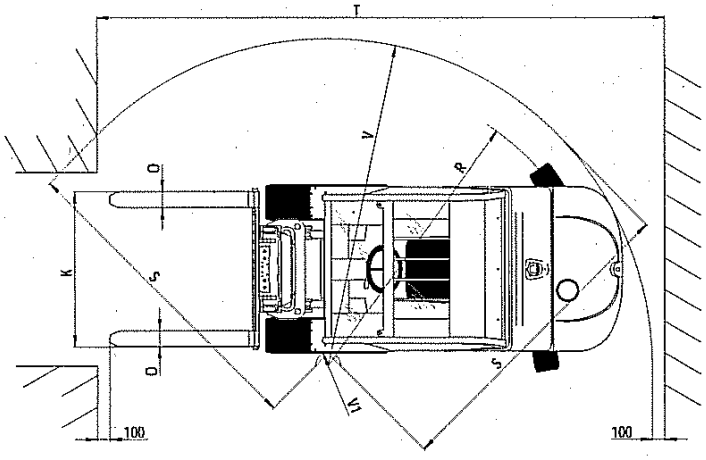
DIMENSIONS AND LOAD CHART

MSI 25 D Série 2-E2 **MSI 25 D BUGGIE Série 2-E2**









A	1100 mm
B	1800 mm
C	625 mm
D	2945 mm
E	4045 mm
F	1046 mm
F1	1102 mm
G	270 mm
G*	240 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	2300 mm
H*	1950 mm
H1	4131 mm
H1*	4470 mm
I	520 mm
J	1025 mm
K	1260 mm
L	40 mm
N	1450 mm
O	100 mm
P1	49,5 °
P2	40,5 °
P3	44 °
R	2310 mm
S	2545 mm
T	4525 mm
U	2105 mm
U*	1990 mm
V	2600 mm
V1	150 mm
W	1323 mm
Y	12 °
Z	10 °

RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

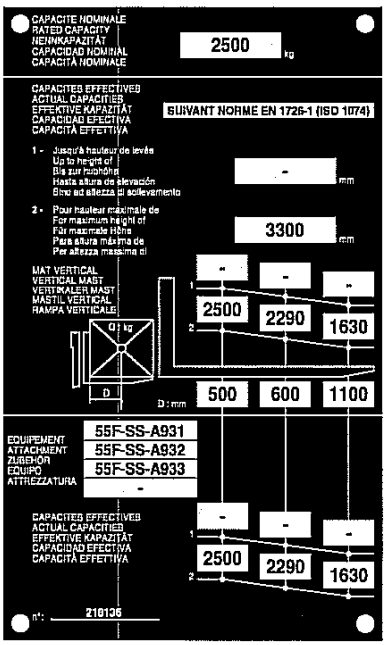
1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

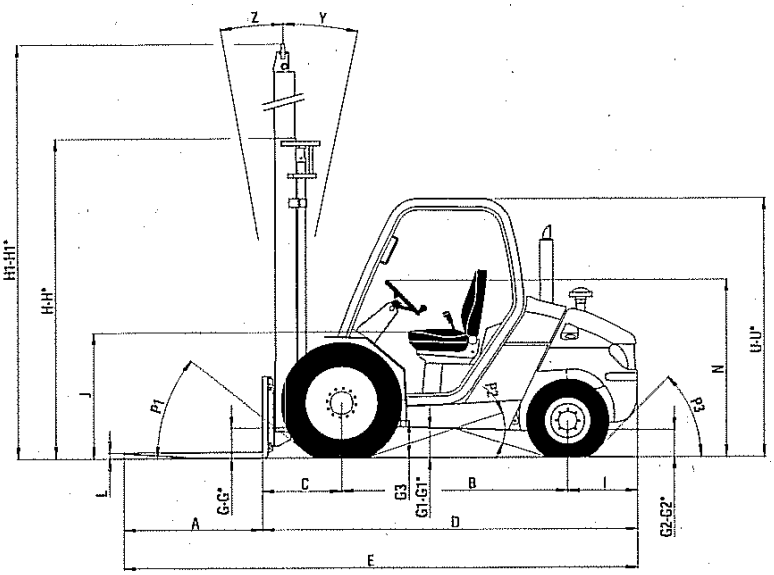
ACTUAL CAPACITIES

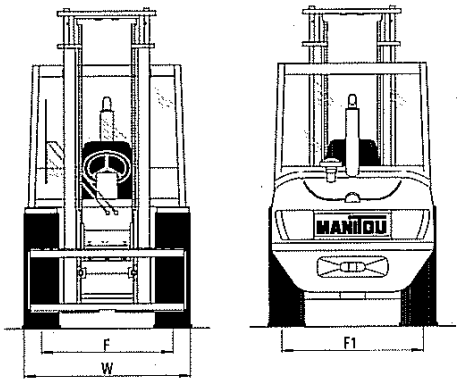


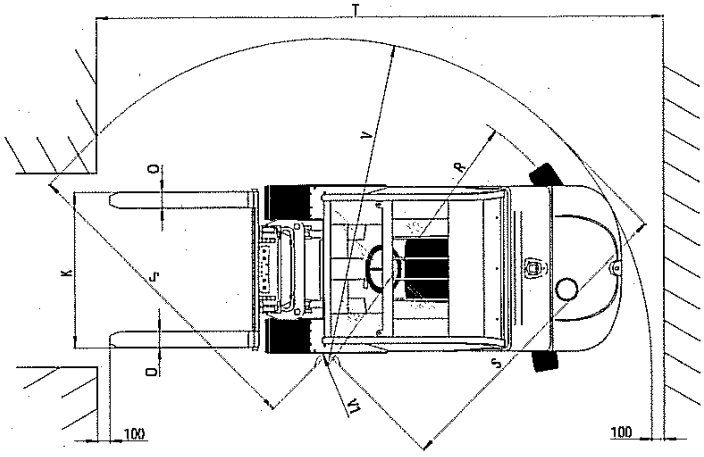
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mastTTRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load
U = MSI 25 D Série 2-E2
U* = MSI 25 D BUGGIE Série 2-E2

DIMENSIONS AND LOAD CHART

MSI 30 D Série 2-E2 **MSI 30 D BUGGIE Série 2-E2**







RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

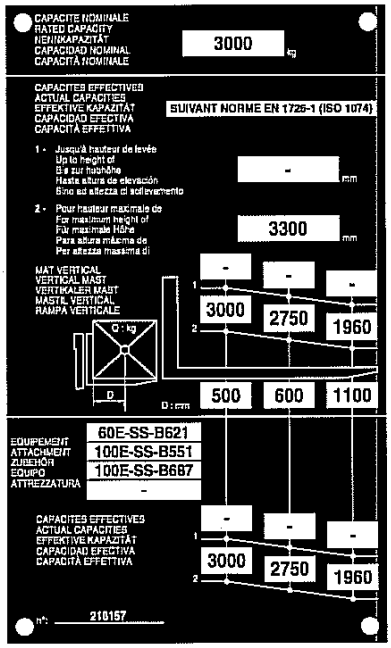
1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

ACTUAL CAPACITIES

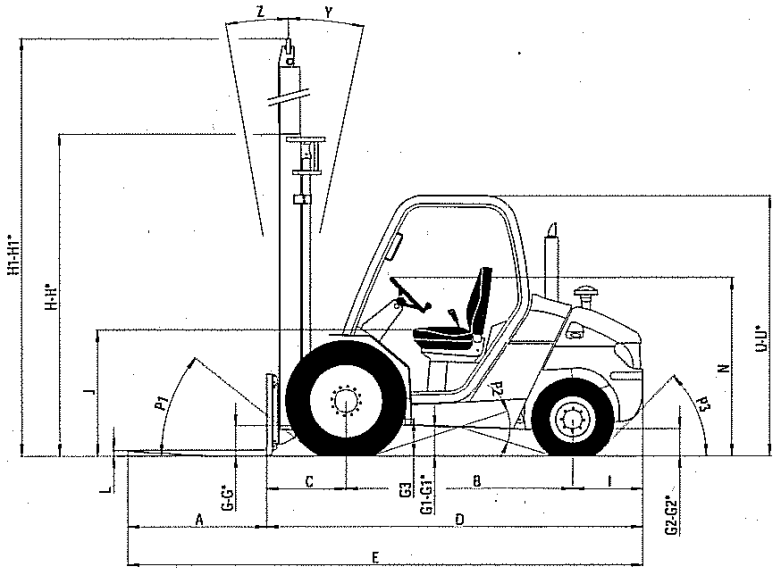


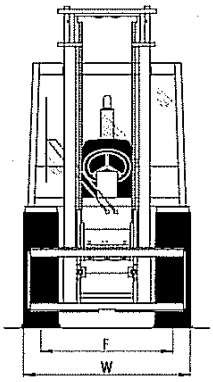
A	1100 mm
B	1800 mm
C	630 mm
D	2980 mm
E	4080 mm
F	1046 mm
F1	1102 mm
G	270 mm
G*	240 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	2300 mm
H*	2050 mm
H1	4193 mm
H1*	4500 mm
I	550 mm
J	1025 mm
K	1260 mm
L	45 mm
N	1450 mm
O	100 mm
P1	49,5 °
P2	40,5 °
P3	40 °
R	2310 mm
S	2580 mm
T	4560 mm
U	2105 mm
U*	1990 mm
V	2635 mm
V1	150 mm
W	1323 mm
Y	12 °
Z	10 °

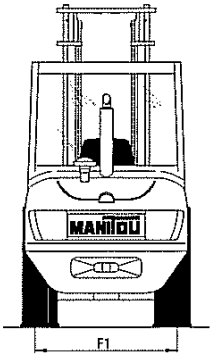
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mast TRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load
U = MSI 30 D Série 2-E2
U* = MSI 30 D BUGGIE Série 2-E2

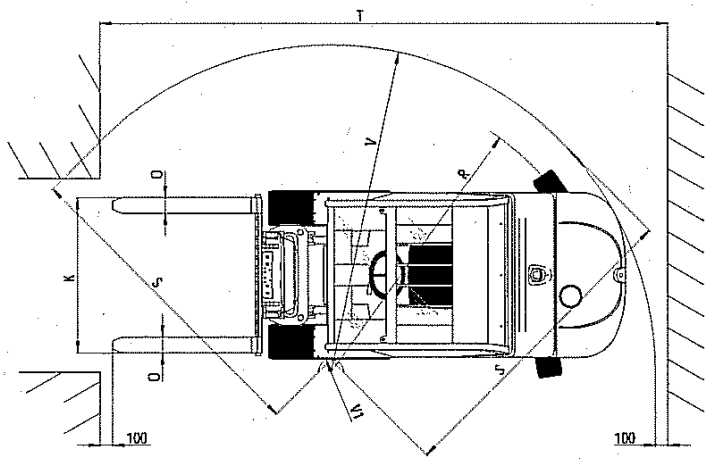
DIMENSIONS AND LOAD CHART

MSI 35 Turbo Série 2-E2 **MSI 35 Turbo BUGGIE Série 2-E2**









A	1100 mm
B	1800 mm
C	630 mm
D	3030 mm
E	4130 mm
F	1046 mm
F1	1102 mm
G	270 mm
G*	240 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	2300 mm
H*	2050 mm
H1	4193 mm
H1*	4500 mm
I	600 mm
J	1025 mm
K	1260 mm
L	45 mm
N	1450 mm
O	125 mm
P1	49,5 °
P2	40,5 °
P3	40 °
R	2330 mm
S	2590 mm
T	4595 mm
U	2105 mm
U*	1990 mm
V	2665 mm
V1	100 mm
W	1323 mm
Y	12 °
Z	10 °

RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

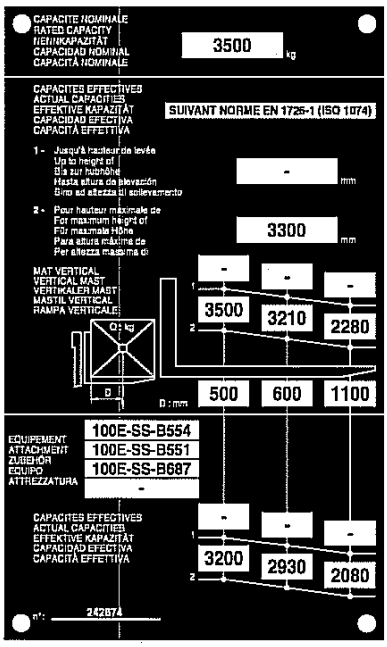
1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

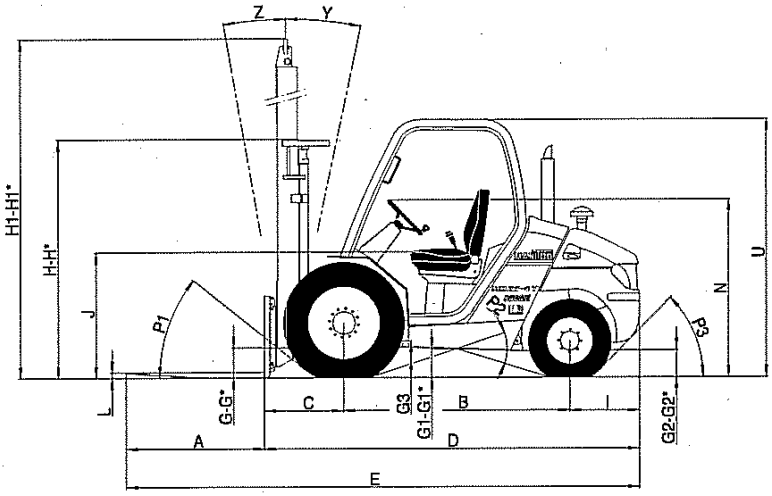
ACTUAL CAPACITIES

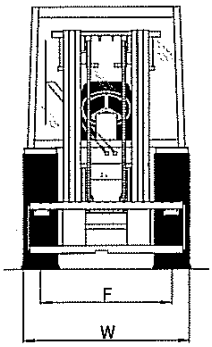


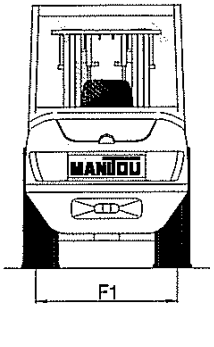
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mast TRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load
U = MSI 35 Turbo Série 2-E2
U* = MSI 35 Turbo BUGGIE Série 2-E2

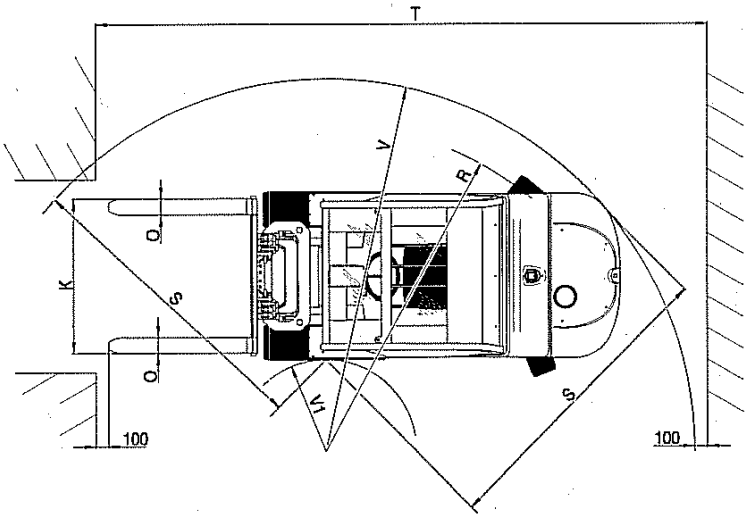
DIMENSIONS AND LOAD CHART

MH 20-4 Turbo BUGGIE Série 2-E2









A	1100 mm
B	1800 mm
C	625 mm
D	2945 mm
E	4045 mm
F	1160 mm
F1	1164 mm
G	265 mm
G*	235 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	1835 mm
H*	1945 mm
H1	4070 mm
H1*	4469 mm
I	520 mm
J	1025 mm
K	1260 mm
L	40 mm
N	1450 mm
O	100 mm
P1	49,5 °
P2	40,5 °
P3	44 °
R	3045 mm
S	2500 mm
T	5090 mm
U	1990 mm
V	3265 mm
V1	1080 mm
W	1440 mm
Y	12 °
Z	10 °

RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

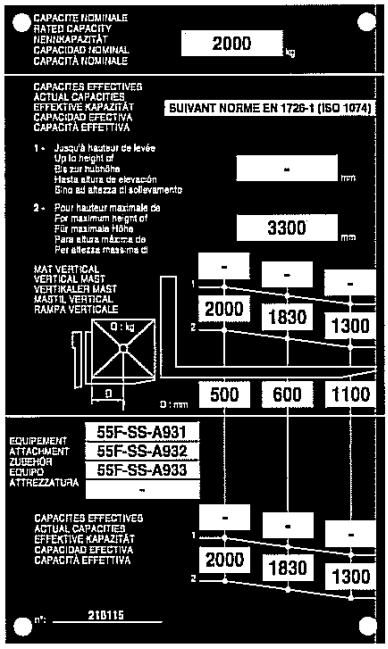
1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

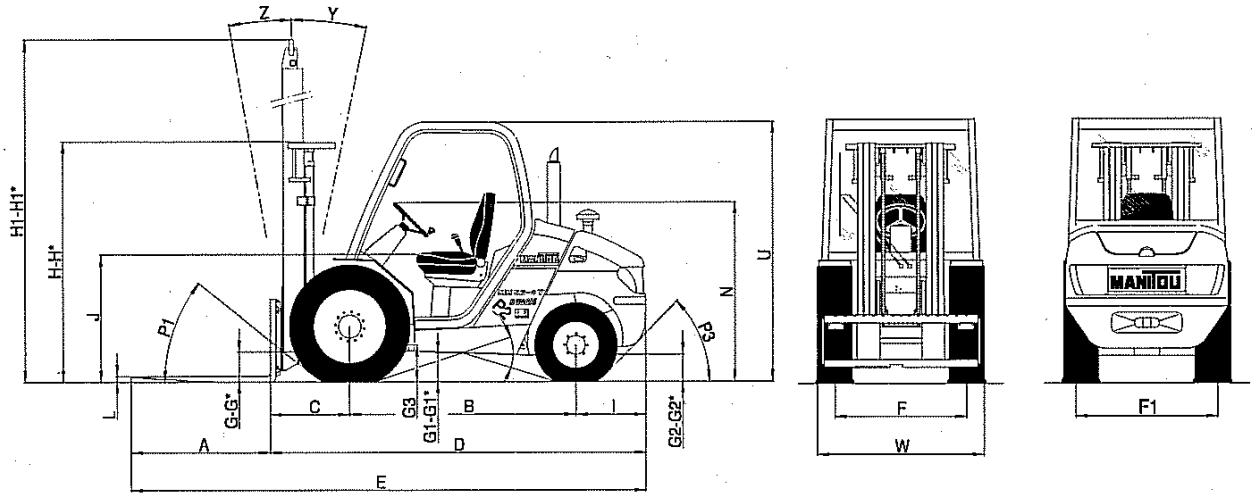
ACTUAL CAPACITIES

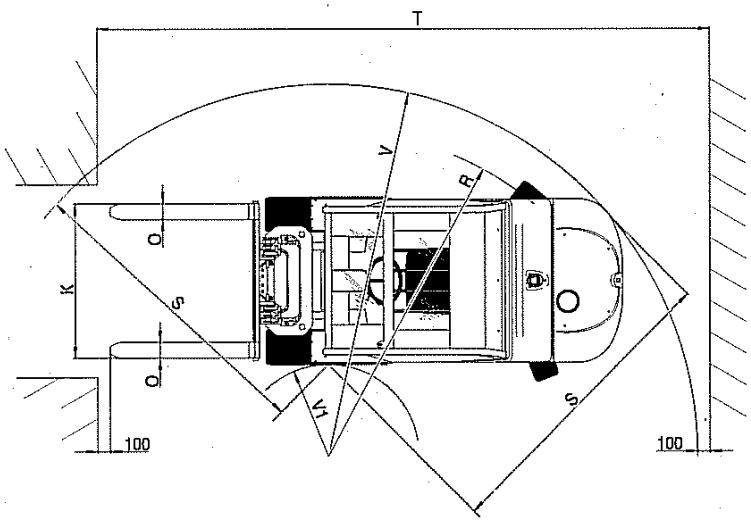


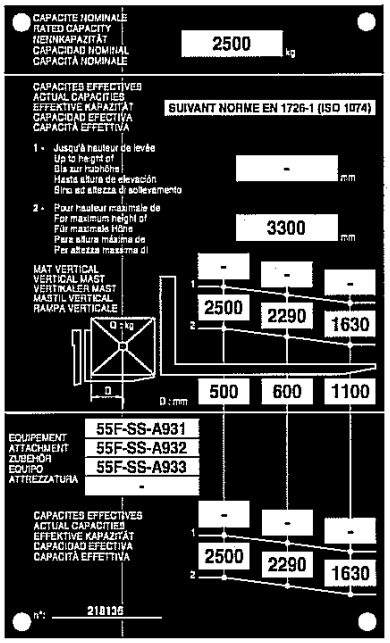
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mast TRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load

DIMENSIONS AND LOAD CHART

MH 25-4 Turbo BUGGIE Série 2-E2







RATED CAPACITY

ACTUAL CAPACITIES (according to standard EN 1726-1)

1 - Up to height of

2 - For maximum height of

VERTICAL MAST

ATTACHMENT

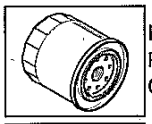
ACTUAL CAPACITIES

A	1100 mm
B	1800 mm
C	625 mm
D	2945 mm
E	4045 mm
F	1160 mm
F1	1164 mm
G	265 mm
G*	235 mm
G1	260 mm
G1*	260 mm
G2	215 mm
G2*	230 mm
G3	270 mm
H	1835 mm
H*	1945 mm
H1	4070 mm
H1*	4469 mm
I	520 mm
J	1025 mm
K	1260 mm
L	40 mm
N	1450 mm
O	100 mm
P1	49,5 °
P2	40,5 °
P3	44 °
R	3045 mm
S	2500 mm
T	5090 mm
U	1990 mm
V	3265 mm
V1	1080 mm
W	1440 mm
Y	12 °
Z	10 °

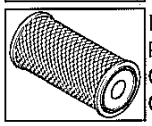
H - H1 = Standard mast DUPLEX 3M30
H* - H1* = Option mast TRIPLEX 3M70
G - G1 - G2 - G3 = Unladen
G* - G1* - G2* = Rated load

FILTERS CARTRIDGES AND BELTS

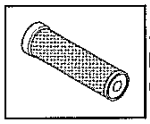
I.C. ENGINE



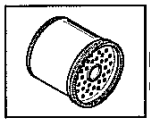
I.C. ENGINE OIL FILTER
Part number : 702577
Change : 500 H



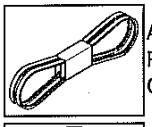
DRY AIR FILTER CARTRIDGE
Part number : 227959
Clean : 50 H*
Change : 500 H*



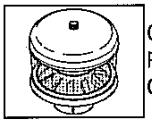
SAFETY DRY AIR FILTER CARTRIDGE
Part number : 227960
Change : 1000 H*



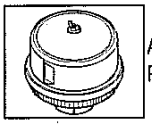
FUEL FILTER CARTRIDGE
Part number : 109401
Change : 500 H



ALTERNATOR BELT
Part number : 703259
Change : 1000 H



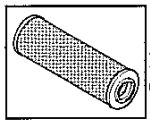
CYCLONIC PRE-FILTER (OPTION)
Part number : 588330
Clean : 10 H



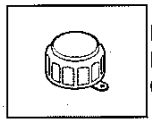
AUTOMATIC VACUUM-CLEANING PRE-FILTER (OPTION)
Part number : 240334

* : This periodicity is given for information only (see : 3 - MAINTENANCE : SERVICING SCHEDULE) for cleaning and changing.

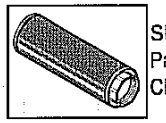
HYDRAULICS



HYDRAULIC RETURN OIL FILTER CARTRIDGE
Part number : 602096
Change : 500 H

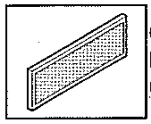


FILTER CAP FOR HYDRAULIC OIL TANK
Part number : 62415
Change : 1000 H



SUCTION STRAINER FOR HYDRAULIC OIL TANK
Part number : 77402
Clean : 1000 H

CAB (OPTION)



CAB VENTILATION FILTER
Part number : 562185
Clean : 500 H

LUBRICANTS AND FUEL

USE THE RECOMMENDED LUBRICANTS AND FUEL :
- For topping up, oils may not be miscible.
- For oil changes, MANITOU oils are perfectly appropriate.

DIAGNOSTIC ANALYSIS OF OILS
If a service or maintenance contract has been organized with the dealer, a diagnostic analysis of engine, transmission and axle oils may be requested depending on the rate of use.

(*) FUEL CHARACTERISTICS
Use a high-quality fuel to obtain optimal performance of the I.C. engine.

CHARACTERISTICS OF RECOMMENDED FUEL :
- Types of diesel N590 - Auto/C0/C1/C2/C3/C4
- BS2869 Class A2
- ASTM D975-91 Class 2-2DA, US DF1, US DF2, US DFA
- JIS K2204 (1992) Grades 1, 2, 3 and Special Grade 3.

I.C. ENGINE

ORGANS TO BE LUBRICATED	CAPACITY	RECOMMENDATION	PACKAGING	PART NUMBER
I.C. ENGINE	9,75 Liters	MANITOU Oil API CG4	5 L. 20 L. 55 L. 209 L.	661706 582357 582358 582359
COOLING CIRCUIT	10,5 Liters	Cooling liquid (protection - 30 °C) Cooling liquid (protection - 25 °C)	2 L. 5 L. 20 L. 2 L. 5 L. 20 L.	473076 470077 470078 554002 554003 554004
FUEL TANK	73,5 Liters	Diesel fuel (*)		

TRANSMISSION

ORGANS TO BE LUBRICATED	CAPACITY	RECOMMENDATION	PACKAGING	PART NUMBER
FRONT WHEELS REDUCERS	1 Liter	MANITOU Oil Mechanical transmission for axles and boxes SAE 80W90	2 L. 20 L. 55 L. 209 L.	499237 546330 546221 546220

MAST

ORGANS TO BE LUBRICATED	RECOMMENDATION	PACKAGING	PART NUMBER
MAST LIFTING CHAINS	MANITOU Lubricant Chain special (aerosol)	400 Ml.	554271
GREASING OF THE MAST	MANITOU Grease Multipurpose NLGI 2	400 g. 1 Kg. 50 Kg.	545996 161590 499235

HYDRAULICS

ORGANS TO BE LUBRICATED	CAPACITY	RECOMMENDATION	PACKAGING	PART NUMBER
HYDRAULIC OIL TANK	95 Liters	MANITOU Oil Hydraulic ISO 46	5 L. 20 L. 55 L. 209 L.	545500 582297 546108 546109

OVERHEAD GUARD

ORGANS TO BE LUBRICATED	RECOMMENDATION	PACKAGING	PART NUMBER
WINDSCREEN WASHER TANK	Windscreen washer fluid	1 L. 5 L.	490402 486424

CAB (OPTION)

ORGANS TO BE LUBRICATED	RECOMMENDATION	PACKAGING	PART NUMBER
CAB DOOR	MANITOU Grease Multipurpose HD NLGI 2	400 g. 1 Kg. 5 Kg. 20 Kg. 50 Kg.	161589 554973 554974 499233 489670
WINDSCREEN WASHER TANK	Windscreen washer fluid	1 L. 5 L.	490402 486424

REAR AXLE

ORGANS TO BE LUBRICATED	RECOMMENDATION	PACKAGING	PART NUMBER
SWIVEL PINS STEERING CONNECTING ROD REAR AXLE OSCILLATION	MANITOU Grease Multipurpose HD NLGI 2	400 g. 1 Kg. 5 Kg. 20 Kg. 50 Kg.	161589 554973 554974 499233 489670

GROUP 10

I. C. ENGINE

DISASSEMBLY OF THE I.C. ENGINE

10-3-16 EN

25 / 01 / 2005

IMPORTANT

To identify the I.C. engine on your lift truck, see the LIFT TRUCK CHARACTERISTICS chapter in section O - GENERAL.

400 Series

Models 403C-11, 403C-15, 404C-22 and 404C-22T

WORKSHOP MANUAL

403C-11 **Three cylinder naturally aspirated diesel engine**

403C-15 **Three cylinder naturally aspirated diesel engine**

404C-22 **Four cylinder naturally aspirated diesel engine**

404C-22T **Four cylinder turbo charged diesel engine**

Perkins Confidential: Green

Publication TPD 1458E, Issue 3.

The information is correct at the time of print.
Published in September 2002 by Technical Publications.

Chapters

The following pages contain a detailed table of contents

Contents

1 General information

2 Specifications

3 Cylinder head assembly

4 Piston and connecting rod assemblies

5 Crankshaft assembly

6 Timing case and drive assembly

7 Cylinder block assembly

8 Engine timing

9 Aspiration system

10 Lubrication system

11 Fuel system

12 Cooling system

Thermostat

13 Flywheel and housing

Flywheel

Starter ring gear

Backplate and rear oil seal

14 Electrical equipment

Electrical shut off solenoid

Bus-bar / glowplugs

Drive belt

Alternator

Starter motor

15 Auxiliary equipment

16 Special tools

1

General information

Introduction

This workshop manual has been written to provide assistance for technicians who service and overhaul the Perkins 403C-11, 403C-15, 404C-22 and the 404C-22T engine. The assumption is made that the engine is removed from the application.

The engine conforms with USA EPA/CARB and EC emissions legislation for agricultural and industrial applications.

Where the information applies only to certain engine types, this is indicated in the text.

Special tools are available and listed in chapter 16. POWERPART recommended consumable products are listed in this chapter. There is a reference to the relevant special tools and consumable products at the beginning of each operation.

Danger is indicated in the text by two methods:

Warning! *This indicates that there is a possible danger to the person.*

Caution: *This indicates that there is a possible danger to the engine.*

Note: Is used where the information is important, but there is not a danger.

Warning! *Read and remember the "Safety precautions". They are given for your protection and must be used at all times.*

Generally, if new joints are to be fitted, it is accepted that the faces for the joint will be cleaned, as this is normal workshop practice. Also, it is understood that during assembly and inspection, all parts are to be thoroughly cleaned and lubricated, and where present, burrs and scale are to be removed.

All open ports of high-precision components e.g. fuel injection equipment must be covered until assembly, to prevent the entry of foreign matter.

When either the "left" or the "right" side of the engine is referred to, it is when viewed from the flywheel end.

When fitting setscrews or studs into holes that enter oil, coolant or air passages, a suitable sealant should be used to prevent leakage.

Micro encapsulated anaerobic sealant (M.E.A.S.) has been applied to the threads instead of jointing compounds or other sealants when the fasteners are fitted in through holes into oil or coolant passages. The identification of these fasteners, as supplied, is by the colour of the sealant.

With M.E.A.S. sealed studs, the sealed end must be fitted into the component. The threaded holes must have a 1,59 mm (0.0625 in) 45° chamfer to ensure that the M.E.A.S. sealant is not removed when the new fasteners are fitted. If the fasteners have to be removed and fitted again, the threads must be cleaned and a suitable sealant used.

Safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only refer to specific applications

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put diesel fuel in the tank during engine operation (unless it is absolutely necessary).
- Do not add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme care must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine or auxiliary equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation. ***Warning!*** Some moving parts cannot be seen clearly while the engine runs.
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap or any component of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets of clothing.
- Discard used lubricating oil in accordance with local regulations to prevent contamination.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Use extreme care if emergency repairs must be made in adverse conditions.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container of water. Fit safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.
- Turbochargers operate at high speed and at high temperatures. Keep fingers, tools and debris away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Do not clean an engine while it runs or while it is hot. If cold cleaning fluids are applied to a hot engine, certain components on the engine could be damaged.
- Fit only genuine Perkins parts.

Viton seals

Warnings!

- *Some seals used in engines and in components fitted to engines are made of Viton. Viton is used by many manufactures and is a safe material under normal conditions of operation. If Viton is burned, a product of this burnt material is an acid which is extremely dangerous. Never allow this burnt material to come into contact with the skin or with the eyes. If it is necessary to come into contact with components which have been burnt, ensure that the precautions which follow are used:*
- *Ensure that the components have cooled.*
- *Use Neoprene gloves and discard the gloves safely after use.*
- *Wash the area with calcium hydroxide solution and then with clean water.*
- *Disposal of components and gloves which are contaminated must be in accordance with local regulations.*

If there is contamination of the skin or eyes, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15 - 60 minutes. **Obtain immediate medical attention.**

Safety cautions when an engine is cleaned

Care should be taken, when an engine is cleaned with a high pressure cleaning system.

Cautions:

- *Do not wash an engine while it runs or while it is hot. If cold cleaning fluids are applied to a hot engine, certain components on the engine could be damaged.*
- *Leave the engine to cool for at least one hour and disconnect the battery connections before cleaning.*
- *Do not wash any part of the fuel injection pump (FIP), cold start device, electrical shut off solenoid (ESOS) or electrical connectors.*
- *Ensure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system.*

If these cautions are ignored, the engine or certain components could be damaged, fail to operate and also make the manufacturer's warranty invalid.

POWERPART recommended consumable products

Perkins have made available the products recommended below in order to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion.

Part number 21825166.

POWERPART Easy Flush

Cleans the cooling system.

Part number 21825001.

POWERPART Gasket and flange sealant

To seal flat faces of components where no joint is used. Especially suitable for aluminium components.

Part number 21820518.

POWERPART Gasket remover

An aerosol for the removal of sealants and adhesives.

Part number 21820116.

POWERPART Griptite

To improve the grip of worn tools and fasteners.

Part number 21820129.

POWERPART Hydraulic threadseal

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems.
Part number 21820121.

POWERPART Industrial grade super glue

Instant adhesive designed for metals, plastics and rubbers.

Part number 21820125.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion.

Part number 1772204.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems.

Part number 1762811.

POWERPART Lay-Up 3

Protects outside metal parts.

Part number 1734115.

POWERPART Metal repair putty

Designed for external repair of metal and plastic.

Part number 21820126.

POWERPART Pipe sealant and sealant primer

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately.

Part number 21820122.

POWERPART Radiator stop leak

For the repair of radiator leaks.

Part number 21820127.

POWERPART Retainer (high strength)

To retain components which have an interference fit. Currently Loctite 638.

Part number 21820638.

POWERPART Safety cleaner

General cleaner in an aerosol container.

Part number 21820128.

POWERPART Silicone adhesive

An RTV silicone adhesive for application where low pressure tests occur before the adhesive sets. Used for sealing flange where oil resistance is needed and movement of the joint occurs.

Part number 21826038.

POWERPART Silicone RTV sealing and jointing compound

Silicone rubber sealant which prevents leakage through gaps. Currently Hylosil.

Part number 1861108.

POWERPART Stud and bearing lock

To provide a heavy duty seal to components that have a light interference fit.

Part number 21820119 or 21820120.

POWERPART Threadlock and nutlock

To retain small fasteners where easy removal is necessary.

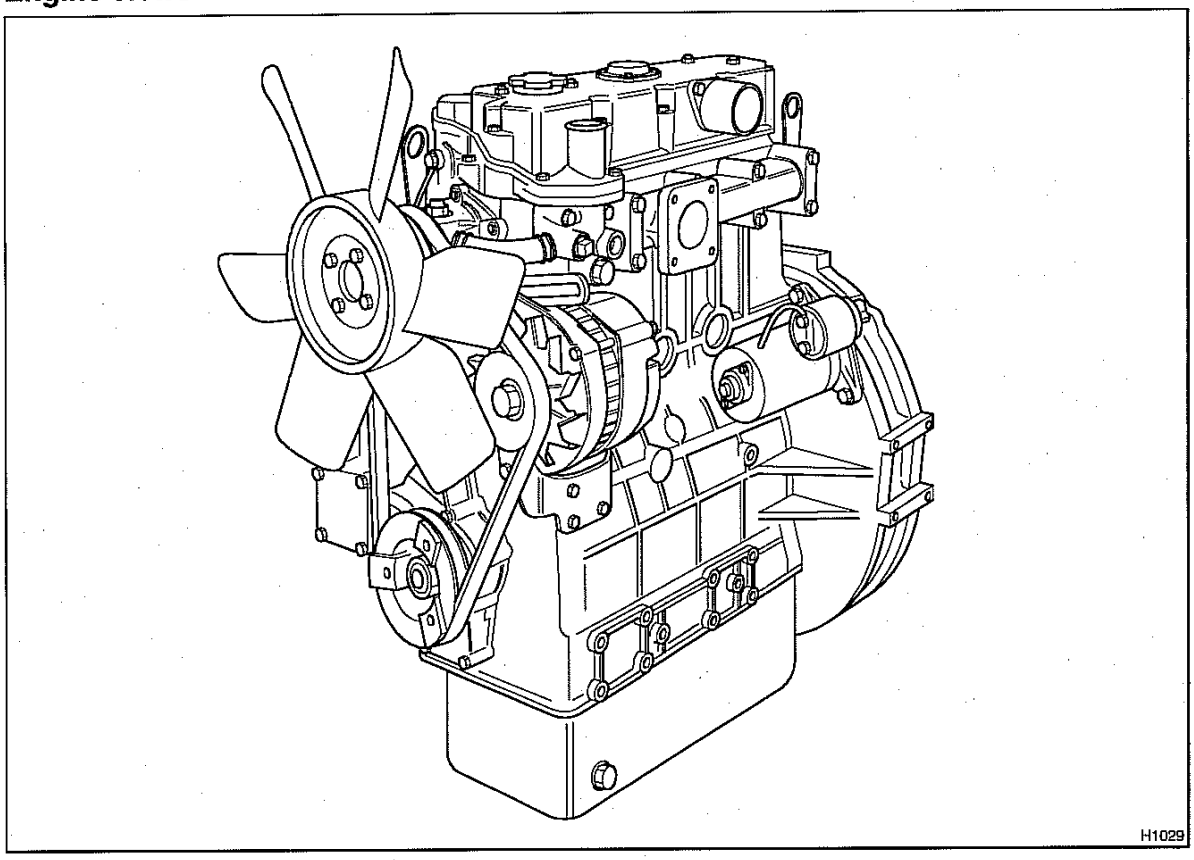
Part number 21820117 or 21820118.

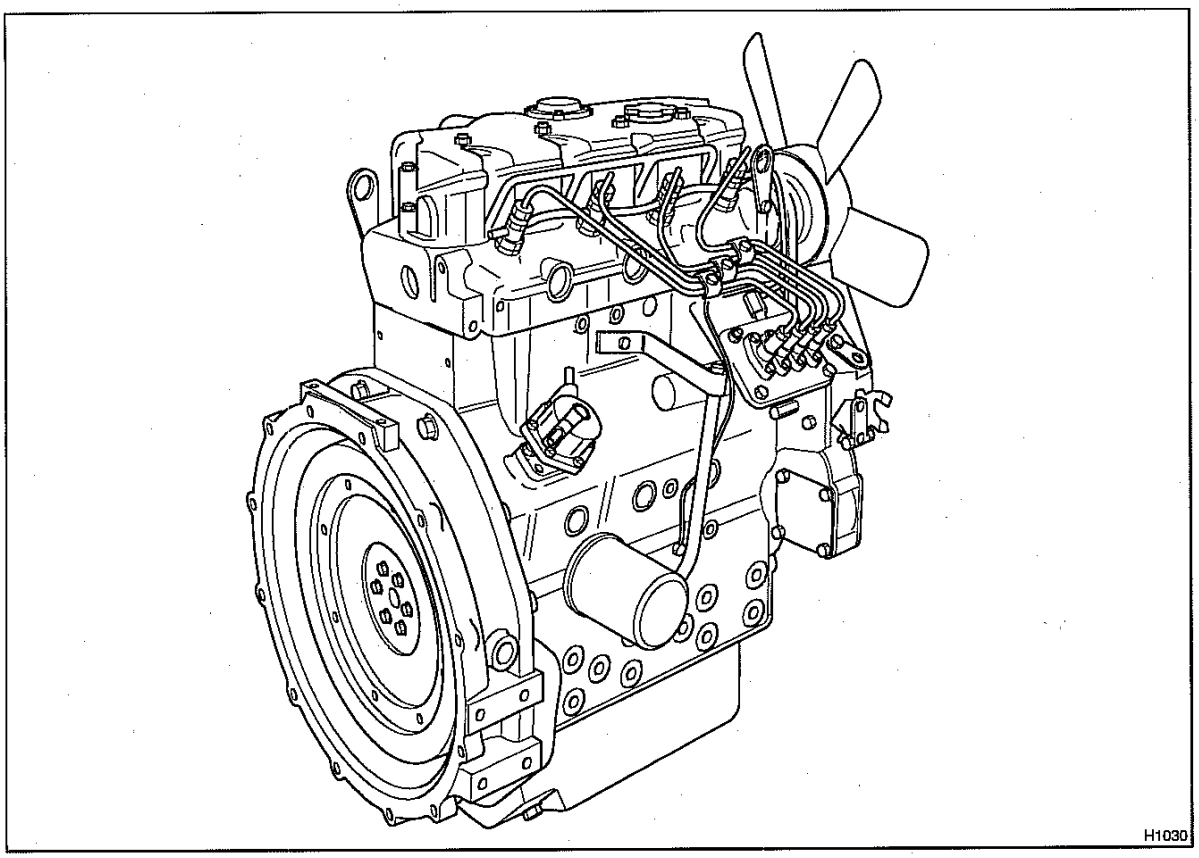
POWERPART Universal jointing compound

Universal jointing compound which seals joints. Currently Hylomar.

Part number 1861117.

Engine views





Engine identification

Engine build lists numbering system

The standard engine build list numbering code is defined as follows:

Code	I	II	III	IV	V
Example	HP	TBA	U	000001	D

Code I Engine build code

Code	HH	HL	HP	HR
Engine	403C-11	403C-15	404C-22	404C-22T

Code II engine build list

The build list increases numerically for both OEMS and distributors.

Code III country of manufacture

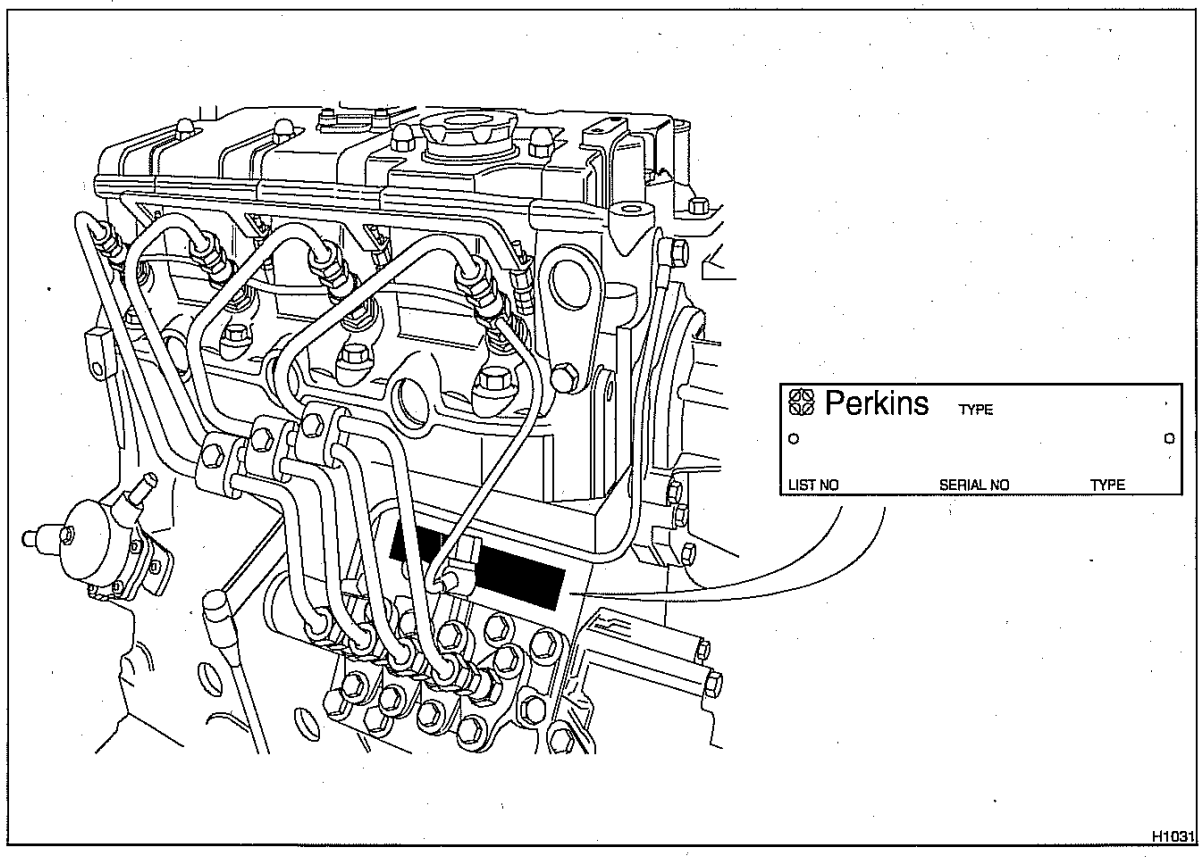
Code	J	U
Country of manufacture	Made in Japan	Made in U.K.

Code IV engine serial number

Individual serial number commencing with 000001 increasing numerically.

Code V year of manufacture

Code	H	J
Year	2001	2002



Engine lift equipment

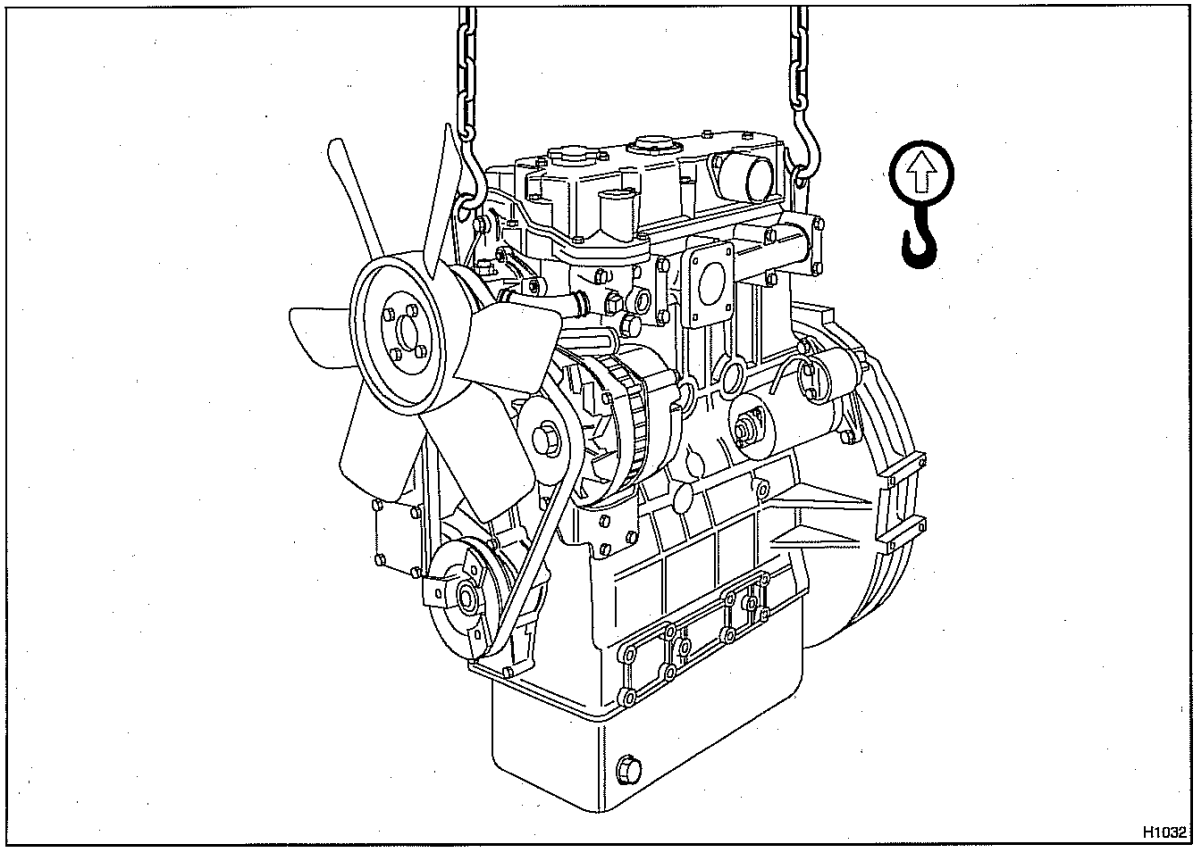
Recommended torque: lifting eye bolts

Engine	Nm (lbf ft) kgf m
All models	26 (19) 2,6

Maximum engine weights

Engine	Engine specification	Maximum engine weights (dry) (1)
403C-11	Long flywheel housing specification	114 kg
	Short flywheel housing specification	96 kg
	Backplate specification	87 kg
403C-15	Long flywheel housing specification	176 kg
	Short flywheel housing specification	154 kg
	Backplate specification	150 kg
404C-22	Long flywheel housing specification	220 kg
	Short flywheel housing specification	196 kg
	Backplate specification	184 kg
404C-22T	Long flywheel housing specification	230 kg
	Short flywheel housing specification	206 kg
	Backplate specification	194 kg

(1) Engine may alter with final specification.



2

Specifications

Basic engine data

Engine model	403C-11	403C-15	404C-22	404C-22T
Engine build code	HH	HL	HP	HR
Number of cylinders	3	3	4	4
Cylinder arrangement	Vertical in line			
Cycle	Four stroke			
Direction of rotation	Clockwise from the front			
Induction system	Naturally aspirated			Turbo charged
Combustion system	Indirect injection			
Nominal bore	77 mm (3.03 in)	84 mm (3.3 in)		
Stroke	81 mm (3.19 in)	90 mm (3.5 in)	100 mm (3.9 in)	
Compression ratio	23: 1	22.5: 1	23.3: 1	
Cubic capacity	1,131 litres (69 in^3)	1,496 litres (91 in^3)	2,216 litres (135.2 in^3)	
Firing order	1, 2, 3	1, 2, 3	1, 3, 4, 2	
Valve tip clearance (cold)				
Inlet	0,2 mm (0.0078 in)			
Exhaust	0,2 mm (0.0078 in)			
Governor	Mechanical all speed			
Fuel injection	Cassette type fuel injection pump			
Electrical system	12 Volt			
Lubricating oil pressure relief valve	304 - 500 kPa	262 - 359 kPa	352 - 448 kPa	
Lubricating oil pressure switch located on top cover	49,0 kPa	29,4 kPa		
Lubricating oil pressure switch located on cylinder block oil rail	49,0 kPa	98,0 kPa		

Standard torques

Most of the torque tensions on the engine are standard. Special torque tensions are listed in the separate specific torque tables. The standard torque tensions listed in the tables below can be used when a specific torque is not necessary.

The torque tensions below apply to components lubricated lightly with clean engine oil before they are fitted.

Standard torques for setscrews and nuts

Thread size	Strength	Coarse thread				Fine thread			
		Pitch mm	Torque Nm	Torque lbf ft	Torque kgf m	Pitch mm	Torque Nm	Torque lbf ft	Torque kgf m
M 4	8.8 11T	0,7	3 4	2 3	0,3 0,4	-	-	-	-
M5	8.8 11T	0,8	6 8	4 6	0,6 0,8	-	-	-	-
M6	8.8 11T	1,0	10 14	7 10	1,0 1,4	-	-	-	-
M8	8.8 11T	1,25	26 32	19 24	2,7 3,3	1,0	30 35	22 26	3,0 3,6
M10	8.8 11T	1,5	50 62	37 46	5,1 6,3	1,25	56 66	41 49	5,7 6,7
M12	8.8 11T	1,75	75 104	55 77	7,6 10,6	1,25	84 113	62 83	8,6 11,5
M14	8.8 11T	2,0	118 157	87 116	12,0 16,0	1,5	132 167	97 123	13,5 17,0
M16	8.8 11T	2,0	167 230	123 170	17,0 23,4	1,5	175 245	129 181	17,8 25,0

Bolt strength	Examples of applicable material
8.8 11T	S45C SCM435

Special torques

	Torque Nm (lbf ft) kgf m
Angleich	5 (3.6) 0,5
Atomiser	64 (47.2) 6,4
Atomiser pipes	23 (16.9) 2,3
Blanking plug rear of cylinder block	7 (5.1) 0,7
Crankshaft carrier to block	27 (19.9) 2,7
Connecting rod nuts	52 (38.3) 5,2
Crankshaft nut	303 (223.5) 30,3
Crankshaft sub assembly	52 (38.3) 5,2
Exhaust manifold	25 (18.4) 2,5
Flywheel	74 (54.5) 7,4
Fuel injection pump	15 (11) 1,5
Fuel injection pump leak off rail	7 (5.1) 0,7
Glow plug	18 (13.2) 1,8
Head setscrew	101 (74.5) 10,3
Leak off rail	27 (19.9) 2,7
Lift pump banjo	12 (8.8) 1,2
Lift pump mounting setscrew	6 (4.4) 0,6
Oil pipe	12 (8.8) 1,2
Oil strainer	10 (7.3) 1,0
Relief valve	64 (47.2) 6,4
Timing case	10 (7.3) 1,0
Rocker assembly nuts	33 (24.3) 3,3
Rocker cover	14 (10.3) 1,4
Electrical shut off solenoid	18 (13.2) 1,8
Sump drain plug	35 (25.8) 3,5
Temperature switch	27 (19.9) 2,7
Thermostat setscrew	14 (10.3) 1,4

Compression test data

Many factors affect compression pressures, the battery, starter motor condition, ambient conditions and the type of gauge used can give a wide variation of results for a given engine.

Standard value	To be repaired
>2940 kPa (426.6 lbf / in²) @ 250 rpm	<2450 kPa (355.5 lbf / in²) @ 250 rpm

Compression tests should only be used to compare between cylinders of an engine. If one or more cylinders vary by more than 350 kPa (50 lbf / in²) then those cylinders may be faulty.

Compression tests should not be the only method used to show the condition of an engine, but they should be used together with other symptoms and tests.

How to do a compression test

Note: Before the compression test, ensure that the battery is in good condition and fully charged. Also ensure the starter motor is in good condition.

1 Ensure that the valve tip clearances are set correctly.

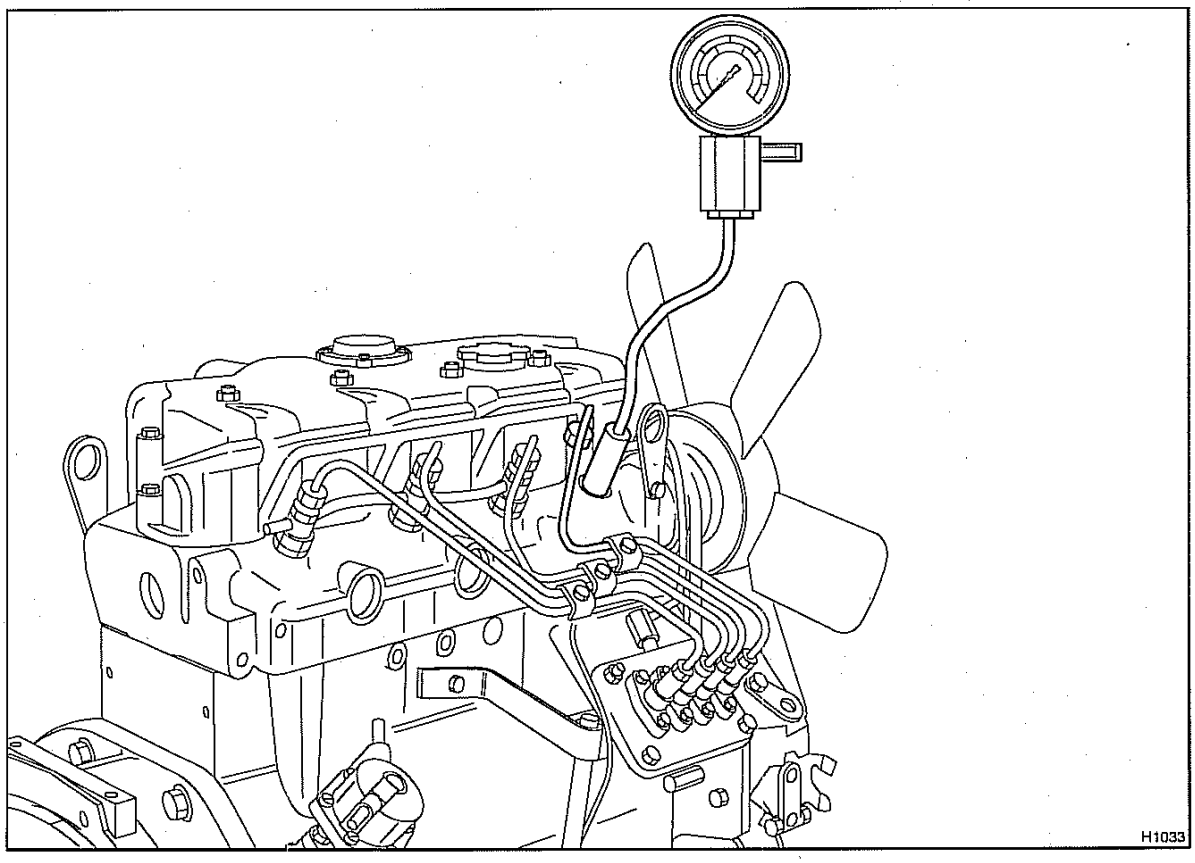
2 Remove the atomisers, see Operation 11-1.

3 Fit a suitable gauge into the atomiser hole of the cylinder to be tested.

4 Disconnect the stop solenoid or put the stop solenoid in the no fuel position. Operate the starter motor and record the pressure indicated on the gauge.

Caution: *Do not remove the stop solenoid as this will allow the engine to start.*

5 Repeat for each cylinder.



3

Cylinder head assembly

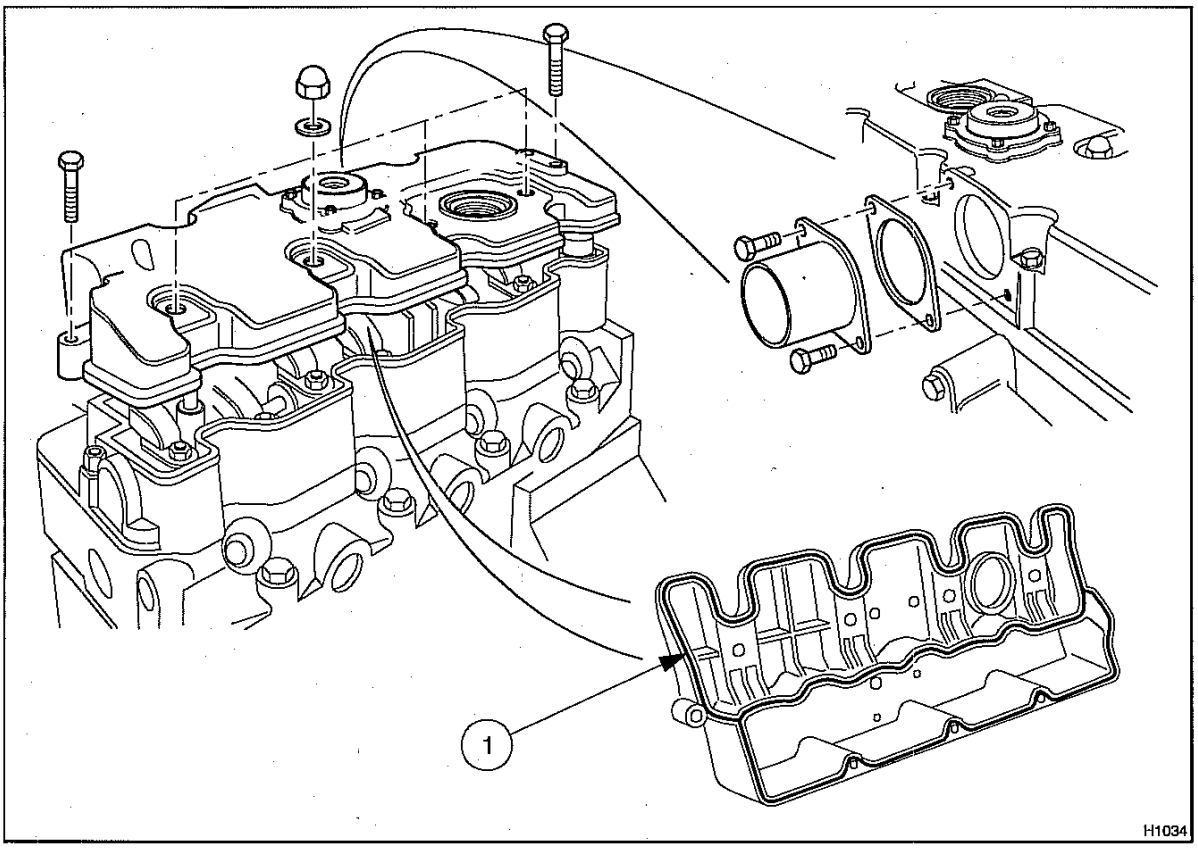
Rocker cover and inlet manifold

To remove and to fit **Operation 3-1**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Cap nut	11 (8.1) 1,1
	Setscrew	11 (8.1) 1,1
403C-15 404C-22 404C-22T	Cap nut	14 (10.3) 1,4
	Setscrew	14 (10.3) 1,4

Notes:

- An 'O' ring (1) is fitted in the groove in the rocker cover.
- Inspect the 'O' ring and renew if necessary.



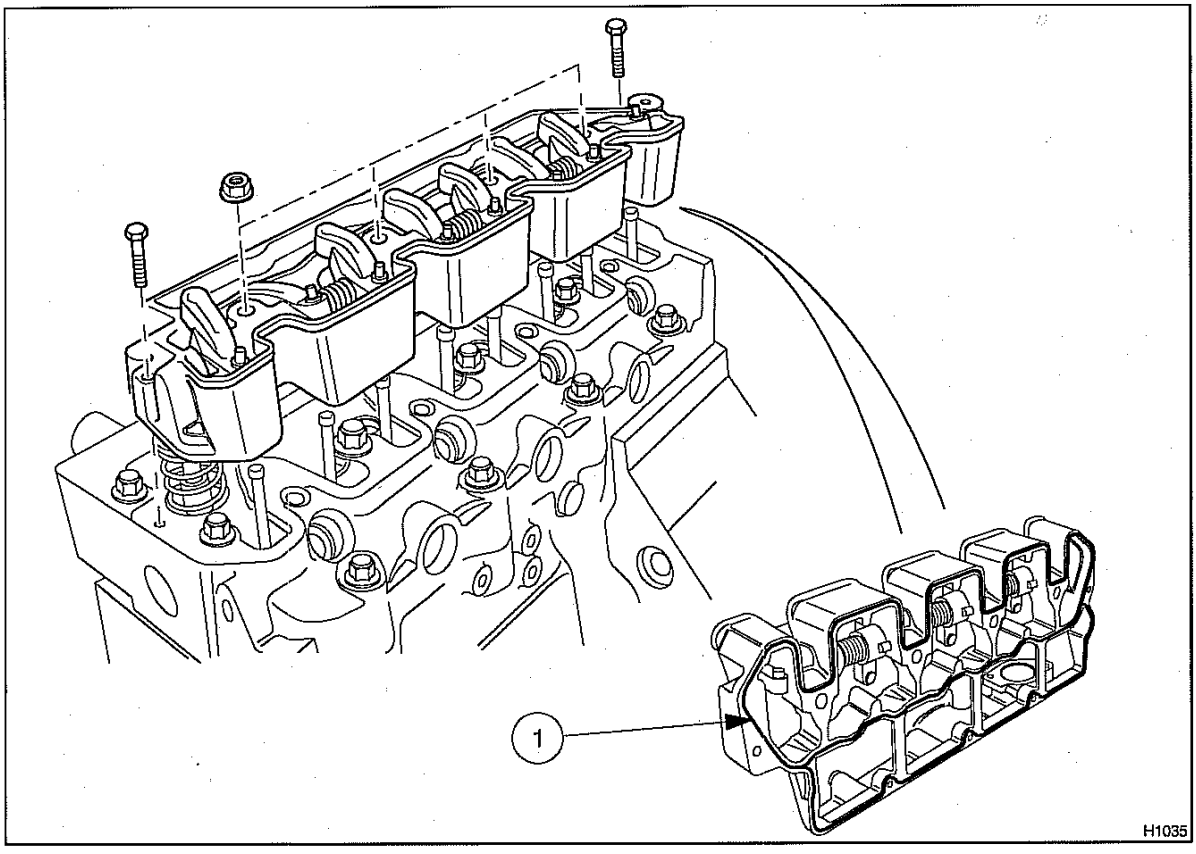
Rocker assembly

To remove and to fit **Operation 3-2**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Rocker assembly nuts	23 (17.0) 2,3
403C-15 404C-22 404C-22T	Rocker assembly nuts	33 (24.3) 3,3

Caution: *Ensure that the valve stem caps are on the valve stems and the pushrods are located in the rockers after assembly.*

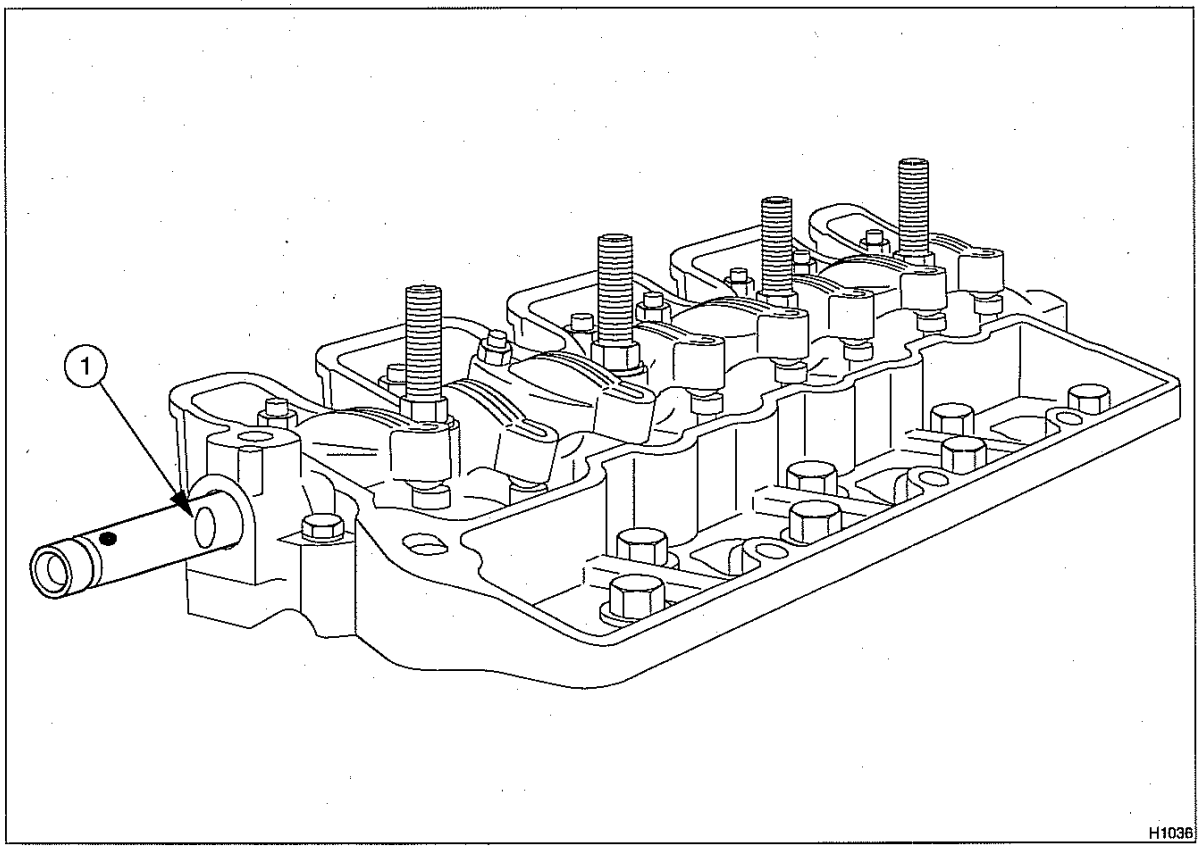
Note: An 'O' ring (1) is fitted in the groove in the rocker assembly.



Engine	Torque Nm (lbf ft) kgf m	
All models	Tappet adjustment nut	14 (10.3) 1,4

Use a suitable puller to extract the rocker shaft.

Note: Remember the position of the recess (1) for assembly.



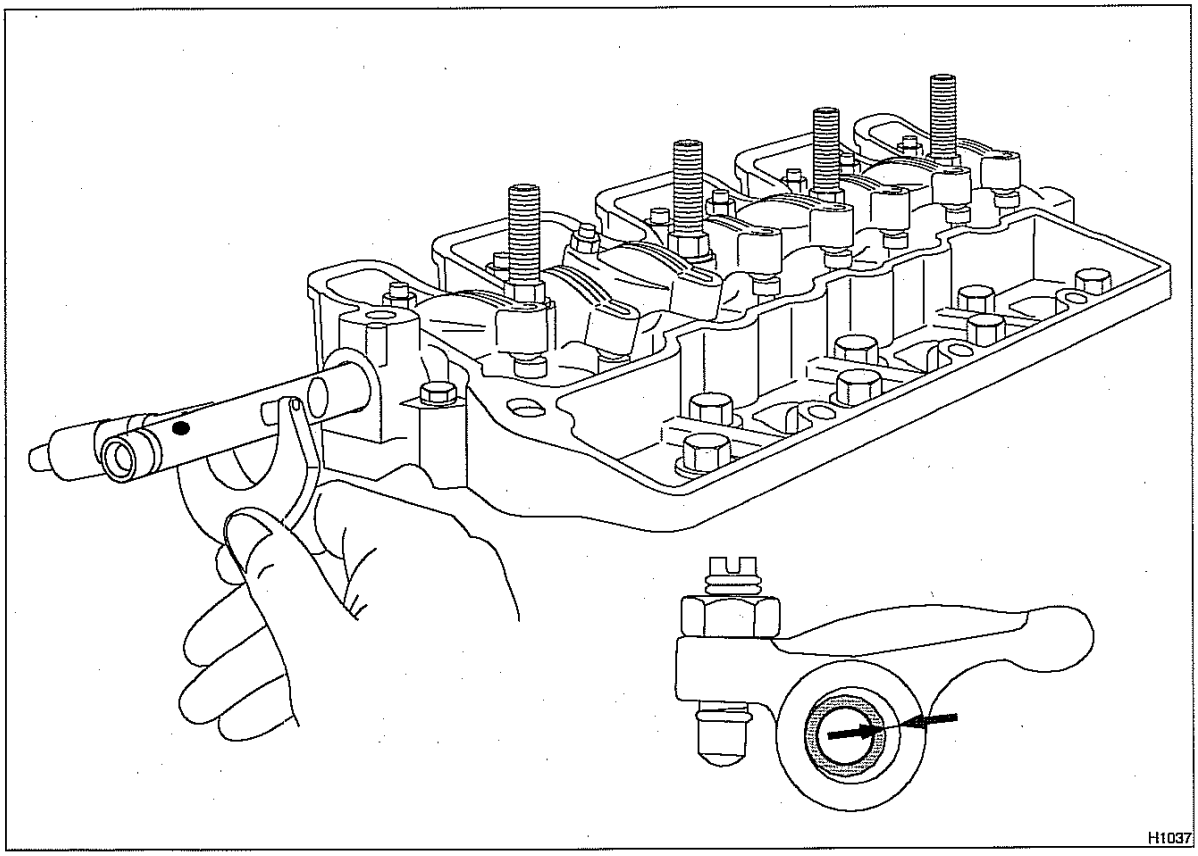
To inspect **Operation 3-4**

Rockershaft diameter

Engine	Diameter mm (in)	
	Standard	Service limit
403C-11 403C-15	11,65 - 11,67 (0.4587 - 0.4595)	11,57 (0.4555)
404C-22 404C-22T	14,95 - 14,97 (0.5886 - 0.5894)	14,87 (0.5854)

Rocker shaft to rocker lever clearance

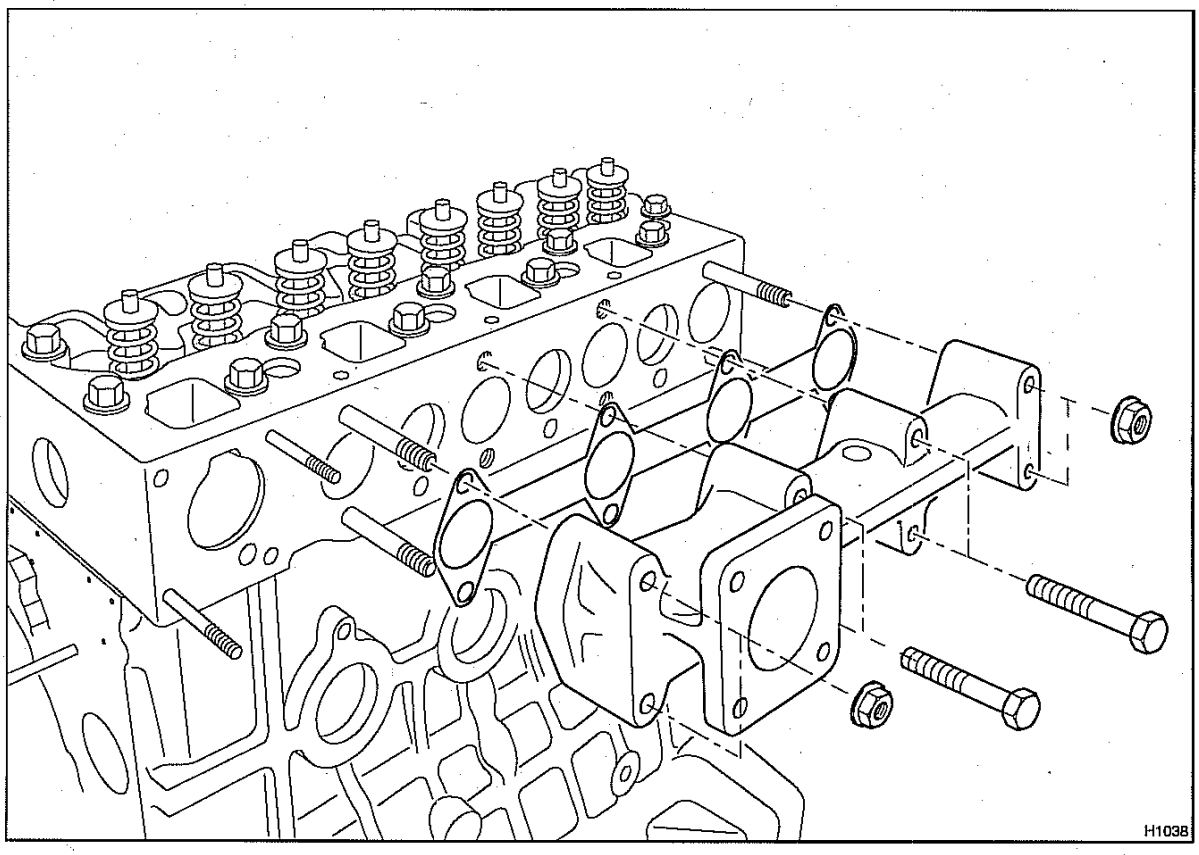
Engine	Clearance mm (in)	
	Standard	Service limit
403C-11 403C-15	0,032 - 0,068 (0.00126 - 0.00268)	0,2 (0.008)
404C-22 404C-22T	0,030 - 0,093 (0.00120 - 0.00366)	0,2 (0.008)



Exhaust manifold and gasket

To remove and to fit **Operation 3-5**

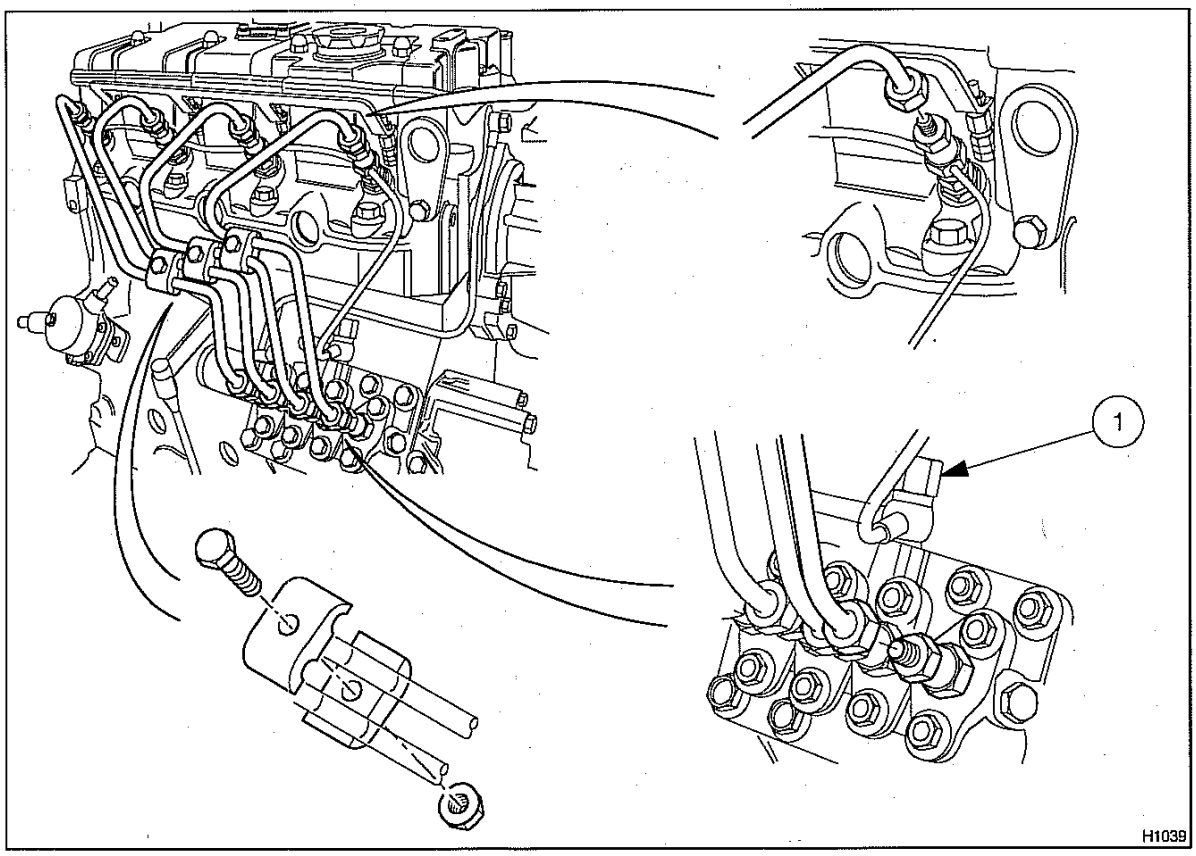
Engine	Torque Nm (lbf ft) kgf m	
403C-11	Setscrew	9,8 (7.2) 0,9
	Nuts	9,8 (7.2) 0,9
403C-15 404C-22 404C-22T	Setscrew	25 (18.4) 2,5
	Nuts	25 (18.4) 2,5



Fuel injection pipes / fuel return pipes

To remove and to fit **Operation 3-6**

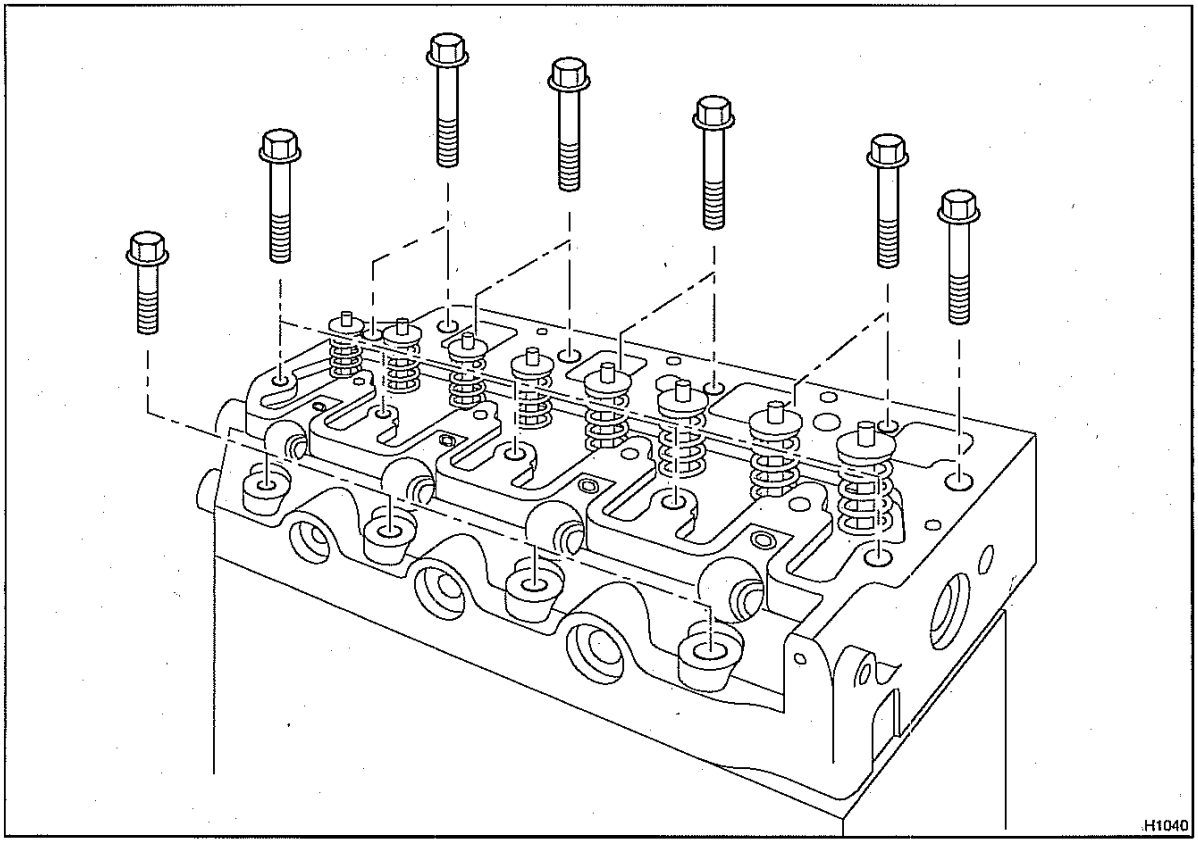
Engine	Torque Nm (lbf ft) kgf m	
All models	Fuel injection pipe	23 (16.9) 2,3
	Banjo bolt (1)	2,5 (3.2) 0,25



Cylinder head setscrews

To remove and to fit **Operation 3-7**

Note: If it is necessary to replace the cylinder head the fuel adjustment screw must not be altered from the original setting. The maximum no load speed must be checked after assembly.



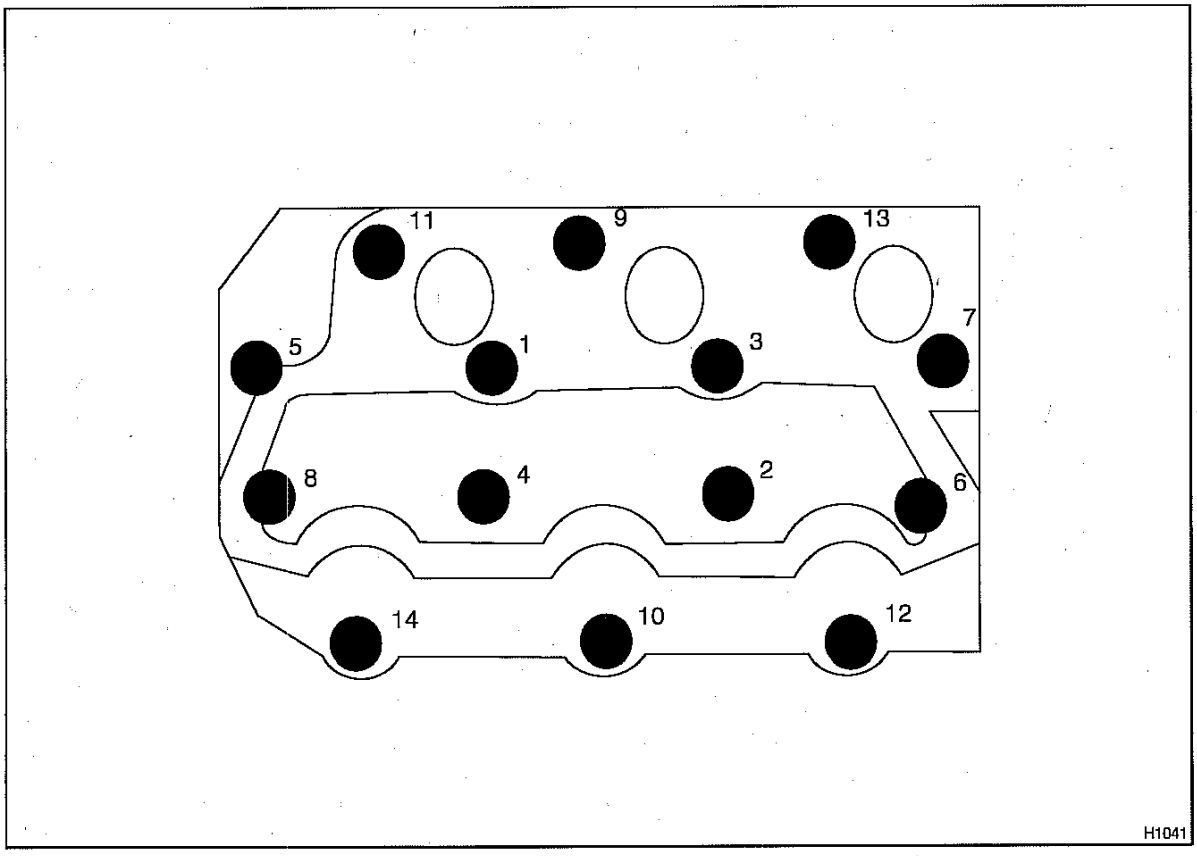
Cylinder head

Tightening sequence 403C-11 and 403C-15 — Operation 3-8

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Cylinder head setscrews	51 (37.6) 5,2
403C-15	Cylinder head setscrews	101 (74.5) 10,3

Notes:

- All torques should be checked again after tightening.
- On assembly lubricate cylinder head setscrews with clean oil.



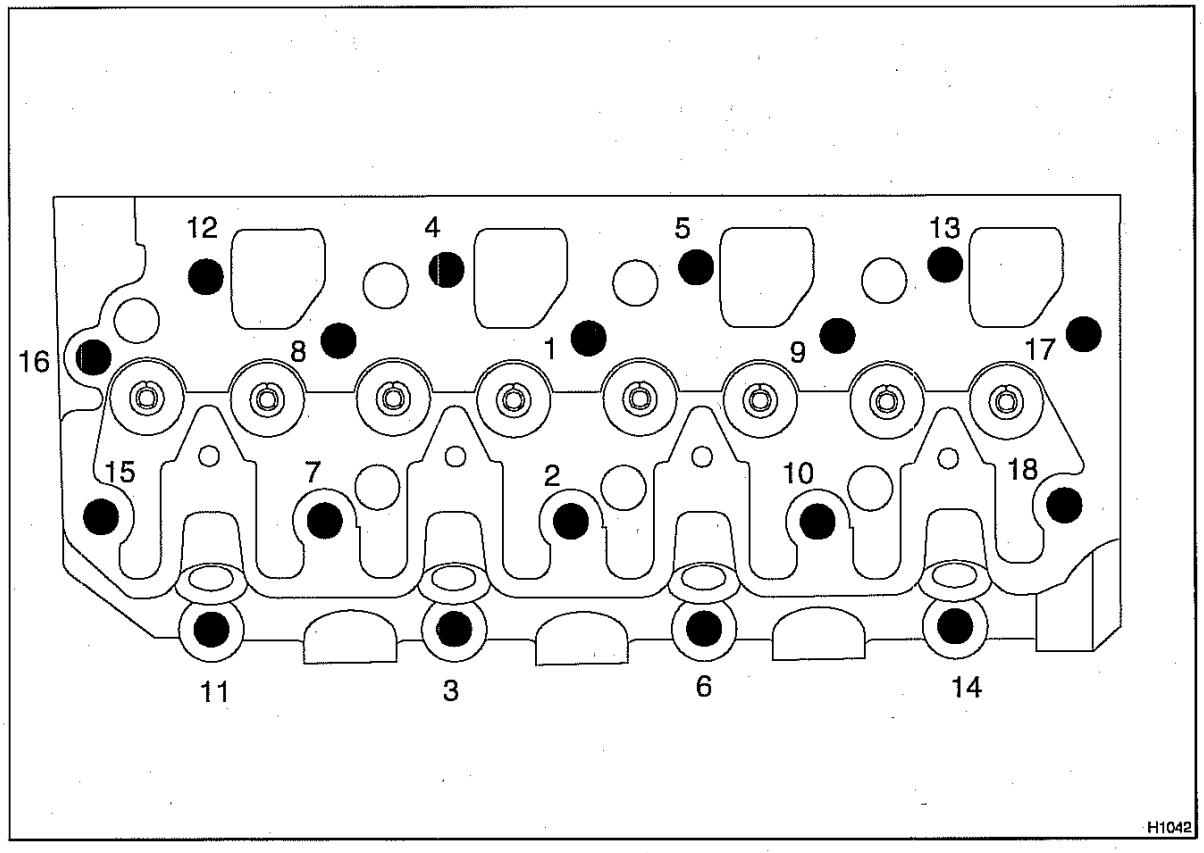
Tightening sequence 404C-22 and 404C-22T

Operation 3-9

Engine	Torque Nm (lbf ft) kgf m	
404C-22 404C-22T	Cylinder head setscrews	101 (74.5) 10,3

Notes:

- All torques should be checked again after tightening.
- On assembly lubricate cylinder head setscrews with clean oil.



Cylinder head gasket

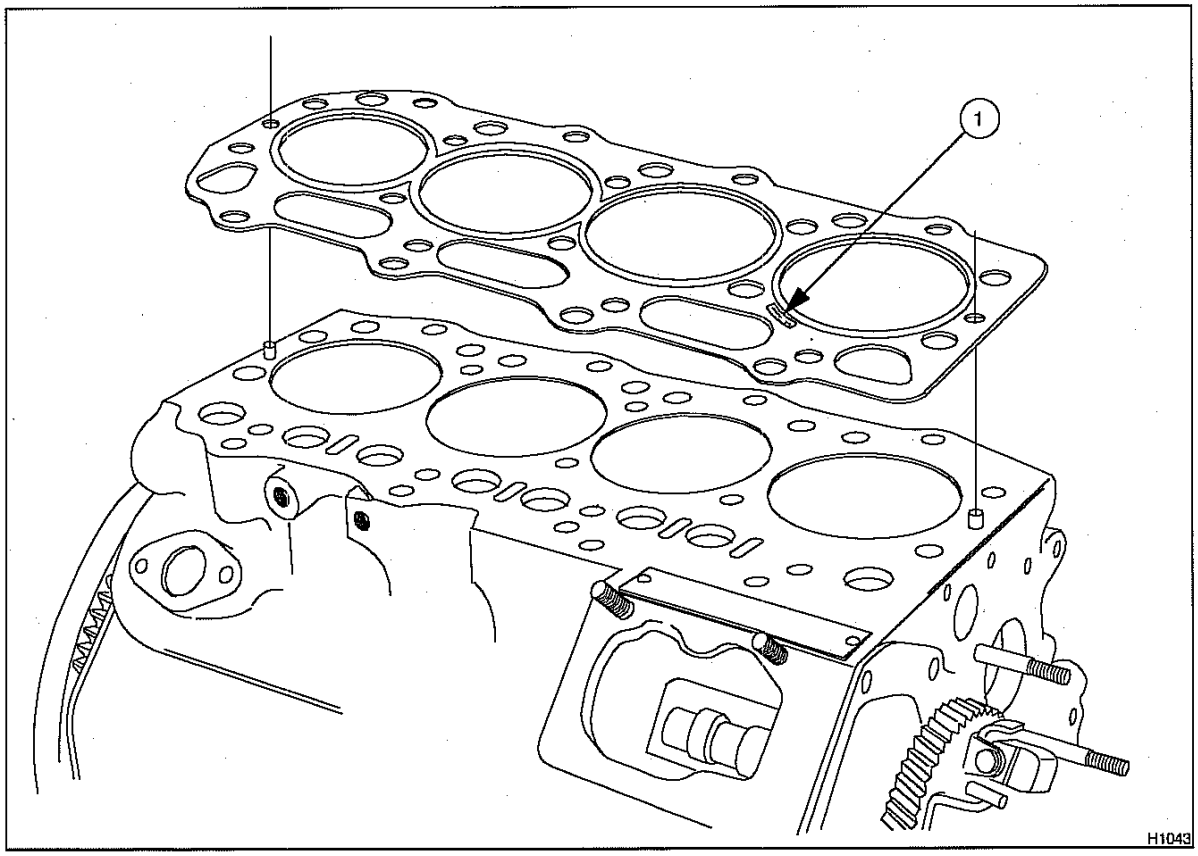
To remove and to fit — Operation 3-10

Align the gasket on the dowels in the cylinder block.

Cautions:

- *The gasket must only be fitted with the markings (1) facing up.*
- *When fitting a new gasket it must be replaced with a gasket of the same thickness as originally fitted. The gasket thickness can be identified by the part number that is stamped on the gasket.*
- *The correct piston height must be maintained to prevent damage to the pistons and valves and ensure that the engine conforms to emission legislation.*

Note: Always fit dry.



To select the correct thickness of cylinder head gasket — Operation 3-11

Caution: *If the correct piston height above or below the cylinder block is not obtained, damage to the engine can occur. The difference between the highest and the lowest piston height must not exceed 0.1 mm.*

1 Put the piston height tool (A) on the face of the **cylinder block** and rotate the gauge dial to the zero position.

2 Rotate the crankshaft until the piston crown is approximately at top dead centre (TDC).

3 Carefully put the tool over the top of the piston with the plunger of the gauge in contact with the piston above the axis of the gudgeon pin.

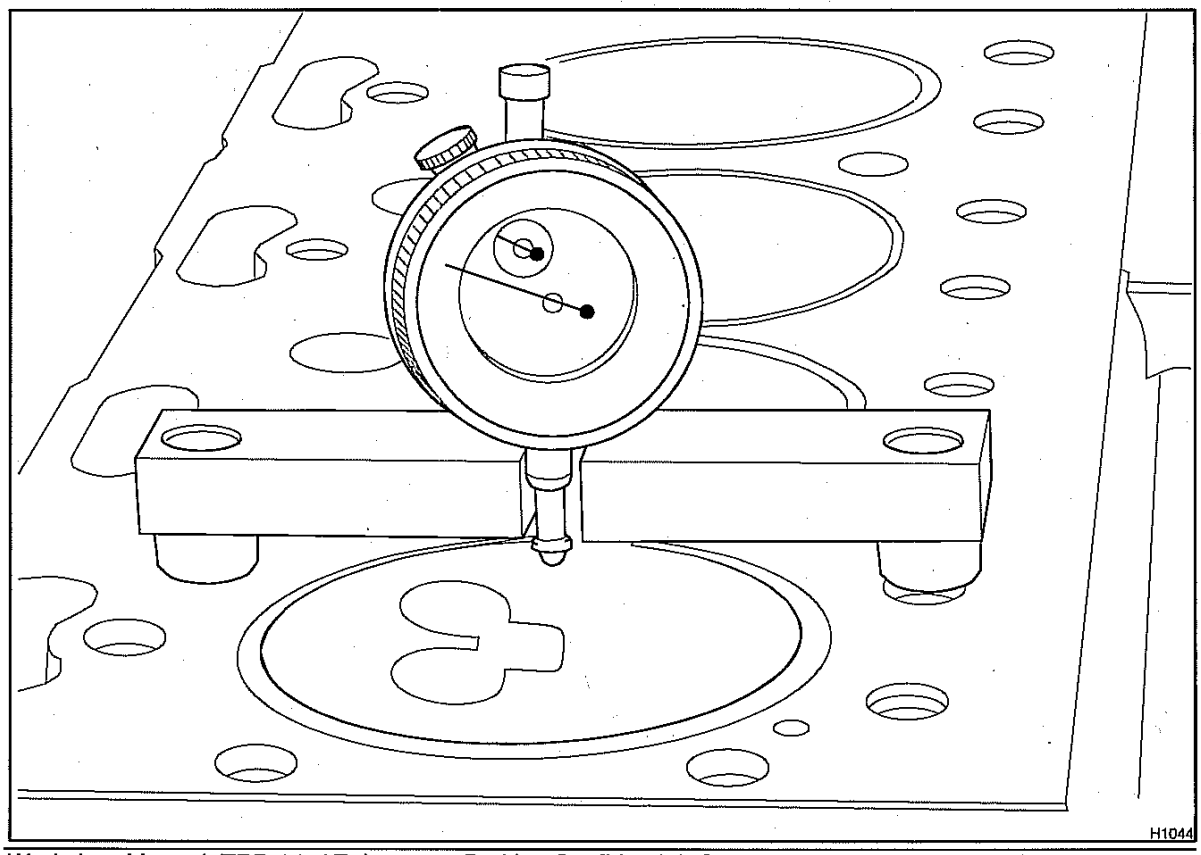
4 Rotate the crankshaft to ensure that the piston is at the highest position and make a note of the gauge indication.

Notes:

- If the cylinder block, crankshaft, connecting rods or pistons are changed the piston height will have to be checked and the correct thickness gasket used.
- If the original piston is used, ensure that it is assembled to the correct connecting rod and is used in the original cylinder.

Cylinder head gasket selection

Engine	Protrusion above cylinder block top face	Gasket thickness
403C-11	0,55 to 0,64	1,2 mm
	0,65 to 0,75	1,3 mm
403C-15	0,60 to 0,69	1,3 mm
	0,70 to 0,79	1,4 mm
Engine	**Protrusion below cylinder block top face**	**Gasket thickness**
404C-22 404C-22T	-0,45 to -0,30	0,4 mm
	-0,29 to -0,20	0,5 mm



Valve and valve spring

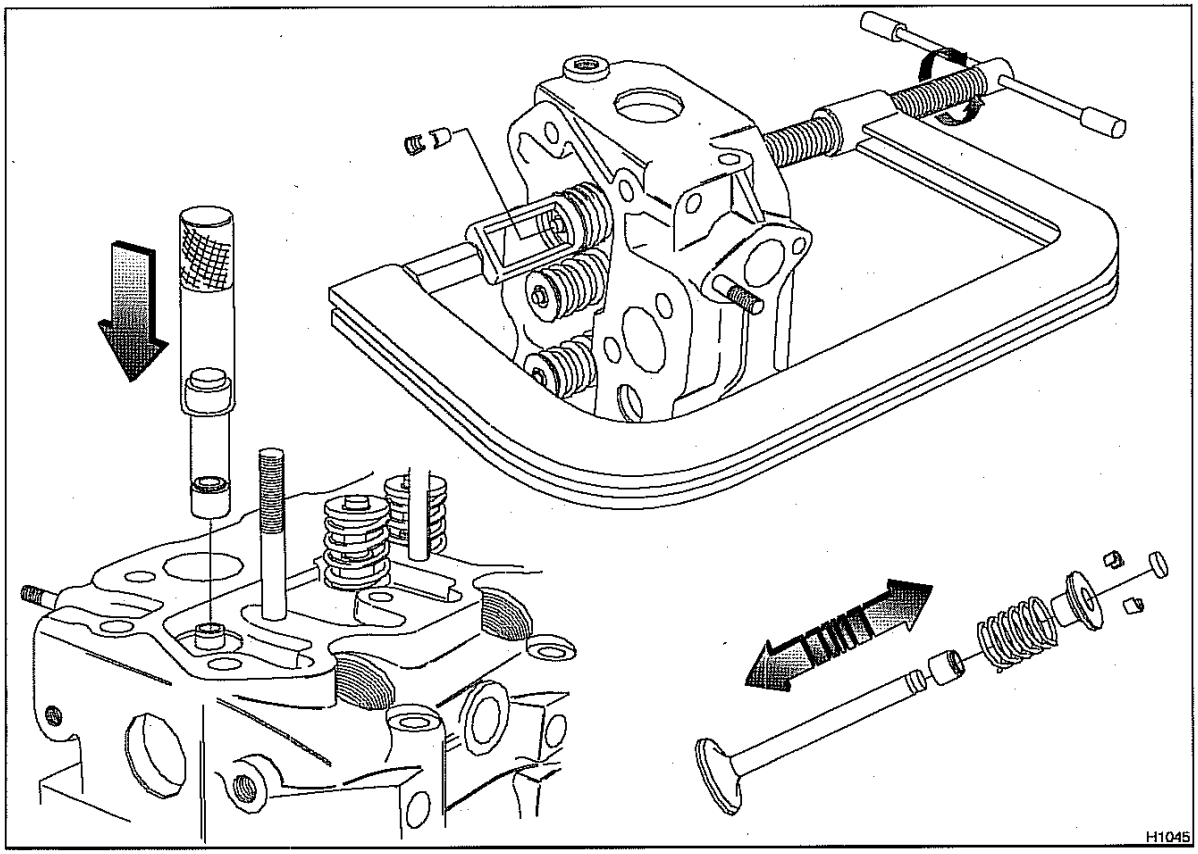
To remove and to fit **Operation 3-12**

Special tools	
Description	**Part number**
Valve spring remover	21825663
Valve stem seal replacer	21825623

Notes:

- The oil seal for the inlet valve stem is identified by a silver garter spring.
- The oil seal for the exhaust valve stem is identified by a black garter spring (not shown) with the letters "EX" on the garter.

Warning! *Safety glasses must be worn for this operation.*



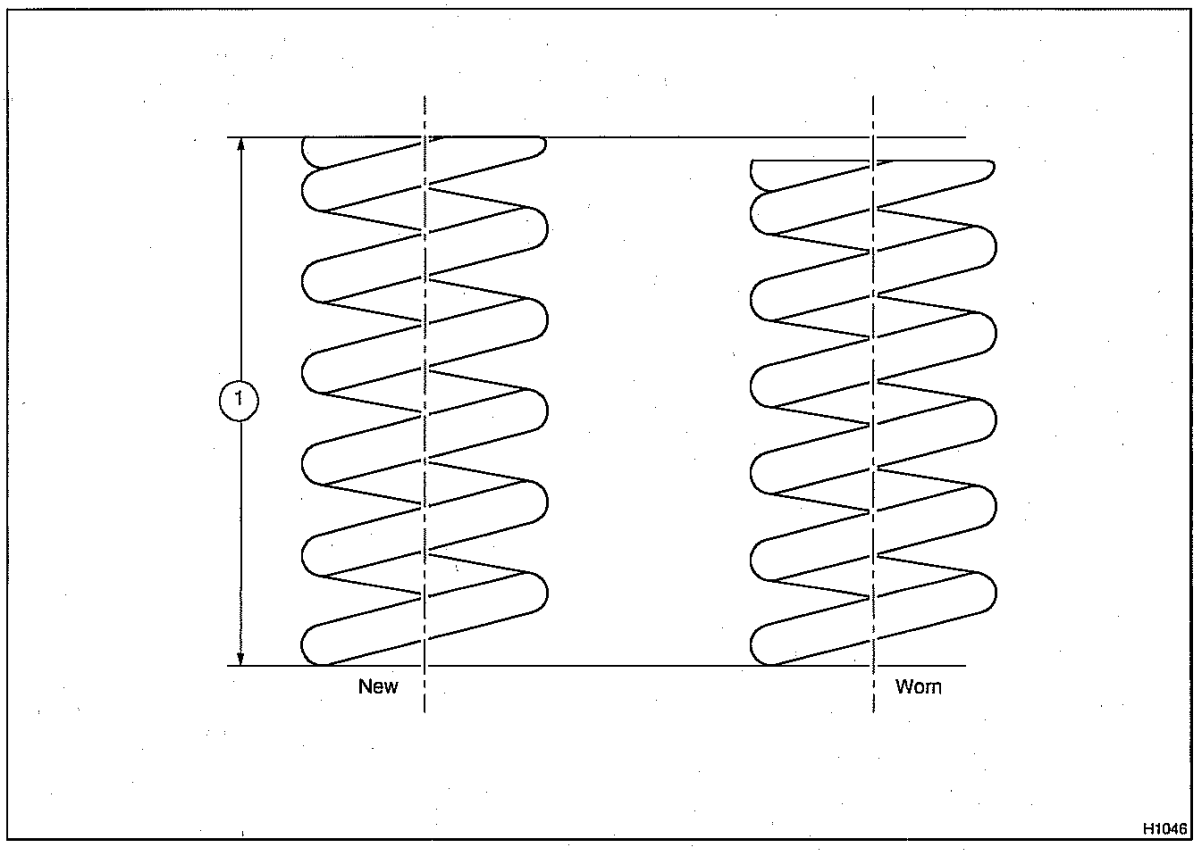
To inspect - valve spring — Operation 3-13

Visually inspect the valve spring for damage.

Use a spring tester to check spring force and free length. Renew the spring if it is outside the service limit.

Engine	Free length (1) mm (in)	
	Standard	Service limit
All models	35,0 (1.378)	33,5 (1.319)

Engine	Spring rate when compressed to 30,4 mm (1.197 in) N (lbf) kgf	
	Standard	Service limit
All models	79 (17.8) 8,1	68,6 (15.4) 7,0



To inspect - valve stem and thickness of valve head — Operation 3-14

Use a micrometer to check the valve stem diameters at positions 1, 2 and 3, if less than the service limit, renew.

Check the valve stem for wear or damage, if outside the service limit, renew.

Inlet valve

Engine	Diameter mm (in)	
	Standard	Service limit
All models	6,955 - 6,970 (0.27382 - 0.27441)	6,89 (0.271)

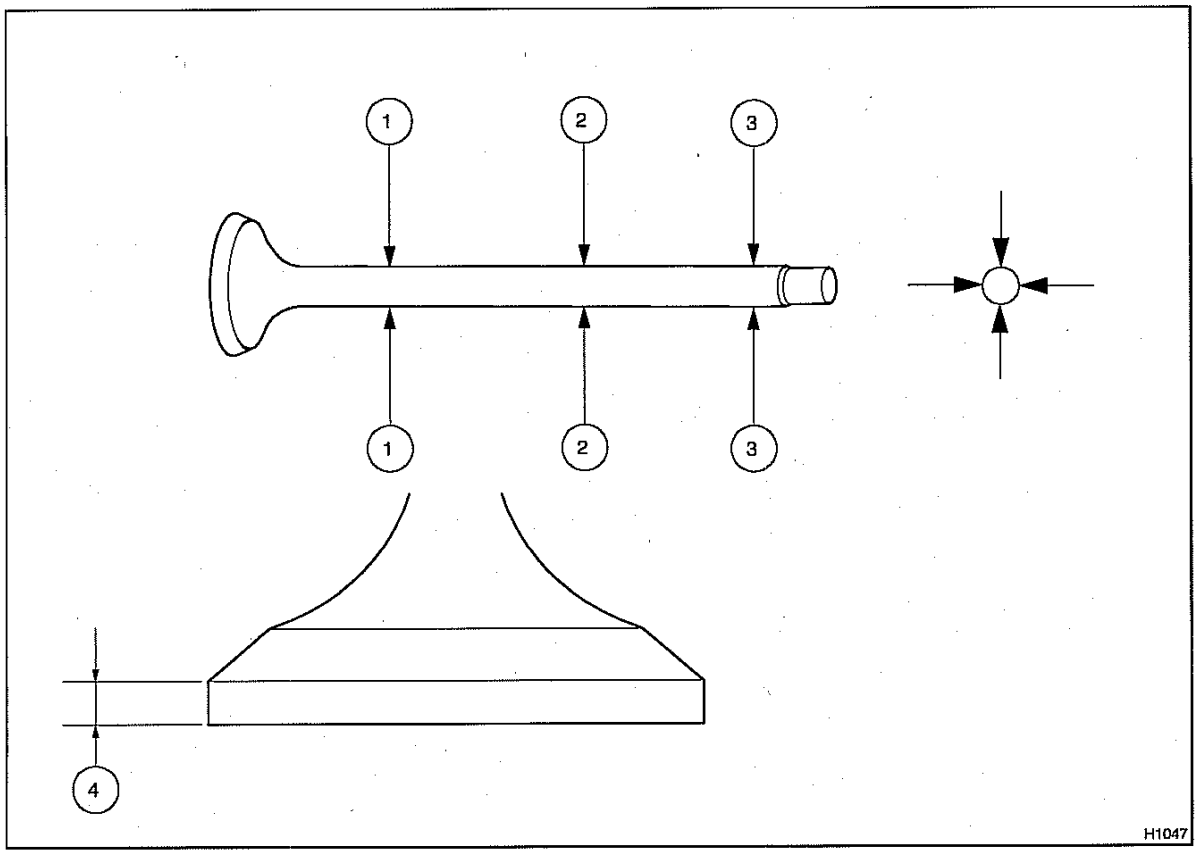
Exhaust valve

Engine	Diameter mm (in)	
	Standard	Service limit
All models	6,940 - 6,950 (0.27323 - 0.27362)	6,84 (0.269)

Valve head thickness

Engine	Thickness mm (in)	
	Standard	Service limit
All models	0,925 - 1,075 (0.03642 - 0.04232)	0,5 (0.020)

If the valve head thickness (4) is less than the service limit, renew the valve.



Cylinder head to valve stem clearance

To inspect **Operation 3-15**

Check the clearance (3) between the valve stem and the cylinder head. If the clearance is greater than the service limit, the valves must be checked for wear, see Operation 3-14, If the valves are within service limits, renew the cylinder head.

1 Put a new valve in the valve guide.

2 Put a dial test indicator with a magnetic base (1) onto the face of the cylinder head.

3 With the valve lifted 15,0 mm (0.6 in) and the gauge (2) in contact with the edge of the valve head, move the valve radially away from the gauge. With the head in this position, set the gauge to '0'.

4 Move the valve radially across the axis of the cylinder head towards the gauge. Make a note of the reading on the gauge if the reading is greater than the service limit, renew the cylinder head.

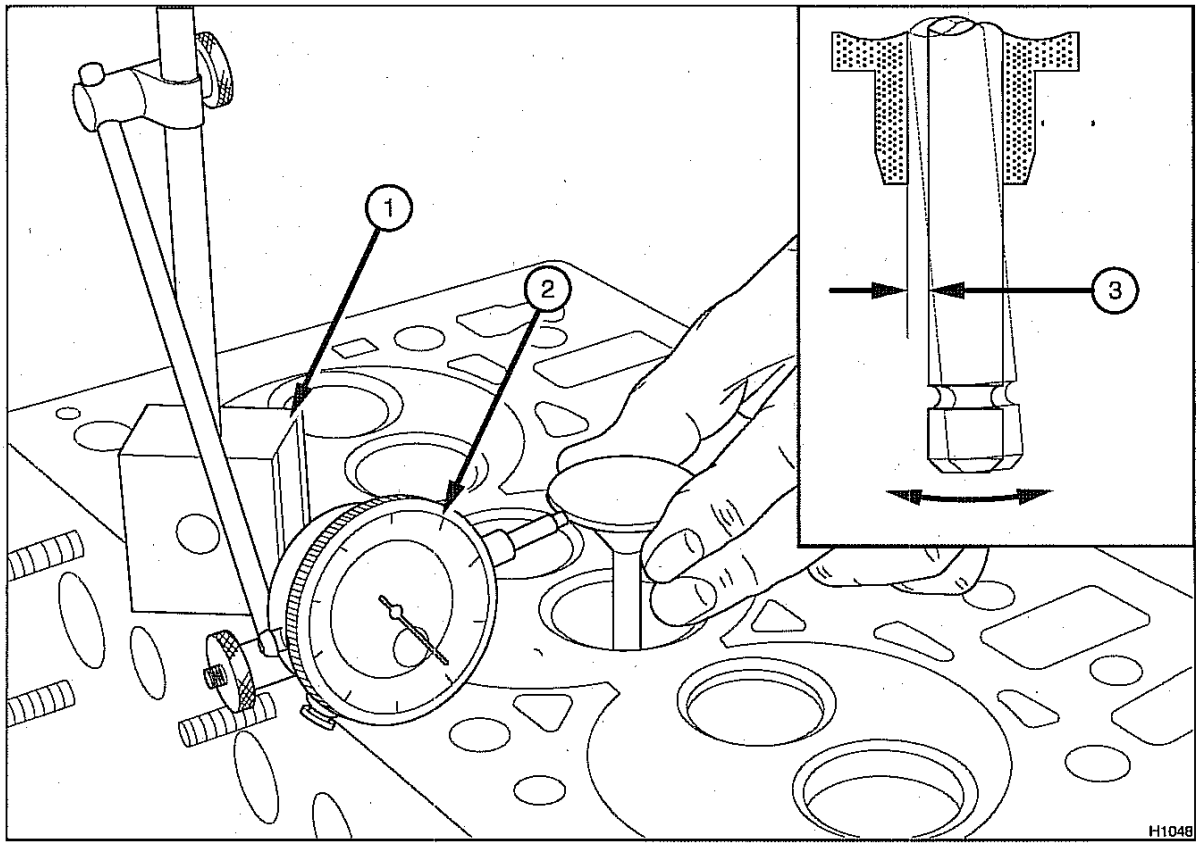
Maximum permissible clearances with a valve lift of 15 mm (0.6 in).

Inlet valve

Engine	Clearance mm (in) standard	Service limit
403C-11	0,025 - 0,052 (0.0010 - 0.0020)	0,2 (0.008)
403C-15, 404C-22 and 404C-22T	0,030 - 0,060 (0.0012 - 0.0024)	0,2 (0.008)

Exhaust valve

Engine	Clearance mm (in) standard	Service limit
403C-11	0,045 - 0,072 (0.0020 - 0.0030)	0,25 (0.010)
403C-15, 404C-22 and 404C-22T	0,050 - 0,075 (0.0020 - 0.0030)	0,25 (0.010)



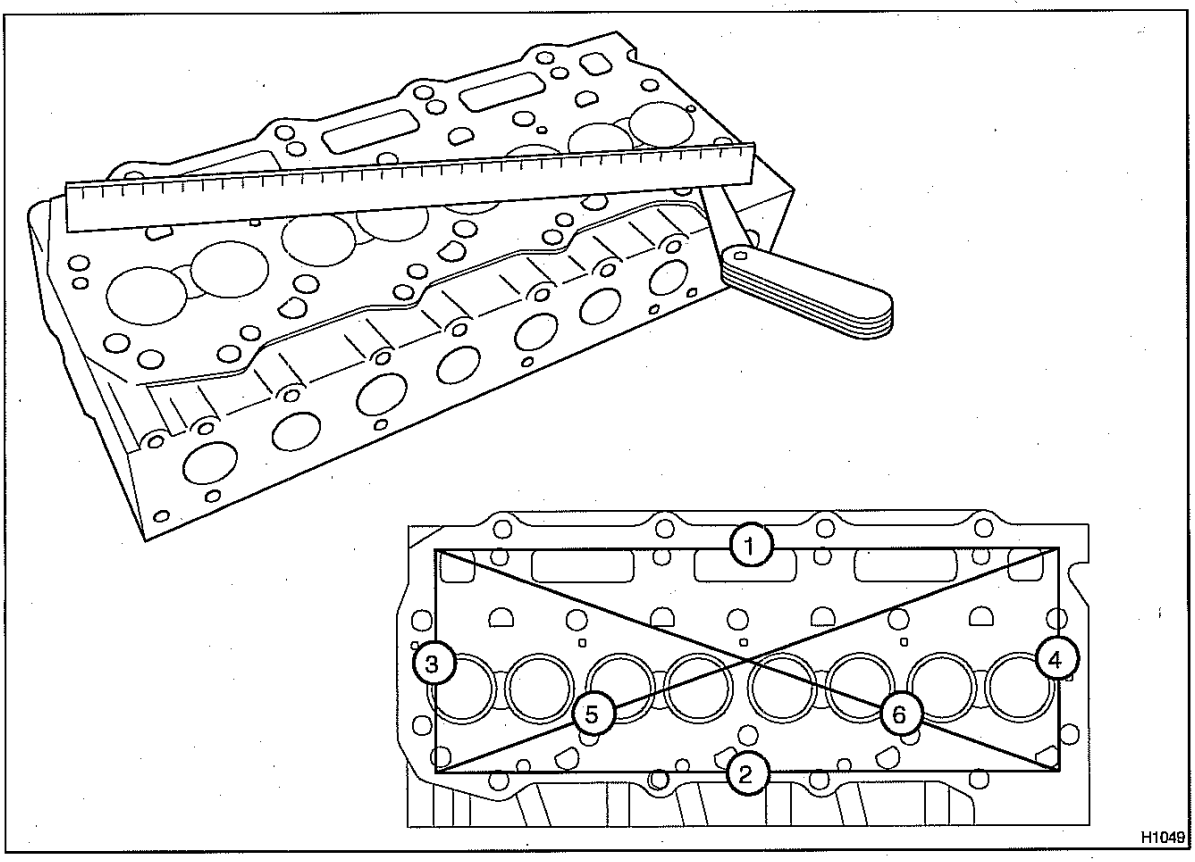
Cylinder head

To inspect **Operation 3-16**

Maximum regrind limit mm (in)		
Distortion	**Maximum service limit**	**Maximum regrind**
0,05 (0.002) or less	0,12 (0.005)	0,15 (0.006)

Use a straight edge and feeler gauge to check the six positions for distortion.

Caution: *Do not grind beyond the maximum limit.*



Valve seat width

To inspect and to correct **Operation 3-17**

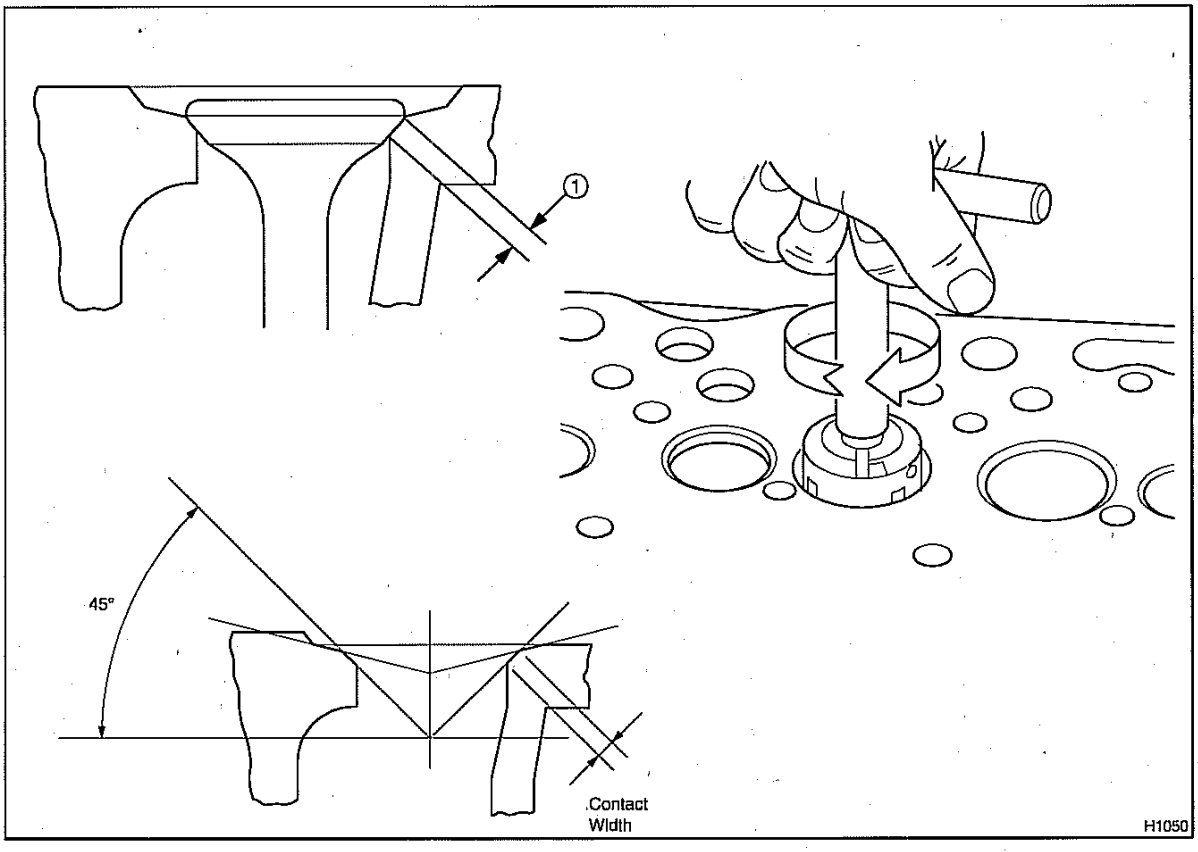
Special tools	
Description	**Part number**
Valve seat cutter	27610030

Engine	Inlet valve		Exhaust valve	
	Clearance mm (in)		Clearance mm (in)	
	Standard	Service limit	Standard	Service limit
403C-11	1,70 - 2,10 (0.0670 - 0.0830)	2,5 (0.098)	1,70 - 2,10 (0.0670 - 0.0830)	2,5 (0.098)
403C-15	1,66 - 1,87 (0.0653 - 0.0736)	2,5 (0.098)	1,66 - 1,73 (0.0653 - 0.0681)	2,5 (0.098)
404C-22 404C-22T	1,50 - 2,00 (0.0591 - 0.0790)	2,5 (0.098)	1,94 - 2,16 (0.0764 - 0.0850)	2,5 (0.098)

If the contact face (1) of the valve seat is more than the service limit, check the valve stem for wear, see Operation 3-14 and the cylinder head to valve stem clearance, see Operation 3-15. If greater than the service limit, use a seat cutter of 45° to correct the seat.

If the valve stem clearance exceeds the service limit, renew the valve.

If the bore in the cylinder head for the valves is worn, replace the cylinder head. If the valve seat in the cylinder head is damaged or worn, cut a new seat if the valve depth will remain within tolerance.



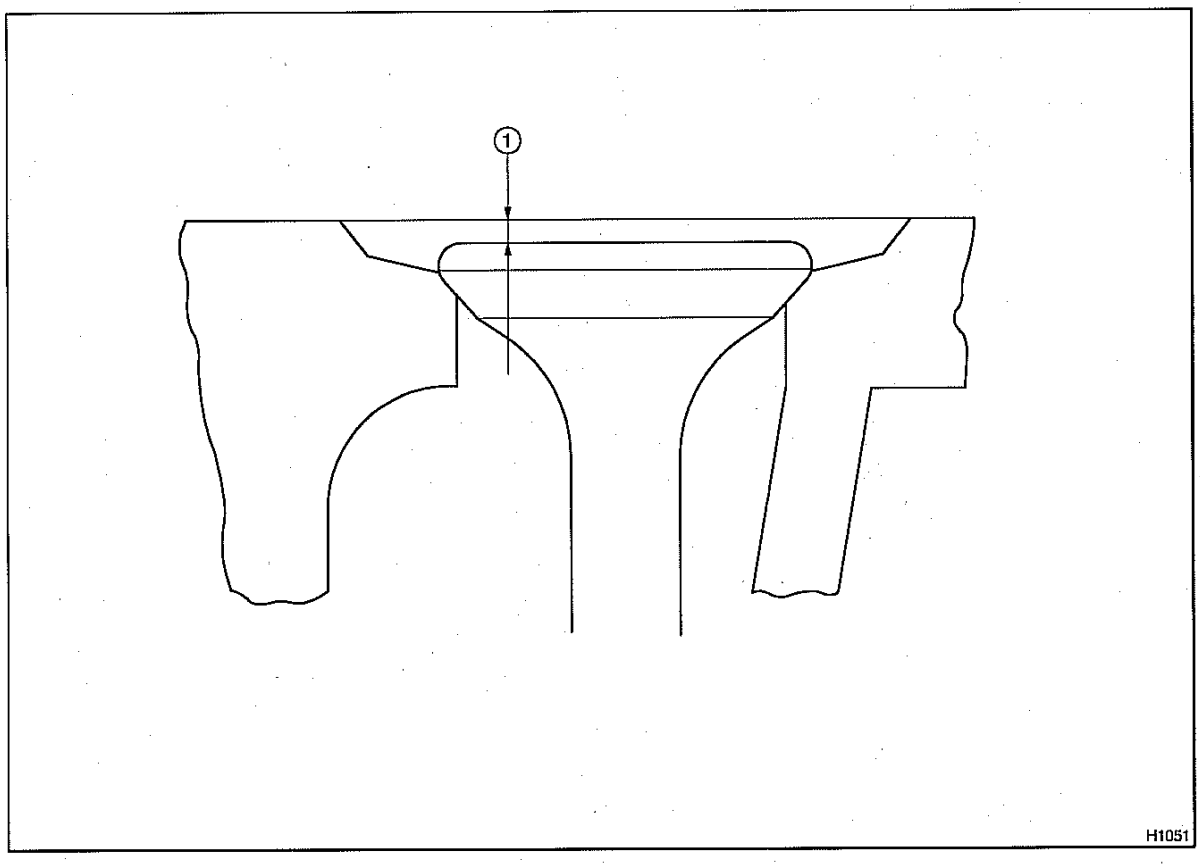
Valve depth

To check **Operation 3-18**

If the valve depth (1) is greater than the service limit, use a new valve to check the valve depth.

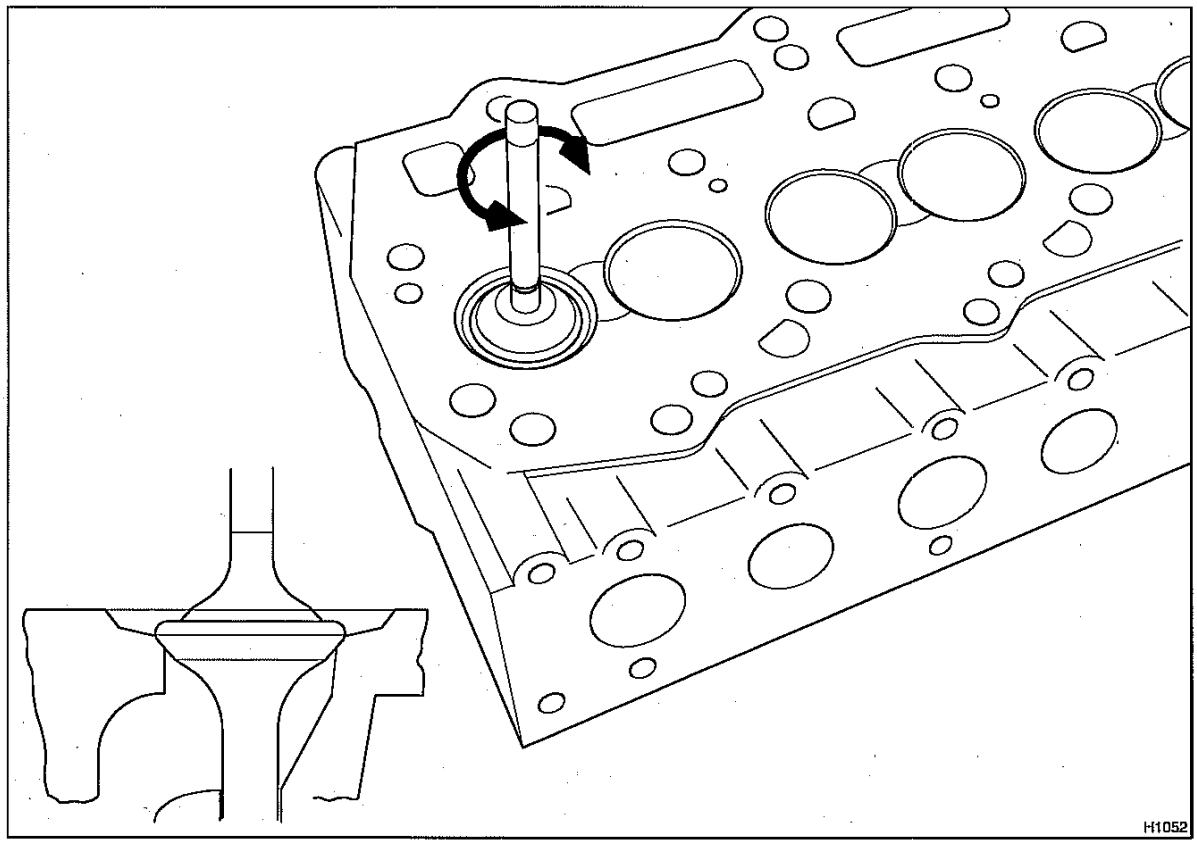
If the depth still exceeds the service limit, renew the cylinder head. If the depth is within the service limit renew the valves.

Engine	Depth mm (in)		
	Inlet standard	Exhaust standard	Service limit
403C-11	0,65 - 0,95 (0.0256 - 0.0374)	0,85 - 1,15 (0.0335 - 0.0453)	1,8 (0.071)
403C-15	0,85 - 1,15 (0.0335 - 0.0453)	0,85 - 1,15 (0.0335 - 0.0453)	1,8 (0.071)
404C-22 404C-22T	0,65 - 0,95 (0.0256 - 0.0374)	0,65 - 0,95 (0.0256 - 0.0374)	1,8 (0.071)



To lap the contact face of the valve seat — Operation 3-19

Use the valve seat cutter to obtain the correct seat contact width and seat recess on a new cylinder head, use a valve lapping tool and lapping compound to finish.



Valve tip clearance

To check and to adjust **Operation 3-20**

The valve adjustment sequence is viewed from the front of the engine.

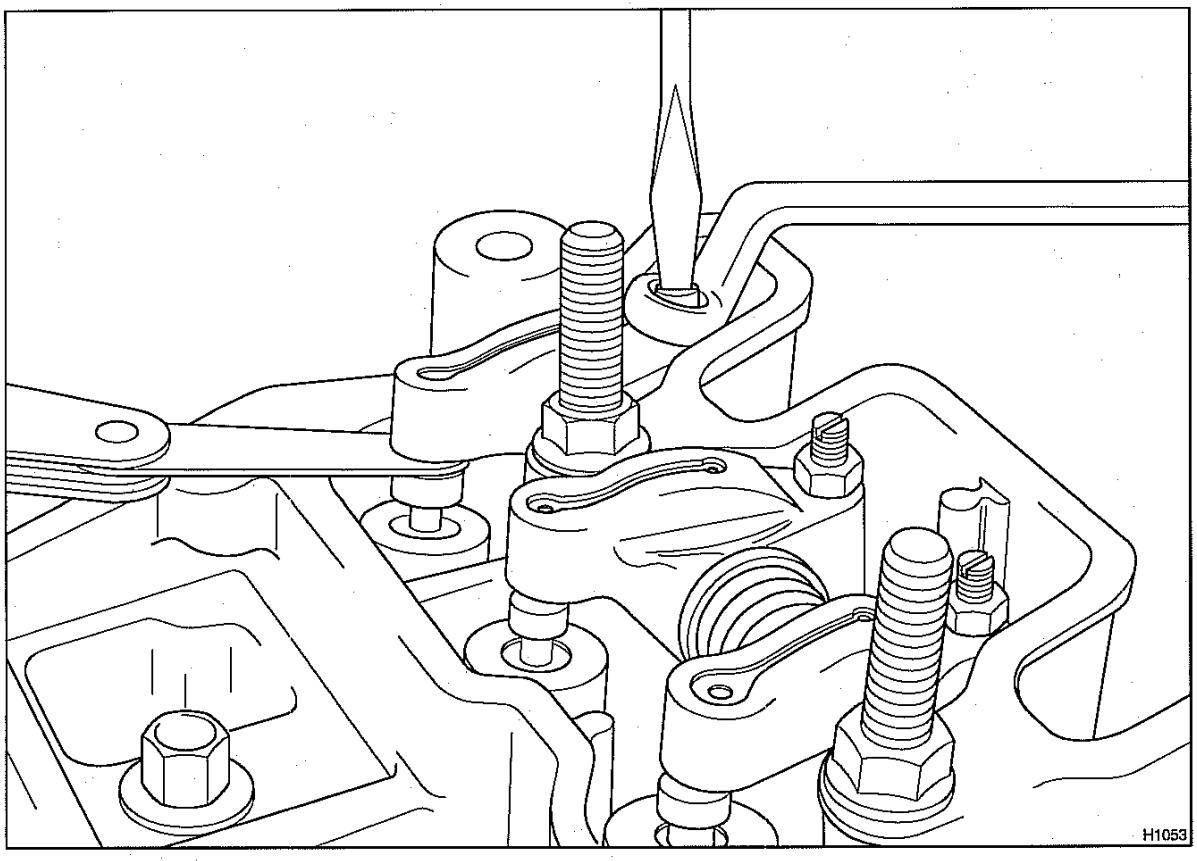
Rotate the crankshaft clockwise when viewed from the front.

Caution: *Only adjust the valve clearances when the engine is cold.*

Engine	Valve overlap	Adjust valves
403C-11 403C-15	No. 1 Cylinder	3 and 6
	No. 2 Cylinder	2 and 5
	No. 3 Cylinder	1 and 4
404C-22 404C-22T	No. 4 Cylinder	1 and 2
	No. 2 Cylinder	5 and 6
	No. 1 Cylinder	7 and 8
	No. 3 Cylinder	3 and 4

Valve tip clearance (cold)	
Inlet	0,2 mm (0.0078 in)
Exhaust	0,2 mm (0.0078 in)

Torque Nm (lbf ft) kgf m	
Tappet adjustment nut	14 (10.3) 1,4



4

Piston and connecting rod assemblies

Big end bearing and cap

To remove and to fit **Operation 4-1**

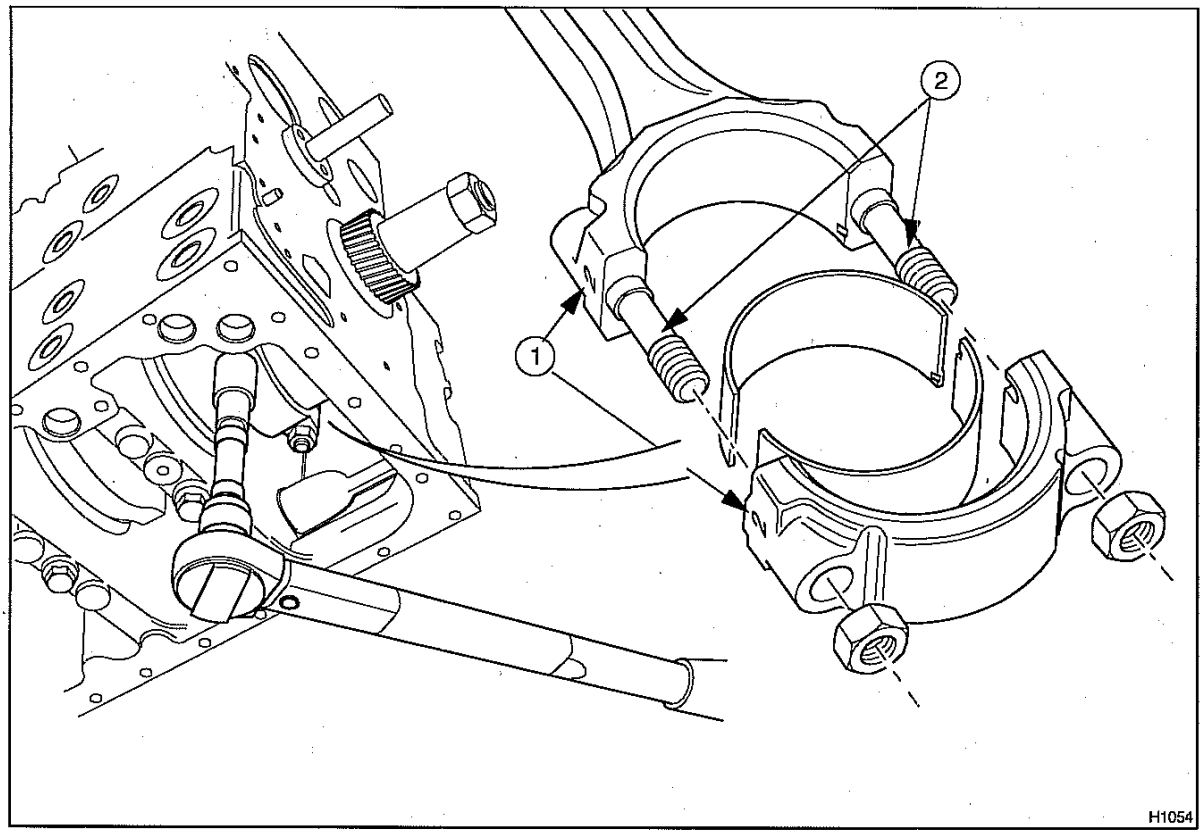
Engine	Torque Nm (lbf ft) kgf m	
403C-11	Nut	32 (23.6) 3,3
403C-15, 404C-22 and 404C-22T	Nut	52 (38.3) 5,2

Standard clearance	Service limit
0,1 - 0,3 mm (0.004 - 0.012 in)	0,7 mm (0.276 in)

Caution: *Ensure that the connecting rod bolts (2) do not damage the crankshaft when the connecting rod is removed or fitted.*

Notes:

- The connecting rods and caps are numbered matched pairs and must be kept together when removed from the engine. The numbers (1) must be aligned when assembled.
- The piston and connecting rods are matched to a cylinder, record the position of each connecting rod and piston for correct assembly. After the connecting rods are fitted check for axial movement.
- The fuel adjustment screw must not be altered from the original setting. The maximum no load speed must be checked after assembly.

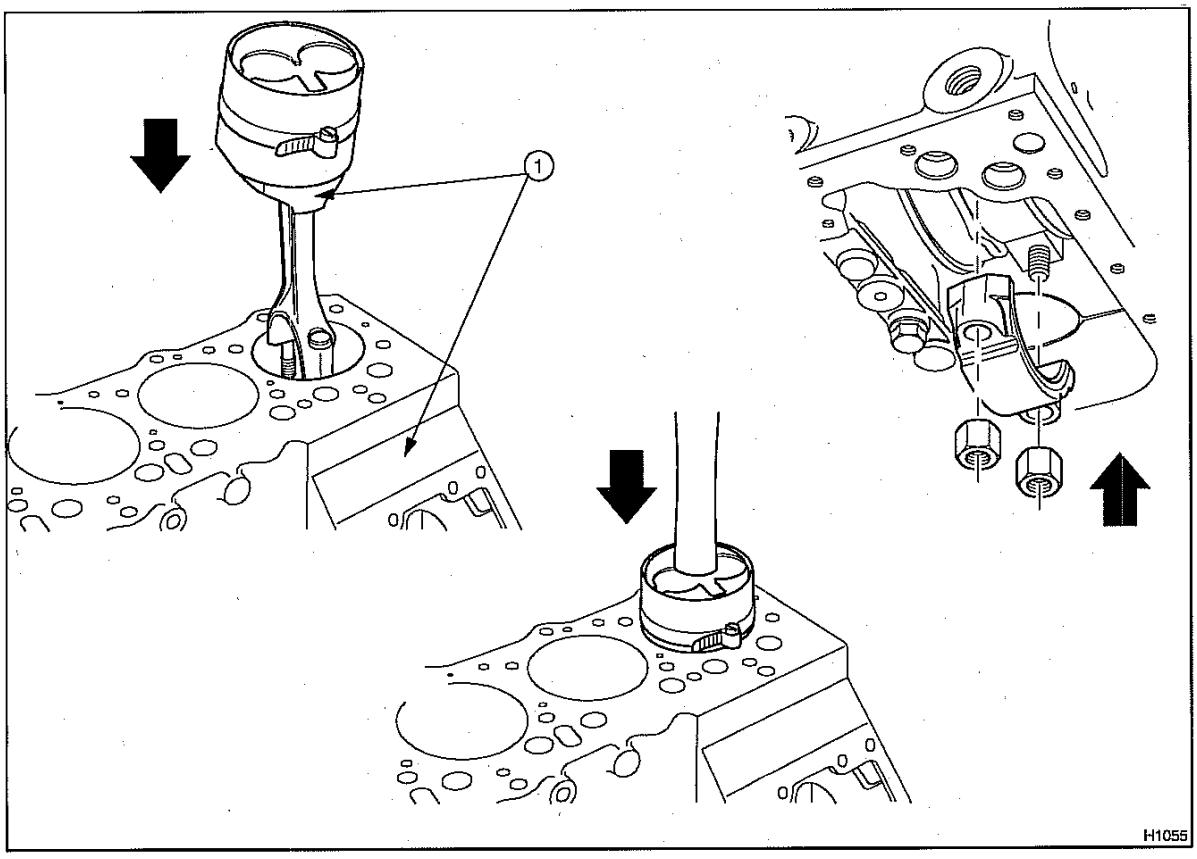


Piston and connecting rod

To remove and to fit — Operation 4-2

The Shibaura name on the inside of the piston must be facing the fuel pump on assembly.

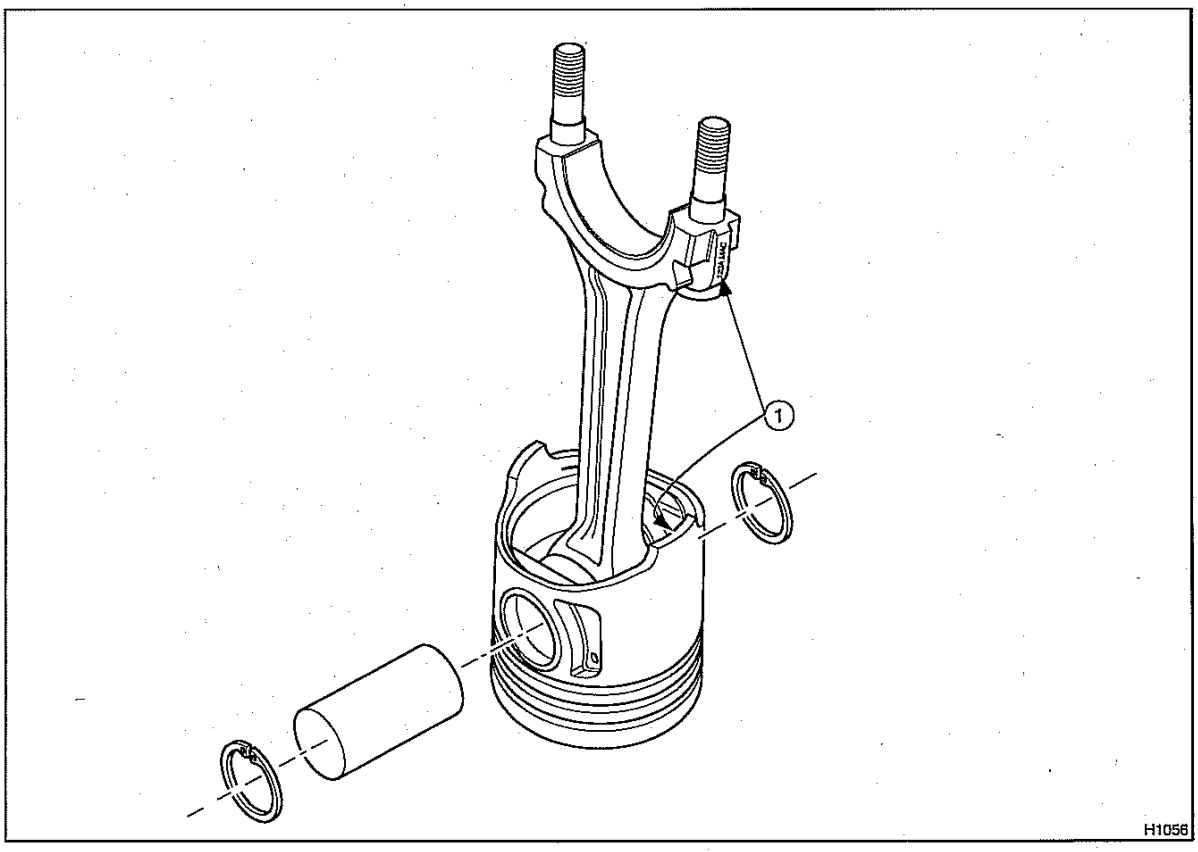
To assemble the connecting rod assembly, see page 35.



To dismantle and to assemble — Operation 4-3

The Shibaura (1) name (inside of the piston) must be aligned with the stamped number on the connecting rod (1).

The numbers stamped on the connecting rods and caps must be the same and aligned.



Piston rings

To fit — Operation 4-4

Any letters or markings on the surface of the ring will always be positioned on the top face (facing upwards). Use a suitable piston ring expander to fit the piston rings.

1 Fit the spring of the oil control ring (6) in the bottom groove of the piston with the latch pin (1) inside both ends of the spring. Fit the oil control ring (4) over the spring (6). Ensure that the ring gap is at 180° to the latch pin.

2 Fit the second ring (3) with the taper face into the second groove, with the word "TOP" towards the top of the piston.

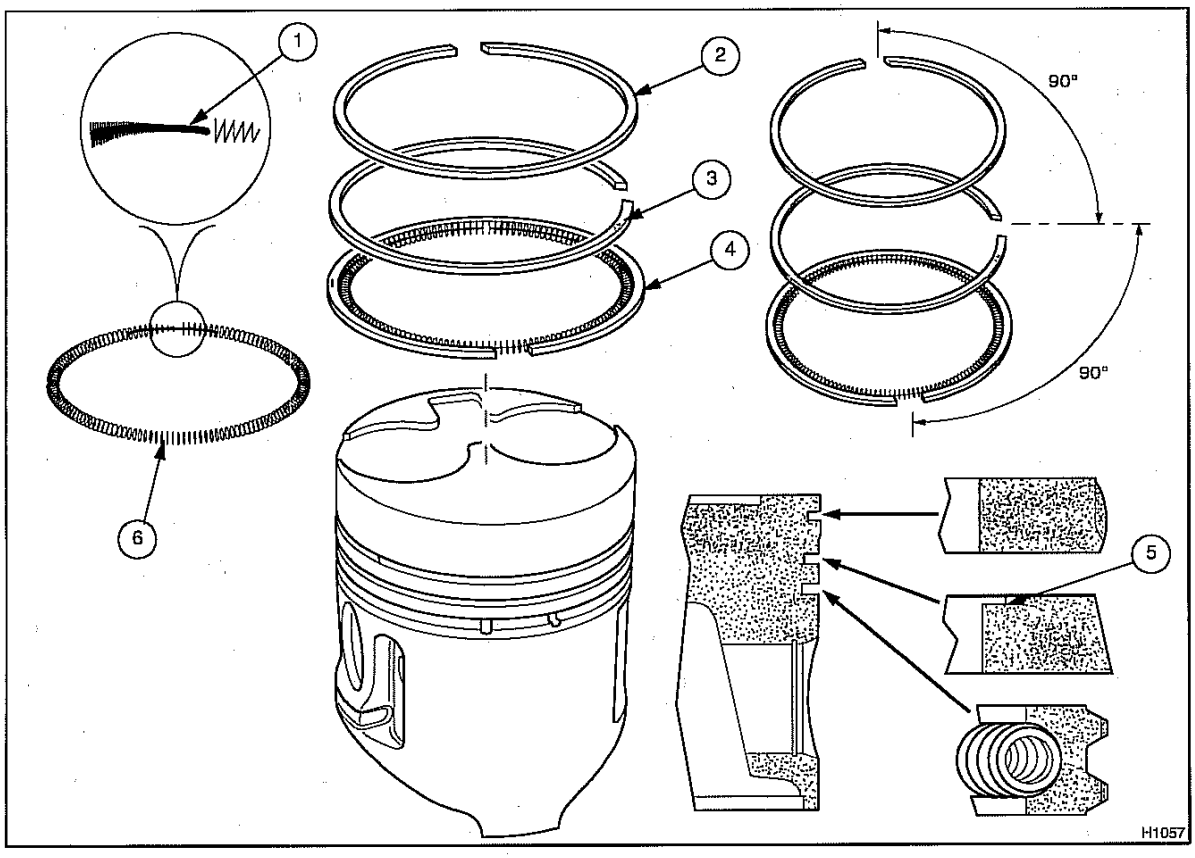
New second rings have a green identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

The second ring has a step (5) at the top inside edge of the tapered face.

3 Fit the top ring (2) with the word 'TOP' towards the top of the piston.

New top rings have a red identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

4 Ensure that the ring gaps are 90° apart.



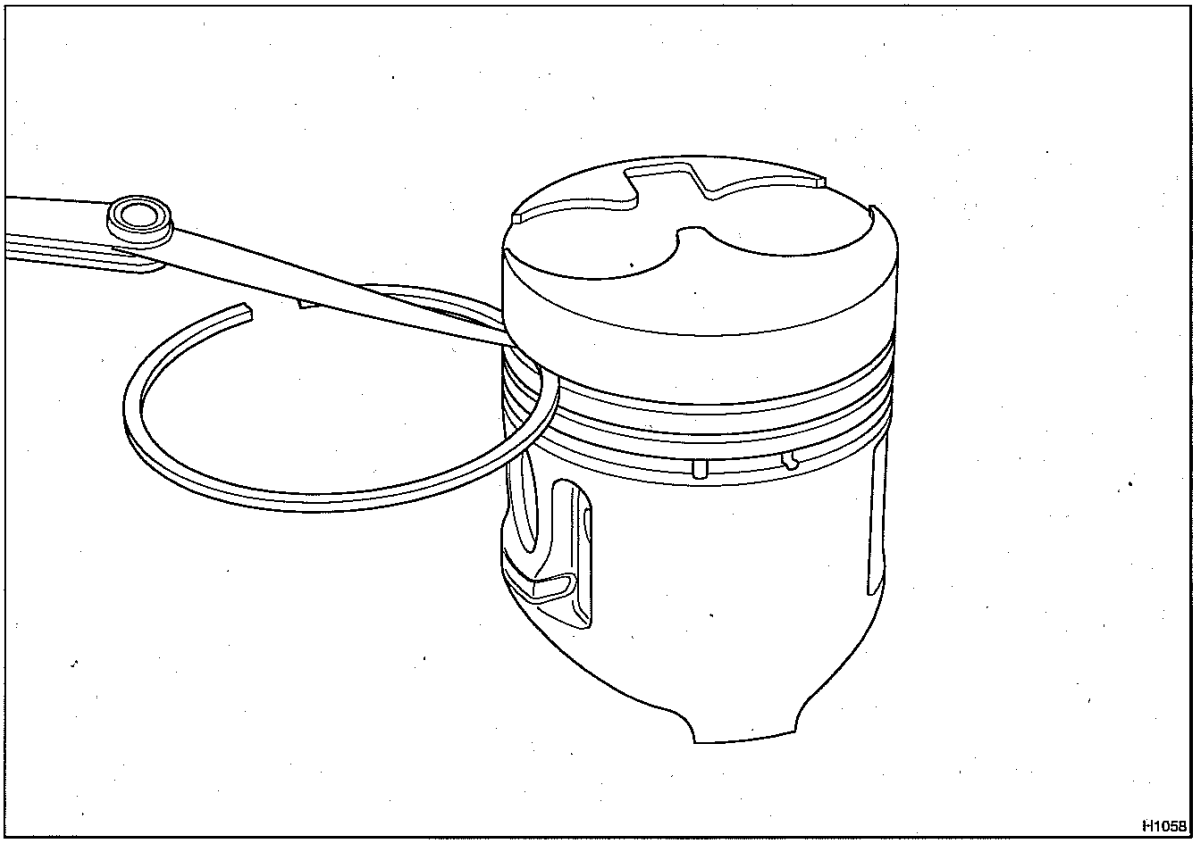
To measure the piston ring clearance — Operation 4-5

Use a feeler gauge to measure the clearance between the piston ring groove and the piston ring. If the clearance is greater than the service limit, use a new piston ring and check the clearance again.

If the clearance is within the service limit with a new piston ring, renew the piston rings. If the clearance is outside the service limit with a new piston ring, renew the piston.

Note: The number 1 piston ring of the 404C-22T is of the 'keystone' design, therefore it is difficult to measure the wear due to it's position in the piston ring groove. When either number 2 ring or the oil control ring is outside the service limit renew all rings.

Engine	Torque Nm (lbf ft) kgf m	Standard	Service limit
403C-11	Number 1 ring	0,06 - 0,10 mm (0.0024 - 0.0039 in)	0,25 (0.0098 in)
	Number 2 ring	0,05 - 0,09 mm (0.0020 - 0.0035 in)	0,25 (0.0098 in)
	Oil control ring	0,02 - 0,06 mm (0.0008 - 0.0024 in)	0,15 (0.0059 in)
403C-15 404C-22	Number 1 ring	0,07 - 0,11 mm (0.0028 - 0.0043 in)	0,25 (0.0098 in)
	Number 2 ring	0,04 - 0,08 mm (0.0016 - 0.0032 in)	0,25 (0.0098 in)
	Oil control ring	0,02 - 0,06 mm (0.0008 - 0.0024 in)	0,15 (0.0059 in)
404C-22T	Number 2 ring	0,04 - 0,08 mm (0.0016 - 0.0032 in)	0,25 (0.0098 in)
	Oil control ring	0,02 - 0,06 mm (0.0008 - 0.0024 in)	0,15 (0.0059 in)



To measure the piston ring gap — Operation 4-6

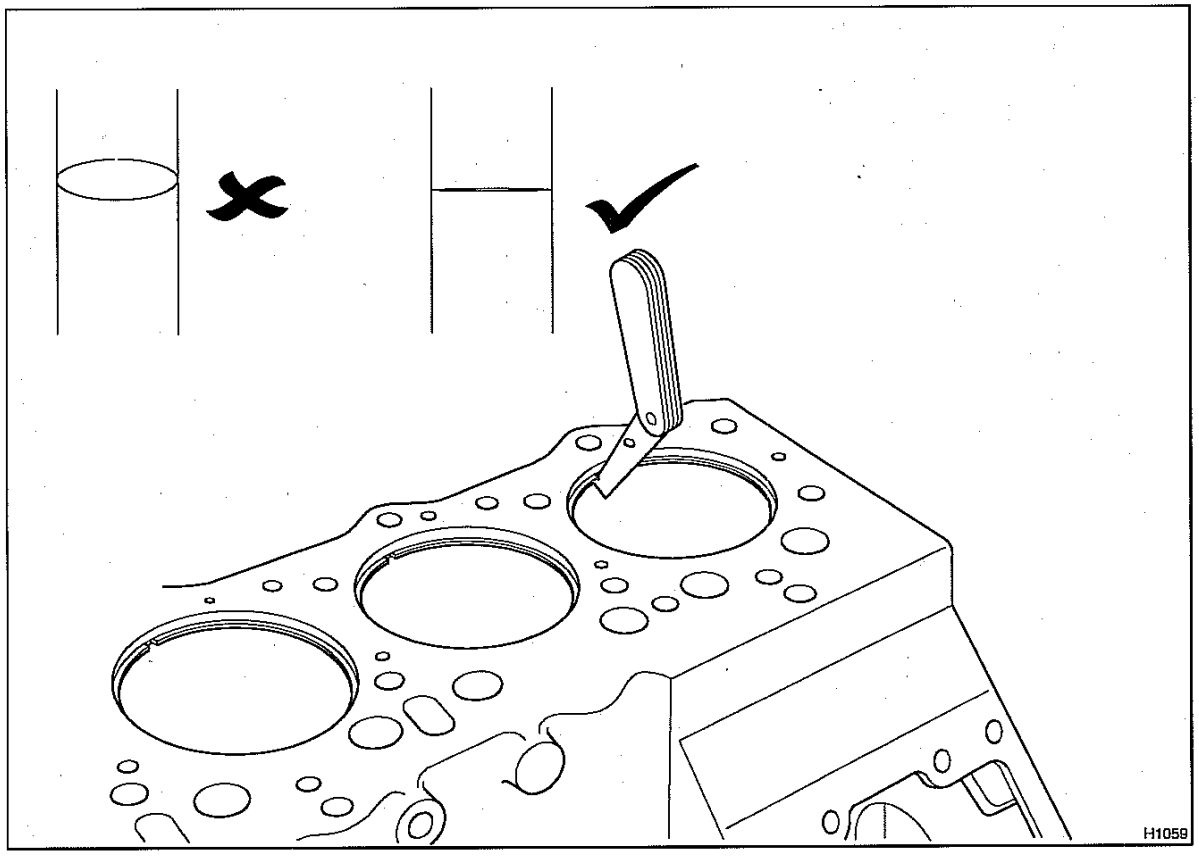
If the piston ring is worn or damaged, renew.

Piston ring gap

Clean the carbon from the top of the cylinder bore.

Insert the ring into the cylinder at right angles to the cylinder block and measure the gap with a feeler gauge. If the gap is greater than the service limit, renew the piston ring.

Engine	Ring number	Standard	Service limit
403C11	Number 1 ring	0,15 - 0,27 mm (0.0059 - 0.0106 in)	1,0 mm (0.039 in)
	Number 2 ring	0,12 - 0,24 mm (0.0047 - 0.0094 in)	1,0 mm (0.039 in)
	Oil control ring	0,20 - 0,35 mm (0.0079 - 0.0138 in)	1,0 mm (0.039 in)
403C-15 404C-22 404C-22T	Number 1 ring	0,20 - 0,35 mm (0.0079 - 0.0138 in)	1,0 mm (0.039 in)
	Number 2 ring	0,20 - 0,40 mm (0.0079 - 0.0158 in)	1,0 mm (0.039 in)
	Oil control ring	0,20 - 0,40 mm (0.0079 - 0.0158 in)	1,0 mm (0.039 in)



Gudgeon pin

Check the outside diameter of the gudgeon pin. If it is less than the service limit, renew the gudgeon pin.

Engine	Outside diameter	Service limit
403C-11	20,996 - 21,002 mm (0.82660 - 0.82680 in)	20,98 mm (0.8260 in)
403C-15 404C-22 404C-22T	27,996 - 28,000 mm (1.10220 - 1.10240 in)	27,98 mm (1.1016 in)

Engine	Standard clearance	Service limit
403C-11	-0,004 - +0,004 mm (-0.00016 - +0.00016 in)	0,02 mm (0.0008 in)
403C15 404C-22 404C-22T	-0,001 - +0,007 mm (-0.00040 - +0.00030 in)	0,02 mm (0.0008 in)

Piston and piston ring

To inspect **Operation 4-8**

Piston

If the outer surface of the piston is damaged (cracked, scored, burning etc) renew.

Piston skirt

Check the larger diameter of the piston skirt (10 mm from bottom).

Check the inside diameter (thrust direction) of the cylinder. Calculate the clearance between the cylinder and the piston. If the clearance is more than the service limit, or piston diameter is less than service limit, renew the piston

Engine	Cylinder diameter	Service limit
403C-11	76,932 - 76,947 mm (3.02880 - 3.02940 in)	76,7 mm (3.020 in)
403C-15 404C-22 404C-22T	83,948 - 83,963 mm (3.30503 - 3.30562 in)	83,7 mm (3.295 in)

Engine	Clearance between piston and cylinder	Service limit
403C-11	0,0525 - 0,0865 mm (0.00210 - 0.00340 in)	0,25 mm (0.010 in)
403C-15 404C-22 404C-22T	0,0380 - 0,0720 mm (0.00150 - 0.00283 in)	0,25 mm (0.010 in)

Connecting rod

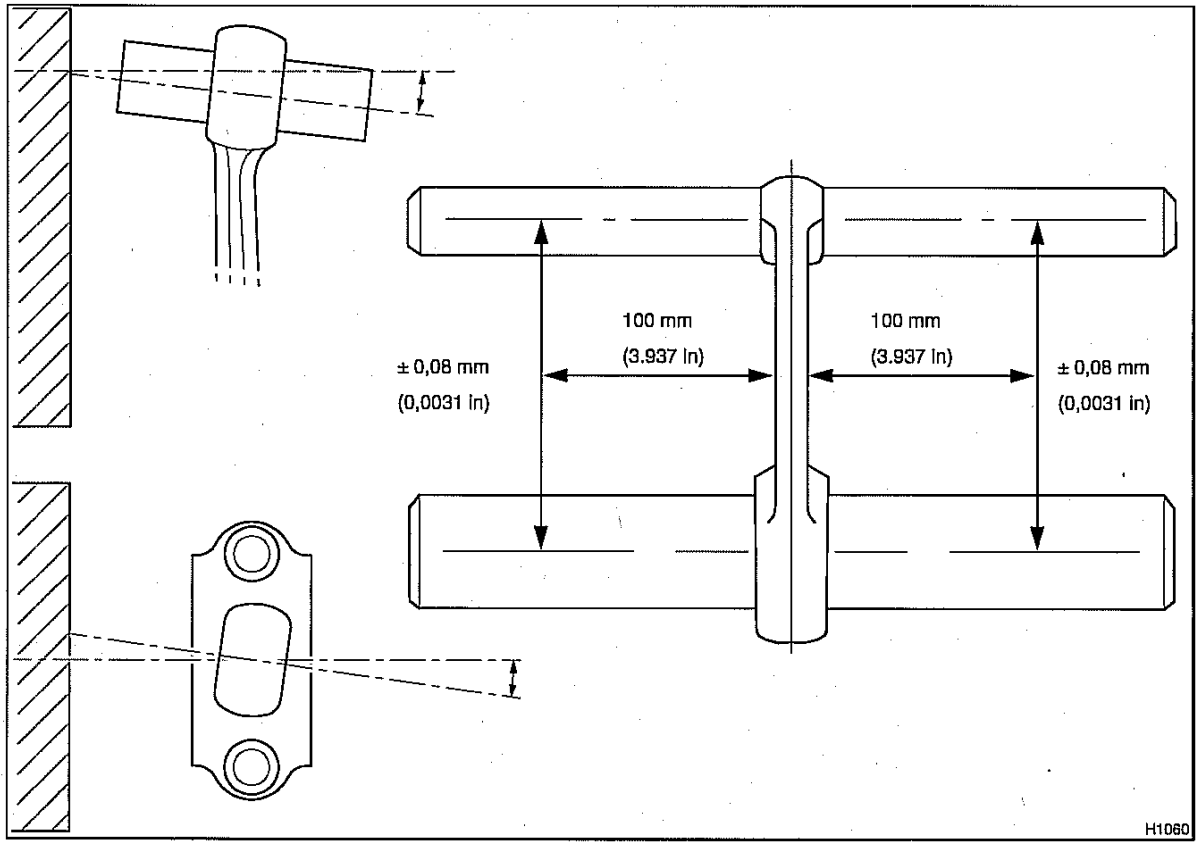
To inspect **Operation 4-9**

Engine	Standard		Service limit
All models	Distortion for 100 mm (3.937 in)	< 0,08 mm (0.0031 in)	0,20 mm (0.0079 in)
	Parallel for 100 mm (3.937 in)	< 0,05 mm (0.0020 in)	0,15 mm (0.0059 in)

The large and small end bores must be parallel with each other within the limits of ± 0,31 mm (0.008 in) measured 100 mm (3.397 in) each side of the connecting rods axis on a test mandrel.

Check the small end bush for wear or for other damage and renew it if necessary.

Check the fit of the gudgeon pin in the small end bush and check the gudgeon pin for wear.



Connecting rod bearing clearance

To check — Operation 4-10

To check the clearance between the crankshaft bearing journal and the bearing cap.

1 Clean the bearing surfaces and the exposed half of the crankshaft journal.

2 Fit the bearing caps and tighten the bearing cap to torque.

3 Remove the bearing cap of the clearance to be checked.

4 Place a piece of Plastigauge ® across the full width of the bearing surface on the crankshaft journal, fit the bearing cap and tighten the bearing cap setscrew to the specified torque.

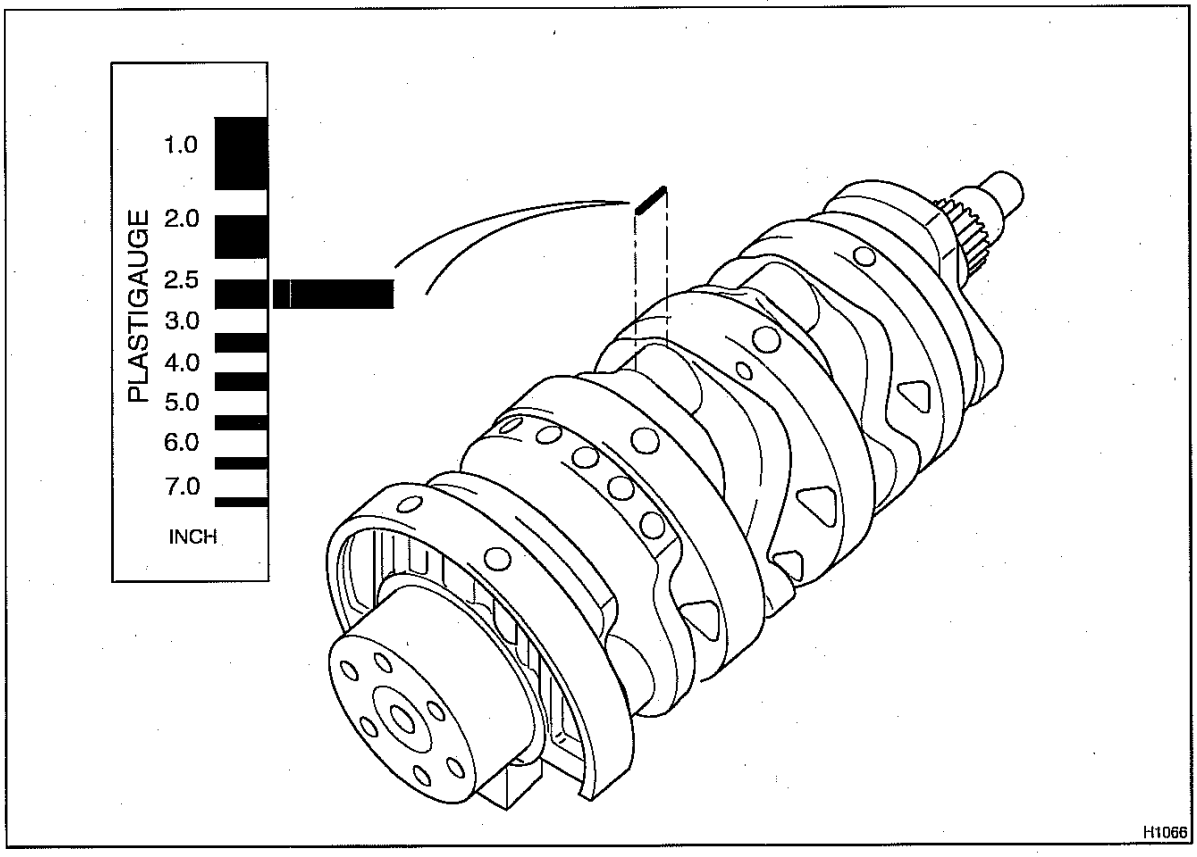
5 Remove the bearing cap but **do not move** the Plastigauge ®.

6 Use the Plastigauge ® envelope to measure the widest point of the Plastigauge ®. This reading indicates the bearing clearance in thousandths of an inch.

7 If the bearing clearance is not within the specifications the crankshaft must be reground and undersize bearings fitted.

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Bearing carrier setscrew	23 (16.9) 2,3
403C-15, 404C-22 and 404C-22T	Bearing carrier setscrew	52 (38.3) 5,2

Engine	Journals	Standard clearance	Service limit
403C-11	1 and 2	0,039 - 0,092 mm (0.00150 - 0.00360 in)	0,20 mm (0.0079 in)
	3	0,029 - 0,082 mm (0.00110 - 0.00320 in)	0,20 mm (0.0079 in)
403C-15, 404C-22 and 404C-22T	All	0,035 - 0,085 mm (0.00138 - 0.00335 in)	0,20 mm (0.0079 in)

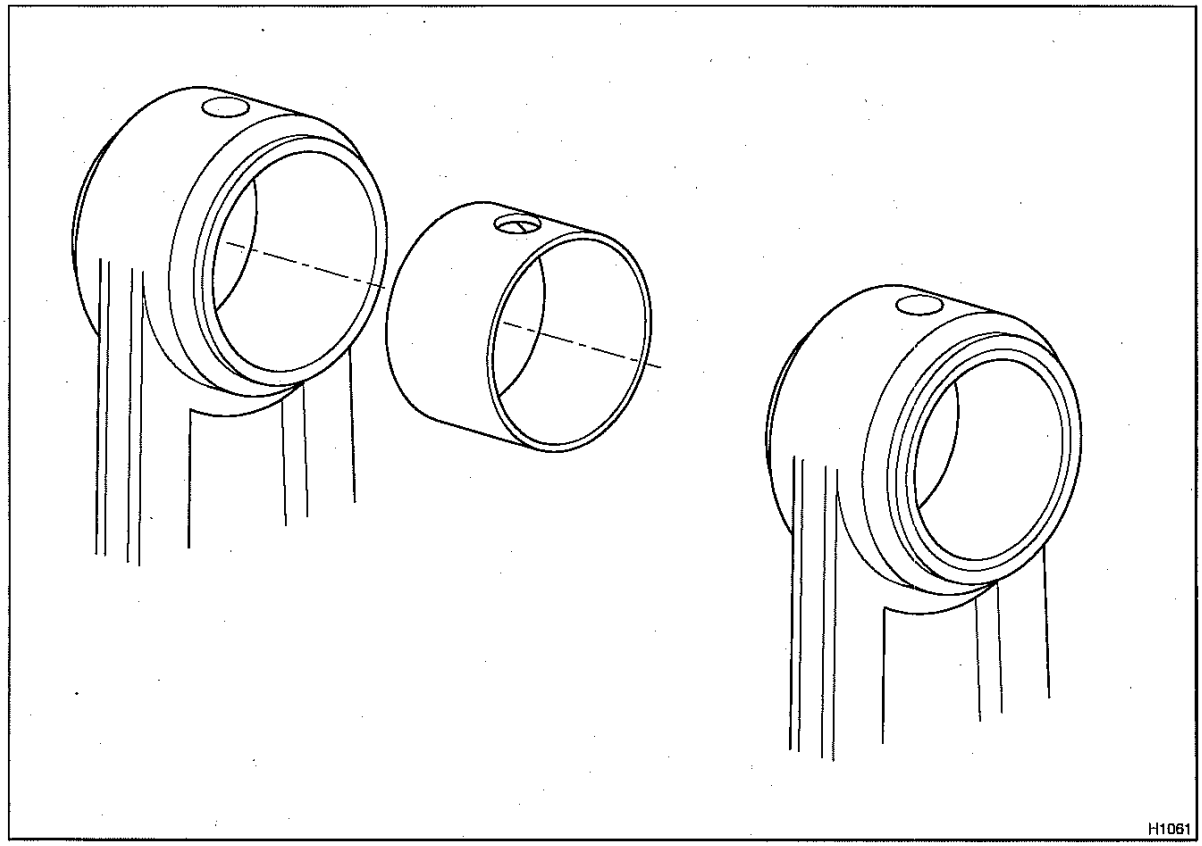


Small end bush

To remove and to fit **Operation 4-11**

Calculate the clearance between the small end bush and the gudgeon pin. if the clearance is greater than the service limit, renew the bush.

Engine	Clearance mm (in)	Service limit mm (in)
403C-11	0,010 - 0,025 (0.00040 - 0.00099)	0.08 (0.0031)
403C-15 404C-22 404C-22T	0,010 - 0,025 (0.00040 - 0.00099)	0,10 (0.0040)



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5

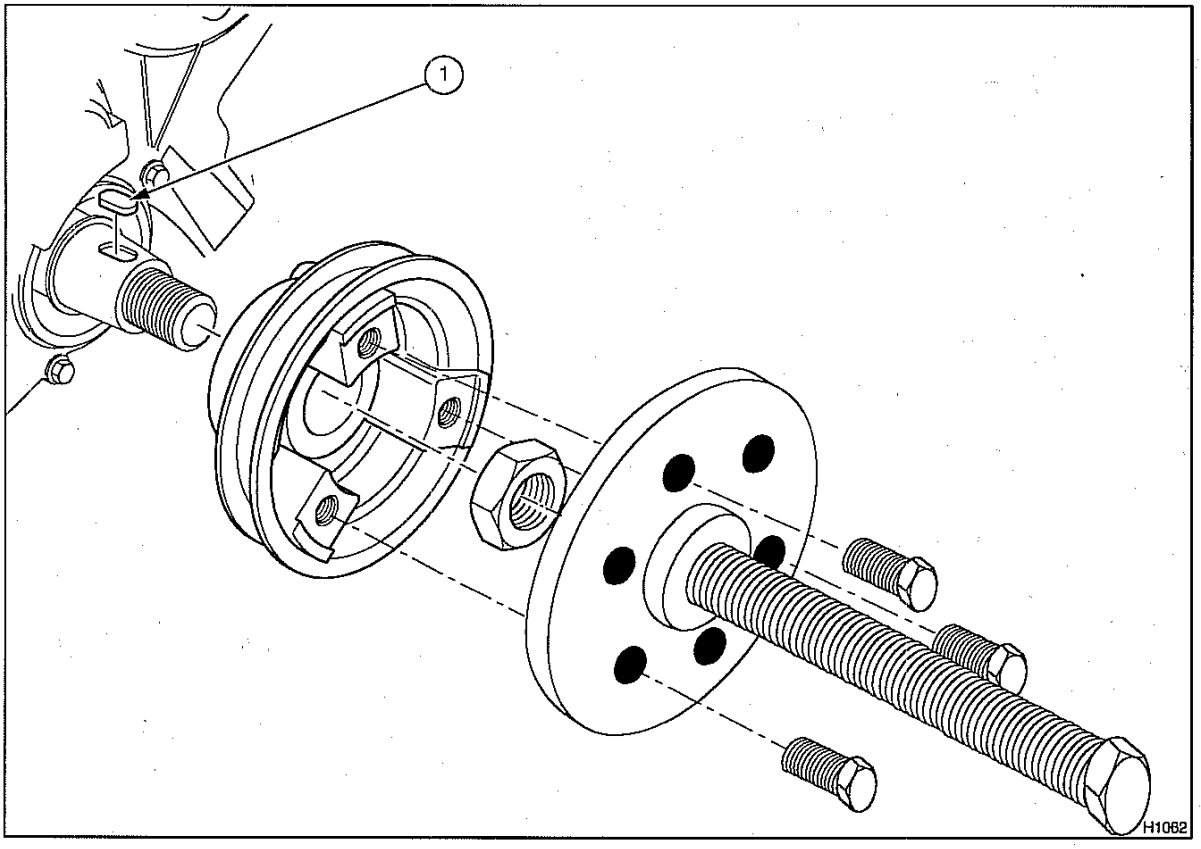
Crankshaft assembly

Crankshaft pulley

To remove and to fit **Operation 5-1**

Engine	Torque Nm (lbf ft) kgf m		Special tools	Part number
403C-11	Crankshaft nut	123 (90.7) 12,5	Crankshaft pulley remover	21825619
403C-15 404C-22 404C-22T	Crankshaft nut	304 (224.2) 30,9		

Note: Store the key (1) in a safe place until assembly.



Crankshaft retaining bolts and crankshaft

To remove and to fit **Operation 5-2**

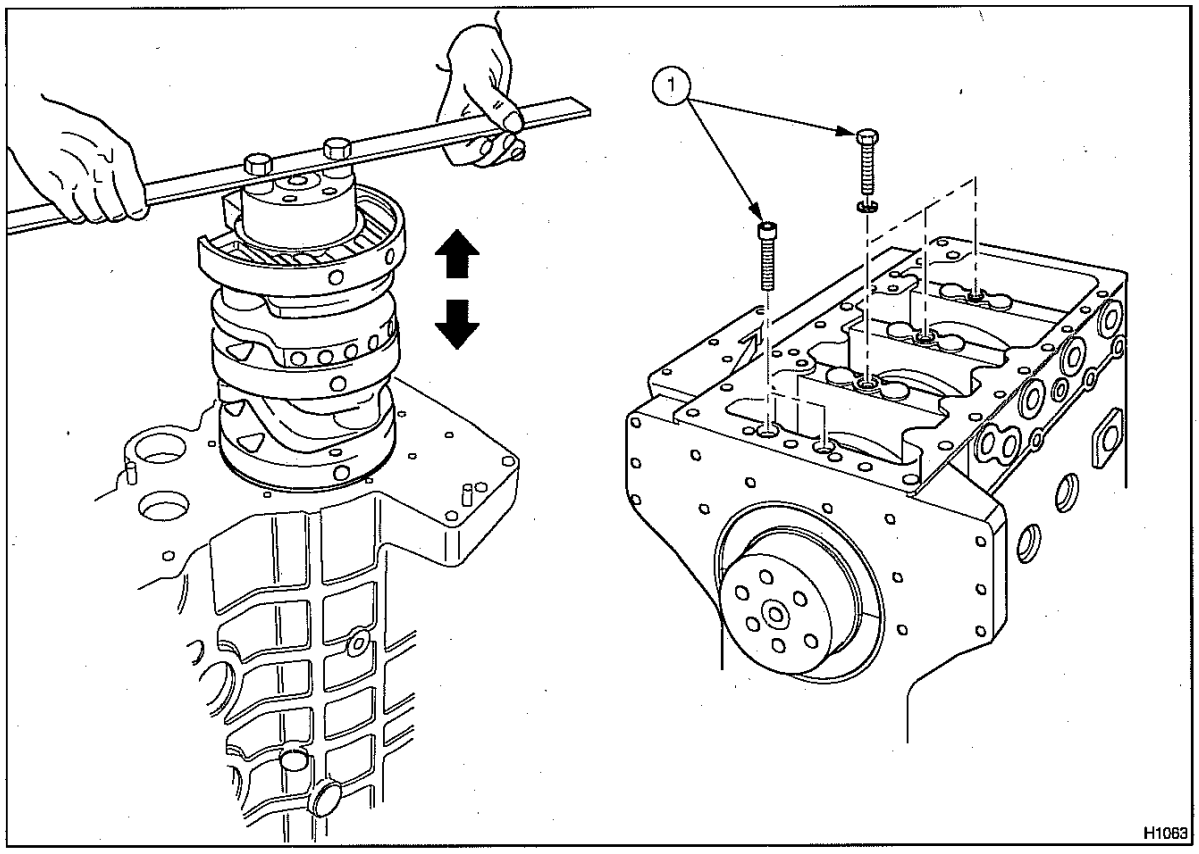
Engine	Torque Nm (lbf ft) kgf m	
403C-11	Crankshaft bearing holder setscrew	27 (19.9) 2,7
	Crankshaft bearing holder to block (allen screws)	27 (19.9) 2,7
403C-15 404C-22 404C-22T	Crankshaft bearing holder setscrew	52 (38.3) 5,2
	Crankshaft bearing holder to block (allen screws)	27 (19.9) 2,7

Cautions:

- *Ensure that the lubricating oil pressure relief valve has been removed before the crankshaft is removed or fitted.*
- *Ensure that the oil ways in the bearings align with the oil ways in the cylinder block.*

Remove the bearing holder setscrews (1) and lift the crankshaft assembly out vertically.

Note: If the crankshaft or crankshaft bearings are replaced the fuel adjustment screw must not be altered from the original setting. The maximum no load speed must be checked after assembly.



Crankshaft

To inspect for deflection — Operation 5-3

1 Support the crankshaft on V-blocks.

2 Position a dial gauge on the crankshaft centre journal, and turn the crankshaft gradually by one full turn.

3 If the gauge reading is more than the service limit, renew or regrind the crankshaft.

Engine	Deflection mm (in)	
	Standard	Service limit
All models	0,03 or less (0.011)	0,06 (0.0023)

4 When the measured diameter is less than the service limit, regrind and use undersized bearings and bushes.

Crankshaft inspection

1 Check the oil seal contact face for damage or wear.

2 Check oil holes for clogging.

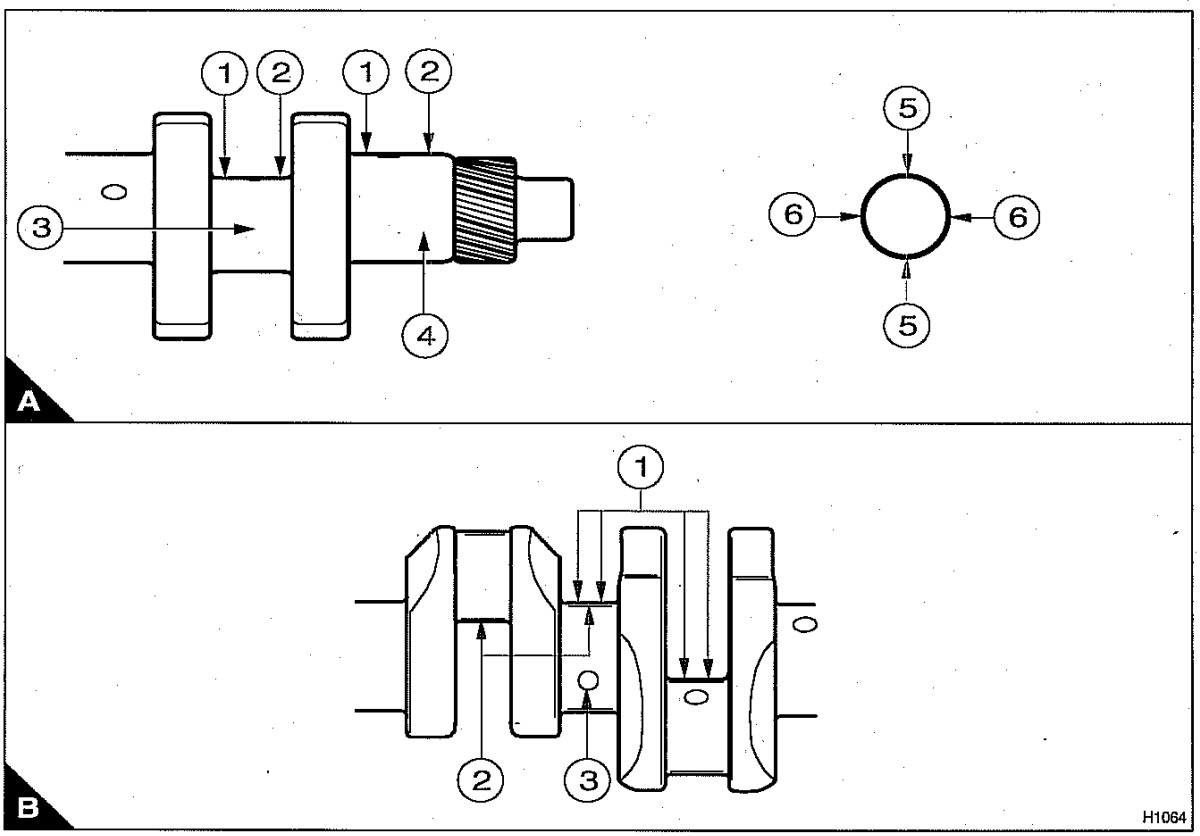
3 Check crankshaft journal (A4) and crank pin (A3) for stepped wear. Take measurements of diameters (A5-A5) and (A6-A6) at positions (A1) and (A2). If the maximum difference between the measurements (stepped wear) is more than the service limit of 0,05 mm (0.0019 in) then correction is required.

Grinding specification

When grinding the crankshaft, work with the following specifications:

Radius at pin / journal (B1)	3 mm (0.118 in) ± 0,2 mm (± 0.0078 in)
Finish precision (B2)	1.6Z (▽ ▽ ▼)
Radius around oil hole (B3)	2 mm (0.787 in) maximum / 5 mm (0.196 in) minimum

Note: Use No. 400 emery cloth for final polishing.



Crankshaft journal diameter

Engine	Size	Standard diameter	Service limit
403C-11	Standard	47,964 - 47,975 mm (1.88830 - 1.88880 in)	47,90 mm (1.8860 in)
	Undersize 0,25 mm (0.01 in)	47,714 - 47,725 mm (1.87850 - 1.87890 in)	47,65 mm (1.8750 in)
	Undersize 0,50 mm (0.02 in)	47,464 - 47,475 mm (1.86870 - 1.86910 in)	47,40 mm (1.8660 in)
403C-15 404C-22 404C-22T	Standard	67,957 - 67,970 mm (2.67550 - 2.67597 in)	67,90 mm (2.6732 in)
	Undersize 0,25 mm (0.01 in)	67,707 - 67,720 mm (2.66563 - 2.66614 in)	67,65 mm (2.6634 in)
	Undersize 0,50 mm (0.02 in)	67,457 - 67,470 mm (2.65579 - 2.65630 in)	67,40 mm (2.6535 in) *

Crankshaft pin diameter

Engine	Size	Standard diameter	Service limit
403C-11	Standard	40,964 - 40,975 mm (1.61280 - 1.61320 in)	40,90 mm (1.6102 in)
	Undersize 0,25 mm (0.01 in)	40,714 - 40,725 mm (1.60290 - 1.60330 in)	40,65 mm (1.6003 in)
	Undersize 0,50 mm (0.02 in)	40,464 - 40,475 mm (1.59310 - 1.59350 in)	40,40 mm (1.5905 in)
403C-15 404C-22 404C-22T	Standard	51,964 - 51,975 mm (2.04582 - 2.04626 in)	51,90 mm (2.0433 in)
	Undersize 0,25 mm (0.01 in)	51,714 - 51,725 mm (2.03598 - 2.03641 in)	51,65 mm (2.0335 in)
	Undersize 0,50 mm (0.02 in)	51,464 - 51,475 mm (2.02614 - 2.02660 in)	51,40 mm (2.0236 in) *

Note: If the diameter is less than the maximum undersize service limit (*), the crankshaft must be renewed.

Main bearings

To dismantle and to assemble **Operation 5-4**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Bearing holder setscrew	23 (16.9) 2,3
403C-15, 404C-22 and 404C-22T	Bearing holder setscrew	52 (38.3) 5,2

End float

If the end float is greater than the service limit check the thrust washers for wear.

Note: Item (1) only used on 404C-22 and 404C-22T.

Engine	Standard clearance	Service limit
403C-11	0,10 - 0,30 mm (0.0040 - 0.0120 in)	0,50 mm (0.0197 in)
403C-15, 404C-22 and 404C-22T	0,10 - 0,40 mm (0.0040 - 0.0160 in)	0,50 mm (0.0197 in)

Engine	Thrust washer thickness	Service limit
403C-11	21,85 - 21,95 mm (0.8602 - 0.8641 in)	21,6 mm (0.8503 in)
403C-15, 404C-22 and 404C-22T	2,95 - 3,00 mm (0.1161 - 0.1181 in)	2,80 mm (0.1102 in)

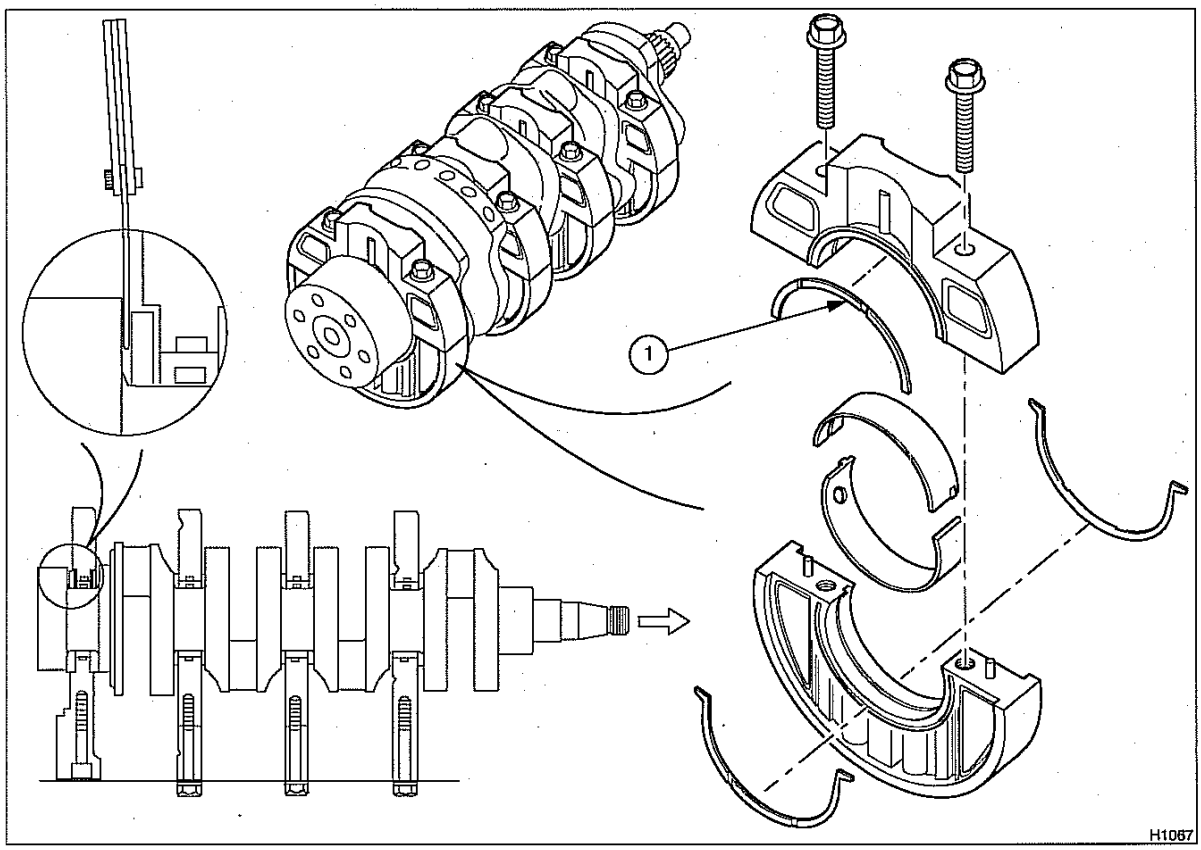
1 Identify the location of bearing carriers on the crankshaft and mark before removal.

2 Install bearing carriers on the crankshaft, ensure that the lubricating oil holes align with the feed holes in the cylinder block.

3 Check end float clearance.

Note: Ensure that the thrust washers are aligned correctly, fitted with their oil grooves towards the crankshaft.

4 Check the thrust washers for wear, poor contact or damage, if damaged renew.



Bearing holder

Centre bearing

1 Remove the bearing holder and inspect for peeling, melting, stepped wear and damage. if it is damaged renew.

2 Use Plastigauge ® to measure the oil clearance (see Operation 4-10) between the crankshaft centre journal and the bearing. If the oil clearance is greater than the service limit, renew the bearings or regrind the centre journal and use undersize bearings.

Engine	Standard oil clearance	Service limit
403C-11	0,039 - 0,106 mm (0.00153 - 0.00401 in)	0,20 mm (0.0078 in)
403C-15 404C-22 404C-22T	0,044 - 0,102 mm (0.00150 - 0.00420 in)	0,20 mm (0.0078 in)

Engine / Bearing size mm (in)	Journal	Centre crankshaft diameter mm (in)
403C-11		
Standard	1, 2	47,965 - 47,975 (1.88830 - 1.88880)
	3	47,954 - 47,965 (1.88800 - 1.88840)
Undersize 0,25 (0.01)	1, 2	47,714 - 47,725 (1.87850 - 1.87890)
	3	47,704 - 47,715 (1.87810 - 1.87850)
Undersize 0,50 (0.02)	1, 2	47,464 - 47,475 (1.86870 - 1.86910)
	3	47,454 - 47,465 (1.86250 - 1.86870)
403C-15		
Standard	1, 2, 3	67,957 - 67,970 (2.67550 - 2.67597)
Undersize 0,25 (0.01)	1, 2, 3	67,707 - 67,720 (2.66563 - 2.66614)
Undersize 0,50 (0.02)	1, 2, 3	67,457 - 67,470 (2.65579 - 2.65630)
404C-22 and 404C-22T		
Standard	1, 2, 3, 4	67,957 - 67,970 (2.67550 - 2.67597)
Undersize 0,25 (0.01)	1, 2, 3, 4	67,707 - 67,720 (2.66563 - 2.66614)
Undersize 0,50 (0.02)	1, 2, 3, 4	67,457 - 67,470 (2.65579 - 2.65630)

6

Timing case and drive assembly

Timing cover

To remove **Operation 6-1**

Engine	Special tools	
	Description	Part number
403C-11	Front oil seal protector	21825620
403C-15, 404C-22 and 404C-22T	Front oil seal protector	21825621

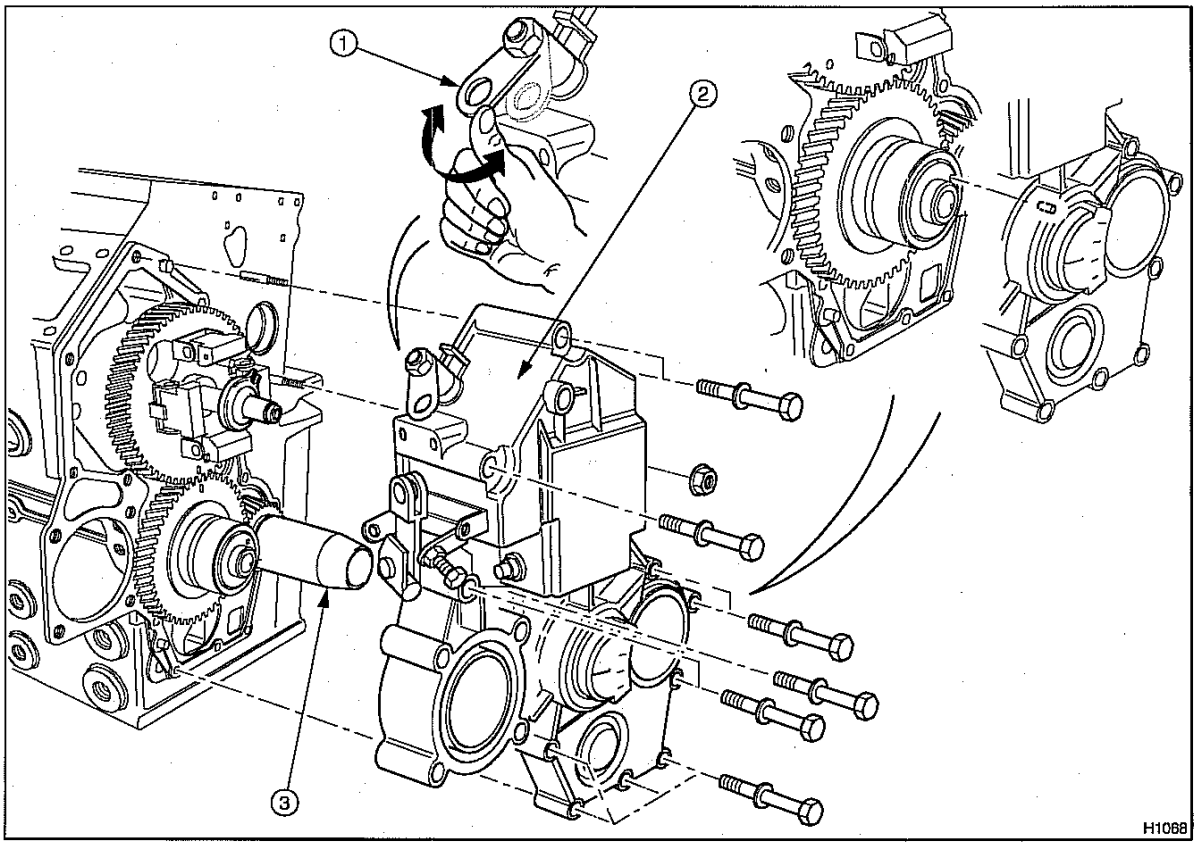
***Cautions*:**

- *If the timing case assembly or internal governor components are replaced the fuel adjustment screw should not be adjusted. The maximum no load speed should be checked after assembly.*
- *The fuel injection pump, see Operation 11-3 and the keyway in the crankshaft must be removed before the timing case is removed.*
- *Ensure that the stop lever arm (1) is held clockwise in tension for removal and assembly.*

Note: If the timing case is renewed, a new emission label must be fitted as shown (2).

1 To remove the PTO cover, see Operation 6-9.

2 To remove and to fit the crankshaft pulley, see Operation 5-1.



To fit **Operation 6-2**

Engine	Special tools	
	Description	Part number
403C-11	Front oil seal protector	21825620
403C-15 404C-22 404C-22T	Front oil seal protector	21825621

To fit

1 The fuel injection pump, see Operation 11-3 and the keyway in the crankshaft must be removed before the timing case is fitted. Fit the front oil seal protector.

2 To fit the PTO cover, see Operation 6-9.

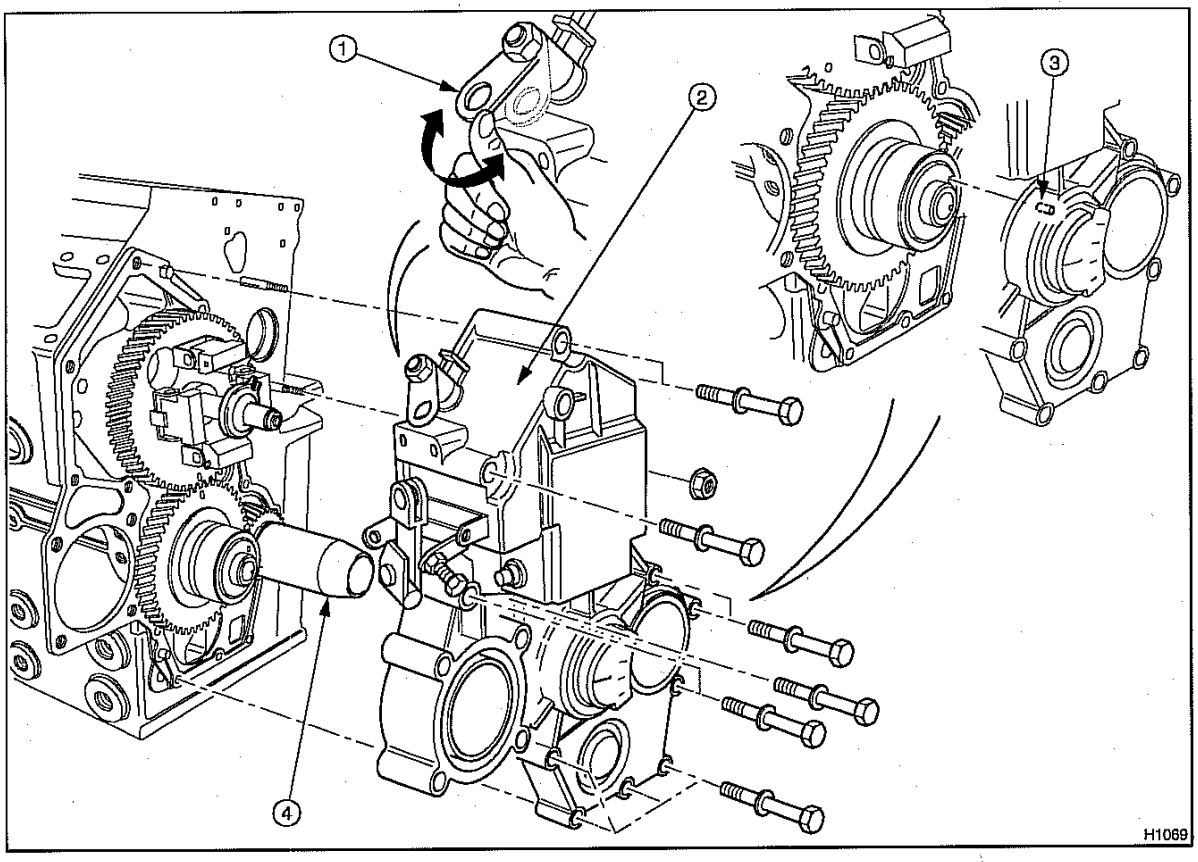
3 Ensure the oil pin (3) locates in the hole in the idler gear and that the stop lever arm (1) is held clockwise in tension for removal and assembly.

4 Remove the oil seal protector (4) after fitting the timing cover. Fit the key into the key way in the crankshaft nose.

5 To fit the crankshaft pulley, see Operation 5-1.

Note: If the timing case is renewed, a new emission label must be fitted as shown (2).

Caution: *If the timing case assembly or internal governor components are replaced the fuel adjustment screw should not be adjusted. The maximum no load speed should be checked after assembly.*



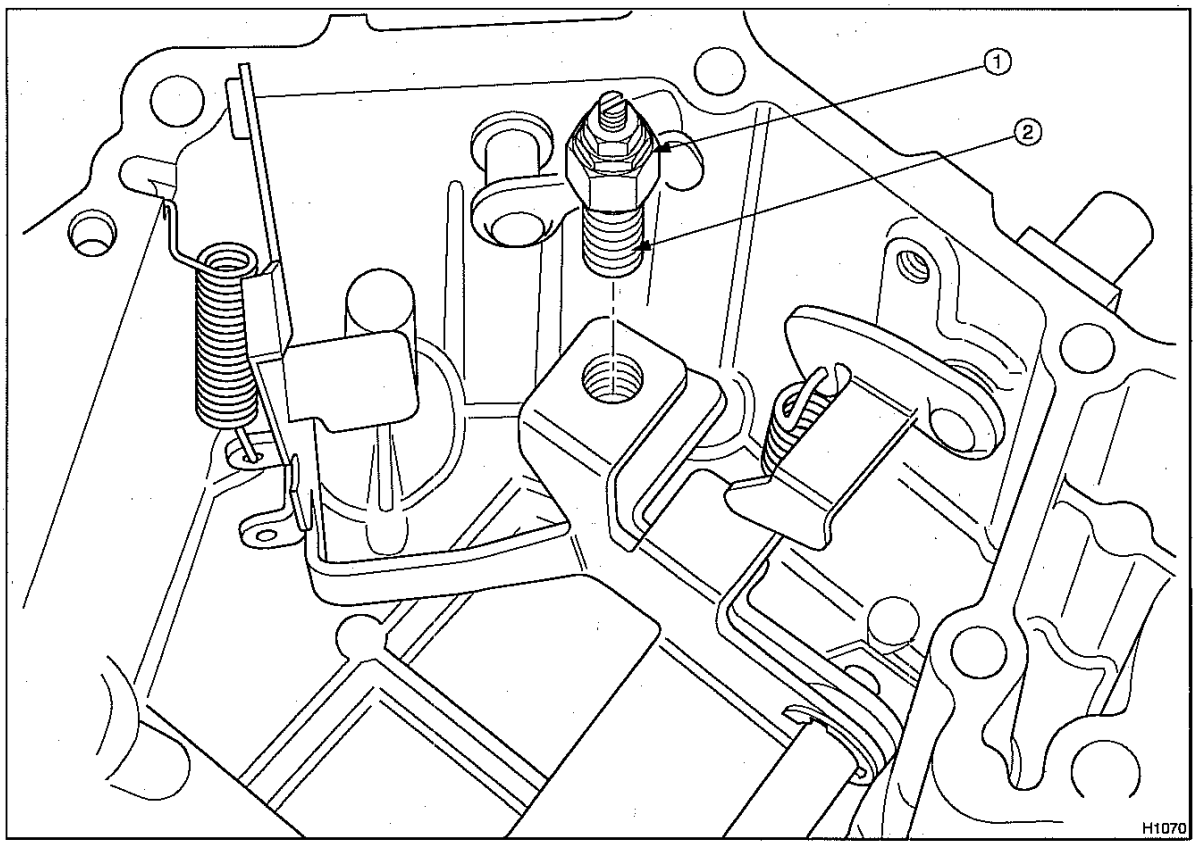
Angleich

To remove and to fit **Operation 6-3**

Engine	Torque Nm (lbf ft) kgf m	
403C-15, 404C-22 404C-22T	Angleich (1)	5 (3.6) 0,5

Notes:

- The internal setting for the Angleich must not be altered.
- Apply a little Loctite 275 to threads (2) before assembly.
- The Angleich is not fitted to the 403C-11 engine.



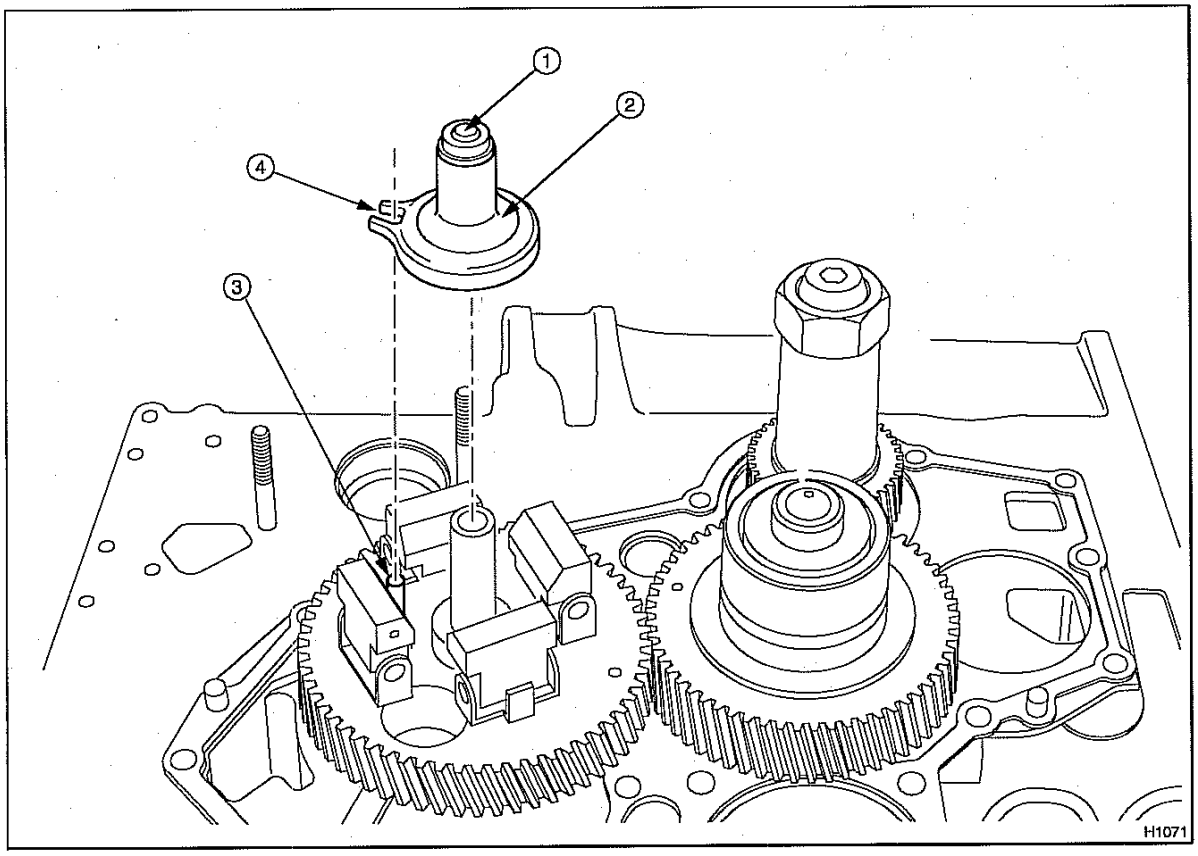
Slider

To remove and to fit — Operation 6-4

The slider (2) must be fitted with the slot (4) held captive by the pin (3).

When fitting the timing case care must be taken to ensure correct alignment of the slider contact (1) with the governor lever.

Caution: *Incorrect alignment of the slider (2) on the pin (3) may result in the loss of engine speed control.*



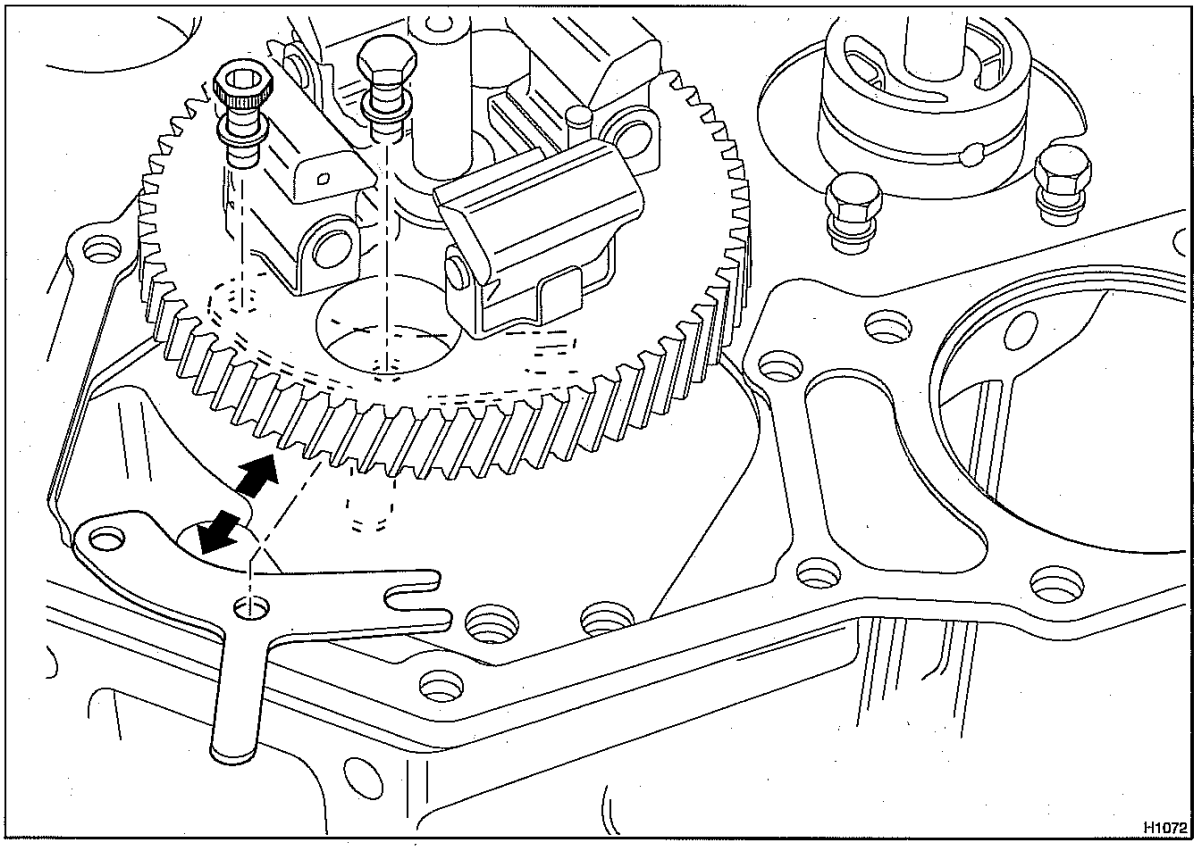
Camshaft retaining plate

To remove and to fit **Operation 6-5**

Engine	Torque Nm (lbf ft) kgf m	
All models	Camshaft retainer plate setscrews	11 (8) 1,1

The camshaft retainer plate is fitted between the cylinder block and the camshaft gear. The camshaft retainer plate is fastened by either two setscrews or a setscrew and an allen screw.

Note: If the camshaft assembly is replaced the fuel adjustment screw must not be altered from the original setting. The maximum no load speed must be checked after assembly.



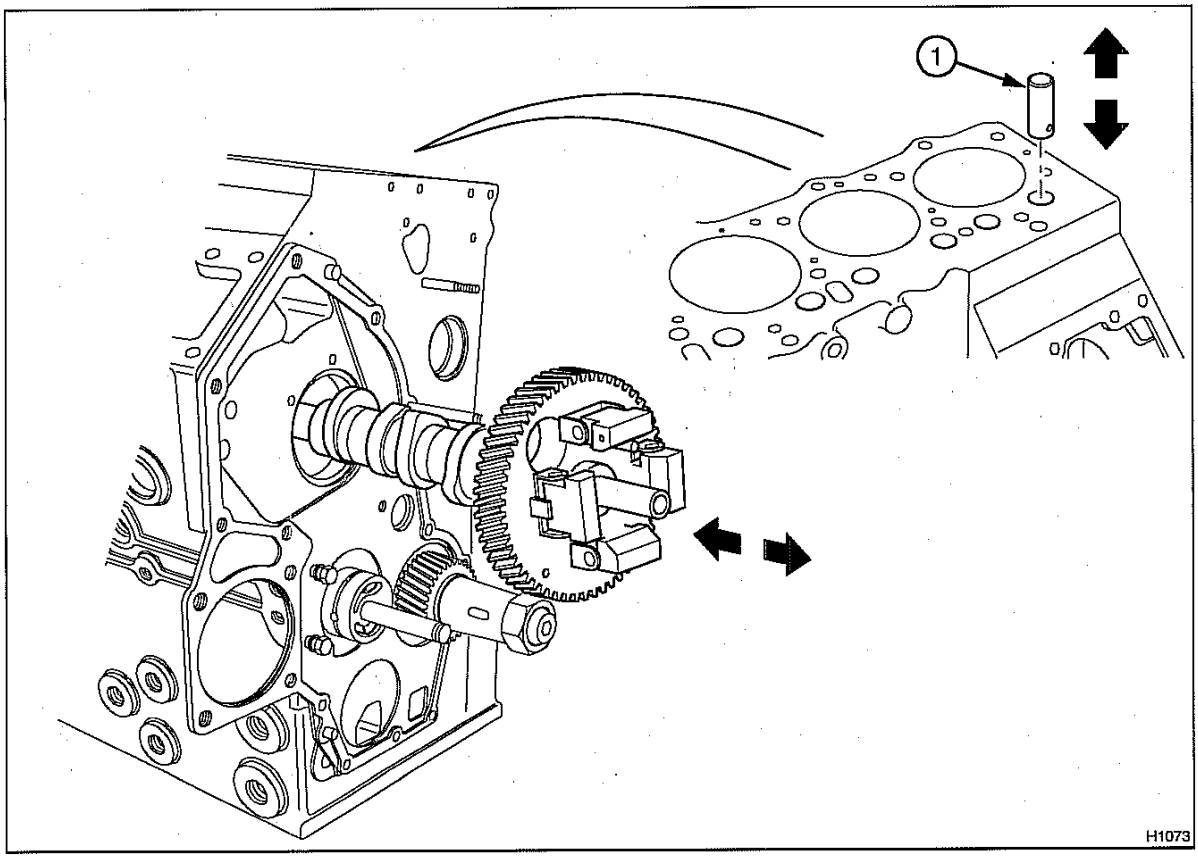
Camshaft and tappets

To remove and to fit — Operation 6-6

Caution: *Remove the lift pump see Operation 11-2 and the fuel injection pump see Operation 11-3 before removing the camshaft.*

Note: If the camshaft assembly is replaced the fuel adjustment screw must not be altered from the original setting. The maximum no load speed must be checked after assembly.

Lubricate the tappets with clean lubricating oil before assembly.



Camshaft assembly

To inspect — Operation 6-7

Height of cam for inlet and exhaust valves (1).

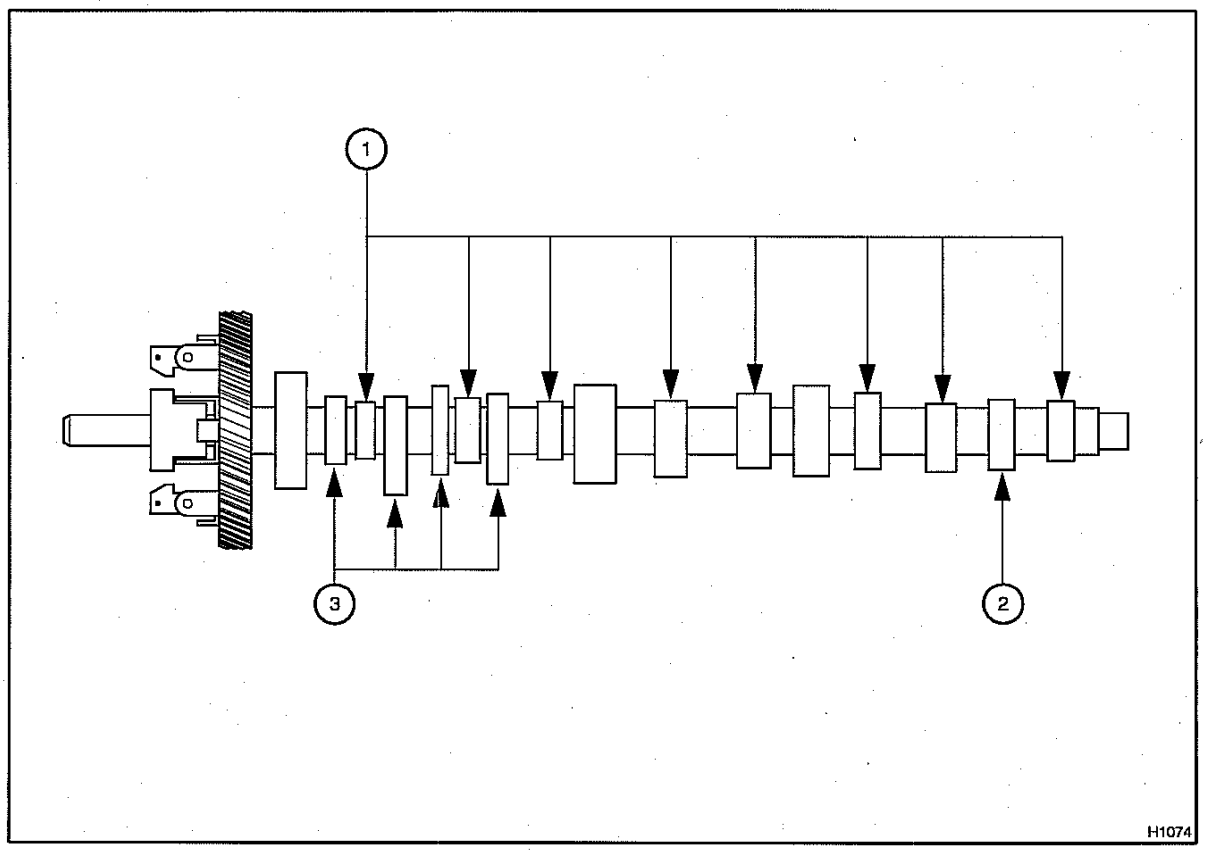
Engine	Height mm (in)	
	Standard	Service limit
403C-11	26,955 - 27,010 (1.06120 - 1.06340)	26,5 (1.0276)
403C-15, 404C-22 and 404C-22T	34,065 - 34,120 (1.34114 - 1.34330)	33,7 (1.3270)

Height of cam for fuel feed pump (2).

Engine	Height mm (in)	
	Standard	Service limit
403C-11	27.900 - 28,000 (1.09842 - 1.10240)	27,0 (1.0630)
403C-15, 404C-22 and 404C-22T	31,900 - 32,000 (1.25590 - 1.25984)	30,0 (1.1810)

Height of cam for fuel injection pump (3).

Engine	Height mm (in)	
	Standard	Service limit
403C-11	39,900 - 40,100 (1.57090 - 1.57870)	39,8 (1.5669)
403C-15, 404C-22 and 404C-22T	41,940 - 42,060 (1.65120 - 1.65590)	41,8 (1.6450)



Maximum fuel screw and maximum speed screw

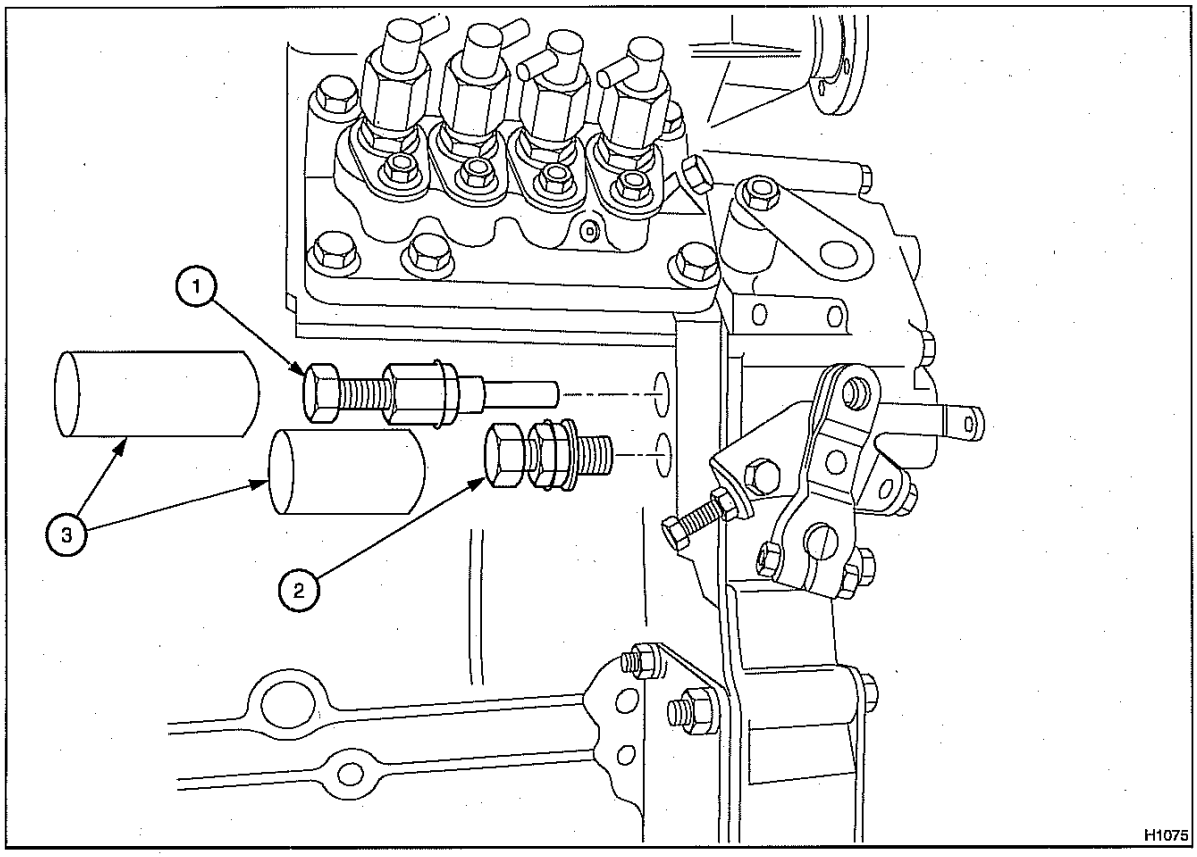
Location **Operation 6-8**

Engine	Torque Nm (lbf ft) kgf m	
All models	Maximum fuel screw lock nut	14 (10.3) 1,4
	Maximum speed screw lock nut	14 (10.3) 1,4

Caution: *The fuel adjustment setscrew must be set correctly for the engine to comply with emissions legislation. This must only be carried out by an approved Perkins distributor.*

Notes:

- The maximum fuel setscrew (1) and the maximum speed setscrew (2) **must not** be adjusted by the operator.
- Under certain circumstances it may be necessary to remove the anti tamper device for the maximum fuel setscrew. This must only be carried out by an approved Perkins distributor.
- Any adjustment to the maximum fuel screw will require an engine test brake, and also a check of maximum no load speed to confirm the settings.

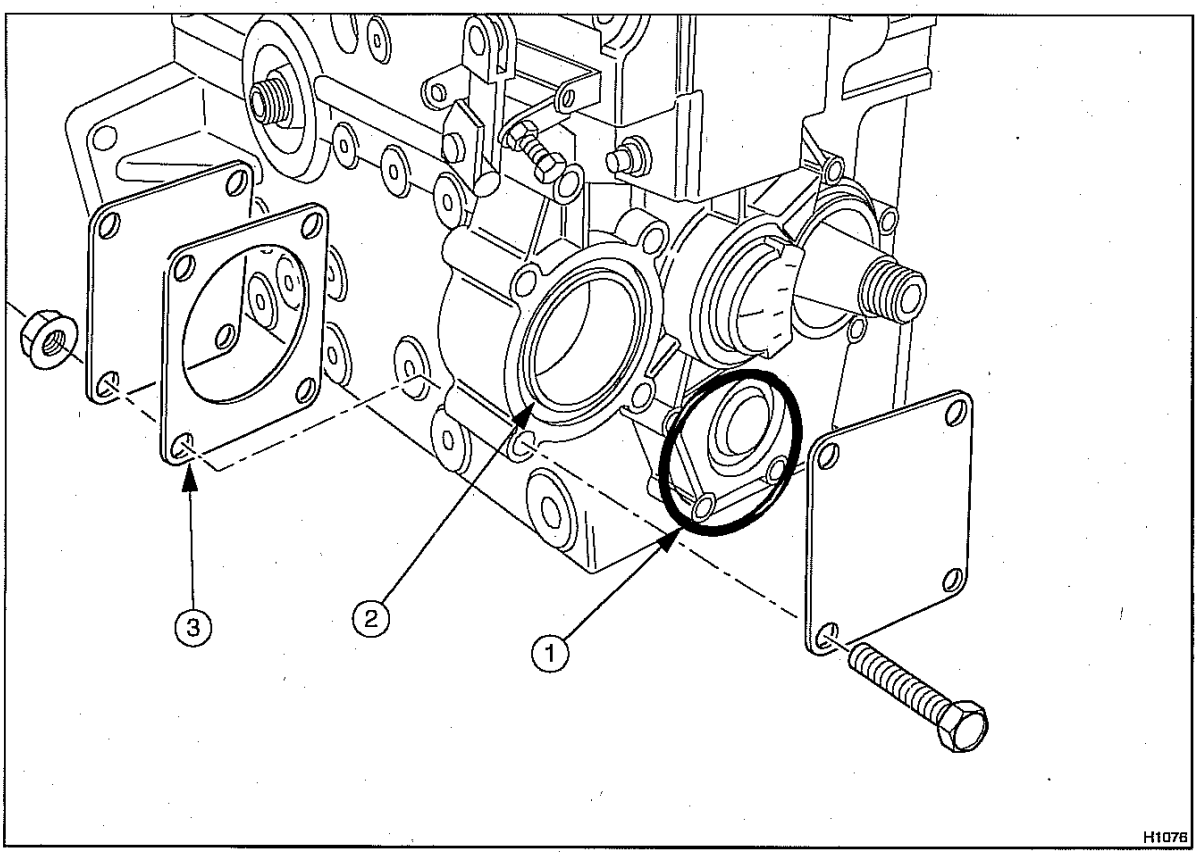


Front oil seal and PTO cover

To remove and to fit **Operation 6-9**

An 'O' ring (1) is fitted in the groove (2) on the front of the timing case.

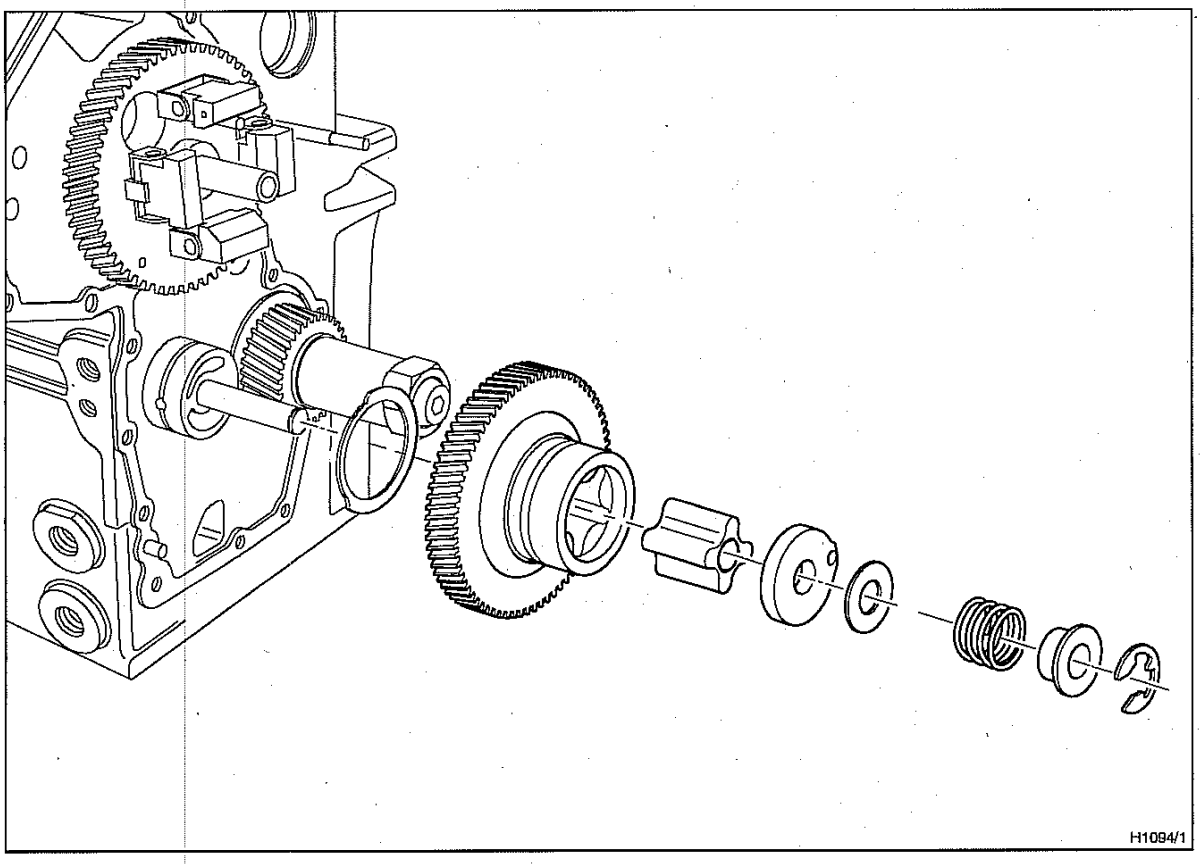
A joint (3) is used on the rear of the timing case PTO cover.



Idler gear and oil pump

To remove and to fit — Operation 6-10

To check the end float, see Operation 6-13.



Idler hub

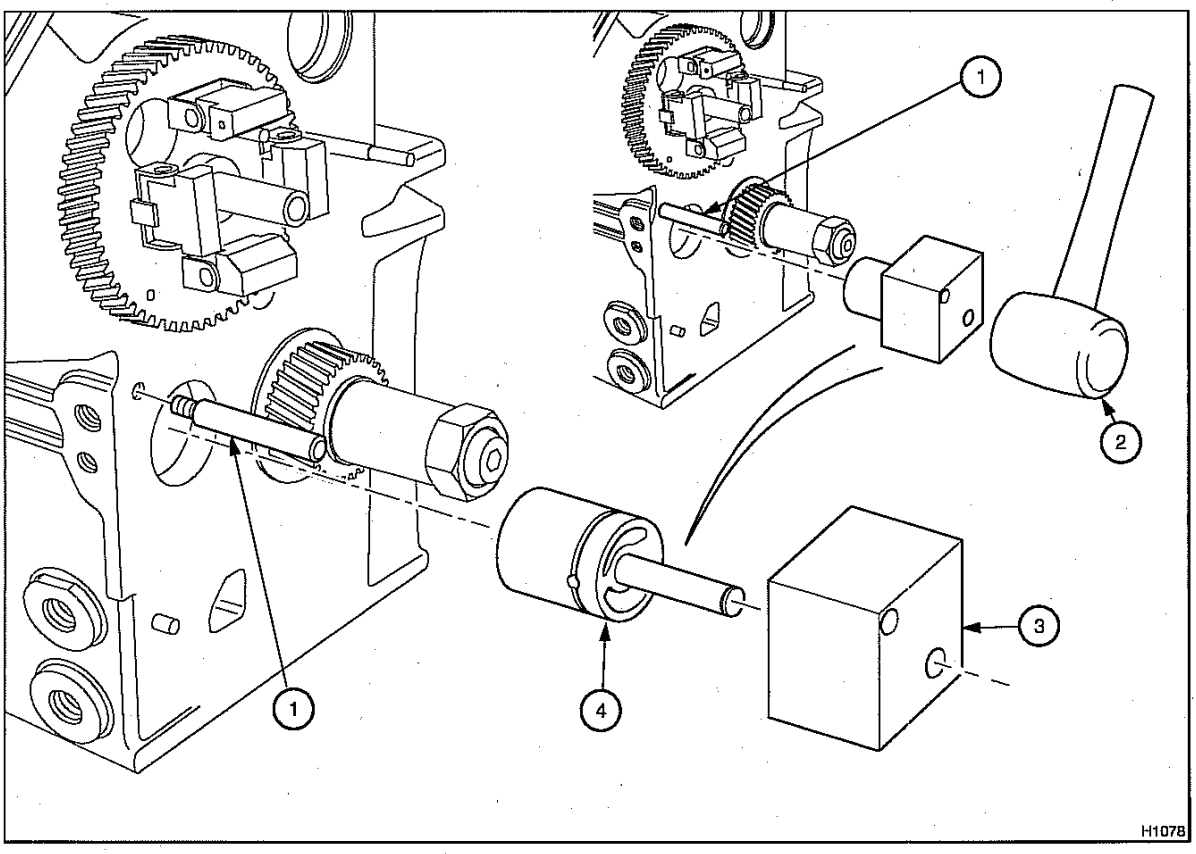
To remove and to fit — Operation 6-11

To remove the lubricating oil pump idler hub the crankshaft must be removed. The oil pump idler hub can then be removed with a suitable drift and hammer from the inside of the engine block.

1 Fit the location pin (1) into the block.
2 Place the idler hub (4) into the idler hub tool (3) and fit on the location pin (1).
3 Using the hammer (2) hit the idler hub tool until the hub is fitted.

Engine	Special tools	
	Description	Part number
403C-11	Idler hub fitting tool	21825625
403C-15 404C-22 404C-22T	Idler hub fitting tool	21825626

Caution: *Always fit a new idler gear hub, do not fit the old hub, as it may be damaged when removed.*

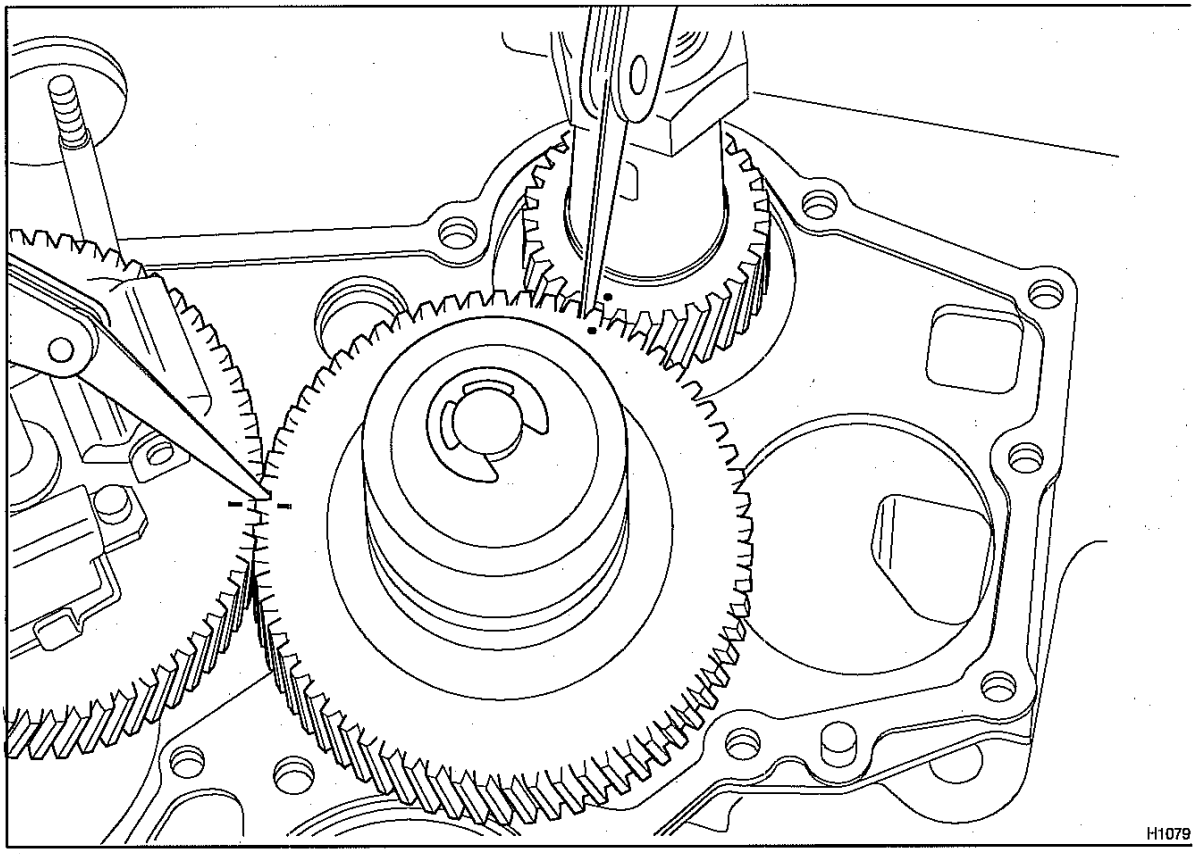


Gear teeth backlash

To check **Operation 6-12**

Engine	Timing gear tolerances mm (in)	
	Standard	Service limit
All models	0,08 (0.0032)	0,25 (0.0098)

Measure the clearances one at a time with a feeler gauge at each of the locations shown. If the measurement is outside the service limit fit new gears.



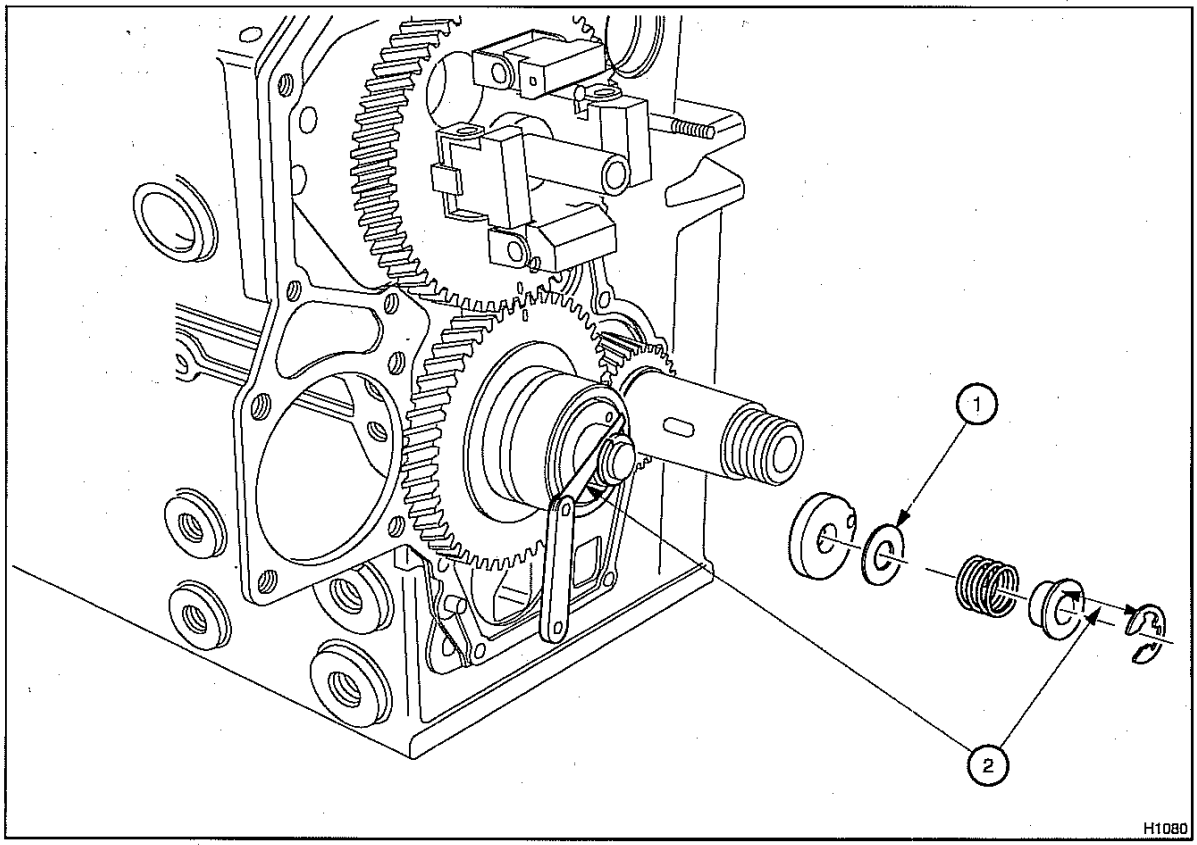
Oil pump end float

To check and adjust — Operation 6-13

Use a feeler gauge to check the oil pump end float (2).

Adjust with 0,1 - 0,15 - 0,2 and 0,5 mm shims (1).

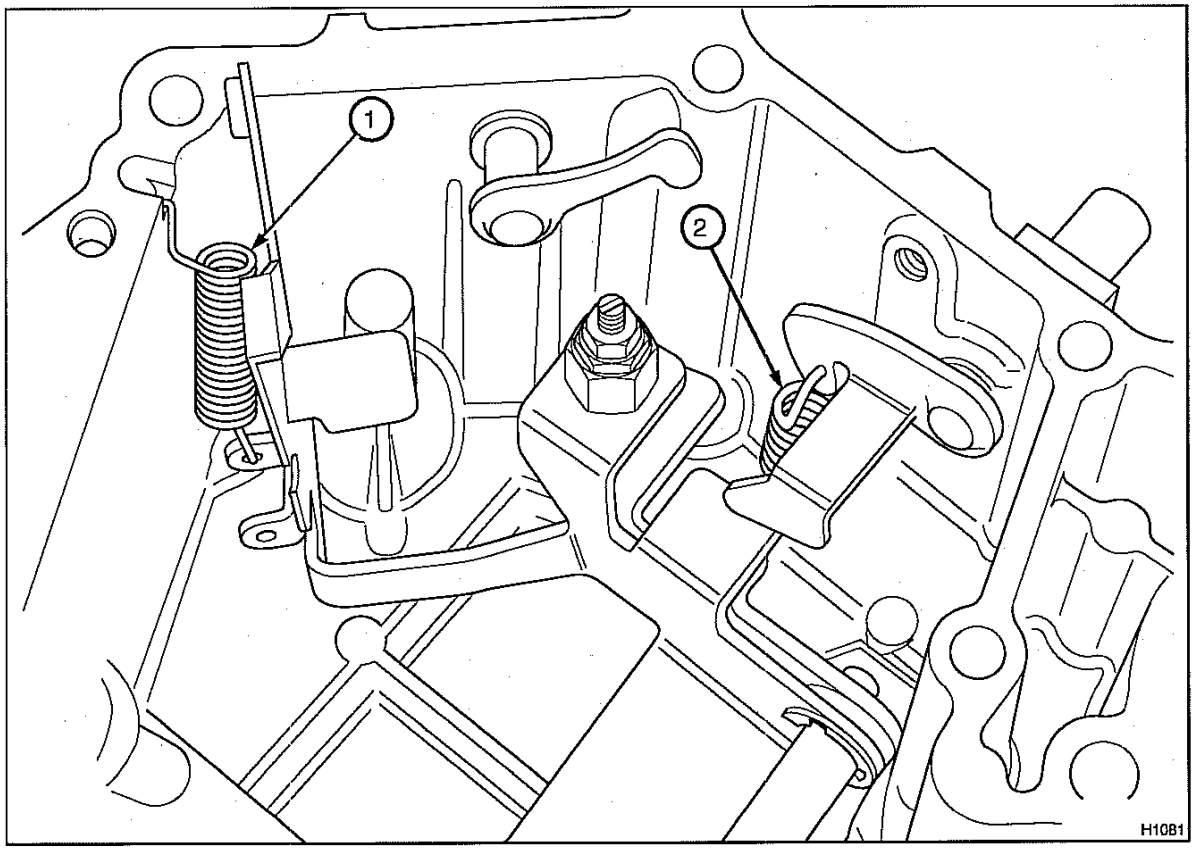
Engine	Standard clearance mm (in)	Service limit mm (in)
All models	0,10 - 0,15 (0.0040 - 0.0060)	0,20 (0.0079)



Governor springs

To inspect **Operation 6-14**

The diagram shows the correct position for the start spring (1) and the governor spring (2).



7

Cylinder block assembly

Front crankshaft bush

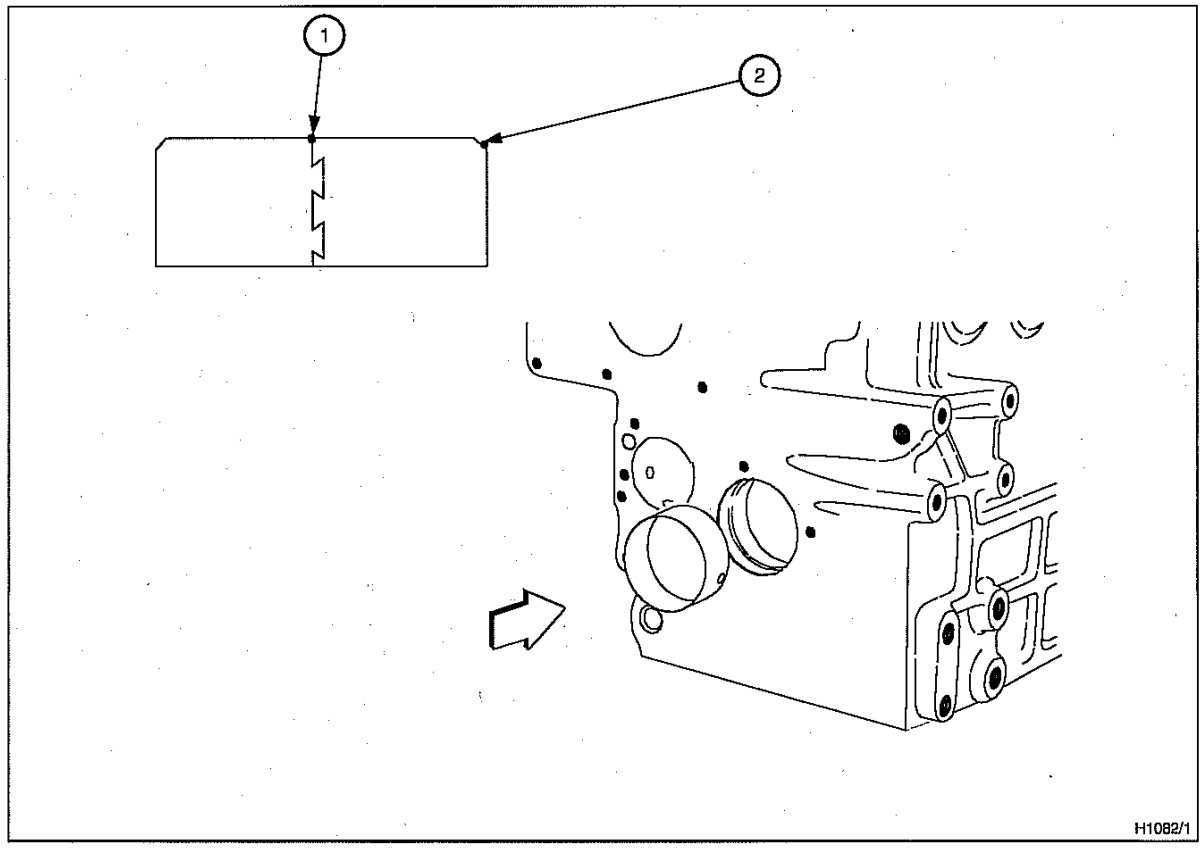
To remove and to fit **Operation 7-1**

Caution: *Ensure that the lubrication oil hole in the bush, aligns with the oil gallery in the block.*

To remove the bush use a suitable drift and hammer from the inside of the block.

Use a suitable press to fit the crankshaft bush.

Note: The bush must be fitted with the chamfered side (2) towards the cylinder block, with the join (1) at the top.



To inspect — Operation 7-2

1 Check the bush for damage, wear and contact. If damaged, worn or poor contact renew the bush.

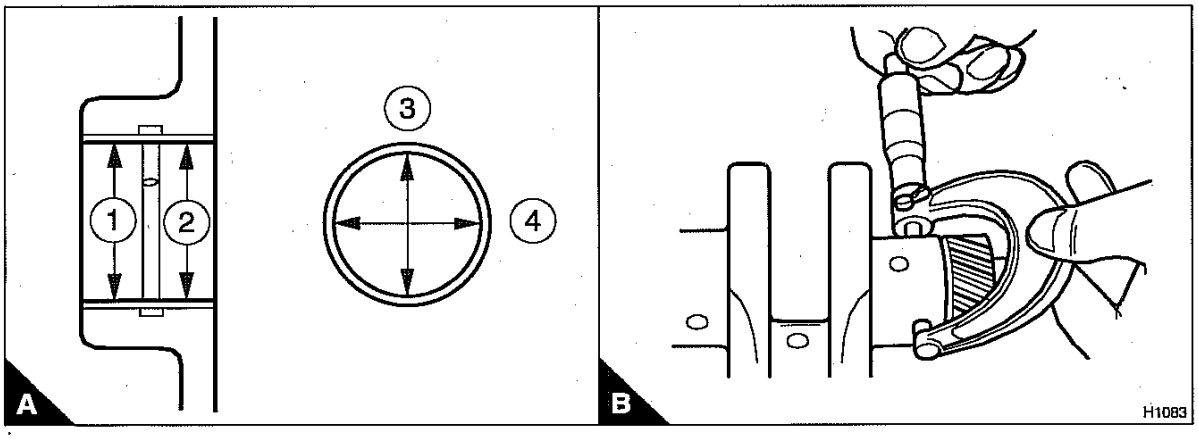
2 Using a cylinder gauge and a micrometer, measure the bush (A) and the crankshaft journal (B) to calculate the clearance.

3 Measure the inside diameters at positions (A1) and (A2) at each position measure in both directions (A3) and (A4) as shown. The oil clearance is the difference between the larger value and the maximum crankshaft journal diameter.

Engine	Standard oil clearance	Service limit
403C-11	0,039 - 0,106 mm (0.00150 - 0.00420 in)	0,20 mm (0.0078 in)
403C-15 404C-22 404C-22T	0,044 - 0,116 mm (0.00173 - 0.00456 in)	0,20 mm (0.0078 in)

4 If the oil clearance exceeds the service limit, renew the bush, or regrind the crankshaft journal and use an undersize bush.

	Bush size	Crankshaft journal O.D finished size
403C-11	Standard	47,964 - 47,975 mm (1.88830 - 1.88880 in)
	0,25 mm (0.01 in)	47,714 - 47,725 mm (1.87850 - 1.87890 in)
	0,50 mm (0.02 in)	47,464 - 47,475 mm (1.86870 - 1.86910 in)
403C-15 404C-22 404C-22T	Standard	67,957 - 67,970 mm (2.67550 - 2.67597 in)
	0,25 mm (0.01 in)	67,707 - 67,720 mm (2.66563 - 2.66614 in)
	0,50 mm (0.02 in)	67,457 - 67,470 mm (2.65579 - 2.65630 in)



Cylinder block top face

To inspect — Operation 7-3

Inspect the cylinder block top face for cracks, damage and warping in the same way as for the cylinder head, see Operation 3-16.

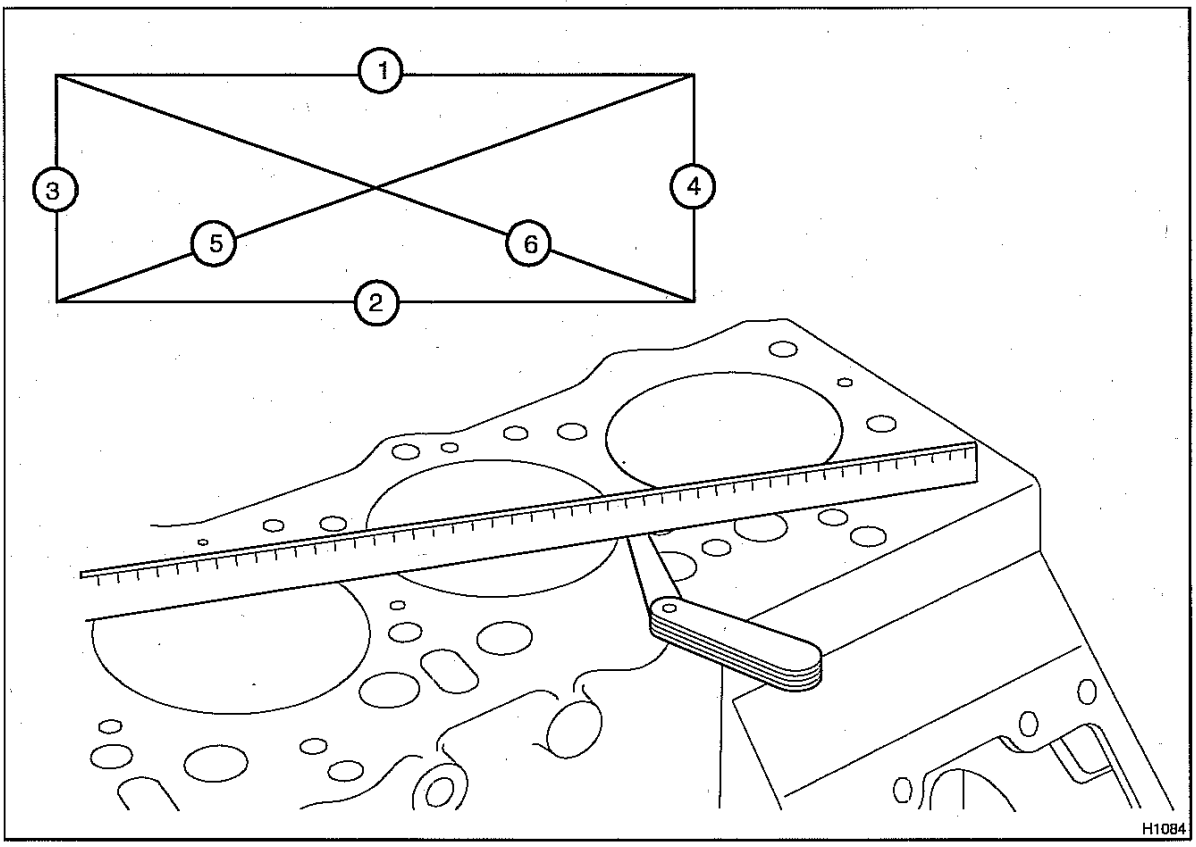
If outside service limit, renew the cylinder block.

Caution: *The fuel adjustment screw must be set by an approved Perkins dealer to ensure that the engine will comply with emissions legislation.*

If the cylinder block is renewed, the engine must be tested on an engine test brake and the fuel adjustment screw set.

If a suitable engine test brake is not available, a long engine is available as a service part.

Engine	Standard value	Service limit
All models	Less than 0,05 mm (0.002 in)	0,12 mm (0.005 in)



Cylinder bore

To inspect — Operation 7-4

1 Visually inspect cylinder bore. There should be no scoring or corrosion.

2 Measure the cylinder bore using a cylinder gauge at the upper, middle and lower areas (piston ring contact area) in the direction of the crankshaft (1) and at the right angle to the crankshaft (2).

3 The upper area in the cylinder block is where the top ring is in contact with the cylinder bore when the piston is at T.D.C. (approximately 10 mm below the cylinder block top face). The lower area is where the oil control ring is in contact with the cylinder bore when the piston is at B. D. C. (about 100 mm from the top face).

Caution: *The 400 Series range of engines must not be flexi honed.*

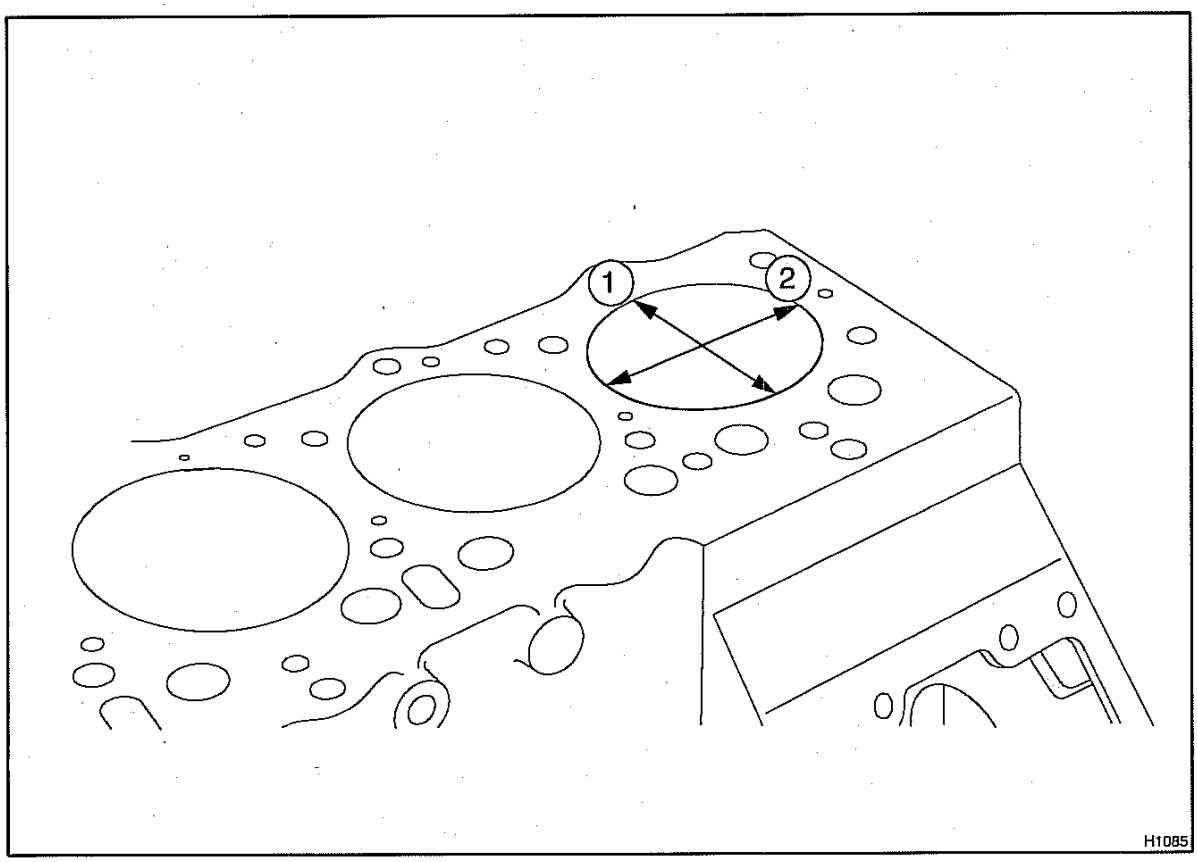
If the bore diameter is larger than the service limit for the engine model listed below, renew the cylinder block with a long engine.

Caution: *The fuel adjustment screw must be set by an approved Perkins dealer to ensure that the engine will comply with emissions legislation.*

If the cylinder block is renewed, the engine should be tested on an engine test brake and the fuel adjustment screw set.

If a suitable engine test brake is not available, a long engine is available as a service part.

Engine	Bore diameter new cylinder block	Service limit
403C-11	77,000 - 77,019 mm (3.03100 - 3.03200 in)	77,200 mm (3.03900 in)
403C-15 404C-22 404C-22T	84,000 - 84,019 mm (3.30710 - 3.30783 in)	84,200 mm (3.31500 in)



8

Engine timing

Injection timing — Operation 8-1

Engine	Maximum rated engine speed rev/min	Injection timing (BTDC)
403C-11 Gen-set	1500	18° ± 1°
403C-11 Gen-set	1800	18° ± 1°
403C-11 Gen-set	3000	23° ± 1°
403C-11 Gen-set	3600	22° ± 1°
403C-11 Industrial	2200	23° ± 1°
403C-11 Industrial	2400	23° ± 1°
403C-11 Industrial	2600	23° ± 1°
403C-11 Industrial	2800	23° ± 1°
403C-11 Industrial	3000	23° ± 1°
403C-15 Gen-set	1500	14° ± 1°
403C-15 Gen-set	1800	14° ± 1°
403C-15 Gen-set	3000	20° ± 1°
403C-15 Gen-set	3600	20° ± 1°
403C-15 Industrial	2200	22° ± 1°
403C-15 Industrial	2400	22° ± 1°
403C-15 Industrial	2600	22° ± 1°
403C-15 Industrial	2800	20° ± 1°
403C-15 Industrial	3000	20° ± 1°
404C-22 Gen-set	1500	12° ± 1°
404C-22 Gen-set	1800	12° ± 1°
404C-22 Gen-set	3000	18° ± 1°
404C-22 Industrial	2200	18° ± 1°
404C-22 Industrial	2400	18° ± 1°
404C-22 Industrial	2600	20° ± 1°
404C-22 Industrial	2800	20° ± 1°
404C-22 Industrial	3000	20° ± 1°
404C-22T Industrial	2800	18° ± 1°

If the fuel injection pump is replaced or renewed, the same shim thickness as originally fitted should be used. The fuel adjustment screw must not be adjusted from the original setting. The maximum no load speed must be checked after assembly.

No service parts are available for the 400 Series fuel injection pump.

To check the timing of the fuel injection pump — Operation 8-2

Engine	Special tools	Part number
All models	Spill pipe	21825680

1 Set the piston for number one cylinder to TDC on the compression stroke. Turn the crankshaft counter clockwise a quarter of a revolution.

2 Remove the ESOS, high pressure fuel pipes and low pressure fuel pipes from the fuel injection pump.

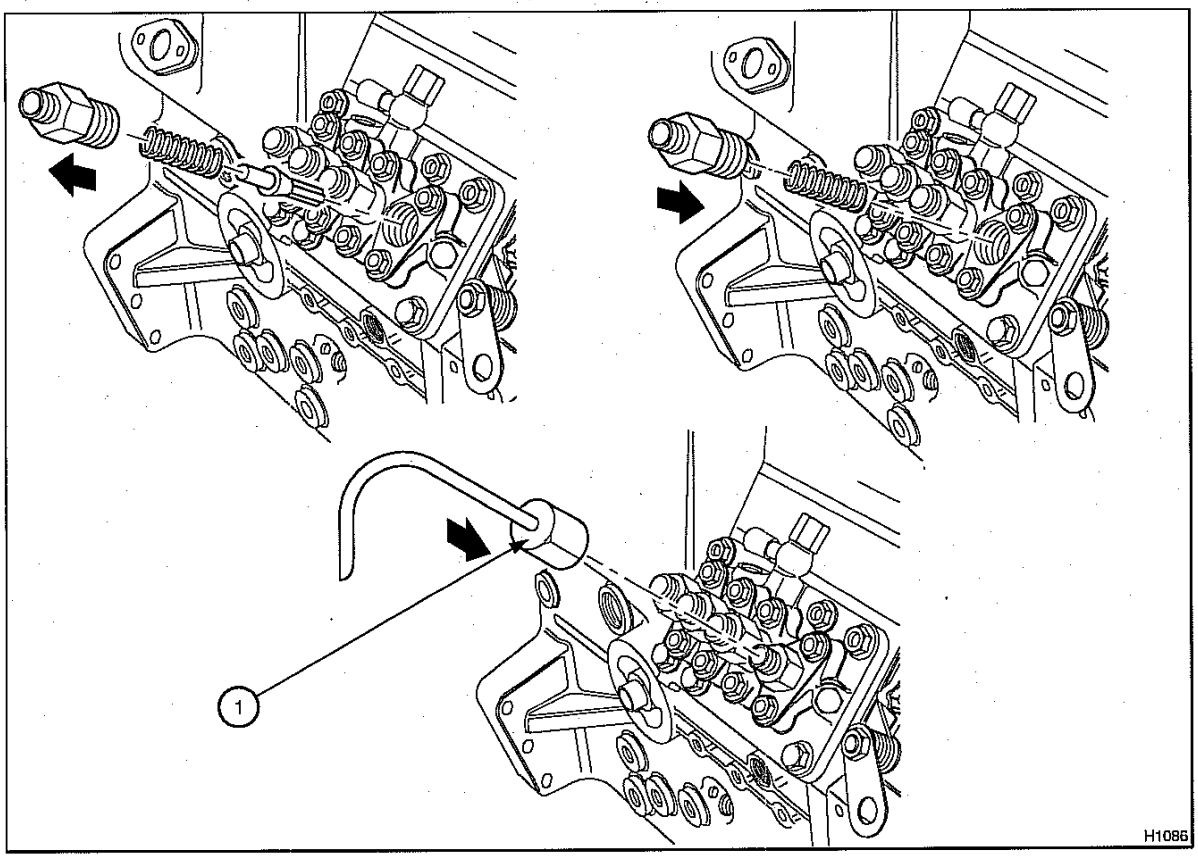
3 Ensure that the fuel pump rack is in the maximum fuel position.

4 Remove the delivery valve holder for number 1 cylinder and remove the delivery valve. Store the delivery valve in clean fuel until assembly.

Note: The fuel pump may have to be removed to an upright position to remove and to fit the delivery valves.

5 Connect the fuel pump spill pipe (1) to the delivery valve holder for number 1 cylinder.

Continued



6 Connect a suitable clean fuel reservoir (1), which has a tap and contains approximately 0,2 litres (¼ pint) of clean fuel, to the fuel injection pump inlet.

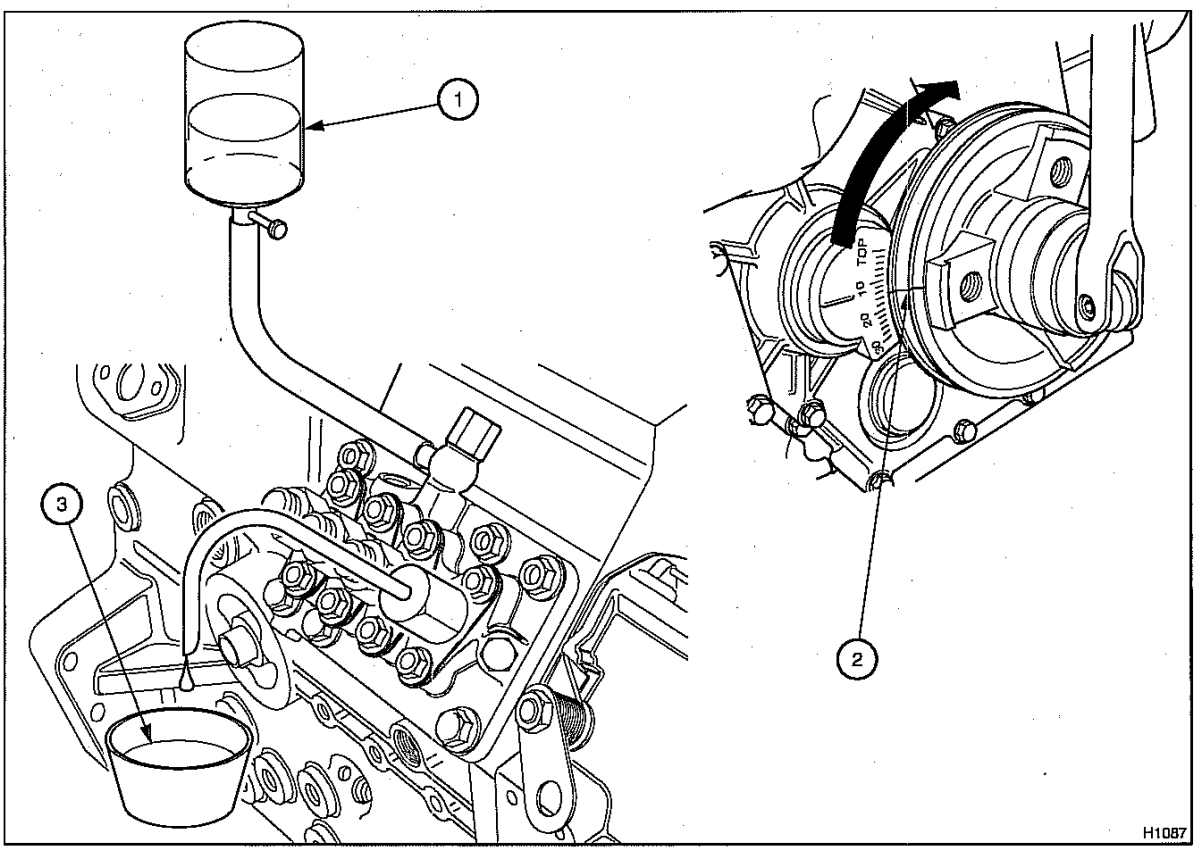
7 Put a suitable waste fuel (3) container below the pipe neck and open the tap, if set correctly the fuel should flow.

Note: The fuel reservoir should be approximately 152 mm (6 in) above the fuel injection pump.

8 Turn the crankshaft slowly until the fuel flow reduces to a drop which falls every 7 - 10 seconds. This is then the timing point.

9 Use the value shown by the timing mark (2) with the injection timing tables on page 69.

Continued



10 If the engine timing is incorrect adjust the thickness of the fuel injection pump shim.

Note: Changing the fuel injection pump shim by 0,1 mm will change the timing by approximately one degree. Thicker shims will retard the timing and thinner shims will advance the timing.

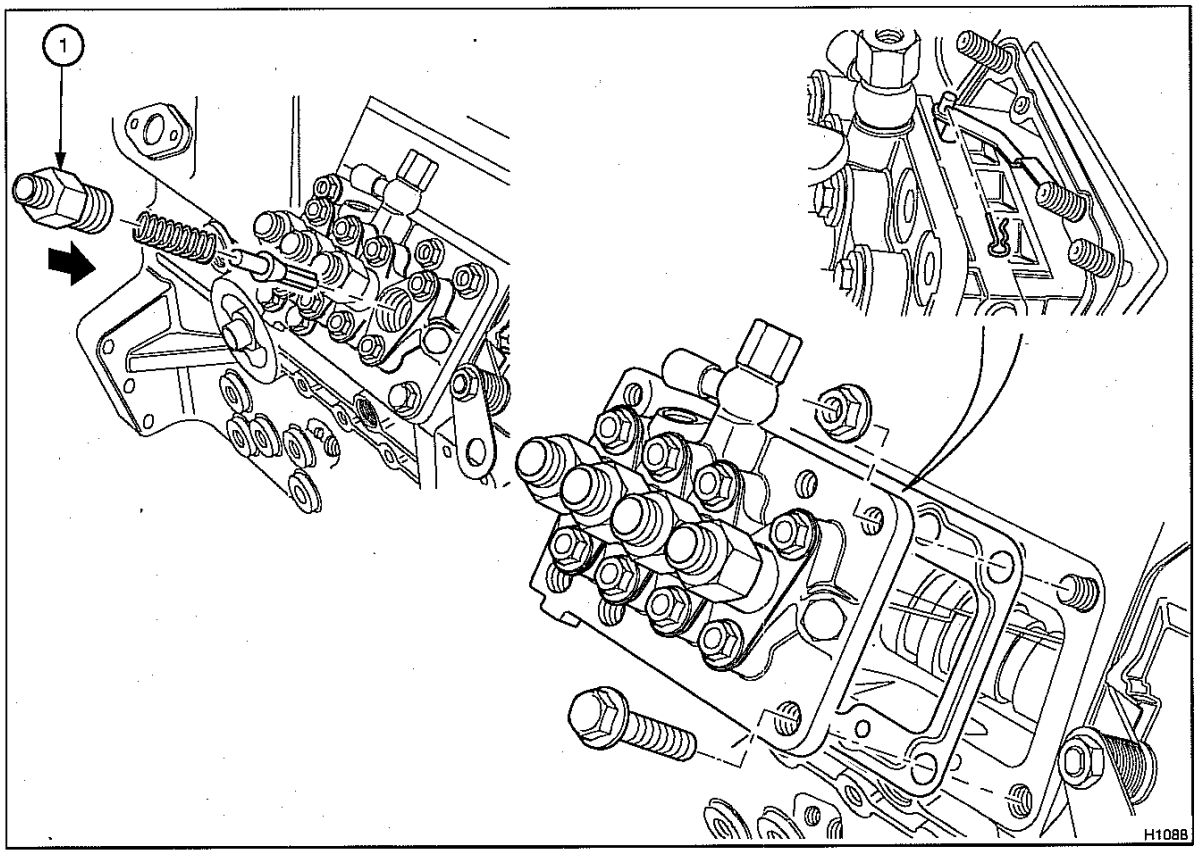
11 Fit the delivery valve (1) and tighten the delivery valve holder.

Caution: *The maximum no load speed must be set by an approved Perkins distributor.*

12 The engine must be tested on an engine test brake to check the maximum no load speed and engine settings after assembly.

Note: There are no service parts available for the 400 Series fuel injection pump.

Engine	Torque Nm (lbf ft) kgf m	
All models	Delivery valve holder	42 (31.0) 4,2



9

Aspiration system

Breather system

Closed circuit, naturally aspirated - to clean and to renew — Operation 9-1

To clean the engine breather assembly

The breather assembly should be renewed every 2000 hours.

Caution: *Ensure that the components of the breather assembly are fitted in their correct position (1 - 6). If they are incorrectly fitted, the engine may be damaged.*

1 Release the four setscrews (2) and remove the breather cover (1), the spring (6) and the diaphragm assembly (4).

Caution: *It is important that the area around the vent hole (3) is clean.*

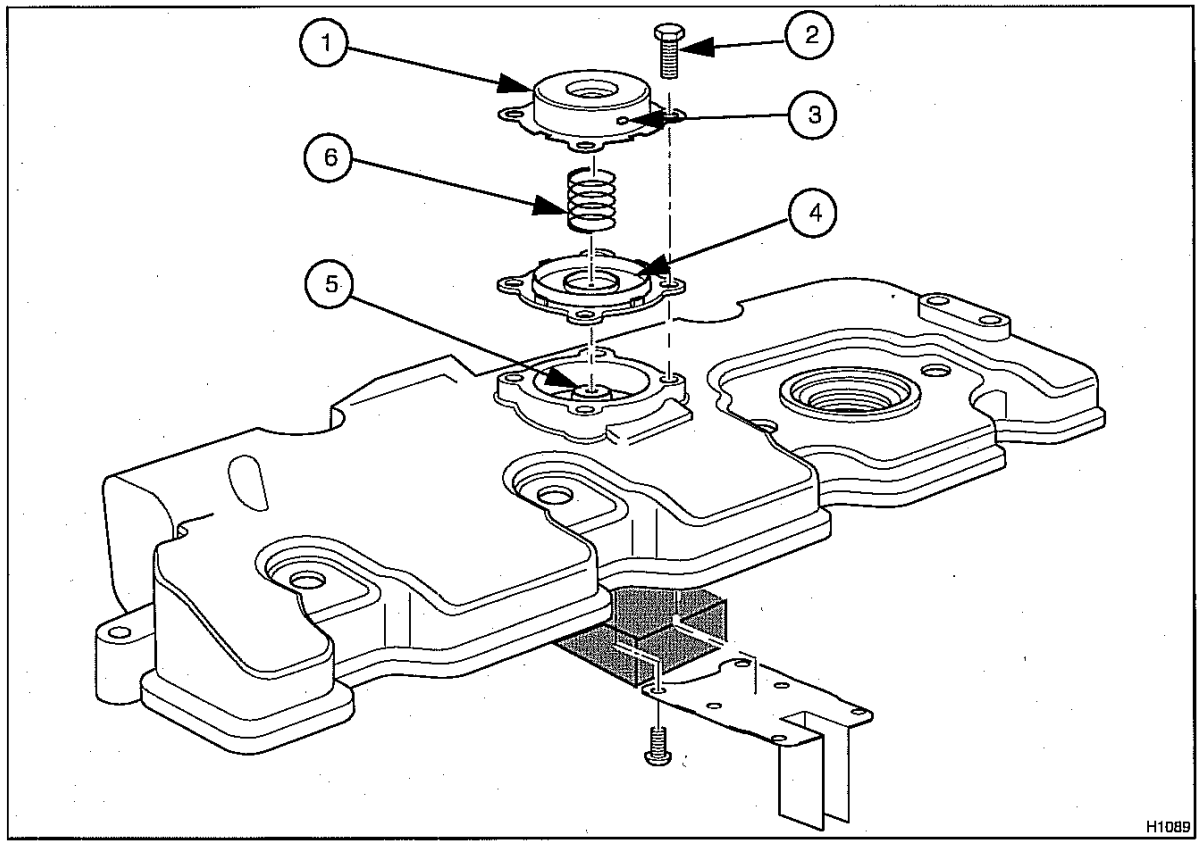
2 Clean the breather cavity (5) in the rocker cover.

3 Clean the breather in clean diesel fuel

4 Fit the breather assembly into the cavity in the rocker cover, ensuring that the breather cover, diaphragm and spring are assembled correctly and that the vent hole (3) faces towards the flywheel.

Tighten the four setscrews.

Clean the breather only with a clean diesel fuel. If the breather is damaged or the diaphragm perforated, renew the breather.



Closed circuit turbo charged - to clean and to renew — Operation 9-2

To clean the engine breather assembly

The breather assembly should be renewed every 2000 hours.

Caution: *Ensure that the components of the breather assembly are fitted in their correct position (1 - 7). If they are incorrectly fitted, the engine may be damaged.*

1 Release the four setscrews (2) and remove the breather cover (1), the spring (7), the diaphragm assembly (4) and the adaptor (6).

Caution: *It is important that the area around the vent hole (3) is clean.*

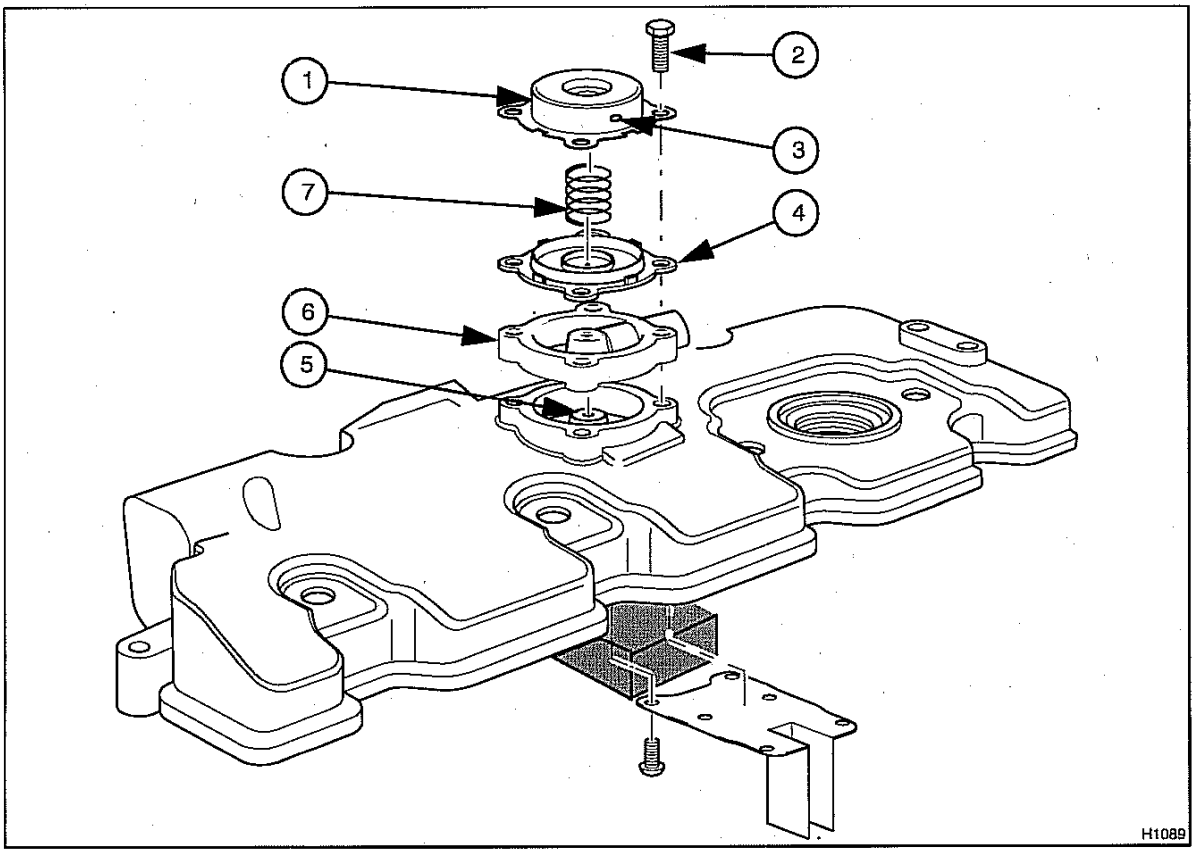
2 Clean the breather cavity (5) in the rocker cover.

3 Clean the breather in clean diesel fuel.

4 Fit the breather assembly into the cavity in the rocker cover, ensuring that the breather cover, diaphragm and spring are assembled correctly and that the vent hole (3) faces towards the flywheel.

Tighten the four setscrews.

Clean the breather only with a clean diesel fuel. If the breather is damaged or the diaphragm perforated, renew the breather.



Turbocharger

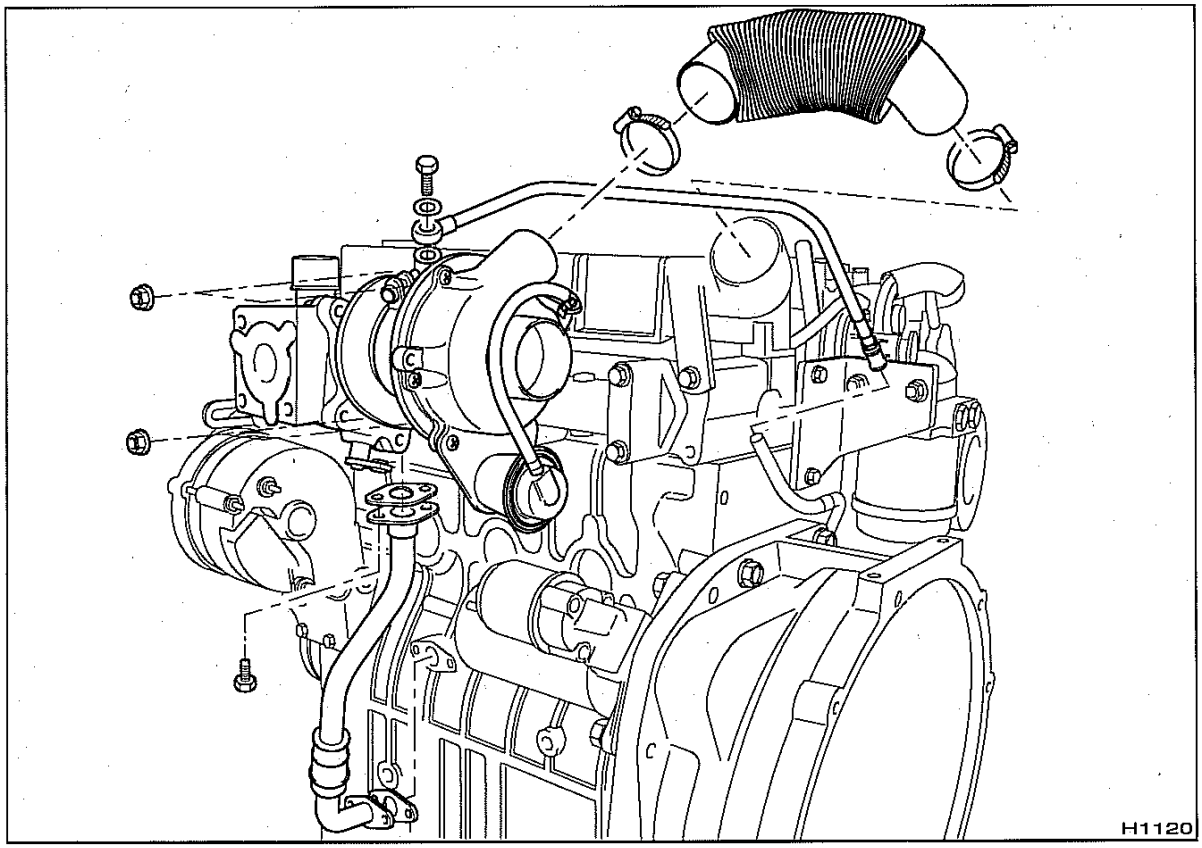
To remove and to fit **Operation 9-3**

Engine	Torque Nm (lbf ft) kgf m	
404C-22T	Turbocharger to manifold nuts	25 (18.4) 2.5
	Elbow securing set screws	32,4 (23.9) 3,3
	Oil feed pipe banjo bolt to turbocharger	20 (14.8) 2,0
	Oil drain pipe set screws	10 (7.3) 1,0
	Oil feed pipe set screws to cylinder block	

The turbocharger is fitted only to the 404C-22T engine.

Caution: *The bearing housing of the turbocharger must be lubricated with clean engine oil on assembly.*

Note: There is an 'O' ring fitted between the oil feed pipe for the turbocharger and the cylinder block.



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10

Lubrication system

Lubricating oil canister

To fit **Operation 10-1**

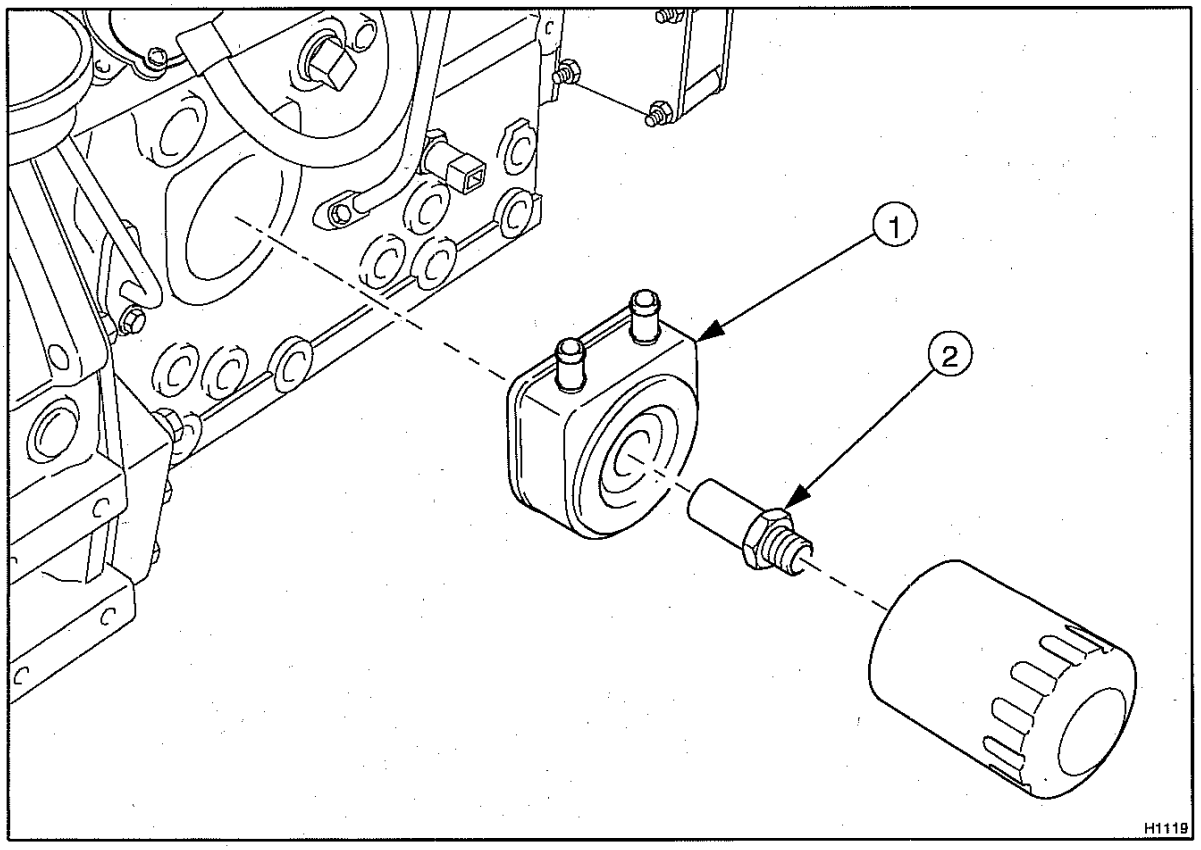
1 Lubricate the seal with clean engine oil before assembly.

2 Tighten by hand until the seal contacts the mounting face of the block.

3 Tighten the canister by a further ½ to ¾ of a turn by hand only.

Note: Do not overtighten oil filter.

4 The modine cooler (1) and fastener (2) are fitted only to the 404C-22T.



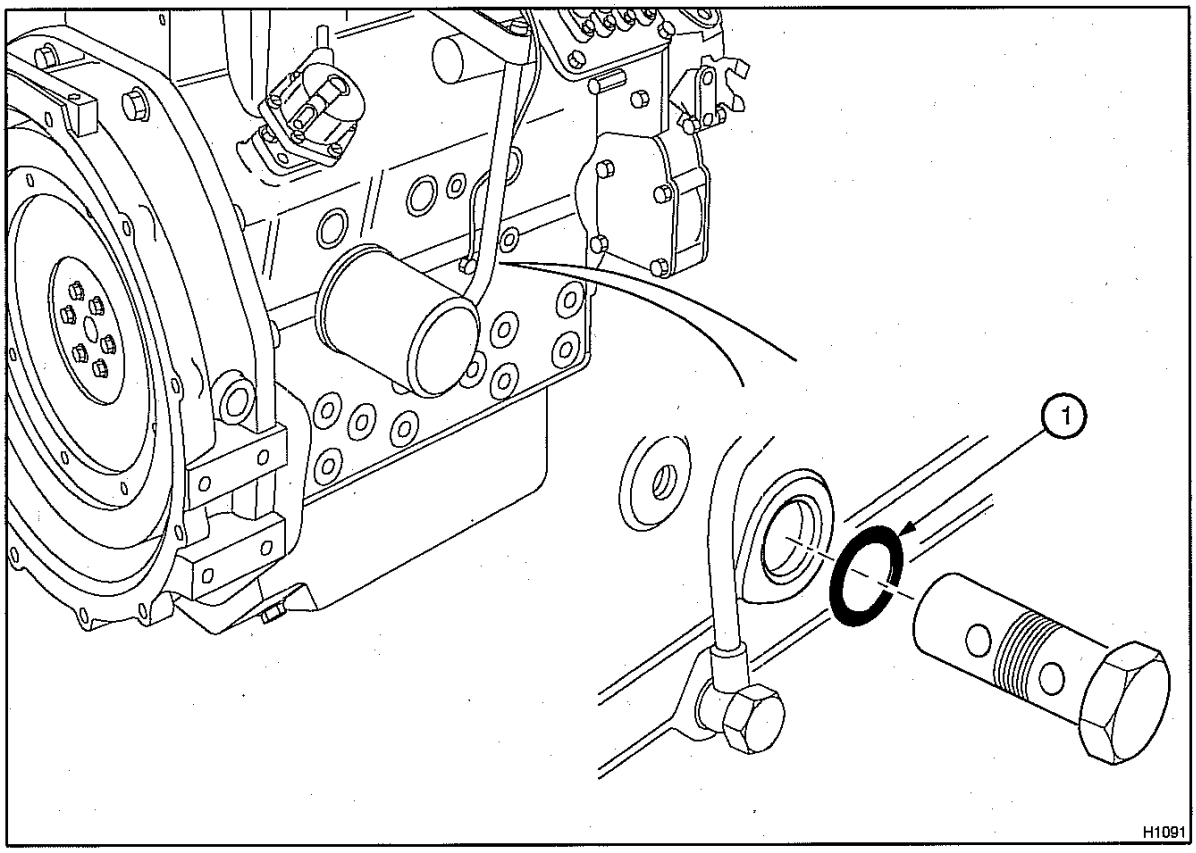
Pressure relief valve

To remove and to fit **Operation 10-2**

Engine	Torque Nm (lbf ft) kgf m	
All models	Pressure relief valve	64 (47) 6,5

Renew the 'O' ring (1) when the pressure relief valve is fitted to the cylinder block.

Caution: *When the crankshaft is removed or fitted the pressure relief valve must be removed first.*

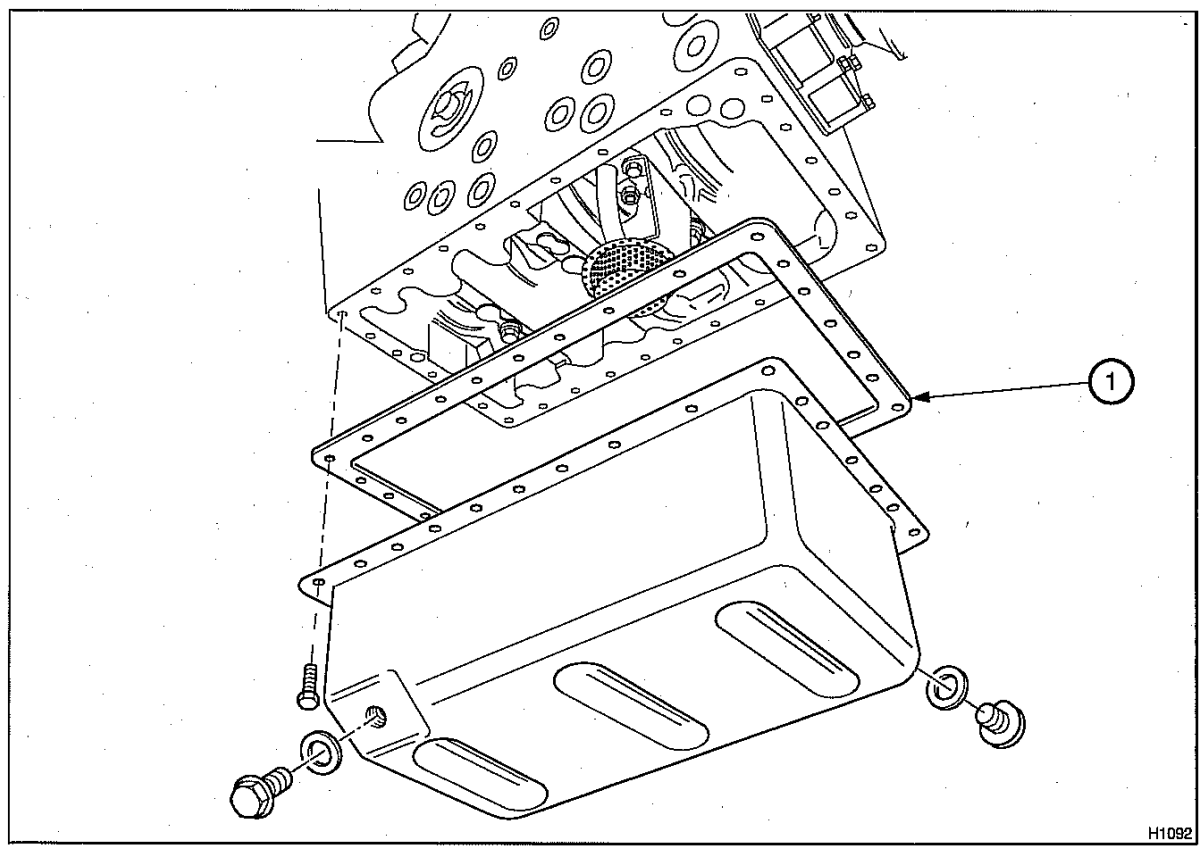


Lubricating oil sump

To remove and to fit **Operation 10-3**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Sump setscrews	6 (4.4) 0,6
	Sump drain plug	35 (25.8) 3,5
403C-15 404C-22 404C-22T	Sump setscrews	11 (8) 1,1
	Sump drain plug	35 (25.8) 3,5

Note: When the sump is fitted renew the joint (1).

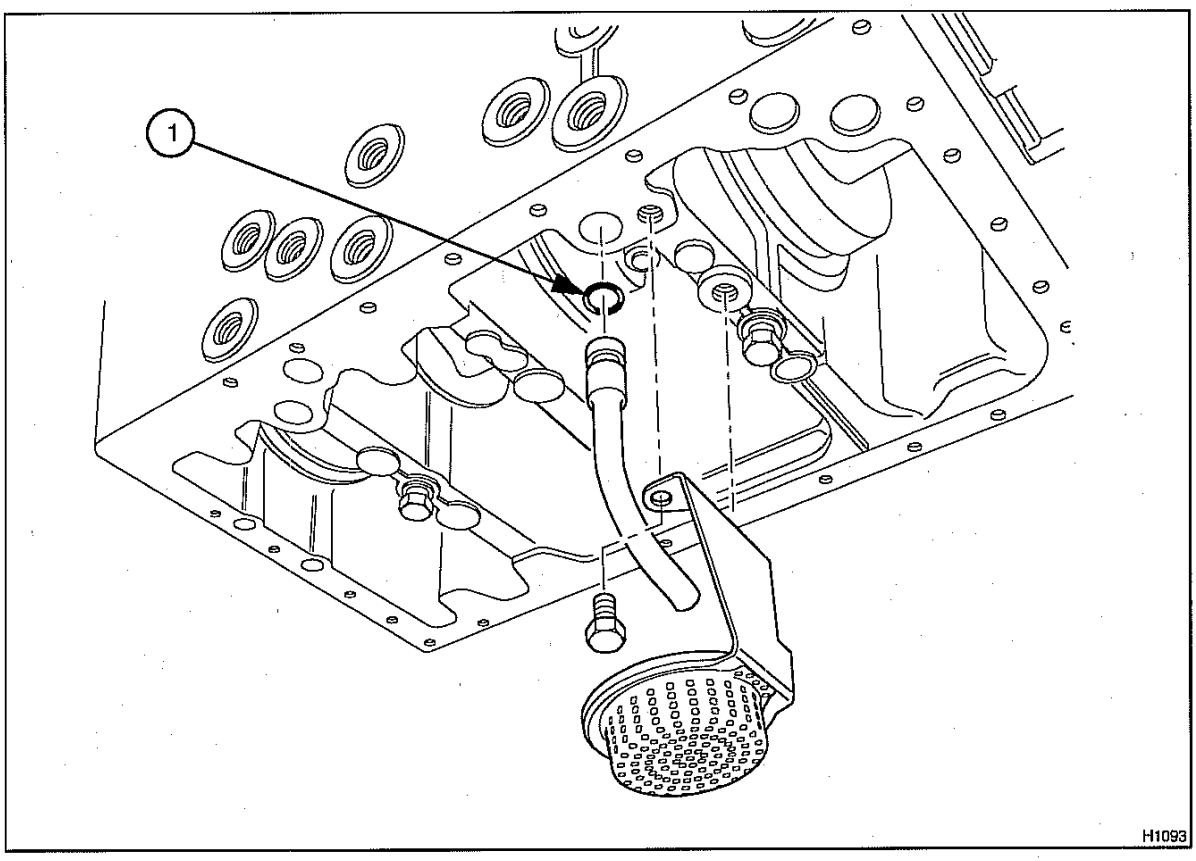


Lubricating oil strainer and suction pipe

To remove and to fit **Operation 10-4**

Engine	Torque Nm (lbf ft) kgf m	
All models	Suction strainer setscrews	11 (8) 1,1

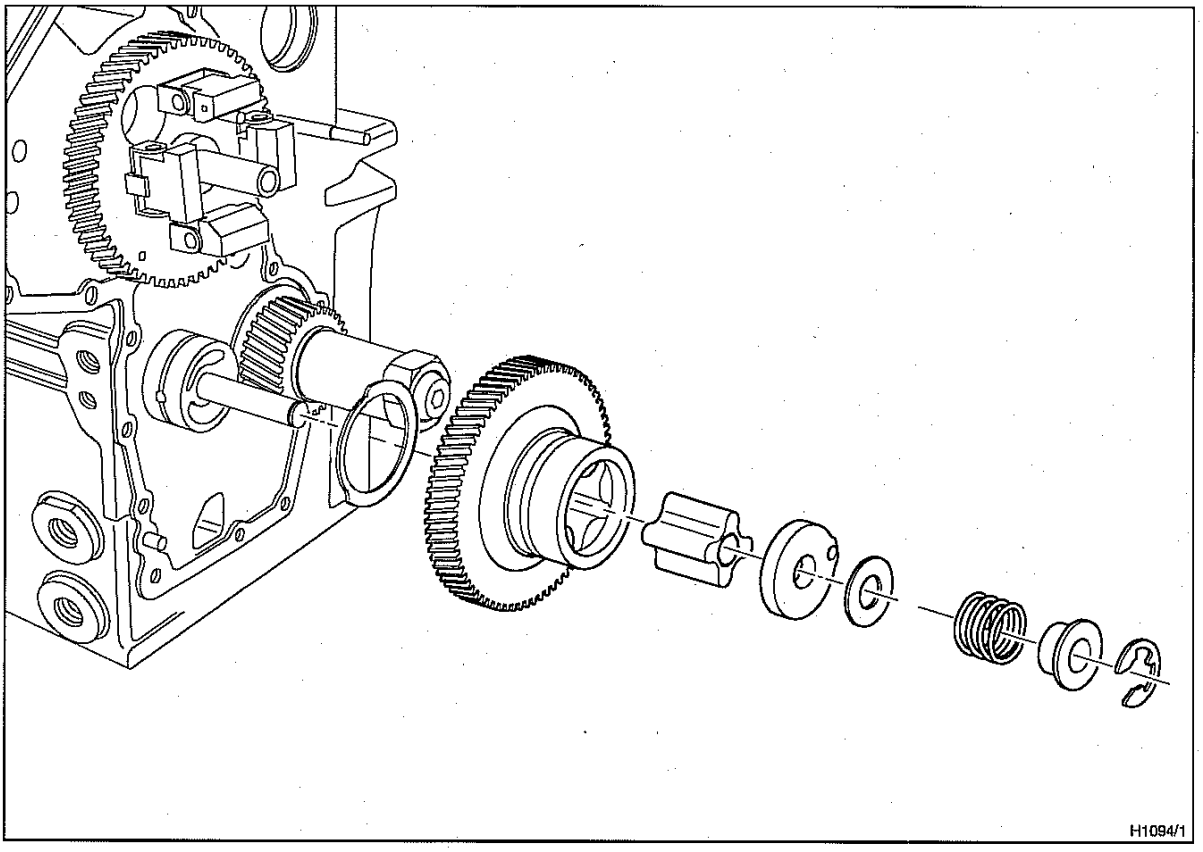
Renew the "O" ring (1) before the suction pipe is fitted.



Lubricating oil pump

To remove and to fit **Operation 10-5**

To check the end float, see Operation 6-13.

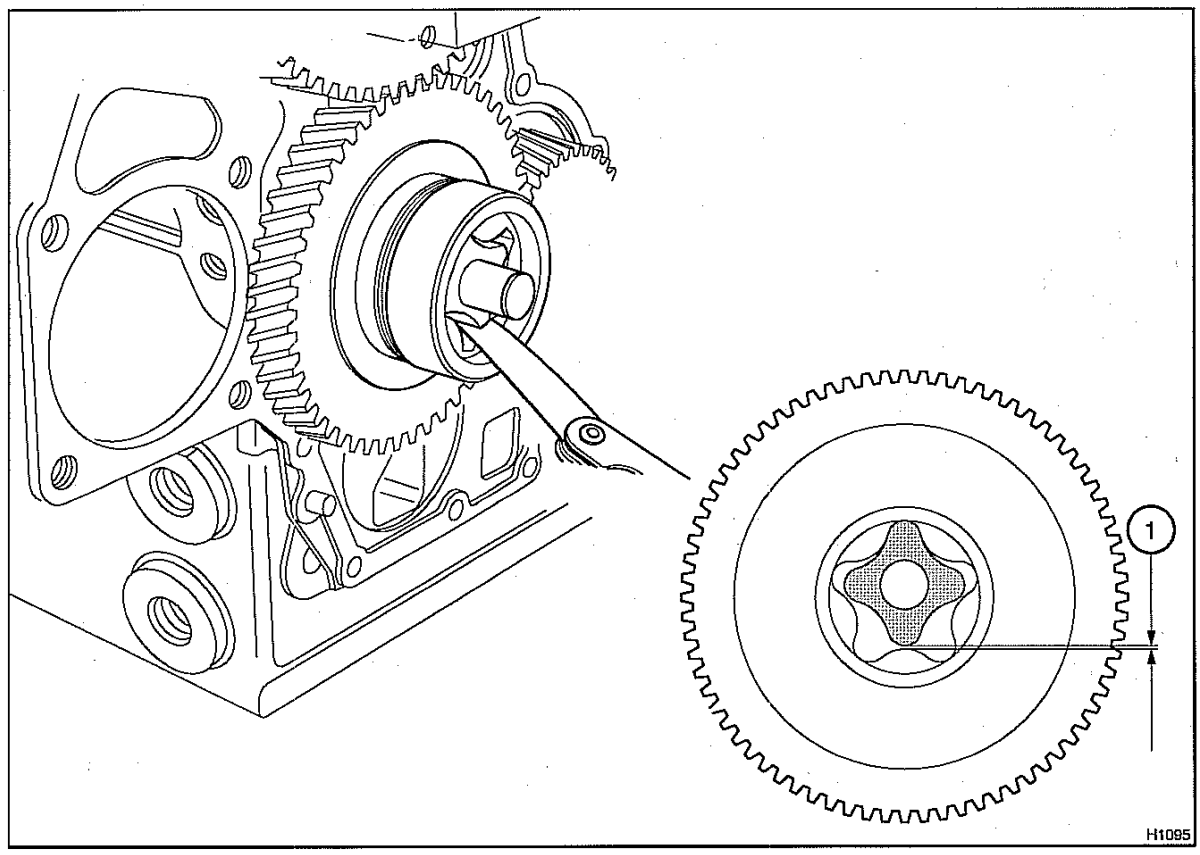


Rotor tip clearance

To inspect **Operation 10-6**

Engine	Clearance standard limit	Service limit
All models	0,01 - 0,15 mm (0.0004 - 0.0060 in)	0,25 mm (0.0098 in)

Inner rotor to outer rotor (1).



Oil pressure switch

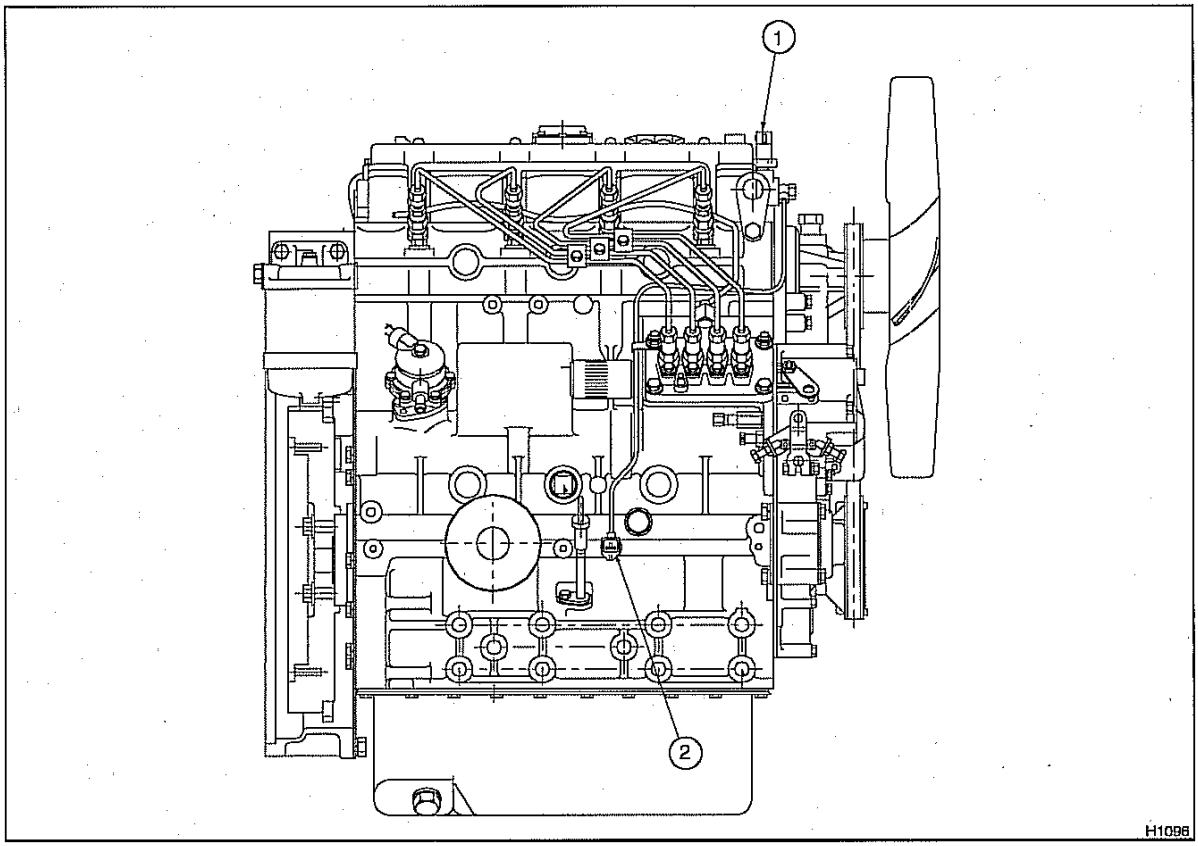
To remove and to fit **Operation 10-7**

Engine	Torque Nm (lbf ft) kgf m	
All models	Oil pressure switch	10 (7.3) 1,0

The lubricating oil pressure switch can be found in two positions.

1 If fitted on the top cover, the switch (1) is brown in colour and rated to 0,3 kgf/cm² (4.27 lbf/in²).

2 If fitted on the cylinder block, the switch (2) is blue in colour and rated to 1,0 kgf/cm² (14.22 lbf/in²).



Lubricating oil pipes

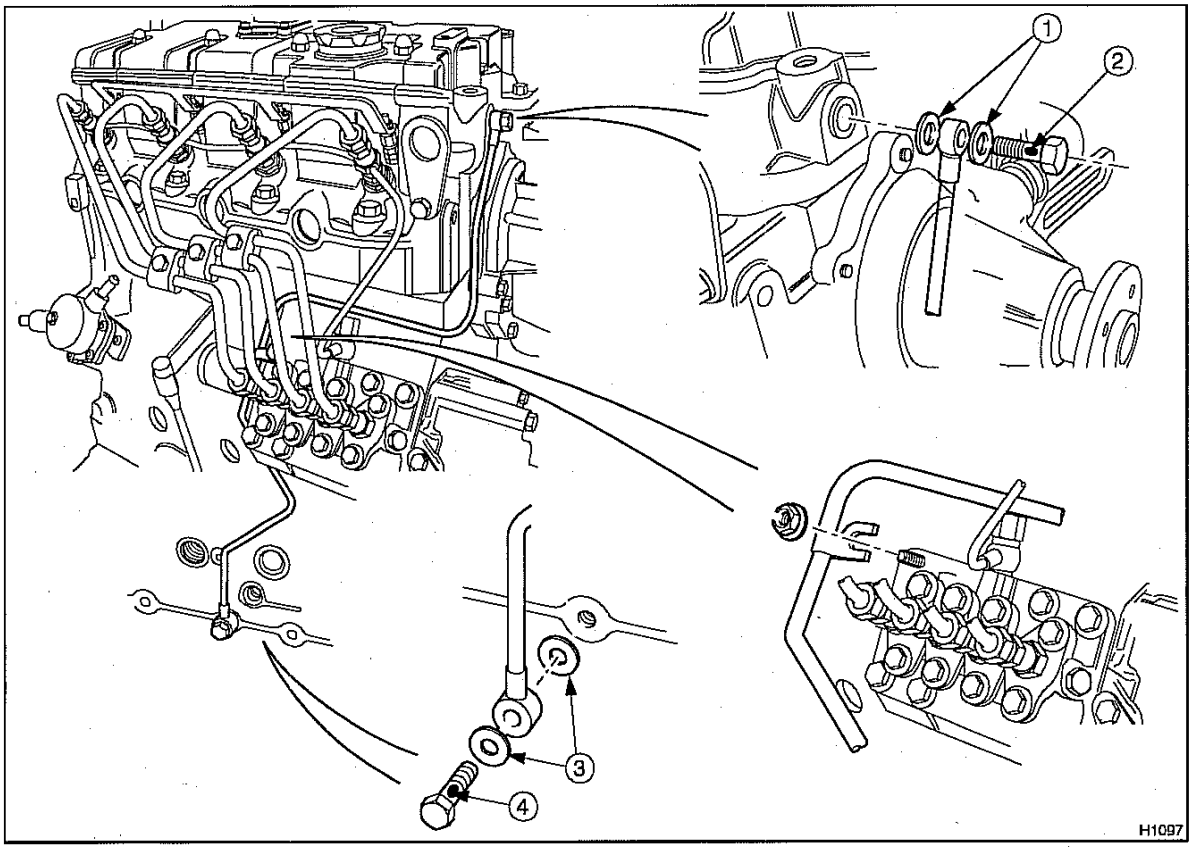
To remove and to fit **Operation 10-8**

Engine	Torque Nm (lbf ft) kgf m	
All models	Banjo bolt	12 (8.8) 1,2

Note: The lubricating oil flow through the banjo bolt (2 and 4) is restricted.

Check the pipe for leaks and damage.

When fitting use new washers (1) and (3).



11

Fuel system

Atomisers

To remove and to fit **Operation 11-1**

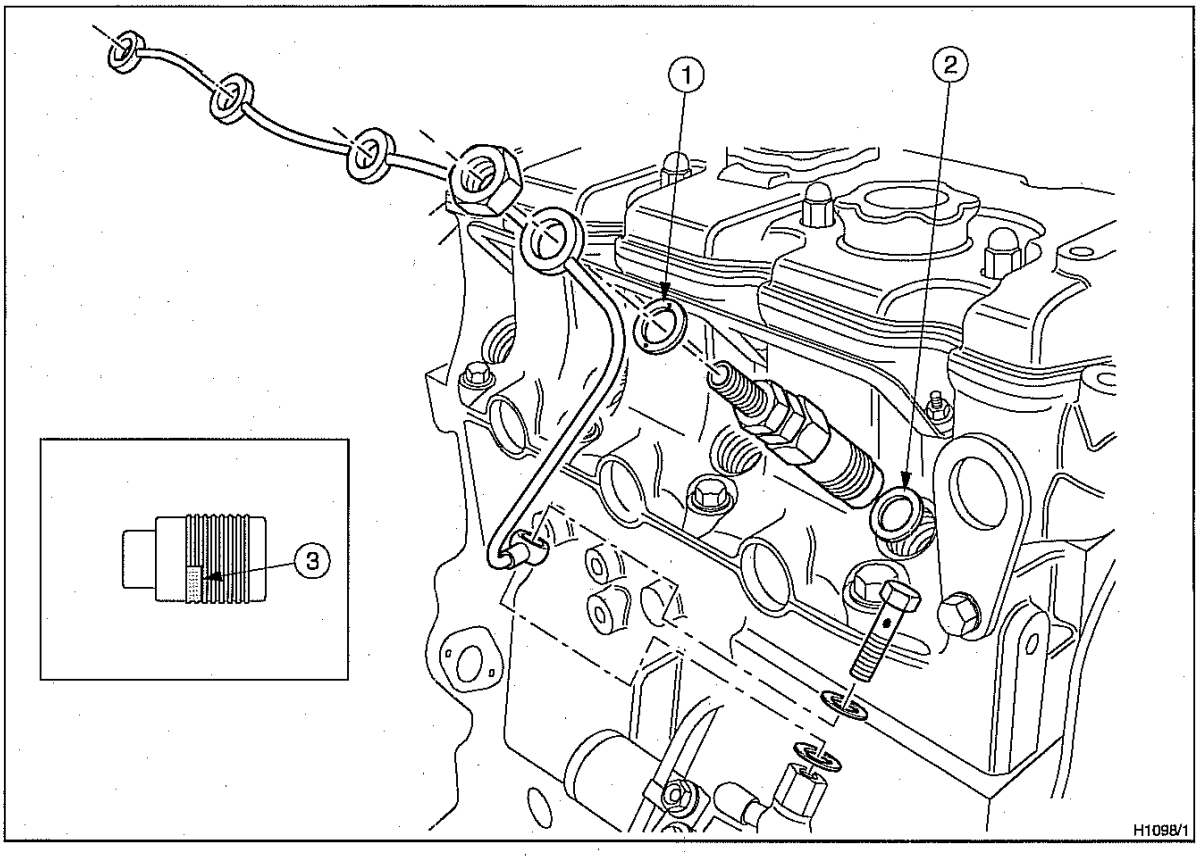
Engine	Torque Nm (lbf ft) kgf m		Test pressure kgf/cm² (lbf/in²) ats
All models	Atomiser	64 (47) 6,5	150 (2133) 145
	Atomiser high-pressure pipes	23 (16.9) 2,3	
	Nut - leak off-rail	27 (19.9) 2,7	

***Cautions*:**

- *Use only deep sockets for this operation.*
- *Connections should be blanked off until assembly.*
- *Washer (1) has two small holes 180° apart.*
- *Discard old washer (2), on assembly fit new nozzle washer.*

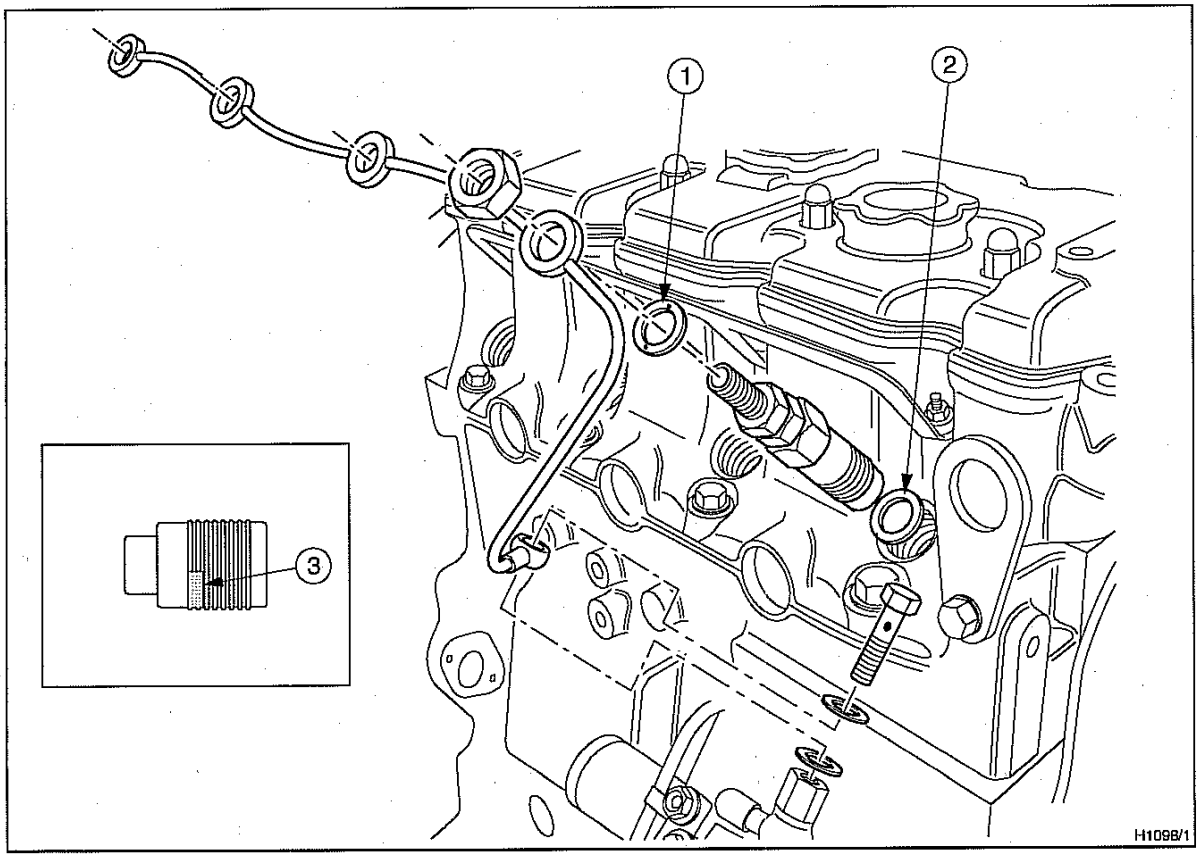
Note: If the atomisers or injection pipes are replaced it is essential that the fuel adjustment screw is not altered from the original settings. The maximum no load speed must be checked after assembly.

Continued



Before fitting the atomiser, clean and dry the male and female threads of the atomiser and the cylinder head.

Apply a 2 mm (0.08 in) bead of sealant POWERPART universal jointing compound, part number 1861117, to extend 6 mm (0.24 in) along the first two threads of the atomiser (3).



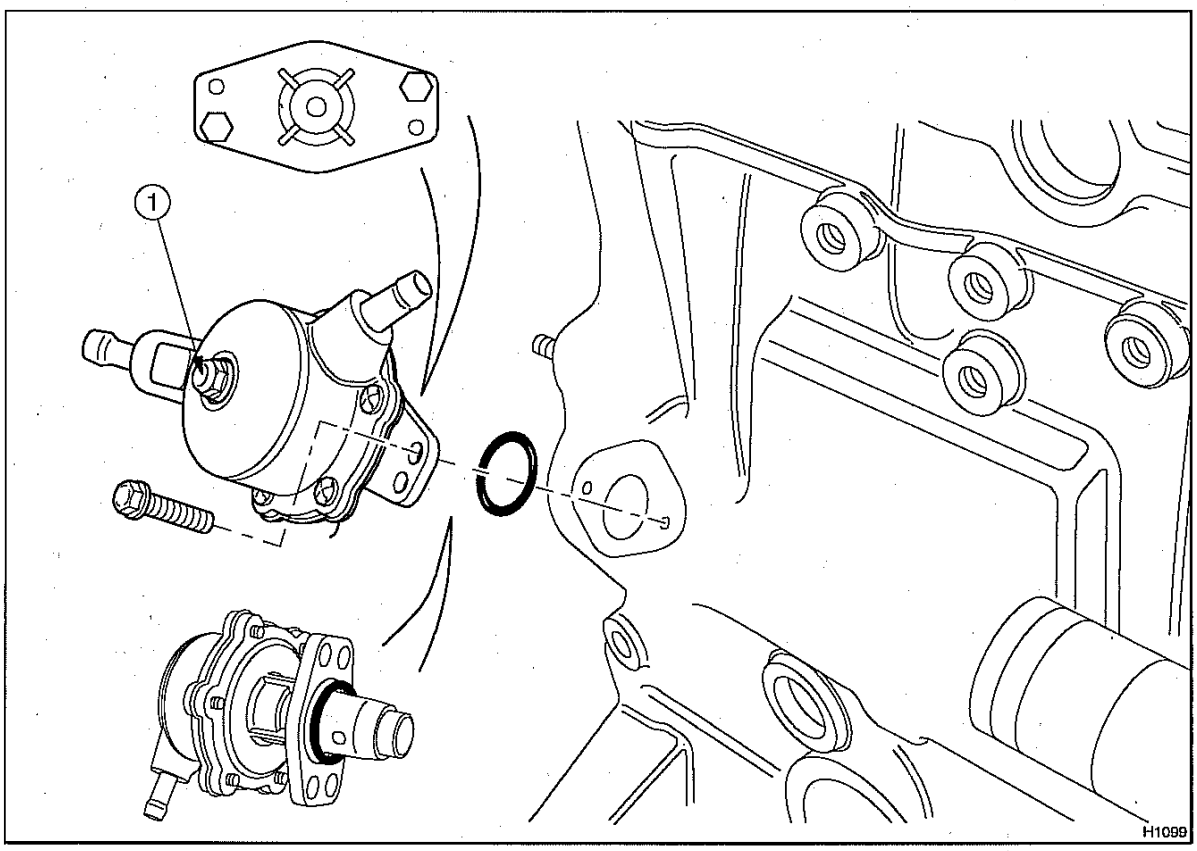
Fuel lift pump

To remove and to fit **Operation 11-2**

Engine	Torque Nm (lbf ft) kgf m	
All models	Lift pump setscrew	6 (4.4) 0,6
	Lift pump inlet adjusting bolt (1)	2,5 (1.8) 0,25

The fuel inlet for the fuel lift pump can rotate 360° and is adjustable in 15° increments.

The fuel lift pump flange has two sets of locating holes this allows the pump to be fitted in four positions for the outlet connection.



Fuel injection pump

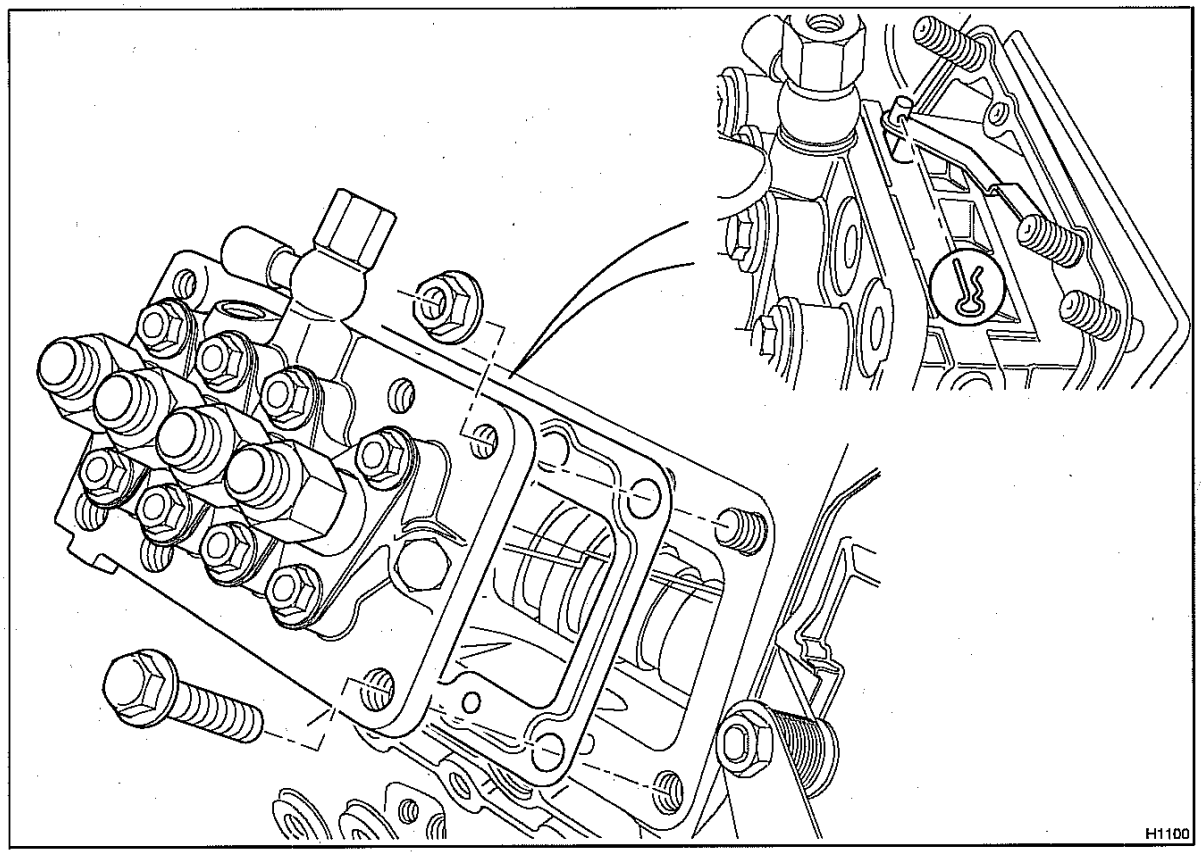
To remove and to fit **Operation 11-3**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Fuel injection pump fasteners	6 (4.4) 0,6
403C-15 404C-22 404C-22T	Fuel injection pump fasteners	15 (11) 1,5

Caution: *Connections should be blanked off until assembly.*

Notes:

- If the fuel injection pump is renewed, shims of the same thickness as originally fitted should be used.
- If a new fuel injection pump is fitted, it should be replaced with a fuel pump with the same part number as originally fitted.
- When the fuel injection pump is replaced it is essential that the fuel adjustment screw is not altered from the original setting. The maximum no load speed should be checked after assembly.



To eliminate air from the fuel system — Operation 11-4

1 Loosen the vent screw on the fuel filter (1).

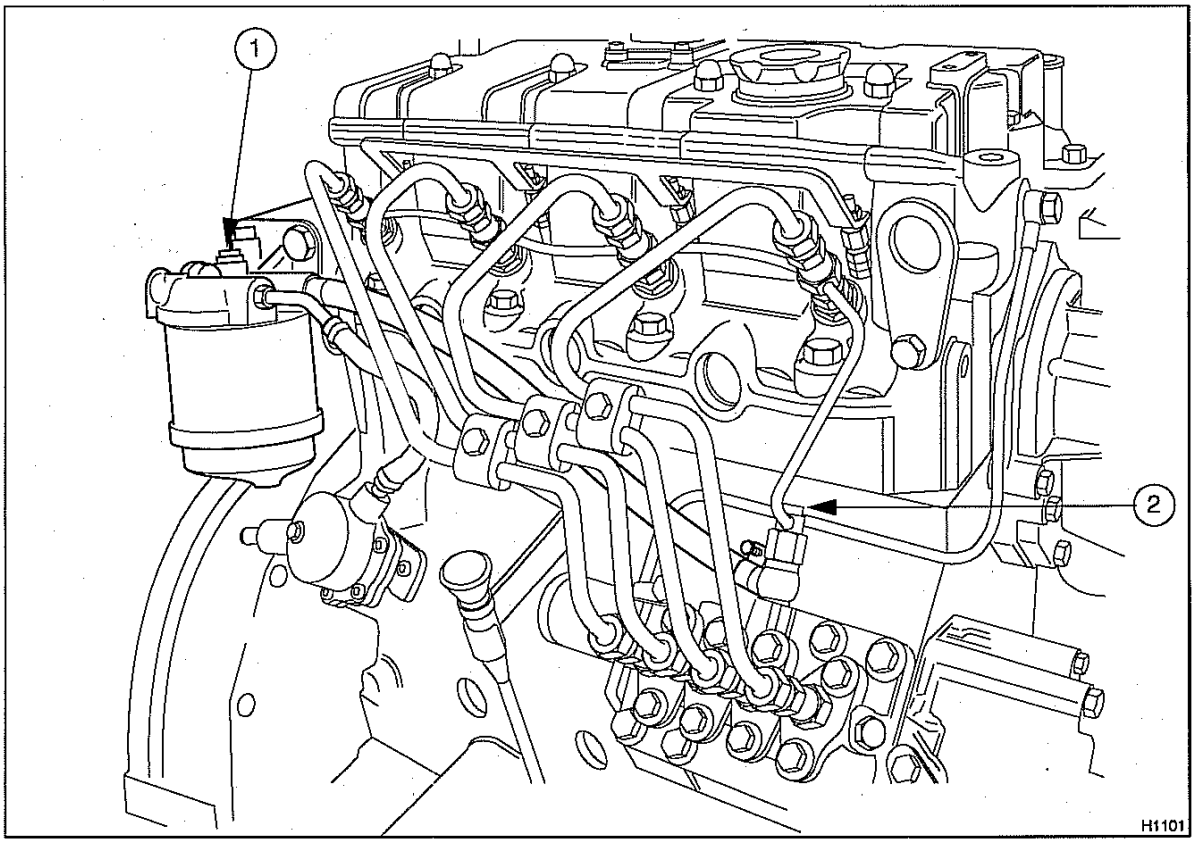
2 Operate the hand primer until fuel, free of air, flows from the vent screw. Tighten the vent screw (1).

3 loosen the vent screw on the fuel injection pump (2). Operate the hand primer until fuel, free of air, flows. Tighten the vent screw (2).

4 Attempt to start the engine using the starter motor for a maximum of 15 seconds, wait for 30 seconds before trying again.

Cautions:

- *When using the starter motor, do not exceed continuous rotation of more than 15 seconds periods. If the engine does not run, on initial rotation, wait for 30 seconds and try again.*
- *Connections should be blanked off until assembly.*



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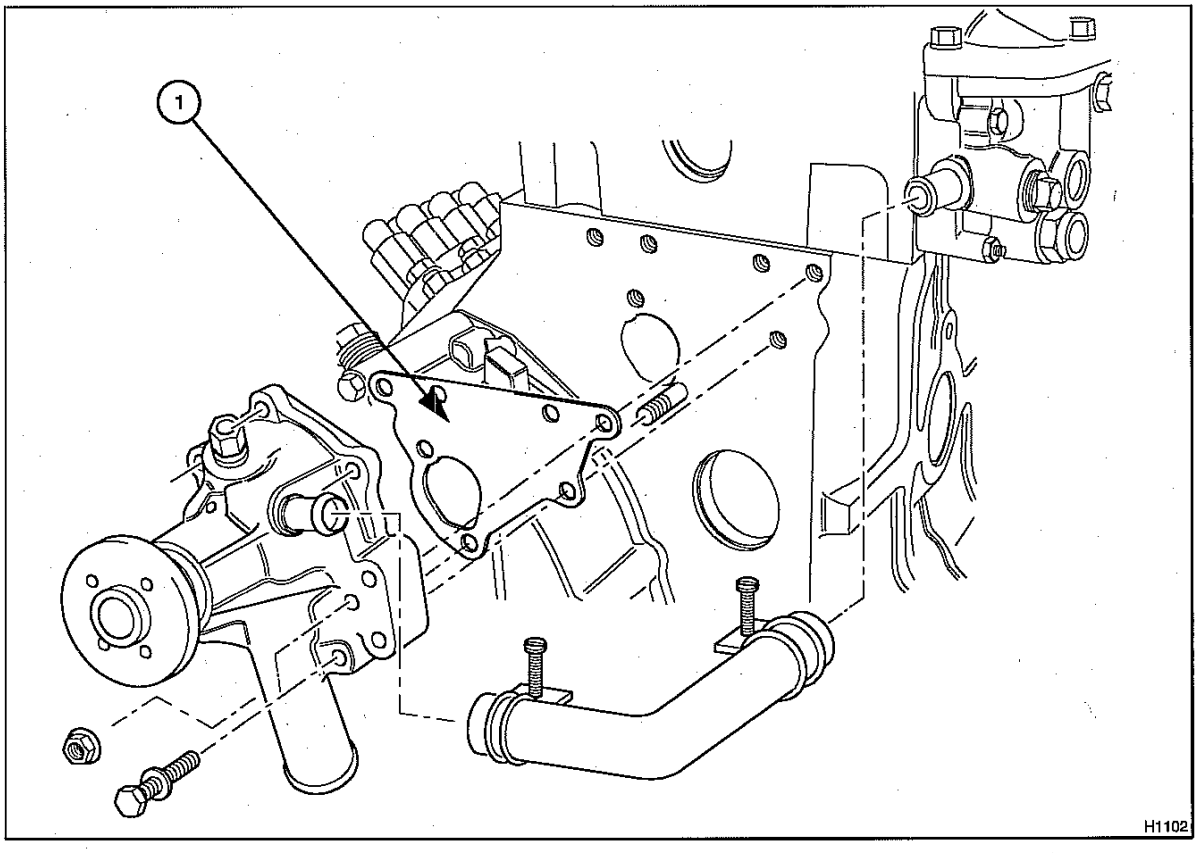
12

Cooling system

Coolant pump

To remove and to fit **Operation 12-1**

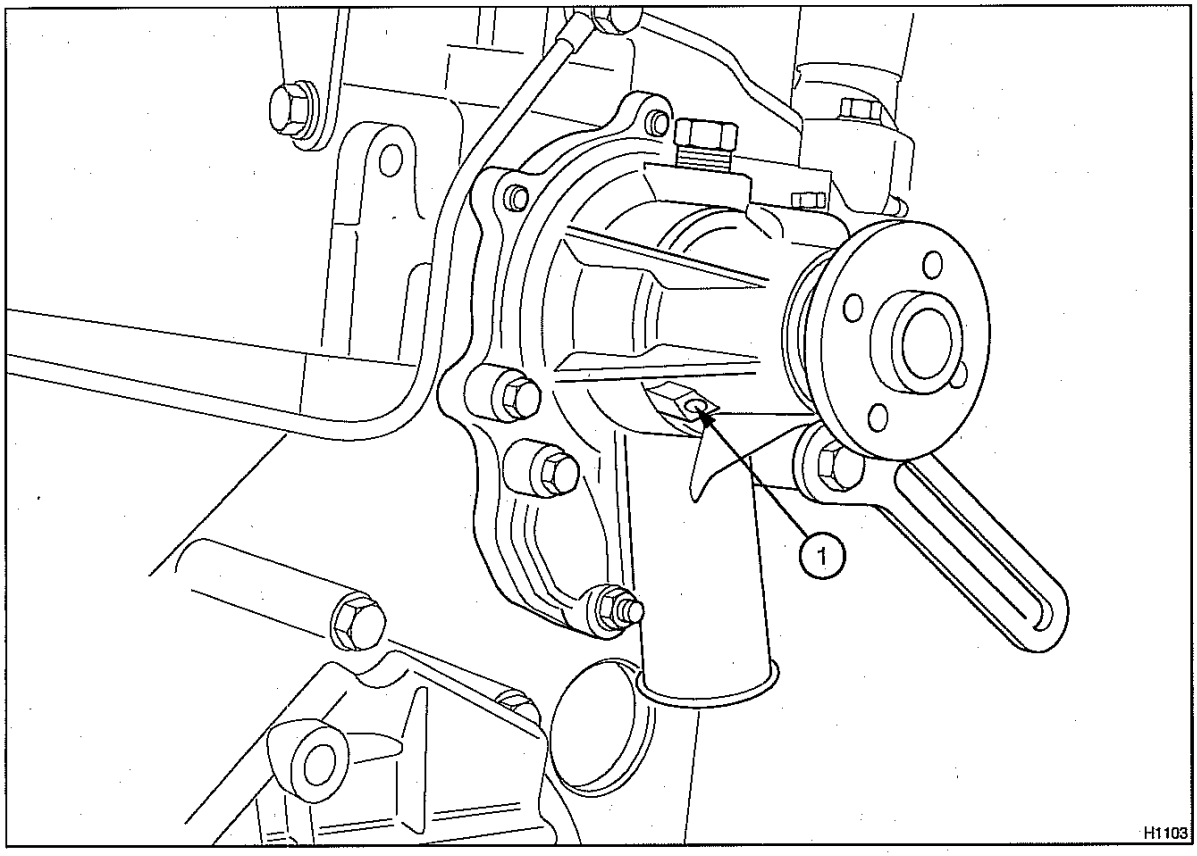
Fit new joint (1) on assembly.



To inspect

Operation 12-2

Start the engine check the coolant pump tell-tale hole (1) for coolant leakage.



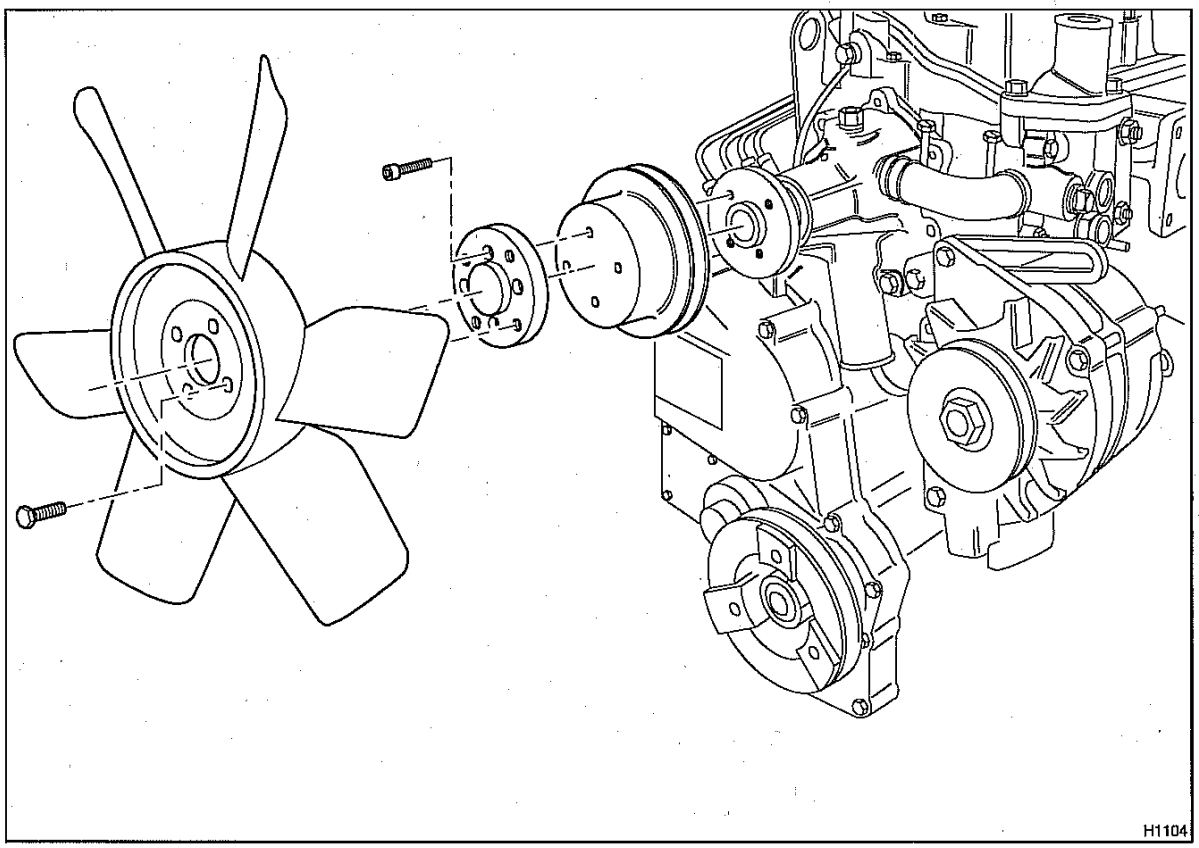
Fan and mounting

To remove and to fit — Operation 12-3

On assembly check the tension of the belt, see Operation 14-3.

To remove and to fit the alternator, see Operation 14-4

Engine	Torque Nm (lbf ft) kgf m	
All models	Setscrew	11 (8) 1,1
	Allen screw	11 (8) 1,1

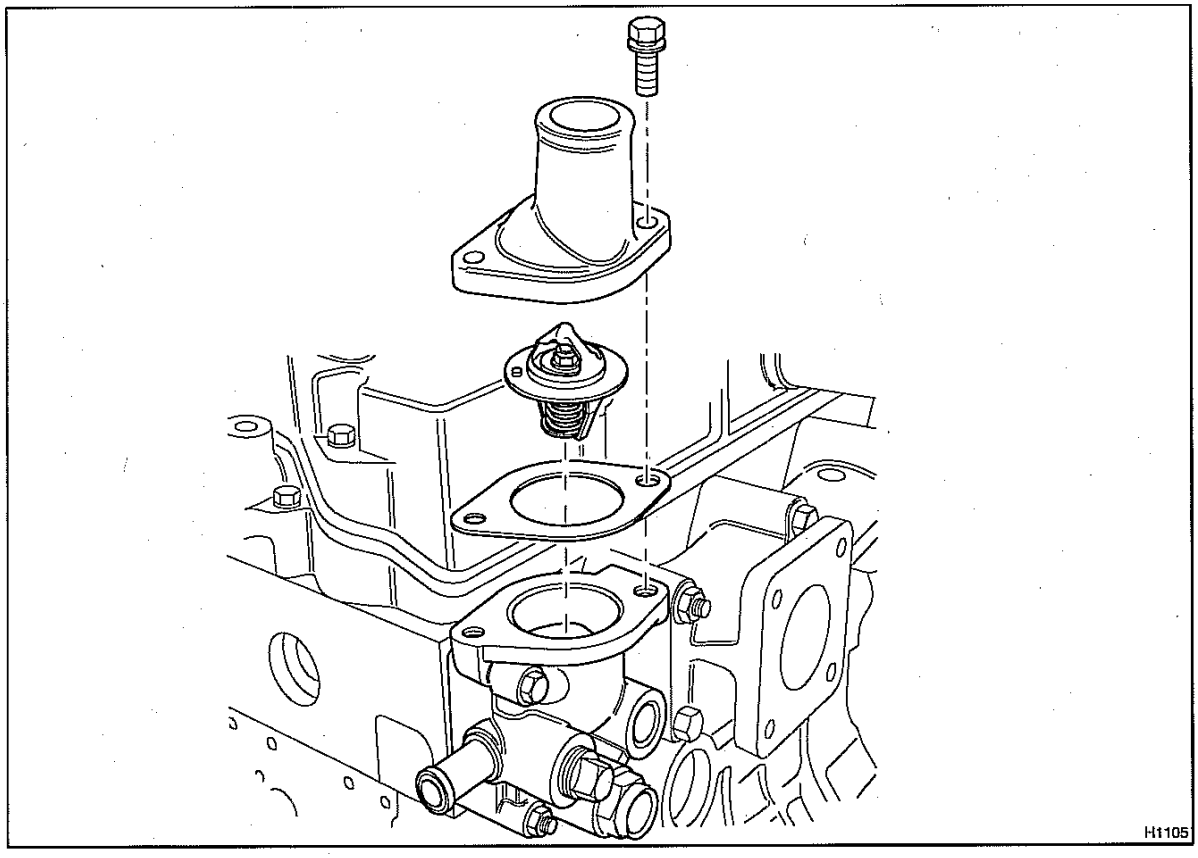


Thermostat

To remove and to fit **Operation 12-4**

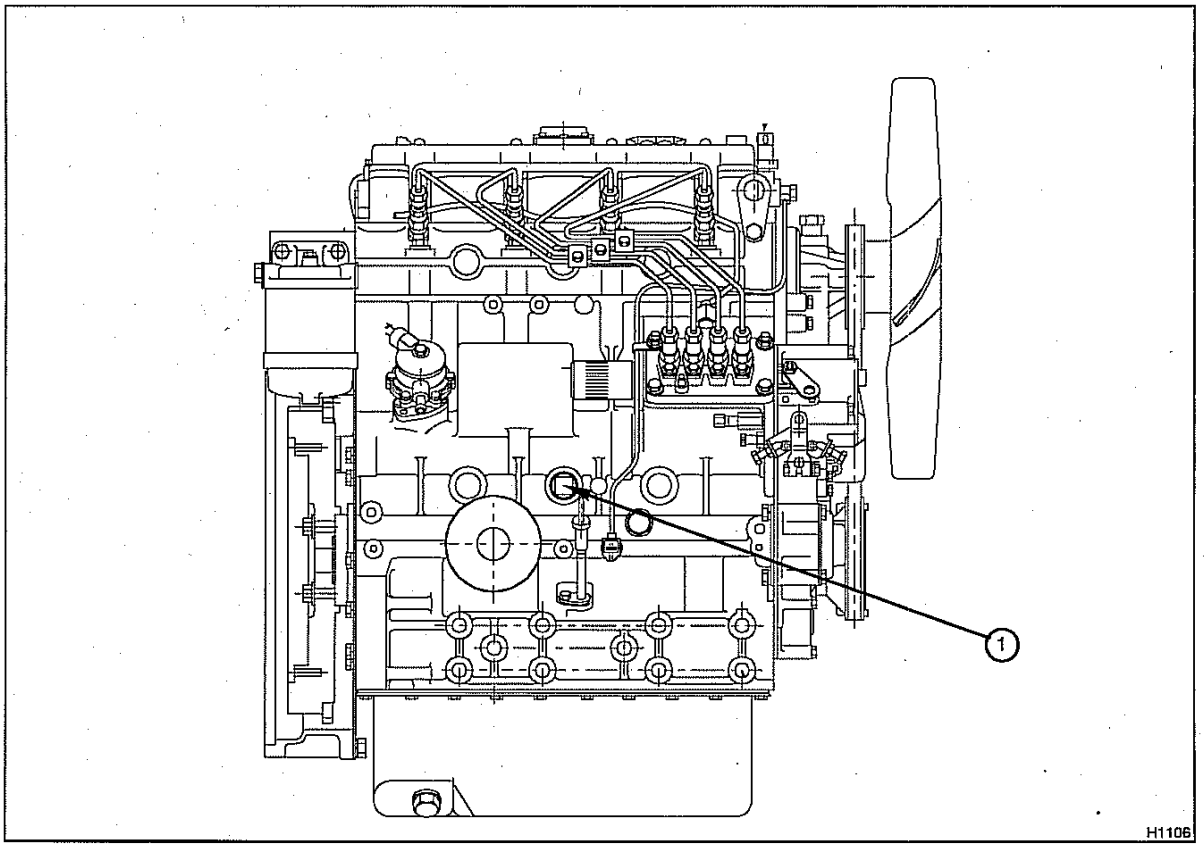
Engine	Torque Nm (lbf ft) kgf m	
All models	Setscrew	14 (10.3) 1,4

Caution: *Ensure that the thermostat is correctly seated in the thermostat housing.*



To drain the cylinder block — Operation 12-5

Engine	Torque Nm (lbf ft) kgf m	
All models	Cylinder block drain plug	30 (22,0) 3,0



To test and to inspect — Operation 12-6

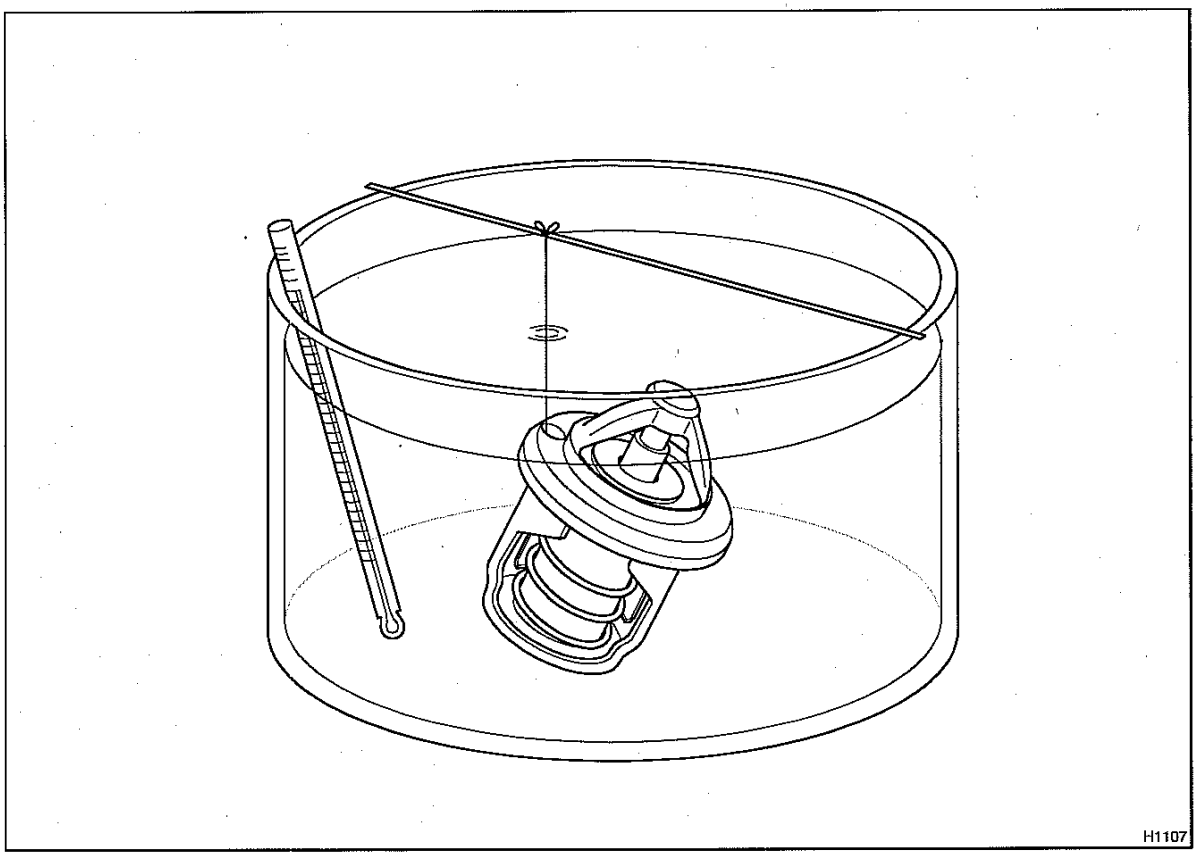
Visually inspect for damage, renew the thermostat if the valve is open at ambient temperature.

1 Put the thermostat into the water.
2 Raise the temperature of the water gradually.
3 Record the valve opening temperature and the valve lift.

Engine	Temperature when thermostat valve starts to open °C (°F)	Temperature when thermostat valve fully open °C (°F)
403C-11	75 (167)	87 (189)
403C-15 404C-22	80 to 84 (176 to 183.2)	95 (203)
404C-22T	71 (159.8)	82 (179.6)

Notes:

- The start to open temperature is stamped on the thermostat
- 3 to 5 minutes will be required before the valve starts to operate.



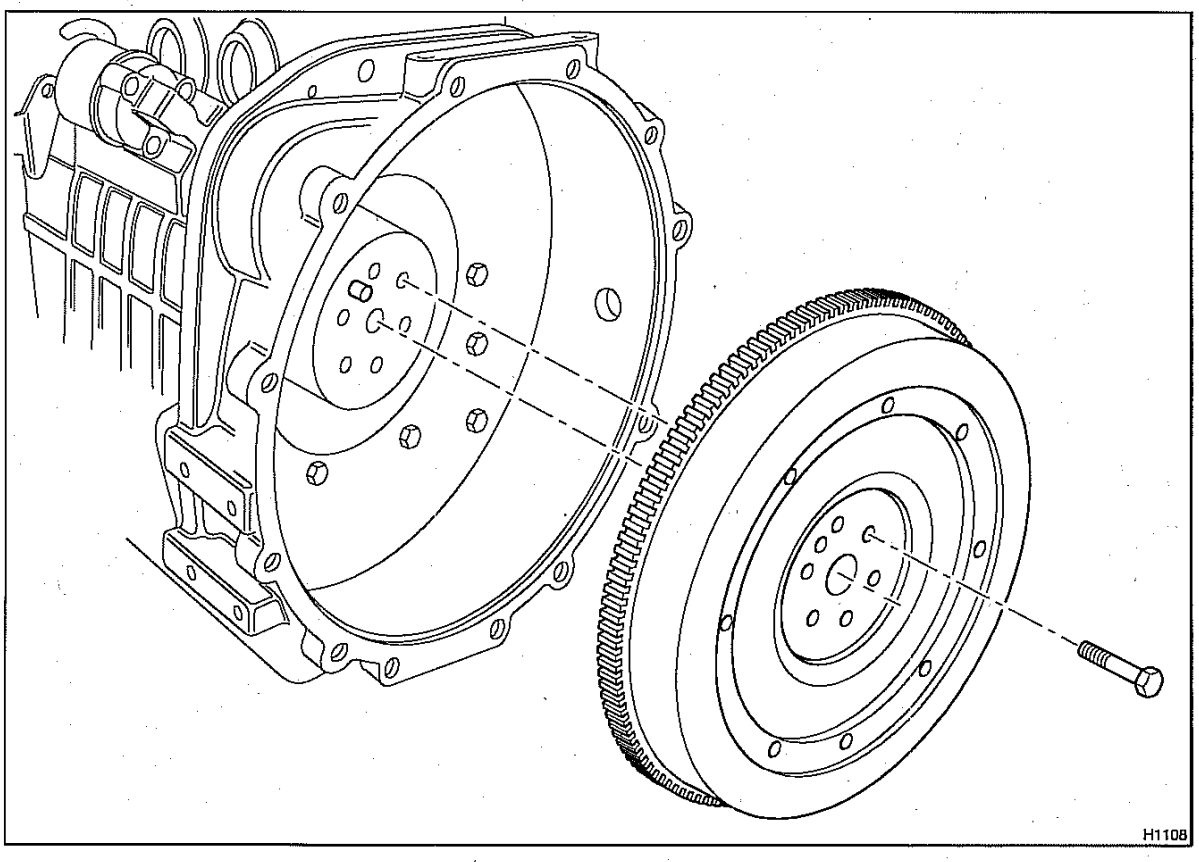
13

Flywheel and housing

Flywheel

To remove and to fit **Operation 13-1**

Engine	Torque Nm (lbf ft) kgf m	
All models	Flywheel setscrew	74 (54.5) 7,4



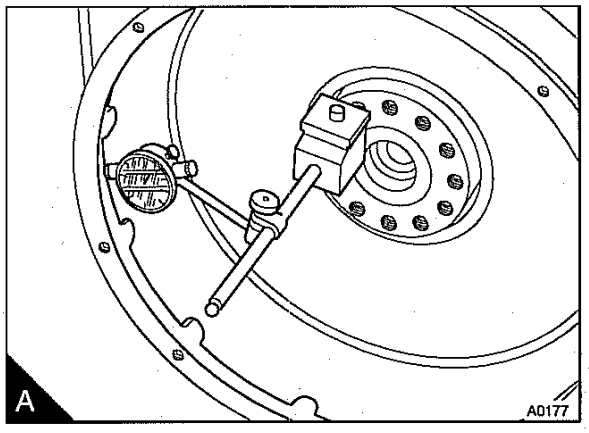
To check for concentricity and alignment of the flywheel housing — Operation 13-2

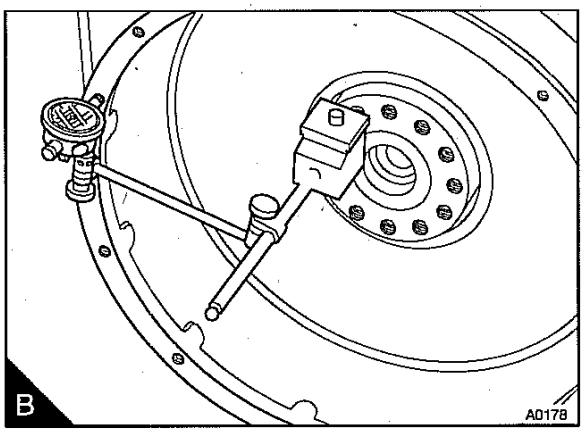
Check the housing concentricity with a dial test indicator (A). The run-out limit is given in the table below. If any adjustment is necessary, it must be made on the housing and the concentricity checked again.

Flywheel housing bore run-out	SAE 5 Flywheel housing	SAE 4 Flywheel housing
All models	0,20 mm (0.008 in)	0,23 mm (0.009 in)

Check the housing alignment (B). The maximum tolerance is given in the table below. Any necessary adjustment must be made on the housing and not on the cylinder block.

Flywheel face run-out	SAE 5 Flywheel housing	SAE 4 Flywheel housing
All models	0,20 mm (0.008 in)	0,23 mm (0.009 in)

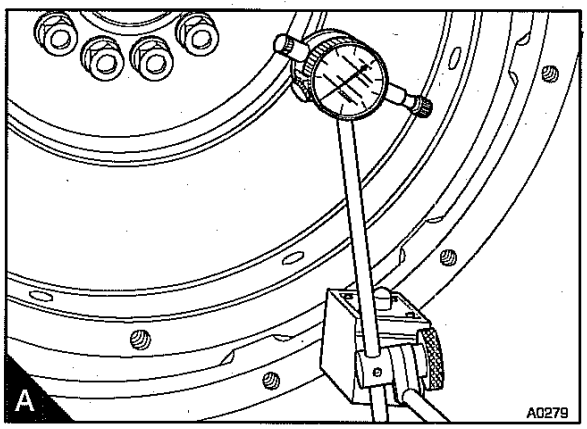


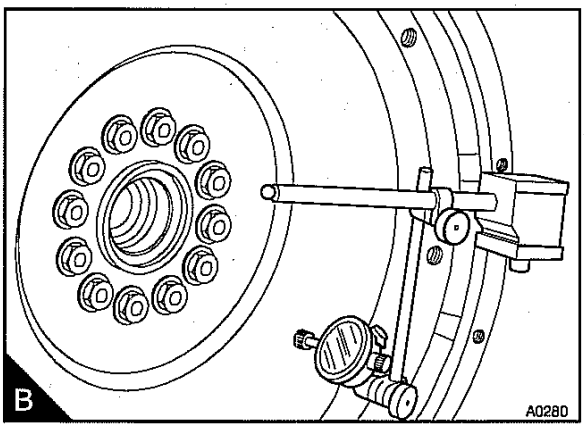


To check for run-out of the flywheel and alignment of the flywheel face **Operation 13-3**

1 Check the flywheel run-out with a dial test indicator (A). This must be less than 0,20 mm (0.008 in) total indicator reading.

2 Check the alignment of the flywheel face (B). During this check, keep the crankshaft pressed toward the front to remove the effect of crankshaft end-float.





Starter ring gear

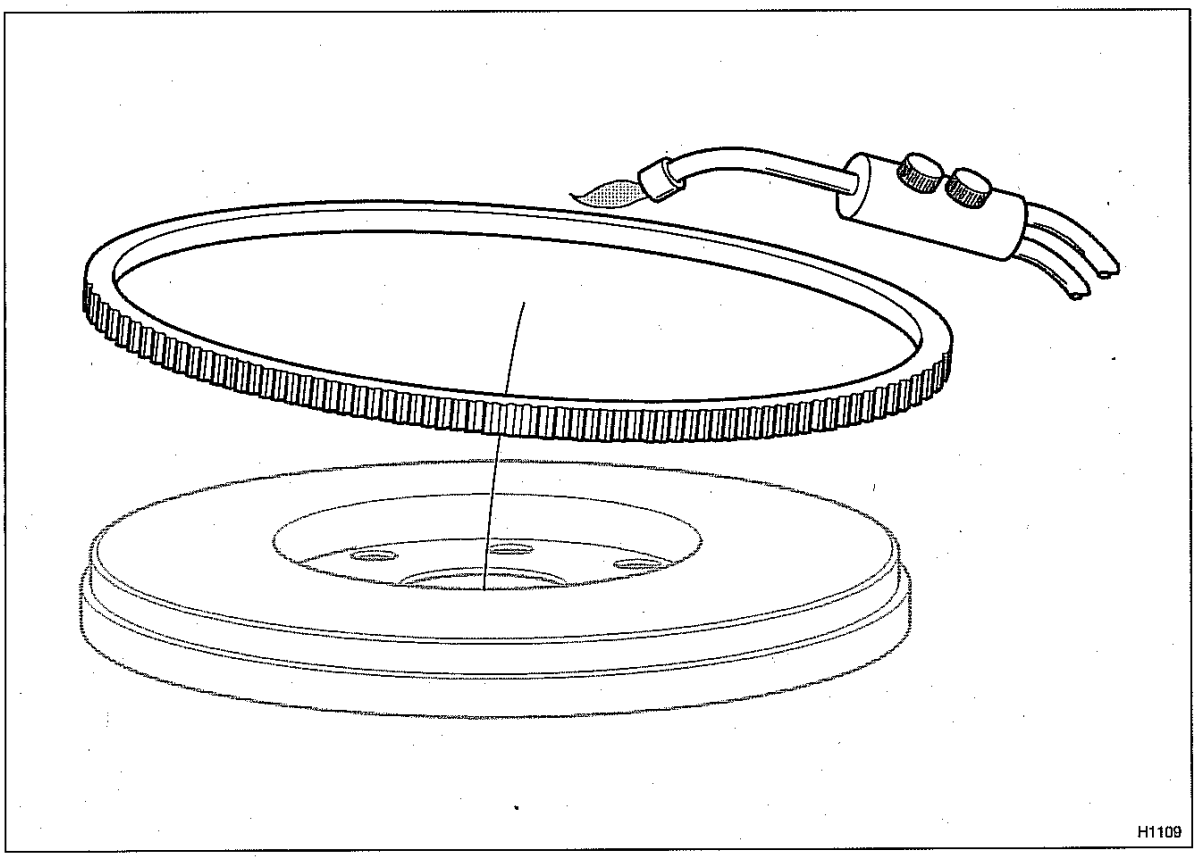
To remove and to fit — Operation 13-4

If the ring gear is excessively worn, renew.

When the wear is not excessive remove the ring gear and fit 90° from the original position.

To fit the ring gear heat to 120 °C to 150 °C (248 °F to 301°F).

Caution: *Heat evenly, do not locally overheat.*



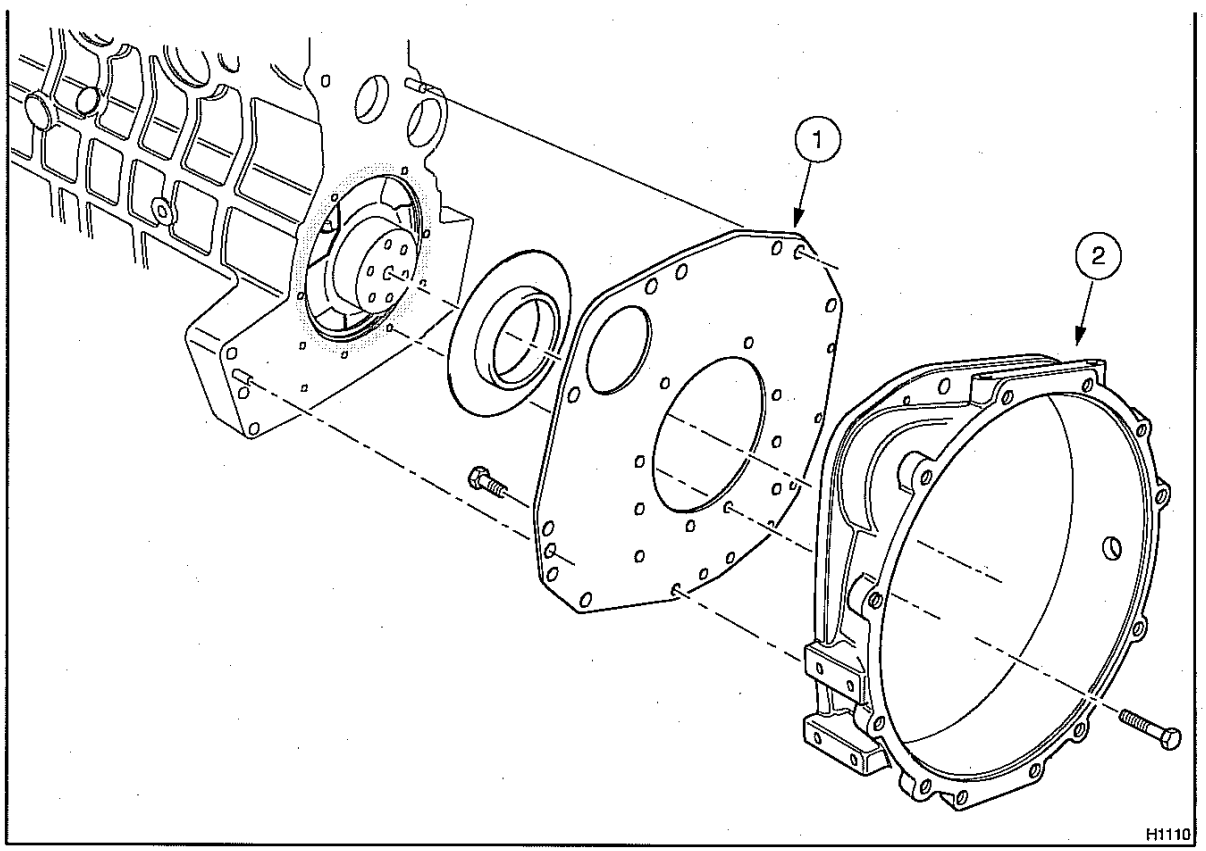
Backplate and rear oil seal

To remove and to fit **Operation 13-5**

Only the 404C-22 engines / models have the backplate and the housing fitted together.

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Setscrew - backplate	50 (36.9) 5,1
	Setscrew - housing	50 (36.9) 5,1
403C-15 404C-22 404C-22T	Setscrew - backplate	25 (18.8) 2,6
	Setscrew - housing	25 (18.8) 2,6

Note: On assembly ensure that Powerpart silicone sealant is used between the cylinder block and the rear end oil seal.



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14

Electrical equipment

Electrical shut off solenoid

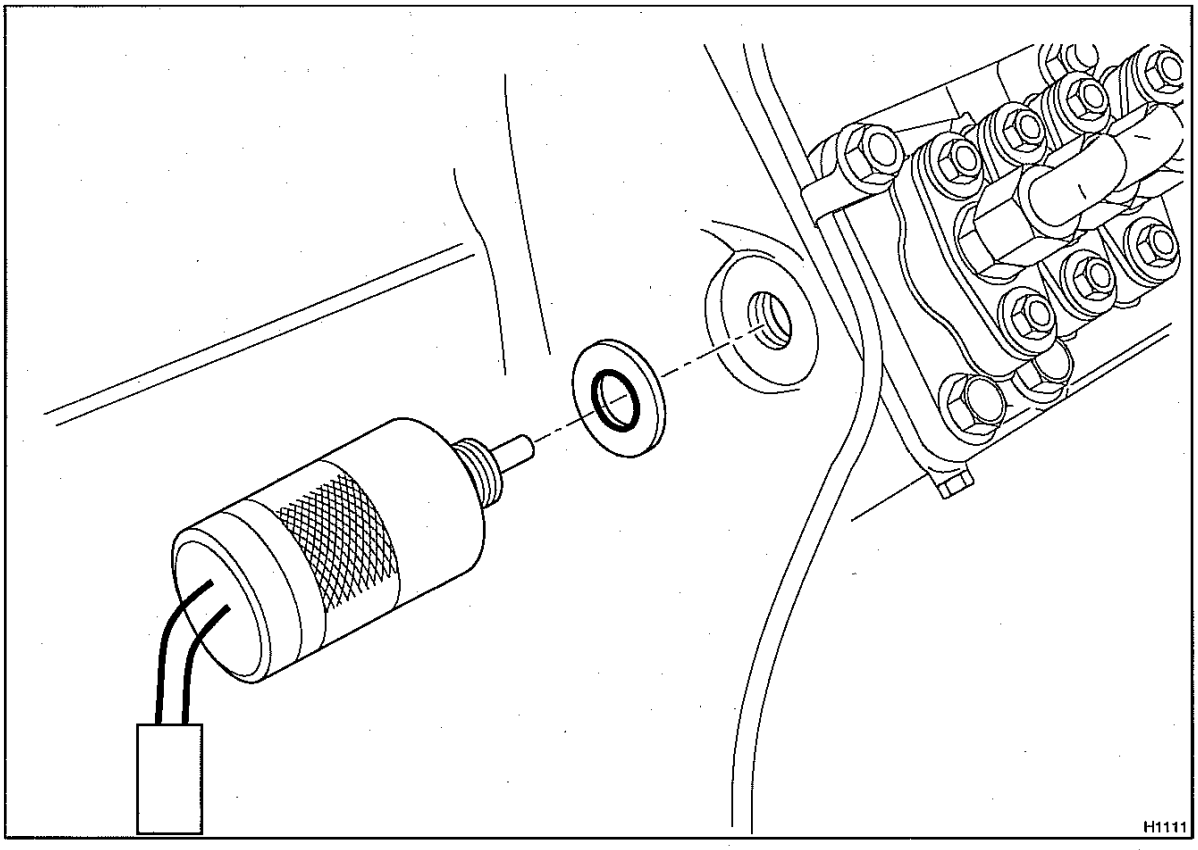
To remove and to fit **Operation 14-1**

Special requirements

Engine	Torque Nm (lbf ft) kgf m	
All models	Solenoid	17 (12) 1,7

Notes:

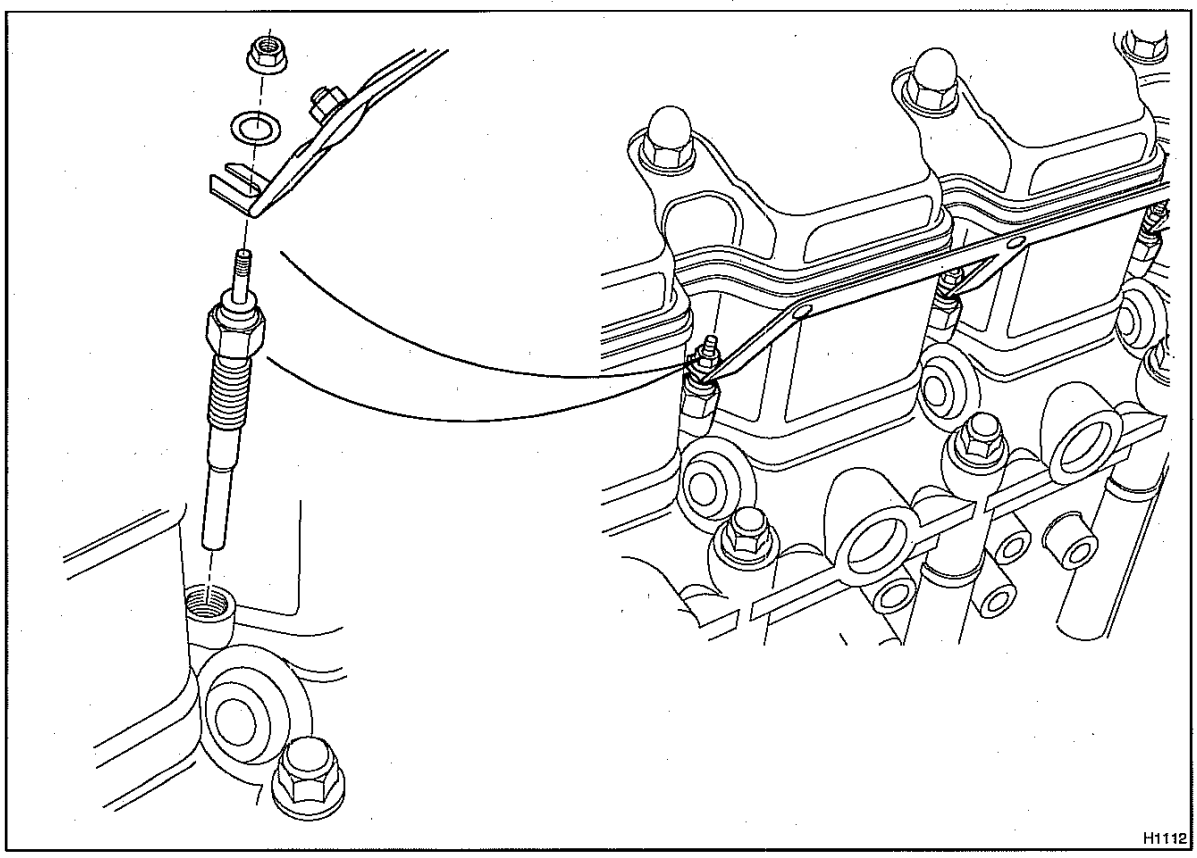
- The washer is fitted with an integral "O" ring.
- Always use a new washer on assembly.



Bus-bar / glowplugs

To remove and to fit **Operation 14-2**

Engine	Torque Nm (lbf ft) kgf m	
403C-11	Glow plug	12 (8.9) 1,2
	Busbar nut	1,2 (0.9) 0,12
403C-15 404C-22 404C-22T	Glow plug	18 (13) 1,8
	Busbar nut	1,2 (0.9) 0,12



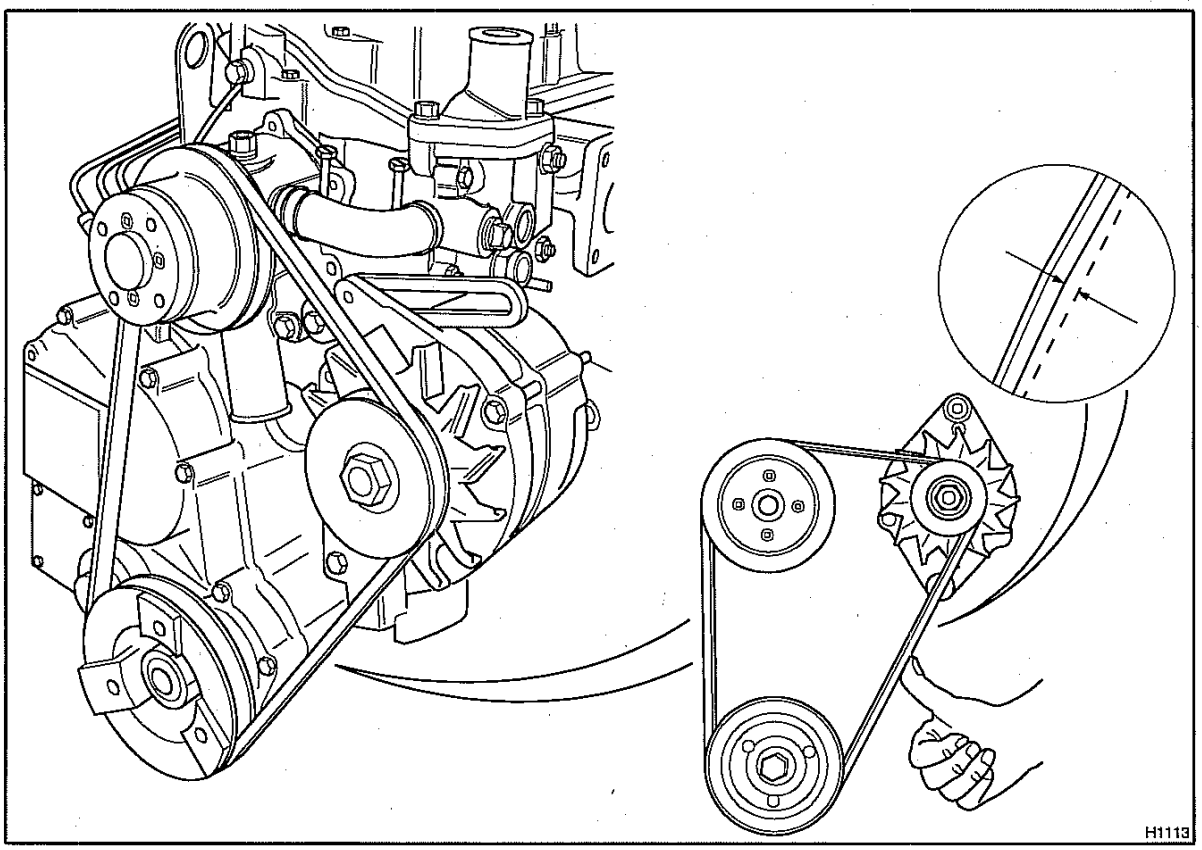
Drive belt

To inspect and to adjust **Operation 14-3**

Press down the centre of the belt on the longest free length with a finger force of 49 Newtons, 11 lbf, 5 kgf approximately.

Engine	Deflection in mm (in)
403C-11	5 (0.19)
403C-15	6 (0.23)
404C-22 404C-22T	7 (0.27)

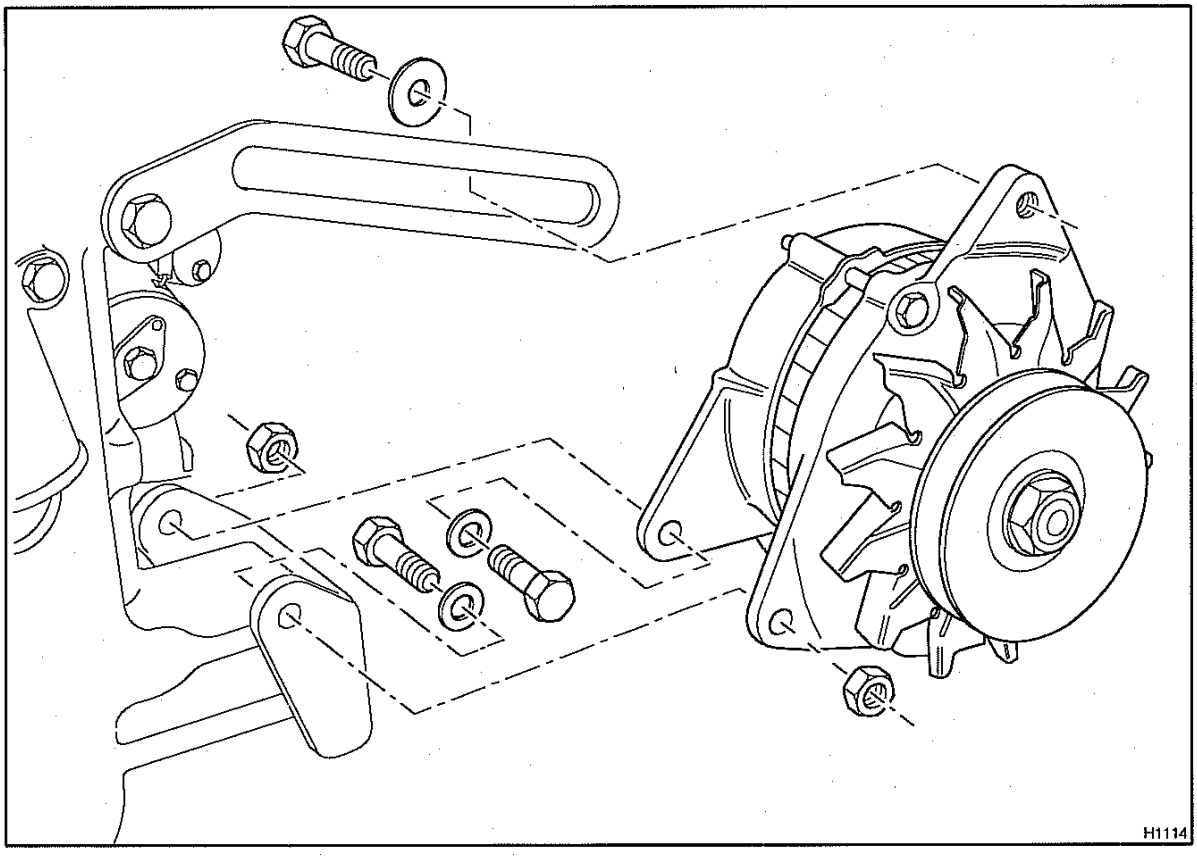
Check the belt for cracks or contamination by oil or grease.



Alternator

To remove and to fit — Operation 14-4

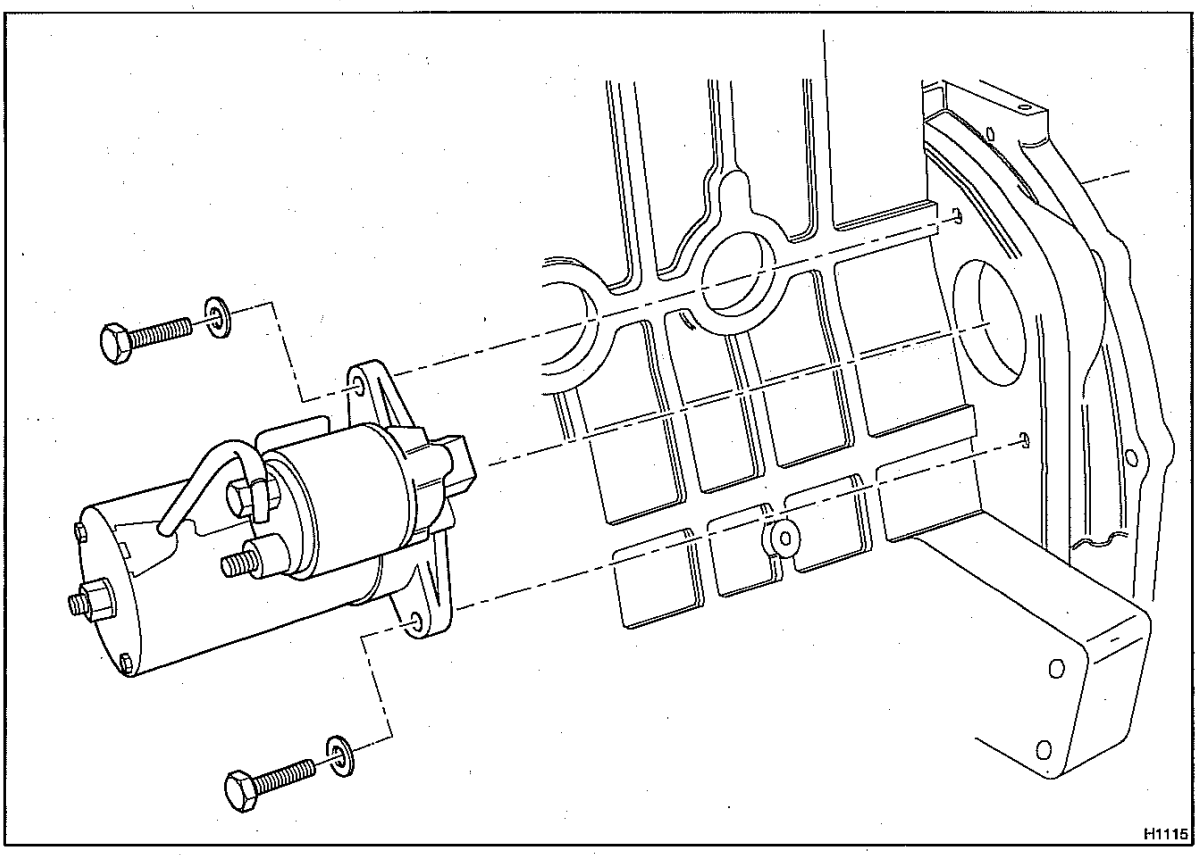
On assembly check the tension of the drive belt, see Operation 14-3.



Starter motor

To remove and to fit **Operation 14-5**

Warning! *The battery must be disconnected before the starter motor is removed.*



Wiring diagram 15 amp alternator - 403C-11

Circuit	Cable number	Circuit current	Maximum circuit resistance	Maximum circuit volt drop	Remarks
Alternator charging	4, 7, 8, 9, 13	14 amp (2 cyl) 15 amp (3 cyl)	0.036 Ω (2 cyl) 0.033 Ω (3 cyl)	0.5 Volt	See Glow Plugs Circuit
Starter motor solenoid	4, 5, 6	15.75 amp	0.04 Ω	0.63 Volt	See Glow Plugs Circuit
STD glow plugs (via glow signal)	4, 5, 10, 11, 12	(Peak max) 26 amp (2 cyl) 39 amp (3 cyl)	0.0192 Ω (2 cyl) 0.0128 Ω (3 cyl)	0.5 Volt	

Wiring diagram maximum circuit resistance

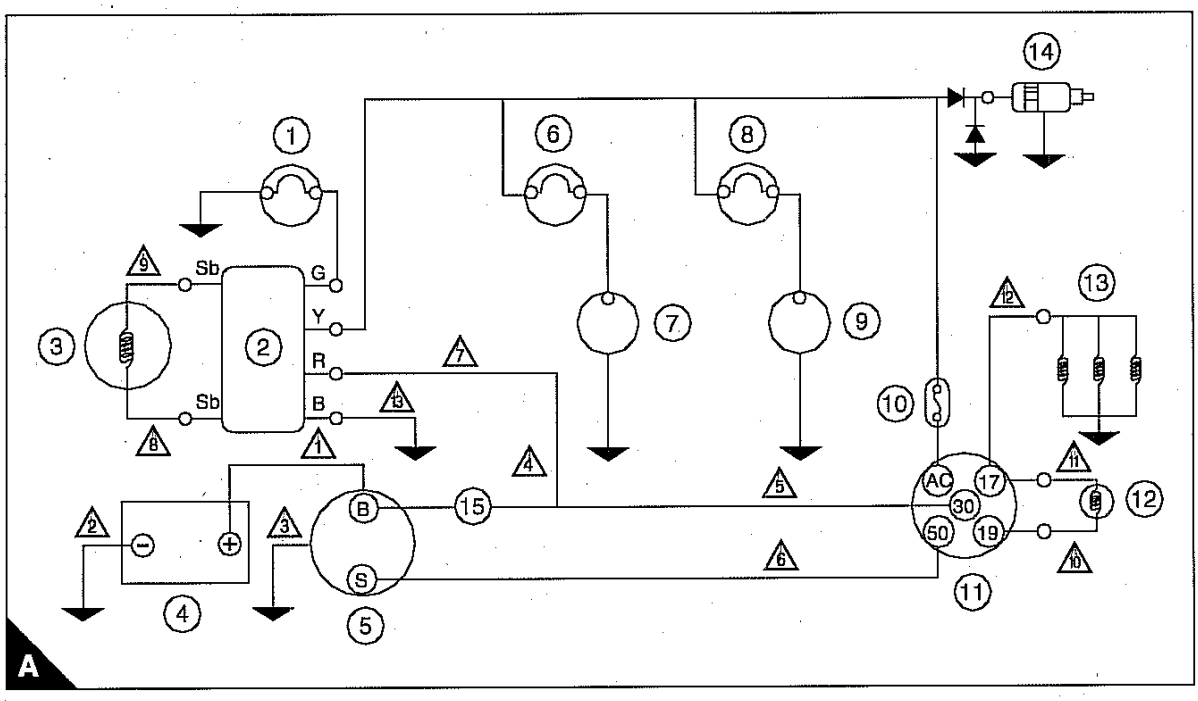
The resistance of battery cables 1, 2 and 3 must not exceed 0.0018 Ω.

Note: If a glow signal is not used - it is still necessary to connect terminal 19 and 17 on the switch.

1 Alternator warning lamp
2 Regulator
3 Alternator
4 Battery
5 Starter motor
6 Oil pressure warning lamp
7 Oil pressure switch (1)
8 Water temperature warning lamp
9 Thermostat switch
10 Fuse
11 Key switch
12 Glow signal
13 Glow plugs
14 Solenoid switch
15 A delayed fuse can be fitted if required

(1) Max current draw for standard oil pressure switch is 0.42 amps (5 Watt lamp max).

—▶|— = Diode. Capacity: Current 3 amp. Reverse Voltage: 600V. **(This is mandatory).**



Wiring diagram 40 amp alternator - 403C-11

Circuit	Cable number	Circuit current	Maximum circuit resistance	Maximum circuit volt drop	Remarks
Alternator charging	4 7 11	40 amp	0.0125 Ωs	0.5 Volt	See Glow Plugs Circuit
Starter motor solenoid	4 5 6	15.75 amp	0.04 Ωs	0.63 Volt	See Glow Plug Circuit
STD glow plugs (via glow signal)	4 5 8 9 10	(Peak max) 39 amp	0.0128 Ωs	0.5 Volt	

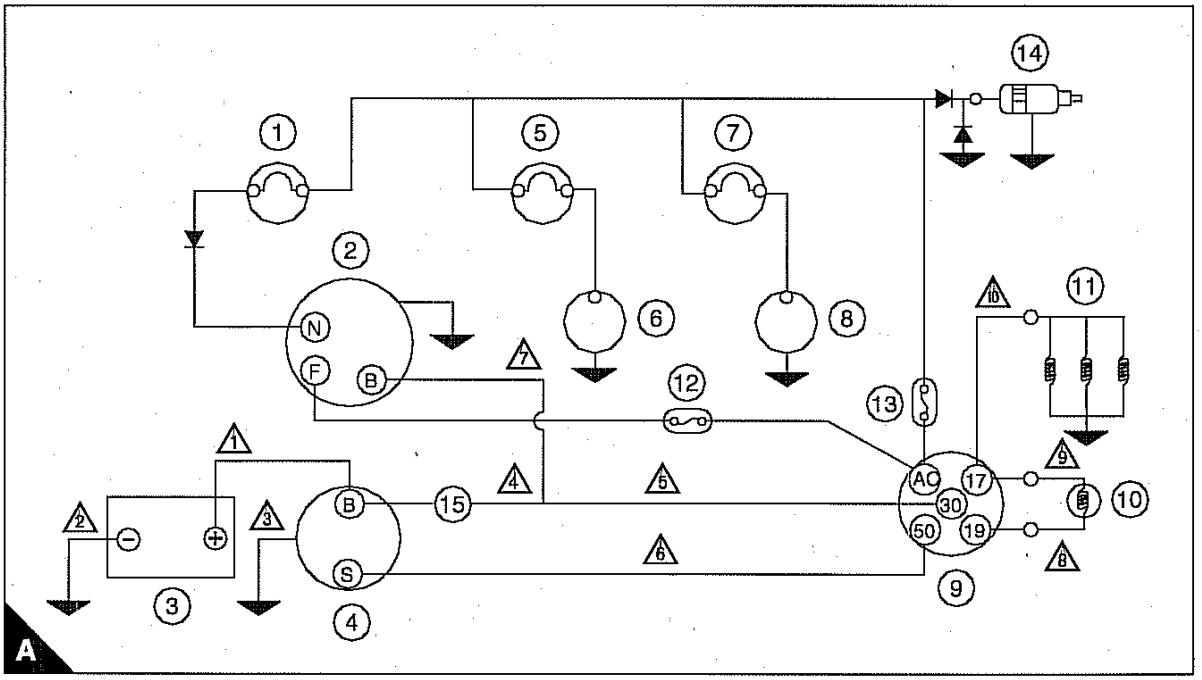
Wiring diagram maximum circuit resistance

The resistance of battery cables 1,2 and 3 must not exceed 0.0018 Ω.

1 Alternator warning lamp
2 Alternator
3 Battery
4 Starter motor
5 Oil pressure warning lamp
6 Oil pressure switch (1)
7 Water temperature warning lamp
8 Thermostat switch
9 Key switch
10 Glow signal
11 Glow plugs
12 Fuse
13 Fuse
14 Solenoid switch
15 A delayed fuse can be fitted if required

(1) Max current draw for standard oil pressure switch is 0.42 amps (5 Watt lamp max).

—▶|— = Diode. Capacity: Current 3 amp. Reverse Voltage: 600V. **(This is mandatory)**.



Wiring diagram 55 amp alternator 403C-15, 404C-22 and 404C-22T

Charging circuit

Circuit	Cable number	Circuit current	Maximum circuit resistance	Maximum circuit volt drop	Remarks
Alternator charging	4, 7, 11	55 Amps	0.0143 ohm	0.50 Volt	See glow plugs circuit
Starter motor solenoid	4, 5, 6	15.75 Amps	0.0400 ohm	0.63 Volt	See glow plugs circuit
STD glow plugs (via glow signal)	4, 5, 8, 9, 10	(Peak max) 52 Amps	0.0139 ohm	0.50 Volt	-

Caution: *Diode capacity: current 3 amps, reverse voltage 600V this is* ***mandatory****.*

Notes:

- Maximum cable size for 375 Lucar terminals on the alternator is 65/0,3 mm (4,5 mm²) therefore twin cables are required at connection to the alternator.
- Maximum current draw for standard oil pressure switch is 0.42 amps (5 Watts maximum bulb).
- A delay fuse can be fitted if necessary.

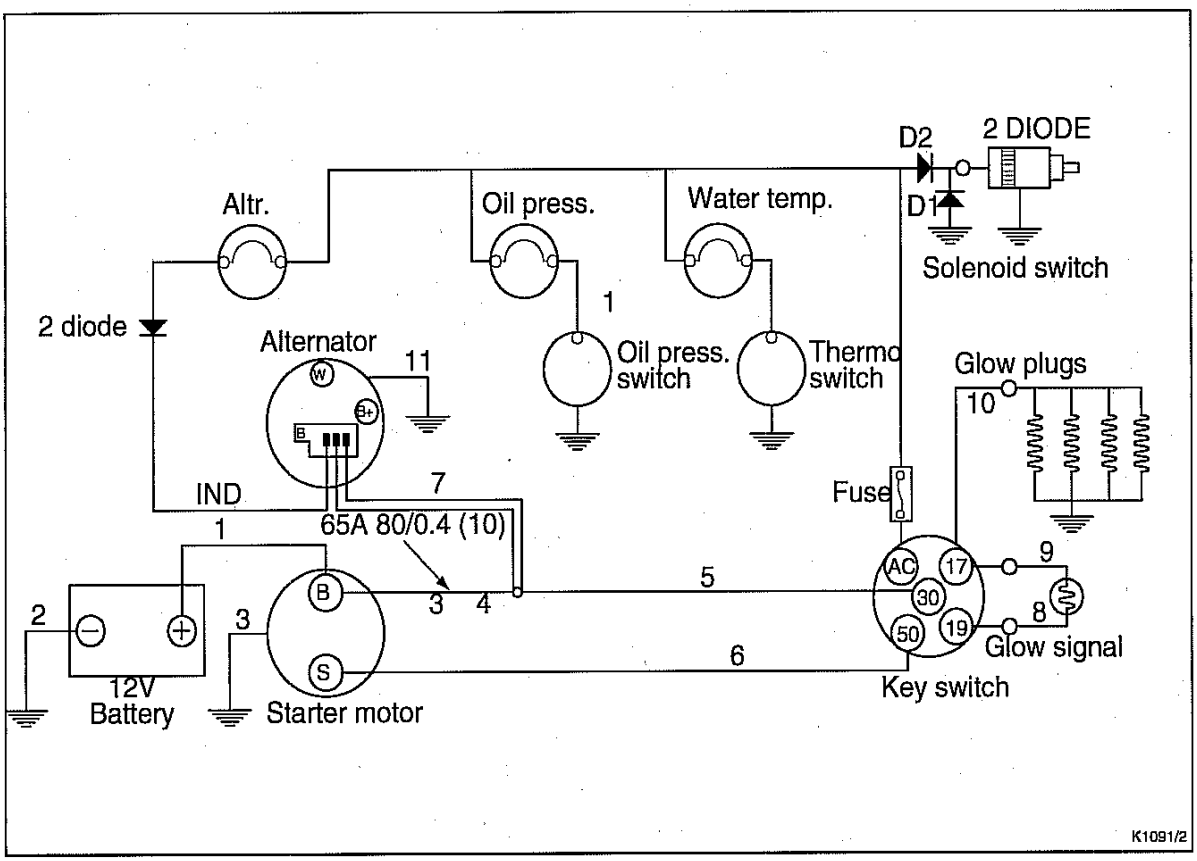
Alternator charge lamp, 55 amps

Alternator charge lamp rating: 12V - 2,2W at 850 rev/min.

When the engine is stopped the alternator charge lamp is illuminated via the battery. The light is extinguished when the engine is operated and the alternator is generating.

The use of a lower wattage bulb than the rating above will increase the speed at which the alternator will operate.

e.g. a charge lamp with a lower wattage bulb will have a rating of 12V - 1,2W at 1300 rev/min.



Automatic shutdown connector

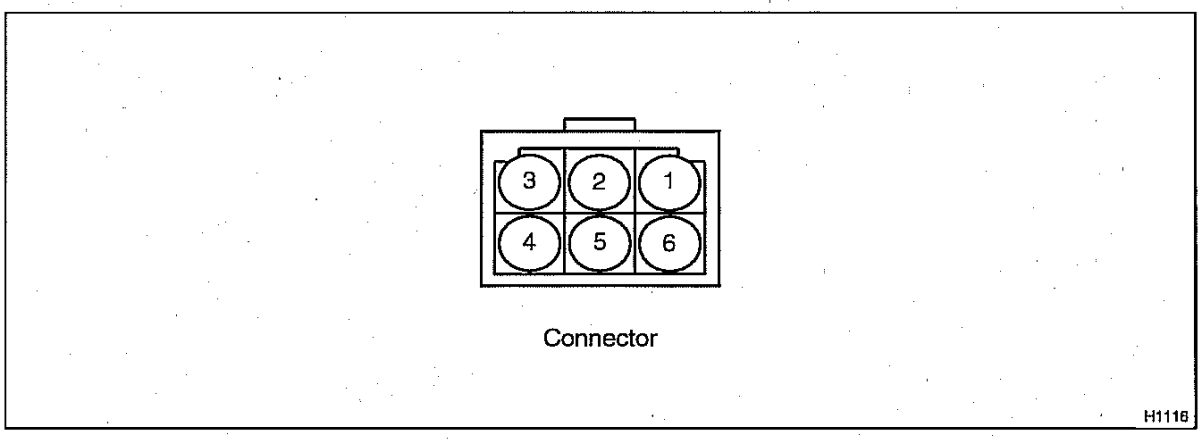
55 Amp alternator charge lamp

Note: Alternator charge lamp rating: 12V - 2.2W at 850 rev/min.

When the engine is at rest the alternator charge lamp is illuminated via the battery and it extinguishes when the alternator operates.

The use of a lower wattage bulb than the above will increase speed at which self excitation occurs upon initial run up, e.g. a charge lamp with a lower wattage bulb will have a rating of 12V - 1.2W at 1300 rev/min.

Pin number connector	Wire colour	Connection
1	Red	Key switch - AC
2	Orange	Key switch - 50
3	Red / Black	Solenoid
4	Brown	Oil pressure switch
5	Blue	Coolant temperature switch
6	Black	Ground (Earth)



Wiring diagram - automatic shutdown 15 amp alternator - 403C-11

Automatic shutdown operation conditions

If the conditions below last for more than 10 seconds during the start operation, the engine will shut down.

If the conditions below last for more than 2 seconds while the engine is operated, the engine will shut down.

Warning! *There is no protection against low water levels.*

Conditions

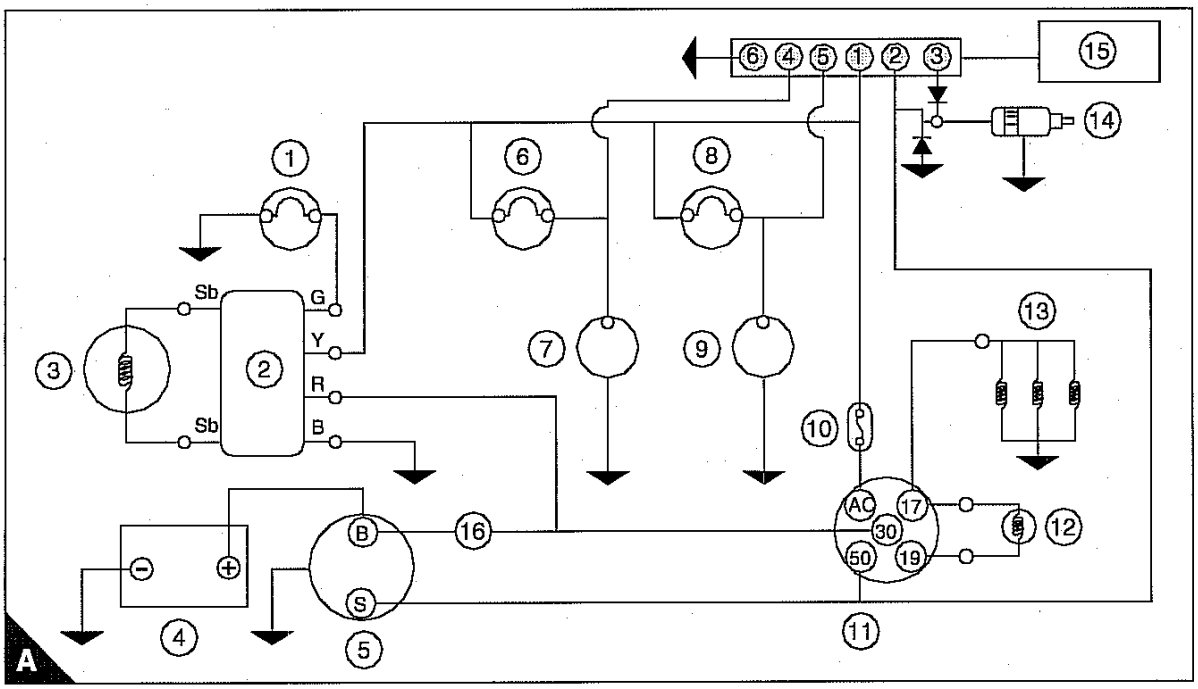
Water temperature switch: If the water temperature exceeds 105 °C ± 4 °C.

Oil Pressure Switch: If the oil pressure falls below 0,3 kgf/cm² (4.27 lbf/in²).

1 Alternator warning lamp
2 Regulator
3 Alternator
4 Battery
5 Starter motor
6 Oil pressure warning lamp
7 Oil pressure switch (1)
8 Water temperature warning lamp
9 Thermostat switch
10 Fuse
11 Key switch
12 Glow signal
13 Glow plugs
14 Solenoid switch
15 Automatic shutdown device
16 A delayed fuse can be fitted if desired

(1) Max current draw for standard oil pressure switch is 0.42 amps (5 Watt lamp max).

→|← = Diode. Capacity: Current 3 amp. Reverse Voltage: 600V. **(This is mandatory).**



Wiring diagram - automatic shutdown 40 amp alternator - 403C-11

Automatic shutdown operation symptoms

If the conditions below last for more than 10 seconds during the start operation, the engine will shut down.

If the conditions below last for more than 2 seconds while the engine is operated, the engine will shut down.

Warning! *There is no protection against low water levels.*

Conditions

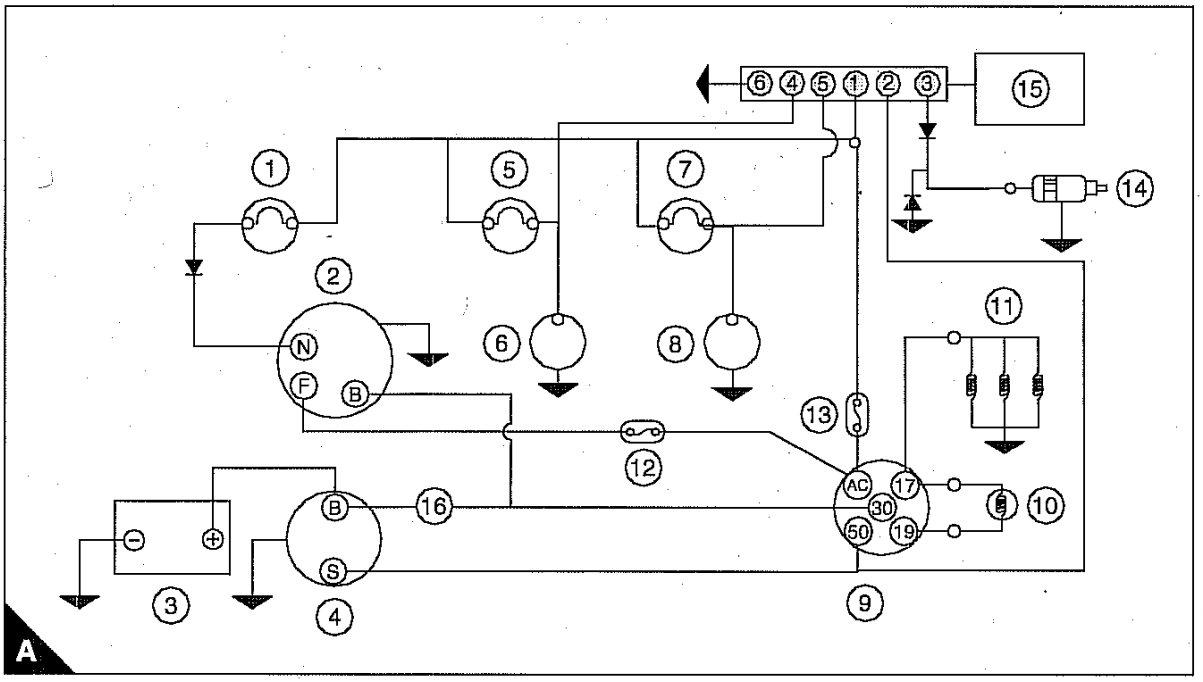
Water temperature switch: If the water temperature exceeds 105 °C ± 4 °C.

Oil Pressure Switch: If the oil pressure falls below 0,3 kgf/cm² (4.27 lbf/in²).

1 Alternator warning lamp
2 Alternator
3 Battery
4 Starter motor
5 Oil pressure warning lamp
6 Oil pressure switch (1)
7 Water temperature warning lamp
8 Thermostat switch
9 Key switch
10 Glow signal
11 Glow plugs
12 Fuse
13 Fuse
14 Solenoid switch
15 Automatic shutdown device
16 A delayed fuse can be fitted if desired

(1) Max current draw for standard oil pressure switch is 0.42 amps (5 Watt lamp max).

→|← = Diode. Capacity: Current 3 amp. Reverse Voltage: 600V. **(This is mandatory)**.



Wiring diagram - automatic shutdown 55 amp alternator 403C-15, 404C-22 and 404C-22T

Automatic shutdown operating conditions

If the conditions listed below continues for more than ten seconds while starting, or two seconds while the engine is being operated, the engine will shutdown.

If the water temperature exceeds 110 °C (230 °F) ± 3°C (5 °F)

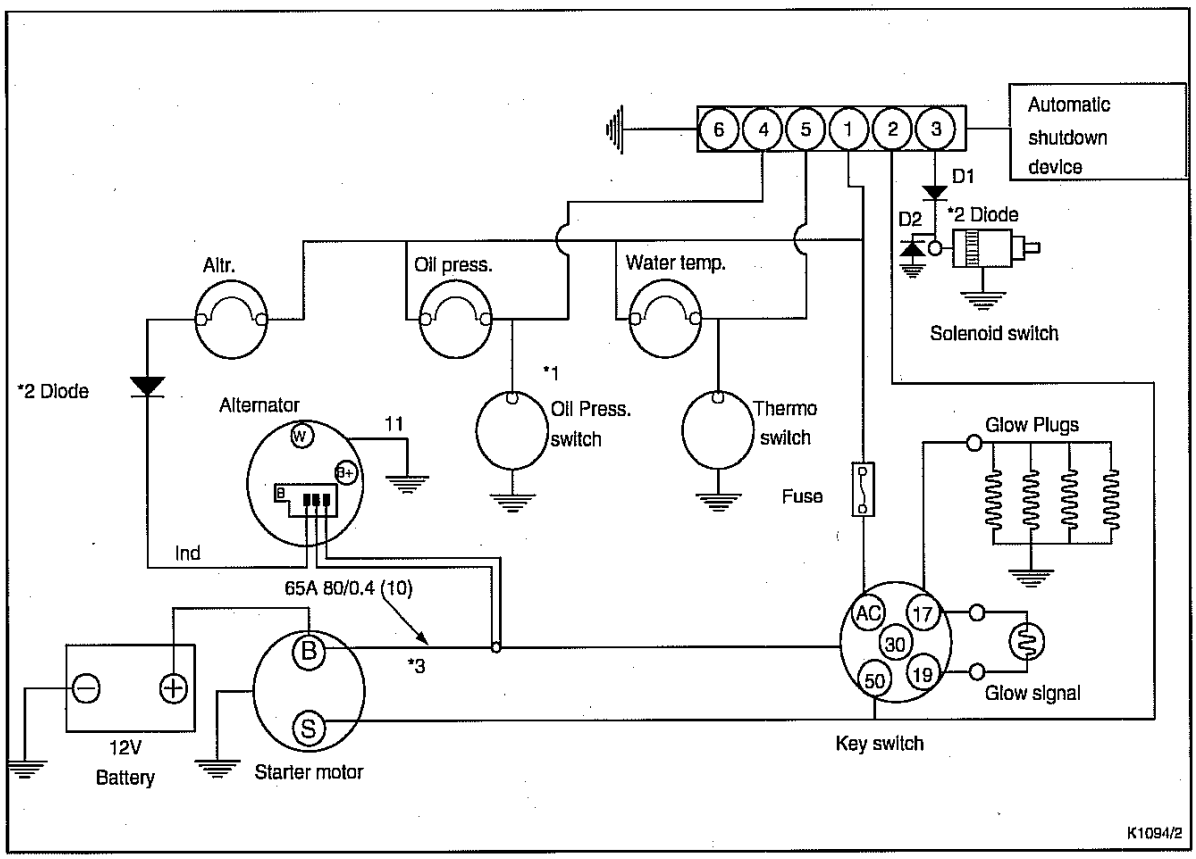
If the oil pressure falls below 0,3 kgf / cm² (4.27 lbf / in² top cover option) or 1,0 kgf / cm² (14.22 lbf / in² oil rail option).

Cautions:

- *There is no automatic shutdown for low water levels.*
- *Diode capacity: current 3 amps, reverse voltage 600V, this is* ***mandatory****.*

Notes:

- Maximum current draw for the standard oil pressure switch is 0.42 amps (5 Watts maximum bulb).
- A delay fuse can be fitted if necessary.



15

Auxiliary equipment

None fitted **Operation 15-1**

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16

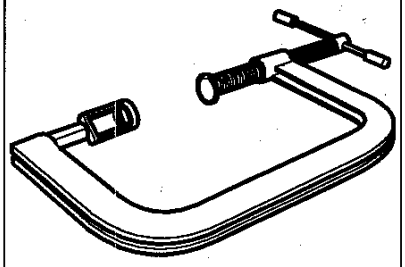
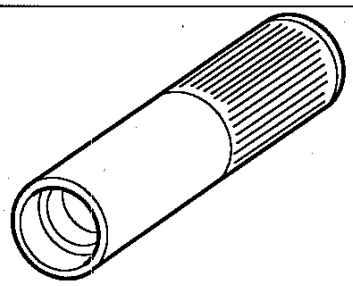
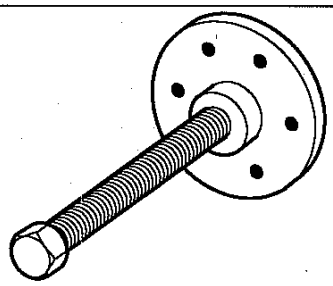
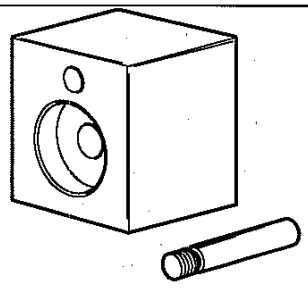
Special tools

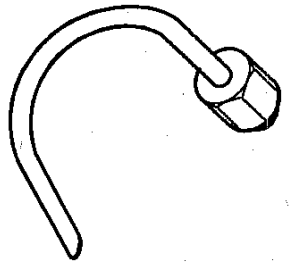
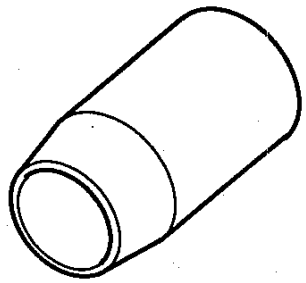
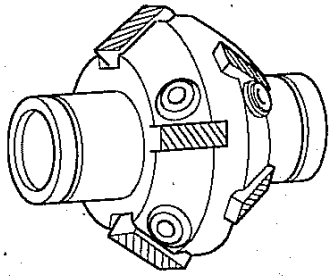
Special tools list

These tools are available locally through your Perkins distributor. If you cannot obtain the correct tool locally contact:

The Perkins Service Department, Peterborough, PE1 5NA, England, UK.

Tel. +44 1733583000 Fax +441733582240 Telex 32501 PERKEN G.

Description	Illustration
Valve spring remover Part number 21825663	
Valve stem seal replacer Part number 21825623	
Crankshaft pulley remover Part number 21825619	
Idler hub fitting tool 403C-11 part number 21825625 403C-15 and 404C-22 part number 21825626	

Description	Illustration
Fuel pump spill pipe Part number 21825680	
Front oil seal protector 403C-11 part number 21825620 403C-15, 404C-22 part number 21825621	
Valve seat cutter Part number 27610030	

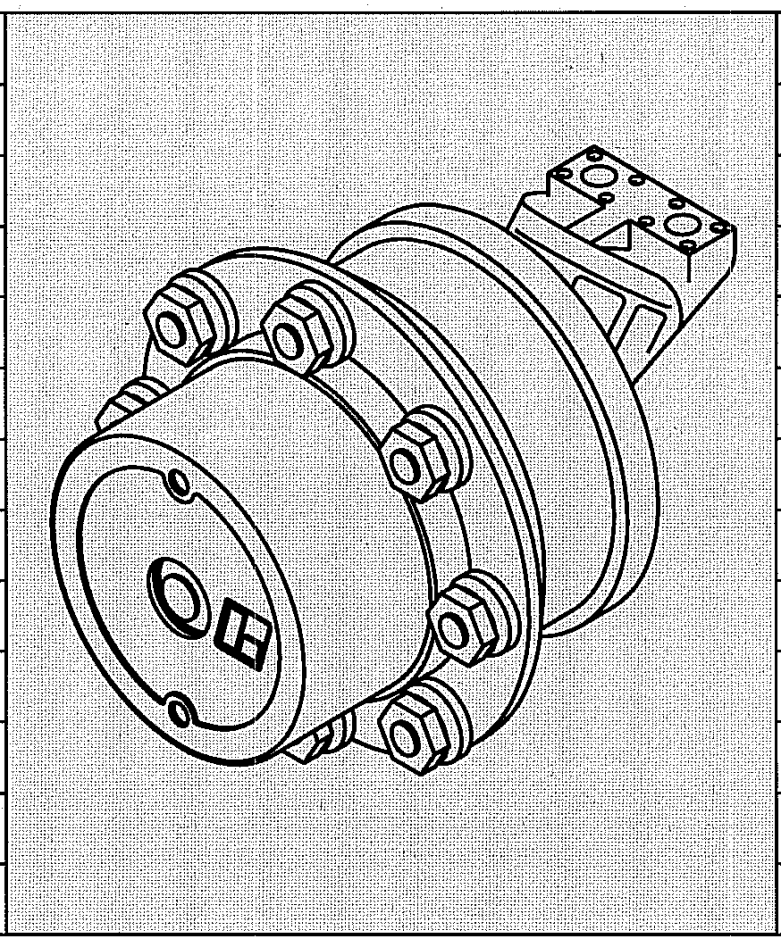
GROUP 30

WHEEL REDUCING

WHEEL DRIVE GEAR 229880

30-3-62EN

25 / 01 / 2005



MANUEL TECHNIQUE DE SERVICE

TECHNICAL SERVICE MANUAL

REDUCTEUR ROUE CWD2050.1M

WHEEL DRIVE GEAR CWD2050.1M

FRANCAIS

1. NETTOYAGE ET ETAT GENERAL DES COMPOSANTS

1.1 Pièces coulées, supports, brides intermédiaires, etc.

Contrôlez : l'absence de bavures,
l'absence de copeaux dans les trous taraudés borgnes,
que les lamages ont bien été exécutés autour de tous les trous (huile, etc.) afin de garantir l'étanchéité,
que tous les diamètres usinés sont chanfreinés et ne présentent pas de manque de matiére ou de porosités,
éliminez les résidus de fonderie.

1.2 Arbres, pignons, joints

Contrôlez : l'absence de bavures sur le filetage, dans le logement de la clavette de l'arbre et dans le logement de la clavette de la partie cylindrique et dans le logement des «circlips»,
que les portées des bagues d'étanchéité, les dentures, les rainures, etc. ne présentent pas de bosses.

1.3 Joints toriques et bagues d'étanchéité

Contrôlez : qu'ils ne présentent pas d'imperfections, entailles ou ébarbures.

1.4 Bagues filetées et rondelles de sécurité

Contrôlez : que les bagues filetées et les rondelles de sécurité soient neuves et n'aient jamais été utilisées.

ATTENTION ! si vous deviez constatér un ou plusieurs des défauts mentionnés ci-dessus, éliminez-les en rétablissant les conditions optimales de la pièce. Si cela n'était pas possible, avertissez le Contrôle Qualité BREVINI et n'utilisez, sous aucun prétexte, les pièces défectueuses sans autorisation.

2. TABLEAUX

2.1 Tableaux des couples de serrage des vis

d x p mm	4.6		5.6		6.8		10.9		12.9		d x p mm	4.6		5.6		6.8		10.9		12.9	
	kN	Nm	kN	Nm	kN	Nm	kN	NM	kN	Nm		kN	Nm	kN	Nm	kN	Nm	kN	NM	kN	Nm
3 x 0,5	1,2	0,9	1,5	1,1	2,3	1,8	3,4	2,6	4,0	3	18 x 1,5	43	121	54	150	82	229	121	336	141	393
4 x 0,7	2,1	1,6	2,7	2	4,1	3,1	6,0	4,5	7,0	5,3	18 x 2,5	49	157	60	194	95	306	135	435	158	509
5 x 0,8	3,5	3,2	4,4	4	6,7	6,1	9,8	8,9	11,5	10,4	18 x 1,5	57	176	70	220	110	345	157	491	184	575
6 x 1	4,9	5,5	6,1	6,8	9,4	10,4	13,8	15,3	16,1	17,9	20 x 2,5	63	222	77	275	122	432	173	615	203	719
7 x1	7,3	9,3	9,0	11,5	13,7	17,2	20,2	25	23,6	30	20 x 1,5	72	248	89	307	140	482	199	687	233	804
8 x1,25	9,3	13,6	11,5	16,8	17,2	25	25	37	30	44	22 x 2,5	78	305	97	378	152	592	216	843	253	987
8 x1	9,9	14,5	12,2	18	18,3	27	28	40	32	47	22 x 1,5	88	337	109	416	172	654	245	932	286	1090
10 x 1,5	14,5	26,6	18	33	27	50	40	73	47	86	24 x 3	90	383	112	474	175	744	250	1060	292	1240
10 x 1,25	15,8	28	19,5	35	30	53	43	76	51	91	24 x 2	101	420	125	519	196	814	280	1160	327	1360
12 x 1,75	21,3	46	26	56	40	86	59	127	69	148	27 x 3	119	568	147	703	230	1100	328	1570	384	1840
12 x 1,25	23,6	50	29	62	45	95	66	139	77	163	27 x 2	131	615	162	760	225	1200	363	1700	425	1990
14 x 2	29	73	36	90	55	137	80	201	94	235	30 x 3,5	144	772	178	955	280	1500	399	2130	467	2500
14 x 1,5	32	79	40	98	61	150	90	220	105	257	30 x 2	165	859	204	1060	321	1670	457	2370	535	2380
16 x 2	40	113	50	141	76	214	111	314	130	366											

d = diamètre de la vis
p = pas de la vis

3. MONTAGE DU REDUCTEUR MODELE CWD2050/M

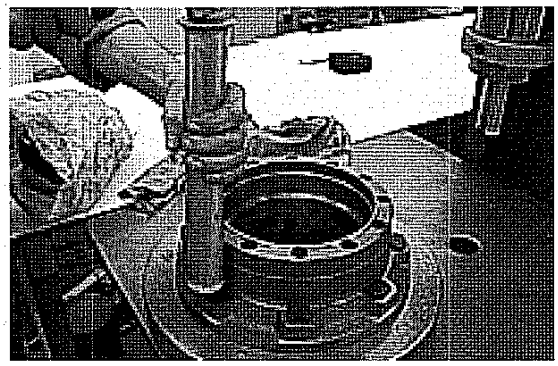
ATTENTION !
Tous les logements et les portées des roulements ainsi que des bagues d'étanchéité, aussi bien internes qu'externes, doivent être lubrifiés avec de l'huile avant le montage afin d'en favoriser l'assemblage.

Toutes les vis doivent être vissées en appliquant le couple (Nm) reporté dans le tableau du paragraphe 2.1.

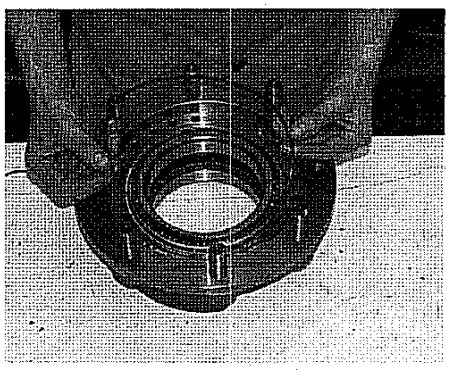
Toutes les vis doivent être vissées en utilisant une colle pour filetage de prise moyenne «Loctite modèle 242» ou similaire.

Pour appliquer un couple précis à l'aide d'une clé dynamométrique, n'utilisez pas de clé dont le couple maximum applicable est proche de celui que vous devez appliquer.

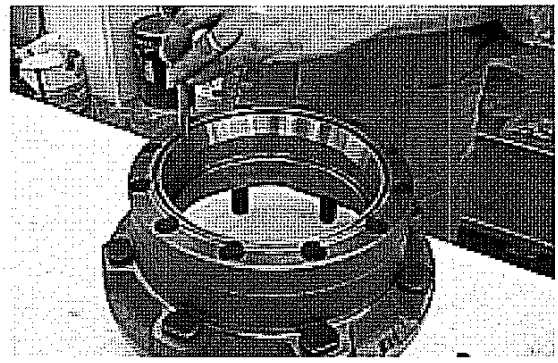
Ne mélangez pas les pistes des roulements mais respectez l'ordre de la piste externe avec la piste interne établi par le fabricant.



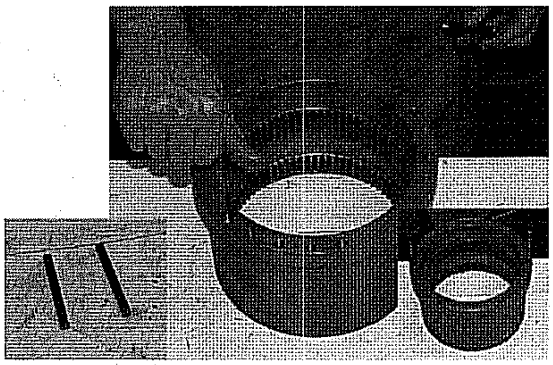
Introduisez les goujons dans leur logement sur le moyeu.



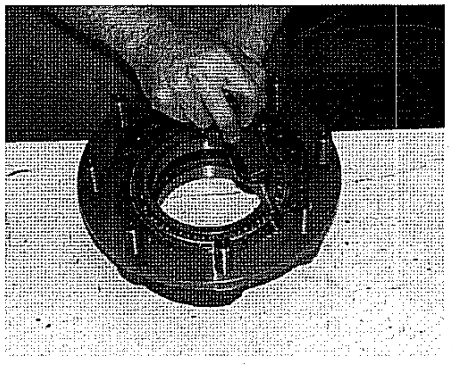
Introduisez le joint torique 2-266 (repère 37) sur le moyeu.



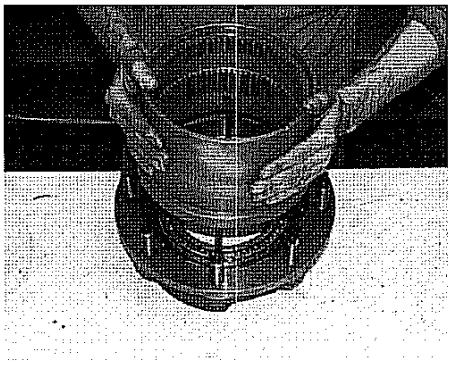
Montez les bagues extérieures des roulements (repère 30.L et 30.R) sur le moyeu.



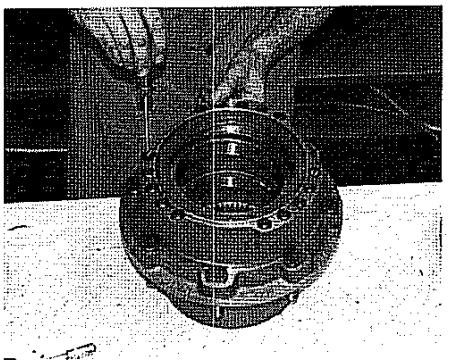
Vissez sur la couronne de la denture interne, deux goujons de repère dans 2 trous filetés à 180°.



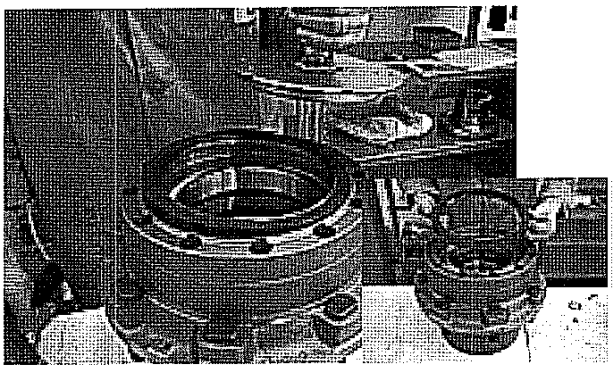
Graissez le logement du joint torique 2-226 sur le moyeu.



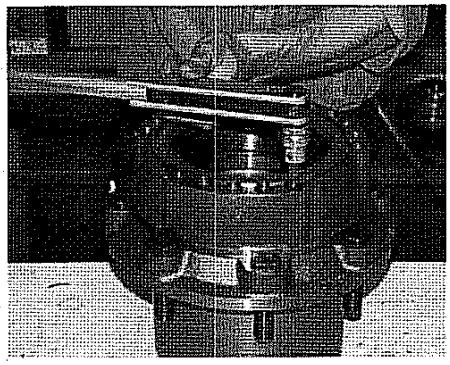
Placez la couronne de la denture interne sur le moyeu en la centrant à travers les deux goujons de repère.



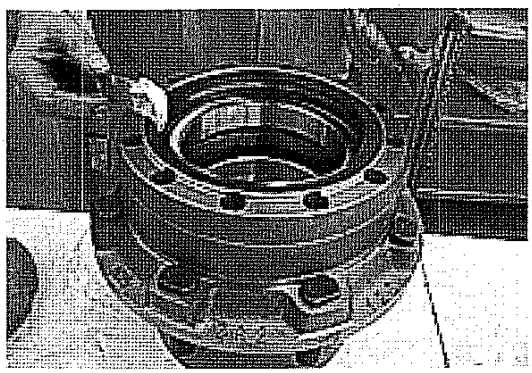
Dévissez et enlevez les deux goujons de repère.



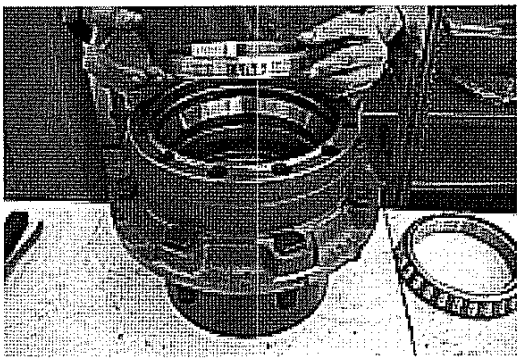
Montez la bague d'étanchéité AS170 x 200 x 15 DIN 3760 dans son logement sur le moyeu.



Serrez le moyeu et la couronne avec 15 vis M10 x 80 12K UNI 5931.

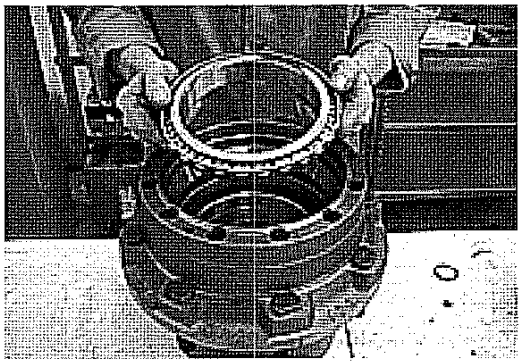


Remplissez les gorges de la bague d'étanchéité de graisse «Staburags NBU 30» de la marque KLUBER ou similaire.



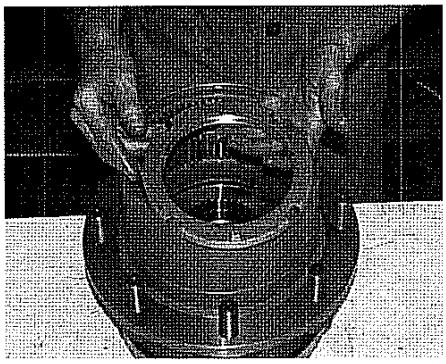
Posez l'entretoise des roulements (repère 10) sur la bague intérieure montée précédemment.

Prenez la fusée et posez-la du côté moteur. Placez avec beaucoup de soin le moyeu-couronne sur la fusée en veillant à bien centrer la bague d'étanchéité, les chemins des roulements et l'entretoise sur la fusée.



Montez la bague intérieure du roulement conique (repère 30.R).

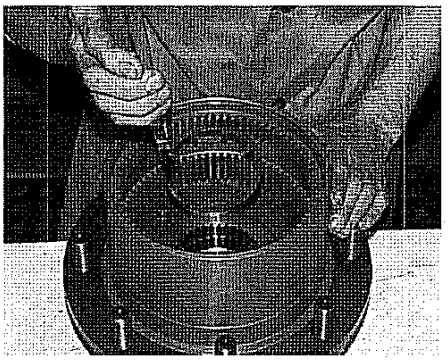
Montez l'ensemble des roulements contre leur butée.



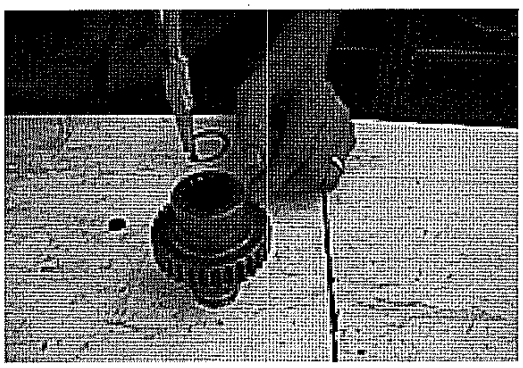
Vissez la bague filetée sur le tourillon d'essieu.

Vissez l'ecrou sur la fusée en appliquant un couple de 500 à 600 Nm.

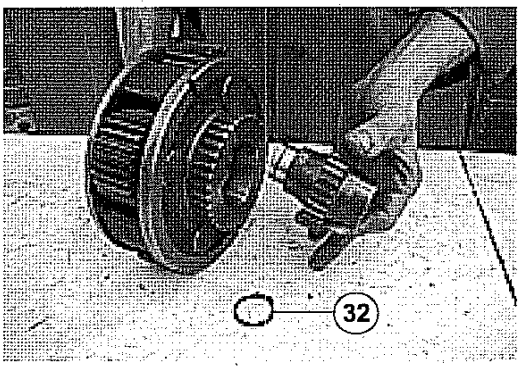
Après avoir effectué cette opération, le frottement des deux roulements à rouleaux coniques se réglera de conséquence car ce réglage est effectué avec la méthode «SET-RIGHT».



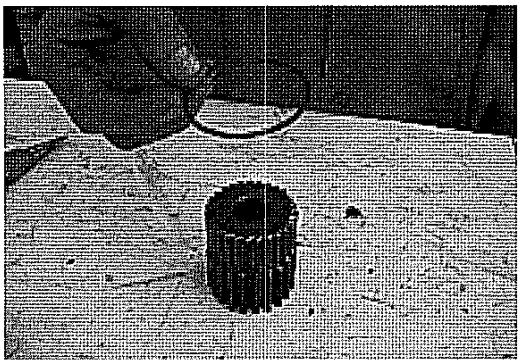
Montez le «circlip» «I» D. 90 UNI 7437 (repère 34) sur la fusée.



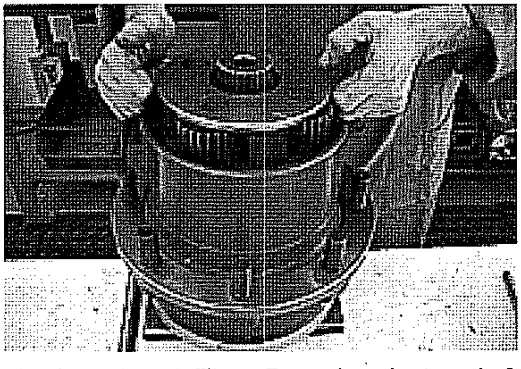
Montez le «circlip» «I» D. 23 UNI 7437 (repère 31) sur l'arbre du frein.



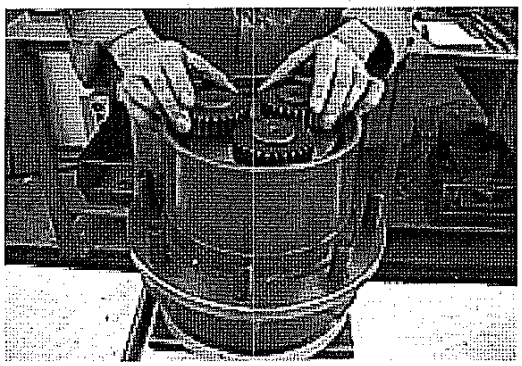
Positionnez l'arbre du frein sur le roulement du porte-satellites «B» et fixez-le avec le «circlip» «E» D. 30 UNI 7435 (repère 32).



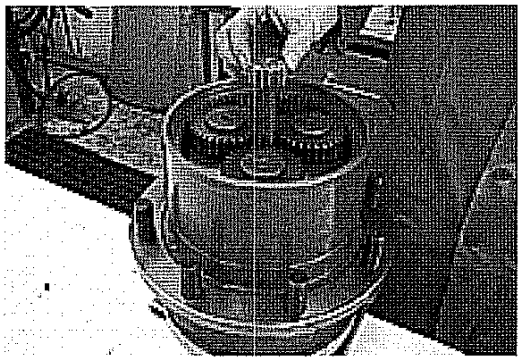
Montez l'anneau-butée «E» SW 58 dans son logement sur le joint central.



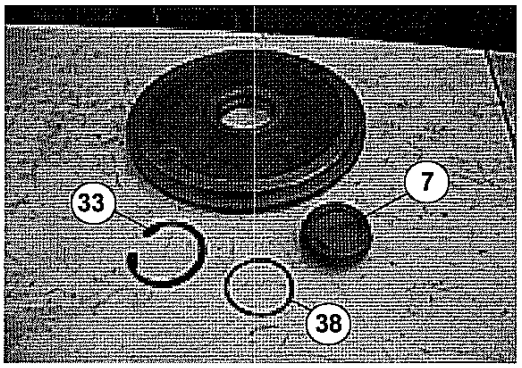
Montez le porte-satellites «B» en le calant sur la fusée.



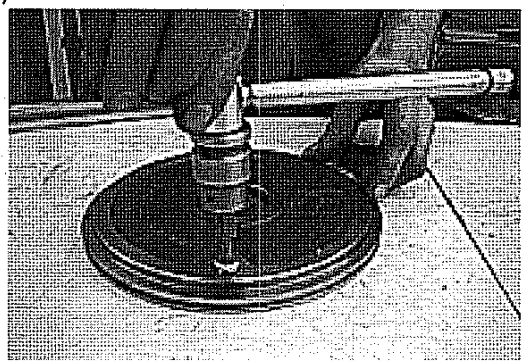
Montez le porte-satellites «B» en le calant sur le joint central.



Introduisez le pignon central dans sa position sur le porte-satellites «A».

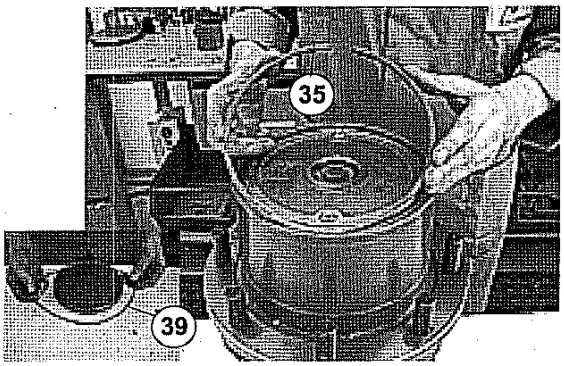


Prenez la butée (repère 7), introduisez le joint torique 2-30 (repère 38) et montez-la sur le couvercle. Fixez-la ensuite avec le «circlip» «I» D. 50 UNI 7437 (repère 33).

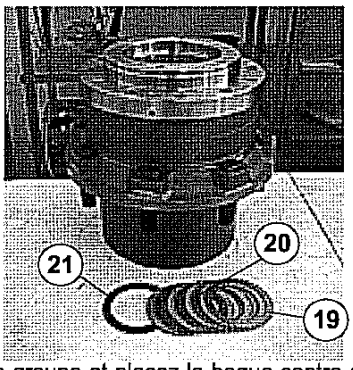


Vissez seulement un bouchon M10 x 1 DIN 908 et sa rondelle sur le couvercle.

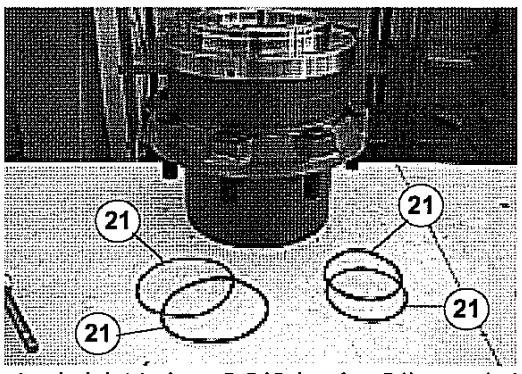
<u>Pour le relevé et le contrôle du jeu axial, reportez-vous au paragraphe 4.1.</u>



Placez le joint torique 2-170 (repère 39) dans son logement sur le couvercle. Montez le couvercle sur la couronne de la denture intérieure, en le fixant avec l'anneau - butée BR D. 205 (repère 35).



Retournez le groupe et placez la bague contre-disque (repère 21) sur la fusée. Introduisez les disques du frein, alternativement et sans en inverser l'ordre : un àfriction (repère 20) et un en acier (repère 19) 4 + 4 disques.

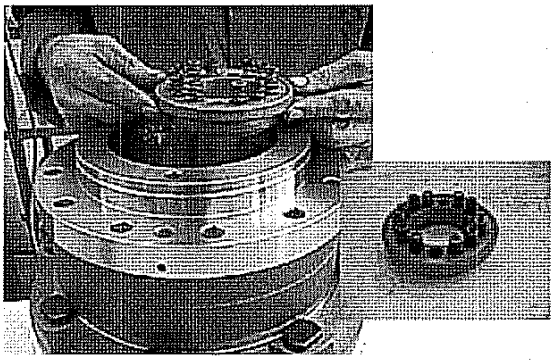


Montez le joint torique 2-240 (repère 24) avec la bague anti-extrusion 8-240 (repère 26) et le joint torique 2-246 (repère 23) avec la bague anti-extrusion 8-246 (repère 25).

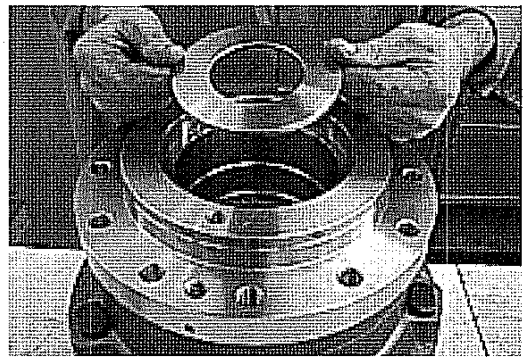
Attention ! montez correctement les bagues anti-extrusion, à savoir :

<u>la 8-240 doit être montée sous le joint torique 2-240.</u>

<u>La 8-246 doit être montée au-dessus du joint torique 2-246</u>

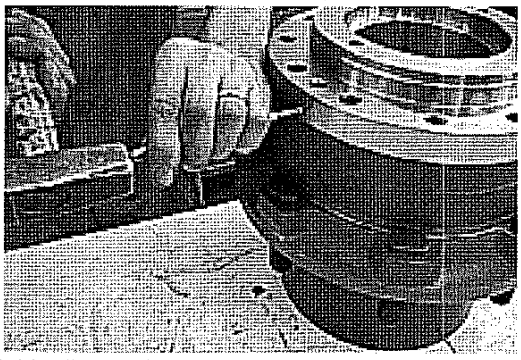


Montez le piston du frein dans son logement, y compris les 12 ressorts du frein (repère 17).



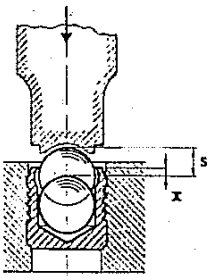
Montez la rondelle d'appui des ressorts sur les ressorts. Montez le «circlip» «I» D. 115 UNI 7437 à côté de son logement.

A l'aide d'un outil iadapté, appuyez sur lla rondelle d'appui des ressorts de façon à comprimer les ressorts et libérer le logement du «circlip». Poussez ensuite le «circlip» dans son logement et bloquez lla rondelle d'appui des ressorts.



A l'aide d'un outil adapté, montez les bouchons à expansion Koenig Modèle MB700 - 060.

ATTENTION ! Il est vivement recommandé d'utiliser l'outil adapté pour cette opération. Dans le cas contraire, vous risquez d'endommager le bouchon.

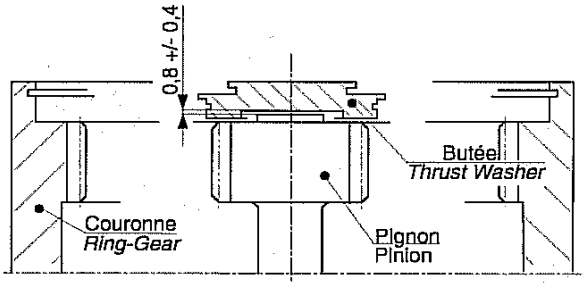


Installation Chart

Expander Ø mm		3	4	5	6	7	8	9
S mm	Stroke	1.2	1.5	2.0	2.5	3.0	3.5	4.0
X mm ±0.2	Final position of ball after insertion. Top of ball versus sleeve edge.	0.4	0.2	0.4	0.4	0.4	0.3	0.4
Expander Ø mm		10	12	14	16	18	20	22
S mm	Stroke	4.5	5.5	6.35	7.0	8.0	9.0	10.0
X mm ±0.2	Final position of ball after insertion. Top of ball versus sleeve edge.	0.4	0.4	0.4	0.6	0.6	0.8	0.8

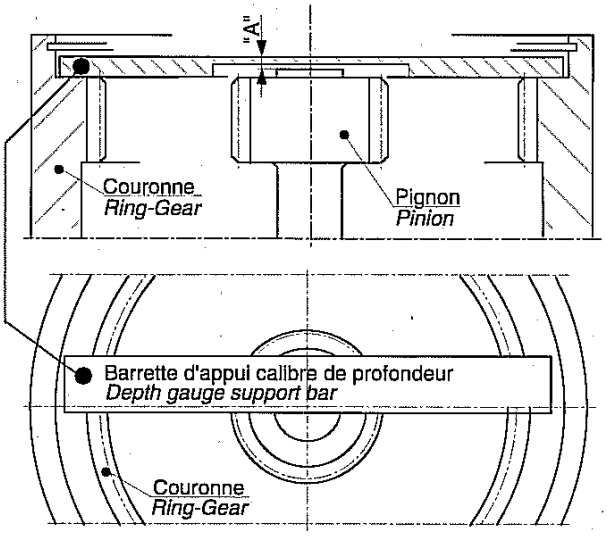
4. RELEVE POUR LE REGLAGE DES ROULEMENTS:

4.1 Relevé et contrôle du jeu axial admis.



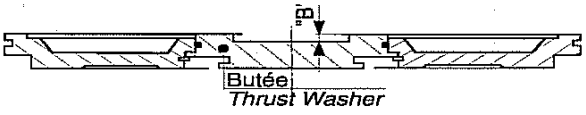
Contrôlez qu'entre la tête du pignon central et la butée logée sur le couvercle, il y ait un jeu axial de 0,8 $^{\pm 0,4}$ mm.

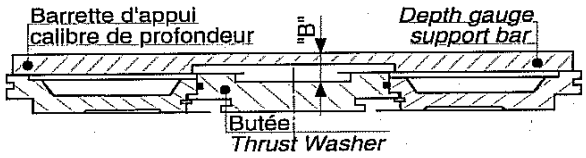
Relevé de la cote «A» du pignon



Posez la barrette d'appui du calibre sur la butée du couvercle. Relevez la cote «A» sur la tête du pignon (la barrette d'appui doit être creusée au centre pour faire passer la tête du pignon).

Relevé de la cote «B» de la couronne





Posez la barrette d'appui du calibre sur le couvercle. Relevez la cote «B» sur le fond du logement de la tête du pignon sur la butée.
La différence des deux valeurs obtenues «B - A» doit donner la valeur du jeu axial admis 0,8 $^{\pm 0,4}$ mm.

ATTENTION ! Si la valeur relevée n'est pas celle admise cela signifie que :
une pièce a été mal montée, par conséquent refaites le montage,
une des pièces n'a pas les bonnes dimensions, dans ce cas contactez le Service Qualité de BREVINI..

5. ESSAIS D'ETANCHEITE:

5.1 Essai d'étanchéité hydraulique du frein

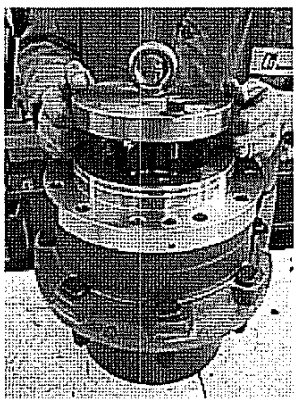
Montez dans l'orifice de commande du frein (cfr. paragraphe N° 7.1), un raccord adapté pour brancher le frein à une centrale ou une pompe hydraulique équipée d'un manomètre ayant un degré de précision de ± 5% pour contrôler la pression en sortie.

Effectuez 3 ou 4 ouvertures du frein à une pression de 200 bar pour tout ajuster.

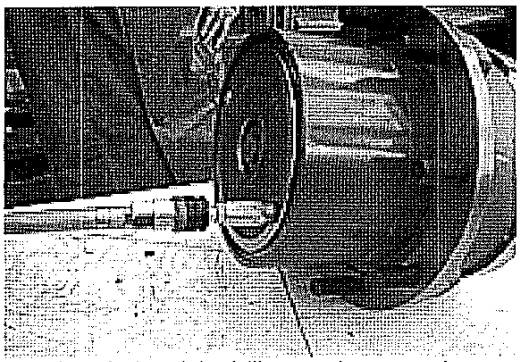
Contrôlez la pression minimale d'ouverture du frein en partant d'une pression de «0» bar et en l'augmentant graduellement jusqu'à ce que vous réussissez à faire tourner manuellement le réducteur de la roue. Lire la pression atteinte sur le manomètre, qui pour un frein de cette grandeur, doit être comprise entre 15 et 18 bar.
Contrôlez l'étanchéité hydraulique en amenant le frein à une pression de 300 bar. Fermez avec un robinet l'alimentation d'huile entre la centrale et le frein pendant 20 - 30 secondes. Pendant ce laps de temps, la pression ne doit pas descendre de plus de 5 bar.

Si tel est le cas, cela signifie que tout est normal.

5.2 Essai d'étanchéité du carter du réducteur de la roue:



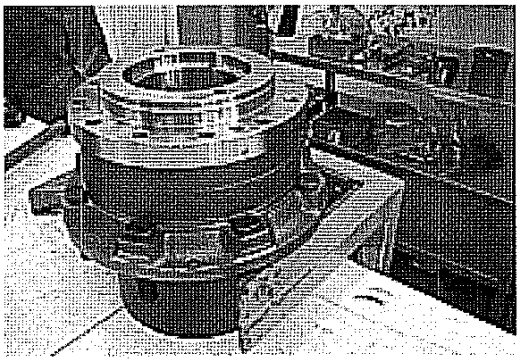
Fermez l'orifice de pilotage du frein avec un bouchon.
Fermez le logement du moteur en appliquant une bride spéciale ou montez le moteur.



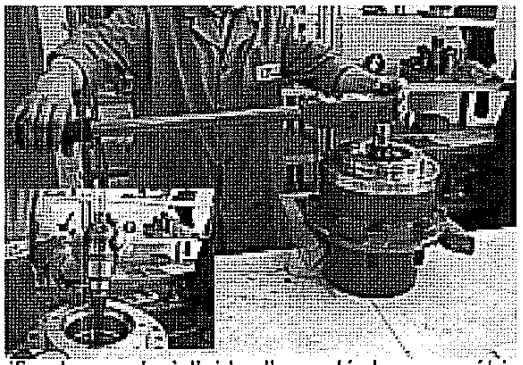
Montez dans le trou laissé libre sur le couvercle, un raccord pour relier le réducteur à de l'air comprimé à une pression de 0,5 bar. A l'aide des instruments adaptés contrôlez la pression à l'intérieur du réducteur et vérifiez qu'il n'y ait pas de fuites.

Si après avoir effectué le test avec de l'air, vous constatez une fuite sur le carter, il convient d'immerger le réducteur dans l'eau pour localiser la fuite.
Le contrôle en immersion est le seul qui permette de déceler les fuites si vous n'êtes pas en possession des instruments spéciaux pour le contrôle de la pression. Il suffit de laisser le réducteur raccordé au tuyau de l'air comprimé à une pression de 0,5 bar.
Plongez ensuite le réducteur et le tuyau d'air comprimé dans un récipient contenant de l'eau et vérifiez si des bulles d'air remontent à la surface.
Dans l'affirmative, cela signifie que le réducteur à des fuites. Repérez la fuite, retirez le réducteur de l'eau et faites le nécessaire pour éliminer la fuite.

5.3 Vérification du couple de freinage du réducteur de la roue:

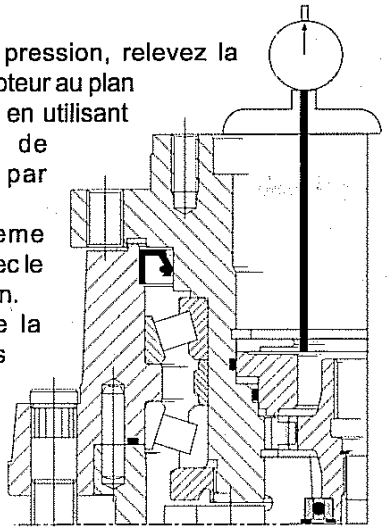


Fixez le moyeu - couronne du réducteur de la roue avec le côté moteur orienté vers le haut.



Vérifiez le couple à l'aide d'une clé dynamométrique ayant un degré de précision de ± 4% et opportunément reliée branchée à l'arbre du frein.
Avec le frein fermé, il doit glisser avec un couple de 220 Nm. avec une tolérance de ± 10%.

Avec le frein en pression, relevez la mesure du plan moteur au plan du piston du frein en utilisant un calibre de profondeur, par exemple.
Rfaites la meme opération mais avec le frein sans pression.
Calculez ensuite la différénce entre les deux valeurs qui doit etre comprise entre $1,5^{+/-0,5}$ mm..



ATTENTION ! Si la valeur relevée n'est pas celle admise cela signifie que :
une pièce a été mal montée, et par conséquent il faut refaire le montage,
une des pièces n'a pas les bonnes dimensions, dans ce cas contactez le Service Qualité BREVINI.

6. DEMONTAGE DU REDUCTEUR DE LA ROUE

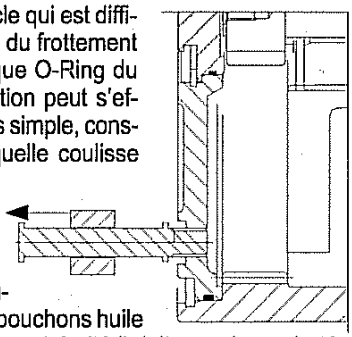
Le démontage des réducteurs Brevini ne présente pas de difficultés particulières. Il suffit de procéder dans le sens contraire du montage en veillant à ne pas endommager les composants du groupe.
Il n'est pas nécessaire de démonter le réducteur, si vous devez intervenir seulement sur la partie «frein» ou «réduction». Le démontage est nécessaire seulement en cas d'intervention sur les roulements ou sur les joints.

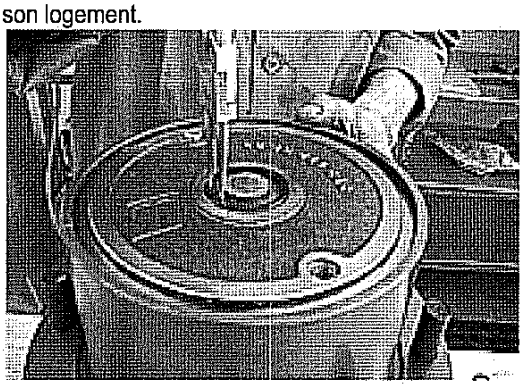
Vidangez l'huile de lubrification en dévissant les bouchons sur le couvercle M10 x 1 DIN 908.

6.1 Démontage du groupe "Réductions":

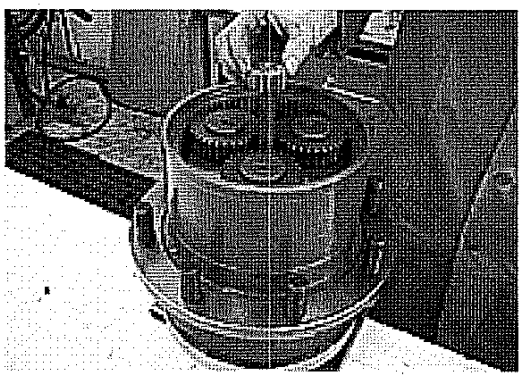
Sortez de son logement l'anneau-butée BR D. 205 qui fixe le couvercle.

Pour extraire le couvercle qui est difficile à extraire en raison du frottement exercé par le joint torique O-Ring du couvercle. Cette opération peut s'effectuer avec un outil trés simple, constitué d'une tige sur laquelle coulisse une masse battante (marteau).
Une extrémité de la tige doit etre filetée à un pas de M10 x 1 pour pouvoir etre vissée dans le bouchons huile du couvercle. Sur l'autre extrémité il doit y avoir une butée pour bloquer la masse battante.
En faisant glisser avec une certaine force la mabbe contre la butée, on obtiendra une action martelante, qui utilisée dans un trou d'abord et dans l'autre ensuite, fera sortir le couvercle de son logement.

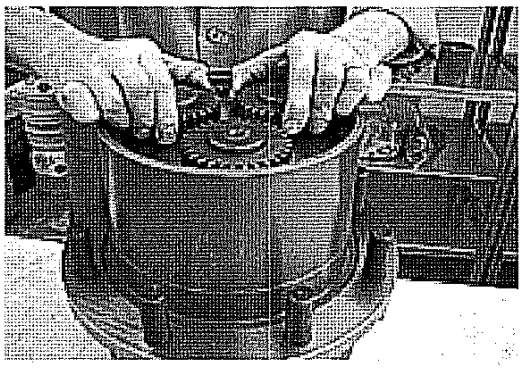




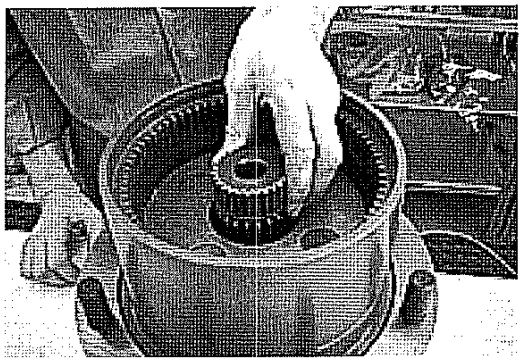
Retirez le «circlip» «I» D. 50 du couvercle et extrayez la butée de son logement avec un marteau.



Retirez le pignon central de son logement.

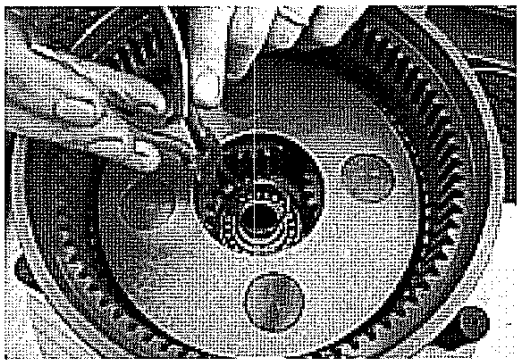


Retirez le porte-satellites «A».



Retirez le joint central.

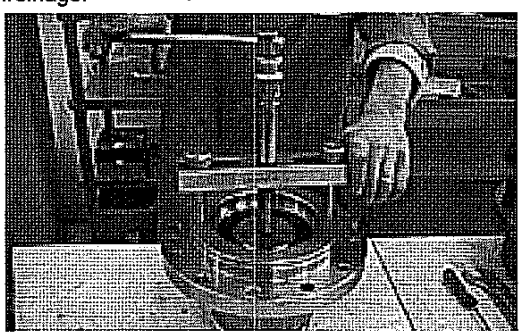
ATTENTION ! En retirant le porte-satelllites «B», l'arbre du frein s'extrait automatiquement avec étant donné qu'il est fixé au roulement à billes qui est lui même fixé au porte-satellites.



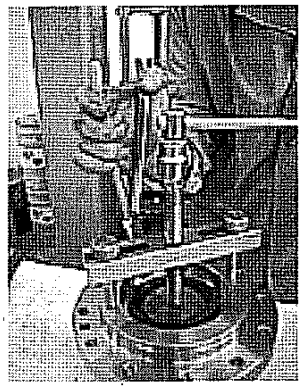
Pour éviter cela, retirez le «circlip» «E» D. 30 UNI 7535 de son logement sur l'arbre.

6.2 Démontage du groupe "frein":

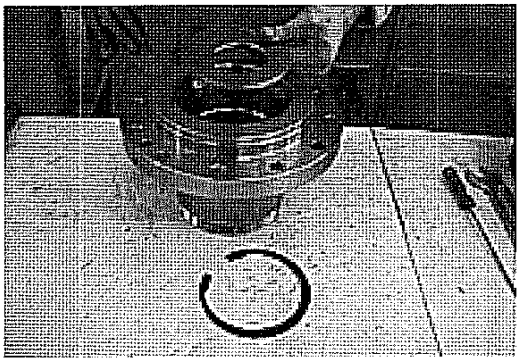
Démontez le moteur et débranchez le frein de l'installation de freinage.



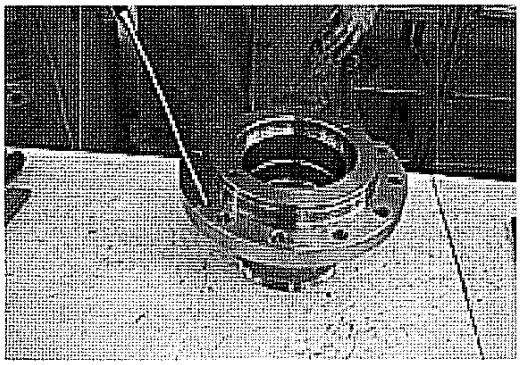
Enlevez la pression du«circlip» «I» D. 115 UNI 7437 en comprimant le plateau fixe-ressorts (il suffit de toucher à peine le plateau, ne comprimez pas trop les ressorts car cela pourrait s'avérer dangereux) de façon uniforme. Evitez que le plateau se mette de travers et s'encastre rendant ainsi son démontage difficile, voire dangereux, en raison de la pression. exercée par les ressorts du frein.



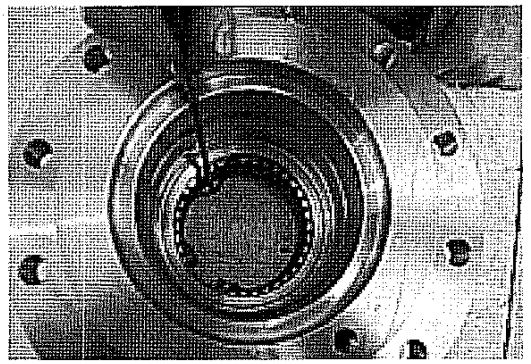
Retirez le «circlip» de son logement. .



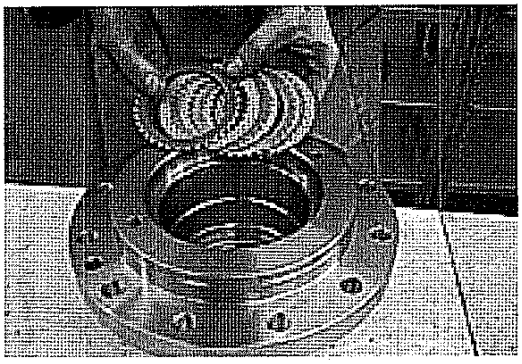
Comprimez la rondelle d'appui des ressorts qui sortira de son logement par effet de la pression exercée par les ressorts du frein.



Insufflez de l'air comprimé (en prenant les précautions d'usage) à travers l'orifice de commande du frein pour faire sortir le piston de sa position.



Enlevez les joints toriques de leur logement ainsi que les bagues de soutien du frein.

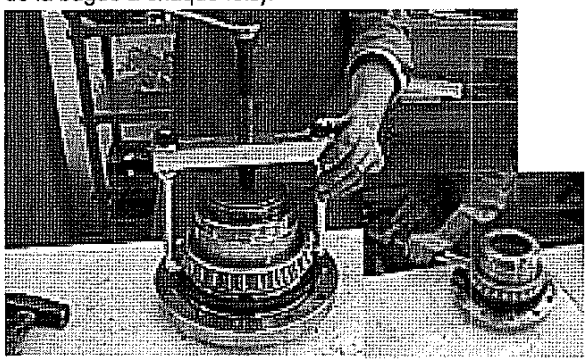


Retirez les disques du frein, le contre-disque mais pas l'arbre qui est fixé sur le roulement par le «circlip» «E» D. 32 du côté des réductions.

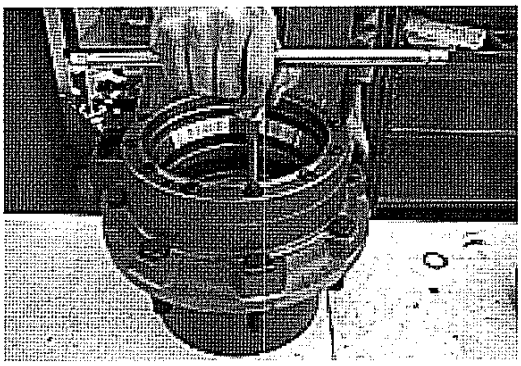
6.3 Démontage du groupe «moyeu - fusée et garniture»

Dévissez l'ecrou à l'aide d'un outil approprié.

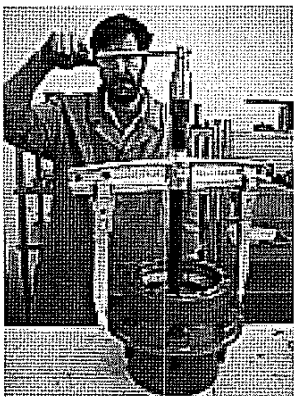
A l'aide d'un outil approprié, extrayez le moyeu - couronne de son logement (cette opération entra"nera sûrement l'endommagement de la bague d'étanchéité AS 170 x 200 x 14 DIN 3760, par conséquent il faut prévoir le remplacement de la bague à chaque fois).



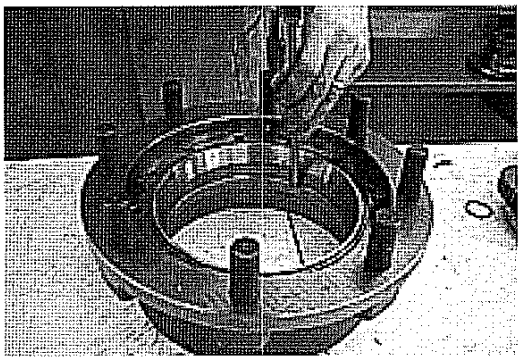
Retirez la bague d'étanchéité AS 170 x 200 x 14 DIN 3760 du fusée et la cage intérieure du premier roulement à rouleaux.



A l'aide d'une clé à 6 pans dévissez et enlevez le vis qui fixent le moyeu à la couronne.



A l'aide d'un outil approprié, séparez le moyeu de la couronne et retirez la cage intérieure du deuxième roulement à rouleaux.



A l'aide d'un outil approprié, retirez les deux cages extérieur des roulements du moyeu.

Une fois le démontage terminé, lavez soigneusement toutes les pièces en utilisant un détergent liquide approprié.
Examinez attentivement les pièces démontées et remplacez celles usées.

ENGLISH

1. CLEANING AND GENERAL CONDITION OF COMPONENTS:

1.1 Forged parts, supports, intermediate flanges, etc.:

Check: No machining burrs.
No chips in solid threaded holes.
Spot-facing for oil plugs, etc. must all be identified to guarantee the required seal.
All machined diameters must have chamfers and no missing material or porosity.
Remove any foundry residues.

1.2 Shafts, pinions, couplings:

Check: No burrs on threads, in tab seat and eventually in the key seat of the cylindrical part and in the circlip seats.
No dents on sliding races, Oil Seals, Toothing, Grooves, etc.

1.3 O-rings and oil seals:

Check: No imperfections, notches or pressing burrs.

1.4 Lock nuts and lock washers:

Check: Lock nuts and lock washers must be new and never used.

ATTENTION: if problems should arise as described above, take the necessary action to restore the optimum service conditions. Otherwise, notify the "BREVINI" Quality Control department and never use non-conforming items without first obtaining approval.

2. TABLES:

2.1 Screw torque setting table

d x p mm	4.6		5.6		6.8		10.9		12.9		d x p mm	4.6		5.6		6.8		10.9		12.9	
	kN	Nm	kN	Nm	kN	Nm	kN	NM	kN	Nm		kN	Nm	kN	Nm	kN	Nm	kN	NM	kN	Nm
3 x 0,5	1,2	0,9	1,5	1,1	2,3	1,8	3,4	2,6	4,0	3	16 x 1,5	43	121	54	150	82	229	121	336	141	393
4 x 0,7	2,1	1,6	2,7	2	4,1	3,1	6,0	4,5	7,0	5,3	16 x 2,5	49	157	60	194	95	306	135	435	158	509
5 x 0,8	3,5	3,2	4,4	4	6,7	6,1	9,8	8,9	11,5	10,4	16 x 1,5	57	176	70	220	110	345	157	491	184	575
6 x 1	4,9	5,5	6,1	6,8	9,4	10,4	13,8	15,3	16,1	17,9	20 x 2,5	63	222	77	275	122	432	173	615	203	719
7 x1	7,3	9,3	9,0	11,5	13,7	17,2	20,2	25	23,6	30	20 x 1,5	72	248	89	307	140	482	199	687	233	804
8 x1,25	9,3	13,6	11,5	16,8	17,2	25	25	37	30	44	22 x 2,5	76	305	97	376	152	592	216	843	253	987
8 x1	9,9	14,5	12,2	18	18,9	27	28	40	32	47	22 x 1,5	88	337	109	416	172	654	245	932	286	1090
10 x 1,5	14,5	26,6	18	33	27	50	40	73	47	86	24 x 3	90	383	112	474	175	744	250	1060	292	1240
10 x 1,25	15,8	28	19,5	35	30	53	43	78	51	91	24 x 2	101	420	125	519	196	814	280	1160	327	1360
12 x 1,75	21,3	46	26	56	40	86	59	127	69	148	27 x 3	119	568	147	703	230	1100	328	1570	384	1840
12 x 1,25	23,8	50	29	62	45	95	66	139	77	163	27 x 2	131	615	162	760	225	1200	363	1700	425	1990
14 x 2	25	73	36	90	55	137	80	201	94	235	30 x 3,5	144	772	178	955	280	1500	399	2130	467	2500
14 x 1,5	32	79	40	98	61	150	90	220	105	257	30 x 2	165	859	204	1060	321	1670	457	2370	535	2380
16 x 2	40	113	50	141	76	214	111	314	130	368											

d = screw diameter
p = screw pitch

3. WHEEL DRIVE GEAR CDW2050/M ASSEMBLY:

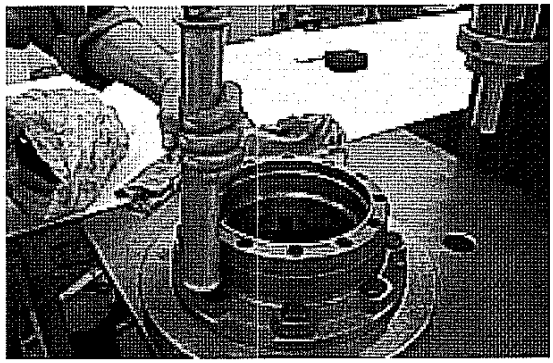
ATTENTION:
Prior to assembly, all the inner and outer bearing and oil seal seats and races must be lubricated with oil to make mounting easier.

All screws will be tightened by applying the torque setting (Nm) indicated in the table in paragraph 2.1.

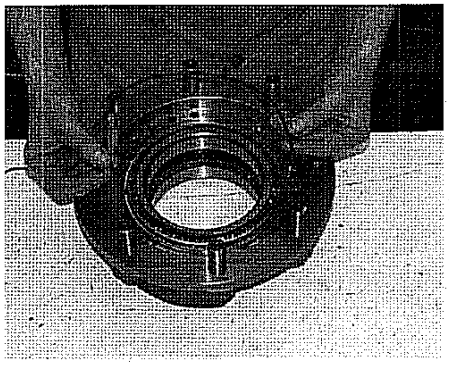
All screws should be mounted using a medium thread lock such as "Loctite type 242" or similar item.

Where a precise torque must be applied using a torque wrench, do not use wrenches for which the maximum applicable torque is close to the required torque setting.

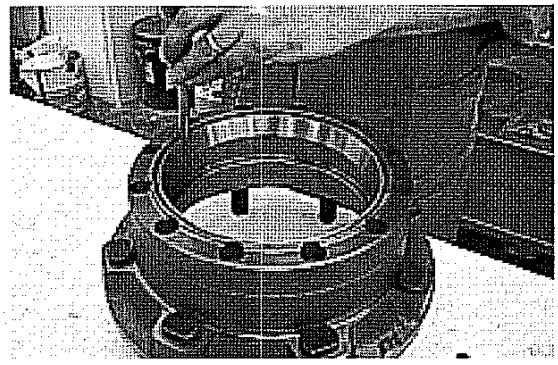
Do not mix the bearing races, but comply with the manufacturer's combination of outer and inner bearing races .



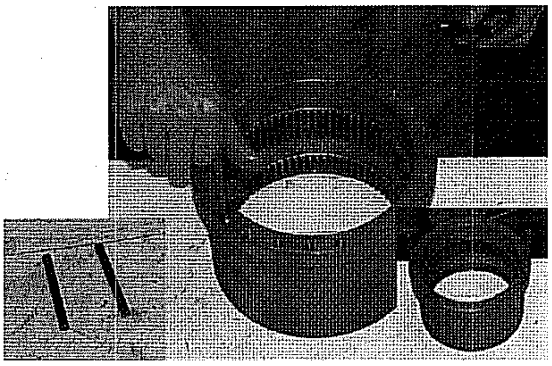
Insert the studs into their seats on the hub.



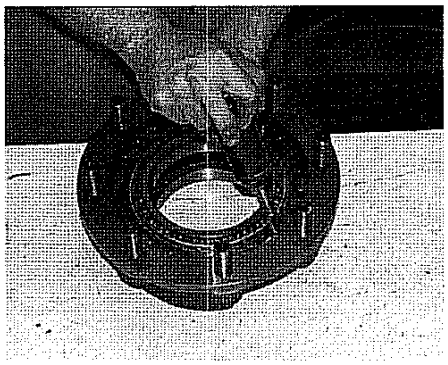
Insert O-ring 2-266 (pos. 37) on the hub.



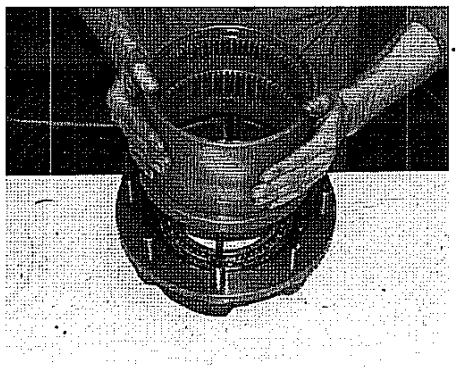
Mount the outer races of the bearings (pos. 30.L and 30.R) on the hub.



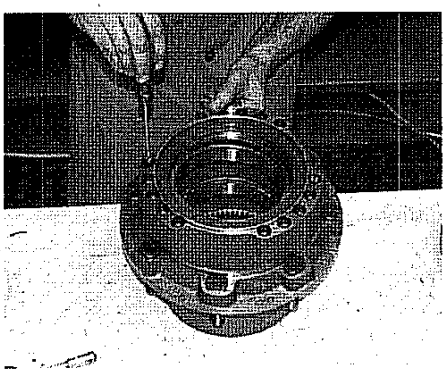
Screw two reference pins into the 2, 180° threaded holes on the housing with inner toothing.



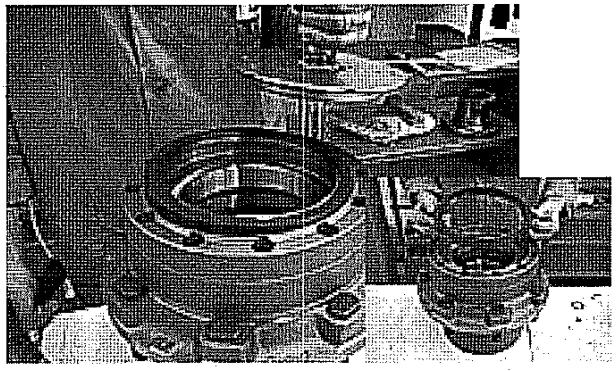
Grease the O-ring 2-226 seat on the hub.



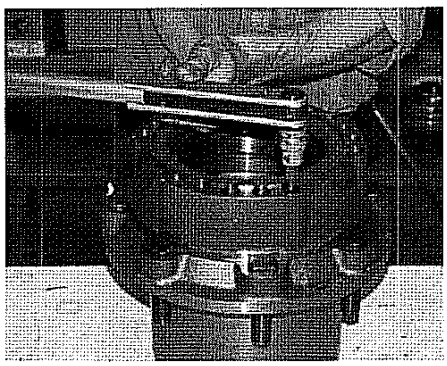
Position the housing with inner toothing on the hub, centering it using the two reference pins.



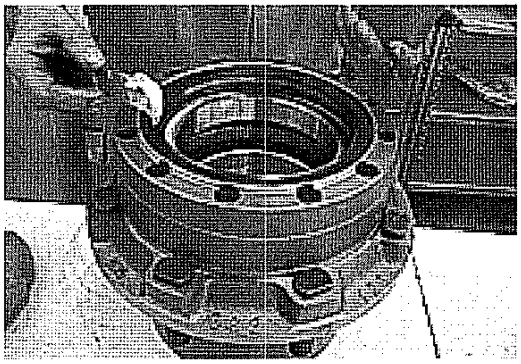
Unscrew and remove the two reference pins.



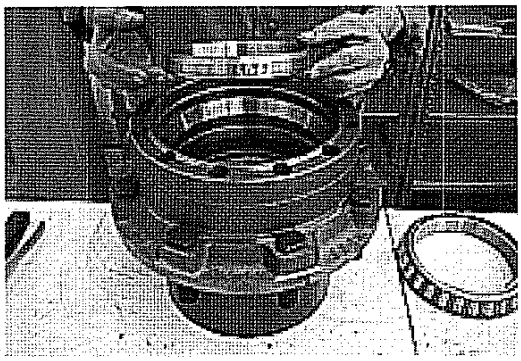
Mount the oil seal AS170x200x15 DIN 3760 in its seat on the hub.



Tighten the hub and housing using 15, M10 x 80 12K UNI 5931 screws.

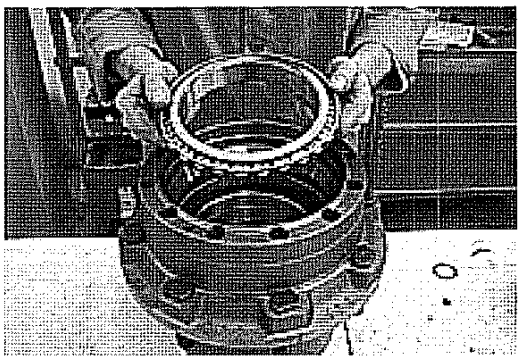


Fill the throats of the Oil seal with Kluber "Staburags NBU30" grease or similar product.



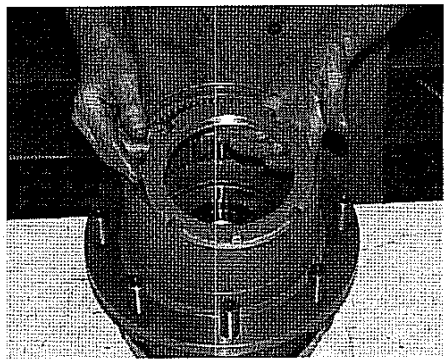
Place the bearing spacer (pos. 10) on the internal race that was previously inserted.

Take the spindle and place it on the motor side. Carefully position the hub-ring gear on the spindle being very careful while centering the Oil seal, the bearing races and the spacer on the spindle.



Position the internal race of the tapered bearing (pos. 30.R).

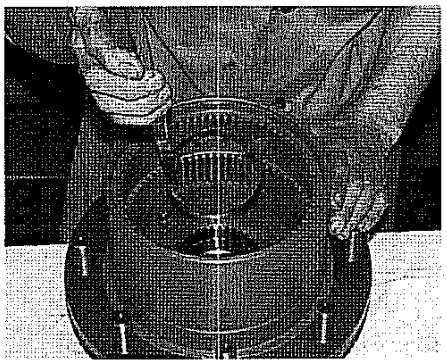
Fit the entire bearing pack.



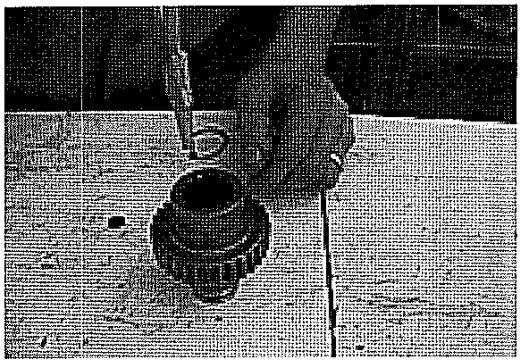
Tighten the lock ring on the spindle.

Tighten the lock nut on the spindle, applying a torque of 500-600 Nm..

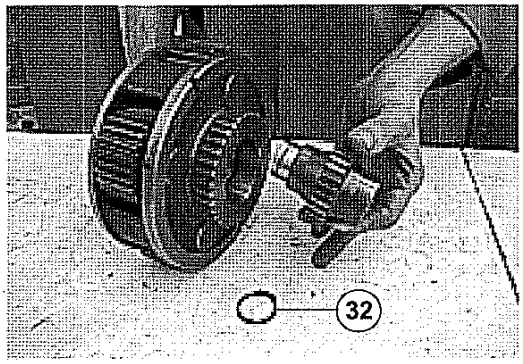
The rolling friction of the barrel roller bearings will be adjusted after completing this operation since the adjustment is performed using the «SET-RIGHT» method.



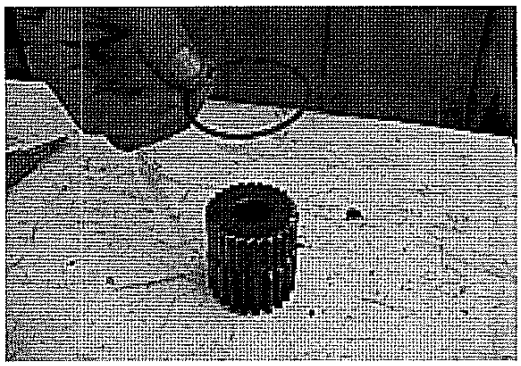
Mount circlip D.90 UNI 7437 (pos. 34) on the spindle.



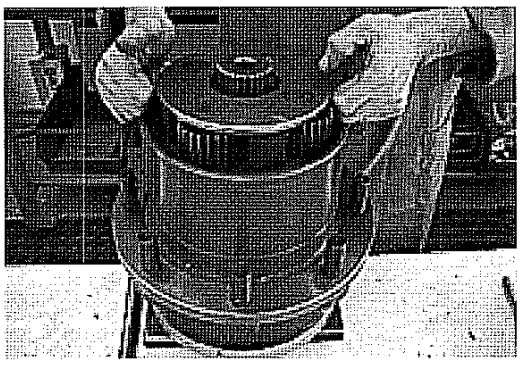
Mount circlip D.23 UNI 7437 (pos. 31) on the brake shaft.



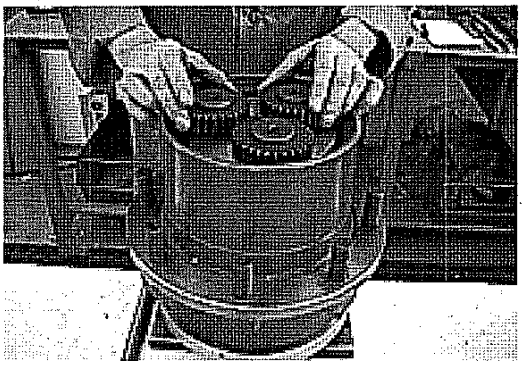
Position the brake shaft on the bearing of spider "B" and lock it with circlip D.30 UNI 7435 (pos. 32).



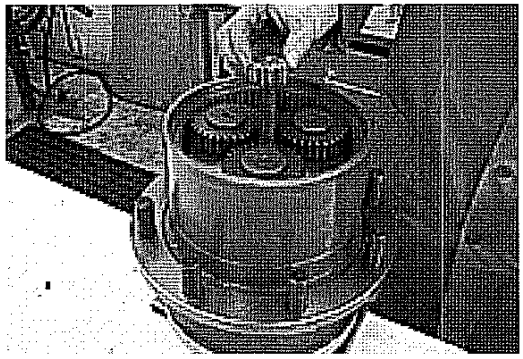
Mount retaining ring "E" SW 58 in its seat on the central coupling.



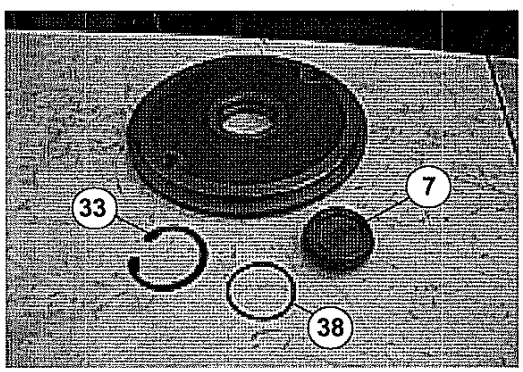
Position spider "B", keying it on the spindle.



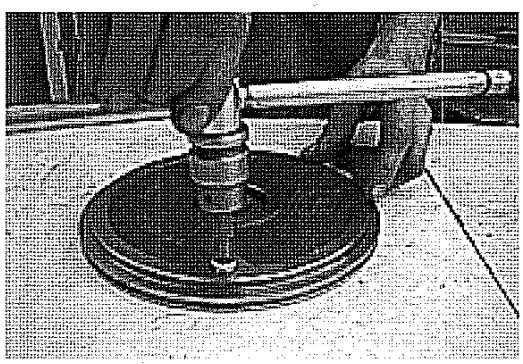
Position spider "A", keying it on the central coupling.



Insert the central pinion into its position on spider "A".

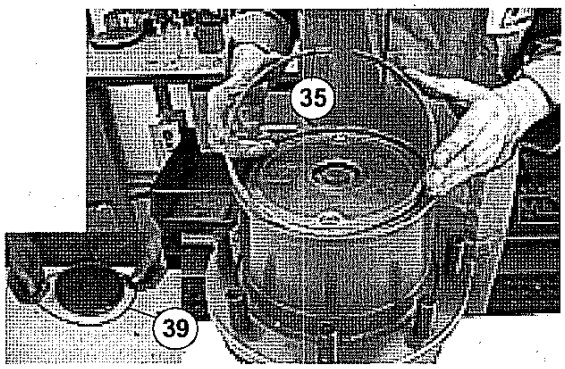


Insert O-ring 2-30 (pos. 38) into its seat on the thrust washer and position it on the cover. Then lock it with circlip D.50 UNI 7437 (pos. 33).

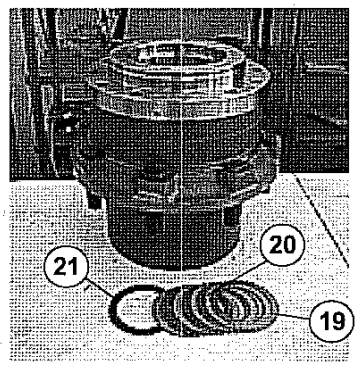


Screw in only one plug M10x1 DIN 908 and the relative washer on the cover.

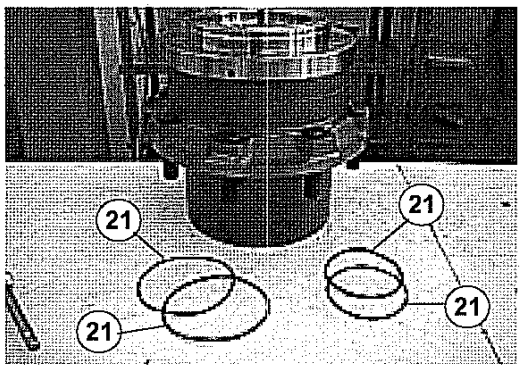
See paragraph 4.1 for axial clearance measurement and control.



Place O-ring 2-170 (pos. 39) in its seat on the cover, mount the cover on the ring gear and lock it with retaining ring BR D.205 (pos. 35).



Turn the assembly upside down and place the disc (pos. 21) on the spindle. Insert the brake discs, alternating them without ever reversing the order: one sintered disc (pos. 20) followed by one steel disc (pos. 19) for 4 + 4 discs.



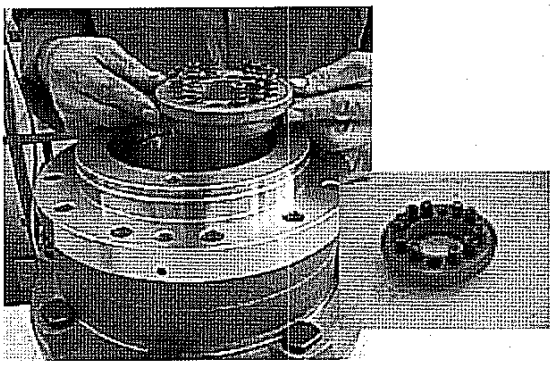
Mount O-ring 2-240 (pos. 24) on the spindle with anti-extrusion ring 8-240 (pos. 26) and O-ring 246 (pos. 23) with anti-extrusion ring 8-246 (pos. 25).

ATTENTION: mount the anti-extrusion rings as follows:

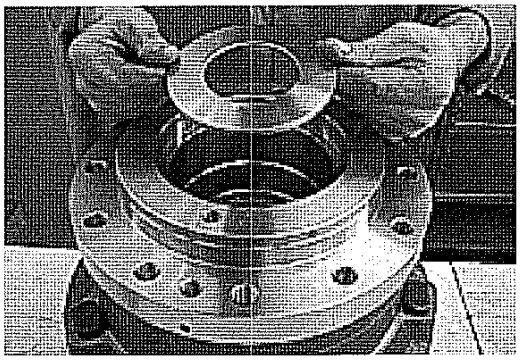
8-240 is placed under O-ring 2-240

8-246 is placed above O-ring 2-246.

ENGLISH

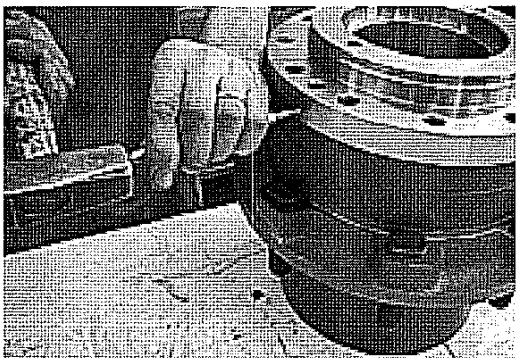


Mount the brake piston in its seat including the 12 brake springs (pos. 17).



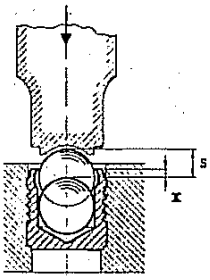
Mount the spring plate on the springs. Position the circlip D.115 UNI 7437 close to its seat.

Use an appropriate tool to press the spring plate in order to compress the springs and release the circlip seat. Push the circlip into its seat, thus blocking the spring plate.



Mount the Koenig Type MB700-060 expansion plugs, using the specific tool.

ATTENTION: it is not recommended to mount this type of plug without using specific tools, because otherwise there is a high probability of demaging the plug.

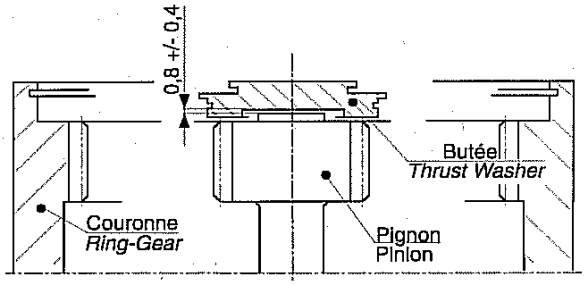


Installation Chart

Expander Ø mm		3	4	5	6	7	8	9
S mm	Stroke	1.2	1.5	2.0	2.5	3.0	3.5	4.0
X mm ± 0.2	Final position of ball after insertion. Top of ball versus sleeve edge.	0.4	0.2	0.4	0.4	0.4	0.3	0.4
Expander Ø mm		10	12	14	16	18	20	22
S mm	Stroke	4.5	5.5	6.35	7.0	8.0	9.0	10.0
X mm ± 0.2	Final position of ball after insertion. Top of ball versus sleeve edge.	0.4	0.4	0.4	0.6	0.6	0.8	0.8

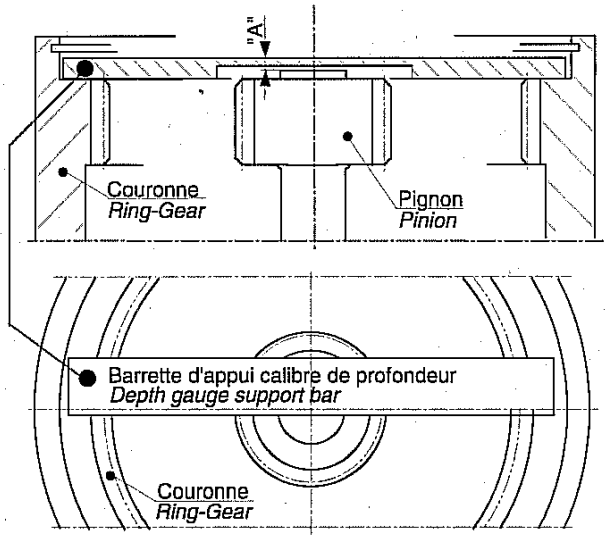
4. BEARING ADJUSTMENT MEASUREMENTS:

4.1 Tolerated axial clearance measurement and check



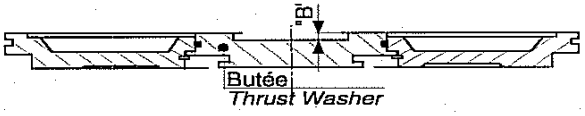
Check that there is an axial clearance of $0.8^{+/-}$ 0.4 mm between the head of the central pinion and the thrust washer housed on the cover.

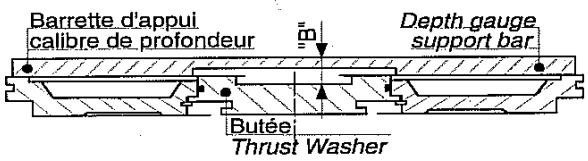
Pinion "A" dimension measurement



Place the "gauge support" bar on the cover contact point, then measure the value of "A" on the pinion head (the gauge support bar must be released in the centre to avoid interfering with the pinion head).

"B" thrust washer dimension measurement





Place the "gauge support" bar on the surface of the cover, then measure the value of "B" on the bottom of the "pinion head" seat on the thrust washer.
The difference between the two values obtained ("B-A") must provide the tolerated axial clearance value of $0.8^{+/-\ 0.4}$ mm.

ATTENTION: if the measured value does not comply with the rating, this means that: a part was mounted incorrectly, thus review the assembly procedure, or there is an incorrect spacing dimension of the parts that are needed to obtain this value. In this case, contact the "Brevini Quality" service department.

5. LEAK TESTS:

5.1 Brake hydraulic leak tests:

Mount a fitting in the brake control hole (see assembly drawing in paragraph no. 7.1) to connect the brake to a control box or hydraulic pump equipped with a pressure grade with precision +/- 5% to check the outlet pressure.

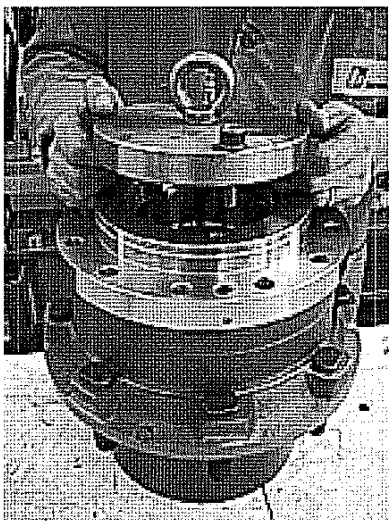
Complete 3 or 4 brake opening operations with a pressure of 200 bar to ensure that the entire system has settled.

Check the minimum brake opening pressure, starting from a pressure of "0" bar and increasing gradually until the drive gear can be turned by hand. Read the pressure on the gauge which for a brake of this size should be 15-18 bar.

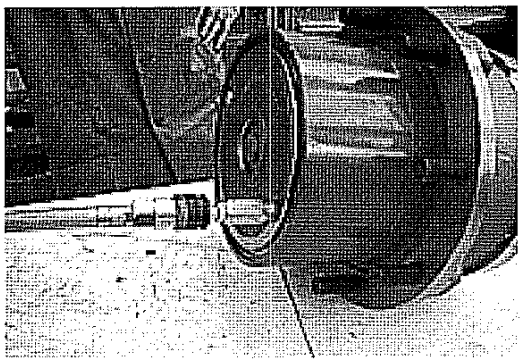
Check the hydraulic seal putting the brake under a pressure of 300 bar, use a valve to close the oil line between the control box and brake for 20-30 seconds during which the pressure should not drop by more than 5 bar.

If these conditions are obtained, everything is operating efficiently.

5.2 Wheel drive gear sump leak tests:



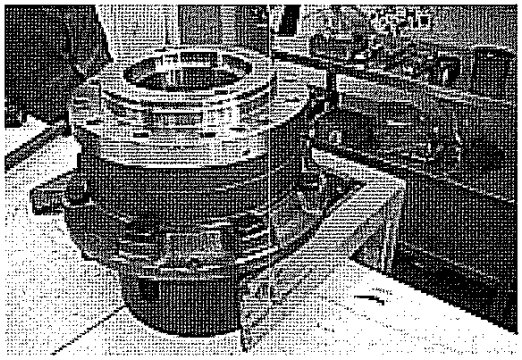
Use a plug to close the brake control hole.
Close the motor seat by using a special cover or by mounting the motor.



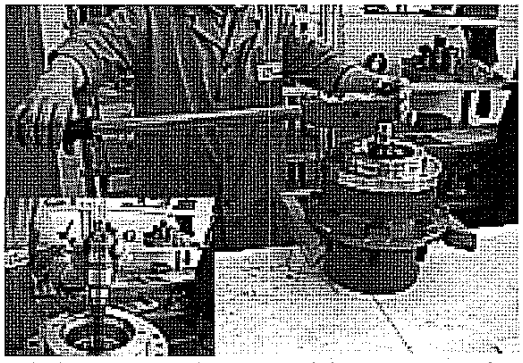
Mount a proper fitting into the hole that is still open on the cover to connect the drive gear to the compressed air supply at a pressure of 0.5 bar. Then use the specific instruments designed to check the pressure inside the reducer and check for any leaks.

After the test, if a leak was found in the oil sump, the water immersion test must be performed to locate the leak.
The immersion test can also be carried out as the only alternative test if specific instruments are not available to check the pressure. Just leave the drive gear attached to the compressed air tube and always at a pressure of 0.5 bar.
Then immerse the drive gear with the relative connections, into a tank of water and note if any air bubbles rise to the surface.
If so, this means that the drive gear leaks. Therefore, find the point where the air comes out of the drive gear, remove the water and take the necessary actions.

5.3 Wheel drive gear braking torque test:



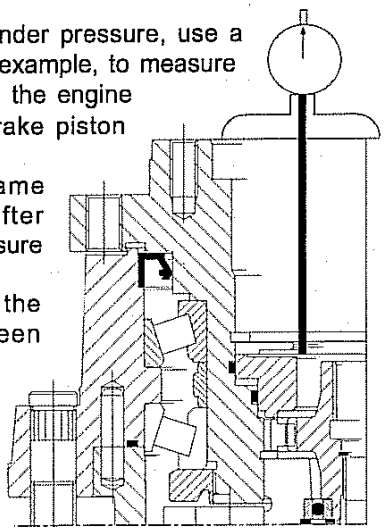
Lock the hub-ring gear of the wheel drive gear with the motor side facing up.



Check the torque using a special torque wrench with precision +/- 4% that is properly connected to the brake shaft.
With the brake closed: the brake must slide with an applied torque of 220 Nm with a tolerance of +/- 10%..

ENGLISH

With the brake under pressure, use a depth gauge, for example, to measure the distance from the engine surface to the brake piston surface.
Repeat the same operation after releasing the pressure on the brake.
Then determine the difference between the two values measured.
The result must be $1.5^{+/-0.5}$mm.



ATTENTION: if the measured value does not comply with the rating, this means that: a part was mounted incorrectly, thus review the assembly procedure, or there is an incorrect spacing dimension of the parts that are needed to obtain this value. In this case, contact the "Brevini Quality" service department.

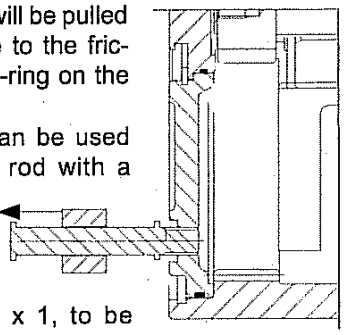
6. WHEEL DRIVE GEAR DISASSEMBLY:

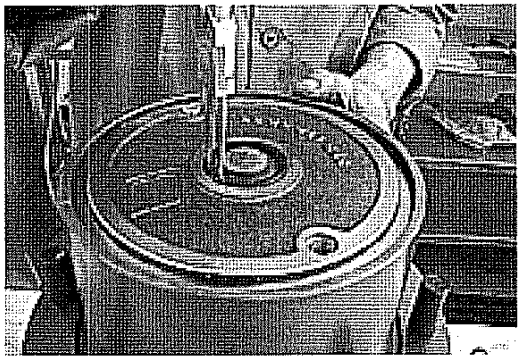
In general, there is nothing particularly difficult about disassembling our drive gears - just reverse the assembly steps and try not to ruin the parts comprising the unit. Only in some cases is it necessary to be familiar with or have the necessary instructions.
For this type of drive gear, in order to work on the "brake" part or the "reduction" part, it is not necessary to disassemble the drive gear from the middle: it is necessary in order to work on the "bearing" part or "seal" part.
Drain the lubricating oil from the wheel drive gear, removing the plugs on the cover M10x1 DIN 908.

6.1 "Reduction" unit disassembly:

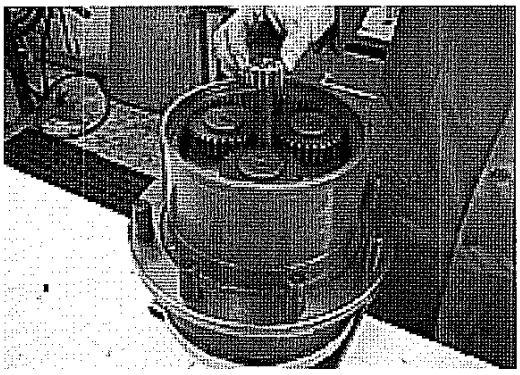
Remove the retaining ring BR D.205 from its seat that keeps the cover locked.

To remove the cover will be pulled out with difficulty due to the friction exerted by the O-ring on the cover itself.
A very simple tool can be used which consists of a rod with a sliding striking mass (hammer).
One end of the rod must be threaded, with a pitch of M10 x 1, to be screwed into the cover oil plug holes.
The other end must have a stop for the striker.
Sliding the striker firmly against the stop plate will create a hammering action that, when applied first in one hole and then in another, will ease the cover from its seat.

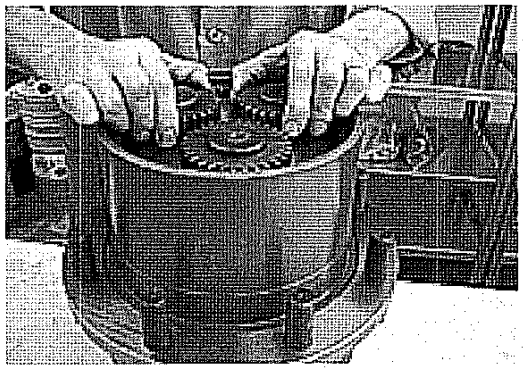




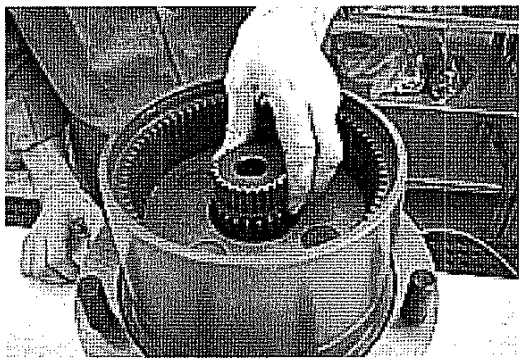
Remove the circlip D.50 from the cover; then use a hammer to remove the thrust washer from its seat.



Remove the central pinion from its position.

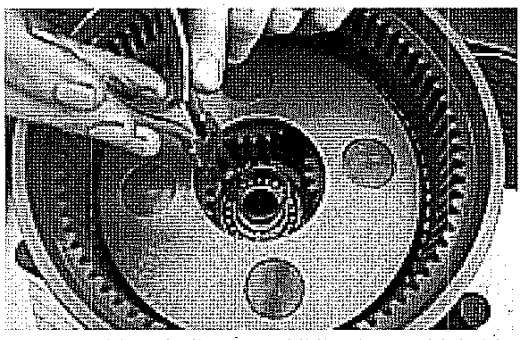


Pull out the spider "A".



Pull out the central coupling.

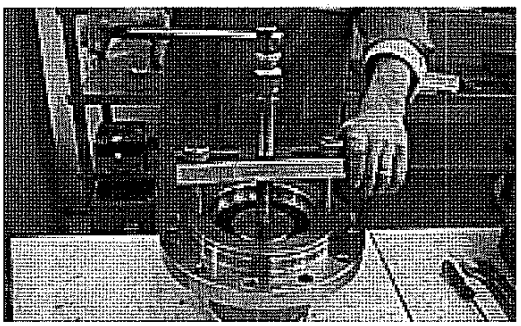
ATTENTION: when pulling out spider "B", the brake shaft will also be removed..



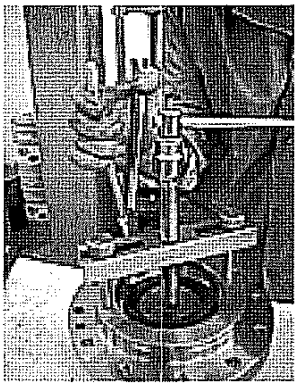
To prevent this, circlip D.30 UNI 7435, which blocks the ball bearing to the shaft and thus also to the spider, must also be removed from its seat on that same shaft.

6.2 "Brake" unit disassembly:

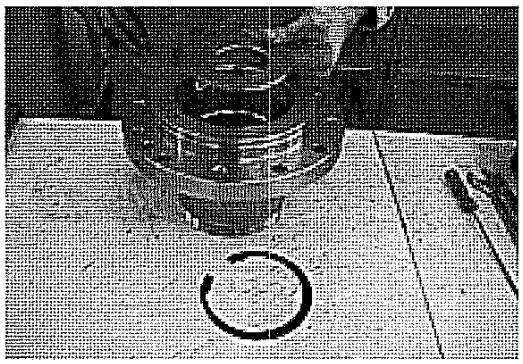
Disassemble the motor and disconnect the brake from the braking system.



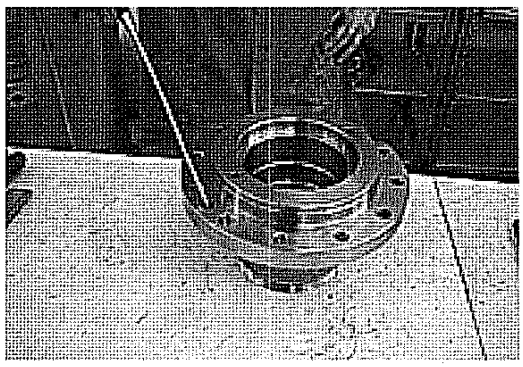
Remove the pressure from circlip D.115 UNI7437, pressing uniformly on the spring plate (just slightly move the plate, do not overload the springs; this could be dangerous) to prevent it from turning sideways and becoming jammed. This would make it dangerous to remove, due to the pressure exerted by the brake springs.



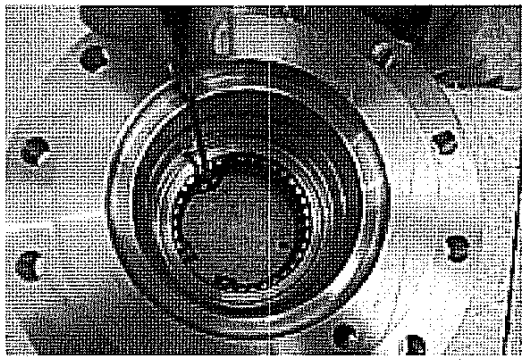
Remove the circlip from its seat..



Remove the pressure from the spring plate which, if the pressure has been exerted uniformly, will come out of its seat due to the pressure from the brake springs.

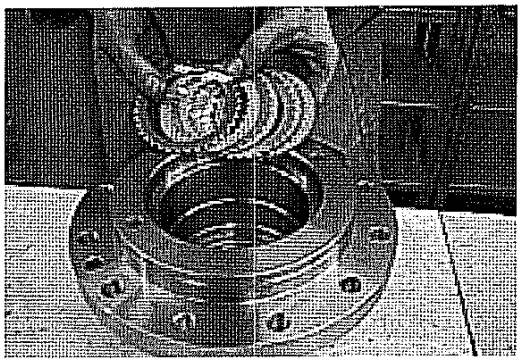


Blow compressed air (very carefully) into the brake control hole to remove the brake piston from its position.



Remove the O-rings and relative brake support rings from their seats.

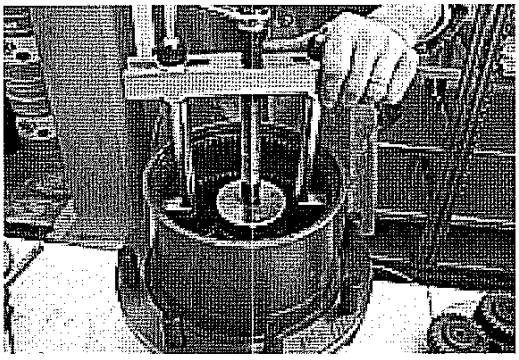
ENGLISH



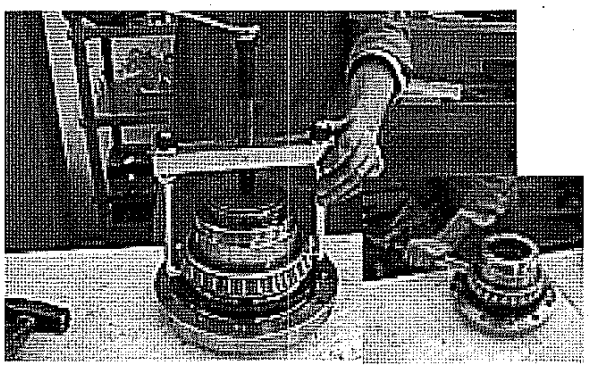
Pull out the brake discs, counter disc, except the shaft which is located on the bearing by circlip D.32, from the part of the reductions.

6.3 "hub-spindle and seal" unit disassembly:

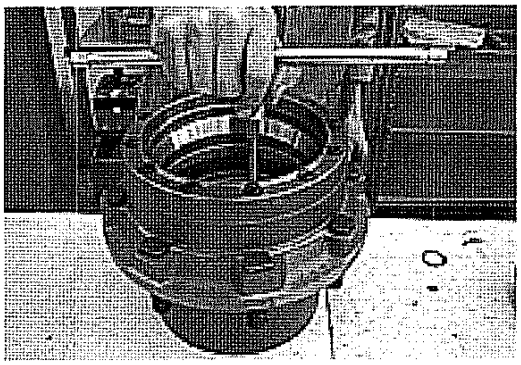
Use a special wrench to unscrew the lock nut..



Use an extractor to remove the hub-ring gear from its position (the oil seal AS170x200x14 DIN 3760 will certainly be ruined during this operation; therefore, the piece must always be replaced each time this type of operation is performed).

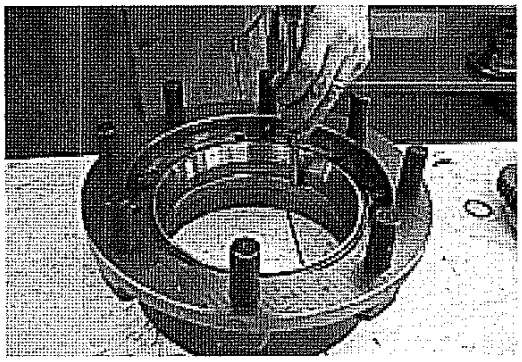


Remove the oil seal AS170x200x14 DIN 3760 from the hub and the inner race of the first roller bearing.



With socket wrench unscrew and remove the screws that attach the hub on the ring gear.

Use the extractor to remove the hub from the ring gear and remove the inner race of the second bearing.



Use the extractor to remove the 2 outer races of the roller bearings from the hub.

After completing the disassembly operation, carefully wash all the parts using a special liquid cleaner. Carefully examine the disassembled parts, then replace those that are worn or damaged.

7. DESSINS D'ENSEMBLE, VUES ECLATEES ET LISTE DES COMPOSANTS DU GROUPE REDUCTEUR ROUE:

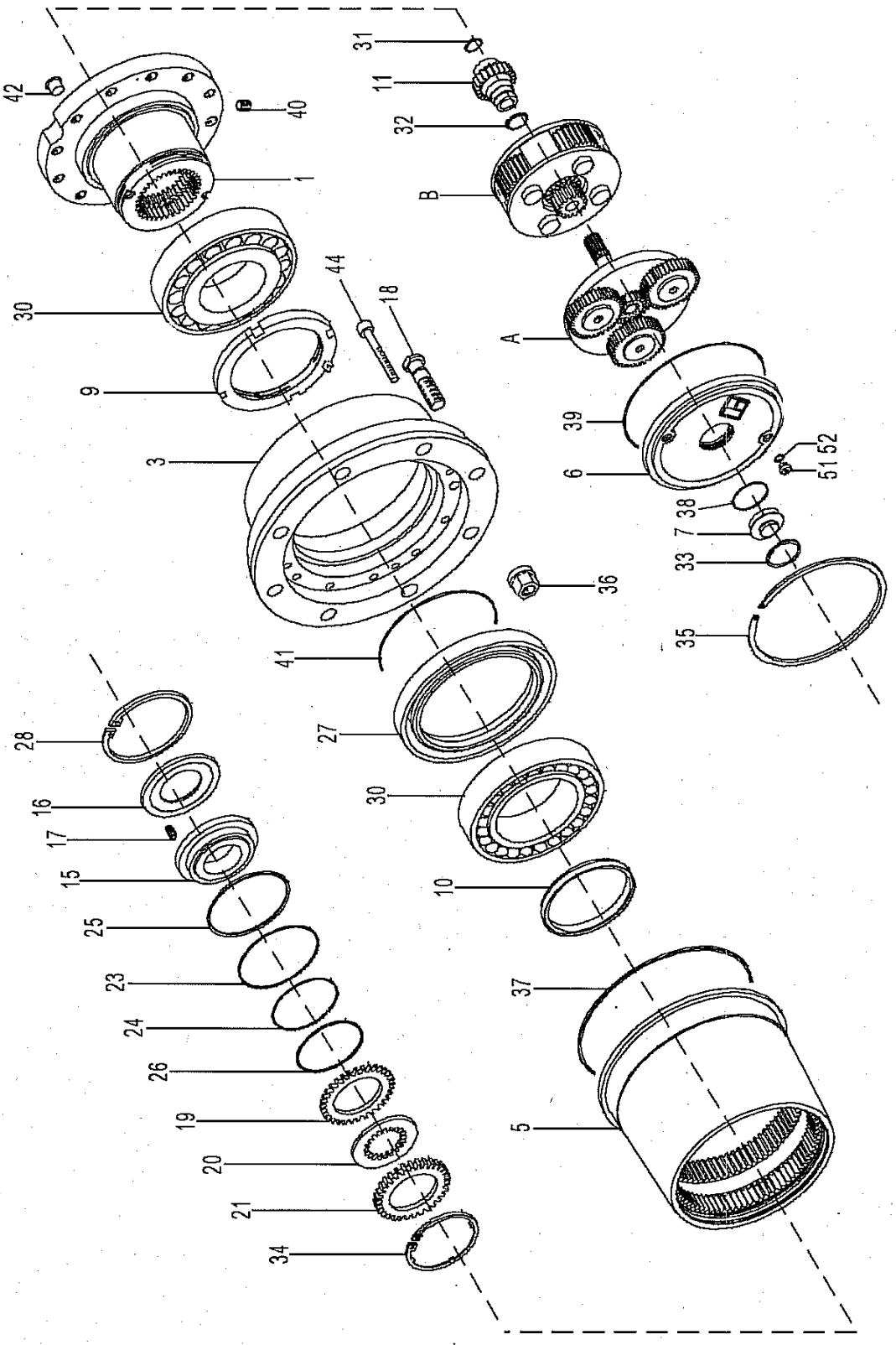
CROSS SECTIONAL DRAWING, EXPLODED DRAWINGS AND WHEEL DRIVE GEAR PARTS LISTS:

7.1 Dessin d'ensemble, Vue éclatée et liste des composants du groupe réducteur roue:

Cross sectional drawing, Exploded drawings and Wheel drive gear parts list:

Vue éclatée n° 15/5467

Exploded drawings n° 15/5467

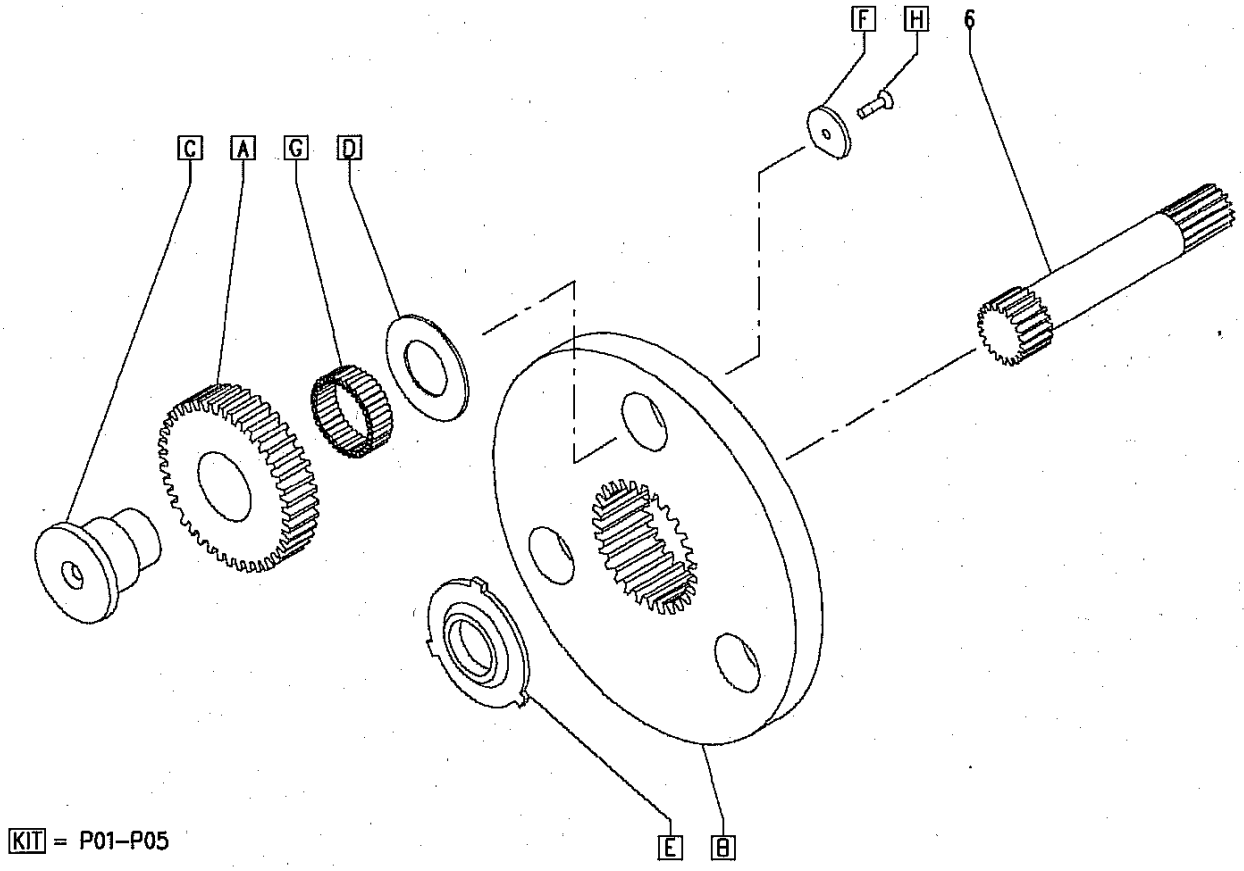


Liste des composants n° 15/5467

Parts list n° 15/5467

P.	CODE	DESCRIPTION	Q.	P.	CODE	DESCRIPTION	Q.
01	3814861000K	Spindle Fusee	1	27	41140800000	Oil seal AS170x200x15 DIN 3760 Joint d'etanch. AS170x200x15 DIN 3760	1
03	3822691000K	Hub Moyeu	1	28	43209700000	Circlip "I" D. 115 UNI 7437 Circlip "I" D. 115 UNI 7437	1
05	3202431000K	Ring-gear Couronne	1	30.L	42223800SET	Bearing JP 14049/010 SET-RIGHT Roulement JP 14049/010 SET-RIGHT	1
06	35317824000	Cover Couvercle	1	30.R	42223800SET	Bearing JP 14049/010 SET-RIGHT Roulement JP 14049/010 SET-RIGHT	
07	36115240100	Thrust washer Butee	1	31	43202100000	Circlip "I" D. 23 UNI 7437 Circlip "I" D. 23 UNI 7437	1
09	3652202000K	Lock nut M135 x 2 Frette M135 x 2	1	32	43103300000	Circlip "E" D. 30 UNI 7435 Circlip "E" D. 30 UNI 7435	1
10	363A593000K	Spacer Entretoise	1	33	43205200000	Circlip "I" D. 50 UNI 7437 Circlip "I" D. 50 UNI 7437	1
11	31744830000	Shaft Arbre	1	34	43208200000	Circlip "I" D. 90 UNI 7437 Circlip "I" D. 90 UNI 7437	1
15	38924330000	Piston Piston	1	35	43320700000	Reatining ring BR D. 205 Anneau-butee BR D. 205	1
16	35435830000	End plate Rondelle d'arbre	1	36	47400200000	Wheelnut M20 x 1,5 DIN 74361 Ecrou colonnette M20 x 1,5 DIN 74361	8
17	36710640000	Spring Ressort	12	37	41236500000	O-ring 2-266 Joint torique 2-226	1
18	37001140000	Stud Colonnette	8	38	41205000000	O-ring 2-30 Joint torique 2-30	1
19	38910630000	Steel disc Disque en acier	4	39	41220900000	O-ring 2-170 Joint torique 2-170	1
20	38910530000	Sintered disc Disque frein	4	40	45205300000	Expansion plug MB 700 - 060 Bouchon expansion MB 700 - 060	2
21	38910730000	Disc Contre-disque	1	42	41726800000	Plug D. 11,5 Bouchon D. 11,5	1
23	41223300000	O-ring 2-246 Joint tirique 2-246	1	44	46211400600	Screw M10 x 80 12K UNI 6873 Vis M10 x 80 12K UNI 6873	15
24	41232400000	O-ring 2-240 Joint tirique 2-240	1				
25	41233300800	Anti-extrusion ring 8-246 Anneau antifilage 8-246	1	51	45128300000	Plug M10 x 1 DIN 908 Bouchon M10 x 1 DIN 908	2
26	41232400800	Anti-extrusion ring 8-240 Anneau antifilage 8-240	1	52	41701800100	Washer RA D.10,2 x 14 x 1,5 Rondelle RA D.10,2 x 14 x 1,5	2

7.2 Vue éclatée et liste des composants du groupe réduction "A":
Reduction "A" exploded drawing and parts list:

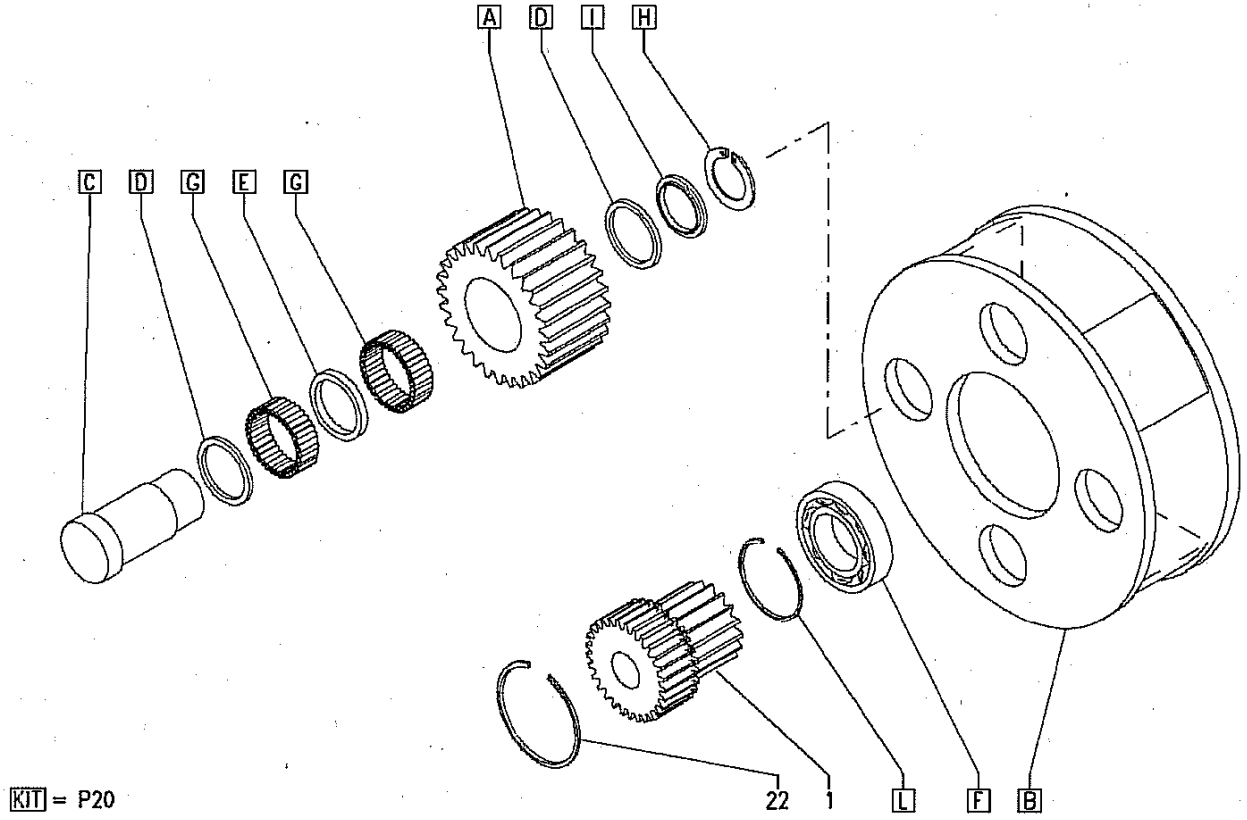


KIT = P01–P05

Liste des pieces n° 15/4044:
Component part list n° 15/4044:

P.	CODE	DESCRIPTION	Q.	Note - Plan
P05	211B1300000	Subassembled I = 7,25 Premonté I = 7,25	1	
06	32772730300	Sun pinion I = 7,25 Pignon central I = 7,25	1	

7.3 Vue éclatée et liste des composants du groupe réduction "B":
Reduction "B" exploded drawing and parts list:



Liste des pieces n° 11/4080:
Component part list n° 11/4080:

P.	CODE	DESCRIPTION	Q.	Note - Plan
P20	214722435V1	Subassembled I = 4,57 Premonté I = 4,57	1	
01	327A3430000	Sun pinion I = 4,57 Pignon central I = 4,57	1	
22	43303900000	Retaining ring "E" SW 58 Anneau-butee "E" SW 58	1	

NOTES:

GROUP 70

HYDRAULIC

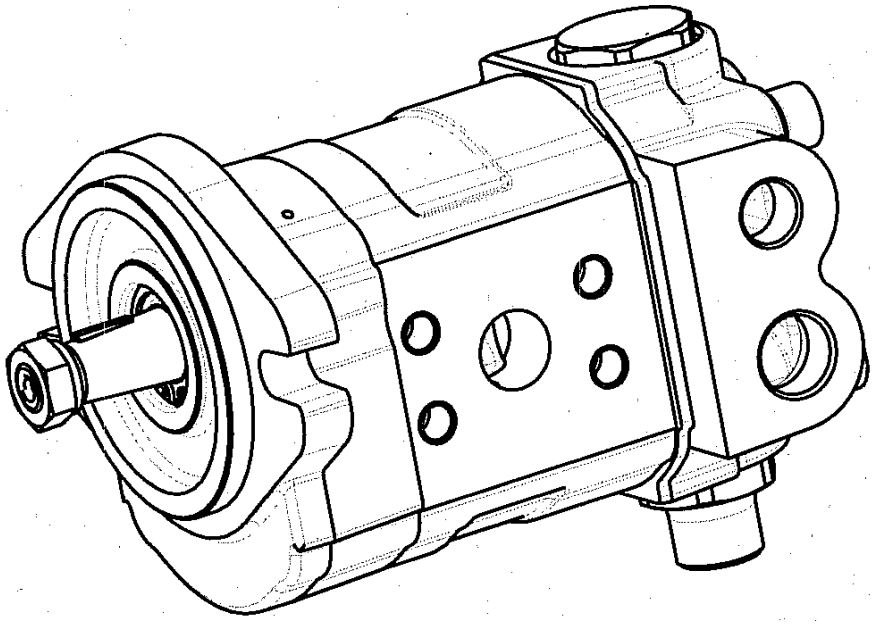
DISMANTLING PUMP KP20

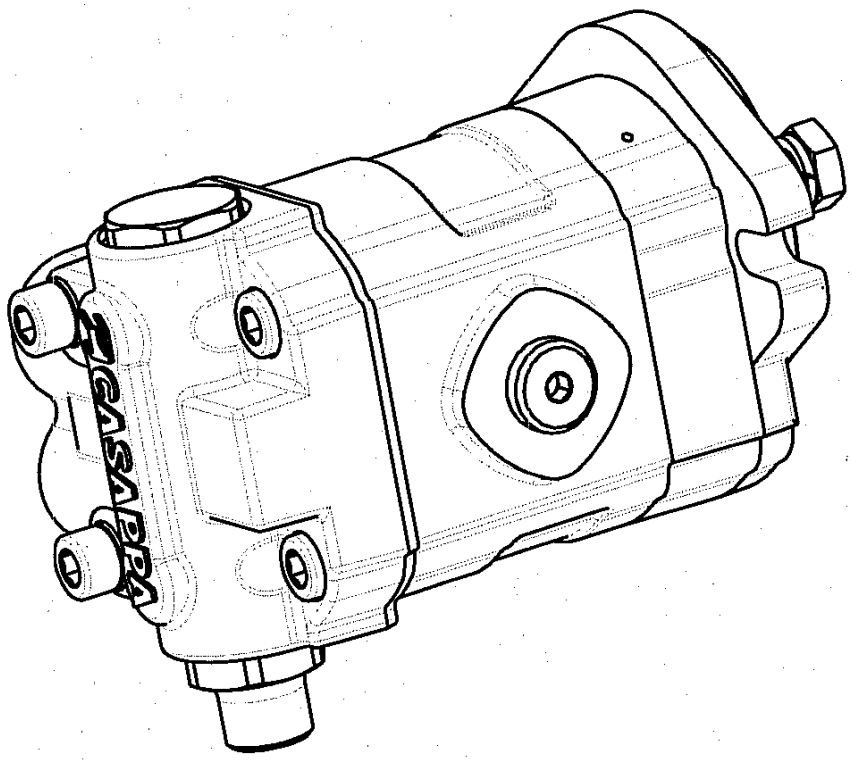
70-3-37 EN

27 / 04 / 2005

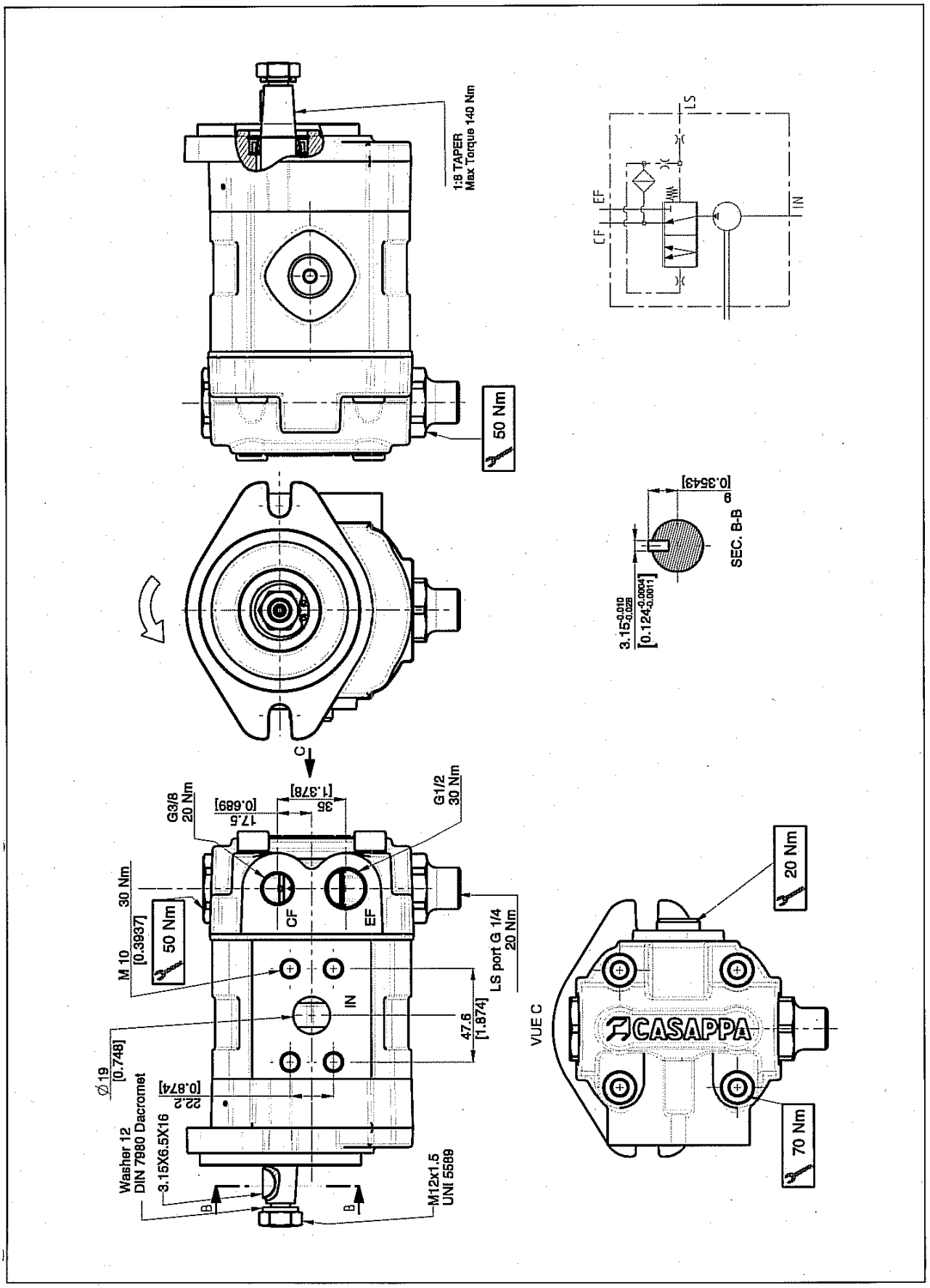
CONTENTS

PUMP VIEW KP20

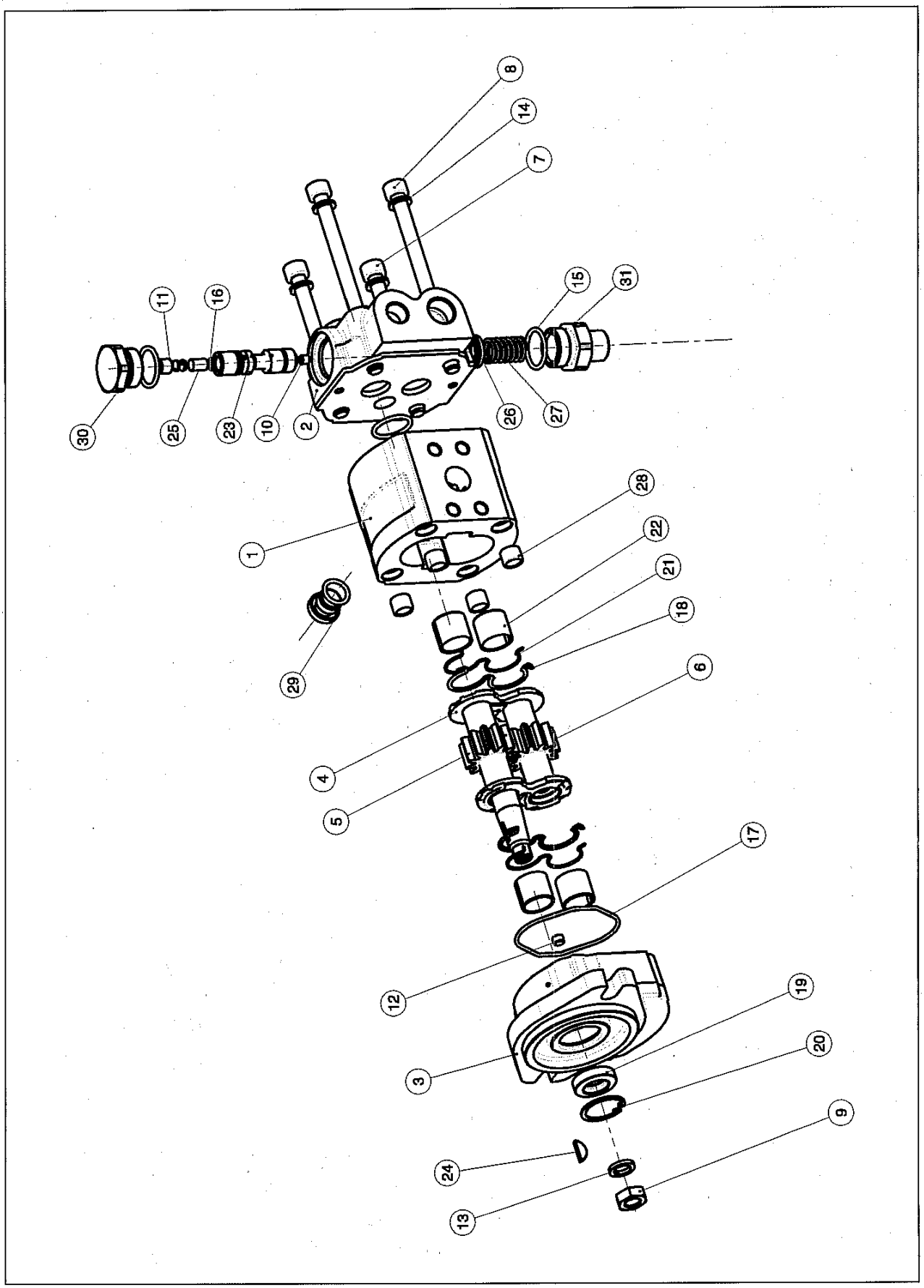




TORQUE


1:8 TAPER
Max Torque 140 Nm
50 Nm
LS
EF
CF
IN
9
[0.3543]
SEC. B-B
3.15 0.010 0.008
[0.124 0.0004 0.0001]
C
G3/8
20 Nm
17.5
[0.689]
35
[1.378]
G1/2
30 Nm
30 Nm
M 10
[0.3937]
50 Nm
CF
EF
IN
LS port G 1/4
20 Nm
47.6
[1.874]
Ø19
[0.748]
22.2
[0.874]
Washer 12
DIN 7980 Dacromet
3.15X6.5X16
M12x1.5
UNI 5589
B
B
VUE C
20 Nm
CASAPPA
70 Nm

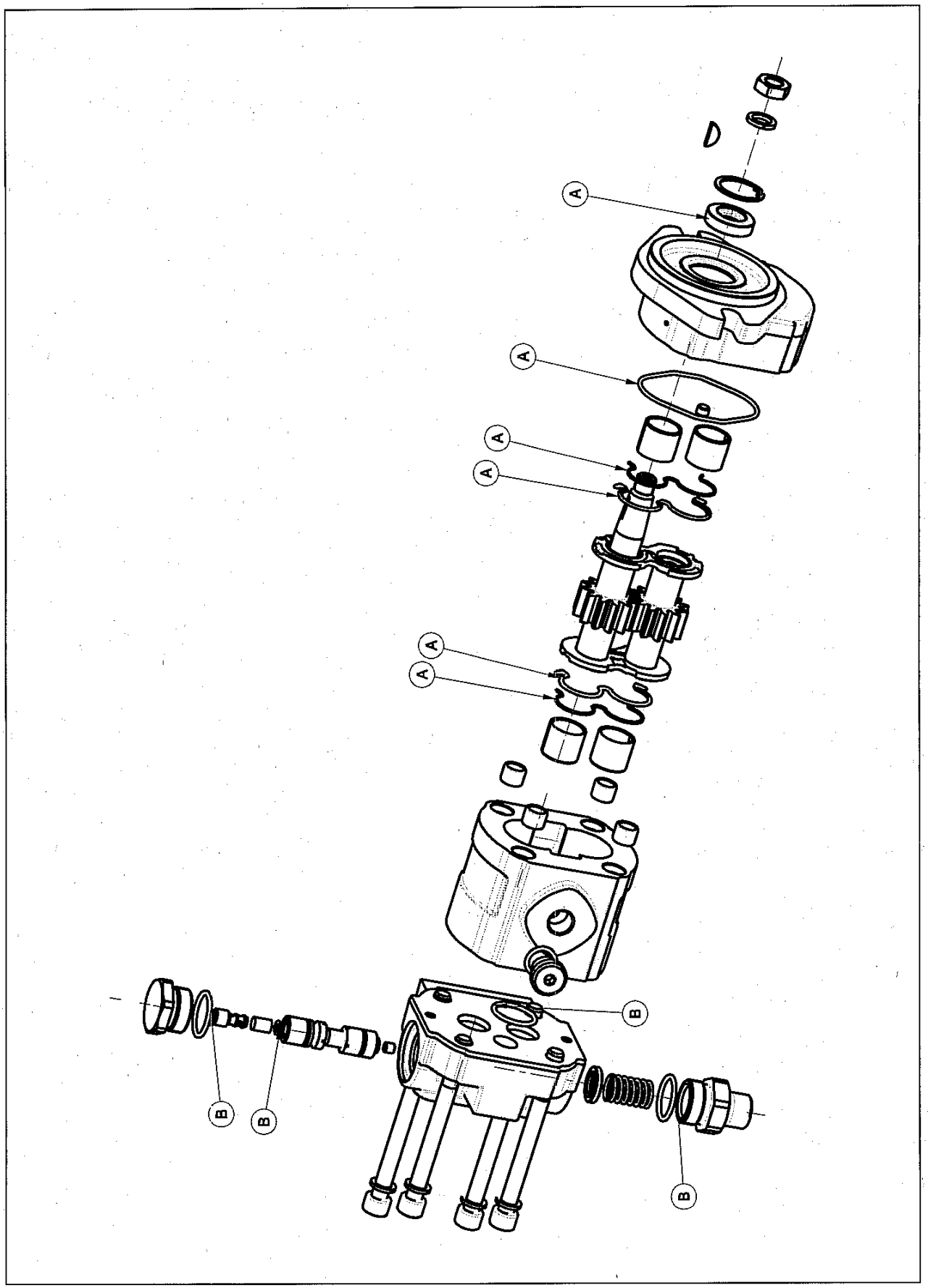
PUMP BURSTING



PUMP BURSTING

1	Barrel
2	Rear cover
3	Front cover
4	Flat
5	Gearing
6	Gearing
7	Screw
8	Screw
9	Nut
10	Screw without head
11	Screw without operating head
12	Screw without head
13	Washer
14	Washer
15	O-ring
16	O-ring
17	O-ring
18	Seal
19	Scraper seal
20	Elastic ring
21	Seal
22	Ring
23	Valve
24	Latch
25	Tubular filter
26	Spring thrust bearing
27	Spring
28	Strut
29	Plug
30	Plug
31	Plug

SEALS KIT



SEALS KIT

A Seals kit

B Seals kit

CYLINDER DISASSEMBLY

70-3-80-M116 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

20 / 04 / 2005

CONTENTS

Extracts from Standard Pr EN 1726-1 - 1997

5.6.3.1 Hydraulic lifting system

The lowering of the nominal load with the mast perfectly vertical ascribable to an internal leakage in the hydraulic system must not exceed 100 mm in the first 10 minutes, the hydraulic system oil being at the normal working temperature.

5.6.3.4 Hydraulic tilt system

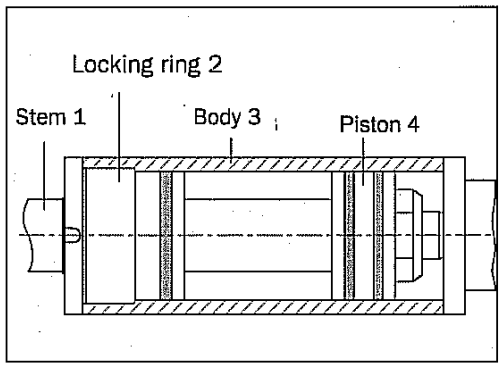
The internal leakages of the whole hydraulic tilt system (cylinders, distributors etc...), with the oil at normal working temperature must allow for a mean speed of forward tilt of the mast of less than 5° during the first 10 minutes, starting from a vertical position of the mast, when the nominal load is at a height of 2,50 m or in cases where the lifting height of the carriage is less than 2,50 m, when the nominal load is at its maximum height. The mean tilt speed allowed by the leakages must not be greater than 0,5°/min for carriages with a maximum forward tilt of less than 5°.

A - REMOVAL AND REASSEMBLY OF THE COMPLETE STEM

REMOVAL

- Place the cylinder in a vice fitted with false jaws
- Tighten the vice, ensuring that the body does not get distorted.
- Free locking ring 2 (Fig. A1) using a spanner wrench.
- If you find it difficult to free the ring, see subsection "REMOVAL" in section E.
- Completely unscrew locking ring 2 (Fig. A1).
- Extract the complete stem from the cylinder body.

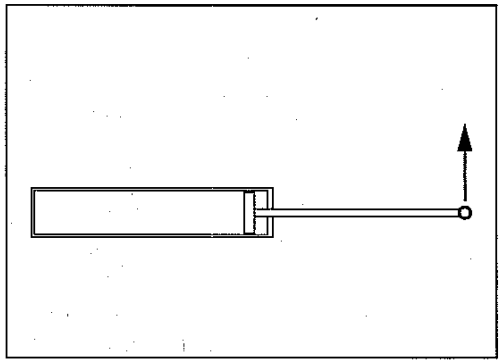
A1



NOTE : VERY LONG CYLINDERS

- Take out the stem over 200 mm maximum.
- Give a half turn to the locking ring to loosen it (very slowly and evenly).
- Take out the stem by about 2500 mm.
- Support the stem end to prevent it from weighing on the locking ring (Fig. A2).
- Carry on unscrewing the locking ring. If the effort is excessive, lift and lower the stem to reduce the friction.

A2



Never force the ring when unscrewing it as this could cause it to seize.

INSPECTION

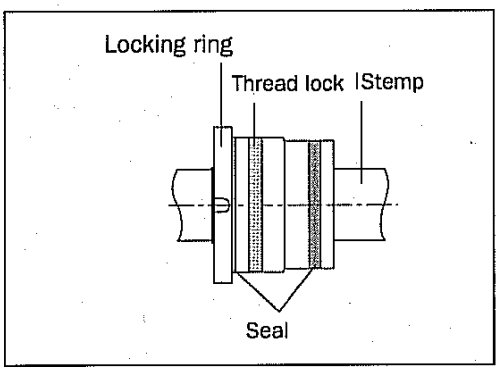
- Degrease and clean the cylinder chamber.
- Visually inspect the cylinder chamber, there should be no scratches, burrs, oxidisation, etc...

REASSEMBLY

- Apply hydraulic oil on the piston seals and ring, using a brush.
- Reassemble the complete stem inside the cylinder body 3 (Fig. A1).
- Ensure that the seals are not damaged while passing through the inside thread in the cylinder body.

NOTA : The locking ring is tightened in different ways depending on whether the cylinder body has a collar or not (Fig. A4). Follow the instructions below.

A3



CYLINDER WITHOUT COLLAR

- Apply hydraulic oil to the outer seals of the locking ring.
- Apply Loctite 222 thread lock (see section E) to the locking ring (Fig. A3).
- Tighten the ring.
- Lock using a pin wrench and a torque wrench. Refer to the tightening torque (Fig. A4) or use the angular tightening procedure (Fig. A4).
- Rotate the stemp through one turn to ensure the seals are correctly positioned.

CYLINDER WITH COLLAR

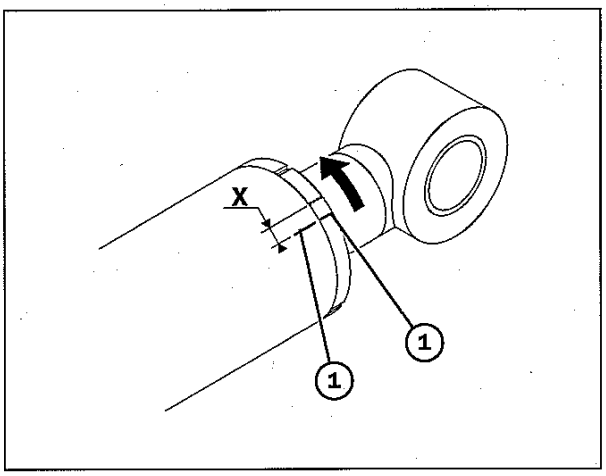
- Apply hydraulic oil to the seals and thread of the locking ring.
- Tighten the ring.
- Lock using a pin wrench and a torque wrench. Refer to the tightening torque (Fig. A4) or use the angular tightening procedure (Fig. A4).
- Rotate the stemp through one turn to ensure the seals are correctly positioned.

NOTE

- It is recommended that the cylinder is tested hydraulically before reassembly on the machine.
- Extend and retract the stemp several times.

A4

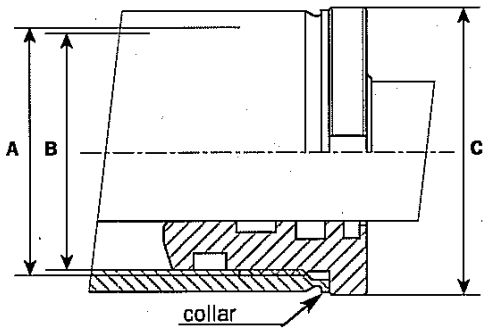
A4-1



Locking ring angular tightening procedure.

- Tighten ring until it comes into contact with cylinder body.
- Mark a line 1 (Fig. A4-1) on the cylinder body and on the locking ring.
- Tighten the ring to obtain dimension X (Fig. A4-2).
- Insert collar in one of the slots on the locking ring.

LOCKING RING TIGHTENING TORQUE



A4-2

THREAD A	BORE Ø B	COLLAR Ø C	TIGHTENING TORQUE	DIMENSION X
M43 x 200	40	51	200 - 250 N.m	
M48 x 200	45	56	200 - 250 N.m	
M53 x 200	50	61	200 - 250 N.m	
M58 x 200	55	66	250 - 300 N.m	
M63 x 200	60	72	250 - 300 N.m	
M66 x 200	63	75	250 - 300 N.m	
M68 x 200	65	78	250 - 300 N.m	
M73 x 200	70	82	300 - 350 N.m	
M78 x 200	75	89	300 - 350 N.m	
M83 x 200	80	94	350 - 400 N.m	
M88 x 200	85	99	350 - 400 N.m	
M93 x 200	90	107	350 - 400 N.m	
M98 x 200	95	109	400 - 450 N.m	
M104 x 200	100	119	400 - 450 N.m	
M109 x 200	105	124	400 - 450 N.m	
M114 x 200	110	129	450 - 500 N.m	
M124 x 200	120	139	450 - 500 N.m	
M129 x 200	125	139	450 - 500 N.m	
M134 x 200	130	149	450 - 500 N.m	8 - 9 mm
	140		450 - 500 N.m	8,5 - 9,7 mm
	150		450 - 500 N.m	9,2 - 10,5 mm

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 sunscrew 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

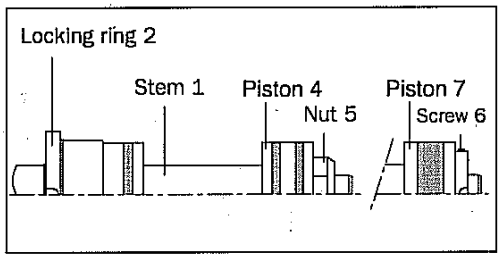
- Check that the stem is straight over its whole length, using a comparator (Fig. B4).
- Check that the stem is not scaling, corroded or scratched.

REASSEMBLY

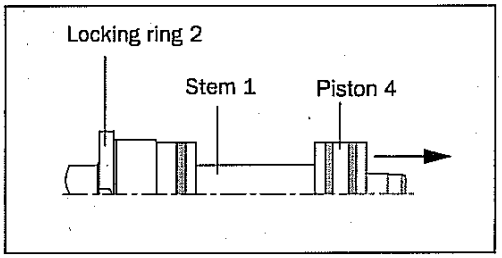
- Reassemble locking ring 2 (Fig. B5) on stem 1 (Fig. B5).
- Reassemble piston 4 (Fig. B1) on the stem.
- Screw and lock nut 5 (Fig. B1) using a box wrench and a torque wrench. See the table for the tightening torque (Fig. B6). Or, depending on the version, screw piston 7 (Fig. B1) using a spanner wrench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

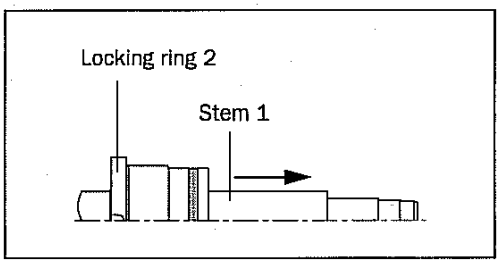
B1



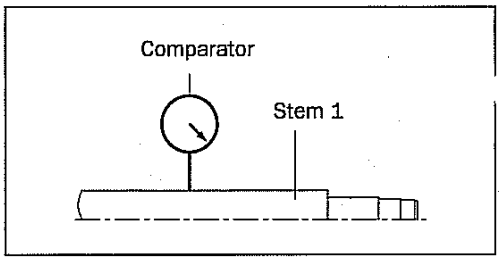
B2



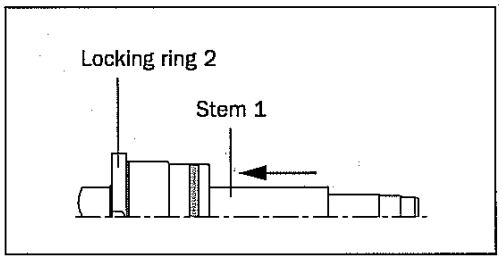
B3



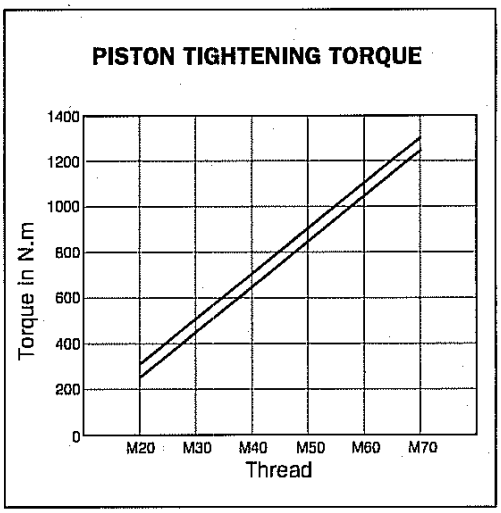
B4



B5



B6


PISTON TIGHTENING TORQUE
1400
1200
1000
800
600
400
200
0
Torque in N.m
M20
M30
M40
M50
M60
M70
Thread

C - REMOVAL AND REASSEMBLY OF THE PISTON SEALS AND RING

NOTE :

Never use cutting or sharp tools (screw drivers, blades, etc.) when assembling and removing seals. Ensure that there are no chippings on the work bench.

REMOVAL

- Remove the piston seals and ring (Fig. C1 or C2).
- Take care not to damage the edges or the bottom of the grooves.

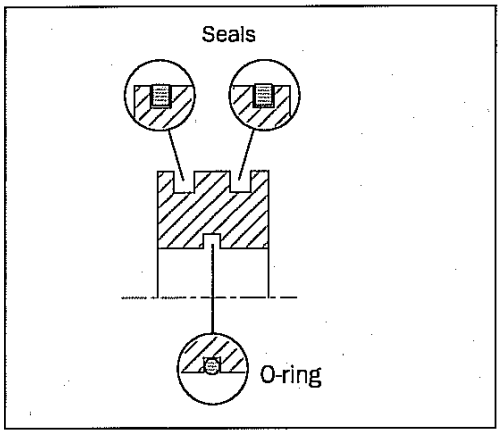
INSPECTION

- Degrease and clean the piston.
- Check that the grooves bottoms and sides are smooth and without scratches.
- There should be no extraneous bodies in the grooves.

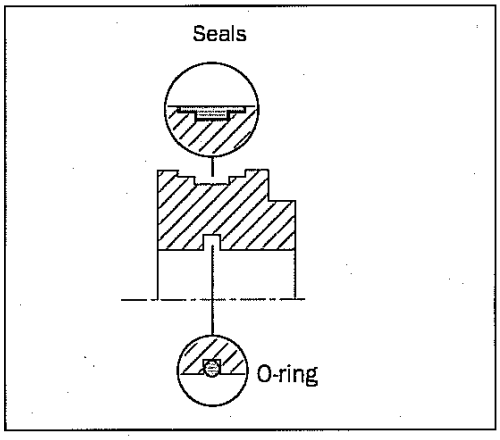
REASSEMBLY

- Fit the seals and ring as in Fig. C1 or C2).
- When fitting the outside seals, open them sufficiently to slip them into the grooves while ensuring that they do not break.
- The inside ring should be fitted by hand.

C1



C2



D - REMOVAL AND REASSEMBLY OF THE SEALS AND RINGS ON THE LOCKING

NOTE :

Never use cutting or sharp tools (screw drivers, blades, etc.) when assembling and removing seals. Ensure that there are no chippings on the work bench.

REMOVAL

- Remove the locking ring seals and rings.
- Take care not to damage the edges or the bottom of the grooves.

INSPECTION

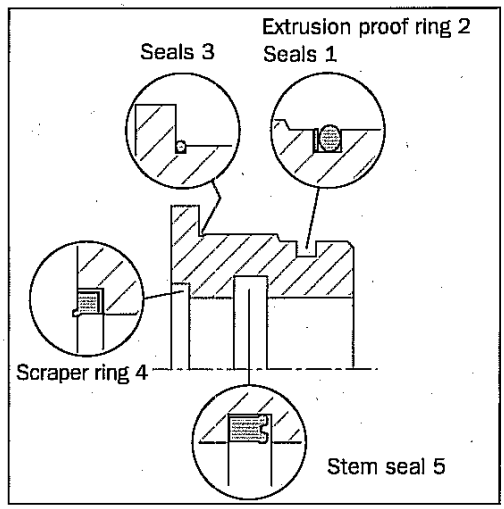
- Degrease and clean the locking ring.
- Check that the groove bottoms and sides are smooth and without scratches.
- There should be no extraneous bodies in the grooves.
- Thread the bare ring on the stem and slide it over its whole length.
- The gap should not be excessive, but it should not grip either.

REASSEMBLY

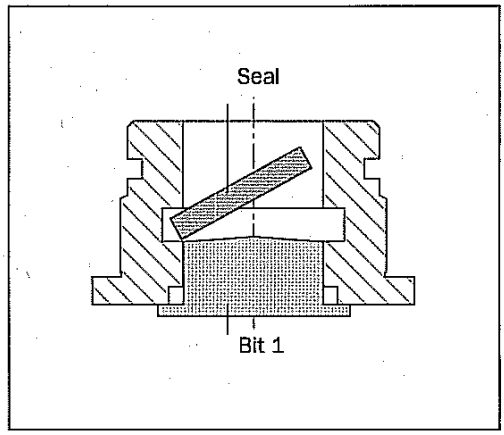
- Fit the seals and rings as in Fig. D1. The lips of the stem seal should face the pressure side.
- When fitting the stem seal, first introduce it in the groove, holding it back either with your thumb or a bit (item 1) with no sharp edges (Fig. D2).
- Push it into the groove with the other hand or a smooth die (item 2) (Fig. D3). If the seal is too tight, dip it into hydraulic oil heated to 50°C.

Fit scraper ring 4 (Fig. D1) using a plug and a mallet. O-rings 1 and 3 (Fig. D1) and extrusion proof ring 2 (Fig. D1) will be fitted by hand.

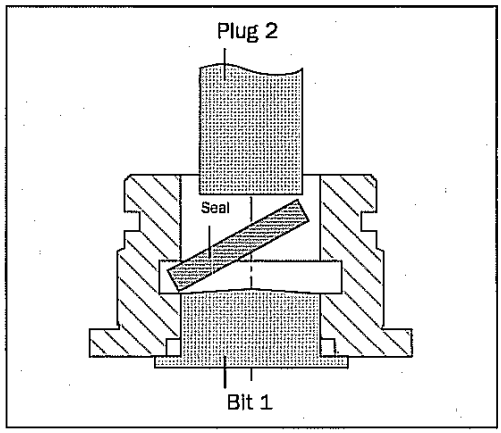
D1



D2



D3



E - APPLICATION OF THE THREAD LOCKING MATERIAL

CHARACTERISTICS

Light thread locking material (Loctite 222)

Application on the locking ring threads.

Without activation agent		
Handling time	10 - 30	minutes
Use time	3 - 6	hours
(Placing of the cylinder under pressure)		
With N Loctite activation agent		
Handling time	10 - 20	minutes
Use time	2 - 4	hours
(Placing of the cylinder under pressure)		
Shearing strength	1,5 - 4	N/mm2

Medium thread locking material (Loctite 243)

Application on the M8 screws to lock the pistons.

Without activation agent		
Handling time	10 - 20	minutes
Use time	3 - 6	hours
(Placing of the cylinder under pressure)		
With N Loctite activation agent		
Handling time	5 - 15	minutes
Use time	2 - 4	hours
(Placing of the cylinder under pressure)		
Shearing strength	5 - 7,5	N/mm2

REMOVAL

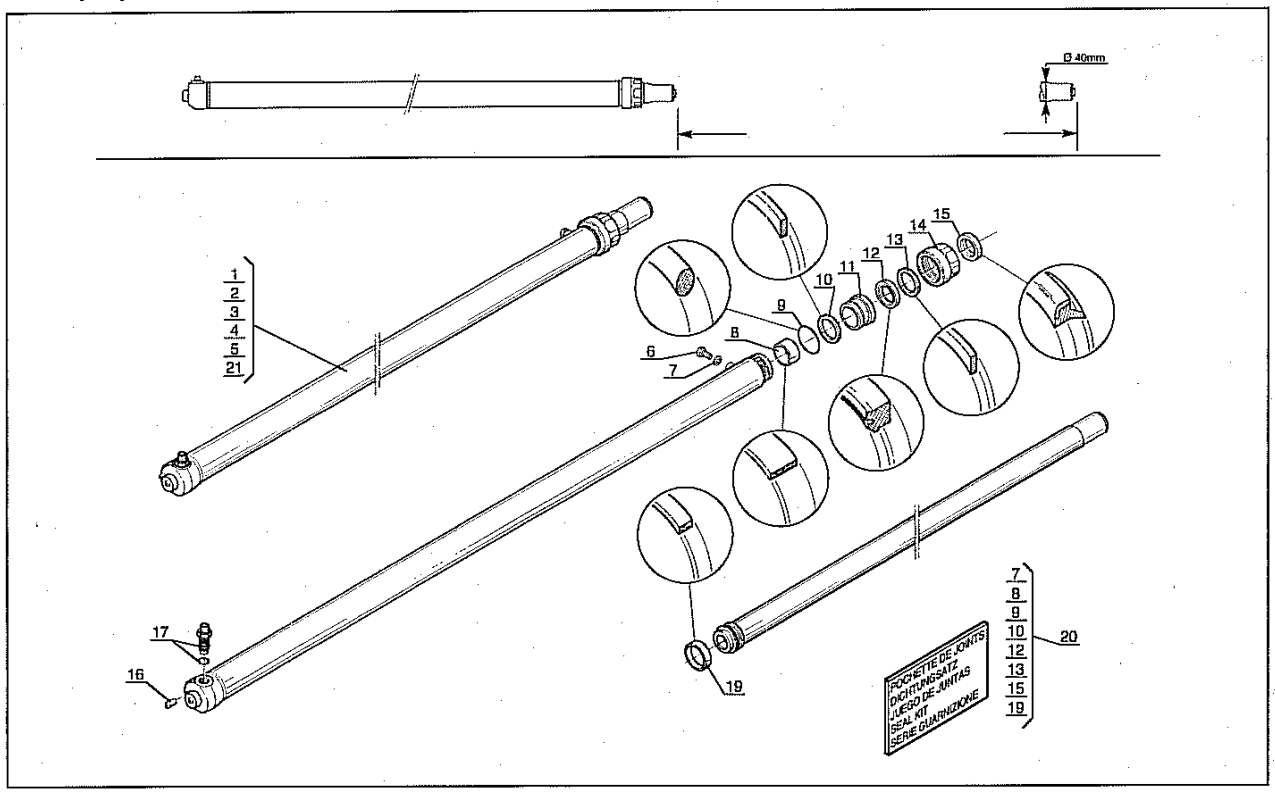
If the parts fitted with locking material cannot be removed using standard tools, we recommend heating the glued area to T = 250°C, preferably using a hot air pistol rather than a blowpipe.

REMARK

If the temperature is near 0°C, we recommend using a Loctite activation agent for the assembly, in addition, this will limit the polymerisation time.

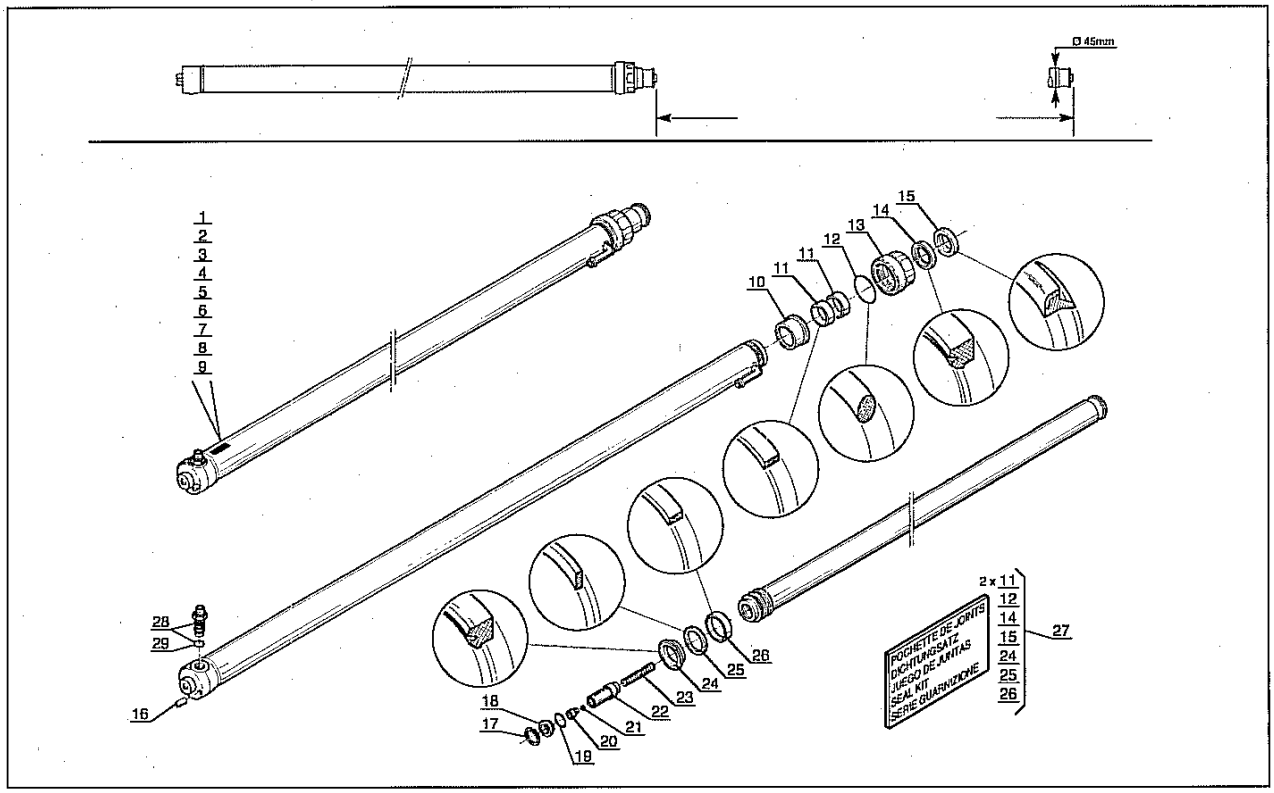
LIFTING CYLINDER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



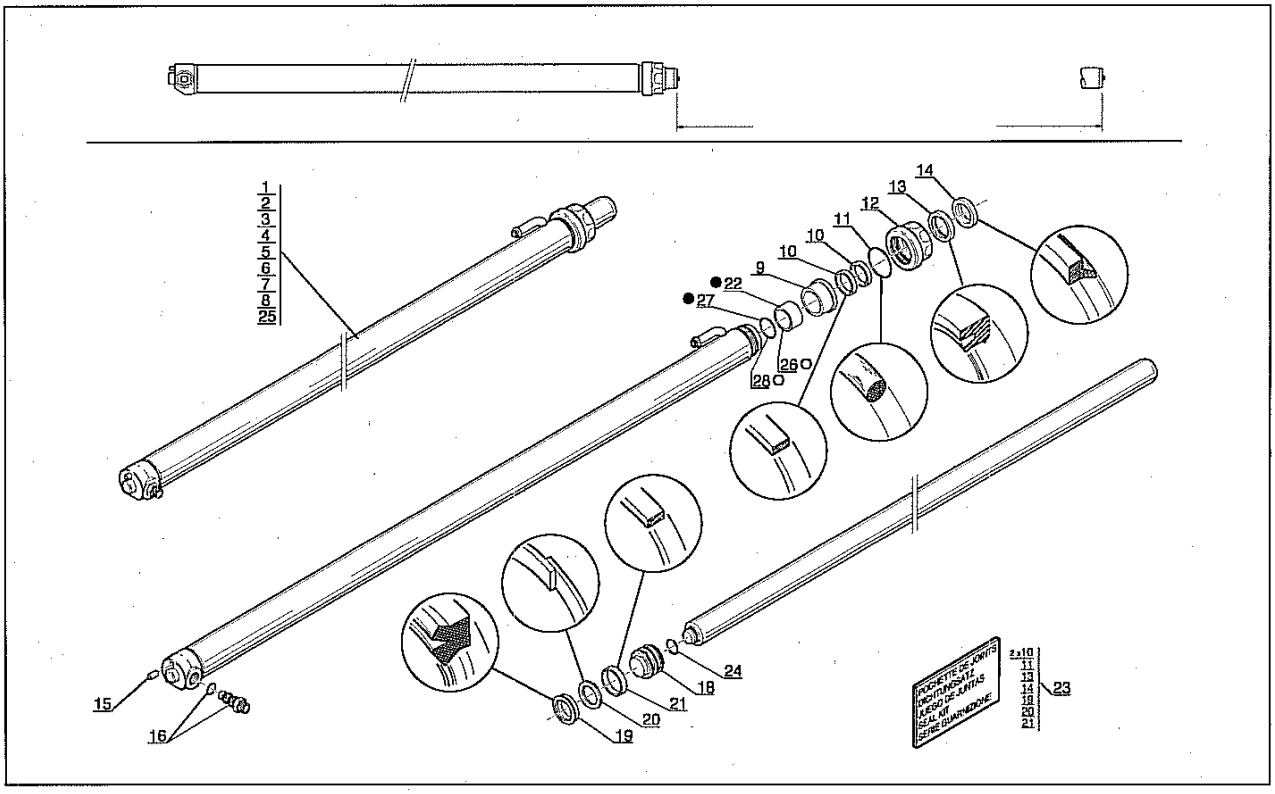
LIFTING CYLINDER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



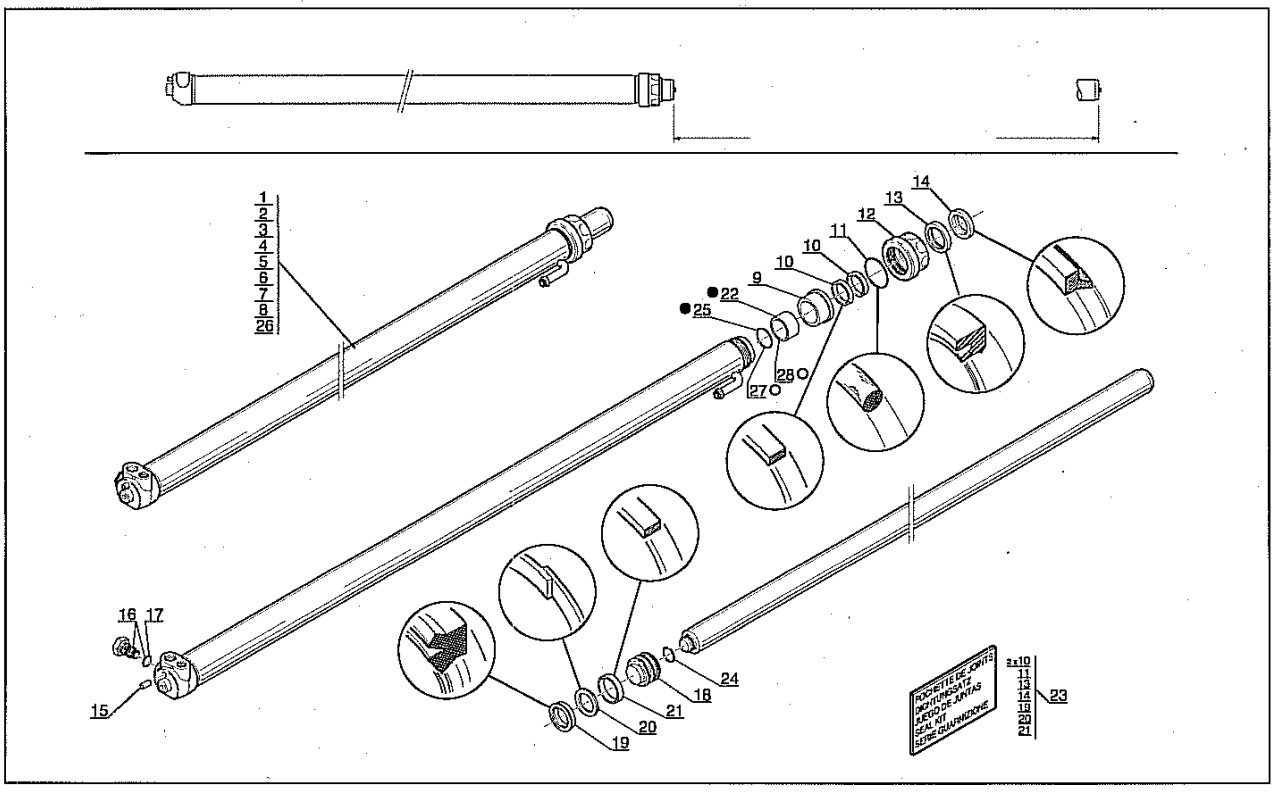
LIFTING CYLINDER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



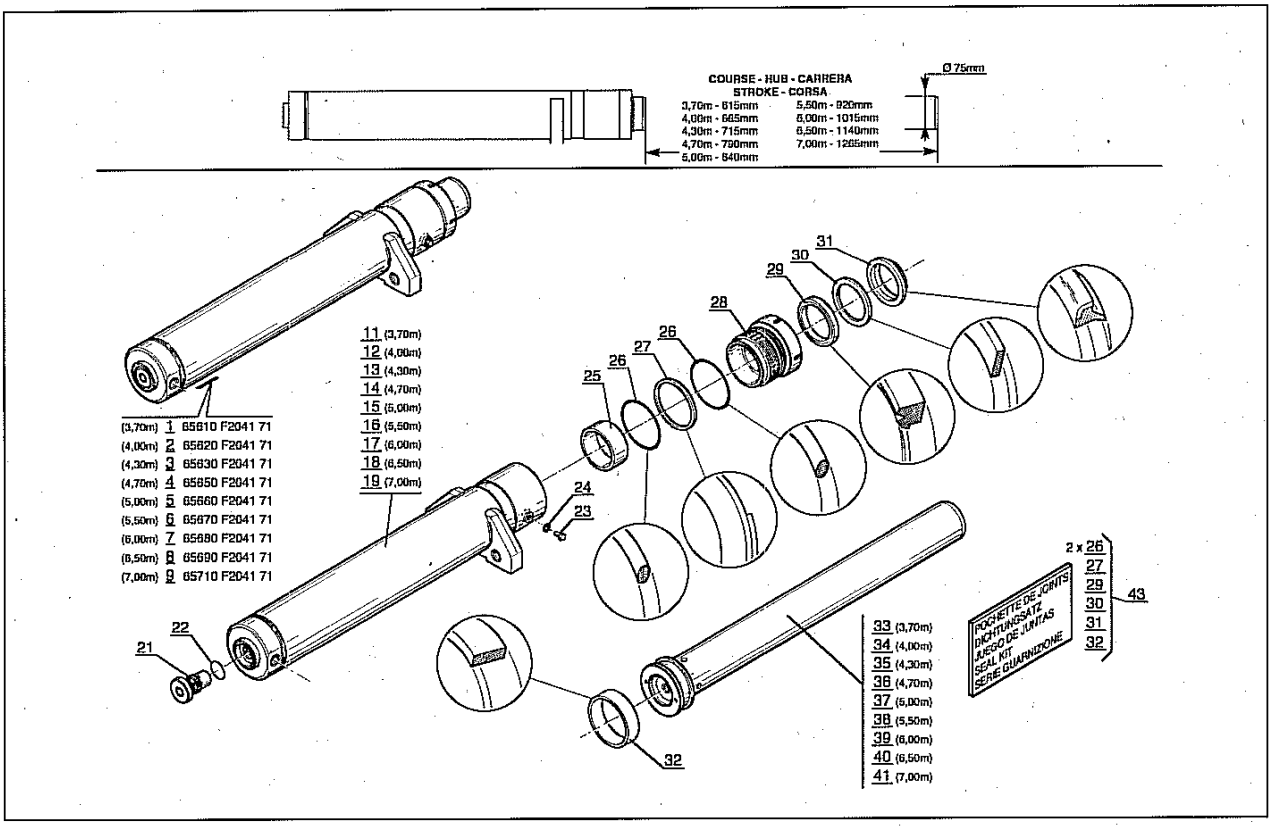
LIFTING CYLINDER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



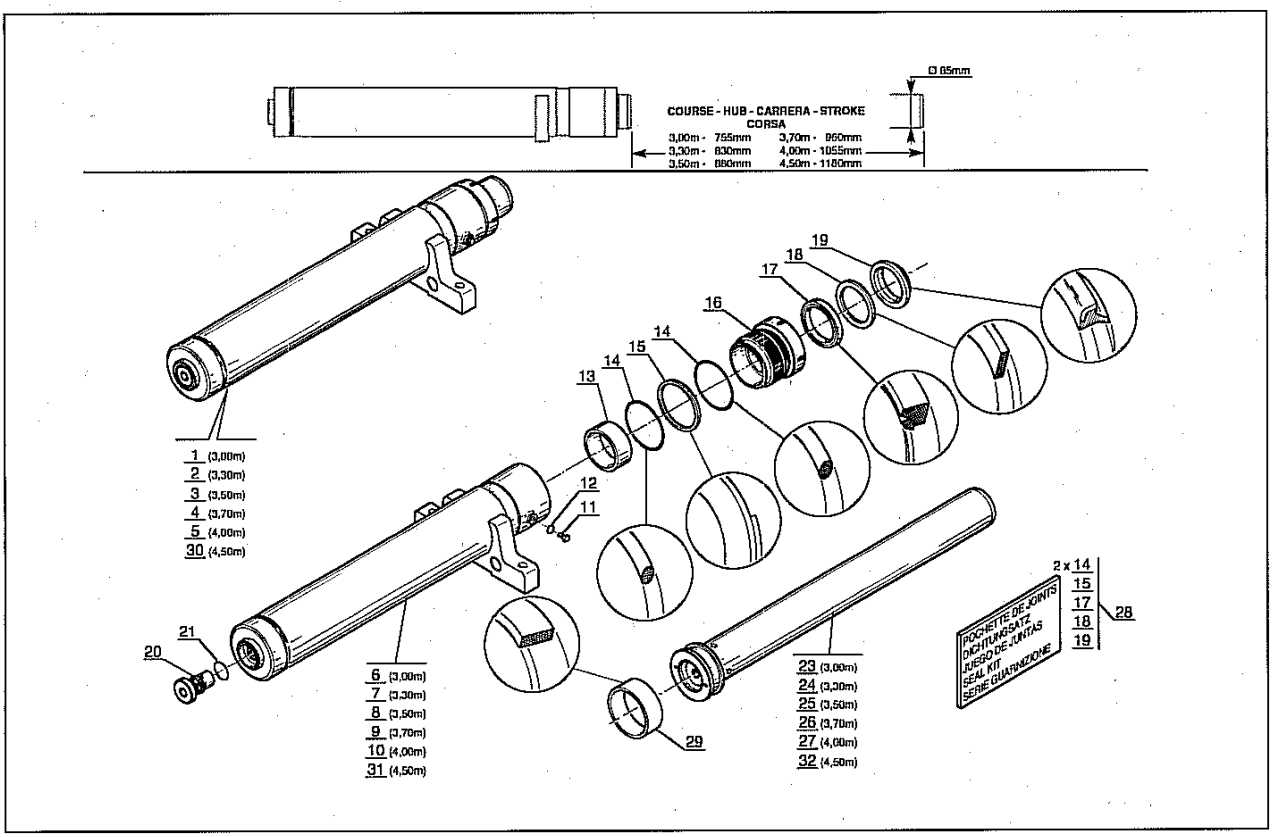
FREE LIFTING CYLINDER

MSI 20/25 D + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



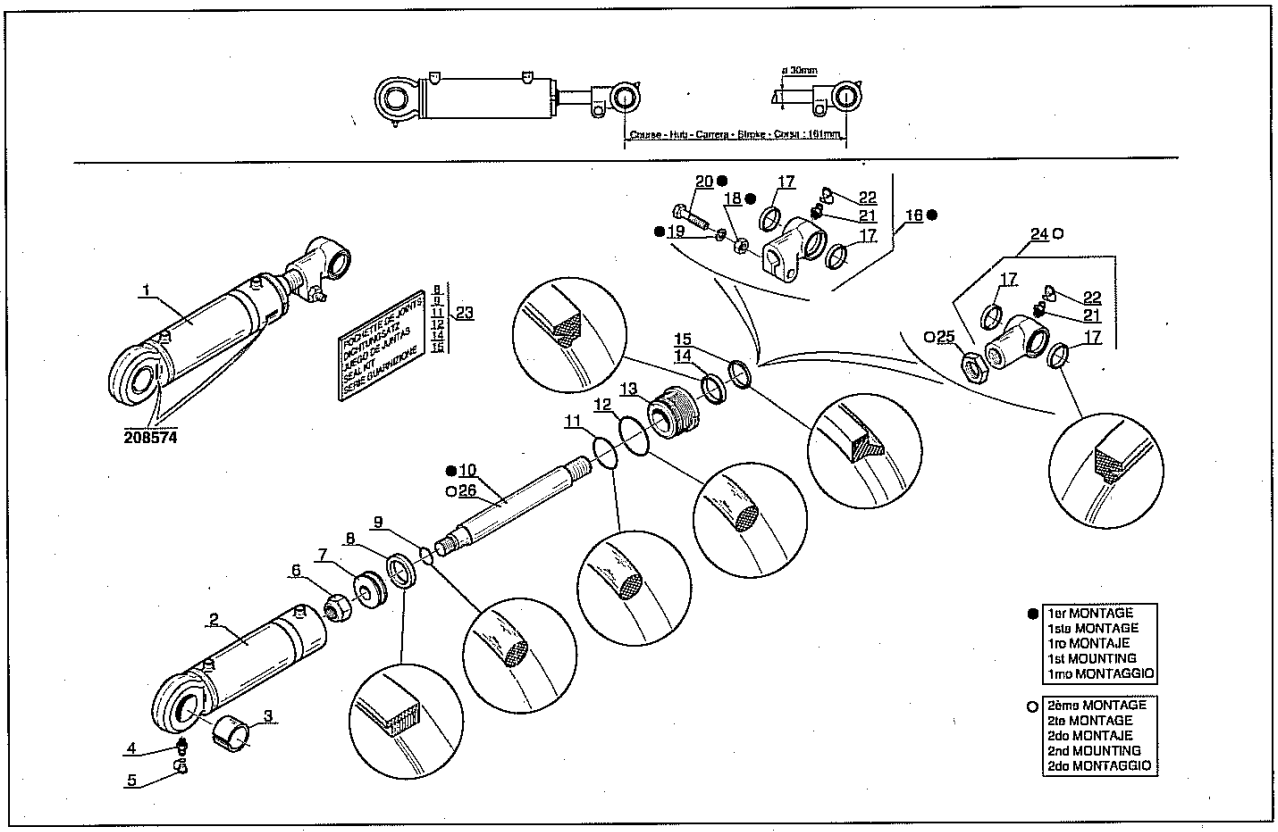
FREE LIFTING CYLINDER

MSI 30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2



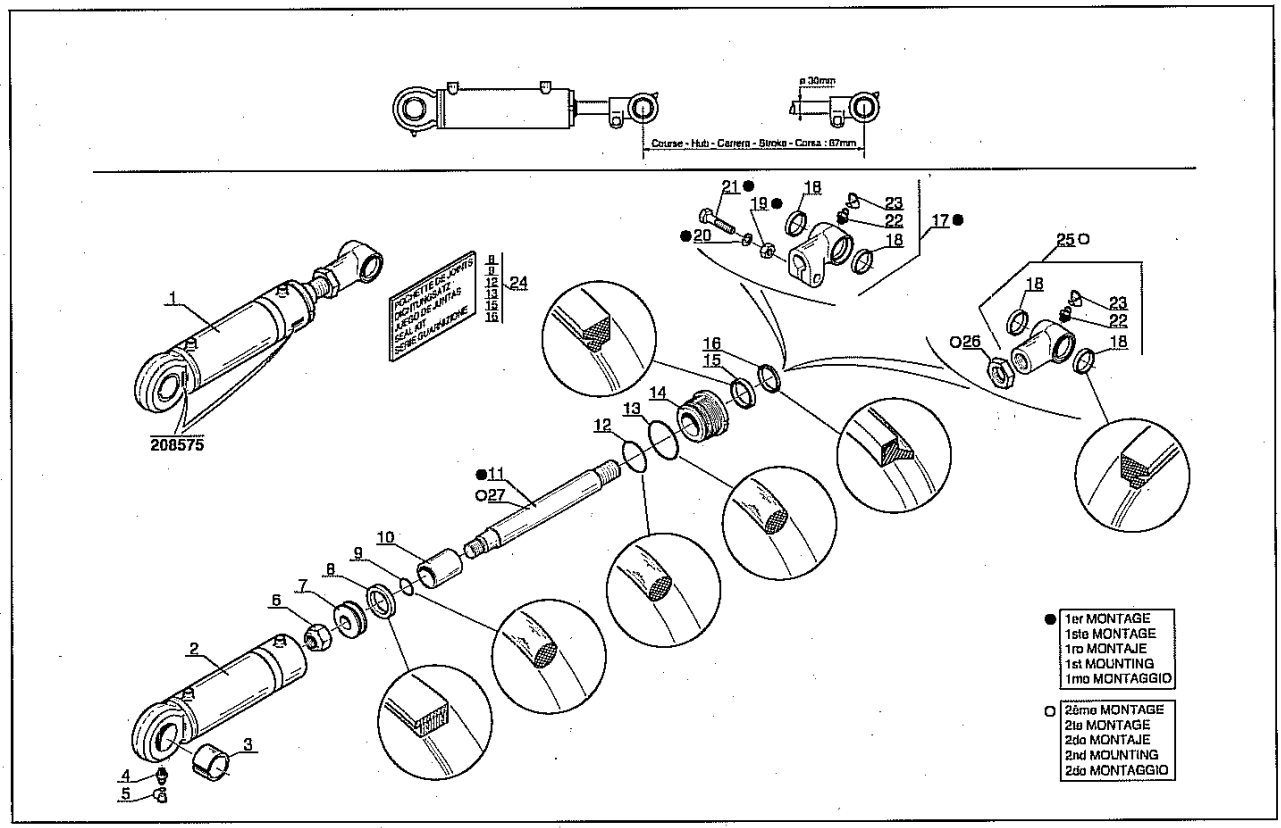
TILTING CYLINDER 10° / 12°

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



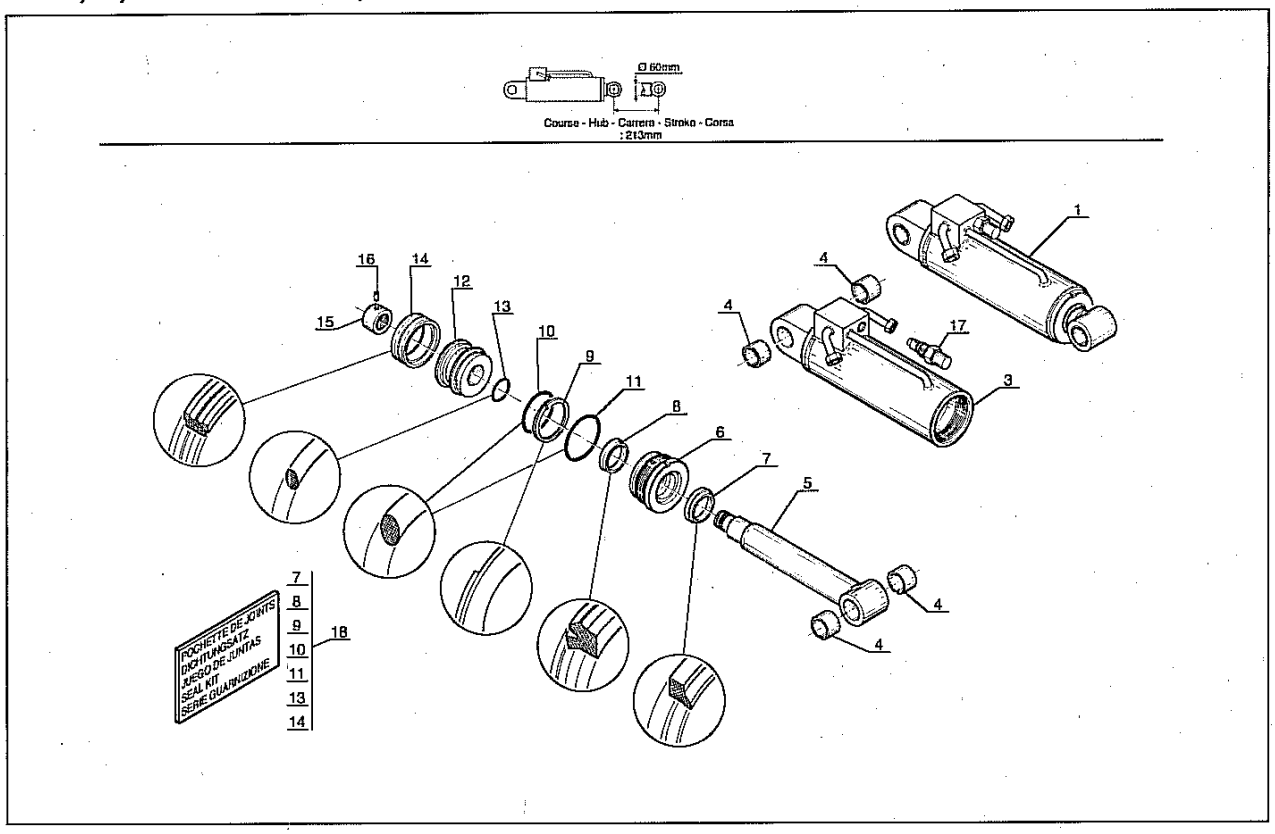
TILTING CYLINDER 6° / 6°

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



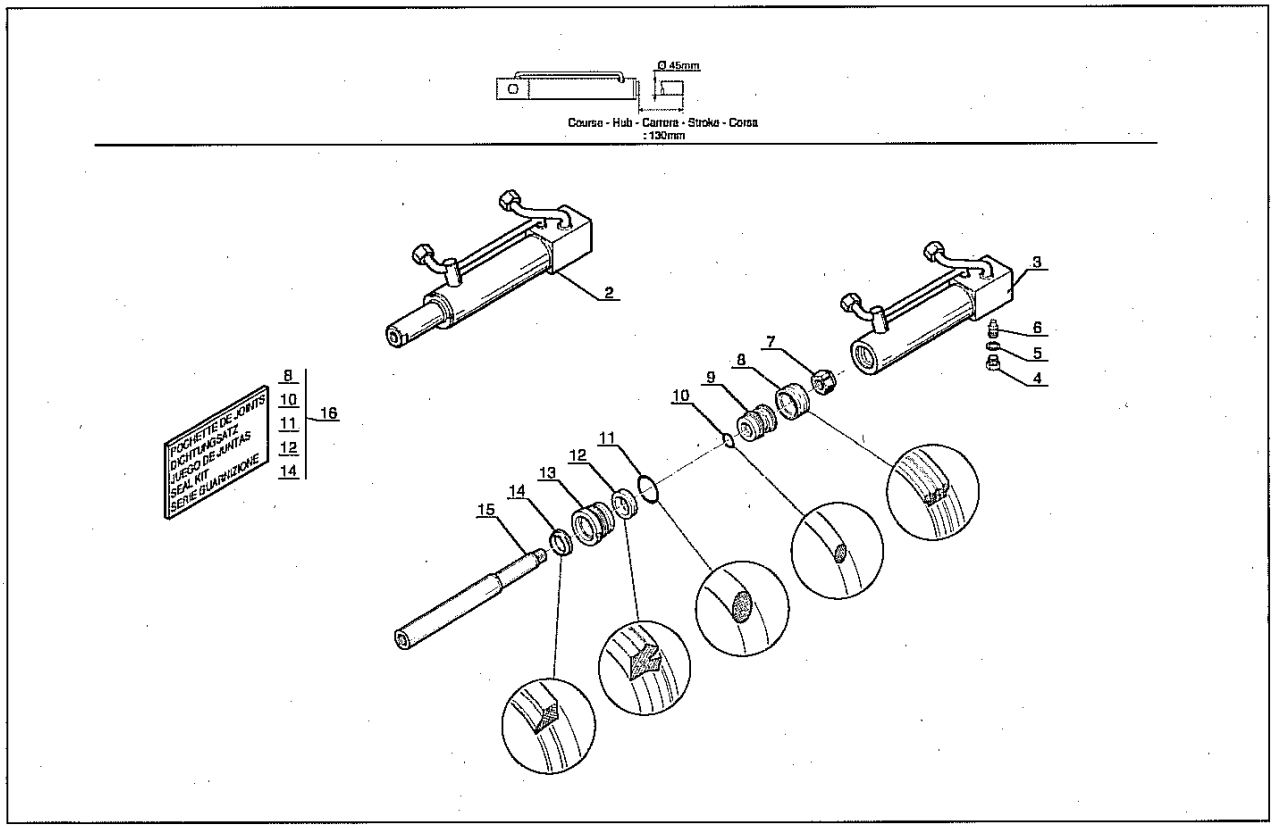
TILTING CYLINDER ON INCLINABLE CARRIER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



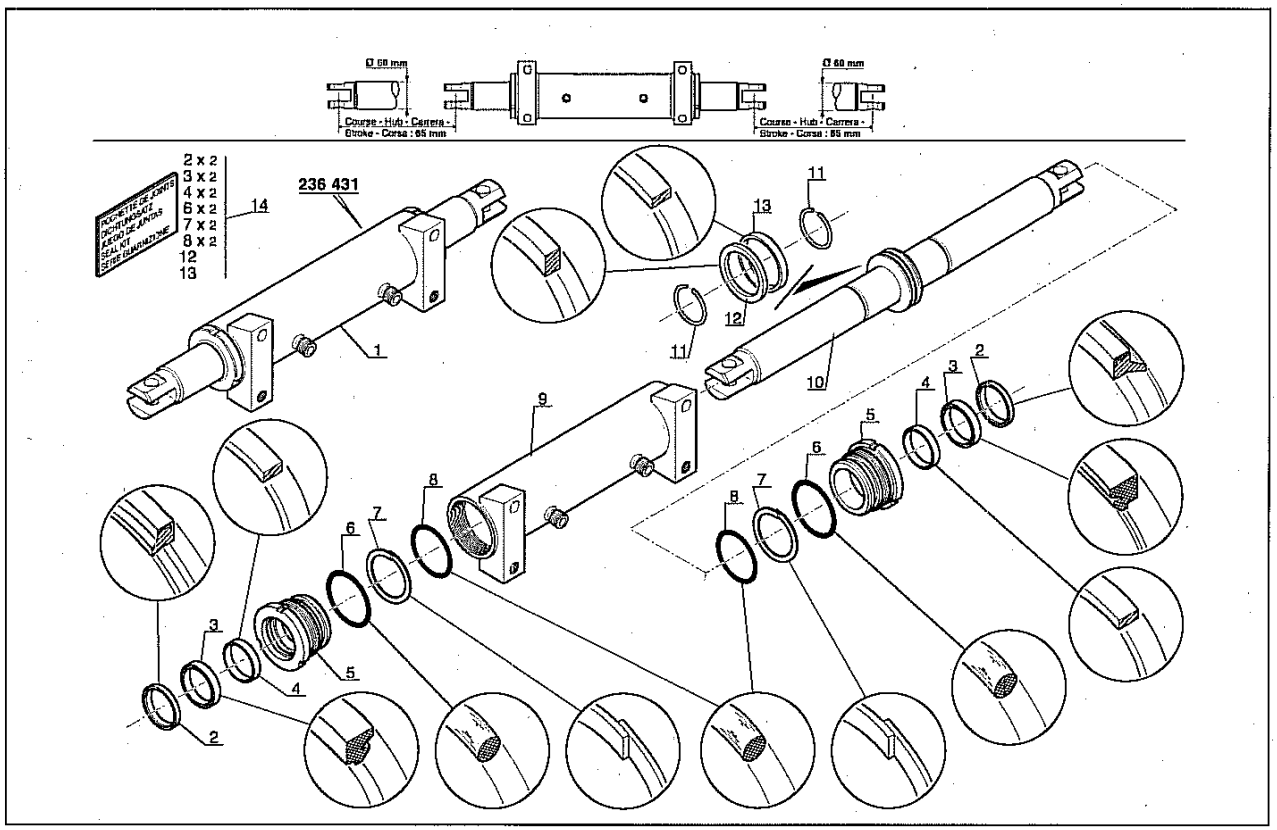
LOCKING CYLINDER OF ATTACHMENTS

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2 / MH 20/25 - 4 T BUGGIE S2-E2



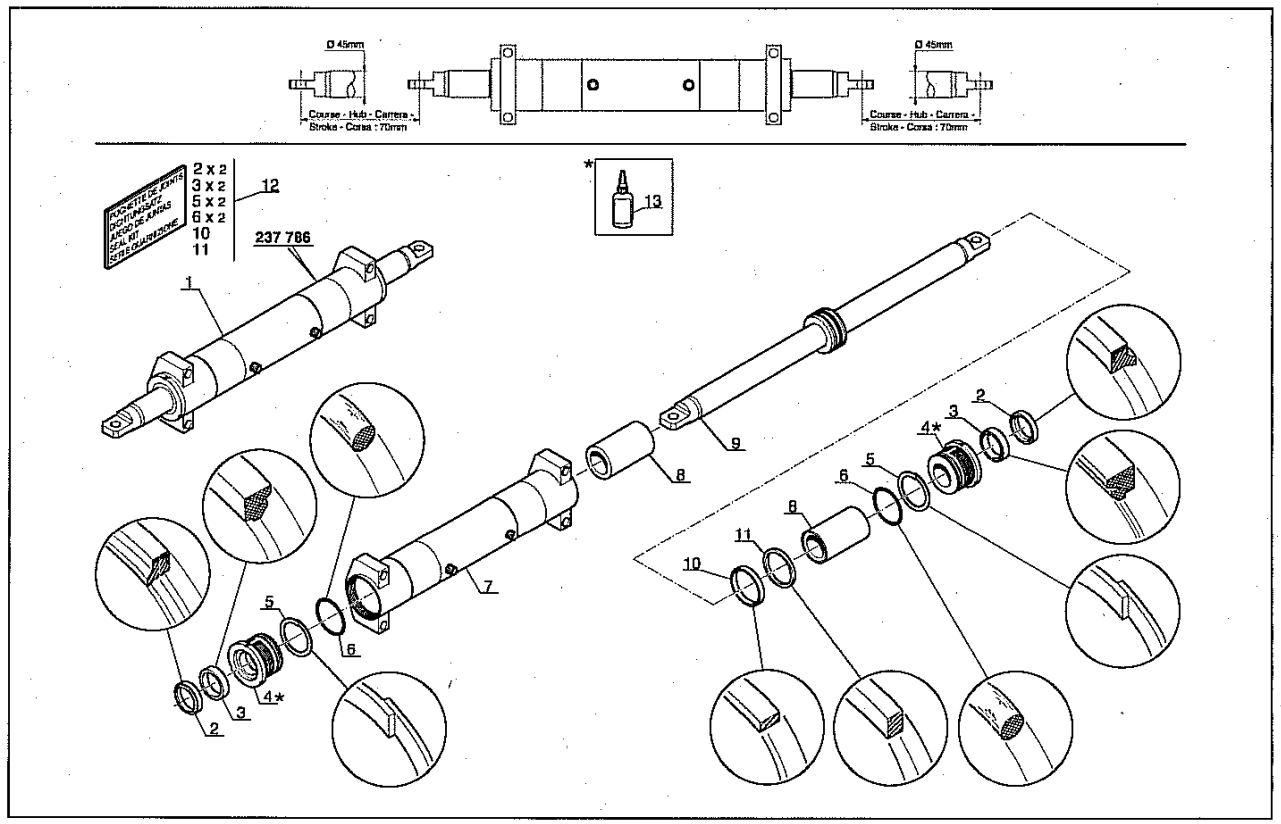
STEERING CYLINDER

MH 20/25 - 4 T BUGGIE S2-E2



STEERING CYLINDER

MSI 20/25/30 D + BUGGIE S2-E2 / MSI 35 T + BUGGIE S2-E2



HYDRAULIC DIAGRAM

70-6-248565 EN

- MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
- MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
- MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 25 Turbo Serie 2-E2
MSI 35 Turbo BUGGIE Série 2-E2
MSI 35-4 Turbo BUGGIE Série 2-E2
MSI 35-4 Turbo BUGGIE Série 2-E2

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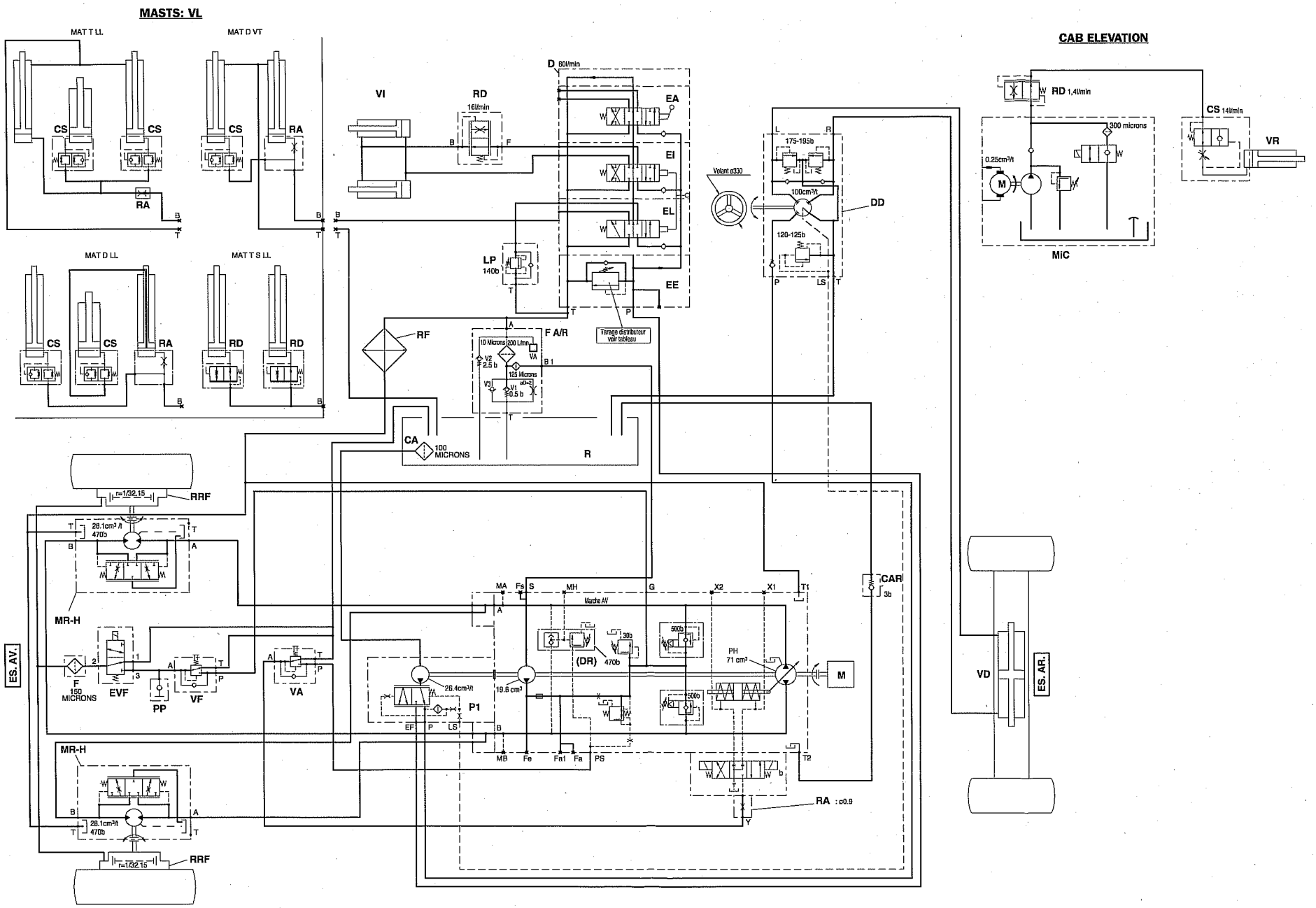
– HYDRAULIC DIAGRAM

CA	Suction strainer
CAR	Back pressure valve
CS	Safety valve
D	Valve bank (3) sections
	EA Attachment section
	EE Inlet section
	EI Tilting section
	EL Lifting section
DD	Steering valve bank
EVF	Braking electrovalve
F	Filter
F-A/R	Suction filter/return
LP	Relief valve
M	I.C. Engine
MiC	Microcentral
M.RH	Hydraulic wheel motor
MAT D LL	Double mast with total free-acting lift
MAT D VT	Double mast with all-round vision
MAT T LL	Triple mast with total free-acting lift
MAT T S LL	Triple mast without free-acting lift
P1	Hydraulic main pump
PH	Hydrostatic pump
PP	Pressure point
R	Hydraulic tank
RA	Restrictor
RD	Flow reducer
RF	Cooler
RRF	Wheel reducing with brake
VA	Acceleration valve
VD	Steering cylinder
VF	Braking valve
VI	Tilting cylinder
VL	Lifting cylinder
VR	Cabin lifting cylinder

		Double mast with all-round vision			Double mast total free-acting lift			Triple mast total free-acting lift			Triple mast without free-acting lift		
		2 t	2,5 t	3 t	2 t	2,5 t	3 t	2 t	2,5 t	3 t	2 t	2,5 t	3 t
Lateral cylinders	Ø of rod	Ø 40	Ø 40	Ø 45	Ø 35	Ø 35	Ø 40	Ø 40	Ø 40	Ø 45	Ø 50	Ø 50	
	Ø interior body	Ø 50	Ø 50	Ø 55	Ø 50	Ø 50	Ø 55	Ø 50	Ø 50	Ø 55	Ø 60	Ø 60	
	Security valve flow ± 10%	60 l/mn	60 l/mn	70 l/mn	60 l/mn	60 l/mn	60 l/mn	60 l/mn	60 l/mn	60 l/mn			
	Flow restrictor ± 10%	60 l/mn	60 l/mn	75 l/mn	65 l/mn	65 l/mn	75 l/mn	75 l/mn	75 l/mn	75 l/mn	25 l/mn	25 l/mn	
Free lift cylinders	Ø of rod				Ø 75	Ø 75	Ø 85	Ø 75	Ø 75	Ø 85			
	Ø interior body				Ø 90	Ø 90	Ø 105	Ø 90	Ø 90	Ø 105			
	Security valve flow ± 10%				95 l/mn	95 l/mn	120 l/mn	95 l/mn	95 l/mn	120 l/mn			
Damaged distributor		140 bar	170 bar	185 bar	140 bar	170 bar	185 bar	140 bar	170 bar	185 bar	145 bar	180 bar	

HYDRAULIC DIAGRAM ***MSI 20 D / MSI 25 D / MSI 30 D + BUGGIE SÉRIE 2-E2***



HYDRAULIC DIAGRAM

70-6-248566 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

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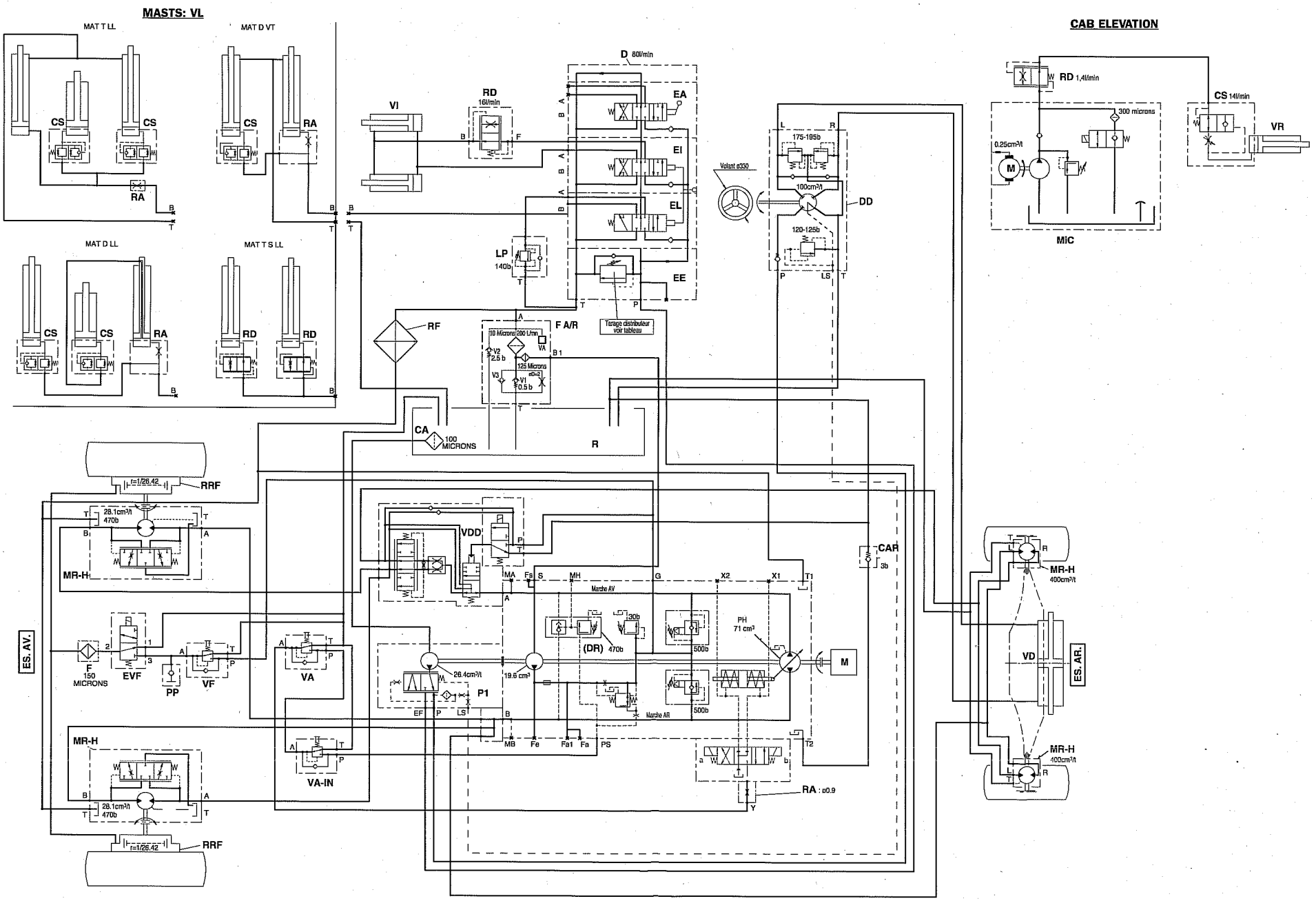
HYDRAULIC DIAGRAM — *MH 20-4 TURBO SÉRIE 2-E2* / *MH 25-4 TURBO SÉRIE 2-E2*

CA	Suction strainer
CAR	Back pressure valve
CS	Safety valve
D	Valve bank (3) sections
	EA Attachment section
	EE Inlet section
	EI Tilting section
	EL Lifting section
DD	Steering valve bank
EVF	Braking electrovalve
F	Filter
F-A/R	Suction filter/return
LP"	Relief valve
M	I.C. Engine
MiC	Microcentral
M.RH	Hydraulic wheel motor
MAT D LL	Double mast with total free-acting lift
MAT D VT	Double mast with all-round vision
MAT T LL	Triple mast with total free-acting lift
MAT T S LL	Triple mast without free-acting lift
P1	Hydraulic main pump
PH	Hydrostatic pump
PP	Pressure point
R	Hydraulic tank
RA	Restrictor
RD	Flow reducer
RF	Cooler
RRF	Wheel reducing with brake
VA	Acceleration valve
VA-IN	Inching valve
VD	Steering cylinder
VDD	Flow divider valve
VF	Braking valve
VI	Tilting cylinder
VL	Lifting cylinder
VR	Cabin lifting cylinder

		Double mast with all-round vision		Triple mast total free acting lift		Triple mast without free acting lift	
		2 t	2,5 t	2 t	2,5 t	2 t	2,5 t
Lateral cylinders	Ø of rod	Ø 40	Ø 40	Ø 40	Ø 40	Ø 50	Ø 50
	Ø interior body	Ø 50	Ø 50	Ø 50	Ø 50	Ø 60	Ø 60
	Security valve flow ± 10%	60 l/mn	60 l/mn	60 l/mn	60 l/mn		
	Flow restrictor ± 10%	60 l/mn	60 l/mn	75 l/mn	75 l/mn	25 l/mn	25 l/mn
Free lift cylinders	Ø of rod			Ø 75	Ø 75		
	Ø interior body			Ø 90	Ø 90		
	Security valve flow ± 10%			95 l/mn	95 l/mn		
Damaged distributor		140 bar	170 bar	145 bar	180 bar	150 bar	180 bar

HYDRAULIC DIAGRAM **MH 20-4 TURBO SÉRIE 2-E2 MH 25-4 TURBO SÉRIE 2-E2**



HYDRAULIC DIAGRAM

70-6-248567 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

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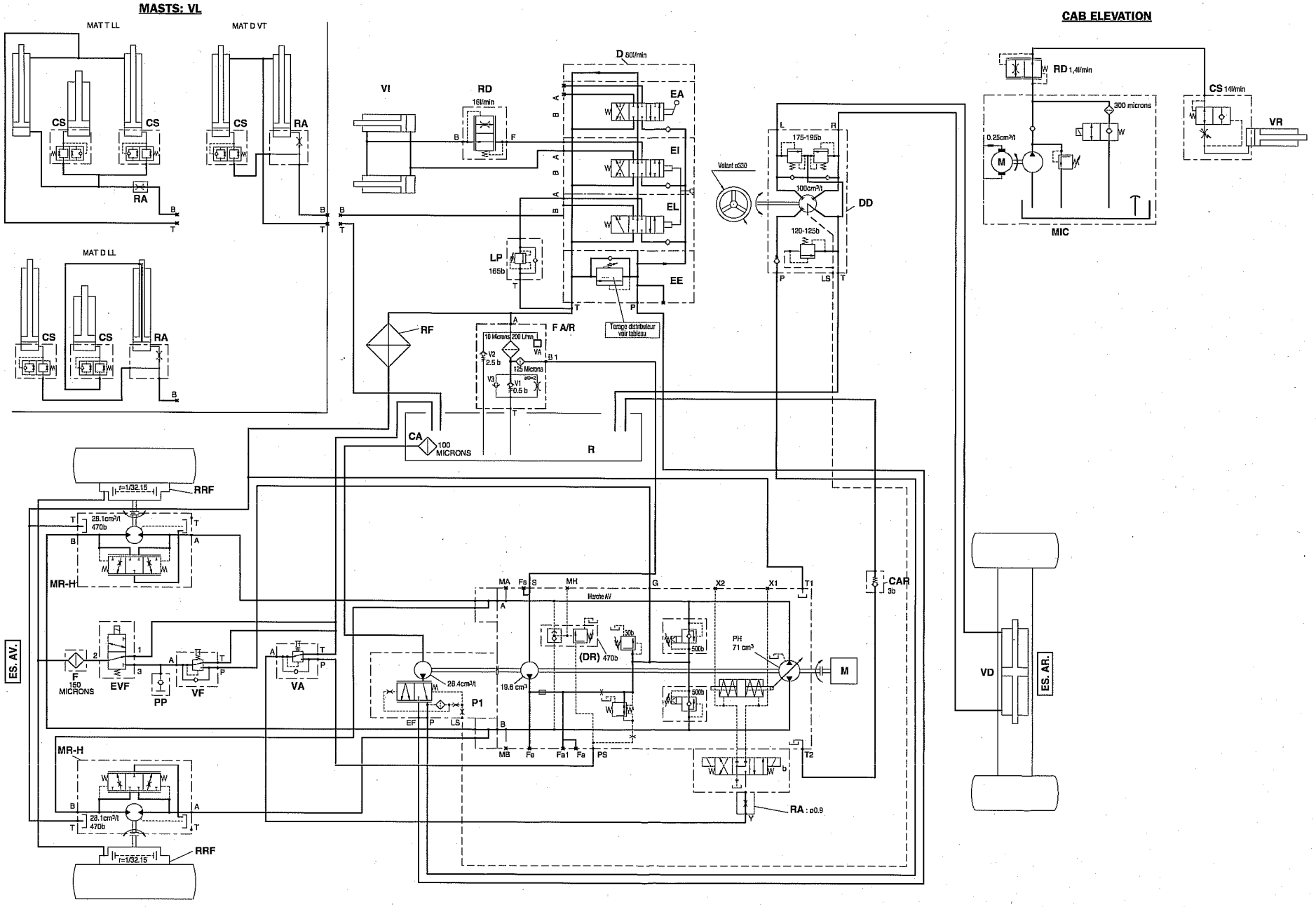
CONTENTS

HYDRAULIC DIAGRAM *MSI 35 TURBO + BUGGIE SÉRIE 2-E2*

CA	Suction strainer
CAR	Back pressure valve
CS	Safety valve
D	Valve bank (3) sections
	EA Attachment section
	EE Inlet section
	EI Tilting section
	EL Lifting section
DD	Steering valve bank
EVF	Braking electrovalve
F	Filter
F-A/R	Suction filter/return
LP"	Relief valve
M	I.C. Engine
MiC	Microcentral
M.RH	Hydraulic wheel motor
MAT D LL	Double mast with total free-acting lift
MAT D VT	Double mast with all-round vision
MAT T LL	Triple mast with total free-acting lift
P1	Hydraulic main pump
PH	Hydrostatic pump
PP	Pressure point
R	Hydraulic tank
RA	Restrictor
RD	Flow reducer
RF	Cooler
RRF	Wheel reducing with brake
VA	Acceleration valve
VD	Steering cylinder
VF	Braking valve
VI	Tilting cylinder
VL	Lifting cylinder
VR	Cabin lifting cylinder

		Double mast with all-round vision	Double mast total free-acting lift	Triple mast total free-acting lift
Lateral cylinders	Ø of rod	Ø 45	Ø 40	Ø 45
	Ø interior body	Ø 55	Ø 55	Ø 60
	Security valve flow ± 10%	70 l/mn	60 l/mn	60 l/mn
	Flow restrictor ± 10%	75 l/mn	75 l/mn	75 l/mn
Free lift cylinders	Ø of rod		Ø 85	Ø 85
	Ø interior body		Ø 105	Ø 105
	Security valve flow ± 10%		120 l/mn	120 l/mn
Damaged distributor		190 bar	190 bar	220 bar


MASTS: VL
MAT T LL
MAT D VT
MAT D LL
CS
RA
VI
RD
16l/min
D 80l/min
EA
EI
EL
EE
LP
165b
RF
F A/R
10 Microns 200 L/mn
125 Microns
V2 2.5 b
V1 0.5 b
CA
100 MICRONS
R
Volant ø330
175-195b
100cm³/t
DD
120-125b
CAB ELEVATION
RD 1,4l/min
300 microns
0.25cm³/t
MIC
CS 14l/min
VR
RRF
28.1cm³/t
470b
MR-H
ES. AV.
F
150 MICRONS
EVF
PP
VF
VA
MA Fs S MH G X2 X1 T1
Marche AV
(DR) 470b
30b
500b
PH 71 cm³
M
28.4cm³/t
19.6 cm³
P1
EF P LS
MB Fe Fa1 Fa PS T2
RA : ø0.9
CAR
3b
VD
ES. AR.

GROUP 75

HYDROSTATIC

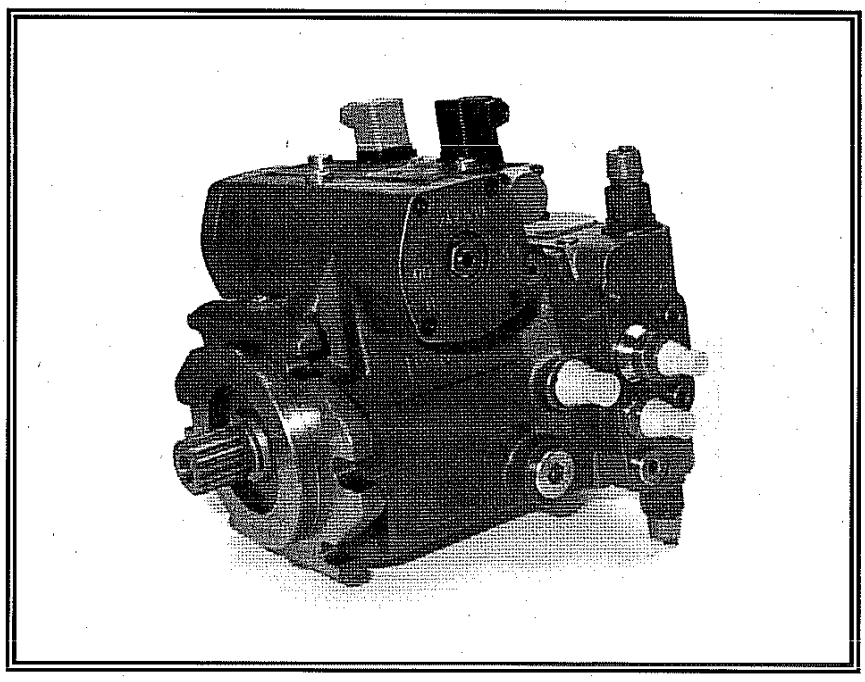
PUMP DISASSEMBLY
A4 VG 71-180 (Série 3.2)
75-3-16 EN

10 / 01 / 2001

REPAIR

PUMP A 4 VG 71 - 180

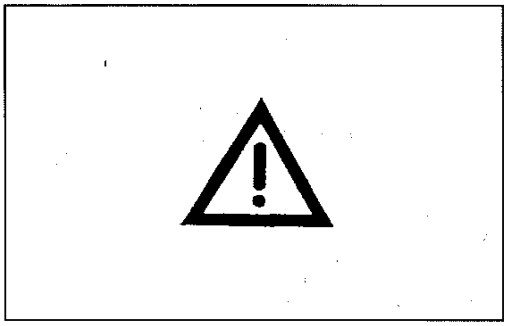
Série 3.2



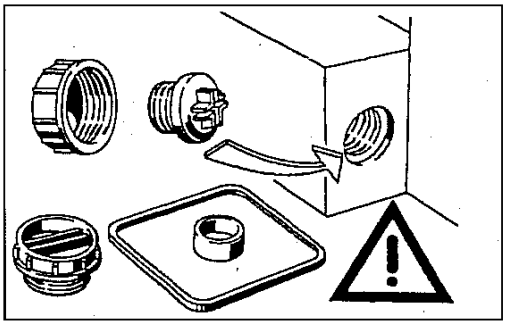
REPAIR INSTRUCTIONS

CONTENTS

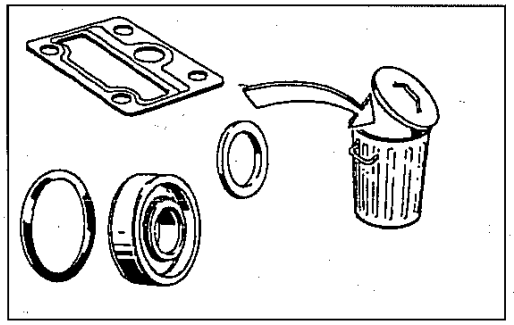
General repair instructions



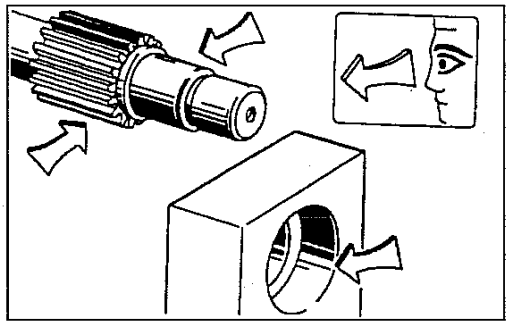
Attention !
Observe the following notices when carrying out repair work at hydraulic aggregates !



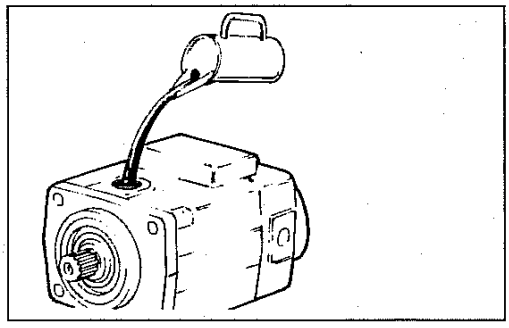
Close all ports of the hydraulic aggregates.



Replace all seals.
Use only original MANITOU spare parts.

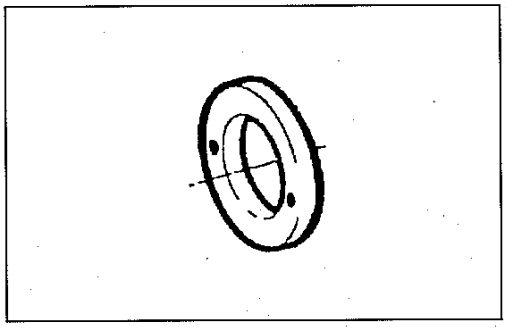


Check all seal and sliding surfaces for swear.
Attention : Rework of sealing area f. ex. with abrasive paper can damage surface.

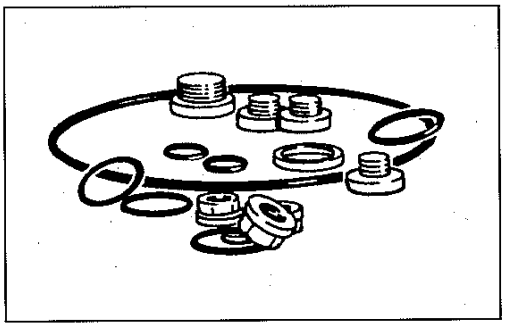


Fill up hydraulic aggregates with medium before start-up.

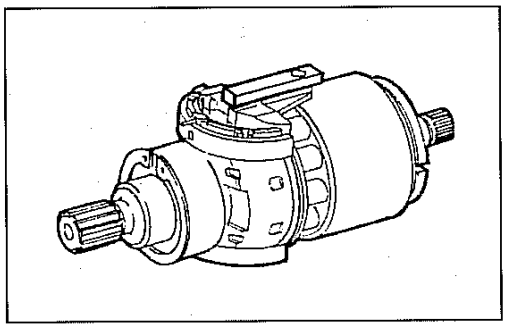
Seal kits and sub assembly groups



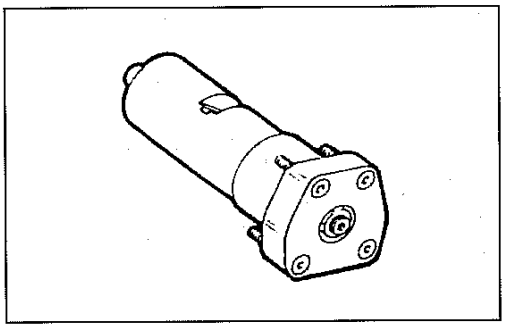
Seal kit for drive shaft.



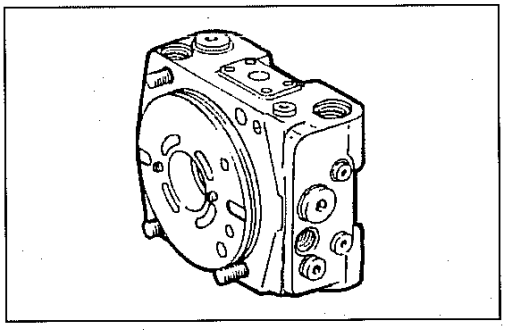
External seal kit.



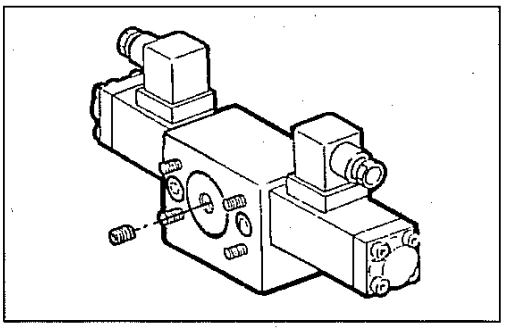
Complete rotary group.



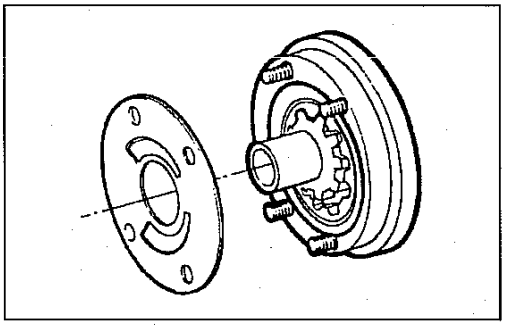
Positioning piston.



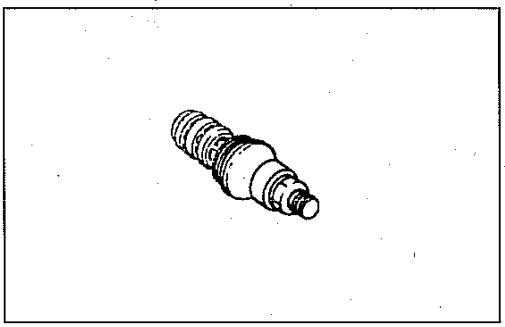
Valve plate.



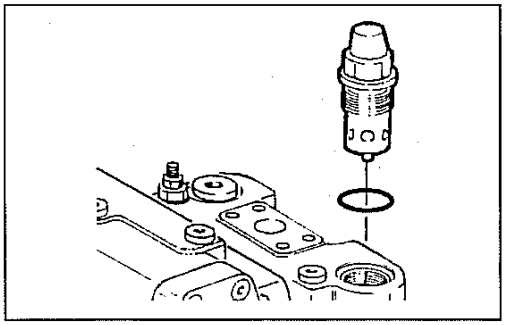
Control device **DA**
Note :
Size 71 control device as size 40 - 56 with flat seal.



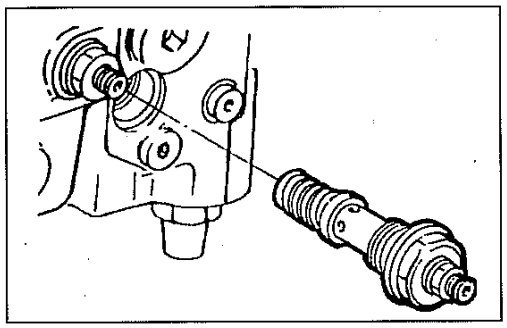
Boost pump.



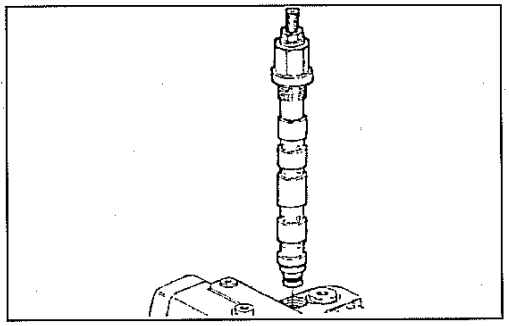
Control valve.



High pressure valve.

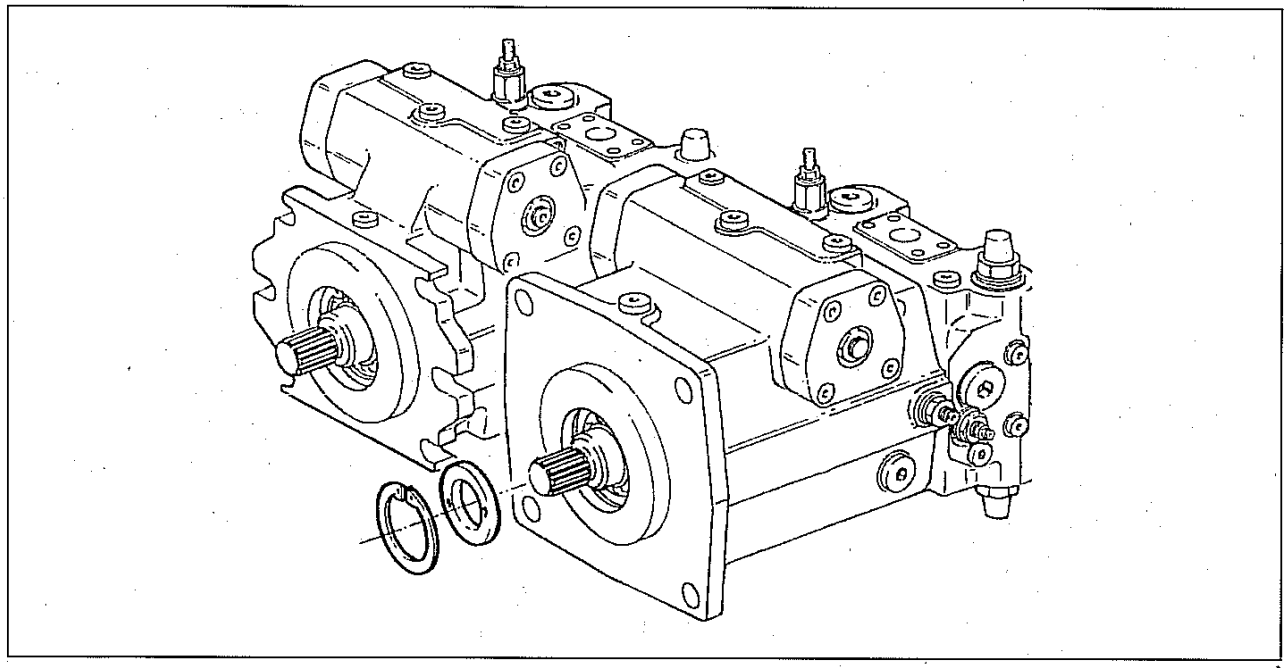


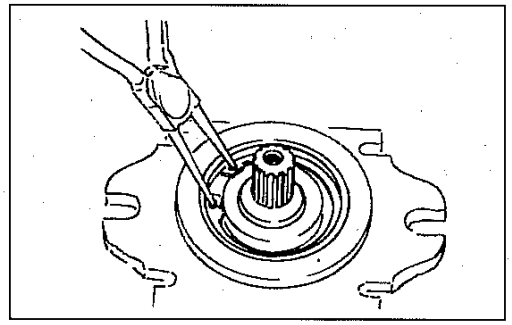
Low pressure valve.



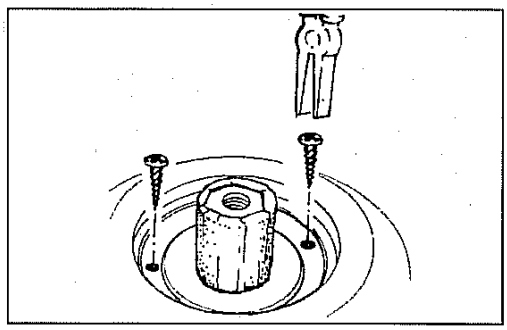
Pressure cut-off.

Sealing of the drive shaft

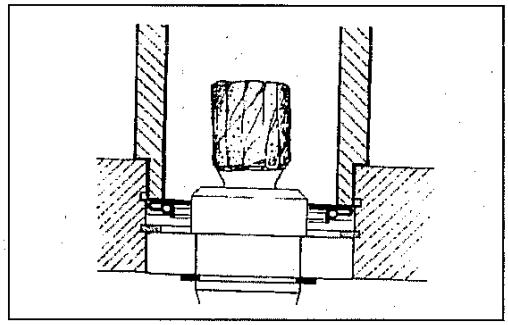




Protecting the drive shaft.
Remove retaining ring.

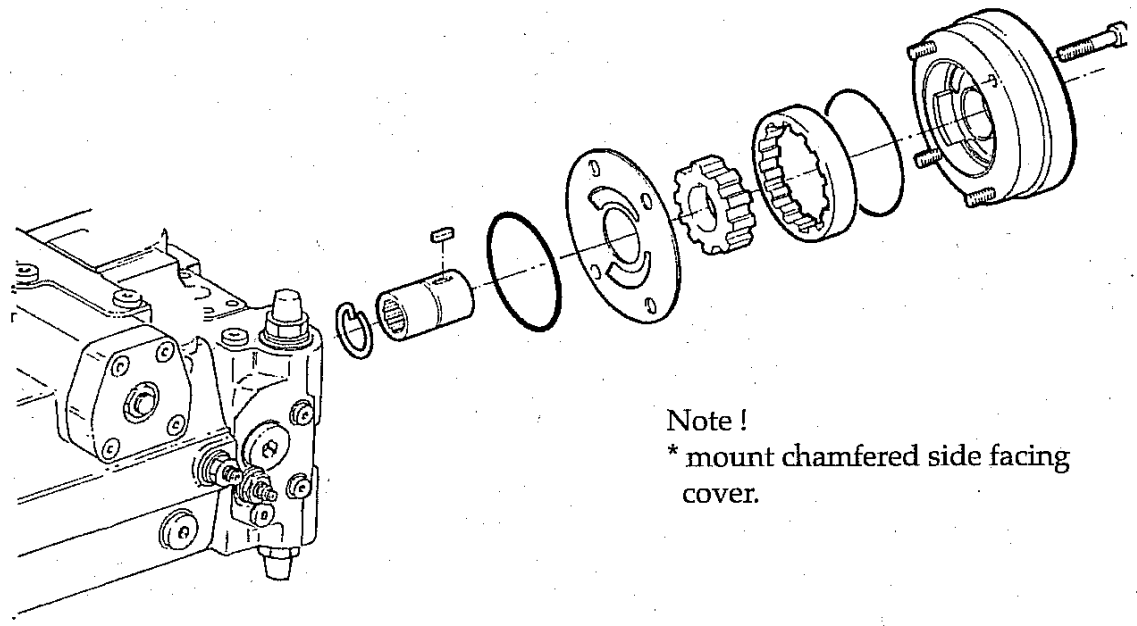


Screw in sheet metal screw into the holes fitted with rubber.
Pull out shaft seal with pliers.

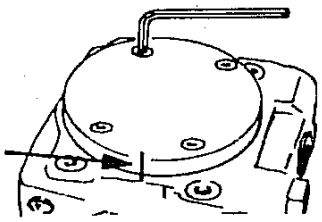


Press-in shaft seal with bush to stop.
Assemble retaining ring.

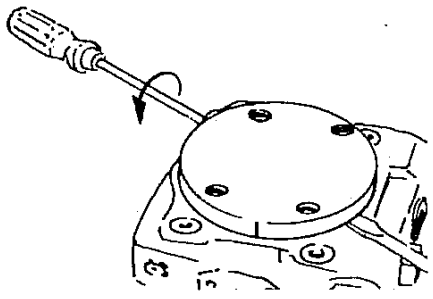
Sealing of the boost pump



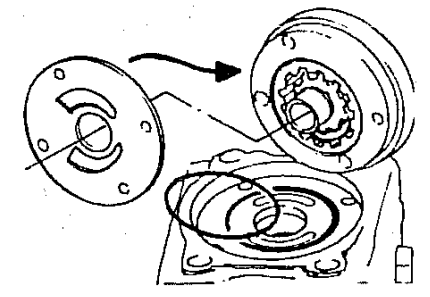
Note !
* mount chamfered side facing cover.



Mark position,
remove fixing screws.

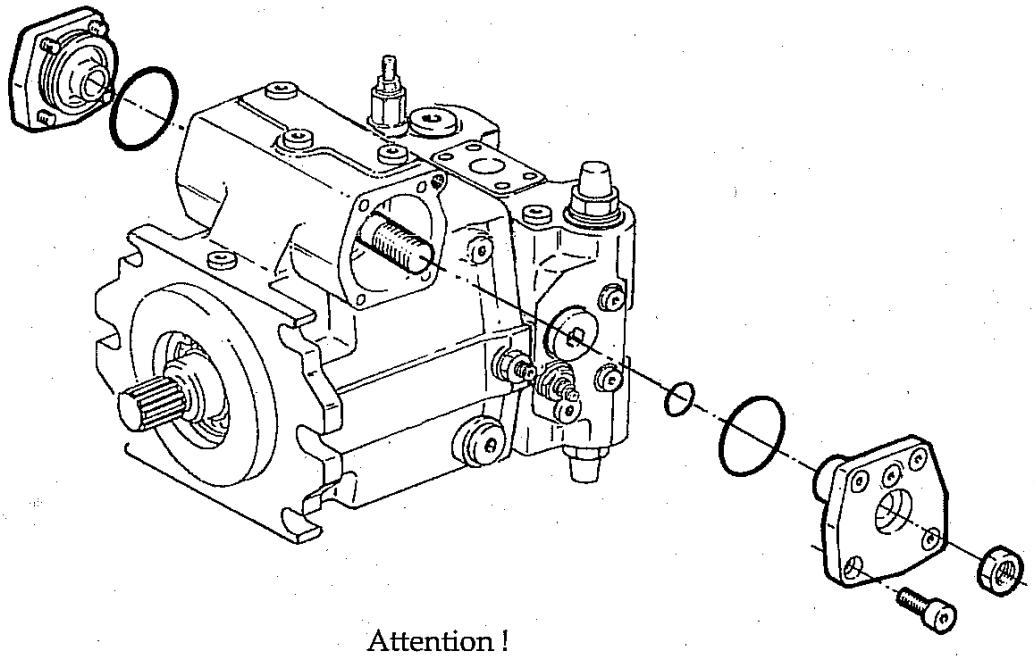


Pry-off cover.

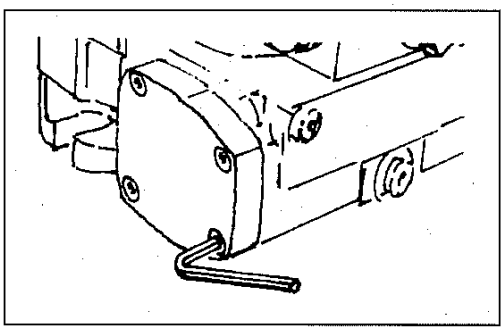


Check :
O-ring, groove, gliding surface, connection plate.

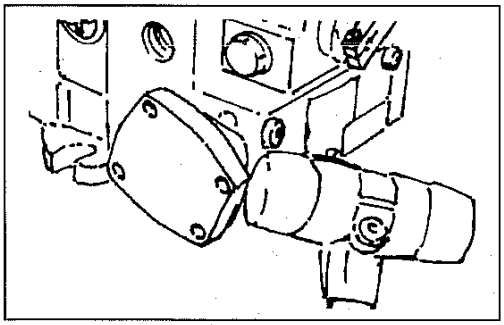
Sealing of the control piston cover



Attention !
Check correct mechanical 0-position.

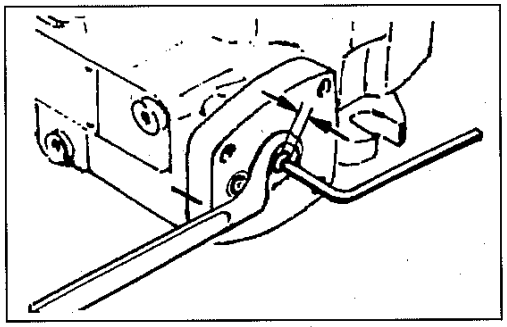


Mark position.

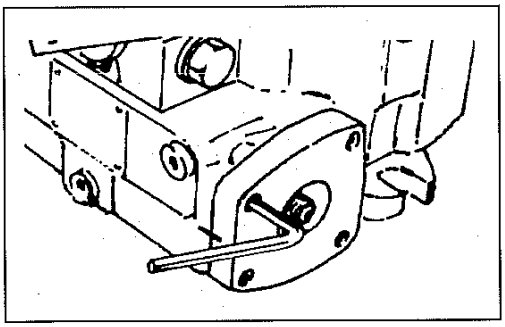


Rotate cover and release by tapping gently with hammer.

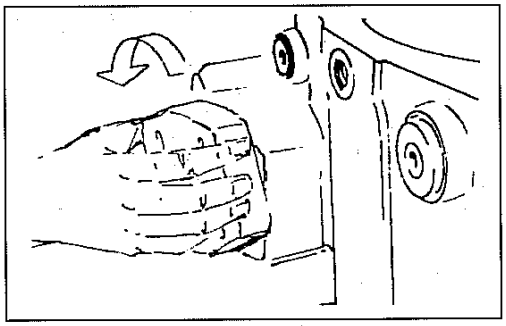
Sealing of the control piston cover



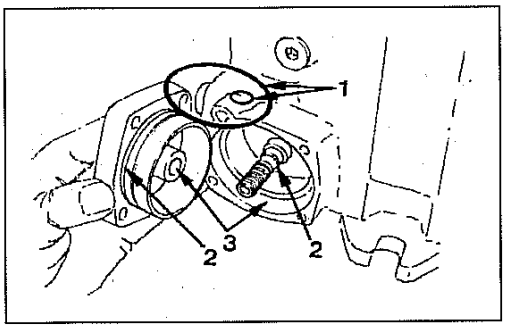
Mark cover. Must be fixed, loosen counter nut, hold adjustment screw.



Remove cover.

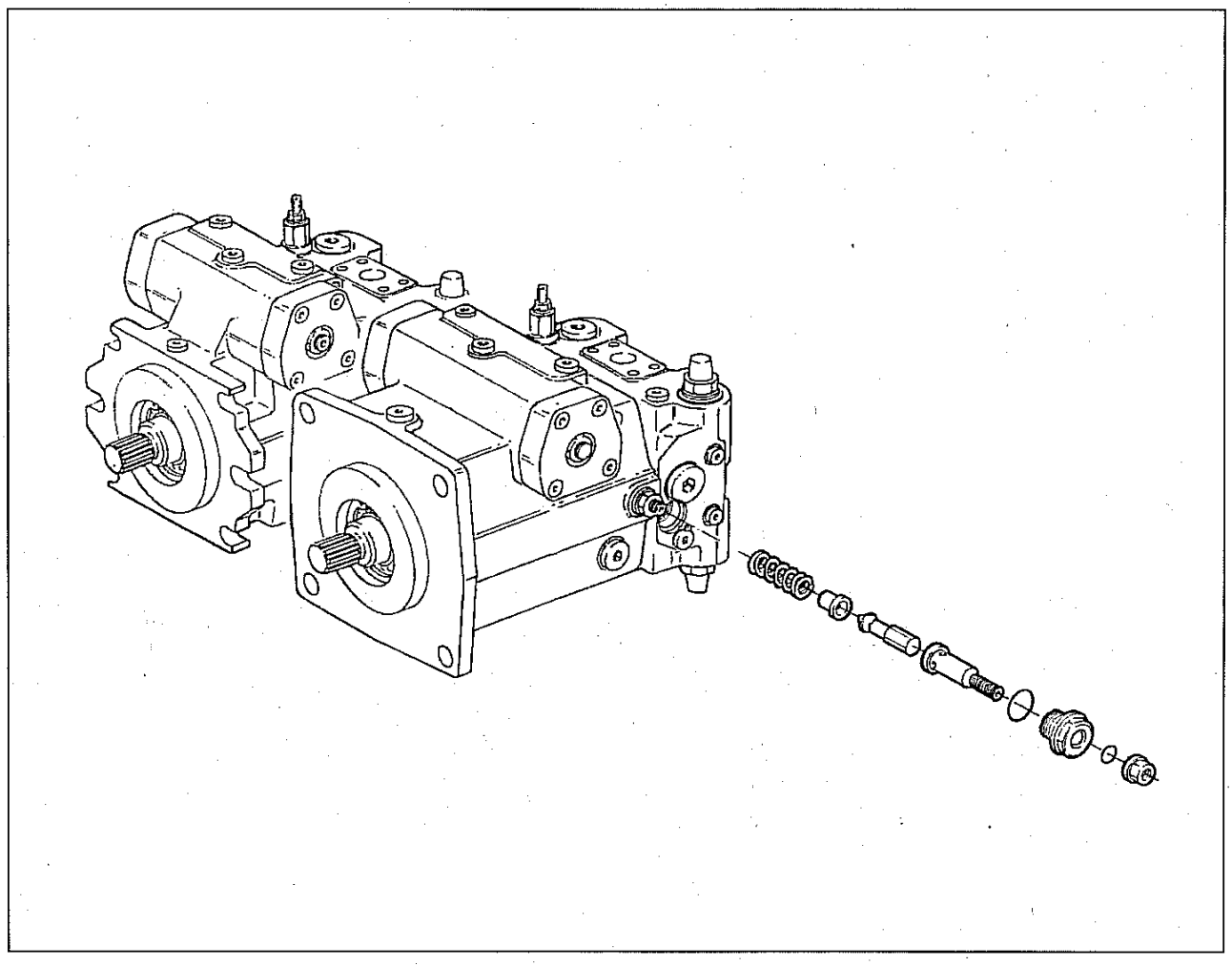


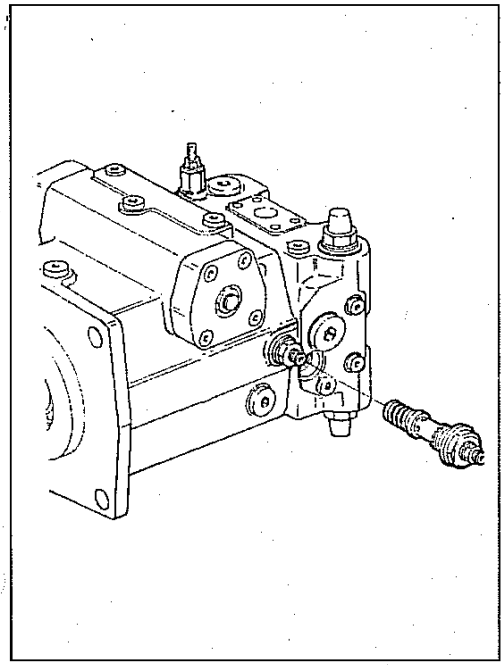
Lift off by turning the setting screw.



Check !
O-ring (1), groove (2), housing (3).

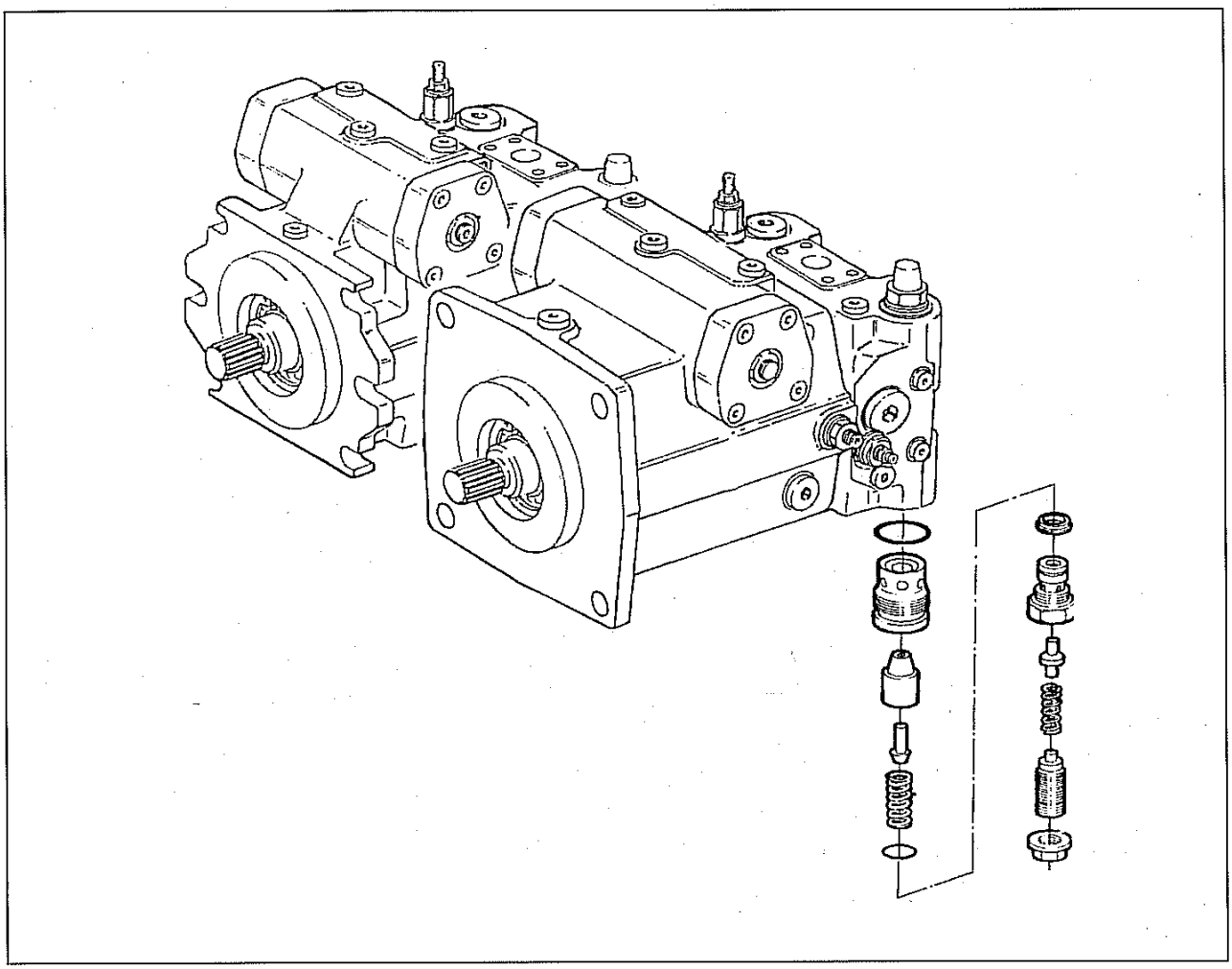
Sealing of the boost pressure valve

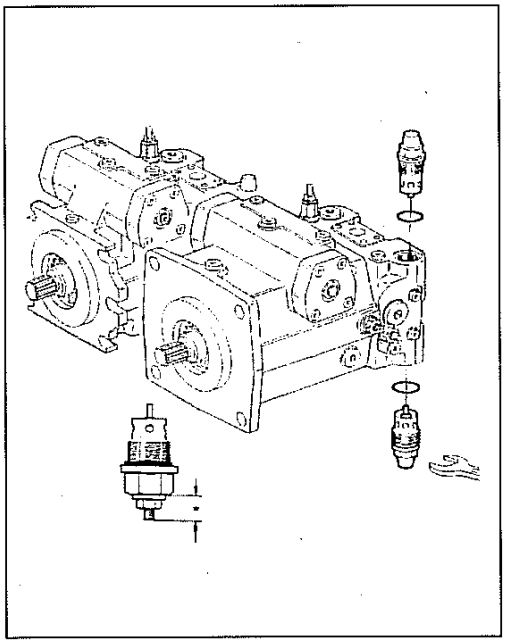




Remove valve completely.
Note :
Do not change adjustment screw.
Attention !
Check valve setting after installation.

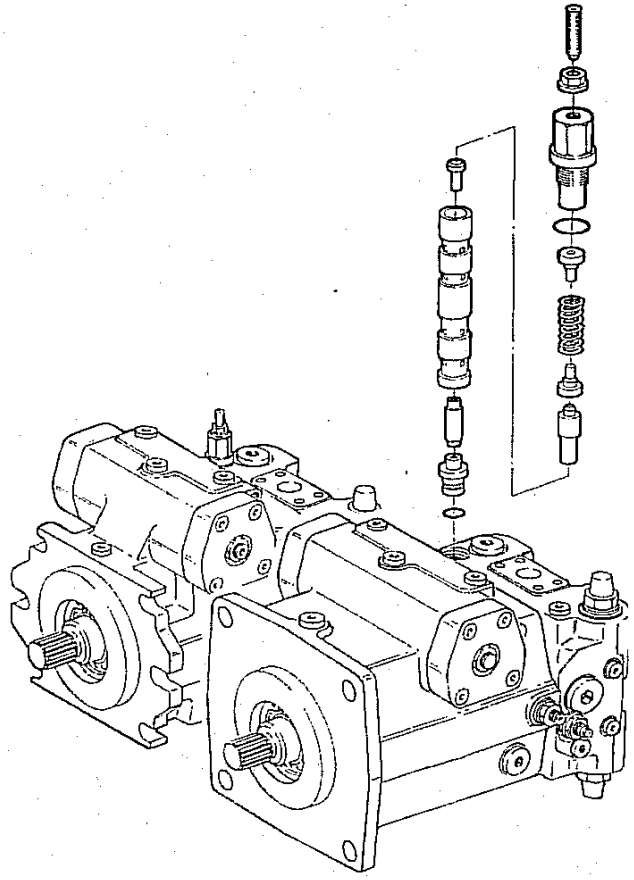
Sealing of the pressure relief valve HD

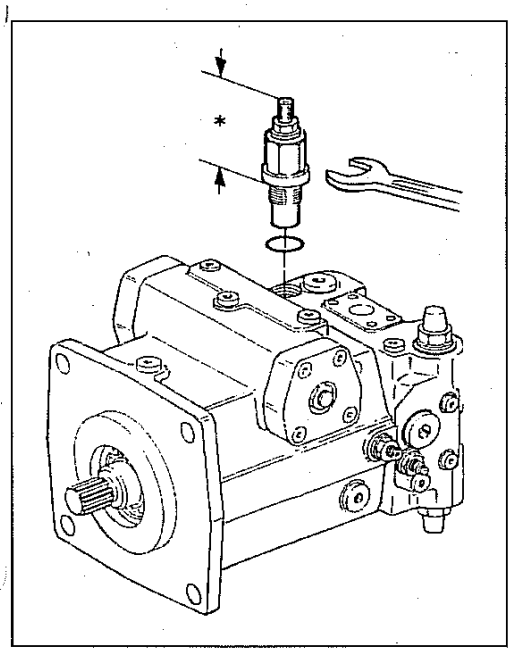




Remove valve completely.
Control : O-ring, housing.
Replacement of the tightening nut, record measure (*).
Attention !
After assembly check "valve setting".

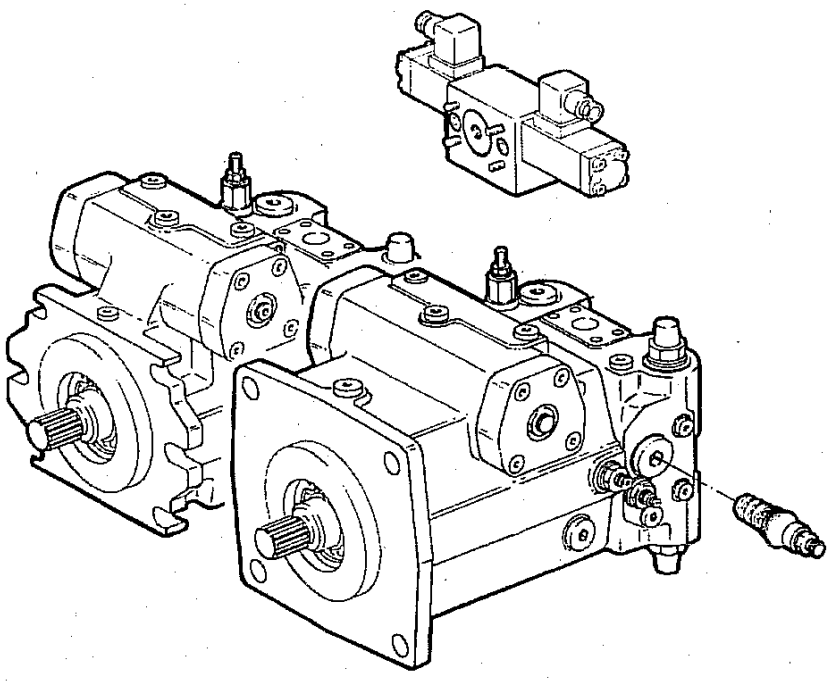
Sealing of the pressure cut-off





Unscrew setting cartridge completely.
Control : 0-ring, housing.
Replacement of the tightening nut, record measure (*).
Attention !
After assembly check "valve setting".

DA



Size
71 - 125

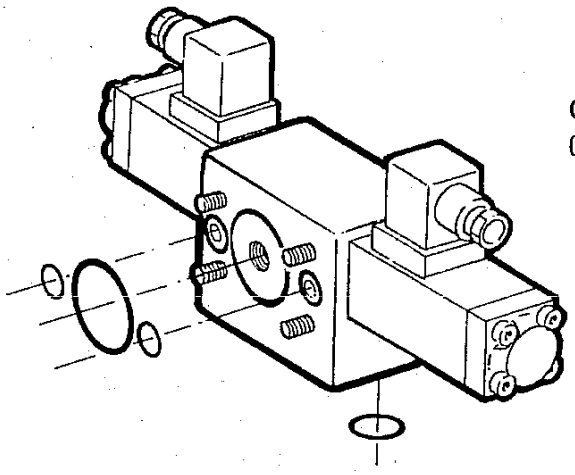
Size 180

Remove control device.

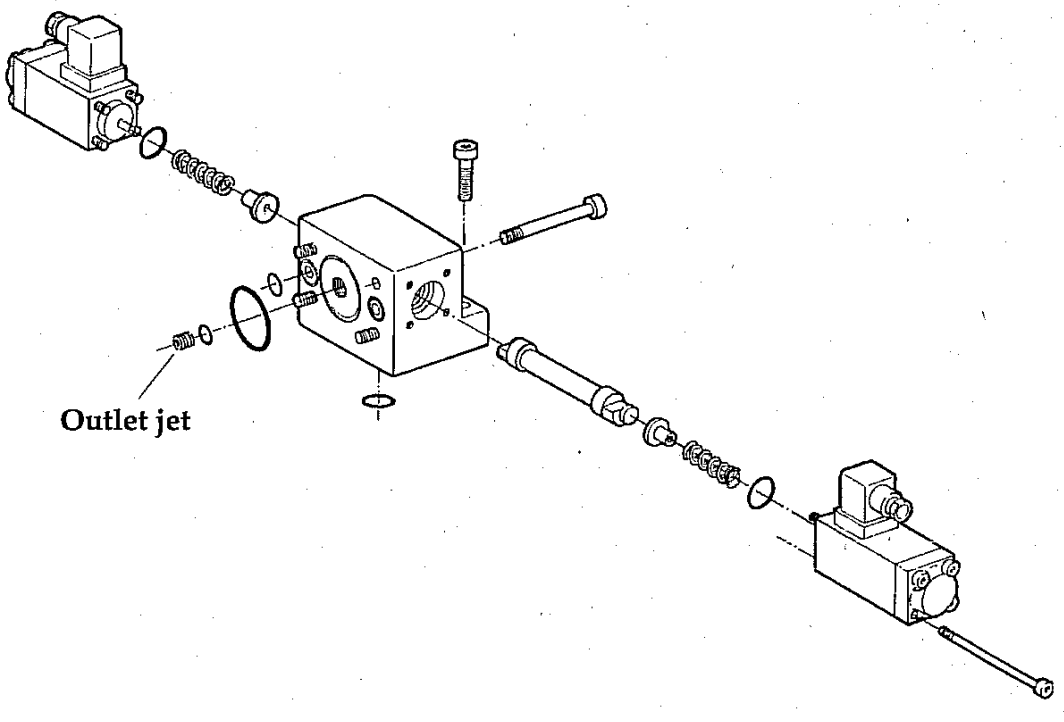
Note :
Size 71 : Sealing of control device as size 40 - 56 with flat seal.

Attention !
Check correct hydraulic 0-position.

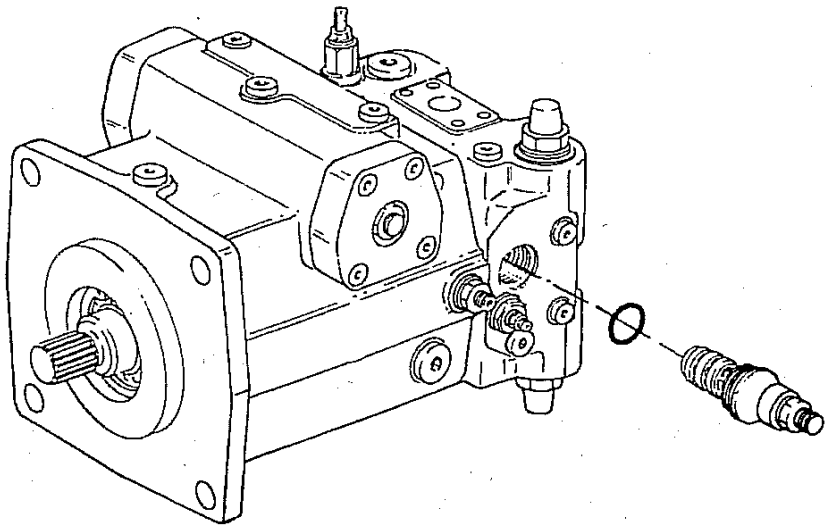
Control front/rear electrovanne

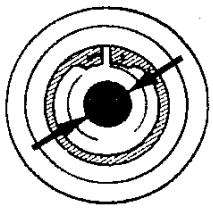


Check :
0-rings

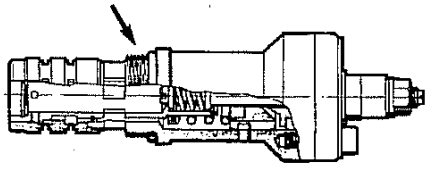


Sealing of the regulator valve



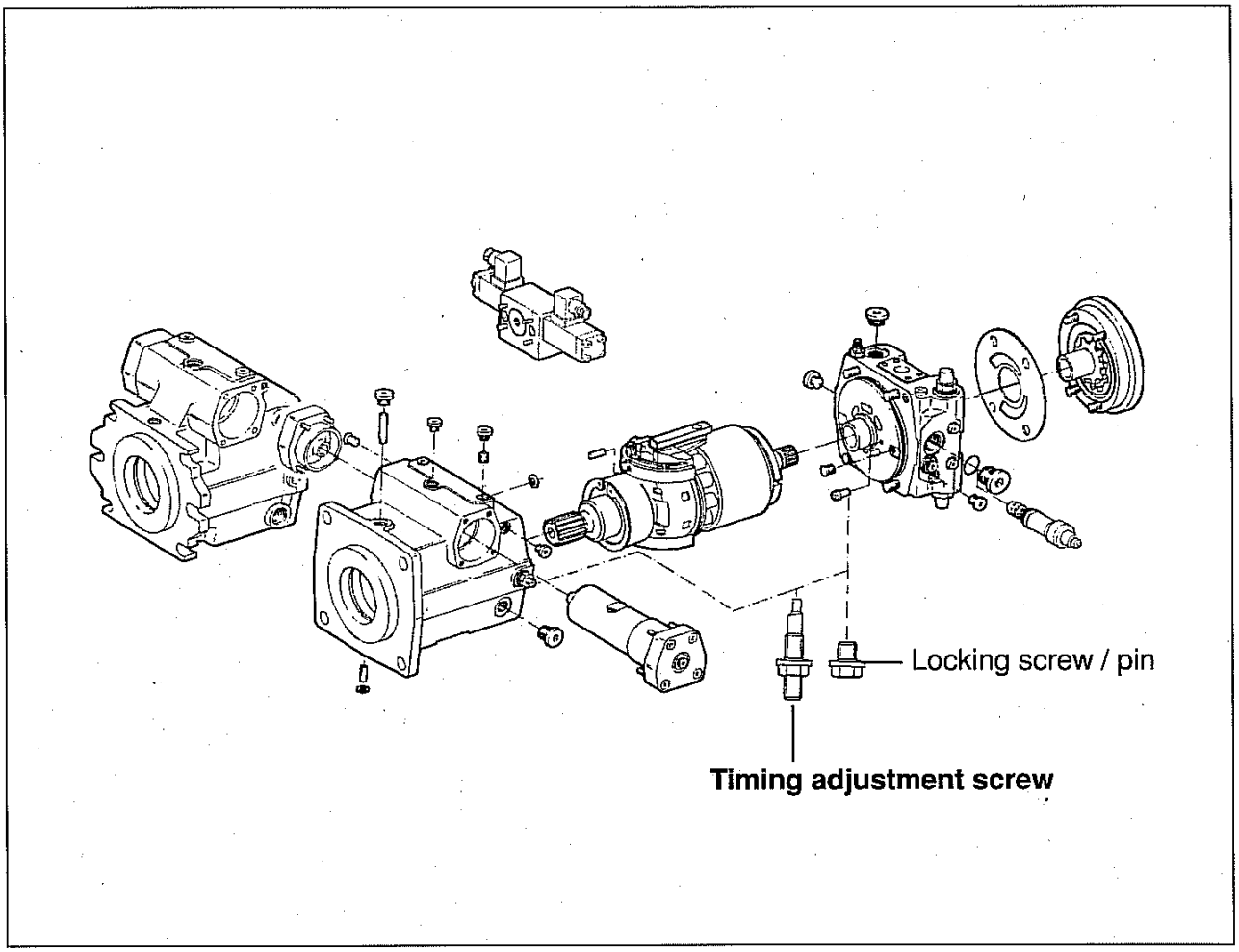


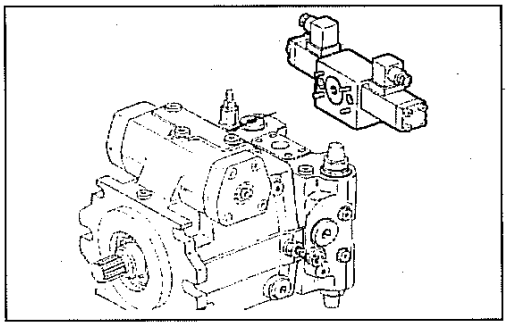
Inspect orifice.
No damage.



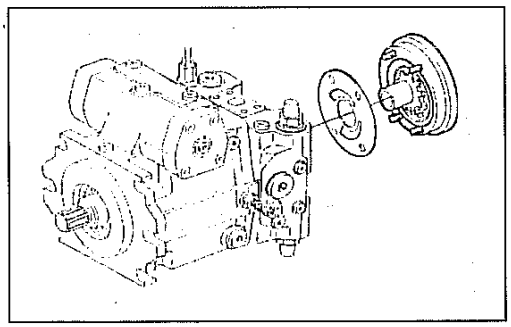
Cover threads.
Insert O-ring.

Démontage de la pompe



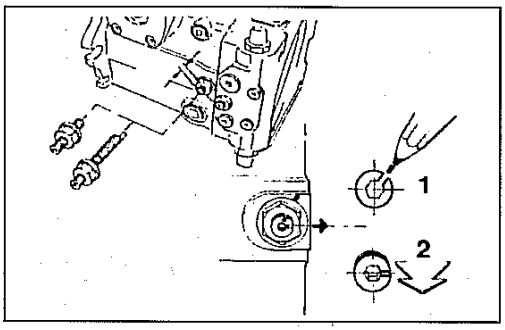


Remove control device.

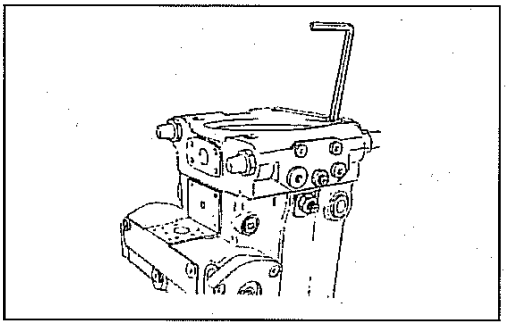


Remove auxiliary pump.
Note :
Mark assembly position previously.

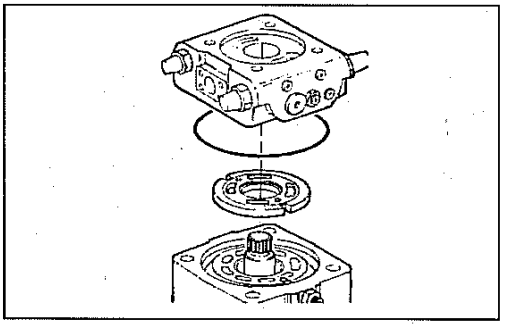
Pump disassembly



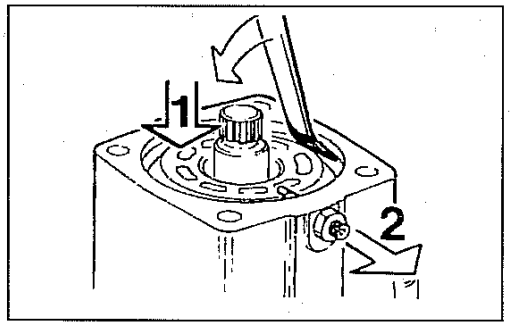
Mark the position of the indexing screw (1).
Record setting measure.
Set the indexing screw to disassembly position (2).



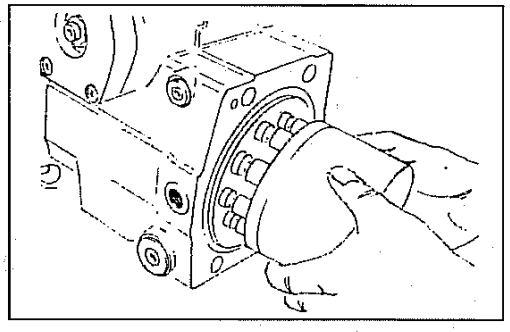
Mark position of the connection plate.
Loosen connection plate fixation.



Lift off port plate and control plate.

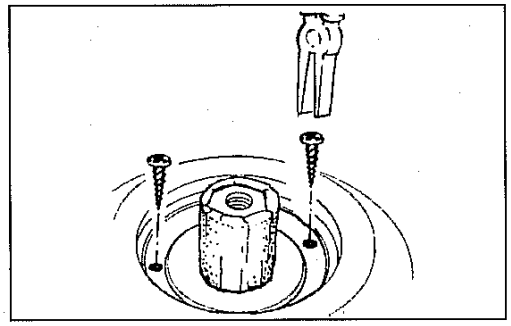


1. Press the cylinder to the bottom.
2. Remove fixing indexing screw.

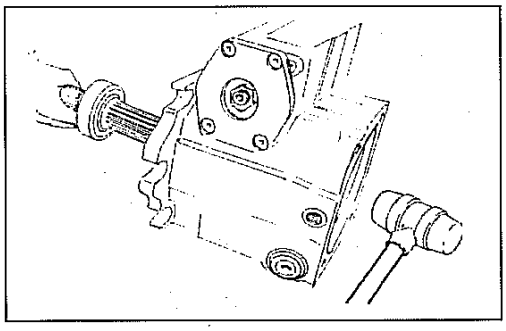


Push off hydraulic section of rotary group.

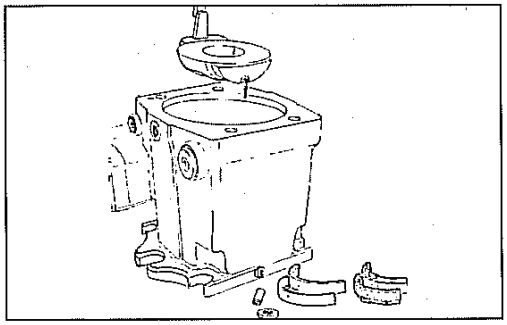
Pump disassembly



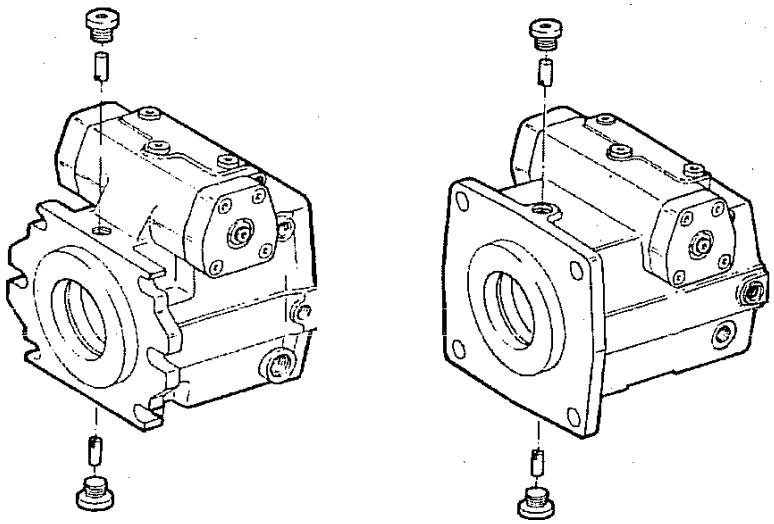
Remove retaining ring and radial seal ring.



Remove drive shaft with slide hammer strokes.

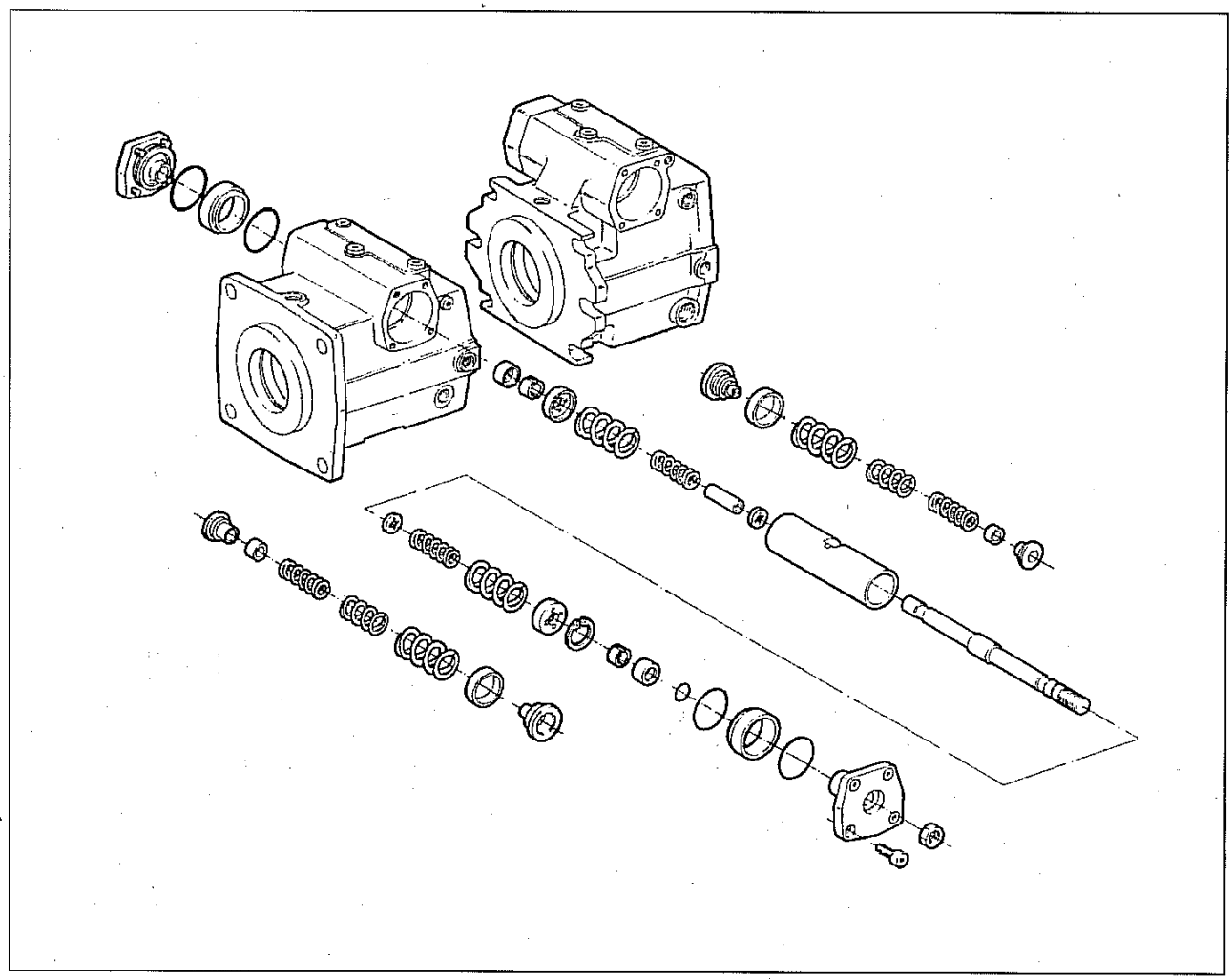


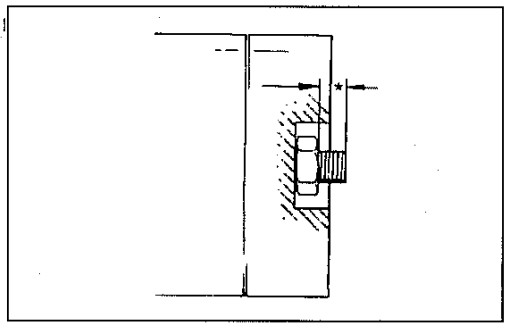
Remove swash plate / bearing cups.



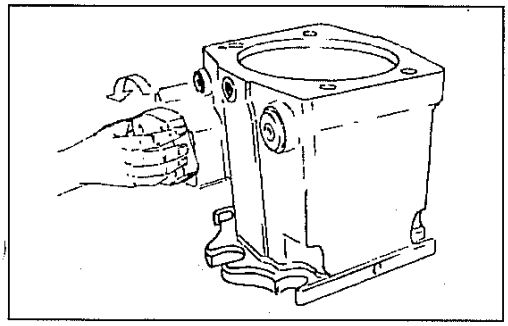
Remove joint pin

Dismantling of the control



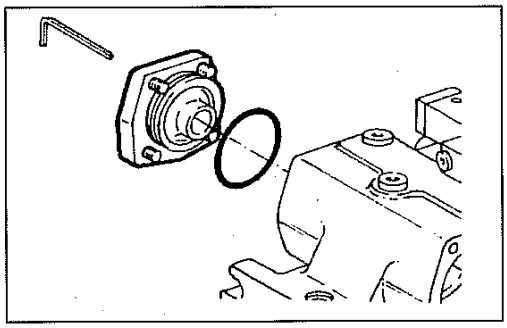


Mark position of the cover, note measure of "zero position".
Loosen nut.

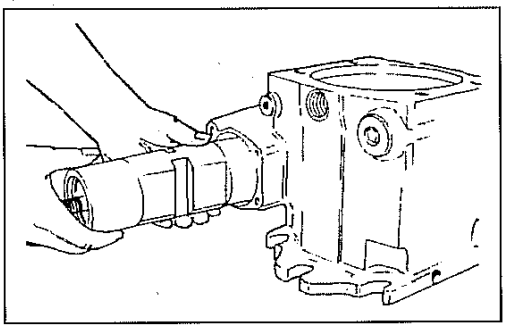


Remove cover.

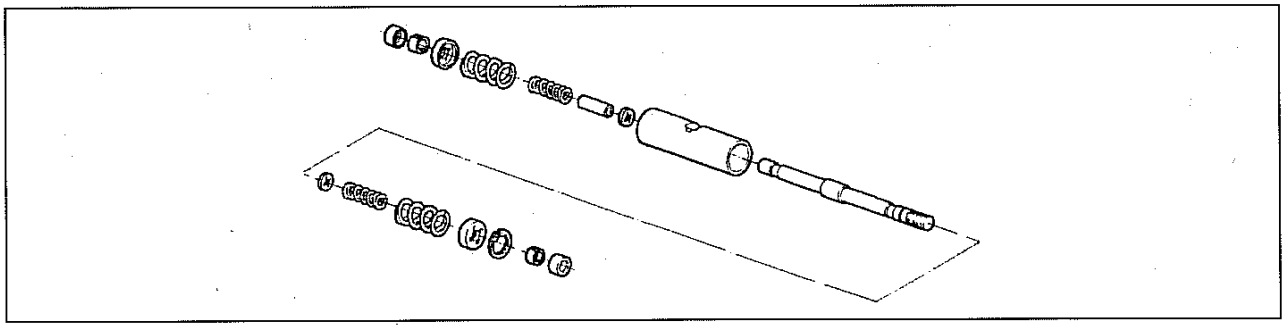
Dismantling of the control

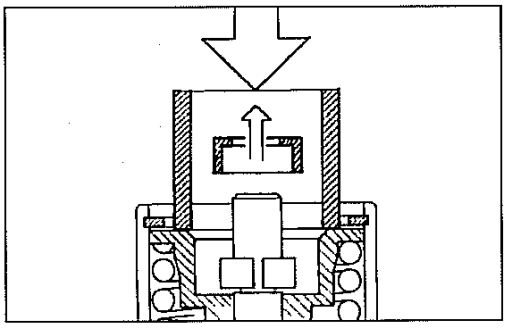


Mark position of the cover.
Loosen locking screw, remove cover.

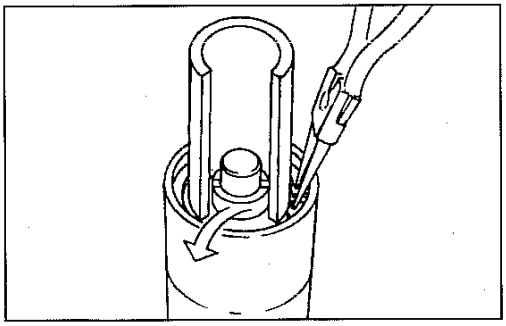


Remove positioning ring.



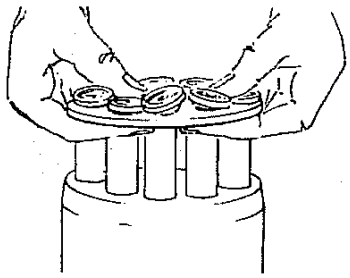


Fit tool device and preload spring.
Remove take-off ring.

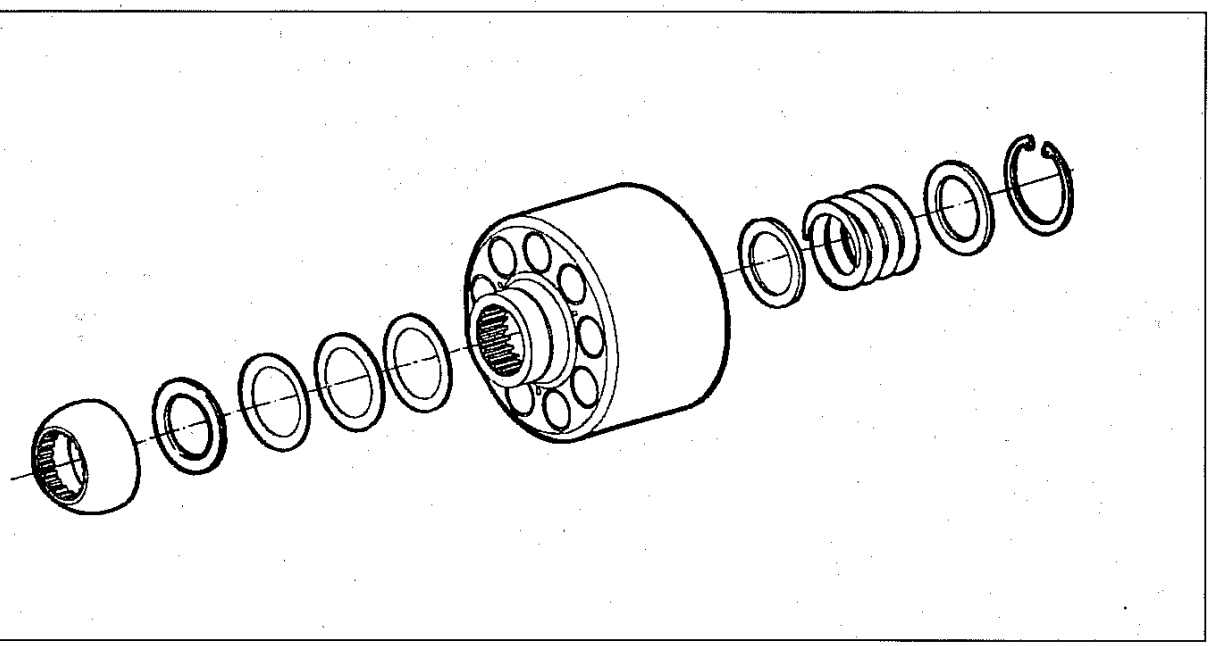


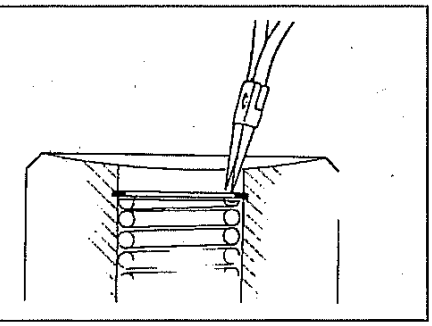
Remove rings.
Remove safety ring.
Attention : parts are under spring load.

Dismantling of the cylinder

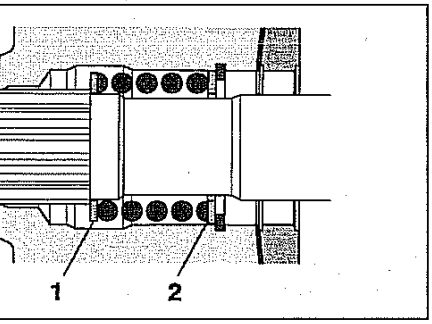


Remove piston with retaining plate.
Remove retaining ball with spring cup assembly.



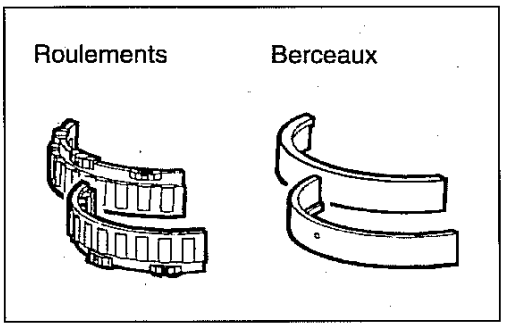


Remove safety ring.

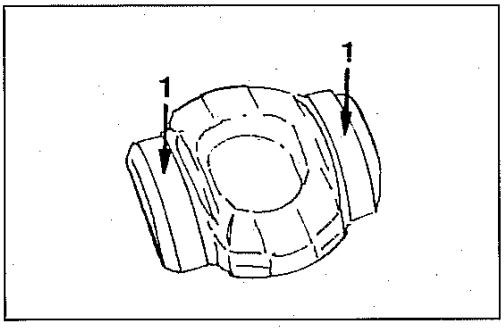


Disc 1, 2

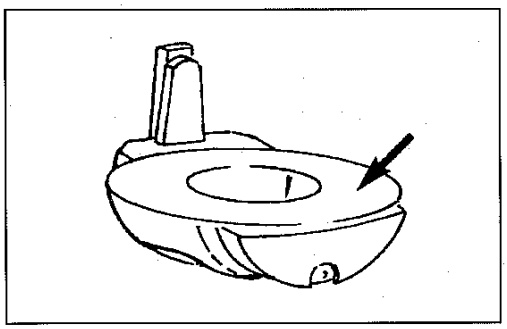
Inspection notes



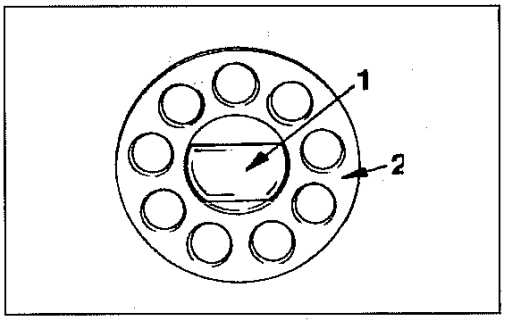
Check !
Cage set (1)
Bearing cup set (2).



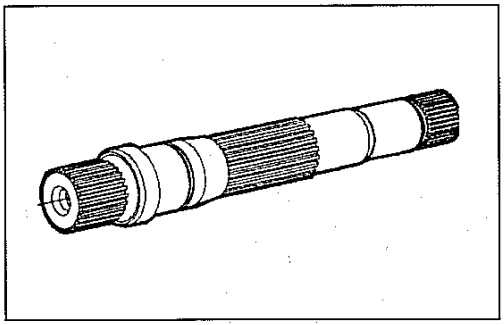
Check !
Bearing surfaces (1)



Check !
Sliding surface free from scoring.

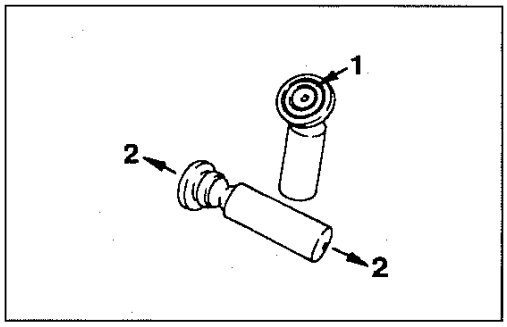


Check !
Check that return device is free of scoring.

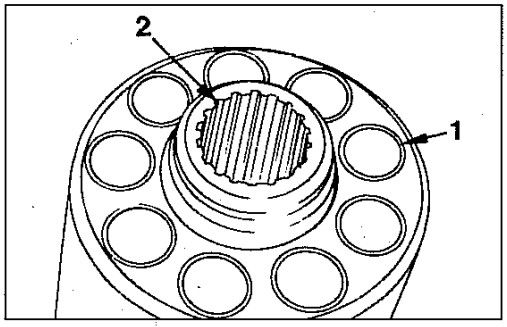


Check !
1. Splines for damage or fretting.
2. Running surfaces.
3. Groove cut by shaft seal.

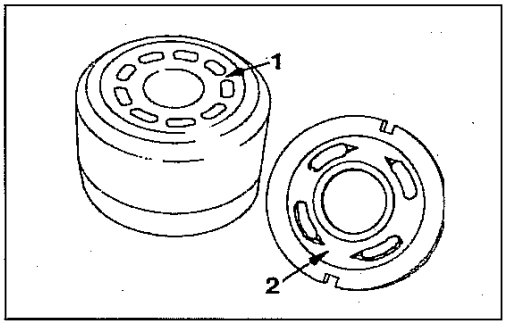
Inspection notes



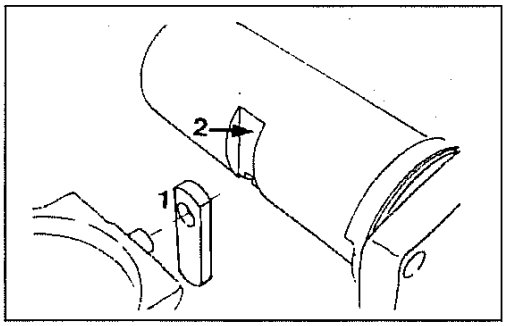
Check !
Check that there are no scratches or metal deposits on sliding surface (1), and there is no axial play (2), (otherwise : pistons must be replaced in sets).



Check !
Cylinder bores (1), splines (2).

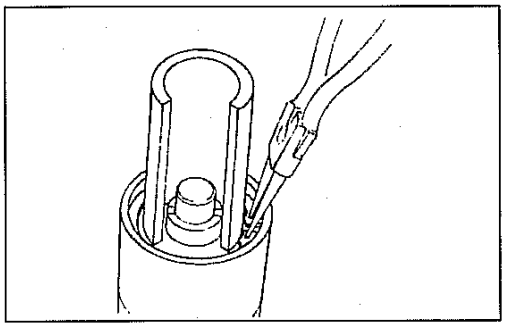


Check !
Cylinder surface (1) free of scoring.
Control plate (2) without scoring.

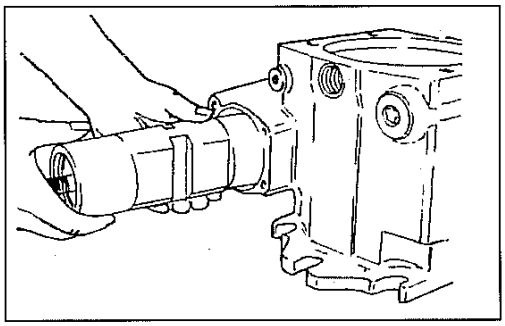


Check !
Positioning piston -cradle linkage
Gliding stone (1), groove at the positioning piston (2),
Positioning piston.

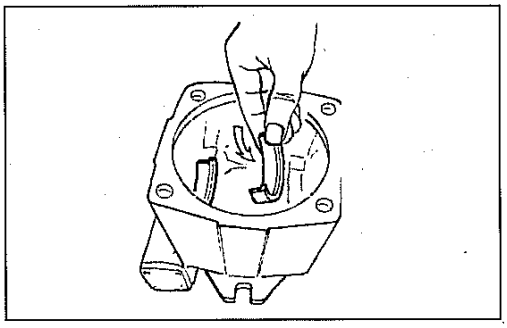
Positioning piston, rotary group assembly



Assemble positioning piston.
Instruction :
Observe correct fit of the divided rings.



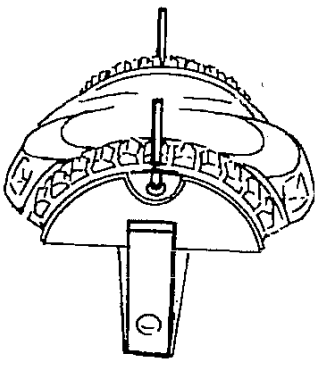
Insert positioning piston into the housing.
Instruction :
Remarque :
Oil positioning piston before assembly.

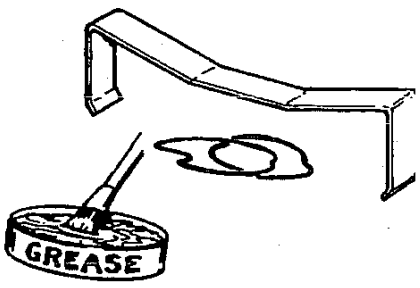


Insert bearing cup set.

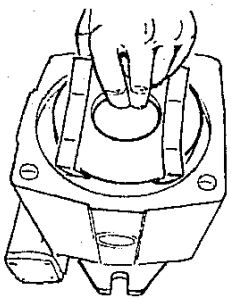
Assemble bearing, wire, gliding stone and articulating pin.

Assistance : Devices e.g - clamp / rubber rings / grease



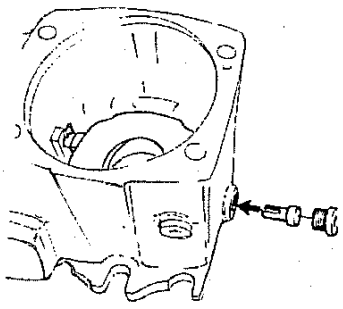


Installation of the rotary group

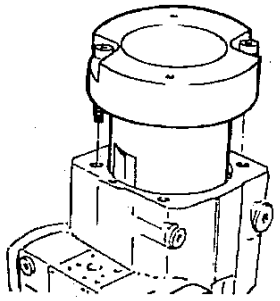


Insert completely swivel cradle into the housing.
Pay attention for correct seat of the swivel cradle in the housing.

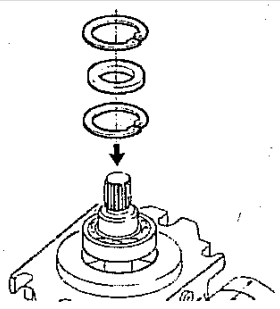
⚠ Remove auuxiliary device.



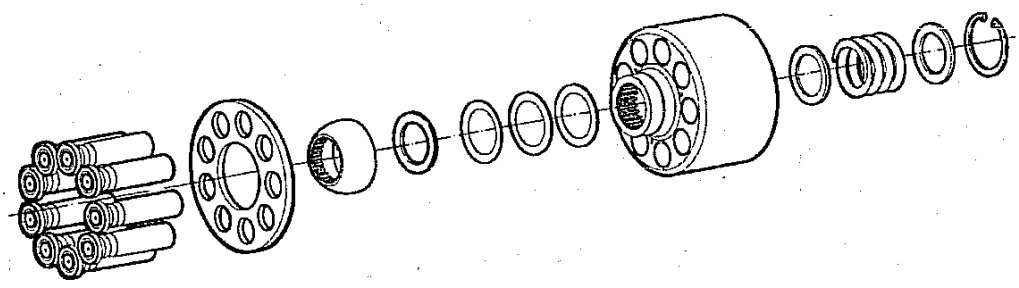
Assemble articulating pins.



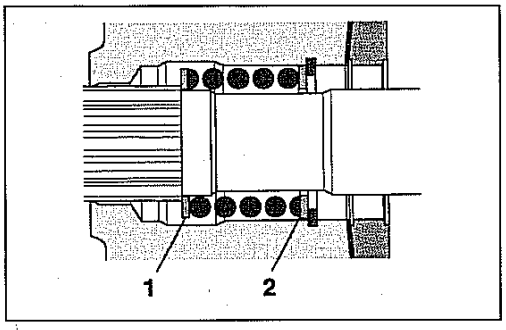
Assemble device for fixation of the swivel cradle.



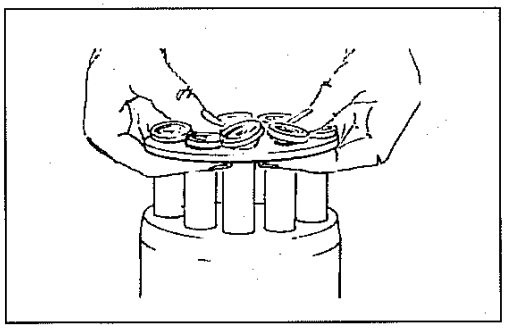
Assemble drive shaft with bearings and radial seal rings.



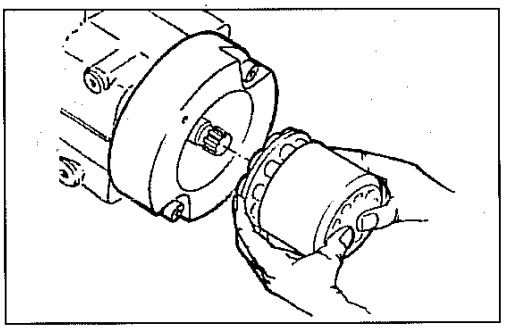
Installation of the rotary group



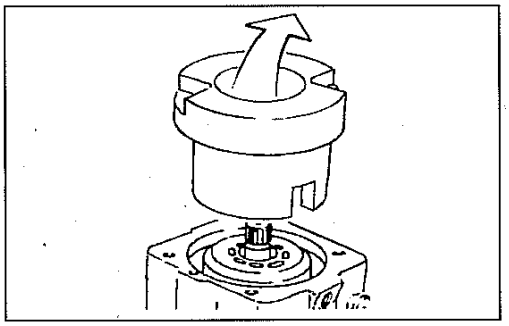
Disc 1, 2



Assemble piston with retaining plate.
Note :
Oil piston and piston pad.

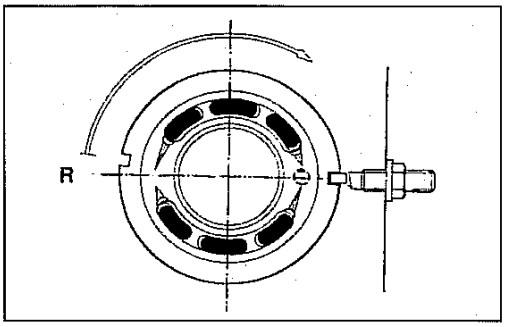


Assemble cylinder completely.

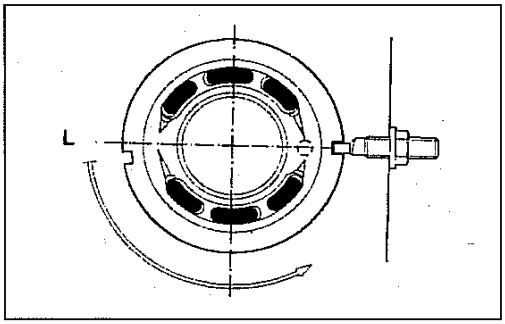


Remove assembly device.

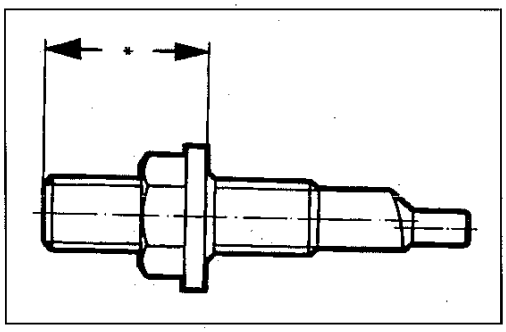
Assembly of the pump



Control plate clockwise rotation - indexed in the direction of rotation.
Note !
Noise grooves are machined - in based on direction of rotation.

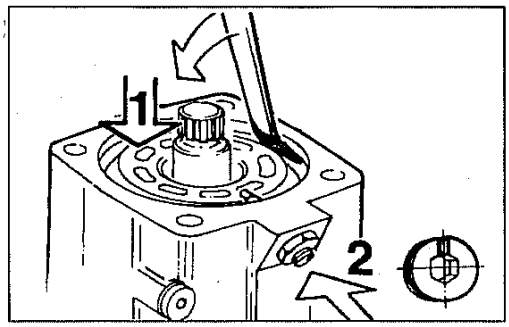


Control plate counter clockwise rotation - indexed in the direction of rotation.
Note !
Noise grooves are machined - in based on direction of rotation.

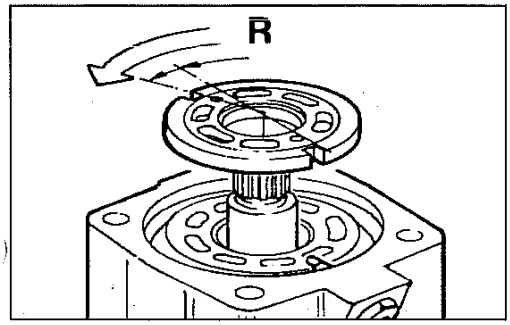


Basic setting - indexing screw
A4VG... 71 * = 28 ± 0,75 mm.
A4VG... 125 * = 20 ± 0,75 mm.

A4VG... 90 * = 29 ± 0,75 mm.
A4VG... 180 * = 22 ± 0,75 mm.

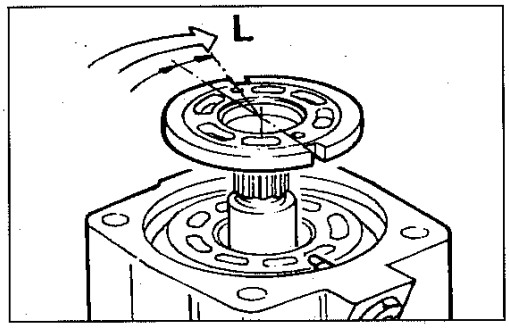


Insert the control plate - clockwise rotation.

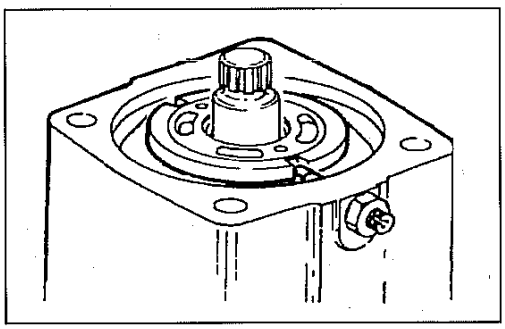


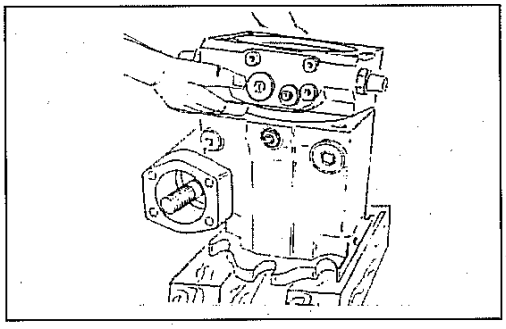
Press the cylinder to the bottom (1)
Screw in the indexing screw (2).
Groove in mounting position.

Assembly of the pump

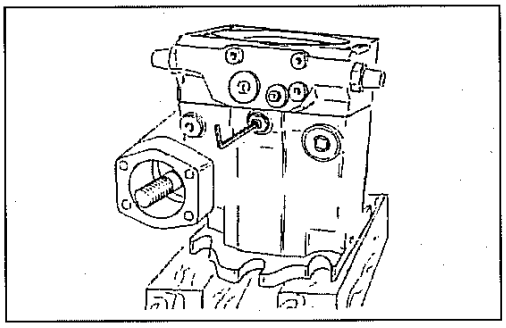


Insert the control plate - counter - clockwise rotation.

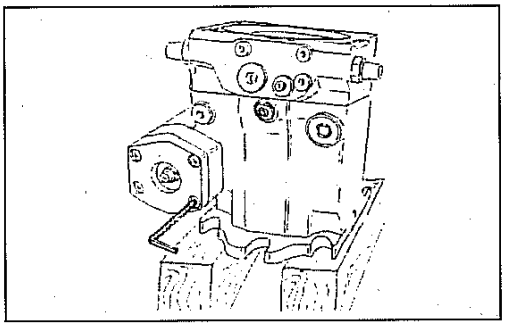




Assemble connection plate.
Attention ! Spring preloaded !
Insert control plate into housing, guidance with two locking screws crossing over - Finish assembly !

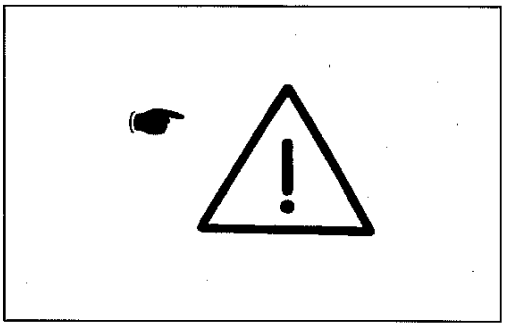


Locking screw - Observe adjusting measure.

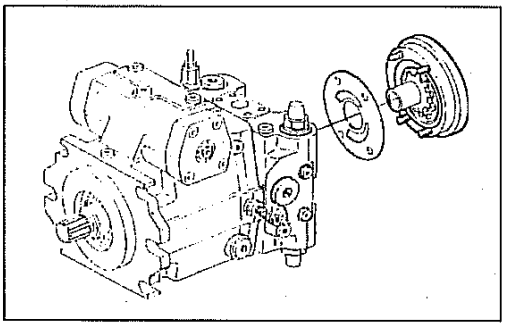


1. Assemble cover.
2. Adjust zero position according to measure.

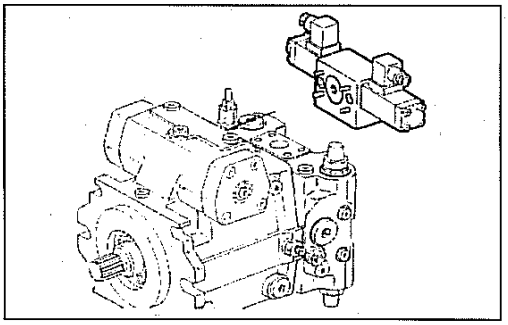
Assembly of the pump



Attention !
Adjustments of the correct zero position to be carried out after installation into the machine or on the bench test.



Assemble auxiliary pump.
Note : Take care of direction of rotation.



Assemble control device.

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO- standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	0,8	1,2	1,4
M 4	2,1	3,0	3,6
M 5	4,4	6,3	7,4
M 6	7,4	10,3	12,5
M 8	18,4	25,8	30,2
M10	36,1	50,9	61,2
M12	63,4	88,4	106,9
M14	99,5	140,0	169,5
M16	154,8	217,4	261,6
M18	213,7	298,5	357,4
M 20	302,2	427,5	508,5
M 22	405,4	574,9	685,4
M 24	523,5	737,0	884,4
M 27	773,9	1105,5	1326,6
M 30	1068,7	1474,0	1768,8

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation		Tightening torques (lb.ft)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 4
M 10 x 1	VSTI 10 x1	-ED	= 7
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 15
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 22
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 22
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 29
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 37
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 44
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 51
M 27 x 2	VSTI 27 x 2	-ED	= 66
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 74
M 33 x 2	VSTI 33 x 2	-ED/SA	= 88
M 42 x 2	VSTI 42 x 2	-ED/SA	= 147
M 48 x 2	VSTI 48 x 2	-ED	= 220

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torque (lb.ft)		
M 6	7,4		
M 8	16,2		
M 10	29,5		
M 12	50,9		
M 14	81,1		
M 16	125,3		

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO- Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torques (lb.ft)		
M 3	0,8		
M 4	2,1		
M 5	4,4		
M 6	7,4		
M 8	18,4		
M10	36,1		

General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if your are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

Please observe the guidelines of the Professional Association and the machine manufacturer.

Before starting

- Observe the operating instructions before starting.
- Check the machine for obvious faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.
- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering the driver's cabin, check if persons or obstacles are beside or beneath the machine.
- Be careful when entering the driver's cabin, use stairs and handles.
- Adjust your seat before starting.

Start

- When starting all operating levers must be in "neutral position".
- Only start the machine from the driver's seat.
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus. Always connect negative (-) cable last and disconnect negative cable first.

Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms !

Hydraulic equipement

1. Hydraulic equipment is standing under high pressure.
   ⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.
   Therefore immediately consult a doctor as otherwise heavy infections can be caused.
2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the machine.
4. When working at the hydraulic equipment, absolutely stop motor and secure tractor against rolling away (parking brake, shim) !
5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. In case of exchanging the ports, the functions are vice versa (f. ex. lift-up/lower) - danger of accidents !
7. Check hydraulic flexible hoses regularly and replace them in case of dammage or wear ! The new hose pipes must comply with the technical requirements of the machine manufacturer !

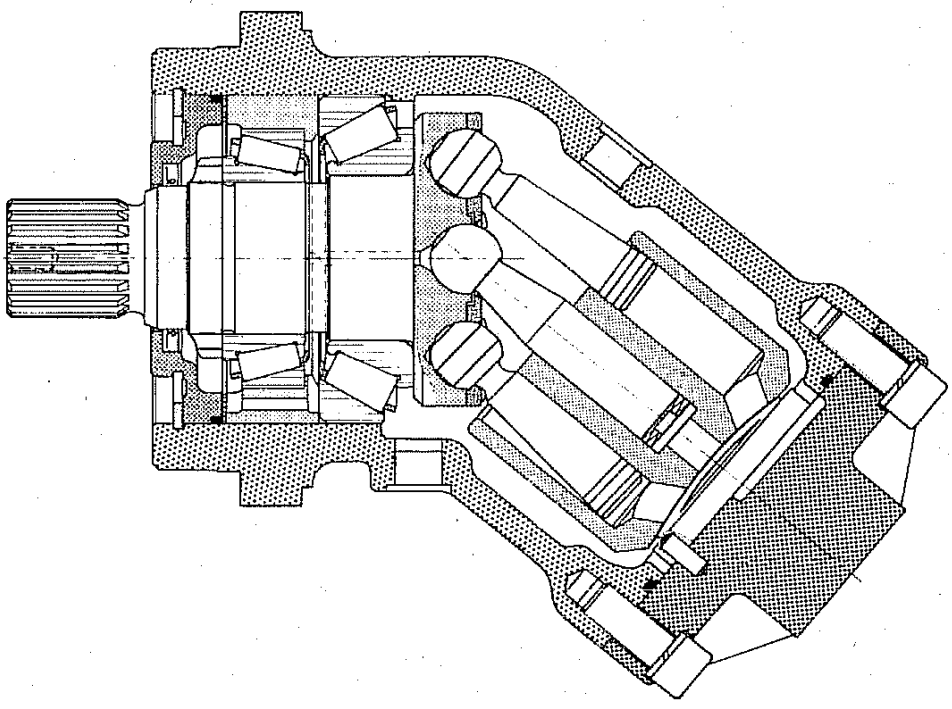
⚠ Orderly disposal or recycling of oil, fuel and filters !

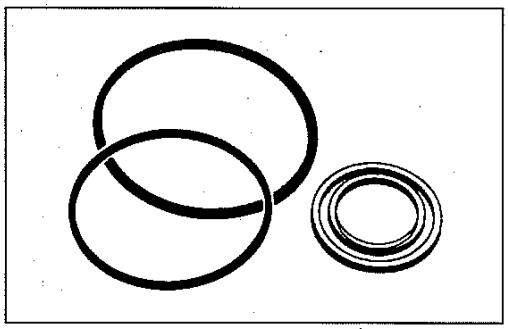
HYDROSTATIC MOTOR DISASSEMBLY
A 2 FE
75-3-25 EN

09 / 06 / 2000

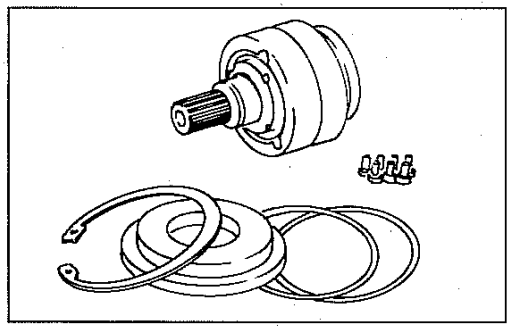
REPAIRS

MOTOR A2FE

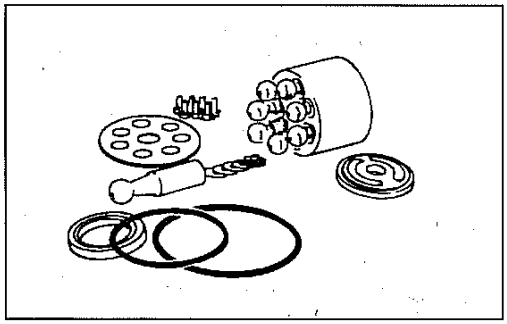




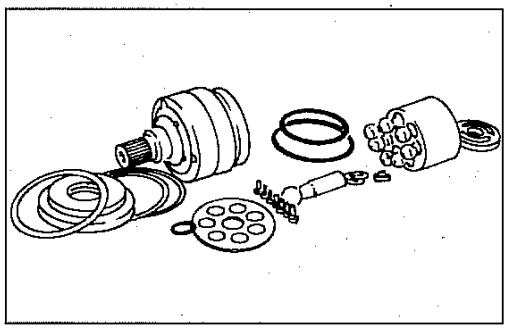
01 Outer seals.



02 Rotor, mechanical parts with seal kit.

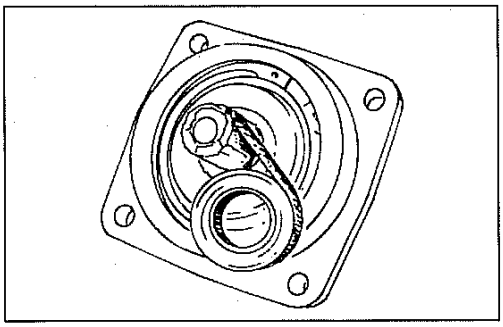


03 Rotor, hydraulic parts with seal kit.

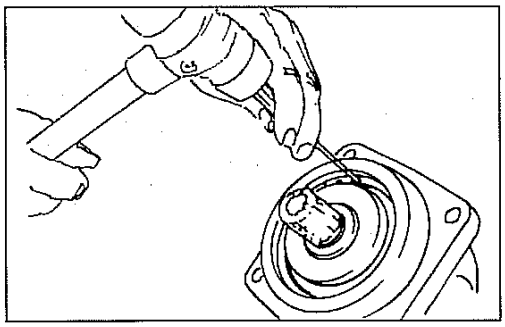


04 Complete rotor with seal kit.

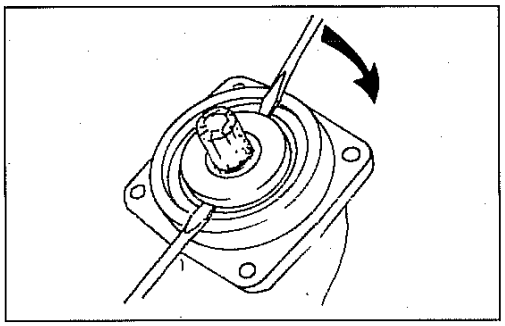
PAGES



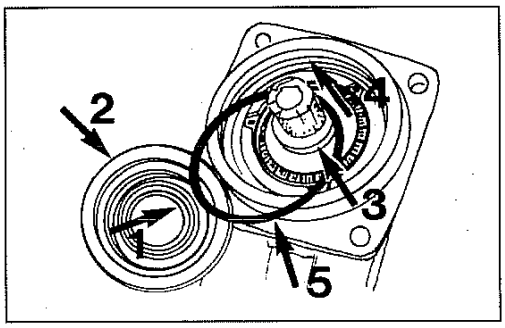
1 Remove the protective cover.



2 Remove the circlip.

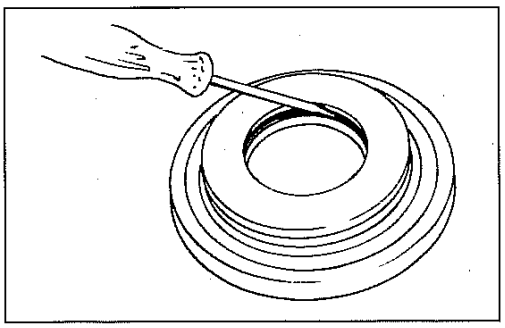


3 Remove the front cover.

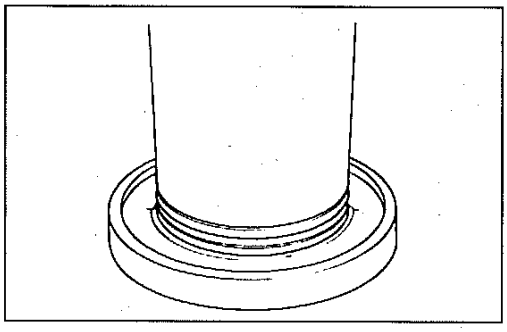


4 **CHECK PARTS :**

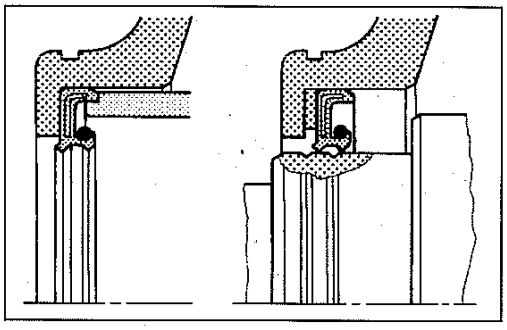
- shaft seal
- cover
- drive shaft
- housing
- "O" ring



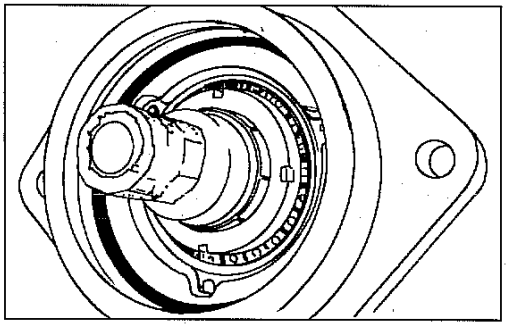
5 Remove the seal.



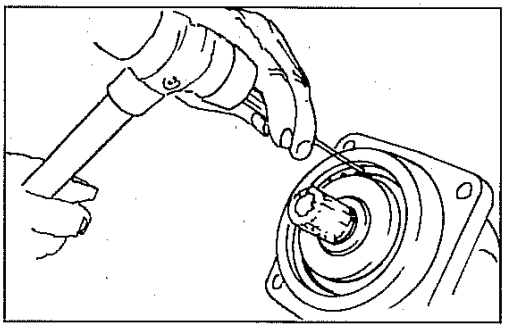
6 Position the shaft seal ring correctly with a suitable sleeve.



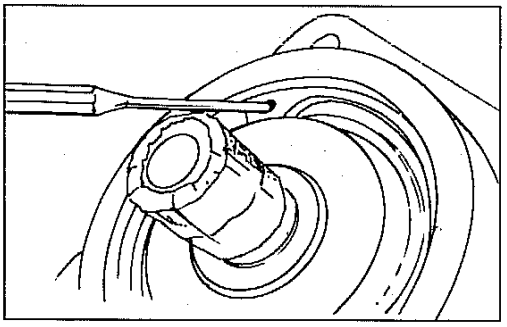
7 If the shaft is deeply grooved, insert a shim behind the seal.



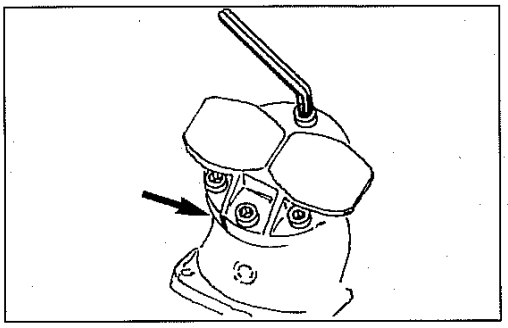
8 Fit a new "O" ring; ensure that it is correctly fitted. Grease the "O" ring and the lips of the seal.



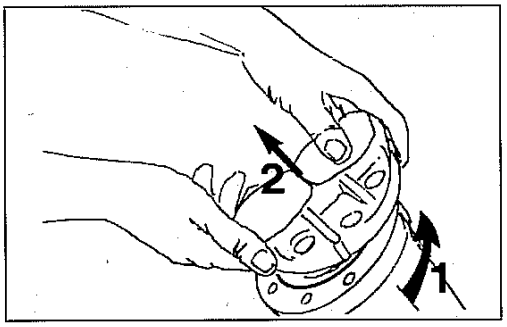
9 Fit the circlip using a punch.



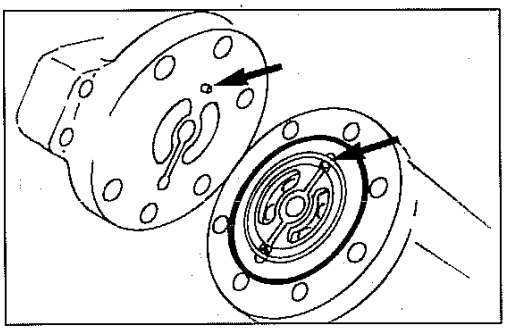
10 Check that the circlip is correctly inserted into its housing.



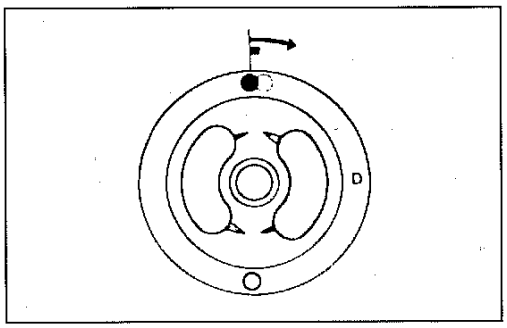
11 Mark the connection plate position on the body (see arrow).
Remove retaining screws.



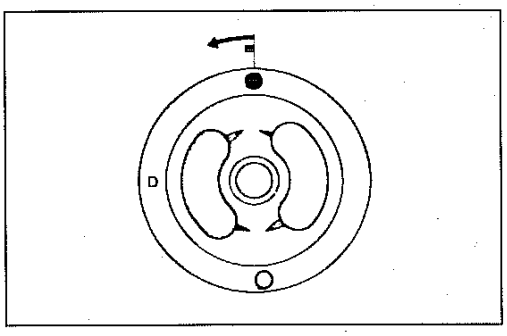
12 Pivot the connection plate around the centering pin and remove.



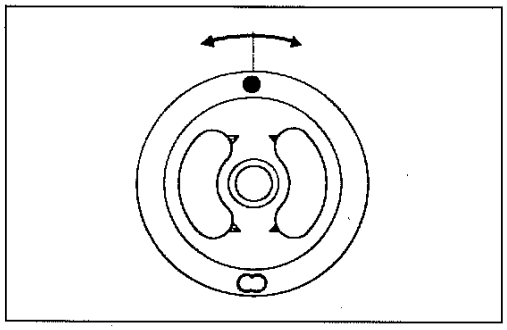
13 Identify the position of the centering pin (see arrow).



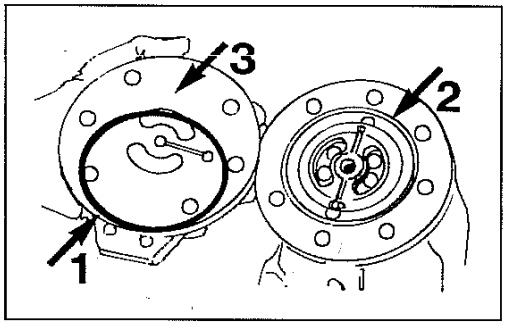
14 Pump : Right-hand rotation (View of control plate, spherical side)



15 Pump : Left-hand rotation (View of control plate, spherical side)

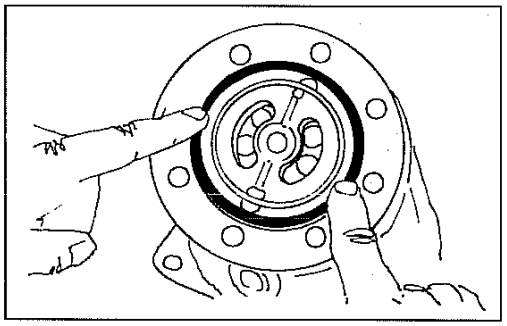


16 Motor : both directions of rotation (View of control plate, spherical side)

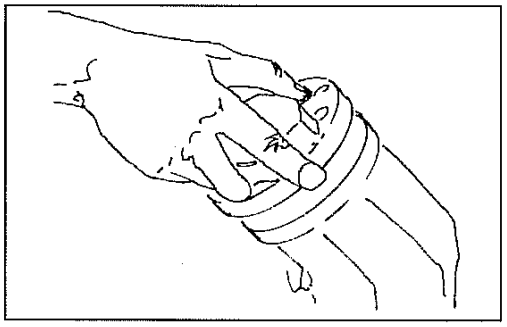


17 Check visually :

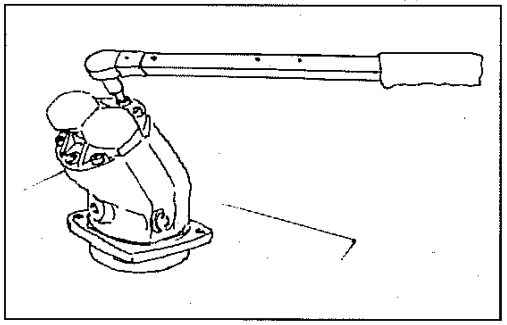
- the "O" ring (1)
- the groove (2)
- the connection plate (3).



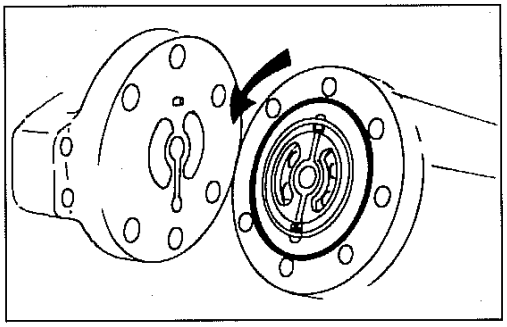
18 Lightly grease and position the seal.



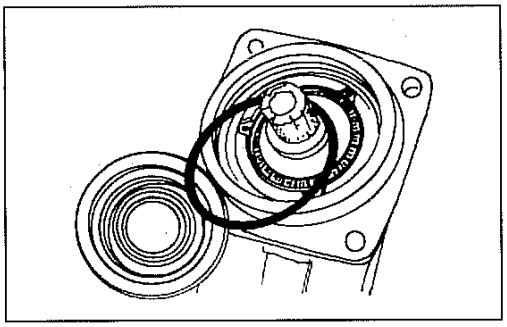
19 Refit the connection plate in its initial position (Fig. 11). Beware of the control plate position.



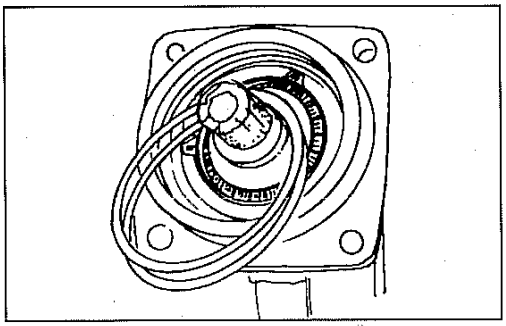
20 Refit the screws to the appropriate torque (see p. 14).



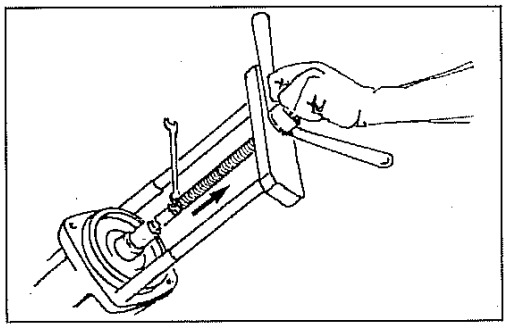
21 Remove the connection plate (page 6). Turn the check plate to remove it.



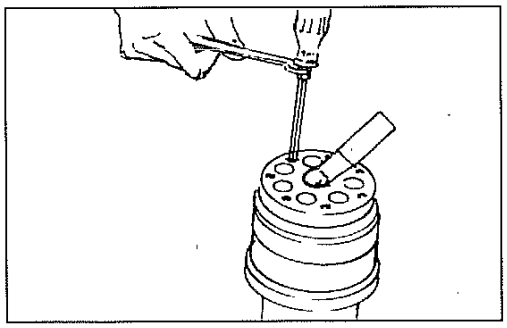
22 Remove the front plate.



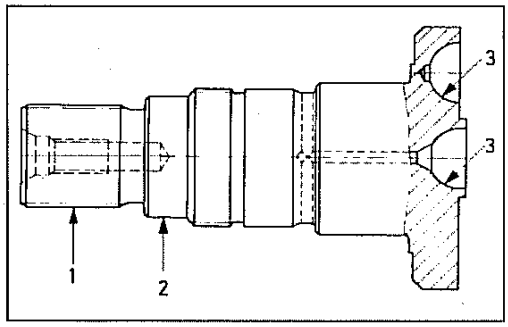
23 Remove the shims.



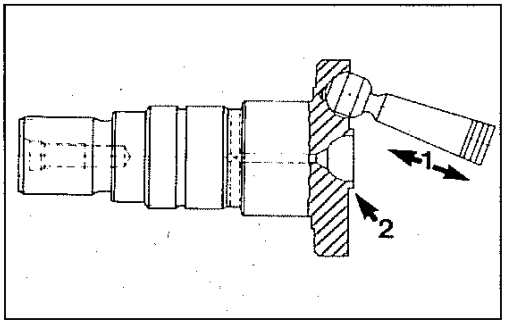
24 Remove the turning gear with an extractor.



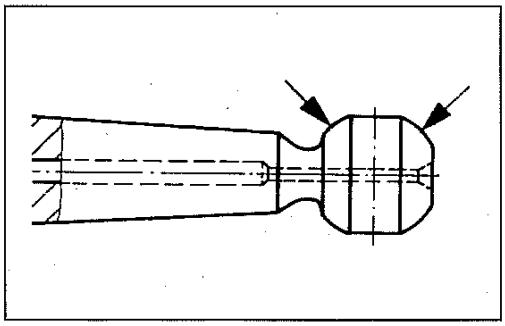
25 Remove the retainer plate; the screws are fixed with Loctite.



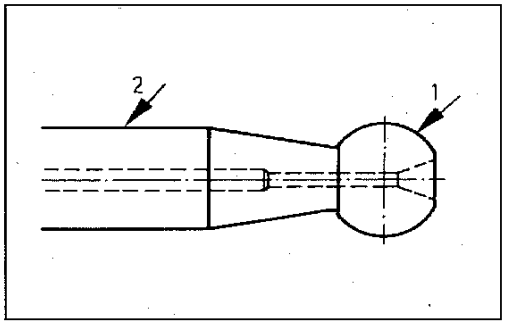
26 Drive shaft
1) Free from corrosion, erosion and spline damage.
2) No traces of wear.
3) No cuts, impact marks or pitting.



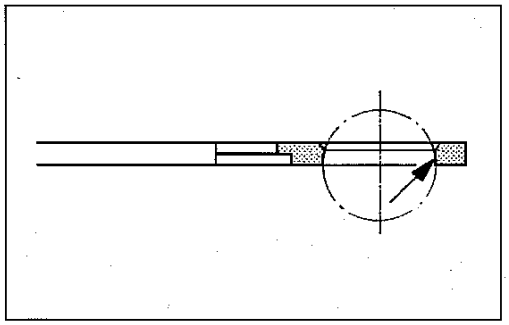
27 1) Axial play on piston
2) Shoulder



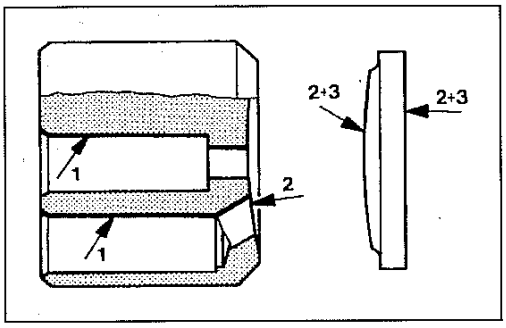
28 Piston
Free from marks, no pitting (do not disassemble the joint).



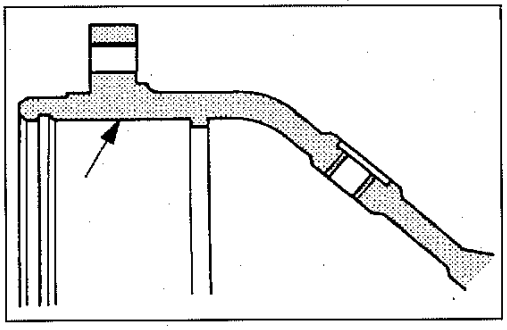
29 Centering head.
1) Free from marks, no pitting (do not disassemble the joint).
2) Free from marks.



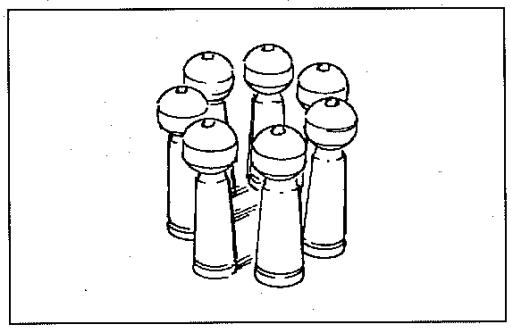
30 Retainer plate
Free from marks and signs of wear.



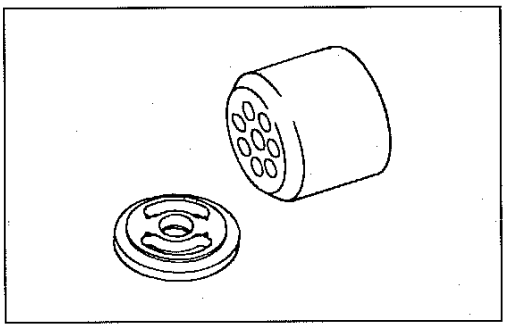
31 Cylinder block/Check plate
1) No marks or signs of wear in bore hole.
2) Faces smooth and flat, free from marks.
3) Min. hardness 700 HV 10.



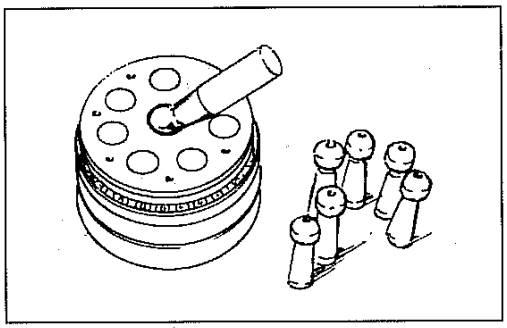
32 Housing
Free from damage and signs of wear on bearing surfaces.



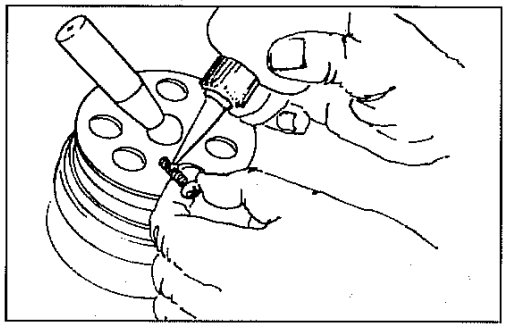
33 Change the piston assembly.
When other components require changing, recalibration is required.



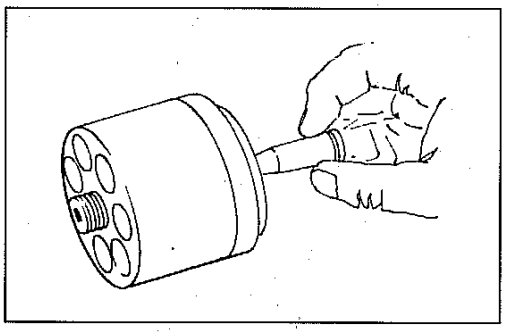
34 Cylinder block and check plate to be changed as a pair.



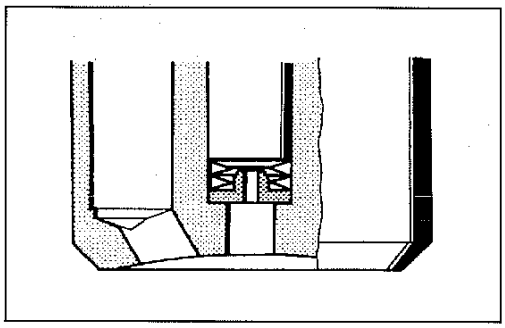
35 Insert a centering pin with a retaining ring.
Fit the retainer plate correctly.



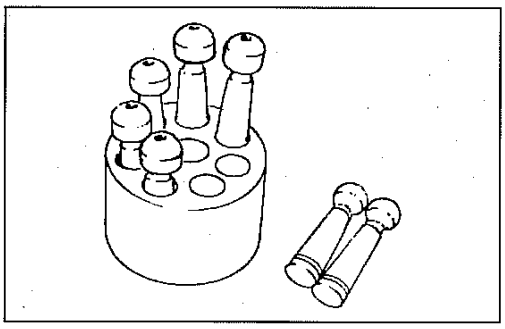
36 Apply a small amount of Loctite to the screws only.



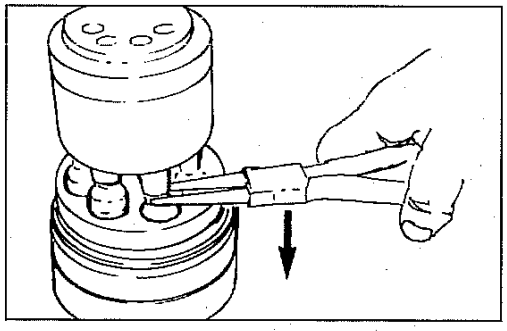
37 Assemble the shoes and the Belleville washers with grease (use a screwdriver).



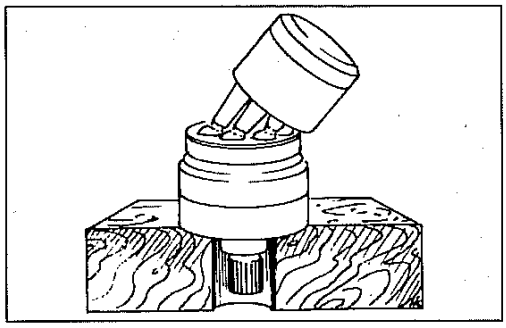
38 Ensure that all parts are correctly fitted.



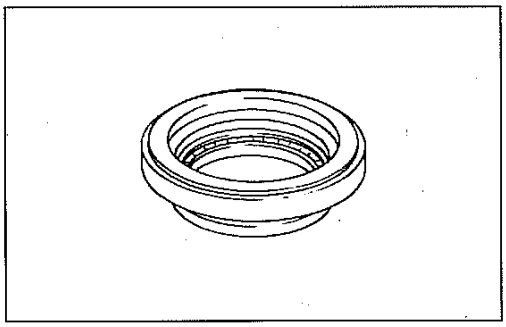
39 Fit the pistons.



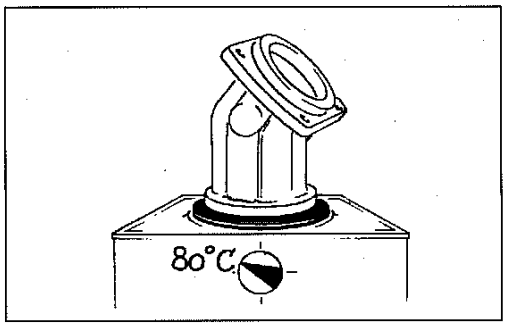
40 Press the pistons firmly into the collars with the cylinder block held centrally.



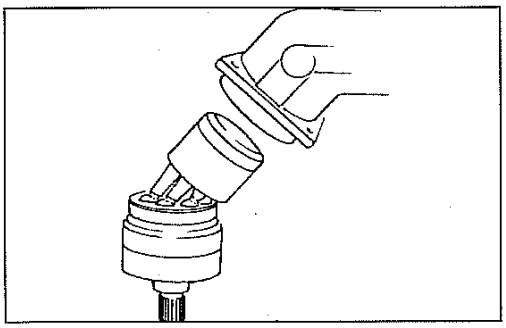
41 Rock the cylinder block to the max. position (Fig. 40)



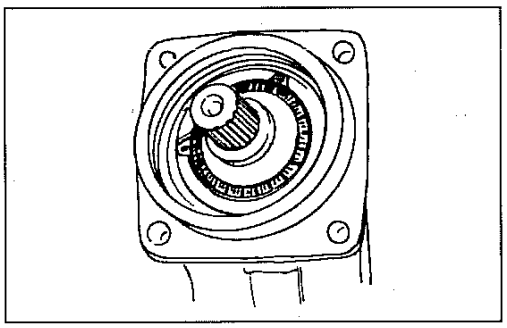
42 Is this a new seal ?
(Compare with Fig. 7)



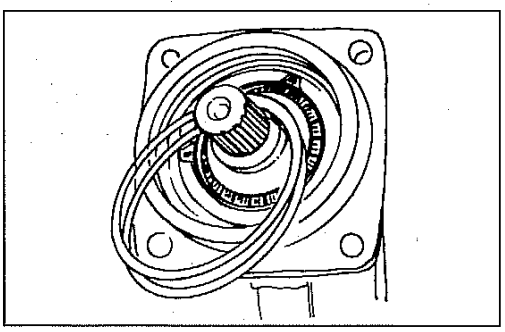
43 Heat the housing to 80°C.



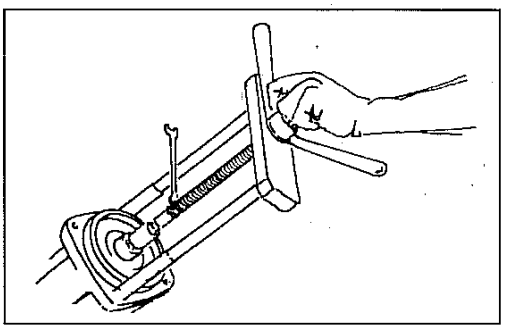
44 Fit the preheated housing.



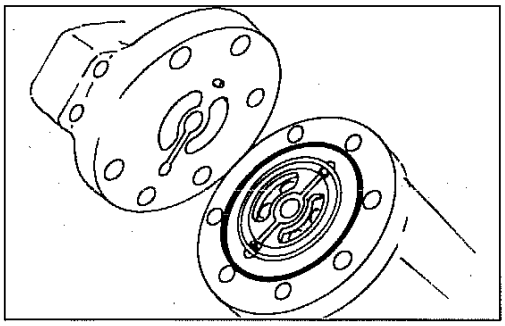
45 Reposition.



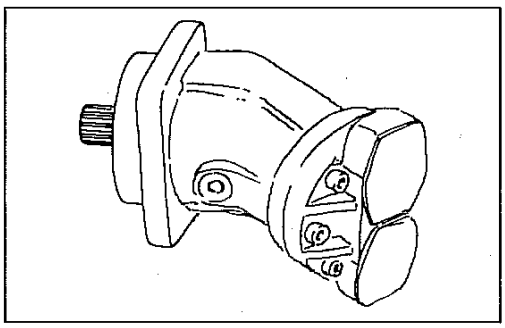
46 Fit the shims and assemble fig. 7-10.



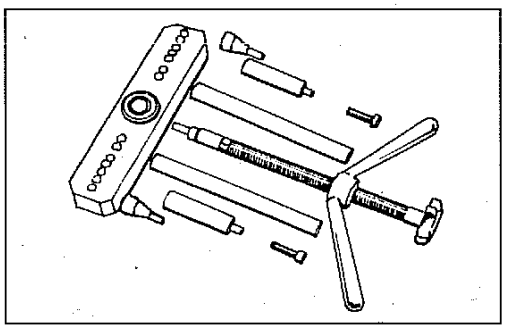
47 Push the rotor against the cover plate.
Check that the cover plate does not move.



48 Complete assembly (see Fig. 18-20).



49 Fit the plugs to protect from dust.
Corrosion protection (inside/outside).



50 Rotor extractor.

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO- standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	0,8	1,2	1,4
M 4	2,1	3,0	3,6
M 5	4,4	6,3	7,4
M 6	7,4	10,3	12,5
M 8	18,4	25,8	30,2
M10	36,1	50,9	61,2
M12	63,4	88,4	106,9
M14	99,5	140,0	169,5
M16	154,8	217,4	261,6
M18	213,7	298,5	357,4
M 20	302,2	427,5	508,5
M 22	405,4	574,9	685,4
M 24	523,5	737,0	884,4
M 27	773,9	1105,5	1326,6
M 30	1068,7	1474,0	1768,8

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation		Tightening torques (lb.ft)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 4
M 10 x 1	VSTI 10 x1	-ED	= 7
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 15
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 22
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 22
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 29
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 37
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 44
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 51
M 27 x 2	VSTI 27 x 2	-ED	= 66
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 74
M 33 x 2	VSTI 33 x 2	-ED/SA	= 88
M 42 x 2	VSTI 42 x 2	-ED/SA	= 147
M 48 x 2	VSTI 48 x 2	-ED	= 220

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torque (lb.ft)		
M 6	7,4		
M 8	16,2		
M 10	29,5		
M 12	50,9		
M 14	81,1		
M 16	125,3		

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO- Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torques (lb.ft)		
M 3	0,8		
M 4	2,1		
M 5	4,4		
M 6	7,4		
M 8	18,4		
M10	36,1		

General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if your are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

Please observe the guidelines of the Professional Association and the machine manufacturer.

Before starting

- Observe the operating instructions before starting.
- Check the machine for obvious faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.
- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering the driver's cabin, check if persons or obstacles are beside or beneath the machine.
- Be careful when entering the driver's cabin, use stairs and handles.
- Adjust your seat before starting.

Start

- When starting all operating levers must be in "neutral position".
- Only start the machine from the driver's seat.
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus. Always connect negative (-) cable last and disconnect negative cable first.

Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms !

Hydraulic equipement

1. Hydraulic equipment is standing under high pressure.
   ⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.
   Therefore immediately consult a doctor as otherwise heavy infections can be caused.
2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the machine.
4. When working at the hydraulic equipment, absolutely stop motor and secure tractor against rolling away (parking brake, shim) !
5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. In case of exchanging the ports, the functions are vice versa (f. ex. lift-up/lower) - danger of accidents !
7. Check hydraulic flexible hoses regularly and replace them in case of dammage or wear ! The new hose pipes must comply with the technical requirements of the machine manufacturer !

⚠ Orderly disposal or recycling of oil, fuel and filters !

WORKING (ADJUSTING) TRANSMISSION 75-8-M116 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

11 / 05 / 2005

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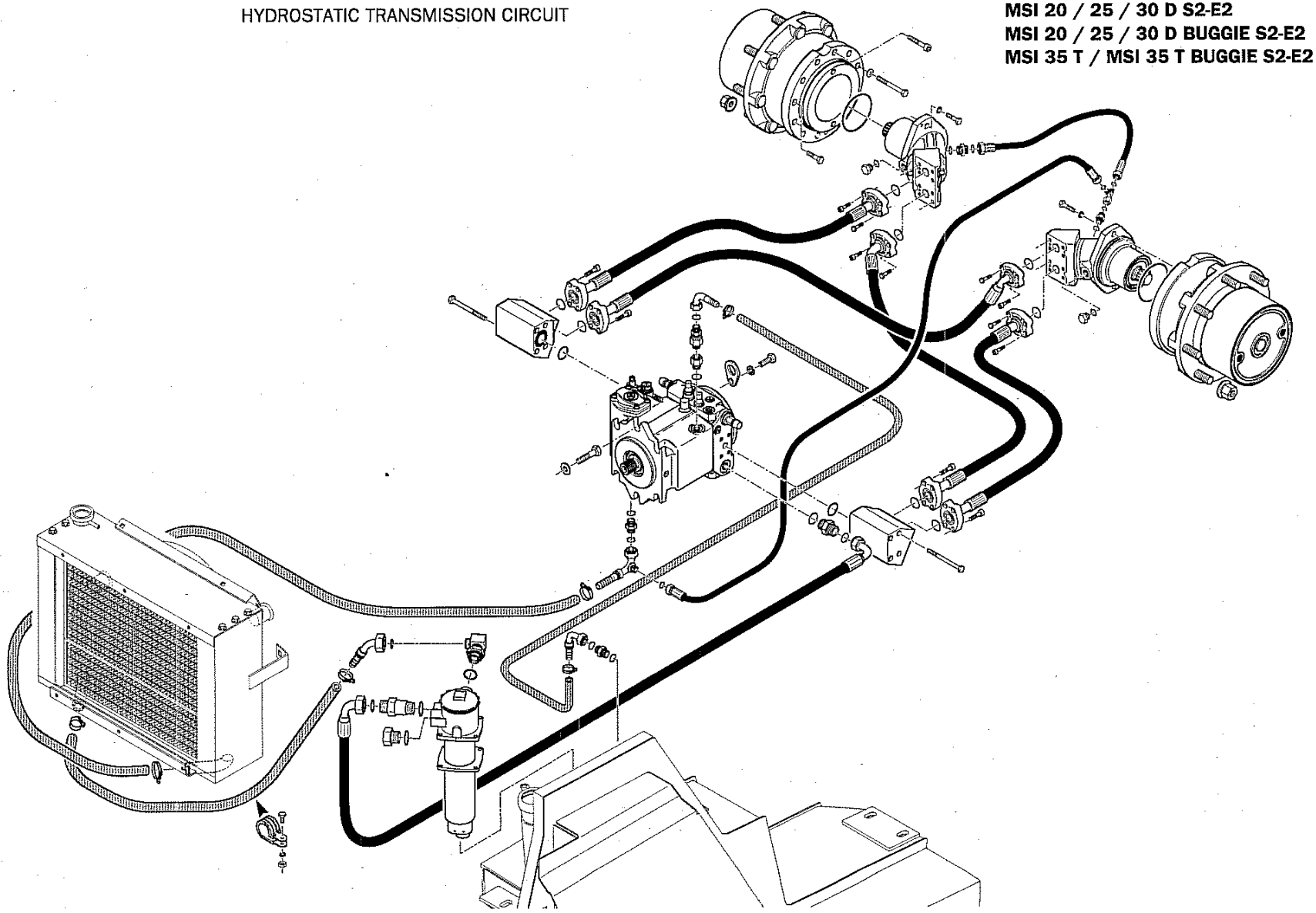
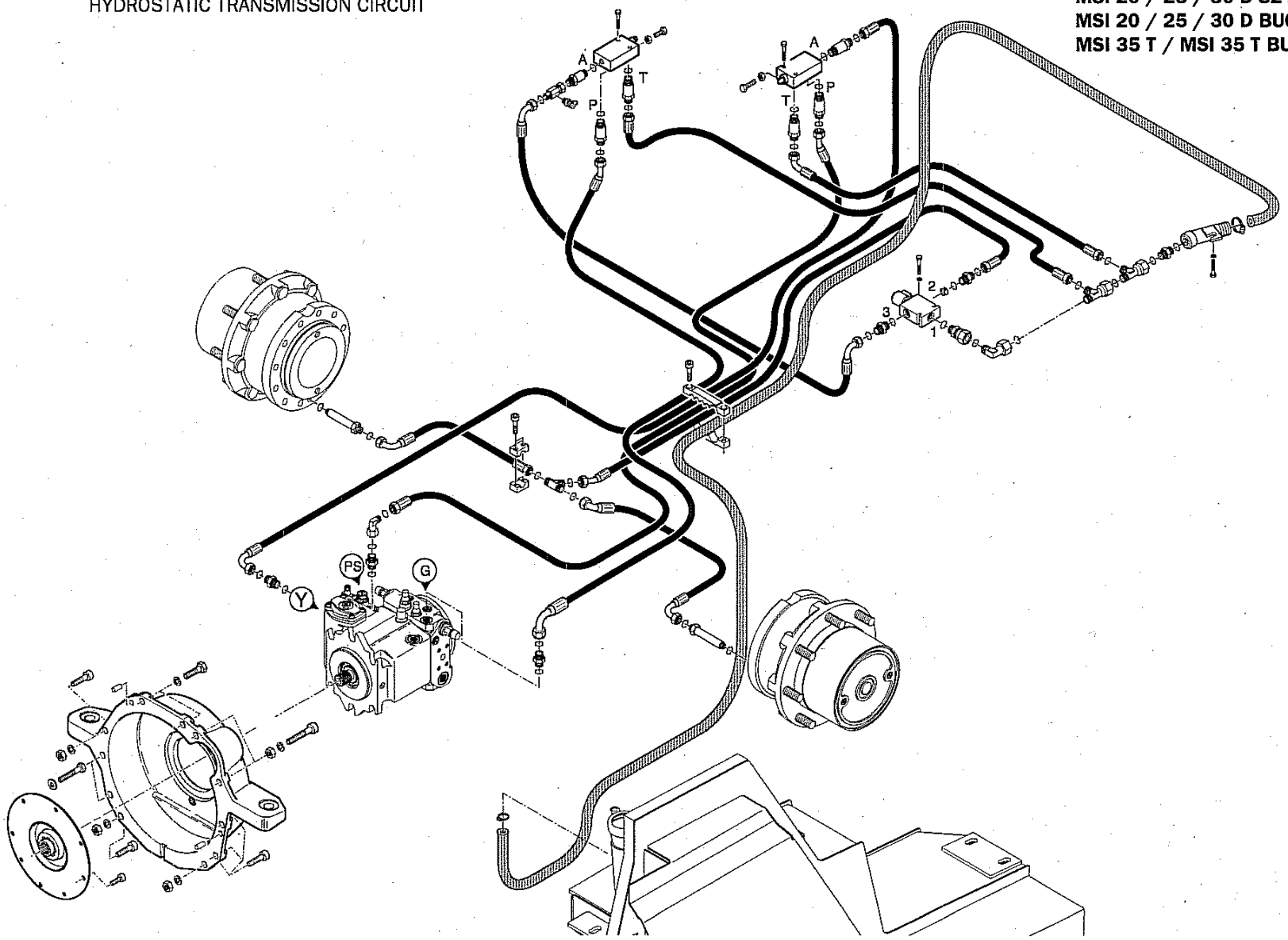
HYDROSTATIC TRANSMISSION CIRCUIT

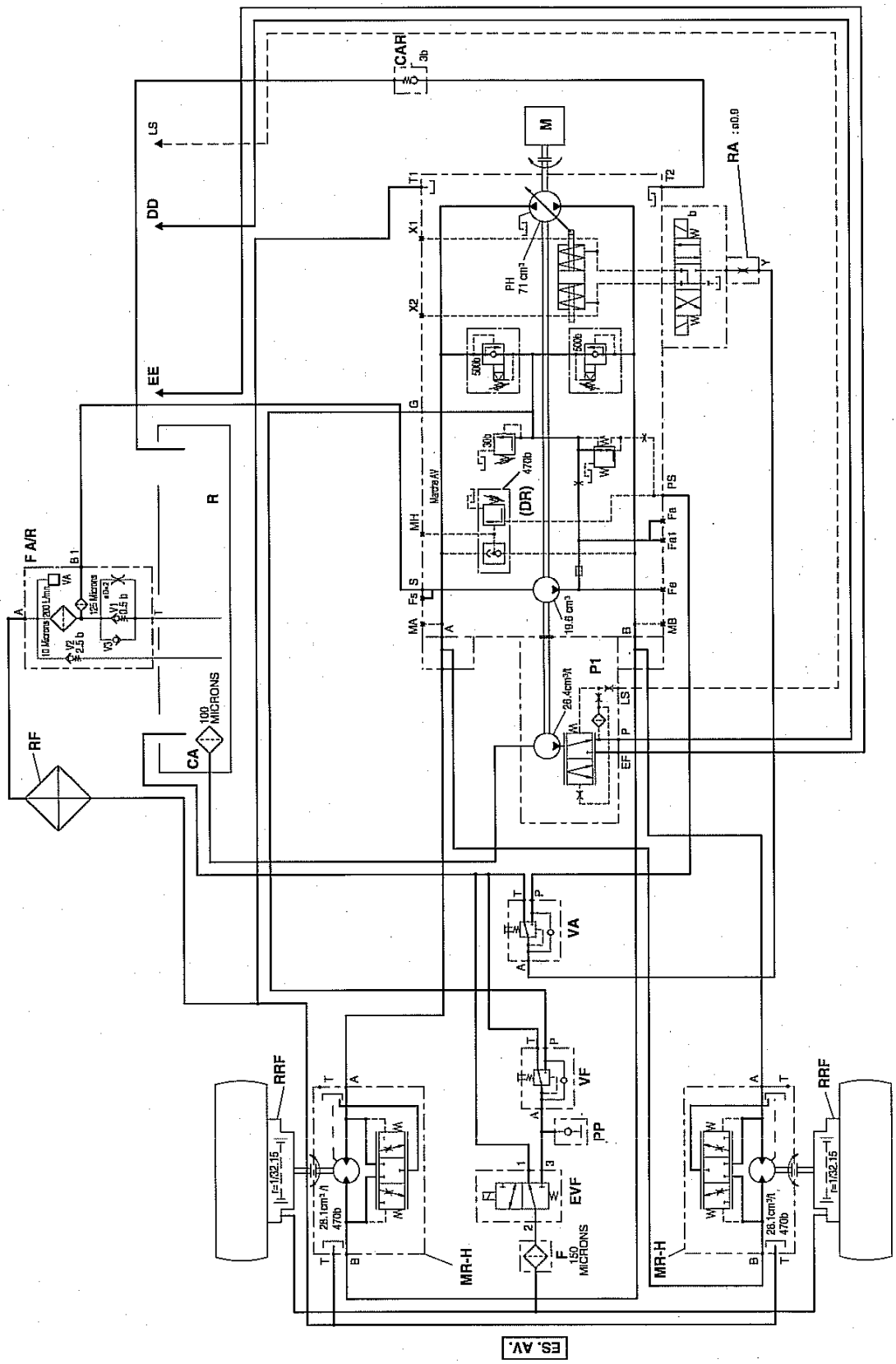
MSI 20 / 25 / 30 D S2-E2
MSI 20 / 25 / 30 D BUGGIE S2-E2
MSI 35 T / MSI 35 T BUGGIE S2-E2

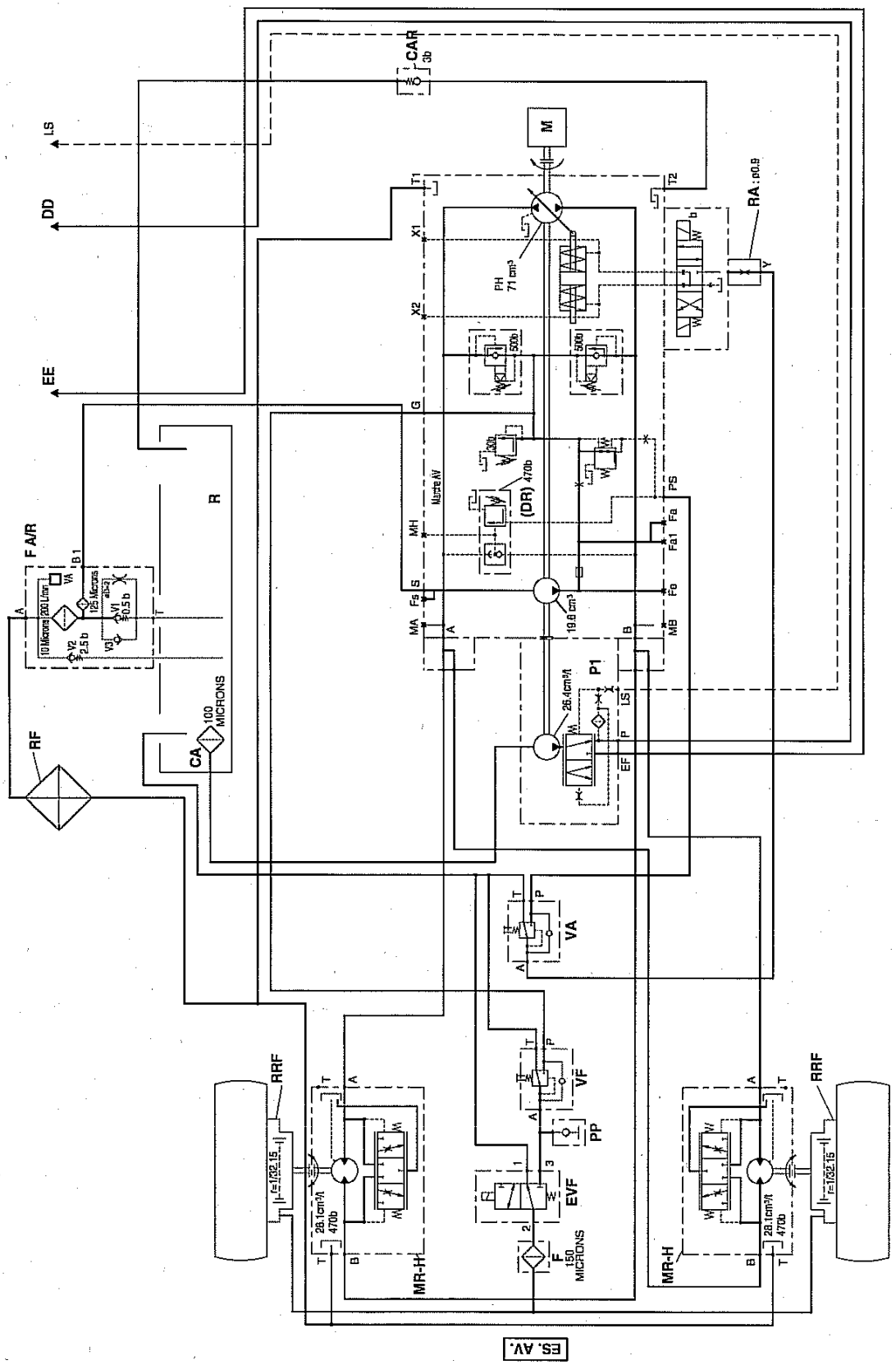


HYDROSTATIC TRANSMISSION CIRCUIT

MSI 20 / 25 / 30 D S2-E2
MSI 20 / 25 / 30 D BUGGIE S2-E2
MSI 35 T / MSI 35 T BUGGIE S2-E2

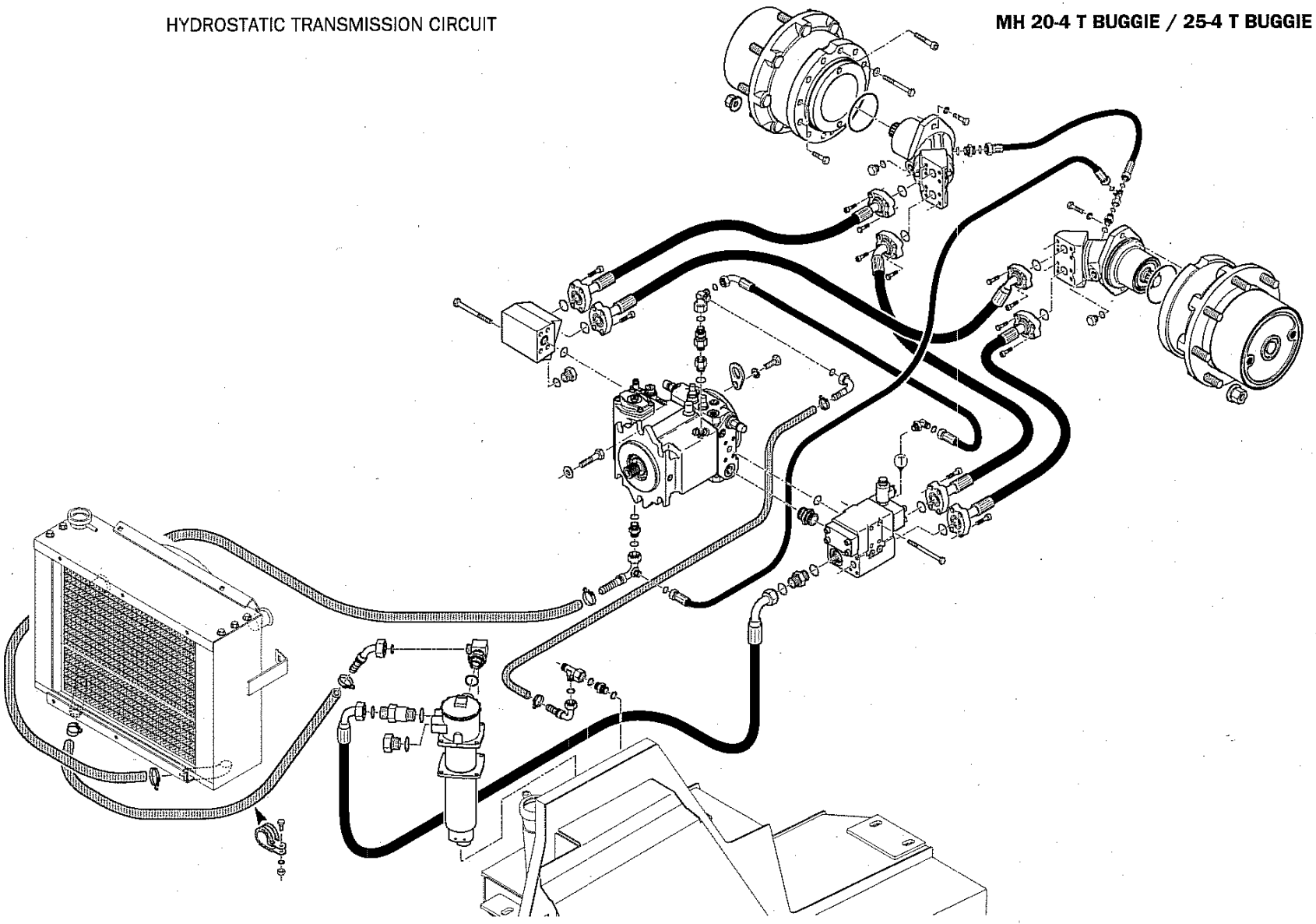


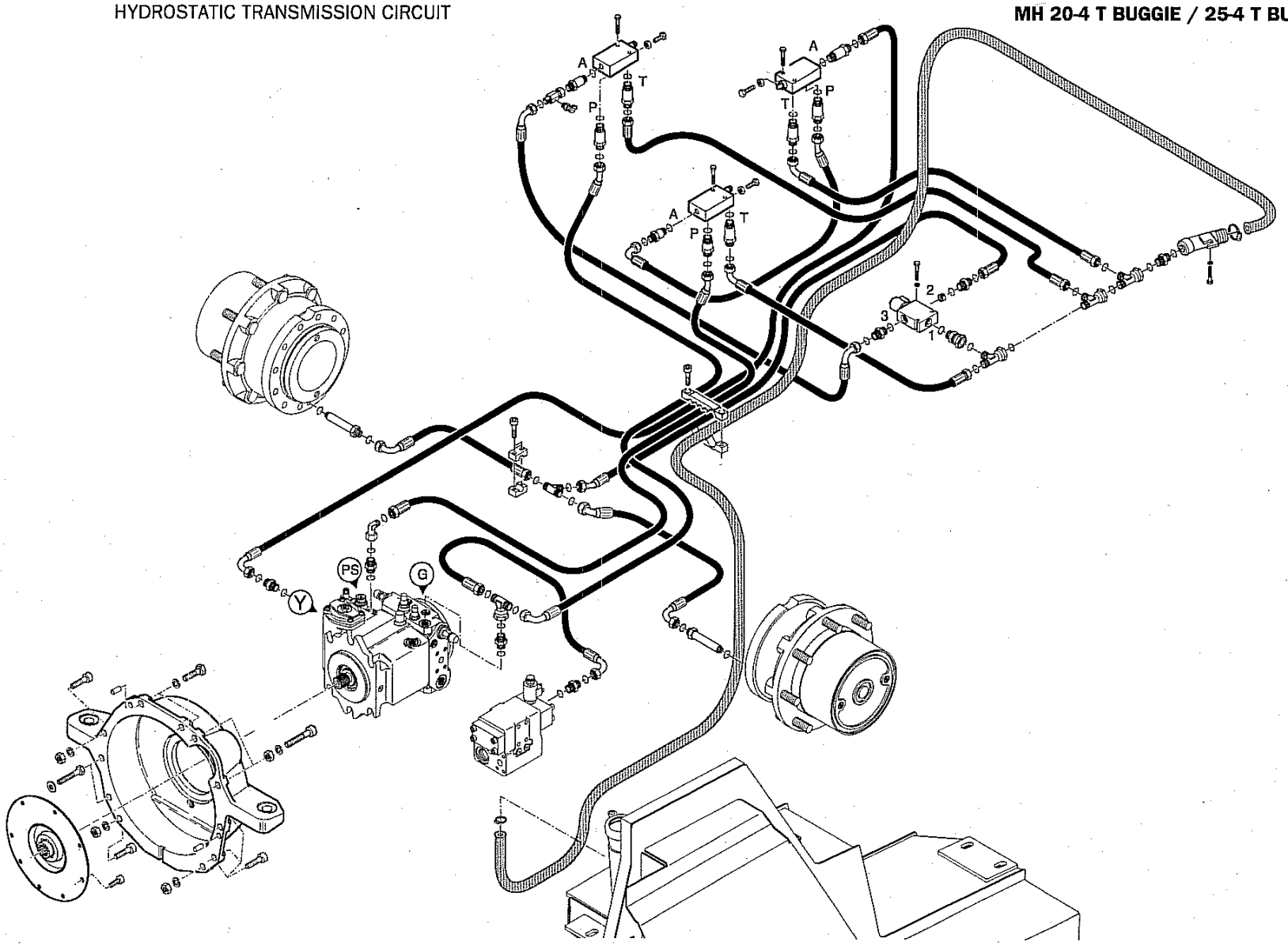

CAR
LS
DD
EE
M
RA
PH 71 cm³
X1
X2
T1
T2
G
MH
MA
MB
PS
Fa
Fa1
Fe
F5
S
(DR)
19.6 cm³
P1
28.4cm³/t
LS
P
EF
F A/R
R
RF
CA
100 MICRONS
VA
VF
PP
EVF
F
150 MICRONS
RRF
MR-H
28.1cm³/t
ES. AV.


LS
DD
EE
CAR
M
RA : ø0.9
PH 71 cm³
(DR) 470b
19.6 cm³
26.4cm³/t
P1
F A/R
R
RF
CA
100 MICRONS
VA
VF
PP
EVF
F 150 MICRONS
RRF
MR-H
MR-H
RRF
ES. AV.

HYDROSTATIC TRANSMISSION CIRCUIT

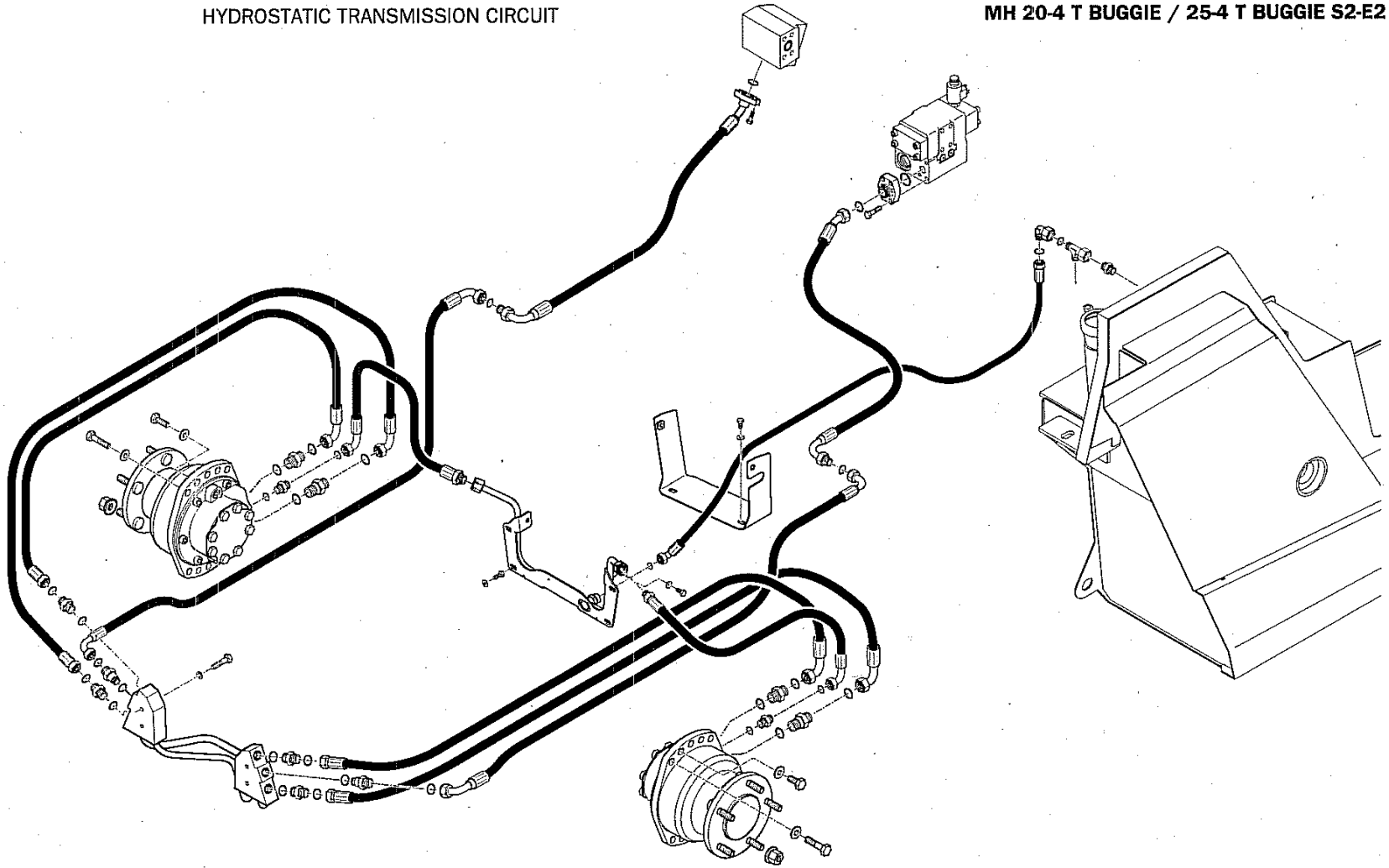
MH 20-4 T BUGGIE / 25-4 T BUGGIE S2-E2



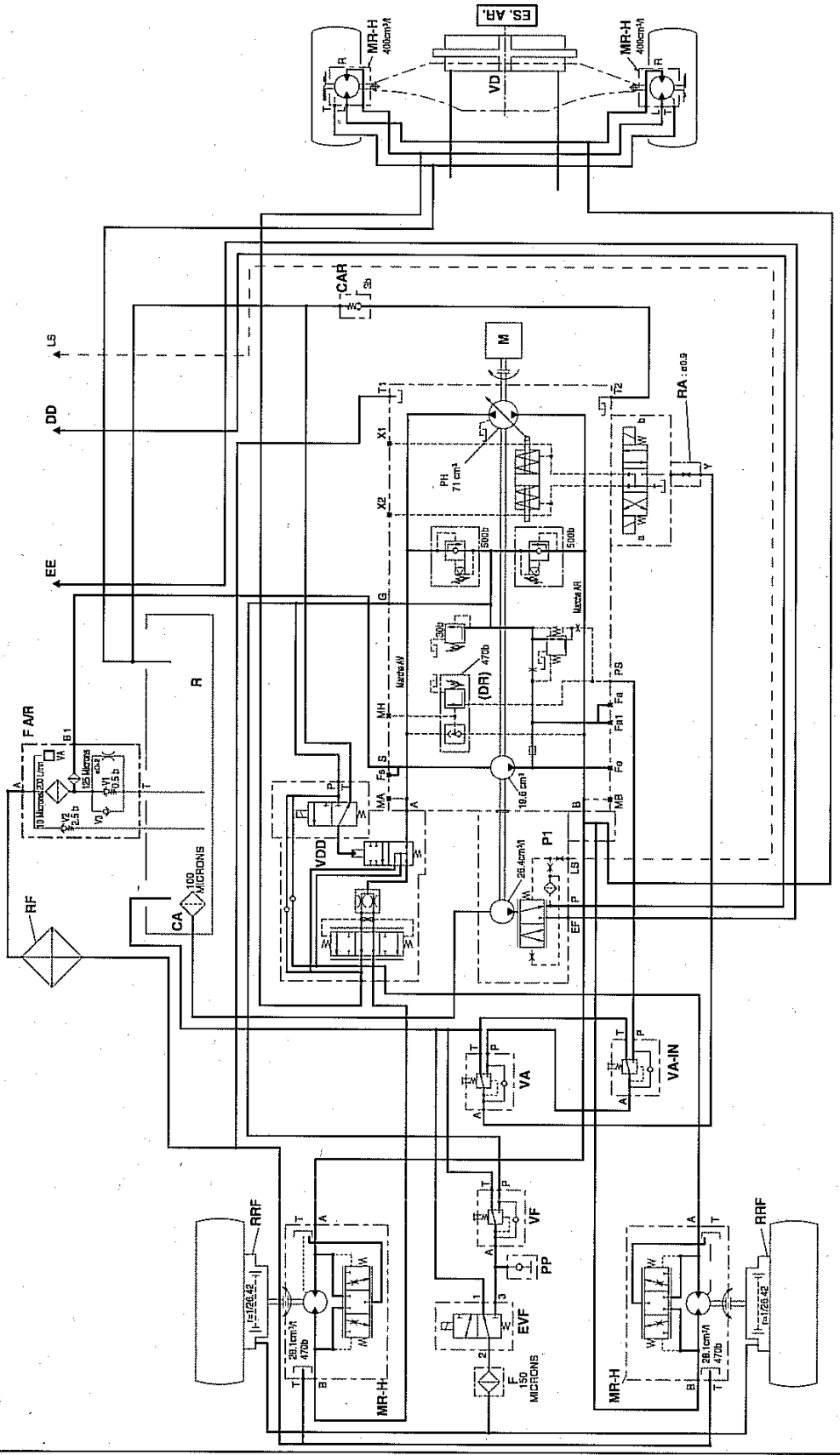

A
T
P
A
T
P
A
T
P
2
3
1
PS
G
Y

HYDROSTATIC TRANSMISSION CIRCUIT

MH 20-4 T BUGGIE / 25-4 T BUGGIE S2-E2



HYDROSTATIC DAGRAM
MH 20-4 TURBO SÉRIE 2-E2
MH 25-4 TURBO SÉRIE 2-E2



Like the A 4 V series, the pump is fitted with :
- a tachometric control device,
- a plate restoring force control device,

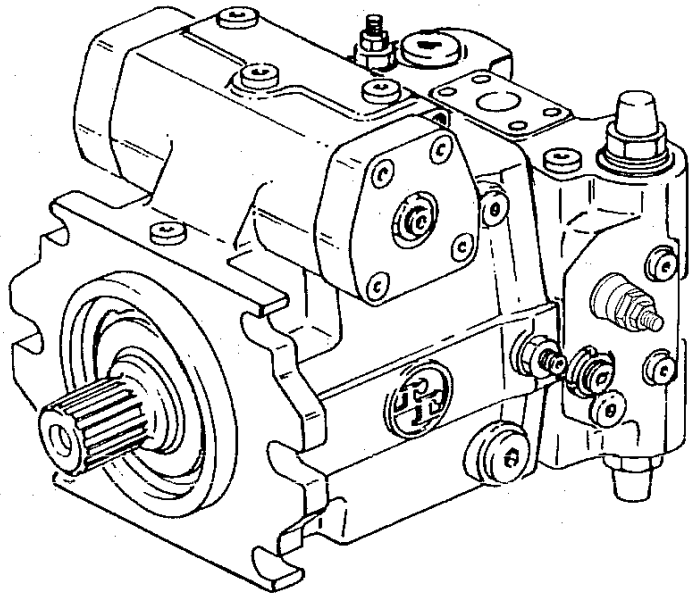
but also :
- a DR control known as a "flow cut-off valve" with pressure hold.

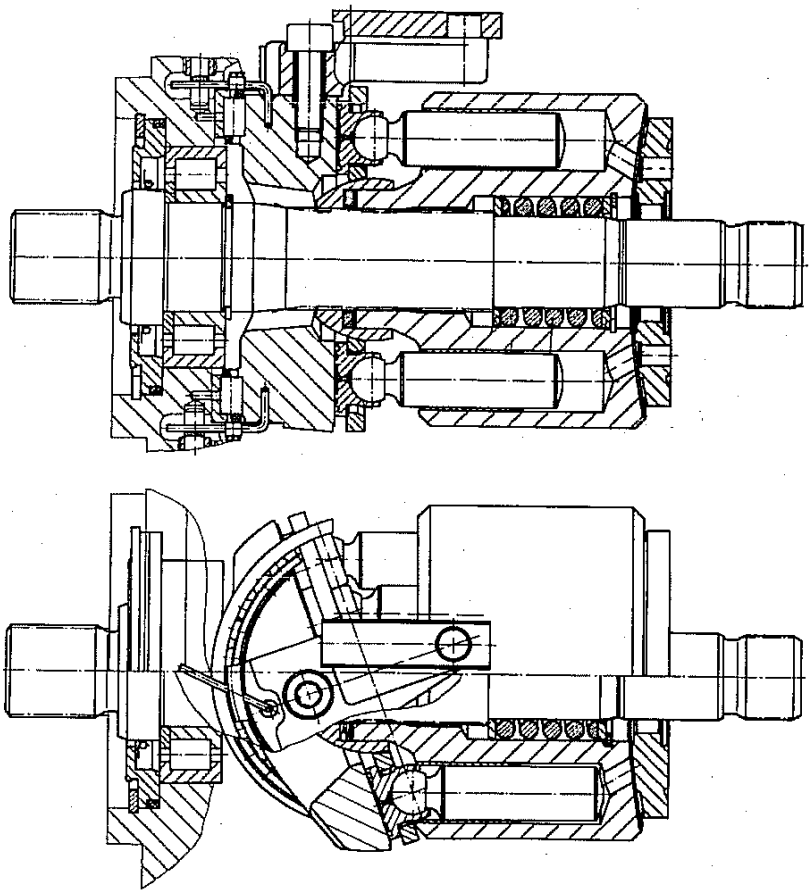
MAIN DIFFERENCES IN RELATION TO THE A 4 V SERIES

- Less space required - 50 mm shorter.
- Booster pump built into the connection plate.
- Larger control cylinder.
- Larger drive shaft to receive greater torque.
- Straight piston pump.
- Plate angle : 18°.
- Greater speed.
- Three ports on pump housing : X1 - X2, housing pressure.

MOST IMPORTANT

A locking screw for the plate oscillation bearings is fitted to the side of the pump fixing flange. Do not mistake this for the pressure connection plug.



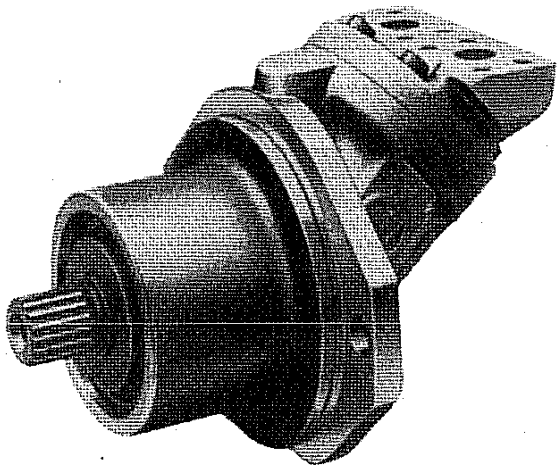


The A2FE fixed displacement plug-in motor is built according to the bent axis design with tapered axial pistons.

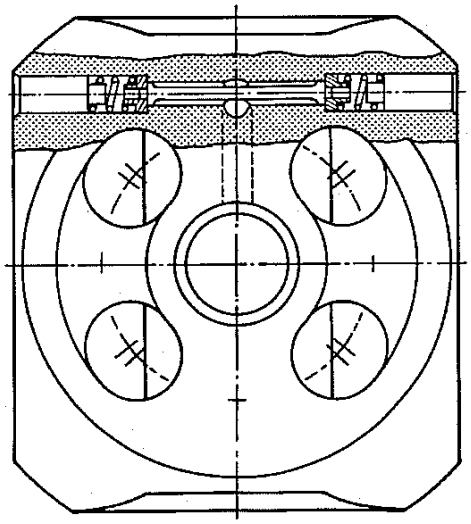
The mounting flange located towards the rear allows the motor to be "plugged in" to the mechanical gearbox to give a short, compact unit.

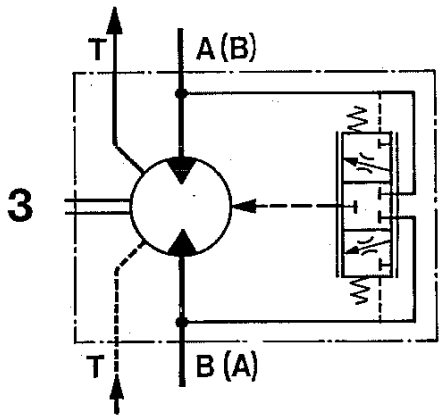
Compared with the integrated kit designs, the plug-in motor offers the following advantages :

- Complete unit, ready assembled and tested.
- Easy to fit, simply plug into the mechanical gearbox.
- No installation tolerances to consider.
- Interchangeable with the A6VE variable displacement plug-in motor.



SCAVENGING NEEDLE BUILT INTO THE CONTROL PLATE



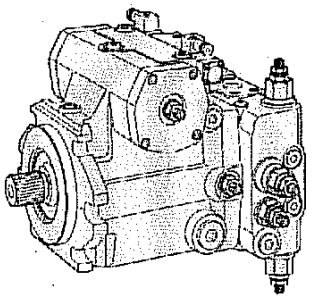


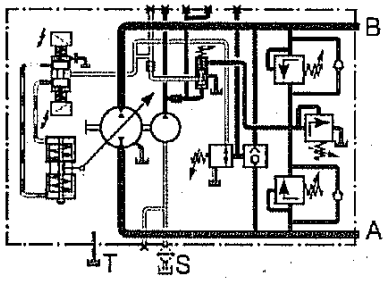
- SCAVENGING RATES :

Size	28
Scavening rates ..... (L/mn)	2.5

• ADVANTAGES OF THE SCAVENGING NEEDLE :

a) Increased bearing life.
b) Reduced oil temperature in motor housing.

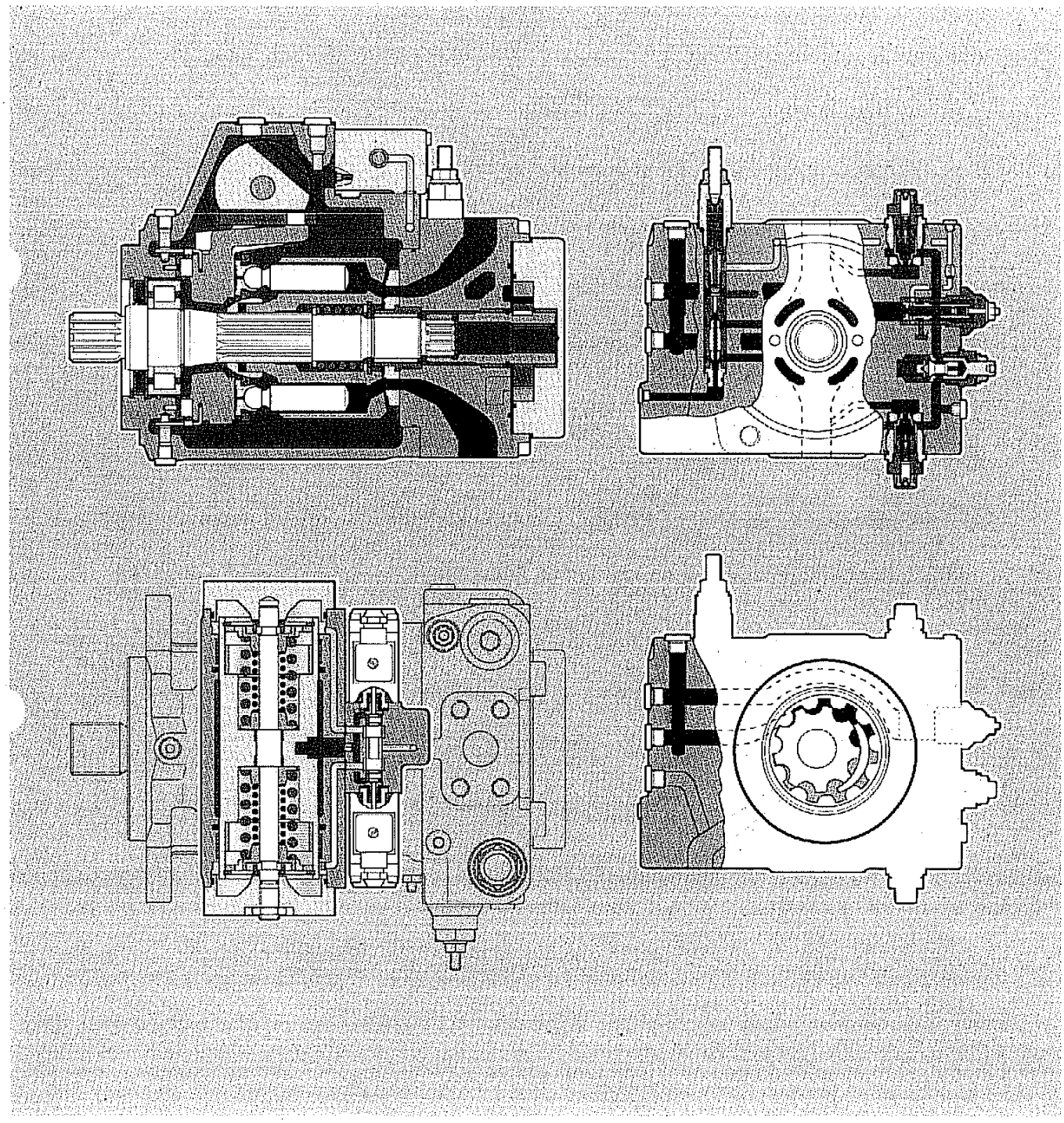




engineering
mannesmann
Rexroth

A4VG ...DAD

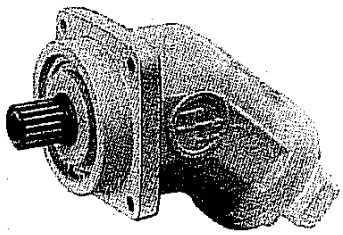
Baureihe/series 32
Verstellpumpe NG 71...180
Variable pump Size 71...180

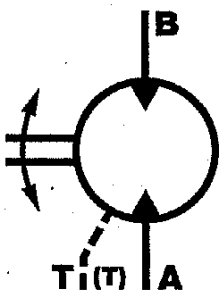


Hochdruck	Niederdruck	Saugdruck	Leckoldruck	Steuerdruck	Stelldruck
High pressure	Return line pressure	Suction pressure	Case drain pressure	Pilot pressure	Control pressure
Haute pression	Basse pression	Pression d'aspiration	Pression de drainage	Pression de pilotage	Pression de commande
Alta pressione	Bassa pressione	Pressione d'aspirazione	Pressione di trafilamento	Pressione di pilotaggio	Pressione di posizionamento
Alta presión	Baja presión	Presión de aspiración	Presión de drenaje	Presión de pilotaje	Presión de mando

Brueninghaus
Hydromatik

⚠ Vor Festlegung Ihrer Konstruktion bitte verbindliche Einbauzeichnung anfordern. - Prior to finalizing your design, please obtain a certified drawing.



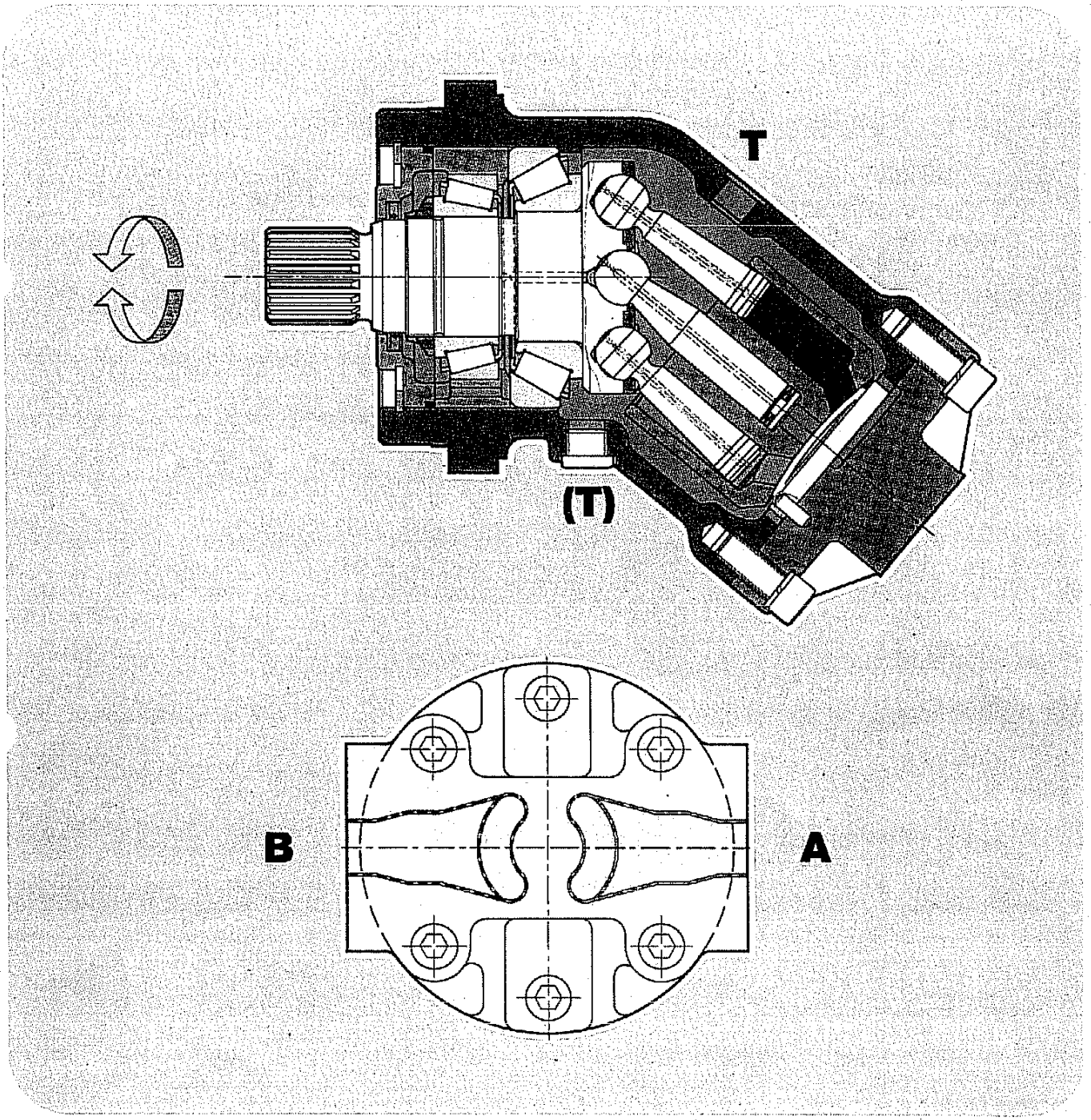


MANNESMANN REXROTH

Hydromatik
Brueninghaus Hydraulik

A2FM

Moteur à cylindrée fixe



Hochdruck High Pressure Haute pression Alta presione Alta presion	Högtryck высокое давление ciśnienie wysokie 高压 ضغط عالي	Niederdruck Return Line Pressure Basse pression Bassa pressione Baja presion	Lågtryck низкое давление ciśnienie niskie 低压 ضغط واطئ	Saugdruck Suction Pressure Pression d'aspiration Pressione d'aspirazione Presion des aspiracion	Sugtryck давление всасывания ciśnienie ssania 吸油口压力 ضغط السحب	Leckoldruck Case Drain Pressure Pression de drainage Pressione di trafilamento Presion de drenaje	Dräneringstryck давления утечки ciśnienie odprowadzania przecieków 排油口压力 ضغط الزيت المصروف	Steuerdruck Pilot Pressure Pression de pilotage Pressione di pilotaggio Presion de pilotaje	Styrtryck управляющее давление ciśnienie sterowania 控制压力 ضغط التحريك	Stelldruck Control Pressure Pression de commande Pressione di positionamento Presion de taraje	Ställtryck установочное давление ciśnienie nastawcze 调节压力 ضغط التنظيم

PILOT CIRCUIT

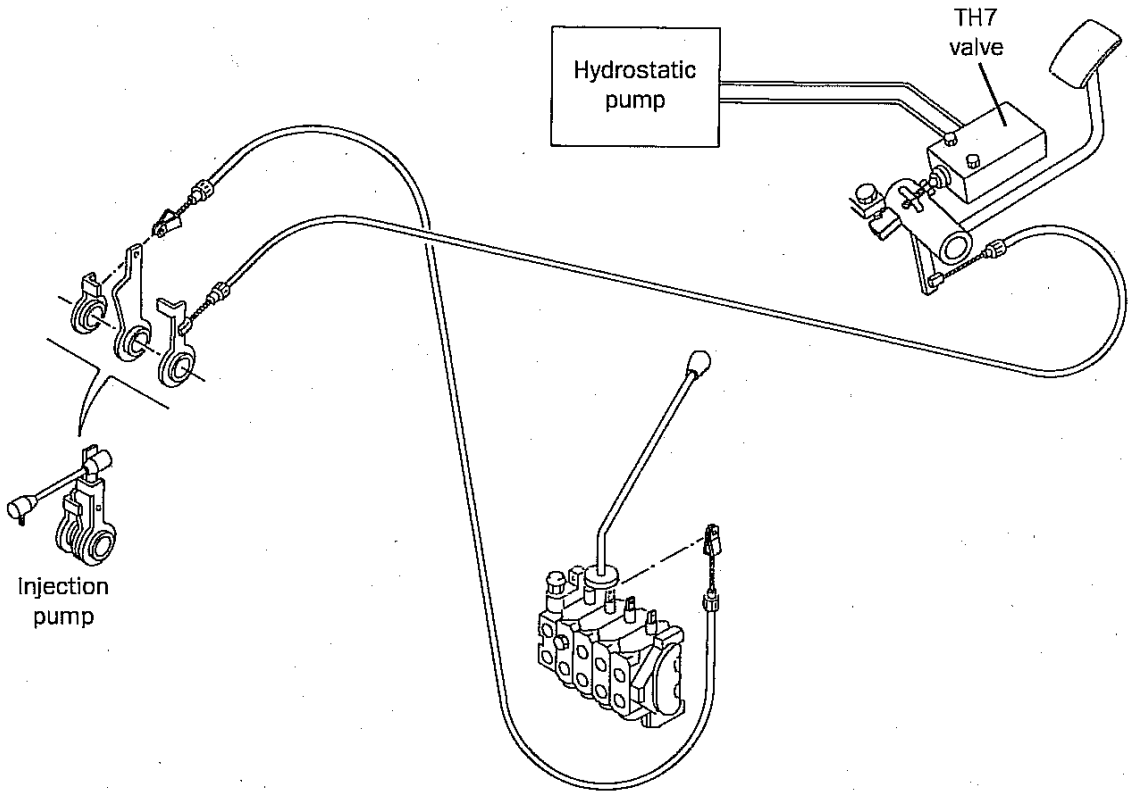
The pilot circuit is drawn from the booster circuit via the control cartridge.
On leaving the control cartridge, the control flow passes through a 1.8 to 2 mm dia. jet to feed the PS outlet at the same time as the DR valve.
The jet is located behind a plug in the pump connection plate near to the MB pressure connection port. Its role is to prevent saturation through the TH7 valve and the DR valve. If the jet is blocked, there is no pilot pressure to the circuit.

The pilot flow through the hydraulic hoses is directed towards two TH7 (accelerator * and one brake) valves, then towards the front/rear drive solenoid valve.

ROLE OF THE TH7 VALVE ON THE ACCELERATOR

The machine is fitted with an IC engine acceleration system couple with the control lever of the hydraulic valve bank used for lifting, so as to obtain a quicker lifting movement automatically when the operator pulls the lever. If, when stationary, the reversing control is left in the forward or reverse direction and if the motor is accelerated using the distributor lever (lifting) without pressing the accelerator pedal, the machine will not start.

If, during a slow approach manoeuvre, the motor is accelerated using the distributor lever whilst lifting without altering the position of the accelerator pedal, the speed of the machine will not change.



ROLE OF BRAKING TH7

The MSI 20, 25 et 30 are fitted with 2 geared motors :
- REXROTH hydrostatic motors
- BREVINI gearboxes

The oil bath multiple disc brakes (contained in the gearboxes) operate using "negative braking"; they are braked by the action of the springs and released by the application of a hydraulic pressure.

- hydrostatic braking :

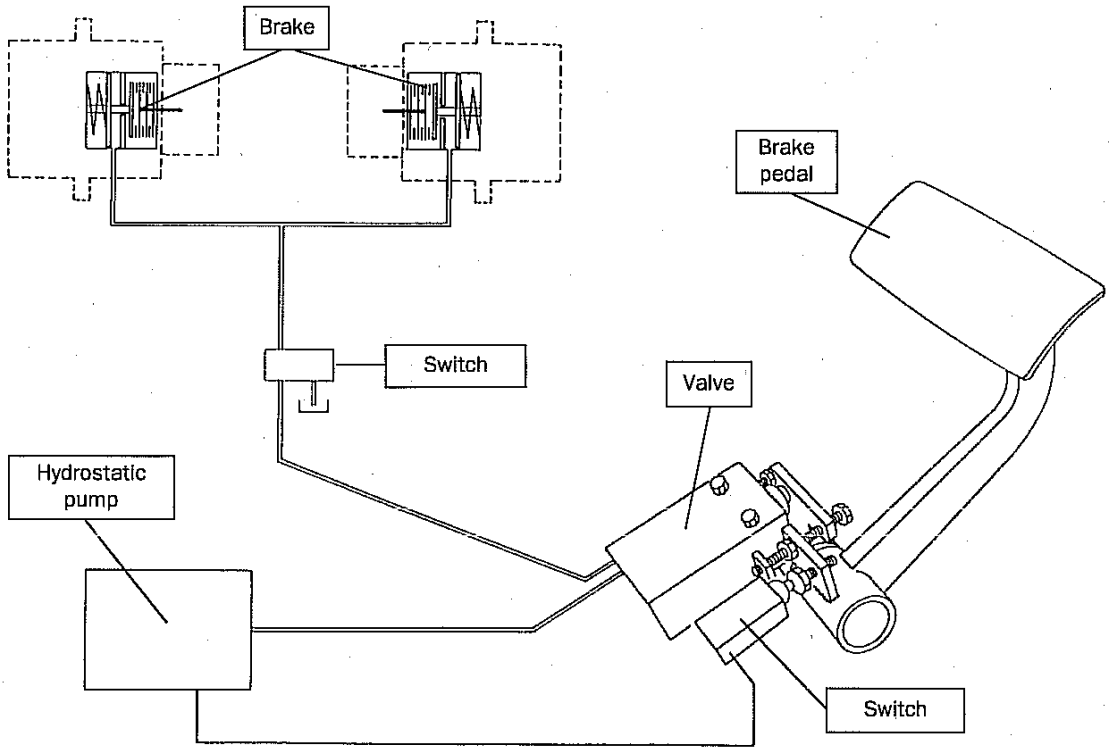
Releasing the accelerator pedal causes a reduction in transmission flow. At the same time, the control pressure is cancelled (see TH7 on accelerator) and the machine therefore decelerates.

- brake pedal :

1 - Action on the pedal
2 - For the first part of pedal travel, the transmission is cut off via a switch.
3 - Over the remaining pedal travel, there is an action on valve TH7 which progressively reduces the hydraulic pressure, thus releasing the action of the braking springs.

PARKING BRAKE

- When the motor is off, there is no pressure on the springs, giving permanent automatic braking.
- When the motor is on, a switch is used to cancel all the pressure on the braking springs (switch on the instrument panel).



ROLE OF THE TH7 VALVE (OPTION) ON THE L.H. PEDAL

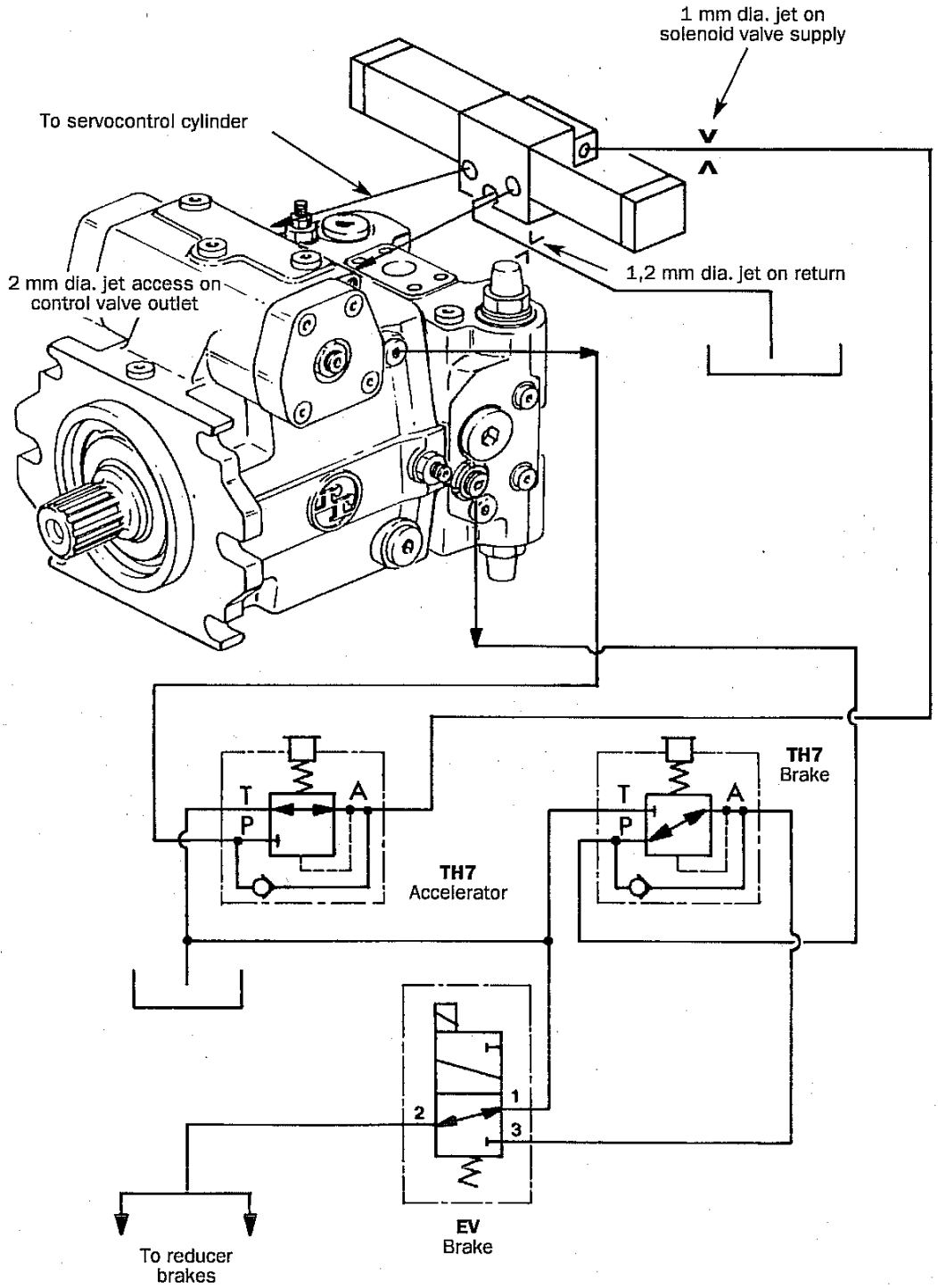
This TH7 valve also allows the operator to reduce or keep the same travel speed when approaching the loading site if he wishes to increase the IC engine to a much higher speed with the accelerator in order to achieve high lifting speed (increased delivery from main pump).

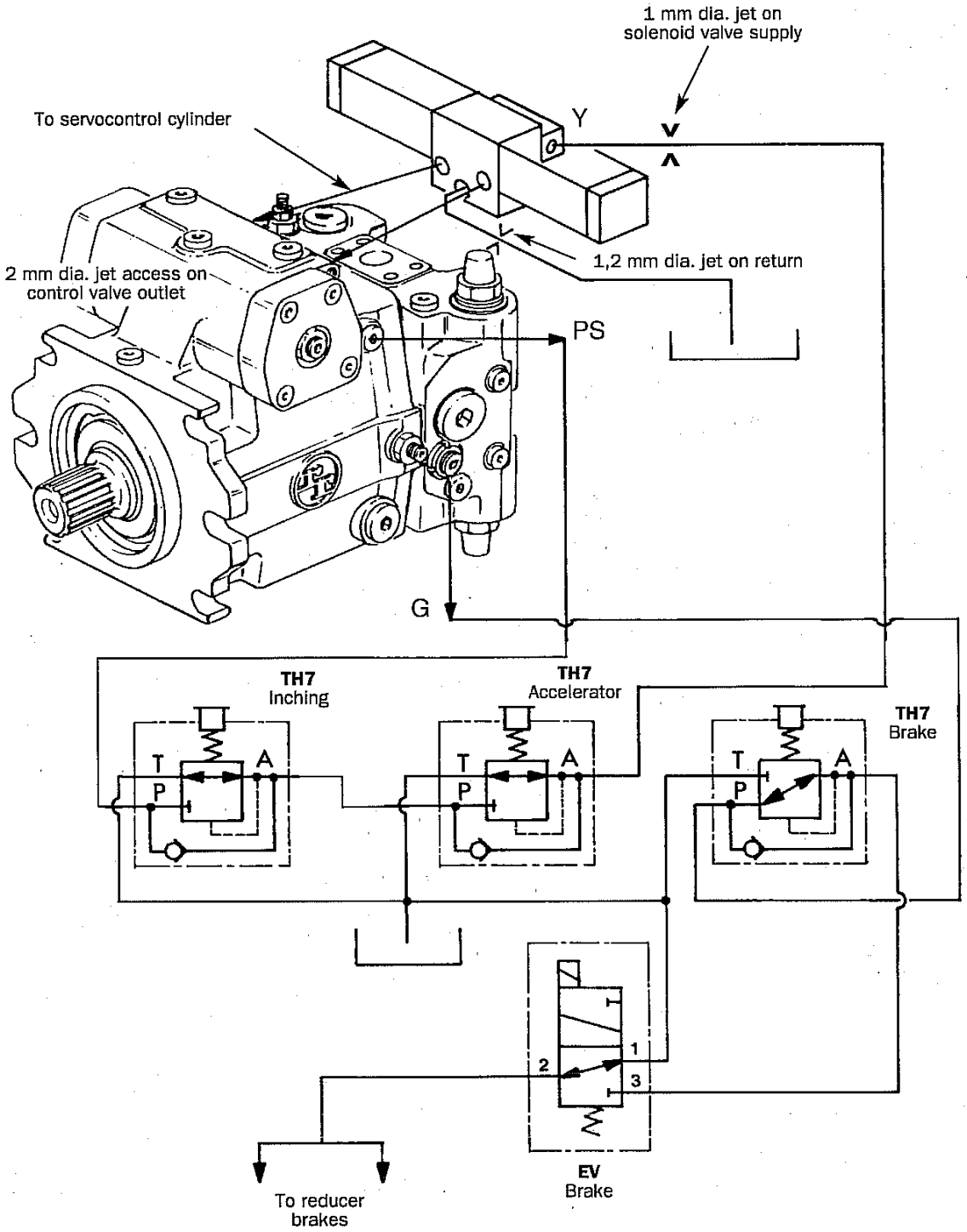
This second valve is activated by the brake pedal on the clearance stroke to cut off the pilot pressure when the brakes are activated. This provides hydrostatic cutting before the brake discs come into action.

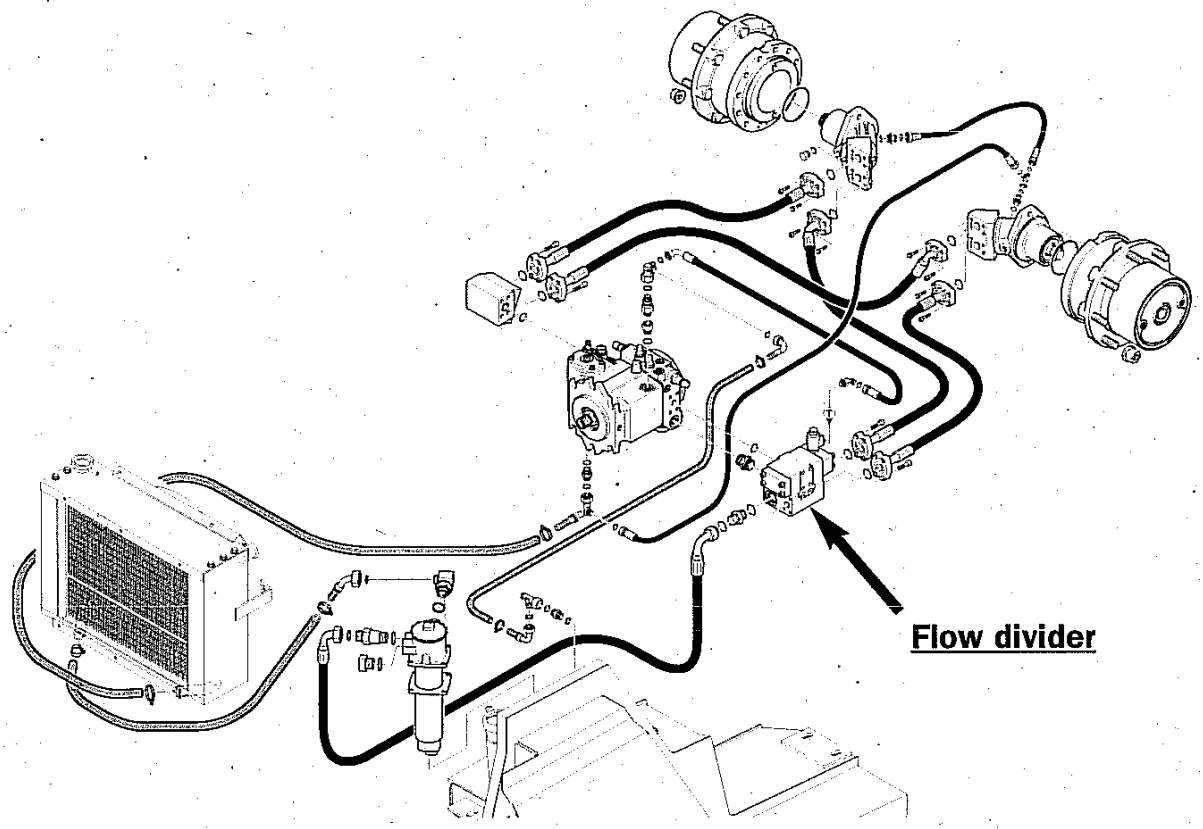
- **FORWARD DRIVE / NEUTRAL / REVERSE DRIVE SOLENOID VALVE :**

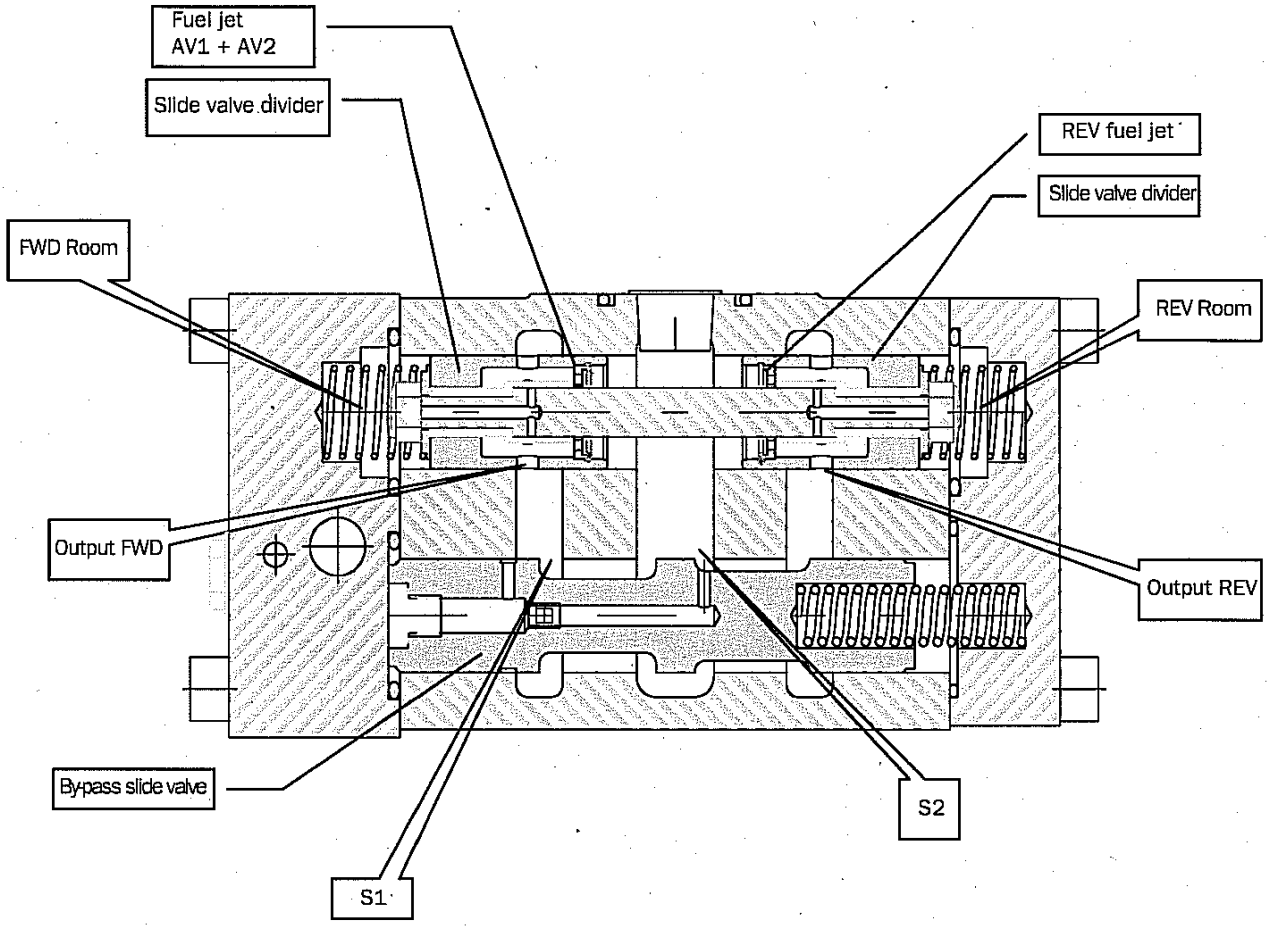
Its function is to direct the pilot flow from one side or another of the control cylinder of the pump in order to pilot the pump towards the forward or rear drive.

The return port located in the center of the solenoid valve is equipped with a 1,2 mm dia. time delay jet acting on the forward/rear drive reversal movement.


1 mm dia. jet on solenoid valve supply
To servocontrol cylinder
1,2 mm dia. jet on return
2 mm dia. jet access on control valve outlet
T
A
P
TH7
Accelerator
TH7
Brake
1
2
3
EV
Brake
To reducer brakes


1 mm dia. jet on
solenoid valve supply
To servocontrol cylinder
Y
V
Λ
1,2 mm dia. jet on return
2 mm dia. jet access on
control valve outlet
PS
G
TH7
Inching
TH7
Accelerator
TH7
Brake
T
A
P
1
2
3
EV
Brake
To reducer
brakes


Flow divider



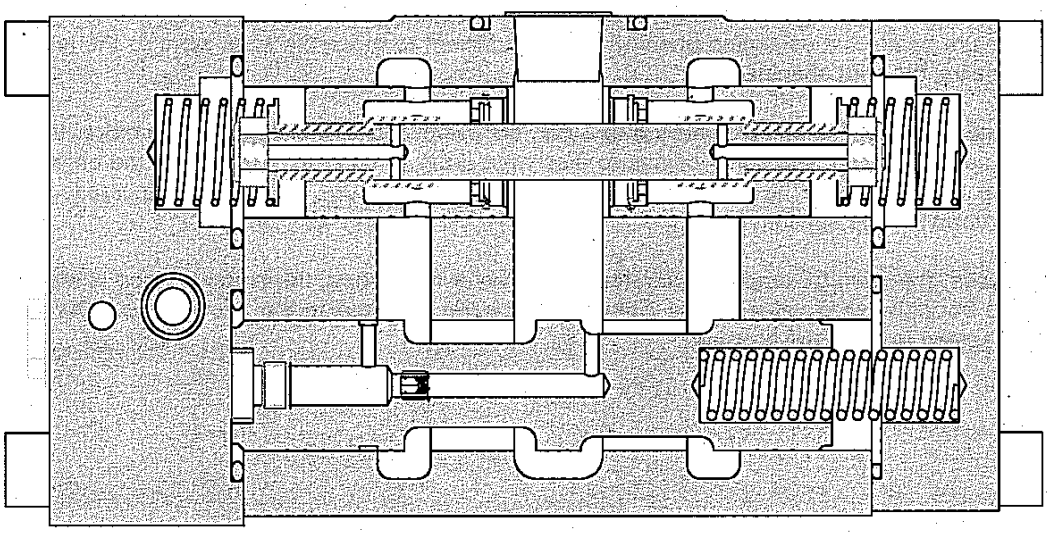
When the by-pass slide valve is in this position, the valve is in free blocking of differential (electro unexcited). When the electro is excited, the passages S1 and S2 are closed abd the differential is blocked.

On forward gear (divider position), the oil flow arrives by opening A and the two divider slide valves are in position like on the figure above.

If, for example, the rear wheel slip :

- ⟶ Important flow which go through the REV fuel jet
- ⟶ Important load waste on this fuel jet bounds
- ⟶ Slide valve maladjustment which move to the right (pressure in the rooms FWD>REV)
- ⟶ The variable section output REV decreases
- ⟶ The pressure in the REV room increase up to the balance with the FWD room pressure

In this way, on the bounds of the two fuel jets, the Δp is the same, the flow statement remains constant and is equal to the fuel jet section statement (in our case k=2.14).



In reverse gear (adder mode), the oil flow arrives by the driving openings AV1, AV2 and AR and the two slide valves divider are in position like on the figure above.
If, for example, the rear wheel strip :

⟶ Important flow which go through the REV fuel jet
⟶ Important load waste on this fuel jet bounds
⟶ Slide valve maladjustment which move to the left (pressure in the rooms REV>FWD)
⟶ The variable section output REV decreases
⟶ The pressure in the REV room decrease down to the balance with the FWD room pressure

In this way, on the bounds of the two fuel jet, the Δp is the same, the flow statement remains constant and is equal to the fuel jet section statement (in our case k=2.14).

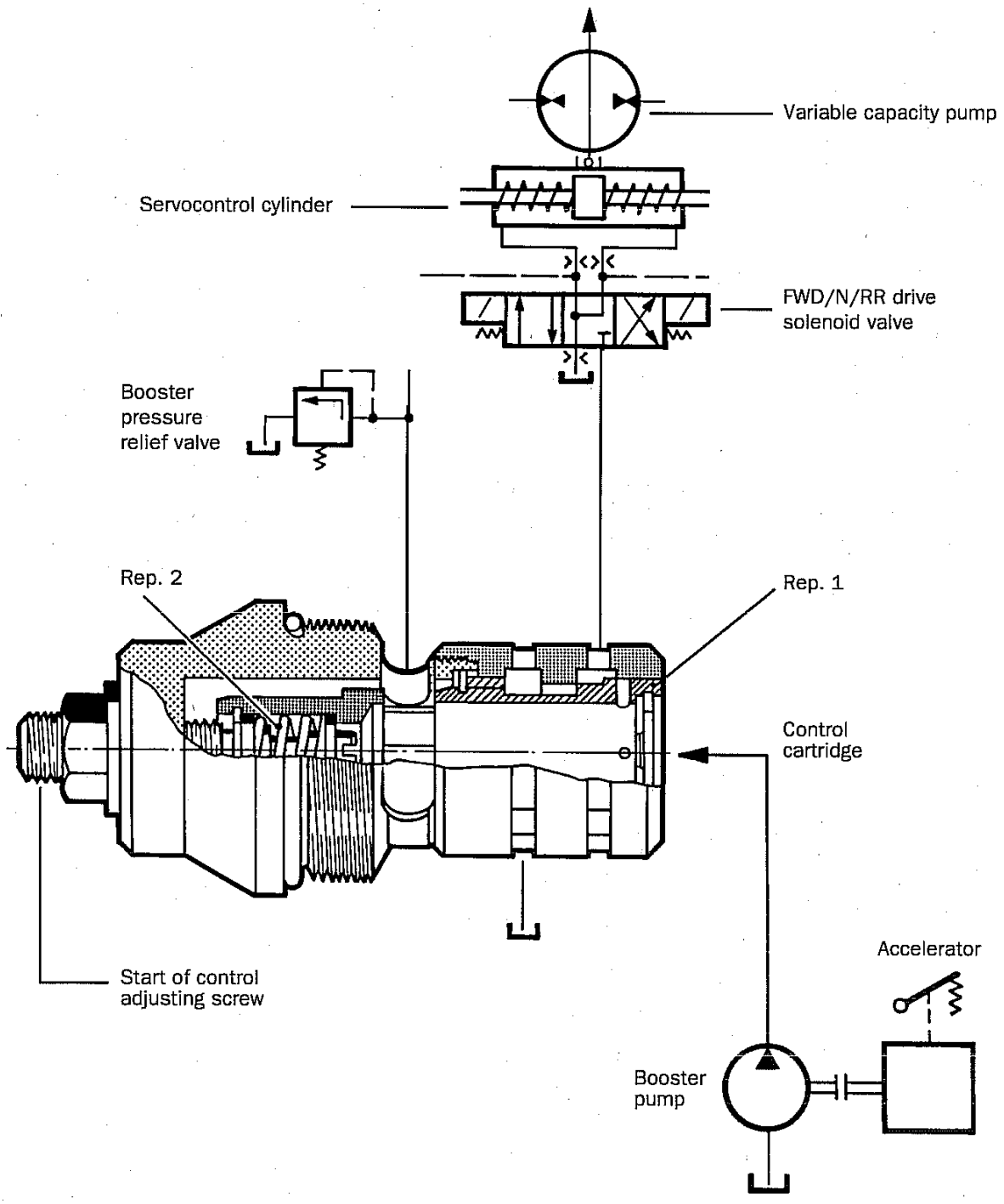
The pilot pressure is drawn via the control cartridge slide valve into the booster circuit. At maximum IC engine speed, the pilot pressure is a few bars lower than the booster pressure.

On idling (850 rpm), the booster flow which passes through the calibrated opening in the control cartridge slide valve is insufficient to create a drop in pressure capable of displacing the slide valve 1 against the force of the spring 2. The pilot pressure is therefore nil.

When the operator accelerates in order to move forward (to approximately 1050 rpm), the booster flow increases; the drop in pressure before the calibrated opening in now sufficient to move the slide valve to the left, against the spring, thus revealing the pilot opening.

When the pilot pressure reaches approximately 6 to 7 bar, the servocontrol cylinder begins to move, tilting the plate of the variablez capacity pump. The pump begins to discharge (start of control). The greater the engine speed, the more the booster flow increases thus leading to a rise in the pilot pressure and therefore increased influence on the pump and greater machie speed.

To halt this process, the operator stops accelerating, the booster flow drops, the pressure drop is reduced and the spring 2 pushes back the slide valve 1 thus closing the booster passage to the pilot conduit. The residual pilot pressure is discharged towards the housing.


Variable capacity pump
Servocontrol cylinder
FWD/N/RR drive
solenoid valve
Booster
pressure
relief valve
Rep. 2
Rep. 1
Control
cartridge
Start of control
adjusting screw
Accelerator
Booster
pump

1) FUNCTION

To cut-off flow while maintaining pressure. This corresponds to a return of the pump displacement to the "0" before the HP valve calibration is reached.

This valve anticipates HP relief valve activation on acceleration and deceleration (rapid rise in pressure).

The peak pressure is reduced by the HP relief valves which also protect the circuit against ultra-rapid fluctuations. The calibration range for cutting off the flow while maintaining pressure covers the whole working pressure range. The corresponding calibration values should however be 20 to 30 bar lower than those of the HP relief valves.

- Reducing transmssion noise.
- Wider control range.

Composition of the DR valve

1) HP circuit sensor flow selector.
2) A slide valve which connects the pilot circuit to the tank in order to release the pump from the pilot control while maintaining the 400 bar level (control starts at 6 to 7 bar, control ends at 20 bar with maximum flow).

The DR valve allows the flow to be reduced while retaining maximum torque.

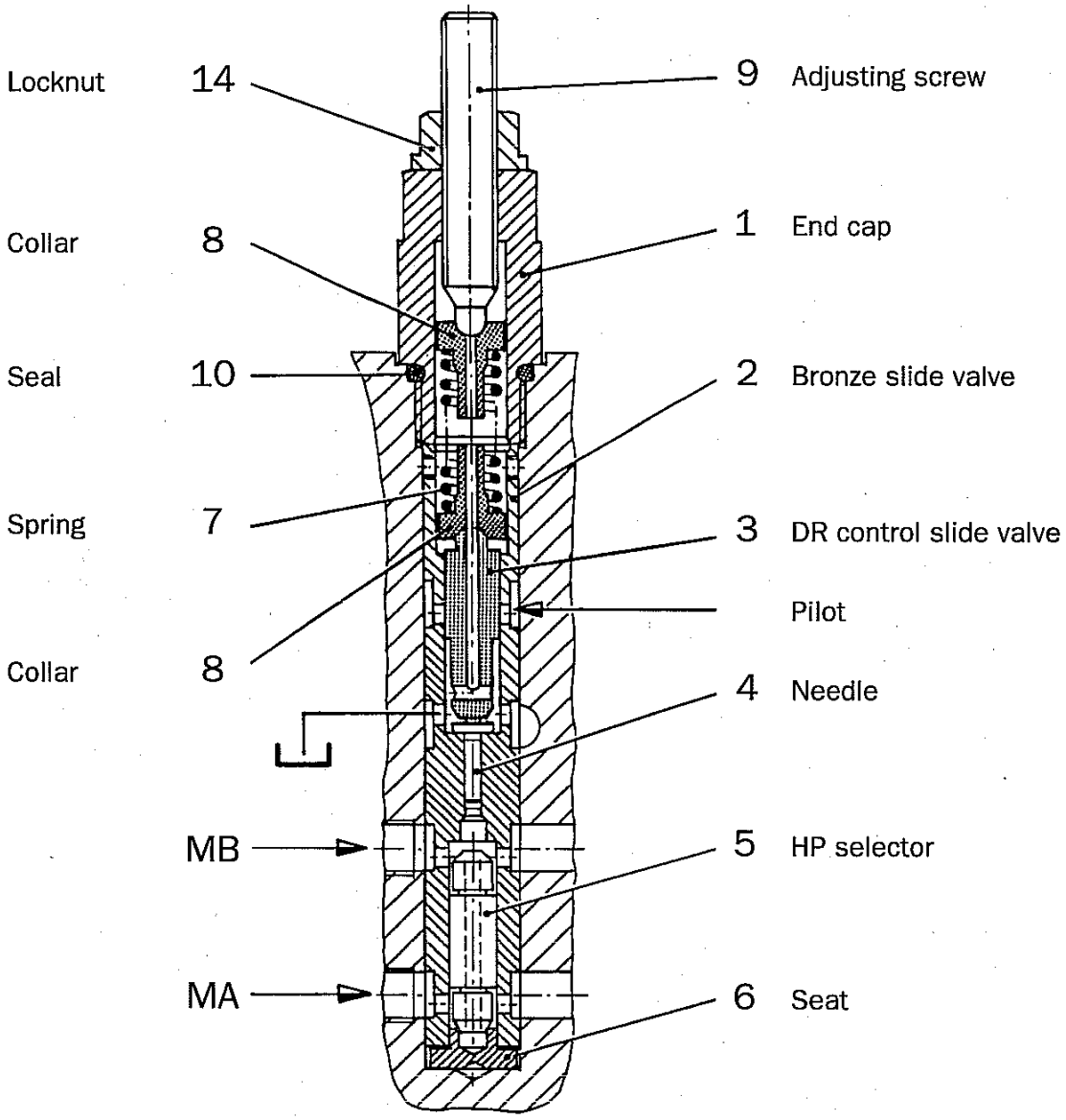
2) OPERATION

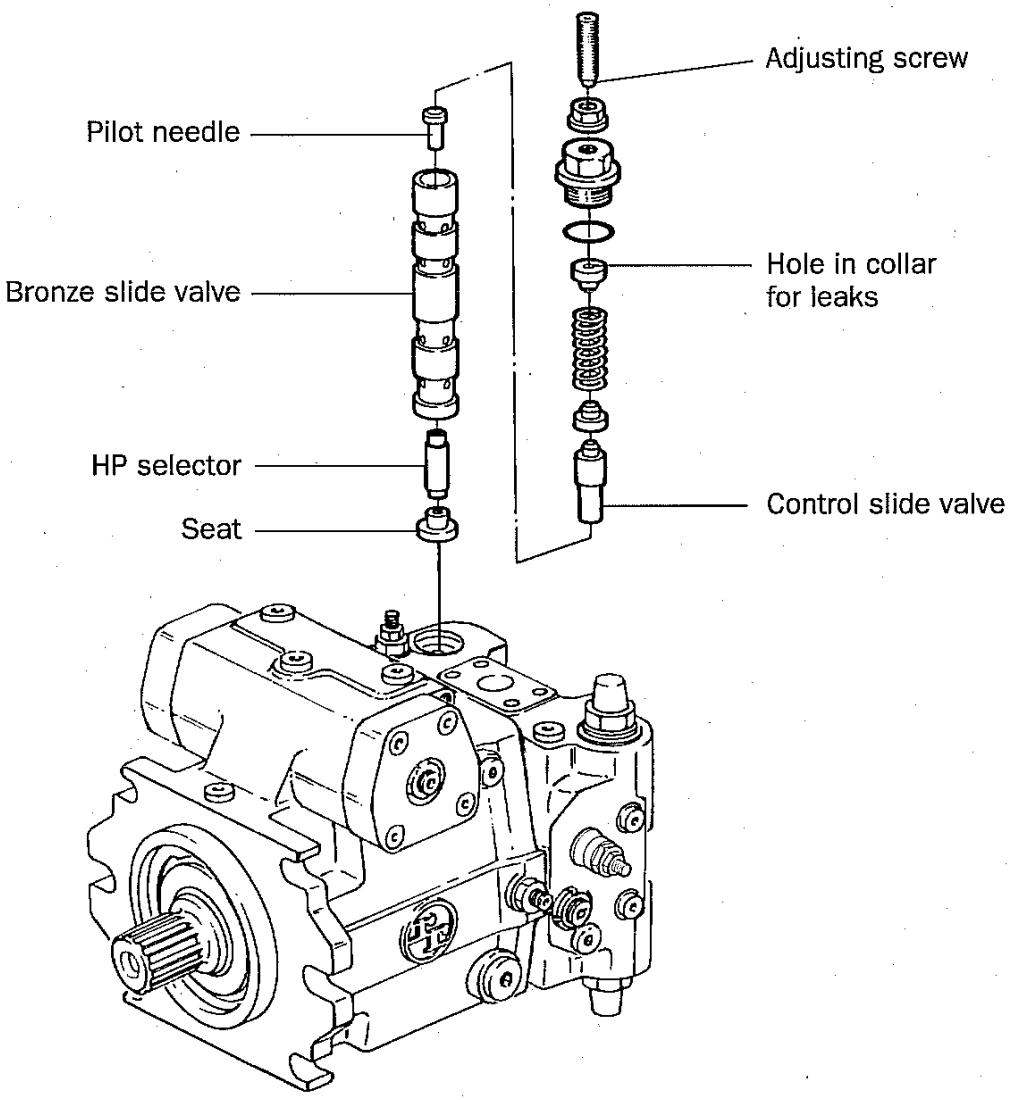
The HP MA or MB pushes the HP circuit selector upwards or downwards thus closing the opposite low pressure port (in a HP direction of A to B, the HP traverses the center of the selector through a small channel).

In all cases, the HP then pushes the needle 4 which in turn raises the control slide valve 3 which creates a partial connection between the control opening and the return thus reducing the pilot pressure.

The effect of this is to reduce the pump displacement, thus reducing the flow while maintaining the 400 bar HP (flow reduction for a maximum torque).

This action of removing the pilot control from the pump acts in the same way as the restoring forces generated by the HP and the adjustment of the control plate.


Locknut
14
9
Adjusting screw
Collar
8
1
End cap
Seal
10
2
Bronze slide valve
Spring
7
3
DR control slide valve
Pilot
Collar
8
4
Needle
MB
5
HP selector
MA
6
Seat

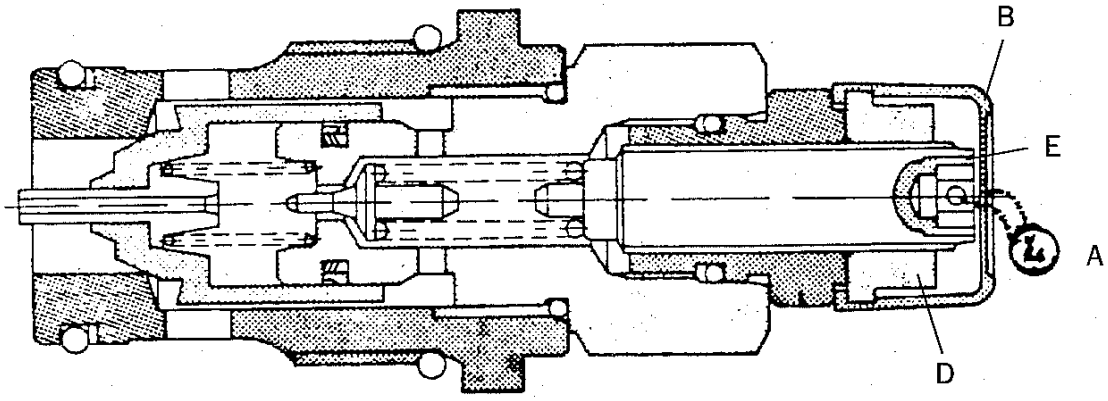


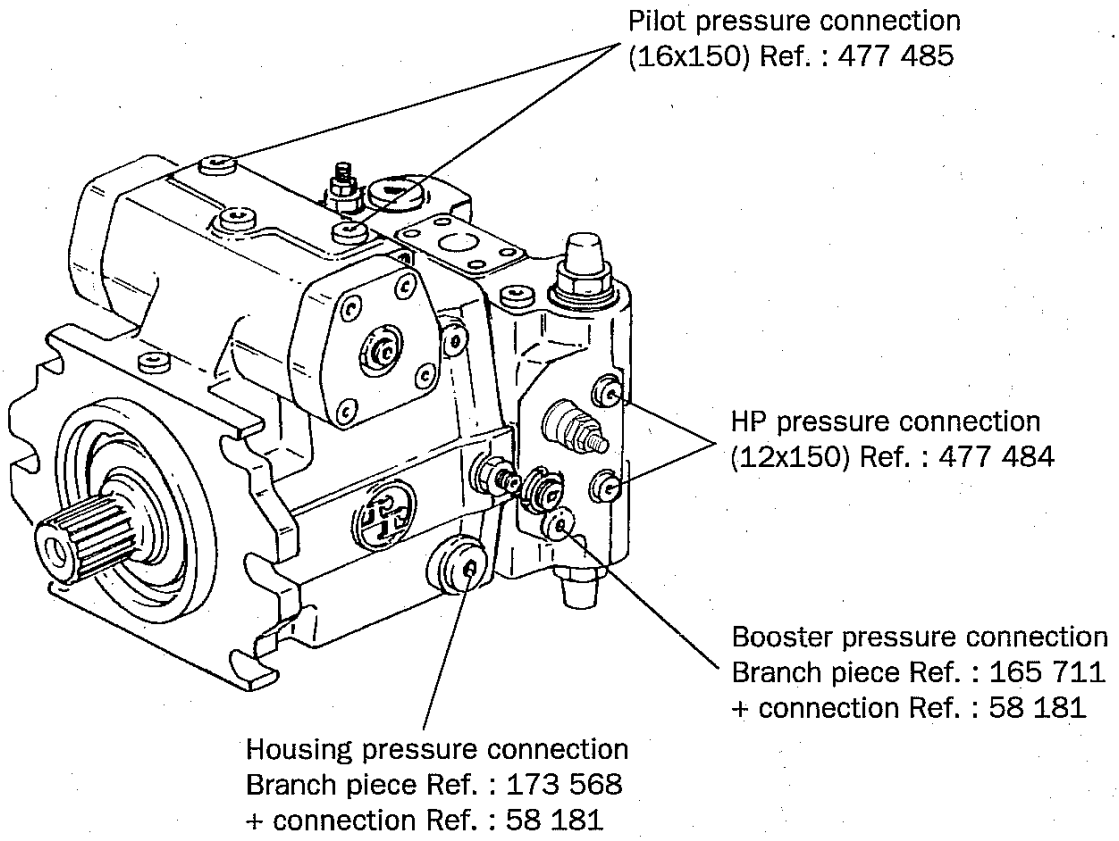
IMPORTANT :

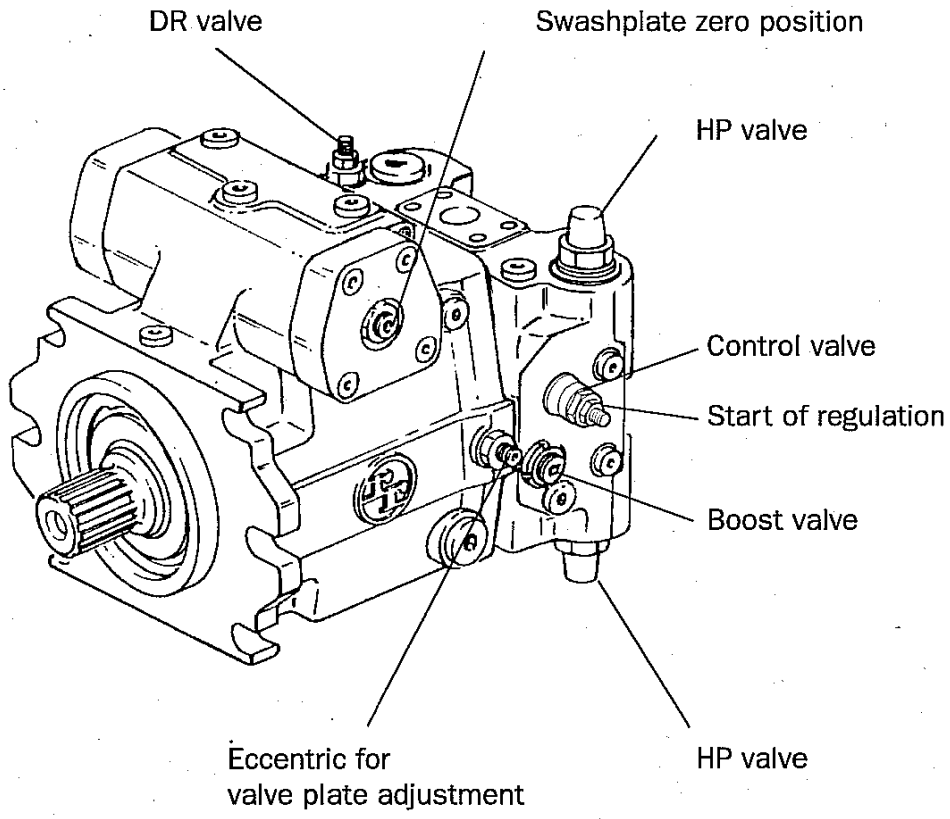
In the event of a considerable drop in the IC engine speed, check that the pilot needle has not become stuck in the slide valve.

PRESSURE RELIEF VALVE ADJUSTMENT :

- Remove the lead seal A.
- Take off the cap B.
- Loosen the locknut D.
- Adjust the screw E to increase the pressure.
- Refit the cap having installed a new lead seal.




Pilot pressure connection
(16x150) Ref. : 477 485
HP pressure connection
(12x150) Ref. : 477 484
Booster pressure connection
Branch piece Ref. : 165 711
+ connection Ref. : 58 181
Housing pressure connection
Branch piece Ref. : 173 568
+ connection Ref. : 58 181


DR valve
Swashplate zero position
HP valve
Control valve
Start of regulation
Boost valve
Eccentric for
valve plate adjustment
HP valve

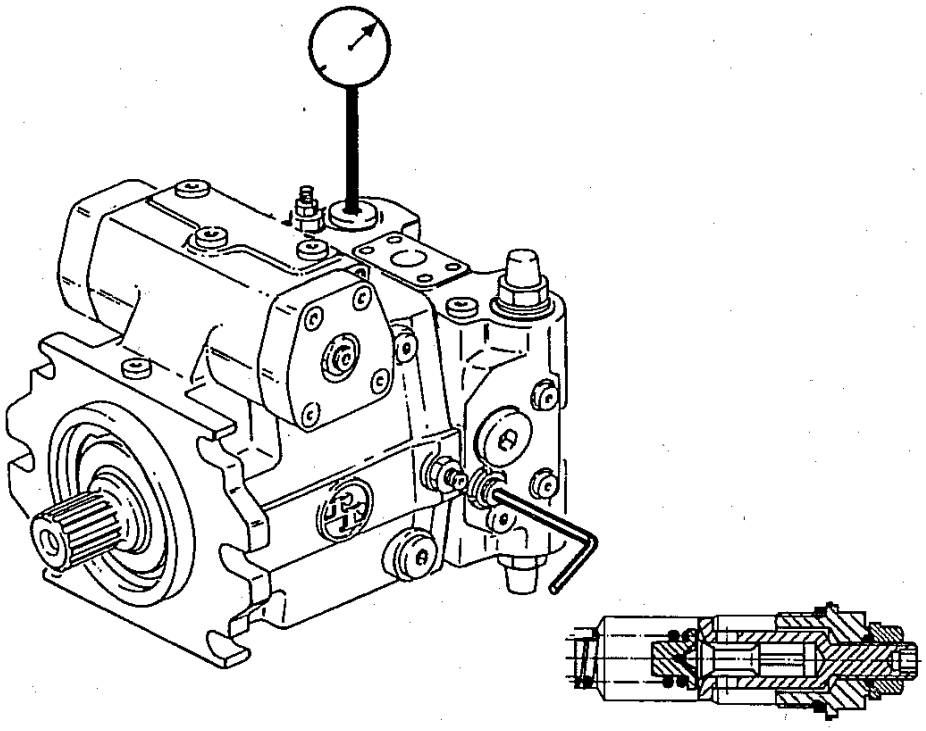
CHECKS BEFORE PRESSURE TESTING

- Check the transmission oil level.
- Check there are no leaks at hoses or unions.
- Check the electrical connections at the solenoid.
- Make sure the circuit is filled with oil. In some cases the filter should be filled with oil prior installation.
- Install the pressure gauges for boost, pilot, HP and housing checks.

PREPARATION

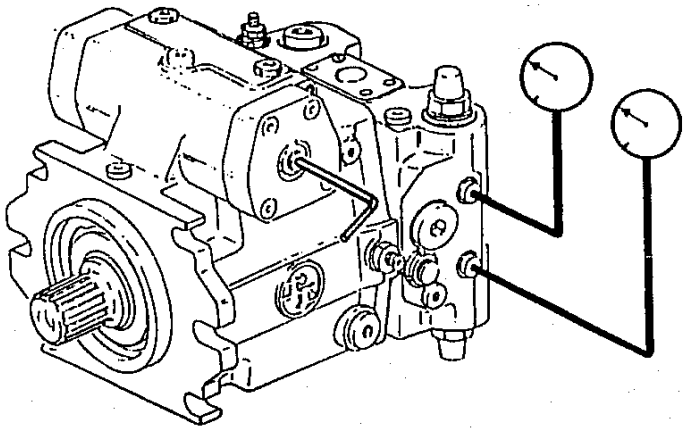
- For safety purposes support the front wheels on blocks (disconnect 4 wd shaft if applicable).
- Crank the engine a few times with the fuel shut off solenoid disconnected, to ensure the circuit is charged with oil.
- The boost pressure during cranking should be around 15 bar. "Never run the transmission without boost pressure".
- Reconnect the fuel shut off solenoid.
- Start the engine and run for a few minutes at idle. The boost pressure should be between 22 and 23 bar. A flickering gauge indicates cavitation in the system.
  With the drive selector in neutral the pressure in the two HP circuits should be the same as the boost pressure.
- Bypass the inching valve(s) using flexible hose.
- When the oil temperature is 50 to 60 C check the engine speed :
  - Idle speed,
  - Maximum speed under load.

1. CHECK/ADJUST BOOST PRESSURE



- The pumps A 4 VG 90 are equipped with an adjustable boost valve.
  To increase the boost pressure, tighten the screw.

2. ADJUSTMENT OF SWASHPLATE "O" POSITION



- Install two 100 bar gauges at the HP test points.
- Ensure the parking brake is released, the truck supported on blocks (wheels free to turn).
- Engine running at idle.
- Drive selector in neutral position.
- Unscrew the locknut of the "O" adjuster (19 mm ring spanner). Screw in very slowly the screw (6 mm allen key) until movement is seen on the pressure gauge.
- Make a mark relative to the allen key position, slowly turn the screw in the opposite direction until movement is seen on the other pressure gauge, mark the position of the allen key. Turn the adjuster back so that the allen key is exactly central between the two marks. Lock the locknut.

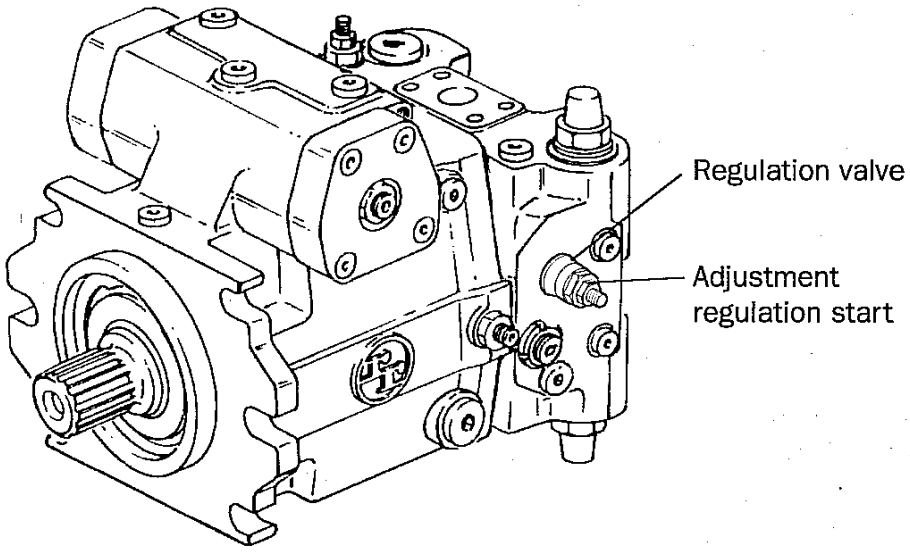
• CKECKING ADJUSTMENT

Remove the low pressure gauges from the HP circuit and install two 600 bar gauges :

1) Check the start of regulation in forward and reverse drive using a tachometer.
   Select forward drive, increase the engine speed slowly until the wheel begin to turn - record the engine speed.
   Repeat the same in reverse drive.
   Compare the two readings ; they should be identical

2) Check the pilot and HP readings.
   Select forward drive, apply foot brake, accelerate progressively to maximum speed.
   Record the forward HP and forward pilot pressure.
   Repeat the same operation in reverse. The valves should be the same.

3. A. CHECK AND ADJUST START OF PUMP REGULATION



START OF REGULATION :

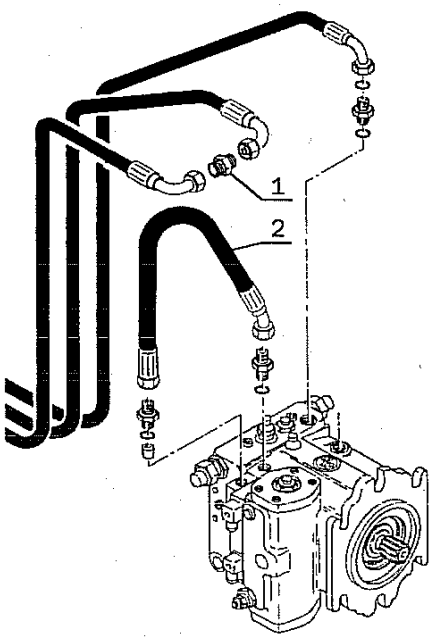
- Check the engine speed at idle depending on machine type. It should be 850 ± 25 rpm.
  Regulation should start at 700 ± 50 rpm. To alter it, adjust the start of regulation setting screw located on the end of the regulation cartridge.
  . Tighten it to retard the start of movement.
  . Loosen it to advance the start of movement.

The start of regulation of the pump can only be adjusted if valve TH7 on the accelerator has been previously bypassed (see fig. A)
. Join the two hoses with a connector 1 Ref. 206 493 to prevent any leaks during the inspection.
. Add a hose 2 Ref. 203 789 to ensure the control circuit switches to direct.

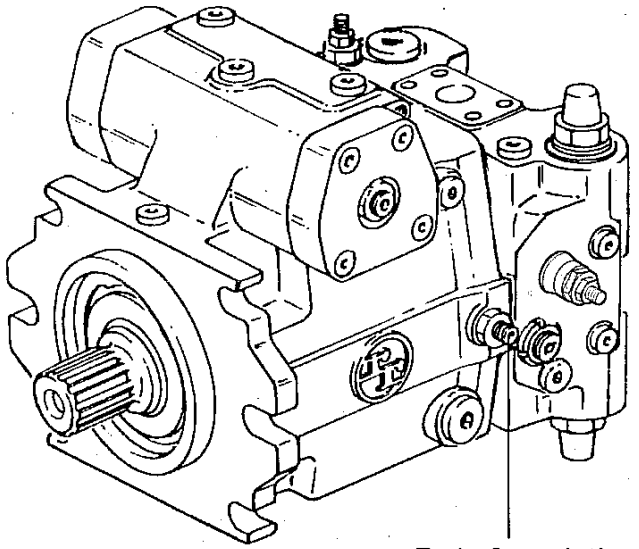
Altering the setting of the starting point offsets the regulation curve of the pump. The "400 bar for a given engine speed" end of regulation must be systematically checked.
(Cf. machine specifications).

- The setting is checked in the same way as the "mechanical 0" - point 2 setting.

Fig. A



3 B. CHECK AND ADJUST END OF REGULATION

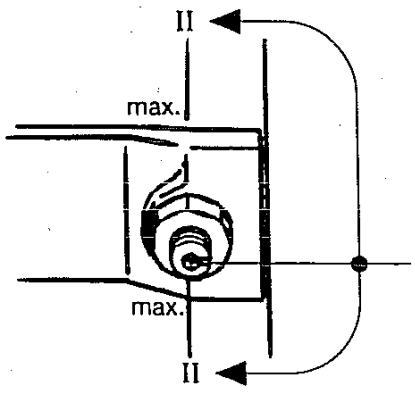


CHECK :

- The carriage must be locked, e.g. against a platform with a load on the forks.
- Drive reverser in forward drive.
- Engine at low idle - check rpm.
- Gradually increase the engine speed until the forward HP reading is 400 bar.

END OF REGULATION :

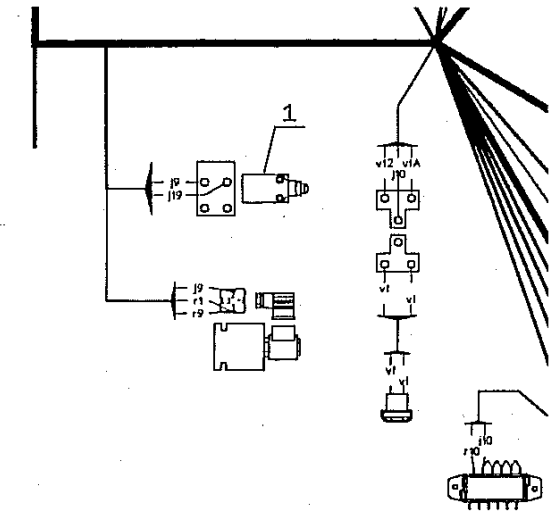
- The adjustment of the pump end of regulation (1600 ± 100 rpm) is obtained using an eccentric screw which restricts the pump flow creating back pressure against the swash plate.



This adjustment can only be set using a test bench.

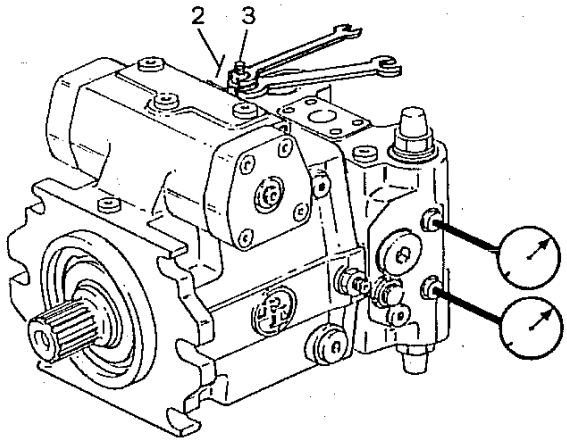
IMPORTANT

The slot in the eccentric screw should point towards the boost pump (opposite to A4V pump where slot pointed to drive shaft). The adjustment must not go beyond 90 to the left or right - Do not exceed or damage may occur.



4. CHECK AND ADJUST HP VALVES

- The carriage must be locked, e.g. against a platform with a load on the forks.
- Disconnect the connection socket from the brake switch Ref. 1 located under the cab (negative braking of the machine).
- Then shunt the two yellow wires of the main harness.

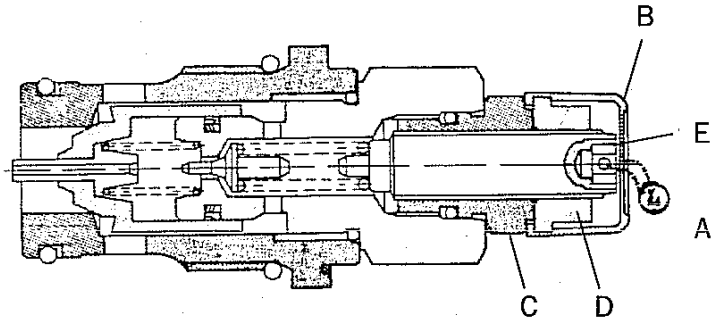


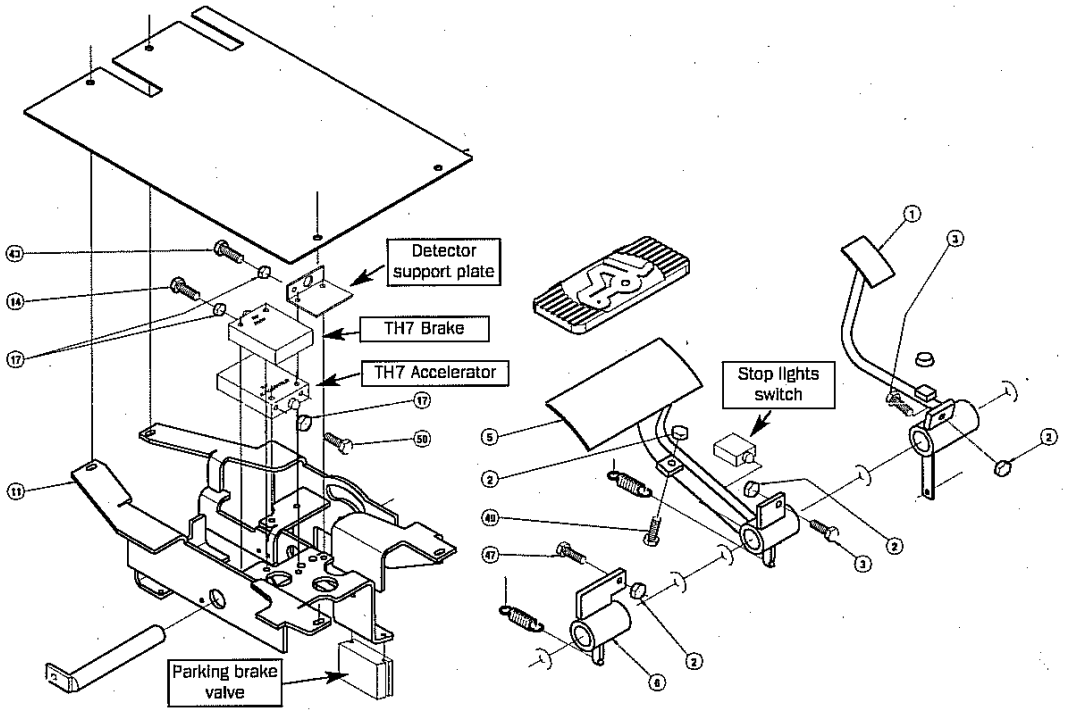
- Overset the DR valve (2) to check the pressure of the HP valves.
  Screw the adjuster (3) in 1 turn.
  The HP valves pressure should be 490 /500 bar.
  During this test the engine speed should drop 500 - 600 rpm.
  After the HP valves have been checked the DR valve should be re-set to 480 bar.

CALIBRATION OF HP RELIEF VALVE :

A 4 VG 71 - 180 DA series pump

- Remove the lead seal A.
- Remove the cap B.
- Loosen the locknut D.
- Turn screw E to increase the pressure.
- Refit the cap having installed a new lead seal.





NB :

- The machine is unladen and on level ground.
- The pressure levels and values are given at a transmission hydraulic oil temperature of approximately 50°C.

1) - Mount a 60 bar pressure gauge on to the TH7 braking valve.
2) - Mount a revolution counter on to the engine.
3) - Check that the pushroad of the braking TH7 is inserted fully and that the pushroad of the accelerator TH7 is completely out. Check that screw Ref. 49 (Fig. 5) of the lower end stop of the brake pedal is tightened correctly.
4) - Check the engine idling speed of $900 \pm \frac{25}{0}$ rpm (unladen).

FIG. 1 :

- Check the height of the inching-brake pedal 05 (dimension A=70mm from the bottom of the pedal to the top of the pedal support).
- Adjust screw 43.
- Tighten the locknut 17.

FIG. 1

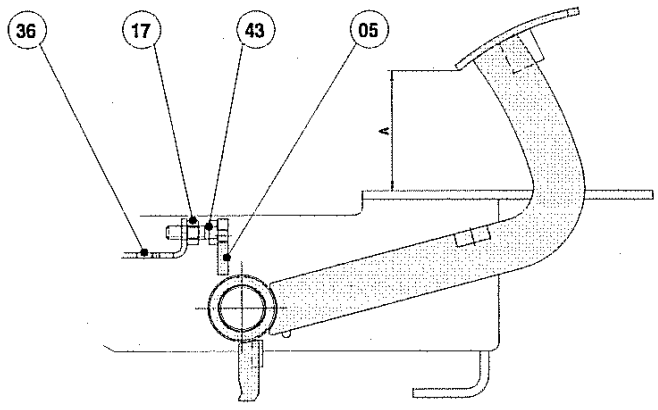


FIG. 2 :
- Adjust the screw 03 for secure a dimension E=6mm (brake pedal released).
- Tighten the locknut.
- Adjust the screw 03 to obtain the lighting of green and red lights on the proximity detector (dimension B= 5 à 6 mm; brake pedal released)
- Tighten the locknut 02.

FIG. 3 :
- Adjust the braking boss 06. Dimension C = approximately 13 mm (in relation to the TH7 body 15).
- Fine down the adjustment to obtain a pressure reading on the gauge of 25 to 30 bar (engine idling speed $900 \pm \frac{25}{0}$ tr/mn).

- Tighten the locknut 17.

FIG. 2

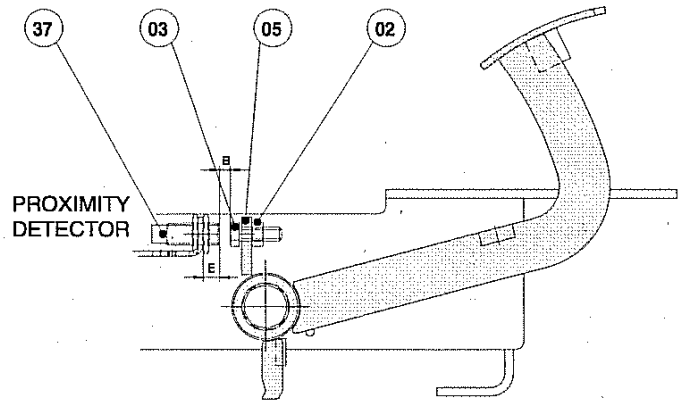


FIG. 3

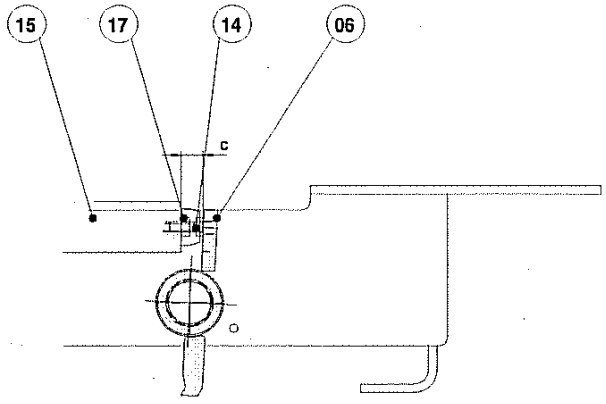


FIG. 4 :
- Press the inching pedal 05 as far as the proximity detector 37 cut-off point (point at which the red LED on the proximity detector switches off) dimension F = 8 mm.
- Adjust the screw 03 on the boss 06 to obtain a pressure gauge reading of $13 + \frac{2}{0}$ bar.
- Tighten the locknut 02.

FIG. 5 :
- Put the forward/reverse lever in neutral.
- Press the brake pedal 05 to obtain a pressure gauge reading of 4 bars.
- Adjust the screw 49 (low stop).
- Tighten the locknut 02.
- Checking the working order of the regulation start of the hydrostatic pump.
- Place the reverser in the forward drive position.
- Pressthe push rod of the TH7 valve 16 with a screwdriver, the machine should avance.

FIG. 4

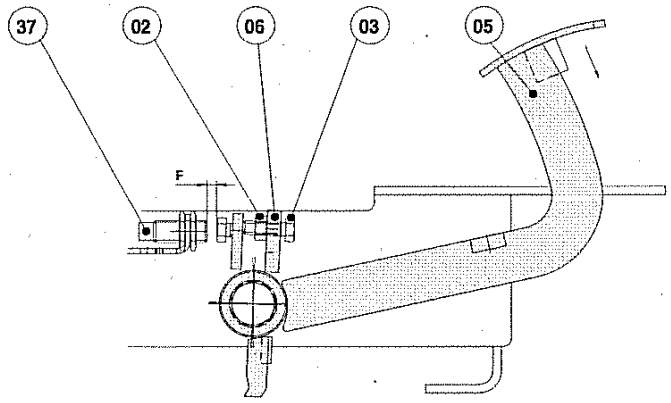


FIG. 5

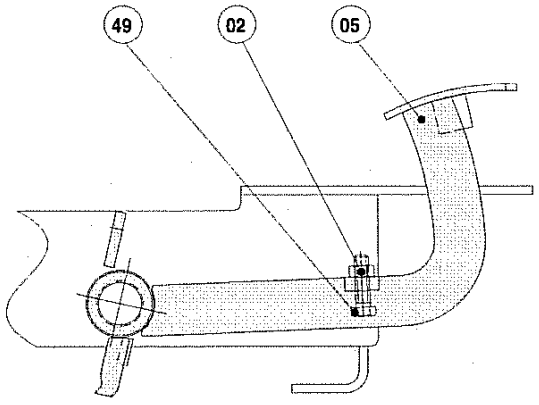


FIG. 6 :
- Press the accelerator pedal 01 until an engine speed of 1050 $+^{100}_{0}$ tr/mm is reached.
- Adjust the screw 03 to obtain the start of travel of the machine.
- Move the reverser lever to neutral.

FIG. 7 :
- Place a 0,5 to 1 mm thick shim between the screw head and the push rod of the TH7.
- Press the accelerator pedal 01 to draw in the push rod of the TH7 valve 16 completely
  the engine speed should be 3050 $+^{10}_{0}$ tr/mm max. unladen (MSI..D)

  the engine speed should be 3000 $+^{10}_{0}$ tr/mm max. unladen (MSI 35 T)

- Adjust the screw 50 on the TH7 valve 16.

Checking the engine speed during lifting.

- Engine speed with cross levers 1750 tr/mn min. unladen. - Engine speed with line levers 2000 tr/mn min. unladen.	MSI 20/25/30 D
- Engine speed with cross levers 2200 tr/mn min. unladen. - Engine speed with line levers 2200 tr/mn min. unladen.	MSI 35 T

- Possible adjustment with the shell 40.

FIG. 6

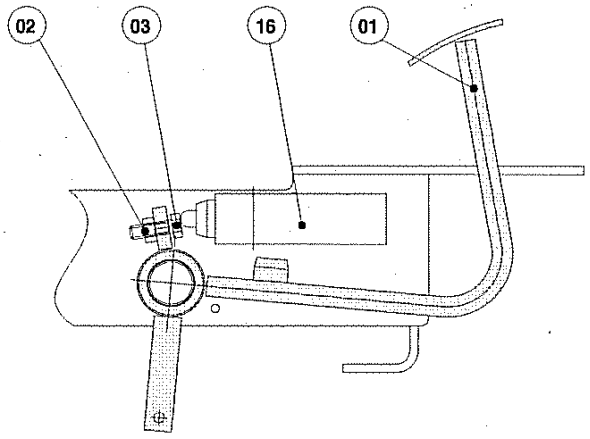
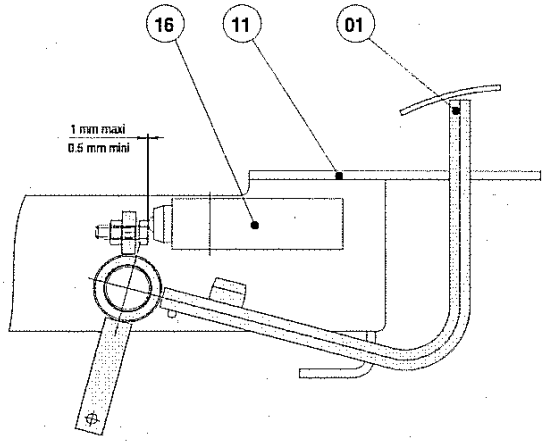
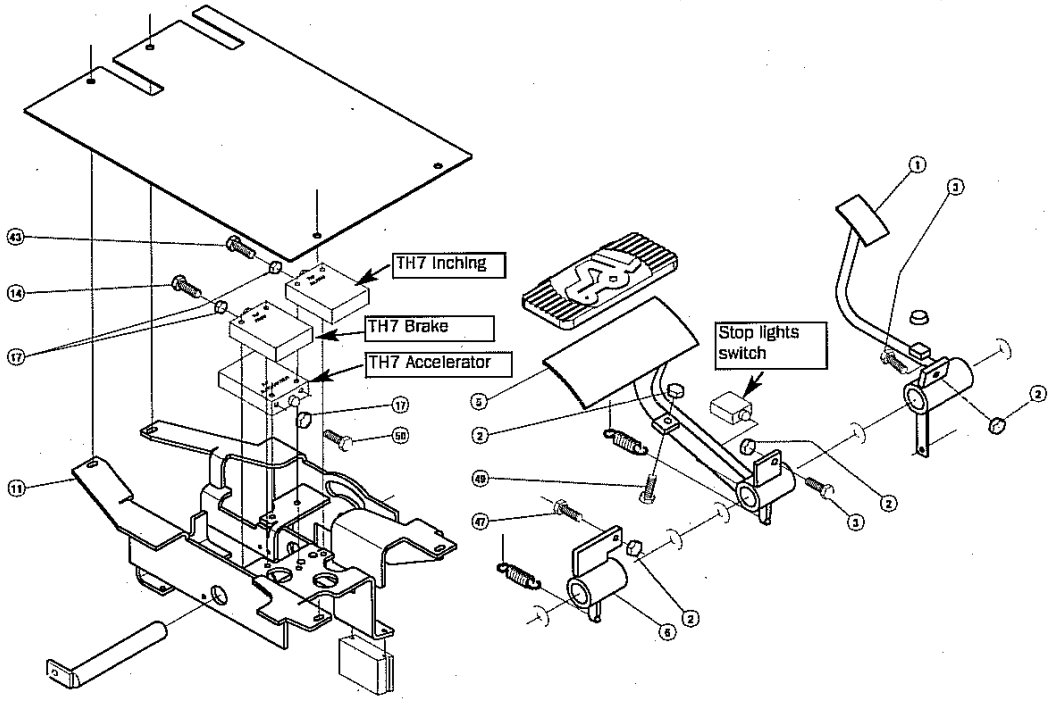


FIG. 7





NOTA :

- The machine is unladen and on level ground.
- The pressure levels and values are given at a transmission hydraulic oil temperature of approximately 50°C.

1) - Mount a 60 bar pressure gauge on to the TH7 braking valve.
2) - Mount a revolution counter on to the engine.
3) - Check that the pushroad of the braking TH7 and inching TH7 are inserted fully and that the pushroad of the accelerator TH7 is completely out. Check that screw Ref. 49 (Fig. 5) of the lower end stop of the brake pedal is tightened correctly.
4) - Check the engine idling speed of 900 $\pm \frac{25}{0}$ rpm (unladen).

FIG. 1 :

- Check the height of the inching-brake pedal 05 (dimension A=70mm from the bottom of the pedal to the top of the pedal support).
- Adjust screw 43 (on the TH7 inching valve 16).
- Tighten the locknut 17.

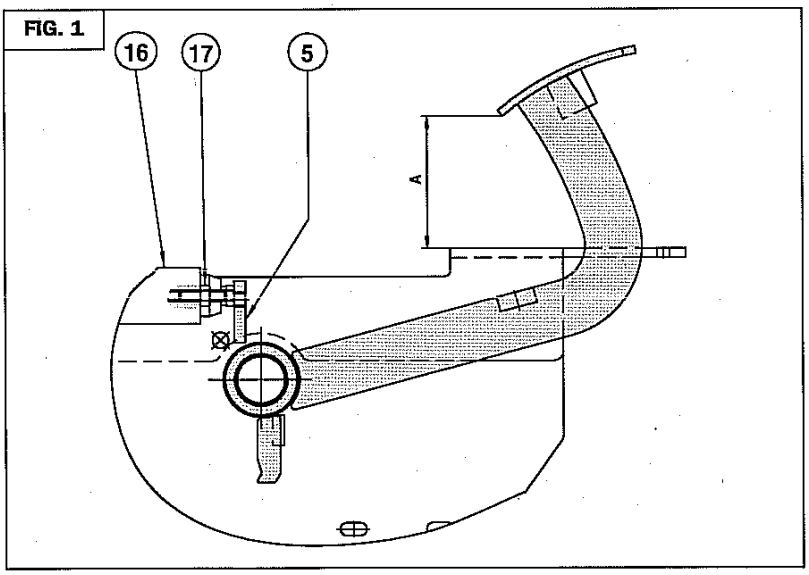


FIG. 2 :
- Adjust the screw 03 for secure a dimension B=0,5mm between the screw and the TH7 inching valve 16.
- Tighten the locknut 02.

FIG. 3 :
- Adjust the screw 14 on the TH7 brake valve 15 to obtain a pressure reading on the gauge of 25 to 30 bar (cramming pressure engine idling speed 900 $\pm \frac{25}{0}$ tr/mn).

- Tighten the locknut 17.

FIG. 2

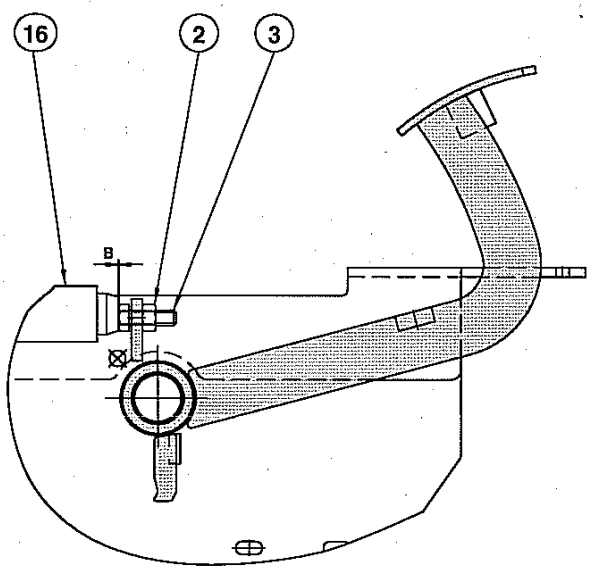


FIG. 3

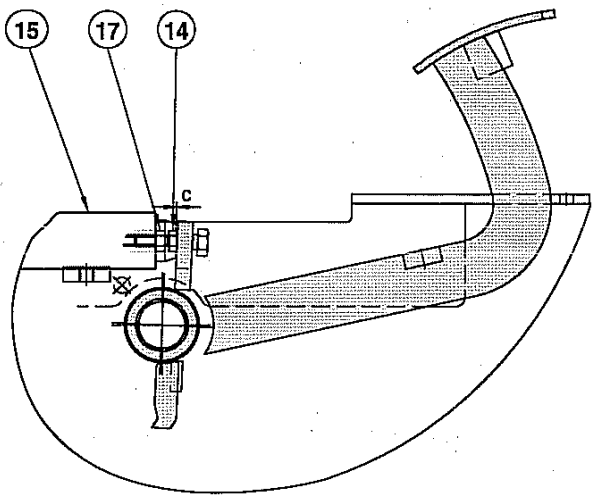


FIG. 4 :

- WARNING THE INCHING ADJUSTMENT IS DELICATE.

- It's absolutely necessary to have 13 + $^{2}_{0}$ bar to start to advance (less thn 12 bar, risk of damaging of the brake discs).
- The operator must have sat with the driver's cab to carry out the following operations
- Place the reverser in the forward drive position or in the backward drive position.
- Press the inching brake pedal 05 as far as possible.
- Press the accelerator pedal until max speed.
- Slacken gently the inching pedal 05 to obtain a pressure gauge reading of 13 +$^{2}_{0}$ bar, the machine should start to advance.
  (Loosening the screw 47, the pressure increase; and tightening, the pressure decrease)
- Adjust the screw 47 on the boss 6.
- Tighten the locknut 02.

FIG. 5 :

- Place the reverser in neutral.
- Press the inching pedal 05 to obtain a pressure gauge reading of 4 Bar.
- Adjust the screw 49 (low stop).
- Tighten the locknut 02.

FIG. 4

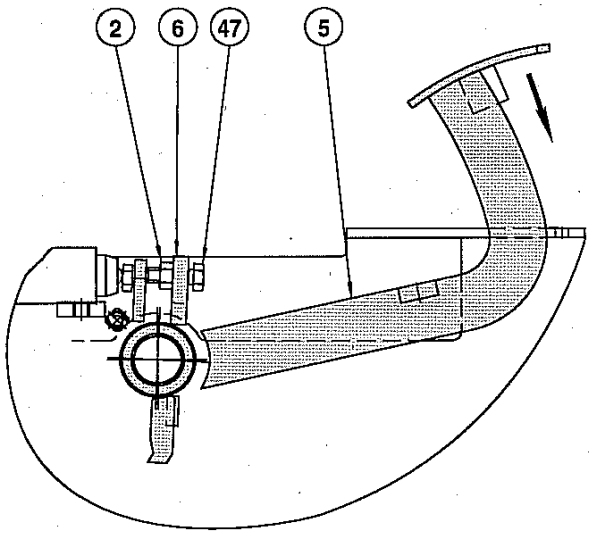


FIG. 5

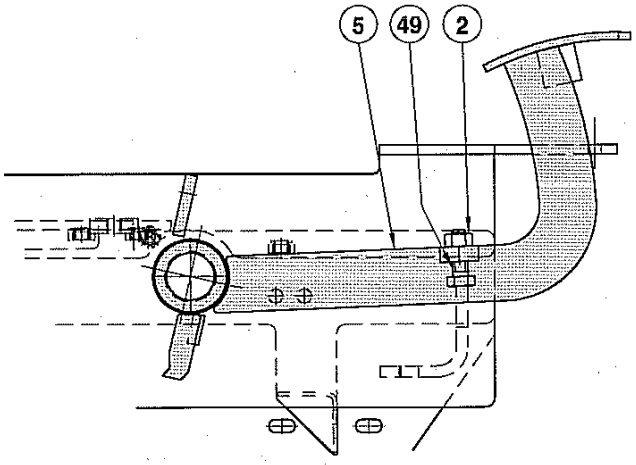


FIG. 6 :
- Place the reverser in the forward drive position or in the backward drive position.
- Press the accelerator pedal 01 until an engine speed of 1100 + $^{100}_{0}$ tr/mm is reached.
- Adjust the screw 03 to obtain the start of travel of the machine.
- Tighten the locknut 02.

FIG. 7 :
- Move the reverser lever to neutral.
- Place a 0,5 to 1 mm thick shim between the screw head and the push rod of the TH7 accelerator.
- Press the accelerator pedal 01 to draw in the push rod of the TH7 valve 16 completely the engine speed should be 3000 + $^{50}_{0}$ tr/mm max. unladen.

- Adjust the screw 50 (butée) on the TH7 accelerator valve 16.

Checking the engine speed during lifting.
- Engine speed with cross levers 2200 tr/mn min. unladen.
- Engine speed with line levers 2200 tr/mn min. unladen.

- Possible adjustment with the shell 40.

FIG. 6

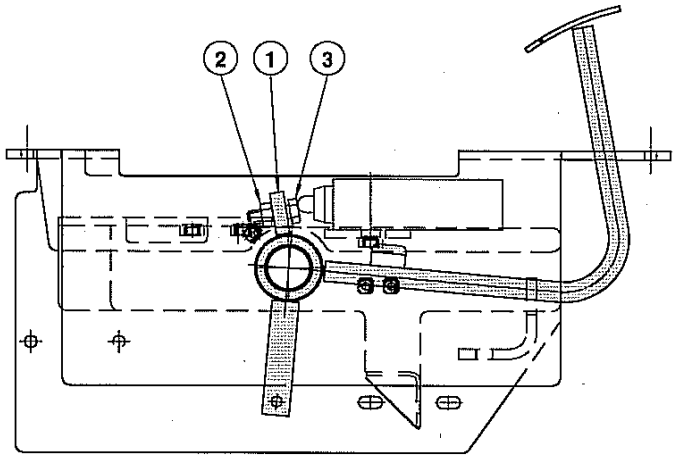
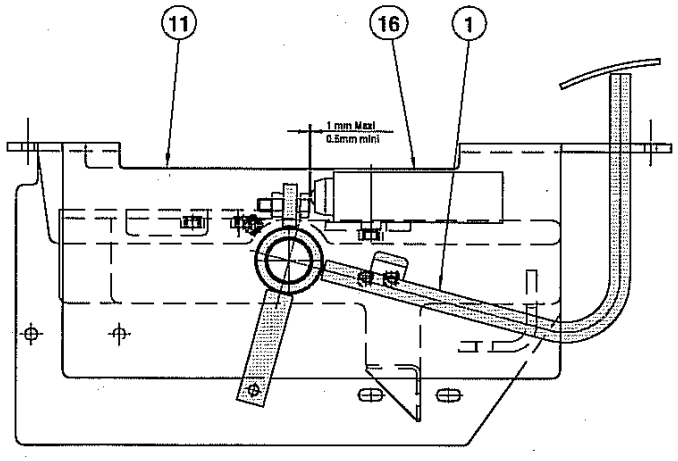


FIG. 7



MANITOU - HYDROSTATIC TRANSMISSION CHECK SHEET - A4VG–DA / A2FE28

DATE OF CHECK	:	*TYPE OF MACHINE*	:	*PUMP TYPE*	:
NAME OF DEALER	:	*SERIAL No*	:	*SERIAL No*	:
NAME OF ENGINEER	:	*HOURS RUN*	:	*MOTOR TYPE*	:
				SERIAL No	:

IC ENGINE SPEED IN RPM:

[1] idle:.....[2] max unladen: .....[3] max with hydraulics blocked: .....[4] start of regulation:.....[5] end of regulation 400 b: .....[6] max fwd drive blocked.....

HYDROSTATIC PUMP

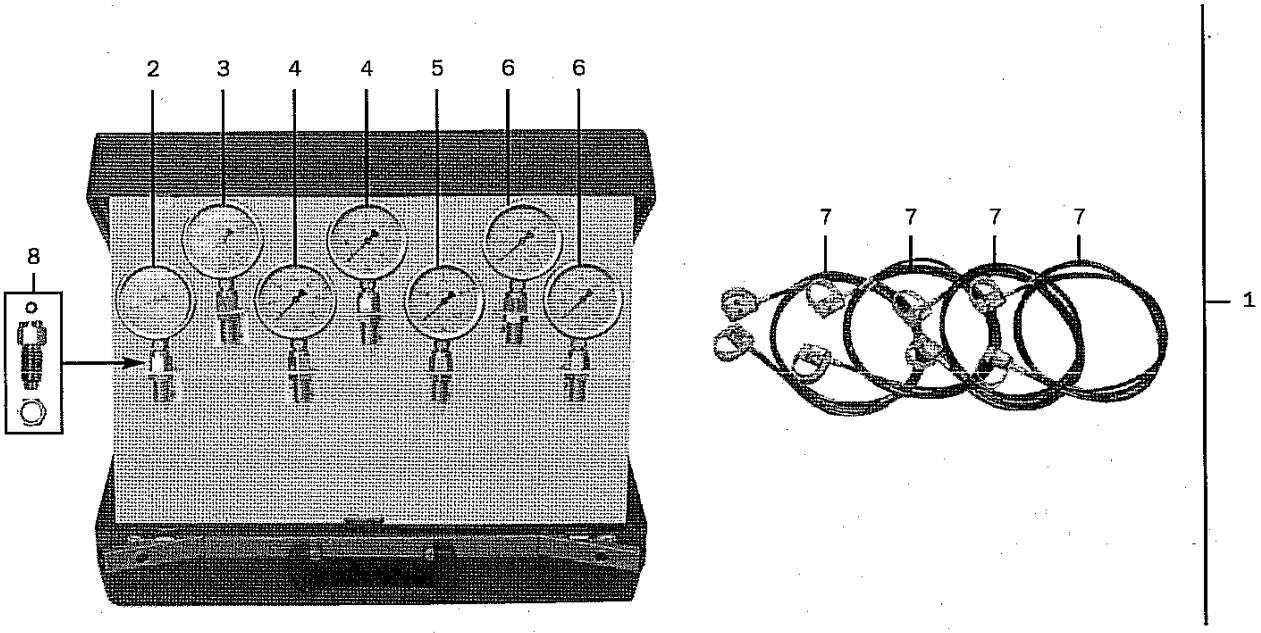
STATE OF MACHINE / CONTROLS	*DRIVE LEVER POSITION*	*ENGINE SPEED*	*BOOST PRESSURE*	*PILOTE PRESSURE* FWD	PILOTE PRESSURE REV	*HIGH PRESSURE* FWD	HIGH PRESSURE REV	*CASE PRESSURE*	*SUCTION VACUUM*
BOOST VALVE ADJUSTEMENT	NEUTRAL	IDLE							
		MAX							
UNLADEN CONTROL CARTRIDGE ADJUSTMENT	FWD	Start of regulation							
		MAX							
	REV	Start of regulation							
		MAX							
BLOCKED CHECK HP VALVE (DR. VALVE OVERSET)	FWD	MAX							
	REV	MAX							
BLOCKED DR VALVE ADJUSTEMENT	FWD	MAX							
	REV	MAX							
BLOCKED END OF REGULATION CHECK	FWD	End of regulation							
	REV	End of regulation							
BLOCKED INCHING VALVE ADJUSTMENT BRAKE PEDAL PUSHED IN	FWD	MAX							

OIL TYPE:

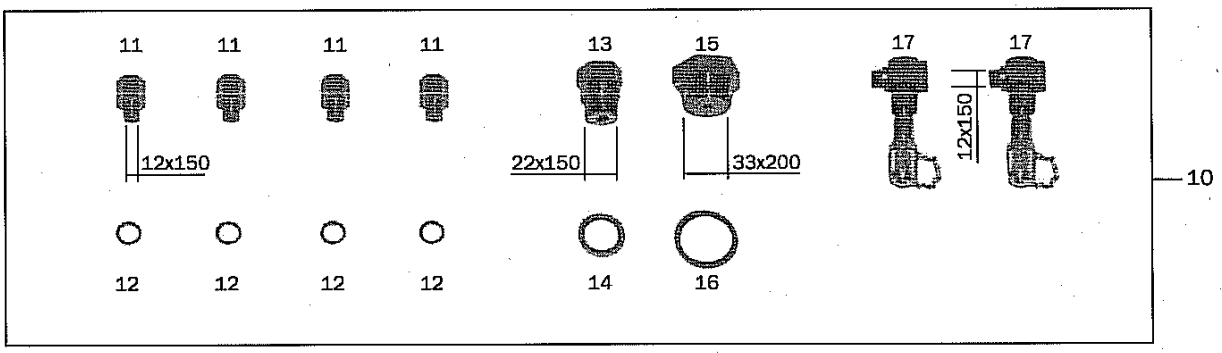
OIL TEMPERATURE : .....°C

TRAVEL SPEED (MAX) :
.....Km / H

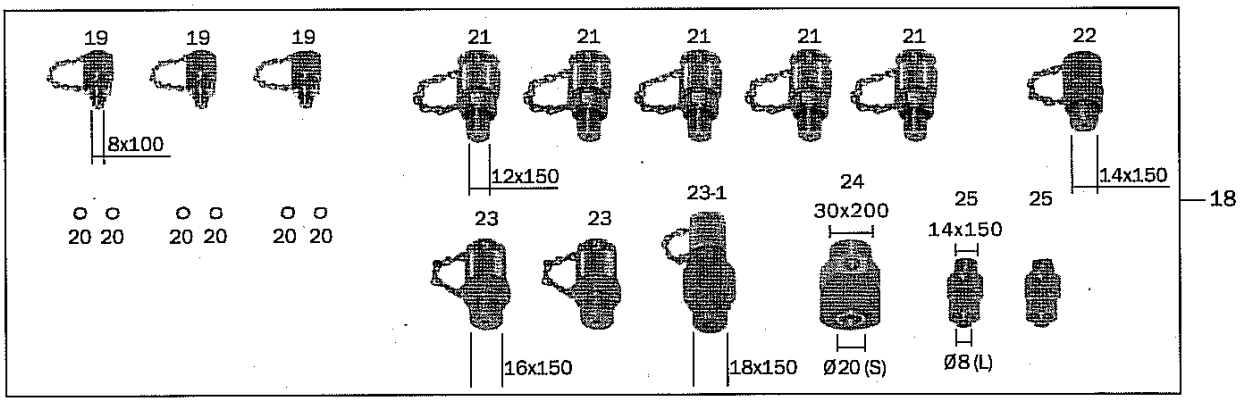
DRAWBAR PULL : .....Kg



HYDROMATIK Kit - 1st MOUNTING - Pump A 4 V - DA / Motor A 6 V - DA



HYDROMATIK Kit - 2nd MOUNTING - Pump A 4 VG - DA / Motor A 6 VM - DA



Item	Part-Nr	Description	Qté
1	**549 671**	**Basis box**	**1**
2	549 882	Gauge 1/9 bar	1
3	549 883	Gauge 0/40 bar	1
4	549 884	Gauge 0/60 bar	2
5	549 885	Gauge 0/400 bar	1
6	549 886	Gauge 0/600 bar	2
7	549 887	Hose	4
8	549 889	Gauge connector	7
10	**209 571**	**HYDROMATIK Kit (1st mounting)**	**1**
11	58 195	Connection 12 x 150	4
12	3 411	Copper seal JC 12	4
13	58 194	Connection 22 x 150	1
14	55 730	Bushing BS C 22	1
15	58 193	Connection 33 x 200	1
16	55 729	Bushing BS C 33	1
17	165 710	Connection 12 x 150	2
18	**209 572**	**HYDROMATIK Kit (2nd mounting)**	**1**
19	58 181	Gauge connector 8 x 100	3
20	58 197	"O" ring Ø 8	6
21	477 484	Gauge connector 12 x 150	5
22	58 189	Gauge connector 14 x 150	1
23	477 485	Gauge connector 16 x 150	2
23-1	199 175	Gauge connector 18 x 150	1
24	173 568	Connection Ø 20 (S) 30x200	1
25	165 711	Connection Ø 8 (L) 14x150	2

GROUP 80

ELECTRICITY

ELECTRIC DIAGRAM

80-6-249017 EN

- MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
- MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
- MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2
- MSI 35 Turbo Série 2-E2
- MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

09 / 05 / 2005

CONTENTS

ELECTRIC DIAGRAM

MSI 20 D / MSI 25 D / MSI 30 D + BUGGIE SÉRIE 2-E2
MSI 35 TURBO + BUGGIE SÉRIE 2-E2

PRINCIPLE ELECTRIC CIRCUIT

1 - Battery / Battery cut-off
2 - Starter
3 - Preheating
4 - Alternator
5 - Engine stop electrovalve
6 - Preheating relay
7 - Machine fault warning
8 - Sealing oil filter
9 - Free
10 - Air filter clogging
11 - Engine water temperature
12 - Engine oil pressure
13 - Parking brake indicator light
14 - Battery load indicator light
15 - Headlight indicator light
16 - Flashing lights
17 - Control panel lighting
18 - Control panel lighting
19 - Hourmeter
20 - Fuel level
21 - Fuel level sensor
22 - Rear right position light
23 - Front right position light
24 - Rear left position light
25 - Front left position light
26 - L.H. front low beam
27 - R.H. front low beam
28 - L.H. front main beam
29 - R.H. front main beam
30 - Switch + parking brake valve
31 - Stoplight
32 - Sound alarm
33 - Forwards movement EV
34 - Forward relay
35 - Starting safety relay
36 - Reverse relay
37 - Reversing EV
38 - Front working headlight
39 - Backward movement alarm
40 - Transmission cut-off (détecteur de proximité)
41 - Flasher unit
42 - R.H. rear indicator
43 - R.H. front indicator
44 - L.H. rear indicator
45 - L.H. front indicator
46 - Switch and warning indicator light
47 - Cab lifting pump
48 - Rear windscreen wiper
49 - R.H. working tail light
50 - L.H. working tail light
51 - R.H. front working headlight
52 - L.H. working tail light
53 - Heating ventilation
54 - Windscreen washer
55 - Front windscreen wiper
56 - Revolving light
57 - Roof light
58 - Cab lifting pump
59 - Cab lifting switch
60 - Free (+ permanent)
61 - Free (+ after contact)

COLOUR CODING

bc : White	bl : Blue	g : Grey
j : Yellow	jvt : Yellow/Green	m : Brown
n : Black	o : Orange	r : Red
ro : Pink	vt : Green	v : Purple

CONNECTOR

A - Indicator light module
C - Predisposition option (connector holder 6 pin white)
D - Predisposition option comodo (clip holder 8 pin white)
E - Predisposition option lighting (clip holder 8 pin green)
J - Gear reverser / Sound alarm
L - Cab

SOUND ALARM

E1 - R.H. rear indicator
E2 - R.H. front indicator
E3 - L.H. rear indicator
E4 - L.H. front indicator
E5 - rear reverse light
E6 -
E7 - Rear right position light
E8 - Front right position light
E9 - Rear left position light
E10 - Front left position light
E11 - L.H. front low beam
E12 - R.H. front low beam
E13 - L.H. front main beam
E14 - R.H. front main beam
E15 - R.H. working tail light
E16 - L.H. working tail light
E17 - L.H. front working headlight
E18 - R.H. front working headlight
E19 - Revolving light
E20 - Stoplight
E21 - Roof light

CAB FUSES

F1 - Lighting switch (15A)
F2 - Warning unit (10A)
F3 - Rear windscreen wiper (7.5A)
F4 - Stop engine electrovalve (5A)
F5 - 1 Front working headlight (7.5 A)
2 Front working headlight (15A)
F6 - Heating ventilation (15A)
F7 - Indicator light module /Fault sound alarm (5A)
F8 - Front windscreen wiper/Front windscreen washer (10A)
F9 - Indicator (10A)
F10 - Light throw-over and backward movement alarm (10A)
F11 - Parking brake / Sound alarm / Stoplight (10A)
F12 - Revolving light (7.5A)
F13 - Right sidelights (5A)
F14 - L.H. sidelights (5A)
F15 - R.H. indicators (7.5A)
F16 - L.H. indicators (7.5A)
F17 - Low beam (10A)
F18 - Main beam (10A)
F19 - Roof light (3A)
F20 - Free (+permanent)
F21 - 1 Working tail light (7.5A)
2 Working tail light (15A)
F22 - Free (+ after contact)
F23 - Start engine (20A)
F24 - Order cab lifting (5A)

POWER FUSES ON BATTERY TANK

F25 - Preheating (50A)
F26 - Alternator (70A)
F27 - Key switch (70A)
F28 - Cab lifting (50A)

B1 - Road alarm
B2 - Failure alarm
B3 - Backward movement alarm

G1 - Battery
G2 - Alternator

H1 - Load indicator light
H2 - Engine oil pressure indicator light
H3 - Sealing oil filter indicator light
H4 - Air filter clogging indicator light
H5 - Engine water temperature indicator light
H6 - Flashing lights
H7 - Free
H8 - Main beam indicator light
H9 - Brake indicator light
H10 - Warning unit indicator light
H11 - Brake indicator light
H12 - Control panel lighting
H13 - Control panel lighting

K1 - Starting safety relay
K2 - Flasher unit
K3 - Reverse relay
K4 - Cab lifting relay
K5 - Transmission cut-off relay (with diode)
K6 - Forward relay
K7 - Preheating relay

M1 - Starter
M2 - Front windscreen wiper
M3 - Windscreen washer
M4 - Rear windscreen wiper
M5 - Ventilator (Heating)
M6 - Cab lifting pump
M7 - Heating ventilation

P1 - Hourmeter
P2 - Fuel level

R1 - Preheating resistor
R2 - Fuel level

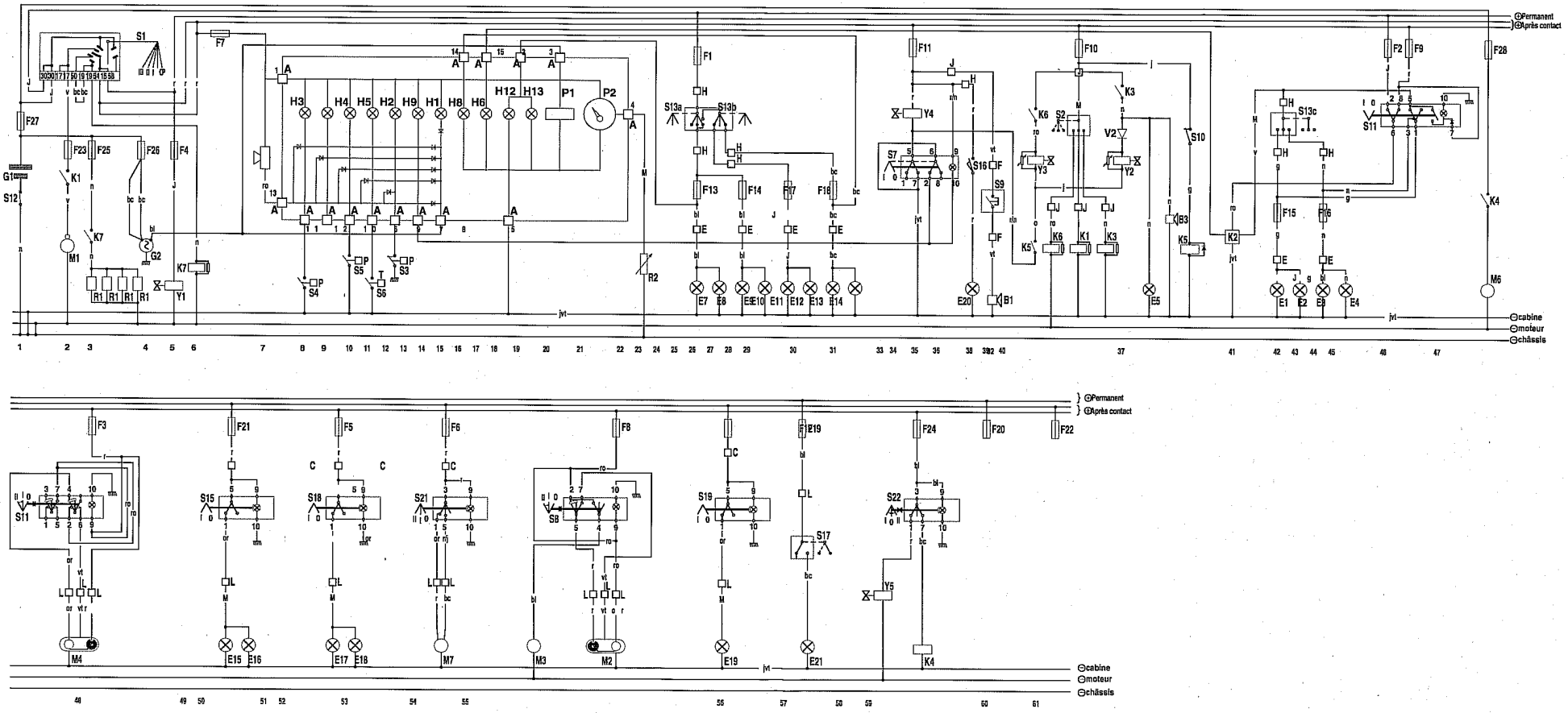
S1 - Key switch
S2 - Forward / reverse selector
S3 - Engine oil pressure switch
S4 - Hydraulic filter clogging
S5 - Air filter clogging
S6 - Engine water temperature
S7 - Parking brake switch
S8 - Windscreen switch/Front windscreen wiper
S9 - Horn switch
S10 - Proximity detector
S11 - Warning unit
S12 - Battery cut-off
S13a - Sidelight lighting switch
S13b - Low beam / main beam lighting switch
S13c - Indicators lighting switch
S15 - Working tail light switch
S16 - Stop contactor
S17 - Roof light switch
S18 - Front working headlight switch
S19 - Revolving light switch
S20 - Windscreen wiper tail switch
S21 - Ventilation switch (heating)
S22 - Cab lifting switch

V1 - Test diode (interior of the module 9 indicator light)
V2 - Rear light diode and buzzer rear gear

Y1 - Motor stop electrovalve
Y2 - Backward gear electrovalve
Y3 - Forward gear electrovalve
Y4 - Parking brake electrovalve
Y5 - Operating cab going down electrovalve

ELECTRIC DIAGRAM

MSI 20 D / MSI 25 D / MSI 30 D + BUGGIE SÉRIE 2-E2
MSI 35 TURBO + BUGGIE SÉRIE 2-E2



ELECTRIC DIAGRAM

80-6-249018 EN

MSI 20 D Série 2-E2 - MSI 20 D BUGGIE Série 2-E2
MSI 25 D Série 2-E2 - MSI 25 D BUGGIE Série 2-E2
MSI 30 D Série 2-E2 - MSI 30 D BUGGIE Série 2-E2

MSI 35 Turbo Série 2-E2
MSI 35 Turbo BUGGIE Série 2-E2

MH 20-4 Turbo BUGGIE Série 2-E2
MH 25-4 Turbo BUGGIE Série 2-E2

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CONTENTS

ELECTRIC DIAGRAM *MH 20-4 TURBO SÉRIE 2-E2*
MH 25-4 TURBO SÉRIE 2-E2

PRINCIPLE ELECTRIC CIRCUIT

1 - Battery / Battery cut-off
2 - Starter
3 - Preheating
4 - Alternator
5 - Engine stop electrovalve
6 - Preheating relay
7 - Machine fault warning
8 - Oil filter clogging
9 - Free
10 - Air filter clogging
11 - Engine water temperature
12 - Engine oil pressure
13 - Parking brake indicator light
14 - Battery load indicator light
15 - Headlight indicator light
16 - Blinker indicator light
17 - Control panel lighting
18 - Control panel lighting
19 - Hourmeter
20 - Fuel level
21 - Fuel level sensor
22 - Rear right position light
23 - Front right position light
24 - Rear left position light
25 - Front left position light
26 - L.H. front low beam
27 - R.H. front low beam
28 - L.H. front main beam
29 - R.H. front main beam
30 - Switch + parking brake electrovalve
31 - Stoplight
32 - Sound alarm
33 - Forwards movement EV
34 - Forward relay
35 - Starting safety relay
36 - Reverse relay
37 - Reversing EV
38 - Rear reverse light
39 - Reverse gear horn
40 -
41 - Warning unit
42 - R.H. rear indicator
43 - R.H. front indicator
44 - L.H. rear indicator
45 - L.H. front indicator
46 - Warning unit / indicator light switch
47 - Cab lifting pump
48 - Rear windscreen wiper
49 - R.H. working tail light
50 - L.H. working tail light
51 - R.H. front working headlight
52 - L.H. front working headlight
53 - Heating ventilation
54 - Windscreen washer
55 - Front windscreen wiper
56 - Revolving light
57 - Roof light
58 - Cab lifting pump
59 - Cab lifting switch
60 - Free (+ permanent)
61 - Differential locking

COLOUR CODING

bc : White	bl : Blue	g : Grey
j : Yellow	jvt : Yellow/Green	m : Brown
n : Black	o : Orange	r : Red
ro : Pink	vt : Green	v : Purple

CONNECTOR

A - Indicator light module
C - Predisposition option (connector holder 6 pin white)
D - Predisposition option comodo (clip holder 8 pin white)
E - Predisposition option lighting (clip holder 8 pin green)
J - Gear reverser / sound alarm
L - Cab

ELECTRICS COMPONENTS

E1 - R.H. rear indicator
E2 - R.H. front indicator
E3 - L.H. rear indicator
E4 - L.H. front indicator
E5 - Rear reverse light
E6 -
E7 - Rear right position light
E8 - Front right position light
E9 - Rear left position light
E10 - Front left position light
E11 - L.H. front low beam
E12 - R.H. front low beam
E13 - L.H. front main beam
E14 - R.H. front main beam
E15 - R.H. working tail light
E16 - L.H. working tail light
E17 - L.H. front working headlight
E18 - R.H. front working headlight
E19 - Revolving light
E20 - Stoplight
E21 - Roof light

CAB FUSES

F1 - Lighting switch (15A)
F2 - Warning unit (10A)
F3 - Rear windscreen wiper (7.5A)
F4 - Motor stop electrovalve (5A)
F5 - 1 Front working headlight (7.5 A)
2 Front working headlight (15A)
F6 - Heating ventilation (15A)
F7 - Indicator light module /Fault sound alarm (5A)
F8 - Front windscreen wiper/Front windscreen washer (10A)
F9 - Indicator (10A)
F10 - Light throw-over and backward movement alarm (10A)
F11 - Parking brake / Sound alarm / Stoplight (10A)
F12 - Revolving light (7.5A)
F13 - Right sidelight (5A)
F14 - L.H. sidelights (5A)
F15 - R.H. indicators (7.5A)
F16 - L.H. indicators (7.5A)
F17 - Low beam (10A)
F18 - Main beam (10A)
F19 - Roof light (3A)
F20 - Free (+permanent)
F21 - 1 Working tail light (7.5A)
2 Working tail light (15A)
F22 - Differential locking (5A)
F23 - Start engine (20A)
F24 - Order cab lifting (5A)

POWER FUSES ON BATTERY TANK

F25 - Preheating (50A)
F26 - Alternator (70A)
F27 - Key switch (70A)
F28 - Cab lifting (50A)

B1 - Road alarm
B2 - Failure alarm
B3 - Backward movement alarm

G1 - Battery
G2 - Alternator

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H1 - Load indicator light
H2 - Engine oil pressure indicator light
H3 - Sealing oil filter indicator light
H4 - Air filter clogging indicator light
H5 - Engine water temperature indicator light
H6 - Flashing lights
H7 - Free
H8 - Main beam indicator light
H9 - Brake indicator light
H10 - Warning unit indicator light
H11 - Brake indicator light
H12 - Control panel lighting
H13 - Control panel lighting

K1 - Starting safety relay
K2 - Flasher unit
K3 - Reverse relay
K4 - Cab lifting relay
K5 - Shunt between 3 and 5 on relay support
K6 - Forward relay
K7 - Preheating relay

M1 - Starter
M2 - Front windscreen wiper
M3 - Windscreen washer
M4 - Rear windscreen wiper
M5 - Ventilator (Heating)
M6 - Cab lifting pump
M7 - Heating ventilation

P1 - Hourmeter
P2 - Fuel level

R1 - Preheating resistor
R2 - Fuel level

S1 - Key switch
S2 - Forward / reverse selector
S3 - Engine oil pressure switch
S4 - Hydraulic filter clogging
S5 - Air filter clogging
S6 - Engine water temperature
S7 - Parking brake switch
S8 - Windscreen switch/Front windscreen wiper
S9 - Horn switch
S10 - Proximity detector
S11 - Warning unit switch
S12 - Battery cut-off
S13a - Sidelight lighting switch
S13b - Low beam / main beam lighting switch
S13c - Indicators lighting switch
S15 - Working tail light switch
S16 - Stop contactor
S17 - Roof light switch
S18 - Front working headlight switch
S19 - Revolving light switch
S20 - Windscreen wiper tail switch
S21 - Ventilation switch (heating)
S22 - Cab lifting switch
S23 - Differential locking switch

V1 - Test diode (interior of the module 9 indicator light)
V2 - Rear light diode and buzzer rear gear

Y1 - Motor stop electrovalve
Y2 - Backward gear electrovalve
Y3 - Forward gear electrovalve
Y4 - Parking brake electrovalve
Y5 - Operating cab going down electrovalve
Y6 - Flow divisor electrovalve

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