W170/W170TC

WHEEL LOADER

Workshop Manual

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THIS ALERT SYMBOL SIGNALS IMPORTANT MESSAGES INVOLVING YOUR SAFETY.

Read and heed carefully the safety instructions listed and follow the precautions recommended to avoid potential risks and to safeguard your health and your safety.

You will find this symbol in the text of this Manual referred to the following key words:

***WARNING* - Cautions directed to avoid improper repair interventions involving potential consequences for the operator's safety.**

***DANGER* - These warnings qualify specifically potential dangers for the safety of the operator or other persons directly or indirectly involved.**

IMPORTANT NOTICE

All maintenance and repair interventions explained in this Manual **must be performed exclusively by the Service Organization of the Manufacturer,** observing strictly the instructions explained using, whenever necessary, the recommended specific tools.
Whoever performs the operations reported without following exactly the precautions is responsible on his own, for the damages that may result.

Neither the Factory nor any Organizations in its Distribution Network, including but not limited to national, regional or local distributors, are responsible for any liability arising from any damage resulting from defects caused by parts and/or components not approved by the Factory for use in maintaining and/or repairing products manufactured or merchandized by the Factory.
In any case, no warranty of any kind is made or shall be imposed with respect to products manufactured or merchandized by the Factory, when failures are caused by the use of parts and/or components not approved by the Factory.

SAFETY RULES

In case tests during which the engine should be kept runninng, a qualified operator must sit in the driver's seat with the mechanic in sight at all times. Place the transmission in neutral, apply and lock the brakes. KEEP HANDS OFF MOVING PARTS.

In case of field service, move machine to level ground, if possible, and block it. If work on an incline cannot be advised, block the machine and its attachments securely. Move damaged to level ground as soon as possible.

Do not trust worn and/or kinked chains and cables. Never use them for lifting or pulling. Always wear heavy gloves to handle chains or cables.

Be sure chains and cables are firmly fastened and that anchor points are strong enough to withstand the expected load. Nobody should stay near the anchor points, cables or chains. DO NOT PULL OR TOW UNLESS THE OPERATOR'S COMPARTMENTS OF THE MACHINES INVOLVED ARE FITTED WITH THE PROPER GUARDS AGAINST BACKLASH IN CASE OF CABLE OR CHAIN FAILURE OR DETACHMENT.
Keep the area where maintenance is carried out CLEAN and DRY at all times. Clean immediately all water and oil spillages.

Do not pile up oily or greasy rags as they represent a major fire hazard. Always store them in closed metal containers.

Before starting the machine or its attachment, check, adjust and lock the operator's seat. Also ensure that nobody is within the machine operating range. Sound the horn.

Rust inhibitors are volatile and flammable. Use them only in well ventilated areas. Keep open flames away - DO NOT SMOKE - Store containers in a cool well ventilatedplace where they could not be reached by unauthorised people.

Do not carry loose objects in your pockets that might fall unnoticed into open compartments.

Wear safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal particles or similar may be ejected and hit you.

Wear appropriate protective equipment such as dark safety glasses, hard hat, protective clothing, special gloves and footwear while welding. Nearby persons should also wear dark safety glasses even if they are not welding. DO NOT LOOK THE WELDING ARC WITHOUT PROPER EYE PROTECTION.

Become acquainted with all your jacking equipment and its capacity. Remember that the jacking point on the machine should be appropriate for the load applied. Also, be sure the support area of the jack at the machine and on the ground is appropriate and stable.

Any load supported by a jack represents a possible hazard. Always transfer the load onto appropriate support means according to local or national safety requirements before proceeding with service or maintenance work.

Metal cables get frayed after prolonged use. Always wear appropriate protections (heavy gloves, goggles, etc.) while handling them.

Handle all parts carefully. Keep hands and fingers away from gaps, gears, and similar. Always use and wear the appropriate protections.

Water can build up in pneumatic systems from condensate moisture due to changes in atmospheric conditions. If necessary, drain such deposits following instructions.

Before carrying out any maintenance work or service, lock the machine articulated frame modules using the appropriate safety device. Remember to remove and store it properly at the end of work.

If the machine is equipped with hydraulic brakes, make sure that the reservoir is always filled up to the correct level.

Always block all wheels, front and rear, before bleeding the braking system or disconnecting control hoses and/or cylinders.

STARTING

Do not run the engine in closed buildings without proper ventilation capable to remove lethal exhaust fumes.

Do not place head, body, limbs, feet, hands or fingers near rotating fans or belts.

Be especially careful near blower fans.

REMEMBER THAT THE STARTING FLUID IS HIGHLY FLAMMABLE. Follow recommendations provided in this Manual and printed on the containers. Containers must be stored in a cool, well ventilated place out of the reach of unauthorised persons.
DO NOT PUNCTURE OR BURN CONTAINERS.

ENGINE

Loosen the radiator cap very slowly to relieve system pressure before removing it. Always top-up coolant level with the engine off.

Avoid that flammable materials could touch exhaust parts. If not possible, provide necessary protections.

Do not refuel with the engine running, especially if hot, as this increases fire hazard.

Never attempt to check or adjust fan belt tensions when the engine is running.

Do not adjust the fuel pump when the machine is motion.

Do not lubricate the machine with the engine running.

Do not run the engine with air intakes, door or guards open.

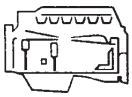
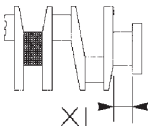
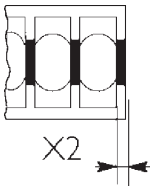
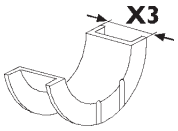
SOUND LEVEL DATA

Emission Engine with Standard Muffler	**Sound Level (Arithmetic Average) dBA**		
	Cab Closed	Cab Open	Canopy
Exterior Sound Level @ 15 meters per SAE J88 SEP80			
Stationary - Rated Speed	76.9	-	-
Stationary - High Idle	78.1	-	-
Moving	78.8	-	-
IMI	77.3	-	-
Component Cycling	79.2	-	-
Operator's Station Sound Level per SAE J919 JUN86			
Stationary - Rated Speed	73.6	84.2	-
Stationary - High Idle	74.3	87.3	-
Moving	74.5	86.4	-
IMI	75.1	87.1	-
Component Cycling	75.8	86.8	-

	Time Weighted Average Sound Level (Leq) dBA		
	Cab Closed	Cab Open	Canopy
Operator's Station Work Cycle per SAE J1166 MAR85 (no blowers)	-	-	-

Note – *Rated speed of engine is 2200 rpm and High - Idle is 2300-2380 rpm.*

Product	Color	Similar Products	Gap (In Inches)	Strength (Steel/Steel)	Working Temperature Range-Farenheit	Fixture/Full Cure (Steel/Steel) Time	Primer	Description
518	Red	515	0.030	500 psi	-65 to +300	1 hr/24 hrs	764	Gasket Eliminator 518 for Aluminum
542	Brown	569	N/A	132/92 in lbs	-65 to +300	2 hrs/24 hrs	747	Hydraulic Sealant
545	Purple		N/A	25/20 in lbs	-65 to +300	4 hrs/24 hrs	747	Low Strength Pneumatic/Hydraulic Sealant
549	Orange	504	0.020	2500 psi	-65 to +300	2 hrs/24 hrs	747	Instant Seal Plastic Gasket
554	Red	277	0.015	240/240 in lbs	-65 to +300	2 to 4 hrs/24 hrs	764	Refrigerant Sealant
567	White	592	N/A	500 psi	-65 to +400	4 hrs/24 hrs	764	Pipe Sealant for Stainless Steel
568	Orange	277	0.015	2500 psi	-65 to +300	12 hrs/24 hrs	764	Plastic Gasket
569	Brown	545	0.010	40/25 in lbs	-65 to +300	1 hr/24 hrs	764	Hydraulic Sealant
570	Brown	592	N/A	25/40 in lbs	-65 to +300	6 hrs/72 hrs	764	Steam Sealant
571	Brown	592	0.015	40/20 in lbs	-65 to +300	2 to 4 hrs/24 hrs	764	Pipe Sealant
572	White	578.575	N/A	80/27 in lbs	-65 to +300	24 hrs/72 hrs	None	Gasketing
592	White		0.020	500 psi	-65 to +400	4 hrs/72 hrs	736	Pipe Sealant with Teflon
593	Black		0.250	400 psi	-95 to +400	30 min/24 hrs	N/A	RTV Silicone
601	Green	609	0.005	3000 psi	-65 to +300	10 min/24 hrs	764	Current PIN #609
609	Green		0.005	3000 psi	-65 to +300	10 min/24 hrs	764	General Purpose Retaining Compound
620	Green	640	0.015	3000 psi	-65 to +450	30 min/24 hrs	747	High Temperature Retaining Compound
635	Green	680	0.010	4000 psi	-65 to +300	1 hr/24 hrs	747	High Strength Retaining Compound
638	Green	680	0.015	4100 psi	-65 to +300	10 min/24 hrs	747	High Strength Retaining Compound
640	Green	620	0.007	3000 psi	-65 to +400	1 hr/24 hrs	747	High Temperature Retaining Compound
660	Silver		0.020	3000 psi	-65 to +300	20 min/24 hrs	764	Quick Metal
675	Green	609	0.005	3000 psi	-65 to +300	20 min/24 hrs	747	General Purpose Retaining Compound
680	Green	635	0.015	4000 psi	-65 to +300	10 min/24 hrs	747	High Strength Retaining Compound
706	Clear	755	N/A	N/A	N/A	N/A	N/A	Cleaning Solvent
707	Amber		N/A	N/A	N/A	N/A	N/A	Activator for Structural Adhesives
736	Amber		N/A	N/A	N/A	N/A	N/A	Primer NF
738	Amber		N/A	N/A	N/A	N/A	N/A	Depend Activator
747	Yellow	N/A	N/A	N/A	N/A	N/A	N/A	Primer T
751	Clear		N/A	N/A	N/A	N/A	N/A	Activator for Structural Adhesives
755	Clear		N/A	N/A	N/A	N/A	N/A	Cleaning Solvent
764	Green		N/A	N/A	N/A	N/A	N/A	Primer N
767	Silver		N/A	N/A	-65 to +1600	N/A	N/A	Anti-Seize Lubricant

	Type		F4HE0684J
			*D100
CRANK GEAR COMPONENTS AND CYLINDER ASSEMBLY			mm
	Half bearings – journals: n. 1-7 n. 2-3-4-5-6		 0.041 to 0.119 0.041 to 0.103
	Half bearings – crankpins		0.033 to 0.041
	Main half bearings Connecting rod half bearings		+ 0.250; + 0.500
	Shoulder journal	X1	37.475 to 37.545
	Shoulder bed support	X2	25.98 to 26.48
	Shoulder half rings	X3	37.28 to 37.38
	Drive shaft shoulder		0.068 to 0.410

DESCRIPTION OF INJECTION SYSTEM

Control of engine pre-heater resistor

The pre-heater is activated every time even just one of the coolant, air or fuel sensors measures a temperature < 5 °C (41 °F).

Timing recognition

Through the signals of the sensor on the camshaft and the one on the crankshaft, the starting cylinder where the fuel must be injected is identified.

Control of injection

The controller, in accordance with the information provided by the sensors, controls the pressure regulator, changing the modes of the pre-injection and the main injection.
On tector engines, the pre-injection is activated at all engine speeds.

Closed circuit control of the injection pressure

Depending upon the engine load, determined by the processing of the signals provided by the various sensors, the controller controls the regulator to provide constantly an optimised pressure.

Control of pilot and main injection advance

The controller, depending upon the signals provided by the various sensors, defines the optimised injection point in accordance with an internal mapping.

Control of low idle speed

The controller processes the signals provided by the various sensors and regulates the quantity of fuel injected. It controls the pressure regulator and changes the injection timing of the electric injectors.
Within certain thresholds, it considers also the voltage of the batteries.

Overheating protection

In the event the coolant temperature reaches 110 °C (230 °F) the controller decreases the performance of the engine.
Once the temperature drops below 100 °C (212 °F) the engine resumes normal operations.

Limitation of maximum speed

At 2300 rpm, the controller limits the delivery of fuel by reducing the opening time of the electric injectors.

Cut-off

The cutting-off of fuel during the engine slow down or when used to brake is managed by the controller by performing these logics:

– it cuts-off supply to the electric injectors;

– it reactivates the electric injectors just before reaching low idle speed;

– it controls the fuel pressure regulator.

Control of smoke emission during accelerations

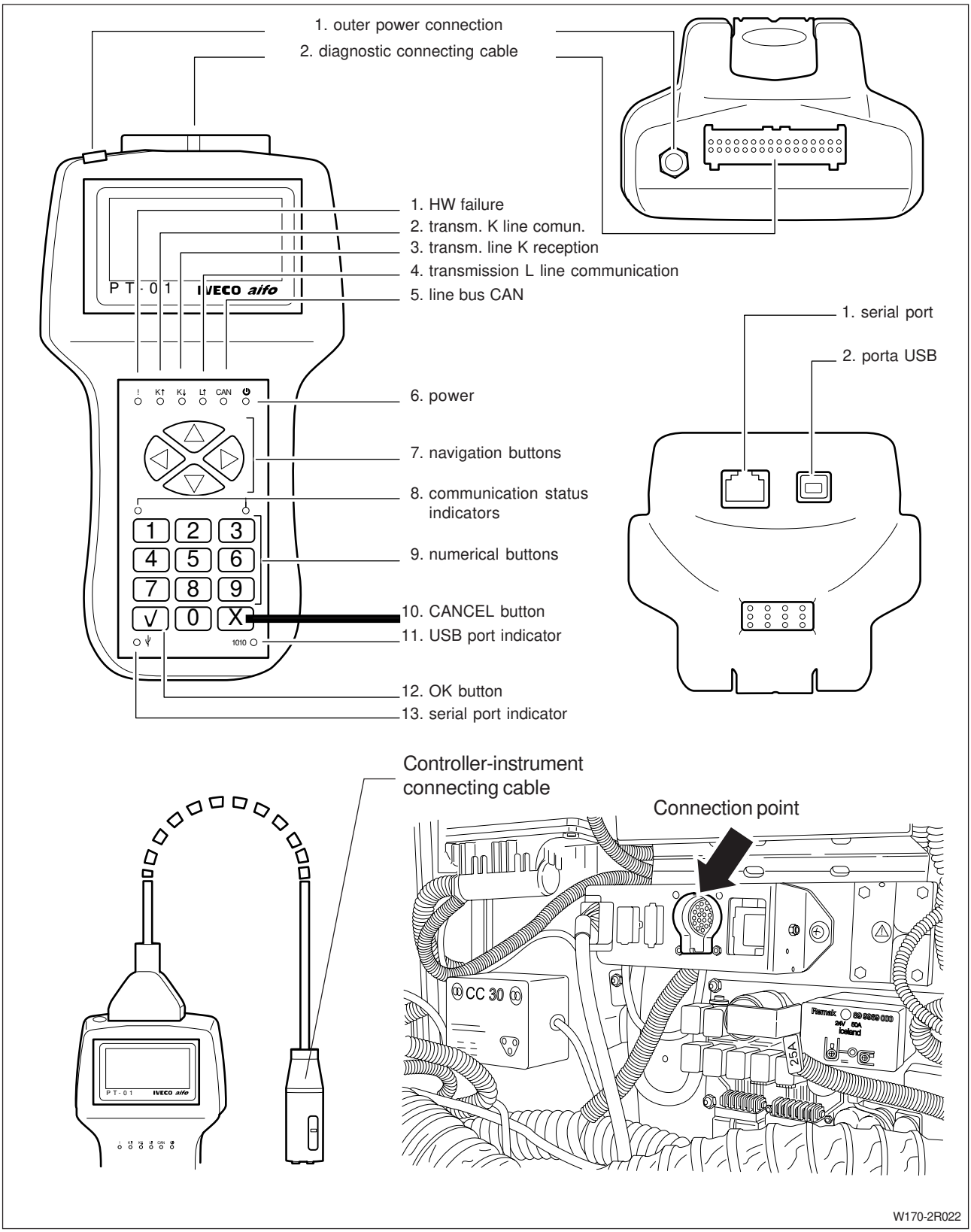
When high loads are required, the controller, depending upon the signals provided by the air intake measuring device and the crankshaft speed sensor, controls the pressure regulator and changes the actuation time of the electric injectors, to prevent the engine from smoking.

After Run

When cutting-off the engine, the microprocessor of the controller memorises some data in the EPROM including a trouble memory, so that the data are available when a new starting occurs.

1.5.1 TROUBLESHOOTING WITH PT-01 INSTRUMENT

The **380001218** diagnostic instrument shown in the illustration is supplied with a set of connecting cables as well as an Operation Manual.



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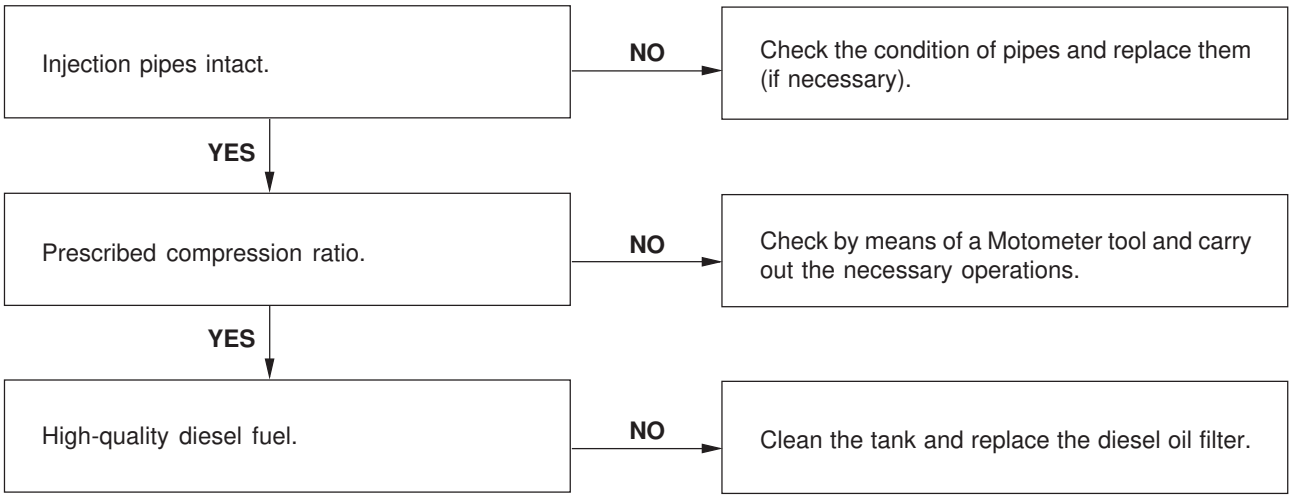
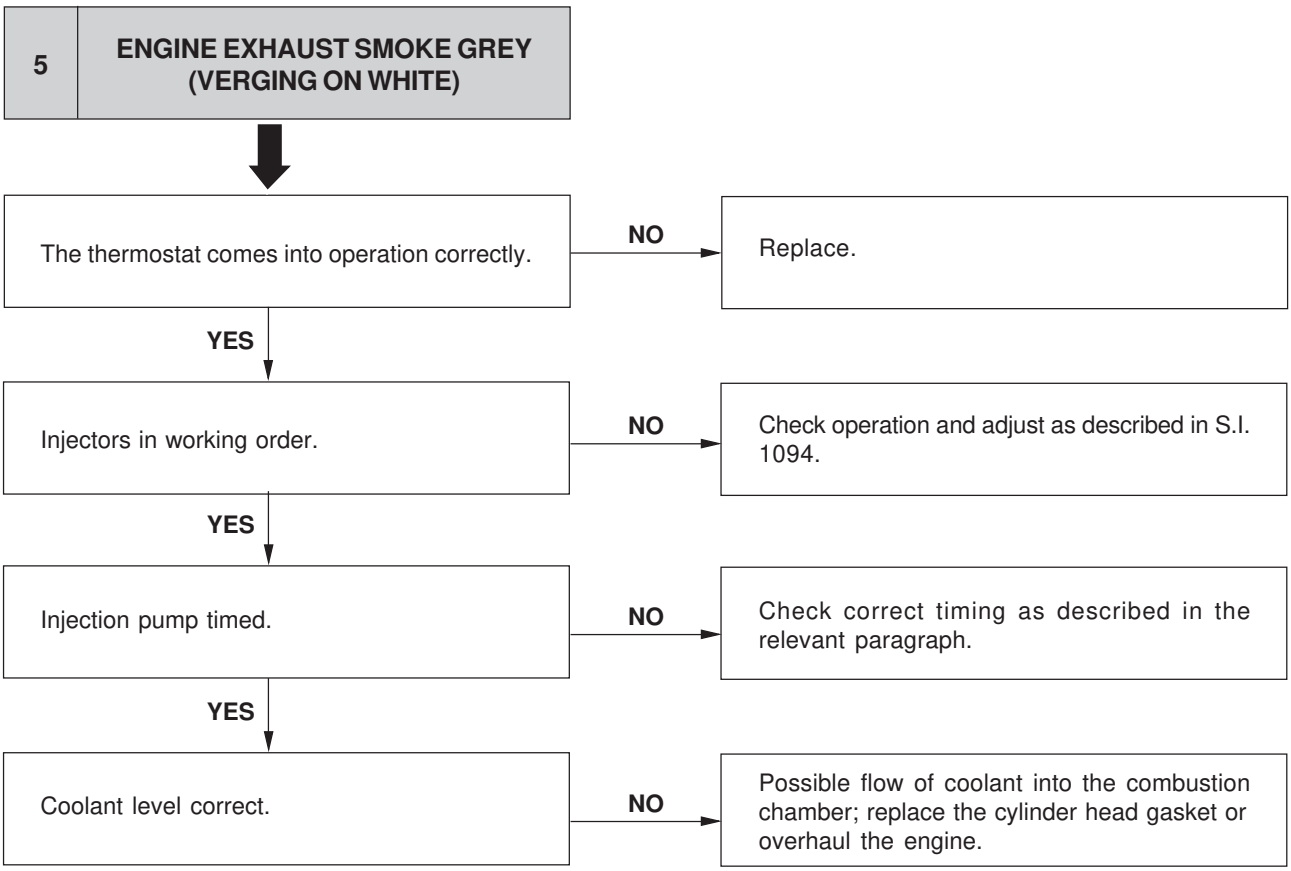
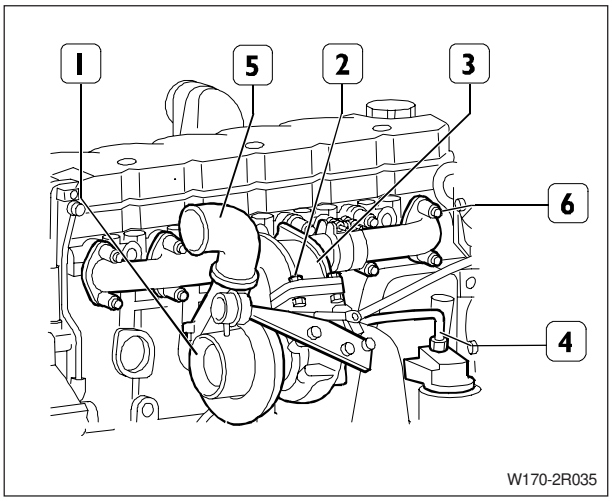
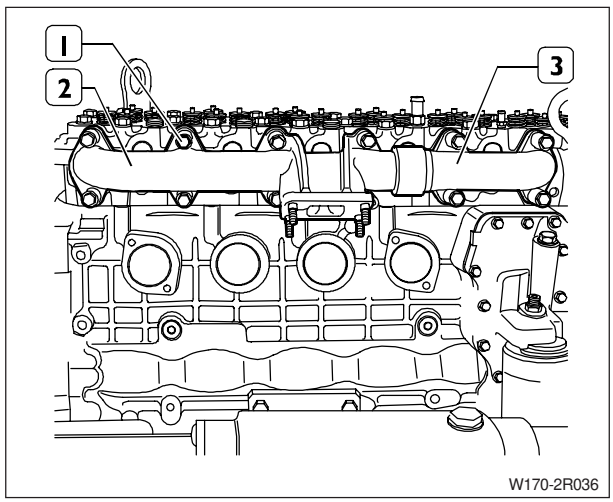

Injection pipes intact.
NO
Check the condition of pipes and replace them (if necessary).
YES
Prescribed compression ratio.
NO
Check by means of a Motometer tool and carry out the necessary operations.
YES
High-quality diesel fuel.
NO
Clean the tank and replace the diesel oil filter.

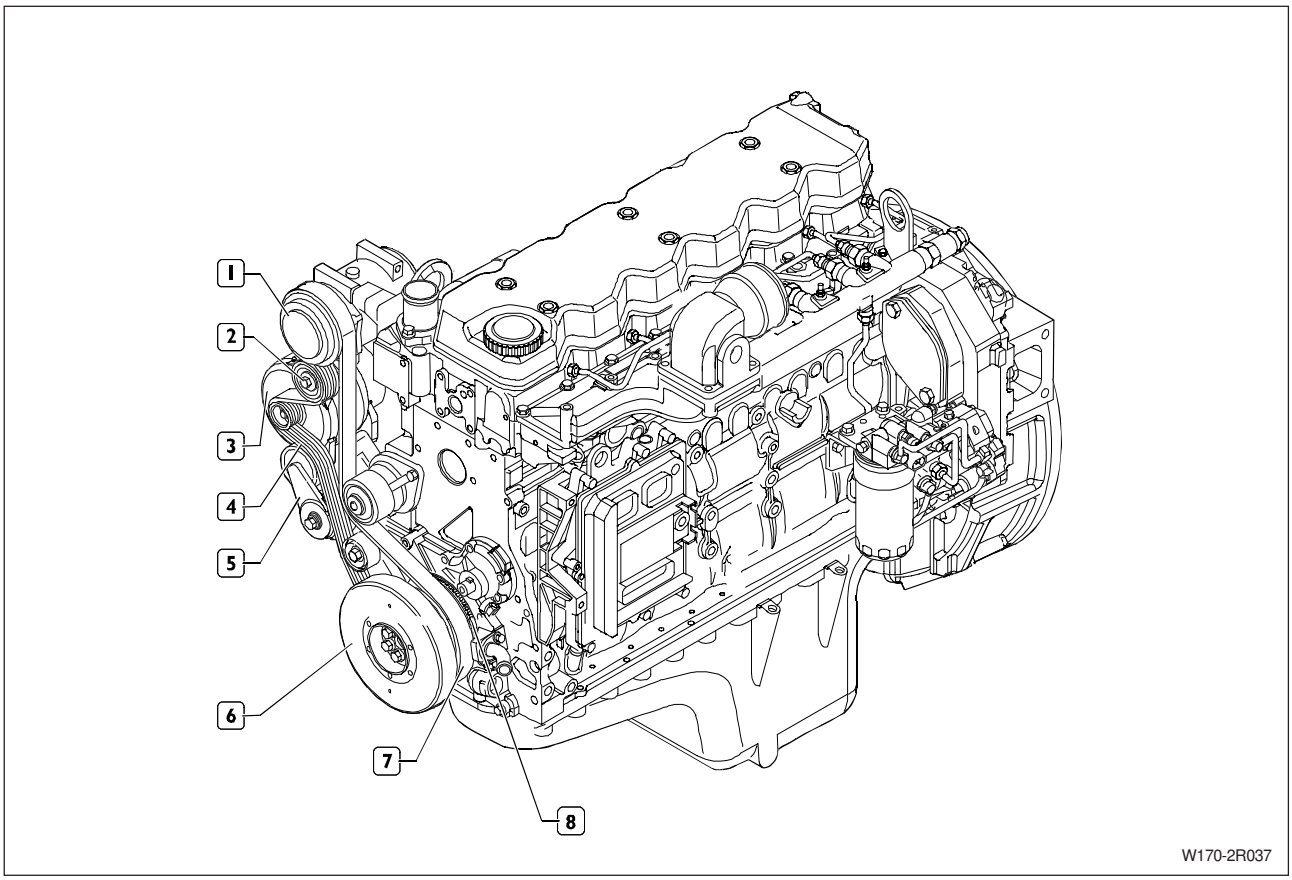

5
ENGINE EXHAUST SMOKE GREY (VERGING ON WHITE)
The thermostat comes into operation correctly.
NO
Replace.
YES
Injectors in working order.
NO
Check operation and adjust as described in S.I. 1094.
YES
Injection pump timed.
NO
Check correct timing as described in the relevant paragraph.
YES
Coolant level correct.
NO
Possible flow of coolant into the combustion chamber; replace the cylinder head gasket or overhaul the engine.



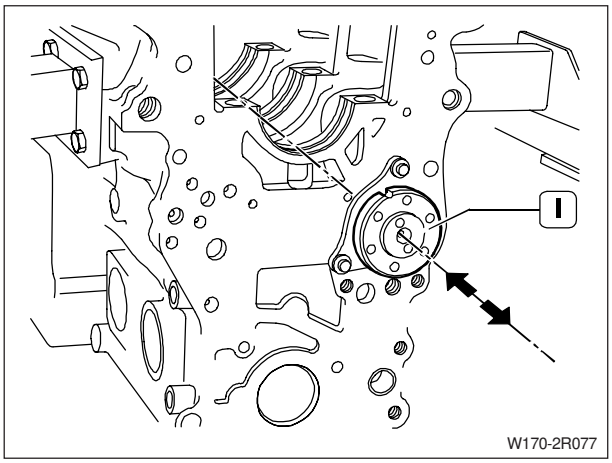
Detach the conveyor (**5**) from the turboblower (**1**).
Disconnect the oil hose from the heat exchange/oil filter support.
Remove the nuts (**2**) and detach the turboblower (**1**) from the exhaust manifold (**3**).



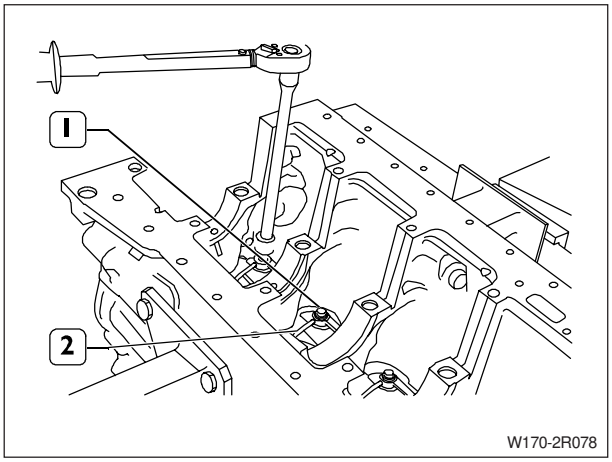
Remove the lock screws (**1**) and detach the exhaust manifold in two parts (**2**-**3**) with the related gaskets.



– Remove the automatic take-up device (**5**);
– remove the Poly-V belt (**4**);
– remove the conditioner compressor (**1**), the alternator (**3**) and the fixed guide pulley (**2**);
– remove the fitting of the engine cooling system from the engine block;
– remove the damper flywheel (**6**) with the pulley underneath (**7**);
– remove the phonic wheel (**8**).



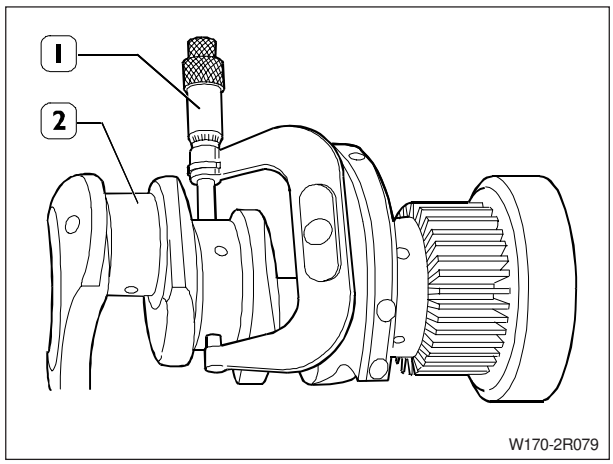
Check camshaft end float (**1**).
It shall be 0.23 ± 0.13 mm (0.009 ± 0.005 in).



Fit nozzles (**2**) and tighten the fastening screws (**1**) to the specified torque.

CRANK SHAFT

Measuring journals and crankpins

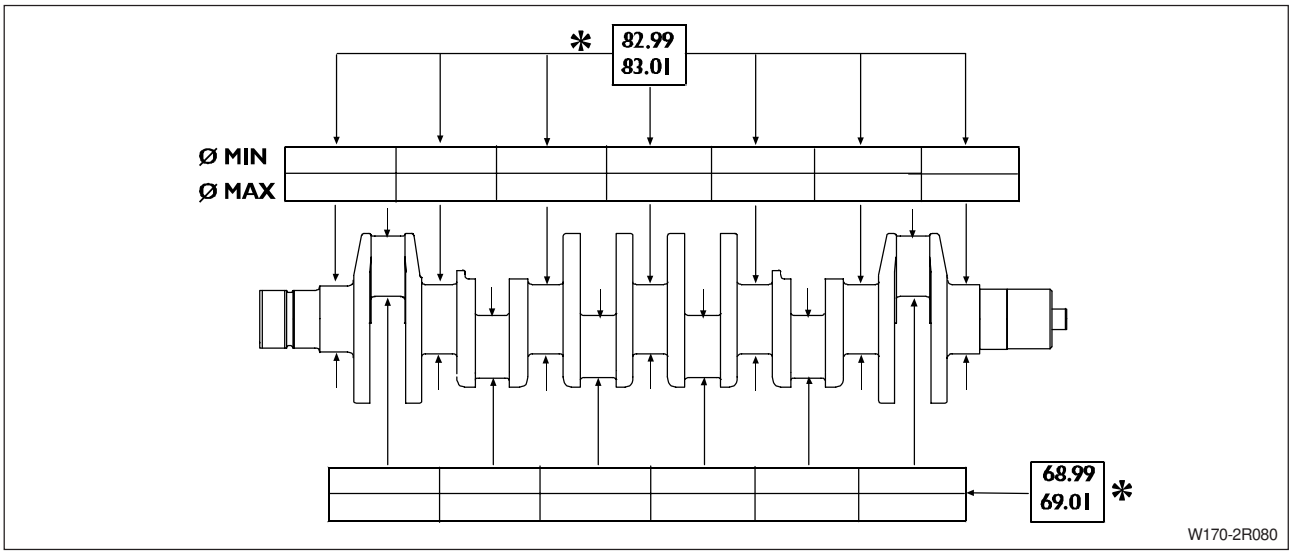


Grind journals and crankpins if seizing, scoring or excessive ovalisation are found. Before grinding the pins (**2**) measure them with a micrometer (**1**) to decide the final diameter to which the pins are to be ground.

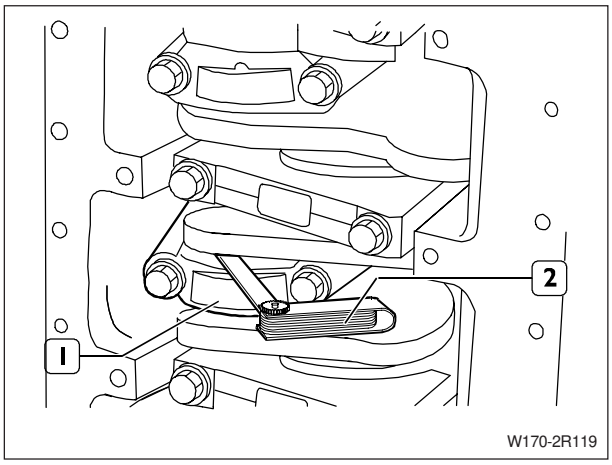
Important – *It is recommended to insert the found values in the proper table.*

Undersize classes are: 0.250 - 0.500 mm (0.010 - 0.020 in)

Important – *Journals and crankpins shall always be ground to the same undersize class. Journals and crankpins undersize shall be marked on the side of the crank arm No.1.*
For undersized crankpins: letter M
For undersized journals: letter B
For undersized crankpins and journals: letters MB



FILL THIS TABLE WITH OUTPUT SHAFT JOURNAL AND CRANKPIN MEASURED VALUES

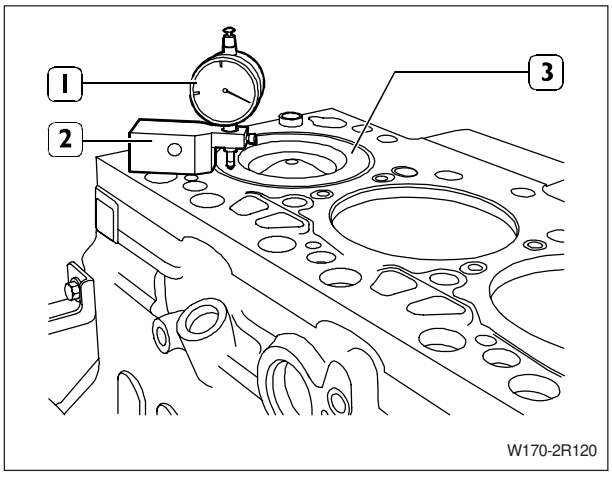


If a different clearance value is found, replace the half bearings and repeat the check. Once the specified clearance has been obtained, lubricate the main half bearings and fit them by tightening the connecting rod cap fastening screws to the specified torque.

Important – *Before the final fitting of the connecting rod cap fastening screws, check that their diameter measured at the centre of the thread length is not < 0.1 mm than the diameter measured at approx. 10 mm from screw end.*

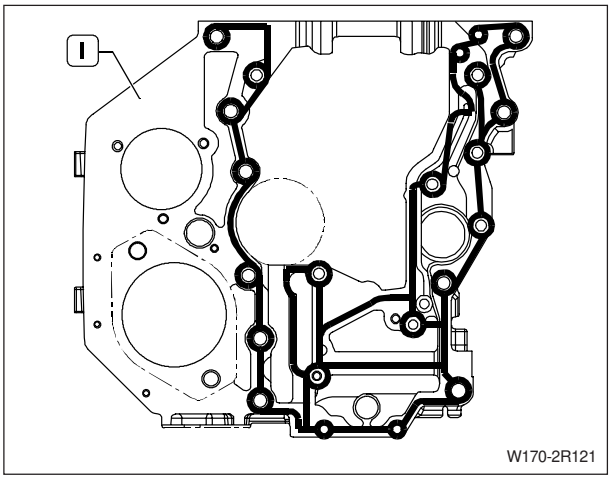
Check manually that the connecting rods (**1**) are sliding axially on the output shaft pins and that their end float, measured with feeler gauge (**2**) is 0.10 ÷ 0.33 mm (0.004 ÷ 0.13 in).

Checking piston protrusion



Once connecting rod-piston assemblies refitting is over, use dial gauge **380000228** (**1**) fitted with base **380000364** (**2**) to check piston (**3**) protrusion at T.D.C. with respect to the top of the engine block.
Protrusion shall be 0.28 ÷ 0.52 mm (0.11 ÷ 0.20 in).

Timing gear case



SEALANT APPLICATION AREAS

Clean accurately the timing gear case (**1**) and the engine block. Perfect seal is only obtained by cleaning accurately the surface to seal. Smear the case with sealant to obtain a bead of few mm diameter. It shall be uniform (no clots), without air bubbles, thin areas or discontinuities. Any imperfection shall be corrected as soon as possible. Avoid to use excess material to seal the joint. Excessive sealant could come out from joint sides and cause lubricant passage clogging. After applying the sealant, the joint shall be assembled immediately (10 - 20 minutes).

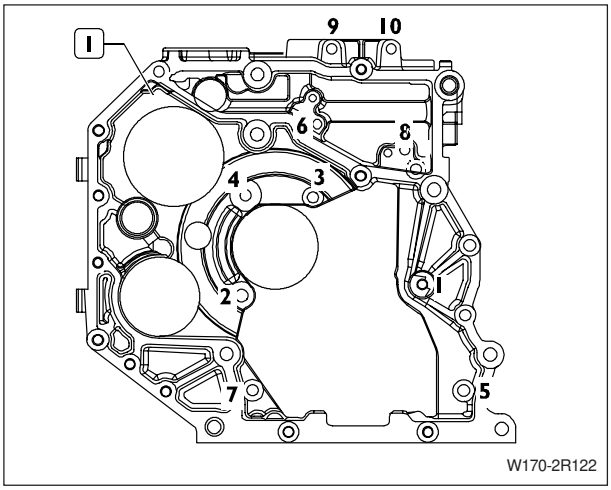
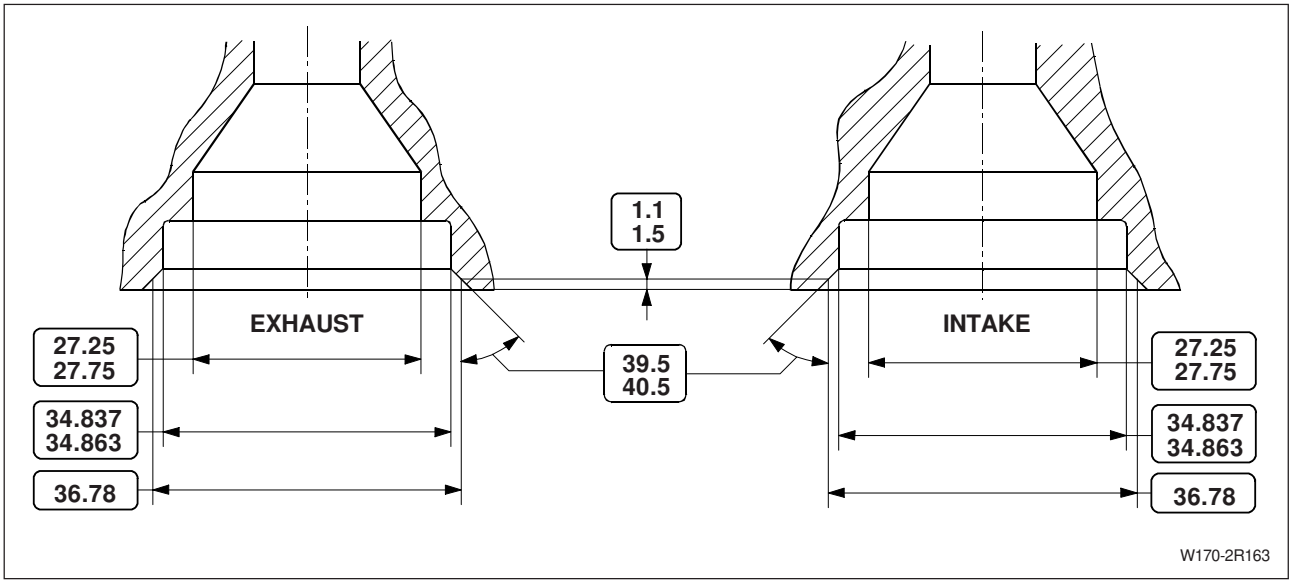


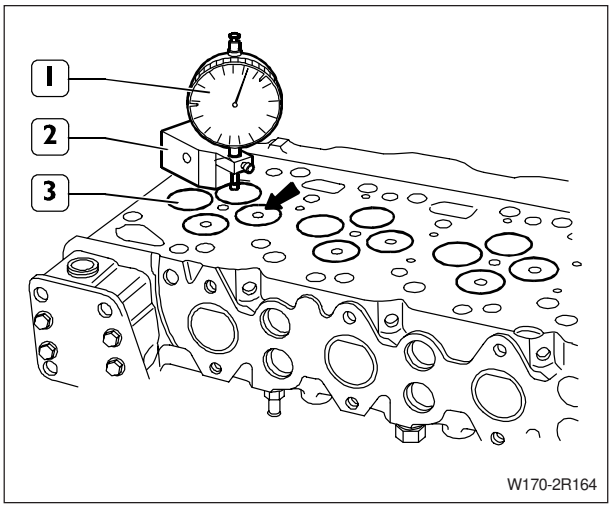
DIAGRAM FOR TIGHTENING THE REAR TIMING GEAR CASE FASTENING SCREWS

Refit the case (**1**) to the engine block. Screw the fastening screws in the same position found at removal and tighten them to the following torque values in the sequence shown in the figure:
Screws M12 65 ÷ 89 Nm (47.94 ÷ 65.64 lb.ft.)
Screws M8 20 ÷ 28 Nm (14.75 ÷ 20.65 lb.ft.)
Screws M10 42 ÷ 52 Nm (30.98 ÷ 38.35 lb.ft.)



MAIN DATA CONCERNING THE SEATS ON THE CYLINDER HEAD

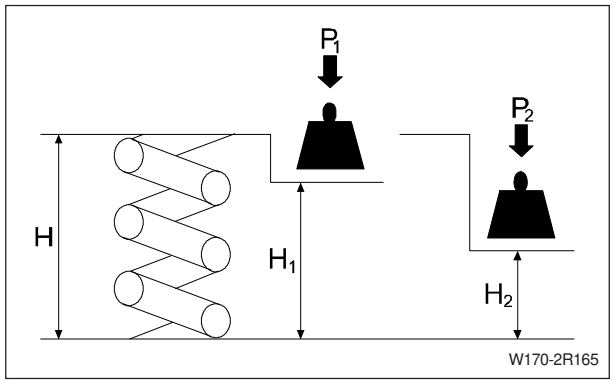
Should valve seats be not reset just by regrinding, replace them with the spare ones. Use tool **380000975** to remove as much material as possible from the valve seats (take care not to damage the cylinder head) until they can be extracted from the cylinder head using a punch.



After regrinding, check that valve (**3**) sinking value is the specified one by using the base **380000364** (**2**) and the dial gauge **380000228** (**1**).

Heat the cylinder head to 80° ÷ 100 °C (176 ÷ 212 °F) and using the proper beater, fit the new valve seats, previously cooled, into the cylinder head.
Use tool **380000828** to regrind the valve seats according to the values shown in Figure.

VALVE SPRINGS



MAIN DATA TO CHECK INTAKE AND EXHAUST VALVE SPRINGS

Before refitting use tool **380000976** to check spring flexibility. Compare load and elastic deformation data with those of the new springs shown in the following table.

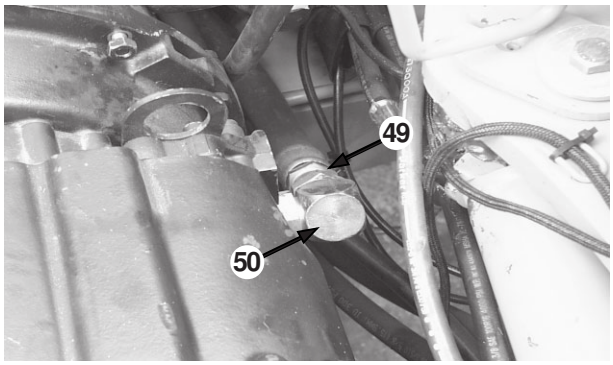
Height		Under a load of	
mm		N	
H	47.75	Free	
H1	35.33	P	339.8 + 9 N
H2	25.2	P1	741 + 39 N

TIGHTENING TORQUE

PART				COUPLE Nm	COUPLE (kgm)
Cylinder head fastening screw	1st phase:	screws M12x1.75x70		50 ± 5	(5 ± 0.5)
		screws M12x1.75x140		40 ± 5	(4 ± 0.5)
		screws M12x1.75x180	s	70 ± 5	(7 ± 0.5)
	2nd phase:			90°	
	3rd phase:	(only for screw 140 and 180 mm lomg)		90°	
Bed cap fastening screws	1st phase			50 ± 6	(5 ± 0.6)
	2nd phase		s	80 ± 6	(8 ± 0.6)
	3rd phase			90° ± 5°	
Connecting rod cap fastening	1st phase			30 ± 5	(3 ± 0.5)
	2nd phase		s	50 ± 5	(5 ± 0.5)
	3rd phase			60° ± 5°	
Engine flywheel fastening screws	pre-tighten		s	30 ± 5	(3 ± 0.5)
	Angle			60° ± 5°	
Injector fastening				60 ± 5	(6 ± 0.5)
Sump oil drain plug				60 ± 5	(6 ± 0.5)
Fuel filter				contact + 3/4 turn	
Injection pump gear cover fastening screw				25 ± 5	(2.5 ± 0.5)
Valve gear cover and case fastening screw				25 ± 5	(2.5 ± 0.5)
Container fastening screw				25 ± 5	(2.5 ± 0.5)
Intake manifold fastening screw				25 ± 5	(2.5 ± 0.5)
Fuel pump fastening screw				25 ± 5	(2.5 ± 0.5)
Exhaust manifold fastening screw				53 ± 5	(5.3 ± 0.5)
Tappet cover fastening nut				25 ± 5	(2.5 ± 0.5)
Rocker arm support fastening screw				48 ± 8	(4.8 ± 0.5)
Nut for rocker arm adjusting screw				25 ± 5	(2.5 ± 0.5)
Screw fastening the pulley on drive shaft		pre-tighten		50 ± 5	(5 ± 0.5)
		Angle		90° ± 5°	
Distributing shaft shoulder plate fastening screw				25 ± 5	(2.5 ± 0.5)
Fan support fastening screw				25 ± 5	(2.5 ± 0.5)
Injection pump fastening screw				12 ± 5	(1.2 ± 0.5)
Fan pulley fastening screw				45 ± 5	(4.5 ± 0.5)
Turbocompressor fastening screw				25 ± 5	(2.5 ± 0.5)
Heat exchanger fastening screw				25 ± 5	(2.5 ± 0.5)
Oil pump and front cover fastening screw				25 ± 5	(2.5 ± 0.5)
Starter motor fastening screw				55 ± 5	(5.5 ± 0.5)
Alternator fastening screw				45 ± 5	(4.5 ± 0.5)
Water pump fastening screw				25 ± 5	(2.5 ± 0.5)
Oil filter				contact + 3/4 turn	
Belt stretcher fastening screw				45 ± 5	(4.5 ± 0.5)

s - Lubrication with oil

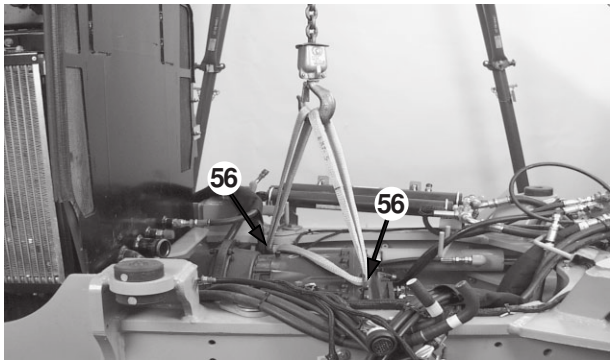
STEP 21



BD01D340

Repeat Steps **20** and **21** to disconnect cooler hose (**49**) and remove fitting (**50**).

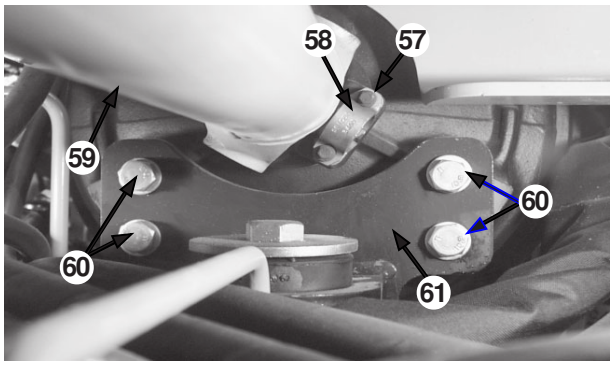
STEP 22



BD01D343

Connect lifting equipment to transmission lifting eyes (**56**). Take up all slack in lifting equipment.

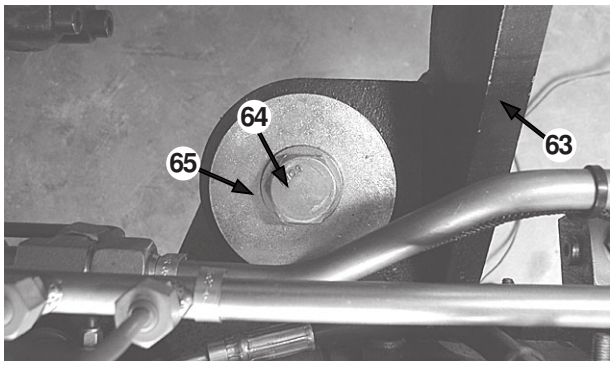
STEP 23



BD01D342

In area between rear of transmission and front of engine, remove four bolts (**57**) and two straps (**58**). Discard bolts (**57**) and straps (**58**). Use pry bar to disconnect engine drive shaft (**59**) from transmission. Using 3/4 inch drive socket, extensions, and impact wrench, remove four bolts (**60**) and washers securing transmission to top mounting bracket (**61**).

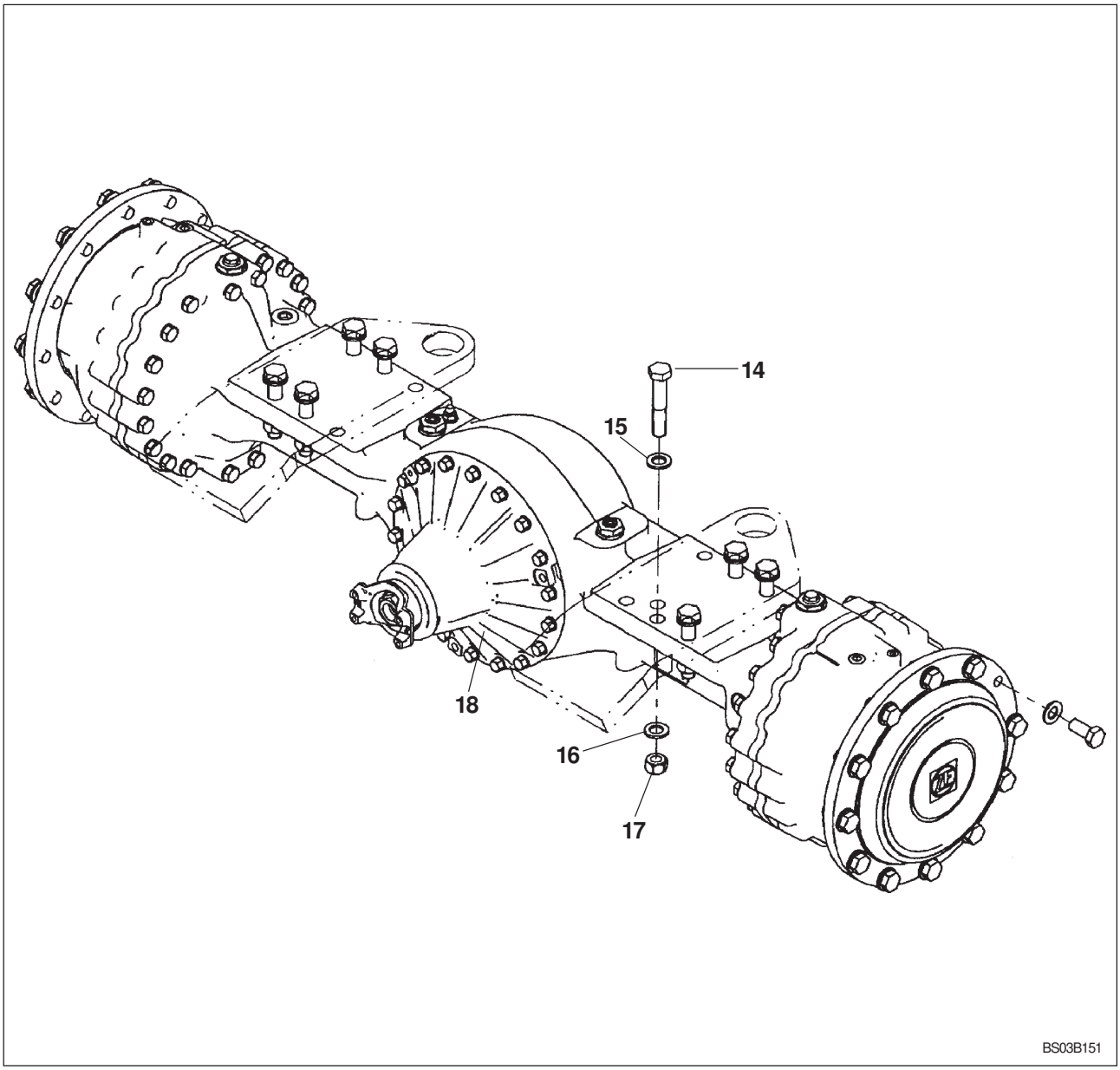
STEP 24



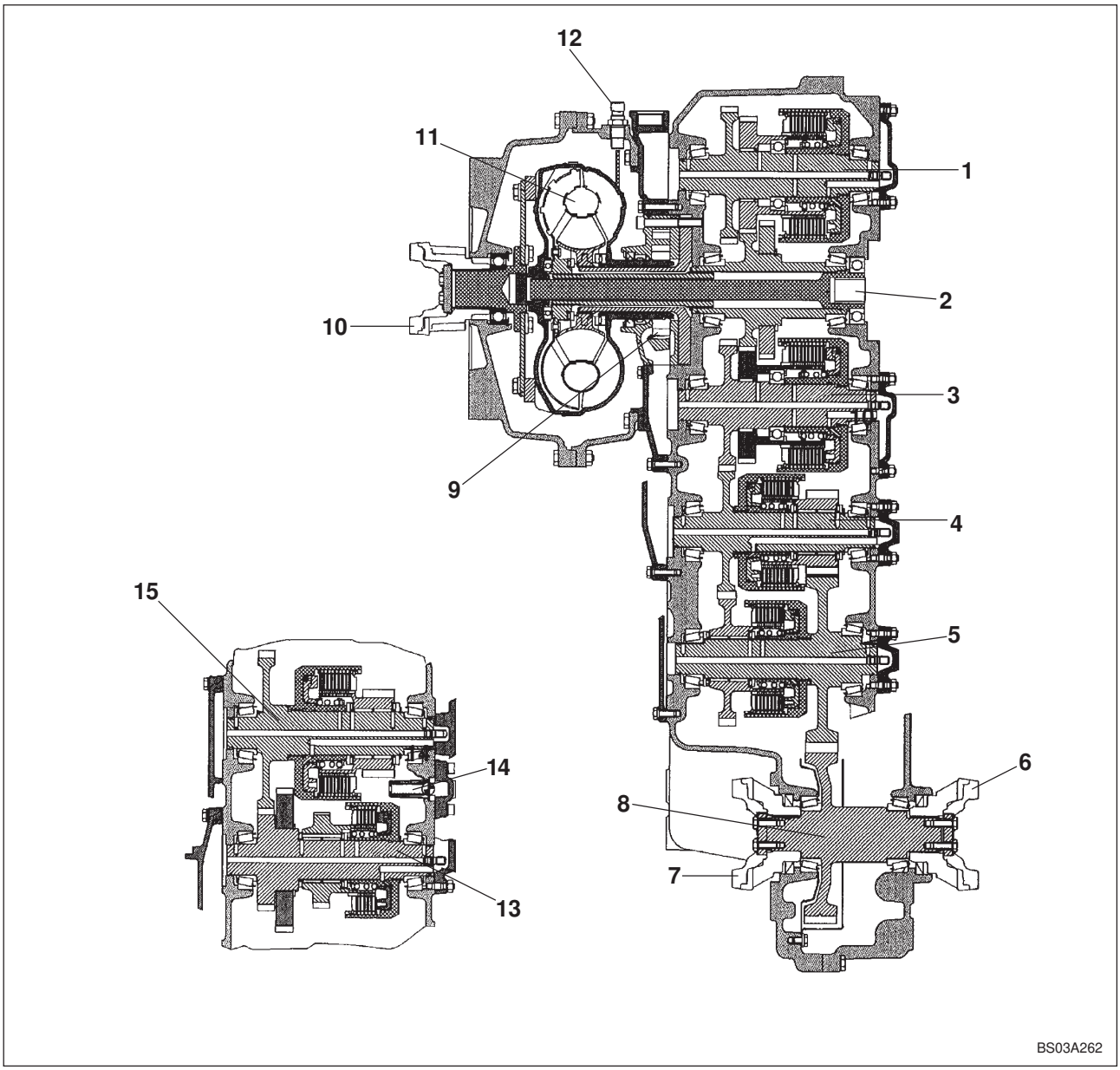
BD03A163

Remove bolts (**64**) and washers (**65**) securing RH and LH mounting brackets (**63**) to rear chassis.

Front Axle Mounting



14. Bolt - **15.** Washer - **16.** Washer - **17.** Nut - **18.** Front axle.



Component locations transmission layout

1. Clutch shaft KR - **2.** Power take OFF - **3.** Clutch shaft KV - **4.** Clutch shaft K2 - **5.** Clutch shaft K3 - **6.** Output flange rear - **7.** Output flange converter side - **8.** Output shaft - **9.** Transmission pump - **10.** Input flange - **11.** Converter - **12.** Inductive transmitter for engine speed - **13.** Clutch shaft K4 - **14.** Converter relief valve - **15.** Clutch shaft K1.

2.2.5 CHART FOR RECORDING PRESSURE READINGS

Use this chart to record the pressure readings.

P.I.N. Number:								Date:		
TEST POINTS										
Shift Speed	P 65	V 53	R 55	1 56	2 57	3 58	4 60	5 51	6 52	LP
1st F										
2nd F										
3rd F										
4th F										
1st R										
2nd R										
3rd R										
Neut										

LP. Lube pressure - **P.** Main pressure - **R.** Reverse clutch - **V.** Forward clutch - **1.** First gear clutch - **2.** Second gear clutch - **3.** Third gear clutch - **4.** Fourth gear clutch - **5.** Converter in - **6.** Converter out.

DEFINITION OF OPERATING MODES

NORMAL:

There's no failure detected in the transmission-system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (see following table)

SUBSTITUTE CLUTCH CONTROL:

TCU can't change the gears or the direction under the control of the normal clutch modulation. TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

LIMP-HOME:

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear .

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

TRANSMISSION-SHUTDOWN:

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1). Transmission shifts to Neutral. The park brake will operate normally, also the other functions which use ADM 1 to ADM 8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU-SHUTDOWN:

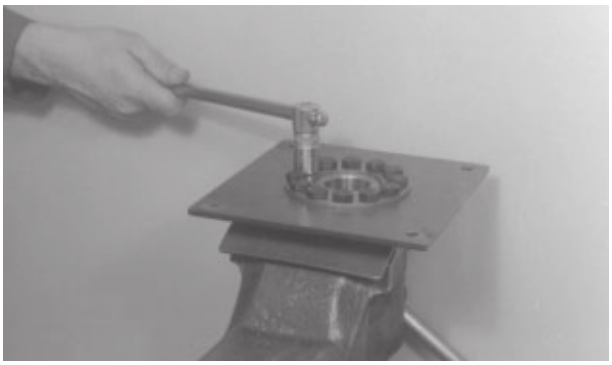
TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also all functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

Fault Code (hex)	SPN	FMI	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
			• *regulator has an internal defect*	OP-Mode: TCU shutdown	• check internal wire harness of the • gearbox	
87	5530	3	S.C. TO BATTERY VOLTAGE AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too high. • *cable / connector is defective and has* • *contact to battery voltage* • *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	• check the cable from TCU to the • gearbox • check the connectors from gearbox • to TCU • check the regulator resistance • check internal wire harness of the • gearbox	
88	5530	4	S.C. TO GROUND AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too low. • *cable / connector is defective and has* • *contact to vehicle ground* • *cable / connector is defective and has* • *contact to another regulator output of* • *the TCU* • *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	• check the cable from TCU to the • gearbox • check the connectors from gearbox • to TCU • check the regulator resistance • check internal wire harness of the • gearbox	
89	5530	5	O.C. AT CLUTCH KR the measured resistance value of the valve is out of limit. • *cable / connector is defective and has* • *no contact to TCU* • *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	• check the cable from TCU to the • gearbox • check the connectors from gearbox • to TCU • check the regulator resistance • check internal wire harness of the • gearbox	
91	5560	4	S.C. TO GROUND AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground • *cable is defective and is contacted* • *to vehicle ground* • *backup alarm device has an internal* • *defect* • *connector pin is contacted to vehicle* • *ground*	backup alarm will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	• check the cable from TCU to the • backup alarm device • check the connectors from backup • alarm device to TCU • check the resistance of backup • alarm device	

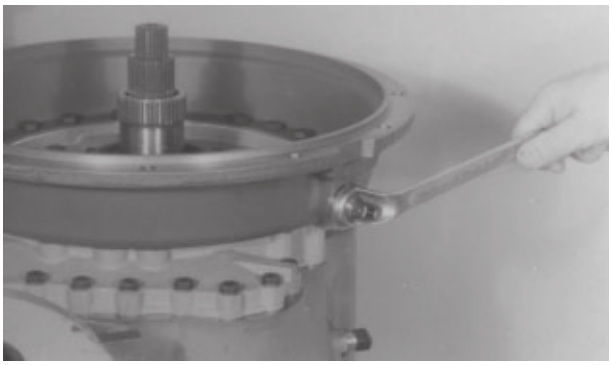
STEP 13



GD98M850

Put input shaft and diaphragm in vise as shown. Remove 12 hex head screws to separate diaphragm and input shaft.

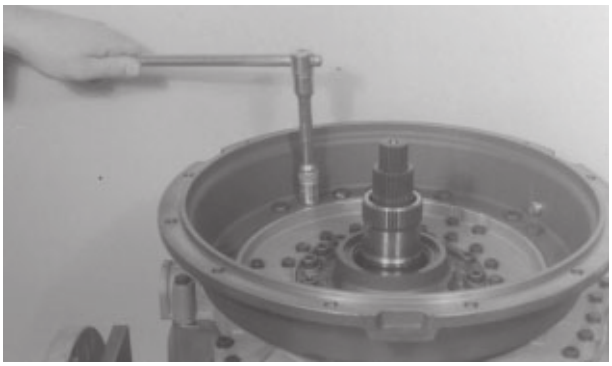
STEP 14



GD98M851

Remove the inductive transmitter.

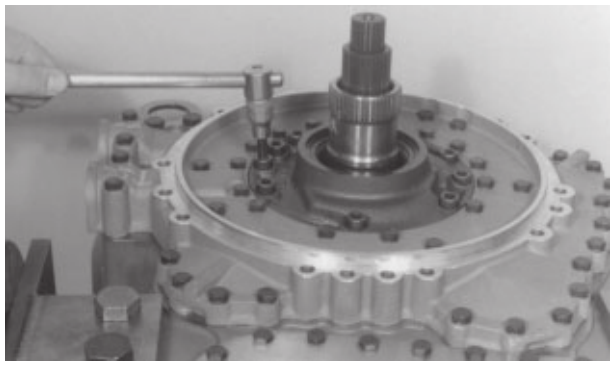
STEP 15



GD98M852

Remove the hex head screws and remove the converter housing.

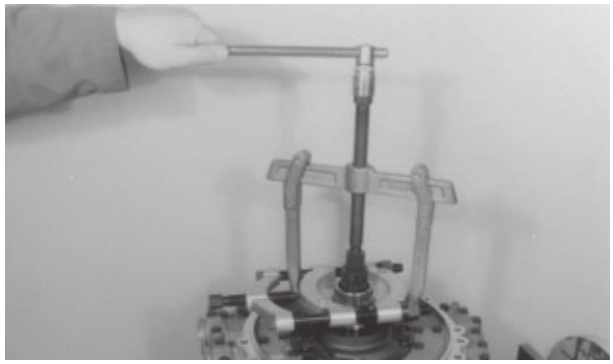
STEP 16



GD98M853

Remove the socket head screws for removal of the transmission pump.

STEP 17

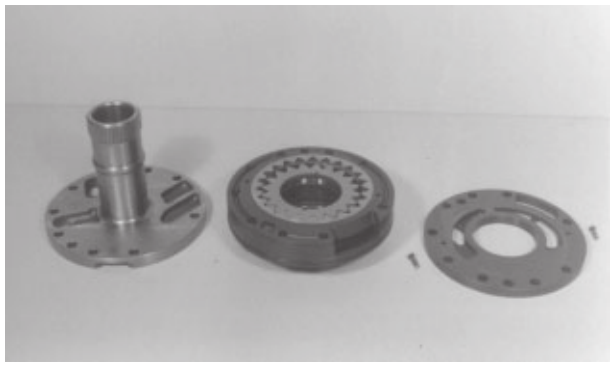


GD98M854

Apply a bearing separator on the splines shoulder of the stator shaft and pull the pump out of the housing bores, using two-leg puller.

Note – *If traces of wear should be encountered in the pump housing or the cam disk, the complete pump has to be replaced.*

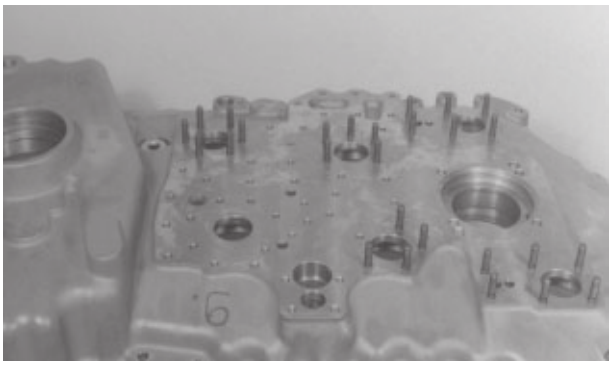
STEP 18



GD98M855

Separate the transmission pump from stator. Separate the cam plate from pump.

STEP 72

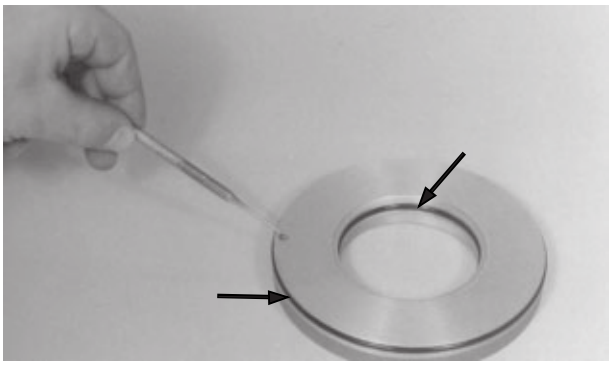


GD98M610

Install the studs. Tighten the studs to a torque of 9 Nm (80 lb-in).

Note – *The following steps are for the assembly of clutches KV and KR, starting with assembly of the clutch disc carrier.*

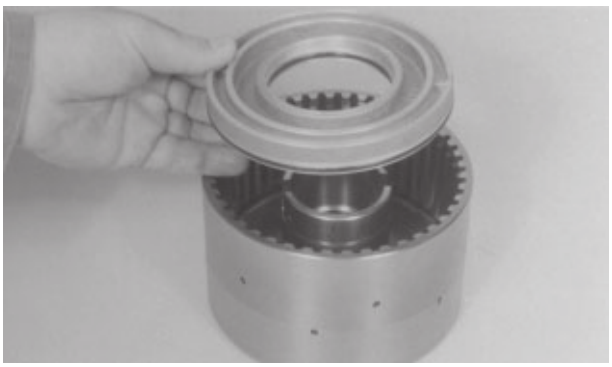
STEP 73



GD98M612

Check that drain hole is clear and free of foreign matter. Install both O-rings in recesses of the piston and apply oil.

STEP 74

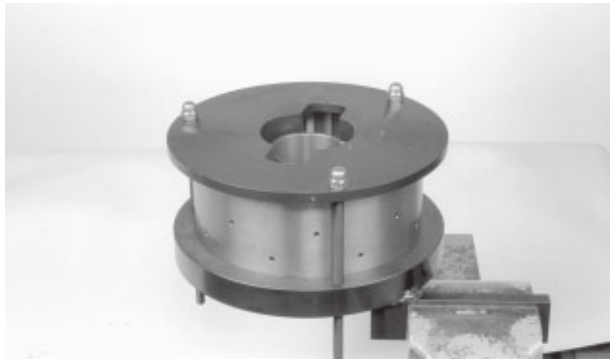


GD98M613

Install piston in clutch disc carrier.

STEP 75

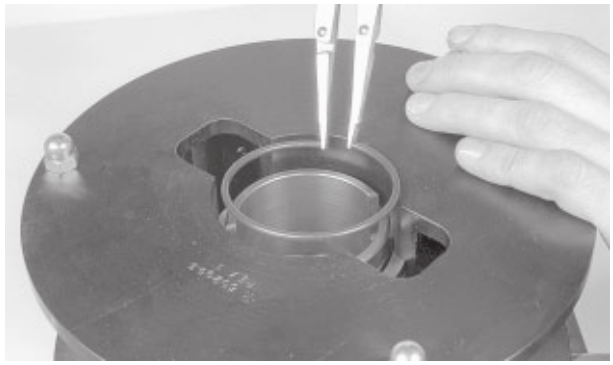
BK00D019



BK00D018

Install compression spring and two spring cups in clutch disc carrier. Preload compression spring using **380001556** clutch pack holder and spring compressor tool.

STEP 76

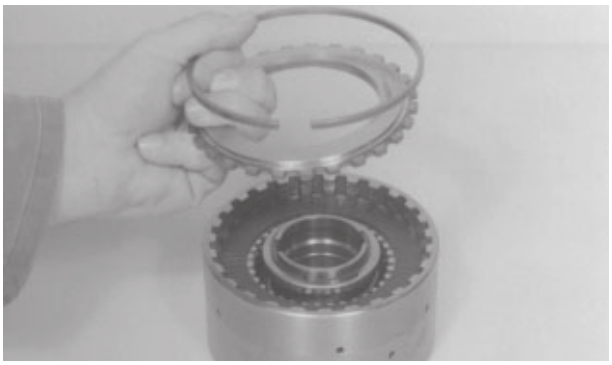


BK00D020

Install the snap ring.

Note – *The following steps are for the KV and KR clutch disc packs. The disc stacking of clutches KV and KR is identical.*

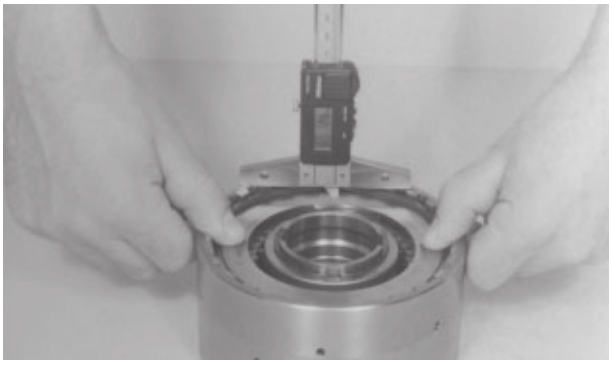
STEP 123



GD98M654

Install end shim and snap ring.

STEP 124

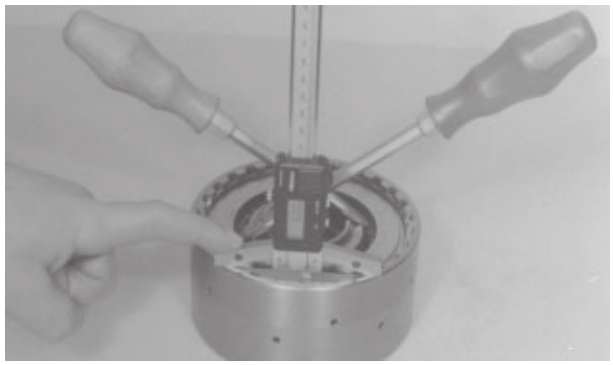


GD98M655

Adjust running clearance to 1.2 to 1.4 mm (0.047 to 0.055 in). Press down on the end shim with approximately 10 kg (20 lb). Measure and record dimension (**A**) from carrier face to end shim using depth gauge as shown.

Example
Dimension **A** ..... 7.2 mm (0.28 in)

STEP 125



GD98M656

Use tools to lift the end shim against snap ring (upward) until contact is obtained. Measure and record dimension (**B**) from carrier face to end shim using depth gauge as shown. Subtract this measurement from the measurement of Step 124. The difference is the running clearance.

Example
Dimension **A** ..... 7.2 mm (0.28 in)
Dimension **B** ..... 6.0 mm (0.24 in)

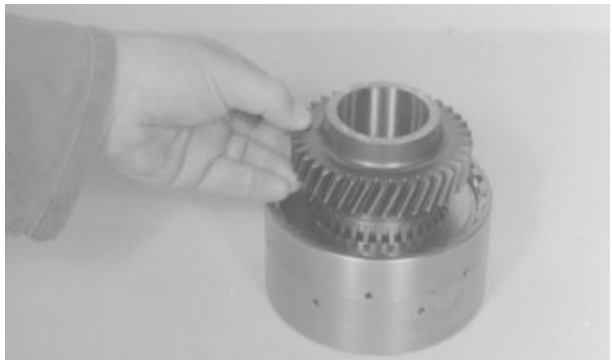
Difference = Running Clearance ..... 1.2 mm (0.04 in)

Required running clearance is 1.2 to 1.4 mm (0.047 to 0.055 in). Use snap ring(s) of different thickness as necessary to obtain correct running clearance.

STEP 126

Remove clutch disc pack, apply oil to discs, and install clutch disc pack, end shim, and snap ring as determined in Step 125.

STEP 127



GD98M657

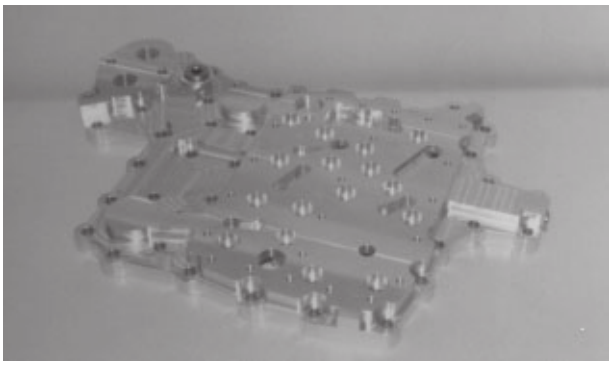
Install the idler gear until all inner discs are engaged, then remove idler gear.

STEP 180

GD98M720

Tighten input flange hex head screws to a torque of 34 Nm (301 lb-in). Lock screws by bending corners of lock plate over screws.

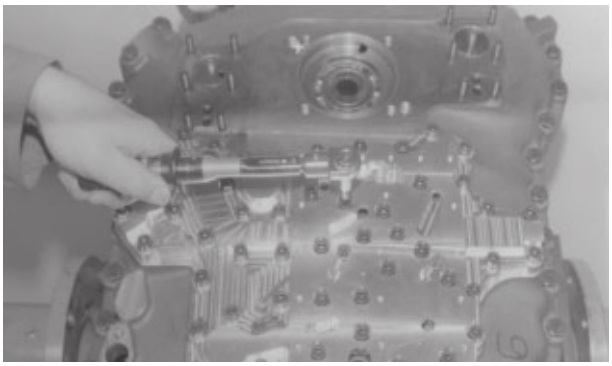
STEP 181



GD98M724

Install new sealing rings and both plugs in duct plate.

STEP 182

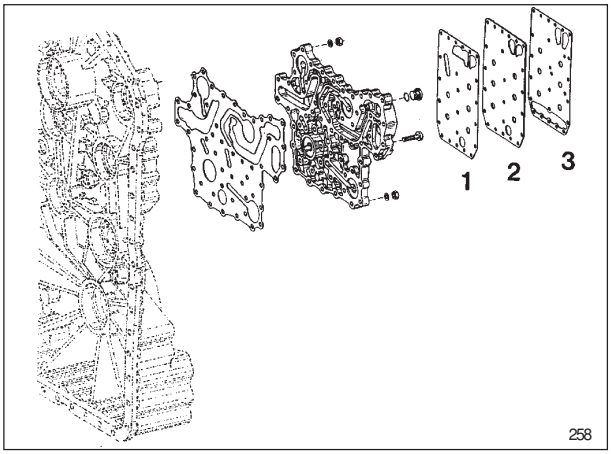


GD98M725

Install the gasket and place the duct plate against shoulder. Install socket head screws and hex nuts. Tighten to a torque of 25 Nm (221 lb-in).

Note – *The following steps are for installation of transmission control valve.*

STEP 183

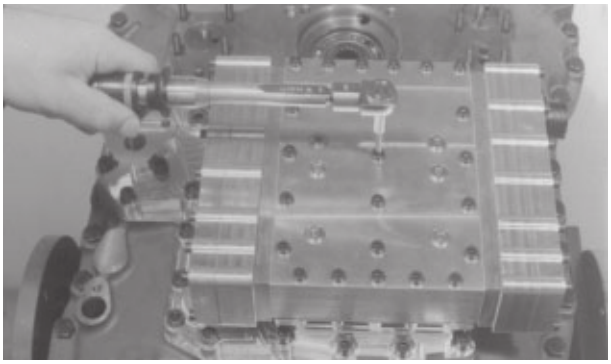


Install **380001577** transmission valve adjustment tool set. Be sure hex rods (part of tool set) are not installed on studs. Mount the gasket (**1**), intermediate plate (**2**), and gasket (**3**).

STEP 184

Install the screw plug with new O-ring. Tighten the plug to a torque of 30 Nm (265 lb-in).

STEP 185

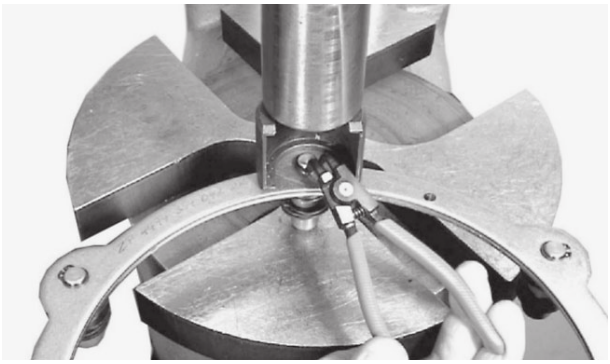


GD98M727

Install control valve on duct plate and **380001577** studs. Install hex rods on studs and tighten against control valve. Install 21 socket head screws. Tighten screws to a torque of 9.5 Nm (84 lb-in). Remove **380001577** transmission valve adjustment tool set. Install remaining two socket head screws. Tighten screws to a torque of 9.5 Nm (84 lb-in).

Note – *The following steps are for the installation of the filter.*

STEP 24



BD00M259

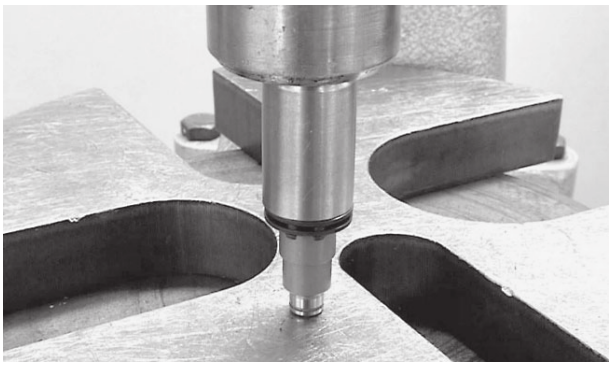
Preload the cup springs using a press and remove the retaining ring.

STEP 25

BD00M260

Pull the pin out of the support shim and remove the released cup springs.

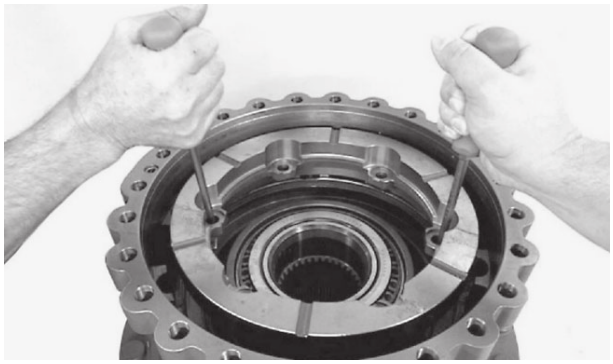
STEP 26



BD00M261

Press the gripping rings off of the pins.

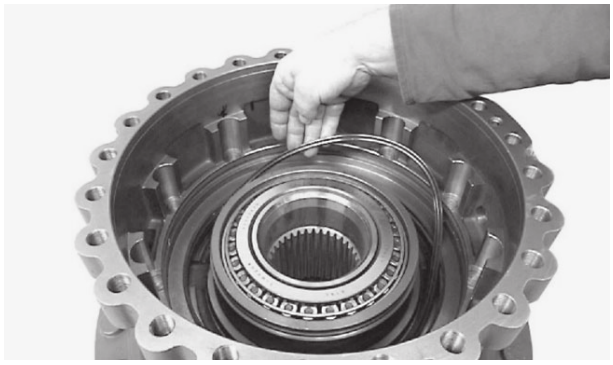
STEP 27



BD00M262

Lift the piston out of the brake housing.

STEP 28



BD00M263

Remove and discard the guide ring, support rings and O-rings from the grooves of the brake housing.

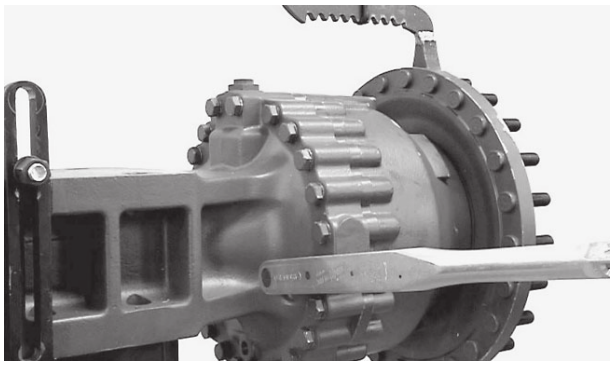
Note – *If replacing brakes only, go to step 44.*

STEP 29

BD03B023

Using **380001564** puller bridge and **380001542** step plate, remove the brake housing from the wheel end shaft.

STEP 72

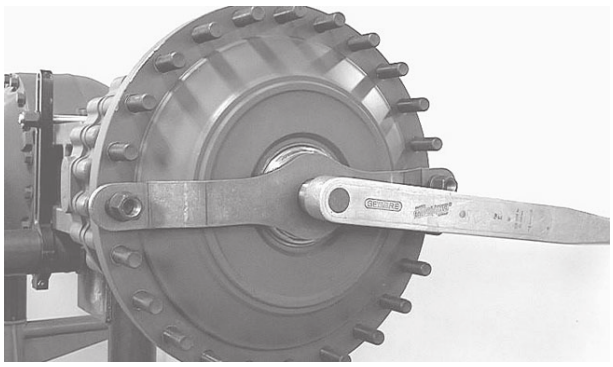


BD00M300

Install the washers and bolts by hand.

Tightening torque ..... 390 Nm (288 pound-feet)

STEP 73

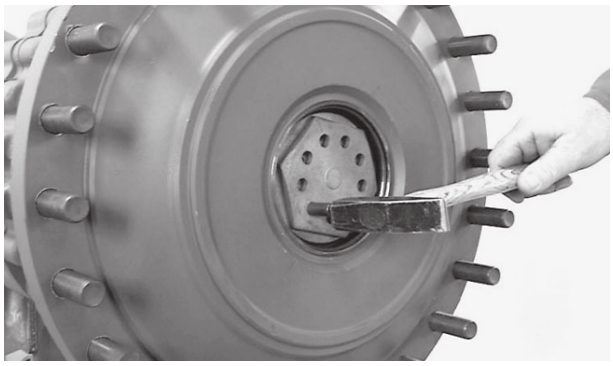


BD03B033

Install the locknut by hand and tighten it using **380001571** locknut socket and **380001576** support bracket.

Tighten torque .....700 $^{+300}$ Nm (516 $^{+221}$ pound-feet)

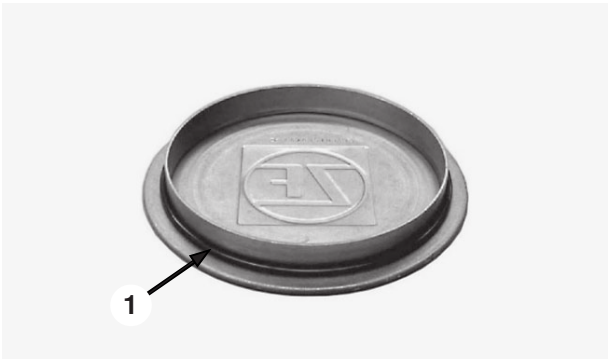
STEP 74



BD00M302

Secure the locknut with the slotted pin.

STEP 75

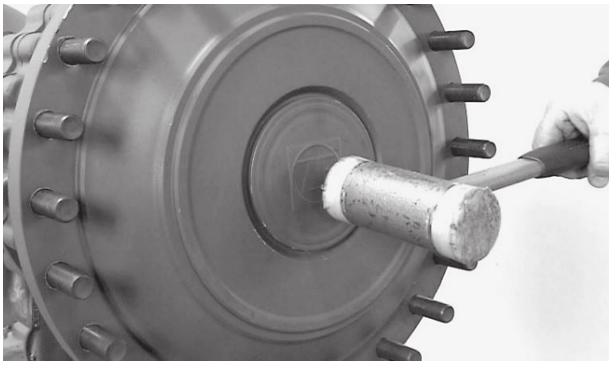


BD00M303

1. O-ring.

Install an O-ring on the cover.

STEP 76



BD00M304

Insert the cover into the wheel end.

2.4.12 DIFFERENTIAL CARRIER ASSEMBLY

Note – *If the ring gear or drive pinion are damaged, both parts have to be replaced together. For new installation of a complete bevel gear set pay attention to the same pair number of drive pinion and ring gear.*

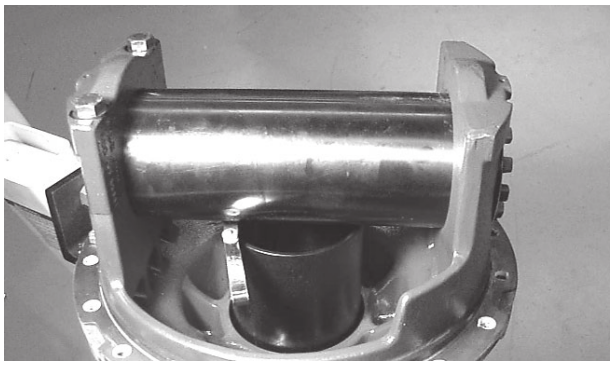
Determine Shim Thickness for Correct Tooth Contact Pattern

Note – *Make the following measuring steps at maximum accuracy. In exact measurements result in a faulty tooth contact pattern and require a repeated disassembly and assembly of the drive pinion as well as of the differential.*

STEP 42

Install the **380001753** pinion depth gauge block and **380001548** gauge tube on the differential carrier.

STEP 43



BD01F106

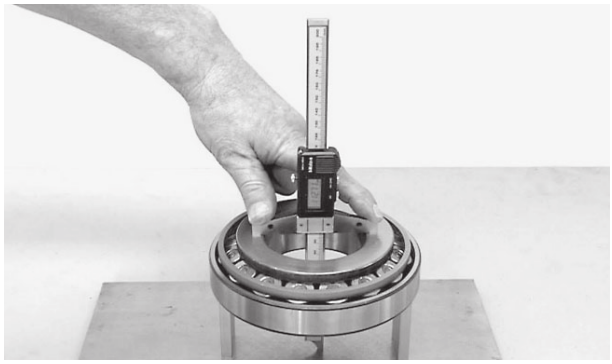
Determine the gap between the measuring shaft and the measuring pin with a feeler gauge.

Dim. **B** e.g. ..... 1.00 mm (0.039 inch)

Example A:

Dimension **A** (tool constant)	204.25 mm (8.041 inch)
Dimension **B** (gap)	+ 1.00 mm (0.039 inch)
Results in Dimension X	**s= 205.25 mm (8.08 inch)**

STEP 44

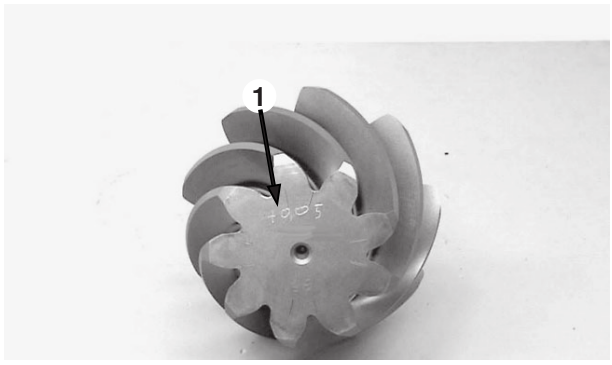


BD00M350

Determine Dimension **I** (bearing width).

Dimension **I** e.g. ..... 36.00 mm (1.417 inch)

STEP 45



BD00M351

1. 168.00 $^{+0.05}$.

Read Dimension **II** (dimension for pinion).

Dimension **II** e.g. ..... 168.05 mm (6.62 inch)

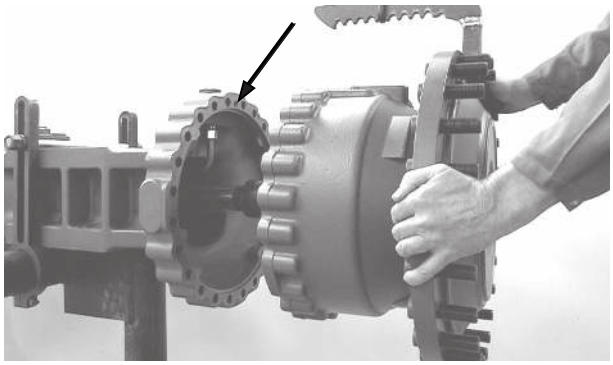
Example B:

Dimension **I**	36.00 mm (1.417 inch)
Dimension **II**	+ 168.05 mm (6.616 inch)
Results in Dimension Y	**s= 204.05 mm (8.04 inch)**

Example C:

Dimension **X**	205.25 mm (8.081 inch)
Dimension **Y**	- 204.05 mm (8.033 inch)
Difference = Shim e.g.	**s= 1.20 mm (0.048 inch)**

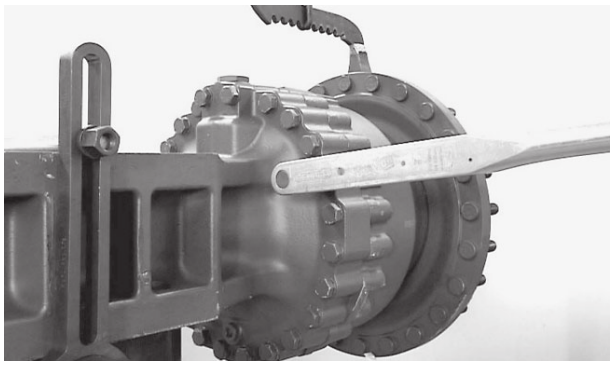
STEP 90



BD03B032

Install O-ring and hold into place with grease. Use acceptable lifting equipment and place the wheel end on the axle housing.

STEP 91



BD00M456

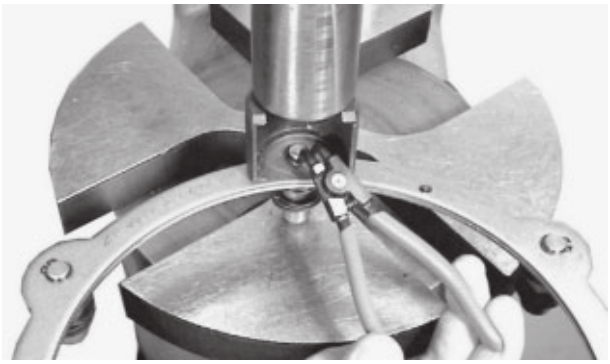
Install the bolts and washers on the wheel end.

Tightening torque ..... 390 Nm (288 pound-feet)

Note – *Repeat steps 1 to 91 for the other wheel end.*

Note – *Prior to putting into operation of the axle, fill with oil.*

STEP 24



BD00M259

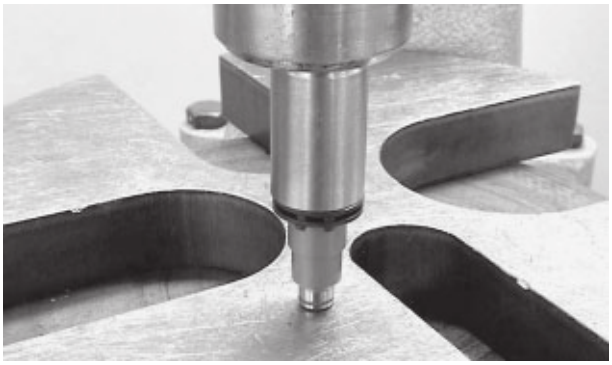
Put support shim in a press and compress Belleville washers. Remove retaining ring and pull pin with Belleville washers and rings installed from support shim. Repeat this step to remove the remaining five retaining rings and pins from support shim.

STEP 25

BD00M260

Remove seven Belleville washers from each pin.

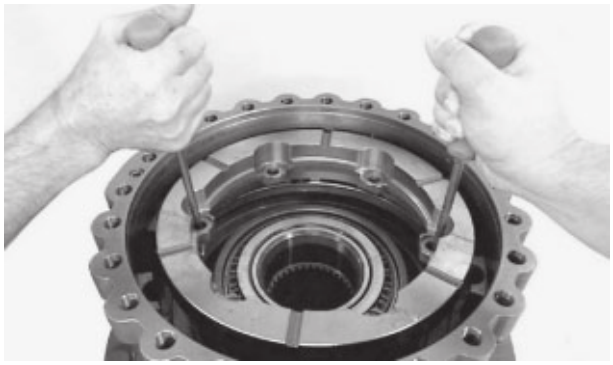
STEP 26



BD00M261

Using a press, remove four gripping rings from each pin.

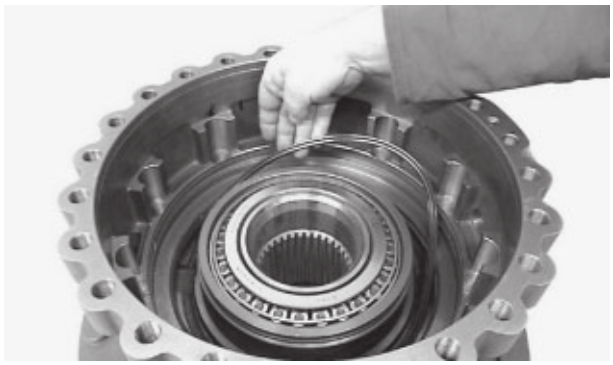
STEP 27



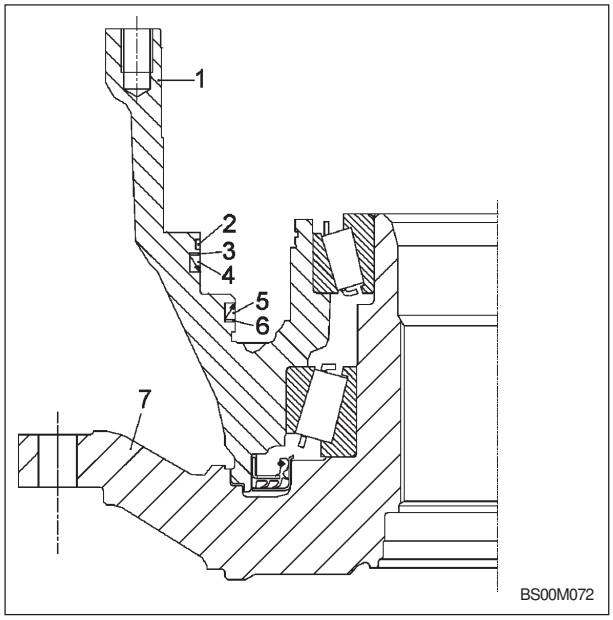
BD00M262

Lift and remove the piston from the brake housing.

STEP 28



BD00M263

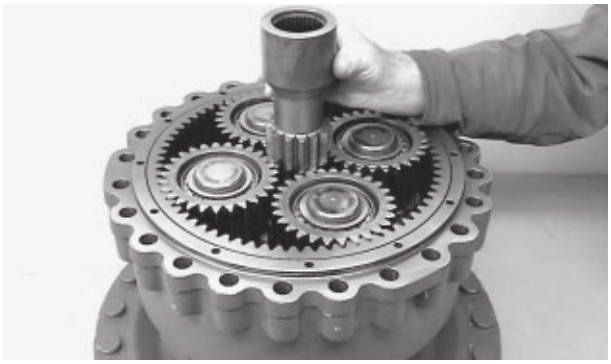


BS00M072

1. Brake housing - **2.** Guide ring - **3.** Support ring - **4.** O-ring - **5.** O-ring - **6.** Support ring - **7.** Wheel end shaft.

Remove the guide ring (**2**), support rings (**3** and **6**), and O-rings (**4** and **5**) from the grooves of the brake housing.

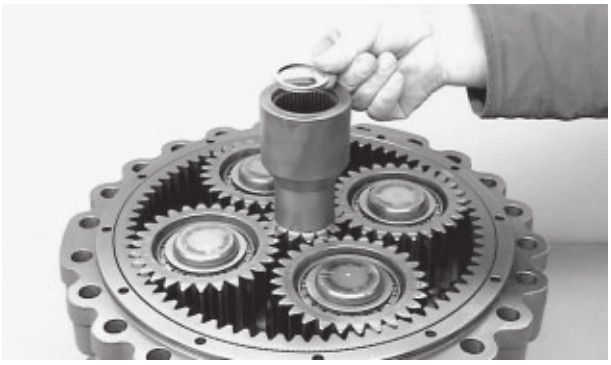
STEP 72



BD00M245

Install the sun gear shaft in the planet carrier.

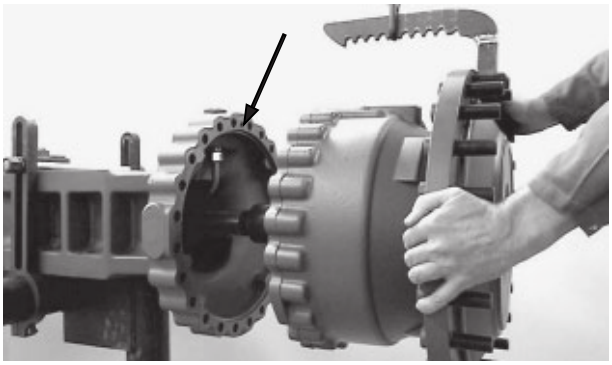
STEP 73



BD00M244

Install the shim set (size as determined in Step 71 above) into the sun gear shaft with grease.

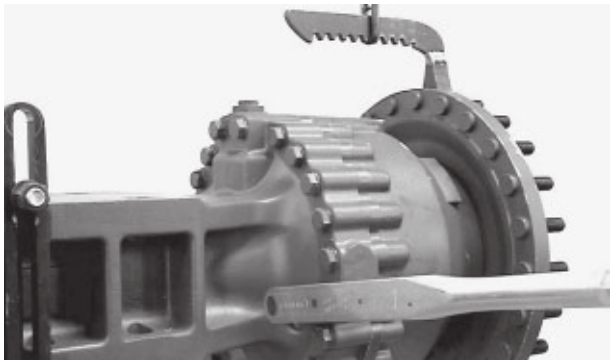
STEP 74



BD00M242

Apply grease to a new O-ring and install O-ring in brake port. Use acceptable lifting equipment and install the assembled wheel end onto the axle housing.

STEP 75



BD00M300

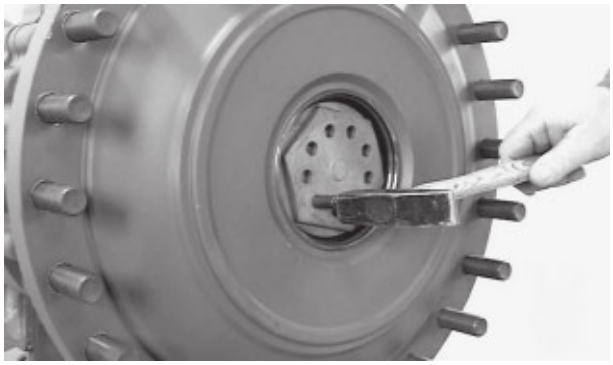
Install the washers and bolts to secure the wheel end to the axle housing. Tighten the bolts to a torque of 390 Nm (288 lb-ft).

STEP 76

BD00M301

Install the lock nut by hand and tighten using **380001576** support bracket and **380001571** locknut socket and nuts. Tighten the lock nut to a torque of 700 to 1000 Nm (516 to 737 lb-ft).

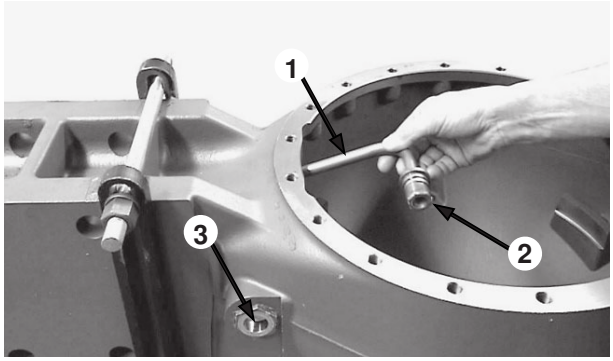
STEP 77



BD00M302

Install the slotted pin into the wheel end lock nut.

STEP 121

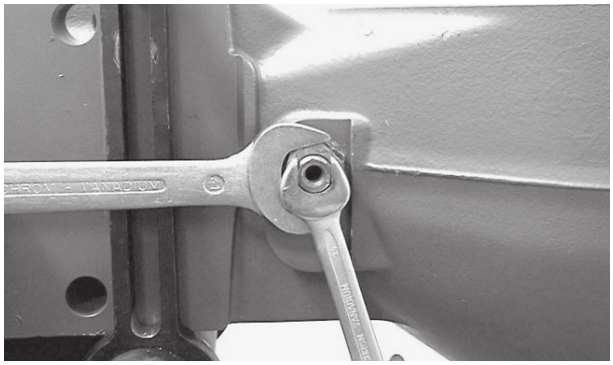


BD00M344

1. Brake tube - **2.** Fitting - **3.** Connector.

Install the brake tube (**1**) in the axle housing, inserting the fitting (**2**) through the connector (**3**).

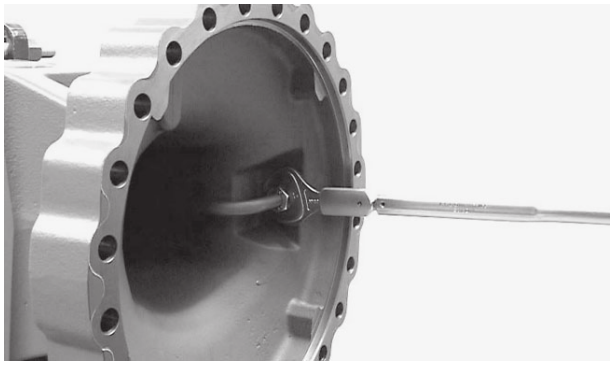
STEP 122



BD00M345

Install the nut to secure the brake tube fitting. Tighten the nut to a torque of 70 Nm (52 lb-ft).

STEP 123

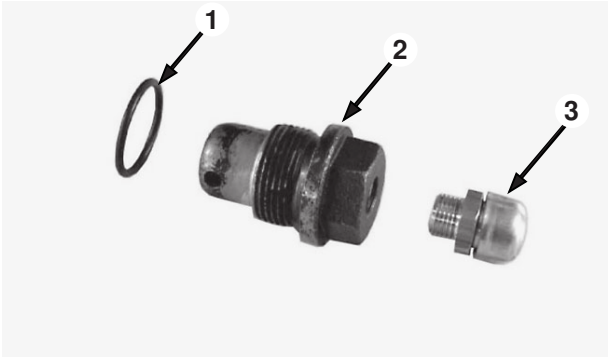


BD00M346

Connect fitting on opposite end of brake tube to fitting installed in wheel end. Tightening brake tube fitting to a torque of 80 Nm (60 lb-ft).

Note – *Do Steps 117 to 123 on other wheel end.*

STEP 124

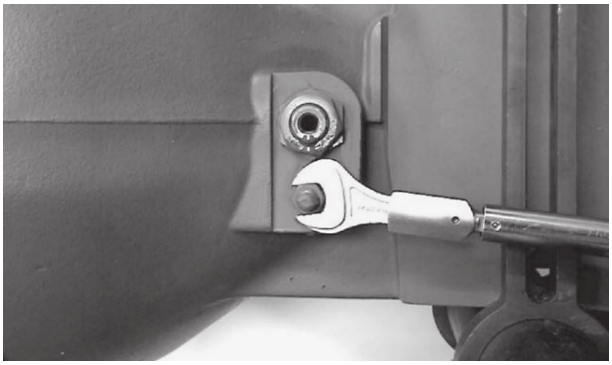


BD00M347

1. O-ring - **2.** Plug - **3.** Breather.

Remove and discard O-ring (**1**) from plug (**2**) and install a new O-ring. Install breather (**3**) in plug.

STEP 125

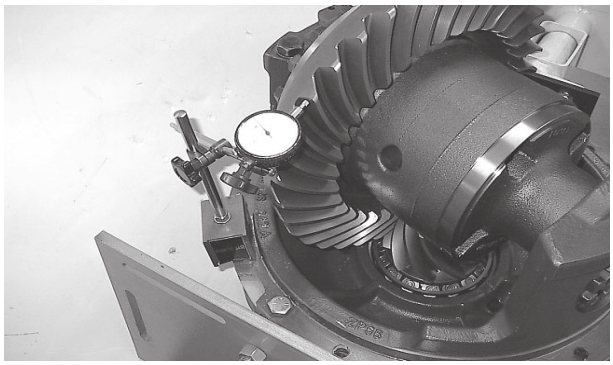


BD00M348

Install the plug in axle housing. Tighten plug to a torque of 70 Nm (52 lb-ft).

Adjust Backlash and Bearing Preload

STEP 170



BD01F061

Place **380001725** dial indicator right-angled at the outer diameter of the tooth flank (ring gear). Adjust the pinion to ring gear backlash to the low side of specifications (see numbers etched on the outer diameter of the ring gear) by alternately turning each of the adjusting nuts to move the ring gear closer to or further away from the pinion.

STEP 171

Go to the adjusting nut opposite the ring gear and loosen the nut approximately one turn to release pressure on the bearing. It should be very noticeable that pressure is released on the bearing, as the adjusting nut will turn much easier.

STEP 172

Tighten the bearing adjusting nut slowly until firm contact is made with the bearing.

Note – *As the adjusting nut makes firm contact with the bearing, the adjusting nut will immediately begin to turn with more effort.*

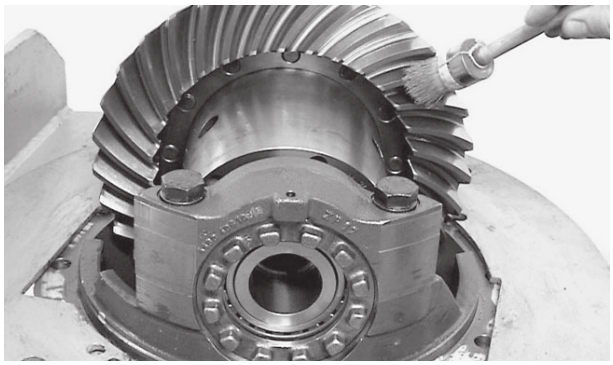
STEP 173

To adjust the differential bearing preload, note the position of the adjusting nut. Now tighten the nut two additional notches.

STEP 174

When the bearing preload is adjusted the backlash may increase slightly. Check pinion backlash to confirm that it is within specifications. If within specifications, install the adjusting nut locking roll pins. If backlash is outside of specified range, repeat Step 170 through 174 again.

STEP 175



BD00M388

Apply marking ink on several teeth of the ring gear and rotate it in both directions. Compare the obtained tooth contact pattern with the examples on pages 138 and 139.

Note – *If the tooth contact pattern differs, the wrong shim size was selected in Step 130. Remove differential and repeat Steps 126 though 130.*

STEP 176

BD00M389

Install pins to secure both adjusting nuts.

STEP 177

Apply sealing compound (Three Bond Type 1215) to differential mounting surface on axle housing. Install two **380001752** alignment studs in axle housing to aid installation of differential carrier. Using suitable lifting equipment, install the differential carrier in the axle housing then remove alignment studs.

2.7 WHEELS AND TIRES

2.7.1 WHEELS AND BOLTS

General Information

The wheel nuts must be tightened after every 20 hours of operation until the wheel nuts stay tight:
A. If the machine is new.
B. If a wheel has been removed and installed.

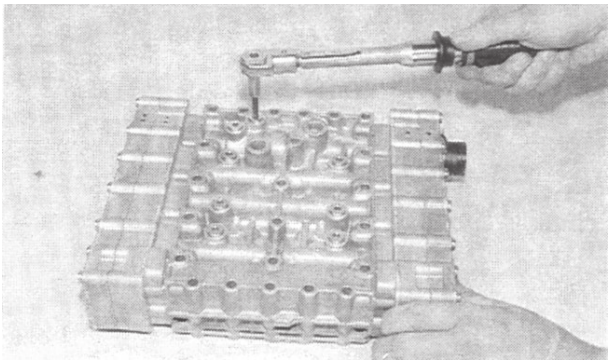
Torque Specification

Tighten the wheel nuts to 298 Nm (220 pound-feet) in the sequence shown in Figure page 186. Then a final torque of 640 to 720 Nm (475 to 530 pound-feet) in the same sequence.

2.7.2 TIRE PRESSURE

20.5 x 25 L2	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5 x 25 L3	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5R x 25 XTLA TL	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5R x 25 XHA TL	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5 x 25 GP2B	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5 x 25 L3	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5 x 25 RT3B	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5R x 25 VUT	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)
20.5R x 25 VMT	Front, 3.45 bar (50 psi), Rear, 2.75 bar (40 psi)

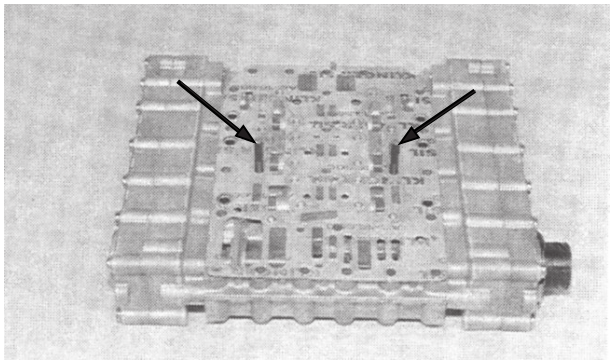
STEP 41



BS02C127

Install a new O-ring (**26**) on eight plugs (**25**). Install eight plugs and tighten to a torque of 6 Nm (53 lb-in).

STEP 42



BS02C128

Install two studs in transmission control valve (**7**, Figure 4) then install housing gasket (**5**).

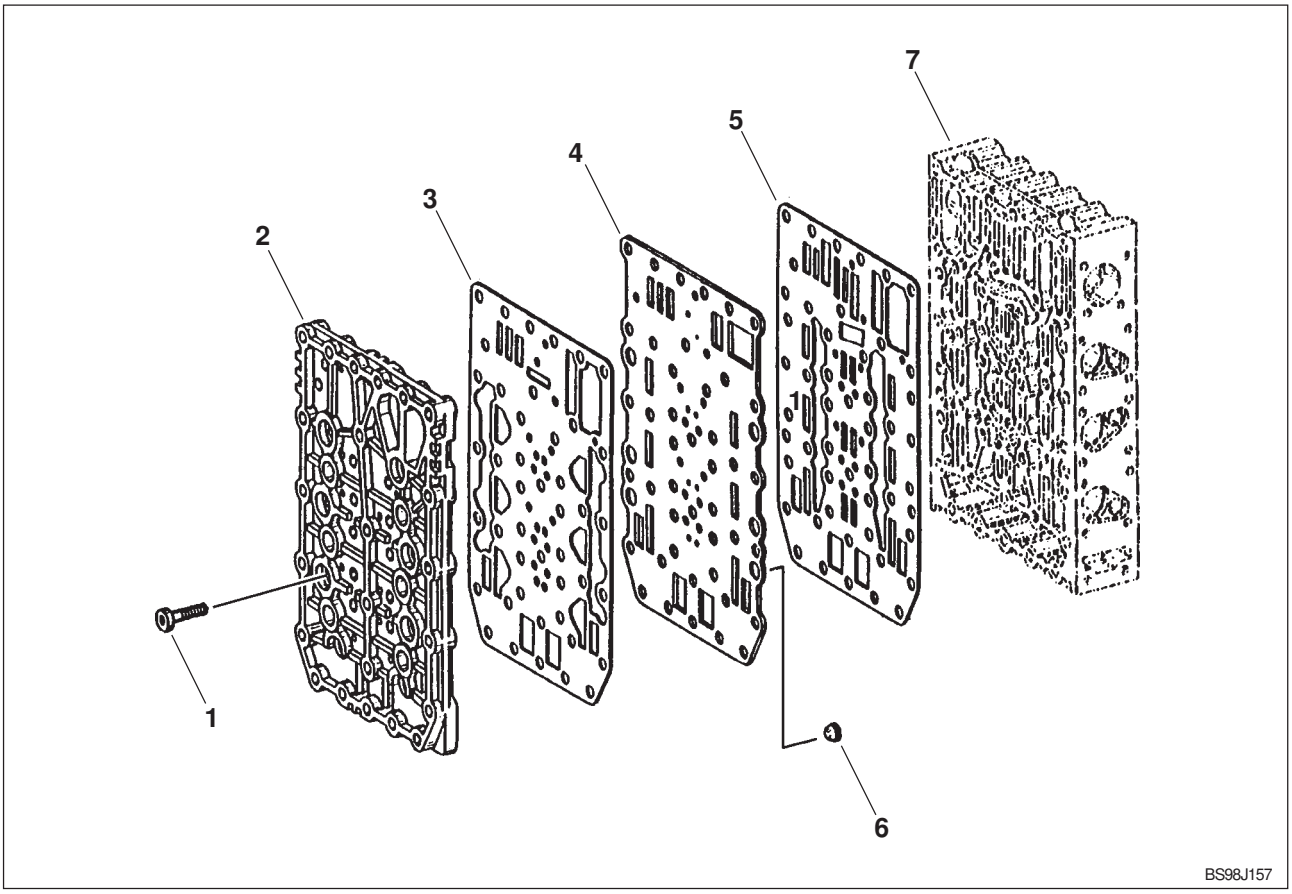


Figure 4 – Transmission control valve plates and gaskets

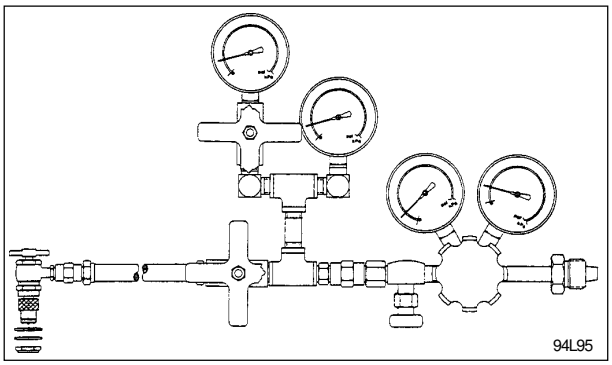
1. Screw - **2.** Distribution plate - **3.** Housing gasket - **4.** Valve plate - **5.** Housing gasket - **6.** Filter screen - **7.** Transmission control valve.

3.2 HYDRAULIC BRAKE TROUBLESHOOTING

3.2.1 SPECIFICATIONS

Brake pump output ..... 41.5 to 43 L/min at 172 bar
..... (10.9 to 11.3 gpm at 2500 psi at 2000 rpm)
Accumulator nitrogen charge pressure .....53.5 to 57 bar (775 to 825 psi)
Accumulator valve cut in pressure ..... 147 to 167 bar (2130 to 2420 psi)
Accumulator valve cut out pressure ..... 190 to 196 bar (2755 to 2842 psi)
Brake warning pressure switch ..... 112 bar (1625 psi) falling
..... 126 bar (1825 psi) rising
Brake redundant pressure switch ..... 62 bar (900 psi)
Brake light pressure switch ..... 4.1 bar (60 psi)
Modulation pressure front brake cylinders .....76 to 83 bar (1100 to 1200 psi)
Modulation pressure rear brake cylinders .....74 to 81 bar (1070 to 1170 psi)

3.2.2 SPECIAL TOOL



380001737 Nitrogen charging kit used to check and charge the accumulator with nitrogen.

3.3.5 PARKING BRAKE

Disassembly

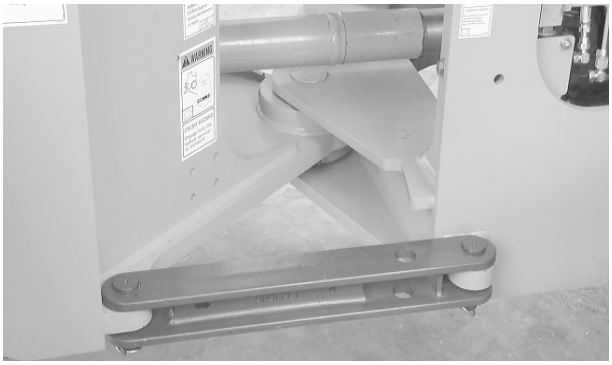
STEP 1

Park the machine on a hard level surface and lower the loader bucket to the ground.

STEP 2

Place wheel chocks on each wheel to prevent machine movement.

STEP 3



BD01F143

Install the articulation lock.

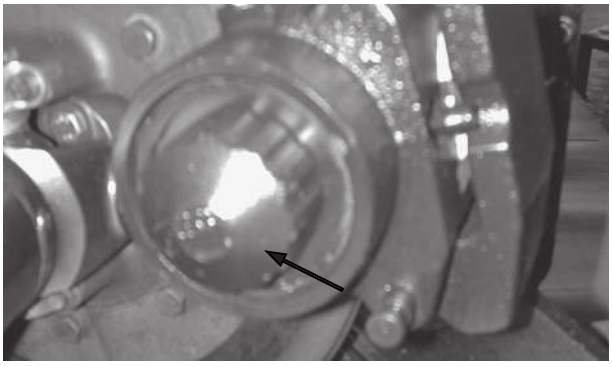
STEP 4

Place the master disconnect switch in the OFF position.

STEP 5

Pump the brake pedal at least 30 times to discharge the accumulators.

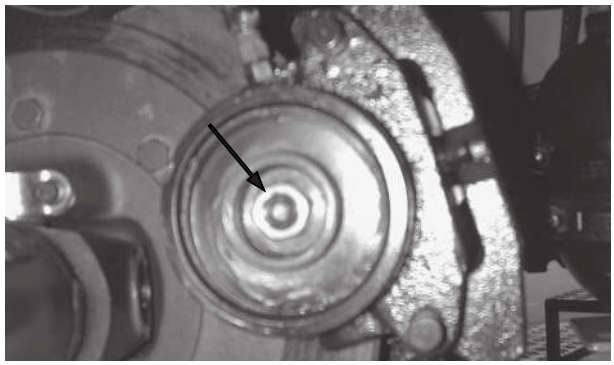
STEP 6



W170-3R002

Loosen and remove the cover from the parking brake.

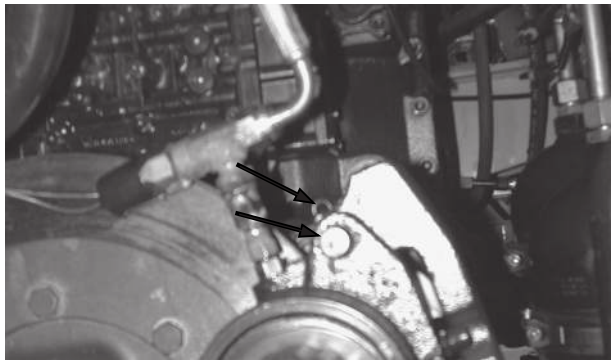
STEP 7



W170-3R003

Loosen the jam nut, turn adjusting bolt counterclockwise until the brake pads are loose.

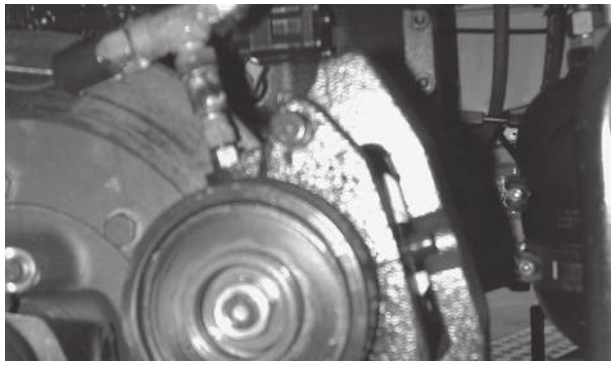
STEP 8



W170-3R004

Remove the retainer pin and brake pin.

STEP 9



W170-3R005

Remove the two brake pads from the parking brake assembly.

4.1.4 AUXILIARY STEERING PUMP AND MOTOR

Removal

1. Park loader on level ground and lower bucket to ground. Put transmission in NEUTRAL, apply parking brake, and shut down engine.
2. Put master disconnect switch in OFF position.
3. Tag and disconnect two wiring harness wires (**1**) from auxiliary steering pump and motor (**7**) solenoid. See illustration on page 4-8.
4. Tag and disconnect positive cable (**2**) from B+ stud of auxiliary steering pump and motor (**7**).
5. Tag and disconnect ground cable (**3**) from ground stud of auxiliary steering pump and motor (**7**).
6. Remove hydraulic reservoir fill cap.
7. Connect a vacuum pump to hydraulic reservoir.
8. Start vacuum pump.
9. Disconnect suction hose (**4**) from elbow installed in auxiliary steering pump and motor (**7**). Install a plug in suction hose and cap on elbow.
10. Stop vacuum pump.
11. Loosen fittings on pressure tube (**5**).
12. Support auxiliary steering pump and motor (**7**). Remove nuts (**6**), bolts, and washers securing auxiliary steering pump and motor (**7**).
13. Remove pressure tube (**5**) and auxiliary steering pump and motor (**7**).

Installation

1. Connect and hand tighten pressure tube (**5**) to auxiliary steering pump and motor (**7**). See illustration on page 4-8.
2. Position auxiliary steering pump and motor (**7**) on its mounting plate while connecting and hand tightening pressure tube (**5**) to auxiliary steering priority valve (**8**).
3. While supporting auxiliary steering pump and motor (**7**) have an assistant install bolts, washers, and nuts (**6**) to secure auxiliary steering pump and motor (**7**).
4. Tighten pressure tube (**5**) fittings securely.
5. Start vacuum pump.
6. Remove plug from suction hose (**4**) and cap from elbow. Connect suction hose to elbow installed in auxiliary steering pump and motor (**7**).
7. Stop and disconnect vacuum pump. Install fill cap in hydraulic reservoir.
8. Connect ground cable (**3**) to ground stud of auxiliary steering pump and motor (**7**) following tag installed during removal.
9. Connect positive cable (**2**) to B+ stud of auxiliary steering pump and motor (**7**) following tag installed during removal.
10. Connect wiring harness wires (**1**) to auxiliary steering pump and motor (**7**) following tags installed during removal.
11. Remove and discard tags installed during removal.
12. Put master disconnect switch in ON position.
13. Start and run engine at low idle and raise bucket 500 mm (20 inches) above ground. Check that auxiliary steering light on information center is OFF.

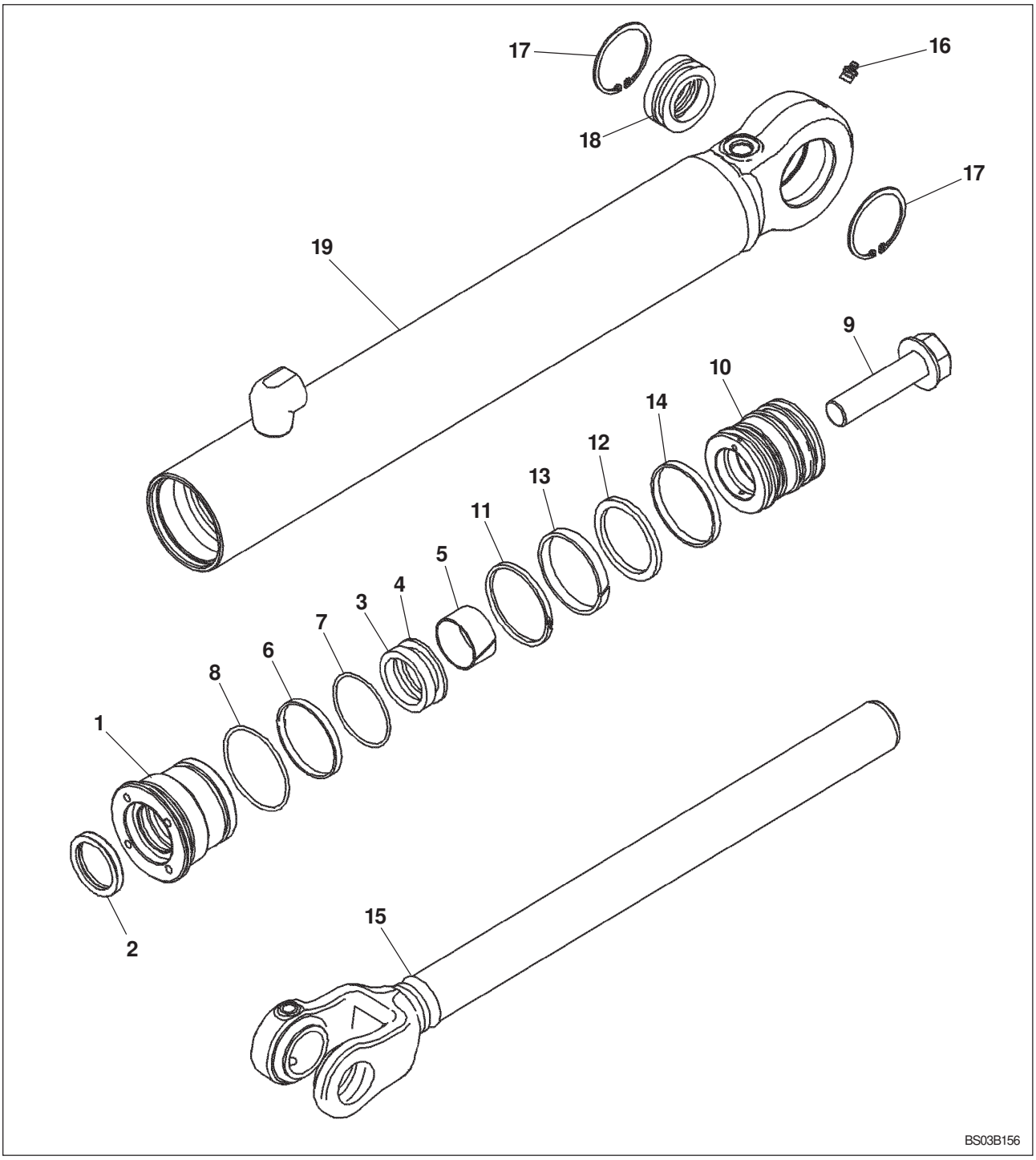
Important – *In following Step, do not run auxiliary steering pump and motor continuously for more than 20 seconds at a time without a two minute cool down.*

14. With engine at low idle and machine steering straight ahead, turn key switch to OFF position to stop engine and then immediately back to ON position (not START position). Auxiliary steering pump and motor should start operating immediately. Check that auxiliary steering light on information center is ON and auxiliary steering pump and motor is operating.
15. Turn steering wheel all the way to left and right to make sure that auxiliary steering pump and motor operates correctly.
16. Restart engine. Check that auxiliary steering light on information center stays ON and auxiliary steering pump and motor is operating. After about three seconds motor should stop operating and auxiliary steering light should go out.
17. Let engine run and allow batteries to recharge for a minimum of 10 minutes.

4.2.7 STEERING CYLINDER LEAK TEST

Note – *Make sure all persons are clear of the area of the center pivot. Make sure the center pivot is free of any obstructions.*

1. Park the machine on a level surface.
2. Turn the machine all the way to the right.
3. Stop the engine and apply the parking brake.
4. Find the tube that is connected to the rod end of the left-hand steering cylinder. Disconnect the tube from the left-hand cylinder.
5. Install a plug in the tube.
6. Start and run the engine at full throttle.
7. Turn the steering wheel to the right. Hold the steering wheel for a full right turn. Have another person check for leakage from the opening of the rod end of the left-hand steering cylinder.
8. If there is constant leakage from the rod end, the piston packing in the left-hand steering cylinder is damaged. Repairs must be made.
9. Connect the tube to the rod end of the left-hand steering cylinder.
10. Turn the machine all the way to the left.
11. Stop the engine.
12. Find the tube that is connected to the rod end of the right-hand steering cylinder. Disconnect the tube from the right-hand steering cylinder.
13. Install a plug in the tube.
14. Start and run the engine at full throttle.
15. Turn the steering wheel to the left. Hold the steering wheel for a full left turn. Have another person check for leakage at the opening of the rod end of the right-hand steering cylinder.
16. If there is constant leakage from the rod end, the piston packing in the right-hand steering cylinder is damaged. Repairs must be made.
17. Connect the tube to the rod end of the right-hand steering cylinder.



Steering cylinder illustration

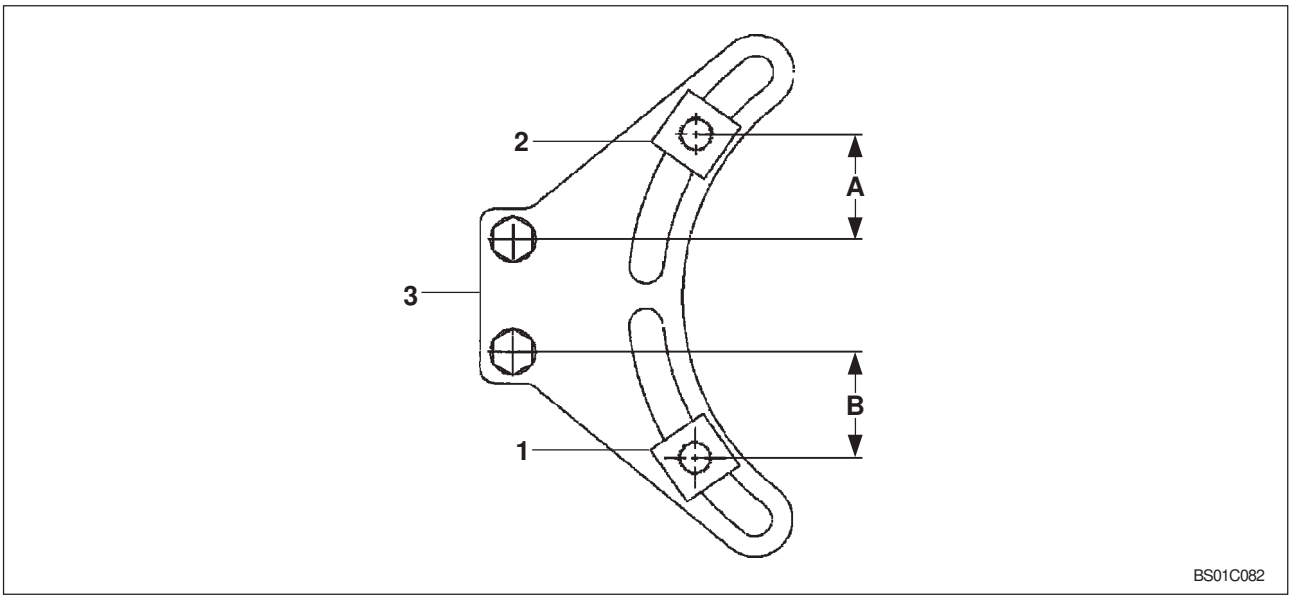
1. Gland - **2.** Rod wiper - **3**. Rod seal - **4.** Buffer seal - **5.** Bearing - **6.** O-ring - **7.** Backup ring - **8.** O-ring - **9.** Bolt and washer - **10.** Piston - **11.** Seal - **12.** Ring loader - **13.** Wear ring - **14.** Ring cast iron - **15.** Piston rod - **16.** Grease fitting - **17.** Retaining ring - **18.** Bushing - **19.** Tube.

4.7 AUXILIARY STEERING MOTOR AND PUMP

4.7.1 SPECIFICATIONS

Auxiliary steering motor
- Maximum amperes ..... 30 amperes
- Minimum armature speed ..... 6950 r/min (rpm)
- Motor ..... 24 volts

Auxiliary steering pump
- Minimum flow ..... 24.6 L/min at 104 bar at 315 amperes (6.5 U.S. gpm at 1500 psi at 315 amperes)



Height control and return to travel adjustment illustration Z-BAR, XR and TC models

1. Height control target - **2.** Return to travel target - **3.** Target mounting plate.

MACHINE	A	APPROXIMATE RESULTING RETURN TO TRAVEL HINGE PIN HEIGHT	B	APPROXIMATE RESULTING HEIGHT CONTROL HINGE PIN HEIGHT
W170 Z-BAR	54 mm (2.1 inches)	380 mm (15 inches)	48 mm (1.9 inches)	3302 mm (130 inches)
W170 XR	78 mm (3 inches)	459 mm (18 inches)	54 mm (2.1 inches)	3302 mm (130 inches)
W170 TC	51 mm (2 inches)	403 mm (15.9 inches)	43 mm (1.7 inches)	3302 mm (130 inches)

8. Refer to the table and the illustration on this page. Position the height control target (**1**) on the target mounting plate (**3**) using the table above.

Note – *The higher the height control target (**1**) is positioned in its slot in the target mounting plate (**3**), the lower the lift arms will stop as they are raised.*

9. Tighten the height control target (**1**).
10. Position the return to travel target (**2**) using the table above.

Note – *The higher the return to travel target (**2**) is positioned in its slot in the target mounting plate (**3**), the lower the lift arms will stop as they are lowered.*

11. Check to make sure the proximity switch (**3**) and all of the mounting bolts are tight. Refer to the illustration on page 5-4.
12. Start the engine.
13. Place the detent switch in the ON position, and set the return to travel/float detent switch to the return to travel position.
14. Place the loader control lever in the raise position and verify that the electromagnet holds it in that position until the height control target (**2**) passes in front of the proximity switch (**3**). Refer to the illustration on page 5-4.
15. With the lift arms still raised, place the loader control lever in the lower position and verify that the electromagnet holds it in that position until the return to travel target (**5**) passes in front of the proximity switch (**3**). Refer to the illustration on page 5-4.
16. Repeat steps 8 through 15 until the desired heights are reached.
17. Lower the bucket to the ground and stop the engine.

6.1.3 REMOVAL AND INSTALLATION OF THE HYDRAULIC PUMP

Removal

STEP 58

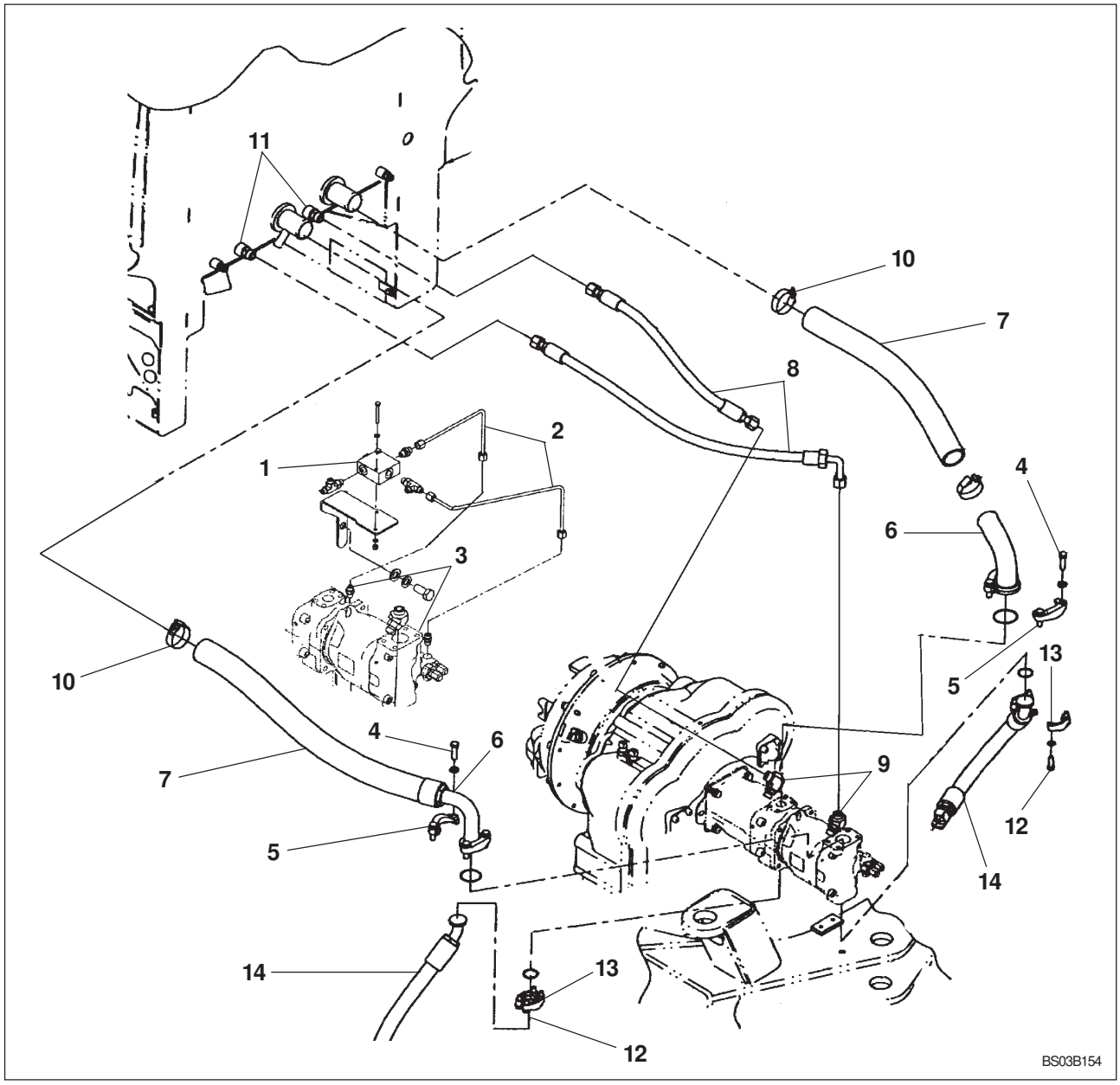
Park the machine on a level surface and lower the bucket to the floor. Stop the engine and apply the parking brake.

STEP 59

Place the master disconnect switch in the OFF position.

STEP 60

Loosen the filler cap on the reservoir to release any air in the reservoir. Connect a vacuum pump to the hydraulic reservoir, turn on the pump.



1. Shuttle valve bracket - **2.** Load sense tubes - **3.** Connector - **4.** Bolt - **5.** Split flange - **6.** Tube - **7.** Hose suction - **8.** Hose case drain - **9.** Fitting - **10.** Clamp - **11.** Connector - **12.** Bolt - **13.** Split flange - **14.** Hose high pressure.

6.1.6 REMOVAL AND INSTALLATION OF THE BUCKET CYLINDERS - TC LOADER

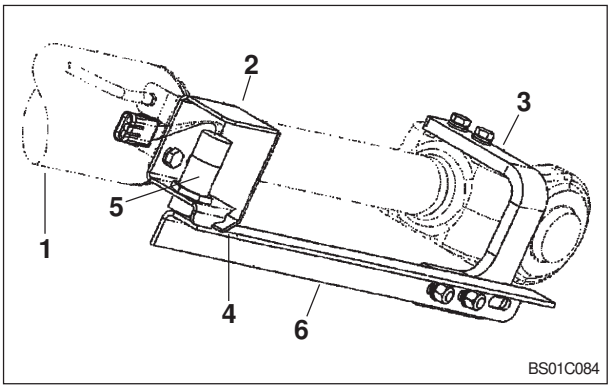
Removal

STEP 127

Lower the bucket to the floor. With the engine stopped, move the bucket control lever to release any pressure in the bucket circuit.

Note – *The following two steps apply only to the left* hand bucket cylinder.

STEP 128



1. Bucket cylinder (left hand side) - **2.** Proximity switch mounting bracket - **3.** Target mounting bracket - **4.** Proximity switch guard - **5.** Proximity switch - **6.** Target bar

Disconnect the Return-to-Dig proximity switch (**5**) and remove with the mounting bracket (**2**) as an assembly.

STEP 129

Remove the Return-to Dig target bar (**6**) with the mounting bracket (**3**) from the yoke of the bucket cylinder (**1**).

STEP 130

Disconnect the hoses from the elbows at both ports of the bucket cylinders. Install a plug in the tube and a cap on the elbow.

STEP 131

Remove the roll pin (**1**) from the yoke (**2**). Remove the pivot pin (**3**).

STEP 132

Loosen and remove the nuts (**4**) and washers (**5**) at the top and bottom of the cylinder bellcrank.

STEP 133

Remove the inner bellcrank (**6**) from the pivot pins (**7**).

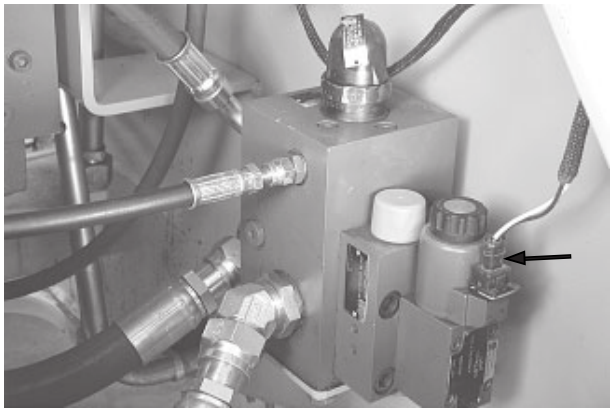
STEP 134

Remove the nut (**8**) and the grease line (**9**) from the bucket cylinder (**10**).

STEP 135

Fasten acceptable lifting equipment to the bucket cylinder (10) and remove the bucket cylinder (10) from the machine.

STEP 196



BD03A094

Connect the electrical connector to the ride control valve.

STEP 197

Turn off the vacuum pump and disconnect from the hydraulic reservoir.

STEP 198

Place the master disconnect switch in the ON position.

STEP 199

Start and run the engine at low idle for two minutes.

STEP 200

Stop the engine and check for hydraulic oil leakage at the ride control valve.

STEP 201

BD03A093

Install the access cover.

STEP 202

BD03A092

Raise the loader arms and remove the safety link.

STEP 203

Check the level of the hydraulic oil in the reservoir and add as required. Tighten the filler cap on the hydraulic reservoir.

STEP 204

Refer to section and perform the "Ride Control Test Procedure".

6.2.6 TESTING AND ADJUSTING THE LOADER LIMIT PRESSURE

Pressure Check

STEP 19

Make sure that the temperature of the hydraulic oil is at least 54 °C to 57 °C (129 °F to 135 °F). The following is the procedure for heating the hydraulic oil.

A. Start the engine and run at full throttle.

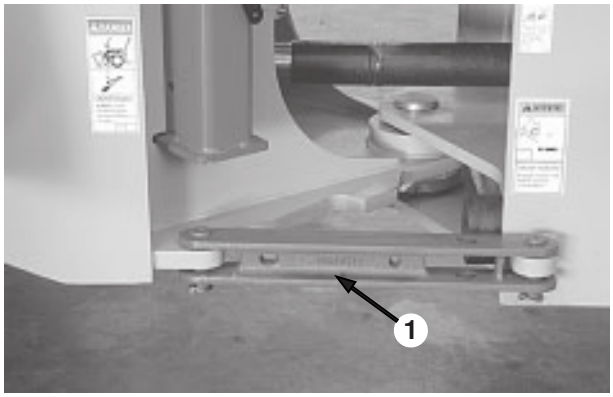
B. Lower the loader bucket to the ground and hold the lift control lever in the FLOAT position.

C. Roll the bucket back against the stops and hold.

D. View the oil temperature by pressing the program switch, then press the up count switch to function 008. Return the program switch to the center (**OFF**) position.

After heating oil to operating temperature, lower bucket to the ground, turn off the engine, and relieve all pressure in the hydraulic system.

STEP 20

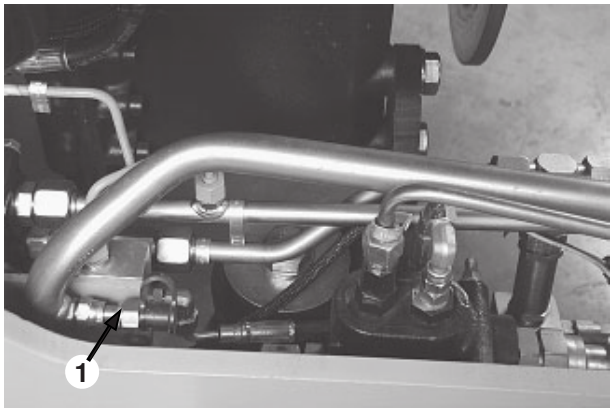


BD00M041

1. Articulation lock.

Install articulation lock (**1**).

STEP 21



BD03A086

1. Test port (load limit).

Connect a 345 bar (5004 psi) test gauge to the test port (**1**), located on the large hydraulic tube near the right side rear frame opening (port 5 optional diagnostic panel).

STEP 22

Start the engine and run at full throttle.

STEP 23

Roll the loader bucket back against the stops.

STEP 24

Record the reading on the test gauge.

STEP 25

Reading should be 248 to 252 bar (3596 to 3654 psi).

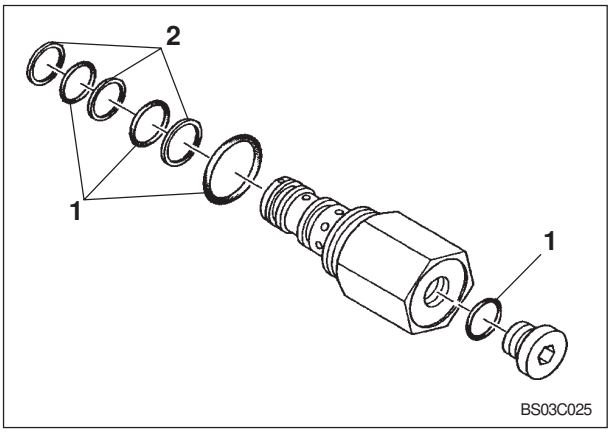
STEP 26

If this reading is more or less than specified, it will be necessary to adjust the pump limit pressure.

6.3.4 CLEANING THE HYDRAULIC SYSTEM

1. Prepare the portable filter on page 6-47 by doing the following steps:
   A. Remove all the hydraulic oil from the inlet and outlet hoses for the portable filter.
   B. Remove the filter element from the portable filter.
   C. Remove all hydraulic oil from the portable filter.
   D. Clean the inside of the housing for the filter element.
2. You must know whether the contamination is microscopic or visible. See types of contamination on page 6-48.
3. If the contamination is microscopic:
   A. Check the maintenance schedule for the machine to learn if the hydraulic oil must be changed. If needed, change the hydraulic oil. See Section 0 for specifications. Change the hydraulic filter.
   B. Do steps 6 through 35.
4. If the contamination is visible:
   A. Change the hydraulic oil and hydraulic filter. See Section 0 for specifications.
   B. Do steps 5 through 35.
5. Check the amount of contamination in the hydraulic system by doing the following steps:
   A. Disassemble one cylinder in two different circuits. Check for damage to seals, scoring of the cylinder wall, etc. Repair the cylinders as necessary.
   B. If, in your judgment, the damage to the cylinders was caused by sever contamination and is not the result of normal wear, it is necessary to remove, clean and repair valves, pump, lines, cylinders, hydraulic reservoir, etc. in the hydraulic system.
6. Remove the breather from the reservoir and connect the vacuum pump to the opening. Start the vacuum pump.
7. Loosen and remove the drain plug from the reservoir.
8. Using the fitting kit shown on page 6-47, install the valve in the hole for the drain plug. Make sure that the valve is closed.
9. Stop the vacuum pump.
10. Connect the inlet hose for the portable filter to the valve that is installed in the hole for the drain plug.
11. Disconnect the vacuum pump from the hydraulic reservoir air breather hose. Remove the filler cap.
12. Install the outlet hose for the portable filter in the hydraulic reservoir filler neck.
13. Open the valve that is installed in the hole for the drain plug.
14. Move the switch for the portable filter to the ON position. Start and run the engine at 1500 rpm (r/min).
15. Run the portable filter for 10 minutes.
16. Continue to run the portable filter. Increase the engine speed to full throttle. Heat the oil to operating temperature by doing the following steps:
   A. Hold the blade control lever in the TILT position for five seconds.
   B. Return the blade control lever in the NEUTRAL position for five seconds.
   C. Repeat steps A and B until the oil in the hydraulic system is at operating temperature.
17. Continue to run the engine at full throttle. Continue to run the portable filter.
18. Operate each hydraulic circuit to completely extend and retract the cylinders. Continue to operate each hydraulic circuit two times, one after the other for 45 minutes.
19. Decrease the engine speed to low idle.
20. Continue to run the portable filter for 10 minutes.
21. Stop the portable filter.
22. Stop the engine.
23. Remove the hose from the hydraulic reservoir.
24. Close the valve that is installed in the hole for the drain plug.
25. Disconnect the inlet hose for the portable filter from the valve. Remove the outlet hose from the reservoir filler neck and replace filler cap.

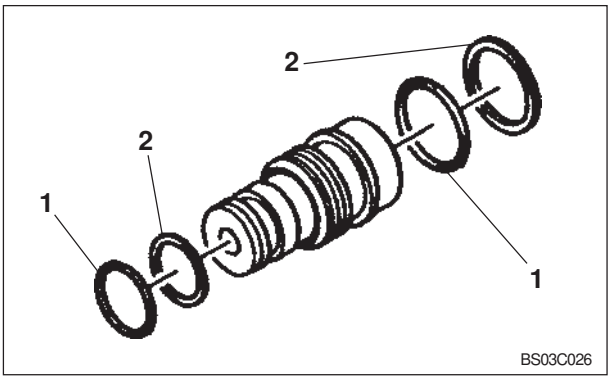
STEP 16



1. O-rings - **2.** Thrust rings.

Remove and discard O-rings and thrust rings from pilot pressure reducing valve (**20**).

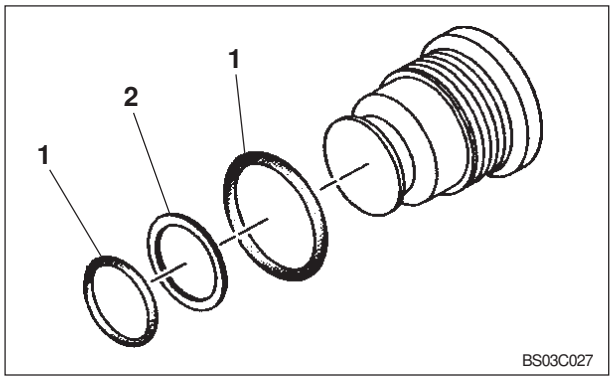
STEP 17



1. O-rings - **2.** Thrust rings.

Remove and discard O-rings and thrust rings from flow limit valve (**9**).

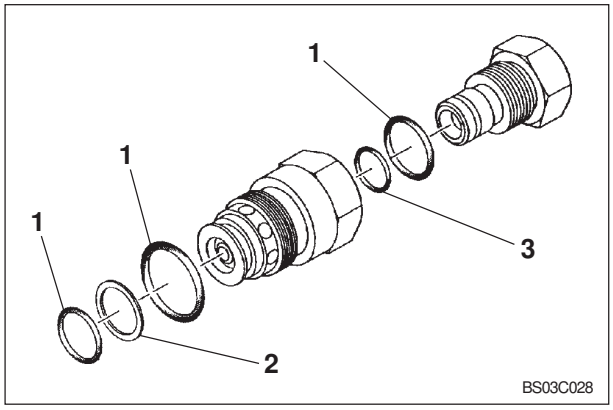
STEP 18



1. O-rings - **2.** Thrust ring.

Remove and discard O-rings and thrust ring from locking screw (**15**).

STEP 19



1. O-rings - **2.** Thrust ring - **3.** Spool seal.

Remove and discard O-rings, thrust ring, and spool seal from anticavitation valve (**22**).

6.5.4 LIFT CYLINDER

Disassembly

1. Clean exterior of cylinder. If hoses were removed with cylinder, remove hoses from cylinder.
2. Fasten tube (**1**) in an acceptable repair stand or other holding equipment, refer to Figure page 6-70. Do not damage tube (**1**).
3. Loosen and remove self-tapping screw (**12**).
4. Use a spanner wrench to loosen and remove gland (**4**) from tube (**1**).
5. Pull piston rod (**13**) straight out of tube (**1**) to prevent damage to tube.
6. Fasten piston rod eye or yoke in a vise and put a support under piston rod (**13**) near piston (**15**). Put a shop cloth between support and piston rod to prevent damage to piston rod.
7. Use a torque multiplier, **380001732**, to loosen and remove bolt (**14**) that fastens piston (**15**) to piston rod (**13**).
8. Remove piston (**15**) from piston rod (**13**).
9. Remove gland (**4**) from piston rod (**13**).
10. Remove and discard seal (**16**), ring (**17**), and wear ring (**18**) from piston (**15**).
11. Remove and discard O-ring (**10**), backup ring (**9**), O-ring (**11**), wiper (**5**), rod seal (**6**), buffer seal (**7**), and bushing (**8**) from gland (**4**).

Inspection

1. Clean all parts in cleaning solvent. Use only lint free cloths for cleaning and drying.
2. Check to be sure that piston rod (**13**) is straight. If piston rod is not straight, replace it with a new piston rod.
3. Shine a light inside tube (**1**) and check for deep grooves and other damage. If there is any damage to tube, replace with a new tube.
4. Remove any small scratches on piston rod (**13**) or inside tube (**1**) with emery cloth of medium grit. Use emery cloth with a rotary motion.
5. Inspect bushings (**2**) in tube eye. Replace as required.
6. Inspect gland (**4**) for rust. Clean and remove rust as necessary.
7. Inspect gland end of tube (**1**) for sharp edges that may cut gland O-ring (**11**) and remove as necessary.
8. Inspect piston (**15**) for damage and wear. If piston is damaged or worn, replace with a new piston.

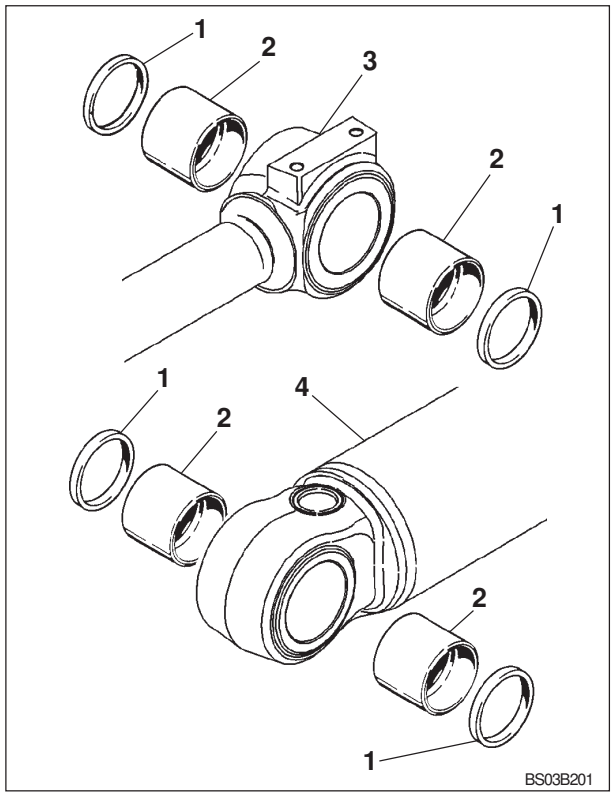
6.5.9. REPLACING BUSHINGS FOR THE BUCKET CYLINDER Z-BAR MODELS

Removal

1. Put piston rod eye (**3**) in a press.
2. Use an acceptable driver to press wipers (**1**) and bushing (**2**) out of piston rod eye (**3**).
3. Put tube (**4**) in a press.
4. Use an acceptable driver to press bushings (**2**) out of tube (**4**) eye.
5. Clean bore for bushings (**2**) in piston rod eye (**3**) and tube (**4**) eye.

Installation

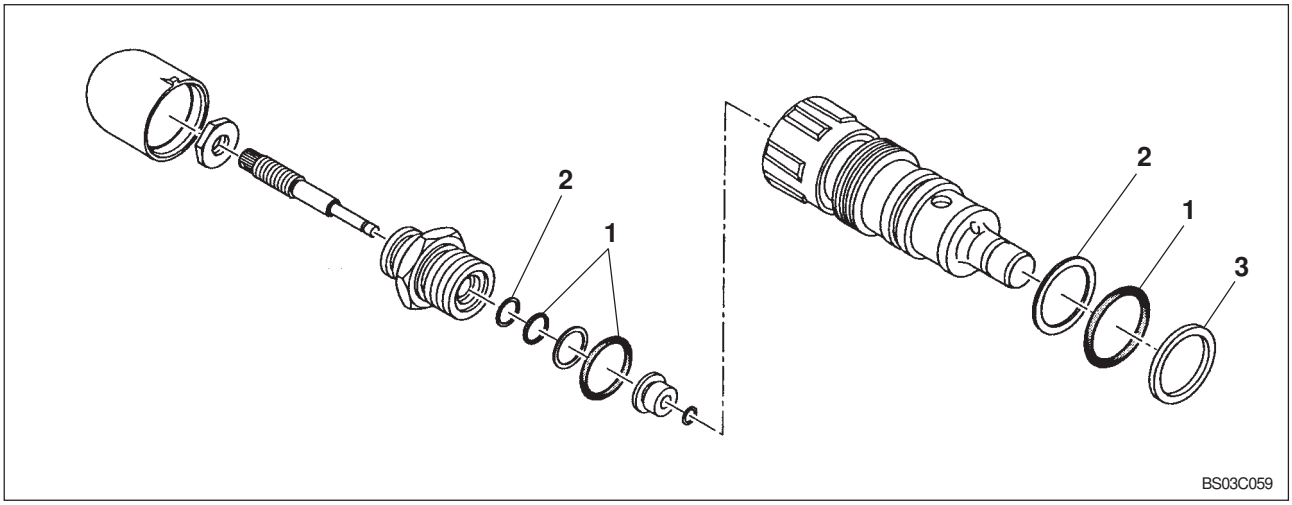
1. Use an acceptable driver to press new bushings (**2**) into piston rod eye (**3**) until recessed 8 mm (0.315 inch).
2. Use an acceptable driver to install wipers (**1**) until flush with piston rod eye (**3**). The lips of the wipers (**1**) must be towards outside of bore.
3. Use an acceptable driver to press new bushings (**2**) into tube (**4**) eye until recessed 8 mm (0.315 inch).
4. Use an acceptable driver to install wipers (**1**) until flush with tube (**4**) eye. The lips of wipers (**1**) must be towards outside of bore.



Bushing and wiper removal and replacement Z-bar bucket cylinder

1. Wiper - **2.** Bushing - **3.** Piston rod eye - **4.** Tube.

STEP 9



Pressure Relief Valve

1. O-rings - **2.** Thrust rings - **3.** Bonded seal.

Replace O-rings (**1**), thrust rings (**2**), and bonded seal (**3**) on the pressure relief valve. Assembly pressure relief valve as shown above.

STEP 10

Install the pressure relief valve (**6**) into the housing (**1**) and tighten.

STEP 11

Install the insert valve (**2**) into the housing (**1**).

STEP 12

Place the logic cover (**7**) into position on the housing (**1**). Secure the logic cover (**7**) with four mounting screws (**10**) and tighten screws.

Note – *Make sure R-rings remain in place and oil ports are properly aligned.*

STEP 13

Place the directional valve (**8**) into position on the logic cover (**7**). Secure the directional valve (**8**) with four mounting screws (**9**) and tighten screws.

Note – *Make sure R-rings remain in place and oil ports are properly aligned.*

STEP 14

Install new O-rings on the locking screws (**3**, **4**, and **5**), install and tighten locking screws.

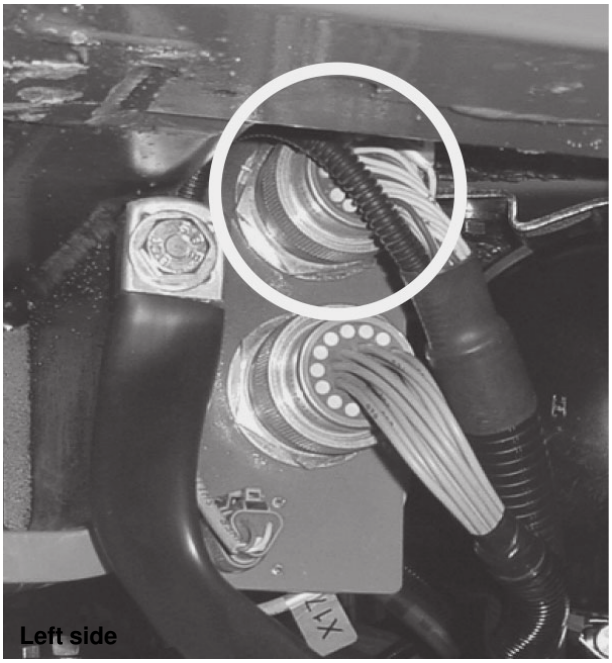
STEP 15

Install the ride control valve in the machine.

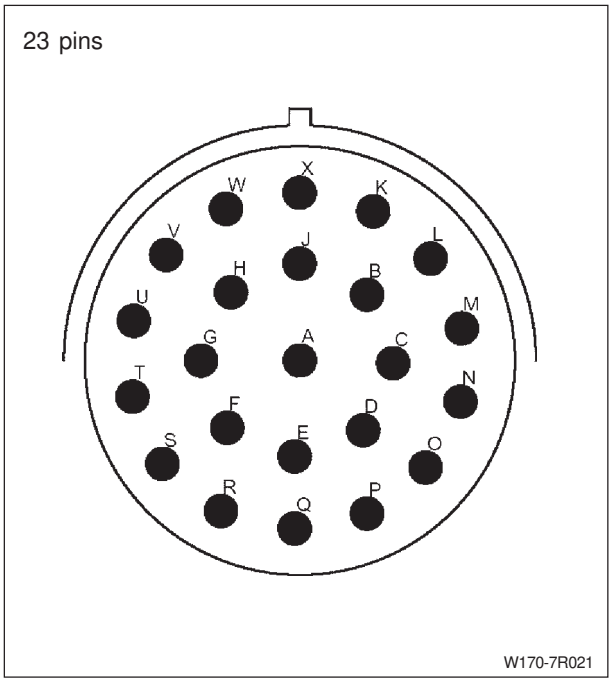
STEP 16

Test the ride control system.

CONNECTOR X21 DETAIL
(Transmission harness)



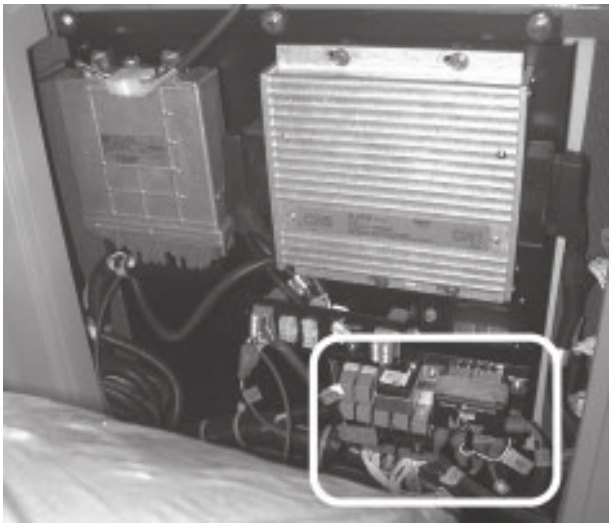
W170-7R071



W170-7R021

CONNECTOR X21			
CAVITY	**USER**	**WIRE NUMBER (Cab side)**	**WIRE NUMBER (Machine side)**
A	Proportional solenoid Y1	ZF56	430
B	Proportional solenoid Y2	ZF10	434
C	Proportional solenoid Y3	ZF32	438
D	Proportional solenoid Y4	ZF55	442
E	Proportional solenoid Y5	ZF9	446
F	Proportional solenoid Y6	ZF51	450
G	Common power supply to prop. solen.	ZF12	454
J	Valve oil temp. sensor power supply	ZF39	458
K	Conv. oil temp sensor power supply	ZF49	574
L	Valve oil temp. sensor return	ZF46	462
M	Engine speed sensor signal	ZF19	GE2
N	Engine speed sensor return	ZF3	BL2
O	Turbine speed sensor signal	ZF41	GN3
P	Turbine speed sensor return	ZF3A	SW3
Q	Intermediate speed sensor signal	ZF42	RT4
R	Intermediate speed sensor return	ZF3B	BL4
S	Output speed sensor ground	ZF4	500
T	Output speed sensor signal	ZF62	504
U	Output speed sensor power supply	ZF45_A	508
V	Oil filter pressure switch power supp.	ZF17	480
W	Oil filter pressure switch return	ZF46B	484
X	Conv. oil temp sensor return	ZF46A	570

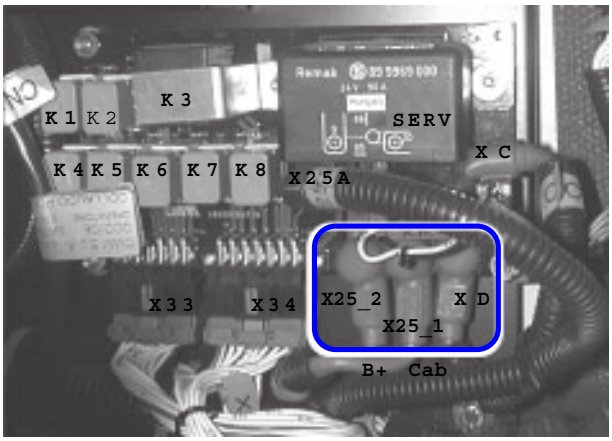
7.3.3 CAB RELAY DESCRIPTION



W170-7R031

Components

K1. Hi -beam relay - **K2.** LTS Relay (Speed = 0 km/h) - **K3.** Flasher unit - **K4.** Low beam relay - **K5.** Neutral starting safety relay - **K6.** Horn relay (controlled by hand switch on the shifter) - **K7.** Horn relay (controlled by foot switch on cab floor) - **K8.** Parking brake relay - **SERV.** Accessory main relay 90 A.

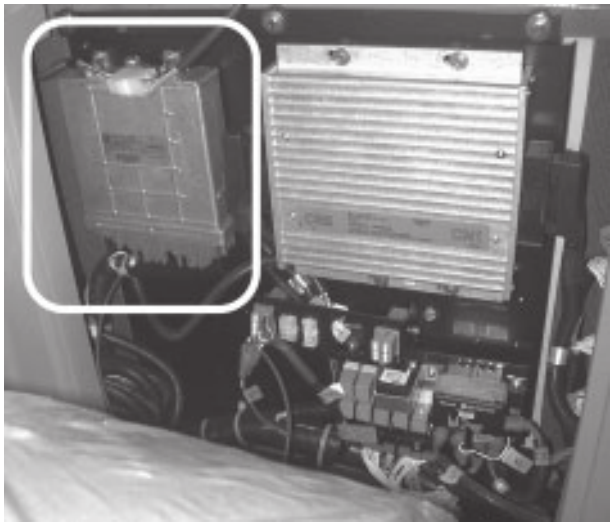


W170-7R032

Connections

X33. Relay K1, K2, K4, K5 - **X34.** Relay K6, K7, K8; Accessory relay coil; Flasher unit K3 - **XC.** Accessory relay 90 A input power (+30) - **XD.** Delivery from batteries to +30 accessory relay 90 A - **X25_A.** Output connection (G) accessory relay 90 A (to ACC connection cab fuse board) - **X25_1.** Power supply from batteries (from engine compartment B+ box) - **X25_2.** Delivery from batteries to +B connection on cab fuse board.

7.3.4 TRANSMISSION CONTROLLER ZF EST 37



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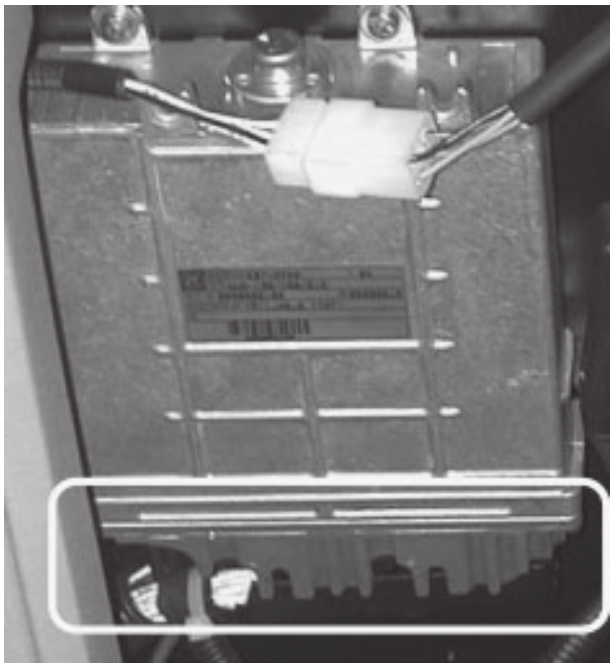
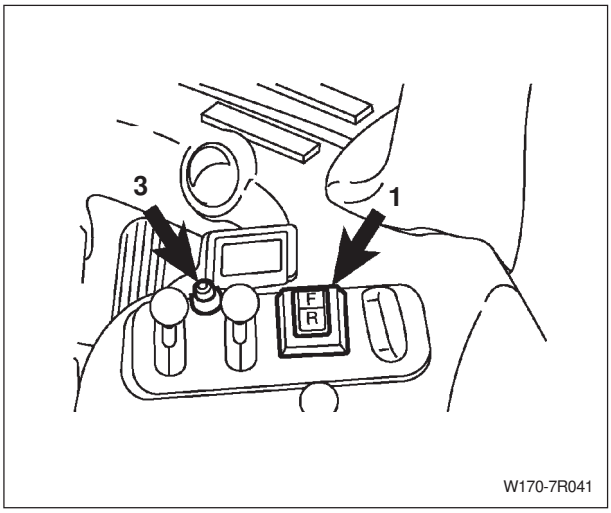
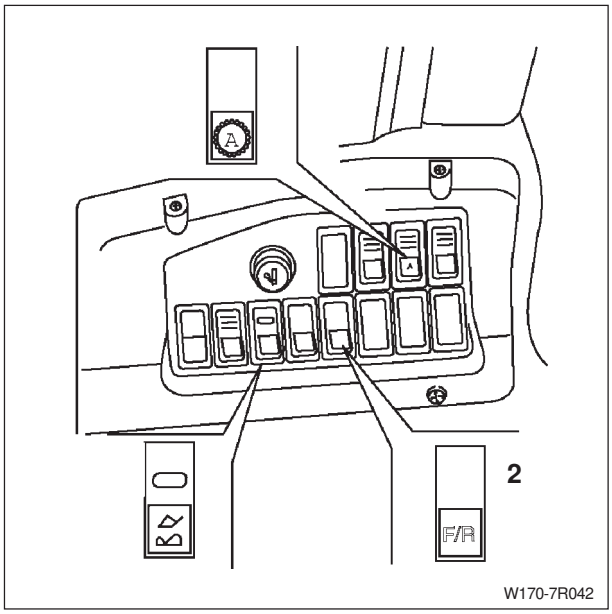


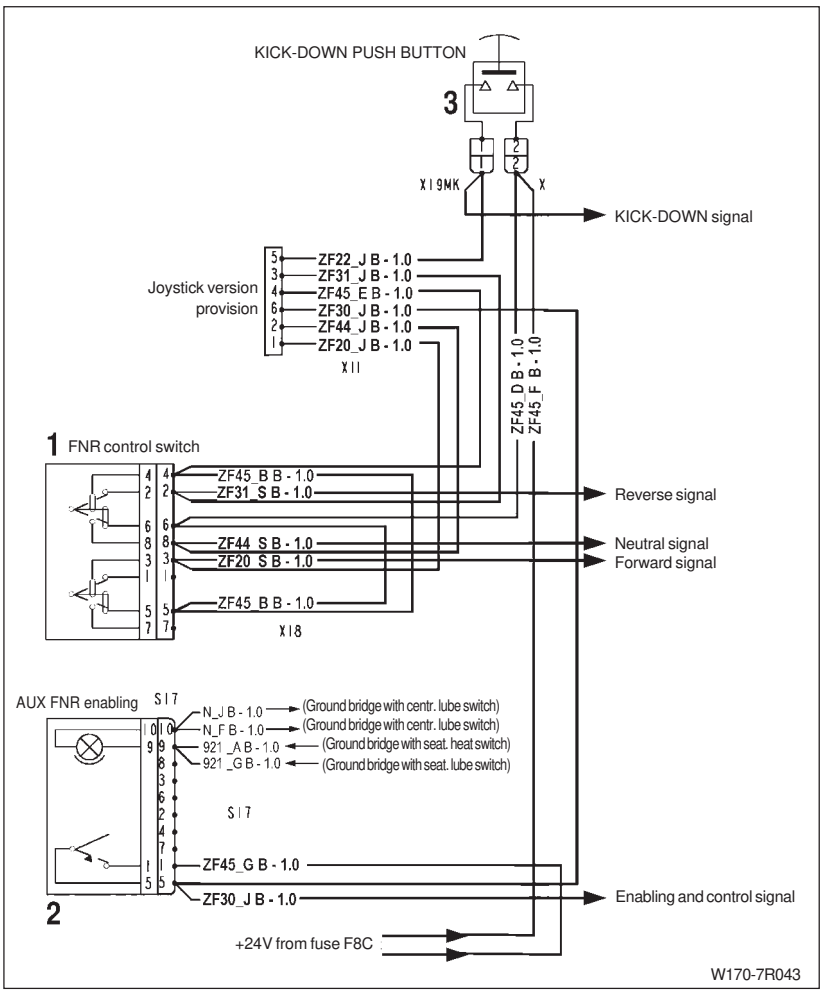
W170-7R034

Auxiliary FNR control
(2/3 levers on hydraulic manipulator)





1. Auxiliary FNR control switch - **2.** Auxiliary FNR function enabling push button - **3.** Kick down push button.

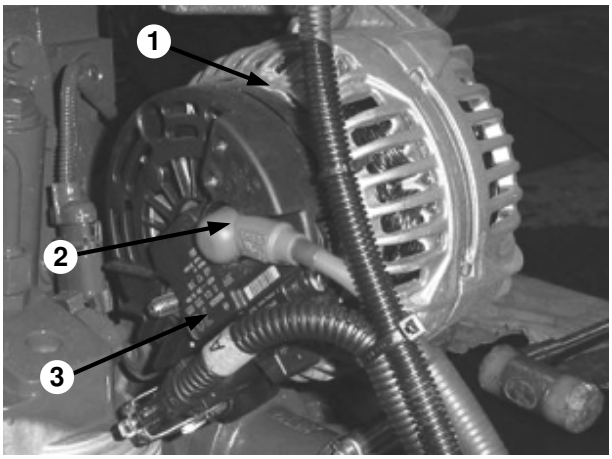


To select the auxiliary FNR function:

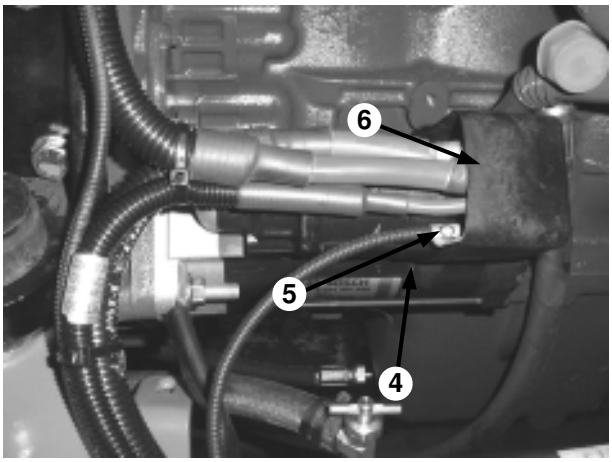
- Start the engine.
- Disengage the parking brake.
- Keep the gear selector in neutral.
- Press once the push button **2** (Aux FNR function enabling).
- Select the travel direction by acting on the rocket switch **1**(Aux FNR control).

The machine will start to move in the selected direction. To invert the travel direction, activate the rocket switch 1. The function will be disabled by using again the gear selector on the steering column. To select the function again, repeat the above procedure.

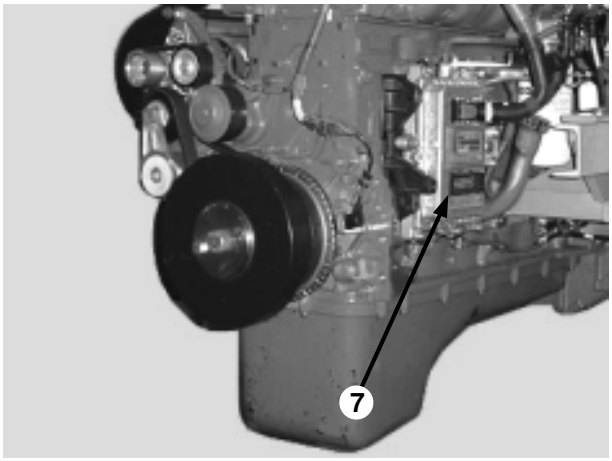
7.4.8 ENGINE COMPONENTS



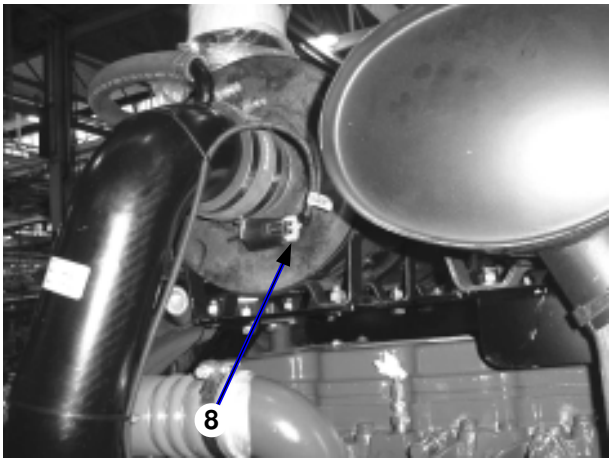
W170-7R064



W170-7R065



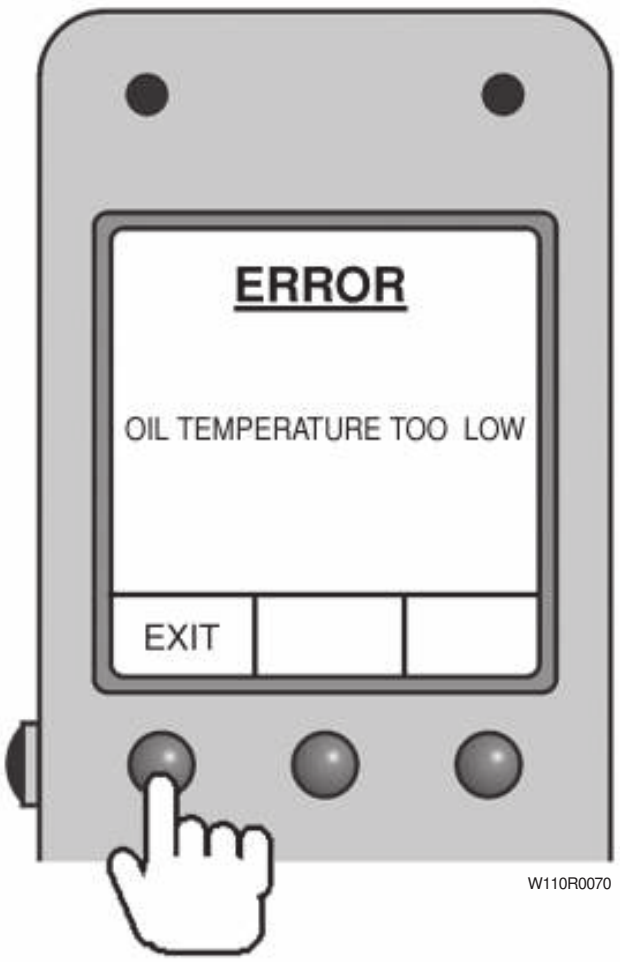
W170-7R066



W170-7R067

Legend
1. Alternator - **2.** Alternator B+ stud (battery charge) - **3.** Alternator "ALT" connector - **4.** Starter motor - **5.** Starter motor "CMS" connector - **6.** Starter motor "B+" studs (power from battery) - **7.** EDC7 engine controller *(for details see chapter 3)* - **8.** Air filter clogging pressure switch (normally open - closed at 62 mbar).

Test conditions: ENGINE IN OPERATION, PARKING BRAKE ENGAGED, GEARSHIFT IN NEUTRAL, TRANSMISSION IN MANUAL MODE, TRANSMISSION CUT-OFF DISENGAGED, TRANSMISSION OIL TEMPERATURE AT 80 °C (176 °F), ENGINE SPEED AT LOW IDLE.

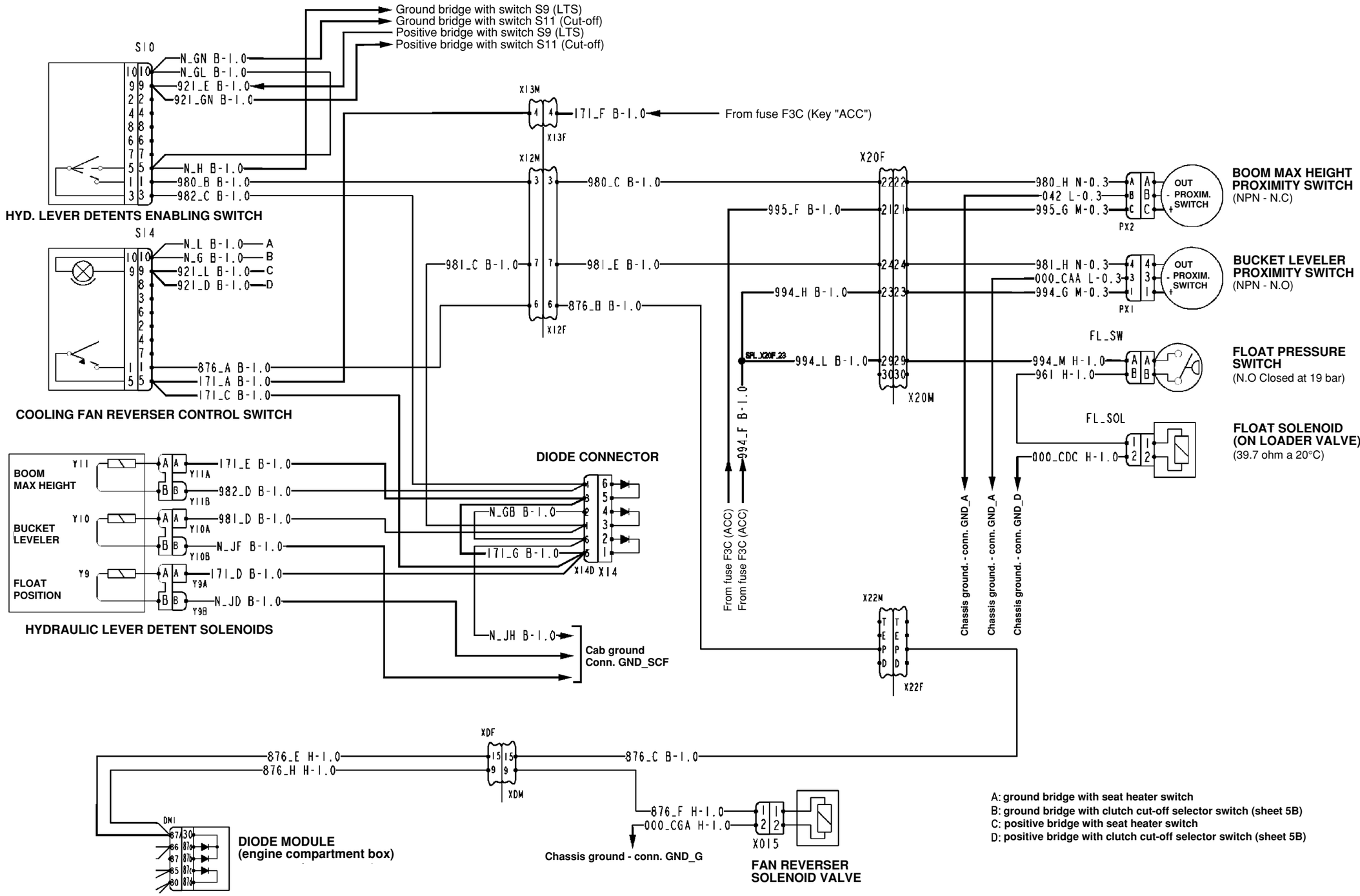


5. In the event even just one of the test conditions is not complied with, the procedure does not start and the system displays the reason for the failed starting. **Under these conditions, it is necessary to exit the program through button P1 and to cut-off the engine.** Then, reinstate the test conditions and restart the procedure.
   In the example in the figure, the system warns the operator that the oil temperature is too low (< 80 °C – 176 °F).
   Other fault messages could appear depending upon which one of the conditions is not complied with:

- Oil temperature too high
  (temperature oil too high)
- Engine speed too low
  (engine speed too low)
- Engine speed too high
  (engine speed too high)
- Output speed is not 0
  (the machine is moving)
- Parking brake not engaged
  (the parking brake is not engaged)
- Gearshift lever not in neutral
  (the selector is not in neutral)

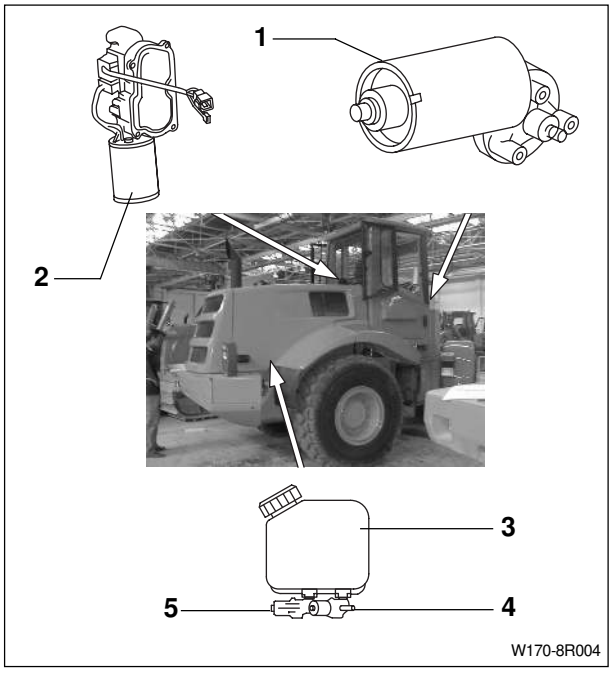
NOTES:

Sheet 7 - HYDRAULIC LEVER DETENTS AND COOLING FAN REVERSER



8.3 WINDSCREEN WIPERS AND WASHERS

The front windscreen wiper motor (**1**) is located at the front of the steering column. The front windscreen wiper has two intermittent working speeds: 35 strokes per min (slow) and 55 strokes per min (fast).
A dog-leg mechanism transforms the motor shaft rotary motion into 45° strokes of the wiping arm.
The rear windscreen wiper motor (**2**) is located under the cab trim behind the driver's seat, on the right-hand side. The rear windscreen motor has but one speed (approx. 54 strokes per min).
Internal gears provide an 80° oscillation of the wiping arm.



The windscreen washer fluid bottle (**3**) is located inside the engine compartment, on the left-hand side. The bottle is fitted with two pumps (**4**) and (**5**) for the front and rear windscreens, respectively.

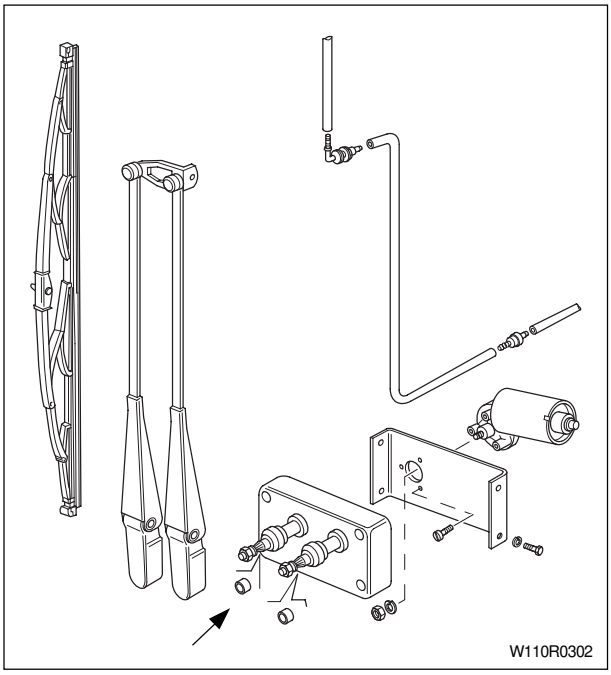
Specifications

Bottle capacity ..... 2.5 lt. (0.87 gal)
Rated voltage 24V
Absorbed current ..... ≤ 2A
Max. flow ..... ≥ 3 lt./min (0.6 USG/min)

Note 1 – *Before setting the wiper blades in motion, operate the windscreen washer to minimise the risk of scratching the glass.*

Note 2 – *Use the cleaning fluid DP1 diluted with water dependent upon working temperature. A 50% detergent/water solution does not freeze down to -10 °C (14 °F). Below this temperature, use cleaning fluid only.*

Pump hoses are connected to the nozzles located at the sides of the wiping arms.



In case of motor or arm assembly replacement, it will be necessary to reassemble the arm assembly to the drive part correctly to centre the wiping action over the glass width.
To this aim, select the most suitable position for the arm on the knurled drive part shown by the arrow in the figure.

8.6.4 TOOL CONNECTIONS

WARNING

Do not connect hoses to the air conditioner system when the manifold gauge valves are open.

CAUTION

If there is any refrigerant in the air conditioner system, connect the hoses only after the service hoses and the manifold gauge have been evacuated.

1. Fully close both manifold gauge valves.
2. Connect the three hoses securely to the manifold gauge.
3. Connect the utility hose to the vacuum pump or refrigerant source.
4. Connect the couplers to the high and low pressure hoses. Turn the knob on the fitting to depress the core if so equipped.
   Before disconnecting hoses, close both manifold gauge valves.