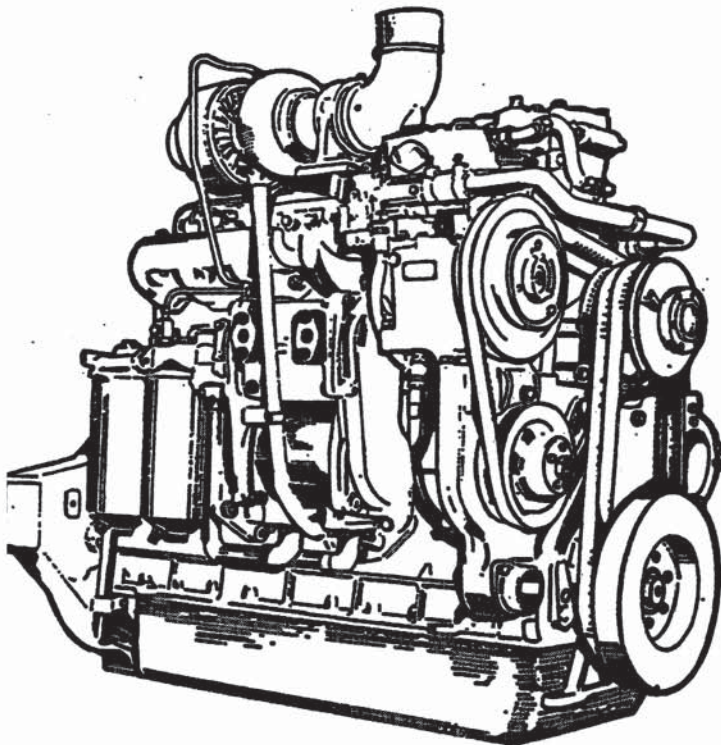




8045

ENGINE

**SERVICE
MANUAL**



Form 604.06.295 English
REPRINT 11/87

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SAFETY RULES

mable, non-toxic solvents.

When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 2 bar (30 psi) according to local or national requirements.

Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.

Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.

Be sure all mechanic's tools are in good condition. DO NOT use tools with mushroomed heads. Always wear safety glasses with side shields.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.

When making equipment checks that require of the engine, have an operator in the operator seat at all times with the mechanic in sight. Place the transmission in neutral and set the brakes and lock. Keep hands and clothing away from moving parts. Shut off engine and disengage the Power Take-Off Lever before attempting adjustments or service.

Never use the bucket as a man lift.

The articulation point between frames will not clear a person. Stay clear when engine is running. Support, using device provided when servicing. Return support to carry position and secure before moving machine after servicing. See Operation and Maintenance Instruction Manual.

For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.

Guard against kinking chains or cables. Do not lift or pull through a kinked chain or cable. Always wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. **DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENTS OF MACHINES INVOLVED ARE PROPERLY GUARDED** against accidental cable or chain backlash.

Keep maintenance area **CLEAN** and **DRY**. Remove water or oil slicks immediately.

DO NOT pile oily, greasy rags – they are a fire hazard. Store in a closed metal container.

Before starting machine or moving attachment check and adjust and lock operator's seat. Be sure all personnel in the area are clear before starting or moving machine and any of its attachments. Sound horn.

Rust inhibitors are volatile and flammable. Prepare parts in well-ventilated place. Keep open flame away – **DO NOT SMOKE**. Store container in a cool well-ventilated place secured against unauthorized personnel.

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

Keep clutches and brakes on machine and attachments such as Power Control Units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturer at all times. **DO NOT** adjust machine with engine running except as specified.

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.

Wear welder's protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding. Wear dark safety glasses near welding. **DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.**

Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support for the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance work according to local or national requirements.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

Inspect your seat belt at least twice a year for signs of fraying, wear, or other weakness that could lead to failure.

Where it is necessary to use diesel fuel as a lubricant make sure all smoking material and open flames are extinguished or that no sparks are near. Place all parts in a closed container of clear diesel fuel for use as needed.

To minimize dangers of fire and explosion, it is recommended that before any welding is done on a fuel tank, the tank be completely drained of fuel, fuel lines disconnected and the ends closed to protect them, and the tank be steam cleaned. All traces of fuel must be removed before welding is started. Flood the tank with carbon dioxide (CO₂) before and during welding. Caps must be removed and vents and other openings left open during welding.

Dry ice (solid carbon dioxide) is extremely cold and will freeze flesh on contact. Use care to prevent contact with skin, eyes, or other parts of the body to avoid personal injury.

When work is required under or between components, block with an external support capable of holding the components in place according to local or national requirements.

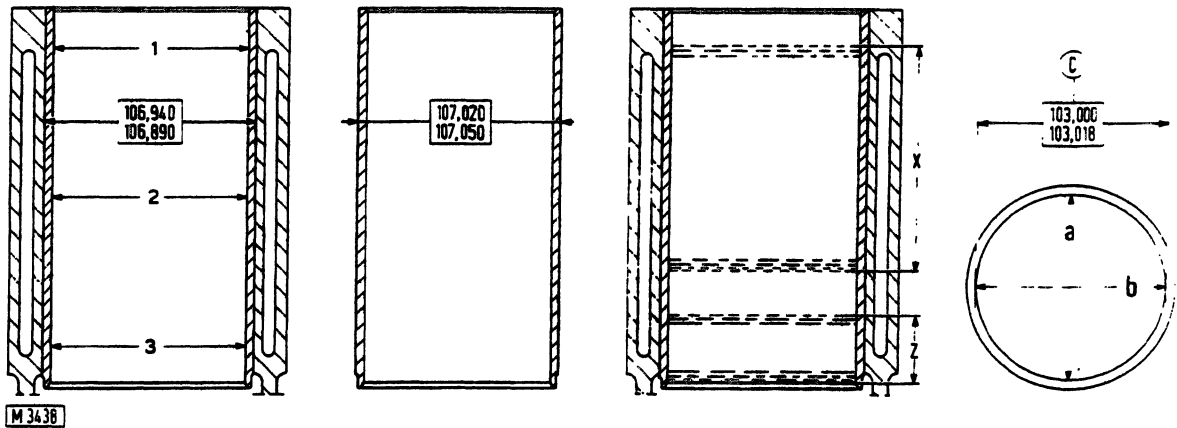


Fig. 5 - Standard dimensions (mm) of cylinder sleeves and seats in the block, and checking sleeve wear.
 a-b. Perpendicular gauge positions for sleeve I.D. measurement - C. Figure to be obtained after sleeve installation - Z. Measurement area of worn sleeve I.D. to determine clearance with pistons (measure along axis b perpendicular to crankshaft) - X. Measurement area of worn sleeve I.D. (area swept by piston rings) to determine out-of-round and taper (measured along axis a and b, parallel and perpendicular to crankshaft) - 1-2-3. I.D. measurement level for new or refaced sleeve, along two perpendicular axes a and b.

black; if distortion is found to exist, dress using a grinder. If a surface plate is not available, use a straightedge (1, Fig. 6) and feeler gauge to detect areas of deformation.

Check the cylinder sleeve bores for sign of pick-up, scoring, out-of-round, taper or abnormal wear. To check the bore diameter in order to assess the amount of out-of-round, taper and wear, use gauge (Fig. 7) with attached dial gauge.

Check sleeve wear as follows (Fig. 5):

- measure I.D. in area X (swept area);
- measure this area at the top and at the bottom along axis (a) parallel to the crankshaft, and along axis (b) perpendicular to the crankshaft;
- compare measurements to determine out-of-round and taper.

To check clearance with pistons measure I.D. of each sleeve in area (Z) only along axis (b).

In case out-of-round or taper exceed 0.12 mm (0.004 in) or clearance with pistons is over 0.3 mm (0.012 in) rebore sleeves (or replace them) to the nearest oversize (see table Specification). Check dimensions along axes (a and b) at three different levels (1, 2, 3).

Then match sleeves with pistons of the correct size (see "Pistons and rings").

2.1.2. REPLACING CYLINDER SLEEVES

By reaming the sleeve, thickness of its wall decreases. Max. thickness of the material that may be removed is 0.8 mm (0.03 in) after which sleeves have to be renewed. To remove sleeves use universal

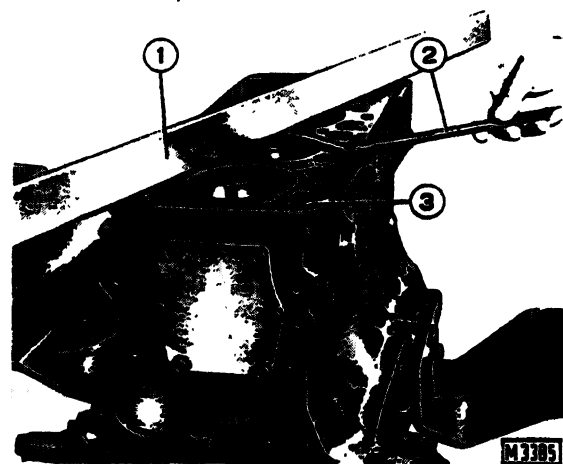


Fig. 6 - Checking engine block top.
 1. Straightedge - 2. Feeler gauge - 3. Engine block top.

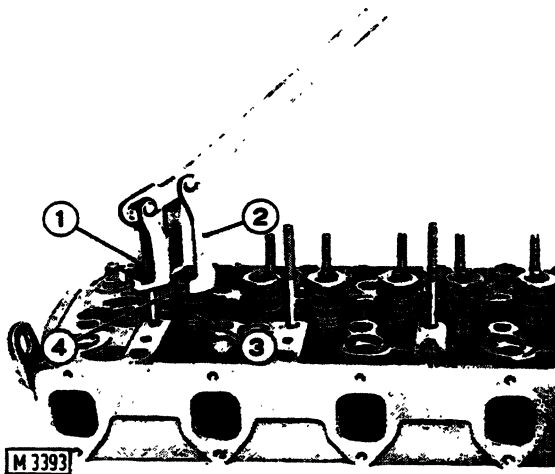


Fig. 26 - Dismantling and installing valves.
 1. Retaining nut - 2. Tool 75291050 - 3. Valve spring -
 4. Upper retaining cup.

3.2.2 INSTALLING VALVES

Reverse dismantling operations considering what follows:

- before installing springs, lubricate valve stems with engine oil;
- spring (a, Fig. 25) must have closer coils on the head side;

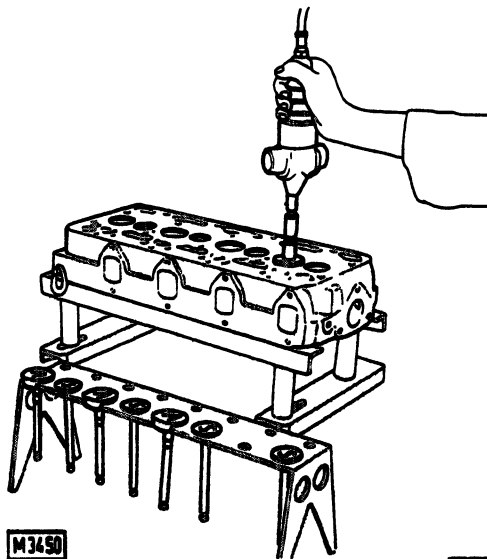


Fig. 27 - Grinding valves with pneumatic grinder 75290084.

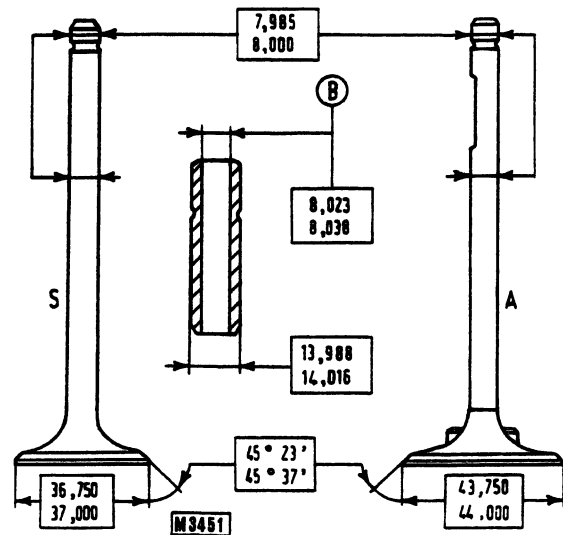


Fig. 28 - Main valve and valve guide dimensions (mm).
 Note - Min. thickness of valve head parallel face is 0.5 mm (0.019 in).

- A. Intake
- B. Value to be obtained by reaming after installation of valve guide.
- S. Exhaust.

- install caps (4, Fig. 25) on valve stems;

NOTE - If only valve springs have to be removed, it is possible not to remove the cylinder heads by bringing the piston concerned to T.D.C., so that valves may be replaced.

Intake valves have a deflector to increase air turbulence and are correctly positioned in their seats by lower cup (3, Fig. 29), which is positioned on the head with a locating dowel (2).

3.2.3 VALVE GUIDES

To renew valve guides use punch 75291046 (Fig. 30) acting on head bottom to extract and on head top to install.

Check valve guides bearing in mind the following:

- bore surface of each guide must be free from scoring, seizing, or scale;
- guides must have their external locating clip;

WARNING

Use proper tools to bring holes into alignment.
DO NOT USE FINGERS OR HANDS.

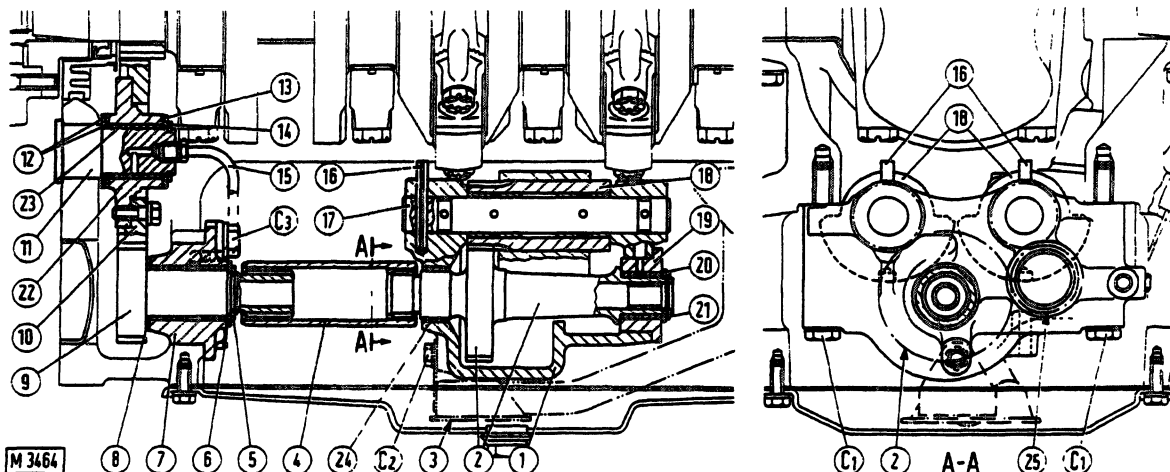


Fig. 51 - Section view of contrarotating weights vibration damper.

C₁. Capscrews securing damper box to oil pan - C₂. Capscrews securing strainer to damper box (1) - C₃. Capscrews securing support to oil pan - 1. Damper box - 2. Weights drive gear - 3. Strainer - 4. Sleeve coupling - 5. Retaining circlip - 6. Washer - 7. Gear (9) support - 8. Washer - 9. Gear with weights driving unit - 10. Idler gear - 11. Gear (10) shaft - 12-13. Washers - 14. Retaining circlip - 15. Bushing (23) lubrication tube - 16. Shaft (17) retaining roll pin - 17. Weights shaft - 18. Weights - 19. Gear (2) supporting flange - 20. Washer - 21. Retaining circlip - 22. Gear (10) supporting flange - 23-24. Bushings - 25. Weights idler gear.

Check flywheel runout and out-of-round with a dial gauge resting on the front and on the edge of the flywheel.

Variations should not exceed 0.1 mm (0.0039 in).

- drive unit with gear (9) and support (7) may be removed separately after removing lubrication tube (15) and screws (C₃).

4.6 CONTRAROTATING WEIGHTS VIBRATION DAMPER

The contrarotating weights vibration damper is housed in a box (1, Fig. 50) mounted in the engine oil pan by means of screws (C₁). In the box are two eccentric weights (18) revolving on their axes (17) and controlled by gears (2 and 25).

4.6.1 DISMANTLING THE VIBRATION DAMPER

In case of vibration damper overhaul dismantle as follows:

- drain engine oil and remove oil pan bottom cover;
- remove strainer (3, Fig. 50) from oil pan removing screws (C₃) securing strainer to pump and to damper box;
- remove screws (C₁, Fig. 51) securing damper box to oil pan, move it away from the support in order to remove locating dowel and move box toward the rear of the engine to free sleeve coupling (4) from drive unit (9) and remove it;

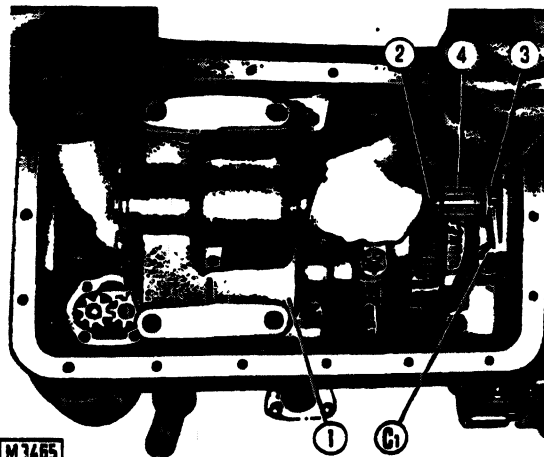


Fig. 52 - Removing damper box (1) with sleeve coupling (2) from oil pan installed on engine.

C₁. Screws securing support (3) to pan - 3. Gear (4) support - 4. Drive gear.

5.6.2. INSTALLING AND TIMING THE INJECTION PUMP

Install pump on engine as follows:

- install flat gasket (2, Fig. 69) on pump support;
- install pump spindle making sure master spline is correctly positioned; after installation bring reference marks (F) into alignment and secure pump with capscrews.

At this stage the pump should be timed with the engine. If in doubt carry out a spill test as detailed below:

- remove pressure fitting of element No. 1 (2, Fig. 70) and temporarily remove the delivery valve, spring and restrictor plug. Reinstall pressure fitting;
- move accelerator lever to max. position and operate supply pump (1) to bleed the circuit;
- remove pump valve lifter cover and slowly turn crankshaft in a clockwise direction to bring pumping element No. 1 to bottom-of-stroke position, at the start of compression stroke;
- keep on supplying fuel and turn crankshaft until fuel stops issuing from fitting (2, Fig. 49) and remains at its top.

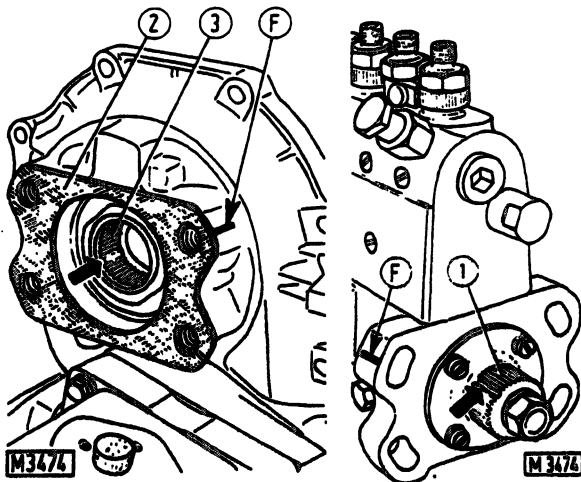


Fig. 69 - Installing injection pump on engine.

Note - Arrows indicate master spline on spindle and bushing.

F. Reference marks for pump location on engine - 1. Splined spindle - 2. Flat gasket - 3. Splined bushing.

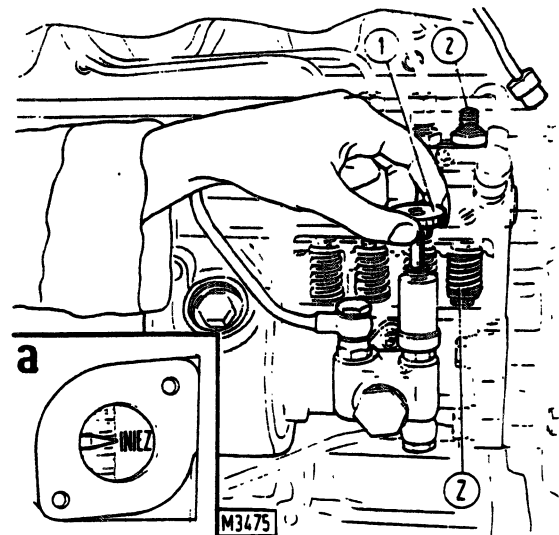


Fig. 70 - Checking injection pump timing with spill test system.

Z. Cylinder No. 1 pumping element - 1. Fuel pump - 2. Pumping element No. 1 fitting.




This condition corresponds to the start of delivery to cylinder No. 1.

In this position the timing mark must be aligned with the word INIEZ. on the flywheel (a). If not, slacken injection pump capscrews and turn it in a clockwise or anticlockwise direction to obtain alignment.






Stamp new reference marks on pump flange and on cylinder block for any future intervention on the pump.











8. TROUBLESHOOTING AND TESTS

DANGER

-  **FLAMMABLE VAPORS:** Extinguish all smoking materials or open flames before checking and filling batteries. **DO NOT** check battery by sparking.
-  Do not use matches, lighters, or torches for a light source on the machine due to the presence of flammable fluids.
-  Extinguish all smoking materials or open flames before checking and filling fuel tanks, changing filters and before opening sediment drain due to the presence of flammable fluids.

WARNING

-  No unauthorized person should be allowed to service or maintain this machine. Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing this machine.
-  Always disconnect the batteries before cleaning, repairing, or servicing the machine.
-  Never use gasoline, solvent or other flammable fluids to clean parts.
-  **DO NOT** check or adjust belts when engine is running. Be especially alert around a pusher fan.
-  Never attempt to operate machine or attachment except when seated in the operator's seat. Keep head, body, limbs, hands and feet inside the operator's compartment to reduce exposure to hazards outside the operator's compartment.

-  Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.
-  Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazard of electrical shock.
-  Never service or adjust the engine running except as called for in the Operation and Maintenance Instruction or Service Manuals to keep from being caught in moving parts or by a moving machine.
-  Before moving machine or attachments be sure exposed people in the area are clear of the unit. Walk completely around machine before mounting. Sound horn.
-  Keep people clear of attachments and tools while in raised position to prevent possible injury.
-  Warn all people who may be servicing or working around machine before starting machine.
-  Use lifting eyes, if provided, for handling by lifting devices.
-  **DO NOT USE HANDS** to search for pressure leaks. Fluid escaping under high pressure can penetrate skin.
-  Place protection over air inlet openings before operating engine.
-  Wear safety glasses with side shields or goggles when using compressed air for cleaning to reduce the danger of personal injury from flying particles. Limit the pressure to 30 psi (2 kg/cm²) according to local or national requirements.

8.2 TESTS

8.2.1 COMPRESSION TEST

If engine performance is found to be unsatisfactory, check the injection system and the compression in each cylinder.

To check engine compression use tester 75291310 and proceed as follows:

1. Clean the outside of the engine to remove any traces of dirt, oil or fuel.
2. Bring engine to normal operating temperature and stop machine.
3. Remove the injectors from the six cylinders.
4. Fit dummy injector 75292632 in place of the injector of the cylinder under test, and ensure sealing by applying a copper washer on the bottom of the fuel injector sleeve.
5. Connect the instrument to the dummy injector through the appropriate flexible pipe.
6. Hold the injection pump at shut off and take the necessary readings driving the engine through the starter.

In normal operating conditions, compression should be higher than 25 bar or 356 psi as recorded at 40-60°C (104-140°F) pan oil temperature, 760 mmHg (sea level) atmospheric pressure.

The minimum compression which is acceptable for a worn engine is 22 bar or 313 psi, max. allowance between cylinders being 3 bar or 43 psi.

Note that every 100 metres or 328 ft altitude increase above sea level results in a 1% (approx.) decrease in compression. Insufficient compression may be due to faulty valves and seats, pistons and associated rings, cylinder sleeves or cylinder head gasket.

NOTE - The purpose of the compression test is to assess the consistency of compression in the cylinders and the test results should not be taken as an absolute indication of engine efficiency.

8.2.2 LUBRICATING PRESSURE TEST

Engine oil pressure should be tested before and after general engine overhaul and whenever oil pump is replaced. Oil pressure should also be checked whenever pressure gauge on dashboard gives unusual readings. It is thus possible to determine immediately whether it is the pressure gauge or the lubricating system which is malfunctioning.

Normal oil pressure with engine at full torque and oil at normal operating temperature (80°C, 176°F) is 3 to 4 bar or 43 to 57 psi.

8.2.3 BENCH TEST DATA

Test conditions:

- engine on bench with fan, air cleaner and exhaust silencer removed;
- atmospheric pressure 740 ± 5 mm Hg (986 ± 7 mbar);
- ambient temperature 20 ± 3°C;
- relative humidity 70% ± 5;
- fuel density 830 ± 10 g/l;
- injection timing: 22 ± 1° BTDC, cylinder no. 1 on compression stroke.

Throttle control lever position	Engine rpm	Engine power		Time required to burn 250 cc (15 cu.in) of fuel - sec.
		50 hour run-in		
		kW	HP	
Maximum (full load)	2400	≈ 51.5	≈ 69	≈ 58.7
Maximum (full torque)	1600	≈ 37.5	≈ 50	≈ 81.2
Maximum (no load)	2590	-	-	-
Minimum (idle)	800 + 850	-	-	-

Continued: TIMING SYSTEM

	mm	in
Valve guide I.D. (installed and reamed)	8.023 ÷ 8.038	0.3158 ÷ 0.3164
Valve stem-to-guide clearance	0.023 ÷ 0.053	0.0009 ÷ 0.0020
– max. clearance due to wear	0.13	0.0051
Max. guided valve offset on the stem measured on a complete revolution with gauge resting on center of tapered seal surface	0.04	0.0015
Intake and exhaust valve springs characteristics:		
– length of free spring	65.5	2.5787
– length of spring with valve closed, with a load of 30.1-33.9 daN (67.6-76.1 lb)	41	1.6141
– length of spring with valve open, with a load of 48.1-52.1 daN (108-117 lb)	30.8	1.2125

CRANKSHAFT AND PISTONS

	mm	in
Crankshaft - Bearings (Fig. 36)		
Standard main journal diameter	76.187 ÷ 76.200	2.9994 ÷ 2.9999
Main journal diameter undersize range	0.102-0.254-0.508-0.762-1.016	0.004-0.009-0.019-0.029-0.039
Standard main bearing shell thickness	2.162 ÷ 2.172	0.0851 ÷ 0.0855
Spare main bearing shell I.D. undersize range	0.102-0.254-0.508-0.762-1.016	0.004-0.009-0.019-0.029-0.039
Main journal-to-shell clearance	0.043 ÷ 0.096	0.0016 ÷ 0.0037
– max. clearance due to wear	0.180	0.007
Standard connecting rod journal diameter	58.730 ÷ 58.743 (*)	2.3122 ÷ 2.3127 (*)
Connecting rod journal diameter undersize range	0.102-0.254-0.508-0.762-1.016	0.004-0.009-0.019-0.029-0.039
Standard connecting rod bearing shell thickness	1.805-1.815	0.0710 ÷ 0.0714
Spare rod bearing shell I.D. undersize range	0.254-0.508-0.762-1.016	0.009-0.019-0.029-0.039
Connecting rod journal-to-shell clearance	0.035 ÷ 0.080	0.0013 ÷ 0.0031
– max. clearance due to wear	0.180	0.007
Crankshaft standard thrust washer thickness	3.378 ÷ 3.429	0.132 ÷ 0.134
Spare thrust washer thickness oversize	0.127	0.0049
Width of main journal with thrust washer	31.766 ÷ 31.918	1.2506 ÷ 1.2566
Length of corresponding crankshaft journal	32.000 ÷ 32.100	1.2598 ÷ 1.2637
Crankshaft end play	0.082 ÷ 0.334	0.0032 ÷ 0.0131
– max. play due to wear	0.40	0.015

(*) In production crankshafts with connecting rod and main journals undersized by 0.1 mm coupled with correspondingly undersized bearings may be installed.

12.5 CRANKSHAFT

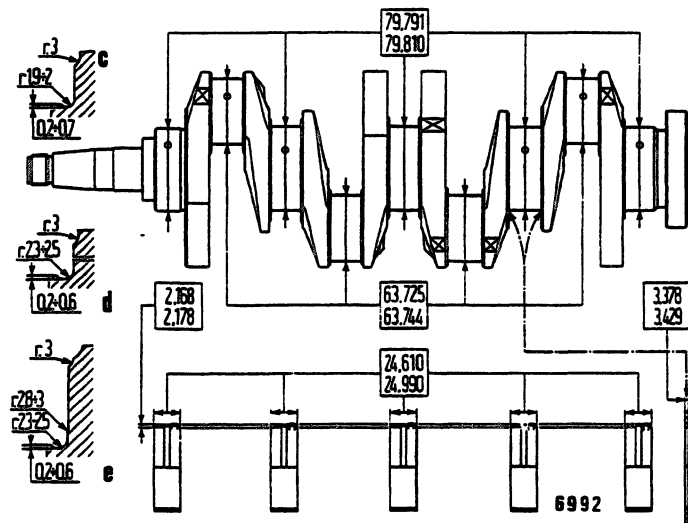


Fig.86 - Crankshaft journal, bearing and thrust washer dimensions.

c.Detail of connecting rod journal fillet radii. - d. Detail of standard main journal fillet radii - e. Detail of fillet radii of main journal with thrust washer.

FRONT AND REAR CRANKSHAFT SEALS

Check condition of double-lip rubber seal with metal armature and internal coil spring.

REMARK - To replace seal (1, Fig.87) remove, together with old seal, spacer (2). The new seal should be installed without the spacer, in order to avoid that the new seal contact the shaft in the same location of former seal.

To renew it, do the following:

- Remove any trace of oil and thoroughly clean seal seat;

WARNING

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial non-flammable, non-toxic solvents.

- dip seal for about half an hour in engine oil and then install into its seat applying an even pressure on the ring with a punch;

- lubricate seal lips with a film of thick oil to prevent a dry contact with the shaft in the first period of operation;
- when installing complete rear cover, insert oil pan semicircular seal and smear jointing compound on the surface contacting the block.

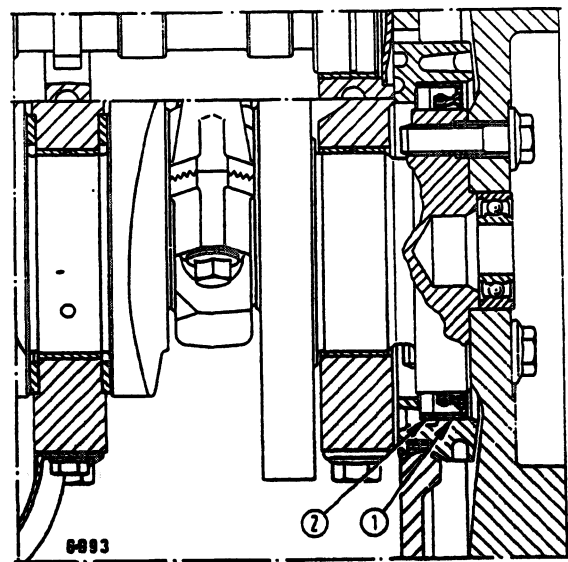


Fig. 87 - Replacement of crankshaft oil seal (1).

2. Spacer

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