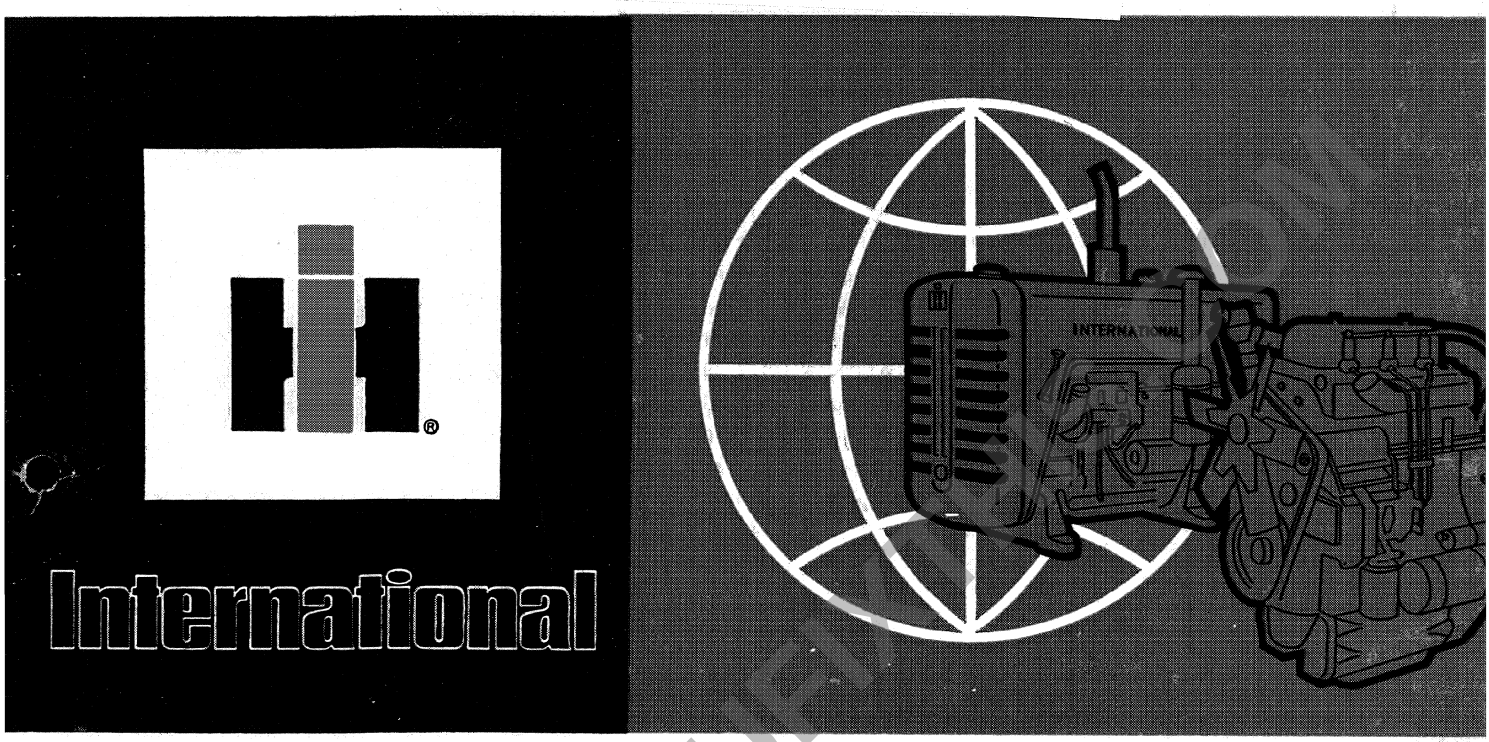


SERVICE MANUAL

PREVIEW YOUR

INTERNATIONAL

BASIC DIESEL ENGINES

D-155 + D-179 + D-206
D-239 + D-246 + D-268
D-310 + D-358
DT-239 + DT-358 + DT-402

1091624R2

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Work Safely — Follow these Rules



This symbol is used to call your attention to instructions concerning your personal safety. Be sure to observe and follow these instructions.

1. Always wear safety glasses when using a hammer, chisel or other tools that may cause chips to fly.

2. Keep work area organized and clean. Wipe up oil or spills of any kind. Keep tools and parts off of the floor. Eliminate the possibility of a fall which could result in a serious injury.

3. Be sure to reinstall safety devices, guards or shields after adjusting and/or servicing the machine.

4. After servicing, be sure all tools, parts, or servicing equipment are removed from the machine.

5. Use a safety catch on all hoist hooks. Do not take a chance, the load could slip off of the hook.

6. Electrical storage batteries give off highly inflammable hydrogen gas when charging and continue to do so for some time after receiving a steady charge. Do not under any circumstances allow an electric spark or an open flame near the battery. Always disconnect a battery cable before working on the electrical system.

7. Use pullers to remove bearings, bushings, gears, cylinder sleeves, etc. when applicable. Use hammers, punches and chisels only when absolutely necessary. Then, be sure to wear safety glasses.

8. Be careful when using compressed air to dry parts. Use approved air blow guns, do not exceed 30 psi, wear safety glasses or cloggles and use proper shielding to protect everyone in the work area.

9. Do not wear rings, wrist watches or loose fitting clothing when working on machinery, they could catch on moving parts causing serious injury. Wear sturdy, rough-soled work shoes. Never adjust and/or service a machine in bare feet, sandals or sneakers.

10. Exhaust gases are highly poisonous! Therefore, do not start the engine in closed rooms unless adequate ventilation is ensured, or an exhaust decontamination device is being used.

Lubrication

Instructions on the lubrication of each assembly are given in the Lubrication Guide in the Operator's Manual. When assembling any parts, always coat all wearing surfaces with the lubricant specified in the guide. Use sufficient quantities of lubricant to prevent any danger of seizing, scoring or excessive wear when the assembly is first operated. Failure to provide "starting lubrication" may result in serious damage. (Refer to "Priming Lubricating System" in this Section.)

Gaskets and Seals

Always use new gaskets and seals. Be extremely careful not to damage the seals in any way during installation.

Service Tools

International diesel engines are designed so that few service tools are required other than those in the mechanic's tool kit. Wherever the application of inexpensive special service equipment will facilitate work, it is shown. Otherwise, it is assumed that servicemen will select from their tool kits such tools as are required. Information regarding special tool equipment is given in the "Parts Catalog".

Service Parts

Always use genuine I. H. service parts. The best material obtainable, and experience gathered through many years of power equipment manufacturing, enable International Harvester to produce quality that will not be found in imitation or "just as good" repair parts. No serviceman can afford to guarantee a repair job that is not serviced with genuine I. H. parts. No owner should be satisfied with other than genuine I. H. parts.

For the correct service parts to be used on a machine, always refer to the parts catalog for the particular machine. The loose-leaf parts catalogs are accurate and are continually being brought up to date by the issuance of new pages covering any changes in part numbers.

Serial Numbers

Depending on engien application the engine serial number is stamped on a pad on the right side of the engine either near the center below the tappet side cover or towards the rear above the side cover.

Priming Lubricating System

Note: Diesel engines must not be rotated when priming with oil; otherwise, they are likely to start running.

When assembling the overhauled engine, it is necessary to thoroughly lubricate the various running parts with clean engine oil to assure initial lubrication when engine is first started. However, to further make certain that complete initial lubrication is available, the engine lubricating system should be pressure primed or charged with oil. Attach the line from a priming device to a suitable fitting located in the main oil gallery, filter header or oil cooler of the engine and inject sufficient oil into the engine to fill the oil filters and charge the entire system. Use only clean engine oil in accordance with Operator's Manual. New or overhauled engines that have been in storage over an extended period should also be primed in a similar manner.

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Probable Cause	Remedy
Engine Fails to Turn	
1. Batteries too low to turn engine	Charge batteries or install new ones.
2. Starting switch inoperative	Inspect for faulty cables and terminals. Replace starting switch if necessary.
3. Cranking motor inoperative	Refer to Service Manual "Electrical Equipment".
4. Engine oil too heavy	Use correct grade of lubricating oil.
5. Internal seizure	Hand crank the engine. If the engine does not turn easily, seizure due to internal damage; including gear train, pistons, sleeves, connecting rods or main bearings, is indicated.
6. Hydrostatic lock	Remove all the injection nozzles and crank the engine. Check for fuel or coolant in the cylinder.
Engine Does Not Develop Full Power	
1. Low or no fuel pressure	
a. Insufficient fuel	Check fuel tank.
b. Fuel oil filter clogged	Disassemble and clean each unit.
c. Fuel filter gaskets defective (air being drawn into fuel)	Replace gaskets.
d. Moisture in fuel tank	Drain entire system including water trap and filter. Refill with clean fuel, and vent the air from the system.
2. Poor fuel	Use good grade of fuel.
3. Air cleaner clogged	Remove and service air cleaner as described in operator's manual.
4. Injection pump not properly timed to the engine	Check timing. (Refer to Section "INJECTION PUMP.")
5. Injection pump not operating properly	Remove injection pump and test it. Refer to Service Manual "Fuel System and Turbocharger" for test specifications.
6. One or more fuel injection nozzles not operating properly	Replace the injection nozzles.
7. Loose or broken fuel lines or fittings between injection pump and injection nozzles	Tighten or repair.
8. Loose or broken connections or leaking gaskets at intake manifold or exhaust manifold	Tighten or repair.
9. Improper valve settings	Reset as necessary. If out of adjustment an excessive amount, check for bent push rods.
10. If equipped with ether priming system with butterfly valve, check the valve position	Correct.
11. Lack of compression	Refer to "Poor Compression".

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High Fuel Pressure

1. Clogged fuel return line or elbow	Remove and clean.

Engine Runs Unevenly and Vibrates

1. Valve and spring assembly inoperative	Repair or install parts needed.

SPECIFICATIONS

Engine	*Number of Cylinders*	*Bore mm (inch)*	*Stroke mm (inch)*	*Piston Displacement cm^3 (cu. inch)*
D-155	3	98.4 (3.875)	111.1 (4.375)	2536 (155)
D-179			128.5 (5.06)	2934 (179)
D-206	4		111.1 (4.375)	3382 (206)
D-239 DT-239			128.5 (5.06)	3911 (239)
D-246		100.0 (3.937)	128.5 (5.06)	4034 (246)
D-268			139.7 (5.5)	4389 (268)
D-310	6	98.4 (3.875)	111.1 (4.375)	5073 (310)
D-358 DT-358			128.5 (5.06)	5867 (358)
DT-402		100.0 (3.937)	139.7 (5.5)	6587 (402)

Type 4–Cycle–Diesel–Engines

Direction of rotation, facing flywheel L. H.

Compression ratio 16 : 1 (except D-268 and DT-402 15:1)

Compression at starting speed, MPa (PSI) 2.2–2.4 (313–341)

Firing order

3 Cyl.	1–3–2
4 Cyl.	1–3–4–2
6 Cyl.	1–5–3–6–2–4

Valve clearance, engine hot, mm (inch) 0.30 (.012)

Lubricating System

Min. oil pressure at main oil gallery and 90 – 100 °C oil temperature

	OLD	NEW
at rated speed MPa (PSI)	0.25 (36)	0.30 (44)
at low idle speed MPa (PSI) *)		0.09 (13)

*) observe oil pressure warning light.

Oil consumption at rated speed and full load, less than 1.5 g/kWh (overhauled engine).

Cooling System

Most favourable operating temperature 90° – 95 °C (194° – 203 °F)

Air System

Max. permissible restriction before servicing the air cleaner 635 mm (25 inch) of water

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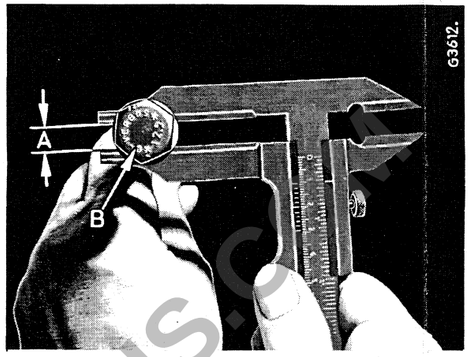
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Special Nut and Bolt Torque Data

	daNm			Lbf-ft		
	1st step	2nd step	final step	1st step	2nd step	final step
* Balance weight necked-down bolts (obsolete)	3	–	5.5 ÷ 6.0	21.7	–	40 ÷ 43.5
* Balance weight pitch diameter bolts	6	–	10.0 ÷ 10.5	44	–	72.3 ÷ 76
* Main bearing cap necked down bolts (obsolete) 10.9	4	8	10.5 ÷ 11.5	29	58	76 ÷ 83
* Main bearing cap necked down bolts (obsolete) 12.9	4	8	13 ÷ 14	29	58	94 ÷ 101
* Main bearing cap pitch diameter bolts 12.9	4	8	19 ÷ 20	29	58	137.5 ÷ 145
* Main bearing cap pitch diameter bolts 10.9	4	8	14 ÷ 15	29	58	101 ÷ 109
* Connecting rod nuts "Angle" tightening procedure, refer to Illust. 144						
* Annular spring tightener element or clamping ring	3	6	6 ÷ 6.5	21.7	43.5	43.5 ÷ 47
* Capscrew-clamping ring front pto	1.5	2.7	3.0	10.8	19.5	22
** Idler gear necked down bolt (obsolete)	–	–	9 ÷ 9.5	–	–	65 ÷ 69
** Idler gear pitch diameter bolt	–	–	10 ÷ 10.5	–	–	72 ÷ 76
* Flywheel bolts	4	8	14 ÷ 15	30	60	103 ÷ 110
Bolts, seal ring retainer, rear	1.5	–	1.8 ÷ 2	10.8	–	13 ÷ 14.5
* Cylinder-head nuts (obsolete)	4	8	11.5 ÷ 12.5	29	58	83 ÷ 90
* Cylinder-head studs (obsolete)	–	–	5 ÷ 6	–	–	36 ÷ 44
* Cylinder-head cap screws with round washer (obsolete)	4	8	11 ÷ 12	29	58	80 ÷ 87
* Cylinder-head cap screws with collar	4	8	14 ÷ 15	29	58	101 ÷ 109
Valve lever bracket studs	–	–	3.5 ÷ 4	–	–	25 ÷ 29
* Valve lever bracket stud nuts	–	–	6 ÷ 7	–	–	44 ÷ 51
Valve lever bracket clamping screw	–	–	1 ÷ 1.2	–	–	7 ÷ 8.6
Side cover screws	–	–	1.6 ÷ 1.8	–	–	12 ÷ 13
Oil pressure gauge			max. 1			max. 7.2
Temperature sender unit			max. 2			max. 14.5
Exhaust manifold stud nuts	–	–	3.5 ÷ 4.0	–	–	26 ÷ 30
Nozzle holder stud)	–	–	1.3 ÷ 1.8	–	–	9.4 ÷ 13
Nozzle holder stud nuts) flange mounted	0.5	–	1 ÷ 1.2	3.6	–	7.2 ÷ 8.7
Nozzle union nut) nozzle holder	–	–	6 ÷ 8	–	–	44 ÷ 58
* Bolt) crab mounted	–	–	2.3 ÷ 2.7	–	–	16.6 ÷ 19.5
Nozzle union nut) nozzle holder	–	–	5 ÷ 7	–	–	36.2 ÷ 50.7
Nozzle holder leak oil connection hollow screw	–	–	0.2 ÷ 0.8	–	–	1.5 ÷ 5.8
Injection line union nuts	–	–	2 ÷ 2.5	–	–	15 ÷ 18
Valve cover adapter stud	–	–	1.6 ÷ 1.8	–	–	11.6 ÷ 13
Valve cover stud nut	–	–	0.5 ÷ 0.7	–	–	3.6 ÷ 5
Valve cover screws (sheet metal)	–	–	0.5 ÷ 0.7	–	–	3.6 ÷ 5
Valve cover screws (gray iron)	–	–	1.5 ÷ 1.7	–	–	11 ÷ 12.3
Oil pan drain plug (when asbesto-filled packing ring is used)	–	–	5 ÷ 6	–	–	36 ÷ 43
Oil pan drain plug (when copper ring is used)	–	–	13.8 ÷ 15	–	–	100 ÷ 118
Plug with socket head (oil gallery-crankcase)	–	–	max. 1.2	–	–	max. 8.7
Injection pump gear bolt (3 radial lines)	1.5	–	2.2 ÷ 2.5	11	–	16 ÷ 18
Injection pump gear bolt (6 radial lines)	1.5	–	2.5 ÷ 2.8	11	–	19 ÷ 21
Injection pump cover bolt (tighten crosswise)	0.4	–	0.8 ÷ 1	3	–	5.8 ÷ 7.2
Injection pump flange nut	1.5	–	2.2 ÷ 2.5	11	–	16 ÷ 18
Injection pump plunger end plug	–	–	4.5 ÷ 5.5	–	–	33 ÷ 40
VA Injection pump drive shaft nut M 12	–	–	6 ÷ 7	–	–	44 ÷ 50
VE Injection pump drive shaft nut M 14	–	–	8.5 ÷ 10	–	–	63 ÷ 72
Hollow screws	–	–	2 ÷ 2.5	–	–	15 ÷ 18
Bolts, sheet metal oil pan	–	–	1.2 ÷ 1.4	–	–	8.7 ÷ 10
Engine breather screw	–	–	0.8 ÷ 1.0	–	–	5.8 ÷ 7.2
Valve set screw clamping torque	–	–	1.7 ÷ 4.5	–	–	12.3 ÷ 32.6
Exhaust manifold, coolant filter mounting stud	–	–	3.5 ÷ 4.0	–	–	26 ÷ 29
VE Injection pump support angle mounting bolt M 6	–	–	0.7 ÷ 0.9	–	–	5.2 ÷ 6.6

* Oiled
** Use liquid locking compound while mounting

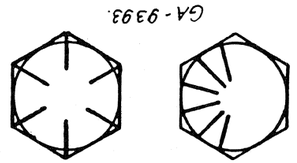
Identification of Different Bolts



Illust. 1
A – Shaft diameter
B – Stamping on bolt head

A – Different shaft diameter	mm	(inch)
Main bearing bolts, necked down	10.4	(0.4094)
Main bearing bolts, pitch diameter	12.7	(0.4999)
Balance weight bolts, necked-down	8.6	(0.3385)
Balance weight bolts, pitch diameter	10.2	(0.4015)
Idler gear bolt, necked-down	9.6	(0.3779)
Idler gear bolt, pitch diameter	11.3	(0.4449)

B – Different stamping on bolt head, e. g. 10K, 12K, 10.9, 12.9 or a circular stamping on idler gear pitch diameter bolt



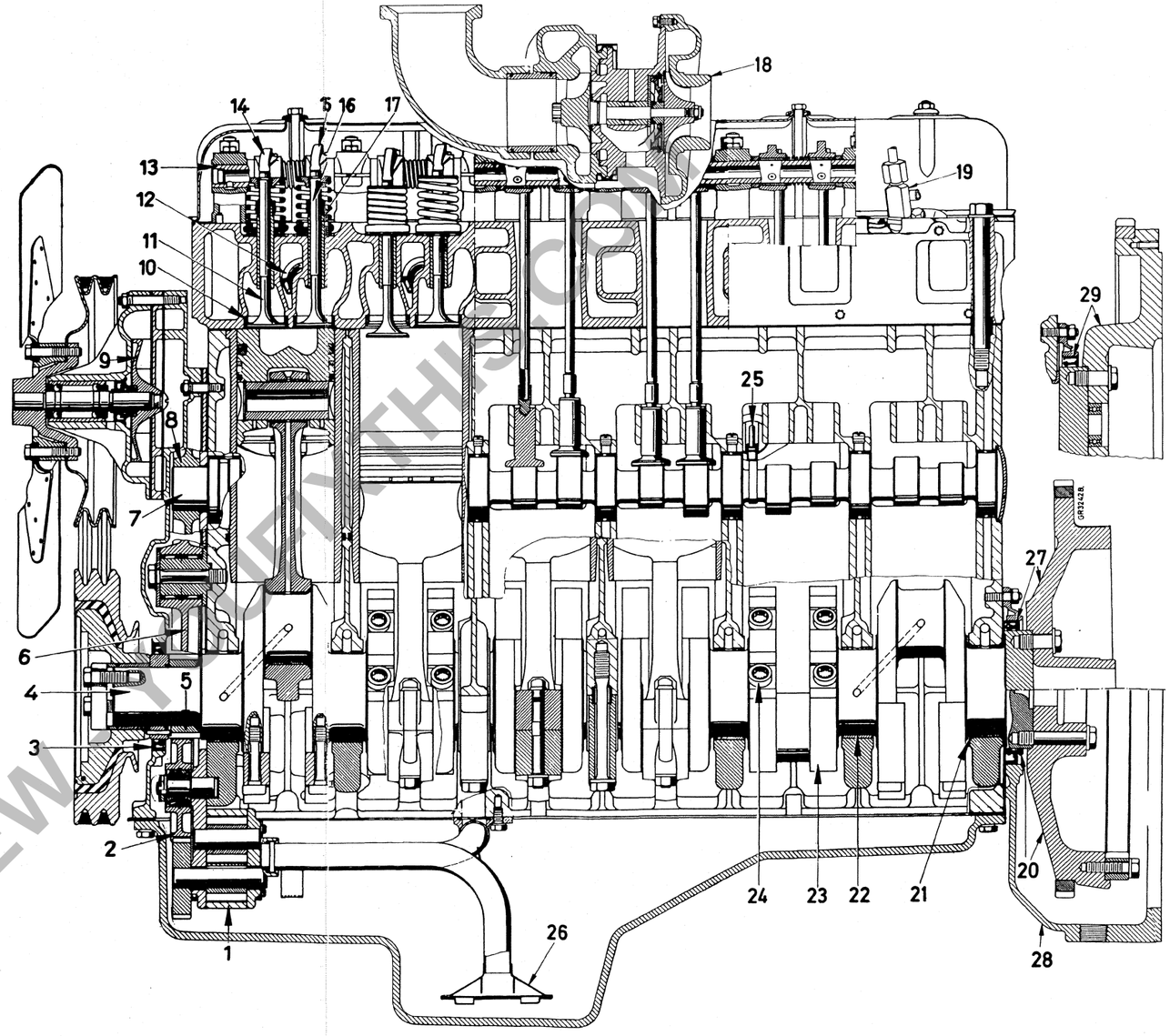
Illust. 2
Special bolt for injection pump gear, 6 radial lines.
Observe increased torque value.

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Longitudinal Section of Engine

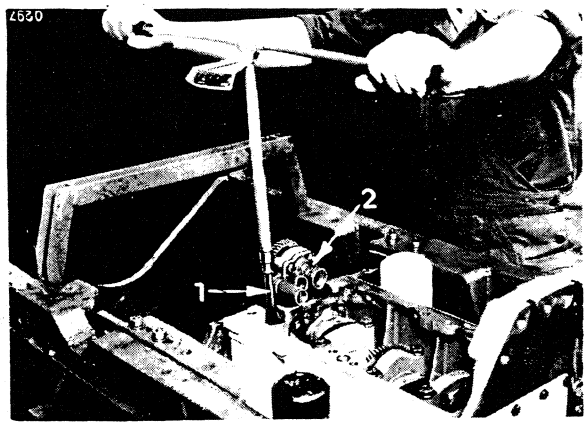
1 – Oil pump
2 – Idler gear (Oil pump)
3 – Crankshaft oil seal, front
4 – Crankshaft
5 – Crankshaft pinion
6 – Idler gear
7 – Camshaft
8 – Camshaft gear
9 – Water pump
10 – Valve seat insert
11 – Exhaust valve
12 – Coolant jet for injection nozzle
13 – Valve lever shaft
14 – Exhaust valve lever
15 – Intake valve lever
16 – Intake valve
17 – Valve stem guide
18 – Turbocharger
19 – Injection nozzle holder
20 – Flywheel and crankshaft oil seal, torque converter version
21 – Main bearing, rear
22 – Main bearing
23 – Balance weight
24 – Balance weight bolts
25 – Fuel feed pump drive
26 – Oil suction screen
27 – Flywheel and crankshaft oil seal, early torque converter version
28 – Flywheel housing
29 – Flywheel and crankshaft oil seal, dry type disk clutch version



Illust. 3
Typical DT-358 engine

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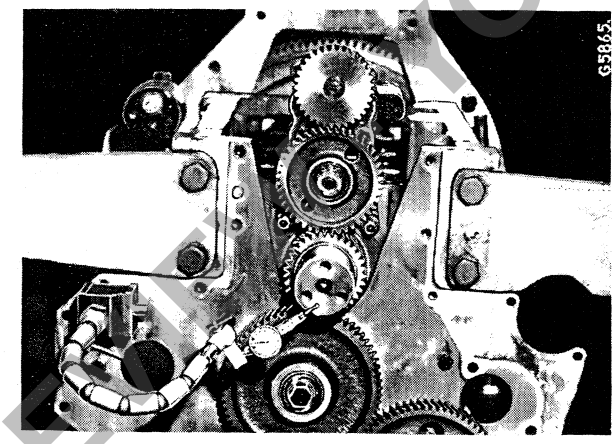


Illust. 114

1 – Special wrench
2 – Oil pump

The oil pump is mounted on bearing cap number 1. These two parts can be installed as a unit. A special wrench (1) Illust. 114 is required to tighten the RH main bearing cap screw. After main bearing cap screws are tightened, the crankshaft must rotate freely when turned by hand.

Take care, that main bearing bolts of the same material designation are used.

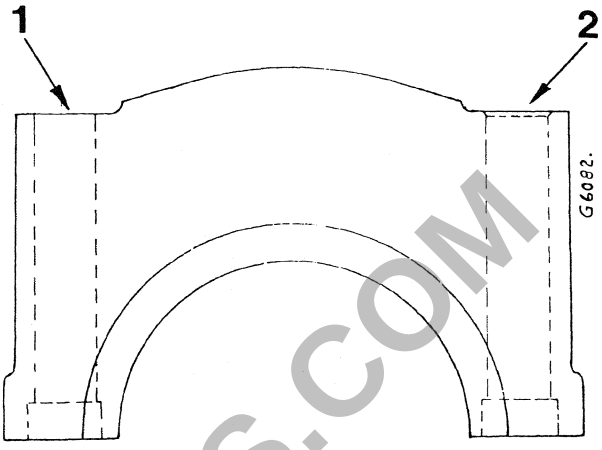


Illust. 115
Checking crankshaft end play

Check end play of crankshaft. See "Specifications".

Note 1: Pitch diameter bolts and correspondingly higher torque values may be used in place of necked-down bolts, provided the bearing caps are chamfered to clear the radius on the underside of the bolt head. See (2) Illust. 116.

Note 2: Whenever a reground crankshaft is installed, be sure running clearance of the journals is within "Specifications". Proceed as follows:



Illust. 116
Main bearing cap

1 – Squer corner
2 – Reworked cap with chamfered corner 0.8 – 1.2 mm x 45° (.03 – .05" x 45°)

Remove the center main bearing cap and the lower bearing, and insert a suitable length of 0.20 mm (.008") virgin, lead wire across the bearing surface of the lower bearing and the crankshaft journal. Install the bearing cap and tighten the cap bolts to specified torque.

Do not turn the crankshaft while the wire is in place. Remove the bearing cap, and carefully remove the wire, which will have been crushed to the amount of clearance present. Measure the wire, using a micrometer. The clearance desired is given in "Specifications".

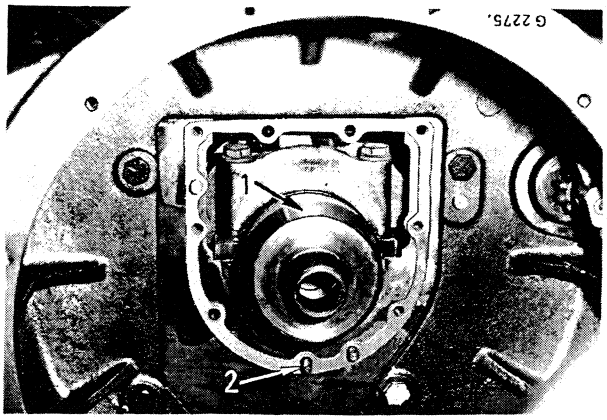
Installing Rear Oil Seal

a. Seal must be clean and lubricated as follows:

Single Lip-Coat lip with clean engine oil.

Double Lip-Fill cavity between lips approx. 2/3 with "Molykote BR2" or "Shell Alvania 3".

b. Apply some engine oil onto crankshaft sealing face.

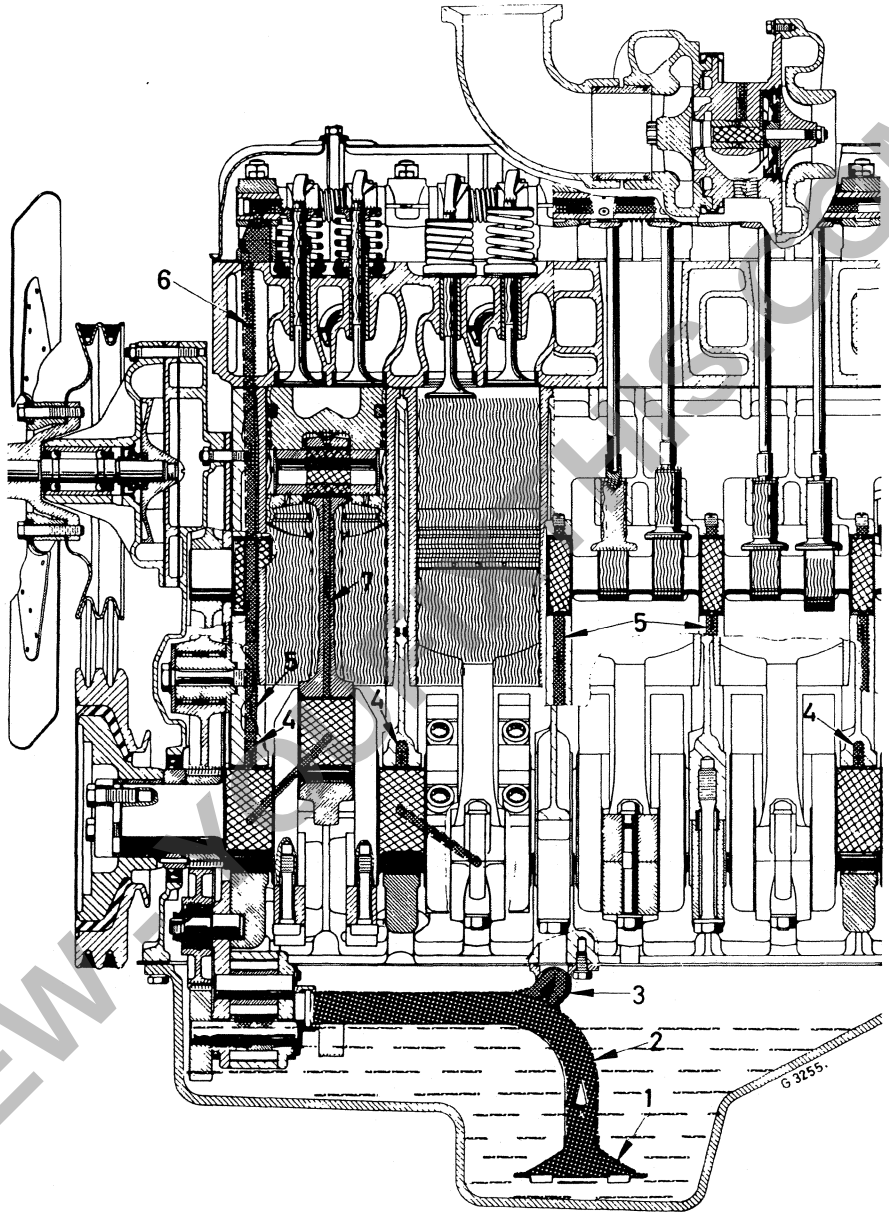


Illust. 117

1 – Seal jumper
2 – Stud

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1 – Screen
2 – Suction line
3 – Pressure line to oil filter and cooler
4 – Oil passages to crankshaft main bearings and crankpins
5 – Oil passages to camshaft
6 – Oil passage to valve lever shaft
7 – Lubrication bore in connecting rod for piston pin and piston cooling



Illust. 166
Longitudinal section of typical turbocharged engine

Oil under pressure

Oil sump and suction line

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Note: Remove balancer drive gear (10) Illust. 84 (4 cyl.) and pinion (6) before nitriding the crankshaft.

Induction hardened crankshafts:

Hardness HRc 50 – 55 minimum hardness for undersize shafts HRc 40.

Journals and Crankpins

Max. permissible out-of-round 0.004 mm (.00015 inch)

Permissible taper per 1 inch length 0.004 mm (.00015 inch)

Run out on every one of the journals, with ends of the crankshaft places in V-blocks:

3-cyl. 0.20 mm (.0078 inch)
4-cyl. 0.40 mm (.0156 inch)
6-cyl. 0.60 mm (.0234 inch)

Parallelism crankpins to journals, permissible deviation

0.010 mm (.00039 inch)

Permissible eccentricity of balancer gear seat to the adjacent journals

0.020 mm (.00078 inch)

Crankshaft Rear Sealing Flange

	mm	*(inch)*
Permissible run-out	0.050	(.0020)
Permissible out-for-true	0.020	(.00078)

Crankshaft Running Clearance and End Play

Running clearance in the main bearings (new)	0.070 – 0.140	(.00275 – .00551)
End play	0.15 – 0.23	(.006 – .009)

Connecting Rod

Running clerance on crankpins (new)	0.060 – 0.120	(.0023 – .0047)
Side clearance	0.15 – 0.25	(.006 – .010)

Crankshaft

Max. permissible imbalance, measured at the front and rear journal
3 and 4 cyl. 45 cmg (.62 oz. inch)
6 cyl. (with counterweights) 60 cmg (.83 oz. inch)

Balancer Drive Gear (10) Illust. 84

Engine	*Number of teeth*	*ID mm*	*ID (inch)*	*Run-out* mm*	*Run-out* (inch)*	*Out of True mm*	*Out of True (inch)*	*Shrinking Temperature °C*	*Shrinking Temperature (°F)*
D-206 up to 2200/min	80	150.000 / 150.025	(5.9055) / (5.9064)	0.08	(.0031)	0.10	(.0039)	100	(212)
D-239 D-246 D-206 above 2200/min	80	150.035 / 150.075	(5.9069) / (5.9085)	0.06	(.0024)	0.04	(.0016)	180 – 200	(356 – 392)
D-268	90	160.035 / 160.075	(6.3006) / (6.3022)	0.06	(.0024)	0.04	(.0016)	180 – 200	(356 – 392)

* Installed and in relation to journals No. 2 + 4

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