

Engine 352 A, 362 LA

Order-No. 6510 5012 02

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Model designation	Sales designation	Output (kW) (rpm)	Output (DIN HP) (rpm)	Version
352.913	OM 352 A I	110 (2800)	150 (2800)	Alternator 420 W/14 V engine brake
352.937	OM 352 A II	115 (2800)	156 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump
352.946	OM 352 A II	115 (2800)	156 (2800)	Alternator 240 W/14 V engine brake
352.949	OM 352 A II	115 (2800)	156 (2800)	Alternator 420 W/14 V engine brake RQV regulator with drag lever
352.950	OM 352 A I	110 (2800)	150 (2800)	Alternator 420 W/14 V engine brake RQV regulator with drag lever
352.968	OM 352 A II	115 (2800)	156 (2800)	Alternator 660 W/14 V engine brake compressed air-operated RQV regulator with drag lever
352.994	OM 352 A I, II	110/115 (2800)	150/156 (2800)	Alternator 420 W/14 V engine brake
353.909	OM 352 A 5	124 (2800)	168 (2800)	Alternator 420 W/14 V engine brake compressed air-operated
353.910	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated
353.911	OM 352 A 5	124 (2800)	168 (2800)	Alternator 420 W/14 V
353.912	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V power steering pump

00.13 Installation Survey

Model designation	Sales designation	Output (kW) (rpm)	Output (DIN HP) (rpm)	Version
353.913	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V RQV regulator with drag lever
353.914	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V power steering pump
353.950	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated
353.951	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump
353.952	OM 352 A 5	124 (2800)	168 (2800)	Alternator 420 W/14 V engine brake compressed air-operated
353.953	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump
353.954	OM 352 A 5	124 (2800)	168 (2800)	Alternator 1440 W/28 V engine brake compressed air-operated power steering pump
353.970	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated
353.971	OM 352 A 5	124 (2800)	168 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump
353.972	OM 352 A 5	124 (2800)	168 (2800)	Alternator 1440 W/28 V engine brake compressed air-operated power steering pump
353.975	OM 352 A 5	127 (2800)	172 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump

Model designation	Sales designation	Output (kW) (rpm)	Output (DIN HP) (rpm)	Version
353.978	OM 352 A 5	124 (2800)	168 (2800)	Alternator 1320 W/28 V engine brake compressed air-operated power steering pump
353.997	OM 352 A 5	124 (2800)	169 (2800)	Alternator 660 W/14 V engine brake compressed air-operated power steering pump
362.906	OM 362 LA	141 (2600)	192 (2600)	Alternator 750 W/28 V engine brake compressed air-operated power steering pump
362.909	OM 362 LA	141 (2600)	192 (2600)	Alternator 750 W/28 V engine brake compressed air-operated power steering pump
362.910	OM 362 LA	141 (2600)	192 (2600)	Alternator 750 W/28 V engine brake compressed air-operated power steering pump 2 air compressors

Special Tools 00.13

Designation	Parts Number
Combination wrench	352 589 00 01 00
Socket wrench socket	000 589 06 03 00
Box wrench	000 589 07 03 00
Box wrench socket	000 589 68 03 00
Stud wrench socket	312 589 09 07 00
Pin wrench socket	321 589 02 07 00
Claw wrench	346 589 00 07 00
Pin wrench socket	352 589 03 07 00
Pin wrench socket	403 589 03 07 00
Pin wrench socket	403 589 04 07 00
Socket wrench socket	000 589 75 09 00
Box slugging wrench	001 589 43 09 00
Socket	001 589 43 09 02
Screwdriver bit	322 589 00 09 00
Valve adjusting wrench	321 589 00 11 00
Combination wrench socket	000 589 01 13 00
Box wrench socket	346 589 00 13 00
Drift	000 589 10 15 00
Drift	110 589 02 15 00
Drift	321 589 07 15 00
Drift	343 589 02 15 00
Drift	346 589 03 15 00

00.13 Special Tools

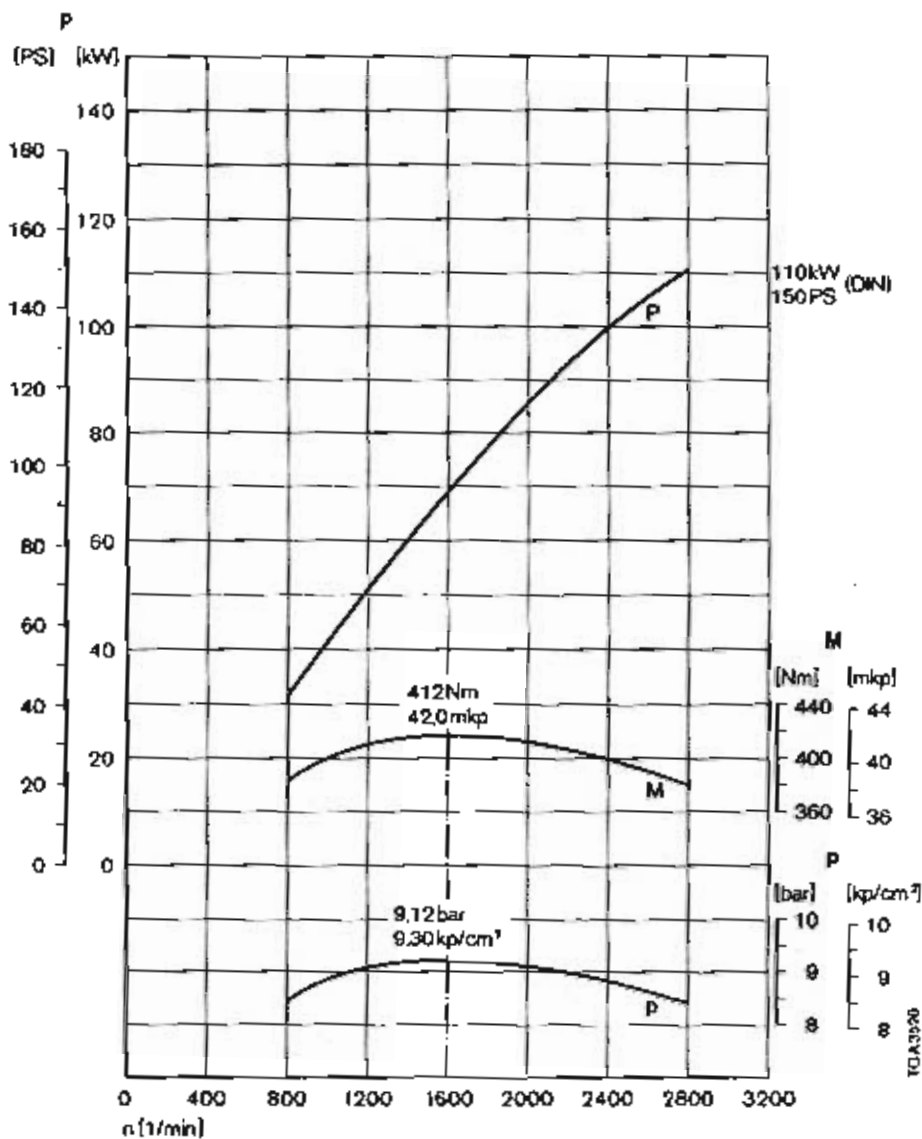
Designation	Parts Number
Drift	352 589 07 15 00
Drift	360 589 00 15 00
Drift	389 589 02 15 00
Drift	395 589 02 15 00
Drift	615 598 01 15 00
Drop hardness tester	000 589 20 21 00
Dial gauge	001 589 53 21 00
Measuring instrument	001 589 69 21 00
Dial gauge holder	363 589 02 21 00
Gauging strip	117 589 00 23 00
Test device	352 589 00 23 00
Gauging strip	117 589 01 23 00
Gauging strip	617 589 02 23 00
Gauging strip	617 589 04 23 00
Nozzle tester	000 589 14 27 00
Heli-Coil tool box M 6, M 8, M 10, M 12, M 14	000 589 03 28 00
Heli-Coil tool box M 8 x 1, M 12 x 1,5, M 14 x 1,5, M 14 x 1,25	000 589 04 28 00
Heli-Coil tool box M 15 x2	000 589 05 28 00
Heli-Coil tool box M 16 x 1,5	000 589 06 28 00
Heli-Coil tool box M 18 x 1,5	000 589 07 28 00
Heli-Coil tool box M 24 x 1,5	000 589 08 28 00
Heli-Coil tool box M 26 x 1,5	000 589 09 28 00
Heli-Coil tool box M 16	000 589 10 28 00
Heli-Coil tool box M 30 x 1,5	000 589 11 28 00
Valve lifter	000 589 15 31 00

Special Tools 00.13

Designation	Parts Number
Clamping strap	000 589 38 31 00
Handles	312 589 01 31 00
Fixing plate	352 589 01 31 00
Mount	403 589 00 31 00
Internal extractor	000 589 26 33 00
Internal extractor	000 589 27 33 00
Internal extractor	000 589 28 33 00
Internal extractor	000 589 29 33 00
Countersupport	000 589 33 33 00
Countersupport	000 589 34 33 00
Puller	000 589 89 33 00
Puller	312 589 07 33 00
Puller	355 589 00 33 00
Pliers	000 589 37 37 00
Pliers	312 589 01 37 00
Pliers	321 589 00 37 00
Clamping strap	321 589 01 37 00
Dial gauge holder	343 589 00 40 00
Gauging strip holder	617 589 00 40 00
Drift	352 589 00 43 00
Reamer	000 589 10 53 00
Reamer	000 589 11 53 00
Reamer	000 589 18 53 00
Collet chuck	000 589 20 61 00
Thrust piece	321 589 00 63 00

00.13 Special Tools

Designation	Parts Number
Cool box	346 589 00 63 00
Oil filling tank	352 589 11 63 00
Clamping device	352 589 12 63 00
Impact extractor	355 589 01 63 00
Cleaning device	000 589 00 88 00
Valve seat turning tool	000 589 16 69 00
Pump unit	617 589 00 71 00
Test line	617 589 00 91 15
Valve	617 589 00 91 31



OM 352 A

Engine output* as per DIN 110 kW at 2800/rpm
150 HP at 2800/rpm

Max. torque 412 Nm (42 kpm) at
1600/rpm

Nominal speed 2800/rpm

No. of cylinders 6

Bore 97 mm Ø

Stroke 128 mm

Total displacement 5675 cm³

Operating principle

Start of delivery

Compression ratio

Injection sequence

Compression pressure
at 150–200 rpm

Ejection pressure of
injection nozzles

new
used

Min. oil pressure at

max. speed
idling speed

Engine oil capacity

oil pan
oil filter

Diesel four-stroke

23° BTDC

16.0

1–5–3–6–2–4

Min.
20 bar (kp/cm²)

200 bar + 10 (kp/cm²)
Min. 180 bar (kp/cm²)

2.5 bar (kp/cm²)

0.5 bar (kp/cm²)

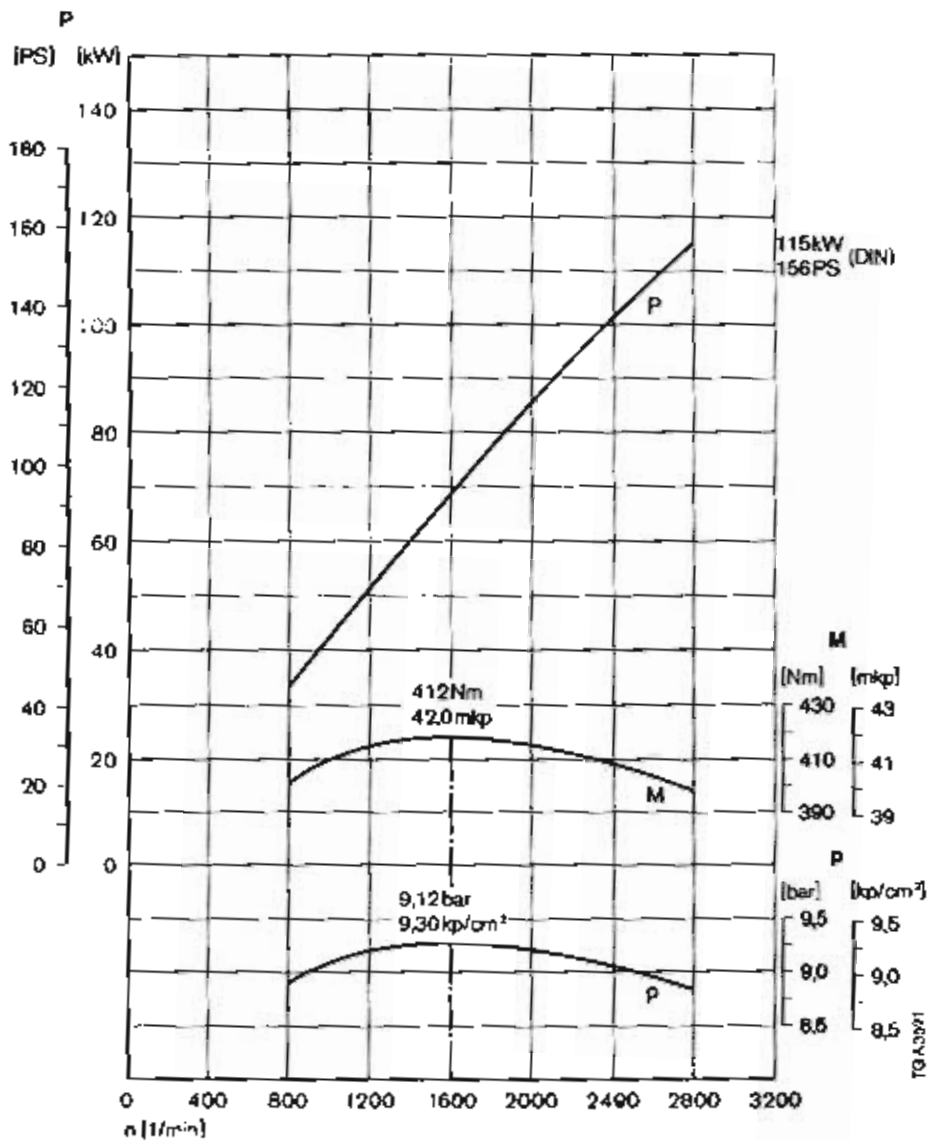
Max. approx. 14 l

Min. approx. 10 l

approx. 2.5 l

* The stated output in HP and kW according to DIN 70020 is effectively available at the clutch for driving the vehicle since all ancillary outputs have already been deducted.

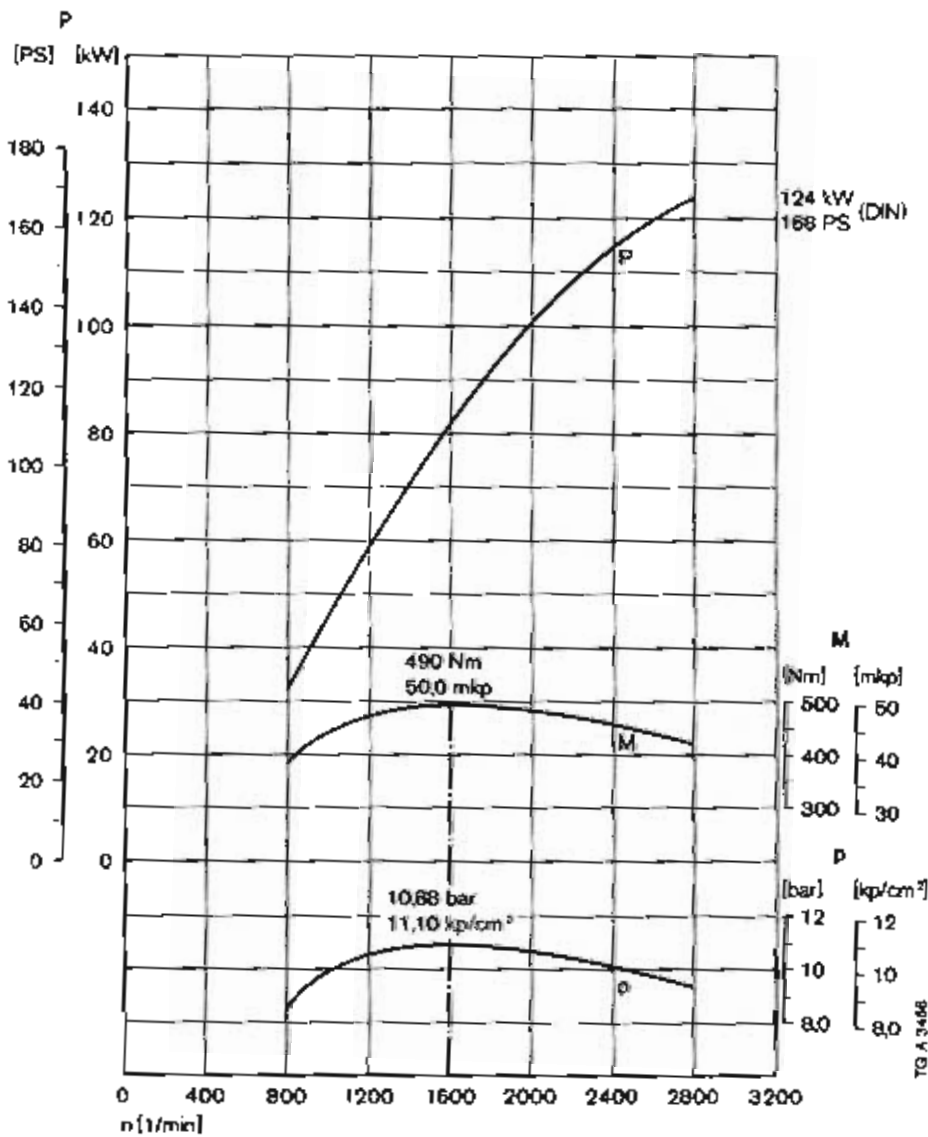
00.13 General Engine Data – Performance Diagram



OM 352 A

Engine output* as per DIN	115 kW at 2800/rpm 156 HP at 2800/rpm	Operating principle	Diesel four-stroke
Max. torque	412 Nm (42 kpm) at 1600/rpm	Start of delivery	23° BTDC
Nominal speed	2800/rpm	Compression ratio	16.0
No. of cylinders	6	Injection sequence	1-5-3-6-2-4
Bore	97 mm Ø	Compression pressure at 150-200 rpm	Min. 20 bar (kp/cm²)
Stroke	128 mm	Ejection pressure of injection nozzles	
Total displacement	5675 cm³	new	200 bar + 10 (kp/cm²)
		used	Min. 180 bar (kp/cm²)
		Min. oil pressure at	
		max. speed	2.5 bar (kp/cm²)
		idling speed	0.5 bar (kp/cm²)
		Engine oil capacity	Max. approx. 14 l
		oil pan	Min. approx. 10 l
		oil filter	approx. 2.5 l

* The stated output in HP and kW according to DIN 70020 is effectively available at the clutch for driving the vehicle since all ancillary outputs have already been deducted.



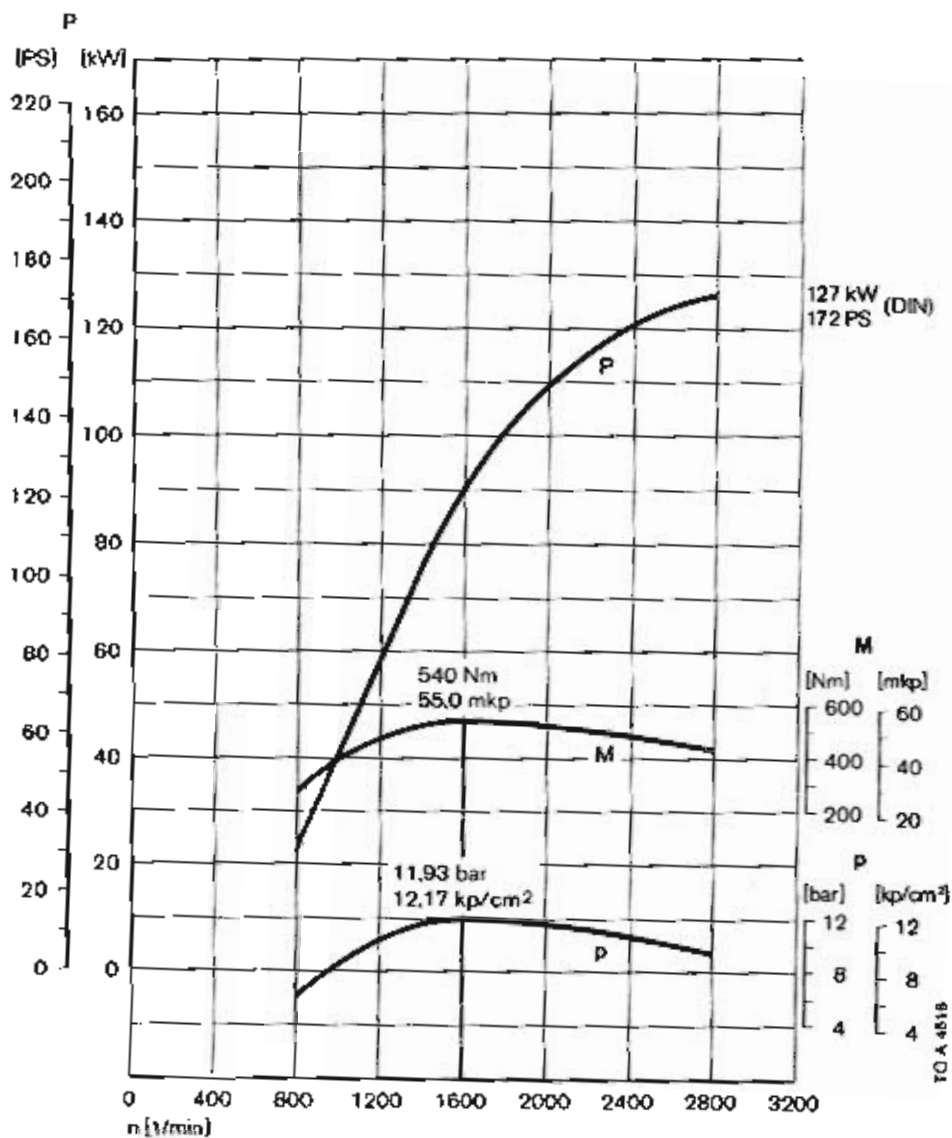
OM 352 A

Engine output* as per DIN	124 kW at 2800/rpm 168 HP at 2800/rpm
Max. torque	490 Nm (50 kpm) at 1600/rpm
Nominal speed	2800/rpm
No. of cylinders	6
Bore	97 mm Ø
Stroke	128 mm
Total displacement	5675 cm ³

Operating principle	Diesel four-stroke
Start of delivery	21° BTDC
Compression ratio	16.0
Injection sequence	1-5-3-6-2-4
Compression pressure at 150-200 rpm	Min. 20 bar (kp/cm ²)
Ejection pressure of injection nozzles	
new	200 bar + 10 (kp/cm ²)
used	Min. 180 bar (kp/cm ²)
Min. oil pressure at	
max. speed	2.5 bar (kp/cm ²)
idling speed	0.5 bar (kp/cm ²)
Engine oil capacity	Max. approx. 14 l
oil pan	Min. approx. 10 l
oil filter	approx. 2.5 l

* The stated output in HP and kW according to DIN 70020 is effectively available at the clutch for driving the vehicle since all ancillary outputs have already been deducted.

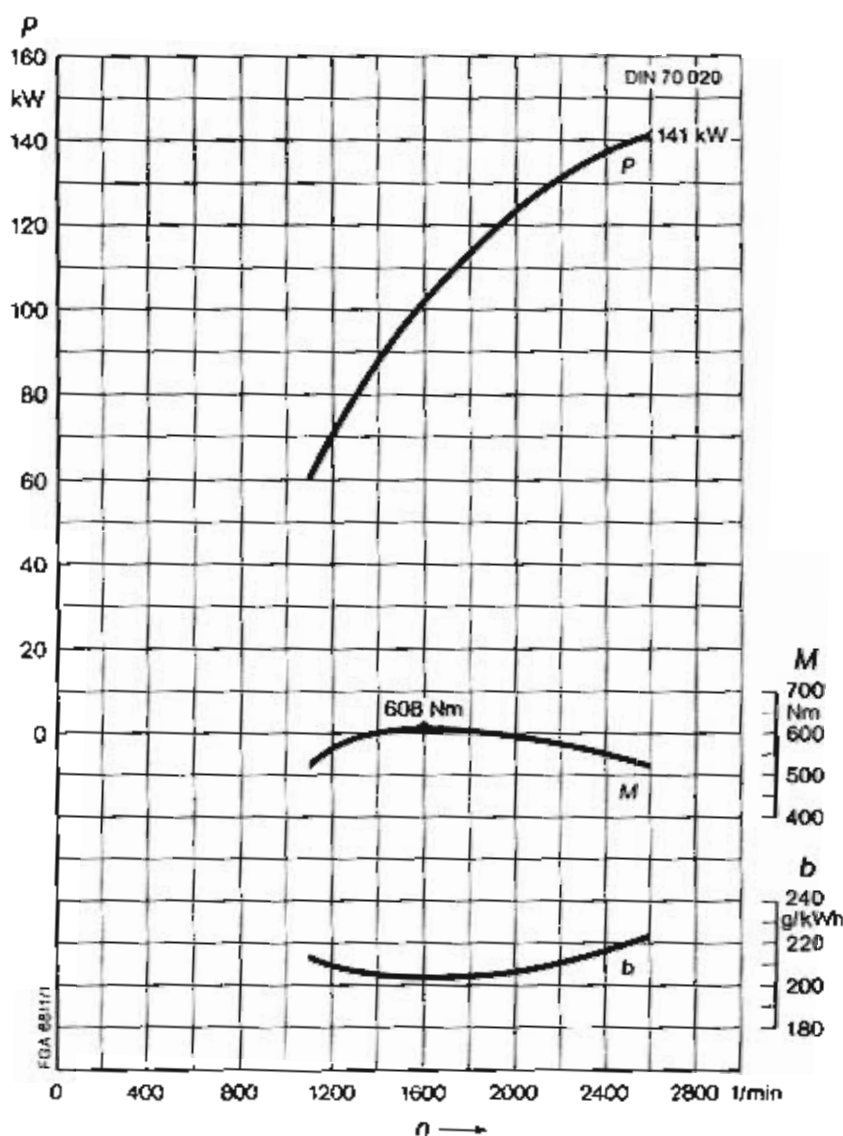
00.13 General Engine Data – Performance Diagram



OM 352 A

Engine output* as per DIN	127 kW at 2800/rpm 172 HP at 2800/rpm	Compression ratio	16.5
Max. torque	540 Nm (55 kpm) at 1600/rpm	Injection sequence	1-5-3-6-2-4
Nominal speed	2800/rpm	Compression pressure at 150-200 rpm	Min. 20 bar
No. of cylinders	6	Ejection pressure of injection nozzles	
Bore	97 mm Ø	S-nozzle new	200 bar + 10
Stroke	128 mm	used	Min. 180 bar
Total displacement	5675 cm ³	P-nozzle new	240 bar + 10
Operating principle	Diesel four-stroke	used	Min. 220 bar
Start of delivery	21° BTDC	Min. oil pressure at max. speed	2.5 bar
		idling speed	0.5 bar
		Engine oil capacity	
		oil pan with	Max. approx. 17.5 l
		oil filter	Min. approx. 12.5 l

* The stated output in HP and kW according to DIN 70020 is effectively available at the clutch for driving the vehicle since all ancillary outputs have already been deducted.


OM 362 LA

Engine output* as per DIN	141 kW at 2600/rpm 192 HP at 2600/rpm	Compression ratio	16.5
Max. torque	608 Nm (62 kpm) at 1600/rpm	Injection sequence	1-5-3-6-2-4
Nominal speed	2600/rpm	Compression pressure at 150-200 rpm	Min. 20 bar
No. of cylinders	6	Ejection pressure of injection nozzles	
Bore	97 mm Ø	new	200 bar + 10 bar
Stroke	128 mm	used	Min. 180 bar
Total displacement	5675 cm ³	Min. oil pressure at max. speed	2.5 bar
Operating principle	Diesel four-stroke	idling speed	0.5 bar
Start of delivery	17° BTDC	Engine oil capacity oil pan with oil filter	Max. approx. 17.5 l Min. approx. 12.5 l

* The stated output in HP and kW according to DIN 70020 is effectively available at the clutch for driving the vehicle since all ancillary outputs have already been deducted.

00.13 Tightening Torques

Group	Designation	Nm	
01	Crankshaft bearing cover on cylinder crankcase	7	
	Oil duct seal cylinder crankcase front and rear	40	
	Seal of connection for engine maintenance counter	60	
	Oil drain on oil pan	80	
	Tube for oil dipstick on cylinder crankcase	25	
	Metal oil pan on cylinder crankcase M 8	9	
	Metal oil pan on cylinder crankcase M 6	8	
	Adjustment indicator on timing case cover	8	
	Push rod chamber cover on cylinder crankcase	4	
	Seal of cleaning holes in cylinder head M 30 x 1.5	100-200	
	Seal of cleaning holes in cylinder head M 24 x 1.5	70-150	
	Cylinder head on cylinder crankcase	2)	
	Seal of threaded bore on cylinder head cover	50-70	
	Injection nozzle start pilot on cylinder head cover	20	
	Cylinder head cover	25	
	Piston injector on cylinder crankcase	25	
Closing screw for oil bore in cylinder crankcase	80		
03	Counterweight on crankshaft	2)	
	Flywheel on crankshaft	3)	
	Belt pulley on crankshaft	500-550	
	Screw for connecting rod bearing cap on connecting rod	4)	
	Vibration damper on crankshaft	500-550	
	Vibration damper with tensioning element on crankshaft	600	
	Stud bolts on vibration damper	15	
05	Thrust bolt on cylinder crankcase	35	
	Ball pin on rocker arm	40	
	Rocker arm axles on rocker arm bracket	5	
	Rocker arm axle complete on cylinder head	100-110	
	Timing device on camshaft	300	
07	Protective sleeve of nozzle holder on cylinder head	60	
	Thrust bolt for nozzle holder on cylinder head	S nozzle	60-70
	Nozzle in nozzle holder		80
	Protective sleeve of nozzle holder on cylinder head	P nozzle	40
	Thrust bolt for nozzle holder on cylinder head		60-80
	Nozzle in nozzle holder	40-50	
	Stud bolt for mount on injection pump	15	
	Injection pump wheel on injection pump M 14	80	
	Injection pump wheel on injection pump M 18	105	
	Delivery line at injection pump	25	
	Delivery line at nozzle holder	25	
	Delivery and leak oil line at cylinder head	10	
	Leak oil line at nozzle holder	15	

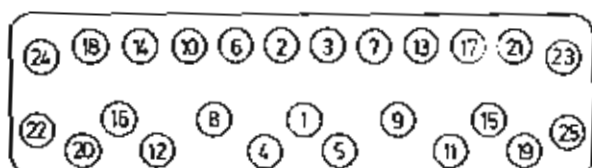
Group	Designation	Nm
09	Fuel line at filter and injection pump	35
	Vent line at injection pump	35
	Vent line at fuel filter	35
	Compressed air manifold at turbocharger	20
	Exhaust turbocharger at exhaust manifold M 10	55-75
	Flange manifold at exhaust turbocharger M 8	30
	Air intake pipe at compressed air manifold	25
	Oil delivery line at oil cooler M 14	40
	Oil line at turbocharger and oil pan M 8	25
13	Connecting rod cover on connecting rod air compressor	15
	Preassembly of delivery valve (94 mm dia.)	20
	Delivery valve in cylinder head air compressor (94 mm dia.)	10
	Suction valve in cylinder air compressor (94 mm dia.)	160-200
	Cylinder head with liner at cylinder crankcase	30
	Suction and delivery valve in cylinder head (77 mm dia.)	100-120
	Liner at crankcase	35
	Cylinder at liner	35
14	Stud bolt on cylinder head outside	15
	Exhaust manifold at cylinder head outside	50
	Exhaust manifold at cylinder head 2-hole metal strap	50
15	Starter at clutch housing	55-65
	Alternator at mount	40
	Tensioning bolt at cylinder crankcase	40
	Lock nut at tensioning bolt	60-80
	Stud bolt for starter at flywheel housing	15
	Belt pulley for alternator	60
	Tensioning bolt at alternator	35
18	Oil overpressure valve at oil pump cover	15-25
	Seal of oil overpressure valve oil filter	60-80
	Delivery oil line at injection pump	15
	Delivery oil line at oil filter	15
	Oil pressure gauge pickup at oil cooler	50
	Oil pressure gauge pickup at oil filter	50
	Oil pump at cylinder crankcase	35
	Cover at oil pump	35
	Suction pipe at oil pump	30-40
	Oil filter at cylinder crankcase (steel)	60
	Oil filter at cylinder crankcase (alum.)	60
	Oil filter bowl at oil filter head (alum.)	40-50
	Oil filter bowl at oil filter head (steel)	40-50
	Oil drain plug at oil filter bowl (alum.)	35
Oil drain plug at oil filter bowl (steel)	50-60	

00.13 Tightening Torques

Group	Designation	Nm
20	Screw plug at top cooling water line 14 x 1.5	35
	Screw plug at top cooling water line 18 x 1.5	50-60
	Screw neck at upper cooling water line	50
	Water pump at cylinder crankcase	60
	Water drain plug at cylinder crankcase	50-60
22	Engine supporting arm at cylinder crankcase M 14 x 1.5	150-190

Notes

1) M 15 bolts	Initial torque 50 to 60 Nm Final torque 90° to 110° torquing angle	
2)	Initial torque 30 to 40 Nm Final torque 90° to 110° torquing angle	
3) No. 19 antifatigue bolt	100 Nm	
3) No. 22 antifatigue bolt	Initial torque 30 to 40 Nm Final torque 90° to 110° torquing angle	
4) M 12 bolts (corrugated parting face)	Initial torque 40 to 50 Nm Final torque 90° to 100° torquing angle	
M 14 and M 15 bolts	Initial 100 to 110 Nm Final torque 90° to 100° torquing angle	
5) Torque in 3 steps:	Hexagon bolt	Nut on stud bolt
1st step	60	60
2nd step	90	90
3rd step	120	120
Final torque	120	120



700-1372



Sequence for tightening or slackening the cylinder head bolts or nuts.

Note: When re-tightening nuts or bolts, slacken slightly individually and only then tighten to the specified torque. On no account may all the bolts be slackened in one operation and only then tightened.

Repairing Threaded Holes with Heli-Coil Elements 00.13

Metric thread	Core hole bore dia.	OD spiral drill
M 6	$\frac{6,31}{6,04}$	6,1-6,2-6,25
M 8	$\frac{8,35}{8,04}$	8,1-8,2-8,25-8,3
M 8 x 1	$\frac{8,32}{8,04}$	8,1-8,2-8,25-8,3
M 10	$\frac{10,40}{10,05}$	10,25
M 12	$\frac{12,50}{12,05}$	12,25-12,5
M 12 x 1,5	$\frac{12,43}{12,05}$	12,25
M 14	$\frac{14,53}{14,05}$	14,25-14,5
M 14 x 1,5	$\frac{14,43}{14,05}$	14,25
M 15 x 2	$\frac{15,30}{15,20}$	15,25
M 16	$\frac{16,53}{16,06}$	16,25-16,5
M 16 x 1,5	$\frac{16,43}{16,05}$	16,25
M 24 x 1,5	$\frac{24,43}{24,05}$	24,25
M 26 x 1,5	$\frac{26,43}{26,05}$	26,25
M 30 x 1,5	$\frac{30,43}{30,05}$	30,25

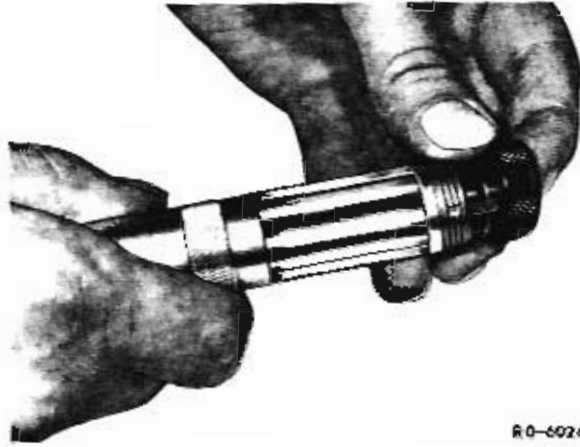
Special Tools

Heli-Coil-Toolbox M 6, M 8, M 10, M 12, M 14		000 589 03 28 00
Heli-Coil-Toolbox M 8 x 1, M 12 x 1,5, M 14 x 1,5, M 14 x 1,25		000 589 04 28 00
Heli-Coil-Tool M 15 x 2		000 589 05 28 00
Heli-Coil-Tool M 16 x 1,5		000 589 06 28 00
Heli-Coil-Tool M 18 x 1,5		000 589 07 28 00
Heli-Coil-Tool M 24 x 1,5		000 589 08 28 00
Heli-Coil-Tool M 26 x 1,5		000 589 09 28 00
Heli-Coil-Tool M 16		000 589 10 28 00
Heli-Coil-Tool M 30 x 1,5		000 589 11 28 00

00.13 Repairing Threaded Holes with Heli-Coil Elements

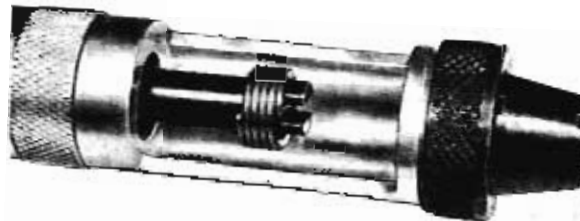
Repairing

- 1 Widen core hole with spiral drill.
- 2 Re-tap the damaged thread with special Heli-Coil tap.
- 3 Fit together mouthpiece and spindle corresponding to the thread.



- 4 Place the Heli-Coil threaded insert into the chamber of the installation tool.

Note: The driver pinion of the Heli-Coil insert must rest against the mouthpiece.



- 5 Turn threaded element with spindle through mouthpiece until it is flush with the latter.



- 6 Place installation tool against tapped hole and screw in insert without exerting pressure on the spindle.

Note: Screw in insert $\frac{1}{2}$ to $1\frac{1}{2}$ turns deeper than the surface of the tapped hole.

- 7 Remove driver pinion up to M 12 by means of a short, sharp blow with a pinion breaker. Remove driver pinion of threaded elements greater than M 12 by means of pointed pliers by moving up and down (not back and forward).



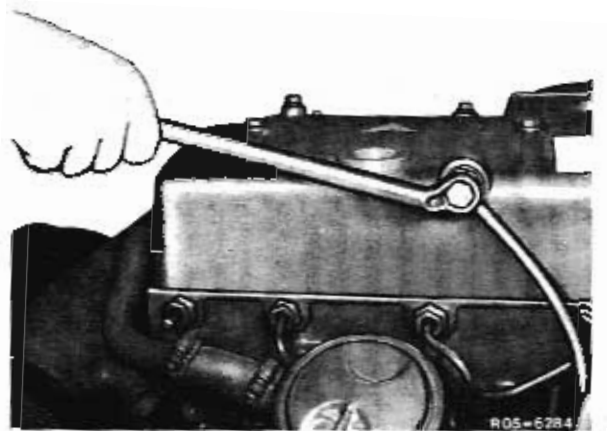
Tightening torques in Nm

Cylinder head cover at cylinder head

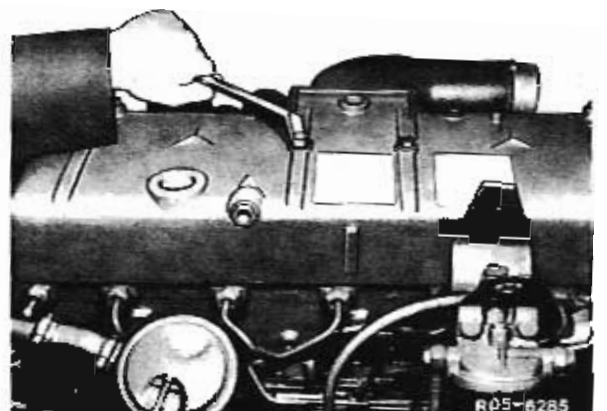
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Removal

- 1 Unscrew hose from charge air cooler 362 LA or from turbocharger 352 A at the cylinder head cover.
- 2 Unscrew the line from the manifold pressure regulator at the cylinder head cover.

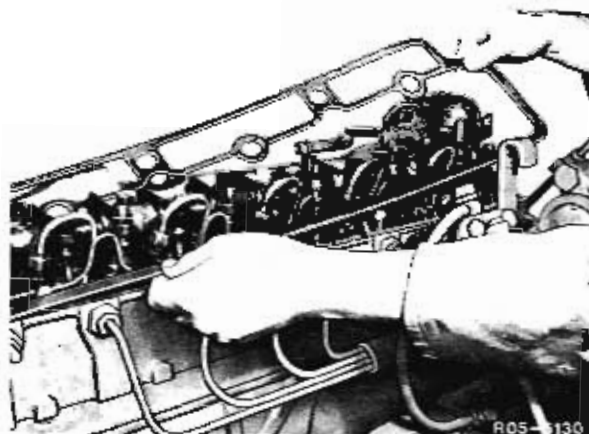


- 3 Unscrew the fastening bolts for cylinder head cover.



01.13 Removing and Fitting Cylinder Head Cover

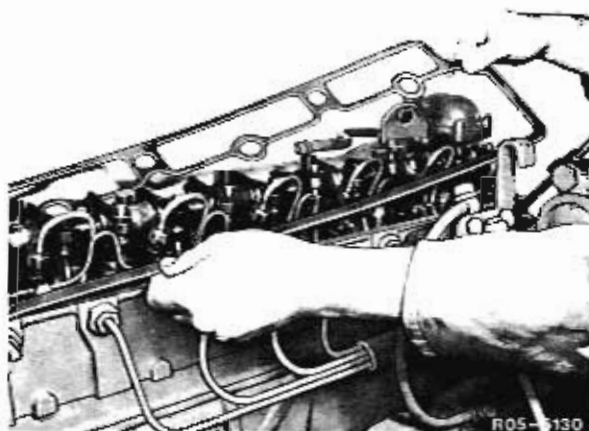
4 Remove cylinder head cover and gasket.



Fitting

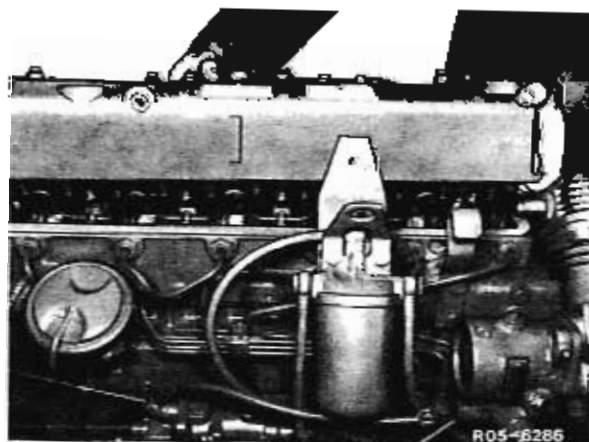
1 Check sealing face of cylinder head cover for signs of damage.

2 Fit new gasket to the cylinder head.



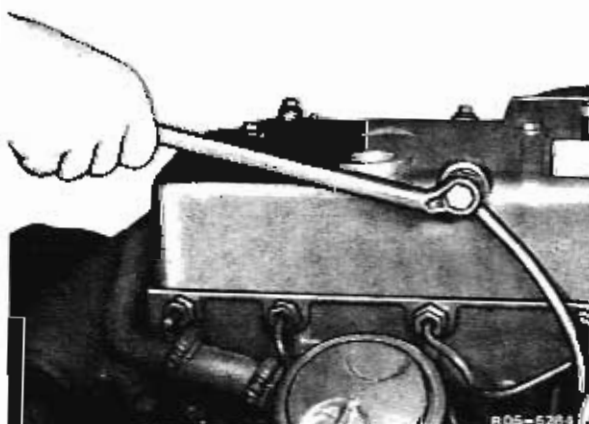
3 Mount cylinder head cover. Torque bolts to 25 Nm with torque wrench.

Note: When fixing the cylinder head cover, first tighten the bolts above the intake passages.



4 Connect hose from charge air cooler 362 LA or from turbocharger 352 A to the cylinder head cover.

5 Connect the line from manifold pressure regulator to the cylinder head cover.



Special Tools



Preparatory Work

Clean the entire upper part of the engine to prevent any dirt entering the valve chamber.

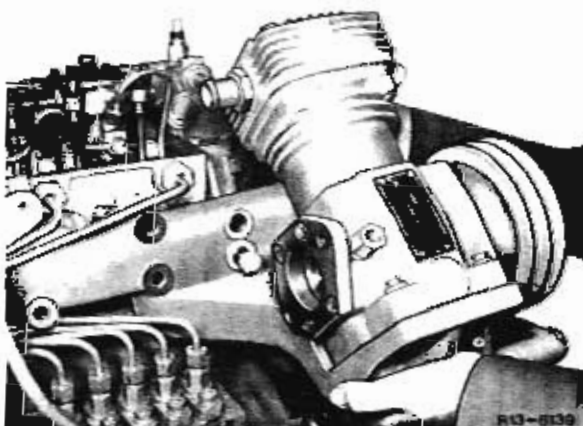
Unscrew cylinder head cover, drain coolant.

Removing cylinder head

- 1 Unscrew holder for fuel filter and swing to the side.

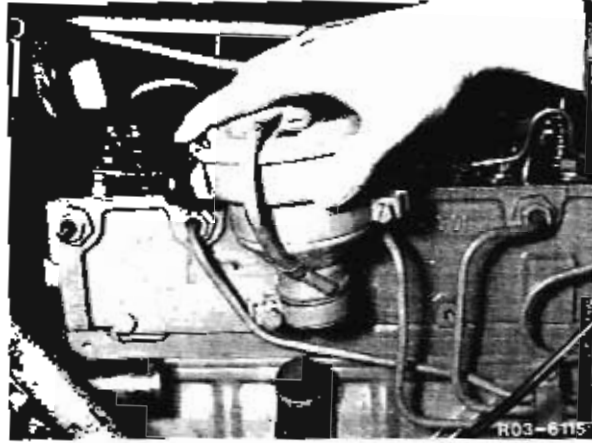


- 2 Remove air compressor with bracket (362 LA).

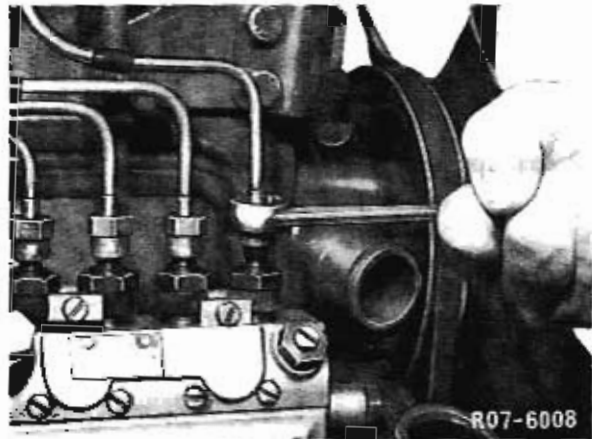


01.13 Removing Cylinder Head

3 Remove engine breather at the cylinder head.

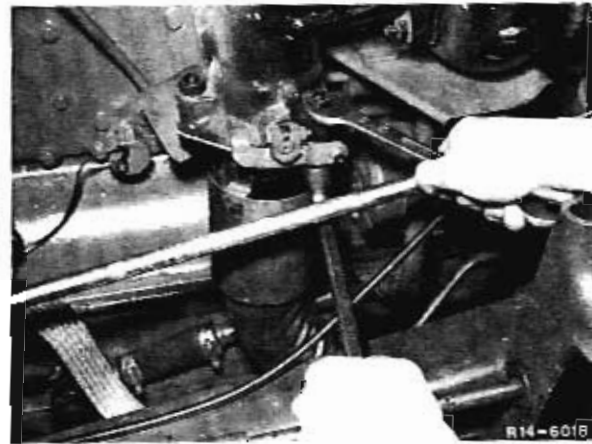


4 Unscrew the Injection lines at the injection pump.

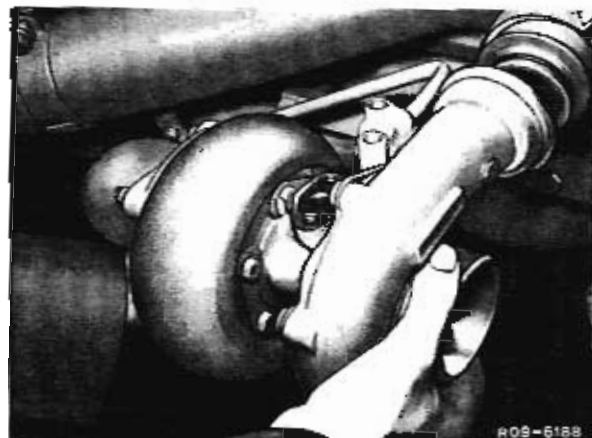


Box wrench 000 589 07 03 00

5 Unscrew the exhaust pipe from the flange.

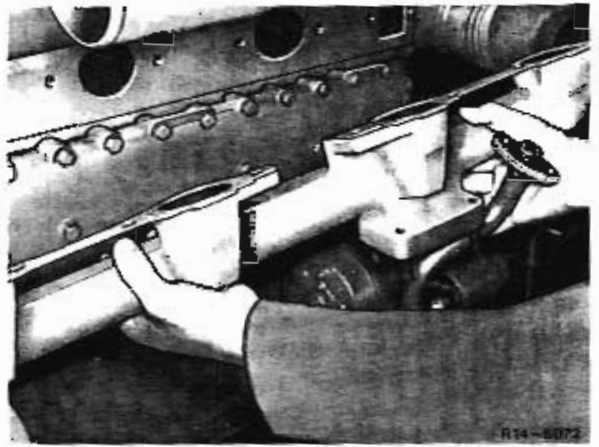


6 Release and detach both operating linkages at the throttle valve lever.



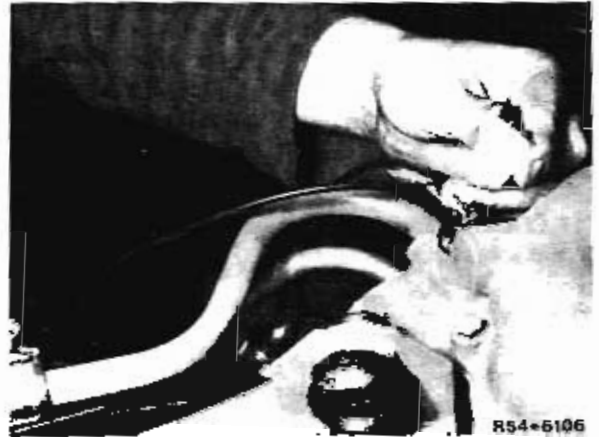
7 Remove turbocharger.

- 8 Remove flange manifold with gasket.

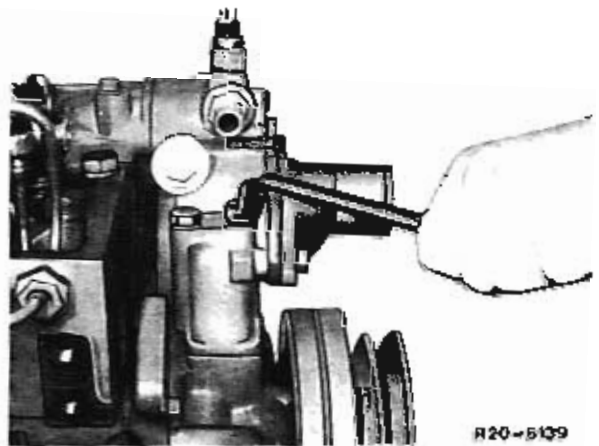


- 9 Remove coolant hose at the thermostat housing.

- 10 Disconnect the plug at the temperature sensor.

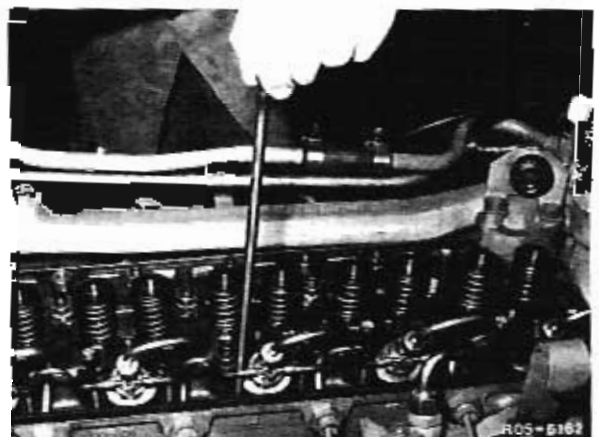


- 11 Detach the thermostat housing at the coolant pump.



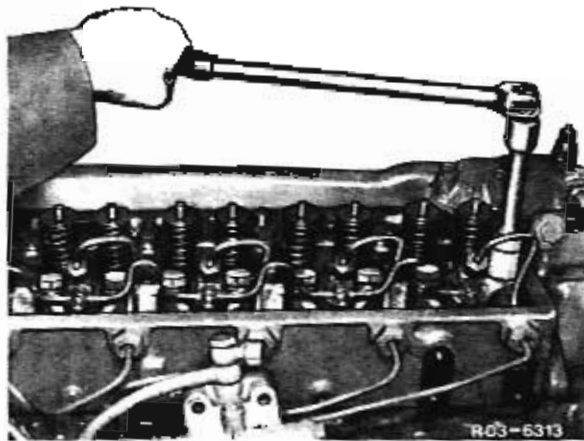
- 12 Remove the rocker arm assembly.

- 13 Take out the tappet rods.



01.13 Removing Cylinder Head

14 Unscrew the cylinder head bolts (352 A up to engine end No. 678 155) slacken cylinder head nuts, unscrew stud bolts.



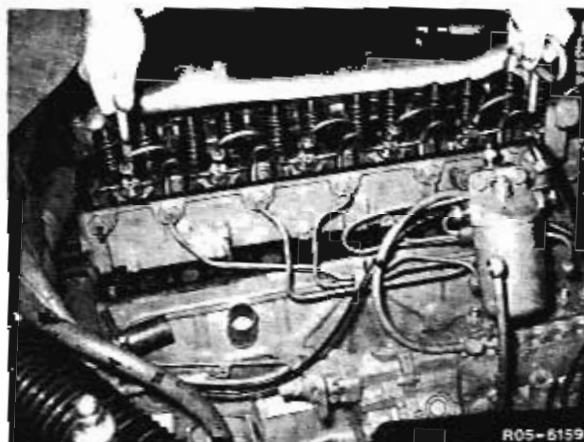
15 Screw in handles.

16 Lift off cylinder head.

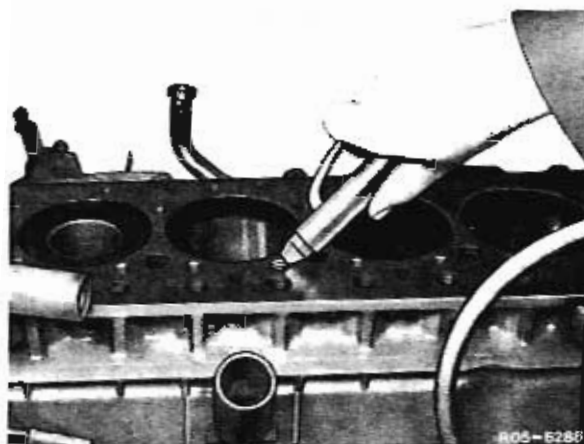
Note: Place wooden blocks below cylinder head at the side to prevent the nozzles being damage.

17 Remove the cylinder head gasket. Clean any residues on contact faces.

Handles 312 589 01 31 00



18 Blow out tapped holes.



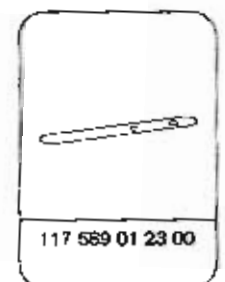
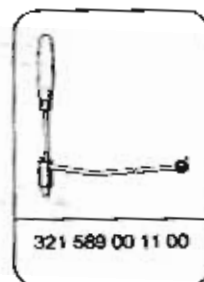
Cylinder Head

Overall height of cylinder head when new		92,1 91,9
Permissible stock removal up to minimum height		90,9
Perm. unevenness of parting face over	a length of 150 mm max.	0,04
	Overall length max.	0,15
Perm. deviation of parallelism of upper and lower parting face		0,1
Testing water chamber for leaks	Air overpressure	2 bar
	perm. leak rate	8 cm ³ /min
Nozzle projection	S nozzle	1,8–2,5
	P nozzle	2,2–2,9
Maximum length of shank of cylinder head bolt		112 mm

Tightening Torques in Nm

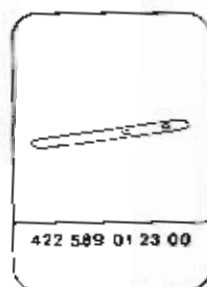
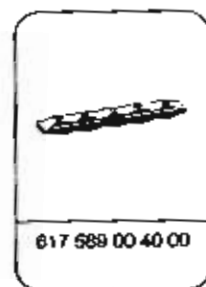
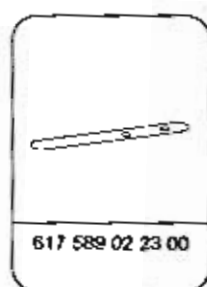
Cylinder head in three steps	1st step	60
	2nd step	90
	3rd step	120
	Final torque	120
Cylinder head cover		25
Union nut injection line		25
Upper cooling water line		25
Rocker arm brackets at cylinder head		100–110
Exhaust pipe at exhaust manifold		45
Exhaust manifold at cylinder head		60

Special Tools



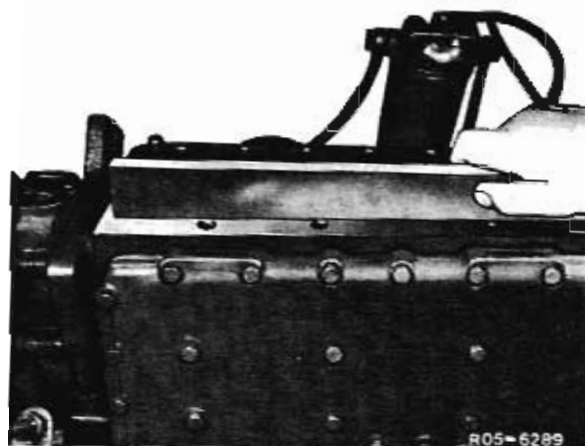
01.13 Fitting Cylinder Head

Special Tools



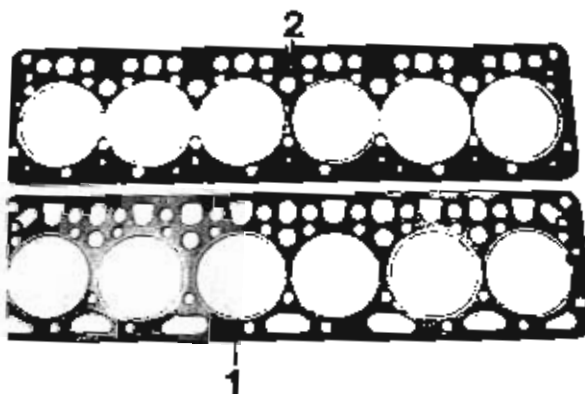
Fitting

1 Check the unevenness of the cylinder head and cylinder crankcase parting face with a straight-edge. Machine any unevennesses.



2 Fit new cylinder head gasket.

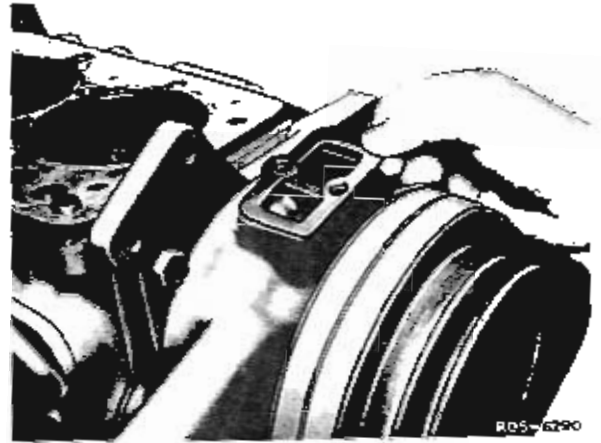
Note: The cylinder head gasket of engine OM 352 A was modified from engine end No. 708 085. The previous gasket can be used up to engine end No. 712 987.



- 1 Previous cylinder head gasket
- 2 Modified cylinder head gasket

A05-626A

3 Fit gasket between coolant pump and thermostat housing.



4 Fit cylinder head. Unscrew handles.

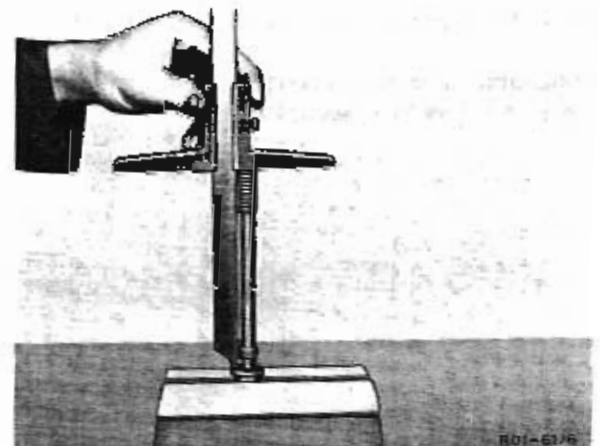
Note: The cylinder head of engine OM 352 A was strengthened from engine end No. 712 988. The strengthened cylinder can be installed together with the modified gasket also in engines with a lower engine end No.



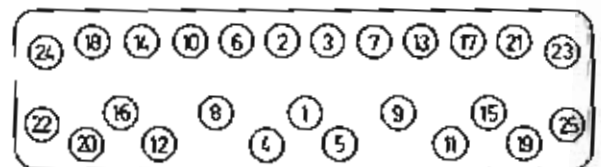
Handles 312 589 01 31 00

5 Check the length of the shank of the cylinder head bolt.

Note: The cylinder head of engine OM 352 A was fixed with stud bolts and nuts up to engine end No. 678 154. In the event of a repair, the hexagon bolts can also be installed as a set in engines with a lower engine end No.



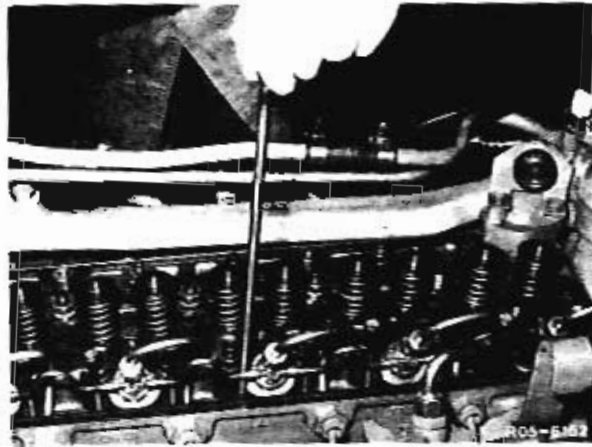
6 Lightly oil the thread and contact face of the cylinder head bolts or stud bolts, screw in and torque to 120 Nm in 3 steps in the order specified.



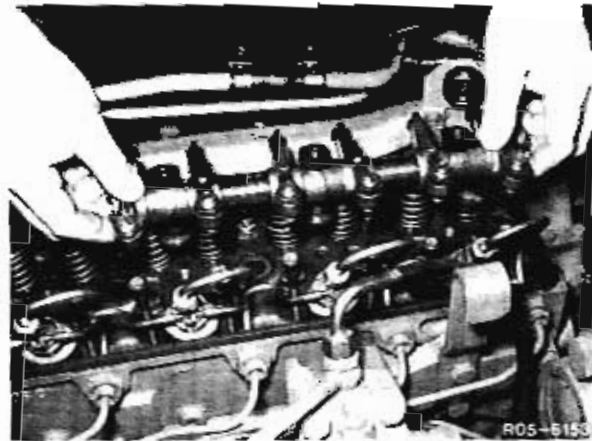
TK-887

01.13 Fitting Cylinder Head

7 Insert the tappet rods.

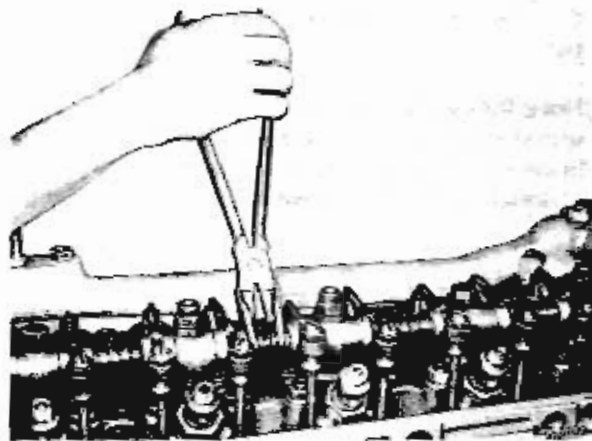


8 Fit rocker arm assembly and torque with 100 to 110 Nm.



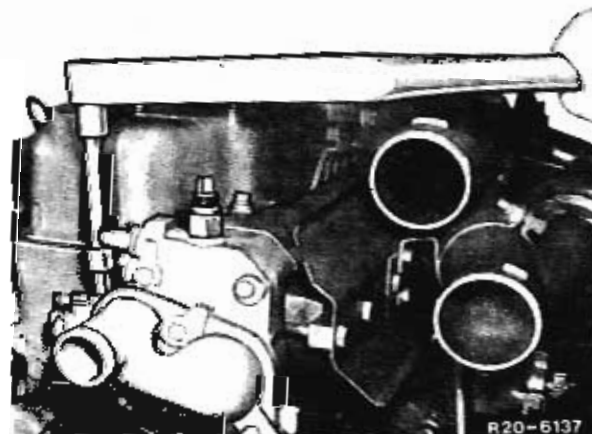
9 Fit the connecting nipples with special tool.

Installation note: When fitting the connecting nipple, install the inner half toward the fan.



Pliers 312 589 01 37 00

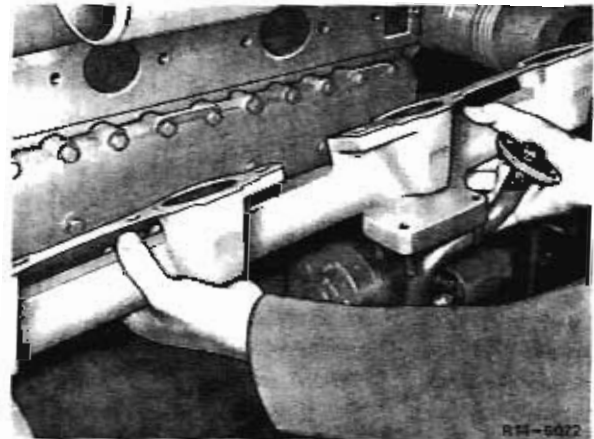
10 Screw the thermostat housing onto the coolant pump with 30 Nm.



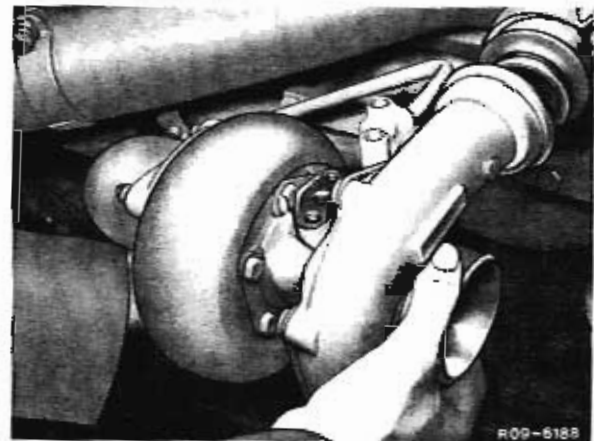
- 11 Fit plug to the temperature sensor.
- 12 Install the coolant hose at the thermostat housing.



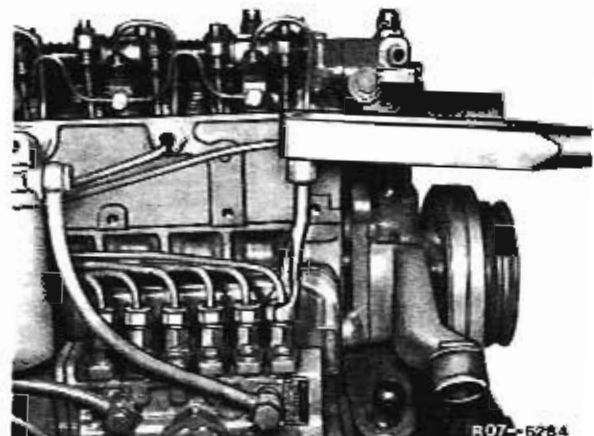
- 13 Fit the flange manifold with gasket and torque with 50 Nm.



- 14 Install turbocharger.
- Attach and secure both operating linkages at the throttle valve lever.



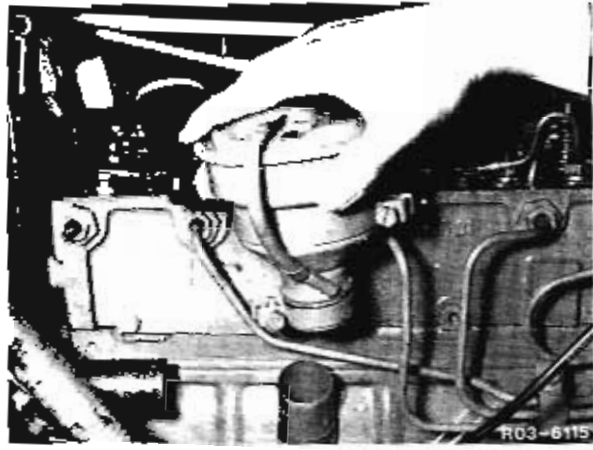
- 15 Install the exhaust pipe at the flange manifold and torque with 45 Nm.
- 16 Tighten the injection lines at the injection pump to 25 Nm.



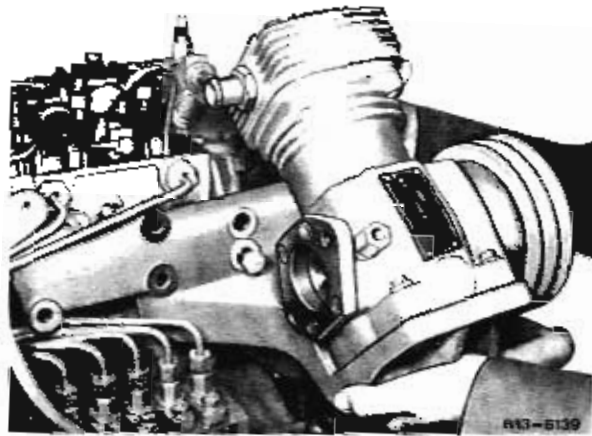
Box wrench socket 000 588 68 03 00

01.13 Fitting Cylinder Head

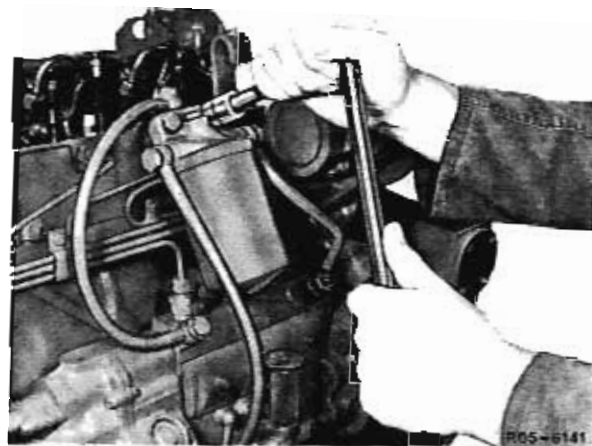
17 Install engine breather at the cylinder head.



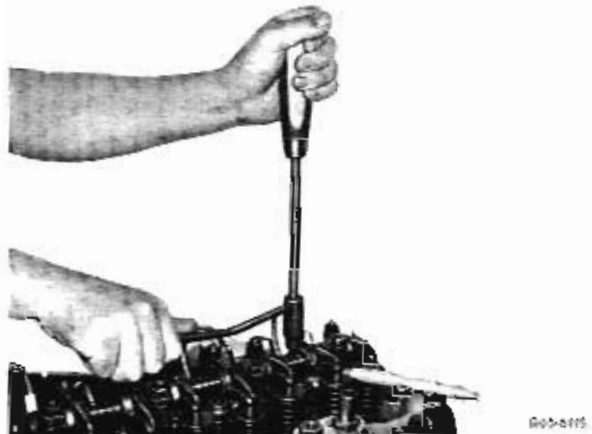
18 Fit the air compressor with bracket and power steering pump.



19 Screw on holder for fuel filter.



20 Adjust valve.

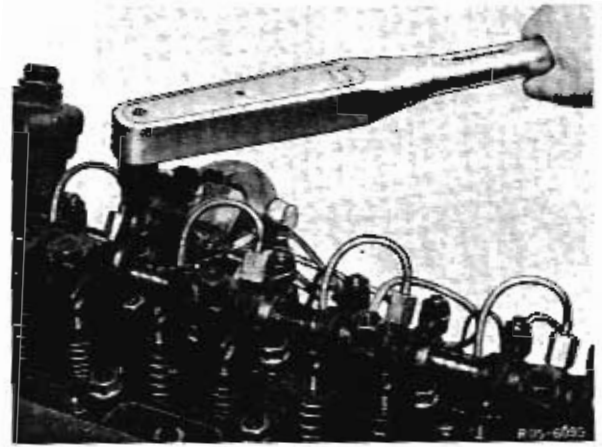


Valve adjusting wrench	321 589 00 11 00
Gauging strap	117 589 00 23 00
Gauging strap	117 589 01 23 00
Gauging strap	617 589 02 23 00
Gauging strap	617 589 04 23 00
Gauging strap	422 589 01 23 00
Gauging strap holder	617 598 00 40 00

Important! Following installation, the engine must be warmed up to operating temperature and each bolt or nut then individually **slackened** slightly in the sequence of the bolt diagram and then **tightened** to the tightening torque.

Do not slacken all of the nuts or bolts at the same time and then tighten. Following this, re-adjust valves. After the first 500 km, the cylinder head nuts or bolts should be tightened a second time and the valves re-adjusted.

Note: The nuts or bolts below the rocker arm shaft can be tightened with a special tool without removing the rocker arm assembly.



Socket wrench 000 589 06 03 00



Data

Overall height of cylinder head		92,1 91,9
Perm. total stock removal to minimum height of δ		90,9
Peak-to-valley height of parting face in μm		8 - 16
Perm. unevenness of lower parting face over	a length of 150 mm	0,04
	overall length	0,15
Perm. deviation of parallelism of upper to lower parting face		0,1
Nozzle projection	P nozzle	2,2 - 2,9
	S nozzle	1,8 - 2,5
Valve stands back		0,7 - 1, 2

1) After machining the cylinder head parting face, the nozzle spacing must be checked and corrected if necessary with nozzle plates.

To achieve the specified peak-to-valley height when grinding, we recommend noting the following particulars:

- Segments required:

Shape: OD 19
 Dimension: 79/70 x 21 x 80
 Specification: 50C 36F 5V 15
 Manufacturer: Tyrolit-Schleifmittelgesellschaft
 Domestic source: Heidemansstr. 166e
 8 München 45

- Machine settings

Speed: $n = 1400/\text{min}$
 Feed: $u = 920 \text{ mm}/\text{min}$
 Cutting rate: $V_s = 27 \text{ m}/\text{s}$

The specified cutting rate is obtained from a segment grinding disc diameter of 370 mm. If the diameter is different (according to the type of machine), the speed should be altered in such a way that $V_s = \frac{920 \cdot \pi \cdot d}{60 \cdot 1000} = 27 \text{ m}/\text{s}$ differs by no more than $\pm 10\%$.

Important: With a smaller feed or manual feed, the grinding pattern is significantly altered and it is no longer certain that the peak-to-valley height of $R_z = 8-16 \mu\text{m}$ will be achieved.

Data

Control range of oil separator

-10 to -80 mm WG

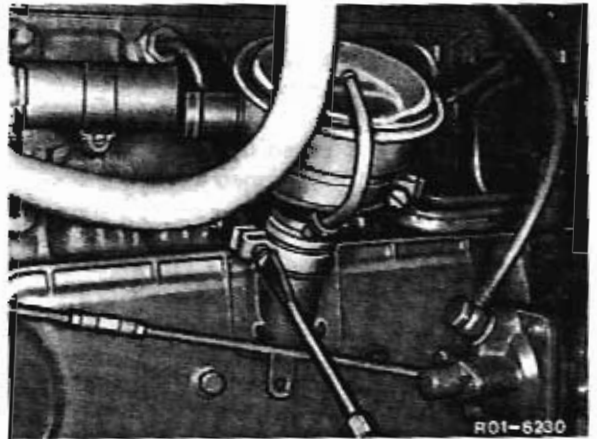
Tightening Torque in Nm

Oil separator at cylinder crankcase

8

Removal

- 1 Slacken fastening clamp and detach hose at oil separator.
- 2 Unscrew oil separator at cylinder crankcase and remove.



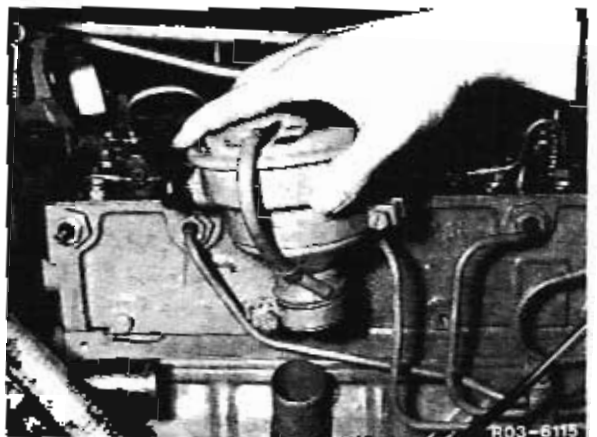
Installation

- 1 Insert O-ring into the oil separator.



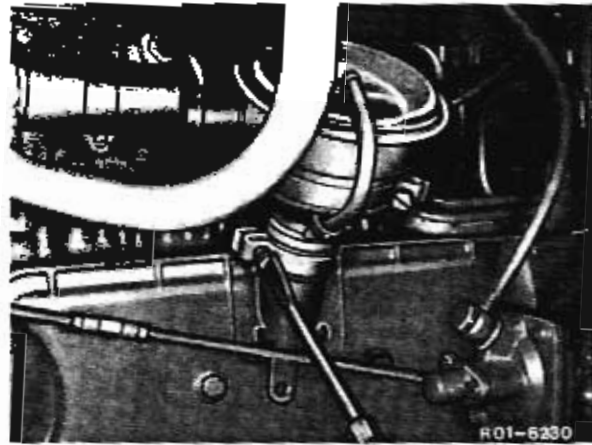
- 2 Mount oil separator above the connection nozzle in the cylinder crankcase.

Note: When performing maintenance and repair work, ensure that the oil separator is not damaged. Even slight damage, such as cap dented, may cause the oil separator to fail. A damaged oil separator must always be replaced.



01.13 Removing and Installing Oil Separator

- 3 Secure the oil separator with 8 Nm to the crankcase.
- 4 Fit the hose to the oil separator and tighten fastening clips.

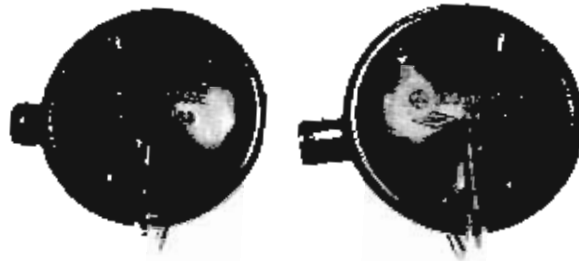


Note OM 352 A:

From engine end No. 716 423, oil separators are installed with improved diaphragm quality.

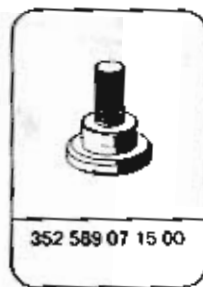
Modified version recognised by code number with supplementary letter "E" stamped on cap.

Oil separators without the supplementary letter "E" should generally be replaced after 2 years.



Vibration damper removed

Special Tools



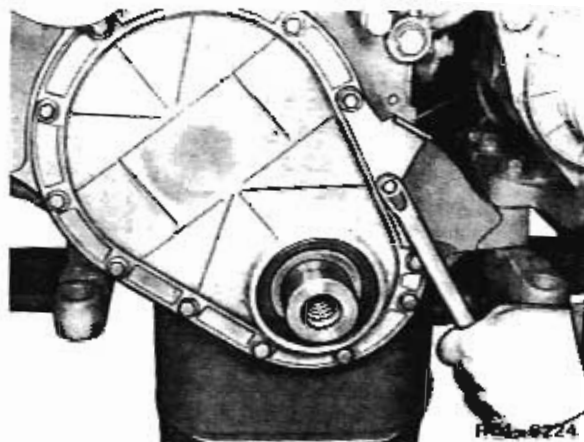
Tightening Torques in Nm

Timing case cover at cylinder crankcase

8

Removal

1 Unscrew the timing case cover and remove together with start of delivery pointer.

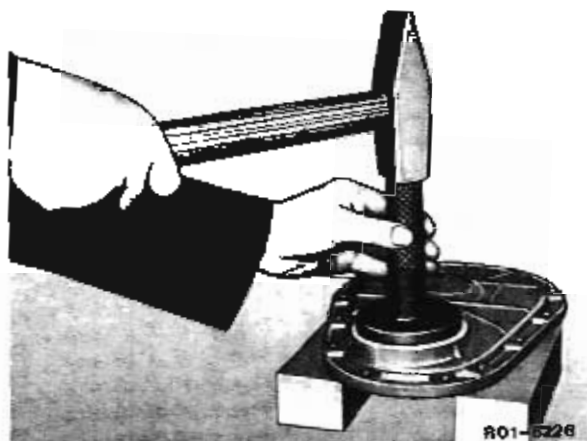


2 Remove gasket.



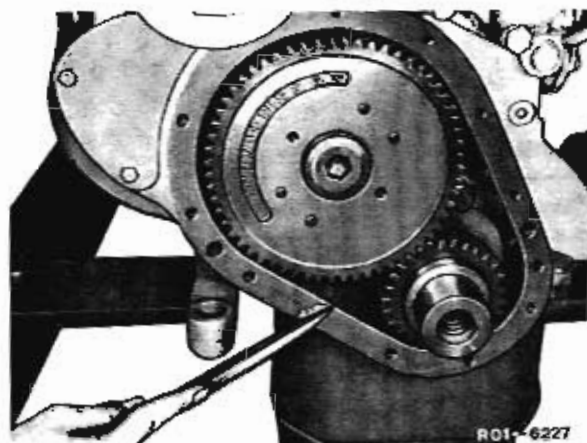
01.13 Removing and Installing, Sealing Timing Case Cover

3 Remove shaft seal.

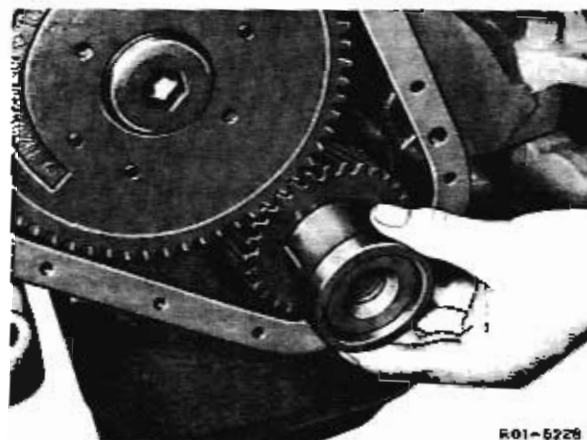


D.P.: 389 589 02 15 00

4 Clean sealing faces.

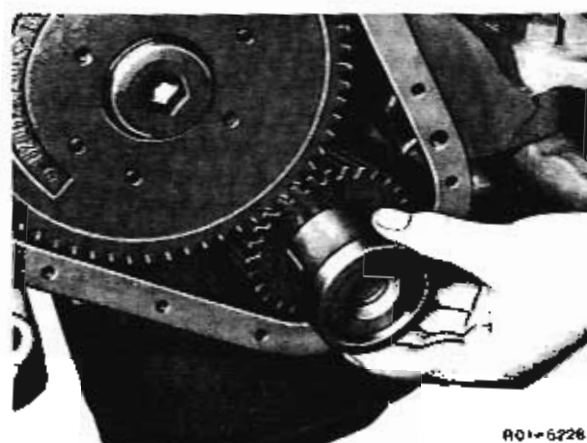


5 Remove bearing race.



Installation

1 Fit new bearing race.



Removing and Installing, Sealing Timing Case Cover 01.13

- 2 Knock new shaft seal into timing case cover.

Note: The sheet metal timing case cover can also be replaced by an aluminium timing case cover. In this case, remove the locking pins from the timing case and use longer bolts.



R01-5111

Drift 352 589 07 15 00

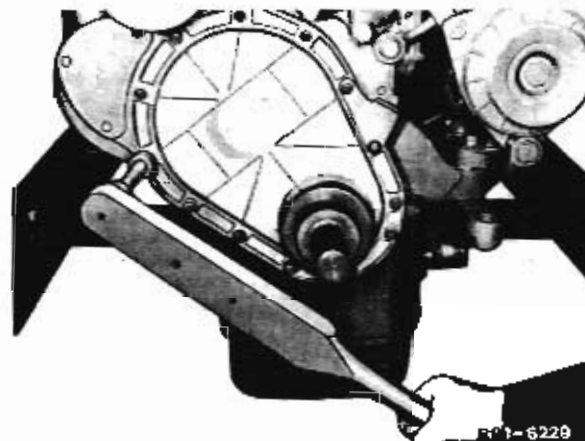
- 3 Fit new gasket.

Note: The aluminium timing case cover can be installed with a gasket, the graphited side toward the timing case or with a liquid sealing compound.



R01-6225

- 4 Centre the aluminium timing case cover with special tool and fit the start of delivery pointer. Screw in the bolts and torque with 8 Nm.



R01-6229

Drift 352 589 07 15 00



Tightening Torques in Nm

Oil drain plug at oil pan	80
Oil pan at cylinder crankcase M 8	9
Oil pan at cylinder crankcase M 6	8

Removal

1 Drain engine oil.



2 Unscrew oil filler neck, oil dipstick guide and oil return pipe for turbocharger at the oil pan.

3 Unscrew the oil pan at the cylinder crankcase and remove.

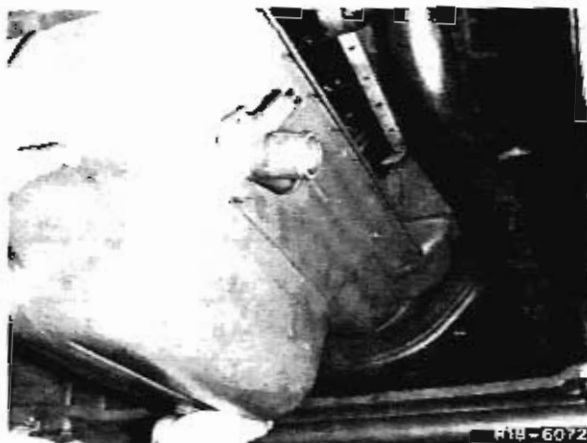
4 Wash out the oil pan.



01.13 Removing and Installing Oil Pan

Installation

1 Fit the oil pan with the new gasket to the cylinder crankcase.

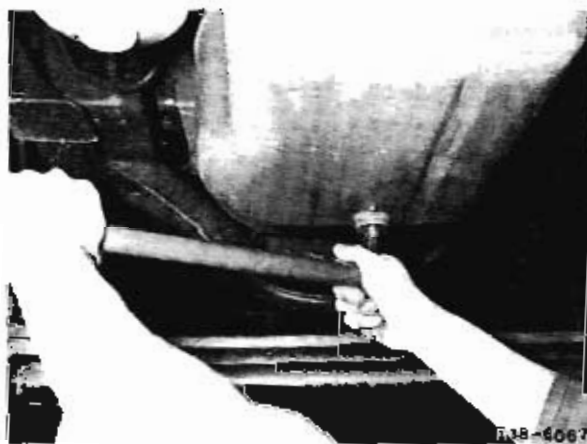


2 Fix the oil filler neck, oil dipstick guide and oil return pipe for turbocharger to the oil pan.



3 Install the oil drain plug and torque with 80 Nm.

4 Pour in engine oil.



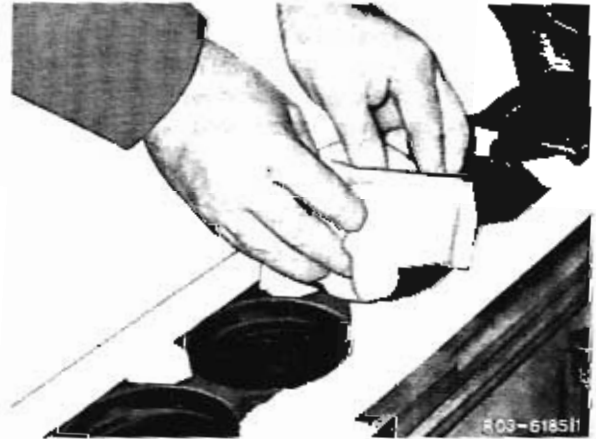
Cylinder head and piston removed

Shop Equipment

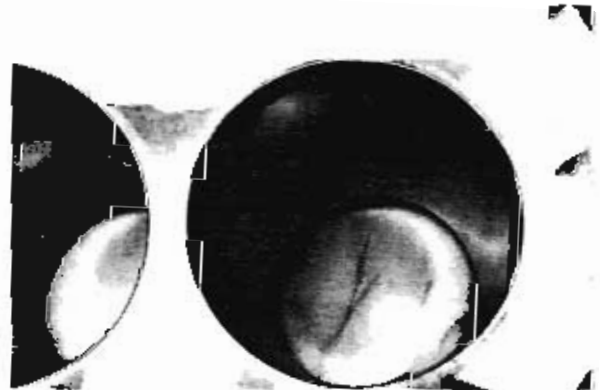
Variable speed hand drill
Honing brush (120 grain) GBD 101

Walter Krupp
Göddertgarten
5309 Meckenheim-Merl

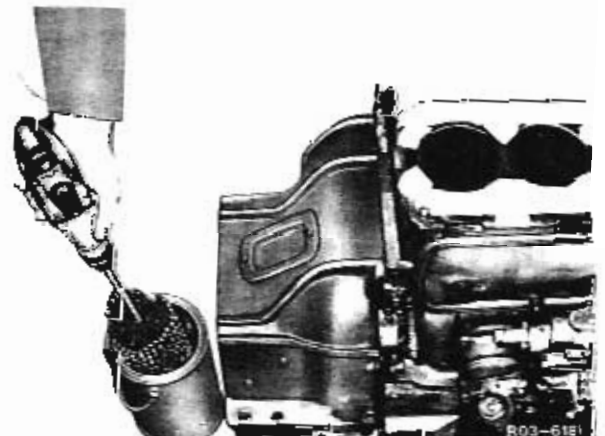
1 Tape over openings of crankcase parting face. Insert pieces of foam (e.g. 40 mm upholstery foam) into the cleaned cylinder walls and fit over crankshaft and bearings to protect them from grinding residue.



Note: Do not use cleaning rags instead of foam pieces since they do not adequately absorb metal abrasion, grinding residues and lubricants. In addition there is a risk of injury if cleaning rags are caught by the honing brush.



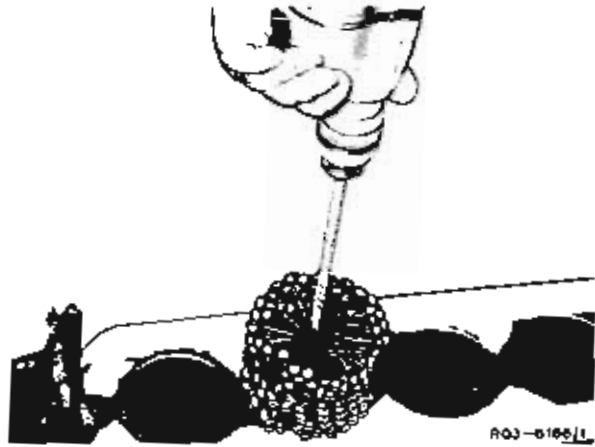
2 Clamp the honing brush in the drill, dip into lubricant (honing oil, thin-bodied engine oil, petroleum or diesel fuel) and allow to drip.



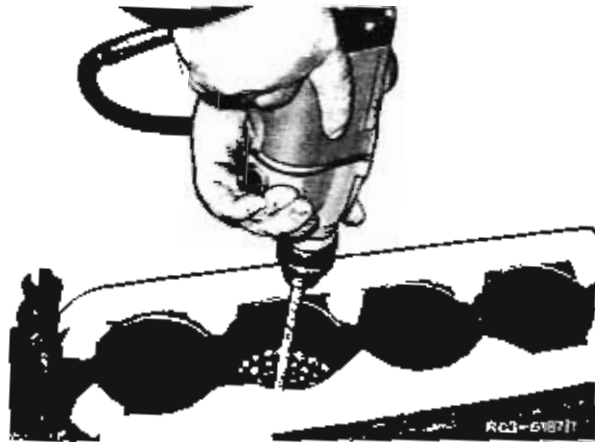
01.13 Machining Cylinder Walls by Flex Honing

3 Position the drilling machine with honing brush centered above the cylinder to be machined and move honing brush into the bore as the drill starts up.

Note: Do not exceed an operating speed of $n = 200$ rpm (risk of brush buckling).

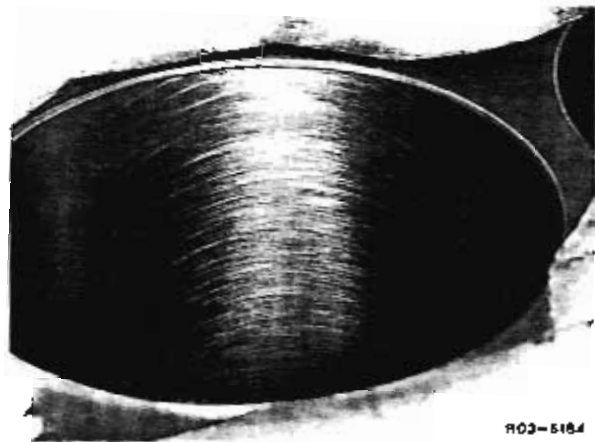


4 Perform one up and down movement per second; alter direction when approx. 1/4 of the honing brush projects over the top or bottom. After a machining time of 1 to 2 minutes, allow drill to run down as the honing brush is being drawn out of the bore.

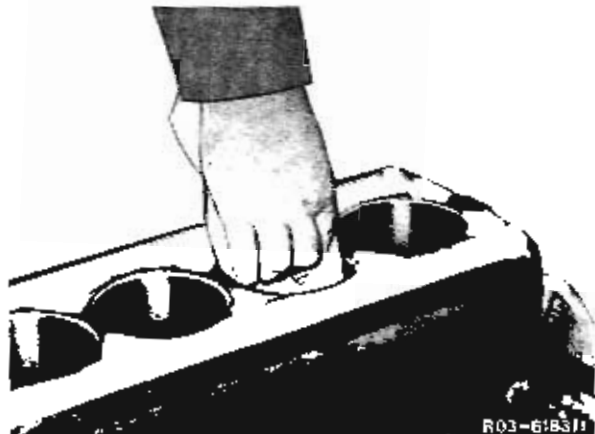


5 A serviceable surface structure has a grinding pattern of approx. 45° , is matt in appearance and has no scratches.

Note: Extremely glossy surfaces are too fine.



6 Following machining, remove grinding residues with rags.

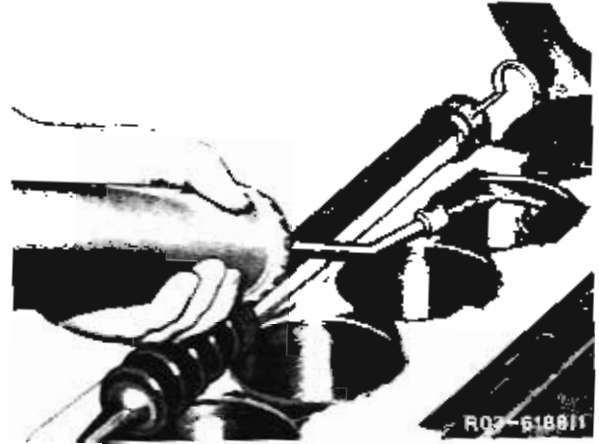


Machining Cylinder Walls by Flex Honing 01.13

7 Flush out cylinder walls with benzene.

8 Fill engine with initial operating oil (Service Product Specifications Sheet 225.3) and crank with starter before starting engine until oil pressure gauge indicates pressure.

Note: Replace initial operating oil after 500 to 1000 km with engine oil. Replace oil filter element as stated in Service Product Specifications and Exchange Engine Conditions.



Engine removed and disassembled

Shop Equipment

Reference should be made to the "Workshop and Spare Parts Store Equipment" (Domestic) Manual or the "Workshop Equipment, Register M" (Export) Manual for details of the workshop equipment required for removing and installing the dry cylinder liners.

Machine Settings

Precision drilling machine:	Speed	approx. 250 – 280/min
	Feed	0,04 – 0,06 mm/revolution
Honing machine	Operating pressure	2,5 – 3,0 bar
	Speed	approx. 60 – 100/min
	Honing angle	40° – 60° (enclosed angle)
	No. of strokes	30 – 40
	Roughness	$R_{32} = 3 – 6 \mu\text{m}$ $R_{max} = 6 – 11 \mu\text{m}$

Surface grinding machine

To achieve the specified peak-to-valley height when grinding grey cast iron materials, note the following particulars:

Important: With a small feed or manual feed, the grinding pattern is significantly altered and it is no longer certain that the peak-to-valley height of $R_z = 8$ to $16 \mu\text{m}$ will be achieved.

Segment Required

Manufacturer:	Tyrolit Schleifmittel- gesellschaft mbH u. Co.	Norton GmbH
Order No.:	816 7551/1	1/153154
Dimensions:	According to machine mount (please state when ordering)	
Specification:	50 C 36 F 5 V 15	39 C 36 – F 8 VK

Note: The segments may be used for wet and dry grinding.

The specified cutting rate (V_s) is obtained with a segment grinding disc diameter of $d = 370$ mm. With a different diameter (according to type of machine) the speed (n) should be altered so that $V_s = \frac{d \cdot n}{1000 \cdot 60} = 27 \text{ m/s}$ deviates by no more than $\pm 10\%$.

Speed:	$n = 1400/\text{min}$
Feed:	$u = 920 \text{ mm}/\text{min}$
Cutting rate:	$V_s = 27 \text{ m/s}$
Infeed/wheel action factor	$= 0,03 \text{ mm}$

Hydraulic press: pressing force approx. 20 tonnes.

01.13 Removing and Installing Dry Cylinder Liners

Data

Machining Dimensions (mm)

Cylinder Crankcase			Cylinder Liners	
Bore diameter for cylinder liner in crankcase (final dim.)		$\frac{100,400}{100,435}$	OD of cylinder liner	$\frac{100,475}{100,495}$
Total depth of bore		228	Diameter of bush collar	$\frac{103,374}{103,428}$
Concentricity boring for piston	Depth of bore	$250^{-1} B$	ID of cylinder liner, final dimension	$\frac{96,990}{97,010}$
	Diameter of bore	$98^{-0,3} A$		
Peak-to-valley height of drilled (honed) cylinder bore		max. Rz 22 μm	Peak-to-valley height of honed cylinder bore max.	$R_{32} = 3-5 \mu\text{m}$
Bore diameter for bush collar		$\frac{103,572}{103,626}$	Coarseness of honing stones	120 - 150
Depth of bore for bush collar		$4,6^{+0,2}$	Permissible out-of-roundness of cylinder bore	0,01
Peak-to-valley height of cylinder crankcase parting face		8 - 16 μm	Permissible concity of cylinder bore	0,01
Coarseness of honing stones		150		
Piston projects (+) Piston stands back (-)		+0,3 bis -0,07		
	(Normal)	$\frac{359,00}{359,10}$		
Housing height centre main bearing bore to parting face cylinder head (size h1)	(0,3)	$\frac{358,70}{358,80}$		
	(0,6)	$\frac{358,40}{358,50}$		
	(0,9)	$\frac{358,10}{359,80}$		

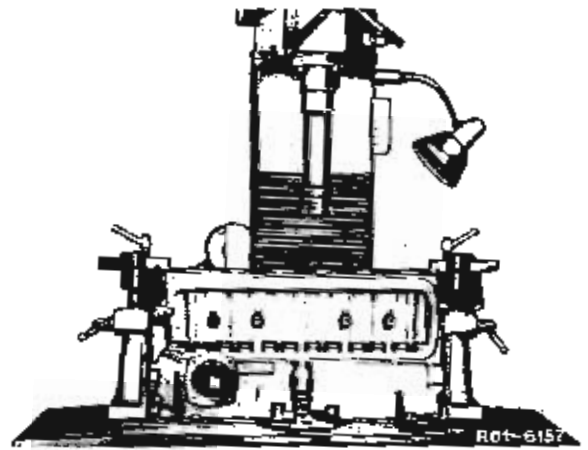
Note 352 A

The dry cylinder liners should preferably be installed on all the cylinders of the engine in question. In exceptional cases only individual cylinder liners are installed, please note the following: observe the **piston projection** and **height of cylinder crankcase** of the particular repair stage.

The non-machined cylinders must be examined for distortion and possibly re-honed.

Removing Cylinder Liners

1 Clamp the clean cylinder crankcase on the drilling machine.

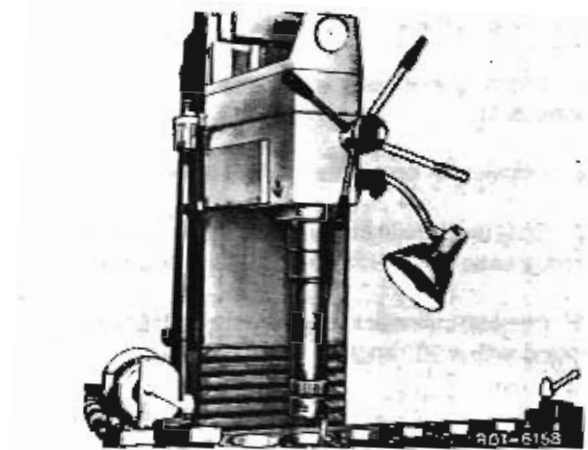


2 Align the cylinder liner to be machined to the drilling tool. Centre above reversing point of first piston ring in TDC by means of centering device.

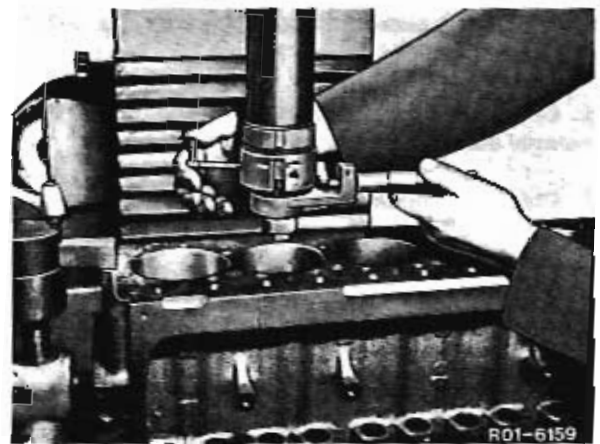
Note: Operating sequence when removing the cylinder liners:

Cylinder bore 1 - 3 - 5 - 2 - 4 - 6

Observing this operating sequence avoids excessive thermal loads.

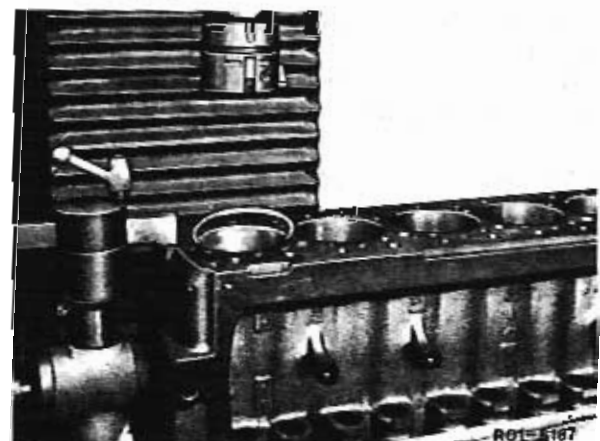


3 Clamp drilling tool in place and adjust in diameter so that approx. half of the wall thickness of the cylinder liner is widened in one or several operations.



4 Adjust the drilling tool for the next operations up to 0.2 mm below the outer diameter of the cylinder liner. Drill out cylinder liner and remove bush collar.

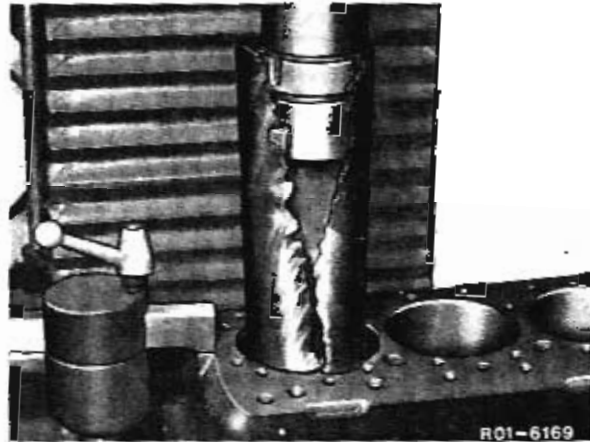
Note: The bush collar is loosened with this setting.



01.13 Removing and Installing Dry Cylinder Liners

5 Score the cylinder liner over the entire length of the cylinder wall with a triangular file so that the liner collapses.

6 Remove cylinder liner.



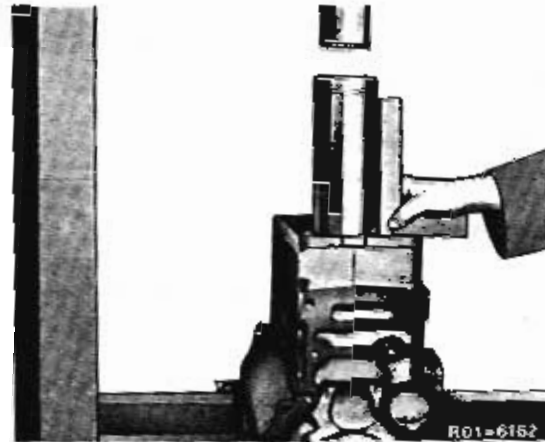
Installing Cylinder Liners

1 Thoroughly clean bore for cylinder liner and balcony seat.

2 Fit cylinder crankcase on the press and align.

3 Coat the bore in the cylinder crankcase with acid-free grease (for example Ate Assemble Grease).

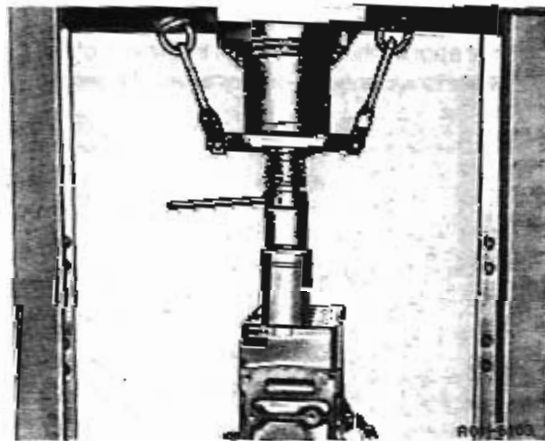
4 Position cylinder liner on bore and align exactly all round with a 90° angle.



5 Fit press-in plate and force in cylinder liner until it projects 20 mm.

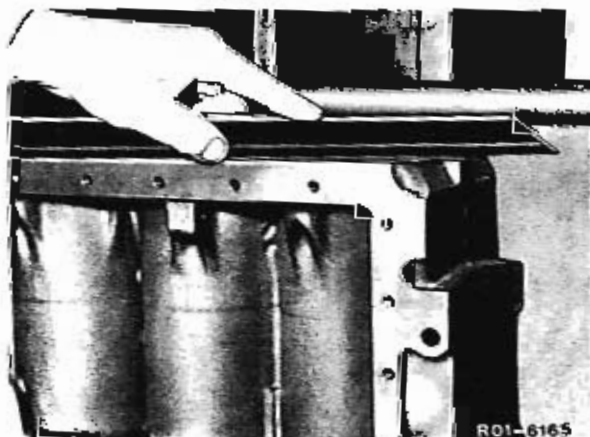
6 Check balcony seat for abrasion and remove any material abrasion present with compressed air.

7 Press in cylinder liner down to its seat with approx. 3 tonnes - briefly relieve pressure - and then apply approx. 7 tonnes pressure for 5 seconds.



8 Face the parting face of the cylinder crankcase including the projecting bushes on a face grinding machine and check with a straight-edge. Peak-to-valley height 8 - 16 µm.

Note: Pay attention to piston projection.



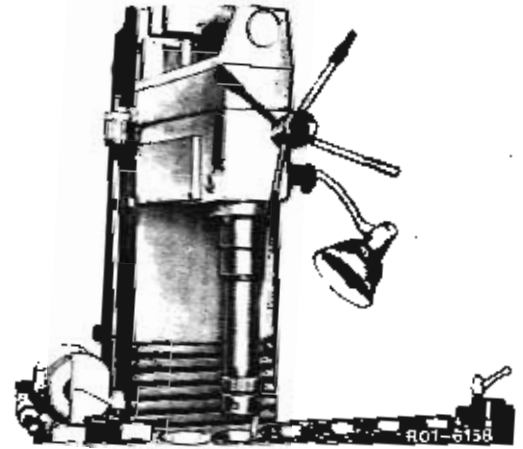
Installing and Removing Dry Cylinder Liners 01.13

9 Clamp cylinder crankcase on the drilling machine and centre appropriate cylinder bore to drilling spindle.

10 Clamp drilling tool in place and adjust. Drill open cylinder liner in several operations up to 0.05 mm below the desired final size (bore diameter) and chamfer the inner edge at the top.

Note: Operating sequence for machining cylinder liners.

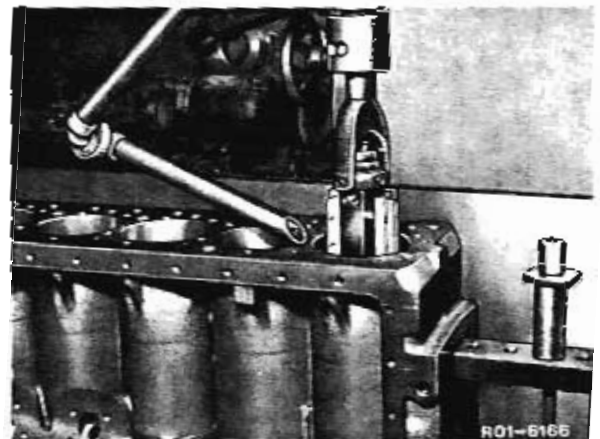
Cylinder bore 1 - 3 - 5 - 2 - 4 - 6



11hone the cylinder liner inner diameter to the final size with the honing machine.

12 Measure adjacent liners and hone as necessary.

13 Thoroughly clean cylinder crankcase.



Note: Fill engine with initial operation oil (Service Products Specifications Sheet 255.3) and crank with starter before starting engine until oil pressure gauge indicates pressure.

Replace initial operation oil with engine oil (Service Product Specifications) after 500 to 1000 km as specified in the conditions for exchange engines and replace oil filter element.

Enlarging Cylinder Bores in Cylinder Crankcase 01.13

Engine removed and disassembled

352 A

Shop Equipment

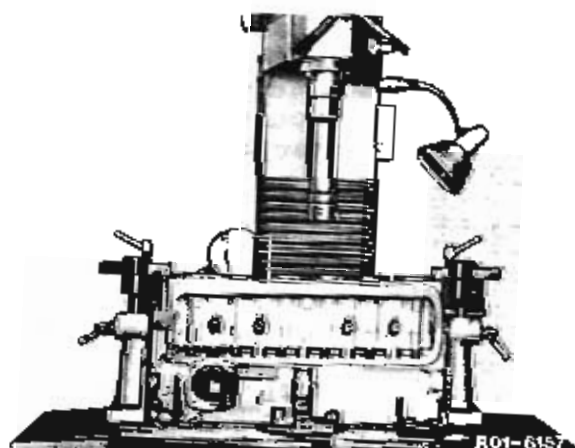
Reference should be made to the "Workshop and Spare Parts Store Equipment" (Domestic) Manual or the "Workshop Equipment, Register M" (Export) Manual for the workshop equipment required for enlarging the cylinder bores.

Machine Settings

Precision drilling machine:	Speed	approx. 250 – 280/min
	Feed	0.04 – 0.06 mm/revolution
Honing machine:	Operating pressure	2,5 – 3,0 bar
	Speed	aprox. 60 – 100/min
	Honing angle	40° – 60° (enclosed angle)
	No. of strokes	30 – 40
	Roughness	$R_{a,2} = 3 - 6 \mu\text{m}$ $R_{a,1} = 6 - 11 \mu\text{m}$

Enlarging

1 Clamp cleaned cylinder crankcase on drilling machine.

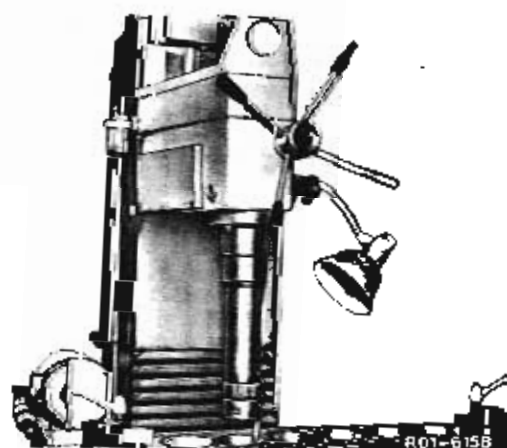


2 Align the cylinder liner to be machined relative to the drilling machine. Centre above the reversing point of the first piston ring in TDC by means of centering device.

Note: If several cylinder liners are to be installed, observe the following operating sequence when drilling the liners:

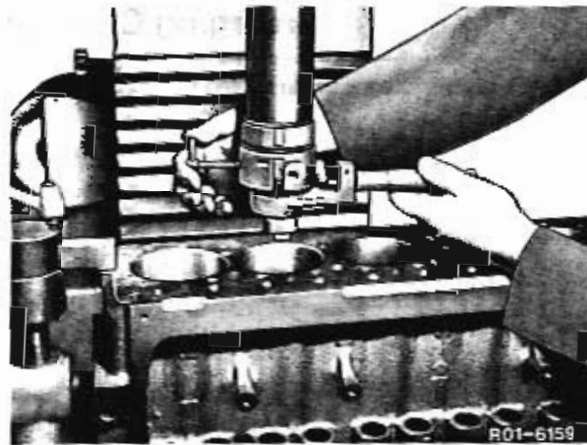
Cylinder bore 1 – 3 – 5 – 2 – 4 – 6

Observing this operating sequence avoids excessive thermal loads.



01.13 Enlarging Cylinder Bores in Cylinder Crankcase

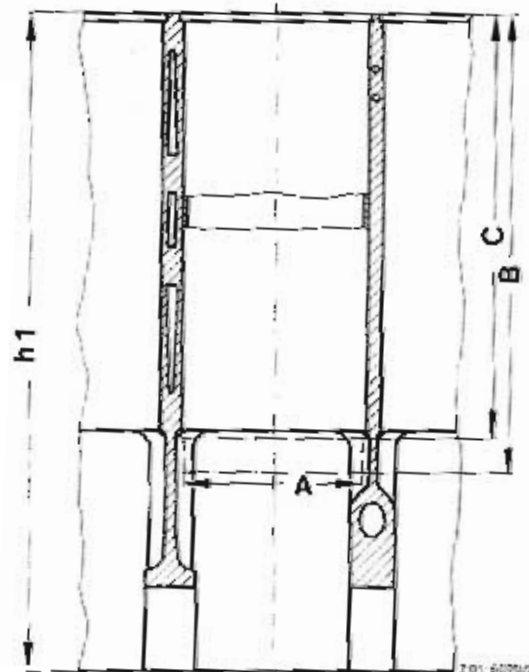
3 Clamp the drilling tool in place and enlarge the cylinder bore in several operations to 0.05 mm below the desired final size (bore diameter). In the final operation, enlarge the cylinder bore to the desired final size with a small feed (precision drilling). This is done by setting the drilling tool to the particular diameter by means of the measuring device. Peak-to-valley height max. 16 μ m.



4 Enlarge the cylinder bores in the first operation with a diameter of $98.2^{+0.3}$ mm to 250^{-1} mm depth.

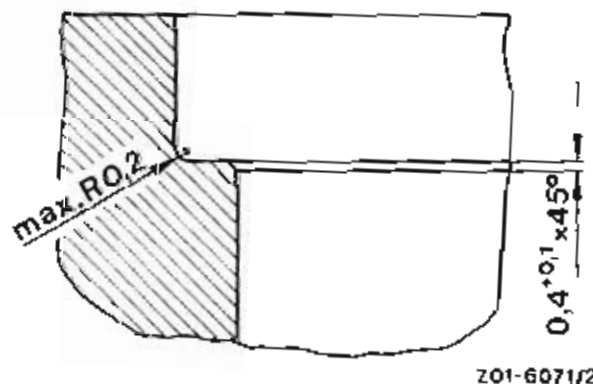
In all further operations, enlarge to a depth of 228 mm.

- Size A = $98.2^{+0.3}$ mm
- Size B = 250^{-1} mm
- Size C = 228 mm
- Size h1 = from centre main bearing bore to parting face cylinder head



5 Adjust the appropriate drilling tool (90° cutting angle) for the bush collar to the specified diameter and drill bush collar seat to the specified depth.

6 Deburr cylinder crankcase at the chamfer.



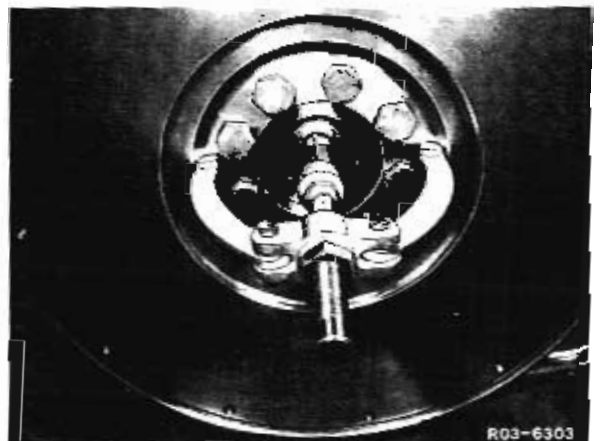
Special tools



Renewal

- 1 Removing guide bearing with special tool.

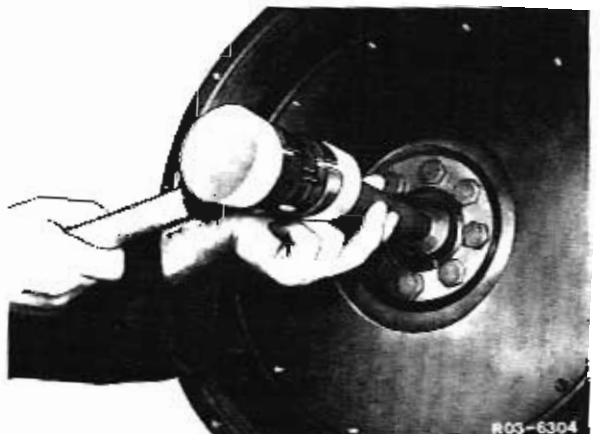
Internal extractor 000 589 26 33 00
Countersupport 000 589 33 33 00



- 2 Fit new ball bearing to flywheel and knock in with drift.

- 3 Knock in closing ring with drift.

Drift 395 589 02 15 00





Tightening torques in Nm

	No. 19	100
Flywheel mount	No. 22 Initial torque	30 – 40
	Final torque	90° – 110° torquing angle
No. 22 re-usable up to max. shank length of		263

Removal

Note: Mark installation position of flywheel relative to crankshaft.

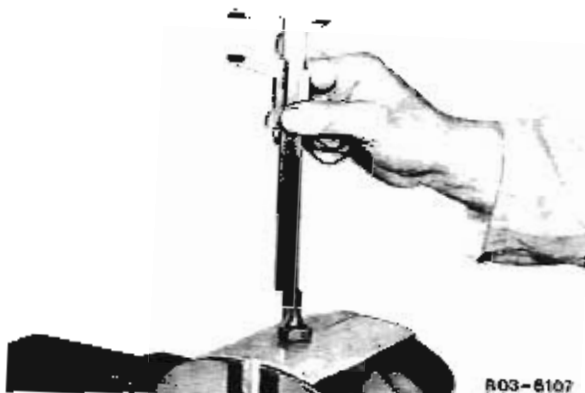
- 1 Unscrew fastening bolts from flywheel.
- 2 Detach flywheel from crankshaft flange by light blows with a plastic hammer and take out flywheel from below.
- 3 Clean flywheel and check for signs of damage.



R03-6305

Installation

- 1 Check elongation of fastening bolts.
- Note:** Antifatigue bolts may only be re-used until they have reached their maximum length.
- 2 Fit flywheel to crankshaft flange and note marking.

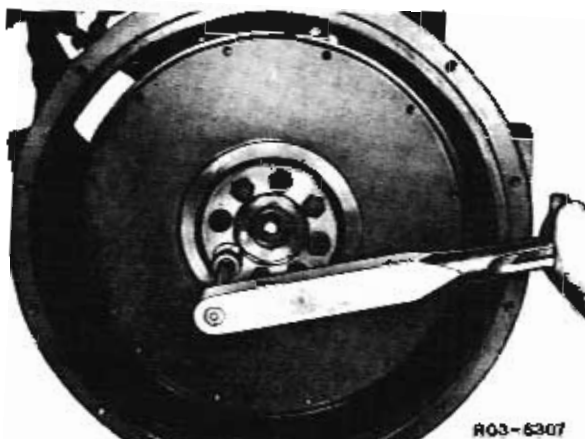


R03-6107

- 3 Oil the thread and contact face of all fastening bolts, screw in and tighten until they make contact.
- 4 Torque fastening bolts crosswise to 30 to 40 Nm with torque wrench. Then torque bolts further crosswise with 90° to 110° torquing angle.

Note: The No. 19 fastening bolts are tightened to 100 Nm.

- 5 Measure horizontal and lateral runout of flywheel.



R03-6307



Flywheel removed

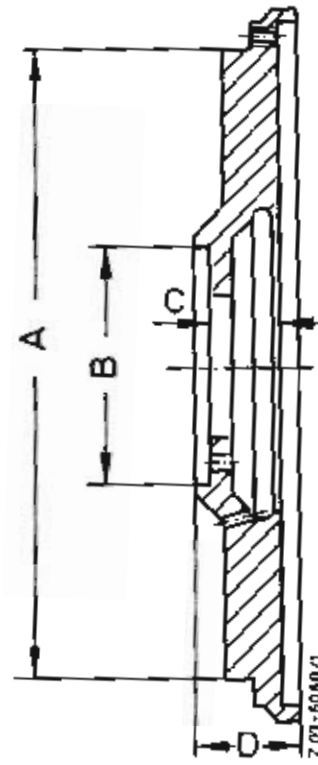
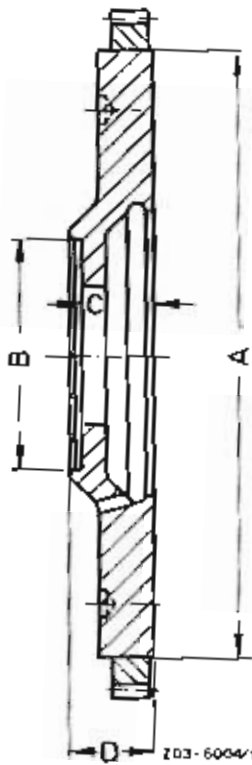
Data

Engine model	352 913 946 949 950	353 909 ¹⁾ 910 ¹⁾ 911 ¹⁾ 912 ¹⁾ 913 ¹⁾ 914 ¹⁾ 951 ¹⁾ 953 ¹⁾ 352 937 968 994	353 909 ²⁾ 910 ²⁾ 911 ²⁾ 912 ²⁾ 913 ²⁾ 914 ²⁾ 950 951 ²⁾ 952 953 ²⁾ 954 970 971 972 975 978 997	362 906 909 910
Diameter "A" for starter ring gear	<u>335,530</u> 335,390	<u>318,530</u> 318,390	<u>335,530</u> 335,390	<u>360,575</u> 360,435
Diameter "B" for mount of crankshaft flange	<u>130,040</u> 139,000	<u>130,130</u> 129,500	<u>130,040</u> 130,000	<u>130,040</u> 130,000
Min. distance "C" between clutch face and face of flange of flywheel (in repair case)	36	36	37	37
Overall width of flywheel Size "D"	46,5 (43)	46,5	51,5	51,5
OD of flywheel	<u>335,530</u> 335,390	<u>361,000</u> 360,900	375	403
Perm. non-parallelism	0,1	0,1	0,1	0,1
Perm. radial runout of flywheel-disk on diameter for starter ring gear	0,05	0,05	0,05	0,05

1) up to engine No. 020 675

2) from engine No. 020 676

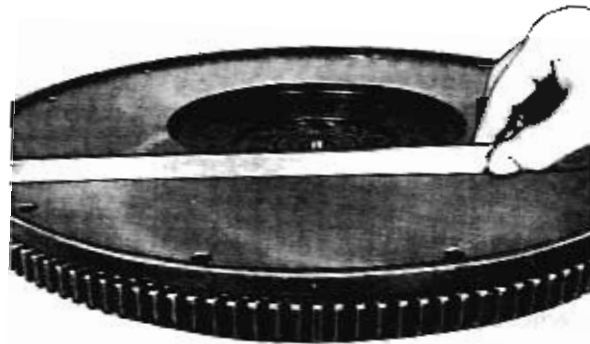
03.13 Machining flywheel



Machining flywheel

Note: After removing the clutch, clean all the parts including flywheel.

- 1 Check the flywheel for signs of cracking and scouring.
- 2 Check the flatness of the contact face with a straight-edge.
- 3 Check the meeting face and tapped holes for mounting the clutch housing.

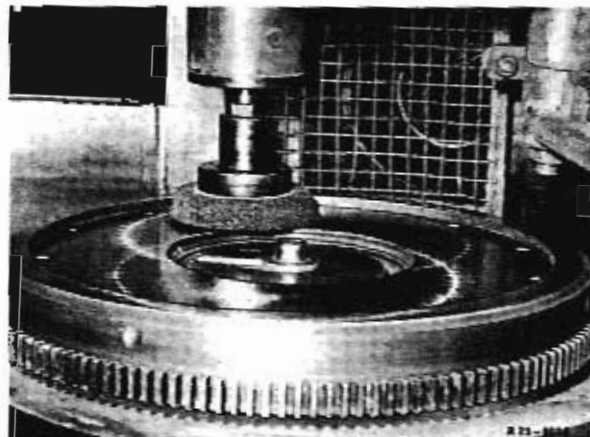


R 03-6222

- 4 If the flywheel is machined, the fastening face of the clutch should be machined by the same amount to maintain the distance between fastening face of clutch and contact face of flywheel.

The permissible stock removal must not be exceeded in so doing.

- 5 The peak-to-valley height of the friction face is 15 μm . Excess of peak-to-valley height increases the wear of the clutch lining while inadequate peak-to-valley height results in separating difficulties with the clutch.



R 03-6222

Flywheel removed

Data

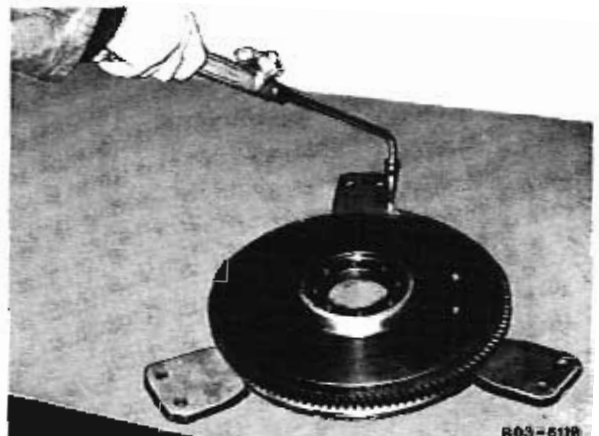
Engine model	352 913 946 949 950	353 909 ¹⁾ 910 ¹⁾ 911 ¹⁾ 912 ¹⁾ 913 ¹⁾ 914 ¹⁾ 951 ¹⁾ 953 ¹⁾ 352 937 968 994	352 950 952 954 970 971 972 975 978 997	353 909 ²⁾ 910 ²⁾ 911 ²⁾ 912 ²⁾ 913 ²⁾ 914 ²⁾ 951 ²⁾ 953 ²⁾	362 906 909 910
Diameter for mounting ring gear	<u>335,530</u> 335,390	<u>318,530</u> 318,390	<u>335,530</u> 335,390		<u>360,575</u> 360,435
ID of ring gear	<u>335,140</u> 335,000	<u>318,140</u> 318,000	<u>334,830</u> 334,690		<u>359,830</u> 359,690
Overlap of ring gear	0,25 - 0,53	0,25 - 0,53	0,56 - 0,84		0,605 - 0,885
Perm. lateral runout of fitted starter ring gear	0,5	0,5	0,5		0,5
Starter ring gear fitted at a temperature of	250 - 280° C	250 - 280° C	250 - 280° C		250 - 280° C

¹⁾ up to engine No. 020 675

²⁾ from engine No. 020 676

Renewal

1 Rapidly heat starter ring gear with welding torch and force off.



R03-6118

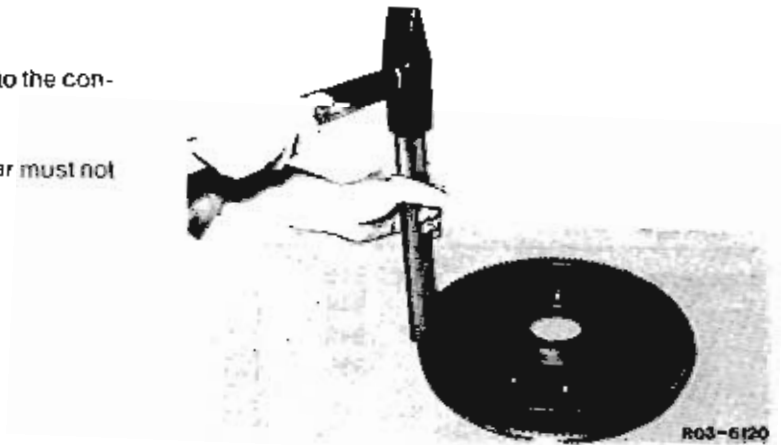
03.13 Replacing starter ring gear

2 Heat new ring gear and force on.

Note: The ring gear must be forced on up to the contact face of the flywheel.

The max lateral runout of the fitted ring gear must not be exceeded.

3 Grease ring gear prior to use.

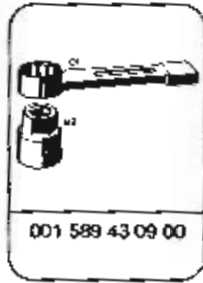


Tightening torques in Nm

Vibration damper at crankshaft

500 - 550

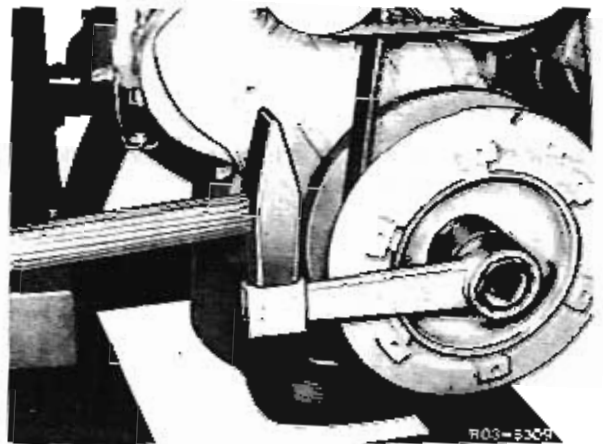
Special tools



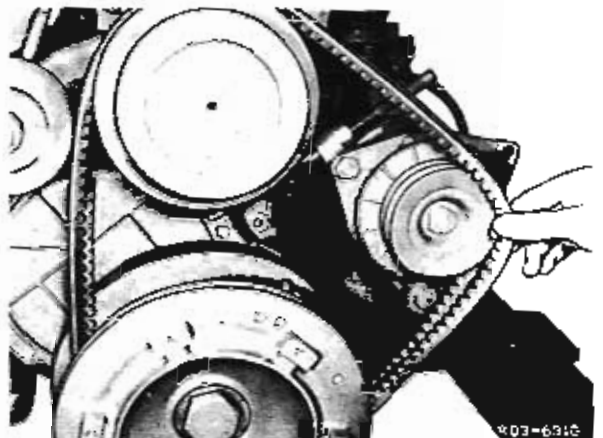
Removal

- 1 Remove fan.
- 2 Slacken central bolt from crankshaft with special tool, unscrew bolt.

Box slugging wrench 001 589 43 09 00



- 3 Take off V-belt.

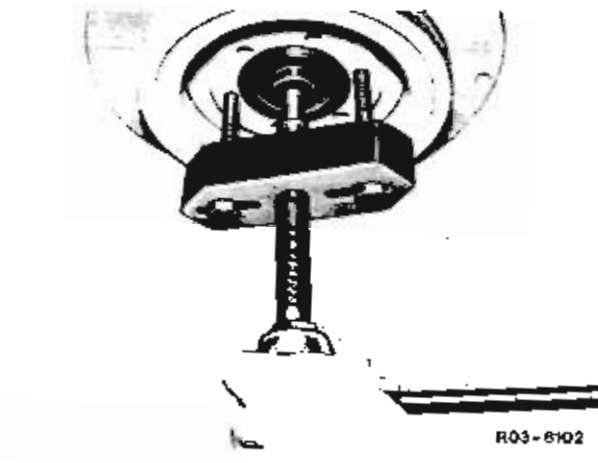


03.13 Removing and fitting vibration damper

4 Pull vibration damper off crankshaft with special tool. 352 A

Note: If a pto is installed to the front, the vibration damper is detached by a blow with a plastic hammer to the hub of the belt pulley. No puller is required in this case.

Puller 355 589 00 33 00
Thrust piece 321 589 00 63 00



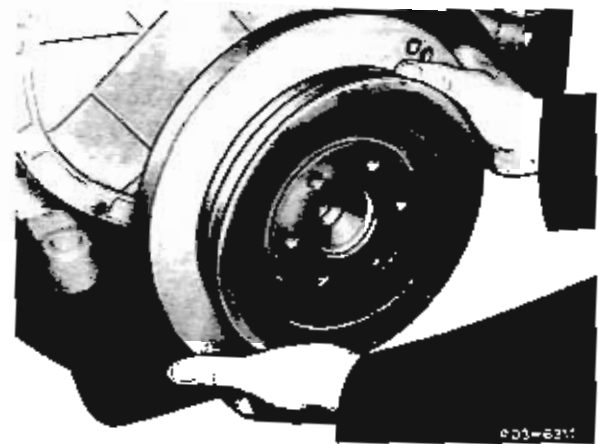
5 If pto fitted to the front, take clamping elements off crankshaft (352 A).

Fitting

1 Fit vibration damper to crankshaft.

Note: Ensure that the Woodruff key meshes into the slot of the vibration damper.

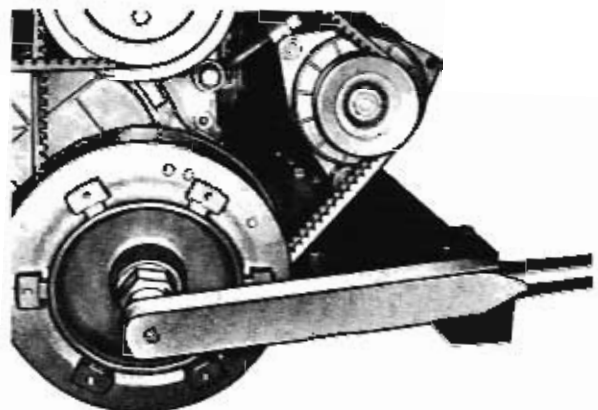
2 Fit V-belt.



3 Screw central bolt into crankshaft and torque with 500 to 550 Nm with special tool and torque wrench.

Note: Do not tighten central bolt with impact wrench.

4 Fit fan.



Box slugging wrench 001 589 43 09 00

R03-6312

Sealing crankshaft at rear 03.13

Crankshaft removed

OM 352 A (up to engine No. 470 359)
with the exception of exchange engines

Data

End play of crankshaft	0.19 - 0.29
Radial play of crankshaft	0.042 - 0.108

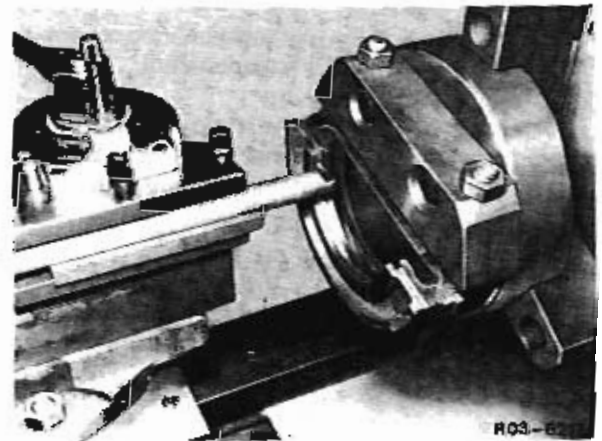
Special tools



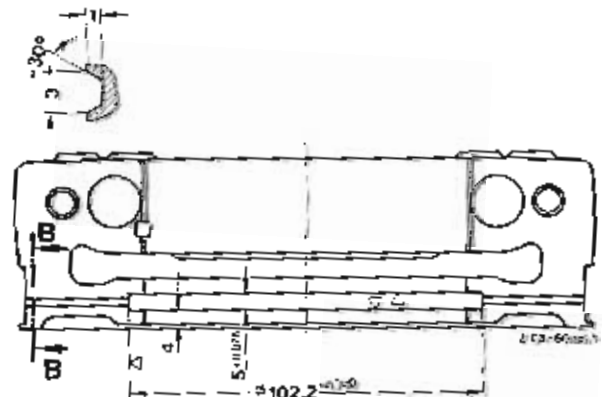
Sealing

- 1 Remove oil pan.
- 2 Remove rear bearing cover.
- 3 Clamp rear bearing cover in lathe with special tool.

Clamping device 352 589 12 63 00



- 4 Turn groove (5 mm wide) in bearing cover as specified in drawing.



03.13 Sealing crankshaft at rear

5 Clamp machined bearing cover in a vice and create a 2 mm wide and 1 mm deep slot with a hacksaw on the parting face. Following this, chamfer the edges of the slot to 3 mm width.

1 slot



R03-6196

6 Insert a fabric seal into the slot and force in with the handle of a hammer.

7 Cut off fabric seal approximately 0.5 to 0.7 mm over the parting faces of the bearing cover.

No fabric fibres may project into the parting faces.

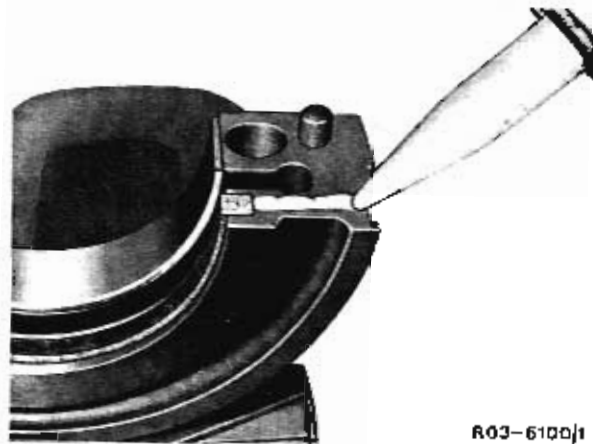
8 Coat fabric seal with hot bearing grease as specified in DBL 6801.10.



R03-6129

9 Coat the slots in the rear main bearing cover with the sealing compound Dirkotransparent.

Note: The parting faces of the fabric ring must not be coated with sealing compound. The faces to be coated with sealing compound must be free of grease.



R03-6100j1

Sealing crankshaft at rear 03.13

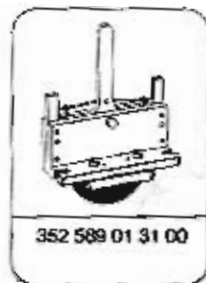
Crankshaft removed

OM 352 A (from engine end No. 470 360)
OM 362 LA (from start of prod.)

Data

End play of crankshaft	0.19 - 0.29
Radial play of crankshaft	0.042 - 0.108

Special tools



Sealing crankshaft

1 Take fabric seal and locking pin out of the cylinder crankcase and the bearing cover.



2 Thoroughly clean the seat for sealing ring in the crankcase and bearing cover.

3 Insert the locking pin in the cylinder crankcase and in the bearing cover with an aluminium drift.

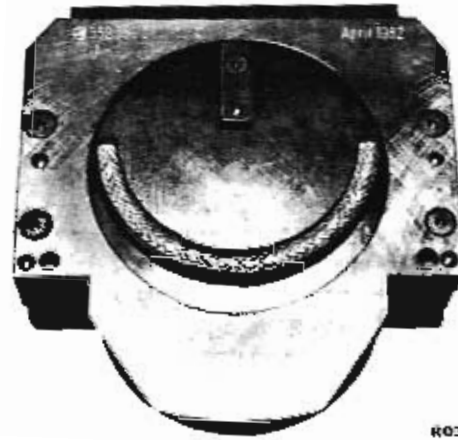
Note: The tip of the locking pin must not be damaged.



03.13 Sealing crankshaft at rear

4 Insert the fabric seal in the special tool.

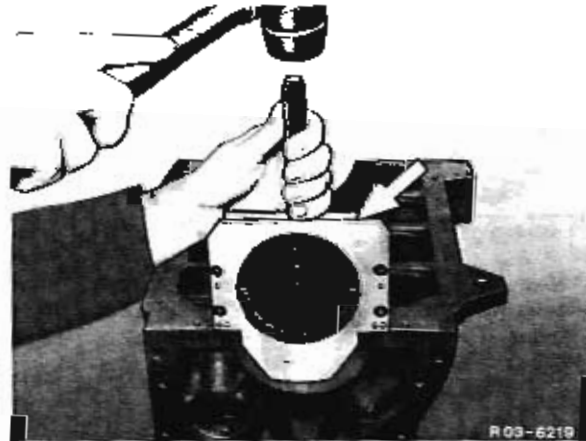
Note: The fabric seal must be inserted exactly in the special tool. Both ends of the fabric seal must rest against the special tool.



Fixing plate 352 589 01 31 00

R03-6314

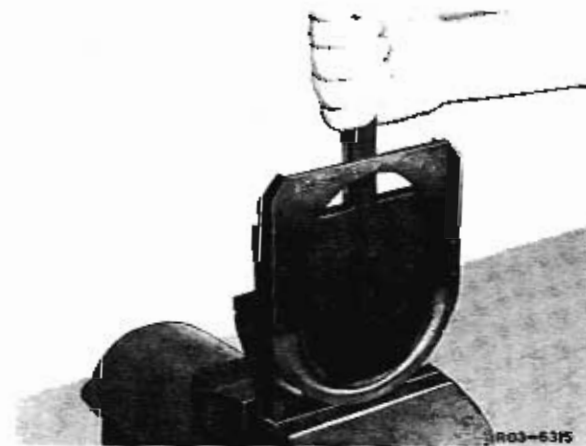
5 Place the special tool with fabric ring on the crankcase and knock in seal.



Fixing plate 352 589 01 31 00

6 Insert the fabric seal with special tool in the bearing cover and knock in.

Note: No fabric fibres may project into the parting face.



Fixing plate 352 589 01 31 00

7 Coat fabric seal in housing and in the bearing cover with hot bearing grease as specified in DBL 6801.10.

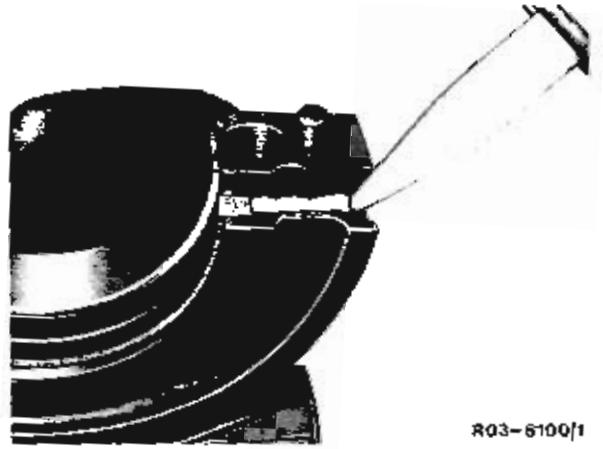


R03-6320

Sealing crankshaft at rear 03.13

8 Coat the slots in the rear main bearing cover with Dirkotransparent. The parting faces of the sealing rings must not be coated with sealing compound.

Note: The parting face of engines without slots in the rear bearing cover should be coated with the sealing compound between housing and bearing cover. The areas to be coated with the sealing compound must be free of grease.



R03-6100/1



Removing and installing pistons 03.13

Cylinder head and oil pan removed

Data

352 A without liners

Rep. stages	Piston designation			Compression height (of pistons)	ID of cyl. wall	Height of cylinder crankcase (from centre main bearing bore to parting face cylinder head)
	previous	transition phase	new			
Standard	96.89	96,0 BA 09	97,0 BA		96,990 97,010	
	96.90	n.a.	n.a.			
	96.91	97,0 BC 01	97,0 BC			
Standard I	96.97	97,075 BA 09	97,075 BA	65,20	97,065 97,085	359,00
	96.98	n.a.	n.a.	65,25		359,10
	96.99	97,075 BC 01	97,075 BC			
Standard II	97.02	97,125 BA 09	97,125 BA		97,115 97,135	
	97.03	n.a.	n.a.			
	97.04	97,125 BC 01	97,125 BC			
Rep. St I	97.39	97,5 BA 09 - 0,3	97,5 BA - 0,3	64,90	97,490 97,510	358,70
	97.40	n.a.	n.a.	64,95		358,80
	97.41	97,5 BC 01 - 0,3	97,5 BC - 0,3			

352 A with liners 362 LA

Rep. stages	Piston designation			Compression height (of pistons)	ID of cyl. liner	Height of cylinder crankcase (from centre main bearing bore to parting face cylinder head)
	previous	transition phase	new			
Standard	96.89	97,0 BA 09	97,0 BA	65,20	96,990 97,010	359,00
	96.90	n.a.	n.a.	65,25		359,10
	96.91	97,0 BC 01	97,0 BC			
Rep. St I	-	97,0 BA 09 - 0,3	97,0 BA - 0,3	64,90		358,70
	-	n.a.	n.a.	64,95		358,80
	-	97,0 BC 01 - 0,3	97,0 BC - 0,3			
Rep. St II	-	97,0 BA 09 - 0,6	97,0 BA - 0,6	64,60		358,40
	-	n.a.	n.a.	64,65		358,50
	-	97,0 BC 01 - 0,6	97,0 BC - 0,6			
Rep. St III	-	97,0 BA 09 - 0,9	97,0 BA - 0,9	64,30		358,10
	-	n.a.	n.a.	64,35		358,20
	-	97,0 BC 01 - 0,9	97,0 BC - 0,9			

03.13 Removing and installing pistons

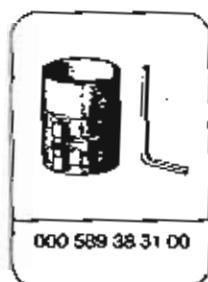
Permissible difference in weight of connecting rod within engine		max. 40 g
Connecting rod bearing radial		0,041 – 0,100
Connecting rod bearing axial		0,100 – 0,400
Piston clearance from upper edge of crank case	Piston may stand back up to –	0,08
	Piston may project up to +	0,30
Perm. wear of piston wall in travelling or transverse direction at upper reversal point of 1 st piston ring compared to thoroughly cleaned top land zone		0,12

Note: When remachined to the next repair stage, always drill 250 mm deep.

Tightening torques in Nm

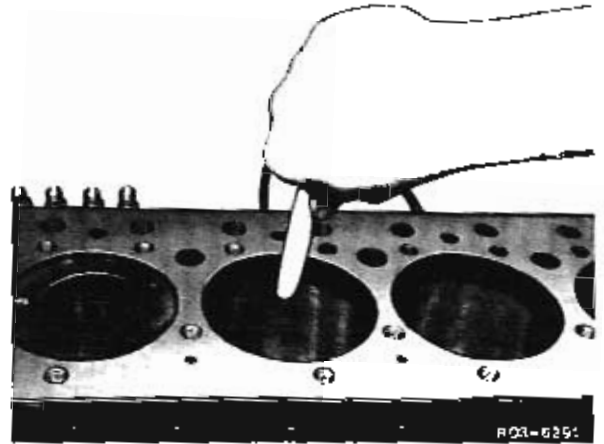
Connecting rod bolts (Conn. rod with serrated parting face)	M 12	Initial torque 40 – 50 Final torque 90° – 100° torquing angle	
Connecting rod bolts	M 14 M 15	Initial torque 100 – 110 Final torque 90° – 110° torquing angle	
Blind hole bolt	M 12	Re-usable up to max. shank length	56,8 mm
Bolt with nut	M 14	Re-usable up to max. shank length	82,5 mm
Blind hole bolt	M 15	Re-usable up to max. shank length	61,5 mm

Special tools

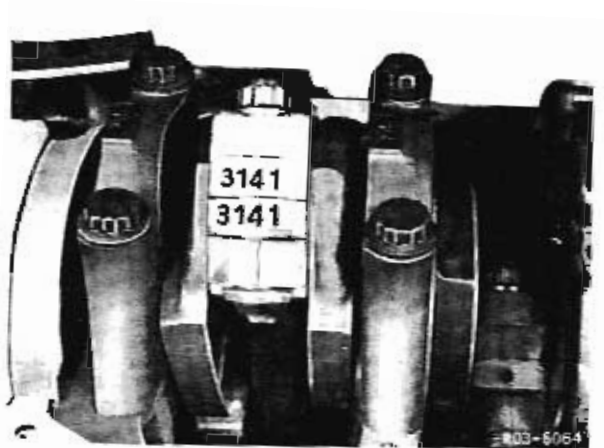


Removal

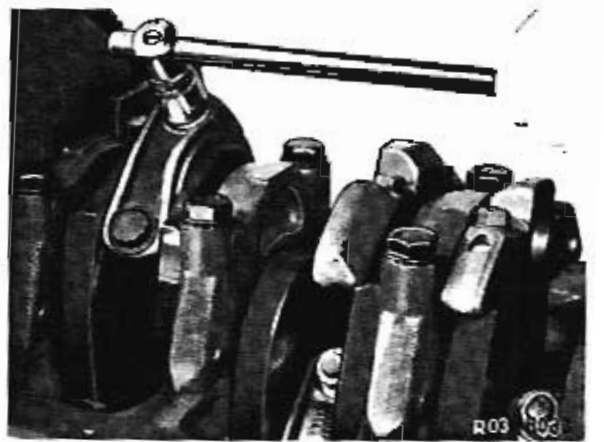
1 Carefully remove combustion residues above top land height in cylinder liner with a scraper to avoid any damage to the piston rings.



2 Ensure that the related bearing cover and connecting rod are marked.

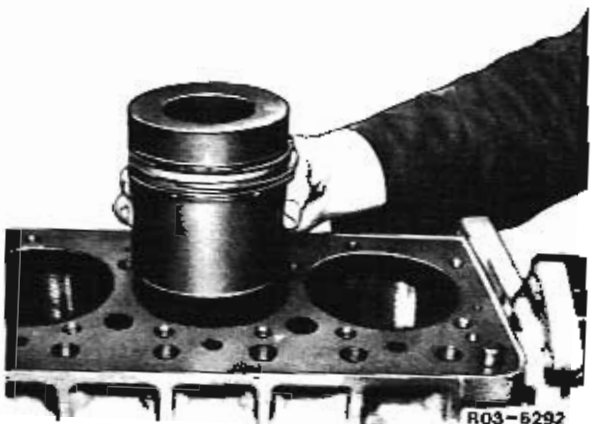


3 Unscrew connecting rod bearing cover from connecting rod and remove.



4 Press out connecting rod with piston from below.

5 Lift out piston from cylinder crank case.



03.13 Removing and installing pistons

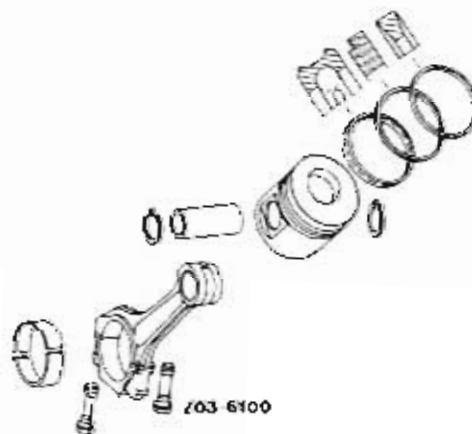
4 Clamp connecting rod with piston in vice (use soft jaws). Take out piston pin circlip, force out piston pin and take piston off connecting rod.



Installing

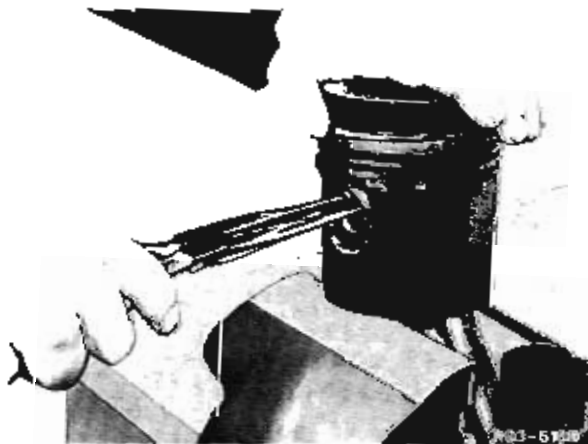
Note 1: If pistons are installed with slight compression height, the cylinder crank case (parting face) must be remachined by the difference of the compression height of the pistons.

Note 2: The top piston ring must always be replaced.

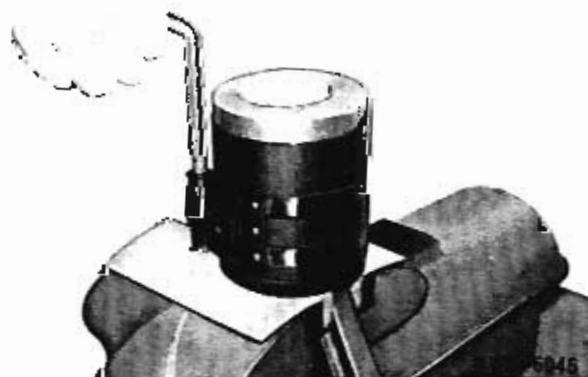


1 Insert connecting rod into the piston so that the longer side of the connecting rod split at an angle is pointing to the right (injection pump) and the arrow on the piston top is pointing forward in the direction of travel.

2 Insert piston pin and secure with circlips.

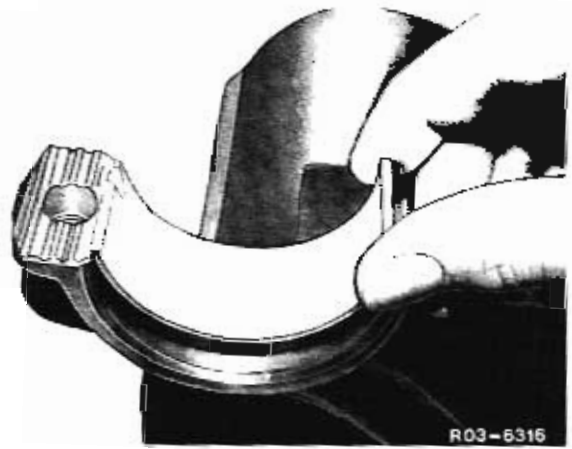


3 Oil piston with engine oil. Offset piston ring joints in turn by 180°. Slip special tool loosely over piston rings and compress to outer diameter of piston so that the sleeves can still just be moved.



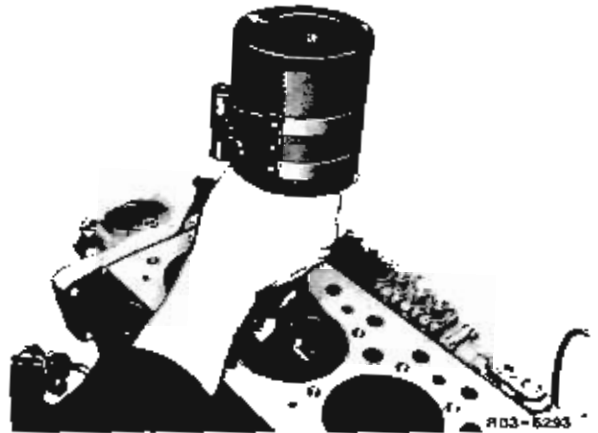
4 Insert piston rod bearing shell in piston rod. Ensure that the lug is located in the slot of the connecting rod. Coat running face with oil.

Note: From engine end No. 761 459 connecting rods are installed with serrated parting faces. Both connecting rod versions may not be installed within one engine.

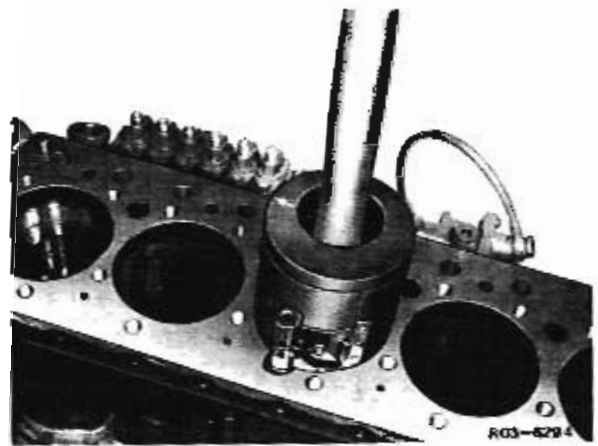


5 Insert piston with connecting rod into cylinder crank case.

Note: The arrow on the piston top must point in the direction of travel and the longer side of the connecting rod split at an angle point toward the injection pump end.



6 Force piston in further until the connecting rod bearing rests against the connecting rod journal of the crankshaft.



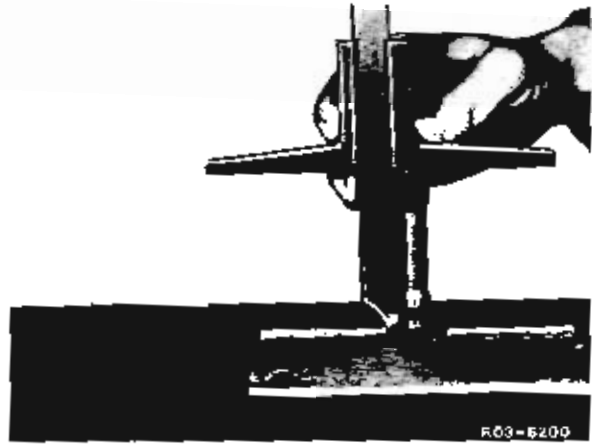
Clamping strap 000 589 38 31 00

7 Insert connecting rod bearing shell in connecting rod bearing, ensuring that the lug is located in the slot of the connecting rod bearing cover. Coat the running face of the connecting rod bearing shell with oil.



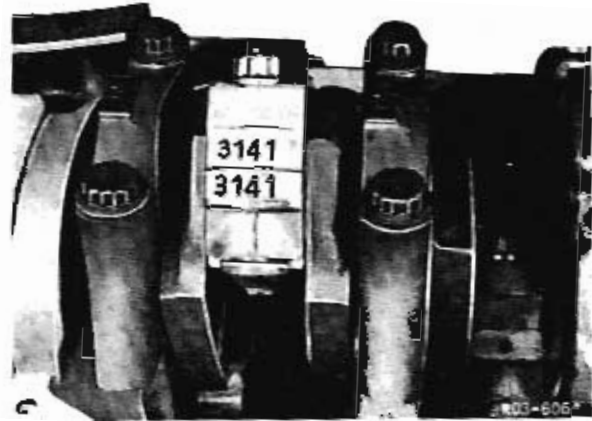
03.13 Removing and installing pistons

8 Measure length of shank of connecting rod bolts.

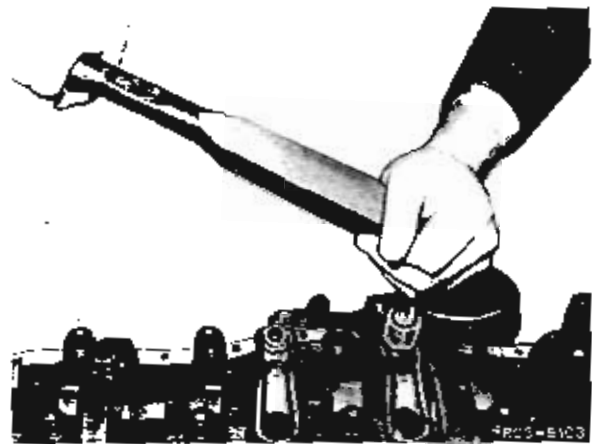


9 Fit the bearing cover to the connecting rod and screw in connecting rod bolts by hand.

10 Ensure that the marking of the bearing cover agrees with the connecting rod.



11 Tighten the bolts alternately in two stages with torque wrench.



12 Tighten fastening bolts to specified torquing angle (final torque).



Piston removed

5-ring piston

piston ring designation groove	angular groove width	vertical play	gap play	
			new	max. in rep. case
I double trapezoidal ring	-	0,044 - 0,080	0,35 - 0,55	1,20
II weak tapered piston ring	$3^{+0,060}$ $+0,045$	0,055 - 0,082	0,35 - 0,55	0,90
III weak tapered piston ring	$3^{+0,60}$ $+0,45$	0,055 - 0,082	0,35 - 0,55	0,90
IV narrow-land oil-control ring	$5,5^{+0,040}$ $+0,025$	0,35 - 0,062	0,25 - 0,40	0,90
V narrow slotted ring	$5,5^{+0,030}$ $+0,015$	0,025 - 0,052	0,25 - 0,40	0,80

3-ring piston

I T-ring	-	0,047 - 0,102	0,20 - 0,35	1,20
II M-ring	$2,5^{+0,050}$ $+0,070$	0,060 - 0,095	0,20 - 0,35	0,90
III D-ring with coil spring	$4^{+0,040}$ $+0,020$	0,030 - 0,065	0,25 - 0,40	0,80

Special tools

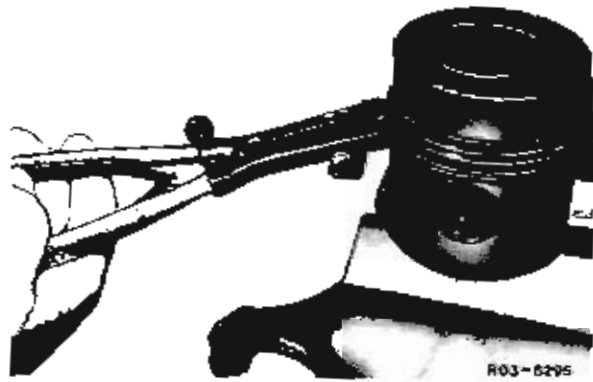


03.13 Replacing piston rings

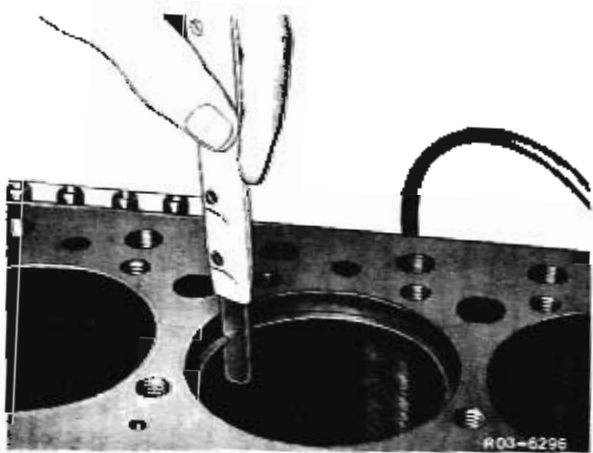
Replacing

- 1 Set piston ring pliers to approx. 98 mm dia. with adjusting screw.
- 2 The piston rings can be removed and installed with this setting.

Piston ring pliers 000 539 37 37 00



- 3 Check piston ring gap play in unworn area of cylinder liner or cylinder wall.



Data

Connecting rod bearing shells

Repair stage	Connecting rod bearings		
	Dia. of connecting rod bearing journals	Bearing bores when installed	Wall thickness for bearing shells ready for installation
Standard	60,015	60,095	2,462 – 2,472
	59,990	60,056	
Rep. Stage I	59,765	59,845	2,587 – 2,597
	59,740	59,806	
Rep. Stage II	59,515	59,595	2,712 – 2,722
	59,490	59,556	
Rep. Stage III	59,265	59,345	2,837 – 2,847
	59,240	59,306	
Rep. Stage IV	59,015	59,095	2,962 – 2,972
	58,990	59,056	
Radial play of crankshaft main bearing journals			0,042 – 0,108
End play of crankshaft (fit bearing)			0,190 – 0,290

Connecting rod

Basic bore in the connecting rod	65,019	
	65,000	
Perm. conicity of basic bore for connecting rod bush	0,005	
Overlap of connecting rod bearing shells	0,04 – 0,07	
Radial play of connecting rod bearing journals	0,041 – 0,100	
End play of connecting rod bearing journals	0,100 – 0,400	
Perm. deviation of axial parallelism of connecting rods	0,01	
Parallelism of bearing surfaces	0,017	
Distance from centre crankshaft - to centre piston pin bore	230,05	
	230,00	
Perm. difference in weight of connecting rods within an engine	40 g	
Width of connecting rod at	Connecting rod eye	37,830
		37,730
	Piston pin eye	35,6
		35,5

03.13 Mounting connecting rod

	Standard	<u>39,025</u> 39,000
Basic bore for connecting rod bush	Rep. Stage I	<u>39,225</u> 39,200
	Rep. Stage	<u>39,525</u> 39,500

Connecting rod bush

	Standard	<u>39,075</u> 39,035
OD of connecting rod bush	Rep. Stage I	<u>39,275</u> 39,235
	Rep. Stage II	<u>39,575</u> 39,535
Overlap of connecting rod bush in connecting rod		0,010 – 0,075
ID of connecting rod bush		<u>36,040</u> 36,030

Tightening torques in Nm

Connecting rod bolts (connecting rod with serrated parting face)	M 12	Initial torque 40 – 50 Final torque 90° – 110° torquing angle	
Connecting rod bolts	M 14 M 15	Initial torque 100 – 110 Final torque 90° – 110° torquing angle	
Connecting rod bolt	M 12	Re-usable up to max. shank length	56,8 mm
Bolt with nut	M 14	Re-usable up to max. shank length	82,5 mm
Blind hole bolt	M 15	Re-usable up to max. shank length	61,5 mm

Special tools



Mounting connecting rod

Note: The bearing shells for the connecting rod bearings, irrespective of the repair stage, are supplied ready for installation ex Works. No reworking of any type may be performed on the bearings.

1 Clean bearing points in the connecting rod and bearing cover with chamois leather.

2 Insert the bearing shell halves in the connecting rods and bearing covers in the correct order, ensuring that the locking lugs of the bearing shells are located properly in the slots of the basic bore.

3 Fit bearing cover with bearing shell to connecting rod, paying attention to the marking of the related gearings (numbers must be on one side).

4 Tighten fastening bolts to the specified level with torque wrench and tighten further according to bolt version with $90^\circ - 110^\circ$ torquing angle.

Note: From engine end No. 761 459 connecting rods are installed with serrated parting faces.

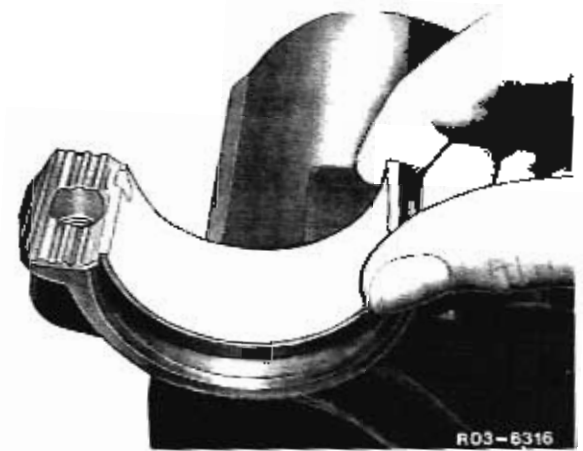
5 Set the 50 to 100 mm dia. internal measuring instrument and dial gauge with 50 to 75 mm dia. micrometer to the zero size of the connecting rod bearing bore.

Dial gauge 001 589 53 21 00

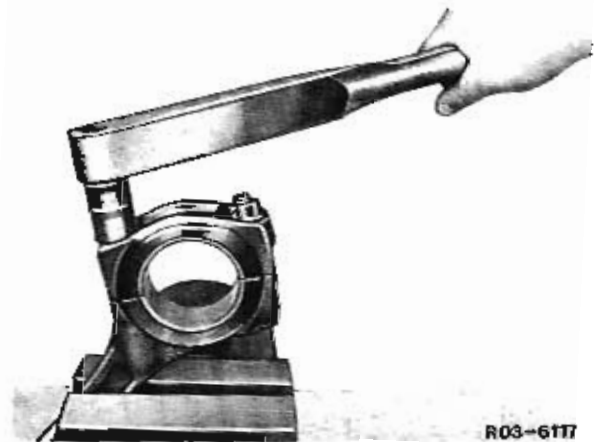
6 Measure the connecting rod bearing bore with the 50 to 100 mm dia. internal measuring instrument set (vertically and approx. 30° away from the parting points at top and bottom).

Note: The values specified in the tables must be observed.

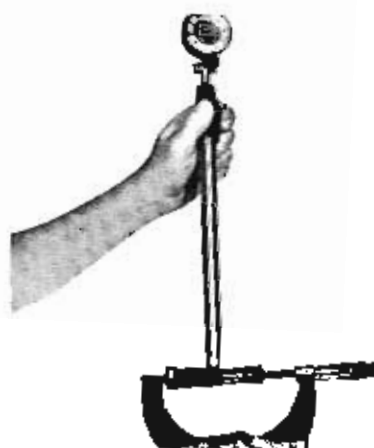
7 Re-fit bearing covers.



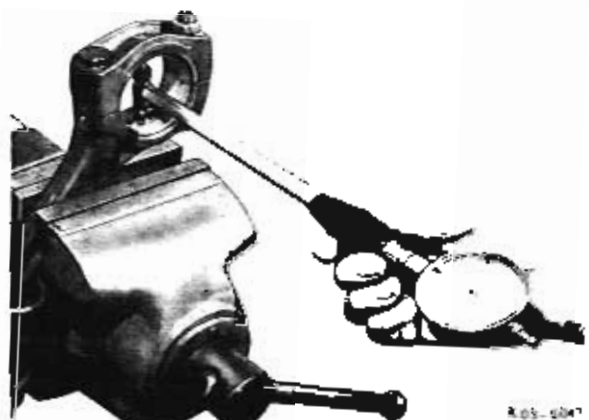
R03-6316



R03-6117



R03-6014



R03-6017

If excess oil consumption or engine failure exists, it is often unclear whether this is due to damage from dust or normal wear.

Possibilities of recognizing damage

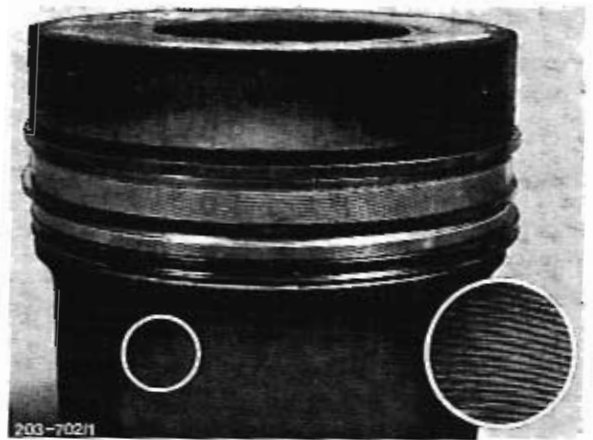
Heavy dust deposits in the bends of the intake passages at the clean-air end (between air filter and engine) is a sure indication of damage due to dust. On engines with an oil-bath air filter, a very fine coating is permissible.

The stem contact pattern of a piston and the honing pattern of a cylinder also provide indications of damage due to increased dust deposits.

Piston without dust damage

The stem contact pattern of the piston extends over a wide area and the machining grooves can be easily recognized within this area.

Note: The machining grooves around the circumference are desired depressions which fill with oil and contribute to enhanced lubrication.



Piston with dust damage

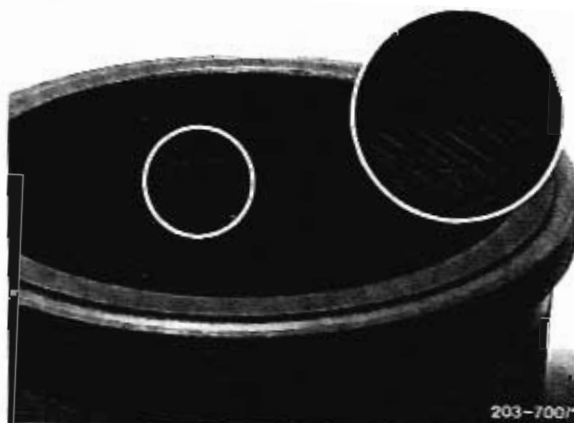
The contact pattern has a mat appearance and the machining grooves are completely worn within the contact area. In the progress of stage, light fretting scores exist on the stem and the piston rings are sharp-edged.



03.13 Recognizing damage due to dust

Cylinder liner without dust damage

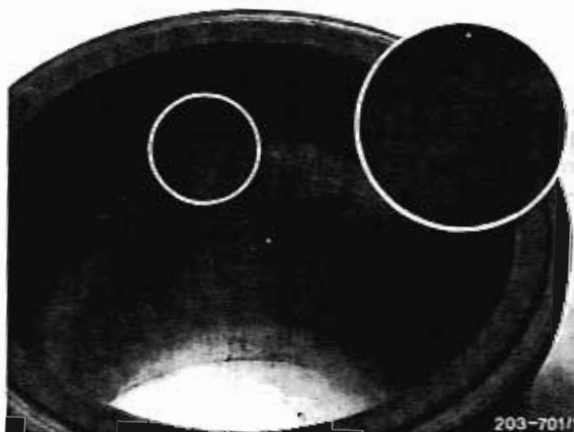
The honing is detectable over the entire area - more or less clearly, depending on the type of engine. The honing may be partially removed at the reversing point of the first piston ring.



Cylinder liner with dust damage

The machining marks due to honing are only very weakly visible or not at all.

In a progress of stage, a wear edge is detectable at the reversing point of the first piston ring.



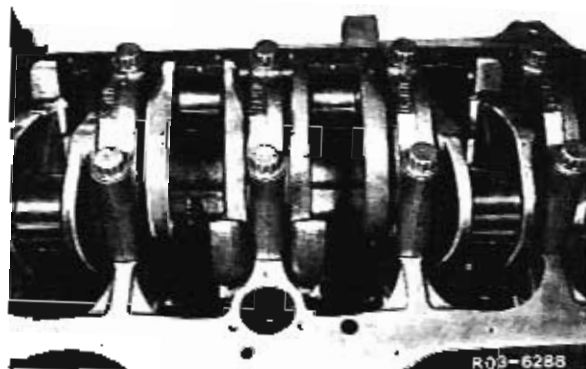
Dust damage can arise due to:

- poor seal of the intake passages at the clean and unclean air ends
- cracks or chafings in the intake hose
- increased presence of dust
- dirty oil being entrained from the oil-bath air filter (excess of quantity of oil)
- if non-approved start pilot versions are installed.

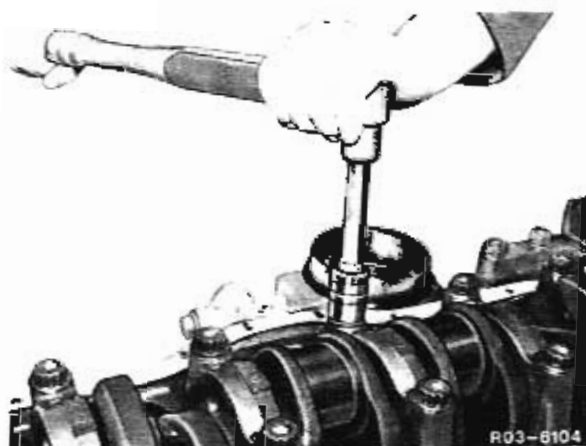
When performing maintenance work, therefore, all the intake lines and joints should be carefully checked to enable even concealed leaks or cracks to be detected.

Removing, mounting and installing crankshaft 03.13

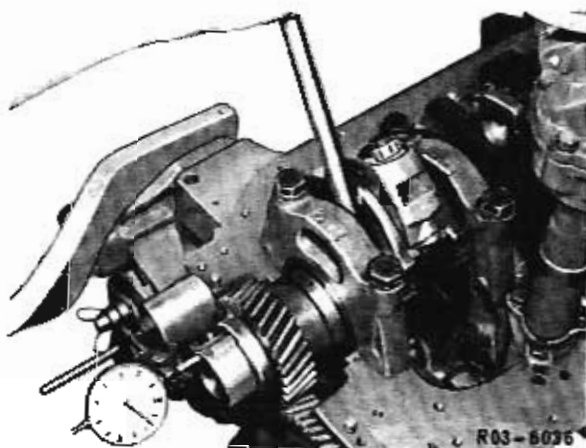
15 Fit main bearing cover with bearing shells, ensuring that marks of the related bearings are aligned.



16 Screw in the main bearing bolts and torque to the specified value with torque wrench and tighten M 15 bolts further by 90° torquing angle.

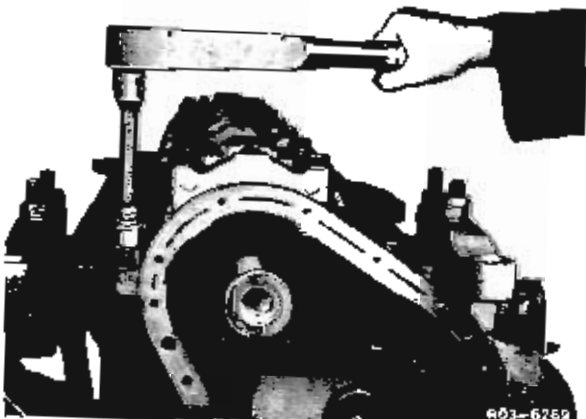


17 Fit the special tool to the cylinder crankcase and measure the end play of the crankshaft.



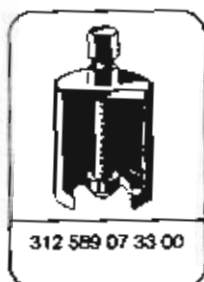
Holder 363 589 02 21 00
Dial gauge 001 589 53 21 00

18 Fit the bottom part of the timing case.



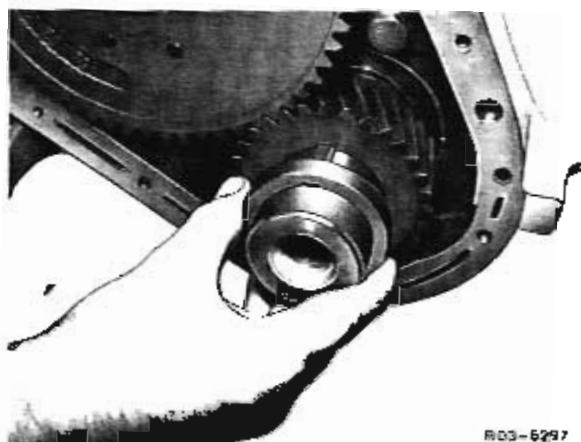
Oil pan and timing case cover removed

Special tools



Removing

- 1 Remove bearing race.
- 2 Take off bottom part of timing case.



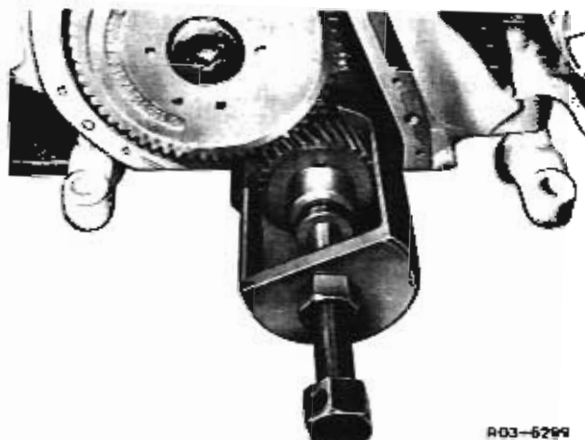
R03-5297

- 3 Remove Woodruff key with pliers.



R03-5298

- 4 Pull crankshaft gear off crankshaft with special tool.



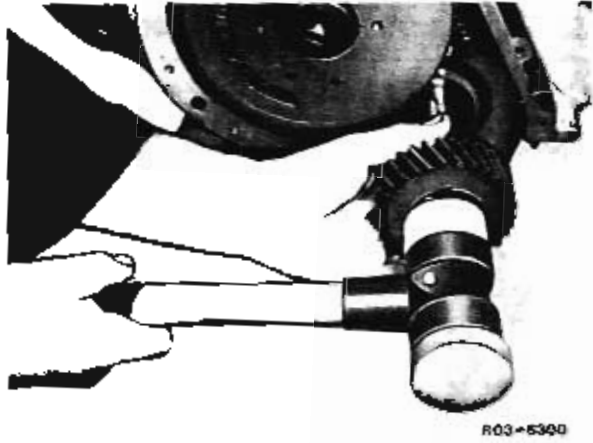
R03-5299

Puller 312 589 07 33 00

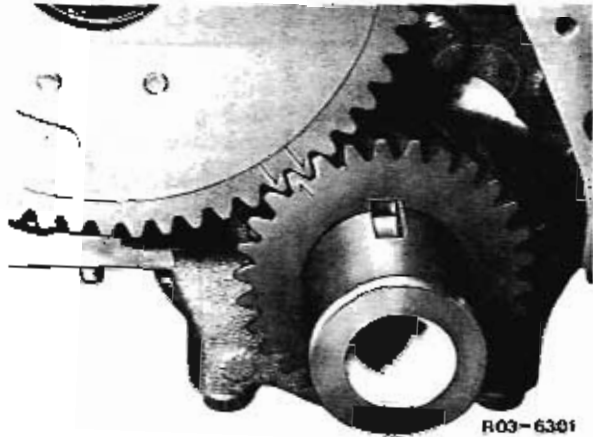
03.13 Removing and installing crankshaft gear

Installing

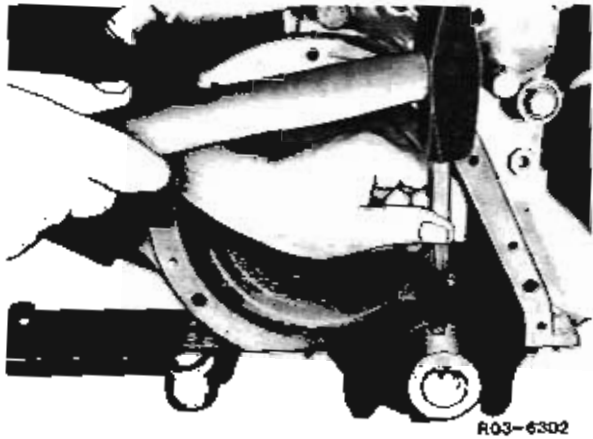
1 Fit crankshaft gear.



2 The tooth of the crankshaft gear marked with "1" must be located between the teeth of the timing device also marked with "1-1".

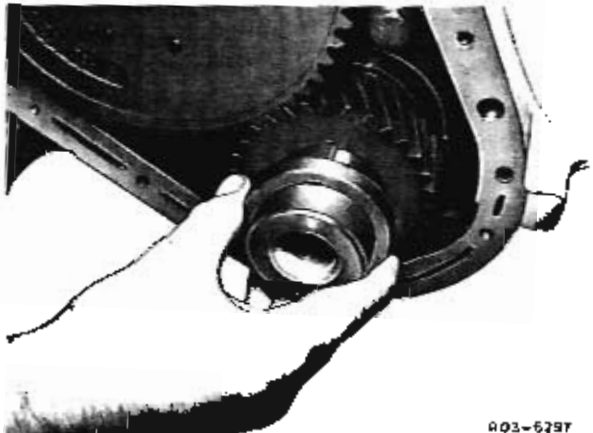


3 Insert the Woodruff key.



4 Fit the bottom part of the timing case.

5 Fit the bearing race.



Removing, mounting and installing crankshaft 03.13

Data

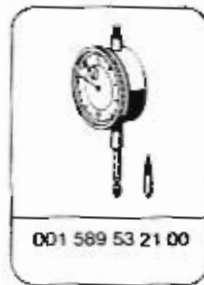
Rep. Stage	Dia. of bearing journals	Bearing bore when installed	Wall thickness for bearing shells ready for installation	Width of fit bearing
Standard	$\frac{88.010}{87.990}$	$\frac{88.098}{88.052}$	2,465 - 2,477	
Standard I	$\frac{87.910}{87.890}$	$\frac{87.998}{87.952}$	2,515 - 2,527	
Rep. Stage I	$\frac{87.760}{87.740}$	$\frac{87.848}{87.802}$	2,590 - 2,602	
Rep. Stage II	$\frac{87.510}{87.490}$	$\frac{87.598}{87.552}$	2,715 - 2,727	$\frac{31.81}{31.74}$
Rep. Stage III	$\frac{87.260}{87.240}$	$\frac{87.348}{87.302}$	2,840 - 2,852	
Rep. Stage IV	$\frac{87.010}{86.990}$	$\frac{87.098}{87.052}$	2,965 - 2,977	
Basic bore dia. for crankshaft bearings in cylinder crank case				$\frac{93.022}{93.000}$
Overlap of crankshaft bearing shell halves in basic bore				$\frac{0.080}{0.050}$
Perm. out-of-roundness of connecting rod bearing journals				0,005
Perm. conicity of connecting rod bearing journals				0,005
End play of crankshaft				0,19 - 0,29
Radial play of crankshaft				0,04 - 0,11
Hardness of crankshaft and connecting rod bearing (Rockwell hardness)				56 ± 3

Tightening torques in Nm

Main bearing bolts	up to engine end No. 000282	M 14	120
	from engine end No. 000283	M 14	140
		M 15 x 2	Initial torque 50 ± 5 Final torque 90° - 100° Torquing angle
Max. shank length of main bearing bolts			123,0

03.13 Removing, mounting and installing crankshaft

Special tools



Removing

Preliminary work:

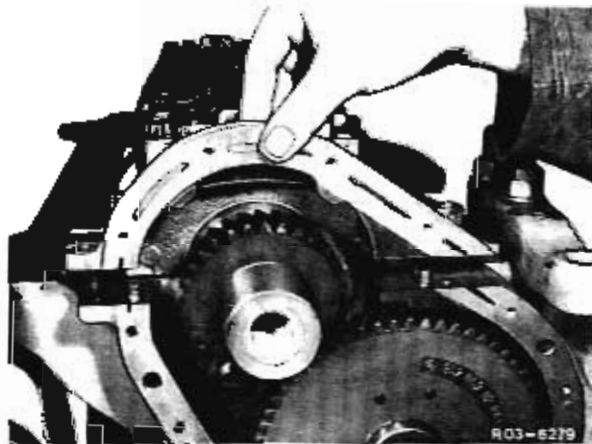
Timing case cover removed.

Flywheel removed.

Pistons removed.

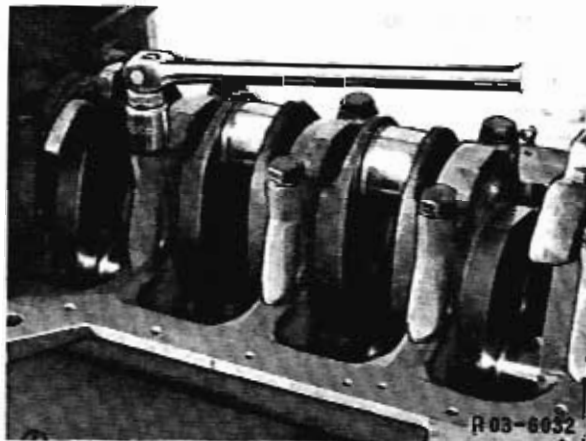
Clutch housing removed (362 LA).

- 1 Unscrew and remove bottom part of timing case.

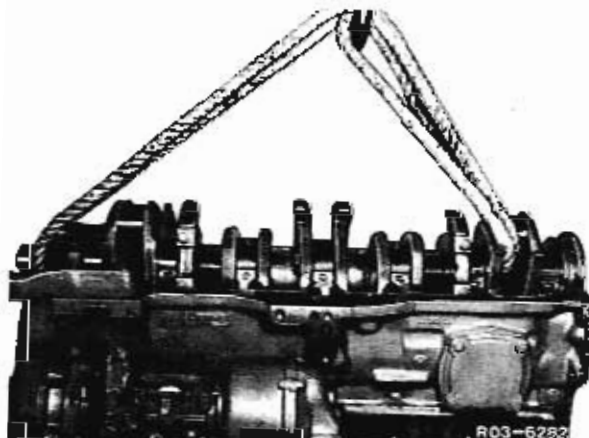


- 2 Unscrew the bolts of the crankshaft bearing covers. Detach bearing covers with a light plastic hammer and remove.

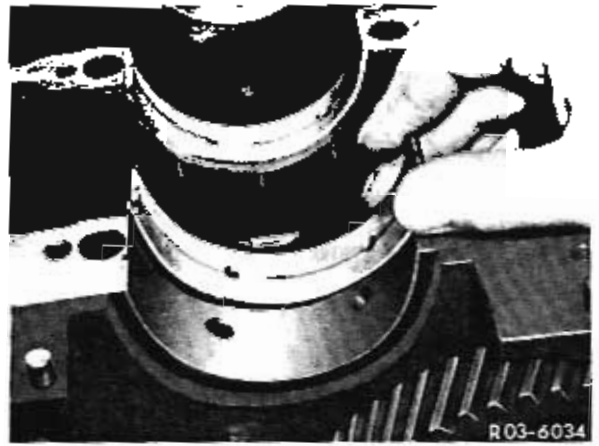
Note: To avoid any confusion, the bearing covers and bearing shells of the main bearings must be marked in the correct order.



- 3 Lift the crankshaft out of the crankcase.



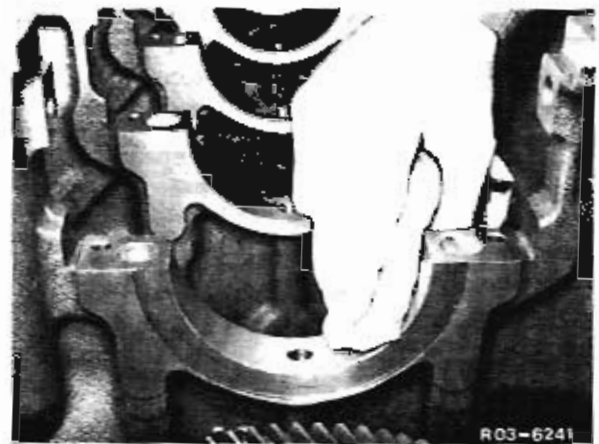
- 4 Take the bearing shell halves out of the crankcase and the bearing covers.
- 5 Check all parts for signs of damage and wear.



Mounting

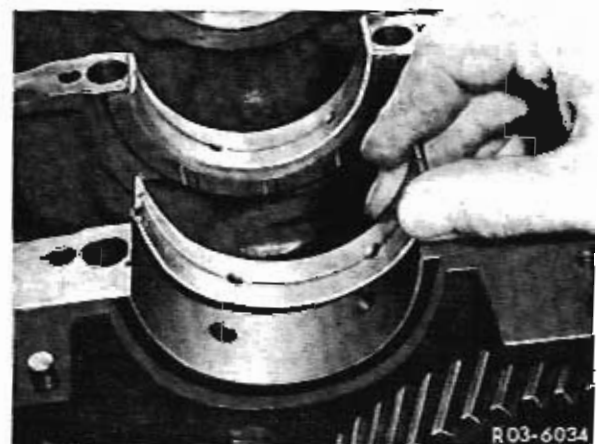
Note: The bearing shells for the crankshaft are supplied ready for installation ex Works. No reworking of any kind may be performed on the bearing shells.

- 1 Clean the bearing points in the crankcase and bearing covers with chamois leather.



- 2 Insert the bearing shell halves in the crankcase and the bearing covers in the correct order, ensuring that the locking lugs of the bearing shells are properly located in the slots and in the basic bores.

Note: The main bearing shells in the housing are provided with an oil bore and must be aligned with the lubrication bores in the housing.

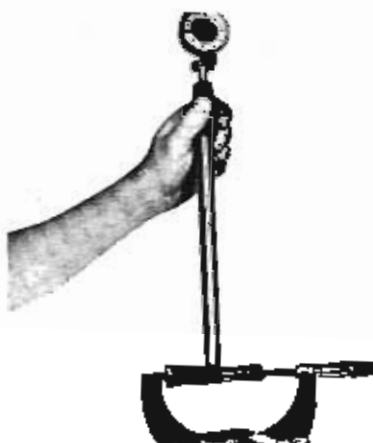


- 3 Insert the bearing covers with bearing shells in the crankcase, ensuring that the marking of the related bearings agrees.

- 4 Screw in main bearing bolts and torque to the specified value with torque wrench according to the engine number or the size of the main bearing bolts and torque the M 15 bolts further by 90° torquing angle.

- 5 Fit the dial gauge to the internal measuring instrument. Set the 50 to 100 mm dia. internal measuring instrument with the 75 to 100 mm dia. micrometer to the zero size of the main bearing bore.

Dial gauge 001 589 53 21 00



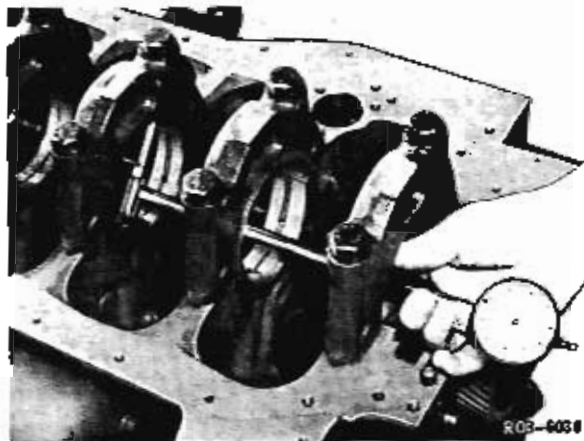
R03-5114

03.13 Removing, mounting and installing crankshaft

6 Measure the main bearing bore with the 50 – 100 mm dia. internal measuring instrument set at 3 points (vertically and approx. 30° to the top and bottom from the parting points).

Note: The values specified in the table must be observed.

7 Remove bearing covers again.



Mounting and installing

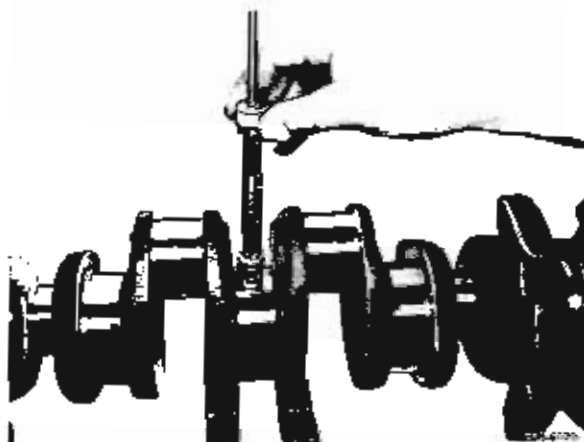
1 Blow out the oil passages of the crankcase with compressed air from the oil pump end.

2 Clean the oil passages of the crankshaft with a wire brush blow out with compressed air. Clean crankshaft bearing journals, bearing shell halves and bearing seats with chamois leather.

3 Check the hardness of the crankshaft and connecting rod bearing journals with special tool.

Note: A conversion table is enclosed with the drop hardness tester.

Drop hardness tester 000 589 20 21 00

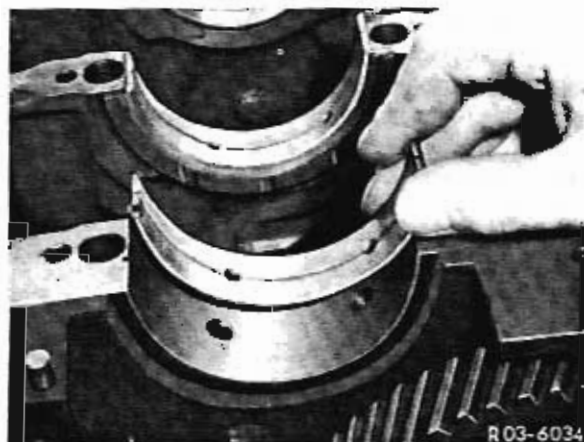


4 Insert the bearing shell halves in the crankcase and in the bearing covers in the correct order, ensuring that the locking lugs of the bearing shells are properly located in the slots and in the basic bores. The lubrication holes in the top main bearing shells must be aligned with the holes in the housing.

Note: Job No. 5 to 11

352 A from engine end No. 470 360

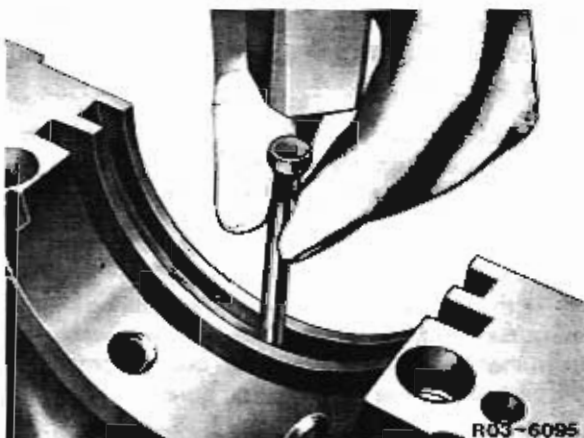
362 LA from start of production



5 Thoroughly clean the seat for seating ring in crankcase and bearing cover.

6 Insert the locking pin in the cylinder crankcase and in the bearing cover with an aluminium drift.

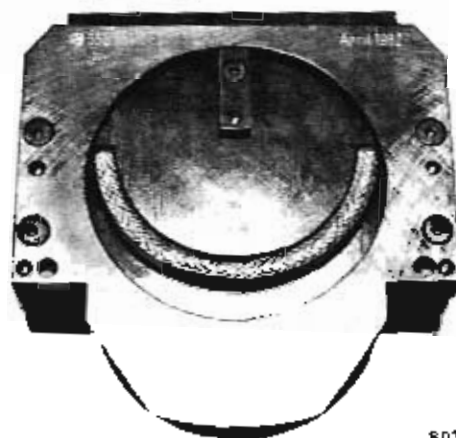
Note: Tip of the locking pin must not be damaged.



Removing, mounting and installing crankshaft 03.13

7 Insert the fabric seal in special tool.

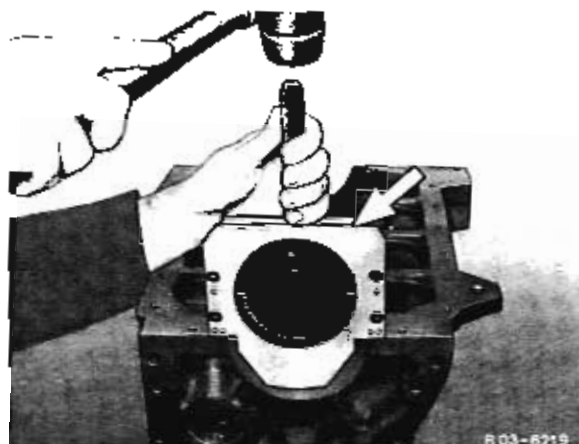
Note: The fabric seal must be inserted exactly in the special tool. Both ends of the seal must rest against the special tool.



Fixing plate 352 589 01 31 00

R03-6314

8 Place the special tool with fabric seal on the crankcase and knock in seal.

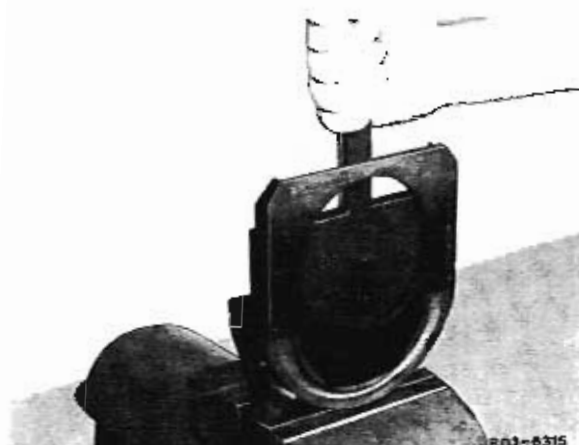


R03-6315

9 Insert the fabric seal with special tool in the bearing cover and knock in.

Note: The seals have a projection of 0.5 mm relative to the parting face after being installed. Measure as a check.

No fabric fibres may project into the parting faces.



R03-6315

Fixing plate 352 589 01 31 00

10 Coat fabric seal in the housing and in the bearing cover with hal bearing grease as specified in DBL 6801.10.



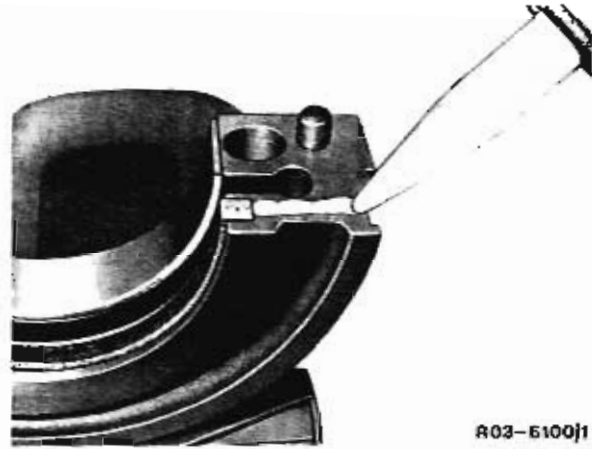
R03-6315

03.13 Removing, mounting and installing crankshaft

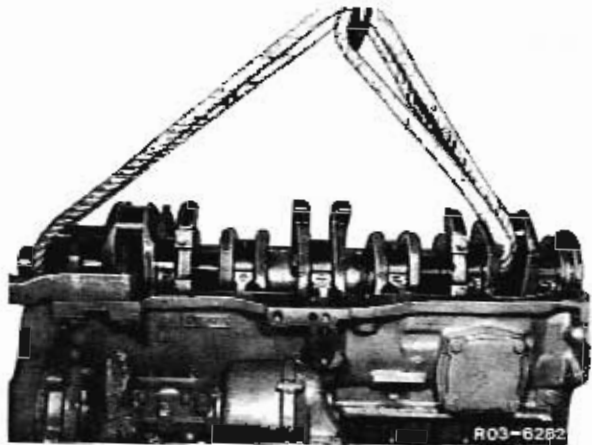
11 Coat the grooves in the rear main bearing cover with the sealing compound Dirkotransparent. The parting faces of the seals must not be coated with sealing compound.

Note: On engines without grooves in the rear bearing cover, the parting face between housing and bearing cover should be coated with the sealing compound.

The areas to be provided with sealing compound must be free of grease.

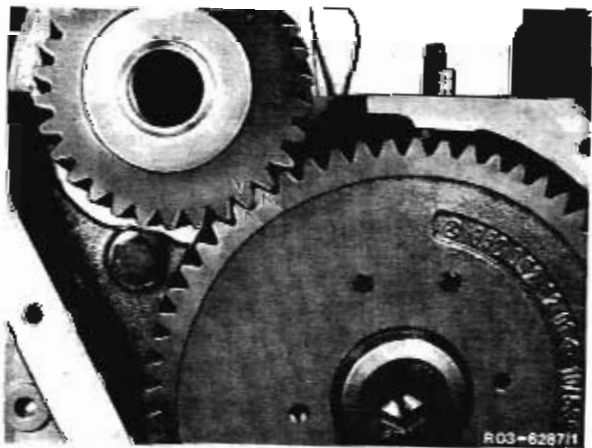


12 Insert the crankshaft in the bearing shells.



13 Oil the running surfaces of the bearing shells with engine oil.

Note: Ensure that the tooth of the crankcase gear marked with "1" rests between the teeth of the timing device or camshaft gear also marked with "1-1".



14 Measure the shank length of the main bearing bolts.

Note: The main bearing bolts may be re-used up to a max. shank length of 123.0 mm.

