

00.13 Tightening Torques

Group	Designation	Nm	
01	Crankshaft bearing cover on cylinder crankcase	1)	
	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	5)	
	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	S nozzle	60
	Thrust bolt for nozzle holder on cylinder head		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

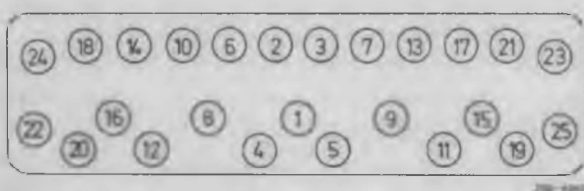
Group	Designation	Nm
09	Fuel line at filter and injection pump	35
	Vent line at injection pump	35
	Vent line at fuel filter	35
	Compressed air manifold at turbocharger	20
	Exhaust turbocharger at exhaust manifold M 10	55–75
	Flange manifold at exhaust turbocharger M 8	30
	Air intake pipe at compressed 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 compresor	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

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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



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.

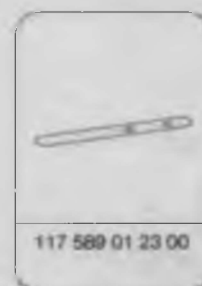
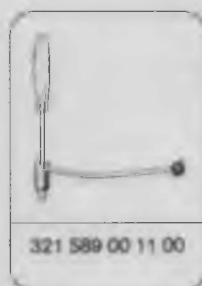
Cylinder Head

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



- 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

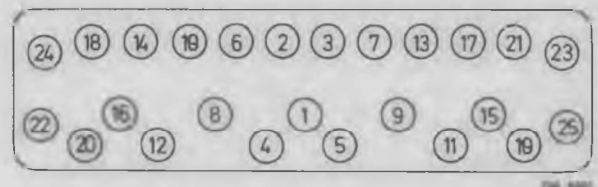


- 5 Check the length of the shank of the cylinder head bolt.

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.



Removing, mounting and installing crankshaft 03.13

Data

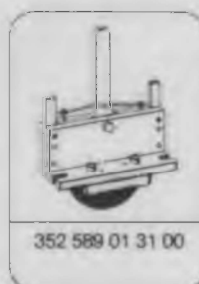
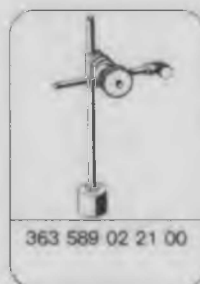
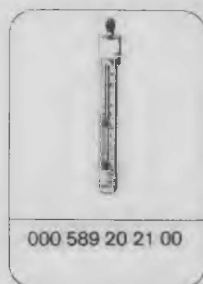
Rep. Stage	Dia. of bearing journals	Bearing bore when installed	Wall thickness for bearing shells ready for installation	Width of fit bearing
Standard	$\frac{88,010}{87,990}$	$\frac{88,098}{88,052}$	2,465 – 2,477	
Standard I	$\frac{87,910}{87,890}$	$\frac{87,998}{87,952}$	2,515 – 2,527	
Rep. Stage I	$\frac{87,760}{87,740}$	$\frac{87,848}{87,802}$	2,590 – 2,602	31,81
Rep. Stage II	$\frac{87,510}{87,490}$	$\frac{87,598}{87,552}$	2,715 – 2,727	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 $90^\circ - 100^\circ$ 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

