

Technical Publication

Diesel Engine

12V 2000 M

16V 2000 M

Maintenance Manual

M020077/00E



Das Handbuch ist zur Vermeidung von Störungen oder Schäden beim Betrieb zu beachten und daher vom Betreiber dem jeweiligen Wartungs- und Bedienungspersonal zur Verfügung zu stellen. Außerhalb dieses Verwendungszwecks darf das Handbuch ohne unsere vorherige Zustimmung nicht benutzt, vervielfältigt oder Dritten sonstwie zugänglich gemacht werden.

Änderungen bleiben vorbehalten.

This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation. Other than for this purpose, the handbook shall not be reproduced, used or disclosed to others without our prior consent.

Subject to alterations and amendments.

Le manuel devra être observé en vue d'éviter des incidents ou des endommagements pendant le service. Aussi recommandons-nous à l'exploitant de le mettre à la disposition du personnel chargé de l'entretien et de la conduite. En dehors de cet usage, le manuel ne pourra être utilisé ni reproduit ou rendu accessible de quelque autre manière à des tiers, sans notre consentement préalable.

Nous nous réservons le droit d'entreprendre toute modification.

El Manual debe tenerse presente para evitar anomalías o daños durante el servicio, y, por dicho motivo, el usuario debe ponerlo a disposición del personal de mantenimiento y de servicio. Fuera de este fin de aplicación, el Manual no se debe utilizar, copiar ni poner en manos de terceros, sin nuestro consentimiento previo.

Nos reservamos el derecho de introducir modificaciones.

Il manuale va consultato per evitare anomalie o guasti durante il servizio, per cui va messo a disposizione dall'utente al personale addetto alla manutenzione e alla condotta. Senza nostra approvazione preventiva non è ammesso impiegare il manuale per scopi diversi, riprodurlo o metterlo a disposizione di terzi.

Con riserva di modifiche.

Amendment Service!

Any changes in contents will be sent to you in the form of an amendment, provided you complete the reverse of this receipt card and return it to us.

M020077/00E
Maintenance Manual
12/16V 2000 M



 
Postcard
MTU Friedrichshafen GmbH Department SCT 88040 Friedrichshafen GERMANY

Please mark all filed amendments here.



No.	Date	Name
1.	98-01	
2.	98-11	Schön
3.	99-07	
4.	01-05	Schön
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Please use block capitals!



Receipt	Amendment No.	1.	98-01
<input type="checkbox"/> Update as (PDF) file by E-mail		2.	98-11
<input type="checkbox"/> Update as (PDF) file as CD-ROM		3.	99-07
<input type="checkbox"/> Update in hardcopy form		4.	01-05
Publication number: M020077/00E		5.	
Name		6.	
Manufacturer		7.	
Department E-mail		8.	
Fax Telephone		9.	
Street		10.	
Postal box number		11.	
(Postal code) City		12.	
Country		13.	
		14.	
		15.	
		16.	

Contents

A 001	Important Information
A 002	Designation of Engine Sides and Cylinders
A 003	Torque Specifications for Screws and Nuts
A 004	Settings
A 005	Hazards in the Work Area
A 006	Data Sheets
A 007	Keyword Index

A 001 Important Information

This manual is intended for use by technical personnel responsible for the maintenance and servicing of the MTU 2000 series diesel engine.

This manual describes

- scheduled service operations from maintenance echelons W6 and
- non-scheduled service operations on the individual assemblies.

Index sheets divide this handbook into 3 main sections:

Section A	General
Section B	Work schedules
Section C	Task description

Section C is further subdivided into main function groups (MFG) and function groups (FG). The structure is oriented toward the logical structure of the parts list and Spare Parts Catalogues.

Intermediate index sheets bearing the MFG numbers subdivide Section C.

Each function group (FG) consists of no more than nine parts:

e.g.

C 011.05.01	General view
C 011.05.02	Special tool
C 011.05.04	Before-removal operations
C 011.05.05	Removal
C 011.05.06	Disassembly
C 011.05.08	Inspection and repair
C 011.05.10	Assembly
C 011.05.11	Installation
C 011.05.12	After-installation operations

Systematic searches for specific information and rapid orientation in the manual are supported by:

- The tables of contents on each main index sheet. They cross-reference the tables of contents of the individual groups.
- An alphabetical subject index in Section A provides direct access to the individual Groups.
- The Group Summary at the start of Section C lists the individual main function groups (HFG).

Other applicable Customer Service Documents:

- Operating Instructions
- Fluids and Lubricants Specification
- Tools List
- Tolerances and Wear Limits List
- Description of Function and Operation of ECS

Specialised information on subjects such as

- Fuel injection
- Governor setting

can be found in the Acceptance Test Record or Governor Record for the engine in question.

Basic requirements for maintenance and service work

Customers performing their own maintenance must ensure that the following conditions and basic requirements are satisfied:

- all safety regulations are observed
- good general-purpose tools are provided
- cleaning and testing equipment is provided
- work is performed by trained personnel
- special tools are provided
- service area is adequately equipped

General assembly instructions

- Component cleanness:

Areas of all components that come into contact with oil, fuel, coolant, water and combustion air must be clean.

- Components requiring "special cleanness" (e.g. oil- and fuel-carrying components) must be cleaned with suitable cleaning procedures before assembly, checked for particular cleanness and treated accordingly.

Note: Component packaging must only be removed immediately before installation.

- Elastomer components (e.g. rubber and similar) must not be washed with diesel fuel, solvent or cold cleaners. Parts dirtied with oil and fuel must be cleaned immediately.

The parts should be wiped with a dry cloth.

Elastomer parts, e.g. engine mounts, damping elements, couplings and V-belts, must not be painted, but must be covered before all painting work.

- Radial-lip shaft seals treated by the manufacturer with oil show as a result definite signs of swelling when delivered. They must therefore be cleaned (not washed) only with an abrasion-proof paper cloth before installation.
- The surfaces of parts that slide against each other must be lubricated with SAE30 engine oil when installed, unless otherwise specified.

- O-rings and surfaces moving against them during installation (bores and shafts) must be coated with petroleum jelly, unless otherwise specified.

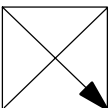
When installing O-rings with counterrings in coolant pumps, always follow the installation instructions.

- After installing O-rings in shaft grooves, in order to remedy twists caused by installation, pass a rounded marking tool under the sealing ring in the direction of the circumference if the O-ring diameter is sufficiently large. Make sure that the O-ring is not damaged.

- Before installing shaft seals

On the shaft, the sealing lip of the shaft seal must be coated with petroleum jelly and the shaft running surface with thin-film lubricant or SAE30 engine oil.


In the support bore, the outer surface of metal outer jackets – unless otherwise specified in the drawing – must be coated with surface sealant. For elastomer outer jackets or combined metal/elastomer outer jackets, the outer surface must be coated with denaturated ethanol.



This symbol applies to radial-lip shaft seals and its significance depends on its position. The arrow indicates the position of the sealing lip.

- Sealing paste must be used to fix the position of flat gaskets. Sealing paste is to be thinly applied in spots on the flat gaskets or mating faces. Immediately after application of the sealing paste, the flat gaskets must be fitted to the component and then (no more than 20 minutes later) the seal components screwed together. Oil, multi-purpose grease or other materials must not be used to fix the position.

- Before installing antifriction bearings, lightly lubricate the bearing seats.
Only remove the bearings from their original packaging immediately before installation so they do not get dirty.
Do not remove the corrosion inhibitor from the bearings in original packaging.
Use petroleum spirit or acid-free kerosene to clean the antifriction bearings.
After cleaning, relubricate the bearings with engine oil.

During assembly, do not apply (axial) forces to antifriction elements and do not hit the bearing rings with a hammer (use assembly aids).
Do not use an open flame to heat bearing inner races.
The temperature must be between 80° C and 100 °C and never exceed 120 °C. 
Deep-freezing for friction bearing installation is not permissible (risk of cracking, rusting through condensate).
 - Dry bearings must not be oiled.
 - When installing gears, the splines must be lubricated with SAE30 engine oil.
 - All support and mating surfaces of components (e.g. mating surfaces for centring devices, flange and sealing surfaces, joint surfaces of press fits) must be clean, polished or provided with the specified surface protection and free from warping and damage. Corrosion inhibitors (e.g. oil, grease) must be removed from support and mating surfaces.
 - After parts are joined which are installed by means of cooling using liquid nitrogen, all condensate must be removed and the parts coated with SAE30 engine oil.
 - Sensors must be coated with long-life lubricant before installation in the immersion sleeves.
 - Cable connections with cutting ring threaded connections must be installed in a vice and tightened, the thread first being coated with thin-film lubricant.
 - If components are to be marked by etching, after the etching is completed the solution must be removed by means of neutralization agent. The affected parts must then be preserved with SAE30 engine oil.
 - Components used in hot part areas (e.g. V-clamps, bellows, plug-in pipes, O-rings) must be coated at the support and mating surfaces with assembly paste, unless otherwise specified in the drawing.
 - The assembly surfaces of screws, nuts, washers and of parts to be tensioned must be clean and polished or provided with the specified surface protection and free from warping and damage. Corrosion inhibitors (e.g. oil, grease) must be removed. Threads and screw heads must be coated with lubricant before assembly as per tightening specifications.

Unless otherwise specified, the following lubricants should be used:
 - SAE30 engine oil for general application
 - Assembly paste in hot part areas.
- a) Threaded connections without tightening specifications
- For threaded connections without tightening specification, the tightening procedure can be selected as required, i.e. mechanical tightening with screwdriver or normal manual tightening with an open-end wrench or box wrench is possible. In the event of mechanical tightening, the tightening torque must be taken from the general tightening specifications according to thread size and property class.
- b) Threaded connections with tightening specifications
- Torque tightening
- The screw connections must be tightened by hand with a torque wrench or angle-of-rotation torque wrench. The specified tightening torques must be set at the torque wrench without consideration of the specified tolerance. When using an angle-of-rotation torque wrench, the torque indicated must be within the torque specification limit value. Proceed in a similar manner with torsionally protected threaded connections. These instructions apply also to testing torque.
- Note:** If no tolerance for tightening torque is stated, the tightening tolerance is +10 % of specified torque.

Angle of rotation tightening:

The additional angles of rotation specified in the tightening specifications must be achieved and may be exceeded within the specified tolerance.

If no tightening tolerance is specified, the following tolerances must be observed:

- + 5° for angle of further rotation less than or equal to 90°
- + 10° for angle of further rotation greater than 90°

Before angle-of-rotation tightening, each screw head must be colour-marked so that after tightening it is possible to check that the angle of rotation is correct (exception: colour-marking is not necessary in the case of a self-monitoring NC screwdriver).

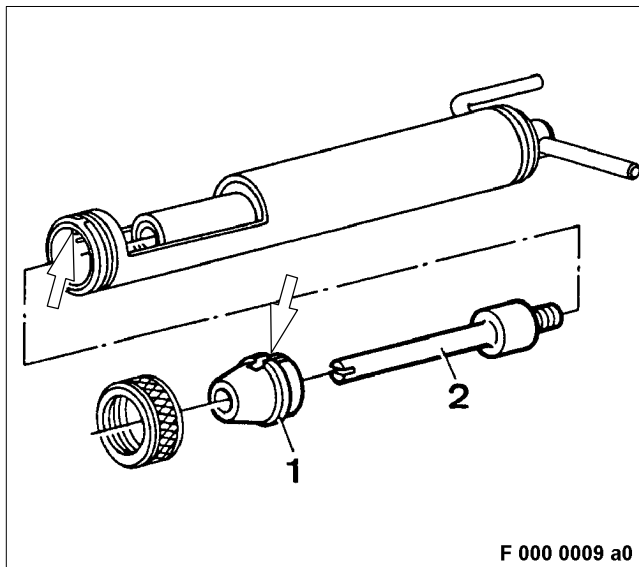
Elongation tightening

Tightening must be carried out in accordance with tightening specifications taking the tightening tolerance into consideration.

Repairing threaded bores with threaded inserts (Heli-Coil)

Data

Thread	Core hole bore dia. (max./min.)	Twist drill dia.
M 6	<u>6.31</u> 6.04	6.1–6.2–6.25
M 8	<u>8.35</u> 8.04	8.1–8.2–8.25–8.3
M 8 x 1	<u>8.32</u> 8.04	8.1–8.2–8.25–8.3
M10	<u>10.40</u> 10.05	10.25
M12	<u>12.50</u> 12.05	12.25–12.5
M 12 x 1.5	<u>12.43</u> 12.05	12.25
M14	<u>14.53</u> 14.06	14.25–14,5
M 14 x 1.5	<u>14.43</u> 14.05	14.25
M 15 x 2	<u>15.30</u> 15.20	15.25
M16	<u>16.53</u> 16.06	16.25–16.5
M 16 x 1.5	<u>16.43</u> 16.05	16.25
M 24 x 1.5	<u>24.43</u> 24.05	24.25
M 26 x 1.5	<u>26.43</u> 26.05	26.25
M 30 x 1.5	<u>30.43</u> 30.05	30.25



Repairing

If necessary, remove thread insert with suitable removal tool from bore (left).

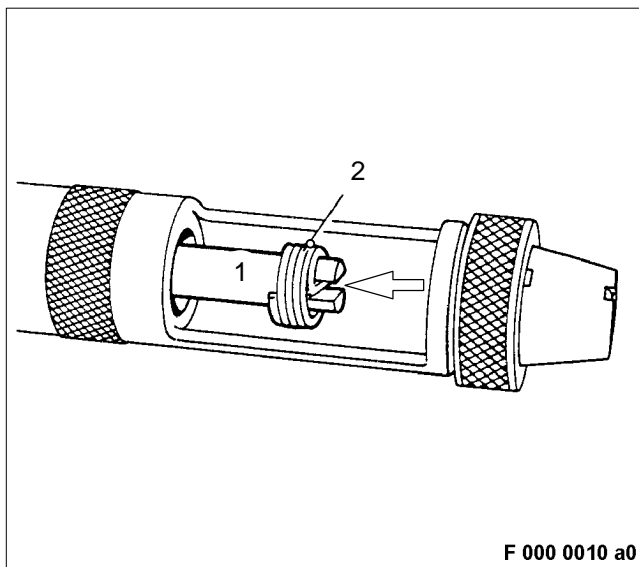
Bore core hole with suitable twist drill – see table.

Cut thread with special tapped bore.

Note: Do not countersink bore!

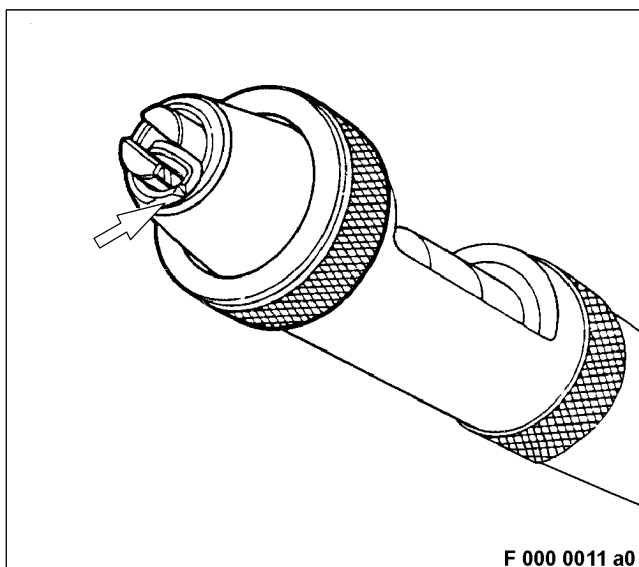
Mount spindle (2) and snout (1) corresponding thread.

Groove on snout must be aligned with markings on installation tool (arrows).

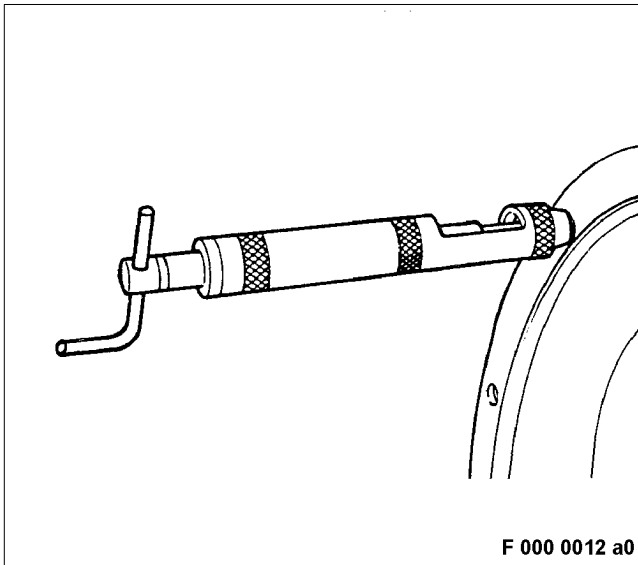


Insert thread insert (2) into spindle (1) in installation tool.

Driver journal of thread insert must be in groove (arrow).



Use spindle to turn thread insert through snout until it is flush at front (arrow).

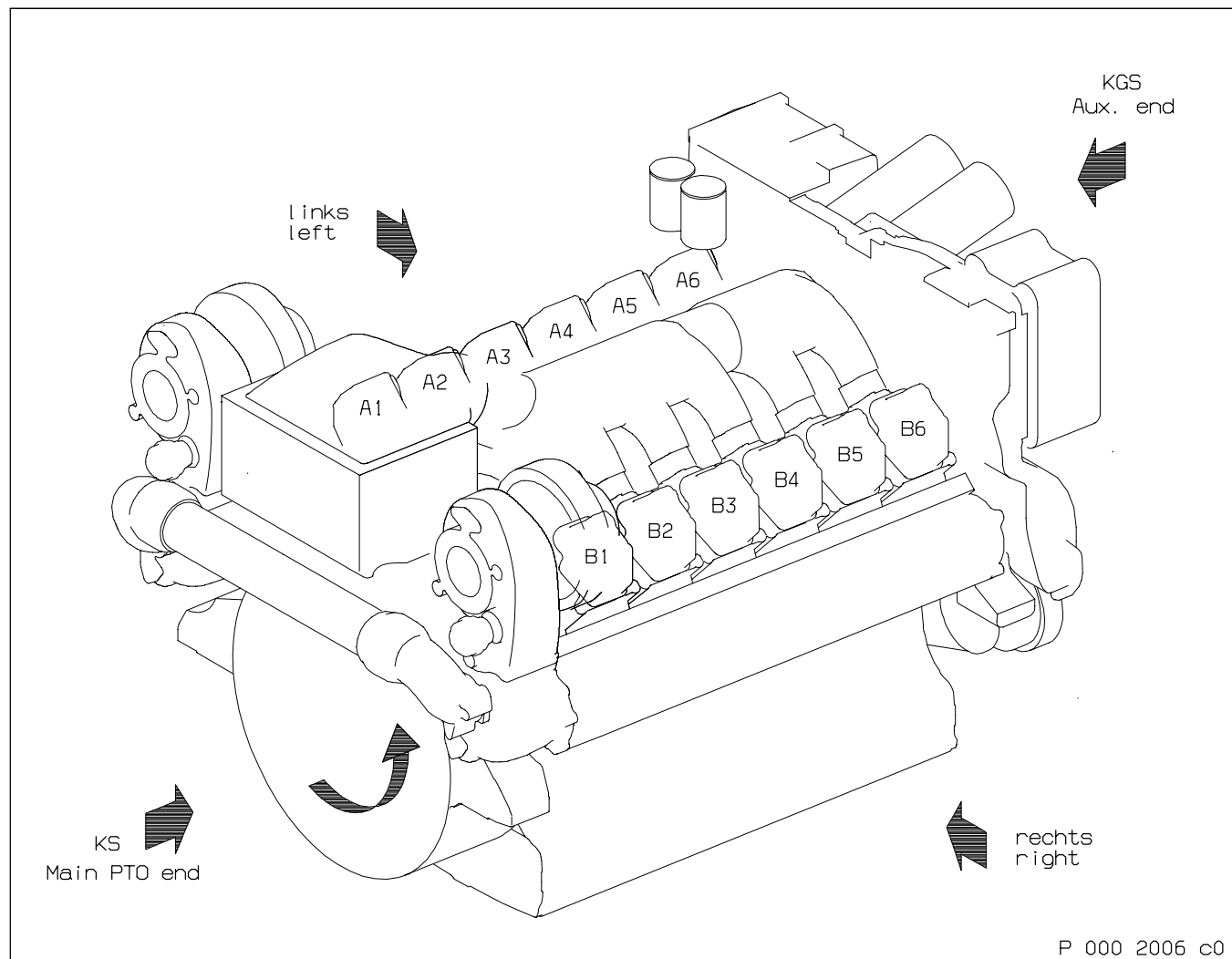


Mount installation tool on threaded hole and install thread insert without applying pressure to spindle.

Note: Insert thread insert 1/2 to 1 1/2 turns deeper than threaded bore surface.

Use bolt shearer to remove driver journal to M 14.
In event of threaded inserts over M 14, move driver journal up and down with pointed pliers and remove.

A 002 Designation of Engine Sides and Cylinders



Engine sides are always designated as viewed from the PTO side (driving end).

The cylinders on the left engine side are designated "A" and those of the right engine side "B" (as per DIN ISO 1204).

Each cylinder bank is numbered consecutively from No. 1, starting at the driving end of the block.

Other components and assemblies are also numbered consecutively starting at No. 1 at the driving end.

Applicable designations and abbreviations

Driving end = KS

Free end = KGS

Left side

Right side

Top

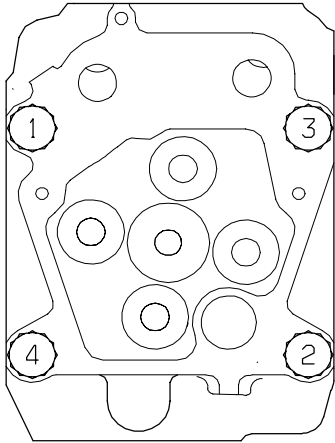
Bottom

A 003 Tightening Specifications for Screws and Nuts

Designation	Tightening specifications	Lubricant	See
Crankcase			
Centre hex screws for crankshaft bearing cap* Max. shaft length: 156 mm – Pretightening torque: – Additional angle of rotation:	300 Nm + 30 Nm 90° + 10°	Engine oil	C 011.05 C 031.05
Side double-hex screws for crankshaft bearing cap*	140 Nm + 10 Nm	Engine oil	C 011.05
Plugs for main oil ducts, driving end (M 30 × 1.5)	180 Nm	Engine oil	C 011.05
Hex screw for clamp on Mann oil separator	8 Nm	Engine oil	C 018.10
Gear train			
Collar nut for drive gear (auxiliary drive)	300 Nm	Engine oil	C 027.05
Running gear			
Screws for counterweights Max. shaft length: 12V: 84.5 mm 16V: 75.5 mm – Pretightening torque: – Additional angle of rotation:	140 Nm + 20 Nm 90° + 10°	Engine oil	C 031.05
Hex screws for flywheel	260 Nm	Engine oil	C 032.05
Hex screws for side plate (vibration damper) M10: M12:	52 Nm 90 Nm	Engine oil	C 035.05
Conrod cap screws ** Max. shaft length : 74.5 mm – Pretightening torque: – Additional angle of rotation:	100 Nm + 15 Nm 90° + 10°	Engine oil	C 037.05

* Tightening sequence: Hex screws before double-hex screws

** Replace conrod cap screws with cracked mating faces during each engine disassembly

Designation	Tightening specifications	Lubricant	See
Cylinder head			
Double-hex screws for cylinder head Max. shaft length: 212 mm Pretightening torque, in stages: – 1st stage – 2nd stage – 3rd stage – 4th stage Additional angle of rotation, in stages: – 1st stage – 2nd stage <u>Cylinder head tightening diagram</u>  K 041 0017 b0	10 Nm 50 Nm 100 Nm 200 Nm 90° + 10° 90° + 10°	Engine oil	C 041.05
Protective sleeve for injector	40 Nm + 5 Nm	Engine oil	C 041.05
Valve gear			
Collar screw for cylinder head cover	20 Nm	Engine oil	C 055.05
Locknut on adjusting screw for rocker arm	50 Nm	Engine oil	C 055.05
Locknut on adjusting screw for valve bridge	25 Nm + 5 Nm	Engine oil	C 055.05
Hex screws for rocker shaft support Max. shaft length: 91 mm – Pretightening torque: – Additional angle of rotation:	60 Nm 90°	Engine oil	C 055.05
Fuel system – high-pressure			
Screws for plug-in clips on injection pump	1 Nm ± 0.2 Nm	Engine oil	C 073.05
Double-hex screws for injection pump	60 Nm + 12 Nm	Engine oil	C 073.05
Hex screw for clamping element on injector	50 Nm	Engine oil	C 075.05
Thrust screw for pressure pipe connections in cylinder head	40 Nm + 5 Nm	Engine oil	C 075.05
Union nuts of injection line	25 Nm + 2 Nm	Engine oil	C 075.05

Designation	Tightening specifications	Lubricant	See
Exhaust system			
Socket-head screw for exhaust diffusor on cylinder head	60 Nm + 6 Nm	Engine oil	C 142.05
Hex screws for exhaust manifold	33 Nm + 4 Nm	Assembly paste	C 142.05
Hex screws for sliding element on exhaust manifold	57 Nm + 6 Nm	Assembly paste	C 142.05
Starting system			
Hex nuts for starter on flywheel housing	80 Nm	Engine oil	C 172.05
Lube Oil System			
Hex screws for oil spray nozzle	25 Nm	Engine oil	C 184.10
Cooling system			
Hex screw for impeller (coolant pump)	60 Nm + 6 Nm	Engine oil	C 202.05
Slotted nut for angular-contact ball bearing (coolant pump)	100 Nm + 10 Nm	Loctite 270	C 202.05
Clamping nut for impeller (raw water pump)	145 Nm ± 5 Nm	Engine oil	C 207.10
Screw for drive gear (raw water pump)	110 Nm ± 5 Nm	Engine oil	C 207.10
Hex screws for bearing cap (raw water pump)	8.5 Nm	Loctite 222 / Loctite 582	C 207.10
Plugs for spiral housing (raw water pump) M 14 × 1.5 G 1/2 A	45 Nm + 10 Nm 140 Nm + 10 Nm	Engine oil	C 207.10
Mounting			
Threaded rod in rubber mount	50 Nm + 5 Nm	Engine oil	C 231.05
Hex screws for engine carrier on crankcase	180 Nm + 18 Nm	Engine oil	C 231.05
Hex screws for plate on flywheel housing	180 Nm + 18 Nm	Engine oil	C 231.05
Hex nut on threaded rod	600 Nm + 60 Nm	Engine oil	C 231.05
Eyebolt on engine carrier	200 Nm + 20 Nm	Engine oil	C 231.05
Hex nut on eyebolt	200 Nm + 20 Nm	Engine oil	C 231.05
Monitoring, control and regulation devices			
Charge air pressure transmitter on charge air manifold	25 Nm	Engine oil	–

Tightening specifications for set screw and stud connections to works standard MTN 5008

This works standard applies to set screws subjected to little dynamic load as per MMN 384, DIN 912, EN 24014 (DIN 931-1), EN 24017 (DIN 933), EN 28765 (DIN 960), EN 28676 (DIN 961), DIN 6912 and to studs as per DIN 833, DIN 835, DIN 836, DIN 938, DIN 939 and associated nuts.

They do not apply to heat-proof screws in the hot component area.

Tightening torques M_A are for screws of strength class 8.8 (bright surface, phosphate coating or galvanised) and 10.9 (bright surface or with phosphate coating).

The values in the table are based on a friction coefficient $\mu_{tot} = 0.125$. Precondition: Thread and mating faces of screws and nuts must be coated in engine oil prior to assembly.

When tightening manually (tightening specifications), an assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

When tightening mechanically, the permitted assembly tolerance is + 15 %

Tightening torques = M_A

Thread	Hand-tightened		Machine-tightened	
	8.8 M_A (Nm)	10.9 M_A (Nm)	8.8 M_A (Nm)	10.9 M_A (Nm)
M 6	9	12	8	11
M 8	21	31	20	28
M 8x1	23	32	21	30
M 10	42	60	40	57
M 10x1.25	45	63	42	60
M 12	74	100	70	92
M 12x1.25	80	110	75	105
M12x1.5	76	105	72	100
M 14	115	160	110	150
M14x1.5	125	180	120	170
M 16	180	250	170	235
M16x1.5	190	270	180	255
M 18	250	350	240	330
M18x1.5	280	400	270	380
M 20	350	500	330	475
M20x1.5	390	550	350	520
M 22	480	680	450	650
M22x1.5	520	730	490	700
M 24	600	850	570	810
M 24x1.5	680	950	640	900
M 24x2	660	900	620	850
M 27	900	1250	850	1175
M 27x2	960	1350	900	1275
M 30	1200	1700	1100	1600
M 30x2	1350	1900	1250	1800

Tightening torques for stress bolt connections prescribed in standard MTN 5007

This standard applies to stress pin bolts and stress bolts which are subjected to static and dynamic load of strength class 10.9 and the associated nuts.

Shaft and transition dimensions as to MMN 209 standard and material and machining to MMN 389 standard (bright surface or with phosphate coating).

The values in the table are based on a friction coefficient $\mu_{tot} = 0.125$. Precondition: Thread and mating faces of screws and nuts must be coated in engine oil prior to assembly.

When tightening manually (defined tightening), an assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

The specifications in the tables apply for hand tightening with a torque wrench.

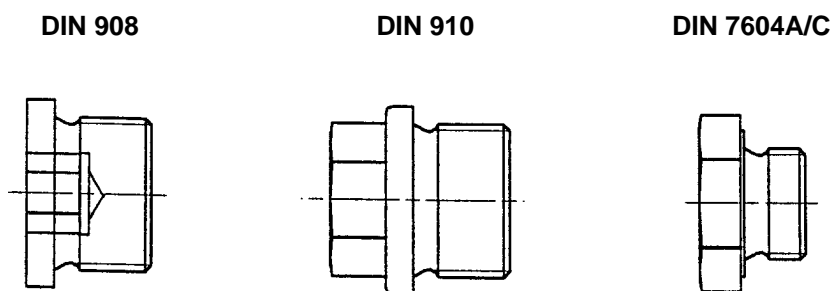
Tightening torques = M_A

Thread	Torsionally unprotected M_A (Nm)	Torsion-protected* M_A (Nm)
M 6	9	12
M 8	21	28
M 8 x 1	24	30
M 10	42	55
M 10 x 1.25	46	60
M 12	75	93
M 12 x 1.5	78	99
M 14	120	150
M 14 x 1.5	135	160
M 16	180	225
M 16 x 1.5	200	245
M 18	250	315
M 18 x 1.5	300	360
M 20	350	450
M 20 x 1.5	430	495
2	500	620
M 22 x 1.5	560	675
M 24	640	790
M 24 x 2	700	850
M 27	900	1170
M 27 x 2	1000	1230
M 30	1250	1575

*Secure bolt/stud shank against torsional stress during tightening.

Tightening torques for plugs prescribed in standard MTN 5183-1

This standard applies to plugs as per DIN 908, DIN 910 and DIN 7604 with screwed plug DIN 3852, model A (sealed by sealing ring DIN 7603-Cu).



Tightening torques M_A are given for plugs made of steel (St) with surface protected by a phosphate coating and oiled or galvanised.

Thread and mating faces beneath heads must be coated in engine oil prior to assembly.

When tightening manually (defined tightening), an assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

Tightening torques = M_A

Tightening torques for plugs DIN 908, DIN 910 and DIN 7604A (with short screwed plug)

Thread	inserted in	
	steel /gray cast iron M_A (Nm)	Al-alloy M_A (Nm)
M 10 x 1	15	15
M 12 x 1.5	35	25
M 14 x 1.5	35	25
M 16 x 1.5	40	30
M 18 x 1.5	50	35
M 20 x 1.5	55	45
M 22 x 1.5	60	50
M 24 x 1.5	70	60
M 26 x 1.5	80	70
M 27 x 2	80	70
M 30 x 1.5	100	90
M 30 x 2	95	85
M 33 x 2	120	110
M 36 x 1.5	130	115
M 38 x 1.5	140	120
M 42 x 1.5	150	130
M 45 x 1.5	160	140
M 48 x 1.5	170	145
M 52 x 1.5	180	150
M 56 x 2	190	160
M 64 x 2	205	175