Winterthur Gas & Diesel

FITTING INSTRUCTIONS

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Winterthur Gas & Diesel

FITTING INSTRUCTIONS

PC-Drawing

Dimension

Design Group	9710	Q-Code	XXXXX	Standard	WDS
A4	Document ID	107.412.130		PC Page/s	1 / 21

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1 Introduction

This instruction provides guidance for the engine installation within the engine room. It briefly describes the layout and arrangement of the assembly parts and the required modifications for project-specific installations which differ from the standard design. It also includes all necessary assembly steps.

2 Layout and arrangement of assembly parts

2.1 Foundation bolts

To ensure the fixing of the engine under all operating conditions, the engine must be effectively and permanently tightened by foundation bolts (see Figure 1)

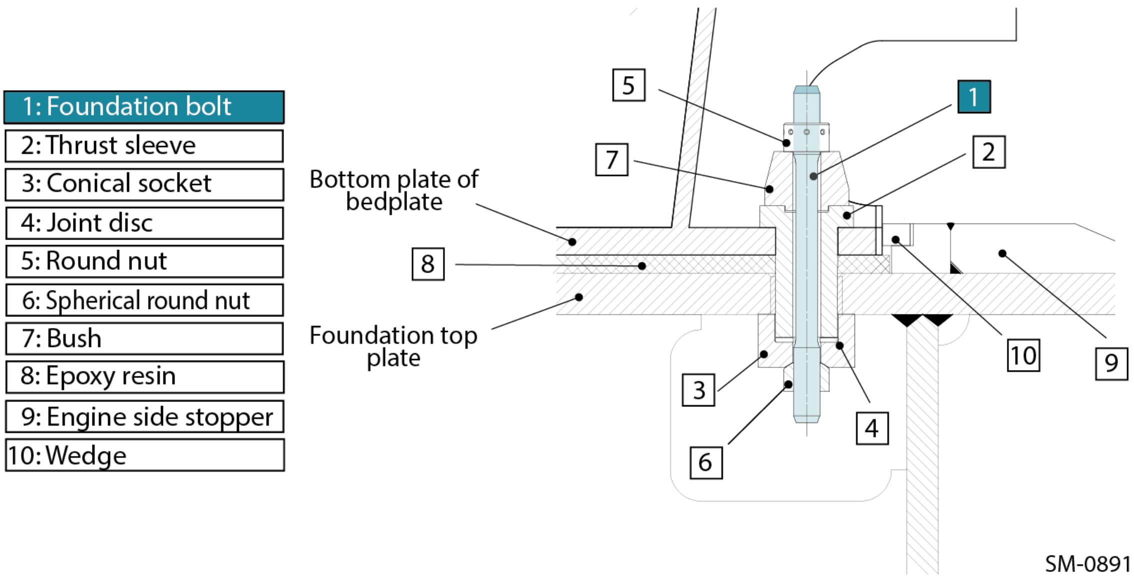

Figure 1: Arrangement of the foundation bolt in the interface between engine bedplate and foundation

2.1.1 Layout

The foundation bolts are designed in compliance with the class requirements which includes the allowance of a minimum elongation in the pre-loaded condition by maintaining the maximum permissible tensile stress. The foundation bolts must be supplied by the shipyard and fulfil the specifications provided in the relevant component drawing.

2.1.2 Arrangement

The foundation bolts are positioned in one of two locations. They can be inserted directly in the pre-machined holes located in the bottom plate of both the engine bedplate and foundation top plate (referred to in Figure 2 as “Standard bolting”). Otherwise, the foundation bolts can be assembled with the thrust sleeves (referred to in Figure 2 as “Bolting with thrust sleeve”).

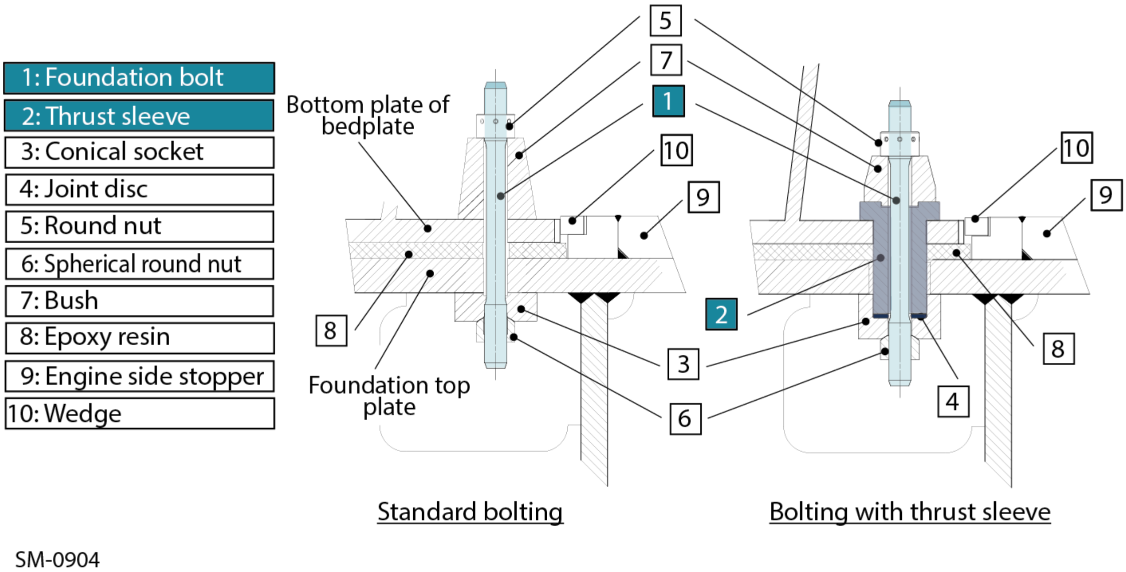

Figure 2: Assembly variants for the foundation bolts

2.2 Thrust sleeves

WinGD specifies the use of thrust sleeves at the engine driving end. It has proven to be an easy, quick, and cost-efficient method for force transmission. The thrust sleeves are fitted to the engine bedplate and to the foundation top plate (see Figure 3). They serve as an interface for the transmission of various forces. The foundation bolts are inserted in the thrust sleeves and tightened together with the same torque as the regular foundation bolts. No end stoppers are required since thrust is transmitted by the thrust sleeves.

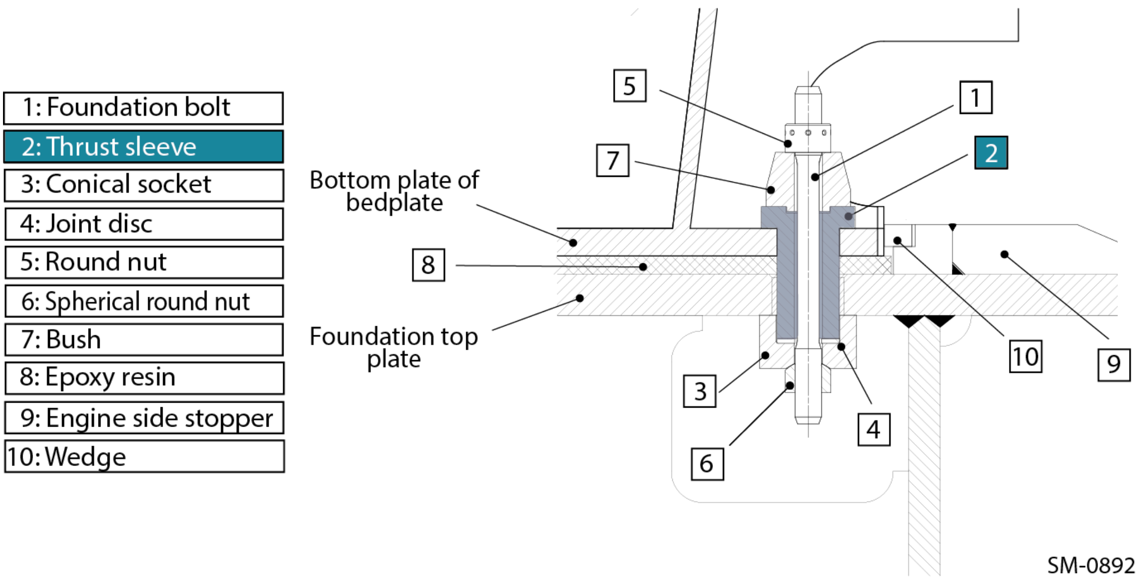

Figure 3: Thrust sleeves in the interface between the engine bedplate and foundation top plate

2.2.1 Layout

The thrust sleeves must be supplied by the shipyard and fulfil the specifications provided in the relevant component drawing.

2.2.2 Arrangement

For the engine bedplate, the required holes for the thrust sleeves must be machined by the engine builder and with a fit connection. For the foundation top plate, these holes must be pre-machined by the shipyard. The holes can be flame-cut or drilled with a larger diameter than the thrust sleeves to enable proper engine alignment without re-machining of the holes. The machining tolerances are provided in the MIDS “DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B”.

Since the epoxy resin thickness in the vertical plane cannot be precisely determined, the standard design of the foundation bolts, thrust sleeves, conical sockets, nuts, and bushes, allows for an epoxy resin thickness ranging from 25 to 60 mm. This range provides full flexibility without any modifications of these components. In this regard, the conical socket as installed at the lower end of the thrust sleeve has a blind hole to enable the thrust sleeve protrusion beyond the foundation top plate. The gap between the end of the thrust sleeve and the bottom of the blind hole must be filled with a joint disc having a proper height (see Figure 4). For the joint disc material, an oil-resistant NBR rubber with a hardness of 60-70 Shore A must be used.

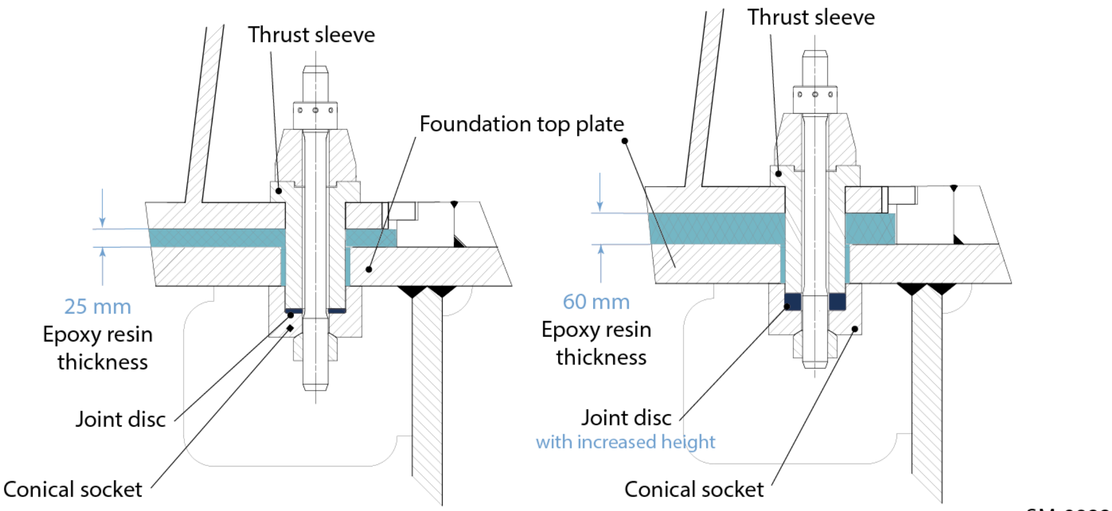

Figure 4: Required adjustment of the joint disc height

2.3 Epoxy resin

After the finalisation of the engine alignment, the epoxy resin is used to fill the gap between the engine bedplate and foundation top plate, and it enables a form-fitted thrust transmission together with the thrust sleeves (see Figure 5). The epoxy resin filling is referred to as chocking in the MIDS, DG 9710.

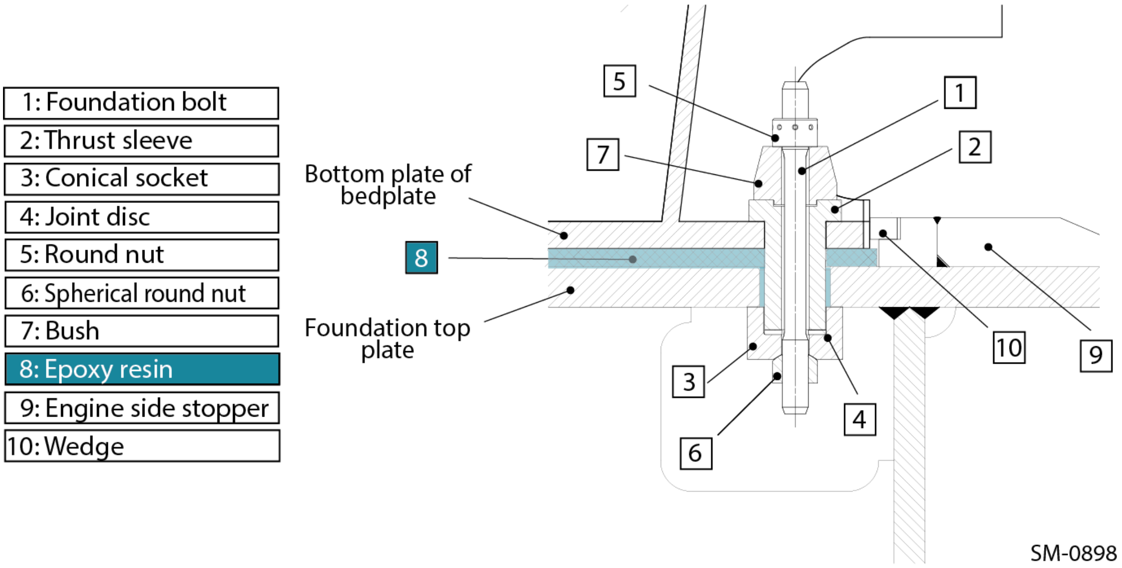

Figure 5: Epoxy resin as an interface between the engine bedplate and foundation top plate

2.3.1 Layout

The epoxy resin material must fulfil the following requirements:

- Approval by the major classification societies
- Meet the properties specified in Table 1

Table 1: Required properties of epoxy resin

Properties	Standard	Values
Ultimate compression strength	ASTM D-695	min. 130 MPa
Compression yield point	ASTM D-695	min. 100 MPa
Compressive modulus of elasticity	ASTM D-695	min. 3100 MPa
Deformation under load: Load 550 N / 70°C Load 1100 N / 70°C	ASTM D-621	 max. 0.10 % max. 0.15 %
Curing shrinkage	ASTM D-2566	max. 0.15 %
Coefficient of thermal expansion (0-60 K)	ASTM D-696	max. 50 • 10-6 1/K
Coefficient of friction – normal		min. 0.3

2.3.2 Arrangement

WinGD recommends arranging the epoxy resin according to the dimensions provided in the MIDS "DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B". The provided layout is based on the following criteria:

1. For the thrust sleeve assembly, the epoxy resin thickness between the outer edge of the thrust sleeves and the outer edge of the holes in the foundation top plate must be within a specific range. It must be a minimum of 5 mm (shown as gap 2 in Figure 6) and a maximum of 12 mm (shown as gap 1 in Figure 6). Within the tolerance range of the bolt positioning this requirement can always be met.

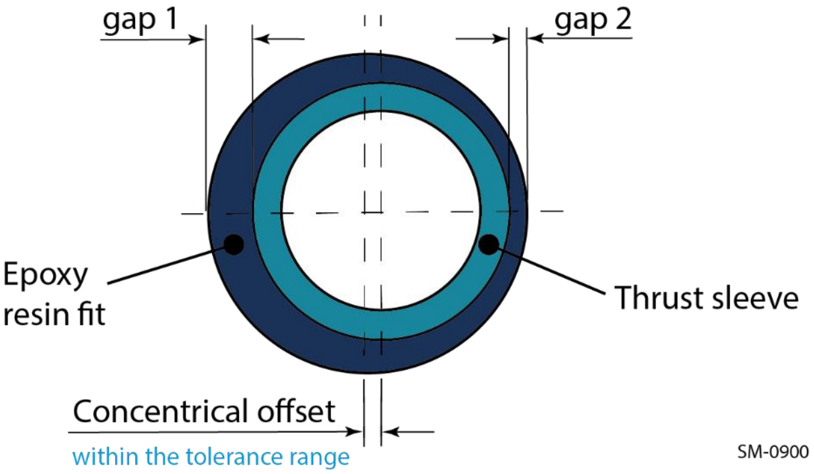

Figure 6: The epoxy resin fit with the required epoxy resin thickness

If the concentrical offset is outside of WinGD‘s specified tolerance range for the bolt positioning, then a modification is possible. A slight elongation of the hole in the foundation top plate can be made into the shape of an egg (see Figure 7). This will also enable the above specified tolerances to be met in the case of a mismatching with an offset outside of the tolerance range.

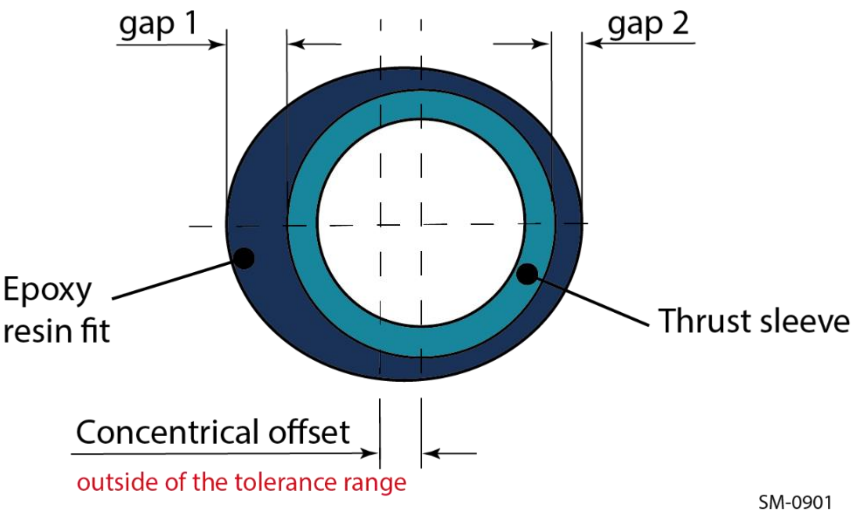

Figure 7: Possible modification with a slight elongation in the shape of an egg to meet tolerance specifications

2. The length of a single epoxy resin area should not exceed 750 mm. Figure 8 shows an example of an epoxy resin area arrangement where this requirement is met.

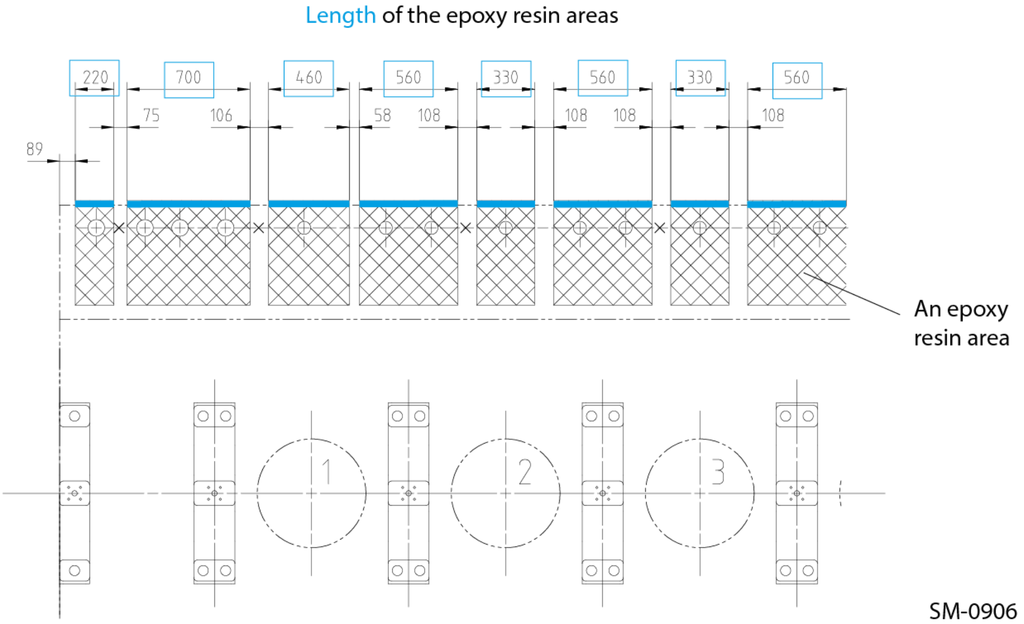

Figure 8: Recommended maximum length of the epoxy resin areas

3. The depth of a single epoxy resin area must be verified by calculation. The entire epoxy resin area underneath the engine bedplate must be large enough to ensure compliance with the maximum permissible surface pressure of the epoxy resin (see Figure 9). The calculated surface pressure includes the engine deadweight and the pre-tension force of the foundation bolts.

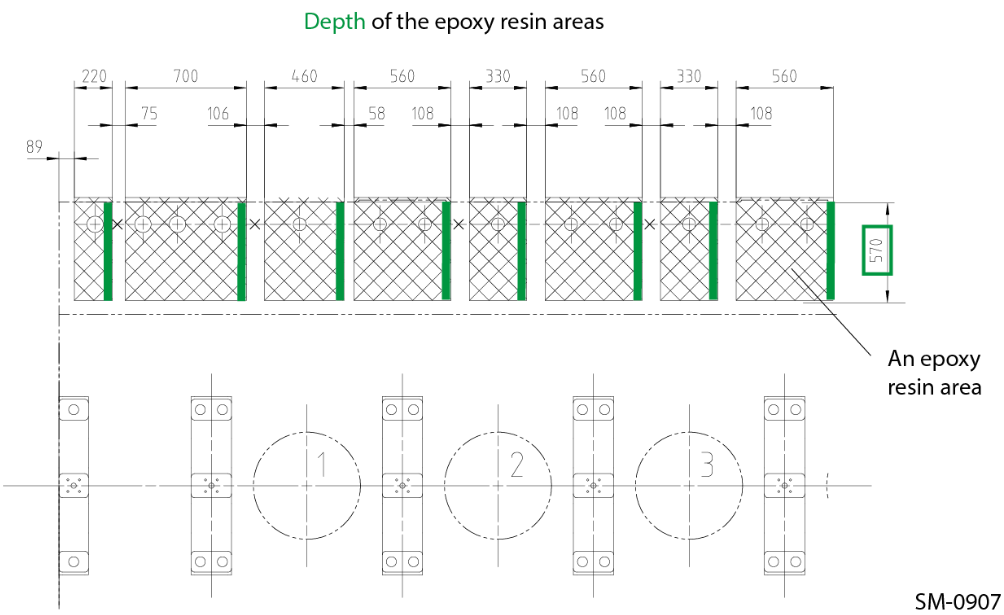

Figure 9: Required depth of the epoxy resin areas

4. The width of gaps between the epoxy resin areas must consider sufficient space for the wedges and the foam that surrounds the epoxy resin (see Figure 10).

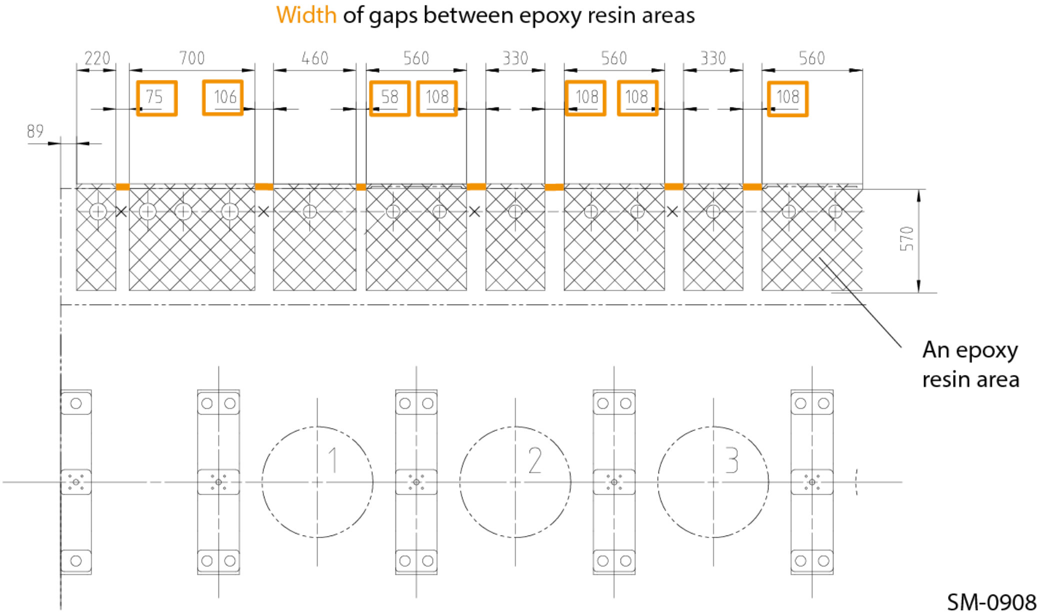

Figure 10: Required width of gaps between the epoxy resin areas

5. The minimum required distance between a single bolting or thrust sleeve hole and the outer edge of a single epoxy resin area must be at least half of the bolting hole diameter (see Figure 11).

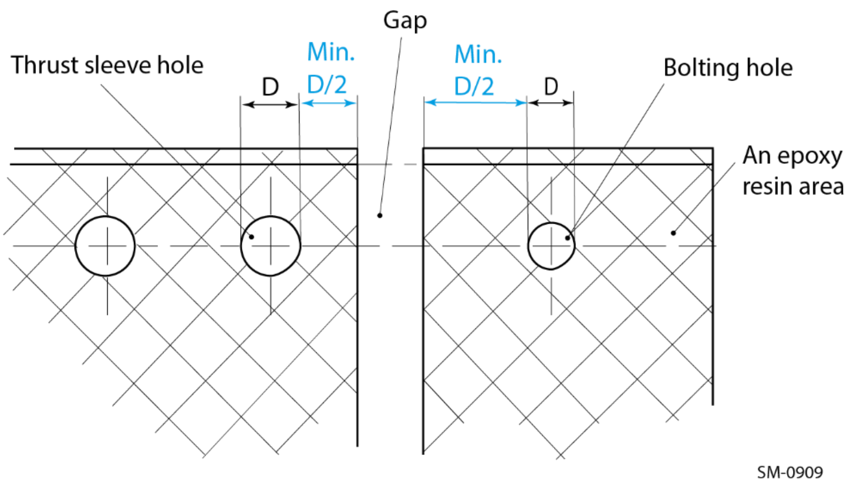

Figure 11: Minimum required distance between a single bolting or thrust sleeve hole and the outer edge of a single epoxy resin area

The MIDS “DG 9710 – Engine Seating Foundation – Chocking and drilling plan for foundation bolts, section B-B” provides one possible proposal for the epoxy resin area arrangement. Variations from this proposal are possible. However, they must still comply with the specification requirements of the epoxy resin supplier.

2.4 Engine side stoppers

2.4.1 Layout

The classification society requests the use of engine side stoppers to prevent any lateral movement of the engine in case of collision. Different designs are possible for the stoppers. WinGD proposes a welded-type stopper design (see Figure 12).

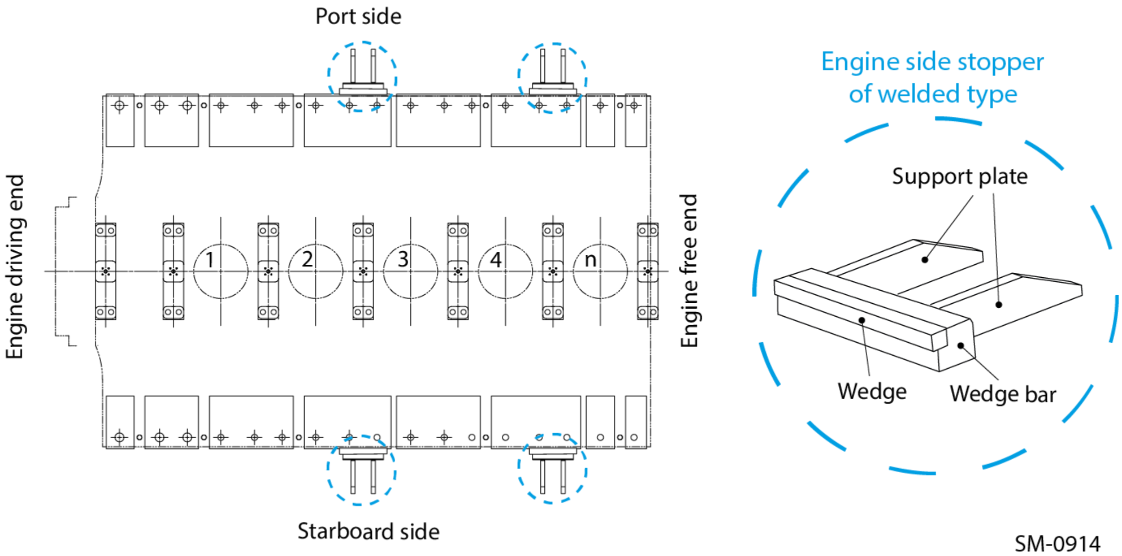

Figure 12: Welded-type engine side stopper

The engine side stoppers must be supplied by the shipyard and fulfil the specifications provided in the relevant component drawing.

2.4.2 Arrangement

Before installing the engine side stoppers on the ship side, the sub-assemblies must be completed. The sub-assemblies are made complete by merging the two support plates with the wedge bar, which is carried out by welding (see Figure 12). The welding specification is provided on the relevant engine side stopper component drawing. The prepared engine side stopper sub-assemblies must then be installed on both the port and the starboard side. Specifications for the minimum numbers of engine side stoppers, their positions, and the welding requirements for fixing them on the foundation top plate are defined in the MIDS “DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B”.

The height of the engine side stopper must be adapted to the final epoxy resin thickness to achieve the minimum required contact area, as specified in the MIDS. This area is based on the engaged length of the engine side stopper (wedge) and the engine bedplate (see Figure 13).

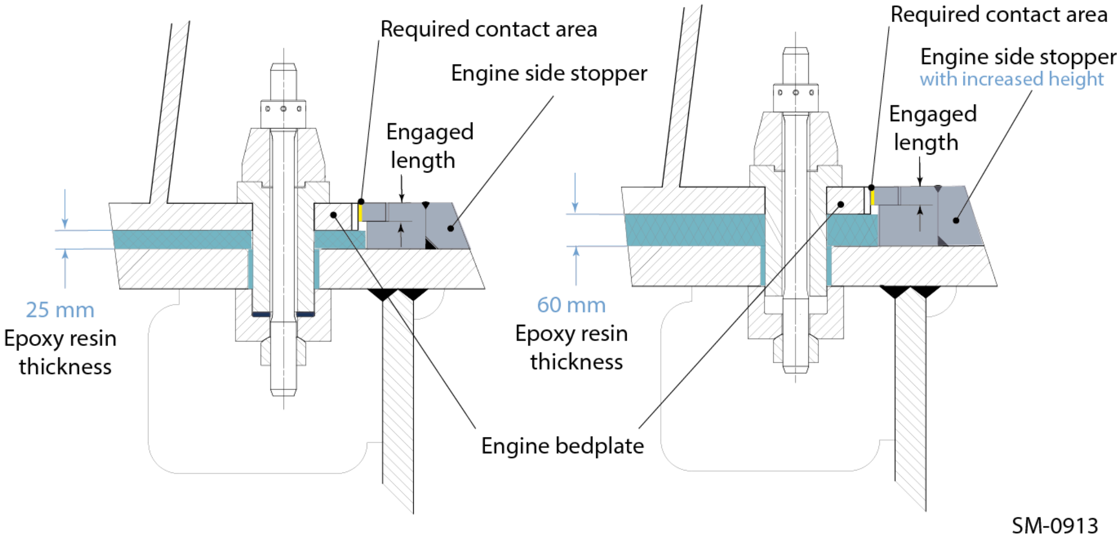

Figure 13: Required height adjustment of the engine side stopper

3 Project-specific adaption of the assembly parts

In general, the standard design of the foundation bolts, thrust sleeves, conical sockets, nuts, and bushes, allows for an epoxy resin thickness ranging from 25 to 60 mm. This thickness range provides full flexibility without any changes to the above components. However, if it is required to exceed this thickness range, then the following checks and adaptions are required:

1. Check with the epoxy resin supplier whether the required epoxy resin thickness is still permissible. If it is not permissible, it can also be executed in several layers like a “sandwich” (i.e. first layer with epoxy resin, second layer with a steel plate, and third layer again with epoxy resin).
2. Check whether the threads of the foundation bolts on both sides are sufficiently long to (a) cover the entire length of the threads within the nuts and (b) leave a thread protrusion beyond the nut, which is equal to at least one thread pitch. If the epoxy resin thickness is above the permissible range, elongate the bolt. Otherwise, if below the permissible range, shorten the bolt.
3. Check (a) whether there is sufficient space in the conical socket to cover the thrust sleeve(s) protrusion or (b) make sure that the sleeve(s) protrude(s) at least 5 mm beyond the lower side of the foundation’s top plate. If the epoxy resin thickness is below the permissible range and there is not sufficient space within the thrust sleeve, the depth of the blind hole in the conical socket must be increased and the total height of the conical socket adapted accordingly. Otherwise, if the epoxy resin thickness is above the permissible range and the thrust sleeve protrusion is too short, the length of the thrust sleeve must be increased.
4. Check whether the minimum contact area between the engine side stoppers and the engine bedplate is still secured. If this requirement is not met, then the height of the engine side stoppers must be adapted.

If an alternative design is necessary, please send a completed “Request for Alternative Execution (RAE)” to WinGD for evaluation and approval.

4 Engine fitting (assembly steps)

For the installation of the engine within the engine room, the assembly steps described in the following sections (4.1 to 4.12) must be followed.

4.1 Drilling of the holes in the foundation top plate

For the foundation top plate, the holes of the foundation bolts and thrust sleeves must be pre-machined by the shipyard. These holes can be flame-cut or drilled with a larger diameter than the thrust sleeves and/or bolts to enable proper engine alignment (without re-machining of the holes). The machining tolerances are provided in the MIDS “DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B”.

4.2 Engine lifting within the engine room

The engine, either in one part or sub-assemblies, must be lifted by means of an appropriate crane into the engine room and placed on temporary support blocks. The blocks must be slightly higher than the starting position for engine alignment. This way, less effort is required to lower the engine than to raise it for alignment.

4.3 Installation of the engine side stoppers

Temporarily secure the engine bedplate against unexpected movement. Then place and weld the engine side stoppers into the positions defined in the MIDS “DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B”. This must be completed without assembly of the wedges.

4.4 Preparation of wedges or jacking screws with hydraulic jacks for engine alignment

For engine alignment there must be jacking screws or wedges and/or shims used. These engine alignment tools are shown in Figure 14 and Figure 15.

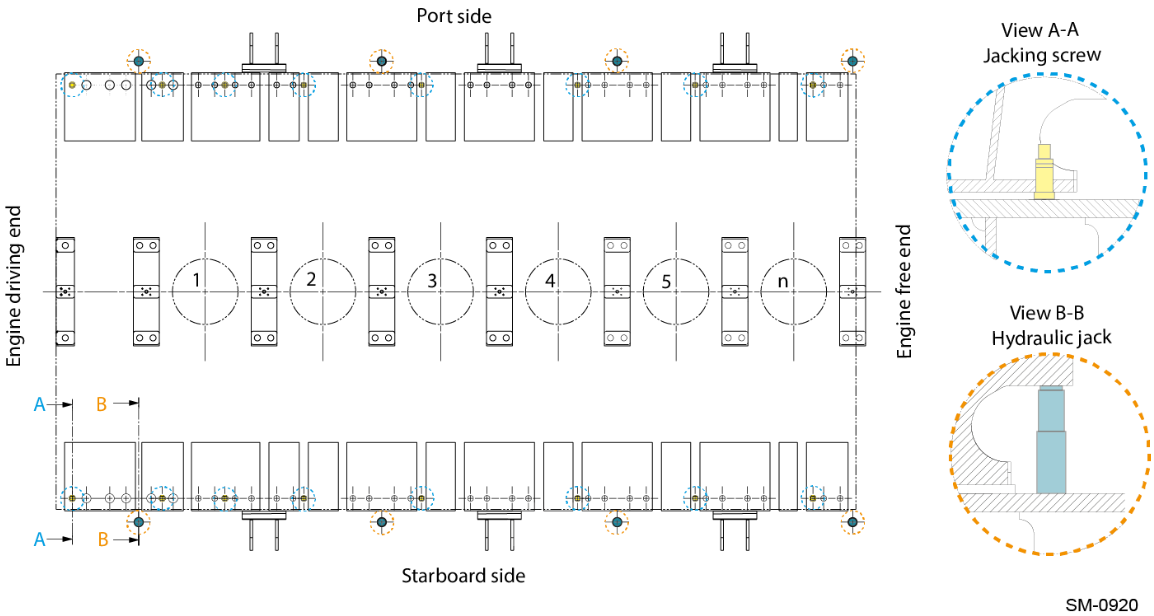

Figure 14: Engine alignment by jacking screws with hydraulic jacks

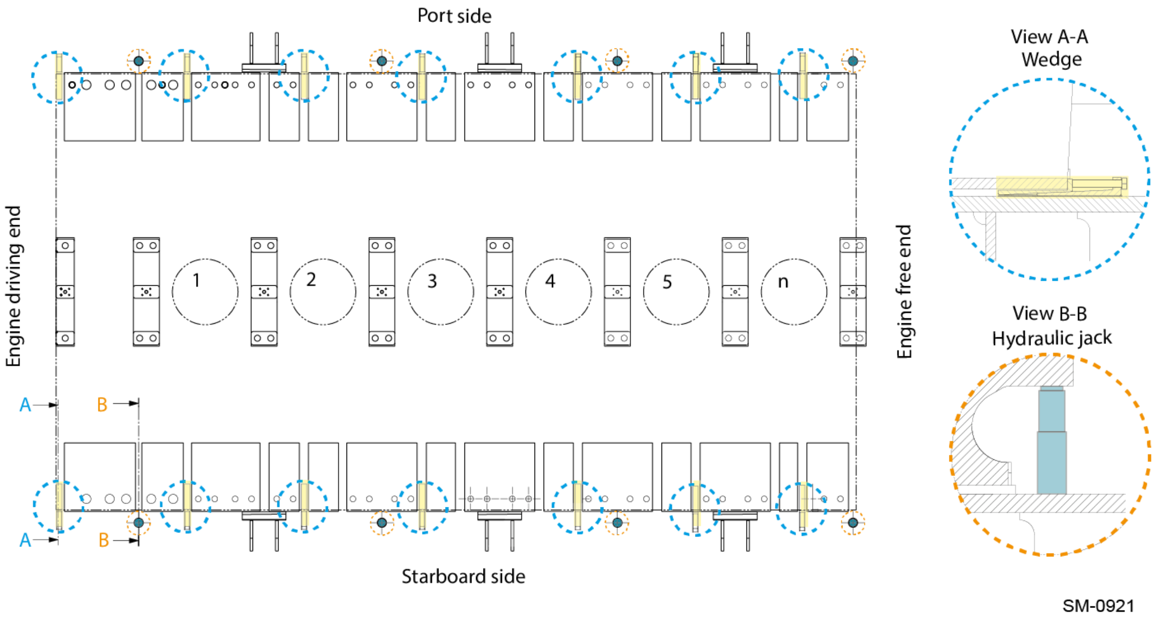

Figure 15: Engine alignment by wedges and/or shims with hydraulic jacks

The lifting must always be supported by hydraulic jacks, independent of whether jacking screws or wedges and/or shims are used. This is to prevent local overloading and to enable easier lifting. All engine alignment tools must be placed in the positions defined in the MIDS “DG 9710 - 01 - Engine Tool Alignment”.

If jacking screws are used, they must be screwed in until they are touching the foundation top plate. If a jacking screw is located within a planned epoxy resin area, the protruding thread underneath the engine bedplate must be encased with a sponge rubber ring (see Figure 16).

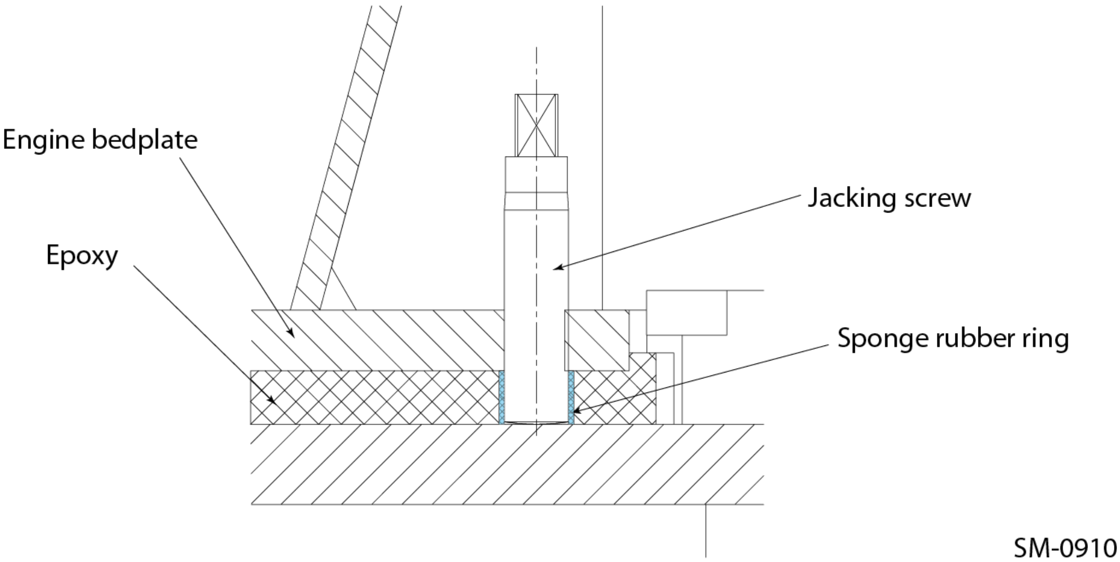

Figure 16: Encasing the thread of the jacking screw

If wedges and/or shims are used, they must be inserted as deep as possible below the engine bedplate. This ensures that the support point is as close to the engine monoblock column.

4.5 Engine alignment

The engine alignment must be completed according to the guidance provided in the MIDS "DG 9709 - Engine Alignment", which is available on the WinGD webpage under the following link:
WinGD-2S Engine Alignment

In addition, the recommendations that follow in section 4.5.1 and 4.5.2, regarding the correct handling of either the jacking screws or wedges and/or shims, must be strictly observed to prevent any potential damage (e.g. the deformation of the engine bedplate by local overloading).

4.5.1 Engine alignment with wedges

1. Remove the temporary blocks by slightly lifting the engine with the hydraulic jacks.
2. Start with the engine alignment by means of wedges and/or shims. Before adjusting the height of wedges and/or shims, lift the engine by the hydraulic jacks. Any height adjustment must be performed in small, incremental steps (maximum 1 mm per step). Changes in height larger than the 1 mm maximum allowance, require a gradual process where all wedges and/or shims are successively adjusted in stages. This is required to ensure the best possible load distribution.
3. Continue with the engine alignment until the target values for load distribution and crankweb deflection are achieved.

4.5.2 Engine alignment with jacking screws

1. Remove the temporary blocks by slightly lifting the engine with the hydraulic jacks.
2. Start with the engine alignment by means of jacking screws. Before turning a jacking screw, reduce its load by use of the hydraulic jacks. Any height adjustment must be performed in small, incremental steps with a maximum of 1 mm per step (equal to a half screw turn, based on a 2 mm thread pitch). Changes in height larger than the 1 mm maximum allowance, require a gradual process where all jacking screws are successively adjusted in stages. This is required to ensure the best possible load distribution.
3. Continue with the engine alignment until the target values for load distribution and crankweb deflection are achieved.

4.6 Inserting of the thrust sleeves and plugs

After completion of the engine alignment, the thrust sleeves must be in inserted in the pre-machined holes in the engine bedplate/foundation top plate. As soon as they are in place, the corresponding foundation bolts with pre-assembled nuts and bushes must also be inserted. Then the contact surfaces between the conical sockets and the foundation top plate must be smeared with a gasket sealant. This must be completed before the conical sockets with the spherical round nuts are fitted (referred to in Figure 17 as "Bolting with thrust sleeves"). Finally, all nuts must be slightly tightened by hand.

For the foundation bolts inserted without thrust sleeves, the holes must be temporary closed with plugs to prevent being filled with epoxy resin (referred to in Figure 17 as "Standard bolting"). Regarding the plug material, there are no special requirements. It can be selected according to shipyard experience.

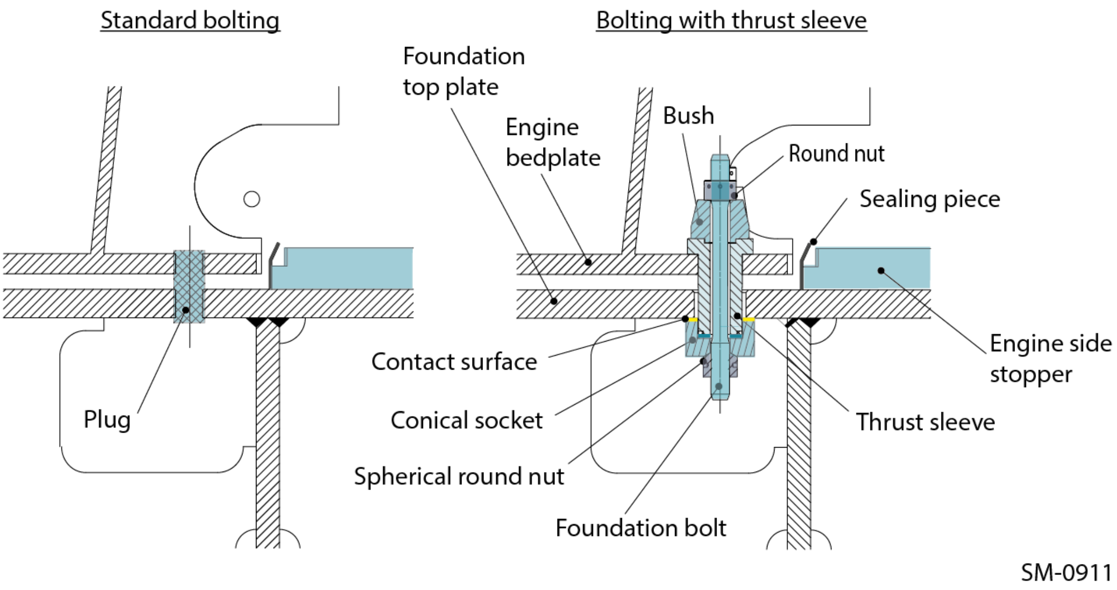

Figure 17: Condition before pouring the epoxy resin

4.7 Pouring of the epoxy resin

Pour the epoxy resin areas with the layout as provided in the MIDS “DG 9710 - Engine Seating Foundation - Chocking and drilling plan for foundation bolts, section B-B”. For the filling of the epoxy resin, a sealing piece can be used. The detailed layout of this sealing piece is provided in the MIDS “DG 9710 – Sealing Piece”. The pouring of the epoxy resin together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. The instructions of the epoxy resin manufacturers must be accurately observed.

4.8 Removal of the tools

Before proceeding with any work on the engine foundation, the curing period in the instructions of the epoxy resin manufacturers or their representatives must be accurately observed. On completion of the curing period, the sealing piece and supporting devices must be removed (e.g. jacking screws, as well as wedges and/or shims).

4.9 Assembly of the foundation bolts

First remove the plugs in the foundation bolt holes and insert the foundation bolts with bushes and pre-assembled round nuts. Then assemble the conical sockets with the spherical round nuts and tighten the nuts slightly by hand (see Figure 18).

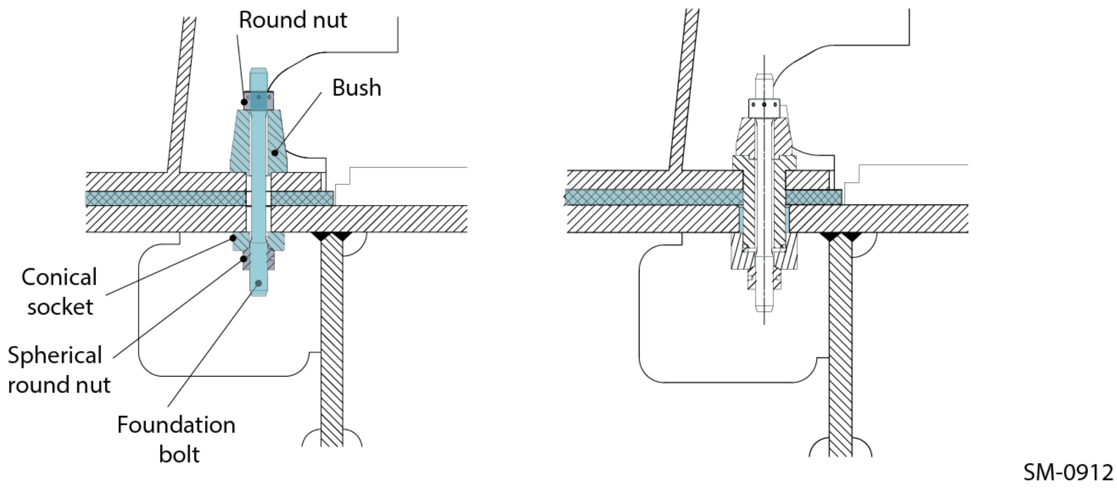

Figure 18: Condition after pouring the epoxy resin

4.10 Assembly and tightening of the foundation bolts

4.10.1 Tightening sequence

All foundation bolts are tightened by means of a hydraulic pre-tensioner, which is included in the engine tool kit. Usually, the tightening procedure begins at the engine driving end and continues alternating from side to side or in parallel on both sides in the direction of the engine free end. Variations in this sequence are possible (see Figure 20 and Figure 19).

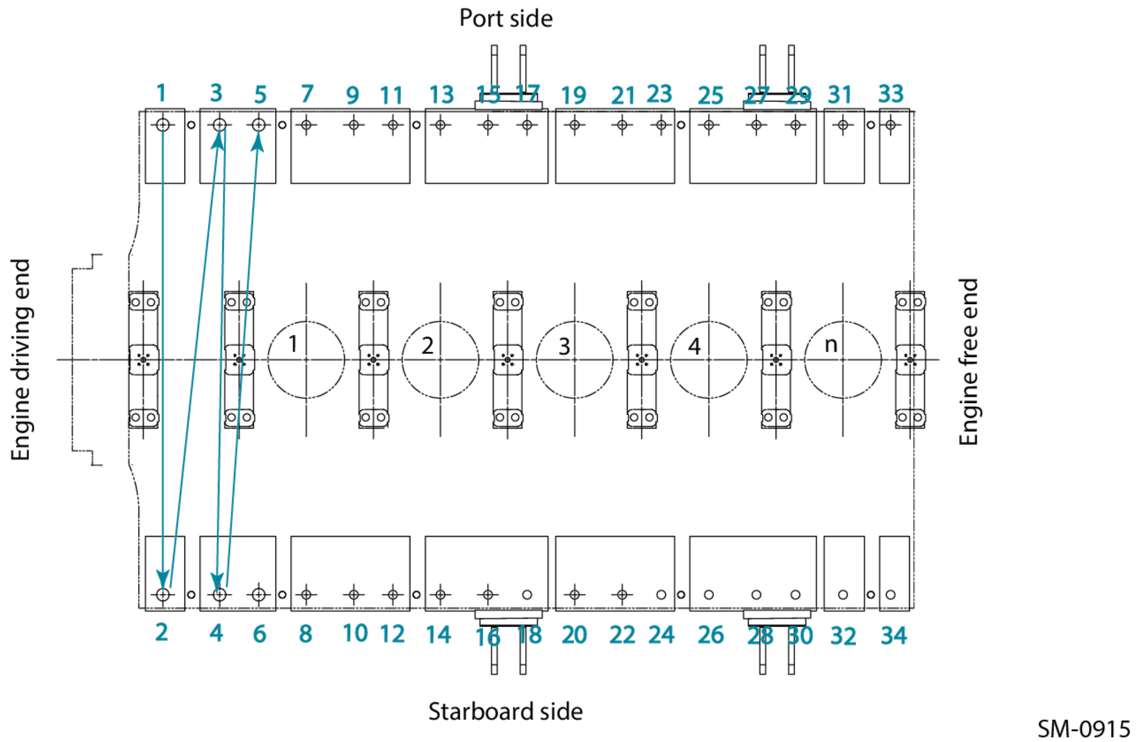

Figure 19: Variant 1 tightening sequence, alternating from side to side with single bolts

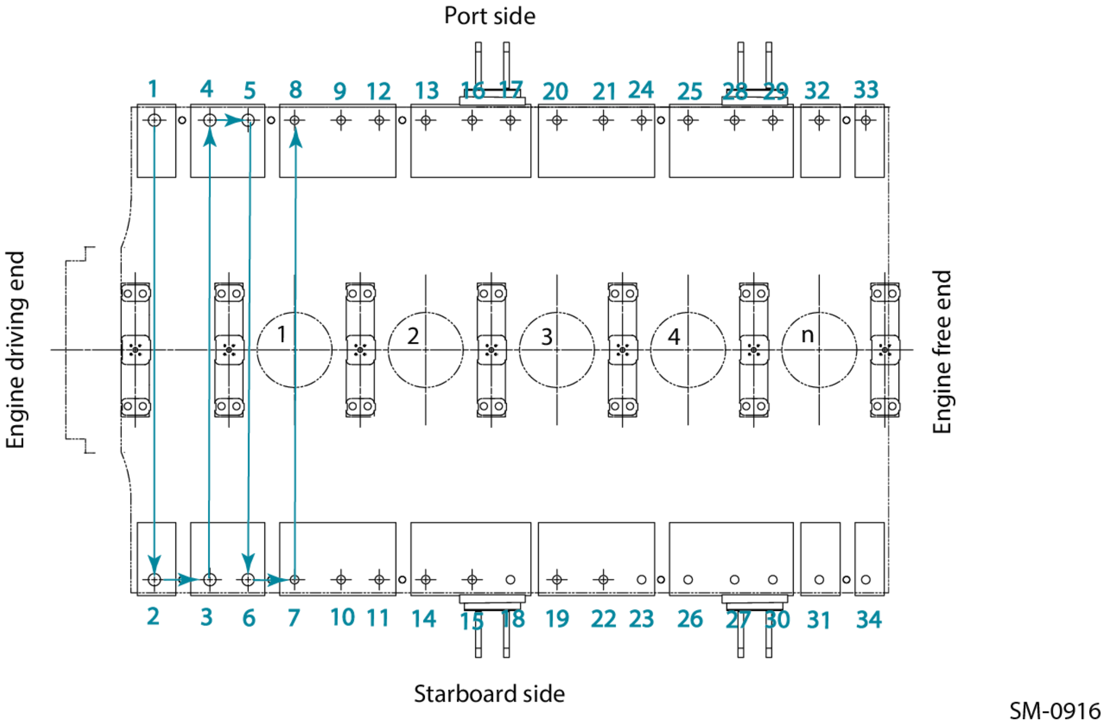

Figure 20: Variant 2 tightening sequence, alternating from side to side with bolts in pairs

4.10.2 Tightening forces

Depending on the engine type, the following specific tightening pressures must be applied on the foundation bolt pre-tensioner, which is included in the engine tool kit (code no. 94145).

Table 2: Foundation bolts tightening data

Engine type	Foundation bolt thread size	Number of foundation bolts per cylinder Total no. of bolts / no. of cylinders a)	Hydraulic tightening pressure p [bar] b)	Nominal pretension force per foundation bolt Fv [kN]
X35/-B	M 36	4	1500	290
X40/-B/DF-1.0	M 36	6	1500	290
RT-flex50/-D/DF	M 48	7	1500	330
X52/-1.1/DF/DF-1.1/DF-2.1	M 48	8	1500	330
X52DF-A-1.0	M 48	8	1500	330
X52DF-M-S1.0	M 30	9	1800	310
X52-S2.0/DF-S1.0/DF-S2.0	M 30	9	1800	310
X62/-B/DF/-1.1	M 64	7	1500	690
X62DF-1.1/DF-2.1	M 64	7	1500	690
X62DF-1.1/DF-2.1	M 36	9	1800	460
X62-S2.0/DF-S1.0/DF-S2.0	M 36	9	1800	460
X72-B/DF	M 42	8	1800	630
X72-B/DF	M 64	8	1500	630
X72DF-1.1/DF-1.2/ DF-2.1/DF-2.2	M 64	8	1500	630
X72DF-1.1/DF-1.2/ DF-2.1/DF-2.2	M 42	10	1800	630
X72DF-A-1.0	M 42	10	1800	630
X82-B	M 64	10	1500	690
X82-2.0/DF-1.0/DF-2.0	M 48	9	1800	800

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X82DF-M-1.0	M 48	9	1800	800
X92/-B/DF/DF-2.0	M 64	10	1500	800
X92-B/DF/DF-2.0	M 56	9	1500	1100
X92-B/DF/DF-2.0	M 56	9	1800	1100
X92DF-M-1.0	M 56	9	1800	1100

Remarks:

[a] Rounded values, only as reference

[b] Tightening procedure: 1st step: 1000 bar, 2nd step: As specified. The maximum working pressure is mentioned on the tool (e.g. on the cover). It must be strictly observed, as there are tool executions for the same thread size but with different effective piston pressure areas available.

4.11 Assembly of engine side stopper wedges

After tightening all foundation bolts, place the wedges on the engine side stoppers and drive them in with light hammer blows (see Figure 21).

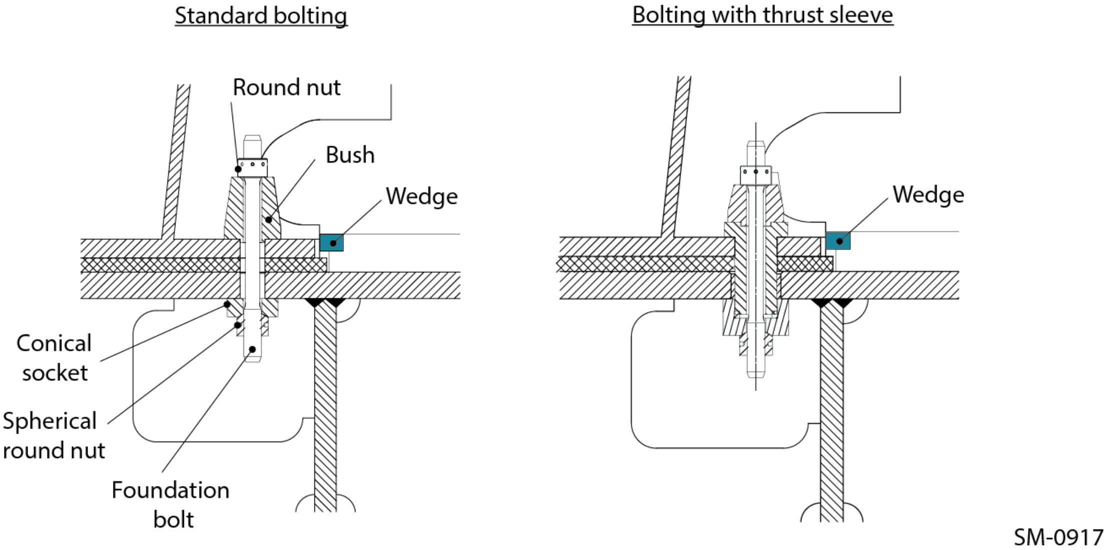

Figure 21: Engine side stopper wedges application

As soon as the wedges have been fitted in the final position, secure them against further drifting by a welding over the entire length of the wedge (see Figure 22Figure 22).

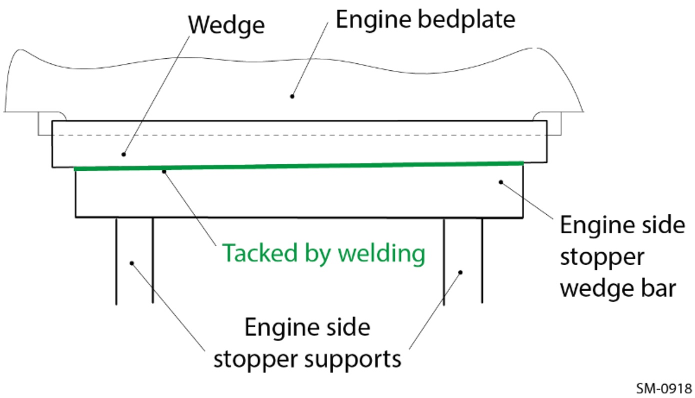

Figure 22: Engine side stopper wedge fixation

4.12 Checks after assembly and during ship operation

The pre-tensioning forces of all bolts must be checked again right after the assembly and within the regular maintenance intervals defined in the engine's Instruction Manual (IM).

MIDS – Fitting Instruction

X, X-DF, X-DF-M, X-DF-A

TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2016-10-26	DRAWING SET	First web upload
2022-11-11	107.412.130-C	New revision
2024-09-11	107.412.130-D	New revision