1 **Introduction**

Apart from the normal conventional engine holding down stud used to fasten the engine to the tank top plate, a different design is to be applied for the propeller thrust transmission. The propeller thrust is transmitted from the engine thrust bearing to the bedplate and to the tank top plate which is part of the ship’s structure by means of thrust sleeves located adjacent to the engine thrust bearing.

2 **Thrust sleeve**

2.1 **Fitting**

The thrust sleeve is fitted in the bottom plate of the engine bedplate and cast in the tank top plate. The diameter of the flame-cut or drilled hole for the thrust sleeve in the tank top plate is larger than the diameter of the sleeve to allow engine alignment without re-machining of the hole. The sleeve in the tank top plate hole is then fixed with epoxy resin material as used for the chocks. The engine holding down stud is inserted in the sleeve and tightened in the same way as the normal holding down studs. This hydraulically tightened holding down stud is of the same design, as the normal holding down stud used to fasten the engine to the tank top plate. Drilling and reaming of the holes in the engine bedplate is carried out by the engine manufacturer. The thrust sleeves with the final tolerance and the holding down studs are supplied by the shipyard.

2.2 **Drilling of the holes in the tank top plate**

The holes for the thrust sleeves must be drilled or flame-cut in the tank top plate before setting the engine in position. These holes are prepared while observing the dimensions given on the drawing ‘Chocking and drilling plan, section B-B’. The holes for the normal holding down studs can be drilled or flame-cut either before or after setting the engine in position.

2.3 **Chock thickness**

Since the chock thickness cannot be precisely determined before engine alignment is finalized, the standard design of the holding down stud, thrust sleeve and conical socket, allows for the application of chock thicknesses from 25 up to 60 mm. To avoid additional machining of the sleeve to adjust its length, the conical socket is provided with a larger bore compared to the sleeve’s external diameter.
The sleeve can protrude beyond the top plate more or less, the space in the conical socket allows for this variability.
If chock thickness needs to be more than 60 or less than 25 mm, the length of the thrust sleeve and its corresponding holding down stud as well as the length of the normal holding down stud must be in- or decreased accordingly. Please note: In any case, if the minimum thickness is less than 25 mm, the epoxy resin supplier must be consulted.

3 Pouring of the epoxy resin chocks

3.1 Conditions before pouring

- Engine fully aligned
- All side stoppers welded in place, wedges not fitted
- For thrust sleeves (see figure 1): Thrust sleeves and their accompanying holding down studs inserted into the corresponding holes with the studs/nuts tightened by hand. The bush and the sponge rubber sealing fixed correctly under the tank top plate. Contact surface conical socket/top plate smeared with gasket sealant.
- For normal holding down studs (see figure 2): Sponge rubber plugs or similar inserted into bedplate where normal studs are applied.

3.2 Pouring

Pouring of the epoxy resin chocks together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. Their instructions must be strictly observed. In particular, no yard work on the engine foundation may proceed before completion of the curing period of the epoxy resin chocks. Epoxy resin material for the thrust sleeve holes is identical to that used for the chocks.

The epoxy resin material applied for the chocking of the engine has to fulfill the following requirements:

- Approved by the major classification societies
- The following materials properties are met:
4 Tightening the holding down studs

The instructions of the epoxy resin manufacturers or their representatives concerning the curing period must be strictly observed before any work on the engine foundation may proceed. On completion of the curing period, the supporting devices, i.e. jacking screws, jacking wedges, etc., must be removed before the holding down studs are tightened. All engine’s holding down studs are tightened by means of a hydraulic pre-tensioning jack. The tightening procedure begins at the driving end and continues alternating from side to side or in parallel on both sides in the direction of the engine free end. After tightening all engine holding down studs, fit the side stopper wedges.

5 Table and figures

5.1 Tightening pressures

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Pretension force per stud Fv [kN]*1</th>
<th>Hydraulic tightening pressure p [bar] *2</th>
<th>Code-No. of hydr. pre-tensioning jack*3</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-X35, W-X40</td>
<td>280</td>
<td>1500</td>
<td>94145</td>
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<td>W-X62, W-X72</td>
<td>700</td>
<td>1500</td>
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<td>W-X92</td>
<td>800</td>
<td>1500</td>
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</tbody>
</table>

Remarks: *1) Including an efficiency loss during tightening process  
*2) Tightening procedure: 1st step 1000 bar, 2nd step 1500 bar  
*3) The hydraulic pre-tensioning jack is part of the engine builder’s tool kit

Table 2: Foundation bolts tightening data
5.2 Figures

Figure 1: Arrangement of thrust sleeve with stud prior pouring the epoxy resin chocks

Figure 2: Arrangement prior pouring the epoxy resin chocks for normal stud (proposal)
Fitting of the engine seating and holding down studs.
For engine seating with epoxy resin chocks

1. Introduction
Apart from the normal, conventional engine holding down stud used to fasten the engine to the tank top plate, a different design is to be applied for the propeller thrust transmission. The propeller thrust is transmitted from the engine thrust bearing to the bedplate and to the tank top plate which is part of the ship's structure by means of thrust sleeves located adjacent to the engine thrust bearing.

2. Thrust sleeve

2.1 Fitting
The thrust sleeve is fitted in the bottom plate of the engine bedplate and cast in the tank top plate. The diameter of the flame-cut or drilled hole for the thrust sleeve in the tank top plate is larger than the diameter of the sleeve to allow engine alignment without re-machining of the hole. The sleeve in the tank top plate hole is then fixed with epoxy resin material as used for the chocks. The engine holding down stud is inserted in the sleeve and tightened in the same way as the normal holding down studs. This hydraulically tightened holding down stud is of the same design, as the normal holding down stud used to fasten the engine to the tank top plate. Drilling and reaming of the holes in the engine bedplate is carried out by the engine manufacturer. The thrust sleeves with the final tolerance and the holding down studs are supplied by the shipyard.

2.2 Drilling of the holes in the tank top plate
The holes for the thrust sleeves must be drilled or flame-cut in the tank top plate before setting the engine in position. These holes are prepared while observing the dimensions given on the drawing 'Chocking and drilling plan, section B-B'. The holes for the normal holding down studs can be drilled or flame-cut either before or after setting the engine in position.

2.3 Chock thickness
Since the chock thickness cannot be precisely determined before engine alignment is finalized, the standard design of the holding down stud, thrust sleeve and conical washer allows for the application of chock thicknesses from 25 up to 60mm. To avoid additional machining of the sleeve to adjust its length, the conical washer is provided with a larger bore compared to the sleeve's external diameter. The sleeve can protrude beyond the top plate more or less, the space in the washer allows for this variable. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the thrust sleeve and its corresponding holding down stud as well as the length of the normal holding down stud must be in- or decreased accordingly. Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

3. Pouring of the epoxy resin chocks
3.1 Conditions before pouring
- Engine fully aligned
- All side stoppers welded in place, wedges not fitted
- For thrust sleeves (see fig. 1): Thrust sleeves and their accompanying holding down studs inserted into the corresponding holes with the studs/nuts tightened by hand. The bush and the sponge rubber sealing fixed correctly under the tank top plate. Contact surface washer/top plate smeared with gasket sealant.
- For normal holding down studs (see fig. 2): Sponge rubber plugs or similar inserted into bedplate where normal studs are applied.
3.2 Pouring

Pouring of the epoxy resin chocks together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. Their instructions must be strictly observed. In particular, no yard work on the engine foundation may proceed before completion of the curing period of the epoxy resin chocks. Epoxy resin material for the thrust sleeve holes is identical to that used for the chocks.

The epoxy resin material applied for the chocking of the engine has to fulfill the following requirements:

- Approved by the major classification societies

- The following materials properties are met:

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

Required properties of epoxy resin material

4. Tightening the holding down studs

The instructions of the epoxy resin manufacturers or their representatives concerning the curing period must be strictly observed before any work on the engine foundation may proceed. On completion of the curing period the supporting devices, i.e. jacking screws, jacking wedges, etc., must be removed before the holding down studs are tightened. All engine’s holding down studs are tightened by means of a hydraulic pre-tensioning jack. The tightening procedure begins at the driving end and continues alternating from side to side in the direction of the engine free end. After tightening all engine holding down studs, fit the side stopper wedges.
### 5. Table and figures

#### 5.1 Tightening pressures

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Pretension force per stud Fv [kN] (^{1)})</th>
<th>Hydr. tightening pressure p [bar]</th>
<th>Code-No. of hydr. pre-tensioning jack (^{2)})</th>
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<td>1500</td>
<td>94145</td>
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<tr>
<td>RTA82T/RT-flex82T</td>
<td>700</td>
<td>1500</td>
<td>94145</td>
</tr>
</tbody>
</table>

Remarks:
*1) Including an efficiency loss during tightening process
*2) The hydraulic pre-tensioning jack is part of the engine builder's tool kit

#### 5.2 Figures

**Fig.1:** Arrangement of thrust sleeve with stud prior to pouring the epoxy resin chocks

- Thrust sleeve
- Prior to assembly: smear gasket sealant (Loctite 574/orange, or similar)
- Sponge rubber sealing, to be compressed when assembled
- Conical washer

---

**Fitting instructions**

to engine seating with epoxy resin chocks

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<th>Group 9710</th>
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</thead>
<tbody>
<tr>
<td>4-107.379.418</td>
<td></td>
<td>3/4</td>
</tr>
</tbody>
</table>
Fig. 2: Arrangement prior to pouring the epoxy resin chocks for normal stud (proposal)

Sponge rubber plug or similar
Fitting of the engine seating and holding down studs
for engine seating with epoxy resin chocks

1. Introduction
Apart from the normal, conventional engine holding down stud used to fasten the engine to the tank top plate, a different design is to be applied for the propeller thrust transmission. The propeller thrust is transmitted from the engine thrust bearing to the bedplate and to the tank top plate which is part of the ship’s structure by means of the a) thrust sleeve or b) fitted stud located adjacent to the engine thrust bearing.

2. Thrust sleeve
2.1 Fitting
The thrust sleeve is fitted in the bottom plate of the engine bedplate and cast in the tank top plate. The diameter of the flame-cut or drilled hole for the thrust sleeve in the tank top plate is larger than the diameter of the sleeve to allow engine alignment without re-machining of the hole. The sleeve in the tank top plate hole is then fixed with epoxy resin material as used for the chocks. The engine holding down stud is inserted in the sleeve and tightened in the same way as the normal holding down studs. This hydraulically tightened holding down stud is of the same design, as the normal holding down stud used to fasten the engine to the tank top plate. Drilling and reaming of the holes in the engine bedplate is carried out by the engine manufacturer. The thrust sleeves with the final tolerance and the holding down studs are supplied by the shipyard.

2.2 Drilling of the holes in the tank top plate
The holes for the thrust sleeves must be drilled or flame-cut in the tank top plate before setting the engine in position. These holes are prepared while observing the dimensions given on the drawing ‘Chocking and drilling plan, section B-B’. The holes for the normal holding down studs can be drilled or flame-cut either before or after setting the engine in position.

2.3 Chock thickness
Since the chock thickness cannot be precisely determined before engine alignment is finalized, the standard design of the holding down stud, thrust sleeve and conical washer allows for the application of chock thicknesses from 25 up to 60mm. To avoid additional machining of the sleeve to adjust its length, the conical washer is provided with a larger bore compared to the sleeve's external diameter. The sleeve can protrude beyond the top plate more or less, the space in the washer allows for this variable. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the thrust sleeve and its corresponding holding down stud as well as the length of the normal holding down stud must be in- or decreased accordingly. Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

3 Fitted stud
3.1 Fitting
The fitted stud is fitted in the bottom plate of the engine bedplate, the epoxy resin chock and the tank top plate. The holes in the bedplate and the top plate are reamed together when the engine is completely aligned. The fitted stud is then inserted and the chocks are poured. The engine bedplate is delivered with pre-drilled holes. The fitted studs with the final tolerance and the holding down studs are supplied by the shipyard.

3.2 Drilling of the holes in the tank top plate
The holes in the tank top plate for the fitted studs are to be pre-drilled when the engine is placed in position. Then drill out and ream the pre-drilled holes in the bedplate together with the holes in the
tank top plate to the foreseen final diameter. The holes for the normal holding down studs are to be drilled according to chocking and drilling plan.

3.3 Chock thickness

Since the chock thickness cannot be precisely determined before the engine alignment is finalised, the standard design of the fitted stud allows for the application of chock thicknesses from 25 up to 60mm. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the fitted stud and also of the normal holding down stud must be in- or decreased accordingly.

Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

4. Pouring of the epoxy resin chocks

4.1 Conditions before pouring

- Engine fully aligned
- All side stoppers welded in place, wedges not fitted
- When using thrust sleeves (see fig. 1): Thrust sleeves and their accompanying holding down studs inserted into the corresponding holes with the studs/nuts tightened by hand. The bush and the sponge rubber sealing fixed correctly under the tank top plate. Contact surface washer/top plate smeared with gasket sealant.
- When using fitted studs (see fig. 2): Fitted studs inserted into the corresponding holes and tightened by hand. The bush should be fixed correctly under the tank top plate.
- For normal holding down studs (see fig. 3): Sponge rubber plugs or similar inserted into bedplate where normal studs are applied.
4.2 Pouring

Pouring of the epoxy resin chocks together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. Their instructions must be strictly observed. In particular, no yard work on the engine foundation may proceed before completion of the curing period of the epoxy resin chocks. The filler material for the thrust sleeve holes is identical to that used for the chocks.

The epoxy resin material applied for the chocking of the engine has to fulfill the following requirements:

- Approved by the major classification societies
- The following materials properties are met:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standard</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate compression strength</td>
<td>ASTM D–695</td>
<td>min. 130 MPa</td>
</tr>
<tr>
<td>Compression yield point</td>
<td>ASTM D–695</td>
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<tr>
<td>Compressive modulus of elasticity</td>
<td>ASTM D–695</td>
<td>min. 3100 MPa</td>
</tr>
<tr>
<td>Deformation under load</td>
<td>ASTM D–621</td>
<td>max. 0.10 %</td>
</tr>
<tr>
<td>Load550 N / 70 °C</td>
<td></td>
<td>max. 0.15 %</td>
</tr>
<tr>
<td>Load1100 N / 70 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing shrinkage</td>
<td>ASTM D–2566</td>
<td>max. 0.15 %</td>
</tr>
<tr>
<td>Coefficient of thermal expansion (0-60 K)</td>
<td>ASTM D–696</td>
<td>max. 50 • 10⁻⁶ 1/K</td>
</tr>
<tr>
<td>Coefficient of friction</td>
<td>normal</td>
<td>min. 0.3</td>
</tr>
</tbody>
</table>

Required properties of epoxy resin material

5. Tightening the holding down studs

The instructions of the epoxy resin manufacturers or their representatives concerning the curing period must be strictly observed before any work on the engine foundation may proceed. On completion of the curing period the supporting devices, i.e. jacking screws, jacking wedges, etc., must be removed before the holding down studs are tightened. All engine’s holding down studs are tightened by means of a hydraulic pre-tensioning jack. The tightening procedure begins at the driving end and continues alternating from side to side in the direction of the engine free end. After tightening all engine holding down studs, fit the side stopper wedges.
6. Table and figures

6.1 Tightening pressures

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Pretension force per stud $F_v$ [kN] $^{(1)}$</th>
<th>Hydr. tightening pressure $p$ [bar]</th>
<th>Code-No. of hydr. pre-tensioning jack $^{(2)}$</th>
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<tr>
<td>RT-flex50</td>
<td>330</td>
<td>1500</td>
<td>94145</td>
</tr>
</tbody>
</table>

Remarks:

*1) Including an efficiency loss during tightening process
*2) The hydraulic pre-tensioning jack is part of the engine builder’s tool kit

6.2 Figures

Fig. 1: Arrangement of thrust sleeve with stud prior to pouring the epoxy resin chocks

![Arrangement of thrust sleeve with stud](image)

Remarks:

- Prior to assembly smear gasket sealant (Loctite 574/orange or similar)
- Sponge rubber sealant, to be compressed when assembled
- Bush (Distance piece)
Fig. 2: Arrangement of fitted stud prior to pouring the epoxy resin chocks

Fig. 3: Arrangement prior to pouring the epoxy resin chocks for normal stud (proposal)
Fitting of the engine seating and holding down studs for engine seating with epoxy resin chocks

1. Introduction
Apart from the normal, conventional engine holding down stud used to fasten the engine to the tank top plate, a different design is to be applied for the propeller thrust transmission. The propeller thrust is transmitted from the engine thrust bearing to the bedplate and to the tank top plate which is part of the ship’s structure by means of the a) thrust sleeve or b) fitted stud located adjacent to the engine thrust bearing.

2. Thrust sleeve
2.1 Fitting
The thrust sleeve is fitted in the bottom plate of the engine bedplate and cast in the tank top plate. The diameter of the flame-cut or drilled hole for the thrust sleeve in the tank top plate is larger than the diameter of the sleeve to allow engine alignment without re-machining of the hole. The sleeve in the tank top plate hole is then fixed with epoxy resin material as used for the chocks. The engine holding down stud is inserted in the sleeve and tightened in the same way as the normal holding down studs. This hydraulically tightened holding down stud is of the same design, except for the length, as the normal holding down stud used to fasten the engine to the tank top plate. Drilling and reaming of the holes in the engine bedplate is carried out by the engine manufacturer. The thrust sleeves with the final tolerance and the holding down studs are supplied by the shipyard.

2.2 Drilling of the holes in the tank top plate
The holes for the thrust sleeves must be drilled or flame-cut in the tank top plate before setting the engine in position. These holes are prepared while observing the dimensions given on the drawing ‘Chocking and drilling plan, section B-B’. The holes for the normal holding down studs can be drilled or flame-cut either before or after setting the engine in position.

2.3 Chock thickness
Since the chock thickness cannot be precisely determined before engine alignment is finalized, the standard design of the holding down stud, thrust sleeve and conical washer allows for the application of chock thicknesses from 25 up to 60mm. To avoid additional machining of the sleeve to adjust its length, the conical washer is provided with a larger bore compared to the sleeve’s external diameter. The sleeve can protrude beyond the top plate more or less, the space in the washer allows for this variable. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the thrust sleeve and its corresponding holding down stud as well as the length of the normal holding down stud must be increased or decreased accordingly. Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

3 Fitted stud
3.1 Fitting
The fitted stud is fitted in the bottom plate of the engine bedplate, the epoxy resin chock and the tank top plate. The holes in the bedplate and the top plate are reamed together when the engine is completely aligned. The fitted stud is then inserted and the chocks are poured. The engine bedplate is delivered with pre-drilled holes. The fitted studs with the final tolerance and the holding down studs are supplied by the shipyard.

3.2 Drilling of the holes in the tank top plate
The holes in the tank top plate for the fitted studs are to be pre-drilled when the engine is placed in position. Then drill out and ream the pre-drilled holes in the bedplate together with the holes in the tank top plate to the foreseen final diameter. The holes for the normal holding down studs are drilled with the same diameter as those in the bedplate.

3.3 Chock thickness

Since the chock thickness cannot be precisely determined before the engine alignment is finalised, the standard design of the fitted stud allows for the application of chock thicknesses from 25 up to 60mm. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the fitted stud and also of the normal holding down stud must be increased accordingly.

Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

4. Pouring of the epoxy resin chocks

4.1 Conditions before pouring

- Engine fully aligned
- All side stoppers welded in place, wedges not fitted
- **When using thrust sleeves (see fig. 1):** Thrust sleeves and their accompanying holding down studs inserted into the corresponding holes with the studs/nuts tightened by hand. The conical washers and the sponge rubber sealings fixed correctly under the tank top plate. Contact surface washer/top plate smeared with gasket sealant.
- **When using fitted studs (see fig. 2):** Fitted studs inserted into the corresponding holes and tightened by hand. The conical washers fixed correctly under the tank top plate.
- **For normal holding down studs (see fig. 3):** Sponge rubber plugs or similar inserted into bedplate where normal studs are applied.
4.2 Pouring

Pouring of the epoxy resin chocks together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. Their instructions must be strictly observed. In particular, no yard work on the engine foundation may proceed before completion of the curing period of the epoxy resin chocks. Epoxy resin material for the thrust sleeve holes is identical to that used for the chocks.

The epoxy resin material applied for the chocking of the engine has to fulfil the following requirements:

- Approved by the major classification societies
- The following materials properties are met:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standard</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate compression strength</td>
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<td>min. 130 MPa</td>
</tr>
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<td>Compression yield point</td>
<td>ASTM D–695</td>
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<td>Load 550 N / 70 °C</td>
<td></td>
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<td>Load 1100 N / 70 °C</td>
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<tr>
<td>Curing shrinkage</td>
<td>ASTM D–2566</td>
<td>max. 0.15 %</td>
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<tr>
<td>Coefficient of thermal expansion (0-60 K)</td>
<td>ASTM D–696</td>
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<td>Coefficient of friction normal</td>
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<td>min. 0.3</td>
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</table>

Required properties of epoxy resin material

5. Tightening the holding down studs

The instructions of the epoxy resin manufacturers or their representatives concerning the curing period must be strictly observed before any work on the engine foundation may proceed. On completion of the curing period the supporting devices, i.e. jacking screws, jacking wedges, etc., must be removed before the holding down studs are tightened. All engine holding down studs are tightened by means of a hydraulic pre-tensioning jack. The tightening procedure begins at the driving end and continues alternating from side to side in the direction of the engine free end. After tightening all engine holding down studs, fit the side stopper wedges.
### 6. Table and figures

#### 6.1 Tightening pressures

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Pretension force per stud Fv [kN]</th>
<th>Hydr. tightening pressure p [bar]</th>
<th>Code-No. of hydr. pretensioning jack</th>
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<td>463</td>
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Remarks:

*1) Including an efficiency loss during tightening process

*2) The hydraulic pretensioning jack is part of the engine builder’s tool kit

#### 6.2 Figures

**Fig. 1:** Arrangement of thrust sleeve with stud prior to pouring the epoxy resin chocks

![Diagram of thrust sleeve with stud](image)

- Thrust sleeve
- Prior to assembly smear gasket sealant (Loctite 574/orange, or similar)
- Sponge rubber sealing, to be compressed when assembled
- Conical washer
Fitting instructions to engine seating with epoxy resin chocks

Fig. 2: Arrangement of fitted stud prior to pouring the epoxy resin chocks

Fig. 3: Arrangement prior to pouring the epoxy resin chocks for normal stud (proposal)
Fitting of the engine seating and holding down studs
for engine seating with epoxy resin chocks

1. Introduction
Apart from the normal, conventional engine holding down stud used to fasten the engine to the tank top plate, a different design is to be applied for the propeller thrust transmission. The propeller thrust is transmitted from the engine thrust bearing to the bedplate and to the tank top plate which is part of the ship’s structure by means of the a) thrust sleeve or b) fitted stud located adjacent to the engine thrust bearing.

2. Thrust sleeve
2.1 Fitting
The thrust sleeve is fitted in the bottom plate of the engine bedplate and cast in the tank top plate. The diameter of the flame-cut or drilled hole for the thrust sleeve in the tank top plate is larger than the diameter of the sleeve to allow engine alignment without re-machining of the hole. The sleeve in the tank top plate hole is then fixed with epoxy resin material as used for the chocks. The engine holding down stud is inserted in the sleeve and tightened in the same way as the normal holding down studs. This hydraulically tightened holding down stud is of the same design, except for the length, as the normal holding down stud used to fasten the engine to the tank top plate. Drilling and reaming of the holes in the engine bedplate is carried out by the engine manufacturer. The thrust sleeves with the final tolerance and the holding down studs are supplied by the shipyard.

2.2 Drilling of the holes in the tank top plate
The holes for the thrust sleeves must be drilled or flame-cut in the tank top plate before setting the engine in position. These holes are prepared while observing the dimensions given on the drawing ‘Chocking and drilling plan, section B-B’. The holes for the normal holding down studs can be drilled or flame-cut either before or after setting the engine in position.

2.3 Chock thickness
Since the chock thickness cannot be precisely determined before engine alignment is finalized, the standard design of the holding down stud, thrust sleeve and conical washer allows for the application of chock thicknesses from 25 up to 60mm. To avoid additional machining of the sleeve to adjust its length, the conical washer is provided with a larger bore compared to the sleeve’s external diameter. The sleeve can protrude beyond the top plate more or less, the space in the washer allows for this variable. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the thrust sleeve and its corresponding holding down stud as well as the length of the normal holding down stud must be increased or decreased accordingly. Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

3 Fitted stud
3.1 Fitting
The fitted stud is fitted in the bottom plate of the engine bedplate, the epoxy resin chock and the tank top plate. The holes in the bedplate and the top plate are reamed together when the engine is completely aligned. The fitted stud is then inserted and the chocks are poured. The engine bedplate is delivered with pre-drilled holes. The fitted studs with the final tolerance and the holding down studs are supplied by the shipyard.

3.2 Drilling of the holes in the tank top plate
The holes in the tank top plate for the fitted studs are to be pre-drilled when the engine is placed in
position. Then drill out and ream the pre-drilled holes in the bedplate together with the holes in the tank top plate to the foreseen final diameter. The holes for the normal holding down studs are drilled with the same diameter as those in the bedplate.

3.3 Chock thickness

Since the chock thickness cannot be precisely determined before the engine alignment is finalised, the standard design of the fitted stud allows for the application of chock thicknesses from 25 up to 60mm. At the project stage, if chock thicknesses are foreseen to be more than 60 or less than 25mm, the length of the fitted stud and also of the normal holding down stud must be increased accordingly.

Please note: In any case, if the minimum thickness is less than 25mm, the epoxy resin supplier must be consulted.

4. Pouring of the epoxy resin chocks

4.1 Conditions before pouring

- Engine fully aligned
- All side stoppers welded in place, wedges not fitted
- When using thrust sleeves (see fig. 1): Thrust sleeves and their accompanying holding down studs inserted into the corresponding holes with the studs/nuts tightened by hand. The conical washers and the sponge rubber sealings fixed correctly under the tank top plate. Contact surface washer/top plate smeared with gasket sealant.
- When using fitted studs (see fig. 2): Fitted studs inserted into the corresponding holes and tightened by hand. The conical washers fixed correctly under the tank top plate.
- For normal holding down studs (see fig. 3): Sponge rubber plugs or similar inserted into bedplate where normal studs are applied.
4.2 Pouring

Pouring of the epoxy resin chocks together with its preparatory work must be carried out either by experts of the epoxy resin manufacturers or by their representatives. Their instructions must be strictly observed. In particular, no yard work on the engine foundation may proceed before completion of the curing period of the epoxy resin chocks. Epoxy resin material for the thrust sleeve holes is identical to that used for the chocks.

The epoxy resin material applied for the chocking of the engine has to fulfil the following requirements:

- Approved by the major classification societies
- The following materials properties are met:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standard</th>
<th>Values</th>
</tr>
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<tbody>
<tr>
<td>Ultimate compression strength</td>
<td>ASTM D–695</td>
<td>min. 130 MPa</td>
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<td>Compression yield point</td>
<td>ASTM D–695</td>
<td>min. 100 MPa</td>
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<td>Compressive modulus of elasticity</td>
<td>ASTM D–695</td>
<td>min. 3100 MPa</td>
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<td>Deformation under load</td>
<td>ASTM D–621</td>
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<td>Load 550 N / 70 °C</td>
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<td>max. 0.15 %</td>
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<td>Load 1100 N / 70 °C</td>
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<tr>
<td>Curing shrinkage</td>
<td>ASTM D–2566</td>
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<td>Coefficient of thermal expansion (0-60 K)</td>
<td>ASTM D–696</td>
<td>max. 50 • 10⁻⁶ /K</td>
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<tr>
<td>Coefficient of friction</td>
<td>normal</td>
<td>min. 0.3</td>
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Required properties of epoxy resin material

5. Tightening the holding down studs

The instructions of the epoxy resin manufacturers or their representatives concerning the curing period must be strictly observed before any work on the engine foundation may proceed. On completion of the curing period the supporting devices, i.e. jacking screws, jacking wedges, etc., must be removed before the holding down studs are tightened. All engine holding down studs are tightened by means of a hydraulic pre-tensioning jack. The tightening procedure begins at the driving end and continues alternating from side to side in the direction of the engine free end. After tightening all engine holding down studs, fit the side stopper wedges.
6. Table and figures

6.1 Tightening pressures

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Pretension force per stud Fv [kN] (^1)</th>
<th>Hydr. tightening pressure p [bar]</th>
<th>Code-No. ofhydr. pre-tensioning jack (^2)</th>
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<tr>
<td>RT-flex48T-D</td>
<td>330</td>
<td>1000</td>
<td>94145</td>
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Remarks:  
\(^1\) Including an efficiency loss during tightening process  
\(^2\) The hydraulic pretensioning jack is part of the engine builder’s tool kit

6.2 Figures

**Fig. 1:** Arrangement of thrust sleeve with stud prior to pouring the epoxy resin chocks

- Thrust sleeve
- Prior to assembly smear gasket sealant (Loctite 574/orange, or similar)
- Sponge rubber sealing, to be compressed when assembled
- Conical washer
Fig. 2: Arrangement of fitted stud prior to pouring the epoxy resin chocks

Fig. 3: Arrangement prior to pouring the epoxy resin chocks for normal stud (proposal)
FITTING-INSTRUCTION_WinGD-2S_ENGINE-SEATING-FOUNDATION

TRACK CHANGES

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