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Norden Maritime AS

COMPANY HISTORY

Established since 1996, Norden Maritime AS, Designs and manufactures synthetic composite bearings and materials. Supplying worldwide markets for Marine Bearings in Ship Building, Ship Repair and Steering Gear. Norden Maritime AS also supplies bearings to many off shore applications such as Oil Rigs, Drill Ships, FPSO Turret Bearings, Drilling Equipment, Hatch cover pads, Subsea equipment and Deck Cranes are just a few of the many diverse applications into which Norden Maritime AS supplies bearings and components.

Supply is mainly direct to our customers but also through appointed agents, distributors and other bearing suppliers around the world.

CONTACT DETAILS

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Norden 605 Marine

DESCRIPTION

Norden 605 Marine has been specifically developed to suit marine bearing applications.

COMPOSITION

Norden 605 Marine composite bearing material is manufactured from a specially produced synthetic fabric reinforcement which is impregnated with thermosetting resins and solid lubricant fillers for enhanced dry running capability. Norden 605 Marine is dark grey in colour.

Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate tensile strength</td>
<td>60</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Typical Elongation</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Ultimate Flatwise compressive strength</td>
<td>350</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Maximum Safe Static Load</td>
<td>110</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Maximum Safe Dynamic Load</td>
<td>55</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Ultimate Edgewise compressive strength</td>
<td>156</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>69</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Ultimate shear strength</td>
<td>100</td>
<td>N/mm²</td>
</tr>
<tr>
<td>Impact strength (flatwise)</td>
<td>&gt;20</td>
<td>IZOD</td>
</tr>
<tr>
<td>Density</td>
<td>1.30 / 1.35</td>
<td>gms/cc</td>
</tr>
<tr>
<td>Coefficient of friction (dry)</td>
<td>0.10 / 0.15</td>
<td>(typical)</td>
</tr>
<tr>
<td>Water adsorption to saturation</td>
<td>&lt;0.15%</td>
<td>Volumetric</td>
</tr>
<tr>
<td>Maximum temperature range</td>
<td>cryogenic to 100</td>
<td>oC</td>
</tr>
<tr>
<td>Linear expansion coefficients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel to laminate</td>
<td>5</td>
<td>10-5 oC</td>
</tr>
<tr>
<td>Normal to laminate</td>
<td>10</td>
<td>10-5 oC</td>
</tr>
</tbody>
</table>

THE ABOVE VALUES ARE TYPICAL

MANUFACTURE

The material is manufactured to a documented formulation and procedure standard. Manufacturing traceability records are kept for the material batch.

CERTIFICATES

Certificates of conformity can be issued to confirm that the material supplied conforms to the grade standard for a particular order.
SPECIFICATIONS

Norden 605 Marine has been specially formulated to provide enhanced material properties, in particular to meet increasing demands for bearings capable of performing at higher loadings.

The properties of the material make it suitable for not only the current ratings of 5.5 MPa and 10 MPa but also for the higher surface pressure of 15 MPa.

Norden 605 Marine bearings are available in a very wide range of sizes, from a diameter of 50mm id with a maximum length of 1000mm up to 700mm id x 1000mm long

Maximum production capability is an id of 2000mm.

Please consult our technical department for the maximum length available for large diameter bearings.

Maximum sheet sizes for thrust bearings 2000mm x 1000mm, maximum thickness 100mm

Typical diameter / height ratio (d/h) ratio 1:1.3 for bushings (can be greater if required)

Maximum thickness / diameter ratio (t/d) ratio 1:10 for thrust bearing.

ACCEPTABLE MATING MATERIALS

Carbon Steels, if oil or grease lubricated. Stainless Steel 316 grade or better, Inconel or duplex stainless, suitable for water, oil, grease lubrication and also dry running. Maximum surface roughness should not exceed 1.6m Ra

HARDNESS

Stainless steel, HB217 or HV225 (95 Rockwell B)
Carbon steels, HB126 or HV131 (71 Rockwell B)
Consult our technical department for suitability against other materials.

BEARING DESIGN

The purpose of this manual is to offer a guide to the design of marine bearings manufactured from Norden 605 Marine and to outline the importance of establishing the correct data required to ensure optimum performance of such bearings.

Essential information to establish
Housing diameter and tolerance
Shaft diameter and tolerance
Shaft material and hardness
Maximum operating speed
Maximum operating load
Minimum operating temperature
Lubrication medium

The above information is essential for the correct design of the bearings.

BEARING DESIGN INFORMATION

NORDEN 605 MARINE

The following information is intended as a guide to design data for NORDEN 605 Marine Rudder Bearings only.

Running Clearance

Recommended minimum running clearances should comply with the relevant classification society to which the vessel is registered.

In cases where such information is not given or available, the following formula can be applied.

Running Clearance = 0.0015 x Rudder Shaft dia +0.75 mm although the minimum clearance should not fall below 1mm after fitting.

Maximum water swell of NORDEN 605 Marine is 0.15%.

No allowance is required when calculating final running clearance.

Minimum wall thickness for NORDEN 605 Marine rudder bearings;-

Minimum Wall = 0.035 x Rudder Shaft dia +2 mm.

The above formula is suitable for both Rudder Stock and Pintle bearings where press fitting, freeze fitting or bonding of the bearing is being employed.
BEARING DESIGN METHOD

To calculate bearing od for machining purposes

1. Housing id max + interference fit = Bearing od min

2. Bearing od min + M/C tolerance = Bearing od max

Subtract min bearing housing diameter from max bearing od, this will give the maximum interference fit value. This value is necessary when calculating machining dimensions for the bearing id due to transfer of interference fit in NORDEN composite bearings.

To calculate bearing id for machining purposes

3. Shaft dia max + “Running clearance” + % transfer value of max interference fit from chart on page 5 (relevant to the wall thickness of the bearing and shaft diameter) = Min bearing id

4. Min bearing id + M/C tolerance = Max bearing id.

The above information is given as a guide for bearing design but we offer an in house bearing design service.

Norden Marine bearings require radial support from the housing, the interference fit quoted is sufficient to ensure retention of the bearing in the housing. Due to its superior properties it is not essential to use a retaining ring or shouldered housing bore but this can be done if so desired. Lead in chamfers on the bearing and housing are recommended to avoid damage to the bearing when press fitting.

Shaft surface finish should be machined to between 0.8 to a maximum of 1.6m Ra.

MACHINING

NORDEN 605 Marine is easily machined using conventional machine tooling. It is advisable that the material is machined in a dry condition using the suggested feeds and speeds, Surface speed 300 to 350 m/min with a feed of 0.1 mm/rev for finishing cuts. 0.25mm feed can be used for roughing cuts.

Tungsten Carbide tipped tools with positive rake geometry of between 3 & 5 degrees top, side and front have been found to give best results.

<table>
<thead>
<tr>
<th>Dia mm</th>
<th>0 – 50</th>
<th>50 – 100</th>
<th>100 – 150</th>
<th>150 – 200</th>
<th>200 – 300</th>
<th>300 – 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM</td>
<td>2100</td>
<td>1000</td>
<td>700</td>
<td>550</td>
<td>350</td>
<td>250</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dia mm</th>
<th>400 – 500</th>
<th>500 – 600</th>
<th>600 – 700</th>
<th>700 – 800</th>
<th>800 – 900</th>
<th>900 –1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM</td>
<td>200</td>
<td>175</td>
<td>150</td>
<td>130</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

Positive rake tool geometry is required, with the tools having 3 – 5 degrees of front side rake, and a top rake between 5 and up to 20 degrees can be used.

A tool point radius of minimum 0.8 up to 2 mm is suggested for good surface finishes.

Boring tools should have 10 degrees side rake and 15 degrees front rake.
**FEED RATES**

<table>
<thead>
<tr>
<th>TURNING</th>
<th>Roughing</th>
<th>0.7</th>
<th>Finishing</th>
<th>0.25 mm per rev</th>
</tr>
</thead>
<tbody>
<tr>
<td>BORING</td>
<td>0.5</td>
<td></td>
<td></td>
<td>0.20 mm per rev</td>
</tr>
<tr>
<td>PARTING</td>
<td>0.4</td>
<td></td>
<td></td>
<td>0.20 mm per rev</td>
</tr>
</tbody>
</table>

**GROOVING**

NORDEN 605 Marine can be easily grooved on a lathe, shaping, milling or boring machine with a 90 degree machining head. For most situations a lathe will be adequate. A sharp tool made from high speed steel ground to the correct form should be clamped to a boring bar with at least 3 degrees clearance ground on the sides of the tool. No top clearance is required.

The chuck should be marked with the correctly spaced number of grooves, each groove should be shaped in turn. A depth of 0.2mm should be used for each subsequent cut until the recommended groove depth is reached, the machines fast traverse with the spindle locked should be used for the power. Linear speeds of up to 20 metres per minute can be achieved. For long bearings a steady may be required.

**DRILLING**

NORDEN 605 Marine is easily drilled using either high speed steel or Carbide tipped drills.

The following feeds and speeds are suggested:

<table>
<thead>
<tr>
<th>DRILL DIA</th>
<th>SPEED RPM</th>
<th>FEED MM/MIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1000</td>
<td>300</td>
</tr>
<tr>
<td>10</td>
<td>800</td>
<td>400</td>
</tr>
<tr>
<td>15</td>
<td>600</td>
<td>400</td>
</tr>
<tr>
<td>20</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>25</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td>30</td>
<td>300</td>
<td>400</td>
</tr>
</tbody>
</table>

No asbestos is used in the manufacture of NORDEN 605 Marine, it is non-hazardous and non-toxic.

It should be machined dry - no cutting or cooling fluids should be used.

Dust extraction is recommended when machining NORDEN 605 Marine, if not available then it is suggested the operator should wear a non toxic particle mask to avoid inhalation of dust particles.
**INSTALLATION**

NORDEN 605 Marine bearings can be pressed into the housing, bonded in or freeze-fitted. Recommendations for freeze fitting are given on the relevant data sheet.

Care must be taken at all times not to damage the bush during the fitting process. The use of lead in chamfers on the bearing and housing are recommended.

Bore sizes must be checked along all axes at ambient temperature to ensure the minimum bearing running clearance has been achieved.

Bearings can also be bonded into housings with the use of a number of types of adhesives possible. Most types of Chockfast can be used, it is recommended to follow the manufacturer’s guide lines when using chocking compounds regarding surface preparation and gap dimensions etc.

Toughened acrylic adhesives have also been found to give good results with Norden composite bearings

Consult our technical department for recommendations on this procedure.

**BEARING FREEZE FITTING PROCEDURE**

NORDEN 605 Marine composite bearings are capable of being freeze fitted using Liquid Nitrogen, a guide for this process is as follows.

1. Select or manufacture a thin wall steel container which can be clad with insulating material around its outside diameter, the container should be just large enough to hold the bearing and allow it to be completely immersed in the liquid nitrogen.

2. Place the bearing into the container then start to pour in the nitrogen. Initially the nitrogen will boil off as soon as it contacts the bearing and the steel surface. Once the bearing and the steel surface has cooled sufficiently the nitrogen will start to fill the container.

3. Due to the extreme temperature differential the liquid nitrogen will continue to boil off for some time, during this period it will be necessary to keep topping up the container ensuring the bearing is completely covered by the nitrogen.

4. When the boiling has subsided, the bearing should be left to stand in the nitrogen for a further period of time. This will be dependant upon the bearing size and can vary from a minimum of 10 minutes for small bearings, up to 90 minutes for large bearings.

**HANDLING AND SAFETY**

When working with liquid nitrogen operators should ensure they are fully conversant with the necessary precautions for its handling and use, Safe working practices as prescribed by the liquid nitrogen supplier should be carefully followed. The correct protective clothing and eye protection should be worn at all times.

**LIQUID NITROGEN IS OXYGEN DEPLETING - IT MUST NOT BE USED IN A CONFINED SPACE**

Thermal contraction coefficient of NORDEN 605 Marine bearings is 3.5 x 10^-5 /°C.

Dry Ice is not recommended, it will not give sufficient shrinkage of the bearing to allow freeze fitting. Additional mechanical force to press fit will be required. Consult Norden Maritime for advice on fitting with Dry Ice.
NORDEN 605 RUDDER BEARING CLEARANCE

NORDEN 605 MARINE INTERFERENCE FIT
NORDEN MARITIME JOURNAL
BEARING TESTING MACHINE