Fixed Pitch Propellers
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Fixed Pitch Propellers from ZF Marine

Manufacturing Location
ZF Faster Propulsion System Co. Ltd

Faster Propulsion System Co. Ltd. was established in 1988 in Kaohsiung, Taiwan.

The design and manufacture of propellers started in 1989, specifically targeting the high quality market with Class S and Class 1 standard propellers according to ISO 484.

ZF Marine, the world’s largest manufacturer of marine transmissions, established a Joint Venture with Faster Propulsion System Co., Ltd. in 2000. Within four years, ZF Marine acquired 100% shares and the company was named ZF Faster Propulsion System Co., Ltd.

The Research and Development team at Kaohsiung has built up a wealth of experience in designing propellers. The aim is to achieve optimum propulsive performance in respect of speed, comfort, and economy according to customer requirements. Every propeller is NC (Numerical Control) machined to a very high accuracy using a 3-D CAM (Computer Aided Manufacturing) system specifically designed for machining propeller blades.

Quality milestones:


Up to today: Certification by LR, GL, DNV, BV, ABS, RINA, RRR, and CR.

The product range of ZF Marine includes fixed pitch propellers up to 3 meters diameter, suitable for all types of vessels e.g. yachts, commercial vessels, ferries, military vessels, patrol craft and work boats.

The high manufacturing quality is complemented by the expertise of ZF Marine’s Sales and Service Organization which guarantees fast delivery and 24/7 worldwide support.
ZF Marine specializes in custom designed and standard propellers using CAD-CAM technology. Whether your vessels are yachts, commercial vessels, ferries, military vessel, patrol crafts, work boats or fishing boats, custom made propellers from ZF Marine offers you more choice and flexibility in design to achieve the optimum propulsion system. Careful design and selection of the propeller series with expanded area ratio can lead to better speed and performance. This is the expertise of ZF Marine!

Propellers for Speed & Performance

Custom Design & Manufacture for Ultimate Efficiency & Design

High Precision for Quality and Smoothness

Fixed Pitch Propellers

Highest performance, custom design and high quality means excellence
Propellers for all Vessels

Pleasure Craft Applications

The ZF Marine fixed pitch propeller range covers a wide variety of pleasure craft including ski-boats, sport fish, cruisers and luxury motor yachts. They are ideally suited to the complete propulsion packages offered by ZF Marine.

Many different propeller designs are available for precise matching to the characteristics of each vessel, ensuring best performance, silent operation and optimum fuel efficiency. Propellers from ZF Marine allow smooth cruising during leisure time.

Fast Craft Applications

Fixed pitch propellers for fast craft applications such as customs and coastguard vessels, as well as fast ferries, are specially designed to match to the high performance needs as defined by ship design engineers and naval architects.

These products are subject to the highest quality control regulations to meet stringent environmental and technical specifications where safety, availability and reliability are of the utmost importance. This ensures the operating profiles of these vessels can be fully satisfied.

Commercial Craft Applications

ZF Marine also supplies fixed pitch propellers which are robustly built to achieve high reliability throughout the long life of commercial vessels. Such ships are required to operate continuously in the most demanding weather conditions.

These heavy duty propellers are suitable for all types of vessels from tugs to tankers – fishing boats to factory ships. Many models are available, perfectly engineered and integrated with the complete propulsion system to meet the customer’s exact requirements.
Design and Manufacturing Process

**Precision means customer satisfaction**

**Design**
Design engineers of ZF Marine work closely with the customers and provide full technical support and advice. This service also extends outside the offices to our experienced field technicians. Throughout the project phase, design phase and after sales, ZF Marine offers excellent customer support.

**CAD System**
The Computer Aided Design system ensures every propeller is designed for optimum performance. This leading edge software permits more selection and flexibility to meet all customers’ requirements.

**CAM System**
The Computer Aided Manufacturing systems generate a precise cutting tool path for propeller machining. Every detail of the manufacturing process is simulated and checked before cutting commences.

**NC Cutting**
Numerical Control machining of propeller blades ensures high precision blade section geometry and the 4-axis machine center system is integrated with the CAD – CAM software. This leading edge technology production assures propeller manufacture to the highest geometrical tolerances required by the ISO R484 Class S standard.

**Casting**
High quality bronze alloys, carefully chosen with the exact composition to meet Classification Society requirements, are used for casting ZF Marine propellers. The chemical composition and physical properties are precisely controlled and tested for each cast.

**New Series Development**
ZF Marine also has joint venture programs with various research establishments to develop advanced technology propulsion system. Latest research includes a new surface – piercing propeller and new-foil section series propeller with excellent low cavitation characteristics.
Quality Control

Accuracy means efficiency and reliability

Strength Test

ZF Marine continuously checks for the best quality casting in propellers. The well equipped laboratories precisely control the physical and this experience leads to continuous improvement of quality.

Dynamic Test

All propellers are dynamically balanced to ensure smooth operation. This dynamic balancing considerably reduces noise and vibration in high-speed vessels.

Inspection

The final inspection of the propellers blades geometry is carried out using computer aided measuring equipments. This quality control has enabled ZF Marine to receive full recognition by DNV as complying with ISO-9001 quality assurance standards.

Spectrometer

The chemical composition of propeller material is controlled using a spectrometer. This control ensures that ZF Marine propellers have enhanced corrosion resistance even in severe marine environments.
## Products

### Series Propellers

**ZF FP KCA - Series**
- **Blades**: 3, 4, 5, 6
- **Pitch Ratio**: 0.80-1.60
- **Area Ratio**: 0.50-1.40
- **Skew Angles**: According to design
- **Section Type**: Aerofoil
- **Remarks**: Theoretical design propellers series.

**ZF FP KCA - S Series**
- **Blades**: 3, 4, 5, 6
- **Pitch Ratio**: 0.60-2.00
- **Area Ratio**: 0.50-1.10
- **Skew Angles**: 0 degree
- **Section Type**: Ogival
- **Remarks**: Most widely use propeller series. Suitable for most applications. Cupped available.

**ZF FP NR - Series**
- **Blades**: 3, 4, 5
- **Pitch Ratio**: 1.00-2.00
- **Area Ratio**: 0.50-1.00
- **Skew Angles**: 0° 30 ° degrees
- **Section Type**: Crescent
- **Remarks**: Suitable for higher speed range in trans-cavitating applications.

**ZF FP KCA – C Series**
- **Blades**: 3, 4, 5
- **Pitch Ratio**: 0.60-2.00
- **Area Ratio**: 0.50-1.10
- **Skew Angles**: 25° 30° 35° degrees
- **Section Type**: Ogival
- **Remarks**: Modified from standard KCA series for commercial application with specific thickness.

**ZF FP NACA - Series**
- **Blades**: 3, 4, 5, 6, 7, 8
- **Pitch Ratio**: 0.80-1.60
- **Area Ratio**: 0.50-1.40
- **Skew Angles**: According to design
- **Section Type**: Aerofoil
- **Remarks**: Theoretical design propellers series.
**ZF FP NF - Series**
- **Blades**: 3, 4, 5, 6, 7, 8
- **Pitch Ratio**: 0.80-1.60
- **Area Ratio**: 0.50-1.40
- **Skew Angles**: According to design
- **Section Type**: New Foil
- **Remarks**: Theoretical design propellers series.

**ZF FP SPP - Series**
- **Blades**: 5, 6
- **Pitch Ratio**: 0.90-1.8
- **Area Ratio**: 0.70-1.10
- **Skew Angles**: According to design
- **Section Type**: SPP, SC
- **Remarks**: Suitable for different surface drive applications.

**ZF FP KA - Series**
- **Blades**: 3, 4, 5
- **Pitch Ratio**: 0.60-1.60
- **Area Ratio**: 0.55-0.75
- **Skew Angles**: 0 degree, skew available
- **Section Type**: Aerofoil
- **Remarks**: Suitable for accelerating nozzle propellers and bow or stern thrusters.

**ZF FP EV - Series**
- **Blades**: 3, 4, 5, 6, 7, 8
- **Pitch Ratio**: 0.80-1.60
- **Area Ratio**: 0.50-1.40
- **Skew Angles**: According to design
- **Section Type**: Mixed Foils
- **Remarks**: Theoretical design propellers series for better cavitations control.
Model Test

Test propellers for models require the highest geometrical precision to ensure accurate test results. This precision is possible using advanced machining technology.

Keyless

For large propellers, hydraulic keyless hub fitting methods are commonly used. ZF Marine has wide experience and expert technicians to provide best solutions for fitting keyless hub propellers.

Products

Special Propellers

Impellers

ZF Marine has supplied a 3.44 m (11 ft, 3in) diameter propeller for a cavitation research tunnel at the National Taiwan Ocean University. This impeller is designed with adjustable pitch for different water speed.

Nozzled

Nozzled propellers generate more bollard pull for tugs. ZF Marine offers a wide selection of different designs.

Propeller Materials

ZF Marine can offer various propellers with the materials of manganese bronze, and nickel aluminum bronze to high strength, special alloys. This means requirements for all types of applications can be met.
In order to select a suitable propeller with optimum efficiency and ensure low cavitation, low exciting force characteristics at the design point specified by the customer, the shape of the blade section (i.e. camber and thickness distribution chord-wise) must be carefully considered in addition to the skew, rake and pitch distribution in radial direction. Guidelines for choosing suitable blade sections are shown in the following table.

<table>
<thead>
<tr>
<th>Ship speed (knots)</th>
<th>Propeller blade section</th>
<th>Related propeller series</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25</td>
<td>Aerfoil</td>
<td>Mau, Wagenengen-B, NACA</td>
</tr>
<tr>
<td>25 - 35</td>
<td>Aerfoil</td>
<td>Mau, Wagenengen-B, NACA</td>
</tr>
<tr>
<td></td>
<td>Ogival</td>
<td>Gawn, Gawn-Burrill (KCA)</td>
</tr>
<tr>
<td></td>
<td>Crescent</td>
<td>NR, NF, EV</td>
</tr>
<tr>
<td>35 - 40</td>
<td>Crescent</td>
<td>NR, NF, EV</td>
</tr>
<tr>
<td>40 - 50</td>
<td>Crescent</td>
<td>NR, NF, EV</td>
</tr>
<tr>
<td></td>
<td>SC or SPP</td>
<td>Rolla, SUS</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>SC or SPP</td>
<td>Rolla, SUS</td>
</tr>
</tbody>
</table>

For sub-cavitation applications (vessel speed less than 32 – 33 knots) the theoretical design method according to NACA 66 is the optimal solution. When shaft inclined angle is less than 10 degrees.

The NF section is especially designed for fast vessels running in the partial cavitation fired (non-uniform flow) typically experienced in installations using high shaft angles as well as fast container ships.

In the partial cavitation field (vessel speed more than 32 – 33 knots) empirical result data is needed, e.g. from a cavitation tunnel. Each year, ZF-FPS tests a new NF and EV design section, with modified Blade Area Ratio, Pitch Ratio and / or Camber Ratio. By this means, a wealth of data has been collected which can be used to develop NF section propellers for the most demanding applications.
Technical information

Hub Dimensions

Taper 1:16

<table>
<thead>
<tr>
<th>Nominal Diameter</th>
<th>Small End Dia. A</th>
<th>Length B</th>
<th>Keyway C</th>
<th>Keyway D</th>
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<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1/2</td>
<td>1.218</td>
<td>1.220</td>
<td>4-1/2</td>
<td>3/8</td>
</tr>
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<td>1-3/4</td>
<td>1.421</td>
<td>1.423</td>
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<td>7/16</td>
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<td>1.626</td>
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<td>1.829</td>
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<td>9/16</td>
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<td>2-1/2</td>
<td>2.030</td>
<td>2.032</td>
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<td>5/8</td>
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<td>2.235</td>
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<td>5/8</td>
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<td>12-1/2</td>
<td>1-1/4</td>
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Materials

Chemical Composition

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<tr>
<th>Composition</th>
<th>Cu</th>
<th>Zn</th>
<th>Mn</th>
<th>Al</th>
<th>Ni</th>
<th>Fe</th>
<th>Sn</th>
<th>Pb</th>
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<td>Manganese Bronze</td>
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<td>&lt;1.5</td>
<td>&lt;0.5</td>
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<tr>
<td>Nickel Aluminium Bronze</td>
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<td>0.5-4.0</td>
<td>7.0-11.0</td>
<td>3.0-6.0</td>
<td>2.0-6.0</td>
<td>&lt;0.1</td>
<td>&lt;0.03</td>
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</tbody>
</table>
Hub Dimensions

Taper 1:10

ISO 4566 Standard. (All dimensions in mm)
Special hub dimensions available upon request

<table>
<thead>
<tr>
<th>Nominal Diameter</th>
<th>Large End Dia. F</th>
<th>Length</th>
<th>Keyway</th>
<th>Keyway</th>
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<td>50</td>
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<td>100</td>
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<td>99.087</td>
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<td>109</td>
<td>109.087</td>
<td>240</td>
<td>28</td>
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<td>119</td>
<td>119.087</td>
<td>260</td>
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<td>140</td>
<td>139</td>
<td>139.100</td>
<td>300</td>
<td>36</td>
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</tbody>
</table>

Materials

Mechanical Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Tensile Strength</th>
<th>0.2% Proof Stress</th>
<th>Elongation</th>
<th>Classification Society Equivalent</th>
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</thead>
<tbody>
<tr>
<td>Manganese Bronze</td>
<td>460</td>
<td>175</td>
<td>20</td>
<td>NF1A Type 2 Cu1</td>
</tr>
<tr>
<td>Nickel Aluminium Bronze</td>
<td>590</td>
<td>245</td>
<td>16</td>
<td>NF2A Type 4 Cu3</td>
</tr>
</tbody>
</table>
## Data Sheet for Propeller Design

**Shipyard:** __________________________

**Boat’s Name or Nr. Project:** __________________________

**Contact:** __________________________

**Phone:** __________________________

**Fax:** __________________________

**E-mail:** __________________________

**Project Nr.:** FPS

**Date:** __________________________

The propeller suggestion can only be as accurate as the information that you provide.

### Boat Information

**Type of Analysis:**
- Powerboat ☐
- Sailboat ☐
- Repower ☐

**Year:**
- New ______
- Old ______
- years______

**Boat Use:**
- Work/Commercial ☐
- Towing ☐
- Pleasure ☐

**Hull Type:**
- Displacement ☐
- Semi-Disp. ☐
- Planing ☐

**Bottom Design:**
- Open ☐
- Tunnel ☐
- Pocket ☐

**Appendage:**
- Skeg ☐
- Wedge ☐
- Stabilizer ☐
- Rope cutter ☐

**Hull Material:**
- Fiberglass ☐
- Wood ☐
- Aluminum ☐

### 1. Hull Data

- **Light Load Displacement:** ______
- **Half Load Displacement:** ______
- **Full Load Displacement:** ______

- **Length Overall:** ______
- **Length Waterline:** ______
- **Bpx (Max. Chine Beam):** ______

- **LCG From Transom:** ______
- **Deadrise Angle at Midship:** ______°, at Transom: ______°

- **Draft at Full Load:** ______
- **Shaft Angle:** ______

- **Max. Diameter:** ______
- **Clearance:** ______
- **Distance between Hull and Center of Prop. shaft:** ______

- **Shaft Diameter:**
  - SAE ☐
  - Metric ☐
  - Size ______

### 2. Existing or New Engine Data

- **Number of Engines:**
  - Single ☐
  - Twin ☐
  - Triple ☐
  - Other ☐

- **Manufacturer:** __________
- **Model:** __________

- **Maximum Engine Rating:** ______ HP ☐
  - ______ KW ☐
  - ______ Cv ☐

- **Make and Type of Gearbox:** __________
- **Reduction Ratio:** ______ : 1

- **Demand Speed, or Not:**
  - Yes ☐
  - ______ knots @ ______ tons,
  - No ☐ if no, suggested by ZF-FPS

### 3. Existing Propeller Data

- **Manufacturer:** __________
- **Model/Series:** __________
- **Material:** MnBr ☐
  - NiAlBr ☐
  - Stainless Steel ☐

- **Propeller Size:**
  - Diameter: ______ x Pitch: ______ x Blade: ______ x Area Ratio: ______

- **Existing Performance:**
  - **Full Throttle ship Speed:** ______ MPH ☐
  - Knots ☐ @ ______ tons (sea trial Disp.)

  **Full Throttle Engine RPM:** ______ RPM @ Engine load ______%

### 4. Re-power Data (Old Engine Information)

- **Number of Engines:**
  - Single ☐
  - Twin ☐
  - Triple ☐
  - Other ☐

- **Manufacturer:** __________
- **Model:** __________

- **Maximum Engine Rating:** ______ HP ☐
  - ______ KW ☐
  - ______ Cv ☐

- **Make and Type of Gearbox:** __________
- **Reduction Ratio:** ______ : 1

- **Existing Performance:**
  - **Full Throttle ship Speed:** ______ MPH ☐
  - Knots ☐ @ ______ tons (sea trial Disp.)

  **Full Throttle Engine RPM:** ______ RPM @ Engine load ______%

### Remarks

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

### Boat Information

- **Type of Analysis:** Powerboat
- **Year:** New ______  Old ______  years______
- **Boat Use:** Work/Commercial
- **Hull Type:** Displacement
- **Bottom Design:** Open
- **Appendage:** Skeg
- **Hull Material:** Fiberglass

#### 1. Hull Data

- **Light Load Displacement:**__________
- **Half Load Displacement:**__________
- **Full Load Displacement:**__________
- **Length Overall:**__________
- **Length Waterline:**__________
- **Bpx (Max. Chine Beam):**__________
- **LCG From Transom:**__________
- **Deadrise Angle at Midship:**__________°, at Transom:__________°
- **Draught at Full Load:**__________, at Mid Ship:__________
- **Shaft Angle:**___________
- **Max. Diameter:**__________
- **Clearance:**__________
- **Distance between Hull and Center of Prop. shaft:**__________
- **Shaft Diameter:** SAE
  - __________
- **Metric
  - __________

#### 2. Existing or New Engine Data

- **Number of Engines:** Single
- **Manufacturer:**_________   Model:_____________
- **Maximum Engine Rating:** __________ HP
- **Make and Type of Gearbox:**______________   Reduction Ratio: ________ : 1
- **Demand Speed:** Yes
  - __________knots @ ________ tons,    No
    - if no, suggested by ZF-FPS

#### 3. Existing Propeller Data

- **Manufacturer:**____________   Model/Series:__________    Material: MnBr □   NiAlBr □   Stainless Steel □
- **Propeller Size:** Diameter:_________ x Pitch:_________ x Blade:_________ x Area Ratio:_________
- **Existing Performance:** Full Throttle ship Speed__________ MPH
  - __________Knots
  - __________ tons (sea trial Disp.)
- **Full Throttle Engine RPM:**__________RPM @ Engine load__________%

#### 4. Re-power Data (Old Engine Information)

- **Number of Engines:** Single
- **Manufacturer:**_________   Model:_____________
- **Maximum Engine Rating:** __________ HP
- **Make and Type of Gearbox:**______________   Reduction Ratio: ________ : 1
- **Existing Performance:** Full Throttle ship Speed__________ MPH
  - __________Knots
  - __________ tons (sea trial Disp.)
- **Full Throttle Engine RPM:**__________RPM @ Engine load__________%