# RULES

# PUBLICATION 43/P

## TYPE TESTING PROCEDURE FOR SYNTHETIC MATERIALS FOR AFTMOST PROPELLER SHAFT BEARINGS

January
2026

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.

GDAŃSK

*Publication 43/P– Type Testing Procedure for Synthetic Materials for Aftmost Propeller Shaft Bearings – January 2026* was approved by the PRS Board on 29 December 2025 and enters into force on 1 January 2026.

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PRS/RP, 12/2025

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# 1 INTRODUCTION

This Publication has been developed based on the requirements of IACS UR **M85**/Rev.**1**.

**1.1** This document gives the requirements for the Type Approval testing of synthetic materials for aftmost propeller shaft bearings.

**1.2** The procedures and requirements of this Publication are applicable to Type Approval obtained for the synthetic material required by Part VII of Seagoing Ships 15.6.1.1 and 15.6.1.4 .

**1.3** The qualification for design and application of aftmost propeller shaft bearings shall be provided and guaranteed by the manufacturer.

**1.4** Testing and inspection shall be carried out in accordance with the specific requirements given in this document.

# 2 DOCUMENTATION

**2.1** The manufacturer shall submit request of approval, test programme (see 3.1) and information including the following contents to the PRS:

- **.1** product name
- **.2** name and address of the manufacturer, including details for all relevant production places
- **.3** reference of applicable rules and standards which the product shall comply with
- **.4** product description:
  - a. material type
  - b. lubrication type
  - c. isotropic or anisotropic behaviour
  - d. elastomeric or non-elastomeric type
- **.5** limitations of the product
- **.6** product specification, technical data sheet, and installation manual including:
  - a. maximum nominal surface pressure
  - b. product dimensions:
    - minimum and maximum dimensions
    - other, if relevant
- **.7** commonly acceptable mating material (type of shaft material, roughness, hardness, etc.)
- **.8** running clearance
- **.9** maximum operating temperature
- **.10** safety data sheet
- **.11** description of production processes
- **.12** description of quality assurance system or copy of ISO 9001 certificate
- **.13** in-service experience, if available
- **.14** list of tests and measuring equipment including calibration certificate.

# 3 TYPE APPROVAL TESTING

## 3.1 Test program

**3.1.1** Test program shall include following items:

- **.1** description of products to be approved
- **.2** description of the selected test samples
- **.3** content of tests (test items, test standard, test conditions, acceptance criteria, etc.)
- **.4** description of the wear testing stands and the test conditions.

**3.1.2** The extent of the test program is to test the material properties of 3.3.

In particular a reduction or complete suppression of the approval tests may be accepted by the PRS taking into account:

**.1** documentation of approval tests performed
**.2** a proven track record.

## 3.2 Wear testing procedure

**3.2.1** Unless otherwise specified in this UR, the requirements for the wear test should refer to ASTM G77-17 or other national or international equivalent standards, with the following data:

- material of the shaft used in the test and its properties are to be specified and shall be equivalent to typical mating material e.g. alloyed steel or stainless steel or copper alloy,
- diameter of shaft: the shaft diameter depends on the bearing size. The running clearance should be considered in the wear test,
- motion of shaft: continuous rotation,
- circumferential velocity should be 6 m/s for oil or water lubrication and should be 3 m/s for grease lubrication,
- lubrication: sea water or substitute ocean_water (23°C±2°C), or mineral oil (80°C±2°C), or grease (80°C±2°C) according to the applicable lubrication type,
- surface roughness of test shaft: Ra shall not exceed 0.5μm for stainless steel and Ra shall not exceed 0.8μm for copper alloy,
- interface pressure : maximum nominal surface pressure±10%,
- duration of test: until the coefficient of friction and wear rate remains constant at least 192h. Wear of bushings shall be measured continuously or regularly. If regularly, wear to be measured by disassembling every 48 hours until a constant wear rate has been achieved (minimum of four points of measurements).

**3.2.2** Parameters to be recorded:

- dimensions of test specimen,
- wear vs. time,
- coefficient of friction vs. time,
- temperature of test specimen during test cycle,
- deviation of load from the maximum nominal surface pressure.

## 3.3 Material properties

The properties of non-elastomeric materials for aftmost propeller shaft bearings are to comply with the requirements of Table 1. The properties of elastomeric materials for aftmost propeller shaft bearings are to comply with the requirements of Table 2.

**Table 1 Type testing for non-elastomeric materials for aftmost propeller shaft bearings**

| Test items | Test standard(1) | Number of specimens for each sample(2), at least | Test conditions | Acceptance criteria |
|---|---|---|---|---|
| Compressive strength [N/mm²] | ISO 604: 2002; ASTM D695-2015 | 5(3) | | Min. 85 N/mm² in the case of isotropic materials.<br>Min. 85 N/mm² for specimens parallel to sheet plane in the case of anisotropic materials.<br>Min. 100 N/mm² for specimens normal to sheet plane in the case of anisotropic materials. |

| Test items | Test standard(1) | Number of specimens for each sample(2), at least | Test conditions | Acceptance criteria |
|---|---|---|---|---|
| Compressive modulus [N/mm²] | ISO 604: 2002; ASTM D695-2015 | 5(3) | | Min. 850 N/mm² in the case of isotropic materials.<br>Min. 850 N/mm² for specimens parallel to sheet plane in the case of anisotropic materials.<br>Min. 1000 N/mm² for specimens normal to sheet plane in the case of anisotropic materials. |
| Water swelling [volume, %], only required for water lubrication | ISO 175: 2010 | 3 | Four weeks in substitute ocean water (ASTM D1141-98(2021)) at 20°C±2°C and maximum temperature (60°C±2°C or advised maximum working temperature by manufacturer, whichever is higher). At least three specimens with dimension: 50x50xt mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition). | Volumetric swelling ≤ 3% |
| Oil swelling (for oil lubricated system) [volume, %], only required for oil lubrication | ISO 175: 2010 | 3 | Four weeks -in oil No.3(ISO 1817:2022) at 20°C±2°C. At least three specimens with dimension: 50x50xt mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition). | Volumetric swelling ≤ 3% |
| Compressive strength and modulus change when immersed in water, only required for water lubrication | ISO 604: 2002; ASTM D695-2015 | 5(3) | Four weeks in substitute ocean water (ASTM D1141) at 20°C±2°C. | Min. 80% retention of minimum specified compressive strength and modulus before water immersion |

| Test items | Test standard(1) | Number of specimens for each sample(2), at least | Test conditions | Acceptance criteria |
|---|---|---|---|---|
| Temperature resistance | ISO 604: 2002; ASTM D695-2015 | 5(3) | Compressive strength and compressive modulus at maximum temperature (60°C±2°C or advised maximum working temperature by manufacturer, whichever is higher). | Min. 80% retention of minimum specified compressive strength and modulus at 20°C±2°C |
| Wear test | See 3.2 | 1 | | |

**Notes:**

1. Other testing standards may also be accepted, provided that they are suitable for testing of the synthetic material selected for application in aftmost propeller shaft bearings.
2. The number of specimens is to be prepared for each sample.
3. Test at least five specimens for each sample in the case of isotropic materials. Test at least ten specimens, five normal to and five parallel to sheet plane, for each sample in the case of anisotropic materials.

## Table 2 Type testing for elastomeric materials for aftmost propeller shaft bearings.

| Test items | Test standard(1) | Number of specimens(2), at least | Test conditions | Acceptance criteria |
|---|---|---|---|---|
| Tensile strength [N/mm²] | ISO 37:2017; Method A of ASTM D412-16 (2021); ASTM D638-22 | 3 | | Min. 10 N/mm² for rubber bearing, and min. 30 N/mm² for other elastomeric bearing |
| Elongation (%) | ISO 37:2017; Method A of ASTM D412-16 (2021); ASTM D638-22 | 3 | | Min. 150% for rubber bearing, and min. 60% for other elastomeric bearing |
| Hardness | ISO 48-4:2018; ASTM D2240-15 (2021) | 3 | | |
| Water swelling [volume, %], only required for water lubrication | ISO1817:2022 | 3 | Four weeks in substitute ocean water (ASTM D1141) at 20°C±2°C and maximum temperature (60°C±2°C or advised maximum working temperature by manufacturer, whichever is higher). At least three specimens with dimension: 50x50xt mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition). | Volumetric swelling ≤ 3% |

| Test items | Test standard(1) | Number of specimens(2), at least | Test conditions | Acceptance criteria |
|---|---|---|---|---|
| Oil swelling (for oil lubricated system) [volume, %], only required for oil lubrication | ISO1817:2022 | 3 | Four weeks in oil No.3(ISO 1817) at 20°C±2°C. At least three specimens with dimension:50x50xt mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition). | Volumetric swelling ≤ 3% |
| Tensile strength and elongation change when immersed in water, only required for water lubrication | ISO 37:2017; Method A of ASTM D412-16 (2021); ASTM D638-22 | 3 | Four weeks in substitute ocean water (ASTM D1141) at 20°C±2°C. | Min. 80% retention of minimum specified tensile strength and elongation before water immersion |
| Temperature resistance | ISO 37:2017; ISO 7743:2017; Method A of ASTM D412-16 (2021); ASTM D638-22 | 3 | Tensile strength and elongation at maximum temperature (60°C±2°C or advised maximum working temperature by manufacturer, whichever is higher). | Min. 80% retention of minimum specified tensile strength and elongation at 20°C±2°C |
| Adhesion to metals (except those not to be adhered to metals) [N/mm$^2$] | ISO 813:2019; ISO 1827:2022 | 3 | | |
| Change of properties due to aging [%] | ISO 37:2017; ISO 7743:2017; Method A of ASTM D412-16 (2021); ASTM D638-22 | 3 | After oven aging for tension and elongation tests. Test specimens shall be subjected to circulating air at maximum temperature (60°C±2°C or advised maximum working temperature by manufacturer, whichever is higher) for 96 hours. Tension and elongation tests shall be performed not less than 20 hours but more than 48 hours after removal from the aging environment. | Min. 75% retention of Tensile strength and elongation before aging |
| Wear test | See 3.2 | 1 | | |

**Notes:**

1. Other testing standards may also be accepted, provided that they are suitable for testing of the synthetic material selected for application in aftmost propeller shaft bearings.
2. The number of specimens is to be prepared for each sample.

## 3.4 Test products

**3.4.1** At least three representative diameter products of each kind of product shall be selected for type approval testing, except for the wear test where one representative product may be selected.

**3.4.2** Each kind of product means:
- same chemical composition range,
- same reinforcement, only applicable to composite materials,
- same production process.

**3.4.3** The test products used for type approval testing are to be selected from the manufacturer's production line or stock by a Surveyor of PRS as a:
- finished certified component itself; or
- on samples taken from earlier stages in the production of the component, when applicable.

### 3.5 Test laboratories

The selected test facility shall have accreditation according to ISO/IEC 17025 for carrying out and recording of the material property tests required by this Publication. The test facility and the testing arrangements are to be to the satisfaction of PRS. If the test laboratory does not have the relevant accreditation, then specified testing will need to be witnessed by a Surveyor of the PRS.

## 4 TYPE APPROVAL CERTIFICATE

**4.1** PRS issues a Type Approval Certificate based on the test reports and manufacturer's technical documentation e.g., installation/ engineering manuals.

**4.2** The Type Approval Certificate shall contain the general information about the product. As minimum, the following information is specifically applicable to products relevant to this document and shall be included on the relevant Type Approval Certificate:

**.1** Product description and properties in accordance with paragraph 3.3 above,
**.2** Maximum nominal surface pressure,
**.3** Maximum operating temperature.