



IRCLASS
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CLASSIFICATION NOTES:

TYPE APPROVAL TESTING OF SYNTHETIC MATERIALS FOR AFTMOST PROPELLER SHAFT BEARINGS

JULY 2025

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Type approval testing of synthetic materials for aftmost propeller shaft bearings

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Section 1

Scope

1 Scope

1.1 This Classification Note specifies the requirements for the Type Approval testing of synthetic materials for aftmost propeller shaft bearings.

1.2 The procedures and requirements of this Classification Note are applicable to Type Approval of the synthetic material required by Part 4, Chapter 4, Sec 6.16 of the *Rules and Regulations for the Construction and Classification of Steel Ships*.

1.3 Testing and inspection is to be carried out in accordance with the requirements given in this Classification Note.

Section 2

Documentation

2.1 The manufacturer is to submit documentation including request for approval, test programme (see 3.1) and information as follows:

- i. product name
- ii. name and address of the manufacturer, including details for all relevant production places.
- iii. reference of applicable rules and standards which the product shall comply with.
- iv. product description:
 - material type
 - lubrication type
 - isotropic or anisotropic behaviour
 - elastomeric or non-elastomeric type
- v. limitations of the product
- vi. product specification, technical data sheet, and installation manual including:
 - (a) maximum nominal surface pressure
 - (b) product dimensions:
 - minimum and maximum dimensions
 - other, if relevant
 - (c) commonly acceptable mating material (type of shaft material, roughness, hardness, etc.)
 - (d) running clearance
 - (e) maximum operating temperature
- vii. safety data sheet.
- viii. description of production processes.
- ix. description of quality assurance system or copy of ISO 9001 certificate.
- x. in-service experience, if available.
- xi. list of tests and measuring equipment including calibration certificate.

Section 3

Type Approval testing

3.1 Test program

3.1.1 The test program is to 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 test program is intended to verify the material properties as specified in 3.3. The extent of the reduction or complete waiver of the approval tests may be specially considered taking into account:

- a) Documentation of approval tests performed
- b) A proven track record

3.2 Wear testing procedure

3.2.1 Unless otherwise specified, wear test is to be carried out in accordance with the requirements in 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 are to 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 is to be considered in the wear test.
- motion of shaft: continuous rotation.
- circumferential velocity is to 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 ($23^{\circ}\text{C}\pm 2^{\circ}\text{C}$), or mineral oil ($80^{\circ}\text{C}\pm 2^{\circ}\text{C}$), or grease ($80^{\circ}\text{C}\pm 2^{\circ}\text{C}$) according to the applicable lubrication type.
- surface roughness of test shaft: Ra is not to exceed $0.5\mu\text{m}$ for stainless steel and Ra is not to exceed $0.8\mu\text{m}$ for copper alloy.
- interface pressure : maximum nominal surface pressure $\pm 10\%$
- duration of test: until the coefficient of friction and wear rate remains constant at least 192h. Wear of bushings is to be measured continuously or regularly. If being carried out regularly, wear is 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 e.g. polytetrafluoroethylene (PTFE) 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

SI No.	Test items	Test standard ¹	Number of specimens ² for each sample (at least)	Test conditions	Acceptance criteria
1.	Compressive Strength [N/mm ²]	ISO 604: 2002; ASTM D695-2015	5 ³	-	Min.85 N/mm ² in the case of isotropic materials. Min.85 N/mm ² for specimens parallel to sheet plane in the case of anisotropic materials. Min.100 N/mm ² for specimens normal to sheet plane in the case of anisotropic materials.
2.	Compressive modulus [N/mm ²]	ISO 604: 2002; ASTM D695-2015	5 ³	-	Min.850 N/mm ² in the case of isotropic materials. Min.850 N/mm ² for specimens parallel to sheet plane in the case of anisotropic materials. Min.1000 N/mm ² for specimens normal to sheet plane in the case of anisotropic materials.
3.	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%

4.	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 $\pm$ 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 $\leq$ 3%
5.	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 $\pm$ 2°C	Min. 80% retention of minimum specified compressive strength and modulus before water immersion
6.	Temperature resistance	ISO 604: 2002; ASTM D695-2015	5 ³	Compressive strength and compressive modulus at maximum temperature (60°C $\pm$ 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 $\pm$ 2°C
7.	Wear test	See 3.2	1		

Note:

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. At least five specimens for each sample in the case of isotropic materials are to be tested. At least ten specimens, five normal to and five parallel to sheet plane, for each sample in the case of anisotropic materials, are to be tested.

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

SI No.	Test items	Test standard ¹	Number of specimens ² (at least)	Test conditions	Acceptance criteria
1.	Tensile strength [N/mm ²]	ISO 37:2017; Method A of ASTM D412-16(2021); ASTM D638-22	3		Min.10 N/mm ² for rubber bearing, and min.30 N/mm ² for other elastomeric bearing
2.	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
3.	Hardness	ISO 48-4:2018; ASTM D2240-15(2021)	3		
4.	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:50x50x t mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition).	Volumetric swelling ≤ 3%
5.	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:50x50x t mm, t is min. 4 mm or the min. thickness of the bushing product. Testing immediately after extraction (wet condition).	Volumetric swelling ≤ 3%
6.	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

7.	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 ($60^{\circ}\text{C}\pm 2^{\circ}\text{C}$ or advised maximum working temperature by manufacturer, whichever is higher).	Min. 80% retention of minimum specified tensile strength and elongation at $20^{\circ}\text{C}\pm 2^{\circ}\text{C}$
8.	Adhesion to metals (except those not to be adhered to metals) [N/mm ²]	ISO 813:2019; ISO 1827:2022	3	-	-
9.	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 are to be subjected to circulating air at maximum temperature ($60^{\circ}\text{C}\pm 2^{\circ}\text{C}$ or advised maximum working temperature by manufacturer, whichever is higher) for 96 hours. Tension and elongation tests are to 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
10.	Wear test	See 3.2	1		

Note:

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

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

.2 Each kind of product means:

- same chemical composition range
- same reinforcement, only applicable to composite materials
- same production process

.3 The test products used for type approval testing are to be selected from the manufacturer's production line or stock by the Surveyor 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

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

Section 4

Type Approval certificate

4.1 Issuance of certificate

4.1.1 A Type Approval Certificate is issued based on the test reports and manufacturer's technical documentation e.g., installation/ engineering manuals.

As minimum, the following information is specifically applicable to products relevant to this document and are to be included on the relevant Type Approval Certificate:

- a) Product description and properties in accordance with section 3.3
- b) Maximum nominal surface pressure
- c) Maximum operating temperature

4.1.2 Approval Certificate will be issued with validity for 5 years.

4.2 Withdrawal of Certificate

4.2.1 The type approval certificate will be invalid if there are substantial modification in the characteristics of the materials unless approved in advance by IRS.

4.3 Intermediate Audit

4.3.1 IRS will carry out an intermediate audit of the manufacturing works during the five year period. The intervals between initial, intermediate audits is not to be more than 30 months.

4.4 Certificate Renewal

4.4.1 A renewal of type approval certificates will be granted upon:

- a) Submission of request for renewal
- b) Submission of modified documents or new documents with substantial modifications replacing former documents compared to the previous submission(s) for TA.
- c) A declaration that no substantial modifications have been applied/ undertaken since the last TA was issued.

End of Classification Note