

# Nordic Boat Standard

Materials and Components  
for

Boats less than 15 metres

1990



Denmark



Finland



Iceland



Norway



Sweden



Secretary

<b>DENMARK</b>	Sjöfartsstyrelsen Vermundsgade 38 C 2100 COPENHAGEN	Tel: 39/271515 Telefax: 39/271516 Telex: 129204
<b>FINLAND</b>	Sjöfartsverket Postfack 158 00141 HELSINKI	Tel: 1/18081 Telefax: 01/1808355 Telex: 121471 mkh st
	Statens Tekniska Forskningscentral VTT Östanvindsvägen 2 SF-01200 ESBO	Tel: 0/4561 Telefax: 0/4550619 Telex: 122972 vttha
<b>ICELAND</b>	Siglingamalastofnun Ríkisins Postbox 7200 121 REYKJAVIK	Tel: 1/25844 Telefax: 1/29323 Telex: 2307 Isinfo is
<b>NORWAY</b>	Sjöfartsdirektoratet P O Box 8123 OSLO DEP OSLO 1	Tel: 02/350250 Telefax: 02/381716 Telex: 16997 aid n
<b>SWEDEN</b>	Sjöfartsverket 601 78 NORRKÖPING	Tel: 011/191000 Telefax: 011/239934 Telex: 64380 shipadm s
<b>SECRETARIAT</b>	Det norske Veritas Classification A/S P O Box 300 1322 HÖVIK NORWAY	Tel: 02/479900 Telefax: 02/479911 Telex: 76192 verit n

## PREAMBLE

The Nordic Boat Standard for Material and Components (MC) contains a number of provisions for sub-contractors to the boat industry. The standard shall be used in connection with certification of boats with a length of less than 15 metres according to the Nordic Boat Standard (NBS). The Standard gives the material and component manufacturers a possibility to get their products accepted according to the Nordic Boat Standard before products are ordered to boats which shall be certified.

Requirements in respect to type and size of material and components to be used in various cases are given in the Nordic Boat Standard for certification of boats. Separate parts of the Nordic Boat Standard are published for commercial boats (NBS C) and pleasure boats (NBS P).

Certification of material and components according to the Nordic Boat Standard can be issued by the Maritime Administrations of the Nordic countries, Denmark, Finland, Iceland, Norway and Sweden, and Det norske Veritas Classification A/S.

Translation from the original languages by Per Eriksson, former Maritime Safety Director of the National Maritime Administration of Sweden.

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# CERTIFICATION

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**MC 1**

## Contents

- 1 General
- 2 Documentation
- 3 Approval tests
- 4 Delivery testing and marking
- 5 Random test procedures

### 1. GENERAL

- 1.1 Certification means issue of a certificate which states that a defined product complies with the requirements in this Standard.
- 1.2 A type approval certificate is issued with a validity of four years and will be published. At the end of the period of validity the manufacturer may apply for renewal of the approval which will be given on the basis of test results for type approval.
- 1.3 An approval ceases to be valid if the provisions on which the approval is based are revoked.
- 1.4 If the manufacturer modifies the composition or the properties of an approved product during the period of validity, he shall report accordingly. A new type approval may be required.

### 2. DUCUMENTATION

- 2.1 Together with the application for certification the manufacturer shall submit information concerning the product and its production.
- 2.2 Information sheets or product information shall contain at least the information required by the different chapters of the Standard. In addition, general information which gives satisfactory characteristic of the product for which approval is requested shall be submitted.

### 3 APPROVAL TESTS

- 3.1 If the submitted datasheet and information are considered satisfactory, an approval test shall be carried out with each type to be covered by the approval.
- 3.2 The requirements specified for approval testing for the products in question shall be controlled.
- 3.3 Standardized test methods other than those specified for the different materials may be used after agreement.

### 4 DELIVERY TESTING AND MARKING

- 4.1 The manufacturer shall normally carry out the delivery tests specified in this Standard for each product.

The specified delivery tests may be substituted by production control in accordance with an approved quality assurance system.

- 4.2 Results and measurements during the delivery testing shall be available at the random-test procedure which might be carried out.
- 4.3 At each delivery each product or package unit shall be marked in accordance with the product designation on the type approval certificate.

### 5 RANDOM TEST PROCEDURES

- 5.1 Random control of the product will be carried out to an extent which is specified when the approval is granted.

# GLASS FIBRE MATERIALS

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**MC 2**

## Contents

- 1 General
- 2 Documentation
- 3 Properties
- 4 Delivery

## 1 GENERAL

- 1.1 This standard specifies the properties which shall be known for glass fiber material to be used in boats with length of less than 15 meters certified in accordance with the Nordic Boat Standard.
- 1.2 The glass is to be of the E-quality where the sum of  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$  is to be less than 1 per cent. A certificate showing the chemical composition is to be presented, or a chemical analysis is to be carried out showing that the requirements to E glass have been met ( $\text{SiO}_2$  52-56 %,  $\text{CaO}$  16-25 %,  $\text{Al}_2\text{O}_3$  12-16 %,  $\text{B}_2\text{O}_3$  6-12 %,  $\text{Na}_2\text{O} + \text{K}_2\text{O}$  0-1 % and  $\text{MgO}$  0-6 %)
- 1.3 Fibres made of other materials may be used, subject to special agreement and provided that their mechanical properties and resistance to hydrolysis are equally good or better.
- 1.4 Coupling agents of silane compounds or complex chromium compounds shall be used.  
  
The coupling agents shall be evenly distributed on the fibres.
- 1.5 The glass fibres shall be produced as continuous fibres. The product quality which is delivered for use shall be tested.

1.6 For roving which will be applied by spraying, a demonstration shall be made in the surveyor's presence which is to show that the roving is suitable for this form of application.

## 2 DOCUMENTATION

2.1 Documentation in the form of test reports for all properties specified in section 3 shall be submitted.

2.2 On the basis of submitted documentation an approval testing programme for control of the submitted documentation will be developed.

## 3 PROPERTIES

### 3.1 Requirements for glass fibre products

Properties	Test method	Required values for approval testing (also requirements for delivery testing)
Moisture content	ISO 3344-1977	Maximum 0,2 %
Ignition loss	ISO/R 1887-1980	The manufacturer's nominal value. tolerance limits for the various materials are subjected to approval in each separate case *
Weight per length	Roving: ISO/R 1889-1975	The manufacturer's nominal (*) value $\pm 10$ %
Weight per area	Mats: ISO 3374-1980 Woven roving: ISO 4605-78	

3.2 All glass fibre reinforcement, when moulded in polyester, shall have at least the following mechanical properties:

Tensile strength  $R_m$ , 80 N/mm<sup>2</sup>  
 flexural strength  $R_{mb}$ , 130 N/mm<sup>2</sup>  
 Modulus of elasticity, tensile 7000 N/mm<sup>2</sup>  
 Modulus of elasticity, flexural 6000 N/mm<sup>2</sup>



- 3.3 Tensile strength and tensile modulus of elasticity shall be determined in accordance with ISO 3268. The samples shall be taken in two directions.

Flexural strength ( $R_{mb}$ ) and flexural modulus of elasticity shall be determined in accordance with ISO 178.

Samples shall be taken in two directions and the mould side is to be subjected to compressive load.

- 3.4 Mean values of the results of the above mentioned tests shall fulfill the stated requirements. No single value shall be lower than 80 per cent of the value used in the calculation.

- 3.5 The glass content in the cured laminate shall be minimum 27 per cent by weight measured in accordance with ISO/R 1172-1975. The glass content in the laminate samples must not vary by more than  $\pm 4$  per cent. All single values shall fulfill the stated requirements.

#### 4 DELIVERY

- 4.1 The manufacturer shall carry out delivery tests on each consignment. The requirements which are marked with an asterisk (\*) in the list of requirements for the various materials shall be fulfilled at the delivery test. The measured values shall be filed and be available at random-test control.
- 4.2 Each delivery shall be marked with the manufacturer's name and type designation in accordance with the type approval certificate.



# POLYESTER MATERIALS

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MC 3

## Contents

- 1 General
- 2 Documentation
- 3 Uncured resin
- 4 Cured resin
- 5 Gelcoat/topcoat
- 6 Delivery tests and marking

### 1 GENERAL

- 1.1 This standard specifies the properties which shall be known for polyester materials to be used in boats less than 15 meters certified in accordance with the Nordic Boat Standard.
- 1.2 Approval of polyesters is divided in two different quality grades.  
  
Grade 1: Polyester with high water resistance.  
  
Grade 2: Polyester with lower water resistance.
- 1.3 Gelcoats and topcoats are approved only in quality grade 1.

### 2 DOCUMENTATION

- 2.1 Documentation shall be submitted in the form of test reports for all properties which are specified in paragraphs 3, 4 and 5.
- 2.2 An approval test programme for control of the submitted documentation is to be developed on the basis of the submitted documentation.

### 3 UNCURED RESIN

- 3.1 The polyester shall be suitable for lamination by hand or spraying. It shall have satisfactory wetting properties and shall cure satisfactorily at normal ambient temperature.

The polyester reinforced with glass fibre mats shall at least fulfil the minimum requirements for laminate strength.

Polyesters for other production methods may be approved after special consideration.

#### 3.2 Requirements for uncured resin

Properties	Test method	Requirements at approval testing *also requirements at delivery testing
Density	ISO 1675-1985	The manufacturer's specified nominal value
Viscosity	(1) Brookfield ISO 2555-1989 (2) Cone/plate ISO 2884-1974	The manufacturer's specified nominal value $\pm$ 20 per cent
Acid number	ISO 2114-1974	The manufacturer's specified nominal value $\pm$ 10 per cent
Monomer content	ISO 3251-1974	The manufacturer's specified nominal value $\pm$ 5 per cent
Mineral content	DIN 16945-1974 page 1, 4, 10	Maximum 5 %  A higher mineral content may be accepted after special consideration
Gel time	ISO 2535-1974 or equivalent	The manufacturer's specified nominal value $\pm$ 20 per cent
Linear curing shrinkage	ASTM P 2566-79	The manufacturer's specified nominal value

## 4. CURED RESIN

## 4.1 Requirements for cured resin

Property	Test method	Requirements at approval testing	
		Grade 1	Grade 2
Density		The manu- fac- turer's specified nominal value	The manu- fac- turer's speci- fied nominal value
Hardness	ASTM D 2583-67	Mini- mum 35	Mini- mum 35
Deformation temperature (H.D.T.)	ISO 75-1987, Method A	Minimum 70 °C	Minimum 62 °C
Water absorption	ISO 62-1980 Test sample 50*50*4 mm (±1*1*0,2) Artificial sea water (DIN 50905) Exposure time: 28 days at 23°C	Maximum 80 mg	Maximum 100 mg
Tensile stress	ISO/R 527-1966	Minimum 50 N/mm <sup>2</sup>	Minimum 45 N/mm <sup>2</sup>
Modulus of elasticity	ISO/R 527-1966	Minimum 3000 N/mm <sup>2</sup>	Minimum 3000 N/mm <sup>2</sup>
Fracture elongation	ISO/R 527-1966	Minimum 2,0 %	Minimum 1,5 %

The curing process used to obtain the above mentioned properties shall be specified.

## Comments

Unless otherwise specified by the manufacturer, the following curing procedure shall be followed:

- o MEKP: 1 % of a 50 % solution
- o curing: 24 hours at 20°C
- o Post-curing: 24 hours at 50°C

- 4.2 Polyesters containing wax or other substances which can lower the external adhesive capacity shall in addition be subjected to the following delamination control:

Production of test piece

- o A laminate consisting of three layers of 450 g/m<sup>2</sup> emulsion mats with excess polyester in the upper surface cured at 20°C for 48 hours.
- o A new laminate consisting of three layers of 450 g/m<sup>2</sup> emulsion mat is built on the first without any form of upper surface treatment.

Curing minimum one week at 20°C.

Tensile testing

- o Tensile strength in the thickness direction is to be tested in accordance with ASTM C 297 on a square test piece 50\*50 mm. The strength shall be at least 9 N/mm<sup>2</sup>. The fracture shall not be a typical brittle fracture with smooth surfaces.
- o If a circular test piece is used the tensile strength shall be at least 18 N/mm<sup>2</sup>.

5 GELCOAT/TOPCOAT

- 5.1 Gelcoat and topcoat shall be produced from a polyester which fulfils the requirements in 4.1, grade 1.
- 5.2 Complete covering shall be achieved with a thickness of maximum 500 microns.

6 DELIVERY TESTS AND MARKING

- 6.1 The manufacturer shall carry out delivery testing of each consignment. The requirements marked with an asterisk (\*) in the list of requirements for the different materials shall be fulfilled at the delivery testing. Measured values shall be filed and be available at random control.
- 6.2 Each delivery shall be marked with the manufacturer's name and type designation according to the type approval certificate.

# TERMO PLASTICS

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## Contents

- 1 General
- 2 Documentation
- 3 Properties of polyethylene
- 4 Properties of ABS and equivalent
- 5 Delivery testing and marking

### 1 GENERAL

- 1.1 The Standard covers polyethylene and ABS materials to be used in boats less than 15 metres to be certified in accordance with Nordic Boat Standard.
- 1.2 Approval is given to the raw material manufacturer at the last stage before the boat production. For rotation moulding the approval is given to the manufacturer of granulate/powder. For thermoforming of sheets the approval is given to the sheet manufacturer.
- 1.3 Control of the ageing properties shall be carried out on a sheet of the material in question with the pigments, etc which are expected to be used.
- 1.4 The pigments shall normally not constitute more than 4 per cent by weight and shall be evenly distributed in the material and any possible lowering effect on the strength properties of the material shall be documented.

1.5 The impact strength of the material at low temperature is subject to approval, taking into account the fracture characteristics at impact testing. Brittle fracture at a temperature above 0 °C is not accepted. If the transition from tensile to brittle fracture occurs between 0 and minus 20 °C, the following text shall be inserted in the certificate:

"The impact strength of the material is reduced at low temperatures and the material should not be used in cold climate."

1.6 The ability of the material to withstand sun heating can be approved on the basis of the reduction in material stiffness between 20 and 65 °C. Reduction in the shear modulus of elasticity of the material greater than 80 per cent is not acceptable. If the reduction is between 30 and 80 per cent the following text shall be inserted in the certificate:

"The material will soften at high temperature and can be permanently deformed by long term loading."

1.7 The approval shall state which production method the material is intended for.

## 2. DOCUMENTATION

2.1 The following properties shall be documented for type approval of raw materials:

Property	Test method	Requirement at approval testing and information which shall be submitted. The asterisk (*) means that the requirement applies also to delivery testing
Tensile properties	ISO/DIS 527-1985 Test piece type 2 5-50 mm/min	Curve at 20°C and 65°C
Shear modulus	ISO 537-1980 Torsion pendulum	Curve for the temperature range -20°C to + 65°C
Creep	ISO 899-1981	Curve for the temperature range 20°C to 65°C



Property	Test method	Requirement at approval testing and information which shall be submitted. The asterisk (*) means that the requirement applies also to delivery testing
Fatigue	Carried out with constant stress or deformation amplitude	Curve for 20°C
Hardness (PE) shore D	ISO 868-1985	Applied at 20°C Read after 15 sec
Impact strength (Falling weight)	ASTM D 3029-72 (method A) The falling hammer shall have an impact surface with a radius of 12,5 mm	Fracture energy at visible crack as fracture criterion stated at 0°C and -20°C for the material thickness in question * ABS
Impact strength (pendulum)	ISO 180-1982 V-notch. For particularly flexible materials, e.g. PE, an alternative test method may be used	Notch impact strength for virgin material
Ageing	ISO 179-1982 (Charpy) without notch Natural ageing: DIN 53 386 item 6.1 Accelerated ageing: DIN 53 387	Recorded fracture energy for aged material as a function of time. The time shall normally be 48 months natural ageing or equivalent accelerated ageing, however, a shorter time can be accepted if the ageing process is clarified at an earlier stage
Fuel resistance	Material under load submerged in normal engine fuel	Recording of surface cracking

Property	Test method	Requirement at approval testing and information which shall be submitted. Asterisk (*) means that the requirement applies also to delivery testing
Melt index	ISO 1133-1981 cond 18	To be stated for polyethylene * PE
Chemical resistance	ISO 175-1981	List of chemical substances which may cause damage to the material
Density	ISO 1183-1983 Method D	To be stated for polyethylene * PE
Oxygen index	ASTM D 2863-77	Value to be stated

2.2 The production method and production conditions for obtaining the above listed data shall be reported.

### 3 PROPERTIES OF POLYETHYLENE

3.1 Test samples (prisms) shall be taken from material produced with a representative method, however, the material shall not be weakened due to the manufacturing process.

3.2 The following material requirements shall be complied with (for test methods, see 2.1):

Property	Requirement PEL	Requirement PEM	Remark
Density kg/m <sup>3</sup>	maximum 930	930 - 945	
Tensile yield stress N/mm <sup>2</sup>	minimum 7,5 minimum 4,5	minimum 13,0 minimum 8,0	at 20°C at 65°C
Tensile modulus N/mm <sup>2</sup>	minimum 180	minimum 350	at 20°C
Tensile creep %	max.2,5 at stress 2,0	max. 2,0 at stress 3,0	Deformation after 100 h at 20°C

Property	Requirement PEL	Requirement PEM	Remark
Hardness, Shore D	Manufac- turer's specified nominal value $\pm 3$	Manufac- turer's specified nominal value $\pm 3$	At 20°C, read after 15 sec.
Impact strength J/mm (falling weight)	minimum 15 and no fracture at notch	minimum 15 and no fracture at notch	Freely supported test piece 0°C and -20°C
Notch impact strength (pendulum test with notch), visual	No brittle fracture	No brittle fracture	At 0°C. This requirement is only ap- plicable to boats with single skins
Pore contents per cent of thick- ness	maximum 15  maximum 20	maximum 15  maximum 20	In strength parts In other parts
Impact tensile strength aged material (internal standard)	No brittle fracture, minimum fracture energy 1,0 J/cm <sup>3</sup>	No brittle fracture, minimum fracture energy 1,0 J/cm <sup>3</sup>	Aged material corresponding to 4 years of natural ageing tested at 0°C and with a test speed of $2 \cdot 10^5$ % strain/min. Re. ageing, see 2.1

4 PROPERTIES OF ACRYLONITRILEBUTADIENESTYRENE (ABS) AND EQUIVALENT MATERIALS

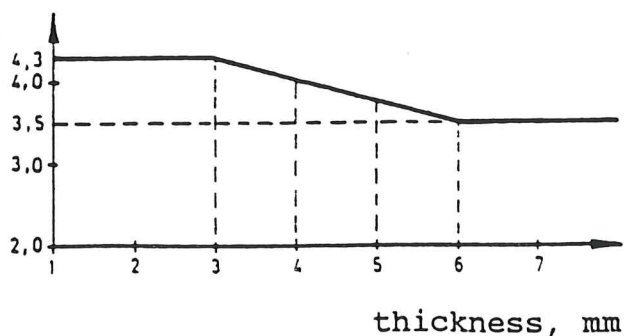
4.1 Material samples for control of properties shall be taken from material which is produced with a representative method.

4.2 The following material requirements shall be complied with (for test methods, see 2.1):

Properties	Requirements
Tensile yield stress	Minimum 30 N/mm <sup>2</sup> at 20°C " 18 " " 65°C
Modulus of elasticity	" 1600 " " 20°C
Creep	Maximum 1,0% deformation after 100 hours at a stress of 7,0 N/mm <sup>2</sup> C
Flexural fatigue strength	At deformation amplitude of 1% and frequency 0,5 Hz the material is to withstand 50 000 load cycles before fracture
Notch impact strength	Minimum 2 kJ/m <sup>2</sup> at 20°C in accordance with ISO 179-82 (Charpy) without notch
Impact strength (pendulum) of aged material	After ageing corresponding to 4 years of natural ageing, the material shall have a fracture energy of at least 2,5 kJ/m <sup>2</sup>

4.3 The plate thickness tolerance at approval tests and delivery control must not be greater than:

tolerance ± %



The tolerance shall be controlled at 20 measurements which are equally distributed over the breadth of the plate.

5 DELIVERY TESTING AND MARKING

- 5.1 The manufacturer shall carry out delivery testing of each consignment. The requirements which are marked with an asterisk (\*) in the list of requirements for the different materials shall be complied with at the delivery testing. The measured values shall be filed and be available at random tests.
- 5.2 Each delivery shall be marked with the manufacturer's name and type according to the type approval certificate.



# CORE MATERIALS

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**MC 5**

## Contents

- 1 General
- 2 Delivery
- 3 Properties
- 4 Marking

### 1 GENERAL

- 1.1 This Standard specifies the properties which shall be known for core materials to be used in boats certified in accordance with Nordic Boat Standard.

### 2 DELIVERY

- 2.1 The manufacturer shall carry out delivery testing of each consignment. The requirements which are marked with an asterisk (\*) in the list of requirements for the various materials shall be complied with at delivery testing. The measured values shall be filed and be available at random tests.

### 3 PROPERTIES

- 3.1 The approval shall be based on a set of minimum properties specified by the manufacturer. These values shall be recorded on the type approval certificate and shall include at least the properties marked in the table 3.2.

### 3.2 Requirements for core materials.

Property	Test method Standard	Required values at approval testing * Also required by delivery. # Minimum values specified		
		Grade 1	Grade 2	
Tensile strength (N/mm <sup>2</sup> )	ASTM C 297-61 <sup>1)2)</sup>	0,8	0,6	#
Tensile modulus (N/mm <sup>2</sup> )	"	30	20	
Compr. strength (N/mm <sup>2</sup> )	ISO 844-1978 <sup>1)2)4)</sup> 23°C	0,7	0,4	#
Compr. modulus (N/mm <sup>2</sup> )	"	30	20	
Compr. strength (N/mm <sup>2</sup> )	ISO 844-1978 <sup>1)2)4)</sup> 45°C	50% of value ob- tained at 23°C	50% of value ob- tained at 23°C	
Shear strength (N/mm <sup>2</sup> )	ISO 1922-1981 <sup>3)4)</sup>	0,6	0,4	#
Shear modulus (N/mm <sup>2</sup> )	"	12	9	#
Shear strain at break	"	Manufacturer's minimum nominal value		
Water absorption (kg/m <sup>2</sup> )	ISO 2896 <sup>2)</sup> 40°C, duration 1 week, salt water DIN 50905-1976	1,5	1,5	
Water resist- ance	% retention of con- pressive and tensile strength after 4 weeks in salt water (DIN 50905) at 40°C, <sup>2)</sup>	75	70	



Property	Test method Standard	Required values at approval testing * Also required by delivery. # Minimum values specified	
		Grade 1	Grade 2
Density (kg/m <sup>3</sup> )	ISO 845-1977	Manufacturer's specified minimum nominal value	* #
Oxygen index	ASTM D-2863	Stated value	
Styrene resistance	ISO/175-1981	The manufacturer shall demonstrate that the laminates on the core material with a standard polyester system do not effect the properties of the core material and that a satisfactory glue attachment between laminate and core material is achieved	

- 1) Maximum speed of deformation, in millimeters per minute: 10% of the value of the measured initial thickness.
- 2) Dimension of specimen 50 \* 50 \* the actual thickness in mm.
- 3) The core material is to be tested with and without a longitudinal adhesive joint. The joint is to be located to the midplane of the specimen, parallel to the steel supports and on equal distance to the supports. The test without joint may be excluded.
- 4) The test is to be carried out on samples with facings or with a layer of suitable resin for stiffening purpose.
- 5) Documentation of fatigue properties and break elongation can be required in addition to the mentioned tests.

4 MARKING

- 4.1 Each delivery shall be marked with the manufacturer's name and type designation in accordance with the type approval certificate.

# SANDWICH ADHESIVES

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MC 6

## Contents

- 1 General
- 2 Delivery
- 3 Properties
- 4 Marking

### 1 GENERAL

- 1.1 This Standard specifies the properties which shall be known for sandwich adhesives to be used in boats less than 15 metres certified in accordance with Nordic Boat Standard.

### 2 DELIVERY

- 2.1 The manufacturer shall carry out delivery testing of each consignment. The requirements which are marked with an asterisk (\*) in the list of requirements for the different material shall be complied with at the delivery testing. The measurement values shall be filed and be available at random tests.

### 3 PROPERTIES

#### 3.1 Requirements for uncured material.

Property	Test method	Required values for approval testing * Also required on delivery
Viscosity	ASTM D 1084-62(81), method B (for free-flowing adhesives)	Manufacturer's nominal value *
Linear curing shrinkage	ASTM D 2566-79 <sup>1)</sup>	Manufacturer's nominal value

<sup>1)</sup> Curing shrinkage is relevant only for gap filling cements.

## 3.2 Requirements for cured material in the joint.

Property	Test method	Required values for approval testing	
		Grade 1	Grade 2
Tensile strength (N/mm <sup>2</sup> )	ASTM C 297-61 (specimen: 50 * 50 mm, speed: 1 mm/min.) at 20 °C: at 50 °C:	min. 1,0	min. 0,8
		min. 80 %	min. 80 %
		retained strength	retained strength
Shear strength (N/mm <sup>2</sup> )	ISO 1922-1981 (20 °C)	min. 0,4	min. 0,3
Water resistance	4 weeks immersion in salt water (DIN 50905-1976) at 40 °C. Tensile testing according to ASTM C 297-61 (specimen: 50*50 mm, speed: 1 mm/min., 20 °C)	min. 80 % retained	min. 80 % retained

- 1 Curing conditions shall be according to the manufacturer's specifications.
- 2 Detailed description of surface treatment and application procedure is required.
- 3 Documentation of fatigue properties and fracture elongation can be required in connection with glueing.

## 4 MARKING

- 4.1 Each delivery shall be marked with the manufacturer's name and type designation in accordance with the type approval certificate.



# BUOYANCY FOAM

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MC 7

## Contents

- 1 General
- 2 Properties
- 3 Marking

### 1 GENERAL

- 1.1 This standard specifies the properties which shall be known for buoyance foam materials which shall be used on boats less than 15 meters certified in accordance with the Nordic Boat Standard.

### 2 PROPERTIES

- 2.1 The buoyancy elements shall be tested in accordance with Swedish Standard (SIS) 88 22 21 item 7 and the alteration of the buoyancy capacity must not exceed 5 %.

The water absorption shall be maximum 8 per cent by volume after 8 days submersion in accordance with ISO 2896-1974.

- 2.2 The buoyancy element shall normally be resistant to gasoline.

### 3 MARKING

- 3.1 Each delivery shall be marked with the manufacturer's name and type designation according to the type approval certificate.





# FUEL HOSES

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## Contents

- 1 Use
- 2 Documentation
- 3 Properties and test method
- 4 Marking

### 1 GENERAL

- 1.1 The requirements of this chapter apply to type approval of fuel hoses mainly for diesel fuel or gasoline to be used onboard boats with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 DOCUMENTATION

- 2.1 When requesting type approval the requirements of this chapter shall be complied with.

### 3 PROPERTIES AND TEST METHOD

- 3.1 Hoses shall be fuel resistant. Rubber hoses shall have a maximum volume change of 30 per cent for the inner rubber and 100 per cent for the outer rubber when tested at room temperature after 72 hours submersion in test liquid C in accordance with ISO/R 1817-1975 or diesel fuel for hoses which shall be approved for diesel fuel.
- 3.2 Plastic hoses shall after the test and after drying at 40° C to a constant weight and conditioning at room temperature not have a greater weight loss than 8 per cent or a greater volume change than 20 per cent.

3.3 Hoses shall after heat ageing in air for 72 hours at 100 °C not have a greater reduction than 33 per cent in tensile strength, 50 per cent in elongation and not more than 10 °IRH hardness change.

3.4 A prototype of each size of the hoses in a series of sizes shall be subjected to an ultimate pressure test at 60 °C. The hoses shall have a bursting pressure of not less than 0,5 MPa (5 kp/cm<sup>2</sup>). For at least 7 days prior to the test the hose shall be kept filled with the fuel test liquid C in accordance with ISO/R 1817-1975.

#### 4. MARKING

4.1 Hoses shall be marked in such a way that they can be identified with the type approval in question.

# EXHAUST HOSES

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MC 9

## Contents

- 1 General
- 2 Documentation
- 3 Properties and test method
- 4 Marking

### 1 GENERAL

- 1.1 The requirements of this chapter apply to type approval of exhaust hoses to be used onboard boats with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 DOCUMENTATION

- 2.1 When requesting type approval the requirements of this chapter shall be complied with.

### 3 PROPERTIES AND TEST METHODS

- 3.1 Exhaust hoses shall consist of an inner rubber layer, reinforcement and an outer rubber layer. The rubber used in the inner layer shall be oil resistant.
- 3.2 The rubber in the outer and inner layer shall after exposure to heat ageing in air for 70 hours at 100°C not have a reduction of more than 20 per cent in tensile strength, 50 per cent in elongation and not more than 10 grades IRH in hardness change. Heat ageing and related mechanical testing shall be carried out in accordance with ISO/R 188-1976, ISO/R 48-1979 and ISO/R 37-1977 or equivalent standards.

3.3 Exhaust hoses shall have a combustibility of not less than 2 according to Swedish Standard SIS 17 22 22. The test sample shall not be less than 300 \* 50 mm. The test sample shall be taken from an unbroken hose.

#### 4 MARKING

4.1 Approved hoses shall be marked in such a way that they can be identified with the type approval in question.

# HYDRAULIC HOSES

MC 10

## Contents

- 1 General
- 2 Documentation
- 3 Properties and test method
- 4 Marking

### 1 GENERAL

- 1.1 The requirements of this chapter apply to type approval of hydraulic hoses to be used onboard boats with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 DOCUMENTATION

- 2.1 When requesting type approval the requirements of this chapter shall be complied with.

### 3 PROPERTIES AND TEST METHODS

- 3.1 The hose material for hydraulic systems shall be resistant to all hydraulic oils which shall be used.
- 3.2 Hoses to be approved for hydrocarbon based hydraulic oils shall be subjected to swell test as described in 3.1 and 3.2 for fuel hoses.
- 3.3 A prototype of each size of the hoses shall be subjected to a bursting pressure test with water of 60°C. Before the pressure is increased the hose shall stay filled with water at the test temperature until the hose is warmed up. The hose shall have a bursting pressure of at least 3 times the maximum working pressure in the system in which it shall be used.

4 MARKING

- 4.1 Approved hoses shall be marked in such a way that they can be identified with the type approval in question.

# WATER HOSES

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**MC 11**

## Contents

- 1 General
- 2 Documentation
- 3 Properties and test method
- 4 Marking

### 1 GENERAL

- 1.1 The requirements of this chapter apply to type approval of hoses to be used for bilge and cooling water hoses onboard boats with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 DOCUMENTATION

- 2.1 When requesting type approval the requirements of this chapter shall be complied with.

### 3 PROPERTIES AND TEST METHOD

- 3.1 Rubber hoses or hoses of thermoplastic material can be used, but hoses without reinforcement are not permitted.
- 3.2 Only hoses guaranteed by the manufacturer to be capable of continuous use at a temperature of at least 93°C shall be accepted.
- 3.3 A prototype of each size of the hoses shall be subjected to a bursting pressure test with water of 60°C. Before the pressure is increased the hose shall stay filled with water at the test temperature until the hose is warmed up. The hose shall have a bursting pressure of at least 3 times the maximum working pressure in the system in which it shall be used.

4 MARKING

- 4.1 Approved hoses shall be marked in such a way that they can be identified with the type approval in question.



# CABLE STEERING SYSTEMS

MC 12

## Contents

- 1 General
- 2 Documentation
- 3 Testing
- 4 Marking

### 1 GENERAL

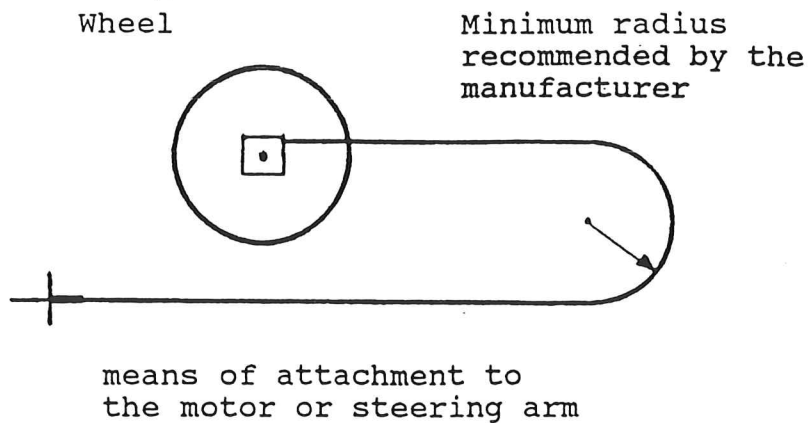
- 1.1 This chapter contains criteria for determining the allowed steering force and requirements for steering systems to be installed in a boat with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.
- 1.2 The chapter applies to ready made systems with an inner steering cable which moves in an outer tube. It does not apply to systems which need supply of mechanical power for their function.
- 1.3 A wheel which shall be considered as part of the system shall comply with the requirements of NBS MC14.

### 2 DOCUMENTATION

- 2.1 A schematic sketch with all components and their article numbers is required. The length of the steering cables shall be indicated.

### 3 TESTING

- 3.1 The system shall be mounted in accordance with the sketch below when it is tested. The testing shall be made at room temperature.



- 3.2 The system shall, when the wheel is locked, be capable of resist a load equal 3,5 times the steering force, both in tension and compression at the point to be connected to the motor steering arm.
- 3.3 With the attachment for the motor or the steering arm locked and the longest steering cable and the largest wheel which can be tested. The wheel shall be subjected to the torsional moment, however not more than a 450 N force applied at the periphery (the wheel ring or the arc described by the middle point of the grip on a peg wheel), which is necessary to achieve the allowed steering force. The deflection along the periphery shall not be more than 300 mm.
- 3.4 It shall be verified that the allowed steering force is achieved in the attachment to the motor or the steering arm when a force of not more than 450 N is applied on the wheel periphery with the smallest wheel which can be used in the system.

### 4 MARKING

- 4.1 The steering gear and the steering cable shall be marked with the manufacturer's article number.

# WHEELS

**MC 14**

## Contents

- 1 General
- 2 Documentation
- 3 Ageing before testing
- 4 Testing
- 5 Marking

### 1 GENERAL

- 1.1 This chapter contains requirements to wheels for steering systems to be used in boats less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 DOCUMENTATION

- 2.1 The construction of the wheel shall be shown in a drawing stating materials. The ageing properties shall be documented in case of plastic wheels without a structural metal frame.

### 3 AGEING BEFORE TESTING

- 3.1 Wheels made of plastic materials without a structural metal frame shall be exposed to xenonlight corresponding to 4 years natural ageing. This requirement may be omitted for black plastic material if good ageing properties can be documented.

4 TESTING

- 4.1 The wheel shall be subjected to a turning force of 450 N applied at the periphery (the wheel ring or the arc describe by the middle point of the grip on a peg wheel). A pull and push load of 670 N in the axial direction distributed over 100 mm at the weakest part of the wheel ring shall be applied. No permanent deformation of the wheel ring or breakage is allowed at any of the tests.

5 MARKING

- 5.1 Wheels shall be marked with the manufacturer's article number.

# LPG COMPONENTS

**MC 15**

## Contents

- 1 General
- 2 Performance and property requirements
- 3 Marking

### 1 GENERAL

The requirements of this chapter apply to components for assembling LPG systems in boats with a length of less than 15 metres certified in accordance with the Nordic Boat Standard.

### 2 PERFORMANCE AND PROPERTY REQUIREMENTS

- 2.1 Components and appliances shall be capable of functioning at temperatures between  $-10^{\circ}$  C and  $+60^{\circ}$  C and shall withstand temperatures between  $-30^{\circ}$  C and  $+60^{\circ}$  C.
- 2.2 Cylinders shall be constructed so that the LPG leaves the cylinder in the gaseous state. The cylinder shall have a manual shut-off valve screwed directly to the cylinder. The valve shall have a permanently mounted manoeuvring device which can be operated without the use of tools.
- 2.3 A gas regulator shall be of a type which can be mounted permanently in the cylinder space or directly to the cylinder.
- 2.4 Tubes shall be documented as suitable for LPG and for use in a marine environment. Tubes made of soft copper together with couplings of copper or copper alloys and pipes of stainless steel are accepted.
- 2.5 Rubber hoses shall comply with the requirements of ISO 2928.

2.6 Burners shall be fitted with a flame failure safety device.

3 MARKING

3.1 Cylinders with their shut-off valves, gas regulators and appliances shall be marked in accordance with the provisions of the competent national authority.

# MOORING CLEATS

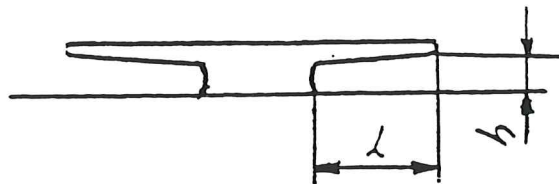
**MC 16**

- 1 Mooring and towing cleats shall be strongly designed and mounted. The cleats and their mountings shall without breaking withstand a load in the longitudinal direction of the boat as follows:

$$P = 50 * \Delta / \text{Loa} \quad \text{N}$$

where  $\Delta$  is the displacement fully loaded in kg.

- 2 Mooring and towing cleats shall be so designed that a mooring or towing line can be securely fastened to them. Cleats shall normally have scantlings in accordance with the figure below.



$$h = 0,2 \sqrt{p} \quad \text{mm}$$

$$l \geq 2 * h \quad \text{mm}$$

- 3 Mooring and towing cleats made of plastics shall before testing in accordance with 1 be aged with xenon light in accordance with DIN 53 387 corresponding to 4 years natural ageing. This requirement may be omitted for black mooring cleats.



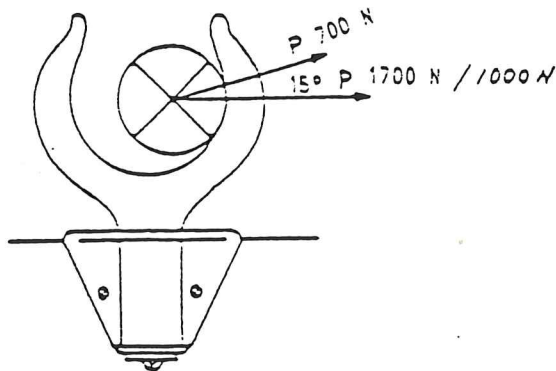


# ROWING CLEATS

**MC 17**

## 1 STRUCTURAL STRENGTH

- 1.1 Rowing cleats shall be capable of withstanding a force of 1000 N parallel with the horizontal plane without any significant plastic deformation. It shall be possible to use the rowing cleat normally after testing.
- 1.2 Rowing cleats shall be capable of withstanding a force of 1700 N parallel with the horizontal plane without breaking and also a load of 700 N in an angle of 15 degrees against the horizontal plane without the loading arm slipping out of the cleat. The strain rate at tensile tests shall be at least 100 mm/minute.



- 1.3 Rowing cleats of plastic materials shall be exposed to xenon light ageing according to DIN 53 387 corresponding to 4 years natural ageing before the test is carried out. The required ageing can be omitted for black rowing cleats.
- 1.4 If the rowing cleat has reinforcement of corrodible material the reinforcement material shall be totally enclosed in the plastic material or be protected with an anti corrosive coating.
- 1.5 If the fastening to the boat of the rowing cleat is different from the normal fastening arrangement for the cleat a tensile test according to 1.2 may be required for a rowing cleat mounted in the boat.



