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## Ships and marine technology — Fibre-reinforced plastic gratings

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Ships and marine technology — Fibre-reinforced plastic gratings

## 1 Scope

This document specifies the terms and definitions, structure, technical requirements and test methods of gratings for fiber reinforced plastics (FRP) in the marine.

This document is applicable to the design, manufacture and inspection of self-support FRP gratings used for pedestrian pathways and platforms on ships or offshore platforms.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 834-1:1999, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 4892-3:2013, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 9227:2017, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 14125:1998, *Fibre-reinforced plastic composites — Determination of flexural properties*

IEC 61892-7:2007, *Mobile and fixed offshore units — Electrical installations — Part 7: Hazardous areas*

IMO *International Code for Application of Fire Test Procedures, 2010 (FTP Code)*

IMO *International convention for the safety of life at sea, 1974 (SOLAS)*

ASTM D2047, *Test method for static coefficient of friction of polish-coated flooring surfaces as measured by the James machine.*

ASTM E84, *Standard test method for surface burning characteristics of building materials*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1 FRP

fiber reinforced plastic, a composite material made of resin reinforced with fiber.

Note 1 to entry: Glass fibers are widely used as reinforced fiber.

### 3.2 skid resistance

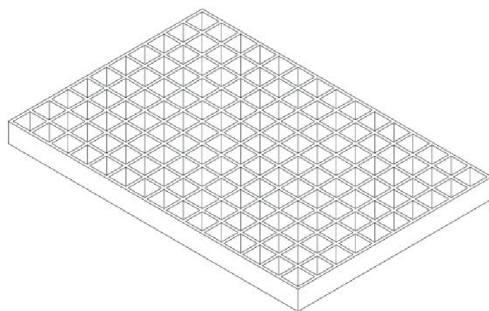
property of the trafficked surface which limits the relative movement between the contact patch of pedestrian footwear or a vehicle tyre and the surface

## 4 Classification

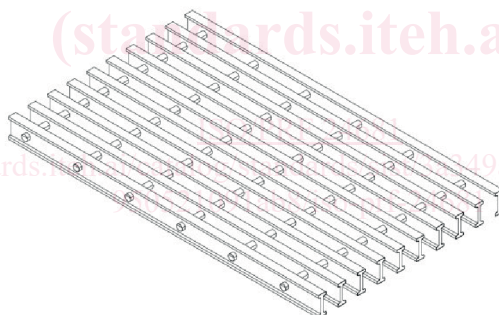
### 4.1 Types

FRP grating is a kind of composite panel material with a certain aperture ratio, which is based on thermosetting resin and reinforced with fiberglass roving, and is processed by special technology. The raw materials shall meet recognized standards and be specified in the technical specification, so as to ensure its continuous and stable performance.

FRP gratings are generally divided into two types, molded or pultruded FRP gratings. For typical examples, see [Figure 1](#) and [Figure 2](#).



**Figure 1 — Molded grating**



**Figure 2 — Pultruded grating**

#### 4.1.1 Molded grating

Molded FRP gratings are produced by the open mold process in which thermosetting resin and dry glass fiber are placed in the mold in cross directions. After filling the mold with the designated amount of material, the resin is allowed to cure in the open mold. Molded grating is usually manufactured in square mesh or rectangular mesh configurations. Square mesh molded grating has nearly equal strength in longitudinal and transverse directions. Rectangular mesh has better strength along longitudinal direction. For the common mesh configuration, see [Table 1](#).

**Table 1 — Common molded FRP grating configuration.**

Dimensions in millimetres

Mesh size	Height	Web thickness
		Bottom thickness / top thickness
25,4×25,4	50	6/8
38,1×38,1	25	5/6,35
38,1×38,1	30	5/6,6
38,1×38,1	38	5/7
38,1×38,1	50	5,8/8,5
38,1×38,1	50	9/11,5
38,1×38,1	63	5,8/9
38,1×38,1	63	9/12
50,7×50,7	50	5/8,3
25,4×50,8	50	9/11,5
25,4×152,4	38	5/7
38,1×101,6	38	5/7
38,1×152,4	50	7/9

NOTE Molded FRP gratings are in general with inverted trapezoidal web section. The bottom thickness is smallest decided by the mold, and top thickness would be larger depending on the height .

#### 4.1.2 Pultruded grating

Pultruded grating consists of longitudinal bearing bars secured in position by transverse bars. The reinforced fiber is impregnated by thermosetting resin and pultruded to make shaped bearing bar under compression and heat. The bearing bar profile is generally “I” or “T” shaped. The product has high strength along bearing bars direction and is suitable for large span use. Common specifications are shown in [Table 2](#) below:

**Table 2 — Common Pultruded FRP grating configuration**

Dimensions in millimetres

Bearing bar	Width	Space	Height
I	15	10/15/23	25/30/38
T	25,4	12,7/25,4	50,8

NOTE The common transverse securing bar is arranged in 152,4 mm interval.

#### 4.1.3 Other type gratings

Other type gratings of occupied areas for workers or machinery must be confirmed by authorities.

## 5 Technical requirements

### 5.1 Appearance

**5.1.1** FRP grating shall be smooth and flat, no obvious stratification, burr, crack, fiber exposure and impurities.

**5.1.2** No pores larger than 3 mm in diameter are allowed. The number of pores between 1 mm and 3 mm in any 300 mm × 300 mm area shall not exceed 10.

**5.1.3** The warpage shall be not more than 2,5 mm/m along bearing bar direction and not more than 5 mm/m in other directions.

## 5.2 Load-bearing capacity

**5.2.1** The flexural strength of FRP grating panel shall be not less than 345 MPa.

**5.2.2** No crack, stratification or other destructive damage shall be observed when the FRP grating is subject to 1,5 times design load.

**5.2.3** The design load of FRP grating used in pedestrian pathways and platform of ship shall be 4 kN/m<sup>2</sup> uniform load or equivalent. The design load may be other specified if they are dedicated for certain load condition. The grating deflection in the middle point of span shall not be greater than 1/120 of the span under design load, and the maximum deflection shall not exceed 9 mm.

**5.2.4** For FRP grating used as steps of stair ladders, 2 kN concentrated load applied at the middle of step shall also be considered. The deflection of the middle point of the tread shall not be greater than 1/200 of its span, and the maximum deflection shall not exceed 6 mm.

## 5.3 Corrosion resistance

FRP grating should have good corrosion resistance. Gratings used for exposed area or ballast tanks shall be designed with good resistance to sea water and high salt fog conditions. After the salt spray test, the load-bearing capacity shall meet the requirements of [5.2.1](#) above.

## 5.4 Skid resistance

FRP gratings should have good skid resistance. The average coefficient of friction of upper surface shall be not less than 0,75 for dry leather conditions.

## 5.5 Flame spread characteristics

When FRP grating is required to have a low flame spread characteristics, the product shall comply with the following:

Test according to IMO FTP Code 2010 Annex 1 Part 5 Test for surface flammability, and the result shall meet the requirements for ceiling, bulkhead, or according to other equivalent standards<sup>1)</sup>.

## 5.6 Smoke and toxicity

When FRP grating is required not to produce excessive quantities of smoke and toxic products or not to give rise to toxic hazards at high temperature, it shall comply with the following.

Test according to IMO FTP Code 2010 Annex 1 Part 2-Smoke and toxicity test, and the result shall meet the requirements for ceiling, bulkhead, or according to other equivalent standards<sup>2)</sup>.

## 5.7 Anti-electrostatic property

FRP grating used in hazardous areas<sup>3)</sup> shall be of antistatic property, and their surface shall be conductive to avoid static accumulation. The resistance value shall not be greater than  $10^5 \Omega$  for any 1 m range of any two points on the surface of the grating. The electrical conductivity shall not degrade due to slight wear on the surface and the static shall be able to be transferred to the metal frame by

1) ASTM E84, flame spread index (FSI)  $\leq 25$

2) ASTM E84, smoke development index (SDI)  $\leq 450$

3) defined by IEC 61892-7:2007



means of securing fixture or other effective means. The grounding resistance at any point of the grating surface shall not be greater than  $10^6 \Omega$ .

## 5.8 Fire integrity

**5.8.1** When fire integrity is required to be maintained for the pedestrian pathways and platform, the self-support FRP grating shall pass the fire integrity test L1 or L2 in [Annex B](#).

**5.8.2** The FRP grating without fire integrity requirements and not subject to fire resistance test is to be classed as Level 0 (L0). L0 FRP grating may be used on steel deck, operation platform, cargo hold access, void space and other areas.

**5.8.3** For design and application of FRP grating, refer to [Annex C](#).

## 5.9 UV resistance

When used in weather exposed areas, the FRP grating should be UV resistant to avoid damage to its structural strength due to long-term weather exposure.

## 5.10 Asbestos-free requirement

The FRP grating shall meet the asbestos-free requirement of IMO, International convention for the safety of life at sea, 2009 chapter II-1.

## 6 Inspection and test methods

### 6.1 Appearance

**6.1.1** Appearance and pores shall be subject to visual inspection.

**6.1.2** The warpage of the grating shall be measured. Place the grating face up horizontally on a flat surface and draw a straight line in the direction of extension and width. Measure the distance between the midpoint of the line and the top of the grating to check the degree of warping.

### 6.2 Load-bearing capacity test

**6.2.1** The flexural strength of FRP grating shall be tested according to ISO 14125:1998.

**6.2.2** Load-bearing capacity of FRP grating shall be tested according to [Annex A](#). Loading force shall be increased evenly to design load. Deflection under groups of typical Span-Load shall be recorded including deflection under maximum span and applied design load.

**6.2.3** When loading to 1,5 times design load, examine whether there are cracks, delamination phenomena on the grating.

### 6.3 Corrosion resistance

The corrosion resistance of FRP grating test shall be conducted according to ISO 9227:2017. The endurance test time shall be 720 h.

### 6.4 Skid resistance

The skid resistance of FRP grating test shall be conducted according to ASTM D2047.

## 6.5 Flame spread characteristics

Test according to IMO FTP Code Annex 1 Part 5 Test for surface flammability or according to equivalent standards<sup>4)</sup>.

## 6.6 Smoke and toxicity

Test according to IMO FTP Code Annex 1 Part 2 Smoke and toxicity test or according to equivalent standards<sup>5)</sup>.

## 6.7 Anti-electrostatic property

A calibrated resistance measuring instrument shall be used to measure the resistance of two points of space 1 m apart. At least 3 groups shall be measured and no value shall exceed  $10^5 \Omega$ .

## 6.8 Fire integrity

The fire integrity of FRP grating shall be tested according to [Annex B](#) FRP grating fire integrity test.

## 6.9 UV resistance

The FRP grating shall be subject to the accelerated weathering test for least 720h according to ISO 4892-3:2013 Method A. No damage such as fracture, crack, blister, delamination, fiber exposure, etc. shall be found.

## 7 Marking, packing and transportation

### 7.1 Marking

**7.1.1** FRP grating that passes fire integrity test shall be marked with 'L1' or 'L2' in a prominent location. FRP gratings that don't subject to fire integrity test shall be marked with 'L0' in a prominent location.

**7.1.2** FRP grating that passes UV resistance test shall be marked with 'UV' in a prominent location.

### 7.2 Packing

**7.2.1** FRP grating shall be packed with cardboard on edge and tied properly.

**7.2.2** Each FRP grating packing shall display handling instructions and transportation notice.

### 7.3 Transportation

**7.3.1** The FRP grating shall be placed on flat bottom of vehicle and safely secured.

**7.3.2** It is forbidden to throw the grating during handling.

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4) ASTM E84 standard

5) ASTM E84 standard