PETROBRAS	**TECHNICAL SPECIFICATION**	Nº: I-ET-3010.00-1352-130-P4X-001	
	CLIENT:		SHEET 1 of 22
	JOB:		
	AREA:		--
SRGE	TITLE: **FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS**		INTERNAL
			ESUP

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EXECUTION	FABIANA	DANISCHMIDT	CJH4	CJH4	CJH4				
CHECK	MMARROIG	FABIANA	CJX4	CJX4	CJX4				
APPROVAL	JUVENTINO	GONZALEZ	U32N	U32N	U32N				

SUMMARY

1 OBJECTIVE

1.1. The objective of this standard is to establish the minimum requirements that shall be met in providing and installing composite materials for floor gratings, cable tray systems, personnel walkways, platforms, ladders, catwalks, stairs and guardrails.

1.2. This Technical Specification applies to composite materials produced by the pultrusion process for use in offshore facilities.

2 NORMATIVE REFERENCES

The application of composite materials shall be in accordance with this Technical Specification, with the following references and with Rules and Regulations of Classification Society. SELLER shall perform the work in accordance with the requirements of Classification Society.

2.1 CLASSIFICATION RULES, CODES & STANDARDS

Refer to Project General Conditions and Data Specification for nominated Classification Society. Relevant Class rules shall apply.

2.2 CODES AND STANDARDS

ABNT NBR 15708	-	Indústria de petróleo e gás natural – Perfis pultrudados – Partes 1 a 6
ASTM B117	-	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D2565	-	Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
ASTM D4385	-	Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products
ASTM D4329	-	Standard Practice for Fluorescent Ultraviolet (UV) Lamp Apparatus Exposure of Plastics
ASTM E119	-	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E84	-	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F3059	-	Standard Specification for Fiber-Reinforced Polymer (FRP) Gratings Used in Marine Construction and Shipbuilding
IACS Rec No 73	-	Type approval procedure for cable trays / protective casings made of plastics materials
IMO RESOLUTION A.653 (16)	-	Recommendation on Improved Fire Test Procedures for Surface Flammability of Bulkhead, Ceiling and Deck Finish Materials
ISO 4892-3	-	Plastics - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps
ISO 5658-2	-	Reaction to fire tests — Spread of flame — Part 2: Lateral spread on building and transport products in vertical configuration
ISO 5659-2	-	Plastics - Smoke generation - Part 2: Determination of optical density by a single-chamber test

USCG PFM 2-98 - Policy File Memorandum on the Use of Fiber Reinforced Plastic (FRP) Gratings and Cable Trays

2.3 SPECIFICATIONS

DR-ENGP-M-I-1.3	SAFETY ENGINEERING GUIDELINE
DR-ENGP-I-1.15	COLOR CODING
I-ET-3010.00-1200-956-P4X-002	GENERAL PAINTING
I-ET-3010.00-5140-700-P4X-002	SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS
I-ET-3010.00-5140-700-P4X-001	SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS
I-DE-3010.00-1400-140-P4X-011	STANDARD-PULTRUDED GUARDRAIL – TYPICAL DETAILS
I-DE-3010.00-1400-140-P4X-007	MODULES SECONDARY STRUCTURE – TYPICAL DETAILS
I-DE-3010.00-5140-700-P4X-002	POWER INSTALLATION TYPICAL DETAILS
I-DE-3010.00-5140-700-P4X-003	GROUNDING INSTALLATION TYPICAL DETAILS
I-ET-3010.00-1200-940-P4X-002	GENERAL TECHNICAL TERMS
I-ET-3010.00-1200-251-P4X-001	REQUIREMENTS FOR BOLTING MATERIALS
I-ET-3010.00-1200-970-P4X-004	NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS

Specific Document to be supplied by BUYER

- ERGONOMICS REQUIREMENTS FOR TOPSIDE

2.4 GOVERNAMENTAL REGULATION

NR-12	Brazilian Regulatory Standard - Safety in Machinery and Equipment work.
NR 26	Brazilian Regulatory Standard - Safety Signing
NR 37	Brazilian Regulatory Standard - Safety and Health in Petroleum Platforms

*Note: Brazilian Government regulations are mandatory and shall prevail, if more stringent, over the requirements of this specification and other references herein.

3 DEFINITIONS

All terms and definitions are established in the latest revision of I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

4 GENERAL CRITERIA

4.1 DESIGN

4.1.1 The application of composite material shall comply with ABNT NBR 15708 requirements, in addition to the requirements indicated in this specification. All structural profiles shall follow ABNT NBR 15708 part 5.

4.1.2 The composite components shall be designed for a minimum design life of 30 years.

4.1.3 Operational temperature for composite components shall be -20°C to 60°C.

4.1.4 The maximum temperatures designed for the components in case of fire are defined in their fire resistance tests, using the standards cited in item 2.

4.1.5 Non typical structures design shall be issued by MANUFACTURER and approved by BUYER.

4.1.6 The design engineering, fabrication, and pre-assembly of structures shall be carried out at MANUFACTURER facilities. At the installation site is allowed final assembly and adjustments and finishing.

4.1.7 This specification is for composite material used in machinery spaces and on-deck areas. Composite material shall not be installed in closed areas, such as accommodation, services or control rooms, where smoke and toxicity are a concern.

4.1.8 The priority relation of the project documents and this specification is described herein. The precedence is applicable to technical requirements and the application (location) of pultruded components.

a) Safety Engineering Guidelines;
b) Classification Rules;
c) This ET (Technical Specification); including ANNEX A
d) Drawings (typical drawings);
e) 3D Model;
f) Other Technical Documents (LIs- Lists, RMs-Material Requisitions, LDs - List of documents, etc.).

4.2 MATERIALS

4.2.1 This technical specification is not applicable to fabrication processes other than pultrusion. Items obtained by other processes shall be previously evaluated by BUYER before being accepted and used.

4.2.2 Materials testing performed in similar standards may be acceptable under previous BUYER approval (e.g., use of in ASTM standard instead of ISO). The list below is already accepted by the BUYER:

a) ASTM E 84 or ISO 5658-2
b) ASTM E 84 or ISO 5659-2
c) ASTM D2565 or ASTM D4329 or ISO 4892-3

4.2.3 The resin system shall be defined at project documentation.

4.2.4 The following alternatives are acceptable for cable trays: acrylic and phenolic resins, as long as all other requirements are reached.

4.2.5 Structural profiles as floor gratings, handrail systems and vertical ladders, shall be produced using phenolic resin.

4.2.6 Other resin system may be applied, provided previous approval by BUYER.

4.2.7 The reports of all tests required by ABNT NBR 15708, as well as the tests to obtain the type approval certificates shall be submitted to BUYER to review.

4.2.8 If a component is required to have an anti-slip surface, the MANUFACTURER shall provide the testing report to ensure this characteristic.

4.2.9 Composite materials shall be evaluated for resistance to weathering (with UV stability) and saline atmosphere according to requirements presented at ABNT 15708-1.

4.2.10 The saltwater spray test shall be conducted in accordance with Practice ASTM B117 as defined in ASTM F3059.

4.2.11 Composite components shall be painted with an ultraviolet (UV) resistant coating, applied to the entire surface of the panel. The type of coat and procedure shall be performed in shop by component MANUFACTURER. The coating shall have at least 50 µm of dry film thickness. The coating thickness shall be assured by wet film thickness measurement. Alternatively, a gel coat may be used under previous BUYER approval.

4.2.12 In case it is necessary to apply a coating in field, the technical specification I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING shall be followed.

4.2.13 The color adopted shall be as defined in document DR-ENGP-I-1.15 – COLOR CODING.

4.2.14 Composite materials for offshore installation shall have a type approval certificate that attest that it complies with all relevant requirements mentioned in this document.

4.2.15 A data-book representative of all components shall be presented including the type approval certificate issued by a classification society and all other material / component tests required by this specification.

4.3 DELIVERY, HANDLING, STORAGE AND PRESERVATION

4.3.1 SELLER shall present a procedure for delivery inspection, storage, preservation, and handling of pultruded components, approved by BUYER and by MANUFACTURER.

4.3.2 The transport and handling of the composite materials shall be carried out carefully, avoiding impacts. Components shall be packed using protections to avoid damage between the parts.

4.3.3 Smaller components, such as screws and metal supports, shall be transported in cardboard boxes, wooden boxes or other suitable packaging.

4.3.4 Shop-assembled sections shall be kept protected in the original packaging of the transport until the beginning of the field assembly. Pre-assembled sections shall not be stacked or placed on top of hard or sharp surfaces that may cause damage (such as stones, for example).

4.3.5 Components in FRP (Fiber Reinforced Plastic) shall never be thrown or dragged on to the ground, as they are susceptible to mechanical damage by impact and by hard or sharp surfaces. Because of their low weight, some components in FRP may be erected manually, however, components of large lengths, or volumes, shall be erected with appropriate equipment or adequate amount of people, avoiding bending.

4.3.6 When unloading individual components and pre-assembled sections, visual inspection shall be carried out in order to verify possible damages caused during transport or not detected after manufacturing, according to ASTM D4385.

4.3.7 Materials and accessories shall be handled in such a way as to prevent damage. The execution of the loading and unloading service shall be carried out in such a way as to

avoid impacts and the equipment used shall be in accordance with the operation performed.

4.3.8 In order to maintain integrity during transportation and handling, materials shall only be removed from their original packaging at the time of installation. If the packaging is required to be opened, it should be replaced. If there is no packaging or damaged packaging, use plastic wrap or other suitable material. The use of metal straps is not allowed.

4.3.9 FRP components shall not be stored directly on the ground, on sharp metal surfaces or on concrete floors. Wooden or polymeric decks may be used.

4.3.10 The MANUFACTURER´s recommendations for packing and maximum stacking of components shall be followed.

4.3.11 In case of use of transport trolleys, care shall be made to avoid damage to the grid rail.

4.3.12 Adhesives or resins that may be required for assembly shall not be exposed to heat, sunlight and moisture, as determined in the MANUFACTURER's guidelines. In that case, the batch and validity of the products should be used in order not to use expired products.

4.3.13 The materials delivery inspection shall consist of visual (ASTM D4385), dimensional and Barcol hardness testing, according to ABNT NBR 15708 - all parts. For sampling system, it must be considered as batch each group of component/material listed in the specific invoice.

4.3.14 The testing shall observe the requirements of I-ET-3010.00-1200-970-P4X-004 NON-DESTRUCTIVE TESTING REQUIREMENTS FOR METALLIC AND NON-METALLIC MATERIALS

4.3.15 Certificates of raw material and reports of the type and of the finished product tests performed at the MANUFACTURE’s site shall be analyzed according to ABNT NBR 15708 Parts 1 and specific Part for each component.

4.4 INSTALLATION

4.4.1 MANUFACTURER shall present a procedure for installation and assembly of all components and structures in composite for evaluation and approval by BUYER.

4.4.2 Components in composite materials (guardrail, floor grating, stair treads and their subcomponents, traying systems, structural profiles and ladders) shall be installed in accordance with the rules of the Classification Societies of each Unit, where applicable.

4.4.3 Drilling and/or cut-off of structural profiles shall be carried out according to the design and MANUFACTURER’s procedures. If any change is required, MANUFACTURER shall approve it previously.

4.4.4 Cut ends of shapes shall be properly sealed with compatible resin and then painted using specification of composite MANUFACTURER.

4.4.5 Pressure washer with a flat washer or self-locking nut with a flat washer shall be used to secure structures.

4.4.6 Any amendment to the structural profile required to be made in the field shall have approval from the MANUFACTURER.

4.4.7 The acceptable torque range on the structural profile fixing screws is shown in Table 1 of this Technical Specification.

Table 1- Recommended torque (N.m)

MATERIAL	CONDITION	MINIMUM	MAXIMUM
Guardrails	2" or 50mm square tube with reinforcement, 1/4 or 6mm thick. Fixation types: Lateral plate; square tube sleeve, Double lateral plate	15	22
	handrail / intermediate crosspiece connection, 1/4 or 6mm thick - without reinforcement	10	15
Structural profiles Cable trays Ladders / catwalks	Union of non-tubular pultruded profiles with thickness > 3mm	15	22

4.4.8 After installation of a composite structural material an inspection shall be carried out to ensure compliance with all requirements presented at design documentation prior the release of the area.

5 SPECIFIC REQUIREMENTS FOR FLOOR GRATINGS AND STAIR TREADS

5.1 DESIGN REQUIREMENTS

5.1.1 Floor grating shall be designed according to ABNT NBR 15708 and ASTM F3059. Molded/Injected gratings may be accepted provided previous BUYER approval, as long as they reach all the requirements as pultruded gratings.

5.1.2 In order to guarantee the proper logistics of installation and replacement of material, all grating panels and stair treads shall meet Level 2 (L2) for fire endurance test, regardless the local of installation.

5.1.3 All components of grating panels and stair treads shall be produced using phenolic resin.

5.1.4 The definition of areas where grating panels may be applied in offshore facilities shall consider Table 1 - Structural Fire Integrity Requirements of ASTM F3059, in addition to that mentioned in ANNEX A.

5.1.5 Bearing bars of pultruded FRP gratings shall have minimum nominal beam depths of 38 mm.

5.1.6 The stair treads design shall consider a structural reinforcement of a square pultruded shaped nosing, made of same resin formulation as the grating, in the front and rear ends. All components shall be fixed together by means of secondary beams or bolts. It shall ensure that the stair treads widths are terminated with closed ends on both sides of the panel.

5.1.7 All gratings and stair treads, as well as all catwalk steps, shall have an anti-slip surface.

Stair treads nosing shall have an anti-slip surface on both the horizontal and vertical faces.

5.1.8 The fasteners for attaching the grating panel to the supporting structure shall be made of UNS S31600 stainless steel. Screws, nuts and washers shall be austenitic stainless steel 316 (UNS S31600), and insulation systems in non-metallic materials shall be provided for in order to avoid contact with a carbon steel structure (e.g., rings, bushings, washers, spacers, polypropylene, polychloroprene, etc.).

5.2 INSTALLATION REQUIREMENT

5.2.1 In cases where there is interference in the grating, it shall be checked in the field whether each part is adequately identified as to its location and positioning, in order to follow the sequence defined in the assembly diagram. If a divergency is confirmed (e.g., no position identification, inadequate identification, different dimensions), SELLER shall correct or replace it.

5.2.2 When installing the stair treads on an inclined ladder, attention shall be paid to the correct position of the tread set + side support (in the case of profile “F”), considering that the bevel of the side bracket shall be aligned with the slope of the ladder, i.e., in the rear position of the ladder.

5.2.3 When there are cut-outs on the grating for pipe and/or equipment passage, the ends of the retaining bearing bars shall be supported. If the cut-out clearance is greater than 10% of the hole diameter or 50 mm, whichever is shorter, the ends shall be reinforced with composite material of the same specification as the grating. The design of this reinforcement shall have approval from the MANUFACTURER and BUYER.

5.2.4 The bearing bars of grating panels shall be supported at least 36 mm on the grating support beam. Details are presented at I-DE-3010.00-1400-140-P4X-007 – SECONDARY STRUCTURE TYPICAL DETAILS. The support beam shall have a width of 75 mm, as shown in Figure 1.

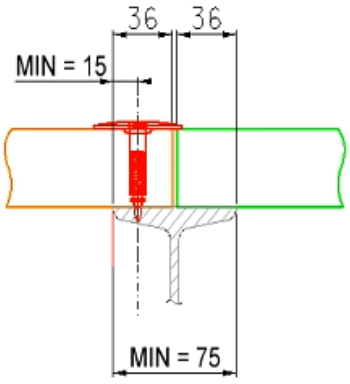


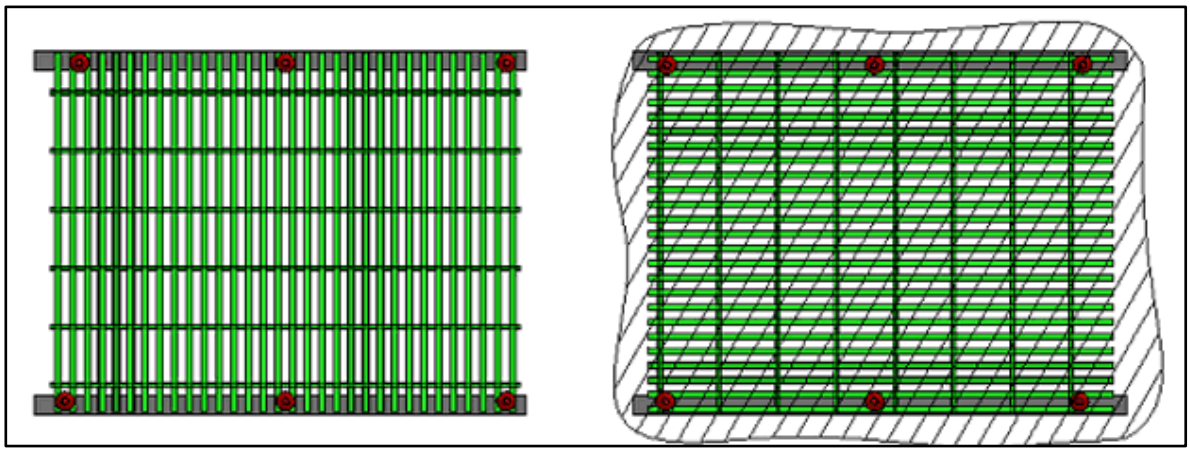
Figure 1: Fixation of grating at support beam.

5.2.5 The gap between floor grating panels that share the same support beam and between any restraints shall not exceed 8 mm.

5.2.6 Where there is no lateral containment to ensure this maximum distance (i.e., no other nearby floor grating, guard kick boards, or others that may serve as a stopper) the containment of the floor grating shall be provided to avoid any horizontal displacement.

5.2.7 Figure 2 illustrates the correct direction to install the grid panel, the bearing bars shall be

transversal to the support beams.



(a) Correct (b) Incorrect

Figure 2 – Orientation regarding gratings supporting beams.

5.2.8 In case the width of support beam is insufficient, considering the indication of item 5.2.4, SELLER shall present to BUYER a construction drawing with a detail of the solution for approval.

5.2.9 The following assembly alternatives were validated by BUYER for grating support with insufficient width:

a) Assembly may be carried out as long as the panels are confined at both ends of the port elements. To do this, the assembly shall provide the installation of additional elements to the fasteners that prevent any displacement in the horizontal plane of the grating. In these situations of confined grating, it shall be accepted that the bearing bar are supported with a minimum of 22 mm on the support beam. Under no circumstances may there be clearance that, with the displacement of the grating to one side, the port bars are less than 22 mm on the beam. Figure 3 and Figure 4 illustrate details for this alternative.

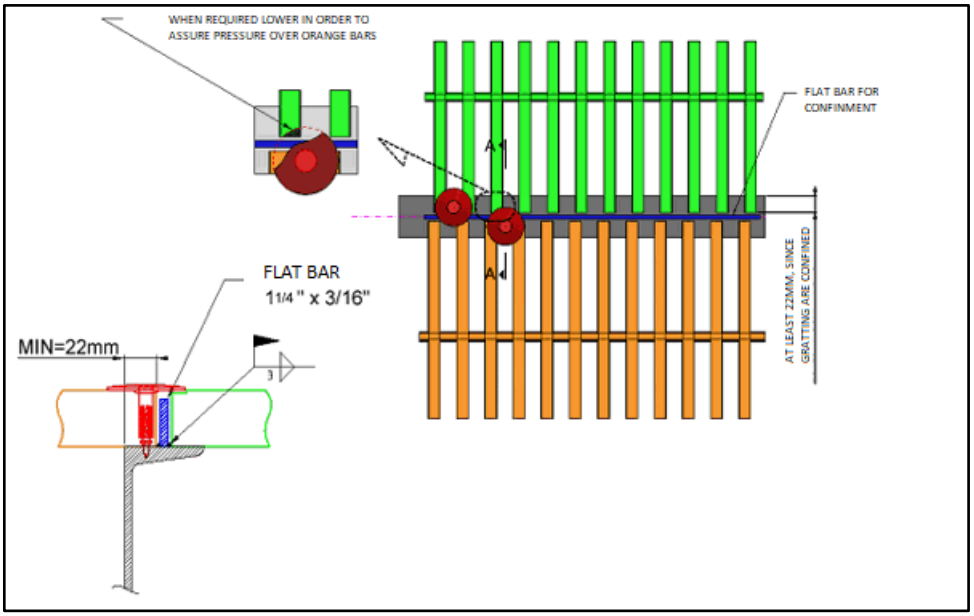


Figure 3 – Alternative with confined gratings with a port bar at the extremity.

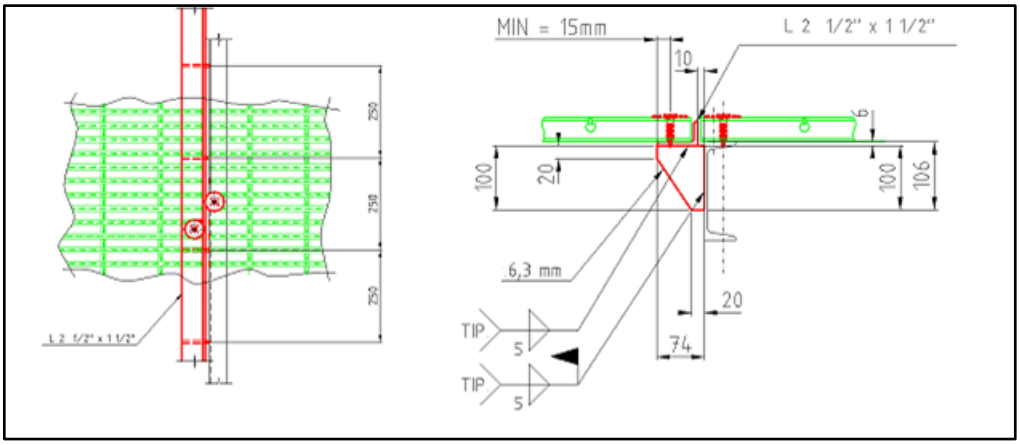


Figure 4 – Alternative for confinement with increase of support width

b) The following alternative allows the grating to be mounted on profiles with a flange width bf ≥ 49 mm. In these cases, it shall be necessary to interlace the bearing bars (for gratings of pultruded composite material), and the fixation shall be by pin stuck in the support beam, respecting the criteria presented in Figure 5.

Note: In this case the assembly shall be preceded by a specific design drawing. The interlacing of composite material grating is only allowed as long as fixing pins are installed at the end of the bearing bars, thus ensuring that the panels do not move in the horizontal plane.

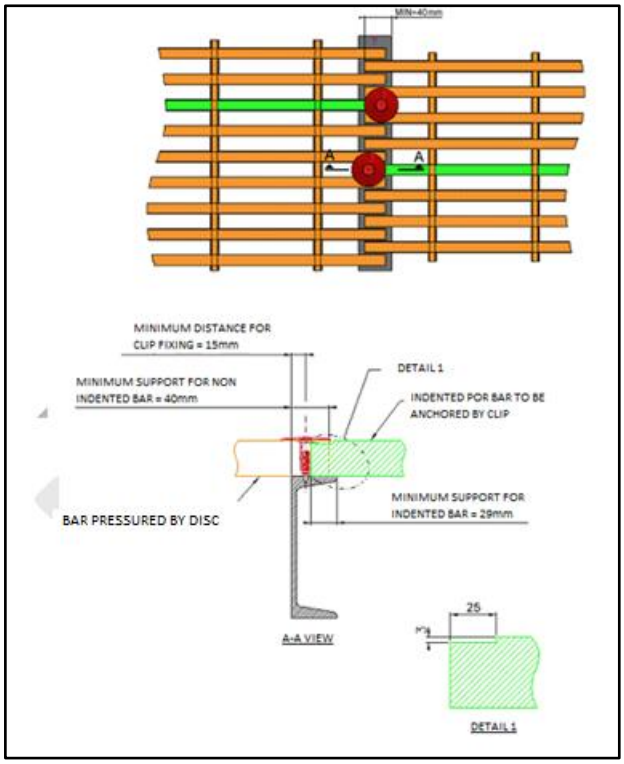


Figure 5 - Alternative for optimization of support with interlacing of composite material gratings and the support beam.

c) The grating panel shall always be sized so that it fills the gap between the supports without any leftovers that exceed the limits of the supports (ends that are in balance).

However, in some situations such as in proximity to equipment or out of accommodation, there may be openings that do not have sufficient supports for supporting of gratings (only one support, for example), with an opening with consequent risk of fall. In that case, the grating may have a length that exceeds the width of the support, with swing ends. However, the unsupported part (in balance) shall not be longer than 400 mm (see Figure 6). In addition, the number of fixed brackets of the grating should be increased by placing 4 (four) additional fasteners to the 4 (four) already mandatory, totaling 8 (eight) fasteners (4 (four) equidistant in each grating support).

For this solution it is considered that the existing supports have sufficient widths for grating support. Otherwise, one of the previous alternatives shall be adopted to increase the width of the supports.

This balance-end solution is restricted to the conditions described herein, i.e., when sufficient supports are missing in an opening not larger than 400 mm.

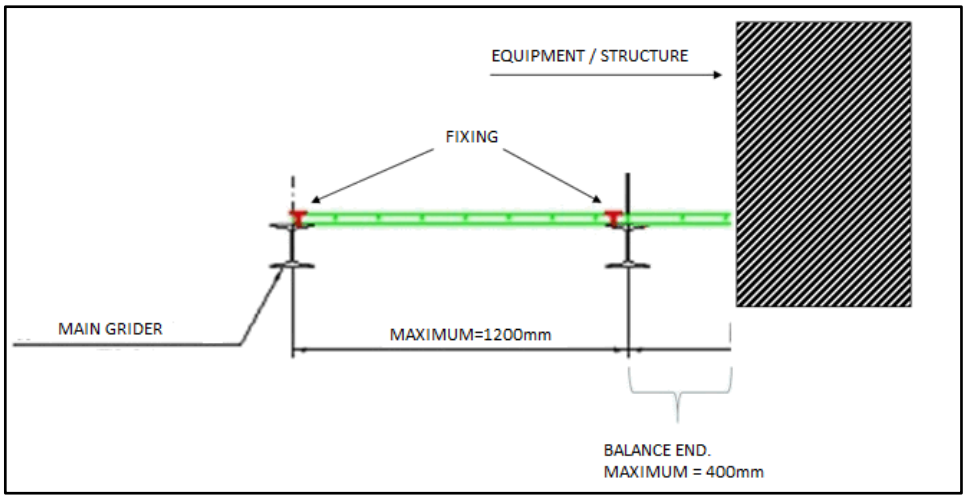


Figure 6: Detail of grating installation in balance

5.2.10 Although the cut-out in grating panels is accepted, the assembly should preferably make use of floor grating panels manufactured already in the dimension and with the cut-outs required for their target position.

5.2.11 The floor grating panel shall have at least 9 (nine) bearing bars. Modifying the floor grating mesh is not permitted, either by removing bearing bars or connecting elements. Even for clipped panels, the original mesh configuration shall be maintained. Some clippings may imply that bearing bars are connected by only one connecting element. In these cases, devices shall be included to ensure that the bars are connected. Figure 7 and Figure 8 present typical details for cut-outs on floor gratings.

5.2.12 To avoid unnecessary cut-off of the floor grating panel, the guardrails should preferably be installed externally to the grating support beam.

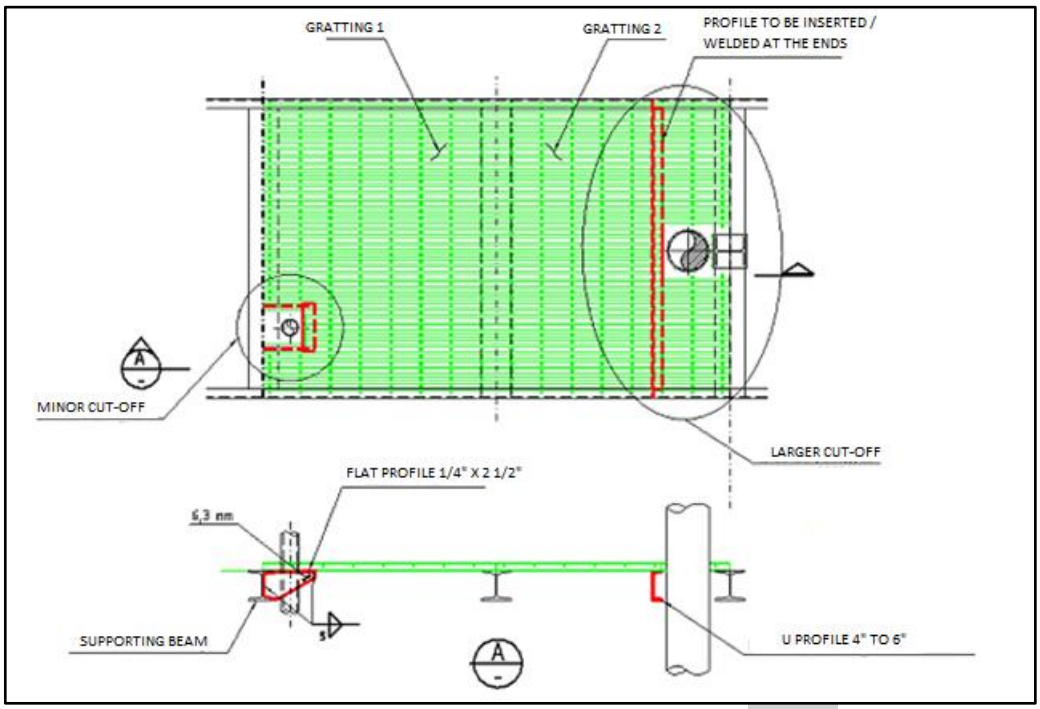


Figure 7: Examples of additional support for cut-off bearing bars

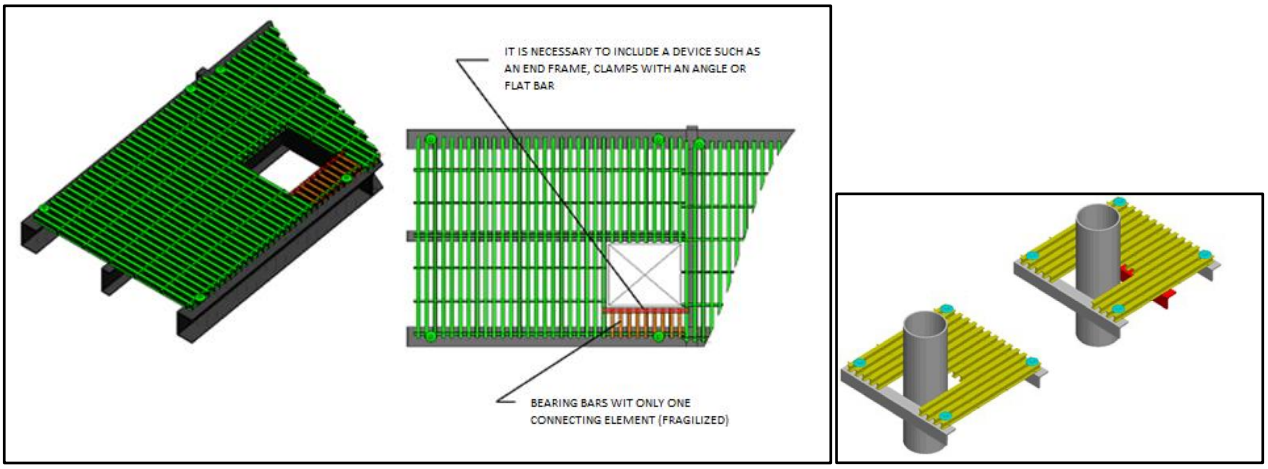


Figure 8: Details of cut-off in pultruded grating

5.3 FIXING ACESSORIES

5.3.1 Typical models of accepted fixing for panel hold down and panel connectors are presented in Figure 9, Figure 10 and Figure 11, which are the saddle clips, insert clips and the pin disc attached by pistol (shot stud). Each type of fixator has its characteristic, and some criteria shall be observed for a correct fixation.

5.3.2 Metallic clip:

a) These typical clips are those for fixing on the side of the "U" profile support beam, clips with lower plate/bar type "L" fixing on the support beam flange, and clip with attachment through hole in the surface of the support beam.

b) The metallic clip models shall also be chosen according to the following criteria:

- Profile of the bearing bars: as the profile of the bars of the metal and composite bars differ from each other (profile "I" without flange and with flange), the clips shall be such that they match each type of profile. For this, the upper clip part that is in contact with the grating shall have an appropriate shape that adapts to the shape of the bearing bar of each grating.
- Grating mesh opening dimension: the dimension of the upper clip shall correspond to the width dimension between the grating bars.
- Size and profile of the support beam: some clips have a shape that are best suited to certain types of support beams, such as "L" lower plate clips for "I" beams.

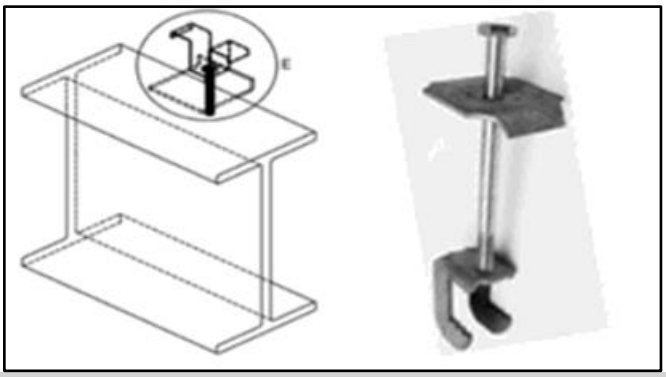


Figure 9: At left, saddle clip with inferior "L" plate for fixing at beam flange; and at right, saddle clip with inferior "L" plate for fixing at beam flange with stud from set top.

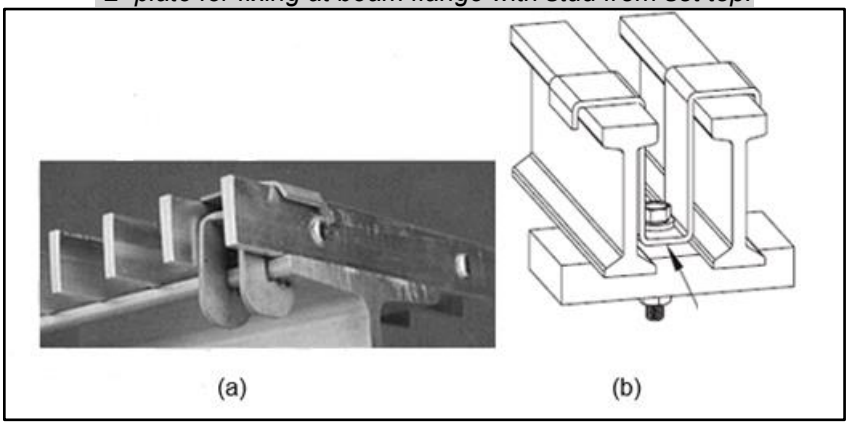


Figure 10: (a) "G" saddle clip for flange beam fixing. (b) "U" saddle clip with fixing through support beam.

c) In case of use grating attachments with metal clamps in regions subjected to vibration, physical means to mitigate the loss of preload of the fasteners shall be provided. It shall be adopted a solution as stainless steel nylon lock nuts ("nyloc") or anti-vibration nut serrated base or chemical locking (threadlockers) that allows the nut to be removed without the need for heat application.

5.3.3 Pin disc by fastening tools (e.g., shot gun)

a) The use of this fastener requires a professional trained by the tool´s SUPPLIER.

b) For the correct installation, two preliminary checks are required, i.e.:

- Thickness of the profile flange where the pin will be fixed - the type of pin to be chosen depends on the thickness, which shall not be less than 4 mm. The thickness value is important to determine the choice of the type of pin to be spiked, which implies the correct type of fastening tools and cartridge to be used.
- Floor grating height: The discs to be threaded into the pin shall be chosen depending on the height of the grating. The application of a disc with height incompatible with the grating generates an inadequate fixation, and the disc may come loose from the pin.
- When using pin-type fasteners, it is essential to follow the correct installation instructions of the MANUFACTURER.

Figure 11 : Pin disc by fastening tools

5.4 FIXATION

5.4.1 Floor grating panels shall be mounted as Figure 12, so that there are:

a) At least 04 (four) fasteners per each grating panel, except for triangular geometries where 03 (three) fasteners may be accepted.

b) In the longitudinal direction of the bearing bars the maximum spacing between fasteners shall be 1200 mm.

c) In the transverse direction to the bearing bars, the maximum spacing between fasteners shall be 1500 mm. When the number of fasteners exceeds 04 (four) per grating panel, they shall be equally distributed.

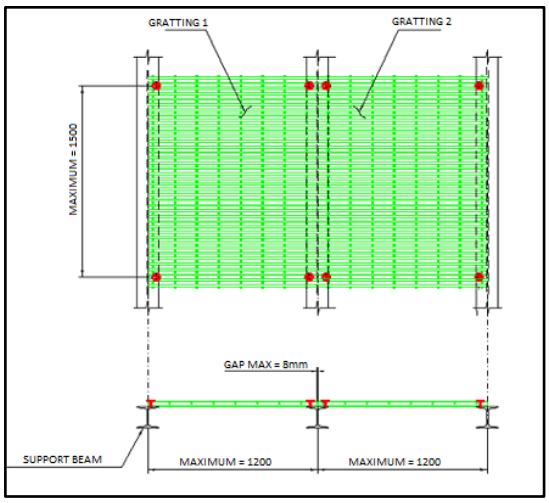


Figure 12: Maximum distance between fixings.

5.4.2 Whenever possible the fasteners should be installed in positions that contribute to avoid the sliding of the grating, that is, that they may act as stops for the horizontal displacement of the floor grating.

5.4.3 Care shall be taken in the assembly of the fastener with pin discs. It shall be guaranteed sufficient contact with the grating, as shown in Figure 13. The minimum thickness for applying the pin disc by pistol is 4 mm.

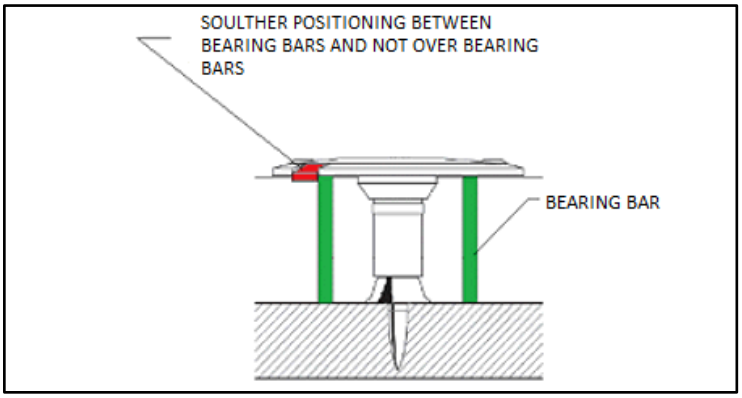


Figure 13: Detail related to pin disc positioning.

6 SPECIFIC REQUIREMENTS FOR GUARDRAIL / HANDRAIL SYSTEMS

6.1 DESIGN REQUIREMENTS

6.1.1 Guardrails shall be design according to ABNT NBR 15708 part 2. All parts shall be pultruded.

6.1.2 The definition of areas where guardrails may be applied in offshore facilities shall be the same as established for grating panels, considering the Fire Integrity Matrix, applicable for gratings and requirements of ANNEX A.

6.1.3 The typical details of guardrails are defined at I-DE-3010.00-1400-140-P4X-011 – STANDARD-PULTRUDED GUARDRAIL – TYPICAL DETAILS and Figure 14.

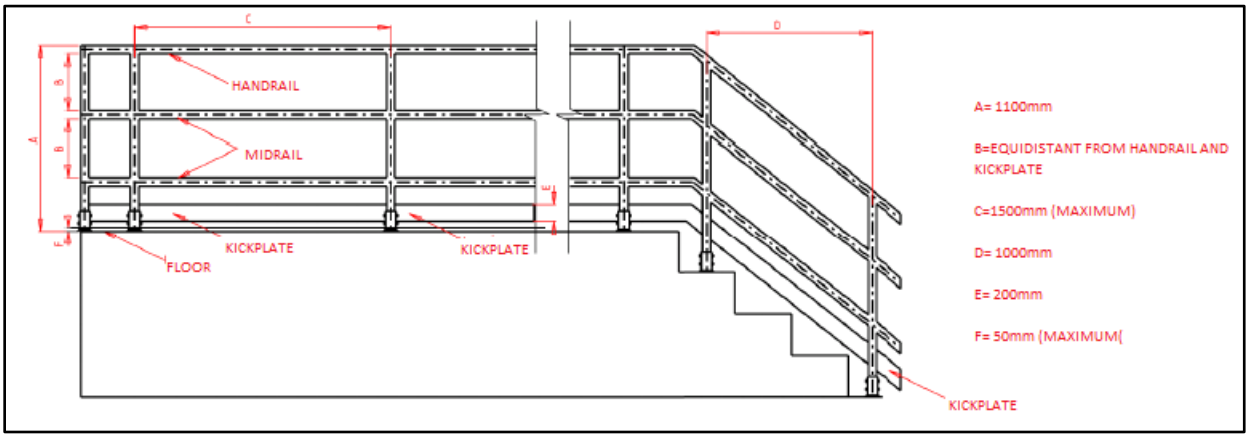


Figure 14: Detail of Guardrail

6.1.4 Handrail shall include at least two midrails (crossbars) at an equivalent distance from the handrail and kickplate. There shall not be more than 3 (three) crossbars, which shall keep the same distance between each other and between the handrail and the kickplate.

6.1.5 Handrail profiles shall be constructed as per ABNT NBR 15708 part 2 and NR-12 requirements. Post height shall be 1100 mm ± 3 mm above the floor level. Leveling flaws after erection shall not be accepted.

6.1.6 The kickplate of the guardrails shall be provided as W-shaped or M-shaped pultruded plate.

6.1.7 The anchoring system of the guardrail shall be made of painted/coated carbon steel suitable for the installation site according to BUYER´s standards. Provision for water drainage shall be provided. The anchoring supports shall be bottomless or, in case of support with closed bottom, drilled holes for water drainage shall be provided to avoid corrosion.

6.1.8 The guardrail anchoring system shall have previous approval from MANUFACTURER and BUYER and shall be designed to avoid damage to the composite material and loss of mechanical resistance (e.g., unnecessary drilling). The guardrail attachment shall be according to one of the schemes of Figure 15, Figure 16 and Figure 17 (installation with two side plates, fixation with square tube sleeve or installation with one side plate).

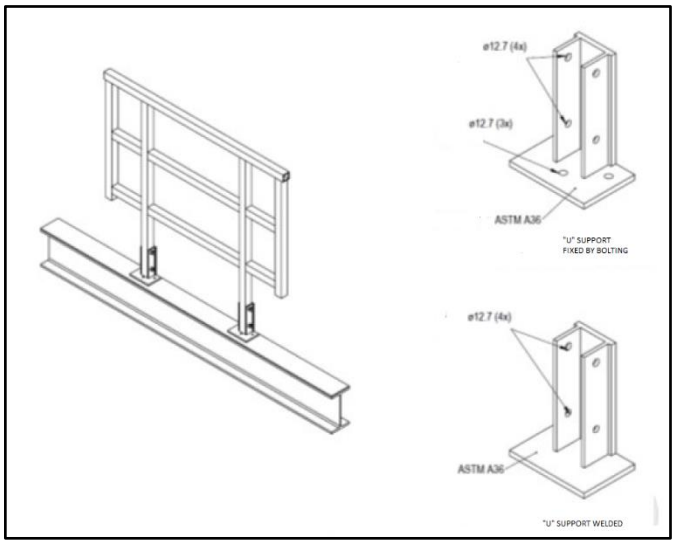


Figure 15: Fixation type two side plates.

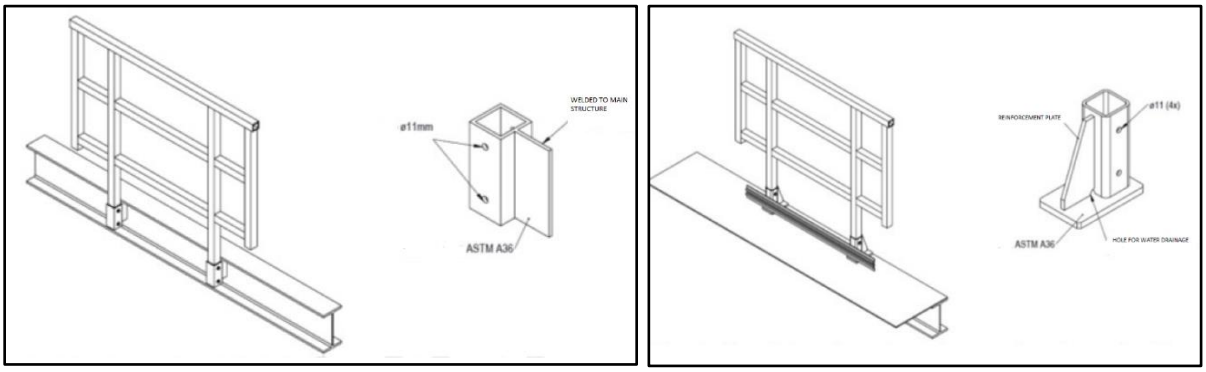


Figure 16 : Fixation with square tube sleeve.

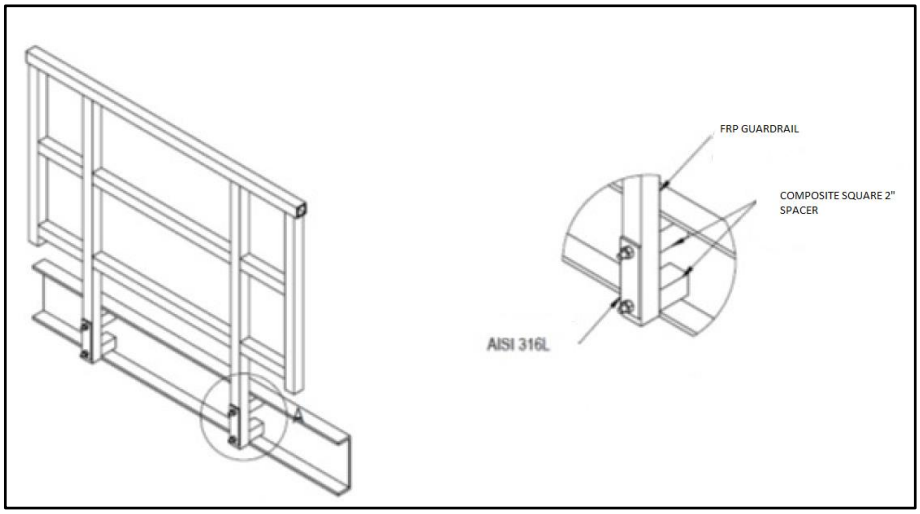


Figure 17: Fixation type one side plate.

6.1.9 The guardrail shall be fixed to the floor by means of 1/2" bolts and nuts and 25 mm washers in accordance with I-ET-3010.00-1200-251-P4X-001 - REQUIREMENTS FOR BOLTING MATERIALS. Bolts shall have a partial thread and be sized so that the thread is not in contact with the composite material of any of the profiles or inserts, thereby avoiding wear on the holes of these profiles and inserts.

6.1.10 Screws, nuts and washers made with austenitic stainless steel 316 (UNS S31600) shall have insulation systems in non-metallic materials (e.g., rings, bushings, washers, spacers, using materials like polypropylene, polychloroprene, etc.) in order to avoid contact with carbon steel structure.

6.2 INSTALLATION REQUIREMENTS

6.2.1 The guardrails shall be checked with regards to dimensions and identification of position prior the assembly.

6.2.2 During anchoring/fastening of guardrails it shall be verified the presence of the solid internal element (plug) in the connections, to prevent tube crushing. In case of absence of the plug, MANUFACTURER shall repair the component to install the solid internal element.

6.2.3 At the side edges of the guardrail, the length of the handrail, crossbars and kick board beyond the fixation point shall not exceed 500 mm. When this length exceeds 200 mm, a connection and locking system shall be provided in the parts (handrail bar, crossing bars and kick board) to ensure the stiffness of the system, as shown in Figure 18. Attention to the proper position of the screws. Screw size shall be kept in order to avoid risks to users due to possible sharp edges.

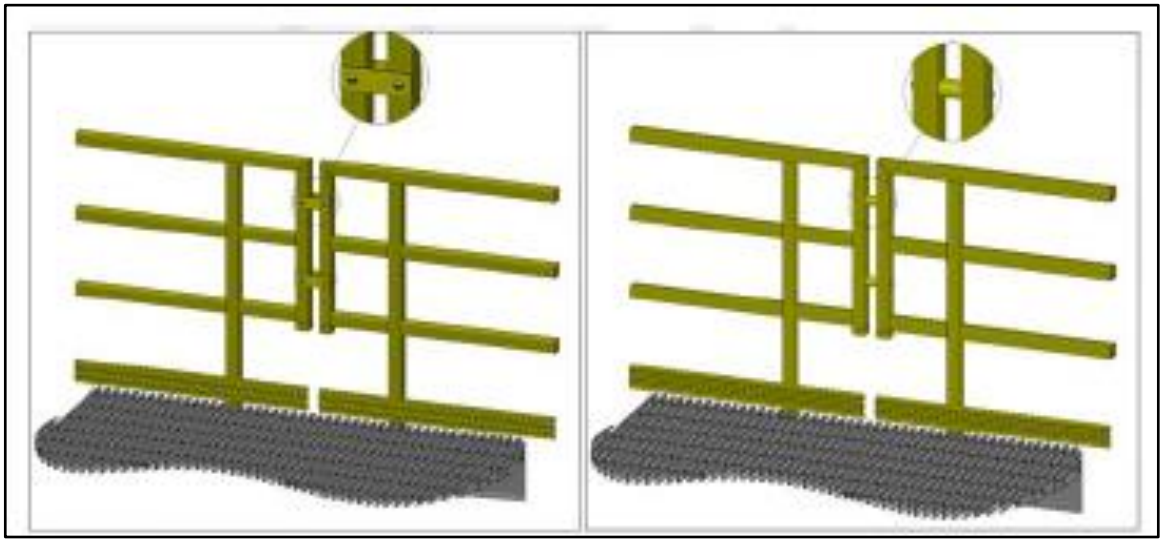


Figure 18: Connection and locking system.

6.2.4 Critical regions such as gaps between the guardrail and metallic supports, as well as dissimilar material joints, shall be protected by a suitable anticorrosive coating, as determined at I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.

6.2.5 It is not permitted to attach seat belt carabiners to the composite handrails/guardrails and to use these guardrails for attachment to other secondary structures, accessories or anchor points for scaffolding. For activities requiring the use of a seat belt, a life cable shall be provided.

6.2.6 The acceptable torque range on the fixing screws is shown in Table 1.

7 SPECIFIC REQUIREMENTS FOR VERTICAL LADDERS (CATWALK / MARINER TYPE) AND ACCESS PLATFORMS

7.1 DESIGN REQUIREMENTS

7.1.1 Catwalks or vertical ladder profiles shall follow ABNT NBR 15708 part 6.

7.1.2 Vertical ladder and cage system in composite material shall be designed by MANUFACTURER. The specification and installation details shall be indicated in a general arrangement drawing to be issued by the MANUFACTURER to BUYER´s approval.

7.1.3 The application of vertical ladders and platforms shall comply with the requirements of Technical Specification I-ET-ERGONOMICS REQUIREMENTS FOR TOPSIDES [document supplied by BUYER].

7.1.4 In case of ladders to be installed at escape routes, the requirement of fire resistance established in item 7.1.6. of ABNT NBR 15708 part 6 is mandatory.

7.1.5 Paint shall not be applied in the region of the steps (rung) where adequate anti-slip material shall be applied.

7.2 INSTALLATION REQUIREMENT

7.2.1 If the design specifies a splice on the main shaft of the ladder, the joint shall be made with locking by means of a solid element with at least two screws at each end of the reinforcement.

7.2.2 The anchor points of the ends (top and bottom) of the ladder shall be provided with an internal solid internal element (plug) to prevent tube crushing during assembly.

7.2.3 The acceptable torque range on the vertical ladder fixing screws is shown in Table 1 of this technical specification.

8 SPECIFIC REQUIREMENTS FOR CABLE TRAY SYSTEM

8.1 DESIGN REQUIREMENTS

8.1.1 Cable Tray systems shall be according to the requirements of I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.

8.1.2 Cable trays installation shall comply with I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS, I-DE-3010.00-5140-700-P4X-002 – POWER INSTALLATION TYPICAL DETAILS and I-DE-3010.00-5140-700-P4X-003 – GROUNDING INSTALLATION TYPICAL DETAILS.

9 SCOPE OF SUPPLY AND SERVICES

9.1.1 The scope of supply shall include, but is not limited to:

a) Datasheets of all components

b) Type approval certificates

c) Raw material certificates

d) Executive procedures of installation

e) Cut-off repair documentation

f) Drawings for each typical component with dimensions

g) Installation drawings (assembly diagram)

h) Supply of component, materials and accessories required to carry out the construction, installation and inspection of the composite component

i) Installation and inspection procedure based on MANUFACTURER'S / SELLER'S documents and ASTM D4385.

9.1.2 SELLER shall assume sole contractual and total engineering responsibility for the FRP components.

9.1.3 SELLER's responsibility shall also include, but is not limited to:

a) Technical responsibility for the entire scope of supply;

b) Resolving all engineering questions and/or problems regarding to design and manufacturing;

c) All coordination with MANUFACTURER and collection of all details, drawings, calculations, and data to achieve optimum design and full submission of the documents requested in the specification;

d) Providing details as requested of any sub-vendors relating to design and manufacture;

e) To submit to the certifying authority the documentation as described in the latest edition of their rules for equipment on offshore facilities.

9.2 INSPECTION

9.2.1 The standard ASTM D4385 shall be used as criteria for visual inspection.

9.2.2 SELLER shall provide documented schedules with the estimated completion dates. These schedules shall be issued by the same time the drawings are submitted for approval, as indicated in the agreed document schedule.

9.2.3 BUYER reserves the right to inspect all items at any time during fabrication to ensure that the materials and workmanship are in accordance with this specification and all applicable documentation.

9.2.4 SELLER is responsible for the overall compliance of the Unit when it comes to the CLASS requirements, including certificates, work examinations and tests, as well as final inspection activities and shipment.

9.2.5 Unless waive by BUYER, the following inspections and checks shall be witnessed by BUYER inspector:

a) Verification of construction materials for conformity with the specification requirements;
b) A visual check noting:

- That the thickness of the parts meets or exceeds the quoted design thickness;
- Any repairs;
- Dry-film thickness of applied coatings;
- The general appearances, materials, workmanship and standard of finish;
- Dimensional check;
- Visual inspection by ASTM D4385;
- Alignment to be demonstrated.

ANNEX A - USE OF FLOOR GRATINGS, VERTICAL LADDERS AND GUARDRAILS IN OFFSHORE FACILITIES

A-1 The use of floor gratings made of composite material in offshore facilities shall consider the maximum allowed exposure temperature as defined by MANUFACTURER.

A-2 The use of floor gratings, inclined ladders, vertical ladders (catwalks), access platforms, structures and guardrails made of composite material shall observe the structural fire integrity matrix presented at ASTM F3059.

A-3 All analysis shall be approved by BUYER.