



TECHNICAL SPECIFICATION

No. I-ET-3010.00-1200-251-P4X-001

CLIENT:
PROJECT:
AREA:

SHEET 1 of 14
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REQUIREMENTS FOR BOLTING MATERIALS

PÚBLICA
ESUP

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DESIGN	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP	ESUP		
EXECUTION	MARIANO	MARIANO	CSM0	CSM0	CSM0	CSM0	CSM0		
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APPROVAL	VITOR	MEYRELLES	U32N	U32N	U32N	U32N	CJW2		

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1 INTRODUCTION

This technical specification establishes the minimum requirements for materials selection and for coating specification for fasteners, for top side and hull applications, as well as manufacturing and inspection requirements.

“Bolting” and “bolt” are terms used in this document to collectively describe fasteners, including screws, nuts, bolts, washers, and studs. The use of the terms “bolt” or “bolting” includes all the materials listed above, unless otherwise specifically noted herein.

This specification applies to all bolting within the UNIT, including those used within static equipment, dynamic equipment, piping systems and structural components.

This specification also applies to all bolting materials within accessories, valves, instruments, and all other components that are connected to piping, structure, or equipment.

This specification also has requirements for bolting intended to be applied in the hull external area of the UNIT, for either continuously or intermittently wet areas.

This specification does not apply to fasteners for subsea application.

Alternative fastener grades, that are not referenced in this technical specification, may be specified by SELLER if deemed necessary. In such cases, SELLER shall submit these new grades for BUYER approval, demonstrating that they meet or exceed the performance of the grades herein indicated.

2 NORMATIVE REFERENCES

The requirements of the following normative references shall be fulfilled, as well as the additional requirements herein listed.


2.1 CLASSIFICATION

MANUFACTURER/PACKAGER shall perform the work in accordance with the requirements of Classification Society.

2.2 CODES AND STANDARDS

The following codes and standards contain provisions, which, through reference in this text, constitute requirements for this specification. SELLER shall use the latest issue of the references unless otherwise agreed. Other recognized standards may be used, provided it can be shown that they meet or exceed the requirements of the standards referenced below.

- API TECHNICAL REPORT 21TR1 - Materials Selection for Bolting.
- API SPEC 20E - Alloy and Carbon Steel Bolting for Use in the Petroleum and Natural Gas Industries.
- API SPEC 20F - Corrosion Resistant Bolting for Use in the Petroleum and Natural Gas Industries.
- ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications.
- ASTM A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- ASTM A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
- ASTM B841 - Standard Specification for Electrodeposited Coatings of Zinc Nickel Alloy Deposits.

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- ASTM B850 - Standard Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement.
- ASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
- ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- ASTM F606 - Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets.
- ASTM F1470 - Standard Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection.
- ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- ASTM F3125 - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- ISO 15156 Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production. Parts 1, 2 and 3.
- ISO 898-1 - Mechanical properties of fasteners made of carbon steel and alloy steel Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread.
- ISO 21457 - Materials selection and corrosion control for oil and gas production systems.
- ISO 27509 - Compact flanged connections with IX seal ring.
- BS EN 10204 - Metallic products - Types of inspection documents.
- ASME B1.1 - Unified Inch Screw Threads.
- ASME B18.2.2 – Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange and Coupling Nuts (Inch Series).

Governmental codes, regulations, ordinances, or rules applicable to the equipment in Brazil shall prevail over the requirements of above specification, including reference codes and standards and/or this Technical Specification, but only in those cases where they are more stringent.

2.3 REFERENCE TECHNICAL SPECIFICATIONS

The following technical specifications contain additional requirements or information. The specific document number and revision may vary, and SELLER shall use the document as applicable to the contract.


- I-ET-3010.00-1200-956-P4X-002 – GENERAL PAINTING.
- I-ET-3010.00-1352-130-P4X-001 – FLOOR GRATINGS, TRAY SYSTEMS AND GUARDRAILS MADE OF COMPOSITE MATERIALS.
- I-ET-3010.00-1200-940-P4X-002 – GENERAL TECHNICAL TERMS.

2.4 CONFLICTING REQUIREMENTS

In case of conflicting information between this Technical Specification and the referred applicable standards, the most stringent shall prevail.

In case of conflicting information between this Specification and other specific BUYER's document, a formal technical query shall be issued to BUYER seeking clarification.

Failure to observe this requirement may result in remedial work at SELLER expense.

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3 DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

Definitions are in accordance with the technical specification I-ET-GENERAL TECHNICAL TERMS, the ones contained in standard API TR 21TR1, and the following:

splash zone

the zone of the platform that is alternately in and out of the water because of the influence of tides, winds and waves.

pressure-containing

part exposed to conveyed/contained fluids whose failure to function as intended would result in a release of conveyed/contained fluid to the environment.

pressure-retaining

part not exposed to conveyed/contained fluids whose failure to function as intended will result in a release of conveyed/contained fluid to the environment.

PTFE

polytetrafluoroethylene, synthetic fluoropolymer of tetrafluoroethylene

3.2 ABBREVIATIONS

Abbreviations shall be as defined in standard API TR 21TR1.

4 BOLTING MATERIAL SELECTION

Bolting materials shall be selected in accordance with the general requirements of the applicable design code and the following additions.

4.1 BOLTING FOR GENERAL APPLICATION – MARINE ATMOSPHERE

4.1.1 The requirements herein listed apply to all bolts within the platform, including those used within static and dynamic equipment, within the piping systems, within internal parts of equipment, within valves and its accessories, within instruments, and all other parts, accessories and components that are connected to piping, equipment, or structure.

4.1.2 Bolting applied to connecting the piping systems, equipment, valves, instruments, and accessories with each other, shall always be fabricated to US customary units (inches series). Threads shall be in accordance with ASME B1.1 and nuts shall be in accordance with ASME B18.2.2.

4.1.3 Bolting applied to the internal assembly of parts of equipment, valves, instruments, and accessories, and therefore are part of its specific design, may be fabricated to US customary units or to metric units (e.g., within a valve actuator, or within an instrument).

4.1.4 Bolting materials selection for piping systems shall be as established in the applicable piping specification (piping SPEC sheets). The materials therein indicated shall be in general agreement with the requirements herein listed.

4.1.5 Bolts with diameters below 10 mm shall be stainless steel Type 316 (ASTM A 193 Grade B8M) for metal temperatures below 60 °C based upon the maximum operating temperature. For metal temperatures greater or equal to 60 °C CRA materials resistant to chloride stress corrosion cracking at the actual temperature shall be selected if the stressed parts are exposed to marine environmental conditions (alloy 625, alloy 718 or other CRA grades may be considered as alternatives).

4.1.6 The general bolting material selection for bolt with diameters above 10 mm shall be in accordance with the ASTM standards listed below (Table 1).

Table 1 – General Bolting Material Selection

Application temperature range (°C) (1)(2)	Bolt Temperature Range (°C)	BOLT	NUT	Size Range (mm)	OBS
-196/-100	-196/+540 (3)	A 193 Grade B8M Class 1	A 194 Grade 8M/ 8MA	All	
-100/-46	-100/+400	A 320 Grade L7	A 194 Grade 7/S3	≤ 65	
		A 320 Grade L7M	A 194 Grade 7/S3	≤ 65	(4)(5)
		A 320 Grade L43	A 194 Grade 7/S3	< 100	
-46/+400	-46/+400	A 193 Grade B7	A 194 Grade 2H	≤ 100	
		A 193 Grade B7M	A 194 Grade 2HM	≤ 100	(4)
+400/+540	-29/+540	A 193 Grade B16	A 194 Grade 7	All	

(1) Bolt materials shall be selected as per the application temperature range indicated in the first column, based on the design minimum temperature and design maximum temperature (the latter for the selection of B16 grade over B7 grade).

(2) Temperature limits as determined in the equipment design code shall also be respected.

(3) Austenitic stainless steel grades of bolting are limited to a maximum temperature of 60 °C when exposed to the marine environment (see ISO 21457 for temperature limits).

(4) Bolt for sour service. Requirements from ISO 15156 shall be met.

(5) Minimum temperature limited to -73°C (-100°F)

4.1.7 Bolting materials different from the ones listed in Table 1 may be necessary for specific applications. This will usually happen to guarantee compatibility with the materials being joined or where there is a limitation in the temperature or size range indicated in Table 1. In this case BUYER approval shall be sought prior to application.


4.1.8 The possibility of galvanic corrosion and the consequences of different thermal expansion coefficients shall be considered when dissimilar metals are used in bolts and materials to be joined.

4.1.9 Bolts screwed into component bodies shall be of a material that is compatible with the body in respect to galvanic corrosion and in respect to galling, so that the connection shall keep its ability to be disassembled for maintenance.

4.1.10 The use of stainless steel grades that are prone to localized corrosion (including pitting corrosion, crevice corrosion and stress corrosion cracking) in marine environment is prohibited. This is valid also for bolting within valves, instruments, equipment, and any other appurtenances or accessories that may have bolting exposed to the offshore marine environment. The following grades are examples of susceptible materials (and therefore forbidden):

- ASTM A 193 Grades B8, B8N, B8T, B8LN (types 304, 304L and 321).
- ISO 3506 Grades A1, A2, A3, C1, C3, C4 or F1.
- ASTM F593 Groups 1, 3, 4, 5, 6 and 7.
- ASTM A540 Grade 630 (S17400), 631 (S17700), and 635 (S17600).
- Any other grades with corrosion resistance inferior to ASTM A193 Grade B8M (type 316).

4.1.11 Titanium bolt materials shall not be coupled to carbon steel parts due the risk of hydride embrittlement of titanium.

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4.1.12 The use of higher strength bolting (compared to the ones listed in Table 1) is not recommended. When the use of higher strength bolting is deemed necessary, the requirements from item 4.5 of this specification shall be met.

4.1.13 Bolts located on immersed areas of the platform (e.g., inside tanks, caissons and within equipment) shall be selected and/or coated so that they remain suitable for the intended service. SELLER shall propose the alternatives for each intended case (CRA material or coating), subject to BUYER evaluation and approval. When coating is selected as the corrosion protection method, it shall be performed as established in I-ET-3010.00-1200-956-P4X-002 (GENERAL PAINTING).

4.1.14 Austenitic stainless steel, duplex and super duplex stainless steel fasteners shall be used within the temperature limits established in ISO 21457 when exposed to marine environments, unless they are being applied in a sheltered area, protected from the marine atmosphere.

4.1.15 The use of organic coating or any other protection (e.g., varnish or grease) as a mean to protect the bolts against any kind of localized corrosion and therefore exceed the temperature limits indicated above is not acceptable.

4.1.16 Failure to observe these requirements may result in remedial work at SELLER's expense.

4.2 CRA BOLTING FOR SPECIAL APPLICATIONS

4.2.1 Alternative materials may be deemed necessary for bolting where the service requires higher corrosion resistance alloys.

4.2.2 The following materials may be applied, subject to the conditions herein stated:

- a) 25% Cr Super Duplex Stainless Steels (UNS S32750 or UNS S32760): In accordance with ASTM A 1082 (bolts and nuts). Shall not be specified if subject to cathodic protection potential. Maximum design temperature for chloride containing environments 110°C. Maximum design temperature for chlorides free environments 260°C.
- b) UNS N06625: In accordance with ASTM F468 Grade Ni625 (bolts) and ASTM F467 Grade Ni625 (nuts).
- c) UNS N07718: In accordance with ASTM F2281. Shall be avoided if there is possibility of crevice corrosion. Shall not be specified as bolting material if subject to cathodic protection.

4.2.3 BUYER approval shall be sought prior to application of any bolt grade different from the ones herein listed.

4.3 BOLTING FOR STRUCTURAL APPLICATIONS


4.3.1 Bolting materials for structural applications shall be as designated by the applicable structural technical specification.

4.3.2 Anchor bolts for equipment shall be categorized as structural application bolting.

4.3.3 Bolting for gratings and tertiary structures made in composite materials shall be according to I-ET-3010.00-1352-130-P4X-001 (Floor Gratings, Tray systems and Guardrails made of Composite Materials).

4.3.4 Bolting that connect galvanized gratings and galvanized tertiary structures shall also be galvanized as per item 5.3.5 (unless they are made of CRA). For this application the bolts need not be painted after installation.

4.3.5 High strength steel bolts (such as ASTM F3125 grades A325 or A490, or ISO 898-1 class 8.8 or class 10.9) may be used but will require prior BUYER's approval.

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4.4 BOLTING FOR HULL EXTERNAL AREAS

4.4.1 Non-pressure retaining and non-pressure containing bolting that will be applied in areas outside of the hull, either permanently or intermittently wetted by the seawater, will be exposed to an extremely corrosive environment. Unless otherwise indicated, the bolt selection shall be as follows.

4.4.2 PERMANENTLY WET (SUBMERGED) AREAS

4.4.3 Non-pressure retaining and non-pressure containing bolting that are permanently submerged shall be selected in low alloy steel, material specification ASTM A193 Grade B7 or equivalent.

4.4.4 These bolts shall be protected from corrosion by the UNIT cathodic protection system. Therefore, electrical continuity between the bolts and the hull shall be assured.

4.4.5 Electrical continuity may be provided by using star (serrated) washers, by removing the coat under the bolt heads (or nuts), or equivalent solution.

4.4.6 Electrical continuity shall be tested after installation.

4.4.7 All bolt and studs must have maximum hardness of 34HRC.

4.4.8 INTERMITTENTLY WET AREAS

4.4.8.1 For material selection purposes, the intermittently wet areas shall include the unit splash zone, and the area above the splash zone but below the upper riser balcony. These are regions of the hull with limited access for inspection and maintenance activities, which therefore require a more noble bolt material selection.

4.4.8.2 Since the CP system is not capable of protecting the materials within this region, non-pressure retaining and non-pressure containing bolting must be selected from a high grade CRA material. Bolting material specification shall be solution annealed nickel alloy 625 (ASTM F468 Grade Ni625 for bolts, ASTM F467 Grade Ni625 for nuts).


4.4.8.3 General quality requirements for these bolting materials shall be in conformance with API SPEC 20F, BSL-2, including the following:

- Qualification Testing (acceptance based on the applicable material specification).
- Limits of Bolting Qualification (including the amount of cold reduction).
- Production of Qualified Bolts (including the Material Specification and the Manufacture Process Specification by the bolting manufacturer).
- Test Report.

4.4.8.4 Evidence of the above-mentioned requirements shall be supplied along with the material certificate.

4.4.8.5 Factory acceptance tests reports for these bolting materials shall include at least the following:

- a) Chemical analysis.
- b) Hardness.
- c) Metallography with microhardness profile measurement.
- d) Tensile tests.
- e) Visual and dimensional inspection.
- f) NDE.

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4.4.8.6 Sampling for the tests listed above shall be as determined in API SPEC 20F.

4.4.8.7 Surface NDE is not required. Volumetric NDE shall be applied for diameters above 2.5 in (as defined in API SPEC 20F).

4.4.8.8 All bolt and studs must have maximum hardness of 32HRC.

4.4.8.9 Microhardness in the root region of the threads: All bolts, studs and nuts must have the maximum individual microhardness of 400 HV measured in the region of the root of the threads. The Vickers microhardness must be conducted with a load of 100 grams and must be carried out from the root of the thread to about 2 mm deep, with 200 µm distance between indentations.

4.4.8.10 Seller may suggest different alloys, but the general quality requirements listed above shall apply (e.g., alloy 59, alloy 686, or alloy C-276). In this case BUYER approval shall be sought prior to application.

4.5 HIGH STRENGTH BOLTING

4.5.1 Bolts with tensile properties in excess of those specifications listed in Table 1 and not covered in item 4.2 or item 4.3 of this specification are considered as high strength bolting (e.g., ASTM A540 Grades 23 or 24 Classes 1, 2 or 3).

4.5.2 BUYER approval shall be sought prior to application of these materials. The maximum hardness for these bolting shall be limited to 35 HRC in order to avoid the risk of hydrogen embrittlement.

4.5.3 High strength bolting shall never be applied to parts subject to cathodic protection.


4.5.4 High strength bolting shall be coated as detailed in item 5.5.

4.6 BOLTING FOR OTHER APPLICATIONS

4.6.1 Bolting that seems to fall outside the scope of the previous items (4.1 through 4.5) still need to follow the general quality requirements therein established, especially regarding the following:

- Galvanic corrosion.
- Galling.
- Thermal expansion coefficient difference.
- Corrosion resistance.
- Embrittlement phenomena.

4.6.2 Material selection for all bolting within the unit shall be performed accordingly. Applied coating on the selected bolting shall be as established in item 5. Failure to observe this requirement may result in remedial work at SELLER expense.

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5 COATING SPECIFICATION

5.1 Coatings as herein specified shall be applied to all fastener's materials within the selected group, including screws, nuts, bolts, washers, and studs. The use of the terms "bolt" or "bolting" includes all the materials listed above.

5.2 Coating herein specified shall not be applied for stainless steel and other CRA bolting, which shall remain uncoated.

5.3 COATING FOR GENERAL APLICATION

5.3.1 The requirements herein listed apply to all and every bolting material within the platform, except for bolting intended for hull external area (which shall remain uncoated), bolting for structural application (to be coated as per item 5.4) and high strength bolting (to be coated as per item 5.5).

5.3.2 Coating for bolting materials shall be selected as follows:

- a) Carbon / Low Alloy Steel bolting materials, applied to piping and equipment with design temperature above 260°C: no coating applied.
- b) Carbon / Low Alloy Steel bolting materials, with design temperature at or below 260°C: zinc/nickel electroplating (see 5.3.3 below) or any other coating process with superior quality (previous BUYER approval is required in this case).

5.3.3 Zinc/Nickel Electroplating

5.3.3.1 The procedure for bolts, nuts and washers Zn-Ni coating shall be in accordance with ASTM B841 standard and the deposit classification shall be as follows:

- a) Class 1 or Class 2 (5%Ni up to 16%Ni).
- b) Type B/E, Type C/E or Type D/E (BN/E, CN/E and DN/E are acceptable).
- c) Grade 10 (minimum thickness of 10 µm).

5.3.3.2 Post-coating treatment according do ASTM B850 shall be applied for parts made of steels with ultimate tensile strengths equal to or greater than 1000 MPa (or hardness above 31 HRC).

5.3.3.3 This post-coating treatment is also mandatory for all fasteners in ASTM A193 Grade B7 and ASTM A320 Grade L7 and L43 specifications. Evidence of the applied treatments shall be provided with due traceability.

5.3.4 PTFE Coating


5.3.4.1 The use of fluoropolymer coating in lieu of the Zn-Ni plating is considered acceptable, but BUYER prior approval is required.

5.3.4.2 Approval will be dependent on the following factors:

- a) Technology to be used.
- b) Qualification of the coating specification and of the coating supplier.
- c) Selected pre-treatment and coating schemes dependence on the design temperatures.

5.3.4.3 In this case SELLER shall use different colors to identify the main bolt specification, as follows:

- a) A 193 Grade B7: Blue.
- b) A 320 Grade L7: Gray.
- c) A 320 Grade L43: Red.
- d) A 193 Grade B7M: Yellow.
- e) A 320 Grade L7M: Green.
- f) A 193 Grade B16: Orange.

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5.3.4.4 BOLT COATING APLICATOR shall be qualified per coating manufacturer in a Quality Approved Program. Alternatively, a BOLT COATING APLICATOR dully approved by SELLER in qualification program may be presented for BUYER evaluation.

5.3.4.5 A report of the bolt coating system application and tests shall be presented.

5.3.5 Hot Dip Galvanizing and Other Zinc Based Coatings

5.3.5.1 Mechanical galvanizing, zinc plating and zinc flake coatings for any bolting are not acceptable.

5.3.5.2 The use of Hot Dip Galvanizing (HDG) for bolts for pressure-retaining and pressure-containing parts is not acceptable.

5.3.5.3 HDG is considered acceptable for bolts for non-pressure retaining and non-pressure containing applications (such as within instruments, actuators, or other accessories), when these parts are applied in a sheltered ambient (not exposed to the marine atmosphere) and the bolting temperature is expected to be lower than 60°C.

5.3.5.4 HDG bolts shall not be used on direct contact with CRA materials.

5.3.5.5 When applied, HDG shall be performed as predicted in ASTM F2329. Safeguarding and testing against embrittlement shall be performed as described in ASTM A 143 for parts made of steel with ultimate tensile strength equal or above 800 MPa (high strength steel bolts such as ASTM F3125 grades A325 or A490, or ISO 898-1 class 8.8 and above).

5.3.6 Cathodic Coating/Plating

The use of coatings that are cathodic with respect to the substrate (non-sacrificial barriers, e.g., nickel plating) for any bolting is not acceptable.

5.4 COATING FOR STRUCTURAL APPLICATIONS BOLTINGS

5.4.1 Carbon and low alloy steel bolting materials for structural applications shall be coated as described in 5.3.3 above (Zinc/Nickel Electroplating) or shall be hot dip galvanized as described in 5.3.5. Safeguarding against embrittlement shall be performed as therein detailed.


5.4.2 Stainless steel bolting material for structural applications shall not be coated.

5.4.3 After coating (either zinc/nickel electroplating or hot dip galvanizing) all bolting shall be field painted after installation. The painting specification, according to I-ET-3010.00-1200-956-P4X-002 (GENERAL PAINTING), shall be suitable to the surface (ASTM D 6386 provides details on the preparation of galvanized surfaces preparation).

5.5 COATING FOR HIGH STRENGTH BOLTINGS

5.5.1 Coating system for higher strength bolting shall be selected so that there is no risk that hydrogen embrittlement can occur, either during the coating application or due to bolt corrosion. Therefore, any manufacturing step that may introduce hydrogen during coating is forbidden (e.g., acid pickling, descaling, cleaning baths, electroplating, or phosphating). Any kind of coating that is anodic when compared to the substrate is also forbidden (e.g., galvanizing, electroplated Zinc, electroplated Zn-Ni, cadmium coating).

5.5.2 For high strength bolting, PTFE coating as per item 5.3.4 is the recommended coating scheme, with due considerations since the surface pretreatment shall be selected as not to cause embrittlement of the substrate.

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5.6 OTHER COATINGS

Coatings other than the ones herein specified may be applied, but they must be subject to prior BUYER approval. SELLER shall demonstrate, through testing and through previous successful application, that the proposed coating meets or exceeds the performance of the originally specified coating.

6 ADDITIONAL QUALITY REQUIREMENTS

6.1 Threads shall be formed by rolling (cold forming), and the roots shall be rounded. Machined threads (cut) are not acceptable.

Note: If rolled threads are expected to cause local fillet hardness due to plastic deformation that may offer any risk to the bolt application, and machined threads are considered a viable option, BUYER approval shall be sought to perform machining instead of rolling.

6.2 When subject to a sour environment (H₂S service) bolting materials shall comply with the requirements of ISO 15156.

6.3 Bolts for compact flanges (as per ISO 27509, or similar design) for piping and equipment conveying fluids which contain H₂S shall always comply with ISO 15156 requirements.

Note: In case of any loss of containment (leakage through the seal ring), the external environmental seal of the compact flanges may give rise to a condition of trapped fluid in contact with the bolts, therefore the bolts need to be sour service resistant.

6.4 All bolts and nuts shall be supplied with certification according to EN 10204 Type 3.1. Satisfactory traceability shall be guaranteed between the material (mill) certificate, the coating application certificate, and the heat treatment reports.

7 MANUFACTURING, INSPECTION AND TESTING


7.1 The quality requirements for the bolting materials shall be as follows:

- General application carbon and low alloy steel bolting: conforming to API SPEC 20E, BSL-1.
- General application CRA bolting: conforming to API SPEC 20F, BSL-2.
- Structural application bolting: as per the applicable ASTM standard.
- Hull external areas, permanently wet: as per the applicable ASTM standard.
- Hull external areas, intermittently wet: as defined in item 4.4.3.
- High strength bolting: conforming to API SPEC 20E, BSL-3.

7.2 The bolting materials certificates issued by the manufacturer shall explicit that the components were manufactured in accordance with the applicable BSL.

7.3 CRA bolting alloys that are not explicitly within the scope of API SPEC 20F shall be supplied as per BSL-2 specification of API SPEC 20F nonetheless. In this case the following requirements are applicable:

- a) Supplier shall have a quality management system that meets the requirements of API Q1 (or equivalent standard).
- b) Qualification testing shall be performed. A Manufacturing Process Specification (MPS) shall be issued for the product, and qualification records shall be made available. The limits of the bolting qualification shall be as therein established.
- c) Production of qualified bolting, including chemistry control, mechanical properties, metallurgical evaluation, hardness testing, and NDE, shall be performed as therein prescribed.

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8 RECEIVING INSPECTING AND TESTING

Upon receiving and before application, the bolting materials shall be inspected and tested by SELLER to check the conformance with the herein specified requirements.

8.1 LOT DEFINITION

For inspection purposes a LOT of bolting is defined as follows:

- Batch furnace: bolting or raw material of a single heat and diameter, heat treated together as a single austenitizing, quenching, tempering, and stress-relieving charge.
- Continuous furnace: bolting or raw material of a single heat and diameter heat treated without interruption in a continuous charge.
- In any case, heat treatment performed in batches after coating implies in separated lots.

8.2 VISUAL INSPECTION

8.2.1 Every lot of bolting material received shall be checked visually upon receiving to verify its main characteristics, such as:

- Applicable marking (stamping).
- Diameter.
- Length.
- Thread type.
- General state when it comes to corrosion or damage.
- Coating integrity.

8.2.2 Bolting materials with no marking (stamping) as required by the applicable material specification shall be rejected.

8.2.3 All material certificates shall be checked against the applicable technical requirements.

8.3 ADDITIONAL TESTING

After the visual inspection, every lot of bolting material shall be tested as follows.


Note: Testing performed by the fasteners manufacturers/suppliers as normally required by the product certification (according to EN 10204 Type 3.1., see item 6) is not considered as a substitute for the tests herein indicated (items 8.3.1 and 8.3.2). Exception to the tests indicated below are detailed in item 8.3.3.

8.3.1 Bolts within the scope of equipment suppliers

8.3.1.1 Suppliers of equipment (static equipment, dynamic equipment, valves, instruments, and so on) shall perform the testing as follows.

8.3.1.2 For pressure retaining and pressure containing bolts a hardness test shall be performed in one sample from each lot received. Hardness testing shall be performed in accordance with ASTM F606.

- If the obtained hardness is below the one stated in the manufacturer certificate (difference greater than 10%) one sample shall be taken from the lot and all applicable tests established by the material specification shall be performed (mechanical tests and chemical composition), as well as a metallographic evaluation of its microstructure and of the coating. Failure in any test implies in the rejection of the whole lot.
- If the obtained hardness is above the one stated in the manufacturer certificate (difference greater than 5%) and a maximum hardness is established for the components (such as in H₂S service) the lot is considered rejected.

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8.3.1.3 For all bolts (pressure retaining, pressure containing and all other bolts) Positive Material Identification (PMI) shall be performed in one sample from each lot. This test intends to verify the chemical composition of the bolt and of the applied coating.

8.3.2 Bolts within the scope of constructors, builders, packagers and erectors

8.3.2.1 Constructors, builders, packagers, erectors, and any other contractors and locations in which fasteners are being used on the assembly of structures, piping, equipment and instruments, testing shall be as follows.

8.3.2.2 Sampling for the tests shall be as determined in ASTM F1470 (Standard Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection) as per the *Detection Process* level.

8.3.2.3 At least the following tests shall be applied:

- Chemistry (including the bolting and the coating).
- Tensile strength (full size or machined specimen).
- Yield strength (full size or machined).
- Elongation / area reduction.
- Hardness.
- Impact.
- Plating/coating thickness.
- Salt spray test.

8.3.2.4 Acceptance criteria for all tests (except for the salt spray) shall be as the applicable ASTM standard. Chemical composition of the coating need not be performed for PTFE coating.

8.3.2.5 The coating (Zn-Ni electroplating, HDG or PTFE) shall sustain over 1000hrs of ASTM B117 salt spray without red rust.

8.3.3 All bolts - material certification as an alternative to testing

Testing performed by the bolting manufacturers/suppliers in conformance with EN 10204 Type 3.2. is considered as a substitute for the tests herein indicated (items 8.3.1 and 8.3.2) when witnessed and signed by a Classification Society representative.

8.4 APPROVAL/REJECTION

8.4.1 Bolting materials may only be considered as approved in the receiving inspection after all tests have been performed with satisfactory results.

8.4.2 Disposition of non-conforming lots shall be as established in ASTM F1470.

8.4.3 Bolting materials approved in the receiving inspection and testing shall be protected against corrosion and stored in an area sheltered from inclement weather.

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Note: This technical specification was revised with the contribution of the following specialists

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