

GENERAL SPECIFICATION

CORROSION

GS EP COR 356

Corrosion Protection of Fasteners for Subsea and Topside Applications
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General Specification		GS EP COR 356
Corrosion Protection of Fasteners for Subsea and Topside Applications		
Rev.: 01	Effective date: 10/2012	Page: 2 of 6

Contents

1. Scope	3
2. Reference documents.....	3
3. Introduction	4
4. Subsea Bolting	4
4.1 Subsea Structural Fasteners corrosion protection.....	4
4.2 Alloy steel Subsea Fasteners for piping and equipment	4
5. Splash zone bolting for structural, risers, piping and equipment	5
6. Topsides bolting	5
6.1 Topsides structural fasteners	5
6.2 Topsides piping and equipment fasteners	5
7. Painting systems for zinc plated dichromate or hot dipped galvanized fasteners	6
8. Pipeline bolting	6

General Specification		GS EP COR 356
Corrosion Protection of Fasteners for Subsea and Topside Applications		
Rev.: 01	Effective date: 10/2012	Page: 3 of 6

1. Scope

This document defines the general technical requirements for the specification of corrosion protection for fasteners (bolts, screws and studs) for structural applications (when authorized by Company), pipelines, piping and equipment whether located subsea or topsides in an offshore environment. Similar requirements apply to coastal facilities.

With regards to materials selection requirements for fasteners, one shall refer to [GS EP PVV 112](#), [GS EP PVV 146](#), [GS EP STR 201](#) and [GS EP SPS 029](#).

Bolting protection requirements for rotating equipment are outside the scope of this specification.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASTM A153	Standard Specification for Zinc Coating (hot Dip) on Iron and Steel Hardware
ASTM A325/325M	Structural bolts, Steel, Heat treated 120/105 ksi (830MPa) Minimum Tensile Strength (Metric)
ASTM A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ISO 898-1	Mechanical properties of fasteners made of carbon and alloy steel. Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread
ISO 10684	Fasteners Hot dip galvanized coatings

General Specification		GS EP COR 356
Corrosion Protection of Fasteners for Subsea and Topsides Applications		
Rev.: 01	Effective date: 10/2012	Page: 4 of 6

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP PVV 112	Piping material classes
GS EP PVV 146	Bolting for piping
GS EP SPS 029	Metallic Materials for Subsea Production Facilities
GS EP STR 201	Materials for offshore steel structures.

3. Introduction

In many operating facilities offshore and onshore significant corrosion of bolting has occurred within the design life of the equipment. The impact on production and safety can be significant and the cost of maintenance can be high.

Consequently, this General Specification specifies corrosion protection requirements for bolting for structures, pipelines, piping and equipment for both subsea and topsides applications.

It is specifically targeted at project groups who require specifying clear coating protection requirements for low alloy steel bolting for many applications.

4. Subsea Bolting

PTFE coatings are not acceptable for subsea fasteners.

Zinc plating shall not be used for subsea bolting.

4.1 Subsea Structural Fasteners corrosion protection

For bolts manufactured in accordance with standard [ASTM A325](#), the fasteners shall be supplied bare or hot dipped zinc galvanized as per the requirements of [ASTM A153](#) since corrosion protection is only required for the fabrication / transport / storage / construction / and installation phases. After this period the submerged structures will be protected by cathodic protection and corrosion in service is not an issue. Zinc coating thickness shall be as per Table 1 of [ASTM A153](#).

4.2 Alloy steel Subsea Fasteners for piping and equipment

Fasteners will be protected by cathodic protection once installed subsea and so only require temporary bolting protection during fabrication / transport / storage / construction and installation phases.

General Specification		GS EP COR 356
Corrosion Protection of Fasteners for Subsea and Topside Applications		
Rev.: 01	Effective date: 10/2012	Page: 5 of 6

Consequently, fasteners shall be supplied either:

- Bare with barrier coatings (temporary¹ corrosion protection) or
- Hot dip galvanized or
- Xylan 1424.

Hot dip galvanising shall be in accordance with [ASTM A153](#) with a coating thickness as per Table 1 of the Standard.

5. Splash zone bolting for structural, risers, piping and equipment

For the splash zone, external coating protection of low alloy steel bolting is not reliable and the service life of hot dipped galvanising is not sufficient. Consequently, corrosion resistant nickel alloys shall be selected such as Alloy 625 (UNS N06625), Alloy 725 (UNS N 07725) or equivalent depending on strength requirements.

6. Topsides bolting

PTFE coatings are not acceptable for topside fasteners.

Both hot dipped galvanized and zinc plated dichromate bolting shall ALWAYS be painted as per [GS EP COR 350](#).

6.1 Topsides structural fasteners

For topsides structural bolting, protection shall be either hot dip galvanized or bare.

Hot dipped galvanising shall be used in accordance with [ISO 10684](#) for property class bolting up to 8.8 of [ISO 898-1](#).

[ASTM A325](#) manufacturing standard can also be specified with hot dip galvanising in accordance with [ASTM A153](#) with a coating thickness as per Table 1 of the Standard.

Zinc plated dichromate shall not be used for structural bolts.

High strength structural grade 10.9 bolting shall be supplied bare (and not hot dipped galvanized) to be consistent with the requirements of [ASTM A490](#) with regards to resistance to hydrogen embrittlement. A suitable barrier protection shall be applied after installation depending on the severity of the corrosive environment.

6.2 Topsides piping and equipment fasteners

Fasteners for topsides piping and equipment shall be supplied either zinc plated dichromate or hot dipped galvanized, the latter being preferred.

When the fasteners are manufactured to ASTM bolting specifications zinc plating dichromate shall be specified in accordance with [ASTM B633](#) to classification Fe/Zn13 service condition with minimum coating thickness of 12 microns. The finish type shall be a coloured chromate treatment type 2. Baking is only required if the actual tensile strength of the bolts exceeds 1000 MPa.

¹ Duration of atmospheric exposure should be in compliance with the temporary protection product Manufacturer recommendations

General Specification		GS EP COR 356
Corrosion Protection of Fasteners for Subsea and Topside Applications		
Rev.: 01	Effective date: 10/2012	Page: 6 of 6

Hot dip galvanizing shall be in accordance with [ASTM A153](#) with a coating as per Table 1 of the Standard.

7. Painting systems for zinc plated dichromate or hot dipped galvanized fasteners

Zinc plated dichromate bolts and hot dipped galvanized bolts shall be painted in accordance with the requirements of [GS EP COR 350](#) system P06.

The bolts shall be degreased and primed before being assembled and the remaining coating system applied after assembly. Alternatively, the bolts can be coated after assembly where accessible.

The following procedure shall be followed:

- The zinc plated dichromate or hot dipped galvanized bolts shall be placed on pallets and any dust particles removed with compressed air.
- All items shall then be solvent degreased with an airless sprayed solvent
- The tie coat of system P06 shall then be applied followed by the intermediate coat by airless spray. The application is made in two steps, first applying the paint to approximately 50% of the exposed surface and then turning the bolt and repeating the process on the other side.
- Thickness measurement shall be performed on a representative test surface
- Each coat shall be of a different colour to facilitate quality control
- After assembly any repair shall be performed as per repair system for P06 painting system
- Finally after fastening any visible surface shall be coated with the final coat of P06.

8. Pipeline bolting

Corrosion protection of bolting for subsea pipelines shall follow the requirements of section 4.2 of this standard.