



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS EP COR 210

Monolithic insulating joints

07	01/2012	General review
06	01/2011	Additional info on external paint
05	10/2009	General review
04	10/2008	Specification becomes limited to EP - New calculation for internal coating
00	03/2001	First issue
Rev.	Date	Notes

Owner: DEV/TEC	Managing entity: DEV/TEC/COR
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1. Scope

This specification deals with the supply of monolithic insulating joints to be installed on pipes to establish an electrical break between the pipe and foreign structures (wellhead, platform, terminal, etc.).

Insulation devices may be installed within piping systems where electrical isolation of portions of the system is required to facilitate corrosion control.

Insulating devices shall be installed only when approved by Company and/or when required by General Specifications **GS EP COR 100**, **GS EP COR 102**, **GS EP COR 110** or **GS EP COR 111**.

Generally, insulating devices may be:

- Isolating flanges in which the central gasket is non conductive and the nuts and bolts are electrically isolated from both flanges by means of non conductive sleeves and washers
- Prefabricated monolithic insulating joints
- Others such as yoke-type, unions, couplings and non-metallic spools
- Combination of an isolating kit and an internally coated spool.

The present specification deals only with the supply of prefabricated monolithic insulating joints.

2. Reference documents

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

ted, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
ASTM D 709	Standard Specification for Laminated Thermosetting Materials
ASTM D 5162	
EN 10204	
	Holidays detection
	Metallic products - Types of inspection documents

Professional Documents

Reference	Title
API 5L	Specification for line pipe
NACE SP0286	
	Electrical isolation of cathodically protected pipelines

**Regulations**

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP COR 100	Design of cathodic protection of offshore structures
GS EP COR 102	Design of cathodic protection of sealine by sacrificial anodes
GS EP COR 110	External cathodic protection of buried pipelines
GS EP COR 111	External cathodic protection of onshore facilities
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 352	Internal protection of equipment by painting
GS EP PLR 222	Carbon steel flanges and branch outlet fittings and forged components for pipelines (sweet service)
GS EP PLR 232	Carbon steel flanges and branch outlet fittings and forged components for pipelines (mild, intermediate and severe sour service)
GS EP PLR 420	Site welding of carbon steel pipelines to API 1104 and DNV-OS-F101 (sweet service)
GS EP PLR 421	Site welding of carbon steel pipelines to API 1104 and DNV-OS-F101 (mild, intermediate and severe sour service)

3. General characteristics

3.1 ANSI Series

The ANSI series corresponding to the working pressure for each joint shall be defined in the requisition.

3.2 Maximum pressures

The maximum working pressure for each joint shall be indicated in the requisition.

3.3 Description

Generally described as flangeless, monolithic insulating joints cannot be dismantled from the pipe; their assembly excludes bolts and nuts.

They are fully assembled in the factory; steel parts shall be separated by rigid insulating rings and sealing gaskets with mechanical and dielectric functions.

Monolithic insulating joints shall be equipped with pup pieces on both sides (see Figure 1).

Lugs shall also be welded on both pup pieces in case of test cable attachment or surge arrestor installation requirements. They can also be used as lifting lugs.

Out-of-roundness of the pipes constituting the sleeves shall not exceed $\pm 0.05\%$.

Additional detailed description is given in [NACE SP0286](#).

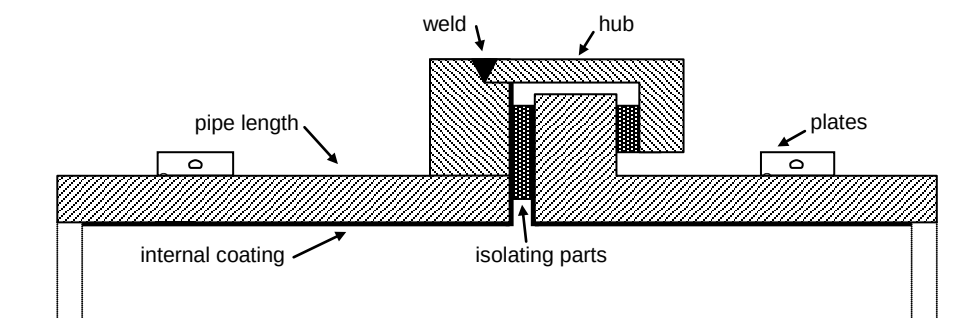


Figure 1 - Simplified arrangement

3.4 Design

The Supplier of the insulating joint shall demonstrate that the proposed design is suitable to sustain the various external and internal loads as extracted from the structural analysis of the adjacent part of the pipeline or riser.

The extreme operating conditions shall be given by Process engineers. The Supplier of the insulating joint shall demonstrate that the insulating joint will resist to these conditions, in particular those related to emergency decompression.



4. Materials

4.1 Pipe lengths

Pipe lengths shall be manufactured from pipes of the same grade, same thickness and same diameter as the line section on which they will be connected. They shall also follow all parent pipe sour service requirements if relevant. All indications regarding the pipe are mentioned in the Requisition.

The length of each pup piece shall be, at least, equal to the external diameter of the pipe, and should comply with the minimum internal coating length (§ 7.2).

The dimensions of the beveled edges shall conform to the requirements of [API 5L](#).

4.2 Hub

Hub mechanical characteristics shall comply with the requirements of Company General Specifications [GS EP PLR 222](#) or [GS EP PLR 232](#) as applicable.

4.3 Insulating materials

Several types of materials may be used such as Bakelised cotton fabric. If low water absorption and enhanced resistance to the mould are needed (wet climate, tropical climate) the following materials shall be used:

- Bakelised glass fabric
- Stratified polyester and glass fibre
- Epoxy resin (Araldite).

In any case, the use of bakelised paper or asbestos containing materials is strictly forbidden.

A fully detailed specification of insulating materials shall be given by Vendor in its bid, outlining in particular the compressive strength of each of the insulating material used perpendicular to the bedding such as:

- Rigid ring
- Insulating gasket
- Epoxy resin.

4.3.1 Characteristics of bakelised cotton fabric

The insulating material shall comply with Type IV G-10 according to [ASTM D 709](#).

4.3.2 Characteristics of epoxy resin and polyester

Those shall be supplied by Vendor, but in any case, they shall be higher than those of bakelised cotton fabric.



5. Manufacture

5.1 Welding operations

All welding operations shall be carried out according to Company General Specifications [GS EP PLR 420](#) or [GS EP PLR 421](#) as relevant.

After all parts have been welded, residual stresses may be relieved if necessary, and welds ~~and~~ shall not contain any detrimental metallurgical heterogeneity or defect.

Vendor shall carry out 100% radiographic inspection of all welds except the last one which shall be checked by UT.

5.2 Electrical connecting plates

Two plates of weldable quality steel ($C \leq 0.23\%$; $CE \leq 0.40\%$), measuring about 50 x 50 mm, with a $\varnothing$ 10 mm hole drilled in the middle shall be fillet welded on each pup piece, as close as possible to the insulating part. This shall be done prior to internal coating application.

The plates shall be thick enough to withstand small impacts but their thickness shall not exceed the thickness of the pup piece.

6. Tests and acceptance

6.1 Acceptance of insulating materials

Supplier shall supply a 3.1 certificate according to [EN 10204](#) and shall supply the following tests results:

- Tensile test on specimen
- Compression test using a 10 mm square stamp
- Low voltage resistance measurement
- Transverse dielectric strength on a plate at least 3 mm thick
- Water absorption
- Checks on thickness of joints, washers, sleeves.

The acceptance criteria are given according to 4.3.1.

In addition, measurement of the transverse electric resistance of the sample may be requested before and immediately after the water absorption test. The difference between the two measurements must not exceed 100 megohms cm²/cm.

6.2 Acceptance of insulating joints assembled in the factory

The following tests shall be carried out on each insulating joint assembled in the workshop:

- Measurement of the electric resistance of the joint. This resistance should be more than 2 megohms in dry atmosphere
- Breakdown voltage tests at 5 kV so that the insulating joint can withstand 1500 V

- Hydrotest on each coupling at a pressure at least equal to the test pressure of the parent pipeline. At this pressure, no leak or seepage shall be allowed
- Dimensional checking on the whole insulating joint.

7. Painting

7.1 External coating

The equipment shall be externally painted according to Company General Specification **GS EP COR 350**. Rich-zinc epoxy primer shall be avoided.

In specific cases where buried or immersed insulating joints are formally accepted by Company, the external coating shall be submitted by Vendor for Company approval.

7.2 Internal coating

The internal coating shall be resistant to degradation by the transported fluid and to abrasion during pigging operations. It shall be also resistant to cathodic disbonding. Except if otherwise specified and accepted by Company, the coating system shall be phenolic epoxy or modified epoxy (system P101 as per **GS EP COR 352**). For stainless steels, the use of coating system P05 second is mandatory. The requirements of **GS EP COR 352** shall apply for all internal painting works.

The metallic faces of the joint in contact with the insulation parts and the internal fluid shall be also coated with the same coating system (see Figure 1).

The location and length of the internal surface to be coated is based on the evaluation of internal corrosion risks due to possible cathodic protection current short-circuit in presence of a water phase. It depends on the aqueous electrolyte resistivity, water cut of the effluent, and on the pipeline diameter and is calculated according to the following simplified formula:

$$L = 400 \frac{D}{\rho}$$

With:

- L Internal coated length in cm
- D Nominal diameter of pipeline in cm
- ρ Electrolyte resistivity in Ohm.cm

As a basic rule, the coated zone shall be on the cathodic side and the anodic side of the joint should not be coated.

If the length to be internally coated is longer than the pup piece or cannot be practically manufactured as part of the joint's integrated pup piece, one (or more) separate spool could be added. In this case this internally coated spool shall follow the same quality procedure as the core of the joint. In addition, it is mandatory in this case that the connection between the spool and the joint is achieved by bolted flange. This flange shall conform to the mechanical and pressure requirement according to **GS EP PLR 222** or **GS EP PLR 232** as applicable. Both faces of the flange (on the spool and on the shortest sleeve of the joint) shall be coated, except for sealing surfaces. In no case the spool will be welded to the joint.



8. Final inspection

The finished insulating joints shall undergo tests and inspections defined below. Inspection certificates shall be submitted to Company.

8.1 Hydraulic tests

The insulating joint shall be hydrotested for 20 minutes at 1.25 times the pressure of the pipeline in which it is to be installed. During this test a visual check of the tightness of the joint shall be made and the integrity of the internal coating shall be verified by measurement of the electrical resistance as indicated in 6.2.

A dynamic test shall then be performed during which the insulating joint is pressure tested. The joint is subjected to a minimum of 20 cycles of 15 seconds each between 0 bar to test pressure. The tightness of the joint and the coating integrity shall again be checked as above.

A static test shall be carried out after the dynamic test. It shall be performed at 1.25 times the service pressure for 24 hours or for 20 minutes at test pressure. Once again, the tightness of the joint and the coating integrity shall be checked as above.

8.2 Electrical tests

8.2.1 High voltage dielectric test

This test shall be carried out after completion of the hydrotests, and after drying of the coating. The joint shall be subjected to a minimum voltage of 2,500 V for a period of one minute. No disruptive discharge shall occur.

8.2.2 Wet testing of coating insulation

This test shall be carried out before and after each hydrotest. The joint is filled with tap water, of known resistivity. The electrical resistance of the joint shall be measured under direct current and very low voltage. The resistance shall be equal to or greater than the theoretical value according to the following formula:

$$R_o = \rho \times \frac{l}{s}$$

Where:

R_o Theoretical electrical resistance of the insulating joint

ρ Resistivity of water at atmospheric pressure

s Cross sectional area of joint

l Length of internal coating of the joint

8.2.3 Dry test of joint insulation resistance

This test shall be carried out when the coating is dry. The electrical resistance of the joint in air shall be measured with an ohmmeter and the resistance shall be greater than 1 M Ω (megohm).



8.2.4 Holiday test of internal coating with wet sponge probe

This test shall be carried out after the dry joint insulation resistance measurement, as a function of the internal coating thickness, according to [ASTM D 5162](#).

This test shall also be performed externally when the insulating joint is to be buried.

8.3 Insulating joint qualification tests

For qualification of a monolithic insulating joint, Supplier shall perform the following tests on a finished joint ready for installation on the pipeline:

- Tests described in section 6
- Mechanical testing (bend, pull and compression) to confirm that the joint was fabricated according to technical calculations resulting from service conditions given in the tender.

8.4 Quality control

A QC dossier shall be submitted to Company for approval, with the following data:

- Name and address of the original Manufacturer
- Characteristics of the insulating joint (coating, steel specification, temperature, test pressure)
- Detailed drawings of the joint with all dimensions
- Characteristics of the pipeline in which the insulating joint is to be installed (steel specification, thickness, etc.)
- Fabrication and test procedures
- Mechanical properties calculation notes
- Internal and external coating applied at the plant with relevant thickness
- Hydrotests results
- Dielectric tests results.

9. Protection for shipment

Ends of pup pieces shall be plugged with suitable end caps to prevent foreign matter from penetrating inside the assembled joints and to protect the internal coating.

Bevels shall be protected by an anti-rust paint or peelable varnish.