



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS COR 210

Insulating joints

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1. Scope

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

Insulation devices consisting of flange assemblies, prefabricated insulating joints, unions, or couplings should be installed within piping systems where electrical isolation of portions of the system is required to facilitate the application of corrosion control. These devices shall be properly rated for temperature, pressure and dielectric strength.

Insulating devices shall be installed only when decided during the design phase, in application with **GS COR 100**, **GS COR 102**, **GS COR 110** and **GS COR 111**. In addition, insulating joints shall be installed:

- At point at which facilities change COMPANY ship
- When imposed by statutory regulations.

More detailed information on when and where installing insulating joints is available in **GM COR 020** (Total internal technical document, supplied on request when necessary).

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 insulating joints.

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

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, 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
Not applicable	

Professional Documents

Reference	Title
API 5L	Specification for line pipe
NACE RP 0286	The electrical isolation of cathodically protected pipelines

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
GM COR 020	Principles of utilisation and rules of calculation for insulating joints

Total General Specifications

Reference	Title
GS COR 100	Design of cathodic protection of offshore structures
GS COR 102	Design of cathodic protection of sea line by sacrificial anodes
GS COR 110	External cathodic protection of buried pipelines
GS COR 111	External cathodic protection of onshore facilities
GS COR 350	External protection of off-shore and coastal structures and equipment by painting
GS COR 352	Internal protection of equipment by painting

3. General characteristics

3.1 Series

The ANSI series corresponding to the working pressures for each installation are defined in the Requisition.

3.2 Maximum pressures

The maximum working pressures in each case are indicated in the Requisition.

3.3 Prefabricated insulating joints

Two types of prefabricated insulating joints are considered, the monolithic ones and the yoke type ones.

3.3.1 Monolithic insulating joint

Generally described as flangeless they cannot be dismantled, their assembly excluding bolts and nuts.

They are assembled only in factory; steel parts are separated by rigid insulating rings and sealing gaskets with good mechanical and dielectric properties.

3.3.2 Yoke type insulating joints

The yoke type joint consists of two hub assemblies. The back edge of one hub is machined to produce a sloping profile. The two hub faces are sealed with O-rings and insulation is provided by insulating spacers or organic compounds. Both hubs are held together under pressure by an encircling yoke made in two or three sections and fitted over the profiled and straight edged hub back faces. The yoke sections are brought together and the assembly tensioned by bolts placed through lugs on the ends of the encircling yokes. These lugs are normally locked in position by welded plates.

3.3.3 Miscellaneous

Insulating joints shall be equipped with pipe pups on both sides; lifting hooks shall be welded on the sleeves for easy handling.

The length of one pup shall be, at least, equal to the external diameter of the pipe. The dimensions of the bevelled edges shall conform to the requirements of [API 5L](#).

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

Insulating rings shall be internally coated with an insulating lining of epoxy resin type. Thickness of the full coat shall not be less than 1 mm. The pipe shall be internally abrasive blasted before the product is applied. This internal coating shall be applied up to 10 cm of ends of the pipe pups and cover at least a length equal to 2 pipe diameters.

4. Materials

4.1 Pup

Pup shall be manufactured from pipes of the same grade and same diameter as the line section on which they will be connected. All indications regarding the pipe are mentioned in the Requisition.

4.2 Insulating materials

The materials used for manufacturing of insulating parts shall be stratified or not, plastics. Several type of material may be used such as Bakelised cotton fabric or, when it is needed to have low water absorption and a good resistance to the mould (wet climate, tropical climate) the following materials:

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

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

The full detailed specification of insulating material shall be given by the Vendor in its bid, particularly regarding the compressive strength of each of the insulating material used perpendicular to the bedding such as:

- Rigid ring
- Insulating gasket
- Epoxy resin.

4.2.1 Mechanical characteristics of bakelised cotton fabric

- Contents (weight): 50 % of cotton, 50 % of bakelite
- Specific gravity: 1.35 approx.
- Tensile strength: 5 bars min.
- Compressive strength perpendicular: 20 bars min. to the bedding
- Brinell hardness: 11 under a load of 500 kg
- Water absorption percentage of a test specimen 50 mm x 50 mm after being in water at 20°C for a period of 24 hours
 - for a thickness of 1 mm: 4 % max.
 - for a thickness of 3 mm: 2.5% max.
- Allowable thickness for the insulator
 - for 1 mm: + 0.15 mm
 - for 2 mm: + 0.20 mm
 - for 3 mm: + 0.30 mm
- Electrical
 - Transverse dielectric strength for a thickness of 3 mm: 7000 V min.
- Low voltage resistivity
 - Transversal: 1000 megohms cm²/cm
 - Above ground: 100 megohms cm/cm

4.2.2 Characteristics of the bakelised glass fabric

- Specific gravity: 1.7 to 1.8

The electrical and mechanical qualities shall be distinctly higher than those of the bakelised asbestos felt or fabric.

4.2.3 Characteristics of epoxy resin and polyester

To be defined according to Vendor requirements; these characteristics must be higher than those of the bakelised cotton fabric.

5. Method of manufacture

All welding operations shall be carried out according to the operating methods devised and proposed by the Vendor for each type of welding.

After all component parts have been welded together, the equipment shall be such that no dangerous residual stress due to welding remains, and the welds and neighbouring transition zones contain no harmful metallurgical heterogeneity or defect likely to cause a break.

The Vendor shall undertake a 100 % radiographic inspection on all welds except the last one which shall be checked by ultrasonic method.

5.1 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 positioned according to the same generatrix of the sleeve-insulating joint assembly. They shall be fixed on either side of the insulating element, but approximately 300 mm away from it. These plates shall be fillet welded on each of the sleeves.

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

6. Tests and acceptance

6.1 Acceptance of insulating materials

The following tests should be requested in order to check the characteristics of the insulating materials:

- Tensile test on specimen
- Compression test using a 10 mm square stamp
- Measurement of low voltage resistance
- Test of transverse dielectric strength on plate 3 mm thickness (or more)
- Measurement of water absorption percentage
- Check on thickness of joints, washers, sleeves.

In addition, measurement of the transverse resistance of the sample may be requested before and immediately after the water absorption test. The difference between the two specific resistance readings must not exceed 100 megohms cm^2/cm .

6.2 Acceptance of insulating joints assembled in factory

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

- Measurement of the electric resistance between the two conducting parts of the insulating 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

- Hydraulic pressure test on each coupling at a pressure at least equal to the test pressure which should be applied to the pipeline. At this pressure, no leak or seepage should be detected
- Dimensional checking on the whole insulating joint.

7. Operating conditions

7.1 General

In general refer to the Requisition for insulating joints. The line pressure, temperature, the nature of the fluid transported and the climatic conditions are given in the Requisition or the particular specification.

7.2 Installation of equipment

The equipment shall be installed outdoor above ground or sea level. Offshore it should be preferably installed on a vertical section. The location of the insulating joint shall be such that it is not shunted by a part of the metallic structure, the electrical heating, etc.

8. Painting

8.1 External coating

The equipment shall be painted for atmospheric corrosion prevention according to **GS COR 350**.

In the specific cases where buried or immersed insulating joints are formally accepted by COMPANY, external coating shall be proposed to COMPANY's approval by the VENDOR.

8.2 Internal coating

Internal coating shall be resistant to the physicochemical environment represented by the transported fluid and to abrasion due to pigging operations. It shall be also resistant to cathodic disbonding due internal current exchanges. Except if otherwise specified and accepted by the COMPANY, the coating system shall be based on a glass flake epoxy material (System P07 second of the **GS COR 350**). The general requirements of internal painting specified in **GS COR 352** apply.

The location and length of internal surface to be coated shall be defined on case by case basis in the design study according to applicable Total General Specifications. It is based on the evaluation of internal corrosion risks due to possible cathodic protection current short-circuit in presence of a water phase.

The length to be coated depends on the aqueous electrolyte resistivity and content and on the pipeline diameter. In absence of better calculation approach (as per **GM COR 020**, Total internal technical document, supplied on request when necessary), the length L to be coated may be defined according to following simplified formula:

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

With:

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

As a basic rule, the coated zone shall be the cathodic side. Consequently, asymmetrical painting shall be done provided that all precautions are taken during installation of insulating flange to prevent any risk of welding the joint in the opposite way which would be very dangerous. In case of any doubt, symmetrical painting on both sides will be chosen.

9. Final inspection

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

9.1 Hydraulic tests

The insulating joint shall be hydraulically tested at the same pressure as the pressure of the pipeline in which it is to be installed. The joint is filled with water and subjected to this test pressure for 20 minutes. 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 the measurement of the electrical resistance as in Subsection 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 a pressure from 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 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.

9.2 Electrical tests

9.2.1 High voltage dielectric test

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

9.2.2 Wet testing of coating insulation

This test shall be carried out before and after each of the hydraulic tests. 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 value obtained 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

9.2.3 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 value obtained shall be greater than 1 M Ω (megohm).

9.2.4 Holiday test of internal coating with wet sponge probe

This test shall be carried out after the dry test of joint insulation resistance, as a function of the internal coating thickness, according to the standards referenced in Section 2.

9.3 Insulating joint qualification tests

For qualification of a monobloc insulating joint, the MANUFACTURER applying for qualification must perform the following tests on a finished joint ready for installation in the pipeline:

- Tests described in Section 6
- Bend, pull and compression tests to confirm that the joint was fabricated according to technical calculations for which appropriate service conditions were used.

9.4 Quality control procedure

A technical document file shall be submitted to the COMPANY for approval, with the following data:

- Characteristics of the insulating joint (coating, steel specification, temperature, test pressure)
- Characteristics of the pipeline in which the insulating joint is installed (steel specification, thickness, etc.)
- Fabrication and test procedures
- Calculation notes of mechanical properties
- Choice of internal and external coating applied in the plant and thickness of each coating
- Hydraulic tests results
- Dielectric tests results.

10. Protection for shipment

Ends shall be plugged with pieces of wood suitably located so as to prevent foreign matter from penetrating inside the assembled joints and to protect the epoxy resin film coating the joints.

Bevels shall be protected by an anti-rust paint or a mastic easy to remove.