



**PTT Exploration and Production Public Company Limited**

**PTTEP Engineering General Specification**  
(Engineering and Development Group)

**Standard**

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**Insulating Joints**

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<b>Prepared By (Author):</b>		Passaworn Silakorn		
<b>Department/Division/Asset/Company:</b>		EFE/ETS/EDE/PTTEP		
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Position	Name	Dept. Code	Signature	Date
Custodian:	Suchada Punpruk	12059	<i>Suchada Punpruk</i>	9/10/17
Manager (N+1):	-	-	-	-
<b>Document Management Approvals Register</b> <i>(To be signed before release of Revision No.R00)</i>				
Approver		Signature	Date	
<b>Name:</b> <b>(N+2)</b>	Pongpun Urarungroj	<i>Pongpun U.</i>	10 OCT 2017	
	<b>VP - Custodian</b>			
	Facility Engineering Department (12059)			
<b>Name:</b> <b>(N+3)</b>	-	-	-	
	<b>Division SVP - Custodian</b>			
	(DIV code)			
<b>Name:</b> <b>(N+3)</b>	Mana Rojpibulstit	<i>Mana</i>	17/10/2017	
	<b>Division SVP - ETS</b>			
	Engineering Technical Services Division (11032)			
<b>Name:</b> <b>(N+4)</b>	Kanit Sangwongwanich	<i>Kanit Sangwongwanich</i>	19/10/17	
	<b>Group EVP - EDE</b>			
	Engineering and Development Group (10008)			
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## 1.0 INTRODUCTION

PEGS (PTTEP Engineering General Specification) is the PTT Exploration and Production PCL internal publishes standard. The objective of PEGS is to promote the best practices collecting from all PTTEP execution projects and to standardize those best practice to the future projects.

Every 5 years or upon request by the internal user, PEGS will be reviewed by related subject experts to reach decisions/agreements, then the document will be updated and publish to PTTEP intranet website. This is to ensure that all lesson learns from users can be applied to the future projects as the benefit to PTTEP.

## 2.0 PURPOSE

Purpose of the document is to provide a good practice in term of protection of oil and gas production facilities against corrosion. It has to be used for the preparation of project specifications and as general guidelines by corrosion and inspection engineers and corrosion engineers either for future or existing installations

## 3.0 SCOPE

This specification deals with the supply of insulating joints to be installed eventually on pipeline or piping system, to establish an electrical break between the pipeline and foreign structures (platform, terminal, other pipe, etc.) or parts of a same piping system consisting of flange assemblies. Prefabricated Insulation devices should be installed within piping systems where electrical isolation of portions of the system is required to facilitate the application of corrosion control by cathodic protection. 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 of [10008-STD-6-COR-020](#), PEGS-12059-COR-020, [10008-STD-6-COR-021](#), PEGS-12059-COR-021, [10008-STD-6-COR-022](#), PEGS-12059-COR-022 and [10008-STD-6-COR-023](#), PEGS-0842-COR-023. In addition, insulating joints shall be installed:

1. At point at which facilities change of ownership
2. When imposed by statutory regulations

Insulating devices may be:

1. 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
2. Prefabricated insulating joints (Monolithic and York type)
3. Others such as unions, couplings and non-metallic spools.
4. Combination of an isolating kit and an internally coated spool.

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

## 4.0 RESPONSIBLE ACTION PARTIES

N/A

## 5.0 DEFINITIONS

A number of different terms are commonly used to describe the work stages, processes, and approvals which take place during the early stages of a development. This can often be a source of confusion so the following section is intended to show the PTTEP preferred terminology as used in this document.

### 5.1 LANGUAGE

In this document, the words should and shall have the following meanings:

<b>Shall</b>	Indicates a course of action with a mandatory status. The term “shall” shall be used if a requirement is considered to be necessary to claim compliance with a PEGS document.
<b>Should</b>	Indicates a preferred course of action. Should is a non-mandatory word and is not forbidden, but use in the body of the text should be the exception. Where none mandatory terms are used, each paragraph within these clauses shall also have an associated commentary paragraph that provides the rationale for why the stated choices and modifications are appropriate and circumstance under which the stated choices and modifications might be different.

### 5.2 TERMINOLOGY

Terminology	Description
<b>Approval</b>	The authorization in writing given by the COMPANY to the Contractor to proceed the work without releasing in any way the Contractor from any of his obligations to conform with the technical specifications, requisitions, etc. The words “Approve”, “Approved” and “Approval” shall be construed accordingly
<b>Company</b>	PTT Exploration and Production Public Company Limited and affiliates.
<b>Contractor</b>	Per contract: Contractor – ‘The contractor who is a PARTY to this CONTRACT and where the context so requires including, SUBCONTRACTORS utilized by CONTRACTOR for the performance of the WORK’
<b>Manufacturer</b>	The company or its sub-contractors selected by the COMPANY or the Contractor or the Supplier (as applicable) as the Manufacturer of the said material.
<b>Purchaser</b>	The COMPANY or the Contractor or the Supplier (as applicable) which have placed the Purchase Order to the Supplier/Vendor/Manufacturer.
<b>Supplier/Vendor</b>	The company designed on the Purchase Order form or Contract as being the selected supplier of the said materials.

### 5.3 COMMON ACRONYMS

Set out below in alphabetical order are common acronyms as found within this document:

<b>ANSI</b>	American National Standards Institute
<b>API</b>	American Petroleum Institute

<b>Approx</b>	Approximate
<b>ASTM</b>	American Society for Testing and Materials
<b>C</b>	Carbon
<b>CE</b>	Carbon Equivalent
<b>kV</b>	Kilovolt
<b>MΩ</b>	Megaohms
<b>mm</b>	Millimeter
<b>MSS</b>	Manufacturers Standardization Society
<b>NACE</b>	National Association of Corrosion Engineers
<b>V</b>	Volt

## 6.0 REFERENCES

The reference documents listed below, including Industry Codes and Standards and COMPANY specifications, form an integral part of this Engineering General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published on the effective date of a contract.

The overall order of precedence of the applicable documents shall be:

1. Applicable Laws, Rules and Regulations of the country in which the system/equipment will be operated (if any);
2. Purchase Order/ Service Order/ Contract Documents (Only applicable for direct purchase by COMPANY);
3. Project Particular Specification (PPS), and relevant data sheet(s) if any;
4. COMPANY General Specification;
5. Codes and Standards in reference.

Any conflict between any of the Contract Documents, or between this specification and any other Contract Documents, shall be reported to COMPANY for decision. In such a case, and unless otherwise agreed or decided by COMPANY, it is understood that the more stringent requirement shall apply.

Exceptions to, or deviations from this specification are not permitted unless previously accepted in writing by COMPANY. For this purpose, requests for substitutions or changes of any kind shall be completed with all pertinent information required for COMPANY assessment. COMPANY's approval, nevertheless, will not, in any way, relieve the responsibility of the Contractor to meet the requirements of the industry Codes and Standards referred to and amended herein, in the event of conflict.

### 6.1 PTTEP INTERNAL REFERENCES

Internal documents applicable to this document are indicated in the table below.

Document Number	Document Title
10008-STD-6-PIP-012 , PEGS-12059-PIP-006	Valves
10008-STD-6-PIP-009 , PEGS-12059-PIP-007	Piping Material Classes
10008-STD-6-PLR-009 , PEGS-0710-PLR-007	Design, Materials and Fabrication of Flanges and Branch Outlet Fittings for Carbon Steel Pipelines
10008-STD-6-COR-004 , PEGS-12059-COR-004	Internal Coating of pressure Vessels and Tanks
10008-STD-6-COR-010 , PEGS-12059-COR-010	Painting of Offshore and Coastal Structures and Facilities
10008-STD-6-COR-011 , PEGS-12059-COR-011	Painting of Onshore Structures and Facilities
10008-STD-6-COR-020 , PEGS-12059-COR-020	Design of Cathodic Protection of Offshore Structures
10008-STD-6-COR-021 , PEGS-12059-COR-021	Design, Installation and Inspection of Cathodic Protection of Sealines by Sacrificial Anodes
10008-STD-6-COR-022 , PEGS-12059-COR-022	Design of Cathodic Protection of buried pipeline
10008-STD-6-COR-023 , PEGS-0842-COR-023	Design of Cathodic Protection of Onshore Facilities
10008-STD-6-COR-032 , PEGS-0842-COR-032	Material for Sour Service

### 6.2 INTERNATIONAL STANDARDS

International standards applicable to this document are indicated in the table below i.e. ISO, IEC or ITU.

Document Number	Document Title
-	-

### 6.3 CODE AND OTHER STANDARDS

Codes, standards and regional legislation applicable to this document are indicated in the table below.

Document Number	Document Title
API 5L	Specification for Line Pipe
ASTM D 709	ASTM D 709 Standard Specification for Laminated Thermosetting Materials
MSS SP 75	Specification for High Test, Wrought, Butt Welding Fittings
NACE SP 0286	Electrical Isolation of Cathodically Protected Linepipes

## 7.0 REQUIREMENTS FOR INSULATING JOINTS

### 7.1 PREFABRICATED INSULATING JOINTS

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

#### 7.1.1 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.

#### 7.1.2 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.

#### 7.1.3 MISCELLANEOUS

Insulating joints shall be equipped with pipe pups on both sides; lifting lugs shall be welded on the sleeves for easy handling. Lifting lugs are not necessary for small diameters  $\leq 6"$  for instance, depending on the rating.

The length of one pup shall be, at least, equal to the external diameter of the pipe. The dimensions of the beveled 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 glass flake filled vinylester type. Other types of coating may be acceptable if they are compatible with the effluent and operating conditions. It is subjected to COMPANY approval. 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.

If the COMPANY specified that post-weld heat treatment will be used for field welding, the Manufacturer/Supplier shall demonstrate that the length of the joint is suitable, i.e. the heat generated by the heat treatment is not detrimental to the insulating and filler materials and the internal coating. Else, the length of the joint shall be increased accordingly.

Insulating joints shall have a smooth and clear bore suitable for uninterrupted passage of cleaning pigs and in-line electronic survey tools (intelligent pigs).

The values of specified minimum yield strength S, wall thickness t and diameter D shall be those of the pipeline section or piping class into which the insulating joint is to be welded.

## 7.2 MATERIALS

### 7.2.1 PUP AND FLANGES

Pup shall be manufactured from pipes of the same grade, same manufacturing process and same diameter as the line section on which they will be connected. All indications regarding the pipe shall be mentioned in the Requisition. Preferably, a pipe joint taken from the project pipe stock should be supplied by Contractor or COMPANY to the insulating joint Manufacturer.

All material that is possibly exposed to sour environment shall comply with the COMPANY specification [10008-STD-6-COR-032](#), PEGS-0842-COR-032.

### 7.2.2 INSULATING MATERIALS

The materials used for manufacturing of insulating parts shall be stratified or not plastics. Several types 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:

1. Bakelised glass fabric
2. Stratified polyester and glass fibre
3. 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:

1. Rigid ring
2. Insulating gasket
3. Glass flake filled vinylester

All non-metallic materials shall be suitable (at maximum operating temperature) for full immersion in water.

#### 7.2.2.1 MECHANICAL CHARACTERISTICS OF BAKELISED COTTON FABRIC

The characteristics shall be in accordance with ASTM D709.

1. Contents (weight): 50 % of cotton, 50 % of bakelite
2. Specific gravity: 1.35 approx.
3. Tensile strength: 5 bars min
4. Compressive strength perpendicular to the bedding: 20 bars

5. Brinell hardness: 11 under a load of 500 kg
6. 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
  - a) for a thickness of 1 mm: 4 % max
  - b) for a thickness of 3 mm: 2.5 % max
7. Allowable thickness for the insulator
  - a) for 1 mm: + 0.15 mm
  - b) for 2 mm: + 0.20 mm
  - c) for 3 mm: + 0.30 mm
8. Electrical
  - a) Transverse dielectric strength for a thickness of 3 mm: 7000 V minimum
9. Low voltage resistivity
  - a) Transversal: 1000 MΩ.cm
  - b) Above ground: 100 MΩ.cm

#### **7.2.2.2 CHARACTERISTICS OF THE BAKELISED GLASS FABRIC**

1. 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.

#### **7.2.2.3 CHARACTERISTICS OF GLASS FLAKE FILLED VINYLESTER AND POLYESTER**

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

### **7.3 METHOD OF MANUFACTURE**

All welding operations shall be carried out according to the operating methods approved by COMPANY (as proposed by the Vendor for each type of welding). Welding and NDT procedure shall be submitted to COMPANY for review and approval.

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.

### **7.3.1 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 fillet welded on each pup piece on each side of insulating part at about 30 cm from the insulating part.

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

## **7.4 TESTS AND ACCEPTANCE**

### **7.4.1 ACCEPTANCE OF MATERIAL**

#### **7.4.1.1 PUPS AND FLANGES MATERIAL**

- Mill certificate shall be provided by manufacturer
- Welding certificate shall be provided by manufacturer

#### **7.4.1.2 INSULATING MATERIAL**

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

1. Tensile test on specimen
2. Compression test using a 10 mm square stamp
3. Measurement of low voltage resistance
4. Test of transverse dielectric strength on plate 3 mm thickness (or more)
5. Measurement of water absorption percentage
6. Check on thickness of joints

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 M $\Omega$  cm.

Acceptance criteria: The test results shall conform, as a minimum, the values mentioned in the sections 7.2.2.1 - 7.2.2.3

### **7.4.2 ACCEPTANCE OF INSULATING JOINTS ASSEMBLED IN FACTORY**

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

1. Measurement of the electric resistance between the two conducting parts of the insulating joint.

This resistance should be more than 2 M $\Omega$  in dry atmosphere:

1. Breakdown voltage tests at 5 kV
2. Hydraulic pressure test 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
3. Dimensional checking on the whole insulating joint.

## 7.5 OPERATING CONDITIONS

### 7.5.1 GENERAL

The operating and design conditions shall be provided to the insulating joint Manufacturer by Contractor or COMPANY.

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

### 7.5.2 INSTALLATION OF EQUIPMENT

Insulating joint shall not be buried or immersed directly in the water.

As a general rule, insulating joints shall be installed in a straight part of the pipeline or piping system in order to mitigate the mechanical stresses. A straight slop of the strait part is recommended to prevent stagnancy of conductive fluid.

Unless otherwise specified, insulating joint shall not be installed on offshore riser.

The equipment shall be installed outdoor above ground or sea level. On offshore facilities, 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, earthing network, the electrical heating, etc.

For onshore buried pipeline or piping system, insulating joints shall be installed in concrete pits. Water accumulation in the concrete pit shall be prevented.

## 7.6 PAINTING

### 7.6.1 EXTERNAL COATING

The equipment shall be painted for atmospheric corrosion prevention according to the relevant painting system (Refer [10008-STD-6-COR-010](#), PEGS-12059-COR-010 or [10008-STD-6-COR-011](#), PEGS-12059-COR-011)

### 7.6.2 INTERNAL COATING

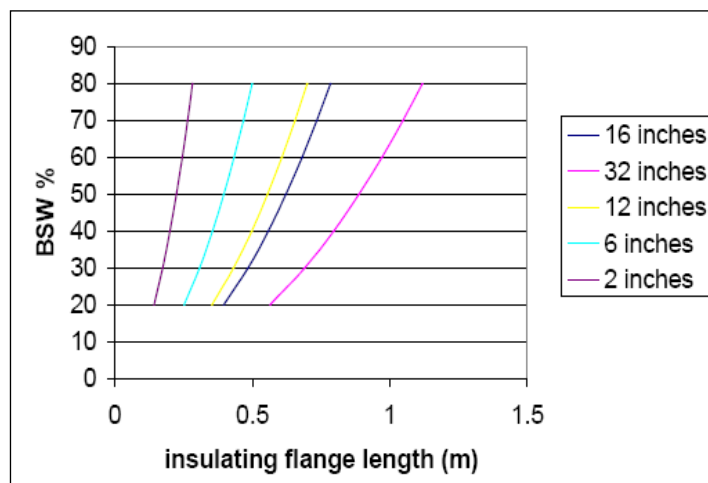
Internal coating shall be resistant to the physicochemical environment represented by the transported fluid and to abrasion due to pigging operations. It shall be also resistant to cathodic disbonding due to the possibility of internal current exchanges. Except if otherwise specified and accepted by the COMPANY, the coating system shall be based on a glass flake vinylester material or a glass flake epoxy material. The COMPANY general requirements for internal coating of pressure vessels shall be applied ([10008-STD-6-COR-004](#), PEGS-12059-COR-004).

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 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, the length L to be coated may be defined according to one of the simplified charts given hereafter.

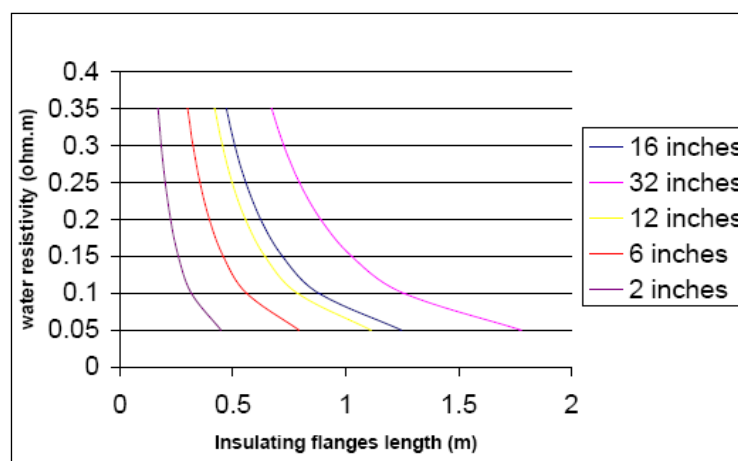
As a basic rule, the coated zone shall be the cathodic side. Theoretically, asymmetrical painting shall be done provided that all precautions are taken during installation of insulating joint to prevent any risk of welding the joint in the opposite way which would be very dangerous. Consequently, In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

BWS % = f (insulating flanges length in m)



**Figure 1 - Relationship between BSW% and Insulating Flange Length**

Water resistivity = f (Insulating flanges length)



**Figure 2 - Relationship between Water Resistivity and Insulating Flange Length**

The practical length L will be chosen from the most conservative value given by both charts.

The insulated length should also be calculated according to the following simplified formula:

$$L = 400 D / \rho$$

With:

L Internal coated length in cm

D Nominal diameter of pipeline in cm

$\rho$  Electrolyte resistivity in Ohm.cm

## 7.7 INSPECTION

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

### 7.7.1 HYDRAULIC TESTS

The insulating joint shall be hydraulically tested at the same pressure as the pressure of the pipeline or piping system 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 section 7.4.2.

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 barg 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.

### 7.7.2 ELECTRICAL TESTS

#### 7.7.2.1 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.

#### 7.7.2.2 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:

$$R_o = \rho \times l/s$$

where:

$R_o$  = theoretical electrical resistance of the insulating joint

$\rho$  = resistivity of water at atmospheric pressure

$s$  = cross sectional area of joint

$l$  = length of internal coating of the joint.

### **7.7.2.3 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 MΩ.

### **7.7.2.4 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 6.

### **7.7.3 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:

1. Tests described in Section 7.4.
2. Bend pull and compression tests to confirm that the joint was fabricated according to technical calculations for which appropriate service conditions were used.

### **7.7.4 QUALITY CONTROL PROCEDURE**

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

1. Characteristics of the insulating joint (coating, steel specification, temperature, test pressure)
2. Characteristics of the pipeline or piping system in which the insulating joint is installed (steel specification, thickness, etc.)
3. Fabrication and test procedures
4. Calculation notes of mechanical properties
5. Choice of internal and external coating applied in the plant and thickness of each coating
6. Hydraulic tests results
7. Dielectric tests results
8. Drawings

### **7.8 PROTECTION FOR SHIPMENT**

Ends shall be plugged with end cap / pieces of wood suitably located so as to prevent foreign matter from penetrating inside the assembled joints and to protect the internal coating of the joints.

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



## 8.0 APPENDICES

N/A



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