TECHNICAL SPECIFICATION
FOR MONOLITHIC INSULATING JOINTS
for Gas and Oil service

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1. **SCOPE AND FIELD OF APPLICATION**

This Specification covers the technical requirements for the design, manufacturing and testing of Monolithic Insulating Joints for Electrical Insulation of gas and oil pipelines.

**Note:**
1) The purpose of insulating joints installation on gas and oil pipelines, it is to ensure electrical isolation among sections of pipelines preventing detrimental electrochemical interaction among the sections themselves. Insulating joints are also used to ensure effective current spreading on cathodic protection systems.

2) The insulating joint is suitable for installation either under, or above ground. It shall be installed on pipeline by means of girth welding it between two sections of pipeline itself.

2. **REFERENCES**

This specification takes into consideration the requirements of the following codes/standards/rules. Unless otherwise specified, the latest editions of the same, including all appendixes and revisions, shall apply.

**ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)**

- ANSI B16.5 “Pipe Flanges and Flanged Fittings”
- ANSI B31.8 “Gas Transmission and Distribution Piping System”
- ANSI B31.4 “Pipeline transportation system for liquid hydrocarbons and other liquids”

**ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)**

- ASME B 16.25 “Butt-welding Ends”
- ASME V NDE
- ASME VIII Pressure Vessels
- ASME IX Welding and Brazing Qualifications
  - SMAW Shield Metal Arc Welding
  - GTAW or TIG Gas Tungsten Arc Welding
  - GMAW Gas Metal Arc Welding
  - SAW Submerged Arc Welding
  - ERW Electrical Resistance Welding

**ASNT (AMERICAN SOCIETY FOR NON DESTRUCTIVE TESTING)**

- SNT TC-1A Recommended Practice

**ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)**

- ASTM A105 Standard Specification for “Forgings, Carbon Steel for Piping Components”
• ASTM A370  Standard Test Method and definition for “Mechanical Testing of Steel Product”
• ASTM A694  Standard Specification for “Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Services”

API (AMERICAN PETROLEUM INSTITUTE)
• API 5L  “Line-pipe”

EN (EUROPEN NORM)
• EN 10204 “Metallic products - Types of inspection documents
• EN 10297 “Seamless circular steel tubes for mechanical and general engineering purposes”

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)
• ISO 8501-1  “Preparation of Steel Surfaces before Application of Paints and Related Products Surface Preparation Methods”

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)
• TM-01-87  “Evaluating Elastomer Materials in Sour Gas Environments”
• MR 01-75  “Materials Requirements Sulfide Stress Cracking Resistance-Metallic Materials for Oilfield Equipment”

3.  UNITS

This Standard is based on International System of Units (SI), unless otherwise specified.

4.  DESIGN

4.1 All Joints shall be of Monolithic type construction by welding pipe-pups on either side of it. The Insulating joints shall be designed and prepared for welding to fit the pipe size and grade specified by the client.

4.2 Construction shall not incorporate any flanges, bolts, nuts and threaded unions and structure shall be stiff, strong and suitable for maintenance free field installation, no matter if installed on buried or surface laid pipeline.

4.3 The insulating joint body shall be designed in accordance with the method described on ASME VIII Division 1 Appendix 2, adequately adapted. As a minimum requirement, the design
pressure shall be the same of the design pressure of the pipeline. If no requirement is specified instead, the design temperature shall be 0/+70°C.

4.4 The pipe-pups of insulating joints shall if not otherwise specified, shall be designeand as per ANSI B31.8 or ANSI B31.4 as applicable.

4.5 The insulating joints shall be designed to withstand the design pressure plus an external applied bending load that combined together are sufficient to induce a total longitudinal stress of 100% of the SMYS of the adjoining pups.

4.6 The insulating joints must be assembled allowing its internal components to get firmly locked in their designated position. Such scope shall be reached by impressing an adequate calculated preload during assembly.

4.7 The number of welds must be as restricted as possible.

4.8 Sealing Gasket shall be designed such that the joint assembly complies with the mechanical and electrical requirements specified in this specification. The seal gasket must be made of one rectangular or “ U” shaped piece.

Sealing Systems that foresee “o-ring/s” cannot be accepted.

4.9 The design of the insulating joint shall include longitudinal electrical insulation across the whole circumference of its bore, a preventing an electrical resistance reduction to occur whenever wet gas flows thru. This could be obtained with a stiff extension of the insulating ring (insulating sleeve), or with lining application of paint having high electrical and abrasive resistance. In case of lining, bevel ends shall be free of paint for 50 mm approx., but protected with an easy removable rust preventive varnish.

5. **MATERIALS**

5.1 The pipe pups material shall be API 5L, of similar grade of the adjacent pipeline itself.

5.2 The other metallic components of the insulating joint shall be of forged steel conforming to the requirements of ASTM A694 , ASTM A105, ASTM A350, or circular steel tube conforming to the requirements of EN10297 or other approved standards. Forged steel shall be normalized or quenched and tempered. Only fully killed material shall be used. Chosen steel grade must have similar SMYS (specified minimum yield strength) of the one of the pipe pups.

5.3 Wherever service conditions are sour, the materials shall comply with the requirements of NACE Standard MR 01-75 (for steel components) and TM 01-87 (for seal gasket).

5.4 The insulating materials shall be suitable for long-term exposure to the conveyed fluid at operating temperature and be made of non –hygroscopic and shall be capable of sustaining high compressive stress. The material shall have good long-term stability, excellent dielectric strength and thermo properties without cracking, distorting, or loss of insulating properties.
5.5 The gasket shall be obtained from moulds and of age resisting rubber material. Only high
dielectric characteristics NBR (Nitrile butadiene rubber), or Viton can be used. It shall resist
explosive decompression, and shall be suitable for long-term exposure to GAS at the design
pressure and temperature.

6. MANUFACTURE

6.1 The insulating joint shall be assembled in such a way that its several components are firmly
locked in position and the complete joint is capable of withstanding stresses due to designed
operating conditions and field hydrostatic testing.

6.2 Prior the assembly all metallic and insulating materials shall be thoroughly cleaned in order to
remove rust or impurities.

6.3 The annular space between the retainer and the pup shall be filled with insulating fillers, stiff
plastics, or combination of the same.

6.4 External filled surface shall be filled with adhesive sealant elastomer to prevent deposit of
sediiments.

6.5 Bevel ends shall be as per ANSI B 16.25 or API 5L. Any lamination found on bevel ends shall
be fully removed.

6.6 Under-cutting on weld seam shall not be permitted.

6.7 For a distance of 100mm from the welding ends, the internal diameter shall not deviate by more
than +/- 1.5mm from the nominal internal diameter of the pipeline.

6.8 Post weld heat treatment, if required, shall be performed according to ASME VIII Division I and
ANSI B31.8 or ANSI B31.4 as applicable. PWHT shall not be carried out on final closure weld,
ever.

7. WELDING REQUIREMENTS

7.1 Approved welding Processes:

Any of the following processes may be used:
1. Shield Metal Arc Welding (SMAW)
2. Gas Tungsten-Arc Welding (GTAW or TIG)
3. Gas Metal-Arc Welding (GMAW or MIG)
4. Submerged–Arc Welding (SAW)
5. Combination of above processes.

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7.2 Procedure Qualification

Welding procedures shall be qualified in accordance with ASME Section IX.

7.3 Welders Qualifications

Welders shall be qualified in accordance with the requirements of ASME Section IX.

7.4 Consumable Materials

Electrodes, filler wires and fluxes shall conform to AWS specifications A 5.1 through A 5.30 as applicable.

8. SURFACE FINISHING AND PROTECTIVE COATING

After all tests and inspections required have been carried out, insulating joint shall be thoroughly cleaned in order to remove rust or impurities.

External surface preparation shall be carried out by shot blasting or sand blasting to SA 21/2 finishing grade in accordance with ISO 8501-1. The insulating joint shall be externally coated with an epoxy resin, or polyurethane paint to a dry film thickness of 200 microns min. The application shall be in strict accordance with the coating supplier’s specification.

Bevel ends for 50 mm approx., shall be free of coating and protected with an easy to remove rust preventive varnish.

9. QUALITY ASSURANCE PROVISIONS

It is the responsibility of the manufacturer to establish quality assurance thru quality control procedures, ensuring that the product will meet the requirements of this specification.

The quality control at the manufacturer’s premises shall include control systems for:

• Raw materials, i.e. checking of documents and/or testing for conformity with the specification.
• Production equipment and process.
• Testing during and after fabrication.
• Checking of dimensions
• Documents (material certificates)

10. TESTS

10.1 General
The scope of tests performing is to prove that the materials comply with this specification and that insulating joint could satisfactorily pass all required tests.

10.2 Metallic Material Chemical Analysis

Chemical analysis and tensile test shall be performed by the ladle analysis for each heat of steel. The results shall comply with requirements of the related standard.

For design temperature lower than 0°C, charpy impact test shall be carried out on all metallic materials according to ASTM A370. Acceptance criteria shall be 37 J average and 27 J minimum for single specimen. The test shall be carried out at the design temperature, or lower.

10.3 Dielectric Test and Megger Test

Upon completion of the assembly and prior to the hydrostatic test, each insulating joints shall be megger teted with 1000 V. d.c. Minimum resistance shall be 5 Mhom.

Each Insulating joint shall be also dielectric tested at 3500 V a.c. (50Hz) for 1 minute. No flashover, or breakdown shall occur during the test.

The above tests shall be repeated immediately after hydrostatic test. The readings before and after hydrostatic test shall be equal.

Moreover, megger test shall also be repeated on wet insulating joint. Test shall be performed right after water immersion, or internal surface water spraying. Tension test shall be 1000 V. d.c. minimum and resistance shall be 1 Mohm minimum.

10.4 Fatigue and Hydrostatic Test

A fatigue hydraulic test shall be carried out on each joint before the hydrostatic test. This test consists on 40 consecutive cycles of quick pressure variations from 1.000 kPa to 1,5 time of the design pressure, back and fore. After fatigue test, the insulating joint shall be hydrostatically tested, at 1.5 times of the design pressure. The test pressure shall be maintained for at least 60 minutes.

No leaks or unacceptable deformation shall occur during this test.

Fatigue and hydrostatic tests shall be carried out in unrestrained conditions.

10.5 Welding Tests

All N.D.E. shall be carried out according to ASME V by a level II ASNT TC-1A practice qualified inspector.

In case of presence of Butt Welds these shall be 100% radio-graphed with X-rays. Acceptance criteria shall be per ASME VIII Div.1 UW.51.

Closure welds shall be inspected by ultrasonic, or magnetic particles method. Acceptance criteria shall be ASME VIII Div.1 Appendix 12 and Appendix 6 respectively.
Welds, which cannot be inspected by radiographic, ultrasonic, or magnetic particles, shall be checked by Dye penetrant test according to ASME Section VIII, Dv. I, Appendix 8.

All finished bevel ends shall be 100% ultrasonically tested for lamination type defects, for a distance of 50mm from the ends. Lamination shall not be acceptable.

10.6 Visual and Dimensional Check

The manufacturer shall carry out visual inspection of all components prior to assembly and after finishing of the insulating joints. General appearance shall prove good workmanship. Dimensions of the insulating joint shall be checked against the specification, purchase order description and/or approved manufacturer drawings.

11. INJECTIONS

The manufacturer/supplier shall be responsible for carrying out all the tests and inspections required by this specification, using his own equipment and devices, and shall maintain complete records of all tests and inspections.

12. TEST CERTIFICATES

The manufacturer/supplier shall submit the following certificates, as a minimum requirement:
1) Test certificates referred to the chemical and mechanical properties of the materials used for construction as per this Specification and related standards
2) Test reports of welding tests
3) Test certificate for fatigue and hydrostatic tests
4) Test certificate for electrical tests
5) Test certificate for dimensional and visual inspection
Certificates shall be as per EN 10204 3.1.

12. Marking

12.1 The following information shall be clearly stated on label attached to external surface of each insulating joint:

- Manufacturer’s name or trademark
- Pipe pups steel grade
- Pipe pups nominal wall thickness
- Pipe pups nominal outside diameter
- Maximum operating pressure
- Maximum operating temperature
- Serial number

No marking by means of stamping is allowed.
13. PACKING AND STORING

13.1 Insulating joint shall be properly packed in closed container fitted with cover to prevent damage during handling, preservation and transportation.

13.2 The content of each package shall be clearly indicated on outside walls.
Typical monolithic insulating joints

Internal lining → longitudinal electrical insulation across the whole circumference of its bore (see 4.9)

insulating sleeve → longitudinal electrical insulation across the whole circumference of its bore (see 4.9)