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FUNCTIONAL SPECIFICATION FOR FIELD JOINT COATING OF SUBMARINE PIPELINES

**OIL AND NATURAL GAS CORPORATION LTD.
INDIA**


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<p>1.0 SCOPE</p> <p>This specification covers the minimum requirements of materials, manpower, equipment and application of field joint corrosion coating and in-fill joint coating of submarine Pipelines and risers.</p> <p>This specification shall be read in conjunction with the requirements of all other specifications and documents included in the Contract.</p> <p>2.0 REFERENCE DOCUMENTS</p> <p>Reference has been made in this specification to the latest editions of the following Standards and specifications:</p> <ul style="list-style-type: none"> a) DIN-30672 : Corrosion Protection Tapes and Heat Shrinkable Sleeves. b) ASTM D-149 : Standard Test Methods of Dielectric Strength of Solid Electrical Insulating Materials at Commercial frequencies. c) ASTM D-638 : Standard Method of Test for Tensile Properties of Plastics. d) ASTM D-1002 : Standard Method of Test for Strength Properties of Adhesives in Shear by Tension Loading (Metal to Metal) e) ASTM D-2671 : Heat-Shrinkable Tubing for Electrical Use. f) ASTM E-96 : Water Vapor Transmission of Materials in Sheet Form g) ASTM G-42 : Cathodic disbonding of Pipeline coatings subjected to Elevated or cyclic Temperatures. 				


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<p>h) SS-7 : Asphalt Protective Coatings for Pipe Lines, The Asphalt Institute, USA</p> <p>i) SIS-055900 : Pictorial surface Preparation Standard for Painting Steel Surfaces.</p> <p>j) SSPC-SP 1 : Solvent Cleaning, Steel Structure Painting Council</p> <p>k) JSC-7711-C 18.7 : Japanese Standard for PU Foam</p> <p>In case of conflict between the requirements of this specification and that of above referred documents, the requirements of this specification shall govern.</p> <p>3.0 MATERIALS AND EQUIPMENT</p> <p>3.1 General</p> <p>3.1.1 Contractor shall supply all required field joint coating materials unless specified otherwise in the Contract, equipments and manpower required for a skillful and adequate application of coating in the field in accordance with this specification.</p> <p>3.1.2 Contractor shall submit and demonstrate to Company, the proposed materials and work procedures for application of field joint coating. Proposed procedures and all materials, equipment and tools used in the work shall be subject to Company's approval.</p> <p>3.2 Field Joint Corrosion Coating Material</p> <p>3.2.1 Field joint corrosion coating materials shall be suitable for design temperature upto 93°C and temperature anticipated at the field joints during normal lay-barge operations. The field joint corrosion coating material shall</p>				

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<p>be either heat shrinkable wraparound sleeve or cold applied pipe wrap having a generic description as stated herein after.</p> <p>3.2.1.1 Heat Shrinkable Wraparound Sleeve</p> <p>Heat Shrinkable Wraparound Sleeve shall consist of radiation cross-linked polyolefin backing, fabricated from thermally stabilized, ultraviolet resistant semi-rigid polyolefin. The inner surface of the sleeve shall be coated with a uniform thickness of high shear strength thermoplastic/copolymer hot melt adhesive. The joint coating system may consist of a solvent free epoxy primer applied to the pipe surface prior to sleeve application. The backing shall be coated with thermo chrome paint which will change color when the desired heat during shrinking is attained. Thickness of the wraparound sleeve shall be as per manufacturer's standard. Properties of the heat shrinkable wraparound sleeve shall meet the requirements of para 3.2.2 of this specification. Heat shrinkable wraparound sleeve shall be supplied in pre-cut sizes complying the requirements of this specification, to enable easy application during laying operations.</p> <p>3.2.1.2 Cold applied pipe wrap</p> <p>Cold applied pipe wrap shall consist of PVC/Polyethylene backing with a uniform thickness of self-adhesive bituminous rubber compound and shall be of the type that can be applied without use of any primer. Thickness of the wraparound sleeve shall be as per Manufacturer's standard. Properties of the cold applied pipe wrap shall meet the requirements of para 3.2.2 of this specification. Cold applied pipe wraps shall be supplied in pre-cut sizes complying the requirements of this specification, to enable easy application during laying operations.</p>				

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3.2.2 Properties of joint corrosion coating material


Properties of the backing and the as-applied joint corrosion coating shall be as follows :

Sl. No.	Property	Unit	Requirement	Test Method
3.2.2.1 Properties of Backing				
i.	Tensile Strength @ 25°C	kg/cm²	≥ 160	ASTM D-638
ii	Ultimate Elongation @ 25°C	%	≥ 250	ASTM D-638
iii	Dielectric withstand with 1000 Volt/Sec.	Volts	≥ 30000	ASTM D-149
iv.	Water Vapour Transmission	g/24h/m²	≤ 0.7	ASTM E-96
v.	Heat Shock @200°C for 4 (four) hours (For Heat shrinkable wraparound sleeve only)	-	No dripping, cracking, flowing	ASTM D-2671
vi)	Heat Shock @ 200°C (For Cold applied pipewrap only)	-	Pass	Drumskin Method
3.2.2.2 Properties of Coating System (As Applied)				
i.	Resistance to impact @ 25°C	kg-cm Zone-A	≥ 20	DIN 30672


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ii	Resistance to peel between coating and steel @ 25°C	kg/cm	≥ 2.75	DIN 30672	
iii	Cathodic Disbondment (After 30 days) Test Method A, @ 60°C	mm	≤ 30	ASTM G-42	
3.3	Joint In-Fill Coating				
3.3.1	The field joint in-fill coating material shall be either mastic or high density polyurethane foam meeting the requirements mentioned below:				
3.3.1.1	Mastic				
	Mastic material comprising of sand, lime dust and asphalt having a minimum density of 1925 kg/m ³ shall be used for field joint in-fill coating. Mastic mix shall comply the requirements of “Asphalt Protective Coatings of Pipelines”, Specification Series No. 7 (SS 7). Asphalt used in mastic mix shall be Type II.				
3.3.1.2	High Density Polyurethane Foam				
	High Density Polyurethane Foam (HDPF) in compliance with JSC 7711-C 18.7 containing polymeric isocyanate and polyol blend having a dry density > 160 kg/m ³ , saturated density > 1025 kg/m ³ and compressive strength > 25 kg/cm ² shall be used for the joint in fill coating.				
3.4	Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch of materials supplied. Company reserves the right to have the materials tested in an independent laboratory. Contractor shall procure the field joint coating materials only after obtaining written approval from Company.				


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<p>3.5 Materials shall not be older than their period of validity at the time of application. Deteriorated and decomposed materials shall be disposed off and replaced by Contractor at his own expense.</p> <p>3.6 Contractor shall ensure that the coating materials supplied by him are properly packed and clearly marked with the following:</p> <ul style="list-style-type: none"> - Manufacturer's Name - Material Description - Batch Number - Date of Manufacturing and date of expiry - Specific storage and handling instructions <p>3.7 All materials shall be stored and handled by the Contractor in such a manner to prevent damage or deterioration, to the satisfaction of the Company.</p> <p>4.0 APPLICATION PROCEDURE</p> <p>4.1 General</p> <p>The field joint corrosion and in-fill coating application procedure shall be in accordance with manufacturer's instruction and the minimum requirements specified hereinafter whichever is more stringent and shall be demonstrated to and approved by the Company. Operators for coating application shall be given necessary instructions and training before start of work by the Contractor.</p> <p>4.2 Surface Preparation</p> <p>4.2.1 Oil and grease shall be removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Solvent cleaning procedure shall be according to SSPC-SP-1.</p>				


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<p>4.2.2 Prior to surface cleaning, the surface shall be completely dry. Surface shall be mechanically cleaned using wire brushes to remove dirt, loose particle of scale, rust and weld spatter to ST-3 finish of Swedish Standard SIS-055900. Tools and the procedure used shall ensure that no burrs or sharp cuts are made on the pipe surface.</p> <p>4.2.3 The ends of existing pipe protective coating shall be inspected prior to application and cleaned as necessary. Unbonded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned to ST – 3 finish.</p> <p>4.3 Application of pipewrap</p> <p>4.3.1 Application of Heat shrinkable wraparound sleeves</p> <p>4.3.1.1 Heat shrinkable wraparound sleeve shall be applied on the surface immediately after the surface cleaning operation. The wraparound sleeve over the joints shall overlap the yard applied coating by minimum 50 mm on both sides.</p> <p>4.3.1.2 Before centering the wraparound sleeve, the bare steel surface shall be preheated with a torch moved back and forth over the surface to remove the moisture. The minimum preheat temperature shall be as recommended by the manufacturer and shall be checked by means of pyrometer or temperature crayons.</p> <p>4.3.1.3 Then the wraparound sleeve shall be entirely wrapped around the pipe positioning the closure patch off to one side of the pipe in 10 or 2 O'clock position, with the edge of the undergoing layer facing upward. Overlap between the sleeve and closure patch shall be minimum 100 mm. The solvent free epoxy primer (Whenever applicable) shall be applied prior to sleeve application as per manufacturer's recommendations.</p>				


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<p>4.3.1.4 A heat shrinking procedure shall be applied to shrink the sleeve in a manner such that all entrapped air is removed using gloved hands and hand rollers. The complete shrinking of the entire sleeve shall be obtained without undue heating of existing pipe coating and providing due bonding between pipe, sleeve and pipe coating. Heating shall be carried out until the thermochrome paint has changed its color completely as recommended by the Manufacturer. Resulting coating shall be free of wrinkles, cold spots and weld profile visible on the sleeve.</p> <p>4.3.2 Application of cold applied pipewrap</p> <p>4.3.2.1 Cold applied pipewrap shall be applied on the surface immediately after the surface cleaning operation. It shall be ensured that no moisture is present on the surface. If moisture is present, the same shall be removed by suitable means such as wiping, heating etc. Cold applied pipewrap shall consist of one 450 mm wide center wrap and two 100 mm wide end wraps. The field joint shall be wrapped first with 450 mm wide wrap, applied in a single continuous layer “Cigarette Wrap” centering on the line of the weld with a minimum of 100 mm end lap. Then 100 mm wide end wrap shall be applied at each end of the 450 mm wide wrap, overlapping the yard applied coating by minimum 50 mm and center wrap with minimum 25 mm. Sufficient tension during application shall be maintained to avoid air pockets and wrinkles.</p> <p>4.4 Application of in-fill joint coating</p> <p>4.4.1 Application of Mastic</p> <p>4.4.1.1 Subsequent to inspection of field joint corrosion coating as mentioned in para 5.0 of this specification, a joint mould shall be formed for pouring the mastic mix around the field joint, by wrapping a 0.5 mm thick sheet metal form. The metal form shall be pre cut with 1.0 m width and length suitable</p>				


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<p>for pipe circumference. The form shall be slit on one end to provide pouring windows. Metal form shall be securely strapped onto the concrete coating with minimum 2 metal straps on each side. The pre cut window opening shall be located on top of the pipe.</p> <p>4.4.1.2 Mastic material shall be applied as one part system. Contractor shall supply all equipment necessary to ensure that the mastic mix is prepared in a proper manner and poured at the desired temperature to prevent voids forming in the in-fill coating. The mastic material shall be heated in a kettle to a temperature of 175-190°C or as recommended by the Manufacturer. Contractor shall monitor and control the temperature of the mastic. Thermocouples shall be used for this purpose. Kettle used for heating the mastic shall always be kept clean. Mastic, which is over-heated, shall not be applied on to the joint.</p> <p>4.4.1.3 The hot mastic shall be poured through the windows of the metal form with due care to avoid voids or honeycombing within the joint and the mould top filled. After filling the mould with mastic, the window opening shall be strapped shut. The entire joint surface area shall then be sprayed with water to cause skinning and retention of the mastic in place during the installation of the pipeline into the sea.</p> <p>4.4.2 Application of HDPF Foam</p> <p>4.4.2.1 Subsequent to inspection of the field joint corrosion coating as mention in para 5.0 of this specification, a joint mould shall be formed for injecting the HDPF mix around the field joint, by wrapping a 0.5 mm thick sheet metal form. The metal form shall be pre cut with 1.0 m width and length suitable for the pipe circumference. The form shall be securely strapped unto the concrete coating with minimum 2 metal straps on each side. The pre cut window opening shall be located on top of the pipe.</p>				


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<p>4.4.2.2 Contractor shall supply all equipment necessary to ensure that the HDPF is mixed in a proper proportion and injected in such a manner to prevent void forming in the in-fill coating.</p> <p>4.4.2.3 High Density Polyurethane Foam (HDPF) consisting of polymeric isocyanate and polyol blend in proper proportion as recommended by the Manufacturer shall then be injected. Adequate foam shall be injected to ensure that foam is extruded from top window after filling all voids and the required density is achieved. After allowing the recommended setting time period, the metal form shall then be removed from the pipeline. During the application, due care shall be taken to ensure proper ventilation of escaping gases.</p> <p>4.5 Application Procedure Qualification</p> <p>Prior to commencement of regular field joint coating, Contractor shall carry out procedure qualification as mentioned below for joint corrosion coating and in-fill (HDPF) coating.</p> <p>4.5.1 Field Joint Corrosion Coating</p> <p>Contractor shall apply either heat shrinkable sleeve or cold applied pipewrap whichever is proposed, following the procedure mentioned above or procedure recommended by the Manufacturer whichever is stringent, on a field joint on the lay-barge. This shall be done in the presence of Company Representative. Resulting coating shall be free of all defects as mentioned in this specification. Immediately after visual inspection and holiday detection, Contractor shall check the adhesion of the coating with the steel by peeling two strips of 25 mm x 200 mm cut perpendicular to the pipe axis and report the peel strength and the temperature of the joint at the time of peeling. Additionally, the joint shall be allowed to cool to 25°C and two similar strips shall be removed to determine the peel strength. Temperature</p>				


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<p>of the joint shall be measured with portable digital thermometer. Peel strength @ 25°C shall be as specified in para 3.2.2 of this specification. In case of compliance, the peel strength determined earlier immediately after holiday detection shall be recorded and the value used as an acceptance criteria for the test mentioned in para 5.3 of this specification. Contractor shall submit the procedure so adopted to Company Representative and obtain Company's approval. Once the approval is given, the same shall be adopted for the regular joint coating operations. No change in the approved procedure shall be made. Contractor shall make available all relevant equipment and tools required for testing on the lay barge.</p> <p>4.5.2 Field joint in-fill Coating</p> <p>In case HDPF is proposed as in-fill coating, Contractor shall cast the HDPF on the field joint mentioned in para 4.5.1 above, following the procedures as recommended by the Manufacturer. Following completion of the in-fill coating, specimen of suitable size shall be obtained from the field joint and tests for dry density, saturated density and compressive strength in compliance with para 3.3.1.2 of this specification shall be carried out. In case of compliance of test results, Contractor shall submit the procedure so adapted to Company Representative for approval. Once the approval is given, the same procedure shall be adopted for the regular in-fill joint coating operations. No change in the approved procedure shall be made. Contractor shall make available all relevant equipments and tools required for testing in the lay barge.</p> <p>4.5.3 In case of any defects and/or non-compliance of test results, the procedure adopted shall suitably be modified and retest carried out. Services of the manufacturer's representative, when ever necessary, shall be arranged by the Contractor at his own cost.</p>				


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<p>5.0 INSPECTION</p> <p>5.1 Visual Inspection</p> <p>Field joint corrosion coating shall be visually inspected to ensure mastic (adhesive) extrusion on either ends of the sleeve, smooth external appearance free of wrinkles, dimples, air entrapment or void formation and weld profile is visible on the sleeve.</p> <p>5.2 Holiday Detection</p> <p>The entire surface of the corrosion coating shall then be inspected by means of a full circle holiday detector of the type approved by Company set to a DC Voltage of atleast 10 KV, prior to application of in-fill joint coating. The holiday detector used shall be checked and calibrated daily with an accurate DC Voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected. No holiday shall be permitted in the coating. In case of any holidays, the coating shall be removed and redone at no extra cost to Company.</p> <p>5.3 In addition the corrosion coating shall be checked for adhesion and a proper bond at the interface between the yard coating and the joint coating as well as at the weld seam. Company reserves the right to remove and test one out of every 100 joint corrosion coating for this purpose. For each test sleeve, two strips of size 25 mm x 200 mm shall be cut perpendicular to the pipe axis and slowly peeled off. The peel strength so determined shall comply the peel strength established at para 4.5.1 of this specification. The system shall only fail in adhesive layer. No failure either adhesive to steel or adhesive to backing shall be permitted. Contractor shall keep all tools, equipment and instruments necessary to carry out testing on-board lay barge. In case of consistent test results, Company may at its discretion,</p>				


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<p>relax the frequency of such testing. Subsequent to testing, the joint coating shall be repaired in compliance with para 6.0 of this specification.</p> <p>5.4 In-fill joint coating</p> <p>Subsequent to coating the joint with HDPF, hammering and pressing of metal form shall be done to locate any voids. In case any voids are found, Contractor shall repair the in-fill joint coating as per para 6.0 of this specification.</p> <p>Dry density, saturated density and compressive strength of the in-fill coating material shall be checked on one out of every 100 joints during laying operations by suitably removing the test specimen from the joint. Test results shall comply the requirements mentioned at para 3.3.1.2 of this specification. Contractor shall keep all tools, equipment and instruments necessary to carry out testing on-board lay barge. In case of consistent test results, Company may at its discretion, relax the frequency of such testing.</p> <p>5.5 If the above tests do not meet the minimum required properties, the cause of failure shall be determined and proper measures taken to achieve the requirements. Contractor shall modify techniques as necessary and further tests shall be carried out to prove adequacy of modified procedure. If necessary, the services of the manufacturer's experts shall be arranged by Contractor at his own cost.</p> <p>6.0 REPAIRS</p> <p>6.1 Inspection slots made during the Company inspection shall be repaired as per the Manufacturer's recommended repair procedures. Manufacturer's recommended repair procedure shall be furnished to Company and approval obtained prior to carrying out the repair works. All repaired joints shall be holiday tested as mentioned in para 5.2 of this specification. Contractor</p>				

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<p>shall supply all materials required to carry out the repair works. Prior to start of the repair works, the surface shall be cleaned with mechanical brushes.</p> <p>6.2 In case of repair of heat shrinkable wraparound sleeve, a patch of suitable size to ensure 50 mm overlap over the joint coating shall be applied. Sufficient heating shall be done to fix the patch with the joint coating so as to achieve a repair coating equivalent to the joint coating.</p> <p>6.3 In case of repair of cold applied pipewraps, a patch of suitable size to ensure 50 mm overlap over the joint coating shall be cold applied.</p> <p>6.4 In case of HDPF in-fill coating, any voids > 50 mm shall be repaired in accordance with the Manufacturer's recommended repair procedure.</p> <p>7.0 DOCUMENTATION</p> <p>7.1 Contractor shall obtain the following documents from Manufacturer of corrosion and in-fill coating materials and submit to Company for approval.</p> <p>7.1.1 Prior to procurement of coating materials, Contractor shall furnish four copies of, but not limited to, the following for qualification of the Manufacturer and material:</p> <ul style="list-style-type: none"> i. Complete descriptive technical catalogs describing the materials offered alongwith samples of corrosion coating materials, its properties and installation instruction as applicable specifically to the project. ii. Test certificates and results of previously conducted tests from independent inspection agency, for all properties listed in para 3.2.2 and 3.3 of this specification. 				

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<p>iii. Reference list of previous supplies of the similar material indicating the project details such as diameter, quantity, service conditions, year of supply, project name, contact person and feed back on performance.</p> <p>Once the Company's approval has been given, any change in material or Manufacturer shall be notified to Company, whose approval in writing of all changes shall be obtained before the materials are manufactured.</p> <p>7.1.2 Prior to shipment of materials from the Manufacturer's Work, Contractor shall furnish six copies of the following:</p> <p>i. Test certificates/results as per Manufacturer's Quality Control Procedure for each batch of materials.</p> <p>ii. Specific installation instructions with pictorial illustrations.</p> <p>iii. Specific storage and handling instruction.</p> <p>7.2 All documents shall be in English Language only.</p>				

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