Bharat Heavy Electricals Limited
Piping Centre Chennai-17
ENGINEERING AND R&D

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Standard Technical Specification for Elastomeric Polyurethane Coating for Mild Steel Pipe Line in contact with Sea Water

APPLICABLE TO UTILITY AND INDUSTRIAL UNITS

01	07.12.09	Adhesive Strength and hardness changed	C.Kumar	C.Karunakaran	C.Karunakaran
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1 SCOPE

This specification covers the general requirements for materials, equipment, application, inspection, testing, repair and handling aspects associated with the coating of using 100% solids (solventless) two component, fast curing elastomeric polyurethane coating classified under ASTM D-16, Type V. The coating process of straight pipes/fittings shall be carried out at shop with necessary cut-back areas at both ends of pipe and fittings for field jointing.

2 QUALIFICATION CRITERIA

2.1 The bidder must have executed such type of coating applications at least for two identical or validly similar installations for sea-water service and that must have been in service satisfactorily for at least two years.

2.2 Bidder shall furnish the reference list for coating material, application along with the offer.

2.3 In case the bidder do not possess the requisite experience criteria as specified in clause 2.1, alternatively bidder can submit the experience criteria of his principal/collaborator or his associate experience with the principal/collaborator for execution of such type of coating job. In such case, the back up guarantee shall be extended by the principal to the bidder for execution of such coating job covering selection of material, coating equipment, application procedure. This shall be submitted along with the offer.

3 CODES AND STANDARDS

The work shall conform to the following documents: (latest revision..)

3.1	SSPC-SP-1 Nov.1, 1982	Solvent cleaning
3.2	SSPC-SP-10/NACE Nov.2,Sep.15,1994	Near white blast cleaning
3.3	SSPC-SP-COM July 1, 1995	Surface preparation commentary
3.4	SSPC PA2	Measurement of dry paint thickness with magnetic gauges
3.5	ASTM D 4541	Method for pull off strength of coatings using Portable adhesion testers
3.6	RP 0188-90	Holiday testing
3.7	RP 0169-94	NACE International Control of external corrosion on underground Of submerged metallic piping systems
3.8	RP 0675-88	NACE International Control of External corrosion on offshore steel Pipelines
3.9	ANSI/AWWA C222	Polyurethane coating for the interior and exterior of Steel water pipe fittings.

4 GENERAL REQUIREMENT

4.1 The bidder shall perform all work in accordance with this specification and other requirements noted herein.

4.2 It is envisaged that the polyurethane on the steel surface will provide a hard yet flexible, impermeable barrier with outstanding adhesion, impact and abrasion

resistance to protect the surface, from corrosion and abrasion in the operating conditions of sea water handling.

4.3 Bidder shall submit a detailed written description in the form of manual covering coating equipment, procedure. materials, inspection, tests and repair etc. for BHEL's approval.

4.4 PROCEDURE QUALIFICATION

Applied coating will be tested for dry film thickness and adhesion. All coating operations shall be performed after the pre-qualification test carried out on 5 pipes.

4.4.1 The following coating parameters shall be recorded during procedure qualification test.

Spray tip(nozzle) size
Fluid pressure
Temperature of the activator and base
Speed of the painting boom
Pipe rotation speed
Number of passes

4.4.2 The following tests shall be carried out on each pipe during pre-qualification.

Inspection of blast cleanliness and profile using Press-O-Film.
Inspection of inside pipe for evacuation of blast abrasive.
Visual inspection of coating.
Coating thickness inspection.
Holiday inspection.

4.4.3 The following tests shall be carried out on one pipe after curing.

Adhesion test

4.5 The bidder shall provide access, during all phases of work to BHEL and their representatives.

4.6 The materials shall be applied by airless spray system, as per the standards specified by the material manufacturer.

4.7 The bidder has to install all preventive equipments necessary to avoid health and fire problems. All safety precautions warranted by good industrial hygiene practices and regulated by local, state or central laws must be taken into consideration while applying these coatings.

5 COATING MATERIAL SPECIFICATION

5.1 Primer

The following is approved primer for the elastomeric urethane coating.

Two component, chemical cure, urethane primer

Other primers, if recommended by material manufacturer, shall be used only after approval by BHEL.

5.2 Spray applied impermeable, 100% solids, elastomeric aromatic urethane coating, as per ASTM D-16, Type V (two components, chemical cure) shall meet following criteria. All tests shall be at ambient (25°C) condition unless otherwise specified.

5.2.1	Nominal thickness	:	2000 microns
5.2.2	Tensile strength as per ASTM D-638	:	17 N/mm²(min.)
5.2.3	Adhesion ASTM-D-4541 (Elcometer pull off)	:	10 N/mm²
5.2.4	Recoverable elongation ASTM D-638	:	10% (min.)
5.2.5	Surface Hardness as per ASTM D-2240 (Cured Film-Shore D)	:	60 (min.)
5.2.6	Water vapour permeability as per ASTM E-96 / F-1249-90	:	0.3 gm / 24 hr / M²(max.)

5.2.7	Operating temperatures	:	0°C to 60°C
5.2.8	Salt spray test 6000 hour as per ASTM B 117-73	:	No effect
5.2.9	Impact resistance as per ASTM G-14	:	0.23 x 10 gm – cm (min.) or 200 inch – lb (min.)
5.2.10	Abrasion resistance ASTM D 4060/ FTMS 141 Taber Abrasion 11-10 Wheel 1,000 gm, 1,000 cycles	:	Weight loss 0.05 gm max.
5.2.11	Flexibility as per ASTM D 1737	:	No effect bending through Pass over 12 mm mandrel 180° bend – 0.5inch thick plate coated with 0.5mm thick coating
5.2.12	Cathodic Disbondment (ASTM G-8)	:	Pass <5mm (28 days @ 25 Deg C)
5.2.13	Accelerated weathering ASTM G-154/ BS-3600, 2000 Hrs	:	No effect except some discoloration.
5.2.14	Chemical Resistance: ASTM D 543 Immersion of 30 days in sea water followed by		
	(%)weight change	:	< 1.0%
	(%) Hardness (Shore D) change	:	< 5.0%
	(%) Tensile strength change	:	< 5.0%

5.3 The bidder shall furnish copies of test reports conducted by an internationally reputed test agencies evidencing that materials conform to minimum performance requirements as above along with the offer.

5.4 The bidder shall also furnish test reports conducted for each manufacturing lot/batch. One sample copy shall be furnished with offer.

6 SURFACE PREPARATION

6.1 The steel surface shall be blast cleaned to SSPC SP-10/NACE No.2 near white blast cleaning.

6.2 A near-white blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter, except for staining.

6.3 Random staining shall be limited to not more than 5 percent of each unit area of surface and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale or stains of previously applied coating.

6.4 Acceptable variations in appearance that do not affect surface cleanliness include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasive, and differences in the blast pattern.

6.5 Anchor profile obtained by blast cleaning will be >75 microns when measured with a surface profile gauge such as Elcometer 123.

6.6 The bidder shall immediately bring BHEL's attention any unacceptable metal defects detected at the time of surface preparation and hold the steel piece till such time as cleared for further action.

6.7 Compressed air used for blast cleaning shall be clean, dry and free of moisture and oil. Moisture separators, oil separators, traps or other equipment may be necessary to achieve clean, dry air.

6.8 Blast cleaning operations shall be done in such a manner that no damage is done to partially or entirely completed portions of the work.

6.9 Dry blast cleaning shall not be conducted during times when the surface will become wet after blast cleaning or when ambient conditions are such that

visible rusting occurs before coating. If any rust forms after blast cleaning, the surface shall be re-blasted before coating.

6.10 Before blast cleaning, visible deposits of oil and grease shall be removed in accordance with SSPC SP-1.

6.11 Before blast cleaning, any surface imperfections remaining (after fabrication) such as sharp pins, weld spatter, or burning, slag shall be removed from the surface

6.12 Any of the following methods of surface preparation may be used to achieve a near white blast cleaned surface.

6.12.1 Dry abrasive blasting using compressed air, blast nozzles and abrasive.

6.12.2 Dry abrasive blasting using a closed cycle, re-circulating abrasive system, with compressed air, blast nozzle and abrasive, with or without vacuum for dust and abrasive recovery.

6.12.3 Dry abrasive blasting using a closed cycle, re-circulating abrasive system with centrifugal wheels and abrasive.

6.13 Wet abrasive blasting shall not be permitted by this specification.

6.14 Steel grit (not shot), non-metallic mineral abrasive – silica sand, garnet, staurolite and olivine, as well as by product abrasive – coal slag are approved abrasive media for blast cleaning. No other abrasive media shall be used by the bidder without prior approval. Selection of abrasive media for the blasting operation will depend upon the type of system employed. Bidder shall adopt good blasting practices such as those recommended in SSPC SP-COM.

6.15 The cleanliness and size of recycled abrasive shall be maintained to ensure compliance with this standard.

6.16 The blast cleaning abrasive shall be dry and free of oil, grease and other contaminants.

6.17 Bidder shall use abrasive media of size that will ensure the necessary anchor profile height specified. The maximum size of abrasive media permitted under this specification is 16 mesh screen, U.S. series.

6.18 Visible deposits of oil, grease or other contaminants shall be removed according to SSPC SP-1.

6.19 Dust and residues shall be removed from prepared surface by brushing, blowing off with clean, dry air or vacuum cleaning. Moisture separators, oil separators, traps or other equipment may be necessary to achieve clean, dry air.

7 PRIMING APPLICATION PROCEDURE

7.1 Priming shall not be done when ambient conditions are dusty or condusive to condensate formation on the steel substrate.

7.2 Before beginning priming and coating, measure the humidity using a sling psychrometer and calculate the dew point. The relative humidity must be lower than 85%. Temperature of steel surface must be at least 3°C higher than the dew point. Under controlled conditions, it is possible to heat the steel surface to eliminate condensation problems.

7.3 The type of primer used shall be as described in the coating specification.

7.4 The blast cleaned steel shall be primed preferably within 2 hours of after blast cleaning, but not more than 24 hours and under no circumstances, shall the primer be applied to a surface where corrosion has occurred.

7.5 Primer shall be sprayed on to the cleaned surface in a fog coat, as thin as possible (approx. 25-30 microns wet), so as to tint but not mask the colour of the substrate. The primer on application shall be free from runs or drips or areas of excessive thickness.

7.6 The primed surface shall be protected so that it will not come into contact with rain, dust or other substances until completely hardened and coated with the elastomeric urethane top coat.

7.7 The time interval between the application of primer and polyurethane coating shall be as recommended by the manufacturer.

8 COATING APPLICATION PROCEDURE

8.1 100% solids, two component elastomeric urethane are specialized coatings characterized by very short pot lives. The coating shall be applied only by applicators who have been trained and certified by the coating manufacturer and who possess the necessary specialised equipment and trained crew required for their application.

8.2 Nominal thickness of the elastomeric urethane shall be 2000 microns. The finished coating shall be generally smooth and free of sharp protuberances. A minor amount of sags, dimpling and "curtaining" which otherwise meets specification requirements shall not be considered cause for rejection.

8.3 Equipment for the spray application shall be airless spray equipment with system specification meeting minimum specified by the coating manufacturer. Equipment shall consist of material feed pumps, purge pump, proportioning pump, mix manifold, static mixer, interconnecting hoses etc. System shall normally be capable of 1500-3000 psi fluid pressure (at tip) and a material supply rate of 4-10 litres/minute.

8.4 Applicator must follow standard written instructions from coating manufacturer on material storage, handling and spray.

8.5 Partially used and unused material drums must be tightly sealed and contain a blanket of nitrogen to prevent moisture contamination when not in use. Use a log sheets for the mix no. and test piece shall be maintained.

8.6 Before application on the substrate apply a test patch for runs or drips and gel time as well as tack free time. Test for adhesion if in doubt.

8.7 The proportioning pump shall be fitted with a numeric counter to keep track of the volume (the proportioning pump delivers a precise volume of materials per stroke) of materials being used while spraying. The applicator shall calculate the steel "unit" area, material volume and counter numbers required, approximate speed (litres / minute) based on spray size as well as

number of passes and spray coating materials according to these criteria. While applying on the joints after installation, same process shall be followed.

8.8 Entire thickness shall be built up in a single application (with a number of passes). If the surface is large enough to require more than one day for the coating, the edges of the coated areas shall be feathered and roughened with a grinding tool prior to beginning priming and coating.

8.9 Areas not to be coated shall be masked with disposable plastic sheets, cardboard etc.

8.10 Any holidays or skips shall be repaired with elastomeric urethane hand mix kit with slower pot life after roughening the edges.

9 FIELD JOINT

9.1 Standard Hold backs

When the pipe sections are joined together by field welding, a holdback that is free of interior or exterior coating shall be left uncoated. This holdback shall be of sufficient width, as required by the constructor, to permit the making of field joints without damage to the interior or exterior coating.

9.2 Protection During Welding

During the welding process the coating shall be protected from welding sparks and spatter using a nonflammable protective barrier. Any coating damaged by the welding process shall be repaired as per Section-8 of this specification. This repair may be made at the same time the welded joint is being coated.

9.3 Surface Preparation

After welding, the joint shall be cleaned so as to be from mud, oil, water, grease, welding flux, weld spatter, dust, and loose residues. The cleaned metal surfaces of the joint shall then be abrasive blast cleaned to provide a surface that complies with Section-6. Other methods of surface preparation shall be permitted as long as they provide the same surface as defined in

Section-6. The existing coating shall be abraded approximately 1 to 2 in (2.5 to 5 cm) from the edge of holdback so that a surface profile in the existing coating meets the manufacturer's recommendations. The entire area to be coated shall be clean, dry and uncontaminated.

9.4 Coating Application:

The coating system shall be applied to the welded joint in accordance with Clause F. The joint material may be the originally applied coating or another material designed specifically for joint coatings as approved by the manufacturer. Apply joint materials to the same thickness or greater as originally specified for the main coating system.

9.5 Material selection at the option of the purchaser, weld areas may be protected with materials and methods conforming to ANSI/AWWA C217 and ANSI/AWWA C222 that are compatible with the originally applied coating material.

10 INSPECTION AND TESTING

10.1 All work under this specification shall be subject to inspection by BHEL or its representatives. All parts of work shall be accessible. The bidder shall correct such work as is found defective under the specifications.

10.2 The following tests shall be made by the applicator prior to during and after priming and coating application.

10.2.1 Blast surface profile using elcometer 123 or equivalent surface profile gauge. The average of readings from five randomly selected areas shall constitute the average surface profile. Test area to be flat (without culvature).

10.2.2 The dry film thickness shall be checked with a magnetic mil gauge (positest by Defeisko or equivalent). The average of readings from five randomly selected areas shall constitute the film thickness. Individual readings shall not vary by more than 25% from the mean.

10.2.3 Holidays testing using high voltage holiday detector (Tinker Rasor or equivalent) as per NACE International RP 0188-90 "Holiday Testing". Coating to have cured at least 24 hours prior to holiday test. Due care should be taken not to use voltage exceeding the dielectric strength of the coating. The location of the holidays shall be noted on the coated surface for repair.

10.3 Pull of Adhesion to steel shall be measured using Elcomeer/ Postitest / Equivalent adhesion tester as per ASTM D 4541. Average reading from three (3) randomly selected spots shall constitute one test and shall be at least 10 (ten) N/mm2. Adhesion test shall be carried out on fully cured coating (7 days at 25 Deg C) & on flat (without curvature) test area.

Minimum 5 nos. tests shall be carried out in one (1) Km at locations desired by Engineer in charge/site engineer/Project Manager on behalf of Employer. If the adhesion is not satisfactory, a systematic inspection (adhesion test) of all pipe shall be carried out and all pipes not meeting this adhesion requirement shall be rejected. Damaged test areas of acceptable pipe shall be repaired as indicated in clause above. The rejected pipes shall be cleaned by blasting and re-coated.

10.4 All previously carried out test-certificates on material shall be furnished for Employer's scrutiny that have done already by manufacturer.

11.0 DOCUMENTS TO BE SUBMITTED WITH OFFER

a) Coating material details (test reports, (Cl.5.3)

b) Application Procedure (Cl.4.3)

c) Experience (Reference List) for the coating material(Cl.1.2.2)

d) Experience (Reference List) for the applicator(Cl.1.2.2)

e) Sample test reports that will be furnished along with material supply (Cl.5.4)

f) Quality Plan

12.0 RECORDS OF REVISION

Rev 01 clause no.5.2.3, 5.2.4, 5.2.5, 5.2.11, 5.2.13 corrected.

5.2.12 Added.

Section 9 from 9.1 to 9.5 added.