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# SPECIFICATION FOR EXTERNAL THREE LAYER POLYETHYLENE COATING & INTERNAL EPOXY COATING OF PIPE

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## 1.0 SCOPE

The Contractor shall arrange or coordinate with line pipes manufacturer for 3LPE coating process and implementation.

This specification defines the minimum technical requirements for supply and application of external anti-corrosion coating of pipes by using three layer side extruded polyethylene coating confirming to DIN 30670, Polyethylene coating for steel pipes and internal anticorrosion coating of pipes by using liquid epoxy coating.





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## 2.0 REFERENCE DOCUMENTS

## 2.1 CODES AND STANDARDS

Reference has also been made to the latest edition of the following standards, codes and specifications.

Doc Number	Title
DIN 30670	Polyethylene sheathing of steel tubes and of steel shapes and fittings.
ASTM D-638	Standard Method of Test for Tensile Properties of Plastics
ASTM G-42	Tentative Methods for Cathodic disbanding of pipeline coatings subjected to Elevated or Cyclic Temperatures
ASTM D-257	Standard Test Methods for D-C Resistance or conductance of insulating materials.
ASTM D-543	Standard method of Test for Resistance of Plastics to Chemical Reagents.
ASTM D-570	Standard Method of Test for Water Absorption of Plastics
ASTM D-792	Standard Test method for Specific Gravity and Density of Plastics by Displacement.
D1N 53735	Testing of Plastics: Determination of Melt Index of Thermoplastics.
SIS 055900	Swedish Standard, Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness.
API 5L	Specification for Line pipeline
API RP 5L1	Recommended Practice for Railroad Transportation of Line pipe.
API RP 5L2	Recommended Practice for Internal Coating of Line Pipe for Non- corrosive Gas Transmission Service
API RP 5LW	Transportation of line pipe on barges and marine vessels
ASME B31.4	Pipeline Transportation System for Liquid Hydrocarbons and Other Liquids
CSA Z245.20	External Fusion Bond Epoxy Coating for Steel Pipe.
ASTM –D618	Test method for brittleness temperature of plastic & Elastomers by Impact
ASTM D 2240	Test method for rubber property Durometer hardness
NACE SSPC 1	Solvent cleaning
ASME A13.1	Committee scheme for the identification of piping systems
ANSI/AWWA C210-07	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

## 2.2 PROJECT DOCUMENTS

P158-30-PL-SPC-0001-00 Specification for Seamless Pipes





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## 2.3 ABBREVIATIONS

DSC	Differential Scanning Calorimetry
ESC	Environmental Stress Cracking Resistance
FBE	Fusion Bonded Epoxy
MDPE	Medium Density Polyethylene
MFR	Melt Flow Rate
PP	Polypropylene
SAW	Submerged Arc Welding
3LPE	Three Layer Polyethylene Coating
CD	Cathodic Disbondment
DFT	Dry Film Thickness
WFT	Wet Film Thickness





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## 3.0 MATERIALS

## 3.1 EXTERNAL PE COATING

**3.1.1** The basic material is epoxy powder, adhesive and polyethylene compound shall have proven compatibility. The group(s) of compatible materials shall be pre-qualified and approved by Employer in accordance with provisions of Clause 5.0 of this specification. Contractor / Sub Contractor / Vendor shall obtain prior approval from Employer for the suppliers of all materials.

**3.1.2** Contractor / the coating materials Manufacturer shall carry out tests for all batches of epoxy, adhesive and polyethylene compound to be supplied for this project. Contractor / Sub Contractor / Vendor shall submit to Employer all the certificates of material conformity and test results for each batch of material supplied for this project for approval prior to their use.

In addition to manufacturer's certificate, Contractor / Sub Contractor / Vendor shall draw samples from one batch out of every five batches of epoxy, adhesive and polyethylene and test at coating yard for the properties as per Clause 4.3 for compliance with the Manufacturer's certificates.

**3.1.3** All materials to be used shall be marked and identifiable with the following minimum information:

- a. Manufacturing Standard
- b. Name of the Manufacturer
- c. Place and Date of Manufacture
- d. Type of Material
- e. Batch Number
- f. Shelf Life / Expiry Date
- g. Health, Safety & Environmental Instructions
- h. Receiving inspection acceptance
- i. Storage Instructions
- k. Instruction of application procedure with key parameters

**3.1.4** All materials noted to be without above identification shall be deemed suspect and shall be rejected by Employer. Such materials shall not be used for coating and shall be removed from site and replaced by Contractor / Sub Contractor / Vendor at his expense.

**3.1.5** Materials shall be handled and stored in accordance with applicable safety regulations and the material Manufacturer's recommendations, and shall be used according to the Manufacturer's batch sequence.

**3.1.6** The containers or packages of materials to be used for coating shall be properly handled in order to avoid any damage, scattering or pollution during loading, unloading and storage.





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**3.1.7** The safe range of storage temperatures for primers or solvents shall be specified by primer or solvent Manufacturer. The materials shall subsequently be stored in accordance with these requirements.

## 3.2 INTERNAL LIQUID EPOXY COATING

**3.2.1** The materials shall be prequalified and approved by Employer. Contractor / Sub contractor / Vendor shall obtain prior approval from Employer for the suppliers of all material.

**3.2.2** The coating material manufacturer shall carry out tests for all batches of liquid epoxy to be supplied for this project. Contractor / Sub Contractor / Vendor shall submit all the certificates of material for each batch to Employer for approval.

**3.2.3** The materials noted to be without identification as mentioned in Section 3.1 shall be deemed suspect and shall be rejected by Employer. All the identification and marking shall be as per Section 3.1.





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## 4.0 FUNCTIONAL REQUIREMENTS AND PROPERTIES OF COATING

The coating shall be able to withstand a maximum in service operating temperature of +80°C and shall conform to 'S' Type of coating as per D1N 30670. In addition, in open storage the coating must be able to withstand a temperature of at least +80°C, without impairing its serviceability and properties specified.

The coating materials used shall be fully stabilized against influence of ultraviolet radiation (i.e. sunlight), oxygen in air and heat (due to environmental temperature as specified above). No appreciable changes shall occur during exposure to such environment up to least a period of 6000 hours. The Contractor / Sub Contractor / Vendor shall submit certificate from Manufacturer in this regard.

Sr.No.	Properties	Unit	Requirement	Test Method
1.	Tensile Strength @ + 25°C	Psi	2100 min	ASTM D 638
2.	Melt Flow Rate	g/10minute	0.3 – 0.50	ASTM D 1238 or D1N 53735
3.	Specific Gravity @ + 25°C		0.92 min. 0.94 max.	ASTM D 792
4.	Hardness @ + 25°C	Shore D	50 min	ASTM D 2240
5.	Water Absorption, 24 hours @ + 25°C	%	0.05 max	ASTM D 570
6.	Volume Resistivity @ + 25°C	Ohm-cm	1015 min	ASTM D 257
7.	Dielectric withstand, 1000 Volt/sec rise @ + 25°C	Volts	30,000 min	ASTM D 149
8.	Vicat Softening Point	°C	110 min	ASTM D 1525
9.	Elongation	%	300 min	ASTM D 638

## 4.1 Properties of Polyethylene Compound

## 4.2 **Properties of Epoxy Powder and Adhesive**

- a. Contractor / Sub Contractor / Vendor shall choose such a brand of epoxy and adhesive that will achieve the functional requirements and properties of coating system as specified in Section 4.1 and 4.3.3 respectively of this specification. Epoxy powder properties shall be as per CSA Z245.20.98. The color of epoxy powder shall be either green or dark red or any other color approved by Employer except grey color.
- b. Copolymer grafted adhesive shall have the following properties.





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No.	Properties	Unit	Requirement	Test Method
1.	Melt Flow Rate	g/10 minute	5 ≠1	ASTM D 1238
2.	Vicat Softening Point	°C	90 min	ASTM D 1525
3.	Specific Gravity	-	0.926 min	ASTM D 792

## 4.3 Properties of Coating System

No.	Properties	Unit	Requirement	Test Method
1.	Bond Strength (using Type 2 Test Assembly i.e. Dynamometer) Kg/cm DIN 30670	Kg/cm	4.5	DIN 30670
	$@ 20 \pm 5^{\circ}C 4.5 \text{ min}$ @ 60 ± 5°C 3.5 min		4.5 min 3.5 min	
2.	Impact Strength (Min. of 30 impacts on	Joules per mm of coating	6 min (for NB	DIN 30670
	body along the length. No breakdown allowed when	thickness	<200mm) 7 min (for NBs 200mm)	
	tested at 25kV)			
3.	Indentation Hardness @ 23 ± 2°C @ 70 ± 2°C	mm	0.2 max. 0.3 max.	DIN 30670
4.	Elongation at Failure	%	300	DIN 30670
5.	Coating Resistivity	Ohm-m <sup>2</sup>	10 <sup>8</sup>	DIN 30607
6.	Heat Aging	-	Melt flow rate shall not deviate by more than 35% of original value	DIN 30670
7.	Light Aging	-	Melt flow rate shall not deviate by more than 35% of original value	DIN 30670
8.*	Accelerated Cathodic Disbondment Test : @ 90°C for 48 hours duration	mm radius of disbondment	40 max.	ASTM G42
9.	Cathodic Disbondment Test : @ 60°C for 30 days duration	mm radius of disbondment	30 max.	ASTM G42
10.	Degree of Cure of epoxy Percentage Cure ΔTg	% ℃	95 +3 / -2	CSAZ 245.20 – 98(**)





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(\*) Accelerated cathodic disbondment test shall be conducted at Contractor / Sub Contractor's / Vendor lab

(\*\*) Temperature to which the test specimens are to be heated during cyclic heating shall however be as per the recommendations of epoxy powder manufacturer.

The Contractor / Sub contractor/ Vendor shall propose combination(s) of coating materials to Employer for approval. Only approved combination of coating material is permitted.

## 4.4 Properties of Liquid Epoxy Coating

The properties of the materials shall be in accordance with API RP 5L2 and shall achieve the functional requirements and properties of the coating system as stated in this Specification. At the time of tender, the Supplier shall furnish a reference list of materials having such properties, applied by the Supplier in similar coating systems and for similar service conditions.

The materials brands offered by the Supplier shall have proven compatibility. The Supplier shall submit at the time of tender an adequate track record demonstrating the compatibility of the materials offered. Only the Company approved materials or combinations of materials shall be used.





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# 5.0 COATING PROCEDURE AND QUALIFICATION FOR EXTERNAL PE COATING

**5.1** Upon the award of the Contract by Contractor, the Contractor / Sub Contractor / Vendor shall submit as per agreed schedule, for Employer approval, a detailed report in the form of bound manual outlining, but not limited, the following:

- a. Details of plant(s), installation, locations, geometry, dimensions, capacity and production rate(s).
- b. Facilities in the yard for unloading, handling, transport, production, storage, stockpiling, loading of bare and coated pipes and warehouses for storage of other coating materials.
- c. Detailed organogram of coating equipment and manpower.
- d. Details of utilities / facilities such as water, power, fuel, access roads and communication, etc. After approval has been given by Employer, no change shall be made. However, unavoidable changes, if any shall be executed only after obtaining written approval from Employer.

**5.2** Prior to the commencement of the work a detailed procedure of Contractor / Sub contractor's / Vendor's methods, material proposed etc. shall be formulated by Contractor / Sub Contractor / Vendor and submitted for Employer's approval. The procedure shall include but not limited to the following information and proposals:

- a. Complete details of raw materials together with quality control and manufacturer's data.
- b. Quality assurance plan, Inspection and testing methods and reporting formats, including instrument and equipment types, makes and uses, etc.
- c. Details of instrument and equipment calibration methods including relevant standards and examples of calibration certificates.
- d. Complete details of inventory of laboratory and equipment for procedure qualification and regular production.
- e. Pipe handling and stock piling procedures.
- f. Sample of recording and reporting formats, including laboratory reports, certificates and requirement as per of this specification.
- g. Complete details of test certificates for raw materials including test methods and standards used.
- h. Test certificates from PE compound manufacturer for tests for thermal aging, aging under exposure to light and coating resistivity. These test certificates shall not be older than three years.





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- i. Pipe heating, temperatures and control.
- j. Steel surface preparation, including preheating, removal of steel defects, cleanliness, degree of care/degree of dust, profile, methods of measurements and consumables.
- k. Application of materials, including characteristics, temperature, etc.
- I. Pipe and coating quenching and cooling, including time and temperature.
- m. Detailed method of repair of coating defects duly classified depending upon nature and magnitude of defects and repairs thereof.

No change in the procedure shall be made after approval has been given by Employer. However, unavoidable changes, if any shall be executed only after obtaining written approval from Employer.

**5.3** Prior to start of production, Contractor / Sub Contractor / Vendor shall at his expense, carry out a coating procedure qualification trial for each pipe diameter on maximum wall thickness, for each type of pipe, for each coating material combination, and for each plant, to prove that his plant, materials, and coating procedures result in a quality of end product conforming to the properties stated in Clause 4.3, relevant standards, specifications and material manufacturer's recommendations.

At least 5 (five) test pipes shall be coated in accordance with the approved procedure. Trial coated pipes shall be subjected to procedure qualification testing as described hereinafter. Out of 5 (five) test pipes 1 (one) pipe shall be coated partly with epoxy and partly with both epoxy and adhesive layers. Remaining 4 (four) test pipes shall be coated with all three layers.

#### 5.3.1 Tests on Raw Materials

The Contractor / Sub Contractor / Vendor shall furnish for each batch of epoxy, adhesive and polyethylene compound a certificate stating that the following tests have been carried out on every batch supplied and results are in compliance with the requirements of the product specification.

- a. Polyethylene
  - Tensile strength
  - Melt Flow Rate
  - Specific Gravity
  - Hardness
  - Water Absorption
  - Volume Resistivity
  - Dielectric withstand
  - Vicat Softening Point
  - Elongation





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- b. Epoxy Powder
  - Gel Time
  - Specific gravity
  - Particle size
  - Cure time
  - Moisture content
  - Thermal characteristics (Tg1, Tg2,  $\Delta$ H)
- c. Adhesive
  - Specific gravity
  - Melt flow rate
  - Vicat softening point

## 5.3.2 Tests on Coated Pipes

- I. Tests on pipe coated partly with epoxy and partly with epoxy & adhesive layers
- a. Degree of Cure

Epoxy film samples shall be removed from the coated pipe using hammer and cold chisel and the samples shall be taken for cure test using DSC procedure. Care shall be taken to remove the samples of full film thickness avoiding inclusion of steel debris. Glass transition temperature differential ( $\Delta$ Tg) and % Cure ( $\Delta$ H) shall comply the specified requirements.

b. Epoxy Layer Thickness

Epoxy layer thickness shall be checked at every one meter spacing at 3, 6, 9 and 12'O clock positions. The thickness shall comply the specified thickness requirements

c. Adhesive Layer Thickness

Adhesive layer thickness shall be checked at every one meter spacing at 3, 6, 9 and 12'O clock positions. The thickness shall comply the specified thickness requirements.

d. Holiday Inspection

Entire pipe shall be subject to holiday inspection and the test voltage shall be set to exceed 5 v/micron of epoxy thickness specified for the portion coated only with epoxy layer. For the portion coated with both epoxy and adhesive also, the test voltage shall as stated above.

e. Adhesion Test





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Adhesion test (24 hrs or 48 hrs) shall be carried out on the epoxy coated pipe. Test method no. of test specimen and acceptance criteria shall comply CSA Z.245,20-98, Table-3.

## II. Tests on pipes coated with all three layers

a. Bond strength

Three test pipes shall be selected for bond strength tests. On each of the selected pipes, three bond strength test shall be performed for each specified temperature i.e. one at each end and one in the middle of the pipe. None of these samples shall fail.

b. Impact Strength

Three test pipes shall be selected for impact strength test and the test shall meet the specified requirements.

c. Indentation Hardness

Four samples for both temperatures from different pipes shall be taken. If any one of these samples fail to satisfy the specified requirements, then the test shall be repeated on eight more samples. In this case, none of the samples shall fail.

d. Elongation at failure

Six samples each from three coated pipes i.e. 18 samples in all shall be tested and the test shall comply the specified requirement. Only one sample per pipe may fail.

e. Cathodic Disbondment Test

One test shall be carried out for the total lot of test pipes having all three layers. In case of obtaining satisfactory test results for 30 days, for subsequent procedure qualification test for different pipe size with same coating material combination, an accelerated CD test (48 hours) is also acceptable in place of 30 days test.

f. Holiday Inspection

All the pipes shall be subject to holiday inspection. The test voltage shall be as specified in Para 8.4, (i).

g. Coating Thickness Measurement

All pipes shall be subject to coating thickness measurements. Acceptance criteria shall be as per Para 7.2.1.

- h. Inspection of all test pipes
  - All pipes shall be subjected to surface roughness measurements. Acceptance criteria shall be as per Para 6.3 & 6.4.
  - All pipes shall be subjected to visual inspection of finished coating, cut back dimensions, internal / external cleanliness, end sealing and bevel inspection.





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**5.3.3** After completion of the above tests and inspection, Contractor / Sub Contractor /Vendor shall prepare and submit to Employer for approval a detailed report of the above tests including test reports / certificates of all materials and coatings tested. Contractor / Sub Contractor / Vendor shall commence production coating after obtaining written approval from Employer.

**5.3.4** On completion of tests, coating of all test pipes shall be removed and completely recycled as per the approved coating procedure specification, at Contractor / Sub contractor's / Vendor's expense.

**5.3.5** Contractor / Sub Contractor / Vendor shall re-establish the requirements of qualification and in a manner as stated before or to the extent considered necessary by Employer, in the event of, but not limited to, the following:

• Every time the coating yard is shifted from one location to the other.

• Every time there is a change in the manufacturer and change in formulation of any of the raw materials and change in location of raw material manufacture.

• Every time there is a change in the previously qualified procedure specification.

• Any time when in Employer's opinion the properties are deemed to be suspect during regular production tests.





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## 6.0 PIPE SURFACE PREPARATION FOR EXTERNAL PE COATING

**6.1** Any oil, grease, salt or other contaminants detrimental to the formation of a good coating bond or coating quality shall be removed prior to coating application. Contaminants may be removed by the use of non-oily solvents. Gasoline or kerosene shall not be used for this purpose. Visible oil and grease spots shall be removed by solvent wiping. Solvent cleaning shall be in accordance with SSPC-SP1.

**6.2** Prior to cleaning operation, Contractor / Sub Contractor / Vendor shall visually examine the pipes and shall ensure that all defects. Flats and other damages have been repaired or removed. The Contractor / Sub Contractor / Vendor shall also remove marking stickers, if any present within the pipe. Record shall be kept of such marking on the stickers to ensure traceability of pipe after coating.

**6.3** All pipes shall be pre-heated to a temperature of 65°C to 85°C prior to abrasive blast cleaning. The external surface of the pipe shall be cleaned by abrasive blast cleaning machine. The pipe bevel area shall be protected from blasting operation by suitable end caps to avoid damages to bevel ends. In addition suitable plugs shall be provided at both pipe ends to prevent entry of any shot / grit into the pipe during blast cleaning operations.

These plugs shall be removed after blast cleaning. Alternatively the Contractor / Sub Contractor / Vendor may link the pipes suitably together to prevent the entry of any shot / grit into the pipe. The standard of finish for cleaned pipe shall conform to white metal finish to Sa2½ of latest edition Swedish Standard SIS 055900: Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness. Surface of pipe after abrasive shot / grit blasting shall have an anchor pattern of 50 to 80 microns. This shall be measured for each pipe by a suitable instrument such as surface profile depth gauge. The ratio of shots to grits shall be established during procedure qualification testing. In addition the pipe surface after blast cleaning shall be checked for the degree of cleanliness Sa 2½ and degree of dust.

Contractor / Sub Contractor / Vendor shall ensure that all shot/grit/loose material left inside the pipe during blast cleaning are cleaned and removed. Suitable mechanical means (stiff brush) shall be employed to remove the same before the pipes are processed further.

At no time blast cleaning shall be performed when the relative humidity exceeds 90%.

**6.4** The blast cleaned surface shall not be contaminated with dirt, dust, metal particles, oil, water or any other foreign material, not shall the surface or its anchor pattern be scarred or burnished. After blast cleaning, all surfaces shall be thoroughly inspected under adequate lighting to determine anchor pattern, quality of blasting and identify any surface defects prior to coating application. All surface defects such as slivers, scab, burns, laminations, welds spatters, gouges, scores, indentations, slugs or any other defects considered injurious to the coating integrity made visible during blast cleaning shall be reported to the Employer and on grinding. After any grinding or mechanical repairs, the remaining wall thickness shall be checked and compared with specified thickness. Any pipes having thickness less than permissible thickness as per line





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pipe specification shall be kept aside and disposed off, at Contractor / Sub contractor's / Vendor cost as per the instructions of Employer. Pneumatic tools shall not be used unless they are fitted with effective air/oil and water traps. Where burnishing results in destruction of anchor pattern, the anchor pattern shall be restored by suitable means. Pipes which have damages repaired by grinding and have ground area more than 50 mm in a diameter shall be re-blasted.

Any dust or loose residues that have been accumulated during blasting and/or during filing/ grinding operations shall be removed by vacuum cleaning. If contamination of surface occurs, the quality of blast cleaning method and process shall be examined. If the surface roughness is outside the specified limit, the blast cleaning material shall be checked and replaced.

**6.5** In order to ensure that pipe with defects are not processed further, provisions shall be available to lift the pipes from inspection stand.

**6.6** The total allowable elapsed time between completion of the blasting operations and commencement of the pre-coating and heating operations shall be such that no detectable oxidation of the surface occurs. Relative humidity readings shall be recorded every half an hour during the blasting operations in the immediate vicinity of the operations. The maximum elapsed time shall not exceed the maximum time as given below:

Relative Humidity %	Maximum elapsed time		
80 or more	2 hours		
70	3 hours		
60 or below	4 hours		

Pipes not brought up to the coating application temperatures within these maximum times shall be returned for complete re-blasting. Any pipe showing flash rusting shall be re-blasted even if the above conditions have not been exceeded.

**6.7** Pipe handling between grit blasting and pipe coating shall not damage the surface profile achieved during blasting. Any pipe affected by the damage to the surface exceeding 200 mm<sup>2</sup> in area and/or having contamination of steel surface shall be rejected and sent for re-blasting.





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## 7.0 COATING APPLICATION FOR EXTERNAL PE COATING

The external surface of the cleaned pipe conforming to clause 6.0 of this specification shall be immediately coated with 3 layer extruded polyethylene coating in accordance with the procedures approved by Employer, relevant standards and this specification. In general the procedure shall be as follows:

## 7.1 PIPE HEATING

**7.1.1** Immediately prior to heating of pipe, all dust and grit shall be removed from both inside and outside of the pipe by a combination of air blast, brushing and vacuum cleaning.

**7.1.2** Induction heater or gas furnace shall be used for heating the pipe. The method shall be capable of maintaining uniform temperature along the total length of the pipe, and shall be such that it shall not contaminate the surface to be coated. In case of induction heating, appropriate frequency shall be used to ensure 'deep heating' and intense skin heating is avoided. Oxidation of the cleaned pipe surfaces prior to coating (in the form of blueing or other apparent oxide formation) is not acceptable.

**7.1.3** External surface of the pipe shall be heated to about 190°C or within a temperature range (min. to max.) as recommended by the powder manufacturer. Required pipe temperature shall be maintained as it enters the coating chamber.

**7.1.4** Temperature measuring & monitoring equipment shall be calibrated twice every shift and/or as per Employer instruction. Temperature of the pipe surface shall be continuously monitored and recorded by using suitable instrument such as infrared sensors, contact thermometers, thermocouples etc. The monitoring instrument shall be able to raise an alarm/ activate audio system in the event of tripping of induction heater / gas furnace or in the event of pipe temperature being outside the range recommended by the manufacturer shall be rectified. If immediate rectification is not feasible, the production shall be stopped until cause of deviation has been removed. Any pipe coated during the duration of temperature deviation shall be identified by marking and rejected. Such rejected pipes shall be stripped and recoated.

**7.1.5** Extreme care shall be taken to note and replace the pipe numbers, heat numbers, length. And weight of the pipe as the stencils mark by pipe manufacturer likely to vanish because of heating of the pipe.

## 7.2 PIPE COATING

**7.2.1** Subsequent to pipe heating, coating shall be carried out on the pipe immediately.Coating shall consist the following 3 layers.





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No.	Coating Material	Minimum Coating Thickness
1.	Epoxy powder - Electrostatically applied	0.180 mm
2.	Crystalline co-polymer adhesive applied by Extrusion	0.250 mm
3.	Polyethylene coating - applied by extrusion	<ul><li>a) 3.5 mm on pipe body</li><li>b) 3.2 mm on weld seam (overall coating thickness)</li></ul>

The coated pipe shall be subsequently quenched and cooled in water for a period that shall sufficiently lower the temperature of pipe coating to permit handling and inspection.

**7.2.2** Coating materials shall be inspected in accordance with the Manufacturer's recommendation prior to coating application and it shall be ensure that the materials are moisture free. In case the relative humidity exceeds 80%, the adhesive and polyethylene material shall be dried using hot air as per the directions of Employer.

**7.2.3** Prior to starting the application of fusion bonded epoxy powder the recovery system shall be thoroughly cleaned to remove any unused powder. The use of recycled powder shall not be permitted. Dry air, free of oil and moisture shall be used in the coating chamber and spraying system and for this purpose filters, dehumidifier / heater as required along with control and monitoring system shall be provided.

**7.2.4** Air pressure in the epoxy spray guns shall be controlled, continuously monitored and recorded by using suitable instruments. The air pressure shall be controlled within the limits established during coating procedure qualification. The monitoring system shall be able capable of raising an alarm / activate audio system (hooter) in the event of change in air pressure beyond the set limits. Any deviation from the pre-set limits shall be rectified. If immediate rectification is not feasible, the production shall be stopped until cause of deviation has been removed. Any pipe coated during the duration of air pressure deviation shall be identified by suitable marking and rejected. Such rejected pipes shall be stripped and recoated.

**7.2.5** Extruded adhesive layer shall be applied before gel time of the epoxy coating has elapsed. The application of the adhesive layer shall not be permitted after epoxy is fully cured. The Contractor / Sub Contractor / Vendor shall establish, to the satisfaction of the Employer, that the adhesive is applied within the gel time window of epoxy and at the temperature recommended by the adhesive manufacturer. The Contractor / Sub Contractor /Vendor shall state the minimum and maximum time interval between epoxy and adhesive application at the proposed pre-heat temperature.

**7.2.6** Extruded polyethylene layer shall be applied over the adhesive layer within the limit established during qualification stage.





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**7.2.7** Resultant coating shall have a uniform gloss and appearance and shall be free from air bubbles, wrinkles, holidays, irregularities, discontinuities, separation between layers of polyethylene & adhesive, etc.

**7.2.8** Air entrapment below the coating and also the coating overlap shall be prevented by forcing the coating on to the pipe using high-pressure roller of suitable design during coating application. In case it is not adequately achieved, Contractor / Sub Contractor / Vendor shall supplement by other method to avoid air entrapment. The methods used shall be approved by Employer. This method shall be witnessed.

**7.2.9** Contractor / Sub Contractor / Vendor shall ensure that there is no entrapment of air or void formation along the seam weld (where applicable) during application of coating. Contractor / Sub Contractor / Vendor shall propose a suitable method for achieving this and the same shall be approved by Employer. This method shall be witnessed.

**7.2.10** Coating and /or adhesive shall terminate 175 mm  $\pm$  25 mm from pipe ends. The adhesive shall seal the end of applied coating. Contractor / Sub Contractor / Vendor shall adopt mechanical brushing for termination of the coating at pipe ends. For coating thicknesses up to 2,2 mm the bevel angle shall be no greater than 45°, for greater coating thicknesses the bevel angle shall be no greater than 30°.

**7.2.11** Failure to comply with any of the above applicable requirement and of the approved procedure shall be cause for the rejection of the coating and such coating shall be removed in a manner approved by Employer at Contractor / Sub contractor's / Vendor's expense.

**7.2.12** During the application of coating, Contractor / Sub Contractor / Vendor shall demonstrate the compliance with the specified degree of cure requirement for each batch of epoxy, by taking a sample on a randomly selected pipe. Pipe shall be selected randomly during the middle of a shift. Suitable provisions/arrangements as per the instructions of Employer shall be made by Contractor / Sub Contractor / Vendor for this purpose. Pipe tested shall be stripped of the coating and recycled.





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## 8.0 COATING APPLICATION FOR INTERNAL EPOXY COATING

## 8.1 Line Pipe Heating

The selected pipe heating method shall maintain uniform temperature along the total length of the pipe. Oxidation of the cleaned pipe surfaces prior to coating (in form of bluing or other apparent oxide formation) is not acceptable.

## 8.2 Pipe Coating

The internal surface of the cleaned pipe shall be immediately coated with the approved epoxy coating to a uniform thickness, the coating dry film thickness shall be 100  $\mu$  m.

The coated pipe shall be cooled sufficiently prior to handling and inspection in order to avoid damage to the coating.

During application, curing and handling, the coating shall not be physically damaged, nor shall it be contaminated with any foreign material whether airborne or from application equipment or enclosures, cutback rings or pipe handling mechanisms.

The resultant coating shall have a uniform appearance and shall be free from blisters, air bubbles, holidays, irregularities and discontinuities.

Coating cut back shall be in accordance with AS/NZS 3862.

Coating materials shall be cut back to 50 mm perpendicular to the pipe axis from end of the pipe. The cutback shall be measured from the bevel shoulder.

The pipe and faces, bevels and uncoated internal and external surface of the pipe at pipe ends shall be free of all coating and foreign material.

Failure to comply with any of the foregoing applicable requirements and the approved procedure shall be cause for the rejection of the coating. Such coating shall be removed in a manner approved by the Company at the Supplier's cost.





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## 9.0 INSPECTION AND TESTING FOR EXTERNAL PE COATING

## 9.1 General

In addition to the tests required on the material batches, the Contractor / Sub Contractor /Vendor shall perform the tests detailed below on finished coatings to demonstrate the compliance with this specification. Details of all tests and inspection shall be as specified subsequently.

Contractor / Sub Contractor / Vendor shall establish and maintain such quality assurance as are necessary to ensure that goods or services supplied comply in all respects with the requirements of this specification.

The Employer have the right of inspection or testing of the goods or services during any stage of manufacturing at which the quality of the finished goods may be affected, and to undertake inspection of testing of raw materials or purchased components.

Contractor / Sub Contractor / Vendor shall measure the ambient conditions at regular intervals during blast cleaning and coating operations and keep records of prevailing temperature, humidity and dew point.

## 9.2 Visual Inspection

Immediately following the coating, each coated pipe shall be visually checked for imperfections and irregularities of the coating. The coating shall be of natural color and gloss, smooth and uniform and shall be blemish free with no dust or other particulate inclusions. The coating shall not show any defects such as blisters, pinholes, scratches, wrinkles, engravings, cuts, swellings, disbonded zones, air inclusions, tears, voids or any other irregularities. Special attention shall be paid to the areas adjacent to the longitudinal weld (if applicable), adjacent to the cut-back at each end of pipe and within the body of the pipe.

In addition inside surface of the pipe shall also be visually inspected for presence of any foreign material or shots and grit (free or embedded/sticking to pipe inside surface). The pipe inside surface shall be examined using sharp floodlight focused at the middle of the pipe at one end while inspection is carried our visually from other end. Any foreign material or shots/grit present in the pipe shall be completely removed by suitable means (mechanical brush, high pressure air jets, by tilting of pipe etc.)

## 9.3 Coating Thinkness

a. The coating thickness shall be determined by taking at least 10 measurements at locations uniformly distributed over the length and periphery of each pipe. In case of welded pipes, five of the above readings shall be made at the apex of the weld seam, uniformly distributed over the length and periphery of each pipe. All readings must meet the minimum requirements. However, no negative tolerance on minimum permissible coating thickness from length / area of the coating is acceptable. The frequency of thickness measurement as stated above shall be initially on every pipe,





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but may be reduced depending upon consistency of results, at the sole discretion of Employer.

- b. Thickness of epoxy and adhesive shall be measured at the beginning of each shift and whenever the plant re-starts after any stoppage for compliance.
- c. Coated pipes not meeting the above requirements shall be rejected. The Contractor / Sub Contractor / Vendor shall remove the entire coating and the pipe shall be recycled to the cleaning and coating operations as per the approved

## 9.4 Holiday Detection

- a. 100% of coating shall be checked for holiday using low pulse high voltage DC full circle electronic detector with audible alarm and precise voltage control. The set voltage for inspection shall be minimum 25 kV. Travel speed shall not exceed 200mm/second.
- b. Contractor / Sub Contractor / Vendor shall calibrate the holiday detector at least once every 4 hours of production. Contractor / Sub Contractor / Vendor shall have necessary instruments or devices for calibrating the holiday detector.
- c. Any pipe coating shall be rejected if more than 1 (one) holiday & area more than 100 cm<sup>2</sup> in size are detected in its length. Any pipe so rejected shall have the coating removed and recycled through the complete cleaning and coating system in accordance with approval procedure and shall be to Contractor / Sub contractor's / Vendor's expense.
- d. Holidays which are lesser in number and size than those mentioned in (c) above, shall be repaired in accordance with a approved procedure and shall be to Contractor / Sub contractor's / Vendor's expense.
- e. However in case more than 10% of coated pipes per shift production (typically eight hour shift) are rejected, Contractor / Sub Contractor shall stop production and make a detailed investigation. Findings of such an investigation shall be submitted to Employer for approval prior to recommencing coating.

#### 9.5 Bond Strength Test

- a. Contractor / Sub Contractor / Vendor shall conduct bond strength test for composite coating as per No.1 of Section.4.3.3 of this specification.
- b. The frequency of test shall be one pipe in every fifteen (15) pipes coated. On each selected pipe, bond strength shall be performed for each specified temperature. Samples shall be taken from the cut back portion of the pipe. The system shall fail cohesively either in adhesive layer or in polyethylene layer.

Failure at epoxy to steel interface or epoxy/adhesive interface or adhesive/polyethylene interface shall not be permitted. The failure mode shall be recorded for each test.





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c. In case the above tests do not comply with the above requirement, Contractor / Sub Contractor / Vendor shall test all the preceding and succeeding coated pipes until the coating is proved acceptable and/or at the discretion of the Employer.

## 9.6 Indentation Hardness

- a. Indentation hardness test shall be as per No. 3 of Section 4.3.3 of this specification. The frequency of test shall be initially 2 (two) coated pipes per shift which shall be further reduced to one test each on 2 coated pipes per fortnight at random after 1 week of consistently acceptable results. Two samples for each temperature shall be taken from the cut back portion of coated pipe for this test.
- b. Two samples for each temperature shall also be taken at five equidistant points along the length of coated pipe at a frequency to be mutually agreed upon between Employer and Contractor / Sub contractor / Vendor. In any case, the minimum frequency shall be once in a week.
- c. In case the pipe is rejected for lack of indentation hardness, Contractor / Sub Contractor / Vendor shall test the preceding and succeeding pipes coated until the coating is proved acceptable and/or at the discretion of the Employer.
- d. Rejected coated pipes shall be removed and shall be recycled through cleaning and coating process in accordance with approved procedure, at Contractor / Sub Contractor / Vendor expense.

## 9.7 Impact Strength

- a. Impact strength test shall be conducted as per No. 2 of Section 4.3.3 of this specification. Initially the frequency of test shall be two (2) coated pipes per shift that may be further reduced and/or waived depending upon consistently acceptable results at the sole discretion of Employer.
- b. Minimum thirty (30) impacts located equidistant along the length of coated pipe shall be performed.
- c. Immediately after testing, the test area shall be subjected to holiday detection at the same voltage as used prior to impact strength test. The pipe shall be rejected if any holiday is noted in the test area.
- d. In case the coated pipe is rejected for lack of impact strength, Contractor / Sub Contractor / Vendor shall test the preceding and succeeding pipes coated until the coating is proved acceptable and/or at the discretion of the Employer at Contractor / sub contractor's / Vendor's expense.
- e. Rejected coating shall be removed and shall be recycled through cleaning and coating process in accordance with the approved procedure at Contractor / sub contractor 's / Vendor's expense.





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**9.8** Damages occurring to pipe coating during above tests shall be repaired in accordance with approved coating repair procedure.

**9.9** Any coated pipe shall neither have more than 100 cm<sup>2</sup> of cumulative repaired (metal) area nor shall have more than one repair. Pipes needing repairs more than the above mentioned are/number of repairs, shall be rejected and shall have the coating removed and recycled to complete coating operations. Repairs occurring on account of the production tests are however excluded from above mentioned limitations.

**9.10** Employer, at its own discretion may inspect and witness tests on any of the activities concerning the pipe coating operations starting from bare pipe to finished coated pipe ready for dispatch. Contractor / Sub Contractor / Vendor shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection to the Employer, whenever required. Inspection and tests performed or witnessed by Employer shall in no way relieve the contractor's obligation to perform the required inspection and tests.

In case rate of defective or rejected pipes and/or samples tests are 10% or more for a single shift (typically 8 hours), Contractor / Sub Contractor / Vendor shall be required to stop production and carry out a full and detailed investigation and shall submit findings to Employer for approval. Contractor / Sub Contractor / Vendor shall recommence the production only after getting the written permission from Employer. Under no circumstances any action or omission of the Employer shall relieve the Contractor / Sub Contractor of his responsibility for material and quality of coating produced. No pipes shall be transported from the coating plants unless authorized by Employer in writing.

**9.11** To confirm that epoxy powder has been manufactured, handled, shipped and stored properly, the Contractor / Sub Contractor / Vendor shall perform Gel time test on each batch of powder one week prior to its use as per the method and acceptance as recommended by powder manufacturer.





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## 10.0 INSPECTION AND TESTING FOR INTERNAL EPOXY COATING

## 10.1 General

The Supplier shall establish and maintain a comprehensive Quality Assurance System and issue a Pipe Coating Quality Plan to ensure that all of the requirements of this Specification are met.

The minimum inspection and testing requirements shall accord with API RP 5L2.

The Company reserves the right to require the inspection and of testing of the goods or services during any stage of manufacture at which the quality of the finished goods may be affected, and to undertake inspection and of testing of raw materials or purchased components.

The Supplier shall carry out all tests and use required acceptance criteria. The Company may require that the tests be carried out at specific locations, or that additional tests be carried out. Additional testing will be to the cost of the Company unless the testing indicates coating defects.

If the lining on a pipe fails one or more of the tests at one or more locations the lining shall be stripped and the pipe relined.

## **10.2 Visual Coating Inspection**

A visual inspection of the finished coating shall be performed on every pipe to identify colour abnormalities, blistering, sagging, porosity and handling damage during coating, stacking and loading. The coating shall have a smooth uniform glossy surface free of any sags, runs, fisheyes, or other lining defects. Finished coating shall only be accepted if it is free of said abnormalities.

## **10.3 Film Thickness Test**

The dry film thickness shall be checked at each end of each pipe. The lining shall have a minimum dry film thickness as specified. The readings shall be corrected for the effect of the blast profile.

## 10.4 Pinhole Test

Not less than three times per 8 hours of production a pinhole test shall be carried out. A solvent washed glass panel (approximately 25 mm x 75 mm 2 mm), with a roughened surface, shall be placed inside the pipe during the lining process. The panel, covered with the lining material shall be examined for pinholes. It shall be examined before and after the lining has dried. No pinholes shall be visible when the panel is viewed with the naked eye against normal sunlight. There shall be no more than 15 pinholes for any 25 mm x 25 mm area of the panel visible when viewed against a 100 watt common household light bulb.





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## 10.5 Strip Test

Not less than three times per 8 hours of production a strip test shall be carried out. A blast cleaned steel panel (approximately 25 mm x 75 mm 2 mm) shall be placed inside the pipe during the lining process.

The panel, covered with the lining material, shall be tested after the lining is cured. A knife blade shall be scraped across the paint film surface. The film shall not peel off in strips from the surface. Coating shall either adhere or shall flake off into powder-like particles when rolled between thumb and forefinger. Inappropriate internal cohesion within the coating material is indicated by failure to meet the above criteria.

## 10.6 Bond (Adhesion) Test

Not less than three times per 8 hours of production a bond test shall be carried out. A blast cleaned steel panel (approximately 25 mm x 75 mm 2 mm) shall be placed inside the pipe during the lining process. The panel, covered with the lining material, shall be tested after the lining is cured. The paint film on a 25 mm x 25 mm section of panel shall be crosshatched into 2 mm squares. A piece of transparent adhesive tape shall be adhered to the surface by firmly pressing it onto the cleaned degreased painted surface. Tape shall be removed from the coating with a steady pull. No coating material shall be removed from the test area by this method.

## 10.7 Bend (Flexibility) Test

Not less than three times per 8 hours of production a flexibility test shall be carried out. A blast cleaned steel panel shall be placed inside the pipe during the lining process. The panel, covered with the lining material, shall be tested after the lining is cured. Cylindrical mandrel flexibility tests shall be conducted in accordance with API RP 5L2. There shall be no cracking or loss of adhesion of the coating.

## 10.8 Cure Test

After curing, a painted test panel shall be immersed in solvent of the type used in thinning the coating prior to application. There shall be no softening, wrinkling, blistering or other effects noted after immersion for one hour.

## 10.9 Water Test

After a minimum of 4 hours immersion in either freshwater or an aqueous solution, containing (by weight) 1% sodium chloride, 1% sodium sulfate, and 1% sodium carbonate, the cured panel shall exhibit no loss of adhesion, softening, wrinkling, or blistering of the coating film.

## 10.10 Repair Of Test Areas

Where the coating is damaged during foregoing tests it shall be repaired in accordance with API RP 5L2 and the approved coating repair procedure.

The rate for pipe rejection shall be in accordance with the following. Any pipe so rejected shall have the coating removed and the pipe recycled through the complete cleaning and coating





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system in accordance with the approved coating application procedure, and shall be to the Supplier's cost.

The Maximum single area that may be repaired is 25 cm<sup>2</sup>

Defective or damaged coating shall be repaired by the Supplier

Smaller areas may be spot repaired with a manual atomising spray gun or brush

If the total area of repair exceeds 1% of the total internal pipe surface, the entire pipe shall be recoated

Maximum area on one 12 m pipe length that may be repaired is 67cm<sup>2</sup>. For other pipe lengths the maximum area will be adjusted to maintain the same area ratio.

Notwithstanding the above, the objective shall be to deliver coated pipe that does not require any defect repair. The Supplier shall record the number of defects requiring repair by pipe number, and shall report these quality statistics.

## 10.11 Approval

The Company reserves the right to perform inspection and witness tests on all activities concerning the pipe coating operations, starting from bare pipe to finished coated pipe, ready for despatch.

The Supplier shall give reasonable notice of time and shall provide, without charge, reasonable access and facilities required for inspection to the Company.

Where the rate of defective or rejected pipes and/or sample tests are 10% or more for a single shift (typically 8 hours), the Supplier shall cease production and carry out a full and detailed investigation and shall submit the findings to the Company for approval. The Supplier shall recommence production only after receiving written permission from the Company.





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## 11.0 MEASUREMENT AND LOGGING

Contractor / Sub Contractor / Vendor shall maintain records in computer using MS-Access database Software containing all the relevant data of individual pipe and pipe coating including heat number, diameter, length, wall thickness, defects, pipe number, batches of materials, material balance, sampling, testing, damages, repairs, rejects and any other information that Employer considers to be relevant and required for all incoming bare pipes and Employer approved outgoing coated pipes as applicable. Contractor / Sub Contractor / Vendor shall submit this information in the form of a report at the agreed intervals. The above data shall also be provided in MS-Access format in Compact Disc. Contractor / Sub Contractor / Vendor shall provide one Computer Terminal to Employer for monitoring / tracking of the above.





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## 12.0 HANDLING, TRANSPORTATION AND STORAGE

**12.1** All pipes shall be checked for bevel damages, weld seam height and contour, dents, gouges, corrosion and other damages. Employer shall decide whether pipe defects/damages are suitable for repair. Damage to the pipes that occur such a dents, flats, or damage to the weld ends shall be cut off or removed and pipes rebeveled and repaired again as necessary. Any reduction in length shall be indicated in the Contractor / Sub Contractor's / Vendor pipe tracking system.

**12.2** Contractor shall load, unload, transport and stockpile the coated pipes within the coating plant using approved suitable means and in a manner to avoid damage to the pipe and coating. The Employer shall approve such procedure prior to commencement of work.

**12.3** Contractor shall unload, load, stockpile and transport the bare pipes within the coating plant(s) using suitable means and in a manner to avoid damage to pipes. The Contractor shall prepare and furnish to Employer a procedure/calculation generally in compliance with API RP-5L1 for stacking of pipes of individual sizes, which shall be approved by Employer prior to commencement.

**12.4** Bare/coated pipes at all times shall be stacked completely clear from the ground so that the bottom row of pipes remains free from any surface water. The pipes shall be stacked at a slope so that driving rain does not collect inside the pipe. Bare/coated pipes may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. This cover can be of dry, germ free straw covered with plastic film, otherwise foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes Stacks shall consist of limited number of layers such that the pressure exercised by the pipes own weight does not cause damages to the coating. Contractor / Sub Contractor / Vendor shall submit calculations for Employer approval in this regard. Each pipe section shall be separated by means spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld seam of pipes shall be positioned always in a manner so as not to touch the adjacent pipes. The ends of the pipes during handling and stacking shall always be protected with bevel protectors.

**12.5** The lorries used for transportation shall be equipped with adequate pipe supports having as many round hollow beds as there are pipes to be placed on the bottom of the lorry bed. Total width of the supports shall be at least 5% of the pipe length. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection must be free from all nails and staples where pipes are in contact. The second layer and all following layers shall be separated from the other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.

**12.6** Contractor / Sub Contractor / Vendor shall strictly follow Manufacturer's regarding storage temperature and methods for volatile materials that are susceptible to change in properties and





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characteristics due to unsuitable storage. If necessary the Contractor / Sub Contractor / Vendor shall provide for a proper conditioning.

**12.7** In case of any marine transportation of bare/coated line pipes involved, the same shall carried out in compliance with API RP 5LW. Contractor / Sub Contractor / Vendor shall furnish all details pertaining to marine transportation including drawings of cargo barges, storing/stacking, sea fastening of pipes on the barges/marine vessels to the Employer for approval prior to undertaking such transportation works. In addition, contractor shall also carry out requisite analyses considering the proposed transportation scheme and establish the same is safe and stable.





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## 13.0 REPAIR OF COATING

Contractor / Sub Contractor / Vendor shall submit to Employer, its methods and materials proposed to be used for executing a coating repair and shall receive approval from Employer prior to use. In open storage the repair coating materials must be able to withstand a temperature of at least 80°C, without impairing its serviceability and properties. Contractor / Sub Contractor / Vendor shall furnish manufacturer's test certificates for the repair materials clearly establishing the compliance of the repair materials with the applicable coating requirements indicated in this specification.

All pipes leaving coating plant shall have sound external coating with no holiday or porosity

on 100% of the surface. Defects, repairs and acceptability criteria shall be as follows:

Pipes showing porosities or very small damage not picked up during holiday test and having a surface less than 0.5 cm<sup>2</sup> or linear damage (cut) of less than 3 cm shall be repaired by stick using material of same quality.

Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2.0 mm and an area not exceeding 20 cm<sup>2</sup> shall be rebuilt by heat shrink patch only and without exposing to bare metal.

Defects of size exceeding above mentioned area or holidays of width less than 300 mm shall be repaired with heat shrink repair patch by exposing the bare metal surface.

Defects exceeding the above an in number not exceeding 2 per pipe and linear length not exceeding 500 mm shall be repaired using heat shrinkable sleeves.

Pipes with bigger damage shall be stripped and recoated.

In case of coating defect close to coating cut back, Contractor / Sub Contractor / Vendor shall remove the coating throughout the entire circumference of the pipe down to the steel surface and increase the coating cut back length. Now if the coating cut back exceeds 140 mm of linear length of pipe than the coating shall be repaired by the use of heat shrink sleeves thereby making up the coating cut back length of 120 mm.

Not withstanding the above, under no circumstances, if the defect exceeds 70 mm from the original coating cut back length, the entire coating shall be removed and the pipe shall be recycled through the entire coating procedure. Irrespective of type of repair, the maximum numbers of repair of coating shall be as follows:

Pinhole repair of size 100 cm<sup>2</sup> shall be maximum one number per pipe.

Defects to be repaired by heat shrink patch shall be maximum 3 (three) per pipe inclusive of maximum one (1) holiday.

Defects exceeding the above limits shall cause pipe coating rejection, stripping and recoating.





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All repairs carried out to coating for whatever reason shall be to the account of Contractor / Sub Contractor / Vendor.

Cosmetic damages occurring in the polyethylene layer only need not be repaired by exposing up to steel surface, as deemed fit by the Employer. In any case of Contractor / Sub Contractor / Vendor shall establish his material, methods and procedure of repair that result in an acceptable quality of product by testing and shall receive approval from Employer prior to use.

Testing of repairs shall be in the same form as testing coating. All repairs shall result in a coating thickness no less than the parent coating thickness. Contractor / Sub Contractor / Vendor shall test repairs to coating as and when required by Employer.





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## 14.0 MARKING

Contractor / Sub contractor / Vendor shall place marking on the outside surface of the coating at one end coated pipe, and marking shall indicate, but not limited to the following information:

- a. Pipe number, Heat number
- b. Diameter & Wall thickness
- c. Coated pipe number
- d. Colour band as per ASME A13.1.
- e. Any other information considered relevant by Employer
- f. Pipe Manufacturer Name
- i. Inspection Mark/Punch Contractor / Sub Contractor / Vendor shall obtain prior approval on marking procedure to be adopted from the Employer.