

GENERAL SPECIFICATION

CORROSION

GS EP COR 220

Three layer polyethylene external coating for pipelines

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1. General

1.1 Scope

This specification covers the manufacturing of 3 layer polyethylene (3LPE) external anticorrosion coatings for onshore or offshore carbon steel pipelines transporting oil, gas, or water.

The coating shall be plant applied and suitable for operating temperature from -40°C up to +80°C.

1.2 Terms and Abbreviations

3LPE	3 layer Polyethylene
PE	Polyethylene
CD	Cathodic disbondment
DMTA	Dynamic mechanical thermal analysis
DSC	Differential scanning calorimeter
FBE	Fusion bond epoxy
IR	Infra red
ITP	Inspection and test plan
PQT	Procedure qualification trial
PPT	Pre production trial
QA/QC	Quality Assurance//Quality Control
SAW	Submerged arc welded

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASTM D4940	Standard test method for conductimetric analysis of water soluble ionic contamination of blasting abrasives
ASTM D570	Standard Test Method for Water Absorption of Plastics
CSA Z245.20	Plant applied external coatings for steel pipes

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Reference	Title
ISO 11124 (All Parts)	Preparation of steel substrates before application of paints and related products-Specifications for metallic blast-cleaning abrasives - All parts
ISO 11125 (All Parts)	Preparation of steel substrates before application of paints and related products-Test methods for metallic blast-cleaning abrasives - All parts
ISO 1133-1	Plastics - Determination of the melt-mass flow rate (MFR) and melt-volume flow rate (MVR) of thermoplastics - Part 1: Standard method
ISO 11357 (Parts 1; 2; 3)	Plastics - Differential scanning calorimetry (DSC) - Parts 1; 2; 3
ISO 1183 (All Parts)	Plastics - Methods for determining the density and relative density of non-cellular plastics - All parts
ISO 18553	Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
ISO 21809-1	Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)
ISO 2808	Paints and varnishes - Determination of film thickness
ISO 2811-1	Paints and varnishes - Determination of density - Part 1: Pyknometer method
ISO 306	Plastics - Thermoplastic materials - Determination of Vicat softening temperature
ISO 527 (Parts 1; 2)	Plastics - Determination of tensile properties - Parts 1; 2
ISO 6964	Polyolefine pipes and fittings: Determination of carbon black content by calcination and pyrolysis: Test method and basic specification
ISO 8130 (Parts 6; 7; 13)	Coating powders - Parts 6; 7; 13
ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-3	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)

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Reference	Title
ISO 8503-4	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile - Stylus instrument procedure

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP PLR 410	Concrete coating for submarine pipelines

3. Qualification of coating products and Applicator coating line

3.1 Coating products

All coating products to be qualified shall fulfill the requirements of Clause 4 of this general specification.

All data required in Clause 4 shall be provided by raw material manufacturer via Applicator upon Company request for review and approval.

3.2 Coating line

Only Company qualified coating line shall be used to coat pipes as per this general specification

The qualification of a new coating line shall consist in a full PQT (Procedure Qualification Trial) as per Appendix 1 using qualified product as per Clause 3.1 and shall be performed under Company supervision.

Once qualified, the Applicator is notified in writing. The need for new PQT is then waived.

The coating line remains qualified as long as no major modification have been implemented (the Applicator shall notify Company of such major modifications to the line).

Company reserves the right to cancel the qualification at any time due to reported quality issues or more than 5 years without coating for Company. The Applicator is notified in written.

The use of alternative or new coating products (complying with Clause 3.1) on an already qualified line without performing a new qualification is subject to Company approval.

A qualified line means that it can potentially meet the requirements of this general specification using qualified raw materials. This shall be confirmed via the PPT.

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4. Coating system and characteristics of the raw materials

For each raw material (epoxy, adhesive and PE), the requirements are as follow:

- Nature and type of raw material
- Technical requirements
- Content of certificate of analysis.

4.1 Coating System

The three layer polyethylene coating shall consist of:

- One epoxy primer (powder)
- One adhesive coat (extruded or powder)
- One extruded polyethylene coat.

4.2 Marking and identification

Raw materials shall be clearly identified with the following markings (whatever the packaging of the product):

- Name of Manufacturer
- Production plant
- Name of product
- Batch number
- Date of manufacture (epoxy only)
- Shelf life (epoxy only). For PE and adhesive, if nothing is specified by the Manufacturer, a shelf life of one year (starting at reception of material by Applicator) shall be considered by default, provided the product is stored according to Manufacturer's recommendation (To be found in Materials Safety Data Sheets).

4.3 Characteristics of epoxy primer

4.3.1 Nature and type

The epoxy primer shall be 100% solid powder form. The use of liquid epoxy is not allowed.

4.3.2 Technical requirements

The epoxy primer shall meet the technical requirements specified in Table 1.

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Table 1 - Technical requirements for epoxy primer

Characteristic	Methods	Units	Acceptable Values
Glass transition temperature*	ISO 11357 (Parts 1; 2) Differential Scanning Calorimeter (DSC)	°C	No less than 100°C for fully cured material
Bend test	CSA Z245.20, Clause 12.11 2.5° at minimum temperature		No cracks
Water absorption (demineralised water)	ASTM D570 on a free film of 500 microns ± 50 thickness	% wt	Less than 15% of weight uptake after 28 days at 80°C

* Tg shall be understood here as inflection point.

The data reported in Table 1 shall be supplied by raw material manufacturer once on a selected batch of material for qualification purposes.

4.3.3 Content of certificate of analysis

The certificate of analysis is issued by raw material Manufacturer with every batch of product. It reports all characteristics controlled on the corresponding batch.

The certificate of analysis shall report also the acceptable range for each of these measured values, as defined by the raw material manufacturer.

The certificate of analysis shall contain the information as reported below:

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MANUFACTURER DETAILS

CUSTOMER DETAILS

MANUFACTURING PLANT LOCATION

Contact person details

PRODUCT REFERENCE (Grade)

BATCH NUMBER

DATE OF MANUFACTURE

DATE OF SHIPMENT

PO Ref

PROPERTIES	Test Method	Unit	Result	Acceptable range
Gel time	ISO 8130-6	seconds		
Density	ISO 2811-1	g/ml		
Glass Transition	ISO 11357 (Parts 1; 2)			
First heating		°C		
Second heating		°C		
Enthalpy		J/g		
Particle size	ISO 8130-13	µm		
Moisture content	ISO 8130-7	(105°C) %		
IR Spectra	Manufacturer specific			enclosed as attachment

Signature with Name of QA/QC and dates

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4.4 Characteristics of the adhesive material

4.4.1 Nature and type

The adhesive shall be based on linear-type (i.e. low pressure manufacturing process) PE with grafted reactive sites. Both extruded and powdered adhesive applications are allowed.

4.4.2 Technical requirements

The Company requirements are given in Table 2.

Table 2 - Technical requirements for adhesive

Characteristics	Standards	Units	Acceptable values
Elongation at break	ISO 527 (Parts 1; 2)	%	≥ 500
VICAT Softening point (9.8 N)	ISO 306	°C	> 90
Melting point	ISO 11357-1 and ISO 11357-3	°C	> 120

The data reported in Table 2 and below spectra shall be supplied by raw material manufacturer once on a selected batch of material for qualification purpose.

In addition:

- A full Differential Scanning Calorimeter (DSC) spectra shall be provided once for each adhesive, from -40°C up to 200°C Heating rate 20°C/min, cooling rate 10°C/min (first and second heating) as per ISO 11357 (Parts 1; 2; 3)
- Dynamic Mechanical Thermal Analysis (DMTA) spectra shall be provided once at a frequency of one Hertz from -40°C up to 200°C (or the melting of the adhesive).

4.4.3 Content of certificate of analysis

The certificate of analysis is issued by raw material Manufacturer with every batch of product. It reports all characteristics controlled on the corresponding batch.

The certificate of analysis shall report also the acceptable range for each of these measured values, as defined by the raw material manufacturer.

The certificate of analysis shall contain the information as reported below: