

GENERAL SPECIFICATION

CORROSION

GS EP COR 231

**External elastomer based coating for
risers of sea line**

04	10/2012	New table 1 for characterization of applied coating – update on test standards
03	10/2005	Qualification for compatibility with parents coating added – Addition of "EP" root to GS identification
02	10/2004	General review, reference to GS SAF 337, transition zone
01	09/2003	Change of Group name and logo
00	03/2001	First issue
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1. Scope

This document defines the minimum requirements for an elastomer based coating. This coating is intended as external protection applied in plant for steel line pipes and fittings to be used for steel risers of submerged pipelines supported along a fixed platform.

Elastomer shall be adapted to the maximum operating temperature. Polychloroprene, EPDM or other rubbers may be proposed.

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
ISO 1431-1	Rubber, vulcanized or thermoplastic - Resistance to ozone cracking - Part 1: Static and dynamic strain testing
ISO 188	Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests
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 8503 (Parts 1; 4)	Preparation of steel substrates before application of paints and related products -- Surface roughness characteristics of blast-cleaned steel substrates cleanliness – Parts 1; 4
ISO 4287	Geometrical Product Specifications (GPS) -- Surface texture: Profile method -- Terms, definitions and surface texture parameters
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)
ISO 6502	Rubber — Guide to the use of curemeters
ISO 2781	Rubber, vulcanized or thermoplastic — Determination of density
ISO 813	Rubber, vulcanized or thermoplastic – Determination of adhesion to a rigid substrate – 90 degree peel method

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Reference	Title
ISO 7619 (Part 1)	Rubber, vulcanized or thermoplastic — Determination of indentation hardness - Part 1: Durometer method (Shore hardness)
ASTM G 8	Standard Tests Methods for Cathodic Disbonding of Pipeline Coatings

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 SAF 337	Passive Fire Protection: Basis of design

3. Characteristics of the coating and the raw materials

3.1 Essential coating properties

They shall be as follows:

- Be stable at service temperature, be continuous and be waterproof to prevent impregnation by the surrounding electrolytic environment (pipeline in immersed zone, splash zone and emerged zone)
- Be compatible with the cathodic protection and have high resistivity so as to have appropriate electrical resistance at the application thickness
- Have good adherence to the metal to avoid the spread of accidental defects of continuity
- Have excellent resistance to ultraviolet rays
- Have good inertia:
 - To chemical and biological agents naturally present in the water or resulting from corrosion or cathodic protection reactions
 - To the products transported, that is, to hydrocarbons in the event of accidental leakage.
- Have good resistance to mechanical and thermal stress generated by movements relative to the environment and the pipe line, during handling, transportation, installation and hydrostatic tests.
- Have fire and jet fire resistance as per **GS EP SAF 337**, paragraph 7.9
- Special care shall be taken as to prevent possible corrosion at the transition zone between this coating and painting or other coating types at the upper limit of splash zone. This transition should be located at a level where inspection is convenient.

3.2 Characteristics of the raw materials

All raw materials shall be stored before use as per MSDS of manufacturers.

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All materials shall be provided with conformity certificate (this is a document issued by raw material manufacturer. It is a list of physical or chemical characteristics controlled for every production batches. For each of these characteristics, a conformity range is reported by the manufacturer).

All material batches shall be provided with their certificate of analysis (this is a document issued by raw material manufacturer with every batch of product. It reports all characteristics controlled on the corresponding batch. The content of certificate of analysis shall be equivalent to the conformity certificate, except that measured values shall be reported instead of conformity ranges).

When submitted during qualification, the company reserves the right to ask for changes with regards to manufacturer's specification ranges in certificate of conformity for each characteristic.

4. Coating application

4.1 Coating system qualification

Qualification tests shall be carried out by the Contractor who shall provide technical qualification documents for the coating including:

- Certified copies of the reports on the tests to check the physical and chemical properties and the behaviour of all products used (including certificate of conformity and certificate of analysis)
- Detailed specifications of the products to be used and instructions for handling and application (for each layer)
- Expected final properties and manufacturer recommendation as per Table 1

All products, application procedure and final properties of Table 1 shall be approved by the company before coating application begins via a PQT (Procedure Qualification Test) to be performed at least a month ahead of the production. Before production a PPT (Pre Production Test) shall be performed. All properties and tests shall be in accordance with Table 1.

The coating shall have, as a minimum, the following layers:

- A primer applied to the steel to provide corrosion protection and adhesion to the subsequent coating. Care shall be taken to control atmospheric conditions, application time and thickness (to provide full coverage), which shall be 60 microns minimum. A cathodic disbondment test shall be provided to ensure its proper application and characteristics.
- A bonding agent or intermediate layer to ensure adhesion between primer and top coat. Care shall be taken to control atmospheric conditions, application time and thickness (to provide full coverage). Adhesion tests shall be provided as to ensure proper application and characteristics of the bonding layer.
- A rubber coat, to ensure proper mechanical and weathering resistance in addition to fire and jet fire protection.

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4.2 Surface preparation

- Before abrasive blasting, the line pipes and accessories surface shall be inspected and cleaned to remove all traces of oil, grease and loose deposits. Any visible trace of oil or grease shall be removed using an appropriate non-oily and non-toxic product.
- If line pipes and accessories have been in contact with marine or industrial atmosphere, they shall be cleaned before abrasive-blasting to remove any contamination. Cleaning shall be carried out using an adapted process. Salt contamination shall be lower than 2 micro grams per square cm as per [ISO 8502-6](#)
- All line pipes and accessories shall be preheated (40 to 70°C) before abrasive blasting. Temperature shall be checked continuously with infra red camera.
- The surface shall be blast cleaned to A or B Sa 3 as per [ISO 8501-1](#)
- The grit shall be selected so that the average roughness Ry5 (as per [ISO 4287](#)) obtained ranges from 60 to 90 microns (as per [ISO 8503-4](#))
- Immediately after abrasive blasting, all dust and traces of abrasives shall be removed from the pipe surface by brushing and vacuum cleaning. Maximum acceptable level shall be 2 according to [ISO 8502-3](#).
- Each cleaned line pipes and accessories shall be inspected for surface defects. Any defect shall be removed.
- Cleaned line pipes and accessories shall then be coated before degradation of surface preparation. They shall not be left in a moist and/or salt contaminated atmosphere. The metal temperature shall be 3°C above the ambient dew point temperature. Any line pipes and accessories which have not been coated before degradation of their surface preparation shall be completely re-blasted before coating.

4.3 Coating application

Application procedure shall be provided by Contractor to Company for approval during qualification stage (see 4.1). Once approved by Company, the procedure and product used shall not be changed without formal approval by Company.

- Special care shall be taken as to make sure that atmospheric conditions are acceptable (10°C minimum and 85% humidity maximum, steel temperature 3°C above dew point) and that no stop in the continuation of coating application has happened. In case the overcoat time between layers exceed the manufacturer recommendation, test results shall be provided as to ensure the proposed procedure to re activate the surface to ensure equivalent adhesion and characteristics as in a continuous process. Failure to do so will lead to the rejection of the coating. Vulcanization condition and parameters shall be continuously recorded.

Repairs: The method of repair used to correct faults found during factory inspections shall be submitted to the Company's approval.

4.4 Transition zone

Transition zone corresponds to the junction between the riser coating and the paint system of pipeline at upper level of the splash zone. Special care shall be taken as to prevent any corrosion or damage in that zone:

- The location of this zone shall be at a level accessible for later inspection, out of any supporting clamp
- A smooth bevel of the riser coating shall prevent disbanding and penetration of water
- A compatible coating shall be applied at the transition zone to prevent water ingress between the two coating types. Adhesion values at maximum service temperature on the two coatings shall be documented.

In any case, all transitions from this coating to parents coating, either PE, PP or paint shall be documented and qualified and submitted to Company for approval, specially in terms of adhesion.

4.5 Required thickness

The thickness shall ensure proper mechanical protection together with fire and jet fire resistance as per **GS EP SAF 337**.

Minimum thickness shall be 12 mm.

4.6 Coating characteristics

The properties required for the coating obtained are given in the table 1.

Table 1 - Characteristics of final coating

Property	Unit	Test method	Requirements	Frequency		
				PQT	PPT	Production
Raw material testing						
Certificate of analysis and certificate of conformity			All batches of materials	Each batch	Each batch	Each batch
Viscosity	Nm	ISO 6502 (Rheometer)	According manufacturer's certificate of conformity range	Each batch	Each batch	Each batch
Hardness	Shore A or D	ISO 7619-1	According to manufacturer's certificate of conformity range	Each batch	Each batch	Each batch
Density	g/cm ³	ISO 2781	According to manufacturer's certificate of conformity range	Each batch	Each batch	Each batch
Surface preparation						
Measurement of the ambient conditions	% °C	Psychrometer	Recording actual values of ambient temperature and RH and calculation	Prior to start of the PQT	Prior to start of the PPT	Prior to blasting of each item

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Property	Unit	Test method	Requirements	Frequency		
				PQT	PPT	Production
- ambient temperature - ambient relative humidity - ambient dew point			of dew point RH<85 %			
Surface temperature prior to blasting	°C	Contact thermocouple	≥ 3 °C above dew point	Each item	Each item	Prior to blasting of each item
Steel surface inspection after blasting		Visual inspection	No mill imperfections. (Such as slivers, scabs, burrs, weld spatter)	Each item	Each item	Each item
Cleanliness grade	Sa	ISO 8501-1	Grade Sa3	Each item	Each item	Each item
Surface profile	Grade	ISO 8503-1 Comparative method	Medium grade (G) or Ry5 60 to 90 microns and compatible with pipeline steel. Finish to be maintained until the moment of coating.	Each item	Each item	Each item
Dust level		ISO 8502-3	Level 2 max	Each item	Each item	Each item
Rubber primer application						
Pot life	s	stopwatch	Cure time check in accordance with manufacturer's recommendation	Each batch	Each batch	Each batch
Substrate temperature	°C		3 °C above dew point	Each item	Each item	Each item
Appearance		Visual	Within manufacturer's recommendation. Comparative visual test panels from PQT.	Each item	Each item	Each item
Rubber application						
Total coating thickness	mm	PI Tape or electronic equipment	as specified by SAF 337 12 mm minimum	Each item	Each item	Each item
Vulcanization temperature	°C	Contact thermocouple	According to manufacturer procedure or within PQT range	Each item monitored	Each item monitored	Each item monitored

Property	Unit	Test method	Requirements	Frequency		
				PQT	PPT	Production
Vulcanization time	min	Stop watch	within PQT range	Each item	Each item	Each item
Vulcanization pressure (where applicable)	MPa	Manufacturer specific	within PQT range	Each item	Each item	Each item
Ovality	-	Calliper and PI tape	$(OD_{\max}-OD_{\min}) / OD_{PI\text{tape}} < 2 \%$	Each item	Each item	1 st pipe then every 20 th pipe
Concentricity	%	Straight edge ruler or electronic equipment at cutback area	± 10 % of nominal thickness	Each item, 8 measurements	Each item, 8 measurements	Once every 20 pipes
Adhesion test/ peel test on test plate	N/mm	ISO 813	Value as agreed during PQT and no disbondment from the steel.	Each vulcanization batch in autoclave		
Laboratory testing						
Hardness	Shore A	ISO 7619-1	65 +/-5	Each item	Each item	Each item
Visual inspection on cutbacks		Visual	No disbondment between layers or defects/voids	Each item	Each item	Each item
Hammer test		manufacturer	No voids	Each item	Each item	Each item
CD test	mm	ASTM G 8	28 days at 23°C<5 mm 48 hours at 65°C<3 mm	Once	Once for 48 hours only	N/A
Ozone resistance		ISO 1431-1	>80	certificate	N/A	N/A
Heat ageing (7 days at 100°C)		ISO 188	Hardness change <10%	certificate	N/A	N/A
Fire and jet fire resistance	hrs	GS EP SAF 337		certificate	N/A	N/A

4.7 Inspection of the coating process and tests

The inspections shall be performed in accordance with the "frequency of inspections" given in table 1.

5. Repairs

Repair procedures shall be approved by the Company.

5.1 Minor repairs for 20 cm² maximum surface defects

Minor surface flaws up to 3 mm in depth shall be repaired using a self curing mix that is compatible with the elastomer coating.

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Before application, the damaged coating surface shall be lightly abraded and cleaned with solvent.

5.2 Other repairs

The faulty coating shall be cut back to bare metal. The steel surface shall be roughened by a sanding disc and the coating lightly abraded.

Primer and adhesive coats shall be applied according the procedure.

After these preliminary operations, the coating shall be restored with a minimum overlap of 20 mm on each side of the repaired area.

These repaired areas shall be covered with a nylon film. Vulcanization shall be performed as for plant vulcanization.

Inspections and tests shall be performed in accordance with the requirements in table 1

6. Field joint coating procedure

This shall be approved by the Company and shall include:

- Surface preparation of steel surfaces and plant coating
- Application of the different coats: primer, adhesive and elastomer in a thickness no greater than the thickness of plant coating
- Elastomer vulcanization: temperature, duration
- Inspections to verify coating conformity, and in particular Shore hardness, holiday detection and hammer tests.

7. Quality assurance procedures

7.1 Design

Before the start of the fabrication, a Quality Plan must be drawn up by the Contractor, detailing all the procurement, fabrication, inspection and acceptance testing procedures.

These shall be described in "detailed procedures".

7.2 Qualifications

Coating procedure and materials shall be approved by the Company.

7.3 Quality control

Erreur ! Signet non défini. The Contractor shall establish a Quality Plan according to table 1.

During coating application, the Contractor's Quality Control department shall carry out measurements, tests and inspections as described in this document. The results of these shall be recorded.

Coating application and the tests listed in Table 1 shall be carried out in the presence of the Company or his representative.

7.4 Nature and frequency of measurements, tests and inspections

As given in the Table 1.

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7.5 Marking

The marking shall be applied to each line pipe by suitable means with a durability compatible with the planned works. The marking details to be used are described in the contractual Job specification.

7.6 Technical file

The technical file submitted by the Contractor at the end of the coating work shall include:

- Line pipe characteristics, a complete list of all line pipes coated
- Line pipe coating type and thickness in plant
- Quality plan
- Data sheets of products used, with their test certificates
- Test, inspection and final acceptance reports
- Repair procedure.

8. Handling, transportation and storage

The coated line pipes must be handled using leather, webbing or rubber slings and must be carefully stored to avoid any damage to the line pipe coatings and the chamfers.

The use of slings made of steel or hemp or any material that can shape the line pipe coating is strictly forbidden.

The coated line pipes must be stored so as to avoid any damage to the coating (on sandy, stone-free ground or on wooden staging). The line pipes must be separated by wooden wedges.