



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS COR 230

**External laminated glass fibre/resin based coating
for risers of sea line**

02	10/04	General review, reference to GS SAF 337, transition zone
01	09/03	Change of Group name and logo
00	03/01	First issue
Rev.	Date	Notes

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1. Scope

This document defines the minimum requirements for the characteristics of the applicable products and methods of applying a laminated resin/glass fibre based coating. This coating is intended as external protection applied in plant and onsite for steel line pipes and fittings to be used for steel risers of submerged pipelines supported along a fixed platform.

The type of resin shall be adapted to the maximum operating temperature. Epoxy, vinylester or other resins may be proposed.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
EN 59	Glass reinforced plastics, measurement of hardness by means of a BARCOL impresser
ISO 8502-3	
ISO 8502-6	Preparation of steel substrates before application of paints and related products -- Tests for the assessment of surface cleanliness -- Part 6: Extraction of soluble contaminants for analysis -- The Bresle method
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 8503-4	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
ISO 4287	Geometrical Product Specifications (GPS) -- Surface texture: Profile method -- Terms, definitions and surface texture parameters
ISO 1172	Textile-glass-reinforced plastics. Prepegs, moulding compounds and laminates determination of the textile glass and mineral. Filler content. Calcination methods
ISO 62	Plastics. Determination of water absorption
ASTM G8	Standard test methods for cathodic disbonding of pipelines coatings

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS SAF 337	Passive Fire Protection

3. Characteristics of the coating and of the raw materials

3.1 Essential coating properties

They shall be as follows:

- Be stable at service temperature, continuous and 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 behaviour to ultraviolet rays
- Have good inertia:
 - To chemical and biological agents 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 pipeline, during handling, transportation, installation and hydrostatic tests.
- Have fire and jet fire resistance as per GS SAF 337, paragraph 7.9
- Special care should be taken as to prevent possible corrosion at transition zone between coating and paint at upper limit of splash zone. This transition should be located at 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.

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 before application of the coating begins shall be approved by the COMPANY.

The coating shall have the following layers, except otherwise agreed:

- A primer applied to the steel to provide corrosion protection and adhesion of the coating to the steel. A cathodic disbondment test shall be provided to ensure its proper application and characteristics.
- An intermediate layer made of resin/glass fibre composite. Its function shall be fire and jet fire protection as per GS SAF 337 and mechanical protection. Certificate for fire and jet fire shall be provided together with impact resistance, adhesion performance and water absorption. Glass fibre content shall be between 50 and 65% by weight.

- A top coat layer, rich in resin formulated with anti UV additives. Its function shall be weathering resistance (UV, thermal, water...). Accelerated ageing tests results shall be provided as to demonstrate the stability of the layer over the lifetime of the coating. Glass fibre content shall be 15% by weight maximum.

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 2 ½ 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 Application of the coating to the line pipes in plant

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

Special care shall be taken as to make sure atmospheric conditions are acceptable (16°C minimum and 85% humidity maximum) and 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 ensure equivalent adhesion and characteristics as in a continuous process. Failure to do so will lead to the rejection of the coating.

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

4.4 Application of the coating to bends in plant

Bends shall be coated in the same way as the line pipes. However, the winding operation may be carried out by hand and the resin cured at ambient temperature.

4.5 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 should 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 heat shrinkable sleeve or equivalent 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.

4.6 Required thickness

The coating shall be at least 9 mm thick (+ 1 mm, - 0 mm). At each end, the coating shall have a bevel between 40° and 60°. The thickness shall ensure fire and jet fire protection as per **GS SAF 337**.

4.7 Coating characteristics

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

4.8 Inspection of coating process and tests

The controls shall be performed according the "frequency of tests" given in appendix 1.

5. Application of the coating on site

The on-site application procedure applies to welded joints and repairs.

The CONTRACTOR shall submit for the COMPANY approval the proposed method of applying the coating on site at the welds and on any repairs.

6. Quality assurance procedures

6.1 Design

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

These shall be described in "detailed procedures".

6.2 Qualifications

Coating procedure and materials shall be approved by the COMPANY.

6.3 Quality control

The CONTRACTOR shall establish a Quality Plan according to the check list in the Appendix 1.

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

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

Table 1: Characteristics of final coating

Characteristics	Standard	Values
Tg1 : Initial curing	Annexe 1	As per manufacturer specification
Tg2 : Final curing	Annexe 1	As per manufacturer specification and at least 20°C above maximum service temperature
Barcol Hardness	EN 59	As per manufacturer specification
Impact	Manufacturer	As per manufacturer recommendation
Adhesion	Manufacturer	As per manufacturer recommendation, with no disbonding between steel and primer
CD test at 65°C, 48 hrs CD test at 23°C, 28 days	ASTM G8	<2 mm <5 mm
Water absorption 23°C (intermediate and top coat layers)	ISO 62	Less than 5% at saturation for each layer
UV resistance	Manufacturer	As per manufacturer recommendation
Glass fibre content (each layer as per 4.1)	Manufacturer	50-65% for intermediate layer 15% max for top coat
Fire and jet fire resistance	GS SAF 337	Conform to GS SAF 337

6.4 Nature and frequency of measurements, tests and inspection checks

As given in the Appendix 1.

6.5 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 Job contractual specification.

6.6 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 reports and final statement of compliance
- Repair procedure.

7. 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.

Appendix 1

1. Nature and frequency of tests and inspections

Description	Qualification	Production
Raw materials (Certificate of conformity as per 3.2)	All raw materials	All raw materials
Raw materials (Certificate of analysis as per 3.2)	All batches	All batches
Surface preparation as per 4.2	All pipes	All pipes
Application procedure as per 4.3	All pipes	All pipes
Tg1 : Initial curing *	All pipes	Once per shift
Tg2 : Final curing *	All pipes	Once per shift
Barcol hardness	All pipes	All pipes
Impact	All pipes	First pipe
CD test	One pipe	First pipe
Water absorption (Intermediate, top coat)	One pipe	First pipe
Glass fiber content	All pipe	First pipe
UV resistance	Test certificate	N/A
Fire resistance	Test certificate	N/A
Aspect (visual)	All pipes	All pipes
Thickness	All pipes	All pipes
Holiday detection	All pipes	All pipes
Adhesion	One pipe	First pipe

2. Determination of the degree of curing by differential Scanning Calorimetry (DSC)

2.1 Scope

This test on a sample of the laminate determines the degree of curing of the resin by comparison with data relating to current production.

2.2 Definition

The glass transition temperature (Tg) is the temperature at the median-point of the bow in the heat flow/temperature curve obtained by DSC.

2.3 Apparatus

A differential scanning calorimeter is used.

Test samples:

- Dimensions

The sample dimensions are limited by the capacity of the calorimeter capsules. The sample may be a fragment or fine powder obtained by filing which facilitates weighing and provides better contact with the capsule.

- Sampling area

The sample must be taken from the laminate to a depth not exceeding 2.5 mm.

2.5 Procedure

- The maximum gradient must be 5°C per minute.
- Scanning begins at ambient temperature and continues to 30°C above the laminate's assumed Tg but not above 250°C.
- Determine Tg1 with an initial temperature scan.
- If Tg1 is more than 5°C either side of the reference temperature determined on the basic products, cool down the sample and take a second scan on the same sample with the same parameters as for the first.
- This gives a second Tg: Tg2.

2.6 Test report

The test report shall include the following:

- Full identification of the samples and the parts from which they came
- Number of samples tested and their location on the parts
- Temperature gradient, initial and final temperatures for each scan
- Records of the heat flow/temperature curves with indication of the Tg obtained
- Test date
- Name of the laboratory and the person responsible for the tests.