



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS COR 223

Hot enamel pipe coating

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1. Scope

This specification covers the external anticorrosion coating of pipes used as pipeline elements for onshore and offshore oil or gas or water lines.

The coating shall be plant applied reinforced hot enamel suitable for service temperature up to 55°C without concrete weight coating. When coated with concrete weight coating, the reinforced hot enamel coating is approved for service temperature up to 90°C.

Its purpose is to define the following:

- Applicator's obligations
- Composition and characteristics of the coating
- Application of the coating and repairing
- Inspection
- Handling, transport and storage rules
- Field joint coating.

In this document the wording:

- "Will" is normally used in conjunction with an action by COMPANY rather than by CONTRACTOR or Applicator or MANUFACTURER
- "Should" indicates a non-mandatory advice, while "may" refers to options
- "Shall" and "is to be" are mandatory requirements
- "Must" is used only where a provision is a statutory requirement.

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
ANSI/AWWA - C203	American National Standard for Coal - Tar Protection Coatings and Lining for Steel Water Pipelines - Enamel and Tape - Hot applied
ISO 8501-1	Pictorial surface preparation standards for painting steel surfaces
ASTM D 271-64	
ASTM D 71-52	
ASTM D 36-64	
ASTM D5	
ASTM 1000	
ASTM G 8	



Reference	Title
ASTM D 638 ASTM G 13 BS 4164-1987 BS 4164-87 E BS 4164-87 G BS 4164-87 H NF A 49-702 NF T 55-007 NF T 30-014 NF T 60-103	French Standard - Steel tubes - External and internal hot dip coatings based on hydrocarbon bearing bonding agents

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
Not applicable	



3. Definitions of main parties involved

3.1 COMPANY

Total or its subsidiary or agents acting on its behalf, shall be referred to herein as the "COMPANY".

3.2 CONTRACTOR

The COMPANY, or their agents, designated in the Contract as being the selected main CONTRACTOR shall be referred to herein as the "CONTRACTOR".

3.3 MANUFACTURER

Means the COMPANY which produces and supplies the basic materials.

3.4 Applicator

Means the COMPANY who prepares the surface and applies the coating.

3.5 Inspector

The COMPANY representatives or members from COMPANY elected Inspection Agencies for the time being or from time to time duly appointed in writing by the COMPANY to act as its Representatives for the purpose of the contract shall be referred to herein as the "Inspector".

4. Applicator's obligations

4.1 Data sheets to be supplied with the tender

The CONTRACTOR shall, in his tender, submit the data sheets of all the components, of the coating and repair product selected by him for approval.

Once approved these components shall not be changed by the Applicator without prior written authorisation of the COMPANY.

The approval decision shall not in any case be considered as a guarantee from the COMPANY with respect to the coating and repair product but at most as an authorisation for use.

4.2 Test certificates and condition of application for each component

The CONTRACTOR shall obtain through the Applicator from the MANUFACTURER and submit to COMPANY:

- The guarantee that the coating and repair product delivered shall meet the required coating characteristics as set forth in Chapter 7 according to the specified methods
- Production test certificates for each batch of base material including test results of the characteristics defined in Chapter 5, which shall be in conformity with the specified methods and acceptable values
- Primer and coal tar enamel main application parameters:
 - Primer coverage
 - Minimum and maximum primer wet thickness

- Primer drying time
- Minimum and maximum heating temperatures of coal tar enamel
- Minimum and maximum application temperatures of coal tar enamel
- Maximum time during which coal tar enamel can be kept at application temperature
- Base material packaging and storage requirements
- Delivery of packings each containing only one base material originating from a single production batch.
- Conditions of application of the repair product
- Packaging and storage requirements of coating material and repair product
- Legible marking of each packing and, if necessary, issue of a delivery note for each container mentioning in both cases the following information:
 - Name of MANUFACTURER
 - Complete identification of the base material
 - Number of production batch
 - Date of production
 - Limit date for use.

4.3 Notification prior starting coating work

The CONTRACTOR shall notify the COMPANY, at least eight working days before coating application, of the dates of coating execution to permit mobilisation of the COMPANY designated Inspector.

The Inspector shall have free access to the workshops, storage yards and laboratory of the Applicator who shall provide him with all the facilities necessary for the proper execution of his mission i.e. office, telephone and telex, personnel, handling equipment, measuring instruments, etc.

Upon arrival in the coating plant, the Inspector shall receive from the CONTRACTOR/Applicator the documents supplied by the MANUFACTURER as specified in § 4.2.

4.4 CONTRACTOR/Applicator commitments

The CONTRACTOR/Applicator shall supply all personnel, coating material and repair product, equipment, application material and inspection apparatus.

He is also in charge of the following operations:

- Unloading, acceptance and storage of bare pipes
- Storage and loading of coated pipes.

The Applicator shall store the coating material and repair product, perform coating application and inspection in conformity with this specification.

4.5 Acceptance certificates

The CONTRACTOR and the Applicator shall co-sign with the Inspector the coated pipes acceptance certificate including the results of all tests and inspection as set forth in this specification.

The acceptance certificate of coated pipes shall certify that the tests and inspection have been performed by the Applicator under the responsibility of the CONTRACTOR on the COMPANY ordered pipes and have been witnessed by the Inspector.

One copy shall be transmitted to the COMPANY and one to the Inspector.

5. Description of coating and characteristics of base materials

5.1 Description of coating

The coating shall consist of up to seven compatible layers i.e.:

- One coat of primer, a liquid product applied cold with straps, brushes or spray guns and forming, upon drying, a uniform, adhering, hard-to-the-touch film
- One protective coat (enamel) of a specially formulated coal tar (or bitumen) enamel premixed with an inert filler
- An inner wrap reinforcing layer of glass cloth or fabric embedded in the protective coating
- One protective coat of coal tar enamel grade 120/5 ([BS 4164-1987](#)) or grade 916-10 or grade C bitumen enamel
- An outerwrap reinforcing layer of glass embedded in the protective coating
- One protective coat of coal tar (or bitumen) enamel as above if a non pre-impregnated outerwrap is used and if the total coating thickness does not meet the contract requirement
- If required, solar protection if the pipes are not mechanically protected immediately after coating and if pipes are likely to be exposed to the sun for more than a week.

5.2 Characteristics of base materials

5.2.1 Primer

The primer shall be based upon chlorinated rubber and shall comply with Table 1 - [BS 4164-1987](#).

The primer shall not contain any inert filler nor form sediment in its containers.

It shall be selected so as to be compatible with the coating material (primer and enamel shall be from the same MANUFACTURER).

Unless otherwise specified primer properties shall satisfy the values given in the table below:

Table 5.2.1

Grade property	Synthetic	Standards or test methods
Density at 25°C	1 to 1,2	NF T 55-007
Viscosity at 23°C 4 mm orifice 2.5 mm orifice	35 to 60 s 110 to 150 s	NF T 30-014
Luchaire flash point - Temperate zones - Hot zones	> 38°C > 45°C	NF T 60-103
Covering capacity (product weight per square meter)	80 to 120 g	
Volatile matter 105-110°C (max)	75% loss by mass	BS 4164-1987
Drying time (dust free area)	See MANUFACTURER's instructions	
Life span: approx. (1) (20°C)	3 hours	
Application temperature	See MANUFACTURER's instructions	

(1) Life span is the maximum time between primer application and coating application after which the primer is considered as not fit for receiving the enamel coating.

5.2.2 Enamel

The enamel shall be selected so as to be compatible with:

- Pipeline operating temperature
- Ambient application, storage and installation temperature.

Taking into account the possible service temperature of the pipeline the specified enamels are the grades 120/5 of METROTECT or 916.10 of BITUMES SPECIAUX or equivalent or grade C bitumen enamel of PHONIX or equivalent.

The properties of the enamel shall satisfy the values given in Table 5.2.2.

Filler incorporated into the enamel shall be non-hygroscopic. The presence of calcium carbonate must be excluded and non-reactive with the other coating ingredients or with any environmental agents. It shall be stable at maximum application temperature.

Table 5.2.2

Grade property	Hotline enamel	Test method
Specific Gravity	mini: 1.40 maxi: 1.65	ASTM D71-52
Softening point	mini: 120°C maxi: 150°C	ASTM D 36-64
Viscosity: at 240°C/secs	9 - 24	BS 4164-1987 F
Filler (in %)	mini 25 - maxi 55	ASTM D271-64
Penetration	mini - maxi	
100 g - 5 secs 25°C	2 - 9	BS 4164-87 E
50 g - 5 secs 45°C	3 - 20	BS 4164-87 E
100 g - 5 secs 77°F	2 - 9	ASTM-D5
Sag-test 24 hours at 80°C	1.5 mm (max)	BS 4164-87 G
Peel test		
initial and delayed at 60°C	3 mm (maxi)	BS 4164-1987 L
at 70°C	3 mm (maxi)	
Low temperature		
No cracking or disbonding	6 hours at - 20°C	BS 4164-87 H

5.2.3 1st reinforcing layer (inner wrap)

The 1st reinforcing layer shall consist of an open structure continuous film of non-oriented glass fibres bonded by appropriate sizing and reinforced by longitudinal flat textile glass yarns placed at regular intervals over the full width of the film.

The reinforcing layer material shall meet the characteristics of Table 5.2.3.

Table 5.2.3

Grade property	Glass mat (reinforced)	Glass fabric.
Weight per square meter (minimum)	> 50 g	> 180 g
Thickness under 1 kg weight and 5 cm ² pressing	0.3 to 0.5 mm	
Thread spacing: • Warp • Weft	15 to 30 mm	< 3 mm < 6 mm
Tensile strength: • Warp • Weft	> 2.5 kg/cm > 1.2 kg/cm	> 8 kg/cm > 6 kg/cm
Flexibility	Wrap around 3 mm dia mandrel at 25°C without tearing	
Temperature without damage for bonding material	10°C greater than enamel application temperature	
Maximum bonding material in weight % of total weight	18	3

5.2.4 2nd reinforcing layer (outer wrap)

The outer wrap shall be of woven glass, saturated with coal tar (or bitumen) enamel and shall meet all the requirements set out in Table 5.2.4.

Table 5.2.4 - Outer wrap physical characteristics

Thickness (mm)	0.5 minimum
Minimum weight per m ² (g)	650 (if pre impregnated)
Glass fibre content	50 (g/m ²)
Tensile strength (N/50 mm) - Longitudinal - Transverse	400 minimum 180 minimum
Hydrolytic grade of glass (DIN 12111)	3
Tear Strength (N) Transverse	35 minimum
Filler content (%)	25 to 35
Bending	Samples shall exhibit no rupture - When bent 90° - Around a block as described in ASTM D 146 - After 10 mins immersion in water at 25°C

Note: A non woven outerwrap may be used but it shall have equal or superior longitudinal and transverse tensile and tear strengths. If a non preimpregnated outer wrap is used, the process of its application shall ensure a complete embedding of the outerwrap in the enamel without crack or reduced total coating thickness. The impregnation shall be coal tar if coal tar enamel is used or bitumen if bitumen enamel is used for the pipe coating.

5.2.5 Solar protection

It shall have a lime water base and shall be produced in accordance with the [AWWA C 203](#).

6. Application of base and repair materials

The coating shall be plant applied on each pipe.

6.1 Surface preparation

All rolling oxide film and annealing skin (scale) as well as any other adherent oxide shall be removed by abrasive blasting.

Before blasting, the pipe surface shall be inspected and cleaned to remove all dirt (old coating, paints, loose particles, grease, oil, etc.).

All traces of oil and grease shall be brushed and wiped off using xylol and using a clean cloth. The use of dirty or greasy cloths shall be prohibited.

If pipes have been left in a marine and/or polluted atmosphere they shall be subject to chemical cleaning before shot-blasting to remove all traces of chlorides and/or sulfides.

All moisture shall be removed by heating using a gas burner or a hot air blower.

Blasting shall be performed on dry surfaces using an automatic machine. Blasting shall not be commenced when:

- The surface is likely to be humid after surface preparation
- The surface temperature is less than 3°C above the surrounding air's dew point
- The air's relative humidity is greater than 85%.

In case the air's relative humidity is greater than 85%, the surface preparation by abrasive blasting may be performed if the pipes have been preheated so as to keep their temperature at least 3°C above the surrounding air's dew point until surface preparation, primer application and enamel applications are completed.

The surface finish of pipes shall meet at least Sa 3 degree of standard [ISO 8501-1](#).

The blasting grit and/or shot shall be selected so that maximum roughness obtained ranges from 30 to 100 microns.

Just before primer application, all dust or grit blast shall be removed from pipe surface.

All pipes shall be primed within two hours of blasting. They shall not be allowed to stay in moist atmosphere. All moist pipes shall be reblasted. Any pipe not primed within two hours after blasting shall be reblasted.

6.2 Application of primer

Primer shall be applied by spraying at ambient temperature in compliance with the technical instructions and wet thickness as specified by the MANUFACTURER (paragraphs 4.2 and 5.2.1).

If at the time of primer application, the pipe surface temperature is below 7°C or if the relative humidity exceeds 80%, the pipes shall be reheated at a temperature of 35°C maximum without direct contact with flames, if any.

The use of primer contaminated by foreign matters or thickened due to solvent evaporation shall be prohibited. The primer viscosity shall always be within the limits given in Table 5.2.1 of this specification.

The primer shall in no case be diluted with solvent or heated to a temperature above 35°C.

The spray gun shall include a pressure holder equipped with a mechanical agitator and a filter to separate oil and moisture from the air feed.

The primer coat shall be uniform and free of runs, overthickness, holidays or bare spots.

6.3 Application of reinforced enamel

The enamel shall be applied mechanically by the pouring method which consists in pouring the molten coal tar enamel over the rotating pipe from a flood box while the inner wrap reinforcement is being unwound.

The heating and transfer kettles shall be provided in sufficient number so that coal tar enamel heating can match the application rate.

Kettle heating shall be indirect fire. All kettles shall be equipped with mechanical agitators, temperature indicators/recorders, thermostats and temperature alarms.

The MANUFACTURER's instructions (paragraph 4.2) concerning:

- Minimum and maximum temperature of coal tar enamel in heating kettles, (200 to 260°C maximum for 120/5, 140 to 210 C maximum for 916.10)
- Minimum and maximum temperature for hydrocarbon base enamel application, (235 to 260°C for 120/5, 140 to 200°C for 916.10)
- Maximum time coal tar enamel may be held at application temperature

shall be strictly complied with.

If the maximum recommended temperature has been exceeded, the enamel shall be sampled and tested for softening point and penetration. The acceptance criteria shall be the tolerances stated on the MANUFACTURER's data sheets and summarised in the Table 5.2.2 above. Failing this the overheated enamel shall be rejected.

At the end of each shift, all kettles shall be emptied and cleaned. The product removed from kettles shall in no case be reused.

The coal tar enamel shall be applied to a dry, non friable, perfectly clean and moist free primer coat.

The inner wrap reinforcement shall be wrapped simultaneously with the pouring of molten coal tar enamel. The inner wrap reinforcement shall be embedded in the coal tar enamel at equal distance from the metal surface and coating surface. The applied tension shall be adequate to permit the inner wrap embedding before cooling or hardening of the enamel.

The inner wrap shall be wide enough to ensure uniform and regular spiral wrapping with minimum overlap of 25 mm.

6.4 Application of the outerwrap

The outerwrap shall be spirally applied mechanically over the still hot and soft coating avoiding folds and air pockets and ensuring adhesion to the underlying coal tar enamel.

The outerwrap width shall be adequate to permit uniform and regular spiral wrapping, with an overlap of 25 mm minimum.

6.5 Application of repair materials

All defects detected by the holiday detector and damaged coating areas not over 1500 cm² in size resulting from destructive testing or mechanical accidents shall be repaired by means of the inner wrap reinforcement impregnated with coal tar enamel as defined in paragraphs 5.2.3 and 5.2.2 respectively.

Repairs shall be made after cleaning of the defective area and bevelling of the adjacent coating.

The repaired coating shall meet the thickness and electrical porosity requirements as defined in paragraph 7.3.

6.6 Application of the solar protection coat

After coating inspection and before storage the solar protection coating shall be applied either by brush or by spraying.

The solar protection shall be applied to 100% of the coating surface. No solar protection shall be applied on to the bare pipe ends.

7. Characteristics of coating

The coating shall meet the characteristics set forth in this chapter according to the following methods and acceptance criteria.

7.1 Appearance

The final coating shall be free of folds, air pockets, voids or any other defect detrimental to its quality.

7.2 Composition

The two reinforcement wraps shall be separated by a 1.5 to 3 mm thick enamel coat. At no point shall either reinforcing wrap be less than 1.0 mm from the metal surface and coating surface.

Each reinforcement wrap shall be free of folds and air pockets.

The overlap of the successive spiral windings of the mechanical protection wrap and double inner wrap shall not be less than 50 mm.

7.3 Thickness

The final coating thickness, shall not be less than 3 mm on pipe and on the weld seam for onshore pipelines unless otherwise specified (in the particular specification) and not less than 6 mm on pipe and 4.5 mm on the weld seam for offshore pipelines.

7.4 Cut-backs

200 mm $\pm$ 10 mm cut-backs shall be provided at each pipe end and the adjacent coating shall be smoothly bevelled over approximately 25 mm, unless a shorter cut-back is specified otherwise.

8. Testing and acceptance methods - Acceptance criteria

Coating acceptance by the COMPANY is governed by:

- Performance of quality controls by the Applicator
- Performance of a specified number of acceptance examinations by the Inspector
- Laboratory testing, if requested, by the COMPANY or the Engineer of the coating's compliance with this specification.

If the coating does not satisfy these requirements and upon a counter check, the COMPANY may refuse the coating.

8.1 Quality control by the Applicator

The following quality control procedures to be performed by the Applicator are mandatory.

8.1.1 Quality control of the materials

The Applicator shall ensure that the delivered products meet:

- The technical specifications given by the MANUFACTURER
- The requirements of this specification.

8.1.2 Continuous checking of the application measurements

The Applicator shall make continuous measurements of:

- The surface preparation, cleanliness and profile
- The primer and coal tar enamel viscosities
- The application temperatures
- The coating thicknesses
- The reinforcement positions
- Adhesion (bond) of the coating to the pipe.

In addition, he shall ensure that ambient conditions (relative humidity, temperature, etc.) are satisfactory for applying the coatings.

8.1.3 Checks made on pipes during surface preparation and coating application operations

a) Each coated pipe shall be submitted to:

- A visual examination
- A thickness check
- An edge inspection
- A holiday detector inspection.

b) The first five (5) pipes coated each day shall be submitted to:

- A surface preparation roughness check
- A visual examination
- A thickness check
- An edge inspection
- A holiday detector inspection
- An adhesion test
- A coating appearance and composition examination.

c) Routine checks frequency shall be:

- Surface preparation roughness check: 1 pipe every 5 prepared pipes
- Adhesion test: 1 pipe every 10 coated pipes
- Coating appearance and composition: 1 pipe every 10 coated pipes.

Note: The adhesion test and the coating appearance and composition examination may be carried out on the cut back area in order to avoid repairs. If the tests results are not acceptable, the tests shall be remade at least one meter from the pipe ends. If necessary, the pipe coating shall be repaired by the Applicator and at his cost.



d) Possible additional tests:

In addition, the Inspector may request that test specimens be removed from the pipes sampled for routine checks to:

- Check spiral overlapping
- Check location of the reinforcement within the coating
- Send specimens for laboratory analysis of the coating's properties.

The test specimens shall be taken at least one meter from the pipe ends.

If necessary, the pipe coating shall be repaired by the Applicator and at his cost.

Notes:

- If the coating is applied on line (on site), the entire pipeline shall be visually examined and checked with a holiday detector
- Thickness shall be measured every five pipe diameter unless otherwise specified
- Adhesion and composition shall be checked every 10 pipes unless otherwise specified.

8.2 Inspection by COMPANY or appointed inspector

The appointed Inspector shall be notified by the Applicator at least 15 days in advance of the beginning of coating operations.

The Applicator shall allow free access to the Inspector at his workshops, storage areas and laboratory for the duration of the operations.

The Applicator shall provide upon the Inspector's request all means necessary for the accomplishment of the latter's duties (office, telephone, use of telex handling equipment, testing equipment, labour, a suitable lighting area 500 Lux minimum, etc.).

The Applicator shall submit examination and test reports to the Inspector, as work progresses, or the checks required by paragraph 8.1 herebefore.

The Inspector shall indicate those pipes to be submitted for testing as per 8.1.3. These checks shall be performed in the presence of the Inspector.

If quality control results are not satisfactory, the Inspector may request quality control of five different pipes that he has chosen, generally those immediately preceeding or following the defective ones.

The Inspector may request cutting of pipe sections for laboratory examination. He may also take specimens from the coating materials for laboratory analysis.

The Inspector must make the arrangements for these checks.

The absence of the Inspector must not stop coating operations unless Applicator notice was too short.

8.3 Laboratory tests

The COMPANY may have laboratory tests performed in a laboratory independent from that of the Applicator's, to determine:

- Materials compliance with requirements to the present specification



- Coating compliance with the requirements of this specification or the particular specification.

The results of these tests shall be made known to the Applicator.

If the results are not conclusive, the Applicator may be requested to proceed, at his expense, with a counter-check by another independent laboratory.

8.4 Quality control methods and frequency

Coating properties shall be tested by the Applicator and independent laboratories in accordance with the methods hereafter.

8.4.1 Properties of the base products

All properties listed in Chapter 5.2 shall be checked by the Applicator in accordance with the procedures of Chapter 5.2.

Other methods may be proposed by the Applicator and the laboratories. They shall be responsible for establishing the results conversion tables.

If quality control methods are not given in the table of Chapter 5.2 the Applicator will propose a method which shall have to be agreed by the COMPANY. Inspection shall be performed on each manufacturing batch of the base products.

Samples of material submitted to quality control tests shall be taken at random from each batch.

Part of these samples shall be made available to the Inspector and the Applicator for further tests, if required.

8.4.2 Coating properties

8.4.2.1 Appearance

Frequency of checks is given in § 8.1.3.

Coated surfaces shall be visually inspected in their entirety.

The finished coating shall be free of folds, puckering, dents or any other injurious defect.

All pipes coated in factory or on permanent sites having a surface defect level of more than 10% shall be rejected and the coating entirely remade to the requirements of this specification.

If defect surface is less than 10% the coating shall be repaired according to the procedure given by the Inspector.

For coatings made on line, the fault shall be removed and the coating repaired by hand in accordance with a procedure to be defined in agreement with the Inspector.

8.4.2.2 Surface preparation roughness

Frequency of checks is given in § 8.1.3.

Roughness shall be checked using "Press-o-Film" patches of TESTEX. Readings shall be in the range 30-100 microns. Below 30 microns the pipe shall be reblasted for increasing the roughness.

8.4.2.3 Thickness

Frequency of checks is given in § 8.1.3.



Thickness shall be checked on each pipe on points defined by the Inspector, using magnetic equipment such as the Elcometer Inspection Gauge; all measurements shall be included in the report.

The instrument's calibration shall be checked every hour. All coating whose thicknesses are not within the tolerances required by the project specification shall not be accepted.

The coating shall be retouched, in each case, in accordance with the Inspector's instructions.

8.4.2.4 End edges

Frequency of checks is given in § 8.1.3.

All pipes ends coated in the factory or on permanent sites shall be checked with calibrated gauges. Edges not within tolerances required shall be retouched or repaired.

8.4.2.5 Holiday Detector Examination

Frequency of checks is given in § 8.1.3.

All coated surfaces shall be examined with a holiday detector for porosity.

The holiday detector voltage shall be set at 3,000 V minimum per mm of coating thickness i.e. 10 kV for a 3 mm coating and 18 kV for a 6 mm coating.

The detector voltage shall be checked before and every 4 hours during working shifts.

All defects shall be clearly marked with a white non wax crayon.

After all repaired surface has dried, it shall be reexamined until all defects have been repaired.

All repairs shall be made to the satisfaction of the Inspector. All repairs shall be holiday detected in accordance with the above procedure.

8.4.2.6 Adherence check

Frequency of checks is given in § 8.1.3.

Adhesion tests shall be made to determine the proper bond between the coal tar coating and the properly primed pipe. The test shall be performed between 10 and 27°C, 48 hours after coating application. If the pipe and coating temperature is outside the range (10-27°C), hot or cold water shall be poured over the test area until this temperature range is attained. A test area shall be selected by the Inspector where the coating is smooth for 150 mm in both directions. Two knife cuts that are 150 mm long and 50 mm apart shall be made through the tape. A flat blade shall be used to pry up 50 mm of the coating. This 50 mm flap of coating shall be grasped firmly in one hand and shall be pulled with a quick motion in the direction of the remaining 100 mm of the 150 mm knife cut.

The adherence is satisfactory if (1) the coating tears at the point of stripping or (2) the reinforcing layer (inner wrap or outerwrap) strips from the underlying coal tar component leaving exposed no more than 10 percent of the primer or metal.

8.4.2.7 Appearance and composition check

The frequency of this check is given in 8.1.3.

This test consists of cutting a transversal section in the coating with a cutter, removing the coating from the metal and examining uniformity, checking for any bubbles or blisters, the



number of reinforcement layers and their position in the coating thickness and the estimated length of successive spirals.

The coupons cut for the adherence check can be used for this test.

8.5 Coating acceptance criteria

Coatings shall not be accepted unless all test results are satisfactory.

Pipes rejected upon a first examination shall be retested after repair and shall not be accepted until further test results are satisfactory.

8.6 Residual magnetic intensity

The residual magnetic intensity shall be below 3 milliTesla (or 30 gauss), measured on the cut-backs at each line pipe end.

8.7 Documents to be submitted

Coatings applied in factory or on stationary bases, shall be certified as having satisfied the requirements of this specification and the special specification by:

- A "factory" acceptance certification, signed by a duly authorised agent of the Applicator's Quality Control Department; the certificate shall contain all test and examination results and attest that tests and examinations were performed on samples from the order
- An acceptance certificate signed by the Inspector containing all the results of tests and examinations performed in his presence attesting that the tests and examinations were performed on samples from the order.

9. Repairs

If coating has been damaged in handling, the damaged area shall be repaired in order to obtain identical characteristics of the initial coating.

The defects observed by COMPANY shall be repaired in the presence of the COMPANY's representative.

Where primer coat is missing or insufficient, the pipe shall be wire brushed to ST 3 standard SIS 05 5900 Specification and a new primer coat shall be applied and allowed to dry for the required time. In case of problems due to rain, the pipe may be dried using a brazing torch before new primer coat application, but the temperature shall be such that it can always be touched with bare hands.

Coating areas where thickness is insufficient or showing pinholes or that are peeled off shall be cut out and repaired by standard procedures.

10. Handling, shipping and storage rules

When pipes are coated in factory or on stationary base, the Applicator shall ensure unloading of bare pipes, their storage and handling until and including their loading onto shipping vehicles.

He is therefore held responsible for any damage to the pipes during the above period.

He shall therefore:

- Inspect the pipes upon arrival to make sure they were not previously damaged
- Take adequate steps to prevent their being damaged.

11. Precautions for welding and bending

11.1 Welding

No particular precaution shall be taken. In case of heavy wall pipe wet rugs shall be used in order to cool down the pipe near the coating edge.

11.2 Bending

Where coating becomes damaged or detached on any bend made after completion of the coating, the coating shall be stripped off until sound coating is found. Then the area shall be recoated using enamel and reinforcing material as per paragraph 6. The newly made coating shall be checked for thickness and holiday as per paragraph 8.

12. Coating of the field joints - Coating repair on job site

12.1 Field joints offshore, for pipes with concrete weight coating

The use of P.V.C. cold applied tapes is recommended. The main characteristics of the P.V.C. tape shall satisfy Table 12.4 Values.

The following procedure shall be adhered to:

- After welding, the area shall be cleaned with a powered brush until a ST 3 degree of cleanliness is achieved
- A thin coat of compatible primer shall be applied, **only if no marine mastic or mastic asphalt is poured over the P.V.C. tape** in order to make the field joint flush with the concrete weight coating. Allow the primer to dry. If marine mastic is used no primer is needed
- A 450 mm wide P.V.C. tape shall be applied in a single continuous layer, cigarette wrap, centred on the line of the weld. Application shall be commenced at the 11 o'clock position
- A 100 mm wide P.V.C. tape shall be applied in a single continuous layer, cigarette wrap, at each extremity of the 450 mm tape, overlapping it by 50 mm minimum and the enamel coating by at least 25 mm
- The field joint coating shall be checked for absence of holiday as per paragraph 8. The first 100 field joints shall be tested for holidays then 5% of the field joints shall be tested for holidays. If one of the checking shows the presence of holidays the next 100 field joint shall be holiday tested
- To fill the gap between the corrosion protective coating and the concrete, the field joint area shall be encapsulated with a galvanised steel sheet, marine mastic or mastic asphalt shall be poured, **the mastic temperature shall not exceed 200°C.**

Alternate solution to marine mastic such as polyurethane foam or fast curing concrete may be proposed by the pipe laying CONTRACTOR subject to approval by COMPANY.

The CONTRACTOR shall submit a detailed procedure of application for COMPANY examination.

12.2 Field joints offshore, for pipes without concrete weight coating

The method described, below, for the field joint onshore should be used. The use of heat shrinkable sleeve could be acceptable if the heating requirement is such that the enamel will never reach the melting temperature minus 20°C. The CONTRACTOR shall submit a detailed procedure of application for COMPANY examination.

12.3 Field joint onshore

12.3.1 Use of reinforced enamel tapes

The following procedure shall be adhered to:

- After welding, the area be cleaned with a powered brush until a St 3 degree of cleanliness is achieved
- A thin coat of compatible primer shall be applied. The primer shall be allowed to dry completely
- The reinforced enamel tape heated with a torch to surface melting temperature shall be applied onto the primer surface. The overlapping between tapes shall be 50%
- The field joint coating shall be checked for absence of holiday as per paragraph 8.

12.3.2 Use of P.V.C. cold applied tapes

The following procedure shall be adhered to:

- After welding, the area shall be cleaned with a powered wire brush until a St 3 degree of cleanliness is achieved
- A thin coat of compatible primer shall be applied. The primer shall be allowed to dry completely
- A 150 mm wide P.V.C. tape shall be spirally wrapped over the primed surface employing a 50% overlap on the sound coating and over itself and using sufficient tension to ensure complete conformability. The main characteristics of the P.V.C. tape shall satisfy Table 12.4 Values
- The field joint coating shall be checked for absence of holiday as per paragraph 9. The first 100 field joints shall be tested for holidays then 5% of the field joints shall be tested for holidays. If one of the checking shows the presence of holidays the next 100 field joint shall be holiday tested.

12.4 Field repairs

Damaged coating areas not over 1500 cm². Shall be repaired as instructed in paragraph 6.5.

In case damage exceeds 1500 cm² in size, the coating shall be totally removed around the damaged area plus 20 cm around or until a good adhesion between steel and coating. The edge of the sound coating shall be bevelled over 25 mm minimum. The area shall be cleaned with a powered brush until a St 3 degree of cleanliness is achieved. Then a new coating shall be applied as per paragraph 6 using enamel and reinforcing material. The newly made coating shall be checked for thickness and holiday as per paragraph 8.

Table 12.4

Characteristics	Standards	Units	Acceptable Mini. Values
Adhesion to steel	ASTM 1000	N/cm	27.5
Adhesion to self	ASTM 1000	N/cm	27.5
Cathodic disbonding	ASTM G8	mm radius	< 10
Tensile strength	ASTM D 638	N/mm ²	16.10
Elongation	ASTM D 638	%	> 200
Insulation resistance		OHMS x cm ²	10 ¹²
Impact resistance	ASTM G 13	Drops	> 20
Tape thickness			
Adhesive		mm	0.90
P.V.C. Carrier		mm	0.75
Total		mm	1.65