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TECHNICAL JOB SPECIFICATION

834/1

REVISION 0

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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

PLANT – APPLIED EXTERNAL 3-LAYER POLYETHYLENE LINE PIPE COATING

QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

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CONTENTS

REFERENCE DOCUMENTS

Job Spec. No. 171/1
[Steel Pipe]

ELOT EN 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]

EN ISO 21809-1
[Petroleum and natural gas industries - External coatings for buried and submerged pipelines used in pipeline transportation systems - Part 1: Polyolefin coatings (3-layer PE and 3-layer PP)]

1.0 SCOPE

1.1 ITEM

This specification defines the minimum requirements for the surface preparation, coating application, inspection and handling of plant-applied three layer polyethylene (PE) coating of pipes; the minimum requirements for the epoxy primer, extruded adhesive, extruded polyethylene outer layer and the applied coating; and the minimum requirements for repair of pipe coating.

1.2 SERVICE TEMPERATURE

The service temperature of the pipeline will be from -5° C to +50° C. However, coated pipes may be stored at ambient temperatures down to -20° C and with a surface temperature up to 80° C under the sun.

2.0 GENERAL REQUIREMENTS

2.1 GENERAL

A record of pipe serial numbers shall be kept for Owner's information. This record shall contain all information on the delivered pipes, i.e. lengths, damages, cuts, repairs, transfer of serial numbers, coated stock, bare stock, scrap.

These records shall be available at all times for review of the Owner. Upon completion of coating operations the Contractor shall satisfactorily account for all materials or shall reimburse the Owner for the full cost of any materials not balanced.

All coating materials, production and repair procedures as well as test methods shall be approved by the Owner before coating starts.

Coating application procedures shall be documented and monitored by the Contractor. Written records shall be maintained by qualified personnel.

The procedures shall include:

- Surface preparation, including number, type and size of cleaning machines, grades and types of abrasive, removal of steel defects, cleanliness, surface profile and methods of measurement.
- Complete details of the coating materials, together with quality control and manufacturer's certification sheets and of materials storage, which shall be in accordance with the manufacturer's recommendations.
- Application of coating, including details of application temperatures, curing times and methods, cutback and beveling methods and acceptable prevailing working conditions (humidity, dust and temperature).
- Inspection and testing, including instrument and equipment types, makes and uses.
- Details of instrument and equipment calibration methods, including relevant standards and examples of calibration certificates.
- Coating defect repair methods and materials.
- Storage, handling and transport procedures for both bare pipes and coated pipes.

2.2 STANDARDS

Coating shall conform to the requirements of **EN ISO 21809-1** and the requirements specified herein.

The coating shall fulfill the requirements given for coating **class A, LDPE** as per **EN ISO 21809-1**.

2.3 COATING THICKNESS CLASS

The coating thickness class, according to **EN ISO 21809-1,** shall be **A2** (for moderate duty). The minimum coating thickness shall be as per Table 2, **EN ISO21809-1** for **class A2.**

3.0 SURFACE PREPARATION

3.1 INITIAL CLEANING

All weld spatter, grease, oil, etc, shall be removed prior to blasting.

In case of presence of chlorides the pipes must be washed prior to preheating for blasting.

If a chemical cleaner is used, subsequent washing with potable water is required.

3.2 BLAST CLEANING

The pipe surface shall be preheated dried before blast cleaning.

The ends of the pipe shall be protected with plugs so as to prevent entry of abrasive into the pipe during the blast cleaning.

Alternatively the Contractor may propose to link the pipes together to prevent entry of abrasive.

Unless otherwise agreed, surfaces shall be cleaned by abrasive blasting to at least degree SA 2 1/2 according to **EN ISO 8501-1.** Angular sharp grit or a mixture of grit and shot shall be used. Shot applied alone is not accepted. Blast cleaning abrasives shall be agreed with the Owner. The use of sand is not permitted. After blast cleaning, the surface profile shall have an average peak to trough height of 40 μm and a maximum of 75 μm. Dust on the pipe exterior shall be removed directly before coating by a method which is approved by the Owner, for example compressed dry air assisted by vacuum cleaning.

Blasting abrasives shall be kept dry, clean and free from contamination. Airlines shall be filtered to remove oil and moisture. Blasting abrasive shall be cleaned by a dust extraction system, which removes fine particles the size of which will be determined after the initial site testing.

When recovered metallic grit systems are used, a stabilized working mix of blast cleaning material shall be established and maintained throughout the entire course of the production by frequent small additions from fresh or cleaned stock at a rate sufficient to replenish consumption. Large additions of new material shall be avoided. Report verifications of the mix quality shall be submitted to Owner by the Contractor.

Blasting and other dust producing areas shall be kept separate from coating application areas.

The blast-cleaned surface shall not be contaminated with dirt, dust, metal particles, hydrocarbons, water, or any other foreign matter, which is detrimental to the coating.

3.3 SURFACE INSPECTION

The metal surface shall be inspected after blast- cleaning under adequate lighting from both ends and all slivers, scabs, burrs, gouges, sharp edges in welding area, etc, made visible shall be removed by grinding. Grinding which reduces the pipe wall thickness below the nominal wall thickness minus the permissible negative pipe-manufacturing tolerance is not permitted.

Pipe lengths containing a dent shall be set-aside for the Owner's Representative to determine its disposition. Gouges in a dent shall not be ground.

The pipe surface shall be uniform throughout before coating.

Coating shall take place quickly after cleaning and before any contamination or rust blooming appear. If the surface shows any contamination or rust blooming, the surface shall be blast-cleaned again.

Pipes, which have not been coated within three hours, shall be reblasted.

Blast cleaning shall be suspended if the pipe surface temperature falls 3° C below the dew point.

4.0 MATERIALS

4.1 GENERAL

The 3-layer polyethylene coating system shall consist of:

- One fusion bonded epoxy powder primer coat.
- One adhesive coat.
- One extruded polyethylene outer coat.

The manufacturer, trade name and data sheet for the coating materials proposed by the Contractor shall be approved by the Owner prior to the placing of any order for coating work.

The coating materials shall be handled, stored and applied in accordance with the manufacturer's specifications, or as directed by an authorized representative of the coating manufacturer.

Materials used are to be demonstrated either on independent test certificates (not older than 1 year) or during the pilot production period of the plant.

The Contractor shall obtain from the manufacturer and submit to the Owner:

- The guarantee that the epoxy primer material, the adhesive material, the polyethylene and the repair products delivered shall meet the coating characteristics of this specification.
- Production test certificates each for the epoxy undercoat material, the adhesive material and the polyethylene.
- For epoxy powder, one test certificate shall be submitted per batch, including results of the tests defined in this specification. The certificate shall be in conformity with the specified methods and acceptance values.
- Standard infrared scan of epoxy powder for each production batch and a

certificate indicating that this complies with the normal scan for the product.

- Major epoxy powder application data.
- Substrate temperature.
- The maximum time interval during which the adhesive has to be applied.
- Packaging and storage requirements of epoxy powder and repair products.
- Details of marking on each package of powder and repair product including:
  - Manufacturer's name,
  - Place of manufacture,
  - Complete identification of powder and repair product,
  - Production batch or cast number,
  - Date of production,
  - Time limit for use,
  - Any special safety or storage instructions relevant to the batches,
  - Conditions of application of any repair products.

4.2 EPOXY PRIMER

Approved fusion bonded epoxy powder primer compatible with the adhesive shall be used.

Epoxy Powder and Adhesive material shall be products of the same manufacturer.

Unless otherwise agreed, the selected epoxy powder shall meet the requirements of paragraph 8.3, Table 3, **EN ISO 21809-1**, for Class A.

EPOXY POWDER RAW MATERIAL REQUIREMENTS

PARAMETER	TEST METHODS	UNITS	REQUIREMENTS
Density	ELOT EN ISO 2811	g/cm^3	As per manufacturer's spec. ±0.05
Gel time	Annex K, EN ISO 21809-1	Sec	Within 20% per manufacturer's spec.
Moisture content (by mass)	EN ISO 21809-2	%	≤ 0.6
Glass transition temperature	Annex D, EN ISO 21809-1	°C	≥ 95
Residual heat	Annex D, EN ISO 21809-1	Cal/g	As per manufacturers spec.

4.3 ADHESIVE

Unless otherwise agreed, the adhesive shall meet the requirements of paragraph 8.4, Table 4, **EN ISO 21809-1,** for Class A.

ADHESIVE RAW MATERIAL REQUIREMENTS

PARAMETER	TEST METHODS	UNITS	REQUIREMENTS
Elongation at break at 23°C	ELOT EN ISO 527	%	≥ 600
Strength at yield point at 23°C	ELOT EN ISO 527	MPa	≥ 5
Notch impact strength	ELOT EN ISO 179	KJ/m^2	---
VICAT Softening temperature	ELOT EN ISO 306	°C	≥ 60
Water content	ELOT EN ISO 15512	%	≤ 0.1

4.4 EXTRUDED POLYETHYLENE

The polyethylene material shall meet the requirements of paragraph 8.5, Table 5, **EN ISO 21809-1,** for Class A.

POLYETHYLENE MATERIAL REQUIREMENTS

PARAMETER	TEST METHODS	UNITS	REQUIREMENTS
Density	ELOT EN ISO 1183	g/cm^3	≥0.920
Strength at yield point at 23°C	ELOT EN ISO 527	MPa	≥ 10
Elongation at break at 23°C	ELOT EN ISO 527	%	≥ 600
Hardness Shore D	ELOT EN ISO 868	---	≥ 100
VICAT Softening temperature	ELOT EN ISO 306	°C	≥ 95

The Material shall, in addition to satisfying the production test requirements covered by **section 6.6,** be suitably stabilized against thermal and UV effects as per **Annex G, EN ISO 21809-1** to withstand open air storage at the conditions specified in **section 1.0** for a period of at least 1 year.

4.5 REPAIR MATERIALS

The Contractor shall present details of proposed repair materials to the Owner for approval. This information shall be submitted together with the relevant repair

procedures.

The repair materials shall be such that the completed repair ensures a coating quality conforming to the requirements specified in this specification.

5.0 COATING APPLICATION

5.1 GENERAL

Prior to the commencement of full production the Contractor shall carry out a qualification test on lengths of line pipe to be coated to demonstrate that the coating applied in accordance with the Contractor's proposed procedures complies with the requirements of this specification.
Production coating will commence only after all qualification tests including Cathodic Disbonding tests have been approved by the Owner.

Long-term test results (thermal aging, electrical resistance, UV exposure etc) at this stage can be covered by test results conducted by Independent Accredited Laboratories taken from line pipe production (with same raw materials) from previous orders of the Applicator.

The pipes shall be coated on a continuous coating line without any risk of damage to the pipe (external pipe wall, bevels, coating) during the heating, coating, curing and quenching operations.

5.2 HEATING

The heating equipment shall be suitably controlled to maintain uniform temperatures and to achieve the required uniform temperatures along the total length of the pipe and it shall be such that it will not result to any contamination of the steel surface.

5.3 EPOXY PRIMER

The primer shall be applied immediately after the final preheating, including drying, is terminated.

The pipes shall be heated to obtain a pipe temperature as recommended by the powder manufacturer.

The epoxy powder shall be sprayed using electrostatic spray guns. The thickness of the coat shall be a minimum of 60 μm. The coating film shall be smooth, and uniform.

The pipe ends shall be left unprimed to a length of 50 mm.

5.4 ADHESIVE

The adhesive coat shall be applied by an extrusion process immediately after the epoxy undercoat has been applied.

The thickness of the adhesive shall be a minimum of 250 μm. The adhesive film shall cover the entire steel surface.

5.5 EXTRUDED POLYETHYLENE

The extruded polyethylene coat shall be applied by extrusion process.

The temperature during extrusion shall be as recommended by the manufacturer.

The number of wrap and the over-lapping shall be such that the polyethylene coat thickness achieved shall meet the requirements of **EN ISO 21809-1,** for **Class A.**

The coating shall be pressed by pressure rollers in order to avoid any air inclusions.

When coating is completed, the pipe shall be cooled with water to such extend where damage of the coating from further plant transportation and handling cannot occur. During cooling, the pipe shall be handled so as to avoid damage to the coating.

Overlap of the coatings shall be at least 50 mm.

5.6 CUT-BACKS

The coating shall be cut-back immediately after cooling, and surplus material shall be removed.

The epoxy, adhesive and polyethylene layers shall be totally removed, removed length shall be 150 mm ± 20 mm.

The remaining coating shall be beveled to approx. 30° to ensure proper void-free bonding of field-applied joint coating.

The cutback prepared will be protected against ingress of moisture and rust by application of a temporary protection system compatible to the welding (organic phosphate or equivalent).

6.0 INSPECTION AND TESTING

6.1 GENERAL

An office and all necessary facilities required for the performance of his work shall be made available to Owner's Representative by the Contractor.

Inspection and testing shall be carried out according to detailed Table 9, **EN ISO 21809-1** by the Contractor and, unless otherwise agreed, in the presence of the Owner's Representative.

It shall include the following operations:

- Inspection of raw materials.
- Systematic inspection of pipe surface preparation.
- Inspection of application parameters.
- Systematic inspection of coated pipes.
- Production testing.

The Owner's Representative may check any pipe for conformity to any requirement specified in this specification. He may take samples of the coating materials or repair product and specimens of coated pipe(s) for testing in laboratories selected by the Owner in order to check the quality of the testing products. He shall also have the right to select the pipes to be tested.

The following properties will be checked according to detailed Table 9, **EN ISO 21809-1:**

- Surface before blasting
- Surface after blasting
- Environmental conditions
- Pipe temperature before blasting

- Size, shape and properties of abrasive
- Water soluble contamination of abrasives
- Surface roughness of blasted surface
- Visual inspection of blasted surface
- Presence of dust after dust removal
- Elapsed time between blasting and coating
- Temperature of extruded adhesive
- Preheating temperature before coating
- Minimum epoxy thickness
- Minimum adhesive thickness
- Degree of cure
- Appearance and continuity
- Total thickness of coating
- Impact resistance
- Peel strength
- Indention
- Elongation at break
- Cathodic disbondment
- Flexibility
- Hot water soak test
- In process degradation of PE
- Pipe and preparation
- Coating repairs

6.2 INSPECTION OF RAW MATERIALS

Upon delivery, the packaging and markings thereon shall be checked. Packaging shall be in accordance with the manufacturer's instructions and marking shall be in conformity with **EN ISO 21809-1** requirements.

Non-conformity with any of the specified requirements shall cause the immediate rejection of the delivery concerned.

Three 50 g samples of each coating material shall be taken for reference purposes from the production batches. One shall be retained by the Contractor, one shall be transmitted to the Owner and one shall be kept as a check sample in the Contractor's laboratory for six months, away from humidity, at a temperature below and close to 20°C.

6.3 INSPECTION OF PIPE SURFACE PREPARATION

6.3.1 FINISH OF PREPARED SURFACE

6.3.1.1 STANDARD

ELOT EN ISO 8501-1.

6.3.1.2 METHOD

Visual comparison of prepared surface finishes with the illustration corresponding to Sa 2 1/2 surface finish.

6.3.1.3 INSPECTION
Each pipe.

6.3.1.4 ACCEPTANCE LEVEL

The inspection of each pipe shall be considered as accepted when the whole prepared surface shows the same aspect as the relevant illustration.

6.3.1.5 CORRECTIVE ACTION
Reblasting.

6.3.2 EXTENT OF DUST ON PREPARED SURFACE

6.3.2.1 EQUIPMENT
Adhesive tape.

6.3.2.2 METHOD

EN ISO 8502-3

Application of the adhesive tape on the prepared surface, removal, sticking of the tape to white paper, and visual comparison to a reference sample.

6.3.2.3 INSPECTION FREQUENCY
Every 1 hour.

6.3.2.4 ACCEPTANCE LEVEL

Equal to or better than the reference sample.

The reference sample shall be considered as accepted when the proportion of adhesive surface, showing dust particles is less than those for a test panel approved by the Owner prior to production.

6.3.2.5 CORRECTIVE ACTIONS
Recleaning.

6.3.3 TOTAL ROUGHNESS OF PREPARED SURFACE

6.3.3.1 EQUIPMENT

Electric micrometer equipment.

6.3.3.2 METHOD

Measure the profile height with an electronic micrometer.

6.3.3.3 INSPECTION FREQUENCY
Every 1 hour.

6.3.3.4 ACCEPTANCE LEVEL

The condition of each pipe shall be considered as acceptable when 4 values have

an average of 50 µm with a maximum of 100 µm. If any value(s) are outside the above, an additional measurement shall be made around each point concerned.

The total roughness value obtained from the new measurements shall be as specified above.

6.3.3.5 CORRECTIVE ACTIONS

If the values measured are not as specified above reblast.

6.4 INSPECTION OF APPLICATION PARAMETERS

6.4.1 PIPE TEMPERATURE AT START OF COATING

6.4.1.1 EQUIPMENT

Optical pyrometer, calibrates by "Tempil sticks" temperature recorder, or monitor.

6.4.1.2 METHOD

Specific to the instrument used which shall be calibrated at least twice per shift by "Tempil Sticks".

6.4.1.3 EXTENT OF INSPECTION
Continuous over total pipe length.

6.4.1.4 ACCEPTANCE LEVEL

Pipe temperature range as specified by epoxy and adhesive manufacturer.

6.4.1.5 CORRECTIVE ACTIONS

Rejection of pipes coated outside specified temperature range.

6.4.2 SPEED OF PIPE TRAVEL

6.4.2.1 EQUIPMENT

Contractor's choice.

6.4.4.2 METHOD

Specific to the equipment used which shall be calibrated at least twice per shift.

6.4.2.3 EXTENT OF INSPECTION

Continuous during pipe travel along the coating line.

6.4.2.4 ACCEPTANCE LEVEL

The inspection of pipe travel speed shall be considered as acceptable when the measured speed conforms to the approved procedure.

6.4.2.5 CORRECTIVE ACTIONS
Intensified check of coating thicknesses. Correction of pipe travel.

6.4.3 PLANT TEMPERATURE

6.4.3.1 EQUIPMENT AND RECORDER
Contractor's obligation.

6.4.3.2 METHOD

Specific to the instruments used, calibrated according to manufacturer's instructions.

6.4.3.3 EXTENT OF INSPECTION
Once per 4 hours.

6.4.3.4 ACCEPTANCE LEVEL

As required in section 3 of this specification.

6.4.3.5 CORRECTIVE ACTIONS

Correction of variant parameter and, at the judgment of the Owner's Representative, rejection of pipes coated since last acceptable test.

6.5 INSPECTION OF COATED PIPES

6.5.1 GENERAL

Equipment, methods, extent and acceptance criteria shall be as per **EN ISO 21809-1**, with the additional requirements outlined below.

If the results of one or more tests do not conform to the specified requirements, additional tests shall be run at the rate of two per defective test, respectively on the pipe coated immediately prior and after the pipe found to be defective.

If the additional tests are acceptable, the coating of the pipes shall be considered to be in conformity with the specified requirements (except for the pipe where the test failed which shall be rejected and recoated).

In case of unsatisfactory result of one of these additional tests, the Contractor shall perform the test concerned on extra 10 pipes chosen at random and submit the results obtained with notification of the values corresponding to a correct test. The pipes with defective coating shall be rejected and recoated. Any further action required shall be based on the results of these tests.

6.5.2 VISUAL STANDARD

6.5.2.1 METHOD
Visual.

6.5.2.2 INSPECTION

100% of the pipe coated surface.

6.5.2.3 ACCEPTANCE LEVEL

No disbonded areas, air pockets, groves, fissures, blisters, splits, scratches, or other imperfections. The coating shall have a uniform colour and gloss.

6.5.3 THICKNESS

6.5.3.1 EQUIPMENT

Magnetic, electromagnetic or ultrasonic measuring instruments with ± 10% accuracy.

6.5.3.2 METHOD

Annex A, EN ISO 21809-1.

6.5.3.3 EXTENT OF INSPECTION

Annex A, EN ISO 21809-1

On each pipe to be tested, the total of 12 measurements shall be carried out in accordance with EN ISO 2808.

Initially one out often pipes shall be selected for checks.

If the required coating thickness is not met, each pipe shall be checked. The frequency may subsequently be varied based on quality.

6.5.3.4 ACCEPTANCE LEVEL
EN ISO 21809-1, Table2 for Class A2.

6.5.3.5 CORRECTIVE ACTIONS

Revision of coating process and rejection of pipes with thickness below the specified one.

6.5.4 CUT-BACK

6.5.4.1 EQUIPMENT

Rule or template.

6.5.4.2 METHOD

Specific to the material used.

6.5.4.3 SCOPE OF INSPECTION

At both ends of each coated pipe.

6.5.4.4 ACCEPTANCE LEVEL

The pipe shall be considered accepted when the cutback length is in conformity with the requirements of **section 5.6.**

6.5.4.5 CORRECTIVE ACTIONS

As required.

6.5.5 POROSITY (HOLIDAY TESTING)

6.5.5.1 EQUIPMENT

Adjustable holiday detector with voltage indicator, and electrode consisting of:

- One circular metal searching coil,
- One elastomer element for possible defect location.

6.5.5.2 METHOD

EN ISO 21809-1, Annex B.

6.5.5.3 EXTENT OF INSPECTION
100% of coated surface.

6.5.5.4 ACCEPTANCE LEVEL

As per **EN ISO 21809-1**. However, every coated pipe with more than two holidays shall be rejected. Coated pipes with max. Two small holidays shall be repaired in accordance with a procedure approved by the Owner. Any pipe subject to a coating repair procedure shall be fully re-examined.

If two successive pipes show 3 or more defects, the Contractor shall stop the coating line immediately to find the cause and remedy it.

6.6 PRODUCTION TESTING

Production testing shall be carried out by the Contractor. The Inspector shall have free access to all parts of the plant and of the test facilities and shall have the opportunity to witness all tests.

6.6.1 CURING / POLYMERIZATION OF EPOXY PRIMER

For each batch of epoxy powder, a test of the degree of polymerization shall be made. This shall be executed as per **Annex D, EN ISO 21809-1**.

Contractor shall verity to Owner that the Manufacturer has run the necessary tests and that the results are satisfactory.

6.6.2 ADHESION

Adhesion of the polyethylene shall be tested at ambient temperature on a single representative pipe for each batch of raw materials used and at least twice per shift. In addition, adhesion tests will be performed after each subsequent start up of the plant.

The tests shall be performed at the pipe ends on coating, which will be cut back.

Adhesion shall also be tested at approximately 50°C once a day.

Test method as per **EN ISO 21809-1**.

6.6.3 IMPACT RESISTANCE

Impact resistance shall be tested as per **Annex E, EN ISO 21809-1** for Class A, on a single representative pipe for each batch of raw materials used and at least once a day.

The tests shall be performed at the pipe ends on coating which will be removed for field welding.

6.6.4 CATHODIC DISBONDING

During pilot production C.D. tests shall be performed on a test ring at three (3) locations. The equipment and method shall be as per **Annex H, EN ISO 21809-1.**

Acceptance criteria shall be a maximum disbonding radius of 7 mm after

- 28 days at 23°C temperature; -1.5V or

- 24 hours at 65°C temperature; -3.5V.

Production testing will also be carried out at maximum operation temperature for 28 days (-1.5V) with a maximum disbonding radius of 15 mm.

Normal production testing will also be carried out to a frequency once a day.

7.0 REPAIRS

Coating defects detected and damaged coating areas less than 100 cm^2 resulting from destructive testing (if not made on pipe ends), mechanical failures, or due to any other reason whatsoever shall be repaired at Contractor's expense according to the following procedure.

If the damaged area is greater than 100 cm^2, the pipe shall be recoated.

If the damaged area is greater than 10 cm^2 and all three layers are damaged, the repair shall be made as outlined below but using heat-shrinkable sleeves and not patches.

Smaller damaged areas shall be repaired as outlined below, using either repair patches or heat-shrinkable sleeves.

A maximum of three repairs per pipe is allowed.

If part of the coating is not bonded satisfactorily in the repair area, it shall be removed by means of a wire brush or knife.

The edges of the coating shall be beveled.

The area shall be made free of dust and in case of hydrocarbons presence shall be degreased with methyl isobutyl ketone or similar.

Repair materials shall be approved by the Owner's Representative.

The repair area (metal and adjacent coating) shall be heated to the temperature specified in the procedure. The area where the coating has been removed shall be filled with approved adhesive filler (epoxy bi-component). The adhesive shall be firmly pressed against the metal without trapping air, and then smoothed using a putty knife.

A piece of repair patch shall be cut; its size shall be such that it will overlap the sound coating by at least 50 mm on all sides.

The repair patch, the corners of which shall be rounded, shall be positioned on the damaged area. The patch shall be heated with a torch until its heat sensitive paint changes colour. Then the patch shall be smoothed using gloves, to remove any air inclusion.

In lieu of repair patches tubular or open heat shrinkable sleeves can be used.

The repaired area shall be tested against porosity (holiday testing) as described in **section 6.5.5.1**

8.0 MARKING

8.1 GENERAL

The identification of the pipes shall be guaranteed during coating.

All identification markings, whether internal or external to the pipe, including the pipe length, shall be carefully recorded before surface preparation begins.

Following completion of coating, each pipe shall be marked as specified in **EN ISO 21809-1** and below using paint stenciling with weather- resistant paint.

8.2 MILL APPLIED DIE STAMPING

Surrounding frame, white.

8.3 PIPE IDENTIFICATION NUMBER AND PIPE LENGTH

On the coating, contrasting colour.

8.4 MID-POINT

Circumferential band, 100 mm wide, contrasting colour.

8.5 WALL THICKNESS CODING

One circumferential band at each end, according to **Job Spec. No. 171/1.**

8.6 TOLERANCE CODING

If so die-stamped from pipe mill, tolerance marks (+, o, -) shall be repeated on the coating, contrasting colour.

9.0 HANDLING. STORAGE AND TRANSPORT

9.1 HANDLING, STORAGE AND TRANSPORT

All procedures for handling, storage, and transportation shall be approved by the Owner.

Care shall be taken to prevent damage to both the uncoated and the coated pipe.

No out-of-roundness, flattening or any other damage may occur.

Coated pipe may, under no circumstances be dragged or rolled over the ground.

When handling the pipes non-metallic slings, spreader bars or protected hooks, shall be used. Large diameter pipe shall preferably be transported by the use of vacuum spreader beams.

The pipes shall be stored on even and firm ground and be placed on supports which keep the pipes clear of the ground, and in such a way that water and mud cannot accumulate inside the pipe. The pipes shall be self-draining.

Supports and stacking shall be according to approved drawings/procedures.

The coated pipe shall be stacked in such a manner that the exterior coating does not contact a hard surface, which may damage the coating.

During transportation the pipes shall be stacked and secured such that they cannot be damaged (abrasion, penning). The following standards shall be taken into consideration concerning transportation: **EN ISO 21809-1** or as recommended by the line pipe manufacturer.

Stockpiling of coated pipes shall be executed so as to avoid any deterioration of the polyethylene coating.

10.0 TECHNICAL DOCUMENTATION

10.1 WITH TENDER

Raw material Suppliers' data sheets, including health safety data.

Written quality assurance procedures, standard operating procedures, and repair procedures.

Request for approval of coating materials, production and repair procedures as well as test methods not otherwise defined.

10.2 AFTER AWARD OF CONTRACT

Valid test records of performance testing as per **EN ISO 21809-1**.

10.3 ON DELIVERY

Manufacturer's Certified Test Report, i.e. certified by Manufacturer's Authorized Representative, who is independent from the manufacturing department, containing the results of performed production testing and **EN ISO 21809-1** and requirements in this specification.

The following tests shall have been witnessed by the Owner's Representative: Surface profile, coating thickness, holiday detection and adhesion tests.

Pipes shall be referred to by their pipe mill assigned number.
Raw material certificates for each batch of materials used.