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HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

CORROSION PROTECTION OF FIELD JOINTS AND UNCOATED PIPELINE COMPONENTS

QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

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CONTENTS

REFERENCE DOCUMENTS

Job Spec. No. 499/4
[Backfilling]

Job Spec. No. 834/1
[Plant Applied External 3-Layer Polyethylene Line Pipe Coating]

ELOT EN 10204
[Inspection Documents for Metallic Products]

ELOT EN 1465 (ISO 4587, modified)
[Adhesives - Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies]

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]

ELOT EN 1594
[Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements]

S.I.S. 055900
[Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessments Clean Lines PTI Rust Grades and Preparation Grade of Uncoated Steel Substrates of Steel Substrates Removal of Previous after Overall]

ELOT EN 10288
[**Steel tubes and** fittings for on and offshore pipelines - External two layer extruded polyethylene based coatings]

ELOT EN 12068
[Cathodic protection - External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection- Tapes and shrinkable materials]

ISO 21809-3
[Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems - Part 3: Field joint coatings]

1.0 SCOPE

This specification covers manufacture and application of field coating for corrosion protection of all pipeline components in natural gas lines with temperatures from -10° C to 60° C. The materials specified will be used for the insulation of welded joints and for those items which are not delivered with factory applied coating.

Casing pipes shall be completely coated throughout the surface as carrier pipes and not only at the welding joints.

For the manufacture and application of these materials, the requirements of the following listed in order of precedence, shall be fulfilled.

This specification (Prevailing document)

Documents to which reference is made in the following

ELOT EN 12068

ELOT EN 1594

ELOT EN 1465 : Shear strength

ELOT EN 12068 : Penetration

ELOT EN 12068 : Cathodic disbonding

2.0 GENERAL

The Contractor shall coat all pipeline components and steel structures, which have not been factory-coated, and all field joints as well as all damages and defects on items already coated. Damages to the pipe beneath the coating shall be brought to the attention of the Owner.

The pipes will be delivered with 3-LAYER PE- coating according to **ELOT EN 10288.** The wrapping material shall be compatible to PE coating material (see also **Job Spec. No. 834/1).** A length of 150 mm at each end will be kept free of coating.

Coating materials shall be certified by an accepted by OWNER internationally reputable independent testing institute according to the data sheet attached to this specification **(ATTACHMENT 1).**

Before field coating starts, the Contractor shall submit detailed procedure specifications for the application and perform procedure tests in the presence of the Owner.

In order to establish practical acceptance criteria for the adhesion between the

field coating and the underlaying wrap, adhesion tests shall be carried out for each procedure specification on five approved procedure test items.

Strips of 25 by 200 mm shall be cut perpendicular to the pipe axis below either 9 or 3 o'clock positions top at bare steel, line coating and/or double wrap areas for tape.

The first 25 mm of the leading edge of the strips shall be removed using a screwdriver or other prying tool. Initial adhesive brodling cut shall essentially be centered within the adhesive layer.

A hand held peel strength gauge shall be attached to the leading edge at the test strip and the clamp fastened. Holding the test gauge with both hands a steady force shall be exerted under an approximate angle at 90° C to the circumference of the substral.

Recorded peel strength data shall be in accordance with the manufacturer's data and the bulk of the adhesive shall remain on the substrate.

Each coating shall be tested with a fault voltage 15 kVolt. The probe shall be in contact with the coated surface.

If the tests show unacceptable adhesion the following steps shall be taken.

Cause for unacceptable adhesion shall be investigated.
If necessary the procedures shall be adjusted and re-examined.

Another five coatings selected by the Owner representative shall be tested. If all these tests meet the required strength values, then no further testing shall be performed. In all other events further wrappings shall be examined as directed by the Owner representative.

After field coating starts, one adhesion test shall be performed every day, per shift, on a place selected by the Owner's Representative. If the test shows poor adhesion, two additional tests shall be performed. In case that these tests show again poor adhesion, Owner's Representative has the right to ask repairs of the production of the particular day and shift.

All coatings shall be repaired after testing.
Application of coating which requires heating, shall not be made on water filled pipeline sections.

3.0 MATERIAL FOR CORROSION PROTECTION

3.1 QUALITY CONTROL

The manufacturer is, under all circumstances, responsible for ensuring that the materials ordered are manufactured in compliance with this specification and, in case of doubt, shall be able to provide proof thereof.

Quality requirements and test methods for the materials shall satisfy the conditions of **ELOT EN 12068**, **Class C** as per para 4.1.2.4 "Mechanical resistance classes" and **Class HT** as per para 4.1.3.4 "Maximum continuous operating temperature classes". Control certificates shall be issued by a works inspector. Certificates shall include the Owner's identification number.

3.2 MATERIAL TYPES

The following types of coating materials may be used:

- Cold-applied tape with PE backing or other material compatible to PE and butyl or bituminous rubber adhesive compound for use with a pipeline operating temperature up to 60° C. At least two tape layers shall be applied. Each layer shall be spirally wrapped employing a minimum overlap of 50% using sufficient tension to prevent the tape to produce wrinkles or air inclusions.

- Sealant layers on both sides of the backing are acceptable with the inner-most tape layer(s). The completed coat shall have a thickness as recommended by the manufacturer, however, never less than 2,5 mm.

- Primer heat shrinkable polyethylene sleeves for use with a pipeline operating temperature up to 60°C. The backing material shall be expanded and radiated polyethylene (UV resistant) and the sealant layer a hot melt adhesive. Final thickness of sleeve shall be at least 2.0 mm.

  The primer to be used shall be of a type recommended by the manufacturer of the materials.

- Viscoelastic compounds and wrapping bands.

Materials shall meet the requirements of the Data Sheet attached to this Spec. (ATTACHMENT 1).

4.0 CORROSION PROTECTION OF UNCOATED PIPES

4.1 SURFACE PREPARATION

Prior to coating, the steel pipe shall be thoroughly cleaned.

The surface shall be dry and free of oil, grease, soil and concrete residues. All loose rust and mill scale shall be removed preferably by abrasive blasting to grade SA 2.5. The surface profile will be 40 : 75 microns peak to trough.

Alternatively, mechanical brushing to grade St 3 as per **SIS 05.59.00 -1998** or **ELOT EN ISO 8501** can be done using sharp brushes to avoid polishing of the steel surface.

4.2 PRIMING

As soon as possible after cleaning (but at the latest after one hour) the cleaned parts shall be primed. The primer shall be as recommended by the manufacturer of the coating material. In case of viscoelastic coating systems applied primer is not required.

Primer shall only be applied on dry and dust free surfaces. A dry surface is defined as a surface having a temperature 4°C or more above the dew point of the surrounding air.

During primer drying time of solvent based primers, necessary precaution shall be taken to keep primed surface free from dust.

A practical check that this requirement is fulfilled can be made using one of the following methods:

- Moisture and humidity indicating papers which are pressed against the surface: a change of color indicates that the surface is not sufficiently dry.
- The moist sponge method: to show sufficient dryness, it must be possible for surface moistened with a wet sponge to dry within 15 minutes.

4.3 APPLICATION OF COATING

Immediately after priming and according to the Manufacturer's recommendations the coating material shall be applied. The material shall be one conforming to clause 3 of this specification and of a form shown by experience to be suitable for the proposed scope of work.

In case of viscoelastic systems application for coating Manufacturer's instructions are applied as well as the applicable standards referred herein.

The application shall ensure a totally uniform coating without folds, leaks, air inclusions or other defects.
The work shall be carried out in strict accordance with the supplier's instructions and with the greatest care.

The material shall be wrapped with an overlap of at least 30 mm. Where a double coating is required, this may be achieved by overlapping 50% of the tape width plus 5 mm.

When application of coating requires heating, the temperature of the already applied PE-Coating (by other) shall not exceed 90° C.
Contractor shall take all necessary precautions to fulfill this requirement.

This work shall only be carried out on completely dry and dust free surfaces, cf. **Section 4.2,** and consequently cannot be carried out in rainy or windy weather without suitable protection.
Where the pipeline is getting above the ground surface, the insulation shall continue approx. 150 mm above ground level.

5.0 CORROSION PROTECTION OF JOINTS ON PE-COATED PIPES

The standards **ISO 21809-3** and **ELOT EN 12068** apply for the field joint coatings.

5.1 CLEANING

Prior to coating, the joint area shall be thoroughly cleaned.

Line coatings edges shall be chamfered, providing a smooth transition between line coating and bare steel over a length of 20 to 30 mm.

If welding has included the use of either electrodes coated with basic slag or silicate bound electrodes, the surface shall be washed thoroughly with fresh and clean water prior to mechanical cleaning.

The surface shall be dry and free of oil, grease, soil and concrete residues. Any weld splatter and deposits shall be removed by filing or light grinding prior to further cleaning.

If the line coating is disbonded along the edges of the joint or if there is evidence of corrosion under the line coating, the line coating shall be cut back until sound line coating has been obtained.

All loose rust and mill scale shall be removed preferably by abrasive blasting to grade Sa.2.5 per **ELOT EN ISO 8501.** The surface profile attained shall be 40-75 microns peak to trough.

Alternatively, mechanical brushing to grade St 3 per **ELOT EN ISO 8501,** can be done using sharp brushes to avoid polishing of the steel surface. Therefore, a stock of readily accessible new brushes is needed.

The line coating at each side of the joint shall be cleaned over at least the Manufacturer's recommended coating overlap onto the line coating.

5.2 PRIMING

Immediately after cleaning, the surface shall be primed as specified by the manufacturer of the coating material. Primer shall only be applied on dry and dust free surfaces, cf. **section 4.2.**

In case of viscoelastic coating systems applied primer is not required.

5.3 APPLICATION OF COATING

The materials shall be compatible with and provide an effective bond to the PE-coating. They shall be applied according to the manufacturer's instructions and shall additionally satisfy the following requirements:

- The overlap both between two wraps and between a wrap and the PE-coating shall be at least 30 mm.
- When application of coating requires heating, the temperature of the already applied PE- Coating (by other) shall not exceed 90°C. Contractor shall take all necessary precautions to fulfill this requirement.
- No air must be trapped beneath the insulation
- A tight seal between wraps and between a wrap and the PE-coating shall

be ensured.

- For the application of the wrapping material a wrapping machine is recommended.

In case of viscoelastic systems application for coating Manufacturer's instructions are applied as well as the applicable standards referred herein.

6.0 COATING OF JOINTS FOR THRUST-BORED CARRIER PIPES AND CASING PIPES

6.1 CLEANING

Prior to coating, the joint area shall be thoroughly cleaned.
If welding has included the use of either electrodes coated with basic slag or silicate bound electrodes, the surface shall be washed thoroughly with fresh and clean water prior to mechanical cleaning.

The surface shall be dry and free of oil, grease, soil and concrete residues. Any weld splatter and deposits shall be removed by filing or light grinding prior to further cleaning.

If the line coating is disbonded along the edges of the joint or if there is evidence of corrosion under the line coating, the line coating shall be cut back until sound line coating has been obtained.

All loose rust and mill scale shall be removed preferably by abrasive blasting to grade Sa.2.5 per **SIS 05.59.00-1998,** or **ELOT EN ISO 8501.** The surface profile attained shall be 40-75 microns peak to trough.

Alternatively, mechanical brushing to grade St 3 per **SIS 05.59.00-1998,** or **ELOT EN ISO 8501** can be done using sharp brushes to avoid polishing of the steel surface. Therefore, a stock of readily accessible new brushes is needed.

The line coating at each side of the joint shall be cleaned over at least the Manufacturer's recommended coating overlap onto the line coating.

The coating edges shall be chamfered, providing a smooth transition between line coating and bare steel over a length of 20 to 30 mm.

6.2 APPLICATION OF PRIMER

Immediately after cleaning, but not more than one hour later the surface shall be primed as specified by the manufacturer of the coating material. Primer shall only be applied on dry and dust free surfaces, cf. **Section 4.2.**

6.3 APPLICATION OF COATING

The joints shall be coated with a material specially developed for this purpose. This coating shall be built up (in layers not exceeding 1 mm) to the level of the PE-coating. Each layer shall be allowed to harden completely (without the application of heat) before the next layer is applied. Other alternative solutions are acceptable, subject to Owner's approval. With this procedure a high voltage test is recommended after approximately half the layers have been applied and are hardened.

7.0 COATING OF FITTINGS. VALVES

Valves may be coated before or after installation.
Fittings shall be delivered uncoated.

7.1 CLEANING

All surfaces shall be clean dry and free from rust. Any shop-primer (on valves vent closures, etc) shall not be removed.

About cleaning reference is made to **para 4.1** of this specification.

If coating is to overlap PE-coated pipes tapering shall be made as mentioned in **para 5.1** of this specification.

7.2 PRIMING

Immediately after cleaning, the surfaces shall be primed according to the manufactures recommendation.

7.3 APPLICATION OF COATING

The coating (as specified in **para 3.0** of this specification) shall be applied achieving a 30 mm overlap between wraps. It shall be ensured that no air is trapped beneath the coating. For the surface irregularities special material (i.g. mastic) shall be used prior to the applying of the coating. Any part getting above ground shall be insulated to 150 mm over final ground level.

Where any pipeline part excluding valves is either to be supported by concrete foundation or to be cast in concrete, it shall be double coated.
For double wrapping, an overlap of the outer layer of 15mm is sufficient.

To fill cavities and sharp edges for better application of coating layers, special mastic material shall be used.

For protective coat thickness and backfilling of irregular pipeline components in locations with a pipeline operating temperature up to 50° C, reference is made to **para 3.0** and DESFA specification, **Job Spec. No. 499/4,** respectively.

Steel support plates, which have not been factory-coated, shall be field coated with a suitable material, in order to prevent corrosion.

The contact faces may be uncoated if other means of electrical insulation between the steel and ground is provided (e.g. insulating plate).
The coating shall cover the steel surface and the concrete foundation at a depth of at least 100 mm below the steel plates. Effective bond to the concrete shall be ensured.

Alternatively valves shall be coated with suitable epoxy coating with Owner's approval. Adhesion test shall be performed according to specifications related to the epoxy coatings. In addition contractor, after Owner's approval, may use other coating materials.

8.0 CONTROL OF THE COMPLETED CORROSION PROTECTION

Visual inspection, destructive testing and holiday detection as described in para 2.0 of this specification shall be performed.

The completed insulation shall be tested by the Contractor. This control shall be made twice, once immediately on completion of the wrapping work and once during pipe lowering. The second control shall be made in the presence of the Owner Representative.

The Contractor shall use a high voltage test apparatus (e.g. Holiday Detector) which has been approved by the Owner. The entire pipe surface shall be tested with a test voltage of 15 kV, and the test probe shall be in contact with the coating. The Contractor shall provide all operating personnel and equipment necessary. Any damage or "holiday" shall be repaired as specified in **section 9.**

The Contractor is liable for any damage to the coating irrespective of the time of discovering (i.e. during or after the working period). If any damage is located (e.g. with electrical measurement) during the making-good period, the Contractor shall excavate the area and repair the coating at his own expense.

9.0 REPAIR OF DAMAGES ON THE PE-COATING

All disclosed damages to the PE-coating shall be repaired.

According to the extent and nature of the damages, these shall be repaired in accordance with either **section 5** or the following procedure.

9.1 CLEANING

The damaged area shall be cleaned of foreign bodies and loose bits of PE coating material.
The surface of the damaged areas shall thereafter be cleaned according to the manufactures instruction.

9.2 APPLICATION OF COATING

The repair shall be done using patch-repairs, non recoverable, irradiation crosslinked UV resistant, HD polyethylene backing precoated with a high shear strength adhesive complying to the requirements of **sections 1, 2 and 3** of this specification to be submitted to the Owner's Representative for approval. Applied repairs shall be tested by 15 kVolt holiday detection.

The Contractor can propose an alternative coating repair method for the approval of the Owner. To obtain this approval the contractor shall submit detailed specifications for the material and its method of application, and will be required to perform a procedure test in the presence of the Owner representative.

ATTACHMENT I

MINIMUM PERFORMANCE REQUIREMENTS FOR THE MATERIALS IN SECTION 3.2.
To be certified by Independent Accredited Testing Institute approved by Owner.

A- BACKING MATERIALS

PROPERTY	METHOD
Tensile Strength	ELOT EN 12068 ANNEX – A & E
Ultimate Elongation (at break)	ELOT EN 12068 ANNEX – A & E

B - ADHESIVE

PROPERTY	METHOD
Shear Strength	ELOT EN 12068 ANNEX - D

CHS = cross head speed.

C - APPLIED PRODUCT

PROPERTY	TEST METHOD
Impact resistance	ELOT EN 12068 ANNEX - H
Penetration (indentation) resistance	ELOT EN 12068 ANNEX - G
Peel strength to steel line coating under laying wrap	ELOT EN 12068 ANNEX - B
Cathodic disbondement	ELOT EN 12068 ANNEX - K