

# **ELASTOMER COATINGS AND MONEL SHEATHING FOR OFFSHORE RISER PROTECTION**

DEP 31.40.30.36-Gen.

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**DESIGN AND ENGINEERING PRACTICE**



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## 1. INTRODUCTION

### 1.1 SCOPE

This DEP specifies requirements and gives recommendations for elastomer coating and Monel sheathing for the external protection of risers of offshore facilities such as fixed-leg production platforms. It includes the minimum requirements with respect to surface preparation, coating materials, application, welding, testing, repair, handling and storage and inspection for:

- Chlorinated Rubber (CR) [polychloroprene (also known by the trade name Neoprene)] elastomer coatings for carbon steel and duplex stainless steel risers. It shall be suitable for use in seawater, ambient air temperatures down to  $-35^{\circ}\text{C}$  and service temperatures of max.  $+90^{\circ}\text{C}$ .
- Ethylene Propylene Diene Monomer (EPDM) elastomer coatings for carbon steel and duplex stainless steel risers. It shall be suitable for use in seawater, ambient air temperatures down to  $-35^{\circ}\text{C}$  and service temperatures of max.  $+120^{\circ}\text{C}$ .
- Monel sheathing shall be considered for application on risers with a design life  $>25$  years and for use in seawater, ambient air temperatures down to  $-35^{\circ}\text{C}$  and service temperatures up to  $+120^{\circ}\text{C}$ . Monel sheathing shall not be selected if the riser will be installed by pulling it through a J-tube or a conductor.

This DEP also covers the application of anti-fouling protection onto the elastomer coating, the protection of elastomer coated risers at riser clamp positions, and field joint coating.

This DEP also covers the elastomer lining of the internal surface of riser clamps and guides, and may also be used for the elastomer lining of line pipe externally. However, the Principal may specify additional requirements above those specified in this DEP for the elastomer lining of clamps or line pipe.

External Monel cladding of riser pipe by either roll bonding or welding is not covered in this DEP.

DEP 70.48.11.30-Gen. shall apply to the parts of the riser above those where the special riser protection in accordance with this DEP has been applied, and also to riser clamps.

If required, additional information on elastomers materials is given in DEP 30.10.02.13-Gen.

All surface preparation, coating application and pipe handling shall be performed in a safe manner and in accordance with the principles of good workmanship.

This is a revision of the DEP of the same number dated April 2003; see (1.6) regarding the main changes.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended to be used in offshore oil and gas production facilities and, where specified, other marine facilities.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than those of this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local

regulations. The Principal may then negotiate with the authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

### 1.3 DEFINITIONS

#### 1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

#### 1.3.2 Specific definitions and abbreviations

|                         |                                                                                                                                                                                                                                                                             |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| abrasive blast cleaning | impingement of a high kinetic energy stream of blast cleaning abrasive onto the surface to be prepared.                                                                                                                                                                     |
| anchor profile          | contour of a blast-cleaned surface on a plane perpendicular to the surface.                                                                                                                                                                                                 |
| applicator              | party that applies the elastomer coating in the coating plant.                                                                                                                                                                                                              |
| atmospheric zone        | part of offshore facility structure from 6 m above HAT.                                                                                                                                                                                                                     |
| batch                   | With regard to priming/bonding agents - the amount of materials produced within one uninterrupted production run of maximum 8 hours under constant production conditions. With regard to elastomers – one complete mixing cycle of base material and compounding materials. |
| bonding agent           | material applied to the primed metal surface in order to ensure proper adhesion of the elastomer coating.                                                                                                                                                                   |
| CR                      | Chlorinated Rubber [polychloroprene (also known by the trade name Neoprene)].                                                                                                                                                                                               |
| cure                    | vulcanization of thermo-set elastomeric coatings.                                                                                                                                                                                                                           |
| dew point               | temperature of a given air/water-vapour mixture at which, under atmospheric pressure, condensation begins to form.                                                                                                                                                          |
| EPDM                    | Ethylene Propylene Diene Monomer, a synthetic elastomer (rubber), also known as EPM.                                                                                                                                                                                        |
| HAT                     | Highest Astronomical Tide level.                                                                                                                                                                                                                                            |
| IRHD                    | International Rubber Hardness Degree.                                                                                                                                                                                                                                       |
| LAT                     | Lowest Astronomical Tide level.                                                                                                                                                                                                                                             |
| MSDS                    | Material safety data sheet.                                                                                                                                                                                                                                                 |
| offshore                | open sea and coastal waters.                                                                                                                                                                                                                                                |
| primer                  | liquid material applied to the metal substrate to ensure proper adhesion of the subsequent layer.                                                                                                                                                                           |

|                                        |                                                                                                                                                                                           |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PTFE                                   | polytetrafluoroethylene, also known by the trade name Teflon.                                                                                                                             |
| PQR                                    | Procedure Qualification test Record.                                                                                                                                                      |
| shift                                  | production run in which the beginning and end coincide with a change in personnel. In the context of the quality control procedures of this DEP, the maximum duration of a shift is 10 h. |
| splash zone                            | zone from 3 m below LAT up to 2 m above HAT.                                                                                                                                              |
| thinner                                | volatile liquid added to lower the viscosity of the paint to ease application.                                                                                                            |
| wetted and intermittently-wetted parts | parts in the tidal and splash zone and parts that are intermittently wetted by wave and spray action up to 6 m above HAT                                                                  |

#### 1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (8).

#### 1.5 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the DEP Administrator at [standards@shell.com](mailto:standards@shell.com). Shell staff may also post comments on this DEP on the Surface Global Network (SGN) under the Standards folder.

#### 1.6 SUMMARY OF CHANGES SINCE PREVIOUS EDITION

This DEP is a revision of the DEP of the same number dated April 2003. The following are the main, non-editorial changes.

- The previous title ("Polychloroprene riser coatings") has been modified to reflect the changed scope.
- Maximum operating temperature for polychloroprene has been reduced from 100 °C to 90 °C.
- EPDM has been included for the temperature range 90 °C to 120 °C.
- Elastomer coating has been extended to the entire riser.
- Monel sheathing has been included for risers with a design life >25 years.
- Quality management requirements for surface preparation and application have been extended.
- Some of the test result requirements have been changed.

## **2. GENERAL REQUIREMENTS AND SURFACE PREPARATION**

### **2.1 PROJECT INFORMATION**

The Principal shall submit technical information to the Contractor regarding the project. This information shall include as a minimum:

- Project name;
- Design life;
- Clamp positions (sliding or fixed/anchor clamps);
- Corrosion protection requirements for riser, clamps, J-tubes etc. (including internal elastomer lining of clamps);
- Anti-fouling requirements for the riser;
- Maximum operating temperature of the riser;
- Riser pipe (including bend) material, diameter, length and wall thickness;
- Expected ambient temperatures during installation;
- Riser installation method and field joint coating requirements;
- Requirements for temporary protection of pipe ends;
- Qualification requirements of inspectors;
- External and internal markings on the coated pipes.

### **2.2 CONTRACTOR'S RESPONSIBILITY**

#### **2.2.1 General**

The Contractor, in addition to the responsibilities under the general conditions of the contract, is responsible for the quality of the work which shall be performed in accordance with this DEP and all other relevant documents, such as site regulations, safety rules and requirements, product data sheets, referenced standards and codes.

The Contractor is fully responsible for all Quality Assurance and Control activities.

The Contractor shall schedule a pre-job meeting to ensure that job and quality requirements are fully understood. Attendees shall include a representative of the Principal, the Contractor's job superintendent and supervisor, the inspector and the applicator of the elastomer coating or Monel sheathing.

For all work, the Contractor shall submit appropriate work planning and a quality plan for implementing the requirements of this DEP for review by the Principal.

Copies of this DEP, the work planning and the quality plan shall be made available to the Coating Contractor at the site.

The obligations of the Contractor are explained in more detail further on in this DEP.

#### **2.2.2 Safety and environment**

The Contractor shall be responsible for all aspects of safety and personal protection related to the work to be done. Environmental regulations and rules shall be met.

All personnel shall be provided with approved personnel protection e.g. protective clothing, safety glasses, safety shoes, hard hats, goggles, respirators, earplugs, fresh-air-fed hood and any other necessary safety equipment. All safety equipment shall be maintained to a good working condition.

Handling and disposal of hazardous waste resulting from the Contractor's activities shall comply with regulations and specific contract requirements.

Unless otherwise agreed, the Contractor shall ensure that coating system and blasting material comply with any local and/or regional standards or regulations on banned materials.

### **2.2.3 Quality assurance**

Both the applicator and the Manufacturer of the coating materials shall operate an ISO 9001 quality management system. In addition, as a minimum an Inspection and Test Plan (ITP) shall be developed for all coating work and shall be approved by the Principal prior to commencement of the work. An example of an ITP is given in DEP 70.48.11.30-Gen.

## **2.3 SURFACE PREPARATION**

### **2.3.1 General**

Unless otherwise specified in this DEP, the surface preparation requirements as specified in (2.3) are applicable to all protective systems as specified in this DEP. The complete pipe lengths shall be prepared even if the areas indicated for coating are of lesser extent. External and internal markings of pipes and clamps shall be preserved before blast cleaning. Open ends shall be closed and kept closed during all surface preparation to protect the interior of the pipes.

### **2.3.2 Inspection prior to surface preparation**

Prior to the actual surface preparation, the riser pipes and clamps shall be visually inspected for fabrication defects, dents, laps, defective bevels, weld spatter, contamination and preservation coating. Welded areas and appurtenances shall be given special attention for the removal of welding flux in crevices. Surface defects such as slivers, weld spatter, laminations, and gouges shall be removed with proper tools.

Weld seams shall be ground to remove surface irregularities, which may affect coating applications.

After grinding or the completion of mechanical repairs, the remaining wall thickness shall be checked and compared with the minimum requirements of the line pipe specification. Pipes not meeting the minimum wall thickness shall be rejected. If defects and damages are too severe to repair, the Principal shall be notified.

A remedial method needs the approval of the Principal before the work is started.

### **2.3.3 Blasting equipment**

The Contractor shall demonstrate that the blasting equipment to be used is in good condition and well maintained. Blasting equipment shall fully comply with any local and/or regional regulation.

The compressed air shall be free of water and oil. Adequate separators and traps shall be provided, installed in the coolest part of the system. The presence of oil and water shall be determined in accordance with ASTM D 4285 at least 2 times per 12 hours and following every compressor start-up. In no case shall the temperature of the compressed air be allowed to exceed 110 °C.

Blast cleaning air, when blown through a white cloth or onto white paper for one minute, shall leave no visible residue.

### **2.3.4 Pre-cleaning of surfaces**

Any pipe surface shall be free of all surface contamination. Oil, grease and other fatty contaminants shall be removed by solvent cleaning in accordance with SSPC-SP1 or by using a biodegradable detergent. Suitable solvents are MEK, Xylene and Toluene. Fatty solvents such as petroleum (kerosene), diesel fuel and white spirit shall not be used. Salt contamination, chemical cleaning agents and remaining detergents shall be washed off by means of potable water. The pipe surface shall be dried prior to blast cleaning.

### 2.3.5 Blast cleaning

Blast cleaning of surfaces shall, as a general rule, be done by dry blast cleaning (hereafter referred to as blast cleaning) as outlined in ISO 8504-2. The surfaces of carbon and low alloy steelwork to be coated with an elastomer or Monel sheath shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1.

In addition to the requirements of ISO 8501-1, blast-cleaned carbon steel surfaces shall be tested to be free of the presence of mill scale. Particular attention shall be given to shop blasted steel work (i.e. blast cleaning using wheel blast machines).

Stainless steel surfaces to be coated with an elastomer coating system shall be blast cleaned using an inert blasting material that shall not harm stainless steel.

Any defect in the steel that becomes visible after the blasting shall be brought to the attention of the Principal and shall be removed or repaired as agreed. Any treated surface shall be re-blasted to the requirements as specified in this section.

Blast cleaned steel surfaces to be coated with the specified elastomer coating system shall not be touched by bare hands.

To prevent dust and grit contamination of primed and coated surfaces, blast cleaning shall not be done in areas close to coating operations.

For the elastomer coating system, the surface profile and the anchor pattern shall be in accordance with the written recommendations of the elastomer coating Manufacturer. Unless otherwise specified by the Manufacturer or in this DEP, the surface profile shall be between 60 µm and 100 µm. However, a sharp profile is required for elastomer coatings.

Before coating, the pipe surface shall be cleaned of dust and foreign matter using clean dry compressed air or vacuum cleaning.

The surface preparation shall meet the quality requirements in (2.3), (5.1), (5.2), (5.3) and (5.4).

### 2.3.6 Abrasives

Abrasives for use in blast cleaning steels shall be in accordance with ISO 8504-2. The properties of the type of non-metallic abrasive used shall meet the requirements of the appropriate part of ISO 11126. The test methods shall be in accordance with the tests specified in ISO 11127. Metallic type of abrasives used shall meet the requirements of the appropriate part of ISO 11124. Blasting materials producing silica dust shall not be used.

The conductivity of abrasives to be used for stainless steels shall be a maximum of 150 µS/cm.

### 3. ELASTOMER COATINGS

#### 3.1 GENERAL

The elastomer rubber coating systems described in this DEP comprise a number of layers as follows:

- **Primer**, which is compatible with the bonding agent and is bonded adequately to the steel substrate;
- **Bonding agent**, which is compatible with both the primer and the elastomer coating;
- **Elastomer compound**, which includes filler and anti-oxidant.

#### 3.2 COATING REQUIREMENT

##### 3.2.1 Risers

Risers for which an elastomer coating is specified shall be coated with an elastomer coating at least 12 mm thick from the seabed up to the most convenient cut-off point in the intermittently wetted zone (indicated to be from 2 m up to 6 m above HAT), e.g. up and through the first clamp. Selection of the cut-off point shall be subject to the approval by the Principal.

The Contractor shall verify whether additional cathodic protection is required, subject to approval by the Principal for riser parts below LAT down to seabed that are left uncoated

If a riser will be installed by pulling through a J-tube or a conductor and an elastomer coating is specified, it should be recognized that the elastomer coating might suffer damage.

The external surface of the J-tube or conductor shall be coated in accordance with this DEP. Internal corrosion protection of J-tubes is detailed in DEP 31.40.10.10-Gen.

- Notes:
1. Elastomer field joints should be avoided in the splash zone.
  2. For shallow waters, a minimum pipe joint length of 12 m is recommended.
  3. Riser clamps and guides shall be designed to allow clearance of the elastomer coating plus the protective sleeves (e.g. PTFE).

Unless otherwise agreed, the elastomer riser coating at the top end of the riser shall be cut to a 45° bevel, after curing. To prevent water penetrating beneath the elastomer riser coating at the top end of the riser, an additional protection such as a suitable shrink sleeve or induced tension polymer wrap approved by the Principal, shall be applied over the interface of the elastomer riser coating and the topside liquid coating system. The additional protection shall be applied with a minimum overlap of 30 cm onto the elastomer coating and the topside coating. The Contractor shall provide details of the working procedure to the Principal for approval prior to application.

Copper-nickel or Polytetrafluoroethylene (PTFE) sleeves shall be bonded to the outer surface of the elastomer at positions where riser clamps will be installed.

##### 3.2.2 Riser clamps

Riser clamps and guides shall be lined with a flat elastomer lining, excepta that this lining may be omitted if the clamps or guides are to be installed on elastomer-coated pipe.

If clamps or guides are to be installed onto submerged uncoated pipes, the riser clamps or guides shall be lined with a ribbed elastomer lining, with the ribs running vertically and at a slightly larger radius than that of the coated riser pipe (so that the riser can move in its axial direction without significant restraint, as described in DEP 31.40.10.10-Gen.)

The lining shall cover the full internal cylindrical surface of the clamp. The dimensions of the elastomer lining shall be in accordance with the respective drawing. The elastomer lining shall as a minimum meet the qualification requirements in this DEP.

### **3.2.3 Line pipe**

Line pipes for which an elastomer coating is specified shall be coated with an elastomer coating at least 6 mm thick.

## **3.3 INFORMATION TO BE SUBMITTED BY THE CONTRACTOR**

### **3.3.1 System identification**

The Contractor shall submit all necessary information on the coating to the Principal. This information shall contain as a minimum:

- System designation or trade name;
- Name of Manufacturers of the coating materials;
- Manufacturer's data;
- Material Safety Data Sheet (MSDS) of primer, bonding agent, and elastomer material;
- Minimum total coating thickness;
- The name of the proposed applicator;
- Relevant international/national coating standard approvals;
- Recommended storage and shelf life of coating materials.

### **3.3.2 Coating facilities**

The Contractor shall submit to the Principal details of the coating facilities, including:

- General description of the equipment available to carry out the coating process;
- Details of process control and inspection equipment required for the coating process, such as temperature control, thickness control, holiday testers, laboratory equipment;
- Details of the pipe handling and transport equipment and procedures;
- Quality control procedures.

### **3.3.3 Coating process**

The Contractor shall submit to the Principal information on the required coating process, including:

- Description of the coating process;
- Pipe cleaning procedure and pipe surface preparation;
- Pipe heating and temperature control;
- Method of coating application;
- Coating repair procedures;
- Transfer of external and internal markings from uncoated pipes to coated pipes.

## **3.4 ELASTOMER COATING MATERIALS**

### **3.4.1 Pre-qualification of the proposed coating system**

The Contractor shall demonstrate that the proposed coating system, applied onto pipes of the same material and nominal wall thickness as the pipes to be coated under the contract, shall meet the performance requirements of (3.4) and (5.).

The elastomer materials used for external riser protection shall be classified according to ISO 1629.

With the approval of the Principal, tests performed in accordance with other coating standards may be used insofar as their procedures are the same as or more stringent than the procedures in this DEP. Such information shall include full reports on test procedures and results and be signed by the laboratory representatives.

In view of the information provided, the Principal may require the proposed coating system to be qualified via a pre-production trial. The results of this pre-production trial shall be reported to the Principal at least one week before the scheduled start of production.

The Manufacturer shall conduct material quality control tests and include the test results with the material shipment.

During application of the coating, the Contractor shall carry out the quality control activities needed to ensure that the final product complies with the requirements of this DEP.

The identity of the riser pipe under test shall be recorded. The testing requirements for the elastomer coating are summarised in Appendix C. Records of all quality control test results shall be kept in accordance with (6).

### **3.4.2 Primer/bonding agents**

Primer and bonding agent shall provide an effective bond between the metal and elastomer coating, in accordance with the appropriate performance requirements given in (5).

### **3.4.3 Elastomers – Laboratory testing**

#### **3.4.3.1 General**

All tests described in this section shall be performed on the elastomer compound:

- during procedure qualification trials;
- on the first production batch;
- with the frequency stated for each batch.

A typical batch size, in kilograms, shall be indicated in the Contractor's procedures.

The test results shall be made available to the Principal.

#### **3.4.3.2 Hardness**

This test shall be performed on every batch in accordance with ISO 7619-1 and the measured hardness shall be:

- 60 to 70 shore A for CR
- 65 to 75 shore A for EPDM

#### **3.4.3.3 Specific gravity**

This test shall be performed on every batch of cured elastomer in accordance with ISO 2781, method A. The specific gravity shall be within  $\pm 2\%$  of the Manufacturer's stated qualification value.

#### **3.4.3.4 Vulcanization characteristics (rotorless curemeter)**

This test shall be performed on every batch of uncured elastomer in accordance with ISO 6502. A standard curve shall be established to define the acceptance limits of the following parameters:

- |          |   |                       |
|----------|---|-----------------------|
| $M_L$    | - | minimum torque value; |
| TSx      | - | time to 90 % cure;    |
| $M_{HR}$ | - | maximum torque value. |

Once a standard curve with the above parameters has been established and approved by the Principal, all subsequent curves shall fall within these limits.