

# CEMENT LINING OF PIPES

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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 the cement lining of carbon steel pipes from nominal size DN 100 to DN 900. This includes applying the cement mortar in the shop, joining the lined pipes in situ and applying cement mortar by hand at the field joints. This DEP is a revision of the DEP of the same number dated December 1990.

This DEP complements the requirements of DIN 2614.

The in-situ lining of piping systems, other than the above mentioned joints, is outside the scope of this DEP and reference is made for this purpose to NSI/AWWA C602 issued by the American Waterworks Association.

Internal cement lining is usually applied to prevent internal corrosion of carbon steel cooling water or fire-fighting water piping systems containing sea-water or brackish water at ambient temperatures. These systems can be installed above and below ground. If an above ground lined piping system is drained for a prolonged period, special precautions are required to prevent cracking of the lining due to high or low temperatures and/or variations in temperature or humidity. The special precautions to be taken are outside the scope of this DEP.

Alternatives to cement lined carbon steel piping for sea-water and brackish water service are glass-reinforced epoxy (GRE) piping, concrete piping or epoxy coated/lined piping, their selection depending on local/process conditions and life-cycle costs.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of or managed by the Royal Dutch/Shell Group. It may be distributed to Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and supply/marketing installations.

If national and/or legal regulations exist in which some of the requirements may be more stringent than in 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, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document 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 objective of obtaining agreement to follow this DEP as closely as possible.

### 1.3 DEFINITIONS

#### 1.3.1 General definitions

The **Contractor** is the party which 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 which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which 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.

#### 1.4 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 (10).

## **2. CONTRACT STRATEGY**

### **2.1 CONTRACTOR INVOLVEMENT**

The Contractor shall prepare a detailed specification for the Manufacturer of cement-lined piping. Additional detailed drawings shall be prepared if the details are not covered by the appendices of this DEP or the referenced Standard Drawings.

### **2.2 SELECTION OF CEMENT LINING MANUFACTURER**

The Manufacturer selected shall be able to design and install complete systems, procure the required piping materials and provide technical services related to the products. In addition the Manufacturer shall be responsible for the proper application of the cement lining to the field-joints. Pre-qualification tests shall be performed in accordance with (8). The final selection of Manufacturer is subject to the Principal's approval.

Damage to the lining may occur during the application of the shop painting, handling, transport and storage of the pipes. The Manufacturer of the cement lining shall therefore be responsible for the shop-painting and/or wrapping of the outside of the pipe.

### **3. DESIGN OF CEMENT LINED PIPING SYSTEMS**

#### **3.1 GENERAL**

Piping design shall be in accordance with ASME B31.3.

The cement lining shall be designed for a life of at least 20 years.

The cement lining shall be designed so that no repairs will be needed within the first five years' service.

#### **3.2 SERVICE CONDITION**

The Principal shall specify the service conditions for which the cement-lined pipe shall be suitable (normally sea water and/or brackish water at an operating temperature between minus 5 °C and plus 60 °C).

The Contractor shall obtain from the Principal a chemical analysis of the fluid to be conveyed.

The composition of the lining shall be agreed with the Principal.

**Amended per  
Circular 15/03**

The lining applied shall have a design life of at least 20 years.

#### **3.3 SIZING CRITERIA**

The diameter of cement-lined piping systems shall be chosen so that the maximum water velocity inside the lined piping shall not exceed 3 m/s for pipes larger than DN 150 and 2 m/s for sizes DN 150 and DN 100.

The minimum outside diameter for piping and fittings to be cement lined is DN 100. The maximum diameter shall be DN 900. The straight length of the pipes shall be between 6 m and 13 m.

Where carrying capacity is of importance, calculations shall be made to determine the maximum friction and loss of water head.

Unless a greater thickness has been specified, the lining thickness after curing shall be in accordance with DIN 2614 section 6.5.3.

#### **3.4 PIPING**

##### **3.4.1 Materials**

Pipe, flange, fitting and valve materials shall be in accordance with piping class 11011 (see DEP 31.38.01.12-Gen).

##### **3.4.1 Welding ends**

Pipe DN 650 and larger shall have butt welding ends in accordance with ASME B16.25. Smaller sizes shall have plain ends, with a sleeve coupling externally welded to one end. Valves and fittings shall have sleeve couplings externally welded to both ends.

##### **3.4.3 Fittings**

For the selection and overall dimensions of fabricated fittings see Standard Drawings S 38.070 and S 38.071.

For typical details of a set-on branch for cement lined fittings see Standard Drawing S 38.076.

For dimensions of sleeves see Standard Drawing S 38.074.

Factory-made butt welding fittings shall be in accordance with ASME B16.9.

#### **3.4.4 Flanges**

Flanges shall be ASME rating class 150, raised face, except where flat face flanges are required for replacement in existing installations.

Slip-on flanges should be installed in pipe sizes from DN 100 through DN 600. For pipe sizes DN 650 and larger, welding neck flanges shall be used. Flanges from DN 100 through DN 600 shall be in accordance with ASME B16.5 and flanges DN 650 and larger shall be in accordance with ASME B16.47.

Flange facing finish shall be in accordance with ASME B16.5.

For flanged ends (slip-on) for cement-lined pipe and fittings, see Standard Drawing S 38.075.

#### **3.4.5 Gaskets**

Gaskets shall be 3 mm thick, reinforced chloroprene rubber with a Shore A hardness of 70.

The inside diameter of the gasket shall be equal to the inside diameter of the cement lining (Appendix 2, Figure 6). On some pipe-to-pipe valve connections the cement lining I.D. is tapered to equal the pipe I.D. at the gasket position to prevent possible interference of the valve disc with the cement lining (Appendix 2, Figure 7).

Full face gaskets shall be used for connecting flat face flanges.