
Jeklene cevi in fittingi za obalne in priobalne (morske) cevovode – Notranja obloga s cementno malto

Steel tubes and fittings for on shore and offshore pipelines - Internal lining with cement mortar

Stahlrohre und Formstücke für erd- und wasserverlegte Rohrleitungen Zementmörtel-Auskleidung

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Tubes en acier et raccords pour canalisations enterrées et immergées - Revêtement interne au moyen de mortier de ciment

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Steel tubes and fittings for on shore and offshore pipelines - Internal lining with cement mortar

Tubes en acier et raccords pour canalisations enterrées et immergées - Revêtement interne au moyen de mortier de ciment

Stahlrohre und Formstücke für erd- und wasserlegte Rohrleitungen Zementmörtel-Auskleidung

This European Standard was approved by CEN on 26 August 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Contents

| | |
|--|----|
| Foreword | 3 |
| 1 Scope | 4 |
| 2 Normative references | 4 |
| 3 Terms and definitions | 4 |
| 4 Classification of linings | 5 |
| 5 Information to be supplied by the purchaser..... | 5 |
| 6 Standard designation | 6 |
| 7 Composition and application of the lining | 6 |
| 8 Requirements for the applied lining | 8 |
| 9 Repairs..... | 10 |
| 10 Marking..... | 11 |
| 11 Handling, transport and storage..... | 11 |
| Annex A (informative) Cut back types | 12 |
| Annex B (informative) Guidance for the choice of the type of cement..... | 14 |
| Annex C (normative) Wet mortar analysis | 20 |
| Annex D (normative) Saponification resistance of organic concrete additives..... | 22 |
| Annex E (informative) Inspection | 23 |
| Bibliography..... | 25 |

Foreword

This European Standard (EN 10298:2005) has been prepared by Technical Committee ECISS/TC 29 “Steel tubes and fittings for steel tubes”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2006, and conflicting national standards shall be withdrawn at the latest by April 2006.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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EN 10298:2005 (E)**1 Scope**

This European Standard specifies requirements for cement mortar linings for protecting the internal surface of steel tubes and pipeline components. It also specifies requirements for their application. It is applicable to the linings of tubes that have been welded longitudinally or spirally, seamless tubes and non-alloy steel components used for fluid transportation. This European Standard does not cover in situ applied or rehabilitation linings.

This type of lining is used in particular in the transport and distribution, under pressure or by gravity, of water intended for human consumption and industrial use, and also in fire extinguishing and waste water systems. The temperature of the water transported should not exceed 50 °C. Higher working temperature can be used by agreement of the parties.

The constituent materials of cement mortar lining, when used under the conditions for which they are designed, in permanent or temporary contact with water intended for human consumption, shall not change the quality of that water to such an extent that it fails to comply with the requirements of European regulations. For this purpose, reference shall be made to the relevant national standards transposing EN standards when available, dealing with the influence of materials on water quality.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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EN 196-1, *Methods of testing cement — Part 1: Determination of strength.*

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements.*

<https://standards.iteh.ai/catalog/standards/sist/cfa1e058-2f72-4bfd-bcd7-7e89924374c1/en-197-1-2012>

EN 1744-1, *Tests for chemical properties of aggregates — Part 1: Chemical analysis.*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings.*

ISO 2591-1, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate.*

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1**product manufacturer**

manufacturer of lining material

3.2**coater**

organisation responsible for lining of tubes and components

3.3**purchaser**

buyer of the lined products

3.4**drinking water**

water intended for human consumption

4 Classification of linings

The cement mortar linings shall be classified according to the cement type used, the additives used and the method of application.

The various possibilities are listed in Table 1.

Table 1 — Classification of linings

| Cement type | Blast furnace cement Portland cement | Blast furnace cement Portland cement sulphate resistant | Calcium aluminate cement | |
|--|---|---|-----------------------------|--------------------------|
| Symbol | CEM III A ^a , CEM I ^a | CEM III B ^a , CEM I-HS ^b | CEM CAC ^b | |
| Additives | No additive | Liquefying additives | Resin dispersion | Mineral additives |
| Symbol | N | L | R | M |
| Application sign | Spinning method | Spraying method | Manual method | |
| | I | II | III | |
| ^a Abbreviation according to EN 197-1. | | | | |
| ^b For cement CEM I HS (Sulphate Resistance) and CEM CAC (High Aluminium Cement) reference shall be made to European standards when available or to the relevant national standards. | | | | |

5 Information to be supplied by the purchaser

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5.1 Mandatory information to be supplied by the purchaser

The purchaser shall state in his enquiry and order the following minimum information:

- reference to this European standard EN 10298;
- type of water to be transported in the pipeline;
- type of cut-back (see annex A);
- transportation under pressure or by gravity for waste water application.

5.2 Options to be indicated by the purchaser

The purchaser may add the following optional information:

- type of cement;
- type of additives;
- method of application;
- service temperature;
- application of a pore sealer.

EN 10298:2005 (E)**6 Standard designation**

Designation of cement mortar lining in compliance with this European Standard shall contain the following:

- reference to this standard;
- type of cement;
- type of additives, if applicable;
- method of application.

EXAMPLE 1 5000 metres of tube - EN 10224 of 406, 4 x4, 0
- internal lining EN 10298 CEM I R I

EXAMPLE 2 8000 metres of tube - EN 10224 of 406, 4-4, 0
- internal lining EN 10298 CEM III M L II

7 Composition and application of the lining**7.1 Surface preparation**

The internal surface to be lined shall be free from objects that can adversely affect the lining or impair its application. Loose rust, loose mill scale, dirt, debris, oil, grease, paint and other material that may have originated from an external coating process, scattered weld beads as well as blasting residues and/or chemical cleaning process residues shall be removed. However the presence of a light adhesive rust layer does not impair the performance of a cement mortar lining and may be left.

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7.2 Composition of the lining

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The mortar shall be a homogeneous mixture of cement, sand and water (certain additives, as given, in Table 1, may be added) of a suitable consistency for producing a regular lining on the internal surface of the tubes and fittings.

The mortar shall be free from foreign bodies, in particular lumps of hardened mortar.

In the cases of drinking water transportation lines, the organic impurities content shall not exceed the amount equivalent to 0,1 g KMnO_4 /kg sand when determined as an extract in deionized water and to 0,3 g KMnO_4 /kg sand when determined as an extract in 0,1 mol NaOH.

7.3 Constituent materials**7.3.1 Cement**

The quality of cement shall comply with EN 197-1 or with European standards when available or the relevant national standards (see Table 1).

NOTE Information in Annex B can be used as a guide in the selection of the cement type.

7.3.2 Sand

7.3.2.1 The sand shall be mainly composed of particles of siliceous material insoluble in alkali and shall not contain organic matter or visible traces of clay. It shall have a controlled particle distribution ranging from fine particles to coarser particles; it shall be clean and composed of hard, stable and resistant inert granular particles.

7.3.2.2 It shall be stored in a clean place in order to avoid any contamination by foreign bodies, and in particular by organic matter.

7.3.2.3 Sampling is carried out according to the requirements of ISO 2591-1.

7.3.2.4 The size-distribution curve of the sand shall be drawn using sieves complying with ISO 565. It shall meet the following requirements.

- a) The fraction of fine particles passing through a sieve with 0,125 mm mesh aperture shall not exceed 10 % in mass. This is important in order to limit the error when determining S/C ratio of the mortar (see 8.2 and Annex C).
- b) The fraction with particles diameters up to and including one third of the minimum thickness of the lining shall not be less than 50 % in mass.
- c) The size of the coarsest particle shall neither exceed half the minimum lining thickness nor 3 mm except otherwise agreed upon by the parties.

7.3.2.5 The cleanness of the sand is evaluated according to the criteria of the contents of chlorides, organic impurities and clay matter.

- a) The maximum chloride content shall be 0,02 %. The chloride content is determined according to EN 1744-1.
- b) The amount of clay matter and other fine particles in the sand is determined by the separation method. This amount shall not exceed 2 % by mass.

7.3.2.6 Sands with a soluble and releasable alkali content of over 0,02 % shall not be used with CEM CAC.

7.3.3 Water

For drinking water systems, only water intended for human consumption shall be used.

For other applications, water of comparable quality, having a conductivity of less than 2 000 $\mu\text{S}/\text{cm}$ and a KMnO_4 consumption of less than 10 mg/l, can be used. For the determination of these parameters the European standards shall be used when available and, if not, use relevant national standards.

7.3.4 Mortar additives

If the use of additives has been agreed and if they are not harmful to the quality of the water (in case of water intended for human consumption) or the performance of the lining they may be used for making up the mortar. For drinking water the additives shall comply with the national requirements in the country of use (see Clause 1).

Pozzolanic (hydraulic) fillers are allowed to be used up to a level of 10 % by mass of the cement and non-pozzolanic (non hydraulic) fillers up to 3 %. Fillers with a soluble and releasable alkali content of over 0,02 % shall not be used with CEM CAC.

All organic additives (liquifiers or resins dispersion) shall have a resistance to saponification greater than 45 ml when tested according to Annex D.

7.4 Method of application

7.4.1 The cement mortar is applied to the inside of tubes and fittings in such a way that the lining has maximum compaction and a surface condition that aids the flow of water.

Frozen material shall not be used and the mortar shall be applied at a temperature in excess of 5 °C; so as to permit its correct curing.

After application, the lining shall be kept damp, and the temperature of the substrate shall not be allowed to fall below 5 °C. To prevent the lining from drying too rapidly, the tube ends shall be capped or otherwise specified unless the lining is allowed to cure under moist/warm conditions or in a draught-free closed space. Curing may be speeded up and the regularity of the lining ensured by suitably adjusting the temperature and humidity of the lining in a regular treatment cycle. The curing period shall be sufficient to ensure that the tubes and fittings can be transported and stacked without the lining being damaged.

EN 10298:2005 (E)

7.4.2 Cement mortar linings are mainly applied in three ways:

- a) the centrifugation-method in which the mortar is spun at a high rotational speed after distribution along the length of the tube. Under the action of centrifugal force the solid components of the mortar are compacted to form a smooth lining, and part of the original water content is driven out. The partly dewatered lining withstands the transportation of the tube to the curing site;
- b) the spinning-head-method in which the mortar is thrown at the wall of the tube or fitting, mostly through the centrifugal force exerted by a rotating throwing head. In this method the original water content of the mortar remains virtually unchanged in the process of application. Some additional smoothing of the mortar layer surface can be carried out by:
 - rotation of the tube;
 - mechanical trowelling or trowellings cones.
- c) the manual-method in which the mortar is trowelled onto the steel surface. This is normally done in order to repair defects in a lining and often in order to line fittings.

7.4.3 The lining is applied at the factory to tubes and fittings. The ends are prepared according to the provisions of the order as applicable, so that jointing may be carried out on site (see Annex A).

7.5 Pore sealer (optional)

If the use of a pore sealer has been agreed, they may be used for covering or modifying the surface of the cement mortar lining. The pore sealer shall not be detrimental to the quality of the water (in case of water intended for human consumption) or to the performance of the lining.

For drinking water, the pore sealer shall comply with the national requirements in the country of use (see Clause 1).

Requirements pertaining to the performance and application of the pore sealer are not part of this standard.

8 Requirements for the applied lining**8.1 General**

The required properties of the applied lining are given below:

- *S/C* ratio according to Annex C;
- *W/C* ratio according to Annex C;
- mechanical properties of the mortar;
- appearance and continuity;
- thickness of the lining system.

Other properties can be specified at the time of enquiry and order.

8.2 *S/C* and *W/C* ratios

NOTE 1 **determination of the sand cement ratio** (*S/C* ratio) according to Annex C;

NOTE 2 **determination of the water cement ratio** (*W/C* ratio) according to Annex C;

8.2.1 The *S/C* and *W/C* ratios of the wet mortar are determined since they have a major influence on the final properties of the cured mortar.

8.2.2 The composition of fresh mortar is such that the *S/C* is from 1,0 to 2,5.

8.2.3 In the case where the lining is applied by centrifugation-method, the fresh mortar after centrifugation shall have a *W/C* ratio less than or equal to 0,42.

8.2.4 In the case of application by spinning-head-method, the *W/C* ratio depends on the value of *S/C* within the limits in the following Table 2.

Table 2 — Relation between *S/C* ratio and *W/C* ratio for the spinning-head-method

| | | | |
|-------------------|--------|--------|--------|
| <i>S/C</i> | 2,5 | 1,7 | 1,0 |
| <i>W/C</i> | ≤ 0,42 | < 0,40 | < 0,37 |

NOTE For intermediate values interpolation is admitted.

8.2.5 For mortar applied by centrifugation-method, the determinations of *S/C* and *W/C* are carried out on samples of mortar taken from the tube within 15 min of the lining having been applied.

8.2.6 For mortar applied by spinning-head-method, the samples of mortar may be taken at the exit from the cement mixer. If during spinning, water is extracted from the mortar, sampling shall be according to 8.2.5.

8.2.7 The samples shall be representative of the total thickness of the layer of mortar. Refer to Annex C for the determination of the *S/C* and *W/C* ratio.

8.3 Mechanical properties of the mortar

For the mechanical properties of the mortar the following shall apply:

- compressive strength after 28 days should be at least 50 N/mm² and the flexural strength 5 N/mm²;
- inspection of the mechanical strength of mortar is carried out on a prismatic specimen 40 mm x 40 mm x 160 mm prepared from fresh mortar taken from the lined tubes. If no water is removed during application the samples of mortar can be taken out of the mixer;
- these specimens are prepared and their flexural and compressive strength are determined according to the provisions given in EN 196-1;
- prisms for testing the mechanical properties of cement mortar mixes shall be cured under the conditions defined in EN 196-1 after 7 and 28 days.

8.4 Appearance and composition of the lining

The appearance of the lining is inspected visually and shall comply with the following:

- mortar lining shall be uniformly smooth and free from cavities and any visible foreign bodies, though a few isolated particles of sand protruding from the surface are acceptable;
- unless otherwise specified at the time of the inquiry and/or order isolated cracks with widths smaller than 1,5 mm are acceptable for drinking water application, provided that they are not deleterious to the stability of the lining;
- for water of an aggressive nature (e.g. waste water, salt water,...), the crack width shall be limited to 0,5 mm;
- should the cracks be larger, then pre-treatment with drinking water could be used until the maximum crack width has been reduced to 0,5 mm for water of an aggressive nature and 1,5 mm for drinking water; when pre-treatment with drinking water is not suitable, the cracks shall be repaired (see Clause 9);