



# SLOVENSKI STANDARD

## SIST EN 641:1996

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**Armiranobetonske tlačne cevi s kovinskim plaščem, skupaj s spoji in fazonskimi kosi**

Reinforced concrete pressure pipes, cylinder type, including joints and fittings

Stahlbetondruckrohre mit Blechmantel einschließlich Rohrverbindungen und Formstücke

Tuyaux pression en béton armé à âme en tôle, joints et pièces spéciales compris

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**ICS:**

23.040.50	Cevi in fitingi iz drugih materialov	Pipes and fittings of other materials
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**en**

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EUROPEAN STANDARD

EN 641

NORME EUROPÉENNE

EUROPÄISCHE NORM

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Descriptors: Water pipelines, pressure pipes, potable water, water pipes, concrete tubes, reinforced concrete, armatures, metal plates, specifications, computation, equipment specifications, dimensions, tests

English version

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including joints and fittings**

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This European Standard was approved by CEN on 1994-10-26. 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.

The European Standards exist 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

## CEN

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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- Annex B (Informative) : Typical Design Procedure for pretensioned type pipe

## FOREWORD

This European Standard for concrete pipes is a standard which was prepared by WG 5 "Concrete pipes" of the Technical Committee CEN/TC 164 "Water Supply", Secretariat of which is held by AFNOR.

During preparation of this standard the provisional results already available of CEN/TC 164/WG 1 "General requirements for external systems and components" and of CEN/TC 164/165/JWG 1 "Structural design" were considered.

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 1995, and conflicting national standards shall be withdrawn at the latest by April 1995.

In accordance with the CEN/CENELEC Internal Regulations, following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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## 0 INTRODUCTION

The product in permanent or temporary contact with water, intended for human consumption, shall not adversely affect the quality of the drinking water and shall not contravene the CE Directives and EFTA Regulations on the quality of drinking water.

This standard is to be used together with the Common Requirements Standard (EN 639).

When the relevant EN dealing with general requirements, such as "General requirements for external systems and components" (CEN/TC 164/WG 1), "Materials in contact with water" (CEN/TC 164/WG 3) and "Structural design" (CEN/TC 164/165/JWG1) are adopted, the current standards shall be revised, where appropriate, in order to ensure that these requirements comply with these relevant EN's.

To the present standard are attached :

- Annex A (informative) : Typical design procedure excluding pretensioned type pipe.
- Annex B (informative) : Typical design procedure for pretensioned type pipe.

## 1 SCOPE

This European Standard specifies the requirements and manufacture of reinforced concrete pressure pipe cylinder type, that is not prestressed, in sizes from DN/ID 250 to DN/ID 4000 inclusive. Pretensioned concrete cylinder pipe, in which the reinforcement is wrapped, under low tension, directly on to the steel cylinder is covered by this standard and is not normally manufactured in sizes above DN/ID 1400. Larger sizes can be manufactured based on the concepts of this standard.

These types of pipe are designed for the internal pressure, external loads and bedding conditions designated by the purchaser. These types of pipes are also suitable for non-pressure load bearing applications.

Should be considered as any product used for the conveyance and distribution of water intended for human consumption.

## 2 MATERIALS

Materials are specified in clause 5 of EN 639 (Common Requirements). An additional requirement is specified as follows :

The maximum size of the aggregate shall not exceed one third of the concrete wall thickness, on either side of the steel cylinder.

## 3 DESIGN AND FABRICATION OF PIPE

### 3.1 General requirements

#### 3.1.1 General

The pipe shall have the following principal features :

- A welded steel cylinder with steel joint rings welded to each end.
- A reinforcing cage or cages, in the form of a continuous helix of steel wire welded on to longitudinal bars, concentric steel hoops welded on to longitudinal bars, or welded steel fabric.
- The cage can also be in the form of a steel rod wrapped directly on to the steel cylinder or on to a first concrete layer covering the steel cylinder.
- A wall of dense concrete covering the steel cylinder and reinforcing cage or cages both inside and outside.
- A joint so designed that it will be watertight under all conditions of service, either using an elastomeric sealing ring or with the steel end rings welded together on site.

#### 3.1.2 Wall thickness

Table 1 shows the minimum design thickness of pipe wall and the minimum design thickness of concrete lining for each type of pipe.

Actual design loading conditions may require an increase in wall thickness.

At the spigot section of the pipe, the shape of the steel end ring may require the thickness of the lining to be less than that specified in Table 1. The internal diameter shall be maintained within the tolerance specified by the Common Requirements.

Table 1 : Minimum design thickness  $t_{min}$  Minimum design thickness of the concrete lining  $t_{i,min}$  including the thickness of the cylinder

DN/ID	$t_{i,min}$ (mm)	$t_{min}$ (mm)	$t_{min}$ pretensioned cylinder pipe (mm)
250	15	50	40
300	15	50	40
400	15	50	40
500	20	55	45
600	20	60	45
700	20	65	45
800	20	70	45
900	20	75	45
1000	20	80	45
1100	25	85	50
1200	25	95	50
1250	25	100	50
1400	25	110	50
1500	25	115	
1600	25	125	
1800	30	140	
2000	40	155	
2100	40	165	
2200	40	170	
2400	45	185	
2500	45	195	
2600	45	200	
2800	45	215	
3000	45	220	
3200	45	230	
3500	50	250	
4000	55	290	

### 3.2 Design of pipe

#### 3.2.1 Reinforced concrete pipe, steel cylinder type, not pretensioned

The reinforcement of the pipe shall consist of a welded steel cylinder surrounded by one or more cages fabricated from concentric steel wire hoops, welded steel fabric or helically wound steel wire properly spaced and supported with longitudinal reinforcing or directly wrapped on to a first concrete layer covering the cylinder.

The cages can be either circular or elliptical. In pipes designed for a maximum design pressure of more than 200 KPa, the cage shall be circular when the reinforcement consists of one cage

only, and the external cage shall be circular when the reinforcement consists of 2 cages or more.

The minimum thickness of the steel cylinder shall be 1,5 mm.

The maximum centreline spacing of circumferentials shall be 100 mm.

The pipes shall be designed to resist the flexural and hoop stresses, resulting from each of the following conditions.

- a combination of maximum design pressure and dead loads ;
- a combination of design pressure, dead loads and live loads.

Under these given conditions, the tensile stresses of the steel calculated as indicated in the typical design procedure shown in Informative Annex A, shall not be greater than two thirds of the yield strength of the steel.

#### 3.2.2 Reinforced concrete pipe, steel cylinder type, pretensioned

The reinforcement of the pipe shall consist of a welded steel cylinder on which a steel wire is directly wrapped under low tension.

The pipe steel content and disposition shall be such that the pipe shall withstand the hydrostatic pressure in both service and transient conditions ; the thickness of the steel cylinder, plus the size and pitch of the helixes shall be such that the stress in steel shall not exceed :

- half of the yield strength of steel when the pipe is subjected to the design pressure ;
- two thirds of the yield strength of steel when the pipe is subjected to the maximum design pressure.

The yield strength considered shall be the lower value of the steel cylinder and the spirals.

The increase of the diameter of the pipe at the springline due to external loads is calculated and checked in comparison with a maximum allowable value

$$\Delta x = 9,8 \cdot 10^{-6} D_i^2 - 2,2 \cdot 10^{-3} D_i$$

Where  $D_i$  and  $\Delta x$  are given in mm,  $D_i$  being the design internal diameter of the pipe.

Informative Annex B gives a typical design procedure for calculating stresses under pressure and deformations of pipe when subjected to external loading.

### 3.3 Reinforcement

#### 3.3.1 Circumferential reinforcement

The circumferential reinforcement shall consist of steel wire hoops with joints butt or lap welded ; steel wire formed in a continuous helix with joints butt or lap welded or welded fabric shaped and lap welded. To ensure quality of joints representative specimens shall be tensile tested during which the strength of the weld shall exceed the strength of the parent steel.

The clear space between circumferential wires shall be not less than 1,25 times the maximum size of the coarse aggregate or 12 mm, whichever is the greater.

For pretensioned concrete pressure pipe the circumferential reinforcement shall consist of a steel wire directly wound on to the steel cylinder. The wrapping tension shall be not less than 50MPa, and not greater than 70 MPa. The tensile stress shall be checked during the winding operation.

For the pretensioned pipe, a cement slurry shall be projected on to the steel cylinder prior to wrapping of the steel rod reinforcement. This slurry shall consist of 1,2 kg of cement to 1 litre of water, and shall be applied at a rate of not less than 1 litre per 2 square metres.

#### 3.3.2 Longitudinal reinforcement

The circumferential reinforcement in cages shall be accurately spaced and rigidly assembled by means of longitudinal bars or wires securely attached so that the cage is maintained in proper shape and position during the casting of the pipe.

Reinforcement cages formed by steel wire wrapped directly on to the steel cylinder or on to a concrete layer external to the cylinder do not require longitudinal bars.

#### 3.3.3 Positioning and cover to steel

Reinforcement cages may be circular, elliptical or a combination of both. The minimum cover to steel shall be one times the maximum size of aggregate or

- 15 mm for pipe less than 800 DN/ID ;

- 20 mm for pipe equal to or greater than 800 DN/ID ;

whichever is the greater.

### 3.4 Concrete and mortar

#### 3.4.1 Mix design

The minimum cement content shall be 300 kg per cubic metre of concrete or mortar.

The water cement ratio of the concrete or mortar shall be suitable for the method of placement and shall not exceed 0,45 after compaction.

For pipes below 1000 DN/ID, a water cement ratio of 0,5 is allowed provided the minimum cement content is 385 kg per cubic metre of concrete.

#### 3.4.2 Concrete strength

The minimum 28-day compressive strength of the concrete shall be 35 MPa (see 4.1).

## 4 FACTORY TESTING

Factory testing is specified in subclause 5.3 of EN 639 (Common Requirements). Additional requirements are specified as follows :

### 4.1 Concrete test

A minimum quantity of three cylinders or cubes per week of manufacture and per mix type of concrete shall be tested for the 28 day compressive strength (see 3.4.2).

### 4.2 Pipe test

One in 250 pipes shall be subjected to an internal hydrostatic test. Should a pipe fail the test, then a further two pipes from the same batch of 250 shall be tested. If both pipes pass then the batch shall be accepted. If one or both pipes fail then the batch shall be rejected or each pipe in the batch shall be tested for individual approval.

The finished pipe shall be subjected to a pressure test at :

- Maximum Design Pressure + 200 kPa or 1,2 times the Maximum Design Pressure, whichever is the greater, for DN/ID less or equal to 1200.



- Maximum Design Pressure + 100 kPa or 1,2 times the Maximum Design Pressure, whichever is the greater, for DN/ID above 1200.

The pipe is restrained within a hydrostatic test rig and pressure tested for a period of 5 minutes. During the test the pipe shall be absolutely watertight and show no leaks, weeping or defects considered detrimental to the pipe's performance. No crack in the external surface shall be wider than 0,5 mm on a length exceeding 300 mm in accordance with 6.4.11 of EN 639.

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