

Prestressed concrete pressure pipes, cylinder and non-cylinder, including joints, fittings and specific requirement for prestressing steel for pipes

The European Standard EN 642:1995 has the status of a
British Standard

ICS 23.040.50

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/505, Water supply, upon which the following bodies were represented:

- Association of Consulting Engineers
- Association of Manufacturers of Domestic Unvented Supply Systems Equipment (MODUSSE)
- British Bathroom Council
- British Foundry Association
- British Non-Ferrous Metals Federation
- British Plastics Federation
- British Plumbing Fittings Manufacturers' Association
- Department of the Environment
- Department of the Environment (Drinking Water Inspectorate)
- Fibre Cement Manufacturers' Association Limited
- Institute of Plumbing
- Institution of Water and Environmental Management
- Local Authority Organizations
- Scottish Association of Directors of Water and Sewerage Services
- Water Companies Association
- Water Research Centre
- Water Services Association of England and Wales

The following bodies were also represented in the drafting of the standards, through subcommittees and panels:

- Association of Metropolitan Authorities
- British Precast Concrete Federation Ltd.
- Concrete Pipe Association
- Concrete Society
- Department of Transport
- Federation of Civil Engineering Contractors
- Institution of Civil Engineers
- Institution of Highways and Transportation

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National foreword

This British Standard has been prepared by Technical Committee B/504 and is the English language version of EN 642:1994 *Prestressed concrete pressure pipes, cylinder and non-cylinder, including joints, fittings and specific requirement for prestressing steel for pipes*, published by the European Committee for Standardization (CEN). Together with BS EN 639 it supersedes BS 4625, which is withdrawn.

EN 642 was published as a result of international discussion in which the UK took an active part.

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English version

Prestressed concrete pressure pipes, cylinder and non-cylinder, including joints, fittings and specific requirement for prestressing steel for pipes

Tuyaux pression en béton précontraint, avec ou sans âme en tôle, y compris joints et pièces spéciales et prescriptions particulières relatives au fil de précontrainte pour tuyaux

Spannbetondruckrohre, mit und ohne Blechmantel, einschließlich Rohreverbindungen, Formstücke und besonderen Anforderungen an Spannstahl für Rohre

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.

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CEN

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

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Foreword

This European Standard for concrete pipes is a standard which was prepared by WG5, Concrete pipes, of the Technical Committee CEN/TC 164, *Water supply*, the 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, the 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 product¹⁾ 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/JWG 1) are adopted, the current standards shall be revised, where appropriate, in order to ensure that these requirements comply with these relevant ENs.

To the present standard are attached:

- Annex A (normative): Specific technical requirements for high tensile steel wire used for prestressing concrete pipe with or without steel cylinder;
- Annex B (informative): Typical joints;
- Annex C (informative): Design guidance for prestressed concrete cylinder pipes;
- Annex D (informative): Design guidance for prestressed concrete non-cylinder pipes.

1 Scope

This standard covers the requirements and the manufacture of prestressed concrete cylinder and non-cylinder pressure pipes and fittings in sizes from DN/ID 500 to DN/ID 4000 inclusive. Larger sizes could be manufactured based on the concepts of this standard. These types of pipes are designed for the internal pressure, external loads and bedding conditions designated by the purchaser.

2 Materials

Materials are specified in Clause 5 of EN 639 (common requirements). Additional requirement is specified as follows:

The maximum size of aggregate shall not exceed the least of the following:

- the concrete cover;
- or 0,33 times the thickness of the non-cylinder core pipe wall;
- or 0,33 times 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

Prestressed concrete cylinder pipe shall have the following principal features:

- a welded steel cylinder with steel joint rings welded to its ends;
- for lined-cylinder pipe, a core consisting of a lining of concrete within the steel cylinder, or for embedded-cylinder pipe, a core consisting of the steel cylinder encased in concrete;
- circumferential prestressing with high-tensile wire wound around the outside of the core in one or more layers at a predetermined stress and fastened securely at its ends;
- a coating of dense mortar or concrete, covering and protecting the core and wire, except for the necessarily exposed surfaces of the joint rings;
- a self-centring joint so designed that the joint shall be watertight under all conditions of service.

¹⁾ Should be considered as any product used for the conveyance and distribution of water intended for human consumption.

Prestressed concrete non-cylinder pipe shall have the following principal features:

- a concrete core pipe either steel reinforced or longitudinally prestressed with pretensioned high tensile steel wire embedded in the concrete;
- circumferential prestressing with high-tensile wire wound around the outside of the core in one or more layers at a predetermined stress and fastened securely at its ends;
- a coating of dense mortar or concrete, covering and protecting the wire;
- a self-centring joint so designed that the joint shall be watertight under all conditions of service.

Or for monolithic type:

- a concrete pipe longitudinally prestressed with pretensioned high tensile steel wire embedded in the pipe wall which is cast in one operation;
- circumferential prestressing by means of a reinforcement cage of high tensile steel wire also embedded in the pipe wall and prestressed to a predetermined stress by means of hydraulic expansion while the concrete is still fresh;
- a self-centring joint so designed that the joint shall be watertight under all conditions of service.

3.1.2 Wall thickness

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

Table 1 — Minimum design wall thickness

Pipe DN/ID mm	Cylinder pipe	Non-cylinder pipe	
	t_1 min mm	t_2 min mm	t_3 min monolithic mm
500	50	40	45
600	50	40	45
700	50	40	50
800	50	45	55
900	55	45	60
1 000	65	50	65
1 100	70	50	70
1 200	75	60	75
1 250	75	60	80
1 400	85	70	85
1 500	90	70	90
1 600	100	75	95
1 800	115	75	105
2 000	125	80	115
2 200	135	90	125
2 400	145	100	135
2 500	150	100	140
2 600	160	110	145
2 800	170	120	155
3 000	180	130	165
3 200	190	140	—
3 500	210	160	—
4 000	240	180	—
NOTES			
t_1 min minimum design thickness of the core wall including the thickness of the cylinder.			
t_2 min minimum design thickness of the core wall.			
t_3 min minimum design thickness of the pipe wall.			

3.2 Design of pipes

3.2.1 General

The reinforcement of the cylinder pipe shall consist of a welded steel cylinder in the core and high-tensile wire helically wound around the core under measured and controlled tension after the concrete in the core has been placed and cured. The minimum design thickness of the cylinder shall be 1,5 mm for all diameters.

For both cylinder and non-cylinder pipe the size of the high-tensile wire and the spacing and tension under which it is wound shall be such that the requirements specified for the design conditions stated in Clause 3.2.2 are met. The design shall fully recognize all losses due to elastic and inelastic deformations. The initial tension in the high-tensile wire shall not exceed 75 % of the characteristic strength of the wire.

The wire shall not be less than 4 mm in diameter. The minimum clear spacing between wires shall be the wire diameter up to a maximum of 6 mm in the same layer of reinforcement.

The maximum centreline spacing of the wire shall be 50 mm. For lined-cylinder pipe with wire 6 mm and larger, the maximum centreline spacing of the wire shall be 25 mm.

3.2.2 Design requirements

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

- design pressure + dead load:
there shall be no tension in the core;
- maximum design pressure + 100 kPa + dead load:
tension in the core shall not exceed $0,38 \sqrt[3]{f_{ck}^2}$ for cylinder pipe or $0,13 \sqrt[3]{f_{ck}^2}$ for non-cylinder pipe;
- design pressure + dead load + live load:
tension in the core shall not exceed $0,38 \sqrt[3]{f_{ck}^2}$ for cylinder pipe or $0,13 \sqrt[3]{f_{ck}^2}$ for non-cylinder pipe;
- maximum design pressure:
there shall be no tension in the core;

where f_{ck} is the 28-day compressive strength of the concrete in MPa.

The total tensile stress in the core shall be considered as the sum of the hoop and flexural stresses without the application of any reduction factors.

When submitted to hydrostatic test (see 4.2) the mortar or concrete coated pipe shall not have cracks in the coating wider than 0,1 mm for 300 mm length as measured in accordance with 6.3.10 of EN 639 (common requirements).

3.3 Reinforcement

Non-tensioned reinforcement is permitted.

3.4 Concrete and mortar

3.4.1 Mix design

3.4.1.1 Core

The concrete shall contain a minimum cement content of 350 kg per cubic metre. The water cement ratio of the concrete shall be suitable for the method of placement and shall not exceed 0,45 after compaction. For steel cylinder cores of less than 1000 DN/ID a maximum water cement ratio of 0,5 is allowed provided that the minimum cement content is 385 kg per cubic metre of concrete.

3.4.1.2 Coating

After the core has been wrapped with prestressing wire, an external coating either of concrete or mortar shall be applied to provide the minimum cover as specified in 3.5.2. For multiple layers see 3.5.3. There shall be no rust scale or pitting on the prestressing wire at the time of coating.