INTERNATIONAL STANDARD

ISO 23991

First edition
2022-04

Irrigation applications of ductile iron pipelines — Product design and installation

Canalisations en fonte ductile pour l'irrigation — Conception des produits et installation

Reference number
ISO 23991:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 2, *Cast iron pipes, fittings and their joints*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Irrigation applications of ductile iron pipelines — Product design and installation

1 Scope

This document specifies the design factor, technical requirements, test methods, installation technologies and operation advices applicable to ductile iron pipes, fittings and accessories used in piped irrigation applications.

NOTE In this document, all pressures are relative pressures expressed in bars[1)].

This document also specifies materials, dimensions and tolerances, mechanical properties and standard coatings of pipes, fittings and accessories. It also gives performance requirements for all components including joints.

Joint design and gasket shapes are outside the scope of this document.

This document applies to pipes, fittings and accessories cast by any type of foundry process or manufactured by fabrication of cast components.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 2531:2009, *Ductile iron pipes, fittings, accessories and their joints for water applications*

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

ISO 10802, *Ductile iron pipelines — Hydrostatic testing after installation*

ISO 10803, *Design method for ductile iron pipes*

ISO 10804, *Restrained joint systems for ductile iron pipelines — Design rules and type testing*

ISO 21051, *Construction and installation of ductile iron pipeline system*

ISO 21052, *Restrained joint systems for ductile iron pipelines — Calculation rules for lengths to be restrained*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

3.1.1
piped irrigation network
PIN
network of installation consisting of pipes, fittings, valves, pumps (if necessary) and other devices properly designed and installed to supply water from the source of the water to the irrigable area

3.1.2
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes

Note 1 to entry: It comprises the letters DN followed by a dimensionless whole number, which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections.

[SOURCE: ISO 2531:2009, 3.20, modified — Note 2 to entry has been removed.]

3.1.3
allowable operating pressure
PFA
maximum internal pressure, excluding surge, which a component can safely withstand in permanent service

[SOURCE: ISO 2531:2009, 3.2]

3.1.4
allowable site test pressure
PEA
maximum hydrostatic pressure that a newly installed component can withstand for a relatively short duration, when either fixed above ground level or laid and backfilled underground, in order to measure the integrity and tightness of the pipeline

Note 1 to entry: This test pressure is different from the system test pressure, which is related to the design pressure of the pipeline.

[SOURCE: ISO 2531:2009, 3.3]

3.1.5
maximum allowable operating pressure
PMA
maximum internal pressure, including surge, which a component can safely withstand in service

[SOURCE: ISO 2531:2009, 3.17]

3.1.6
nominal pressure
PN
numerical designation, which is a convenient rounded number, used for reference purposes

Note 1 to entry: All components of the same *nominal size, DN* (3.1.2), designated by the same PN number have compatible mating dimensions.

[SOURCE: ISO 2531:2009, 3.19, modified — Note 2 to entry has been removed.]

3.2 Abbreviated terms

CDN canal distribution network

PVC poly (vinyl chloride)

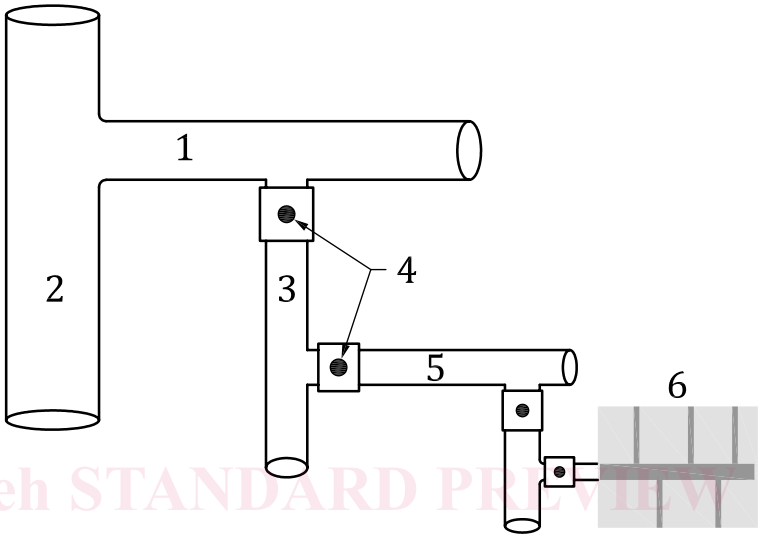
PE polyethylene

4 Piped network for irrigation applications

A pipe irrigation network (PIN) consists of water mains, water branch, field irrigation lines, hydrant or outlets and other devices (see Figure 1).

An analogy between the CDN and PIN is depicted in Figure 1. Main advantages and limitations of PIN are listed in Annex A.

For DI pipes, the DN range for PIN is DN 40 to DN 2 600 as per ISO 2531.



Key

1 branch line
2 main line
3 distribution line
4 control valves
5 minor line
6 field irrigation lines

Figure 1 — Pipe irrigation network (PIN)

Details of piped irrigation network planning are given in Annex B.

5 Technical requirements of DI pipeline components for irrigation applications

5.1 General

The ductile iron pipeline components system consists of standardized components equipped with fully compatible socket or flange joints which facilitate the design networks of any size and complexity.

The technical requirements of DI pipeline components shall be in accordance with ISO 2531.

Note DI pipes with joints compatible with plastic piping systems (PVC or PE) and referring to ISO 16631 are outside the scope of this document.

5.2 Material characteristics

Material characteristics of pipes, fittings and accessories shall comply with ISO 2531:2009, 4.3.

5.3 Pressure class and dimensions

5.3.1 Preferred pressure classes

Components with flexible joints are classified by the allowable operating pressure (PFA) in bar, prefixed by the letter C. Components with flanged joints are classified by the PN number of the flange. The allowable pressures within a pipeline system shall be limited to the lowest pressure classification of all components within the system.

Preferred pressure classes of irrigation pipes with flexible joints are C25, C30, and C40. Other classes are allowed by agreement between the manufacturer and the customer.

Pressure classes for components with flanged joints are PN10, PN16, PN25 and PN40.

5.3.2 Allowable pressures

Allowable pressures of components are as given in Tables 1 and 2.

Table 1 — Allowable pressures of components with flexible joints for preferred classes

Pressure class C	Allowable operating pressure PFA bar	Maximum allowable operating pressure PMA bar	Allowable site test pressure PEA bar
25	25	30	35
30	30	36	41
40	40	48	53

Table 2 — Allowable pressures of components with flanged joints

Pressure class PN	Allowable operating pressure PFA bar	Maximum allowable operating pressure PMA bar	Allowable site test pressure PEA bar
10	10	12	17
16	16	20	25
25	25	30	35
40	40	48	53

Allowable pressures of pipes with flexible joints are given in Table 3.

Table 3 — Allowable pressures of pipes with flexible joints for preferred classes

DN	Pressure class C	Allowable operating pressure PFA bar	Maximum allowable operating pressure PMA bar	Allowable site test pressure PEA bar
40 to 300	40	40	48	53
350 to 600	30	30	36	41
700 to 2 600	25	25	30	35

Allowable pressures for fittings as specified in ISO 2531:2009, Tables 15 to 33 are as follows.

— Socketed fittings, except tees, are given in Table 4.

— Socketed tees may be less than those given in Table 4 and shall be given in the manufacturer's handbook.

— All flanged fittings and fittings with one flange, such as double-socketed tees with flanged branch, flanged spigots and flanged sockets, are limited by the flange PN and are given in Table 2.

Table 4 — Allowable pressures for socketed fittings

DN	Allowable operating pressure PFA bar	Maximum allowable operating pressure PMA bar	Allowable site test pressure PEA bar
40 to 200	64	77	82
250 to 350	50	60	65
400 to 600	40	48	53
700 to 1 400	30	36	41
1 500 to 2 600	25	30	35

Appropriate limitations shall be taken into account, which can prevent the full range of these pressures being used in an installed pipeline. For example, operation at the PFA values can be limited by the lower pressure capability of other pipeline components, e.g. flanged pipework, certain types of tees and specific designs of flexible joints. When other limitations exist due to the joint type or to any specific design arrangement, they shall be given in the manufacturer's handbook.

5.3.3 Diameter of socket and spigot pipes

The dimensions of preferred pressure classes of socket and spigot pipes are as given in Figure 2 and Table 5.

When, by agreement between the manufacturer and the purchaser, pipes and fittings with different lengths, thicknesses and/or coatings, and other types of fittings than those given below are supplied in accordance with this document, they shall comply with all the other requirements of this document.

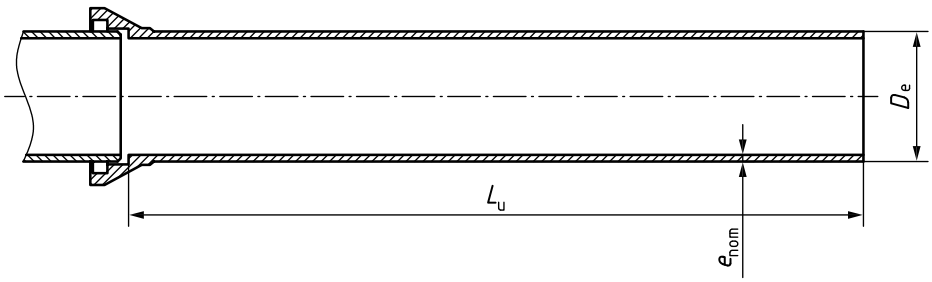


Figure 2 — Socket and spigot pipe

Table 5 — Preferred pressure classes of Irrigation pipes with flexible joints

DN	Spigot external diameter D_e[a] mm	Pressure class	Nominal iron wall thickness e_{nom} mm
40	56	C40	4,4
50	66	C40	4,4
60	77	C40	4,4
65	82	C40	4,4
80	98	C40	4,4
100	118	C40	4,4
125	144	C40	4,5
150	170	C40	4,5
200	222	C40	4,7
250	274	C40	5,5
300	326	C40	6,2
350	378	C30	6,3[b]
400	429	C30	6,5[b]
450	480	C30	6,9
500	532	C30	7,5
600	635	C30	8,7
700	738	C25	8,8[b]
800	842	C25	9,6
900	945	C25	10,6
1 000	1 048	C25	11,6
1 100	1 152	C25	12,6
1 200	1 255	C25	13,6
1 400	1 462	C25	15,7
1 500	1 565	C25	16,7
1 600	1 668	C25	17,7
1 800	1 875	C25	19,7
2 000	2 082	C25	21,8
2 200	2 288	C25	23,8
2 400	2 495	C25	25,8
2 600	2 702	C25	27,9

[a] A tolerance of +1 mm applies (see ISO 2531).

[b] Thickness is greater than calculated for “smoothing” between C40 and C30 and also between C30 and C25.

5.3.4 Length of Socket and spigot pipes

Socket and spigot pipes shall be supplied to the lengths given in Figure 2 and Table 6.