INTERNATIONAL STANDARD

ISO 16631

First edition
2016-03-01

Corrected version
2018-03

Ductile iron pipes, fittings, accessories and their joints compatible with plastic (PVC or PE) piping systems, for water applications and for plastic pipeline connections, repair and replacement

Tuyaux, raccords et accessoires en fonte ductile et leurs assemblages compatibles avec les canalisations plastiques (PVC ou PE) pour la distribution d'eau et pour les connexions, réparations et remplacements des canalisations en plastiques

Reference number
ISO 16631:2016(E)

© ISO 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

 © ISO 2016 – All rights reserved

Contents

Page

Foreword ... **v**

1 Scope ... **1**

2 Normative references ... **2**

3 Terms and definitions ... **2**

4 Technical requirements ... **6**
4.1 General ... 6
4.2 General requirements ... 6
4.2.1 Pipes and fittings nominal sizes ... 6
4.2.2 Surface condition ... 6
4.2.3 Types of joints and interconnection ... 6
4.2.4 Materials in contact with water intended for human consumption ... 7
4.3 Pressure classification and dimensional requirements ... 8
4.3.1 Pressure classification ... 8
4.3.2 Diameter ... 8
4.3.3 Wall thickness ... 9
4.3.4 Length ... 9
4.3.5 Straightness of pipes ... 9
4.4 Material characteristics ... 9
4.4.1 Tensile properties ... 9
4.4.2 Brinell hardness ... 10
4.5 Coatings and linings for pipes ... 10
4.5.1 General ... 10
4.5.2 External coatings ... 10
4.5.3 Internal linings ... 10
4.6 Coatings and linings for fittings and accessories ... 10
4.7 Marking ... 11
4.8 Packaging and handling ... 11

5 Leaktightness requirements ... **11**
5.1 Pipes and fittings ... 11
5.2 Flexible joints ... 12
5.2.1 General ... 12
5.2.2 Ductile iron socket assembled with ductile iron spigot end ... 12
5.2.3 Ductile iron socket assembled with plastic spigot end ... 13

6 Test methods ... **17**
6.1 Dimensions ... 17
6.1.1 External diameter ... 17
6.1.2 Wall thickness ... 17
6.1.3 Length ... 17
6.2 Straightness of pipes ... 17
6.3 Tensile test ... 18
6.3.1 Centrifugally cast pipes ... 18
6.3.2 Fittings and accessories ... 18
6.3.3 Test bar ... 18
6.3.4 Equipment and test method ... 18
6.3.5 Test results ... 18
6.3.6 Test frequency ... 18
6.4 Brinell hardness ... 18
6.5 Works leaktightness test of pipes and fittings ... 19
6.5.1 General ... 19
6.5.2 Centrifugally cast pipes ... 19
6.5.3 Fittings ... 19

7 Type tests ... **19**

© ISO 2016 – All rights reserved

7.1 Type tests on ductile iron spigot ends 19
7.1.1 Leaktightness of joints to internal pressure 19
7.1.2 Leaktightness of joints to external pressure 20
7.1.3 Leaktightness of joints to negative internal pressure 21
7.2 Type tests on plastic spigot ends 21
7.2.1 General 21
7.2.2 Leaktightness of joints to internal hydrostatic pressure 21
7.2.3 Leaktightness of joints to negative internal pressure 23
7.2.4 Long-term hydrostatic strength test for joints of fittings for PE pipes 24
7.2.5 Pull out test at 25 °C for restrained joints for PE pipes 24
7.2.6 Long-term hydrostatic strength test for joints of fittings for PVC pipe 25

8 Tables of dimensions 25
8.1 Pipes 25
8.1.1 General 25
8.1.2 External diameters 26
8.1.3 Wall thickness 26
8.1.4 Pipes length 27
8.1.5 Sockets for push-in flexible joints 27
8.2 Fittings 28
8.2.1 General 28
8.2.2 Wall thickness 28
8.2.3 Sockets for push-in socketed fittings 28
8.2.4 Flanged socket 28
8.2.5 Flanged spigot 29
8.2.6 Collars 30
8.2.7 Double socket bend 90° (1/4) 31
8.2.8 Double socket bend 45° (1/8) 32
8.2.9 Double socket bend 22°30’ (1/16) 33
8.2.10 Double socket bend 11°15’ (1/32) 34
8.2.11 Double socket tee with flanged branch 35
8.2.12 All socket tee 37
8.2.13 Double socket taper 39

Annex A (informative) **External coating 41**

Annex B (informative) **Internal lining 42**

Annex C (normative) **Stiffness determination 43**

Annex D (normative) **Quality assurance 44**

Annex E (informative) **Safety factors 45**

Annex F (normative) **Water pipeline systems incorporating ductile iron and plastic components 46**

Annex G (informative) **Environmental aspects 47**

Bibliography 48

 © ISO 2016 – All rights reserved

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 2, *Cast iron pipes, fittings and their joints*.

This corrected version of ISO 16631:2016 incorporates the following correction:

— in Table 8, “PFA” has been changed to “PEA”.

© ISO 2016 – All rights reserved

Ductile iron pipes, fittings, accessories and their joints compatible with plastic (PVC or PE) piping systems, for water applications and for plastic pipeline connections, repair and replacement

1 Scope

This International Standard specifies the requirements and test methods applicable to ductile iron pipes, fittings, accessories and their joints with dimensions compatible with plastic (PVC or PE) piping systems:

— to replace or repair existing plastic pipelines;

— to convey water (e.g. for human consumption, raw water, etc.);

— operated with or without pressure;

— installed below or above ground;

— defined according to their external diameter (DN/OD series);

— classified according to pressure (C class).

The pressure class specified in this International Standard is C25. This pressure resistance level will meet or exceed those of plastic pipes. These ductile iron pipes, fittings, accessories and joints can be used along with plastic pipelines, where they are needed (for example, with higher pressure rating sections, higher traffic load, etc.), for the construction of water pipelines.

The dimensions of the products according to this International Standard, in the size range DN/OD 50 to DN/OD 225, are compatible with those of plastic pipes (ISO 1452-2 for PVC and ISO 4427-2 for PE). The spigots of plastic pipes used for water applications can be inserted into sockets of pipes manufactured according to this International Standard. The spigots and sockets of products defined in this International Standard are not dimensionally compatible with the products defined in ISO 2531.

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

This International Standard covers pipes, fittings and accessories cast by any type of foundry process or manufactured by fabrication of cast components, as well as corresponding joints in the size range DN/OD 50 to DN/OD 225 inclusive.

It is applicable to pipes, fittings and accessories which are

— manufactured with socketed or spigot ends for jointing by means of various types of gaskets (which are not within the scope of this International Standard), and

— compulsory delivered internally and externally coated.

This International Standard is also applicable to socketed fittings which include flanged connections.

NOTE In this International Standard, all pressures are relative pressures expressed in bar[1)].

1) 100 kPa = 1 bar.

© ISO 2016 – All rights reserved

2 Normative references

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

ISO 1167-1:2006, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1452-2, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 2: Pipes*

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

ISO 4016, *Hexagon head bolts — Product grade C*

ISO 4034, *Hexagon regular nuts (style 1) — Product grade C*

ISO 4179, *Ductile iron pipes and fittings for pressure and non-pressure pipelines — Cement mortar lining*

ISO 4427-2, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 2: Pipes*

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

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892-1, *Metallic materials —Tensile testing — Part 1: Method of test at room temperature*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

ISO 7091, *Plain washers — Normal series — Product grade C*

ISO 8179-1, *Ductile iron pipes — External zinc-based coating — Part 1: Metallic zinc with finishing layer*

ISO 8179-2, *Ductile iron pipes — External zinc coating — Part 2: Zinc rich paint with finishing layer*

ISO 8180, *Ductile iron pipelines — Polyethylene sleeving for site application*

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

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

ISO 13846, *Plastics piping systems — End-load-bearing and non-end-load-bearing assemblies and joints for thermoplastics pressure piping — Test method for long-term leaktightness under internal water pressure*

ISO 16132, *Ductile iron pipes and fittings — Seal coats for cement mortar linings*

3 Terms and definitions

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

3.1
ductile iron
type of cast iron used for pipes, fittings and accessories in which graphite is present primarily in spheroidal form

3.2
pipe
casting of uniform bore, with straight axis, having either socket, spigot or flanged ends, except for flanged sockets, flanged spigots and collars which are classified as fittings

© ISO 2016 – All rights reserved

3.3
fitting
casting other than a pipe, which allows pipeline deviation, change of direction or bore

Note 1 to entry: In addition, flanged sockets, flanged spigots, flange adaptors and collars are also classified as fittings.

3.4
accessory
component other than a pipe or fitting, which is used in a pipeline, such as

— glands and bolts for *mechanical flexible joints* (3.14), and

— glands, bolts and locking rings or segments for *restrained joints* (3.15).

Note 1 to entry: Valves and hydrants of all types are not covered by the term accessory.

3.5
component
product defined in 3.2 to 3.4

3.6
flange
end of a pipe or fitting, extending perpendicular to its axis, with bolt holes equally spaced on a circle

Note 1 to entry: A flange may be fixed (e.g. integrally cast, threaded-on or welded-on) or adjustable; an adjustable flange comprises a ring, in one or several parts bolted together, which bears on an end joint hub and can be freely rotated around the pipe axis before jointing.

3.7
spigot
male end of a pipe or fitting

3.8
spigot end
maximum insertion depth of the spigot plus 50 mm

3.9
socket
female end of a pipe or fitting to make the connection with the spigot of the next component

3.10
gasket
sealing component of a joint

3.11
joint
connection between the ends of pipes and/or fittings in which a gasket is used to effect a seal

3.12
flexible joint
joint which provides significant angular deflection and movement parallel and/or perpendicular to the pipe axis

3.13
push-in flexible joint
flexible joint assembled by pushing the spigot through the gasket into the socket of the mating component

© ISO 2016 – All rights reserved

3.14
mechanical flexible joint
flexible joint in which sealing is obtained by applying pressure to the gasket by mechanical means, e.g. a gland

3.15
restrained joint
joint in which a means is provided to prevent separation of the assembled joint

3.16
flanged joint
joint between two flanged ends

3.17
nominal size
DN/OD
alphanumerical designation of size for components of a pipework system, which is used for reference purposes

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

3.18
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 6708:1995, 2.1, modified]

3.19
nominal pressure
PN
numerical designation expressed by a number which is used for reference purposes

Note 1 to entry: All components of the same nominal size DN/OD designated by the same PN number have compatible mating dimensions (see ISO 7268).

3.20
allowable operating pressure
PFA
maximum internal pressure, excluding surge, that a component can safely withstand in permanent service and designated, C

3.21
maximum allowable operating pressure
PMA
maximum internal pressure, including surge, that a component can safely withstand in service

3.22
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.

© ISO 2016 – All rights reserved

3.23
diametral stiffness of a pipe
characteristic of a pipe which allows it to resist diametral deflection under loading

3.24
longitudinal bending resistance
characteristic of a pipe which allows it to resist bending deformations under loading when installed

3.25
batch
quantity of castings from which a sample may be taken for testing purposes during manufacture

3.26
type test
proof-of-design test which is done once and is repeated only after change of design

3.27
laying length of a socket and spigot pipe
laying length L_e, equal to the overall length of pipe (L_{tot}) minus the maximum spigot insertion depth (L_i) as given by the manufacturer and as shown in Figure 4

3.28
standardized length
standardized length of socketed pipes and fittings (L_u or l_u for branches) is equal to the overall length L_{tot} minus the depth of socket (L_2) as indicated in the manufacturer's catalogues, as shown in Figure 5 for pipes and Figure 6 to 14 for fittings

3.29
spigot end
maximum insertion depth of the spigot plus 50 mm

3.30
deviation
amount by which the design length may differ from the standardized length of a pipe or a fitting

Note 1 to entry: Pipes and fittings are designed to a length selected in the range of standardized length plus or minus the deviation. They are manufactured to this length plus or minus the tolerance (see 8.1.4).

3.31
ovality
out of roundness of a pipe section, equal to:

$$100\,\frac{\left(A_1 - A_2\right)}{\left(A_1 + A_2\right)}$$

where

A_1 is the maximum axis of the pipe cross-section, in millimetres;

A_2 is the minimum axis of the pipe cross-section, in millimetres.

3.32
hoop stress
σ
stress in a pipe or fitting under pressure, acting tangentially to the perimeter of a transverse section

3.33
thickness
e_{nom}
nominal thickness of a pipe or a fitting

© ISO 2016 – All rights reserved

3.34
minimum thickness
nominal thickness of a pipe or a fitting minus the manufacturing tolerance

4 Technical requirements

4.1 General

General requirements, pressure classification and dimensional requirements, material characteristics, coatings and linings, marking and packaging and handling are specified in 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8, respectively.

When, by agreement between the manufacturer and the purchaser, pipes and fittings, with different pressure classes, lengths and/or coatings and other types of fittings are supplied with reference to this International Standard, they shall comply with all the other requirements of this International Standard.

4.2 General requirements

4.2.1 Pipes and fittings nominal sizes

The standardized nominal sizes DN/OD of pipes and fittings are as follows according to ISO 161-1:

— 50, 63, 75, 90, 110, 125, 140, 160, 180, 200 and 225.

4.2.2 Surface condition

Pipes, fittings and accessories shall be free from defects and surface imperfections which could impair their compliance with the requirements of Clauses 4 and 5.

Repairs which affect the wall thickness are not allowed. Pipe whose wall thickness is below the local minimum thickness required, after repair, shall be rejected.

4.2.3 Types of joints and interconnection

4.2.3.1 General

Joint design and gasket shapes are beyond the scope of this International Standard.

Rubber gasket materials shall conform to the requirements of ISO 4633 for water applications. When materials other than rubber are necessary, they shall conform to the appropriate ISO standards.

4.2.3.2 Flexible joints

Pipes and fittings with flexible joints shall be in accordance with 4.3.2 for their spigot ends external diameters DE and their tolerances. This provides the possibility of interconnection between components equipped with different types of flexible joints. In addition, each type of flexible joint shall be designed to meet the leaktightness requirements of Clause 5.

4.2.3.3 Restrained joints

Restrained joints for ductile iron pipelines shall be designed in accordance with ISO 10804. Their spigot ends external diameters DE and their tolerances shall comply with 4.3.2.

© ISO 2016 – All rights reserved