BRITISH STANDARD

BS EN
14525:2004

Ductile iron wide tolerance couplings and flange adaptors for use with pipes of different materials: Ductile iron, Grey iron, Steel, PVC-U, PE, Fibre-cement

The European Standard EN 14525:2004 has the status of a British Standard

ICS 23.040.10; 23.040.60

National foreword

This British Standard is the official English language version of EN 14525:2004.

The UK participation in its preparation was entrusted to Technical Committee PSE/10, Iron pipes and fittings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 30, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 19 August 2005

ISBN 0 580 46203 X

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14525

November 2004

ICS 23.040.10; 23.040.60

English version

Ductile iron wide tolerance couplings and flange adaptors for use with pipes of different materials: ductile iron, Grey iron, Steel, PVC-U PE, Fibre-cement

Adaptateurs de brides et manchons à larges tolérances en fonte ductile destinés à être utilisés avec des tuyaux faits de différents matériaux : fonte ductile, fonte grise, acier, PVC-U, PE, fibre-ciment

Großbereichskupplungen und -flanschadapter aus duktilem Gusseisen zur Verbindung von Rohren aus unterschiedlichen Werkstoffen: Duktiles Gusseisen, Gusseisen mit Lamellengraphit, Stahl, PVC-U, PE, Faserzement

This European Standard was approved by CEN on 23 September 2004.

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.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 14525:2004: E

Contents

Page

Foreword

This document (EN 14525:2004) has been prepared by Technical Committee CEN/TC 203 “Cast iron pipes, fittings and their joints”, the secretariat of which is held by AFNOR.

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 May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

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.

Introduction

This standard is in conformity with the general requirements already established by CEN/TC 164 in the field of water supply.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard :

a) this standard provides no information as to whether the product may be used without restriction in any of the member states of the EU or EFTA ;

b) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

1 Scope

This document specifies the requirements and associated test methods applicable to wide tolerance ductile iron couplings and wide tolerance flange adaptors intended for use with pipe components made from a number of pipe materials (ductile iron, grey iron, PE, PVC-U, steel, fibre-cement), for providing a leak tight seal over a wide range of pipe external diameters :

— to convey water (e.g. potable water) ;

— with or without pressure ;

— to be installed below or above ground, inside or outside buildings.

This document is not intended to cover sewerage or gas applications, where other requirements may be necessary.

This document specifies requirements for materials, dimensions and tolerances, mechanical properties and standard coatings of ductile iron products.

This standard covers ductile iron products cast by any type of foundry process or manufactured by fabrication of cast components, as well as corresponding joints, in a size range extending from DN 40 to DN 600, for an allowable operating pressure (PFA) up to 16 bar, for fluid temperatures between 0 °C and 25 °C excluding frost. For higher temperatures, up to 50 °C, additional type testing should be carried out.

It also gives performance requirements and associated test methods for restrained and non-restrained flexible joints. Joint design and gasket shapes are outside the scope of this standard.

NOTE 1 PFA may be limited depending on pipe materials effectively connected.

NOTE 2 In this document, all pressures are relative gauge pressures, expressed in bars (100 kPa = 1 bar).

NOTE 3 EN 545 gives the specifications for the ductile iron fittings to be used with ductile iron pipes.

NOTE 4 EN 12842 gives the specifications for the ductile iron fittings to be used with PVC-U and PE pipes.

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.

EN 681-1, *Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Part 1 : vulcanized rubber.*

EN 805, *Water supply – Requirements for systems and components outside buildings.*

EN 1092-2, *Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 2 : Cast iron flanges.*

EN 10002-1, *Metallic materials – Tensile testing – Part 1 : Method of test at ambient temperature.*

EN ISO 4016, *Hexagon head bolts – Product grade C (ISO 4016:1999).*

EN ISO 4034, *Hexagon nuts – Product grade C (ISO 4034:1999).*

EN ISO 6506-1, *Metallic materials – Brinell hardness test – Part 1 : Test method (ISO 6506-1:1999).*

EN ISO 7091, *Plain washers – Normal series – Product grade C (ISO 7091:2000).*

3 Terms and definitions

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

3.1
ductile iron
cast iron used for pipes, fittings and accessories in which graphite is present substantially in spheroidal form.

3.2
fitting
casting other than a pipe which allows pipeline deviation, change of direction or bore.In addition flanged-socket pieces, flanged spigot pieces and collars are also classified as fittings.

3.3
flange
end of a pipe or fitting extending perpendicular to its axis, with bolt holes equally spaced on a circle.

NOTE A flange may be fixed (e.g. integrally cast or welded-on) or adjustable ; an adjustable flange comprises a ring, in one or several parts assembled together, which bears on an end joint hub and can be freely rotated around the axis before jointing. See EN 545.

3.4
spigot
male end of a pipe or fitting

3.5
socket
female end of a pipe or fitting to make the connection with the spigot of the next component

3.6
gasket
sealing component of a joint

3.7
joint
connection between the ends of two pipes and/or fittings in which a gasket is used to effect a seal

3.8
flexible joint
joint which permits significant angular deflection both during and after installation and which can accept a slight offset of the centreline

3.9
push-in flexible joint
flexible joint assembled by pushing the spigot through the gasket in the socket of the mating component

3.10
mechanical flexible joint
flexible joint in which sealing is obtained by applying pressure to the gasket by mechanical means, e.g. a gland

3.11
restrained flexible joint
flexible joint in which a means is provided to prevent separation of the assembled joint

3.12
flanged joint
joint between two flanged ends

3.13
joint angular deflection
angle between the axis of two connected pipeline components which a flexible joint can accommodate

3.14
joint gap
axial distance between any point of the spigot ends of the pipes to be connected, when aligned (coupling), or, axial distance between any point of the spigot end of the pipe and the flange face, when aligned (flange adaptor) (See also 4.2.2)

3.15
depth of engagement
distance between any point of the spigot end and the face of the socket of the coupling or the flange adaptor (See also 4.2.2)

3.16
outside diameter (OD)
outside diameter of the pipe(s) to be connected

3.17
nominal size (DN)
alphanumerical designation of size for components of a pipework system, which is used for reference purposes.

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.

[see EN ISO 6708]

3.18
nominal pressure (PN)
alphanumerical designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system.

It comprises the letters PN followed by a dimensionless number.

[see EN 1333]

NOTE All equipment of the same nominal size DN designated by the same PN number have compatible mating dimensions.

3.19
leak tightness test pressure
pressure applied to a component during manufacture in order to ensure its leak tightness

3.20
allowable operating pressure (PFA)
maximum hydrostatic pressure that a component is capable of withstanding continuously in service

[see EN 805]

NOTE In EN 1452 and EN 12201, the term nominal pressure (PN) at 20 °C is used in place of PFA.

3.21
allowable maximum operating pressure (PMA)
maximum pressure occurring from time to time, including surge, that a component is capable of withstanding in service

[see EN 805]

3.22
allowable test pressure (PEA)
maximum hydrostatic pressure that a newly installed component is capable of withstanding for a relatively short duration, in order to insure the integrity and tightness of the pipeline

[see EN 805]

NOTE This test pressure is different from the system test pressure (STP), which is related to the design pressure of the pipeline and is intended to ensure its integrity and leak tightness.

3.23
performance test
proof of design test which is done once and is repeated only after change of design

3.24
wide tolerance flange adaptor
fitting intended for use with pipes of various materials which :

— is used in a pipeline to make the connection with a spigot of a pipe or a fitting and the flange of another component of the pipeline (e.g. pipe, fitting, valve, etc.) ; and

— allows for radial and axial displacements

NOTE Some flange adaptors are designed such that they can be slid over the pipes in order to facilitate easy assembly.

3.25
wide tolerance coupling
fitting intended for use with pipes of various materials which :

— is used in a pipeline to make the connection between two spigots of pipes, fittings or valves, etc. , and,

— allows for radial and axial displacements.

NOTE Some couplings are designed such that they can be slid over the pipes in order to facilitate easy assembly.

3.26
wide tolerance stepped or reducer coupling
wide tolerance coupling intended for use with pipeline components of different nominal sizes.

4 Technical requirements

4.1 General

4.1.1 Diameter range

The wide tolerance couplings are defined by the minimum and maximum outside diameters of the pipes to be connected. Within this diameter range, the performance shall be guaranteed at the manufacturer's declared PFA.

The wide tolerance flange adaptors are defined by the DN and the PN of the flange and by the minimum and maximum outside diameters of the pipes to be connected. Within this diameter range, the performance shall be guaranteed at the manufacturer's declared PFA.

The minimum working range of outside diameters for wide tolerance couplings and wide tolerance flange adaptors is given in Table 1.

Table 1 – Minimum working diameter range

Maximum OD or DN of the pipes to be connected		**Minimum working diameter range**
OD (mm)	**DN**	(mm)
OD ≤ 110	DN ≤ 100	10
110 < OD ≤ 225	100 <DN ≤ 200	15
225 < OD ≤ 315	200 < DN ≤ 300	20
315 < OD ≤ 400	300 < DN ≤ 400	25
400 < OD ≤ 630	400 < DN ≤ 600	30

The working range defined by the minimum and the maximum outside diameter range shall be specified by the manufacturer.

Informative Annex A gives the outside diameters of existing pipes, according to current ISO, EN or national standards.

The preferred PFA's are 6 bar, 10 bar and 16 bar.

4.1.2 Surface condition and repairs

Wide tolerance couplings and wide tolerance flange adaptors shall be free from defects and surface imperfections which could lead to non-compliance with clauses 4 and 5.

When necessary, couplings and flange adaptors may be repaired, for example by welding, in order to remove surface imperfections and localised defects which do not extend through the entire wall thickness, provided that :

— the repairs are carried out according to the manufacturer's written procedure ;

— the repaired couplings and flange adaptors comply with all the requirements of clauses 4 and 5.

4.1.3 Types of joints and interconnection

4.1.3.1 General

Rubber gasket materials shall comply with the requirements of EN 681-1 for the type WA.

4.1.3.2 Flanged joints

Flanged joints shall be constructed in such a way that they may be attached to flanges whose dimensions and tolerances comply with EN 1092-2. This ensures interconnection between all flanged components (pipes, fittings, valves, etc.) of the same PN and DN and adequate joint performance.

Flanges may be designed to be compatible with different DN (e.g. DN 50-60-65) and/or different PN (e.g. PN 10/16).

Certain flange adaptors, especially for repair purposes, are designed to cater for flanges other than EN 1092-2. Consequently, some dimensions (e.g. thickness, bolt holes) have been designed to suit. Such flange adaptors shall not compromise functionality or compatibility with EN 1092-2 flanges.

NOTE Flange gaskets may be one of those given in EN 1514.

4.1.3.3 Flexible joints

Flexible joints, restrained or non-restrained, shall meet the performance requirements detailed in clause 5.

The manufacturer shall declare for which pipe materials restrained joints may be used.

Supporting sleeves (inserts) may be necessary depending on pipe material, on pipe wall thickness, on joint design and on local authorities. They shall provide adequate support over the entire compression area of the gasket. The manufacturer shall indicate when supporting sleeves are required.

4.1.3.4 Mechanical properties of bolts and nuts

Bolts and nuts shall comply as a minimum with the requirements of EN ISO 4016 and EN ISO 4034, grade 4.6. When applicable, washers shall comply with EN ISO 7091.

4.1.3.5 Materials in contact with water intended for human consumption

Wide tolerance couplings and wide tolerance flange adaptors include several materials given in this standard. When used under the conditions for which they are designed, in permanent or in temporary contact with water intended for human consumption, wide tolerance couplings and wide tolerance flange adaptors shall not change the quality of that water to such an extent that it fails to comply with the requirements of national regulations.

For this purpose, reference shall be made to the relevant national regulations and standards, transposing EN standards when available, dealing with the influence of materials on water quality, and to the requirements for external systems and components as given in EN 805.

NOTE A European Approval Scheme (EAS) is in course of development in relation to the Construction Product Directive and the Drinking Water Directive ; its requirements will be introduced in this standard when completed.

4.2 Dimensional requirements

4.2.1 Wall thickness

The minimum wall thickness shall be as given in Table 2, provided that they comply to the requirements of 4.6 and of clause 7.

Table 2 – Minimum wall thickness

Maximum OD or DN of the pipes to be connected		Minimum wall thickness
OD (mm)	**DN**	(mm)
OD ≤ 225	DN ≤ 200	4,0
225 < OD ≤ 315	200 < DN ≤ 300	5,0
315 <OD ≤ 630	300 < DN ≤ 600	6,0

4.2.2 Joint gap and depth of engagement

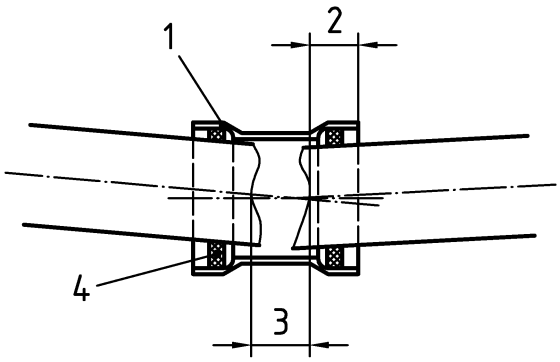
The manufacturer shall declare his maximum allowable joint gap, and it should be not less than the values given in Table 3.

NOTE The maximum joint gap between the pipes or the flange to be connected may be affected by pipe contraction or expansion occurring as a result of temperature or pressure change.

The depth of engagement is related to the joint design. The manufacturer shall declare the minimum depth of engagement in the jointing instructions for each type of pipe material. The minimum depth of engagement shall be such that the pipes can support the loads imparted by the jointing system.

Table 3 – Joint gap

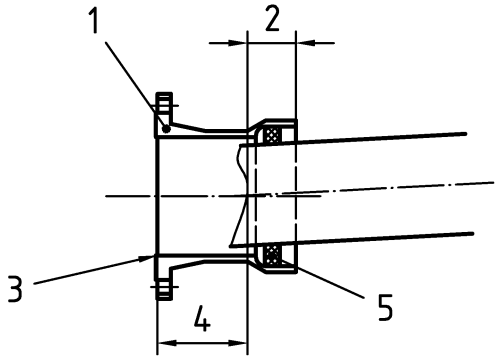
Maximum OD or DN of the pipes to be connected		Coupling joint gap	Flange adaptor joint gap
OD (mm)	**DN**	(mm)	(mm)
OD ≤ 110	DN ≤ 100	20	15
110<OD ≤ 225	100<DN ≤ 200	25	20
225<OD ≤ 315	200<DN ≤ 300	35	30
315<OD ≤ 400	300<DN ≤ 400	55	40
400<OD ≤ 630	400<DN ≤ 600	70	50



Key

1 Coupling
2 Depth of engagement
3 Joint gap
4 Joint gasket

Figure 1 – Joint gap for wide tolerance coupling (example)



Key

1 Flange adaptor
2 Depth of engagement
3 Flange face
4 Joint gap
5 Joint gasket

Figure 2 – Joint gap for wide tolerance flange adaptor (example)

4.3 Mechanical properties of ductile iron

4.3.1 Tensile properties

Ductile iron couplings and flange adaptors shall have a minimum tensile strength, R_m, of 420 MPa and a minimum elongation at fracture of 5 %. The tensile strength shall be tested in accordance with 6.1.

4.3.2 Hardness

The Brinell hardness, when measured in accordance with 6.2, shall not exceed 250 HB. For components manufactured by welding, a higher Brinell hardness is allowed in the heat-affected zone of the weld.

4.4 Coatings

4.4.1 General

Unless otherwise agreed between manufacturer and purchaser, all couplings and flange adaptors shall be delivered externally and internally coated. The external and internal coatings shall comply with the corresponding EN standards or, where no EN standard exists, they shall comply with ISO standards or with national standards, or with an agreed technical specification.

4.4.2 Coating of ductile iron components

Unless otherwise agreed between the manufacturer and the purchaser, one of the coatings listed below shall be used :

— epoxy ;

— polyamide ;

— polyester ;

— polyurethane ;

— vitreous enamel.

Curing shall be sufficient to ensure that it will not stick to adjacent coated pieces.

All coatings shall be works-applied.

4.4.3 Coating of bolts and nuts

Bolts and nuts shall be suitably protected to inhibit corrosion depending on the external conditions of use. The following coatings may be supplied :

— epoxy ;

— polyamide ;

— zinc based corrosion protection ;

— PTFE.

4.5 Product information

4.5.1 Marking requirements

All fittings shall be legibly and durably marked and shall bear at least the following information :

— manufacturer's name or mark ;

— identification of the year of manufacture ;

— identification of ductile iron ;

— DN and PN rating of flanges when applicable ;

— reference to this standard ;

— an identification of the minimum and maximum outside diameters (range of external diameters over which the product works) ;

— PFA of the coupling or of the flange adaptor.

The first five markings given above shall be cast-on or cold stamped ; the other markings can be applied by any method, e.g. painted on the casting or attached to the packaging.

4.5.2 Additional information

The following information shall be supplied on or with each product :

— maximum joint gap ;

— minimum depth of engagement ;

— maximum allowable angular deflection ;

— pipe materials for which the coupling or the flange adaptor is intended to be used with non-restrained joints, and, if applicable, pipe materials for which the coupling or the flange adaptor is intended to be used with restrained joints ;

— need for supporting sleeves (insert) ;

— bolt torque.

Jointing instructions shall be supplied with the product.

4.6 Leak tightness

4.6.1 Couplings and flange adaptors

Couplings and flange adaptors shall be designed to be watertight at their allowable test pressure (PEA).

They shall be tested in accordance with 6.3 and shall exhibit no visible leakage, sweating or any other sign of failure.

4.6.2 Joints

Joints, restrained and non-restrained, shall comply with the performance requirements of clauses 5 and 7.

5 Performance requirements for joints

5.1 General

In order to ensure the fitness for purpose of the joints in the field of water supply, there shall be a performance test (see 3.23) for at least one OD or DN for each of the groupings given below :

— OD 40 mm to 140 mm or DN 32 to DN125 (preferred around 100 mm) ;

— OD 141 mm to 315 mm or DN 150 to DN 300 (preferred around 200 mm) ;

— OD 316 mm to 630 mm or DN 350 to DN 600 (preferred around 400 mm).

One outside diameter is representative of a grouping when the performances are based on the same design parameters throughout the size range. The performance tests shall be carried out either on coupling or flange adaptor, provided the joint design is identical.

If a grouping covers products of different designs and/or manufactured by different processes, the grouping shall be sub-divided.

If for a manufacturer a grouping contains only one outside diameter or nominal diameter, this outside diameter or nominal diameter may be considered as part of the adjacent grouping provided that it is of identical design and manufactured by the same process.

The performance tests shall be carried out using supporting sleeves (inserts) when necessary (see 4.1.3.2.).

5.2 Pressure rating

The relationship between PFA and PMA shall be as follows :

— PMA ≥ PFA + 2 bar.

5.3 Flexible joints

5.3.1 General

The requirements and test conditions are summarized in Table 4. The joints shall exhibit no visible leakage when subjected to the tests. For a joint that can be used in the restrained and in the non-restrained configuration, only one set of tests in the restrained condition is required.

5.3.2 Angular deflection

All flange adaptors and couplings shall be designed to be fully flexible ; consequently, the allowable angular deflection declared by the manufacturer shall be not less than (for each wide tolerance end) :

— 3° for OD 40 mm to 315 mm or DN 32 to DN 300 ;

— 2° for OD 316 mm to 630 mm or DN 350 to DN 600.

5.3.3 Test conditions

All joint designs shall be performance tested under the following conditions of tolerance and joint movement :

a) Joint of maximum annulus, aligned, withdrawn to the allowable value declared by the manufacturer and, if applicable, with shear load ;

b) Joint of maximum annulus, deflected to the allowable value declared by the manufacturer ;

c) All joints shall be tested with a stiff pipe material (e.g.: ductile iron, grey iron, steel, fibre cement) of minimum and maximum DN or OD. If they are intended to be used with PVC or PE pipes, they shall be also performance tested with PFA 6 and PFA 16 pipes.

NOTE Depending on the joint design and on the pipe material, a long term leak tightness test may be necessary to check the possible influence of the creep of the plastic pipe spigot material. Such a test is not defined at this stage.

5.3.4 Test parameters

5.3.4.1 Annulus

All joints shall be performance tested at the extreme outside diameter range such that the annular gap between the sealing surfaces of the socket and of the spigot is equal to the maximum design value plus 0 %, minus 5 %. It is permissible to machine socket internal surfaces to achieve the required annulus for the performance test even though the resultant diameter can be slightly outside the normal manufacturing tolerance.

5.3.4.2 Pipe thickness

All joints shall be performance tested with a spigot having an average wall thickness (over a distance of 2 times the mean OD range in millimetres from the spigot end face) equal to the specified minimum value for the pipe for which the joint is designed plus 10 %, minus 0 %. It is permissible to machine the spigot end of the test pipe in the bore to achieve the required thickness.

5.3.4.3 Shear

All joints shall be performance tested with a resultant shear force of not less than 20 times the OD or DN, in newtons, taking into account the weight of the pipe and of its contents and the geometry of the test assembly (see 7).

The shear load test condition is not required for PE pipes, due to their longitudinal flexibility.

5.4 Restrained flexible joints

All restrained joint designs shall be performance tested in accordance with 7.1 to 7.3 following the requirements of 5.3, except that :

— the withdrawal condition of 5.3.3 a) shall not apply. The performance tests shall be carried out with the maximum joint gap ;

— there shall be no external axial restraint in positive internal pressure tests so that the joint is subjected to the full end thrust.

During the positive internal pressure tests, the axial movement shall reach a stable value and cease.

When the restraining mechanism and the sealing component of a restrained joint are independent, such a joint does not need to be subjected to the negative internal pressure test if the unrestrained version of the joint has passed this test.

Table 4 – Performance testing of the joints: requirements and test conditions

Test	Tests requirements	Pipe section	Test conditions
Positive internal pressure	- test pressure (bar): 1.5PFA + 5 - test duration: 2 h - no leakage	Stiff pipe of maximum OD	Joint deflected
			Joint aligned and withdrawn, with shear load
		Stiff pipe of minimum OD	Joint of maximum annulus, deflected
			Joint of maximum annulus, aligned and withdrawn, with shear load
Positive internal pressure (if applicable)	- test pressure (bar): 1.5PFA + 5 - test duration: 2 h - no leakage	PFA 6 bar PVC pipe [a]	Joint of maximum annulus, aligned and withdrawn, with shear load
		PFA 16 bar PVC pipe [a]	Joint of maximum annulus, aligned and withdrawn, with shear load
Positive internal pressure (if applicable)	- test pressure (bar): 1.5PFA + 5 - test duration: 2 h - no leakage	PFA 6 bar PE pipe [a]	Joint of maximum annulus, aligned and withdrawn.
		PFA 16 bar PE pipe [a]	Joint of maximum annulus, aligned and withdrawn
Negative internal pressure	- test pressure: - 0,8 bar - test duration: 2 h - max pressure change: 0,08 bar	Stiff pipe of minimum OD	Joint of maximum annulus, aligned and withdrawn, with shear load
Negative internal pressure (if applicable)	- test pressure: - 0,8 bar - test duration: 2 h - max pressure change: 0,08 bar	PFA 6 bar PVC pipe [a]	Joint of maximum annulus, aligned and withdrawn, with shear load
Negative internal pressure (if applicable)	- test pressure: - 0,8 bar - test duration: 2 h - max pressure change: 0,08 bar	PFA 6 bar PE pipe [a]	Joint of maximum annulus, aligned and withdrawn.
Dynamic internal pressure	- test pressure: 24 000 cycles between (0,5 PMA or PMA – 5 bar)[b] and PMA - no leakage	Stiff pipe of minimum OD	Joint of maximum annulus, aligned and withdrawn, with shear load
Dynamic internal pressure (if applicable)	- test pressure: 24 000 cycles between (0,5 PMA or PMA – 5 bar)[b] and PMA - no leakage	PFA 6 bar PVC pipe [a]	Joint of maximum annulus, aligned and withdrawn, with shear load
Dynamic internal pressure (if applicable)	- test pressure: 24 000 cycles between (0,5 PMA or PMA – 5 bar)[b] and PMA - no leakage	PFA 6 bar PE pipe [a]	Joint of maximum annulus, aligned and withdrawn.

[a] The PFA 6 and PFA 16 PVC and / or PE pipes may be replaced by the lowest and the highest PVC and / or PE pipe series declared by the coupling/flange adaptor manufacturer

[b] Whichever pressure range is the greater

5.5 Flanged joints

The performance of flanged joints is deemed to be satisfactory as long as they comprise two metallic flanges in accordance with 4.1.3.3.

6 Test methods

6.1 Tensile testing

6.1.1 Samples

The thickness of the sample and the diameter of the test bar shall be as given in Table 5.

At the manufacturer's option, samples shall be either cast integrally with the castings or cast separately. In the latter case they shall be cast from the same metal as that used for the castings. If the castings are subjected to heat treatment, the samples shall be subjected to the same heat treatment cycle.

6.1.2 Preparation of test bar

A test bar shall be machined from each sample to be representative of the metal at the mid thickness of the sample, with a cylindrical part having the diameter given in Table 5.

The test bar shall have a gauge length equal to at least five times the nominal test bar diameter. The ends of the test bar shall be such that they will fit the testing machine.

The surface roughness profile of the cylindrical part of the test bar shall be such that R_z < 6,3.

If the specified diameter of the test bar is greater than 60 % of the measured minimum thickness of the sample, it is allowed to machine a test bar with a smaller diameter.

Table 5 – Test bars for tensile testing

Type of casting	Nominal diameter of the test bar (mm)	Limit deviations on Diameter (mm)	Tolerances on shape[a] (mm)
— integrally cast samples	5,0	± 0,06	0,03
— separately cast samples:			
— sample thickness 12,5 mm for casting thickness less than 12 mm	6,0	± 0,06	0,03
— sample thickness 25 mm for casting thickness 12 mm and over	12,0 or 14,0	± 0,09	0,04

[a] Maximum difference between the smallest and the largest measured diameter of the test bar

The tensile strength shall be calculated either from the nominal diameter of the test bar when it has been machined to fulfil all the tolerances given in Table 5, or, if it is not the case, from the actual diameter of the test bar measured before the test ; the actual diameter shall be measured with an error limit of ≤ 0,5 % and shall be within ± 10 % of the nominal diameter.

6.1.3 Apparatus and test method

The tensile test shall be carried out in accordance with EN 10002-1.

6.1.4 Test results

Test results shall comply with the requirements of 4.3.1. If they do not comply, the manufacturer shall :

a) in the case where the metal does not achieve the required mechanical properties, investigate the reason and ensure that all castings in the batch are either re-heat treated or rejected. Castings which have been re-heat treated are then re-tested in accordance with 6.1 ;

NOTE The manufacturer may limit the amount of rejection by making tests until the rejected batch of castings is bracketed, in order of manufacture, by a successful test at each end of the interval in question.

b) in the case of a defect in the test bar, carry out a further test. If it passes, the batch is accepted ; if not, the manufacturer has the option to proceed as in a) above.

6.2 Brinell hardness

When Brinell hardness tests are carried out (see 4.3.2), they shall be performed either on the casting in dispute or on a sample cut from the casting. The surface to be tested shall be suitably prepared by slight local grinding and the test shall be carried out in accordance to EN ISO 6506-1 using a steel ball of 2,5 mm or 5 mm or 10 mm diameter.

6.3 Works leak tightness test

6.3.1 General

At the manufacturer's option, coupling and flange adaptor bodies shall be submitted to an air test (see 6.3.2) or to a hydrostatic pressure test (see 6.3.3), or to any other leak tightness test of equivalent performance. Coupling and flange adaptor bodies shall be tested before application of their internal and external coatings.

The test apparatus shall be suitable for applying the specified test pressures to the fittings. It shall be equipped with an industrial pressure gauge with an error limit of ± 3 %.

6.3.2 Air test

When the air test is carried out, it shall be with an internal pressure of at least 1 bar and a visual inspection time not less than 10 s ; for leak detection, the castings shall be either uniformly coated on their external surface by a suitable foaming agent or submerged in water.

6.3.3 Hydrostatic pressure test

When the hydrostatic pressure test is carried out, the minimum test pressure shall be PFA.

The internal hydrostatic pressure shall be raised steadily until it reaches the test pressure which shall be maintained for a sufficient time to allow visual inspection. The total duration of the pressure cycle shall be not less than 15 seconds, including 10 seconds at test pressure.

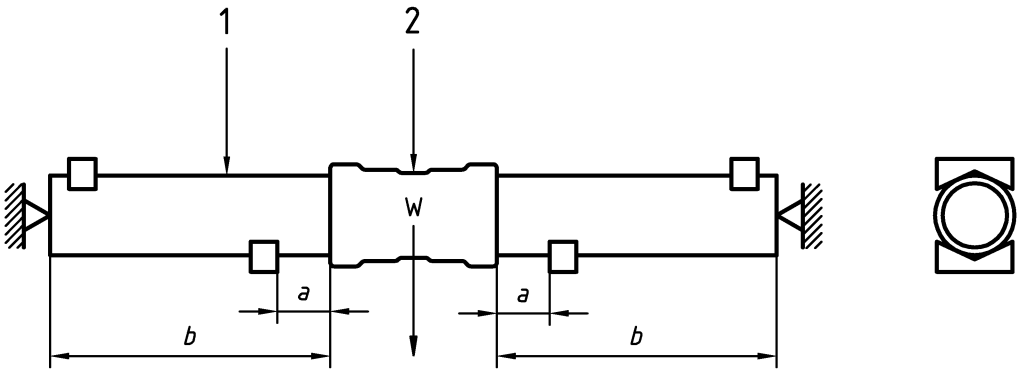
7 Performance tests

7.1 Leak tightness of joints to positive internal pressure

7.1.1 Coupling

The test shall be carried out on an assembled joint comprising a ductile iron coupling and two pipe sections (see figure 3).

The test apparatus shall be capable of providing suitable end and lateral restraints whether the joint is in the aligned position, deflected or subjected to a shear load. It shall be equipped with a pressure gauge with an error limit of ± 3 %.



Key

1 Pipe section

2 Ductile iron coupling

Figure 3 – Test assembly for a coupling

The pipes shall be supported by means of V shaped blocks with an angle of 120°, located at a distance a, of 0,2 × OD in mm, from the coupling face, and up to a maximum of 50 mm. The length of each pipe section, b, shall be at least 2 × OD in mm, and with a minimum of 1 m. A vertical force W shall be applied to the coupling. The vertical force W shall be such that the resultant shear force F across each of the two joints is equal to the value specified in 5.3.4.3, taking into account the weight force M of the coupling and of its contents :

$$W = 2F - M$$

where

W is the vertical force in newtons

F is the shear force in newtons

M is the weight force in newtons.

The test assembly shall be filled with water and suitably vented of air. The test shall not begin before the temperature of the test assembly has stabilised between 10 °C and 25 °C. The pressure shall be raised steadily until it reaches the test pressure given in Table 4. The test pressure shall be kept constant within ± 0,5 bar for at least 2 h during which the joint shall be thoroughly inspected every 15 min. All necessary safety precautions should be taken for the duration of the pressure test.

For a restrained joint, the test assembly, and the test procedure are identical, except that there shall be no end restraint so that the axial thrust is taken by the restrained joint under test. In addition, possible axial movement of the spigot shall be measured every 15 min.

7.1.2 Flange adaptor

For a flange adaptor, half of the test apparatus shall be used (see Figure 4). The vertical force W applied to the flange adaptor shall be such that the resultant shear force F across the joint is equal to the value specified in 5.3.4.3, taking into account the weight force M of the flange adaptor and of its contents :

$$W = F - M$$

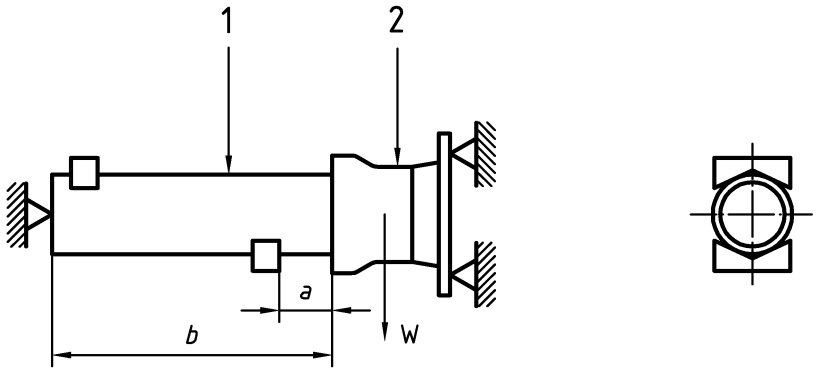
where

W is the vertical force in newtons

F is the shear force in newtons

M is the weight force in newtons.

The test procedure shall be as in 7.1.1.



Key

1 Pipe section
2 Flange adaptor

Figure 4 – Test assembly for a flange adaptor

7.2 Leak tightness of joints to negative internal pressure

The test assembly shall be as given in 7.1.1 or 7.1.2 with the pipe section(s) axially restrained to prevent them from moving towards each other.

The test assembly shall be empty of water and shall be evacuated to a negative internal pressure of 0,8 bar (see Table 4) and then isolated from the vacuum pump. The test assembly shall be left under vacuum for at least 2 h during which the pressure shall not have changed by more than 0,08 bar. The test shall be at a temperature between 10 °C and 25 °C. The temperature of the test assembly shall not vary by more than 10 °C for the duration of the test.

7.3 Leak tightness of joints to dynamic internal pressure

The test assembly shall be as given in 7.1.1 or 7.1.2. The test assembly shall be filled with water and suitably vented of air.

The pressure shall be steadily increased up to PMA, the allowable maximum operating pressure of the joint, then automatically monitored according to the following pressure cycle:

a) steady pressure reduction to 0,5 PMA or PMA -5 (as applicable) ;

b) maintain 0,5 PMA or PMA -5 (as applicable) for at least 5 s ;

c) steady pressure increase to PMA ;

d) maintain PMA for at least 5 s.

The number of cycles shall be recorded and the test stopped automatically in the occurrence of a failure of the joint.

For a restrained joint, the test assembly, the test apparatus and the test procedure shall be identical, except that there shall be no end restraint, so that the axial thrust is taken by the restrained joint under test. In addition, possible axial movement of the spigot shall be measured every 15 min.

All necessary safety precautions should be taken for the duration of the pressure test.

Annex A
(informative)

Outside diameters of existing pipes

Table A.1 – Outside diameters of existing pipes (in mm), according to current ISO, EN and national standards

Sizes (DN)	Grey iron		Ductile iron	Steel		PVC		PE	Fibre-cement DIN 19800[a]			
	Metric	Imperial	EN 545 ISO 2531	DIN 2448	DIN 2458 EN 10224 ISO 559	EN 1452	Imperial	EN 12201	PN6	PN10	PN12,5	PN16
40	56^{+3}_{-2}		$56^{+1,0}_{-1,2}$	44,5	$48,3^{+0,8}_{-0,4}$	$50^{+0,2}_{-0}$		$50^{+0,4}_{-0}$				
50	66^{+3}_{-2}	68^{+3}_{-2}	$66^{+1,0}_{-1,2}$	57	$60,3^{+0,8}_{-0,4}$	$63^{+0,3}_{-0}$	$60,3^{+0,2}_{-0,1}$	$63^{+0,4}_{-0}$				
60	79^{+3}_{-4}		$77^{+1,0}_{-1,2}$		$76,1^{+0,8}_{-0,8}$	$75^{+0,3}_{-0}$		$75^{+0,5}_{-0}$				
65	82^{+3}_{-2}	81^{+3}_{-2}	$82^{+1,0}_{-1,2}$	76,1			$76,1^{+0,2}_{-0,1}$				83	85
70	86^{+3}_{-2}											
80	98^{+3}_{-2}	95^{+3}_{-2}	$98^{+1,0}_{-2,7}$	88,9	$88,9^{+0,8}_{-0,8}$	$90^{+0,3}_{-0}$	$88,9^{+0,2}_{-0,2}$	$90^{+0,6}_{-0}$		98	100	104
90	107^{+3}_{-2}											
100	118^{+3}_{-2}	121^{+3}_{-2}	$118^{+1,0}_{-2,8}$	108	$114,3^{+0,8}_{-0,8}$	$110^{+0,4}_{-0}$	$114,3^{+0,2}_{-0,2}$	$110^{+0,7}_{-0}$	118	120	124	130
						$125^{+0,4}_{-0}$		$125^{+0,8}_{-0}$				
125	144^{+4}_{-3}	149^{+3}_{-2}	$144^{+1,0}_{-2,8}$	133	$139,7^{+1,6}_{-0,8}$	$140^{+0,5}_{-0}$	$140,2^{+0,2}_{-0,2}$	$140^{+0,9}_{-0}$	145	149	153	159
150	170^{+4}_{-3}	177^{+3}_{-2}	$170^{+1,0}_{-2,9}$	159	$168,3^{+1,6}_{-0,8}$	$160^{+0,6}_{-0}$	$168,3^{+0,2}_{-0,3}$	$160^{+1,0}_{-0}$	172	178	182	190
175	197^{+4}_{-3}	204^{+3}_{-2}				$180^{+0,6}_{-0}$		$180^{+1,1}_{-0}$				

Table A.1 (*continued*)

Sizes (DN)	Grey iron		Ductile iron	Steel		PVC		PE	Fibre-cement DIN 19800[a]			
	Metric	Imperial	EN 545 ISO 2531	DIN 2448	DIN 2458 EN 10224 ISO 559	EN 1452	Imperial	EN 12201	PN6	PN10	PN12,5	PN16
200	222^{+4}_{-3}	232^{+3}_{-2}	$222^{+1,0}_{-3,0}$	216	$219,1^{+1,6}_{-0,8}$	$200^{+0,6}_{-0}$	$219,1^{+0,3}_{-0,3}$	$200^{+1,2}_{-0}$	226	234	240	252
225	245^{+4}_{-3}	259^{+3}_{-2}				$225^{+0,7}_{-0}$		$225^{+1,4}_{-0}$				
250	274^{+4}_{-3}	285^{+3}_{-2}	$274^{+1,0}_{-3,1}$	267	$273^{+1,6}_{-0,8}$	$250^{+0,8}_{-0}$	$273^{+0,4}_{-0,4}$	$250^{+1,5}_{-0}$	278	286	296	308
275	296^{+4}_{-3}					$280^{+0,9}_{-0}$		$280^{+1,7}_{-0}$				
300	326^{+5}_{-3}	324^{+3}_{-2}	$326^{+1,,0}_{-3,3}$	318	$323,9^{+1,6}_{-0,8}$				334	342	352	368
		345^{+3}_{-2}				$315^{+1,0}_{-0}$	$323,9^{+0,4}_{-0,5}$	$315^{+1,9}_{-0}$				
350	378^{+5}_{-3}	386^{+3}_{-2}	$378^{+1,0}_{-3,4}$	368	$355,6^{+1,6}_{-1,6}$	$355^{+1,0}_{-0}$	355,6	$355^{+2,2}_{-0}$	388	400	410	428
		398^{+3}_{-2}										
375		413^{+3}_{-2}										
		426^{+3}_{-2}										
400	429^{+10}_{-5}	439^{+3}_{-2}	$429^{+1,0}_{-3,5}$	419	$406,4^{+1,6}_{-1,6}$	$400^{+1,0}_{-0}$	406,4	$400^{+2,4}_{-0}$	442	456	470	488
		453^{+3}_{-2}										
450	480^{+10}_{-5}	492^{+3}_{-2}	$480^{+1,,0}_{-3,6}$			$450^{+1,0}_{-0}$		$450^{+2,7}_{-0}$				
		507^{+3}_{-2}										

Table A.1 (*concluded*)

Sizes (DN)	Grey iron		Ductile iron	Steel		PVC		PE	Fibre-cement DIN 19800[a]			
	Metric	Imperial	EN 545 ISO 2531	DIN 2448	DIN 2458 EN 10224 ISO 559	EN 1452	Imperial	EN 12201	PN6	PN10	PN12,5	PN16
500	532^{+10}_{-5}	545^{+3}_{-2}	$532^{+1,0}_{-3,8}$	521	$508^{+1,6}_{-1,6}$	$500^{+1,0}_{-0}$	508	$500^{+3,0}_{-0}$	550	564	582	606
		560^{+3}_{-2}										
525		571^{+3}_{-2}										
		587^{+3}_{-2}										
550		613^{+3}_{-2}				$560^{+1,0}_{-0}$		$560^{+3,4}_{-0}$				
600	635^{+10}_{-5}	650^{+3}_{-2}	$635^{+1,0}_{-4,0}$	610	$609,6^{+1,6}_{-1,6}$	$630^{+1,0}_{-0}$	609,6	$630^{+3,8}_{-0}$	660	678	698	726
		667^{+3}_{-2}										

[a] Tolerances on OD in DIN 19800: ± 0,5 mm for OD < 300, ± 0,7 mm for 300 < OD < 500, and ± 0,9 mm for 400 < OD < 730

NOTE 1 The dimensions given are for guidance only, as quoted in the relevant standards. Where existing installed pipe is to be repaired, the OD should be checked to ensure that the coupling or the flange adaptor is suitable.

NOTE 2 For Fibre Cement pipes, EN 512 or other national standards specify only the OD of the spigot ends of the pipe. When using fibre-cement products, special precautions should be taken when cutting, machining or carrying out operations likely to create dust.

Annex B
(informative)

Quality assurance

B.1 General

The manufacturer has the responsibility to demonstrate the conformity of his products with this standard by :

— carrying out performance type tests (see B.1) ; and,

— controlling the manufacturing process (see B.2).

B.2 Performance test

The performance tests specified in clauses 5 and 7 of this standard are carried out either by the manufacturer or, at his request, by a competent testing institute in order to demonstrate compliance with the requirements of this standard. Full reports of these performance tests are retained by the manufacturer as evidence of compliance.

B.3 Manufacturing process

B.3.1 Quality Control

The manufacturer controls the quality of its products during their manufacture by a system of process control in order to comply with the technical requirements of this standard. Wherever possible, statistical sampling techniques should be used.

It is recommended that the manufacturer's quality system conforms to EN ISO 9001.

If third party certification is involved, it is recommended that the certification body is accredited to EN 45011 or EN 45012, as applicable.

B.3.2 Tensile strength

During the manufacturing process the manufacturer carries out suitable tests in order to verify the tensile properties specified in 4.3.1. These tests may be :

— either a batch [1)] sampling system whereby samples are cast separately or integrally with the castings concerned. Test bars are machined from these samples and tensile tested in accordance with 6.1 ; or,

— a system of process control (e.g. by non-destructive testing) where a positive correlation can be demonstrated with the tensile properties specified. Testing verification procedures are based on the use of comparitor samples having known and verifiable properties. This system is supported by tensile testing in accordance with 6.1.

The frequency of testing is related to the system of production and quality control used by the manufacturer. The maximum batch size is as follows :

— 4 t of crude castings, excluding risers, when a batch sampling system is used ;

— 48 t of crude castings, excluding risers, when a process control system is used.

---

1) batch: Quantity of castings from which a sample is taken for testing purposes during manufacture.

Bibliography

[1] EN 512:1994, *Fibre-cement products – Pressure pipes and joints*

[2] EN 545:2002, *Ductile iron pipes, fittings, accessories and their joints for water pipelines – Requirements and test methods*

[3] EN 1333, *Pipework components – Definition and selection of PN*

[4] EN 1452-2, *Plastics piping systems for water supply – Unplasticized poly(vinyl chloride) (PVC-U) – Part 2 : Pipes*

[5] EN 1514-1 to EN 1514-4:1997, *Flanges and their joints – Dimensions of gaskets for PN-designated flanges*

[6] EN 10224:2002, *Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions*

[7] EN 12201-2, *Plastics piping systems for water supply – Polyethylene (PE) – Part 2 : Pipes*

[8] EN 12842, *Ductile iron fittings for PVC-U or PE piping systems – Requirements and test methods*

[9] EN 45011:1998, *General requirements for bodies operating product certification systems (ISO/IEC Guide 65:1996)*

[10] EN 45012:1998, *General requirements for bodies operating assessment and certification/registration of quality systems (ISO/IEC Guide 62:1996)*

[11] EN ISO 6708, *Pipeworks components – Definition and selection of DN (nominal size).*

[12] EN ISO 9001:2000, *Quality management systems – Requirements (ISO 9001:2000)*

[13] ISO 559:1991, *Steel tubes for water and sewage*

[14] ISO 2531:1998, *Ductile iron pipes, fittings, accessories and their joints for water or gas applications*

[15] DIN 19800:1973, *Asbestzementrohre und -formstücke für Druckrohrleitungen; Rohre, Masse*

[16] DIN 2448:1981, *Geschweisste Stahlrohre : Masse, längenbezogene Massen*

[17] DIN 2458:1981, *Nahtlose Stahlrohre : Masse, längenbezogene Massen*

[18] EEC Directive 98/83/EC of 3 November 1998, known as “Drinking Water Directive”

[19] EEC Directive 89/106/EEC of 12 December 1989, known as “Construction Products Directive”

National Annex NA (informative)
Additional information on the selection and use of mechanical ductile iron wide tolerance couplings and flange adaptors in the UK

NA.1 Introduction

BSI Technical Committee PSE/10 gives the following advice concerning the selection and use of ductile iron wide tolerance couplings and flange adaptors within and outside the scope of this British Standard.

NOTE The committee is of the view that with regard to polymeric barrier coatings for ductile iron wide tolerance coupling and flange adaptor components and threaded fasteners, WIS 04-52-01[3] and 04-52-03[4] are the relevant WISs respectively.

NA.2 Ductile iron wide tolerance couplings and flange adaptors for PE pipes

Where ductile iron wide tolerance couplings and flange adaptors are used with PE pipes, UK experience indicates that they should have a degree of end load restraint to prevent spigot withdrawal from the fitting as a consequence of the following: thermal contraction, contraction from internal pressurization and pipeline settlement. It is UK practice that all couplings and flange adaptors for PE pipes with the highest restraint rating are supplied with internal pipe support sleeves.

NOTE The BSI Technical Committee PSE/10 is of the view that information regarding the highest restraint rating, the specification for support sleeves where appropriate, and verification and classification of couplings and flange adaptors for their end load resistance can be found in WIS 04-24-01[2].

NA.3 Design life

BS EN 805 requires that water supply systems have a 50-year design life.

NOTE It is in the opinion of BSI Technical Committee PSE/10 that the tests contained in WIS 04-21-02[1] and WIS 04-24-01[2] for assessing long-term joint performance represent established UK practice.

NA.4 Ferrous pipe repair applications

The majority of ductile wide tolerance couplings and flange adaptors in the UK are used to repair or connect to existing ferrous pipes. To be effective in such applications they need to be able to seal on uneven surfaces. This standard does not simulate sealing on uneven surfaces.

NOTE It is in the opinion of the BSI Technical Committee that the tests for this condition found in WIS 04-21-02[1] represent established UK practice.

NA.5 Restrained joints

Where couplings and flange adaptors are specified with end load restraint, their use should be carefully considered on pipe materials that may be notch sensitive. Users should ensure that only restraint systems and pipe materials that are compatible are used together. Also, users should be aware that use of a restrained joint in a single location may transfer axial loads along the pipe to the next unrestrained joint, which may withdraw as a consequence.

NOTE Relevant standards that have product information on pipe materials are listed in the bibliography of EN 14525.

National Bibliography

[1] WRc. WIS 04-21-02 (Issue 1), *Specification for mechanical couplings and repair clamps for iron pipes for the conveyance of cold potable water (underground use) for the size range 40 to 1600 mm*, Swindon: WRc, 2004.

[2] WRc. WIS 04-24-01 (Issue 2), *Mechanical fittings and joints for polyethylene pipes for nominal sizes 90 to 1 000*, Swindon: WRc, 1998.

[3] WRc. WIS 04-52-01 (Issue 1), *Specification for polymeric anti-corrosion (barrier) coatings. Plus amendment* Swindon: WRc, 1992.

[4] WRc. WIS 04-52-03 (Issue 1), *Anti-corrosion coatings on threaded fasteners*, Swindon: WRc, 1994.

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL