BS 8537:2010

BSI Standards Publication

Copper and copper alloys

Plumbing fittings – Specification for press ends of plumbing fittings for use with metallic tubes

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Contents

List of tables

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 34, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 December 2010. It was prepared by Technical Committee NFE/34/3, *Copper and copper alloy fittings*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other documents

This standard is related to parts of the BS EN 1254 series of standards for copper and copper alloy fittings for joining metallic tubes or plastics pipes. BS EN 1254 is published in five parts:

Part 1: *Fittings with ends for capillary soldering or capillary brazing to copper tubes*;

Part 2: *Fittings with compression ends for use with copper tubes*;

Part 3: *Fittings with compression ends for use with plastics pipes*;

Part 4: *Fittings combining other end connections with capillary or compression ends*;

Part 5: *Fittings with short ends for capillary brazing to copper tubes*.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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 cannot confer immunity from legal obligations.

Particular attention is drawn to the Water Supply (Water Fittings) (Amendment) Regulations 1999 [1].

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1 Scope

This British Standard specifies requirements for materials and design and gives methods of test for copper press end connections of plumbing fittings up to 108 mm in diameter used for the purpose of joining copper tubes conforming to BS EN 1057 and non-copper metallic tubes that are intended for use in water, in heating and cooling systems, and in natural gas and liquefied petroleum gas systems.

*NOTE See Clause **4** for plumbing fitting operating temperatures and pressures.*

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.

BS 6001-1 (ISO 2859-1), *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

BS EN 549:1995, *Specification for rubber materials for seals and diaphragms for gas appliances and gas equipment*

BS EN 681-1:1996, *Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber*

BS EN 1057, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 1254-2:1998, *Copper and copper alloys – Plumbing fittings – Part 2: Fittings with compression ends for use with copper tubes*

BS EN ISO 6509:1995, *Corrosion of metals and alloys – Determination of dezincification resistance of brass*

BS ISO 9924-1, *Rubber and rubber products – Determination of the composition of vulcanizates and uncured compounds by thermogravimetry – Part 1: Butadiene, ethylene-propylene copolymer and terpolymer, isobutene-isoprene, isoprene and styrene-butadiene rubbers*

ISO 6957:1988, *Copper alloys – Ammonia test for stress corrosion resistance*

3 Terms and definitions

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

3.1 adaptor fitting
plumbing fitting joining two or more different types of tube end

3.2 marking

3.2.1 durable marking
marking that is legible at least up to the time of commissioning of the installation

NOTE An example of this is ink marking.

3.2.2 permanent marking
marking that is legible up to the end of the life of the installation

NOTE This is usually achieved through stamping, etching or engraving.

3.3 maximum operating pressure (MOP)
highest pressure at which pipework can be continuously operated

3.4 nominal diameter
diameter of a plumbing fitting end expressed as the nominal outside diameter of the connecting tube

3.5 plumbing fitting
component used in a plumbing system to connect one tube either to another tube or to an integral part of the system

3.6 press end
plumbing fitting end which incorporates an elastomeric sealing element and to which a pressing tool and jaw are applied to make a mechanical and leaktight joint

3.6.1 Type 1 press end
press end for use in water applications

3.6.2 Type 2 press end
press end for use in gas applications

NOTE 1 Some designs incorporate an additional device to aid retention.

NOTE 2 Compression of the ends of the plumbing fitting and the tube for a Type 2 press end can be achieved directly or indirectly by radial compression.

3.7 pressing tool and jaw
mechanical device which, by closing jaws, causes radial compression of the plumbing fitting end onto the connecting tube

NOTE Jaws also include slings.

3.8 tests

3.8.1 routine test
test carried out periodically to determine the continued quality and performance of a product

NOTE Routine tests are often repeated type tests and are often used to prove product compliance with relevant requirements of a specification.

3.8.2 type test
one or more tests carried out to determine the performance of a new product

NOTE Type tests can include calculations, for example. Type tests are normally written in the technical specification and are carried out on product samples that are representative of the product type. Type tests are usually used to prove product compliance with the relevant requirements of a specification.

4 Operating temperatures and pressures

4.1 Unless otherwise specified in the manufacturer's instructions, the MOP shall be as given in Table 1.

Table 1 **Operating temperatures and pressures for Type 1 and Type 2 press ends**

Press end type	Operating temperature	MOP for nominal diameters ≤108 mm
	°C	bar
Type 1 [A)]	≥4 to ≤15	16
	>15 to ≤95 [B)]	16 reducing to 10 [B)]
Type 2	≥–20 to ≤70	1 or 5 [C)]

A) Certain designs of Type 1 press ends can be used at temperature/pressure ratings outside those given in this table, where specified by the manufacturer. For such applications, the manufacturer's instructions shall be followed.

B) Intermediate MOP, P_{int}, shall be determined by linear interpolation:
$P_{int} = (T_{int} - 30\ °C)(16\ bar - 10\ bar)/(95\ °C - 30\ °C) + 10\ bar$.
Where $15\ °C < T_{int} < 95\ °C$

C) This is determined by the MOP of the Type 2 press end.

4.2 Type 1 press ends shall be capable of withstanding temporary excursions of temperatures up to 110 °C at a pressure of 10 bar. [1)]

NOTE This is to allow for system malfunctions.

5 Plumbing fitting press end and tube compatibility

5.1 Where copper tubes are used in conjunction with plumbing fitting press ends, they shall conform to BS EN 1057, have wall thicknesses and tempers in accordance with Table 2 of this British Standard and be compatible with plumbing fitting press ends.

5.2 Where non-copper metallic tubes are used in conjunction with plumbing fitting press ends, they shall have tempers, wall thicknesses and dimensions conforming to the press end manufacturer's instructions for compatibility.

Table 2 **Minimum wall thicknesses of copper tube with R250/R290 temper conforming to BS EN 1057 that are suitable for press end jointing**
Dimensions in millimetres

Nominal diameter	Minimum wall thickness						
	0.6	0.7	0.8	0.9	1.0	1.2	1.5
6	X						
8	X						
10	X						
12	X						
15		X					
18			X				
22				X			
28				X			
35					X		
42					X		
54					X		
66.7						X	
76.1						X	
108							X

1) 1 bar = 100 kPa.

6 Plumbing fittings

6.1 Materials

6.1.1 General

6.1.1.1 Plumbing fitting bodies shall be made from copper or copper alloys.

NOTE Some of the standardized coppers and copper alloys commonly used for the manufacture of plumbing fittings are given in Annex A.

6.1.1.2 Other components of the plumbing fittings shall be made from materials that do not cause the connected tube to degrade.

NOTE For plumbing fittings intended for use in drinking water applications, attention is drawn to the Water Supply (Water Fittings) (Amendment) Regulations 1999 [1].

6.1.2 Type 1 press end sealing elements

6.1.2.1 General

6.1.2.1.1 Sealing elements for Type 1 press ends shall conform to the requirements for elastomeric materials specified in BS EN 681-1.

6.1.2.1.2 The minimum tear strength for butyl rubber shall be in accordance with BS EN 681-1:1996, Table 3.

6.1.2.2 Thermogravimetric analysis (TGA)

6.1.2.2.1 A TGA shall be carried out for identity testing of elastomeric materials in accordance with BS ISO 9924-1.

6.1.2.2.2 The TGA shall be carried out at the same time as the type tests (see Clause **8**). The resulting graph shall be retained as a master graph for comparison with future TGA graphs.

6.1.2.2.3 Routine TGA tests shall be carried out at a frequency of one per year. Result graphs from routine TGA tests shall be compared to the master graph (see **6.1.2.2.2**) and differences investigated. The TGA results shall be retained for future comparison.

6.1.2.3 Durability test

A durability test shall be carried out in accordance with BS EN 681-1:1996, Appendix B, using the following parameters.

a) A test duration of 3 000 h.

b) A test temperature of 110 °C.

c) A test medium of distilled water.

d) A compression set after 3 000 h of ≤35%.

e) A compression set increase between 1 000 h and 3 000 h of ≤5%/1 000 h.

6.1.3 Type 2 sealing elements

6.1.3.1 General

Sealing elements for Type 2 press ends shall conform to **6.1.3.2** and BS EN 549.

6.1.3.2 Infrared spectrometric identification

6.1.3.2.1 An infrared spectrometric identification test shall be carried out in accordance with BS 549:1995, Annex B, during type testing. The resulting graph shall be retained as a master graph for comparison with future infrared spectrometric identification graphs.

6.1.3.2.2 Routine infrared spectrometric identification tests shall be carried out at the frequency of one per year. Results from the routine infrared spectrometric identification tests shall be compared to the master graph and differences investigated. The infrared spectrometric identification tests shall be retained for future comparison.

6.2 Dimensions and tolerances

6.2.1 Minimum bore area

6.2.1.1 The minimum cross-sectional area of the bore through each fitting, excluding any internal pipe support, shall be calculated from a minimum bore diameter conforming to Table 3.

Table 3 **Minimum bore diameter**
Dimensions in millimetres

Nominal diameter	Minimum bore diameter
6	4.0
8	6.0
10	7.0
12	9.0
15	11.0
18	14.0
22	18.0
28	23.0
35	29.0
42	36.0
54	47.0
66.7	57.0
76.1	65.0
108	92.0

6.2.1.2 The smallest diameter on an unequal-ended press fitting shall conform to Table 3, and shall not restrict other outlets.

6.2.2 Tolerance for the alignment of the plumbing fitting press ends

The alignment of the press ends of the plumbing fitting shall be within 2° of the specified axis.

6.3 Design and manufacture

6.3.1 Joint assembly tools

Pressing tools and jaws specified by the plumbing fittings manufacturer shall be used to assemble the joint.

NOTE The maintenance frequency for pressing tools and jaws is either automatically indicated by a cycle counter in the press tool (e.g. every 20 000 cycles) or a maintenance frequency is specified by the manufacturer (e.g. every 12 months).

6.3.2 Tube abutment

Unless otherwise specified by the manufacturer, press ends shall have a tube abutment to limit the depth to which a tube can be inserted.

NOTE Plumbing fittings can be produced for special purposes, where the plumbing fitting ends do not incorporate abutments, allowing for the fitting to slide along the tube. This can be particularly useful for pipework repairs.

6.3.3 Plated or coated surfaces

The manufacturer shall agree the requirements for plated or coated surfaces with the purchaser.

7 Evaluation of plumbing fittings

Plumbing fittings shall be evaluated through type tests in accordance with Clause **8** and routine tests in accordance with Clause **9**. The type tests and routine tests shall be carried out in accordance with Table 4.

The results of type tests and routine tests shall be recorded and held by the manufacturer for a minimum of five years.

*NOTE When carrying out a series of type tests, it is not essential to repeat tests that have already been performed on plumbing fittings, except in those circumstances specified in **8.1**.*

8 Type tests

8.1 Circumstances in which to carry out type tests

8.1.1 Type tests shall be carried out on new designs before introduction to the market.

8.1.2 The manufacturer shall implement a documented procedure to assess the necessity for carrying out repeat type tests on press ends where a change is proposed to an existing product.

*COMMENTARY ON **8.1.2***
The performance characteristics of press ends might be affected by the following changes:

a) alterations to the press end design;

b) changes to the raw material;

c) changes in the production process; or

d) change of the supplier of the components.

In these instances, it is likely to be necessary to repeat type tests.

8.1.3 Where changes are made to the material or supplier of the sealing element, the press ends shall conform to either **6.1.2** and **8.4.3** (Type 1 press ends) or **6.1.3** and **8.4.4** (Type 2 press ends), as applicable.

Table 4 **Tests for plumbing fittings with Type 1 and Type 2 press ends**

Description of test	**Tests for press end**	
	Type 1	**Type 2**
Type tests		
Leaktightness under internal hydrostatic pressure (Annex B)	Yes	No
Leaktightness under internal pneumatic pressure (Annex C)	No	Yes
Resistance to pull-out (Annex D)	Yes	Yes
Resistance to temperature cycling (Annex E)	Yes	No
Resistance to temperature cycling (Annex F)	No	Yes
Resistance to pressure cycling (Annex G)	Yes	No
Leaktightness under vacuum (Annex H)	Yes	Yes
Resistance to vibration (Annex I)	Yes	Yes
Resistance to static flexural strength (Annex J)	No	Yes
Resistance to high temperature (Annex K)	No	Yes
Resistance to stress corrosion (copper-zinc alloys) (**8.4.10**; ISO 6957:1988, Clause **8**)	Yes	Yes
Routine tests		
Pressure test for plumbing fitting bodies with as-cast microstructure or fabricated by welding or brazing (Annex L)	Yes [A)]	Yes [A)]
Resistance to dezincification (Annex M)	Yes [A)]	Yes [A)]

[A)] These tests shall only be applicable where the plumbing fitting material or method of construction allows for testing to take place.

8.2 Type 1 and Type 2 press ends

8.2.1 Plumbing fittings intended for joining tubes and having Type 1 press ends shall be subjected to the applicable type tests, in accordance with Table 4.

8.2.2 Plumbing fittings intended for joining tubes and having Type 2 press ends shall be subjected to the applicable type tests, in accordance with Table 4.

8.3 Preparation of plumbing fittings for type tests

8.3.1 General

The plumbing fittings to be tested shall be assembled with the relevant tube, in accordance with the manufacturer's instructions.

NOTE For the purposes of testing, plumbing fittings may be grouped into families, where it is considered that the selected property/properties is/are common to all plumbing fittings within that family. Type tests are applicable to all sizes of plumbing fitting and each tube material. Combinations of these can be tested within a test rig.

8.3.2 Test temperature

Type tests shall be conducted at a temperature of (23 ±5) °C unless otherwise stated within a test procedure.

8.4 Testing

8.4.1 Leaktightness tests

8.4.1.1 Leaktightness under internal hydrostatic pressure

8.4.1.1.1 Plumbing fittings with Type 1 press ends shall undergo an internal hydrostatic pressure test for leaktightness in accordance with Annex B, using the following parameters.

a) A test pressure of (24 ±1) bar.

b) A 1 h test duration.

c) One test sample per size.

8.4.1.1.2 Throughout the test period, plumbing fittings shall not exhibit visible signs of leakage or seepage.

8.4.1.2 Leaktightness under internal pneumatic pressure

8.4.1.2.1 Plumbing fittings with Type 2 press ends shall undergo a pneumatic pressure test for leaktightness in accordance with Annex C, using the following parameters.

a) A first test pressure of 22 mbar.[2)]

b) A second test pressure of 110 mbar.

c) A third test pressure of 1.1 bar × nominal working pressure (min. 3 bar).

d) A test duration of 10 min at each pressure.

e) One test sample per size.

8.4.1.2.2 Throughout the test period, plumbing fittings shall not exhibit visible signs of leakage.

2) 1 mbar = 100 Pa.

8.4.2 Resistance to pull-out

8.4.2.1 Plumbing fittings with Type 1 press ends

8.4.2.1.1 Plumbing fittings with Type 1 press ends shall undergo a test for resistance to pull-out in accordance with Annex D. One test sample per size shall be used. The joint assemblies shall withstand the pull-out force without separation.

NOTE Some movement between tube and plumbing fitting is to be expected during this test.

8.4.2.1.2 The joint assemblies shall subsequently undergo a test for leaktightness under internal hydrostatic pressure in accordance with Annex B and conform to **8.4.1.1**.

8.4.2.2 Plumbing fittings with Type 2 press ends

8.4.2.2.1 Plumbing fittings with Type 2 press ends shall undergo a test for resistance to pull-out with tubes in accordance with Annex D. One test sample per size shall be used. The joint assemblies shall withstand the pull-out force without separation.

8.4.2.2.2 Plumbing fittings with Type 2 press ends shall subsequently undergo a test for leaktightness under internal pneumatic pressure in accordance with Annex C and conform to **8.4.1.2**.

8.4.3 Resistance of plumbing fittings with Type 1 press ends to temperature cycling

When tested in accordance with Annex E using the parameters shown in Table 5, plumbing fittings under test shall not exhibit signs of leakage.

Table 5 **Temperature cycling parameters for water applications**

Fitting end size	Water inlet temperature		Test pressure	Test duration	Number of test cycles	Average flow velocity
mm	hot °C	cold °C	bar	min		m/s
≤54	93 ±2	20 ±5	10 ±1	15 ±1 hot; 15 ±1 cold	5 000	≥0.5
66.7–108				30 ±2 hot; 30 ±2 cold	2 500	

8.4.4 Resistance of plumbing fittings with Type 2 press ends to temperature cycling

8.4.4.1 Plumbing fittings with Type 2 press ends shall undergo a test for the resistance of plumbing fittings with Type 2 press ends to temperature cycling in accordance with Annex F, using the following parameters.

a) A hot temperature of (70 ±2) °C and a cold temperature of (–20 ±2) °C.

b) One test sample per size.

c) A free tube length in the test assembly of ≥100 mm.

8.4.4.2 Plumbing fittings with Type 2 press ends shall subsequently undergo a test for leaktightness under internal pneumatic pressure in accordance with Annex C and conform to **8.4.1.2**.

8.4.4.3 At the end of the test period, the plumbing fittings shall not exhibit visible signs of leakage.

8.4.5 Resistance of joints with tubes to pressure cycling

8.4.5.1 Plumbing fittings with Type 1 press ends shall undergo a test for the resistance of joints with tubes to pressure cycling in accordance with Annex G, using the following parameters.

a) A low pressure limit of (1 ±0.5) bar and a high pressure limit of (25 ±0.5) bar.

b) 10 000 cycles at a frequency of (30 ±5) cycles per min.

c) Three test samples per plumbing fitting size.

8.4.5.2 At the end of the test period, the plumbing fittings shall not exhibit visible signs of leakage.

8.4.6 Vacuum test for leaktightness of joints with tube under vacuum

8.4.6.1 Plumbing fittings with Type 1 or Type 2 press ends shall undergo a vacuum test for leaktightness in accordance with Annex H, using the following parameters.

a) A test pressure of (–0.8 ±0.05) bar.

b) A 1 h test duration.

c) Three test samples per size.

8.4.6.2 At the end of the test period, the change in pressure shall be not greater than 0.05 bar.

8.4.7 Resistance of joints and tube to vibration

8.4.7.1 Plumbing fittings with Type 1 press ends

Plumbing fittings with Type 1 press ends shall undergo a test for the resistance of joints to vibration in accordance with Annex I, using the parameters given in Table 6. At the end of the test period, the plumbing fittings shall not exhibit visible signs of leakage.

Table 6 **Vibration test parameters**

Type of fitting end	Test pressure	Deflection	Number of cycles	Frequency of cycles	Number of test samples per size
		mm		Hz	
1	(15 ±0.5) bar	±1	1 000 000	20	4
2	Atmospheric				

8.4.7.2 Plumbing fittings with Type 2 press ends

Plumbing fittings with Type 2 press ends shall undergo a test for the resistance of joints to vibration in accordance with Annex I, using

the parameters given in Table 6. This shall be followed by a test for leaktightness of joints and tube under internal pneumatic pressure in accordance with Annex C and conforming to **8.4.1.2**. Throughout the complete test period, the plumbing fittings shall not exhibit visible signs of leakage.

8.4.8 Resistance of joints to static flexural force

8.4.8.1 Plumbing fittings with Type 2 press ends shall undergo a test for the resistance of joints to static flexural force in accordance with Annex J, using the following parameters.

a) A test pressure of 3 bar.

b) A test load in accordance with **J.2.4**.

c) A maximum deflection of 100 mm.

d) A 1 h test duration.

e) One test sample per size.

8.4.8.2 Plumbing fittings tested in accordance with **8.4.8.1** shall subsequently be followed by a test for leaktightness of joints and tube under internal pneumatic pressure in accordance with Annex C and conforming to **8.4.1.2**.

8.4.8.3 At the end of the test period, the plumbing fitting shall exhibit no visible signs of leakage.

8.4.9 Resistance to high temperature

8.4.9.1 Plumbing fittings with Type 2 press ends shall undergo a test for the resistance of joints to high temperature in accordance with Annex K, using the following parameters.

a) A temperature of (650 $\pm$10) °C.

b) An MOP 5 pressure of (5.0 +0.5) bar and an MOP 1 pressure of (1.0 +0.5) bar.

c) An average leakage rate per end of 30 dm^3/h.

d) A 30 min test duration.

8.4.9.2 At the end of the test period, each plumbing fitting press end shall not exceed a leakage rate of 30 dm^3/h (nitrogen).

*NOTE The pressure for testing is selected by the manufacturer according to its MOP classification [see **8.4.9.1**b)].*

8.4.10 Resistance to stress corrosion of plumbing fittings made from copper-zinc alloys

8.4.10.1 Plumbing fittings manufactured from copper-zinc alloys containing more than 10% zinc shall be resistant to stress corrosion. The plumbing fittings shall be tested in accordance with ISO 6957:1988, Clause **8**, using a test solution of pH 9.5 (without prior pickling). At the end of the test period, the component parts made from copper-zinc alloys shall not exhibit visible signs of cracking. Test samples shall be complete fittings incorporating all components and shall be assembled to the tube with the joints already made. One test sample per size shall be tested.

8.4.10.2 After testing, a test report shall be completed, including the following:

a) the identifier and date of this British Standard (i.e. BS 8537:2010); [3)]

b) the date of the test;

c) the pH value of the solution used (i.e. pH 9.5);

d) the exposure temperature;

e) the number of replicate samples; and

f) the test result (i.e. cracks/no cracks).

9 Routine tests

9.1 General

Routine tests shall be carried out on plumbing fittings as part of the factory production control (see **9.2**) and in accordance with **9.3** and **9.4**.

9.2 Factory production control

The manufacturer shall establish, document and maintain a factory production control system so that the products placed on the market conform to the stated requirements. The factory production control system shall consist of procedures, regular inspections and routine tests and/or assessments and the use of results to control raw and other incoming materials or components, the production process and the product.

NOTE This requirement would be satisfied by a quality control system conforming to BS EN ISO 9001 or equivalent.

9.3 Pressure test for the bodies of plumbing fittings with as-cast microstructure or fabricated by welding or brazing

9.3.1 The bodies of plumbing fittings with an as-cast microstructure or a structure that has been fabricated by welding or brazing shall be subjected to a leakage test, either:

a) using a pneumatic test pressure of (5 $\pm$0.5) bar; or

b) using a hydrostatic test pressure of (24 $\pm$1) bar; or

c) in accordance with BS EN 1254-2:1998, **5.7**.

9.3.2 The test method used and the test pressure and other parameters applied shall be listed in the test report.

NOTE Suitable test methods for a) and b) are given in Annex L.

[3)] Marking BS 8537:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

9.3.3 Samples shall be selected in accordance with BS 6001-1. The minimum number of samples to be tested per batch shall be in accordance with the single sample plan to achieve an acceptance quality limit (AQL) of 2.5% at general inspection level II, as specified in BS 6001-1. Where a batch is rejected, based on selected samples, 100% of the plumbing fittings within that batch shall be tested in accordance with **9.3.1** and **9.3.2**.

9.3.4 When subjected to the leakage test specified in **9.3.1**, the bodies of the plumbing fittings shall not exhibit visible signs of leakage or spillage within the pressure zone of the assembled plumbing fitting.

9.4 Resistance to dezincification

9.4.1 Test samples for components which are manufactured from alloys containing more than 10% zinc and which are declared to be resistant to dezincification, shall be tested for their resistance to dezincification in accordance with Annex M.

9.4.2 Samples shall be selected in accordance with the following.

a) One sample shall be tested for batches of up to and including 500 pieces.

b) Two samples shall be tested for batches of more than 500 pieces.

9.4.3 When tested in accordance with Annex M, the maximum depth of dezincification, in any direction, shall be:

a) for grade A: ≤200 μm;

b) for grade B: ≤400 μm and the mean depth of dezincification <200 μm.

9.4.4 Where test samples do not conform to **9.4.3**, further test samples from the same batch shall be selected for re-testing in accordance with **9.4.2**.

9.4.5 Where all further test samples conform to **9.4.3**, the batch represented shall be deemed acceptable for resistance to dezincification. Where any of the further test samples do not conform to **9.4.3**, the batch represented shall be deemed unacceptable for resistance to dezincification.

10 Designation

10.1 Plumbing fittings shall be designated by:

a) the common term or manufacturer's catalogue number;

NOTE 1 Plumbing fittings are normally designated either by a manufacturer's catalogue number or by the common terms, straight coupling, bend, elbow, tee, etc.

b) the number and date of this British Standard (i.e. BS 8537:2010);[4)]

c) the plumbing fitting press end type (i.e. Type 1 or Type 2), and for Type 2 fittings the pressure category (e.g. MOP 1 or MOP 5);

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4) Marking BS 8537:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

d) the size of the connecting ends by the nominal outside diameter of the connecting tube or, in the case of plumbing fittings incorporating threaded connections, by the thread designation;

NOTE 2 The sequence for specifying ends is run-run-branch for tees (run-run-branch-branch for crosses). Where plumbing fittings incorporating threaded connections conform to BS EN 1254-4 or other standards, this should also be stated.

e) the presence or absence of an abutment, where applicable;

f) the grade of dezincification resistance acceptance criteria, where required;

g) the type of plating or coating, where required.

10.2 The designation information specified in **10.1**a) to **10.1**g) shall be documented in writing by the manufacturer.

10.3 For plumbing fittings with equal ends, the nominal size shall be specified by one diameter. For plumbing fittings with unequal ends or adaptor fittings, the ends shall be specified in the same order, but the largest end of the run shall be stated first.

EXAMPLE
Designation of a reducing tee fitting conforming to this British Standard, for use with water in dezincification resistant material, CuZn36Pb2As (CW602N), grade A:

Tee – BS 8357:2010 – Type 1 – 22 × 22 × 15 – DRA

11 Permanent and durable marking

11.1 General

Plumbing fittings shall have a legible, permanent marking of the manufacturer's identity symbol.

NOTE It is preferable for plumbing fittings also to be legibly and durably marked with the nominal diameter.

11.2 Additional permanent marking

11.2.1 Plumbing fittings with Type 1 press ends manufactured from dezincification resistant copper-zinc alloys conforming to **9.3.2** shall be legibly marked with the following.

a) For grade A material, the symbol ᑕR or characters DRA.

*NOTE ᑕR indicates corrosion resistance; DRA indicates dezincification resistance for grade A material, see BS EN 1254-2:1998, **7.2**.*

b) For grade B material, the characters DRB.

*NOTE DRB indicates dezincification resistance for grade B material, see BS EN 1254-2:1998, **7.2**.*

11.2.2 Plumbing fittings with Type 2 press ends shall be legibly marked with the following:

a) GT followed by the nominal pressure in bars; and

NOTE 1 GT indicates that the plumbing fitting has been high temperature tested for gas applications.

b) PN followed by the MOP.

NOTE 2 PN (nominal pressure) is the designation used for reference purposes that relates to a combination of mechanical and dimensional characteristics of a component of a pipework system. The letters PN are followed by a dimensionless number. The maximum pressure that can be exerted upon a pipework component depends on factors such as the PN number, the material and design of the component and the temperature range that the component can withstand.

NOTE 3 There is no relationship between PN and GT (gas temperature) tests but plumbing fittings may be supplied with pressure ratings, tested at high temperature, in the following combinations; GT 1/PN 1, GT 1/PN 5 or GT 5/PN 5.

11.3 Additional durable marking for plumbing fittings with Type 1 and Type 2 press ends

11.3.1 Seals for plumbing fittings with Type 1 press ends shall be colour coded black.

11.3.2 Bodies and seals for plumbing fittings with Type 2 press ends shall be colour coded yellow.

NOTE The yellow colour on the bodies of plumbing fittings with Type 2 press ends should remain visible after installation.

12 Documentation

12.1 The manufacturer shall make assembly instructions available to the purchaser of the plumbing fittings.

12.2 The designation information (see Clause **10**) shall be given to the purchaser upon request.

Annex A (informative) Copper and copper alloys commonly used for the manufacture of plumbing fittings

Table A.1 gives some of the standardized types of copper and copper alloys commonly used in the manufacture of plumbing fittings.

Table A.1 **Examples of copper and copper alloys commonly used for plumbing fittings**

Material designation		British Standard
Symbol	**Number**	
Cu-DHP	CW024A	BS EN 12449
CuSn5Zn5Pb5-C	CC491K	BS EN 1982
CuSn5Zn5Pb2-C	CC499K	BS EN 1982
CuZn36Pb2As	CW602N	BS EN 12164
CuZn39Pb3	CW614N	BS EN 12164
CuZn40Pb2	CW617N	BS EN 12165
CuZn33Pb2-C	CC750S	BS EN 1982
CuZn15As-C	CC760S	BS EN 1982

NOTE These examples do not constitute an exhaustive list.

Annex B (normative) Method for testing the leaktightness of joints with tube under internal hydrostatic pressure

B.1 Principle

The test samples incorporating one or more Type 1 plumbing fittings are subjected to continuous internal hydrostatic water pressure for a specified period of time and the plumbing fitting examined for evidence of leakage.

B.2 Apparatus

B.2.1 *Pressure measurement device*, capable of measuring the pressure applied to the test sample. Where gauges or similar calibrated pressure measurement devices are used, the range of the gauge shall be such that the pressure setting used shall lie within the calibrated range of the device used.

NOTE The use of master gauges for calibration of the apparatus is recommended.

B.2.2 *Pressurizing pump*, capable of applying and maintaining pressure in accordance with **8.4.1.1.1** for the duration of the test.

NOTE The pressure can be applied to each individual test sample or simultaneously to several test samples, which may be of different sizes, in a test sample assembly.

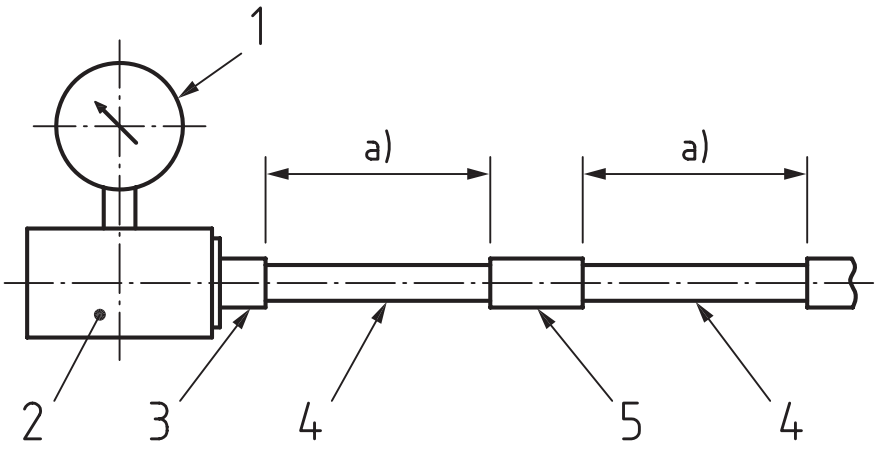
B.2.3 *Pump connection*, capable of connecting the pressurizing device to the pipe and test sample assembly and remaining leaktight for the duration of the test.

B.3 Test sample

B.3.1 The test sample shall be an assembly consisting of the plumbing fitting or plumbing fittings to be tested connected to the relevant tube. The tube shall be in accordance with **8.4.1.1.1**. The free end of the tube shall be fitted with an end cap to seal off the assembly.

B.3.2 The test sample and apparatus shall be arranged as shown in Figure B.1. Dimension a) shall be a minimum of 100 mm in length.

Figure B.1 **Arrangement of apparatus for leaktightness under internal hydrostatic pressure test**



Key

1 Pressure measurement device
2 Pressurizing pump
3 Pump connection
4 Tube
5 Plumbing fitting under test
a) Length of tube ≥100 mm

B.4 Procedure

B.4.1 Connect the test sample (**B.3**) to the pressurizing pump (**B.2.2**) and bleed off the air.

B.4.2 Progressively increase the pressure until the test pressure specified in **8.4.1.1.1**a) is reached and has stabilized. Maintain the pressure for the duration of the test, in accordance with the parameters specified in **8.4.1.1.1**.

B.4.3 Inspect the test samples for signs of leakage.

*NOTE For plumbing fittings with Type 2 press ends, a leaktightness test should be carried out in accordance with Annex C and conform to **8.4.1.2**.*

Annex C (normative) Method for testing leaktightness of joints and tube under internal pneumatic pressure

C.1 Principle

This annex describes the test method for determining the resistance of the joint assemblies to internal pneumatic pressure. The test samples incorporating one or more plumbing fittings are subjected to continuous internal pneumatic air pressure for a specified period of time at three different pressure settings while immersed in a tank of

water. Throughout the test period, the test samples are examined for visual evidence of gas leakage.

C.2 Apparatus

C.2.1 *Pressure measurement device*, capable of measuring the pressure applied to the test sample. Where gauges or similar calibrated pressure measurement devices are used, the range of the gauge shall be such that the pressure setting used shall lie within the calibrated range of the device used.

NOTE The use of master gauges for calibration of the apparatus is recommended.

C.2.2 *Pressurizing device*, capable of applying and maintaining pressure in accordance with **8.4.1.2.1** for the duration of the test.

NOTE The pressure can be applied to each individual test sample or simultaneously to several test samples in a test sample assembly.

C.2.3 *Pressure connection*, capable of connecting the pressurizing device to the pipe and test sample assembly and remaining leaktight for the duration of the test.

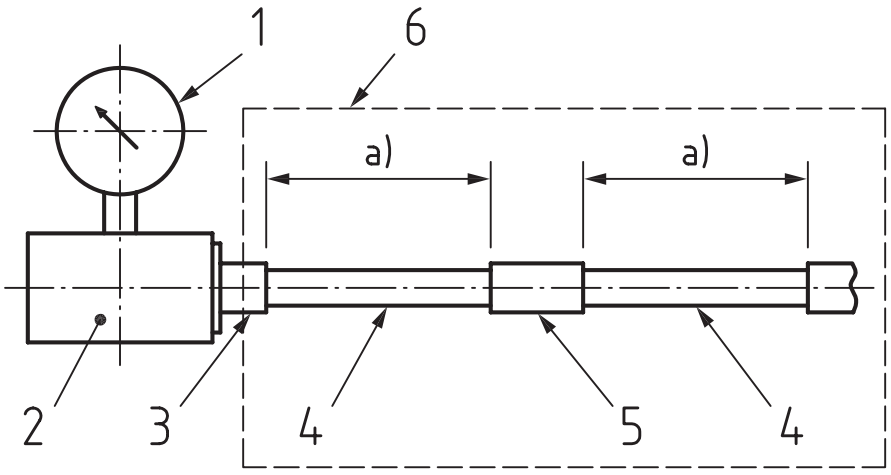
C.2.4 *Tank filled with water*.

C.3 Test sample

C.3.1 The test sample shall be an assembly consisting of the plumbing fitting(s) to be tested, connected to the relevant tube. The test sample shall be in accordance with **8.4.1.2.1**e). The free end of the tube shall be fitted with an end cap to seal off the assembly.

C.3.2 The test sample and apparatus shall be assembled as shown in Figure C.1.

Figure C.1 **Assembled test sample and apparatus for leaktightness under internal pneumatic pressure test**



Key

1 Pressure measurement device
2 Pressurizing device
3 Pressure connection
4 Tube
5 Test sample
6 Tank filled with water
a) Length of tube ≥100 mm

C.4 Procedure

C.4.1 Connect the test sample (**C.3**) to the pressurizing device (**C.2.2**) and assemble the apparatus (**C.2**) in accordance with Figure C.1.

C.4.2 Ensure that the test sample is immersed in the tank filled with water (**C.2.4**).

C.4.3 Apply the first test pressure and maintain for the duration of the test as specified in **8.4.1.2.1**.

C.4.4 Inspect the test samples for the emission of bubbles within the tank filled with water.

C.4.5 Repeat **C.4.1** to **C.4.4** at the second and third test pressures specified in **8.4.1.2.1**.

Annex D (normative) Method for testing resistance to pull-out

D.1 Principle

The test sample consists of one plumbing fitting assembled with two pieces of tube, which is subjected to axial tensile loading and held under tension for a set period of time, followed by a leaktightness test. Separate combinations are assembled for each type of tube for which the plumbing fittings are designed.

D.2 Apparatus

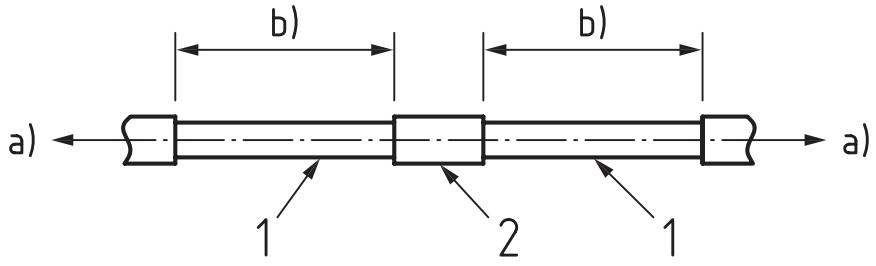
D.2.1 *Load applying apparatus*, capable of gradually applying and maintaining a constant force to the test assembly for the test period.

D.3 Test assembly

Separate test assemblies shall be used for each size and type of plumbing fitting.

NOTE A typical test assembly is shown in Figure D.1.

Figure D.1 **Test assembly for resistance to pull-out test**



Key

1 Tube
2 Plumbing fitting under test
a) Tensile force
b) Length of tube ≥100 mm

NOTE For magnitude of tensile force, see Table D.1.

D.4 Procedure

D.4.1 Secure the test assembly in the load applying apparatus and apply the relevant tensile force given in Table D.1 or calculate the necessary tensile force in accordance with **D.4.2** and apply gradually over a period of not less than 30 s. Maintain the test sample with the applied tensile force in a state of constant tension for 1 h.

Table D.1 **Tensile force**

Nominal diameter	**Tensile force (*F*)** [A)]
mm	N
6 to 15	600 ±30
18	611 ±31
22	913 ±46
28	1 478 ±74
35	2 310 ±116
42	3 326 ±166
54	5 497 ±275
66.7	8 386 ±419
76.1	10 916 ±546
108	21 986 ±1 099

[A)] The tolerance for the tensile force is ±5%.

D.4.2 For sizes above 15 mm, calculate the tensile force, *F*, from the following equation:

$$F = \frac{\pi \times d_n^2 \times p_D \times S_f}{4}$$

where:

F is the tensile force, in newtons (N);

d_n is the nominal diameter of the tube, in millimetres (mm);

p_D is the maximum design pressure of 16 bar, in megapascals (MPa);

S_f is a safety factor of 1.5.

NOTE For sizes up to and including 15 mm, the tensile force, F, is based on a minimum requirement for the separation of joints.

Annex E (normative) Test method for resistance of plumbing fittings with Type 1 press ends to temperature cycling

E.1 Principle

An assembly of tube and plumbing fittings is subjected to thermal cycling by passing cold water and then hot water (both at specified temperatures and a set pressure) through the tube. The test sample is then subjected to an internal hydrostatic pressure test. The joints of the plumbing fitting are subsequently inspected for evidence of leakage.

E.2 Apparatus

E.2.1 *Means of alternately circulating hot and cold water through the test assembly*. The means shall have the functionality to change between hot and cold sources within a specified period of time.

E.2.2 *Means of regulating the water pressure in the test assembly*.

E.2.3 *Thermometers*, for measuring the water temperature at the inlet and outlet from the test assembly.

E.2.4 *Pump*, capable of providing the pressure specified in Table 5.

E.3 Test assembly

E.3.1 The test assembly shall comprise tube and plumbing fittings that are jointed and clipped in accordance with the manufacturer's instructions. The test assembly shall be in accordance with Figure E.1 for sizes up to and including 54 mm in diameter and Figure E.2 for sizes of 66.7 mm up to 108 mm in diameter.

E.3.2 In total, a minimum of 20 plumbing fitting press ends shall be tested. These plumbing fitting press ends shall include straight connectors and 90° elbows.

E.3.3 A combination of size, material (tempers) and the minimum and maximum wall thickness, in accordance with BS EN 1057, shall be permitted in one test line (see Figure E.1 and Figure E.2).

NOTE A test line may comprise a number of plumbing fitting combinations but no more than three different sizes of plumbing fitting, providing that the test conditions can be met. A test rig may include multiple lines but the flow velocity should be equal to or higher than the minimum average flow velocity specified in Table 5 throughout the test line.

E.3.4 For sizes above 22 mm, each size shall be tested in one line.

NOTE Combinations of material temper and the minimum and maximum recommended wall thickness should be tested in the same line, or as specified by the manufacturer.

Figure E.1 **Test assembly for systems based on tubes measuring ≤54 mm in diameter**

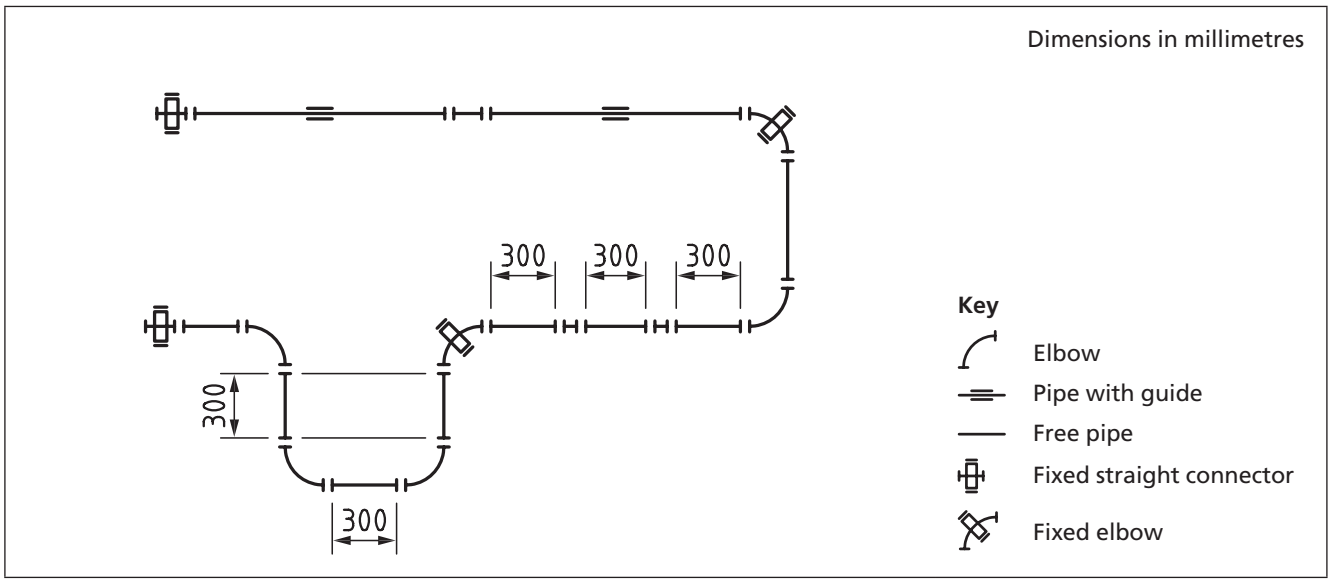
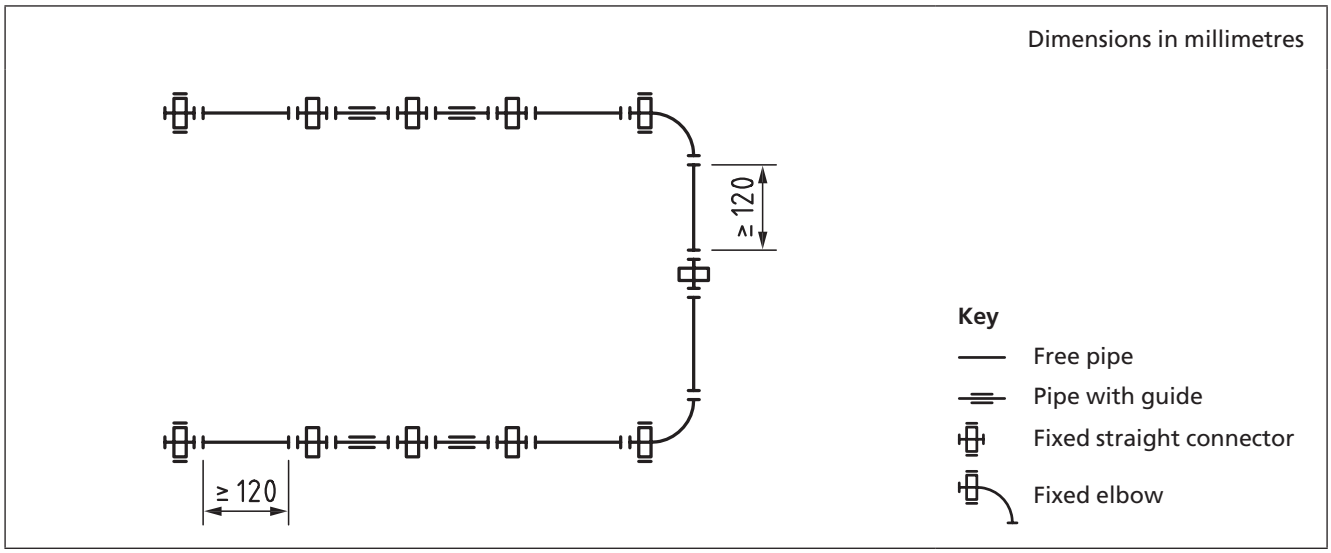


Figure E.2 **Test assembly for systems based on tubes measuring 66.7 mm to 108 mm in diameter**



E.4 Procedure

E.4.1 Prepare the test assembly in accordance with **E.3** and flow water through it to expel the air within.

E.4.2 Subject the test assembly to the number of cycles of hot and cold water at the pressures, temperatures and other parameters specified in Table 5. Make any necessary adjustments to the joints within the first five cycles.

E.4.3 Control the flow of the circulating water to prevent the measured temperature (either on the hot cycle or the cold cycle) from fluctuating by more than 5 °C from the inlet to the outlet of the test assembly.

E.4.4 For plumbing fitting sizes up to and including 54 mm, the water temperature cycle from cold to hot and vice-versa shall be completed within 1 min when measured at the inlet.

E.4.5 For plumbing fitting sizes of 66.7 mm and above, the water temperature cycle from cold to hot and vice-versa shall be completed within 5 min.

E.4.6 On completion of the hot and cold water cycles, subject the test assembly to a hydrostatic pressure test in accordance with Annex B at 16 bar in the ambient temperature for not less than 15 min.

NOTE It is recommended that the hydrostatic pressure test is carried out before the test assembly is removed from the test rig.

Annex F (normative) Test method for the resistance of plumbing fittings with Type 2 press ends to temperature cycling

F.1 Principle

A test assembly of tubes and plumbing fittings is subjected to specified variations of temperature of specified duration.

F.2 Apparatus

F.2.1 *Means of heating the assembly*, capable of attaining the temperatures specified in **8.4.4.1**a).

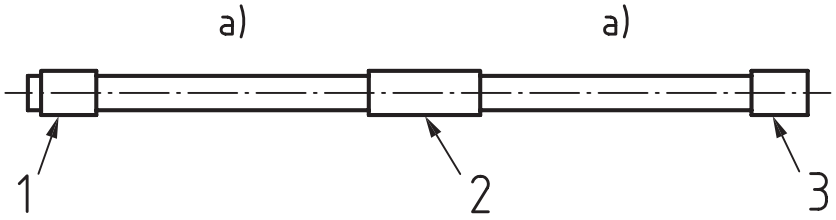
F.2.2 *Means of cooling the assembly*, capable of attaining the temperatures specified in **8.4.4.1**a).

F.3 Test assembly

F.3.1 The test assembly shall consist of the plumbing fitting(s) to be tested connected to the minimum free tube length specified in **8.4.4.1**c). The open end of the tube shall be fitted with an end cap to seal off the test assembly.

F.3.2 The test assembly shall be arranged in accordance with Figure F.1.

Figure F.1 **Typical test assembly**



Key

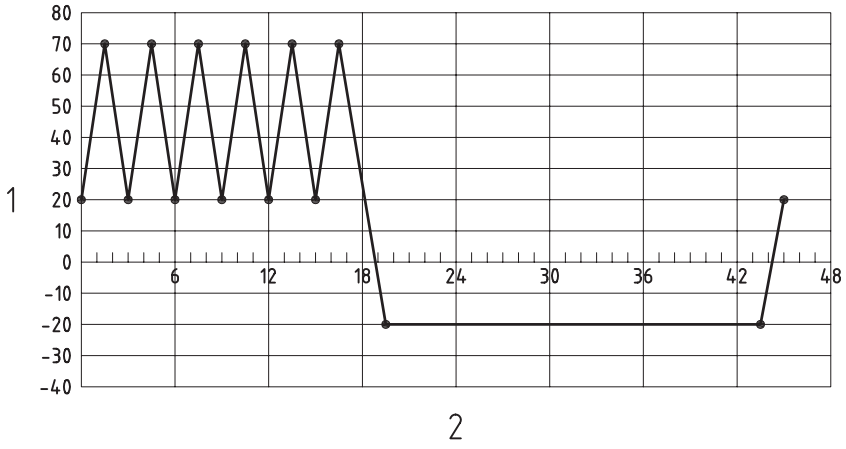
1 Pressure connection
2 Test plumbing fitting
3 End stop
a) Length of free tube ≥100 mm

F.4 Procedure

F.4.1 Heat the test assembly to the hot temperature specified in **8.4.4.1**a).

F.4.2 Remove the test assembly and allow it to cool to room temperature in ambient air, within a 3 h cycle time in accordance with Figure F.2.

Figure F.2 **Cycle times**



Key

1 Temperature (°C)
2 Time (h)

F.4.3 Repeat **F.4.1** and **F.4.2** six times.

F.4.4 Cool the test assembly to the cold temperature specified in **8.4.4.1**a) and maintain it at this temperature for 24 h.

F.4.5 Allow the test assembly to return to room temperature in ambient air, within a cycle time of 27 h in accordance with Figure F.2.

F.4.6 Carry out a test for leaktightness of joints and tube under internal pneumatic pressure in accordance with Annex C and conforming to **8.4.1.2**.

Annex G (normative) Method for testing the resistance of joints with tubes to pressure cycling

G.1 Principle

A test assembly of tubes and plumbing fittings in air or in water is subjected to pressure alternating between two set pressure limits.

G.2 Apparatus

G.2.1 *Pressurizing device*, capable of applying water pressure to the test sample and regulating it to the high and low pressure limits and number and frequency of cycles specified in **8.4.5.1**.

G.2.2 *Pressure-measuring device*, capable of measuring water pressure in the test sample with an accuracy of ±5 %.

G.3 Test assembly

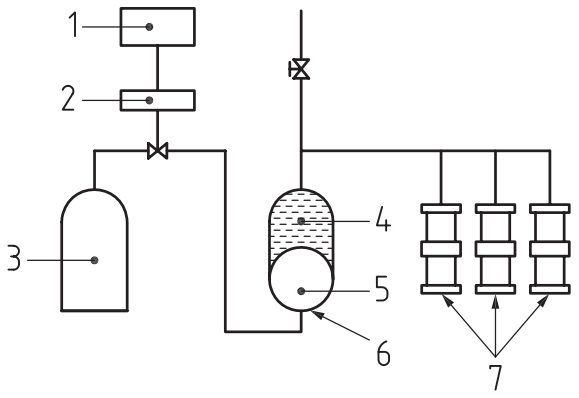
A test assembly shall comprise pipes and plumbing fitting samples, joined in accordance with the manufacturer's instructions. Three test samples per plumbing fitting size shall be used, in accordance with **8.4.5.1**c). The free length on each side of the plumbing fitting(s) under test shall be not less than 1.5 DN, or 300 mm, whichever is greater.

NOTE 1 DN is the nominal size of the tube.

NOTE 2 Several plumbing fittings of different sizes may be tested simultaneously.

NOTE 3 A typical test arrangement incorporating three test assemblies is shown in Figure G.1.

Figure G.1 **Typical test arrangement for testing the resistance of joints with a tube to pressure cycling**



Key

1 Electrical control
2 Valve
3 Compressed air cylinder
4 Water
5 Air
6 Pressure converter
7 Test assemblies

*NOTE For dimensions see **G.3**.*

G.4 Procedure

G.4.1 Fill the test assembly with water to expel the air within, prior to testing.

G.4.2 Apply the internal test pressures to the test assembly for the number of cycles and at the frequency specified in **8.4.5.1**b).

Annex H (normative) Test method for the leaktightness of joints with tube under vacuum

H.1 Principle

Assembled tubes and plumbing fittings are subjected to partial vacuum for a specific period during which the joints are inspected for airtightness.

H.2 Apparatus

H.2.1 *End-sealing device*, capable of sealing the non-jointed end of the test sample.

NOTE The end-sealing device selected should be of appropriate size and sealing method for the plumbing fitting under test.

H.2.2 *Shut-off valve*, capable of creating a barrier between the test assembly and the vacuum source.

H.2.3 *Vacuum pressure measuring device*, capable of measuring the pressure in the test assembly with an accuracy of ±0.01 bar.

NOTE $1\ bar = 10^5\ N/m^2 = 0.1\ MPa.$

H.2.4 *Vacuum pump*, capable of producing the partial vacuum and test pressure in the test assembly, as specified in **8.4.6.1**.

H.3 Test assembly

H.3.1 The test assembly shall comprise tubes and plumbing fittings, joined in accordance with the manufacturer's instructions.

H.3.2 The test assembly shall be connected to the vacuum pump via a line with a shut-off valve (**H.2.2**) in accordance with Figure H.1.

NOTE A typical test assembly is given in Figure H.1.

H.4 Procedure

H.4.1 Attach the vacuum pump (**H.2.4**) to the test assembly in accordance with **H.3.2**.

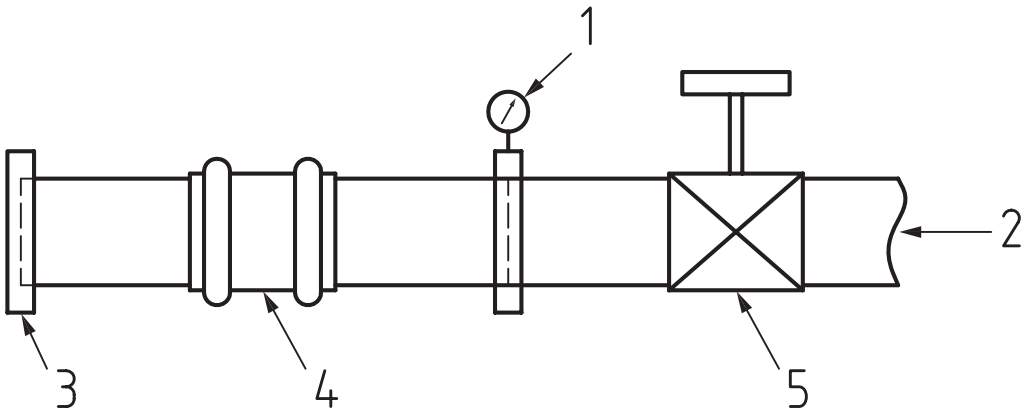
H.4.2 Maintain the test temperature in the range (23 ±5) °C throughout the test period.

H.4.3 Use the vacuum pump (**H.2.4**) to partially remove the air and decrease the pressure level within the test assembly to the test pressure specified in **8.4.6.1**a).

H.4.4 Record the time at which the test pressure is achieved and close the shut-off valve (**H.2.2**).

H.4.5 Use the vacuum pressure measuring device (**H.2.3**) to record the increase of pressure until either the 1 h test duration specified in **8.4.6.1** elapses or the internal pressure within the test assembly changes by more than 0.05 bar.

Figure H.1 **Typical test assembly**



Key

1 Gauge or manometer
2 To vacuum pump
3 End seal
4 Joint under test
5 Shut-off valve

Annex I (normative) Test method for the resistance of joints and tube to vibration

I.1 Principle

A test assembly of tubes and plumbing fittings with Type 1 or Type 2 press ends are subjected to vibration of a specified displacement and duration.

For plumbing fittings with Type 1 press ends, the test assembly is placed under internal hydrostatic pressure for the duration of the test.

For plumbing fittings with Type 2 press ends, the test assembly is held at atmospheric pressure for the duration of the test and then subjected to a pneumatic pressure test.

I.2 Apparatus

I.2.1 *Drive*, which incorporates an eccentric disc to produce a displacement of ±1.0 mm at the free end of the test assembly, and provides vibration at a frequency of (20 ±2) Hz.

I.2.2 *Means of counting the elapsed cycles*.

NOTE An elapsed cycle is one motor revolution.

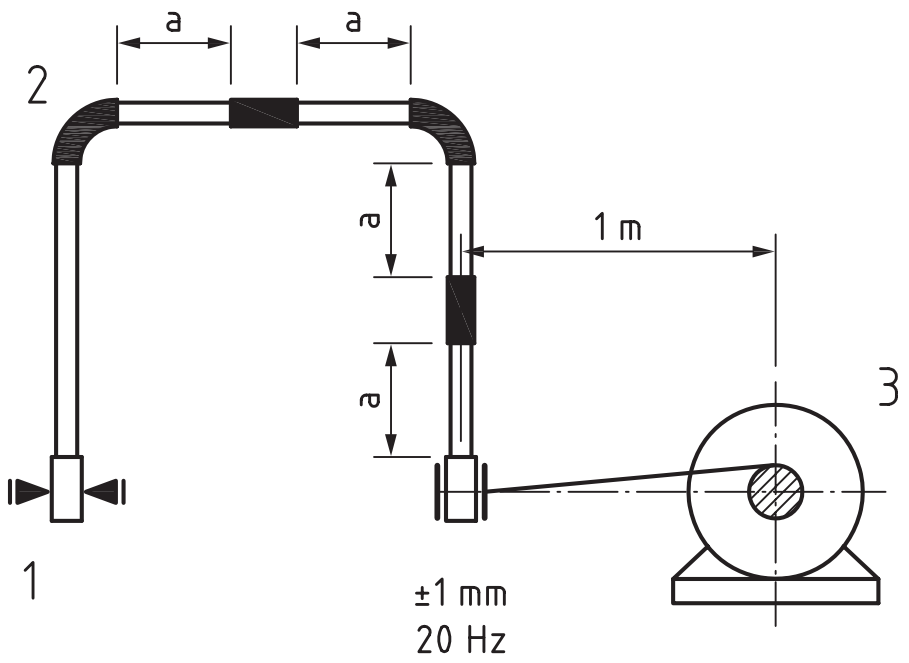
I.2.3 *Means of pressurizing the test assembly*, capable of exerting the test pressure specified in Table 6, and maintaining that pressure throughout the test period.

NOTE This is only required for testing plumbing fittings with Type 1 press ends.

I.3 Test sample

The test sample shall comprise five tubes, four plumbing fittings having two 90° elbows, and two straight couplers, arranged in accordance with Figure I.1.

Figure I.1 **Test assembly for a vibration test**



Key

1 Fixed point and pressurized water connection point
2 Test sample
3 Motor and eccentric disc (see **I.2.1**)
a Length of tube, 200 mm

I.4 Procedure

I.4.1 General

Fit the test sample (**I.3**) to the apparatus (**I.2**). For plumbing fittings with Type 1 press ends, carry out testing in accordance with **I.4.2**. For plumbing fittings with Type 2 press ends, carry out testing in accordance with **I.4.3**.

I.4.2 Plumbing fittings with Type 1 press ends

I.4.2.1 When testing plumbing fittings with Type 1 press ends, fill the test assembly with water to remove the air within.

I.4.2.2 Using the means of pressurizing the test assembly (**I.2.3**), increase the test pressure to (15 ±0.5) bar, in accordance with Table 6.

I.4.2.3 Using the means of counting the elapsed cycles (**I.2.2**), start the electric motor and using the means of counting the elapsed cycles, allow the motor to run until 1 000 000 cycles at a frequency of 20 Hz, as specified in Table 6, are complete.

I.4.2.4 When the cycles have been completed, inspect the test sample for visible signs of leakage before removing it from the test rig.

I.4.3 Plumbing fittings with Type 2 press ends

I.4.3.1 When testing plumbing fittings with Type 2 press ends, hold the test assembly at atmospheric pressure in accordance with Table 6.

I.4.3.2 Using the means of counting the elapsed cycles (**I.2.2**), start the electric motor and using the means of counting the elapsed cycles, allow the motor to run until 1 000 000 cycles at a frequency of 20 Hz have been completed in accordance with Table 6.

I.4.3.3 Carry out a test for leaktightness under internal pneumatic pressure in accordance with Annex C and conforming to **8.4.1.2**.

Annex J (normative) Test method for the resistance of joints of plumbing fittings with Type 2 press ends to static flexural force

J.1 Principle

A test assembly of tubes and a plumbing fitting with Type 2 press ends is subjected to a test load or specified displacement for a specified duration while under pressure.

J.2 Apparatus

J.2.1 *Means of loading the test assembly*.

J.2.2 *Means of supporting the assembly without slippage*.

J.2.3 *Pressurizing pump*, capable of applying pressure to the test assembly and maintaining this pressure for the duration of the test.

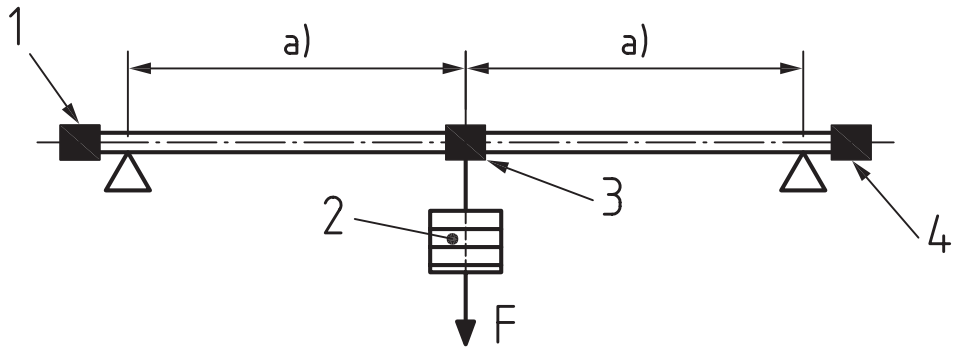
J.2.4 *Test load*, capable of exerting a force in accordance with Table J.1.

J.3 Test assembly

The test assembly shall comprise two tubes and one plumbing fitting with Type 2 press ends, arranged in accordance with Figure J.1.

Figure J.1 **Typical test assembly for testing the resistance of joints of plumbing fittings with Type 2 press ends to static flexural force**

Dimensions in millimetres



Key

1 Plug
2 Test load
3 Plumbing fitting
4 Pressurized water connection point
a) Length of tube, 1 000 mm

J.4 Procedure

J.4.1 Connect the test assembly (**J.3**) to the pressurizing pump (**J.2.3**).

J.4.2 Apply a force in accordance with Table J.1 using the means of loading the test assembly (**J.2.1**) with the test load (**J.2.4**). For half hard and annealed tubes, limit the deflection of the tube to a maximum of 100 mm [**8.4.8.1**c)].

Table J.1 **Bending force**

Nominal diameter of the plumbing fitting	**Force (*F*)**
mm	N
6	20
8	40
10	60
12	80
15	110
18	140
22	180
28	240
35	310
42	380
54	500
66.7	627
76.1	720
108	1 040

NOTE The test load force, F, is calculated from the equation:

F = nominal diameter × 10 − 40

J.4.3 Gradually apply a test pressure to the test assembly in accordance with **8.4.8**a).

J.4.4 Maintain the pressure for the 1 h duration of the test in accordance with **8.4.8**d).

J.4.5 Carry out a test for leaktightness under internal pneumatic pressure in accordance with Annex C and **8.4.1.2**.

Annex K (normative) Test method for the resistance of joints of plumbing fittings with Type 2 press ends to high temperature

K.1 Principle

A test assembly comprising tubes and a plumbing fitting with Type 2 press ends is subjected to an elevated temperature. While being subjected to the elevated temperature, pressure is created on the plumbing fittings by flowing nitrogen gas into the test assembly pipe and containing it for a specific period of time. The volume of leaked test gas is measured at the end of the test.

K.2 Apparatus

K.2.1 *Means for measuring the leakage rate of nitrogen gas during the test period*.

K.2.2 *Nitrogen gas*.

K.2.3 *Oven or furnace*, capable of heating and maintaining a test temperature in accordance with **8.4.9.1**a).

K.2.4 *Pre-pressurized nitrogen gas cylinder with pressure regulating valve*.

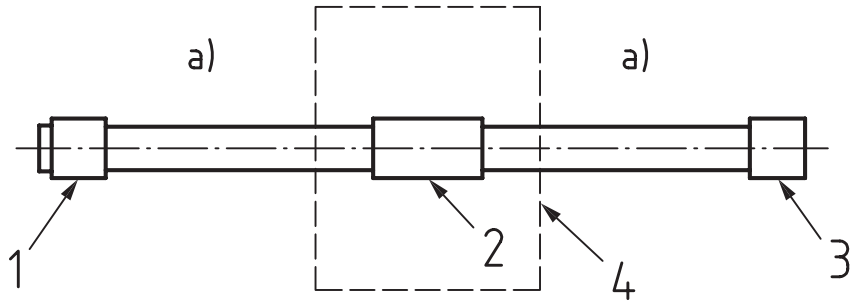
K.2.5 *Pressurizing pump*, capable of applying and maintaining pressure from nitrogen gas (**K.2.2**) at a level in accordance with **8.4.9.1**b) for the duration of the test.

K.2.6 *Thermometer*, capable of measuring the temperature of the test assembly.

K.3 Test assembly

The test assembly shall comprise tubes and one plumbing fitting with Type 2 press ends, in accordance with Figure K.1.

Figure K.1 **Test assembly for testing the resistance of plumbing fittings to high temperature**



Key

1 Pressure connection
2 Test plumbing fitting
3 End stop
4 Oven or furnace
a) Length of tube, ≥100 mm

K.4 Procedure

K.4.1 Connect the test assembly (**K.3**) to the pressurizing pump (**K.2.5**) and the source of nitrogen gas (**K.2.2**) or a pre-pressurized nitrogen gas cylinder (**K.2.4**).

K.4.2 Insert the test assembly and attached apparatus into the oven or furnace (**K.2.3**).

K.4.3 Raise the temperature of the oven or furnace to the temperature stated in **8.4.9.1**a) and maintain for the duration of the test.

K.4.4 Flow the nitrogen gas into the test assembly, creating a test pressure in accordance with **8.4.9.1**b) and maintain the pressure level created for the test duration of 30 min, as specified in **8.4.9.1**d), while carrying out **K.4.5**.

K.4.5 Using the means of measuring the leakage rate of nitrogen gas (**K.2.1**), measure the volume leaking from the test assembly until the 30 min test duration is complete. Divide the total volume of nitrogen that escaped during the test by the number of press ends to determine the leakage rate.

NOTE The volume of gas that escapes in 30 min when testing a coupling gives the average leakage rate per plumbing fitting press end per hour.

K.4.6 Record the nitrogen gas leakage rate of the test sample.

Annex L (informative) Pressure test for plumbing fittings bodies with as-cast microstructure or fabricated by welding or brazing

L.1 Principle

The test samples are subjected to internal pressure for a set period of time. The internal pressure applied is either pneumatic or hydrostatic. For the pneumatic pressure test the test sample is entirely immersed in water. During testing, the test sample is examined for visible signs of leakage and spillage.

L.2 Apparatus

L.2.1 *Pressure measurement device*, capable of measuring the applicable pressures specified in **9.3.1**. Gauges or similar calibrated pressure measurement devices used shall have a calibrated range including the applicable pressure setting specified in **9.3.1**.

NOTE The use of master gauges for calibration of the apparatus is recommended.

L.2.2 *Pressurizing device*, capable of applying and maintaining the applicable pressure as specified in **9.3.1** for the duration of the test.

L.2.3 *Pressure connection*, capable of connecting the pressurizing device to the test sample and remaining leaktight for the duration of the test.

L.2.4 *Tank filled with water,* for the pneumatic pressure test.

L.3 Test sample

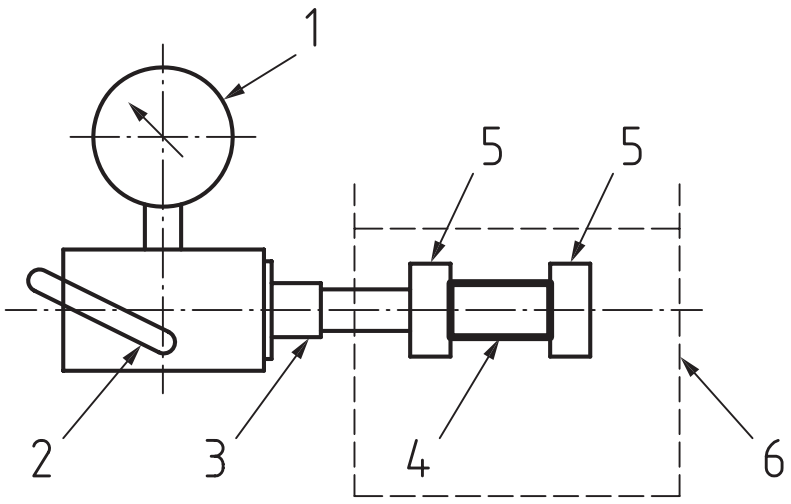
L.3.1 The test sample shall consist of the machined plumbing fitting to be tested.

NOTE A machined plumbing fitting is one for which all metal removal processes have been completed though it might not be completely finished.

L.3.2 The test sample shall not be assembled to any other component.

L.3.3 The test sample and apparatus shall be assembled in accordance with Figure L.1.

Figure L.1 **Typical arrangement of apparatus and test sample for an internal pressure test of plumbing fitting bodies with as-cast microstructure or fabricated by welding or brazing**



Key

1 Pressure measurement device
2 Pressurizing device
3 Pressure connection
4 Test sample
5 Press end sealing device
6 Tank of water for pneumatic pressure test

L.4 Procedure

L.4.1 Assemble the apparatus (**L.2**) and the test sample (**L.3**) in accordance with Figure L.1.

L.4.2 For a pneumatic pressure test, ensure that the test sample is entirely immersed in the tank filled with water (**L.2.4**).

L.4.3 Apply one of the following internal pressures, as applicable.

a) A pneumatic pressure of (5 ±0.5) bar, as specified in **9.3.1**a) for a duration of 5 s.

b) A hydrostatic pressure of (24 ±1) bar, as specified in **9.3.1**b) for a duration of 5 min.

L.4.4 For a pneumatic pressure test, inspect the test sample for bubbles rising to the surface of the tank filled with water throughout the test period and complete a test report.

L.4.5 For a hydrostatic pressure test, inspect the test sample for visible signs of leakage and spillage throughout the test period and complete a test report.

Annex M (normative) Determination of mean depth of dezincification

COMMENTARY ON ANNEX M

*BS EN ISO 6509 specifies a method for the determination of the maximum depth of dezincification of a brass specimen. The method given in this annex extends the method given in BS EN ISO 6509 for the determination of the mean depth of dezincification, in order to conform to the criteria for dezincification resistant alloy grade B products in accordance with **9.4.2**b). This is in accordance with BS EN ISO 6509:1995, **7.5.3**.*

M.1 General

The reagents, materials and apparatus and the procedure for the selection and preparation of the test samples shall be in accordance with BS EN ISO 6509.

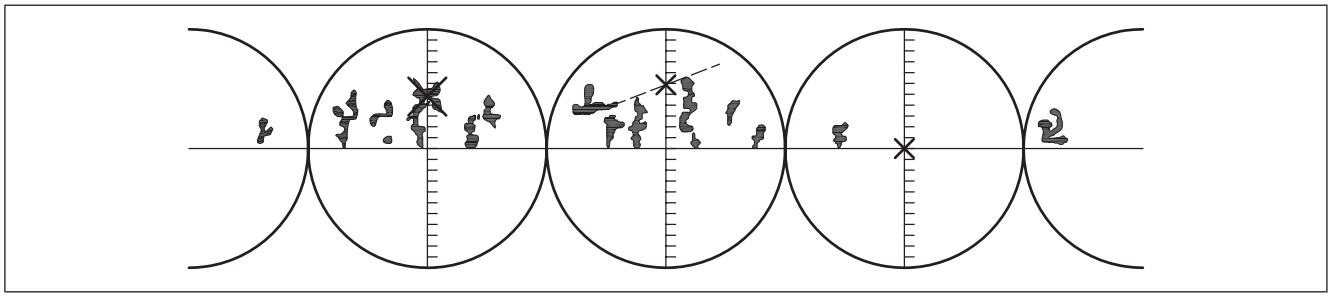
M.2 Procedure

M.2.1 Having determined the maximum depth of dezincification in a longitudinal direction, in accordance with BS EN ISO 6509:1995, Clause **7**, carry out **M.2.2** to **M.2.5** to determine the mean depth of dezincification.

M.2.2 Adjust the magnification of the microscope to suit the general depth of dezincification. Use the same magnification for all measurements. Examine the entire length of the section for evaluation, in contiguous visual fields of the microscope.

NOTE To increase measurement accuracy, the largest number of contiguous fields at the greatest magnification practicable should be measured. An example of contiguous fields is given in Figure M.1.

Figure M.1 **Example of contiguous fields**



M.2.3 Using the measuring scale incorporated in the microscope, measure and record the dezincification depth.

NOTE The dezincification depth is the point of intersection of the scale and the dezincification front for each contiguous field.

M.2.4 Where the scale lies between two dezincified areas within the usual field, the dezincification depth shall be recorded at the point of intersection of the scale and an imaginary line joining the extremities of the two dezincification fronts adjacent to the scale.

M.2.5 Where there is no evidence of dezincification in the field examined, or only one dezincified area which does not intersect the scale, then record the dezincification as zero.

M.3 Expression of results

After measuring all of the contiguous fields along the entire length of the section being evaluated, calculate and report the mean dezincification depth as the sum of the measured depths for every field, divided by the number of contiguous fields examined. Assess the dezincification acceptability of grade A copper alloys through its conformity to **9.4.3**a) and **9.4.4** and the dezincification acceptability of grade B copper alloys through its conformity to **9.4.3**b) and **9.4.4**.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 1254-4, *Copper and copper alloys – Plumbing fittings – Part 4: Fittings combining other end connections with capillary or compression ends*

BS EN 1982, *Copper and copper alloys – Ingots and castings*

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BS EN 12165, *Copper and copper alloys – Wrought and unwrought forging stock*

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Other publications

[1] GREAT BRITAIN. The Water Supply (Water Fittings) (Amendment) Regulations 1999. London: The Stationery Office Limited. SI 1999 No. 1148.

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