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# WATER INDUSTRY SPECIFICATION

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**WIS 4-22-02**  
March 1991: Issue 1  
(Page 1 of 14)  
ISSN 0267-0305

Reprinted June 2006  
for web publication

UK Water Industry

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## SPECIFICATION FOR FERRULES (TAPPING TEES) AND FERRULE STRAPS FOR UNDERGROUND USE

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### FOREWORD

This specification has been prepared by WRc plc under the direction of the Water Services Association/Foundation for Water Research Sewers and Water Mains Committee and is the result of consultation between WRc, the Water Industry and fittings manufacturers. It applies to ferrules (tapping tees), including those with integral straps (i.e. ferrule straps), made of copper alloy or copper alloy-thermoplastics materials combinations for underground water services. Attention is drawn to the WRc Water Fittings and Materials Directory in which those products complying with the Water Byelaws are listed.

This specification does not attempt the complete dimensional standardisation of any of these types of fittings, since the variety in the design and methods of production already established by the various manufacturers makes any such attempts impracticable, and to do so would restrict further development. It does, however, specify such dimensions and requirements as are essential to ensure satisfactory installation, performance and maintenance.

Purchasers are reminded that this specification requires that the manufacturer shall operate a quality system relating to the manufacture of fittings to this specification in compliance with BS 5750: Part 2 (EN 29002) which ensures that products claimed to comply with this specification consistently meet the required level of quality. Enquiries regarding the availability of NACCB or equivalent accredited third party certification should be addressed to an appropriate third party certification scheme or to WRc.

Compliance with this specification does not of itself confer immunity from legal obligations.

This specification does not purport to include all the necessary provisions of a contract. Users of this specification are responsible for its correct application. Reference to a British Standard, Water Industry Specification or any other specification applies equally to any equivalent specification.

Users will give preference to fittings which give low headloss values. At the next revision of this Specification, it is intended to specify maximum headloss requirements.

This specification includes the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at work.

It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

Information contained in this specification is given in good faith but neither the Foundation for Water Research, WSA nor WRc can accept any responsibility for actions taken as a result.

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#### A. METHOD OF TEST FOR DETERMINATION OF HYDRAULIC PERFORMANCE (HEADLOSS)

## 1. SCOPE

1.1 This specification defines the materials, dimensions and construction details together with the performance requirements for ferrules (tapping tees) and ferrule straps made either predominantly of copper alloy or of a copper alloy-thermoplastics material combination, for the connection of service pipes to underground water mains.

1.2 This specification covers ferrules designed to connect service pipes of copper (to BS 2871: Part 1:1971: Table Y) or MDPE (to BS 6572\* or WIS No. 4-32-02) to distribution mains of ductile iron (to BS 4772), cast iron\*\*, imperial PVC-U (to BS 3505), blue metric PVC-U (to WIS No. 4-31-06), MDPE (to BS 6572\*, WIS No. 4-32-02 or WIS No. 4-32-03), PE-100 (to WIS 4-32-13) or asbestos cement (to BS 486).

\* BS 6572 is equivalent to WIS No. 4-32-02 and is now regarded as the lead specification.

\*\* Ferrules which are designed for use on cast iron mains shall be tested in accordance with the performance requirements for ductile iron.

1.3 This specification applies to the most commonly used types of ferrules with outlets suitable for polyethylene service pipes of nominal sizes between 20 and 63 or for copper service pipes of nominal sizes between 15 and 54 (imperial ½" to 2") with either a threaded or a threadless inlet. It does not cover connection to lead or galvanised steel (commonly referred to as galvanised iron) service pipes, although similar ferrules are available with suitable outlets for such connections.

1.4 The fittings when assembled with pipes complying with the above standards or specifications and in accordance with the manufacturer's instructions shall be suitable for maximum continuous working pressures at 20°C of 12 bar for MDPE service connections, and 16 bar for copper service connections.

1.5 Ferrules incorporating fusion (hot-tool) or electrofusion saddles are not included in the present specification. Solvent cement jointed ferrules and ferrule straps are also excluded from this specification.

## **2. QUALITY ASSURANCE**

Manufacturers shall operate a quality system relating to this specification in compliance with BS 5750: Part 2 (EN 29002).

## **3. DEFINITIONS**

### **3.1 General**

For the purposes of this specification the following definitions apply:

**Ferrule** A pipe fitting for connecting a service pipe to a water main.

**Saddle strap** A ring-shaped clamp used to reinforce a pipe where a screwed ferrule is inserted.

**Ferrule strap** A combined ferrule and saddle strap which can be used to initiate a service connection.

### **3.2 Ferrule**

A ferrule is generally used to make a direct connection, if necessary under pressure, between a water main and a service pipe.

### **3.3 Ferrule strap**

A ferrule strap, incorporating a bolted or wedge-secured saddle, is generally used to make a connection, if necessary under pressure, between a metal, or a plastic (PVC-U or MDPE), or an asbestos cement main and a service pipe. A self-tapping ferrule strap, incorporating an integral cutter, can be used to make a connection, if necessary under pressure, between an MDPE, PVC-U or asbestos cement main and a service pipe.

### **3.4 Saddle strap**

Ferrules (including self-tapping types) can also be used with independent saddle straps which reinforce the main and enable satisfactory tapping and service performance to be achieved.

**NOTE** Where a ferrule is connected to a PVC-U main via an independent saddle strap, the ferrule stem should not protrude through the strap in order to avoid the application of a point load to the pipe on tightening.

## **4. MATERIALS**

### **4.1 Ferrule stems**

Ferrule stems, ferrule bodies (where these consist of an integral stem-outlet unit), related metallic valve components and the straps of ferrule straps shall be either of gunmetal to BS 1400 (grade LG2), of copper alloys complying with Table 7 of BS 864: Part 2 and which are immune or resistant to dezincification, or of copper alloys complying with Table 1 of BS 5433.

### **4.2 Outlets**

Removable swivel outlets (commonly referred to as banjos) shall be either of a metallic material complying with 4.1 of this specification, or alternatively of a thermoplastics material which does not suffer from corrosion in potable water (pH range 6 to 8) or low resistivity soils ( $\leq 200\text{ohm.cm}$ ).

### **4.3 Bolts**

Bolts used in conjunction with ferrule straps shall be manufactured in high-tensile aluminium bronze (to BS 2872 Grade CA 104 or BS 2874 Grade CA 104).

### **4.4 Cutters**

Cutters in self-tapping types shall be of high-tensile aluminium bronze (to BS 2874 Grades CA 104 or CA 107) or stainless steel (to BS 970 or BS 1449 Grade 304).

### **4.5 Elastomeric seals**

Elastomeric joint rings shall be made from a biodeterioration-resistant elastomer meeting the Type W requirements of BS 2494.

### **4.6 Effect on water quality**

Ferrule stems, ferrule bodies, swivel outlets, jointing rings, gaskets, lubricants and any other components or materials coming into contact with potable water shall comply with 8.2 of this specification.

## 5. DESIGNATION OF FERRULE AND FERRULE STRAP SIZES

### 5.1 Inlet

The size of the ferrule inlet shall be designated by the nominal diameter of the aperture in the ferrule stem in imperial or metric units.

Preferred nominal inlet sizes are ½", ¾", 1", 1½" and 2".

### 5.2 Outlet

The size of the ferrule outlet shall be designated by the nominal metric size of the service pipe for which the outlet connection is designed together with the service pipe material. Table 1 indicates the approximate equivalence of nominal sizes for ferrules and service pipes.

**Table 1 - Approximate equivalence of nominal sizes for ferrule outlets and service pipes**

Ferrule nominal size (PE outlet)	PE pipe nominal size BS 6572	Ferrule nominal size (Copper outlet)	Copper pipe nominal size BS2871: Part 1: Table Y
20 PE	20	15 Cu	15
25 PE	25	22 Cu	22
32 PE	32	28 Cu	28
50 PE	50	42 Cu	42
63 PE	63	54 Cu	54

### 5.3 Size designation

The overall designation of a ferrule will be the combination of the ferrule inlet and outlet nominal sizes, e.g. for a ½" inlet, 20 PE outlet the designation will be ½"/20 PE.

### 5.4 Strap

The size of the strap of a ferrule strap shall be designated by the nominal size and material of the pipe it can accommodate.

## 6. DIMENSIONS

### 6.1 Body

The minimum wall thickness of metallic stems, bodies, outlets and union nuts of ferrules and ferrule straps shall be as specified in Table 2.

**NOTE**The integral straps of ferrule straps are not covered by this requirement.

The minimum wall thickness specified shall not apply to the thickness of the loose ring or sleeve where such a ring or sleeve must be deformed to form a seal.

The minimum wall thickness shall not apply to the thickness of any internal support or liner.

### 6.2 Outlets

Outlets of thermoplastics materials shall have a wall thickness which enables associated ferrules or ferrule straps to meet all the relevant requirements of this specification.

### 6.3 Length of engagement

Compression joint threads, where appropriate, except those specified in Table 6 of BS 864: Part 2, shall, when hand tightened, have a minimum length of engagement in accordance with Table 3 (see also Figure 3).

**Table 2 - Minimum wall thickness of metallic stems, bodies, outlets and union nuts of ferrules and ferrule straps**

Nominal size of ferrule outlet	Minimum wall thickness at any point of body or nut* A, B, C OR D (see Figures 1 and 2)	
	Hot pressings and components made from rod(mm)	Castings (mm)
20 PE or 15 Cu	1.4	1.5
25 PE or 22 Cu	1.5	1.8
32 PE or 28 Cu	1.6	1.8
50 PE or 42 Cu	1.9	2.3
63 PE or 54 Cu	2.0	2.4

\* **NOTE:** These values will be reviewed against European Standard EN 133 on final publication of the Standard.

**Table 3 - Minimum length of thread engagement for compression joints when assembled hand tight**

Nominal size of outlet ferrule	Minimum length of thread engagement (A - B) for compression joints (mm) (see Figure 3)
20 PE or 15 Cu	4.5
25 PE or 22 Cu	5.5
32 PE or 28 Cu	5.5
50 PE or 42 Cu	5.5
63 PE or 54 Cu	6.5

## 7.2 Surface irregularities

Ferrules and ferrule straps shall be free from internal fins, flash or other irregularities which might restrict the free flow of fluid.

The portways in the bodies of the 20, 25 and 32 PE nominal size ferrules and ferrule straps and the equivalent 15, 22 and 28 Cu nominal size ferrules and ferrule straps shall be cleanly machined. Portways in larger sizes can be cast-in with the minimum apertures at least equal to the total area of the ferrule seat and cleanly aligned with the ferrule outlet.

## 7.3 Inlets

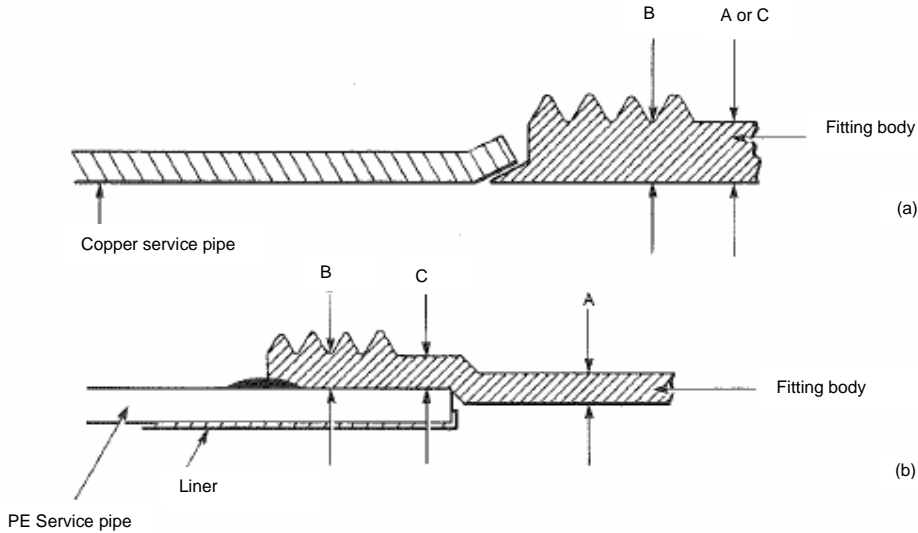
Inlets can be either threaded or threadless. Where threaded, inlets are to be screwed male BSP taper threads to BS 21.

# 7. GENERAL DESIGN REQUIREMENTS

## 7.1 Appearance

The finished quality of metallic components made from castings, hot pressings, rod or drawn tube shall be in accordance with Clause 6 of BS 864: Part 2.

Thermoplastic components shall be clean and free from defects, such as grooves or pinholes, likely to affect the performance of the unit.



**Figure 1 – Ferrule outlets**

#### 7.4 Outlets for copper services

Outlets for copper services shall be of a compression design Type B as defined in BS 864: Part 2. Threads, where present, shall be screwed with one of the appropriate forms of thread in accordance with clause 4 of BS 864:Part 2.

For copper service compression outlets, the cone and seating against which the pipe abuts shall be accurately machined to ensure a good fit.

#### 7.5 Union nuts

Union nuts shall be either hexagonal or octagonal or shall have other suitable means for tightening.

#### 7.6 Outlets for PE services

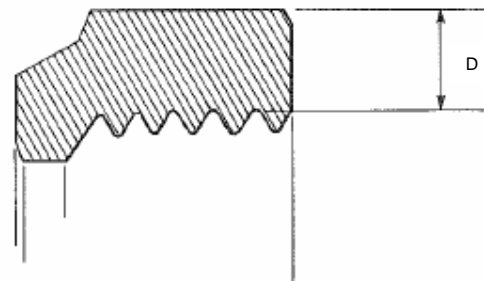
Outlets for PE services shall be either a compression design according to BS 864: Part 5 (WIS No. 4-22-01)\* or of a push-fit design to WIS No. 4-32-11. Threads, where present, shall be screwed with one of the appropriate forms of thread in accordance with clause 4 of BS 864:Part 2.

Compression ferrule outlets for PE services shall be supplied with a means for ensuring the correct position of the service pipe within the fitting; for example an internal shoulder or stop against which an inserted pipe, cut square with its axis, shall abut, either directly or in conjunction with an insert.

Outlets for PE services shall incorporate a gripping mechanism manufactured from corrosion-resistant material (see also 4.6) and meet the requirements for end-load resistance in accordance with BS 864: Part

5 (WIS No. 4-22-01)\* or WIS No. 4-32-11, as applicable. Push-fit joints shall also incorporate a gasket manufactured from elastomeric material complying with 4.5 and 4.6 of this specification.

\* BS 864: Part 5 is equivalent to WIS No. 4-22-01 and is now regarded as the lead specification.

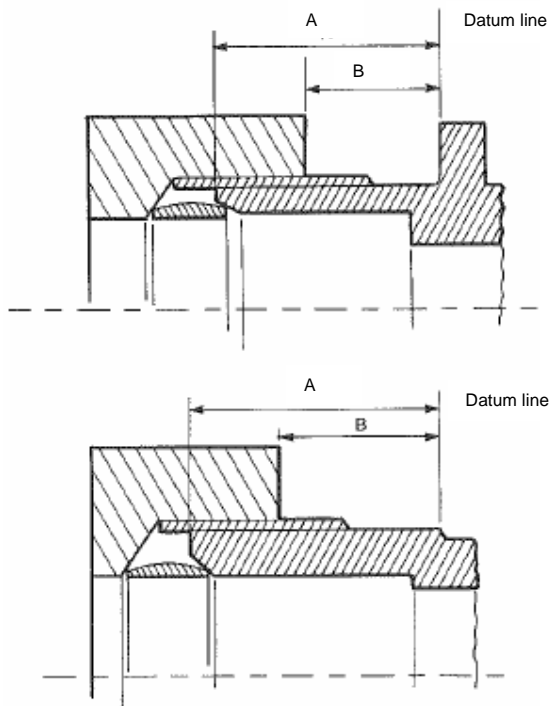


**Figure 2 – Union nuts**

**NOTE** Figures 1 and 2 are diagrammatic only; they do not purport to indicate standard forms or shapes and are solely for the purpose of indicating where the dimensions are to be measured.

#### 7.7 Closure mechanism

Ferrules and ferrule straps shall be designed to enable the water supply to be cut off when the closure mechanism is fully screwed down. Closure shall be effected by means of a square ferrule key, a crutch head, a square head or the like. The torque required to actuate the inner plug shall be  $25 \pm 4\text{Nm}$ .



**Figure 3 – Diagram for determination of thread engagement in hand-tight condition**

**NOTE** Dimension A is measures from the datum line to the commencement of the thread on the body of the fitting.

### 7.8 Cutters

Self-tapping cutters, where present, shall be designed to shut off the supply when fully screwed down and to retract out of the waterway when in the open position. Cutters must, except in the case of asbestos cement mains, positively retain the swarf and coupon removed from the pipe.

**NOTE** It is not a requirement of this specification that asbestos cement coupons be retained in the cutter. When asbestos cement mains are so tapped, the swarf should be flushed out prior to connecting the service pipe.

### 7.9 Bolted ferrule straps

Bolted ferrule straps, together with ferrule straps incorporating closure mechanisms other than bolts (e.g. wedge types), shall when correctly assembled for use not allow excess pressure to be exerted on the external diameter of the pipe so as to distort its circumference sufficiently to impair the performance

of the pipe or fitting seal. The ovality of the strap shall be so limited that the assembly operation can be completed satisfactorily and that the distribution main is not distorted sufficiently to impair performance of the pipe or fitting seal.

## 8. TYPE TEST PERFORMANCE REQUIREMENTS

### 8.1 General

**8.1.1** The requirements in this section shall be met before compliance with this specification can be claimed. Ferrules and ferrule straps shall be capable of meeting the requirements of those tests, described in 8.2 to 8.8, which are deemed relevant by this specification to the fittings being inspected and tested (see Table 4). If there is a change in process technique or introduction of a new or modified material, then it will be necessary to ensure that the conditions of this specification are still satisfied.

**8.1.2** Type tests shall be repeated periodically. Unless otherwise specified, the test samples shall be taken from a production batch which has complied with all other requirements of this specification.

**8.1.3** Unless otherwise specified, the inlet and outlet connections of the ferrules and ferrule straps to be tested shall be assembled in accordance with the manufacturer's instructions with the distribution main/service pipe combination for which the fitting is designed. Assemblies shall be tested incorporating ferrules or ferrule straps of maximum diameter tolerance with pipes of minimum diameter tolerance and vice versa. Unless stated otherwise, the service outlet connection shall be oriented parallel to the line of the distribution main.

Where a ferrule has been designed to be installed using an independent saddle strap, such a saddle strap (as recommended by the manufacturer) shall be used to prepare the test assembly and its presence noted in the test reports.

**Table 4 – Type testing of ferrules and ferrule straps**

Service/main connection	Relevant tests
PE to all distribution main materials	8.2, 8.3, 8.4, 8.5.1, 8.6.1, 8.7 and 8.8
Copper to ductile iron or AC mains	8.2, 8.3, 8.4, 8.7 and 8.8
Copper to PE or uPVC mains	8.2, 8.3, 8.4, 8.5.2, 8.7 and 8.8

**NOTE** Tests involving the inspection of pressurised systems are potentially hazardous. Appropriate measures should be taken to ensure safety of personnel undertaking these tests.

**8.1.4** Ferrules and ferrule straps incorporating self-tapping cutters shall in addition satisfy 8.9 of this specification.

## **8.2 Effects of materials on water quality**

### **8.2.1 Metallic components**

When used under the conditions for which they are designed, materials in contact with or likely to come into contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odours or discolouration.

**NOTE 1** Details of applicable test methods are available from the Water Regulations Advisory Scheme, Fern Close, Pen-Y-Fan Industrial Estate, Oakdale, Gwent, UK. NP11 3EH

### **8.2.2 Non-metallic materials**

When used under the conditions for which they are designed, non-metallic products in contact with or likely to come into contact with potable water shall comply with the requirements of BS 6920: Part 1.

**NOTE 1** Non-metallic products for installation and use in the United Kingdom which are verified and listed under the UK Water Fillings Byelaws Scheme are deemed to satisfy the requirements of this sub-clause. Details of the scheme are obtainable from the Water Byelaws Advisory Service, 660 Ajax Avenue, Slough SL1 4BG.

Pending the determination of suitable means of characterising the toxicity of leachates for materials in contact with potable water, materials (in manufactured form) shall be approved by the Department of the Environment Committee on Chemicals and Materials of Construction for use in

Public Water Supply and Swimming Pools as being free from adverse health effects.

**NOTE 2** A list of approved chemicals and materials is available from the Technical Secretary of the above committee at the DoE, Water Division, Romney House, 43 Marsham Street, London SW1P 3PY.

## **8.3 Hydraulic performance: Headless test**

**8.3.1** Ferrules and ferrule straps shall be assembled according to 8.1.3 using the design service pipe and distribution main materials. The assembly shall be tested in accordance with Appendix A.

**8.3.2** The manufacturer shall declare the maximum headloss for the ferrule or ferrule strap at velocities of 0.5 and 1.25m/s.

## **8.4 Short-term hydrostatic pressure test**

Ferrules and ferrule straps shall be assembled according to 8.1.3 using the design service pipe and distribution main materials. When tested in all other respects in accordance with Appendix A of BS 5114: 1975 using a hydrostatic test pressure of 1.5 x maximum permissible working pressure of the distribution main material for 1 hour, neither the ferrule nor the joint shall on visual inspection show any sign of leakage during the test.

## **8.5 Long-term hydrostatic pressure test**

### **8.5.1 Assembled ferrules and ferrule straps with PE service pipe**

Ferrules and ferrule straps shall be assembled according to 8.1.3 using the design distribution main material. When tested in all other respects in accordance with Appendix A of BS 5114 using a hydrostatic test pressure of 2.2 x maximum permissible working pressure of the distribution main material or 24 bar, whichever is the lesser for 1,000 hours, neither the ferrule nor the joint shall on visual inspection show any sign of leakage during the test.

Where ferrule outlet connections to PE already meet the requirements of BS 864: Part 5 or WIS 4-32-11, as appropriate, then the long-term hydrostatic test requirements have only to be met by those ferrules and ferrule straps which are to be connected to PE or uPVC distribution mains.

### **8.5.2 Assembled ferrules and ferrule straps with copper service pipe**

Long-term hydrostatic test requirements have only to be met by those ferrules and ferrule straps which are to be connected to PE or PVC distribution mains. In these cases ferrule straps assembled according to

8.1.3 shall be capable of meeting the minimum requirements for PE service connections (see 8.5.1 above) when tested for 1.000 hours under identical pressure (appropriate to the distribution main material) and temperature conditions.

## **8.6 Hydrostatic pressure test with service pipe subjected to an external bending stress**

### **8.6.1 Ferrules and ferrule straps with PE service pipe**

Ferrules and ferrule straps shall be assembled using the design PE service pipe according to manufacturer's instructions. The ferrule or ferrule strap inlet shall be connected to the hydraulic pump apparatus.

Ferrules and ferrule straps with outlets of thermoplastics materials shall be tested in all other respects in accordance with 7.3 of WIS No. 4-32-11, and meet the requirements therein. Ferrules and ferrule straps with outlets of copper alloys shall be tested in all other respects in accordance with 11.5 of BS 864: Part 5 (11.3 of WIS No. 4-22-01)\* using a bend radius of 25 x service pipe outside diameter, and meet the requirements therein.

\* BS 864: Part 5 is equivalent to WIS No. 4-22-01 and is now regarded as the lead specification.

## **8.7 External pressure resistance test**

Ferrules and ferrule straps shall be assembled according to 8.1.3 using the design service pipe and distribution main materials. When tested in all other respects in general accordance with Appendix C of BS 5114, a test assembly shall withstand an internal pressure of 0.10 bar below atmospheric pressure for 1 hour followed by an internal pressure of 0.80 bar below atmospheric for a further 1 hour without leakage at either pressure.

## **8.8 Resistance to pull-out of assembled service pipe connections**

The service outlet connections of ferrules and ferrule straps are required to be fully end-load resistant. Fittings with PE service pipe outlets shall be tested to and meet the requirements of 7.5 of WIS No. 4-32-11 (Test methods - Appendices C1/C2 therein). Fittings with copper service pipe outlets shall be tested in accordance with the test method described in Appendix C2 of WIS No. 4-32-11. For the test method defined in Appendix C2 of WIS No. 4-32-11 the service pipe (PE and copper as appropriate) shall

not fracture within the ferrule or separate from the ferrule for the duration of the test.

## **8.9 Assessment of cutter efficiency**

Ferrules and ferrule straps incorporating a self-tapping cutter shall be tested for efficiency of the cutter. A batch of 25 such fittings for each distribution main material shall show 100% success in cutting a clean hole and, except in the case of asbestos cement mains, in securely retaining the cut coupon within the cutter bore. The range of distribution main diameters and wall thicknesses appropriate to the cutter design shall be represented in the 25 tests.

**NOTE** It is not a requirement of this specification that asbestos cement coupons be retained in the cutter.

# **9. QUALITY CONTROL TEST REQUIREMENTS**

## **9.1 Sampling frequency**

The sampling method and frequency shall be in accordance with the quality plan in operation.

## **9.2 Visual inspection**

Every fitting shall be visually inspected. All fittings shall be neatly finished and free from burrs or other defects likely to damage or score the service pipe or distribution main. The bore or waterway shall be free from irregularities or obstructions which may restrict the free flow of water.

## **9.3 Porosity test**

The porosity test shall be carried out in accordance with sub-clause 13.2 of BS 864: Part 2.

## **9.4 Short-term hydrostatic pressure test**

Ferrules and ferrule straps assembled according to manufacturer's instructions using design service and distribution main materials shall be tested to and meet the requirements of 8.4 of this specification.

### 9.5 Hydrostatic pressure test with service pipe subjected to an external bending stress

Ferrules and ferrule straps assembled according to manufacturer's instructions using the design service pipe material shall be tested to and meet the requirements of 8.6.1 of this specification as appropriate to the service connection.

### 9.6 Resistance to pull-out of assembled service pipe connections

Ferrules and ferrule straps assembled according to manufacturer's instructions using the design service pipe material shall be tested to and meet the requirements of 8.8 of this specification.

### 9.7 Cutter efficiency

Ferrules and ferrule straps incorporating a self-tapping cutter shall demonstrate acceptable cutter efficiency by cutting a clean hole and, except in the case of asbestos cement mains, by securely retaining the cut coupon within the cutter bore.

**NOTE** It is not a requirement of this specification that asbestos cement coupons be retained in the cutter.

## 10. TEST CONDITIONS

During type testing or in any case of dispute, unless otherwise specified, ferrule assemblies shall be conditioned for not less than 24 hours at  $23 \pm 2^\circ \text{C}$  prior to testing. For hydrostatic tests involving liquid immersion, the specimens shall be conditioned in the liquid at the test temperature for not less than 24 hours.

## 11. MARKING

Products manufactured to this specification shall be clearly and permanently marked. No method of marking shall prejudice the performance of a ferrule or ferrule strap when tested to the requirements of this specification.

The marking shall give the following information:

(a) Each ferrule body shall be legibly marked with the manufacturer's name or trade mark, the nominal inlet size (see 5.1) and operating pressure (in bar) in line with 1.4 of Clause 1 - Scope.

(b) Outlets shall be marked with the type of outlet connection, in terms of service pipe material, and nominal size (as given in Table 1).

(c) Straps shall be marked with the type and nominal size of the distribution main they are able to accommodate.

(d) The number of this specification (i.e. 4-22-02). (The use of this mark is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of this specification and the claim is solely his responsibility.)

(e) Fittings may be marked with a third party certification mark, where appropriate.

In addition:

(f) The nominal size designations (to this specification) shall be clearly marked on the packaging.

## 12. ASSEMBLY INSTRUCTIONS

Manufacturers shall ensure that full jointing instructions are available for the ferrules/ferrule straps. These instructions shall include the following where appropriate:

Minimum penetration depth of the service pipe needed to effect a seal to allow the fitting to meet the performance requirements.

The chamfer angle necessary on the end of an MDPE service pipe to allow the pipe to seal correctly in the fitting without disturbing any seal or clamping rings.

Details of the type of insert, if any, needed to allow the fitting to meet the performance requirements.

The maximum out-of-square tolerance on the cut end of the service pipe.

Where ferrules/ferrule straps rely on the tightening of an external nut to compress grip rings or seals, the degree to which the nut needs tightening to effect full performance.

Recommended torque for assembly of ferrule straps.

Details of any specialised equipment required for installation.

### 13. REFERENCES

This specification makes reference to the latest edition of the following publications (except otherwise stated) including all addenda and revisions, which should also be consulted.

#### European Standards

- EN 133      Compression fittings of copper and copper alloy.  
                    Part 2 – for copper tubes.  
                    Part 3 – for plastics pipes
- EN 29002    Quality systems – Model for quality assurance in production and installation.

#### British Standards

- BS 21        Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads.
- BS 486      Specification for asbestos cement pressure pipes and joints.
- BS 864      Capillary and compression tube fittings of copper and copper alloys.  
                    Part 2: Specification for capillary and compression fittings for copper tubes.  
                    Part 5: Specification for compression fittings for polyethylene pipes with outside diameters to BS 5556.
- BS 970      Specification for wrought steels for mechanical and allied engineering purposes.
- BS 1400     Specification for copper alloy ingots and copper alloy and high conductivity copper castings.
- BS 1449     Steel plate, sheet and strip.
- BS 2494     Specification for elastomeric joint rings for pipework and pipelines.
- BS 2871     Specification for copper and copper alloys. Tubes.  
                    Part 1: Copper tubes for water, gas and sanitation.

- BS 2872     Specification for copper and copper alloys. Forging stock and forgings.
- BS 2874     Specification for copper and copper alloys. Rods and sections (other than forging stock).
- BS 3505     Specification for unplasticised polyvinyl chloride (PVC-U) pressure pipe for cold potable water.
- BS 4772     Specification for ductile iron pipes and fittings.
- BS 5114     Specification for performance requirements for joints and compression fittings for use with polyethylene pipes.
- BS 5433     Specification for underground stop valves for water services.
- BS 5728     Measurement of flow of cold potable water in closed conduits.  
                    Part 3: Methods for determining principal characteristics of meters.
- BS 5750     Quality systems.  
                    Part 2: Specification for production and installation.
- BS 6105     Specification for corrosion resistant stainless steel fasteners.
- BS 6572     Specification for blue polyethylene pipes up to nominal size 63 for below ground use for potable water.
- BS 6920     Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water.  
                    Part 1: Specification.

#### Water Industry Specifications

- No. 4-22-01\*    Specification for compression fittings of copper and copper alloy for polyethylene pipes with outside diameters to BS 5556 (metric).
- No. 4-31-06    Specification for blue unplasticised PVC (PVC-U) pressure pipes and fittings for buried cold potable water - metric series.

No. 4-32-02	Specification for polyethylene pressure pipe for cold potable water (underground use).
No. 4-32-03	Specification for blue polyethylene (PE) pressure pipe for cold potable water (nominal size 90 to 1000 for underground or protected use).
No. 4-32-11	Specification for end-load resistant mechanical joints and compression fittings made principally of thermoplastics for use with polyethylene pipes of nominal size $\leq 63$ with outside diameters to BS 5556 (metric).
FR 0147	Interim specification (WIS No. 4-32-13P) for higher performance blue polyethylene (PE/MRS 100) pressure pipes, nominal sizes 90 to 500, for underground or protected use for the conveyance of water intended for human consumption.
WAA/WRc	Water Fittings and Materials Directory.

\* WIS No. 4-22-01 is equivalent to BS 864: Part 5.

## APPENDIX A - METHOD OF TEST FOR DETERMINATION OF HYDRAULIC PERFORMANCE (HEADLOSS)

### A.1 FORM OF TEST PIECE

The test piece shall consist of the fitting to be tested assembled using sections of the design service pipe and distribution main according to the manufacturer's instructions. The section of service pipe shall have length  $L_1$ , where  $L_1 > 10 \times$  nominal diameter; the section of distribution main shall be 450mm in length with the ferrule positioned as shown in Figure 4a. The service outlet connection shall be oriented such that the maximum headloss through the assembly is measured.

### A.2 APPARATUS

The apparatus will in general be similar to that described in BS 5728: Part 3. A schematic representation of a suitable test assembly is shown in Figure 4b. The test assembly shall be connected to a water supply using suitable pipework and equipment which enables the water to be pumped at flowrates

between 2 and 158 litres/ minute. Pressure tappings shall be made at 4 positions equally spaced around the circumference of the distribution main section at a distance of  $\frac{2}{3} \times L_2$  from the ferrule inlet (where  $L_2$  is the length of distribution main between input and ferrule and is a minimum of 15 x outside diameter of the service pipe). A pressure tapping shall be made on the service pipe. The tapping points themselves shall be carefully designed (see 7.2.1.3 and 7.2.1.4 of BS 5728: Part 3).

### A.3 PROCEDURE

The test shall be conducted generally in accordance with the procedure described in clause 7 of BS 5728: Part 3 (clauses 4 and 5 of this British Standard are also relevant to this test procedure). Measure the static differential pressure ( $\Delta P_1$ ), at the flowrates specified in Table 5, across the downstream (service) pipe length.  $\Delta P_1$  shall be measured by connecting a service pipe of the correct size such that the distance between the two pressure tappings is 1m.

Install the ferrule to be tested in the test rig and repeat the measurement  $\Delta P_2$  at the same flowrates.

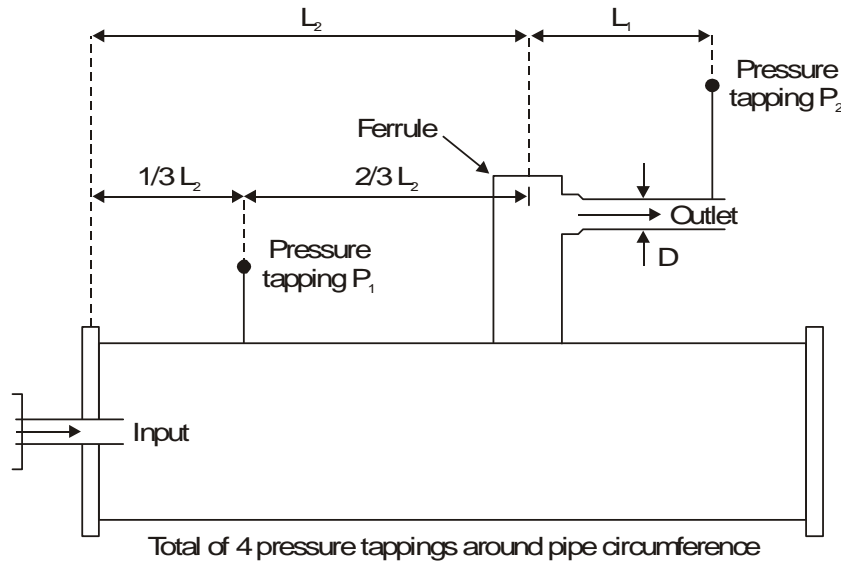
The actual headloss due to the fitting is given by:

$$\Delta P = \Delta P_2 - \Delta P_1.$$

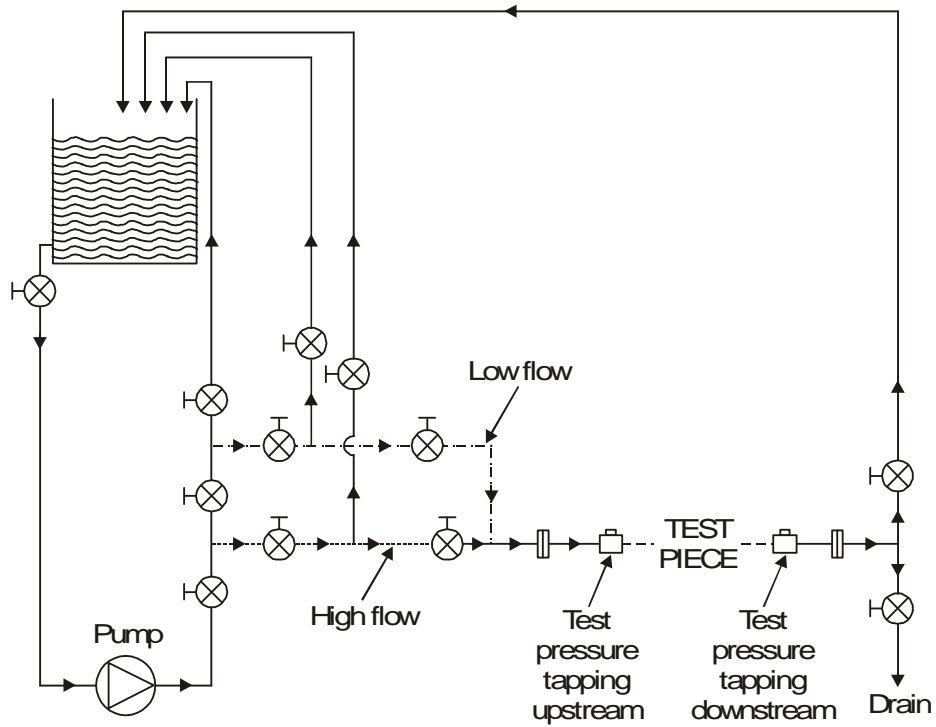
### A.4 REPORT

The report shall include the following:

- (a) The full identification of the specimens;
- (b) Description of ferrule or ferrule strap assembly;
- (c) Test conditions including flowrates and laboratory temperature;
- (d) For each flowrate, the headloss due to the fitting in metres;
- (e) The date of the test.



(a) Test place



(b) Test rig

**Figure 4 – Schematic representation of test assembly for hydraulic performance testing**

**Table 5 – Flow rate (L/min) at velocities of 0.5m/s and 1.25m/s**

<b>Copper pipes to BS 2871: Part 1</b>			<b>PE Pipes to BS 6572</b>		
<b>DN</b>	<b>Flow rate (L/min)</b>		<b>DN</b>	<b>Flow rate (L/min)</b>	
	<b>0.5m/s</b>	<b>1.25m/s</b>		<b>0.5m/s</b>	<b>1.25m/s</b>
12	2.8	7.0	-	-	-
15	4.4	11.0	20	5.8	14.5
18	6.4	15.8	-	-	-
22	9.6	24.0	25	10.0	25.0
28	16.2	40.5	32	16.3	40.7
35	25.0	62.5	-	-	-
42	40.0	100.0	50	40.0	100.0
54	59.9	149.8	63	63.2	158.0