

Water Industry Specification

SPECIFICATION FOR MECHANICAL FITTINGS AND JOINTS INCLUDING FLANGES FOR POLYETHYLENE PIPES FOR THE CONVEYANCE OF COLD POTABLE WATER FOR THE SIZE RANGE 90 TO 1 000 INCLUSIVE MADE OF METAL OR PLASTICS OR A COMBINATION OF BOTH

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 in consultation with the Water Industry and Fittings Manufacturers. It defines the properties required for mechanical fittings for use with polyethylene pipe conforming to WIS No. 4-32-03, for the conveyance of cold potable water. Such fittings may be made of metal, plastics or a combination of both.

These fittings are designed for jointing pipe to pipe and pipe to metal fittings such as valves, tees and bends as well as for effecting repairs.

Three types of fittings are covered by this specification, classified according to their end-load performance, as follows:

Type 1 fittings: where the end-load resistance of the joint is greater than the longitudinal strength of the pipe;

Type 2 fittings: where the end-load resistance of the joint is greater than the maximum axial forces assumed to be acting on the joint (see IGN No. 4-01-02);

Type 3 fittings: where the end-load resistance of the joint is less than that required for Type 2 fittings.

Anchor blocks will normally be required with Type 3 fittings and the advice of the manufacturer should be sought.

The specification includes a fatigue test which is at present limited to sizes up to and including 315. In a subsequent revision, the fatigue test will be extended to cover all sizes up to and including size 1 000. Pending the publication of such a revision, it is assumed that the behaviour of fittings of sizes greater

than 315 will be similar to that of fittings of the same design up to and including size 315.

Attention is drawn to the WAA/WRc Manual for MDPE pipe systems for water supply which has been prepared to offer guidance to the UK Water Industry on the practical design, installation and operation of PE water pipeline systems.

Attention is also drawn to the following Water Industry Specifications:

WIS No 4-32-04

WIS No 4-32-06

WIS No 4-32-09

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 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.

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 any stage.



It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people.

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.

CONTENTS

FOREWORD

1. SCOPE
2. QUALITY ASSURANCE
3. MATERIALS
4. GENERAL DESIGN REQUIREMENTS
5. TYPE TEST REQUIREMENTS
 - 5.1 General
 - 5.2 Effect of materials on water quality
 - 5.3 Long-term hydrostatic strength test at 20°C
 - 5.4 Accelerated relaxation and end-load test
 - 5.5 Pull-out test at 23°C
 - 5.6 Fatigue test
6. QUALITY CONTROL TEST REQUIREMENTS
 - 6.1 External pressure test
 - 6.2 1-hour pressure test at 20°C
 - 6.3 Pull-out test at 23°C
 - 6.4 Visual appearance
7. TEST CONDITIONS
8. MARKING
9. PROTECTION OF FITTINGS
10. REFERENCES

APPENDICES

- A. Hydrostatic pressure test
- B. Accelerated relaxation and end-load test
- C. Pull-out test at 23°C
- D. Fatigue test

1. SCOPE

1.1 This specification specifies the materials and design details together with the testing requirements for mechanical fittings, including flanges, for use with polyethylene pipes complying with WIS No. 4-32-03, in the size range 90 to 1 000 inclusive, for working pressures of 6 bar and 10 bar at 20°C.

1.2 Fittings shall be designated by the nominal size of the pipe with which they are to be used and their pressure rating or standard dimension ratio e.g. 6 bar or SDR17.6, and 10 bar or SDR11.

1.3 Three types of fittings are covered by this specification, classified according to their end-load performance, as follows:-

Type 1 fittings: where the end-load resistance of the joint is greater than the longitudinal strength of the pipe;

Type 2 fittings: where the end-load resistance of the joint is greater than the maximum axial forces assumed to be acting on the joint (see IGN No. 4-01-02);

Type 3 fittings: where the end-load resistance of the joint is less than that required of Type 2 fittings.

NOTE The titles of the publications referred to in this document are listed under Clause 10 - REFERENCES.

2. QUALITY ASSURANCE

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

3. MATERIALS

3.1 The body of the fitting shall be made either of metal, coated where applicable (see 4.3) or plastics which do not suffer from corrosion in potable water or low resistivity soils. These materials shall comply with the relevant parts of 5.2.

3.2 Copper and copper alloy fittings shall be made from materials conforming to BS 1400 and shall be immune or resistant to dezincification (see BS 864: Part 2: 1987 - Table 7).

3.3 Where alternative materials are used, they shall comply with the relevant British Standard, or equivalent, where available. Where such materials are likely to come into contact with potable water, they shall meet the relevant requirements of 5.2.

3.4 Elastomeric sealing rings shall conform to BS 2494 Type W.

3.5 All materials shall be chosen so as not to introduce a risk of bimetallic corrosion into the assembled fitting.

4. GENERAL DESIGN REQUIREMENTS

4.1 Fittings to this specification shall be suitable for use with polyethylene pipes to WIS No. 4-32-03 at working pressures of up to 6 or 10 bar at temperatures from 0°C to 20°C.

4.2 Fittings shall be capable of being assembled and meeting the requirements of Clauses 5 and 6 of this specification under the extremes of pipe dimensional tolerances specified in WIS No. 4-32-03.

4.3 Metallic fittings shall be suitably protected against corrosion. Where applicable, hot dip galvanising shall be carried out to BS 729 and zinc plating to

4.4 Flanged joints

4.4.1 Flanged joints shall be constructed such that they may be attached to flanges designated PN16 whose dimensions are shown in Table 18 of BS 4772 as well as certain flanges in Tables 7 and 11 of BS 4504: Section 3.2.

4.4.2 The faces of flanges to this specification shall be at right angles to, and concentric with, the longitudinal axis.

5. TYPE TEST REQUIREMENTS

5.1 General

5.1.1 The requirements in this section shall be met before compliance with this specification can be claimed. If there is a change in process techniques or a new or modified material is introduced, then it will be necessary to ensure that the conditions of this specification are still satisfied.

The Quality plan may also require tests to be repeated at specified intervals.

5.1.2 Unless otherwise specified, the test samples shall be taken from a production batch which has complied with all the other requirements of this specification.

Details and results for each type test relevant to each material composition and manufacturing process shall be made available to the purchaser or his representative on request.

5.1.3 All sizes, types (shape and design) and pressure classes of fittings produced by the manufacturer shall conform to all the requirements of Clause 5.

For certification purposes, during any one year period, at least one sample shall be tested from each of the size ranges given in Table 1, within the limits of the manufacturer's product range, for each of the requirements of Clause 5.3 to 5.6 inclusive.

Table 1 Size ranges for test

Range No.	Nominal pipe size
1	90 - 315
2	355 - 500
3	560 - 1000

To ensure that, initially, a representative cross-section of the manufacturer's product range is evaluated, it is recommended that a minimum of the smallest fitting of the manufacturer's product range and the largest size manufactured within each size band shall be evaluated.

5.2 Effect of materials on water quality

5.2.1 Metallic components

When used under the conditions for which they are designed, metallic products 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 Byelaws Advisory Service, 660 Ajax Avenue, Slough, SL1 4BG.

5.2.2 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 be tested in accordance with BS 6920: Part 2 and 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 Fittings Byelaws Scheme are deemed to satisfy the requirements of this Clause. Details of the scheme are obtainable from the Water Byelaws Advisory Service; 660 Ajax Avenue, Slough SL1 4BG.

In addition, 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.

5.3 Long-term hydrostatic strength test at 20°C

When tested by the method described in Appendix A at a temperature of 20 (+2-1)°C, the jointed assembly shall withstand the appropriate pressures given in Table 2.

If after 1 000 or 10 000 hours, as appropriate, the sample has not failed, the test may be discontinued.

Table 2 Requirements for long-term pressure tests at 20°C

Time to failure (h)	Pressure (bar) - minimum	
	SDR17.6	SDR11
100 - 1 000	13.5	22
5 000 - 10 000	12.5	20

5.4 Accelerated relaxation and end-load test

5.4.1 This test is applicable to Type 1 and Type 2 fittings only.

5.4.2 When tested by the method described in Appendix B there shall be no detectable pull-out of the pipe from the fitting. Whilst initial movement of the pipe within the joint is permitted, no further such movement is allowed after the test load has been attained. The test load shall be maintained for not less than 500h.

NOTE The test specified in sub-clause 5.4.2 is carried out at a temperature of 80°C. In order to permit the use of thermoplastics of lower softening point in such fittings, a similar test in which the test temperature is 60°C will be considered in future revisions of the specification when suitable data are made available.

5.4.3 The assembly shall then be disconnected from the test rig and allowed to cool to ambient temperature. The following tests in accordance with Appendix A shall then be applied:

- (a) a test at an internal pressure of $25 \pm 3\text{kN/m}^2$ (0.25 bar) below atmospheric pressure for 8 hours at a temperature of 20 (+2 -1)°C (external pressure test).
- (b) a test at 6 bar gauge pressure for 6 bar fittings (SDR 17.6) and at 10 bar gauge pressure for 10 bar fittings (SDR 11) for 8 hours at a temperature of 20 (+2 -1)°C.

The tests shall be carried out in accordance with the method described in Appendix A. During the tests, the assembly shall not leak or weep nor shall the pipe fracture.

The test described in 5.5 shall then be carried out.

5.5 Pull-out test at 23°C

This test is applicable to Type 1 and Type 2 fittings only.

After having been subjected to the requirements of 5.4, the assembly shall be tested by the method described in Appendix C. The pipe shall not pull out from the fitting nor shall it fracture within the jointed assembly. Whilst initial movement of the pipe within the joint is

allowed, no further such movement is permitted after the test load has been attained.

5.6 Fatigue test

This test applies to fittings up to and including size 315 (see Foreword).

When tested by the method described in Appendix D, the test assembly shall withstand 4×10^4 cycles.

Alternatively, the test specimens shall be conditioned and the test carried out at a temperature of 60 (+2 -1)°C but otherwise in accordance with the method described in Appendix D. The test assembly shall withstand 25×10^4 cycles.

6. QUALITY CONTROL TEST REQUIREMENTS

6.1 External pressure test

When tested by the method described in Appendix A, the test assembly shall withstand a pressure of $25 \pm 3\text{kN/m}^2$ (0.25 bar) below atmospheric pressure for 8 hours at a temperature of 20(+2 -1)°C.

6.2 1-hour pressure test at 20°C

When tested by the method described in Appendix A, the test assembly shall withstand a pressure of 1 bar for 1 hour followed by a pressure of 16 bar for a 6 bar fitting (SDR17.6) and 26 bar for a 10 bar fitting (SDR11) for 1 hour at a temperature of 20(+2 -1)°C.

6.3 Pull-out test at 23°C

This test is applicable to Type 1 and Type 2 fittings only.

When tested by the method described in Appendix C, the pipe shall not fracture within the jointed assembly. Whilst initial movement of the pipe within the joint is allowed, no further such movement is permitted after the test load has been attained.

6.4 Visual appearance

The internal and external surfaces shall be free from features such as cracks, holes, blisters, distortion, inclusions and dents which would impair the performance of the product in service.

7. TEST CONDITIONS

During type testing or in any case of disagreement, specimens shall be conditioned prior to test by being kept at $23 \pm 2^\circ\text{C}$ in air for not less than 12 hours for fittings of wall thickness up to and including 12.7mm or not less than 24 hours for fittings of wall thickness over 12.7mm unless otherwise specified.

For hydrostatic tests involving liquid immersion, the specimens shall be conditioned in the liquid at the test temperature for not less than 24 hours.

8. MARKING

Fittings and liners (where required) shall be marked legibly in red for 6 bar fittings and black for 10 bar fittings. No method of marking shall prejudice the performance of the fitting when tested to the requirements of this specification.

The marking shall include:-

- (a) the manufacturer's identification,
- (b) the number of this specification i.e. WIS No. 4-24-01. (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 his sole responsibility),
- (c) the nominal size of the fitting and its pressure rating,
- (d) the word "WATER",
- (e) the type of fitting e.g. "Type 1", "Type 2" or "Type3",
- (f) a third party certification mark (if permissible).

9. PROTECTION OF FITTINGS

9.1 Fittings shall be suitably protected, following manufacture, against damage during storage and handling.

9.2 The faces of all flanges shall be protected against damage.

10. 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.

British Standards

BS 729	Hot dip galvanised coatings on iron and steel articles.
BS 864	Capillary and compression tube fittings of copper and copper alloys. Part 2. Specification for capillary and compression fittings for copper tubes.
BS 1400	Copper alloy ingots and copper alloy and high conductivity copper castings.
BS 2494	Specification for elastomeric joints rings for pipework and pipelines.
BS 3382	Electroplated coatings on threaded components. Part 2. Cadmium on steel components. Zinc on steel components.

BS 4504	Specification for flanges and bolting for pipes, valves and fittings. Metric series. Section 3.2 Cast iron flanges.
BS 4728	Determination of the resistance to constant internal pressure of thermoplastics pipes.
BS 4772	Ductile iron pipes and fittings.
BS 5750	Quality systems. Part 2. Specification for production and installation.
BS 6920	Suitability of non-metallic products for use in contact with potable water intended for human consumption. Part 1 - Specification. Part 2 - Methods of test.

European Standards

EN 29002	Quality Systems - model for quality assurance in production and installation.
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Water Industry Specifications

No. 4-32-03	Specification for polyethylene pressure pipe for cold potable water (for nominal sizes greater than 63).
No. 4-32-04	Specification for polyethylene fusion joints and fittings for use with cold potable water pressure pipe.
No. 4-32-06	Specification for polyethylene electrofusion couplers and fittings for cold potable water supply for nominal sizes up to and including 180.
No. 4-32-09*	Specification for black polyethylene pressure pipes for sewage and above ground potable water (nominal sizes 90 to 1 000).
FR No. 0028	Interim Water Industry Specification (WIS No. 4-52-01) for polymeric anti-corrosion (barrier) coatings. September 1989.

* *In preparation.*

Information and Guidance Notes

No. 4-01-02*	The determination of end-loads to be applied in the performance testing of end-load resistant pipeline fittings.
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WAA/WRC Manual for the design, installation and operation of MDPE pipe systems for water supply. June 1986.

* *In preparation.*

APPENDIX A – HYDROSTATIC PRESSURE TEST

A.1 TEST PIECE

For the tests specified in 5.3 and 6.2, more than one fitting may be tested at a time. A fitting shall be assembled on polyethylene pipe conforming to WIS No. 4-32-03 in accordance with the manufacturer's instructions and conditioned as specified in clause 7 of this specification.

The type of end caps shown in Figure 1 of BS 4728: 1971 shall be used for Type 1 fittings. The type of end caps shown in Figure 2 or 3 of BS 4728 shall be used for Type 2 and Type 3 fittings. There shall be a free length of pipe, between any two fittings or a fitting and an end cap, of not less than three times the nominal size of the fitting for test pieces of nominal size up to and including 315 and a minimum of 1m for sizes greater than nominal size 315.

For type testing, three assemblies shall be evaluated at each test level.

A.2 PROCEDURE

A.2.1 Internal pressure test

The test shall be performed in accordance with the method described in BS 4728.

For each of the pressure ratings for which the fitting is designed, assemblies shall be tested both to the 100 - 1000 h. and the 5000 - 10000 h. test.

Failure of the pipe within a distance of less than 0.1L (where L is the free length of pipe between fittings or between fitting and end cap) from the mouth of the fitting shall be disregarded and a new test piece evaluated. Any axial movement of the pipe within the joint at the end of the test shall be determined and recorded.

The test pressures and times to failure shall be as specified in 5.3 and 6.2 of this specification.

A.2.2 External pressure test

The test equipment and procedure shall be that specified in BS 4728 except that the pressurising unit is replaced by a vacuum pump. When the test pressure is attained, a suitable valve is closed to isolate the test piece from the pump.

The test shall be continued for 8 hours after which time the pressure shall not have changed from the initial value by more than 3kN/m^2 .

A.3 TEST REPORT

The test report shall include at least the following particulars:

- (a) the type of test (internal or external pressure);
- (b) full identification of the test piece;
- (c) the type of end fitting used;
- (d) the test temperature;
- (e) the circumferential stress or pressure;
- (f) the test result and, in the case of premature failure, the time to rupture;
- (g) reference to this Specification.

APPENDIX B – ACCELERATED RELAXATION AND END-LOAD TEST

B.1 TEST PIECE

A fitting shall be assembled with polyethylene pipe conforming to WIS No. 4-32-03 in accordance with the manufacturer's instructions.

There shall be a free length of pipe between any 2 fittings, or between a fitting and the end-loading grips of three times the nominal size (up to nominal size 315) and a minimum of 1m for sizes greater than nominal size 315.

B.2 TEST PIECE FOR FLANGE ASSEMBLIES

A typical test piece for the testing of flange assemblies is illustrated in Figure 1.

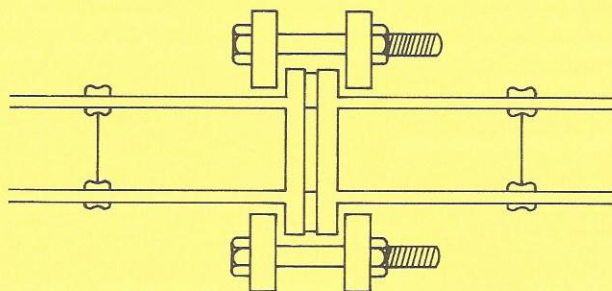


Figure 1 Section through typical test piece for the testing of flange assemblies (for clarification only)

B.3 PROCEDURE

B.3.1 The test piece shall be mounted in a jig capable of applying a constant tensile axial load to the pipe(s) and fitting. The fitting shall not be held in such a way that distortion or support of any of the fitting components can occur.

B.3.2 The test piece shall be suspended in a water bath at $80(+2-1)^{\circ}\text{C}$ for a minimum of 500 hours with an axial load in accordance with Table 3(a) for Type 1 fittings and Table 3(b) for Type 2 fittings.

Table 3a Pull out test force at 80°C for Type 1 fittings

Nominal size	Test force (kN) – minimum	
	6 bar (SDR17.6)	10 bar (SDR11)
90	—	7.5
125	9.0	14.0
180	19.0	29.5
250	37.0	57.0
315	58.5	90.0
355	74.0	115.0
400	94.0	145.0
450	120.0	185.0
500	145.0	225.0
560	180.0	300.0
630	230.0	380.0
710	295.0	—
800	375.0	—
900	475.0	—
1000	585.0	—

Table 3b Pull out test force at 80°C for Type 2 fittings

Nominal size	Test force (kN) – minimum	
	6 bar (SDR17.6)	10 bar (SDR11)
90	—	4.0
125	5.0	8.0
180	11.0	16.0
250	21.0	31.0
315	32.0	50.0
355	41.0	63.0
400	52.0	80.0
450	66.0	102.0
500	80.0	124.0
560	99.0	165.0
630	126.0	208.0
710	162.0	—
800	206.0	—
900	261.0	—
1000	321.0	—

B.3.3 After 500 hours, the tests in accordance with clause 5.4.3 shall be carried out.

B.4 REPORT

The report shall include:-

- (a) date of the test,
- (b) identification of the test piece,
- (c) type of fitting tested (Type 1 or Type 2)
- (d) evidence of leakage, weepage and fracture of the pipe during the 500 hour test,
- (e) compliance with the pressure tests in clause 5.4.3.

APPENDIX C – PULL OUT TEST AT 23°C

C.1 TEST PIECE

The test piece shall be a fitting jointed to polyethylene pipe, conforming with WIS 4-32-03, in accordance with the manufacturer's instructions. The free length of pipe between the fitting under test and the end-loading grips shall be as specified in Clause B.1 of Appendix B.

C.2 TEST PIECE FOR FLANGE ASSEMBLIES

A typical test piece for testing flange assemblies is illustrated in Figure 1 of Appendix B.

C.3 APPARATUS

The apparatus shall be capable of applying a tensile axial load, as given in Table 4(a) or 4(b), as appropriate, at a cross-head speed of not less than 25mm/min.

C.4 TEST PROCEDURE

C.4.1 Plain metal plugs shall be inserted in the end of the PE pipe(s) to support the pipe(s) under the action of the loading grips. Alternatively, mechanical fitting(s), not under test, shall be assembled on the end of the PE pipe(s). Loading grips shall not be applied to the fitting body under test.

C.4.2 The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$. A tensile axial load shall be applied to the fitting under test at a cross-head speed of $25 \pm 1\text{mm/min}$. until the maximum load is clearly defined.

C.4.3 The fitting passes the test provided the minimum load in Table 4(a) for Type 1 fittings and Table 4(b) for Type 2 fittings is exceeded without pull-out occurring. If fracture of the pipe occurs, the test shall be repeated on a completely new assembly. If the pipe yields at a distance greater than 0.1L from the mouth of the socket or loading grip (see A.2.1), the fitting shall be deemed to have satisfied the requirements of this test.

C.5 REPORT

The report shall include the following:-

- (a) the date of test,
- (b) identification of the sample,
- (c) type of fitting tested (Type 1 or Type 2),
- (d) the maximum load at failure,
- (e) the type of failure (pull-out, necking of the pipe, fracture of the pipe).

Table 4a Pull-out test forces for Type 1 fittings

Nominal size	Test force (kN) – minimum	
	6 bar (SDR17.6)	10 bar (SDR11)
90	–	32
125	40	61
180	82	127
250	158	245
315	251	386
355	318	491
400	404	624
450	512	789
500	632	975
560	792	1221
630	1003	1547
710	1272	–
800	1618	–
900	2044	–
1000	2525	–

Table 4b Pull-out test forces for Type 2 fittings

Nominal size	Test force (kN) – minimum	
	6 bar (SDR17.6)	10 bar (SDR11)
90	–	18
125	22	34
180	45	70
250	87	135
315	138	212
355	175	270
400	222	343
450	280	433
500	346	535
560	434	670
630	550	849
710	697	–
800	886	–
900	1121	–
1000	1384	–

APPENDIX D – FATIGUE TEST

D.1 TEST EQUIPMENT

The equipment shall consist of a thermostatically controlled water bath maintained at 80(+2–1)°C, together with equipment that permits the application of a fatigue load using pneumatics or other suitable means, to produce a trapezoidal pressure change profile (see Figure 2).

Typical equipment is illustrated in Figure 3 and consists principally of compressed air supplied from line A, filtered (B) and then regulated (C) to the desired pressure. The filtered and regulated compressed air is then passed through a 5 way solenoid valve (D) which is controlled by a dual timer (E). The valve D cycles the compressed air between two lines (F and G) which supply the two samples (SF and SG). By using a symmetrical loading profile, the greatest use is made of the one supply of compressed air (line A) with the two samples out of phase, as shown schematically in Figure 4. Between the 5-way valve (D) and the two samples (SF and SG) there are two 3-way solenoid valves (H and I) on the two lines (F and G) which are

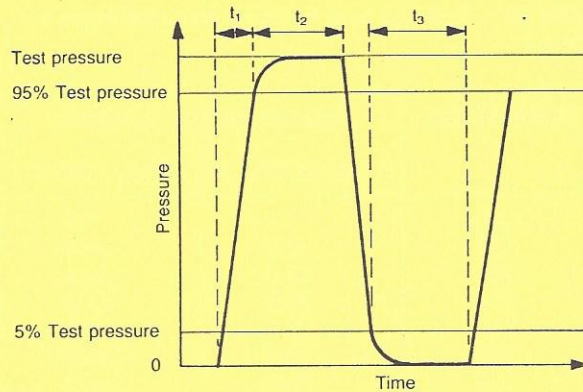


Figure 2 Schematic representation of pressure loading profile

normally open. When one or both of the samples is detected as having failed, a current is supplied to either or both solenoid valves (H and I) to isolate the sample(s) from the compressed air.

Equipment in which a pressure point is connected to a single sample is also permitted.

D.2 TEST PIECES

For this test, 3 test pieces shall be evaluated.

Test pieces shall consist of fittings into which pipes have been jointed together with suitable end caps. The free length (L) of pipe between fitting and end cap shall be calculated from:

$$L = 3 \times \text{outside diameter minimum for test pieces up to and including size 315.}$$

The test pieces shall be filled with water and all air vented.

NOTE Testing with air can be dangerous and the test specimen must be vented of all air.

D.3 CONDITIONING

The assembly shall be conditioned for not less than 2 hours at a temperature of 80 ± 1°C, before testing shall commence.

D.4 TEST METHOD

The sample shall be connected to the pressurising unit to produce the following pressure regime:

$$t_1 = 2 \pm 1.0 \text{ s}$$

$$t_2 = 5 \pm 0.5 \text{ s}$$

$$t_3 = 5 \pm 0.5 \text{ s}$$

where

t₁ = time to raise the pressure from 0 bar to 95% of the test pressure (i.e. 95% of 4.8 bar for a 6 bar fitting, 95% of 8 bar for a 10 bar fitting).

t₂ = time from when 95% of the test pressure has been reached to removal of the test pressure.

t₃ = time from when the pressure has decayed to 5% of the test pressure to the time when the pressure is raised.

NOTE 1 See Figure 2.

NOTE 2 The time from the end of cycle t_2 to the beginning of cycle t_1 is typically 6 - 8 seconds.

NOTE 3 The test pressure shall be reached and maintained during time t_2 at 4.8 ± 0.2 bar for a 6 bar fitting and 8 ± 0.2 bar for a 10 bar fitting.

NOTE 4 The test pressure shall reduce to 0 bar during time t_3 .

Failure of the pipe within a distance of less than 0.1L from the mouth of the fitting shall be considered to be a failure to meet the requirements of this test.

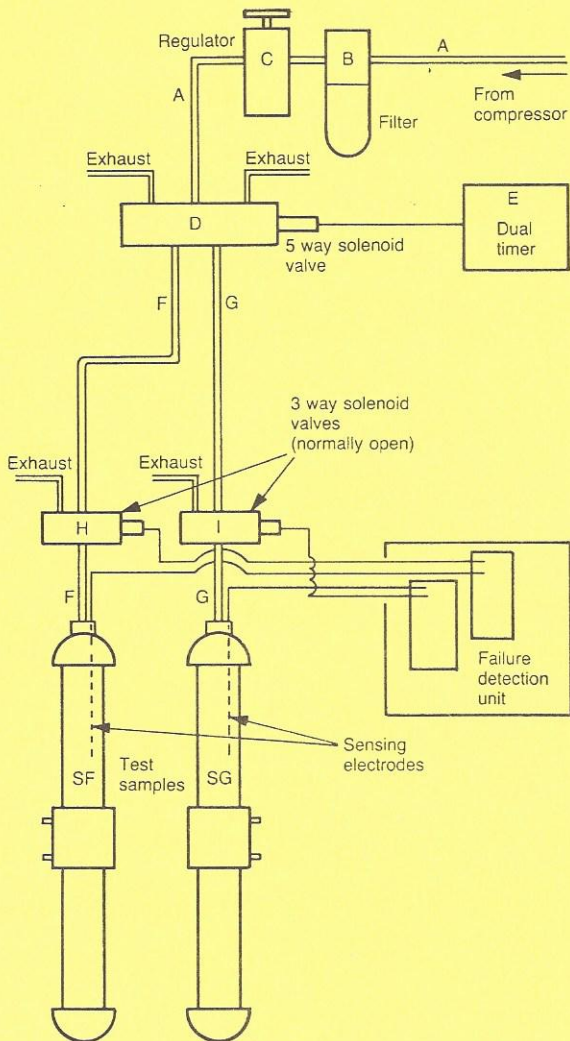


Figure 3 Typical pneumatic equipment

D.5 REPORT

The report shall include:

- (a) date of the test,
- (b) identification of the sample,
- (c) type of fitting (Type 1 or Type 2),
- (d) test temperature,
- (e) maximum test pressure,
- (f) number of test cycles achieved.

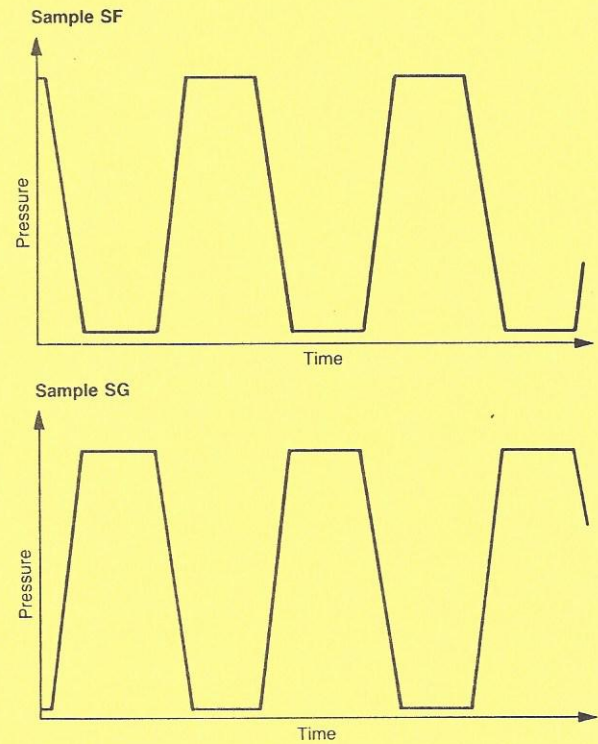


Figure 4 Schematic presentation of internal pressure changes using one test point connected to two samples