



**Estate Strategy & Policy Directorate  
Policy Instruction**

**Construction Policy**

17/05/04

Number 16/2004

<b>Subject:</b>	Defence Works Functional Standard Specification 036 Heating, hot and cold water, steam and gas installations for buildings etc. Amended Section Four - Distribution Installation to incorporate Alternative Pipework Technology.
<b>To be read by:</b>	Top Level Budget Holders, Chief Executives, Commanding Officers, Directors, Heads of Establishments, Property Managers, Project Managers, Project Sponsors and other Managers with responsibility for design, specification, installation, operation and maintenance of Heating, hot and cold water, steam and gas installations for buildings etc.
<b>When it takes effect:</b>	Immediately
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**The aim of this Instruction is to inform staff of Alternative Pipework Technology for buildings.**

**This Instruction updates and supersedes section 4 (Distribution Installation) of Defence Works Functional Standard Specification 036- Heating, hot and cold water, steam and gas installations for buildings**

**The final page of this PI shows where changes are made.**

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<b>17/2004</b>	VAT charges for sport and physical recreation
<b>16/2004</b>	Not Yet Issued
<b>15/2004</b>	Changes to Part 2 of the Landlord and Tenant Act 1954 - Contracting-Out and Other Changes
<b>14/2004</b>	Not Yet Issued
<b>13/2004</b>	Clawback - New Standard Clause & Guidance
<b>12/2004</b>	High Voltage 11kV Electricity Distribution Equipment: Brush Switchgear Oil Circuit Breaker R8/2 Mk 4 - Suspension of normal operational practice
<b>11/2004</b>	Code of Practice for the Installation of Telecommunications Equipment on Government Buildings
<b>10/2004</b>	High Voltage 11kV Electricity Distribution Equipment: Merlin Gerin Genie SF6 - Suspension of normal operational practice
<b>09/2004</b>	High Voltage 11kV Electricity Distribution Equipment: Reyrolle YMV2 Circuit Breakers - Suspension of normal operational practice
<b>08/2004</b>	Countryside Agency Issued 'Land Managers Guidance Pack'
<b>07/2004</b>	Attendance at Local Access Forums established under Part V of the Countryside and Rights of Way Act 2000.
<b>06/2004</b>	MQE Sale Dilapidation Claims- Residual Current Devices (RCDS)
<b>05/2004</b>	Audit and Monitoring of MOD Safety Rules and Procedures
<b>04/2004</b>	Authorising Engineer and Authorised Person appointment procedures
<b>03/2004</b>	Nuffield Trust for the Forces of the Crown Super Grant Projects
<b>02/2004</b>	Independent Review of Public Sector Relocation- Requirement for Treasury Approval to Property Decisions within London/South East
<b>01/2004</b>	Alternative Dispute Resolution (ADR)

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Section Four - Distribution Installation

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4.1 TUBES AND PIPES

- 4.1.1 Tubes and pipes used for LTHW, MTHW, HTHW, steam, condensate, DHWS and cold water services, shall be as indicated in Table 4A.
- 4.1.2 Tubes and pipes used for natural gas, LPG, oil fuel and fire protection services, shall be as indicated in Table 4B.
- 4.1.3 Additionally, where permitted by Particular Specification or other authority, thin-wall tubes to EN 10305-3, BS EN ISO 1127 and DVGW GW 392 or equivalents in every respect may be used for applications as indicated.
- 4.1.4 Steel pipework shall be ungalvanised with the exception of the following, which are required to be galvanised:
- a) Drain pipework.
  - b) Vent pipework.
  - c) Overflow pipework.
  - d) DHWS pipework as indicated.
  - e) Cold Water Service pipework.
  - f) LPG pipework (where indicated).
  - g) Fire protection system pipework (where indicated).
- 4.1.5 Pipework designated as ‘concealed’ in Tables 2 and 3 shall include all pipework in chases, ducts, service shafts, partitions, ceiling voids, floors etc. It shall not include short lengths of pipework passing through the building structure.
- 4.1.6 Pipe ‘risers’ used for natural gas services inside multi-storey buildings (buildings more than 5 storeys and over 20m high) shall not exceed DN100 and shall be mild steel to BS 1387 or carbon steel to BS EN 10216-1 and BS EN 10217-1 of wall thickness as indicated.
- 4.1.7 Polyethylene tubes for natural gas or LPG services shall be for below ground application only, and shall not be exposed to daylight or to ultra-violet light sources during transit and storage.

4.2 PIPEWORK JOINTS AND FITTINGS

4.2.1 ALTERNATIVE [TECHNOLOGY] JOINTING SYSTEMS

**4.2.1.1 Push-fit Systems**

Push-fit joints are suitable for copper, copper alloy and light-gauge stainless steel tubes, (and also cross-linked polyethylene [Pex] barrier pipe) and for polybutylene (PB).

Purpose-made push-fit jointing fittings, valves, and expansion devices of DZR copper alloy material shall incorporate factory-fitted plastics seals at each opening, and grab-ring retainers to prevent tube withdrawal when in normal service.

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Designated fittings shall be used with light gauge stainless steel tubes.

Provision shall be made to permit joint disassembly, and subsequent re-use, by use of a dedicated tool.

Tubes sizes 10mm to 54mm inclusive may be jointed by this method.

Fittings shall not be spaced more closely together than tabulated by the manufacturer and tubes shall be truly aligned with fittings.

“Cold-draw” techniques in relation to provisions for thermal expansion shall not be used.

Push-fit joints shall not be used for natural gas nor waste services.

Where electrical continuity is required, the correct fittings to provide this facility shall be selected.

Manufacturers’ guarantees shall be 25 years minimum against manufacturing defects for fittings.

Grab-ring release tools for push-fit joints shall be provided to a scale of one per 25 installed joints and handed to the PM on Practical Completion.

#### **4.2.1.2 Press-fit Systems**

Press-fit joints are suitable for tubes of copper, copper alloy, light-gauge stainless steel, thin walled galvanised and thin wall PP-coated carbon steel, “Supersize” Cr-Ni (heating installations), stainless and galvanised steel to BS EN 1057, BS EN 10312, DIN 2394, BS EN ISO 1127, and BS EN 10305.

Purpose-made press-fit jointing fittings shall incorporate factory-fitted seal rings within a circumferential profile.

The joint shall be accomplished by use of a jawed circumferential crimping tool or a similar tool utilizing press slings.

Tube sizes 12mm to 108mm may be jointed by this method, sizes 42mm to 108mm joints being accomplished by the additional use of press slings.

System operating temperatures and pressures shall be commensurate with the seal ring material.

Connections to equipment items shall be accomplished with threaded or flanged press-fit conversion fittings.

Copper tube and copper alloy fittings shall be protected from exposure to ammonia-bearing atmospheres.

Stainless steel tube and fittings shall be protected from contact with chlorides.

Water treatment regimes shall be to the tube/fittings manufacturers’ approvals.

Only press-fit tools which will not operate with an incorrectly set-up joint and/or inadequate power supply, and will not disengage until the joint is completed, shall be used.

#### **4.2.1.3 Preparation and Procedures**

Operatives shall have documentary proof of adequate and sufficient training by the joint system manufacturer, and shall also be fully experienced in the layout, arrangement and installation of traditionally jointed systems. Account shall be taken of the overall dimensions of fittings in order to achieve neat and economic installations.

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Pipe for push-fit and press-fit jointing shall be prepared fully in accordance with the published instructions of the jointing systems fittings manufacturers including the neat removal of any plastics coatings to pipes. Pipe and jointing fittings within a system shall be fully compatible. A complete system shall be of one manufacturers' supply only.

Procedures shall be adopted to ensure that all joints are successfully made and fluid-tight. A checking regime shall be set up at site to ensure that all joints are properly completed and documented before systems are filled and pressure-tested.

Tools shall be regularly cleaned and otherwise maintained to the manufacturers' published instructions.

Piping support provisions shall comply with the manufacturers' requirements.

All systems shall be leakage tested on completion.

The Installer shall be responsible for any cost and delay resulting from incorrect off-site assemblies (where used) requiring modifications, or on-site modification to completed work to suit.

#### **4.2.1.4 Other Limitations**

Press-fit joints shall not be made within 300mm of brazed (or welded) joints (tube possibly annealed).

Brazed (or welded) joints shall not be made into push- or press-fit jointed systems to ensure that the plastics seals are not affected by heat.

Stainless steel pipe shall not be directly connected to galvanised pipe. Non-ferrous connectors shall be interposed.

#### **4.2.2 LTHW and MTHW Systems**

4.2.2.1 Joints on galvanised pipework to BS 1387 shall be screwed.

4.2.2.2 The following LTHW pipework joints shall be welded:

- a) Concealed pipework.
- b) Pipework over DN 100.
- c) LTHW systems connected to MTHW injection sets.

All other LTHW pipework may have screwed or welded joints or, where permitted by Particular Specification or other authority, press-fit jointing may be employed.

#### **4.2.3 MTHW Systems**

4.2.3.1 All MTHW pipework joints shall be welded.

#### **4.2.4 LTHW and MTHW Systems**

4.2.4.1 Where screwed joints are allowed, the male component shall be taper threaded to BS 21/ISO 7-1 and the jointing between them shall be PTFE tape to BS 7786 unless otherwise indicated.

4.2.4.2 Threaded fittings shall be malleable cast iron, banded or beaded pattern, manufactured in accordance with BS 143& 1256 and BS EN 10242, galvanised to match associated piping as necessary.

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4.2.4.3 Butt welding pipe fittings shall comply with BS EN 10253-1.

4.2.4.4 Flanges for steel pipework shall be forged steel. Headers shall be of flanged steel tube with flanges welded on. Spare outlets shall be blanked with bolted flanges.

4.2.4.5 At dismantling points and where the pipework is connected to an appliance, spherical seated unions shall be used for pipework up to DN 50, and flanges shall be used for pipework DN 65 and above.

4.2.4.6 Flanges shall be raised face to BS EN 1092-1 with bolting to BS EN 1515-1 . Exceptionally, where flanged connections are made to existing equipment having flanges of Imperial sizes, the flange shall be flat faced to BS 10, Table A for LTHW systems, and Table D for MTHW systems, appropriate to the temperature and working pressure.

4.2.4.7 Where flanged connections are made to copper alloy valves, with flat faced flanges to BS EN 1092-3, the raised face of the mating flange shall be removed and the resulting machined surface shall comply with the tolerances quoted in BS EN 1092-3.

4.2.4.8 Metric bolts of the correct diameter shall be used with flanges to BS 10. Where Imperial bolts are unobtainable for use with existing Imperial flanges, Metric bolts shall be used as follows:

Bolt Hole Diameter (Inches)

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9/16	5/8	11/16	3/4	13/16	7/8	1
						15/16

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Metric Bolt (M)

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12*	14	16	18	18*	20*	22	24
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Where bolts are marked thus \* washers shall be fitted under the bolt heads and nuts.

4.2.4.9 Flanged joints shall be made with gaskets to BS EN 1514-1, or BS 3063 as appropriate. They shall be of a grade and thickness suitable for the temperature, pressure and operating conditions of the service and shall be approved by the PM.

4.2.4.10 Proprietary grooved pipe jointing systems using elastomeric seal rings may be used up to a maximum temperature of 95 °C and a maximum pressure of 9.5 bar with the approval of the PM. These shall be suitable for the temperature, pressure and operating conditions of the service. Manufacturer’s recommendations on pipe wall thickness, methods of groove forming, groove dimensions, seal materials and limiting operational loads shall be followed. Piping ends shall be within the recommended tolerances and shall be free from burrs and distortion.

**4.2.5 HTHW Systems**

4.2.5.1 Where galvanised pipework is used (to the direction of clause 4.1.4) the joints shall be screwed. Thin wall tube shall not be used.

4.2.5.2 Joints in pipelines and at fittings shall be welded. Butt-welding pipe fittings shall comply with BS EN 10253-1.

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4.2.5.3 Steel welding neck or slip-on boss flanges shall be used for connections to valves and at dismantling points.

4.2.5.4 Flanges shall be raised face and suitable for the operating temperature and pressure selected (from the appropriate tables) in BS EN 1092-1 with bolting to BS EN 1515-1. Exceptionally, where flange connections are made to existing equipment having flanges of Imperial sizes, the connecting flange shall be flat faced to BS 10 Table E.

4.2.5.5 Where appropriate there shall be compliance with Clauses 4.2.4.7 and 4.2.4.8.

4.2.5.6 Flanged joints shall be made with gaskets inside the bolt circle to BS EN 1514-1, or BS 3063 as appropriate. They shall be of a grade and thickness suitable for the temperature, pressure and operating conditions of the service and shall be approved by the PM.

### **4.2.6 Steam Systems**

4.2.6.1 Joints in steam pipework up to DN50 conveying steam at up to 3.5 bar and not concealed (Clause 4.1.5) may be either welded, or have taper threads as Clause 4.2.4.1. All other joints shall be welded.

4.2.6.2 Threaded fittings shall be malleable cast iron to BS 143&1256 and BS EN 10242 or wrought steel to BS EN 10241.

4.2.6.3 Butt-welding pipe fittings shall comply with BS EN 10253-1.

4.2.6.4 At dismantling points and where pipework is connected to an appliance, bronze seated malleable iron unions shall be used on pipework up to DN50 conveying steam at up to 3.5 bar. All other connections shall be flanged.

4.2.6.5 Flanges shall be suitable for the operating temperature and pressure and shall comply with Clauses 4.2.4.7, 4.2.4.8, 4.2.5.3, 4.2.5.4 and 4.2.5.6 as appropriate.

### **4.2.7 Condensate Systems**

4.2.7.1 Joints in steel condensate pipework shall comply with Clauses 4.2.6.1 to 4.2.6.5 as appropriate.

4.2.7.2 Joints in copper condensate pipework shall be made with compression fittings to BS EN 1254-2 or by brazing with fittings to BS EN 1254-1 or -5. Screwed joints may be used with the prior approval of the PM outside buildings or where several fittings are installed closely together in the condensate system.

4.2.7.3 Threaded fittings in copper pipework shall be of copper alloy to BS 143 & BS 1256 and shall be threaded to BS 61. Unions or flanges may be used for connecting to traps, strainers and other items of plant and equipment.

4.2.7.4 Flanges for copper pipework shall be of composite type to BS EN 1092-3 comprising copper alloy inserts brazed to the tube with loose steel locking rings. Flange connections shall comply with Clause 4.2.4.8 and 4.2.4.9 as appropriate.

### **4.2.8 DHWS Systems**

4.2.8.1 Stainless steel, copper or galvanised steel with stainless steel or copper dead-legs as indicated shall be used.

4.2.8.2 Joints on galvanised pipework to BS 1387 shall be screwed, except at dismantling points where they shall be flanged.

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4.2.8.3 Fittings for copper pipework up to and including DN50 shall be of the capillary or compression type to BS EN 1254-1 and -2. Capillary fittings shall be either lead-free solder ring or end feed type as indicated. Lead free solder shall be used on all hot and cold water service systems. Fittings shall be resistant to dezincification where recommended by the Water Company and as approved by the PM. Joints over DN50 shall be brazed or flanged as Clause 4.2.7.4.

Approved push-fit joint systems and approved press-fit joint systems (for copper alloy and thin-wall grade 316 stainless steel tubes) may be used where permitted by Particular Specification or other authority within the project. Push-fit joints may also be used with cross-linked PE barrier pipe where this pipe is permitted.

4.2.8.4 Pipework shall be arranged to allow easy dismantling. Dismantling points in copper pipework up to and including DN50 shall be unions, otherwise they shall be flanged.

4.2.8.5 Where internal cold water services distribution does not form part of the Works, the DHWS system shall terminate within 450mm of each sanitary fitting or range of appliances.

#### **4.2.9 Cold Water Services**

4.2.9.1 These shall be stainless steel, polythene, PVC, other plastics, copper or galvanised steel as indicated.

4.2.9.2 Copper systems shall comply with Clauses 4.2.8.3 and 4.2.8.4.

4.2.9.3 Fittings for stainless steel pipe shall be stainless steel capillary or compression types or push- or press-fit as indicated. Socket length of capillary type straight couplings shall be to BS EN 1254-1 and -2. Compression, push- and press-fit fittings shall be of grade 316 stainless steel.

4.2.9.4 Polyethylene and PVC, or other approved plastics pipes, shall have compression fittings to BS EN 1254-3 or solvent welded fittings to BS EN 1452-1 to -5. Where approved by the PM, mechanical joints to BS EN 1452, or joints entirely suitable for ABS or PB pipework may be used.

4.2.9.5 For tube sizes 10mm to 54mm approved push-fit joint systems and approved press-fit joint systems (for copper alloy and thin-wall stainless steel tubes) may be used where permitted by Particular Specification or other authority within the project. Push-fit joints may also be used with cross-linked PE barrier pipe or polybutylene pipe where these are permitted.

4.2.9.6 Galvanised steel systems shall comply with Clause 4.2.82.

4.2.9.7 Where internal cold water services distribution does not form part of the Works, the CWS system shall terminate within 450mm of each sanitary fitting or range of appliances.

4.2.9.8 Cleaning and sterilisation shall be carried out as specified in Section 12, Clauses 12.3.7 and 12.3.8.

#### **4.2.10 Natural Gas Services**

4.2.10.1 Installation, pipework, joints and fittings shall be in accordance with IGE Utilization Procedures IGE/UP/2.

4.2.10.2 Where pipework is to be buried in the ground, the Contractor shall mark out the position of the trenches to be excavated and shall indicate where concrete is required for pipe supports. The trench shall provide a minimum cover of 750mm. Where a common excavation is made for gas pipes and electric cables, a minimum clearance of 300mm shall be maintained between the two services. Depending on the nature of the subsoil, and where required by the PM, the gas pipes shall be bedded and covered with soft sand to a thickness as indicated.

4.2.10.3 Steel pipework buried in the ground shall be protected against corrosion as indicated.



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4.2.10.4 Iron pipework shall be slung and sounded before laying. An approved plunger or disc stopper shall be drawn through the pipework as the work proceeds.

4.2.10.5 Within buildings the Contractor shall arrange for dismantling points at intervals not exceeding 24m and at such other points as required by the PM. For this purpose unions shall be used on pipework up to DN50, and flanges on pipework DN65 and above.

4.2.10.6 A minimum clearance of 150mm shall be maintained between gas pipes and electric cables, conduits etc, in all internal installations and above ground external installations.

4.2.10.7 Pipes shall be laid to a fall of not less than 1 in 240.

4.2.10.8 Push-fit joints shall not be used in natural gas systems.

4.2.10.9 Press-fit joints may be used provided seal rings based on acrylonitrile butadiene rubber (NBR) are included in the joint assembly for tube sizes 15mm to 108mm

### **4.2.11 LPG Vapour Distribution Systems**

4.2.11.1 Pipework shall be steel, PE tube or copper.

4.2.11.2 Joints in steel pipework DN50 and under shall be welded, flanged or screwed. Joints in steel pipework DN65 and above shall be welded or flanged.

4.2.11.3 Joints in copper pipework shall be either compression type, silver soldered or brazed.

4.2.11.4 Joints in polyethylene tube shall be made with clamped or compression fittings complying with Clause 4.2.8.7 or may be fusion jointed to British Gas Corporation Standard Specification BGC/PS/PL2.

4.2.11.5 Fittings for steel pipes shall be of steel. Flanges shall be suitable for the temperature and pressure (as selected from the appropriate tables) of BS EN 1092-1 and bolting to BS EN 1515-1, or from BS 10 when connection is made to existing equipment having flanges of Imperial sizes. Bolting shall be to BS 4882 and BS EN 1515-1. Flange connections shall comply with Clauses 4.2.4.7, 4.2.4.8 and 4.2.4.9 as appropriate. Butt welding fittings shall be to BS EN 10253-1. Socket welding and threaded fittings shall be to BS 3799.

4.2.11.6 Fittings for copper pipes shall be of copper, forged brass or gunmetal to BS EN 1254 or BS 2051-1. Compression fittings shall only be used in accessible positions.

4.2.11.7 Fittings for polyethylene tube shall be of gunmetal resistant to dezincification to British Gas Corporation Standard Specifications BGC/PS/PL2 and BGC/PS/PL3.

4.2.11.8 The requirements of Clauses 4.2.10.2, 4.2.10.3, 4.2.10.6 and 4.2.10.7 shall apply as appropriate.

### **4.2.12 Oil Fuel Systems**

4.2.12.1 Steel pipework shall have welded joints using butt welding fittings to BS EN 10253-1. Joints and fittings for copper pipework shall be silver soldered or brazed and comply with Clause and 4.2.8.3, as appropriate. Soft solder fittings shall not be used and compression fittings shall only be used where required to facilitate dismantling. Galvanised pipework shall not be used.

4.2.12.2 Protection of external buried steel pipework shall be as indicated. Where indicated a non-corrodible secondary containment system shall be provided in accordance with National Rivers Authority requirements.

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### **4.2.13 Fire Protection Systems**

4.2.13.1 Fire protection systems shall comply with BS 5306-1 (with BS EN 671), and BS EN 12845 as appropriate.

4.2.13.2 Fittings used within galvanised pipework shall be galvanised.

4.2.13.3 Where joints and fittings are threaded they shall comply with Clauses 4.2.4.1. and 4.2.4.2.

4.2.13.4 Proprietary grooved pipe jointing systems shall comply with the requirements of Clause 4.2.4.10.

4.2.13.5 Fittings to which Fire Brigade connections will be made shall comply with the requirements of the Fire Fighting Authority.

### **4.3 WELDING**

4.3.1 Unless otherwise indicated steel pipework complying with BS 1387 or BS EN 10216-1 and 10217-1 with diameters, and wall thicknesses, not exceeding DN200 and 20mm respectively shall be welded in accordance with the recommendations in HVCA/JIB Recommended Practice and Tests for Competency 1990 (Formerly known as TR/5), as modified below. Steel pipes of larger diameters and greater thicknesses shall be welded in accordance with BS 2971, BS 2640, or other specifications as indicated or approved by the PM.

4.3.2 Joint designs, welding procedures, welder certification and production weld quality shall comply with the requirements as interpreted by the appointed Inspection Body: see Section 12.

4.3.3 Unless otherwise indicated joint designs, welding procedures and welders' competency tests shall be as described in the Recommended Practice and Tests. Prior approval shall be obtained to the installation of gusseted bends.

4.3.4 Welders shall hold current certificates of competency validated by the appointed Inspection Body, or similar approved body. Welders without validated current certificates shall undertake the relevant standard tests, witnessed and certified by the appointed Inspection Body before commencing work. Welders with validated certificates who lack relevant welding work experience in the preceding 3 months, and other welders as directed by the PM, shall undertake the relevant tests witnessed and certified by the appointed Inspection Body before commencing work.

4.3.5 Welders shall permanently identify each of their welds with their own marker which will withstand site conditions without damaging system or component performance. Methods of marking shall be approved.

4.3.6 Welds in unconcealed LTHW and fire protection system pipework shall be visually inspected to BS EN 970, and copies of the records shall be given to the PM. Welds will be checked by the appointed Inspection Body at the time the pipework is pressure tested. Where the appointed Inspection Body is not satisfied, the welds shall be subjected to the non-destructive testing procedures described in Clause 4.3.7.

4.3.7 Unless otherwise indicated welds in MTHW, HTHW, steam and gas pipework, and in LTHW pipework which is to be concealed, shall be subjected to a programme of non-destructive testing in accordance with the relevant Standards. The method of testing shall be ultrasonic or radiographic in accordance with BS EN 1714 or BS EN 1435 respectively, as approved by the PM. Tests shall be carried out by certified competent persons recognised by the appointed Inspection Body. Copies of the test reports shall be given to the appointed Inspection Body and the PM to permit full consideration whilst the relevant welds remain exposed. The NDT programme shall include:

a) testing one of the first 5 production welds made by each welder.

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- b) testing 10% of the subsequent production welds made by each welder.
- c) in the event of finding a faulty weld, at the discretion of the PM, the testing of a further 2 welds made by the relevant welder.

4.3.8 The welds to be tested in compliance with Clause 4.3.7 shall be randomly selected by the PM.

4.3.9 Welds found to be defective shall be rectified to a standard complying with BS Class II welding specifications to the satisfaction of the appointed Inspection Body. At the discretion of the PM, rectification work shall be carried out by different welders. Welders with failure rates considered excessive by the appointed Inspection Body shall be taken off the Works at the discretion of the PM.

#### **4.4 BRAZING**

4.4.1 Copper pipework up to DN200 with wall thicknesses up to 4.5mm shall be brazed in accordance with the recommendations in HVCA/JIB Recommended Practice and Tests for Competency 1990 (Formerly known as TR/3), as modified below. For other pipe sizes and wall thicknesses, brazing shall be carried out in accordance with BS 1723-1, or other specification as indicated or approved by the PM. Testing shall be to BS EN 12797 and BS EN 12799.

4.4.2 Joint designs, brazing procedures, brazer certification and production joint quality shall comply with the requirements as interpreted by the appointed Inspection Body see clause 12.1.1. Section 12.

4.4.3 Unless otherwise indicated or approved filler metal shall be AG2 to BS EN 10441845.

4.4.4 Brazing procedures shall include auxiliary heating for pipe sizes DN75 and larger, for solid copper flanges, and in other circumstances where exposure weather, wall thickness etc, indicate sound joints will not be otherwise assured.

4.4.5 Brazers shall hold a valid certificate of competency issued by the appointed Inspection Body or similar approved body. Unless otherwise indicated the Code of Practice TR/3 standard test piece will be the accepted test of competency. Brazers without valid certificates and those without relevant brazing work experience within the preceding three months shall undertake the TR/3 test, witnessed and certified by the appointed Inspection Body, before commencing work.

4.4.6 Brazers shall permanently identify each of their joints with their own marker which will withstand site conditions without damaging system or component performance. Methods of marking shall be approved.

4.4.7 A proportion of the joints made by each brazer each day shall be cut out and subjected to destructive testing under the supervision of the appointed Inspection Body. In the event of finding a faulty joint a further 2 joints made by the relevant brazer shall be cut out and tested. Joints shall be selected for test at the discretion of the PM up to the numbers as indicated. Cutting out and consequential repair works shall be carried out by the contractor at his expense.

4.4.8 Visual examination and non-destructive testing of joints will be carried out by the appointed Inspection Body during the system pressure tests. The test criteria shall be those stated in Code of Practice TR/3.

4.4.9 At the discretion of the PM rectification work on faulty joints shall be carried out by different brazers. Brazers with failure rates considered excessive by the appointed Inspection Body shall be taken off the Works at the discretion of the PM.

#### **4.5 ANCILLARY EQUIPMENT**

##### **4.5.1 Pipework Supports**

## **Amendment to SPEC 36 Section Four - Distribution Installation**

4.5.1.1 Pipework shall be supported adequately in such a manner as to permit free movement due to thermal expansion and contraction. Pipework supports shall be arranged as near as possible to joints, and the spacings shall not exceed those given in Tables 4 and 5. Where pipes are thermally insulated the insulation shall be carried through the support. Where there are two or more sizes of pipes, the common support spacings shall be those required by the smallest bore pipework. Supports for natural gas pipework shall comply with the requirements of IGE Utilization Procedures IGE/UP/2.

4.5.1.2 Plastic pipework shall be continuously supported as far as possible. Where this is impracticable the spacings of the supports shall not exceed those indicated in the appropriate tables in BSCP 312: Parts 2 and 3.

4.5.1.3 Branches from vertical pipework shall not be used as a means of support for risers.

4.5.1.4 Brackets for mild steel pipework shall be mild steel or malleable iron with ferrous fixings. Brackets for copper pipework shall be brass or gunmetal with non-ferrous fixings. Stainless steel pipework shall be separated from all galvanised metals, with dielectric material where necessary.

4.5.1.5 Where pipework up to 50mm size is fixed to solid walls, brackets may be of the screw-on or long shank built-in type, except where the walls are plastered when only the long shank built-in type shall be used. For fixing to woodwork and lightweight partitions or walls, brackets shall be screw-on pattern and may be adjustable two-piece type. The detachable part of a pipe clip shall be capable of removal without disturbance of the fixing or adjacent pipes. Allowance shall be made in the support for the thickness of thermal insulation where required. Cast-iron and steel spigot and socket pipework shall be supported at each joint on mild steel angle or tee brackets embedded not less than 115mm into walls. Pipework shall be secured to the brackets by 'U' bolts or mild steel stirrup bolts.

4.5.1.6 Brackets screwed to walls shall be secured by expanding plugs or other purpose designed fixing devices; wooden plugs will not be accepted.

4.5.1.7 Pipework subject to expansion and contraction and hung from supports shall be suspended on swivel hangers unless otherwise approved.

4.5.1.8 Hangers for horizontal pipework at high level shall be adjustable mild steel supported from mild steel angle or channel sections, supplied by the Contractor, suitable for building-in or otherwise securing to the structure by the Building Contractor. Welding to the structure shall not be undertaken without the prior approval of the PM. Pipe rings shall be of malleable cast-iron or fabricated steel, made in halves and secured by bolts or screws. Alternatively, malleable iron hinged pipe rings may be used. Calliper hooks will not be accepted. Proprietary pipework suspension systems may be used with the approval of the PM.

4.5.1.9 Where pipework is fitted in ducts or trenches, or where DN65 or greater, supports shall be of the type indicated. Allowance shall be made for thermal insulation to be applied to the requirements of Section 10. Load-bearing insulation at supports shall be fitted by the Contractor at the time of erecting the pipework (see Clause 10.3.5).

### **4.5.2 Anchors**

4.5.2.1 On mild steel pipework, mild steel anchors capable of resisting the maximum stresses shall be provided and preferably shall be welded to the pipework. Where it is not practicable to weld the anchors to the pipework, cast-iron chairs with at least two wrought-iron stirrup bolts shall be used, the bolts to have sufficient thread to ensure an effective grip on the pipe.

4.5.2.2 For copper pipework the anchors shall be provided by wide copper straps secured to the pipework in such a manner that the pipe is not damaged.

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4.5.2.3 The Contractor shall supply, and fix in position ready for building-in, all cleats, brackets and steelwork required for anchor points.

4.5.2.4 Steelwork in trenches or ducts to which anchors are attached shall be hot-dip galvanised. Anchors shall have two coats of aluminum paint.

4.5.2.5 Fixed supports shall not be located at press-fit fittings positions.

### **4.5.3 Expansion Devices**

4.5.3.1 Provision for movement due to thermal expansion and contraction shall be made by changes in direction of the pipework, by loops or by special expansion joints approved by the PM. Measures shall be taken to prevent the movement of pipework causing damage to thermal insulation. Supports and guides shall be arranged to ensure that movement is taken up as intended. Where pipework is required to be pre-stressed, the extent of the cold pull shall be as indicated (see also clause 4.2.2 paragraph 5. Fixing bolts for flanged joints shall not be used for taking up cold pull allowance.

4.5.3.2 Expansion joints may be of the articulated or axial type as indicated and have screwed or flanged ends as appropriate. Internal liners shall be incorporated if required, manufactured from a corrosion-resistant steel, or other approved material appropriate to the duty, and designed to withstand the test pressure of the system. Expansion joints shall be capable of not less than 2000 complete cycles of movement over the designed working range.

4.5.3.3 Expansion joints for angular movements shall be provided with tie rods or hinges to take end thrust, and shall comply in general with Clause 4.5.1.1.

4.5.3.4 Expansion joints shall be provided with external protection against damage where indicated. The method of protection shall be approved by the PM.

4.5.3.5 Expansion joints shall be installed so that they are not subjected to stresses other than those for which designed. Installation shall ensure joints are in the free position at a temperature midway between the high and low limits of normal service.

4.5.3.6 Expansion joints shall have guides to ensure that all movements are taken up in the designed manner. Expansion joints shall be installed in accordance with the manufacturer's recommendations. On completion of installation and before heat is applied to the system the Contractor shall obtain certification that the installation is in accordance with the manufacturers' instructions. Guides shall be rigidly secured and allow freedom of movement for pipe expansion without excessive clearance. Lubrication points shall be provided where necessary.

### **4.5.4 Air Venting**

4.5.4.1 Devices for air release shall be provided at all high points.

4.5.4.2 Air bottles for LTHW systems shall be made from DN50 tube approximately 230mm long fitted with a cap and size 3/8 air cock; these shall be fitted to equal tees or have DN50 connections if the main is larger than DN50. Where an air bottle is fixed out of reach a DN10 extension tube shall be run from the cap to within 1.5m of the floor, terminating with a size 3/8 needle-seated globe valve or air cock.

4.5.4.3 Air bottles for MTHW and HTHW systems shall be of welded construction. On pipework up to and including DN80 each bottle shall be manufactured from DN50 tube 300mm long with a cap. Air bottles on pipework DN100 and over shall be manufactured from DN100 tube each 380mm long with a cap. All air bottles shall be complete with DN15 tube from the top brought down to within 1.5m of the floor and fitted with a DN15 lockable flanged globe valve. The open ended outlet pipe from the valve shall discharge at a

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position approved by the PM.

4.5.4.4 Automatic air vents, suitable for the system temperature and pressure, shall be used only where indicated and have malleable iron, nodular iron, gunmetal or brass bodies, as indicated, with non-ferrous or stainless steel floats and guides and non-corrodible valves and seats. Each air vent shall have a lock-shield valve. Air release pipes shall be run to discharge at the nearest suitable visible safe point.

4.5.4.5 Air vent and air release pipes installed where freezing is likely to occur shall be insulated.

#### **4.5.5 Emptying Down, Draining and Flushing**

4.5.5.1 Steel pipework from drain valves or cocks shall be galvanised.

4.5.5.2 Drain valves or cocks shall be lockable except where prohibited by the Water Company.

4.5.5.3 In addition to the requirements of clauses 4.5.5.4 and 4.6.12, for emptying purposes, 15mm minimum size drain cocks or valves, with hose connections, shall be fitted at all low points of LTHW, MTHW, DHWS and cold water systems.

4.5.5.4 Where a pipe dips under a door into an accessible floor chase a 15mm plugged outlet shall be fitted to LTHW, MTHW, DHWS and cold water systems.

4.5.5.5 For HTHW systems, drain points with flanged valves of the sizes indicated shall be installed at all low points. Valves shall be lockable needle-seated globe type.

4.5.5.6 In LTHW, MTHW and HTHW systems, where indicated, facilities shall be included to permit pre-commissioning cleaning of pipework. These facilities shall include the following:

a) In systems, where pipework sizes are DN40 to DN200 inclusive (other than those in which boiler flow and return headers are fitted with spare blanked connections), a flushing connection shall be fitted to the common flow from the boiler(s) and the common return to the boiler(s). These connections shall be of the same size as the largest pipe size of any sub-circuit. Additionally, at intervals not exceeding 100m, an isolating valve immediately preceded by a drain valve, shall be included in all the circuit pipework. The drain valves shall be of the straight through lockable type and shall be line size for pipework up to DN40 and DN50 otherwise.

b) For pipework sizes exceeding DN200 provision shall be made for flexible or rigid lance water jetting. Flanged make-up pieces, three pipe diameters in length shall be fitted at intervals not exceeding 100m to facilitate access.

On completion of pre-commissioning cleaning, and before final filling, the flushing connections shall be blanked and the drain valves locked in the closed position.

4.5.5.7 Steam and condensate mains shall be graded to fall in the direction of flow unless indicated otherwise. The minimum gradient shall be 1 in 300. Drainage and relay points shall be provided at the lowest points in the mains. Drainage points and scale pockets shall consist of a short length of vertical tube extending downwards from a tee on the main. The diameter of the tube and the connection shall be not less than DN50 or the same diameter as the main. Pockets up to and including DN80 shall be not less than 230mm long and terminate in a screwed cap. Pockets DN100 and above shall be not less than 300mm long and shall be flanged. The drainage connection shall be taken from approximately one-third up from the bottom of the pocket to a strainer and steam trap set.

#### **4.6 GENERAL**

4.6.1 Unless otherwise indicated steel and copper pipework systems shall be designed and installed in accordance with BS EN 13480 or BS 1306 as relevant.

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4.6.2 Where any of the services referred to in this section require the connection of differently sized items, the Contractor shall be responsible for providing and installing the adaptors.

4.6.3 Joints shall not be made in the thickness of any wall, floor or ceiling, and pipework shall not be embedded in the structure of floors unless approved by the PM. Where pipework passes through walls, floors or ceilings, sleeves shall be provided. Pipework passing through floors shall be provided with approved floor and ceiling plates fastened securely to the pipe. The sleeves shall be of the same material as the pipe. Where a piped service penetrates a structure which is a fire barrier with a designated fire delay characteristic to BS 476: Part 22, the sleeve shall provide a fire stop to comply with the Building Regulations.

4.6.4 Fittings shall be of the same size as the tubes and pipes to which they are connected. Exceptionally where a fitting having the required outlet is not of standard manufacture, the necessary size reduction may be accomplished by the use of one bush for each connection.

4.6.5 Unless otherwise indicated, malleable fittings to BS 143 & 1256 shall be used as follows:

- a) Elbows to ISO Code A1 shall be used in preference to bends to ISO Code D1.
- b) Tees to ISO Code B1 shall be used in preference to pitcher tees to ISO Code E1.

4.6.6 Pipework shall follow the contours of walls. The clearance between pipework, fittings, lagging or flanges, and the wall or any other fixtures, shall be not less than 25mm.

4.6.7 Purpose-made bends or springs may be used where it is necessary to deviate from a straight run in non-galvanised pipework. In galvanised pipework deviations shall be formed from standard fittings.

4.6.8 Bends or springs in tubes of DN50 and above shall be hot pulled and the tubes shall remain circular after being set.

4.6.9 Eccentric reducing sockets (ISO Code M3) shall be used where changes of bore are made in runs of nominally horizontal pipework to facilitate air venting and draining.

4.6.10 Before pipework is assembled, the Contractor shall ensure that tubes and tube ends are free from burrs and cutting dross. Tube ends shall be cleaned thoroughly of dirt, rust, scale, paint, oil, etc (see also Clause 12.3.1). Open ends left during the progress of work shall be closed temporarily with purpose-made metal, plastics or wood plugs or caps, or blank metal flanges.

4.6.11 Entry and exit holes for pipework services from buildings shall be sealed and plugged. For service conditions below 60°C the sealant shall be mastic compound; above this temperature the sealant shall be silicone rubber. Where pipework enters a building through a duct or hole which is considered by the PM to be too large for such treatment, a mild steel blanking plate not less than 6mm thickness shall be built into the walls of the duct or hole. The service pipes shall pass through clearance sleeves (not less than 4 diameters in length) welded into the blanking plate. Annular spaces between pipes and sockets shall be sealed and plugged as above.

4.6.12 Return headers, where indicated, shall be welded with flanged connections and ends. Circuit isolating valves shall be connected direct to a vertical flanged stub on the top of the return header. On the circuit side of the isolating valve a tee shall be fitted with a vertical thermometer in the top reduced outlet. Each circuit return shall have an emptying pipe connected and extended to a drain cock or valve below the level of the header. Headers shall be horizontal and thermometers, drain valves and circuit isolating valves shall each be arranged at common horizontal levels.

4.6.13 Flow headers where indicated shall be welded with flanged connections and ends, and installed to prevent undue stresses on the boilers and the connections.

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4.6.14 Unless otherwise indicated both flow and return headers shall be provided with one spare flanged connection. These connections shall be of sizes not less than the largest circuit connections to the headers and they shall be sealed with blank flanges (see also Clause 4.5.5.6).

4.6.15 Metallic pipework systems shall be bonded to BS 7671:2001 and BS 7430:1998 (Code of practice for earthing) see Clauses 11.7.1 and 11.7.2.

**4.7 BELOW GROUND DISTRIBUTION PIPEWORK**

4.7.1 Below-ground distribution pipework shall comply with the following as indicated:

a) DE (ex PSA) Standard Specification (M&E) No. 168: Thermally Insulated Underground Piping Systems for the Conveyance of Steam, Hot and Chilled Water.

b) BS 7572 and BS EN 13941 - Code of practice for thermally insulated underground piping systems.

c) BS EN 253:2003 - Preinsulated bonded pipe systems for underground hot water networks.

d) BS EN 448:1995 - Preinsulated bonded pipe systems for underground hot water networks. Fittings assemblies of steel service pipes, PU thermal insulation and outer casing of high-density polyethylene.

e) BS EN 488:2003 - Preinsulated bonded pipe systems for underground hot water networks. Steel valve assembly of steel service pipes, PU thermal insulation and outer casing of polyethylene.

f) BS EN 489:2003 - Preinsulated bonded pipe systems for underground hot water networks. Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.

**4.8 THE ENVIRONMENTAL AGENCY (FORMERLY NRA) REQUIREMENTS**

4.8.1 The requirements of the Agency in respect of double-wall pipe systems shall be met as applicable to the particular installation. Outer casings shall be of non-corrodible material.

4.8.2 Oil storage tanks installed underground shall be double-skinned with GRP or plastics outer skin and interstitial leak detection system incorporated where deemed necessary by the Agency.

4.8.3 The foregoing requirements shall apply to installations within Source Protection Zones. All installations shall conform to those recommended in Agency Publications 2,5,8,15 and 19.

4.8.4 The Agency shall be consulted prior to start of installation of any buried oil pipeline or storage tank to establish final local requirements.

4.8.5 Plantroom and boiler room discharge water arrangements shall comply with PPG 15.



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**TABLE 4A** SELECTION TABLE FOR TUBES AND PIPES FOR LTHW, MTHW, HTHW, STEAM, CONDENSATE, DHWS AND CWS INSTALLATIONS

Material	Limitations	BS	LTHW/MTHW				HTHW & Steam		Condensate		DHWS		CWS	
			□125mm		*Con	150 to 300 mm	□125 mm	150 to 300 mm	□125 mm	150 to 300 mm	20 and 40mm threaded pipe	Other sizes	20 and 40mm threaded pipe	Other sizes
			Exposed	Other sizes										
Mild Steel	Galvanised as stated in Section 4.1	1387 medium		✓								✓		✓
		1387 heavy	✓		✓		✓		✓		✓		✓	
Carbon Steel	Wall thickness as indicated	EN 10216-1	✓	✓	✓	✓	✓	✓	✓	✓				
		EN 10217-1	✓	✓	✓	✓	✓	✓	✓	✓				
Copper	Working pressure □7 bar compression joints	EN 12449							✓	✓				
	Working pressure □7 bar screwed joints	EN 12449							✓	✓				
	Working pressure >7 bar compression joints	EN 12449 6							✓	✓				
	Working pressure >7 bar screwed joints	EN 12449							✓	✓				
	(R250)	EN1057										✓		✓
	Up to 22mm final connections	EN1057		✓										
	(R250)	EN1057										✓		✓
Poly-ethylene	Class as indicated	EN 562 and 12201												✓
PVC	Class as indicated	EN 1052-1 to -5												✓
Stainless Steel		EN 10312										✓		✓

\* Concealed. See Clause 4.1.4

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**TABLE 4B SELECTION TABLE FOR TUBES AND PIPES FOR NATURAL GAS, LPG, OIL FUEL AND FIRE PROTECTION INSTALLATIONS**

Material	Specification	Natural Gas			LPG Vapour Distribution			Oil Fuel Services				Fire Protection Systems	
		Outside Bldgs	Inside Bldgs		Outside Bldgs	Inside Bldgs		Filling, Vent & Drain Pipes		Feed Pipes	*Concealed	20 and 40mm threaded pipe	Other sizes
			20 and 40mm threaded pipe	Other sizes		□15mm	>15mm	20 and 40mm threaded pipe	Other sizes				
Ductile Iron	Spigot and socket to BS EN 545, 596, and 969	✓											
Ductile Iron	Flanged to BS EN 545, 596, and 969	✓											
Mild Steel	BS 1387 Medium see Clause 4.1.3			✓		✓			✓	✓			✓
Mild Steel	BS 1387 Heavy see Clause 4.1.3	✓	✓		✓	✓		✓			✓	✓	
Carbon Steel	BS EN 10217-1 - Wall thickness as indicated	✓		✓	✓	✓	✓	✓					
Copper	BS EN 1057			X		✓				X			
Poly-ethylene	# Wall thickness to SDR 11	✓			✓								

Notes

- # British Gas Corporation Standard Specification BGC/PS/PL2 Part 1 metric series
- \* Concealed. See Clause 4.1.5
- X Less than 42mm size only

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**TABLE 4C INTERVALS BETWEEN SUPPORT CENTRES FOR STEEL PIPEWORK**

Size of tube mm	Horizontal runs		Vertical runs bare or lagged m
	Bare m	Lagged m	
15	1.8	1.8	2.4
20	2.4	2.4	3.0
25	2.4	2.4	3.0
32	2.7	2.4	3.0
40	3.0	2.4	3.7
50	3.0	2.4	3.7
65	3.7	3.0	4.6
80	3.7	3.0	4.6
100	4.0	3.0	4.6
125	4.5	3.7	5.5
150	5.5	4.5	5.5
200	8.5	6.0	8.5
250	9.0	6.5	9.0
300	10.0	7.0	10.0

**TABLE 4D** INTERVALS BETWEEN SUPPORT CENTRES FOR COPPER PIPEWORK AND LIGHTGAUGE STAINLESS STEEL UP TO 54MM.

Size of tube mm	Horizontal runs		Vertical runs bare or lagged m
	Bare m	Lagged m	
15	1.2	1.2	1.8
22	1.2	1.2	1.8
28	1.8	1.5	2.4
35	2.4	1.8	3.0
42	2.4	1.8	3.0
54	2.7	1.8	3.0
65	3.0	2.4	3.7
76	3.0	2.4	3.7
108	3.0	2.4	3.7
133	3.7	3.0	3.7
159	4.5	3.7	3.7

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The effect of PI 16/2004 on Spec 36 Section 4 is to change the following sub paragraphs

Note: Occurrence of “as indicated” / “where indicated”.

Previous Version

PI 16/2004

4.1.1	4.1.1
4.1.2	4.1.2
4.1.4(d)	4.1.3(d)
4.1.4(f)	4.1.3(f)
4.1.4(g)	4.1.3(g)
4.1.6	4.1.5
4.2.4.1	4.2.1
4.2.8.1	4.2.6.1
4.2.8.3	4.2.6.3
4.2.9.1	4.2.7.1
4.2.10.2	4.2.8.2
4.2.10.3	4.2.8.3
4.2.12.2	4.2.10,2
4.3.1 (last line)	4.3.1
4.4.1	4.4.1
4.4.7	4.4.7
4.5.3.1	4.3.5.1
4.5.3.2	4.3.5.2
4.5.4.4	4.5.4.4
4.7.1	4.7.1
Table 4A (line 2; line 10; line 11)	SAME
Table 4B (line 5).	SAME