

English Version

Gas supply - Gas pipework for buildings - Maximum operating pressure less than or equal to 5 bar - Functional recommendations

Alimentation en gaz - Tuyauteries de gaz pour les bâtiments - Pression maximale de service inférieure ou égale à 5 bar - Recommandations fonctionnelles

Gasversorgung - Gasleitungsanlagen für Gebäude - Maximal zulässiger Betriebsdruck kleiner oder gleich 5 bar - Funktionale Empfehlungen

This European Standard was approved by CEN on 30 June 2007.

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Foreword

This document (EN 1775:2007) has been prepared by Technical Committee CEN/TC 234 "Gas supply", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

This document supersedes EN 1775:1998.

The CEN/TC 234 functional standards specify the common appropriate principles and the recognised practices concerning design, construction, operation and maintenance, all for the safety and integrity of gas supply systems, taking the form of general recommendations and/or requirements.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This functional standard is to be used as a reference standard in codes of practice in CEN member countries. These codes of practice also need to take account of regulations made by the municipal, regional or national authorities in each country to design and construct gas installations for buildings.

At the time this standard was prepared, new pipe materials and jointing techniques were being developed or are already authorized for use in some member countries. Any requirements additional to the requirements of this standard put in place in member countries shall be identified in CEN/TR 13737. It is important to ensure that designers and installation operatives are trained in the correct methods of application for each system as prepared by its supplier/manufacturer.

This standard contains general recommendations for the safety of persons, animals and property and the protection of their environment.

The recommendations in this standard are intended to be applied by competent persons who have suitable knowledge and experience.

This standard does not consider contractual agreements, qualifications or authorizations imposed by gas distribution system operators, LPG suppliers or public authorities upon companies who design, construct or work on gas installations.

1 Scope

1.1 This standard specifies general recommendations for the design, construction, testing, commissioning, operation and maintenance of installation pipework; pipework between the delivery point of the gas and the inlet connection to the gas appliance.

This standard specifies common basic principles for gas installation pipework.

Users of this European standard need to be aware that more detailed national standards and/or codes of practice may exist in the CEN member countries.

This standard is intended to be applied in association with these national standards and/or codes of practice setting out the above mentioned basic principles.

In the event of conflicts in terms of more restrictive requirements in national legislation/regulation with the requirements of this standard, national legislation/regulation takes precedence as illustrated in CEN /TR 13737.

NOTE 1 CEN/TR 13737 contains:

- clarification of relevant legislation/regulations applicable in a country;
- if appropriate, more restrictive national requirements;
- national contact point for the latest information.

This standard applies to:

- gas installations in residential, commercial and public access building having a maximum operating pressure (MOP) less than or equal to 5 bar;
- industrial gas installations having a maximum operating pressure (MOP) less than or equal to 0,5 bar.

NOTE 2 For industrial gas installations having a MOP above 0,5 bar, or installations having a MOP above 5 bar, see prEN 15001-1.

This standard is applicable to new installation pipework as well as to replacements of, or extensions to, existing installation pipework.

This standard does not contain detailed recommendations relating to the laying of buried pipework.

NOTE 3 For more information on buried pipework, see EN 12007-1, EN 12007-2 and EN 12007-3.

NOTE 4 For more information on gas pressure regulating installations, see EN 12279.

NOTE 5 For more information on gas metering systems, see EN 1776.

1.2 This standard is applicable to installation pipework supplied from gas distribution systems and from liquefied petroleum gases (LPG) storage vessels.

Excluded are:

- single appliance LPG installations without fixed pipework, achieved by a flexible appliance connector from an adjacent LPG storage cylinder.
- LPG storage vessels.

1.3 In this standard the term 'gas' refers to combustible gases, which are gaseous at 15 °C and 1 013,25 mbar. These gases, odorized for safety reasons, are commonly referred to as manufactured gas, natural gas or liquefied petroleum gases (LPG). They are also referred to as first, second or third family gases (see EN 437).

In this standard, all pressures are gauge pressures, unless otherwise stated.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 331, *Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings*

EN 437, *Test gases — Test pressures — Appliance categories*

EN 751-1, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 1: Anaerobic jointing compounds*

EN 751-2, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 2: Non-hardening jointing compounds*

EN 751-3, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes*

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

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

EN 1762, *Rubber hoses and hose assemblies for liquefied petroleum gas LPG (liquid or gaseous phase) and natural gas up to 25 bar (2,5 Mpa) — Specification*

prEN 1763, *Flexible rubber and plastics hoses, tubing, coupling tails and assemblies for use with propane and butane in the vapour phase — Requirements*

EN 10226-1, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads — Dimensions, tolerances and designation*

EN 10226-2, *Pipe threads where pressure tight joints are made on the threads — Part 2: Taper external threads and taper internal threads — Dimensions, tolerances and designation*

EN 10242, *Threaded pipe fitting in malleable cast iron*

EN 14291, *Foam producing solutions for leak detection on gas installations*

EN 14800, *Corrugated safety metal hose assemblies for the connection of domestic appliances using gaseous fuels*

3 Terms and definitions

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

3.1 Definitions relating to pressures

3.1.1

design pressure

pressure on which design calculations are based

3.1.2

operating pressure (OP)

pressure which occurs within the pipework under normal operating conditions

3.1.3

maximum operating pressure (MOP)

maximum pressure at that pipework can be operated under normal operating conditions

3.1.4

maximum incidental pressure (MIP)

maximum pressure that pipework can experience during a short time, limited by the safety devices

3.1.5

tightness test pressure (TTP)

pressure applied to pipework during tightness testing

3.1.6

strength test pressure (STP)

pressure applied to pipework during strength testing

3.2 Definitions relating to the gas installation

3.2.1

pipework

assembly of pipes and fittings

NOTE Fittings include, for example, means of isolation, valves, regulators, meters.

3.2.2

point of delivery

point of a gas network where the gas is transferred to the user

NOTE 1 This can be at a means of isolation (e.g. at the outlet of a LPG storage vessel) or at a meter connection.

NOTE 2 For this standard, the point of delivery is typically nominated by the distribution system operator and may be defined in National Regulations or Codes of Practice.

3.2.3

installation pipework

pipework downstream of the point of delivery, terminating at the appliance inlet connection

NOTE This pipework is normally the property of the customer.

3.2.4

pliable corrugated tubing

corrugated tubing capable of being easily bent by hand a limited number of times, which can be covered with a tubular outer sheath by the manufacturer at the time of production

3.2.5

service line

pipework from the main to the delivery point of the gas into the installation pipework

3.2.6

riser

section of vertical installation pipework that is taller than one floor of a building

3.2.7

lateral

section of generally horizontal installation pipework

3.2.8

ventilated space

space where the air is continuously changed by natural or mechanical means

3.2.9

duct

space specifically designed and constructed for the passage of building services

EXAMPLE Building services include gas pipework, water systems, power and telecommunication cables.

3.2.10

equipotential bond

means of ensuring that metallic gas pipework and other metallic parts of the building are at the same electrical potential

NOTE For safety reasons, this equipotential bonding is connected to the ground.

3.2.11

residential building

building which contains one or more dwelling areas but excludes areas principally intended for professional activities and locations accessible to the public

3.2.12

public access building

building principally containing areas where the public can be admitted.

EXAMPLE Such a building can be a school, hospital, movie theatre, railway station or a shop.

NOTE The public may not be given access to all parts of the building (e.g. operating theatres of a hospital, etc.).

3.2.13

commercial building

building containing, with the exception of industrial production plants, only areas reserved for professional activities

EXAMPLE Such a building can be an office block or a repair workshop.

3.2.14

high rise building

building in which the height from the floor of the highest occupied level to ground level is:

- for a residential building greater than 50 m;
- other buildings greater than 30 m

NOTE The design considerations relate to the use of the building and the vertical height of the sections of pipework.

3.3 Definitions relating to means of isolation

3.3.1

means of isolation

device intended to interrupt the gas flow in pipework

EXAMPLE This device can be a manually operable valve.

3.3.2

appliance means of isolation

means of isolation intended to isolate an appliance

3.4 Definitions relating to jointing methods

3.4.1

joint

means of connecting elements of a gas installation

3.4.2

threaded joint

joint in which gas tightness is achieved by metal to metal contact within threads with the assistance of a sealant

3.4.3

mechanical joint

joint in which gas tightness is achieved by compression with or without a seal and which can be disassembled and reassembled.

NOTE A compression joint is a mechanical joint which is not normally intended to be disassembled and reassembled.

3.4.4 Definitions for pressed joints

3.4.4.1

pressed joint

joint in which tightness is achieved by using an appropriate tool for either compressing a fitting to form the joint or expanding a pipe to enable forming the joint

NOTE Such a joint cannot be disassembled and reused.

3.4.4.2

pressed joint for copper pipe

pressed joint whose jointing is carried out by a radial deformation of the end of a fitting body onto a tube and whose sealing is carried out by an elastomeric o-ring.

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

NOTE 2 The press tool includes a press machine and a set of jaws or collars

3.4.4.3

pressed joint for multilayer or PEX pipe

pressed joint whose jointing is carried out by the insertion of a fitting body fitting inside a tube end followed by the mechanical compression of the tube onto the fitting body.

NOTE This jointing method can be achieved either by expansion followed by the radial compression of the tube onto the fitting body thanks to the memory effect of PEX materials or, by the axial or radial pressing of a sleeve onto the external wall of the tube. Sealing can require the use of elastomeric o-rings.

3.4.5

electrofusion joint

joint formed between polyethylene components using fittings which have an integrated electric heating element

3.4.6

butt fusion joint

joint formed between polyethylene components where the two pipe ends are heated and brought together to be fused directly without using a separate fitting or filler material

3.5 Definitions relating to fittings

3.5.1

regulator

device that reduces the gas pressure to a set value and maintains it within prescribed limits

3.5.2

meter

device for measuring a volume of gas or a quantity of energy

3.5.3

flexible appliance connector

element of flexible pipework to be fitted between the end of the fixed pipework and the appliance inlet connection

3.5.4

insulating joint

fitting installed to electrically interrupt one section of pipework from another

3.5.5

sleeve

protective pipe through which a gas pipe passes

3.5.6**siphon**

receptacle connected to the lowest part of a section of pipework in which liquids are collected for removal

3.5.7**reverse flow protection system**

security device which activates when reverse flow of gases occurs

3.5.8**vent pipe**

pipe connected to a safety or control device to release gas to a safe location

3.6 Definitions relating to tests**3.6.1****strength test**

specific procedure to verify that the pipework meets the requirements for mechanical strength

3.6.2**tightness test**

specific procedure to verify that the pipework meets the requirements for tightness

3.6.3**fitness test**

simple test to verify that gas can be admitted or re-admitted to the pipework

NOTE This test is normally carried out at operating pressure by appropriate means (rotation of a meter dial, leak detection fluid, measuring apparatus, etc.).

3.6.4**leak detection fluid**

specially formulated fluid and foaming product that gives a clear indication that a leak exists when applied to a element of pressurized pipework

3.7 Definitions relating to commissioning, operation and maintenance**3.7.1****admission of gas**

operation of replacing the air or inert gas contained in pipework with distributed gas

3.7.2**purging**

operation of safely removing gas (normally air or inert gas) from pipework and replacing it with distributed gas, or the reverse process

3.7.3**commissioning**

activities performed to put a gas installation into operation

3.7.4**competent person**

person who is trained, experienced and approved to perform activities relating to gas supply systems or installation pipework

NOTE Means of approval, if any, will be determined within each country

3.7.5**authorized person**

competent person who is appointed to fulfil a given task on pipework

3.8 Definitions relating to assembling processes

3.8.1 Definitions for welding

3.8.1.1

welding

union of two or more parts by heat or pressure or a combination of both, such that the materials form a continuity. A filler metal having a melting point similar to that of the materials to be welded may be used

3.8.1.2

fusion welding

welding involving localized melting without application of force and with or without the addition of filler metal

3.8.1.3

arc welding

fusion welding in which heat for welding is obtained from an electric arc

3.8.1.4

gas welding

fusion welding in which the heat for welding is produced by the combustion of a fuel with oxygen gas

3.8.1.5

oxy-acetylene welding

gas welding in which the fuel gas is acetylene

3.8.2 Definitions for soldering and brazing

3.8.2.1

soldering and brazing

operations in which metal parts are joined by means of capillary action of a filler metal in the liquid state with a melting temperature lower than that of the parts to be joined and wetting the parent metal(s), which does not participate in the making of the joint

3.8.2.2

brazing / hard soldering

jointing by means of capillary action of a filler metal having a melting (liquidus) temperature higher than 450 °C

3.8.2.3

soldering / soft soldering

jointing by means of capillary action of a filler metal having a melting (liquidus) temperature lower than 450 °C

4 Design

4.1 General

4.1.1 Any person who is responsible for the design of gas pipework shall be a competent person.

4.1.2 The pipework designer shall provide detailed information on the design and location of the pipework to the persons responsible for the construction.

4.1.3 Installation pipework should be designed to be supplied from only one point of delivery. In exceptional cases, where installation pipework could be supplied by more than one point of delivery, a controlling system or an operating procedure shall be put in place to ensure that only one point of delivery is active at any time.

4.1.4 The pipework shall be designed and constructed to enable testing and purging to be carried out.

4.1.5 The choice of materials for pipework shall reflect the requirements of 4.3 for location, 4.4 for protection in case of fire, and when necessary 4.6 for safety devices.

4.1.6 All metallic parts of the pipework other than cathodically protected or electrically isolated systems shall

be at the same electrical potential.

NOTE Equipotential bonding may be subject to national regulations.

4.1.7 Particular attention shall be paid to the design of pipework and selection of materials in areas known to be susceptible to ground movement, for example caused by mine working or seismic disturbances.

4.1.8 Pipework including joints and seals shall be designed to be in accordance with the expected lifetime of the building or to the first expected renovation period of the pipework.

NOTE A period of at least 50 years is often used as a guide.

4.1.9 Pipework shall be designed and constructed to facilitate maintenance.

4.2 Selection of components

4.2.1 Pipework components shall conform to the appropriate European or national standard for gas applications for buildings-

Copper pipes shall comply with EN 1057. The minimum wall thickness of copper pipes shall be suitable for the jointing method chosen.

4.2.2 The pipework components shall be appropriate for:

— types of gases being distributed;

NOTE Particular attention should be given to hydrogen sulphide, water content, dust content and water/hydrocarbon dew point which can require adapted materials, drainage of low points and filtration.

— pipework design pressure;

— location of the pipework;

— pipework temperature under normal operating conditions;

— potentially corrosive environments.

4.2.3 Regulators and meters shall be suitable for the range of flow rates and pressures that will occur during use.

4.2.4 The type, number and strength of pipework supports shall be appropriate for the pipework materials.

NOTE The wall thickness and material, jointing methods and pressure test procedure can also affect the requirements for spacing and strength of supports.

4.3 Location

4.3.1 The location of the pipework shall minimize the risk of damage caused by e.g. mechanical impact, UV exposure, accelerated corrosion, chemical attack, extreme temperatures, lightning ... or additional safety measures shall be applied. See also 4.4 and 4.6.

4.3.2 The route and location of externally buried pipework or pipework built within the internal structure shall be such that third party damage is minimized and that any ground or building movement cannot lead to failure.

4.3.3 The route of pipework in buildings should preferably be located in ventilated spaces.

The ventilation shall be adequate to safely dilute any small gas leak taking due account of the density of the gas (heavier than air e.g. LPG or lighter than air e.g. natural gas).

Where it is not possible to achieve adequate ventilation, other solutions shall be applied, e.g. ventilated sleeves or ducts, pipes which are all welded, all brazed or joint-free, or the filling of the space around the pipe with inert materials, etc.

4.3.4 The route of the pipework shall be as short as practicable and the number of joints kept to a minimum.

The use of diagonal routes should always be avoided.

Where pipework is concealed, particular attention shall be given to the mode of construction and corrosion protection of the pipework.

4.3.5 The position of the pipework in relation to other services shall be such that it can function properly and be used with safety.

Pipework shall not be located near to high voltage conductors or hot or chilled water systems nor subjected to vibrations unless appropriate precautions are taken.

NOTE Spaces reserved for other uses, such as lift shafts, garbage chutes, transformers, sewage pipes and bomb shelters, should be avoided unless specific precautions are taken.

4.3.6 Where temperature change and building movements can lead to significant stresses on pipework, adequate provisions shall be made for moving the pipework.

4.3.7 The effects of lightning shall be taken into consideration when designing the pipework.

4.3.8 Where the distributed gas is wet or has a low vapour pressure, pipework shall be protected against frost and/or condensation and siphons shall be fitted at low points.

4.4 Protection in case of fire

The designer shall consider the possibility of an outbreak of fire within a building containing installation pipework, that may cause damage to the fabric of the building and consequently or separately to the installation pipework.

The design objective shall be to minimize the likelihood of an explosion, or serious aggravation of the fire.

The design objective can be achieved for example by the use of one or more of the following:

- accessible manual means of isolation,
- automatic means of isolation,
- use of materials, components and joints that withstand high temperatures,
- location of all or part of the pipework in an enclosure providing protection in the event of fire,
- coating pipework with a protective material to enable the pipework to withstand high temperatures for a given period of time.

NOTE 1 Reference should be made to the national legislation/regulation.

NOTE 2 Annex A gives, as examples, two procedures (A & B) for tests on components of pipework and their jointing for resistance to high temperatures.

4.5 Sizing

4.5.1 Gas pipework shall be sized so that the pressure at the inlet of all appliances is compatible with their safe and effective operation. The pressure at the inlet of gas appliances, which conform to the Gas Appliance Directive, shall remain within the limits prescribed in EN 437.

NOTE Account should be taken of the maximum flow rate together with any foreseeable increase in the load. The maximum flow rate for sizing the pipework is not necessarily equal to the total gas flows to all appliances.

4.5.2 The gas velocity in the pipework shall not have a significant effect on the pipework, for example by erosion, nor shall it cause a nuisance due to noise.

Where high gas velocities exist, consideration shall be given to gas filtration, the choice of erosion resistant materials and protection against the transmission of noise.

4.5.3 When designing the pipework and when choosing meters and regulators, allowance shall be made for effects produced by the start up and shut down of the appliances (e.g. sudden pressure and flow variations).

4.5.4 Consideration shall be given to the change in pressure due to the height of the building, in particular for low pressure pipework.

NOTE The following formula can be used:

$$\Delta p = K (1 - d) \Delta H \quad (1)$$

where

K is equal to 0,123 millibars per metre;

Δp is the pressure change due to altitude, in millibars;

ΔH is the altitude change, in metres (negative when pipe leads to lower level);

d is the density of gas relative to air (dimensionless).

4.5.5 The operation of gas appliances and machinery (for example compressors) shall not adversely affect the safe operation of the pipework and regulators or the accuracy of the meter system.

4.5.6 Billing meters, meter by-passes and regulators shall be chosen by agreement with the gas supplier/distribution system operator/LPG supplier.

4.6 Safety devices

4.6.1 Where a pressure relief valve is fitted, this gas shall be vented to a safe location, usually outside the building.

NOTE Safety devices may be incorporated within regulators.

If a vent pipe is fitted, it shall be dimensioned so as not to impair the safe operation of the safety device.

The termination of vent pipes shall be protected against the ingress of foreign substances (such as dust, water, soil, snow).

4.6.2 The pipework shall be designed so that air, oxygen or other gases used in conjunction with the combustible gas cannot enter the pipework. This can require the use of a reverse flow protection system.

4.6.3 Where required by risk assessment, specific additional protection shall be installed to protect against the consequence of failure of any component within the pipework.

NOTE This may be a safety device (for example one that protects against excess temperatures or excess flow) or a passive protection measure (e.g. enclosure of the pipework).

The number, location and sizing of excess flow device(s) shall be assessed and should be optimised during design to allow such a device to actuate when a failure of a pipework component occurs and to cope with the locally allowed pressure drop values. This process shall rely on accurate pressure drop values given by system/component manufacturers e.g. in design specification recommendations.

5 Construction

5.1 Installation

5.1.1 Any person who constructs gas pipework shall be a competent person.

5.1.2 The construction of the gas pipework installation shall follow the design objectives of clause 4.

5.1.3 During the construction of pipework care shall be taken to prevent the ingress of foreign matter (e.g. dirt, water, flux, swarf, thread cutting oil) into the pipework. Foreign matter which has entered the pipework shall be removed.

NOTE Thread cutting oil can affect thread sealants.

5.1.4 Open ends of pipework and valve outlets shall be sealed with appropriate fittings.

5.1.5 Pipework installed above ground shall be suitably supported. (see 4.2.4).

5.1.6 Pipework shall be protected against damage (see 4.3.1).

5.1.7 External above ground metallic pipework shall be protected against the effects of lightning where appropriate.

5.1.8 When an insulating joint is fitted in order to electrically isolate the pipework inside the building from the buried pipework, it shall not be fitted in the buried section of pipework.

5.1.9 All metallic pipework shall be electrically continuous or at the same electrical potential. (see 4.1.6).

NOTE Equipotential bonding may be subject to national regulations.

5.1.10 Where pipework can be confused with other pipework in the vicinity, which might lead to danger, it shall be identified, in accordance with a recognized specification or standard.

NOTE The colour yellow typically identifies gas pipework.

5.1.11 Pipework shall be installed so that it does not impose excessive stresses on meters and other fittings and vice-versa.

5.1.12 Any new connection shall not impair the existing pipework.

NOTE 1 Welding, soldering or brazing should not be performed in close proximity to joints that rely on elastomeric seals for tightness or to polymeric pipes where the resulting heat can lead to failure unless suitable precautions have been taken.

NOTE 2 Annex B contains guidelines for the construction of joints.

5.2 Pipework jointing methods

5.2.1 Threaded joints

5.2.1.1 Threaded joints for pipework shall comply with EN 10226-1 or EN 10226-2.

NOTE The application of taper/taper threaded joints may be prohibited in some countries.

Threaded joints in steel pipes are only permitted up to and including DN 50.

5.2.1.2 Threaded joints shall not be made with thread forms conforming to different standards.

5.2.1.3 Threaded pipe fittings shall comply with EN 10242 (malleable cast iron), or EN 10241 (steel), or EN 1254-4 (copper and copper alloys).

5.2.1.4 Sealants shall comply with EN 751 parts 1 through 3. Sealants shall be used with threaded joints and shall be applied to threaded pipe joints in accordance with the sealant manufacturer's instructions. Sealants shall not be used for pipework that might be subjected to lower or higher temperatures than specified in the manufacturer's instructions.

NOTE The choice of sealant types may be limited in some countries.

5.2.2 Welded, brazed, soldered and fusion joints

Joints of this type shall only be performed by persons with a specific competence.

NOTE 1 Annex C contains guidelines on these jointing methods.

NOTE 2 Soldering may not be permitted in some countries.

5.2.3 Mechanical joints

5.2.3.1 Mechanical joints shall conform to the appropriate standards.

NOTE Such standards may be:

- EN 1555-3 for PE fittings;
- EN ISO 228-1 for threads;
- EN 1092-1, EN 1515-1 for flanges; and
- EN 1254-2 and EN 1254-3 for compression joints.

5.2.3.2 Mechanical joints should be located in ventilated (see 4.3.3) and accessible spaces.

5.2.3.3 Mechanical joints used in pipework shall be resistant to pipework forces e.g. tension, bending, torsion.

5.2.4 Pressed joints

5.2.4.1 General

5.2.4.1.1 Pressed joints shall conform to the appropriate standards.

5.2.4.1.2 Joints of this type shall only be performed by persons with a specific training.

5.2.4.1.3 Pressing shall be considered as a complete process for which the integrity of the completed joint relies upon the correct selection of pipe, fitting and its sealing 'O' ring or external sleeve, as well as upon the correct selection of the press tool and its related parts such as jaws or collars.

5.2.4.1.4 Pressed joints should be located in ventilated and accessible spaces.

5.2.4.1.5 Pressed joints used in pipework shall be resistant to pipework forces e.g. tension, bending, torsion.

NOTE Some countries may place a pressure limitation on the application of press fittings.

5.2.4.2 Pressed joints for copper pipe

5.2.4.2.1 The profile and the size of jaws or collars of a press tool shall be suitable for the profile and the size of the fitting to be pressed.

5.2.4.2.2 The press tool shall be such that once a pressing cycle has commenced, that cycle cannot be abandoned until the pressing cycle has been completed. Completion occurs when the jaws or collars of the press tool totally enclose the mouth of the fitting.

It is permitted for the cycle to be abandoned in an emergency for the safety of the installation operative.

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In the event of the cycle being abandoned before completion of the pressing action, the joint and fitting shall be discarded and the complete process repeated.

NOTE Annex D.1 contains guidelines on this jointing method (see also prEN 1254-7 and prEN 14905).

5.2.4.3 Pressed joints for multiplayer or PEX pipes

They shall conform to or be compatible with the complete system delivered by the manufacturer.

NOTE Annex D.2 contains guidelines on this jointing method.

5.2.5 Stainless steel pliable corrugated tubing system jointing

Joints of this type shall only be performed by persons with a specific training.

NOTE Annex E contains guidelines on this jointing method (see also EN 15266).

5.3 Entries through walls and floors

5.3.1 Gas pipework including any sleeves shall not impair the building's construction requirements, e.g. mechanical stability, fire resistance, thermal and sound insulation.

5.3.2 Sleeves shall be sealed to the structure of the building.

5.3.3 Pipes shall not be installed within wall cavities. Pipes passing through cavities in walls and floors shall be located within a sleeve of which at least one end is open (see also 4.3.3).

5.3.4 Pipes passing through floors or walls shall do so by the shortest route.

5.3.5 Sleeves shall be of a material which is resistant to corrosion and is impermeable to gas.

5.4 Corrosion

5.4.1 Metallic pipework shall, where necessary, be protected against corrosion.

NOTE Metallic pipework can be wrapped with a protective covering, painted or sheathed or, also, if buried can be fitted with cathodic protection, in which case reference should be made to EN 12007-1 and EN 12007-3. Galvanised pipes are permitted but might require additional protection.

5.4.2 Metallic pipework shall be coated or electrically insulated at points of contact with other metallic components where galvanic corrosion can take place.

5.5 Means of isolation

5.5.1 Manually operated ball valves and closed bottom taper plug valves up to DN50 shall comply with EN 331.

5.5.2 The on and off positions of all manually operated valves shall be clearly marked.

5.5.3 A means of isolation shall be located in an accessible position at or near to the point of entry of a gas pipe into a building. (see also 5.5.4)

In high rise buildings, this means of isolation shall be located in an accessible position in the pipework outside the building. For public access buildings or commercial buildings, installation of such a means shall be considered.

5.5.4 Means of isolation shall always be accessible, as applicable, to the gas distribution system operator, emergency services and the customer.

Measures shall be taken, as necessary, to discourage inappropriate use of the means of isolation.

5.5.5 Means of isolation should be fitted in pipework to enable all or sections of the pipework to be isolated when necessary.

NOTE Where a lateral supplies several risers a means of isolation should be fitted at the base of each riser. Where a riser supplies several laterals a means of isolation should be fitted at the start of each lateral.

5.5.6 Individual installation pipework systems shall be fitted with a means of isolation.

When a meter is fitted, this means of isolation shall be located upstream of that meter.

When a regulator is fitted upstream of the meter, this means of isolation shall be located upstream of that regulator.

5.5.7 Where confusion can be possible, individual means of isolation and meters shall be marked to permit identification of the installation pipework supplied.

5.5.8 It shall be possible to isolate each appliance inlet from the pipework.

5.5.9 Pipework shall be supported so that normal operation of means of isolation does not lead to excessive stresses on the pipework.

5.6 Regulators and meters

5.6.1 Meters and any associated correction devices shall be installed so as to ensure accurate measuring over their flow range.

5.6.2 Regulators and meters shall be installed in ventilated spaces and protected against corrosion, vibration, impact, variations in temperature and vandalism, which might damage them or cause malfunction.

When installed in communal parts inside high rise buildings, meters and regulators shall be:

- either resistant to high temperatures (see 4.4); or
- fitted in spaces which provide protection in the event of fire.

They can also be located outside the building.

5.6.3 The regulator and the meter shall be accessible.

5.6.4 The meter index shall be accessible for reading.

5.6.5 Billing meter by-passes shall only be installed as agreed with the gas distribution system operator.

5.6.6 Where required, the regulator system shall cause the gas flow to cease where the pressure at its outlet reaches a predetermined minimum value.

The regulator system shall be designed to prevent the downstream pressure from exceeding a predetermined maximum value.

This requirement does not apply to regulators where the inlet pressure is below or equal to 100 mbar.

5.7 Flexible appliance connectors

5.7.1 Flexible appliance connectors shall have permanently fitted end fittings.

Flexible appliance connectors shall comply with the appropriate standards as for example EN 14800, EN 1762 or prEN 1763.

This requirement does not apply to flexible connectors used for low gas rate appliances in laboratories, for example Bunsen burners.

5.7.2 Where an end fitting is designed to permit quick connection and disconnection of the flexible appliance connector, this fitting shall be self-sealing and shall prevent the release of gas from the upstream pipework.

This fitting shall be designed to prevent accidental disconnection and incorrect assembly.

6 Testing

6.1 General recommendations

6.1.1 New pipework, or any existing pipework that has been subjected to work as described in 8.5, shall be put into service, or put back into service only if the tests specified in clause 6 have been carried out successfully.

6.1.2 The tests shall be carried out on the whole pipework or on separate sections.

6.1.3 Before testing, all pipework open ends shall be sealed. Any leak tight device used to seal the pipework shall be capable of withstanding the test pressure.

In general, means of isolation in the closed position should not be assumed to be leak tight.

6.1.4 Tests shall be conducted by the authorized person identified as being responsible for their execution.

6.1.5 Tests carried out in accordance with clause 6 shall entail the preparation of a test report by the authorized person. This report shall enable the section of the pipework concerned to be clearly identified. It should detail the date, the type of tests performed, the readings measured (duration, pressure, temperature, etc.) and the results obtained.

6.1.6 In cases where the results of tests are negative, leaks shall be identified by appropriate means, for example, use of an appropriate leak detection fluid (See 8.4.3). Defective parts shall be replaced or repaired. After elimination of leaks the test shall be repeated until the results are positive.

NOTE For components made of stainless steel, the level of Cl⁻ in the leak detection fluid should be below 30 mg/l.

6.2 Recommendations relating to the safety of persons and property during testing

6.2.1 The test procedure shall not jeopardize the safety of persons and property.

6.2.2 Before testing, the authorized person shall have full knowledge of the pipework and shall verify the validity of information about the pipework. The authorized person shall ensure, or have certificates or documents attesting, that the pipework has been constructed in compliance with legal requirements and regulations in force, and in accordance with the design specifications.

6.2.3 Depending on the test pressure selected, the type of joint(s) used, and the location of the pipework, the person authorized to carry out tests with a fluid under pressure shall judge whether it is necessary to first carry out non-destructive tests.

6.2.4 If necessary, the authorized person should take measures to indicate that a test is in progress. Any area deemed to be dangerous shall be indicated and access prohibited.

6.2.5 The applied test pressure shall not exceed the pressure that the pipework can withstand.

If necessary, appliances shall be disconnected or isolated.

6.2.6 Any sudden increase in pressure within the pipework to be tested shall be avoided.

6.3 Test fluids

6.3.1 Fluids used

The test fluid shall be one of the following:

- air;
- inert gas (e.g. nitrogen);
- gas to be distributed (see 6.3.3).

6.3.2 Use of inert gas

When inert gas is used from a storage vessel under pressure, precautions shall be taken to ensure that the pressure inside the pipework does not exceed the specified test pressure.

6.3.3 Utilisation of the gas to be distributed

Where the use of air or inert gas is not practicable, it may be acceptable to use the gas to be distributed as a test fluid for tightness tests carried out at operating pressure, provided that all joints are easily accessible.

If the test is not immediately followed by commissioning of the pipework, the gas to be distributed shall be purged from the pipework which shall be sealed.

6.4 Test conditions

Test fluid temperature and atmospheric pressure can affect strength testing and tightness testing because of their effects on measured pressures. Variation in these parameters shall be taken into account in the assessment of the results of the tests.

6.5 Strength testing

6.5.1 When a strength test is to be performed, it shall be in accordance with 6.5.2 to 6.5.6.

6.5.2 The strength test pressure is a function of the MOP, as indicated in Table 1.

**Table 1 — Strength Test Pressure (STP)
as a function of the maximum operating pressure MOP**

MOP bar	STP bar
$2 < \text{MOP} \leq 5$	$> 1,40 \text{ MOP}$
$0,1 < \text{MOP} \leq 2$	$> 1,75 \text{ MOP}$
$\text{MOP} \leq 0,1$	$\geq 2,5 \text{ MOP}$

6.5.3 The strength test may be performed simultaneously with the tightness test, using the same fluid at the same pressure level.

6.5.4 If the strength test is not combined with the tightness test, the strength test shall precede it.

6.5.5 If the strength test is not combined with the tightness test, the duration of the strength test shall be to the time required to confirm, by appropriate means, that there has been no rupture in the pipework.

6.5.6 All fittings integral with the pipework, such as regulators, meters, means of isolation, safety devices, etc., which are not capable of withstanding the pressure selected for the test shall be removed prior to the test.

In this case either the fitting shall be replaced with a section of pipework, or parts of the pipework situated upstream and downstream of the removed component shall be sealed and tested separately.

Appliances shall be disconnected before the strength test is performed.

6.6 Tightness testing

6.6.1 All pipework mentioned in 6.1.1 shall be subjected to a tightness test.

6.6.2 The applied tightness test pressure shall be:

— at least equal to the operating pressure;

— not normally greater than 150 % of the MOP when the MOP is over 0,1 bar.

For pipework with an MOP below or equal to 0,1 bar, the tightness test pressure shall not be greater than 150 mbar.

6.6.3 The tightness test should be carried out in situ, with all joints easily accessible and free from any covering.

6.6.4 The tightness test shall not commence until the test fluid temperature has stabilised.

6.6.5 Absence of leaks shall be verified by the absence of a difference between the pressures measured at the start and completion of the test which cannot be explained by variations in fluid temperature, atmospheric pressure and ambient temperature during the test.

6.6.6 The pressure gauge used shall have a sensitivity suitable for the pressures to be measured.

6.6.7 For tests carried out on pipework of short length up to 3 joints which must be accessible, it is permissible to verify the absence of leaks by an appropriate means other than a pressure gauge.

6.6.8 The duration of the test shall be set by the authorized person responsible for the tests. It shall be greater than a minimum threshold compatible with:

- sensitivity of the pressure gauge used;
- volume of the pipework under test.

It shall be limited so as to reduce the effect of variations of fluid temperature, atmospheric pressure and ambient temperature on the difference between the pressures measured.

6.6.9 In certain cases, isolation of pipework being tightness tested can be achieved by a means of isolation in the closed position.

This means of isolation shall be gas tight at the test pressure.

Precautions shall be taken where necessary to prevent the back flow of air or inert gas into the pipework upstream of this means of isolation.

6.6.10 When the appliance inlet connection is not tested as part of the tightness test, a tightness test shall be performed on it when the appliance is installed (see 6.6.7).

6.7 Additional tests

During the admission of gas the authorized person shall carry out a fitness test to ensure the absence of leaks at joints between:

- sections of new pipework separately tested;
- sections of tested new pipework and sections of tested existing pipework to which they are connected.

7 Commissioning

7.1 General

7.1.1 Commissioning shall be carried out by an authorized person. The authorized person responsible for the installation and/or commissioning shall give instructions and the installation documents to the customer or the property owner.

The authorized person shall ensure, or shall obtain certificates or documents attesting, that the pipework has been constructed and tested according to clause 6, in compliance with legal requirements and regulations in force, and in accordance with the design specifications.

7.1.2 The authorized person shall clearly identify the pipework to be commissioned by means of a visual inspection or any other appropriate means.

7.1.3 If admission of gas does not immediately follow tightness testing, before proceeding with the admission of gas, the authorized person shall:

- ensure that all extremities of the pipework are sealed with appropriate fittings, or connected to appliances; and
- carry out a fitness test of the pipework.

7.1.4 Where site drawings have been provided by the designer, these shall be updated to reflect the as built situation before handing them over to the person responsible for the operation of the building.

7.1.5 Purging can necessitate the use of an inert gas. Purging procedures should take account of the volume and velocity of the purged gases and the mixing of gas and air.

7.2 Admission of gas

7.2.1 The admission of gas shall be supervised.

7.2.2 Purge gases shall be vented safely, preferably to the open air.

For small volumes the purge gases may be vented through a burner, e.g. a hotplate burner of a cooker. In this case there shall be permanent ventilation in the room, and it should be verified that the operation has finished, for example by lighting the burner.

For large volumes consideration should be given to the purge gases being flared off in the open air to reduce environmental emissions.

The content of vented gas should be verified, e.g. by measurement of gas concentration.

7.2.3 The duration of the operation shall be sufficient to ensure that the pipework contains the gas to be distributed.

7.2.4 Precautions shall be taken to prevent any accidental ignition of the purge gases.

7.2.5 When admitting gas to the pipework, the pressure rise shall be progressive.

7.2.6 The authorized person in charge of commissioning shall give operating instructions to the person (e.g. occupier or caretaker) who will operate the means of isolation which isolates the installation pipework.

If this operation necessitates the use of an operating handle, this handle shall be fitted to the means of isolation or made available to the person who will operate the means of isolation.

7.2.7 When the operating conditions specify that a means of isolation shall be in the open or closed position, the authorized person in charge of commissioning shall verify that measures designed to prevent the operation of the means of isolation by any non-authorized person have been taken.

7.2.8 If the appliances are not installed when gas is admitted to the pipework, the open ends of the pipework shall first be closed and sealed with (an) appropriate device(s).

7.2.9 If the appliances are installed when gas is admitted to the pipework, the appliances shall be commissioned at the same time unless precautions are taken to prevent their operation until commissioned.

8 Operation and maintenance

8.1 General

8.1.1 One person should be designated to be in charge of the operation of the pipework (or each part of it) from the time of its commissioning.

This person is referred to hereafter as "the person responsible for operation".

At a given moment and for any given pipework (or part of it) there should be only one person responsible for operation.

NOTE The gas distribution system operator can be responsible for the service line and meter / regulator installation; the customer or the property owner can be responsible for the installation pipework.

8.1.2 If maintenance is necessary, the person responsible for operation shall authorize only a competent person to perform work on pipework (see 8.5.1).

8.1.3 The person responsible for operation of the pipework shall, where appropriate (e.g. public access buildings, buildings with complex pipework installations), have descriptive information concerning its location, its nature and/or a plan of its layout kept up to date

8.1.4 For sensitive installation pipework, the person responsible for operation shall put in place a procedure which, in the event of an abnormal situation, e.g. gas leak or fire, takes effect with the minimum of delay. The procedure shall ensure the safety of people and property.

NOTE Sensitive installation pipework can include, for example, pipework for power plants, industrial boiler houses and hospitals.

8.1.5 The means of isolation shall remain identifiable and accessible at all times.

8.2 Maintenance

8.2.1 The maintenance of the pipework, from the time of its commissioning, should be the responsibility of the person responsible for its operation.

8.2.2 A maintenance schedule should be prepared especially for installation pipework of large diameter and/or high pressure.

The maintenance schedule shall include measures to be taken to ensure that the means of isolation are accessible and capable of being operated.

8.2.3 The maintenance of pipework including safety devices shall ensure that leakage/emissions of gas is minimized.

8.2.4 Any redundant pipework shall be isolated, purged, disconnected and closed or sealed at each end. For large volumes consideration should be given to the purge gases being flared off in the open air to reduce environmental emissions. Measures shall be taken to avoid any unintended reopening of any isolating valve. If practical, the pipework should be removed.

8.3 Abnormal situations

8.3.1 To facilitate the detection of gas presence, when the distributed gas is not odorized the use of appropriate combustible gas monitors shall be considered.

NOTE This can apply to specific installations, e.g. in the industrial or chemical fields.

8.3.2 Instructions stating the precautions to be taken in the event that the smell of gas persists shall be given to the person responsible for operation.

8.3.3 If gas is detected (e.g. by smell or by gas monitor), it is essential:

- take measures to avoid the presence of flame, spark, electric arc, incandescent heat source etc.;
- isolate the gas supply from an appropriate point situated, if possible, outside the affected space;
- as soon as possible, to ventilate and control the concentration of gas in the atmosphere using appropriate equipment.

8.3.4 In the event of fire, measures shall be taken to shut off the gas supply to the building.

8.4 Leak detection

8.4.1 The investigation of leaks on gas pipework shall be undertaken using specific means, such as leak detection fluid or gas detectors.

8.4.2 Naked flames shall not be used.

8.4.3 Leak detection fluids shall comply with EN 14291 "Foam producing solutions for leak detection on gas installation".

NOTE For components made of stainless steel, the level of Cl⁻ in the leak detection fluid should be below 30 mg/l.

8.4.4 The gas detectors used shall be in good working order, calibrated and appropriate for the type of gas to be detected and the purpose intended.

8.5 Work on operating pipework

8.5.1 Any person who works on operating pipework shall be a competent person. This requirement need not apply to flexible appliance connectors specifically designed to be removed or refitted by the appliance user, e.g. domestic cooker connection systems.

8.5.2 Prior to the commencement of work the pipework shall be isolated and should be depressurized and purged from gas. For large volumes consideration should be given to the purge gases being flared off in the open air to reduce environmental emissions.

8.5.3 All pipework (or parts of pipework) of which the routing or the materials and fittings have been altered during work carried out in the absence of gas shall again satisfy clause 6 and clause 7.

8.5.4 The requirements of 8.5.2 and 8.5.3 need not apply for the replacement of flexible appliance connectors, or the replacement with identical components of items integral to the pipework such as meters, regulators, means of isolation, safety devices. In these cases a fitness test shall be carried out after the admission of gas, together with a check, using appropriate means, that there are no leaks at the joints of the replaced components.

8.5.5 Specific measures shall be taken to cross-bond the parts of the pipework concerned using an appropriate equipotential bond before and during the work (See also 5.1.9).

8.5.6 For separation of plastic pipework or purging through plastic pipework, components should be earthed by appropriate means.

8.5.7 A compression joint should not be re-utilized.

8.6 Purging from gas

8.6.1 Prior to purging from fuel gas, it is necessary to ensure that the means of isolation are closed and to take and maintain all measures to prevent them from being operated by an unauthorized person.

8.6.2 Purging from gas shall be supervised.

8.6.3 Precautions shall be taken to prevent any accidental ignition of the purged gases.

8.6.4 The pipework shall be de-pressurized, prior to purging. Purging can necessitate the use of an inert gas. Purging procedures should take account of the volume and velocity of the purged gases and the mixing of gas and air.

Oxygen shall not be used.

8.6.5 Purge gases shall be vented safely, preferably to the open air.

For large volumes consideration should be given to the purge gases being flared off in the open air to reduce environmental emissions.

The content of vented gas should be verified, e.g. by measurement of gas concentration.

Annex A (informative)

Resistance to high temperatures

A.1 General

This annex describes procedures A and B mentioned in note 2 of 4.4.

A pipework component is considered to be resistant to high temperatures when it retains its leak-tightness up to a temperature at which there is no longer any danger of a gas explosion.

For first, second and third family gases (see Table 1 of EN 437:2003) the permissible temperature is 650 °C.

NOTE 1 This is the self ignition temperature of a natural gas / air mixture which is a secured value for all gas families.

It is accepted that for certain pipework components, such as meters and insulating joints, this leak-tightness relates to the atmosphere (external leak-tightness).

For other pipework components, such as means of isolation, leak-tightness also includes leak-tightness at the outlet in relation to the inlet (internal leak-tightness).

A pipework component may be considered to be resistant to high temperatures if it has passed a test following either procedure A or procedure B.

NOTE 2 Procedure A is generally applied to building products, and Procedure B to pipework components.

A.2 Procedure A

A.2.1 Test criteria

This test is deemed to be passed if the leakage rate of the pipework component, measured under the conditions of A.2.2, does not exceed 150 dm³/h or the value specified in the European Standard for the pipework component, during and after the 30 min increase in temperature in accordance with the curve specified in ISO 834-1 and under a constant pressure of 50 mbar.

A.2.2 Test method

A.2.2.1 Apparatus

Using the furnace it is possible to increase the temperature by 821 K in 30 min in accordance with the curve specified in ISO 834-1.

The dimensions of the furnace are such that the pipework component and its connections can be installed in positions which are similar to those observed in practice.

The test is carried out with the pipework component under air or nitrogen pressure.

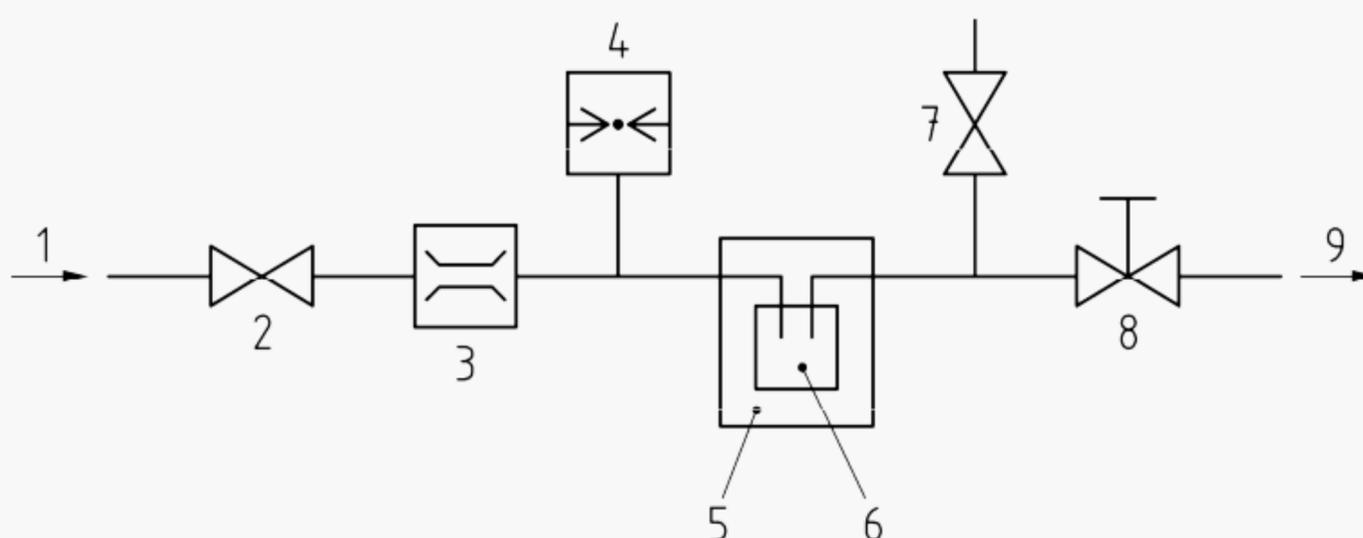
Arrangements are made to maintain a constant pressure of 50 mbar in the pipework component throughout the test.

A.2.2.2 Test procedure

The pipework component is connected to inlet and outlet joints and the complete assembly is installed in the centre of the furnace using supports if necessary (see Figure A.1). With the discharge valve closed the pipework component is subjected to a pressure of 50 mbar and its leak-tightness is checked.

With the pipework component subjected to a pressure of 50 mbar, the temperature of the furnace is increased by 821 K in 30 min in accordance with the curve specified in ISO 834-1.

During the increase in temperature, the internal pressure of the pipework component is maintained at 50 mbar by means of the discharge valve and the leakage rate recorded on a flow meter is checked.



Key

- 1 Test gas inlet
- 2 Cock
- 3 Flow meter
- 4 Pressure gauge (up to 100 mbar)
- 5 Furnace
- 6 Pipework element
- 7 Purge valve
- 8 Discharge valve
- 9 Outlet

Figure A.1 — Equipment for test procedure A

A.3 Procedure B

A.3.1 Test criteria

This test is deemed to be passed if the leakage rate of the pipework component, measured under the test conditions described in A.3.2, does not exceed 150 dm³/h or the value specified in the EN standard of the pipework component under the following test conditions:

- increase in the furnace temperature in accordance with the curve specified in ISO 834-1 until the coolest part of the pipework component has reached 650 °C;

NOTE The time for the increase of temperature according to ISO 834-1 may be exceeded by considering the design of the furnace and the mass of the pipework component.

- maintenance of the constant temperature of 650 °C for 30 min;
- constant test pressure equal to the maximum operating pressure with a value of at least 100 mbar;
- test fluid: nitrogen.

A.3.2 Test method

A.3.2.1 Apparatus

Using the furnace, it is possible to increase the temperature in relation to time in accordance with the curve specified in ISO 834-1.

The dimensions of the furnace are such that the pipework component and its connections can be installed in positions which are similar to those observed in practice.

Arrangements are made to maintain a constant pressure in the pipework component throughout the test.

A.3.2.2 Test procedure

The pipework component is connected to inlet and outlet joints and the complete assembly is installed in the centre of the furnace using supports if necessary (see Figure A.2).

With the discharge valve closed, the pipework component is subjected to the test pressure with nitrogen and its leak-tightness is checked.

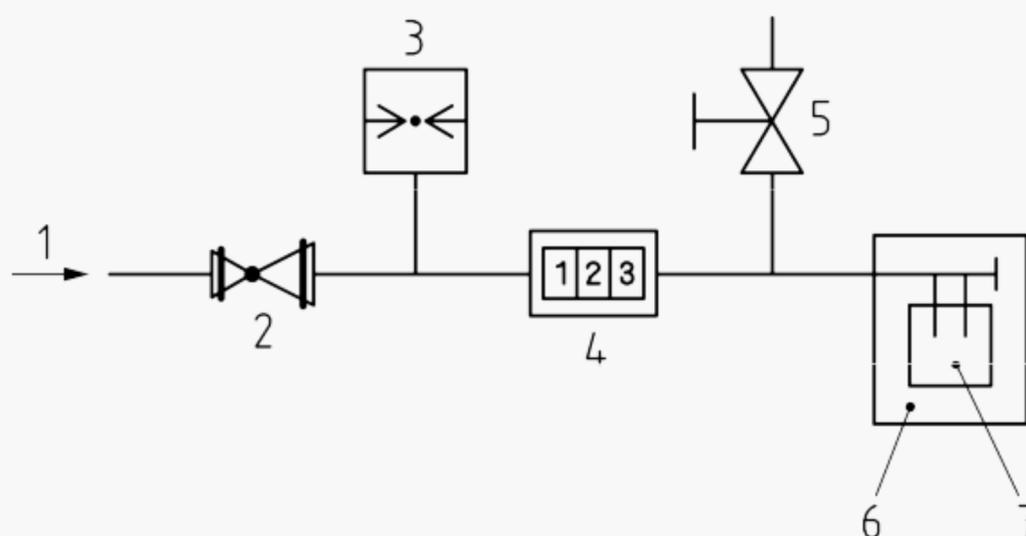
With the pipework component subjected to nitrogen pressure at the test pressure, the temperature of the furnace is increased in accordance with the ISO 834-1 curve.

When the temperature of the pipework component reaches 650 °C in the coolest part, the temperature of the furnace is adjusted to maintain this temperature at a constant level on the pipework component for 30 min.

Throughout the test the pressure is maintained at a constant level in the pipework component by means of the discharge valve and the leakage rate is monitored at all times by successive measurements with each measurement time being less than 5 min.

The leakage rate is the ratio of the volume of nitrogen measured to the measuring time.

Reference shall also be made to the relevant product standard for pipework components.



Key

- 1 Test gas inlet
- 2 Pressure regulator
- 3 Pressure gauge
- 4 Measuring meter
- 5 Discharge valve
- 6 Furnace
- 7 Pipework element

Figure A.2 — Equipment for test procedure B

Annex B (informative)

General guidelines for the construction of joints

B.1 General

This annex gives recommendations for jointing procedures, qualification of personnel and choice of materials relative to the correct execution of joints made by welding of steel, soldering and brazing of copper and its alloys and by fusion of polyethylene.

The general recommendations of this clause should be applied to all welded, brazed, soldered joints and polyethylene fusion joints. In addition, specific recommendations given in Annex C, Annex D and Annex E, should be applied as relevant to the jointing methods.

B.2 Installation operatives

Installation operatives should be trained to perform joints fit for purpose.

Update training should take place when necessary, and particularly for those installation operatives who make joints infrequently.

Training should be performed by instructors who have wide practical and theoretical experience in the procedures. Instructors should keep themselves up-to-date with the latest good practices, they should be able to analyse the causes of failures, and be capable of organizing the resultant necessary additional training.

Training can comprise 'on the job' instruction under the direction of competent installation operatives.

Training should incorporate the following matters, depending on the jointing methods, as a minimum:

- pipes and fittings materials and thicknesses;
- visual inspection of joints;
- basics of relevant destructive and non-destructive testing;
- selection, handling, storage and use of pipes, fittings, fluxes, filler rods and gases as appropriate;
- suitable equipment (welding and fusion machines, clamps, ancillary tooling);
- effect of weather conditions on joint quality;
- preparation and cleanliness of pipe ends and fittings;
- personal, third party and environmental safety.

Training should give the installation operative:

- ability to consistently perform satisfactory joints in compliance with corresponding procedures;
- awareness of and ability to implement safety procedures;
- appreciation of what produces unsatisfactory joints.

Evidence should be provided that training is appropriate for the installation work to be executed.

B.3 Quality Control

Procedures should be developed for the determination of any necessary testing of joints. These should clearly specify how joints will be assessed as "pass or fail".

NOTE Quality control procedures may need to be agreed as part of any contract for the work.

Supervisors should be trained, assessed and experienced in the jointing procedures being undertaken and all relevant safety matters. They should be aware of quality procedures and be able to determine when additional on or off site investigation is necessary.

Unsatisfactory joints shall be replaced or repaired.

B.4 Documentation

Procedures should be developed to retain records of instructor's qualifications, and training and assessment of installation operatives for checking by relevant persons.

Installation operative assessment should be formally recorded and should include all the appropriate parts of the training relevant to design pressure and jointing procedures.

Annex C (informative)

Guidelines for the construction of welded, brazed, soldered joints, and polyethylene fusion joints

C.1 Welding of steel

C.1.1 Materials

C.1.1.1 Pipes and fittings

Pipes and fittings should be capable of being welded reliably under site conditions. The manufacturer will provide data on the weldability of the material and demonstrate weldability by tests when required in accordance with the specifier requirements.

The pipes and weldable steel fittings should comply with EN 10208-1 or EN 10255 as appropriate.

For steels not complying with these specifications, a weldability test should be performed before any welding work commences.

NOTE Reference can be made to EN 1011-2 for welding of ferritic steels.

C.1.1.2 Welding consumables

Welding consumables should be in accordance with the relevant European standards.

EXAMPLE : EN 499 for shielded metal arc welding (SMAW), EN 440 for gas metal arc welding (GMAW).

C.1.2 Approval of the welding procedure

Evidence of the qualification of the welding procedure to be used should be available for all the welding work on the joints. The welding procedure should be submitted in accordance with EN ISO 15607 and either EN ISO 15609-1, or EN ISO 15614-1, or EN ISO 15610, or EN ISO 15611, or EN ISO 15612 or EN ISO 15613 as appropriate.

C.1.3 Pipework with a maximum operating pressure (MOP) up to and including 0,1 bar and a wall thickness less than 4mm

C.1.3.1 Welders

Welders should be trained in accordance with B.2.

C.1.3.2 Quality control

Adequate seam quality should be ensured, e.g. by visual inspection (See EN 970, with which the following is consistent).

Visual inspection of welds should be carried out on the completed weld, with the naked eye or using a simple magnifying glass. The weld surface for examination should be brightly illuminated and should be free of grease, dirt, slag and any protective coatings.

The surface of the weld and the adjacent wall should not contain cracks, notches or porosity and the area adjacent to the weld should contain no electrode run points or other burnt areas. The weld surface should be smooth. The acceptability of surface roughness should depend on the type of weld and the application. There should be no sharp transitions between weld beads.

C.1.4 Pipework with a maximum operating pressure (MOP) over 0,1 bar or wall thickness including and above 4 mm

C.1.4.1 Qualification of personnel

C.1.4.1.1 Welding operatives

For all welding work, welding operatives should be qualified according to the appropriate qualified welding procedures, covering the techniques, material groups and dimension ranges concerned. Welding operatives should be in possession of the valid qualification certificate.

A copy of the relevant certificates should be provided upon request.

Welder qualification should be performed according EN 287-1 or to another appropriate national standard where EN 287-1 is not relevant. In accordance with clause 8 of EN 287-1, the acceptance criteria should be defined according to the MOP of the pipework and the type of weld procedure.

NOTE Welding of pipework at operating pressure requires special training and qualification.

C.1.4.1.2 Weld quality supervisors

Persons in charge of quality control (supervisors) should be identified. Persons performing quality control should be competent in quality control matters. They should be able to determine on site the quality of the joint and to decide when additional on- or off-site joint investigations are necessary.

C.1.4.1.3 Testing personnel

Destructive testing and non destructive testing personnel should be appropriately qualified for the duties they are to perform according to an appropriate recognised international or national standard (e.g. EN 473).

All companies providing such personnel should be certified according to an appropriate standard (e.g. EN ISO IEC 17020).

C.1.4.2 Quality Control

Adequate seam quality should be ensured by visual inspection of the site welding work and/or by any non destructive and/or destructive tests (See EN 970, with which the following is consistent). The results of the tests should be recorded.

Visual inspection of welds should be carried out on the completed weld with the naked eye or using a simple magnifying glass. The weld surface for examination should be brightly illuminated and should be free of grease, dirt, slag and any protective coatings.

The surface of the weld and the adjacent wall should not contain cracks, notches or porosity and the area adjacent to the weld should contain no electrode run in points or other burnt areas. The weld surface should be smooth. The acceptability of surface roughness should depend on the type of weld and the application. There should be no sharp transitions between weld beads.

When destructive testing is required, it should be carried out according to recognised international or national standards.

Non destructive examination of welds is generally radiographically performed, carried out in accordance with an appropriate standard (e.g. for radiographic examination EN 444).

In order to ensure the required quality level, it is necessary to determine if non destructive testing is required and, when required, the number of points to be examined.

The quality of welds examined by non destructive testing should be evaluated in accordance with an appropriate standard (e.g. EN ISO 5817 for arc welding). The acceptance criteria should be defined according to the MOP of the pipework and the type of weld procedure (e.g. arc welding, oxy-acetylene welding).

C.1.4.3 Documentation

Records of identification and qualification of welders and welding procedures, non-destructive or destructive tests, pipework materials and welding consumables should be retained in order to comply with 7.1.1.

NOTE Reference should be made to EN 14717 in order to consider environmental aspects of welding for gas pipes and fittings.

C.2 Brazing and soldering of copper and copper alloys

C.2.1 Materials

C.2.1.1 Pipes and fittings

Pipes and fittings should be capable of being brazed or soldered reliably under site conditions. The manufacturer will provide data on the ability to braze and solder the material.

It is recommended to use:

- tubes conforming to EN 1057;
- fittings conforming to EN 1254-1, EN 1254-4 and EN 1254-5, as appropriate.

NOTE When using fittings conforming to EN 1254-5, care should be taken to ensure that the tolerances and dimensions of the fittings do not adversely affect the joint quality. This can necessitate that additional design and quality control requirements are agreed with the manufacturer.

C.2.1.2 Consumables

Brazing and soldering consumables should be in accordance with the relevant European standards.

EXAMPLE EN 1044 or EN 29453 for filler materials, EN 1045 or EN ISO 9454-2 for brazing fluxes.

C.2.2 Brazing and soldering procedure

A procedure for the production of brazed or soldered joints should be available for the materials to be joined and the fluxes and filler metals to be applied.

C.2.3 Pipework with a maximum operating pressure (MOP) up to and including 0,1 bar

C.2.3.1 Brazing and soldering operatives

Brazing and soldering operatives should be trained in accordance with B.2.

C.2.3.2 Quality control

Adequate joint quality should be ensured, e.g. by visual inspection (See for example EN 12799, with which the following is consistent).

Visual inspection of joints should be carried out on the completed joint with the naked eye or using a simple magnifying glass. The joint surface for examination should be brightly illuminated and should be free of grease, dirt, slag and any protective coatings.

The application of heat to form the joint should not adversely affect the materials.

It is essential that the filler metal is visible and free of porosity defect around the complete circumference of the joint.

C.2.4 Pipework with a maximum operating pressure (MOP) over 0,1 bar

C.2.4.1 Qualification of personnel

C.2.4.1.1 Brazing and soldering operatives

For all brazing and soldering work, brazing and soldering operatives should be qualified according to the appropriate qualified procedures covering the techniques, material groups and dimension ranges concerned. Brazing and soldering operatives should be in possession of the valid qualification certificate.

A copy of the relevant certificates should be provided upon request.

Brazing and soldering operative qualification should be performed according to an appropriate standard.

C.2.4.1.2 Brazed and soldered joint quality supervisors

Persons in charge of quality control (supervisors) should be identified. Persons performing quality control should be competent in quality control matters. They should be able to determine on site the quality of the joint and to decide when additional on- or off-site joint investigations are necessary.

C.2.4.2 Quality control

Adequate joint quality should be ensured, e.g. by visual inspection of the brazing and soldering work (see for example EN 12799, with which the following is consistent).

Visual inspection of joints should be carried out on the completed joint with the naked eye or using a simple magnifying glass. The joint surface for examination should be brightly illuminated and should be free of grease, dirt, slag and any protective coatings.

The application of heat to form the joint should not adversely affect the materials.

It is essential that the filler metal is visible and free of porosity defects around the complete circumference of the brazed or soldered joint.

C.2.4.3 Documentation

Records of identification and qualification of operatives and brazing and soldering procedures, non-destructive tests, pipework materials, fluxes and filler metals should be retained in order to comply with 7.1.1.

C.3 Fusion jointing of polyethylene

The following is consistent with EN 12007-2. For more detailed information, reference should be made to that standard.

C.3.1 Materials

Pipes and fittings should be capable of being jointed reliably under site conditions. The manufacturer will provide data on the ability to perform polyethylene fusion joints of the material and demonstrate this ability by tests when required in accordance with the specified requirements.

It is recommended to use:

- pipes complying with EN 1555-2;
- fittings complying with EN 1555-3;
- valves complying with EN 1555-4;
- equipment for fusion jointing complying with ISO 12176-1 (Butt fusion) or ISO 12176-2 (Electrofusion).

C.3.2 Polyethylene fusion jointing procedure

Fusion procedure should, at least, contain the following information:

- range of ambient temperatures enabling a reliable fusion jointing;
- fusion cycle;
- hotplate temperature;
- pressures to apply at each step of the cycle;
- time of each step (included cooling time);
- average bead width.

Jointing procedure parameters for electrofusion fittings are normally developed by, and the responsibility of, the PE fitting manufacturer. The correct equipment (control box, clamps) and preparation (scraping, alignment, cleanliness) should be applied. Fittings and equipment should be compatible.

Range of ambient temperatures enabling the operative to perform electrofusion should be declared by the manufacturer.

The jointing procedure should be available on site at any time and exhibited on request to relevant persons.

NOTE Socket fusion is not recommended.

C.3.3 Qualification of personnel

Persons employed to perform or supervise jointing by electrofusion or butt fusion should be trained in accordance with B.2.

NOTE The personnel could be qualified on the basis of an appropriate standard, example: EN 13067.

C.3.4 Quality control

C.3.4.1 Butt fusion joint

Visual examination should be carried out on each joint with the following criteria:

Bead shape: the bead depression 'A' (Figure C.1) should not extend below the pipe surface, the surface should be smooth and symmetrical around the entire pipe circumference (different melt flow rate (MFR) materials can give non symmetrical beads).

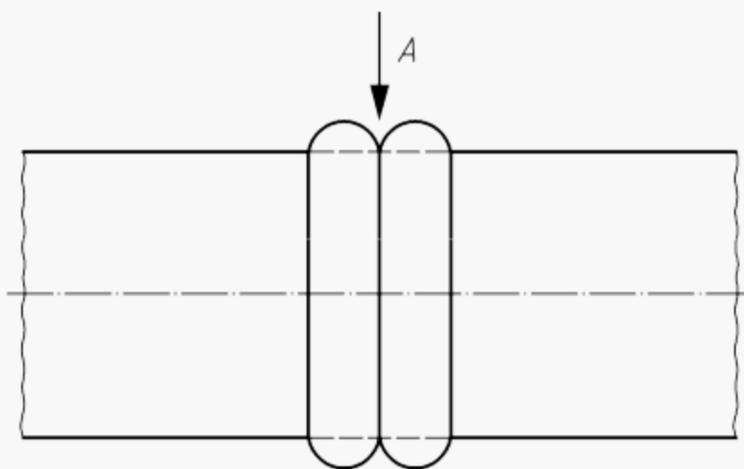


Figure C.1 — Bead shape

Alignment: pipes, fittings, valves should be as closely aligned as possible. Normally, a 10 % of wall thickness mismatch ('v', Figure C.2) is allowable but particular care should be given to pipes with a thickness under 10 mm.

Bead width: 'B' (Figure C.2) is indicative of a well performed joint, but it depends on procedure, MFR and production method (extrusion or injection moulding). Once the last two variables are defined, 'B' is a good indicator if the procedure has been correctly applied. 'B' variations along the circumference indicate poor conditions of the fusion equipment.

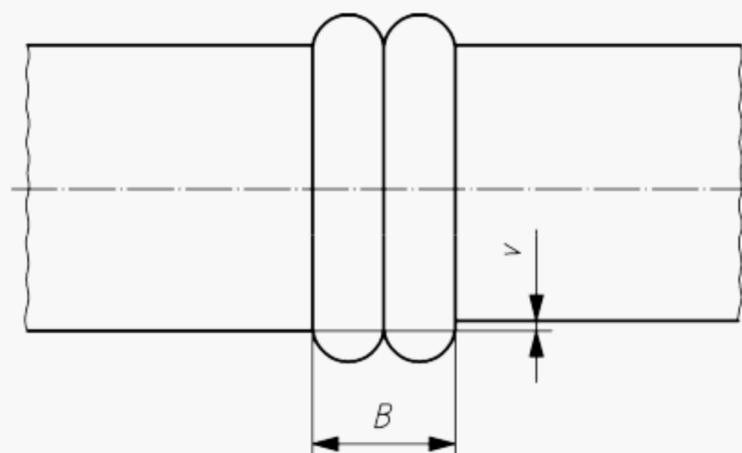


Figure C.2 — Bead width

External beads can be removed with appropriate tooling, and checked for contamination or lack of fusion. A thin root and curled bead can lead to more investigation on the joint (e.g. transverse tensile testing). Removed beads can be kept as one of the proofs of the joint quality.

C.3.4.2 Electrofusion joint

For electrofusion sockets fitting (e.g. couplers), the quality control should include the following items:

- pipes and fittings alignment (permissible misalignment is given in EN 1555-5);
- adequate scraping (deep enough and covering the entire circumference);
- penetration : marking should give evidence that pipe or spigot are correctly coupled with socket;
- cleanliness : no grease or dirt should be present near or within the fusion interface (immediately before or after the application of the fusion cycle);
- no melt exudation outside of the fitting;
- heating indicators (if present) should comply with the instructions given by the manufacturer;
- clamps, if necessary, should not be removed before the cooling time has elapsed;
- no abnormal displacement (after fusion) of electric wire.

For electrofusion saddles fitting (e.g. tapping tees, branch saddles), the quality control should include the following items:

- adequate scraping (deep enough and covering the entire fusion area);
- stack of the saddle should be perfectly radial to the pipe;
- no rotation or movement should occur during the application of the entire fusion cycle (including cooling time);
- no grease or dirt should be present near or within the fusion interface (immediately before or after the application of the fusion cycle);
- fitting should not collapse on the pipe;

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- no melt exudation outside of the fitting;
- visual inspection of heating indicators (if present) should be in compliance with the instructions given by the manufacturer;
- clamps, if necessary, should not be removed before the cooling time has elapsed;
- application of ancillary tooling should not result in significant damage to pipe.

Annex D (informative)

Guidelines for the construction of pressed joints

D.1 Jointing procedure with press fittings on copper pipes

D.1.1 General

Copper pipes should comply with EN 1057 and the wall thickness of the pipes used should be suited to the pressing process according to prEN 1254-7:2006, Table 7.

Press fitting should comply with prEN 1254-7.

Press tool, including its jaws and collars should be suitable for the size and the profile of fitting and pipe to be assembled.

The press tool should be able to develop sufficient force to complete the pressing of the fitting.

A method of traceability should be used in order to confirm the technical compatibility between the press jaws and/or the collars and the press fitting.

Example: A permanent mark directly on the fitting.

NOTE 1 The traceability of a jointing method to a press fitting is an important element of quality assurance of a gas installation. This traceability permits verification that the installation operative has used the appropriate press jaws and/or collars for the fittings.

The press tool including its jaws and collars should be maintained as specified by the manufacturer and kept in a clean and working condition.

NOTE 2 The maintenance frequency is either automatically indicated by a cycle counter in the press tool (e.g. every 20 000 cycles) or a maintenance frequency is specified by the manufacturer (e.g. every 12 months).

The tool should be chosen in accordance with the atmospheric conditions, e.g. explosive environment.

D.1.2 Installation process

The installation process should take into account the recommended practices of prEN 14905 and the manufacturer's recommendations including the following items:

- Press tool including its jaws and collars should be selected to match the selected fittings.
- Press tool including its jaws and collars should be checked for correct operation and cleanliness.
- Fitting should be checked for suitability and the correct insertion of an 'O' ring suitable for gas, normally yellow or grey with a yellow mark on the fitting.

NOTE The 'O' ring seals for water installations are normally black.

- Pipe should be cut at a perpendicular angle and be deburred with appropriate tools. For half-hard and soft copper tubes, restore the right outside diameter of the tube with an appropriate tool.

- Pipe end and the inside of the fitting should be checked for cleanliness.
- Pipe should be inserted with a slight twisting action into the joint.
- Insertion depth should be visually marked for indication when the tube is fully inserted into the fitting.

The jaws and collars of the press tool should be located over the bead at the mouth of the fitting and held during operation with a perpendicular angle between the jaws or collars and the tube.

D.2 Jointing procedure with press fittings on multi-layer and PEX

D.2.1 General

Multilayer and PEX pipes are generally delivered as a complete system. Pipes, fittings, tools etc have been tested as a complete system. However systems are generally not compatible with systems of another brand.

Installation operative applying different systems should be aware of this lack of compatibility.

Because of the lack of compatibility, repair instructions are given by the manufacturer.

The manufacturer should provide a transition-fitting intended to be connected to a standardised system, connection complying with the relevant standards.

NOTE 1 ISO FDIS 17484-1 gives requirements for multilayer and PEX systems. According to this standard each system should have a transition fitting in order to make a connection to a standardised system possible.

NOTE 2 Some countries require standardized dimensions (outside diameter and/or wall thickness). No standardization of dimensions on International level is available yet.

Special attention should be paid to:

- mounting instructions of the manufacturer;
- non-interchangeability of pipes and/or fittings of a system manufacturer with pipes and/or fittings of another system manufacturer, excepted where interchangeability is indicated by each of the system manufacturer;
- use only of tools, of accessories (jaws, collars) and of procedures which are appropriate to the jointing system being applied by the installation operative;
- connection of M-Type multilayer pipes (which comprises at least one metallic layer, e.g. PEX-Al-PEX or PE-AL-PE) to the equipotential bonding system of the building.

NOTE 3 Some types of M-pipes systems are electrically disconnected in the fitting. For these systems connection to the equipotential bonding system should not be advised.

D.2.2 Installation process

The installation process should take into account the manufacturers recommendations.

Annex E

(informative)

Guidelines for the construction of stainless steel pliable corrugated tubing systems

E.1 General

The stainless steel pliable corrugated tubing system consists of pipes with mechanical fittings that can also be suitable for connection to other components of the installation pipework.

Even if the stainless steel pliable corrugated tubing systems offers the advantage of installation with a limited number of fittings, some jointing remains necessary.

NOTE Flexible appliances connectors are not included in this annex (see 5.7).

E.2 Components of the system

Only the pipes and compatible fittings as specified by the manufacturer should be used to construct a stainless steel pliable corrugated tubing system.

For every system pipes and fittings complying with EN 15266 (stainless steel pliable corrugated pipework systems) should be used.

E.3 Stainless steel pliable corrugated tubing systems jointing procedure

E.3.1 General

Stainless steel pliable corrugated tubing systems jointing procedure should be given by the system manufacturer and should, at least, contains the following:

- verification that the various components of the system fit together (pipe, gasket, fittings,...) according to the manufacturer recommendations,
- list and description of the specific tools needed for performing the jointing together with installation instructions and recommended maintenance plan.

If a reassembly of a fitting firstly disassembled implies the replacement of one or several components of the fitting (e.g. a gasket) this operation should only be allowed if foreseen and described in the installation instructions provided by the manufacturer.

E.3.2 Training of personnel

The training procedure is based upon the compliance with the installation instructions given by the system manufacturer.

For all joints on stainless steel pliable corrugated tubing systems, installation operatives should have been trained (e.g. by the manufacturer).

E.3.3 Quality control

The compatibility of the pipe and fitting components should be checked visually.

The appropriate torque used to perform joints on stainless steel pliable corrugated pipework systems should be checked by using an appropriate procedure.

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