

Gas Infrastructure — Gas installation pipework with an operating pressure greater than 0,5 bar for industrial installations and greater than 5 bar for industrial and non- industrial installations

**Part 1: Detailed functional
requirements for design, materials,
construction, inspection and testing**

ICS 23.040.01; 91.140.40

National foreword

This British Standard is the UK implementation of EN 15001-1:2009.

The UK participation in its preparation was entrusted to Technical Committee GSE/33, Gas supply.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2009

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ISBN 978 0 580 54498 9

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 15001-1

July 2009

ICS 23.040.01

English Version

Gas Infrastructure - Gas installation pipework with an operating pressure greater than 0,5 bar for industrial installations and greater than 5 bar for industrial and non-industrial installations - Part 1: Detailed functional requirements for design, materials, construction, inspection and testing

Infrastructures gazières - Canalisations d'installations de gaz avec une pression de service supérieure à 0,5 bar pour les installations industrielles et supérieures à 5 bar pour les installations industrielles et non industrielles (domestiques et commerciales) - Partie 1: Exigences fonctionnelles détaillées relative à la conception, aux matériaux, à la construction, à l'inspection et aux essais

Gasinfrastruktur - Gas-Leitungsanlagen mit einem Betriebsdruck größer 0,5 bar für industrielle Installationen und größer 5 bar für industrielle und nicht-industrielle Installationen - Teil 1: Detaillierte funktionale Anforderungen an Planung, Material, Bau, Inspektion und Prüfung

This European Standard was approved by CEN on 16 May 2009.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 15001-1:2009) has been prepared by Technical Committee CEN/TC 234 “Gas Infrastructure”, 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 January 2010, and conflicting national standards shall be withdrawn at the latest by January 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

Annexes A to D are informative.

The normative Annex E of this document lists some suitable materials for pipework, in addition to the materials listed in Clause 5.

This standard includes requirements concerning current design practice and reflects the state of the art at the time of publication. It provides clear solutions for users of the standard. Other design solutions and construction materials, as well as new developments, may be used if equal or greater safety than that required by this EN can be demonstrated or established.

There is a complete suite of functional standards prepared by CEN/TC 234 “Gas infrastructure” to cover all parts of the gas supply system from the input of gas to the transmission system up to the inlet connection of the gas appliances, whether for residential, commercial or industrial purposes.

In preparing this standard, a basic understanding of gas supply by the user has been assumed.

Gas supply systems are complex and the importance on safety of their construction and use has led to the development of very detailed codes of practice and operating manuals in the member countries. These detailed statements embrace recognised standards of gas engineering and the specific requirements imposed by the legal structures of the member countries.

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 the United Kingdom.

1 Scope

This European Standard specifies detailed functional requirements for the design, selection of materials, construction, inspection and testing of

- industrial gas installation pipework and assemblies with an operating pressure greater than 0,5 bar, and
- non-industrial gas installation pipework (residential and commercial) with an operating pressure greater than 5 bar in buildings,

starting from the outlet of the network operator's point of delivery up to the inlet connection to the gas appliance; normally the inlet isolation valve. This standard also covers the inlet connection to the gas appliance comprising of the pipework that does not fall within the scope of the appliance standard.

NOTE The use of the term installation and pipework is interchangeable.

This standard applies to gas installations operating at ambient temperatures between - 20 °C and 40 °C and operating pressures up to and including 60 bar. For operating conditions outside these limitations, reference should additionally be made to EN 13480 for metallic pipework.

For industrial gas installations up to and including 0,5 bar and for non-industrial (residential and commercial) gas installations up to and including 5 bar in buildings, EN 1775 applies.

For gas installations that do not fall within the scope of EN 1775 or other European Standards, this standard applies.

In this standard, the term "gas" refers to combustible gases, which are gaseous at 15 °C and 1 013 mbar absolute atmospheric pressure (normal conditions). These gases are commonly referred to as manufactured gas, natural gas or Liquefied Petroleum Gas (LPG). They are also referred to as first, second or third family gases (see Table 1 of EN 437:2003). The given values are considered as normal conditions for all volumes given in this standard.

LPG storage vessels (including all ancillaries fitted directly to storage vessels) are excluded. Also excluded are LPG installations and sections of LPG installations operating at vapour pressure in the liquid state (e.g. between the storage vessel and any pressure regulator).

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

This standard has been harmonised to address the essential safety requirements of the Pressure Equipment Directive (PED, 97/23/EC) relevant for the joining of gas installation pipework (assemblies) falling within the scope of the PED. These are listed in Annex ZA. However, "this Directive does not cover the assembly of pressure equipment on the site and under the responsibility of the user, as in the case of industrial installations" (PED, Preamble, 5th recital, last paragraph).

Although in this respect, the standard takes into account the essential safety requirements of the PED, no inference can be drawn from this as to whether or not the installation or parts of the installation falls within the scope of the PED. Reference should be made to the PED and national legislation.

This European Standard specifies common basic principles for gas supply systems. Users of this European Standard should be aware that more detailed national standards and/or code of practice may exist in the CEN member countries.

This European 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, the national legislation/regulation shall take precedence as illustrated in CR 13737.

This provision does not apply to requirements that are harmonised to directive 97/23/EC (see Annex ZA).

This CR 13737 gives:

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

Functional requirements for commissioning, operation and maintenance of industrial gas installations and assemblies with an operating pressure greater than 0,5 bar and of gas installations greater than 5 bar in buildings and areas intended for non-industrial installations greater than 5 bar are described in EN 15001-2.

Generally, additional safety precautions may be necessary where non-odorized gas is used. For non industrial purposes, the gas should be odorized.

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 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 331:1998, *Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings*

EN 334:2005, *Gas pressure regulators for inlet pressures up to 100 bar*

EN 571-1, *Non destructive testing — Penetrant testing — Part 1: General principles*

EN 583-1:1998, *Non-destructive testing — Ultrasonic examination — Part 1: General principles*

EN 751-1:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 1: Anaerobic jointing compounds*

EN 751-2:1996, *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 751-3:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes*

EN 764-5:2002, *Pressure equipment — Part 5: Compliance and Inspection Documentation of Materials*

EN 970:1997, *Non-destructive examination of fusion welds — Visual examination*

EN 1044:1999, *Brazing — Filler metals*

EN 1057:2006, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1092-1:2007, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1092-3:2003, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 3: Copper alloy flanges*

EN 1254-1:1998, *Copper and copper alloys — Plumbing fittings — Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes*

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

EN 1254-5:1998, *Copper and copper alloys — Plumbing fittings — Part 5: Fittings with short ends for capillary brazing to copper tubes*

EN 1290, *Non-destructive examination of welds — Magnetic particle examination of welds*

EN 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints*

EN 1514-1:1997, *Flanges and their joints — Dimensions of gaskets for PN-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

EN 1514-2:2005, *Flanges and their joints — Gaskets for PN-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

EN 1515-1:1999, *Flanges and their joints — Bolting — Part 1: Selection of bolting*

EN 1515-2:2001, *Flanges and their joints — Bolting — Part 2: Classification of bolt materials for steel flanges, PN designated*

EN 1555-1:2002, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

EN 1555-2:2002, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

EN 1555-3:2002, *Plastic piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

EN 1555-4:2002, *Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) — Part 4: Valves*

EN 1555-5:2002, *Plastic piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 5: Fitness for purpose of the system*

EN 1563:1997, *Founding — Spheroidal graphite cast irons*

EN 1594:2009, *Gas supply systems — Pipelines for maximum operating pressure over 16 bar — Functional requirements*

EN 1714:1997, *Non-destructive examination of welds — Ultrasonic examination of welded joints*

EN 1759-1:2004, *Flanges and their joint — Circular flanges for pipes, valves, fittings and accessories, Class designated - Part 1: Steel flanges, NPS 1/2 to 24*

EN 1775:2007, *Gas supply- Gas pipework for buildings — Maximum operating pressure less than or equal to 5 bar — Functional recommendations*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10045-1:1990, *Metallic materials — Charpy impact test — Part 1: Test method*

EN 10087:1998, *Free-cutting steels — Technical delivery conditions for semi-finished products, hot-rolled bars and rods*

EN 10088-1:2005, *Stainless steels — Part 1: List of stainless steels*

EN 10088-3:2005, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10208-1:2009, *Steel pipes for pipelines for combustible fluids — Technical delivery conditions — Part 1: Pipes of requirement class A*

EN 10208-2, *Steel pipes for pipe lines for combustible fluids — Technical delivery conditions — Part 2: Pipes of requirement class B*

EN 10216-1:2002, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10216-5:2004, *Seamless steel tubes for pressure purpose — Technical delivery conditions — Part 5: Stainless steel tubes*

EN 10217-1:2002, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-7:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 7: Stainless steel tubes*

EN 10220:2002, *Seamless and welded steel tubes — Dimensions and masses per unit length*

EN 10226-1:2004, *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 10240:1997, *Internal and/or external protective coatings for steel tubes — Specification for hot dip galvanized coatings applied in automatic plants*

EN 10253-2:2007, *Butt-welding pipe fittings — Part 2: Non alloy and ferritic alloy steels with specific inspection requirements*

EN 10255:2004, *Non-alloy steel tubes suitable for welding and threading — Technical delivery conditions*

EN 10289:2002, *Steel tubes and fittings for onshore and offshore pipelines — External liquid applied epoxy and epoxy-modified coatings*

EN 10290:2002, *Steel tubes and fittings for onshore and offshore pipelines — External liquid applied polyurethane and polyurethane-modified coatings*

EN 12007-2:2000, *Gas supply systems — Gas pipelines for maximum operating pressure up to and including 16 bar — Part 2: Specific functional recommendations for polyethylene (MOP up to and including 10 bar)*

EN 12007-3:2000, *Gas supply systems — Pipelines for maximum operating pressure up to and including 16 bar — Part 3: Specific functional recommendations for steel*

EN 12068:1998, *Cathodic protection — External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection — Tapes and shrinkable materials*

EN 12186:2000, *Gas supply systems — Gas pressure regulating stations for transmission and distribution — Functional requirements*

EN 12266-1:2003, *Industrial valves — Testing of valves — Part 1: Pressure tests, test procedures and acceptance criteria - Mandatory requirements*

EN 12279:2000, *Gas supply systems — Gas pressure regulating installations on service lines — Functional requirements*

EN 12327:2000, *Gas supply systems — Pressure testing, commissioning and decommissioning procedures — Functional requirements*

EN 12560-1:2001, *Flanges and their joints — Gaskets for Class-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

EN 12560-2:2001, *Flanges and their joints — Gaskets for Class-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

EN 12732:2000, *Gas supply systems — Welding steel pipework — Functional requirements*

EN 12799:2000, *Brazing — Non-destructive examination of brazed joints*

EN 12954:2001, *Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines*

EN 13100-1:1999, *Non destructive testing of welded joints of thermoplastics semi-finished products — Part 1: Visual examination*

EN 13134:2000, *Brazing — Procedure approval*

EN 13445-6, *Unfired pressure vessels — Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

EN 13480-2:2002, *Metallic industrial piping — Part 2: Materials*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-5:2002, *Metallic industrial piping — Part 5: Inspection and testing*

EN 13480-6:2004, *Metallic industrial piping — Part 6: Additional requirements for buried piping*

EN 13774:2003, *Valves for gas distribution systems with maximum operating pressure less than or equal to 16 bar — Performance requirements*

EN 13785:2005, *Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar, other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures*

EN 13786:2004, *Automatic change-over valves having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures*

EN 14141:2003, *Valves for natural gas transportation in pipelines — Performance requirements and tests*

EN 14291:2004, *Foam producing solutions for leak detection on gas installations*

EN 14382:2005, *Safety devices for gas pressure regulating stations and installations — Gas safety shut-off devices for inlet pressures up to 100 bar*

EN 20898-2:1993, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread (ISO 898-2:1992)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60079-10:2003, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas (IEC 60079-10:2002)*

EN 60079-14, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection (IEC 60079-14:2007)*

EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 898-1:2009, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2009)*

EN ISO 3506-1:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 1: Bolts, screws and studs (ISO 3506-1:1997)*

EN ISO 3506-2:1997, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 2: Nuts* (ISO 3506-2:1997)

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections* (ISO 5817:2003, corrected version:2005, including Technical Corrigendum 1:2006)

EN ISO 10380:2003, *Pipework — Corrugated metal hoses and hose assemblies* (ISO 10380:2003)

EN ISO 10806:2003, *Pipework — Fittings for corrugated metal hoses* (ISO 10806:2003)

EN ISO 12944-1:1998, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems —Part 1: General introduction* (ISO 12944-1:1998)

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules* (ISO 15607:2003)

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding* (ISO 15609-1:2004)

EN ISO 15610:2003, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables* (ISO 15610:2003)

EN ISO 15612:2004, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption for a standard welding procedure* (ISO 15612:2004)

EN ISO 15614-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys* (ISO 15614-1:2004)

ISO 9329-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Unalloyed and alloyed steels with specified elevated temperature properties*

ISO 15348, *Pipework — Metal bellows expansion joints — General*

3 Terms and definitions

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

3.1 Definitions relating to pressure

3.1.1

pressure

gauge pressure of the fluid inside the system, measured in static conditions

3.1.2

design pressure

DP

pressure at which the design calculations are based; this is equivalent to the maximum allowable pressure (PS) as given in the PED

3.1.3

maximum allowable pressure

PS

maximum pressure for which pipework is designed in accordance with the strength requirements in this document

NOTE For this standard, PS is equivalent to the design pressure (DP).

3.1.4

maximum incidental pressure

MIP

maximum pressure which a system can experience during a short time, limited by the safety devices

3.1.5

operating pressure

OP

pressure which occurs within a system under normal operating conditions

3.1.6

maximum operating pressure

MOP

maximum pressure at which a system can be operated continuously under normal operating conditions

NOTE Normal conditions are: no fault in any device or stream.

3.1.7

tightness test pressure

TTP

pressure applied to a system during tightness testing

3.1.8

strength test pressure

STP

pressure applied to a system during strength testing

3.1.9

combined test pressure

CTP

pressure applied to a system during combined testing

3.2 Definitions relating to the gas installation

3.2.1

components

any item from which a gas supply system or installation is constructed; a distinction is drawn between the following groups of components:

- ancillaries (for example: pressure regulators, valves, safety devices, expansion joints and insulating joints)
- pipes, including bends made from pipe
- instrumentation pipework
- fittings (for example: reducers, tees, factory-made elbows, flanges, dome ends, welding stubs and mechanical joints)

3.2.2

flexible appliance connector

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

3.2.3

point of delivery

point where the gas is transferred to the user

NOTE This can be at a means of isolation or at the meter outlet connection and is normally at the point of transfer of ownership.

3.2.4

user(s)

person(s) responsible for the safety of the gas installation and associated risks on a site

NOTE Normally the user will be the site occupier or owner. It should be assumed that every user has a responsibility for work performed on their site, whether or not the work is performed directly for the user or not. This does not mean that they cannot take advice from an independent specialist.

3.2.5

pipework

assembly of pipes and fittings

3.2.6

installation pipework

pipework including components and stations downstream of the point of delivery terminating at the appliance inlet connection

NOTE This pipework is normally the property of the customer.

3.2.7

ventilated space

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

3.2.8

safety zone

area around the pipework from which persons who are not involved in the strength test are excluded during testing

3.2.9
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 earth.

3.2.10
duct

space specifically designed and constructed for the passage of building services

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

3.2.11
ventilation duct

duct forming part of the structure of the building and intended exclusively for ventilation purposes

3.3 Definition relating to means of isolation

3.3.1
means of isolation

device which is intended to interrupt the gas flow in pipework

EXAMPLE Manually operable valve.

3.4 Definitions relating to jointing methods

3.4.1
joint

means of connecting elements of a gas installation

3.4.2
flanged joint

joint in which gas tightness is achieved by compression of a gasket between the faces of two flanges

3.4.3
threaded joint

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

3.4.4
mechanical joint

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

NOTE This definition includes twin ferrule type joints.

3.4.5
pressed joint

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

3.4.6
brazed joint

joint formed by brazing

3.4.7

welded joint

joint formed by welding

3.4.8

electro fusion joint

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

3.4.9

butt fusion joint

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

3.4.10

compression joint

type of joint in which gas tightness is achieved by compression within a socket with or without a seal

3.5 Definitions relating to components

3.5.1

regulator

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

3.5.2

appliance connection

flexible pipe or length of rigid pipework connecting an appliance's means of isolation with the appliance inlet connection

3.5.3

insulating joint

fitting installed to insulate electrically one section of pipework from another

3.5.4

sleeve

protective pipe through which a gas pipe passes

3.5.5

vent pipe

pipework connected to a safety or control device to release gas at a safe location

3.5.6

creep relief valve

device designed to release a limited flow of gas in the event of an unacceptable pressure being detected within the system it protects

3.5.7

safety slam-shut device

device designed to quickly shut off the gas flow in the event of an unacceptable pressure being detected within the system it protects

3.5.8

instrumentation pipework

pipework required for the proper functioning of the ancillaries installed within the pressure regulating installation

EXAMPLE Sensing, measuring, auxiliary and sampling lines.

3.5.9

DN

alphanumeric designation of size for components of a pipework system, which is used for reference purposes; it comprises the letters DN followed by a dimensionless whole number, which is directly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

NOTE 1 The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified.

NOTE 2 Where DN designation is used, any relationship between DN and component dimensions are given, e.g. DN/OD or DN/ID.

3.5.10

safety system

system which ensures, independent of the pressure regulating system, that the outlet pressure of that system does not exceed the safety limits

3.6 Definitions relating to tests

3.6.1

strength test

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

3.6.2

tightness test

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

3.6.3

combined test

specific procedure to verify that the pipework and/or installation meets the requirements for mechanical strength and tightness

3.6.4

leak detection fluid

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

3.7 Definition relating to testing and inspection

3.7.1

competent person

person who is trained, experienced and approved to perform activities relating to gas pipework

NOTE Means of approval are determined within each country.

3.8 Definitions relating to assembly processes for metallic materials

3.8.1

welding

joining (union) of two or more parts by heat or pressure or a combination of both (fusion, arc or oxy-acetylene), 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

3.8.2

brazing

operation in which metal parts are joined by means of capillary action of a filler metal in the liquid state with a melting temperature, higher than 450 °C, 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

NOTE This is often referred to as hard soldering.

3.8.3

hot tapping

procedure involving the safe use of heat, e.g. welding or fusion, to affix an attachment to a section of pipework containing gas at pressure

3.9 Definitions relating to pressure regulating and metering

3.9.1

compressors

a complete unit for raising the gas pressure within installation pipework above 0,5 bar to an OP greater than 5 bar

3.9.2

station

gas pressure regulating and/or metering system including (where applicable) the housing, the odourisation facilities and the fenced site

3.9.3

gas pressure regulating and metering system

system comprising all equipment, together with inlet and outlet pipework up to and including the isolating valves, which together performs the functions of pressure regulation, pressure safety and/or quantitative gas measurement, whether or not including pressure boosting and/or gas mixing facilities

3.9.4

monitor

second regulator used as a safety device in series with the active regulator which assumes control of the pressure at a higher set value in the event of the active regulator failing open

4 General

4.1 Quality system

The life of a gas installation can be divided into four phases:

- design;
- construction and testing;
- commissioning;
- operation and maintenance.

A quality system shall be applied to the design, construction, and testing activities in accordance with this standard also considering the requirements for commissioning, operation and maintenance in EN 15001-2. Reference may be made to the EN ISO 9000 series of standards or to equivalent quality system standards.

NOTE After the gas installation has been put into operation, the integrity should be maintained by the programme of operation, maintenance and condition monitoring in accordance with EN 15001-2.

4.2 Selection of materials

4.2.1 Specification

Materials shall be selected to be compatible with anticipated fabrication and to be suitable for the internal fluid and external environment. Both normal operating conditions and transient conditions occurring during fabrication, transport, testing, commissioning and decommissioning shall be taken into account when specifying the materials.

4.2.2 CE marking

Wherever relevant, components shall be CE marked.

4.3 Protection against hazards

4.3.1 Resistance to fire

Pipework including supports shall be designed and constructed to limit the release of gas in case of damage caused by a fire; so as to minimise the possibility of an explosion or a significant increase in the fire.

4.3.2 Resistance to corrosive substances and atmosphere

Pipework including supports in contact with soil or building materials, which can be expected to contain corrosive substances, or in contact with corrosive atmosphere shall be resistant to or protected against these substances.

4.3.3 Protection against variations in the operating pressure

The specifiers and designers of pipework shall ensure that the supply pressure conditions are suitable for the safe operation of the appliances.

4.3.4 Protection against gas hazards

4.3.4.1 General

Gas escaping through apertures in ancillaries can result in a flammable mixture in an enclosed space or in small building areas.

To avoid this, the following provisions may be used:

- the apertures are fitted with vent pipes terminating in a safe location;
- the fitting of restrictions in breather connections, provided the operational performance is not impaired;
- providing extra ventilation to the room.

The above apertures also include breather holes serving diaphragms in pressure regulators and safety devices.

Consideration should also be given to the heavier than air properties of LPG.

4.3.4.2 Zone classification

A risk assessment shall be performed to verify if a hazardous area classification has to be established.

NOTE 1 See Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC). All mechanical and electrical equipment will need to conform with 94/9/EC ATEX when within the scope of this Directive. Reference can also be made to EN 60079-10.

NOTE 2 Normally, pipework designed and constructed to this standard and subsequently maintained in accordance with EN 15001-2, should not leak during its service life.

However, where gas detection systems are to be installed, they shall not be considered as an alternative to good ventilation.

NOTE 3 Gas detection systems should be in compliance with EN 61779-1 to EN 61779-5. They are only reliable when maintained regularly.

4.3.5 Electrical installation

4.3.5.1 Voltage fluctuation

The safety of the gas installation shall not be impaired by the failure or restoration of electric power or by a voltage fluctuation or by overload (flash of lightning).

4.3.5.2 Installation in hazardous area

Electrical installations in hazardous areas shall comply with EN 60079-14.

4.4 Accommodation and location of gas pressure regulating and metering systems, gas pressure compressors and gas mixing systems

4.4.1 Installation in a separate space

4.4.1.1 Requirements for the enclosure of installations

If a gas pressure regulating and metering system for DP upstream greater than 5 bar or a gas mixing system is installed in an isolated enclosed space, the enclosure shall comply with the relevant requirements of EN 12186.

The information contained within EN 12186 may be considered for compressors in the absence of specific recognized standards or information from the manufacturer.

4.4.1.2 Layout of the site and site security

The relevant requirements of EN 12186 shall be met. Compressors shall comply with the manufacturer's indications and/or the national legislation/regulation.

4.4.2 Installation in an appliance room

A gas pressure regulating and metering system for one or more gas appliances may be installed in the same room as the appliance(s) provided there is adequate ventilation and a DP upstream is equal to or less than 5 bar. In this case, the construction, layout, facilities and location of the room shall be subject to the requirements applicable to the gas appliances concerned. For examples, see Figure A.1 and Figure A.2.

Where compressors and/or gas mixing systems are installed, additional safety precautions may be necessary.

An external means of isolation shall be provided.

4.4.3 Protection against adverse influences

Gas pressure regulating and metering systems, gas pressure boosters/compressors and/or gas mixing systems in appliance rooms as referred to in 4.4.2 shall, where necessary, be protected against adverse influences such as corrosion, heat and vibration.

5 Materials

5.1 Standards and specifications for pipes and pipe fittings

5.1.1 General

Pipes and fittings shall be constructed of:

- materials complying with the restrictions given in Tables 1 to 4, 7 and 8; or
- materials given in Annex E.

5.1.2 Carbon steel

5.1.2.1 Pipes

Longitudinally and spiral welded pipes and seamless pipes are permitted:

- steel threaded pipes to a design pressure of 5 bar and nominal diameter of 50 mm;
- welded steel pipes and seamless steel pipes in accordance with EN 10220 with nominal external diameter greater than or equal to 17,2 mm.

As a minimum, the pipe material shall be in conformance with Table 1. They may also be in compliance with EN 13480-2.

Table 1 — Standards for carbon steel pipes

DP	Standard	Steel grade	Elongation (%)	Charpy V (J) >	Operating Temperature - 20 °C to + 40 °C	Upper Yield strength T ≤ 16 mm N/mm ²
≤ 5 bar	EN 10255	L195*	20		X	195
≤ 16 bar	EN 10208-1	L210GA*	25		X	210
		L235GA*	23		X	235
	EN 10217-1	P 235 T1*	23		X	235
	EN 10216-1	P 235 T1*	23		X	235
> 16 bar	EN 10208-2	L245 NB	22	40	X	245
		L290 NB	21	40	X	290
	ISO 9329-2	PH 26	19	27	X	265
	EN 10216-1	P 235 T2	23	27	X	235
		P 265 T2	19	27	X	265
	EN 10217-1	P 235 T2	23	27	X	235
		P 265 T2	19	27	X	265

* Materials listed in Annex E.

5.1.2.2 Pipe fittings

As a minimum, pipe fittings shall be in conformance with Table 2.

Table 2 — Standards and steel grades for pipe fittings

	Dimensions defined in	Steel grade (defined in)	Ductility according to the standard	
			Charpy V (J)>	Elongation (%)>
Tee Bend or elbow Reducer Cap	EN 10253-2	P235 (EN 10253-2)	27	23
		P265 (EN 10253-2)	27	19
Flange	EN 1092-1	S235JR (EN 10025),	27	26
		P245GH (EN 10222-2),		23
		GP240 GH (EN 10213-2)		22

5.1.2.3 Test certificate

5.1.2.3.1 DP greater than 5 bar

Carbon steel pipes and pipe fittings shall, as a minimum, be certificated on the basis of EN 10204 and in accordance with EN 764-5.

5.1.2.3.2 DP less than or equal to 5 bar

Carbon steel pipe and pipe fittings for use with MOP up to and including 5 bar shall be certificated by an inspection document 2.2 in accordance with EN 10204.

For pipework falling in PED, Table 6, Category II or Category III, the certificate shall be in accordance with EN 764-5.

5.1.3 Stainless steel

5.1.3.1 Pipes and pipe fittings (including flanges and valves)

As a minimum, the material shall be in accordance with Table 3.

5.1.3.2 Test certificate

Materials for pressure containing parts compliant with the requirements of this European Standard shall be certified on the basis of EN 10204.

NOTE The certification should be in accordance with EN 764-5.

Table 3 — Standards and EN material numbers for stainless steel

Component	Standards	Material		
		EN material number (EN 10088-3, EN 13480-2)	Ductility according to the EN material number	
			Charpy V (J) >	Elongation (%)
Welded pipe	EN 10217-7	1.4301 1.4306 1.4311 1.4401 1.4404 1.4571	100 100 100 100 100	45 45 40 40 40
Seamless pipes	EN 10216-5			
Tee	EN 10253-2			
Bend				
Reducer				
Convex bottom				
Welding stub	None			
Flange	EN 1092-1			
Valve	EN 13774 EN 14141			

5.1.4 Copper

As a minimum, copper pipes and pipe fittings intended for use with copper pipes shall be in accordance with Table 4.

For pressure limits and wall thickness of copper pipes, see 6.4.2.2.

Table 4 — Standards and material type for copper pipework and pipe fittings

	Standards	Material type
Pipes	EN 1057	R250 (half hard, elongation 20 %, hardness 75 N/mm ² to 100 N/mm ²)
Flanges	EN 1092-3	
Soldered fittings*	EN 1254-1 and EN 1254-5	Bronze or brass
Compression fittings*	EN 1254-2	

* Materials listed in Annex E.

5.1.5 Polyethylene

PE 80* (MRS 8 N/mm²) and PE 100* (MRS 10 N/mm²) pipes and fittings of series SDR 17,6 or SDR 11 shall be in accordance with EN 1555-1 to EN 1555-3.

* Materials listed in Annex E.

5.1.6 Flange types, dimensions and drilling patterns

The pressure class of a flange depends on the type of material, the maximum allowable pressure, and the operating temperature as defined in EN 1092-1 and EN 1759-1.

5.1.7 Threaded joint sealants

A sealant in accordance with EN 751-1, EN 751-2 or EN 751-3 shall be used in combination with the self-sealing thread.

5.1.8 Requirements for prevention of cracking and control of elongation

5.1.8.1 Weldability

Where the material standard is not listed in Table 1, the chemical composition of steels intended for welding or forming shall not exceed the values in Table 5. Exceptions shall be technically justified (weldability test) and agreed between the parties involved.

Table 5 — Maximum carbon, phosphorus and sulphur content of steel for welding and forming

Steel group	Maximum content of cast analysis		
	% C	% P	% S
Carbon steel	0,21	0,035	0,030
Stainless steel	0,08	0,045	0,015

For stainless steel products to be machined, a controlled sulphur content of 0,015 % to 0,030 % may be permitted by agreement provided the resistance to corrosion is satisfied for the intended purpose.

For carbon steel products the sum of sulphur and phosphorus as a total of the ladle analysis shall be less than, or equal to 0,050 %.

To meet the weldability criteria, the value of the carbon equivalent (CE) of carbon steels shall be less than or equal to 0,45 for grades with specified minimum yield strength (SMYS) not exceeding 360 N/mm², unless otherwise agreed between the parties involved. This value shall be guaranteed by the manufacturer.

Carbon equivalent is given by the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

where

CE is the carbon equivalent;

C is the weight percentage of carbon content;

Mn is the weight percentage of manganese content;

Cr is the weight percentage of chromium content;

Mo is the weight percentage of molybdenum content;

V is the weight percentage of vanadium content;

Cu is the weight percentage of copper content;

Ni is the weight percentage of nickel content.

5.1.8.2 Notch impact strength and elongation

Steels for pipework for a MOP greater than 16 bar and with a wall thickness greater than 5 mm shall have specified minimum impact energy measured on Charpy V notch test specimen (EN 10045-1) that is:

— ≥ 27 J for carbon steel;

— ≥ 40 J for stainless steel;

at a temperature not higher than 20 °C. The test temperature and the requirements of EN 13480-2, Annex B, shall apply.

Carbon steel materials shall be subjected to a tensile test carried out by a standard procedure, its elongation after rupture shall be no less than 14 % and its bending rupture energy measured on an ISO V test-piece shall be less than 27 J, at a temperature not greater than 20 °C but not higher than the lowest scheduled operating temperature.

5.2 Ancillaries

5.2.1 Pressure and materials

Minimum material requirements for ancillaries not otherwise specified in this standard shall be at least in accordance with Table 6.

Table 6 — Materials for ancillaries

Design Pressure	Above-ground	Buried
< 5 bar	Brass; Aluminium alloy ^a ; Steel; Nodular/spheroidal graphite cast iron in accordance with Table 7 ^b	Steel; Nodular/spheroidal graphite cast iron in accordance with Table 7; Approved plastic and suitable for purpose.
≥ 5 bar to 16 bar	Steel Nodular/spheroidal graphite cast iron grade EN-GJS-400-18-LT ^c	
^a Not to be used for appliance isolation. ^b Appliance isolating valve EN-GJS-400-18-LT or equivalent. ^c Standards equivalent in terms of their mechanical properties (tensile strength, yield limit and elongation over 10 %) are also acceptable.		

Table 7 — Nodular/spheroidal graphite cast iron grades with elongation over 14 %

Standard	Ductility according to the standard		Designation	Required safety factor EN 13445-6
	Charpy V (J) >	Elongation (%)		
EN 1563	12 (at – 40 °C ± 2 °C)	22	EN-GJS-350-22-LT*	2,4
	12 (at – 20 °C ± 2 °C)	18	EN-GJS-400-18-LT*	2,4
	17 (at 23 °C ± 5 °C)	22	EN-GJS-350-22-RT*	3,5
		22	EN-GJS-350-22*	3,5
	14 (at 23 °C ± 5 °C)	18	EN-GJS-400-18-RT*	3,5
		18	EN-GJS-400-18*	3,5
		15	EN-GJS-400-15*	3,5

* Materials listed in Annex E.

5.2.2 Valves

Valves, if applicable, shall meet the requirements of EN 331, EN 1555-4, EN 12266-1, EN 13774 and/or EN 14141 (see Annex E).

5.3 Gas pressure regulating and safety systems

5.3.1 Pipe materials, pipe fittings and ancillaries

Materials for instrumentation pipes shall be in accordance with EN 1057 and EN 10088-1.

Materials for connectors (compression fittings) shall be in accordance with Table 8.

Materials for bolts, screws, studs and nuts shall be in accordance with Table 8.

All other metallic materials for pipes, fittings and joints in regulating and metering systems, other than instrumentation pipework, shall meet the requirements of Clause 5 of this Standard.

Gas pressure regulators shall meet the requirements of EN 334 for natural gas, manufactured gas and EN 13785 or EN 13786 for LPG.

Safety slam shut devices shall meet the requirements of EN 14382.

Creep relief valves shall meet the requirements of EN 334.

Table 8 — Materials for compression fittings, bolts, nuts, etc.

Materials			Restrictions
Description	Type	Relevant standard	DP bar
Compression* fittings	11 SMnPb30/1.0718 and 11 SMnPb37/1.0737 both with a min 8 % and $5 \leq d \leq 100$	EN 10087	60 ^a
	All steel designations	EN 10088-3	
Bolts, screws, studs and nuts*	Class 10.9	EN ISO 898-1	50
	Class 10 for nuts	EN 20898-2	
	Class 4.6, 5.6, 8.8	EN ISO 898-1	60 ^a
	Grade A2ss, A4ss	EN ISO 3506-1 EN ISO 3506-2	
	Classes 5, 8, 9 for nuts	EN 20898-2	
^a These materials are generally applicable up to 100 bar.			

* Materials listed in Annex E.

6 Design of pipework

6.1 General

6.1.1 Installation drawings and technical file

The user shall ensure that a technical file is available and that it contains the following information (with parts lists where appropriate):

- the manufacturers technical file under PED;
- the location (route) of the installation pipework;
- the pipe diameters, MIP, DP, OP, materials and coatings;
- the location and design of supports;
- the location and design of wall and floor transits, points where pipework crosses or runs parallel with other systems, etc.;
- location of ancillaries, stating the make, type, connection sizes and type of material;
- joints, gaskets, bolts, etc.;
- location and layout of internal gas pressure regulating systems, stating the required settings for regulators and safety devices;
- the location and sizes of valved points for testing and purging;

- maximum flow in pipework sections including any extension, expressed in m³/h under normal conditions of gas;
- cathodic protection system, where fitted.

The gas appliances to be connected to the system shall be specified separately, stating:

- supplier/make and type;
- maximum flow, in m³/h under normal conditions of gas;
- minimum and maximum operating pressure.

6.1.2 Measuring and test instruments

Gas installations shall incorporate such measuring instruments and test points as are necessary for its safe operation.

A threaded valve with integral means of depressurisation, having a 15 mm connection in accordance with EN 10226-1 shall be provided at an accessible and appropriate point of the pipework for pressure measurement and sampling.

6.1.3 Properties of gas

If a gas is toxic or corrosive or contains moisture, then this shall be taken into account. Condensation of gas is not permissible.

NOTE Some manufactured or process gases can be toxic, corrosive or 'wet'. Higher hydrocarbon gases can be heavier than air.

In case of possible exceeding the temperature limits of - 20 °C and + 40 °C, a temperature monitoring device shall be provided.

6.2 Layout

6.2.1 Limits of the pipework location

Pipework shall be laid, if possible, within the property for which the gas installation is intended.

6.2.2 Above-ground pipework

Whether installed in a building or above ground within the site, gas pipework shall:

- be able to absorb expansion;
- be well supported;
- not be exposed to mechanical damage;
- not be of PE-pipe unless encased in a steel sleeve, see 6.6.6.1.

The design shall take into account the adverse effects of stray currents, lightning and differing electrical potentials between nearby metallic components.

6.2.3 Buried pipework

The pipework design shall take account of any future requirements for inspection and repair.

Buried pipework shall not impair the building's construction and shall be protected against movement of the building (such as through the use of a protective sleeve), see 8.3.1. Above 5 bar, buried pipework below buildings is not permitted. For systems up to 5 bar, it may be permissible to locate pipework under buildings on the completion of a risk assessment to determine any additional safety precautions or constructional requirements.

6.2.4 Distance between buried pipework and buildings

Except at the point where the pipe enters a building, pipework should be located at least 1 m away from any building or structure.

6.2.5 Unacceptable locations for gas pipework in buildings

Pipework shall not be laid in:

- wall cavities, walls or ceilings except for pipe transits employing a pipe sleeve;
- chimneys, flue ducts or ventilation ducts and ducts forming part of an air conditioning system;
- garbage chutes, fuel chutes or lift shafts;
- immediately adjacent to hot or refrigerated services or high voltage cables unless taken into account in the design.

6.3 Dimensioning

6.3.1 Pressure loss

At maximum flow, the pressure drop shall not exceed 10 % of the OP in the case of gas appliances without pressure regulators.

In the case of appliances with pressure regulators, the pressure shall not be outside that specified for the safe operation of all connected appliances under all operating and flow conditions.

6.3.2 Gas velocity

In the metering and regulating systems, the design shall be limited to 20 m/s to prevent erosion and flow-induced pulsation, the velocity of the gas in the pipe should not exceed 25 m/s. For higher velocities flow-induced pulsation calculations shall be made and noise and erosion aspects should be taken into account.

NOTE VDI 3733 may be consulted for designs based on noise criteria.

6.4 Pressure and wall thickness

6.4.1 DP and test pressure

DP and STP of the gas installation are based on the MOP of the point of delivery. **DP is equivalent to the maximum allowable pressure (PS) as given in PED.** The MIP at the point of delivery shall be less than or equal to 1,1 times the DP. Components shall be chosen in such a way that they are leak tight at a pressure at least equal to the MIP.

Table 9 — Required STP/CTP in relation to DP

DP bar	STP/CTP bar
> 40	≥ 1,43 DP
16 < DP ≤ 40	≥ 1,43 DP
5 < DP ≤ 16	≥ 1,43 DP
2 < DP ≤ 5	≥ 1,43 DP
0,5 < DP ≤ 2	> 1,75 DP

6.4.2 Pipe wall thickness

6.4.2.1 Steel pipe

6.4.2.1.1 General

The wall thickness of carbon steel pipes shall be at least equal to the relevant value given in Table 10 below.

The wall thickness as stated in Table 10 for carbon steel is the calculated minimum wall thickness plus the absolute value of the negative tolerance taken from the material standards or as provided by the pipe manufacturer and the corrosion allowance. Site conditions can alter the corrosion allowance.

The dimensions have been rounded off to standard pipe sizes, taking into account ease of handling and weldability.

6.4.2.1.2 Straight pipe wall thickness determination

If no additional requirements are imposed, for straight pipe the minimum wall thickness to withstand the internal pressure is calculated as follows:

$$T_{\min} = \frac{DP \times D}{20 \sigma_p \times z}$$

with the requirement that:

$$\sigma_p \leq f_0 \times R_{t0,5}(\theta)$$

where

$T_{\min}$ is the calculated minimum wall thickness, in millimetres (mm);

DP is the design pressure, in bar;

D is the outside diameter of the pipe, in millimetres (mm);

if D_i is preset, D shall equal $D_i + 2 T_{\min}$, D_i being the inside diameter in millimetres (mm);

σ_p is the hoop stress, in Newton per square millimetre (N/mm²);

f_0 is the design factor;

$R_{t0,5}(\theta)$ is the specified minimum yield strength at the design temperature, in Newton per square millimetre (N/mm²);

$R_{t0,5}$ is the specified minimum yield strength at ambient temperature, in Newton per square millimetre (N/mm²) (see EN 10002-1);

z joint coefficient.

NOTE If temperature less than or equal to 60 °C, $R_{t0,5}(\theta)$ is equal to $R_{t0,5}$.

If the temperature is over 60 °C, the value of the specified minimum yield strength has to be corrected for the temperature.

6.4.2.1.3 Calculation conditions for Table 10

The wall thicknesses shown in the table are calculated using the following:

- maximum design factor f_o shall be 0,45;
- z is taken as 1 for equipment subject to destructive and non destructive testing which confirm that the whole series of joints show no significant defects;
 - for equipment subject to random non destructive testing, z is taken as 0,85;
 - for equipment not subject to non-destructive testing other than visual inspection, z is taken as 0,7;
- $R_{t0,5}$ is taken as 240 N/mm² (from material specification);
- external corrosion allowance taken as:
 - carbon steel 2 mm;
 - stainless steel 0 mm;
- supported in accordance with 6.6.6, or else laid in an open trench;
- measures to prevent additional loads affecting the pipe, for example crossings with roads and railway tracks;
- service temperature between - 20 °C and 40 °C;
- no other loads other than those in the note in Table 17, and the depth of cover is not to exceed 3 m;
- no corrosive components in the gas;
- no pipe bends made on the user's site with a radius smaller than 20 D_o (outside diameter), nor any such bends where DP exceeds 10 bar.

In other cases, the wall thickness shall be calculated in accordance with EN 1594 or EN 12007-3 or EN 13480-6 for buried pipes and in accordance with EN 13480-3 for above-ground pipework. In all cases the design factor of 0,45 is recommended for use.

Table 10 — Minimum wall thickness of steel pipes as a function of diameter and DP

Nominal pipe diameter (DN)	Outside diameter mm	Minimum wall thickness mm											
		DP bar											
		≤ 1	≤ 10	≤ 16	≤ 25	≤ 40	≤ 50	≤ 60	≤ 16	≤ 25	≤ 40	≤ 50	≤ 60
		Material											
		Carbon steel welded and seamless							Stainless steel welded and seamless				
		Smooth (threaded)	Smooth (threaded ≤ 5 bar)	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth				
15	21,3	2,6 (3,2)	2,6 (3,2)	2,6	3,6	3,6	3,7	3,7	2,6	2,6	2,6	2,6	2,6
20	26,9	2,6 (3,2)	2,6 (3,2)	2,6	3,6	3,6	3,9	3,9	2,6	2,6	2,6	2,9	2,9
25	33,7	2,6 (3,2)	2,6 (3,2)	2,6	3,6	3,6	4,5	4,5	2,6	2,6	2,6	3,2	3,2
40	48,3	2,6 (3,2)	2,6 (3,2)	2,6	3,6	3,6	5,0	5,0	2,6	3,6	3,6	3,6	3,6
50	60,3	2,9 (3,6)	2,9 (3,6)	2,9	3,6	3,6	5,6	5,6	2,9	3,6	3,6	4,0	4,0
65	76,1	2,9	2,9	2,9	3,6	3,6	5,2	5,6	2,9	3,6	3,6	5,0	5,0
80	88,9	3,2	3,2	3,2	3,6	4,0	5,6	5,6	3,2	3,6	3,6	5,6	5,6
100	114,3	3,6	3,6	3,6	3,6	4,5	6,3	6,3	3,2	3,6	3,6	6,3	6,3
125	139,7	4,0	4,0	4,0	4,0	5,6	6,6	6,6	3,6	4,0	4,0	6,3	6,3
150	168,3	4,5	4,5	4,5	4,5	5,6	7,1	7,1	4	4,5	5,0	7,1	7,1
200	219,1	5,9	5,9	6,3	6,3	7,1	8,0		4,5	6,0	6,3	8,0	
250	273,0	6,3	6,3	7,1	7,1	8,0	10,0		5	6,3	8,2	10,0	
300	323,9	7,1	7,1	8,0	8,0	8,8	-		5,6	6,3	9,5	-	

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Table 10 (continued)

Nominal pipe diameter (DN)	Outside diameter mm	Minimum wall thickness mm											
		DP bar											
		≤ 1	≤ 10	≤ 16	≤ 25	≤ 40	≤ 50	≤ 60	≤ 16	≤ 25	≤ 40	≤ 50	≤ 60
		Material											
		Carbon steel welded and seamless							Stainless steel welded and seamless				
		Smooth (threaded)	Smooth (threaded)	Smooth (threaded)	Smooth	Smooth	Smooth	Smooth	Smooth				
350	355,6	7,1	7,1	8,0	8,0	10,0	-		-	-	-	-	
400	406,4	7,1	7,1	8,8	8,8	-	-		-	-	-	-	
450	457,2	7,1	7,1	10,0	-	-	-		-	-	-	-	
500	508,0	7,1	7,1	10,0	-	-	-		-	-	-	-	

6.4.2.2 Copper pipes

6.4.2.2.1 General

The wall thickness and DP of copper pipes shall be in accordance with Table 11.

Table 11 — Wall thickness for copper pipework

DP ≤ 10 bar	
Outside diameter ^a mm	Wall thickness mm
12/15/18/22	1,0
28/42	1,5
54/64/76,1/88,9	2,0
^a For tolerance, see EN 1057.	

6.4.2.2.2 Calculation of the wall thickness

The minimum wall thickness is calculated as follows:

$$T_{\min} = \frac{DP \times D_a}{1\,000 + DP}$$

where

$T_{\min}$ is the calculated minimum wall thickness, in millimetres (mm);

DP is the design pressure, in bar;

D_a is the average diameter of the pipe, in millimetres (mm);

1 000 is factor resulting from calculation constant 20 (bar × mm²), from special tensile strength, $R = 200 \text{ N/mm}^2$ and a safety factor of 4.

6.4.2.2.3 Limits for using copper pipework given in Table 11

The wall thicknesses shown in the table are calculated using the following:

- supported according to 6.6.6.3;
- only above-ground;
- no internal and external corrosion allowance;
- bends made at the user's site shall be made according to the pipe manufacturer's instructions;
- no external loadings.

6.4.2.3 PE pipes

6.4.2.3.1 General

The DP corresponding to the wall thickness and the material shall be selected according to Table 12.

Table 12 — DP for PE pipe

	PE 80 bar	PE 100 bar
SDR 11	8	10
SDR 17,6	5	6

NOTE At the time of publication of this standard, PE 80 products are only available up to 5 bar.

6.4.2.3.2 Selection of the standard dimension rate (SDR)

The SDR ratio shall be calculated according to the following formulae:

$$SDR = \frac{20 MRS + DP \times C \times D_F}{DP \times C \times D_F}$$

where

- DP is the design pressure, in bar;
- MRS is the minimum required strength, in N/mm²;
- C is overall service (design) coefficient;
- SDR is standard dimension ratio $\approx \frac{D}{T}$;
- D is the nominal outside diameter;
- T is the nominal wall thickness;
- D_F is the derating factor.

NOTE The derating factor is a coefficient, which takes into account the influence of the operating temperature. Temperature derating coefficients are given in Table 13.

Table 13 — Temperature derating coefficients

Temperature °C	Derating coefficient
Up to/including 20	1,0
20 to 30	1,1
30 to 40	1,3

PE pipes are available in a standardised SDR series. In order to select the right standardised SDR series, the first value of SDR series lower than the calculated value shall be selected.

EXAMPLE Calculated value of SDR is 17,2. The first lower series is SDR 11 (see Table 12).

6.4.2.3.3 Limits for using PE pipe in the SDR Series

The conditions that apply to the standard SDR series are:

- The overall design coefficient shall be greater than or equal to 2 based on the DP of the SDR series.
- The ratio of critical RCP pressure (P_{RCP}) to DP shall be greater than or equal to 1,5. P_{RCP} is the critical pressure level at which a rapid crack propagation (RCP) can occur in a pipe, defined at a reference temperature. The critical RCP pressure is based on a temperature of 0 °C (see EN 12007-2).

NOTE Where the pipe temperature is below 0 °C, the P_{RCP}/DP ratio should be recalculated in accordance with EN 1555-5 using a value of RCP pressure determined from the minimum expected operating temperature of the pipe. If necessary, the value of DP should be reduced so as to maintain the P_{RCP}/DP ratio at a value greater than or equal to 1,5.

- Bending on site shall be in accordance with 8.10.2.
- Pipe trench filling should be in accordance with 8.9.4.
- Pipework is normally to be buried.

6.5 Safety engineering

6.5.1 Principles of pipework

The pipework design shall take account of any future requirements for inspection and repair.

Above ground pipework shall be protected against mechanical damage.

The number of joints shall be kept to a minimum.

Where pipes are subject to vibration, flexible hoses shall be used unless other means of removing the effects of the vibration are employed. Flexible connections and fittings shall be in accordance with EN ISO 10806 or EN ISO 10380.

Gas pipework which is subject to temperature variations that could lead to excessive stresses shall incorporate means such as bellows or other expansion joints to remove those stresses. This is not normally needed where the temperature variation is less than 60 K. Bellows shall be in accordance with ISO 15348.

Compression joints shall be suitable for the application and should not be used as part of the main supply pipework. However, PE to steel transition fittings may be used.

Twin ferrule type joints may be used for applications above 5 bar for steel instrumentation and ancillary pipework.

6.5.2 Isolation of the gas supply

6.5.2.1 Isolation in an emergency

A quick-acting manual isolating valve shall be installed in the pipework at a readily accessible position for use in an emergency.

The isolating valve shall be fitted in the pipework at one of the following readily-accessible locations and its location visibly indicated:

- before the point of entry into a building – in this case, it shall be possible to operate the valve at a distance of;
 - for buried valves, no more than 20 m and preferably more than 1 m from the building or installation; consideration should be given to the potential for gas leakage from joints near to buildings;
 - for above ground valves, no more than 20 m from the building or installation;
- immediately after the point of entry in a building – in this case, it shall be possible to operate the valve close to the entrance on the outside of the building.

Buried valves shall not be located in any area where vehicular parking can occur.

Examples are given in Figure 1 and Figure 2.