INTERNATIONAL STANDARD

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Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications —

Part 4: System design and installation guidelines

Tubes et raccords en matières plastiques — Systèmes de tubes en polyéthylène réticulé (PE-X) pour le transport de combustibles gazeux — Série métrique — Spécifications —

Partie 4: Lignes directrices pour la conception et l'installation du système

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 14531-4 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastic pipes and fittings for the supply of gaseous fuels*.

ISO 14531 consists of the following parts, under the general title *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications*:

— *Part 1: Pipes*

— *Part 2: Fittings for heat-fusion jointing*

— *Part 3: Fittings for mechanical jointing (including PE-X/metal transitions)*

— *Part 4: System design and installation guidelines*

Introduction

Further to the publication of International Standards for crosslinked polyethylene (PE-X) hot-water pipes, it has become evident that the properties of PE-X, in particular its high fracture resistance and a recently established socket and saddle fusion-jointing capability, render it suitable for use in high-performance gas-distribution systems. The philosophy of ISO 14531 is to provide the basis for the introduction of PE-X gas pipe systems by the specification of a performance envelope beyond that covered by existing PE standards in order to take its application into regimes of higher operating pressures and extremes of operating temperature.

This part of ISO 14531 is therefore one part of a four-part system standard covering pipes, fittings for heat-fusion jointing, fittings for mechanical jointing and design and installation guidelines. The content is suitable for use by procurement authorities and distribution engineers responsible for the design, installation and operation of pipeline systems.

Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications —

Part 4: System design and installation guidelines

1 Scope

This part of ISO 14531 provides guidance for the design, construction, installation and on-site testing of PE-X pipeline systems. The standard deals with trenchless and open-trench installation methods.

This part of ISO 14531, when used in conjunction with the other parts of ISO 14531, provides the basis for the design, manufacture and installation of PE-X piping systems (PE-X pipes, and PE-X and PE heat-fusion fittings and mechanical fittings) for the supply of category D and category E hydrocarbon-based fuels (see ISO 13623) at

a) maximum operating pressures (MOPs) up to and including 16 bar [1] and

b) a maximum operating temperature of +60 °C and

c) a minimum operating temperature of

   1) −50 °C

   2) −35 °C

   3) −20 °C.

This part of ISO 14531 provides for the jointing and installation of PE-X and PE heat-fusion fittings and mechanical fittings to PE-X pipes within the temperature range −5 °C to +40 °C. The jointing of pipes and fittings outside the stated temperature range should be the subject of consultation between the pipeline operator and the pipe, fitting and equipment manufacturers.

Users of this part of ISO 14531 should be aware that useful supplementary information is given in the standards listed in the bibliography.

1) 1 bar = 10^5 N/m^2 = 100 kPa.

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.

ISO 4065, *Thermoplastic pipes — Universal wall thickness table*

ISO 8085-3, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 10838 (all parts), *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels*

ISO/TS 10839:2000, *Polyethylene pipes and fittings for the supply of gaseous fuels — Code of practice for design, handling and installation*

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 12176-2, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion*

ISO 13623, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 13760, *Plastics pipes for the conveyance of fluids under pressure — Miner's rule — Calculation method for cumulative damage*

ISO 14531-1:2002, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes*

ISO 14531-2, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 2: Fittings for heat-fusion jointing*

ISO 14531-3, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 3: Fittings for mechanical jointing (including PE-X/metal transitions)*

EN 12007-1, *Gas supply systems — Pipelines for maximum operating pressure up to and including 16 bar — Part 1: General functional recommendations*

EN 12007-2, *Gas supply systems — 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)*

3 Terms and definitions

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

3.1
nominal outside diameter
d_n
numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size

NOTE 1 It is a convenient round number for reference purposes.

NOTE 2 The nominal outside diameter expressed in millimetres is the minimum mean outside diameter $d_{e,min}$ of pipe produced in accordance with ISO 14531-1.

3.2
nominal wall thickness
e_n
nominal designation of wall thickness of a pipe in millimetres in accordance with ISO 4065

3.3
standard dimension ratio
SDR
ratio of the nominal outside diameter of a pipe to its nominal wall thickness

$$SDR = \frac{d_n}{e_n}$$

NOTE The value of the SDR is selected from Table 5 in ISO 14531-1:2002.

3.4
gaseous fuel
fuel which is in a gaseous state at a temperature of +15 °C and a pressure of 1 bar

3.5
category D gaseous fuel
natural gas

NOTE Categories of gaseous and liquid fuels are defined in detail in ISO 13623.

3.6
category E gaseous fuel
LPG vapour or natural gas conveyed in association with liquid condensate

NOTE Categories of gaseous and liquid fuels are defined in detail in ISO 13623.

3.7
design pressure
DP
pressure on which design calculations are based

NOTE The design pressure for pipes is designated DP_P and for fittings DP_F.

3.8
design stress
σ_S
pipe wall circumferential stress calculated from the design pressure DP_P and pipe SDR with a maximum limiting value determined by the quotient of $MRS_{\theta,t}$ and the overall service (design) coefficient C

3.9
maximum operating pressure
MOP
highest effective pressure, in bars, of the gas in the piping system which is allowed in continuous use

NOTE The MOP takes into account the physical and the mechanical characteristics of the components of a piping system.

3.10
temporary operating pressure
TOP
maximum pressure that can be generated on a temporary basis under the control of the regulating devices

3.11
maximum incidental pressure
MIP
maximum pressure generated for example by surges or failure of pressure control equipment and limited by the activation of overpressure protection devices

3.12
pipeline operator
private or public organization authorized to design, construct and/or operate and maintain the gas supply system

3.13
minimum required strength
MRS$_{\theta, t}$
value of σ_{lpl} for the pipe material, in megapascals, calculated using ISO 9080 for a specific design temperature θ and lifetime t and then categorized in accordance with Table 3

NOTE At 20 °C and 50 years, MRS$_{\theta, t}$ = MRS.

3.14
overall service (design) coefficient
C
overall coefficient, with a value greater than 1,0, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower prediction limit (3.15)

3.15
lower prediction limit
σ_{lpl}
quantity, expressed in megapascals, which can be considered as a property of the material and which represents the 97,5 % lower prediction limit of the long-term hydrostatic strength at a temperature of 20 °C and a time of 50 years in water

3.16
heat-fusion fitting
fitting designed to connect PE-X pipes to form an assembly for subsequent jointing by heat fusion and the creation of an integral pipe-to-fitting connection

3.17
operating-temperature range
assumed range of temperatures experienced by a PE-X pipeline at the intended service location, for use in the process of designing the pipeline for operation at MOP

3.18
minimum operating temperature
T_{min}
minimum operating temperature (above and/or below ground) expected during the service life of the pipeline

3.19
maximum operating temperature
T_{max}
maximum operating temperature (above and/or below ground) expected during the service life of the pipeline

3.20
design temperature
θ
temperature used to determine MRS$_{\theta, t}$

NOTE See 4.1.5.3.

4 Requirements

4.1 Design

4.1.1 General

The design pressure (DP) of any PE-X pipeline component shall not be less than the intended maximum operating pressure (MOP) of the pipeline. The DP shall be at least 2,0 bar. The MOP shall be selected from a range of pressures up to a maximum of 16 bar in accordance with the requirements of the pipeline operator.

NOTE Requirements for MOP in the gas industry are not standardized on the basis of PN pressure ratings. An alternative classification system has been adopted in CEN (EN 12007) and is incorporated in Table 1.

Operating pressures during transient conditions in excess of MOP are permitted provided they are of limited frequency and duration. Guidance regarding acceptable levels of transient operating pressure conditions is given in 4.1.3.

The normal permissible operating-temperature ranges for PE-X pipelines extend from –50 °C to a maximum of +60 °C and are applicable up to the maximum pressure (MOP) of 16 bar. Limiting temperatures are dependent upon the materials used in the manufacture of pipes and fittings (see 4.1.4). Operating temperatures up to 70 °C are not excluded by this part of ISO 14531 provided local regulations permit.

4.1.2 Materials

The materials and components used in PE-X pipelines shall conform to ISO 14531-1, ISO 14531-2 or ISO 14531-3, as appropriate.

Other materials, components and equipment used shall conform to a relevant ISO standard or appropriate national standard that ensures a product fit for the purpose intended.

4.1.3 Pressure ranges

Internal pressures generated in PE-X pipelines under transient operating conditions should not exceed the values given in Table 1.

Table 1 — Transient pressure limits

Pressures in bars

Maximum operating pressure (MOP)	Temporary operating pressure (TOP) [a]	Maximum incidental pressure (MIP) [b]
$5 < MOP \leqslant 16$	1,20 × MOP	1,30 × MOP
$2 < MOP \leqslant 5$	1,30 × MOP	1,40 × MOP
$0,1 < MOP \leqslant 2$	1,50 × MOP	1,75 × MOP
$MOP \leqslant 0,1$	1,50 × MOP	2,50 × MOP

[a] TOP is the maximum pressure that can be generated on a temporary basis under the control of the regulating devices.

[b] MIP is, for example, the maximum pressure generated by surges or failure of pressure control equipment and is limited by the activation of overpressure protection devices.

The use of pipes at TOP shall be the responsibility of the pipeline operator. Acceptability for use at TOP can be assessed using Miner's rule in a supplementary design calculation undertaken in accordance with the guidelines given in Annex A and in conjunction with the pipe manufacturer.