
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)**

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

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Partie 3: Raccords pour assemblage mécanique (y compris transitions PE-X/métal)



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 14531-3 was prepared by Technical Committee ISO/TC 138, *Plastic pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastic pipes and fittings for the supply of gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 14531-3:2006), of which it constitutes a minor revision.

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.

This part of ISO 14531 is structured to ensure the supply of mechanical fittings with an end-load resistance greater than that exhibited by the pipe(s) to which the fittings are connected.

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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)

1 Scope

This part of ISO 14531 specifies the physical properties and mechanical-performance requirements for full-end-load-resistant mechanical fittings for use in the connection of crosslinked polyethylene (PE-X) pipes conforming to ISO 14531-1 and in the construction of transition assemblies for joining PE-X pipes to metal pipes having plain spigot, screw thread, compression socket and flange terminations. In addition, it lays down dimensional requirements and specifies some general material properties (including chemical resistance) together with a classification scheme for PE-X fitting materials produced in the form of pipe.

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, PE-X 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 bar¹⁾ 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.

Conformity to this part of ISO 14531-3 of mechanical fittings produced in accordance with ISO 10838-1, ISO 10838-2 or ISO 10838-3 may be claimed subject to the satisfactory conclusion of the tests listed in 5.6 and an end-use restriction on operating temperatures to the temperature range -20 °C to +40 °C.

NOTE It is recognized that mechanical fittings conforming to ISO 10838-1, ISO 10838-2 or ISO 10838-3 are limited to a maximum operating temperature of 40 °C. Provision is made in ISO 14531-4 for the use on a restricted-temperature basis of ISO 10838 fittings conforming to 5.6 in conjunction with PE-X pipes conforming to ISO 14531-1. The fitting manufacturer's technical file should also be consulted for relevant supporting information.

For installation purposes, this part of ISO 14531 provides for the jointing of mechanical fittings to PE-X pipes within the temperature range -5 °C to +40 °C.

1) 1 bar = 10⁵ N/m² = 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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 1167-1, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces*

ISO 1167-3, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 3: Preparation of components*

ISO 16010, *Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids*

ISO 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*

ISO 3458, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of leakproofness under internal pressure*

ISO 4437, *Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications*

ISO 8085-3:2001, *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 10838-1:2000, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 1: Metal fittings for pipes of nominal outside diameter less than or equal to 63 mm*

ISO 10838-2:2000, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 2: Metal fittings for pipes of nominal outside diameter greater than 63 mm*

ISO 10838-3:2001, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 3: Thermoplastics fittings for pipes of nominal outside diameter less than or equal to 63 mm*

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

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

ISO 13951, *Plastics piping systems — Test method for the resistance of polyolefin pipe/pipe or pipe/fitting assemblies to tensile loading*

ISO 13957, *Plastics pipes and fittings — Polyethylene (PE) tapping tees — Test method for impact resistance*

ISO 14531-1, *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 14531-4:2006, *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*

ISO 16010, *Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids*

ISO 19899, *Plastics piping systems — Polyolefin pipes and mechanical fitting assemblies — Test method for the resistance to end load (AREL test)*

3 Terms and definitions

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

3.1

mechanical fitting

fitting within a pipeline system that relies, fully or in part, upon the mechanical loading of component parts to effect a pipeline seal that provides pressure integrity, leaktightness and resistance to end loads

3.2

end-load resistance

resistance to end load transmitted via the connecting pipe and generated by internal pressure, pipeline external interference and thermally induced pipe stresses in any combination

NOTE Full-end-load resistance is the condition in which the joint is stronger than the connecting pipe when exposed to all applied end loads.

3.3

design temperature

θ

temperature used to determine the minimum required strength $MRS_{\theta, t}$

NOTE See ISO 14531-4.

3.4

design pressure

DP_F

pressure upon which design calculations are based

NOTE 1 See ISO 14531-4.

NOTE 2 For fittings, the design pressure is designated DP_F , whereas for pipes it is designated DP_P .

4 Materials

4.1 General

The materials from which the fitting components are manufactured shall have properties consistent with the production of a mechanical fitting with a pressure and end-load resistance equal to or better than that of the connecting PE-X pipes over the intended design life.

Materials (e.g. plastics, rubbers and metals) utilized in the manufacture of fittings conforming to this International Standard shall be supplied in accordance with a relevant ISO standard. For rubber ring seals, the applicable standard shall be ISO 16010; for PE and PE-X materials the standard shall be ISO 14531-2.

Alternative standards may be utilized in cases where suitable ISO standards do not exist. In such cases, fitness for purpose shall be established.

All metal parts susceptible to corrosion shall be adequately protected. When dissimilar metallic materials are used which may be in contact with moisture, steps shall be taken to avoid the possibility of galvanic corrosion.

The manufacturer of the fittings shall maintain the availability of a technical file (generally confidential) with all relevant data to prove the conformity of fittings to this part of ISO 14531. Any change in the materials used that is likely to affect product quality and performance shall require a re-assessment of material performance against the requirements of this part of ISO 14531.

4.2 Strength

The susceptibility of materials to crack failure in locations of high stress concentration, e.g. at threads, shall be examined. Materials shown to be vulnerable to brittle fracture throughout the specified operating temperature range(s) as given in Clause 1 shall be discarded as failing to conform to this part of ISO 14531.

Thermoplastic materials (reinforced and un-reinforced) incorporated in fitting components subjected to long-term, time-dependent tensile stresses shall be evaluated in the form of pipe in accordance with ISO 9080, and the MRS determined for classification in accordance with ISO 12162. Materials that are shown by the test to be likely to exhibit premature failure at the intended maximum operating temperature within the fitting design life shall be rejected as unsuitable for use.

Unclassified materials may be introduced provided fitting assemblies containing such unclassified material elements are subjected to long-term hydrostatic-strength tests to demonstrate that the MRS of the connecting PE-X pipe(s) is not impaired in such cases.

4.3 Chemical resistance

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The selection of component materials shall take into account the effect of gas stream chemicals associated with the transport of category D and category E gaseous fuels, as classified by ISO 13623, on the material properties of components contained within the fitting assembly.

The demonstration of adequate chemical resistance shall be made by subjecting a joint assembly to the test listed in Table 1 and by the provision for consideration by the pipeline operator of relevant environmental stress cracking failure data from tests using chemical compounds encountered in, or external to, gas piping systems.

NOTE Materials should have a demonstrated resistance to environmental stress cracking when exposed, under stress, to chemical compounds encountered in, or external to, gas piping systems since liquids such as antifreeze agents, odorants and hydrocarbons are known to have a deleterious effect on some plastics, particularly under service conditions.

Table 1 — Chemical resistance

Characteristic	Units	Requirement	Test parameters	Test method
Resistance to gas constituents	h	No failure when tested to 1 000 h	Temperature: 80 °C Pipe hoop stress: 2 MPa	ISO 1167-1 Test piece in accordance with ISO 1167-2 Type A end caps Annex A

4.4 Lubricants

Lubricants and/or greases may be used to assist in joint assembly or for corrosion protection subject to the following measures being taken:

- a) The fitting manufacturer shall provide evidence that the lubricant and/or grease does not have a deleterious effect on the performance of the component parts of the fitting likely to be in contact with the connecting PE-X pipe.
- b) The fitting assemblies used for testing conformity with the requirements of this part of ISO 14531 shall have the lubrication in place.
- c) Surfaces intended for fusion jointing shall be free of lubrication.

4.5 Reprocessable (re-work) material

PE-X shall not be reprocessed and used in the manufacture of fittings intended to conform to this part of ISO 14531.

Non-crosslinked base material for PE-X components, produced in the course of manufacturing fittings conforming to this part of ISO 14531, may be reprocessed if derived from the same non-crosslinked material grade already employed in the relevant production. Products containing reprocessed material shall conform to the requirements of this part of ISO 14531.

The extent of any use of reprocessable PE 80 and PE 100 material shall be in accordance with ISO 4437 and ISO 8085 (see e.g. ISO 8085-3:2001, Subclause 5.3).

The manufacture of components from other thermoplastic materials shall utilize virgin material compounds unless an acceptable manufacturing history is available that demonstrates a capability of manufacturing components produced from reprocessable materials.

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For metallic materials, refer to relevant ISO standards.

5 Fittings

5.1 Design

Mechanical fittings, including any integral heat-fusion joints, shall be designed for the connection of PE-X pipes conforming to ISO 14531-1 to create full-end-load, pressure-resistant pipe/fitting assemblies conforming to the requirements of this part of ISO 14531. Transition assemblies connecting PE-X pipes to metal pipes (e.g. steel or iron) shall also meet the requirements of this part of ISO 14531.

Terminating and integral heat-fusion joints made of PE or PE-X materials shall conform to ISO 14531-2.

The effect of pipe outside diameter and wall thickness tolerances specified in ISO 14531-1 shall be taken into account.

The provision of end-load resistance shall not rely on the influence of internal pressure.

The fitting design pressure DP_F at a design temperature θ of 20 °C shall be declared by the fitting manufacturer in accordance with Table 2 and recorded in the manufacturer's technical file. The declaration of design pressure shall take into account stress concentration effects generated by the fitting and joint assembly geometries and shall be supported by the provision of appropriate experimental data (see 5.5) or design calculations. The effect on the design pressure at 20 °C of variations in operating temperature from 0 °C to +60 °C shall be established and recorded in the technical file.

NOTE The pipeline operator is required by ISO 14531-4 to ensure that $MOP \leq DP_F$.