
**Plastics piping systems — Multilayer
pipes — Determination of long-term
strength**

*Systèmes de canalisations en matières plastiques — Tubes
multicouches — Détermination de la résistance à long terme*

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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 17456 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 5, *General properties of pipes, fittings and valves of plastic materials and their accessories — Test methods and basic specifications*.

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Introduction

This is one of three International Standards developed by ISO/TC 138/SC 5, following the creation of the Subcommittee's Working Group WG 16 at Kyoto, Japan, in 1998, in response to worldwide demand for specifications, requirements and test methods for multilayer plastics pipes. The others are ISO 17454 ^[1] and ISO 17455 ^[2].

Only multilayer pipes are dealt with in this International Standard and for its purposes cross-linked polyethylene (PEX) as well as adhesives are to be considered as a thermoplastics material.

The long-term pressure strength of a multilayer pipe can be measured experimentally using pressure test data acquired by testing multilayer pipes to failure.

Alternatively, the pressure strength of the pipe can be theoretically determined using an equation (see Annex A) that calculates the pressure resistance of each individual pipe layer from the layer dimensions and the long-term hydrostatic strength of the layer material: the long-term pressure strength of the multilayer pipe is then the sum of the calculated pressure strengths of the individual pipe layers.

Consequently, two procedures for the determination of the long-term pressure strength of multilayer pipes are given by this International Standard: Procedure I, a calculation method applicable for type P pipes only, and Procedure II, a pressure test method applicable for both types P and M pipes. At the time of publication of this International Standard, no calculation method existed for predicting the long-term strength of a multilayer M pipe, taking into account all possible constructions.

Although 100 % adhesion between individual layers is assumed, Procedure I does not take this into account. Confirmation pressure tests are necessary for assessing possible interaction effects between layers and for validating the use of the method (see Annex A).

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Plastics piping systems — Multilayer pipes — Determination of long-term strength

1 Scope

This International Standard specifies two alternative methods for determining the long-term hydrostatic strength of multilayer pipes: a calculation method applicable to multilayer P pipes (all polymer layers) and a test method applicable to both multilayer P and multilayer M pipes (polymer and metal layers).

This International Standard is not applicable to pipes consisting of one polymeric stress-designed layer or having an outside polymeric layer that is not stress-designed. Those types of multilayer pipe are covered by the International Standards referenced in Clause 2.

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

3 Terms and definitions

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

3.1

multilayer pipe

pipe comprising layers of different materials

3.2

multilayer M pipe

pipe comprised of stress-designed polymeric layers and one or more stress-designed metallic layers

NOTE The wall thickness of the pipe consists of at least 60 % of polymeric materials (e.g. PEX/Al/PEX or PE-RT/Al/PEX).

3.3

multilayer P pipe

pipe comprised of more than one stress-designed polymeric layers (e.g. PVC-C/PEX)

3.4

similar construction type

⟨multilayer P pipes⟩ construction type that is the same for more than one pipe diameter under conditions where

- the same process technology is used,
- materials having the same characteristics are used for each stress bearing layer: i.e. material type and specifications,
- the layers are assembled in the same sequence for different diameters, and
- for all diameters, the standard dimension ratio (SDR) of each stress-designed layer is equal to the design value $\pm 10\%$.

NOTE See Clause 5.

3.5

similar construction type

⟨multilayer M pipes⟩ construction type that is the same for more than one pipe diameter under conditions where

- the same process technology is used (e.g. welding process for the aluminium layers, type of welding, etc.),
- materials having the same characteristics are used for each stress bearing layer, i.e. material type and specifications,
- the layers are assembled in the same sequence for different diameters, and
- for all diameters, the metal layer standard dimension ratio (SDR_m) is, $\pm 10\%$, the same.

NOTE If, for a certain diameter range, the same metal layer thickness is used, the SDR_m value of the metal layer of all smaller diameters of this diameter range can be adapted up to the SDR_m of the metal layer for the largest diameter of the diameter range (e.g. a diameter range from 12 mm up to 20 mm with a 0,2 mm metal layer).

3.6

metal layer standard dimension ratio

SDR_m

nominal outside diameter (DN or OD) divided by the nominal wall thickness of the metal layers, $e_{n,m}$

3.7

lower confidence limit of the predicted hydrostatic pressure

p_{LPL}

quantity with the dimension of pressure, which represents the 97,5 % (one sided) lower confidence limit of the predicted hydrostatic pressure at a temperature, T , and a time, t

3.8

lower confidence limit of the predicted hydrostatic strength

σ_{LPL}

quantity in megapascals (MPa), with the dimensions of stress, which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength at a temperature, T , and a time, t

3.9

procedure I

calculation method for determination of the long-term hydrostatic pressure strength of multilayer P pipes

3.10**procedure II**

test method for determination of the long-term hydrostatic pressure strength of both multilayer M pipes and multilayer P pipes

3.11**long-term hydrostatic pressure**

p_{LTHS}

quantity with the dimension of pressure, which represents the predicted mean pressure at a temperature, T , and time, t (50 % confidence limit)

3.12**long-term hydrostatic strength**

σ_{LTHS}

quantity with the dimensions of stress, expressed in megapascals (MPa), which represents the predicted mean strength at a temperature, T , and time, t

3.13**referring product standard**

International Standard or Draft International Standard prepared by ISO/TC 138/SC 2, PVC pipes, and applicable to pipes other than multilayer pipes, to which this International Standard refers for clauses related to the materials

4 Principle**iTeh STANDARD PREVIEW**

The long-term pressure strength of the multilayer pipe construction is determined either

- a) by calculation (for multilayer P pipes only) using the equation given in Annex A, which incorporates the dimensions of each layer and the LTHS of each layer material using ISO 9080 or “reference lines” as directed by the referring product standard, or
- b) by analyses of the results of a series of pressure tests conducted on the multilayer pipe (for both multilayer M and multilayer P pipes).

In the case of a), it is necessary to validate the use of the Annex A equation for each design of multilayer pipe by a confirmation test.

NOTE It is assumed that the following test parameters of stress bearing layers have been set by the referring product standard or the manufacturer's instructions:

- for M pipes, the dimension groups, if applicable (see 6.2.3.1);
- wall stress and/or test pressure.

5 Test pieces

Test pieces shall be prepared in accordance with ISO 1167-2.

P-pipes with the same overall wall thickness within a diameter group are considered to be of a similar construction type and only the largest diameter within that diameter group shall be tested.