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

Systèmes de canalisations en matières plastiques — Assemblages de tubes en polyoléfines et raccords mécaniques — Méthode d'essai de résistance en fin de charge (essai AREL)

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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 19899 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*.

Introduction

The Accelerated Relaxation and End Load test (AREL) was introduced initially in the gas industry product standard for full end-load-bearing mechanical fittings designed for connection to PE gas pipes. Its introduction as a stand-alone test method covering polyolefin pipes provides the opportunity for the method to be used in other application areas.

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

1 Scope

This International Standard specifies a method to determine, for mechanically jointed polyolefin pipe and fitting assemblies in sizes of $d_n \leqslant 63$ mm, the effect of component relaxation and creep on the resistance of the assembly to pipe pull out under the long-term application of a constant and longitudinally applied force.

The susceptibility of the polyolefin pipe to stress crack failure initiated by the joint assembly is also examined.

NOTE For sizes $d_n > 63$ mm, the method is under development.

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 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

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

3 Terms and definitions

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

3.1
lower confidence limit of the predicted hydrostatic strength
σ_{LPL}
quantity, with the dimensions of stress, which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength at a temperature θ and time t

NOTE 1 The quantity is expressed in megapascals.

NOTE 2 Temperature, θ, is expressed in degrees Celsius and time, t, is expressed in years.

3.2
minimum required strength
MRS
value of σ_{LPL} at 20 °C and 50 years, rounded down to the next smaller value of the R10 series or the R20 series

NOTE The R10 series conforms to ISO 3[1], the R20 series conforms to ISO 497[2].

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

4 Principle

A test piece assembly of a polyolefin pipe(s) and a mechanical fitting, suspended in a bath of water or in air at 80 °C is subjected to a constant tensile force, F, applied along the longitudinal axis of the pipe for a defined period of time. The force, F, is then removed and the assembly conditioned to 23 °C before testing for leakage.

NOTE 1 The magnitude of the applied force is intended to simulate the combined effect of internal pressure, thermal contraction and secondary bending effects arising from loss of soil support around the pipe close to the fitting. For sizes $d_n \geqslant 355$ mm, experience has suggested loss of localized soil support is less likely to result in significant longitudinal bending stresses and consequently the applied force has been determined taking into account internal pressure and thermal contraction only.

NOTE 2 The elevated test temperature for fittings containing non-metallic non-polyolefin components can be less than 80 °C in order to avoid transitions in material properties that are non-representative of the in-service application and possible degradation effects.

Any reduction in test temperature should be undertaken in conjunction with an extension in the test period to take account of the time dependent properties of the component parts of the joint.

5 Apparatus

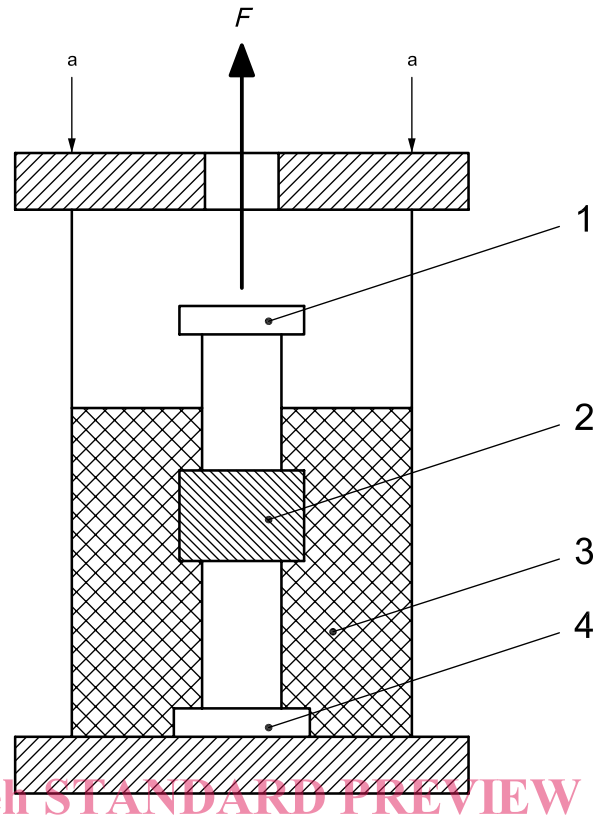
5.1 Tensile loading equipment, capable of applying a constant tensile force along the longitudinal axis of the pipe(s) connected to the mechanical fitting being tested. The force on the pipe shall be accurate to within ±1 % of the indicated force. The tensile force may be applied directly or via a lever arm, using dead weights or a fluid-activated loading cylinder. The test framework, as diagrammatically illustrated in Figure 1, shall be designed to permit the transmission of the applied force from the pipe to the joint and fitting assembly without reduction by frictional losses generated by the supporting structure.

5.2 External environment

5.2.1 Water, contained in a tank, and kept at a constant temperature, as specified by the referring standard, normally 80 °C, with a permissible variation of ±1 °C from the specified temperature. The water shall not contain impurities which could affect the results.

5.2.2 Air, in an enclosure, kept at a constant temperature, as specified by the referring standard, normally 80 °C, with a permissible variation of $^{+2}_{-1}$ °C from the specified temperature.

5.2.3 Circulation, forced. As the results are strongly influenced by temperature, the variation in temperature shall be kept as small as possible within the limits specified in 5.2.1 and 5.2.2, e.g. by using forced circulation of the test fluid. When testing with air, it is recommended that the surface temperature be checked in addition to the air temperature.



Key

F applied longitudinal end load force
1 end load bearing type A end cap
2 fitting to be tested
3 test fluid — water or air
4 end load bearing type A end cap
a End load reaction forces generated within the loading framework.

Figure 1 — Schematic illustration of tensile loading equipment

5.3 Leak test apparatus, to enable the conduct of leakage tests on fitting to pipe assemblies in accordance with ISO 3458, using air, inert gas or water as the pressurizing medium at an ambient temperature of (23 ± 2) °C and pressures of 25 mbar[1)] and 1,5 times nominal pressure (see Clause 7).

NOTE Nominal pressure for gas applications is MOP and for water, P_N.

6 Test piece

The test piece shall comprise a polyolefin pipe or pipes connected to a mechanical fitting conforming to ISO 1167-4. Type A end caps, as specified in ISO 1167-1, shall be attached to the pipe(s). The free length of pipe between the fitting and the terminating end caps shall be at least 100 mm or twice the nominal pipe diameter, d_n, in millimetres, whichever is the greater value, with a maximum of 250 mm. The end caps shall be capable of withstanding the applied tensile force and maintaining pressure during the leak test.

1) 1 mbar = 100 Pa.