INTERNATIONAL STANDARD

ISO 8513

Third edition
2016-02-01

Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test methods for the determination of the initial longitudinal tensile strength

Systèmes de canalisations en plastiques — Tubes en plastiques thermodurcissables renforcés de verre (PRV) — Méthodes d'essai pour la détermination de la force en traction longitudinale

Reference number
ISO 8513:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

This third edition cancels and replaces the second edition (ISO 8513:2014) which has been technically revised.

Introduction

Although this International Standard was revised in 2014, it was found necessary to again revise to correct several small errors in presentation and to revise the allowable testing speed (crosshead movement) range. A review of ISO testing standards for glass-reinforced thermosetting plastics (GRP) materials and the results of a recent testing program indicated that a testing speed of 2 mm/min to 5 mm/min is more appropriate. Also, evidence was presented that method C, the plate method, lead to results that were frequently from shear failures rather than tensile failures and lead to a falsely high prediction of Longitudinal Tensile Strength. Method C has been removed from this edition. Also, the term “Apparent” was removed from the title as it seemed to have no clear meaning.

Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test methods for the determination of the initial longitudinal tensile strength

1 Scope

This International Standard specifies two test methods for determining the longitudinal tensile properties of glass-reinforced thermosetting plastics (GRP) pipes. The properties which can be determined are

— the longitudinal tensile strength, and

— the percentage ultimate elongation.

Method A uses, for the test piece(s), a longitudinal strip cut from a pipe.

Method B uses a specified length of the full cross-section of the pipe.

Method A is applicable to pipes with a nominal size of DN 50 or greater with circumferentially wound filaments, with or without chopped glass and/or woven rovings and/or fillers, and to centrifugally cast pipes. It is applicable to pipes with helically wound filaments with a nominal size of DN 200 or greater.

Method B is applicable to all types of GRP pipe. It is usually used for pipes with a nominal size up to and including DN 150.

Results from one method are not necessarily equal to the results derived from any of the alternative methods. However, all methods have equal validity.

Annex A describes additional considerations for method B that have been found useful for the testing of thin-walled helically wound pipes and can be used to supplement the basic text.

NOTE This International Standard does not address the determination of longitudinal tensile modulus. Due to the multi-layer construction of many GRP pipes, the accurate measurement of strain, necessary for modulus determination, can be very difficult. If it is desired to determine longitudinal modulus, see ISO 527-4 and/or ISO 527-5.

2 Terms and definitions

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

2.1
helical wound
refers to filament-wound pipes made with a balanced winding angle

Note 1 to entry: Sometimes called cross wound.

2.2
longitudinal tensile strength
σ_{LA}^*
σ_{LB}^*
maximum tensile force in the longitudinal direction per unit mean circumference at failure

Note 1 to entry: It is expressed in newtons per millimetre of the circumference (N/mm).

Note 2 to entry: The subscripts A and B denote the method of test used.

2.3
mean circumference
circumference corresponding to the mean diameter multiplied by π (π ≈ 3,141 6)

Note 1 to entry: It is expressed in millimetres.

2.4
mean diameter
d_m
diameter of the circle corresponding with the middle of the pipe wall cross-section

Note 1 to entry: It is given by any of the following:

a) the average of the external diameter of the pipe minus the average of the wall thickness;

b) the external circumference of the pipe divided by π (π ≈ 3,141 6) minus the average of the wall thickness;

c) the average of the internal diameter of the pipe plus the average of the wall thickness.

Note 2 to entry: It is expressed in millimetres.

2.5
ultimate longitudinal tensile stress
$\sigma_{L,ULT}$
maximum longitudinal tensile force per unit cross-sectional area at failure

Note 1 to entry: It is expressed in newtons per square millimetre (N/mm).

2.6
ultimate elongation
ε_L
elongation coincident with the ultimate longitudinal tensile stress

Note 1 to entry: For the purposes of this International Standard, the measurement of elongation is limited to measurement of the movement of the tensile testing machine cross-heads.

Note 2 to entry: It is expressed as a percentage of an initial gauge length or free length of a test piece.

3 Principle

Test pieces comprising either strips cut longitudinally from a pipe wall segment (method A) or a specified length of pipe (method B) are subjected to extension in the longitudinal direction at a constant speed such that fracture occurs within a specified time.

The tensile properties are determined using the initial dimensions of the test piece, the tensile force, and the cross-head movement.

NOTE It is assumed that the following test parameters are set by the standard making reference to this International Standard:

a) the methods to be used, i.e. method A or method B;

b) the number of test pieces (see 5.4);

c) if applicable, the requirements for conditioning, e.g. temperature, humidity, time, and associated tolerances (see Clause 6);

d) the test temperature and its tolerance (see Clause 7);

e) the properties to be measured (see Clause 8).

4 Apparatus

4.1 Tensile-testing machine, of the constant rate of cross-head movement type, incorporating the following features:

a) a fixed part, fitted with a grip to hold one end of the test piece without permitting any longitudinal movement thereof, and a moveable part, incorporating a grip to hold the other end of the test piece during extension [the fixed and moving parts and their associated grips (see 4.2) shall enable the test piece to be aligned when a force is applied so that its longitudinal axis coincides with the direction of this force];

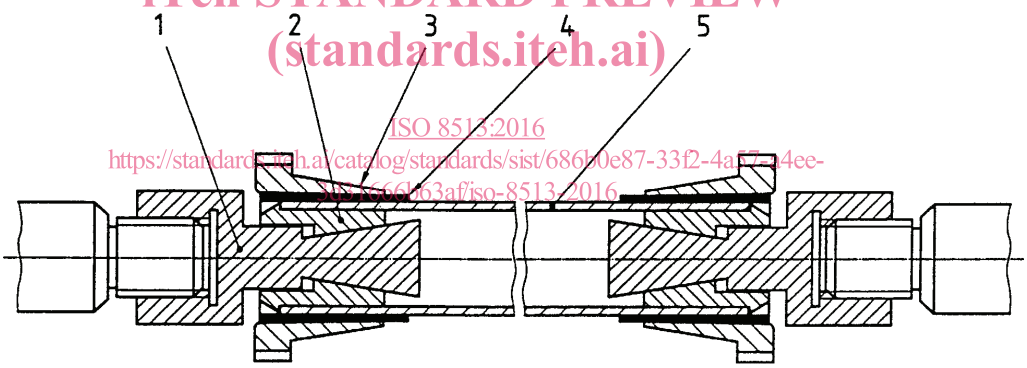
b) a drive mechanism, capable of imparting a constant speed (see 8.3) to the moving part;

c) a force indicator, capable of measuring the force applied to a test piece which is held in the grips (the mechanism shall be free from significant inertia lag at the necessary speed of testing and shall indicate or record force, or consequent stress, with an accuracy of within ±1 % of the value to be measured);

d) a means to measure the cross-head movement as a function of the applied load.

4.2 Grips, for holding the test piece.

Each of the two grips shall be capable of holding one end of the test piece without slip or crushing to an extent that will affect the results obtained. Grips which tighten automatically might be suitable. Typical grips for a pipe section test piece (see 5.3) are shown in Figure 1.



Key

1 mandrel
2 segmented grips
3 sleeve
4 reinforcing band
5 test piece

Figure 1 — Typical grips for a pipe section test piece (method B)

4.3 Dimension measurement devices, capable of measuring the necessary dimensions of the test piece (e.g. length, width, wall thickness) to an accuracy of half the accuracy required in Clause 8 for measurements, e.g. a measuring accuracy of ±0,1 mm requires a device accuracy of ±0,05 mm.

5 Test pieces

5.1 General

The test piece shall be a strip or dumbbell conforming to 5.2, or a pipe section conforming to 5.3.