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Ring expansion testing for determination of transverse tensile properties of round steel pipe



AS 1855:2022

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Preface

This Standard was prepared by Standards Australia Committee MT-006, Mechanical Testing of Metals, to supersede AS 1855—2008, *Methods for the determination of transverse tensile properties of round steel pipe*.

The objective of this document is to specify the method of test for transverse tensile properties of steel pipes. This document specifies the use of a pressure expansion test as a means of determining the circumferential strength of a pipe. The expansion test may typically use a short ring or may use a capped pipe section.

The test is based on both AS 1391 and ASTM A370.

ASTM A370 only permits the use of short-length test specimens whereas this document includes provision for the long-length test specimens which may also be used for the performance of a pressure proving test demonstrating that a length of pipe has a yield strength above a specified minimum without the result being influenced by test specimen preparation.

The test is specified in AS 2885.1, where accurate measurement of line pipe yield strength is required and in particular for testing where portions of a pipeline will receive a field pressure test at a pressure above nominal yield strength.

This document is one of a series of Standards covering the range of tensile testing methods. The series comprises the following:

AS 1391, *Metallic materials — Tensile testing — Method of test at room temperature*

AS 1545, *Methods for the calibration and grading of extensometers*

AS 1855, *Ring expansion testing for determination of transverse tensile properties of round steel pipe* (this Standard)

AS 2193, *Calibration and classification of force-measuring systems*

AS 2291, *Metallic materials — Tensile testing — Method of test at elevated temperatures*

AS 2403, *Metallic materials — Sheet and strip — Determination of plastic strain ratio*

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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NOTES

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Ring expansion testing for determination of transverse tensile properties of round steel pipe

1 Scope

This document specifies methods by which transverse (circumferential) yield strength, and the yielding behaviour of a section of a round steel pipe, may be determined, or proven to be above specified values.

The methods permit the use of both short-length (ring expansion) and long-length pipe test specimens.

The methods cover the testing of steel pipe in the size range DN 150 and larger in diameter, having a thickness/diameter ratio of less than 0.06.

The methods can be used for the determination of, or as a proving test for —

- (a) yield strength; and
- (b) proof strength.

The methods cannot be used to measure properties associated with fracture, as in a conventional tensile test, because fracture of pipe is not achieved during the test.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1545, *Methods for the calibration and grading of extensometers*

AS 2193, *Calibration and classification of force-measuring systems*

3 Terms and definitions

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

3.1 elongation

increase in the original gauge length (L_0) at any moment during the test

3.2 extension

increase of the extensometer gauge length

3.3 original gauge length

L_0
length of pipe circumference covered by the extensometer

3.4 pipe

hollow cylindrical product, long in proportion to its diameter, designed to carry fluid under pressure

3.5 proof strength

3.5.1 proof strength, plastic extension

R_p
stress at which a plastic extension is equal to a specified percentage of the extensometer gauge length (L_e)

Note 1 to entry: Refer to AS 1391:2020 Figure 3. The symbol used is followed by a suffix giving the prescribed percentage, for example $R_{p0.2}$.

3.5.2 proof strength, reduced slope

R_s
stress at which the slope of the stress/strain curve is reduced to a prescribed fraction of the slope during elastic extension e.g., half slope yield strength

Note 1 to entry: When a proof strength (R_s) is specified, the prescribed fraction of the elastic slope is stated (e.g. 0.5) and the symbol used for the stress supplemented by an appropriate index giving the prescribed fraction of the elastic slope (e.g. $R_{s0.5}$).

3.5.3 proof strength, total extension

R_t
stress at which total extension (elastic extension plus plastic extension) is equal to a specified percentage of the extensometer gauge length (L_e)

Note 1 to entry: Refer to AS 1391:2020 Figure 4. The symbol used is followed by a suffix giving the prescribed percentage, for example $R_{t0.5}$.

Note 2 to entry: The term “total elongation” is commonly used in place of “total extension”.

3.6 proving test

test made without determination of the actual numerical value of a property, to ascertain if the pipe material fulfils the minimum specified requirement

3.7 strain

increase of length per unit length

Note 1 to entry: For the purpose of this document, strain is the increase of circumferential gauge length at any moment during the test divided by the original circumferential gauge length.

3.8 stress

force calculated from applied pressure, divided by the original cross section

Note 1 to entry: For further guidance on the relationship between stress and pressure, see Appendix [E](#).

3.9 test specimen

prepared piece for testing, made directly from a pipe sample by some mechanical operation

3.10 von Mises correction factor

M

factor by which the transverse stress (σ) and radial stress is changed when a longitudinal stress is imposed

Note 1 to entry: The longitudinal stress is governed by the end constraint (see also [Clause 10.3](#)).