

Australian Standard[®]

**STEEL TUBES FOR
MECHANICAL PURPOSES**

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Carbon-manganese Steel, for Mechanical
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Confederation of Australian Industry
Department of Defence
Department of Industry and Commerce
Institute of Steel Service Centres of Australia
Metal Trades Industry Association of Australia
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MECHANICAL PURPOSES**

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PREFACE

This edition of this standard was prepared by a subcommittee of the Association's Committee on Iron and Steel to supersede AS 1450—1974. It applies to carbon steel and carbon-manganese steel tubes of round, square, rectangular or other non-circular cross-section made by various processes and intended for use in mechanical applications.

In this edition, alignment with AS 1163, Structural Steel Hollow Sections, has been effected as far as practicable, resulting in a modification to the designation system and properties. Grades have been rationalized, and the electric fusion welded (EFW) and hot-finished seamless (HFS) types have been deleted from the standard. The appendix detailing maximum size limits normally applicable to each process of manufacture has also been deleted, as manufacturers' product literature is regarded as the preferred reference to size, shape and grade.

An appendix has been added which presents purchasing guidelines, including contractual requirements previously covered in the body of AS 1450—1974, and which directs attention to matters requiring consideration at the time of enquiry and/or order. The intention of the appendix is to prevent misinterpretation or other problems and to ensure a clear understanding of product requirements by both purchaser and supplier.

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
STEEL TUBES FOR MECHANICAL PURPOSES

1 SCOPE. This standard specifies the technical requirements for the production and supply of carbon and carbon-manganese steel tubes of round, square, rectangular or other non-circular cross-section produced by either cold-forming or hot-forming, and intended for use in mechanical applications.

NOTE: Guidelines to purchasers on requirements that must be specified by the purchaser and those that must be agreed at the time of enquiry and/or order are given in Appendix A.

2 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 1050	Methods for the Analysis of Iron and Steel
AS 1171	Methods for Magnetic Particle Testing of Ferromagnetic Products and Components
AS 1213	Iron and Steel—Methods of Sampling
AS 1391	Methods for Tensile Testing of Metals
AS 2084	Methods for Eddy Current Testing of Metal Bar and Tubular Products
AS K1	Methods for the Sampling and Analysis of Iron and Steel
ISO 2566/1	Steel—Conversion of Elongation Values Part 1—Carbon and Low Alloy Steels

3 GRADE DESIGNATION. All tubes shall be designated in the following manner:

AS 1450/XY/Z

where

AS 1450 is the number of this standard

X is the steel condition as follows:

H—hot—formed or heat treated
C—cold—formed

Y is the specified minimum yield strength in megapascals, i.e. 200, 250, 350, 450 (see Table 2)

Z is the process reference symbol as follows:

CW—continuous welded
ERW—electric resistance welded
CEW—cold-drawn electric resistance welded
CFS—cold-finished (including cold-drawn) seamless

Examples of designation:

- (a) AS 1450/ H200/ CW is a continuous welded hot-formed or heat-treated tube having a specified minimum yield strength of 200 MPa.
- (b) AS 1450/H250/CFS is a cold-drawn seamless tube, heat-treated and having a specified minimum yield strength of 250 MPa.

4 DEFINITIONS. For the purpose of this standard, the following definitions apply:

4.1 Batch—a number of tubes of the same shape, size, wall thickness, grade designation and heat treatment.

4.2 Cold-formed (C)—made by a process involving shaping, sizing or cold working at ambient temperature, including electric resistance welded, cold-drawn electric resistance welded and cold-finished (including drawn) seamless.

4.3 Hot-formed or heat treated (H)—made by a process involving shaping, sizing, or hot working at temperatures above 600°C, or by heat treating cold-formed tube at temperatures above 600°C.

5 STEEL REQUIREMENTS.

5.1 Steelmaking Process. The steel shall be made by the open hearth, basic oxygen or an electric process.

NOTES:

1. A basic oxygen process means the process of making steel in a basic converter blown with commercially pure oxygen.
2. Additional refining by vacuum-arc-remelt (VAR), electro-slag-refining (ESR) or vacuum degassing is permitted.

5.2 Chemical Composition.

5.2.1 General. The method of sampling for chemical analysis shall be in accordance with AS 1213. Chemical composition shall be determined by any procedures which are not less accurate than AS 1050 or AS K1.

NOTE: A product analysis is not required by this standard and need be performed only where specified by the purchaser (see Paragraph A1 of Appendix A). Details of product analysis are given in Table 1.

5.2.2 Cast analysis. A chemical analysis of the steel from each ladle shall be made to determine the proportions of the specified elements. In cases where it is impractical to obtain samples from liquid steel, analysis on test samples taken in accordance with Clause 3.5 of AS 1213 may be reported as cast analysis.

The reported cast analysis of the steel shall conform to the limits given in Table 1 for the appropriate steel grade.

6 FREEDOM FROM DEFECTS. The tubes shall be free from segregation, lamination, surface flaws and other defects detrimental to their use for the applications defined in Clause 1.

The ends of each length shall have the burr held to a minimum.

Notwithstanding that tubes have been accepted previously if subsequent processing reveals that they contain defects found to be detrimental, the tubes shall be deemed not to comply with this standard, provided that they have not been improperly treated after delivery.

7 REMOVAL OF SURFACE DEFECTS. The removal of surface defects from tubes by grinding shall comply with the following requirements:

- The defect shall not encroach on the minimum thickness permitted by tolerance.
- The ground area shall be well flared.
- The grinding shall not encroach on the minimum thickness permitted by tolerance.

8 REMOVAL OF UPSET. Tubes produced by electric resistance welding shall have the external upset removed.

9 MANUFACTURING TOLERANCES.

9.1 Length. The maximum permissible variation from the length of a tube specified as 'exact' or cut shall conform to the limits given in Table 3.

9.2 Cross-section.

9.2.1 Circular tube. The maximum permissible variation in the cross-sectional dimensions of a circular tube shall conform to the limits given in Table 4.

NOTE: CEW and CFS tube can be produced to specified outside and/or inside dimensions (see Paragraph A1 of Appendix A).

9.2.2 Rectangular or square tube. The maximum permissible variation in the cross-sectional dimensions of a rectangular or square tube shall conform to the limits given in Table 5.

The radii of the corners shall conform to the appropriate values given in Table 6.

The maximum permissible out-of-square of adjacent sides shall not exceed ± 1 degree.

NOTE: Tolerances for other non-circular sections are negotiable (see Paragraph A1 of Appendix A).

9.3 Thickness. The maximum permissible variation in section thickness, exclusive of the weld area, shall conform to the limits given in Table 7.

The section thickness shall be measured remote from the weld in circular tube, and in the centre of a side in rectangular or square tube.

9.4 Straightness. The maximum permissible variation from straightness in a length of tube shall not exceed—

Specified length
600

9.5 Twist (Non-circular Sections). For noncircular tubes, the maximum value of V (see Fig. 1) shall not exceed 2 mm plus 0.5 mm per metre length.

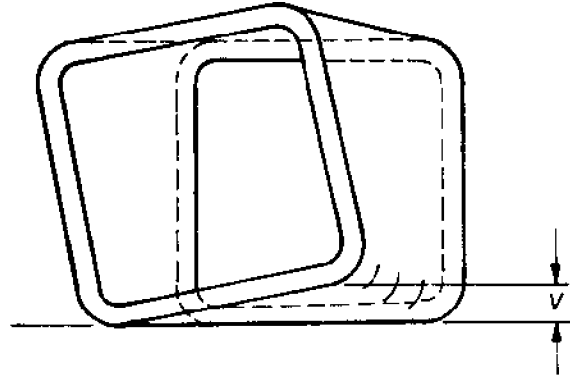


Fig. 1. MEASUREMENT OF TWIST OF NON-CIRCULAR SECTIONS

10 MECHANICAL PROPERTIES.

10.1 Tensile Test. When tested in accordance with Clause 13.1, the tensile strength, yield strength and elongation of the test piece shall conform to the limits given in Table 2 for the appropriate grade.

10.2 Cold Flattening Test. When tested in accordance with Clause 13.2, a test piece taken from a circular section with a longitudinal weld shall show no signs of cracks or flaws. Superficial ruptures arising from surface imperfections shall not be cause for rejection.

11 SAMPLING FOR MECHANICAL PROPERTIES.

11.1 General. When a test certificate is required (see Paragraph A1(f) of Appendix A), one length of tube shall be selected at random from each batch, the maximum size of which shall be as follows:

- For circular tubes with longitudinal welds where the specified outside diameter is 90 mm or less—20 t.
- For other tubes—40 t.

Samples shall be in the same condition as the sections they represent.

TABLE 1
CHEMICAL COMPOSITION

Grade designation	Type of analysis	Chemical composition, percent max.					
		C	Si	Mn	P	S	C + Mn/6
C200 and H200	Cast Product (Note 2)	0.15	—	—	0.050	0.050	0.25
		0.19	—	—	0.060	0.060	—
C250 and H250	Cast Product	0.25	0.40	—	0.040	0.040	0.42
		0.29	0.45	—	0.050	0.050	—
C350 and H350	Cast Product	0.22	0.50	1.60	0.040	0.040	0.45
		0.26	0.55	1.70	0.050	0.050	—
C450	Cast Product	0.25	0.40	—	0.040	0.040	0.42
		0.29	0.45	—	0.050	0.050	—

NOTES:

- Micro-alloying elements to a maximum total of 0.15 percent may be added to Grades C350 and H350.
- Product analysis limits do not apply when rimmed steel is used.

One tensile test sample shall be taken from each batch.

One cold flattening test sample shall be taken from each batch of circular sections with a longitudinal weld.

11.2 Position of Test Specimens.

11.2.1 Tensile test. The test specimen shall be selected from any position along the length of the tube.

11.2.2 Cold flattening test. A cross-section shall be cut from one end of a finished length of a tube which contains a longitudinal weld.

11.3 Orientation of Test Specimens.

11.3.1 Tensile test. The test specimen shall be such that the major axis is in the longitudinal direction.

11.3.2 Cold flattening test. The test specimen shall be cut in the transverse direction.

12 PREPARATION OF TEST PIECES FOR MECHANICAL TESTING.

12.1 General. It shall be permissible to discard a test piece which shows defective machining or develops flaws and to submit another test piece.

12.2 Tensile Test Piece.

12.2.1 Form of test piece. The tensile test piece shall be in the form given in either (a) or (b) below:

- (a) A test piece with dimensions conforming to those specified in AS 1391, cut from the length of tube. The location of the test piece shall be as specified in Clause 12.2.2 or Clause 12.2.3, as appropriate.
- (b) A length of the full section of the tube.

12.2.2 Circular tube. The tensile test piece cut from a length of circular tube shall not be flattened between gauge marks. For a length of circular tube containing a longitudinal weld, the test piece shall be taken from a location approximately 90 degrees from the weld.

12.2.3 Non-circular tube. The tensile test piece cut from a length of non-circular tube shall be taken from any side midway between and excluding the corners. The test piece shall not include a longitudinal weld.

12.3 Cold Flattening Test Piece. The test piece shall be taken in the form of a cross-section from one end of a finished length of a circular tube which

contains a longitudinal weld. The length of the test piece shall be not less than 40 mm. All burrs shall be removed before testing.

13 MECHANICAL TEST METHODS.

13.1 Tensile Test. The tensile test shall be carried out in accordance with AS 1391. The rate of straining when approaching the yield point shall lie within the highest range of strain rate given in AS 1391.

Elongation results shall be reported on a gauge length $L_o = 5.65 \sqrt{S_o}$, where S_o is the original cross-sectional area. Conversion of results from a non-proportional gauge length shall be in accordance with ISO 2566/1.

13.2 Cold Flattening Test. The flattening test piece shall be flattened at room temperature between two parallel plane surfaces with the weld located as follows in relation to the direction of flattening:

- (a) for $D \leq 60$ mm at 45 degrees;
- (b) for $D > 60$ mm at 90 degrees;

where D = the nominal outside diameter of the circular tube.

The test piece shall be flattened until the distance between the surfaces is $0.75D$.

14 RETESTS FOR MECHANICAL TESTS. If a retest is carried out, one or more of the following procedures shall be adopted:

- (a) Two further test samples shall be taken at random from the remainder of the batch. This remainder shall be deemed to comply with this standard only if the test pieces from both these additional samples comply with Clause 10.1 or Clause 10.2 as appropriate.
- (b) Two further test samples shall be taken from the tube which failed. The tube shall be deemed to comply with this standard only if the test pieces from both these additional samples comply with Clause 10.1 or Clause 10.2, as appropriate.
- (c) Test samples shall be taken from each tube, and shall be individually tested in accordance with this standard. The tube shall be deemed to comply with this standard only if the test piece from the additional sample complies with Clause 10.1 or Clause 10.2, as appropriate.
- (d) The failed batch shall be reprocessed, e.g. heat-treated, and another complete set of tests shall

**TABLE 2
TENSILE STRENGTH REQUIREMENTS**

Grade designation	Minimum yield strength MPa	Minimum tensile strength MPa	Minimum elongation as a proportion of gauge length of $5.65 \sqrt{S_o}$ (Note) percent	
			Circular tube	Non-circular tube
C200 and H200	200	320	24	20
C250 and H250	250	350	22	18
C350 and H350	350	450	20	16
C450	450	500	—	—

NOTE: This requirement does not apply to CFS and CEW tube supplied in the 'as-drawn' or 'as-drawn and stress-relieved' condition.

be performed in accordance with this standard. The batch shall be deemed to comply with this standard only if the test pieces from the reprocessed batch comply with Clause 10.1 or Clause 10.2 as appropriate.

15 IDENTIFICATION. Each securely tied bundle of tubes shall be marked or tagged with the following:

- (a) Manufacturer's name or trademark.
- (b) Designation in accordance with Clause 3.

When required (see Paragraph A1(e) of Appendix A), every finished tube shall be marked or tagged with the above.

NOTE: Manufacturers who place the number of this Australian standard on carbon and carbon-manganese steel tubes, on pack

aging or on literature related thereto should ensure that the tubes are manufactured to comply with the standard.

16 ROUNDING OF RESULTS OBTAINED BY INSPECTION AND TESTING.

16.1 General. For the purpose of deciding whether a particular requirement of this standard is complied with, the determined value, observed or calculated, shall be rounded off in accordance with Appendix B. The number of significant places retained in the rounded off value shall be the same as that of the specified value in this standard.

16.2 Tensile Properties. The determined value of tensile strength shall be rounded off to the nearest 10 MPa and the determined value of yield strength shall be rounded off to the nearest 5 MPa.

TABLE 3
MAXIMUM PERMISSIBLE VARIATION FROM LENGTH SPECIFIED
AS 'EXACT' OR CUT

Range of length m	Maximum permissible variation in length mm
≤ 14	+ 6 - 0
> 14 ≤ 18	+ 10 - 0
> 18	Not specified*

* Tolerances should be specified by agreement between purchaser and supplier where length exceeds 18m.

TABLE 4
CIRCULAR TUBE—MAXIMUM PERMISSIBLE VARIATIONS IN
CROSS-SECTION

Specified outside diameter mm		Maximum permissible variation from specified outside diameter mm			
Over	Up to and incl.	CW	ERW	CEW	CFS
—	50	+ 0.4 - 0.8 ± 1.0 percent	—	—	—
50	—	—	—	—	—
—	25	—	± 0.15	± 0.10	± 0.10
25	50	—	± 0.20	± 0.15	± 0.15
50	75	—	± 0.30	± 0.20	± 0.20
75	100	—	± 0.40	± 0.25	± 0.25
100	125	—	± 0.50	± 0.30	± 0.30
125	150	—	± 0.60	± 0.35	± 0.35
150	175	—	± 0.70	± 0.40	± 0.40
175	—	—	± 1 percent of specified dimension	—	—

NOTE: Tolerances for CEW and CFS also apply to inside diameter where this is the specified dimension.

TABLE 5
RECTANGULAR OR SQUARE TUBE—MAXIMUM PERMISSIBLE
VARIATIONS IN CROSS-SECTION

Side dimension mm		Maximum permissible variation from specified outside dimension of side			
Over	Up to and incl.	CW	ERW	CEW	CFS
—	50	± 0.5 mm		± 1 percent of specified dimension	
50	—	± 1 percent of specified dimension			

NOTE: Tolerances for CEW and CFS also apply to inside dimensions where these are the specified dimensions.

TABLE 6
RECTANGULAR OR SQUARE TUBE—RADII OF CORNERS

Maximum outside radius	Minimum inside radius
$3t^*$	$0.1t^*$

* t = section thickness.

TABLE 7
MAXIMUM PERMISSIBLE VARIATION IN THICKNESS

Specified thickness	Thickness tolerance, percent			
	CW	ERW	CEW	CFS
All thicknesses	+ 15 - 10	± 10	± 10	± 10

APPENDIX A

PURCHASING GUIDELINES

A1 INFORMATION TO BE SUPPLIED BY THE PURCHASER. The purchaser should supply the following information at the time of enquiry and/or order, after making due reference to the explanation, advice and recommendations contained in this Appendix:

- (a) Designation of the tube (see Clause 3).
- (b) Dimensions of cross-section.
- (c) Length, bundle masses, if applicable.
- (d) Quantity and delivery instructions (dates, schedules, delivery point).
- (e) Whether each tube should be identified (see Clause 15).
- (f) Whether a test certificate or a certificate of compliance is required (see Paragraph A3).
- (g) Whether it is the intention of the purchaser to inspect the tubes at the manufacturer's works (see Paragraph A4).
- (h) Any information concerning processing or end use that the purchaser considers would assist the manufacturer.

NOTE: Any special or supplementary requirements of this standard are to be subject to agreement between the purchaser and the supplier at the time of enquiry and/or order, and stated on the order, e.g. zinc coating or other surface coating, special tolerances, non-destructive inspection

A2 TEST REQUIREMENTS.

A2.1 Non-destructive Testing. If non-destructive testing is required by the purchaser, the test method to be used and the limits of acceptance should be determined at the time of enquiry and/or order.

The test method should be in accordance with AS 1171 and AS 2084, where appropriate.

A2.2 Independent Tests. In the event of a dispute as to the compliance of the tubes with the requirements of this standard, the purchaser and the supplier should agree to have referee testing carried out by an independent laboratory, whose results should be accepted as final. A laboratory registered by the National Association of Testing Authorities, Australia, for the relevant field and class of testing, is recommended.

A3 CERTIFICATES.

A3.1 Certificates of Compliance. A certificate of compliance states that the tubes comply with the requirements of this standard, i.e. AS 1450.

A3.2 Test Certificates. A test certificate shows the results of tests carried out to establish compliance with this standard, plus any additional tests agreed at the time of ordering.

A4 INSPECTION. Inspection at the manufacturer's works may be a negotiated requirement, but is usually not otherwise requested, since the purchaser may reject tubes if faults are revealed in subsequent processing (see Clause 6).

If it is the purchaser's intention to undertake any of the following functions at the manufacturer's works, this should be notified at the time of enquiry and/or order, and should be accomplished in a manner which will not interfere with the operation of the works:

- (a) Inspection of the tubes.
- (b) Witnessing the selection and identification of the test samples.
- (c) Witnessing the tests being performed.

The manufacturer should afford the purchaser all reasonable facilities to satisfy himself that the tubes are in accordance with the standard.

APPENDIX B

ROUNDING OF RESULTS OBTAINED BY
INSPECTION AND TESTING

B1 ROUNDING OFF. The following procedure is to be used in rounding off numbers:

- (a) Choose the rounding (up or down) whichever is the nearer. In general this will be evident.
- (b) If, despite the use of all the figures which can be obtained from the data, the figures to be discarded fall exactly between two alternative prospective round values, and there is no evidence to indicate in which direction to round, choose the even round value. This rule applies to both positive and negative values.

Rounding off should be carried out in one operation. If a value, e.g. of 99.253 percent, is to be rounded off to one place of decimals, the figures in the second and third decimal places should be considered together, the rounded-off value being 99.3 percent. If rounding off is carried out in two operations an incorrect figure may be obtained in the last place, e.g. if 99.253 percent is rounded off in two operations, it first becomes 99.25 percent and then 99.2 percent.

Where the figure next beyond the last figure or place to be retained is 5, or a 5 followed only by zeros, the figure in the last place retained shall be:

- (i) increased by one if it is odd, and
- (ii) left unchanged if even.

NOTE: Zero would be regarded as an even number for this purpose.

As examples of the above rule:

0.0505 is rounded-off to 0.050

0.15 is rounded-off to 0.2

10.5 is rounded-off to 10

99.84 is rounded-off to 99.8

99.85 is rounded-off to 99.8

99.851 is rounded-off to 99.9

99.86 is rounded-off to 99.9

B2 MEANING TO BE ATTACHED TO NUMERICAL VALUES OF MAXIMA AND MINIMA. The interpretation to be placed on the maxima and minima given in this standard for chemical composition and mechanical properties is to be in accordance with the following examples.

1		2	3	4
Specified Value (minimum, maximum or limit or range)		Values deemed to comply with the specified value	Remarks	
min.	max.			
16		15.5 and over	The figure in the last place retained is odd (5) and it is therefore increased by one.	
15		Over 14.5	The figure in the last place retained is even (4) and it is therefore left unchanged.	
16.0		15.95 and over	The figure in the last place retained is odd (9) and it is therefore increased by one.	
15.0		14.95 and over		
16.00		15.995 and over		
15.00		14.995 and over		
14.7		Over 14.65	The figure in the last place retained is even (6) and it is therefore left unchanged.	
	32	Up to and incl. 32.5	The figure in the last place retained is even (2) and it is therefore left unchanged	
	33	Under 33.5	The figure in the last place retained is odd (3) and it is therefore increased by one.	
	32.0	Up to and incl. 32.05	The figure in the last place retained is even (0) and it is therefore left unchanged.	
	33.0	Up to and incl. 33.05		
	32.00	Up to and incl. 32.005		
	33.00	Up to and incl. 33.005		

B3 REFERENCES.

- BS 1957 Presentation of Numerical Values (Fineness of expression: Rounding of numbers).
- BS 2846 Guide to Statistical Interpretation of Data.
- ASTM E29 Recommended Practice for Indicating Which Places of Figures are to be Considered Significant in Specified Limiting Values.
- IS:2 Indian Standard Rules for Rounding Off Numerical Values.

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