AS/NZS 3679.1:2010

Australian/New Zealand Standard™

Structural steel

Part 1: Hot-rolled bars and sections

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Australian/New Zealand Standard™

Structural steel

Part 1: Hot-rolled bars and sections

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-023, Structural Steel, to supersede AS/NZS 3679.1:1996.

The objective of this Standard is to specify requirements for hot-rolled structural steel bars and sections for general structural and engineering applications.

This edition incorporates the following major changes to the previous edition:

(a) The definition of a batch has been clarified.

(b) A new grade S0, which complies with the seismic material requirements in NZS 3404.

(c) Redundant grades 250, 250L0, 250L15, 400, 400L0, 400L15 have been removed.

(d) References to tapered-flange channels have been removed.

(e) The new requirement for individual length markings.

(f) The new requirement for test reports and test certificates to be performed by third-party accredited laboratories.

(g) The introduction of mandatory minimum information required on test certificates.

(h) The inclusion of Appendix B on ‘Product Conformity’ as a mandatory provision for conformance with this Standard.

(i) Appendix F—Steel for seismic and fracture critical applications for New Zealand only has been added.

To permit the steel industry time to adjust to the new edition of the Standard, the 1996 version of AS/NZS 3679.1 will remain available superseded and will be withdrawn 12 months from the date of publication of this Standard.

A statement expressed in mandatory terms in a note to a table is deemed to be a requirement of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix 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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Part 1: Hot-rolled bars and sections

1 SCOPE

This Standard specifies the requirements for the production and supply of hot-rolled structural steel bars and sections.

For general structural and engineering applications, all grades specified in this Standard are suitable for—

(a) welding in accordance with AS/NZS 1554.1; or

(b) riveting and bolting as specified in AS/NZS 4600, AS 3990, AS 4100 and NZS 3404.

This Standard does not cover the following:

(i) Structural steel—Hot-rolled plates, floorplates and slabs, and welded I sections.

(ii) Steel plates for pressure equipment.

(iii) Structural steel hollow sections.

(iv) Carbon steels and carbon-manganese steels—Hot-rolled bars and semifinished products.

(v) Steel reinforcing bars for concrete.

(vi) Structural and pressure vessel steel—Quenched and tempered plate.

Requirements for product conformity to this Standard are given in Appendix B.

NOTES:

1 Guidelines to purchasers on requirements that should be specified by the purchaser and those that should or may be agreed on at the time of enquiry and order are given in Appendix A.

2 Guidelines on cold-bending of rounds, flats and squares during fabrication are given in Appendix C.

2 NORMATIVE REFERENCES

The following normative documents are referenced in this Standard:

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

AS

1391 Metallic materials—Tensile testing at ambient temperature

1544 Methods for impact tests on metals
1544.2 Part 2: Charpy V-notch

2706 Numerical values—Rounding and interpretation of limiting values

3990 Mechanical equipment—Steelwork

4100 Steel structures

AS/NZS

1050 Methods for the analysis of iron and steel
1050.1 Part 1: Sampling iron and steel for chemical analysis

AS/NZS
1554 Structural steel welding
1554.1 Part 1: Welding of steel structures

4600 Cold-formed steel structures

AS/NZS ISO
9001 Quality management systems—Requirements

ISO
2566 Steel—Conversion of elongation values
2566-1 Part 1: Carbon and low alloy steels

7966 Acceptance control charts

NZS
3404 Steel Structures Standard
3404.1 Part 1: Materials, fabrication, and construction

3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

3.1 Analysis

3.1.1 *Cast analysis*

Chemical analysis determined from test samples taken from the ladle, tundish or mould during casting.

3.1.2 *Product analysis*

Chemical analysis determined from a test sample of the finished product.

3.2 Bars

Finished products of solid section, which may be flats, hexagons, rounds or squares.

3.3 Batch

A unit of production consisting of hot-rolled bars and sections of the same shape and grade manufactured from the same cast.

3.4 Can

To denote a capability or possibility that is available or that might occur.

3.5 Longitudinal direction

Direction of the greatest extension of the steel during rolling.

3.6 May

Indicates the existence of an option.

3.7 Off-square

Deviation of the sawn or shear-cut end from square if measured with respect to the longitudinal axis of the section.

3.8 Out-of-hexagon

Greatest difference between the three dimensions measured at the same cross-section across opposite flats of the hexagon.

3.9 Out-of-round

Difference between the maximum and minimum diameters of the bar, measured at the same cross-section.

3.10 Out-of-square

(a) *For square bars* Difference between the two dimensions at the same cross-section across opposite flats of the square.

(b) *For sections* Displacement of one end of a flange or leg from the other end of the same flange or leg if measured parallel to the web or leg of the section.

3.11 Primary rolled product

Steel product produced in a primary mill by the direct hot-rolling of an ingot or from a continuously cast bloom.

3.12 Sections

Rolled finished sections of special contour and dimensions (see Appendix D).

3.13 Shall

Indicates that a statement is mandatory.

3.14 Should

Indicates a recommendation.

3.15 Testing

Chemical analysis tests and mechanical tests as specified in Clauses 6 and 9.4, respectively.

3.16 Test piece

Prepared piece for testing, made from a test specimen by a mechanical operation.

3.17 Test sample

Portion of material or product, or a group of items selected from a test batch or group by a sampling procedure.

3.18 Test specimen

Portion or a single item taken from the test sample for the purpose of applying a particular test.

3.19 Transverse direction

Direction at right angles to the direction of the greatest extension of the steel during rolling.

4 DESIGNATION

The grade designation shall be based on the nominal minimum yield stress of the steel (see Clause 10.1) and impact strength requirement (see Clause 10.2).

All designations shall include the number of this Australian/New Zealand Standard, i.e. AS/NZS 3679.1. Where material has specified minimum impact properties, the suffix ‘L’ or ‘S’ indicates that the material has been impact tested and the suffix is followed by the value of the test temperature at or below 0°C.

Examples: AS/NZS 3679.1—350

AS/NZS 3679.1—350L0

where

AS/NZS 3679.1 = number of this Standard

350 = nominal minimum yield stress of the steel

L0 = low temperature impact test at 0°C

5 STEEL MANUFACTURING PROCESS

The steel shall be made by either the basic oxygen process or an electric arc process.

6 CHEMICAL COMPOSITION

6.1 General

The method of sampling for chemical analysis shall be in accordance with AS/NZS 1050.1. Chemical composition shall be determined by any procedures that are at least as accurate as those given in accordance with AS/NZS 1050 series.

6.2 Cast analysis

Wherever possible, a chemical analysis of the steel from each cast shall be made to determine the proportions of the specified elements. In cases where it is impracticable to obtain samples from liquid steel, analysis on test samples taken in accordance with AS/NZS 1050.1 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 grade.

Test certificates reporting cast analysis shall indicate values for those elements necessary to establish compliance with the appropriate grade.

6.3 Product analysis

The chemical analysis of the finished product is not a mandatory requirement of this Standard. If the steel is subjected to a product analysis, the analysis shall conform to the limits given in Table 2.

6.4 Residual elements

Elements not given in Table 1 (see Note 2 of Table 1) for the appropriate grade shall not be intentionally added to the steel.

7 MANUFACTURING TOLERANCES

7.1 Bars

Variations from nominal dimensions of a bar shall not exceed the limits given in Tables 3 to 7, as appropriate.

Permissible variations in straightness for bars and light angles having a combined leg length of 150 mm or less shall not exceed—

$$\frac{\text{Length}}{250}$$

NOTE: This permissible variation does not apply if any heating operation has been performed subsequent to rolling.

7.2 Sections

Variations from nominal dimensions of a section shall not exceed the appropriate limits given in Tables 7 to 10, and Figures 1 to 4, as appropriate. The mass per unit length as measured on a sample shall be not less than 97.5% of the nominal value. The mass of any group of lengths of section shall be within 2.5% of the nominal value.

For the purpose of this Clause, a group of lengths shall consist of sections of the same nominal dimensions, having—

(a) minimum mass of 1 tonne; and

(b) minimum number of 10 lengths.

8 FREEDOM FROM DEFECTS

8.1 General

The steel shall be free from pipe, harmful segregation, surface flaws and other defects detrimental to its use as set out in Clause 8.2.

Notwithstanding that steel has been accepted previously, if subsequent processing reveals that it contains defects found to be detrimental, the steel shall be deemed not to comply with this Standard.

8.2 Removal of surface defects

8.2.1 *Bars*

Surface defects greater than 4% of the element nominal thickness or diameter shall be removed by machining, grinding, chipping, scarfing or other similar processes. The dimensions remaining after removal of the surface defects shall be in accordance with Clause 7.1.

8.2.2 *Sections*

The removal of surface defects from a section by grinding, or by chipping followed by grinding, shall comply with the following:

(a) The area ground shall be well flared without abrupt changes in contour.

(b) The grinding shall not extend below the rolled surface by more than—

  (i) 0.5 mm for material less than 10 mm thick at the point of the defect; or

  (ii) 7% of the nominal thickness or 3 mm, whichever is the lesser, for material greater than or equal to 10 mm thick at the point of the defect, as appropriate.

8.3 Weld repair of surface defects

8.3.1 *General*

Weld repair of surface defects from a section, where defects are greater than the limits specified in Clause 8.2.2(b), shall comply with the following:

(a) The total area of the chipped or ground surface of any piece of the section prior to welding shall not exceed 2% of the total surface area of that piece.

(b) The reduction in thickness of the material resulting from removal of defects at any location shall not exceed the lesser of—

  (i) 30% of the nominal thickness of the material at the defect; and

  (ii) 25 mm.

(c) For the toe of an angle, a beam or a channel, the depth of the chipped or ground depression, measured from the toe inward, shall not exceed the remaining material thickness at the base of the depression.

8.3.2 *Welding*

Welding used in the repair of surface defects shall be performed in accordance with AS/NZS 1554.1, Category SP.

Welds shall be sound, the weld metal being thoroughly fused without undercutting or overlap. The weld metal shall project at least 1.5 mm above the rolled surface, and the projecting metal shall be removed by grinding, or by chipping followed by grinding, to make it flush with the rolled surface.

9 TESTING

9.1 Selection of test samples

9.1.1 *General*

Samples for the preparation of test pieces for tensile and impact tests shall be taken in accordance with Clauses 9.1 and 9.2. Samples shall be tested in the same condition as the finished product.

NOTE: Where the product is to be further heat-treated and separate heat treatment of test samples is appropriate, this should be specified at the time of enquiry and order (see Appendix A).

9.1.2 *Sampling*

Test samples shall be taken to represent finished steel of the same product form, treated in the same manner and from the same batch.

9.2 Position and orientation of test samples

Test specimens for tensile and impact tests shall be taken from the test sample, as shown in Figures 5, 6 and 7, as appropriate.

The test specimens shall be taken with their major axes in the longitudinal direction.

9.3 Preparation of test pieces for mechanical testing

9.3.1 *General*

Test specimens may be straightened cold before preparation in accordance with this Standard. A test piece that shows defective machining or develops flaws may be discarded and another test specimen may be submitted.

9.3.2 *Tensile test piece*

9.3.2.1 *General*

A test piece for tensile testing shall be prepared in accordance with AS 1391.

9.3.2.2 *Bars*

Bars shall comply with the following:

(a) Hexagons, rounds and squares with nominal diameter or thickness less than or equal to 30 mm, shall be tested in full section.

(b) For flats with width greater than 40 mm and nominal thickness of less than or equal to 30 mm, the axis of the test piece shall be as near as practicable to the quarter-width position, and shall be tested in full thickness.

(c) For hexagons, rounds and squares with nominal cross-sectional dimensions greater than 30 mm, a proportional test piece may be used. The axis of the test piece shall be parallel to the rolling direction and as near as practicable to a point one-sixth of the distance between diagonally (or diametrically) opposite surfaces.

(d) For flats with nominal thickness greater than 30 mm, a proportional test piece may be used. The axis of the test piece shall be parallel to the rolling direction and as near as practicable to the quarter-width position and to a point one-sixth of the distance between opposite surfaces.

9.3.2.3 *Sections*

For material with thickness greater than 30 mm, either a proportional cylindrical test piece or a non-proportional test piece may be used. For material with thickness less than or equal to 30 mm, a non-proportional test piece of full product thickness shall be used (see Figure 5).

9.3.3 *Impact test piece*

The axis of the notch shall be perpendicular to the rolled surface of the bar or section other than rounds (see Figures 6 and 7). Test pieces shall be prepared in accordance with AS 1544.2 and with the following, as appropriate:

(a) *Sections and flat bars* For sections and flat bars of nominal thickness greater than or equal to 20 mm, material within 3 mm from the surface shall not be included. Machine standard 10 mm × 10 mm test pieces.

For sections and flat bars of nominal thickness less than 20 mm, material within 1 mm from the surface shall not be included. Machine standard 10 mm × 10 mm test pieces.

NOTE: Impact tests on material with nominal thickness less than 8 mm are not covered by this Standard.

(b) *Rounds, squares and hexagons* For rounds, squares and hexagons of nominal thickness greater than 50 mm, material within 3 mm from the surface shall not be included. Machine standard 10 mm × 10 mm test pieces.

For rounds, squares and hexagons of nominal thickness less than or equal to 50 mm, material within 1 mm from the surface shall not be included. Machine standard 10 mm × 10 mm test pieces.

NOTE: Impact tests on rounds, squares and hexagons with nominal thickness less than 16 mm are not covered by this Standard.

9.4 Testing procedures

9.4.1 *Tensile test*

A tensile test shall be made on each test piece prepared from each test sample specified in Clause 9.1.

The tensile test shall be carried out in accordance with AS 1391. The rate of straining when approaching the yield stress shall be within the limits of the conventional straining rate as specified in AS 1391.

Elongation results shall be reported on a gauge length L_o equal to $5.65\sqrt{S_o}$ where S_o is the cross-sectional area of the test piece before testing. Conversion of results from a non-proportional gauge length shall be in accordance with ISO 2566-1.

For test pieces with cross-sectional area greater than 1000 mm^2, the minimum elongation after conversion to the gauge length of $5.65\sqrt{S_o}$, shall be reduced by 2% from that given in Table 11.

9.4.2 *Charpy V-notch impact test*

One test in accordance with AS 1544.2 shall be carried out on each of three test pieces prepared from each test sample specified in Clauses 9.1 and 9.2.

10 MECHANICAL PROPERTIES

10.1 Tensile test

For tensile tests carried out in accordance with Clause 9.4.1, the yield stress, tensile strength and elongation, shall conform to the limits given in Tables 11 and 12, as appropriate.

10.2 Impact test

For impact tests, carried out in accordance with Clause 9.4.2, the absorbed energy values shall conform to the limits given in Table 13.

1 1 IDENTIFICATION, TEST CERTIFICATES AND INDEPENDENT TESTS

11.1 Identification

11.1.1 *Individual length markings*

All angles with nominal combined leg lengths not less than 150 millimetres and other hot rolled sections, not less than 150 millimetres in depth, shall be clearly and legibly identified by a mark that is rolled into the section at the time of production with the following requirements:

(a) A mark with the two characters 'AS' to indicate that it is made to this Australian Standard.

(b) The manufacturer's name or mark, or both.

(c) The markings specified in Items (a) and (b) shall be at intervals of no greater than 4 m along the length of the member.

(d) Nominal offset of markings specified in Items (a) and (b) shall be not less then 0.1 mm above the surface of a web or leg of the section to ensure legibility.

Details of the steel producer's marking shall be made available on request.

11.1.2 *Bundle pack markings*

The material shall be marked or tagged for bundles with the following:

(a) The manufacturer's name or mark, or both.

(b) Reference to this Standard, i.e. AS/NZS 3679.1.

(c) The grade of steel (see Clause 4).

(d) The product to be traced to the batch of steel from which it was made.

(e) The nominal size and shape.

NOTE: If the identified portion of the product is subsequently removed, then these identifications are to be transferred to each remaining portion of the product.

11.2 Test reports and test certificate

11.2.1 *Qualifications on test reports and test certificates*

A test report or test certificate shall provide results, if required by agreement between the purchaser and the manufacturer, relating to the following:

(a) Tests performed by a laboratory accredited by signatories to ILAC (MRA) on behalf of the manufacturer for the purpose of establishing compliance with this Standard.

(b) Additional tests as agreed between the purchaser and manufacturer.

11.2.2 *Minimum requirements for test certificates*

Any report or test certificate shall be written in English alphanumeric characters, be issued by the manufacturer and shall include the following:

(a) Manufacturer's, supplier's and testing authority's name.

(b) Test certificate number.

(c) Date.

(d) Product, testing specification and grade, e.g. AS/NZS 3679.1—350 Grade (see Clause 4).

(e) Product designation (see Appendix D).

(f) Product steelmaking process, e.g. Basic oxygen—Slab cast (see Clause 5).

(g) Length, bundle, pack or unique identifier to which the test certificate applies (see Clause 11.2.1).

(h) Heat number (from casting).

(i) Mechanical properties—Tensile tests: Yield stress in MPa, tensile strength in MPa and % elongation (see Clause 9.4.1).

(j) Chemical analysis type, e.g. cast analysis 'L' or product 'P' (see Clauses 6.2, and 6.3).

(k) Chemical composition of carbon (C), phosphorus (P), manganese (Mn), silicon (Si), sulphur (S), chromium (Cr), molybdenum (Mo), vanadium (V), nickel (Ni), copper (Cu), aluminium (Al), titanium (Ti), Niobium (Nb), carbon equivalence (CE) (see Clauses 6.1, 6.2 and 6.3) and any element intentionally added.

(l) Impact test results at the specified test temperature for low temperature and seismic grades (L0 and S0 Grades, see Clause 9.4.2).

(m) Additional tests agreed between the purchaser and the manufacturer.

(n) Statement acknowledging material being supplied in accordance with Items (a) to (m).

(o) Any third party quality certifying body or accredited body, or both, recognized by ILAC (MRA).

(p) Signatory from manufacturer, supplier and testing authority attesting to Items (a) to (o).

11.3 Independent tests

In the event of a dispute as to the compliance of the steel with this Standard, the referee testing shall be carried out by independent laboratories accredited by signatories to ILAC (MRA).

1 2 ROUNDING OF NUMBERS

12.1 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 AS 2706.

The number of significant places retained in the rounded-off value shall be the same as that of the specified value in the appropriate material Standard.

12.2 Tensile properties

The determined value of tensile strength shall be rounded off to the nearest 10 MPa, and the determined value of yield stress shall be rounded off to the nearest 5 MPa.

TABLE 1

CHEMICAL COMPOSITION OF BARS AND SECTIONS

Grade (see Note 1)	Cast analysis (max.) (see Notes 2 and 3)						
	C	Si	Mn	P	S	Micro-alloying elements (see Note 4)	CE (see Note 5)
300, 300L0, 300L15 and 300S0	0.25	0.50	1.60	0.040	0.040	(See Note 6)	0.44
350, 350L0, and 350S0	0.22	0.50	1.60	0.040	0.040	(See Note 7)	0.45

NOTES:

1 The use of sulphide modification steel-making techniques for these grades is permitted.

2 Grain refining elements, i.e. aluminium and titanium may be added, provided that the total content does not exceed 0.15%. Limits are for total or soluble aluminium.

3 The following elements may be present to the limits stated, subject to a maximum total of 1.00% (see also Table 2):

(a) Copper:..... 0.50%.

(b) Nickel:..... 0.50%.

(c) Chromium:..... 0.30%.

(d) Molybdenum:..... 0.10%.

4 For grades, 300, 300L0 and 300S0, the following are not considered as micro-alloying elements:

(a) Titanium:.....0.040% maximum.

(b) Niobium: .....0.020% maximum.

(c) Vanadium: .....0.030% maximum.

(d) Niobium plus vanadium: .....0.030% maximum.

5 Carbon equivalent (CE) is calculated from the following equation:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

6 Micro-alloying elements are not permitted in grades 300, 300S0 and except in thicknesses greater than or equal to 15 mm, where the following apply:

(a) The maximum combined micro-alloying element content is 0.15%.

(b) Where micro-alloying elements are used, the percentage of each element is to be shown on the certificates.

7 For grades 350, 350L0, and 350S0 micro-alloying elements niobium, vanadium and titanium may be added, provided that their total combined content does not exceed 0.15%.

TABLE 2

PRODUCT ANALYSIS TOLERANCES FOR GRADES GIVEN IN TABLE 1

Element	Tolerance over maximum limit %
Carbon	0.04
Silicon	0.05
Manganese	0.10
Phosphorus	0.01
Sulfur	0.01

TABLE 3

PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR ROUNDS AND SQUARES

millimetres

Specified size (diameter or thickness)	Permissible variation from specified size	Permissible out-of-round or out-of-square
≤25	+0.25 –0.25	0.40
>25 ≤30	+0.30 –0.30	0.45
>30 ≤40	+0.40 –0.40	0.60
>40 ≤50	+0.50 –0.50	0.75
>50 ≤60	+0.60 –0.60	0.90
>60 ≤70	+0.70 –0.70	1.05
>70 ≤80	+0.80 –0.80	1.20
>80 ≤100 (see Note)	+0.90 –0.90	1.35
>100 ≤125	+3.20 –0	3.20
>125 ≤170	+4.80 –0	4.80
>170 ≤215	+6.40 –0	6.40

NOTE: For material produced as primary-rolled product (see Clause 3.11), optional dimensional tolerances in the size range >80 ≤100 are +2.45, –0, and the permissible out-of-round or out-of-square is 1.85.

TABLE 4

WIDTH TOLERANCES FOR FLATS

millimetres

Specified width	Width tolerance
≤25	+0.40, –0.40
>25 ≤50	+0.80, –0.80
>50 ≤100	+1.60, –0.80
>100 ≤150	+2.40, –1.60
>150 ≤200	+3.20, –3.20
>200 ≤300	+3.20, –3.20

TABLE 5

THICKNESS TOLERANCES FOR FLATS

millimetres

Specified width	Thickness tolerance (plus or minus)				
	Specified thickness				
	<6	≥6 ≤12	>12 ≤25	>25 ≤50	>50
≤25	0.20	0.20	0.25	—	—
>25 ≤50	0.20	0.30	0.40	0.80	—
>50 ≤100	0.20	0.40	0.50	0.80	1.20
>100 ≤150	0.25	0.40	0.50	0.80	1.60
>150 ≤200	0.25	0.40	0.50	0.80	—
>200 ≤300	—	0.40	0.50	0.80	—

TABLE 6

PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR HEXAGONS

millimetres

Specified thickness	Permissible variation from specified thickness	Permissible out-of-hexagon
≤12	+0.20, –0.20	0.30
>12 ≤25	+0.25, –0.25	0.40
>25 ≤40	+0.55, –0.35	0.60
>40 ≤50	+0.80, –0.40	0.90
>50 ≤65	+1.20, –0.40	1.10

TABLE 7

PERMISSIBLE VARIATIONS IN LENGTH FOR BARS AND SECTIONS

Specified length m	Permissible variation from specified length mm
≤7	+50, –0
>7 ≤12	+75, –0
>12	+100, –0

NOTE: Universal sections are normally supplied to a tolerance of +150 mm, –0.

TABLE 8

PERMISSIBLE OFF-SQUARE FOR END CUTS OF SECTIONS OTHER THAN UNIVERSAL SECTIONS

Section	Permissible off-square for end cuts of sections mm
Channels and tapered-flange beams	0.030 per mm of depth (*d*) (see Note 1)
Angles	0.030 per mm of leg length (see Note 2)

NOTES:

1 See Figure 3, 4 or 5, as appropriate.

2 For unequal angles, the off-square is determined on the longer leg.

TABLE 9

PERMISSIBLE VARIATIONS IN STRAIGHTNESS FOR SECTIONS OTHER THAN UNIVERSAL SECTIONS

Characteristic (see Note 1)	Permissible variation mm
Camber (see Note 2)	$\frac{\text{Length}}{500}$
Sweep	Owing to the extreme variations in flexibility of tapered-flange beams and channels about the *y* axis, straightness tolerances are as specified by the purchaser for the individual sections involved

NOTES:

1 Measuring of camber and sweep in universal sections shall be in accordance with Appendix E.

2 For angles having a combined leg length of greater than 150 mm, this is the straightness tolerance.

TABLE 10

PERMISSIBLE VARIATIONS IN STRAIGHTNESS FOR UNIVERSAL SECTIONS

millimetres

Nominal size	Sweep	Camber
Sections with a flange width (b_f) less than 150 mm	$\frac{\text{Length}}{500}$	$\frac{\text{Length}}{1000}$
Sections with a flange width (b_f) equal to the depth (d):		
(a) Lengths of 14 m and less	$\frac{\text{Length}}{1000}$ but not more than 10 mm	
(b) Lengths greater than 14 m	$10\text{ mm} + \frac{\text{Length} - 14000}{1000}$	
All other sections	$\frac{\text{Length}}{1000}$	

NOTE: Owing to the extreme variation in the elastic flexibility of universal sections about the *y* axis, difficulty may be experienced in obtaining reproducible sweep measurements. Measuring of sweep shall be in accordance with Appendix E.

TABLE 11

TENSILE TEST REQUIREMENTS FOR FLATS AND SECTIONS

Grade	Minimum yield stress, (R_{eH}) MPa (see Note 1)				Minimum tensile strength, (R_m)	Minimum elongation on a gauge length of $5.65\sqrt{S_o}$ (see Note 4)
	Thickness, mm (see Note 3)					
	<11	≥11 to ≤17	>17 to <40	≥40	MPa	%
300, 300L0	320	300	280	280	440	22
300L15, 300S0	320	300	280	280	440	25 (see Note 2)
350, 350L0	360	340	340	330	480	20
350S0	360	340	340	330	480	25 (see Note 2)

NOTES:

1 R_{eH} is the upper yield point as determined using AS 1391.

2 S0 is the seismic grade. Refer to Clause F2, Appendix F for limitations.

3 For a section, the term 'thickness' refers to the nominal thickness of the part from which the sample is taken.

4 S_o is the cross-sectional area of the test piece before testing.

5 For flat product, S0 grades are not applicable.

TABLE 12

TENSILE TEST REQUIREMENTS FOR HEXAGONS, ROUNDS AND SQUARES

Grade	Minimum yield stress (R_{eH}) MPa (see Note 1)			Minimum tensile strength	Minimum elongation on a gauge length of $5.65\sqrt{S_o}$ (see Note 3)
	Thickness, mm (see Note 2)				
	≤50	>50 to <100	≥100	MPa	%
300, 300L0, 300L15	300	290	280	440	22
350, 350L0	340	330	320	480	20

NOTES:

1 R_{eH} is the upper yield point as determined using AS 1391.

2 For a section, the term 'thickness' refers to the nominal thickness of the part from which the sample is taken.

3 S_o is the cross-sectional area of the test piece before testing.

4 For flat product, S_0 grades are not applicable.

TABLE 13

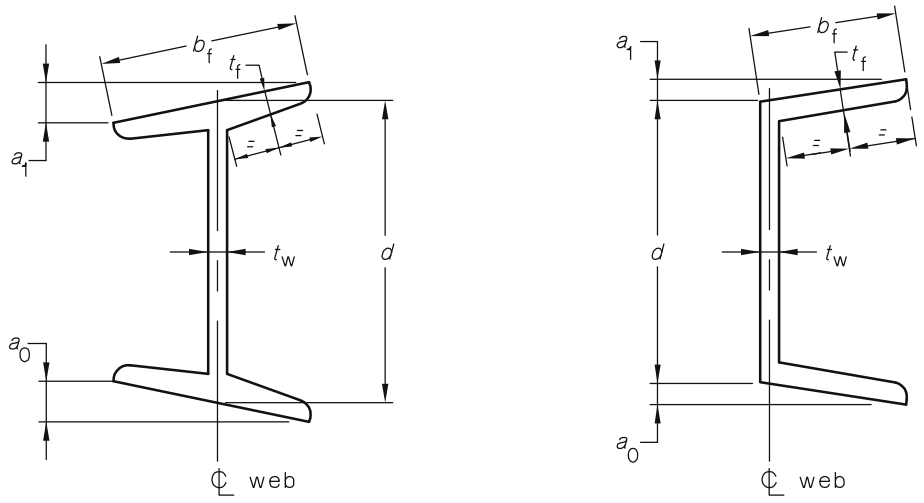
CHARPY V-NOTCH IMPACT TEST REQUIREMENTS

Grade	Test temperature	Minimum absorbed energy, J					
		Size of test piece					
		10 mm × 10 mm		10 mm × 7.5 mm		10 mm × 5 mm	
	°C	Average of 3 tests	Individual test	Average of 3 tests	Individual test	Average of 3 tests	Individual test
300L0 350L0	0 0	27	20	22	16	18	13
300L15	-15	27	20	22	16	18	13
300S0	0	70	50	—	—	—	—
350S0 (see Note 1 and 2)	0	70	50	—	—	—	—

NOTES:

1 S0 is a seismic grade low temperature impact test at 0°C.

2 Impact testing for S0 only applies to sections with elements greater than 12 mm thick.



NOTES:

1 Dimensions d, a_1 and a_0 are measured parallel with the centre-line of the web. Dimension b_f is measured parallel with the plane of the flange.

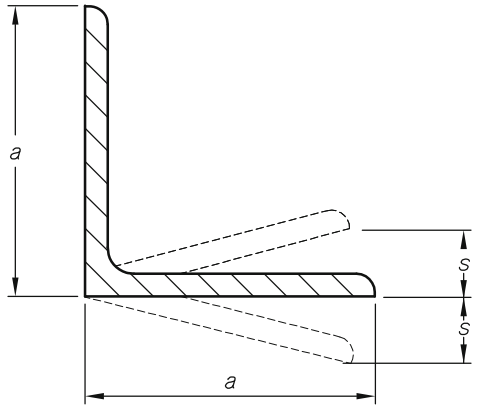
2 Dimension d is measured at the centre-line of the web for beams and at the back of the web for channels.

3 Out-of-square is given by a_1 or a_0 whether the flanges are turned in the same or opposite directions.

millimetres

1	2	3		4	5		6		7	8
Section	**Depth of section (d)**			**Flange width (b_f)**			**Permissible variation in flange or web thickness**		**Permissible out-of-square on each leg or flange**	**Permissible out-of-square per mm of nominal flange width b_f**
	Nominal dimension	**Permissible variation**		**Nominal dimension**	**Permissible variation**		**(t_f or t_w)**		**(a_1 or a_0)**	**($a_1 + a_0$)**
		Plus	**Minus**		**Plus**	**Minus**	**Plus**	**Minus**		
Tapered-flange beams	>75 ≤125	2.5	1.5	>40 ≤80	3.0	3.0	0.7	0.7	1.5	0.030
				>80 ≤90	3.0	3.0	0.7	0.7	2.0	0.030
Parallel flange channels	≥75 ≤ 120	3.0	1.5	>35 ≤55	3.0	3.0	0.7	0.7	1.0	0.030
	>120 ≤ 360	3.0	1.5	>55 ≤80	3.0	3.0	1.0	1.0	1.5	0.030
	>360 ≤ 390	5.0	3.0	>80 ≤105	3.0	4.0	1.0	1.0	2.0	0.030

FIGURE 1 PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR TAPERED-FLANGE BEAMS AND PARALLEL FLANGE CHANNELS



NOTES:

1 When measuring the out-of-square, the back of the square and the centre-line of the reference leg are to be parallel.

2 The nominal size is to be determined as follows:

(a) For equal angles—legs length (a).

(b) For unequal angles—length of the longer leg.

3 For actual thickness, see Figures 6 and 7.

millimetres

Nominal leg size	Permissible variation		
	Leg length		Out-of-square
	Over	Under	(*s*)
≤40	2.5	1.5	1
>40 ≤75	2.5	1.5	2
>75 ≤125	3.0	3.0	3
>125 ≤150	3.0	3.0	4
>150	5.0	3.0	5

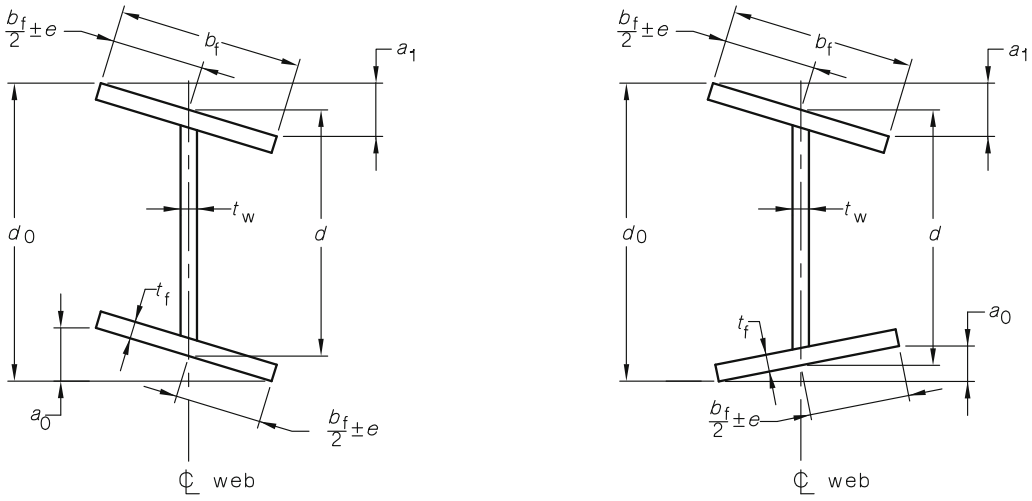
(a) Tolerance on leg length and out-of-square

millimetres

Actual thickness (*t*)	Permissible variation	
	Plus	Minus
≤10	0.5	0.5
>10 ≤15	0.7	0.7
>15 ≤25	1.0	1.0
>25	1.5	1.5

(b) Thickness tolerance

FIGURE 2 PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR ANGLES



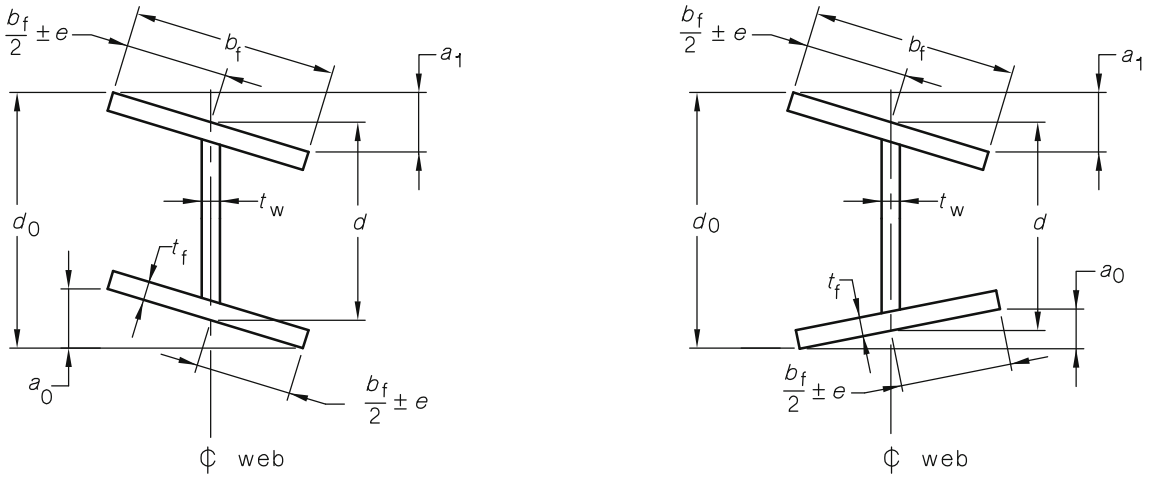
NOTES:

1 Dimensions d_0, d, a_1 and a_0 are measured parallel with the centre-line of the web. Dimensions b_f and $b_f/2 \pm e$ are measured parallel with the plane of the flange.

2 Dimension d is measured at the centre-line of the web.

1	2	3	4	5	6	7	8	9	10	11
Designation		**Permissible variation of depth**	**Permissible variation of flange width**	**Permissible variation of web thickness**	**Permissible variation of flange thickness**	**Maximum difference of flange over four flanges**	**Permissible out-of-square on each flange**	**Permissible total out-of-square**	**Permissible web off-centre**	**Permissible overall depth over specified depth**
Nominal size mm	**Nominal mass kg/m**	(d) **mm**	(b_f) **mm**	(t_w) **mm**	(t_f) **mm**	**mm**	(a_1 *or* a_0) **mm**	($a_1 + a_0$) **mm**	(e) **mm**	($d_0 - d$) **mm**
610 UB	125.0				±1.5	1.5				
	113.0									
	101.0				±1.0	1.0				
530 UB	92.4				±1.5	1.5	5	8	5	6
	82.0	±3	+6 to −5	±0.7	±1.0	1.0				
460 UB	82.1				±1.5	1.5				
	74.6									
	67.1									
410 UB	59.7									
	53.7									
360 UB	56.7									
	50.7									
	44.7				±1.0	1.00				
310 UB	46.2									
	40.4									
	32.0									
250 UB	37.3									
	31.4						4	6		
	25.7									
200 UB	29.8									
	25.4									
	22.3									
	18.2									
180 UB	22.2						2			
	18.1	+2.5 to −1.5	±3					2.5	2.5	4
	16.1									
150 UB	18.0						1.5			
	14.0									

FIGURE 3 PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR UNIVERSAL BEAMS



NOTES:

1 Dimensions d_0, d, a_1 and a_0 are measured parallel with the centre-line of the web. Dimensions b_f and $b_f/2 \pm e$ are measured parallel with the plane of the flange.

2 Dimensions d is measured at the centre-line of the web.

1	2	3	4	5	6	7	8	9	10	11
Designation		**Permissible variation of depth**	**Permissible variation of flange width**	**Permissible variation of web thickness**	**Permissible variation of flange thickness**	**Maximum difference of flange over four flanges**	**Permissible out-of-square on each flange**	**Permissible total out-of-square**	**Permissible web off-centre**	**Permissible overall depth over specified depth**
Nominal size	**Nominal mass**	**(d)**	**(b_f)**	**(t_w)**	**(t_f)**		**(a_1 *or* a_0)**	**($a_1 + a_0$)**	**(e)**	**($d_0 - d$)**
	kg/m	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**
310 UC	158.0			±1.0						
	137.0									
	118.0				±1.5	1.5	5	8		
	96.8									
250 UC	89.5									
	72.9	±3	+6 to −5						5	6
200 UC	59.5									
	52.2			±0.7	±1.0	1.0	4	6		
	46.2									
150 UC	37.2									
	30.0									
	23.4									
100 UC	14.8									

FIGURE 4 PERMISSIBLE VARIATIONS IN CROSS-SECTIONAL DIMENSIONS FOR UNIVERSAL COLUMNS

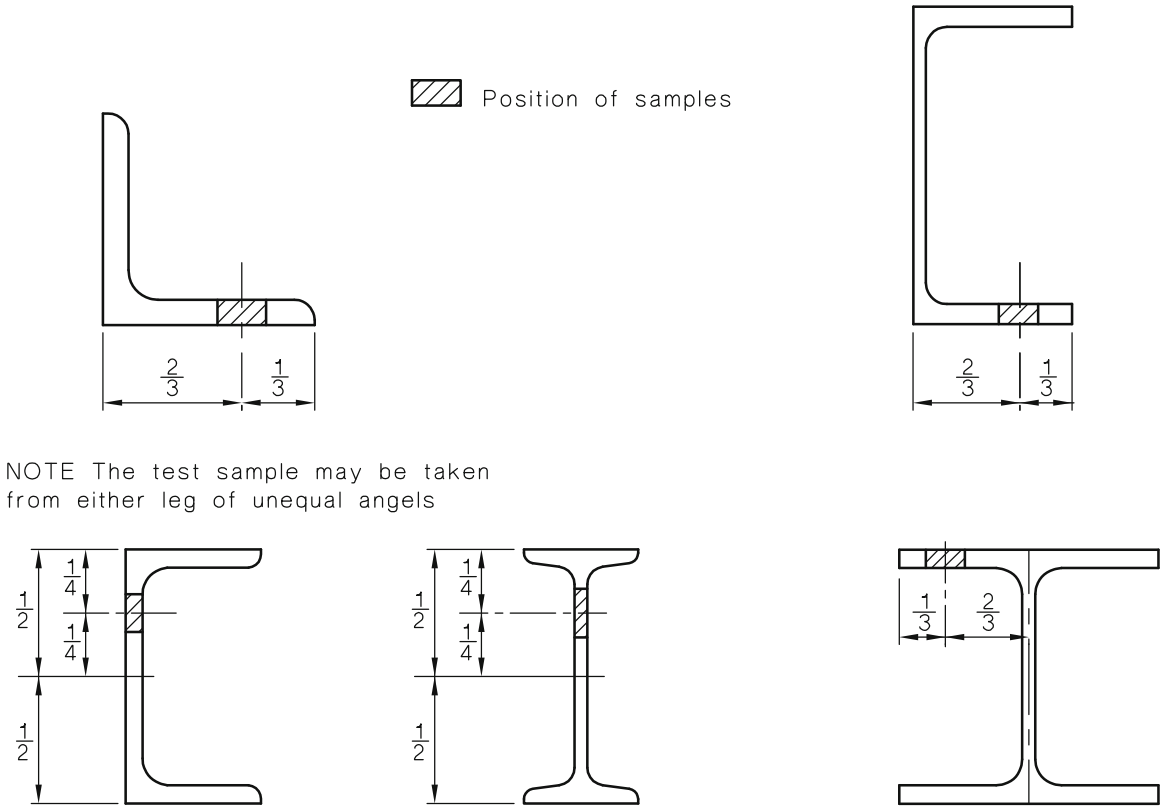


FIGURE 5 POSITION OF TEST SPECIMENS FOR TENSILE TESTS

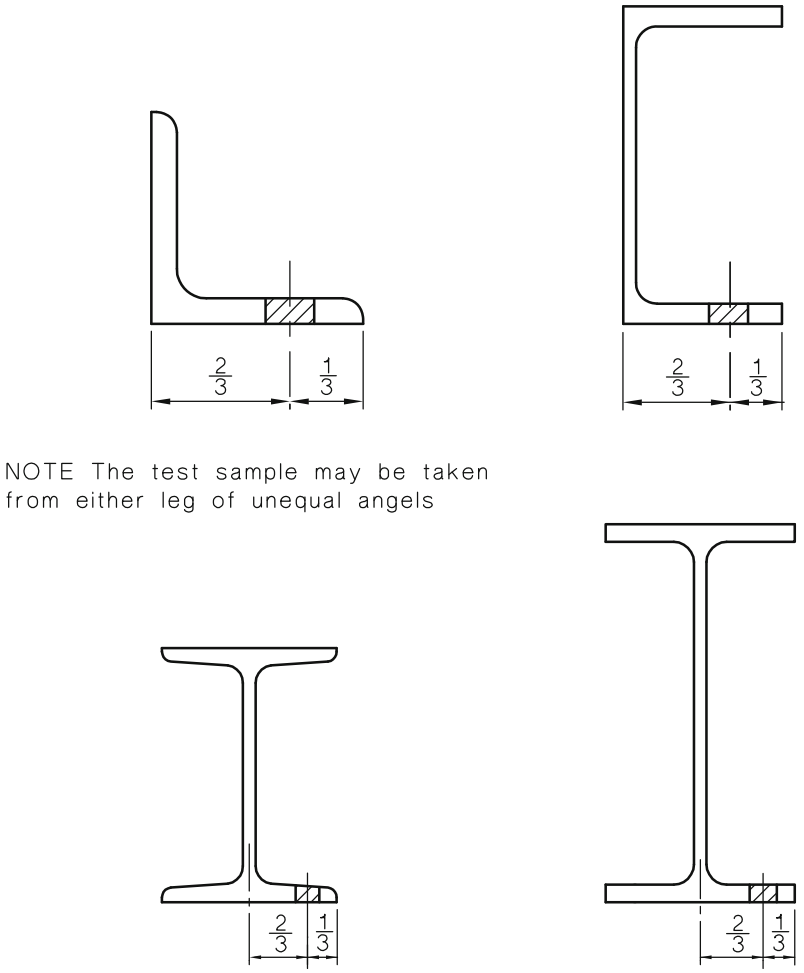


FIGURE 6 POSITION OF TEST SPECIMENS AND TEST PIECE NOTCH LOCATION FOR IMPACT TESTS

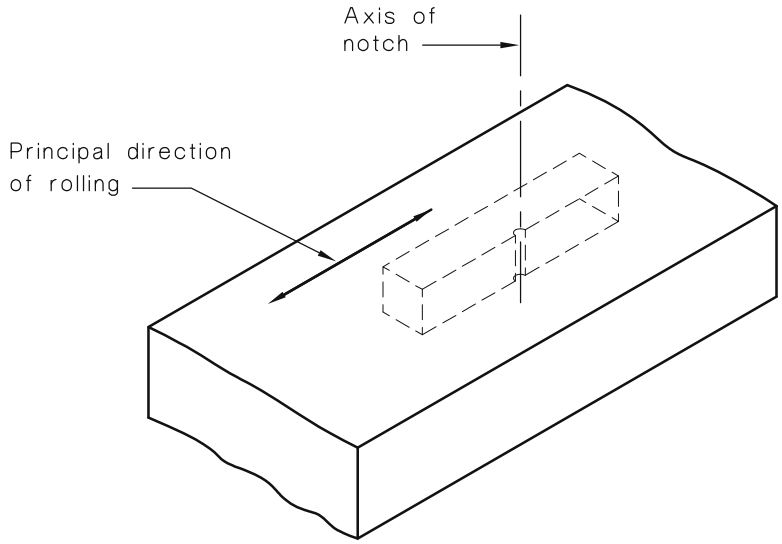


FIGURE 7 ORIENTATION OF IMPACT TEST SPECIMEN

APPENDIX A

PURCHASING GUIDELINES

(Informative)

A1 GENERAL

Australian/New Zealand Standards are intended to include the technical provisions necessary for the supply of materials referred to in the particular Standard, but do not purport to comprise all the necessary provisions of a contract. In a number of cases, the purchaser is asked to state the requirements or is given a choice of optional requirements. These are contractual matters to be agreed upon between the purchaser and the manufacturer, or the supplier.

This Appendix contains detailed explanations, advice and recommendations on the information to be supplied by the purchaser at the time of enquiry and order.

Its aims are to avoid misunderstandings and to result in the purchaser receiving satisfactory products and services.

A2 INFORMATION TO BE SUPPLIED BY THE PURCHASER

The purchaser should consider and supply the following information at the time of enquiry and order, after making due reference to the explanation, advice and recommendations contained in this Appendix:

(a) Quantity and delivery instructions (dates, schedules, delivery point).

(b) Dimensions of steel, e.g. section, length, mass per unit length applicable, bundle masses.

(c) Designation of grade and Standard number (see Clause 4).

(d) Whether a certificate of compliance or test certificate is required (see Paragraph A5).

(e) Whether it is the intention of the purchaser to inspect the steel at the manufacturer's works (see Paragraph A4).

(f) Any information concerning processing or end use that the purchaser considers would assist the manufacturer.

(g) Any exceptions to the Standard and any special or supplementary requirements, e.g. non-destructive testing inspection (see Paragraph A3).

NOTE: Any special or supplementary requirements of this Standard are to be subject to agreement between the purchaser and the manufacturer, or the supplier at the time of enquiry and order, and stated on the order.

A3 NON-DESTRUCTIVE EXAMINATION

If non-destructive examination is required by the purchaser, the method to be used and the limits of acceptance should be determined at the time of enquiry and order.

The method should be in accordance with AS 1171 and AS 2062 as appropriate.

A4 INSPECTION

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 order, and should be accomplished in a manner which will not interfere with the operation of the works. The functions are as follows:

(a) Inspect the product during manufacture.

(b) Select and identify the test samples.

(c) Witness the tests being made.

The manufacturer should provide all reasonable facilities to enable the purchaser to be satisfied that the product complies with this Standard.

APPENDIX B

PRODUCT CONFORMITY

(Normative)

B1 SCOPE

This Appendix sets out the minimum sampling and testing plan for Product Conformity to this Standard which shall be demonstrated by the manufacturer or supplier.

The Product Conformity requirements shall enable Conformity Assessment to be made by a manufacturer or supplier (first party), a user or purchaser (second party), or an independent body (third party), and shall not be dependent on a quality management systems standard (e.g. AS/NZS ISO 9001).

NOTE: These provisions are based on—

(a) ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*, 5th Edition, 2004

(b) ISO/IEC Directives, Supplement – Procedure specific to IEC, 4th Edition, 2009.

(c) IEC, Conformity Assessment Board (CAB/822/INF, 2009-05-27), Agenda item 7.2, ISO/IEC Directives, text concerning conformity assessment: current status.

B2 SAMPLING AND TESTING

B2.1 General

Sampling and testing shall be carried out by the manufacturer in accordance with Paragraph B2.2 or B2.3 as appropriate. For every batch, the chemical composition shall be obtained in accordance with Clause 6.1, 6.2 or 6.3 as appropriate.

B2.2 Minimum batch sampling and testing

B2.2.1 *Tensile test*

For tensile tests, samples representative of the batch shall be taken as follows:

(a) One sample for a batch not exceeding 50 t.

(b) One additional sample for the balance of the batch.

If the quantity includes steel of more than one thickness or diameter, a further tensile test shall be made for product from each of the thickness ranges specified in Table 11. Additional tensile tests shall be made for each variation in thickness or diameter, above or below the thickness or diameter of the first test piece selected within each of the thickness ranges as follows:

Thickness mm	Variation mm
≤50	±5
>50	±25

B2.2.2 *Impact test*

For impact tests, samples representative of the batch shall be taken as follows:

(a) One sample for a batch not exceeding 50 t.

(b) One additional sample for the balance of the batch.

If the quantity includes steel of more than one thickness or diameter, a further impact test shall be made for each variation in thickness or diameter.

B2.2.3 *Retests*

B2.2.3.1 *Tensile tests*

Two test samples shall be taken at random from the remainder of the test batch. If the test pieces from both additional samples comply with Clauses 9.2, 9.3, 9.4.1 and 10.1, the remainder is need to comply with this Standard.

If one of these additional samples fails to comply, the steel of the applicable test batch is deemed to not comply with this Standard.

B2.2.3.2 *Impact tests*

If the average value of the three impact test results is less than the specified minimum average, or if one value is less than the specified individual test value given in Table 13, then three additional test pieces from the original sample shall be tested in accordance with Clauses 9.2, 9.3, 9.4.2 and 10.2; and add the results to those previously obtained and calculate a new average. If the average value of the six tests is not less than the specified minimum average, and not more than one result of the six tests is less than the specified individual test value given in Table 13, then the unit is deemed to comply with this Standard.

B2.3 Statistical sampling

B2.3.1 *General*

Process verification by statistical sampling or alternate methods can be used to demonstrate product conformity where the conditions required by this Clause are met.

Where it can be demonstrated that the tensile and impact properties of any group of products manufactured under the same conditions of steel supplier, steel grade and steel processing (e.g. mill) are distributed normally, then it shall be permissible to adopt statistical sampling to verify process acceptance for each product in accordance with ISO 7966.

For product conformance to this Standard via statistical sampling, the inputs of process acceptance verification, ongoing testing and statistical sampling must be demonstrated and, where applicable, also maintained.

Additionally, any sample or sampling that indicates a predicted proportion of non-conforming product in excess of an amount considered within the demonstrated statistical sampling method, shall cause the sampling for that combination of size, thickness and grade to revert to batch testing rules until it can be demonstrated that the conditions of statistical sampling are valid for that combination.

In the event of actual non-conforming test results, the retest provisions of normal batch testing shall also apply.

NOTE: Statistical sampling is a procedure that enables decisions to be made about the quality and conformity of batches of items after inspecting or testing only a portion of those items. This procedure will only be valid if the sampling plan has been determined on a statistical basis and the following requirements are met:

(a) The sample is drawn randomly from a population of product of known history that enables verification that the product was made from known materials at essentially the same time by essentially the same processes and under essentially the same system of control.

(b) For each different situation, a suitable sampling plan is defined. A sampling plan for one manufacturer of given capability and product throughput may not be relevant to another manufacturer producing the same items.

In order for statistical sampling to be meaningful to the customer, the manufacturer or supplier needs to demonstrate how the above conditions have been satisfied. Sampling and the establishment of a sampling plan should be carried out in accordance with recognised Standards (e.g. AS 2490, AS 1199, Parts 0 and 1) and methods.

Under this approach, ongoing sampling and testing of product shall be directed primarily at monitoring the process to ensure that product outcomes are acceptable, within characteristic ranges, as well as being stable and under control.

B2.3.2 *Tensile tests*

B2.3.2.1 *General*

Testing to AS 1391, as noted in Clause 10.1, is only considered within this Paragraph (B2.3.2) for product conformance assessment to tensile testing requirements.

B2.3.2.2 *Sampling conditions*

In conjunction with the provisions of Paragraph B2.3.1, statistical sampling shall only be used for a combination of section shape, size, and grade, where the statistically predicted proportion of non-conforming product is less than 5% at a confidence level of 90%.

Changes in steel supplier, steel grade chemistry and process (e.g. mill) shall necessitate a re-evaluation of the conditions in this Paragraph (B2.3.2.2).

B2.3.3 *Impact tests*

B2.3.3.1 *General*

Testing to AS 1544.2 as noted in Clause 10.2 is only considered within this Paragraph (B2.3.3) for product conformance assessment to impact testing requirements.

B2.3.3.2 *Sampling conditions*

In conjunction with the provisions of Paragraph B2.3.1, statistical sampling shall only be used for a combination of section shape, size, and grade where the statistically predicted proportion of non-conforming product is less than 5% at a confidence level of 90% .

Changes in steel supplier or steel grade and significant changes in steel or tube processing shall necessitate a re-evaluation of the conditions in this Paragraph (B2.3.3.2).

APPENDIX C

COLD-BENDING OF ROUNDS, FLATS AND SQUARES DURING FABRICATION

(Informative)

For rounds manufactured in accordance with this Standard, the minimum diameter of former to be used for cold-bending during fabrication should be as given in Table C1.

For flats and squares manufactured in accordance with this Standard, the minimum diameter of former to be used for cold-bending during fabrication should be as given in Table C2.

NOTES:

1 Cold-bending is not recommended where product is to be hot-dipped galvanized or where any acid treatment may cause hydrogen embrittlement.

2 Warm-bending should be carried out within the temperature range of 75°C to 100°C.

Hot-bending should be carried out within the temperature range of either 580°C to 630°C or 870°C to 920°C.

TABLE C1

RECOMMENDED MINIMUM FORMER DIAMETER FOR COLD-BENDING OF ROUNDS DURING FABRICATION

Diameter of bar (d)	Diameter of former			
	mm			
	Grade			
mm	250	300	350	400
≤36	3d	3d	4d	Warm-bend 4d
>36 ≤50	4d	4d	Warm-bend 5d	Hot-bend

TABLE C2

RECOMMENDED MINIMUM FORMER DIAMETER FOR COLD-BENDING OF FLATS AND SQUARES DURING FABRICATION

Thickness of bar (t)	Diameter of former			
	mm			
	Grade			
mm	250	300	350	400
≤10	2t	2t	3t	4t
>10 ≤25	3t	3t	4t	Warm-bend 4t
>25 ≤50	4t	5t	Warm-bend 5t	Hot-bend

NOTE: Bars should only be bent in the transverse direction.

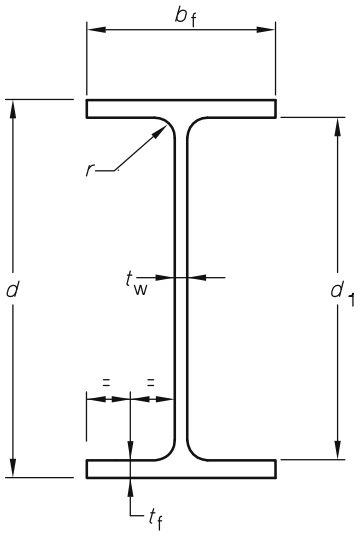
APPENDIX D

DIMENSIONS

(Normative)

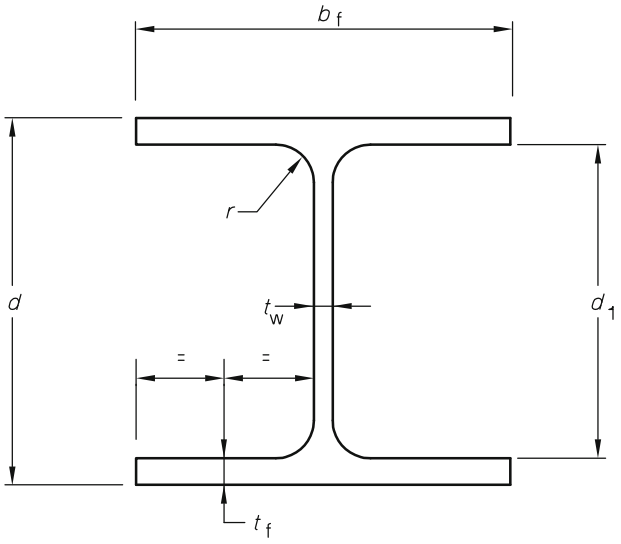
This Appendix provides a list of common hot-rolled structural sections produced in Australia. The list provides their designation and respective dimensions. Figures D1 to D7 are not restrictive or exhaustive. These nominal values shall be used to calculate their section properties.

Other sizes and shapes with different designations and dimensions may be produced to this standard. Manufacturers shall provide the designation and dimensions for bars and sections produced that are not listed in Figures D1 to D7.



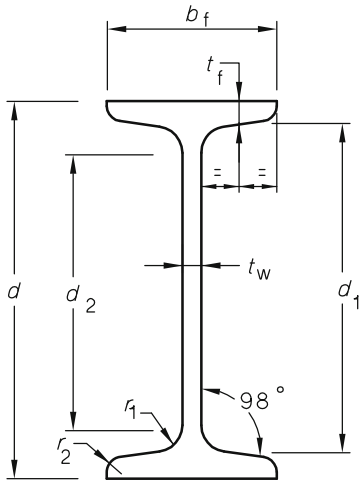
1		2	3	4	5	6	7
Designation		Depth of section	Flange		Web thickness	Root radius	Depth between flanges
			Width	Thickness			
		(d)	(b_f)	(t_f)	(t_w)	(r)	(d_1)
	kg/m	mm	mm	mm	mm	mm	mm
610 UB	125	611.6	229.0	19.6	11.9	14.0	572.4
	113	607.0	228.0	17.3	11.2	14.0	572.4
	101	602.0	228.0	14.8	10.6	14.0	572.4
530 UB	92.4	533.0	209.0	15.6	10.2	14.0	501.8
	82.0	528.2	209.0	13.2	9.6	14.0	501.8
460 UB	82.1	460.4	191.0	16.0	9.9	11.4	428.4
	74.6	457.4	190.0	14.5	9.1	11.4	428.4
	67.1	453.8	190.0	12.7	8.5	11.4	428.4
410 UB	59.7	406.4	178.0	12.8	7.8	11.4	380.8
	53.7	402.6	178.0	10.9	7.6	11.4	380.8
360 UB	56.7	358.6	172.0	13.0	8.0	11.4	332.6
	50.7	355.6	171.0	11.5	7.3	11.4	332.6
	44.7	352.0	171.0	9.7	6.9	11.4	332.6
310 UB	46.2	307.2	166.0	11.8	6.7	11.4	283.6
	40.4	304.0	165.0	10.2	6.1	11.4	283.6
	32.0	298.0	149.0	8.0	5.5	13.0	282.0
250 UB	37.3	256.2	146.0	10.9	6.4	8.9	234.4
	31.4	251.6	146.0	8.6	6.1	8.9	234.4
	25.7	248.0	124.0	8.0	5.0	12.0	232.0
200 UB	29.8	207.0	134.0	9.6	6.3	8.9	187.6
	25.4	203.2	133.0	7.8	5.8	8.9	187.6
	22.3	201.6	133.0	7.0	5.0	8.9	187.6
	18.2	198.0	99.0	7.0	4.5	11.0	184.0
180 UB	22.2	179.0	90.0	10.0	6.0	8.9	159.0
	18.1	175.0	90.0	8.0	5.0	8.9	159.0
	16.1	173.0	90.0	7.0	4.5	8.9	159.0
150 UB	18.0	155.0	75.0	9.5	6.0	8.0	136.0
	14.0	150.0	75.0	7.0	5.0	8.0	136.0

FIGURE D1 UNIVERSAL BEAMS



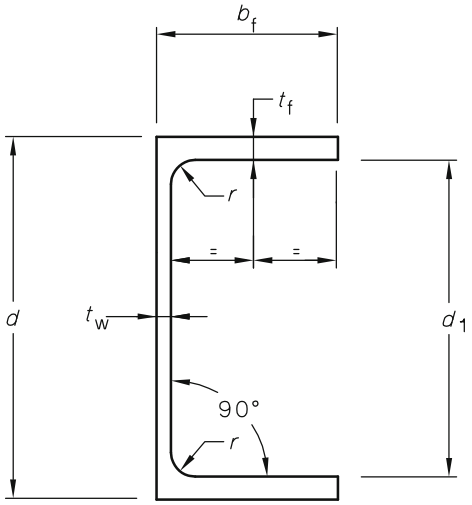
1		2	3	4	5	6	7
Designation		Depth of section	Flange		Web thickness	Root radius	Depth between flanges
			Width	Thickness			
		(d)	(b_f)	(t_f)	(t_w)	(r)	(d_1)
	kg/m	mm	mm	mm	mm	mm	mm
310 UC	158	327.2	311.0	25.0	15.7	16.5	277.2
	137	320.6	309.0	21.7	13.8	16.5	277.2
	118	314.6	307.0	18.7	11.9	16.5	277.2
	96.8	308.0	305.0	15.4	9.9	16.5	277.2
250 UC	89.5	260.0	256.0	17.3	10.5	14.0	225.4
	72.9	253.8	254.0	14.2	8.6	14.0	225.4
200 UC	59.5	209.8	205.0	14.2	9.3	11.4	181.4
	52.2	206.4	204.0	12.5	8.0	11.4	181.4
	46.2	203.4	203.0	11.0	7.3	11.4	181.4
150 UC	37.2	161.8	154.0	11.5	8.1	8.9	138.8
	30.0	157.6	153.0	9.4	6.6	8.9	138.8
	23.4	152.4	152.0	6.8	6.1	8.9	138.8
100 UC	14.8	97.0	99.0	7.0	5.0	10.0	83.0

FIGURE D2 UNIVERSAL COLUMNS



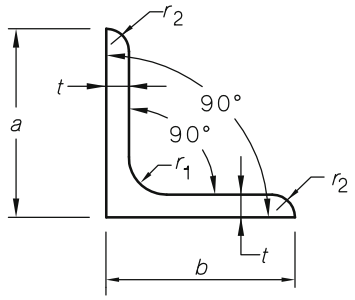
1	2	3	4	5	6	7	8	9	10
Designation	Mass per unit length	Depth of section	Flange		Web thickness	Depth at mid-point of flanges	Depth between fillets	Radii	
			Width	Thickness				Root	Toe
	kg/m	(d) mm	(b_f) mm	(t_f) mm	(t_w) mm	(d_1) mm	(d_2) mm	(r_1) mm	(r_2) mm
125 TFB	13.1	125.0	65.0	8.50	5.00	108.0	89.9	8.00	4.00
100 TFB	7.20	100.0	45.0	6.00	4.00	88.0	72.9	7.00	3.00

FIGURE D3 TAPERED-FLANGE BEAMS



1	2	3	4	5	6	7	8
Designation	Mass per unit length	Depth of section	Flange		Web thickness	Depth between flanges	Root radius
			Width	Thick-ness			
		(d)	(b_f)	(t_f)	(t_w)	(d_1)	(r)
	kg/m	mm	mm	mm	mm	mm	mm
380 PFC	55.2	380	100	17.5	10.0	345	14.0
300 PFC	40.1	300	90	16.0	8.0	268	14.0
250 PFC	35.5	250	90	15.0	8.0	220	12.0
230 PFC	25.1	230	75	12.0	6.5	206	12.0
200 PFC	22.9	200	75	12.0	6.0	176	12.0
180 PFC	20.9	180	75	11.0	6.0	158	12.0
150 PFC	17.7	150	75	9.5	6.0	131	10.0
125 PFC	11.9	125	65	7.5	4.7	110	8.0
100 PFC	8.31	100	50	6.7	4.2	86.6	8.0
75 PFC	5.90	75	40	6.1	3.8	62.8	8.0

FIGURE D4 PARALLEL-FLANGE CHANNELS

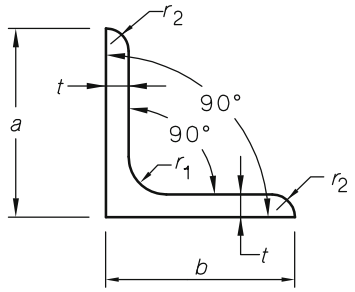


1	2	3	4	5	6
Designation		Mass per unit length	Actual thickness	Radii	
Nominal leg size ($a \times b$) mm	Nominal thickness mm	kg/m	(t) mm	Root (r_1) mm	Toe (r_2) mm
200 × 200	26	76.8	26.0	18.00	5.00
	20	60.1	20.0	18.00	5.00
	18	54.4	18.0	18.00	5.00
	16	48.7	16.0	18.00	5.00
	13	40.0	13.0	18.00	5.00
150 × 150	19	42.1	19.0	13.00	5.00
	16	35.4	15.8	13.00	5.00
	12	27.3	12.0	13.00	5.00
	10	21.9	9.50	13.00	5.00
125 × 125	16	29.1	15.8	10.00	5.00
	12	22.5	12.0	10.00	5.00
	10	18.0	9.50	10.00	5.00
	8	14.9	7.80	10.00	5.00
100 × 100	12	17.7	12.0	8.00	5.00
	10	14.2	9.50	8.00	5.00
	8	11.8	7.80	8.00	5.00
	6	9.16	6.00	8.00	5.00
90 × 90	10	12.7	9.50	8.00	5.00
	8	10.6	7.80	8.00	5.00
	6	8.22	6.00	8.00	5.00
75 × 75	10	10.5	9.50	8.00	5.00
	8	8.73	7.80	8.00	5.00
	6	6.81	6.00	8.00	5.00
	5	5.27	4.60	8.00	5.00
65 × 65	10	9.02	9.50	6.00	3.00
	8	7.51	7.80	6.00	3.00
	6	5.87	6.00	6.00	3.00
	5	4.56	4.60	6.00	3.00
55 × 55	6	4.93	6.00	6.00	3.00
	5	3.84	4.60	6.00	3.00
50 × 50	8	5.68	7.80	6.00	3.00
	6	4.46	6.00	6.00	3.00
	5	3.48	4.60	6.00	3.00
	3	2.31	3.00	6.00	3.00
45 × 45	6	3.97	6.00	5.00	3.00
	5	3.10	4.60	5.00	3.00
	3	2.06	3.00	5.00	3.00
40 × 40	6	3.50	6.00	5.00	3.00
	5	2.73	4.60	5.00	3.00
	3	1.83	3.00	5.00	3.00
30 × 30	6	2.56	6.00	5.00	3.00
	5	2.01	4.60	5.00	3.00
	3	1.35	3.00	5.00	3.00
25 × 25	6	2.08	6.00	5.00	3.00
	5	1.65	4.60	5.00	3.00
	3	1.12	3.00	5.00	3.00

NOTE: Column 2 shows the nominal thickness of the leg of the angle for designation only. The actual thickness is shown in Column 4.

(a) From Australian production

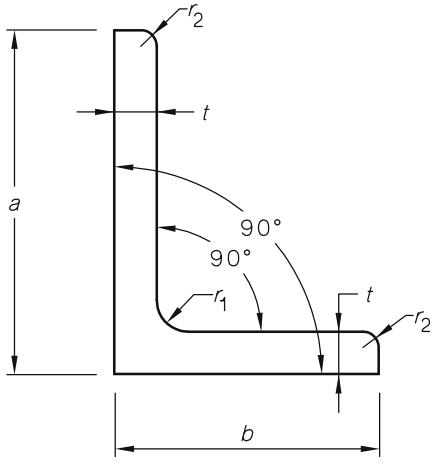
FIGURE D5 (in part) EQUAL ANGLES



1	2	3	4	5	6
Designation		Mass per unit length	Actual thick-ness	Radii	
Nominal leg size ($a \times b$) mm	Nominal thickness mm	kg/m	(t) mm	Root (r_1) mm	Toe (r_2) mm
80 × 80	10	11.9	10.0	10.00	4.80
	8	9.63	8.0	10.00	4.80
	6	7.34	6.0	10.00	4.80
60 × 60	10	8.69	10.0	8.00	2.40
	8	7.09	8.0	8.00	2.40
	6	5.42	6.0	8.00	2.40
50 × 50	8	5.82	8.0	7.00	2.40
	6	4.47	6.0	7.00	2.40
	5	3.77	5.0	7.00	2.40
	3	2.33	3.0	7.00	2.40
40 × 40	5	2.97	5.0	6.00	2.40
	3	1.84	3.0	6.00	2.40
30 × 30	5	2.18	5.0	5.00	2.40
	3	1.36	3.0	5.00	2.40
25 × 25	5	1.77	5.0	3.50	2.40
	3	1.12	3.0	3.50	2.40

(b) From New Zealand production

FIGURE D5 (in part) EQUAL ANGLES



1	2	3	4	5	6
Designation		Mass per unit length	Actual thickness	Radii	
Nominal leg size ($a \times b$) mm	Nominal thickness mm	kg/m	(t) mm	Root (r_1) mm	Toe (r_2) mm
150 × 100	12	22.5	12.0	10.00	5.00
	10	18.0	9.50	10.00	5.00
150 × 90	16	27.9	15.8	10.00	5.00
	12	21.6	12.0	10.00	5.00
	10	17.3	9.50	10.00	5.00
	8	14.3	7.80	10.00	5.00
125 × 75	12	17.7	12.0	8.00	5.00
	10	14.2	9.50	8.00	5.00
	8	11.8	7.80	8.00	5.00
	6	9.16	6.00	8.00	5.00
100 × 75	10	12.4	9.50	8.00	5.00
	8	10.3	7.80	8.00	5.00
	6	7.98	6.00	8.00	5.00
75 × 50	8	7.23	7.80	7.00	3.00
	6	5.66	6.00	7.00	3.00
	5	4.40	4.60	7.00	3.00
65 × 50	8	6.59	7.80	6.00	3.00
	6	5.16	6.00	6.00	3.00
	5	4.02	4.60	6.00	3.00

NOTE: Column 2 shows the nominal thickness of the leg of the angle for designation only. The actual thickness is shown in Column 4.

FIGURE D6 UNEQUAL ANGLES

APPENDIX E

MEASUREMENT OF CAMBER AND SWEEP IN UNIVERSAL SECTIONS

(Normative)

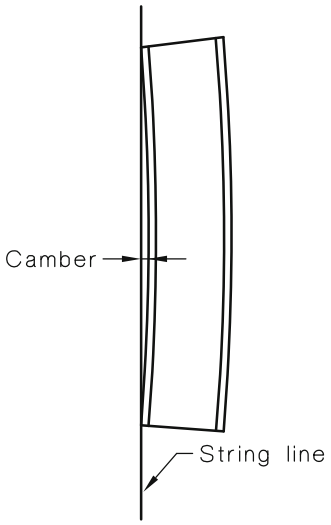
NOTE: Refer to Tables 9 and 10.

E1 CAMBER

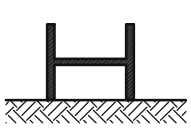
The length of section to be tested shall be placed with its web horizontal on a test surface. Camber is measured as shown in Figure E1.

E2 SWEEP

The length of section to be tested shall be placed with its web vertical on a test surface. Sweep is measured as shown in Figure E2.

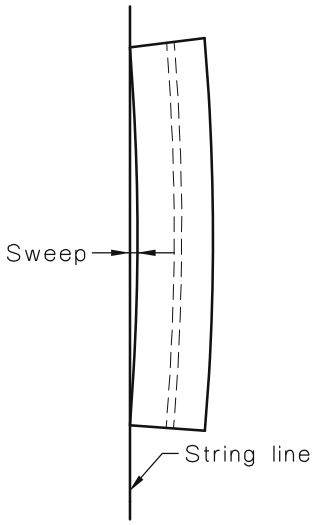


(a) Top view



(b) Section

FIGURE E1 CAMBER



(a) Top view

(b) Section

FIGURE E2 SWEEP

APPENDIX F

STEEL FOR SEISMIC AND FRACTURE CRITICAL APPLICATIONS (NEW ZEALAND ONLY)

(Normative)

F1 ADDITIONAL REQUIREMENTS FOR SEISMIC AND FRACTURE CRITICAL APPLICATIONS

Additional requirements for steel used for seismic and fracture critical applications are set out in the New Zealand Steel Structures Standard, NZS 3404.1. Where steel is required to be supplied for these applications, the steel shall comply with those additional requirements and as set out in this Appendix.

F2 STEEL FOR SEISMIC APPLICATIONS

The lower yield stress R_{eL} shall be used for determining the limiting ratios in Table F1 for S0 grade seismic steels. The R_{eL} value used shall be either—

(a) the R_{eL} value determined in accordance with AS 1391 and reported on the mill test certificate; or

(b) the R_{eL} value calculated from the R_{eH} value reported on the mill test certificate. The steel manufacturer shall provide the difference in mean values of R_{eH} and R_{eL} for all S0 grades of steel with a 90% statistical confidence level. These values shall be published by the manufacturer and made freely available to the purchaser on request.

TABLE F1

LIMITING RATIO REQUIREMENTS FOR S0 GRADE SEISMIC STEELS

Item	Requirement	Ratio
1	Maximum yield to tensile ratio (R_{eL}/R_m) (see Note 1)	0.8
2	Maximum yield stress R_{eL}	$<1.33f_y$ (see Note 2)

NOTES:

1 The R_m value is the actual R_m value recorded on the mill test certificate.

2 f_y is the grade nominal yield stress for steel 16 mm thick.

F3 STEEL FOR FRACTURE CRITICAL MEMBERS

The following requirements apply:

(a) Steel shall be manufactured using killed fine grain practice with continuous casting.

(b) No weld repairs shall be performed to the steel.

(c) The removal of defects from a section by grinding, or by chipping followed by grinding, shall not extend below the rolled surface by more than 0.5 mm for all thicknesses of material.

(d) If heat numbers are to be applied by die stamping, low stress dies shall be used.

NOTE: Fracture critical members are typically fatigue sensitive members in bridges and other structures as defined in NZS 3404.1.

BIBLIOGRAPHY

AS

1171 Non-destructive testing—Magnetic particle testing for ferromagnetic products, components and structures

1199 Sampling procedures for inspection by attributes

1199.0 Part 0: Introduction to the ISO 2859 attribute sampling system

1199.1 Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

2062 Non-destructive testing—Penetrant testing of products and components

2490 Sampling procedures and charts for inspection by variables for percentage nonconforming

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GPO Box 476 Sydney NSW 2001
Phone (02) 9237 6000
Fax (02) 9237 6010
Email mail@standards.org.au
Internet www.standards.org.au
SAI Global Customer Service
Phone 13 12 42
Fax 1300 65 49 49
Email sales@saiglobal.com

Level 10 Radio New Zealand House
155 The Terrace Wellington 6011
(Private Bag 2439 Wellington 6140)
Phone (04) 498 5990
Fax (04) 498 5994
Customer Services (04) 498 5991
Information Service (04) 498 5992
Email snz@standards.co.nz
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