AS/NZS 1594:2002
Reconfirmed 2016

Australian/New Zealand Standard™

Hot-rolled steel flat products

Standards Australia

STANDARDS NEW ZEALAND
Paerewa Aotearoa

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee MT-001, Iron and Steel. It was approved on behalf of the Council of Standards Australia on 16 August 2002 and on behalf of the Council of Standards New Zealand on 7 August 2002. It was published on 27 August 2002.

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This Standard was issued in draft form for comment as DR 01382.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

RECONFIRMATION
OF
AS/NZS 1594:2002
Hot-rolled steel flat products

RECONFIRMATION NOTICE

Technical Committee MT-001 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

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NOTES

Australian/New Zealand Standard™

Hot-rolled steel flat products

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee MT-001, Iron and Steel, at the request of Australian industry, to supersede AS/NZS 1594:1997.

This edition incorporates recent changes which have occurred in the hot-rolled flat products area of the Australian and New Zealand steel industries.

The objective of this Standard is to ensure that hot-rolled steel plate, floorplate, steel and strip, rolled on a continuous mill meets the needs of users in areas of dimensional tolerances and material requirements.

The objective of this revision is to update the requirements for hot-rolled steel plate, floor plate, sheet and strip, rolled on a continuous mill, in thicknesses up to 16 mm and widths up to 2000 mm.

During this revision the following International Standards were considered:

ISO	
3573:1999	Hot-rolled carbon steel sheet of commercial and drawing qualities
4995:2001	Hot-rolled steel sheet of structural quality
4996:1999	Hot-rolled steel sheet of high-yield-stress structural quality
5951:2001	Hot-rolled steel sheet of higher yield strength with improved formability
6316:2000	Hot-rolled steel strip of structural quality
6317:2000	Hot-rolled carbon steel strip of commercial and drawing qualities
7452:1984	Hot-rolled structural steel plates—Tolerances on dimensions and shape
9034:1987	Hot-rolled structural steel wide flats—Tolerances on dimensions and shape
10384:2001	Hot-rolled carbon steel sheet as defined by chemical composition

Australia is a participating member of ISO Subcommittee ISO/TC 17/SC 12 which is responsible for the development of the majority of these Standards.

Australian and New Zealand industries consider that there are considerable advantages in having the requirements for all types of hot-rolled flat steel products in the one 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.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

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S E C T I O N 1 S C O P E A N D G E N E R A L

1.1 SCOPE

This Standard specifies requirements for hot-rolled steel plate, floorplate, sheet and strip, rolled on a continuous mill, in thicknesses up to 8 mm for formability and extra formability grades and up to 16 mm for other grades, and for widths up to 2 000 mm. It includes slit material, provided that the parent material has an as-rolled width of not less than 600 mm.

The Standard specifies the following grade requirements:

(a) *For analysis grades*—chemical composition only.

(b) *For formability grades, extra formability grades, and structural grades including weather-resistant grades*—both chemical composition and mechanical properties.

(c) *For floorplate*—both chemical composition and mechanical properties.

The Standard permits the addition of boron and micro-alloying elements for the achievement of special properties.

NOTES:

1 This Standard does not cover the following:
   (a) Steel plate for boilers and pressure vessels (see AS 1548).
   (b) Hot-rolled structural steel plates, floorplates and slabs (see AS/NZS 3678).

2 Advice and recommendations on information to be supplied by the purchaser at the time of enquiry or order are contained in the purchasing guidelines set out in Appendix A.

3 Alternative means for demonstrating compliance with this Standard are given in Appendix B.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1199	Sampling procedures and tables for inspection by attributes
1391	Methods for tensile testing of metals
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
1548	Steel plates for pressure equipment
2338	Preferred dimensions of wrought metal products
2505	Methods for bend and related testing of metals
2505.1	Part 1: Sheet, strip and plate
2706	Numerical values—Rounding and interpretation of limiting values
HB 18	Guidelines for third-party certification and accreditation
HB 18.28	Guide 28—General rules for a model third-party certification system for products

AS/NZS
1050 Methods for the analysis of iron and steel (all parts)
1050.1 Part 1: Sampling iron and steel for chemical analysis

1365 Tolerances for flat-rolled steel products

3678 Structural steel—Hot-rolled plates, floorplates and slabs

AS/NZS ISO
9001 Quality management systems

9004 Quality management systems—Guideline for performance improvements

1.3 DEFINITIONS

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

1.3.1 Ageing

A term applied to changes in mechanical properties of low carbon steel that occur with the passage of time, and that adversely affect formability. Ageing accelerates as the temperature is raised.

1.3.2 Cast analysis

A chemical analysis determined on a test sample taken during the casting of the liquid steel.

1.3.3 Edge conditions

1.3.3.1 *Trimmed edge*

The resulting edge produced by the removal of material by mechanical means or gas cutting; also referred to as ‘sheared edge’ or ‘slit edge’.

1.3.3.2 *Untrimmed edge*

The edge produced by rolling between horizontal rolls, with or without vertical edging rolls; also referred to as ‘mill’ or ‘universal edge’.

1.3.4 Floorplate

A hot-rolled product supplied in cut lengths or in coils, having a rolled raised pattern, at regular intervals, on one surface, with a minimum width of 600 mm and a nominal minimum thickness of 2 mm. Its edges may be either trimmed or untrimmed.

1.3.5 Hot-rolled sheet

A hot-rolled product supplied in cut lengths and produced by cutting from a coil rolled on a continuous mill. It has a width of at least 600 mm and a nominal thickness of less than 3 mm. The edges of the sheet may be either trimmed or untrimmed.

1.3.6 Longitudinal direction

The direction of greatest extension of the steel during rolling.

1.3.7 Plate

A hot-rolled product supplied in cut lengths and produced by cutting from a coil rolled on a continuous mill. It has a width of at least 600 mm and a nominal thickness of 3 mm minimum. Its edges may be either trimmed or untrimmed.

1.3.8 Product analysis

A chemical analysis determined on a test sample of the finished product.

1.3.9 Slit strip

A coiled product produced by slitting a parent coil which has a width of at least 600 mm. This operation results in two or more coils being produced from the one parent coil.

1.3.10 Strip

A continuously rolled product of any width or thickness, supplied in coil form. Its edges may be trimmed or untrimmed.

1.3.11 Temper rolling

The practice of producing a property range by controlled cold rolling after hot rolling.

1.3.12 Test batch

A quantity of hot-rolled product processed from the same cast of steel under similar conditions in one of the following thickness ranges: ≤3.0 mm, >3.0 mm ≤6.0 mm, and >6.0 mm.

1.3.13 Test piece

A prepared piece for testing, made from a test specimen.

1.3.14 Test sample

A portion of material or product, or a group of items, selected from a batch by a sampling procedure.

1.3.15 Test specimen

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

1.3.16 Testing

The process of carrying out the chemical analysis and mechanical tests required by this Standard.

1.3.17 Transverse direction

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

1.4 DESIGNATION OF GRADE

1.4.1 General

The steel designation shall comprise the number of this Australian/New Zealand Standard, i.e. AS/NZS 1594, followed by a hyphen and additional characters in accordance with Clauses 1.4.2 to 1.4.5, as appropriate.

1.4.2 Analysis grades

1.4.2.1 *Designation*

The designation for analysis grades shall consist of a six-character alphanumeric system in accordance with the following:

(a) First character, the letter ‘H’ to indicate hot-rolled steel.

(b) Second character, a letter to indicate deoxidation practice as follows:

A: aluminium killed.

K: silicon killed, with or without aluminium additions.

U: unspecified deoxidation.

NOTE: The character ‘U’ indicates that the steelmaker has the option to decide on the deoxidation practice.

(c) A four-digit series designation, wherein the first two digits of the number indicate the type of steel and the last two digits indicate the approximate mean of the specified carbon range.

NOTE: The designation may contain a letter to indicate a special additional element.

Examples of designation:

10XX: plain carbon steels.

15BXX: carbon-manganese steel containing boron for heat treatment purposes.

1.4.2.2 *Modification symbols*

Modification symbols are added to the grade designation given in Clause 1.4.2.1 as follows:

(a) The prefix letter 'X' is used to indicate a major deviation in chemical composition of any grade from the corresponding AISI-SAE grade.

NOTE: Information on AISI-SAE grades is given in the relevant steel products manual of the Iron and Steel Society of AIME which is located at 410 Commonwealth Drive, Warrendale, PA 15086, USA.

(b) The letter 'B' is used to indicate that the steel is boron-treated, and is placed between the second and third digits of the four-digit series designation.

Examples of designation: AS/NZS 1594-HA1006, AS/NZS 1594-HXA1016, AS/NZS 1594-HK10B55.

1.4.3 Formability grades

1.4.3.1 *Designation*

The designation for formability grades shall consist of a three-character alphanumeric system in accordance with the following:

(a) First character, the letter 'H' to indicate hot-rolled steel.

(b) Second character, a letter, 'U' or 'A', indicating deoxidation practice (see Clause 1.4.2.1(b)).

(c) Third character, a digit indicating formability in accordance with the following:

1—commercial forming.

3—deep drawing.

4—extra-deep drawing.

Example of designation: AS/NZS 1594-HA1.

1.4.3.2 *Modification symbol*

The suffix letter 'N' is added to the grade designation given in Clause 1.4.3.1 to indicate that the steel is non-ageing.

Example of designation: AS/NZS 1594-HA4N.

1.4.4 Extra formability grades

The designation for extra formability grades shall consist of a five-character alphanumeric system in accordance with the following:

(a) First two characters, the letters 'XF' to indicate extra formability.

(b) Third to fifth characters, three digits indicating the nominal minimum yield strength, in megapascals.

Examples of designation: AS/NZS 1594-XF300, AS/NZS 1594-XF500.

1.4.5 Structural grades

1.4.5.1 *Designation*

The designation for structural grades shall consist of a five-character alphanumeric system in accordance with the following:

(a) First character, the letter 'H' to indicate hot-rolled steel.

(b) Second character, a letter, 'U' or 'A', indicating deoxidation practice (see Clause 1.4.2.1(b)), or 'W' indicating a weather-resistant grade.

(c) Third to fifth characters, three digits indicating the nominal minimum yield strength, in megapascals.

Examples of designation: AS/NZS 1594-HA200, AS/NZS 1594-HW350.

1.4.5.2 *Modification symbol*

A suffix number preceded by a slash is added to the grade designation given in Clause 1.4.5.1 to indicate any deviation from the base grade mechanical property requirements.

Example of designation: AS/NZS 1594-HU300/1.

1.5 ROUNDING OF TEST RESULT VALUES

1.5.1 General

With the exception of the yield strength and tensile strength results, the observed or calculated values shall be rounded to the same number of figures as in the specified values and then compared with the specified values. For example, for specified maximum or minimum values of 2.5, 2.50 and 2.500, the observed or calculated value would be rounded to the nearest 0.1, 0.01 and 0.001, respectively (see also AS 2706).

1.5.2 Tensile properties

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

1.6 MARKING

Each coil or shipping unit shall be clearly and durably marked or tagged to indicate the following:

(a) Steel grade designation.

(b) Dimensions.

(c) Name or registered trade name or mark of the manufacturer.

(d) Batch identification.

NOTES:

1 If the marked portion of the material is subsequently removed then these markings are to be transferred to each remaining portion of the material.

2 Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product or on packaging or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

SECTION 2 MANUFACTURING REQUIREMENTS

2.1 SCOPE

This Section specifies general manufacturing requirements including chemical composition and dimensional tolerances.

2.2 STEEL-MAKING PROCESS

The steel shall be made by the basic oxygen process or an electric process, at the manufacturer's option. Where test certificates are supplied, they shall identify the steel-making process.

If analysis grades are required to be fine-grained, the steel-making practice shall ensure that the steel has a minimum soluble aluminium content of 0.010% or a minimum total aluminium content of 0.015%.

2.3 CHEMICAL COMPOSITION

2.3.1 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 AS/NZS 1050 (all parts).

2.3.2 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 Tables 2.1 to 2.3 for the appropriate grade.

2.3.3 Product analysis (for analysis grades only)

For steels supplied in accordance with the cast analysis requirements of Table 2.1, the results of individual determinations carried out on the product shall be within the product analysis tolerance limits specified in Table 2.4. Where several determinations of a single element are carried out on products from any one cast, the spread of individual results shall not extend both above and below the range specified in Table 2.1.

2.3.4 IIW carbon equivalent

The equation used for calculating IIW carbon equivalent shall be as follows:

$$\text{IIW CEQ} = C + Mn/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15$$

2.4 FREEDOM FROM DEFECTS

The steel shall be free from pipe, harmful segregation, surface flaws and other defects detrimental to its use.

If, after acceptance of the steel and provided that it has been properly treated after delivery, subsequent processing reveals that it contains defects found to be detrimental, the steel shall be deemed not to comply with this Standard.

2.5 DIMENSIONAL TOLERANCES

Steel shall be supplied to the dimensional tolerances specified in AS/NZS 1365.

TABLE 2.1

CHEMICAL COMPOSITION REQUIREMENTS FOR ANALYSIS GRADES*

Grade	Chemical composition (cast analysis), % (see Note 1)									
	Carbon		Silicon	Manganese		Phosphorus	Sulfur	Aluminium (see Notes 2 and 3)	Titanium	IIW Carbon equivalent
	Min.	Max.	Max.	Min.	Max.	Max.	Max.	Max.	Max.	Max
HA1006	—	0.08	0.03	—	0.40	0.040	0.030	0.100	0.040	0.29
HA1010	0.08	0.13	0.03	0.30	0.60	0.040	0.030	0.100	0.040	0.29
HA1016	0.12	0.18	0.03	0.60	0.90	0.040	0.030	0.100	0.040	0.39
HXA1016	0.12	0.18	0.03	0.80	1.20	0.040	0.030	0.100	0.040	0.39
HK1042	0.39	0.47	0.50	0.60	0.90	0.040	0.030	0.100	0.040	—
HK10B55 (Note 4)	0.50	0.60	0.50	0.60	0.90	0.040	0.030	0.100	0.060	—
HXK15B30 (Note 4)	0.25	0.33	0.50	—	1.50	0.030	0.020	0.100	0.060	0.64
HK1073	0.68	0.78	0.50	0.70	1.00	0.040	0.030	0.100	0.040	—

* The use of sulfide-modification steel-making techniques for these grades is permitted.

NOTES:

1 For all grades except HXK15B30, the following elements may be present to the limits stated, subject to a maximum total content of 1%:

(a) Copper—0.35% maximum.

(b) Nickel—0.35% maximum.

(c) Chromium—0.30% maximum.

(d) Molybdenum—0.10% maximum.

For grade HXK15B30, the following elements may be present to the limits stated:

(i) Copper—0.35% maximum.

(ii) Nickel—0.5% maximum.

(iii) Chromium—1.2% maximum.

(iv) Molybdenum—0.5% maximum.

2 The limits specified are for total aluminium; for soluble aluminium subtract 0.005%.

3 For fine-grained steels: soluble aluminium 0.010% minimum, or total aluminium 0.015% minimum (see Clause 2.2).

4 For boron-treated steels: acid-soluble boron 0.0005% minimum or total boron 0.0008% minimum, and titanium 0.060% maximum.

TABLE 2.2

CHEMICAL COMPOSITION REQUIREMENTS FOR FORMABILITY, STRUCTURAL AND WEATHER-RESISTANT GRADES*

Grade	Chemical composition (cast or product analysis), %															IIW Carbon Equivalent
	Carbon	Silicon		Manganese	Phosphorus		Sulfur	Chromium (see Note 1)		Nickel (see Note 1)	Copper (see Note 1)		Aluminium (see Note 2)	Titanium	Micro-alloying elements	
	Max.	Min.	Max.	Max.	Min.	Max.	Max.	Min.	Max.	Max.	Min.	Max.	Max.	Max.	Max	Max
HA1	0.13	—	0.03	0.50	—	0.040	0.030	—	0.15	0.15	—	0.15	0.100	0.040	(see Note 3)	—
HA3	0.08	—	0.03	0.40	—	0.030	0.025	—	0.15	0.15	—	0.15	0.100	0.040	(see Note 3)	—
HA4N	0.08	—	0.03	0.40	—	0.030	0.020	—	0.15	0.15	—	0.15	0.100	0.040	(see Note 3)	—
HA200	0.15	—	0.35	0.60	—	0.030	0.030	—	0.15	0.15	—	0.15	0.100	0.040	(see Note 4)	0.29
HA250, HU250	0.20	—	0.35	1.20	—	0.040	0.030	—	0.25	0.25	—	0.25	0.100	0.040	(see Note 4)	0.39
HA250/1	0.13	—	0.03	0.60	—	0.025	0.015	—	0.10	0.10	—	0.10	0.060	0.040	(see Notes3&5)	0.25
HA300, HU300	0.20	—	0.35	1.60	—	0.040	0.030	—	0.25	0.25	—	0.25	0.100	0.040	(see Note 4)	0.39
HA300/1, HU300/1	0.20	—	0.35	1.60	—	0.040	0.030	—	0.25	0.25	—	0.25	0.100	0.040	(see Note 4)	0.39
HA350	0.20	—	0.35	1.60	—	0.040	0.030	—	0.25	0.25	—	0.25	0.100	—	(see Note 6)	0.44
HW350	0.15	0.15	0.75	1.60	0.055	0.160	0.030	0.35	1.05	0.55	0.15	0.50	0.100	—	(see Note 6)	0.54
HA400	0.20	—	0.35	1.60	—	0.040	0.030	—	0.25	0.25	—	0.25	0.100	—	(see Note 6)	0.44

* The use of sulfide-modification steel-making techniques for these grades is permitted.

NOTES:

1 For all grades other than HW350-Molybdenum 0.05% maximum. Copper + nickel + molybdenum—0.6% maximum.

2 The limits specified are for total aluminium, for soluble aluminium subtract 0.005%.

3 Niobium—0.010% maximum. Niobium + vanadium—0.030% maximum. Boron (total)—0.015% maximum.

4 Niobium + vanadium—0.030% maximum.

5 Molybdenum 0.04% maximum.

6 Vanadium—0.10% maximum. Niobium + vanadium + titanium—0.15% maximum.

TABLE 2.3

CHEMICAL COMPOSITION REQUIREMENTS FOR EXTRA FORMABILITY GRADES*

Grade	Chemical composition (cast or product analysis), % (see Note 1)										
	Carbon	Silicon	Manganese	Phosphorus	Sulfur	Chromium	Molybdenum	Aluminium (see Note 2)	Titanium	Micro-alloying elements	IIW Carbon equivalent
	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
XF300	0.16	0.35	1.60	0.025	0.010	0.15	0.10	0.100	0.040	(see Note 3)	0.39
XF400	0.11	0.35	1.60	0.025	0.010	0.70	0.50	0.100	—	(see Note 4)	0.39
XF500	0.11	0.35	1.80	0.025	0.010	0.70	0.50	0.100	—	(see Note 4)	0.44

* The use of sulfide-modification steel-making techniques for these grades is permitted.

NOTES:

1 The following elements may be present to the limits stated:

(a) Copper—0.15% maximum.

(b) Nickel—0.15% maximum.

2 The limits specified are for total aluminium; for soluble aluminium subtract 0.005%.

3 Niobium plus vanadium—0.030% maximum.

4 Vanadium—0.10% maximum. Niobium plus vanadium plus titanium—0.15% maximum.

TABLE 2.4

PRODUCT ANALYSIS TOLERANCES FOR GRADES GIVEN IN TABLE 2.1

Element	Specified maximum, %		Tolerance, %	
			Under minimum limit	Over maximum limit
Carbon		≤0.25	0.03	0.03
	>0.25	≤0.40	0.03	0.04
	>0.40	≤0.80	0.04	0.05
Silicon		≤0.05	—	0.010
	>0.05	≤0.50	—	0.05
Manganese		≤1.50	0.10	0.10
Phosphorus		≤0.040	—	0.010
Sulfur		≤0.040	—	0.010

SECTION 3 MECHANICAL PROPERTY REQUIREMENTS

3.1 SCOPE

This Section specifies the mechanical property requirements for hot-rolled flat products in terms of the tensile test, a strain-age tensile test and the bend test, and gives requirements for the selection of test samples and the preparation of test pieces.

3.2 SELECTION OF TEST SAMPLES

3.2.1 Tensile and strain-age tensile tests

Samples for the tensile and strain-age tensile tests shall be taken midway between the centre and the edge of the as-rolled product to provide tensile test pieces that are aligned in the appropriate direction, as follows:

(a) *For structural, extra formability and weather-resistant grades*—the longitudinal direction.

(b) *For formability grades*—the transverse direction.

3.2.2 Bend tests

Samples for bend tests shall be taken midway between the centre and the edge of the as-rolled product and shall be aligned in the transverse direction.

3.2.3 Sampling from coil

When plate, floorplate or sheet is supplied in coil form or from a coil, the test sample shall be taken either at a sufficient distance from the ends of the coil to be representative of the major portion of the coil, or from the middle third of the coil length.

3.3 PREPARATION OF TEST PIECES

3.3.1 General

Any test piece that shows defective machining, or other flaws, shall be discarded and another test piece substituted.

NOTE: Test specimens may be straightened cold before preparation of the test piece, in accordance with AS 1391 or AS 2505.1, as appropriate.

3.3.2 Test piece for the tensile and strain-age tensile test

Prepare a non-proportional test piece of full product thickness in accordance with AS 1391, with a gauge length as specified in Table 3.1.

3.3.3 Test piece for the bend test

Prepare a test piece of full product thickness in accordance with AS 2505.1.

3.4 TENSILE TEST

The tensile properties shall be determined in accordance with AS 1391 and shall be not less than those specified in Tables 3.1 or 3.2, as appropriate to the grade.

The rate of straining when approaching the yield point shall lie within the limits of the standard strain rate range (category S) specified in AS 1391.

3.5 BEND TEST

All steel shall be capable of meeting the bend test requirements of this Clause regardless of whether or not bend testing is specified. When a bend test is specified, the test piece shall be bent in accordance with AS 2505.1, at room temperature, through 180° around a mandrel of the appropriate diameter specified in Tables 3.3 and 3.4. The outer surface of the test piece shall not show any evidence of cracks.

NOTES:

1 Small cracks at the edges of rectangular test pieces, and cracks which require magnification to be visible, may be disregarded.

2 Information on the recommended minimum bend radii to be used in the cold forming of hot-rolled flat products is given in Appendix C.

3.6 STRAIN-AGE TENSILE TEST (applicable to non-ageing grades only)

The susceptibility of the steel to strain ageing shall be determined in accordance with Appendix D. The material shall be deemed to pass the test if the increase in force required to re-initiate plastic strain after ageing is not more than 5% of the maximum force applied prior to ageing.

TABLE 3.1

TENSILE PROPERTY REQUIREMENTS FOR FORMABILITY, STRUCTURAL AND WEATHER-RESISTANT GRADES

Grade	Minimum upper yield stress	Minimum tensile strength	Elongation, % min. (see Notes 1 and 2)					
			Nominal thickness, mm					
			≤3			>3		
	MPa	MPa	L_o=50mm	L_o=80mm	L_o=200mm	L_o=50mm	L_o=80mm	L_o=200mm
HA1	(see Note 3)	(see Note 3)	—	—	—	—	—	—
HA3	200	300	34	32	22	36	34	24
HA4N	170	280	36	34	24	38	36	26
HA200	200	300	24	22	17	28	26	19
HA250, HU250	250	350	22	20	16	26	24	17
HA250/1	250	350	29	26	19	33	30	24
HA300, HU300	300	400	20	18	15	24	22	16
HA300/1, HU300/1	300	430	20	18	15	24	22	16
HA350	350	430	18	16	14	22	20	15
HW350	340	450	—	—	15	—	—	15
HA400	380	460	16	14	13	20	18	14

NOTES:

1 L_o= original gauge length of test piece.

2 Elongation testing is not required for floorplate.

3 For design purposes, yield and tensile strengths approximate those of Structural Grade HA200. For specific information contact the supplier.

4 If a product does not exhibit a well-defined yield point, the 0.5% total elongation proof stress shall be determined (see AS 1391).

TABLE 3.2

TENSILE PROPERTY REQUIREMENTS FOR EXTRA FORMABILITY GRADES

Grade	Nominal thickness	Minimum upper yield stress (see Note 1)	Minimum tensile strength	Elongation, % min. (see Note 2)		
				Gauge length (L_o) mm		
	mm	MPa	MPa	50	80	200
XF300	≤3	300	440	28	26	20
	>3	300	440	31	29	23
XF400	≤8	380	460	25	23	18
XF500	≤8	480	570	18	16	14

NOTES:

1 If a product does not exhibit a well-defined yield point, the 0.2% proof stress should be determined (see AS 1391).

2 L_o= original gauge length of the test piece.

TABLE 3.3

180° BEND TEST REQUIREMENTS FOR FORMABILITY AND STRUCTURAL GRADES*

Grade	Diameter of mandrel (see Notes 1 and 2)		
	Nominal thickness, mm		
	≤3	>3, ≤5	>5
HA1	*a*	*a*	*a*
HA3	0	0	0
HA4N	0	0	0
HA200	0	*a*	*a*
HA250, HU250	*a*	*a*	2*a*
HA250/1	0	0	0
HA300, HU300	*a*	2*a*	2*a*
HA300/1	*a*	2*a*	2*a*
HA350	2*a*	2*a*	3*a*
HA400	2*a*	2*a*	3*a*

* For floorplate, bend tests are not required.

NOTES:

1 *a* = thickness of test piece.

2 0 indicates that the test piece is bent flat on itself.

TABLE 3.4

180° BEND TEST REQUIREMENTS FOR EXTRA FORMABILITY GRADES

Grade	Nominal thickness mm	Diameter of mandrel (see Note)
XF300	≤8	0
XF400	≤8	0
XF500	≤8	0

NOTE: 0 indicates that the test piece is bent flat on itself.

APPENDIX A

PURCHASING GUIDELINES

(Informative)

A1 GENERAL

Australian/New Zealand Standards are intended to include the technical requirements for relevant products, but do not purport to comprise all the necessary provisions of a contract. This Appendix contains advice and recommendations on the information to be supplied by the purchaser at the time of enquiry or order.

A2 INFORMATION TO BE SUPPLIED BY THE PURCHASER

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

(a) Product form required, i.e. plate, floorplate, sheet or strip.

(b) Designation of grade (see Clause 1.4).

(c) Whether fine-grained steel-making practice is required for analysis grades of steel.

(d) Whether a product analysis is required and, if so, the frequency of the analysis.

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

(f) Dimensions of steel, e.g. thickness, width, length, bundle mass or coil mass.

NOTES:

1 Attention is drawn to the desirability of specifying dimensions in terms of AS 2338. It should be noted that sizes not listed in AS 2338 are not necessarily precluded for ordering purposes.

2 If steel is supplied to theoretical mass, the density value 7850 kg/m^3 should be used.

(g) The type of edge required, i.e. whether trimmed or untrimmed (see Clause 1.3.3).

(h) Whether any further processing is required for sheet or plate produced from a coil, e.g. skin-passing, pickling or oiling.

NOTE: When supplied in coil form for further processing, the manufacturer controls those operations that affect the chemical and mechanical properties of the coil. However, the processor may be responsible for performing and certifying mechanical tests and any operations not intended to affect the properties of the coil.

(i) Any limitations in respect of mass of coils or packs, or inside or outside diameters of coils.

NOTE: Where full coils are cut to obtain test pieces and then recoiled, the purchaser should accept the small coils resulting from this operation.

(j) Defects allowable.

NOTE: Defects such as laminations, segregation, or surface flaws cannot be completely quantified. Where the presence, size or frequency of any defect is considered to be of concern, arrangements should be made between the purchaser and the manufacturer. These may be achieved by the provision of acceptable type samples.

Where defects are present and the product is submitted for acceptance, the manufacturer should be able to demonstrate fitness for purpose.

(k) Whether a bend test is required (see Clause 3.5).

(l) Any limitations in respect of packaging, e.g. the number of sheets and plates per pack and the mass of packaging materials.

(m) Whether a test certificate or certificate of compliance is required.

(n) Whether it is the intention of the purchaser to inspect the steel at the manufacturer's works.

(o) Any special or supplementary requirements.

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

(q) Reference to this Standard, i.e. AS/NZS 1594.

APPENDIX B

MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS STANDARD

(Informative)

B1 SCOPE

This Appendix sets out the following different means by which compliance with this Standard can be demonstrated by the manufacturer or supplier:

(a) Evaluation by means of statistical sampling.

(b) The use of a product certification scheme.

(c) Assurance using the acceptability of the supplier's quality system.

(d) Other such means proposed by the manufacturer or supplier and acceptable to the customer.

B2 STATISTICAL SAMPLING

Statistical sampling is a procedure which enables decisions to be made about the quality 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 needs to be drawn randomly from a population of product of known history. The history needs to enable 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 needs to be 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 AS 1199, guidance to which is given in AS 1399.

B3 PRODUCT CERTIFICATION

The purpose of product certification is to provide independent assurance of the claim by the manufacturer that products comply with the stated Standard.

The certification scheme should meet the criteria described in HB 18.28 (SANZ HB18.28) in that, as well as full type testing from independently sampled production and subsequent verification of conformance, it requires the manufacturer to maintain effective quality planning to control production.

The certification scheme serves to indicate that the products consistently conform to the requirements of the Standard.

B4 SUPPLIER'S QUALITY MANAGEMENT SYSTEM

Where the manufacturer or supplier can demonstrate an audited and registered quality management system complying with the requirements of the appropriate or stipulated Australian or international Standard for a supplier's quality management system or systems, this may provide the necessary confidence that the specified requirements will be met. The quality assurance requirements need to be agreed between the customer and supplier and should include a quality or inspection and test plan to ensure product conformity.

Information on establishing a quality management system is set out in AS/NZS ISO 9001 and AS/NZS ISO 9004.

B5 OTHER MEANS OF ASSESSMENT

B5.1 General

If the above methods are considered inappropriate, determination of compliance with the requirements of this Standard may be assessed from the results of testing in accordance with Paragraphs B5.2, B5.3 and B5.4 in the assessment compliance.

Irrespective of acceptable quality levels (AQLs) or test frequencies, the responsibility remains with the manufacturer or supplier to supply products that conform with the full requirements of this Standard.

B5.2 Sampling

When test certificates are required, test samples are taken from each test batch to provide the following:

(a) One test of each type for a batch not exceeding 100 t.

(b) One test of each type for the balance of the batch.

B5.3 Compliance

Each batch is deemed to comply with this Standard if all of the samples tested give results that are within the specified limits.

If any of the properties of the tested samples give results outside the specified limits, Paragraph B5.4 is applied.

B5.4 Retesting

If a retest is required, one or more of the following procedures is adopted:

(a) Take two further test samples at random from the remainder of the batch. The batch is deemed to comply with this Standard if the results of testing both these additional samples comply with Clauses 3.4 to 3.6. If one of these additional samples fails the test, the steel of the applicable batch is deemed not to comply with this Standard.

(b) Take test samples from each rolled unit of steel and individually test them in accordance with this Standard. The rolled unit of steel is deemed to comply with this Standard if the results of testing of the additional samples comply with Clauses 3.4 to 3.6.

(c) Make two additional tests on test pieces from samples taken from a position as near as practical to the failed sample. Should the results of testing of both these additional test pieces comply with Clauses 3.4 to 3.6, the batch is deemed to comply with this Standard.

(d) Reprocess the batch which has failed, e.g. heat-treat the batch again, and perform another complete set of tests on test pieces selected and prepared in accordance with Clauses 3.2 and 3.3. The batch is deemed to comply with this Standard only if the results of testing of the reprocessed test pieces comply with the requirements of Clauses 3.4 to 3.6.

APPENDIX C

RECOMMENDED MINIMUM INTERNAL RADII OF COLD BENDS IN FORMING

(Informative)

Figure C1 contains graphs that relate strip thickness to the minimum internal bend radius recommended for cold forming of some structural grades.

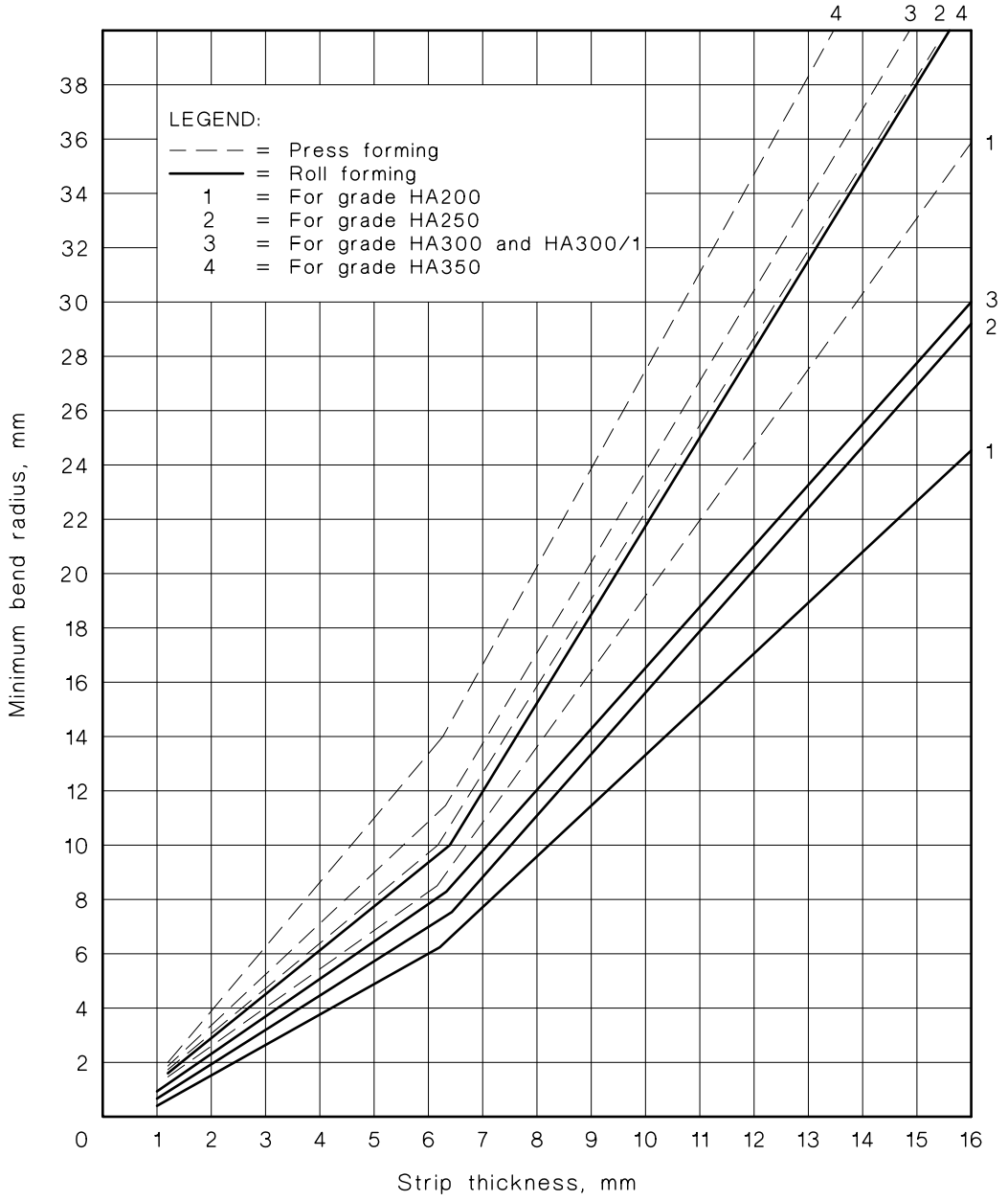

FIGURE C1 RECOMMENDED INTERNAL RADII OF COLD BENDS FOR VARIOUS THICKNESSES OF STRIP

APPENDIX D

METHOD FOR THE STRAIN-AGE TENSILE TEST

(Normative)

D1 SCOPE

This Appendix sets out the method for assessing the susceptibility of hot-rolled flat products to strain-age embrittlement.

D2 PRINCIPLE

A tensile test piece is strained in tension to produce a specified permanent extension and, after an artificial ageing treatment, is retested to determine the effect of the ageing process on the force required to re-initiate plastic strain.

D3 APPARATUS

A tensile testing machine capable of testing metals to the requirements of AS 1391.

D4 PROCEDURE

The procedure shall be as follows:

(a) Prepare the test piece in accordance with Clause 3.3.2.

(b) Strain the test piece in tension to produce a permanent extension of 10 ±2% of its original gauge length. Record the force required to produce this strain.

(c) Subject the test piece to an accelerated ageing treatment by heating it to 100 ±5°C for 30 min to 45 min.

(d) Re-strain the test piece in tension and determine the force required to re-initiate plastic strain.

NOTE: The force required to initiate plastic strain is that force detected when a sudden decrease in loading rate occurs.

D5 TEST REPORT

On completion of the test a report shall be issued. The report shall include the following information:

(a) Name of testing authority.

(b) Report number and date of issue.

(c) Identification of the batch of material under test.

(d) Results of the test, and a statement of compliance or otherwise with the requirements of this Standard.

(e) Reference to this test method, i.e. Appendix D of AS/NZS 1594.

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Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

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Under an Active Co-operation Agreement between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

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Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

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