

Australian/New Zealand Standard™

Steel for the reinforcement of concrete



AS/NZS 4671:2019

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee BD-084, Steel Reinforcing and Prestressing Materials. It was approved on behalf of the Council of Standards Australia on 26 November 2019 and by the New Zealand Standards Approval Board on 4 December 2019.

This Standard was published on 13 December 2019.

The following are represented on Committee BD-084:

- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Steel Association
- Austrroads
- Building Industry Federation
- Bureau of Steel Manufacturers of Australia
- Business New Zealand
- Concrete NZ
- Concrete Pipe Association of Australasia
- Galvanizers Association of Australia
- Master Builders Australia
- National Precast Concrete Association Australia
- Steel Reinforcement Institute of Australia

This Standard was issued in draft form for comment as DR AS/NZS 4671:2019.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

www.standards.govt.nz

ISBN 978 1 76072 671 3

Australian/New Zealand Standard™

Steel for the reinforcement of concrete

Originated in Australia as part of AS A81—1958, AS A82—1958, AS A83—1958, AS A84—1958, AS A92—1958 and AS A97—1965.
Originated in New Zealand as part of NZS 197:1949, NZS 1255:1956, NZS 1693:1962, NZS 1879:1964 and NZS 3423P:1972.
Previous edition AS/NZS 4671:2001.
Second edition 2019.

COPYRIGHT

© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2019

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth).

Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-084, Steel Reinforcing and Prestressing Materials, to supersede AS/NZS 4671:2001, *Steel reinforcing materials*.

The objective of the Standard is to provide materials specifications for steel bars and welded mesh used to reinforce concrete structures that have been designed in accordance with standards such as AS 3600, *Concrete structures*, or NZS 3101.1, *Concrete structures standard, Part 1*. This Standard has also been referenced by other design standards.

Differences between this Standard and the 2001 edition are briefly outlined below.

- (a) *General* — The title of the Standard has been changed to harmonize with ISO 6935, *Steel for the reinforcement and prestressing of concrete*. Although closely aligned technically with both ISO 6935, *Steel for the reinforcement and prestressing of concrete — Test methods* (series) and ENV 10080, *Steel for the reinforcement of concrete — Weldable ribbed reinforcing steel B500 — Technical delivery conditions for bars, coils and welded fabric*, this Standard continues to be classed as not equivalent to these documents primarily because —
 - (i) ISO 15630 does not contain specific requirements appropriate for reinforcement for earthquake-resistant structures; and
 - (ii) consequential differences in both the text and numerical values, although minor in nature, are too numerous.

Minor technical and editorial errors and omissions have been addressed.

Changes proposed by the New Zealand Ministry of Business, Innovation and Employment (MBIE) in 2016, in relation to Class E mesh, have been incorporated where possible.

- (b) *Strength grades* — Additional higher strength grades of reinforcing steel with a lower characteristic yield stress up to 750 MPa have been introduced in consultation with design standard committees.

The chemical, mechanical and identification requirements for each standard strength grade have been specified.

- (c) *Product conformity* — Product conformity requirements have been extensively redrafted to introduce requirements for type testing, batch conformance and long-term quality. In particular, batch conformance criteria allows for minor deviations outside specified limits provided the long-term quality levels are achieved. The importance of long-term quality is emphasized.

The Standard requires that testing is conducted by laboratories in accordance with AS ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

An optional manufacturer's certificate has been introduced to replace the test report in the previous [Appendix B](#). Minimum requirements for the certificate include long-term quality statements.

Two new appendices have been added. [Appendix E](#) provides an explanation of the concept of long-term quality versus batch testing. [Appendix F](#) gives a rationale for product conformity and sampling, and discusses appropriate points for sampling decoiled products.

The terms “normative” and “informative” are used in Standards 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.

Contents

Preface	ii
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Notation	4
5 Classification and designation	6
5.1 Classification	6
5.2 Standard grades	6
5.3 Designation of bar and coil	7
5.4 Designation of welded mesh	7
6 Manufacturing methods	8
6.1 Production	8
6.2 Processing	8
6.2.1 Bars and coils	8
6.2.2 Mesh	8
6.3 Manufacturing control	8
7 Chemical, mechanical and geometric requirements	8
7.1 Chemical composition and weldability	8
7.2 Mechanical properties	8
7.2.1 General	8
7.2.2 Tensile properties	10
7.2.3 Bending and rebending properties	10
7.2.4 Fatigue strength	11
7.2.5 Shear strength of joints in mesh	11
7.3 Geometric properties	11
7.3.1 Diameters, cross-sectional areas and masses	11
7.3.2 Length of bars	12
7.3.3 Straightness tolerance of bars	13
7.3.4 Coil size	13
7.4 Surface geometry	13
7.4.1 General	13
7.4.2 Geometry of ribs and indentations	13
7.5 Form and dimensions of mesh	15
7.5.1 General	15
7.5.2 Commonly available mesh	15
7.5.3 Minimum number of bars	15
7.5.4 Bar arrangement	15
7.5.5 Purpose-made mesh	15
7.5.6 Pitch	17
7.5.7 Sheet size tolerances	17
7.5.8 Welds	17
7.5.9 Deemed-to-satisfy rib or indentation geometry	17
8 Quality of finished bar	17
9 Demonstrating product conformity	18
10 Identification and certificates	18
10.1 Identification of reinforcing steels	18
10.2 Identification of the steel producer	20
10.3 Labelling of reinforcing steel for supply	20
10.4 Product conformity reports and certificates for reinforcing steels	20

Appendix A (normative) Product conformity	22
Appendix B (normative) Manufacturing control	28
Appendix C (normative) Requirements for determining the mechanical and geometric properties of reinforcement	36
Appendix D (informative) Purchasing guidelines	42
Appendix E (informative) Long term quality data	43
Appendix F (informative) Rationale for product conformity and sampling	47
Bibliography	49

Introduction

The publication of AS/NZS 4671:2001 enabled a number of significant benefits to the concrete construction industry:

- (a) More efficient use of materials, and for designers, to detail less congested reinforcing layouts (particularly in columns and walls) with the use of 500 MPa steels.
- (b) More reliable member performance as a result of the clarification of minimum ductility levels.
- (c) More uniform product as a result of tighter conformance requirements.
- (d) Compatibility between “design” and “production” parameters with the introduction of characteristic values based on normative long-term production statistics.

Since 2001 there have been significant changes in areas that needed to be addressed by this new edition of the Standard.

The limit of 500 MPa for reinforcing steel did not allow manufacturers and designers to explore the options of producing higher strength grades, which can carry higher loads and in turn, may reduce costs further or enhance sustainability.

The existing strength grades remain unchanged except for plain grade 300E (R300E), where the A_{gt} has been reduced to 12 %. R300E, produced off coil, is used solely for fitments and stirrups and does not have as high ductility demand. Higher grades of reinforcing steel up to 750 MPa have been included in separate tables. This change will allow designs to standards such as AS 3600, *Concrete structures*, and NZS 3101, *Concrete structures standard*, to utilize the potential benefits offered by higher strength reinforcing steels. High strength reinforcing steels are typically used for fitments in confinement regions to reduce congestion. Research has shown that high strength ligatures offer improved performance at the joints of concrete beams and columns under seismic loading.

Higher strength grades of reinforcing steel have the potential to improve the sustainability outcomes for the Australian and New Zealand community.

The provision of an optional product conformity report and the requirement for testing to be conducted by laboratories conforming with AS ISO 17025 for the specific test required is designed to address the concerns raised in the New Zealand Ministry of Business, Industry and Employment (MBIE) 2016 amendment to the building code.

NOTES

Australian/New Zealand Standard

Steel for the reinforcement of concrete

1 Scope

This Standard specifies requirements for the chemical composition, mechanical properties and geometric properties of steel used for reinforcing concrete, in the form of —

- (a) deformed or plain bars and coils;
- (b) machine-welded mesh; and
- (c) continuously threaded bars.

This Standard does not apply to prestressing steels, stainless steel, epoxy coated and galvanized reinforcing steels.

NOTE 1 Prestressing steels are covered by AS/NZS 4672.1 and AS/NZS 4672.2.

NOTE 2 Information on galvanized reinforcing steels is available in *Galvanized Reinforcement In Concrete—An Introduction For Engineers and Designers* and S.R. Yeomans, *Galvanized Reinforcement In Concrete Structures—Questions and Answers*. Both are available from the Galvanizers Association of Australia.

2 Normative references

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

NOTE Documents for informative purposes are listed in the Bibliography.

AS 1391, *Metallic materials — Tensile testing at ambient temperature*

AS ISO/IEC 17025, *General requirements for the competence of test and calibration laboratories*

AS/NZS 1554.3, *Structural steel welding, Part 3: Welding of reinforcing steel*

AS/NZS 1050.1, *Methods for the analysis of iron and steel, Part 1: Sampling iron and steel for chemical analysis*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 15630-1, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, rods and wire*

ISO 15630-2, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 2: Welded fabric and lattice girders*

ASTM E415, *Test method for analysis of carbon and low-alloy steel by spark atomic emission spectrometry*

3 Terms and definitions

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

3.1

ageing

heating of the test specimen to 100 ± 10 °C, maintaining this temperature for a period of 60 +15, 0 min and then cooling the specimen in still air to room temperature

Note 1 to entry: The method used to determine the temperature can be a calibrated oven (calibrated for both temperature and temperature spatial distribution) or boiling water.

3.2

assigned diameter

diameter of a bar used for designating a product

Note 1 to entry: In some cases the assigned and nominal diameters may be the same.

3.3

bar

straight length of reinforcing steel

3.4

batches

3.4.1

batch [for material covered by long term quality (LTQ)]

quantity of reinforcing steel of the same designation, produced by the same designation(s) of feed material, process, equipment and conditions —

- (a) for hot-worked products, from the same cast; or
- (b) for cold-worked products, not exceeding 50 t of bars or coils; or
- (c) for mesh products not exceeding 1000 sheets.

3.4.2

batch [for material not covered by long term quality (LTQ)]

quantity of reinforcing steel of the same designation produced by the same process with a maximum mass of 100 t for bars or coils and 2000 sheets for mesh

3.5

characteristic values

3.5.1

lower characteristic value

C_{vL}

value of a property having a prescribed (high) probability (p) of being exceeded in a hypothetical unlimited series of standard tests

3.5.2

upper characteristic value

C_{vU}

value of a property having a prescribed (high) probability (p) of not being exceeded in a hypothetical unlimited series of standard tests

3.6

coil

single length of reinforcing steel wound concentrically

3.7

cold-worked products

reinforcing steel produced by any change in cross-sectional geometry or shape (e.g. straight or coil) below the re-crystallization temperature

3.8

decoiled products

reinforcing steel manufactured in coils and subsequently processed

3.9 deformed reinforcement

3.9.1

indented reinforcement

reinforcing steel with at least two rows of transverse indentations, which are distributed uniformly along the entire length

3.9.2

ribbed reinforcement

reinforcing steel with at least two rows of transverse ribs that are distributed uniformly along the entire length

3.10

hot-worked products

reinforcing steel produced by any change in cross-sectional geometry or shape (e.g. straight or coil) above the re-crystallization temperature

3.11

item

single piece of reinforcing steel (e.g. a bar, a coil or a sheet of mesh)

3.12

long-term quality

LTQ

assessment of a mechanical property of a reinforcing steel product by statistical analysis of the test results for the given property

Note 1 to entry: Further information on LTQ is provided in [Appendix E](#).

3.13

mesh

longitudinal and transverse bars of the same or different diameter and length, which are arranged substantially at right angles and factory electrical resistance welded at the points of intersection and rely on the shear strength of the welds for lapping sheets

3.13.1

length of mesh

longest side of the mesh, irrespective of the manufacturing direction

3.13.2

longitudinal bars in mesh

reinforcing steel in the manufacturing direction of the mesh

3.13.3

overhang of mesh

length of longitudinal or transverse bar projecting beyond the outside edge of the outer cross bar in the mesh

3.13.4

pitch of mesh

centre-to-centre distance between bars in the mesh

Note 1 to entry: For twin bar mesh, the pitch is measured between the midpoint of the adjacent bars.

3.13.5

purpose-made mesh

mesh manufactured according to specific requirements

3.13.6

transverse bars in mesh

reinforcing steel perpendicular to the manufacturing direction of the mesh

3.13.7**twin bars in mesh**

two bars of the same designation placed adjacent to each other as a pair

3.13.8**width of mesh**

the shortest side of the mesh, irrespective of the manufacturing direction

3.14**nominal equivalent diameter**

diameter in millimetres of an equivalent circular section of reinforcing steel having the same mass per metre of the deformed or indented bar

3.15**plain reinforcing steel**

reinforcing steel without surface deformations excluding identifying marks

3.16**reinforcing steel**

steel that is suitable for the reinforcement of concrete

3.17**ribs****3.17.1****longitudinal rib**

uniform continuous protrusion parallel to the axis of the reinforcing steel

3.17.2**transverse rib**

any protrusion on the surface of the product other than a longitudinal rib or identifying marks as detailed in [Clause 10](#)

3.18**steel producer**

organization responsible for manufacturing reinforcing steel in bar or coil form from a hot-working or cold-working process

3.19**steel processor**

organization responsible for subsequent processing of reinforcing steel supplied by a steel producer, which significantly changes the profile and properties of the reinforcing steel. This may include cold-rolling, cold-drawing, decoiling and straightening, or automatic, electrical-resistance welding

Note 1 to entry: Cutting and bending of bar or mesh is covered by AS 3600 and NZS 3101.

3.20**test piece**

portion of an item of the size (length or other measure) specified in the relevant test method, suitable for carrying out the required test and which has not been subjected to any post-production treatment that may affect the test result other than ageing (where ageing is required)

4 Notation

The following symbols are used in this Standard.

A	=	calculated cross-sectional area of a reinforcing steel, in mm ²
A_{gt}	=	elongation at maximum force from a single tensile test as a percentage

$A_{gt.kL}$	=	lower characteristic value of the elongation determined from a series of tensile tests as a percentage
A_s	=	nominal cross-sectional area of a reinforcing steel bar calculated using the nominal diameter, in mm ²
a	=	pitch of bars in a mesh, in mm
C_{vL}	=	specified lower characteristic value of a variable parameter
C_{vU}	=	specified upper characteristic value of a variable parameter
c	=	longitudinal pitch of the transverse deformations measured parallel to the axis of the reinforcing steel, in mm
d	=	nominal diameter of a reinforcing steel, in mm
f_P	=	relative area of indentations
f_R	=	relative area of ribs
g	=	circumferential gap between deformations, in mm
h	=	rib height or indentation depth, in mm
$J_{k.L}$	=	lower characteristic value of a property (R_e , R_m/R_e or A_{gt}) determined from a series of tests
$J_{k.U}$	=	upper characteristic value of a property (R_e , R_m/R_e) determined from a series of tests
K	=	statistical multiplying factor
k	=	acceptability index
k_i	=	coefficient
L_n	=	nominal length of a bar, in mm
n	=	number of tests or specimens in a series of tests
N	=	number of longitudinal bars in a particular trench mesh
n_b	=	number of test values determined in a batch
n_p	=	number of samples in a collection of test results
p	=	proportion of a population
R_e	=	value of the yield stress (or 0.2 % or 0.5 % proof stress as applicable) determined from a single tensile test in accordance with AS 1391 or ISO 6892-1, in MPa
$R_{ek.L}$	=	lower characteristic value of the yield stress determined from a series of tensile tests, in MPa
$R_{ek.U}$	=	upper characteristic value of the yield stress determined from a series of tensile tests, in MPa
R_m	=	value of the tensile stress (expressed as strength) determined at the maximum force from a single tensile test in accordance with AS 1391 or ISO 6892-1, in MPa
s_n	=	standard deviation for n number of specimens

u	=	edge overhang of a bar in a mesh, in mm
w_c	=	crest width of ribs, in mm
w_i	=	indentation width, in mm
$\bar{X}_b$	=	mean of individual test values determined in a single batch
$\bar{X}_p$	=	mean of individual test values determined in a number of batches for the purpose of an LTQ calculation
x_n	=	mean value for n number of specimens
x_s	=	individual test value
α	=	rib flank inclination, in degrees (see Figure 7.3)
β	=	angle of inclination between the centre-line of the transverse deformation and the longitudinal axis of the reinforcing steel, in degrees (see Figure 7.2)

5 Classification and designation

5.1 Classification

Reinforcing steel shall be classified by —

- (a) profile, as characterized by the presence or absence of ribs or indentations on its surface;
- (b) strength grade, denoted by the specified lower characteristic value (C_{vL}) of its yield stress;
- (c) ductility, as characterized by the specified lower characteristic (C_{vL}) of its uniform elongation (A_{gt}) and the ratio of the tensile strength to yield stress (R_m/R_e) in accordance with [Tables 7.2\(A\)](#) and [7.2\(B\)](#);
- (d) size, as characterized by its assigned diameter.

5.2 Standard grades

The standard grades of reinforcing steels, characterized by strength grade and relative ductility class shall be as follows:

- (a) 250N.
- (b) 300E.
- (c) 500L.
- (d) 500N.
- (e) 500E.
- (f) 600N.
- (g) 750N.

5.3 Designation of bar and coil

Each of the reinforcing steels described in [Clause 5.1](#) shall be designated by distinguishing letters or numbers in the following manner:

- (a) *Profile* — By the letters, R, D, or I, representing plain Round, Deformed ribbed, or deformed Indented surfaces respectively.
- (b) *Strength grade* — By the numerical value of the specified lower characteristic yield stress, expressed in MPa.
- (c) *Ductility class* — By the letters L, N or E, representing Low, Normal or Earthquake (seismic) ductility respectively.
- (d) *Size* — By the numerical value of the assigned diameter, expressed in mm.

The designators shall be stated in the order of profile, strength grade, ductility class and size.

Full designators shall be used in all communications unless the use of abbreviated forms causes no ambiguity, and the omitted characteristics can be readily distinguished or deduced.

EXAMPLE A deformed ribbed bar, of grade 500 MPa normal ductility reinforcing steel with an assigned 16 mm diameter, would be designated as “D500N16”.

However, if all the reinforcement ordered or required for a particular project was to be deformed ribbed bars of the same strength grade but varied in other characteristics, and there was a general note to this effect in the project plans and specifications, the designation may be abbreviated to ‘N16’.

5.4 Designation of welded mesh

Welded mesh shall be designated by distinguishing letters or numbers in the following manner:

- (a) *Profile* — By the letters, R, D, or I, representing plain Round, Deformed ribbed, or deformed Indented, surfaces respectively.
- (b) *Strength grade* — By the numerical value of the specified lower characteristic yield stress expressed in MPa.
- (c) *Configuration of the orthogonal bars* — By the letters S or R, representing Square or Rectangular configurations.
- (d) *Ductility Class* — By the letters L, N or E representing Low, Normal or Earthquake (seismic) ductility respectively, in accordance with [Table 7.2\(A\)](#) and [Table 7.2\(B\)](#).
- (e) *Size* — By the numerical value of the assigned bar diameter in the longitudinal direction, expressed in mm.
- (f) *Transverse spacing of the longitudinal reinforcing steel* — By the numerical value of the transverse spacing, expressed in mm, divided by 100.
- (g) *Transverse reinforcement for rectangular configured welded mesh* — By the numerical value of the assigned bar diameter, expressed in mm. Transverse reinforcement shall be of the same shape, strength grade and ductility class as the longitudinal reinforcing steel. Unless noted otherwise, transverse reinforcement is usually spaced at 200 mm centres.

The designators shall be stated in the order shape, strength, configuration, ductility, size, spacing and secondary reinforcement if applicable.

Full designators shall be used in all communications unless the use of abbreviated forms causes no ambiguity, and the omitted characteristics can be readily distinguished or deduced.

EXAMPLE A square mesh with an assigned diameter of 9 mm deformed ribbed bar at 200 mm centres, of grade 500 MPa low ductility reinforcing steel, would be designated as “D500SL92”.

However, if all the welded mesh ordered or required for a particular project was to be deformed ribbed bars, of the same strength grade but may vary in other characteristics, and there was a general note to this effect in the project plans and specifications, the designation may be abbreviated to “SL92”.

6 Manufacturing methods

6.1 Production

A report of the production methods shall be made available on request.

6.2 Processing

6.2.1 Bars and coils

Processing of coiled steel shall only be carried out in such a way that ensures the material properties of this Standard are met.

6.2.2 Mesh

All mesh shall be factory made and machine welded. The joints at the intersections of the longitudinal bars and the transverse bars shall be made by electrical resistance welding to provide shear resistant connections in accordance with [Clause 7.2.5](#). Mesh that includes butt welded bars shall be permitted.

6.3 Manufacturing control

Production and processing shall be subject to continual control in accordance with [Clause 8](#) and [Appendix B](#).

7 Chemical, mechanical and geometric requirements

7.1 Chemical composition and weldability

The chemical composition, of reinforcing steels, expressed as percentages by mass of the non-ferrous constituents, shall be determined in accordance with the relevant item of [Clause 9](#). The results, including the calculated carbon equivalent, shall conform to the corresponding values specified in [Table 7.1\(A\)](#) and [Table 7.1\(B\)](#). Non-standard grades shall meet the chemical requirements for the nearest lower grade.

The carbon equivalent value (*CEV*) shall be determined by the following equation:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad 7.1$$

where the symbols of the chemical elements indicate content in percent by mass.

The reinforcing steels conforming to this Standard shall be deemed to be weldable under the conditions specified for each class in AS/NZS 1554.3.

7.2 Mechanical properties

7.2.1 General

Mechanical properties of reinforcing steels shall be determined in accordance with the applicable item of [Appendix B](#) and the values obtained for the standard grades shall satisfy the applicable criteria given in [Table 7.2\(A\)](#) and [Table 7.2\(B\)](#).

Non-standard grades shall meet the ratio and uniform elongation requirements of the nearest lower grade for the applicable ductility class.

In all determinations of mechanical properties, the condition of test pieces at the time of testing shall be as given in [Table 7.3](#). Where required, test pieces shall be aged in accordance with ISO 15630-1 and ISO 15630-2.

Table 7.1(A) — Composition of reinforcing steels grades ≤ 500 MPa

Type of analysis	Chemical composition, % max.							
	All grades			Carbon equivalent value (CEV) for standard grades				
	C	P	S	250N	500L	500N	300E	500E
Cast analysis	0.22	0.050	0.050	0.43	0.39	0.44	0.43	0.49
Product analysis	0.24	0.055	0.055	0.45	0.41	0.46	0.45	0.51

Table 7.1(B) — Composition of reinforcing steels grades > 500 MPa

Type of analysis	Chemical composition, % max.				
	All grades			Carbon equivalent value (CEV)	
	C	P	S	600N	750N
Cast analysis	0.33	0.050	0.050	0.49	0.49
Product analysis	0.35	0.055	0.055	0.51	0.51

Table 7.2(A) — Mechanical properties of reinforcing steel grades ≤ 500 MPa

Characteristic property	Specified value					Type of specified value
	250N ^a	500L ^b	500N	300E (Seismic)	500E (Seismic)	
Yield stress (MPa) $R_{ek.L}$	≥ 250	≥ 500	≥ 500	≥ 300	≥ 500	C_{vL} : $P = 0.95$
	—	≤ 750	≤ 650	≤ 380	≤ 600	C_{vU} : $P = 0.05$
Ratio $(R_m/R_e)_{k.L}$	≥ 1.08	≥ 1.03	≥ 1.08	≥ 1.15	≥ 1.15	C_{vL} : $P = 0.90$
	—	—	—	≤ 1.50	≤ 1.40	C_{vU} : $P = 0.10$
Uniform elongation (%) $A_{gt.k.L}$	≥ 5.0	≥ 1.5	≥ 5.0	≥ 15.0 ^c ≥ 12.0 ^d	≥ 10.0	C_{vL} : $P = 0.90$
^a Grade 250N may be supplied as plain reinforcing steel in accordance with AS/NZS 3679.1. ^b For 500L mesh (NZ only) and all 500L steels in coil form, the only requirement for $d < 5.0$ mm shall be $R_{ek.L} \geq 500$ MPa, except where smaller diameter bars are substituted as permitted by Table 7.6(A) . ^c Deformed reinforcing steel only. ^d Plain reinforcing steel only.						

Table 7.2(B) — Mechanical properties of reinforcing steel grades > 500 MPa

Characteristic property		Specified value		Type of specified value
		600N	750N	
Yield stress (MPa)	$R_{ek,L}$	≥ 600	≥ 750	$C_{VL}: P = 0.95$
	$R_{ek,U}$	≤ 750	≤ 900	$C_{VU}: P = 0.05$
Ratio	$(R_m/R_e)_{k,L}$	≥ 1.08	≥ 1.04	$C_{VL}: P = 0.90$
Uniform elongation (%)	$A_{gtk,L}$	≥ 5.0	≥ 4.0	$C_{VL}: P = 0.90$

Table 7.3 — Condition of test pieces for mechanical properties

Manufacturing and delivery condition of the reinforcing steel	Condition of testing (test pieces)
Produced in straight lengths or coils by hot working	As produced ^a
Produced in straight lengths by cold working	Aged ^b
Produced as coil and delivered in straight lengths	Aged ^b
Produced by cold working and delivered as coil	Straightened and aged ^b
Welded mesh	Aged ^b
^a Coiled product shall be straightened before testing and requires aging after straightening.	
^b Except for the rebend test, see Clause 7.2.3 .	

7.2.2 Tensile properties

The yield stress (R_e), maximum tensile strength (R_m) and uniform elongation (A_{gt}) shall be determined in accordance with [Appendix C](#).

The values for R_e and R_m shall be calculated using the nominal cross-sectional areas of the reinforcing steels.

For R_e , the lower yield stress shall apply. If an observable yield phenomenon is not present then:

- (a) 0.2 % proof stress ($R_{p0.2}$) shall apply for ductility class L and ductility class N.
- (b) 0.5 % proof stress ($R_{p0.5}$) shall apply for ductility class E.

Test specimens shall have a maximum out-of-straightness of $L_n/50$.

7.2.3 Bending and rebending properties

This property shall apply to deformed reinforcing steels only excluding mesh. The suitability of bars for bending or rebending shall be determined by bending the bars around the stated mandrel diameters and angles specified in [Table 7.4](#).

For bars subject to the rebend test, after the initial 90° bend, the bars shall be aged and cooled and then bent in the reverse direction through the applicable rebend angle specified in [Table 7.4](#) (see [Figure 7.1](#)) applying a constant force. After bending or rebending there shall be no visible evidence of cracking on the surface of the test bar, when inspected with the naked eye or with normal corrected vision.

In case of dispute the rebent bar may be subject to a tensile test and will be deemed to have passed the rebend requirements if $C_{VL} \leq R_e \leq C_{VU}$.