

Application of 500PLUS Reinforcing Bars

For more details on 500PLUS Rebar supplied by OneSteel Reinforcing Pty Limited, please refer to the website www.reinforcing.com

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Rebar Types

OneSteel Reinforcing supply three types of 500PLUS Reinforcing Bars to AS4671.

500PLUS TEMPCORE straight length bar

-available in 12, 16, 20, 24, 28, 32, 36 and 40mm diameters.

500PLUS MICROALLOY bar, straightened from coil

-available in 10, 12 & 16mm diameters

500PLUS REIDBAR continuously threaded Rebar

-available in 12, 16, 20, 25, & 32mm diameters

Bending and Rebending

Bending of 500PLUS rebars should be carried out according to AS3600-2001 and bend testing according to AS4671-2001. If engineers/builders request bending diameters tighter than those required by AS3600, such bends can only be supplied if the designer gives written approval to the order. OneSteel Reinforcing recommends that pullout bars are only manufactured from 500PLUS TEMPCORE bars.

If the designer's written request is for tighter bends, then these will only be supplied if they are within the limits of capability as defined in the 500PLUS Product Guide for either 500PLUS TEMPCORE rebar or for Microalloy bar – NOTE: minimum TEMPCORE pin diameters are smaller than those for MICROALLOY bars.

Rebending 500PLUS rebars on site – due to limitations of adequate rebending facilities on site, we recommend that the customer's attention is drawn to following the guidelines set out in the OneSteel Reinforcing 500PLUS Product Brochures and BHP TEMPCORE Manuals as issued from 1989 to 2007.

The following guidelines are applicable to 500PLUS reinforcing bars in which a preformed bend is to be subsequently straightened or rebent on a construction site. A common application is “pullout bars”.

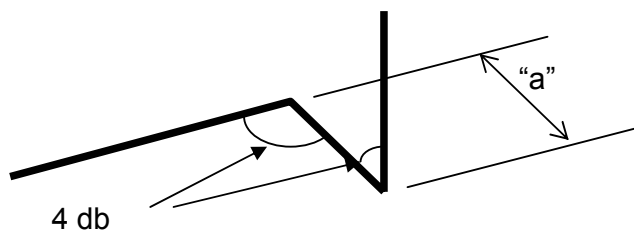
AS3600, Clause 19.2.3.2 (c), advises that if a bar is to be subsequently bent on site, then for bar sizes of **16 mm or less, the diameter of the bending pin**, or the internal bend radius (radius = diameter/2), **that is originally formed in the bar, shall not be less than 4db** (db = bar diameter). The pin diameters that the code recommends are listed in the table below.

Bar Diameter	Pin Diameter
10 mm	40 mm
12 mm	48 mm
16 mm	64 mm

Care must be taken, when bending or rebending is performed on a construction site, to ensure that the bend radii are not formed below the prescribed minimum sizes.

OneSteel Reinforcing recommends that **500PLUS TEMPCORE** be used in such situations for use as ‘pull-out’ bars rather than micro-alloyed bars. TEMPCORE bars can be identified by their rib geometry whereby these bars have two rows of crescent shaped ribs and two longitudinal ribs. Micro-alloyed bars have four rows of transverse ribs and four longitudinal ribs.

For “pullout bars” the minimum overall length of dimension “a” that can be produced by OneSteel Reinforcing is 10db.



Bar Diameter	Minimum Dimension “a”
10 mm	100 mm
12 mm	120 mm
16 mm	160 mm

Other options, that may be suitable if the design requirements are outside the above minimums, are:

- Reduce the bar diameter and spacings so that the steel intensity is maintained.
- Replace the pullout bar with a 500PLUS REIDBAR and a threaded insert.

General Rules for Bending Welded Reinforcement

This is a summary of AS4671, AS1554 pt 3, & AS3600 rules

For reinforcing steels conforming to AS 4671, it is preferable to bend bars prior to welding.

For bars bent prior to welding

- 1) Bend diameters shall be as specified in AS 3600 unless otherwise approved.
- 2) For butt and tack welds (other than locational tack welds), the weld shall be at least 2d away from any bent portion of bar.
- 3) Locational Tack Welds are permitted in bent portions of bar provided the bars have been bent around pin diameters as specified in AS 3600.
- 4) For lap, strap and indirect butt splice welds, the ends of the weld shall be at least 2d from any bent portion of bar.
- 5) Except for minor reworking, no bending or rebending shall be permitted in welded areas.

For bars welded prior to bending

- 1) Lap, strap and indirect butt splice welds shall not be bent
- 2) For butt and tack welds (other than locational tack welds), the following bend diameter limits shall apply. Bend angles shall not exceed 90°.

Bar Diameter	Minimum Bend Diameter
≤ 16mm	5d
> 16mm and ≤ 25mm	8d
> 25mm	10d

- 3) For locational tack welds, the following bend diameter limits shall apply. Bend angles shall not exceed 90°.

Bar Diameter	Minimum Bend Diameter
≤ 8mm	5d
> 8mm and ≤ 12mm	6d
> 12mm and ≤ 20mm	8d
> 20mm and ≤ 32mm	10d
> 32mm	12d

- 4) Except for minor reworking, no re-bending shall be permitted in welded areas.

Welding

TEMPCORE and MICROALLOY rebars have different welding regimes. These are detailed in the 500PLUS Product guide for AS4671 500 Grade rebars.

Welding of reinforcing steels is covered by AS 1554 Part 3, 2002; Structural Steel Welding – Welding of reinforcing steel.

For further details, please see the 500PLUS Welding Notes on www.reinforcing.com

Temperature Effects on 500PLUS Rebars

Elevated temperature tensile properties

The strength and Modulus of steel decrease with increasing temperature. In fire situations, the loss of strength at elevated temperatures may be significant and design requirements for fire are covered in Section 5 of AS3600. For design purposes, assumed characteristic values for yield stress may be taken as follows :-

At 300 °C - 400MPa, At 500 °C - 250 MPa.

Effect of heat on ambient temperature properties

After heating and cooling, the resulting ambient temperature properties of reinforcing steels may be significantly altered. This is an important consideration if heat has been applied to assist bending of rebars or if the bars have been subjected to a fire.

Use of heat to assist bending

Heating should be avoided if the original bar properties are to be retained.

For smaller diameter bars (10, 12 and 16 mm) it is usually possible and preferable to cold bend bars if rework or unplanned bending is required.

Effect of fire on reinforcing steel properties

Prolonged exposure to elevated temperatures will significantly degrade reinforcing steel strength properties. Based on Australian and European tests for steels corresponding to Class N, normal bar properties can be assumed after exposure to temperatures up to 500 °C for one hour and up to 400 °C for longer exposure times.

For higher temperatures, estimates of retained yield stress as a proportion of normal bar properties for exposure times of one hour are :-

600 °C - 0.9, 700 °C - 0.7, 800 °C - 0.6.

Note – these are estimates only and lower values should be assumed for longer exposure times. The elastic modulus, E, is not affected by prior exposure to elevated temperatures and can still be taken as 200,000 MPa.

Low temperature properties

At low temperatures, steels typically display higher strength values and lower toughness and ductility. OneSteel can supply cryogenic rebar to BS4449-460 to comply with BS7777 Part 3 at -50° Celsius.

Machine Threaded Bars

It is recommended that the tensile design capacity of threaded OneSteel 500PLUS rebars be based on the strength limit state criteria of Australian Standard AS4100, Steel Structures. Tensile tests on threaded OneSteel 500PLUS bar show that it can achieve a minimum effective yield stress of 75% of the nominal yield and a minimum effective tensile stress of 85% of nominal tensile stress (of 1.08 times 500 MPa) when calculated on the relevant thread Stress Area.

OneSteel 500PLUS, when threaded with AS1275 threads and fitted with AS1112 class 5 nuts, can achieve the calculated limit state tensile strengths, ϕN_{tf} (Kn) as set out in the Table below. These strengths are based on the (thread) Stress Area from AS1275, a capacity factor ϕ of 0.8 and a modified f_{uf} value of 459 MPa.

Table – Threaded bar tensile capacity

Bar Size mm	Thread Size mm	Tensile limit state strength ϕN_{tf} (Kn)
12	M10	21
16	M12	31
20	M16	58
24	M20 (M22*)	90 (110*)
28	M24	130
32	M30	205
36	M30 (M33*)	205 (255*)

*Second choice thread size – nuts may be difficult to obtain.

N.B. Engineers should be aware that the threading of reinforcing bars not only reduces the load carrying capacity of the bar but the thread greatly reduces the ductility of the bar. The threaded bar will probably not meet the minimum ductility requirements for Class N bars as required by AS4671.