KONNECT FASTENING SYSTEMS	TCB®	**Ref:** TN004 Rev3
Konnect Fastening Systems® *1300 KONNECT (566 632)* *235 Settlement Road,* *Thomastown VIC 3074*	*Tension Control Bolts Ltd* *TCB House, Clywedog Road South* *Wrexham Industrial Estate, Wrexham* *LL13 9XS United Kingdom*	**Author:** Steve Jones
Technical Note TN004		**Date:** October 2019
AS/NZS 1252:2016 in relation to Property Class 10.9 Tension Control Bolts (TCBs)		

Background

AS/NZS 1252 was revised by the Standards Committee ME-029 and was published during 2016 in two parts:

- *AS/NZS 1252 High-strength steel fastener assemblies for structural engineering – Bolts, nuts and washers: Part 1 – Technical requirements*
- *AS/NZS 1252 High-strength steel fastener assemblies for structural engineering – Bolts, nuts and washers: Part 2 – Verification testing for bolt assemblies*

In the Preface of the standard the committee inserted the following.

> *Note: It is the intent of the committee to replace this Standard with the EN 14399 series, subject to Standards Australia review processes. This may require further amendment of AS 4100.*

Within AS/NZS 1252:2016 the European Standard for high strength structural bolting assemblies (EN 14399) is cited as the reference document but is undated. As the EN 14399 series was revised and updated in 2015 it is deduced that it is the 2005 version that was referenced by ME-029. This is important within the context of this TN as EN 14399:2005 did not include any technical references to TCBs; not for the reason that these bolting assemblies were disregarded or omitted but because the European Standards Technical Committee CEN/TC185/WG6 did not publish the standard EN 14399-10 relating to TCBs until 2009.

AS/NZS 1252.1:2016

As detailed above in the Preface to AS/NZS 1252:2016, the Standards Committee ME-029 undoubtedly show that the intended direction of future supply of high strength structural bolting in Australia and New Zealand is towards international alignment. Indeed, the sections detailed below clearly document the use of property class 10.9 bolt assemblies that are manufactured in accordance with EN 14399-3.

> *SCOPE: This Standard also specifies an additional bolt assembly type of property class 10.9 to **EN 14399-3.***
>
> *1.6 ALTERNATIVE ASSEMBLY TYPE: High-strength structural bolt assemblies for preloading that are manufactured in accordance with **EN 14399-3, System HR**, property class 10.9 are the only additional assembly type that is deemed to satisfy the requirements of this Standard and may be used where reference is made to property class 10.9 fasteners conforming to this standard.*

As EN 14399-3 hex bolting assemblies are similar in style AS/NZS 1252 products they were included within the standard as both 'alternative and additional assembly types'.

NOTE: Here it is important to understand the reference to 'System HR'. Within Europe there are two technical systems in use to obtain the necessary ductility in structural bolting assemblies; system HV (Hochfest Vorgespannte) used

primarily in Germany and system HR (High Resistance) used in France/UK; system HR includes HRC (High Resistance Calibrated) which is the European terminology for TCB bolting assemblies.

- System HV assemblies have a short bolt thread and use a thinner nut (0.8*D*) to obtain ductility by plastic deformation of the threads within the nut. This system needs strict control on site when tightening the assemblies and the ductile failure mode of thread stripping is hard to detect.
- System HR assemblies achieve the necessary ductility primarily by plastic deformation of the bolt threads. This system of bolting is less susceptible to overtightening during preloading however if assemblies are subject to overtightening, the failure mode is by bolt breakage and is therefore easily detectable.

The standard AS/NZS 1252.1:2016 Appendix A contains additional information on these two bolting systems.

Differences between Australian Hexagon and European TCB products

As shown above, the failure mode of HR/TCB bolting assemblies is closely aligned in terms of performance characteristics with AS/NZS 1252 products and as EN 14399-3 system HR property class 10.9 bolting assemblies are accepted as 'additional assembly types', the argument could be made that TCBs 'are one and the same' with the only differences being:

- Bolt geometry – apart from the obvious cup-head, the addition of a 12-point metric spline attached to the threaded end and small differences in the under-head fillet detail, geometry is identical to AS/NZS 1252 bolts.
- Nut geometry – nut geometry is virtually identical apart from M12 and M16 diameters.
- HRD nuts have a higher proof load based on a stress under proof load value of 1,245 MPa.
- Washer geometry – TCB assemblies are supplied with EN 14399-6 washers which have a chamfer on both inner and outer diameters.
- Washer hardness – AZ/NZS 1252 washers call for 320-390 HV whilst EN 14399-6 are 300-370 HV.

Corrosion protection

One of the most effective coatings for steel in both performance and cost is galvanized zinc. Galvanizing of fasteners involves the application of a layer of zinc by dipping the fastener in a bath of molten zinc then centrifuge spinning the fasteners for the removal of the excess. Typical coating thicknesses are 50 to 80 microns (µm) and for non-preloaded fasteners this is sufficient however due to the thickness of the coating, the inconsistency of zinc deposits and the fact that the molten zinc moves to the extremities of the bolt during centrifugal spinning, this coating is not suitable for TCB assemblies.

Tension Control Bolts Ltd in the UK developed an alternative coating called Greenkote® that delivers the same performance as hot dipped galvanising but with the advantages of a conformal coating.

Greenkote® is an innovative diffusion coating incorporating the very latest technology. The patented process involves Thermo-Chemical Surface Modification (TCSM) which can be applied to various metals, alloys, sintered ferrous base materials, grey iron and cast iron. Products are placed inside a sealed retort with a dry zinc/aluminium powder mix and placed inside an industrial oven. The retort slowly rotates as the temperature ramps up; when then critical temperature is reached the zinc/aluminium powder diffuses into the base metal forming a uniform and conformal coating.

Unlike conventional coatings, Greenkote® is totally environmentally friendly and does not produce any solid, liquid or gaseous toxic wastes. The process is also free from chrome, cadmium, acids, cyanides and chlorides.

Advantages of Greenkote®

- Environmentally friendly; no VOCs produced.
- Diffusion sacrificial corrosion resistance coating.
- High degree of wear and abrasion resistance.
- Salt spray resistance over 1,440 hours (C5 High corrosivity protection).
- No possibility of hydrogen embrittlement during the coating process.
- Thickness uniformity +- 10% maximum.
- Low processing temperature that does not affect mechanical properties.
- Excellent preparation for painting, duplex coatings, adhesives and rubber mouldings.

Advantages of using TCB bolting assemblies

- Installation of TCB assemblies is carried out with shear wrenches that require no calibration.
- The QC is in the bolt assembly itself so the responsibility of correct installation is taken away from the operator.
- Assessment of full preload is achieved by visual inspection on 100% of the bolting assemblies.
- Shear Wrenches are non-impacting with vibration levels under 2.5 m/s^2; this allows constant use of the tools on site with no danger of vibrational white finger for the operators.
- Low noise tooling means less aggravation on-site.
- Shear wrenches do not self-destruct unlike impact tools; last for many years with low maintenance costs.
- Assembly of structural steel is quicker & safer and delivers large cost savings.
- Identification – TC bolts and nuts are stamped during production with a unique 3-digit identifying code; this code directly correlates with the heat number of the wire from the steel mill and thus provides full and permanent traceability.
- Uniform and conformal coating ensures consistent preloads.
- Greenkote® accepts paint without any preparation; no mordant acids needed on site.

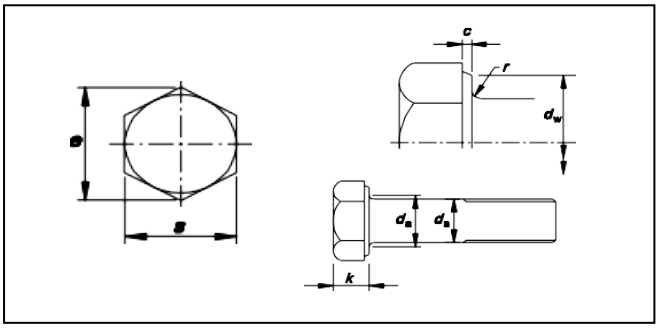
Cost savings from using TCB bolting assemblies

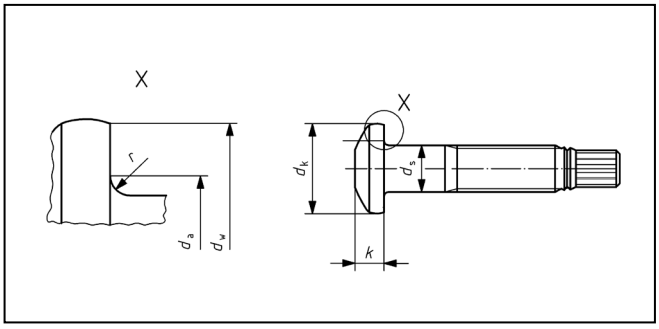
- Install twice as fast.
- One man installation.
- Reduced inspection time.
- Less time on site.
- Less crane hire.
- Faster handover of projects.
- Less highways/rail possessions required.
- Choice of TCB products to suit standard, blind, and single side fixing applications.
- No risk of mixing bolting assemblies that could lead to structural failures.

All the above gives up to 60% reduction in total installation & inspection costs!

COMPARISON OF SIGNIFICANT BOLT DIMENSIONS

AS/NZS 1252 VS EN 14399-10 TYPE TCB



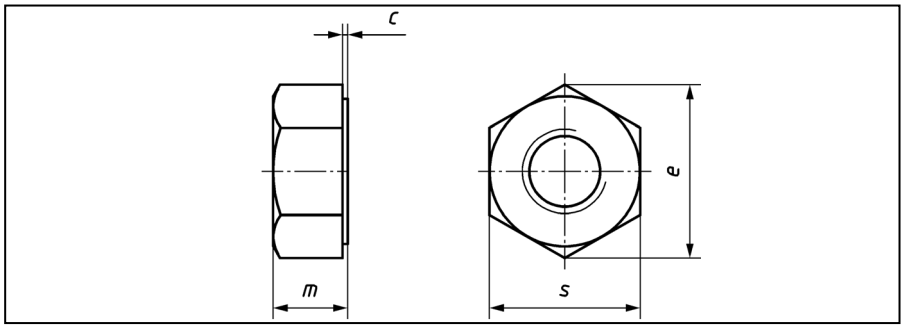


Ø	Dimension	AS/NZS 1252.1		EN 14399-10 TYPE TCB	
		Max (mm)	Min (mm)	Max (mm)	Min (mm)
M12	Shank dia. (*d*s)	12.70	11.30	12.70	11.30
	Width across flats (*s*)	21.0	20.16	NA	NA
	Width across corners (*e*)	24.25	22.78	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	19.2	-	20.0
	Width across head (d_k)	NA	NA	-	21.0
	Fillet transition dia. (*d*a)	14.7	-	15.2	-
	Fillet radius (*r*)	-	0.6	-	1.2
	Height of head (*k*)	7.95	7.05	8.8	7.2
M16	Shank dia. (*d*s)	16.70	15.30	16.70	15.30
	Width across flats (*s*)	27	26.16	NA	NA
	Width across corners (*e*)	31.2	29.56	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	24.9	-	26.0
	Width across head (d_k)	NA	NA	-	27.0
	Fillet transition dia. (*d*a)	18.70	-	19.2	-
	Fillet radius (*r*)	-	0.6	-	1.2
	Height of head (*k*)	10.75	9.25	10.8	9.2
M20	Shank dia. (*d*s)	20.84	19.16	20.84	19.16
	Width across flats (*s*)	32	31.00	NA	NA
	Width across corners (*e*)	36.9	35.03	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	29.5	-	33.0
	Width across head (d_k)	NA	NA	-	34.0
	Fillet transition dia. (*d*a)	23.24	-	24.4	-
	Fillet radius (*r*)	-	0.8	-	1.5
	Height of head (*k*)	13.90	12.10	13.9	12.1
M22	Shank dia. (*d*s)			22.84	21.16
	Width across flats (*s*)			NA	NA
	Width across corners (*e*)			NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$		-	37.0
	Width across head (d_k)	NA	NA	-	38.5
	Fillet transition dia. (*d*a)		-	26.4	-
	Fillet radius (*r*)	-		-	1.5
	Height of head (*k*)			14.9	13.1

Ø	Dimension	AS/NZS 1252.1		EN 14399-10 TYPE TCB	
		Max (mm)	Min (mm)	Max (mm)	Min (mm)
M24	Shank dia. (*d*s)	24.84	23.16	24.84	23.16
	Width across flats (*s*)	41	40.00	NA	NA
	Width across corners (*e*)	47.3	45.20	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	38.0	-	41.0
	Width across head (d_k)	NA	NA	-	43.0
	Fillet transition dia. (*d*a)	27.64	-	28.4	-
	Fillet radius (*r*)	-	1.0	-	1.5
	Height of head (*k*)	15.90	14.10	15.90	14.10
M27	Shank dia. (*d*s)			27.84	26.16
	Width across flats (*s*)			NA	NA
	Width across corners (*e*)			NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$		-	46.0
	Width across head (d_k)	NA	NA	-	48.0
	Fillet transition dia. (*d*a)		-	32.4	-
	Fillet radius (*r*)	-		-	1.5
	Height of head (*k*)			17.90	16.10
M30	Shank dia. (*d*s)	30.84	29.16	30.84	29.16
	Width across flats (*s*)	50	49.00	NA	NA
	Width across corners (*e*)	57.7	55.37	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	46.5	-	50.0
	Width across head (d_k)	NA	NA	-	52.0
	Fillet transition dia. (*d*a)	34.24	-	35.4	-
	Fillet radius (*r*)	-	1.2	-	2.0
	Height of head (*k*)	19.75	17.65	20.0	18.0
M36	Shank dia. (*d*s)	37.00	35.00	37.00	35.00
	Width across flats (*s*)	60	58.80	NA	NA
	Width across corners (*e*)	69.3	66.44	NA	NA
	Washer face dia. (*d*w)	$d_{w\,max} = s_{actual}$	55.9	-	61.0
	Width across head (d_k)	NA	NA	-	66.0
	Fillet transition dia. (*d*a)	41.00	-	42.4	-
	Fillet radius (*r*)	-	1.5	-	2.0
	Height of head (*k*)	23.55	21.45	24.0	22.0

COMPARISON OF SIGNIFICANT NUT DIMENSIONS

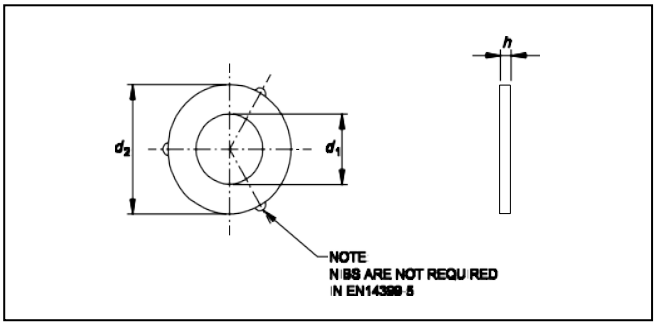
AS/NZS 1252 VS EN 14399-10 TYPE HRD

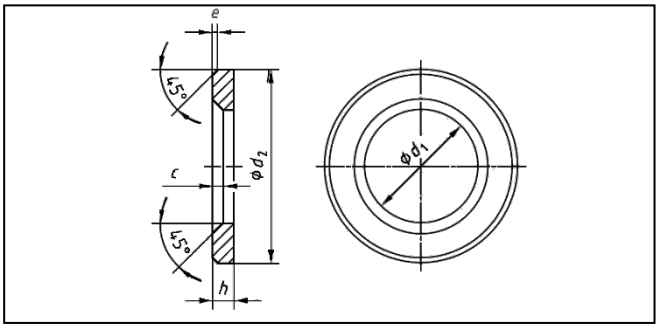


Ø	Dimension	AS/NZS 1252.1		EN 14399-10 TYPE HRD	
		Max (mm)	Min (mm)	Max (mm)	Min (mm)
M12	Width across flats (*s*)	21.0	20.16	22	21.16
	Width across corners (*e*)	24.25	22.78	-	23.91
	Nut height (*m*)	13.1	12.0	12.35	11.65
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4
M16	Width across flats (*s*)	27.0	26.16	27	26.16
	Width across corners (*e*)	31.2	29.56	-	29.56
	Nut height (*m*)	17.1	16.4	16.35	15.65
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4
M20	Width across flats (*s*)	32.0	31.00	32	31.00
	Width across corners (*e*)	36.9	35.03	-	35.03
	Nut height (*m*)	21.3	20.0	20.65	19.35
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4
M22	Width across flats (*s*)			36.00	35.00
	Width across corners (*e*)			-	39.55
	Nut height (*m*)			22.65	21.35
	Depth of washer face (*c*)			0.8	0.4
M24	Width across flats (*s*)	41.0	40.00	41	40.00
	Width across corners (*e*)	47.3	45.20	-	45.20
	Nut height (*m*)	24.2	22.9	24.65	23.35
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4
M27	Width across flats (*s*)			46.00	45.00
	Width across corners (*e*)			-	50.85
	Nut height (*m*)			27.65	26.35
	Depth of washer face (*c*)			0.8	0.4
M30	Width across flats (*s*)	50.0	49.00	50	49.00
	Width across corners (*e*)	57.7	55.37	-	55.37
	Nut height (*m*)	30.7	29.1	30.65	29.35
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4
M36	Width across flats (*s*)	60.0	58.80	60	58.80
	Width across corners (*e*)	69.3	66.44	-	66.44
	Nut height (*m*)	36.6	35.0	36.80	35.20
	Depth of washer face (*c*)	0.8	0.4	0.8	0.4

COMPARISON OF SIGNIFICANT WASHER DIMENSIONS

AS/NZS 1252 VS EN 14399-6





Ø	Dimension	AS/NZS 1252.1		EN 14399-6	
		Max (mm)	Min (mm)	Max (mm)	Min (mm)
M12	Inside diameter (d_1)	14.43	14.0	13.27	13
	Outside diameter (d_2)	27.0	25.7	26	25.48
	Thickness (h)	4.6	3.1	3.3	2.7
	Marking			HD	
M16	Inside diameter (d_1)	18.43	18.0	17.27	17
	Outside diameter (d_2)	34.0	32.4	32	31.38
	Thickness (h)	4.6	3.1	4.3	3.7
	Marking			HD	
M20	Inside diameter (d_1)	21.33	21.0	21.33	21
	Outside diameter (d_2)	39.0	37.4	40	39.38
	Thickness (h)	4.6	3.1	4.3	3.7
	Marking			HD	
M22	Inside diameter (d_1)			23.33	23
	Outside diameter (d_2)			44	43.38
	Thickness (h)			4.3	3.7
	Marking			HD	
M24	Inside diameter (d_1)	26.52	26.0	25.33	25
	Outside diameter (d_2)	50.0	48.4	48	47.38
	Thickness (h)	4.6	3.4	4.3	3.7
	Marking			HD	
M27	Inside diameter (d_1)			28.52	28
	Outside diameter (d_2)			50	49.00
	Thickness (h)			4.4	5.6
	Marking			H	
M30	Inside diameter (d_1)	33.62	33.0	31.62	31
	Outside diameter (d_2)	60.0	58.1	56	54.80
	Thickness (h)	4.6	3.4	5.6	4.4
	Marking			H	
M36	Inside diameter (d_1)	39.62	39.0	37.62	37
	Outside diameter (d_2)	72.0	70.1	66	64.80
	Thickness (h)	4.6	3.4	6.6	5.4
	Marking			H	