

Use of High Strength Structural Bolting Assemblies for Preloading BS EN 14399-3 PC 8.8 with Direct Tension Indicators (DTI's)

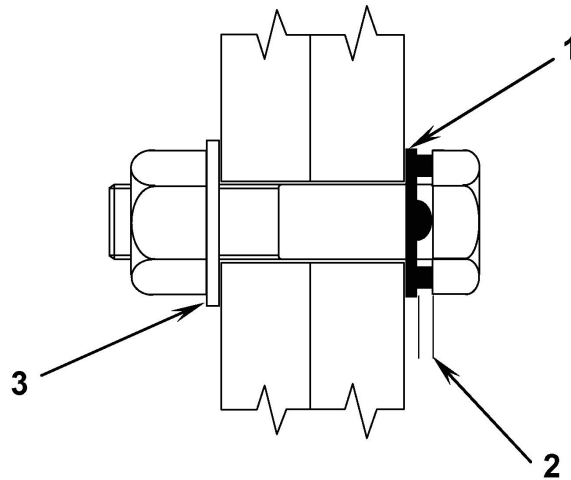
**DTI fitted under bolt head tightened by nut rotation and DTI fitted
under nut with a nut face washer tightened by nut rotation**

Assembly Configuration - DTI fitted under bolt head

The most common assembly configuration for BS EN 14399-3 property class 8.8 is when the DTI is fitted under the bolt head and the assembly is tightened by nut rotation, as follows:-

- a) BS EN 14399-3 property class 8.8 bolt (marked 8.8 HR)
- b) Direct tension indicator (component identified as 1 below)
- c) BS EN 14399-6 hardened chamfered washer (marked H) (component identified as 3 below)
- d) BS EN 14399-3 property class 10 nut (marked 10 HR)

The components shall be assembled as shown below (Figure1) with the direct tension indicator fitted under the bolt head and with the indicator protrusions bearing directly under the bolt head. The bolt and the direct tension are placed in the steelwork and at the other side of the connection the hardened chamfered washer is fitted with the plain side of the washer placed against the steelwork and the chamfered side facing outwards. The nut is assembled with the side containing the marking facing outwards and the smooth unmarked side of the nut against the chamfered washer.



KEY

1 Direct Tension Indicator
2 Gap
3 Washer according to EN 14399-6

**Assembly configuration for EN 14399-3 Property Class 8.8 with DTI fitted
under the bolt head - Tightened by nut rotation**
Figure 1

Use of High Strength Structural Bolting Assemblies for Preloading BS EN 14399-3 PC 8.8 with Direct Tension Indicators (DTI's)

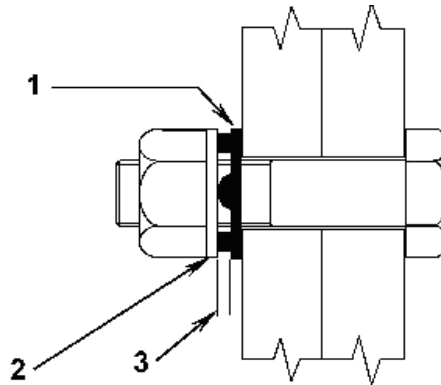
**DTI fitted under bolt head tightened by nut rotation and DTI fitted
under nut with a nut face washer tightened by nut rotation**

Assembly Configuration - DTI fitted under the nut

The alternative assembly configuration for BS EN 14399-3 property class 8.8 is when the DTI is fitted under the nut with a nut face washer and the assembly is tightened by nut rotation, as follows:-

- BS EN 14399-3 property class 8.8 bolt (marked 8.8 HR)
- Direct tension indicator (component identified as 1 below)
- BS EN 14399-9 nut face washer (marked HN) (component identified as 3 below)
- BS EN 14399-3 property class 10 nut (marked 10 HR)

The components shall be assembled as shown below (Figure 2) with the direct tension indicator fitted under the nut. The bolt is placed in the steelwork and at the other side of the connection the direct tension indicator is fitted with the plain side placed against the steelwork and the indicator protrusions facing outwards. The nut face washer is fitted over the bolt threads so that sits on top of the indicator protrusions and the nut is assembled with the side containing the marking facing outwards and the smooth unmarked side of the nut against the nut face washer.



KEY 1 Direct Tension Indicator
2 Nut face washer
3 Gap

**Assembly configuration for EN 14399-3 Property Class 8.8
with DTI fitted under the nut– Tightened by nut rotation
Figure 2**



Use of High Strength Structural Bolting Assemblies for Preloading BS EN 14399-3 PC 8.8 with Direct Tension Indicators (DTI's)

DTI fitted under bolt head tightened by nut rotation and DTI fitted under nut with a nut face washer tightened by nut rotation

Initial Tightening

The bolt head shall be prevented from rotation and each assembly shall be brought to 'snug tight' condition by nut rotation. The tightening process shall be carried out from bolt to bolt within the group, starting from the most rigid part of the connection and moving progressively towards the least rigid part.

Note: The most rigid part of a cover plate connection of an 'I' section is commonly in the middle of the connection bolt group.

The 'snug tight' condition of a fastener assembly shall be when initial deformation of the DTI protrusions begins. This first step shall be completed for all bolts in one connection prior to commencement of the second step.

Final Tightening

When all the assemblies in a connection have been snug tightened then final tightening can commence. Tightening shall be carried out progressively from the most rigid part of the connection to the least rigid part. Tightening shall continue until the specified indicator gap has been achieved (see Table 1)

Table 1	
Thickness of feeler gauge	
Direct tension indicator position	Thickness of feeler gauge
Under bolt head, when nut is rotated (Figure 1)	0.4mm
Under nut with a nut face washer, when nut is rotated (Figure 2)	0.25mm

The average specified indicator gap shall be determined using the following measurement procedure; the feeler gauge shall be used as a 'no go' inspection tool. The feeler gauge shall be pointed at the centre of the bolt see Figure 2 and shall refuse to enter the number of refusal spaces specified in Table 2. It is advisable to leave some small gap to prevent accidental overtightening and breakage but if the gap has been completely closed inadvertently this is not considered by Cooper & Turner to be cause for rejection.

Table 2	
Feeler gauge requirements	
Number of indicator protrusions	Minimum number of feeler gauge refusals
4	3
5	3
6	4
7	4
8	5
9	5

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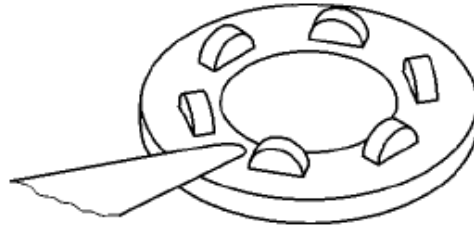


Figure 2 - Checking the indicator gap (example with six protrusions)

When the Direct Tension Indicators are installed in accordance with Cooper & Turner's instructions then the shank tension achieved will be in the range shown below.

Nominal bolt diameter	Shank tension kN	
	H8 for 8.8	
	min	max
M16	88	106
M20	137	164
M22 ¹	170	204
M24	198	238
M27 ¹	257	308
M30	314	377
M36	458	550
¹ Non – preferred sizes. Can only be supplied if the quantity required is sufficient to warrant manufacture.		