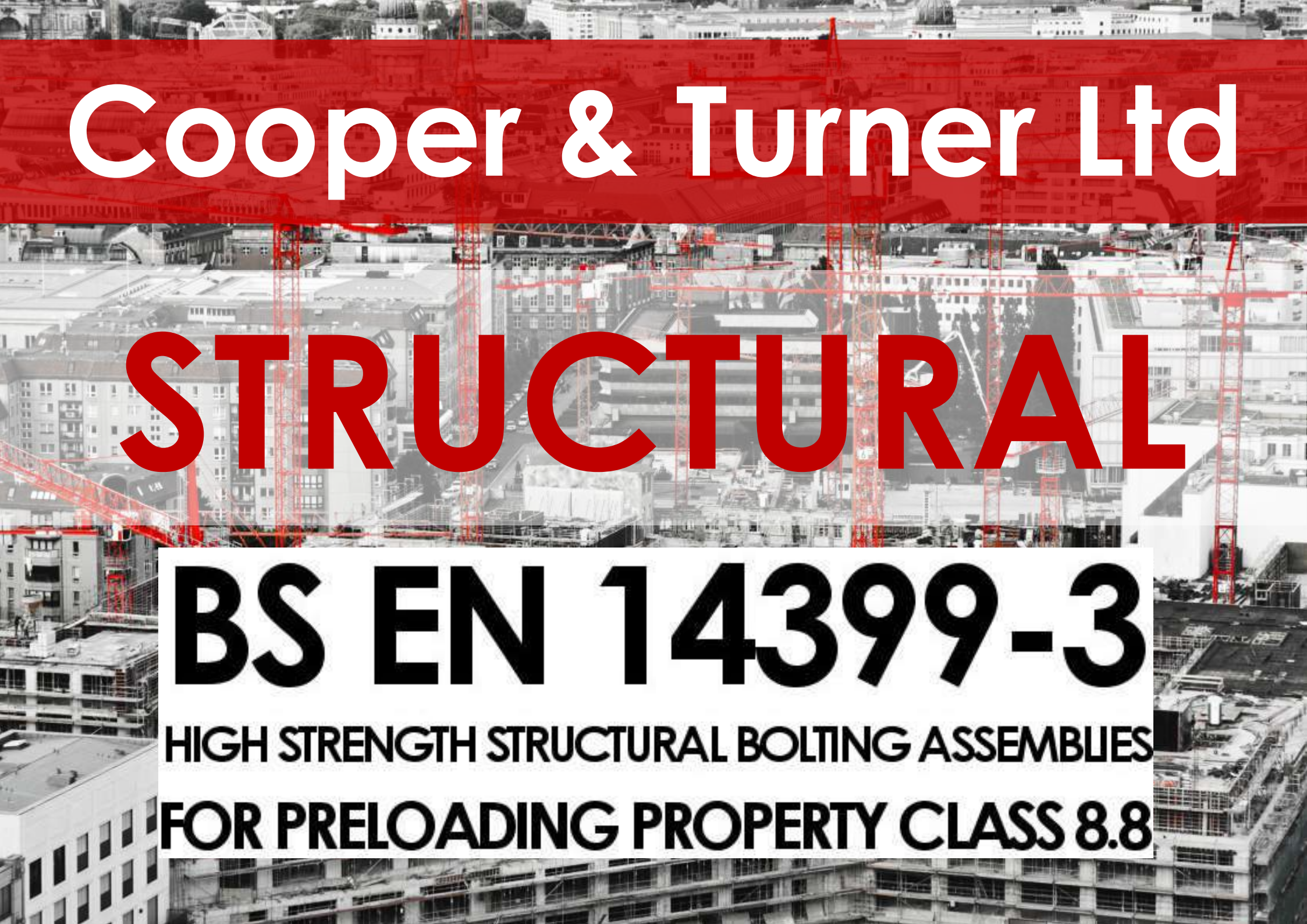
# Cooper & Turner Ltd

# STRUCTURAL

## BS EN 14399-3

### HIGH STRENGTH STRUCTURAL BOLTING ASSEMBLIES

### FOR PRELOADING PROPERTY CLASS 8.8



# BOLT PROPERTY CLASS 8.8



## BS EN 14399-3 BOLT DIMENSIONS

| Thread *d* | | M16 | M20 | M22[2] | M24 | M27[2] | M30 | M36 |
|---|---|---|---|---|---|---|---|---|
| ***P*** pitch of thread | | 2 | 2.5 | 2.5 | 3 | 3 | 3.5 | 4 |
| ***b*** | Bolt ≤125 | 38 | 46 | 50 | 54 | 60 | 66 | 78 |
| | Bolt >125 ≤200 | 44 | 52 | 56 | 60 | 66 | 72 | 84 |
| | Bolt › 200 | - | 65 | 69 | 73 | 79 | 85 | 97 |
| ***c*** | max. | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| | min. | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| ***da*** | max. | 19.2 | 24.4 | 26.4 | 28.4 | 32.4 | 35.4 | 42.4 |
| ***ds*** | max. | 16.70 | 20.84 | 22.84 | 24.84 | 27.84 | 30.84 | 37.00 |
| | min. | 15.30 | 19.16 | 21.16 | 23.16 | 26.16 | 29.16 | 35.00 |
| ***dw***[1] | min. | 24.9 | 29.5 | 33.3 | 38.0 | 42.8 | 46.6 | 55.9 |
| ***e*** | min. | 29.56 | 35.03 | 39.55 | 45.20 | 50.85 | 55.37 | 66.44 |
| ***k*** | max. | 10.75 | 13.40 | 14.90 | 15.90 | 17.90 | 19.75 | 23.55 |
| | min. | 9.25 | 11.60 | 13.10 | 14.10 | 16.10 | 17.65 | 21.45 |
| ***r*** | min. | 1.2 | 1.5 | 1.5 | 1.5 | 2.0 | 2.0 | 2.0 |
| ***s*** | max. | 27 | 32 | 36 | 41 | 46 | 50 | 60 |
| | min. | 26.16 | 31 | 35 | 40 | 45 | 49 | 58.8 |

[1]) The maximum value of ***dw*** shall not exceed the actual width across flats

[2]) Non-preferred sizes. Can only be supplied if the quantity required is sufficient to warrant manufacture.

Dimensions are in millimetres and apply prior to any coating.

| CHARACTERISTIC | | STANDARD |
|---|---|---|
| General Requirements | | BS EN 14399-1 |
| Materials & Manufacture | | BS EN ISO 898-1 Property Class 8.8 |
| Finish / Coatings | Self Colour/Black | BS EN 14399-3 - as processed |
| | Zinc Electroplated | BS 7371-3 or BS EN ISO 4042 |
| | Hot Dip Galvanized | BS EN ISO 10684 |
| Mechanical Properties | | BS EN 14399-3, BS EN ISO 898-1 8.8 |
| Dimensions & Tolerances | | BS EN 14399-3 |
| Threads | | ISO 261, ISO 965-2 tolerance 6g |
| Product Marking | | BS EN 14399-3 |

## IMPORTANT NOTE

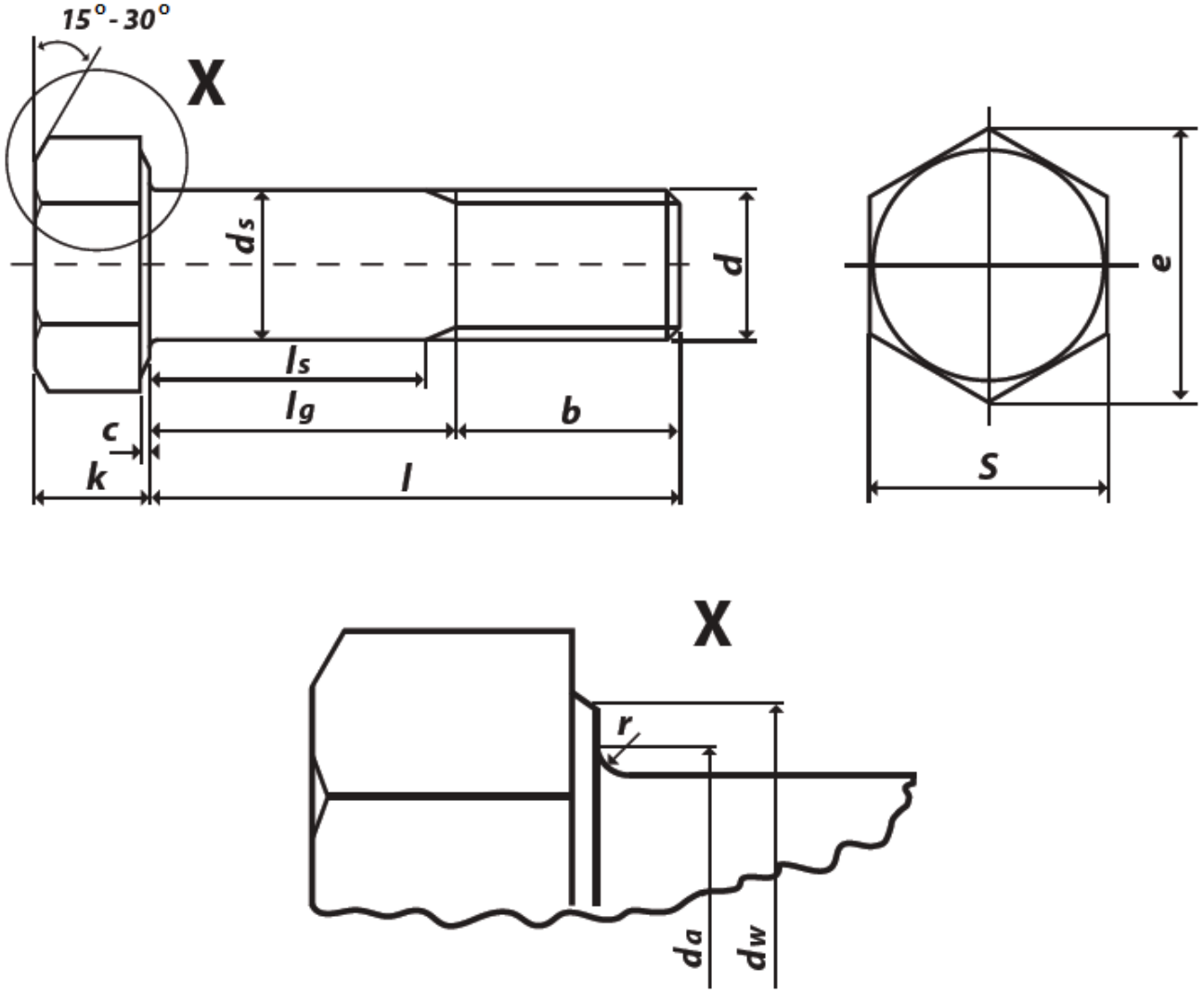
**It is a requirement of BS EN 14399 that**

- **The bolt, nut and washer assembly is supplied by one manufacturer who is responsible for the function of the assembly.**
- **All the components are identified with the manufacturer's mark.**
- **The coating of the assembly is under the control of the manufacturer.**

**Cooper & Turner BS EN 14399-3 HR preload assemblies are supplied in accordance with *k* class K0 this means that C&T EN 14399-3 preload assemblies should only be installed using Direct Tension Indicators (DTI's). "CE" marking can only be supplied if the whole assembly (bolt, nut, washer(s) and DTI) is purchased.**

# BOLT PROPERTY CLASS 8.8






## BS EN 14399-3 HEAD MARKING


## BS EN 14399-3 MECHANICAL PROPERTIES OF PROPERTY CLASS 8.8 BOLTS

| Bolt Thread Diameter | Stress Area | Proof Load min. | Ultimate Load min. | Hardness Rockwell HRC | |
|---|---|---|---|---|---|
| | mm² | kN | kN | min. | max. |
| **M16** | 157 | 94.5 | 130 | 23 | 34 |
| **M20** | 245 | 147 | 203 | 23 | 34 |
| **M22** | 303 | 182 | 252 | 23 | 34 |
| **M24** | 353 | 212 | 293 | 23 | 34 |
| **M27** | 459 | 275 | 381 | 23 | 34 |
| **M30** | 561 | 337 | 466 | 23 | 34 |
| **M36** | 817 | 490 | 678 | 23 | 34 |

**This drawing shows part threaded bolts and represents all those that appear below the stepped line in the Table on Page 3, however, some of the shorter bolts are fully threaded – See footnote 2) in the Table on Page 3**

# BS EN 14399-3 BOLT LENGTH AND THREAD TOLERANCES

| Thread d | | | M16 | | M20 | | M22[1] | | M24 | | M27[1] | | M30 | | M36 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *l* | | | *ls* | *lg* | *ls* | *lg* | *ls* | *lg* | *ls* | *lg* | *ls* | *lg* | *ls* | *lg* | *ls* | *lg* |
| nom. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| 40 | 38.75 | 41.25 | FT [2] | FT [2] | | | | | | | | | | | | |
| 45 | 43.75 | 46.25 | FT [2] | FT [2] | | | | | | | | | | | | |
| 50 | 48.75 | 51.25 | 8 [2] | 11 [2] | FT [2] | FT [2] | FT [2] | FT [2] | | | | | | | | |
| 55 | 53.5 | 56.5 | 8 [2] | 11 [2] | FT [2] | FT [2] | FT [2] | FT [2] | | | | | | | | |
| 60 | 58.5 | 61.5 | 12 | 22 | 10 [2] | 14 [2] | FT [2] | FT [2] | FT [2] | FT [2] | FT [2] | FT [2] | | | | |
| 65 | 63.5 | 66.5 | 17 | 27 | 10 [2] | 14 [2] | 11 [2] | 15 [2] | FT [2] | FT [2] | FT [2] | FT [2] | | | | |
| 70 | 68.5 | 71.5 | 22 | 32 | 11.5 | 24 | 11 [2] | 15 [2] | 12 [2] | 17 [2] | FT [2] | FT [2] | FT [2] | FT [2] | | |
| 75 | 73.5 | 76.5 | 27 | 37 | 16.5 | 29 | 12.5 | 25 | 12 [2] | 17 [2] | FT [2] | FT [2] | FT [2] | FT [2] | | |
| 80 | 78.5 | 81.5 | 32 | 42 | 21.5 | 34 | 17.5 | 30 | 12 [2] | 17 [2] | 13.5 [2] | 19.5 [2] | FT [2] | FT [2] | | |
| 85 | 83.25 | 86.75 | 37 | 47 | 26.5 | 39 | 22.5 | 35 | 16 | 31 | 13.5 [2] | 19.5 [2] | 15 [2] | 24 [2] | FT [2] | FT [2] |
| 90 | 88.25 | 91.75 | 42 | 52 | 31.5 | 44 | 27.5 | 40 | 21 | 36 | 15 | 30 | 15 [2] | 24 [2] | FT [2] | FT [2] |
| 95 | 93.25 | 96.75 | 47 | 57 | 36.5 | 49 | 32.5 | 45 | 26 | 41 | 20 | 35 | 15 [2] | 24 [2] | 18 [2] | 26 [2] |
| 100 | 98.25 | 101.75 | 52 | 62 | 41.5 | 54 | 37.5 | 50 | 31 | 46 | 25 | 40 | 16.5 | 34 | 18 [2] | 26 [2] |
| 110 | 108.25 | 111.75 | 62 | 72 | 51.5 | 64 | 47.5 | 60 | 41 | 56 | 35 | 50 | 26.5 | 44 | 18 [2] | 26 [2] |
| 120 | 118.25 | 121.75 | 72 | 82 | 61.5 | 74 | 57.5 | 70 | 51 | 66 | 45 | 60 | 36.5 | 54 | 22 | 42 |
| 130 | 128 | 132 | 76 | 86 | 65.5 | 78 | 61.5 | 74 | 55 | 70 | 49 | 64 | 40.5 | 58 | 26 | 46 |
| 140 | 138 | 142 | 86 | 96 | 75.5 | 88 | 71.5 | 84 | 65 | 80 | 59 | 74 | 50.5 | 68 | 36 | 56 |
| 150 | 148 | 152 | 96 | 106 | 85.5 | 98 | 81.5 | 94 | 75 | 90 | 69 | 84 | 60.5 | 78 | 46 | 66 |
| 160 | 156 | 164 | 106 | 116 | 95.5 | 108 | 91.5 | 104 | 85 | 100 | 79 | 94 | 70.5 | 88 | 56 | 76 |
| 170 | 166 | 174 | | | | | | | 95 | 110 | 89 | 104 | 80.5 | 98 | 66 | 86 |
| 180 | 176 | 184 | | | | | | | 105 | 120 | 99 | 114 | 90.5 | 108 | 76 | 96 |
| 190 | 186 | 194 | | | | | | | 115 | 130 | 109 | 124 | 100.5 | 118 | 86 | 106 |
| 200 | 196 | 204 | | | | | | | 125 | 140 | 119 | 134 | 110.5 | 128 | 96 | 116 |

[1] Non-preferred sizes. Can only be supplied if the quantity required is sufficient to warrant manufacture.

[2] Bolts shown above the stepped line have sufficient thread to meet the requirements of EN 1090-2. FT indicates fully threaded and in the near future all bolts above the stepped line will be manufactured fully threaded

Dimensions are in millimetres and apply prior to any coating

# NUT
# PROPERTY CLASS 10



## BS EN 14399-3 NUT DIMENSIONS

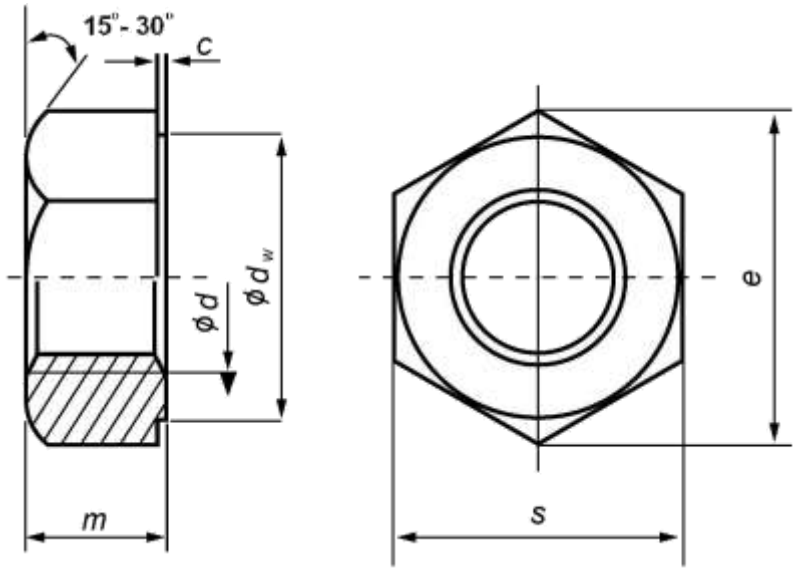
| Thread size ***d*** | | **M16** | **M20** | **M22**[2] | **M24** | **M27**[2] | **M30** | **M36** |
|---|---|---|---|---|---|---|---|---|
| ***P*** pitch of thread | | 2 | 2.5 | 2.5 | 3 | 3 | 3.5 | 4 |
| ***c*** | max. | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| | min. | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| ***dw***[1] | min. | 24.9 | 29.5 | 33.3 | 38.0 | 42.8 | 46.6 | 55.9 |
| ***e*** | min. | 29.56 | 35.03 | 39.55 | 45.20 | 50.85 | 55.37 | 66.44 |
| ***m*** | max. | 14.8 | 18 | 19.4 | 21.5 | 23.8 | 25.6 | 31 |
| | min. | 14.1 | 16.9 | 18.1 | 20.2 | 22.5 | 24.3 | 29.4 |
| ***s*** | max | 27 | 32 | 36 | 41 | 46 | 50 | 60 |
| | min. | 26.16 | 31 | 35 | 40 | 45 | 49 | 58.8 |

[1] The maximum value of ***dw*** shall not exceed the actual width across flats

[2] Non-preferred sizes.

Dimensions are in millimetres and apply prior to any coating

| CHARACTERISTIC | | STANDARD |
|---|---|---|
| General Requirements | | BS EN 14399-1 |
| Materials & Manufacture | | BS EN ISO 898-2 Property Class 10 |
| Finish / Coatings | Self Colour / Black | BS EN 14399-3 as processed |
| | Zinc Electroplated | BS EN 7371-3 or BS EN ISO 4042 |
| | Hot Dip Galvanized | BS EN ISO 10684 |
| Mechanical Properties | | BS EN 14399-3<br>BS EN ISO 898-2 Property Class 10 |
| Dimensions & Tolerances | | BS EN 14399-3 |
| Threads | | ISO 261<br>ISO 965-2 tolerance class 6H or 6AZ |
| Product Marking | | BS EN 14399-3 |



# NUT PROPERTY CLASS 10

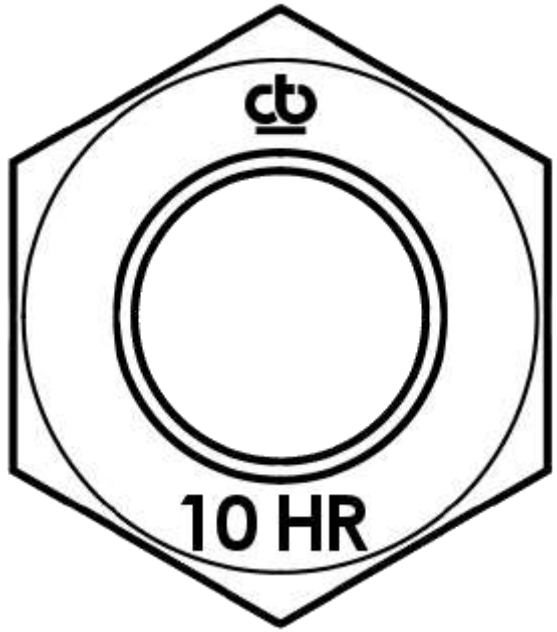


## BS EN 14399-3 PROOF LOAD VALUES OF PROPERTY CLASS 10 NUTS

| Nut thread diameter | Stress Area Test Mandrel | Tolerance Class 6H[1] or 6AZ[1] |
|---|---|---|
| | mm² | Proof Load kN |
| **M16** | 157 | 182.1 |
| **M20** | 245 | 284.2 |
| **M22** | 303 | 351.2 |
| **M24** | 353 | 409.5 |
| **M27** | 459 | 532.4 |
| **M30** | 561 | 650.8 |
| **M36** | 817 | 947.7 |

[1] 6H is the tolerance class for self colour and zinc electroplated nuts and 6AZ is the tolerance class for hot dipped galvanized nuts.

## BS EN 14399-3 NUT MARKING



# WASHER CHAMFERED



## BS EN 14399-6 CHAMFERED WASHER DIMENSIONS

| Nominal size *d*[1] | | M16 | M20 | M22[2] | M24 | M27[2] | M30 | M36 |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | min. | 17 | 21 | 23 | 25 | 28 | 31 | 37 |
| | max. | 17.27 | 21.33 | 23.33 | 25.33 | 28.52 | 31.62 | 37.62 |
| $d_2$ | min. | 29.48 | 36.38 | 38.38 | 43.38 | 49 | 54.80 | 64.80 |
| | max. | 30 | 37 | 39 | 44 | 50 | 56 | 66 |
| *h* | nom. | 4 | 4 | 4 | 4 | 5 | 5 | 6 |
| | min. | 3.7 | 3.7 | 3.7 | 3.7 | 4.4 | 4.4 | 5.4 |
| | max. | 4.3 | 4.3 | 4.3 | 4.3 | 5.6 | 5.6 | 6.6 |
| *e* | nom.=min. | 0.75 | 0.75 | 0.75 | 0.75 | 1 | 1 | 1.25 |
| | max. | 1.50 | 1.50 | 1.50 | 1.50 | 2 | 2 | 2.50 |
| *c* | min. | 1.6 | 2.0 | 2.0 | 2.0 | 2.5 | 2.5 | 2.5 |
| | max. | 1.9 | 2.5 | 2.5 | 2.5 | 3.0 | 3.0 | 3.0 |

[1] Nominal thread diameter of associated bolts

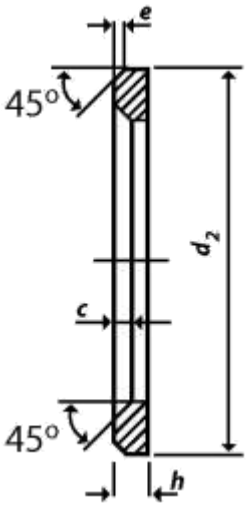
[2] Non-preferred sizes.

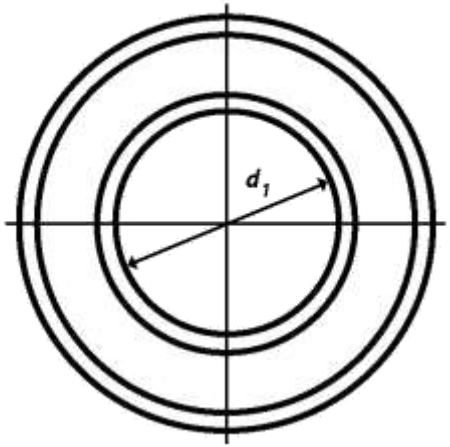
Dimensions are in millimetres and apply prior to any coating

| CHARACTERISTIC | | STANDARD |
|---|---|---|
| General Requirements | | BS EN 14399-1 |
| Finish / Coatings | Self Colour / Black | BS EN 14399-6 – as processed |
| | Zinc Electroplated | BS 7371-3 or BS EN ISO 4042 |
| | Hot Dip Galvanized | BS EN ISO 10684 |
| Mechanical Properties | | BS EN 14399-6 |
| Dimensions & Tolerances | | BS EN 14399-6 |
| Product Marking | | BS EN 14399-6 |

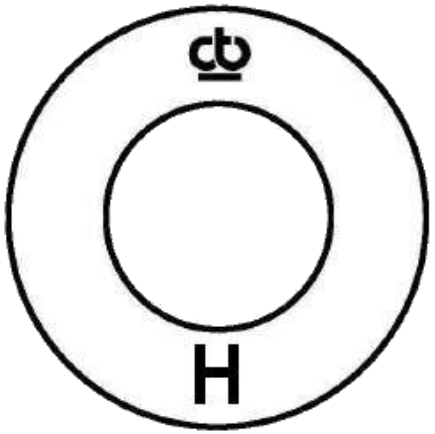
**BS EN 14399-6 MECHANICAL PROPERTIES OF CHAMFERED WASHERS**

| Nominal Size | Vickers Hardness (HV) | |
|---|---|---|
| | min. | max. |
| **M16** to **M36** inclusive | 300 | 370 |




## BS EN 14399-6 WASHER MARKING



# DIRECT TENSION INDICATORS (DTI's) DESIGNATION H8



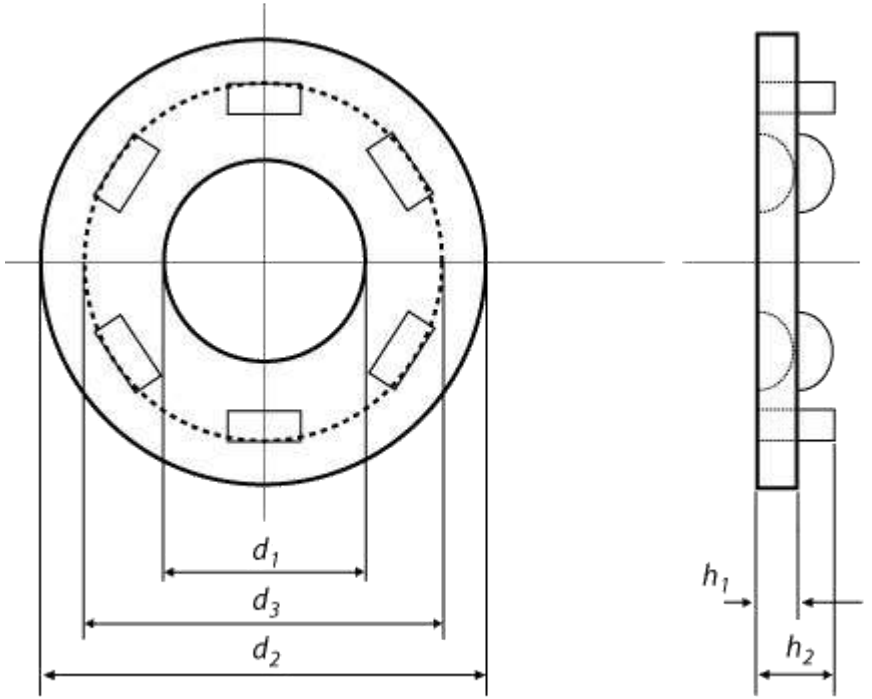
## BS EN 14399-9 DIRECT TENSION INDICATOR DIMENSIONS

| Nominal size $d$[1] | | M16 | M20 | M22[2] | M24 | M27[2] | M30 | M36 |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | max. | 16.85 | 21.05 | 23.15 | 25.25 | 28.40 | 31.55 | 37.85 |
| $d_2$ | max. | 36.8 | 46.0 | 50.6 | 55.2 | 62.1 | 69.0 | 83.0 |
| $d_3$ | max. | 25 | 29 | 33 | 38 | 43 | 46.5 | 56 |
| $h_1$ | min. | 3.0 | 3.5 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| $h_2$ | max. | 6.0 | 6.5 | 7.0 | 7.0 | 7.0 | 7.0 | 7.5 |

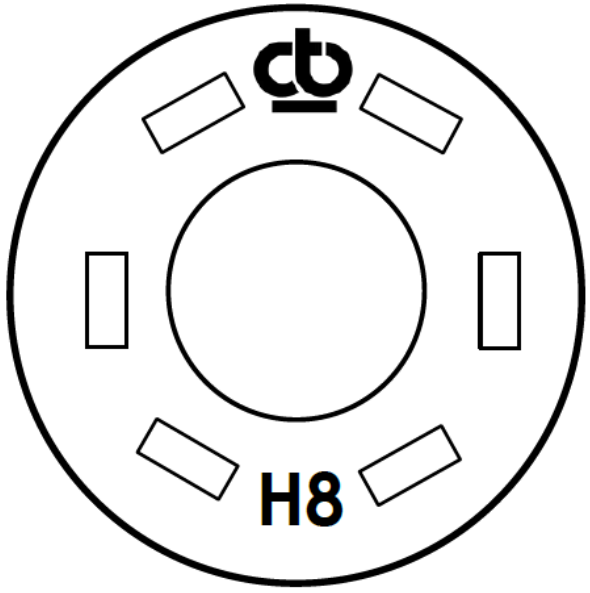
[1] Nominal thread diameter of associated bolt
[2] Non-preferred sizes.
Dimensions are in millimetres and apply prior to any coating

| CHARACTERISTIC | | STANDARD |
|---|---|---|
| General Requirements | | BS EN 14399-1 |
| Finish / Coatings[1] | Self Colour / Black | BS EN 14399-9 – as processed |
| | Mechanically Galvanized | BS 7371-7 / ASTM B695 Class 50 |
| Mechanical Properties | | BS EN 14399-9 Designation H8 |
| Dimensions & Tolerances | | BS EN 14399-9 |
| Product Marking | | BS EN 14399-9 |

[1] All stocks of DTI's are mechanically galvanized.




## BS EN 14399-9 DTI MARKING




**NOTE: This a schematic representation of the protrusions and other forms including curved may be used**

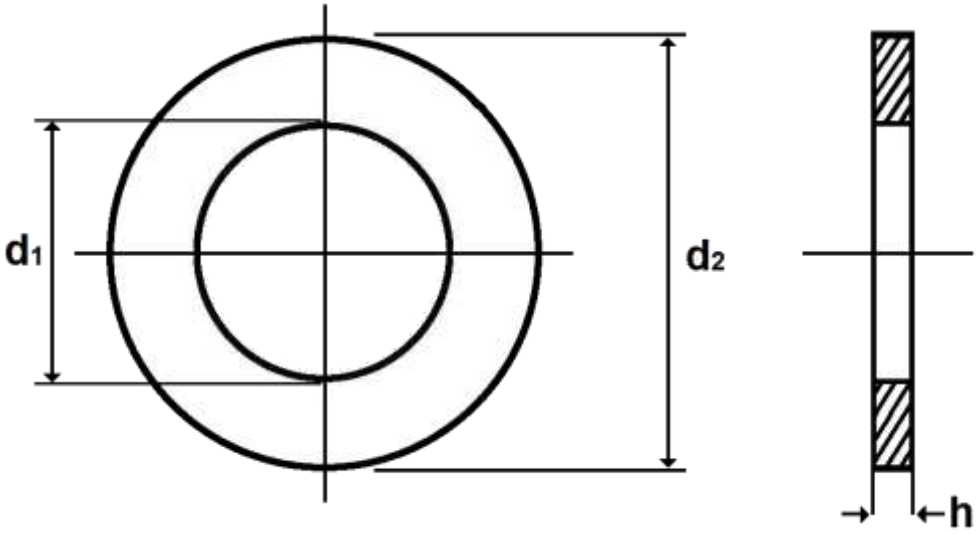
## BS EN 14399-9 NUT FACE WASHERS

| Nominal size *d*[1] | | M16 | M20 | M22[2] | M24 | M27[2] | M30 | M36 |
|---|---|---|---|---|---|---|---|---|
| $d_1$ | min. | 16.1 | 20.1 | 22.3 | 24.2 | 27.2 | 30.2 | 36.2 |
| | max. | 16.35 | 20.40 | 22.60 | 24.5 | 27.55 | 30.55 | 36.55 |
| $d_2$ | min. | 27.7 | 34.4 | 37.4 | 41.4 | 46.4 | 50.1 | 60.1 |
| | max. | 29 | 36 | 39 | 43 | 48 | 52 | 62 |
| *h* | min. | 3.7 | 3.7 | 3.7 | 3.7 | 4.4 | 4.4 | 5.4 |
| | max. | 4.3 | 4.3 | 4.3 | 4.3 | 5.6 | 5.6 | 6.6 |

[1] Nominal thread diameter of associated bolt

[2] Non-preferred sizes.

Dimensions are in millimetres and apply prior to any coating



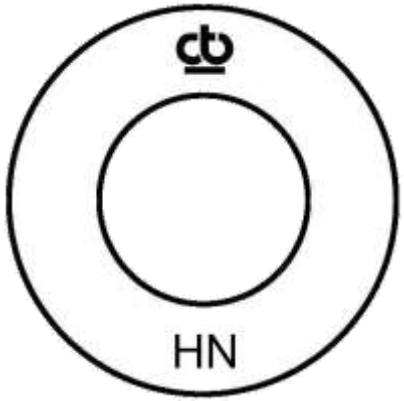

| CHARACTERISTIC | | STANDARD |
|---|---|---|
| General Requirements | | BS EN 14399-1 |
| Finish / Coatings[1] | Self Colour / Black | BS EN 14399-9 - as processed |
| | Sherardized | BS 7371 - 8 |
| Mechanical Properties | | BS EN 14399-9 |
| Dimensions & Tolerances | | BS EN 14399-9 |
| Product Marking | | BS EN 14399-9 |

[1] All stocks of nut face washers are sherardized

## BS EN 14399-9 MECHANICAL PROPERTIES OF NUT FACE WASHERS

| Nominal Size | Vickers Hardness (HV30) | | Rockwell Hardness (HRC) | |
|---|---|---|---|---|
| | min. | max. | min. | max. |
| **M16** to **M30** inclusive | 372 | 448 | 38 | 45 |

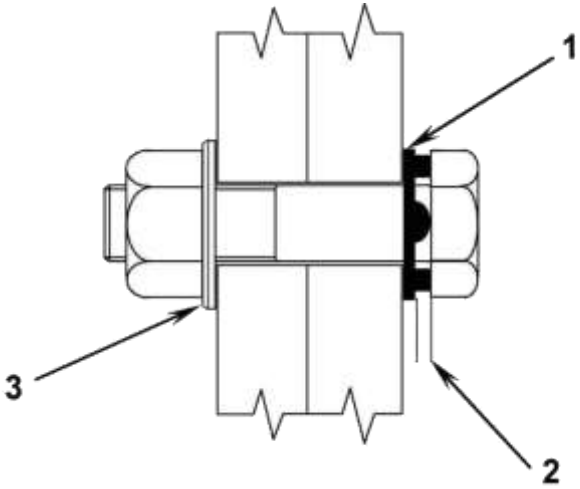
## BS EN 14399-9 NUT FACE WASHER MARKING



# BS EN 14399-3 PC 8.8 ASSEMBLIES WITH DIRECT TENSION INDICATORS H8



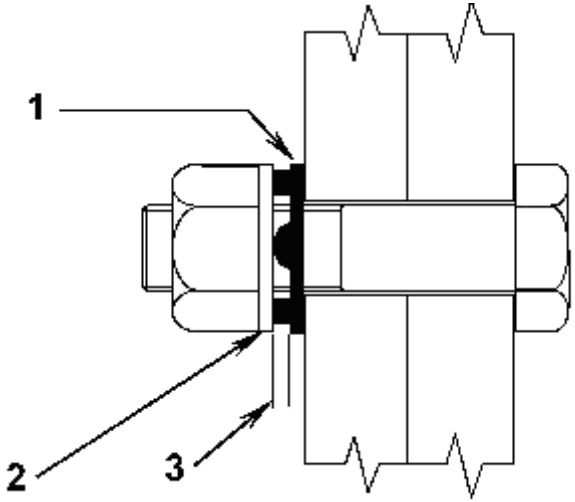
## Assembly configuration for EN 14399-3 Property Class 8.8 with DTI fitted under the bolt head - Tightened by nut rotation




**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 nut– Tightened by nut rotation




**KEY**

1. Direct Tension Indicator
2. Nut face washer according to EN 14399-9
3. Gap

## 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.

**Further information is contained in the sheet entitled 'Use of High Strength Structural Bolting Assemblies for Preloading BS EN 14399–3 PC 8.8 Hex with Direct Tension Indicators (DTI's)' which is available on our website.**