



## Assembly of screwed fastenings

### Preloads and tightening torque for fasteners from steel

#### Preloads and tightening torque for countersunk head steel screws with hexagon/hexalobular socket

If, for example, countersunk head screws are tightened according to ISO 10642 (DIN 7991) using the hexagon socket, only preloads amounting to some 80% of the preloads of the corresponding property class can be applied. This is due to either the torsion strength of the screwdriver or the contact ratio in the hexagon socket. This also applies when tightening using a nut due to the existing critical stress area between the hexagonal socket and the shank. The same applies for countersunk head screws with hexalobular socket. For screws with fine pitch thread, the same tightening torque is to be used. Table 6 contains non-binding typical values for the total friction coefficient  $\mu = 0.14$ , valid for screws with coarse thread according to DIN 7991 or ISO 10642 in property classes 8.8 and 10.9.

**Table 6: Typical values for countersunk heads screws with hexagon/hexalobular socket, friction coefficient  $\mu_{\text{total}} = 0.14$**

| Dimensions | Preloads $F_v$ (kN) for property class |        | Tightening torque $M_A$ (Nm) for property class |       |
|------------|----------------------------------------|--------|-------------------------------------------------|-------|
|            | 8.8                                    | 10.9   | 8.8                                             | 10.9  |
| M 4        | 3.10                                   | 4.40   | 2.6                                             | 3.4   |
| M 5        | 5.10                                   | 7.30   | 5.6                                             | 6.7   |
| M 6        | 7.20                                   | 10.30  | 9.6                                             | 11.6  |
| M 8        | 13.20                                  | 18.90  | 23                                              | 28.3  |
| M 10       | 21.00                                  | 30.10  | 46                                              | 56.0  |
| M 12       | 30.70                                  | 43.90  | 81                                              | 96.8  |
| M 14       | 42.00                                  | 60.30  | 125                                             | 154.0 |
| M 16       | 58.00                                  | 82.70  | 195                                             | 239.0 |
| M 18       | 72.80                                  | 100.90 | 275                                             | 332.0 |
| M 20       | 93.60                                  | 129.40 | 390                                             | 468.0 |

#### Preloads and tightening torque for steel shank screws with UNC/UNF threads and head contact area sizes according to ASME B18.2.1, ASME B18.3 and ASME B18.2.2

The following are taken into account in table values for  $M_A$ :

- Friction coefficient  $\mu_{\text{total}} = 0.14$
- Utilisation of the minimum yield strength = 90%
- Torsion torque when tightening

The values in Tables 7 and 8 are to be determined using the VDI guideline 2230-1: 2003-02

**Table 7: Typical values for hexagon head screws with UNC threads, friction number  $\mu_{\text{total}} = 0.14$**

| Dimensions  |    | Preloads $F_v$ (kN) (lbf) for property class |       |          |        |         |       |         |       | Tightening torque $M_A$ (Nm) (ft-lbs) for property class |          |          |          |         |          |         |          |
|-------------|----|----------------------------------------------|-------|----------|--------|---------|-------|---------|-------|----------------------------------------------------------|----------|----------|----------|---------|----------|---------|----------|
|             |    | Grade 5*                                     |       | Grade 8* |        | Type 2* |       | Type 3* |       | Grade 5*                                                 |          | Grade 8* |          | Type 2* |          | Type 3* |          |
| $\emptyset$ | M  | [kN]                                         | [lbf] | [kN]     | [lbf]  | [kN]    | [lbf] | [kN]    | [lbf] | [Nm]                                                     | [ft-lbs] | [Nm]     | [ft-lbs] | [Nm]    | [ft-lbs] | [Nm]    | [ft-lbs] |
| 1/4         | 20 | 10.1                                         | 2260  | 14.2     | 3194   | -       | -     | -       | -     | 12.1                                                     | 8.95     | 17.1     | 12.6     | -       | -        | -       | -        |
| 5/16        | 18 | 16.7                                         | 3764  | 23.7     | 5319   | -       | -     | -       | -     | 25.7                                                     | 18.9     | 36.3     | 26.7     | -       | -        | -       | -        |
| 3/8         | 16 | 24.9                                         | 5594  | 35.2     | 7904   | -       | -     | -       | -     | 44.6                                                     | 32.9     | 63.0     | 46.4     | -       | -        | -       | -        |
| 7/16        | 14 | 34.2                                         | 7684  | 48.3     | 10858  | -       | -     | -       | -     | 70.9                                                     | 52.3     | 100      | 73.9     | -       | -        | -       | -        |
| 1/2         | 13 | 45.8                                         | 10300 | 64.7     | 14554  | 45.8    | 10300 | 45.8    | 10300 | 109                                                      | 80.3     | 154      | 114      | 109     | 80.3     | 109     | 80.3     |
| 5/8         | 11 | 73.2                                         | 16464 | 103      | 23265  | 73.2    | 16464 | 73.2    | 16464 | 213                                                      | 157      | 301      | 222      | 213     | 157      | 213     | 157      |
| 3/4         | 10 | 109                                          | 24485 | 154      | 34599  | 109     | 24485 | 109     | 24485 | 383                                                      | 283      | 541      | 399      | 383     | 283      | 383     | 283      |
| 7/8         | 9  | 151                                          | 33891 | 213      | 47889  | 151     | 33891 | 151     | 33891 | 614                                                      | 453      | 868      | 640      | 614     | 453      | 614     | 453      |
| 1           | 8  | 198                                          | 44499 | 280      | 62879  | 198     | 44499 | 198     | 44499 | 922                                                      | 680      | 1303     | 961      | 922     | 680      | 922     | 680      |
| 1 1/8       | 7  | 219                                          | 49326 | 252      | 79166  | -       | -     | 219     | 49326 | 1153                                                     | 850      | 1850     | 1364     | -       | -        | 1153    | 850      |
| 1 1/4       | 7  | 280                                          | 62934 | 449      | 101005 | -       | -     | 280     | 62934 | 1618                                                     | 1194     | 2597     | 1916     | -       | -        | 1618    | 1194     |
| 1 3/8       | 6  | 333                                          | 74796 | 534      | 120043 | -       | -     | 333     | 74796 | 2121                                                     | 1565     | 3405     | 2511     | -       | -        | 2121    | 1565     |
| 1 1/2       | 6  | 406                                          | 91358 | 652      | 146624 | -       | -     | 406     | 91358 | 2806                                                     | 2070     | 4504     | 3322     | -       | -        | 2806    | 2070     |

**Table 8: Typical values for hexagon head screws with UNF threads, friction number  $\mu_{\text{total}} = 0.14$**

| Dimensions  |    | Preloads $F_v$ (kN) for property class |       |          |       |         |       |         |       | Tightening torque $M_A$ (Nm) for property class |          |          |          |         |          |         |          |
|-------------|----|----------------------------------------|-------|----------|-------|---------|-------|---------|-------|-------------------------------------------------|----------|----------|----------|---------|----------|---------|----------|
|             |    | Grade 5*                               |       | Grade 8* |       | Type 2* |       | Type 3* |       | Grade 5*                                        |          | Grade 8* |          | Type 2* |          | Type 3* |          |
| $\emptyset$ | M  | [kN]                                   | [lbf] | [kN]     | [lbf] | [kN]    | [lbf] | [kN]    | [lbf] | [Nm]                                            | [ft-lbs] | [Nm]     | [ft-lbs] | [Nm]    | [ft-lbs] | [Nm]    | [ft-lbs] |
| 1/4         | 28 | 11.8                                   | 2653  | 16.7     | 3749  | -       | -     | -       | -     | 13.8                                            | 10.2     | 19.5     | 14.4     | -       | -        | -       | -        |
| 5/16        | 24 | 18.9                                   | 4252  | 26.7     | 6008  | -       | -     | -       | -     | 28.3                                            | 20.9     | 40.0     | 29.5     | -       | -        | -       | -        |
| 3/8         | 24 | 28.9                                   | 6486  | 40.8     | 9165  | -       | -     | -       | -     | 50.0                                            | 36.9     | 70.7     | 52.2     | -       | -        | -       | -        |
| 7/16        | 20 | 39.0                                   | 8758  | 55.0     | 12375 | -       | -     | -       | -     | 78.6                                            | 57.9     | 111      | 81.9     | -       | -        | -       | -        |
| 1/2         | 20 | 52.8                                   | 11861 | 74.6     | 16760 | 52.7    | 11861 | 52.7    | 11861 | 122                                             | 89.7     | 172      | 127      | 122     | 89.7     | 122     | 89.7     |
| 5/8         | 18 | 84.7                                   | 19050 | 120      | 26918 | 84.7    | 19050 | 84.7    | 19050 | 239                                             | 176      | 337      | 249      | 239     | 176      | 239     | 176      |
| 3/4         | 16 | 124                                    | 27814 | 175      | 39302 | 124     | 27814 | 124     | 27814 | 423                                             | 312      | 597      | 441      | 423     | 312      | 423     | 312      |

\* Grade 5 (~ 8.8) and Grade 8 (~ 10.9) according to SAE J 429, Type 2 and Type 3 (~ 8.8) according to ASTM A325