



# TORQUE-TENSION REFERENCE GUIDE

## TORQUE-TENSION RELATIONSHIP FOR A307A, GRADE 5, 8 & 9 BOLTS

| Nominal Dia. (in.) | Threads per inch | ASTM A307 Grade A |                             |           |           | SAE J429 Grade 5  |                             |           |            | SAE J429 Grade 8  |                             |            |            | FNL Grade 9       |                             |            |            |            |            |      |     |
|--------------------|------------------|-------------------|-----------------------------|-----------|-----------|-------------------|-----------------------------|-----------|------------|-------------------|-----------------------------|------------|------------|-------------------|-----------------------------|------------|------------|------------|------------|------|-----|
|                    |                  | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.15    | K=0.20    | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.15    | K=0.20     | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.15     | K=0.20     | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.15     | K=0.20     |            |            |      |     |
| 1/4                | 20               | 859               | 32 in-lbs                   | 37 in-lbs | 43 in-lbs | 2029              | 81 in-lbs                   | 76 in-lbs | 110 in-lbs | 2064              | 86 in-lbs                   | 107 in-lbs | 122 in-lbs | 143 in-lbs        | 3357                        | 101 in-lbs | 126 in-lbs | 143 in-lbs | 168 in-lbs |      |     |
| 5/16               | 18               | 1416              | 66                          | 75        | 88        | 3342              | 125                         | 157       | 178        | 209               | 479                         | 177        | 221        | 251               | 5531                        | 207        | 259        | 294        | 346        |      |     |
| 3/8                | 16               | 2092              | 10 in-lbs                   | 11 ft-lbs | 13 ft-lbs | 4940              | 19 ft-lbs                   | 23 ft-lbs | 26 ft-lbs  | 31 ft-lbs         | 36 ft-lbs                   | 44 ft-lbs  | 44 ft-lbs  | 8174              | 31 ft-lbs                   | 38 ft-lbs  | 43 ft-lbs  | 51 ft-lbs  |            |      |     |
| 7/16               | 14               | 2870              | 16                          | 18        | 21        | 6777              | 30                          | 37        | 42         | 49                | 56                          | 68         | 70         | 11214             | 49                          | 61         | 70         | 82         |            |      |     |
| 1/2                | 13               | 3831              | 24                          | 27        | 32        | 9046              | 45                          | 57        | 64         | 75                | 12771                       | 64         | 80         | 90                | 106                         | 14969      | 75         | 94         | 106        | 125  |     |
| 9/16               | 12               | 4912              | 35                          | 39        | 46        | 11599             | 65                          | 82        | 92         | 109               | 16375                       | 92         | 115        | 130               | 154                         | 19183      | 108        | 135        | 153        | 180  |     |
| 5/8                | 11               | 6102              | 48                          | 54        | 64        | 14408             | 90                          | 113       | 128        | 150               | 20340                       | 127        | 159        | 180               | 212                         | 23840      | 149        | 186        | 211        | 248  |     |
| 3/4                | 10               | 8030              | 65                          | 73        | 87        | 19322             | 120                         | 149       | 170        | 200               | 267                         | 30191      | 226        | 280               | 320                         | 376        | 35241      | 285        | 331        | 375  | 441 |
| 7/8                | 9                | 12467             | 136                         | 155       | 182       | 29436             | 258                         | 322       | 365        | 429               | 41556                       | 384        | 485        | 515               | 606                         | 48707      | 426        | 533        | 604        | 710  |     |
| 1                  | 8                | 16355             | 204                         | 232       | 273       | 38616             | 386                         | 483       | 547        | 644               | 54517                       | 545        | 681        | 772               | 909                         | 63889      | 638        | 799        | 905        | 1065 |     |
| 1-1/4              | 7                | 26166             | 409                         | 463       | 545       | 53786             | 672                         | 840       | 952        | 1121              | 87220                       | 1090       | 1363       | 1545              | 1817                        | 102229     | 1278       | 1597       | 1810       | 2130 |     |
| 1-3/8              | 6                | 31182             | 536                         | 607       | 715       | 64096             | 881                         | 1102      | 1249       | 1469              | 103939                      | 1429       | 1768       | 2025              | 2382                        | 121826     | 1675       | 2094       | 2373       | 2792 |     |
| 1-1/2              | 6                | 37942             | 711                         | 806       | 949       | 77919             | 1170                        | 1462      | 1657       | 1950              | 126473                      | 1897       | 2371       | 2688              | 3162                        | 148237     | 2244       | 2779       | 3150       | 3706 |     |

## ELECTRODEPOSITED ZINC & LUBRICATED PREVAILING-TORQUE ALL-METAL TYPE NUTS

| Locknut Size | Threads per inch | Steel Hex Locknut |              |            |         | Steel Hex Flange Nut |                             |                   |                             |             |       |              |             |
|--------------|------------------|-------------------|--------------|------------|---------|----------------------|-----------------------------|-------------------|-----------------------------|-------------|-------|--------------|-------------|
|              |                  | Grade C           | FNL Grade 9  | Grade F    | Grade G | Clamp Load (lbs.)    | Tightening Torque (ft-lbs.) | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) |             |       |              |             |
| 1/4          | 20               | 2864              | 93.1 in-lbs  | 144 in-lbs | 3357    | 100.7 in-lbs         | 134.3 in-lbs                | 2029              | 76.1 in-lbs                 | 96.4 in-lbs | 2864  | 107.4 in-lbs | 136 in-lbs  |
| 5/16         | 18               | 4719              | 162          | 251        | 5524    | 171                  | 274                         | 3242              | 153                         | 232         | 4198  | 171          | 260         |
| 3/8          | 16               | 6974              | 283.3 in-lbs | 37 in-lbs  | 8174    | 30.7 in-lbs          | 40.9 in-lbs                 | 4940              | 23.2 in-lbs                 | 29.3 in-lbs | 6974  | 32.7 in-lbs  | 41.4 in-lbs |
| 7/16         | 14               | 9568              | 45           | 59         | 11214   | 49                   | 65                          | 6777              | 37                          | 47          | 9568  | 52           | 66          |
| 1/2          | 13               | 12771             | 69           | 90         | 14969   | 75                   | 100                         | 9046              | 57                          | 72          | 12771 | 80           | 101         |
| 9/16         | 12               | 16375             | 100          | 130        | 19183   | 108                  | 144                         | 11599             | 82                          | 103         | 16375 | 115          | 146         |
| 5/8          | 11               | 20340             | 138          | 180        | 23840   | 149                  | 199                         | 14408             | 113                         | 143         | 20340 | 159          | 201         |
| 3/4          | 10               | 26166             | 245          | 320        | 35281   | 265                  | 353                         | 21322             | 200                         | 253         | 30191 | 282          | 357         |
| 7/8          | 9                | 31182             | 394          | 516        | 40707   | 426                  | 568                         | 25840             | 219                         | 287         | 40707 | 349          | 452         |
| 1            | 8                | 37942             | 591          | 772        | 63889   | 639                  | 852                         | 30101             | 243                         | 313         | 54517 | 419          | 542         |
| 1-1/8        | 7                | 46096             | 837          | 1095       | 80516   | 906                  | 1208                        | 38483             | 295                         | 389         | 63889 | 519          | 672         |
| 1-1/4        | 7                | 53786             | 1181         | 1545       | 102229  | 1278                 | 1704                        | 48707             | 377                         | 496         | 80516 | 610          | 796         |

## METRIC FASTENERS

| Nominal Dia. (mm) | Pitch | Class 4.6         |                             |              | Class 8.8         |                             |             | Class 10.9        |                             |        | Class 12.9        |                             |             |
|-------------------|-------|-------------------|-----------------------------|--------------|-------------------|-----------------------------|-------------|-------------------|-----------------------------|--------|-------------------|-----------------------------|-------------|
|                   |       | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.20       | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.20      | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.20 | Clamp Load (lbs.) | Tightening Torque (ft-lbs.) | K=0.20      |
| 4                 | 0.7   | 333               | 7.9 in-lbs                  | 8.9 in-lbs   | 10.3 in-lbs       | 858                         | 23 in-lbs   | 27 in-lbs         | 28                          | 1228   | 29 in-lbs         | 32.9 in-lbs                 | 38.7 in-lbs |
| 5                 | 0.8   | 538               | 15.9 in-lbs                 | 18.0         | 21.2              | 1387                        | 40.9        | 46.4              | 54.6                        | 1985   | 56.6              | 66.4                        | 78.1        |
| 6                 | 1     | 763               | 23.0 in-lbs                 | 26.7         | 31.1              | 1964                        | 67          | 76.9              | 92.9                        | 277    | 80.9              | 93.9                        | 113.1       |
| 7                 | 1     | 1095              | 45.3 in-lbs                 | 51.3         | 60.3              | 2822                        | 116.6       | 132.2             | 155.5                       | 4039   | 187               | 189                         | 223         |
| 8                 | 1.25  | 1389              | 65.6 in-lbs                 | 74.4         | 87.5              | 3880                        | 169.1       | 191.6             | 225.4                       | 5123   | 242               | 274                         | 323         |
| 10                | 1.5   | 2200              | 108 in-lbs                  | 123.3 in-lbs | 14.4 ft-lbs       | 5671                        | 27.9 in-lbs | 31.8 ft-lbs       | 37.2 ft-lbs                 | 8115   | 39.9 in-lbs       | 45.2 ft-lbs                 | 53.2 ft-lbs |
| 12                | 1.75  | 3197              | 18.9 in-lbs                 | 21.4         | 25.2              | 8240                        | 48.7        | 55.1              | 64.9                        | 11792  | 69.6              | 78.9                        | 92.8        |
| 14                | 2     | 4379              | 30.2 in-lbs                 | 34.2         | 40.2              | 11289                       | 77.8        | 88.1              | 103.7                       | 16154  | 111.3             | 126.1                       | 148.4       |
| 16                | 2     | 5943              | 47                          | 53           | 62                | 15220                       | 121         | 137               | 161                         | 21924  | 173               | 196                         | 230         |
| 18                | 2.5   | 7201              | 65                          | 73           | 86                | 18822                       | 167         | 189               | 220                         | 26524  | 239               | 270                         | 310         |
| 20                | 2.5   | 9286              | 91                          | 104          | 122               | 23938                       | 236         | 267               | 311                         | 34256  | 337               | 382                         | 449         |
| 22                | 2.5   | 11509             | 125                         | 141          | 166               | 29669                       | 321         | 364               | 428                         | 42457  | 460               | 521                         | 613         |
| 24                | 3     | 13372             | 158                         | 179          | 211               | 34471                       | 407         | 461               | 543                         | 49329  | 582               | 660                         | 777         |
| 27                | 3     | 17428             | 232                         | 262          | 309               | 44924                       | 597         | 676               | 796                         | 64288  | 854               | 968                         | 1139        |
| 30                | 3.5   | 21266             | 314                         | 356          | 419               | 54819                       | 809         | 917               | 1079                        | 78448  | 1108              | 1312                        | 1544        |
| 33                | 3.5   | 28310             | 427                         | 484          | 570               | 67821                       | 1101        | 1248              | 1488                        | 97055  | 1576              | 1786                        | 2101        |
| 36                | 4     | 39982             | 549                         | 622          | 732               | 79866                       | 1415        | 1603              | 1886                        | 114291 | 2024              | 2294                        | 2699        |

## A2 OR A4 METRIC STAINLESS STEEL FASTENERS

| Nominal Dia. (mm) | Pitch | Torque (in-lbs through M10 & over ft-lbs) |             |
|-------------------|-------|---|-------------|
|                   |       | Dry                                       | Lubricated  |
| 3                 | 0.5   | 14  | 7.0 in-lbs  |
| 4                 | 0.7   | 17.5                                      | 16.2        |
| 5                 | 0.8   | 25.4                                      | 32.7        |
| 6                 | 1     | 36.2                                      | 55.8        |
| 8                 | 1.25  | 146.2                                     | 135.2       |
| 10                | 1.5   | 241.1 in-lbs                              | 22.3 ft-lbs |
| 12                | 1.75  | 42.1                                      | 38.9        |
| 14                | 2     | 67.2                                      | 62.2        |
| 16                | 2     | 104                                       | 96          |
| 18                | 2.5   | 144                                       | 133         |
| 20                | 2.5   | 204                                       | 188         |
| 22                | 2.5   | 268                                       | 243         |
| 24                | 3     | 388                                       | 354         |

CAUTION: All material included in these charts is solvent-free and its use by anyone is voluntary. In developing this information, Fastenal has made a determined effort to present its contents accurately. Extreme caution should be used when using a formula for torque/tension relationships. Torque is only an indirect indicator of tension. Under-torque tightening of fasteners can result in costly equipment failure or personal injury.

## ALLOY STEEL LOW HEAD SOCKET HEAD CAP SCREW

| Nominal Size | Alloy Steel Socket Head Other Configurations Torque (in-lbs) |             |                |          |
|--------------|--|-------------|----------------|----------|
|              | Flat Head  | Button Head | Shoulder Screw | Low-Head |
| Size         | 1/4  | 5/16        | 3/8            | 1/2      |
| 1/4          | 0.073  | 2.5         | 2              | -        |
| #1           | 0.086  | 4.5         | 7              | -        |
| #2           | 0.099  | 7           | 7              | -        |
| #3           | 0.112  | 10          | 9              | -        |
| #4           | 0.125  | 13          | 13             | -        |
| #5           | 0.138  | 17          | 15             | -        |
| #6           | 0.151  | 21          | 19             | -        |
| #7           | 0.164  | 26          | 23             | -        |
| #8           | 0.177  | 31          | 28             | -        |
| #9           | 0.190  | 37          | 35             | -        |
| #10          | 0.203  | 44          | 42             | -        |
| 1/8          | 0.216  | 52          | 50             | -        |
| 5/16         | 0.229  | 61          | 60             | -        |
| 3/8          | 0.242  | 71          | 70             | -        |
| 1/2          | 0.255  | 82          | 81             | -        |
| 5/8          | 0.268  | 94          | 93             | -        |
| 3/4          | 0.281  | 107         | 106            | -        |
| 7/8          | 0.294  | 121         | 120            | -        |
| 1            | 0.307  | 136         | 135            | -        |

Note: Torque values are based on a standard 1000 ft-lb torque wrench. Torque values are based on a standard 1000 ft-lb torque wrench. Torque values are based on a standard 1000 ft-lb torque wrench.

## ASTM A574 SOCKET HEAD CAP SCREWS

| Nominal Size or Basic Screw Dia. | Threads per inch | Tensile Stress Area (sq. in.) | ASTM A574 Tightening Torque |        |            |            |
|----------------------------------|------------------|-------------------------------|-----------------------------|--------|------------|------------|
|                                  |                  |                               | Clamp Load (lbs.)           | K=0.15 | K=0.17     | K=0.20     |
| #1                               | 0.0730           | 64                            | 0.0026                      | 275    | 3.0 in-lbs | 4.0 in-lbs |
| #2                               | 0.0860           | 56                            | 0.0037                      | 288    | 5.0        | 5.7        |
| #3                               | 0.0990           | 48                            | 0.0049                      | 511    | 7.6        | 8.6        |
| #4                               | 0.1120           | 40                            | 0.006                       | 633    | 10.6       | 12.1       |
| #5                               | 0.1250           | 40                            | 0.008                       | 835    | 16         | 18         |
| #6                               | 0.1380           | 32                            | 0.0091                      | 954    | 20         | 22         |
| #8                               | 0.1640           | 32                            | 0.014                       | 1471   | 36         | 41         |
| #10                              | 0.1900           | 24                            | 0.0175                      | 1841   | 52         | 59         |
| 1/4                              | 0.2500           | 20                            | 0.0318                      | 3341   | 125        | 142        |
| 5/16                             | 0.3125           | 18                            | 0.0324                      | 5055   | 258        | 292        |
| 3/8                              | 0.3750           | 16                            | 0.0375                      | 8138   | 38 ft-lbs  | 43 ft-lbs  |
| 7/16                             | 0.4375           | 14                            | 0.0431                      | 11162  | 61         | 69         |
| 1/2                              | 0.5000           | 13                            | 0.0419                      | 14899  | 93         | 106        |
| 5/8                              | 0.6250           | 11                            | 0.026                       | 22883  | 179        | 203        |
| 3/4                              | 0.7500           | 10                            | 0.0345                      | 33864  | 317        | 360        |
| 7/8                              | 0.8750           | 9                             | 0.0417                      | 46751  | 511        | 580        |
| 1                                | 1.0000           | 8                             | 0.0557                      | 61322  | 767        | 869        |
| 1-1/4                            | 1.2500           | 7                             | 0.0991                      | 98123  | 1513       | 1738       |
| 1-1/2                            | 1.5000           | 6                             | 0.14053                     | 142282 | 2668       | 3023       |

## ASTM A193 B7

| Nominal Dia. | Threads per inch | Clamp Load (lbs.) | ASTM A193 B7 Tightening Torque |                  |                  |                  |
|--------------|------------------|-------------------|--------------------------------|------------------|------------------|------------------|
|              |                  |                   | K=0.12 (ft-lbs.)               | K=0.15 (ft-lbs.) | K=0.17 (ft-lbs.) | K=0.20 (ft-lbs.) |
| 1/4          | 20               | 2506              | 75.2 in-lbs                    | 94               | 106.5 in-lbs     | 125.3 in-lbs     |
| 5/16         | 18               | 4129              | 155                            | 194              | 208              | 258              |
| 3/8          | 16               | 6102              | 22.9 in-lbs                    | 28.6 in-lbs      | 32.4 in-lbs      | 38.1 in-lbs      |
| 7/16         | 14               | 8372              | 37                             | 46               | 52               | 61               |
| 1/2          | 13               | 11175             | 56                             | 70               | 79               | 93               |
| 5/8          | 11               | 17798             | 111                            | 139              | 158              |                  |