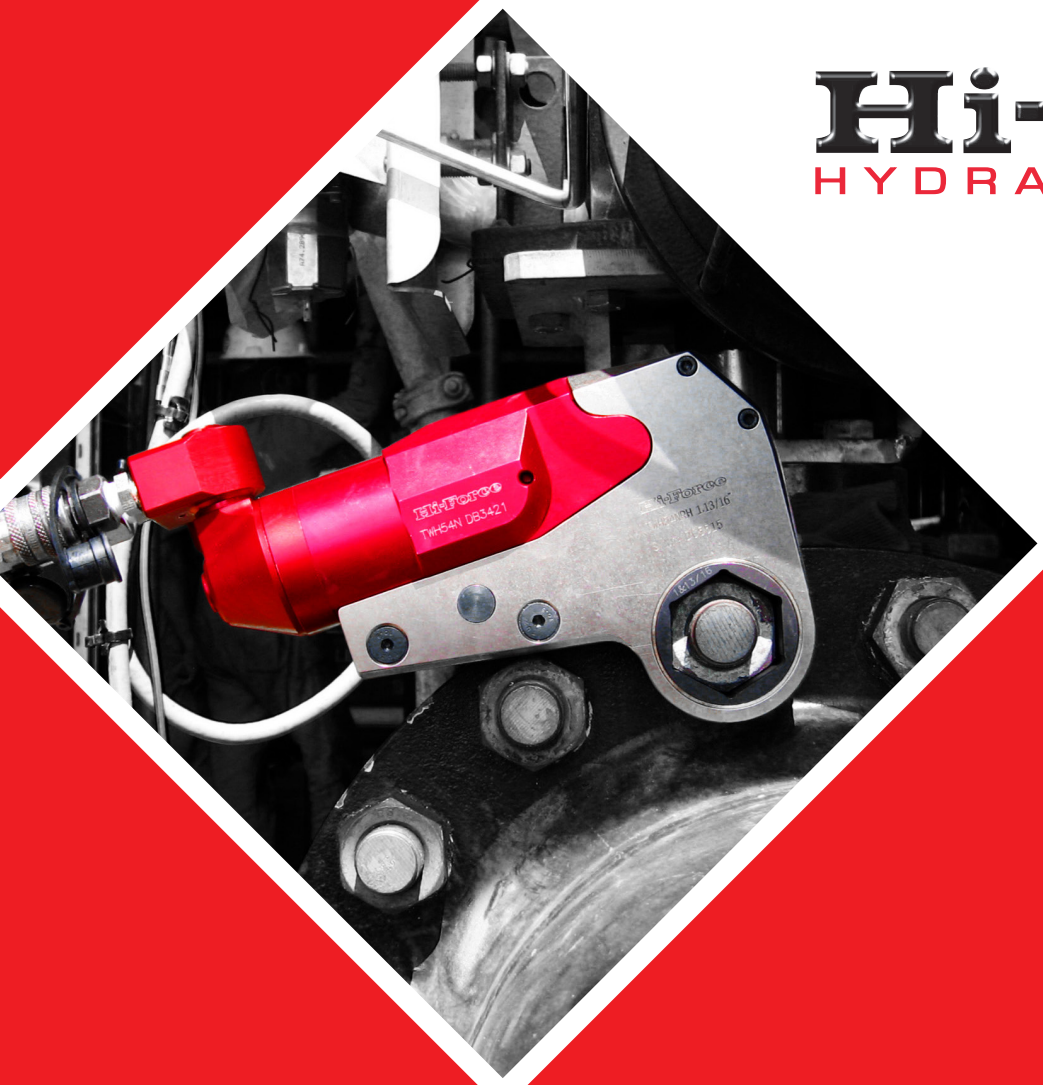
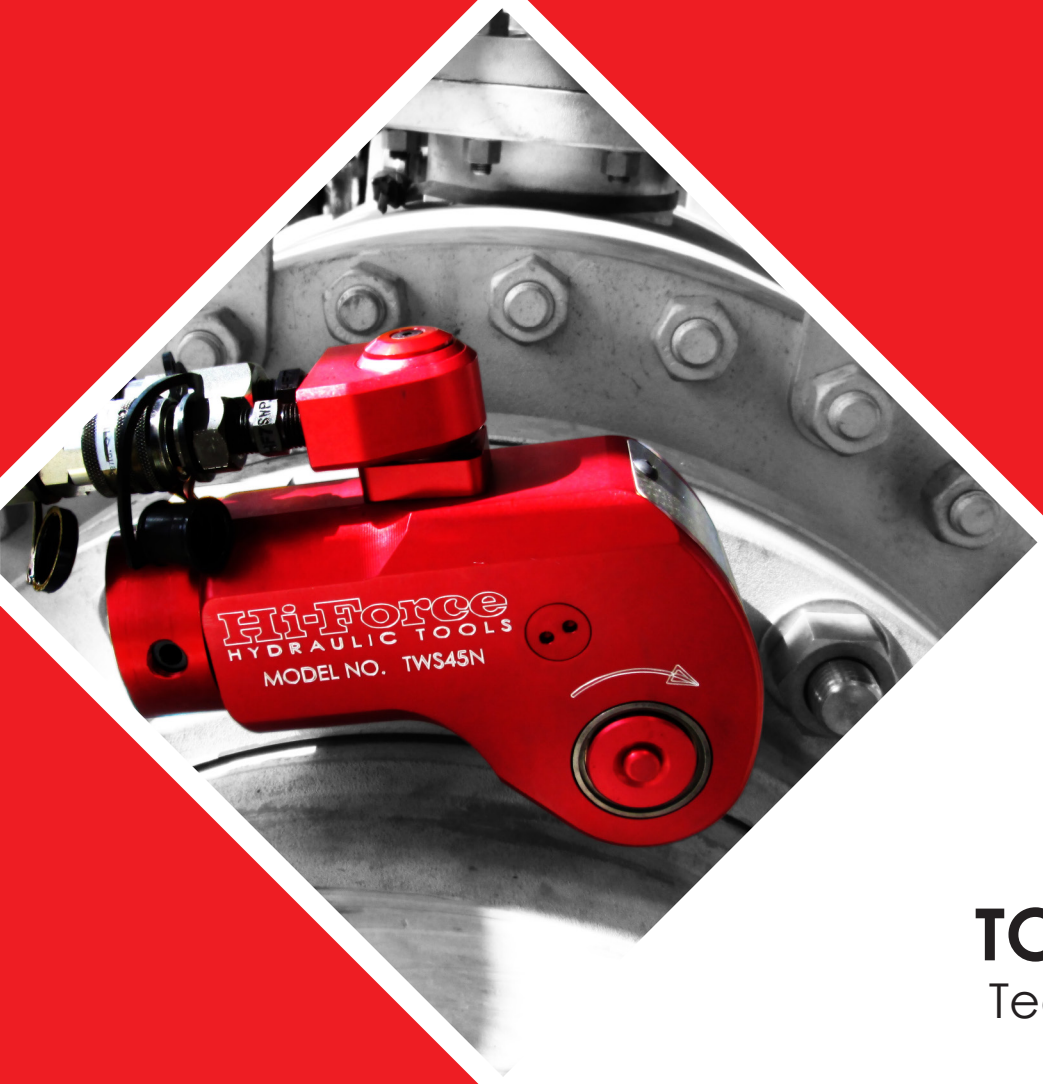
Hi-Force®
HYDRAULIC TOOLS




# TORQUE TOOLS

Technical Information

# TORQUE COMPARISON TABLE

The below table should be used as a guideline for the correct torque to be applied to standard size metric and imperial bolts in grade 8.8 (metric) and ASTM A193 grade B7 (imperial) or similar. The torque figures are calculated in both metric (Nm) and imperial (lbf.ft) values using a choice of three commonly used bolt thread lubricants. The coefficient of friction applicable for the chosen bolt lubricant, using the 'k' value or the 'μ' (mu) value should always be considered. The below torque values are for guidance purposes only. Always check with the equipment / bolt manufacturer for the actual torque required for the specific bolted components.

Hi-Force is able to support our valued clients with bolt load calculations on an hourly chargeable time basis.

**IMPERIAL**

| ALL VALUES ARE BASED ON 50% OF THE BOLT YIELD STRESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Torque value (for grade ASTM A193 B7) for specified lubricant(s) | | | | | |
| Bolt diameter (see note 1) | Nut AF Size (see note 2) | Bolt preload value (for grade ASTM A193 B7) (see note 3) | | Moly: f = 0.06 (see note 4) | | Copper: f = 0.10 (see note 4) | | Machine Oil: f = 0.15 (see note 4) | |
| inches | inches | kN | lbs.force | Nm | lbf.ft | Nm | lbf.ft | Nm | lbf.ft |
| 5/8" | 1 1/16" | 52 | 11866 | 82 | 61 | 124 | 91 | 176 | 130 |
| 3/4" | 1 1/4" | 78 | 17560 | 142 | 105 | 315 | 159 | 307 | 227 |
| 7/8" | 1 7/16" | 107 | 24243 | 225 | 166 | 342 | 252 | 489 | 361 |
| 1" | 1 5/8" | 141 | 31804 | 334 | 246 | 509 | 376 | 728 | 537 |
| 1 1/8" | 1 13/16" | 184 | 41502 | 478 | 353 | 735 | 542 | 1056 | 779 |
| 1 1/4" | 2" | 233 | 52488 | 658 | 486 | 1019 | 751 | 1469 | 1083 |
| 1 3/8" | 2 3/16" | 288 | 64763 | 878 | 648 | 1367 | 1008 | 1977 | 1458 |
| 1 1/2" | 2 3/8" | 348 | 78327 | 1142 | 842 | 1786 | 1317 | 2591 | 1911 |
| 1 5/8" | 2 7/16" | 414 | 93179 | 1453 | 1072 | 2283 | 1684 | 3320 | 2448 |
| 1 3/4" | 2 3/4" | 486 | 109320 | 1817 | 1340 | 2864 | 2112 | 4173 | 3078 |
| 1 7/8" | 2 15/16" | 563 | 126750 | 2235 | 1649 | 3536 | 2608 | 5161 | 3807 |
| 2" | 3 1/8" | 647 | 145468 | 2714 | 2002 | 4305 | 3175 | 6294 | 4642 |
| 2 1/4" | 3 1/2" | 830 | 186771 | 3865 | 2851 | 6162 | 4545 | 9032 | 6662 |
| 2 1/2" | 3 7/8" | 938 | 211001 | 4796 | 3538 | 7678 | 5663 | 11279 | 8319 |
| 2 3/4" | 4 1/4" | 1146 | 257693 | 6383 | 4708 | 10252 | 7561 | 15088 | 11128 |
| 3" | 4 5/8" | 1374 | 309049 | 8284 | 6110 | 13344 | 9842 | 19669 | 14507 |
| 3 1/4" | 5" | 1623 | 365069 | 10530 | 7767 | 17003 | 12541 | 25094 | 18508 |
| 3 1/2" | 5 3/8" | 1893 | 425751 | 13148 | 9697 | 21275 | 15692 | 31434 | 23185 |
| 3 3/4" | 5 3/4" | 2184 | 491097 | 16167 | 11924 | 26208 | 19330 | 38761 | 28588 |
| 4" | 6 1/8" | 2495 | 561107 | 19615 | 14467 | 31850 | 23492 | 47145 | 34772 |

**METRIC**

| ALL VALUES ARE BASED ON 50% OF THE BOLT YIELD STRESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Torque value (for grade 8.8) for specified lubricant(s) | | | | | |
| Bolt diameter (see note 1) | Nut AF Size (see note 2) | Bolt preload value (for grade ASTM A193 B7) (see note 3) | | Moly: f = 0.06 (see note 4) | | Copper: f = 0.10 (see note 4) | | Machine Oil: f = 0.15 (see note 4) | |
| mm | mm | kN | lbs.force | Nm | lbf.ft | Nm | lbf.ft | Nm | lbf.ft |
| M16 | 24 | 51 | 11623 | 75 | 55 | 114 | 84 | 163 | 120 |
| M20 | 30 | 80 | 18161 | 147 | 108 | 223 | 164 | 318 | 235 |
| M24 | 36 | 116 | 26151 | 253 | 186 | 384 | 283 | 548 | 404 |
| M27 | 41 | 151 | 34082 | 365 | 270 | 561 | 414 | 805 | 594 |
| M30 | 46 | 185 | 41588 | 500 | 369 | 765 | 564 | 1095 | 808 |
| M33 | 50 | 228 | 51453 | 666 | 491 | 1026 | 756 | 1475 | 1088 |
| M36 | 55 | 269 | 60590 | 863 | 637 | 1325 | 977 | 1901 | 1402 |
| M39 | 60 | 322 | 72388 | 1104 | 814 | 1703 | 1256 | 2452 | 1808 |
| M42 | 65 | 369 | 83157 | 1376 | 1015 | 2117 | 1561 | 3043 | 2244 |
| M45 | 70 | 431 | 96888 | 1700 | 1254 | 2627 | 1938 | 3786 | 2793 |
| M48 | 75 | 486 | 109288 | 2067 | 1524 | 3186 | 2350 | 4586 | 3383 |
| M52 | 80 | 580 | 130408 | 2625 | 1936 | 4067 | 2999 | 9051 | 4329 |
| M56 | 85 | 669 | 150601 | 3280 | 2419 | 5076 | 3744 | 5869 | 5400 |
| M60 | 90 | 779 | 175231 | 4030 | 2972 | 6262 | 4618 | 7321 | 6676 |
| M64 | 95 | 883 | 198522 | 4867 | 3590 | 7550 | 5569 | 10904 | 8042 |
| M68 | 100 | 1008 | 226663 | 5833 | 4302 | 9080 | 6697 | 13139 | 9691 |
| M72 | 105 | 1141 | 256668 | 6918 | 5102 | 10803 | 7968 | 15689 | 11549 |
| M76 | 110 | 1283 | 288538 | 8128 | 5995 | 12729 | 9389 | 18481 | 13631 |
| M80 | 115 | 1433 | 322272 | 9470 | 6985 | 14871 | 10968 | 21622 | 15948 |
| M90 | 130 | 1845 | 414765 | 13519 | 9971 | 21357 | 15752 | 31155 | 22979 |
| M100 | 145 | 2308 | 518911 | 18614 | 13729 | 29553 | 21797 | 43228 | 31883 |

*Note:*
1 = Bolt material grade ASTM A193 B7 (Imperial) or grade 8.8 (Metric)
2 = Nut AF size is based on heavy series nuts
3 = Bolt Preload equates to a bolt yield stress of 50% of the minimum yield strength
4 = Torque figure values are based on 50% of the minimum bolt yield stress

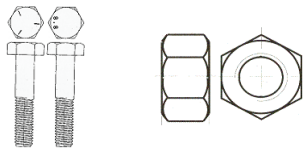
The above figures do not take into account either gasket stress or flange stress load loss that occur. To consider these load loss probability will require a full 'Bolt load / Stress calculation'.Please contact Hi-Force for more information.

# TORQUE VALUE CHART FOR HI-FORCE HYDRAULIC TORQUE WRENCHES

| TORQUE VALUE CHART FOR HI-FORCE HYDRAULIC TORQUE WRENCHES | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model Number** | **TWH27N** | | **TWH54N** | | **TWH120N** | | **TWH210N** | | **TWH430N** | | **TWS17N** | **TWS45N** | **TWS100N** | **TWS150N** | **TWS370N** |
| **IMPERIAL** | | | | | | | | | | | | | | | |
| min | 1 1/16" | 2" | 1 7/16" | 2 3/4" | 2 3/16" | 3 1/2" | 2 3/4" | 4 1/4" | 3 1/8" | 5" | Square Drive | | | | |
| max | 1 13/16" | 2 3/8" | 2 9/16" | 3 1/8" | 3 1/8" | 3 7/8" | 3 7/8" | 4 5/8" | 4 5/8" | 6 7/8" | | | | | |
| **METRIC** | | | | | | | | | | | | | | | |
| min | 24 | 50 | 36 | 70 | 50 | 85 | 70 | 105 | 80 | 130 | ¾" | 1" | 1 ½" | 1 ½" | 2 ½" |
| max | 46 | 60 | 65 | 80 | 80 | 100 | 100 | 115 | 115 | 175 | | | | | |
| **psi** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** | **lbf.ft** |
| 1000 | 191 | 223 | 390 | 438 | 852 | 1042 | 1541 | 1679 | 3180 | 3499 | 125 | 329 | 731 | 1087 | 2686 |
| 1500 | 286 | 334 | 585 | 658 | 1278 | 1563 | 2311 | 2519 | 4770 | 5248 | 188 | 493 | 1096 | 1631 | 4029 |
| 2000 | 381 | 446 | 780 | 877 | 1704 | 2084 | 3081 | 3358 | 6360 | 6997 | 251 | 658 | 1462 | 2175 | 5372 |
| 2500 | 477 | 557 | 975 | 1096 | 2131 | 2605 | 3851 | 4198 | 7950 | 8746 | 314 | 822 | 1827 | 2718 | 6715 |
| 3000 | 572 | 668 | 1170 | 1315 | 2557 | 3126 | 4622 | 5037 | 9539 | 10496 | 376 | 987 | 2192 | 3262 | 8058 |
| 3500 | 667 | 780 | 1365 | 1534 | 2983 | 3647 | 5392 | 5877 | 11129 | 12245 | 439 | 1151 | 2558 | 3806 | 9401 |
| 4000 | 762 | 891 | 1560 | 1754 | 3409 | 4168 | 6162 | 6716 | 12719 | 13996 | 502 | 1316 | 2923 | 4349 | 10744 |
| 4500 | 858 | 1003 | 1755 | 1973 | 3835 | 4689 | 6932 | 7566 | 14309 | 15743 | 564 | 1480 | 3289 | 4893 | 12087 |
| 5000 | 953 | 1114 | 1951 | 2192 | 4261 | 5210 | 7703 | 8396 | 15899 | 17493 | 627 | 1645 | 3654 | 5437 | 13430 |
| 5500 | 1048 | 1225 | 2146 | 2411 | 4687 | 5730 | 8473 | 9235 | 17489 | 19242 | 690 | 1809 | 4019 | 5980 | 14773 |
| 6000 | 1144 | 1337 | 2341 | 2630 | 5113 | 6251 | 9243 | 10075 | 19079 | 20991 | 752 | 1973 | 4385 | 6524 | 16116 |
| 6500 | 1239 | 1448 | 2536 | 2850 | 5539 | 6772 | 10013 | 10914 | 20669 | 22740 | 815 | 2138 | 4750 | 7067 | 17459 |
| 7000 | 1334 | 1560 | 2731 | 3069 | 5965 | 7293 | 10784 | 11754 | 22259 | 24490 | 878 | 2302 | 5116 | 7611 | 18802 |
| 7500 | 1430 | 1671 | 2926 | 3288 | 6392 | 7814 | 11554 | 12593 | 23849 | 26239 | 941 | 2467 | 5481 | 8155 | 20145 |
| 8000 | 1525 | 1782 | 3121 | 3507 | 6818 | 8335 | 12324 | 13433 | 25438 | 27988 | 1003 | 2631 | 5846 | 8698 | 21488 |
| 8500 | 1620 | 1894 | 3316 | 3726 | 7244 | 8856 | 13094 | 14272 | 27028 | 29737 | 1066 | 2796 | 6212 | 9242 | 22831 |
| 9000 | 1715 | 2005 | 3511 | 3946 | 7670 | 9377 | 13865 | 15112 | 28618 | 31487 | 1129 | 2960 | 6577 | 9786 | 24174 |
| 9500 | 1811 | 2117 | 3706 | 4165 | 8096 | 9898 | 14635 | 15951 | 30208 | 33236 | 1191 | 3125 | 6943 | 10329 | 25517 |
| 10000 | 1906 | 2228 | 3901 | 4384 | 8522 | 10419 | 15405 | 16791 | 31798 | 34985 | 1254 | 3289 | 7427 | 10873 | 26860 |
| **bar** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** | **Nm** |
| 100 | 375 | 438 | 767 | 862 | 1677 | 2050 | 3031 | 3303 | 6256 | 6883 | 247 | 647 | 1438 | 2139 | 5285 |
| 150 | 563 | 657 | 1151 | 1294 | 2515 | 3075 | 4546 | 4955 | 9384 | 10325 | 370 | 971 | 2157 | 3209 | 7927 |
| 200 | 750 | 877 | 1535 | 1725 | 3353 | 4100 | 6062 | 6607 | 12512 | 13766 | 493 | 1294 | 2875 | 4278 | 10569 |
| 250 | 938 | 1096 | 1919 | 2156 | 4192 | 5125 | 7577 | 8259 | 15640 | 17208 | 617 | 1618 | 3594 | 5348 | 13211 |
| 300 | 1125 | 1315 | 2302 | 2587 | 5030 | 6150 | 9093 | 9910 | 18768 | 20649 | 740 | 1941 | 4313 | 6417 | 15854 |
| 350 | 1313 | 1534 | 2686 | 3019 | 5869 | 7175 | 10608 | 11562 | 21896 | 24091 | 864 | 2265 | 5032 | 7487 | 18496 |
| 400 | 1500 | 1753 | 3070 | 3450 | 6707 | 8199 | 12123 | 13214 | 25024 | 27532 | 987 | 2588 | 5751 | 8557 | 21138 |
| 450 | 1688 | 1972 | 3453 | 3881 | 7545 | 9224 | 13639 | 14865 | 28152 | 30974 | 1110 | 2912 | 6470 | 9626 | 23781 |
| 500 | 1875 | 2191 | 3837 | 4312 | 8384 | 10249 | 15154 | 16517 | 31280 | 34415 | 1234 | 3235 | 7189 | 10696 | 26423 |
| 550 | 2063 | 2411 | 4221 | 4743 | 9222 | 11274 | 16670 | 18169 | 34408 | 37857 | 1357 | 3559 | 7907 | 11765 | 29065 |
| 600 | 2250 | 2630 | 4605 | 5175 | 10060 | 12299 | 18185 | 19821 | 37536 | 41298 | 1480 | 3882 | 8626 | 12835 | 31707 |
| 650 | 2438 | 2849 | 4988 | 5606 | 10889 | 13324 | 19701 | 21472 | 40664 | 44740 | 1604 | 4206 | 9345 | 13904 | 34350 |
| 700 | 2625 | 3068 | 5372 | 6037 | 11737 | 14349 | 21216 | 23124 | 43792 | 48181 | 1727 | 4529 | 10064 | 14974 | 36992 |

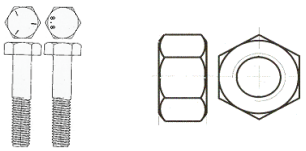
# REFERENCE TABLE BOLT SIZE TO NUT AF SIZE

## Imperial Bolts



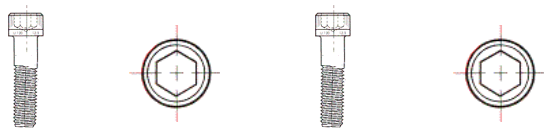
| Bolt size (inch) | Nut size (AF inch) |
|---|---|
| 5/8" | 1 1/16" |
| 3/4" | 1 1/4" |
| 7/8" | 1 7/16" |
| 1" | 1 5/8" |
| 1 1/8" | 1 13/16" |
| 1 1/4" | 2" |
| 1 3/8" | 2 3/16" |
| 1 1/2" | 2 3/8" |
| 1 5/8" | 2 9/16" |
| 1 3/4" | 2 3/4" |
| 1 7/8" | 2 15/16" |
| 2" | 3 1/8" |
| 2 1/4" | 3 1/2" |
| 2 1/2" | 3 7/8" |
| 2 3/4" | 4 1/4" |
| 3" | 4 5/8" |
| 3 1/4" | 5" |
| 3 1/2" | 5 3/8" |
| 3 3/4" | 5 3/4" |
| 4" | 6 1/8" |
| 4 1/4" | 6 1/2" |
| 4 1/2" | 6 7/8" |

## Metric Bolts



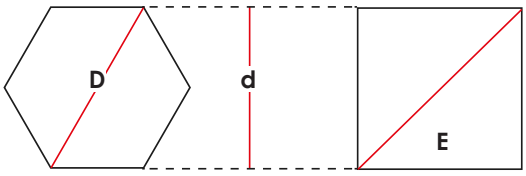
| Bolt size (mm) | Nut size (AF mm) |
|---|---|
| M16 | 24 |
| M18 | 27 |
| M20 | 30 |
| M22 | 32 |
| M24 | 36 |
| M27 | 41 |
| M30 | 46 |
| M33 | 50 |
| M36 | 55 |
| M39 | 60 |
| M42 | 65 |
| M45 | 70 |
| M48 | 75 |
| M52 | 80 |
| M56 | 85 |
| M60 | 90 |
| M64 | 95 |
| M68 | 100 |
| M72 | 105 |
| M76 | 110 |
| M80 | 115 |
| M90 | 130 |
| M100 | 145 |
| M110 | 155 |
| M115 | 165 |

## Socket Cap Bolts



| METRIC | | IMPERIAL | |
|---|---|---|---|
| Thread Size (mm) | Female Hexagon (AF mm) | Thread Size (inch) | Female Hexagon (AF inch) |
| M16 | 14 | 5/8" | 1/2" |
| M18 | 14 | 3/4" | 5/8" |
| M20 | 17 | 7/8" | 3/4" |
| M22 | 17 | 1" | 3/4" |
| M24 | 19 | 1 1/8" | 7/8" |
| M27 | 19 | 1 1/4" | 7/8" |
| M30 | 22 | 1 3/8" | 1" |
| M33 | 24 | 1 1/2" | 1" |
| M36 | 27 | 1 5/8" | 1 1/8" |
| M39 | 30 | 1 3/4" | 1 1/4" |
| M42 | 32 | 1 7/8" | 1 3/8" |
| M48 | 36 | 2" | 1 5/8" |
| M52 | 36 | 2 1/4" | 1 3/4" |
| M56 | 41 | 2 1/2" | 1 7/8" |
| M60 | 46 | 2 3/4" | 2" |
| M64 | 46 | 3" | 2 1/4" |
| M68 | 50 | 3 1/4" | 2 1/4" |
| M72 | 55 | | |
| M76 | 60 | | |

Formula for distance across corners of squares and hexagons




D = 1.1547 x d
E = 1.4241 x d

# METRIC TO IMPERIAL CONVERSION CHART

| | SI Unit System International | Conversion Factor | Imperial Equivalent | Conversion Factor | SI Unit System International |
|---|---|---|---|---|---|
| **Pressure** | bar | x 14.5 | psi | x 0.069 | bar |
| | bar | x 14.5 | lbf.in² | x 0.069 | bar |
| | kPa | x 0.145 | psi | x 6.89 | kPa |
| | mPa | x 145 | psi | x .00689 | mPa |
| **Volume** | cm³ | x 0.061 | inch³ | x 16.4 | cm³ |
| | litre | x 61 | inch³ | x 0.016 | litre |
| | litre | x 0.264 | gallon | x 3.785 | litre |
| | m³ | x 1.3 | yard³ | x 0.76 | m³ |
| **Area** | mm² | x 0.00155 | inch² | x 645 | mm² |
| | cm² | x 0.155 | inch² | x 6.45 | cm² |
| | m² | x 10.76 | foot² | x 0.0929 | m² |
| **Length** | mm | x 0.03937 | inch | x 25.4 | mm |
| | cm | x 0.3937 | inch | x 2.54 | cm |
| | m | x 3.28 | foot | x 0.305 | m |
| **Force** | N | x 0.225 | force | x 4.45 | N |
| | kN | x 225 | force | x 0.00445 | kN |
| **Torque** | Nm | x 0.738 | lbf.ft | x 1.356 | Nm |
| | Nm | x 8.9 | lbf.in | x 0.113 | Nm |
| | kgf.m | x 7.2345 | lbf.ft | x 0.1382 | kgf.m |
| **Mass** | g | x 0.035 | ounce | x 28.3 | g |
| | kg | x 2.2046 | pound | x 0.4536 | kg |
| | t | x 1.1 | ton (short) | x 0.907 | t |
| **Flow** | cm³/min | x 0.61 | inch³/min | x 16.4 | cm³/min |
| | litres/min | x 0.264 | gallon/min | x 3.785 | litres/min |
| **Power** | kW | x 1.341 | hp | x 0.746 | kW |
| | kW | x 0.948 | Btu/s | x 1.055 | kW |
| | W | x 0.74 | ft lbf/s | x 1.36 | W |

| | | |
|---|---|---|
| **Temperature** | To calculate Celsius to Fahrenheit | (°C x 1.8) + 32 = °F |
| | To calculate Fahrenheit to Celsius | (°F - 32) / 1.8 = °C |

# HI-FORCE TORQUE TOOL RANGE

## SQUARE DRIVE

### TWS-N | HYDRAULIC TORQUE WRENCHES - SQUARE DRIVE

- Output torque capacities from 1727 to 36992 Nm (1254 to 26860 lbf.ft) with working pressure of 700 bar
- Compact, lightweight aluminium body construction
- Choice of square drive sizes from ¾" to 2 ½"
- Multi-position reaction arm with safety lock feature
- Allen hexagon drives in both metric and imperial available as optional extra

### IS & MS | IMPERIAL AND METRIC HEXAGON AF SIZE HEAVY DUTY SOCKETS

- Square drives from ¾" to 2 ½"
- Across flat sizes up to 6 7/8" (imperial) and 145 mm (metric)
- Supplied complete with retaining ring and pin
- High quality, metric size heavy duty impact sockets
- Suitable for use with TWS-N hydraulic torque wrenches and IW range impact wrenches

## FEMALE HEXAGON

### TWH-N | HYDRAULIC TORQUE WRENCHES - LOW PROFILE HEXAGON

- Output torque capacities from 2625 to 48181 Nm (1906 to 34985 lbf.ft) with working pressure of 700 bar
- Narrow cassette head design makes it ideal for limited access applications
- Ratchet head can be easily changed by simply withdrawing/inserting a single pin
- Imperial ratchet heads available with across flat (AF sizes) sizes from 1 1/16" to 6 7/8"
- Metric ratchet heads available with across flat (AF sizes) sizes from 24 to 175 mm

### IB & MB | IMPERIAL AND METRIC HEXAGON AF SIZE REDUCER BUSHES

- Economical solution of reducing female hexagon AF size of TWH-NRH imperial and metric ratchet head
- Available in imperial sizes from 1 1/16" up to 6 ½" female hexagon
- Available in metric sizes from 24 up to 130 mm female hexagon
- Wall thickness from only 2 mm up to 17.5 mm

### BW | BACKUP WRENCHES

- Suitable for use with TWS-N & TWH-N wrenches
- Interchangeable hexagon links
- Positive release mechanism
- Imperial female hexagon link sizes available from 1 7/16" to 3 7/8"
- Metric female hexagon link sizes available from 36 to 100 mm

### HTWP | TORQUE WRENCH PUMPS - STANDARD LINE

- Two stage operation with working pressure of 700 bar
- Air or electric driven options
- 110, 120, 220 and 230 volt single phase electric motor with auto retract function
- Remote hand pendant controller with a 3-metre cable for easy operation
- Factory fitted roll bar protection frame included

### TPA & TPE | TORQUE WRENCH PUMPS - PREMIUM LINE

- High speed, 8 piston pump unit with 3-stage design for faster flow
- Air or electric driven with analogue and digital gauge options
- Multi outlet 4-way split block allows for 4 hydraulic torque wrenches to be used simultaneously
- Compact and fitted with a rigid protection and carrying frame
- Suitable for use in harsh environments and high usage operations

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