



Steel Structural Fastener

Heavy Hex Type

ASTM F3125, Grade A325 / A490
EN 14399-4 System HV
JIS B1186, Grade F8T/F10T

Tension Control Type

ASTM F3125, Grade F1852 / F2280
EN 14399-10 System HRC
JSS-II-09, Grade S10T

KPF Locations

KPF HQ

Songhyuntower 6F, 136, Unjung-ro, Bundang-gu
Seongnam-si, Gyeonggi-do, 463-440, Korea

KPF Korea factory

50, Chungjusandan5-ro, Chungju-Si,
Chungcheongbuk-Do, 380-250, Korea

KPF Vina

Plox XN 2, Dai AN Expansion IZ, Hai Duong
Province, 170000, Vietnam

KPF Jinan

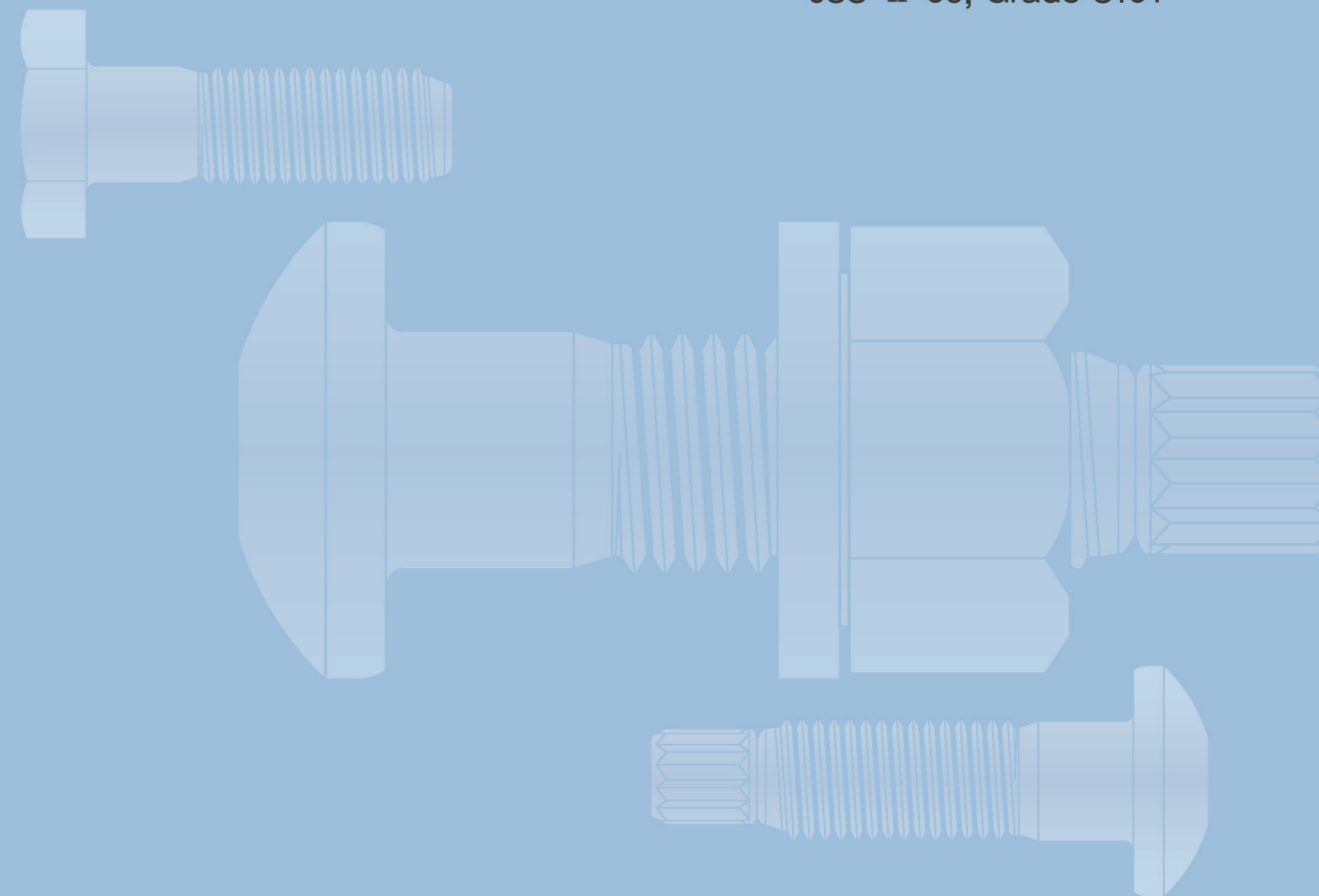
North of Century Road, East of Sino Truck
Canting and Forging Plant, Zhangqiu City,
Shandong Province, China

KPF USA

1701 E. Lake Ave. #442
Glenview, IL 60025

KPF Europe

MesseTurm.33.OG Friedrich-Ebert-Anlage 49,
D-60308, Frankfurt am Main, Germany



Why you can trust KPF

Why you can trust KPF.

We proudly produce steel structural fasteners in Korea with its high technology.

More than 57 years experience in fastener manufacturing.

Full accreditation : ISO 9001, ISO 14001, ISO/TS 16949, A2LA, JIS and so on.

Wide range of availability in size from cold and hot forging machines.

Both bolt and nut are produced in house.

All mechanical properties are tested and certified by A2LA in house lab.

100% traceability by lot control system.

Technical support from engineering stage to after service on the job site.

One of the biggest steel structural fasteners providers in the world.

Supplying 50 million pcs per year.

Proven its quality over the years of application in many important projects.

Please check the projects where the KPF products are used in the last page.





Construction



Production Range



SIZE RANGE

DIA : M12 – M64 (1/2" – 2 1/2")
LENGTH : 30 – 500mm (1 1/4" – 20")

APPLICABLE SPECIFICATION

ASTM F3125, Grade A325 A490
EN 14399 – 3&4
JIS B1186



SIZE RANGE

DIA : M16 – M36 (5/8" – 1 1/2")
LENGTH : 30 – 500mm (1 1/4" – 20")

APPLICABLE SPECIFICATION

ASTM F3125, Grade F1852 & F2280
EN 14399 – 10
JSS – II – 09



**Heavy Hex
Type**

ASTM F3125 Grade A325 / A490
EN 14399-4 System HV
JIS B1186 F8T/F10T
DASt-021

Type 1 & Type 3
Carbon & Alloy steel Weathering steel
are available

Plain finish, HDG
Zinc Flake coatings are available.



Korea Parts
& Fasteners

songhyun

“KPF”

ASTM F3125 Grade A325 & A490

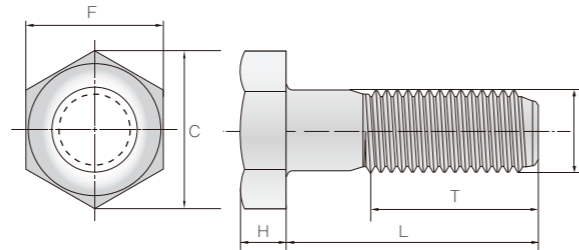
ASTM F3125 Grade A325 & A490



► Dimensions

ASTM A325 and A490 covers high strength structural bolts used in structural steel construction.

In 2016, specifications A325 and A490 were officially withdrawn and consolidated under the new F3125 specification.



Bolt Specification : ASME B18.2.6

| Bolt Diameter | D | | F | | C | | H | | | T |
|---------------|---------------|---------|--------------------|-------|----------------------|-------|--------|-------|-------|---------------|
| | Body Diameter | | Width Across Flats | | Width Across Corners | | Height | | | Thread Length |
| | Max | Basic | Max | Min | Max | Min | Basic | Max | Min | Basic |
| ½ | 0.515 | 7/8 | 0.875 | 0.850 | 1.010 | 0.969 | 5/16 | 0.323 | 0.302 | 1.00 |
| 5/8 | 0.642 | 1 1/16 | 1.062 | 1.031 | 1.227 | 1.175 | 25/64 | 0.403 | 0.378 | 1.25 |
| ¾ | 0.768 | 1 ¼ | 1.250 | 1.212 | 1.443 | 1.383 | 15/32 | 0.483 | 0.455 | 1.38 |
| 7/8 | 0.895 | 1 7/16 | 1.438 | 1.394 | 1.6 | 1.589 | 35/64 | 0.563 | 0.531 | 1.50 |
| 1 | 1.022 | 1 5/8 | 1.625 | 1.575 | 1.876 | 1.796 | 39/64 | 0.627 | 0.591 | 1.75 |
| 1 1/8 | 1.149 | 1 13/16 | 1.812 | 1.756 | 2.093 | 2.002 | 11/16 | 0.718 | 0.658 | 2.00 |
| 1 ¼ | 1.277 | 2 | 2.00 | 1.938 | 2.309 | 2.209 | 25/32 | 0.813 | 0.749 | 2.00 |
| 1 5/8 | 1.404 | 2 3/16 | 2.188 | 2.119 | 2.526 | 2.416 | 27/32 | 0.878 | 0.810 | 2.25 |
| 1 ¾ | 1.531 | 2 3/8 | 2.375 | 2.300 | 2.742 | 2.622 | 15/16 | 0.974 | 0.902 | 2.25 |

► Mechanical Properties

| Grade | Size | Tensile, min. | Yield, min. | Elongation, % min | Reduction of Area, % min |
|----------------|----------|---------------|-------------|-------------------|--------------------------|
| A325 (120 ksi) | ½ ~ 1 ½" | 120 ksi | 92 ksi | 14 | 35 |
| A490 (150 ksi) | ½ ~ 1 ½" | 150 ~ 173 ksi | 130 ksi | 14 | 40 |

Bolt Tensile Strength

| Nom Diameter (in) | Stress Area ^A (in ²) | 120 ksi – A325 | | | 150 ksi – A490 | | | |
|-----------------------|---|---------------------|-----------------------------------|-----------------------------------|-------------------|-------------------|-----------------------------------|-----------------------------|
| | | Tensile min (Lbf) | Proof Load ^C min (Lbf) | Proof Load ^D min (Lbf) | Tensile min (Lbf) | Tensile max (Lbf) | Proof Load ^C min (Lbf) | Proof Load ^D min |
| ½ – 13 UNC | 0.142 | 17050 | 12050 | 13050 | 21300 | 24600 | 17050 | 18500 |
| 5/8 – 11 UNC | 0.226 | 27100 | 19200 | 20800 | 33900 | 39100 | 27100 | 29400 |
| ¾ – 10 UNC | 0.334 | 40100 | 28400 | 30700 | 50100 | 57800 | 40100 | 43400 |
| 7/8 – 9 UNC | 0.462 | 55450 | 39250 | 42500 | 69300 | 79950 | 55450 | 60100 |
| 1 – 8 UNC | 0.606 | 72700 | 51500 | 55750 | 90900 | 104850 | 72700 | 78800 |
| 1 1/8 – 7 UNC | 0.763 | 91600 ^B | 64900 ^B | 70250 ^B | 114450 | 132000 | 91550 | 99200 |
| 1 ¼ – 7 UNC | 0.969 | 116300 ^B | 82400 ^B | 89200 ^B | 145350 | 167650 | 116300 | 126000 |
| 1 5/8 – 6 UNC | 1.155 | 138600 ^B | 98200 ^B | 106300 ^B | 173250 | 199850 | 138600 | 150200 |
| 1 ¾ – 6 UNC | 1.405 | 168600 ^B | 119500 ^B | 129300 ^B | 210750 | 243100 | 168600 | 182600 |
| Above values based on | | 120000 psi | 85000 psi | 92000 psi | 150000 psi | 173000 psi | 120000 psi | 130000 psi |

Bolt Hardness

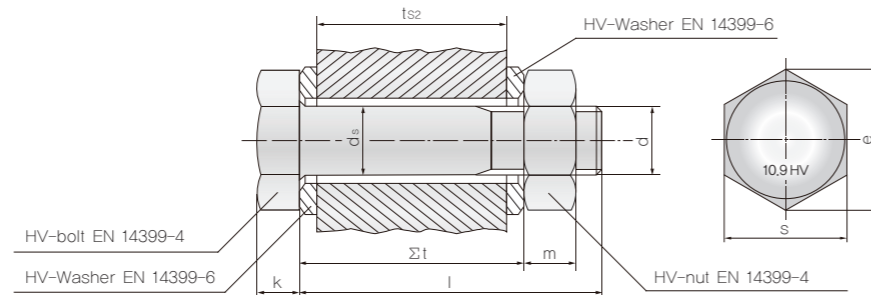
| | | 120 ksi/830 MPa Tensile, Grade A325 | | | | 150 ksi/1040 MPa Tensile, Grade A490 | | | |
|----------------------------|---------------|-------------------------------------|-----|--------------|-----|--------------------------------------|-----|--------------|-----|
| | | Brinell HB | | Rockwell HRC | | Brinell HB | | Rockwell HRC | |
| | | Min | Max | Min | Max | Min | Max | Min | Max |
| Up to 1 in., M24 inclusive | Less than 2D | 253 | 319 | 25 | 34 | 311 | 352 | 33 | 38 |
| Up to 1 in., M24 inclusive | 2D and longer | – | 319 | – | 34 | – | 352 | – | 38 |
| Over 1 in., M24 | Less than 3D | 253 | 319 | 25 | 34 | 311 | 352 | 33 | 38 |
| Over 1 in., M24 | 3D and longer | – | 319 | – | 34 | – | 352 | – | 38 |

► Matching Components

| | Inch | | Inch | |
|-------------------------------------|---------------------|-------------|---------------------|-------------|
| | 120 ksi Min Tensile | | 150 ksi Min Tensile | |
| | Type 1 | Type 3 | Type 1 | Type 3 |
| Style – Heavy Hex Bolts | | | | |
| Dimensions, ASME ^B | B18.2.6 | B18.2.6 | B18.2.6 | B18.2.6 |
| Thread Fit, ASME ^B | B1,1 UNC 2A | B1,1 UNC 2A | B1,1 UNC 2A | B1,1 UNC 2A |
| Grade Marking ^{A,D} | A325 | A325 | A490 | A490 |
| Recommended Nut and Washer | | | | |
| Plain Nut | A563 DH | A563 DH3 | A563 DH | A563 DH3 |
| Suitable Alternative ^E | DH3, D, C, D3 | C3 | – | – |
| Coated Nut | A563 DH | A563 DH3 | A563 DH | A563 DH3 |
| Flat, Bevel or Thick Washer if used | F436 – 1 | F436 – 3 | F436 – 1 | F436 – 3 |

EN14399-4 System HV

EN14399-4 System HV



► Dimensions

► k factor and Tightening Methods

| Thread diameter Ø d | M12 | M16 | M20 | M22 | M24 | M27 | M30 | M36 |
|-------------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
| Shaft diameter Ø d | - thread diameter Ø d | | | | | | | |
| Head height k | 8 | 10 | 13 | 14 | 15 | 17 | 19 | 23 |
| Nut height m | 10 | 13 | 16 | 18 | 20 | 22 | 24 | 29 |
| Width across flats | 22 | 27 | 32 | 36 | 41 | 46 | 50 | 60 |
| Corss-measure e | 23,91 | 29,56 | 35,03 | 39,55 | 45,20 | 50,85 | 55,37 | 66,44 |
| Washer outer diameter Ø | 24 | 30 | 37 | 39 | 44 | 50 | 56 | 66 |
| Washer inner diameter Ø | 13 | 17 | 21 | 23 | 25 | 28 | 31 | 37 |
| Washer thickness | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 6 |

| k-class | Information to be supplied | Tightening method |
|---------|---|-------------------|
| K0 | No requirements for k-factor | No required |
| K1 | Range of individual test value k_i | Combined method |
| K2 | Mean test value k_m Coefficient of variation of k-factor V_k | Torque method |
| | | Combined method |

| Nominal length | Clamp length $\Sigma t_{min} - \Sigma t_{max}$ / Steel structure thickness mm Package thickness +, in mm | | | | | | | | | |
|----------------|--|---------|---------|---------|---------|---------|-------|-------|---------|---------|
| 30 | 11-16 | 5-10 | | | | | | | | |
| 35 | 16-21 | 10-15 | 12-17 | 4-9 | | | | | | |
| 40 | 21-26 | 15-20 | 17-22 | 9-14 | 13-18 | 5-10 | | | | |
| 45 | 26-31 | 20-25 | 22-27 | 14-19 | 18-23 | 10-15 | | | | |
| 50 | 31-36 | 25-30 | 27-32 | 19-24 | 23-28 | 15-20 | 22-27 | 14-19 | 19-24 | 11-16 |
| 55 | 36-41 | 30-35 | 32-37 | 24-29 | 28-33 | 20-25 | 27-32 | 19-24 | 24-29 | 16-21 |
| 60 | 41-46 | 35-40 | 37-42 | 29-34 | 33-38 | 25-30 | 32-37 | 24-29 | 29-34 | 21-26 |
| 65 | 46-51 | 40-45 | 42-47 | 34-39 | 38-43 | 30-35 | 37-42 | 29-34 | 34-39 | 26-31 |
| 70 | 51-56 | 45-50 | 47-52 | 39-44 | 43-48 | 35-40 | 42-47 | 34-39 | 39-44 | 31-36 |
| 75 | 56-61 | 50-55 | 52-57 | 44-49 | 48-53 | 40-45 | 47-52 | 39-44 | 44-49 | 36-41 |
| 80 | 61-66 | 55-60 | 57-62 | 49-54 | 53-58 | 45-50 | 52-57 | 44-49 | 49-54 | 41-46 |
| 85 | 66-71 | 60-65 | 62-67 | 54-59 | 58-63 | 50-55 | 57-62 | 49-54 | 54-59 | 46-51 |
| 90 | 71-76 | 65-70 | 67-72 | 59-64 | 63-68 | 55-60 | 62-67 | 54-59 | 59-64 | 51-56 |
| 95 | 76-81 | 70-75 | 72-77 | 64-69 | 68-73 | 60-65 | 67-72 | 59-64 | 64-69 | 56-61 |
| 100 | 81-86 | 75-80 | 77-82 | 69-74 | 73-78 | 65-70 | 72-77 | 64-69 | 69-74 | 61-66 |
| 105 | 86-91 | 80-85 | 82-87 | 74-79 | 78-83 | 70-75 | 77-82 | 69-74 | 74-79 | 66-71 |
| 110 | 91-96 | 85-90 | 87-92 | 79-84 | 83-88 | 75-80 | 82-87 | 74-79 | 79-84 | 71-76 |
| 115 | 96-101 | 90-95 | 92-97 | 84-89 | 88-93 | 80-85 | 87-92 | 79-84 | 84-89 | 76-81 |
| 120 | 101-106 | 95-100 | 97-102 | 89-94 | 93-98 | 85-90 | 92-97 | 84-89 | 89-94 | 81-86 |
| 125 | 106-111 | 100-105 | 102-107 | 94-99 | 98-103 | 90-95 | | | 94-99 | 86-91 |
| 130 | 111-116 | 105-110 | 107-112 | 99-104 | 103-108 | 95-100 | | | 99-104 | 91-96 |
| 135 | 116-121 | 110-115 | 112-117 | 104-109 | 108-113 | 100-105 | | | 104-109 | 96-101 |
| 140 | | | 117-122 | 109-114 | 113-118 | 105-110 | | | 109-114 | 101-106 |
| 145 | | | 122-127 | 114-119 | 118-123 | 110-115 | | | 114-119 | 106-111 |
| 150 | | | 127-132 | 119-124 | 123-128 | 115-120 | | | 119-124 | 111-116 |
| 155 | | | 132-137 | 124-129 | 128-133 | 120-125 | | | 124-129 | 116-121 |
| 160 | | | 137-142 | 129-134 | 133-138 | 125-130 | | | 129-134 | 121-126 |
| 165 | | | 142-147 | 134-139 | 138-143 | 130-135 | | | 134-139 | 126-131 |
| 170 | | | 147-152 | 139-144 | 143-148 | 135-140 | | | 139-144 | 131-136 |
| 175 | | | 152-157 | 144-149 | 148-153 | 140-145 | | | 144-149 | 136-141 |
| 180 | | | 157-162 | 149-154 | 153-158 | 145-150 | | | 149-154 | 141-146 |
| 190 | | | 162-172 | 159-164 | 163-168 | 155-160 | | | 159-164 | 146-151 |
| 200 | | | 177-182 | 169-174 | 173-178 | 165-170 | | | 169-174 | 151-156 |
| 210 | | | | | 183-188 | 175-180 | | | 179-184 | 156-161 |
| 220 | | | | | 193-198 | 185-190 | | | 189-194 | 161-166 |
| 230 | | | | | 203-208 | 195-200 | | | 199-204 | 166-171 |
| 240 | | | | | 213-218 | 205-210 | | | 209-214 | 171-176 |
| 250 | | | | | 223-228 | 215-220 | | | 219-224 | 176-181 |
| 260 | | | | | | | | | 224-229 | 181-186 |

| Nominal diameter | The required preloading force F_v [kN] is calculated with the following formula : $F_{p,C^*} = 0.7 \times f_{yb} \times A_s$ | Torque method |
|------------------|---|--|
| | | Torque method MA for achieving the required preload force F_v [Nm] |
| M 12 | 50 | 100 |
| M 16 | 100 | 250 |
| M 20 | 160 | 450 |
| M 22 | 190 | 650 |
| M 24 | 220 | 800 |
| M 27 | 290 | 1250 |
| M 30 | 350 | 1650 |
| M 36 | 510 | 2800 |

*EN14399-3 is available. Please check with KPF.

*The manufacturer always delivers prelubricated nuts (e.g.molybdenum disulphide MoS2 or KD-200). The torque is identical for hot dip galvanised and plain assemblies.

The combined method also involves two stages of tightening. In the first stage, the assemblies are tightened to a preload torque indicated by the manufacturer. Final torque is achieved by rotating the nut by the indicated degree.

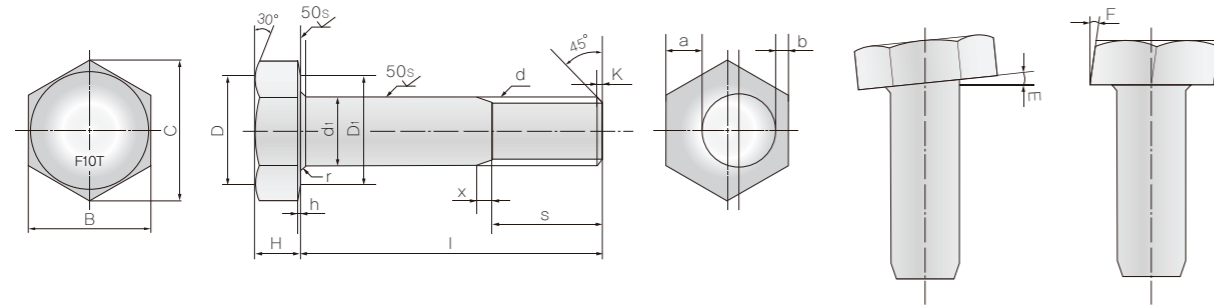
| Combined method | | | | | | | | |
|---|--------------------------|-----|-----|------------------------|-----|-----|------|------|
| Nominal diameter | M12 | M16 | M20 | M22 | M24 | M27 | M30 | M36 |
| Preloading $F_{p,C^*} = 0.7 \times f_{yb} \times A_s$ [kN] | 59 | 110 | 172 | 212 | 247 | 321 | 393 | 572 |
| Preload torque M_A [Nm] | 75 | 190 | 340 | 490 | 600 | 940 | 1240 | 2100 |
| Final tightening by rotating ; depending on the clamp length Σt | | | | | | | | |
| Total clamp length connection components Σt (incl. any spacers and washers) | Rotation in degrees | | | Rotation in part-turns | | | | |
| 1 | $\Sigma t < 2d$ | | | 60° | | | | |
| 2 | $2d \leq \Sigma t < 6d$ | | | 90° | | | | |
| 3 | $6d \leq \Sigma t < 10d$ | | | 120° | | | | |

JIS B1186 Grade F8T & F10T

JIS B1186 Grade F8T & F10T



► Dimensions



High-tensile hex bolt (HT) : JIS B 1186

unit : mm

| Dia (d) | d1 | | H | | B | | C | D | D1 | r | K | a-b | E | F | h | s | |
|---------|-----------------|--------------|-----------------|------|-----------------|------------|--------|--------|------|---------|---------|--------|------|------|---------|---------|-----------------|
| | Basic dimension | Tol. | Basic dimension | Tol. | Basic dimension | Tol. | Approx | Approx | Min. | | | Approx | Max. | Max. | | Max. | Basic dimension |
| M12 | 12 | +0.7 -0.2 | 8 | ±0.8 | 22 | +0 -0.8 | 25.4 | 20 | 20 | 0.8~1.6 | 2 | 0.7 | 1° | 2° | 0.4~0.8 | 25 | +5 -0 |
| M16 | 16 | | 10 | | 27 | | 31.2 | 25 | 25 | 1.2~2.0 | | 0.8 | | | | | |
| M20 | 20 | +0.8 -0.4 | 13 | ±0.9 | 32 | +0 -1 | 37 | 30 | 29 | | 1.6~2.4 | 3 | 2.5 | 1° | 2° | 0.4~0.8 | 35 |
| M22 | 22 | | 14 | | 36 | | 34 | 33 | 1.1 | 40 | | | | | | | |
| M24 | 24 | | 15 | | 41 | | 39 | 38 | 1.2 | 45 | | | | | | | |
| M27 | 27 | | 17 | | 46 | | 44 | 43 | 1.3 | 50 | | | | | | | |
| M30 | 30 | | 19 | ±1.0 | 50 | | 57.7 | 48 | 47 | 2.0~2.8 | 3.5 | 1.5 | | | 55 | | |

► Mechanical Properties

Combination Type & Grade

Table1 Combination of classes of sets and grades according to mechanical properties of components

| Class of set | | Grade according to mechanical properties of applicable component | | |
|--|---|--|-----|--------|
| Class according to mechanical properties | Class according to torque coefficient value | Bolt | Nut | Washer |
| Class 1 | A | F8T | F10 | F35 |
| | B | | | |
| Class 2 | A | F10T | | |
| | B | | | |

Bolt Specimen

Table2 Mechanical properties of bolt test pieces

| Grade according to mechanical properties of bolt | Proof stress N/mm ² | Tensile strength N/mm ² | Elongation % | Reduction of area % |
|--|--------------------------------|------------------------------------|--------------|---------------------|
| F8T | 640 min. | 800 to 1 000 | 16 min. | 45 min. |
| F10T | 900 min. | 1 000 to 1 200 | 14 min. | 40 min. |

Bolt Product

Table3 Mechanical properties of bolt products

| Grade according to mechanical properties of bolt | Tensile load (min.) (kN) | | | | | | | Hardness |
|--|-----------------------------|-----|-----|-----|-----|-----|-----|------------------|
| | Designation of screw thread | | | | | | | |
| | M12 | M16 | M20 | M22 | M24 | M27 | M30 | |
| F8T | 68 | 126 | 196 | 243 | 283 | 368 | 449 | 18 HRC to 31 HRC |
| F10T | 85 | 157 | 245 | 303 | 353 | 459 | 561 | 27 HRC to 38 HRC |

NUT for JIS B 1186 (F10)

unit : mm

| Nom. Diameter (d) | Outside dia of external threads | H | | B | | C | D | D1 | a-b | E | F | h |
|-------------------|---------------------------------|-----------------|-------|-----------------|------------|--------|--------|------|------|------|----|-----------------|
| | | Basic dimension | Tol. | Basic dimension | Tol. | Approx | Approx | Min. | Max. | Max. | | |
| M12 | 12 | 12 | ±0.35 | 22 | +0 -0.8 | 25.4 | 20 | 20 | 0.7 | 1° | 2° | 0.4 ~ 0.8 |
| M16 | 16 | 16 | | 27 | | 31.2 | 25 | 25 | 0.8 | | | |
| M20 | 20 | 20 | ±0.4 | 32 | +0 -1 | 37 | 30 | 29 | 2.5 | 1° | 2° | 0.4 ~ 0.8 |
| M22 | 22 | 22 | | 36 | | 34 | 33 | 1.1 | | | | |
| M24 | 24 | 24 | | 41 | | 39 | 38 | 1.2 | | | | |
| M27 | 27 | 27 | | 46 | | 44 | 43 | 1.3 | | | | |
| M30 | 30 | 30 | | 50 | | 57.7 | 48 | 47 | 1.5 | | | |

Washer : JIS B 1186 (F35)

| Nom. Diameter (d) | d | | D | | t | | c / r |
|-------------------|-----------------|-----------|-----------------|------------|-----------------|------|-------|
| | Basic dimension | Tol. | Basic dimension | Tol. | Basic dimension | Tol. | |
| M12 | 13 | +0.7 0 | 26 | +0 -0.8 | 3.2 | ±0.4 | 1.5 |
| M16 | 17 | 0 | 32 | | 4.5 | ±0.5 | |
| M20 | 21 | +0.8 0 | 40 | +0 -1 | 6 | ±0.7 | 2 |
| M22 | 23 | | 44 | | | | |
| M24 | 25 | | 48 | | | | |
| M27 | 28 | | 56 | | | | |
| M30 | 31 | +1.0 0 | 60 | +0 -1.2 | 8 | | 2.8 |

Nut

Table4 Mechanical properties of nuts

| Grade according to mechanical properties of nut | Hardness | | Proof load |
|---|----------|--------|--|
| | Min. | Max. | |
| F10 | 20 HRC | 35 HRC | Same as tensile load (min.) of bolt in table 3 |

Washer

Table5 Hardness of washer

| Grade according to mechanical properties of washer | Hardness |
|--|------------------|
| F35 | 35 HRC to 45 HRC |

JIS B1186 Grade F8T & F10T

JIS B1186 Grade F8T & F10T



Axial Load of Bolt

Table6 Axial tension for measuring torque coefficient value

| Grade according to mechanical properties of bolts | Tensile load (min.) (kN) | | | | | | |
|---|-----------------------------|-----------|------------|------------|------------|------------|------------|
| | Designation of screw thread | | | | | | |
| | M12 | M16 | M20 | M22 | M24 | M27 | M30 |
| F8T | 38 to 51 | 71 to 95 | 110 to 148 | 136 to 184 | 159 to 214 | 206 to 279 | 252 to 341 |
| F10T | 54 to 72 | 99 to 134 | 155 to 209 | 191 to 259 | 223 to 301 | 290 to 392 | 354 to 479 |

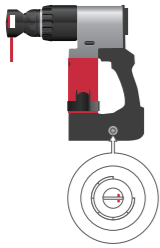
Classification by Torque Coefficient

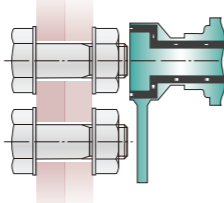
Table7 Torque coefficient values of sets

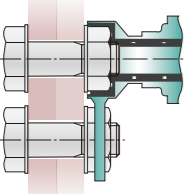
| Division | Class of set according to torque coefficient value | |
|--|--|----------------|
| | A | B |
| Mean value of torque coefficient values of one set lot | 0.110 to 0.150 | 0.150 to 0.190 |
| Standard deviation of torque coefficient values of one set lot | 0.010 max. | 0.013 max. |

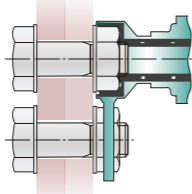
NOTE : The set lot mentioned herein means the set lot as specified in 4,3

Fastening order of high-tensile hex bolt (HT)

- 

Set the fastening torque. Turn torque dial using(-) driver to set to your desired torque.
- 

Insert the lever socket in the nut which you want to fasten. (Because it rotates in the opposite direction of rotation direction of nut when fastening, adjust to lock bolt of member of framework so that reaction is applied to the lever socket guide.)
- 

Pull operation switch to rotate the lever socket. At this time, operate the lever socket rotary guide adjusting it to the neighboring bolt or member of framework.
- 

When it reaches as much as set torque after fastening, electric wrench stops automatically.

Formula of torque coefficient

$$K = \frac{T}{d \times N} \times 1,000$$

K : Torque coefficient
 T : Torque (Moment tightening nut)(N,m)
 d : nominal dimension of O,D of thread of bolt (mm)
 N : Axial load of bolt (N)

Weight Table

| Length (mm) | M12 Weight (g) | M16 Weight (g) | M20 Weight (g) | M22 Weight (g) | M24 Weight (g) | M27 Weight (g) | M30 Weight (g) |
|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 30 | 98 | - | - | - | - | - | - |
| 35 | 103 | 194 | - | - | - | - | - |
| 40 | 107 | 202 | 336 | - | - | - | - |
| 45 | 112 | 210 | 348 | - | - | - | - |
| 50 | 116 | 217 | 361 | 496 | 648 | - | - |
| 55 | 121 | 225 | 373 | 510 | 666 | - | - |
| 60 | - | 233 | 385 | 525 | 683 | - | - |
| 65 | - | 241 | 398 | 540 | 701 | 976 | - |
| 70 | - | 249 | 410 | 555 | 719 | 999 | 1319 |
| 75 | - | 257 | 422 | 570 | 737 | 1022 | 1347 |
| 80 | - | 265 | 435 | 585 | 754 | 1045 | 1375 |
| 85 | - | 273 | 447 | 600 | 772 | 1068 | 1403 |
| 90 | - | 281 | 459 | 615 | 790 | 1091 | 1431 |
| 95 | - | 289 | 472 | 630 | 808 | 1114 | 1459 |
| 100 | - | 296 | 484 | 645 | 825 | 1137 | 1487 |
| 105 | - | 304 | 497 | 660 | 843 | 1160 | 1515 |
| 110 | - | 312 | 509 | 674 | 861 | 1183 | 1543 |
| 115 | - | 320 | 521 | 689 | 879 | 1206 | 1571 |
| 120 | - | 328 | 533 | 704 | 896 | 1229 | 1599 |
| 125 | - | 336 | 545 | 719 | 914 | 1252 | 1627 |
| 130 | - | 344 | 557 | 734 | 931 | 1275 | 1655 |
| 135 | - | 352 | 569 | 749 | 949 | 1298 | 1683 |
| 140 | - | 360 | 581 | 764 | 966 | 1321 | 1711 |
| 145 | - | 368 | 593 | 779 | 984 | 1344 | 1739 |
| 150 | - | 376 | 605 | 794 | 1001 | 1367 | 1767 |
| 155 | - | 384 | 617 | 809 | 1018 | 1390 | 1795 |
| 160 | - | 392 | 629 | 824 | 1035 | 1413 | 1823 |
| 165 | - | 400 | 641 | 839 | 1052 | 1436 | 1851 |
| 170 | - | 408 | 653 | 854 | 1069 | 1459 | 1879 |
| 175 | - | 416 | 665 | 869 | 1086 | 1482 | 1907 |
| 180 | - | 424 | 677 | 884 | 1103 | 1505 | 1935 |
| 185 | - | 432 | 689 | 899 | 1120 | 1528 | 1963 |
| 190 | - | 440 | 701 | 914 | 1137 | 1551 | 1991 |
| 195 | - | 448 | 713 | 929 | 1154 | 1574 | 2019 |
| 200 | - | 456 | 725 | 944 | 1171 | 1597 | 2047 |
| 205 | - | 464 | 737 | 959 | 1188 | 1620 | 2075 |
| 210 | - | 472 | 749 | 974 | 1205 | 1643 | 2103 |
| 215 | - | 480 | 761 | 989 | 1222 | 1666 | 2131 |
| 220 | - | 488 | 773 | 1004 | 1239 | 1689 | 2159 |
| 225 | - | 496 | 785 | 1019 | 1256 | 1712 | 2187 |
| 230 | - | 504 | 797 | 1034 | 1273 | 1735 | 2215 |
| 235 | - | 512 | 809 | 1049 | 1290 | 1758 | 2243 |
| 240 | - | 520 | 821 | 1064 | 1307 | 1781 | 2271 |
| 245 | - | 528 | 833 | 1079 | 1324 | 1804 | 2299 |
| 250 | - | 536 | 845 | 1094 | 1341 | 1827 | 2327 |

JIS B1186 F10T Hex bolt with (one) F10 Hex nut and (two) F35 Washers

JIS B1186 Grade F8T & F10T

▶ Tightening Method

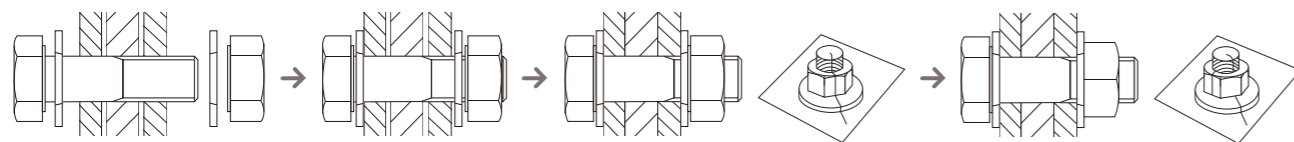
Attention in Fastening

Check the installation side for the nut and the washer.

Tightening by hands

Marking after the snug-tightening

In case the washer has rotated After pretensioning, replace the bolt set.

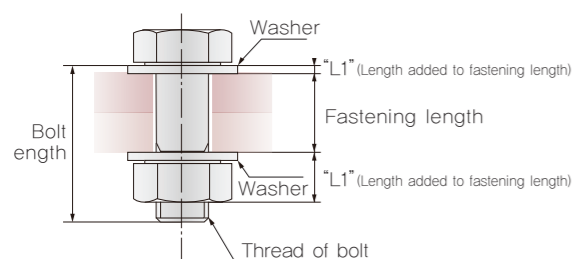


All boltholes shall be aligned to permit insertion of the bolts without undue damage to the threads before snug-tightening. (Do not hammer bolt head to insert the bolt in to the holes.)

In case it rains or snows after the snug-tightening, pretensioning must be done with the Bolts which are snug-tightened.

▶ Calculation criteria of bolt length

High-tensile hex bolt (HT)



Calculation criteria of bolt length for TS bolt · hex bolt (HT)

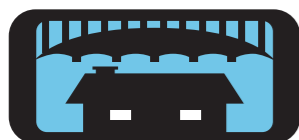
| SIZE | Pitch | L1 | |
|------|-------|-----------|-----------------|
| | | TS (S10T) | HT (F8T · F10T) |
| M16 | 2.0P | 25 | 30 |
| M20 | 2.5P | 30 | 35 |
| M22 | 2.5P | 35 | 40 |
| M24 | 3.0P | 40 | 45 |
| M27 | 3.0P | 45 | 50 |
| M30 | 3.5P | 50 | 55 |

In calculating bolt length, add "L1" to fastening length.

High-tensile TS bolt includes 1 washer in nut part.

High-tensile hex bolt(HT) includes each 1 washer in bolt head and nut part.

Recommendation for storage



Things to avoid in storage



Tension Control

ASTM F3125 Grade F1852 / F2280
EN 14399-10 System HRC
JSS-II-09 S10T

Type 1 & Type 3
Carbon & Alloy steel Weathering steel
are available

Plain finish, HDG
Zinc Flake coatings are available.



songhyun

“KPPF”



Case study of using Hex bolts vs T/C bolts

* 22,000 bolts are used for fabrication

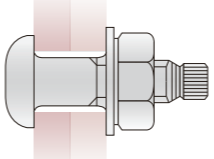
| A325 HEX HEAD BOLT (A325, HV, HR) | A325 TENSION CONTROL BOLT (F1852, HRC) |
|---|---|
| EQUIPMENT AND TOOLS | EQUIPMENT AND TOOLS |
| 1. Impact Wrench – 3 sets (Weight = 33 lbs (pounds) + Socket Weight) 2. Tension Calibrator – 1 set 3. Torque Wrench – 2 set 4. Air Compressor – 1 set | 1. Electric Wrench – 3 sets (Weight = 13 lbs (pounds)) 2. Tension Calibrator – 1 set 3. Generator – 1 set |
| LABOR DAYS | LABOR DAYS |
| 1. Installation job 22,000 bolts / 1,200 bolts x 3 man = 55 days (3 man per group, 1,200 bolts per group per day) 2. Inspection 22,000 x 5% / 250 x 2 inspectors = 9 days (5% of total assembly should be torque checked, checks 250 bolts per day by 2 inspectors) | 1. Installation job 22,000 bolts / 2,400 bolts x 3 man = 28 days (3 man per group, 2,400 bolts per group per day) 2. Inspection Visual inspection with Installation = 0 day |
| 3. Total Labor Days – 64 Days | 3. Total Labor Days – 28 Days |
| COST | COST |
| 1. Installation job \$ 50 x 8 labor hours per day x 55 labor days = \$ 22,800 2. Inspection \$ 50 x 8 labor hours per day x 9 labor days = \$ 3,600 3. Product cost = \$ 12,320 (3/4 inch hex bolt) | 1. Installation job \$ 50 x 8 labor hours per day x 27 labor days = \$ 10,800 2. Inspection Visual inspection with installation = \$ 0.00 3. Product Cost = \$ 15,523 (3/4 inch TC bolt) |
| 3. Total cost – \$ 38,720 | 3. Total cost – \$ 26,323 |
| CONCLUSION | CONCLUSION |
| 1. Cost : \$ 38,720 2. Labor days : 64 days | 1. Cost : \$ 26,323 2. Labor days : 28 days |

SUMMARY :
Estimated Savings 32%, 36 Fewer erection Days

(Cost reductions increase proportionately as project size and labor duration increase_ Figures do not reflect savings due to fewer rental days of equipment)

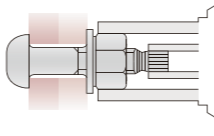


Installation Procedure

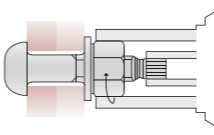


1
 Install the T.C bolt through the structure, and engage a mating washer and nut. Nut and washer marking should face away from the connection.

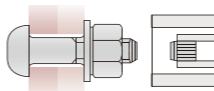
Snug-tighten the assembly to approximately 10% of assembly installation tension. Snug-tight can be achieved by a few impacts of an impact wrench or by full effort of a person using a standard spanner or preset torque wrench.



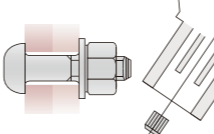
2
 Slide the inner socket over the bolt pintail and the outer socket over the nut.



3
 Switch the wrench on. The outer socket will rotate and tighten the nut until the bolt reaches the required tension. When the proper bolt tension is reached, the outer socket will stop rotating and the inner socket will rotate in the opposite direction and shear the pintail off.



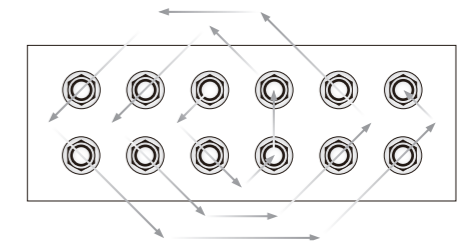
4
 The bolt pintail is retained by the wrench and can be discarded by engaging the small trigger on the wrench handle.



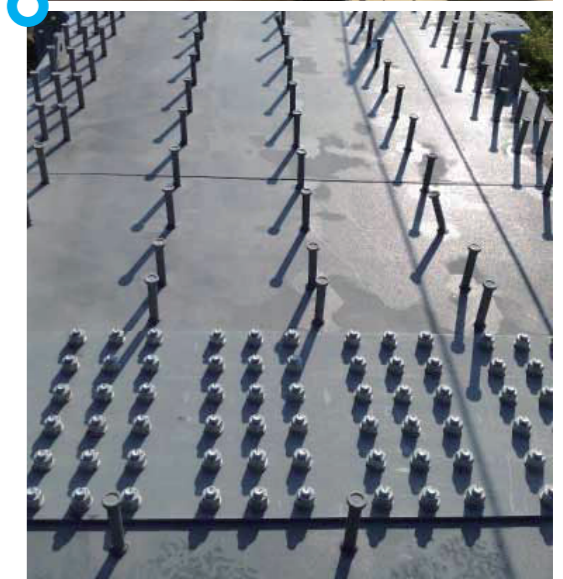
5
 When the pintail has sheared off, pull back the wrench until the outer socket is no longer engaging the nut.



Tightening Pattern



Snug-tightening and final tensioning of the bolts in a connection shall proceed from the stiffest part of the connection towards the free edges. An example interpretation of a systematic pattern for tightening provided :



ASTM F3125 Grade F1852 & F2280



▼ Handling and storage

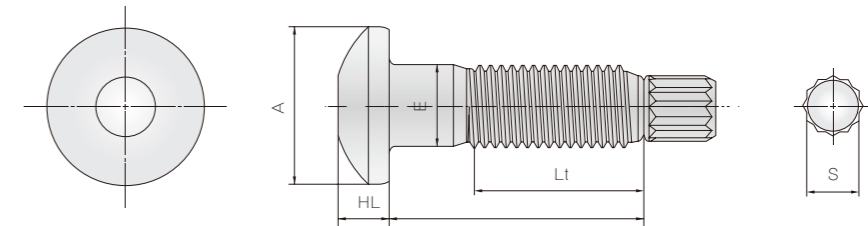


All structural fasteners should be protected from dirt and moisture at the job site. Only as many fasteners as are anticipated to be used should be taken from protected storage. Fasteners not used should be returned to the protected storage at the end of day. Dirty or rusted bolts should not be used.



Fasteners shall not be cleaned or modified from the as-delivered condition. Lubrication or coating shall be applied by manufacturer only. The used bolt shall not be reused.

► Dimensions

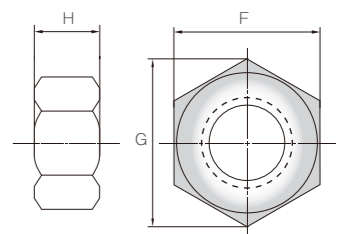


Bolt

| Nom. Diameter (d) | | 3/8 | 1/2 | 5/8 | 1 | 1 1/2 | 1 3/4 |
|-------------------|------|-------|-------|-------|-------|-------|-------|
| E | max | 0.642 | 0.768 | 0.895 | 1.022 | 1.149 | 1.277 |
| | mix | 0.605 | 0.729 | 0.852 | 0.976 | 1.098 | 1.223 |
| A | Ref. | 1.313 | 1.580 | 1.880 | 2.158 | 2.375 | 2.760 |
| H | max | 0.403 | 0.483 | 0.563 | 0.627 | 0.718 | 0.813 |
| | min | 0.378 | 0.455 | 0.531 | 0.591 | 0.658 | 0.749 |
| Lt | Ref. | 1.250 | 1.380 | 1.500 | 1.750 | 2.000 | 2.000 |
| Ls | Ref. | 0.600 | 0.650 | 0.720 | 0.800 | 0.900 | 1.00 |
| S | Ref. | 0.43 | 0.53 | 0.61 | 0.70 | 0.80 | 0.90 |

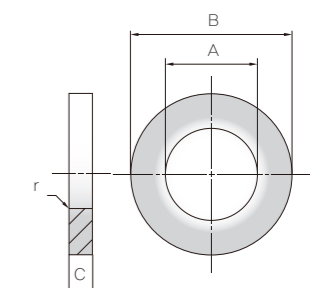
Nut

| Nom. Diameter (d) | | 3/8 | 1/2 | 5/8 | 1 | 1 1/2 | 1 3/4 |
|-------------------|-----|-------|-------|-------|-------|-------|-------|
| H | max | 0.631 | 0.758 | 0.885 | 1.012 | 1.139 | 1.251 |
| | min | 0.587 | 0.710 | 0.833 | 0.956 | 1.079 | 1.187 |
| F | max | 1.062 | 1.250 | 1.438 | 1.625 | 1.812 | 2.000 |
| | min | 1.031 | 1.212 | 1.394 | 1.575 | 1.756 | 1.938 |
| G | max | 1.227 | 1.443 | 1.660 | 1.876 | 2.093 | 2.309 |
| | min | 1.175 | 1.382 | 1.589 | 1.796 | 2.002 | 2.209 |



Washer

| Nom. Diameter (d) | | 3/8 | 1/2 | 5/8 | 1 | 1 1/2 | 1 3/4 |
|-------------------|-----------|------------|-------|-------|------------|-------|-------|
| B | nom | 1.313 | 1.468 | 1.750 | 2.000 | 2.250 | 2.500 |
| | Tolerance | ±0.032 | | | ±0.063 | | |
| A | nom | 0.688 | 0.813 | 0.938 | 1.063 | 1.188 | 1.375 |
| | Tolerance | -0, +0.032 | | | -0, +0.063 | | |
| C | max | 0.177 | 0.177 | 0.177 | 0.177 | 0.177 | 0.177 |
| | min | 0.122 | 0.122 | 0.136 | 0.136 | 0.136 | 0.136 |



ASTM F3125 Grade F1852 & F2280

ASTM F3125 Grade F1852 & F2280



► Mechanical Properties

Assembly Installation Tension

| Nom. Diameter (in) | Bolt Tension Min (Lbf) | |
|--------------------|------------------------|---------|
| | F 1852 | F 2280 |
| 5/8 – 11 UNC | 19,900 | 24,900 |
| 3/4 – 10 UNC | 29,450 | 36,800 |
| 7/8 – 9 UNC | 40,750 | 50,950 |
| 1 – 8 UNC | 53,450 | 66,800 |
| 1 1/8 – 7 UNC | 67,350 | 84,100 |
| 1 1/4 – 7 UNC | 85,500 | 106,850 |

Bolt Tensile Strength (Full Size)

| Nom. Diameter (in) | Stress Area (in ²) | Tensile Strength (Lbf) | | | | Proof Load (Lbf) | |
|--------------------|--------------------------------|------------------------|---------|--------|---------|------------------|---------|
| | | Min | | Max | | Min | |
| | | F 1852 | F 2280 | F 1852 | F 2280 | F 1852 | F 2280 |
| 5/8 – 11 UNC | 0.226 | 27,100 | 33,900 | – | 39,100 | 19,200 | 27,100 |
| 3/4 – 10 UNC | 0.334 | 40,100 | 50,100 | – | 57,800 | 28,400 | 40,100 |
| 7/8 – 9 UNC | 0.462 | 55,450 | 69,300 | – | 79,950 | 39,250 | 55,450 |
| 1 – 8 UNC | 0.606 | 72,700 | 90,900 | – | 104,850 | 51,500 | 72,700 |
| 1 1/8 – 7 UNC | 0.763 | 91,600 | 114,450 | – | 132,000 | 64,900 | 91,550 |
| 1 1/4 – 7 UNC | 0.969 | 116,300 | 145,350 | – | 167,650 | 82,400 | 116,300 |

Bolt Tensile Strength (Specimen)

| GRADE | Tensile Strength (psi) | | Yield Strength min (psi) |
|--------|------------------------|---------|--------------------------|
| | Min | Max | |
| F 1852 | 120,000 | – | 92,000 |
| F 2280 | 150,000 | 173,000 | 130,000 |

Bolt Hardness

| Bolt Grade | Nom. Diameter (in) | Length | Rockwell HRC | |
|------------|--------------------|--------|--------------|-----|
| | | | Min | Max |
| F 1852 | 5/8 – 1 | L < 2D | 25 | 34 |
| | | L ≥ 2D | – | 34 |
| | 1 1/8 – 1 1/4 | L < 3D | 25 | 34 |
| | | L ≥ 3D | – | 34 |
| F 2280 | 5/8 – 1 | L < 2D | 33 | 38 |
| | | L ≥ 2D | – | 38 |
| | 1 1/8 – 1 1/4 | L < 3D | 33 | 38 |
| | | L ≥ 3D | – | 38 |

Nut

| Nut Grade | Proof Load Strength (psi) | | Rockwell HRC | |
|-----------|---------------------------|---------|--------------|-----|
| | Coating | | Min | Max |
| | Plain | Galv. | | |
| A563 DH | 175,000 | 150,000 | 24 | 38 |

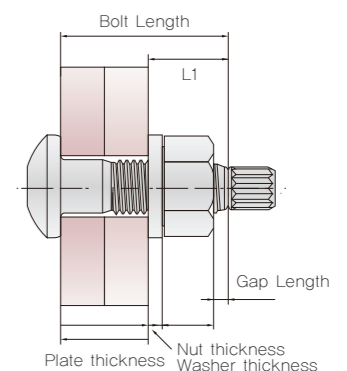
Washer

| Washer Grade | Rockwell HRC | |
|--------------|--------------|-----|
| | Min | Max |
| F 436 | 38 | 45 |

► Bolt Length Selection

To determine the proper length of bolt, Please add "L1" to plate thickness.

| Nom Diameter (in) | L1 (in) |
|-------------------|---------|
| 5/8 | 1 1/8 |
| 3/4 | 1 1/4 |
| 7/8 | 1 1/2 |
| 1 | 1 3/4 |
| 1 1/8 | 2 |
| 1 1/4 | 2 1/4 |

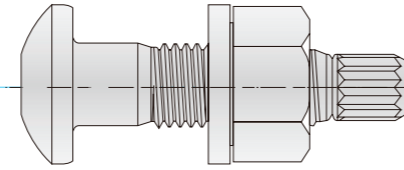


ASTM F3125 Grade F1852 & F2280

EN 14399-10 System HRC



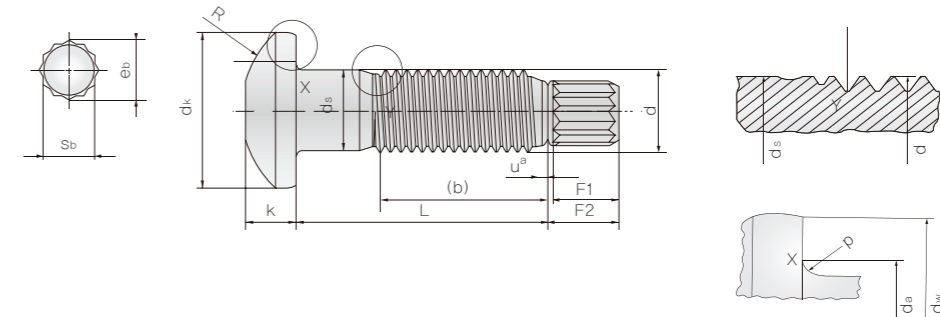
► Weight Table



| Nom. Diameter | ¾ | ¾ | ¾ | 1 | 1 ¼ | 1 ½ |
|------------------|-------|-------|-------|-------|-------|-------|
| Weight of Nut | 0.051 | 0.088 | 0.134 | 0.194 | 0.269 | 0.332 |
| Weight of Washer | 0.02 | 0.024 | 0.035 | 0.043 | 0.054 | 0.094 |
| Bolt Length | | | | | | |
| 1 ¼ | – | – | – | – | – | – |
| 1 ½ | 0.173 | 0.284 | – | – | – | – |
| 1 ¾ | 0.186 | 0.294 | – | – | – | – |
| 2 | 0.195 | 0.301 | 0.432 | 0.609 | – | – |
| 2 ¼ | 0.202 | 0.314 | 0.451 | 0.63 | – | – |
| 2 ½ | 0.215 | 0.328 | 0.471 | 0.648 | 0.873 | – |
| 2 ¾ | 0.224 | 0.341 | 0.49 | 0.672 | 0.901 | – |
| 3 | 0.233 | 0.355 | 0.509 | 0.696 | 0.933 | 0.875 |
| 3 ¼ | 0.242 | 0.369 | 0.528 | 0.721 | 0.964 | 0.914 |
| 3 ½ | 0.251 | 0.382 | 0.547 | 0.746 | 0.955 | 0.954 |
| 3 ¾ | 0.26 | 0.396 | 0.566 | 0.771 | 1.026 | 0.993 |
| 4 | 0.269 | 0.41 | 0.585 | 0.795 | 1.057 | 1.033 |
| 4 ¼ | 0.278 | 0.423 | 0.603 | 0.823 | 1.088 | 1.072 |
| 4 ½ | 0.287 | 0.437 | 0.622 | 0.844 | 1.121 | 1.112 |
| 4 ¾ | 0.296 | 0.45 | 0.641 | 0.871 | 1.15 | 1.151 |
| 5 | 0.305 | 0.464 | 0.66 | 0.894 | 1.182 | 1.190 |
| 5 ¼ | 0.314 | 0.478 | 0.675 | 0.917 | 1.213 | 1.230 |
| 5 ½ | 0.323 | 0.491 | 0.697 | 0.941 | 1.247 | 1.269 |
| 5 ¾ | – | 0.505 | 0.716 | 0.966 | 1.278 | 1.309 |
| 6 | – | 0.519 | 0.735 | 0.991 | 1.307 | 1.348 |
| 6 ¼ | – | 0.533 | 0.768 | 1.015 | 1.336 | 1.388 |
| 6 ½ | – | 0.558 | 0.773 | 1.046 | 1.368 | 1.427 |
| 6 ¾ | – | 0.565 | 0.792 | 1.071 | 1.402 | 1.467 |
| 7 | – | 0.574 | 0.811 | 1.096 | 1.433 | 1.506 |
| 7 ¼ | – | – | – | 1.121 | 1.462 | 1.546 |
| 7 ½ | – | – | – | 1.146 | 1.496 | 1.585 |
| 7 ¾ | – | – | – | 1.174 | 1.526 | 1.625 |
| 8 | – | – | – | 1.201 | 1.556 | 1.664 |
| 8 ¼ | – | – | – | 1.219 | 1.587 | 1.704 |
| 8 ½ | – | – | – | 1.237 | 1.618 | 1.743 |
| 8 ¾ | – | – | – | 1.261 | 1.651 | 1.782 |
| 9 | – | – | – | 1.285 | 1.683 | 1.822 |
| 9 ¼ | – | – | – | 1.309 | 1.717 | 1.861 |
| 9 ½ | – | – | – | 1.333 | 1.751 | 1.901 |
| 10 | – | – | – | – | – | 1.980 |

*Longer sizes are available. Please check with KPF. *Unit = kg

► Dimensions



Bolt

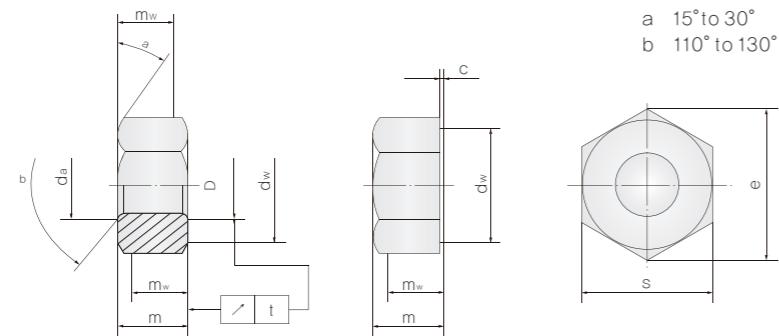
| Thread (d) | | M12 | M16 | M20 | M22 | M24 | M27 | M30 | M36 |
|---|-----|-------|-------|-------|-------|-------|-------|-------|-------|
| p ^a | – | 1,75 | 2 | 2,5 | 2,5 | 3 | 3 | 3,5 | 4 |
| b (ref.) | b | 30 | 38 | 46 | 50 | 54 | 60 | 66 | 78 |
| | c | – | 44 | 52 | 56 | 60 | 66 | 72 | 84 |
| | d | – | – | 65 | 69 | 73 | 79 | 85 | 97 |
| c | max | 0,8 | 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 | 0,4 |
| d _s | max | 15,2 | 19,2 | 24,4 | 26,4 | 28,4 | 32,4 | 35,4 | 42,4 |
| d _k | min | 21,0 | 27,0 | 34,0 | 38,5 | 43,0 | 48,0 | 52,0 | 66,0 |
| d _s | max | 12,70 | 16,70 | 20,84 | 22,84 | 24,84 | 27,84 | 30,84 | 37,00 |
| | min | 11,30 | 15,30 | 19,16 | 21,16 | 23,16 | 26,16 | 29,16 | 35,00 |
| d _w | min | 20 | 26 | 33 | 37 | 41 | 46 | 50 | 61 |
| e | min | 23,91 | 29,56 | 35,03 | 39,55 | 45,20 | 50,85 | 55,37 | 66,44 |
| k | nom | 8 | 10 | 13 | 14 | 15 | 17 | 19 | 23 |
| | max | 8,8 | 10,8 | 13,9 | 14,9 | 15,9 | 17,9 | 20,0 | 24,0 |
| | min | 7,2 | 9,2 | 12,1 | 13,1 | 14,1 | 16,1 | 18,0 | 22,0 |
| k _w | min | 4,9 | 6,5 | 8,1 | 9,2 | 9,9 | 11,3 | 12,4 | 15,0 |
| R | nom | 18 | 20 | 22 | 23 | 25 | 27 | 30 | 36 |
| s | max | 22 | 27 | 32 | 36 | 41 | 46 | 50 | 60 |
| | min | 21,16 | 26,16 | 31,0 | 35,0 | 40,0 | 45,0 | 49,0 | 58,8 |
| Width across flats of spline end, s _{s2} | nom | 7,7 | 11,3 | 14,1 | 15,4 | 16,8 | 19,0 | 21,1 | 25,4 |
| | max | 8,0 | 11,6 | 14,4 | 15,7 | 17,1 | 19,3 | 21,4 | 25,7 |
| | min | 7,4 | 11,0 | 13,8 | 15,1 | 16,5 | 18,7 | 20,8 | 25,1 |
| Width across corners of spline end, s _{s2} | min | 8,36 | 12,43 | 15,60 | 17,06 | 18,65 | 21,13 | 23,50 | 28,50 |
| Length of spline-end, F ₁ | min | 11,0 | 13,0 | 15,0 | 15,5 | 16,0 | 19,0 | 21,0 | 25,0 |
| Break off length, F ₂ | max | 16,0 | 18,0 | 20,0 | 21,0 | 21,5 | 24,0 | 26,0 | 31,0 |

EN 14399-10 System HRC

EN 14399-10 System HRC



➤ Dimensions



Nut-HR

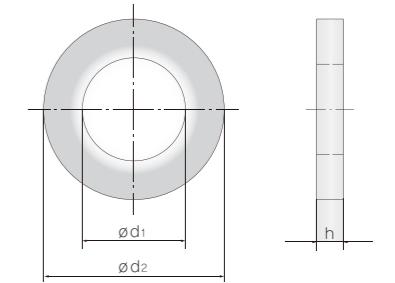
| Thread (d) | | M12 | M16 | M20 | M22 | M24 | M27 | M30 | M36 |
|----------------|-----|-------|-------|-------|-------------------|-------|-------|-------|-------|
| p ^a | | 1,75 | 2 | 2,5 | 2,5 | 3 | 3 | 3,5 | 4 |
| d _a | max | 13,0 | 17,3 | 21,6 | 23,7 | 25,9 | 29,1 | 32,4 | 38,9 |
| | min | 12 | 16 | 20 | 22 | 24 | 27 | 30 | 36 |
| d | max | | | | | | | | |
| | min | 20,1 | 24,9 | 29,5 | 33,3 ^b | 38,0 | 42,8 | 46,6 | 55,9 |
| e | min | 23,91 | 29,56 | 35,03 | 39,55 | 45,20 | 50,85 | 55,37 | 66,44 |
| m | max | 10,80 | 14,80 | 18,00 | 19,40 | 21,50 | 23,80 | 25,60 | 31,00 |
| | min | 10,37 | 14,10 | 16,90 | 18,10 | 20,20 | 22,50 | 24,30 | 29,40 |
| m | min | 8,3 | 11,3 | 13,5 | 14,5 | 16,2 | 18,1 | 19,5 | 22,4 |
| c ^w | max | 0,8 | 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 | 0,4 |
| s | max | 22 | 27 | 32 | 36 | 41 | 46 | 50 | 60 |
| | min | 21,16 | 26,16 | 31,00 | 35,00 | 40,00 | 45,00 | 49,00 | 58,80 |
| t | | 0,38 | 0,47 | 0,58 | 0,63 | 0,72 | 0,80 | 0,87 | 1,05 |

Nut-HRD

| Thread (d) | | M12 | M16 | M20 | M22 | M24 | M27 | M30 | M36 |
|----------------|-----|-------|-------|-------|-------|-------|-------|-------|-------|
| m | max | 12,35 | 16,35 | 20,65 | 22,65 | 24,65 | 27,65 | 30,65 | 36,80 |
| | min | 11,65 | 15,65 | 19,35 | 21,35 | 23,35 | 26,35 | 29,35 | 35,20 |
| m _w | min | 9,32 | 12,52 | 15,48 | 17,08 | 18,68 | 21,08 | 23,48 | 28,16 |

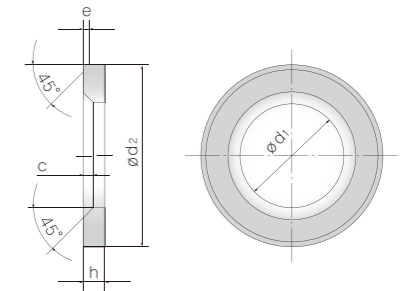
For all other dimensions, see the HR Nut table

➤ Dimensions



EN14399-5 Plain washers

| Nominal size d (nominal thread diameter of associated bolt) | | 12 | (14) ^a | 16 | (18) ^a | 20 | 22 | 24 | 27 | 30 | 36 |
|--|-----|-------|-------------------|-------|-------------------|-------|-------|-------|-------|-------|-------|
| d ₁ | min | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 28 | 31 | 37 |
| | max | 13,27 | 15,27 | 17,27 | 19,33 | 21,33 | 23,33 | 25,33 | 28,56 | 31,62 | 37,62 |
| d ₂ | min | 23,48 | 27,48 | 29,48 | 33,38 | 36,38 | 38,38 | 43,38 | 49 | 54,80 | 64,80 |
| | max | 24 | 28 | 30 | 34 | 37 | 39 | 44 | 50 | 56 | 66 |
| h | nom | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 6 |
| | min | 2,7 | 2,7 | 3,7 | 3,7 | 3,7 | 3,7 | 3,7 | 4,4 | 4,4 | 5,4 |
| | max | 3,3 | 3,3 | 4,3 | 4,3 | 4,3 | 4,3 | 4,3 | 5,6 | 5,6 | 6,6 |



EN14399-6 Plain chamfered washers

| Nominal size d (nominal thread diameter of associated bolt) | | 12 | (14) ^a | 16 | (18) ^a | 20 | 22 | 24 | 27 | 30 | 36 |
|--|---------|-------|-------------------|-------|-------------------|-------|-------|-------|-------|-------|-------|
| d ₁ | min | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 28 | 31 | 37 |
| | max | 13,27 | 15,27 | 17,27 | 19,33 | 21,33 | 23,33 | 25,33 | 28,56 | 31,62 | 37,62 |
| d ₂ | min | 23,48 | 27,48 | 29,48 | 33,38 | 36,38 | 38,38 | 43,38 | 49 | 54,80 | 64,80 |
| | max | 24 | 28 | 30 | 34 | 37 | 39 | 44 | 50 | 56 | 66 |
| h | nom | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 6 |
| | min | 2,7 | 2,7 | 3,7 | 3,7 | 3,7 | 3,7 | 3,7 | 4,4 | 4,4 | 5,4 |
| | max | 3,3 | 3,3 | 4,3 | 4,3 | 4,3 | 4,3 | 4,3 | 5,6 | 5,6 | 6,6 |
| e | nom=min | 0,5 | 0,5 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 1 | 1 | 1,25 |
| | max | 1,0 | 1,0 | 1,50 | 1,50 | 1,50 | 1,50 | 1,50 | 2 | 2 | 2,50 |
| c | min | 1,6 | 1,6 | 1,6 | 2 | 2,0 | 2,0 | 2,0 | 2,5 | 2,5 | 2,5 |
| | max | 1,9 | 1,9 | 1,9 | 2,5 | 2,5 | 2,5 | 2,5 | 3,0 | 3,0 | 3,0 |

EN 14399-10 System HRC

EN 14399-10 System HRC



➤ Mechanical Properties

Limiting values of bolt force at the fracture of the spline-end

| Thread <i>D</i> | Nominal stress area of standard test mandrel A_s mm ² | F_t min $0,7 \times f_{ub} \times A_s^a$ N | F_t mean min $0,77 \times f_{ub} \times A_s^a$ N |
|--------------------|---|--|--|
| M 12 | 84,3 | 59 010 | 64 911 |
| M 16 | 157 | 109 900 | 120 890 |
| M 20 | 245 | 171 500 | 188 650 |
| M 22 | 303 | 212 100 | 233 310 |
| M 24 | 353 | 247 100 | 271 810 |
| M 27 | 459 | 321 300 | 353 430 |
| M 30 | 561 | 392 700 | 431 970 |
| M 36 | 817 | 571 900 | 629 090 |

Proof load values of nuts

| Thread <i>d</i> | Nominal stress area of standard test mandrel A_s mm ² | Property class 10 Tolerance class 6H to 6AZ | |
|--------------------|---|---|---|
| | | Proof load($A \times S$), N | |
| | | Regular nuts (HR) to EN 14399-3 ^a | Nuts with height $m = 1D$ (HRD) ^b |
| M 12 | 84,3 | 97 800 | 104 900 |
| M 16 | 157 | 182 100 | 195 500 |
| M 20 | 245 | 284 200 | 305 000 |
| M 22 | 303 | 351 200 | 377 200 |
| M 24 | 353 | 409 500 | 439 500 |
| M 27 | 459 | 532 400 | 571 500 |
| M 30 | 561 | 650 800 | 698 400 |
| M 36 | 817 | 947 700 | 1 017 100 |

Bolt Tensile Strength (Specimen)

| Mechanical or physical property | | 10.9 |
|---|-------------------|------|
| Tensile strength, R_m , MPa | nom. ^c | 1000 |
| | min | 1040 |
| Percentage elongation after fracture for machined test pieces, A , % | min | 9 |
| Percentage reduction of area after fracture for machined test pieces, Z , % | min | 48 |
| Stress at 0,2% non-proportional elongation, $R_{p0,2}$, MPa | nom. ^c | 900 |
| | min | 940 |

Bolt Hardness

| Mechanical or physical property | | 10.9 |
|---------------------------------------|-----|------|
| Vickers hardness, HV $F \geq 98$ N | min | 320 |
| | max | 380 |
| Rockwell hardness, HRC | min | 32 |
| | max | 39 |

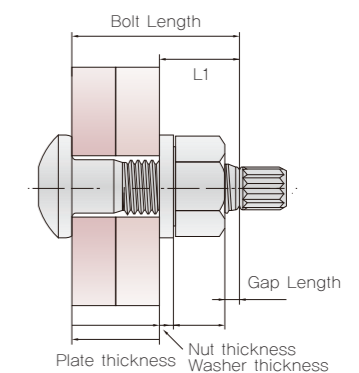
Nut & Washer

| Nut | | Hardness | Proof Load | Washer | | Hardness |
|------|-----|----------|------------|--------|-----|----------|
| | | n = 5 | n = 5 | | | n = 5 |
| Unit | min | HV | KN | Unit | min | HV |
| | max | HV | - | | max | HV |
| Spec | min | 272 | 439,5 | Spec | min | 300 |
| | max | 353 | - | | max | 370 |

➤ Bolt Length Selection

To determine the proper length of bolt, Please add "L1" to plate thickness.

| Nom Diameter (mm) | L1 (mm) |
|-------------------|---------|
| M 12 | 25 |
| M 16 | 30 |
| M 20 | 35 |
| M 22 | 35 |
| M 24 | 40 |
| M 27 | 45 |
| M 30 | 50 |
| M 36 | 55 |

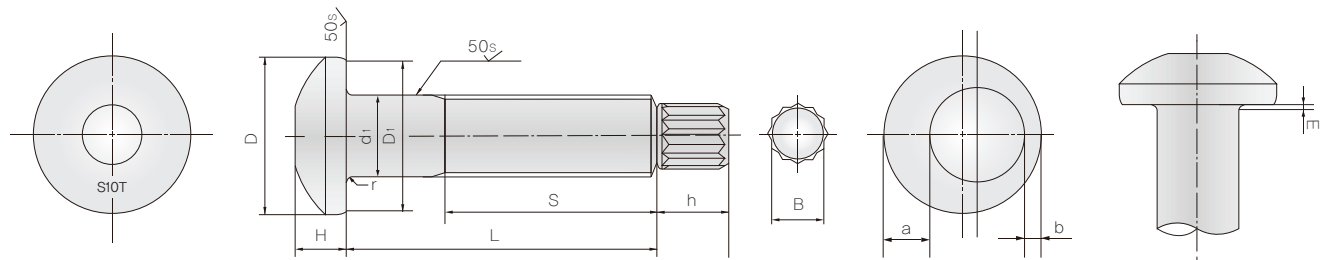


JSS-II-09 Grade S10T

JSS-II-09 Grade S10T



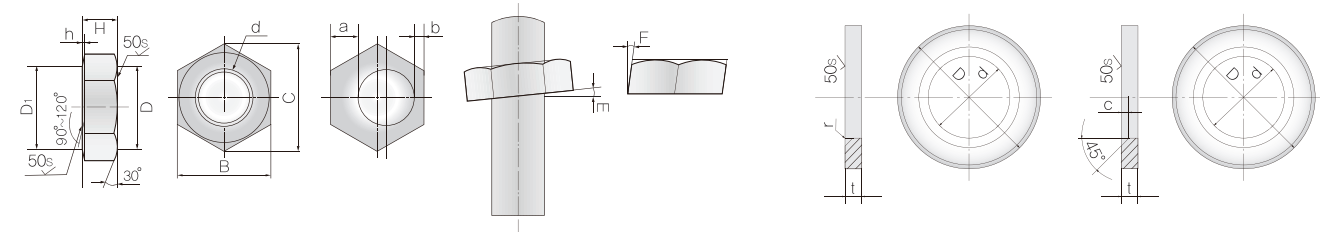
► Dimensions



Tension Control (T/C) bolt for JSS-II-09

unit : mm

| Dia (d) | d1 | | D1 | | D | | H | | h | B | | r | E | | s | |
|---------|-----------------|--------------|------|------|-----------------|------|---------|-----------------|------|---------|---------|----|------|---------|-----------------|---------|
| | Basic dimension | Tol. | Min. | Min. | Basic dimension | Tol. | Approx. | Basic dimension | | Tol. | Approx. | | Max. | Max. | Basic dimension | Tol. |
| M16 | 16 | +0.7 -0.2 | 26 | 27 | 10 | ±0.8 | 15 | 11.3 | ±0.3 | 1.2~2.0 | 0.8 | 1° | 30 | +5 0 | | |
| M20 | 20 | +0.8 -0.4 | 33 | 34 | 13 | ±0.9 | 18 | 14.1 | | | | | | | | |
| M22 | 22 | | 37 | 38.5 | 14 | | 19 | 15.4 | | | | | | | | |
| M24 | 24 | | 41 | 43 | 15 | | 20 | 16.8 | | | | | | | | |
| M27 | 27 | | 47 | 49 | 17 | | 22 | 19.0 | | | | | | | | |
| M30 | 30 | | 53 | 55 | 19 | | ±1.0 | 24 | | | | | | | 21.1 | 1.6~2.4 |
| | | | | | | | | 2.0~2.8 | 1.5 | 45 | | | | | | |
| | | | | | | | | | | 50 | | | | | | |



NUT for JSS-II-09(F10)

unit : mm

| Nom. Diameter (d) | Outside dia Of external threads | H | | B | | C | D | D1 | a-b | | E | F | h |
|-------------------|---------------------------------|-----------------|-------|-----------------|------|------|----|-----|------|------|----|-----------------|---|
| | | Basic dimension | Tol. | Basic dimension | Tol. | | | | Max. | Max. | | | |
| M12 | 12 | 12 | ±0.35 | 22 | +0 | 25.4 | 20 | 20 | 0.7 | 1° | 2° | 0.4 ~ 0.8 | |
| M16 | 16 | 16 | | 27 | -0.8 | 31.2 | 25 | 25 | 0.8 | | | | |
| M20 | 20 | 20 | 32 | +0 -1 | 37 | 30 | 29 | 0.9 | | | | | |
| M22 | 22 | 22 | 36 | | 41.6 | 34 | 33 | 1.1 | | | | | |
| M24 | 24 | 24 | 41 | | 47.3 | 39 | 38 | 1.2 | | | | | |
| M27 | 27 | 27 | 46 | | 53.1 | 44 | 43 | 1.3 | | | | | |
| M30 | 30 | 30 | 50 | | 57.7 | 48 | 47 | 1.5 | | | | | |

Washer :JSS-II-09 (F35)

| Nom. Diameter (d) | d | | D | | | t | | c / r |
|-------------------|-----------------|-----------|------------|------------|-----------------|------|---------|-------|
| | Basic dimension | Tol. | Tol. | Tol. | Basic dimension | Tol. | Approx. | |
| M12 | 13 | +0.7 0 | 26 | +0 -0.8 | 3.2 | ±0.4 | 1.5 | |
| M16 | 17 | +0.8 0 | 32 | +0 -1 | 4.5 | ±0.5 | | |
| M20 | 21 | | 40 | | 6 | ±0.7 | 2 | |
| M22 | 23 | 44 | | | | | | |
| M24 | 25 | 48 | | | | | | |
| M27 | 28 | 56 | +0 -1.2 | 8 | 2.4 | | | |
| M30 | 31 | 60 | | | | 2.8 | | |

| Length | Under 50 | From 50 to 120 | Over 120 |
|---------------------|----------|----------------|----------|
| Tolerance of Length | ±1.0 | ±1.4 | ±1.8 |

► Mechanical Properties

Combination Type & Grade

Table1 Component Grades of Bolt Sets

| Component of set | Bolt | Nut | Washer |
|------------------|------|-----|--------|
| Grade | S10T | F10 | F35 |

Bolt Specimen

Table2 Mechanical Requirements for Coupons

| Grade | Yield Strength N/mm ² | Tensile Strength N/mm ² | Elongation % | Reduction of Area % |
|-------|----------------------------------|------------------------------------|--------------|---------------------|
| S10T | 900 min. | 1 000 to 1 200 | 14 min. | 40 min. |

Bolt Product

Table3 Mechanical properties of bolt products

| Grade | Minimum Tensile Load (kN) | | | | | | Hardness (HrC) |
|-------|---------------------------|-----|-----|-----|-----|-----|----------------|
| | Nominal Diameter | | | | | | |
| | M16 | M20 | M22 | M24 | M27 | M30 | |
| S10T | 157 | 245 | 303 | 353 | 459 | 561 | 27 to 38 |

Nut

Table4 Mechanical properties of nuts

| Grade according to mechanical properties of nut | Hardness | | Proof load |
|---|----------|--------|--|
| | Min. | Max. | |
| F10 | 20 HRC | 35 HRC | Same as tensile load (min.) of bolt in table 3 |

Washer

Table5 Hardness of washer

| Grade according to mechanical properties of washer | Hardness |
|--|------------------|
| F35 | 35 HRC to 45 HRC |

JSS-II-09 Grade S10T

JSS-II-09 Grade S10T

Axial load of Bolt

| Size | Axial load of Bolt (kN) | | |
|------|--------------------------------|--------------------|--------------------------------------|
| | Normal temperature (10°C~30°C) | Standard Deviation | Beyond normal temperature (0°C~60°C) |
| M16 | 110 ~ 133 | ≤8.5 | 106 ~ 139 |
| M20 | 172 ~ 207 | ≤13 | 165 ~ 217 |
| M22 | 212 ~ 256 | ≤16 | 205 ~ 268 |
| M24 | 247 ~ 298 | ≤19 | 238 ~ 312 |
| M27 | 322 ~ 388 | ≤24 | 310 ~ 406 |
| M30 | 394 ~ 474 | ≤30 | 379 ~ 496 |

▶ Weight Table

JSS II-09 S10T T/C Bolt with (one) F10 Hex nut and (one) F35 Washer

| Length (mm) | M16 | M20 | M22 | M24 | M27 | M30 |
|-------------|------------|------------|------------|------------|------------|------------|
| | Weight (g) | Weight (g) | Weight (g) | Weight (g) | Weight (g) | Weight (g) |
| 35 | 183 | | | | | |
| 40 | 191 | 318 | | | | |
| 45 | 199 | 328 | 449 | | | |
| 50 | 207 | 341 | 463 | 619 | | |
| 55 | 215 | 354 | 478 | 631 | | |
| 60 | 223 | 367 | 493 | 649 | | |
| 65 | 231 | 380 | 508 | 667 | | |
| 70 | 239 | 393 | 523 | 685 | 923 | |
| 75 | 247 | 406 | 538 | 703 | 946 | |
| 80 | 255 | 419 | 553 | 721 | 969 | 1231 |
| 85 | 263 | 432 | 568 | 739 | 992 | 1259 |
| 90 | 271 | 445 | 583 | 757 | 1015 | 1288 |
| 95 | 279 | 458 | 598 | 775 | 1038 | 1316 |
| 100 | 287 | 471 | 613 | 793 | 1061 | 1344 |
| 105 | 295 | 484 | 628 | 811 | 1084 | 1372 |
| 110 | 303 | 497 | 643 | 829 | 1107 | 1401 |
| 115 | 311 | 510 | 658 | 847 | 1130 | 1429 |
| 120 | 319 | 523 | 673 | 865 | 1153 | 1458 |
| 125 | 327 | 536 | 688 | 883 | 1176 | 1486 |
| 130 | 335 | 549 | 703 | 901 | 1199 | 1514 |
| 135 | 343 | 562 | 718 | 919 | 1222 | 1542 |
| 140 | 351 | 575 | 733 | 937 | 1245 | 1571 |
| 145 | 359 | 588 | 748 | 955 | 1268 | 1599 |
| 150 | 367 | 601 | 763 | 973 | 1291 | 1628 |
| 155 | 375 | 614 | 778 | 991 | 1314 | 1656 |
| 160 | 383 | 627 | 793 | 1009 | 1337 | 1684 |
| 165 | 391 | 640 | 808 | 1027 | 1360 | 1712 |
| 170 | 399 | 653 | 823 | 1045 | 1383 | 1740 |
| 175 | 407 | 666 | 838 | 1063 | 1406 | 1768 |
| 180 | 415 | 679 | 853 | 1081 | 1429 | 1796 |
| 185 | 423 | 692 | 868 | 1099 | 1452 | 1824 |
| 190 | 431 | 705 | 883 | 1117 | 1475 | 1852 |
| 195 | 439 | 718 | 898 | 1135 | 1498 | 1880 |
| 200 | 447 | 731 | 913 | 1153 | 1521 | 1908 |
| 205 | 455 | 744 | 928 | 1171 | 1544 | 1936 |
| 210 | 463 | 757 | 943 | 1189 | 1567 | 1964 |
| 215 | 471 | 770 | 958 | 1207 | 1590 | 1992 |
| 220 | 479 | 783 | 973 | 1225 | 1613 | 2020 |
| 225 | 487 | 796 | 988 | 1243 | 1636 | 2048 |
| 230 | 495 | 809 | 1003 | 1261 | 1659 | 2076 |
| 235 | 503 | 822 | 1018 | 1279 | 1682 | 2104 |
| 240 | 511 | 835 | 1033 | 1297 | 1705 | 2132 |
| 245 | 519 | 848 | 1048 | 1315 | 1728 | 2160 |
| 250 | 527 | 861 | 1063 | 1333 | 1751 | 2188 |



▶ Tightening Method

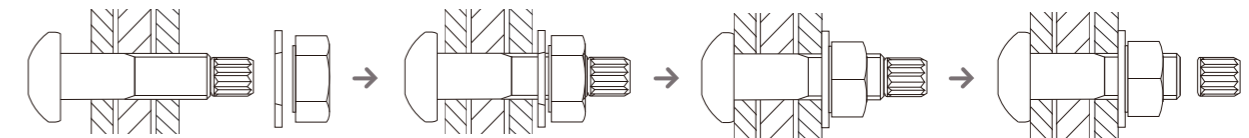
Torque Shear Bolt (S10T)

Confirm the direction of fastening nut and washes

Tightening by hands

Snug-Tightening

In case the washer has rotated or the splined end has not been severed After pretensioning, replace the bolt set.



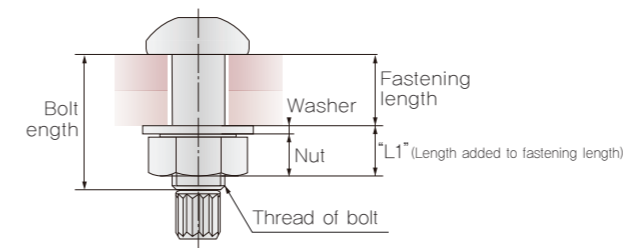
All boltholes shall be aligned to permit insertion of the bolts without undue damage to the threads before snug-tightening. (Do not hammer bolt head to insert the bolt in to the holes.)

In case it rains or snows after the snug-tightening, pretensioning must be done with the Bolts which are snug-tightened.

Do fastening after exact adjusting and confirmation the condition of inner socket. Use of bad socket may happen problem. (Torque Shear Bolt Sets)

▶ Calculation criteria of bolt length

High-tensile TS bolt



Calculation criteria of bolt length for TS bolt · hex bolt (HT)

| SIZE | Pitch | L1 | |
|------|-------|-----------|-----------------|
| | | TS (S10T) | HT (F8T · F10T) |
| M16 | 2.0P | 25 | 30 |
| M20 | 2.5P | 30 | 35 |
| M22 | 2.5P | 35 | 40 |
| M24 | 3.0P | 40 | 45 |
| M27 | 3.0P | 45 | 50 |
| M30 | 3.5P | 50 | 55 |

In calculating bolt length, add "L1" to fastening length.

High-tensile TS bolt includes 1 washer in nut part.

High-tensile hex bolt(HT) includes each 1 washer in bolt head and nut part.

Recommendation for storage



Things to avoid in storage



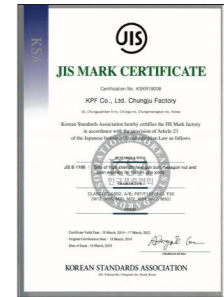


Core Competence

To maintain the quality and reliability of KPF products, we are continuously expanding our facilities and applying the latest technologies.

Proven quality and technical know-how of KPF

KPF's efforts to improve quality and the excellent values of our products were recognized through the rigorous certification procedures of leading certification authorities.



JIS B 1186



JIS B 1186_jp



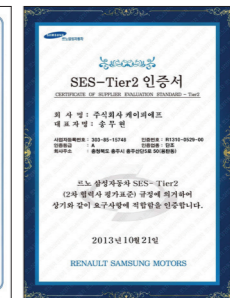
ISO / TS16949



A2LA



EN 15048



SES-Tier2



ISO9001



KS B 1002



KS B 1010



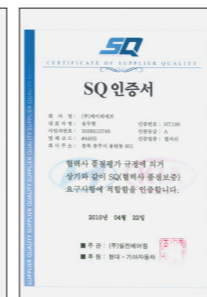
KS B 1012



EN 10204



SQ-Mark (forging)



SQ-Mark (Heat Treatment)



Lloyd' Register



EN 14399



DAST Richtlinie 021



K-OHSMS 18001 OHSAS 18001



KOSHA 18001



ISO14001



KPF PROJECTS

Towers and Buildings

- Lotte Tower (6th highest building), Korea
- Wilshire Grand Tower, USA
- SOCAR Tower, Azerbaijan
- Shard of glass Tower, UK
- Wells Fargo Towers, USA
- Al Bahr Towers, Abu Dhabi
- Mall of America Expansion, USA
- 20 fenchurch street building, UK
- Intel buildings, USA
- Apple new HQ, USA
- Tesla building, USA
- Nippon Express Pharmaceutical Center

Plants and Refineries

- Nuclear power plant, UAE
- CSP Steel Plant Project, Brazil
- Shah gas development, UAE
- Gasco ngi gas plant, UAE
- Manzanillo LNG Terminal, Mexico
- Refinery Master Plan 2, Philippines
- SULB Steel Mill, Bahrain
- Borouge 3 Polyolefin plant, Abu Dhabi
- Skikda Refinery, Algeria
- Saudi SPC PDH/PP, Saudi Arabia
- Boeing 777X Wing Plant, USA
- Chernobyl Confinement Shelte, Ukraine
- Taketoyo Power Plant
- Tanjung Jati Power Plant
- MIBU Biomas Power Plant
- IGCC Nakoso Power Plant
- Jimah East Power Plant
- Hekinan 2 Power Plant
- IGCC Hirono Power Plant

Stadiums

- Olympic stadium, Korea
- Minnesota Vikings Stadium, USA
- Haymarket Arena, USA
- Houston Rockets basketball stadium, USA
- NRG Football Stadium, USA
- Busch Baseball Stadium, USA
- TCF Stadium–University of Minnesota, USA
- San Diego Qualcomm stadium, USA
- Dallas cowboy football stadium, USA
- Sanfrancisco Giants baseball stadium, USA
- Houston Astros baseball stadium, USA
- Worldcup stadium, South Africa
- London Olympic stadium, UK
- Sacramento Kings Basketball stadium, USA
- Epic Systems Deep Space Auditorium, USA
- Ground zero museum, USA

Bridges

- Bridges
- Clyde Arc Bridge, Scotland
- Bay bridge, USA
- Orinoco river bridge, Venezuela
- Incheon Bridge, Korea
- Cheongdam Bridge, Korea
- Seongsu Bridge, Korea
- Gwangan Bridge, Korea
- Seohae Bridge, Korea
- Pathein Bridge Myanmar
- Yar Maung Bridge Myammar

Airports

- LA Airport renovation, USA
- Doha airport, Qatar
- Incheon International airport, Korea
- Mexico city airport, Mexico



Stadium



Plant



Nuclear power plant



Refinery

