# TRU-TENSION® FASTENERS

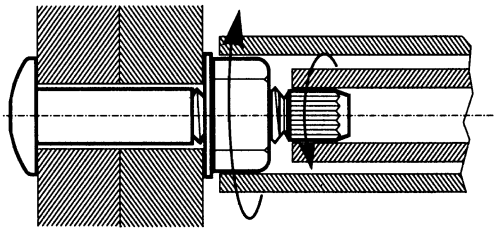
Tru-Tension® Structural Fasteners are a bolting system offering many advantages over conventional structural bolt systems. Lower costs for bolting installation and inspection can add up to tremendous savings when compared to conventional structural bolting systems.

In addition to the features offered by the Tru-Tension® Bolting System, you get the added confidence knowing that Tru-Tension® Assemblies come from Nucor Fastener Division, a leading manufacturer of structural fastener's in the United States. When buying structural products from Nucor Fastener Division, you are selling fasteners that are formed domestically in our QS9000 and ISO9002 registered facility from steel melted and rolled in the U.S.A. and tested in our A2LA Accredited in-house laboratory. Certifications are always available to the purchaser, including original steel certifications.

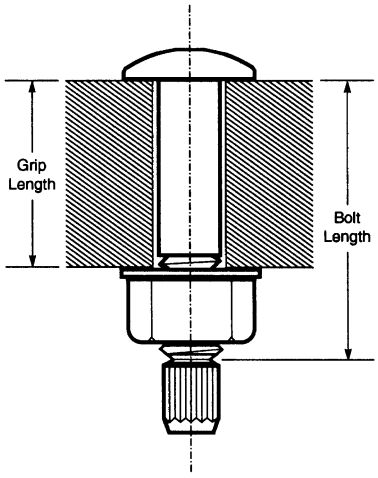
Tru-Tension® Structural Assemblies are installed with a quiet, light weight electric installation tool which reduces operator fatigue and eliminates problems in compliance with OSHA Noise Regulations encountered when using pneumatic impact wrenches. Since the bolt is calibrated so the spline tip twists-off when the proper bolt tension is achieved, there is no need to rely on a calibrated wrench or on an operator's skill to correctly install the bolt to the proper tension. Tru-Tension® Assemblies feature a specially developed lubricant system which provides consistent assembly properties over a wide range of installation conditions. The correct fastener tension compliance with AISC Bolting Specifications is achieved in the Tru-Tension® Assembly because the bolt assembly is factory calibrated, and evidence of proper tension can be accomplished by visual inspection to see that the spline has twisted off, thus reducing the expense of more costly bolting inspections.

## How The Tru-Tension® System Works

Tru-Tension® Fasteners are designed to be installed with various types of lightweight portable electric wrenches specifically intended for use with this style of structural fastener. They can be utilized for any applications where A325 - Type I or Type III (weathering steel) and A490 bolts are specified. The installation tool has an inner socket which engages the spline tip of the bolt, while the outer socket engages the nut. The outer socket rotates the nut relative to the bolt spline, and when the tension is sufficient in the fastener, the spline tip simply twists-off, leaving the tightened bolt correctly installed in the connection.



## Determination Of Tru-Tension® Length




| BOLT SIZE (IN.) | TO DETERMINE REQUIRED BOLT LENGTH, ADD TO GRIP, (IN.) |
|---|---|
| 5/8 | 7/8 |
| 3/4 | 1 |
| 7/8 | 1-1/8 |
| 1 | 1-1/4 |
| 1-1/8 | 1-1/2 |

## Structural Fastener Tension

Fastener test tension required for slip-critical connections and connections subject to direct tension.

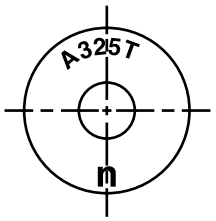
| NOMINAL BOLT SIZE, INCHES | MINIMUM TENSION[2] IN 1000'S OF POUNDS (kips) | |
|---|---|---|
| | A325 BOLTS | A490 BOLTS |
| 5/8 | 20.0 | 25.2 |
| 3/4 | 29.4 | 36.8 |
| 7/8 | 41.0 | 51.5 |
| 1 | 53.6 | 67.2 |
| 1-1/8 | 58.8 | 84.0 |

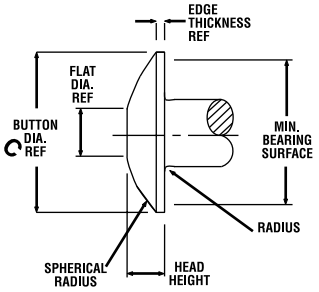
[2]Equal to 70 percent of specified minimum tensile strengths of bolts (as specified in ASTM Specifications for test of full size A325 and A490 bolts with UNC threads loaded in axial tension) rounded to nearest 100 lbs. (includes 5% per AISC spec.)

## *Dome Head Tru-Tension® Fasteners*

Tru-Tension® A325 Assemblies are manufactured to ASTM F1852 in the United States using domestically produced steel. Each Tru-Tension® Bolt is pre-assembled with an ASTM F436 Hardened Washer and a Heavy Hex Nut. The lots are fully traceable from raw material through to finished product. Each lot is fully tested by our A2LA Accredited Laboratory and certified test reports are included with each shipment.

The bolts are supplied as ASTM A325 ("Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength") or ASTM A490 ("Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength") with a dome, or round head configuration. The mechanical properties, threads, and thread length are the same as for Heavy Hex Structural Bolts. The diagram (to the side) and the table (below) show the dimension of the dome head configuration used by Nucor Fastener.




| *BOLT DIAMETER* | *NUCOR FASTENER HEAD HEIGHT-h* | *LARGE HEAD BEARING DIAMETER-D* | *ASTM F1852 (SMALL) BEARING DIAMETER-D* | *ASTM F436 WASHER DIAMETER* | *FILLET RADIUS - r* |
|---|---|---|---|---|---|
| 3/4″ | .455″/.483″ | 1.438″ minimum | 1.338″ minimum | 1.438″/1.500″ | .021″/.062″ |
| 7/8″ | .531″/.563″ | 1.719″ minimum | 1.535″ minimum | 1.719″/1.781″ | .031″/.062″ |
| 1″ | .591″/.627″ | 1.969″ minimum | 1.771″ minimum | 1.969″/2.031″ | .062″/.093″ |
| 1-1/8″ | .658″/.718″ | 2.219″ minimum | 1.991″ minimum | 2.219″/2.282″ | .062″/.093″ |

## *Dimensions For Tru-Tension® Bolts*

Because of Nucor Fastener's full range of manufacturing capabilities, we are able to offer Tru-Tension® Fasteners in a wide range of sizes and grades that may be specified. Nucor offers Tru-Tension® Fasteners in 3/4″, 7/8″, 1″, and 1-1/8″ diameters in lengths up to 6″. Grades offered include A325 - Type I Plain, A325 - Type III, and A490.

The correct fastener tension, in compliance with AISC/RCSC Bolting Specifications (covered in the "Specification for Structural Joints Using ASTM A325 or A490 Bolts"), is assured by proper control of the dimensions (especially the groove diameter of the spline) and friction conditions.

## *Advantages And Features Of Tru-Tension® Fasteners*

### *Meets Or Exceeds AISC Tension Requirements*

- Provides dependability by consistently exceeding the minimum AISC bolt installed tensions.
- Fully tested and certified assemblies.
- Installation is completed without putting torsion into bolt length - only the bolt length between the nut and splined tip is in torsion - the balance of the bolt is in tension, providing more consistent and greater available bolt tensions.

### *Confident Domestic Supply*

- Domestic single source.
- Technical service and supported with inventory.
- Full Traceability, just like all other Nucor Fastener Division products.

### *Easy To Install*

- Can be used anywhere a standard structural bolt is used (provided that it is acceptable to the responsible designer or project engineer).
- Does not depend on tool calibration or operator skill for proper assembly.
- Lightweight installation tool.
    - Electric tools are powered by 110 volt electricity.
    - Quiet installation system.
- Reduced operator fatigue.
    - Non-Impacting Electric Tool.
    - No external reaction moment (to twisting).
    - Easier to setup and move than air compressor and air lines.
- Shipped assembled (nut, bolt & washer) in sealed metal kegs. No field nutting required.
- Pre-assembled fasteners that ensure matched sets - saves assembly time.

### *Allows For Rapid Visual Inspection*

- Eliminates operator error during assembly.
- Can visually inspect for proper installation by seeing that the spline has twisted off.
- No need for expensive installation tool calibration.

### *Reduced Cost Of Installation*

- Save money in installation.
    - Increased installation speed (typically 2 to 3 times more bolts installed per man-hour).
    - Lower inspection costs (quick visual check vs. typical rechecking of - 5% of all joints).
- Pre-assembled fasteners that ensure matched sets - saves assembly time.
- One man, one side assembly (no need for a back-up man).
- Tru-Tension® Bolting can save money in shop fabrication by using bolted web stiffeners and gussets rather than welding. Successful bolt installation does not require highly skilled labor.

## *Typical Expected Cost Savings*

The following information is an overview of typical savings that may be possible when using Tru-Tension® Fasteners instead of a standard A325 Bolt with a nut and washer.

| *Installation Condition* | *Regular A325 Bolt-Nut-Washer* | *Tru-Tension® Fastener* |
|---|---|---|
| Purchase Fasteners | Buy Bolt, Nut, and Washers Separately.<br>Come in separate containers.<br>Maintain separate test reports, lot numbers, documentation. | Buy Tru-Tension® Fastener.<br>Come pre-assembled in 1 can.<br>One source for test reports, documentation. |
| Pre-Testing | Test each combination of bolt-nut-washer in load cell. Maintain this combination in the field. Test daily for calibrated wrench tightening. | Run confirmation testing in load cell using standard electric wrench. |
| Equipment and Tools<br>(enough to do the job) | Impact Wrenches (~35# each) and air compressors/air lines.<br>Load Cell.<br>Calibrated Torque Wrench. | Shear Wrenches (~15# each) and electric generator.<br>Load Cell. |
| Pre-tensioning | Each connection, starting from most rigid section. | Each connection, starting from most rigid section. |
| Installation | Typically ~24/40 bolts/man-hour. | Typically ~60/100 bolts/man-hour |
| Inspection | Typically, could expect to recheck 5-10% of the bolts by manual torque wrench | Visual inspection is normally all that is required. |

- The cost of the first three rows will vary by project. The cost of additional paperwork and maintenance of the individual containers can be expected to take up to 1/2 hour per lot of received material. Pre-testing is very quick and simple for Tru-Tension® products. If calibrated torque wrenches are used for installation, pre-testing must be done on a daily basis (resulting in several additional hours over the course of the project). Also, tool calibration is required for installation by torque.

- Pre-tensioning operations are the same for all high strength structural bolts. The snug tight condition is required for all connections prior to final tightening.

- Final installation is typically two to three times faster with Tru-Tension® Fasteners. At typical hourly rates of $50/hour and an average installation of 30 bolts/man-hour for separate components, the following savings can be expected:

| | *1,000 Bolts* | *5,000 Bolts* | *10,000 Bolts* | *25,000 Bolts* | *50,000 Bolts* |
|---|---|---|---|---|---|
| ***Two Times Faster*** | $833.00 | $4,167.00 | $8,333.00 | $20,833.00 | $41,667.00 |
| ***Three Times Faster*** | $1,111.00 | $5,556.00 | $11,111.00 | $27,778.00 | $55,556.00 |

- The direct labor installation cost savings is approximately $1/bolt, not counting savings for inspection costs after final installation (which will vary based on testing scheme, but would likely add more than $0.10/bolt to the total cost).

## Handling, Storage And Pre-Installation

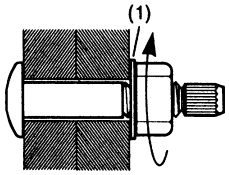
1. Handling and Storage: The following information, from the AISC/RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", is applicable to all high strength fasteners, including Tru-Tension® products: "Fasteners shall be protected from dirt and moisture at the job site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that is present in as-delivered condition." The last point is very important for Tru-Tension® Fasteners. The lubrication condition on the fasteners cannot be modified (That is: never clean, strip, or add additional lubrication to the product). Opened cans should be stored indoors, protected from the elements, to prevent environmental contamination (rain, dirt, rust, etc.).

2. Use of Washers: The ASTM F436 Washer must be placed under the nut in all cases. No additional washer is needed for dome head Tru-Tension® for oversize or short slotted holes since the bearing circle under the head is equal to the diameter of an ASTM F436 hardened washer. An additional ASTM F436 hardened washer is required under the bolt head in these situations for a hex head or a smaller dome head product.

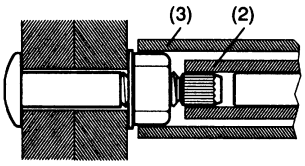
3. Snug Tightening: All of the fasteners in the connection must be brought to a snug tight condition prior to final tightening. This method will prevent interactions between bolts as additional bolts are tightened. As always, fasteners should be tightened in sequence from the most rigid section outward. In some cases, this may require more than a single cycle of systematic tightening.

4. Sample Testing: Representative samples should be checked at the job site in a device capable of indicating bolt tension. The testing should demonstrate that the system develops the proper tension, prior to installation, in accordance with AISC recommendations.

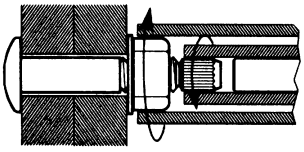
## Installation Procedures

1. 

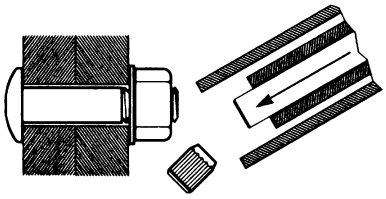

Nut and washer (1) identification markings should face away from the connection. All fasteners in the connection should be snug tight.

2. 


Fit inner socket (2) over the grooved spline and push the wrench slightly, then engage the outer socket (3) over the nut.

3. 

Start the wrench. The outer socket rotates the nut relative to the bolt during tightening, and the bolt will be tightened until the required bolt tension is reached. At this point the splined tip shears off.

4. 

When the installation is complete, remove the socket from the nut and depress the ejection lever to discharge the sheared spline from the inner socket of the wrench.