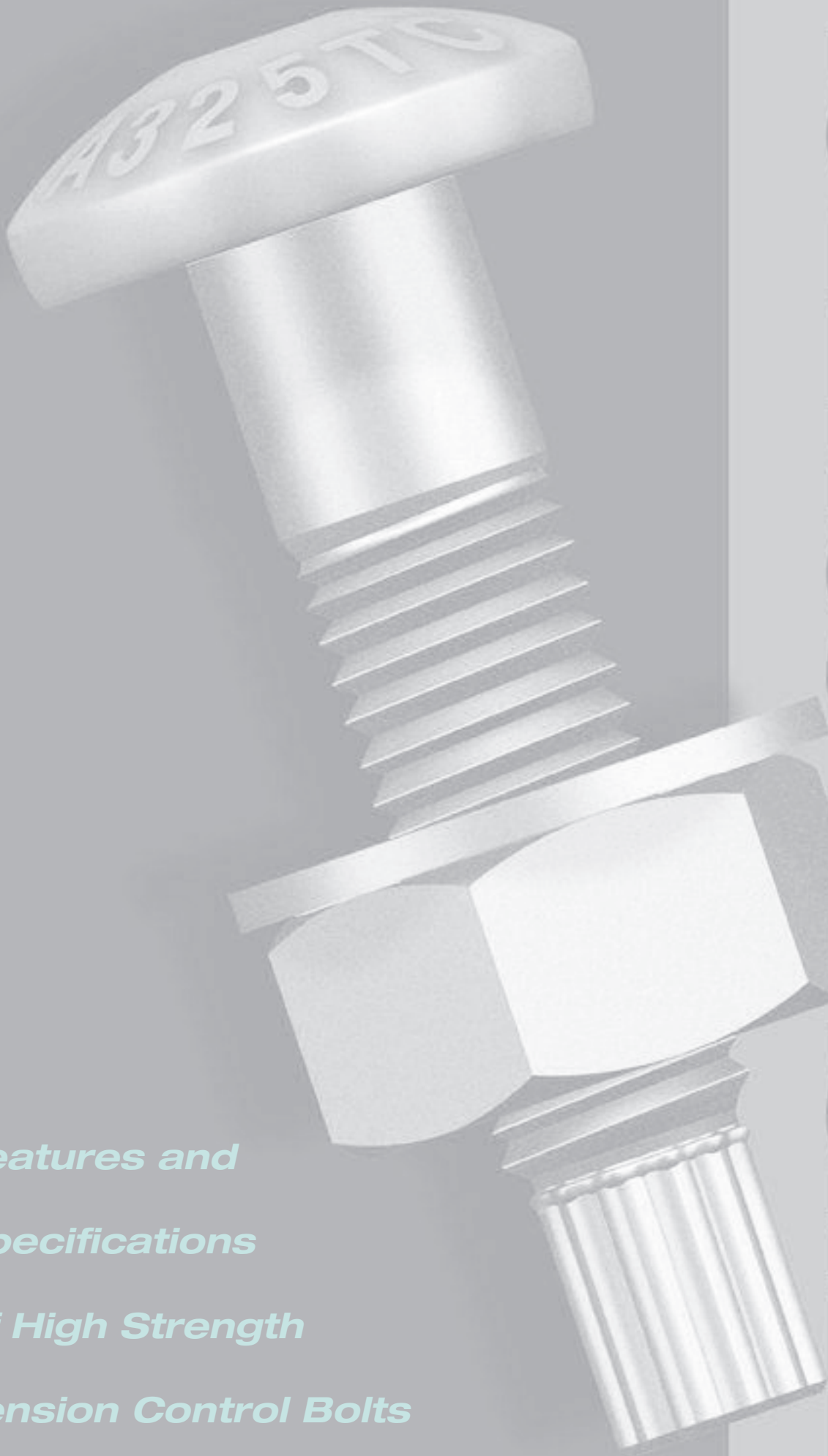


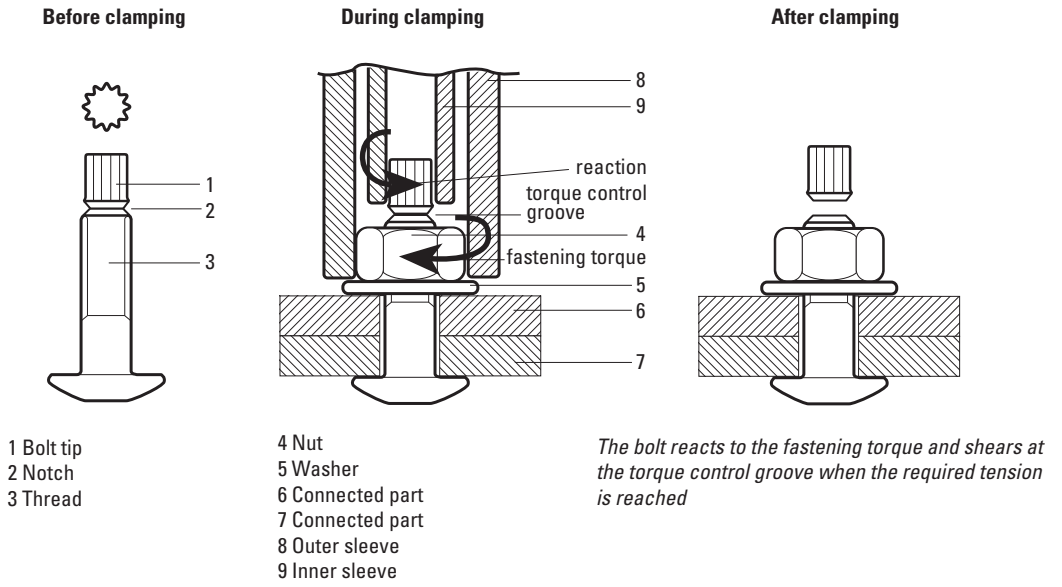
*Features and
Specifications
of High Strength
Tension Control Bolts*

**TENSION CONTROL
BOLTING, INC.**



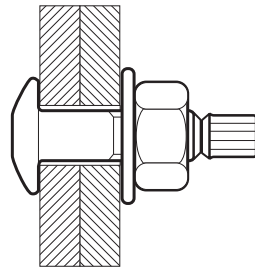
Features of High Strength T.C. Bolts

- Controlled clamping force
- One man installation
- Noiseless installation
- No tool calibration
- Visual inspection
- Direct tension installation
- Single washer installation

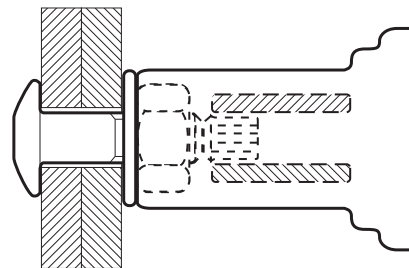


Installation Procedure

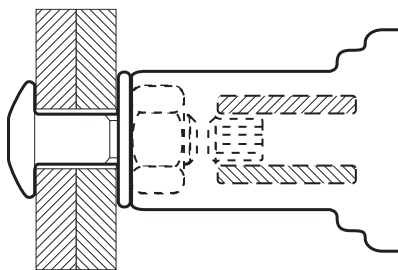
1. Place the bolt into the connection with the washer under the nut.



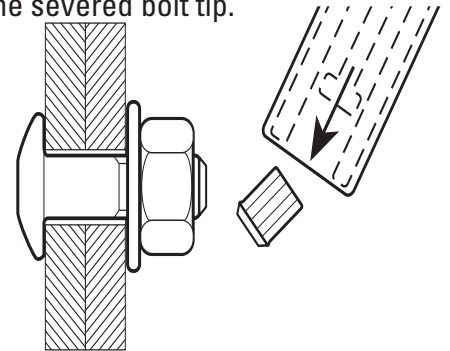
2. Slide the inner socket over the bolt tip and the outer socket over the nut.



3. Turn 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 tip of the bolt will shear off.



4. When the tip of the bolt shears, pull back on the wrench until the outer socket is no longer engaging the nut. Push the ejector lever to discharge the severed bolt tip.





TC BOLT DESIGNATION

As of 1998, TC Bolts have their own ASTM Designation – F-1852.

This specification has the same chemical and mechanical specs as A325. The new head marking is A325 TC.

1. Mechanical Requirements

Tensile Requirements for Full-Size Tension Control Bolts

Bolt Size Threads per Inch & Series Designation	Stress ^a Area in.	Tensile ^b Strength	Proof Load ^b Length Measurement Method Minimum	Alternate Proof Load ^b Yield Strength Method Minimum
	Minimum	Minimum	Minimum	Minimum
Column 1	Column 2	Column 3	Column 4	Column 5
5/8" -11 UNC	0.226	27,100	19,200	20,800
3/4" -10 UNC	0.334	40,100	28,400	30,700
7/8" -9 UNC	0.462	55,450	39,250	42,500
1" - 8 UNC	0.606	72,700	51,500	55,750
1 1/8" -7 UNC	0.763	80,100	56,450	61,800

a. The stress area is calculated as follows: $A_s = 0.7854 [D - (0.9743/n)]^2$ where:

A_s = stress area in²

D = nominal bolt diameter, and

n = threads per inch

b. Loads tabulated and based on the following:

Bolt size	Column 3	Column 4	Column 5
1/2" to 1" incl.	120,000 psi	85,000 psi	92,000 psi
1 1/8"	105,000 psi	74,000 psi	81,000 psi

Hardness of Bolts

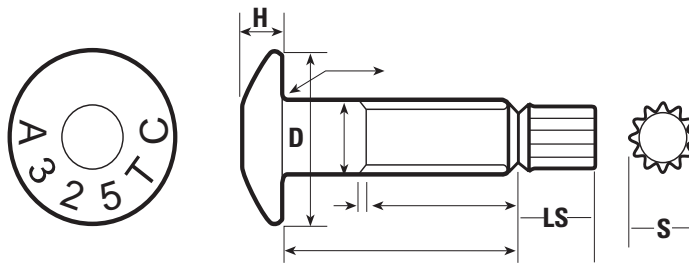
Hardness Requirements for Tension Control Bolts

Bolt size, in.	Bolt Length, in.	Hardness			
		Brinell		Rockwell C	
		minimum	maximum	minimum	maximum
1/2" to 1", incl.	Less than 3D(A)	253	319	25	34
	3D and over	-	319	-	34
1 1/8"	Less than 3D(A)	223	286	19	30
	3D and over	-	286	-	30

(A) Bolts having a length less than 3 times the diameter are subject only to minimum/maximum hardness. Such lengths cannot be reasonably tensile tested.

D = Nominal diameter or thread size.

4. Shape and Dimensions



Dimensions for Tension Control Bolts

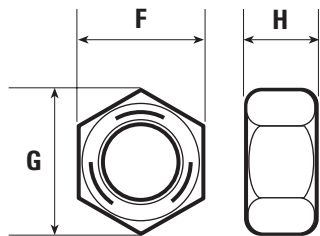
Nominal Size or Basic Product Diameter	D Bearing Surface Diameter	H Height		LS Length of Spline	S* Width Across Flats
		Min.	Max.		
5/8"	0.625	1.102	0.403	0.378	0.43
3/4"	0.750	1.338	0.483	0.455	0.53
7/8"	0.875	1.535	0.563	0.531	0.61
1"	1.000	1.771	0.627	0.591	0.70
1-1/8"	1.125	1.991	0.718	0.658	0.80
		A		B	B

Length Tolerance

Nominal Bolt Size	5/8"	3/4" thru 1"
Nominal Bolt Length	Tolerance of Length	
thru 6 in.	-0.12	-0.19
over 6 in.	-0.25	-0.25

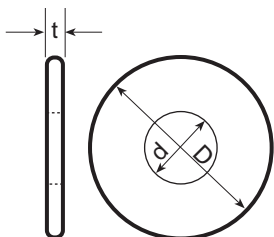
Dimensions of Heavy Hex Nuts

Nominal Nut Size in.	Width Across Flats F			Width Across Corners G		Height H		
	Basic	Max.	Min.	Max.	Min.	Basic	Max.	Min.
5/8	1-1/16	1.062	1.031	1.227	1.175	39/64	0.631	0.587
3/4	1-1/41	1.250	1.212	1.443	1.382	47/64	0.758	0.710
7/8	1-7/16	1.438	1.394	1.660	1.589	55/64	0.885	0.833
1	1-5/8	1.625	1.575	1.876	1.796	63/64	1.012	0.956
1-1/8	1-13/16	1.812	1.758	2.093	2.002	17/64	1.139	1.079



Dimensions of Circular Washers

Nominal Bolt Size in.	Outside Dia. D		Dia. of Hole d		Thickness t	
	Nom.	Tolerances	Nom.	Tolerances	Max.	Min.
5/8	1-5/16	-1/32: +1/4	11/16	-0: +1/32	0.177	0.122
3/4	1-15/32	-1/32: +1/4	13/16	-0: +1/32	0.177	0.122
7/8	1-3/4	-1/32: +1/4	15/16	-0: +1/32	0.177	0.136
1	2	-1/32: +1/4	1-1/8	-0: +1/32	0.177	0.136
1-1/8	2-1/4	-1/32: +1/4	1-1/4	-0: +1/32	.0177	0.136



2. Fastener Tension Required for Slip-critical Connections Subject to Direct Tension

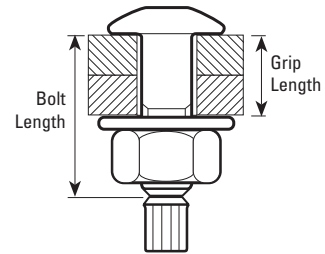
Nominal Bolt Size, Inches	Minimum Tension*
	in 1000's of Pounds (kips) A325 Bolts
5/8	19
3/4	28
7/8	39
1	51

*Equal to 70 percent of specified minimum tensile strengths of bolts, rounded off to the nearest kip.

3. Determination of Bolt 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

*Exclusive washers –
The length determined by the use of table above should be adjusted to the next longer 1/4 inch.



5. Assembly

Assembly Type and Finish	Nut Specification, Class and Finish	Washer Specification, Type and Finish
Type 1 Plain	A563 DH Plain A194 2H Plain A563 C Plain	F436 Type 1 Plain
Type 1 Mech. Zinc Coated	A563 DH Mech. Zinc Coated	F436 Type 1 Mech. Zinc Coated
Type 3 Plain	A563 DH3 Plain A563 C3 Plain	F436 Type 3 Plain

6.6.4 All nuts shall be Heavy Hex. All washers used in the assembly shall be circular and through hardened.

6. Chemical Composition

CARBON STEEL

Element	Heat Analysis	Product Analysis
Carbon	0.30 - 0.52	0.28 - 0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.048
Sulfur, max	0.050	0.058
Silicon	0.15 - 0.30	0.13 - 0.32

Boron
For Type 1 bolts made from plain carbon steel or alloy steel, heats of steel to which boron has been intentionally added shall not be permitted. Compliance with ASTM F1852 Sections 7.1.4 and 7.1.5 shall be based on certification.

CARBON BORON STEEL

Element	Heat Analysis	Product Analysis
Carbon	0.30 - 0.52	0.28 - 0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.048
Sulfur, max	0.050	0.058
Silicon	0.10 - 0.30	0.08 - 0.32
Boron	0.0005 - 0.003	0.0005 - 0.003

ALLOY STEEL

Element	Heat Analysis	Product Analysis
Carbon	0.30 - 0.52	0.28 - 0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Silicon	0.15 - 0.35	0.13 - 0.37

Boron
For Type 1 bolts made from plain carbon steel or alloy steel, heats of steel to which boron has been intentionally added shall not be permitted. Compliance with ASTM F1852 Sections 7.1.4 and 7.1.5 shall be based on certification.

Alloying Elements (B) (B)

(B) Steel, as defined by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese, 1.65%, silicon, 0.60%, copper, 0.60%; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99%, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

Specifications for the Installation and Inspection of Tension Control Bolts

Installation

Follow the procedures illustrated on page 1 of this brochure.

Inspection

1. Sample bolts should be selected at random from those delivered to the fabricating shop and/or job site.
2. These sample bolts should be placed individually into a device capable of indicating bolt tension and tightened with a T.C. wrench until the splined tip shears off.
3. After the tip of the bolt has sheared, the bolt tension should be equal to or greater than those in the table below.

4. Minimum Bolt Tension:

Bolt Diameter	Minimum Bolt Tension	
	ASTM A-325	ASTM A-490
1/2"	13,000 lbs.	16,000 lbs.
5/8"	20,000 lbs.	25,000 lbs.
3/4"	29,000 lbs.	37,000 lbs.
7/8"	41,000 lbs.	51,000 lbs.
1"	54,000 lbs.	67,000 lbs.
1-1/8"	59,000 lbs.	84,000 lbs.

5. After the inspector has determined that the bolt tips are shearing at or above minimum bolt tension, visual inspection of the bolt tip is sufficient.**

6. Disagreement over test results:

When there is disagreement concerning the results of inspection of bolt tension, the arbitration inspection procedure specified in A.I.S.C. Publication "Specification for Structural Joints Using ASTM A325 or A490 Bolts" should be used. This procedure is Section 9(b) of the publication.

**If the tip of the bolt has been sheared, then the bolt is properly installed.