

# STRUCTURE BULLETIN





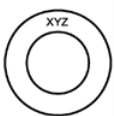
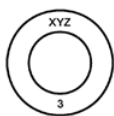


## NCDOT Construction Unit

[Website](#) [email](#)

### Current Issue: High Strength Bolts, Nuts & Washers

When installing structural bolts and washers for NCDOT bridge construction projects, it is important to understand the differences between Type 1 and Type 3 fasteners as defined in ASTM F3125. Type 1 bolts are made from medium carbon steel or carbon alloy steel and require an approved corrosion-resistant coating, such as mechanical galvanizing (Subarticle 1072-5(F)). In contrast, Type 3 bolts are made from weathering steel and are designed to form a protective rust-like patina, eliminating the need for additional coatings. Type 3 bolts are used when the girders are made with weathering steel.

Project personnel should verify that the fasteners installed match what is specified in the structure plans, which will indicate whether Type 1 or Type 3 bolts are required. The appropriate nuts and washers must also be selected based on the bolt type and should meet the identification requirements outlined in the NCDOT Standard Specifications. **Type 3 bolts can be visually distinguished by an underline beneath the grade marking on the bolt head. Similarly, Type 3 nuts include a “3” in the grade (e.g., DH3), and Type 3 washers are marked with the numeral “3.” Proper identification and installation of the correct bolt type are essential to ensure the long-term durability and performance of structural connections.**

ASTM F3125 Grade A325 bolt	Type 1	Type 3
		
ASTM A563 nut	Type 1, Grade DH	Type 3, Grade DH3
		
ASTM F436 washers	Type 1	Type 3
		
ASTM F959 Direct Tension Indicators for Group 120	Type 1	Type 3
		



1. High Strength Bolts – Grade and Type
2. Squirt DTI's
3. Bolted Connections

### Bolted Connections

Bolted Connections should look right... meaning the bolt head, nut, and washers should be physically seated properly. Section 440-8 covers this in some detail. We are looking for a connection that fits "solidly together". There should be no gaps or separation between the planes of each material incorporated in the connection. The contact surfaces should be free of anything that could inhibit the connection planes from mating together appropriately.

Additionally, the slope of surfaces of bolted parts in contact with the bolt head and nut should not exceed 1:20 with respect to a plane normal to the bolt axis.

When a slope greater than 1:20 is encountered, a hardened beveled washer is typically used to compensate for the lack of parallelism. If this situation is encountered, elevate this to your Regional Bridge Construction Engineer for guidance.

## Question: Can contractors use “squirt” DTIs on our project?

**Answer:** In *Structure Bulletin – Volume 2, Issue 2*, we answered this same question—but since it’s been several years, it’s worth repeating.

A DTI (Direct Tension Indicator) is a washer with raised protrusions. When a high-strength bolt is tensioned, it compresses these protrusions against the bolt head. The remaining “gap” can be checked with a feeler gauge to verify that the required tension has been achieved.

A standard DTI and a squirt DTI are functionally the same, except that a squirt DTI contains a silicone material in the protrusions forming the dimples. As the bolt is tightened and the DTI compresses, the silicone is squeezed out, providing a visual indicator that compression has occurred (see picture).



As noted previously, we do **not** use this visual indicator for acceptance. A minimum of 10% of the bolts in each connection must still be checked with a feeler gauge. The silicone is strictly for contractor convenience.

NCDOT requires the DTI to be placed under the bolt head, *unlike the picture above*. A slide from the 2023 Structure Inspector Training class is included on Page 3 for reference on how to install DTI’s and check the gap with a feeler gauge.

## Videos:

**\*\*\*NEW\*\*\*** The 2025 Basic Structure Inspector Training videos are now posted on the [Construction Unit YouTube playlist](#). Prior year’s inspector training videos and other helpful videos can also be found here.

## Structure Inspector Training:

The 2026 Structure Inspector Training is currently being planned. Retaining Walls will be the primary topic for next year’s training.

Structure Bulletins are archived on the [Construction Unit](#) website under [Construction Resources](#).

## Structure Bulletin Signup:

Scan the QR code below to sign up for the distribution lists to avoid missing any valuable information.

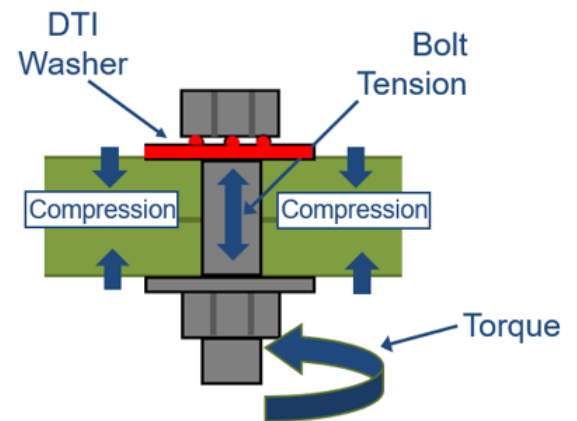


## *Direct Tension Indicators (DTI's)*

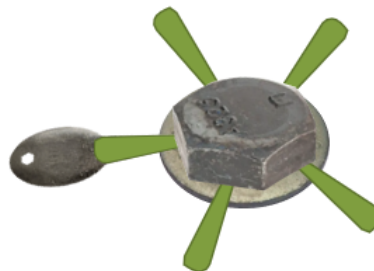
- DTI's measure tension in a bolt
- DTI's Do Not measure torque

7/8" Bolt - Minimum Tension  
**39,250 lbs**

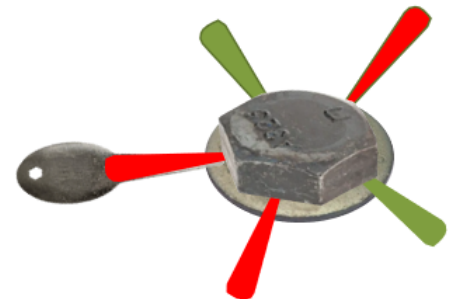
Number of Spaces in Washer	Number of Spaces Gauge is Refused
4	2
5	3
6	3
7	4



A) 0.005" Feeler Gauge



B) Feeler Gauge Entry



C) Feeler Gauge Refusals

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