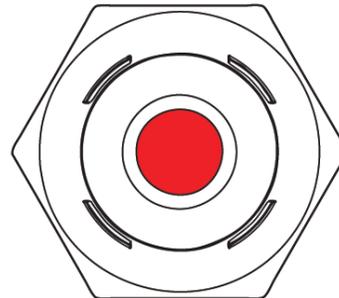
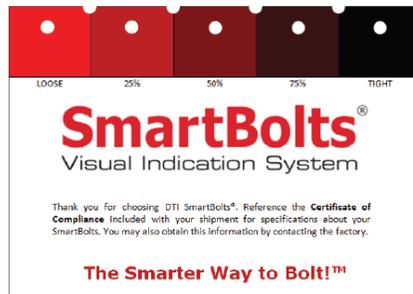


DTI SmartBolts® are tension indicating fasteners designed for use your most important bolted joints. SmartBolts® ensure proper preloading of these bolted joints with its Visual Indication System. The Visual Indication System also makes monitoring of in-service tension straightforward and eases maintenance of bolted joints.



DTI Visual Indication System

- **The DTI Verification Guide** – The Verification Guide is a calibrated color scale that enables accurate comparison and measurement of the indicator’s color during installation and inspection.
- **The DTI Visual Indicator** – The indicator of the DTI SmartBolt measures actual fastener elongation and converts this deflection in to a distinct color change. The color of the indicator gives a continuous real-time signal to the observer.

Available DTI SmartBolt Specifications

| | |
|---------------------------------------|--|
| Bolt Types | HHCS, HVCS, HFLB, SHCS, STUD, and more |
| Bolt Diameter Ranges | 7/16" (M10) to 2 1/2" (M64) |
| Bolt Length Ranges | 1 1/4" (30mm) to 24" (600mm) |
| Available Material Grades | Grade 5, Grade 8, Class 8.8, Class 10.9, and more |
| Available Finishes | Plain, Clear Zinc, Yellow Zinc, and more |
| Thread Length | Partial or Full |
| Available Design Tension Range | 30 – 90% of Modified Proof Load |
| Operating Temperature Range | - 4°F to 168°F [- 20°C to 75°C] |
| Grip Lengths | Minimum Grip Lengths apply to some partially threaded and all fully threaded bolts |
| Optional Features | Protective Recess, Contamination Seal, Made in USA Bolt |

Engineering Design Process

The SmartBolt engineering design process begins with the **Product Request Form**. This form is used to gather all of the specifications related to the bolt and bolted joint as well as expected customer demand.

Industrial Indicators then analyzes the feasibility of the customer's request and recommends a unique SmartBolt design to match the customer requirements. During the application analysis, information on design tension, bolt tensile and shear strength, installation requirements, and environmental considerations are gathered and recorded.

The base bolt conforming to the requested specifications is then sourced from a quality supplier, where pricing and availability is established. With this information and knowledge of the recommended SmartBolt configuration, we provide a **Quote** for a specific SmartBolt solution.

Once the customer places an order, a **Final Production Design** is established through trials. Design trials are tested for accuracy to the requested Nominal Design Tension established in the analytical design. When the indicating tension of the new design is within acceptable limits, the final production run is approved and the **Basic Design Tension** is established.

Each and every SmartBolt is then tested and inspected to ensure they are within the +/- 10% specification limits established by the **Basic Design Tension**. A **Certificate of Compliance** is included and lists the **Production Testing Mean and Standard Deviation** as well as other data such modified proof load and grip length limits.

The finished SmartBolts are then shipped to the customer with **Quick Start Guide**, **Certificate of Compliance**, and a **Verification Guide**. The Verification Guide is a calibrated color scale that is used to match the indicator color during installation and inspection.

SmartBolt Terminology

- **Head Type**
 - **HHCS – Hex Head Cap Screw** – Features a bearing surface that is flat and washer faced.
 - **HVCS – Heavy Hex Head Cap Screw** – Features a greater width across wrenching flats with a bearing surface that is washer faced and flat.
 - **HFLB – Hex Flange Bolt** – Features an enlarged bearing surface that extends beyond the hex head like a built in washer.

- **Bolt Dimensions**
 - **Nominal Diameter** – Standard (rounded) size of the unthreaded body or major diameter of the threads.
 - **TPI / Pitch** – The pitch is the distance between two successive thread crests or roots. Pitch is usually specified for metric fasteners. TPI stands for “threads per inch” and is used with inch fasteners. Pitch is equal to the reciprocal of TPI.
 - **Length** – The length of a bolt as measured from underneath the head (bearing surface).

- **Grade/Class** – The grade or class is used to describe the fastener material properties.
 - **Grade 5** - SAE J429 Grade 5 is an inch property grade of medium carbon (or alloy) steel
 - **Grade 8** - SAE J429 Grade 8 is an inch property grade of medium carbon alloy steel
 - **Class 8.8** - ISO 898-1 Class 8.8 is a metric property class of medium carbon steel
 - **Class 10.9** - ISO 898-1 Class 10.9 is a metric property class of carbon alloy steel

- **Finish** – Describes the coating applied to base materials in order to provide enhanced properties, such as increased corrosion resistance.
 - **Plain** – Bare metal and may or may not have a coating of light oil to resist corrosion, generally provided with a cosmetic black oxide finish.
 - **Clear Zinc** – Electroplated Zinc with clear trivalent Chromate finish. Provides better corrosion protection than Plain.
 - **Yellow Zinc** – Electroplated Zinc with yellow hexavalent Chromate finish. Provides better corrosion protection than Clear Zinc but is not RoHS compliant.
- **Thread Length** – Describes whether the shank of the fastener should be fully threaded or only partially threaded.
- **Nominal Design Tension** – The indicating tension of the SmartBolt rounded to the nearest 5% increment. Usually given as a percentage of proof strength, denoted by a capital **P** suffix. A capital **Y** will signify when the Nominal Design Tension is a percentage of yield strength. A standard Nominal Design Tension for SmartBolts® is 70% of Modified Proof Load.
- **Basic Design Tension** – The expected mean indicating tension of a particular SmartBolt design. The +/- 10% upper and lower specification limits are based off of this value. The Basic Design Tension will be within 5% of the Nominal Design Tension in most situations.
- **Production Testing Mean** – The actual mean of tension measurements gathered from the entire production job during testing and inspection.
- **Production Testing Standard Deviation** – The calculated spread of tension measurements gathered from the entire production job during testing and inspection.
- **Grip Length** – The distance from the fastener bearing surface to the plane of thread engagement
 - **Minimum** – As related to SmartBolts®, the minimum grip length specifies the shortest grip length that the SmartBolt can have in a bolted joint without affecting accuracy.
 - **Specified** – As related to SmartBolts®, the specified grip length states the exact grip length that the SmartBolt is designed to be used with. Specified grip length is generally used when the grip length required is less than the minimum grip length.
- **Shear Plane** – The shear plane is the plane in which shear stress occurs. It can be specified as the distance from fastener bearing surface to the related plane. In cases of single shear, only one shear plane exists while cases of double shear have two shear planes.
- **Modified Proof Load** – The maximum tensile force after modification the SmartBolt can withstand without any yielding. The modified proof load is usually the same as the original proof load except in cases of reduced strength (see question on strength under the FAQ section).
- **Modified Yield Strength** – The maximum tensile force after modification the SmartBolt can withstand without greater than 0.2% yielding. The modified yield strength is generally used when a proof strength is not specified for a certain material. The modified yield strength is usually the same as the original yield strength except in cases of reduced strength (see question on strength under the FAQ section).

- **Modified Ultimate Tensile Strength** – The maximum tensile force after modification the SmartBolt can withstand before fracture. The ultimate tensile strength is usually the same as the original tensile strength except in cases of reduced strength (see question on strength under the FAQ section).

DTI SmartBolts: Frequently Asked Questions

Q) What range of indicating tensions are available?

A) In general, customers are able to request indicating tensions from 30 – 90% of the fastener proof load in increments of 5%. Indicating tensions beyond this range are assessed on a case by case basis.

Q) Do DTI SmartBolts lose tensile strength due to the conversion?

A) In most cases, DTI SmartBolts do not lose any tensile strength. However, when the modification of the indicator protrudes into the threaded or transition regions of the bolt, a reduction in tensile strength will occur. The amount of strength reduction is determined during the engineering analysis and made available to the customer prior to ordering. In cases of reduced strength, the original proof and tensile loads are derated by various amounts, depending on the bolt.

Q) Can DTI SmartBolts be reused?

A) Yes! DTI SmartBolts are designed to operate in the elastic range of the fastener and therefore are reusable for the endurance limit of the bolt.

Q) What happens if I over stretch the bolt?

A) The DTI SmartBolt Visual Indicator is essentially a linear strain gauge within the bolt. If the portion of the bolt that contains the indicator is permanently deformed (yielded), it can lose calibration by zero shift error in the indicator. This zero shift error can make the indicator appear darker than normal at zero tension. An easy way to check if a bolt has been significantly yielded is to loosen the bolt and check that the indicator matches the “loose” red color.

Q) Can DTI SmartBolts operate in wet environments?

A) Yes, DTI SmartBolts operate well in outdoor, wet weather exposure as well as metalworking fluid environments. For full submersion or direct blast exposure, please contact us for options.

Q) What is the temperature range that DTI SmartBolts can operate within?

A) DTI SmartBolts are specified to operate in environments from -4°F to 168°F (-20°C to 75°C)

Q) What does minimum grip length mean?

A) When relating to DTI SmartBolts, the minimum grip length specifies the shortest grip length that the SmartBolt can have in a bolted joint without affecting accuracy.

If you have any additional questions about DTI SmartBolts® or their use, please don't hesitate to contact us at (240) 631-7246 or by email at sales@smartbolts.com.