

INSTALLATION
PROCEDURE
FOR
TENSION
CONTROL
BOLTS

Introduction

This booklet is for steel erectors and inspectors and should be referred to as a guide when making structural bolted connections.

Tension Control Bolts (TCBs) are HRC (High Resistance Calibrated) high strength structural bolting assemblies for preloading and conform to EN 14399-1. TCBs provide an easily installed and inspected method of bolting.

The TCB[®] concept is a simple and uncomplicated system that completely removes the responsibility of attaining the correct preload in a given connection away from the erector and there is no requirement for the use of *k* factors with HRD (1d) nuts. The 110 or 220 volt electric non-impact shear wrench is light in weight and quiet to use.

Under the Construction Product Regulations (CPR) all preloaded bolting assemblies should conform to EN 14399-1 or have a relevant European Technical Approval (ETA) in force. All class 10.9/10 TCB products are CE marked with the appropriate Declaration of Performance (DoP) available to download from our website.

Technical advice is always available and if required, on-site training can be provided. Installation videos are available online via the links below:-

Installation of TCBs in a steel joint.

<https://www.youtube.com/watch?v=INgadYjTiWk>

The concept of Fail-to-Safe

<https://www.youtube.com/watch?v=hJtRZRfn3E0>

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Quality Assurance

TCB[®] preloaded bolting assemblies are manufactured and supplied in accordance with EN 14399-1 and CE marked in accordance with the CPR. Bolts and HRD nuts are manufactured in accordance with EN 14399-10 with washers manufactured in accordance with EN 14399-6. Assemblies are (usually) supplied unassembled as extended bolting assembly lots. Bolts and nuts have an embossed 3 digit heat code added during production to identify lot numbers plus bolts also have their nominal length stamped on the head.

Inspection Certificates

TCB[®] assemblies are tested in accordance with EN 14399-2 and certified in accordance with EN 14399-1. The relevant DoP can be downloaded via the QR code found on packaging labels.

Storage

TCB[®] bolting assemblies shall be stored in a clean and dry condition.

Shear Wrenches

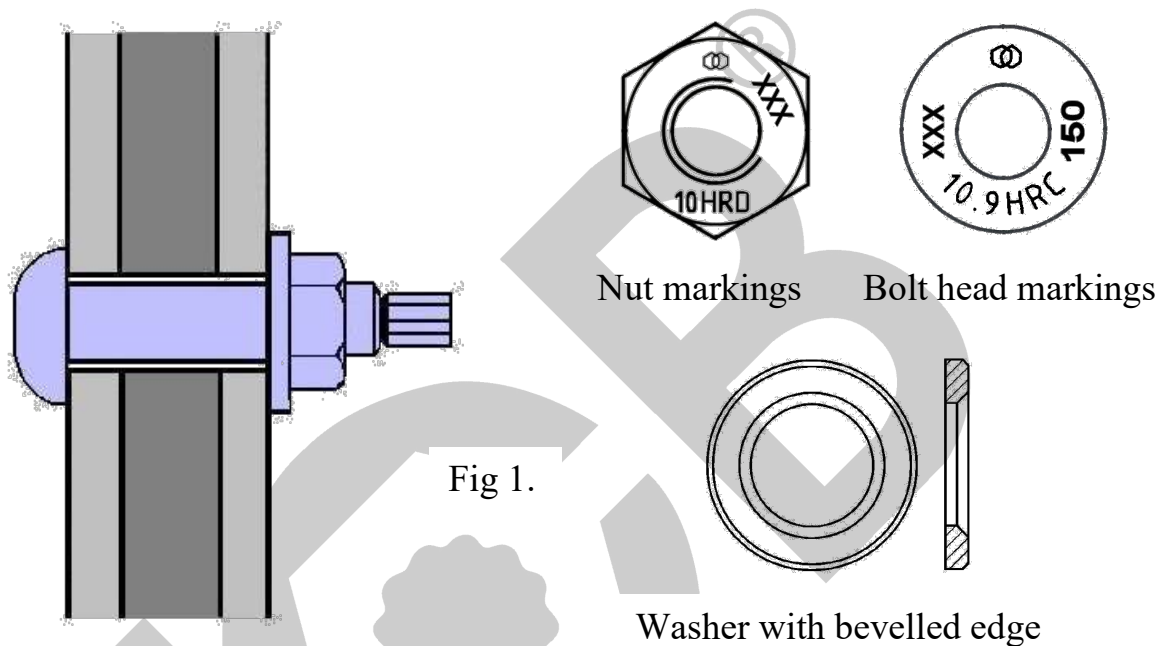
Shear wrenches are non-impacting, lightweight, low noise tools available in various models all of which meet Directive 2006/42/CE on machinery.

Please note - Shear Wrenches are 'dumb' tools and require no calibration

Shear Wrench	110 volt	220 volt
Model number	GM161EZ GM221EZ GH241EZ GV301EZ GMC221EZ GHC241EZ GVC301EZ SSGM221EZ SSGV271EZ GX361EZ	GM162EZ GM222EZ GH242EZ GV302EZ GMC222EZ GHC242EZ GVC302EZ SSGM222EZ SSGV272EZ GX362EZ
Serial number	Tools marked with unique number	
Directives	Machinery Directive EMC Directive RoHS Directive	2006/42/EC 2004/108/EC 2011/65/EU

Installation procedure – connections with few TCBs

1. As per Fig 1 insert the bolt into the connection and place the washer, bevelled side outermost, onto the bolt followed by the nut. Nut markings should be outermost to ensure Quality Assurance is visible. If two washers are being used, ensure the washer under the bolt head is placed bevelled side facing the bolt head.



2. The non-impacting electric shear wrench has two sockets which operate in opposing directions; engage the inner socket over the bolt spline and the outer socket over the nut (Fig 2). Ensure that both inner and outer sockets are fully engaged before proceeding.

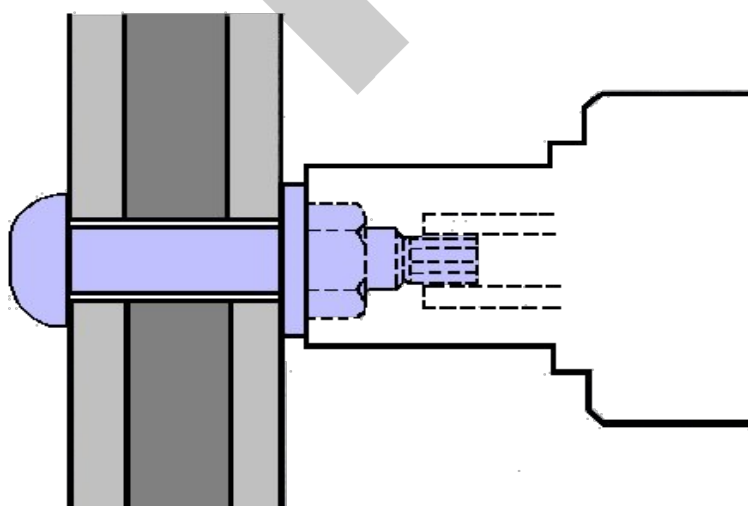


Fig 2.

3. Press the power switch. The outer socket rotates clockwise and tightens the nut whilst the inner socket holds the bolt spline (only one socket can move at any one time). When the correct preload is reached the outer socket stops rotating, the inner socket counter rotates and shears the spline off (Fig 3)

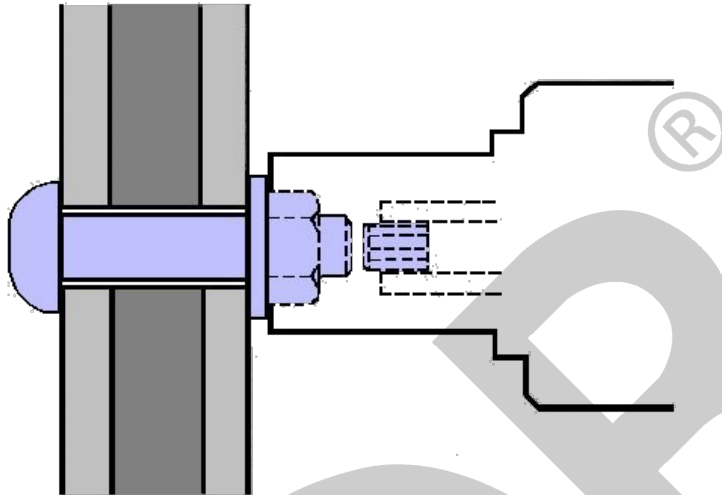


Fig 3.

4. Stop the wrench and pull the outer socket off the nut. The spline is retained in the inner socket. The wrench has a second trigger to eject the spline safely (Fig 4). Ensure that the wrench motor has come to rest prior to engaging the next bolt.

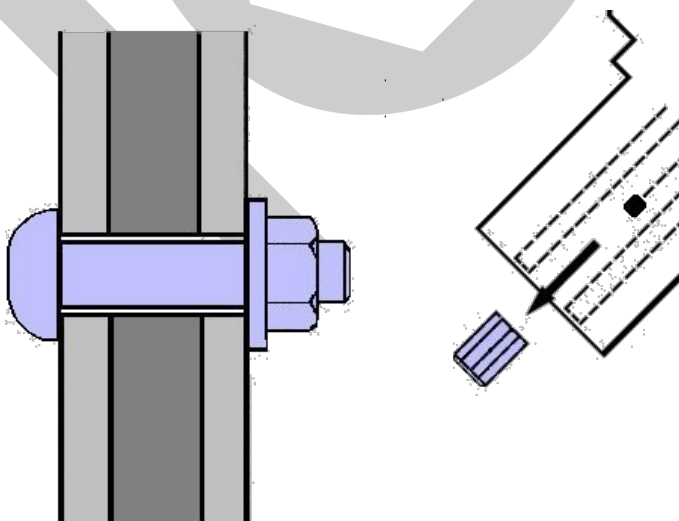


Fig 4.

Installation procedure – multi-bolt, multi-ply connections

Before commencement of preloading, the connected components shall be fitted together (as previously detailed in section 1) and the bolting assemblies shall be brought to a snug tight condition. This tightening process shall be carried out from bolt to bolt of the group starting from the most rigid part of the connection and moving progressively towards the least rigid part (contact to non-contact surfaces). In order to ensure that the preload in fully installed bolting assemblies meets the specified minimum preload requirement, the installation process consists of two tightening stages. The first stage applies a bedding torque to the bolts to ensure a firm contact between components. This pre-tensioning (or snug tightening) can be accomplished by:

- i. Using the shear wrench but only snug tightening assemblies and not shearing off the splines. When using this method the operator will notice a distinct change in the sound/tone of the wrench motor. This indicates that pre-tensioning has commenced as the bedding load is being applied. If pre-tensioning has occurred, then when the power trigger is disengaged the wrench gearing will backtrack and reverse allowing the tool to be easily removed from that particular bolt. This whole process can also be ‘felt’ by the operator.
or
- ii. Using a standard nut runner/impact wrench with a deep socket to pull all surfaces into contact without involving the bolt spline.

NOTE – If mating surfaces are significantly distorted or misaligned then ‘slave’ bolts should be used. TCBs can be used as slave bolts but they must be clearly marked and then replaced prior to final completion of the joint.

The second tightening stage can only be achieved using a shear wrench. When the spline end of the bolt shears off at the break neck, full preload has been induced.

If the bolting assembly cannot be installed using shear wrenches, tightening shall be carried out in a conventional manner by either;

- i. Using the torque method with the aid of the *k*-class K2 information (K2 values are provided upon request)
or
- ii. Using a direct tension indicator.

Greenkote® PM1

Greenkote® is a metal surface treatment for the prevention of corrosion and the name simply relates to the process. Greenkote® PM1 is a Thermo-Chemical Surface Modification (TCSM) process which gives better protection than electro-galvanizing and zinc flake coating and offers similar protection to hot dip galvanising.

Bolting Assemblies coated with Greenkote® are ready for installation and no additional treatments are necessary.

T Washing

T-washing or etching of bolting assemblies prior to installation **MUST NOT BE DONE**. Greenkote® provides an excellent surface for paint adhesion (sample paint pull-off tests available upon request)

Paint

Faying surfaces along with surfaces under the bolt head and washer should be masked off and left unpainted. If bolting assemblies are installed with paint under the bolt head and/or washer, loss of preload in the bolting assembly could occur over time; this is known as paint creep and should be avoided.

When a connection has been fully assembled with the bolts correctly installed (splines sheared off), a zinc rich primer can be used to protect the exposed bolt end until the painting contractors have access to the joint.

Testing, certification and inspection

Five bolt assemblies per extended lot are systematically tested in accordance with European standards. Axial loads are recorded onto the Certificates of Inspection for TCB® assemblies being delivered to site / works.

- After the spline of the bolt has sheared, the assembly preload should be equal to or greater than those values as required by the specification (see table 1).
- Since the quality assurance and integrity of the bolted connection is determined by the bolting assembly itself, visual inspection of the bolt spline removal is sufficient.

EN 1090-2

8.5 Tightening of preloaded bolts

8.5.1 General

Unless otherwise specified, nominal minimal preloading force $F_{p,c}$ shall be taken as:

$F_{p,c} = 0.7 f_{ub} \cdot A_s$ where f_{ub} is the ultimate strength of the bolt material and A_s is the stress area of the bolt as defined in EN1993-1-8 and specified in Table 1. This level of preload shall be used for all slip resistant preloaded connections and for all the other preloaded assemblies unless a lower level of preloaded is specified.

Table 1 – Values of $F_{p,c}$ in kN

	Bolt diameter							
	M12	M16	M20	M22	M24	M27	M30	M36
10.9 HRC	59	110	172	212	247	321	393	572

‘Fail Safe’ bolts

It is important to understand the difference between tension control bolts and conventional preloaded bolts.

As with any threaded fastener an occasional failure can occur. This is generally attributed to a problem during installation and can be the result of several factors including the following examples:

- Using a TCB as a slave bolt
- Alignment problems
- Foreign materials in the threads such as grit, mastic, oil etc
- Temperature
- Moisture

In all of these cases, the friction co-efficient of the TCB assembly reduces resulting in the 'dumb' tool continuing to take the least line of resistance (rotate the outer socket).

One of two things will happen. Either:

- i. Threads will strip in which case the spline will not be removed
or
- ii. Threads will hold and the increased preload will break the bolt due to torsional overload.

IN EITHER CASE THE OPERATOR WILL BE AWARE AND THE ASSEMBLY WILL ALWAYS 'FAIL-TO-SAFE'

These assemblies should be removed and replaced with new ones.

If, on inspection it can be seen that the spline has sheared off, then one can be certain that the bolt is installed correctly. It is not possible to properly remove the spline during installation AND the bolt break afterwards without additional forces being applied, thus reinforcing the 'fail-to-safe' properties of this type of bolting system.



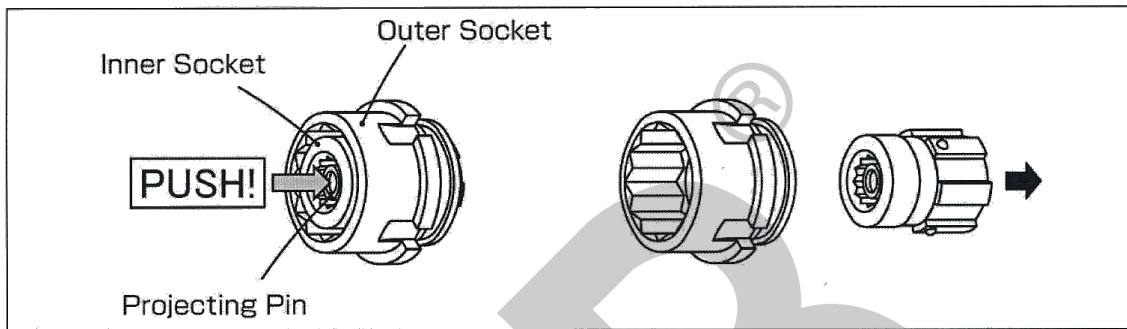
Example of thread stripping



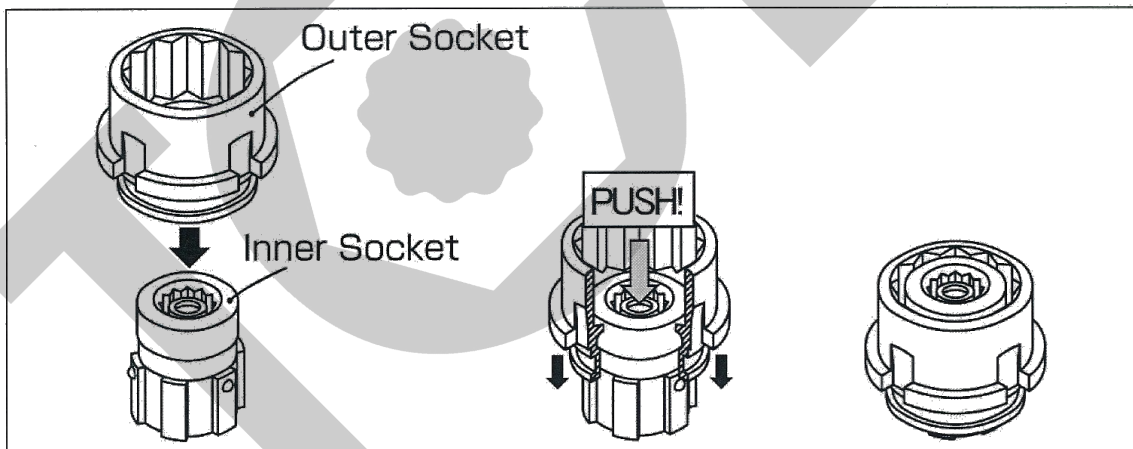
Example of torsional overload

Changing of sockets

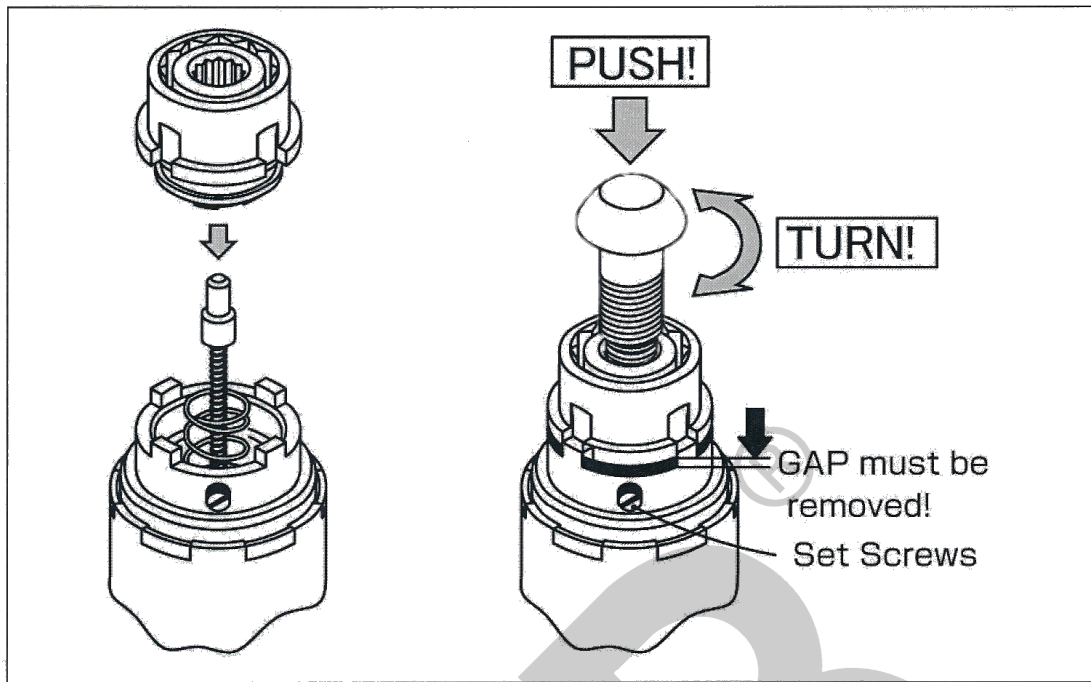
- Loosen the 2 set screws on the side of the socket (keep screws safe)
- Remove the socket set
- Push central portion of inner socket with screwdriver or correct size bolt spline as below; the sockets will disassemble
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- To reassemble, connect both inner and outer sockets; push the central portion of inner socket with a correctly sized bolt (with spline) to assemble both parts fully

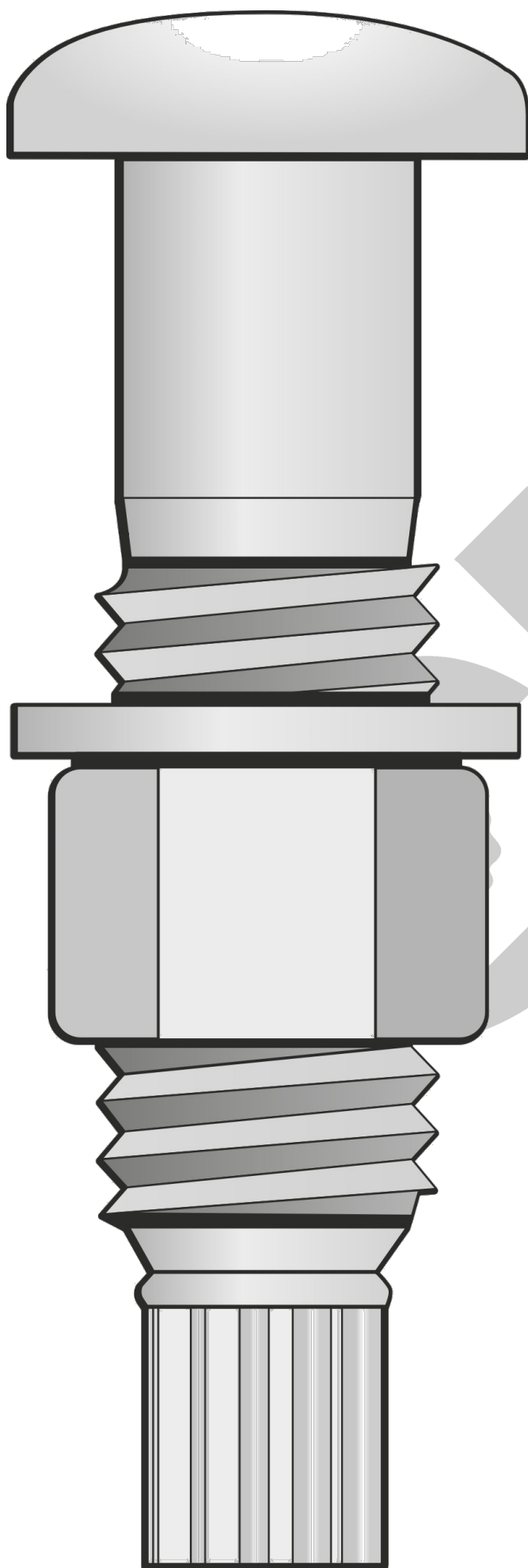


- Place assembled socket over ejector rod and socket holder on the shear wrench
- When a gap remains between the outer socket and socket holder, simply insert a correctly sized bolt spline into the inner socket thus allowing the inner socket to “drop” and become correctly seated into the socket holder
- Retighten grub screws



Shear Wrench Maintenance

- Maintain the wrench in a state of cleanliness as with any other electrical tool
- Check electric cable and plug regularly – replace if damaged to avoid electric shock
- Do not pick up or carry the shear wrench by the electric cable
- Clean sockets occasionally with a dry cloth to avoid build up of debris/dirt
- Change motors carbon brushes when necessary. The length of the brush needs to be more than 6mm. If shorter than this an insulation pin protrudes through the carbon, disabling further motor operations to protect the armature
- To maintain the shear wrench in good condition and service, return to TCB[®] Ltd every 6 months or 30,000 bolt installations whichever is first.



TCB[®]

