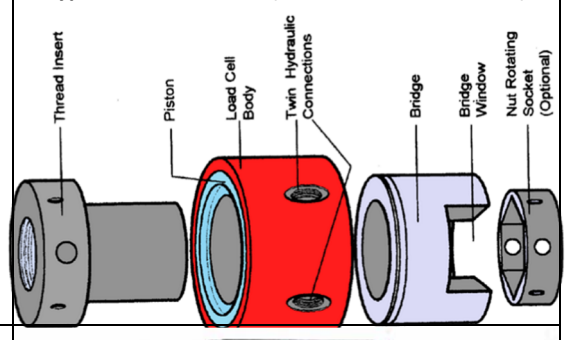
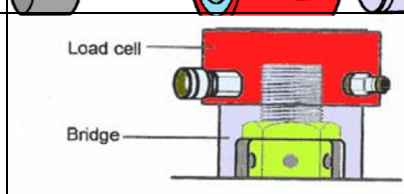
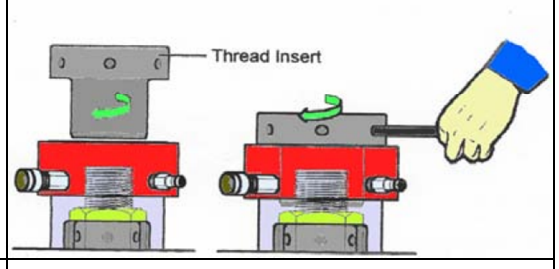
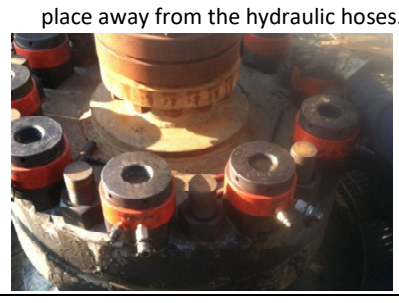
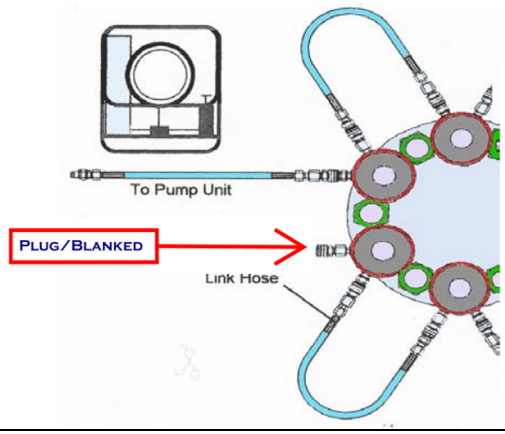
TASK SAFETY PROCESS

Title: Bolt Tensioning – Hi Force TDS 1247 TSP Number: T0010 Issue Date: 1/29/2014
Revision Date: N/A Reviewed By: Doug Patton, Ron Beverly, Chad Smit, Brad Bechinske

The following are guidelines. Client or Project Specifics may superseded this document. Consult Project Manager with conflicts.

Task Step	Step Hazard	Hazard Mitigation	Picture
BEFORE ATTEMPTING THIS PROCESS! **Have you been through the proper training?** **Do you have the Manufacturers Operations Manual for reference?** **Do you know the required tension to be applied to the bolts you are using?**	**Serious Injury or Damaged Equipment & Property could result from lack of knowledge or information on this topic.** **Consult the Tensioner's O&M for specific questions.** **The bolt manufacturer or bolt supplier will have this information.**	*****Persons unfamiliar with the task should receive proper training prior to attempting this work.** - - - - - - - - - - - - - - - **Example of the MFG Instruction Manual can be found starting on page 2.**	
1. INSPECT EQUIPMENT to ensure that it is free of defects and functioning properly. a. Bolt Tensioner is properly maintained. b. Hydraulic Hoses for cracks & defects. c. Quick Couplings to verify they connect securely.	1. Defective/damaged equipment.	1. Red tag and remove from service.	**Typical Bolt Tensioner (Hi ForceTDS1247 Shown)** 
2. ASSEMBLE THE BOLT TENSIONER over the bolts/studs to be tensioned***. a. Set the Bridge over the nut, ensure the bridge window faces away from the center of the flanged joint**. b. Set the Load Cell on top of the Bridge with the hydraulic connectors facing away from center. c. Place the Threaded Insert into the Load Cell and screw* onto the threads. Use Tommy bar to tighten until contact is made with face of the Load Cell.	a. Heavy bridge unit and load cell. Pinch points possible. b. Body positioning, soft tissue and muscle strain.	a. Stay aware of hand positioning and follow 100% glove policy. b. On larger flanges utilize the buddy system, have work platforms built for proper access.	 
3. PRESSURIZING THE SYSTEM a. Connect Link Hoses to the hydraulic connectors on the tensioners and to the pump. b. Gently Tug on the hose to ensure connection is secure. c. Start to pressurize the system. **Constantly Monitor the pressure to ensure that you are not losing pressure! Stop Immediately if pressure drops, depressurize and check connections & equipment.**	a. Pinch Points b. N/A c. Leaks, hoses disconnecting from couplings. 	a. Wear proper gloves for the task. b. N/A c. Check connections thoroughly before pressurizing, stand in a safe place away from the hydraulic hoses. 	
4. TENSIONING PROCESS a. Once the desired pressure is reached and is stable , use a Tommy Bar and a mallet to ensure all the Thread Inserts are threaded tightly. b. Slowly release the "return to tank" valve on the pump. This transfers the load from the tensioner to the nuts. c. Depressurize and disconnect all hoses, set onto remaining 50% of bolt if necessary and return to Step 2 to tension the remaining bolts.	a. The tommy bar tends to slip out of the nut rotating socket. b. Depressurizing the air supply to the hydraulic pump.	a. Hand positioning is critical here, a slip could cause an abrasion, burse or even fracture to the hand or arm. b. Air supply must be shut down and depressurized prior to disconnecting the supply line.	
5. CLEANUP and demobilize from the area.	1. Defective tools and equipment.	1. Red tag , remove from service, inform the supervisor.	

***At a minimum, one full length of the bolt diameter must be available above the top of the nut in order for the bolt tensioner to function properly.**
****Ensure the two halves of the flanged joint are pulled together and any gaskets properly in place before beginning the process.**
*****If you don't have enough tensioners to cover all the bolts, alternate bolts and then perform the tensioning a second time to complete the set.**

In addition to proper training, http://www.youtube.com/watch?v=O96AUlIBkU8 may be useful to ensure the crew has a working knowledge of the task at hand. (Tension is Not Torque)

Hi-Force HYDRAULIC TOOLS	STS STUD BOLT TENSIONER OPERATING INSTRUCTIONS			TDS:- 1247
Prepared by:-	Mark Dalley	Approved by:-	Matthew Hughes	Date:12/10/12
REV NO:-002				
ECO:- 3936				

WARNING!

All equipment used must be rated for the same operating pressure i.e. 1500 bar (21,750 psi). DO NOT MIX high and low pressure components. If in doubt, contact your local Hi-Force Distributor.

SAFETY NOTES

Never attempt to use this High Pressure equipment if you are in any doubt regarding the correct assembly and operation.

Always ensure the equipment is of Hi-force supply and is in good working order.

Never use Bolt Tensioning equipment that has been modified or machined by anyone other than Hi-Force.

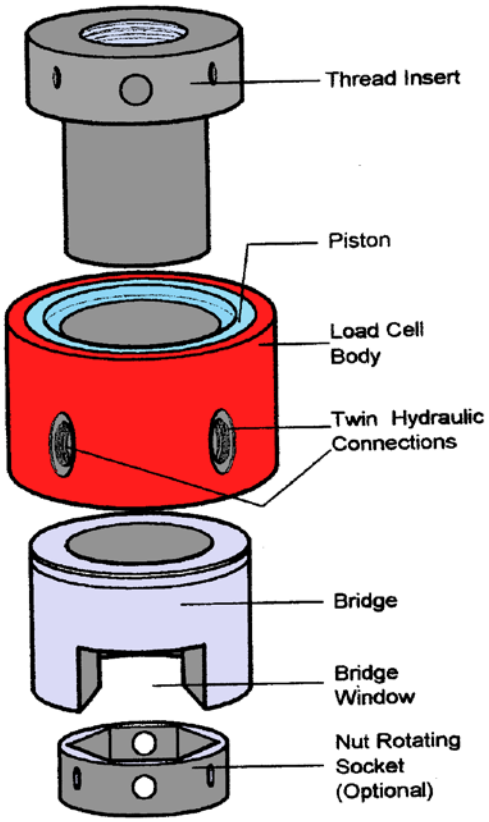
Always wear eye protection and gloves.

Ensure that all personnel in the immediate Vicinity are aware that pressurisation of High Pressure equipment is about to take place.

Only approach pressurised Bolt Tensioners When you are certain pressure is holding.

Never attempt to solve leaks in the system While the system is pressurised.

Do not exceed the maximum working pressure As stated on the load cell, or exceed the Maximum piston stroke of the tool, As indicated by the marker band.

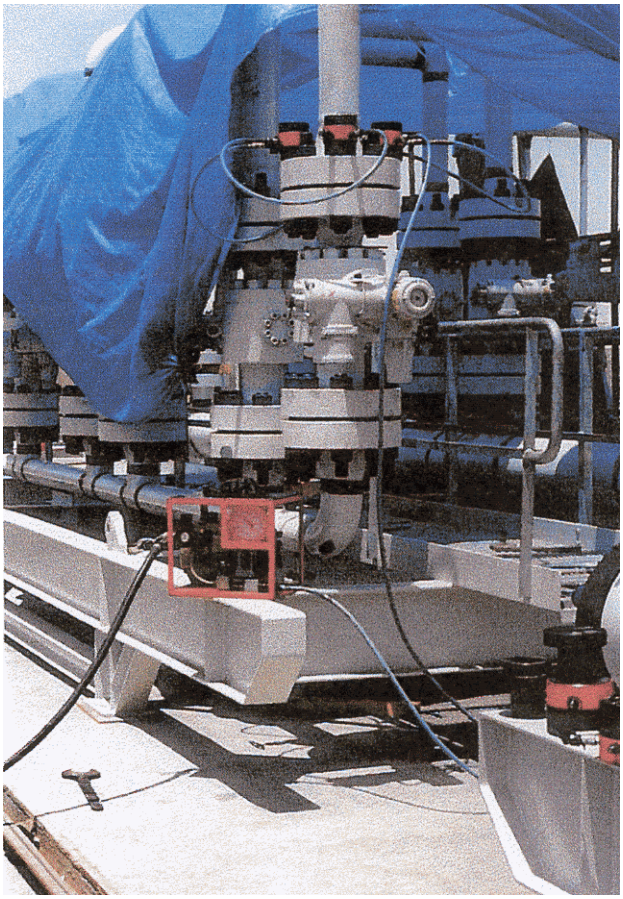


Conventional Bolt Tensioner

Failure to follow these instructions will result in damage to the unit or may result in operator injury or death.

TENSIONING

In order to apply an evenly distributed load to a bolted joint, the sequence in which Hydraulic Tensioners are applied to the joint is important.
The exact detail of this sequence is dependant upon the number of bolts in the joint, and the number of bolt tensioners available.



STEP 1

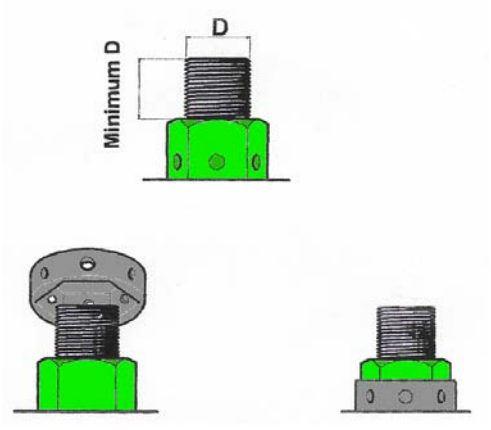
Ensure there is sufficient stud protruding from the top of the nuts. A minimum of 1 x stud diameter is essential.
Example: for a bolt size of M30 the minimum required stud protrusion is 30mm.

STEP 2

If holes are not drilled in the faces of the hexagonal nuts, assemble the nut rotating sockets over every alternate bolt to be simultaneously tensioned.
Tighten down every bolt on the flange using the Tommy bar supplied with the tensioning equipment.
Ensure the two halves of the joint are pulled firmly together.

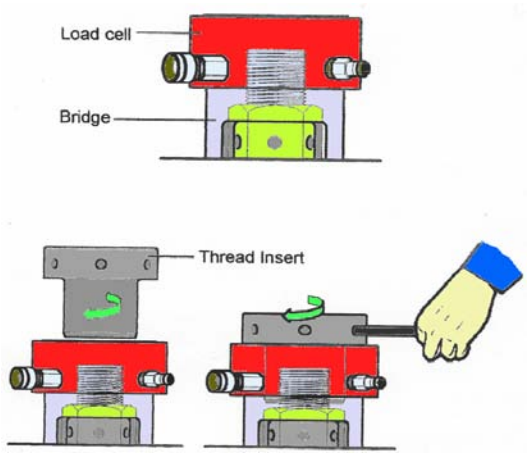
STEP 3

Assemble the load cell and bridge over the first 50% of The bolts to be tensioned (every alternate bolt).
Position the bridge window so that access to either the nut rotating socket or hexagon nut is comfortably achieved.
It is normal for the bridge window to face radially out from the centre of a circular flanged joint. Examine around the circumference of the bridge base to ensure it is sitting flat against the tensioning surface.
The bridge can be adjusted in relation to the load cell by means of 3 set screws, positioned around the base of the load cell.



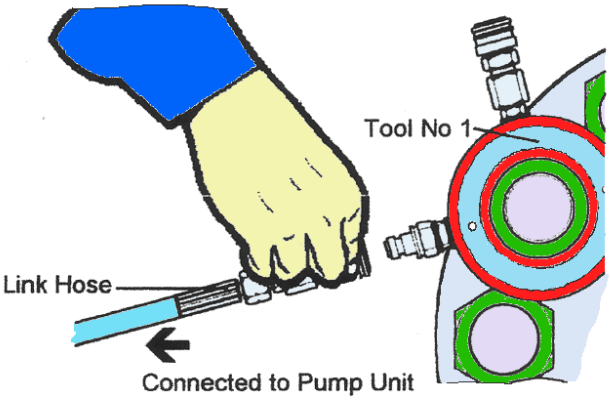
STEP 4

Ensure the threaded inserts are threaded to the same diameter, thread form and pitch as the bolts to be tensioned. Assemble the threaded inserts into each bolt tensioner, screwing down onto the threads protruding Using the Tommy bar, fully screw down the inserts, until contact is made with the top face of the load cells.



STEP 5

Remove the plastic protection caps from all male and female quick connect couplings. Connect a link hose from the pump unit to the first tool, connection is made by pulling back the spring loaded collar on the female connection. Insert the male connector and release the female collar. A gentle tug on the link pipe should be enough to make sure the hose is connected properly.



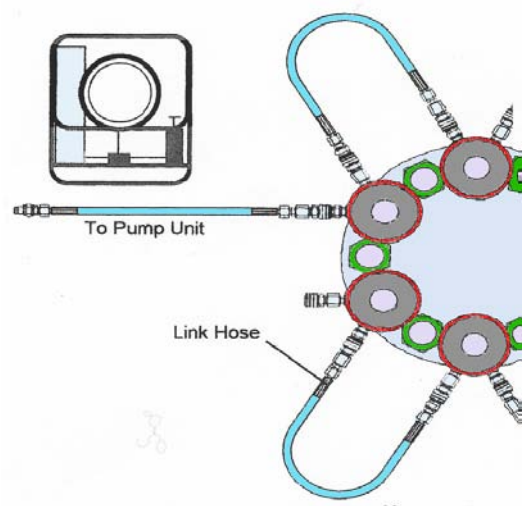
SAFETY NOTE

Link hose – maximum working pressure = 21750 psi (Bar)

STEP 6

Continue until all of the tensioners are connected together with link hoses. The last tensioner in the system will have an unconnected female coupling, This is correct, and can be left un-connected, alternatively this last coupling can be removed and a suitable high pressure blanking plug fitted (consult Hi-force for further details).

Never pressurise an un-connected male connector!



TENSIONING PROCEDURE

The tensioning system is now ready to apply a bolt load to the joint. Before applying pressure to the system make sure you observe the following points

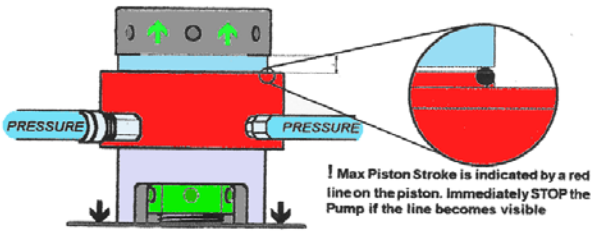
- You are aware of the correct operation of the pump unit.
- You are aware of the maximum working pressure of the tensioners.
- You are aware of the maximum piston movement of the tensioners.
- You are aware of the required working pressure that must be applied to the tensioners.
- It is recommended the next steps 7,8,9 are read and understood prior to tensioning.

STEP 7

During the pressurisation procedure, continually monitor both piston stroke and pressure. Never exceed either. It the maximum piston stroke is reached before the working pressure is Obtained go to STEP 9.

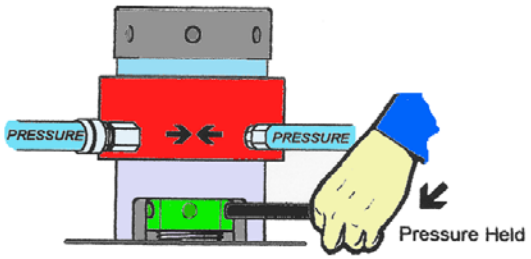
Close stop valve on pump unit, then pressure the system to the required pressure.

When the required pressure is reached, stop the pump (by closing off the air supply shut off valve). At this stage, the bolts will be initially loaded, with the load being held by the tensioners.



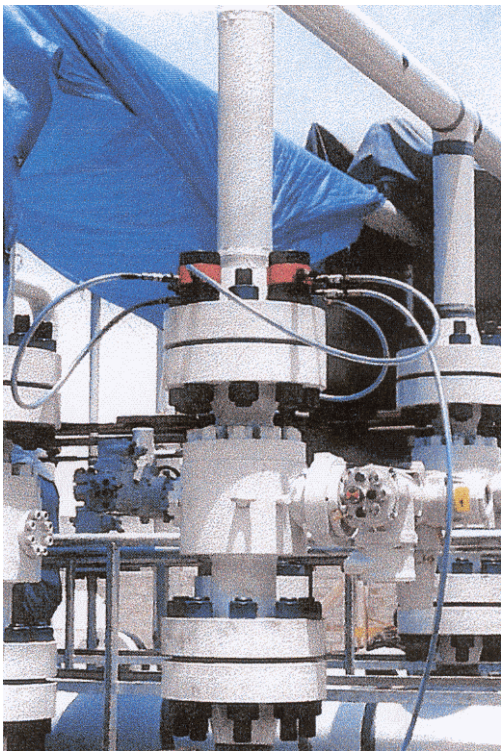
STEP 8

Check the pump and gauge to ensure the pressure is holding firm. When you are satisfied the pressure is stable, approach the tensioners and by Using the Tommy bar, rotate the nuts, (through the bridge access windows) back down towards the face of the joint. Seat the nuts firmly against the joint, by use of a mallet and Tommy bar (if the nuts are not seated firmly, the tensioning procedure will take much longer to complete). It is not important which order the nuts are tightened but to be sure of not missing one, it is recommended they are tightened in sequence.



STEP 9

Slowly release the return to tank valve on the pump. The load is now transferred from the tensioners to the nuts. Use a Tommy bar in the thread insert to return the pistons to their fully closed position. If the desired pressure has not yet been reached, continue from STEP 6. Disconnect all of the hydraulic link hoses and reposition the tensioners on to the final 50% of bolts to be tensioned, and continue from STEP 4.



SEQUENCE

It is generally agreed the correct bolt / tool ratio is 50%, in certain instances a 25% ratio is acceptable or even a minimum of 4 tensioners diametrically opposed. The general rule is:- The lower the bolt / tool ratio, the more time it will take to tension the joint.

SEAL REPLACEMENT PROCEDURE

There are two types of seals used in Hi-force hydraulic bolt tensioners. Type 1 is a single piece polyurethane seal, type 2 is a double polyurethane seal, comprising of an inner and outer seal. This replacement procedure is applicable for both types of seal.

SEAL REMOVAL

Isolate the failed load cell, unscrew and remove the hydraulic quick connect couplings. Remove the piston from the load cell body.
It is recommended that both seals are replaced at the same time. Firmly hold the piston in a vice fitted with soft jaws, making sure not to clamp the featheredge of the piston. You are working very close to this delicate edge at the moment so take care not to damage it.
Using long nose pliers, firmly grip the sealing edge of the outer seal and pull it away from the seal housing (see fig1). The same procedure can now be used on the inner seal. Discard used seals.

SEAL REPLACEMENT

Thoroughly clean the seal housing and the hydraulic chamber in the load cell. Place the piston, feather edge face up, on a clean flat surface. Offer the new outer seal to the seal housing. The seal has a clip – in arrangement on the base. This is a push fit into the seal housing. Push the seal tenon into the housing by hand as far as possible then by using a flat bottomed pin punch, apply a downward pressure at four points at 90^0 to each other, on the top face of the seal (see fig3). Ensure the tenon at these four points is completely seated in the housing. e careful where you apply the downward pressure as damage to the sealing edge will render the seal useless (see fig2).

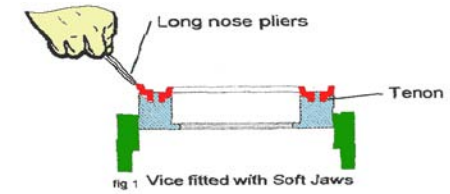


fig 1 Vice fitted with Soft Jaws

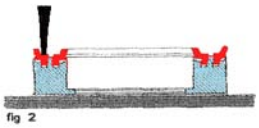


fig 2

Fig 3

Now gradually work your way around the seal applying pressure in between points A and B, then between points C and D, then B and C and finally between A and D. Ensure the seal is fully seated around its complete periphery. The same can now be applied to the inner seal.

Before refitting the seal/piston assembly, back into the load cell, smear the sealing edges with either hydraulic oil or light grease to ease piston assembly. Place the load cell body on a flat clean surface with the hydraulic chamber facing upwards. Assemble the piston back into the load cell, making sure that the piston is not tilted during assembly. Finally refit the quick connect couplings.

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