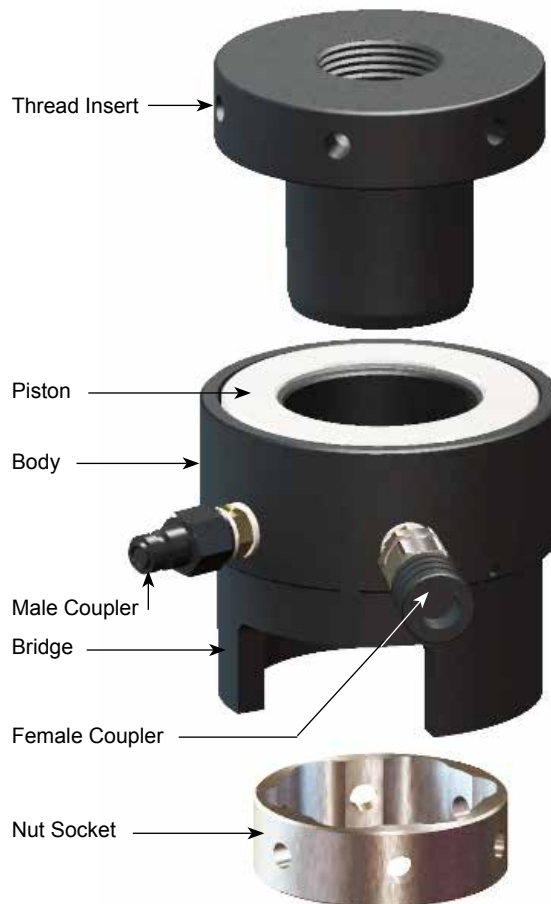


Instruction Document

CTST Series Hydraulic Bolt Tensioners
 Document No: TDR129R3
 Issued: 04/12/12

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1.0 General Hydraulic System Safety Warnings

- Failure to practice the following safety warnings could lead to personal injury and/or equipment damage
- Always wear recommended protective clothing during the tensioning procedure.
- Never exceed the maximum working pressure of the tensioning system. The maximum working pressure of the whole system is determined by the lowest pressure rated component.
- Treat hydraulic hose with respect. Do not sharply bend or kink the hose when connecting tensioning tools. Be aware of the minimum bend radius of the hose. Sharply bending or kinking hose can lead to premature hose rupture.
- Do not drop sharp objects on to the hydraulic hose, do not drive any type of vehicle over hydraulic hose. Doing so will cause internal hose damage and lead to premature hose failure.
- Never lift tensioning tools by the hydraulic hose or hydraulic connections.
- Never touch pressurised hoses or couplers. Escaping high pressure oil can penetrate your skin and is extremely dangerous. Seek urgent medical attention if oil penetrates skin.
- Never preset the pump unit relief valve to a pressure greater than the lowest rated pressure component in the system. Doing so may lead to injury and or equipment damage.
- If prior to the tensioning operation you have any doubt in the correct and safe use of Tentec bolt tensioning equipment. Contact Tentec for advise.
- Thoroughly read all instruction documentation prior to using the tensioning equipment. Ensure all safety precautions are followed to avoid personal injury and/or equipment damage during the tensioning procedure. Tentec can not be held responsible for injury or damage to equipment caused by product misuse or by lack of equipment maintenance.



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2.0 Specific Bolt Tensioner Safety Warnings.

-  Bolt tensioning systems should only be used by trained and experienced personnel familiar with safe operating practices of bolt tensioning systems.
-  Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.
-  Always wear suitable protective clothes including boots, gloves and eye protection during the tensioning procedure.
-  Always ensure that all personnel in the near vicinity are aware that pressurisation of high pressure equipment is about to take place. Cordon off the work area and exclude anyone from the area who is not involved directly with the tensioning procedure.
-  Never exceed the maximum working pressure of the system. The maximum working pressure of the tensioning tool is hard stamped on the tensioner body component.
-  Never exceed the maximum piston stroke capability of the tensioning tool. A red maximum piston stroke line will become visible as the tensioner approaches maximum stroke. The maximum piston stroke value will be hard stamped on the tensioner body.
-  Never stand in-line with the bolt axis during the tensioning or de-tensioning procedure. Unexpected bolt failure can result in serious personal injury or death. Premature bolt failure can lead to parts of the tensioner or bolt becoming high velocity projectiles. Alert all personnel to the consequences of premature bolt failure and clear the area of non essential personnel before the procedure starts.
-  Only approach pressurised tensioning tools when you are certain that the pressure is holding steady. Continually monitor the pump pressure at all times. If the pressure is not holding steady do not approach the system but release the pressure to zero and then investigate the cause of pressure loss. Never investigate at high pressure.
-  Thoroughly inspect the main thread of the thread insert component, look for sign of thread damaged or worn threads. Replace any worn or damaged parts. Ensure you have adequate thread engagement between the thread insert component and the bolt being tensioned.
-  Never attempt to disconnect an hydraulic coupler while at pressure.
-  Before pressure is applied to the system check that each hydraulic hose is connected correctly. Physically pulling on the connector will determine if the male couplers are correctly fitted to the female connectors.
-  Never pressurise an unconnected male coupler. Male couplers are not designed to withstand high pressure, in the unconnected mode. Pressurising an unconnected Male coupler can lead to serious personal injury or death.
-  It is safe to pressurise the unconnected female coupler fitted to the last tensioner in the circuit.
-  Check that the bolt is capable of taking the initial load applied by the tensioners. Tensioners are capable of breaking bolts if the bolt material is not strong enough to withstand the tensioner load.
-  Users should be aware at all times that pressure can build up very quickly and a member of the tensioning team should be ready to release pressure at any time.
-  Never leave a pressurised system unattended.
-  All investigation, maintenance or repair work should only be carried out when the tensioner is at zero pressure.
-  All tensioner specifications can be found hard stamped on the body of the tool. Be aware of the maximum working pressure and the maximum piston stroke capability.
-  The calculated required working pressure of the tensioners will typically be less than the maximum working pressure of the tool. Never exceed the maximum rated working pressure of the tensioner.

Technical Specification Of Tentec CTST Tensioner Range

Series	Maximum Working Pressure		Maximum Stroke Capacity		Hydraulic Pressure Area	
	psi	bar	In	mm	In ²	mm ²
1CTST	21750	1500	0.393	10	2.35	1516
2CTST	21750	1500	0.59	15	4.58	2955
3CTST	21750	1500	0.59	15	8.38	5406
4CTST	21750	1500	0.59	15	13.16	8490
5CTST	21750	1500	0.59	15	18.9	12194
6CTST	21750	1500	0.59	15	27.35	17645

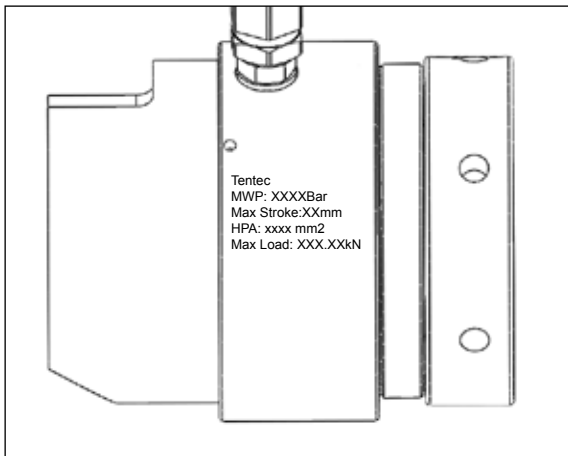
-  Tentec supply many special bolt tensioners, never assume you are working with a standard CTST range tool. Always check the hard stamping on the load cell to verify the actual tool specifications.

3.0 Maximum Stroke Indicator

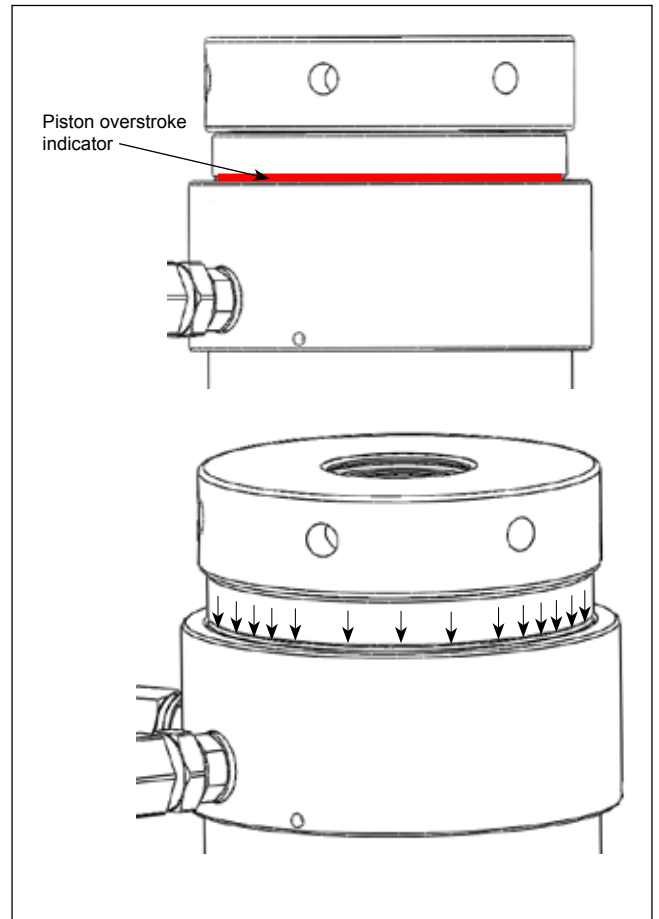
The tensioner maximum allowable stroke is indicated by a red line machined into the circumference of the piston. Continually monitor the piston stroke during the tensioner pressurisation. If the maximum piston stroke indicator becomes visible on any of the tensioners before the target pressure is reached immediately stop the pump, tighten the nuts down and then release the pressure to zero. Rotate the thread inserts until the pistons are shut down into the zero stroke position. Recommence the tensioning procedure.



Failure to stop the tensioning sequence once a piston overstroke indicator becomes visible may result in failure of the tensioner seal and will eventually cause a release of high pressure fluid which could lead to injury or death. Escaping high pressure oil can penetrate your skin and is extremely dangerous. Seek urgent medical attention if oil penetrates skin.

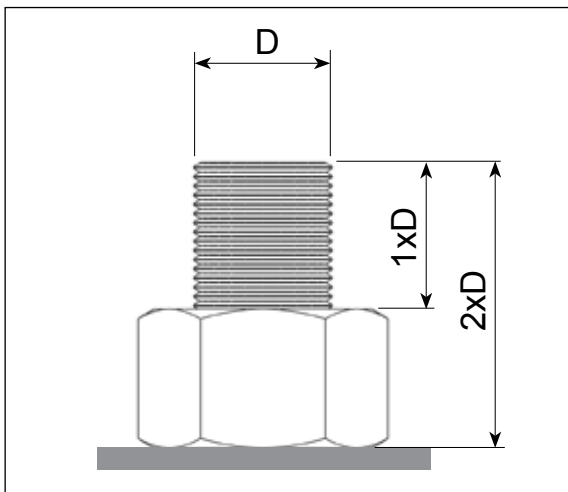


The technical specification of the tensioner can be found hard stamped on the side of the body



4.0 Pre-Procedure Checks

1. Check that each bolt to be tensioned is visually free from obvious thread defects. Make sure all nuts and thread inserts are free to rotate on the bolts. Try a thread insert on a bolt and make sure they are correct mating threads. Ensure there is sufficient stud protruding from the top of the nuts. A minimum of 1 x stud diameter is essential and also a minimum of 2 x D from top of the bolt to the base of the nut. Also make sure full thread engagement is available through the hexagon nut on the opposite end of the studs being tensioned.
2. Check that all calculations pertaining to the tensioning procedure, including pressures, bolt loads, etc are available and have been reviewed by a qualified engineer with bolting experience.
3. Ensure that personnel are fully trained in bolt tensioning procedures and have thoroughly read this guide and safety notes.
4. Ensure the pump reservoir is filled and an adequate oil volume is available. Refer to the pump instruction manual document
5. Ensure the correct and preferred grade of oil is used in the pump. Refer to the pump instruction manual document.
6. Ensure the pump instruction manual is thoroughly read and understood.
7. Be sure all personnel are aware of the maximum working pressure and maximum piston stroke of the tensioners. These details are hard stamped on the tensioner bodies



5.0 Tensioner System Configuration.

The most efficient use of bolt tensioning tools is where every bolt (100% bolt to tensioner ratio) is tensioned simultaneously. Tensioners can be fitted to either one side or both sides of the bolted joint depending on accessibility. Common examples of system configuration are 100% & 50% bolt to tensioner ratio. This document details both of these tensioner system configurations.

5.1 Tensioner Arrangement - 100% Configuration

All bolts simultaneously tensioned.

Commonly, due to space restrictions, it will not be possible to fit tensioners to every bolt from the same side of the bolted joint. It is normal practice to stagger the tensioners over both sides of the bolted joint.

It is normal practice to fit the bolts so adequate thread protrudes from the side of the joint that the tensioner will be fitted. Refer to fig 5.2 & 5.3

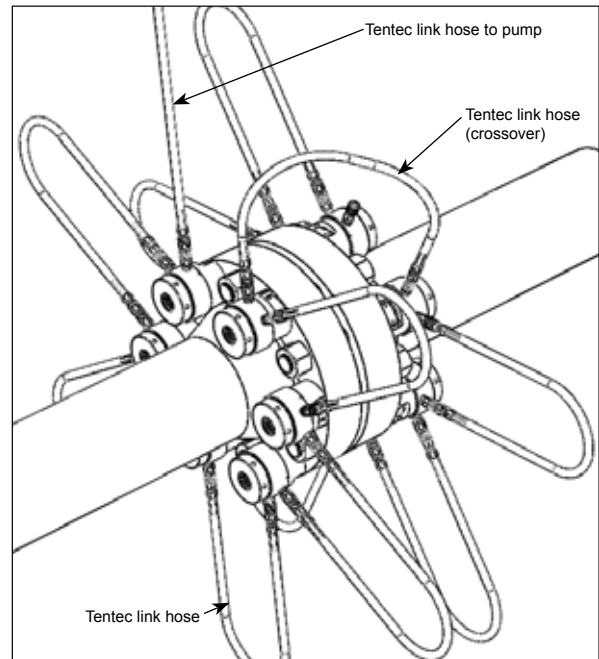


Fig 5.1

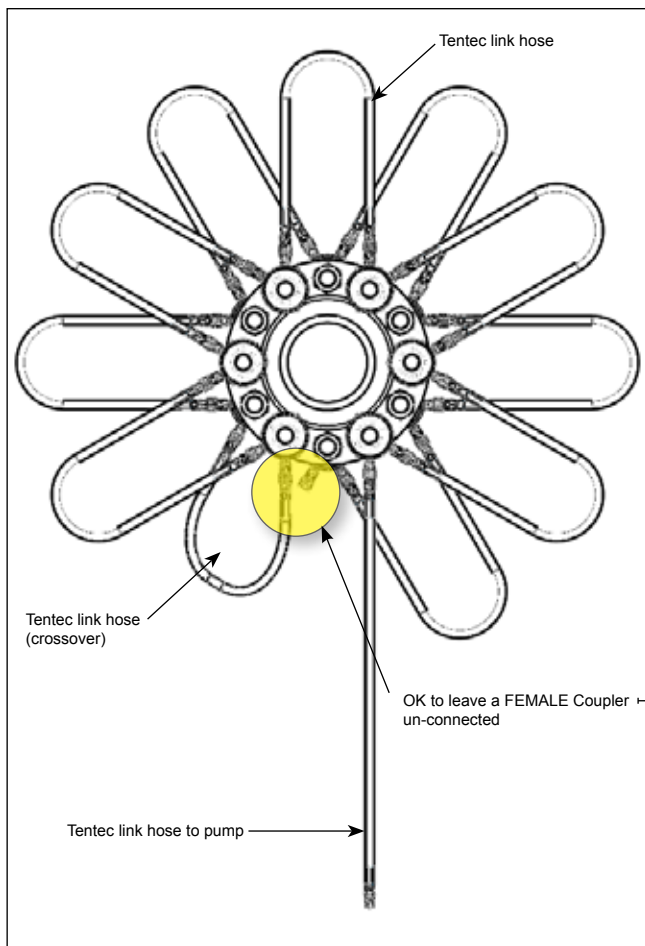


Fig 5.4



Never pressurise an unconnected male coupler. Male couplers are not designed to withstand high pressure, in the unconnected mode. Pressurising an unconnected MALE coupler can lead to serious personal injury or death.

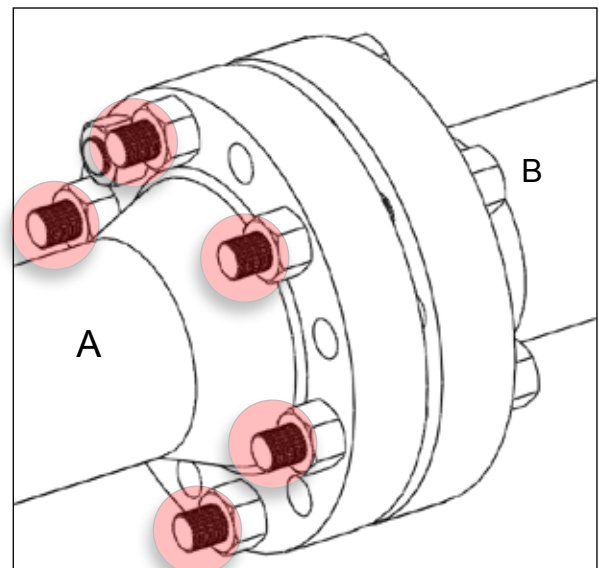


Fig 5.2 Joint Side A

Every other bolt consists of adequate bolt protrusion

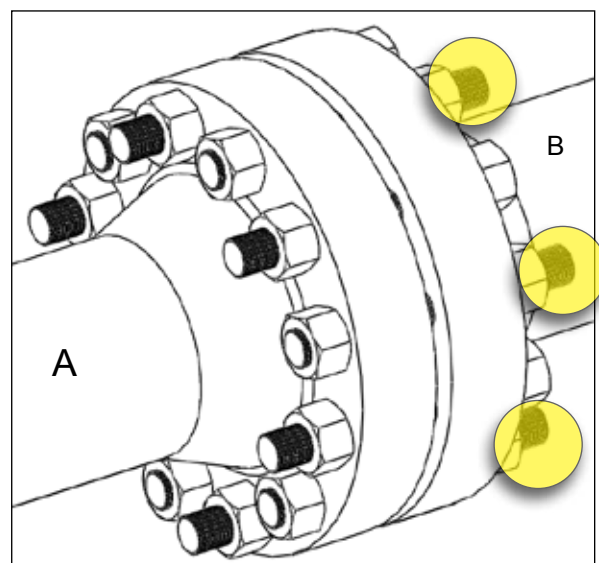


Fig 5.3 Joint Side B

Every other bolt consists of adequate bolt protrusion

5.2 Tensioner Arrangement - 50% Configuration

Every other bolt simultaneously tensioned.

In this configuration the bolt to tensioner ratio is 50%. The tensioning procedure consists of:-

1. Simultaneously tensioning every other bolt, to first pass pressure "A"
2. Tension the final 50% of bolts, to 2nd pass pressure "B"
3. Optional checking pass.

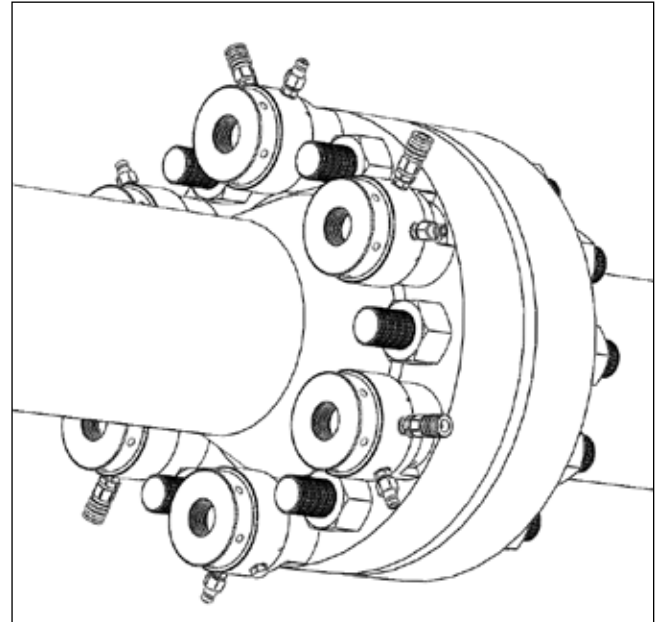


Fig 5.5

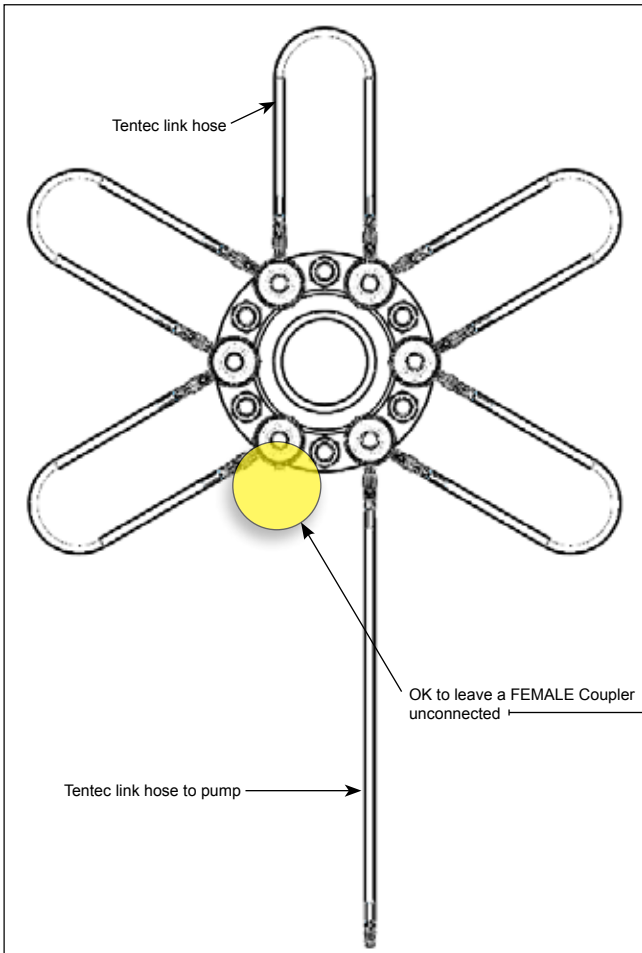


Fig 5.7

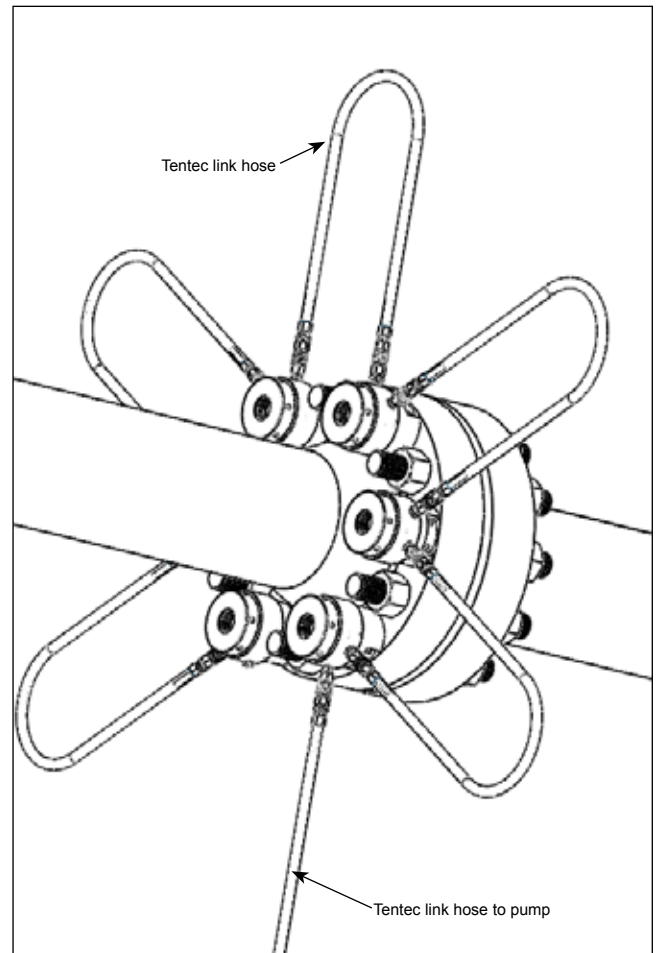


Fig 5.6



Never pressurise an unconnected male coupler. Male couplers are not designed to withstand high pressure, in the unconnected mode. Pressurising an unconnected MALE coupler can lead to serious personal injury or death.

6.0 Tensioner Installation.

Prior to installing the tensioners read section 5 to determine the suitable tensioner arrangement to be used.

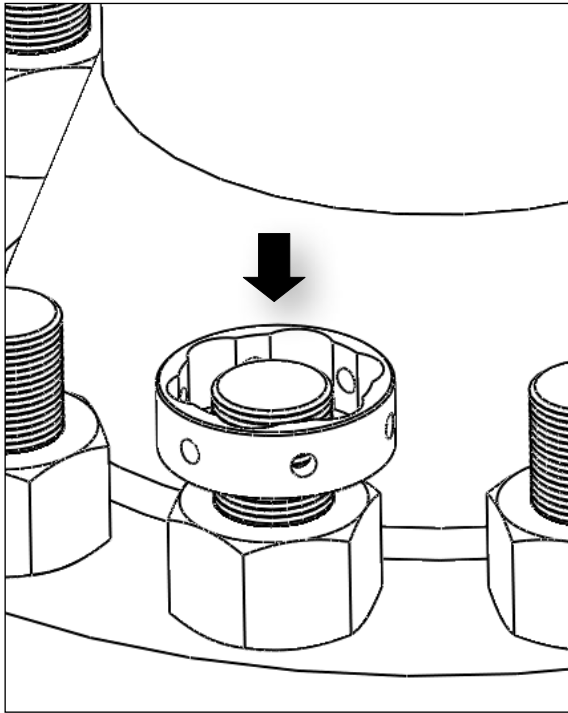


Fig 6.1
Fit the nut socket over the hexagon nut.

Prior to installing the tensioners ensure the bolt threads are clean and free of damage.

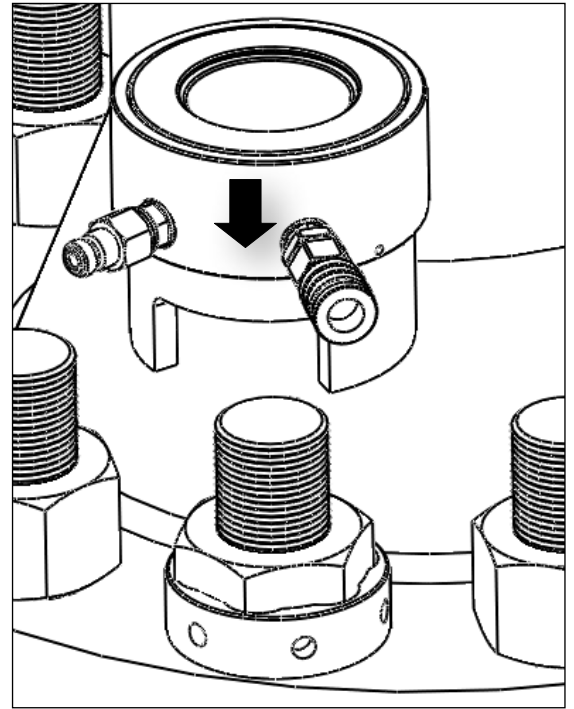


Fig 6.2
Fit the tensioner over the stud until it sits flat on the bolted joint. Ensure the bridge access window faces radially out with easy accessibility to the tommy holes in the nut socket. Ensure the hydraulic connections are also facing radially outwards.

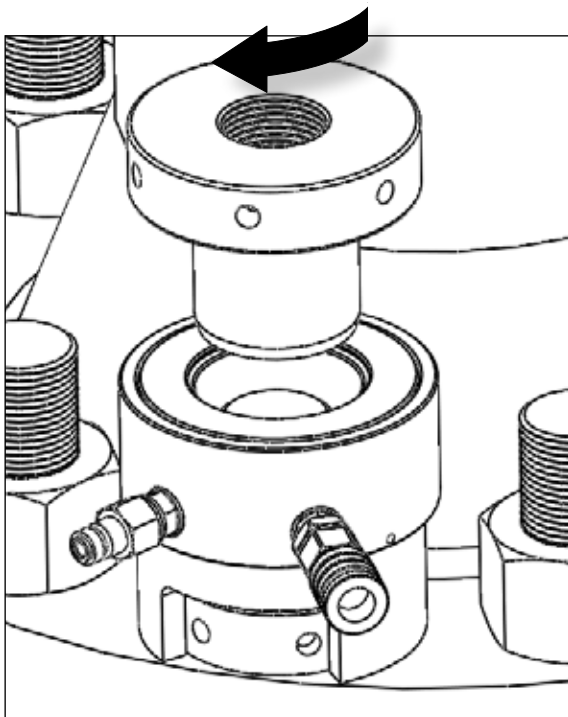


Fig 6.3
Place the thread insert into the tensioner bore until contact is made with the top face of the bolt. Using the tommy bar rotate the thread insert downwards until the thread insert head makes contact with the top face of the tensioner piston.

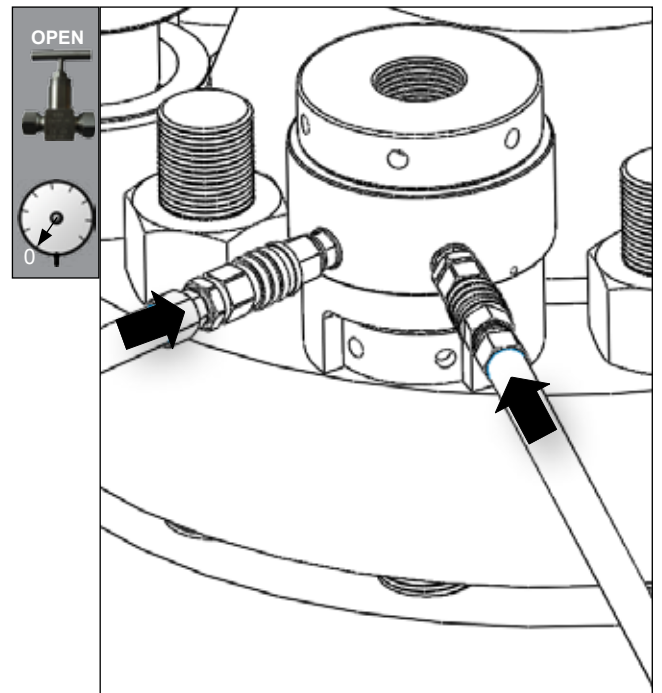






Fig 6.4
Ensure the pump pressure release valve is fully open and the pump is off. Connect the link hoses to the installed tensioners. Refer to section 5 for different tensioning procedure configurations and illustrations.

7.0 Tensioning Procedure

 Never stand in-line with the bolt axis during the tensioning or de-tensioning procedure. Unexpected bolt failure can result in serious personal injury or death. Premature bolt failure can lead to parts of the tensioner or bolt becoming high velocity projectiles. Alert all personnel to the consequences of premature bolt failure and clear the area of non essential personnel before the procedure starts.

 Always ensure that all personnel in the near vicinity are aware that pressurisation of high pressure equipment is about to take place. Cordon off the work area and exclude anyone from the area who is not involved directly with the tensioning procedure.

 Never exceed the maximum working pressure of the system. The maximum working pressure of the tensioning tool is hard stamped on the tensioner body component.

 All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

Make sure the tensioning team have read and understood the "Specific Bolt Tensioner Safety Warnings" in Section 2.0.

NOTE: If the maximum stroke indicator appears (fig 7) on any of the tools before the target operating pressure is reached immediately stop the pump and firmly tighten down the joint nuts (tensioner end) using a tommy bar engaged into the holes of the nut socket. Access the nut socket holes through the tensioner access window then release the pressure to zero. Using a tommy bar engaged in the thread insert head rotate the thread inserts towards to the tensioners to fully close the piston. Restart the tensioning pass.

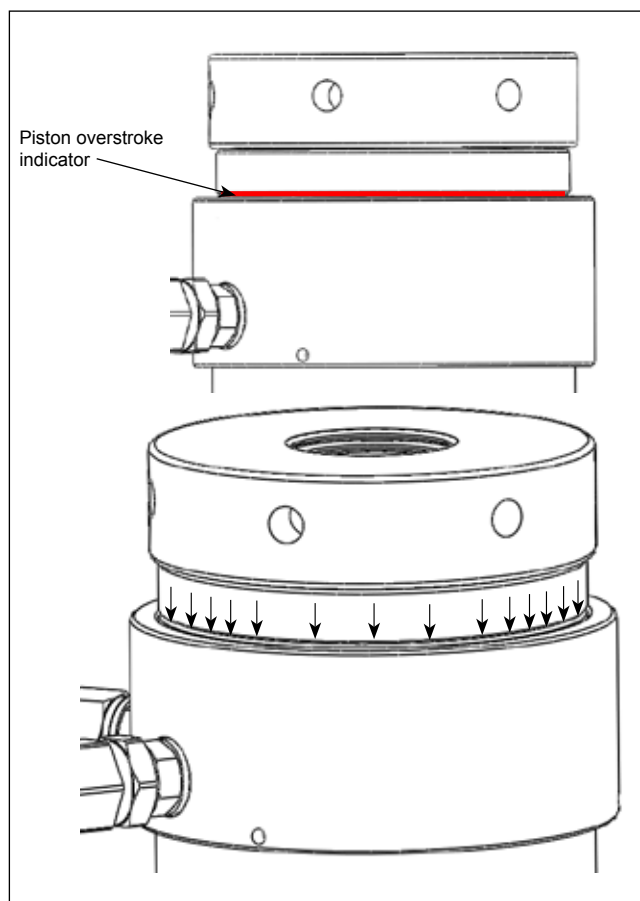




Fig 7.0

7.1 Tensioning Procedure 100% bolt to tensioner ratio configuration.

1. Ensure the two halves of the bolted joint are full aligned.
2. Fit the tensioners to all of the bolts (Refer to section 5.1 for illustrations of tensioner set up, refer to section 6.0 for installation instructions).
3. Using link hoses connect the tensioners together and to a suitable pump unit. Refer to section 5.1 for configuration illustrations and fig 6.4 for link hose connection instructions. Before connecting a link hose to the pump unit make sure the pump is turned off and the pressure release valve is in the open position.
4. Ensure the tensioning team are aware of the target-working pressure.

 Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.

5. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.

 All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

6. Once the pressure is holding steady, continue to pressurise the system up to the target calculated working pressure. (Fig 7.1) Continually monitor for piston overstroke, should any piston overstroke indicator become visible immediately stop the pump to hold the pressure, go to step 8 then 9 then 9b. Then recommence the tensioning procedure from step 5.
7. Once the target working pressure is reached, stop the pump to hold pressure. Monitor the pump pressure gauge to ensure the pressure is neither falling or rising.



Only approach pressurised tensioning tools when you are certain that the pressure is holding steady. Continually monitor the pump pressure at all times. If the pressure is not holding steady do not approach the system but release the pressure to zero and then investigate the cause of pressure loss. Never investigate at high pressure.

8. Once the pressure is holding steady approach the tensioners and by using a tommy bar inserted into the nut socket holes rotate the nuts firmly against the joint face. Repeat until all of the nuts have been firmly seated against the bolted joint. (Fig 7.2 & 7.3)
9. Slowly open the pressure relief valve, the pressure will drop to zero.
- 9b. **Optional Step:** If the pistons are close to their fully extended position. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread insert to close the tensioner piston to zero. Repeat until the pistons are fully closed (Fig 7.4)
10. Repeat steps 5 through 9b for a second time
11. Repeat steps 5 through 9b for a third time

Optional checking procedure.

Pressurise the system for a 4th time and try to seat the hexagon nuts. Use a tommy bar inserted into the nut sockets try to tighten down the nuts further by hand.

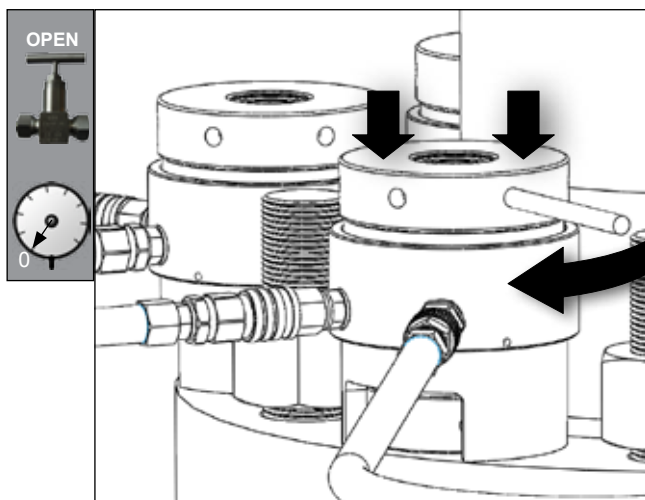
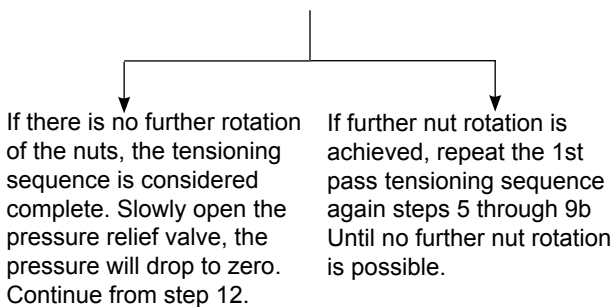


Fig 7.4

12. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread insert to close the tensioner piston to zero. Repeat until the pistons are fully closed (Fig 7.4)
13. Dis-connect all hydraulic hoses and remove all tensioners from the bolted joint. The tensioning procedure is considered complete

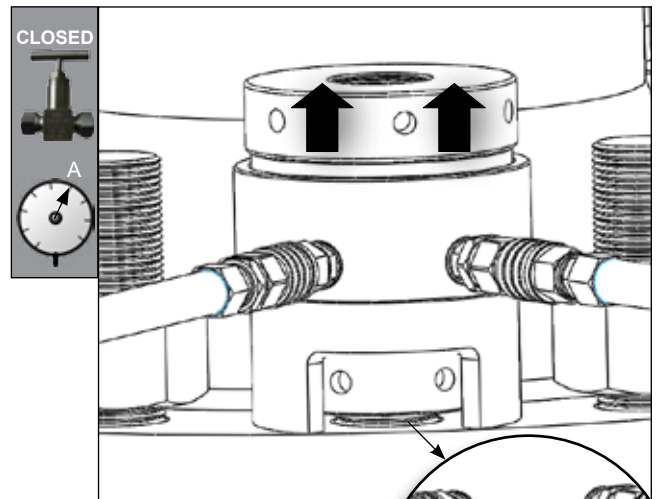


Fig 7.1

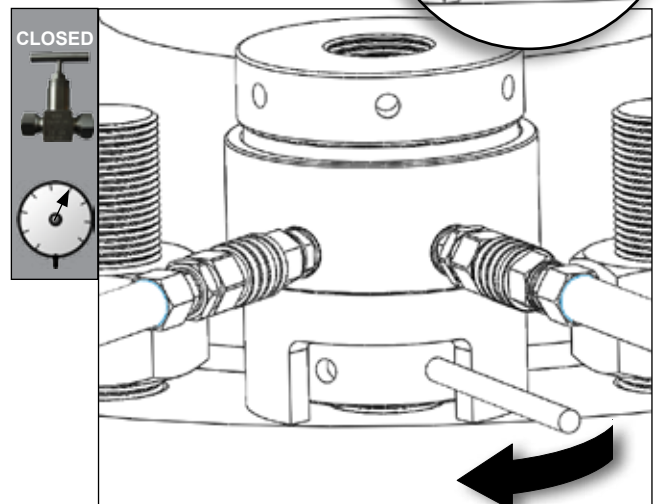


Fig 7.2

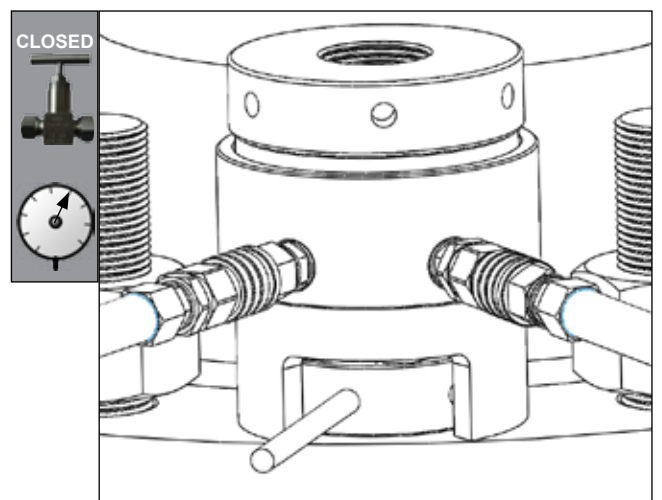


Fig 7.3

7.2 Tensioning Procedure

50% bolt to tensioner ratio configuration.

Tensioner installed on every other bolt.

First Pass Procedure

1. Ensure the two halves of the bolted joint are fully aligned. Number each bolt alternatively "1" and "2". Refer to fig 7.5.
2. Fit the tensioners to all the bolts marked "1", refer to section 6.0 for installation instructions. Refer to Fig 7.5
3. Using link hoses connect the tensioners together and to a suitable pump unit. Refer to section 5.2 for configuration illustrations and fig 6.4 for link hose connection instructions. Before connecting a link hose to the pump unit make sure the pump is turned off and the pressure release valve is in the open position.
4. Ensure the tensioning team are aware of the target "A" Pressure (1st pass working pressures) and "B" Pressure (2nd pass working pressure).



"A" pressures are generally higher than "B" pressures to compensate for load loss.

Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.

5. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.



All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

6. Once the pressure is holding steady, continue to pressurise the system up to the target "A" pressure (1st pass pressure). Continually monitor for piston overstroke, fig 7. Should any piston overstroke indicator become visible immediately stop the pump to hold the pressure, go to step 8 then 9 then 9b. Then recommence the tensioning procedure from step 5.
7. Once the target "A" (1st pass pressure) is reached, stop the pump to hold pressure. Monitor the pump pressure gauge to ensure the pressure is neither falling or rising.



Only approach pressurised tensioning tools when you are certain that the pressure is holding steady. Continually monitor the pump pressure at all times. If the pressure is not holding steady do not approach the system but release the pressure to zero and then investigate the cause of pressure loss. Never investigate at high pressure.

8. Once the pressure is holding steady approach the tensioners and by using a tommy bar inserted into the nut socket holes rotate the nuts firmly against the joint face. Repeat until all of the nuts have been firmly seated against the bolted joint. (Fig 7.2 & 7.3)
9. Slowly open the pressure relief valve, the pressure will drop to zero.
- 9b. **Optional Step:** If the pistons are close to their fully extended position. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread insert to close the tensioner piston to zero. Repeat until the pistons are fully closed (Fig 7.4)
10. Repeat steps 5 through 9b for a second time
11. Repeat steps 5 through 9b for a third time

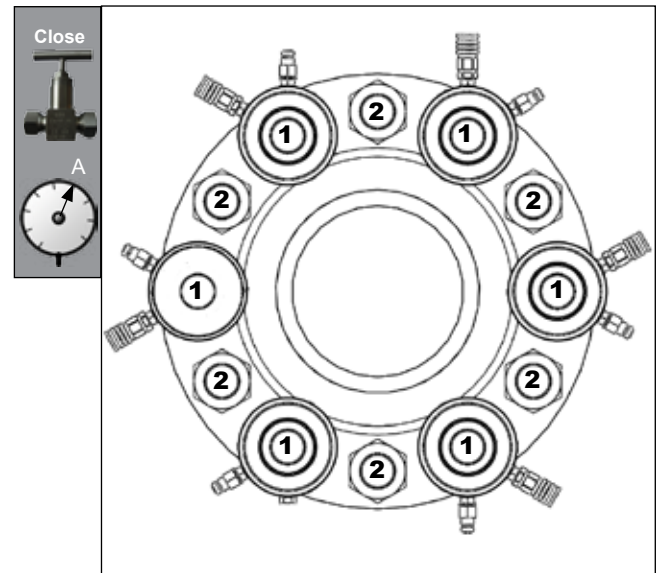


Fig 7.5

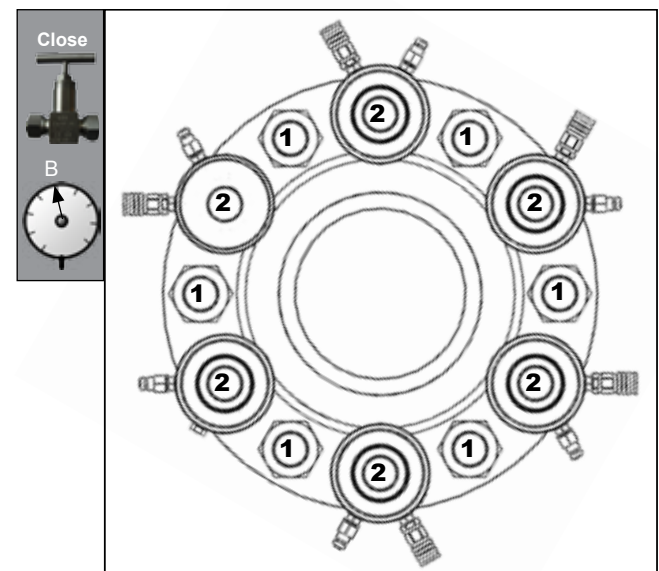


Fig 7.6

Second Pass Procedure

12. Reposition the tensioners on to the remaining 50% of bolts, bolts marked "2" (Fig 7.6)
13. Ensure the tensioning team are aware of the target "B" Pressure (2nd pass pressure)

"B" pressures are generally lower than "A" pressures



Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.

14. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.



All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

15. Once the pressure is holding steady, continue to pressurise the system up to the target "B" pressure (2nd pass pressure). Continually monitor for piston overstroke. If the piston over stroke indicator becomes visible on any of the tensioners, immediately stop the pump to hold the pressure. Go to step 17, 18, 18b. Then recommence the tensioning procedure from step 14.
16. Once the target working pressure is reached, stop the pump to hold pressure. Monitor the pump pressure gauge to ensure the pressure is neither fall or rising.

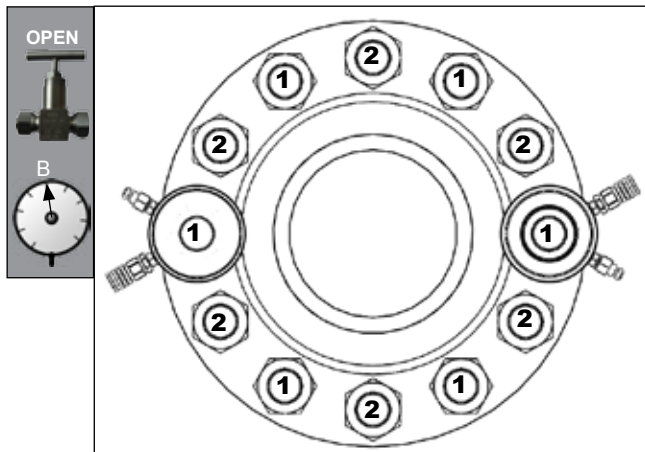


Fig 7.7



Only approach pressurised tensioning tools when you are certain that the pressure is holding steady. Continually monitor the pump pressure at all times. If the pressure is not holding steady do not approach the system but release the pressure to zero and then investigate the cause of pressure loss. Never investigate at high pressure.

17. Once the pressure is holding steady approach the tensioners and by using a tommy bar inserted into the nut socket holes rotate the nuts firmly against the joint face. Repeat until all of the nuts have been firmly seated against the bolted joint. (Fig 7.2 & 7.3)
 18. Slowly open the pressure relief valve, the pressure will drop to zero.
- 18b.Optional Step:** If the pistons are close to their fully extended position. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread insert to close the tensioner piston to zero. Repeat until the pistons are fully closed (Fig 7.4)
19. Repeat steps 14 through 18 for a second time, to pressure "B"
 20. Repeat steps 14 through 18 for a third time, to pressure "B"
 21. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread insert to close the tensioner piston to zero. Repeat until the pistons are fully closed (Fig 7.4)
 22. Dis-connect all hydraulic hoses and remove all tensioners from the bolted joint. The tensioning procedure is considered complete

Checking Procedure.

In order to check if excessive load was lost from the first 50% of bolts (bolts marked "1")

- A. Install two tensioners on two 1st 50% bolts (Marked "1", diametrically opposite each other. (Fig 7.7)
- B. Connect the hydraulic link hoses.
- C. Pressurise the system to "B" Pressure, Hold the pressure.
- D. Using a tommy bar inserted into the nut sockets try to tighten down the nuts further by hand.

If there is no further rotation of the nuts, Slowly open the pressure relief valve, the pressure will drop to zero. go to step 21.

If further nut rotation is achieved, repeat the 1st & 2nd pass tensioning sequence again, steps 2 through 20. Then repeat this checking Procedure.

8.0 De-Tensioning Instructions

100% bolt to Tensioner Ratio Configuration.

All bolts simultaneously tensioned.

Read the safety instructions at the start of section 7.0 before beginning de-tensioning work

1. Fit a tensioner to every bolt and connect the link hose, refer to section 5.1 for system configuration and section 6.0 for installation guide



Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.

2. Before commencing pressurisation, back off all of the thread inserts by 5mm (0.2") see fig 8.1. (Ensure there is still enough thread engagement between the thread inserts and the bolt thread protrusions.

3. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.



All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.



NOTE: During the de-tensioning procedure NEVER exceed the maximum working pressure of the tensioner. Ensure the bolt is strong enough to withstand the load your applying.

Definition: Break Loose Pressure (BLP) is the pressure at which the user can rotate one of the joint nuts (tensioner end) by hand with a tommy bar.

4. Once the pressure is holding steady, continue to slowly increase the pressurise, continually monitor a single joint nut (tensioner end) for rotation. Use a tommy bar inserted into the nut socket fig 8.2. Once the break loose pressure (BLP) is found, stop the pump to hold the pressure and make a note of the pressure.
5. Make sure the pressure is holding steady and using a tommy bar inserted in the nut socket, back off every joint nut (tensioner end) by 3mm (1/8"). Do not back off the nut to a greater value than the distance that you backed off the thread insert in step 2 see fig 8.3

Note: *If nuts are difficult to rotate at this break loose pressure, slightly increase the pressure until the nuts become loose. Never exceed the maximum working pressure of the tool. Make sure that the bolt material and joint material can withstand the load you are applying.*

6. Slowly release the pressure to zero.
7. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread inserts to close the tensioner piston to zero. Repeat on all tensioners until all of the pistons are fully closed.
8. Disconnect all hoses and remove all tensioners from the joint.
9. The de-tensioning procedure is complete.

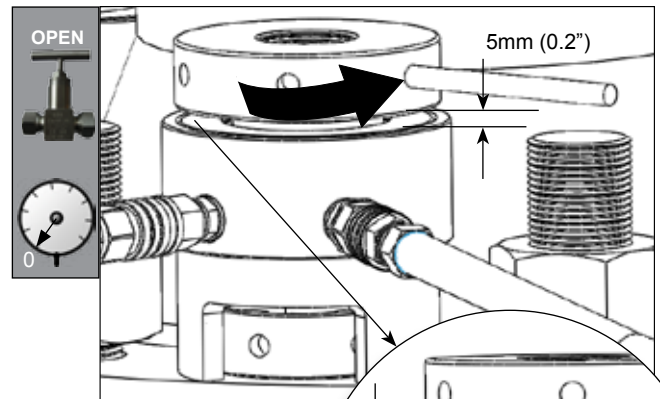


fig 8.1

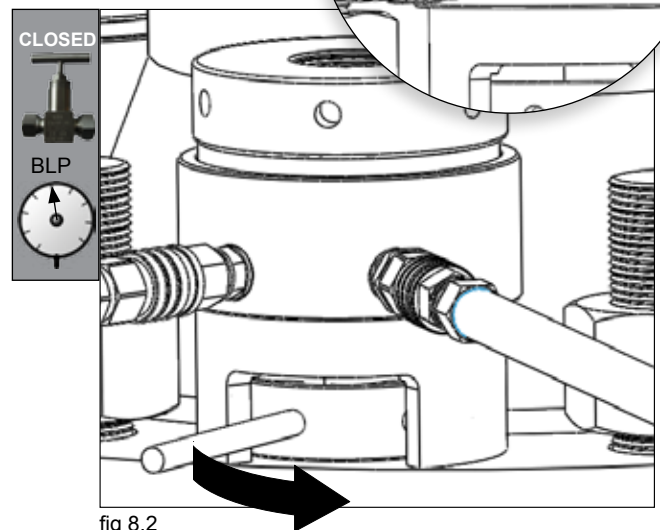


fig 8.2

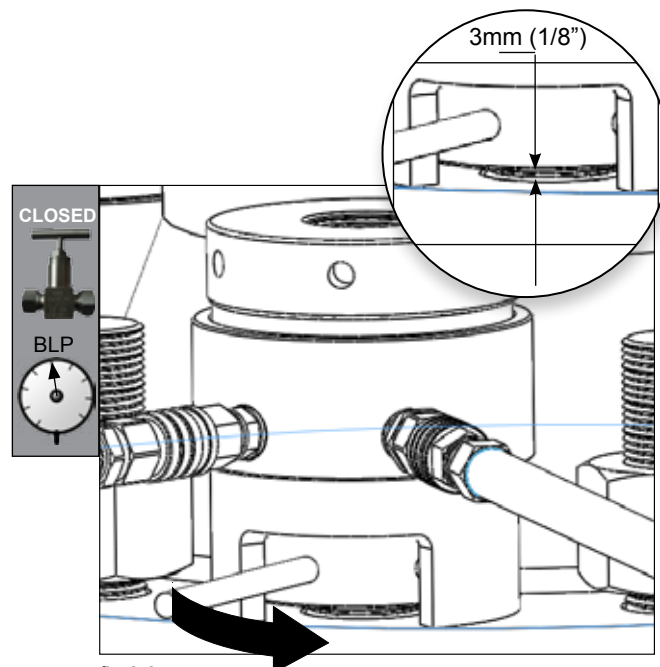


fig 8.3

8.1 De-Tensioning Instructions

50% bolt to Tensioner Ratio Configuration.

All bolts simultaneously tensioned.

Read the safety instructions at the start of section 7.0 before beginning de-tensioning work

1. Fit a tensioner to every other bolt and connect the link hose, refer to section 5.2 for system configuration and section 6.0 for installation guide

Bolting calculations should only be carried out by trained and qualified engineers who have been appropriately trained or have suitable experience in bolting technology.

2. Before commencing pressurisation, back off all of the thread inserts by 5mm (0.2") see fig 8.1. (Ensure there is still enough thread engagement between the thread inserts and the bolt thread protrusions.

3. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.

All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

NOTE: During the de-tensioning procedure NEVER exceed the maximum working pressure of the tensioner. Ensure the bolt is strong enough to withstand the load your applying.

Definition: Break Loose Pressure (BLP) is the pressure at which the user can rotate one of the joint nuts (tensioner end) by hand with a tommy bar.

4. Once the pressure is holding steady, continue to slowly increase the pressurise, continually monitor a single joint nut (tensioner end) for rotation fig 8.2. Once the break loose pressure (BLP) is found, stop the pump to hold the pressure and make a note of the pressure.
5. Make sure the pressure is holding steady and using a tommy bar inserted in the nut socket, back off every joint nut (tensioner end) by 3mm (1/8"). Do not back off the nut to a greater value than the distance that you backed off the thread insert in step 2 see fig 8.3

Note: If nuts are difficult to rotate at this break loose pressure, slightly increase the pressure until the nuts become loose. Never exceed the maximum working pressure of the tool. Make sure that the bolt material and joint material can withstand the load you are applying.

6. Slowly release the pressure to zero.
7. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread inserts to close the tensioner piston to zero. Repeat on all tensioners until all of the pistons are fully closed.
8. Reposition the tensioners and link hoses to the remaining 50% of bolts

9. Before commencing pressurisation off the final 50% of bolts, back off all of the thread inserts by 5mm (0.2") see fig 8.1. (Ensure there is still enough thread engagement between the thread inserts and the bolt thread protrusions.

10. For pump operation refer to the supplied pump instruction document. Operate the pump unit and pressurise the system to 1000psi (70 bar) and check that the pressure is holding steady. If the pressure drops investigate the problem looking for leaks.

All investigation, maintenance or leak repair work should only be carried out when the tensioning system is at zero pressure.

NOTE: During the de-tensioning procedure NEVER exceed the maximum working pressure of the tensioner. Ensure the bolt is strong enough to withstand the load your applying.

Definition: Break Loose Pressure (BLP) is the pressure at which the user can rotate one of the joint nuts (tensioner end) by hand with a tommy bar.

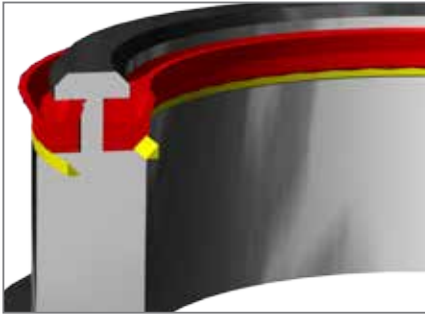
11. Once the pressure is holding steady, continue to slowly increase the pressurise, continually monitor a single joint nut (tensioner end) for rotation fig 8.2. Use a tommy bar inserted into the nut socket. Once the break loose pressure (BLP) is found, stop the pump to hold the pressure and make a note of the pressure.
12. Make sure the pressure is holding steady and using a tommy bar inserted in the nut socket, back off every joint nut (tensioner end) by 3mm (1/8"). Do not back off the nut to a greater value than the distance that you backed off the thread insert in step 2 see fig 8.3

Note: If nuts are difficult to rotate at this break loose pressure, slightly increase the pressure until the nuts become loose. Never exceed the maximum working pressure of the tool. Make sure that the bolt material and joint material can withstand the load you are applying.

13. Slowly release the pressure to zero.
14. Using a tommy bar inserted into the holes in the thread insert head, rotate the thread inserts to close the tensioner piston to zero. Repeat on all tensioners until all of the pistons are fully closed.
15. Disconnect all hoses and remove all tensioners from the joint.
16. The De-tensioning procedure is complete.

9.0 Seal Replacement S2/K2 Type.

Tentec use different seal configurations due to differences in tensioner specifications and tensioner usage environments. This page details the replacement of S2/K2 type high pressure seals.



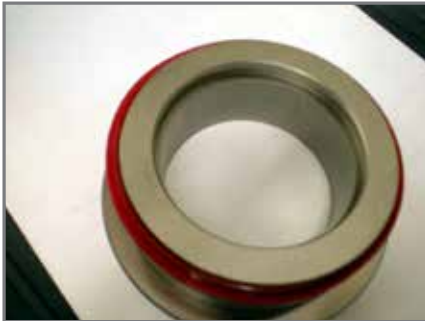
Make note of the correct orientation of the triangular back up rings.



Place the outer back-up ring in to the piston outer seal housing.



Position and stretch over the outer seal into the piston outer seal housing. The seal fits above the back up ring



With a rounded smooth screwdriver push home the seal until the seal clips into the seal housing. Ensure the seal and back-up ring are fully seated around circumference



Squeeze the inner seal into the inner seal housing.



Push home the inner seal with a smooth rounded screwdriver.



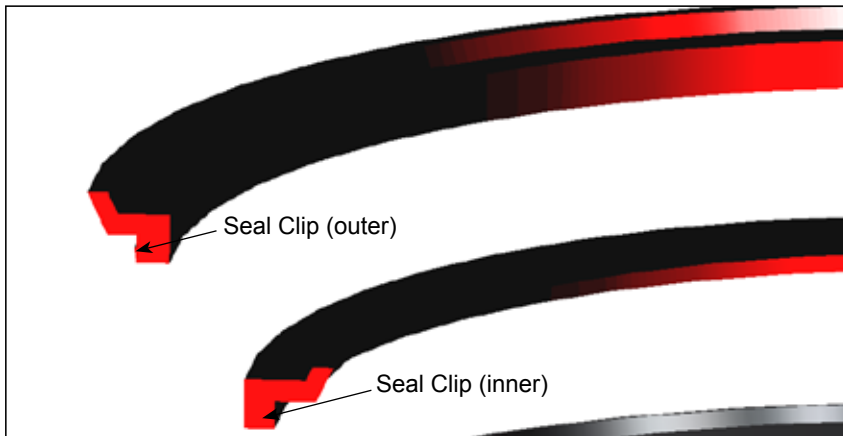
Place the inner back-up ring below the inner seal



Carefully bend the back-up ring to enable it to clip into position. Ensure the seal and back-up ring are fully seated around the circumference.

9.1 Seal Replacement "Clip - In" Type.

Tentec use different seal configurations due to differences in tensioner specifications and tensioner usage environments. This page details the replacement of "Clip - In" type high pressure seals.



Insert the inner seal into the seal housing, the seal clip fits into the seal clip housing



Using a blunt nose tool push the seal fully into the seal clip housing, work around the periphery of the seal until the seal is completely inserted into the clip housing



Insert the outer seal into the seal housing, the seal clip fits into the seal clip housing.



Using a blunt nose tool push the seal fully into the seal clip housing, work around the periphery of the seal until the seal is completely inserted into the clip housing

Theory of Bolt Tensioning

Cross Load Factor (CLF)

For less than 100% bolt to tool ratio tensioning it is necessary to use two tightening pressures. Tentec refer to these pressures as Pressure A and Pressure B. These two pressures are necessary in order to compensate for the bolt load loss that occurs when a bolt is tensioned adjacent to an already tensioned bolt. The already tensioned bolt loses load as load is being applied to its adjacent partner.

To compensate for this load loss extra load is applied in the form of pump pressure A, to the first bolt so that it relaxes down to the required load.

Generally Tentec recommend a cross load factor of 1.2.

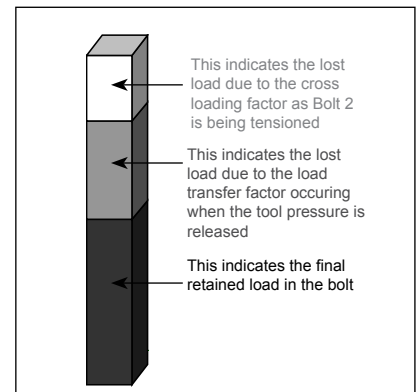


Fig 2 Shows the breakdown of load losses and the final retained load

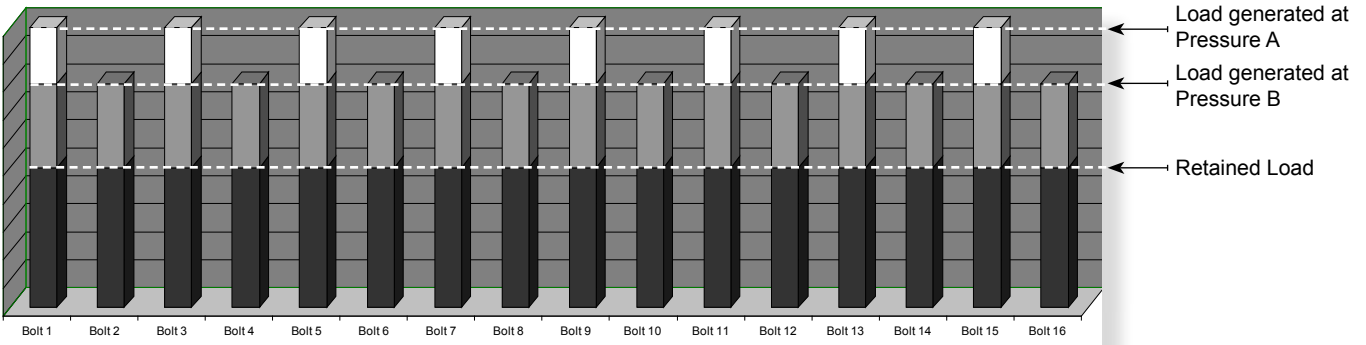


Fig 1 This diagram shows the normal load losses associated with stretch bolt tensioners

Load Transfer Factor. (LTF)

Any stretch bolt tensioner regardless of make, exhibits a load transfer loss as the bolt load is transferred from the tensioner to the joints hexagon or round nuts. The bolt load loss is a direct loss of stud elongation; this is due to many different factors, such as thread deflections, radial expansion of the nut and ' bedding in' of the nut into the joint reaction surface. Because of this phenomenon it is essential that a load allowance is made when calculating the required operating pressure of a tensioner, to achieve a known residual bolt load, extra load must be applied so the bolt will relax down to the required load on transfer. The load transfer factor can be accurately calculated and is a direct function of joint clamp length and the nominal diameter of the stud

Formula to use:

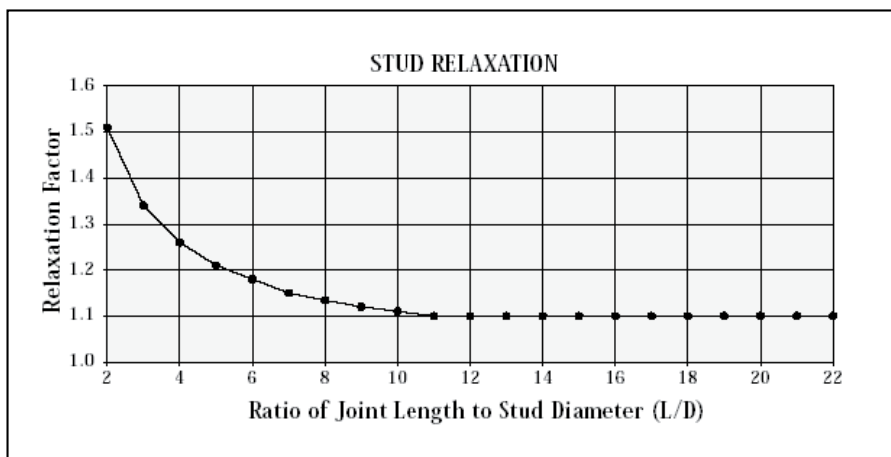
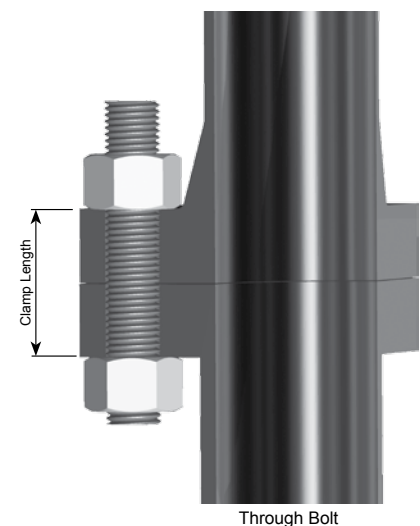
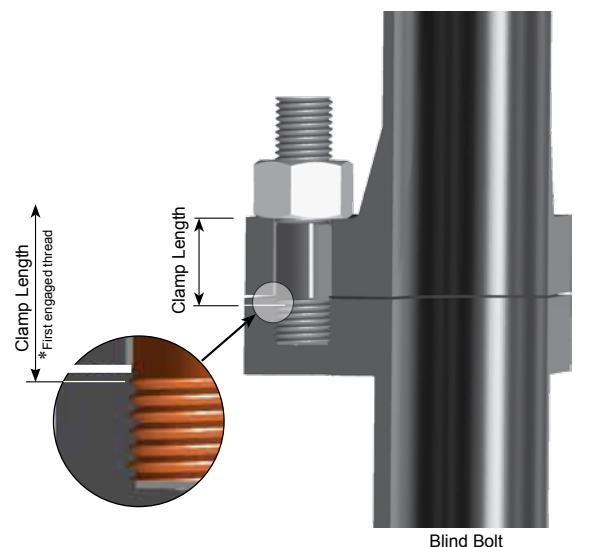
$$\text{Load Transfer Factor (LTF)} = 1.01 + (D / C)$$

Units:-

D = Nominal Thread Diameter (mm or In)

C = Bolt Clamp Length (mm or In)

Note: If the calculated LTF is less than 1.1, then use 1.1



Useful Formula Relating to Bolt Tensioners

Determining required bolt load from known bolt stress.

Residual Bolt Load = Bolt Stress x Bolt Tensile Stress Area

Units:

Residual Bolt Load = (N or Tons)

Bolt Tensile Stress Area = (mm² or In²)



Caution:

Using these Tensile Stress Area values is only applicable for fully threaded studs, if the stud in question is waisted or reduced in diameter, the Tensile Stress Area will need to be calculated using the smallest stressed diameter on the bolt.

Bolt Tensile Stress Area = $\pi/4 \times (d^2)$

Units

Bolt Tensile Stress Area = (mm² or In²)

d = Smallest Stressed Diameter on bolt = (mm or In)

Determine Tool Pressure B to achieve required Bolt Load.

Tool Pressure = (Required Bolt Load x LTF) / Tool Hydraulic Pressure Area

Units

Tool Pressure = (N/mm² or Ton/In²)*

Required Bolt Load = (N or Ton)

LTF = (No Units)

Tool Hydraulic Pressure Area = (mm² or In²)

*To convert N/mm² to bar: Multiply by 10

** To Convert Ton/In² to psi: Multiply by 2240

Determine Tool Pressure A to achieve required Bolt Load.

Tool Pressure = (Required Bolt Load x LTF x CLF) / Tool Hydraulic Pressure Area

Units

Tool Pressure = (N/mm² or Ton/In²)*

Required Bolt Load = (N or Ton)

LTF = (No Units)

Tool Hydraulic Pressure Area = (mm² or In²)

*To convert N/mm² to bar: Multiply by 10

** To Convert Ton/In² to psi: Multiply by 2240

% of Bolt Yield

(Bolt Stress Required / Yield Strength of bolt) x 100 x LTF x CLF

Units

Bolt Stress Required (N/mm² or Ton/In²)

Bolt Stress Required (N/mm² or Ton/In²)

The tool Hydraulic Pressure Area and Max Working

Pressure can be found hard stamped on the Tentec tool.



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