Top Collar Hydraulic Nut

Operational and Maintenance Manual

Project Number:

Date:

Copyright Statement & Disclaimer

Please note that the scope of this document covers the safety, operation and maintenance instructions concerned with the equipment supplied ONLY. Safe handling, usage and storage of this equipment on customer applications and installations is the responsibility of the customer. This document should only be considered a part of the customer's wider procedure for installation of plant and therefore HYTORC cannot accept any responsibility for any actions arising as a result of misuse of this equipment.

The contents of this manual may periodically be subject to alteration. HYTORC reserves the right to alter or modify this manual without prior notification.

Further copies of this manual may be purchased from HYTORC.

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Foreword

Thank you for purchasing or renting HYTORC Bolt Tensioning Equipment.

Before using the bolt tensioning equipment you are advised to study this operating manual carefully.

The bolt tensioning equipment has been designed to comply with the European Pressure Equipment Directive and is CE marked. However the pressures and forces involved with the use of this equipment are high and it is imperative that use users of the equipment read and understand the operating manual, paying particular attention to the safety information in Section 2.0.

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Section 1

Health & Safety

Important Notice

THINK SAFETY

Thank you for purchasing or renting your hydraulic bolt tensioning equipment from **HYTORC**. Hydraulic Nuts are very powerful and capable of inducing very high bolt stresses. This equipment has been designed to give many years of safe tightening of bolted connections when used in accordance with these instructions.

Persons using hydraulic bolt tensioning tools must be properly trained in the correct use of the equipment and must take adequate steps to ensure their own safety, and the Health and Safety of others working in the area where bolt tensioning operations are being performed. **HYTORC** will be pleased to quote for the provision of training courses either at its UK base or on site anywhere in the world.

Operators must read all of this instruction and maintenance manual before attempting to use the equipment. Do not use the equipment if you are not already an experienced user of hydraulic bolt tensioning tools or if you have not already received proper training. Your attention is particularly drawn to the notes in **RED**.

When using hydraulic nuts, loads of many hundreds of tonnes and even thousands of tonnes can be induced. If the bolt material is incorrect or faulty or the tool is incorrectly installed, the broken bolt could be launched at high speed along the axis of the bolt. This is a very rare occurrence. If there is a failure, anyone standing near to the hydraulic nut or in line with the axis of the bolt during the tensioning operation will suffer critical, possibly fatal, injury. It is therefore essential that anyone operating this equipment is properly trained in its safe use and takes every precaution to ensure that nobody is allowed to stand, work or stray near to or into line with the axis of any hydraulic nut during the bolt tensioning operation.

Hydraulic nuts are powerful and use high pressure hydraulics it is essential that you are trained in the correct use of the equipment and adhere fully with the Health and Safety Instructions.

European Pressure Equipment Directive

The 1500 bar range of HYTORC hydraulic nuts have been designed to operate at pressures up to 1500 bar with Group 2 liquid (hydraulic oil ISO10) and volume less than 10 litre. This equipment falls into category 1 of the specified pressure volume thresholds. Under the regulations the equipment must therefore:-

a) be safe
b) meet the essential safety requirements covering design, manufacture and testing
c) satisfy the appropriate conformity assessment procedure
d) be accompanied by adequate instructions for use
e) be marked to identify the manufacturer and CE marked

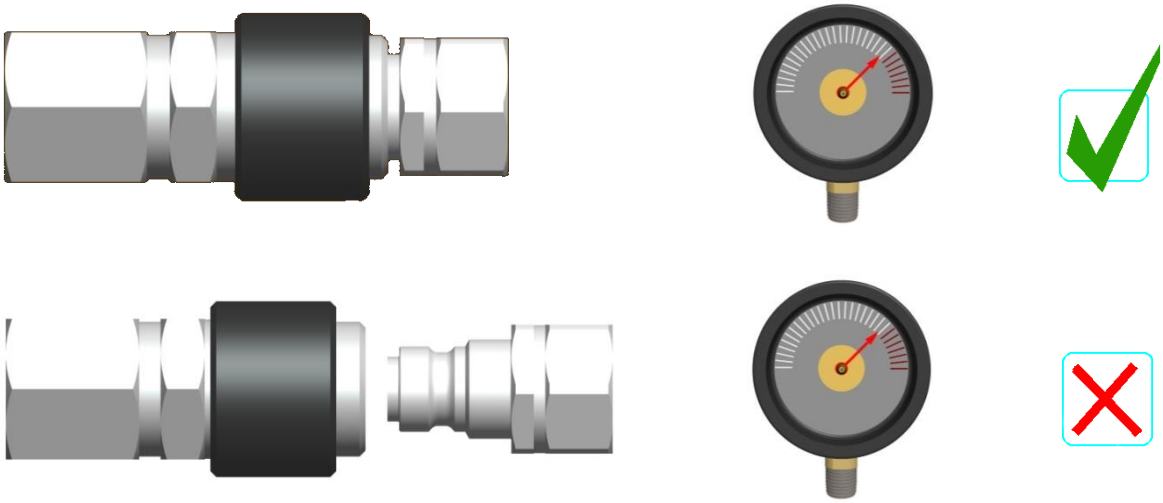
The pressure equipment directive calls for the pressure equipment to be pressure tested at 1.43 times the maximum pressure. However the directive recognises that in some cases this may be harmful or impractical. Because of the very high bolt stress developed, it is impractical to pressure test the equipment above 1650 bar. It would also be harmful to the oil seals if a pressure test of 2145 bar were applied.

The 1500 bar max pressure hydraulic nuts have been pressure tested at 1650 bar and a test certificate has been issued. The CE mark has been applied.

Quick Connectors

DO NOT pressurise the connectors when they are disconnected.

Check there is no pressure in the system before attempting to connect or disconnect the couplings.



Hoses

The flexible hydraulic hoses supplied by **HYTORC** have a small plastic core tube surrounded by multiple high tensile steel spiral windings. The outside of the hose is moulded with a coloured plastic coating. Most hoses are also given a clear plastic cover to provide additional protection against damage when in use. Each hose is identified with a serial number. All hoses are pressure tested when manufactured and test certificates can be issued.

HYTORC supplies three types of high pressure flexible hydraulic hose and they are easily identified by the colour of the moulded plastic coating beneath the clear plastic cover. The maximum working pressure for the hose is sometimes marked on the outside of the coloured plastic coating; however this is the working pressure of the hose ONLY and not the hose ASSEMBLY. The maximum working pressure of a hose assembly is often limited by the pressure rating of the quick connect couplings and/or the fittings on the end of the hose. Although the hose may be capable of operating at higher pressures the limit you must observe is shown below along with the minimum bend radius.

Colour	Max Working Pressure	Min Bend Radius
GREEN	1000 bar	95 mm
BLUE	1500 bar	130 mm
RED	2500 bar	200 mm

Each type of hose is fitted with self sealing quick connect couplings at one or both ends.

You must observe the following Health & Safety instructions when using hydraulic hoses.

- Discard and do not use any hose that does not have an identifying serial number
- Discard and do not use any hose that shows any sign of damage either:-
  a) To the coloured moulded plastic coating
  b) Where the spiral windings are exposed
  c) Where the spiral windings are damaged or broken
  d) Where there is damage to the swaged metal ends
- Do not allow any hose to be kinked or knotted. Hoses which have been kinked or knotted will have suffered damage to the windings and must be discarded.
- Do not allow heavy objects to fall on, rest on, or roll over the hoses.
- Do not allow hoses to be subjected to temperatures higher than 60°C.
- Discard and do not use any hose which has been subjected to heat or fire.
- Do not bend the hose tighter than the minimum bend radius of the hose or it will be kinked.
- Do not exceed the maximum working pressure of 1000 bar for the GREEN colour hose, 1500 bar for BLUE colour hose, and 2500 bar for RED colour hose.
- Only use the hoses for their intended purpose – for use with **HYTORC** hydraulic equipment.
- After use check the hoses for damage, wipe to remove dirt and oil, refit dust caps and prepare for storage.

- When not in use store the hoses in a safe place where they cannot easily be damaged.
- Do not mix the **GREEN**, **BLUE**, **RED** colour coded hoses. The end fittings and quick disconnect couplings on these hoses have different pressure ratings.
- Never move hose end connectors or quick disconnects from one colour hose to another.
- Check the bolt tensioning equipment you are using is compatible with the hoses you are using. All **HYTORC** tools are marked with the maximum operating pressure.
- Never pressurise a quick disconnect coupling or nipple when disconnected.
- Do not take apart any ring main harness component or hose assembly. These are filled with oil and pressure tested after assembly. When taken apart the integrity of the assembly is lost and the pressure test invalidated. Return any parts that need attention to **HYTORC** where the correct specification parts will be used to effect repairs, followed by pressure testing and certification before return.
- Never use the hoses as a handle to carry or pick up the bolt tensioning equipment.

Hydraulic Nuts – Maximum Pressure

DO NOT exceed the maximum working pressure.

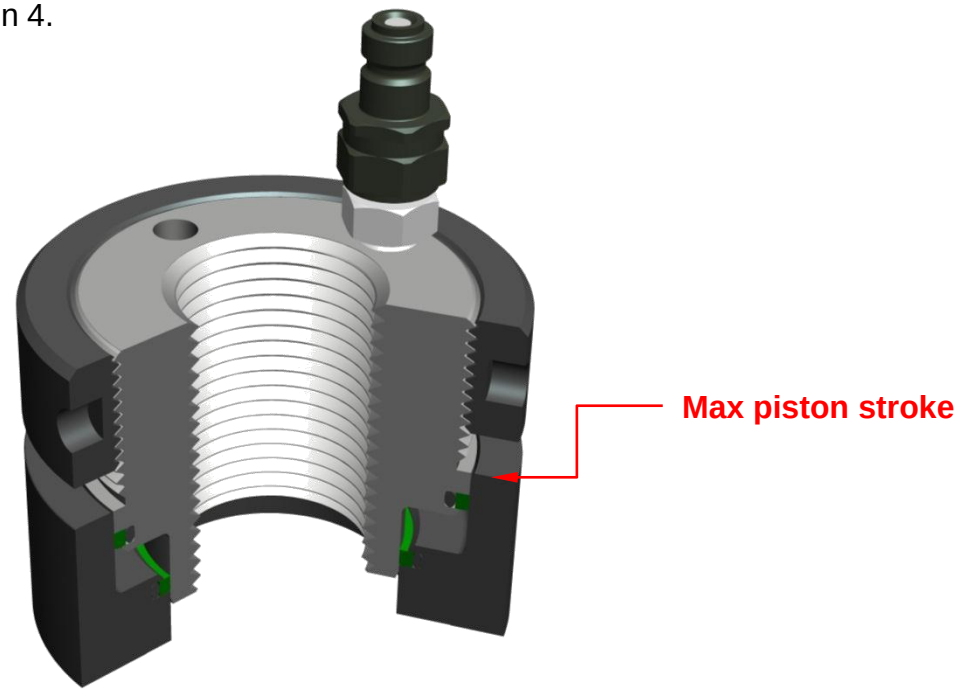
The maximum pressure for the hydraulic nut can be found in section 4.

The bolt being tensioned may have a maximum load less than that generated by the hydraulic nut at maximum working pressure. The operator needs to confirm and check what the maximum pressure is for the particular application being tensioned.

Hydraulic Nuts – Maximum Stroke

DO NOT exceed the maximum piston stroke.

The maximum piston stroke is indicated by the flat at the end of the piston thread. When this can be seen stop the pump immediately. The maximum stroke of the tool can be found in section 4.



Hydraulic Nuts – Safety Notes

Hydraulic nuts **MUST** always be used with a hydraulic pump which has a pressure limiting device. Always check that the pump stall pressure is set at or below, the maximum working pressure for the tool being used.

Clear all personnel from the area where the bolt tensioning operation is to be performed. Position the pump a safe distance away from the Hydraulic nuts. Set up barriers and warning signs, or make other adequate arrangements to prevent unauthorised personnel from accidentally straying into the bolt tensioning area.

Make certain that nobody is allowed to stand near to a hydraulic nut during the pressurisation process. At no time should anyone allow any part of their body to be positioned over the axis of the hydraulic nut whilst the pressure is rising or when it is pressurised. Do not allow anyone to stand anywhere near a direct line with the long axis of a bolt during the tensioning operation. In the case of studbolts with nuts at each end it is important that nobody stands in line with the long axis of the bolt at either end during the tensioning operation.

Do not approach a hydraulic nut whilst it is being pressurised. Remember that a damaged bolt or tool is most likely to fail at this critical time. When the operating pressure has been reached, approach a pressurised hydraulic nut only for as long as it takes to turn the nut collar, always keeping away from the axis of the bolt.

Never leave a pressurised hydraulic nut unattended. Keep the hydraulic nuts under pressure for the minimum time necessary to complete the bolt tightening job.

The hydraulic nuts should only be used as a bolt tensioning tool. **DO NOT** use the tools as hydraulic jacks or for any other purpose.

Take care when handling the tools. Large tools may be heavy and require the use of lifting equipment.

Do not try to tighten a leaking hydraulic connection when it is under pressure. First release the pressure then repair the leak.

Personal Protective Equipment

When using bolt tensioning tools the operator should ensure that they are wearing the correct Personal Protective Equipment (P.P.E.).

This equipment includes (but is not limited to):

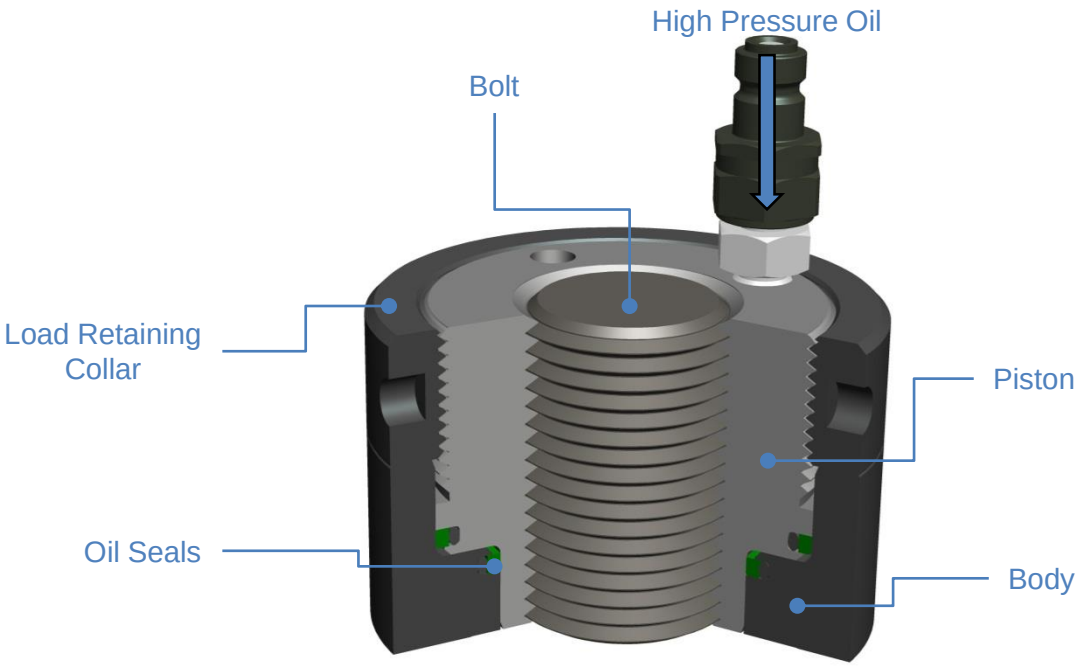
- Eye Protection
- Gloves
- Overalls
- Hard Hat
- Steel Toe-Capped boots or shoes.
- Any other site specific P.P.E. required.

Section 2

Operating Instructions

Introduction

A hydraulic nut provides a quick and easy method for tightening large diameter bolts to high and accurate pre-loads. Unlike conventional methods it does not use torque and does not require any forceful turning of the nut or bolt, like impact wrenches, flogging spanners or hydraulic torque wrenches. All of these methods have one common enemy, FRICTION. Overcoming thread friction and friction between the nut and the washer uses up over 80% of the torque energy applied to the nut or bolt, leaving less than 20% of the energy to produce useful tension in the shank of the bolt. Variations in the friction loss, from bolt to bolt causes non uniform tension in the bolts that have been tightened to the same torque or impact wrench settings.



A hydraulic nut is an internally threaded annular jack which screws onto the bolt to be tightened. The jack pushes against the bolted joint and pulls on the bolt. The bolt must be fully engaged into the hydraulic nut. Because the force produced, by the nut, is applied directly to the bolt, a tension equal to the load generated by the nut, is developed in the shank of the bolt. With the nut applying the tension, the bolted joint is compressed and the bolt is stretched. A gap appears between the nut body and the load retaining collar. The collar is turned to take up the piston travel and the oil pressure is released. The load is transferred from the hydraulics to the load retaining collar. Some load is lost as the previously unloaded threads of the collar deflect. Depending on the length of the bolt a high load can be retained in the bolt.

Hydraulic Nuts may be tightened individually or they can be ganged together to enable multiple bolts to be tightened simultaneously, to the same high and accurate pre-load. This is particularly useful when compressing gaskets in pipeline or pressure vessel flanged connections or where even tightening of a group of bolts is important. The high load developed by the multiple nuts, is evenly distributed around the joint causing the gasket to flow into the surface irregularities of the flange giving a much better seal. Flexible hoses with self sealing quick connect couplings are used to gang the nuts together to form a hydraulic ring main. The ring main and hydraulic nuts are pressurised using an air driven pump working from a compressed air supply.

Tightening a Bolt – Step 1

Assemble the joint with the bolts to be tightened. Washers may be used under the nut if desired but they are normally not necessary. The surface of the joint onto which the nut is to be fitted is ideally machined or spot faced to ensure the nut is fully supported by the joint and sits square in relation to the bolt axis.

Make sure a minimum thread length equal to the thickness of the hydraulic nut is protruding from the surface of the joint on the side the hydraulic nut is to be fitted. Whilst the nut is designed to cope with thread lengths in excess of the nut thickness it may be found that excessive length will interfere with the quick connector supplying oil to the nut.

Also make sure the nut at the other end of the bolt is fully engaged with the bolt or where a tapped hole is used, that the bolt is fully engaged with the hole threads.

It is very important this operation is performed properly otherwise the thread engagement between the nut and the bolt, or the bolt and the nut or threaded hole at the other end, will be too short, which could cause the bolt and/or nut threads to be stripped.

CORRECT & SAFE

WRONG & DANGEROUS

Health & Safety Warning

If insufficient threads are engaged at either end of the bolt, and an attempt is made to apply tension with the hydraulic nut, the bolt or nut threads may strip and components of the nut and or the bolt, could be launched with the possibility of serious injury.

Tightening a Bolt – Step 2

Place the Hydraulic Nut over the bolt.

Lower the nut onto the bolt. Take care that the Piston is not allowed to move out of the Nut Body during this operation.

Make sure the Load Retaining Collar is screwed back a little.

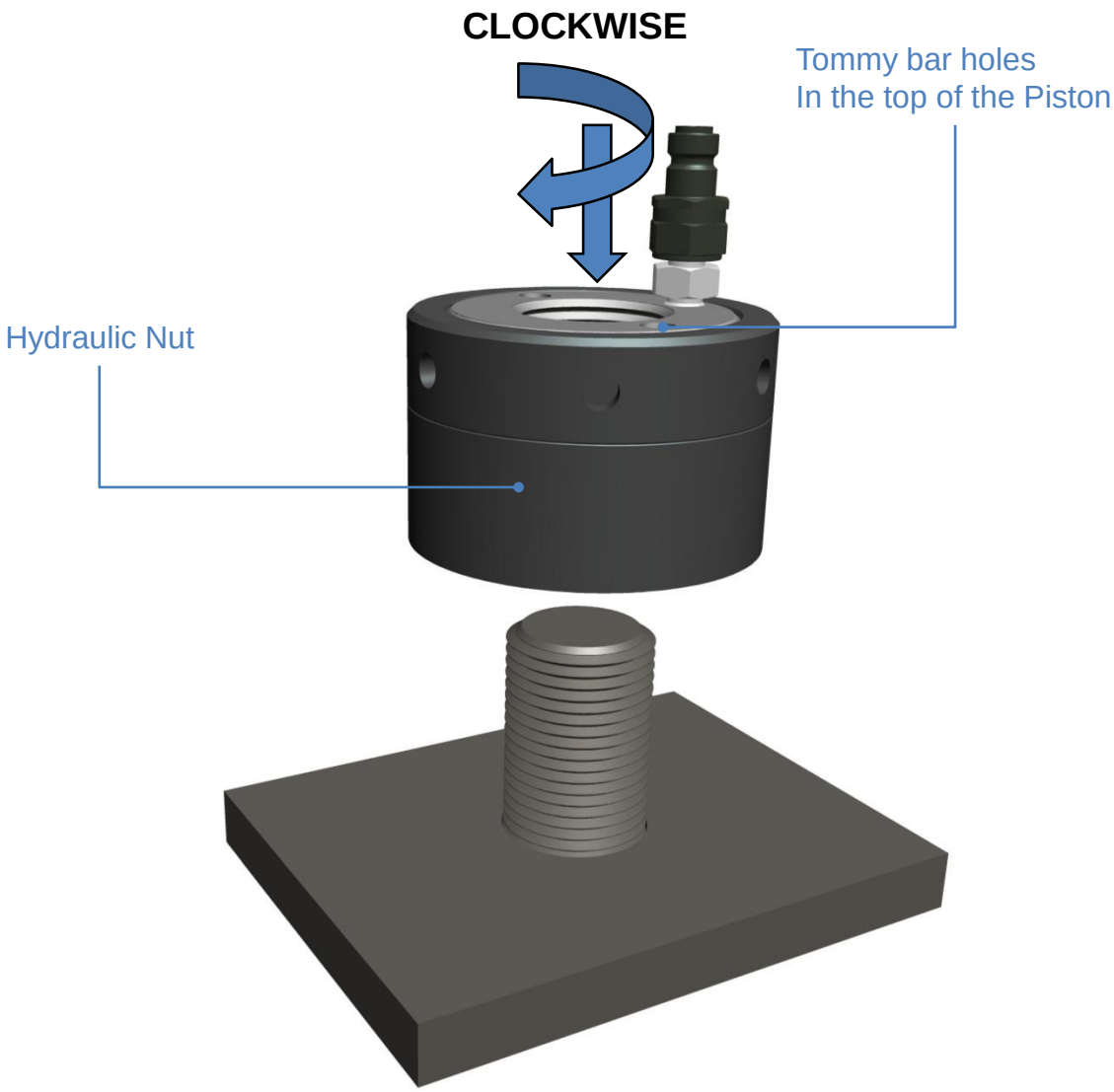
Tightening a Bolt – Step 3

Screw the nut onto the bolt.

Take care that the nut threads properly engage the bolt and do not become cross threaded.

Screw the nut fully onto the bolt threads. The nut should run freely on the bolt.

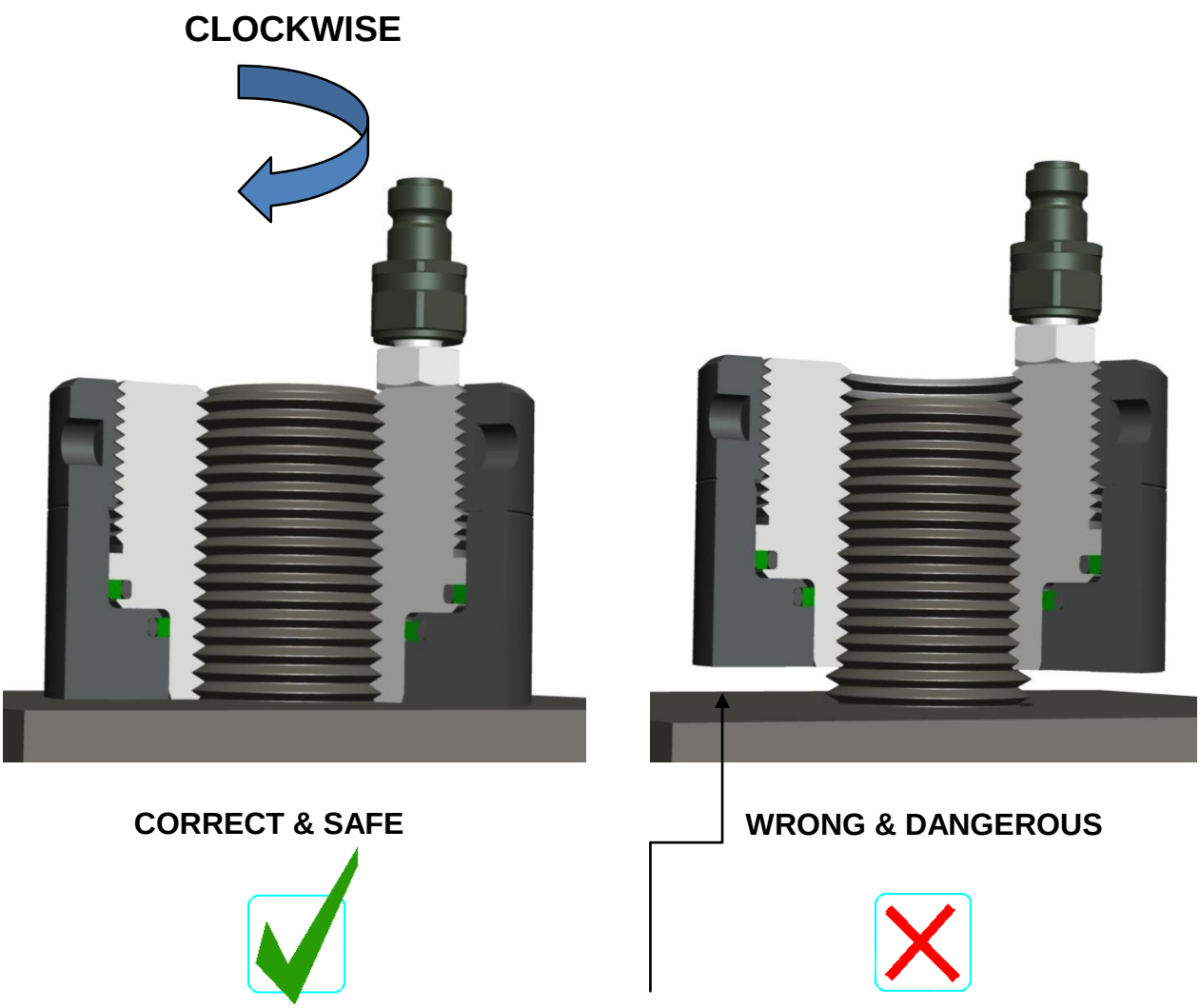
Tommy bar holes are provided in the top of the piston to assist with this operation.



Tightening a Bolt – Step 4

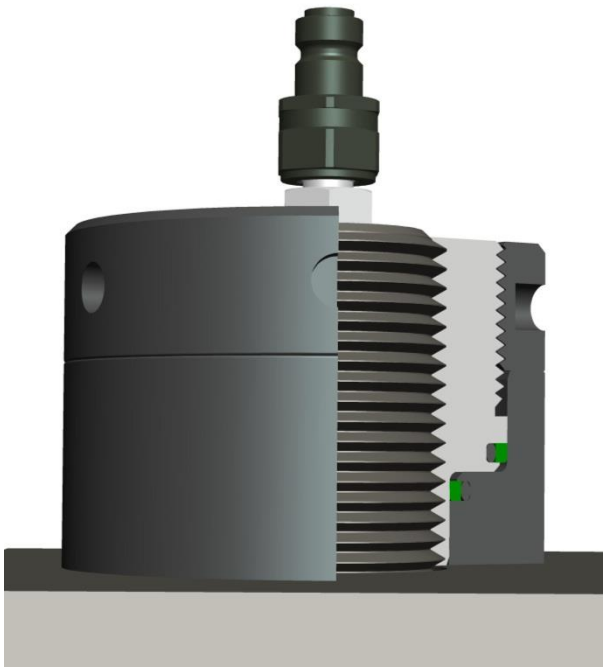
Screw the hydraulic nut fully down onto the top surface of the joint.
This will normally be turned by hand but the final tightening should be assisted with the help of a tommy bar.

Take extra care to stop the bolt turning with the hydraulic nut which would reduce the thread engagement on the bolt. In the worst case the nut could be left with only a few threads engaged even though sufficient thread was initially protruding through the bolted joint.

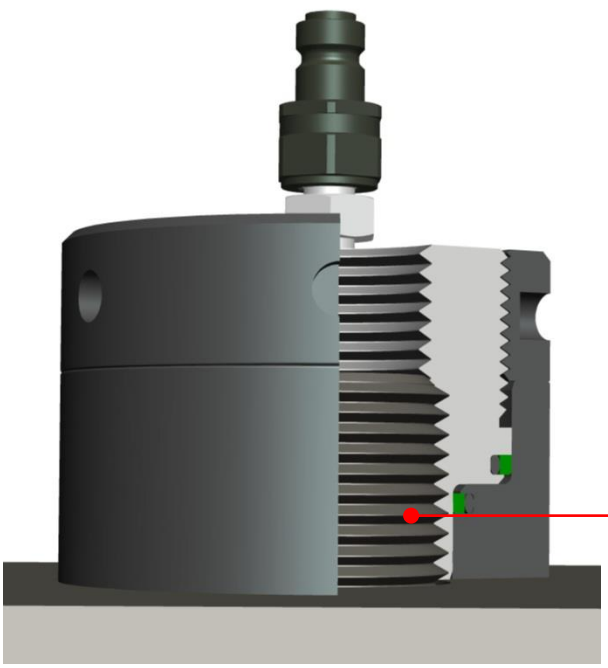


Tightening a Bolt – Step 5

Once the NUT has been screwed down, double check the thread engagement with the bolt is still correct.



CORRECT & SAFE



WRONG & DANGEROUS

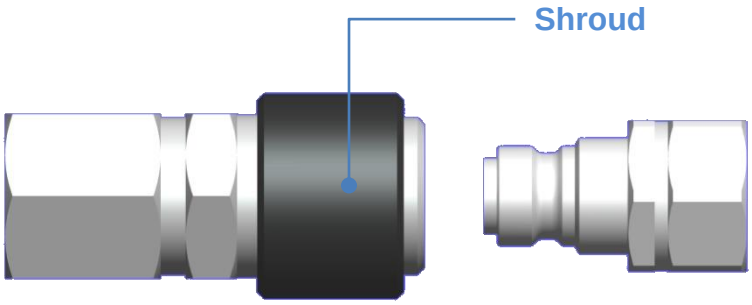
The Bolt has turned with the Nut and the thread engagement between the Bolt and Nut has been reduced.

If pressure is applies the threads might strip and cause injury.

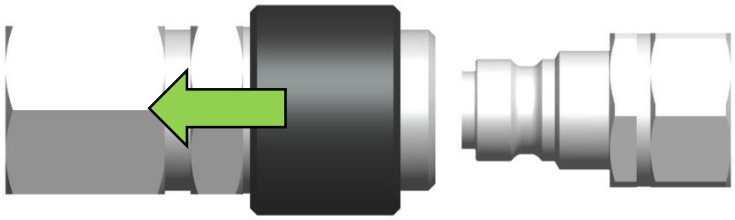
The hydraulic nut is now locked in place and cannot fall off. The nut is now ready for the hydraulic connection to be fitted.

Using Quick Connectors

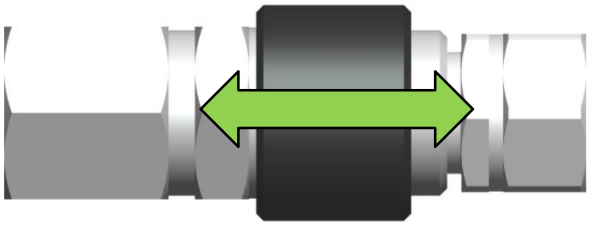
Before using Quick Connectors the operator should ensure that they have read and understood the Quick Connectors Health and Safety instructions in section 1.
To connect the Quick Connect Coupling and Nipple, first check there is no pressure in the system. Then pull back the shroud by hand and push the coupling onto the nipple. When together, release the shroud which will spring back to lock the Coupling and Nipple together. To disconnect, first check there is no pressure in the system. Pull back the shroud, by hand, and pull the coupling and nipple apart. Release the shroud when apart.



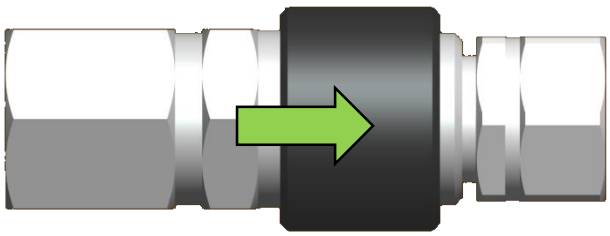
Pull the shroud back to retract.



Coupling and nipple with the shroud retracted.



Coupling and nipple pushed together with the shroud retracted.

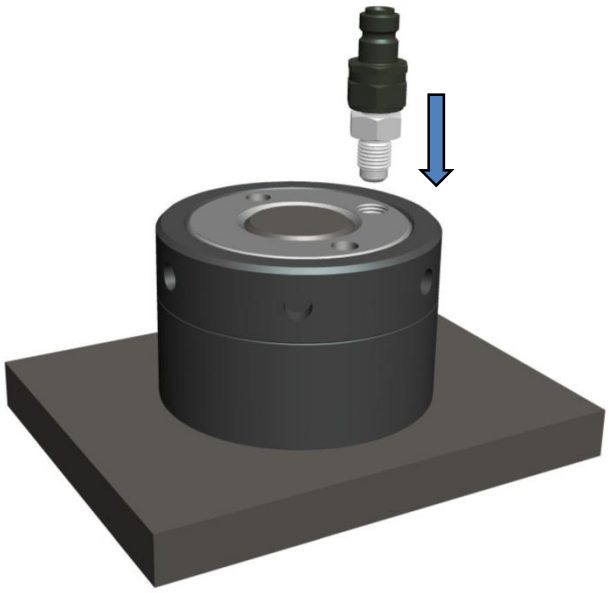


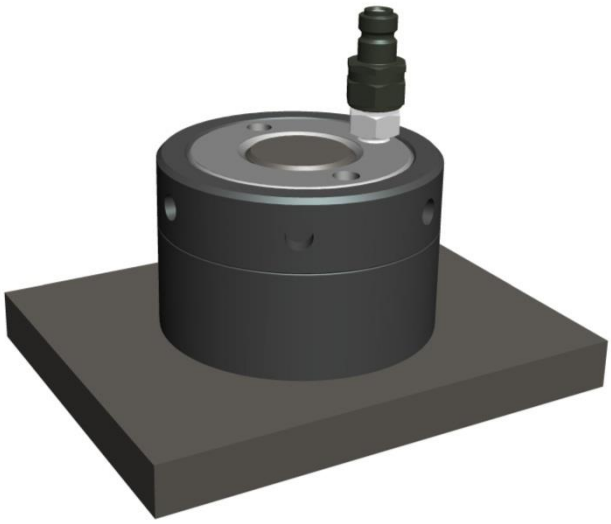
Shroud released, coupling and nipple are now locked together and safe to use.

Tightening a Bolt – Step 6

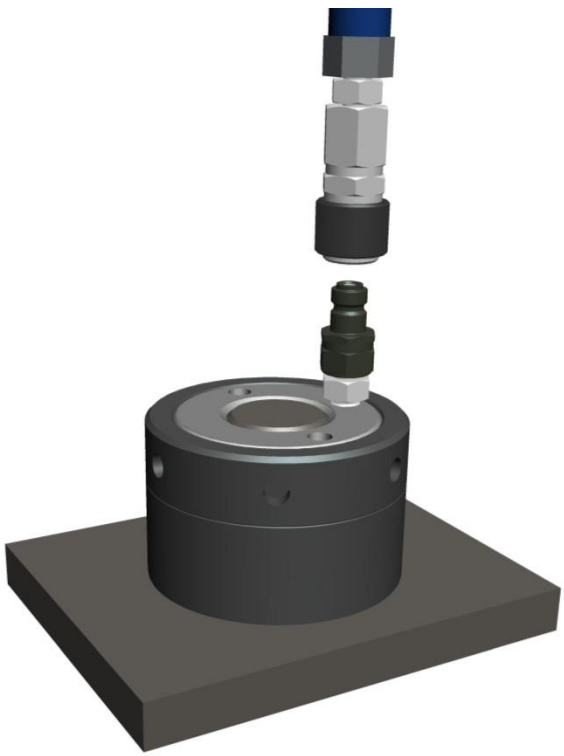
If applicable fit the male/male adaptor and the quick connect nipple.

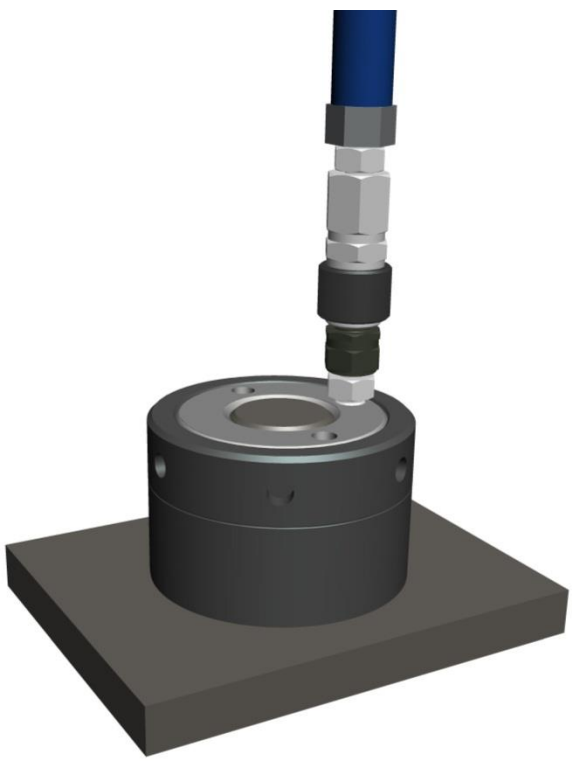
Do not over tighten the adaptor into the nut.





Connect the hydraulic hose. Make sure the quick connect coupling is fully engaged.





Tightening a Bolt – Health & Safety

The Hydraulic Nut is now ready to be pressurised. Before proceeding read the Health & Safety Instructions given in this manual then proceed as follows:-

Clear all personnel from the area where the bolt tensioning operation is to be performed. Position the pump a safe distance away from the hydraulic nut.. Set up barriers and warning signs, or make other adequate arrangements to prevent unauthorised personnel from accidentally straying into the bolt tensioning area.

Make certain that nobody is allowed to stand near to a hydraulic nut during the pressurisation process. At no time should anyone allow any part of their body to be position over the axis of a hydraulic nut, whilst the pressure is rising or when it is pressurised. Do not allow anyone to stand anywhere near a direct line with the long axis of a bolt during the tensioning operation. In the case of studbolts with nuts at each end it is important that nobody stands in line with the long axis of the bolt at either end during the tensioning operation.

Do not approach a hydraulic nut whilst it is being pressurised. Remember that bolt or tool failure is most likely to happen at this critical time. When the operating pressure has been reached, approach a pressurised hydraulic unt only for as long as it takes to turn the locking collar always keeping away from the axis of the bolt.

Wear eye protection, gloves, overalls and a hard hat.

Never leave a pressurised hydraulic nut unattended.

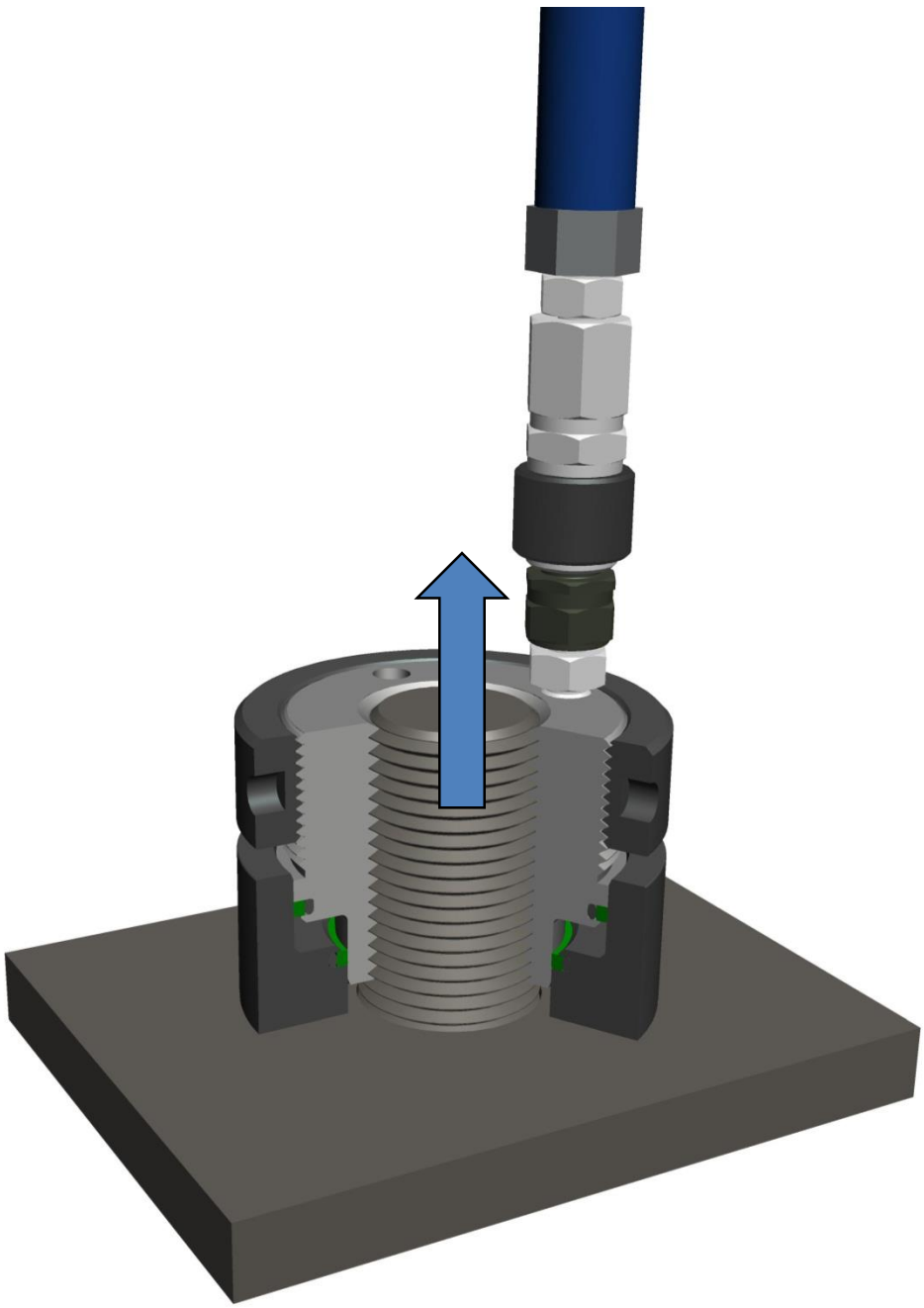
Release the oil pressure immediately is any unauthorised person moves into the bolt tensioning area and especially is anyone stands iin line with the long axis of a bolt being tensioned.
Determine the correct working pressure for the bolts to be tightened.
Proceed with the following operations keeping the hydraulic nuts under pressure for the minimum time necessary to complete the bolt tightening job.

Tightening a Bolt – Step 7

Apply the correct hydraulic pressure. The Piston will move out of the Nut Body as the bolt is stretched and the bolted joint is compressed.

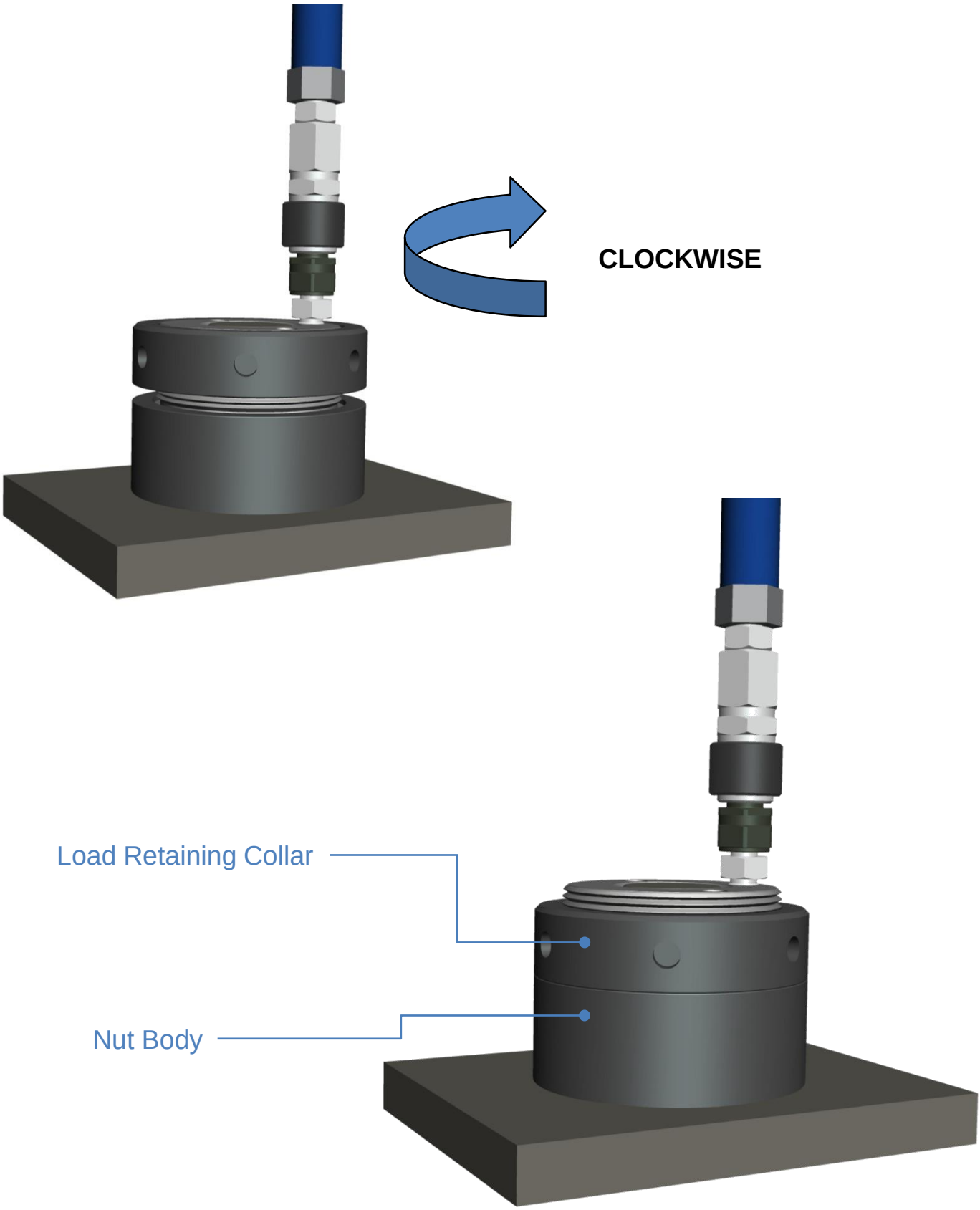
DO NOT exceed the maximum piston stroke of the tool. This information can be found in section 4.

DO NOT exceed the maximum working pressure of the tool. This information can be found in section 4.



Tightening a Bolt – Step 8

Turn the Load Retaining Collar clockwise until it comes back into contact with the Nut Body.



Tightening a Bolt – Step 9

Release the pressure slowly.

Steps 7, 8 and 9 may now be repeated to bed in the threads of the load retaining collar which will help to increase the retained load.

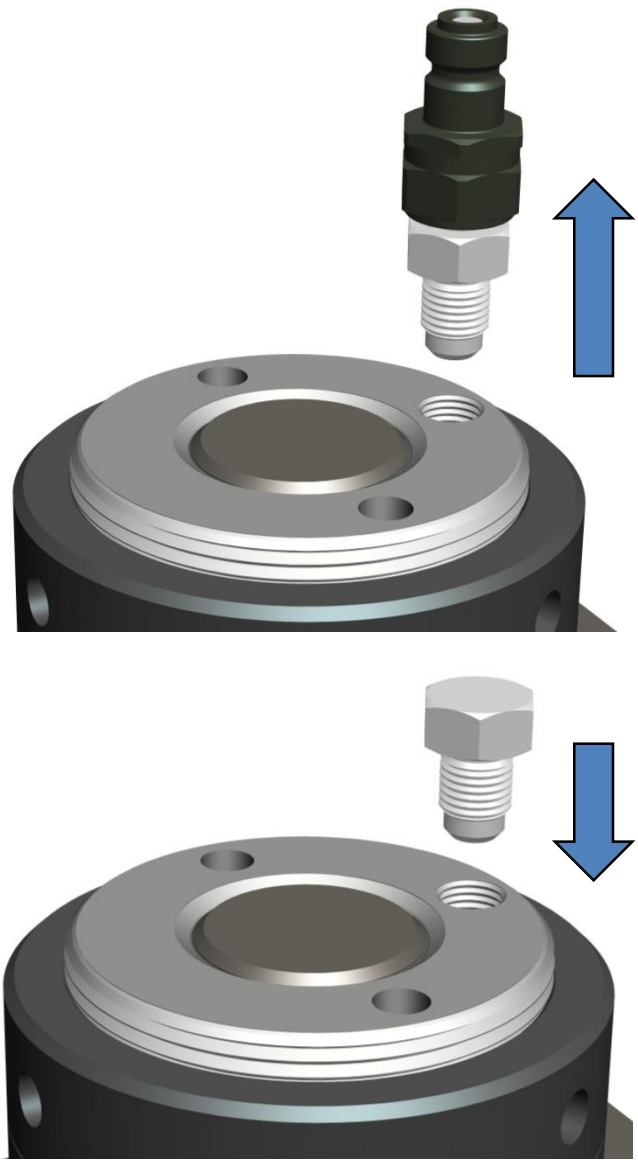
Tightening a Bolt – Step 10

Remove the Hydraulic Hose

Tightening a Bolt – Step 11

If the self sealing quick connector is to remain in place, fit the dust cap.

If the quick connector and adaptor are to be used elsewhere, remove the connector and the adaptor and fit a blanking plug.



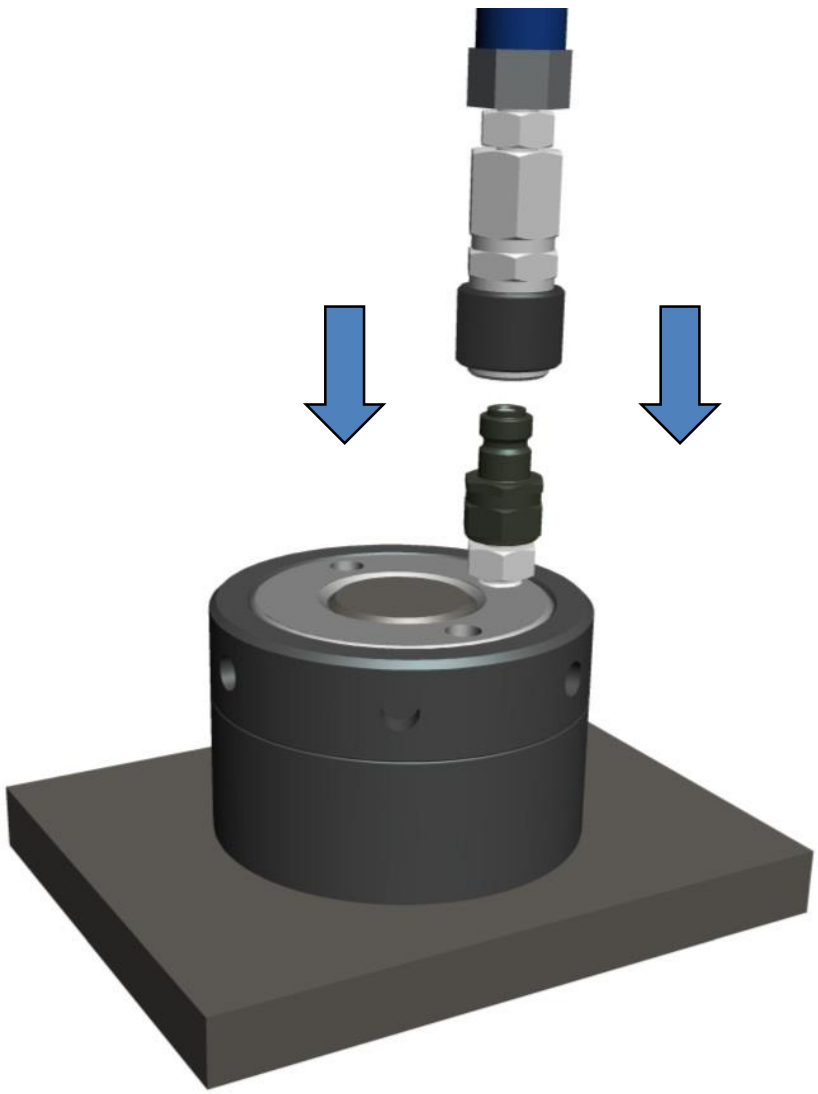
Loosening a Bolt – Step 1

Loosening bolts which have been tightened with a hydraulic nut is simply a reverse of the tightening operation.

Check the hydraulic nut to be loosened. If the hydraulic connection has been fitted with a blank plug, remove it and fit a quick connector as described in Section 4 of this manual.

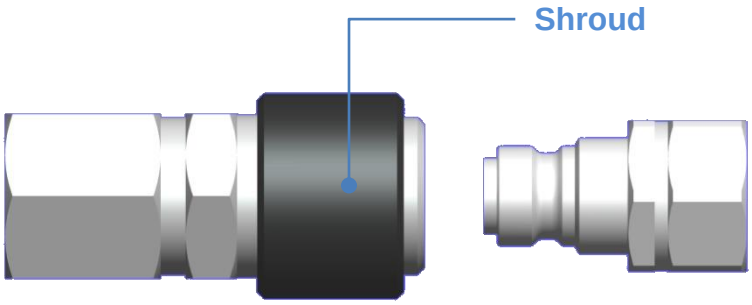
Loosening a Bolt – Step 2

Connect the Hydraulic Hose. Make sure the Quick Connect Coupling is fully engaged.

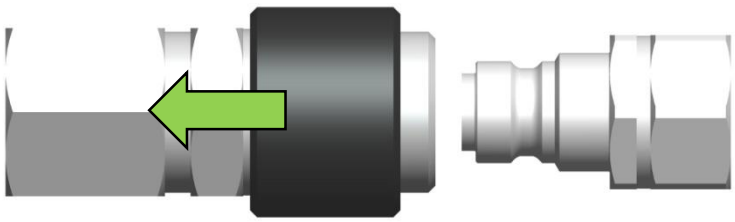


Using Quick Connectors

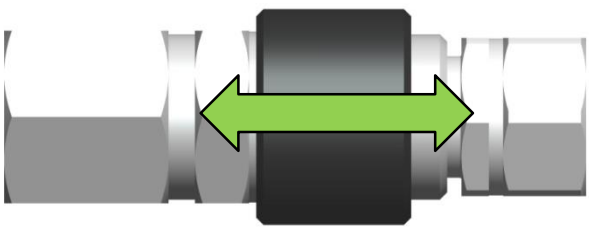
Before using Quick Connectors the operator should ensure that they have read and understood the Quick Connectors Health and Safety instructions in section 1.
To connect the Quick Connect Coupling and Nipple, first check there is no pressure in the system. Then pull back the shroud by hand and push the coupling onto the nipple. When together, release the shroud which will spring back to lock the Coupling and Nipple together. To disconnect, first check there is no pressure in the system. Pull back the shroud, by hand, and pull the coupling and nipple apart. Release the shroud when apart.



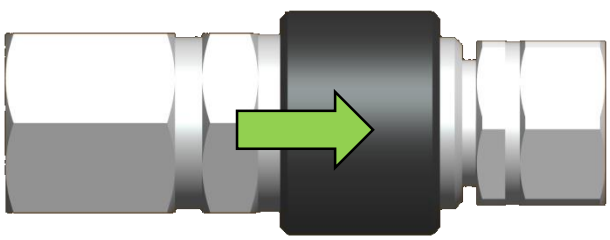
Pull the shroud back to retract.



Coupling and nipple with the shroud retracted.



Coupling and nipple pushed together with the shroud retracted.



Shroud released, coupling and nipple are now locked together and safe to use.

Loosening a Bolt – Health & Safety

The Hydraulic Nut is now ready to be pressurised. Before proceeding read the Health & Safety Instructions given in this manual then proceed as follows:-

Clear all personnel from the area where the bolt tensioning operation is to be performed. Position the pump a safe distance away from the bolt tensioning tools. Set up barriers and warning signs, or make other adequate arrangements to prevent unauthorised personnel from accidentally straying into the bolt tensioning area.

Make certain that nobody is allowed to stand near to a bolt tensioning tool during the pressurisation process. At no time should anyone allow any part of their body to be position over the Puller of a bolt tensioning tool, whilst the pressure is rising or when it is pressurised. Do not allow anyone to stand anywhere near a direct line with the long axis of a bolt during the tensioning operation. In the case of studbolts with nuts at each end it is important that nobody stands in line with the long axis of the bolt at either end during the tensioning operation.

Do not approach a bolt tensioning tool whilst it is being pressurised. Remember that bolt or tool failure is most likely to happen at this critical time. When the operating pressure has been reached, approach a pressurised bolt tensioning tool only for as long as it takes to turn the permanent nut, always keeping away from the axis of the bolt and the Puller.

Wear eye protection, gloves, overalls and a hard hat.

Never leave a pressurised bolt tensioning tool unattended.

Release the oil pressure immediately is any unauthorised person moves into the bolt tensioning area and especially is anyone stands in front of the Puller of a bolt tensioning tool under pressure or stands in line with the long axis of a bolt being tensioned.
Determine the correct working pressure for the bolts to be tightened.
Proceed with the following operations keeping the bolt tensioning tools under pressure for the minimum time necessary to complete the bolt tightening job.

Loosening a Bolt – Step 3

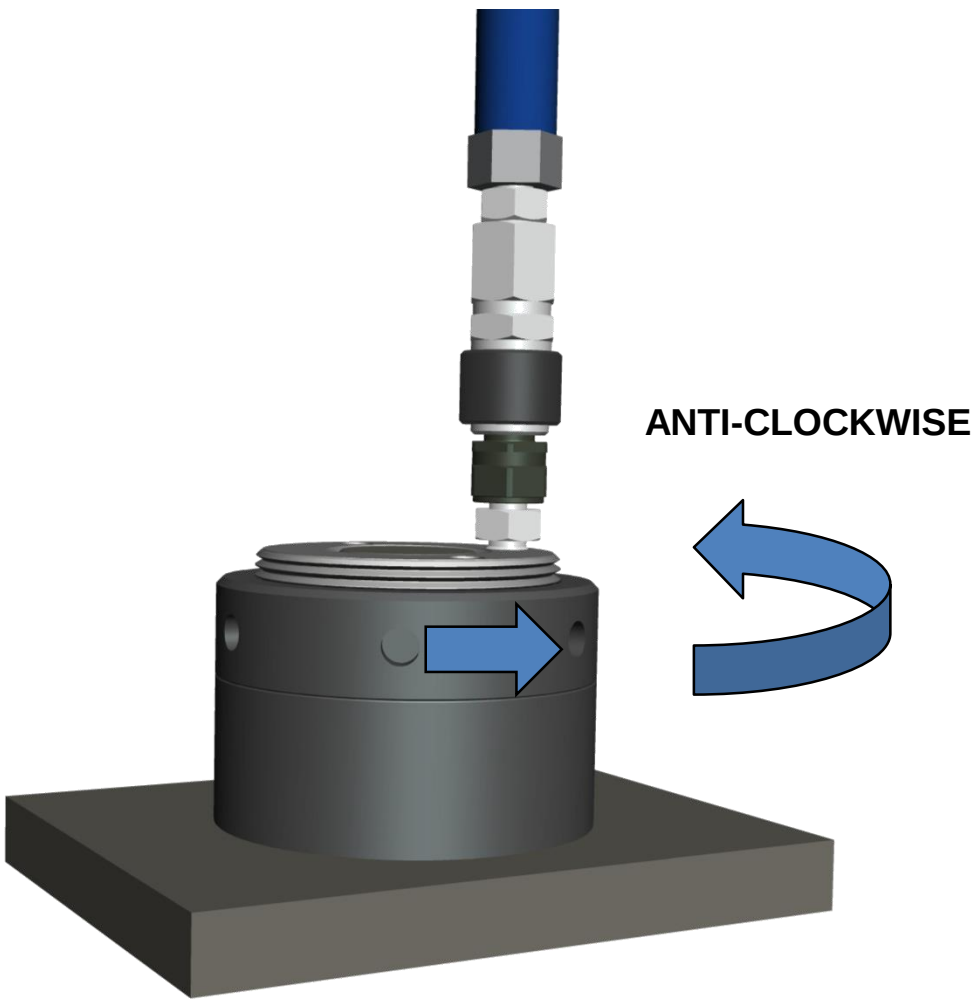
Slowly increase the hydraulic pressure.

Check the Load Retaining Collar to see if it is free to turn anticlockwise.

When the Collar is free to turn STOP the pump.

DO NOT exceed the maximum piston stroke of the tool. This information can be found in section 4.

DO NOT exceed the maximum working pressure of the tool. This information can be found in section 4.



Loosening a Bolt – Step 4

Wind back the Load Retaining Collar one full turn.

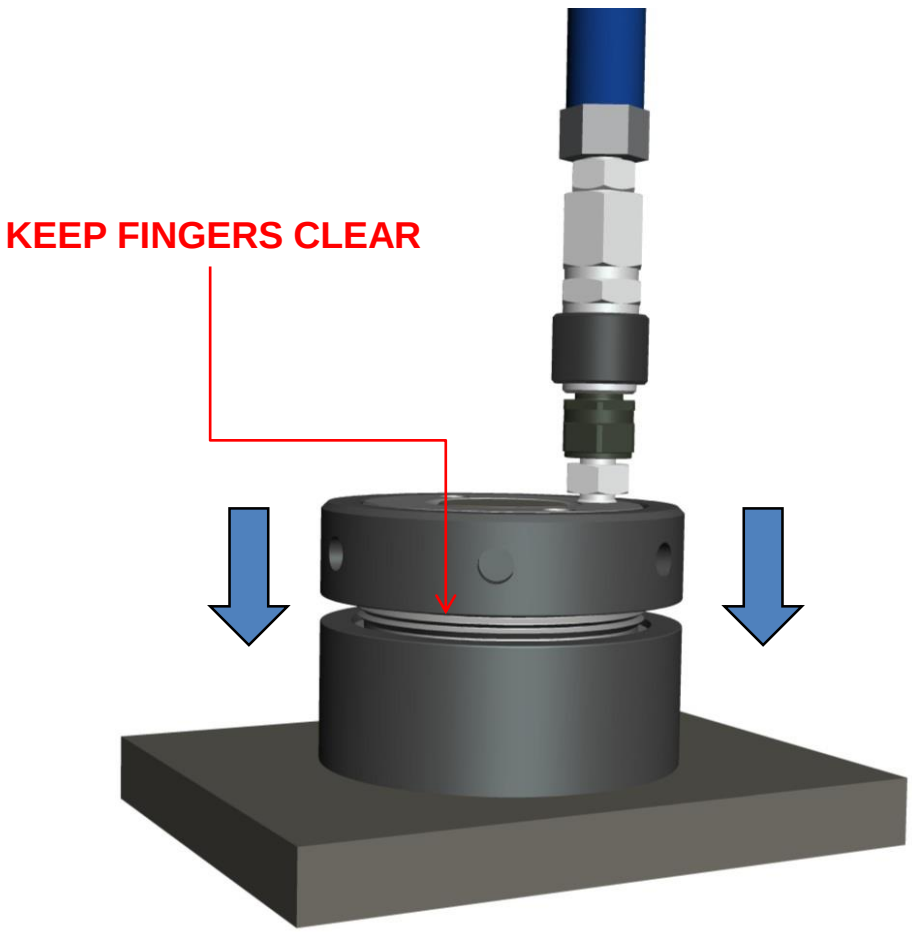
Loosening a Bolt – Step 5

Slowly release the pressure.

As the pressure falls the Piston will be pushed back into the Nut Body.

Make sure there is nothing that can be trapped between the Collar and the Nut Body.

Keep your fingers away from the Collar and the Nut Body during this operation otherwise they could be trapped and crushed.



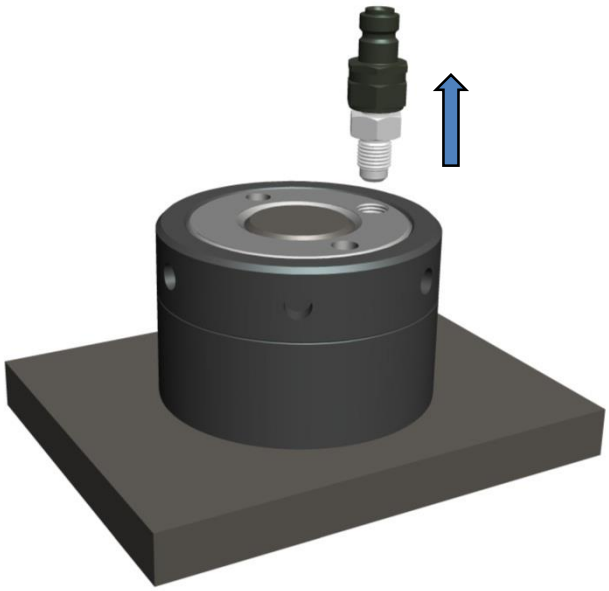
Loosening a Bolt – Step 6

When the pressure has fallen to zero, the hydraulic nut will be loose.

Remove the Hydraulic Hose.

Loosening a Bolt – Step 7

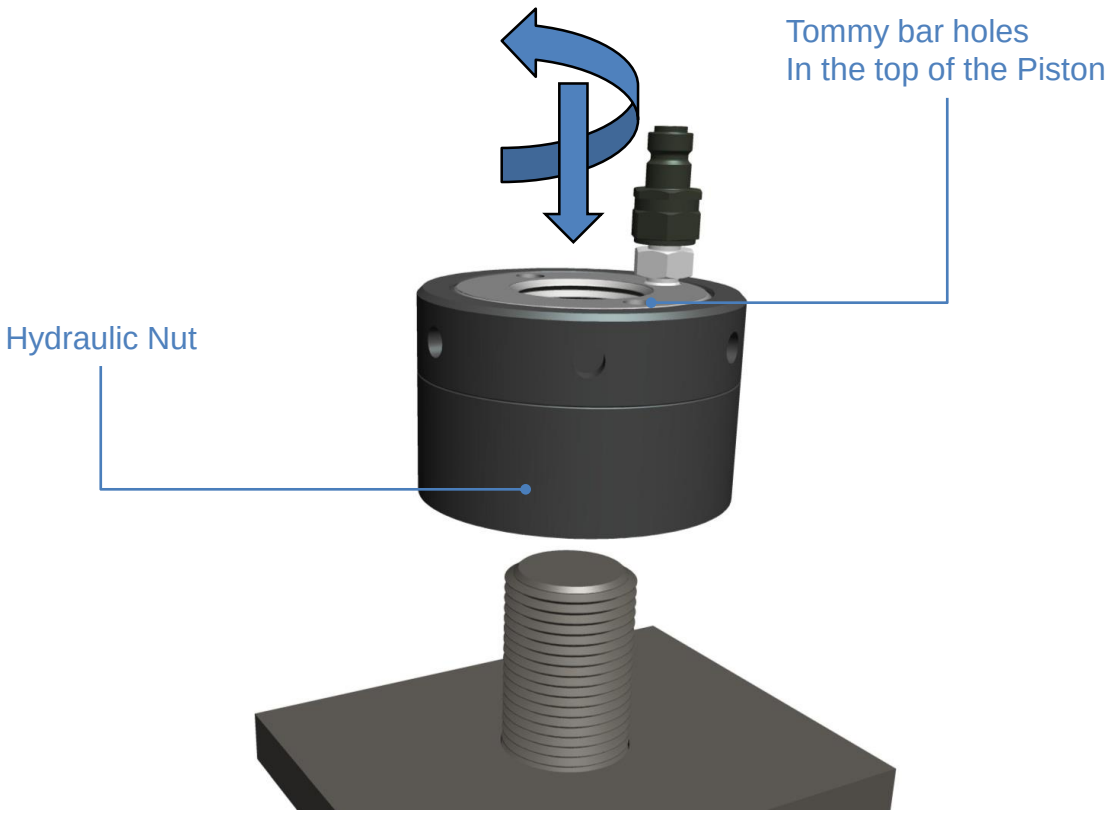
The quick connect nipple and adaptor may now be removed (if required – this is not recommended)



The Hydraulic Nut can be unscrewed.

Use a tommy bar to release the nut. Tommy bar holes are provided in the top face of the piston.

ANTI-CLOCKWISE



Simultaneous Bolt Tensioning

You should have read and understood **tightening & loosening bolts** before attempting to use multiple nuts for simultaneous operation.

Simultaneous bolt tensioning may involve the use of any number of Hydraulic Nuts from two to more than twenty, depending on the number of the bolts in the joint and the percentage of bolts to be tightened simultaneously. In flanged applications, HYTORC strongly recommends simultaneous tensioning of 100% of the bolts.

The method for simultaneous tensioning is similar to tightening one bolt, but requires a number of additional operations. These simply involve the ganging of the Nuts together with flexible hydraulic hoses and tee blocks to construct a hydraulic main which will supply oil under pressure to all of the tools simultaneously.

The user may construct a hydraulic main to suit their circumstances. The hoses and tee blocks may be connected together in any combination as long as the end result is a hydraulic main which will supply oil to all of the Hydraulic Nuts simultaneously.

Section 3

Maintenance & Storage

Introduction

A hydraulic nut will provide many years of trouble free service if used, maintained and stored correctly.

Storage

Nuts may be delivered in self colour or chemically blacked before leaving the factory. This later provides a degree of corrosion protection but additional protection should be applied when the nuts are installed or are to be stored for any period of time. It is recommended that, before storage, the nuts should be checked for damage and if OK, lightly oiled or greased.

The nut should be stored with the piston returned to the zero stroke position and the quick connect nipple must have it's plastic protective cap fitted or alternatively the hydraulic connection should be fitted with a blanking plug.

Nuts that have been installed may be coated with grease, oil or painted.

Maintenance

Very little maintenance is required for a hydraulic nut. The only items which may require changing will be the seals and the quick connect fittings.

Maintenance – Changing Seals

Each bolt tensioning tool has an inner and an outer seal set. Each seal set consists of a rubber "O" ring and an elastomeric seal. If the seals are damaged or badly worn, the complete set ("O" ring and seal) must be changed. It is recommended that both inner and outer sets are changed at the same time.

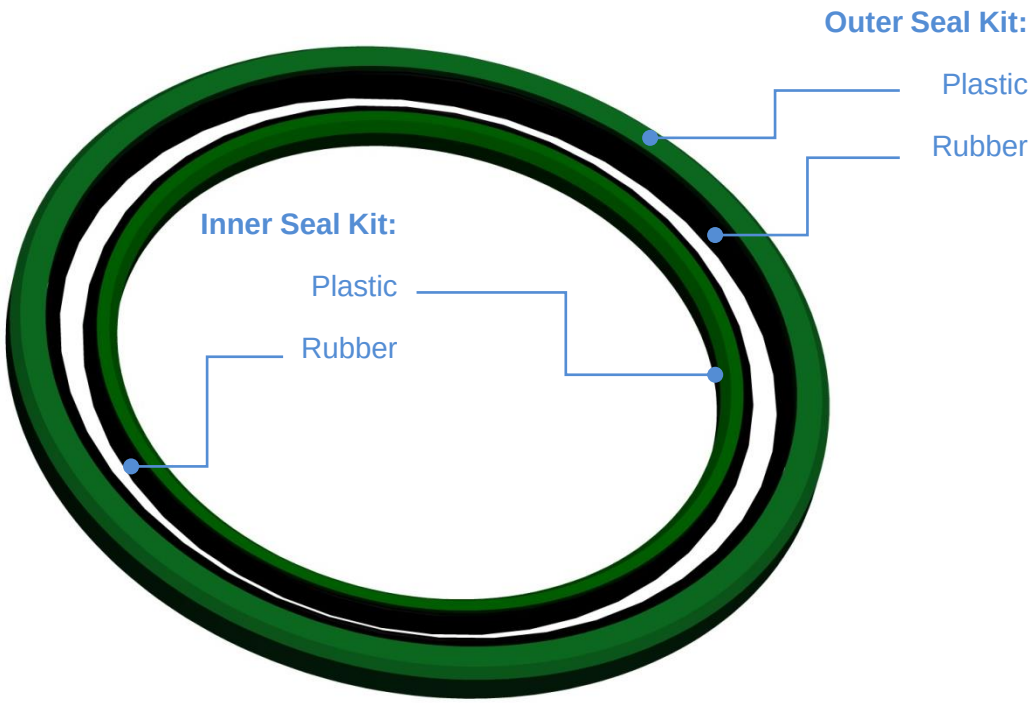
To change the seals, the piston must be withdrawn from the cylinder. If the seals are not badly damaged this may be achieved by carefully blowing compressed air into the cylinder through the quick connect nipple. All applicable Health & Safety precautions relating to the use of compressed air must be observed. In addition suitable safe provision must be made to catch the piston and any escaping oil when it leaves the cylinder.

Section 3 Page 02

If the seal damage is too great to allow air to be used, the piston may be removed by making a simple piston extraction tool from a bar of steel. The bar must be drilled with two holes to align with the threaded holes found in the top of the piston. Two screws can be used to secure the bar to the piston. The piston can then be pulled from the body using the bar.

The seals used do not run dry. They are self lubricating and will always exhibit a small amount of oil around the inner and outer edges of the piston. The presence of a small amount of a small volume of oil around the piston is NOT a signal the seals need to be changed. It is normal and to be expected. The oil lubricates the cylinder wall, reduces the force required to return the piston and helps to prevent corrosion. After extensive use as much as 5 ml of oil may be present around the piston. Simply wipe away any oil when the tools have been used. The seals will need to be changed only if the tool will not pressurise or a very large volume of oil escapes whilst the oil pressure is being increased, or it the tools will not hold pressure.

Each bolt tensioning tool has an inner and an outer seal kit. Each seal kit consists of a rubber “O” ring and a plastic seal. If the seals are damaged or badly worn, the complete set (“O” ring and seal) must be changed. It is recommended that both inner and outer sets are changed at the same time.



Maintenance – Changing the Inner Seal

The old seal set must be removed by cutting through the seal with a knife. The “O” ring can be removed by cutting or by levering it out. Both items should be discarded.

Lubricate the “O” ring with grease. Ensure the seal groove is clean.

Place the Nut Body on a clean surface and insert the Rubber “O” ring into the seal groove.

Fit the “O” ring into the Seal groove.

Pack the “O” ring with grease.

Section 3 Page 04

Insert the green plastic seal into the seal groove. Make sure the chamfer is at the top.

Work the seal into the groove using hand force only.

The seal will snap into the seal groove.

Wipe away any excess grease.

Maintenance – Changing the Outer Seal

The old seal set must be removed by cutting through the seal with a knife. The “O” ring can be removed by cutting or by levering it out. Both items should be discarded.

Lubricate the “O” ring with grease. Ensure the seal groove is clean.

Place the Piston on a clean surface. Insert the rubber “O” ring into the seal groove.

Stretch the “O” ring until it snaps into the seal groove.

Pack the “O” ring with grease.

Section 3 Page 06

Insert the green plastic seal into the seal groove. Make sure the chamfer is at the top.

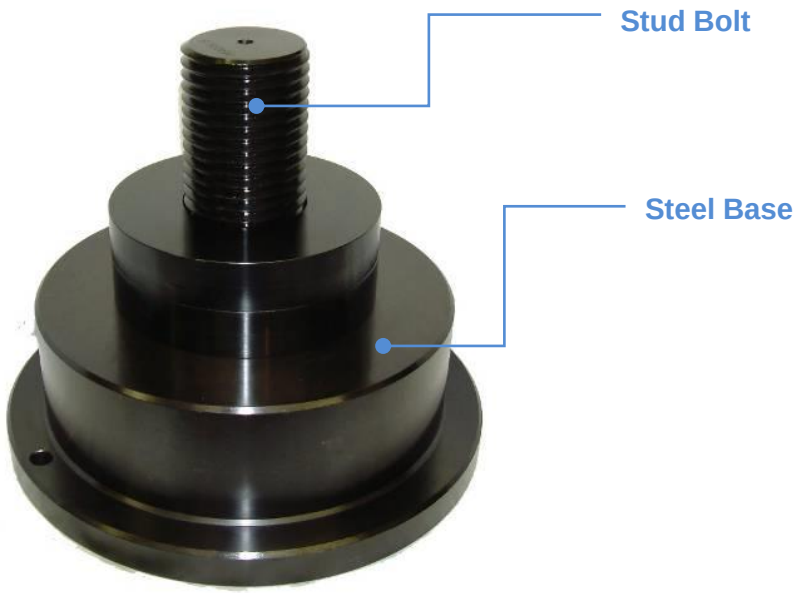
Stretch the seal over the outer lip of the piston by working around both sides of the piston simultaneously.

Work the seal into the groove using hand force only.

Wipe away any excess grease.

Fitting the Piston

HYTORC recommends that the easiest and safest method of fitting a is by using a test block such as the one shown below. This can be easily manufactured with a steel base threaded through the centre to accept the correct stud bolt for the tool in question. Assuming that the test block has been manufactured from the appropriate grade of steel, it can also be used to pressure test the nut once the pistons are fitted.



Alternatively the piston could be fitted using an application bolt on a flange that is to be tensioned. The principal remains the same.

To fit the piston, proceed as follows :-

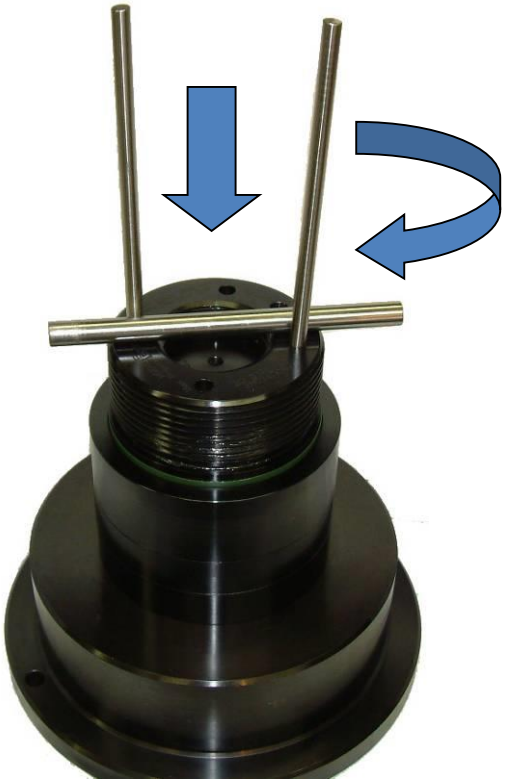
Firstly make sure all the components are clean and lightly lubricated with oil.

Make sure all the components are clean and lightly lubricated with oil.
Remove any quick connector and adaptor fitted to the hydraulic connection in the top face of the piston. This will allow air to be expelled as the Piston is pushed into the Nut Body.

Section 3 Page 08

Place the Nut Body over the bolt

Screw the Piston onto the bolt. Centralise the Nut Body around the Piston.



Use tommy bars to screw the Piston down into the Nut Body

Section 3 Page 09

Screw the Piston fully into the Nut Body.

The Piston is fitted and the nut is ready to receive the Load Retaining Collar

Energising the Seals

After fitting new seals and before the Hydraulic Nut can be used, the new seals must be energised.

Observing the safety instructions given in Section 2 and Section 3 of this manual proceed as follows :-

Make sure the PISTON is fully returned into the NUT BODY.

Using the test bolt, or an actual bolt to be tensioned, install the nut onto the bolt.

Connect the nut to the pump.

Run the pump quickly and pump oil into the nut. Air and oil may escape from the seals during this operation and the pressure gauge may indicate rising and falling pressure at each stroke of the pump.

If the seals have been properly fitted the seals will quickly energise. Any leakage from the seals will stop and pressure will start to be generated in the nut.

Stop the pump when the pressure reaches 1500 bar.

The pressure should be steady and not fall, to show the seals are working.

When satisfied the seals are functioning, release the oil pressure.

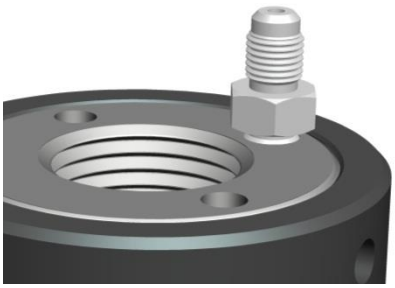
The seals are now energised and the nut is ready for use.

If the seals will not energise, the nut must be taken apart again because the seals have not been correctly fitted. The seals may not energise if the pump is unable to deliver oil quickly enough.

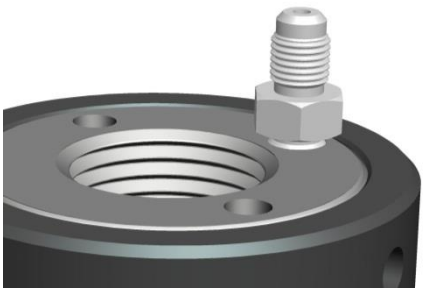
Fitting a Quick Connector

Fitting either the quick connect nipple or coupling, can be achieved by following the simple steps shown below.

Check the internal and external threads are clean and free from damage.



Screw the adaptor into the hydraulic Cylinder. The adaptor is identical at each end so it does not matter which end is inserted into the Cylinder.



Screw the Nipple or Coupling onto the adaptor.

Using a spanner, firmly tighten then the nipple or coupling onto the adaptor. Take care not to over tighten the adaptor into the Nut.

Section 4

Technical Information

Oil Pressure Calculations

The formula used to calculate the Oil Pressure to be used with a bolt tensioning tool are given below along with definitions of the terms used :-

Bolt Load

Residual Bolt Load required when the tensioning operation is complete

Tensioning Force

The load that will be applied by the bolt tensioner during the tensioning operation

Load Loss Allowance

The ratio of ***Tensioning Force*** to ***Bolt Load***

$$\textbf{\textit{Load Loss Allowance}} = \frac{Tensioning\ Force}{Bolt\ Load} = \frac{1.01 + Bolt\ Diameter}{Grip\ Length}$$

If the ***Load Loss Allowance*** calculates to less than 1.10 then use 1.10.

$$\textbf{\textit{Tensioning Force}} = Bolt\ Load \times Load\ Loss\ Allowance$$

Always check that the tensioning force will not exceed 90% of the yield strength of the bolt material. If it does, the grip length of the bolt must be increased. Contact HYTORC for advice on this.

$$\textbf{\textit{Oil Pressure}}\ (bar) = \frac{10 \times Tensioning\ Force\ (Newtons)}{Tool\ Pressure\ Area\ (mm^2)}$$

Oil pressure graphs are provided for each bolt size.

One graph shows the theoretical tensioning force developed by the tool against the oil pressure applied.

The next graphs show the initial bolt stress developed by the tool against the oil pressure applied for each bolt size. This graph is provided to assist with the check that the tensioning force does not exceed 95% of the yield strength of the bolt material.

Users who require highly accurate residual bolt stresses should perform a bolt extension measurement before and after tensioning. In this way residual bolt stresses can be calculated from the actual bolt extensions measured.