

SPX Bolting Systems

Operating Manual for:
TWHC Series

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Original Instructions

High Cycle Hydraulic Torque Wrench

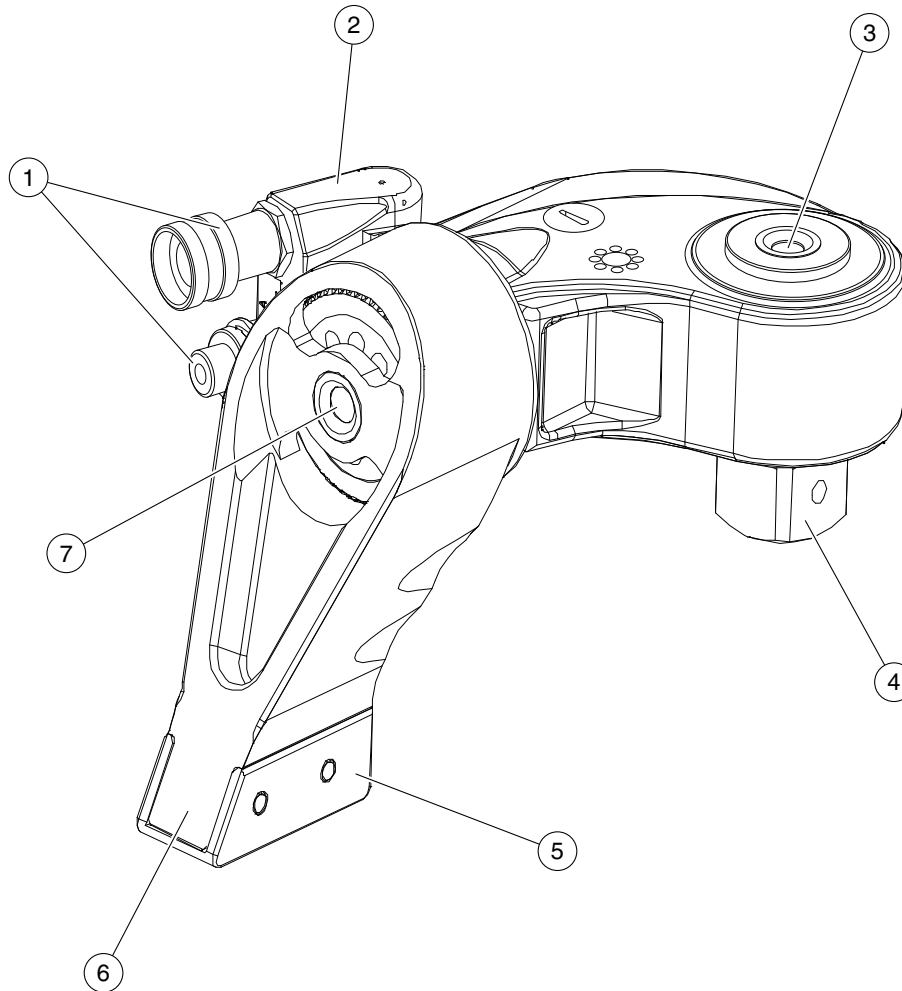


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Torque Wrench High Cycle (TWHC)

Description: The TWHC torque wrench is a ratchet-type torque tool used in conjunction with standard impact sockets to hydraulically tighten nuts and bolts. It is powered using a 690 bar (10,000 psi) hydraulic pump unit. The torque output from the TWHC torque wrench is proportional to the pump-pressure applied.



Item	Description
1	Hydraulic Couplings
2	Multiswivel Manifold
3	Square Drive Release Button
4	Square Drive
5	Reaction Arm Protection Pad
6	Reaction Arm
7	Reaction Arm Release Button

Figure 1. TWHC Hydraulic Torque Wrench

Safety Symbols and Definitions

The safety signal word designates the degree or level of hazard seriousness.



DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

IMPORTANT: Important is used when action or lack of action can cause equipment failure, either immediate or over a long period of time.

Safety Precautions



WARNING: To prevent personal injury,



- The following procedures must be performed by qualified, trained personnel who are familiar with this equipment. Operators must read and understand all safety precautions and operating instructions included with the device. If the operator cannot read these instructions, operating instructions and safety precautions must be read and discussed in the operator's native language.

- These products are designed for general use in normal environments. These products are not designed for use in special work environments such as: explosive, flammable, or corrosive. Only the user can decide the suitability of this product in these conditions or extreme environments. SPX Bolting Systems will supply information necessary to help make these decisions. Consult your nearest SPX Bolting Systems facility.



- Safety glasses must be worn at all time by the operator and anyone within sight of the unit. Additional personal protection equipment may include: face shield, goggles, gloves, apron, hard hat, safety shoes, and hearing protection.



- The owner of this tool must verify that safety-related decals are installed, maintained, and replaced if they become hard to read.



- Shut OFF the motor before opening any connections in the system.

Pump



WARNING: To prevent personal injury,

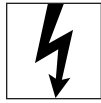
- Do not exceed the hydraulic pressure rating noted on the pump nameplate or tamper with the internal high pressure relief valve. Creating pressure beyond rated capacities can result in personal injury.
- Retract the system before adding fluid to prevent overflowing the pump reservoir. An overflow can cause personal injury due to excess reservoir pressure created when

cylinders are retracted.

Electric Motor



WARNING: To prevent personal injury,



- Electrical work must be performed and tested by a qualified electrician per local directives and standards.
- Disconnect the pump from the power supply and relieve pressure before removing the motor case cover or performing maintenance or repair.
- Check the total amperage draw for the electrical circuit you will be using. *For example: Do not connect a pump that may draw 25 amps to a 20 amp fused electrical circuit.*
- Never use an ungrounded power supply with this unit.
- Changing the voltage is an involved and, if incorrectly performed, hazardous procedure. Consult the manufacturer for specific information before attempting rewiring.
- Wire pump motors for counterclockwise rotation when viewed from the shaft end of the motor.



- Do not attempt to increase the power line capacity by replacing a fuse with another fuse of higher value. Overheating the power line may result in fire.
- Exposing electric pumps to rain or water could result in an electrical hazard.
- Avoid conditions that can cause damage to the power cord, such as abrasion, crushing, sharp cutting edges, or corrosive environment. Damage to the power cord can cause an electrical hazard.

Hoses



WARNING: To prevent personal injury,



- Before operating the pump, tighten all hose connections using the correct tools. Do not overtighten. Connections should be only secure and leak-free. Overtightening can cause premature thread failure or high pressure fittings to split at pressures lower than their rated capacities.
- Should a hydraulic hose rupture, burst, or need to be disconnected, immediately shut off the pump and shift the control valve twice to release pressure. Never

Safety Precautions continued



attempt to grasp a leaking hose under pressure with your hands. The force of escaping hydraulic fluid could cause serious injury.

- Do not subject the hose to potential hazard, such as fire, sharp surfaces, heavy impact, or extreme heat or cold. Do not allow the hose to kink, twist, curl, or bend so tightly that the fluid flow within the hose is blocked or reduced. Periodically inspect the hose for wear, because any of these conditions can damage the hose and possibly result in personal injury.
- Do not use the hose to move attached equipment. Stress can damage the hose and possibly cause personal injury.
- Hose material and coupler seals must be compatible with the hydraulic fluid used. Hoses also must not come in contact with corrosive material such as creosote-impregnated objects and some paints. Consult the manufacturer before painting a hose. Never paint the couplers. Hose deterioration due to corrosive materials may result in personal injury.

Initial Setup

Each hydraulic torque wrench is supplied completely assembled and ready for use. A hydraulic pump is required to provide the speed and pressure that makes the hydraulic wrench system efficient and accurate.

1. Read and understand all instructions before operating the hydraulic torque wrench. It is the operator's responsibility to read, understand, and follow all safety instructions.
2. Remove the hydraulic torque wrench from the shipping container and visually inspect all components for any shipping damage. If any damage is found, notify the carrier immediately. **DO NOT USE TOOL.**

Power Requirements

The TWHC hydraulic torque wrench requires a hydraulic pump unit, twin-line connecting hose, and couplings to operate. All components must be capable of operating at the system maximum working pressure of 690 bar (10,000 psi). Note that the system maximum working pressure is dynamic, not static.

Pump unit specification varies between manufacturers; however, for correct torque wrench operation, the pump unit must include the following:

Double Acting—Pump unit must be capable of double acting operation for advancing and retracting the Torque Wrench.

Variable Pressure Output—For torque setting, the pump unit must be able to be easily adjusted by the operator for different pressure outputs.

Retract Pressure—Sometimes termed 'idle' pressure, this is the pressure used for torque wrench retraction and must be fixed at approximately 103 bar (1,500 psi). This pressure must not be operator adjustable.

Remote Handset Controls—The preferred configuration for the handset is such that, upon starting the pump unit, the pump enters retract or idle mode (pressure fixed at 103 bar (1,500 psi)). To advance the torque wrench, the handset advance/pressure button or lever is pressed and held, upon release of the button, retract mode is automatically entered. A separate button or lever is used to stop the pump.

Automatic Pressure Release—The pump must automatically release system pressure when switching between advance and retract modes.

Pump Flow Rate—The speed at which the hydraulic torque wrench operates is proportional to the oil flow rate. In general, 2-stage pump units are preferred for torque wrench use as this allows rapid nut rotation under low loads, with fast wrench retraction. As a minimum, 250 cm³/min @ 7 bar (15 ci/min @ 100 psi) to 20 cm³/min @ 690 bar (1.2 ci/min @ 10,000 psi) should be specified; however, for optimum speed and performance, at least 360 cm³/min @ 7 bar (22 ci/min @ 100 psi) to 30 cm³/min @ 690 bar (1.8 ci/min @ 10,000 psi) is recommended.

Pressure Gauge—Clarity is important for accurate torque setting; therefore, a pressure gauge of at least 100-mm (4-in.) diameter should be fitted.

Hydraulic Couplings—TWHC hydraulic torque wrenches are fitted with CEJN 230 screw-to-connect couplings (1/4-in. NPT) as standard. Verify any couplings that are used are compatible with these couplings and rated to the same working pressure, e.g. Parker 3000 couplings.

SPX Bolting Systems will not be responsible for torque wrench damage, malfunction or operator injury caused by the use of an incorrect pump unit; therefore, check the compatibility of your pump unit before operating the hydraulic torque wrench.

Initial Setup continued

Torque Wrench Usage

To ensure reasonable life and performance from the torque wrench and system (pump and hoses), these guidelines should be followed:

- Under normal use, the torque wrench should be limited to 75–80% of its maximum achievable torque output.
- Under breakout conditions, because the bolt can suddenly break free and result in shock loads, jumping/jolting, it is recommended to limit the wrench output torque to 60–70% of maximum achievable torque output. It is also a good idea to have torque in reserve for the odd stubborn bolt/nut.
- Once a corroded bolt has broken free, do not use a torque wrench to wind the nut from the bolt. This can cause the nut to bind and lock onto the bolt and make it impossible to remove. It is preferred that a nut runner or impact wrench be used to remove the nut following initial breakout by hydraulic torque wrench.
- Occasional use of the torque wrench at full pressure/torque is acceptable, but unnecessary continuous use at full pressure will reduce the life of the torque wrench and system.
- In elevated temperature environments, it is advisable to cool the torque wrench as much as practical to maintain the sealing systems in good order. Depending upon the pressure applied to the wrench, repeated use in temperatures in excess of 40°C (104°F) will affect the life of the hydraulic seals.

If the temperatures are likely to exceed 40°C (104°F), it is advisable to use a larger capacity wrench so that the pressure to achieve the required torque is reduced. This will result in less temperature buildup and less softening of the seals.

Seals should be replaced regularly because, at elevated temperatures, the extrusion resistance of the seal is reduced.

Connecting the System

The hydraulic wrench head and power pack are connected by a 690 bar (10,000 psi) twin-line hose assembly. Refer to the power-unit manufacturer's operating instructions for proper use.

Hydraulic Connections

- Never connect or disconnect any hydraulic hoses or fittings without first unloading the wrench and the pump.
- Open all hydraulic controls several times to verify the system has been completely depressurized.
- If the system includes a gauge, double check the gauge to verify pressure has been released.
- When making connections with quick-disconnect coupling, verify the couplings are fully engaged. Threaded connections such as fittings, gauges, etc., must be securely tightened and leak-free.

Use of Sockets

Use high-quality, industrial impact sockets at all times. Verify that sockets are rated to accept the full torque output of the torque wrench they are used with. Regularly check the socket for cracks and flaws. If any sign of damage is evident, discard immediately. A damaged socket breaking under load can cause equipment damage or operator injury.

Long-reach or deep sockets are not recommended for use with hydraulic torque tools because they can make the wrench and socket unstable. However, some applications demand the use of long-reach sockets. When long-reach sockets are used, support for both the socket and reaction facility must be provided. The same applies to socket accessories, such as extension bars, knuckle joints (not recommended), etc.

Safety

The TWHC hydraulic torque wrench is a high-power hydraulic tool. It is strongly recommended that all users are fully trained and competent in the use of hydraulic torque wrench systems. Incorrect use of the equipment or failure to follow any of the safety precaution included herein could lead to serious injury.

NOTE: The TWHC torque wrench is designed for torque tightening of engineering nuts only. Do not use it for any other purpose.

- Never exceed the hydraulic torque wrench maximum working pressure of: Advance 690 bar (10,000 psi) and Retract 103 bar (1,500 psi).
- Keep hands and fingers clear of the hydraulic torque wrench head and reaction pad area, before and during operation.
- Keep other personnel clear of the working area and only allow trained personnel to use the equipment.
- Before operation, verify all hoses and equipment are in proper working order. Verify all hydraulic torque wrench components (i.e. square drive, reaction arm, etc.) are properly attached and secure. Verify the square drive retainer button is properly located.
- Do not strike any of the components, including the socket, to shock the nut free.
- Verify reaction structures are strong and rigid enough to accept the torque tool reaction forces. Do not use wedges, packing pieces, etc. as temporary reaction structures.
- If backing wrenches are used, keep hands and limbs well clear of the backing wrench.
- Do not tighten any equipment while under pressure. Do not move or rotate the multiswivel manifold while under pressure.
- Verify that any sockets to be used with the hydraulic torque wrench are of impact quality and capable of withstanding the full torque output of the tool.
- Some hydraulic torque wrenches weigh in excess of 20 Kg (44 lb). If necessary, lifting equipment can be used.
- In some instances, it may be necessary for the operator to support the hydraulic torque wrench while it is tightening, i.e. upside-down operations. If the hydraulic torque wrench cannot be strapped into position using ropes, etc., the operator must take care to avoid pinch points.
- Verify hoses are in good condition and undamaged. Do not bend hoses beyond their safe bend radius limit or kink the hose.
- Never use the hydraulic torque wrench with just one hose connected to the Advance port (Port A). This will cause the pressure to intensify within the retract chamber possibly leading to tool damage. Always verify that both hoses are correctly connected.
- Take care when handling equipment. Quick connect couplings are especially susceptible to knocks and damage and therefore care must be taken. Note that damaged couplings are difficult to connect. Do not force couplings.

Initial Setup continued

- Do not strike, misuse or abuse any of the equipment. If any abuse or misuse of the equipment is evident, the warranty shall be invalid and the Manufacturer shall not be responsible for any injuries or failures as a result.
- If not in use, and when practical, disconnect the wrench and pump from the power supply to prevent accidental starting.

Preparing the Torque Wrench for Use

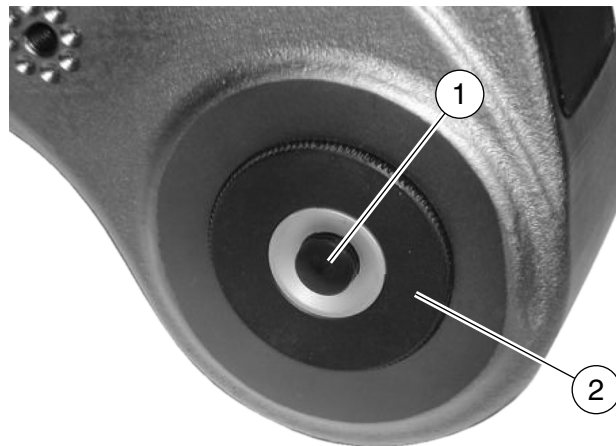
IMPORTANT: For a copy of the calibration certificate for a specific hydraulic torque wrench, e-mail info@spxboltingsystems.com with serial number of the hydraulic torque wrench.

CAUTION: For top performance, frequently inspect wrench, pump, and accessories for visual damage. Always follow instructions for proper wrench and pump maintenance. Do not use other equipment to increase the capability (i.e., hammering on socket wrench).

Changing the Drive Direction

To change the drive direction:

1. Press and hold the drive-release button and pull out the square drive. The square drive, retainer cap, and button assembly are now free.
2. To reinstall, insert the square drive into the opposite side of the tool head, aligning the splines, and replace the retainer cap assembly.
3. Pull the square drive to verify that it is locked in position.



Item	Description
1	Square Drive Release Button
2	Square Drive Cap

Figure 2. Square Drive Operation

Setting Torque

1. Verify the system is fully connected and the proper power supply is available.
2. Refer to the Pressure/Torque Conversion Chart in the Performance Specifications section. Note that this pressure is set on the pump.
3. Turn on the pump.

4. Press and hold the remote control button.
5. Check the pressure on the gauge.
6. Increase or decrease pressure as required. Refer to pump manufacturer's operating instructions.
7. Before tightening a nut, press the remote control button and confirm the correct pressure has been set.
8. Verify that the bolt threads, nut threads, and nut-to-flange contact faces are liberally coated with anti-seize lubricant of the same friction coefficient used to derive the torque value.
9. Make sure the hydraulic torque wrench is suitable to deliver the required torque. Should the torque value exceed 80% of the hydraulic torque wrench output, consider using a higher capacity hydraulic torque wrench.
10. Use the Pressure/Torque Conversion Chart in this manual to obtain the required pump pressure.
11. Verify that the socket to be used is of the correct type and size. A poor fitting or oversized socket can damage nuts, induce inaccurate bolt loads, and may result in operator injury.
12. Place the proper size impact socket on the square drive and secure it properly with the locking ring and pin. Verify that the square drive is fully engaged into the socket.
13. Verify that the reaction arm is placed firmly against a stationary object such as an adjacent nut, flange, equipment housing, etc.

NOTE: When positioning the wrench, verify the hose connection will not hit any stationary object, which can result in snapping a hose connection or breaking the coupler connection.

NOTE: TWHC torque wrenches are equipped with a pressure-release valve built into the multiswivel manifold to protect against retract pressure intensification should the retract port hydraulic coupling not be fully connected or become loose during use. If an intensification occurs, the valve will bleed hydraulic oil externally from the manifold yoke. Oil bleeding from the swivel manifold is not a sign of seal leakage.

14. Before applying the hydraulic torque wrench to the application, the pump output pressure must be preset to relieve at the pressure obtained from the Pressure/Torque Conversion Chart. This can be done with the hydraulic torque wrench connected to the pump and resting on the floor or bench. Applying advance pressure to the hydraulic torque wrench will extend the piston until it reaches the end of its stroke whereby the pump pressure will build. Holding the wrench at the end of its stroke will allow the pump pressure to be adjusted. Retract the hydraulic torque wrench piston and advance again making sure that the pump relieves at the desired pressure setting. The pump pressure can also be set by blanking the pump outlets using blank couplings.

NOTE: Allow time for the wrench to retract. If another advance stroke is made before the torque wrench has fully retracted, the ratchet mechanism may not engage correctly, causing it to jump a ratchet tooth, and possibly damaging the ratchet. Before applying another advance stroke, make sure the pump is idling at 103 bar (1,500 psi), which indicates full retraction.

Operating Instructions

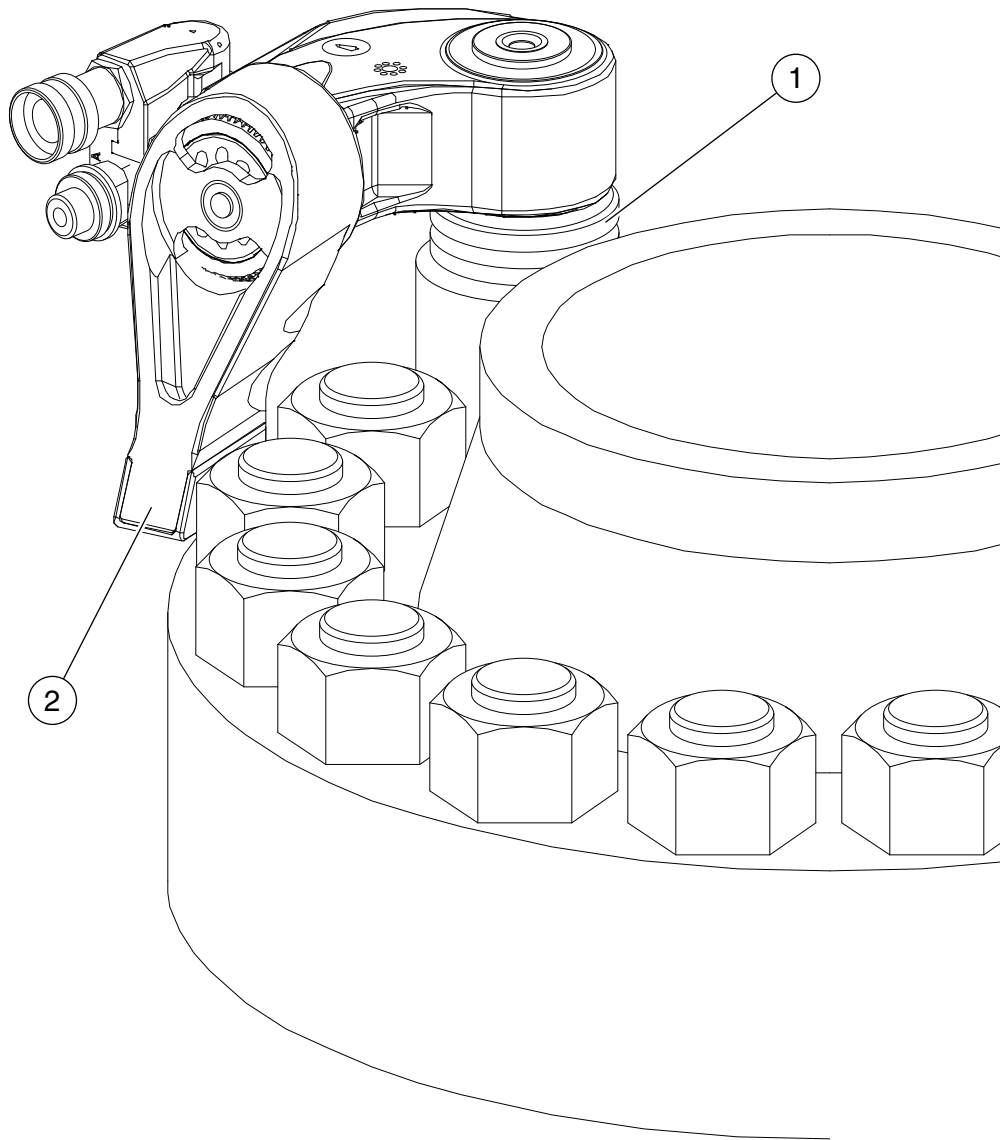
Positioning the Hydraulic Torque Wrench on the Nut

Figure 3 indicates correct position of the hydraulic torque wrench (shown in tightening mode). Always verify that the reaction pad braces firmly against an adjacent nut or secure reaction structure.

Using the Reaction Arm

See Figure 3. The TWHC hydraulic torque wrench features a 360° adjustable reaction arm. Although the reaction arm can be placed in a multitude of positions, always try to use the torque tool with the reaction arm positioned parallel to the socket (i.e. 90° to the torque tool body).

NOTE: Always verify that the reaction arm is locked onto the body before use, and never attempt to unlock and slide the reaction arm part way off the body to facilitate a reaction point out of reach of its engaged position.



Item	Description
1	Socket
2	Reaction Arm Parallel to Socket and Braced Firmly Against Flange Nut

Figure 3. Correct Reaction Arm Positioning

Reaction Point Safety

Follow these guidelines when selecting appropriate reaction points:

- The reaction structure must be rigid enough to accommodate the forces from the hydraulic torque wrench. Carefully inspect the reaction points for suitability before applying the torque tool. If in doubt, contact the torque wrench supplier for advice.
- Tapered surfaces are generally unsuitable as the torque wrench tends to 'ride up' the taper, causing adverse tool loads. Flat surfaces are preferred.
- Packing pieces, spacers, etc. must never be used as a makeshift reaction point. Reaction accessories are available to increase the access to reaction points.

Use of Backing Wrenches

Backing wrenches are often used to prevent the non-tightening nut on the opposite side of the joint assembly from turning during the torquing operation. Verify that the backing wrench is the correct size and securely fastened in position (using straps, ropes, etc.). As the torquing operation begins, it is normal for the backing wrench to move/rotate in conjunction with the torqued nut, until the backing wrench contacts an adjacent reaction point. It is important that the operator stand clear of the moving backing wrench to prevent accidental entrapment. The operator must also verify that the reaction point is secure and sufficiently rigid to prevent damage to the structure.

Torque Wrench Selection

To choose the correct capacity Torque Wrench for the application, the estimated break-out torque should be considered, not the tightening torque. Loosening bolts usually requires a higher torque, and if a wrench has been selected on tightening criteria only, it will seldom perform in a break-out situation.

Break-out Considerations

Nuts / Bolts which have been correctly lubricated at the make-up / tightening stage will require approximately 1.5 x tightening torque to loosen following a period of service, PROVIDED THEY HAVE NOT BEEN SUBJECTED TO HEAT.

Corroded / rusted bolts, and bolts without lubrication applied at make-up, will require approximately 2 x tightening torque to loosen. PROVIDED THEY HAVE NOT BEEN SUBJECTED TO HEAT.

Nuts / bolts subjected to heat, seawater corrosion, chemical corrosion, can require 3 to 4 x tightening torque.

Before selecting a torque wrench for the application, ensure that the above has been considered.

Tightening Bolts

1. Apply the torque wrench and socket to the nut to be tightened, verifying that the reaction arm firmly and squarely contacts the selected reaction point.
2. Start the pump and advance the hydraulic torque wrench. As the wrench strokes forward, the reaction pad will press against the reaction point and the socket will rotate. When the hydraulic torque wrench reaches the end of its stroke, the pump pressure will build rapidly. Fully retract the hydraulic torque wrench (the wrench ratchet mechanism will be heard clicking as it retracts), and apply another forward stroke.
3. Several forward strokes are made until the nut ceases to rotate during the stroke (known as stalling), but bear in mind that nut rotation will always cease at the end of the wrench stroke and must not be confused with the wrench stalling. When the wrench stalls, apply another forward stroke and observe the pump pressure gauge. The pump pressure gauge should read the desired preset pressure.

Operating Instructions continued

- Retract the hydraulic torque wrench, stop the pump unit, and remove the wrench from the nut.

Tightening a Flanged Joint

This procedure outlines the basic steps to torque-tighten a flanged joint with a TWHC hydraulic torque wrench. It is important that personal protective equipment (gloves, footwear, safety helmet, eye protection, etc.) is worn at all times by the operator and any other personnel in the work area. The torquing procedure uses a single hydraulic torque wrench to accurately achieve a predetermined residual bolt stress.

WARNING: Before bolt torquing, verify that:

- **The procedure and data to be used is authorized by a responsible engineer.**
- **The joints/pipework being worked on are not live. Joints must be at zero pressure and free from hazardous substances.**
- **The torque value selected must be based upon the lubricant applied.**

Procedure

- Working in a crisscross pattern, number each bolt in order of torque sequence.
- Square up the flanged joint using hydraulic torque wrenches, if necessary.
- Set the pump at its lowest possible output, 103 bar (1,500 psi), and following the numbers on the bolts, apply the minimum torque to the bolts.
- In the same tightening sequence, apply approximately 25% of the torque value specified in the torque data.
- In the same tightening sequence, apply approximately 50% of the torque value specified in the torque data.
- In the same tightening sequence, apply the full torque value specified in the torque data.
- Working in a clockwise (or counter-clockwise) direction, make a final pass around the flange, tightening each bolt to the full torque value specified in the torque data.
- Using a hammer, “ring” each nut to verify that each bolt has been correctly loaded and that no slack bolts remain.

Loosening Bolts

Loosening bolts using hydraulic torque wrenches can be unpredictable and often unsuccessful, especially if the nuts and bolts are severely corroded. However, some measures can be carried out to increase the success rate of nut breakout:

- In general, loosening mildly rusted bolts requires up to twice the makeup torque to release the nut. Heavily corroded bolts may take up to three times the makeup torque. Verify that the bolt and nut material is strong enough to accept these higher torques.
- Remove surface rust and scale using a wire brush. Apply releasing oil to the nut, bolt, and bearing face, and allow time for the release oil to soak in and penetrate.
- Only use the hydraulic torque wrench to break the nut free. Using the torque tool to wind the nut from the bolt can induce high torsion and reaction forces. Therefore, it is better to use an impact wrench to completely remove the nut.

Operating Instructions continued

- Never strike the torque wrench or nut/bolt in an attempt to 'shock' the nut free. This can cause damage to the hydraulic torque wrench and operator injury. Evidence of torque wrench abuse will void the Manufacturer's Warranty.

NOTE: Should maximum pump pressure be reached, and the nut has not broken free, use a higher capacity hydraulic torque wrench (if the nut/bolt material will accept the higher torques without damage). Do not, under any circumstances, strike the hydraulic torque wrench or nut/bolt in an attempt to 'shock' the nut free.

Procedure

1. Connect the hydraulic torque wrench to the pump unit. Verify that the couplings are fully screwed together; they are self-sealing and will restrict oil flow if not fully connected.
2. Before applying the hydraulic torque wrench to the application, the pump output pressure must be preset to deliver the maximum pressure of 690 bar (10,000 psi). This can be done with the torque wrench connected to the pump and resting on the floor or bench. Applying advance pressure to the hydraulic torque wrench will extend the piston until it reached the end of its stroke whereby the pump pressure will build. Holding the wrench at the end of its stroke will allow the pump pressure to be adjusted. Retract the hydraulic torque wrench piston and advance again making sure that the pump delivered full pressure. The pump pressure can also be set by blanking the pump outlets using blank couplings.
3. Apply the hydraulic torque wrench and socket to the nut to be loosened and verify that the reaction pad is braced firmly and squarely against the selected reaction point.
4. Start the pump and advance the hydraulic torque wrench. As the wrench strokes forward, the reaction pad will press against the reaction point. As the pump pressure builds (and torque is applied to the nut), the nut will break free. Once the nut has been released, remove the nut by hand if loose enough, or alternatively use an impact wrench. Using the hydraulic torque wrench is not recommended.

NOTE: Should maximum pump pressure be reached, and the nut has not broken free, use a higher capacity hydraulic torque wrench (if the nut/bolt material will accept the higher torques without damage). Do not, under any circumstances, strike the hydraulic torque wrench or nut/bolt in an attempt to 'shock' the nut free.

5. Retract the hydraulic torque wrench, stop the pump unit, and remove the wrench from the nut.

Performance Specifications

Technical Specifications

The following technical data is applicable to all TWHC hydraulic torque wrenches:

MAXIMUM PRESSURE: Advance - 690 bar (10,000 psi)
 Retract - 103 bar (1,500 psi)
OPERATING TEMPERATURE LIMITS: -20°C to +40°C (-4°F to 104°F)
HYDRAULIC OIL TYPE: Grade 46 hydraulic oil

Wrench Ref	Square Drive, mm (in.)	Torque Output, ft-lb		Approximate Weight, kg (lb)
		MIN**	MAX	
TWHC1	19.05 (3/4)	170	1,413	2.8 (6.2)
TWHC3	25.4 (1)	376	3,136	5.3 (11.7)
TWHC6	38.1 (1 1/2)	726	6,050	8.8 (19.4)

** Note that minimum torque can be lower depending upon pump low-pressure capability

Pressure/Torque Conversion Chart

Pump Pressure		Torque Output					
		TWHC1		TWHC3		TWHC6	
bar	psi	Nm	ft-lb	Nm	ft-lb	Nm	ft-lb
83	1200	230	170	510	376	984	726
97	1400	268	198	595	439	1148	847
110	1600	306	226	680	502	1312	968
124	1800	345	254	765	564	1476	1089
138	2000	383	283	850	627	1640	1210
152	2200	421	311	935	690	1804	1331
165	2400	460	339	1020	753	1967	1452
179	2600	498	367	1105	815	2131	1573
193	2800	536	396	1190	878	2295	1694
207	3000	574	424	1275	941	2459	1815
221	3200	613	452	1360	1004	2623	1936
234	3400	651	480	1445	1066	2787	2057
248	3600	689	509	1530	1129	2951	2178
262	3800	728	537	1615	1192	3115	2299
276	4000	766	565	1700	1254	3279	2420
290	4200	804	593	1785	1317	3443	2541
303	4400	842	622	1870	1380	3607	2662
317	4600	881	650	1955	1443	3771	2783
331	4800	919	678	2040	1505	3935	2904
345	5000	957	707	2125	1568	4099	3025
359	5200	996	735	2210	1631	4263	3146
372	5400	1034	763	2295	1693	4427	3267
386	5600	1072	791	2380	1756	4591	3388
400	5800	1110	820	2465	1819	4755	3509
414	6000	1149	848	2550	1882	4919	3630
427	6200	1187	876	2635	1944	5083	3751
441	6400	1225	904	2720	2007	5247	3872
455	6600	1264	933	2805	2070	5411	3993
469	6800	1302	961	2890	2132	5575	4114
483	7000	1340	989	2975	2195	5738	4235
496	7200	1379	1017	3060	2258	5902	4356
510	7400	1417	1046	3144	2321	6066	4477
524	7600	1455	1074	3229	2383	6230	4598
538	7800	1493	1102	3314	2446	6394	4719
552	8000	1532	1130	3399	2509	6558	4840
565	8200	1570	1159	3484	2572	6722	4961
579	8400	1608	1187	3569	2634	6886	5082
593	8600	1647	1215	3654	2697	7050	5203
607	8800	1685	1243	3739	2760	7214	5324
621	9000	1723	1272	3824	2822	7378	5445
634	9200	1761	1300	3909	2885	7542	5566
648	9400	1800	1328	3994	2948	7706	5687
662	9600	1838	1356	4079	3011	7870	5808
676	9800	1876	1385	4164	3073	8034	5929
690	10000	1915	1413	4249	3136	8198	6050

General Maintenance

Maintenance

Maintenance should follow each period of use to keep the TWHC hydraulic torque wrench in good working condition.

TWHC Hydraulic Torque Wrench

1. Wipe away any debris that may have accumulated, particularly around the square-drive area, reaction arm, and hydraulic couplings.
2. Inspect the following components:
 - Hydraulic couplings for signs of damage.
 - Swivel manifold to verify the retaining ring is present and fitted correctly.
 - Verify the guard is present and securely attached. Replace/reattach as necessary.
3. Remove the square drive from the torque wrench and inspect for damage, cracks, etc. Lubricate the bearing journals using Revol R5 Moly Anti-Seize, and replace the square drive.

NOTE: The TWHC torque wrench drive components must be lubricated using the specified product only. Using alternative lubricants will affect the torque wrench and might lead to premature component failure.

4. Lightly spray the hydraulic torque wrench with water repellent spray before placing in storage. Drive components should be lubricated at regular intervals depending on usage. Refer to the repair procedures section for instructions.

Hoses

1. Clean and inspect each hydraulic hose and quick-connect coupling. Check the entire length of the hose for cuts, abrasions, and damage. Replace the entire hose if any evidence of damage is present.
2. Coat each quick-connect coupling with a water repellent spray.

Maintenance, Service, and Warranty

In addition to post-use maintenance, and to ensure that the Product Warranty remains valid, it is recommended that routine maintenance and servicing be carried out by the Manufacturer or Authorised Service Centre.

Maintenance and servicing should be carried out in accordance with the manufacturers ' Equipment Maintenance and Servicing Manual'.

All TWHC torque wrenches are supplied under the Manufacturers' standard terms and conditions.

All components shall be guaranteed for a period of twelve months from the date of purchase against material defects and workmanship. All components shall be guaranteed for a period of twelve months from the date of purchase against defects arising from normal use, with the following exclusions:

- Hydraulic seals and back-up rings
- Bushes and bearings
- O-ring seals
- Quick-disconnect couplings
- Labels and decals
- Springs

- Circlips
- Paints and coatings
- Plastic screws and plugs

End of Life and Disposal

In accordance with our End of Life Policy, should the product be no longer required for use, it should be returned to SPX Bolting Systems where it shall be disposed of in a safe and environmentally friendly manner.

Troubleshooting

Fault	Possible Cause	Remedy
Cylinder will not advance. Cylinder will not retract.	<ol style="list-style-type: none"> 1. Coupling not fully mated. 2. Cylinder seal leakage. 3. Pump unit. 4. Faulty coupling. 	<ol style="list-style-type: none"> 1. Check coupling. 2. Replace seal. 3. Check pump unit. 4. Replace coupling.
Torque wrench operates backwards.	<ol style="list-style-type: none"> 1. Reversed couplings. 	<ol style="list-style-type: none"> 1. Check pump, hose, and torque wrench for cross connection.
Pressure will not build.	<ol style="list-style-type: none"> 1. Cylinder seal leakage. 2. Swivel seal leakage. 3. Defective pump unit. 	<ol style="list-style-type: none"> 1. Change seals. 2. Change seals. 3. Check pump unit.
Pressure builds, but wrench does not move.	<ol style="list-style-type: none"> 1. Hose restriction. 2. Coupling not fully assembled. 	<ol style="list-style-type: none"> 1. Change hose. 2. Fully tighten coupling.
Slow torque wrench operation.	<ol style="list-style-type: none"> 1. Hose restriction. 2. Coupling not fully assembled. 3. Pump flow rate too small. 	<ol style="list-style-type: none"> 1. Change hose. 2. Fully tighten coupling. 3. Use higher flow pump.
Erratic or slow retraction speed.	<ol style="list-style-type: none"> 1. Hose restriction. 2. Coupling not fully assembled. 	<ol style="list-style-type: none"> 1. Change hose. 2. Fully tighten coupling.
Torque wrench does not ratchet.	<ol style="list-style-type: none"> 1. Broken drive shoe. 2. Jammed drive shoe. 3. Damaged ratchet. 	<ol style="list-style-type: none"> 1. Replace drive shoe. 2. Check drive shoe and spring. 3. Check/replace ratchet.
Ratchet jumps while driving.	<ol style="list-style-type: none"> 1. Worn/damaged ratchet. 2. Worn/damaged drive shoe. 3. Wrench incorrectly retracted. 4. Weak/snapped drive shoe spring. 	<ol style="list-style-type: none"> 1. Replace ratchet and drive shoe. 2. Replace ratchet and drive shoe. 3. Allow time to fully retract. 4. Replace springs.
Difficulty in hose connection.	<ol style="list-style-type: none"> 1. Pressure within hose. 2. Damaged coupling. 	<ol style="list-style-type: none"> 1. Vent hose. 2. Replace coupling.

Repair Procedures

It is recommended that full servicing is carried out on an annual basis by the manufacturer or approved service agent (other than maintenance, lubrication, and emergency seal replacement). All components shall be inspected and critical components subjected to nondestructive testing. Hydraulic torque wrenches will be pressure tested and issued with test certification.

Although it is possible to disassemble the TWHC hydraulic torque wrench on site, it is recommended that this operation be carried out in a clean workshop environment, as dirt and debris can severely affect the performance of the seals and other components. Eye protection should be worn at all times during tool assembly and disassembly.

General servicing/repair can be carried out in three specific areas of the hydraulic torque wrench. This allows servicing and lubricating of specific components without complete stripdown. The three servicing areas are:

- Drive components and lubrication.
- Multiswivel manifold components.
- Hydraulic cylinder components.

Full servicing indicates that all three areas are serviced.

Drive Component Disassembly

The drive components should be lubricated at regular intervals, typically every three for normal use but monthly or even weekly for frequent/prolonged use. Component lubrication is carried out as follows.

1. Verify the torque wrench is fully retracted. Disconnect the power supply.
2. See Figure 4. Remove the guard, unscrewing the guard screws.
3. See Figure 5. Remove the body plugs (both sides).



Item	Description
1	Guard Screw
2	Guard

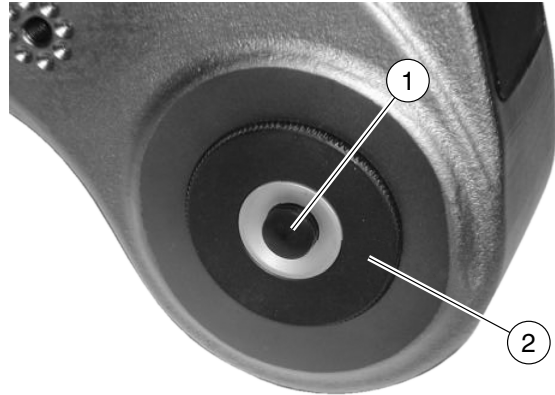
Figure 4. Guard Removal



Figure 5. Body Plug Removal

Repair Procedures continued

- See Figure 6. Remove the square drive and square drive cap.



Item	Description
1	Square Drive Release Button
2	Square Drive Cap

Figure 6. Square Drive Removal

- See Figure 7. Push the drive assembly upward until the crank pin is centralised in the body plug hole. Push and remove the crank pin from the drive assembly via the opposite body plug hole.



Figure 7. Crank Pin Alignment

- See Figure 8. Using a screwdriver, lever the drive assembly forward and withdraw the complete assembly from the front of the body.



Figure 8. Drive Assembly Removal

7. See Figure 9. Remove the ratchet, drive shoe and springs from the crank.
8. Thoroughly clean all components, removing the old lubricant using a mild degreasing agent. Inspect all components for damage and/or excessive wear. Inspect the ratchet and drive shoe teeth for damage, cracks, etc. Any substandard component must be replaced immediately using genuine parts supplied by SPX Bolting Systems.

Drive Component Assembly

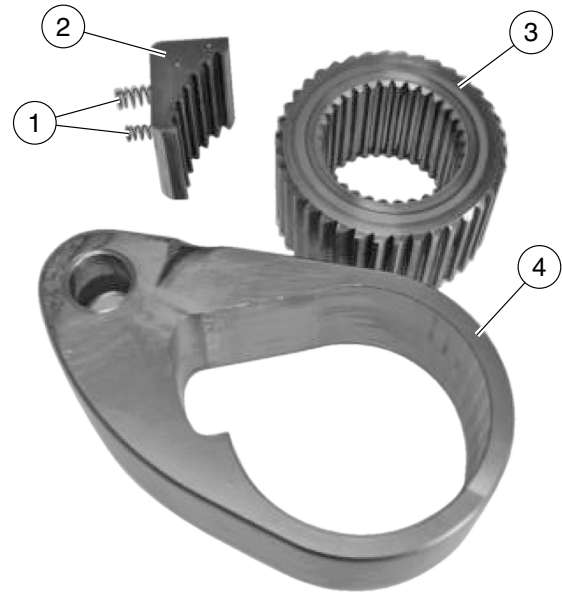
See Figure 10. Before assembly, apply a liberal coat of Revol R5 Moly Anti Seize to the following areas:

- Body internal sideplates (where the crank contacts).
- Crank bearings.
- Crank pocket where the drive shoe is located (not the crank bore).
- Body sideplate journals.
- Square drive bearings.
- Square drive cap bearing.

IMPORTANT: Do not apply lubricant to the ratchet and drive shoe teeth.

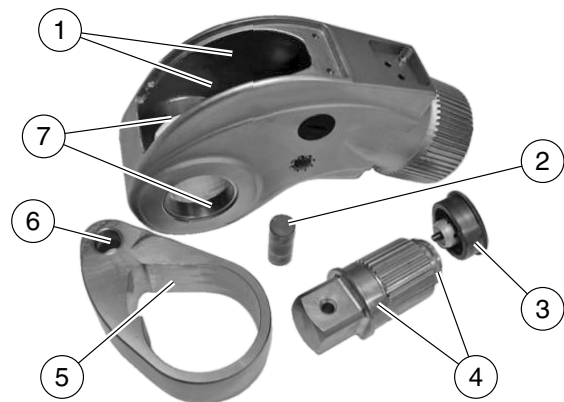
The hydraulic torque wrench drive components must be lubricated using the specified product only. Using alternative lubricants will affect the output and possibly lead to premature component failure.

1. Place the drive shoe and springs into the crank pocket and install the ratchet ensuring the springs do not tilt. Verify that the ratchet teeth are driving in the correct direction and are engaged with the drive shoe teeth. Rotate the ratchet to ensure correct operation.
2. Install the drive assembly into the wrench body, centralise the crank pin hole in the body plug hole and install the crank pin.
3. Press the drive assembly downwards to centralise the ratchet in the sideplate journals.
4. Slide the square drive into the wrench body and attach the square drive cap.
5. Install both body plugs
6. Refit the guard.



Item	Description
1	Springs
2	Drive Shoe
3	Ratchet
4	Crank

Figure 9. Drive Disassembly



Item	Description
1	Body Internal Sideplates
2	Crank Pin
3	Square Drive Cap Bearing
4	Square Drive Bearings
5	Crank Pocket
6	Crank Bearings
7	Sideplate Journals

Figure 10. Lubrication Areas

Repair Procedures continued

7. Test the operation of the torque wrench by connecting to the appropriate pump unit. Keeping hands clear of the wrench, advance and retract the wrench several times ensuring the drive mechanism functions correctly.

Following stripdown and/or lubrication, the hydraulic torque wrench should be calibrated to verify that the torque output is within specification.

Multiswivel Manifold Disassembly

The multiswivel manifold should only be removed for seal replacement or during full servicing.

1. Disconnect the hydraulic torque wrench from the power supply.
2. Attach open ended couplings to the swivel manifold couplings to vent any residual pressure.
3. See Figure 11. Remove the swivel yoke screw.
4. See Figure 12. Disengage the swivel yokes by rotating the advance yoke away from the retract yoke, disengaging the keyways.

5. See Figure 13. Pull each yoke away from the banjo, if necessary, a screwdriver can be inserted into the slot provided to lever the yoke. Remove and discard the yoke seals.



Figure 11. Swivel Yoke Screw Removal

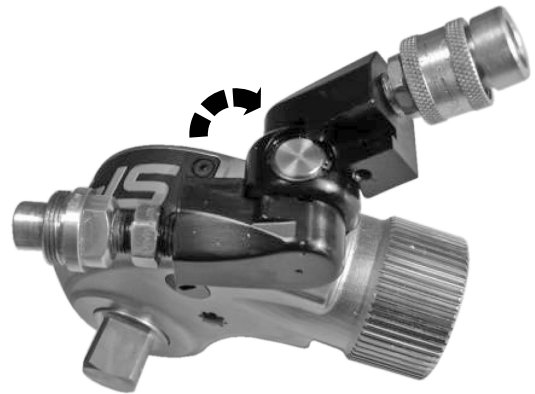


Figure 12. Swivel Yoke Disengagement

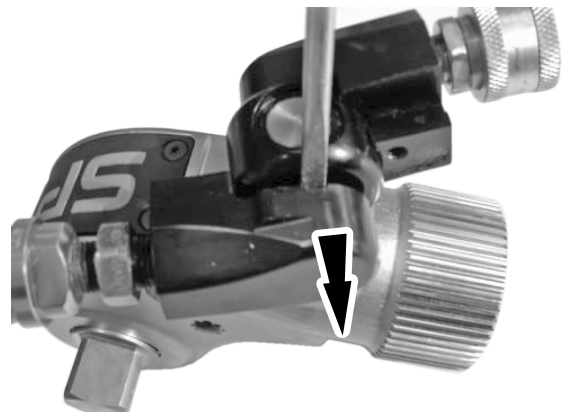


Figure 13. Swivel Yoke Removal

- See Figure 14. Remove the banjo circlip.



Figure 14. Swivel Banjo Circlip Removal

- See Figure 15. Remove the banjo from the swivel post. Remove and discard the banjo seals.

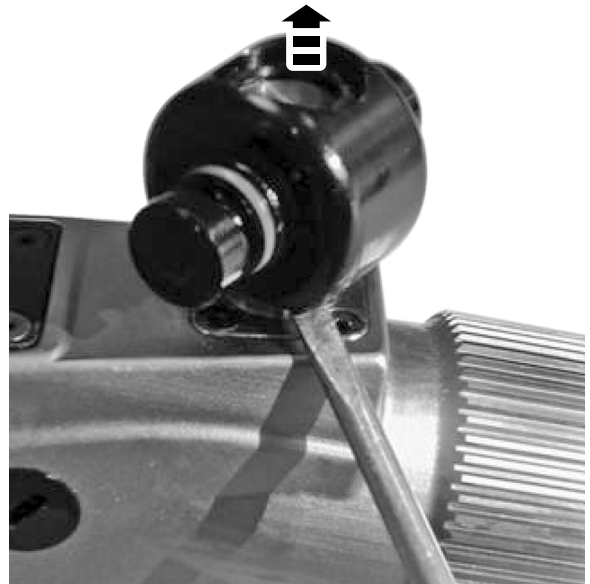


Figure 15. Swivel Banjo Removal

- See Figure 16. Unscrew and remove the four capscrews that attach the swivel post to the wrench body.

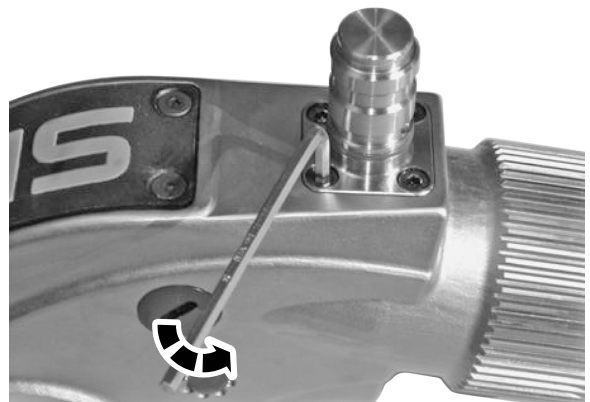


Figure 16. Swivel Post Removal

Repair Procedures continued

9. See Figure 17. Lift off the swivel post. Remove and discard the post and port seals.

Clean and inspect all components including the hydraulic couplings. If the hydraulic couplings are damaged, remove and replace (swivel yoke threads are $\frac{1}{4}$ " NPT). Inspect the components for scoring, pitting and damage, which could impair the sealing ability and replace as necessary.

Multiswivel Manifold Assembly

NOTE: All seals should be new and lubricated with clean hydraulic oil or seal assembly paste before installation.

1. Install the new port o-ring seals into the base of the swivel post.
2. Apply Loctite 222 to the four screws and attach the swivel post to the wrench body. Torque the screws as follows.
 - TWHC1 & 3 (M4) – 5.1 Nm (45 in-lb).
 - TWHC6 (M5) – 10.2 Nm (90 in-lb).
3. Assemble a new o-ring seal to the swivel post.
4. Assemble four new o-ring seals to the banjo.
5. Carefully push the banjo onto the swivel post ensuring the seals do not get nipped.
6. Attach the banjo circlip to the post.
7. Assemble a new o-ring seal into the advance and retract yokes.
8. Assemble the advance and retract yokes to the banjo ensuring the seals do not get nipped.

IMPORTANT: See Figure 18. Ensure the advance and retract yokes are installed correctly onto the banjo. The banjo and advance yoke are engraved with A (advance) to indicate the correct position of the respective yoke. Reversal of the yokes will cause the torque wrench to malfunction and can lead to damage.

9. Rotate the yokes around the banjo until the keyways engage.
10. Clamp the yokes together by installing the yoke screw and torquing to 5.1 Nm(45 lb-in).
11. Check the operation of the multiswivel manifold by rotating and tilting, movement should be free and smooth.

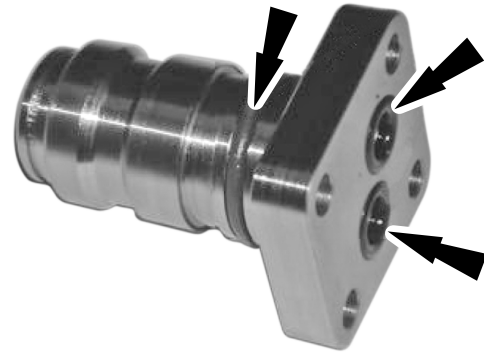


Figure 17. Swivel Post Seals

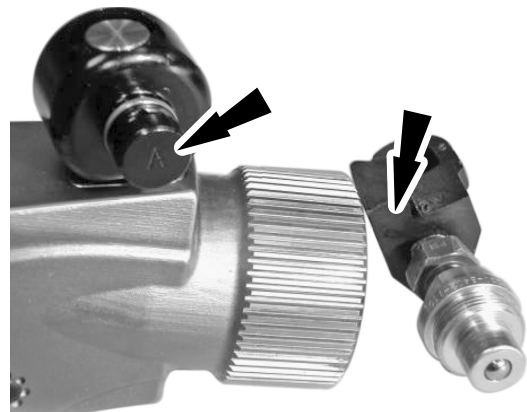


Figure 18. Swivel Banjo/Yoke Identification

12. Test the operation of the torque wrench by connecting to the appropriate pump unit. Keeping hands clear of the wrench, advance and retract the wrench several times ensuring the drive mechanism functions correctly. Apply full pressure to the wrench (690 bar/10,000 psi advance; 103 bar/1500 psi retract), and check for leaks.

NOTE: If the hydraulic couplings were removed, verify that they are installed into the correct yoke. The male coupling/nipple assembles into the advance yoke (A) and the female coupling assembles into the retract yoke (R). Apply hydraulic thread sealant to the hydraulic coupling thread before assembly. Thread sealing tape should not be used as debris from the sealing tape can contaminate the system.

Hydraulic Cylinder Disassembly

It is only necessary to remove the hydraulic cylinder/body components if seal replacement is required.

1. Verify the torque wrench is fully retracted. Disconnect the power supply.
2. Attach open ended couplings to the swivel manifold couplings to vent any residual pressure.
3. See Figure 19. Unscrew the endcap using a pin spanner.
4. Remove the drive assembly as described in section 'Drive Component Disassembly'.
5. See Figure 20. The piston assembly can be withdrawn from the rear of the body by pushing the end of the piston rod.
6. Remove and discard the piston seal and the rod seal located in the centre of the body.

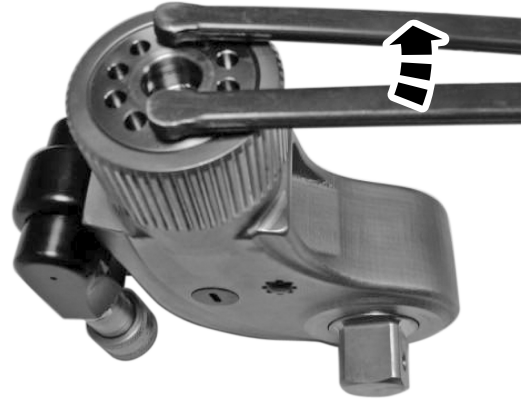


Figure 19. Endcap Removal

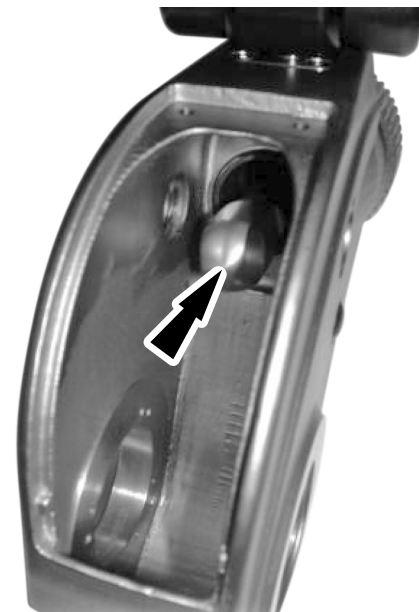
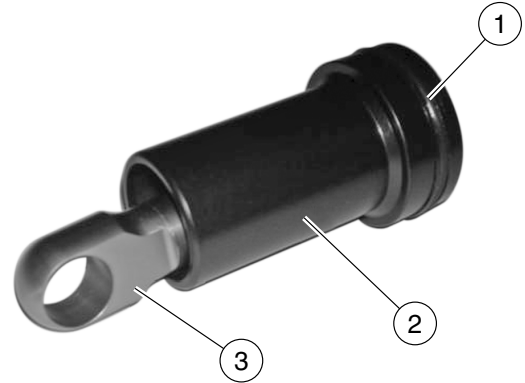


Figure 20. Piston Removal

Repair Procedures continued

7. See Figure 21. Clean and inspect the piston assembly for wear/damage. It is not necessary to remove the piston rod from the piston.
8. Clean and inspect the cylinder bore for scoring, pitting and damage that could impair the sealing ability and replace/repair as necessary.
9. Remove and discard the endcap seal. Clean and inspect the endcap ensuring the threads are checked for damage.



Item	Description
1	Seal
2	Piston
3	Piston Rod

Figure 21. Piston Assembly

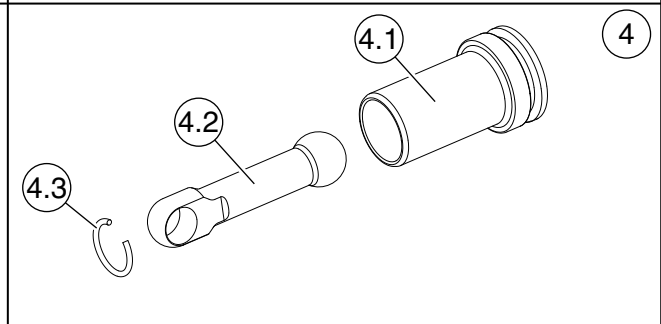
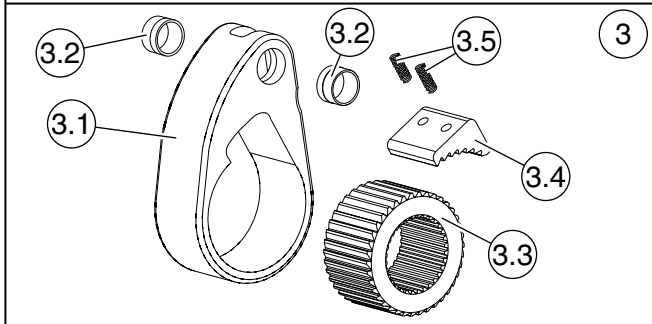
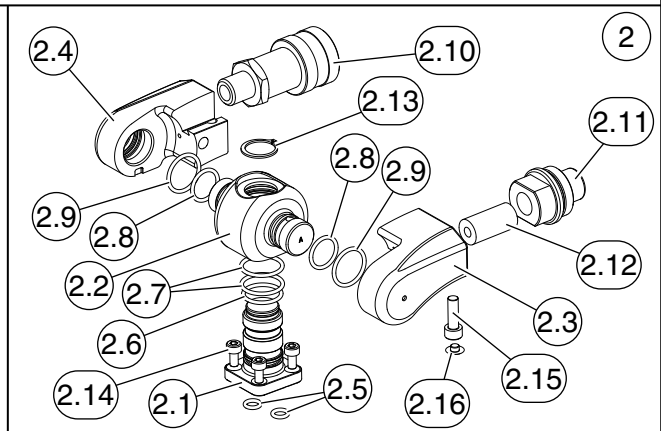
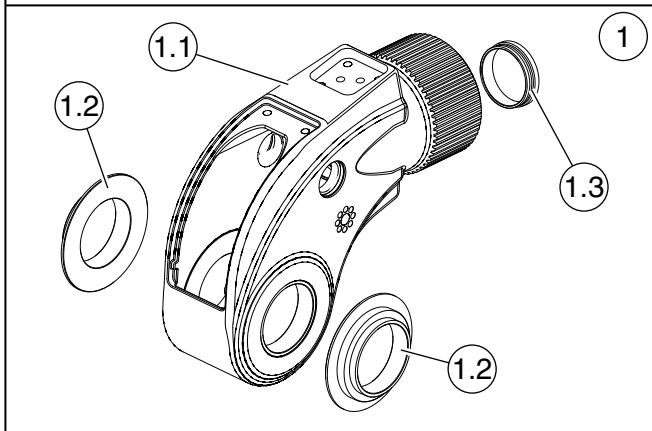
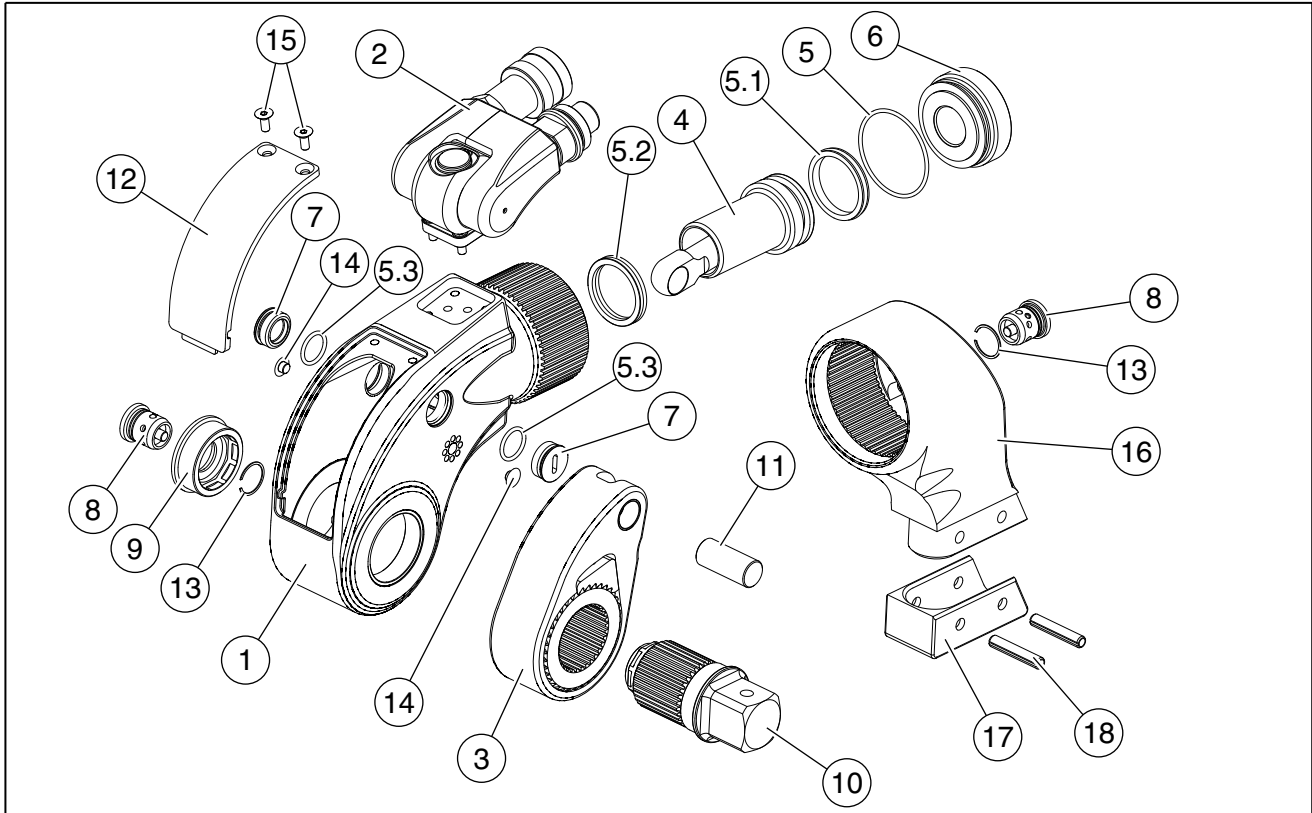
Hydraulic Cylinder/Body Assembly

NOTE: All seals should be new and lubricated with clean hydraulic oil or seal assembly paste before installation.

1. Assemble a new rod seal into the body. Assemble a new piston seal onto the piston ensuring the seal backup ring scarved joints are rotated 180° apart.
2. With the seals and bores coated in clean hydraulic oil, insert the piston into the body bore, guiding/aligning the piston through the rod seal during installation. Ensure the piston backup rings are not dislodged during installation.
3. Install a new o-ring seal onto the endcap and install it into the body. Tighten the endcap using a pin spanner.
4. Assemble the drive components as described in section 'Drive Component Assembly'.
5. Replace the guard.
6. Test the operation of the torque wrench by connecting to the appropriate pump unit. Keeping hands clear of the wrench, advance and retract the wrench several times ensuring the drive mechanism functions correctly. Apply full pressure to the wrench (690 bar/10,000 psi advance; 103 bar/1500 psi retract), and check for leaks.

Following stripdown and/or lubrication, the hydraulic torque wrench should be calibrated to verify that the torque output is within specification.

Parts Lists



Parts List continued

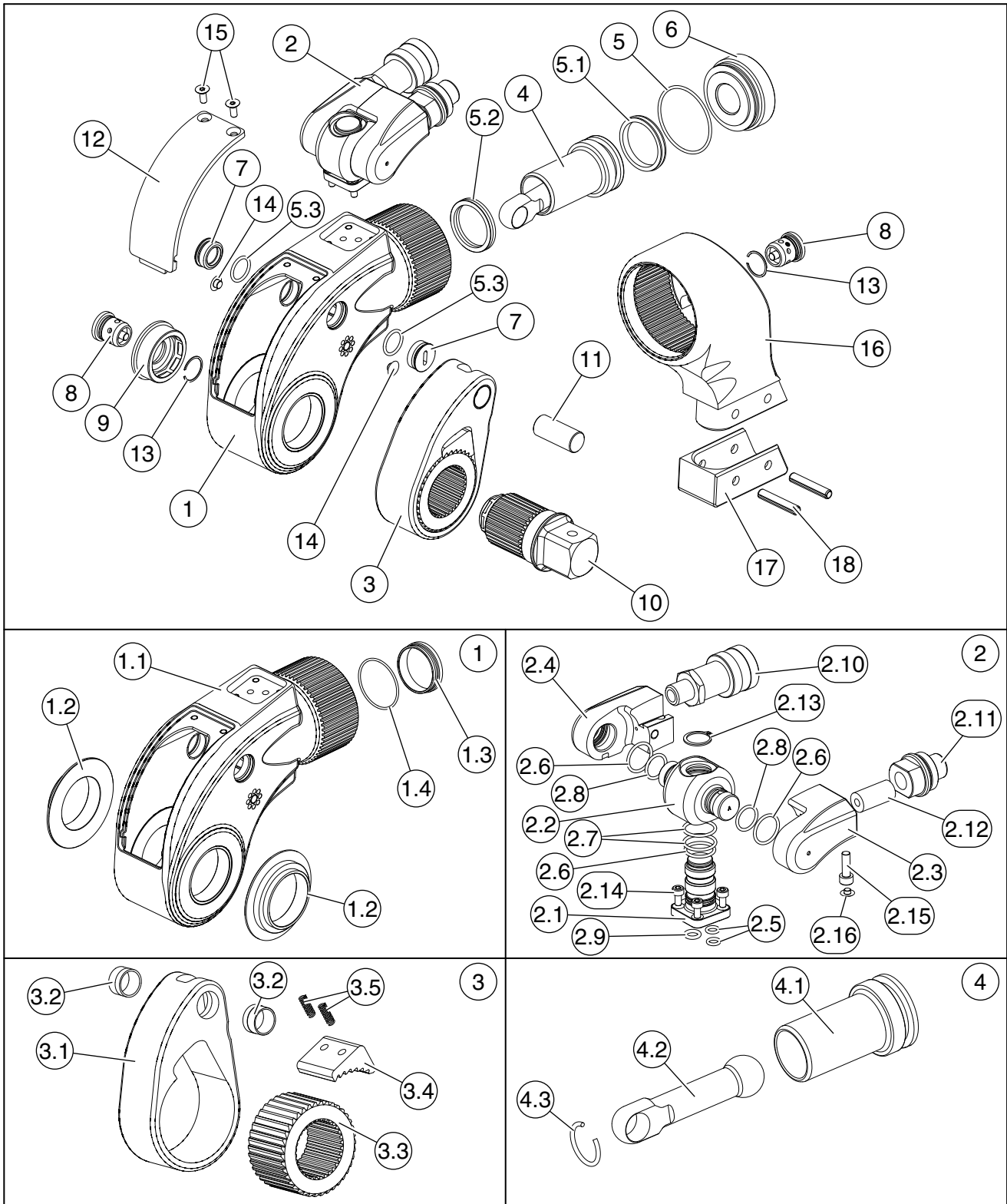
TWHC1/3 Torque Wrench Parts List

Item No.	Part No.		Qty	Description
	TWHC1	TWHC3		
1	TWHCAS010003	TWHCAS030003	1	TWHC Body Assembly
1.1	TWHCBD010001	TWHCBD030001	1	-TWHC Body
1.2	TWHCSJ010001	TWHCSJ030001	2	-TWHC Sideplate Journal
1.3	TWHCBB010001	TWHCBB030001	1	-TWHC Body Bush
2	TWHCAS010008	TWHCAS030008	1	TWHC Multiswivel Manifold Assembly
2.1	TWHCSP010001	TWHCSP010001	1	-TWHC Swivel Post
2.2	TWHCSB010001	TWHCSB010001	1	-TWHC Swivel Banjo
2.3	TWHCAY010001	TWHCAY010001	1	-TWHC Swivel Advance Yoke
2.4	TWHCAS010009	TWHCAS010009	1	-TWHC Swivel Retract Yoke
2.5	Multiswivel seal Kit TWHCAS010010	Multiswivel seal Kit TWHCAS010010	2	-Seal
2.6			1	-Seal
2.7			2	-Seal
2.8			2	-Seal
2.9			2	-Seal
2.10	STDHC000005	STDHC000005	1	-Female Coupling
2.11	STDHC000004	STDHC000004	1	-Male Coupling
2.12	INTHC000002	INTHC000002	1	-Adapter
2.13	STDRC000057	STDRC000057	1	-Clip
2.14	STDFA000025	STDFA000025	4	-Screw
2.15	STDFA000027	STDFA000027	1	-Screw
2.16	STDST000078	STDST000078	1	-Cap
3	TWHCAS010005	TWHCAS030005	1	TWHC Drive Assembly
3.1	TWHCCR010001	TWHCCR030001	1	-Crank
3.2	TWHCCB010001	TWHCCB030001	2	-Crank Bearing
3.3	TWHCRT010001	TWHCRT030001	1	-Ratchet
3.4	TWHCDS010001	TWHCDS030001	1	-Drive Shoe
3.5	STDST000105	STDST000106	2	-Spring
4	TWHCAS010004	TWHCAS030004	1	TWHC Piston Assembly
4.1	TWHCPI010001	TWHCPI030001	1	-Piston
4.2	TWHCPR010001	TWHCPR030001	1	-Piston Rod
4.3	STDRC000061	STDRC000062	1	-Clip
5	Body Seal Kit TWHCAS010007	Body Seal Kit TWHCAS030007	1	Seal
5.1			1	Seal
5.2			1	Seal
5.3			2	Seal
6	TWHCEC010001	TWHCEC030001	1	TWHC Endcap
7	TWHCBP010001	TWHCBP030001	2	TWHC Body Plug
8	BSDAS010008	BSDAS010008	2	TWHC Lock Button Assembly

Parts List continued

Item No.	Part No.		Qty	Description
	TWHC1	TWHC3		
9	TWHCSC010001	TWHCSC030001	1	TWHC Square Drive Cap
10	TWHCSD010001	TWHCSD030001	1	TWHC Square Drive
11	TWHCCP010001	TWHCCP030001	1	TWHC Crank Pin
12	TWHCGD010001	TWHCGD030001	1	TWHC Guard
13	STDRC000030	STDRC000030	2	Clip
14	STDST000079	STDST000079	2	Cap
15	STDFA000156	STDFA000156	2	Screw
16	TWHCRA010001	TWHCRA030001	1	TWHC Reaction Arm
17	TWHCAP010001	TWHCAP030001	1	TWHC Reaction Arm Pad
18	STDST000098	STDST000104	2	Pin

Parts Lists continued



TWHC6 Torque Wrench Parts List

Item No.	Part No.	Qty	Description	
	TWHC6			
1	TWHCAS060003	1	TWHC Body Assembly	
1.1	TWHCBD060001	1	-TWHC Body	
1.2	TWHCSJ060001	2	-TWHC Sideplate Journal	
1.3	TWHCBB060001	1	-TWHC Body Bush	
1.4	STDSE000006	1	-Seal	
2	TWHCAS020001	1	TWHC Multiswivel Manifold Assembly	
2.1	TWHCSP020001	1	-TWHC Swivel Post	
2.2	TWHCSB020001	1	-TWHC Swivel Banjo	
2.3	TWHCAY020001	1	-TWHC Swivel Advance Yoke	
2.4	TWHCAS020002	1	-TWHC Swivel Retract Yoke	
2.5	Multiswivel seal Kit	2	-Seal	
2.6		3	-Seal	
2.7		2	-Seal	
2.8		TWHCAS020003	2	-Seal
2.9		1	-Seal	
2.10	STDHC000005	1	-Female Coupling	
2.11	STDHC000004	1	-Male Coupling	
2.12	INTHC000002	1	-Adapter	
2.13	STDRC000064	1	-Clip	
2.14	STDFA000157	4	-Screw	
2.15	STDFA000027	1	-Screw	
2.16	STDST000078	1	-Cap	
3	TWHCAS060005	1	TWHC Drive Assembly	
3.1	TWHCCR060001	1	-Crank	
3.2	TWHCCB060001	2	-Crank Bearing	
3.3	TWHCRT060001	1	-Ratchet	
3.4	TWHCDS060001	1	-Drive Shoe	
3.5	STDST000107	2	-Spring	
4	TWHCAS060004	1	TWHC Piston Assembly	
4.1	TWHCPI060001	1	-Piston	
4.2	TWHCPR060001	1	-Piston Rod	
4.3	STDRC000063	1	-Clip	
5	Body Seal Kit TWHCAS060007	1	Seal	
5.1		1	Seal	
5.2		1	Seal	
5.3		2	Seal	
6	TWHCEC060001	1	TWHC Endcap	

Parts Lists continued

Item No.	Part No.	Qty	Description
	TWHC6		
7	TWHCBP060001	2	TWHC Body Plug
8	BSDAS060008	2	TWHC Lock Button Assembly
9	TWHCSC060001	1	TWHC Square Drive Cap
10	TWHCSD060001	1	TWHC Square Drive
11	TWHCCP060001	1	TWHC Crank Pin
12	TWHCGD060001	1	TWHC Guard
13	STDRC000031	2	Clip
14	STDST000109	2	Cap
15	STDFA000156	2	Screw
16	TWHCRA060001	1	TWHC Reaction Arm
17	TWHCAP060001	1	TWHC Reaction Arm Pad
18	STDST000034	2	Pin

Declaration of Incorporation



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We declare that this product complies with the appropriate ESR's of the following directives,

- 2006/42/EC

Where appropriate the requirements of the following standards have been invoked,

- EN 292/2/91

Product description: HYDRAULIC TORQUE WRENCH.

Model type: TWHC1, 3, 6, SQUARE DRIVE TORQUE WRENCH.


In addition, the goods supplied have been classified as falling into the Sound Engineering Practice (SEP) category according to the EC Pressure Equipment Directive (PED) 97/23/EC.

SPX Bolting Systems is the person authorised to compile the technical file.

SPX Bolting Systems, the manufacturer / supplier, undertake to transmit and / or make available in response to reasoned request, technical file details and other relative information to EEC National Authorities, in electronic or hard copy format

Installation and operation of this equipment must be in accordance with the installation and operating instructions provided. This product must not be put into service until the machinery into which it is incorporated has been declared in conformity with the provisions of the above directives.

The Company Directors are the equally responsible persons. The person named below is empowered to act as signatory on behalf of the Company Directors

Signed: 

Printed: DAVID CAMPBELL

Date: 6th December 2011