

SUPERIOR BOLTING SOLUTIONS



T SERIES TORQUE WRENCHES



TITAN
SUPERIOR BOLTING SOLUTIONS

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Safety Precautions

WARNING:

Titan Hydraulic Wrenches are power tools, as with any power tool, all precautions should be taken to avoid injury. Please follow the important precautions below. Failure to follow instructions may cause serious injury or death.

- **Read all written instructions carefully!** Most problems with new equipment are caused by improper operation or installation.
- Keep work area clean.
- Always operate tools in a well-lit area.
- Always use Personal Protective Equipment (PPE).
- Do not use power tools under the influence of drugs, alcohol, or any mind altering substances.
- Stay clear of tool during operation. NEVER hold, attempt to grab, or adjust the tool or reaction arm during operation.
- Ensure that all hydraulic connections are tight and there are no visible cracks in the tool or socket.
- Never use an ungrounded power supply with a pump.
- The pump must be compatible with existing line voltage.
- Never exceed the pressure rating on the pump nameplate. Do not tamper with the internal high pressure relief valve.
- Disconnect the pump from the power source before performing any maintenance or repair on the pump.
- If wires (internal and external) are frayed, cut, or exposed in any way, discontinue use and replace immediately.
- Do not attempt to replace a fuse with one of a higher voltage.
- Do not kink, curl, or bend a hose tightly, preventing oil from passing through.
- Do not expose hoses to hazards such as fire, sharp surfaces, extreme hot or cold, or heavy impact. If a hose is damaged in any way, destroy it and replace with a new hose.
- If a hydraulic hose or tool ever burst, rupture, or need to be disconnected, immediately shut off pump.
- Improper and loose fittings can become hazardous when pressurized. Never hold or grab a hydraulic pressure leak; hydraulic fluid is toxic and escaping oil can penetrate the skin and cause injury.
- Never move a tool or pump by pulling the hose, stress can damage the hose.
- Do not attempt to repair a tool or pump. Only certified Titan personnel may repair damaged pumps and tools. Any attempt to repair a pump or tool by persons other than qualified technicians may result in serious injury or death. Call Titan for service and repair.
- Failure to follow written instructions above will void the warranty.

Chapter 1: General Information

1.1 Inspection

Prior to use, inspect tool for any damage caused in the shipping process, if there is damage, contact your Titan sales representative immediately.

All Titan Products are supplied assembled and ready for immediate use. The use of Titan Power Pack is strongly recommended to provide the proper flow, speed and accuracy of your hydraulic tools.

The accuracy of your new Titan Hydraulic Torque Tools is $\pm 3\%$. Titan Hydraulic tools may be calibrated by Titan or by any calibration facility that can be traced to the National Institute of Standards and Technology (N.I.S.T).

1.2 Hydraulics, Connections, and Safety Precautions

All Titan Hydraulic Torque Tools operate at 10,000 psi (700kg/cm²)
Make sure all hoses are rated for 10,000 psi (700kg/cm²)

Before connecting or disconnecting hydraulic hoses release any pressure by turning the pump off and double checking that the pressure gauge reads Zero (0). When connecting hose to the pump or tool, check fitting for cleanliness and ensure the fitting is engaged fully and hand tight.

WARNING:

Always ensure both hoses are securely connected.

Do not attempt to force the fitting using a wrench or any other means!

1.3 Electric Power Requirements and Safety Precautions

Check the specification plate (See Figure 10) located on the pump for proper power requirements. Operating the pump with the wrong power source will cause motor failure. If you are unsure of the power requirements in your facility, seek a qualified electrician for guidance.

WARNING:

Do not remove the grounding prong from the electrical plug.

Electrical motors should not be used in volatile situations. Do not use an electrical pump in explosive atmospheres or in the presence of conductive liquids. A Titan Air Pump should be used. Contact your local Titan representative for a demonstration.



1.4 Air Connections

Please consult your compressor manufacturer's air flow rating (in cfm) prior to using and pressurizing your pump.

Improper airflow will damage the pump motor. Titan recommends an air-hose with a diameter greater than 3/4".

A filter lubricator regulator unit (FLR) should be used. An FLR will regulate flow and pressure as well as lubricate and remove water from compressed air to keep the air motor in your pump running properly.

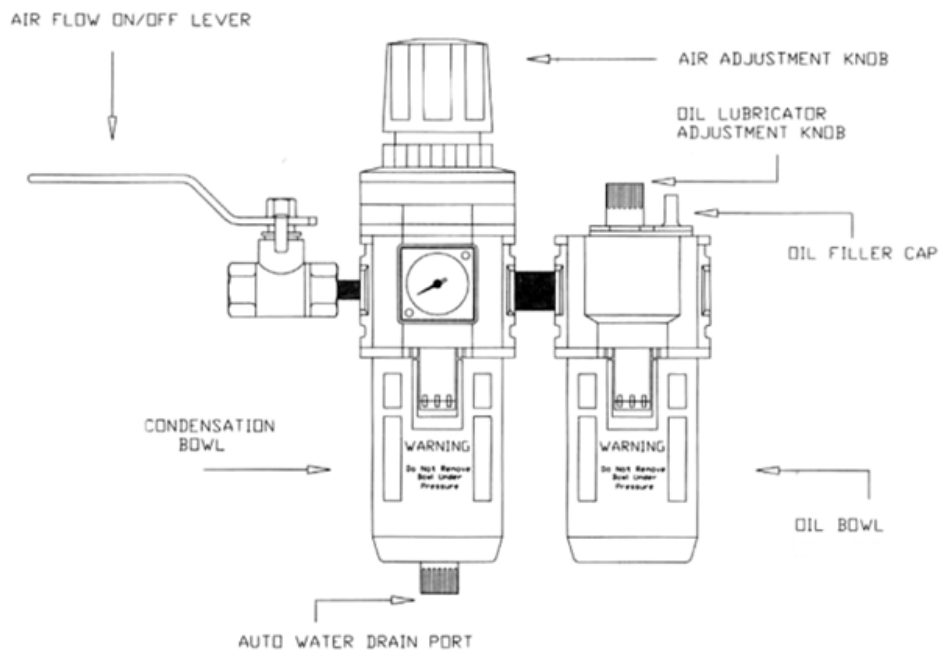


Figure 1 FLR Unit

Chapter 2: Operation

2.1 Connecting the System

All hydraulic connections are rated for 10,000psi. Connect the couplers on the hose, tool, and pump as shown in Figure 2. Make sure male couplers are connected to female couplers and are fully engaged and hand tight.

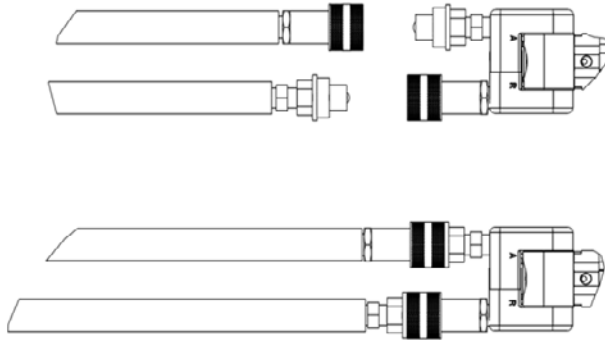


Figure 2 Hydraulic Connections on Tool

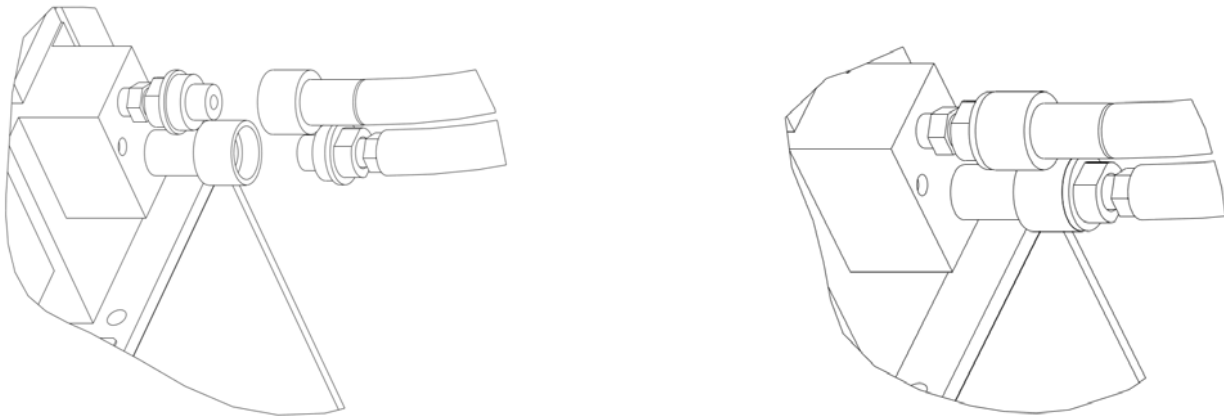


Figure 3 Hydraulic Connections on Pump

Warning:

Tightening fittings with a tool may cause permanent thread damage and will lead to failure of the fitting.

ALWAYS CONNECT BOTH HOSES!!!!

**Failure to connect the retract fitting may result in tool failure, serious injury, or death.
To avoid tool malfunction do not reverse the connector on either the pump or the tool.**



2.2 Drive Direction

To change drive rotation (see Figure 4):

- 1) Depress silver push button on drive retainer.
- 2) Pull drive out of tool.
- 3) Determine desired direction of rotation for tightening or loosening. Note direction of threading (right hand or left hand).
- 4) Align spline on square drive with ratchet spline and insert drive into tool. Do not attempt to force a drive into a tool using a hammer or any other tools as this may cause permanent damage to the square drive or ratchet.
- 5) Attach drive retainer
- 6) Double check fitment by firmly pulling on the square end of the drive.

Refer to Figures 5 & 6 for drive directions based on **right-hand threads**.

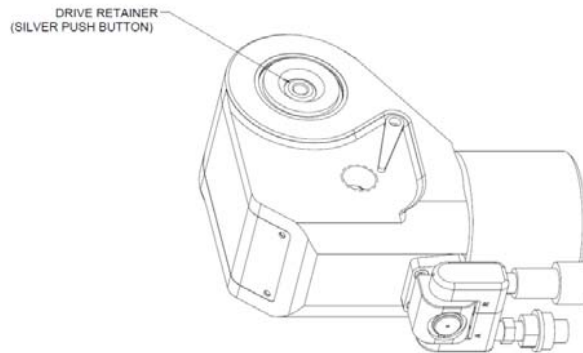


Figure 4 Drive Direction Change

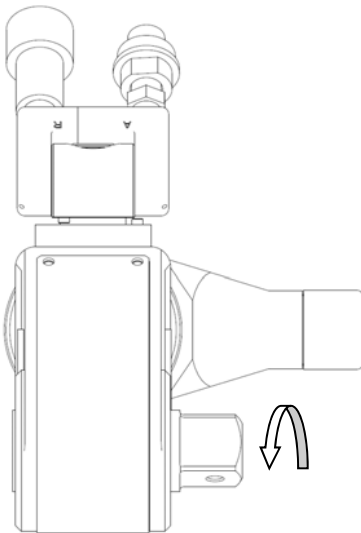


Figure 5 Tighten

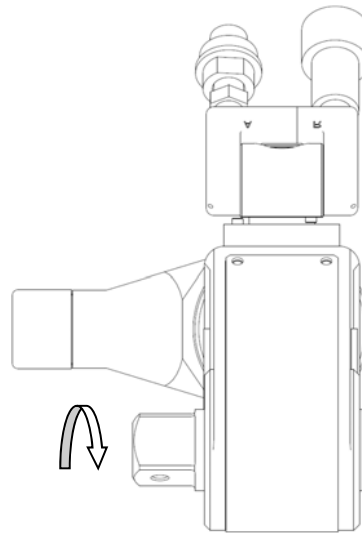


Figure 6 Loosen

2.3 Reaction Arm

Every Titan T-Series Hydraulic Torque tool is equipped with a universal reaction arm. This component is used to counteract turning forces as the unit operates. The reaction arm can rotate 360° in 6° increments and should extend in the same direction as the square drive, see Figure 7.

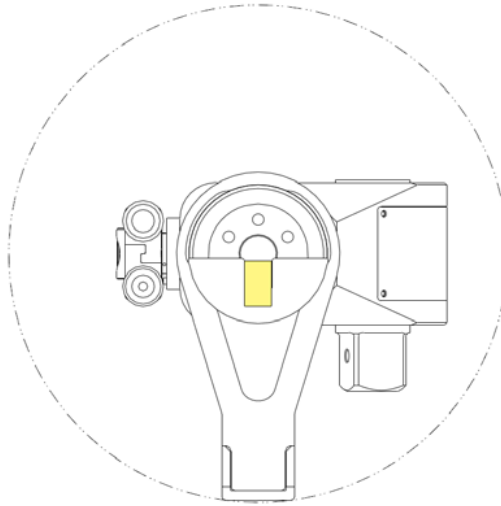


Figure 7 Typical Reaction Configuration and Adjustability

******* WARNING *******

NEVER CUT, WELD OR MODIFY REACTION ARMS!!!!

THIS CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR AND DAMAGE TO THE TOOL OR APPLICATION.

CONTACT TITAN IF A CUSTOM REACTION ARM IS REQUIRED.

To attach the reaction arm to the tool:

- 1) Determine the best position for the reaction arm on the application
- 2) Align the splines on the reaction arm to the splines on the tools
- 3) Slide the reaction arm onto the tool till a “click” is heard. Pull reaction arm to confirm it is secure.
- 4) To remove, push the reaction arm lever (gold lever shown in Figure 7) and slide the reaction arm off the tool.



2.4 Determining the Pump Pressure

The torque of your Titan T-Tool is controlled via the pressure of the pump. Every Titan tool comes with a pressure to torque calibration chart that will help you determine the pump pressure settings for your torque requirements.

Refer to the torque requirements of the plant or equipment manufacturer before beginning the job!!!

- 1) Locate the torque chart (figure 8) for your tool serial number and find the closest torque to your requirements. (For this example, we will use a T3 to torque to 1,100 ft-lbs.)
- 2) For this example, the closest torque is 1089 ft-lbs (within +/- 3% of the tools accuracy) and the corresponding pressure is 3400 psi.
- 3) Set the pump to 3400 psi following the instructions in Section 2.4.

Pressure Vs Torque Conversion Chart						
<i>Titan T Series Tools</i>						
	<i>T-1</i>	<i>T-3</i>	<i>T-5</i>	<i>T-8</i>	<i>T-10</i>	<i>T-25</i>
Pressure (Psi)	Torque(Ft- Lb)					
1500	197	468	816	1168	1662	3726
1600	210	499	871	1246	1773	4002
1800	236	562	979	1402	1994	4554
2000	271	644	1101	1574	2236	5106
2200	298	708	1212	1731	2460	5626
2400	325	773	1322	1889	2683	6145
2600	352	837	1432	2046	2907	6665
2800	379	902	1542	2204	3130	7184
3000	411	961	1656	2378	3365	7704
3200	438	1025	1767	2537	3589	8221
3400	465	1089	1877	2695	3814	8738
3600	493	1153	1988	2854	4038	9254
3800	520	1217	2098	3012	4262	9771
4000	549	1278	2230	3216	4456	10288
4200	577	1342	2341	3377	4679	10809
4400	604	1406	2452	3538	4902	11330
4600	632	1470	2564	3698	5124	11852
4800	659	1534	2675	3859	5347	12373
5000	686	1592	2790	3990	5588	12894
5200	714	1656	2902	4150	5812	13385
5400	741	1719	3013	4309	6035	13876

Torque nearest to required

Figure 8 Sample Torque Chart

2.5 Adjusting the Pump Pressure

To set the pressure on your Titan Pump follow this procedure:

1. Locate and loosen the locking ring below the "T" handle on the pumps external pressure regulator. Then turn the "T" handle counter clockwise until it turns freely. (See Figure 9)
2. Turn the pump "on" using the pumps remote control, press and hold the advance switch (or button on air pumps). (See Figure 10)
3. While holding the switch in the advance position, slowly turn the "T" handle clockwise. You will notice the pressure on the pump gage rise.
4. When the needle reaches the desired pressure stop turning the "T" handle and let the pressure settle.
5. Release and then depress the advance button. If the pressure continues to rise, release the advance button and slowly turn the "T" handle counter-clockwise. Repeat this process till the target pressure is reached.
6. Tighten the knurled locking ring under the "T" handle.
7. Cycle your tool one more time to ensure you have the desired working pressure.

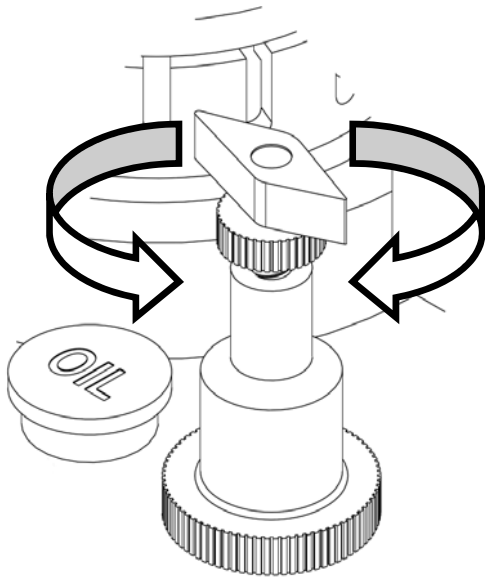


Figure 9 Manual Pressure Control Valve, Clockwise to Increase Pressure, Counter-clockwise to Decrease Pressure

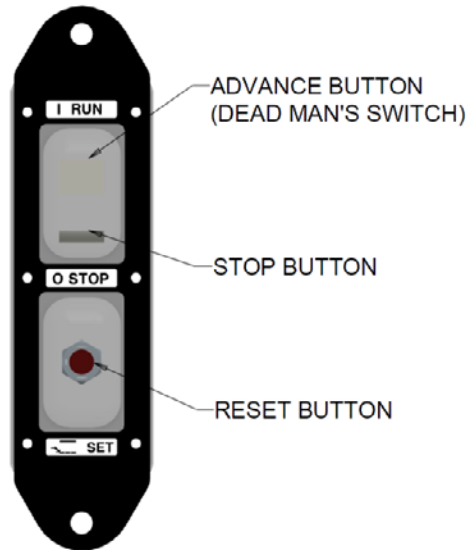


Figure 10 Control Pendant (Electric Pump)

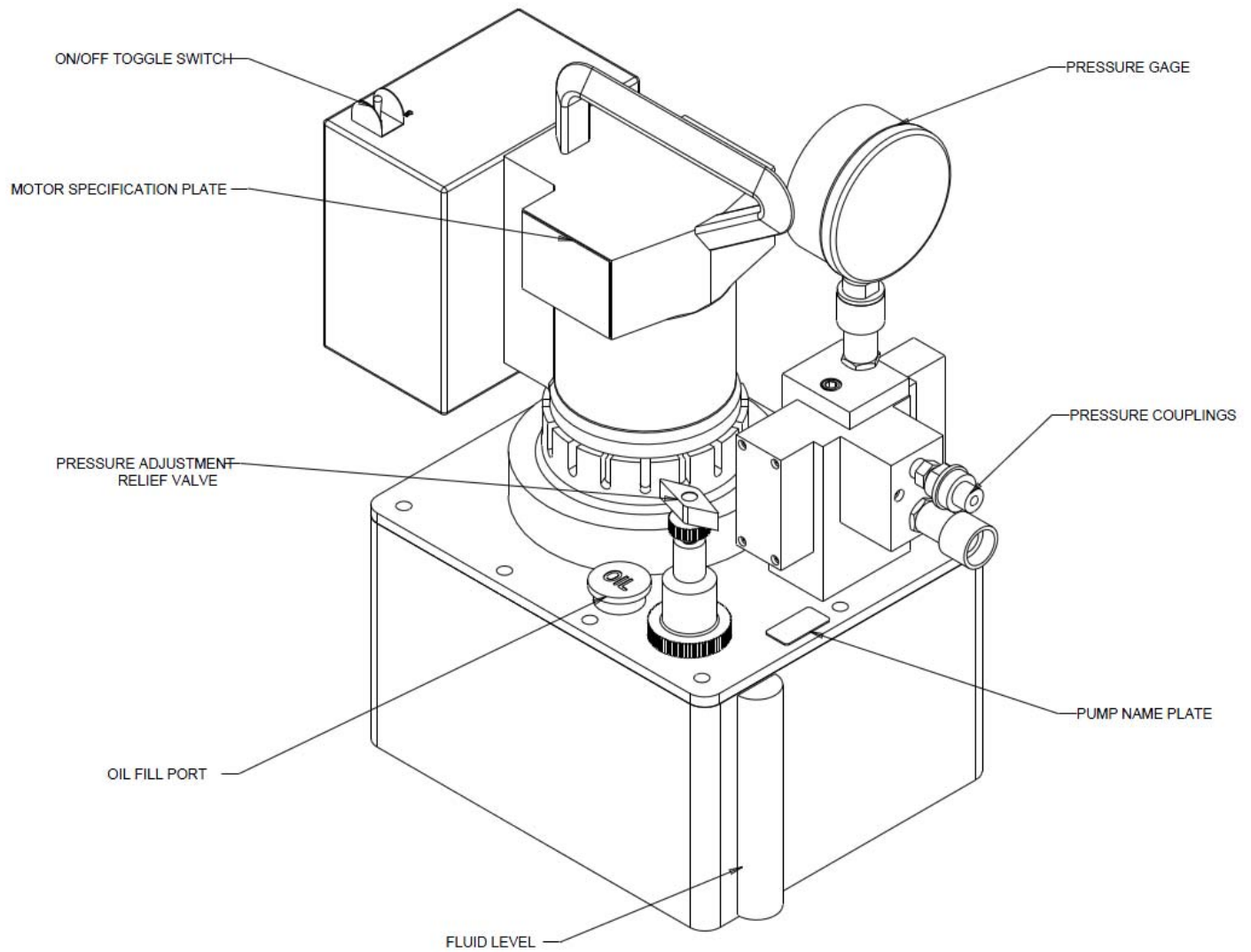


Figure 11 Electric Pump

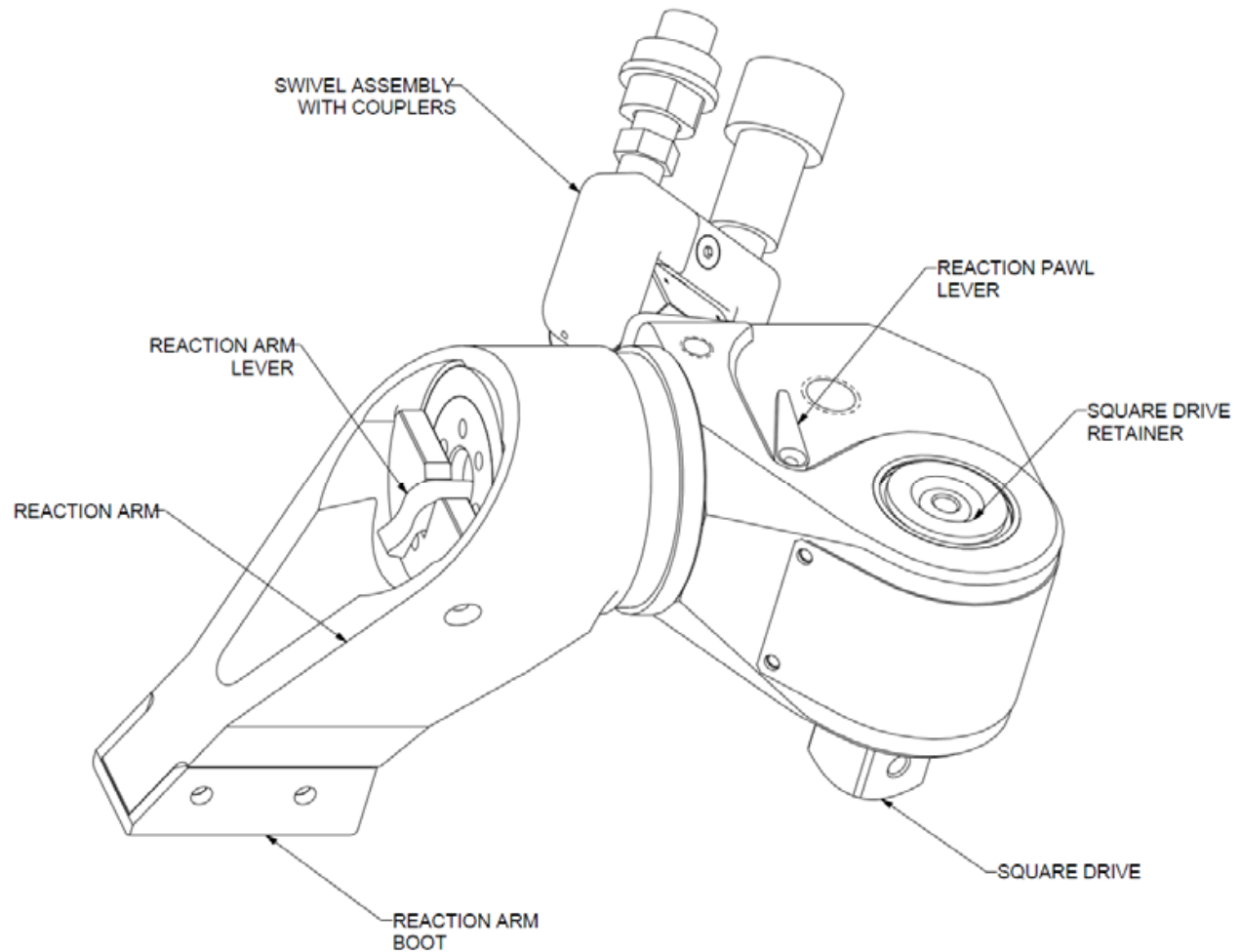


Figure 12 Major Tool Components



2.6 Setup to Tighten Fasteners

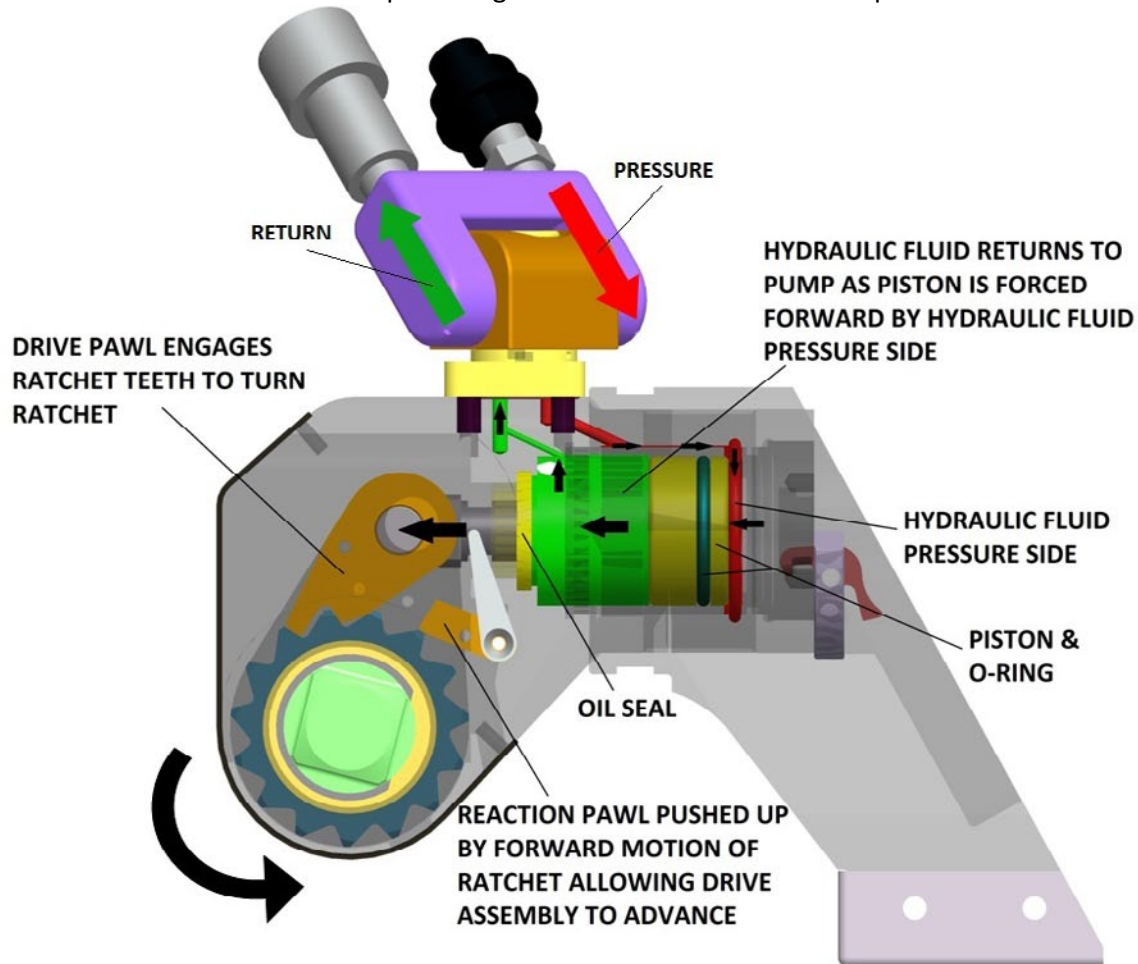
1. Once you have set your target pressure, cycle the tool several times without load to ensure the system is operating properly and any air is out of the lines.
2. Place the proper sized impact grade socket on the square drive. Insert the retaining pin into the hole in the socket and square drive and secure with the retaining O-ring.
3. Place the tool with socket on the nut and double check that the retaining ring is secure.
4. Place the reaction arm boot (Figure 12) against a strong stationary object (i.e.) an adjacent nut, flange or equipment housing.

******NEVER HOLD THE REACTION ARM DURING TOOL OPERATION******

5. Be sure all body parts are out of harm's way.
6. Make sure all hoses and electric cords are clear of obstructions and the reaction arm.
7. Apply momentary pressure to ensure that the tool is properly placed and does not "ride up" or move on the application.

2.7 Operation

1. Depress the advance button on the remote control. The tool will spin slightly about the square drive until the reaction arm contacts the reaction point. Figure 13 shows the tool at start position.



T-TOOL START POSITION

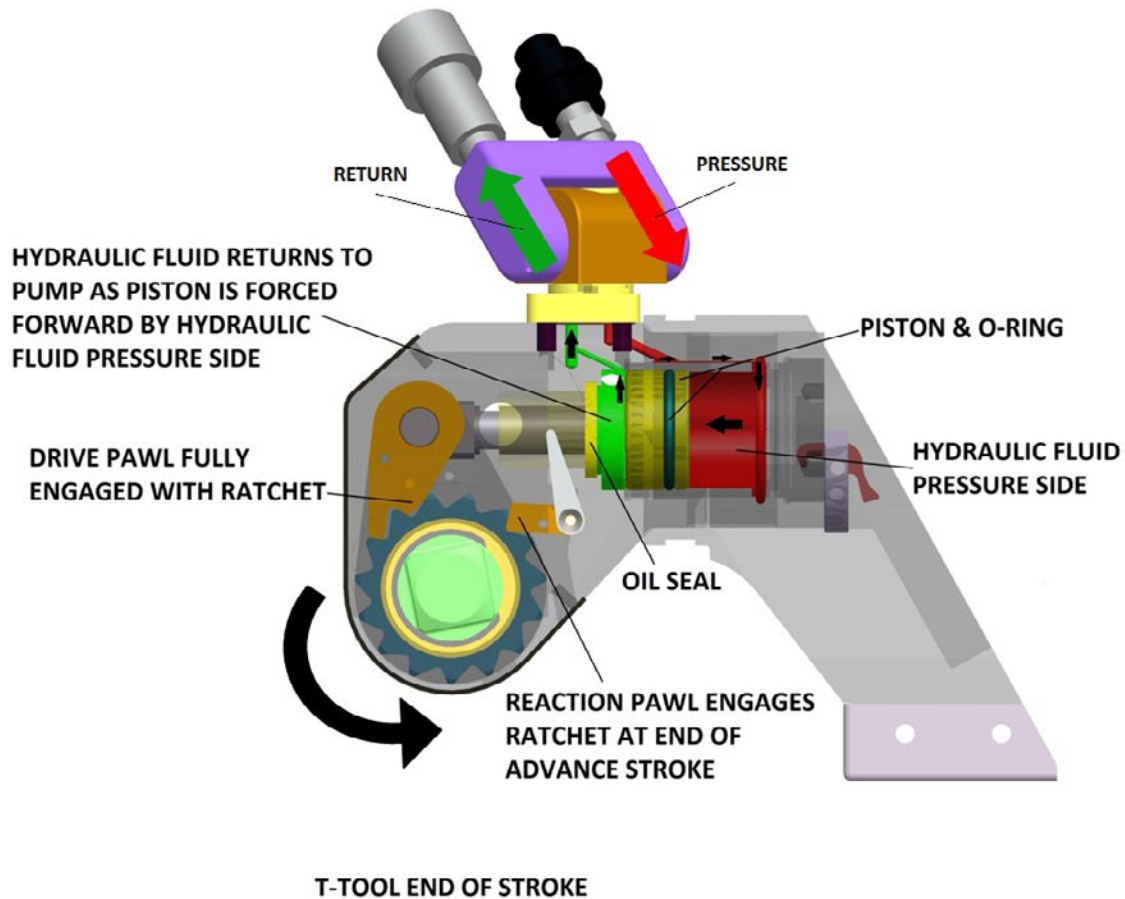
GREEN IS THE HYDRAULIC FLUID RETURN SIDE

RED IS THE HYDRAULIC FLUID PRESSURE SIDE

Figure 13 T-Tool Start Position



2. Continue to hold down the advance button as the socket turns until you hear a “click”. This click is the reaction pawl engaging the ratchet, signifying the piston is at the end of the stroke. Figure 14 shows the tool at the end of its stroke.



GREEN IS THE HYDRAULIC FLUID RETURN SIDE

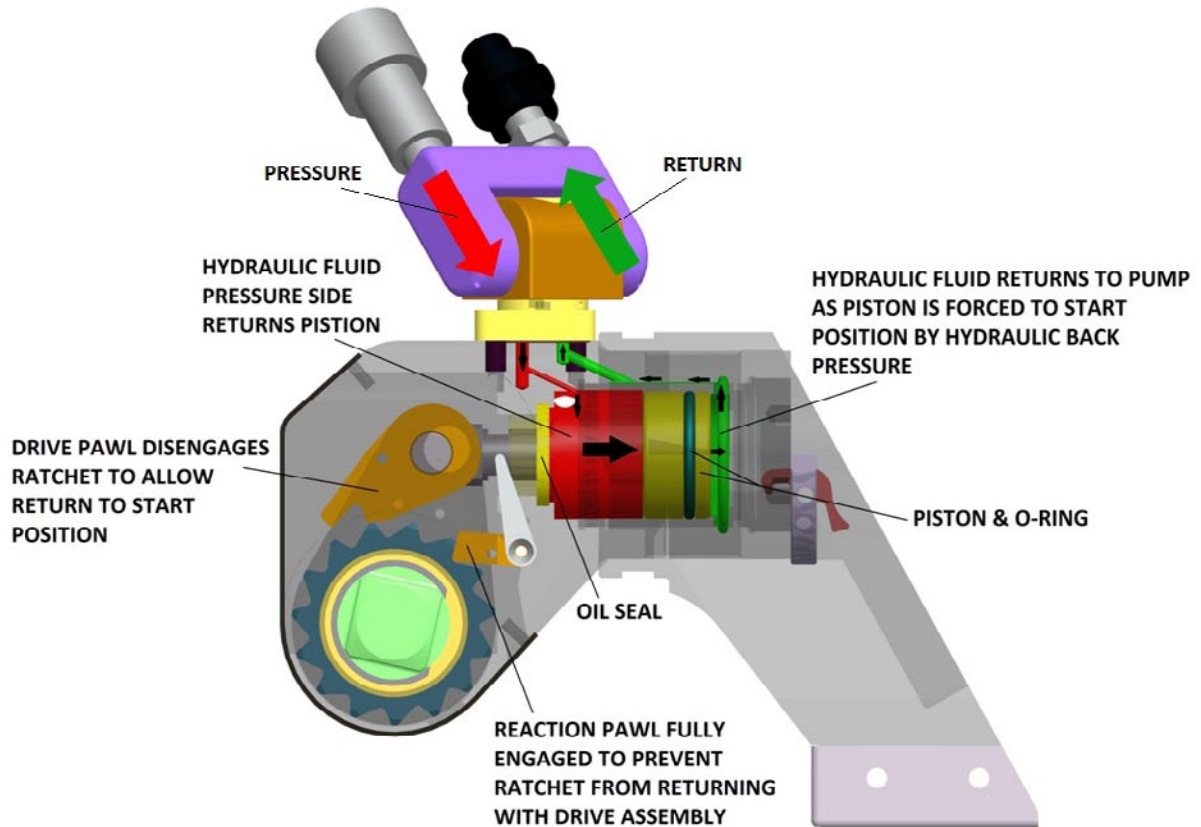
RED IS THE HYDRAULIC FLUID PRESSURE SIDE

Figure 14 T-Tool Stroke End

3. Continuing to hold down the advance button will result in a rapid pressure increase.

Note: The reading of the preset pressure after the piston is extended **DOES NOT** indicate the set torque is applied to the bolt. This only indicates that the piston is fully extended and cannot turn the socket further.

4. Release the advance button on the remote control and the piston will retract. The tool will automatically reset itself and the operator will hear another audible “click”. This second click is the drive pawl engaging the ratchet, and the “cycle” can begin again. Figure 15 shows the tool as the piston retracts to its start position.



T-TOOL DURING RETURN STROKE

GREEN IS THE HYDRAULIC FLUID RETURN SIDE
RED IS THE HYDRAULIC FLUID PRESSURE SIDE

Figure 15 T-Tool During Return Stroke

5. Repeat steps 1-4 until the tool stalls.
6. To verify the set torque is reached, release the advance button and allow the piston to retract. Listen for the “click” at the end of the piston stroke. Depress the advance button again, if the tool stalls and the pump pressure increases to the set pressure, the torque has been reached.



Note: Occasionally the tool will lock on the application and become difficult to remove. This usually happens when applying torque to long fasteners. To release the tool from the fastener:

1. Depress the advance button on the control pendant
2. Flip reaction pawl lever in the direction shown in Figure 13 and hold in position.
*** Note: If the reaction lever does not move, increasing the pump pressure slightly may help. ***
3. Release the advance button and allow the piston to retract. The tool should be free and it can be removed from the application.

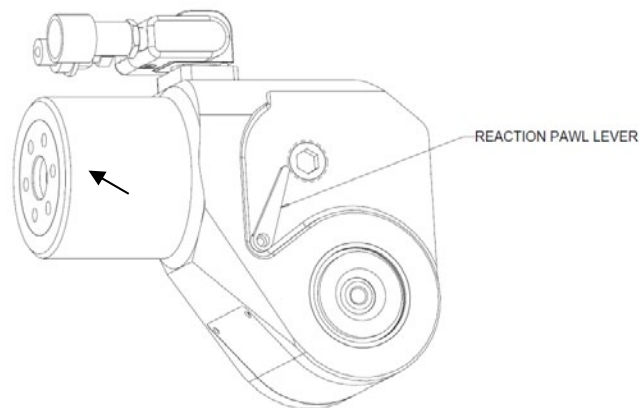


Figure 16 Reaction Pawl Lever Location

2.8 Removing Fasteners

To remove fasteners:

1. Change the drive to the direction necessary to loosen the fasteners, refer to Figures 5 & 6.
2. For right-hand threads, square should rotate counter-clockwise.
3. For left hand threads, square drive should rotate clockwise.
4. Set the pump to pressure to 10,000PSI.
5. Place the reaction arm against a strong, immovable surface.
6. Press and hold the advance button. The socket should begin to turn.
7. Cycle the tool until the fastener can be removed by hand.

More torque is required to remove a fastener than to tighten it. If the tool was near maximum capacity during fastening, a larger tool may be required to remove the fastener.

2.9 Tool Care and Maintenance

1. Clean all dirt and grit from the housing
 - a. If tool is used in an underwater situation, especially sub-sea, remove all water. Dry and grease tool before storage.
2. Inspect the square drive, reaction arm, and housing for cracks and other signs of wear. If one is present, discontinue use and contact Titan for a replacement part.
3. Store tool in a clean, dry area

Storage cases are available from Titan at an additional cost.

Following these simple procedures can extend the service life of your tool.

- Re-calibrate your tool periodically. Over time, internal components wear and can bring the tool out of calibration. Titan recommends a 6-12 month calibration cycle. Your work may require a different calibration cycle, check with your manager for this cycle.
- Periodically clean and lubricate internal parts in the tool with Dow Corning GN Metal paste. Call Titan to order this lubricant or send the tool to Titan for this service.



Section 3: Hydraulic Pumps

Overview:

Titan pumps are designed to be powerful, portable and durable. Before use please note the following points:

- Titan pumps operate between 1500 psi to 10,000 psi. Use ONLY Titan hoses to ensure you and your co-workers safety.
- Make sure the reservoir is filled with oil and you can see the oil level through the clear indicator on the front of the pump.
- Ensure there is enough air pressure (100PSI) and flow(50CFM for 1 pump, 90 CFM for 2 pumps) from your air lines otherwise the pump will not operate properly.
- Inspect the gauge and make sure it is rated for 10,000PSI and not damaged.
- Check to make sure the oil filler plug is completely sealed.

3.1 Filling the Pump

1. Clean the Area around the filler cap to remove all dust and grit. Grit and dust will damage components in the pump and tools.
2. Remove the filler cap and insert a clean funnel and filter. Fill with hydraulic oil, watching the oil level indicator on the pump.
3. Replace the filler cap
4. Cycle the pump (with wrench attached) several times. Retract the wrench(s), and check the oil level in the pump reservoir again.

3.2 Hydraulic Connections

1. Never disconnect the hoses without first releasing the pressure from the system.
2. Unplug the power cord and open all hydraulic controls to ensure that the tool is not pressurized. Make sure the gauge reads 0 (zero) to assure pressure has been released.
3. Screw the coupler to the nipple and tighten by hand.

3.3 Connecting the Electric Power

1. Check for the proper electrical power before you get started.
2. Locate the specification plate on the pump to ensure the proper electrical connection. Having the proper current will protect against dangerous overloading and motor burnout. See Figure 11 for location of specification plate.

DO NOT OPERATE IN VOLATILE OR EXPLOSIVE ATMOSPHERES OR IN THE PRESENCE OF COMBUSTIVE OR FLAMMABLE LIQUIDS!

3.4 Priming the Pump

When operating the pump for the first time:

1. Valve and hose connections must be tight and the reservoir must be filled to the proper oil level. Start the motor.
2. Cycle the pump several times to build pressure. If the pump doesn't build pressure, it may not be primed. Disconnect a hose from the system and route it back to the pump reservoir. Run the pump till a steady flow of oil is observed free of suspended air bubbles. Reconnect the hose to the system.
3. Run wrench several times to eliminate air from the system. For more complete instructions, refer to the section titled "Bleeding Air from the System".
4. The pump is ready for regular operation.

IMPORTANT: After eliminating trapped air from a large work-holding system, retract the wrenches and refill the pump to the appropriate level. This is especially important when using a large tool(s) or long hose(s).

3.5 Bleeding Air from the System

Air may accumulate in the hydraulic system if the reservoir oil level is too low. This causes the wrench to respond in an unstable or slow manner. To remove air from system:

1. Plug in the pressure return line into the pump and connect the other side of the hose to the male-female quick connect.
2. Run the pump for at least 5 minutes through several cycles.



3.6 Operating the Pump

1. Before powering your pump, connect hoses to both the pump and the wrench.
2. Place the on/off toggle switch (Figure 11) to the on position and the rocker switch on the control pendant to the OFF position.
3. Push the rocker switch to advance and release. This will start your pump and place the piston in the retract position.
4. Your titan pump is equipped with an auto shut off system. The pump will shut off after approximately 30 seconds of non-cycling. This is necessary to prevent your pump from overheating and contribute to a longer life of the pump. To restart simply push the reset switch and then advance the pump.

3.7 Pump Preventative Maintenance

Following these simple procedures can extend the service life of your pump.

- Coupling Maintenance - Couplings should be checked periodically for wear. Keep all dirt and debris out of the couplings. Inspect O-rings for cuts and abrasion and replace as necessary.
- Hydraulic Oil – Check hydraulic oil before each use. Keep hydraulic oil clean, 75-80% of hydraulic component failures are due to dirty hydraulic oil. If dirt, grit, metal shavings, or any other debris is present in the oil, replace immediately. Hydraulic oil should be changed every 40 hours of operation. Use Titan hydraulic oil for best results.
- Pump Filter - Filters should be changed at least twice a year under normal use. Dirty environments may require more frequent changes.
- Hydraulic Gauge - Gauges are liquid filled. If the liquid level drops or becomes filled with hydraulic oil, discontinue use and replace gauge. Gauges should be calibrated periodically. Contact Titan to have your gauge calibrated.
- Control Pendant - Rocker switches on electrical pumps should be checked for signs of wear and replaced if necessary. Titan Air Pump pendants should be checked for leaks, kinks or any other obstructions.
- Hydraulic and Pneumatic hoses – Check hoses for signs of cuts, kinks, or other damage, if damage is present, destroy the hose and replace.
- Air Valve - The air valve should be checked at least 2 times a year under normal use.
- Brushes and Brush Holders - Check and replace if worn.

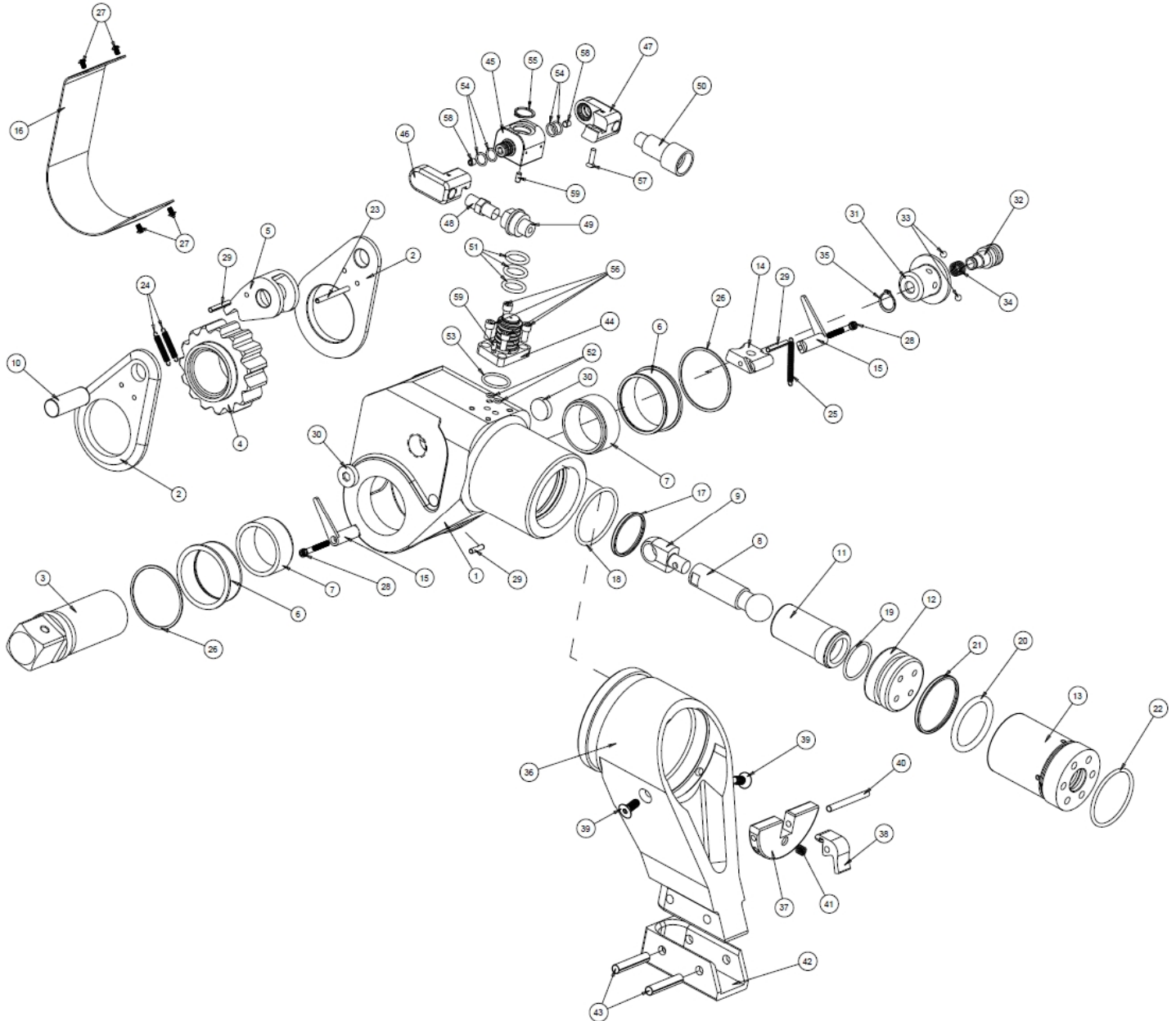
Trouble Shooting Guide

Problem	Probable Cause	Solution
Tool will not advance	1. Coupling not secure	1. Secure coupling
	2. Damaged coupling	2. Replace coupling
Tool will not retract	See above	See above
Tool cannot be removed	1. Reaction pawl is engaged	1. See Section 2.8
	2. Piston did not retract	2. Check couplings as described above
Tool will not build pressure	Gauge is not secured	Secure couplings on gauge
Tool leaks oil	Damaged seal(s) in tool	Replace seal(s)
Ratchet returns on retract stroke	Missing or broken reaction pawl and/or reaction pawl spring	Replace reaction pawl and/or reaction pawl spring
Tool will not cycle	1. Loose or defective coupling	1. Secure coupling
	2. Cycling tool too quickly	2. See Section 2.8
No pressure reading on gauge	1. Defective Gauge	1. Replace gauge
	2. Loose coupling	2. Secure coupling
Pump will not build pressure	1. Inadequate power supply	1. Use proper power source according to motor specification plate (plate location shown in Figure 11)
	2. Pump starved for air	2. Use minimum 1" diameter air hose attached to 100 psi/50cfm air source
	3. Defective gauge	3. Replace
	4. Dirty oil	4. Clean reservoir and replace oil
	5. Clogged oil filter	5. Replace filter
	6. Clogged FLR	6. Clean or replace FLR
Air pump sluggish	1. Pump starved for air	1. Use minimum 1" diameter air hose attached to 100 psi/50cfm air source
	2. Dirt in air motor	2. Flush motor with solvent, clean, dry and lubricate
Air motor frozen	1. FLR is missing or broken	1. Replace FLR
	2. Obstruction in Air valve	2. Inspect and clean
	3. Remote control hoses installed incorrectly	3. Install hoses correctly
	4. Defective remote control hoses	4. Replace
	5. Defective buttons	5. Replace
Socket pops off nut	Improper reaction	See Section 2.7



ITEM	DESCRIPTION	QTY	T1	T3	T5	T8	T10	T25	
1	HOUSING	1	T1-01	T3-01	T5-01	T8-01	T10-01	T25-01	
2	DRIVE PLATE	2	T1-04	T3-04	T5-04	T8-04	T10-04	T25-04	
3	SQUARE DRIVE	1	T1-05	T3-05	T5-05	T8-05	T10-05	T25-05	
4	RATCHET	1	T1-06	T3-06	T5-06	T8-06	T10-06	T25-06	
5	DRIVE PAWL	1	T1-63	T3-63	T5-63	T8-63	T10-63	T25-63	
6	DRIVE SLEEVE	2	T1-07	T3-07	T5-07	T8-07	T10-07	T25-07	
7	DRIVE BUSHING	2	T1-08	T3-08	T5-08	T8-08	T10-08	T25-08	
8	PISTON ROD	1	T1-29	T3-29	T5-29	T8-29	T10-29	T25-29	
9	ROD END CONNECTOR	1	T1-17	T3-17	T5-17	T8-17	T10-17	T25-17	
10	DRIVE PIN	1	T1-19	T3-19	T5-19	T8-19	T10-19	T25-19	
11	PISTON SLEEVE	1	T1-24	T3-24	T5-24	T8-24	T10-24	T25-24	
12	PISTON	1	T1-25	T3-25	T5-25	T8-25	T10-25	T25-25	
13	END CAP	1	T1-26	T3-26	T5-26	T8-26	T10-26	T25-26	
14	REACTION PAWL	1	T1-10	T3-10	T5-10	T8-10	T10-10	T25-10	
15	REACTION PAWL LEVER	2	T1-15	T3-15	T5-15	T8-15	T10-15	T25-15	
16	SHROUD	1	T1-31	T3-31	T5-31	T8-31	T10-31	T25-31	
17	LIP SEAL	1	T1-01-N	T3-01-N	T5-01-N	T8-01-N	T10-01-N	T25-01-N	
18	HOUSING/END CAP O-RING	1	T1-01-027	T3-01-031	T5-01-034	T8-01-142	T10-01-146	T25-01-238	
19	PISTON/PISTON SLEEVE O-RING	1	T1-25-018	T3-25-022	T5-25-025	T8-25-126	T10-25-128	T25-25-138	
20	PISTON/END CAP O-RING	1	T3/25-70-120	T3-25-219	T5-25-223	T8-25-327	T10-25-329	T25-25-233	
21	PISTON LIP SEAL	1	N/A						T25-25-N
22	END CAP/HOUSING O-RING	1	T1-26-122	T3-26-129	T5-26-135	T8-26-135	T10-26-143	T25-26-338	
23	DRIVE PLATES ROLL PIN	1	T1-13	T3-13	T5-13	T8-13	T10-13	T25-13	
24	DRIVE PAWL SPRING	2	T1-27	T3-27	T5-27	T8-27	T10-27	T25-27	
25	REACTION PAWL SPRING	1	T1-18	T3-18	T5-18	T8-18	T10-18	T25-18	
26	DRIVE BUSHING SNAP RING	2	T1-30	T3-30	T5-30	T8-30	T10-30	T25-30	
27	SHROUD SCREW	4	T1-32	T3-32	T5-32	T8-32	T10-32	T25-32	
28	LEVER SCREW	2	T1-39	T3-39	T5-39	T8-39	T10-39	T25-39	
29	DRIVE/REACTION PAWL ROLL PIN	3	T1-40	T3-40	T5-40	T8-40	T10-40	T25-40	
30	HOUSING CAP	2	T1-85	T3/5-85		T8-85	T10-85	T25-85	
31	DRIVE RETAINER BODY	1	T1-11	T3-11	T5-11	T8-11	T10-11	T25-11	
32	DRIVE RETAINER PUSH-LOCK	1	T1-12	T3/8-12			T10/25-12		
33	DRIVE RETAINER BALL BEARING	3	T1-12B	T3/8-12B			T10/25-12B		
34	DRIVE RETAINER SPRING	1	T1-12C	T3/8-12C			T10/25-12C		
35	DRIVE RETAINER SNAP RING	1	T1-12D	T3/8-12D			T10/25-12D		
36	REACTION ARM	1	T1-03	T3-03	T5-03	T8-03	T10-03	T25-03	
37	REACTION ARM PLATE	1	T1-36	T3-36	T5-36	T8-36	T10-36	T25-36	
38	REACTION ARM LEVER	1	T1/3-28		T5/10-28			T25-28	
39	REACTION ARM SCREW	2	T1-37	T3-37	T5/25-37				
40	REACTION ARM LEVER PIN	1	T1-45	T3-45	T5-45	T8/10-45		T25-45	
41	REACTION ARM LEVER SPRING	1	T1/3-38		T5/10-38			T25-38	
42	REACTION ARM BOOT	1	T1-43	T3-43	T5-43	T8-43	T10-43	T25-43	
43	REACTION ARM BOOT PIN	2	T1-44	T3-44	T5-44	T8-44	T10-44	T25-44	
44	SWIVEL POST	1	T1-70	T3/25-70					
45	SWIVEL BODY	1	T1-71	T3/25-71					
46	ACTUATE MANIFOLD	1	T1-72	T3/25-72					
47	RETRACT MANIFOLD	1	T1-73	T3/25-73					
48	ACTUATE MANIFOLD COUPLING	1	090103	090101					

49	ACTUATE MANIFOLD QD	1	090155	
50	RETRACT MANIFOLD QD	1	090156-1	090156
51	SWIVEL HOUSING/POST O-RING	3	T1-70-014	T3/25-70-210
52	SWIVEL POST/HOUSING SMALL O-RING	2	T1-70-006	T3/25-70-010
53	SWIVEL POST/HOUSING LARGE O-RING	1	N/A	T3/25-70-120
54	SWIVEL BODY O-RING	4		T1/25-71-013
55	SWIVEL SNAP RING	1	T1-74	T3/25-74
56	SWIVEL POST SCREW	4	T1-75	T3/25-75
57	SWIVEL MANIFOLD SCREW	1	T1-76	T3/25-76
58	HEX PLUG	2		T1/25-80
59	SWIVEL DOWEL PIN	2	T1-81	T3/25-81



9001 Jameel Rd. Suite 180 | Houston, TX 77040
Toll-Free + 1.866.345.8484 **Phone** + 1.281.449.9994 **Fax** + 1.281.449.9996

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