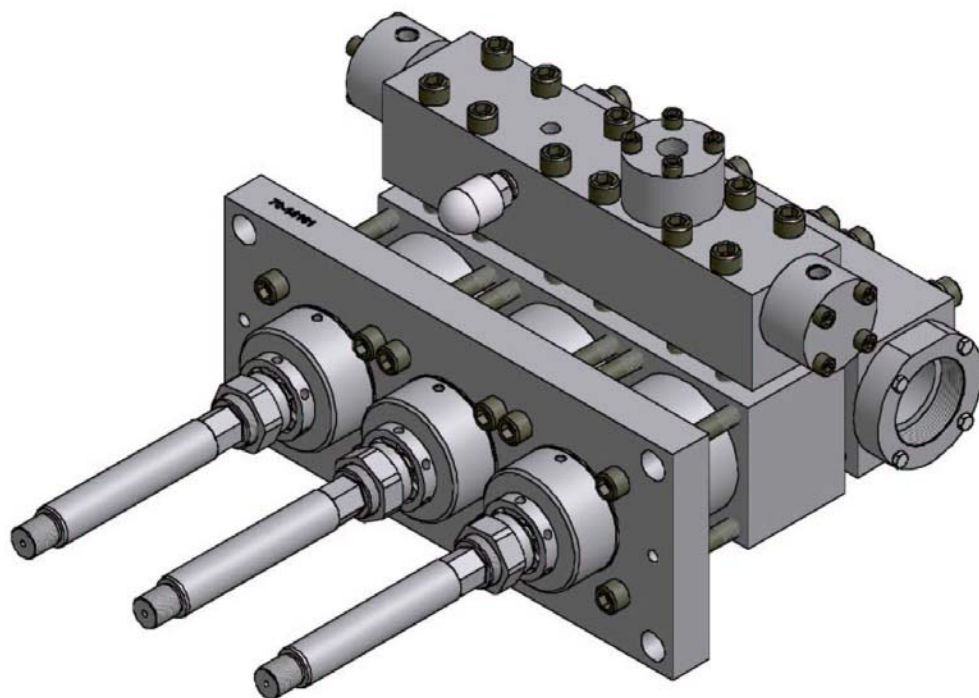




Instruction & Operation Manual



TY-375S Fluid End Assembly

9801014
Rev. – A
June 2006

HOW TO CONTACT:

If you need additional information about your high pressure pump fluid assembly that is not included in this manual, please contact customer service at:

Gardner Denver Water Jetting Systems, Inc.

12300 North Houston-Rosslyn Rd
Houston, Texas 77086

Phone: 281 448-5800

Toll Free: 800 231-3628

Fax: 281 448-7500

E-mail:

sales@gardnerdenver.com

Additional copies of this manual may be obtained from customer service.

GENERAL INTRODUCTION:

This manual covers the Triplex TY-375S Fluid End Assembly which is mounted on the TY-375 Power End.

This manual must be supplemented by other manuals and training materials to ensure that all operators sufficiently understand how to use this high pressure equipment safely.

Consult the power end manual for maintenance, disassembly, assembly, troubleshooting and recommended spare parts.

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Gardner Denver
Water Jetting Systems, Inc.
Houston, TX USA

**GENERAL SAFETY
INSTRUCTIONS:**

- All high velocity water jets can be extremely dangerous to personnel. This potential hazard is magnified with introduction of abrasive materials into the water stream. All personnel operating this equipment should be properly trained and familiar with all safety and operational procedures furnished with the high-pressure unit used in conjunction with this equipment. A thorough understanding of "Recommended Practices for the Use of Manually Operated High Pressure Water Jetting Equipment" by the Water Jet Technology Association is required.

- Never permit untrained personnel to operate this equipment.

- All personnel must be trained in safe operation of water jetting equipment.

- Erect barricades or warning signs around work area.

- Water jet lacerations can induce air and bacteria into the blood stream. Seek immediate medical attention.

- Wear appropriate personal protective equipment including rain suit, face shield, gloves, safety glasses with side shields, and hearing protection.

- Never aim the water jet at your body or others.

- Do not use damaged or leaking fittings.

- Inspect hoses and nozzles for leaks, obstructions or other damage before every use. Do not use if damaged.

- Keep work areas clean and well lit.

- Clean all water jetting equipment parts after each use.

- Do not use water jetting equipment in pressure ranges outside of maximum allowable working pressure (MAWP). Consult manuals for proper use.

- Do not modify or alter factory shipped equipment. Use only genuine Gardner Denver replacement parts. Warranties will not apply to equipment, which has been modified or subjected to improper handling, installation, operation or inadequate maintenance by customer. Consult warranty information provided by GDWJSI.

- Without limitation, GDWJSI shall not be held liable in any event for any claims arising from the misuse of any Gardner Denver equipment.

- Failure to follow the rules listed on this page and in the Water Jetting Technology Association Recommended Practices Manual may result in property damage and bodily injury or death.

**Water Jet Technology
Association**

Copies of "Recommended Practices for the Use of Manually Operated High Pressure Water Jetting Equipment may be ordered directly from GDWJSI or the WJTA

917 Locust Street, Suite 1100,
St. Louis, MO 63101-1419,
telephone: (314) 241-1445,
fax: (314) 241-1449, email:
wjta@wjta.org

RECEIVING, INSPECTION AND STORAGE

The fluid end assembly is shipped on a heavy-duty wood pallet to prevent damage during shipping. It should be similarly protected during subsequent handling and storage. Always keep all ports plugged to prevent intrusion of foreign materials. All fluid end assemblies are shipped with an ethylene glycol – water solution to protect the cylinder against freezing. Each assembly is tested prior to shipment to verify function and water is trapped in the internal ports of the manifolds, cylinders and stuffing boxes. Ethylene glycol is added and the pump operated briefly to mix a solution that will not freeze at temperatures down to 0° F.

When you receive a fluid end assembly, it should immediately be inspected visually. If there are indications of physical damage, report this to the carrier.

The fluid end assembly should be left on the pallet until it is to be mounted on the pump or unit. It should be handled by one of the following means:

- Overhead crane with slings hung around the stuffing boxes in front of the adapter plate.
- Tow Motor with forks extended from the front of the suction manifold to the adapting plate.

It should be stored in a clean environment until it is to be mounted on the pump. If it is to be stored for an extended period of time, check with the factory for recommendations.

INSTALLATION

The fluid cylinder assembly covered in this manual is designed to be mounted on the TY-375 Power End assembly.

WARNING:

The fluid end assembly must be properly mounted on the pump power end assembly. There are four mounting studs. Refer to the power end assembly for the torque requirements. These should be tightened in steps to ensure uniform loading.

Any high pressure leakage shall be repaired immediately. Damage to components may be severe if the leakage is not repaired immediately.

NOTE – do NOT tighten high pressure system components until all pressure has been dumped.

Fluid End Assembly

Weight: 675 Lbs. (Est.)

Water Requirements:

Supply:

40 - 150 PSIG

Suction Hose:

3" ID (minimum)

Filtration:

100 micron (recommended)

Suction Accumulator:

Nitrogen charged accumulator is recommended; pre-charge pressure should be 30 – 40% of supply pressure.

Note: If water supply is pressurized, it is not necessary to connect suction piping to both sides of the suction manifold.

Introduction:

The TY-375S Fluid End Assembly is designed to accept four different plunger sizes. The table below lists the pressure and flow rates delivered by each of the plunger options when the fluid end is used with the TY375 Power end at 515 RPM.

It is a sectional design that consists of three individual fluid cylinders with common suction and discharge manifolds.

Fluid End Disassembly

Remove the suction and discharge piping from both manifolds. Loosen the socket head cap screws that retain the manifolds. In the case of the suction manifold, it must be supported before the last screws are removed. Do not set the suction manifold down on the side that seals against the suction valve seats. This will prevent scratching or other damage to the sealing area which could cause leaks in operation.

The suction and discharge valve assemblies are identical. The cage can be unscrewed; it should be hand tight. Inspect the valve seat area, which is coated with an elastomer material; if there is evidence of wear, erosion, or pitting, it is recommended that the assembly be replaced. **Remember to keep the valve assembly components as matched sets.**

Table 1: Plunger Groups

Pump Model	TY-375 S	
Assy. Drawing	D-70-14160	
Plunger Size	Pressure (PSI)	Flow Rate (GPM)
1.063"	15,000	22.2
1.250"	15,000	30.8
1.563"	10,000	48.1
1.750"	8,000	60.3

Note: Flow capacity is based on 100% Volumetric Efficiency. Nominal power required = 300 BHP for 1.25", 1.56" & 1.75" plungers.

Unless there is evidence of leaking between the manifolds and the piping adapter flanges, it is not necessary to remove the flanges. They utilize an O-Ring seal between the flange and manifold which will need periodic replacement.

Use the valve seat removal tool to remove the suction valve assemblies from the cylinder block.

The discharge valve assembly can be lifted out of the counter-bore in the top of the fluid cylinder when the manifold has been removed. Remove all three valve assemblies.

Inspect the O-Rings on the seat OD and the bottom of the seat. Replace if they show signs of wear, extrusion, swelling or other form of damage.

WARNING

The pressurized components of this fluid end assembly must be protected against over-pressure by an appropriately sized safety relief valve(s) and rupture disc assembly. If your fluid end is not equipped with these devices please consult the factory for recommendations.

The safety head (rupture disc) is normally set at 150% of the working pressure and relief valve at 115 – 120% above the working pressure.

Check the valve springs; replace if cracked, broken or if they show signs of wear on either the ID or OD. Also look for signs of wear on the valve guides. This can occur on the stem bore or on the outside where the spring rides. Replace as needed.

The valve assembly is sold as a set; it is more economical to replace than purchasing the individual components that make up the assembly.

It is not necessary to remove the stuffing boxes for replacement of packing, plungers or normal maintenance.

All parts should be laid out on a clean work bench in the same orientation that they were removed from the pump. Clean all threaded ports and mating surfaces and inspect for signs of corrosion, wear or other damage.

Packing and Plunger Removal Procedure

Loosen the collet nut; in most cases, a half turn is sufficient. If it has become corroded, the collet nut may have to be completely unscrewed.

It is good practice to turn the crankshaft manually so that the plunger adapter will move all the way away from the fluid cylinder. Rotate the crankshaft (belt drive, U-Joint, coupler, etc.) at least one revolution. The plunger adapter will usually release the plunger at the top dead center position so the gland nut can be unscrewed and removed from the stuffing box.

Push the plunger forward through the bushings toward the front of the cylinder. Pull the plunger and remove it from the front. Use caution to avoid scratching either the sealing surface or where it locks in the collet nut & bushing.

Using a wood or plastic rod approx. 2.25" in diameter, push the throat bushing from the front to the rear. This will push the spring, front packing ring, packing set, back packing ring and lantern ring out of the cylinder.

It is recommended that the back packing ring should always be replaced at the same time as the packing set. This will ensure optimal packing life.

Assembly

Before starting to reassemble the fluid end, threaded connections should be coated with an anti-seize lubricant. All 'O'-rings should be lubricated with silicone grease.

The recommended sequence of installation steps is:

- Packing/Brass components in stuffing box
- Plungers
- Discharge Valves & Manifold
- Suction Valves & Manifold

Packing and Plunger Installation Procedure

Lubricate the packing by dipping in light machine oil. Do not use silicon grease to lubricate packing and plungers. Use silicon grease to lubricate 'O'-rings and any other static seals.

Install the throat bushings, packing spring, the front packing rings, the packing, back packing ring, second throat bushing and finally the lantern ring in the stuffing box. Install the gland nuts, but do not tighten. Insert the plungers from the front of the fluid end and through the bushings into the plunger adapter collet. It is very important to know that the plungers are seated properly against the plunger adapter in the collet nut. Tighten the collet nut firmly.

Finally tighten the gland nuts

Discharge Valves & Manifold Installation Procedure

Lay the discharge manifold on its' side and insert the discharge valves into the bore. The friction between the lightly lubricated O-Rings and the manifold bore should be sufficient to hold the seats in place. Using a crane or other lifting device and the eye bolt supplied in the manifold, carefully rotate it into the orientation it will be installed on the fluid cylinder. Set the assembly down so that the valve seats engage into the counterbore of each fluid cylinder.

Note that the rupture disc port should be located at the back of the manifold (closest to the power frame).

Torque the socket head capscrews (SHCS) that mount the manifold to the individual fluid cylinders. Start at the middle and work outward. Torque according to the specifications in Table 2 on page 12. Tighten them in at least three increments to avoid distorting the manifold.

Suction Valves & Manifold Installation Procedure

After lubricating the O-Rings on the suction valves, insert them into the individual fluid cylinder bores. They shoulder against the front face of each cylinder, which results in a gap between the manifold and the fluid cylinders.

Use a crane or other lifting device to support the manifold; align it with the fluid cylinder hole pattern and insert a SHCS in the four outside mounting holes. Tighten them by hand sufficiently to pull the manifold snugly against the valve seats. Install the balance of the SHCS's and torque them according to the specifications in Table 2 on page 12. Tighten these in at least three steps to avoid distorting the manifold.

Note that for normal maintenance it is not necessary to remove the stuffing boxes or fluid cylinders from the adapting plate. In the event that this is required, note that the stuffing boxes must be installed with the lubrication port located on top.

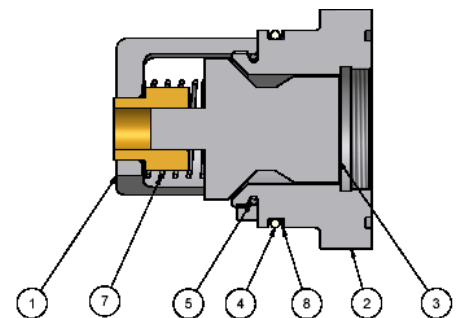


Fig. 1 Valve Assembly Suction & Discharge

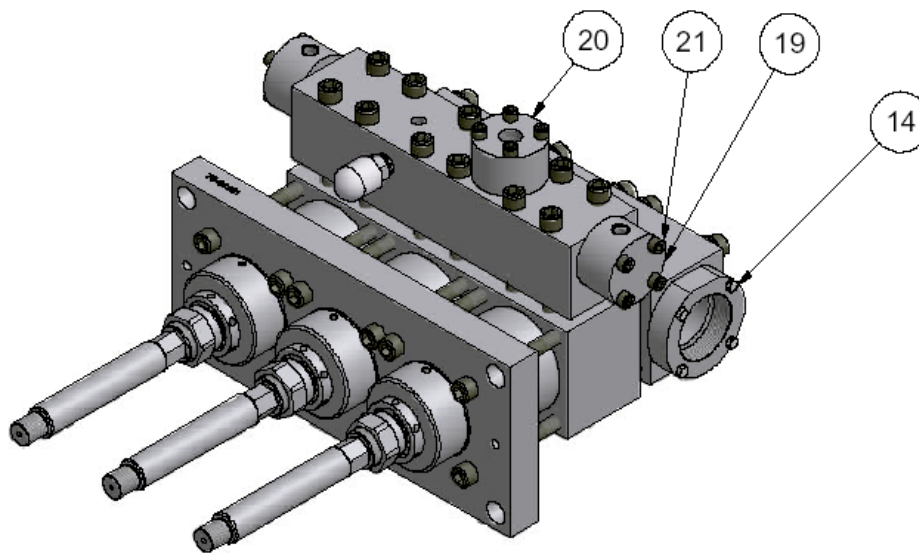


FIG. 2 DISCHARGE & SUCTION FLANGE LOCATION ON FLUID END ASSEMBLY

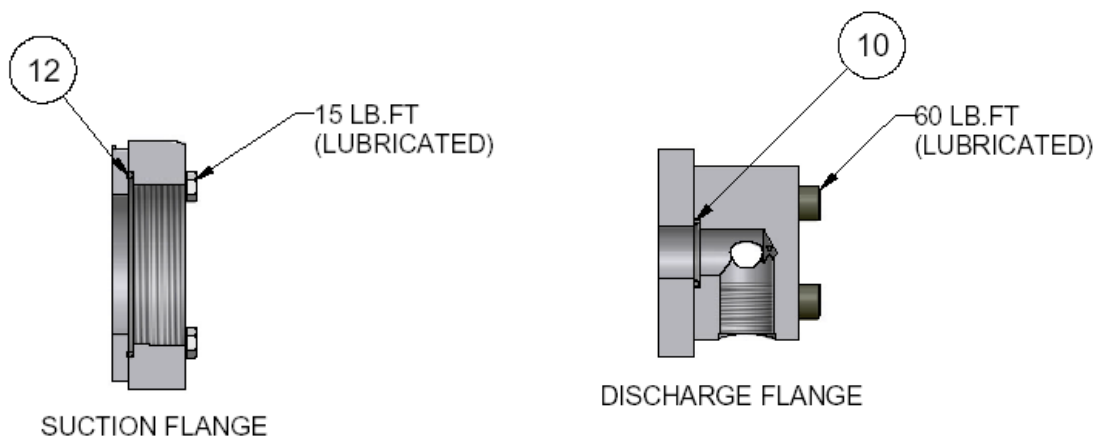


FIG. 3 DISCHARGE & SUCTION FLANGE INSTALLATION

Installation of Suction & Discharge Flanges:

1. Lubricate and insert the O-ring into the discharge flange, use the four screws with each adapter and attach them to the discharge manifold. Torque as indicated below; reference Table 2 on page 13.
2. Lubricate and insert the O-ring into the suction flange, use four screws with each adapter and attach them to the suction manifold. Torque as indicated above; reference Table 2 on page 13.
3. Install the rupture disk in the discharge manifold. Tighten the safety head body firmly against the rupture disk and then install the safety head cap in the port located in the back of the discharge manifold.

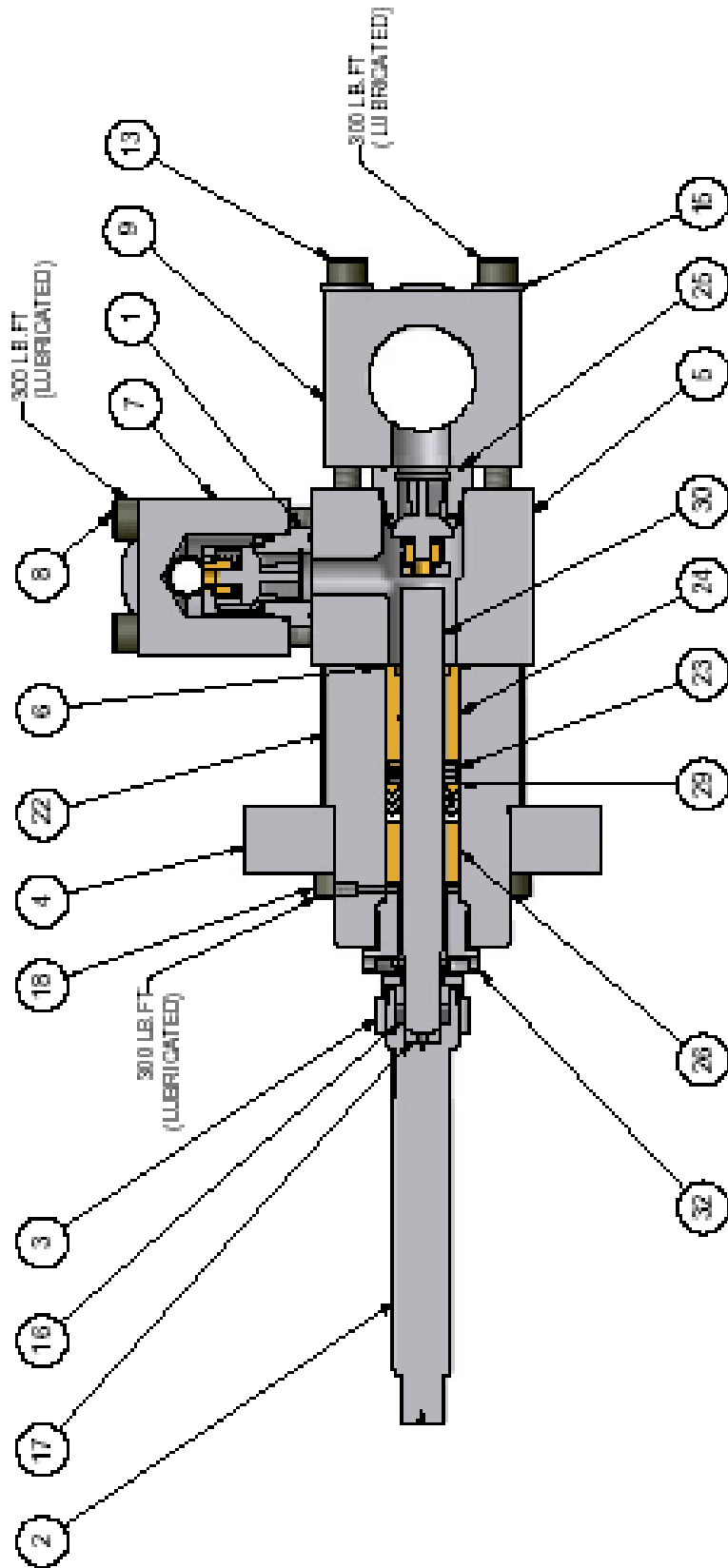


FIG. 4
TY-375S TRIPLEX
PUMP FLUID END
ASSEMBLY

BASIC FLUID END KIT - PARTS LIST

ITEM	QTY	P/N	DESCRIPTION
0	0	7014160	KIT, TY-375S FLUID END
1	6	7014156	VALVE, ASSY. TY-375S SUCTION & DISCHARGE
2	3	7014164	ADAPTER, PLUNGER, TY-375S
3	3	7014184	NUT ASSEMBLY, COLLET, TY-375S
4	1	7014161	ADAPTING PLATE, TY-375S
5	1	7014166	CYLINDER, FLUID, TY-375S
6	3	2280120	O-RING, 2 1/2, 228-90
7	1	7014159	MANIFOLD, DISCHARGE, TY-375S
8	12	1614152	SCREW, SHC, 3/4-16 X 5 3/4
9	1	7014153	MANIFOLD, SUCTION, TY-375S
10	3	2274207	O-RING, 1-1/2, 2-218-90
11	2	7080118001	FLANGE, S.S., SUCTION MANIFOLD, 3 NPT
12	2	2280179	O-RING, 4, 2-240-70,
13	12	1614151	SCREW, SHC, 3/4-16 X 6 1/2
14	8	1640002	BOLT, HEX HD, 3/8-16 1 3/4 #5
15	12	1620101	WASHER, SERIES N, TYPE A, 3/4
16	3	7014181	SOFT BUSHING, COLLET, TY-375S
17	3	7014163	SUPPORT, PLUNGER, TY-375S, 1 IN SHANK
18	12	1614154	SCREW, SHC, 3/4-16 X 7
19	1	7078604005	ADAPTER, MANIFOLD, 1 NPT AT 90 DEG.
20	2	7078604006	FLANGE STRAIGHT 1 NPT, 90 ELL 1/2 NPT
21	12	1608205	SCREW, SHC, 1/2-13 X 3
22	3	7014162	STUFFING BOX, TY-375S
23	3	2514160	SPRING, PACKING, TY-375S, 2.11 OD X 1.31 FL
25	6	2274217	O-RING, 2-3/8, 2-139-90
33	1	1214160	VALVE REMOVAL TOOL, TY-375S

PLUNGER KITS - PARTS LIST

Item	QTY	Part No.	Description
0	0	7014160300	TY-375S FLUID END, 1 1/4 PLUNGERS, 15K
23	3	2514160	SPRING, PACKING, TY-375S, 2.11 OD X 1.31 FL
24	3	7014177001	BUSHING, THROAT, TY-375S, 1 1/4 PLUNGER
26	3	7014178001	RING, BACK PACKING, TY-375S, 1 1/4 PLUNGER
29	3	7014179001	RING, FRONT PACKING, TY-375S, 1 1/4 PLUNGER
30	3	7014165031	PLUNGER, 1 1/4, TUNGSTEN CARBIDE, TY-375S
31	3	2214165011	PACKING, TY-375S, 1 1/4 X 2 1/8 (W,B,W)
32	3	7014176001	NUT, GLAND, TY-375S, 1 1/4 PLUNGER

Item	QTY	Part No.	Description
0	0	7014160400	TY-375S FLUID END, 1 1/16 PLUNGERS, 15K
23	3	2514164	SPRING, PACKING, TY-375S, 2.11 OD, 80#
24	3	7014177004	BUSHING, THROAT, TY-375S, 1 1/16 PLUNGER
26	3	7014178004	RING, BACK PACKING, TY-375S, 1 1/16 PLUNGER
29	3	7014179004	RING, FRONT PACKING, TY-375S, 1 1/16 PLUNGER
30	3	7014165034	PLUNGER, 1 1/16, TUNGSTEN CARBIDE, TY-375S
31	3	2214165014	PACKING, TY-375S, 1 1/16 X 2 1/8 (W,B,W)
32	3	7014176001	NUT, GLAND, TY-375S, 1 1/4 PLUNGER

Item	QTY	Part No.	Description
0	0	7014160500	TY-375S FLUID END 1 9/16 PLUNGERS 10K
23	3	2514160	SPRING, PACKING, TY-375S, 2.11 OD X 1.31 FL
24	3	7014177002	BUSHING THROAT TY-375S 1 9/16 PLUNGER
26	3	7014178002	RING BACK PACKING TY-375S 1 9/16 PLUNGER
29	3	7014179002	RING FRONT PACKING TY-375S 1 9/16 PLUNGER
30	3	7014165050	PLUNGER 1 9/16 COLMONOY TY-375S
31	3	2214165002	PACKING TY-375S 1 9/16 X 2 1/8
32	3	7014176002	NUT GLAND TY-375S, 1 1/2 TO 1 3/4 PLUNGER

Item	QTY	Part No.	Description
0	0	7014160700	TY-375S FLUID END 1 3/4 PLUNGERS 10K
23	3	2514160	SPRING, PACKING, TY-375S, 2.11 OD X 1.31 FL
24	3	7014177003	BUSHING THROAT TY-375S 1 3/4 PLUNGER
26	3	7014178003	RING BACK PACKING TY-375S 1 3/4 PLUNGER
29	3	7014179003	RING, FRONT PACKING, TY-375S, 1 3/4 PLUNGER
30	3	7014165070	PLUNGER, 1 3/4, COLMONOY, TY-375S
31	3	2214157004	SET, PACKING, 2 1/8 X 1 3/4, TY-375S
32	3	7014176002	NUT GLAND TY-375S, 1 1/2 TO 1 3/4 PLUNGER

TABLE 2: TORQUE SPECIFICATIONS: FLUID END ASSEMBLY (LUBRICATED)				
QTY.	ITEM	DESCRIPTION	THREAD SIZE	TORQUE
12	13	SHCS – SUCTION MANIFOLD & FLUID CYLINDER	3/4"-16 UNF	300 FT. LBS.
12	8	SHCS – DISCHARGE MANIFOLD & FLUID CYLINDER	3/4"-16 UNF	300 FT. LBS.
12	18	SHCS – STUFFING BOX & ADAPTING PLATE	3/4"-16 UNF	300 FT. LBS.
8	14	HHCS – SUCTION FLANGE & SUCTION MANIFOLD	3/8"-16 UNC	15 FT. LBS.
12	21	SHCS – DISCHARGE FLANGE & DISCHARGE MANIFOLD	1/2"-13 UNC	60 FT. LBS.

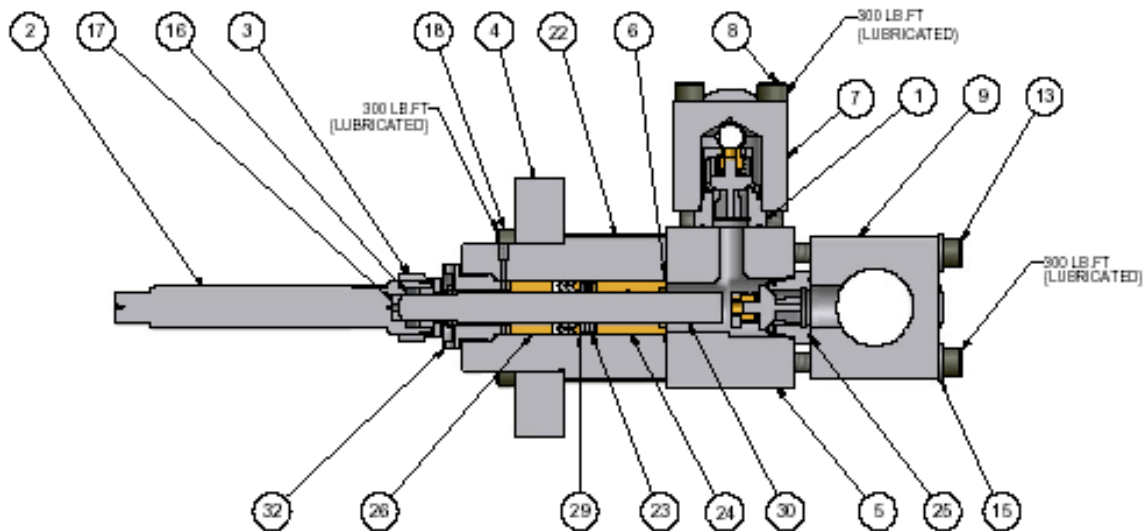


Fig. 5 – Fluid End Assembly Torque Specifications

Note: All torque specifications assume lubricated fasteners

RECOMMENDED SPARE PARTS:

ITEM	QTY.	PART NO.	DESCRIPTION
30	3	See Note 1	PLUNGER
24	6	See Note 1	BUSHING, THROAT
31	3	See Note 1	PACKING SET
23	3	See Note 1	PACKING SPRING
29	5	See Note 1	RING, FRONT PACKING
25	6	2233031	O-RING VALVE SEAT – FACE
N.S.	6	2280205	O-RING VALVE SEAT - OD
N.S.	6	2214167	BACK-UP RING VALVE SEAT - OD
N.S.	6	2214156004	O-RING CAGE I.D.
6	3	2280120	O-RING STUFFING BOX
12	2	2280179	O-RING SUCTION FLANGE
10	3	2274207	O-RING DISCHARGE FLANGE

Note:

1. Locate the specific plunger group kit for the component part numbers. These are listed in the tables on page 10.
2. Refer to the assembly drawings on page 6 and 8 to locate parts.

ABBREVIATIONS:

ABBREVIATION	DESCRIPTION
GDWJSI	GARDNER DENVER WATER JETTING SYSTEMS INC.
HHCS	HEX HEAD CAPSCREW
I.R.	INITIAL RELEASE
MAWP	MAXIMUM ALLOWABLE WORKING PRESSURE
NPT	NATIONAL TAPER PIPE THREAD
NS	NOT SHOWN
PE	POWER END ASSEMBLY
PSI	POUNDS PER SQUARE INCH
SHCS	SOCKET HEAD CAPSCREW
WJTA	WATER JET TECHNOLOGY ASSOCIATION

TROUBLESHOOTING GUIDE

PROBLEM	INSPECTION	SUGGESTED CORRECTIVE ACTION (see notes below)
Fluid End or Power End Knocking - Cavitation This can be caused by any of the following: <ul style="list-style-type: none"> Inadequate suction supply pressure, Inadequate supply hose size Air trapped in the fluid end assembly Broken or weak valve springs. 	Audible sound	<ul style="list-style-type: none"> Follow the Pump Cavitation Warning label on the unit; a minimum 40 PSIG supply pressure is required for this pump. Supply hose must be at least 3" ID Open the flow control valve completely if the pump is so equipped to remove all air Replace weak or broken valve springs on both suction & discharge ports. (See notes below)
Low Capacity – Pump Speed	Low Pressure observed on gauge	Check pump speed; verify pump is operating at the rated RPM.
Low Capacity – Valve Leakage	Low Pressure observed on gauge	Replace Valve Assembly
Low Capacity – Packing Leakage	Excessive water flow thru gland nut	Replace packing set
Short Packing Life – Water Quality	Premature packing failure	Replace filter bags with correct micron rating.
Short Packing Life – Worn Plunger(s)	Premature packing failure	Replace plunger(s)
Short Packing Life – Worn Packing Bushing(s)	Premature packing failure	Replace throat bushing(s) and/or back packing ring(s)
Fasteners improperly tightened	Leakage between manifold & valve seat	Loosen all fasteners holding the suction manifold and re-torque following assembly instructions on page 6.
Worn or damaged O-Ring(s)	Leakage between manifold & valve seat	Replace O-Rings on valve seat face and OD.
Broken stud or capscrew	Visual	Replace and torque per guidelines in Table 2.

Notes: To determine if the knocking sound is coming from the power end or fluid end of the pump, it may be necessary to temporarily disconnect the plungers from the plunger adapter.

- Carefully push the plungers forward into the fluid cylinder until they reach a mechanical stop; do not force them.
- Remove collet nuts and bushings from the plunger adapter. Momentarily start the driver and immediately turn it off to verify that the pump will rotate through a complete stroke without hitting the plungers.
- If the sound continues with the fluid end disconnected, the problem is in the power end. Check the power end manual for troubleshooting instructions.

GENERAL MAINTENANCE

Maintenance Overview:

Both the fluid and power end assemblies of this pump are manufactured from precision-machined components. A preventative maintenance program is essential to ensure that the pump continues to operate properly over an extended period of time.

Some of the following environmental categories will require special or more frequent maintenance:

- Offshore platforms, salt water or corrosive environments such as chemical plants.
- Dusty environments such as construction sites; mining operations or plants that process grains, pellets, ground materials or fibrous products.
- Climates where the pump will be exposed to freezing temperatures.

It is very helpful to record maintenance work performed on your pump. It will allow tracking of component life and help you establish a preventative maintenance program that will avoid unscheduled downtime. A sample maintenance log is included in this manual for your use. It may be copied or modified for your specific requirements.

The maintenance schedule should be based on the hour-meter reading on either the engine or motor that drives the pump.

Corrosive Environments:

Efforts to minimize the contamination of the power end lubricant from corrosive vapors and high humidity

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should be made. If this can't be accomplished by appropriate ventilation, the oil change interval must be reduced. If the power end oil is observed to be milky or there is water accumulating, the oil should be changed.

If the pump is operated with salt water or water contaminated with corrosive materials, it is recommended that the fluid end be flushed with fresh or potable water at least once a week. This is especially important if air is allowed into either the suction or discharge ports when the pump is not operated for an extended period. Do not store fluid end without thoroughly flushing with fresh or potable water.

Dusty Environments:

Gritty or abrasive airborne materials can deposit on the plungers and plunger adapters when the pump is not operating. When the pump starts some of the particles will be pulled through the packing and/or seals. This may score the plungers and drastically shorten packing life.

The power end cradle has a plexiglass cover that will minimize the intrusion of these materials and should be visually inspected daily. It can easily be removed to clean off the plungers and plunger adapters as needed.

Abrasives that are ingested into the power end will contaminate the oil and can damage the crankshaft journals, connecting rod and main bearings and the cross-head or power frame bores.

The power end breather should include a 40 micron filter element. It should be inspected frequently and

blown clean or replaced if necessary.

Freezing Temperatures:

Freezing water in the pump fluid end can crack the fluid cylinder, discharge and suction manifolds and stuffing boxes. If the pump is exposed to potential freezing temperatures, drain all water from fluid end and add an anti-freeze mixture that will remain in the liquid state.

If the pump is to be operated at temperatures approaching freezing conditions, it may be necessary to heat both the power and fluid end assemblies before the pump is started. The power end oil will be very viscous and may not adequately lubricate all metal to metal surfaces. The pump should be operated under low pressure to avoid loading the power end until the lubricant temperature is elevated. Oil pressure will be significantly higher at low temperature and can damage cartridge filter housings and coolers that have relatively low MAWP ratings.

Maintenance Schedule:

Period	Interval – Hrs.
Daily	8
Monthly	150 - 200
Semi-Annual	1000

Packing should be replaced before it fails to minimize damage to the brass components and plungers. Backup rings should be replaced at the same time as the packing.

It is recommended that tungsten carbide plungers be used when operating at 15K .

Gardner Denver
Water Jetting Systems, Inc.
Houston, TX USA

Daily Maintenance:

- Check the power end oil level; observe if there is any visual evidence of water accumulation or contamination.
- Verify that suction supply pressure exceeds minimum requirements.
- Check and replace filter bags or cartridges as required.
- At startup listen to pump operation for any abnormal sounds or vibration.
- Verify plunger water lubrication is flowing at approximately 1 GPM per plunger. Look for excessive flow from any of the gland nuts that would indicate significant packing leakage. Make sure that the water is not accumulating in the pump cradle.
- Check operating temperatures using a hand held infrared temperature gauge. Key locations include the back of the stuffing boxes, power end near the main bearings & oil level indicator.

Monthly Maintenance:

- Check torque of all fluid end fasteners.
- Inspect the crankcase breather on the power end assembly. Clean or replace as needed. This may have to be checked more frequently depending on environmental conditions.

Semi-Annual:

- Disassemble and inspect expendable fluid end components including valves and valve seats, valve springs, plungers and brass components.
- If necessary, lap valve and valve seats.
- Replace broken or weak springs.
- Replace scored or worn plungers.
- Inspect diaphragm seals on power end and replace if there is evidence of oil leakage into the pump cradle.
- Drain all oil from the power end, remove the rear crankcase cover and wipe the interior clean. It is normal to find fine metal worn from the crosshead and frame bore. Magnets are located in the bottom of the sump to attract these shavings; remove and wipe each clean. Replace in the same location. Refill the crankcase to the specified level. See instructions in the power end manual.
- Reassemble the fluid end per instructions on page 6. Refer to the torque specifications in Table 2 on page 11.

PUMP MAINTENANCE LOG:

Pump Model:	
Pump Serial Number:	
Fluid End Assembly Drawing No:	
Power End Assembly Drawing No:	
Startup Date:	

Fluid End Maintenance:			
Brass – Packing Replacement	Plunger #1	Plunger #2	Plunger #3
Throat Bushing - Front			
Valve Spring			
Front Packing Ring			
Packing Set			
Throat Bushing - Rear			

Oil Change Performed by:		Change Date:	
Oil Specification:		Gallons of Oil:	
Power End Temperature Log:	___/___/___	___/___/___	___/___/___
Main Bearing – opposite to Gear			
Main Bearing – adjacent to Gear			
Crankcase – below oil level			
Planetary Gearbox - Housing			
Power Frame – above crossheads			

Maintenance Performed:	
Describe Work:	
List Parts Changed:	
Comments:	

LIMITED WARRANTY

Gardner Denver Water Jetting Systems, Inc. (Gardner Denver) warrants all goods are conveyed with good title and are delivered free of any lawful security interest or other lien or encumbrance unknown to Buyer.

Gardner Denver warrants all goods manufactured by Gardner Denver will be free from defects in material or workmanship under normal use and service. The period of this warranty shall be in accordance with the various periods for such goods as stated below.

Gardner Denver does not warrant any equipment or accessories manufactured by others to be free of defects in design and manufacture. When goods manufactured by others are supplied by Gardner Denver as an accessory or component part of Gardner Denver products, then such goods shall be warranted in accordance with the terms of this warranty; PROVIDED, HOWEVER, that any repair or replacement of such accessory or component part(s) shall be limited by any warranty allowance made to Gardner Denver by the original manufacturer of such accessory or component part(s), if any.

During the warranty periods set forth herein, Gardner Denver, at its option, will either repair or replace, free of charge, FOB Gardner Denver, such warranted goods as appear upon inspection by a Gardner Denver representative to be defective in materials or workmanship, providing the Buyer gives written notice to Gardner Denver of the defect within (10) days from receipt and promptly delivers the defective goods to Gardner Denver freight prepaid (COD freight will not be accepted.) This repair or replacement provision is expressly agreed to be the exclusive remedy between the parties and constitutes fulfillment of all of Gardner Denver's obligations in respect to the material supplied hereunder.

DISCLAIMER OF WARRANTIES

THE LIABILITY OF GARDNER DENVER IS LIMITED TO THAT EXPRESSLY SET FORTH IN THIS WARRANTY. ANY WARRANTY NOT PROVIDED HEREIN, AND ANY REMEDY THAT, BUT FOR THIS PROVISION, MIGHT ARISE BY IMPLICATION OF LAW, IS HEREBY EXPRESSLY EXCLUDED AND DISCLAIMED, AND GARDNER DENVER, WITHOUT LIMITATION, SPECIFICALLY DISAVOWS ANY OTHER REPRESENTATION, WARRANTY, OR LIABILITY RELATING TO THE CONDITION OR USES OF ANY GOODS PROVIDED; IN PARTICULAR, BUT WITHOUT LIMITATION, THE IMPLIED WARRANTY OF MERCHANTABILITY AND IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED AND HEREBY EXCLUDED. FURTHER, WITHOUT LIMITATION, GARDNER DENVER SHALL NOT BE LIABLE IN ANY EVENT FOR ANY SPECIAL, INCIDENTAL, INDIRECT, PUNITIVE, OR CONSEQUENTIAL DAMAGES TO BUYER OR OTHERS, INCLUDING, WITHOUT LIMITATION, CONSEQUENTIAL DAMAGES FOR DELAYS IN DELIVERING GOODS OR DELIVERING GOODS THAT DO NOT COMPLY WITH ANY WARRANTY PROVIDED HEREIN OR OTHERWISE.

Gardner Denver will grant no allowance for any repairs or modifications made by Buyer without prior written consent of Gardner Denver or otherwise undertaken by Buyer without conforming to the provisions of any warranty provided herein.

Any warranty obligation of Gardner Denver is voided in the event that Buyer either misuses the goods or fails to properly maintain and service them [as provided in the Gardner Denver Operation and Maintenance Manual]. Such misuse and lack of maintenance may include, but is not limited to: misapplication, failure to change wear components, improper lubrication, corrosion (due to environmental conditions or [use of improper] fluids), improper drive alignment, excessive pump speed, improper modification or use of incompatible or improper components manufactured by others with equipment sold by Gardner Denver. During the period of the warranty, maintenance of the equipment with other than genuine Gardner Denver replacement and service parts will be considered to be an unauthorized modification or misuse of the equipment and will void all warranty obligations of Gardner Denver.

GARDNER DENVER GOODS, COMPONENTS, AND/OR ACCESSORIES NOT EXPRESSLY DESIGNATED IN THIS WARRANTY ARE NOT WARRANTED.

WARRANTY PERIODS

1. **PUMP POWER END**

Non-wear components - 1 year from date of shipment by Gardner Denver or 2,000 hours of operation, whichever occurs first.

Wear components - No warranty.

Power ends purchased from other manufacturers are subject to that manufacturer's warranty.

2. **PUMP FLUID END**

Non-wear components - such as stuffing boxes, suction manifolds, discharge manifolds, spacer plates, adapter plates - 1 year from date of shipment by Gardner Denver or 2,000 hours, whichever occurs first.

Wear components - No warranty.

3. **ACCESSORIES**

(Whether provided as part of a unit or separately)

Other than normal wear components, all accessories manufactured by Gardner Denver are warranted for ninety (90) days from date of shipment.

4. **UNIT COMPONENTS**

Unit components, other than pumps and accessories including but not limited to skids, trailer components, tanks and other fabricated items manufactured by Gardner Denver shall be warranted for 1 year from date of shipment. As indicated above, items manufactured by others shall be subject to that manufacturer's warranty.

For purposes of that limitation of warranty set forth in Paragraphs 1-4 above, "wear components" shall include, but shall not be limited to, plungers, valves, packing, brass "O" rings, seals, fasteners and bearings.

WARNING:

Gardner Denver LIQUA-BLASTER is potentially hazardous equipment and may impose a risk of harm if not used properly and in accordance with instructions provided by Gardner Denver or other manufacturer's instructions. By its acknowledgment and acceptance of these Terms and Conditions of Sale, Buyer acknowledges that it has been provided with instructions for the safe use of the LIQUA-BLASTER, and its component and accessory parts, and that it will properly advise its employees (and any other persons reasonably expected to make use of the LIQUA-BLASTER) of the use of such equipment, including, but not limited to, instructions as to the proper safety devices to be worn or utilized in connection with operation of the LIQUA-BLASTER, subject only to any express warranty provided by Gardner Denver herein, and, without limiting any other indemnity provided by Buyer under these Terms and Conditions of Sale, Buyer does and shall release, hold harmless, indemnify and defend Gardner Denver from and against any loss, liability, claim, suits and costs (including attorneys fees), third party or otherwise, caused by, or arising out of or relating to the operation of, the LIQUA-BLASTER.

I HAVE READ ALL OF THE TERMS AND CONDITIONS CONTAINED IN THIS LIMITED WARRANTY AND AM MAKING THIS PURCHASE FREELY IN AGREEMENT WITH THOSE TERMS AND CONDITIONS.



Gardner Denver Water Jetting Systems, Inc.

12300 N. Houston Rosslyn Road

Houston, TX 77086

USA

Phone: 800) 231-3628

Fax: (281) 448-7500

E-Mail: mktg.wjs@gardnerdenver.com