MILTON ROY

Instruction Manual

Centrac B Metering Pump

Please record the following data for file reference
Tag Number(s): _____
Model Number: _____
Serial Number: _____
Installation Date: _____
Installation Location: _____

339-0038-000
1/2004

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LIST OF ILLUSTRATIONS

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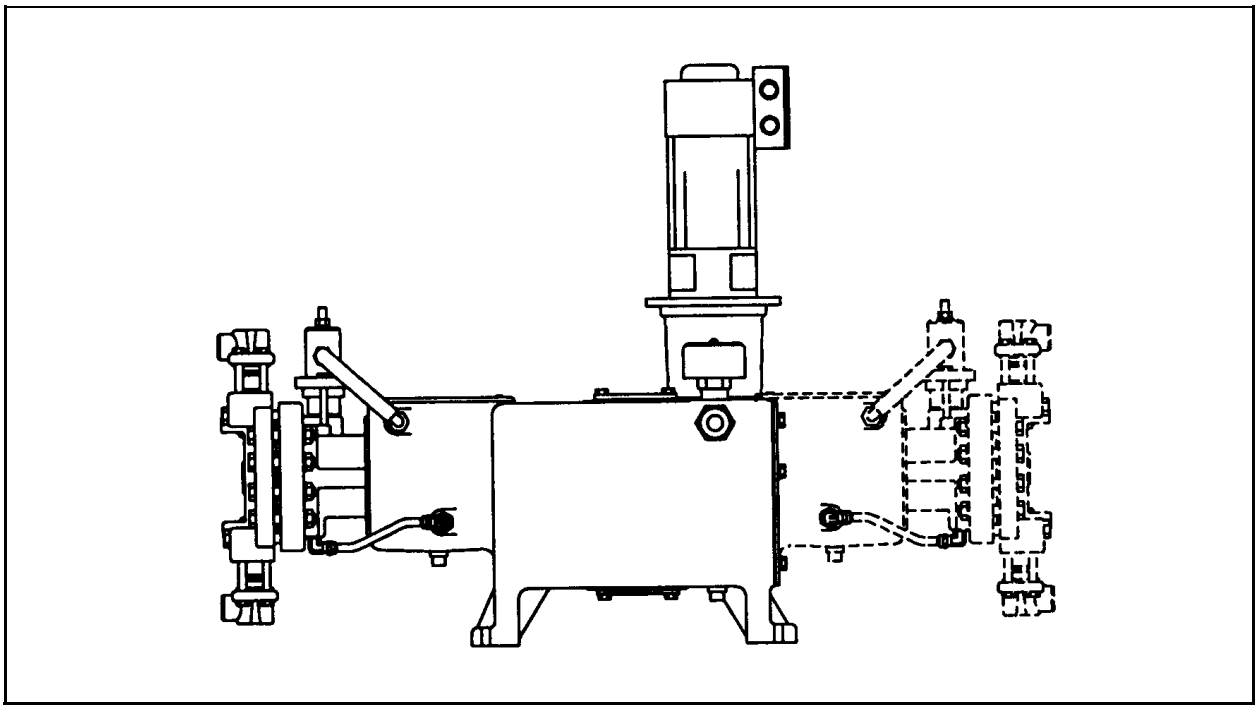

Figure 1. Centrac B.

Pump Model Code

End Item | Select Number

CBH X X X X - X X X X X X X X X X

Plunger Diameter
16 = 1"
BG = 1" HP
20 = 1 1/4"
CA = 1 1/4" HP
24 = 1 1/2"
32 = 2"
40 = 2 1/2"
56 = 3 1/2"
05= 11/32"
07= 7/16"
09= 9/16"
10= 5/8"
12= 3/4"
64= 4"

Liquid End Material
1 = 316 SS
2 = PVC
5 = Alloy 20
6 = Hast C22
7= PVDF

Configuration
1 = Simplex
2 = Duplex

Drive HP
E1 = 1 HP Explosion Proof Motor Mount Less Controller/Motor
E2 = 2 HP Explosion Proof Motor Mount Less Controller/Motor
S1 = 1 HP Standard Motor Mount Less Controller/Motor
S2 = 2 HP Standard Motor Mount Less Controller/Motor
S3 = 3 HP Standard Motor Mount Less Controller/Motor
1B = 56C Mount Less Motor †
2C = Low Pressure (2 HP) 143C/145C Mount Less Motor †
3C = High Pressure (3 HP) 143C/145C Mount Less Motor †
4C= Low Pressure (3 HP) 183/185TC Mount Less Motor t
5C= High Pressure (5 HP) 183/185TC Mount Less Motor t

Pressure*
PB = 30-220 psi
PC = 221-450 psi
PD = 451-750 psi
PE = 751-1550 psi
PF = 1551-2362 psi

Connections
(Metallic Only)
SE = Standard NPT
T1 = 150# RF Threaded Flange
T3 = 300# RF Threaded Flange
T6 = 600# RF Threaded Flange**
S1 = 150# RF Socket Weld
S3 = 300# RF Socket Weld*
S6 = 600# RF Socket Weld**
(Plastic Only)
T1 = SCH 80 Flat Face
S1 = SCH 80 Flat Face Solvent Weld

Rupture* Detection**
NN = None
(Metallic Only)
C5 = Gauge Only
SN = NEMA 4 Switch & Gauge
SE = NEMA 7 Switch & Gauge
(Plastic Only)
DD = Double Diaphragm (3 1/2" only)
DP = Double Diaphragm with Conductivity Probe

Ball Quantity
11 = Single
22 = Double
G2=Degas

* - Not all pressure ranges are available with all plunger sizes. See capacity pressure tables fc proper pressure availability.
** - Not available on 3 1/2" plungers
*** - Rupture detection codes C5, SN, & SE limited to 200 psig on all plunger diameters
† - Motor mount for standard type motors (AC/DC). 100:1 turndown may not be available with option

Figure 2. Centrac B Model Codes.

SECTION 1
INTRODUCTION

Centrac is a reciprocating piston, positive displacement metering pump. Under reasonably constant inlet and outlet conditions, Centrac will produce a flow rate which remains the same over extended periods of time within ±0.5%.

Unlike centrifugal pumps, Centrac produces a flow rate which is nearly unaffected by system pressure changes, typically less than 1 percent per 100 psi.. See Figure 3.

Centrac's flow rate is adjustable from zero up to the maximum capacity rating of the pump by means of adjusting the stroking speed from zero to 162 strokes per minute. The pump has an operating range of at least 100:1, and will operate from maximum flow rate down to less than 1/100 of maximum flow. Fitted with various piston arrangements, Centrac can have maximum rated flow rates of 45 GPH to 1100 GPH. See Figure 5.

Centrac is designed to handle corrosive liquids with a variety of metal and plastic alloys available.

Centrac consists of three major functional components: the mechanical drive system, the electronic drive system (See manual 339-0084-000), and the liquid end system. This manual has seperate sections for the mechanical drive system and liquid end system. Each pump and drive system is identified with a serial number and model number.

This is stamped on two data plates, one attached to the pump housing and the other attached to the electronic drive control chassis. See Figure 4.

> ***NOTE:*** *This equipment has been factory tested and calibrated as an operating unit. At installation, mount and connect only those items which have IDENTICAL serial numbers.*

This manual is organized into four sections. Section 2 discusses pumping system components and practices, including piping, pulsation dampeners, NPSH, etc. Section 3 details the mechanical drive system, including start-up and maintenance. The fourth section details the liquid end system. See manual 339-0025-000 for information on the double diaphragm pressure-type leak detection information

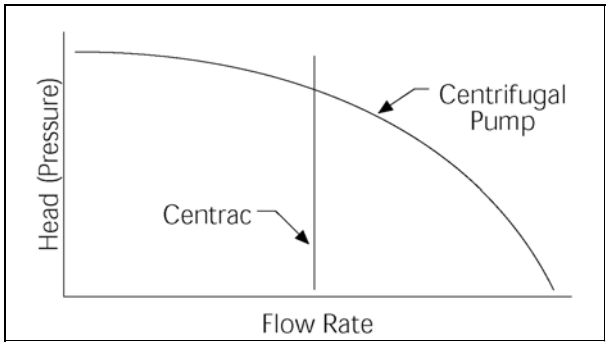

Figure 3. Centrac's Flow Rate.

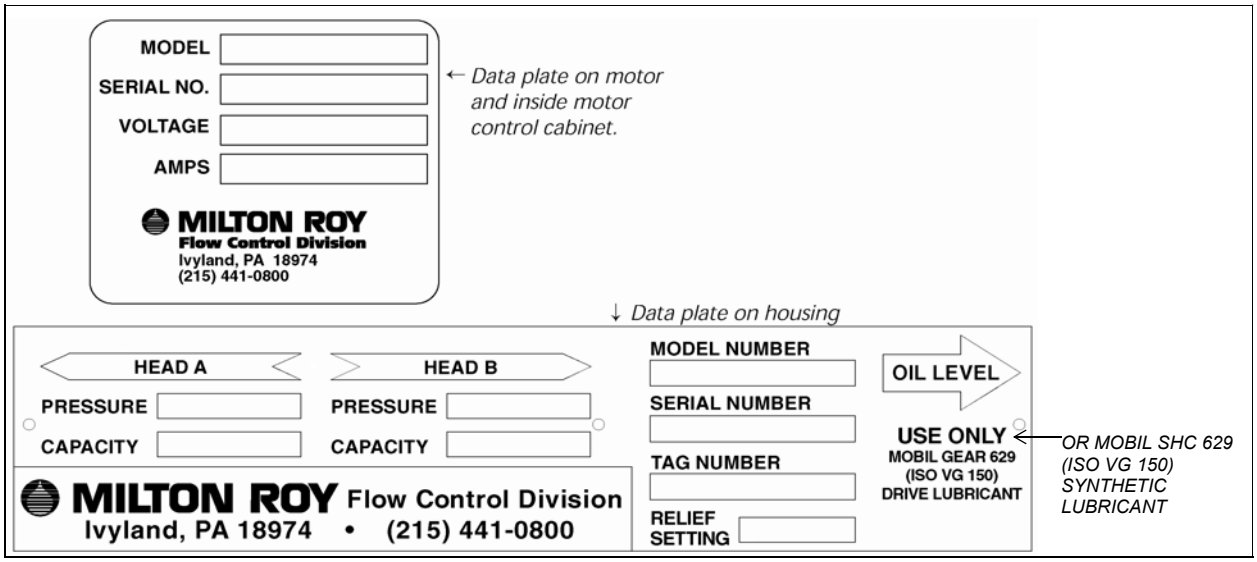

Figure 4. Data Plates.

PLUNGER DIA		MAXIMUM CAPACITY GPH	DRIVE HORSEPOWER				
			1	1.5	2	3	5 ++
			MAXIMUM DISCHARGE PRESSURE PSIG				
11/32"	Simplex	4.1	4534	5000	XXXX	XXXX	XXXX
	Duplex	8.2	2725	4205	5000	XXXX	XXXX
7/16"	Simplex	7.0	2440	3660	4880	XXXX	XXXX
	Duplex	14.7	1665	2525	3387	XXXX	XXXX
9/16"	Simplex	12.6	1475	2215	2950	4430	XXXX
	Duplex	25.2	1100	1660	2215	3325	XXXX
5/8"	Simplex	17.5	1195	1795	2390	3590	XXXX
	Duplex	35	895	1345	1795	2690	4400
3/4"	Simplex	25	830	1245	1660	2490	4070
	Duplex	50	620	935	1245	1870	3055
1"	Simplex	45	465	700	935	1400	2290
	Duplex	90	350	525	700	1050	1715
1 1/4"	Simplex	70	315	420	630	950	1310
	Duplex	140	235	315	470	710	985
1 1/2"	Simplex	100	205	310	415	620	1015
	Duplex	200	155	230	310	465	760
2"	Simplex	180	115	175	230	350	570
	Duplex	360	85	130	175	260	425
2 1/2"	Simplex	280	70	110	145	220	365
	Duplex	560	55	80	110	165	275
3 1/2"	Simplex	550	XXXX	55	75	110	185
	Duplex	1100	XXXX	XXXX	55	85	140
4"	Simplex	715	XXXX	XXXX	55	85	140
	Duplex	1430	XXXX	XXXX	XXXX	65	105

Capacities listed are for discharge pressures up to 200 PSIG.
Capacity will decrease by 0.8% for each 100 PSIG over 200 PSIG.

NOTES:
1. Pressure limitation above are based on standard Centrac B pump gears.
2. **++** High endload gears are required for 5 HP. Consult factory for details and pricing.
3. HPD liquid ends are limited to maximum pressure of 150 PSIG @ 68°F, and are linearly derated to 65 PSIG @ 140°F.
4. Capacity is shown at 162 SPM (100: 1 turndown).
5. Maximum speed can be set below 162 SPM where required. Consult factory.
6. Minimum capacity is 1 % (100: 1 turndown) of actual maximum flow at full speed.
7. Centrac is only available with motor and controller supplied by Milton Roy.
8. Consult NPIP Calculator at www.miltonroy.com for proper design of suction lines.

Figure 5. Performance Chart.

SECTION 2
GENERAL PUMPING SYSTEM COMPONENTS & CONSIDERATIONS

A pumping/piping system can take many shapes, depending on system needs. A typical system is shown on page 4.

2.1 GENERAL PIPING

Most importantly, piping must be strong enough to withstand system pressures without bursting or leaking. An excellent reference to help with selection is the American National Standard for Power Piping, ANSI B31.1, and other application specific standards within the ANSI "31" series, such as ANSI B31.3 for chemical plant piping. Local construction codes may also apply. Select piping, fittings and components strong enough to withstand maximum pressures.

In addition to being strong enough, piping must also be large enough to not restrict the flow through it.

All single piston metering pumps produce pulsing flow (see Figure 6) which must be taken into account when selecting suction and discharge piping.

A very important fact to know is that the peak flow rate in the pipeline is about 3 times greater than the average flow. This is true for the suction line and the discharge line. For example, if a metering pump is delivering 50 gallons per hour to a process, the pump's suction and discharge lines have a peak flow in them of about 3 X 50, or 150 GPH.

If the pipelines are long, or smaller than the connection size to the pump, these flow pulses will usually cause pressure pulses. On the discharge pipeline, positive pressure pulses occur. The pump has to operate against the regular system pressure, plus the positive pressure pulses. For example, a pump operating at 150 strokes per minute and 65 gallons per hour (1.1 GPM) operating into 100 feet of 1/2" pipe generates pressure pulses of over 100 psi! This is true of any single piston metering pump. If the pump is injecting into a 150 psi process system, then it must actually pump against 150 + 100 psi; or 250 psi. To reduce or prevent the "water hammer," or motor overloads, or pressure relief valve problems which might result from this, either the pipeline size should be at least doubled, or an accessory pulsation dampener should be installed.

The same pulsations happen in the system suction piping. Instead of the pulse pressure adding to what the pump is exposed to, pulse pressure subtracts from system suction pressure. In the previous example, a suction line 10 feet long of 1/2 inch pipe would subtract 10 psi from the pump's supply pressure, and almost certainly would restrict flow into the pump to the point where the pump would be starved, and not operate.

A reasonable rule of thumb is: For discharge piping, use piping one pipe size larger than the pump's discharge connection. For suction piping, use piping at least two times larger than the pump's suction connection. These are approximations. The pressure pulse for suction or discharge can be predicted using the equation:

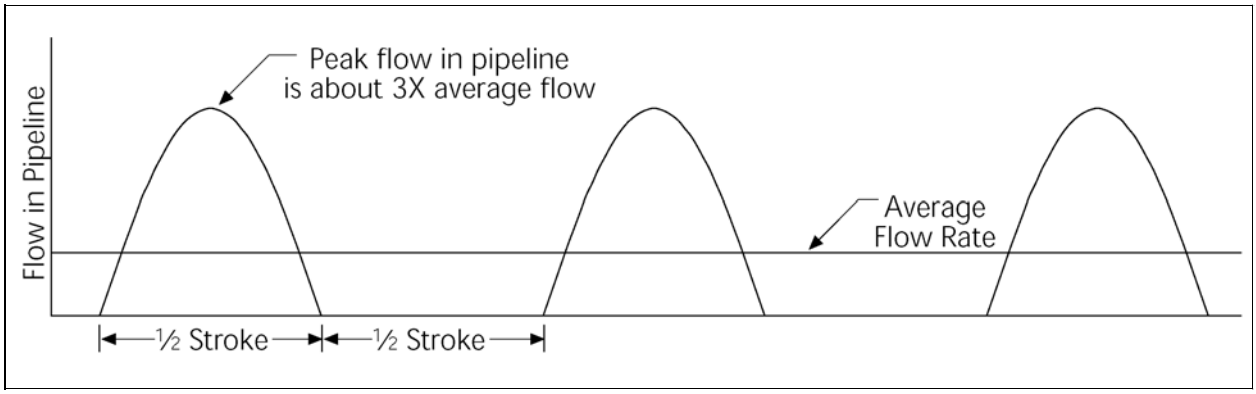

Figure 6. Example of Pulsing Flow.

$$Pa = \frac{NQ(SG)Lp}{27{,}700 \times D^2_p}$$

where: Pa = pulse (acceleration) pressure, psi
N = pump stroke speed, SPM
Q = pump flow rate, GPH
SG = Liquid specific gravity
Lp = Actual length of pipeline, ft.
Dp = Inside diameter of pipeline, in.

For more information on this subject, refer to Milton Roy Company's NPSH handbook.

In addition to selecting properly sized piping, select piping material (316 SS, PVC, Alloy 20, Alloy HC, PVDF,etc.) which will withstand corrosive effects of the liquid being pumped. Avoid effects of galvanic corrosion by connecting metals of the same alloy.

2.2 DISCHARGE PIPING EQUIPMENT

Refer to Figure 7, Typical Pumping/Piping System. This shows a number of components in the discharge line which are often required for safety, proper operation, or accurate metering.

2.2.1 SAFETY VALVE

This is a safety item, and should be a part of any metering pump discharge system. It is a valve which will open and bypass process liquid if presure in the pipeline gets to be greater than the valve's pressure setting. It is recommended that the valves outlet be piped back to the top of supply tanks. Do not pipe the outlet back into the pumps suction line. Piped into the suction line, it is difficult to tell if the valve is open and relieving, and suction pressures often alter the pressure at which the valve will operate. Pipe it back to top of supply tank.

This valve must be located between the pump and any flow shut-off valve to protect the pipeline from over pressure if the shut-off valve is closed while the pump is operating. Most positive displacement pumps can build tremendous pressures (hundreds or thousands of psi) within a couple of pump strokes if the discharge line is shut off. A pressure relief valve installed between the pump and a shut-off valve will protect people, piping and pump.

2.2.2 BACK PRESSURE

Metering pumps must have discharge pressure greater than inlet (suction) pressure. The pump's internal check valves will block (or "check") flow backwards through the pump, but will allow free flow forward through the pump. Therefore, outlet pressure must be greater than suction pressure or suction pressure will just push liquid through the pump. It will do this if the pump is running or stopped.

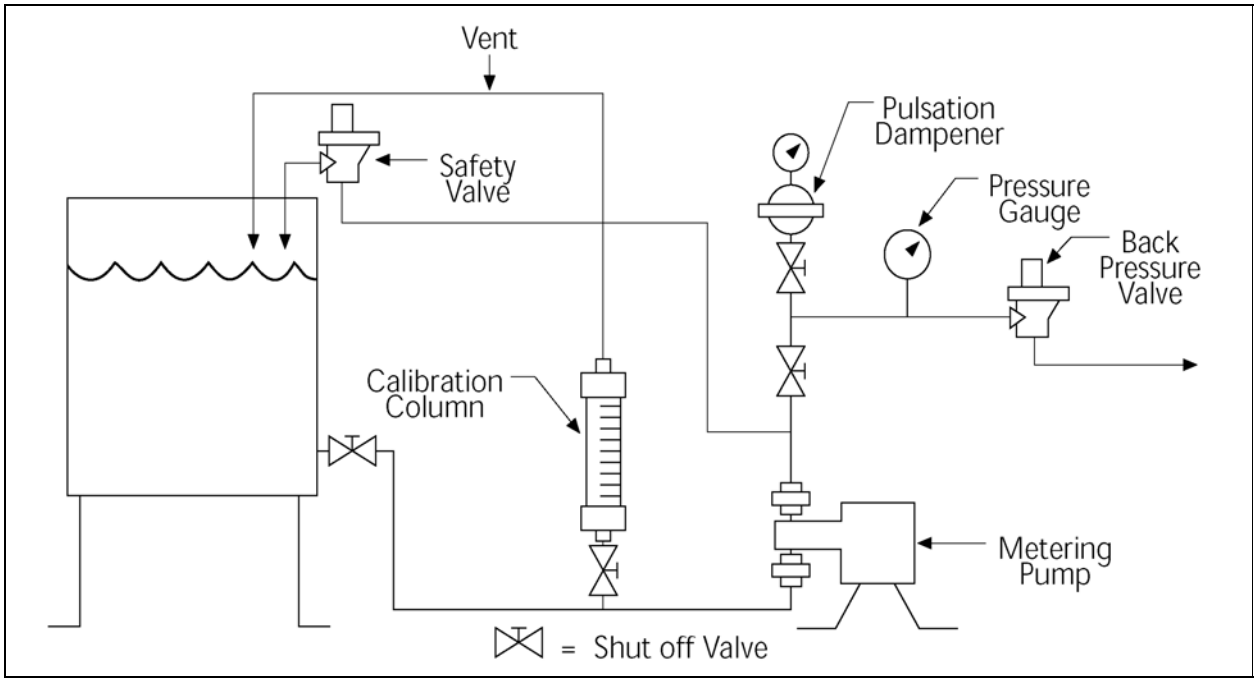

Figure 7. Typical Pumping/Piping System.

For good metering performance, discharge pressure should be at least 35 psi more than suction-pressure. Depending on pipeline sizes and pump stroke speed, good metering may be achieved with less pressure or may need to be increased, but 35 psi is a good average pressure.

If the pump is discharging into an open tank or into a low pressure pipeline, or if suction pressure is elevated (such as with pumping liquefied gasses) a back pressure valve should be used in the discharge line to generate the 50 psi differential needed. The back pressure valve should be located downstream of the pressure relief valve, and downstream of any pulsation dampeners. Although it can usually be located anywhere down stream of the pressure relief valve, it is recommended that it be located as far downstream, and as close to the point of injection as possible.

2.2.3 PULSATION DAMPENING

A pulsation dampener smooths metering pumps flow pulsations, and reduces the pressure pulsations which cause pump overloads, piping over-pressure and "water-hammer." Use a pulsation dampener with a back pressure valve to smooth flow through the valve and greatly extend the valves life.

A pulsation dampener must be properly sized and precharged for good operation. The pulsation dampener only smooths flow down-stream of itself, therefore it should be located within a few feet of the pump.

A pressure gauge, with a small gauge shut-off valve provides a lot of information, and can be used to indicate when things are operating properly, or when they aren't. Select a gauge which will withstand maximum expected pressures.

2.3 SUCTION PIPING EQUIPMENT

Most start up and operating problems involve suction piping which restricts flow into the pump. For suction piping "bigger is better:' and "shorter is sweeter."

A pump's suction system always restricts flow. Pumps can withstand some restriction, but all pumps and all liquids have limits. Provide the pump with a suction system which doesn't restrict flow beyond the pump's or the liquid's limit. Centrac's HPD liquid end can operate with a limit of about 12 psi vacuum (3 psia).

The two most common restrictions of flow into metering pumps are suction lift and pulse (acceleration) pressure. For a well operating suction piping system, the restrictions can't be more than the pump's limit. If the pump is located above the supply tank, lifting liquid to the pump acts like a restriction of about 1 psi for every 2 feet of lift. Restriction from pulse (acceleration) pressure can be calculated from the same equation shown on the previous page. If these restrictions are added together and equal or are more than the 12 psi pump limit, the system will not work. The pump will pump much less liquid (if any at all) than expected.

The above analysis is approximate. There are other considerations about viscous liquids (thick, like automotive transmission fluid or thicker), liquids with suspended solids, liquefied gasses and others that this analysis does not cover. Contact your Milton Roy Company sales agent for a copy of the NPSH handbook and further discussion.

In some cases the effects of restrictive suction lines can be overcome by installing a standpipe in the suction line near the pump.

Other techniques such as pulsation dampeners and "stuffer” pumps can be used to help overcome suction problems. Remember a good practice is to make the suction pipe size twice the size of the pump inlet connection. If in doubt, contact Milton Roy’s Engineering Department, for analysis of system conditions and help with sizing piping.

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SECTION 3
CENTRAC MECHANICAL DRIVE SYSTEM

3.1 GENERAL

This section covers the mechanical drive system. See section 4 of this instruction manual for the procedure for the liquid end system.

This pump is available in both a simplex (single pump head) and a duplex (two pump head) configuration. The two versions use mostly identical parts. The major difference is addition of another hydraulic fluid chamber for the duplex, and use of a different crosshead for simplex and duplex. Otherwise, parts (including gears, bearings and seals) are identical.

3.2 LUBRICATION

For operation at ambient temperatures from 40°F to 140°F, use Mobil Gear 629 or Mobil SHC 629 (synthetic) lubricant. For other temperatures, consult factory.

Total oil capacity, for both drive and liquid end, is approximately 5 U.S. gallons. Change oil every 6 months or 3000 operating hour, whichever comes first.

3.3 DISASSEMBLY

Refer to Figures 8 (simplex) and 9 (duplex) for parts location and identification.

WARNING

DISCONNECT ALL ELECTRICAL POWER FROM THIS EQUIPMENT BEFORE STARTING ANY DISASSEMBLY. OTHERWISE, EQUIPMENT COULD BE UNEXPECTEDLY STARTED, OR HAZARDOUS ELECTRICAL POWER ENCOUNTERED, RESULTING IN SERIOUS PERSONAL INJURY.

NOTE: *A special shim pack is needed for reassembly of upper bearing cap (90) and the motor mount adapter (520). Do not remove these items from the main housing (10) unless the shims are available for re-assembly.*

NOTE: *The main shaft and gear assembly (55) is a permanent assembly. Only the bearings (40 & 60) are replaceable. All other components are unitized and are replaceable only as a factory assembled unit.*

NOTE: *The eccentric cage (70) is available only as a factory assembled unit induding the large bearing.*

3.3.1 PINION SHAFT REMOVAL

1. Drain oil from main housing gearbox area and from main housing catchall area by removing drain plugs (140).

2. Confirm that electrical power to the motor is disconnected, then unbolt and lift off motor from motor mount adapter (520). Save the motor coupling insert (spider).

3. Remove the remaining coupling half from the pinion shaft (132). Save the square key (7000).

4. Remove the four hex head bolts (5/16-18 UNC x 1" long) from inside the motor mount adapter (572) and lift the adapter off.

5. Lift out the pinion shaft (132), taking care to not hit the pinion shaft bearing (105 & 42) against main gear (55) teeth.

6. The bearing cup (105 & 42) cannot be removed from main housing until main gear is removed.

3.3.2 MAIN SHAFT & GEAR ASSEMBLY

3.3.2.1 REMOVAL

1. If work is being done on a duplex pump, first remove the duplex catchall assembly (Figure 9, Item 15) by removing the retaining bolts and sliding catchall straight away from housing.

2. Remove the upper bearing cap (90).

WARNING

THE MAIN SHAFT AND GEAR ASSEMBLY (55) WEIGHS ABOUT 45 POUNDS (20 KG). IT CAN DROP DOWN SUDDENLY, WHEN LOWER CAP (35) IS LOOSENED. SUPPORT THE LARGE GEAR BY INSERTING WOODEN BLOCKS OR CLOTH TOWELS BETWEEN THE GEAR AND MAIN HOUSING.

3. Remove the lower bearing cap (35).

WARNING

IN THE NEXT STEP, A GROUP OF THREE LOOSE PARTS WILL BE REMOVED AS ONE. ONCE THEY CLEAR THE MAIN HOUSING, TAKE CARE TO PROTECT YOURSELF AND THE PARTS FROM HARM IF DROPPED.

4. Carefully slide the entire combination of crosshead (75, simplex) or (75, duplex), main shaft, gear assembly (55), and eccentric cage assembly (70) out the open rear of main housing.

5. Carefully separate the pieces.

   NOTE: *The crosshead bearing can now be re moved if necessary by using the four screws as jack-screws in the bearing's tapped holes.*

   NOTE: *Be aware that replacement of this bearing requires a "strong" press fit.*

Bearing outer race (cup) can be pulled from the cap (35) and from the main housing using commercially available slide-hammers specifically designed for this purpose. The pinion shaft bearings (42 & 105) are Timken Cup #LM11710 or equal; the main gear and eccentric shaft bearings (40 & 60) are Timken Cup #LM11910 or equal.

Bearing cones must be removed from their respective shafts by pressing them off. Do this carefully to avoid damage to the pinion shaft (132) or the main gear and eccentric shaft (55).

3.4 REASSEMBLY

Refer to Figures 8 (simplex) and 9 (duplex).

NOTE: *Two special shim packs are needed for assembly of upper bearing cap (90) and* motor mount adapter (572) *to main housing.*

1. If replacing, press the bearing cones (60 & 42) onto their shafts. Press them on, oriented as shown in the drawing. Remember to install bearing spacer (110) between bearing and pinion gear. Seat the bearings squarely on their shaft and tightly against their locating shoulder. When pressing, push against the bearing only on the inner race. If the bearing is pressed on by pushing against the rollers, it will be damaged and will probably fail within a few hours of operation.

2. Press the pinion shaft seal (130) into the motor mount adapter (572) as shown in the drawing. Press it into place open-face-first, with the closed face flush or to 1/16" below flush of the cap surface. Apply a thin film of grease to seal lip to help protect it during subsequent assembly.

3. If replacing, squarely and firmly press the bearing cups (40 & 105) into the main housing and into the three bearing caps. Press them fully against their stops. The cap bore which receives the bearing cup must be clean and free of grit, scratches, gouges and burrs. If not, the cup will either fit loosely and spin when operated, or will be distorted out-of-round. Early bearing failure would be expected.

4. Install crosshead bearing (part of 10), using an arbor or hydraulic press to fully and squarely seat the bearing.

5. Place O-rings (45 & 95) onto clean upper and lower bearing caps (90 & 35). Apply a thin coat of grease to groove and O-ring to help avoid damage to the O-ring during subsequent assembly.

6. Lightly oil the bearing of the eccentric cage (70) and place it onto the main shaft and gear assembly (55).

7. In this step, the loosely assembled crosshead, eccentric cage, main shaft, and gear will all be inserted into the main housing.

    a) Lay the crosshead (75 for simplex and duplex) in place over the eccentric cage (70) and main shaft and gear assembly (55).

    b) The crosshead is different on each end. The long round portion must be inserted into the housing first.

    c) Rotate the crosshead and gear until the high point of the eccentric is pointing toward the long end of crosshead.

    d) Holding loose assembly together, slide it all into housing, inserting crosshead into main housing bore, and fitting the lower bearing into its mating cup by aligning three holes.

8. Assemble lower bearing cap (35) into main housing. Be careful not to damage the O-ring. Be very careful that the cap seats fully against housing with no debris or burrs between the two. It may be necessary to lightly tap bearing cap using a wooden mallet. Torque the 5/16" bolts (135) to 30 ft. # (41 Nm).

9. Using no bolts, install the upper bearing cap (90) firmly into place over the upper bearing on main shaft. It may be necessary to lightly tap bearing cap using a wooden mallet.

10. The next series of steps is to assemble the upper bearing cap with appropriate shims. The end result is to obtain 0.001 inch (0.03 mm) to 0.003 inch (0.08 mm) shaft end play.

    a) Use a feeler gauge to measure the gap between the main shaft upper bearing cap (90) and the main housing. Press down firmly on the cap to get an accurate measurement.

    b) Select an appropriate selection of shims so they add up to 0.001 inch (0.03 mm) more than the measured gap.

    c) Remove the cap, install the shims, replace the cap, and install and torque the bolts to 30 ft. # (41 Nm).

    NOTE: *For duplex, support overhanging crosshead by hand while checking for smooth operation in the next step.*

    d) Reach in and rotate the large gear; it should rotate smoothly, with no tight spots, and no end play looseness should be felt. If it is not smooth and snug, repeat the measuring and shimming procedure to get 0.001 inch (0.03mm) shaft end play.

11. Install the pinion shaft (132). Make sure the lower bearing is in place and seated, and that the gears are in mesh.

12. Apply a thin coat of grease to upper portion of pinion shaft and to oil seal in motor mount adapter (572). Carefully, to prevent damage to seal lip, slide motor mount adapter (572) over shaft and into place in main housing. Use no bolts at this time.

13. Install shims between motor mount adapter (572) and main housing using the same procedure outlined above with a feeler gauge to obtain 0.001 inch (0.03 mm) pinion shaft end play.

14. Finish installing the motor mount adapter (520), and torque the bolts (135) to 30 ft. # (41 Nm).

15. Rotate shaft by hand to confirm smooth operation.

    NOTE: *For duplex, support the overhanging crosshead by hand while checking for smooth operation.*

16. Place gasket (20) onto large open face of main housing. Retain in place with small amount of grease.

17. For duplex version only make sure that the locating pins are installed in main housing. Install cross head bearing in catchall (15). Apply aditional gasket sealant to catchall (15)

and mount to main housing with 3/8-16 UNC x 1 1/2 long bolts (30) and lock washers (25). Torque to 30 ft. #. (41 Nm).

18. For simplex version only apply aditional gasket sealant to rear cover (15) and mount to main housing. Secure with 3/8-16 UNC x 3/4 long bolts (30) and lock washer (25). Torque to 10 to 15 ft. #. (17 Nm).

19. Inspect the main casing. Install oil drain plugs, filler caps and view ports.

20. Fill pump with recommended lube oil.

21. Install motor, motor coupling, and keys. Pay particular attention that the coupling halves are installed to leave a gap of about 1/16" to 1/8" (2.5 mm) between them and the rubber coupling "spider" or insert. This will prevent damage to the motor from unexpected end loads on its shaft.

22. Re-assembly of the gearbox drive is complete.

Table 1: Centrac Mechanical Drive Recommended Spares

Item Number	Description	Quantity		Part Number
		Simplex	Duplex	
45	Main Shaft Bearing Cap O-Ring	2	4	408-0109-331
40 & 60	Main Shaft Bearing Kit, Includes: 409-0116-050 & 409-0116-040	2	2	409-0116-030
42 & 105	Pinion Shaft Bearing Kit, Includes: 409-0116-020 & 409-0116-010	2	2	409-0116-000
80	Main Shaft Shim Kit, Includes: 409-0115-053, 409-0115133, & 409-0115-213	1	1	336-0007-003
125	Pinion Shaft Shim Kit, Includes: 409-0115-033, 409-0115-113, & 409-0115-193	1	1	336-0007-004
115	Pinion Cap O-Ring	2	2	408-0109-291

SECTION 4
HPD LIQUID END SYSTEM

4.1 DESCRIPTION

4.1.1 GENERAL

The HPD liquid end is particularly suitable for pumping costly, aggressive or hazardous liquids without leakage. The diaphragm is hydraulically balanced between the process liquid on one side and the hydraulic oil on the other side. The hydraulic oil takes the place of a mechanical connection between pump and plunger diaphragm.

4.1.2 PRINCIPLE OF OPERATION

Milton Roy's HPD liquid end overcomes the net positive suction head (NPSH) restrictions associated with conventional disc diaphragm liquid ends. This is accomplished by a patented mechanically actuated refill system (MARS) that eliminates the process-side support plate and lowers NPSH requirements.

The MARS also does away with the need for field adjustments of the refill mechanism by automatically compensating for process liquid changes. This, combined with removable check valves, makes the HPD an ideal choice for any process in which downtime is critical.

The HPD features a preformed, PTFE-faced elastomer diaphragm that is compatible with a wide range of process liquids and chemicals.

HPD operation is similar to that of other hydraulically actuated diaphragm liquid ends. There is no mechanical connection between the plunger and the diaphragm and there is no plunger packing to leak or require adjustment.

Each suction stroke of the plunger pulls the diaphragm towards the oil side contour plate so that process liquid flows into the displacement chamber through the suction ball-check valve. Each discharge stroke of the plunger pushes the diaphragm forward to expel the process liquid from the displacement chamber through the discharge ball-check valve. On each suction stroke, the discharge ball-checks are seated, and on each discharge stroke, the suction ball-checks are seated. This mode of operation prevents back flow and ensures liquid movement from the suction port, through the displacement chamber, and out the discharge port. Precise hydraulic oil volume is maintained by an automatic air-bleed valve (incorporated in the relief valve) and MARS.

4.1.3 SAFETY PRECAUTIONS

When installing, operating and maintaining the HPD liquid end, keep safety considerations foremost. Use proper tools, protective clothing, and eye protection when working on the equipment and install the equipment with a view toward ensuring safe operation. Follow the instructions in this manual and take additional safety measures appropriate to the liquid being pumped. Be extremely careful in the presence of hazardous substances (e.g. corrosives, toxins, solvents, acids, caustics, flammables, etc.).

4.2 INSTALLATION

4.2.1 PIPING

General piping instructions are given in the pumping system section of this instruction manual. No reciprocating plunger pump can be expected to perform satisfactorily unless those recommendations are followed. Pay particular attention to plastic liquid ends, as these units are relatively fragile and can be damaged by strain on the connections. For best results, install a section of flexible tubing between rigid, fixed piping and suction and discharge cartridges on plastic liquid ends.

> ***NOTE:*** *Maximum reliability may be ensured by protecting plastic liquid ends and plastic piping with an external relief valve installed in the system discharge line.*

The HPD liquid end is far superior to conventional diaphragm liquid ends for suction lift and many other NPSH-critical applications. Its patented diaphragm and advanced design refill mechanism give this liquid end truly high performance in these applications. Refer to "NPSH Handbook." Apply a 3 psia minimum operating pressure limitation in evaluating applications for this liquid end.

4.3 OPERATION

4.3.1 INITIAL START-UP

After installing the pumps and the HPD liquid end, perform the following operations before placing the pump in routine service. Item numbers refer to part numbers shown in Figures 10, 11, 12, 13, and 14.

4.3.2 SINGLE DIAPHRAGM

NOTE: *The following procedure is completed only ofter diaphragm removal/replacement, usually replaced as part of a Routine Preventive Maintenance (RPM) kit. All Centrac B pumps are filled with hydraulic oil at the factory.*

1. Disconnect outlet tube from relief valve (1040), and remove relief valve from liquid end. Make sure that the O-ring between liquid end and relief valve does not get lost or damaged, and that the opening in the liquid end is clean.

2. Fill displacement chamber (630) through the clean relief valve port just uncovered, with hydraulic oil furnished with the pump. For operation at ambient temperature from -20°F to 140°F, use Mobil SHC 629 lubricant. For other temperatures, consult factory. Total oil capacity for drive and liquid end is approximately 5 U.S. gallons.

3. Replace the relief valve. Make sure that the O-ring is seated in the liquid end counterbore before replacement. Tighten the retaining nuts evenly and securely.

4. Remove the pumps front housing cover and fill the reservoir with hydraulic oil to top of crosshead.

5. Replace the tube and cover.

4.3.3 INITIAL ADJUSTMENT

The HPD relief valve may be adjusted to operating conditions by the following procedures. Adjust this valve after first installing pump and after any corrective maintenance.

4.3.4 RELIEF VALVE

WARNING

THE INTERNAL PRESSURE RELIEF VALVE IS FACTORY SET TO OPEN AT A PRESSURE SLIGHTLY ABOVE THE PUMP MAXIMUM OPERATING DISCHARGE PRESSURE; NEVER SET THE VALVE AT ANY GREATER PRESSURE.

1. First, operate pump against system operating pressure to insure the pump is functioning properly.

2. Stop pump.

3. Install a pressure gauge, with a range higher-than desired relief pressure, in the discharge line, near the pump discharge connection.

4. Install a shutoff valve in the discharge line downstream from the pressure gauge.

5. Set capacity control to approximately 30%.

6. Open shutoff valve. Start pump; pump process liquid to drain or other safe point to establish proper pumping action.

7. Close shutoff valve ("dead head" the pump) and closely watch pressure increase on pressure gauge. If pressure exceeds desired value, quickly open shutoff valve to relieve pressure in line.

8. Adjust the relief valve adjusting screw located on top of valve and repeat Step 7 until the maximum pressure gauge reading equals the relief valve pressure setting desired.

9. After setting relief valve, ensure shutoff valve is fully open. Remove pressure gauge from line or leave in place, as desired, and place pump in routine service.

4.4 MAINTENANCE

WARNING

BEFORE ANY MAINTENANCE, RELIEVE ALL PRESSURE FROM SYSTEM, ISOLATE LIQUID END FROM ALL SOURCES OF PROCESS LIQUID WITH APPROPRIATE VALVING, AND PURGE LIQUID END OF ALL PROCESS LIQUID.

HPD liquid ends are available in a number of different plunger sizes and materials of construction. It is necessary to know the specific plunger size to identify the correct liquid end replacement parts.

The correct plunger size code number and material of construction code number are found in the model number stamped onto the data plate attached to the pump drive housing. See Figures 2 & 4.

4.4.1 ROUTINE PREVENTIVE MAINTENANCE (RPM) KIT

RPM kits include the parts recommended for periodic replacement to keep a metering pump operating at factory specification. HPD liquid end duplex pumps and metallic pumps with double ball checks require two kits. HPD liquid end plastic pumps are standard double ball check and only require one kit.

Metallic Kits Include:

2	Seats
2	Ball Checks
1	Hydralic Fluid Strainer
10	Gaskets

Plastic Kits Include:

4	Seats
4	Ball Checks
1	Strainer
15	Gaskets

See Table 2 for a list of RPM kit numbers.

4.4.2 HYDRAULIC OIL

Mobil Gear 629-approximately one gallon (4 liters). Inspect and replace hydraulic oil on the same schedule as gear drive lubricant.

Table 2. RPM Kit Numbers

Plunger Diameter	Pump Product Code	Material	RPM Kit Number
11/32", 7/16", 9/16", 5/8",	CBH-XX1	316 SS	RPM-0011-011
	CBH-XX2	PLASTIC	RPM-0011-052
	CBH-XX5	ALLOY 20	RPM-0011-015
	CBH-XX6	HAST C 22	TBD
3/4 & 1”	CBH-161	316 SS	RPM-0011-021
	CBH-162	PLASTIC	RPM-0011-052
	CBH-165	ALLOY 20	RPM-0011-025
	CBH-166	HAST C 22	RPM-0011-026
1 1/4”	CBH-201	316 SS	RPM-0011-021
	CBH-202	PLASTIC	RPM-0011-052
	CBH-205	ALLOY 20	RPM-0011-025
	CBH-206	HAST C 22	RPM-0011-026
1 1/2”	CBH-241	316 SS	RPM-0011-021
	CBH-242	PLASTIC	RPM-0011-062
	CBH-245	ALLOY 20	RPM-0011-025
	CBH-246	HAST C 22	RPM-0011-026

Table 2. RPM Kit Numbers (continued)

Plunger Diameter	Pump Product Code	Material	RPM Kit Number
2”	CBH-321	316 SS	RPM-0011-031
	CBH-322	PLASTIC	RPM-0011-062
	CBH-325	ALLOY 20	RPM-0011-035
	CBH-326	HAST C 22	RPM-0011-036
2 1/2”	CBH-401	316 SS	RPM-0011-031
	CBH-402	PLASTIC	RPM-0011-062
	CBH-405	ALLOY 20	RPM-0011-035
	CBH-406	HAST C 22	RPM-0011-036
3 1/2" / 4”	CBH-56/64 1	316 SS	RPM-0011-041
	CBH-56/64 2	PLASTIC	RPM-0011-072
	CBH-56/64 5	ALLOY 20	RPM-0011-045
	CBH-56/64 6	HAST C 22	RPM-0011-046

4.4.3 CHECK VALVE

HPD check valves are modular in design and can be serviced without disconnecting them from the piping system. At the user's option, they can be supplied as either single or double ball configuration.

4.4.3.1 DISASSEMBLY (REFER TO FIGURES 10, 11, 12, 13, AND 14.)

After insuring that all system pressure has been relieved and that all hazardous process liquids have been flushed from the liquid end, the four retaining nuts (765) can be loosened evenly, then removed. A slight force applied to the port connector (820) will usually provide sufficient clearance to lift and slide out the ball guide (790), seat, ball, and gasket. Once disassembled, the gasket (780) is not suitable for reuse and should be discarded. Balls should be smooth, round and free of deposits or pits for continued use. Any imperfection visible on the seat seating surface (pits, erosion, cracks, or a ball matching contour greater than 0.030 deep) makes the seat unusable.

A thin PTFE gasket fits between all mating components of the check valve stack, and is captured in place with sealing grooves in the metallic or plastic parts. If the grooves are deformed, dented or damaged, the part should be replaced. Clean these grooves with a small, stiff brush prior to reassembly.

4.4.3.2 REASSEMBLY

Replace the components in the orientation shown in the appropriate assembly drawing. Install an unused gasket between each set of thoroughly cleaned components. Tighten the stud nuts evenly by hand only, then rotate the components to insure that they are properly guided and mated. Snug up on the nuts evenly to prevent cocking of the assembly and subsequent leakage of process liquid to surroundings.

WARNING

BEFORE ANY MAINTENANCE, RELIEVE ALL PRESSURE FROM SYSTEM, ISOLATE LIQUID END FROM ALL SOURCES OF PROCESS LIQUID WITH APPROPRIATE VALVING, AND PURGE LIQUID END OF ALL PROCESS LIQUID.

4.4.4 RELIEF VALVE ASSEMBLY

This valve operates in filtered hydraulic oil and should require maintenance only if unusual circumstances occur, such as if corrosive media contaminates the fluid.

Assembly and disassembly is straightforward. Field servicing should be limited to inspection and cleaning only. Further repairs of this critical component should be carried out by an authorized Milton Roy repair facility.

4.4.5 “MARS" REFILL VALVE ASSEMBLY

This component requires no periodic maintenance. Clean hydraulic oil is critical for proper operation. If this valve is to be removed from displacement chamber I, push the valve only on its body with the displacement chamber removed. Do not attempt removal by prying the large poppet on the front side of the valve.

To reinstall the valve, replace the two 0-rings and back-up rings with new ones. Lubricate the rings and displacement chamber liberally with oil, and press the valve straight into the chamber.

4.4.6 PISTON ASSEMBLY

(Plunger Diameter Model Code Designations 16, 20, 24 only.)

1. Locate floating adaptor nut and install two set screws.

2. Locate piston and place floating adaptor nut assembly over piston, with threads of floating adaptor nut facing away from piston.

3. Place piston assembly onto press and install floating adaptor into bore of piston and press until flush.

4. Place piston assembly into drill fixture and drill through with a 1/8” (0.129-0.125) and install spring pin. Piston Assembly

(Plunger Diameter Model Code Designations 32, 40, 56 only.)

1. Locate floating adaptor nut and install two set screws.

2. Locate plunger and place floating adaptor nut assembly over plunger with threads of floating adaptor nut facing away from plunger.

3. Place plunger assembly onto press and place floating adaptor onto bore at end of plunger and press until flush.

4. Place plunger assembly into drill fixture and v drill through hold 1/8" (0.129-0.125) and install spring pin.

5. Place O-ring into groove at the end of plunger, apply O-ring lube onto O-ring. Place piston onto plunger making sure plunger is bottomed out into piston. Locate hex head bolt and apply loctite onto threads of bolt and install bolt through piston into plunger.

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SECTION 5
TROUBLESHOOTING

Excessive delivery	• Low discharge line pressure (discharge pressure must exceed suction pressure by more than 10 psi). Increase line pressure (e.g., install a back pressure valve).
Insufficient delivery	• Blocked discharge line. Clear line. • Relief valve set too low. Adjust valve to operating conditions. • Air in hydraulic system. Fill displacement chamber with hydraulic oil to proper level. • Clogged refill line. Remove strainer assembly and clean. • Restricted suction line. Remove blockage and/or increase pipe size. • Insufficient NPSH. Analyze suction system for proper NPSH.
Erratic delivery	• Repair or replace leaky relief valve./

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SECTION 6
PARTS LIST

6.1 GENERAL

1. This section gives information regarding replaceable components.

6.2 ILLUSTRATED PARTS LIST

1. Figure and Item Number Column

    a) The item numbers shown in the detailed parts list correspond to the item numbers appearing on the exploded view illustration. To find an unknown part number, locate the part on the illustration and note the item number. Look for the item number on the detailed parts list. The part number is on the same line. A dash (-) precedes non-illustrated item numbers.

2. Description Column

    a) The name of the item is in the description column.

3. Part Number Column

    a) The supplier's part number is listed in the part number column.

4. Quantity Column

    a) The numbers appearing in the quantity column are the total quantity of the listed part required in its immediate assembly.

5. Reference Code Column

    a) This column is used to denote assembly and detail part variations among similar components (models) covered by this publication. When the symbol "A", "B", etc. is entered in this column, the part is used only in the model at which the symbol appears. If the column is blank, the part is used in all models.

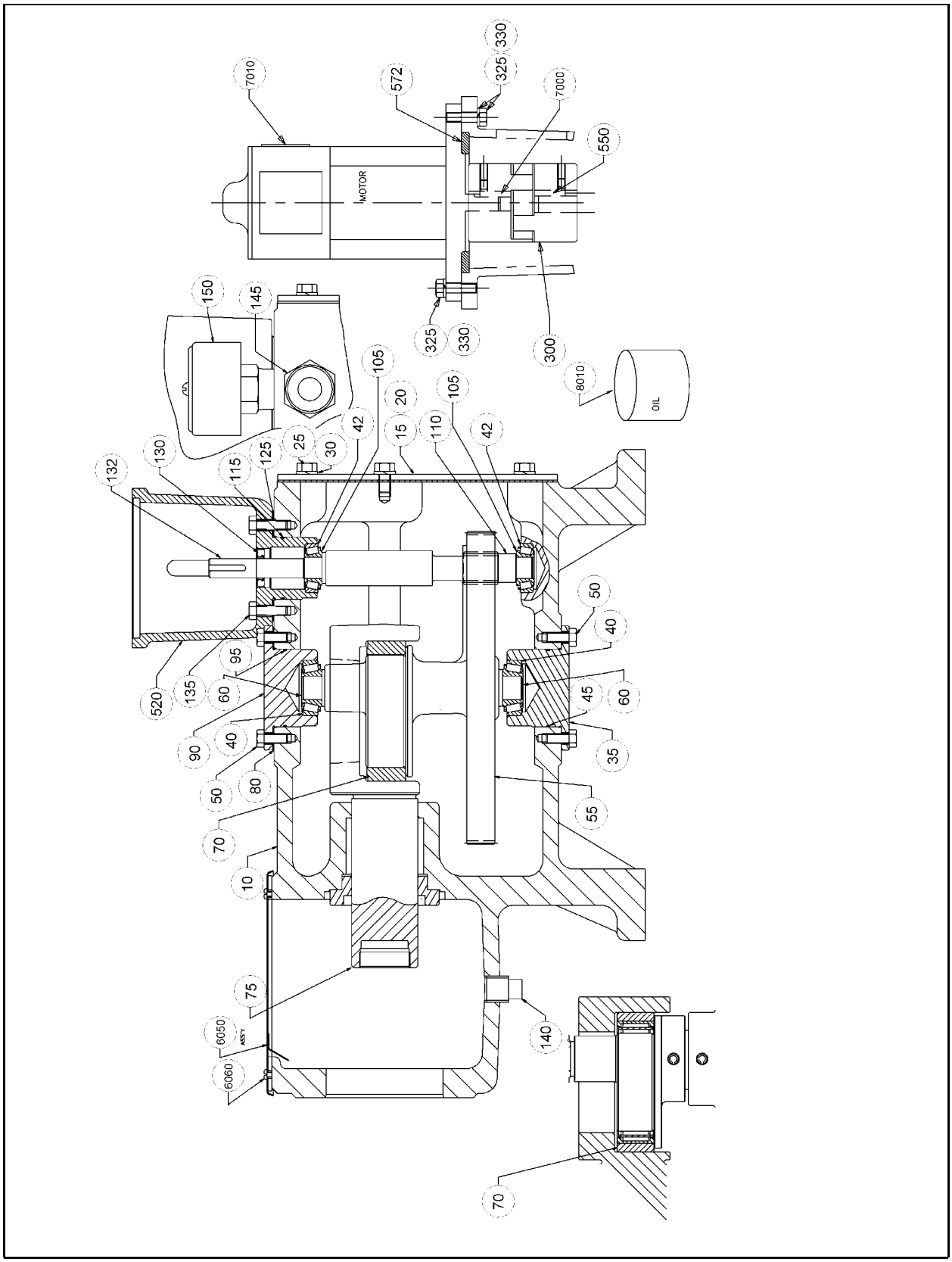

Figure 8. Centrac Simplex Drive Assembly Parts Reference Drawing (102-2925-0001).

6.3 CENTRAC SIMPLEX MECHANICAL DRIVE SYSTEM.

Model: Code:

Centrac B

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION		QUANTITY	REFERENCE CODE
8	10	Housing, Main Sub-Assembly Consisting of:	281-0243-000	1	
		Housing, Main	281-0239-001	1	
		Bearing, Crosshead	237-0092-053	1	
	15	Cover, Rear	281-0236-006	1	
	20	Gasket, Rear Cover	225-0091-000	1	
	25	Lock-washer, Spring - 3/8 18.8SS	404-0041-022	22	
	30	Screw, Hex Head - 3/8-16X3/4 Z PLT	405-0018-096	10	
	35	Bearing, Lower Cap - Steel	237-0086-006	1	
	40	Bearing, Cup - Timken LM11910	409-0116-050	2	
	42	Bearing, Cup - Timken LM11710	409-0116-020	2	
	45	O-ring - Parker, 2-036	408-0109-331	2	
	50	Screw, Hex Head - 5/16-18X3/4 STL	405-0017-091	7	
	55	Gear Set 11:1 Ratio (Used with 1 & 2 HP Motors)	252-0153-000	1	
	55	Shaft, Main Sub-Assy (Used with 3HP Motor)	268-0056-000	1	
	55	Pinion Shaft (Used with 3HP Motor)	252-0139-006	1	
	60	Bearing, Cone - Timken LM11949	409-0116-040	2	
	70	Eccentric Slide Block (Used with 1 & 2 HP Motors)	237-0101-062	1	
	70	Eccentric Cage - STL (Used with 3HP Motor)	237-0089-006	1	
	70	Bearing, Needle Roller (Used with 3HP Motor)	409-0117-000	1	
	75	Crosshead - Steel (Used with 1 & 2 HP Motors)	210-0020-002	1	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION		QUANTITY	REFERENCE CODE
	75	Crosshead - Steel (Used with 3HP Motor)	210-0018-006	1	
	80	Shim - Timken 0.005 THK	409-0115-053	1	
	80	Shim - Timken 0.007 THK	409-0115-133	1	
	80	Shim - Timken 0.020 THK	409-0115-213	1	
	90	Bearing, Upper Cap	237-0085-006	1	
	95	O-ring - Parker, 2-036	408-0109-331	2	
	105	Bearing, Cone - Timken LM11749	409-0116-010	2	
	110	Spacer, Bearing - Steel	219-0090-006	1	
	115	O-ring - 1.864 X 0.070 BUNA	408-0109-291	1	
	125	Shim - Timken 0.005 THK	409-0115-033	1	
	125	Shim - Timken 0.007THK	409-0115-113	1	
	125	Shim - Timken 0.020 THK	409-0115-193	1	
	130	Seal, Shaft	408-0131-020	1	
	132	Shaft, Pinion	252-0139-006	1	
	135	Screw, Hex Head - 5/16-18X1 Z PLT	405-0017-116	4	
	140	Plug, Oil Drain - 1/2”, 150# NPT	402-0009-131	2	
	145	Glass, View	407-0323-002	1	
	150	Filter, Breather/Oil	407-0326-005	1	
	-	Base Assy - CBH56	201-0410-000	1	
	-	Base - 4”, CBH24, 32, 40	201-0407-106	1	
	-	Base - 8”, CBH56	201-0407-206	1	
	300	Coupling L-100 5/8 X 14MM (1HP Drive)	410-0068-340	1	
	300	Coupling 5/8 X 24MM 3/16 X 8MM (2HP Drive)	410-0065-210	1	
	300	Coupling 5/8 X 24MM 3/16 X 8MM (3HP Drive)	410-0065-210	1	
	300	Coupling 5/8 X 5/8 X 3/16 (56C)	410-0064-020	1	
	300	Coupling 5/8 X 7/8 X 3/16 (143/145TC)	410-0064-090	1	
	325	Lock-washer, Spring - 5/16 Z PL (1 & 2HP Exp Proof Drive)	404-0040-028	4	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION		QUANTITY	REFERENCE CODE
	325	Lock-washer, Spring - 3/8 18.8SS (1, 2 & 3HP Drive)	404-0041-022	4	
	330	Screw, Hex Head - 5/16-18X1 Z PLT (1HP Exp Proof Drive)	405-0017-116	4	
	330	Screw, Hex Head - 5/16-18 X 1 1/4 GR5 (2HP Exp Proof Drive)	405-0017-139	4	
	330	Screw, Hex Head - 3/8-16 X 1 1/4 Z PLT (1, 2 & 3HP Drive)	405-0018-136	4	
	520	Adapter, Motor Mount, (1 & 2HP Exp Proof Drive)	272-0123-101	1	
	520	Adapter, Motor Mount, (1, 2 & 3HP Drive)	272-0123-001	1	
	550	Key, Square - 3/16 X 3/16 X 1”	404-0056-061	1	
	572	Adapter, Motor Plate - Steel (1HP Exp Proof Drive)	272-0120-006	1	
	572	Adapter, Motor Plate - Steel (2HP Exp Proof Drive)	272-0145-006	1	
	572	Adapter, Motor Plate - (143/145TC & 56C)	272-0143-006	1	
	6050	Cover, Catchall Sub-Assy	281-0251-000	1	
	6060	Screw, Pan Head - #8-32NC X 1/2 18.8SS	405-0179-073	4	
	7000	Key, Square - 5mm X 5mm X 1” (1HP Drive)	404-2001-011	1	
	7000	Key, Square - 8mm X 8mm X 1” (2 & 3HP Drive)	404-2002-011	1	
	7010	Decal, Serial #	253-0129-000	1	
	8010	Oil, Mobil Gear 629	407-0324-020	5 GAL	

- Items not shown.

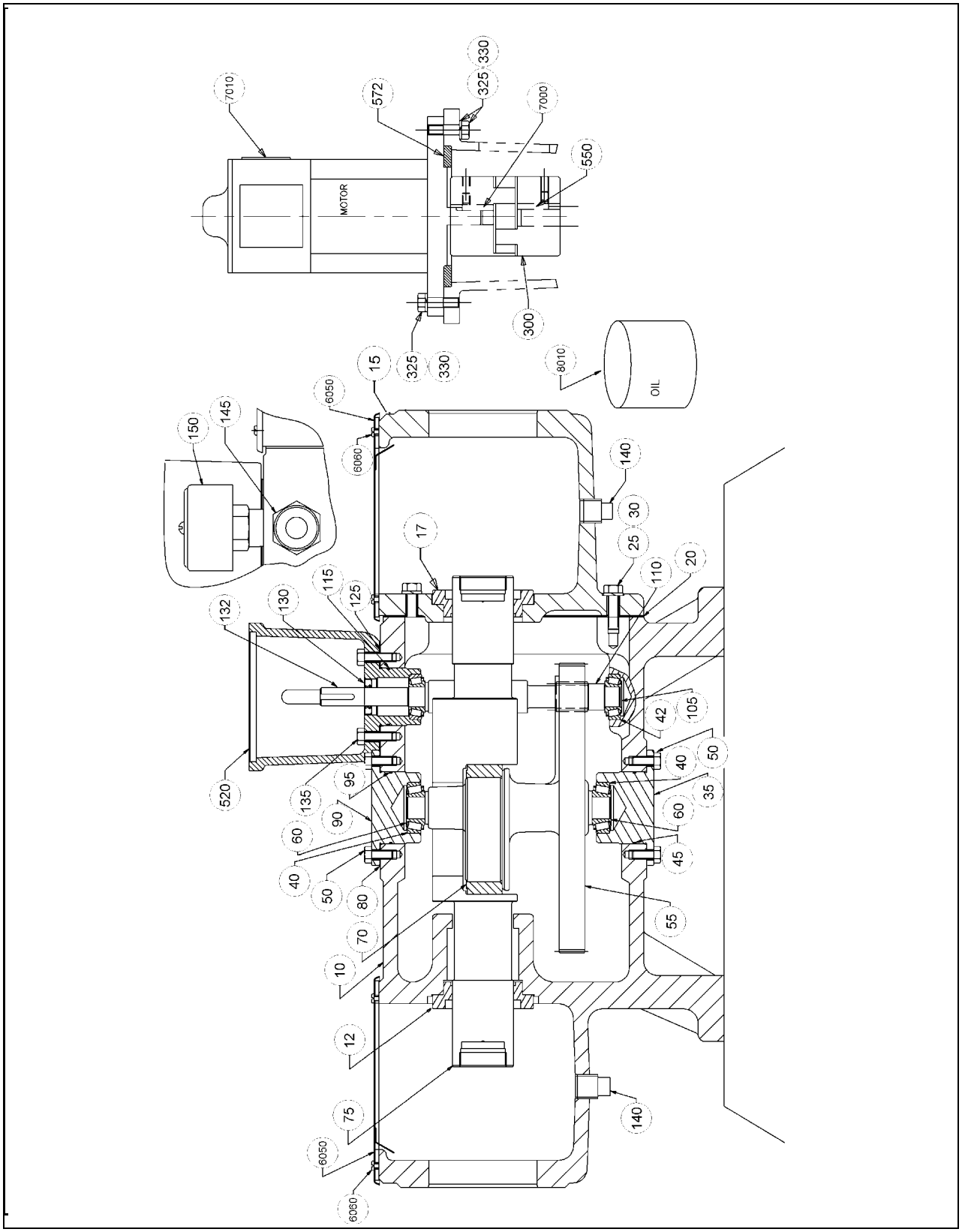

Figure 9. Centrac Duplex Drive Assembly Parts Reference Drawing (DWG. 102-2925-0002).

6.4 CENTRAC DUPLEX MECHANICAL DRIVE SYSTEM.

Model: Code:

Centrac B

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION		QUANTITY	REFERENCE CODE
9	10	Housing, Main Sub-Assembly	281-0243-000	1	
	12	Bearing, Crosshead	237-0092-053	1	
	15	Catchall, Duplex Sub Assy	281-0252-000	1	
	17	Bearing, Crosshead	237-0092-053	1	
	-	Pin, Dowel - 3/16 X 1/2 STL	401-0022-011	2	
	20	Gasket, Rear Cover/Catchall	225-0091-000	1	
	25	Lock-washer, Spring - 3/8 18.8SS	404-0041-022	10	
	30	Screw, Hex - 3/8- 16 X 1 1/2 18.8SS	405-0018-096	10	
	35	Bearing, Lower Cap - Steel	237-0086-006	1	
	40	Bearing, Cup - Timken LM11910	409-0116-050	2	
	42	Bearing, Cup - Timken LM11710	409-0116-020	2	
	45	O-ring - Parker, 2-036	408-0109-331	2	
	50	Screw, Hex - 5/16-18X3/4	405-0017-091	7	
	55	Gear Set 11:1 Ratio	252-0153-000	1	
	60	Bearing, Cone - Timken LM11949	409-0116-040	2	
	70	Eccentric Slide Block	237-0101-062	1	
	75	Crosshead, Duplex - Steel	210-0019-006	1	
	80	Shim - Timken 0.005 THK	409-0115-053	1	
	80	Shim - Timken 0.007 THK	409-0115-133	1	
	80	Shim - Timken 0.020 THK	409-0115-213	1	
	90	Bearing, Upper Cap	237-0085-006	1	
	95	O-ring - Parker, 2-036	408-0109-331	2	
	105	Bearing, Cone - Timken LM11749	409-0116-010	2	
	110	Spacer, Bearing - Steel	219-0090-006	1	
	115	O-ring - 1.864 X 0.070 BUNA	408-0109-291	1	
	125	Shim - Timken 0.005 THK	409-0115-033	1	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION		QUANTITY	REFERENCE CODE
	125	Shim - Timken 0.007THK	409-0115-113	1	
	125	Shim - Timken 0.020 THK	409-0115-193	1	
	130	Seal, Shaft	408-0131-020	1	
	132	Shaft, Pinion	252-0139-006	1	
	135	Screw, Hex Head-5/16-18X1	405-0017-116	4	
	140	Plug, Oil Drain - 1/2", 150# NPT	402-0009-131	3	
	145	Glass, View	407-0323-002	1	
	150	Filter, Breather/Oil	407-0326-005	1	
	300	Coupling L-100 5/8 X 14MM	410-0068-340	1	
	300	Coupling, 2HP & 3HP	410-0065-210	1	
	300	Coupling, 56C	410-0064-020	1	
	300	Coupling, 143/145TC	410-0064-090	1	
	-	Base, - 4", CBH24, 32, 40	201-0407-106	2	
	-	Base, Duplex, 10", CBH56	201-0409-000	1	
	325	Lock-wash, Exp Proof-5/16	404-0040-028	4	
	325	Lock-wash, 1, 2, & 3HP-3/8	404-0041-022		
	330	Screw, Hex, Exp Pf-5/16-1HP	405-0017-116	4	
	330	Screw, Hex, Exp Pf-5/16-2HP	405-0017-139		
	330	Screw, Hex, 3/8-1, 2, 3HP	405-0018-136		
	520	Adapter, Motor Mt, Exp Pf, 1 & 2 HP	272-0123-101	1	
	520	Adapter, Motor Mt, 1, 2, 3 HP	272-0123-001		
	550	Key, Square-3/16 X 3/16 X 1"	404-0056-061	1	
	572	Adapter, Motor Plate, Exp Pf-1HP	272-0120-006	1	
	572	Adapter, Motor Plate, Exp Pf-2HP	272-0145-006		
	572	Adapter, Motor Plate, (143/145TC & 56C)	272-0143-006		
	6050	Cover, Catchall Sub-Assy	281-0251-000	1	
	6060	Screw, Pan - #8-32NC X 1/2	405-0179-073	4	
	7000	Key, Sq-5X5mmX1", 1HP	404-2001-011	1	
	7000	Key, Sq-8X8mmX1", 2 & 3HP	404-2002-011		
	7010	Decal, Serial #	253-0129-000	1	
	8010	Oil, Mobil Gear 629	407-0324-020	5 GAL	

- Items not shown.

6.5 HPD METALLIC LIQUID END, PLUNGER SIZES 3/4" THRU 2 1/2".

Model:	Code:	Model:	Code:
Centrac "B" 16 (3/4 & 1")	A	Centrac "B" 32 (2")	D
Centrac "B" 20 (1 1/4")	B	Centrac "B" 40 (2 1/2")	E
Centrac "B" 24 (1 1/2")	C		

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
10	630	Chamber, Displacement - 106MM STL	1	221-0672-002	A, B
	630	Chamber, Displacement - 166MM STL	1	221-0839-002	C, D, E
	640	Valve, Mars Assy - Use P/N 103-0001-010	1	21608	
	642	O-ring, Parker - 2-234 BUNA	2	408-0095-251	
	650	Plate, Contour 106MM - Steel	1	298-0075-006	A, B
	650	Plate, Contour 166MM - 303SS	1	298-0102-014	C, D, E
	655	Pin, Spring - 0.062 X 5/16 STL	1	401-0001-031	A, B
	655	Pin, Spring - 0.094 X 3/8 STL	1	401-0002-031	C, D, E
	660	O-ring, Parker - 2-157 BUNA	1	408-0068-471	A, B
	660	O-ring, Parker - 2-167 BUNA	1	408-0068-571	C, D, E
	670	Diaphragm 106 HPD	1	298-0074-099	A, B
	670	Diaphragm 166 HPD	1	298-0072-099	C, D, E
	700	Head, Diaphragm - 106MM 316SS, Less than 1600 psig	1	221-0671-016	A, B
	700	Head, Diaphragm - 106MM 316SS, More than 1600 psig	1	221-0818-016	A
	700	Head, Diaphragm - 106MM CA20, Less than 1600 psig	1	221-0671-029	A, B
	700	Head, Diaphragm - 106MM CA20, More than 1600 psig	1	221-0818-028	A
	700	Head, Diaphragm - 106MM HAST C22	1	221-0671-030	A, B
	700	Head, Diaphragm - 166MM 316SS	1	221-0822-016	C
	700	Head, Diaphragm - 166MM CA20	1	221-0822-029	C
	700	Head, Diaphragm - 166MM HAST C22	1	221-0822-030	C

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	700	Head, Diaphragm - 166MM 316SS	1	221-0823-016	D, E
	700	Head, Diaphragm - 166MM CA20	1	221-0823-029	D, E
	700	Head, Diaphragm - 166MM HAST C22	1	221-0823-030	D, E
	710	Screw, Hex Head - 1/2 - 13 x 3 1/4, GR 5	8	405-0020-218	A, B
	710	Screw, Hex Head - 5/8 - 11 x 3 3/4, GR 8	8	405-0021-239	C, D, E
	720	Washer, Flat - SAE 1/2” Z PLT	24	404-0151-033	A, B,
	720	Washer, Flat - SAE 5/8” Z PLT	24	404-0151-041	C, D, E
	730	Nut, Hex - 1/2 - 13NC, ASTM GRD 2H	8	405-0068-017	A, B
	730	Nut, Hex - 5/8 - 11NC, GR 8	12	405-0069-019	C, D, E
	750	Screw, Hex Head - 1/2 - 13 x 3 1/2, GR 5	4	405-0020-228	A, B
	750	Screw, Hex Head - 5/8 - 11 x 5 1/2, GR 8	4	405-0021-279	C, D, E
	755	Stud - 7/16 NC X 3 STL, Single Ball Check Valve	8	405-0161-091	D, E
	755	Stud - 7/16 NC X 4 1/2 STL, Double Ball Check Valve	8	405-0161-141	D, E
	755	Stud - 7/16 NC X 2 1/2 STL, Single Ball Check Valve	8	405-0161-071	C
	760	Stud - 7/16 NC X 3 3/4 STL, Double Ball Check Valve	8	405-0161-331	C
	765	Nut, Hex - 7/16 - 14NC, 18.8SS	8	405-0067-012	C, D, E
	770	Elbow - 3/8T X 3/8NPT Brass	1	402-0079-041	
	780	Gasket, Teflon - 5/8” Ball, 106 HPD	6(10, Double Ball)	225-0075-175	A, B, C
	780	Gasket, Teflon - 1” Ball, 166 HPD	6(10, Double Ball)	225-0075-275	D, E
	790	Guide - 5/8” Ball 316SS HPD	2(4, Double Ball)	292-0051-016	A, B, C
	790	Guide - 5/8” Ball CA20 HPD	2(4, Double Ball)	292-0051-029	A, B, C
	790	Guide - 5/8” Ball HAST C22 HPD	2(4, Double Ball)	292-0051-030	A, B, C

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	790	Guide - 1” Ball 316SS HPD	2(4, Double Ball)	292-0052-016	D, E
	790	Guide - 1” Ball CA20 HPD	2(4, Double Ball)	292-0052-029	D, E
	790	Guide - 1” Ball HAST C22 HPD	2(4, Double Ball)	292-0052-030	D, E
	800	Seat - 5/8” 316SS	2(4, Double Ball)	224-0088-016	A, B, C
	800	Seat - 5/8” CA20	2(4, Double Ball)	224-0088-028	A, B, C
	800	Seat - 5/8” HAST C22	2(4, Double Ball)	224-0088-030	A, B, C
	800	Seat - 166MM 316SS	2(4, Double Ball)	224-0089-016	D, E
	800	Seat - 166MM CA20	2(4, Double Ball)	224-0089-028	D, E
	800	Seat - 166MM HAST C22	2(4, Double Ball)	224-0089-030	D, E
	810	Ball - 5/8” 316SS	2(4, Double Ball)	407-0014-172	A, B, C
	810	Ball - 5/8” CA20	2(4, Double Ball)	407-0014-173	A, B, C
	810	Ball - 5/8” HAST C22	2(4, Double Ball)	407-0014-176	A, B, C
	810	Ball - 1” 316SS	2(4, Double Ball)	407-0014-232	D, E
	810	Ball - 1” CA20	2(4, Double Ball)	407-0014-233	D, E
	810	Ball - 1” HAST C22	2(4, Double Ball)	407-0014-236	D, E
	820	Flange, Port Adapter - 1/2” NPT Female, 316SS	2	271-0044-116	
	820	Flange, Welded Port Adapter Assy - 150 #, 316SS	2	20141	
	820	Flange, Threaded, Port Adapter - 150 #, 316SS	2	271-0045-116	
	820	Flange, Port Adapter - CA20	2	271-0044-129	A, B
	820	Flange, Port Adapter - CA20	2	271-0045-129	C
	820	Flange, Port Adapter - CA20	2	271-0045-229	D, E
	820	Flange, Port Adapter - HAST C22	2	271-0044-130	A, B

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	820	Flange, Port Adapter - HAST C22	2	271-0045-130	C
	820	Flange, Port Adapter - HAST C22	2	271-0045-230	D, E
	-	Flange, Threaded - 150#, 316SS	2	402-0013-033	
	-	Nipple, Threaded Pipe 1” x 3” NPT 316SS	2	402-0054-043	
	830	Nut, Hex Head - 3/8 - 16NC, 18.8SS, Single Ball Check Valve	4	405-0066-012	C
	830	Screw, Hex Head - 3/8 - 16 x 1 1/2, 18.8SS, Single Ball Check Valve	4	405-0018-143	A, B
	840	Screw, Hex Head - 3/8 - 16 x 1 1/2, 18.8SS, Single Ball Check Valve	4	405-0018-143	C
	840	Screw, Hex Head - 3/8 - 16 x 2 3/4, 18.8SS, Double Ball Check Valve	8	405-0018-193	A, B
	880	3/4" Sleeve, Piston	1	1790595000	A
	880	1" Sleeve, Piston	1	237-0055-006	A
	880	Sleeve, Piston	1	237-0055-106	B
	880	Sleeve, Piston	1	237-0093-006	C
	880	Sleeve, Piston	1	237-0093-106	D
	880	Sleeve, Piston	1	237-0094-006	E
	890	3/4" Piston Assy	1	1790594000	A
	890	1" Piston Assy	1	212-0141-100	A
	890	Piston Assy	1	212-0141-200	B
	890	Piston Assy	1	212-0141-300	C
	890	Piston Assy	1	212-0142-100	D
	890	Piston Assy	1	212-0142-200	E
	892	3/4"Seal, Piston Bore	1	408-0130-091	A
	892	1"Seal, Piston Bore	1	408-0130-021	A
	892	Seal, Piston Bore	1	408-0130-031	B
	892	Seal, Piston Bore	1	408-0130-041	C
	892	Seal, Piston Bore	1	408-0130-051	D
	892	Seal, Piston Bore	1	408-0130-061	E
	894	3/4" Ring, Piston Wear	2	408-0134-080	A
	894	1" Ring, Piston Wear	2	408-0134-010	A
	894	Ring, Piston Wear	2	408-0134-020	B
	894	Ring, Piston Wear	2	408-0134-030	C
	894	Ring, Piston Wear	2	408-0134-040	D

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	894	Ring, Piston Wear	2	408-0134-050	E
	920	O-ring, Parker - 2-238 BUNA	1	408-0095-291	
	930	Gasket - 166 & 266 HPD	1	225-0077-099	
	970	Lock-washer, Spring - 7/16, 18.8SS	8	404-0042-022	
	980	Screw, Hex Head - 7/16 - 14 x 1 1/2, GR 5	2	405-0019-149	
	990	Bushing , Hexagon Pipe - 1/2” X 3/8” STL	1	402-0001-043	
	1000	Fitting, Strainer	1	245-0021-000	
	1010	Elbow - 3/8T X 1/4 NPT BRASS	1	402-0079-031	
	1030	Tube - 3/8 OD X 0.062 THK	24 IN	402-0145-XXZ	
	1040	Valve, Relief Assy	1	See Figure 14	
	1050	Elbow, Tube - 1/2 NPT X 3/8	1	402-0503-081	
	1060	Lock-washer, Spring - 5/16, Z PL	2	404-0040-028	
	1070	Screw, Hex Head - 5/16 - 18 x 2 3/4, GR 5	2	405-0017-199	A, B
	1070	Screw, Socket Head - 5/16 - 18 x 2 1/2, ALY	2	405-0028-184	C, D, E
	1080	Tubing - 1/2”OD X 3/8” ID VINYL	1 FT	402-0296-091	
	3000	Tube, Elbow - 1/2 NPT X 3/8, POLY	1	402-0503-081	
	3000	Tube, Barb - 1/2”NPT X 1/2”ID	1	402-0503-091	

- Items not shown.

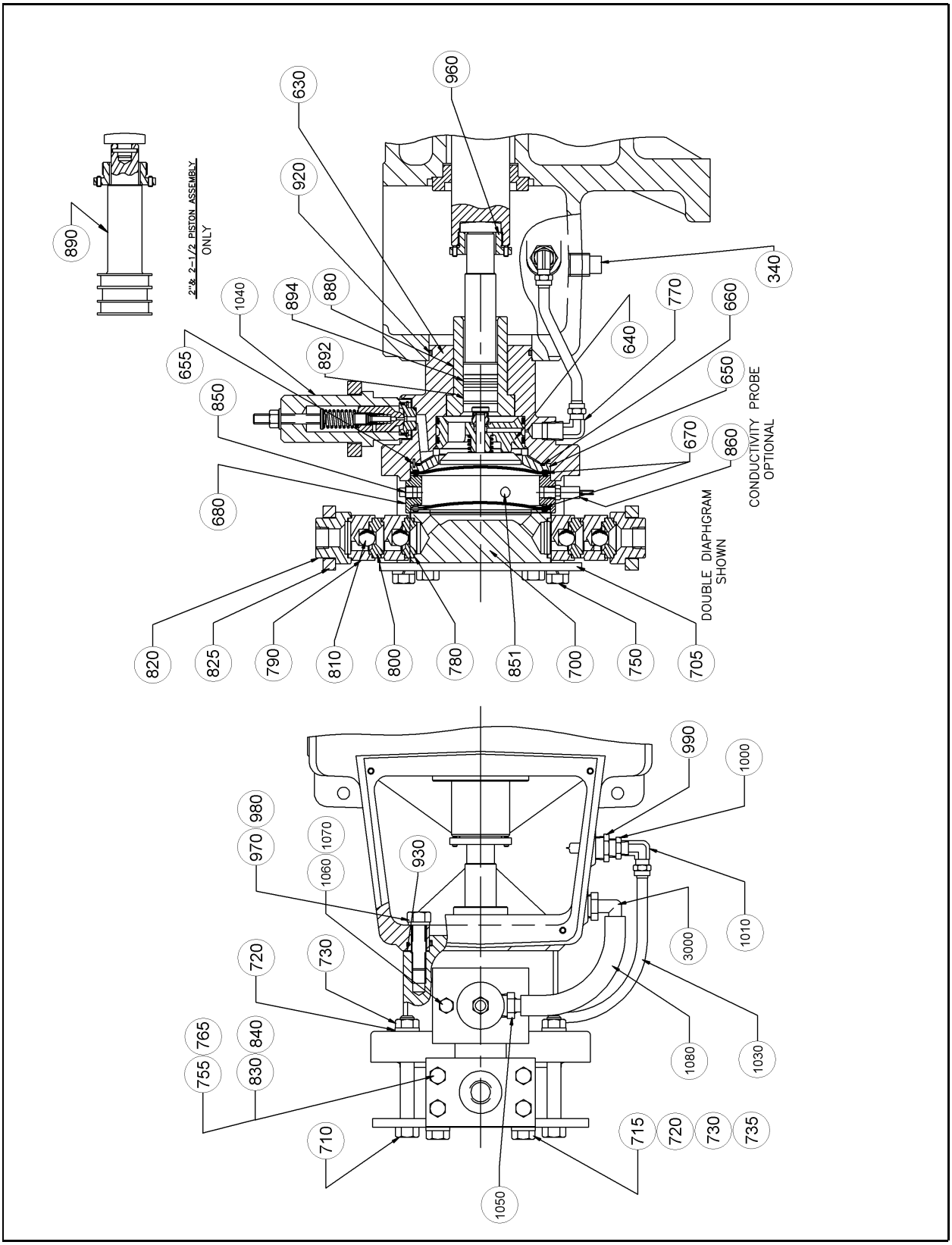

Figure 11. HPD Plastic Liquid End (DWG. 102-2925-0005, Plunger Sizes 1” thru 2 1/2”).

6.6 HPD PLASTIC LIQUID END, PLUNGER SIZES 1” THRU 2 1/2”.

Model:		Code:	Model:		Code:
Centrac “B”	16 (1”)	A	Centrac “B”	32 (2”)	D
Centrac “B”	20 (1 1/4”)	B	Centrac “B”	40 (2 1/2”)	E
Centrac “B”	24 (1 1/2”)	C			

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
11	340	Plug, Pipe - 150# THRD	1	402-0009-131	
	630	Chamber, Displacement - 106MM STL	1	221-0672-002	A, B
	630	Chamber, Displacement - 166MM STL	1	221-0839-002	C, D, E
	640	Valve, Mars Assy - Use P/N 103-0001-010	1	21608	
	650	Plate, Contour 106MM - Steel	1	298-0075-006	A, B
	650	Plate, Contour 166MM - 303SS	1	298-0102-014	C, D, E
	655	Pin, Spring - 0.062 X 5/16 STL	1	401-0001-031	A, B
	655	Pin, Spring - 0.094 X 3/8 STL	1	401-0002-031	C, D, E
	660	O-ring, Parker - 2-157 BUNA	1	408-0068-471	A, B
	660	O-ring, Parker - 2-167 BUNA	1	408-0068-571	C, D, E
	670	Diaphragm 106 HPD	1 (2, Double Diaphragm)	298-0074-099	A, B
	670	Diaphragm 166 HPD	1 (2, Double Diaphragm)	298-0072-099	C, D, E
	680	Chamber, Inter - DD with Probe	1	221-0675-015	A, B
	680	Chamber, Inter - DD with Probe	1	221-0674-015	C, D, E
	700	Head, Diaphragm - 106MM PVC	1	221-0673-071	A, B
	700	Head, Diaphragm - 166MM PVC	1	221-0663-071	C, D, E
	705	Plate, Back-up	1	271-0021-006	A, B
	705	Plate, Back-up - Steel	1	271-0047-006	C, D, E
	710	Screw, Hex Head - 5/8 - 11 x 5 1/2, 316SS	4	405-0021-275	
	710	Screw, Hex Head - 1/2 - 13 x 5, GR 5 - DD with Probe	4	405-0020-268	A, B
	710	Stud - 5/8NC x 7 3/4, 304 SS - DD with Probe	4	405-0163-256	C, D, E

- Items not shown.

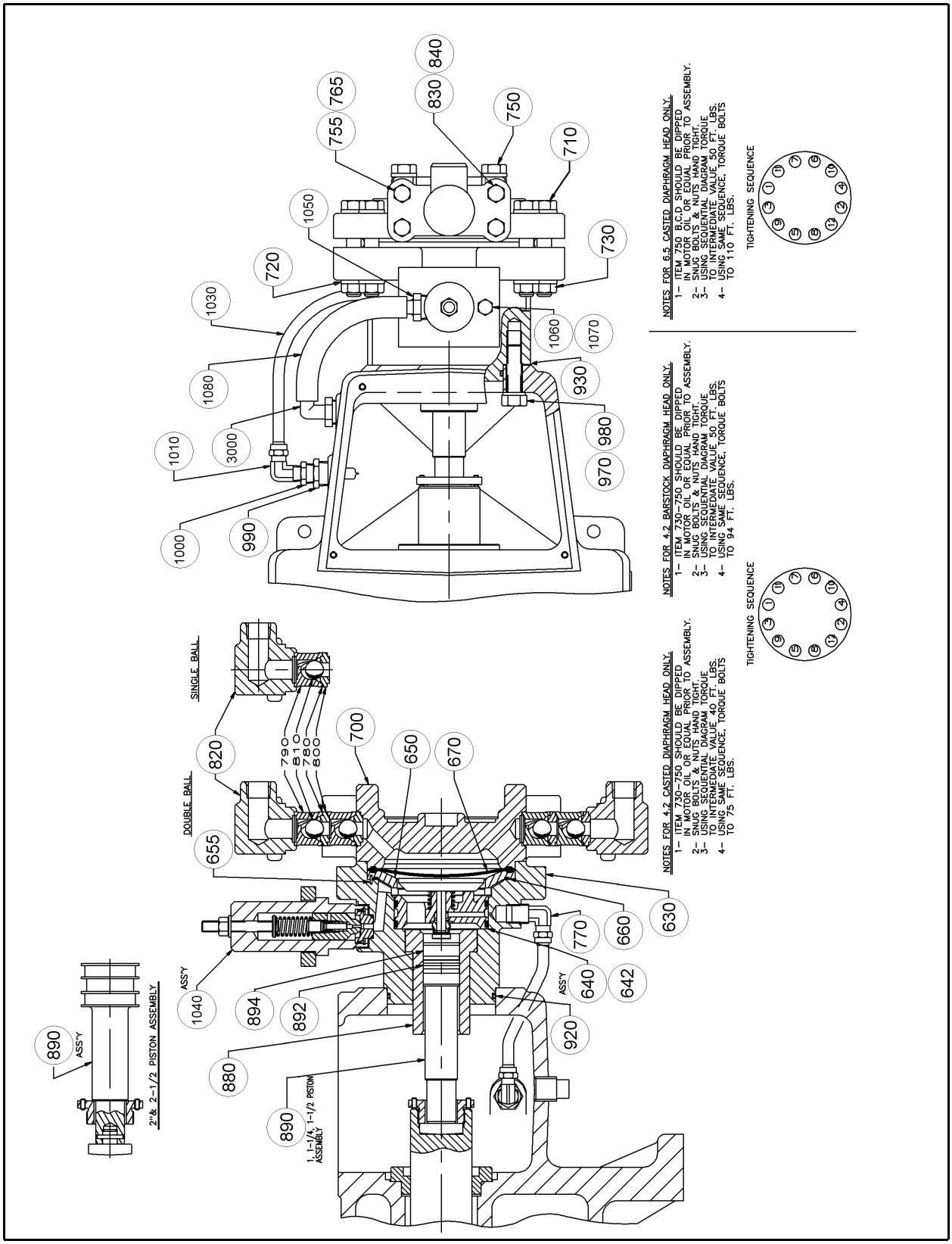

Figure 10. HPD Metallic Liquid End (DWG. 102-2925-0006, Plunger Sizes 3/4" thru 2 1/2").

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	715	Anchors, Stud - 302/303SS HPD	8	294-0016-014	A, B
	720	Lockwasher, Flat - SAE 1/2” 18.8SS	8	404-0043-022	B
	720	Screw, Hex Head - 1/2 - 13 x 3 1/2, GR 5	4	405-0020-228	A, B
	730	Nut, Hex - 1/2 - 13NC, 18.8SS	4	405-0068-012	A, B
	730	Nut, Hex - 5/8 - 11NC, GR 8	12	405-0069-019	C, D, E
	735	Lock-washer, Spring - 5/8”, 18.8SS	24	404-0044-022	C, D, E
	750	Stud, Engagement - 303SS	4	232-0035-014	
	750	Screw, Hex Head - 1/2 - 13 x 6, DD with Probe	4	405-0020-285	A, B
	750	Stud, Engagement, DD with Probe	4	232-0036-014	C, D, E
	755	Stud - 7/16 NC X 6 STL	8	405-0161-183	C, D, E
	765	Nut, Hex - 7/16 - 14NC, 18.8SS	8	405-0067-012	C, D, E
	770	Elbow - 3/8T X 3/8NPT Brass	1	402-0079-041	
	780	Gasket, Teflon - 5/8” Ball, 106 HPD	10	225-0075-475	A, B
	780	Gasket, Teflon - 1 1/2” Ball, 166 HPD	10	225-0075-575	C, D, E
	790	Guide -5/8” Ball PVC HPD	4	292-0055-071	A, B
	790	Guide - 1” Ball PVC HPD	4	292-0053-071	C, D, E
	800	Seat - 5/8” PVC	4	224-0092-071	A, B
	800	Seat - 1” PVC	4	224-0091-071	C, D, E
	810	Ball - 5/8” Ceramic	4	407-0015-171	A, B
	810	Ball - 1” Ceramic	4	407-0015-231	C, D, E
	820	Connection, Port PVC	2	271-0022-071	A, B
	820	Connection, Port PVC	2	271-0019-071	C, D, E
	-	Flange, Flat Threaded - 1/2”, 150#, PVC	2	402-0093-011	A, B
	-	Flange, Flat Threaded - 1”, 150#, PVC	2	402-0093-031	C, D, E
	-	Nipple, Threaded Pipe 1/2” x 2” NPT PVC	2	402-0052-206	A, B
	-	Nipple, Threaded Pipe 1/2” x 3” NPT PVC	2	402-0052-226	A, B

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	-	Nipple, Threaded Pipe 1” x 2” NPT PVC	2	402-0054-186	C, D, E
	-	Nipple, Threaded Pipe 1” x 3” NPT PVC	2	402-0054-206	C, D, E
	-	Elbow - 90OD 1/2” NPT SCH 80 PVC	2	402-0047-032	A, B
	-	Elbow - 90OD 1” NPT SCH 80 PVC	2	402-0047-052	C, D, E
	825	Plate, Compression	2	204-0127-015	A, B
	825	Plate, Compression - 304SS	2	204-0126-115	C, D, E
	830	Nut, Hex - 3/8 - 16NC, 18.8SS	4	405-0066-012	C, D, E
	840	Screw, Hex Head - 3/8 - 16 X 1 1/2, 18.8SS	4	405-0018-143	C, D, E
	850	Plug, 1/2 NPT, 316SS, DD with Probe	1	402-0095-042	
	851	Plug, Hex, 3/8 NPT, 316SS, DD with Probe	2	402-0095-032	
	860	Alarm Probe, Conductivity, DD with Probe	1	301-0307-000	
	880	Sleeve, Piston	1	237-0055-006	A
	880	Sleeve, Piston	1	237-0055-106	B
	880	Sleeve, Piston	1	237-0093-006	C
	880	Sleeve, Piston	1	237-0093-106	D
	880	Sleeve, Piston	1	237-0094-006	E
	890	Piston Assy	1	212-0141-100	A
	890	Piston Assy	1	212-0141-200	B
	890	Piston Assy	1	212-0141-300	C
	890	Piston Assy	1	212-0142-100	D
	890	Piston Assy	1	212-0142-200	E
	892	Seal, Piston Bore	1	408-0130-021	A
	892	Seal, Piston Bore	1	408-0130-031	B
	892	Seal, Piston Bore	1	408-0130-041	C
	892	Seal, Piston Bore	1	408-0130-051	D
	892	Seal, Piston Bore	1	408-0130-061	E
	894	Ring, Piston Wear	2	408-0134-010	A
	894	Ring, Piston Wear	2	408-0134-020	B
	894	Ring, Piston Wear	2	408-0134-030	C

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	894	Ring, Piston Wear	2	408-0134-040	D
	894	Ring, Piston Wear	2	408-0134-050	E
	896	Adapter, Floating	1	272-0111-006	A
	897	Pin, Spring - 0.125 X 13/16	1	401-0003-082	A
	920	O-ring, Parker - 2-238 BUNA	1	408-0095-291	
	930	Gasket - 166 & 266 HPD	1	225-0077-099	
	960	Nut, Floating Adapter - 303SS	1	272-0110-014	A
	970	Lock-washer, Spring - 7/16, 18.8SS	8	404-0042-022	
	980	Screw, Hex Head - 7/16 - 14 x 1 1/2, GR 5	2	405-0019-149	
	990	Bushing , Hexagon Pipe - 1/2” X 3/8” STL	1	402-0001-043	
	1000	Fitting, Strainer	1	245-0021-000	
	1010	Elbow - 3/8T X 1/4 NPT BRASS	1	402-0079-031	
	1030	Tube - 3/8 OD X 0.062 THK	24 IN	402-0145-XXZ	
	1040	Valve, Relief Assy, Max 255 PSI	1	See Figure 14	
	1050	Elbow, Tube - 1/2 NPT X 3/8	1	402-0503-081	
	1060	Lock-washer, Spring - 5/16 Z PL	2	404-0040-028	
	1070	Screw, Socket Head - 5/16 - 18 x 2 3/4, ALY	2	405-0017-199	A, B
	1070	Screw, Socket Head - 5/16 - 18 x 2 1/2, ALY	2	405-0028-184	C, D, E
	1080	Tubing - 1/2”OD X 3/8” ID VINYL	1 FT	402-0296-091	
	3000	Tube, Elbow - 1/2 NPT X 3/8, POLY	1	402-0503-081	
	3000	Tube, Barb - 1/2”NPT X 1/2”ID	1	402-0503-091	

- Items not shown.

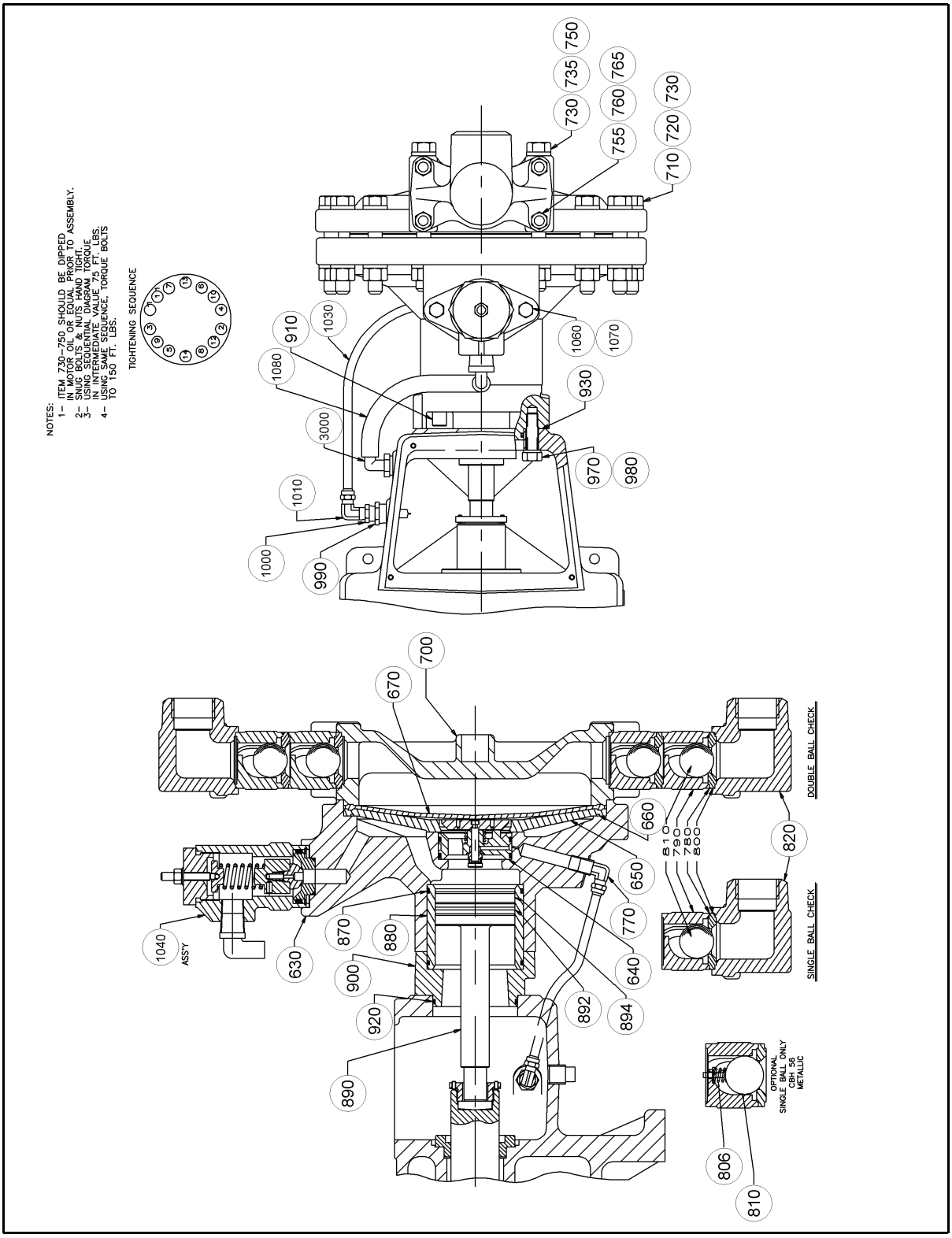

Figure 12. HPD Metallic Liquid End (DWG. 102-2925-0004, Plunger Size 3 1/2").

6.7 HPD METALLIC LIQUID END, PLUNGER SIZE 3 1/2".

Model: Centrac "B"

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
12	-	Screw, Hex Head - 3/8" - 16 x 1 1/2"	4	405-0018-143	
	-	Nut, Hex - 3/8" - 16NC	4	405-0066-012	
	-	Lock-washer, Spring - 3/8	4	404-0041-022	
	630	Chamber, Displacement - 266MM STL	1	221-0642-002	
	640	Valve, Mars Assy - Use P/N 103-0001-010	1	21608	
	-	O-ring, Parker - 2-234 BUNA, Part of Item 640	1	408-0095-251	
	650	Plate, Contour 266MM - Steel	1	298-0067-006	
	660	O-ring, Parker - BUNA	1	408-0095-671	
	670	Diaphragm 10.5" HPD	1	298-0068-099	
	700	Head, Diaphragm - 266MM 316SS	1	221-0824-016	
	700	Head, Diaphragm - 266MM CA20	1	221-0824-029	
	700	Head, Diaphragm - 266MM, Hast C22	1	221-0824-030	
	710	Screw, Hex Head - 5/8" - 11 x 4", GR 8	10	405-0021-249	
	720	Washer, Flat - SAE 5/8" Z PLT	24	404-0151-041	
	730	Nut, Hex - 5/8" - 11NC, GR 8	14	405-0069-019	
	735	Lock-washer, Spring - 5/8 18.8SS	14	404-0044-022	
	750	Screw, Hex Head - 5/8" - 11 x 6 1/2, GR 8	4	405-0021-299	
	755	Stud - 7/16" NC X 3 1/2" STL (Single Ball Only)	8	405-0161-111	
	755	Stud - 7/16" NC X 5 3/4" STL (Double Ball Only)	8	405-0161-201	
	760	Lock-washer, Spring - 7/16 18.8SS	8	404-0042-022	
	765	Nut, Hex - 7/16 - 14NC, 18.8SS	8	405-0067-012	
	770	Elbow - 3/8T X 3/8NPT Brass	1	402-0079-041	
	780	Gasket, Teflon - 1 1/2" Ball, 266 HPD	6(10, Double Ball)	225-0075-375	
	790	Guide - 1 1/2" Ball 316SS HPD	2(4, Double Ball)	292-0049-016	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	790	Guide - 1 1/2” Ball CA20 HPD	2(4, Double Ball)	292-0049-029	
	790	Guide - 1 1/2” Ball Hast C22 HPD	2(4, Double Ball)	292-0049-030	
	800	Seat - 1 1/2” 266MM 316SS	2(4, Double Ball)	224-0084-016	
	800	Seat - 1 1/2” 266MM CA20	2(4, Double Ball)	224-0084-028	
	800	Seat - 1 1/2” 266MM Hast C22	2(4, Double Ball)	224-0084-030	
	806	Spring - C-276 (Single Ball Only)	2	40953	
	810	Ball & Stem Assy- 1 1/2” 316SS (Single Ball Only)	2	40954	
	810	Ball & Stem Assy- 1 1/2” CA20 (Single Ball Only)	2	40951	
	810	Ball & Stem Assy- 1 1/2” Hast C22 (Single Ball Only)	2	40956	
	810	Ball - 1 1/2” 316SS (Double Ball Only)	4	407-0014-272	
	810	Ball - 1 1/2” CA20 (Double Ball Only)	4	407-0014-273	
	810	Ball - 1 1/2” Hast C22 (Double Ball Only)	4	407-0014-276	
	820	Flange, Port Adapter - 1 1/2” NPT Female, 316SS	2	271-0046-016	
	820	Flange, Port Adapter - 1 1/2” NPT Female, CA20	2	271-0046-029	
	820	Flange, Port Adapter - 1 1/2” NPT Female, Hast C22	2	271-0046-030	
	820	Flange, Welded Port Adapter Assy - 150 #, 316SS	2	20141	
	820	Flange, Threaded, Port Adapter - 150 #, 316SS	2	271-0045-116	
	-	Flange, Threaded - 150#, 316SS	2	402-0013-033	
	-	Nipple, Threaded Pipe 1” x 3” NPT 316SS	2	402-0054-043	
	870	O-ring, Parker - 2-242 BUNA	2	408-0095-331	
	880	Sleeve, Piston	1	237-0095-006	
	890	Piston Assy	1	212-0142-300	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	892	Seal, Piston Bore	1	408-0130-071	
	894	Ring, Piston Wear	2	408-0134-060	
	900	Adapter, Liquid End - 266HPD	1	272-0092-001	
	910	Screw, Socket Head - 5/8 - 11 x 2 STL	4	405-0032-164	
	920	O-ring, Parker - 2-238 BUNA	1	408-0095-291	
	-	Stud - 5/8NC X 1/4 STL	1	405-0163-331	
	930	Gasket - 166 & 266 HPD	1	225-0077-099	
	-	Lock-washer, Spring - 5/8 18.8SS	1	404-0044-022	
	-	Nut, Hex - 5/8 - 11, GR 8	3	405-0069-019	
	970	Lock-washer, Spring - 7/16, 18.8SS	12	404-0042-022	
	980	Screw, Hex Head - 7/16 - 14 x 1 1/2, GR 5	2	405-0019-149	
	990	Bushing , Hexagon Pipe - 1/2” X 3/8” STL	1	402-0001-043	
	1000	Fitting, Strainer	1	245-0021-000	
	1010	Elbow - 3/8T X 1/4 NPT BRASS	1	402-0079-031	
	1030	Tube - 3/8 OD X 0.062 THK	24 IN	402-0145-XXZ	
	1040	Valve, Relief Assy	1	See Figure 14	
	1060	Lock-washer, Spring - 7/16, Z PL	2	404-0042-021	
	1070	Screw, Hex Head - 7/16 - 14 x 2 1/4, ST	2	405-0019-171	
	1080	Tubing - 1”OD X 3/4” ID-1/8” Wall	1 FT	402-0296-171	
	3000	Tube, Elbow - 1/2” NPT X 3/4” ID, PLASTIC	1	402-0503-182	

- Items not shown.

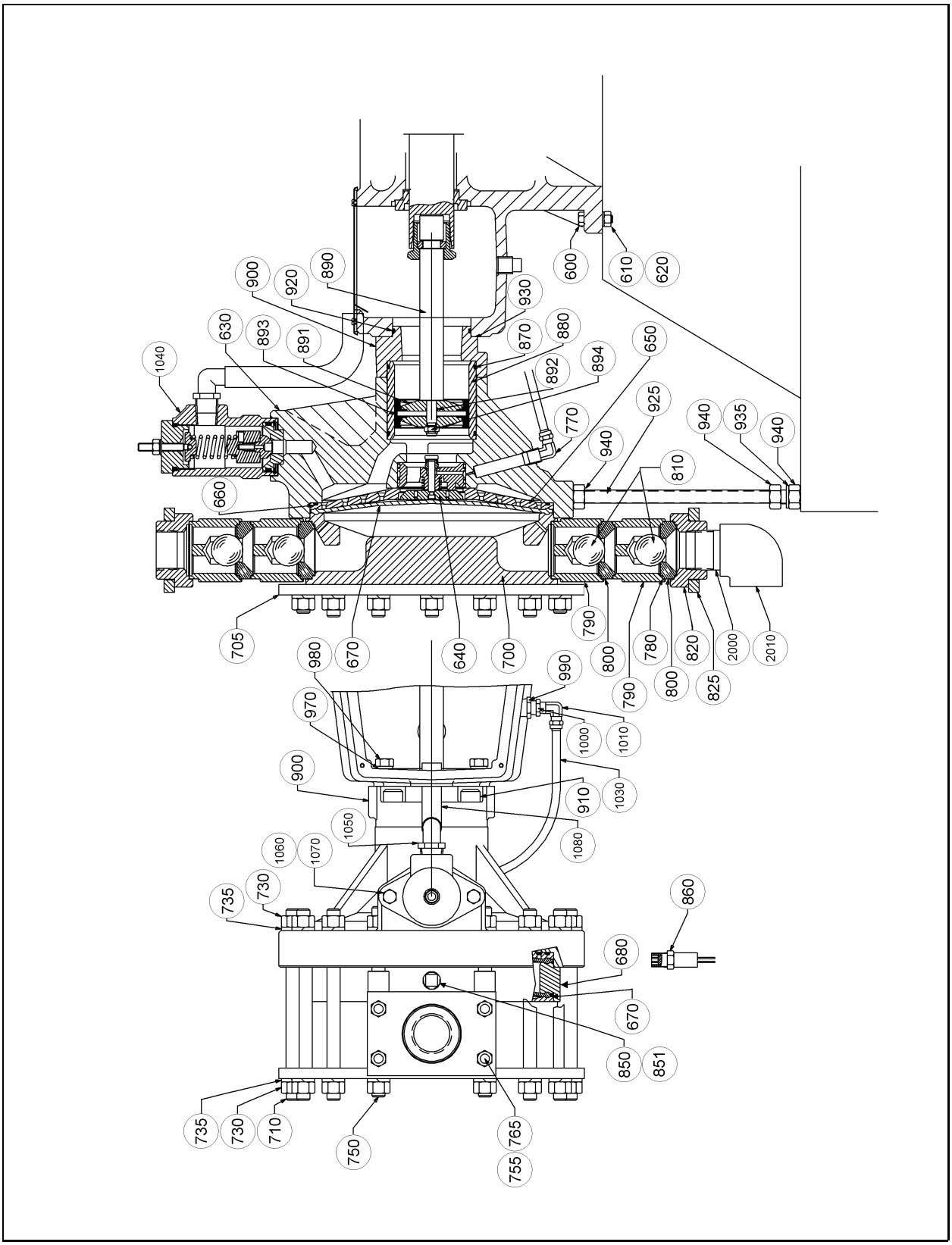

Figure 13. HPD Plastic Liquid End (DWG. 102-2925-0003, Plunger Size 3 1/2").

6.8 HPD PLASTIC LIQUID END, PLUNGER SIZE 3 1/2".

Model: Centrac "B"

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
13	600	Screw, Hex - 3/8" - 16 x 1 1/2"	4	405-0018-143	
	610	Nut, Hex - 3/8" - 16NC	4	405-0066-012	
	620	Lock-washer, Spring - 3/8	4	404-0041-022	
	630	Chamber, Displacement - 266MM STL	1	221-0642-002	
	640	Valve, Mars Assy - Use P/N 103-0001-010	1	21608	
	650	Plate, Contour 266MM - Steel	1	298-0067-006	
	660	O-ring, Parker - BUNA	1	408-0095-671	
	670	Diaphragm 10.5" HPD	1	298-0068-099	
	670	Diaphragm 10.5" HPD, DD with Probe	1	298-0068-099	
	680	Chamber, Inter - DD with Probe	1	221-0689-015	
	700	Head, Diaphragm - 266MM, PVC	1	221-0648-071	
	705	Plate, Back-up - STL	1	271-0016-006	
	710	Screw, Hex Head - 5/8" - 11 x 6 1/2", GR 8	10	405-0021-299	
	710	Studs - 5/8" - 11 x 9 1/8", DD with Probe	10	232-0030-214	
	730	Nut, Hex - 5/8" - 11NC, GR 8	18	405-0069-019	
	735	Lock-washer, Spring - 5/8 18.8SS	18	404-0044-022	
	750	Stud, Engagement - 10.5 HPD	4	232-0024-014	
	750	Stud, Engagement DD with Probe	4	232-0031-014	
	755	Stud - 7/16" NC X 8" 304SS	8	405-0161-283	
	765	Nut, Hex - 7/16 - 14NC, 18.8SS	8	405-0067-012	
	770	Elbow - 3/8T X 3/8NPT Brass	1	402-0079-041	
	780	Gasket, Teflon - 1 1/2" Ball, 266 HPD	10	225-0075-675	
	790	Guide - 1 1/2" Ball PVC HPD	4	292-0050-071	
	800	Seat - 1 1/2" 266MM PVC	4	224-0086-071	
	810	Ball - 1 1/2" Ceramic	4	407-0015-271	
	820	Connector, Port - PVC	2	271-0015-071	
	825	Plate, Compression	2	204-0123-015	

- Items not shown.

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
	850	Plug, 1/2 NPT, 316SS, DD with Probe	1	402-0095-042	
	851	Plug, Hex, 3/8 NPT, 316SS, DD with Probe	2	402-0095-032	
	860	Alarm Probe, Conductivity, DD with Probe	1	301-0307-000	
	870	O-ring, Parker - 2-242 BUNA	2	408-0095-331	
	880	Sleeve, Piston	1	237-0095-006	
	890	Piston Assy	1	212-0142-300	
	892	Seal, Piston Bore	1	408-0130-071	
	893	Seal, Shaft	1	408-0131-020	
	894	Ring, Piston Wear	2	408-0134-060	
	900	Adapter, Liquid End - 266HPD	1	272-0092-001	
	910	Screw, Socket Head - 5/8 - 11 x 2 STL	4	405-0032-164	
	920	O-ring, Parker - 2-238 BUNA	1	408-0095-291	
	925	Stud - 5/8NC X 1/4 STL	1	405-0163-331	
	930	Gasket - 166 & 266 HPD	1	225-0077-099	
	935	Lock-washer, Spring-5/8,18.8SS	1	404-0044-022	
	940	Nut, Hex - 5/8 - 11, GR 8	3	405-0069-019	
	970	Lock-wash, Spring-7/16, 18.8SS	12	404-0042-022	
	980	Screw, Hex Head - 7/16 - 14 x 1 1/2	2	405-0019-149	
	990	Bushing , Hexagon Pipe - 1/2” X 3/8” STL	1	402-0001-043	
	1000	Fitting, Strainer	1	245-0021-000	
	1010	Elbow - 3/8T X 1/4 NPT BRASS	1	402-0079-031	
	1030	Tube - 3/8 OD X 0.062 THK	24 IN	402-0145-XXZ	
	1040	Valve, Relief Assy	1	See Figure 14	
	1060	Lock-washer, Spring-7/16, Z PL	2	404-0042-021	
	1070	Screw, Hex Head - 7/16 - 14 x 2 1/4, ST	2	405-0019-171	
	1080	Tubing-1”OD X 3/4” ID-1/8” Wall	1 FT	402-0296-171	
	2000	Nipple, Threaded Pipe 1 1/2” x 3/4” NPT PVC	1	402-0121-176	
	2010	Elbow - 90D 1 1/2 NPT SCH80 PVC	1	402-0047-072	
	3000	Tube, Elbow - 1/2” NPT X 3/4” ID, PLASTIC	1	402-0503-182	

- Items not shown.

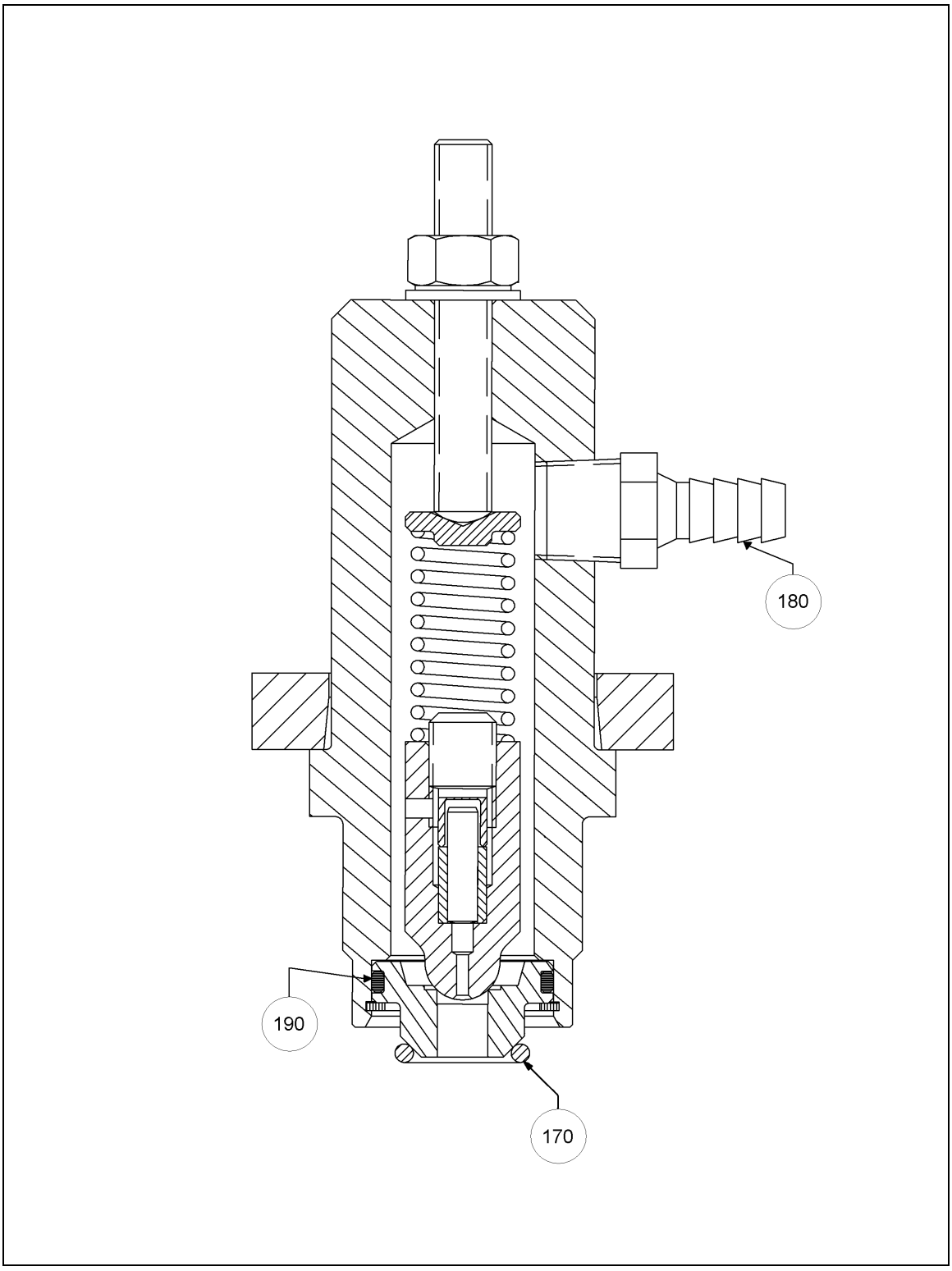

Figure 14. Relief Valve Assembly, Plunger Size 3/4” thru 2 1/2” (101-0021-X06).

6.9 RELIEF VALVE ASSEMBLY, PLUNGER SIZES 3/4" THRU 2 1/2".

Model:	Code:	Model:	Code:
Centrac "B" 16 (1")	A	Centrac "B" 32 (2")	D
Centrac "B" 20 (1 1/4")	B	Centrac "B" 40 (2 1/2")	E
Centrac "B" 24 (1 1/2")	C		

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
14	N/A	Discharge Pres. (PSI) 30-150 (Plastic)	1	101-0020-010	A, B, C, D, E
	N/A	Discharge Pres. (PSI) 451-750	1	101-0021-706	A
	N/A	Discharge Pres. (PSI) 751-1550	1	101-0021-306	A
	N/A	Discharge Pres. (PSI) 1551-2362	1	101-0021-406	A
	N/A	Discharge Pres. (PSI) 221-450	1	101-0021-606	B
	N/A	Discharge Pres. (PSI) 451-750	1	101-0021-706	B
	N/A	Discharge Pres. (PSI) 751-1550	1	101-0021-306	B
	N/A	Discharge Pres. (PSI) 221-450	1	101-0021-606	C
	N/A	Discharge Pres. (PSI) 451-750	1	101-0021-706	C
	N/A	Discharge Pres. (PSI) 751-1050	1	101-0021-306	C
	N/A	Discharge Pres. (PSI) 30-220	1	101-0021-506	D
	N/A	Discharge Pres. (PSI) 221-450	1	101-0021-606	D
	N/A	Discharge Pres. (PSI)451-600	1	101-0021-706	D
	N/A	Discharge Pres. (PSI) 30-220	1	101-0021-506	E
	N/A	Discharge Pres. (PSI) 221-375	1	101-0021-606	E
	N/A	Discharge Pres. (PSI) 30-142	1	101-0020-010	F
	N/A	Discharge Pres. (PSI) 30-187	1	101-0020-010	F
	170	O-Ring 2-114 VITON	1	408-0068-045	A, B, C, D, E
	180	3/8" X 3/8" NPT Tube Adapter	1	402-0225-118	A, B, C, D, E
	190	O-Ring, Parker 2-120 BUNA	1	408-0068-101	A, B, C, D, E

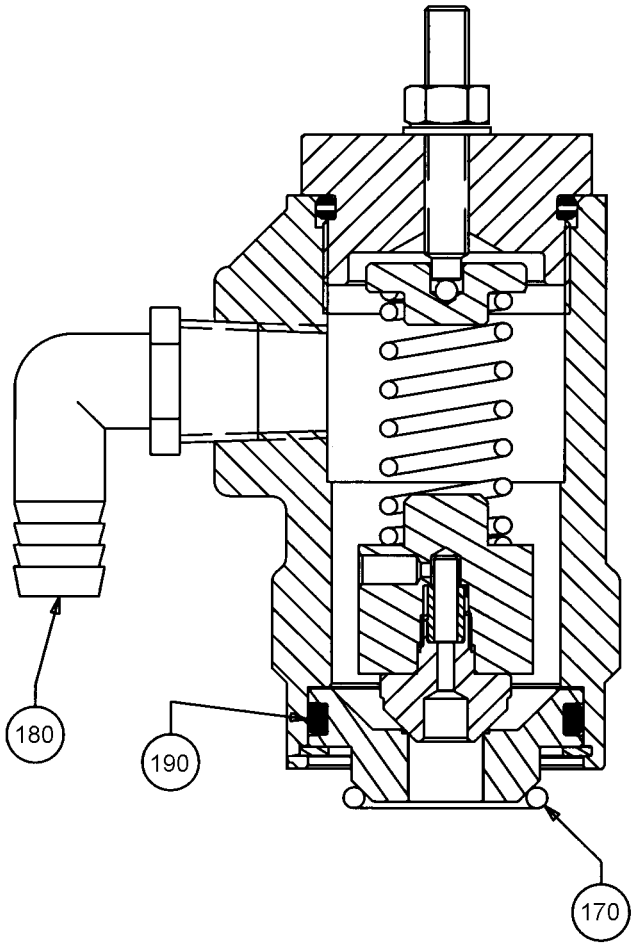

Figure 15. Relief Valve Assembly, Plunger Size 3 1/2” (101-0020-XX0).

6.10 RELIEF VALVE ASSEMBLY, PLUNGER SIZE 3 1/2".

Model: Code:

Centrac "B" 56 (3 1/2")

FIGURE NUMBER	ITEM NUMBER	DESCRIPTION	QUANTITY	PART NUMBER	REFERENCE CODE
14	N/A	Discharge Pres. (PSI) 30-150 (Plastic)	1	101-0020-010	
	N/A	Discharge Pres. (PSI) 30-142	1	101-0020-010	
	N/A	Discharge Pres. (PSI) 30-187	1	101-0020-010	
	170	O-Ring, Parker 2-220 BUNA	1	408-0095-111	
	180	Elbow, Plastic Tube	1	402-0503-152	
	190	O-Ring, Parker 2-328	1	408-0002-011	

LIMITED WARRANTY

The Milton Roy Company (“Company”) warrants that its pumping products will be free from defects in title, and so far as of its own manufacture, will be free from defects in materials and workmanship for a period of thirty six months from shipment by the Company. The Company additionally warrants that all of its other products, including actuators, will be free from defects in title, and so far as of its own manufacture. will be free from defects in materials and workmanship for a period of twelve months from shipment by the Company. The Company will, as its option, repair or replace its products provided the Company’s inspection reveals the products to have been defective or nonconforming within the terms of this warranty. This warranty is expressly conditioned upon the following: (a) proper installation, maintenance, and use under the Company specified service conditions, (b) prompt notice of nonconformance or defect, (c) the Company’s prior written authorization for return, (d) the products being returned to the Company, or at the Company’s discretion, to a Factory Authorized Service Center, all at no cost to the Company. The Company will deliver repaired or replacement products Ex Works its factory or Factory Authorized Service Center. Products not of the Company’s manufacture are warranted only to the extent provided by the original manufacture. The company shall not be liable for damage of any kind resulting from erosive, corrosive or other harmful action of any liquids, gases, or any other substance handled by the Company’s products.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS, OR LIABILITIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM THIS CONTRACT, ITS PERFORMANCE, OR IN CONNECTION WITH THE USE OF, OR INABILITY TO USE THE COMPANY’S PRODUCTS.

The liability of the Company in respect of all damages, losses, costs or expenses, whether suffered or incurred by the Purchaser or any third party arising in any manner or incident related to this contract of the performance hereunder, shall be limited in the aggregate to the actual price paid by the Purchaser to the Company.

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