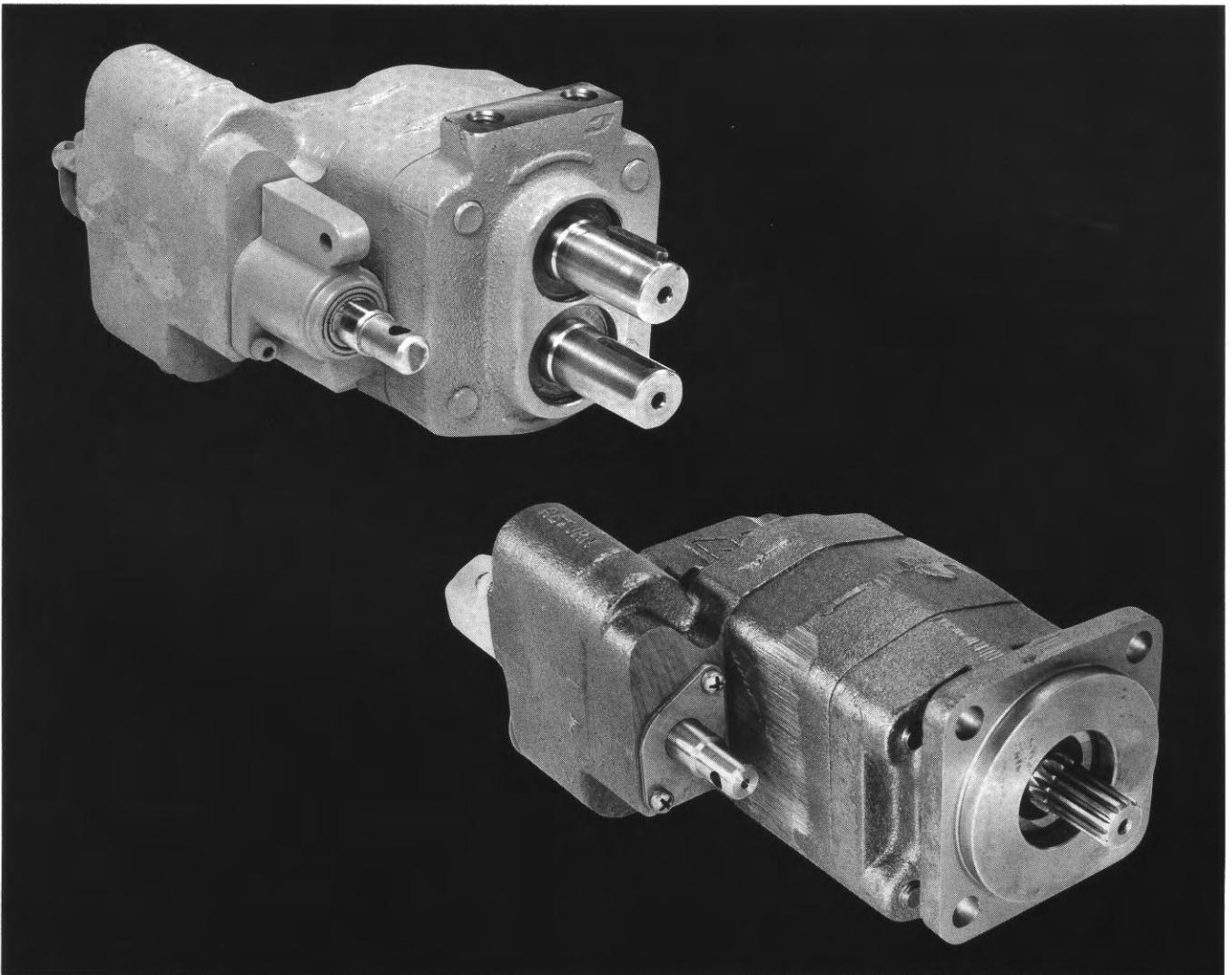


G101•G102

Pump/Valve

Service Instructions
HS35



contents:

• Cleanliness	1
• Options	1
• Lubrication and Oil Recommendations	2
• Recommended Start-up Procedure for new or rebuilt pump or motor	3
• Tool List	3
• Disassembly	4
• Assembly	5
• C101 Relief Valve Maintenance ...	6
• C101 Relief Valve Adjustment	6
• Parts List	7
• C101 Service Kits	8
• Troubleshooting	9

introduction

Commercial's G101 and G102 pump valve assemblies are compact power sources for smaller dumptrucks. These units are based on Commercial's well-proven P30 gear pumps and produce flows of 21 gpm (1 1/2" gears) to 29 gpm (2" gears) at 1800 rpm. Maximum working pressure is 2500 psi and maximum speed is 2400 rpm.

cleanliness

The most common cause of premature pump failure is dirty oil. Modern hydraulic components require very close tolerances to operate efficiently at high pressures. Contaminants, no matter how small, cause wear and decrease the life of the piece of equipment. Make sure all components are clean when they're installed and that regular maintenance practices keep the oil clean.

options

- Spring return-to-neutral or detent spool actuation.
- G101 remote mount units can be driven in either rotation.
- G102 direct mountings:
 SAE "B" 4-bolt
 SAE "B" 2-bolt
 Cloverleaf 4-bolt
 Please specify the direction of rotation when ordering G102 direct mount units.
- Choice of two- or three-line installations.

These Warnings Apply to All Pump / Valve Units

• A device to lock the control lever in the neutral position must be installed. Pump / valve units without a lockable control lever may allow the dump bed to rise unintentionally while in transit. Failure to provide such a lock may lead to loss of vehicle control, accidental injury and/or property damage.

• Failure to disengage the PTO from driving the pump/valve when in transit may allow the dump bed to rise unintentionally. This may lead to loss of vehicle control, accidental injury and/or property damage.

• Commercial's pump/valves are equipped with a neutral stop device for those applications using a pull-out cable. This device allows the pull-out cable to move the valve spool from the raise to the neutral position only. Since shock loading in the cable is possible, **it is essential that a spring (Commercial's part no. 391-3581-854 or**

equal) be incorporated in the pull-out cable hookup. Failure to do so could result in breakage of the neutral stop device and could lead to injury. We recommend that the cable be fully enclosed and directly in line with the spool.

• **Never work under a raised dump bed without first securely blocking the bed to prevent its accidental lowering.**

• 3-line installations are recommended whenever possible. 3-line circuits consist of a pump inlet line, a line to the cylinder and a return line to tank. A sleeve must be installed in the pump's inlet to allow oil to circulate through the unit and return to tank when running in neutral. Lower operating temperatures and the ability to install a return-line filter are two advantages of a 3-line circuit. Be sure the return line is always below the oil level in the reservoir. 2-line installations are for intermittent operation only.

If you do not understand these warnings or have any questions about any of them, contact your Commercial Intertech distributor or the Product Support Group at Commercial. Phone (216) 746-8011 or Fax (216) 746-1148

Lubrication and oil recommendations

All parts are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the system clean. Whenever there is a pump failure and there is reason to feel that metal particles may be in the system, the oil must be drained, the entire system flushed clean and any filter screens thoroughly cleaned or replaced. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Commercial's pumps and motors should meet the following specifications.

viscosity:

- 50 SSU minimum @ operating temperature
- 7500 SSU maximum @ starting temperature
- 150 to 225 SSU @ 100°F (37.8°C) (generally)
- 44 to 48 SSU @ 210°F (98.9°C) (generally)

approximate SSU at...

Oil Grade	100°F (37.8°C)	21°F (98.9°C)
SAE10	150	43
SAE20	330	51

viscosity index: 90 minimum

aniline point:

+175° (80°C) minimum

recommended additives:

- Foam Depressant
- Rust and Oxidation Inhibitors

other desirable characteristics:

- Stability of physical and chemical characteristics.
- High demulsibility (low emulsibility) for separation of water, air and contaminants.
- Resistant to the formation of gums, sludges, acids, tars and varnishes.
- High lubricity and film strength.

general recommendations:

A good quality hydraulic oil conforming to the characteristics listed is essential to satisfactory performance and long life of any hydraulic system.

Oil should be changed on regular schedules in accordance with the manufacturer's recommendations and the system periodically flushed.

Oil temperature in reservoir must not exceed 200°F (93.3°C) with a maximum temperature of 180°F (82.2°C) recommended. Higher temperatures will result in rapid oil deterioration.

Reservoir capacity should equal that of the cylinder(s) plus 20 gallons or be approximately 1 1/2 times the output of the pump.

Oil poured into the reservoir should pass through a 100 mesh screen. Pour only clean oil from clean containers into the reservoir.

3-line installations ONLY

A 100 mesh screen may be used in the suction line. If a suction filter is used, it should be of sufficient size to handle twice the pump's rated flow. It must be cleaned and checked regularly to avoid damage due to contamination and cavitation.

Always mount the pump lower than the hydraulic reservoir to ensure the inlet will be flooded with a good supply of oil.

normal temperatures:

- Ambient.
- 0°F (-18°C) to 100°F (37.8°C) System.
- 100°F (37.8°C) to 180°F (82.2°C)

Be sure your oil is recommended

for the temperatures you expect to encounter.

cold weather operations:

Oils for use in cold weather should have a viscosity not exceeding 7500 SSU at the minimum start-up temperature. A pour point of at least 20°F below start-up temperature is recommended. Start-up procedures should allow for a gradual warm-up until the oil reaches a reasonably fluid state.

the use of other oils:

- Automatic Transmission Fluid (ATF): General experience here has been satisfactory; however, ATF oils are sometimes too expensive for normal use in hydraulic systems.
- Diesel Fuel or Kerosene (Coal Oil): Sometimes used as dilutants for cold weather operations but are not recommended as they are not sufficiently refined products.

DO NOT USE ANY FIRE RESISTANT FLUIDS OR NON-PETROLEUM OILS WITHOUT CONSULTING OUR PRODUCT SUPPORT DEPARTMENT.

• These suggestions are intended as a guide only. OBTAIN YOUR FINAL OIL RECOMMENDATIONS FROM YOUR OIL SUPPLIER.

recommended start-up procedure for new or rebuilt pump or motor

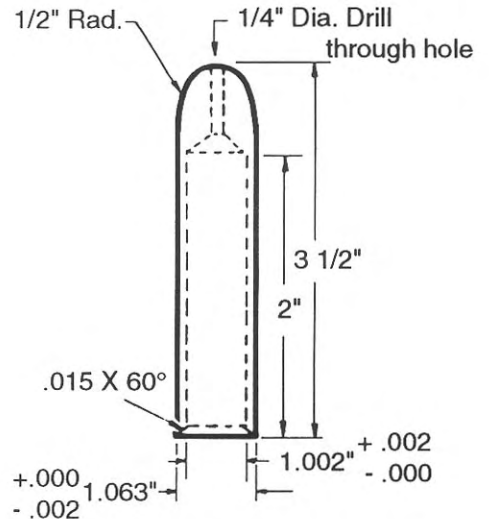
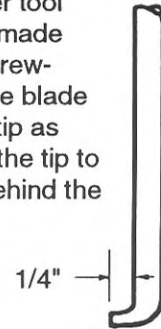
Before connecting any lines to the pump pour a small quantity of clean oil in the inlet port to provide initial lubrication.

After connecting the lines and mounting the replacement unit, operate the pump at least two minutes at zero pressure at lowest possible rpm. During this break-in period, the unit should run free and not develop an excessive amount of heat. If the unit operates properly, speed and pressure can then be increased to normal operating setting of 2000 psi.

tool list

- Arbor Press
- Bearing Puller (Owatonna Tool Co. MD-956 or equivalent)
- Clean Lintless Cloths
- Deburring Tool (an old file with the cutting teeth ground off)
- Machinist's Hammer
- Feeler Gage
- Soft Hammer
- Permatex™ Aviation Form-A-Gasket No. 3 Non-hardening Sealant or Equivalent
- Medium Grit Carborundum Stone
- Oil and Grease
- Snap Ring Pliers
- Prick Punch
- Sharp Razor Blade
- Scale (1/32" or 1/64" graduations)
- Small Screwdriver
- 8" Adjustable Wrench
- Torque Wrench
- Vise with 6" Minimum Open Spread
- Bar for Lip Seal Installation (use 1 5/8" dia. by 2" bar)
- Special Steel Sleeve

A seal remover tool can be easily made from an old screwdriver. Heat the blade and bend the tip as shown. Grind the tip to fit the notch behind the shaft seal.



All external surfaces must be free of scratches and burrs.

This special steel sleeve can be made from bar stock and is used to prevent damage when inserting the drive shaft through the lip seal. The drawing gives details for making this tool.

plumbing options

two-line installation

Generally used for intermittent operation. When the spool is in neutral, the unit recirculates oil internally. Two lines are used, one to cylinder and one to the tank.

three-line installation

3-line circuits are recommended whenever possible. With the spool in neutral, oil circulates through the pump and returns to tank. 3-lines are used, one to tank, one inlet line and one to the cylinder. This circuit requires a sleeve in the pump's inlet (P/N) 391-3283-052)

disassembly

1. Wash and wipe all dirt from the outside of the unit. Mark the castings to simplify reassembly.

2. (G101 ONLY) Remove the key from the drive shaft and save for reassembly.

3. Grip the valve end of the unit in a large vise with the drive shaft(s) up. If the pump is a G102, remove the snap ring, spacer and seal retainer. If a G101, remove the snap rings from both drive shafts.

4. Turn the pump end-for-end and grip the shaft end cover in the vise.

NOTE: If the valve spool or relief valve is not to be removed, go to step 7. Be sure that the valve spool moves easily in the bore. If the spool is detented, make sure the detent holds.

5. Remove the relief valve cartridge from the valve assembly. Maintenance instructions are on page 6. Keep dirt and foreign matter out of the open end of the cartridge.

6. If spool "O" rings are to be replaced, you must remove the spool from the housing. Methods differ depending on the type of operator:

detent

a. Move the spool to the neutral detent position. Remove the detent retaining cap, lock washer, spring, detent ball and the end cap. A pen magnet works well to remove the detent ball. Be careful not to lose the spring or ball.

b. Remove the two cap screws and slide the spool end cap off of the spool. Remove the retainer plate.

spring return

a. Remove the two socket head cap screws from the spool end cap and slide the cap off of the spool.

b. Remove the two retaining rings, the two spring guides, spring and its retainer. **CAUTION: The spring is compressed.**

From this point, instructions are the same for both types of operators.

c. Remove the two socket head cap screws from the bracket over the rear of the spool and slide the bracket over the end of the cap. Remove the spirol pin from the spool and slide off the spool end cap.

d. Remove any dirt and paint from the spool.

e. Push the spool through the bore to be sure it slides freely. Remove the spool.

If the spool drags in the bore, inspect the spool for nicks or burrs. If possible, remove these with 330 or finer emery or crocus cloth.

If the spool continues to drag, it may be bent or the spool bore may be damaged. Spools are hone-fitted to their individual housings. Therefore, damage to either the spool or housing means the entire valve must be replaced.

f. Remove the "O" rings from both ends of the bore and discard. Check "O" ring groove for any foreign material.

7. Remove cap screws with a sturdy socket and breaker bar and lift the valve housing from the assembly. Remove thrust plate if it remains attached to the valve housing.

8. Push upward on the end of the drive shaft(s) until gears can be lifted out of gear housing.

9. Using two pry tools or screwdrivers, separate the gear housing from the shaft end cover. Be careful not to damage machined surfaces. Remove the gasket seals from their grooves and discard. Remove the thrust plate from housing bore. Discard the rubber pocket seals.

10. Use the bent pry tool or a screwdriver to tap the shaft seals out of G101 bores or the shaft seal out of the G102. Discard the seals.

11. Remove bearings from the shaft end cover and valve housing with a bearing puller. The high pressure ring seals can then be lifted out and inspected for wear.

12. Wash all component parts in solvent and blow dry prior to inspection.

component inspection

Wear on component parts will often indicate what problems existed while the unit was in operation. Listed below are major components and general rules to help you determine acceptable wear limits.

gear housing

Pressure pushes the gears against the housing on the low pressure side. As the hubs and bearings wear, the cut-out becomes more pronounced. Excessive cut-out in a short period of time indicates excessive pressure or oil contamination.

Place a straight-edge across bore. If you can slip a .005" feeler gage under the straight edge in the cut-out area, replace the gear housing.

The G101/G102 gear housing can not be "flopped" because the high and low pressure sides are not interchangeable.

drive shafts/gears

Replace if there is excessive wear in the ring seal areas or at the drive coupling. .002" wear is the maximum allowable.

Any scoring on gear hubs detectable by touch, or wear in excess of .002" necessitates replacement. Scoring, grooving or burring of

outside diameter of teeth requires replacement. Nicking, grooving or fretting of tooth surfaces also necessitates replacement.

The gears in the G101/G102 are matched sets. Damage to either gear means both gears must be replaced with another matched set.

bearings

If the gears are replaced, replace the bearings. We recommend replacing bearings during any major repair or rebuild.

Worn bearings are indicated by rollers falling out of the cage, pitting or metal flaking from the roller tips or the inside race.

Bearings should fit into the bore with a light press fit, however, a neat hand fit is allowable. If bearings do not fit snugly, the bearing bores may be worn and the casting should be replaced.

thrust plates

The thrust plates seal the oil at the sides of the gears. Wear here will allow internal slippage, allowing oil to bypass within the pump and decreasing efficiency. .002" maximum wear is allowable.

Replace thrust plates if they are scored, eroded, discolored or pitted.

Check center of thrust plates where the gears mesh. Erosion here indicates oil contamination.

Pitted thrust plates indicate cavitation or oil aeration.

Discolored thrust plates indicate overheating, probably insufficient oil or traveling with PTO engaged, a dangerous practice.

seals and gaskets

Replace all rubber and polymer seals whenever repairing pump,

including all "O" rings, pocket seals behind the thrust plates, shaft seals and gasket seals.

valve repairs

Repairs to the valve assembly are limited to replacing worn spool seals and relief valve maintenance detailed on page 6. No repair should be attempted on the spool itself except the light polishing as indicated in disassembly step 6.

combination relief valve/check valve

Major wear points are the check poppet, internal poppet and seat. The relief valve can be disassembled and cleaned in solvent and blown dry. If parts are worn or the operation of the relief valve is suspect, replace the cartridge.

assembly

Always Use Genuine Commercial Intertech Replacement Parts

1. Wash parts in solvent. Blow dry.

2. Clean shaft seal bores with fine emery cloth to remove any burrs or old sealant.

Apply Permatex™ Aviation Form-a-Gasket #3, non-hardening sealant or equivalent to the O.D. of the seals. Press the seals into the bores with an arbor press. Wipe any excess sealant off the O.D. of seal. Install snap rings.

3. If bearings were removed at disassembly, place the high pressure ring seals in each bearing bore with flat side down.

Press new bearings into their respective bores in the shaft end cover and valve housing using a flat bar and arbor press. The bearings will bottom out in the casting and should protrude equally from the machined surface.

4. Place the shaft end cover in a vise with the bearings facing up. With a razor blade, cut the two center pocket seals 3/16" long from the pocket seal strip and insert them in the thrust plate. Use light grease to hold seals in place.

CAUTION: The gear housing has arrows cast into the surface to indicate rotation direction. The units must be assembled with the arrows pointing toward the valve.

5. With the pocket seals facing down, place the thrust plate over the bearings in the shaft end cover. Tap thrust plate with a soft hammer to about 1/32" from the machined surface.

Cut four pocket seals approximately 1/4" long from the pocket seal strip. Insert one pocket seal into each of the slots in the thrust plate. Push each pocket seal all the way in so that it touches the roller bearings. Tap the thrust plate down firmly against the machined surface with a soft hammer. Use a sharp razor blade to trim exposed end of the pocket seal square and flush with the thrust plate. Repeat the procedure for the valve housing thrust plate.

6. Insert the end of the drive shaft into the steel sleeve (see Tool List). Lightly grease the drive shaft and sleeve. Insert the integral gear and drive shaft with sleeve into the shaft end cover with a twisting motion. Be careful not to damage the lip seal. Push down carefully until the gear rests against the thrust plate. Remove the steel sleeve. Insert the other gear.

7. Lightly coat the gasket seals with grease and install them in the gasket seal grooves in the gear housing. Slip the gear housing over the gears.

8. Seat the valve housing assembly on the gear housing. Be sure not to pinch the gasket seals. A light tapping with a soft mallet may be needed to seat the casting.

9. Install the four washers on the cap screws and thread into the shaft end cover. Tighten the cap screws cross-corners to 2400 in./lb. Check for free shaft movement by turning shafts with a wrench.

10. Install the spool "O" ring into the groove in the valve at the end opposite from the detent housing. Apply a light coating of **clean** hydraulic oil to the spool. Insert the spool into the housing from the detent cap end. Be careful not to cut the "O" ring. Push the spool through the housing.

11. Apply a light coating of oil to the second spool "O" ring and install it over the spool and into its groove behind the retainer plate.

12. Slip the spool end cover over the rear spool clevis. Align the spool's pineye with the slot in the spool end cap and insert the spool pin. Install the bracket with two socket head cap screws.

13. detent installation:

a. Slide the seal retainer plate over the front of the spool. Slide the end cap on and attach it with two socket head cap screws.

b. Install the detent ball, spring, washer and detent retainer.

13. spring return installation:

a. Slide the seal retainer plate over the front of the spool. Install the rear spring retainer, rear spring guide, spring and front spring guide.

b. Compress the spring and install the front spring retainer.

c. Slide on the end cap and attach it with two socket head cap screws.

14. Install the relief valve in the housing.

15. If the G101/G102 is to be used in a 3-line installation, insert the optional sleeve in the inlet port. Be sure to remove the pipe plug from the return port.

G101/G102 relief valve maintenance

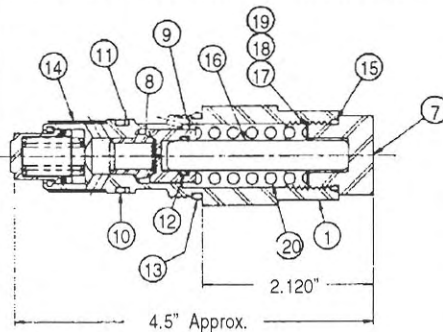


Figure 2
Relief Valve

item	qty	description	Part No.
1	1	Cartridge	355-9001-198
7	1	Cap	391-0585-070
8	1	Poppet Seat	391-2383-034
9	1	Floating Seat	391-2383-035
10	1	"O"-ring	391-2681-333
11	1	Backup Ring	391-2681-349
12	1	Seal	391-2885-067
13	1	"O" Ring	391-2881-204
14	1	Wire Screen	391-2781-016
15	1	"O" Ring	391-2881-246
16	1	Plunger	391-2383-033
17	1	Adj Slug .015" thk	391-3782-104
18	1	Adj Slug .062" thk	391-3782-103
19	1	Adj Slug .005" thk	391-3782-105
20	1	Spring	391-3583-035

Commercial's G101/G102 pump/valve units have unique internal passages in the valve assembly that allow the relief valve to function as a main and a port relief and a load-hold check. All mechanical structures integrated with the hydraulic system are consequently protected from overload and excessive shock stresses.

Figure 2 shows the arrangement of internal parts and the location of the serviceable seals. If contamination lodges between the poppet and seat, the relief valve will leak internally and prevent the cylinder from being pressurized or allow the load to drift.

The relief valve can be cleaned by removing the hex cap, floating seat, shims, spring and plunger. These components, plus the exposed seat area, can then be flushed with solvent and blown dry with air.

The load-holding check seats on a machined face in the valve housing. The relief valve cartridge must be removed to inspect or to clean the check's seat area.

If cleaning or replacing seals fails to correct relief valve problems, the cartridge should be replaced.

All G101/ G102 units have a tubular wire screen which fits snugly over the poppet end of the relief valve. The screen (P/N 391-2781-016) greatly reduces the possibility of any contamination reaching the seat area.

G101/G102 relief valve adjustment

All relief valves in these units are factory pre-set at 2000 psi. The table below has been developed to aid in the readjustment of these relief valves if it becomes necessary.

Factory pressure setting 2000 psi

Pressure Desired	Additional Shims Req'd	
	.005"	.015"
2000	0	0
2050	1	0
2100	2	0
2150	0	1
2200	1	1
2250	2	1
2300	0	2
2350	1	2
2400	2	2
2450	0	3
2500	1	3

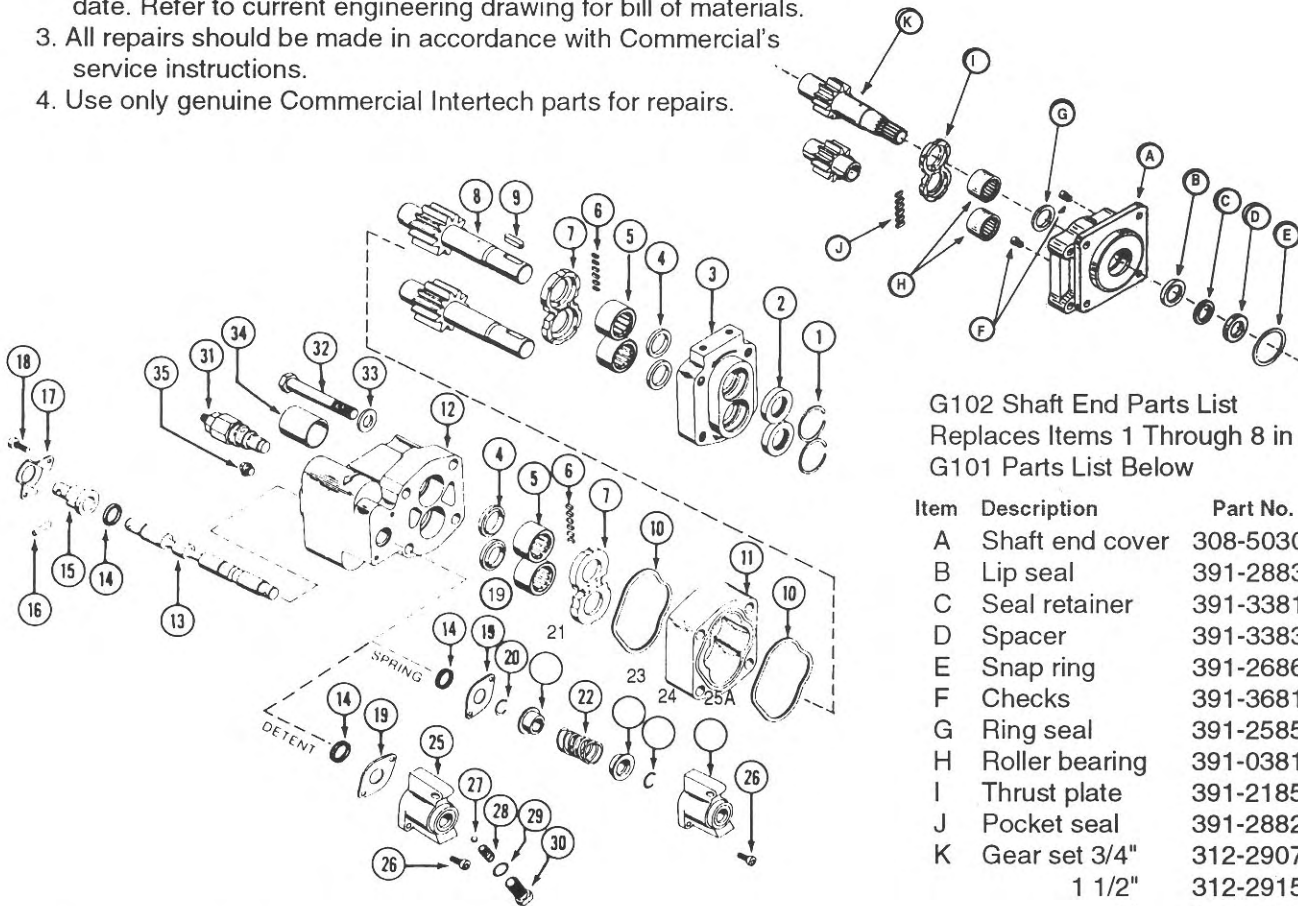
Note: Due to normal manufacturing tolerance, the actual pressure settings obtained by these adjustments may vary slightly from those shown in the table. **Always check pressure setting with an accurate gage.**

parts list

G101 and G102 Models

Caution:

1. Exploded view is not to scale and may not be pictorially correct.
2. Exploded view and attached parts list will not be kept up to date. Refer to current engineering drawing for bill of materials.
3. All repairs should be made in accordance with Commercial's service instructions.
4. Use only genuine Commercial Intertech parts for repairs.



G102 Shaft End Parts List
Replaces Items 1 Through 8 in
G101 Parts List Below

Item	Description	Part No.	Req.
A	Shaft end cover	308-5030-201	1
B	Lip seal	391-2883-119	1
C	Seal retainer	391-3381-040	1
D	Spacer	391-3383-069	1
E	Snap ring	391-2686-063	1
F	Checks	391-3681-001	2
G	Ring seal	391-2585-006	2
H	Roller bearing	391-0381-068	4
I	Thrust plate	391-2185-013	2
J	Pocket seal	391-2882-086	12
K	Gear set 3/4"	312-2907-130	1
	1 1/2"	312-2915-130	1
	2"	312-2920-130	1

G101 Parts List

Item	Description	Part No.	Req.	Item	Description	Part No.	Req.	Item	Description	Part No.	Req.
1	Snap Ring	391-2681-487	2	14	Quad Ring Seal	391-1985-014	2	29	Lock Washer	391-3788-002	1
2	Lip Seal	391-2883-119	2	15	Spool End Cap	391-1881-072	1	30	Detent Retainer	391-2583-079	1
3	Shaft End Cover	308-5016-201	1	16	Spiral Pin	391-2085-009	1	31	Relief Valve	355-9001-197	1
4	Ring Seal	391-2585-006	4	17	Bracket	391-0981-007	1	32	Cap Screw 3/4"	391-1401-395	4
5	Roller Bearing	391-0381-068	4	18	Skt Hd Cap Screw	391-1402-063	2		1 1/2"	391-1401-381	4
6	Pocket Seal	391-2882-086	12	19	Cover Plate	391-2183-124	1		2"	391-1401-382	4
7	Thrust Plate	391-2185-013	2	20	Retaining Ring	391-2681-485	1	33	Washer	391-3782-146	4
8	Gear Set 3/4"	312-2907-842	1 set	21	Spring Guide	391-1642-136	1	34	Sleeve (Optional)	391-3283-052	1
	1 1/2"	312-2915-842	1 set	22	Spring	391-3581-212	1	35	Pipe Plug	391-2282-003	1
	2"	312-2920-842	1 set	23	Spring Guide	391-1642-137	1				
9	Key	391-1781-021	1	24	Retaining Ring	391-2681-486	1				
10	Gasket Seal	391-2884-019	2	25A	End Cap	308-4000-100	1				
11	Gear Housing 3/4"	308-8007-901	1 or	25	End Cap	308-4000-102	1				
	1 1/2"	308-8015-901	1 or	26	Cap Screw	391-1433-020	2				
	2"	308-8020-901	1	27	Detent Ball	391-0282-009	1				
12	Port End Cover		1	28	Spring	391-3581-383	1				
13	Spool		1								

Items 12 and 13 are not serviceable

G101/G102 service kits

Shaft seal service kits and repair kits are available for the G101/G102 pump/valves. Parts included in these kits are shown below. Refer to exploded drawing on page 7 for location of parts.

G102 Service Kit 391-1802-623

Item	Qty	Descript.	Part No.
B	1	Shaft Seal	391-2883-119
J	1	Pocket Seal Strip	391-2882-051
10	2	Gasket Seal	391-2884-019
14	2	Quad Ring Seal	391-1985-014

G101 Service Kit 391-1802-622

Item	Qty	Descript.	Part No.
2	2	Shaft Seal	391-2883-119
6	1	Pocket Seal Strip	391-2882-051
10	2	Gasket Seal	391-2884-019
14	2	Quad Ring Seal	391-1985-014

G101 Repair Kit 391-1802-604

Item	Qty	Descript.	Part No.
1	2	Snap Ring	391-2681-487
2	2	Lip Seal	391-2883-119
4	4	Ring Seals	391-2585-006
5	4	Roller Bearings	391-0381-906
6	1	Pocket Seal Strip	391-2882-051
7	2	Thrust Plate	391-2185-913
10	2	Gasket Seal	391-2884-019
19	2	Retainer Ring	391-3782-126

Note * Items are shown on page 6 in relief valve drawing

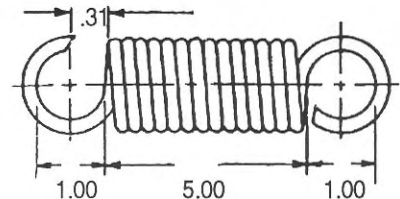
10*	1	"O" Ring	391-2881-333
11*	1	Backup Ring	391-2681-349
13*	1	'O" Ring	391-2881-204
15*	1	"O" Ring	391-2881-246

neutral stop cable spring

For applications using a pull-out cable

This spring, attached to the dump body bed, is required in the cable assembly to protect the spool cap of the neutral stop device from pull shocks when the dump body reaches full extension. It will work with C101/C102, C101 Airshift and G101 /G102 pumps

Neutral Stop Cable Spring
(P/N 391-3581-854)



trouble	improper operation of pump/valve unit	
	possible causes	remedies
Pump Making Noises	Insufficient oil supply	Check reservoir oil level. Fill as required.
	Air leaks at inlet fittings	Tighten as required.
	Restricted or collapsed inlet hose	Remove and inspect. Remove blockage or replace hose as required.
	Plugged reservoir air vent	Clean or replace breather.
	Oil too thick	Change to lower viscosity.
	Air bubbles in the oil or air drawn in through inlet pipe opening	Be sure suction and return lines are well submerged in the reservoir.
Pump Overheating	Insufficient oil supply	Check reservoir oil level. Fill as required.
	Roading with PTO engaged	Disengage pump PTO when traveling.
	Internal leak due to wear	Rebuild pump as required. Check oil cleanliness, replace if dirty.
	Oil too thick	Change to lower viscosity.
Pump Leaks Externally	Leaking relief valve	Check for wear or contaminant in seat.
	Worn drive shaft due to abrasive material in the oil	Rebuild pump as required. Clean reservoir and replace oil.
	Worn shaft seal	Replace seals
	Blown or pinched gasket seal	Replace seal. Check torque on tie bolts (2400 in./lbs.)
Pump Won't Deliver Fluid	Worn or damaged spool seal	Replace seal.
	Insufficient oil supply	Check reservoir oil level. Fill as required.
	Blocked or collapsed suction line	Remove and inspect. Replace or remove blockage as required.
	Wrong drive shaft rotation	Check rotation against indicator at front of pump.
	Air leak in suction line preventing priming	Eliminate leak.
No Pressure in the System	Pump worn due to abrasive material in the oil	Rebuild pump as required. Clean reservoir and replace oil.
	Pump not delivering fluid	Follow remedies in the failure to deliver section.
	Relief valve set too low	Check pressure, increase if required.
Failure to Hold a Load	Relief valve leaking	Check seat for foreign material or damage. Replace if required.
	Valve spool not in the neutral-hold position	Check linkage and adjust.
	Foreign material lodged in the holding check or in the relief valve seat	Remove relief valve and clean it out.

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