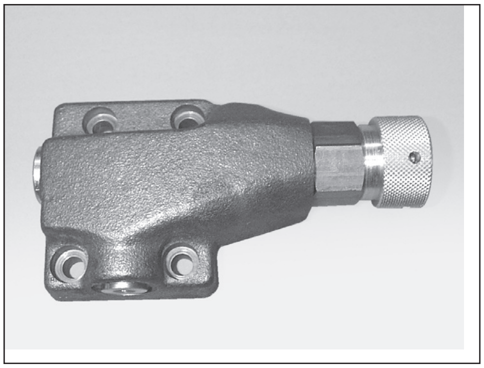
Disassembly Procedures – Single Stage Compensator

General
Shown below is the Continental Hydraulics single stage compensator. Following are the complete disassembly procedures. The single stage control is normally available on the PVX-8/11/15 pumps only.

The step number corresponds to the photo or illustration of the same number.
Any dimensions or values stated will have the English value first followed by the metric equivelent in parenthesis.



Disassembly Instructions
1. Remove the roll pin on the backside of the compensator. Use a hammer and a small punch to drive the pin out. then remove it with pliers.

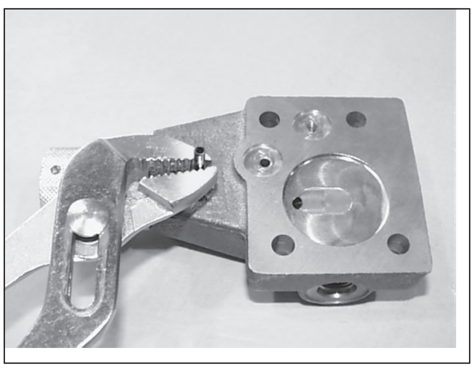


Figure 1.

2. Remove the adjustment knob, including the spring and spring seat as one (1) assembly.

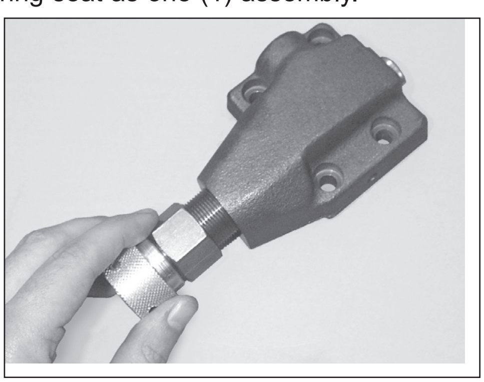


Figure 2.

3. Remove the hex. head plug on the side of the single stage compensator by using the appropriate Allen wrench.

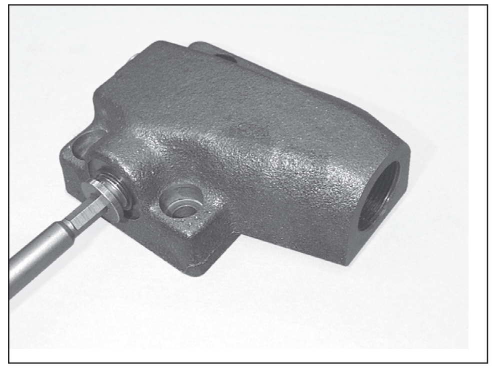


Figure 3.

4. Remove the hex. head plug opposite to the adjustment knob by using the appropriate Allen wrench.

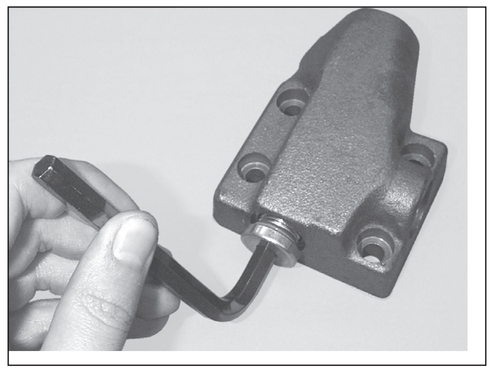


Figure 4.

5. Insert an Allen wrench to remove the compensator spool.

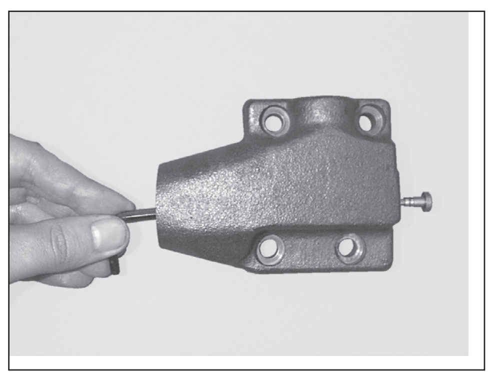


Figure 5.

Assembly Procedures – Single Stage Compensator

General

To guarantee proper operation of the single stage compensator, Continental Hydraulics recommends relacing all compensator seals included in the CHD Compensator Seal Kit.

The step number corresponds to the photo or illustration of the same number.
Any dimensions or values stated will have the English value first followed by the metric equivelent in parenthesis.

Getting Started - Kits

COMPLETE ASSEMBLY FOR SINGLE STAGE COMPENSATOR	
SAE	264404

Assembly Instructions

1. Thoroughly lubricate the compensator spool with clean hydraulic fluid. Insert the compensator spool into the single stage body by holding the rounded end and inserting the small round end first.

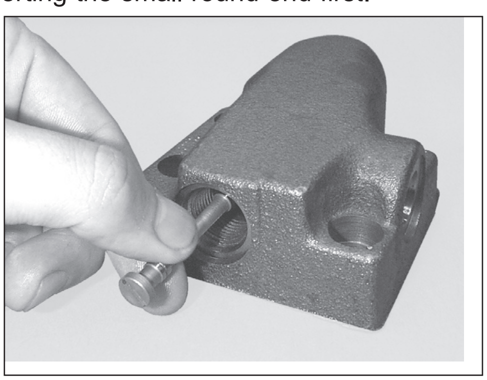


Figure 1.

2. Replace the O-ring and the back-up ring on the adjustment knob.

Figure 2.

2a. Place the spring seat on the spring, then insert the spring and spring seat into the adjustment knob.

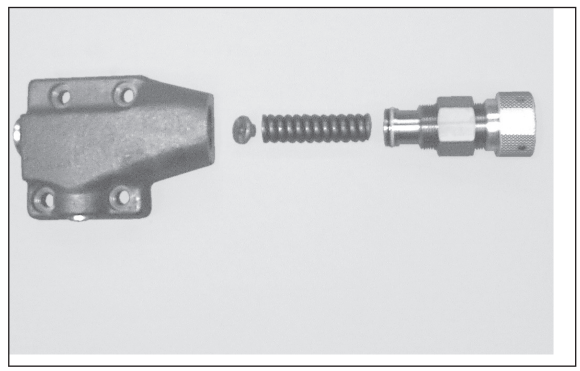


Figure 2a.

3. Insert the adjustment knob.

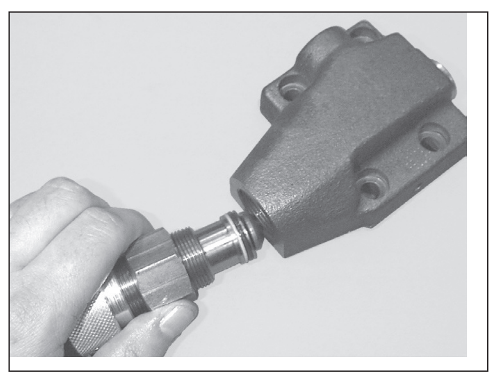


Figure 3.

Assembly Procedures – Single Stage Compensator (continued)

4. Replace the O-ring on the hex. head plug and insert it into the compensator on the opposite side of the adjustment knob. Torque to 283-369 in.-lbs. (33-43 Nm).

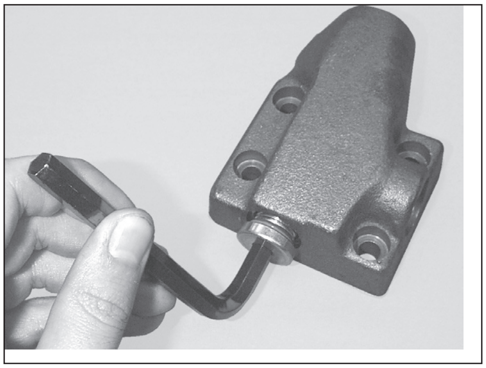


Figure 4.

5. Replace the shock clipper plug including the O-ring on the side of the single stage compensator and insert it by using the appropriate Allen wrench.

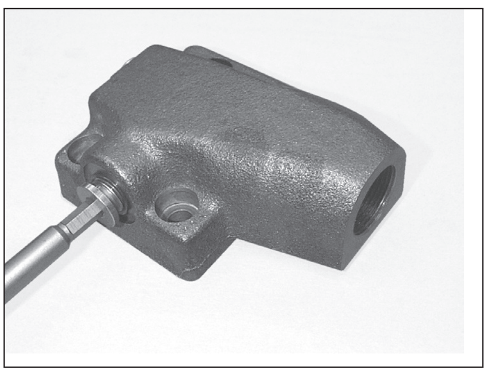


Figure 5.

6. Insert the roll pin on the backside of the single stage compensator.

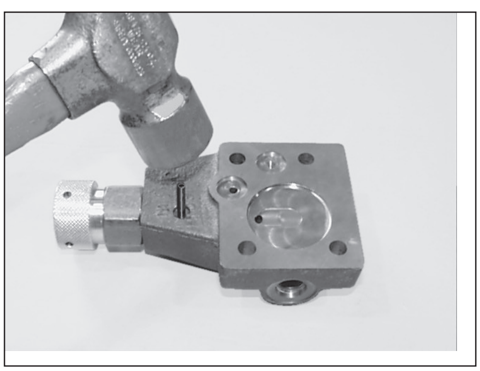


Figure 6.

7. Replace the O-rings on the backside of the compensator.

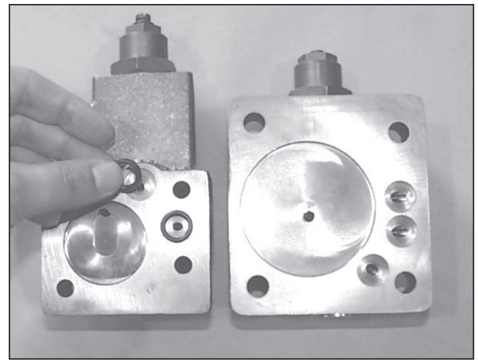


Figure 7.

Proper Setting of the Thrust Screw

Adjustment Instructions

1. Make sure the pump is in “deadhead” condition before attempting adjustment of the thrust screw. The “deadhead”, or compensated condition, can be reached by blocking the outlet port by shutting off downstream valves which means that the output flow is blocked. The output flow must be completely shut off. Any valve leakage will affect the proper setting of the pump.

2. Loosen the pressure adjustment locknut on the compensator.

3. Back off the pressure adjustment to its absolute minimum (until it stops) by turning counterclockwise. On a two-stage control, this adjustment is on the second stage (the top assembly).

4. If your pump has a torque limiter control, back out the torque limiter adjustment all the way.

5. Using a flat blade screwdriver, back out the first stage adjustment to its absolute minimum (until it stops).

6. The chart below shows the minimum thrust screw settings and differential pressure settings.

Two-Stage Compensator (1800 rpm)

PVX Model	Thrust Screw	Differential Setting (First Stage)
PVX-8	170-190 psi (12-13 bar)	
PVX-11/15	190-205 psi (13-14 bar)	100-110 psi
PVX-20/29/36	230-250 psi (16-17 bar)	(7-7.5 bar)
PVX-46/60/75	210-230 psi (14-16 bar)	

- On PVX-8/11/15 pumps, the shock clipper port must be blocked when calibrating the pump. The first stage setting is always additive to the thrust screw setting.

Thrust Screw Setting + Differential Setting (1st Stage) = Total Minimum Setting

Example for PVX-75 (1800 rpm, 3000 psi):

1st adjustment - Thrust Screw Adjustment	210-230 psi
2nd adjustment - Differential Spring (1st stage)	100-110 psi
Total Minimum Setting	310-340 psi

Example for PVX-75 (1800 rpm, 210 bar):

1st adjustment - Thrust Screw Adjustment	14-16 bar
2nd adjustment - Differential Spring (1st stage)	7-7.5 bar
Total Minimum Setting	21-23.5 bar

7. If you are working on a PVX-8/11/15 pump, make sure the shock clipper port is blocked (located on the side of stage one, the lower section of the two-stage control) before adjusting the thrust screw. For PVX-20 thru 75, there is no external shock clipper port, therefore proceed to the next step.

8. If the pump has a stroke limiter, also known as a maximum flow limiter or volume control, make sure it is backed out all the way. This is done by turning the bolt at the position on the pump housing opposite the pump control.

9. To adjust the thrust screw, loosen the thrust screw locking nut. For PVX-8/11/15 pumps, a 5/16” Allen wrench is required; for PVX-20 thru 75, a spanner wrench.

- While observing a pressure gauge, turn the thrust screw clockwise to increase pressure, counterclockwise to decrease it, to the appropriate thrust screw pressure setting from the chart. Be careful, the thrust screw should not be turned more than a 1/4 turn in either direction.

- Once the proper minimum thrust screw pressure is set, then adjust the differential pressure on the first stage compensator with a flat blade screwdriver. Adjust the first stage differential screw 110 psi (7.5 bar) over the thrust screw setting.

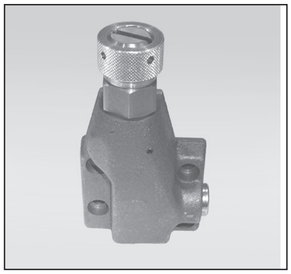
- It is useful to “jog” the pump from deadhead to full flow several times and then recheck the thrust screw setting to assure repeatability.

10. Turn the second stage compensator knob in to the desired pressure and lock the setting with the jam nut.

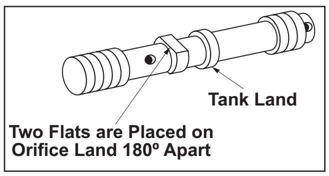
11. Replace the locknut on the thrust screw and tighten securely.

Adjustment Procedures – Single Stage Compensator

General

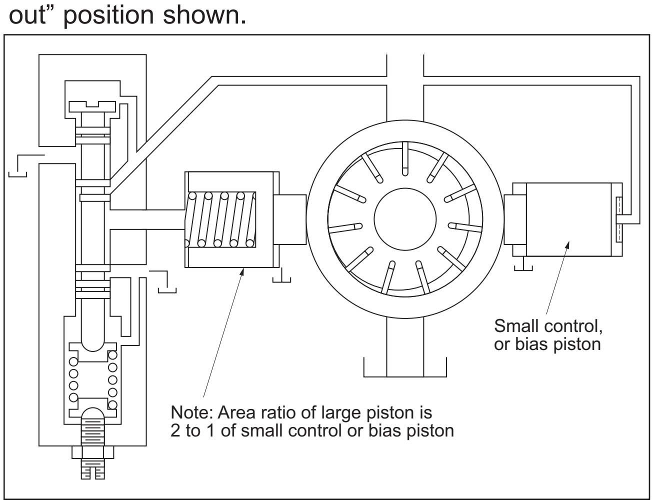


The single stage compensator consists of a spool, spring and adjusting screw, which are assembled in a body and bolted to the pump body. To control the pressure at the control piston, the spool is designed to meter flow fluid in and out of the control piston chamber. A hole is drilled about three-fourths the length of the spool and intersects with a hole drilled at a right angle to the spool axis. The purpose of these holes is to allow fluid from the pressure port of the pump to the end of the spool. No matter what position the spool is in, system pressure is applied to the end of the spool, creating a force, which opposes the spring force. As the system pressure increases, the force on the end of the spool also increases and the balance of forces determines the spool position. The spring cavity of the compensator is drained to the tank to prevent any pressure buildup from leakage, which would add to the spring force and change the compensator setting.



Spool Position	Pump Condition	System Condition
1	Full Flow	System Pressure < Compensator Setting
2	Deadhead	System Pressure > Compensator Setting

The compensator spool is really an infinite positioning servo valve held offset by the compensator adjusting spring and activated by system pressure. To simplify the explanation, the spool travel will be broken down into two (2) finite positions as shown below.
When there is no resisitance to pump flow, the spring will force the spool into the spring offset or "bottomed out" position shown.

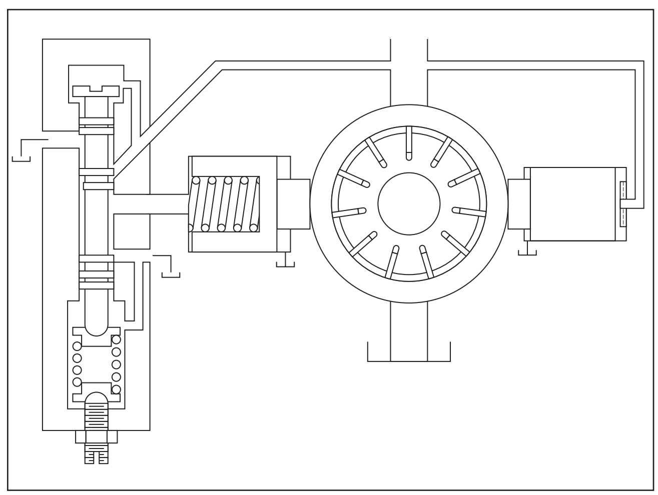


Offset or "bottomed out" position.

In this position, fluid from the pressure port can flow through the compensator to the control piston and allow system pressure to be applied to the control piston. A land on the spool (tank land) prevents the fluid in the control piston chamber from flowing to the tank. Because the control piston has twice the area of the bias piston and the same pressure is applied to both pistons, the greater force exerted by the control piston will force the ring into the flow or "on-stroke" position. The length of the bias piston, which bottoms out against the bias cover and prevents the ring from over-stroking and hitting the rotor, establishes the maximum flow rate.

As the resistance to pump flow increases, the pressure will be sensed on the end of the spool and when the force exerted is great enough to partially compress the spring, the spool will move. The ring will remain in the flow or "on-stroke" position because the tank line is still blocked and fluid can flow to the control piston through an orifice created by two (2) flats ground on the adjacent land (orifice land).

When the system pressure reaches the compensator setting (spring precompression),the spool will move to position #2 which meters fluid out of the control piston chamber as well as into it.



Position #2 - Deadhead.

Adjustment Procedures – Single Stage Compensator (continued)

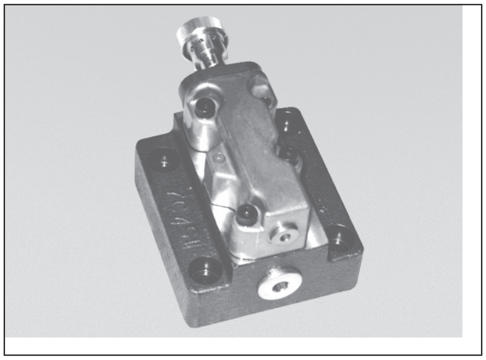
The further the spool moves, the greater the amount of fluid bled off from the control piston chamber across the variable orifice created by the tank land. Since the flow of fluid to the control piston is limited by the orifice created by the flats on the pressure land, the pressure in the control chamber has dropped to approximately half of the outlet pressure, the bias piston force will exceed the control piston force move the ring off-stroke, reducing flow. As the ring shifts, the flow rate out of the pump is being reduced and the compensator is positioning the ring to find the exact flow rate necessary to maintain the pressure setting of the compensator. If the pump flow becomes blocked, the ring will continue to be destroked until the deadhead or no-flow position is reached. Remember that system pressure is always applied to the bias piston, which is trying to push the ring off-stroke. A balance of forces of the control piston verses bias piston determines the ring position.

To set-up a single stage compensator, follow the instructions given in the previous section *"Proper Setting of the Thrust Screw"*. Once the thrust screw pressure is set, adjust and lock the compensator knob at the maximum compensating pressure of your system.

Adjustment Procedures – Two-Stage Compensator

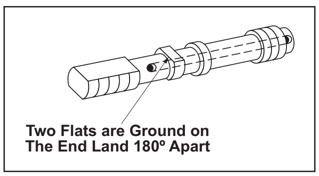
General

The two-stage compensator works exactly the same as the single stage control. However, instead of loading the spool with a spring, it is hydraulically loaded. To do this, a small relief valve referred to as the second stage is connected to the spring chamber.



Two-Stage Compensator.

Two (2) additional flats are ground on the land at the end of the spool which will allow fluid to flow into the spring chamber.

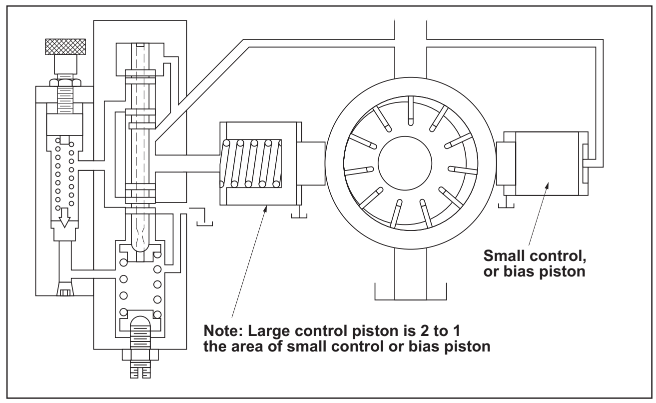


If there is a pressure spike in the system above the compensator setting, the spool will momentarily move to the over travel position in an effort to destroke the pump. Only in position #2 is it a true compensating condition. Do not be confused with the term "deadhead", it means the same thing as compensating.

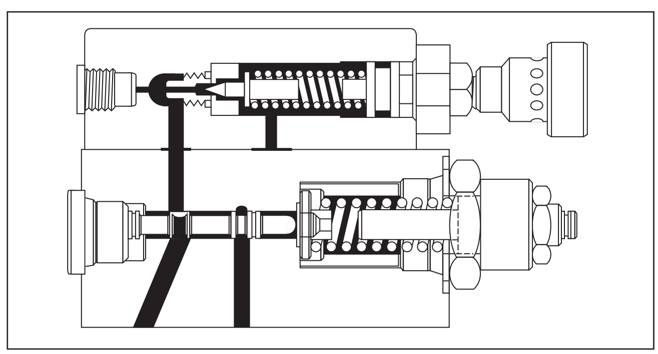
When the spring in the second stage is compressed, it will hold the poppet in its seat and block the flow to the tank. With the flow blocked, the pressure at the bottom of the spool will be the same as the pressure at the top. Remember that pressure is equal throughout a static fluid. Since the area at the ends of the spool are equal, the hydraulic forces created are equal but opposite in direction and cancel each other out. To unbalance the forces, a light bias spring is added which pushes the spool into the bottomed-out position shown. With the spool in this position, system pressure is applied to the control piston and will push the ring on-stroke as it did in the single stage control.

As system pressure increases, the pressure at the end of the spool is always equal until it reaches the second stage setting. At that point, the relief valve (second stage) will open and limit the pressure in the bias spring chamber by allowing fluid from the chamber to flow to the tank. This will limit the amount of hydraulic force applied to the bottom end of the first stage spool. Fluid that is under pressure always takes the path of least resisitance and, when the second stage opens, the entire pump flow is going to try to flow through the compensator to the tank. To get to the tank, the fluid must flow through the very small flats ground on the end of the spool. As the entire pump flow tries to flow through the flats, they offer resisitance to the flow, the pressure upstream of the flats is increased. This pressure is sensed at the top of the spool and, as the pressure increases, the hydraulic force pushing down on the spool increases. When this force becomes greater than the hydraulic force at the bottom, plus the bias spring force, the spool will be pushed towards the bias spring and vent the pressure behind the control piston to the tank. The pump will then compensate as it did with the single stage control.

Full Flow Position.



To set-up a two-stage compensator, follow the instructions given in the previous section *"Proper Setting of the Thrust Screw"*. Once this is done, adjust and lock the compensator knob at the maximum compensating pressure of your system.



Two-Stage Compensator Cut-Away View.

Multi-Pressure Compensator

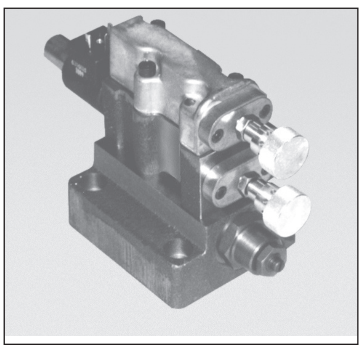
General Information

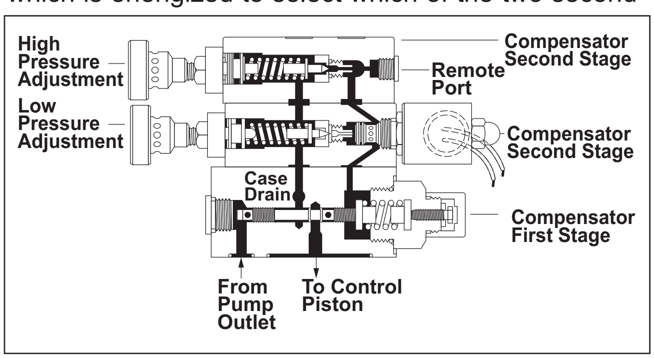
Multi-pressure pump control can markedly reduce horsepower demand and heat generation during periods of idle time or time in the machine operating cycle when maximum pressure is not required. The modular design of the standard two-stage compensator lends itself to variable preset multi-pressure control arrangements with integral or remotely located valving. Whenever remote relief valves and switching valves are used, care must be taken not to introduce too much contained fluid between the pump and the remote valving.

Severe reduction of the pump reaction time constants or erratic control may occur with lines larger than 1/4” (6 mm) O.D.T. or of lengths exceeding 20 feet (610 cm). Special circuits might be needed in certain cases to alleviate problems, including the use of orifices at each end of the remote line.

Solenoid Two-Pressure Control

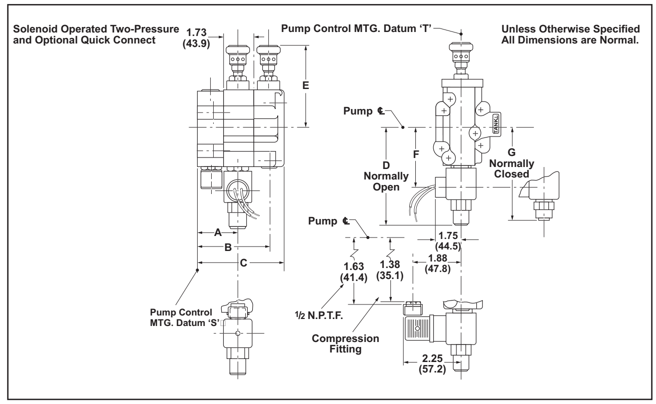
The illustration below shows the construction of the solenoid two-pressure compensator. The upper second stage is the high pressure control and serves to limit the maximum desired circuit pressure. The lower second stage contains either a normally open or normally closed two-way valve which is eneirgized to select which of the two second stages will have control of the pump.





Soleniod Two-Pressure Compensator.

To adjust a solenoid operated two-pressure control, determine if the solenoid is normally open (N.O. means low pressure) or normally closed (N.C. means high pressure). The hydraulic code on the pump name plate will identify which type of solenoid is on the compensator, assuming that the pump and compensator have not been modified from the factory.



Solenoid Two-Pressure & Optional Quick Disconnect.

An example hydraulic code of a two-pressure control is: PVX-60B25-XX-XX-**<u>27</u>**24-A. In this example, the **27** identifies the pump as a two-pressure compensator with a **normally open** solenoid. If the code had a **28** in this place, the solenoid is **normally closed**.

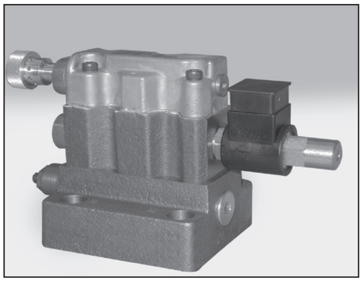
The solenoid must be closed to begin compensator adjustment. If the solenoid is normally closed, leave the solenoid de-energized. If the solenoid is normally open, energize the solenoid to close. Use the following steps to adjust the compensator:

1. Back out both the low pressure and high pressure adjusting knobs all the way.
2. Back out the first stage adjusting screw all the way.
3. Follow the procedure to set the thrust screw setting as detailed in the section *“Proper Setting of the Thrust Screw”*.
4. Follow the procedure to set the first stage setting as detailed in the section *“Proper Setting of the Thrust Screw”*.
5. With the solenoid closed, adjust the high pressure adjusting knob to set the maximum compensating pressure of the pump. Tighten the locknut on the adjusting screw to fix this pressure.
6. The solenoid must be opened to adjust the low pressure setting. After opening the solenoid (energize if N.C. or de-energize if N.O.), adjust the low pressure adjusting knob to set the second (i.e. low) pressure on the pump. Tighten the locknut on the adjusting screw to fix this pressure.

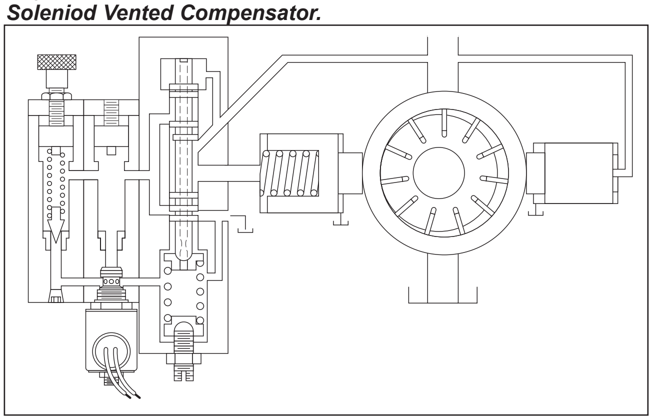
Multi-Pressure Compensator (continued)

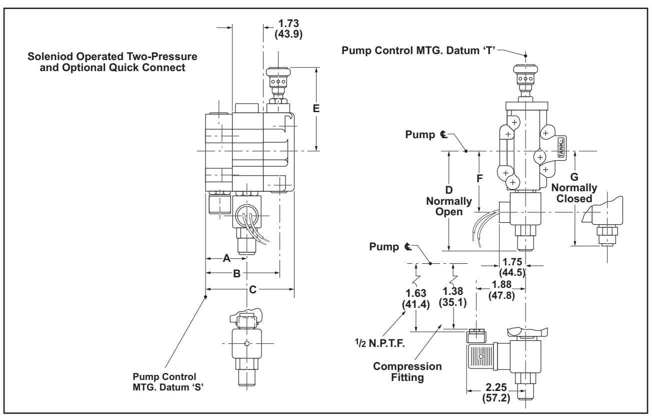
Solenoid Vented

The following illustration shows the solenoid vented compensator. Once again, the solenoid must be closed to begin compensator adjustmment.



Soleniod Vented Compensator.



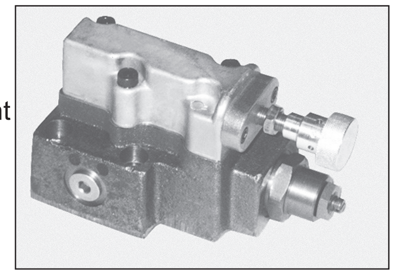


Using the hydraulic code on the pump name plate, determine if the solenoid id normally open or closed. An example hydraulic code of a vented control is: PVX-60B25-XX-XX-**29**24-A. In this example, the **29** identifies the pump as a vented compensator with a **normally open** solenoid. If the code had a **30** in this place, the solenoid is **normally closed**.

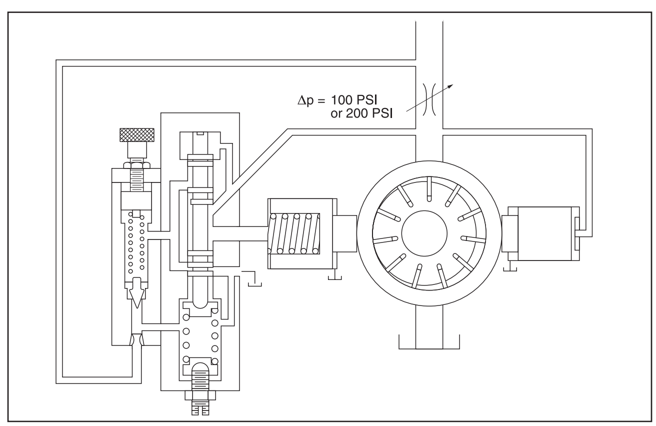
If the solenoid is normally closed, leave the solenoid de-energized. If the solenoid is normally open, energize the solenoid to close. Use the following steps to adjust the compensator:

1. Back out both the low pressure and high pressure adjusting knobs all the way.
2. Back out the first stage adjusting screw all the way.
3. Follow the procedure to set the thrust screw setting as detailed in the section *"Proper Setting of the Thrust Screw"*.
4. Follow the procedure to set the first stage setting as detailed in the section *"Proper Setting of the Thrust Screw"*.
5. With the solenoid closed, adjust the high pressure adjusting knob to set the maximum compensating pressure of the pump. Tighten the locknut on the adjusting screw to fix this pressure.
6. To check the solenoid vent pressure, the solenoid must be opened. After opening the solenoid (energize if N.C. or de-energize if N.O.), the system pressure should decrease to the first stage setting.

Load Sense



The purpose of the load sensing flow compensator (LSFC) is to maintain constant flow regardless of changes in load or pump shaft rotational speed. This is accomplished by using an external metering valve and continually sensing pressure drop across this valve with a pilot line. The pump becomes a "control element" with this option, very similar to a very accurate pressure compensating flow control. However, because manipulation of the hydraulic power source is extremely efficient and the pump only uses precisely enough pressure to accomplish the task, the LSFC is very energy conserving. Accuracy of the LSFC is +2 - 5% of set flow rate over the full range of load pressure. A changeable orifice is installed as standard and built into the compensator body.



Load Sense Flow Compensator (LSFC).

Multi-Pressure Compensator (continued)

The two-stage pressure compensator module is the basic foundation for the LSFC. The control seeks to maintain a constant pressure drop across a remote orifice. Any increase in flow due to decreasing load or increase in pump shaft rpm will cause an increase in the differential pressure. The PVX load sense ∆P is factory set at 100 psi (7 bar) for PVX-8 thru 36 pumps and 200 psi (14 bar) for PVX-46 thru 75 pumps. The opposite control action occurs smoothly should the ∆P fall below this differential setting, dynamically changing ring position to adjust to any differential pressure changes. Constant velocity of the load under widely varying pressure conditions results.

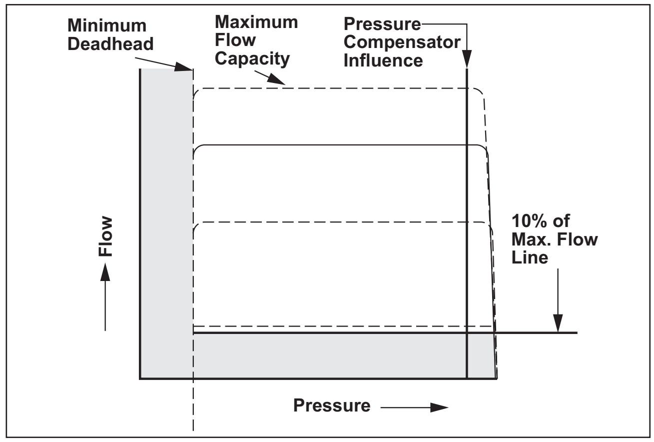
Should the load stall or otherwise be restricted from movement or use of fluid, the pressure compensator as secondary control will take over and maintain deadhead pressure until the proble is corrected. Should the remote valve be totally closed, the pump will go to minimum deadhead.

The sensing pilot line P1, which is downstream, connects to the compensator shown in the illustration. A #4 SAE connector for P1 has a 0.040 inch (1.0 mm) orifice in it to dampen out any tendency to oscillate for sense lines of 1/4 inch (6 mm) tubing up to eight (8) feet (243.8 cm) long. Additional 0.030 inch (0.8 mm) orificing in each line might be necessary for longer lines. Sense lines should be hard tubing of approximately equal length and 1/4 inch (6 mm) diameter tapped into the main line, at least 10 pipe diameters upstream and downstream of the remote orifice. If located too close to the remote orifice, turbulent flow might created erratic action. Thorough air bleeding of the sense lines is absolutly essential to proper operation.

The quality of the remote valve is very important to the accuracy and stablity of the LSFC. Successful valves used are standard flow control valves and electro-hydraulic proportional flow controls of many types.

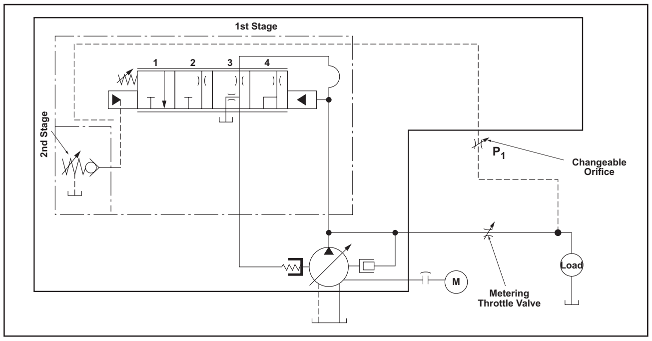
All orifices must be non-pressure compensated and sharp edged for temperature stability. If only low accurracy is needed, the ∆P of a four-way valve or other two-way valve is generally useable. Remember that at least 100 psi (7 bar) for PVX-8 thru 36 pumps; 200 psi (14 bar) for PVX-46 thru 75 pumps ∆P must be developed at the minimum flow rate or the LSFC will not work well.

The following graphic illustration shows a flow versus pressure characteristic curve. The curve shows that two (2) shaded areas must be avoided! First, flow rates below 10% of maximum output at rated rpm and second, pressures below minimum deadhead, generally 400 psi (28 bar) on 3000 psi (210 bar) rated pumps. Flat flow lines extend from minimum deadhead to approximately 100 psi (7 bar) below the setting of the pressure compensator, at any flow rate within the limits of maximum to 10% of maximum capability.



Flow Versus Pressure Characteristic Curve.

The LSFC is intended for and should be applied on meter-in circuits only. Meter-out circuits could pose serious safety problems or design difficulties because of the P1 sense line location downstream of the orifice. This puts P1 at atmosheric or at tank line pressure, which can vary drastically. Please do not apply LSFC equipped pumps on meter-out circuits unless the factory advises otherwise.



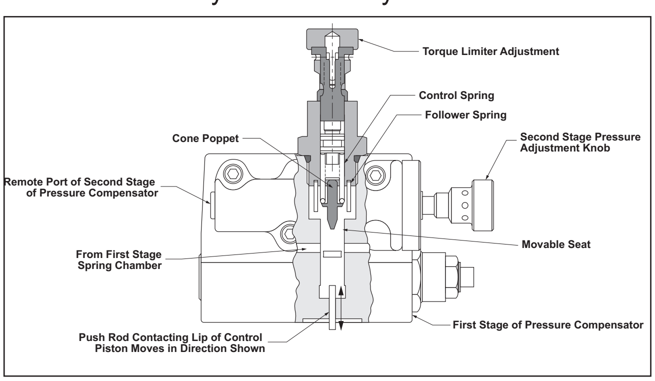
Load Sensing Flow Compensator Schematic.

LSFC Condition	Valve Position	Condition	System Condition
Rated ΔP	3	On stroke to set flow	Constant flow close deadhead
Above Rated ΔP	4	Minimum deadhead	External orifice shut-off
Below Rated ΔP	2 to 1	Full deadhead	External orifice open beyond pump displacement
Zero ΔP	3 to 4 Compensator Override	Deadhead	Load resistance above compensator setting

The procedure to set-up a load sense control is essentially the same as the procedure to set-up a two-stage control. The differential setting (first stage adjustment) must be set to a minimum of 100 psi (7 bar) for PVX-8 thru 36 pumps; 200 psi (14 bar) for PVX-46 thru 75 pumps, above the thrust screw setting. This ΔP can be increased to 200 psi (14 bar) for better operation, but this higher differential setting does increase the minimum compensating pressure at which the pump can operate at. Therefore, the higher differential setting should only be used if low pressure compensating is not a concern for your system.

Torque Limiter

The torque limiter control is only available on PVX-20 thru 75 pumps and with SAE connections. If your application requires BSPP connections, please contact the factory for availability.



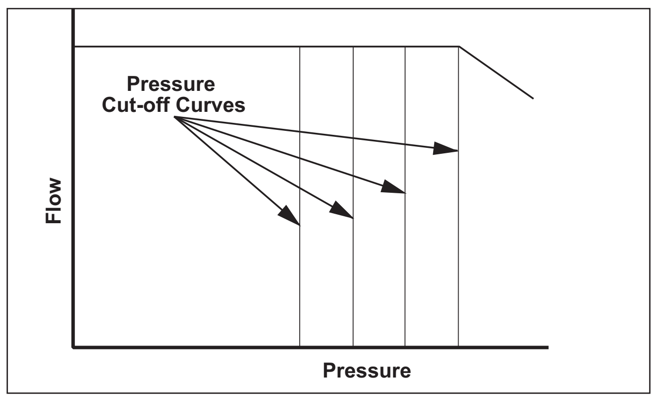
Torque Limiter.

The torque limiter control has two (2) customer settable adjustments: the second stage pressure adjustment (knurled knob parallel to the inlet/outlet ports) is used to set maximum deadhead pressure of the pump. A family of pressure cut-off curves are achievable using this adjustment. Clockwise adjustment increases the maximum deadhead pressure, while counterclockwise adjustment decreases it.

The other adjustment is the torque limiter adjustment (knurled knob perpendcular to the inlet/outlet ports) and it is used to set the torque cut-off curves. A family of torque cut-off curves are achievable using this adjustment. Clockwise adjustment increases the torque cut-off point, while counterclockwise adjustment decreases it.

It is also possible to use a torque limiter control as a standard two-stage pressure compensator up to the maximum full-flow pressures as shown in this chart.

PVX Model	psi (bar)
20	2250 (155)
29	2250 (155)
36	1750 (121)
46	2250 (155)
60	2250 (155)
75	1500 (103)

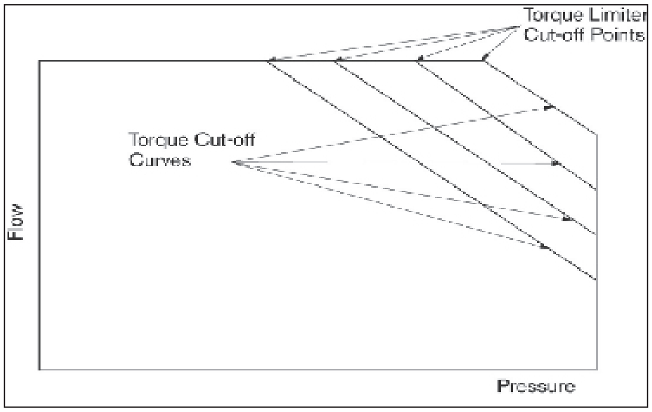


Torque Limiter Control Up to Maximum Full Flow Pressures.

The illustration below shows the second stage pressure adjustment (pressure cut-off curve) will override the torque limiter adjustment (torque cut-off curve) when the two intersect. This feature limits the maximum pressure of the pump.

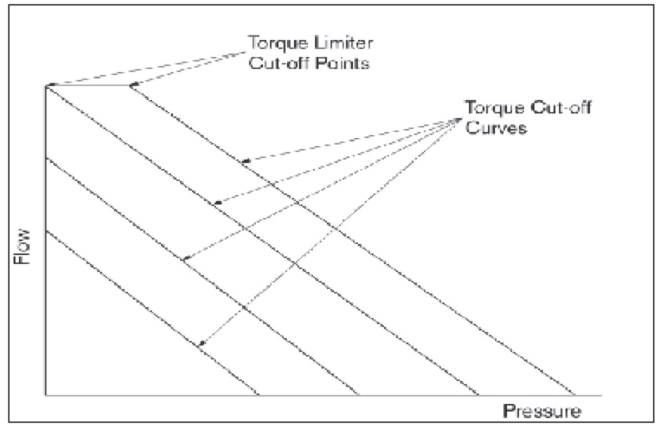
Multi-Pressure Compensator (continued)

The illustration below shows the second stage pressure adjustment (pressure cut-off curve) will override the torque limiter adjustment (torque cut-off curve) when the two intersect. This feature limits the maximum pressure of the pump.

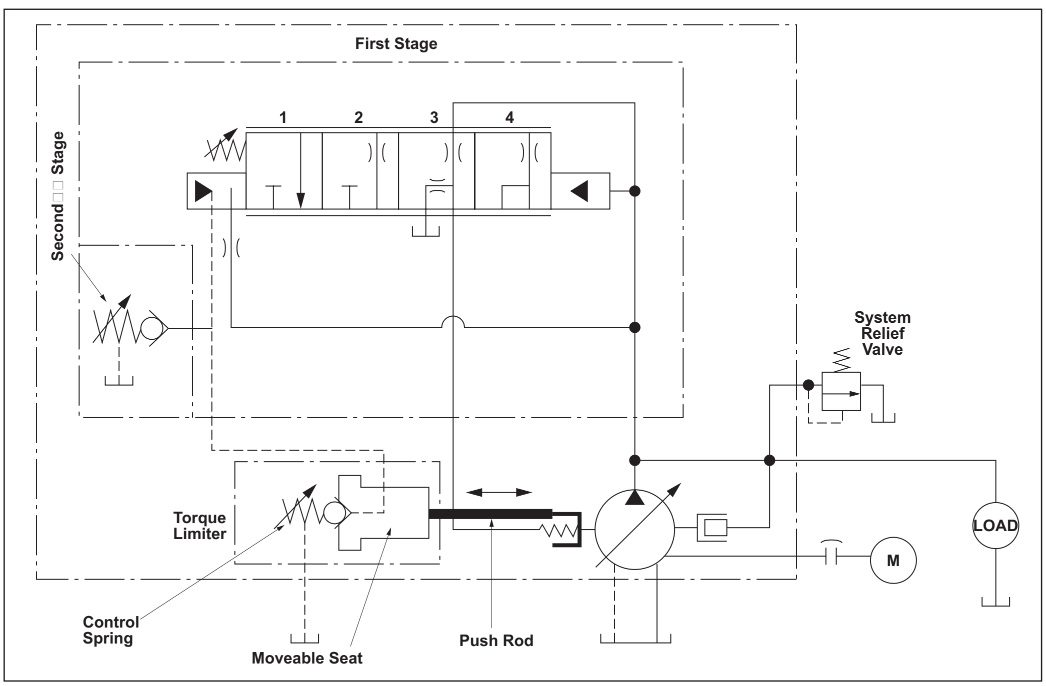


Second Stage Pressure Adjustment Overriding Torque Limiter Adjustment.

The illustration below shows that it is possible to set the torque limiter cut-off point to a level where the pressure cut-off curve is not reached. In this case, the maximum deadhead pressure is limited by the torque limiter cut-off adjustment. It can also be seen that the torque limiter cut-off point can be set to a level where maximum output flow of the pump can not be achieved.



Second Stage Pressure Adjustment Torque Limiter Cut-Off Point Where the Pressure Cut-Off Curve Not Reached.



Torque Limiter Schematic.

Torque Limiter	Valve Position	Condition	System Condition
Poppet Seated	1	Free Flow	No Resistance
Poppet Opening	2	Full Flow	Resisatance Starting
Poppet Metering	2 to 3	Reduced Stroke	Resistance Increasing
Poppet Metering	3	Deadhead	Blocked
Poppet Open	4	Spool Over Travel	Shock Pressure Above Deadhead

Setting the Maximum Deadhead Pressure (Second Stage Setting)

PVX torque limiter adjustment stems that have the adjustment knob removed pose special concerns when the pump is restarted. Some internal control components can be damaged if the torque limiter is not adjusted properly. Please consult the factory if this condition exists.

1. If you recieved a pump straight from the factory, skip to step 7. Otherwise, proceed with the following steps:
2. Before starting the pump, complete the following operations:
   - Back out (counterclockwise) the second stage of the compensator all the way.
   - Turn the torque limiter adjustment knob fully out (counterclockwise).
3. Start the pump running into an open circuit under minimal load and at normal operating temperature.
4. If the pump is not prime, turn the thrust screw clockwise in small increments until the pump primes.
5. Close a load valve in the circuit such that the pump has no output flow (i.e. deadhead condition).
6. Follow the procedure to set the thrust screw setting and the first stage differential setting as detailed in the section *"Proper Setting of the Thrust Screw"*.
7. Torque limiter pumps straight from the factory should already have the proper thrust screw and first stage settings. With the pump operating in deadhead, turn the torque limiter adjustment knob fully in (clockwise). This will set the torque limiter function out of the way such that the second stage pressure adjustment can be made.
8. Adjust the second stage pressure adjustment to the desired maximum deadhead pressure and lock in place with the jam nut. Proceed to setting the torque limiter adjustment.

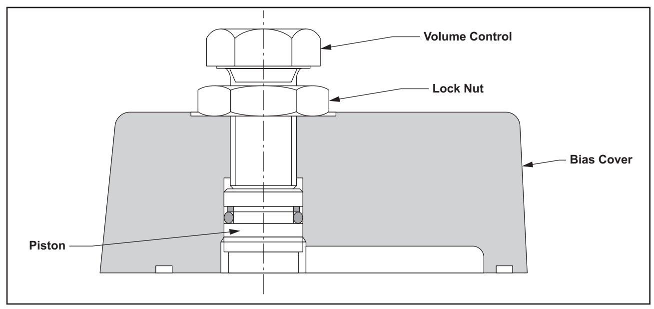
Setting the Torque Limiter

1. With the pump still in deadhead, adjust the torque limiter knob out (counterclockwise) as follows:
   - PVX-20/36/75 1-1/2 full turns
   - PVX-29/46/60 2 full turns
2. Turning the torque limiter adjustment out by this amount will assure a low torque setting when the circuit is open.
3. Take the pump out of deadhead by opening the circuit.
4. Load the hydraulic circuit and check to see if the desired flow/pressure/torque requirements of your system are achieved.
5. To adjust the torque limiter settings, turn the torque limiter adjustment knob in for higher torque and out for less torque in small increrments.
6. Continue this process until the desired conditions are achieved.
7. Lock the jam nut under the torque limiter knob.

Application Notes

1. When the torque limiter adjustment is fully backed out or near its lowest setting, the pump may not reach full flow.
2. Putting a flow and pressure load on the pump with the torque limiter adjusted fully in may cause the pump motor to stall or be damaged if the motor is undersized for full flow and high pressure.
3. It is possible for the torque limiter to control the maximum deadhead pressure of the pump. This condition can occur if the torque limiter curve reaches zero output flow before the second stage maximum deadhead pressure is achieved.

Maximum Flow Limiter



Maximum Flow Limiter.

Maximum Flow Limiter			
Pump Model	**Nominal Stroke**	**Decrease in Flow Per turn**	**Minimum Flow Attainable**
PVX-8	0.075" (1.9 mm)	53%	< 0%
PVX-11	0.080" (2.0 mm)	50%	0%
PVX-15	0.099" (2.5 mm)	40%	20%
PVX-20	0.077" (1.9 mm)	80%	< 0%
PVX-30	0.106" (2.7 mm)	56%	8%
PVX-36	0.132" (2.4 mm)	44%	26%
PVX-46	0.117" (3.0 mm)	50%	17%
PVX-60	0.150" (3.8 mm)	40%	34%
PVX-75	0.186" (4.7 mm)	32%	47%

During initial start-up, volume should be at least 50% of maximum flow.

Only make adjustments to the volume control with the pump running at full flow and low pressure while observing output flow.

Fluids, Filters and System Preparation

General Information
Thorough system preparation is of the utmost importance if satisfactory component life is to be achieved. Sufficient care in system preparation and fluid selection, as well as filtration, can mean the difference between successful operation and shutdown.

Prior to installing the pump, the entire system, reservoir, cylinders, valving and all piping must be drained, flushed and filled with new or refiltered fluid. Once drained, the reservoir's inside surfaces must be cleaned of all chips, scale, rust, etc. All return and/or pressure line filter elements must be inspected and replaced if necessary. We do not recommend the use of suction strainers as they tend to be the leading cause of cavitation. If suction strainers are used, we recommend oversizing them.

Fluid Recommendations
Continental Hydraulics recommends the use of premium quality hydraulic fluids, such as Mobil DTE 25, DTE 26 or equivalent, with zinc anti-wear additives. The viscosity grade selected for your system should be based on the information shown on the chart below.

Fluid Temperature
Pump reservoir (bulk) fluid temperature should not exceed 140° F. (60° C.). Always select fluid for optimumviscosity at operating temperature. Maximum start-up viscosity should not exceed 4000 SUS (864 cSt).

Filtration
For increased component life, fluid contamination should not exceed 18/15 (up to 2000 psi or 140 bar), or 17/14 (from 2000 to 3000 psi or 140 to 210 bar), per ISO/DIS 4406 "Solid Particulate Contamination Code". We do not recommend the use of inlet strainers as they tend to be a leading cause of cavitation.

When converting your system from petroleum base fluids to water-glycol, water-in-oil emulsion, or synthetic fluids, contact the factory and/or your fluid supplier for system preparation instructions.

Continental Hydraulics recommend that the usersof fire resistant fluids obtain a copy of the NFPA publication entitled "Recommended Practice – Hydraulic Fluid Power – Use of Fire Resistant Fluids in Industrial Systems"

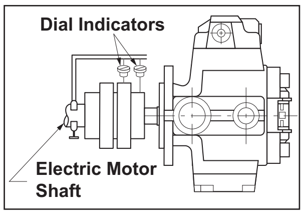
PVX Model	Fluid Type	Oil (anti-wear)	Oil (anti-wear)	Phosphate Ester	Polyol Ester	Water-Glycol	FDA	Environmentally Acceptable
	ISO Classification	HM	HL	HFDR	HFDU	HFC	---	HETG, HEPG, HEES, HEPR
		Note 1	Note 1 & 2	Note 3	Note 3	Note 3	Note 4	
8/11/15	Max. Press. psi (bar)	3000 (210)	3000 (210)	3000 (210)	3000 (210)	1500 (103)	1500 (103)	Note 5
	Min. Viscosity SUS (cSt)	100 (21)	100 (21)	100 (21)	100 (21)	100 (21)	100 (21)	
	Seal Material	Viton	Viton	Viton	Viton	Buna	Viton	
20/29/36	Max. Press. psi (bar)	3000 (210)	3000 (210)	3000 (210)	3000 (210)	1500 (103)	1500 (103)	Note 5
	Min. Viscosity SUS (cSt)	150 (32)	150 (32)	150 (32)	150 (32)	150 (32)	150 (32)	
	Seal Material	Viton	Viton	Viton	Viton	Buna	Viton	
46/60/75	Max. Press. psi (bar)	3000 (210)	2000 (140)	Note 5	Note 5	1500 (103)	1000 (70)	Note 5
	Min. Viscosity SUS (cSt)	150 (32)	150 (32)			150 (32)	150 (32)	
	Seal Material	Viton	Viton	Viton	Viton	Buna	Viton	

Notes:
1. Consult factory for detailed viscosity limits and approved oils.
2. Anti-wear oils are recommended, but not required, when operating at noted pressures.
3. Consult the factory for information pertaining to the use of Fire Resistant Fluids.
4. Maximum operating pressures are contingent upon the fluid used, as there is a wide range of fluid types that are FDA approved. Pressures listed are based on typical fluids. Please consult the factory.
5. Please consult the factory with viscosity information on these fluids.

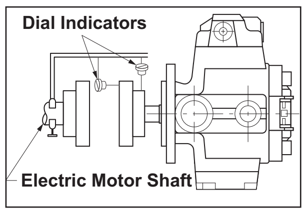
Pump Installation Procedures

Installation Instructions

1. Remove all plastic protective cap plugs from the components before installation.
2. Prior to installation, Continental Hydraulics recommends pouring a small amount of clean hydraulic fluid into the pump inlet port. Then rotate the pump shaft by hand in the direction indicated by the arrow cast into the pump body. All Continental pumps rotate from thrust block to compensator (i.e. clockwise as viewed from the shaft end of the pump). This insures lubrication at initial start-up.
3. Mount the pump and drive motor to a rigid base not more than three (3) feet (91.4 cm) above the fluid level. Align the pump shaft to within 0.006 inch (0.152 mm) of full indicator movement of the motor shaft, as shown below.



Proper Alignment #1.



Proper Alignment #2.

- Two (2) precision dial indicators must be used to insure proper alignment in the vertical, horizontal and parallel planes. The coupling halves can be either engaged or disengaged.
- If disengaged, the outside diameter of the pump coupling must be smooth and machined true in respect to the coupling bore (illustration #1).
- In illustration #2, one (1) indicator rides the inside face of the pump coupling and is measuring parallel offset alignment, as in illustration #1.
- Proper alignment, with either method, is achieved when neither dial indicator varies more than 0.006 inch (0.152 mm) during one (1) complete revolution of the shaft.

The coupling selected should provide a clearance fit on the pump and motor shafts. Never use couplings with interference or sweat fits. Do not press jaw-coupling hub together tightly. Allow air gap betweenthe hub and insert to prevent end thrust into the pump rotor, which will damage the pump. No external forces (other than rotational) should be applied to the shaft.

4. Carefully connect the inlet, outlet and drain plumbing to the pump. Do not force hard piping to align to the pump ports. This may pull the pump out of alignment with the motor.

- The inlet line must be plumbed full size to within three (3) inches (76 mm) of the bottom of the reservoir. Never reduce or restrict the inlet.
- Case flow on all PVX pumps exit through the port located on the pump body. PVX-8/11/15 models also have an external shock clipper drain port located on the compensator that, if you wish to enable the clipper feature, must be plumbed. PVX-20 thru 75 models have internal shock clipper drains and no additional plumbing is necessary.
- The case drain line must also be plumbed to within three (3) inches (76 mm) of the bottom of the reservoir. The case drain and main system return lines must be seperated from the pump inlet line by a baffle. This enables all return flow to travel the length of the reservoir before entering the pump again, allowing heat dissipation and deaeration.

5. The case drain lines from multiple pump in a combination should independently be plumbed back into the reservoir to prevent problems. Continental Hydraulics recommends not to install check valves in case drain lines if possible. If so, Continental strongly suggest “swing style” check valves which have low mass and will limit case drain spikes.
6. Fill the reservoir with fluid recommended for your application (see chart).

System Start-Up Procedures

Start-Up Instructions

1. Rotate the shaft by hand in the direction of the arrow on the pump body to insure freedom of rotation.
2. To prime the pump on initial start-up, it is imperative to clear all air from the pumping chambers. To do this, open center valving should be immediately downstream of the pump outlet port, which allows all flow (fluid and air) to pass directly to the tank upon start-up. If open center valving is not included in your circuit, position your valving so as to move cylinders and/or motors in a no-load condition (75-150 psi or 5-10 bar) until the pump has primed. This “no-load condition” value is not a pump compensating value, but is strictly the result of system resistance.

- Another way to clear air from the pumping chamber and allow the pump to prime is to incorporate an automatic air bleed valve on the pump discharge port, or as close to the discharge port as possible. This valve will automatically open to allow air to exit back to the tank upon start-up. Once all air contained in the pump has been purged, the valve automatically closes.

3. If your pump incorporates the optional screw volume control, Continental Hydraulics recommends not reducing the pump’s output flow by more than 50% on start-up (pump flow is reduced by turning the adjustment screw clockwise).
4. Jog the motor (no more than ten (10) revolutions if possible) and observe the direction of rotation. If the pump shaft is not rotating in the correct direction as the arrow on the pump body indicates, reverse the direction of rotation of the motor.

- If rotation is correct, continue jogging the electric motor until the pump is primed. You will notice a definite pump tone change as well as pressure gauge movement when the pump begins to prime. Once the pump has primed, pressure adjustments can be made.

5. Pressure adjustments must be made against a blocked or deadhead system (cylinders and/or motors stalled or valving shut off). Increase the pressure by turning the pressure adjustment clockwise; counterclockwise to decrease it. The pump pressure setting should be as low as possible, yet high enough to insure satisfactory machine performance.
6. Continental recommends installing a low resistance check valve to prevent pump reversal on system shutdown.

Trouble Shooting

Some of the most common difficulties that could be experienced in the field are listed here with potential causes and their remedies.

TROUBLE	POTENTIAL CAUSE	REMEDY
Excessive pump noise	1) Coupling misalignment	Align the pump and motor shaft to within .006 inch (.152 mm) total indicator reading. The tighter the alignment, the quieter the pump will be.
	2) The continuous system pressure is significantly above or below the rated pressure of the pump.	Decrease system pressure to the pump rated pressure or adjust adjust the pump thrust screw to match system requirements.
	3) Fluid in the reservoir is low and the pump is sucking air.	Fill the reservoir so that the fluid level is well above the end of the suction line during all of the working cycle.
	4) Restricted inlet.	If a suction strainer is used, check it for obstructions or dirt. **It is not recommended the use of strainers as they tend to be a leading cause of cavitation which manifests as excessive noise.** Check also for shop rags left in the reservoir.
	5) Air leak in the suction line.	Tighten all fittings. If it still leaks, smear grease over the joints to locate the leak.
	6) Suction line has too many elbows, or is too long.	The suction line should be as short and as straight as possible reduce the resistance to flow.
	7) Air in the fluid.	The return line should terminate below the fluid level to prevent splashing.
	8) Suction line is too small.	Suction line should always be equal in size to the suction port. **Never** reduce it.
	9) Vane does not move freely.	Contamination in the fluid or a burr in the vane slot can cause a vane to bind up. Proper filtration and/or deburring of the vane slots is required.
	10) Vane is installed incorrectly.	Vanes must be mounted with the rounded edge toward the ring and toward the pump direction of rotation.
	11) A vane is missing.	Make sure all vane slots have a vane in them.
	12) Port plates installed incorrectly.	Plates must be installed so that the arrows point in the same direction as the rotational arrows on the pump body.
	13) Wrong direction of pump rotation.	Change the motor rotation.
	14) Low oil level.	Fill the reservoir so that the fluid level is well above the end of the suction line during all of the working cycle.
	15) Wrong type of oil.	Use a premium, clean hydraulic oil having the viscosity recommended for your application.
	16) Reservoir not vented.	Vent reservoir through the air filter to allow breathing action for fluctuating oil level.
	17) Slip line (case drain) does not terminate below oil level.	Extend case drain piping so that it terminates below the oil surface when oil is at its lowest level during any one machine cycle.
	18) Worn pressure ring.	Caused by hot, dirty, thin oil or no oil at all. Replace the pressure ring.
	19) Two pumps to a common manifold.	A check valve must be placed in the discharge line of both pumps to prevent back flow and surging. This check valve must also be present if an accumulator is in the dischrge line.
Pump will not prime	1) Shaft rotation in the wrong direction.	When installing a pump, always jog the electric motor to check for proper shaft rotation. Rotation should only be clockwise (right hand) for PVX pumps.
	2) Air leak in the suction line.	Make sure all fittings are tight.
	3) Pump is air bound.	Use an air bleed valve to void the pump and suction line of air.
	4) Fluid level in the reservoir is too low.	Fill the reservoir so that the fluid level is well above the end of the suction line.
	5) Stroke limiter is turned in too far.	Flow should not be reduced more than 50% of maximum. Turn CW to restrict flow (see chart, page 41).
	6) Suction port dust plug left in place.	Remove plug.

Trouble Shooting (continued)

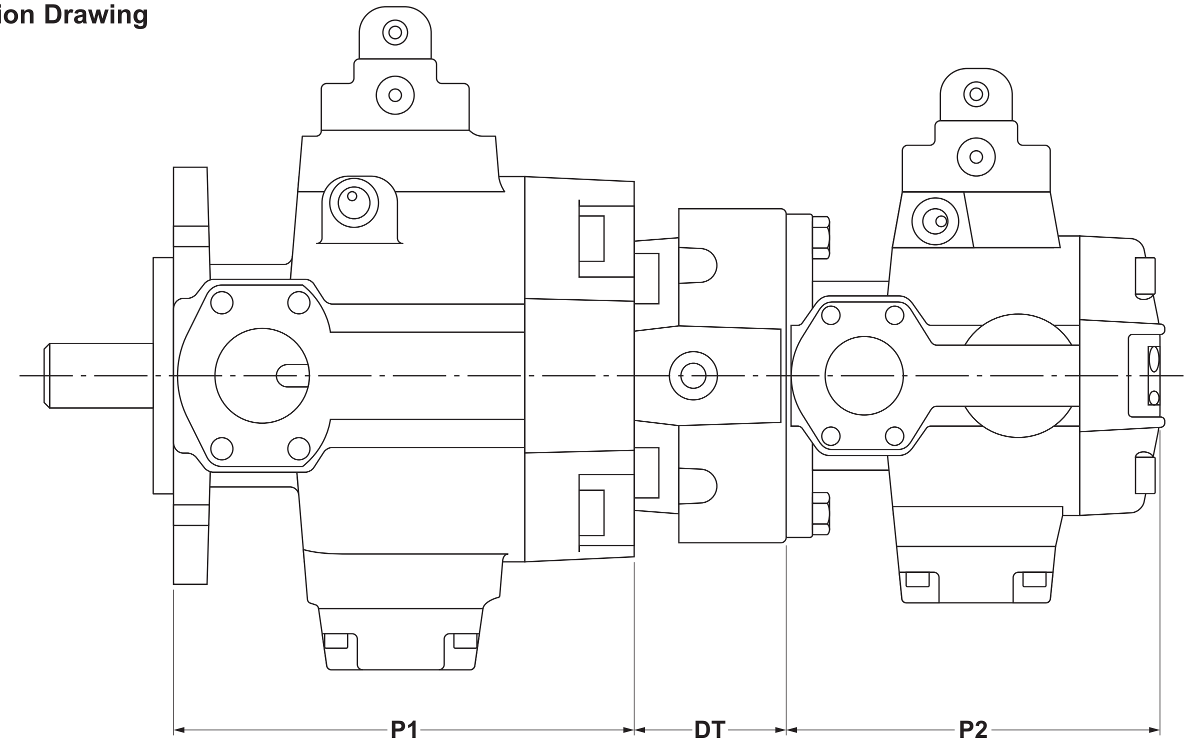
TROUBLE	POTENTIAL CAUSE	REMEDY
Pump is unstable	1) Contamination in the compensator.	Thoroughly clean the control orifices and check filtration.
	2) Pressure ring is not moving properly.	Control piston should be checked for freedom of movement.
System is too hot	1) Case drain line is installed too close to the pump inlet line.	The case drain and pump inlet should be separated by a baffle in the reservoir.
	2) Reservoir is undersized. Rule of thumb is a minimum or 2 to 3 times pump output flow.	Add a cooler.
	3) Pump operated at higher pressures than required.	Reduce pump pressure to the minimum required for installation.
	4) Pump discharging through relief valve.	Remove the relief valve. Relief valves are not required with Continental pumps having a spring or hydraulic pressure compensator governor (these valves create additional heat).
	5) Excessive system leakage through cylinders or valves.	Check progressively through the system for excessive leakage.
	6) High ambient or radiant temperature.	Relocate the power unit or baffle against radiant heat.
	7) Low oil in reservoir.	Bring the oil level up to recommended point.
	8) Excessive friction.	Make sure fluid is of proper viscosity.
	9) Reservoir too small.	Increase the size or install auxiliary cooling equipment.
	10) Restricted or undersize valves on hydraulic lines.	Clean valves and piping. Use adequate pipe sizes.
Leakage at oil seal	1) Abrasives on pump shaft.	Protect shaft from abrasive dust and foreign material.
	2) Scratched or damaged shaft seal.	Replace the oil seal assembly.
	3) Coupling misalignment.	Realign the pump and motor shafts. Align within 0.006 inch (0.152 mm) of the total indicator reading.
	4) Pressure in pump case.	Inspect case drain line for restrictions. Should be full pipe size direct to the reservoir. PVX-20 thru 75 pumps, the case drain has a check valve as standard equipment. Check for possible failure.
	5) Oil is too hot.	See *Trouble Shooting* section “System is too hot”.
Bearing failure	1) Chips or other foreign material in bearings.	Make sure only clean oil is used. It is essential for efficient operation and long life of the bearings.
	2) Coupling misalignment.	Realign the pump and motor shafts. Align within 0.006 inch (0.152 mm) of the total indicator reading.
	3) System excessively hot.	See *Trouble Shooting* section “System is too hot”.
	4) Electric motor shaft end play or driving/hammering on or off the pump shaft.	Continental pumps are not designed to handle end thrusts against the drive shaft. Eliminate all end play on electric motors. Couplings should be a slip fit onto the pump shaft.
	5) Incorrect fluid.	See fluid recommendations.
Pump not delivering oil	1) Adjusting screw for pressure adjustment too loose.	Tighten adjustment screw three (3) to five (5) turns after spring tension is felt.
	2) Wrong direction of pump rotation.	Change the motor rotation.
	3) Oil level low in reservoir.	Fill the reservoir so that the fluid level is well above the bottom of the suction line.
	4) Air leak in suction line. with the hydraulic fluid.	Tighten joints and apply good pipe compound that is compatible
	5) Oil viscosity too heavy for proper priming.	Thinner oil should be used per recommendations for given temperatures and service.
	6) Maximum volume control turned in too far.	Turn counterclockwise on volume control adjusting screw to increase delivery.
	7) Bleed-off in other portion of circuit.	Check for open center valves or other controls connected with a tank port.
	8) Pump is not tuned correctly.	Recalibrate pump (see calibration procedures).
	9) Pump cover too loose.	Tighten bolts on the pump cover.

Trouble Shooting (continued)

TROUBLE	POTENTIAL CAUSE	REMEDY
Pump not maintaining pressure	1) Pump not delivering oil.	See *Trouble Shooting* section “Pump not delivering oil”.
	2) Pressure adjustment screw not set high enough.	Set adjusting screw to obtain desired operating pressure.
	3) Compensator is in bad condition.	Replace the compensator.
	4) Vane or vanes stuck in rotor slots.	Inspect for wedged chips or sticky oil. Clean slots or replace oil.
	5) Oil is bypassing to reservoir.	Watch for open center valves or other valves open to the reservoir. Make sure that the relief valve settings are properly set high enough above the operating pressure in the system.
	6) Thrust screw not set properly.	Reset the thrust screw.

Dimensions of Double Pumps

Dimension Drawing



Possible Size Combinations	Pump 1 (P1) Inches (mm)	Adapter (DT) Inches (mm)	Pump 2 (P2) Inches (mm)
PVX-8 + PVX-8	6.10 (154.9)	1.95 (49.5)	6.05 (153.7)
PVX-11/15 + PVX-8	6.94 (176.3)	1.95 (49.5)	6.05 (153.7)
PVX-11/15 + PVX-11/15	6.94 (176.3)	2.55 (64,8)	7.05 (179.1)
PVX-20/29/36 + PVX-8	9.64 (244.9)	2.60 (66.0)	6.05 (153.7)
PVX-20/29/36 + PVX-11/15	9.64 (244.9)	3.59 (91.2)	7.05 (179.1)
PVX-20/29/36 + PVX-20/29/36	9.64 (244.9)	3.80 (96.5)	9.74 (247.4)
PVX-45/60/75 + PVX-8	12.00 (304.8)	2.61 (66.3)	6.05 (153.7)
PVX-45/60/75 + PVX-11/15	12.00 (304.8)	3.19 (81.0)	7.05 (179.1)
PVX-45/60/75 + PVX-20/29/36	12.00 (304.8)	3.80 (96.5)	9.74 (247.4)
PVX-45/60/75 + PVX-45/60/75	12.00 (304.8)	4.83 (122.7)	11.53 (292.9)

CONTINENTAL HYDRAULICS

Continental Hydraulics
5505 West 123rd St.
Savage, MN 55378
Phone: (952) 895-6400 Fax: (952) 895-6444
www.continentalhydraulics.com

Because Continental Hydraulics is continually improving its' products, specifications and appearance are subject to change without notice.