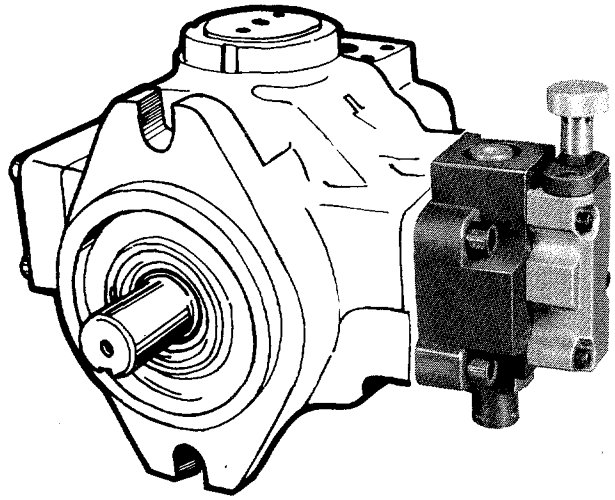
BOSCH

Engineering Data

SV PUMP CONTROLS

SINGLE STAGE
2 STAGE
SOLENOID 2 PRESSURE
SOLENOID VENTED
HYDRAULIC 2 PRESSURE
LOAD SENSING
TORQUE LIMITING
REMOTE CONTROL
KEY LOCK

Multi-pressure level pressure compensators both pump ***mounted and remote mounted***



The "DASH 62" controls are designed to give SV/TV pump users additional energy-saving options and provide a flexible series of modular control.

Racine's two-stage pressure compensator is a two-piece design. This control is tolerant of circuit disturbances and is generally more stable than the single-stage design (although the single-stage compensator is still popular). It can be easily controlled by remote valving and has good reaction characteristics.

The two-stage pressure compensator is the foundation for all controls and functions to override any primary control by limiting pressure at the maximum setting.

The first stage is made in two sizes; one for the SV-10/15/20/25, and TV-15/25 series and the other for the SV-40/80/100, and TV-40/80. The second stage is common to all SV/TV frame sizes.

A load sensing flow compensator (in the form of a cylinder that threads into the first stage pressure compensator body) gives the SV/TV pump a valuable capability. In combination with a remote orifice (fixed or variable) and two sensing lines, the pump will maintain constant flow (and constant differential pressure across the orifice), even if prime mover speed or load changes occur.

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The torque limiter is just that — a limiter of the torque provided by the prime mover to turn the pump shaft. The SV-TV pump with this control automatically reduces output flow with a rise in pressure to approximate a constant horsepower curve. It bolts onto the foundation first stage block.

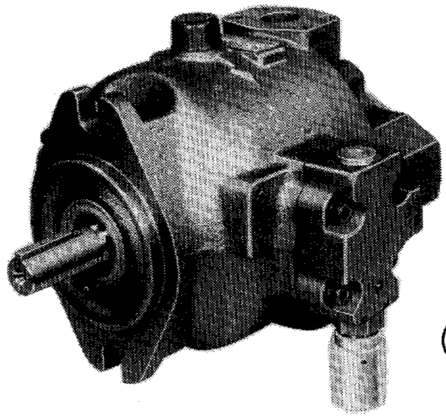
Both solenoid operated and hydraulic pilot two-pressure level pressure compensators are available.

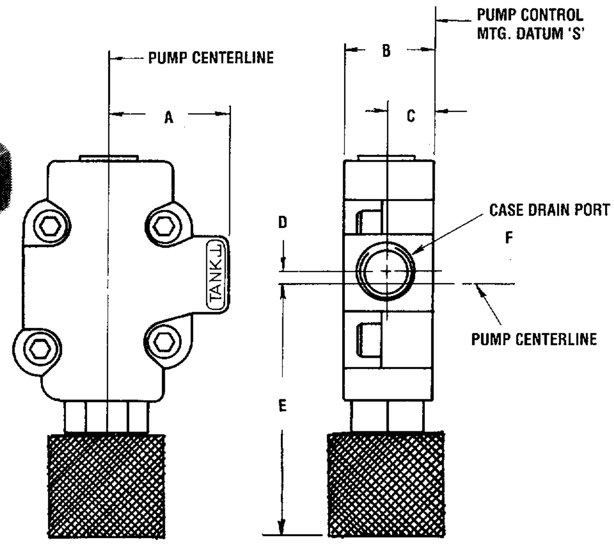
Body construction conforms to "DASH 62" controls design; compensator pilot and drain construction holes move into the body, the case drain ports on flange pumps move to the control body and foolproof offset mounting holes for the first stage pressure compensator body can be accommodated. All of this provides customer safety features and economy in manufacture. True right and left-hand bodies for flange pumps have cast-in rotational arrows. Different bolt patterns for foolproof non-interchange of bias piston cover and compensator control were also designed into the "DASH 62" bodies.

True left and right-hand bodies for all flange mounting pumps now have an offset bolt hole in the cover to prevent accidental interchange.

Twinvane® controls are essentially the same as Silentvane controls™, with slight modifications in the TV-80 and TV-40 series only. Service Books S129, S130, S131, and S132 covering TV pump repair procedures will give all necessary calibration data and parts details.

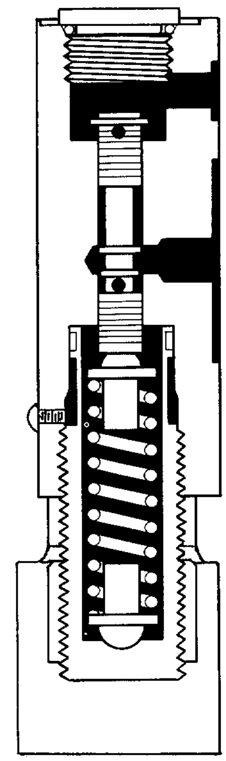
■ SINGLE STAGE





INCHES
(MILLIMETRES)

NOTE:
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE NOMINAL.



SINGLE STAGE PRESSURE COMPENSATOR

PUMPS	A	B	C	D	E	F
SV-10, 15, 20, 25	1.75 (44.5)	1.31 (33.2)	.69 (17.5)	.16 (4.1)	3.68 (93.4) Max.	#8 SAE or 3/8-14 BSPP
SV-40, 80, 100	2.24 (56.9)	1.98 (50.3)	.94 (23.9)	.19 (4.8)	3.60 (91) Max.	#10 SAE or 1/2-14 BSPP

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 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 to flow 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 tank to prevent any pressure buildup from leakage which would add to the spring force and change the compensator setting.

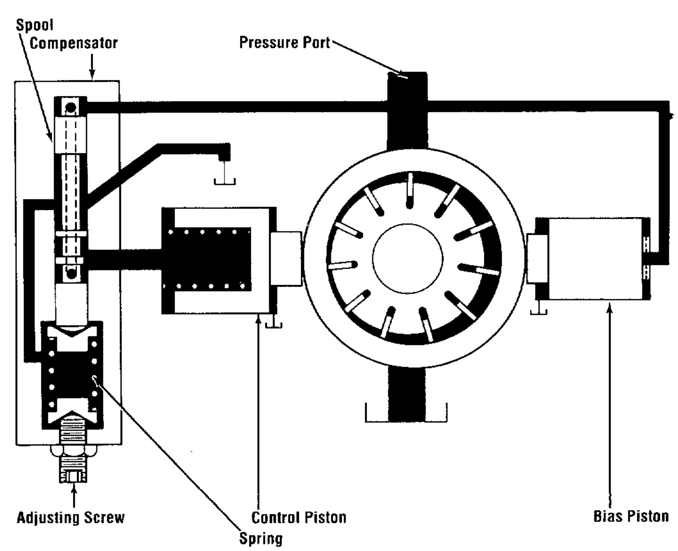
The compensator spool is really an infinite positioning servo valve held offset by the compensator adjusting spring and activated by system pressure. To simplify the explanation, the spool travel will be broken down into four finite spool positions, which are shown in Table 1.

Table 1

Compensator Spool Position As System Conditions Change

Spool Position	Pump Condition	System Condition
1	Full Flow	No Resistance
2	Full Flow	Resistance Below Deadhead Setting
3	Deadhead	Resistance Exceeds Compensator Setting
4	Spool Over Travel	Shock Pressure Above Deadhead

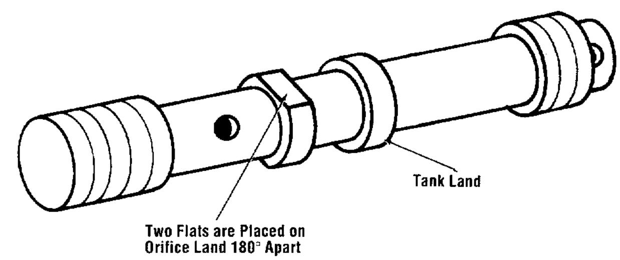
When there is no resistance to pump flow, the spring will force the spool into the spring offset or "bottomed out" position (position #1) shown. In this position, fluid from the pressure port can flow through the compensator to the control piston and allow system pressure to be applied to the control piston. A land on the spool (tank land) prevents the fluid in the control piston chamber from flowing to 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 on-stroke or flow position. The maximum flow rate is established by the length of the bias piston which bottoms out against the bias cover and prevents the ring from over-stroking and hitting the rotor.

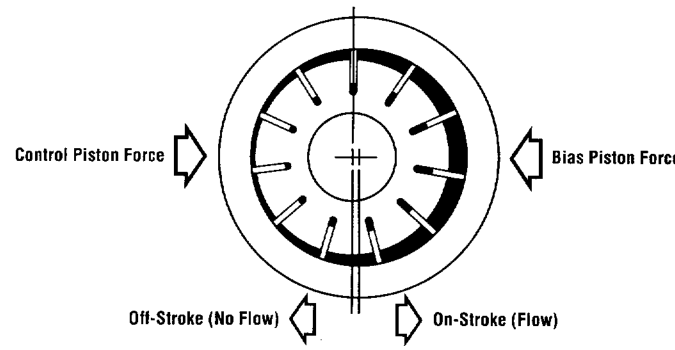


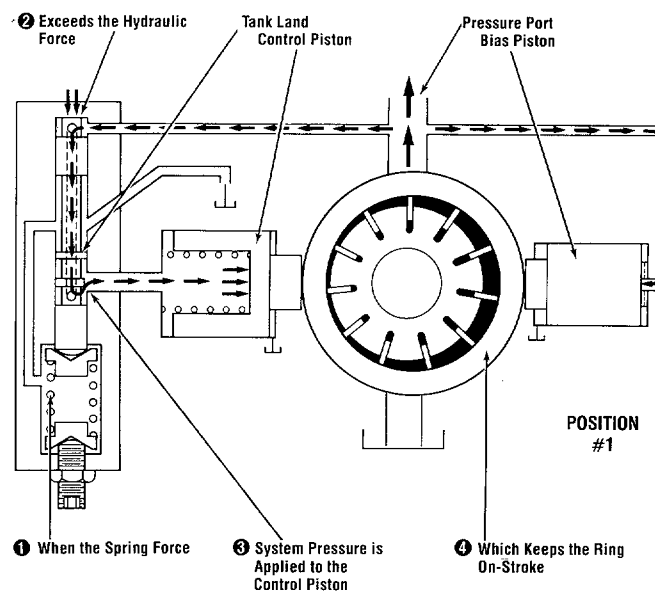
As the resistance to pump flow increases, the pressure will be sensed on the end of the spool and when the force exerted is great enough to partially compress the spring, the spool will move to position #2. The ring will remain in the on-stroke or flow position because the tank line is still blocked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

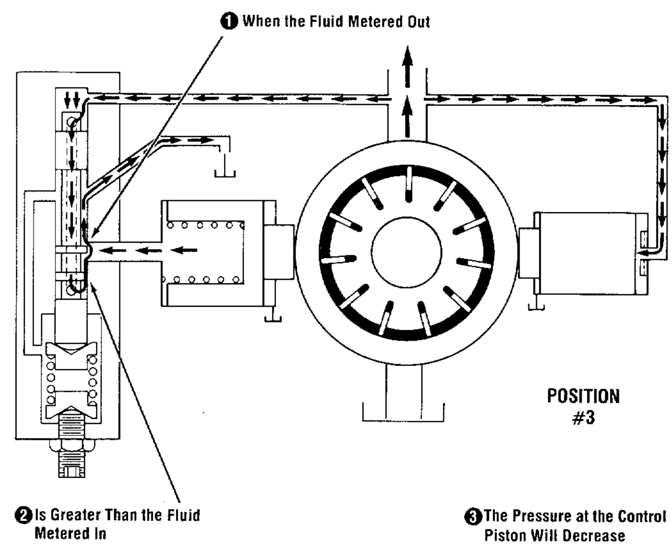
When system pressure reaches the compensator setting (spring precompression), the spool will move into position #3 which meters fluid out of the control piston chamber as well as into it.

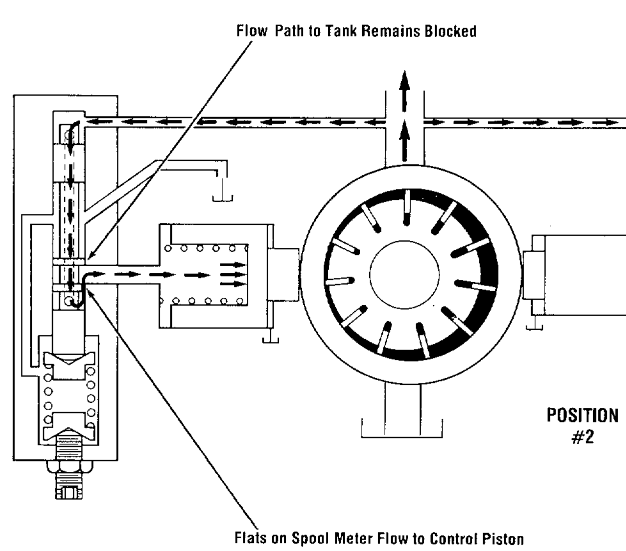
The further the spool moves toward position #4, the greater will be the amount of fluid bled off from the control piston chamber across the variable orifice created by the tank land. Since the flow of fluid to the control piston is limited by the orifice created by the flats on the pressure land, the pressure in the control chamber will drop when more fluid is bled off than is flowing in. When the pressure in the control piston chamber has dropped to approximately half of the outlet pressure, the bias piston force will exceed the control piston force and 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 on 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. The ring piston is determined by a balance of forces: control piston versus bias piston.

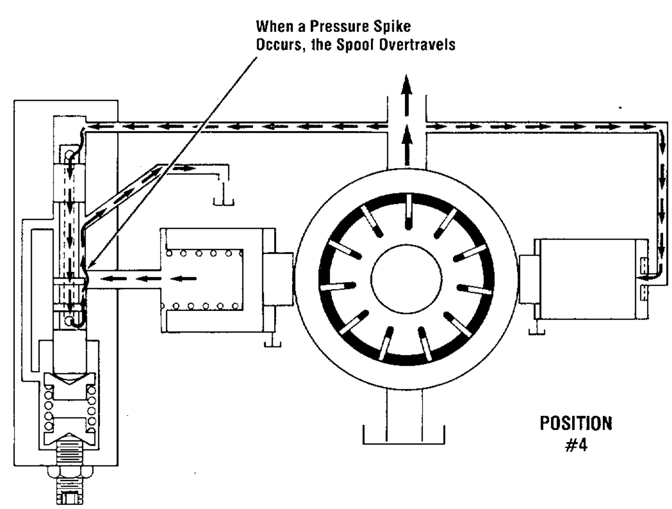




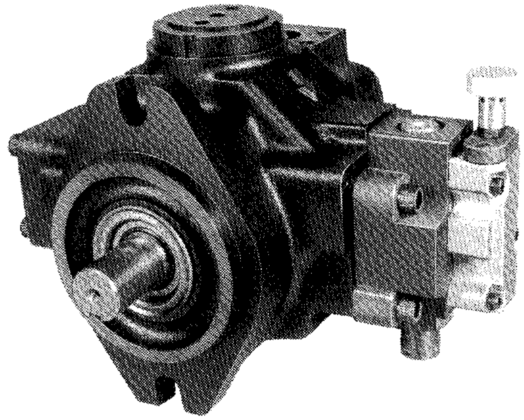


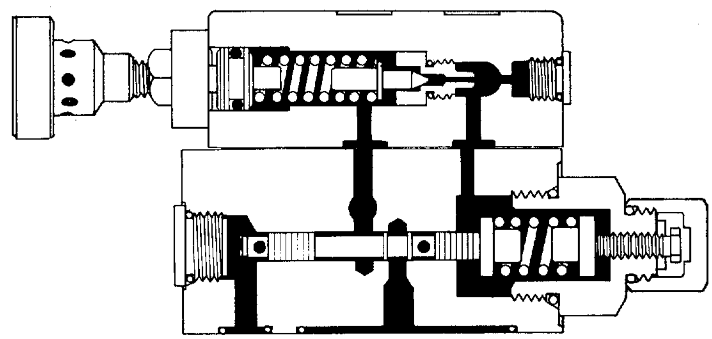


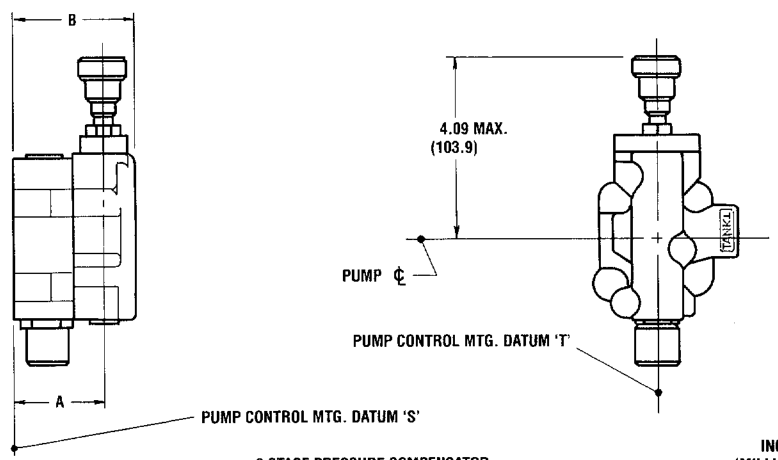




2 STAGE







2 STAGE PRESSURE COMPENSATOR

PUMPS	A	B
SV-10, 15, 20, 25	1.98 (50.3)	2.75 (69.8)
SV-40, 80, 100	2.67 (67.8)	3.37 (85.7)

INCHES
(MILLIMETRES)

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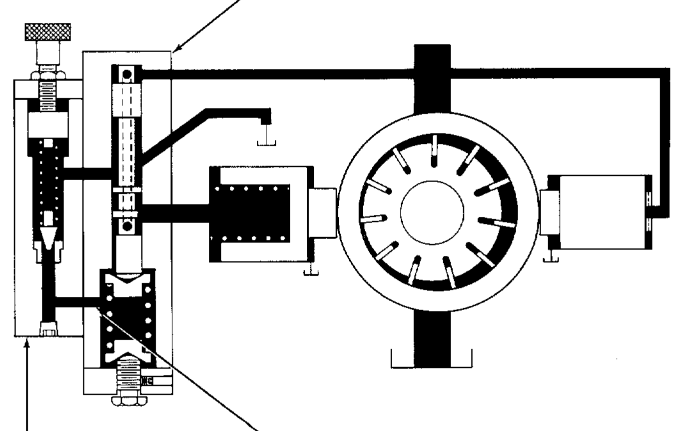
The two-stage control works exactly the same as the single-stage control but, instead of loading the spool with a spring, it is hydraulically loaded. To do this, a small relief valve referred to as the second stage is connected to the spring chamber.

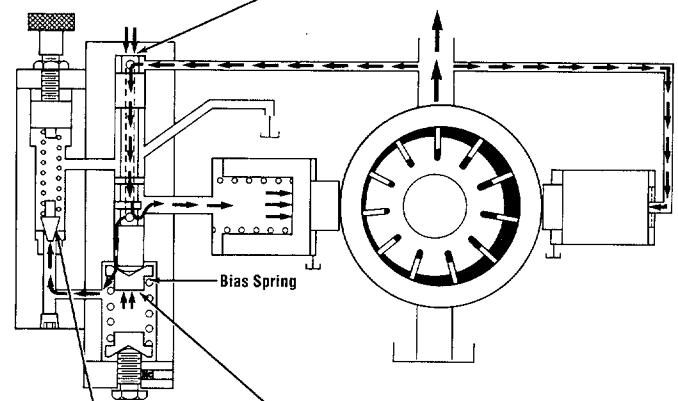
Two additional flats are ground on the land at the end of the spool, which will allow fluid to flow into the spring chamber.

If there is a pressure spike in the system above the deadhead setting, the spool will momentarily move to position #4. Only position #3 is a true compensating condition, while positions #1, #2, and #4 are over-travel. Do not become confused with the term "deadhead", which may be unique to Racine. It means the same thing as compensating.

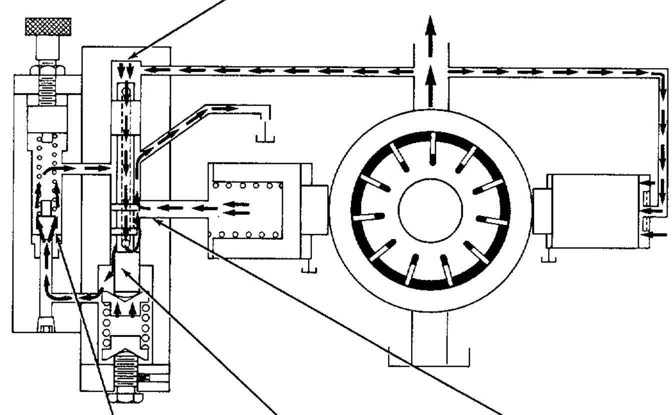
When the spring in the second stage is compressed, it will hold the poppet on its seat and block the flow to tank. With the flow blocked, the pressure at the bottom of the spool will be the same as the pressure at the top. Remember that pressure is equal throughout a static fluid. Since the area at the 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 ends 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 tank. This will limit the amount of hydraulic force applied to the bottom end of the first-stage spool. Fluid which is under pressure always takes the path of least resistance and, when the second-stage opens, the entire pump flow is going to try to flow through the compensator to tank. To get to 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 resistance to the flow which increases the pressure upstream of the flats. 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 tank. The pump will then compensate as it did with the single-stage control.

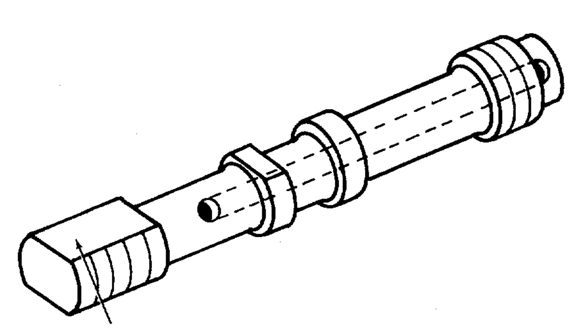




❷ Pressure at the Top of the First-Stage Spool
Bias Spring
❶ When System Pressure is Below the Setting of the Second-Stage
❸ Is Equal to the Pressure at the Bottom and the Light Bias Spring will Force the Spool Up.

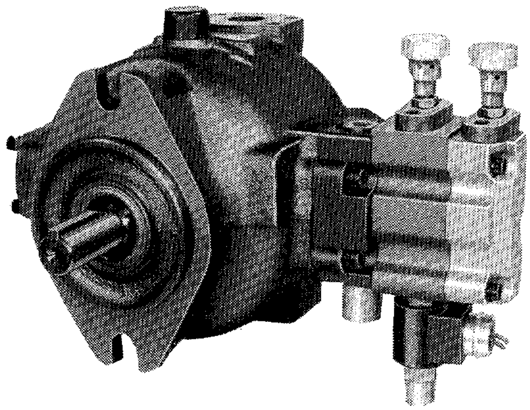


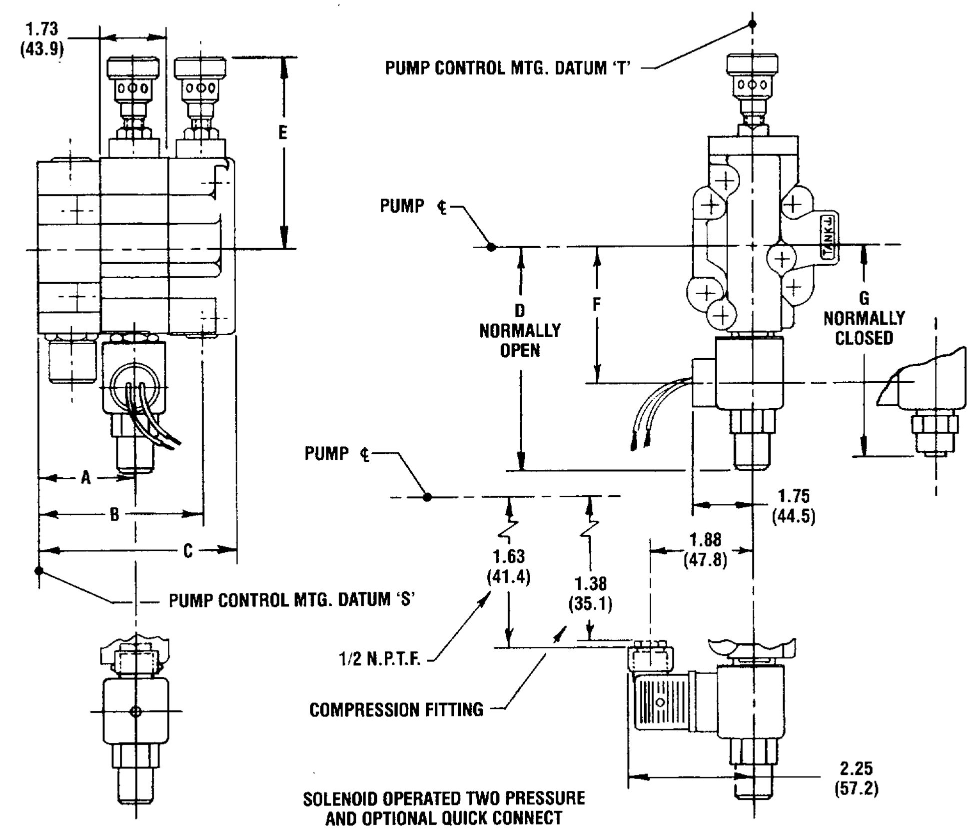
❸ Will Create a Greater Pressure Upstream Which is Sensed at the Top of the Spool and will Push it Down
❶ When System Pressure Exceeds the Setting of the Second-Stage
❷ Fluid will Flow Across the Flats and the Resistance to Flow
❹ Venting the Pressure at the Control Piston to Tank



Two Flats are Ground on the End Land 180° Apart

SOLENOID 2 PRESSURE





SOLENOID OPERATED TWO PRESSURE
AND OPTIONAL QUICK CONNECT

INCHES
(MILLIMETRES)

NOTE:
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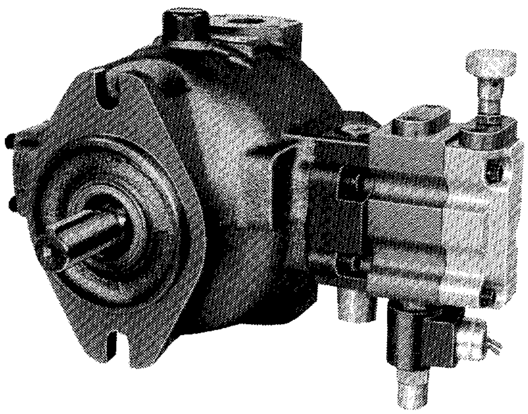
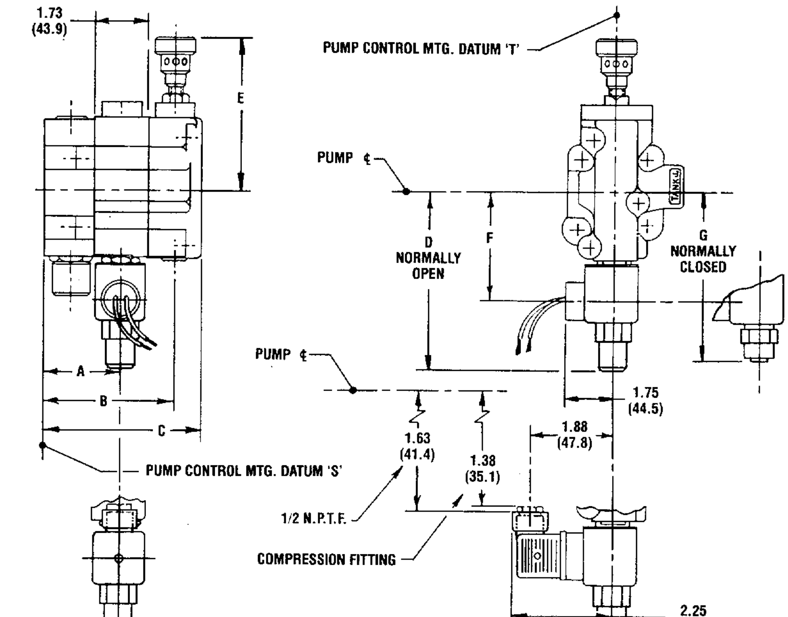
PUMP MODEL	A	B	C	D	E	F	G
SV-10, 15, 20, 25	2.16 (54.9)	3.71 (94.2)	4.40 (111.8)	4.64 (117.9)	4.09 (103.9)	2.82 (71.6)	4.39 (111.5)
SV-40, 80, 100	2.85 (72.4)	4.40 (111.8)	5.09 (129.3)	4.42 (112.3)	4.31 (109.5)	2.60 (66.0)	4.17 (105.9)

SOLENOID VENTED





SOLENOID OPERATED TWO PRESSURE
AND OPTIONAL QUICK CONNECT

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INCHES
(MILLIMETRES)

NOTE:
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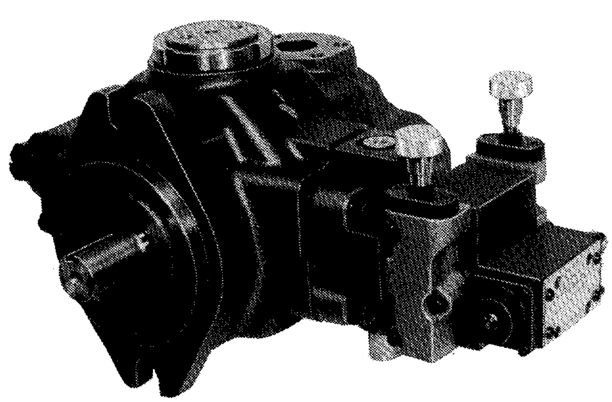
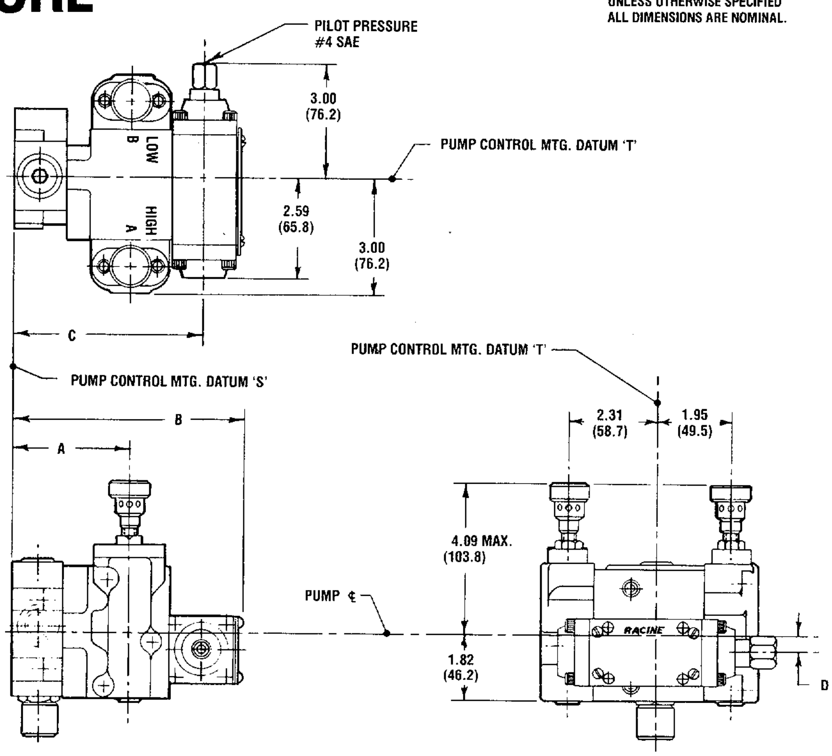
HYDRAULIC 2 PRESSURE





HYDRAULIC OPERATED TWO PRESSURE

PUMPS	A	B	C	D
SV-10, 15, 20, 25	2.94 (74.7)	6.03 (153.2)	4.92 (125.0)	.44 (11.2)
SV-40, 80, 100	3.63 (92.2)	6.72 (170.7)	5.61 (142.5)	.25 (6.4)

Multi-pressure pump control can markedly reduce horsepower demand and heat generation during periods of idle cycle 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 of large size (larger than 1/4" O.D.T.) or of lengths exceeding 20 feet. Special circuits might be needed in certain cases to alleviate problems, including the use of orifices at each end of the remote line.

Figure 7 shows the construction of the integral two-pressure level 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 energized to select which of the two second stages will have control of the pump. A normally open two-way valve will produce the condition of normally low pressure, energize to high pressure. A normally closed two-way valve will produce the condition of normally high pressure energize to low.

Due to its modular design, the multi-pressure Level pressure compensator is not limited to two pressure settings. In fact, as can be seen in Figure 8, multiple pressure circuits can be created either integral to the pump (up to 4 separate adjustable pressure settings) or remotely (Figure 9) by utilizing the second stage remote port. (Due to additive leakage rates, only one normally open or normally low pressure second stage can be used per pump.)

When utilizing the second stage remote port, different types of remote relief valves (including electrohydraulic) can be used. Each relief valve, however, must be identical on any one installation and each must be able to handle low control flows without erratic operation (approximately 40 cipm maximum available from remote port at maximum pump pressure rating). The Racine FE1-SBAD-C02S panel mounted relief will work well, as does a separate second stage(s) (same as second stage on pump) mounted on subplate #308749. Settings of each relief valve (or each second stage) should maintain at least a 50 psi separation to avoid interaction. The valves used to switch from one remote pressure setting to another must exhibit low cross port leakage rates (below 20 cipm) and must not be of open crossover construction unless momentary loss of pressure can be tolerated.

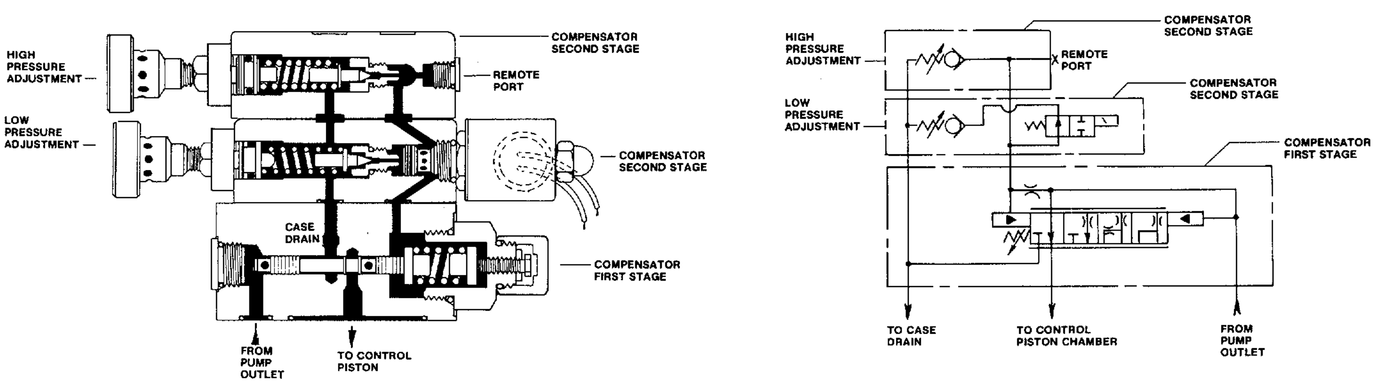


FIGURE 7.

MULTIPLE PRESSURE INTEGRAL TO THE PUMP

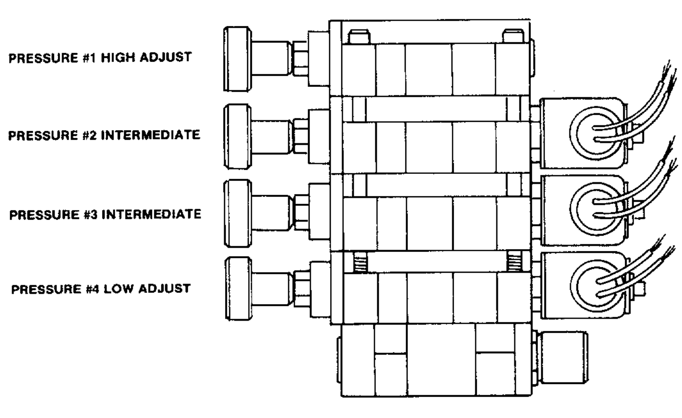
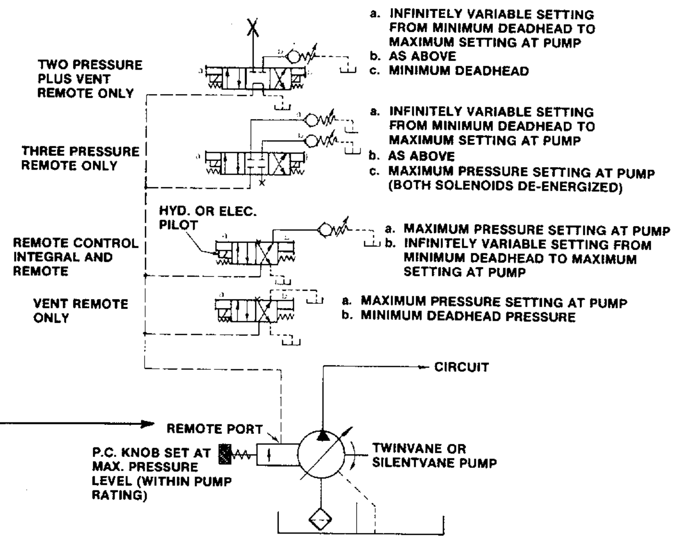


FIGURE 8.

The other option available for remote mounted, multiple pressure compensators is to mount them on a subplate, #308749. The remote port of the pump's second stage is connected to the subplate for this remote capability. This is shown in Figure 9.

Multiple pressure level compensators (pump mounted or remote mounted) are available as either non-vented or vented. The vented option means there is no adjustment possible; there are no internal components in the auxiliary second stage compensator. By venting the compensator, the pump will go to minimum deadhead.

MULTIPLE PRESSURE REMOTE FROM THE PUMP



SECOND STAGE PRESSURE COMPENSATOR

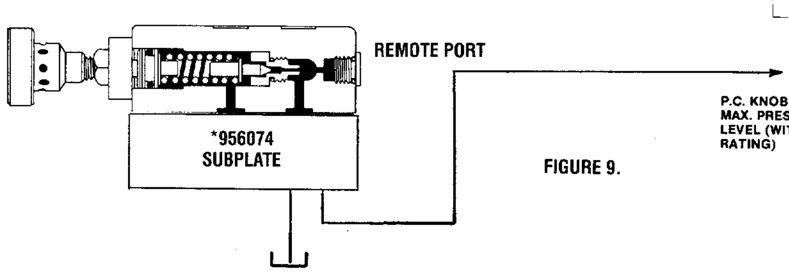
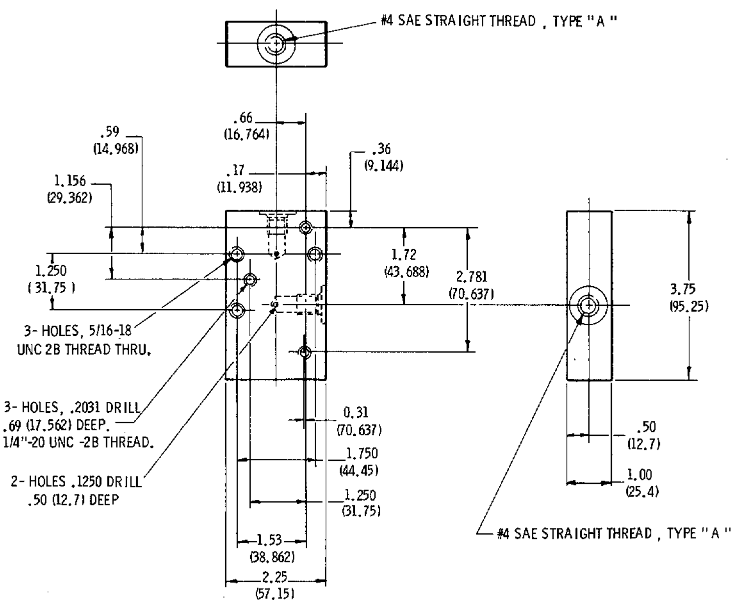
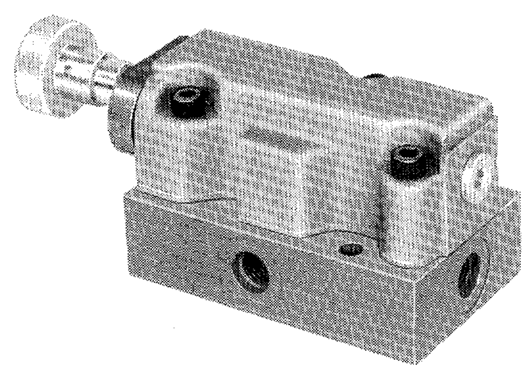


FIGURE 9.





MULTIPLE PRESSURE – REMOTE

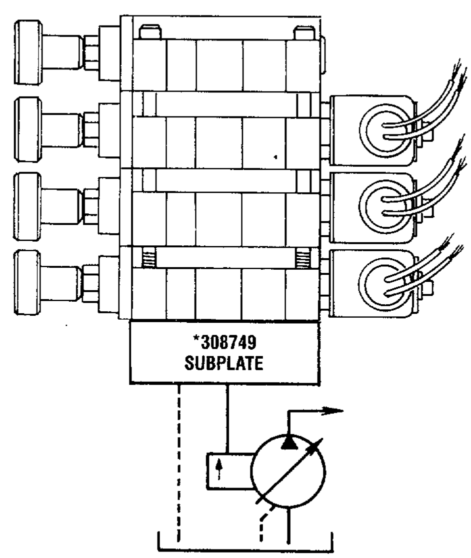


FIGURE 10.

***NOTE:** 956074 Kit includes bolts for one second stage compensator and Subplate #308749. For Kit numbers with Subplate #308749 and longer bolts, consult the factory.

There is a simple way to get two-pressure operation without the use of switching valves and remote reliefs while saving energy. Please note Figure 9A.

In this circuit, a 1/4 inch line is connected to the compensator remote port which controls the pressure limiting set point. The 3 psi check valve in the sense line does not allow the pump to go to infinite pressure. The .060 inch orifice is a safety device in case the check valve leaks. The relief valve in the main pressure line is a "peak clipper" which is rated at 30% of maximum pump flow and set 150 psi above maximum operating pressure. It helps to smooth out any transient peaks during 4-way valve operation.

When the cylinder meets significant resistance, the pressure in the head end of the cylinder rises rapidly and the load sensing line check valve closes. At this point in time, the pump no longer has remote control and reverts to the setting of the second stage. Pressure rises to this maximum level and the pump compensates.

It is important to use 7C spools or two position spring return only, to avoid cylinder drift, due to compensator control flow. Another method is shown (Figure 9B) when a 1C main spool two-stage valve is used with a 7C spool pilot stage. The sensing line is connected to a cross drilling port located between the pilot section and main spool, which allows the compensator to vent to tank when neither pilot solenoid is energized. If solenoid "A" is energized, the pump goes to second stage compensator setting; and, if solenoid "B" is energized, the compensator remains vented to give minimum deadhead pressure. Of course, the connection of the pressure sensing line can be changed to allow high pressure when solenoid "B" is energized.

Other circuits have been devised to enable the sense line to give anticipatory compensator action. This is valuable in cases where timing is critical so that the pump can anticipate flow demand. The length of the sense line is very important because too much contained fluid will easily negate the anticipation action. Usually five feet of 1/4 inch tubing is maximum.

TWO PRESSURE LEVEL OPERATION USING COMPENSATOR REMOTE POST

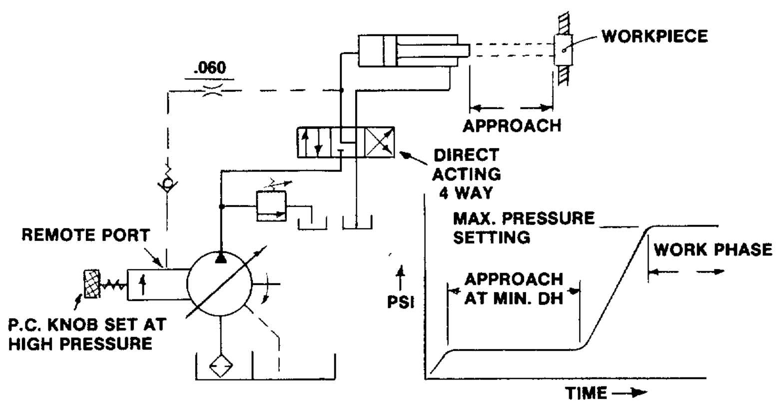


FIGURE 9A.

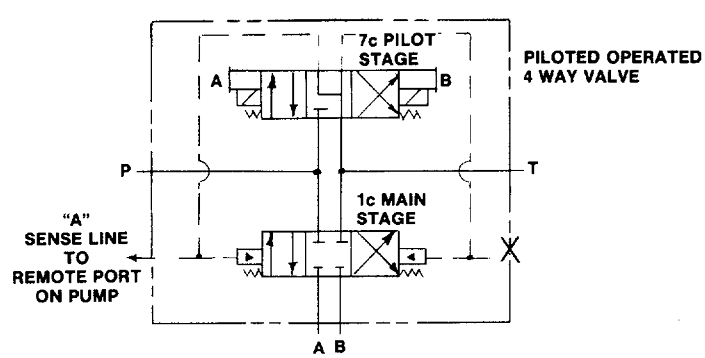
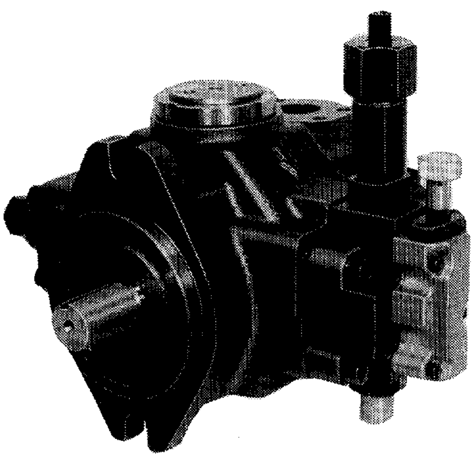
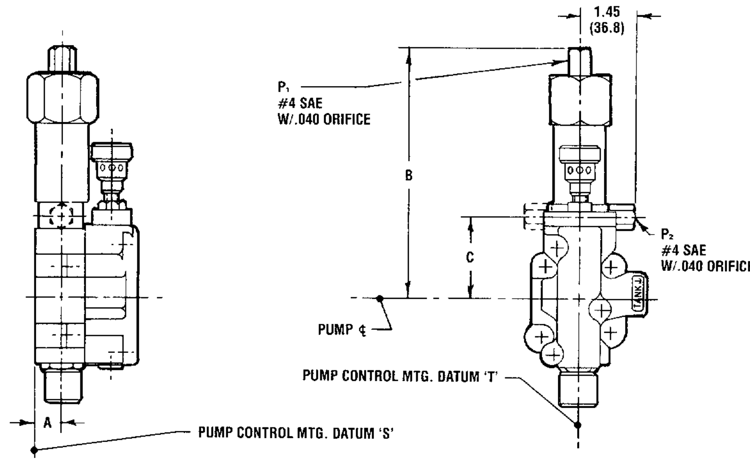


FIGURE 9B.

■ LOAD SENSING





INCHES
(MILLIMETRES)

NOTE:
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE NOMINAL.

LOAD SENSING CONTROL

PUMPS	A	B	C
SV-10, 15, 20, 25	.69 (17.5)	6.56 (166.6)	2.18 (55.4)
SV-40, 80, 100	.94 (23.9)	7.31 (185.7)	2.92 (74.2)

The purpose of the load sensing flow control is to maintain constant flow regardless of changes in load or pump shaft rotational speed. This is accomplished by using an external orifice (fixed or variable) and continually sensing pressure drop across this orifice with two pilot lines. The pump becomes a "control element" with this option, very similar to a very accurate pressure compensated 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 load sensing flow compensator (LSFC) is very energy conserving. Accuracy of the LSFC is +2-5% of set flow rate over the full range of load pressure, if a high quality remote orifice is used.

Please note Figure 1 which shows the LSFC in pictorial form, and Figure 2 which shows actual construction.

The two-stage pressure compensator module is the basic foundation for the LSFC. A differential pressure piston assembly is threaded into a normally plugged SAE port located in the blank end of the first stage body. The differential piston area is very great compared to the flat end of the servo spool, so less ▲P and greater accuracy is developed as the piston translates small pressure level changes into mechanical force. This force is transmitted by a free floating push rod/push pin to the servo spool.

The control seeks to maintain a constant pressure drop of 100 psi across the remote orifice, and any increase in flow due to decreasing load or increase in pump shaft rpm, will cause an increase in the differential pressure. This action immediately results in movement of the push rod/push pin towards the servo spool to vent the control piston which destrokes the pump to reduce output flow, thereby re-establishing 100 psi across the sense lines P1 and P2. The opposite control action occurs should the ▲P fall below 100 psi, with the pump smoothly, dynamically changing ring position continually to adjust for any differential pressure changes. Constant velocity of the load under widely varying load 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 maximum deadhead pressure until the problem is corrected. Should the remote orifice be totally closed, the pump will go to minimum deadhead.

The sensing pilot line P1, which is upstream of the remote orifice, and sensing pilot line P2, which is downstream, connect to the piston body as shown. The piston has a bias spring that is factory shimmed to obtain a ▲P of 90-110 psi across the piston. This energy is irrevocably lost, but is necessary to assure proper control operation.

Each #4 SAE connector for P1 and P2 has a 0.040 inch orifice in it to damp out any tendency to oscillate for sense lines of 1/4 inch tubing up to 10 feet long. Additional 0.030 inch orificing in each line might be necessary in lines up to 20 feet long. Sense lines should be hard tubing of approximately equal length and 1/4 inch 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 create erratic action. Thorough air bleeding of the sense lines is absolutely essential to proper operation.

LOAD SENSING FLOW COMPENSATOR CONTROL

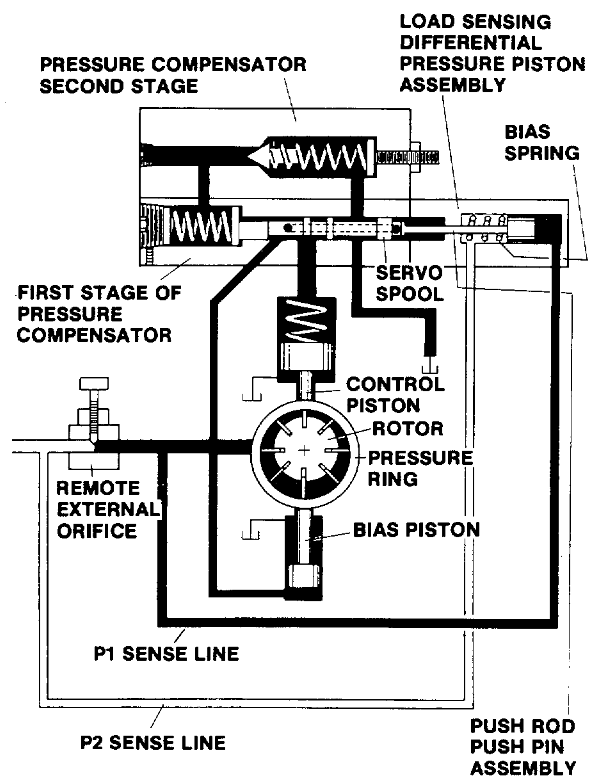


FIGURE 1.

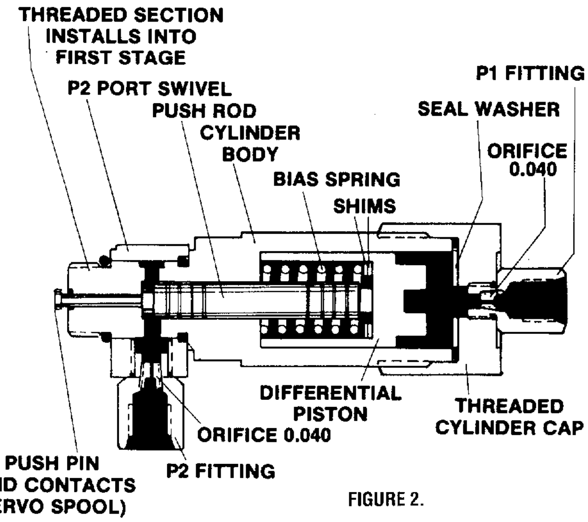


FIGURE 2.

Directional valves in the sense lines P1-P2 can cause the pressure compensator to override load sensing flow compensation and give the following circuit conditions:

Circuit Condition	Pump Reaction
1. P1 Open To Circuit P2 Vented To Tank	Minimum Compensated Pressure (Deadhead)
2. P1 Closed P2 Open To Circuit	Maximum Compensated Pressure (Deadhead)
3. P1 Closed P2 Vented To Tank	Maximum Compensated Pressure (Deadhead)
4. Vent Pump Pressure Compensator	Minimum Compensated Pressure (Deadhead)

The chart assumes both remote orifice and load are open to flow.

The quality of the remote orifice is very important to the accuracy and stability of the LSFC. Successful orifices are:

1. Needle valves with contoured plugs for good rangeability.
2. Standard flow control valves such as FF2-DHSL-03L with the P.C. spool blocked open.
3. Electrohydraulic flow controls of many brands and types.

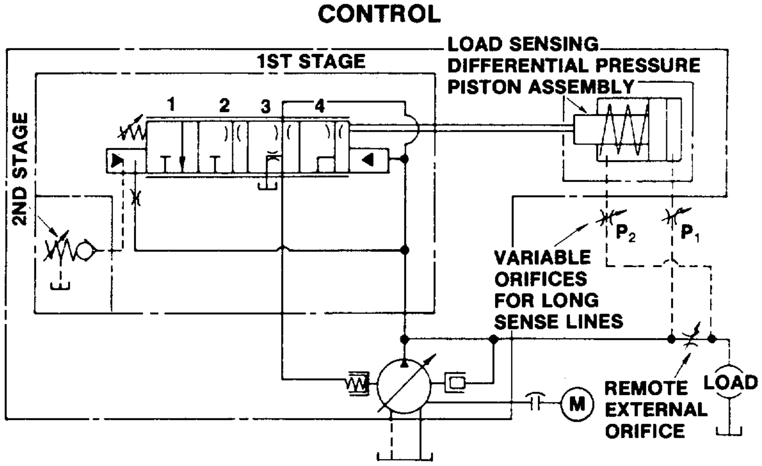
All orifices must be non-pressure compensated and sharp edged for temperature stability. If only low accuracy is needed, the ▲ P of a four-way valve or other two-way is generally useable. Remember that at least 100 psi ▲ P must be developed at the minimum flow rate or the LSFC will not work well.

Figure 14 is the schematic for the LSFC plus a flow versus pressure characteristic curve. The curve shows that two areas (cross-hatch) must be avoided. Flow rates below 10% of maximum output at rated rpm and pressures below minimum deadhead (generally 400 psi on 2000 psi rated pumps, 350 psi on 1500 psi rated pumps, and 175 psi on 750 psi rated pumps). Flat flow lines extend from minimum deadhead to approximately 100 psi below the setting of the pressure compensator, at any flow rate within the limits of maximum to 10% of maximum flow capability.

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 P2 sense line location downstream of the orifice. This puts P2 at atmospheric or at tank line pressure, which can vary drastically. Please do not apply LSFC-equipped pumps on meter-out circuits until the factory advises otherwise.

Applications that could induce higher pressure in P2 than pump output can manage in P1 also will not operate satisfactorily. This can occur in some lifting circuits with load weight return and open center directional valving.

LOAD SENSING FLOW COMPENSATOR CONTROL



LSFC FLOW VS PRESSURE CHARACTERISTIC CURVES

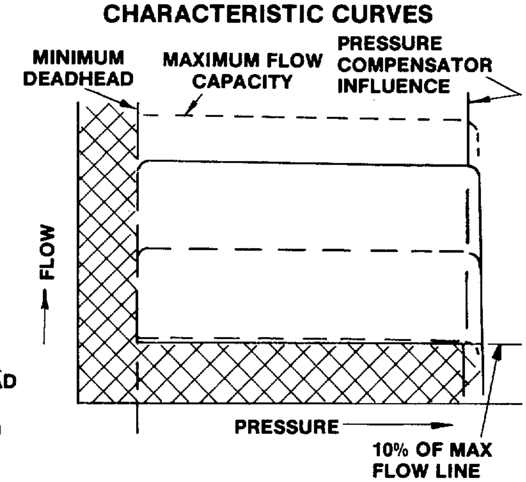
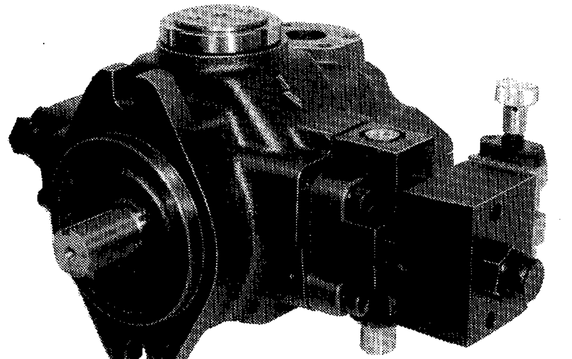


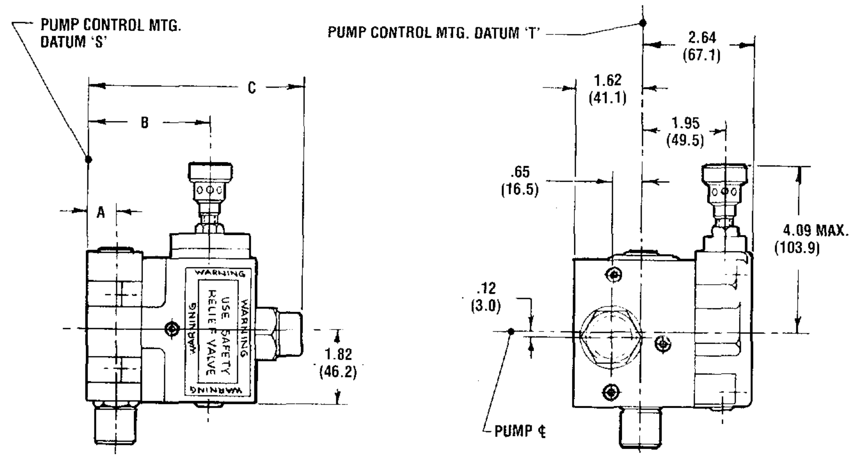
FIGURE 14.

LSFC CONDITION	POSITION	CONDITION	SYSTEM CONDITION
RATED ΔP	3	ON STROKE TO SET FLOW	CONSTANT FLOW
ABOVE RATED ΔP	4	MIN. D.H.	EXTERNAL ORIFICE SHUT OFF
BELOW RATED ΔP	2 TO 1	FULL STROKE	EXTERNAL ORIFICE OPEN BEYOND PUMP DISPL.
ZERO ΔP	3 TO 4 COMP. OVRRIDE	D.H.	LOAD RESISTANCE ABOVE COMP. SETTING

$\Delta P = P_1 - P_2$

TORQUE LIMITING





INCHES
(MILLIMETRES)

NOTE:
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE NOMINAL.

TORQUE LIMITING CONTROL

PUMPS	A	B	C
SV-10, 15, 20, 25	.69 (17.5)	2.94 (74.7)	5.16 (131.1)
SV-40, 80, 100	.94 (23.9)	3.63 (92.2)	5.85 (148.6)

The purpose of this control is to limit the input torque to the pump shaft. In effect, this does limit the horsepower transmitted to the load and creates a constant horsepower control. No torque or power sensing is done at the load, only within the pump structure itself.

Pump output flow rate is linear and directly proportional to pressure ring movement, so the physical displacement of the ring can be used as a pressure reference in the following manner. Please refer to Figure 17, which shows a pictorial view of the torque limiting control.

An adapter block is bolted to the basic first stage compensator body. The adapter has internal drillings to cross connect to the second stage of the pressure compensator and form cavities for the push rod and movable seat. As the control piston moves toward the deadhead (compensated) position of the pressure ring, powered by the bias piston, it retracts into the control piston bore. This forces the push rod against the movable seat and cone poppet and compresses the control spring. When the pump goes on stroke toward full flow, the spring preload decreases and the follower spring (Figure 18) keeps the movable seat, push rod and control piston in constant contact throughout the full stroke of the pressure ring. This action allows proportional, linear reduction of flow as pressure increases, or increase of flow as pressure decreases, to conform to constant horsepower formulas of maximum flow limit — minimum load pressure; 1/2 flow — 1/2 pressure and minimum flow limit — maximum load pressure. Also, the condition of high flow, high pressure, beyond certain limits, cannot be obtained and torque limiting is achieved, without allowing the pump to go into pressure compensation. The pressure compensator will override the torque limiter at the maximum pressure set point. The control spring rate selected as the standard takes into account the need for a relatively consistent slope of the flow dropoff line, plus the effective poppet seat area, and a balance of forces necessary to retain catalog standard minimum deadhead pressure.

The control spring can be adjusted clockwise to give a family of parallel drop off slopes from minimum deadhead to a maximum pressure point limited by the pressure compensator setting. The slope itself cannot be changed to a steeper line without an entirely different spring and then only within strict limits as a special pump code. No flatter (less angle of inclination) slope is possible than that of the standard spring.

Since the second stage of the pressure compensator is in parallel with the cone poppet in the torque limiter, the secondary pressure limiting control must be set at some pressure level at least 150 psi above the maximum operating pressure. Therefore, as system pressure rises, the reference pressure in the first stage spring cavity changes to upset the force balance across the servo spool. This vents or meters out fluid from the control piston chamber to shift the pressure ring to decrease flow. When maximum operating pressure is achieved, very little flow to the load is present and this should be carefully noted to avoid stalling at start-up or when overload conditions exist.

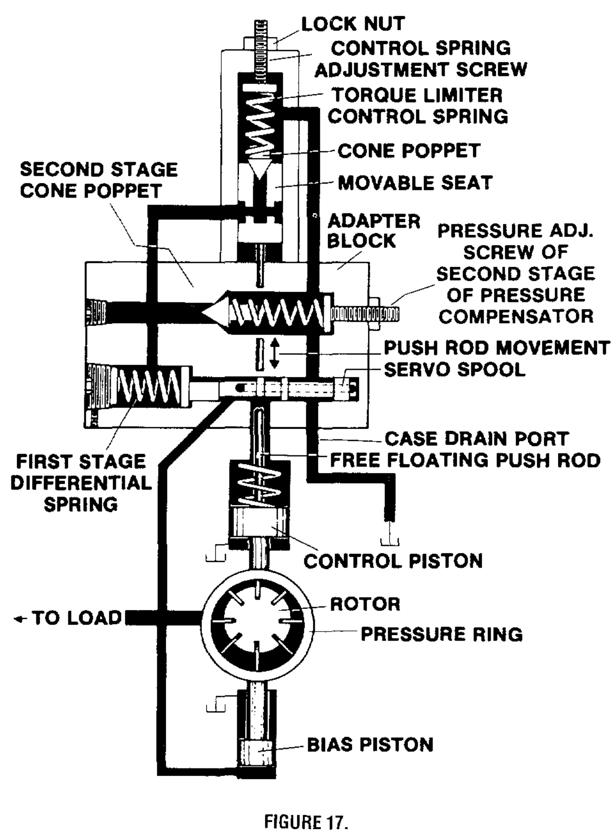


FIGURE 17.

Figure 18 indicates actual construction as a cross sectional view, and Figure 19 is a schematic of the control. Figure 20, 20A shows the base line flow vs. pressure curves for SV-10, 15, 20, 25, 40, 80 and 100 pumps. Since each frame size has its own control spring rate, control force constants and pressure ring stroke distance, they do not have the same characteristics.

In the remote possibility that the push rod or movable seat would jam up mechanically, the pressure ring might be restricted in going to deadhead. Therefore, when using a torque limiting control, it is necessary to use a system relief valve.

Torque limiting control-equipped pumps are best applied in the following circuits:

1. Inherently constant horsepower machines such as center shaft winders; metal cutting, milling, shaping, grinding, turning machine tools; rubber extruding and coating and various mixing equipment.
2. Fork lift trucks, loaders and lifting machinery use a wide load range where heavier loads usually are handled more slowly than lighter loads. Full velocity is possible at moderate pressures while conserving power, and still there is sufficient power available under full load conditions.
3. All systems that have input power restrictions, for whatever reason.
4. All loads that have constant power demands independent of speed with torque varying inversely with speed.

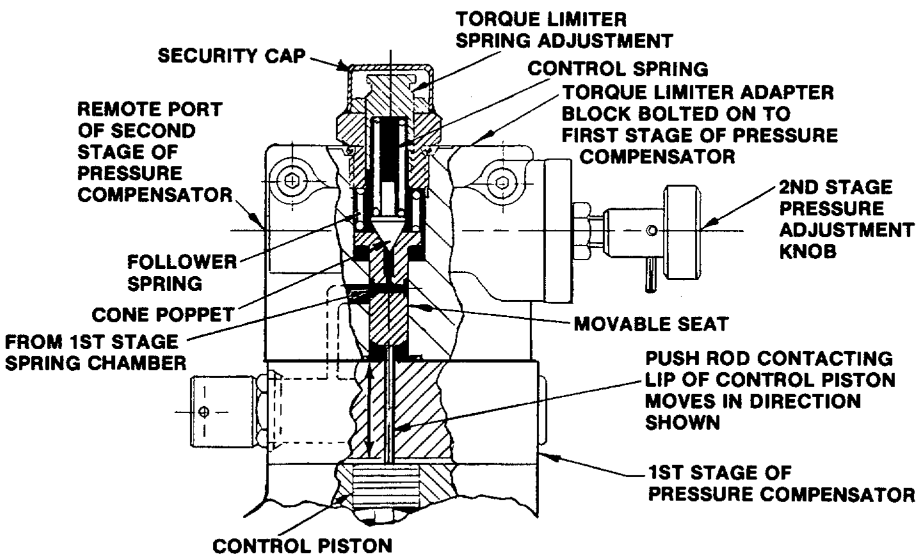


FIGURE 18.

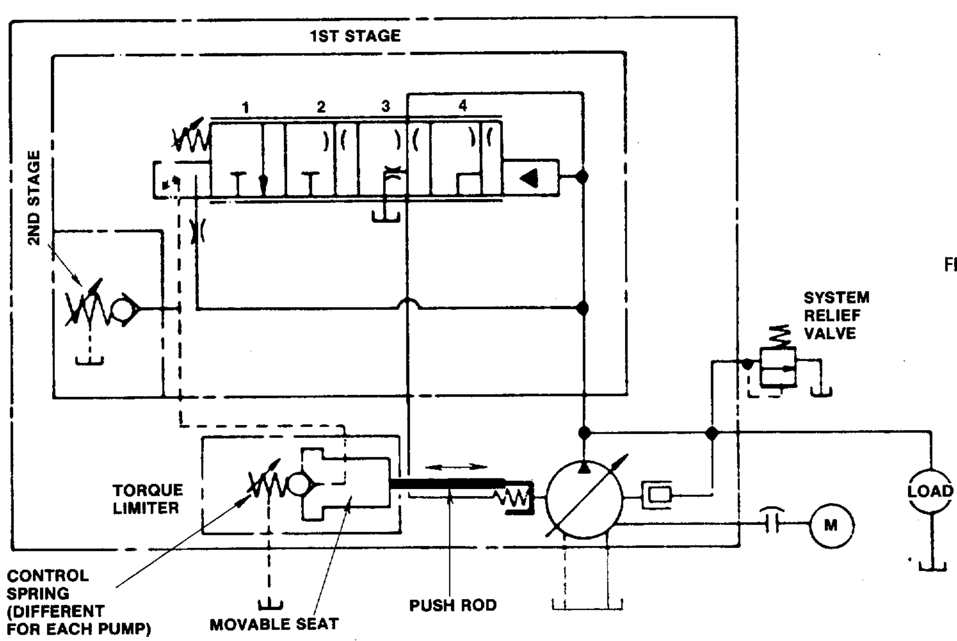
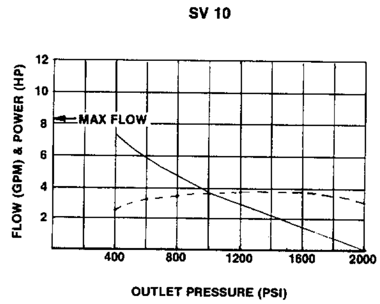
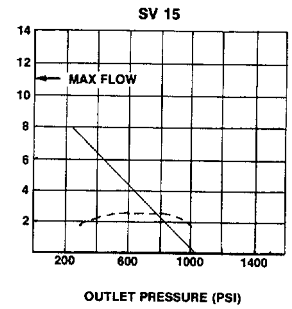


FIGURE 19.

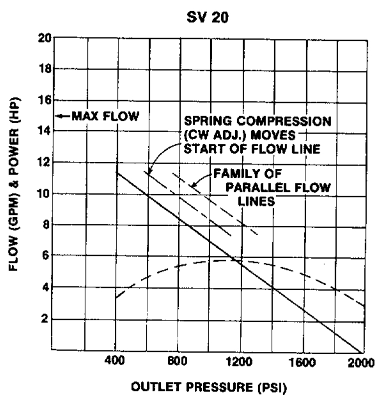
TORQUE LIMITER	SPOOL POSITION	PUMP CONDITION	SYSTEM CONDTION
POPPET SEATED	1	FREE FLOW	NO RESISTANCE
POPPET OPENING	2	FULL FLOW	RESISTANCE STARTING
POPPET METERING	2 TO 3	REDUCED STROKE	RESISTANCE INCREASING
POPPET METERING	3	DEADHEAD	BLOCKED
POPPET OPEN	4	SPOOL OVER TRAVEL	SHOCK PRESSURE ABOVE DEADHEAD

**TORQUE LIMITING CONTROL CHARACTERISTIC CURVES
USING STANDARD LIMITER SPRING AT 1800 RPM**





SOLID LINE IS BASE FLOW, DOTTED LINE IS BASE INPUT HORSEPOWER
ALL DATA IS NOMINAL: EACH PUMP WILL VARY DEPENDING
ON SETTING, LEAKAGE AND CIRCUIT.



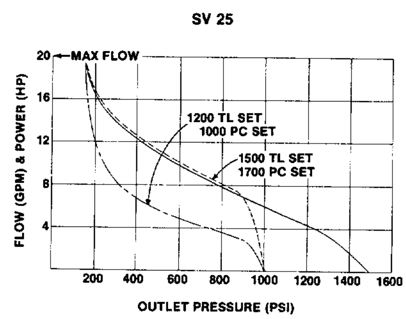


FIGURE 20.

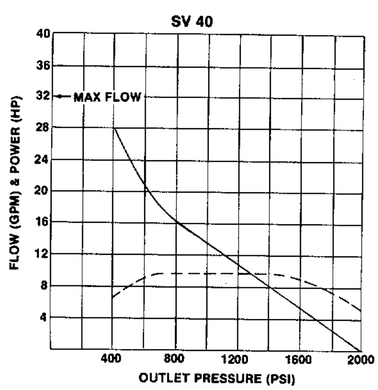
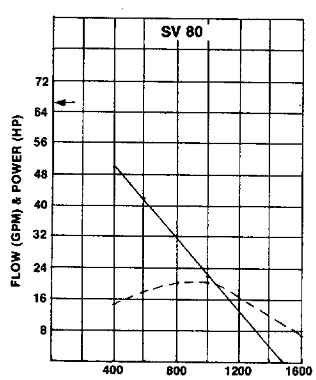
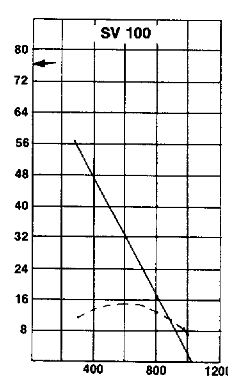


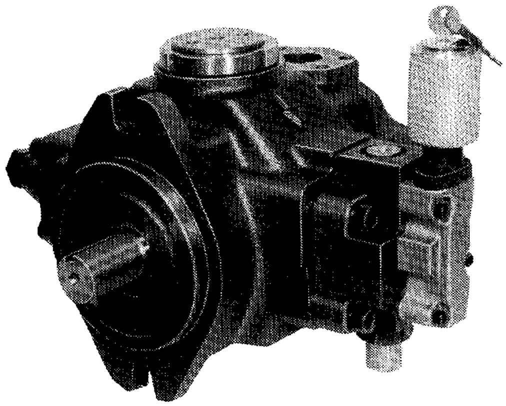
FIGURE 20A.

**SOLID LINE IS BASE FLOW, DOTTED LINE IS BASE INPUT HORSEPOWER
ALL DATA IS NOMINAL: EACH PUMP WILL VARY DEPENDING
ON SETTING, LEAKAGE AND CIRCUIT.**





KEY LOCK



*TO USE LOCKING HANDLE WITH LOAD SENSING CONTROL AND MULTIPLE PRESSURE CONTROLS, ADD RISER BLOCK (308883) BETWEEN 1ST AND 2ND STAGE COMPENSATORS AND ADD .735 (18.7) TO DIMENSIONS IN CHART BELOW.

LOCKING HANDLE

PUMPS	A	B
SV-10, 15, 20, 25	1.98 (50.3)	2.86 (72.6)
SV-40, 80, 100	2.67 (67.8)	3.55 (90.2)

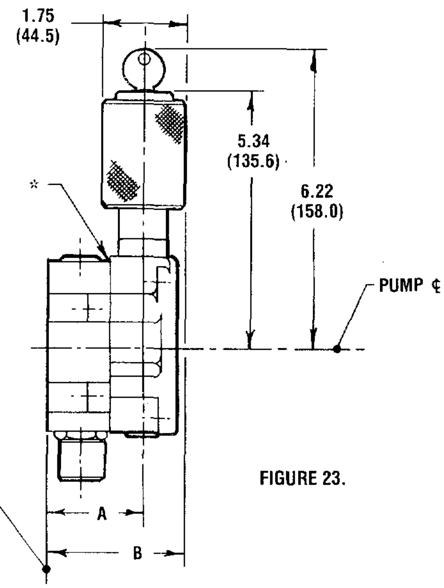


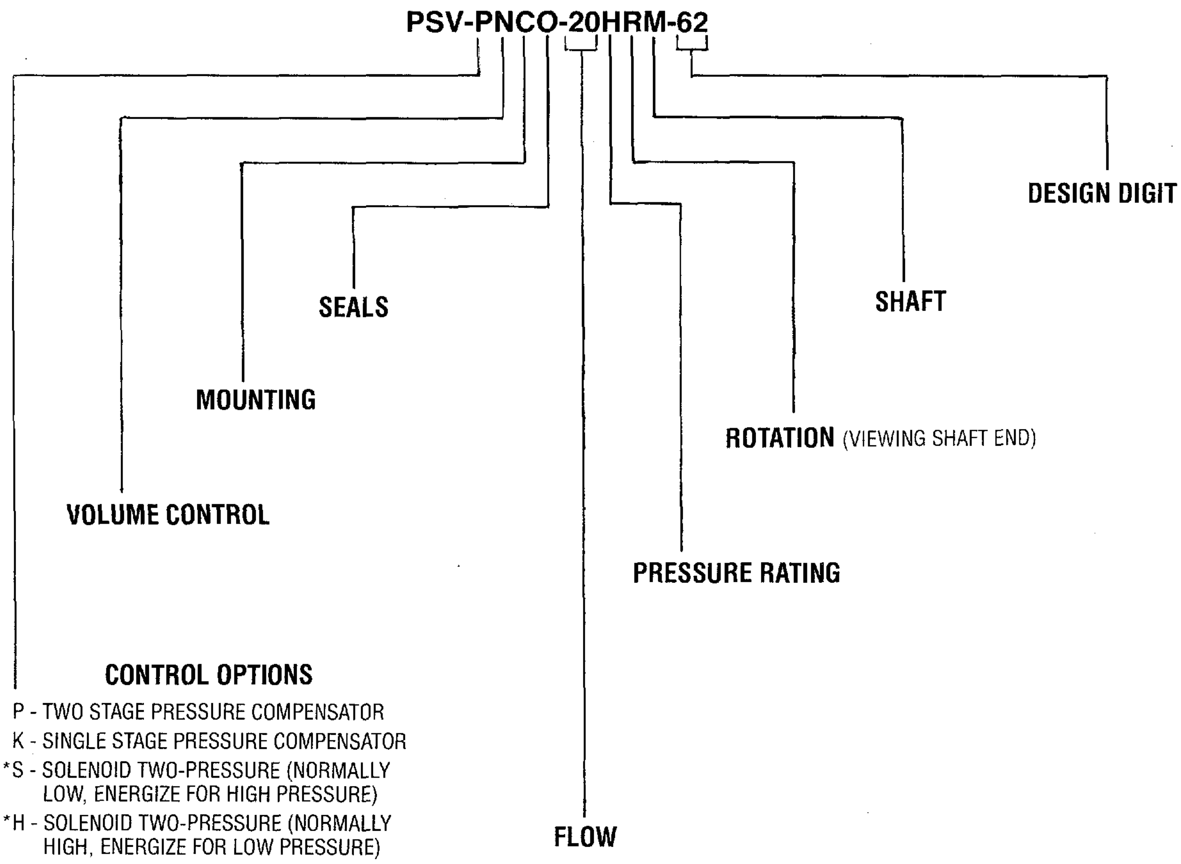
FIGURE 23.

INCHES
(MILLIMETRES)

NOTE:
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE NOMINAL.

COMPENSATOR LOCKING DEVICE — A locking handle is available which interchanges with the aluminum knob on the second stage of the pressure compensator. Adjustment is possible only when the key is inserted and turned 1/4 turn. When the key is removed, the handle spins free and no adjustment is possible. The device prevents tampering with pressure adjustments if the keys are limited to authorized personnel only.

Please refer to Figure 23 for construction details.



CONTROL OPTIONS

P - TWO STAGE PRESSURE COMPENSATOR
K - SINGLE STAGE PRESSURE COMPENSATOR
*S - SOLENOID TWO-PRESSURE (NORMALLY LOW, ENERGIZE FOR HIGH PRESSURE)
*H - SOLENOID TWO-PRESSURE (NORMALLY HIGH, ENERGIZE FOR LOW PRESSURE)
*V - SOLENOID TWO-PRESSURE (NORMALLY VENTED, ENERGIZE FOR HIGH PRESSURE)
J - HYDRAULIC TWO-PRESSURE (NORMALLY LOW, ENERGIZE FOR HIGH PRESSURE)
L - LOAD SENSING
T - TORQUE LIMITING

*Indicate the desired solenoid voltage and frequency at the end of the pump code.

To order the lock for the compensator adjusting screw, specify "LOCK" at the end of the code.

FEMALE CONNECTORS FOR SOLENOID OPTIONS

ORDERING CODE	DESCRIPTION
492480	COMPRESSION FITTING
492479	1/2" NPT

SOLENOID VOLTAGES AVAILABLE
110/115 VAC 50/60 Hz (DUAL FREQUENCY) 220/230 VAC 50/60 Hz (DUAL FREQUENCY) 12 VDC 24 VDC
FOR SOLENOIDS WITH QUICK CONNECT (HIRSCHMANN TYPE) CONSULT FACTORY

STANDARD SILENTVANE (SV) COMPENSATOR

PUMP MODEL	SV10	SV15	SV20	SV25	SV40	SV80	SV100
Single Stage	956302	956304	956302	956304	956323	956324	956325
Two Stage (complete)	956131	956112	956131	956112	956132	956113	956114
Second Stage only	956119	956120	956119	956120	956119	956120	956121
Load Sensing (complete)	956073	956073	956073	956073	956080	956080	956080
Load Sensing cartridge	956139	956139	956139	956139	956138	956138	956138
Torque Limiting	956072	956087	956140	956088	956079	956089	956090
Hydraulic Two Pressure	956069	956069	956069	956069	956070	956070	956070
Remote (w/subplate)	956074						
Solenoid Two Pressure							
110/115 VAC NO (fly)	956241						
110/115 VAC NO (hirsch)	956243						
110/115 VAC NC (fly)	956242						
110/115 VAC NC (hirsch)	956244						
220/230 VAC NO (fly)	956245						
220/230 VAC NO (hirsch)	956247						
220/230 VAC NC (fly)	956246						
220/230 VAC NC (hirsch)	956248						
VDC NO (fly)	956255						
12 VDC NO (hirsch)	956257						
12 VDC NC (fly)	956256						
12 VDC NC (hirsch)	956258						
24 VDC NO (fly)	956259						
24 VDC NO (hirsch)	956261						
24 VDC NC (fly)	956260						
24 VDC NC (hirsch)	956262						
Solenoid Vent Control							
110/115 VAC NO (fly)	956263						
110/115 VAC NO (hirsch)	956265						
110/115 VAC NC (fly)	956264						
110/115 VAC NC (hirsch)	956266						
220/230 VAC NO (fly)	956267						
220/230 VAC NO (hirsch)	956270						
220/230 VAC NC (fly)	956268						
220/230 VAC NC (hirsch)	956271						
12 VDC NO (fly)	956272						
12 VDC NO (hirsch)	956274						
12 VDC NC (fly)	956273						
12 VDC NC (hirsch)	956275						
24 VDC NO (fly)	956276						
24 VDC NO (hirsch)	956278						
24 VDC NC (fly)	956277						
24 VDC NC (hirsch)	956279						

THESE CONTROLS ARE THE SAME FOR ALL THE FRAME SIZES

LOW PRESSURE SILENTVANE (SV) COMPENSATORS

PUMP MODEL	SV10	SV15	SV20	SV25
Single Stage	REFERENCE THE NOTE BELOW (*)			
Two Stage (complete)	956115	956115	956116	956116
Second Stage only	956124	956124	956124	956124
Load Sensing (complete)	REFERENCE THE NOTE BELOW (*)			
Load Sensing cartridge	956139	956139	956139	956139
Torque Limiting	REFERENCE THE NOTE BELOW (*)			
Hydraulic Two Pressure	956069			
Remote (w/subplate)	956074			
Solenoid Two Pressure				
110/115 VAC NO (fly)	956241			
110/115 VAC NO (hirsch)	956243			
110/115 VAC NC (fly)	956242			
110/115 VAC NC (hirsch)	956244			
220/230 VAC NO (fly)	956245			
220/230 VAC NO (hirsch)	956247			
220/230 VAC NC (fly)	956246			
220/230 VAC NC (hirsch)	956248			
12 VDC NO (fly)	956255			
12 VDC NO (hirsch)	956257			
12 VDC NC (fly)	956256			
12 VDC NC (hirsch)	956258			
24 VDC NO (fly)	956259			
24 VDC NO (hirsch)	956261			
24 VDC NC (fly)	956260			
24 VDC NC (hirsch)	956262			
Solenoid Vent Control				
110/115 VAC NO (fly)	956263			
110/115 VAC NO (hirsch)	956265			
110/115 VAC NC (fly)	956264			
110/115 VAC NC (hirsch)	956266			
220/230 VAC NO (fly)	956267			
220/230 VAC NO (hirsch)	956270			
220/230 VAC NC (fly)	956268			
220/230 VAC NC (hirsch)	956271			
12 VDC NO (fly)	956272			
12 VDC NO (hirsch)	956274			
12 VDC NC (fly)	956273			
12 VDC NC (hirsch)	956275			
24 VDC NO (fly)	956276			
24 VDC NO (hirsch)	956278			
24 VDC NC (fly)	956277			
24 VDC NC (hirsch)	956279			

THESE CONTROLS ARE THE SAME FOR ALL THE FRAME SIZES (Hydraulic Two Pressure through 24 VDC NC (hirsch))

*NOTE – AVAILABLE UPON APPLICATION AND ENGINEERING APPROVAL.

TWINVANE (TV) COMPENSATORS

PUMP MODEL	TV15	TV25	TV40	TV80
Single Stage	N/A	N/A	N/A	N/A
Two Stage (complete)	956117	956118	956130	956130
Second Stage only	956122	956123	956123	956123
Load Sensing (complete)	REFERENCE THE NOTE BELOW (*)			
Load Sensing cartridge	956139	956139	956138	956138
Torque Limiting	REFERENCE THE NOTE BELOW (*)			
Hydraulic Two Pressure	956069	956069	956070	956070
Remote (w/subplate)	956074	THESE CONTROLS ARE THE SAME FOR ALL THE FRAME SIZES		
Solenoid Two Pressure				
110/115 VAC NO (fly)	956241			
110/115 VAC NO (hirsch)	956243			
110/115 VAC NC (fly)	956242			
110/115 VAC NC (hirsch)	956244			
220/230 VAC NO (fly)	956245			
220/230 VAC NO (hirsch)	956247			
220/230 VAC NC (fly)	956246			
220/230 VAC NC (hirsch)	956248			
12 VDC NO (fly)	956255			
12 VDC NO (hirsch)	956257			
12 VDC NC (fly)	956256			
12 VDC NC (hirsch)	956258			
24 VDC NO (fly)	956259			
24 VDC NO (hirsch)	956261			
24 VDC NC (fly)	956260			
24 VDC NC (hirsch)	956262			
Solenoid Vent Control				
110/115 VAC NO (fly)	956263			
110/115 VAC NO (hirsch)	956265			
110/115 VAC NC (fly)	956264			
110/115 VAC NC (hirsch)	956266			
220/230 VAC NO (fly)	956267			
220/230 VAC NO (hirsch)	956270			
220/230 VAC NC (fly)	956268			
220/230 VAC NC (hirsch)	956271			
12 VDC NO (fly)	956272			
12 VDC NO (hirsch)	956274			
12 VDC NC (fly)	956273			
12 VDC NC (hirsch)	956275			
24 VDC NO (fly)	956276			
24 VDC NO (hirsch)	956278			
24 VDC NC (fly)	956277			
24 VDC NC (hirsch)	956279			

*NOTE – AVAILABLE UPON APPLICATION AND ENGINEERING APPROVAL.

WORLDVANE (HV) COMPENSATORS

PUMP MODEL	HV10	HV20	HV40	HV80
Single Stage (SAE)	956300	956300	956322	956323
(ISO)	REFERENCE THE NOTE BELOW (*)			
Two Stage (complete)(SAE)	956329	956329	956330	956132
(ISO)	956331	956331	956332	956333
Second Stage only (SAE)	956296	956296	956334	956119
(ISO)	956335	956335	956336	956337
Load Sensing (complete)	REFERENCE THE NOTE BELOW (*)			
Load Sensing cartridge	956139	956139	956138	956138
Torque Limiting	956072	956140	956079	956089
Hydraulic Two Pressure	956069	956069	956070	956070
Remote (w/subplate)	956074			
Solenoid Two Pressure				
110/115 VAC NO (fly)	956241			
110/115 VAC NO (hirsch)	956243			
110/115 VAC NC (fly)	956242			
110/115 VAC NC (hirsch)	956244			
220/230 VAC NO (fly)	956245			
220/230 VAC NO (hirsch)	956247			
220/230 VAC NC (fly)	956246			
220/230 VAC NC (hirsch)	956248			
12 VDC NO (fly)	956255			
12 VDC NO (hirsch)	956257			
12 VDC NC (fly)	956256			
12 VDC NC (hirsch)	956258			
24 VDC NO (fly)	956259			
24 VDC NO (hirsch)	956261			
24 VDC NC (fly)	956260			
24 VDC NC (hirsch)	956262			
Solenoid Vent Control				
110/115 VAC NO (fly)	956263			
110/115 VAC NO (hirsch)	956265			
110/115 VAC NC (fly)	956264			
110/115 VAC NC (hirsch)	956266			
220/230 VAC NO (fly)	956267			
220/230 VAC NO (hirsch)	956270			
220/230 VAC NC (fly)	956268			
220/230 VAC NC (hirsch)	956271			
12 VDC NO (fly)	956272			
12 VDC NO (hirsch)	956274			
12 VDC NC (fly)	956273			
12 VDC NC (hirsch)	956275			
24 VDC NO (fly)	956276			
24 VDC NO (hirsch)	956278			
24 VDC NC (fly)	956277			
24 VDC NC (hirsch)	956279			

THESE CONTROLS ARE THE SAME FOR ALL THE FRAME SIZES (Remote through 24 VDC NC (hirsch))

*NOTE – AVAILABLE UPON APPLICATION AND ENGINEERING APPROVAL.

9 535 233 092
HPUS AKY 003/5 US (10.95)

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