Vickers®
Directional Controls

CMX Sectional Controls

Application Guide

Third generation closed center load sensing is here...today

The time has arrived when you can move up to higher levels of vehicle performance by incorporating the Vickers CMX load sensing controls in your next design. It's no longer necessary to demand that the machine operator demonstrate outstanding skills to obtain maximum performance.

By incorporating advanced state-of-the-art valve element concepts, the CMX provides "velvet smooth" controllability of the raw brute force available from your hydraulic system. No other system offers the flexibility to easily tailor individual function control to your exact needs!

Today's load sensing systems will dramatically reduce the overall power requirements of your machine's hydraulic system by eliminating unnecessary losses when multiple unequal loads are operated simultaneously.

However, care must be taken to insure proper phasing to avoid unnecessary power waste in unequal displacement functions such as typical cylinder applications. Competitive systems require careful and lengthy spool development to match each operating section to its specific functional load requirements. Since each spool must be matched to its individual function, service support is costly.

The CMX family has been designed from the first line on the computer screen with your needs in mind. Thanks to its modular element construction, it can be easily tailored to your exact specifications. Prototype system development and debugging is reduced to a matter of days rather than the traditional weeks or months necessary with competitive designs. On-site service is a breeze. Service and production support inventory is dramatically reduced.

And best of all, it's available today in all the popular basic and optional configurations, just the way you want it. Hydraulic or electrohydraulic controls, mid-inlets, and mixed flow arrangements are just a few of the almost endless features available.

This application guide has been developed to assist in selection of the features desired to meet your system requirements. Additional assistance with your CMX valve requirements is as near as your local Vickers distributor. With Vickers *EZSpec* CMX Program, which incorporates the use of *pre-engineered* components, he can quickly design, price, assemble, test, and ship valve banks that satisfy the requirements of most applications.

Consult your Vickers sales representative if special features – beyond those shown in the following pages – are desired.

Table of Contents

General Description

The CMX sectional valve is a stackable, load sensing, proportional directional control valve, and can be operated by hydraulic remote control (HRC) or electronic remote control (ERC) via integral electrohydraulic reducing valves.

A characteristic feature of the CMX valve line is the concept of separate meter-in and meter-out elements (Figure 1). The meter-in element is a pilot operated, flow force, pressure compensated, proportional sliding spool and controls fluid from the pump to the actuator. The meter-out elements are pilot controlled metering poppets, and control exhaust fluid from the actuator to tank. Each meter-out poppet functions as a variable orifice between one of the actuator's ports and the tank port, with the degree of opening proportional to the pilot signal.

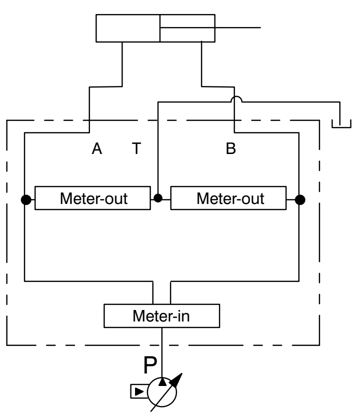


Figure 1. Basic CMX Concept

The separation of the meter-in and meter-out elements, plus the valve's modular design, permits a broad range of control options to meet a variety of load requirements. This is especially desirable for a stackable mobile valve, where a single valve bank must handle many different functions.

The CMX sectional valve family consists of two basic series with different flow ratings – the CMX100 and the CMX160. These valves are functionally identical, with most differences being due to the differences in their physical size.

A CMX valve bank is made up of an inlet body, from one to eight valve sections, and an end cover (Figure 2). The valve sections are connected internally to common pressure, tank, load sense, pilot supply and pilot drain passages. Face seals between the sections seal the connecting passages, and the sections are held together by tie rods and nuts. Threaded mounting bolt holes are provided on the inlet body and end cover.

The pump, tank, load sense and electrohydraulic pilot supply passages are terminated in the inlet body, and the pilot drain is terminated in the end cover. Connections for the actuator and the HRC are made at each section. Electrical connections for electro-hydraulic valves are made at each coil. HRC and ERC controlled valves can be used in the same valve bank.

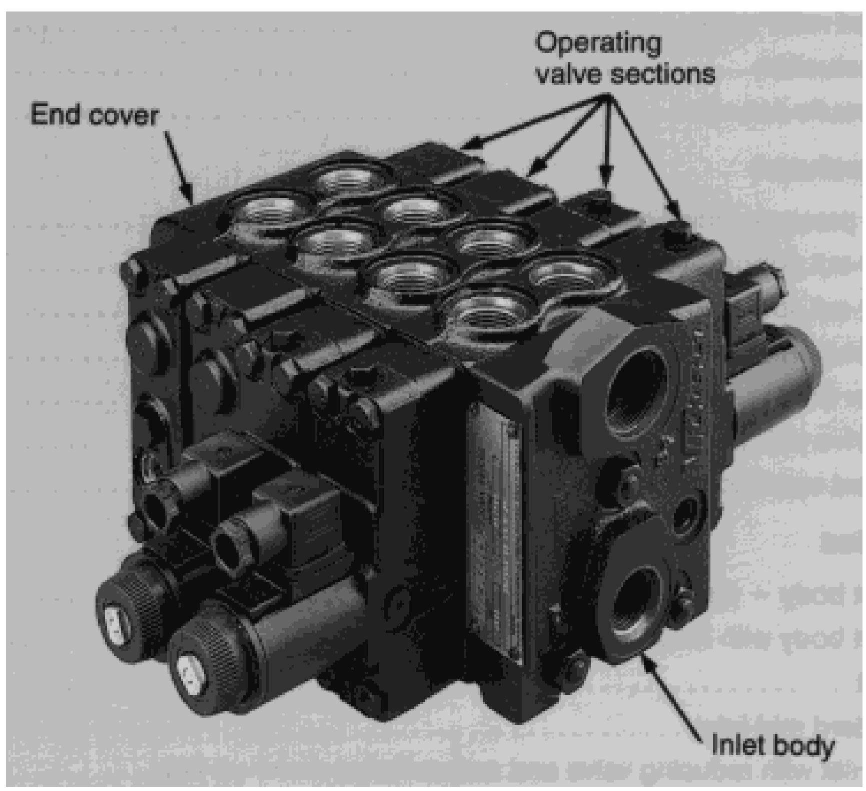


Figure 2

Operating Valve Section

The CMX valve section consists of three basic parts: the main valve body, which contains the main flow passages and main control elements, and two control caps that contain the pilot circuitry. The one-piece control cap gaskets (Figure 3), which provide a seal between the control caps and the main valve body, are also part of the pilot circuit, providing a passage from the meter-in spring chamber to the relief valve pilot stage and the meter-out servo. This format allows for a wide variety of control options from relatively few basic parts; thus the valve can be tailored to the application at minimal extra cost. It also makes the valve quick and easy to fine tune for a specific application.

Flow Path/Actuation

Hydraulically Actuated

(Refer to following page.)

- When pilot pressure is applied to Port C1, pump flow is to Port B.
- When pilot pressure is applied to Port C2, pump flow is to Port A.

Electrohydraulically Actuated

(Click here for illustrations.)

- When Solenoid A is energized, pump flow is to Port A.
- When Solenoid B is energized, pump flow is to Port B.

Control Cap Gasket

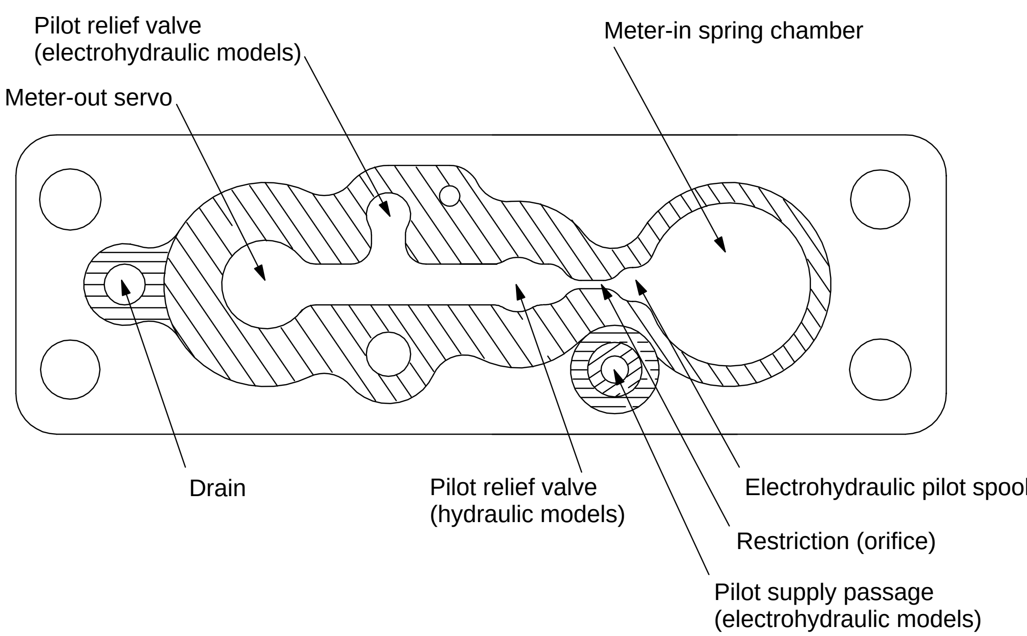


Figure 3

Operating Valve Section

Cutaway views of the hydraulic and electrohydraulic versions of the CMX are shown in Figures 4 and 5, along with schematic diagrams. The relief valve pilot stages are shown in detail in the schematic diagrams used in this discussion to promote a better understanding of the valve's operation.

Hydraulic Valve Section

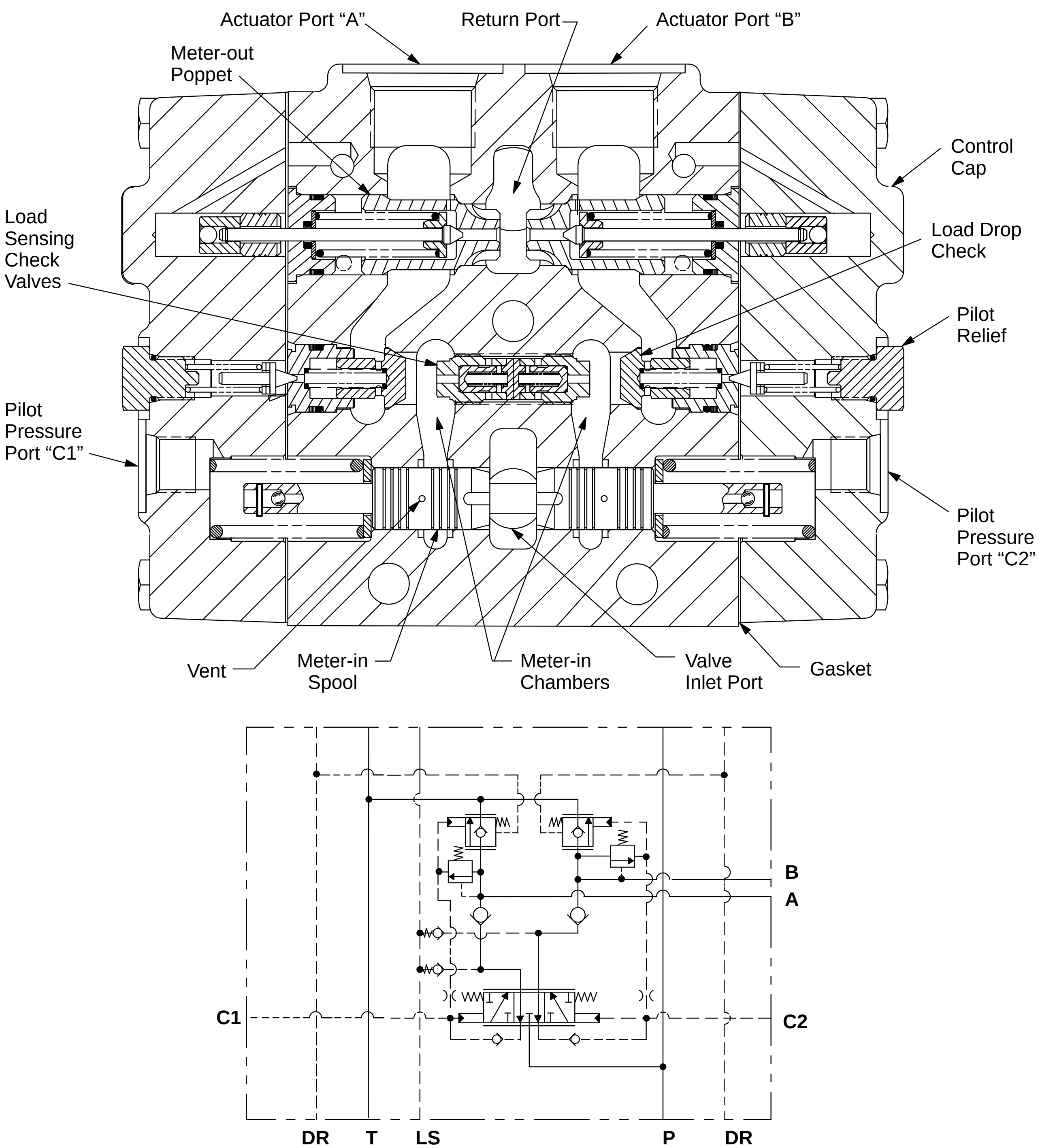


Figure 4

Electrohydraulic Valve Section

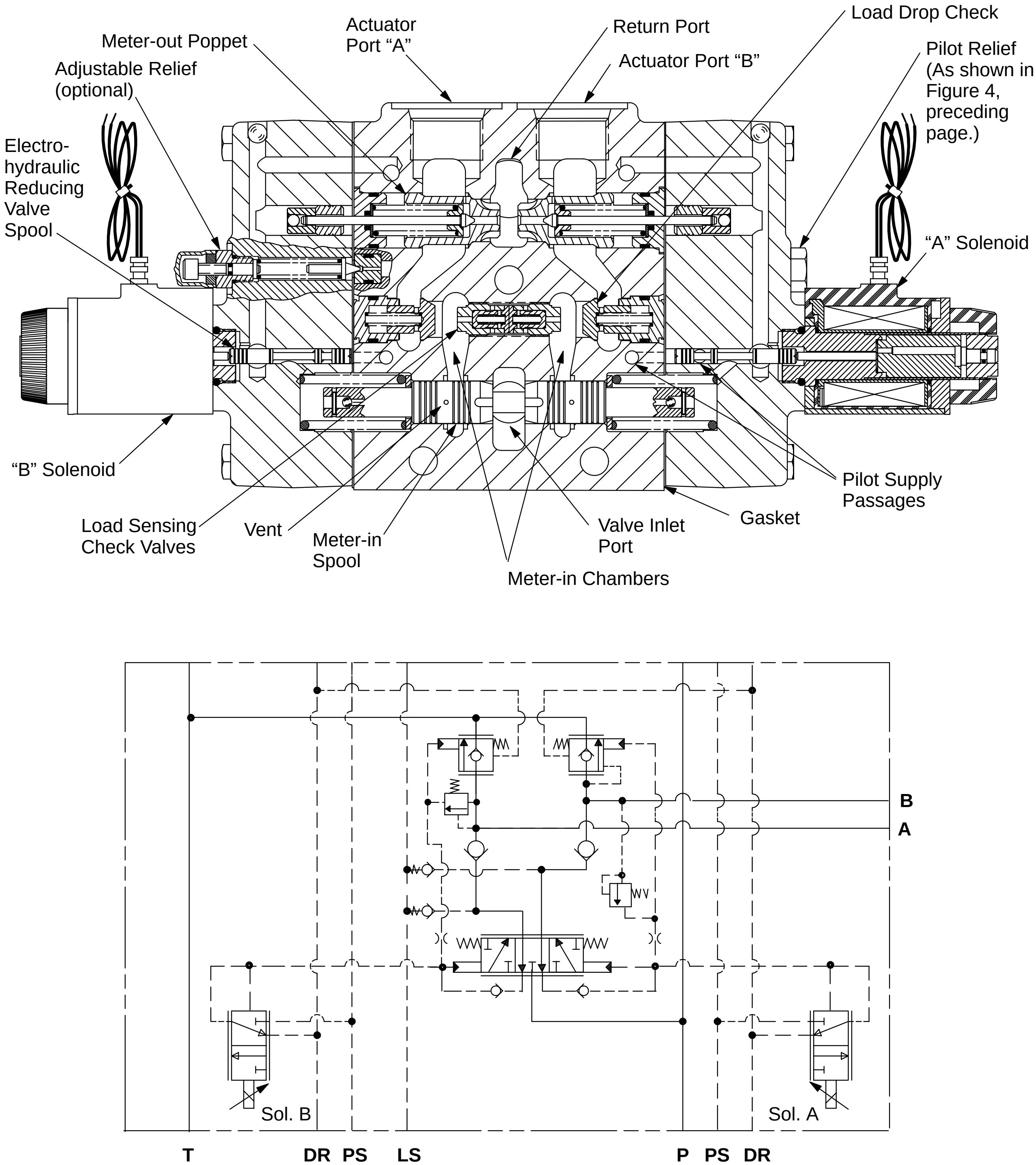


Figure 5

Operating Valve Section

The main valve body is available as a narrow body with an actuator port pressure rating of 290 bar (4200 psi) and an inlet port pressure rating 250 bar (3625 psi), or as a wide body with an actuator port pressure rating of 380 bar (5510 psi) and an inlet port pressure rating of 350 bar (5075 psi). Valve sections with different pressure ratings can be used in the same valve bank. Valve section sizes and ratings are shown below.

Click here for port and mounting hole sizes.

Valve Section Sizes

CMX100-S2 (narrow body and 290 bar (4200 psi) rating)
Hydraulic Actuation -
Dimensions: 201 mm (7.9 in) long x 47,0 mm (1.85 in) wide x 149 mm (5.87 in) high.
Weight: 7,3 kg (16.2 lbs)

Electrohydraulic Actuation -
Dimensions: 366 mm (14.4 in) long x 47,0 mm (1.85 in) wide x 149 mm (5.87 in) high.
Weight: 9,0 kg (19.8 lbs)

CMX100-F2 (wide body and 380 bar (5510 psi) rating)
Hydraulic Actuation -
Dimensions: 201 mm (7.9 in) long x 59,0 mm (2.32 in) wide x 144 mm (5.67 in) high.
Weight: 8,7 kg (19.2 lbs)

Electrohydraulic Actuation -
Dimensions: 366 mm (14.4 in) long x 59,0 mm (2.32 in) wide x 144 mm (5.67 in) high.
Weight: 10,4 kg (22.8 lbs)

CMX160-S2 (narrow body and 290 bar (4200 psi) rating)
Hydraulic Actuation -
Dimensions: 243 mm (9.6 in) long x 51,0 mm (2.01 in) wide x 172 mm (6.77 in) high.
Weight: 10,2 kg (22.5 lbs)

Electrohydraulic Actuation -
Dimensions: 386 mm (15.2 in) long x 51,0 mm (2.01 in) wide x 172 mm (6.77 in) high.
Weight: 11,8 kg (26.1 lbs)

CMX160-F2 (wide body and 380 bar (5510 psi) rating)
Hydraulic Actuation -
Dimensions: 243 mm (9.6 in) long x 75,0 mm (2.95 in) wide x 165 mm (6.50 in) high.
Weight: 13,4 kg (29.6 lbs)

Electrohydraulic Actuation -
Dimensions: 386 mm (15.2 in) long x 75,0 mm (2.95 in) wide x 165 mm (6.50 in) high.
Weight: 15,1 kg (33.2 lbs)

Notes:
Dimensions and weights for "G" and "W" sections are identical to "F" sections.

Click here for port dimensions.
Click here for valve bank dimensions.

Ratings

Model Series	Rated Flow * l/min (USgpm)	Hydraulic Horsepower	Pressure Port Rated Pressure bar (psi)	Actuator Port Rated Pressure bar (psi)	Pilot, Tank and Drain Port Rated Pressure bar (psi)
CMX100–F/G/W	100 (26)	77	350 (5075)	380 (5510)	35 (508)
CMX100–S	100 (26)	55	250 (3625)	290 (4200)	35 (508)
CMX160–F/G/W	160 (42)	124	350 (5075)	380 (5510)	35 (508)
CMX160–S	160 (42)	89	250 (3625)	290 (4200)	35 (508)

* At 14 bar (200 psi) load-sensing pressure drop.

The operating elements in the CMX sectional valve can be divided into five functional groups: meter-in, meter-out, load drop check valves, load sense check valves and relief valve pilot stages. The electrohydraulic version includes additional solenoid operated proportional reducing valves to provide pilot control pressure. Each functional group is described in the following pages.

Meter-in element

The meter-in element ports fluid from the valve inlet port to the "A" or "B" meter-in chamber. The meter-in element is a pilot operated, spring centered, proportional sliding spool. The inlet port is closed in neutral. Two different springs are available to provide different meter-in cracking pressures (the pilot pressure required to begin flow from the inlet to an actuator port). The area gain (or slope of the metering curve) is the same for both springs. The meter-in element is available as a flow control type (S*0**) or a pressure control type (S***).

Low flow spool options are available for both the flow control meter-in element (L*0**) and the pressure control meter-in element (L***). The low flow option provides finer metering and lower flow capability than the standard S*** spool for functions where the full flow capability of the valve is not desired. Low flow spools are available for the CMX100 only.

Flow control meter-in elements "S*0" and "L*0"

The flow control element (shown on the following page) provides nearly constant flow for a given command signal, independent of pressure drop across the meter-in spool and independent of load pressure. Flow is proportional to command pilot pressure differential. Pressure compensation, which is achieved by utilizing flow forces, minimizes load interaction caused by the simultaneous operation of more than one function.

In general, the flow force compensation characteristic of the CMX will satisfy the majority of application requirements. CMX valve bank output flow can be enhanced by use of a pressure compensated hydrostat in the pilot flow circuit. *It should be noted that, due to load interaction, competitive valves require separate pressure compensators for each working section to provide similar performance.*

In the standard vented spool, fluid passes through an orifice to the center of the spool to the pilot pressure ports, where it is drained to tank via the HRC (hydraulic pilot models) or the reducing valve (electrohydraulic models). Ball check valves prevent reverse flow through the vent when pilot pressure is applied to spools.

Click here for Meter-in Flow vs. Command Pressure curves.

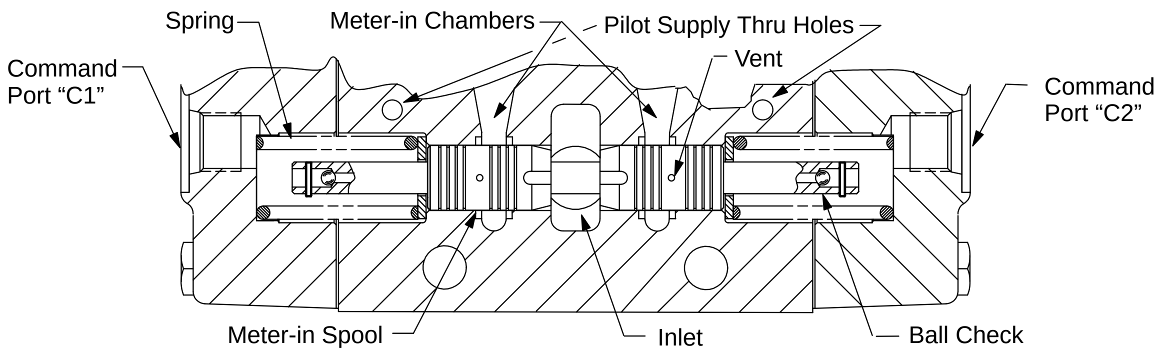
Click here for CMX100 Meter-in Pressure Compensation curves.

Click here for CMX100 Low Flow M-I Pressure Compensation curves.

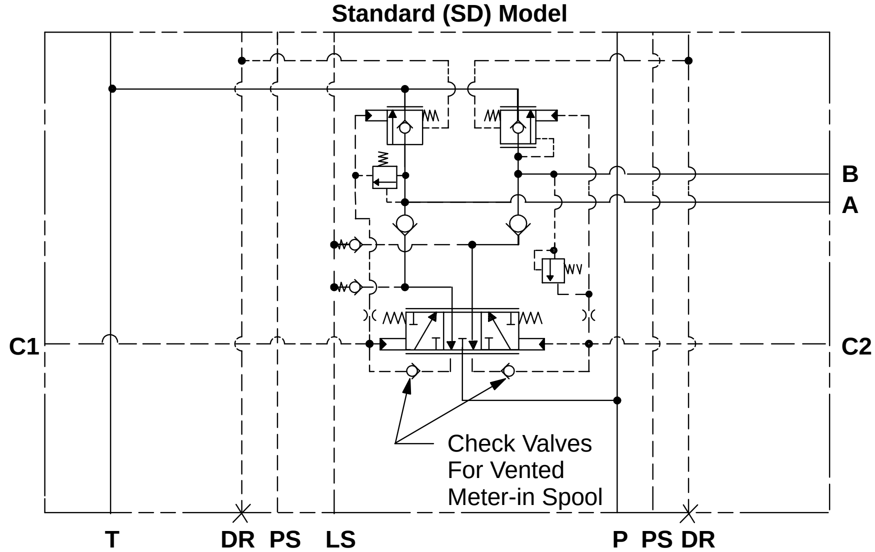
Click here for CMX160 Meter-in Pressure Compensation curves.

Non-vented meter-in spools are generally used in meter-out *spool* sections where actuator ports are open to tank in the neutral position (M00**) and N00**).

Operating Valve Section



Standard (SD) Model



Non-vented (SN) Model

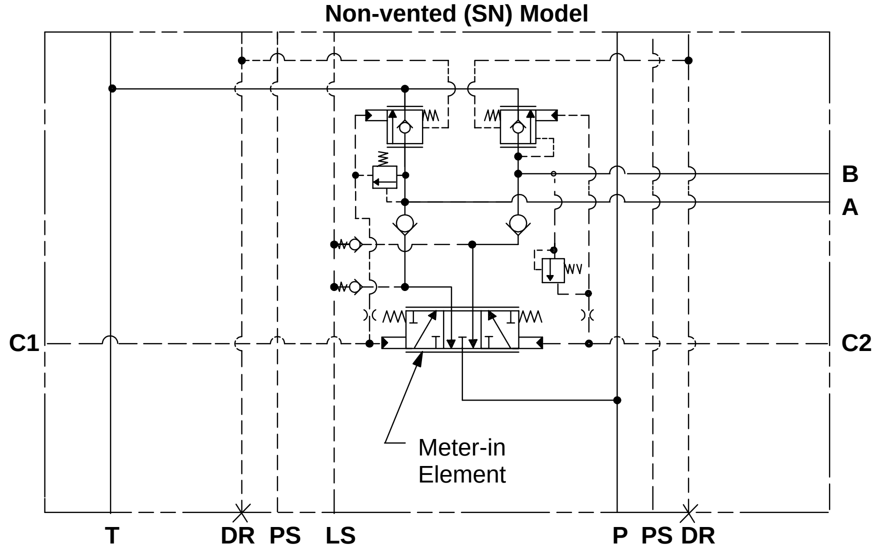


Figure 6

CMX Meter-In Flow vs. Command
at 20 bar P-LS Pressure Differential

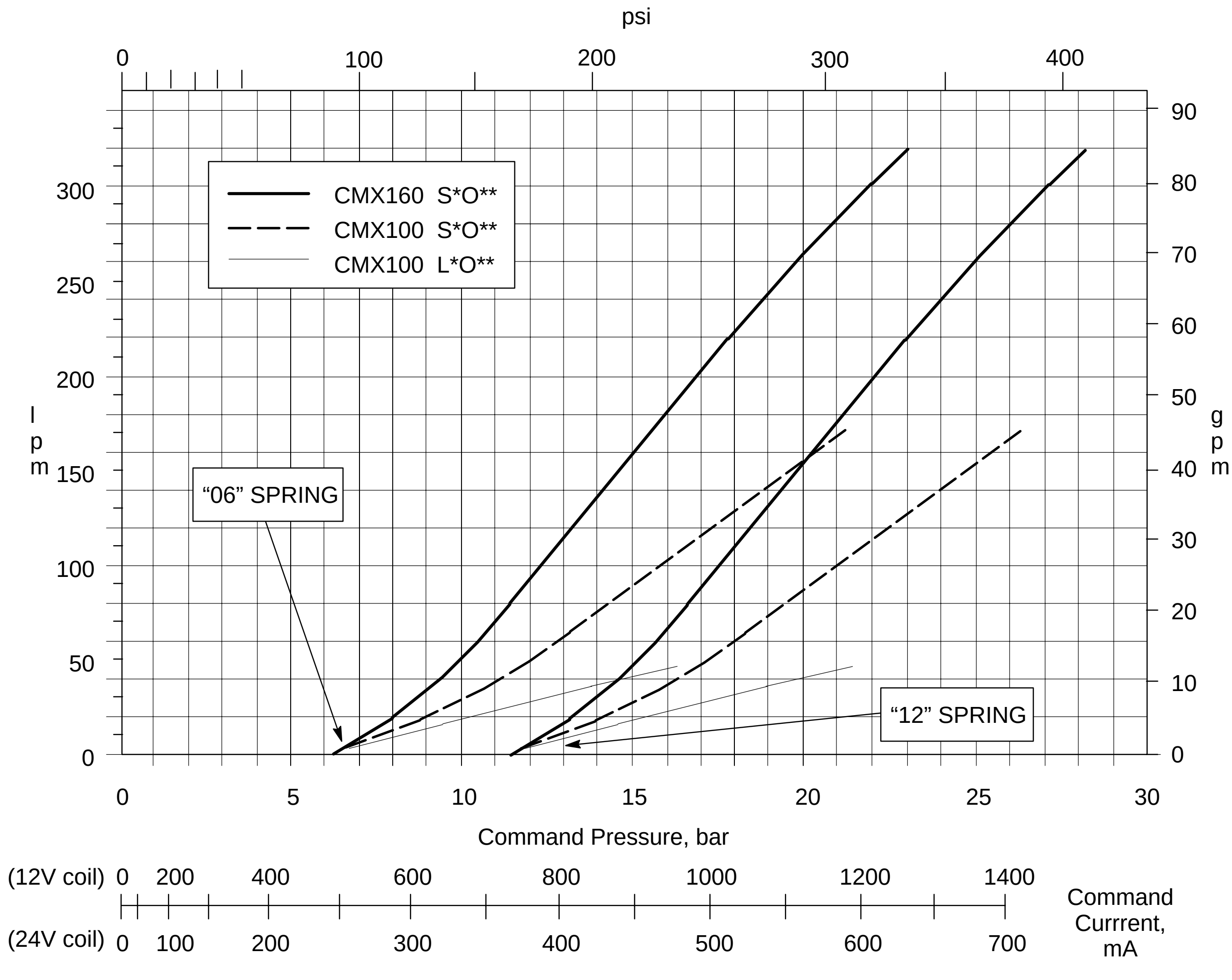


Figure 7

Operating Valve Section

CMX100 Meter-In Pressure Compensation
Model "S006" Meter-in Element

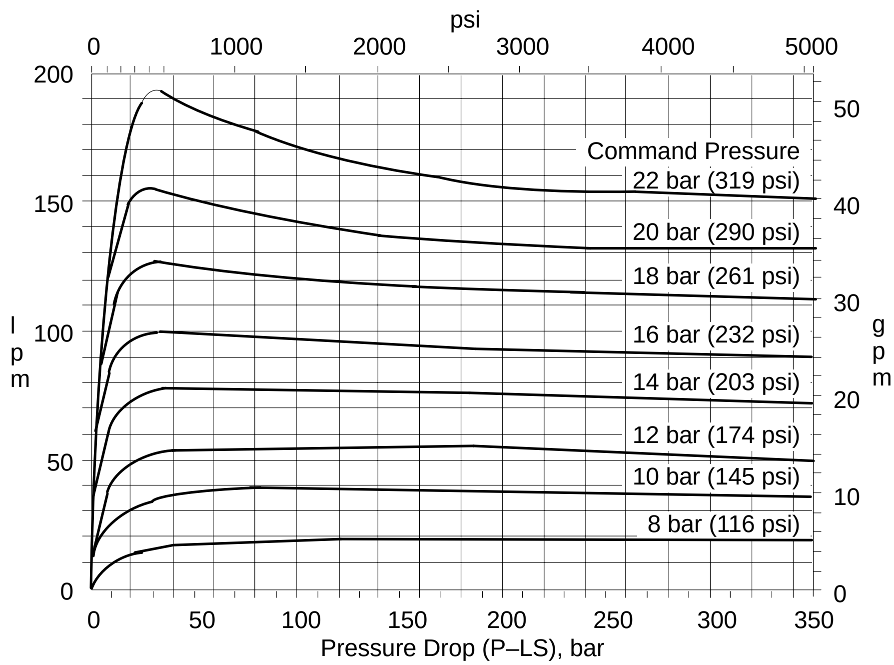


Figure 8a

CMX100 Meter-In Pressure Compensation
Model "S012" Meter-in Element

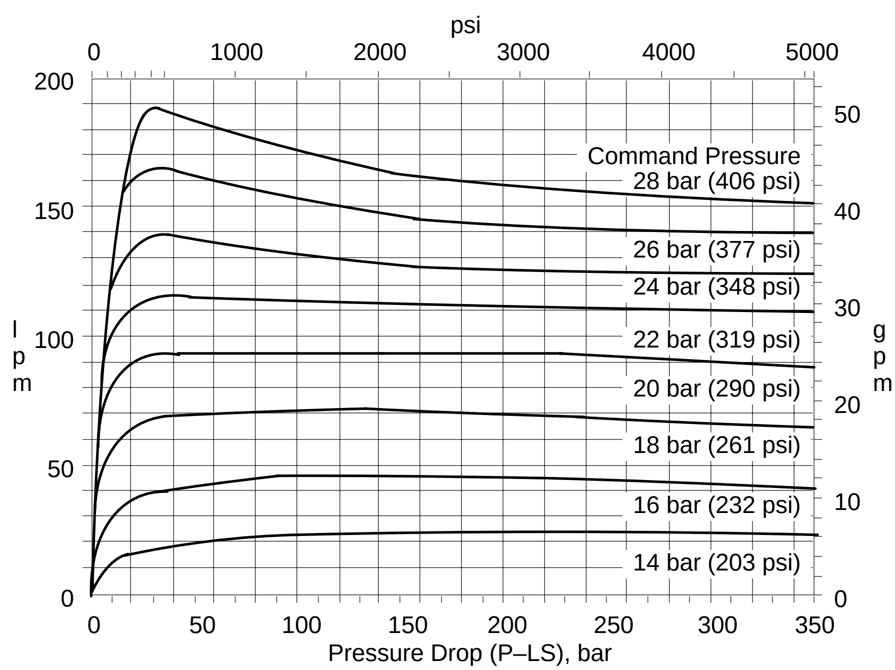


Figure 8b

CMX100 Low Flow M-I Pressure Compensation
Model “L006” Meter-in Element

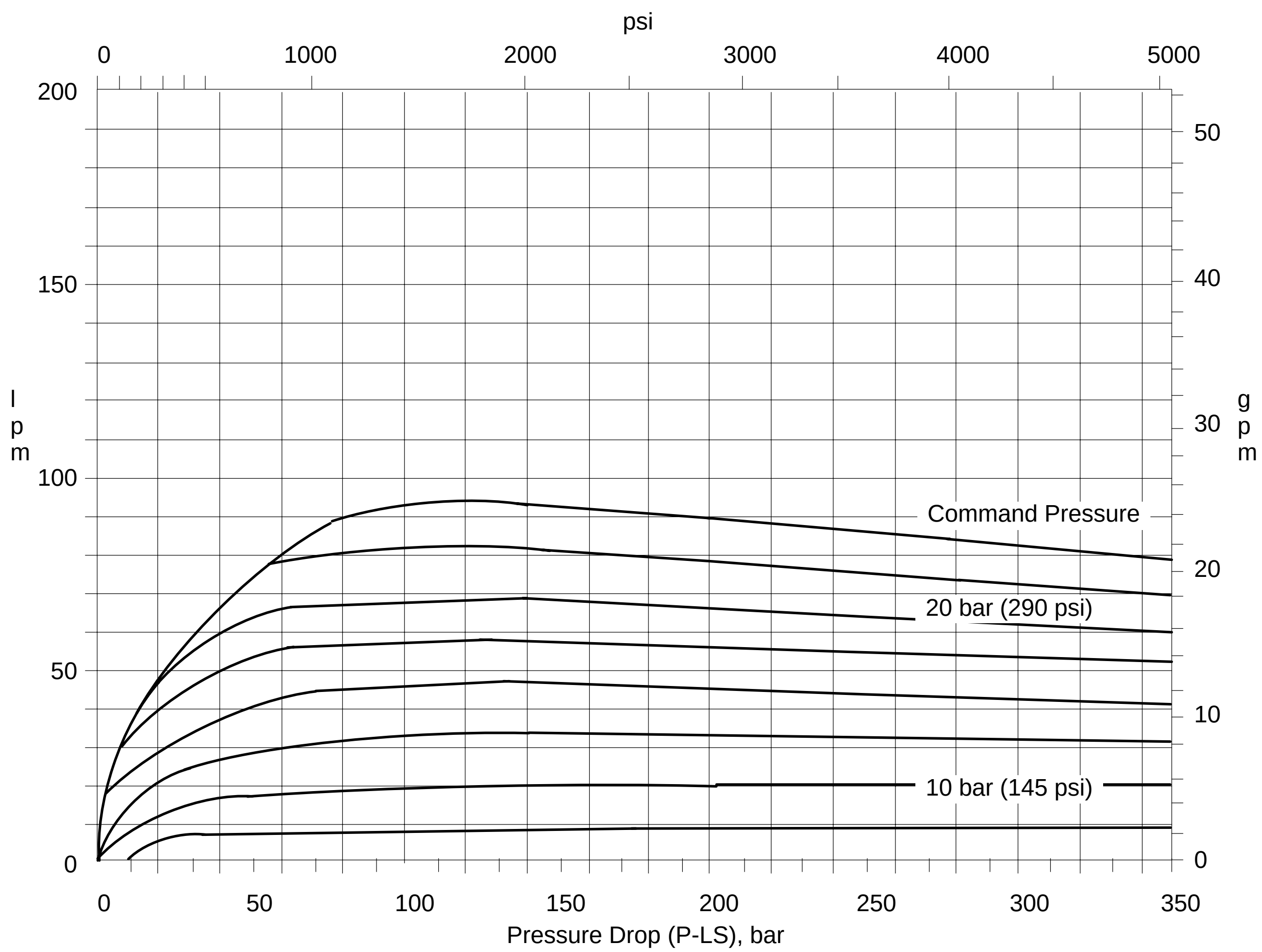


Figure 8c

Operating Valve Section

CMX160 Meter-In Pressure Compensation
(Flow Force Compensation)
Model “S006” Meter-in Element

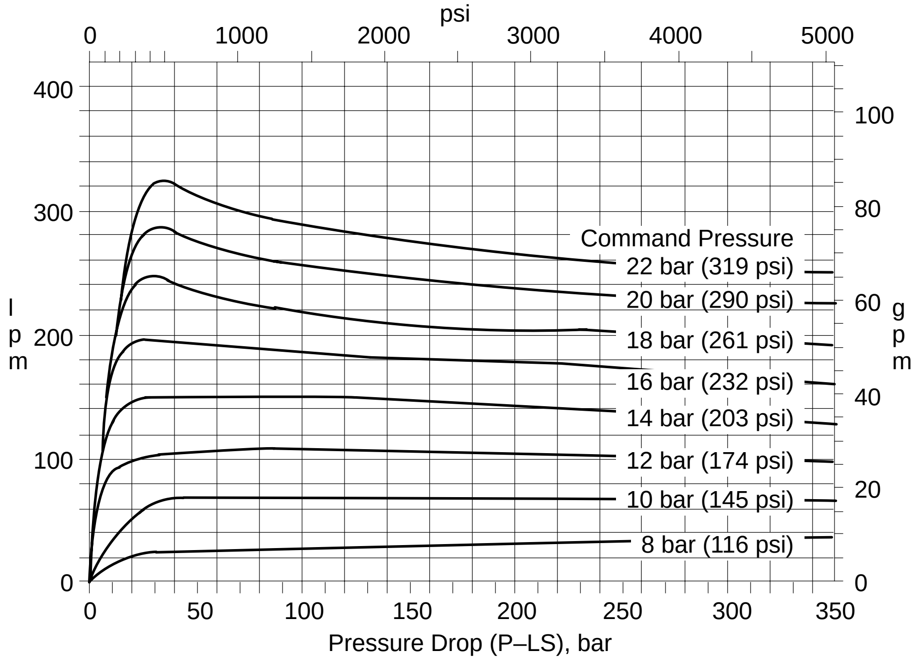


Figure 9a

CMX160 Meter-In Pressure Compensation
(Flow Force Compensation)
Model “S012” Meter-in Element

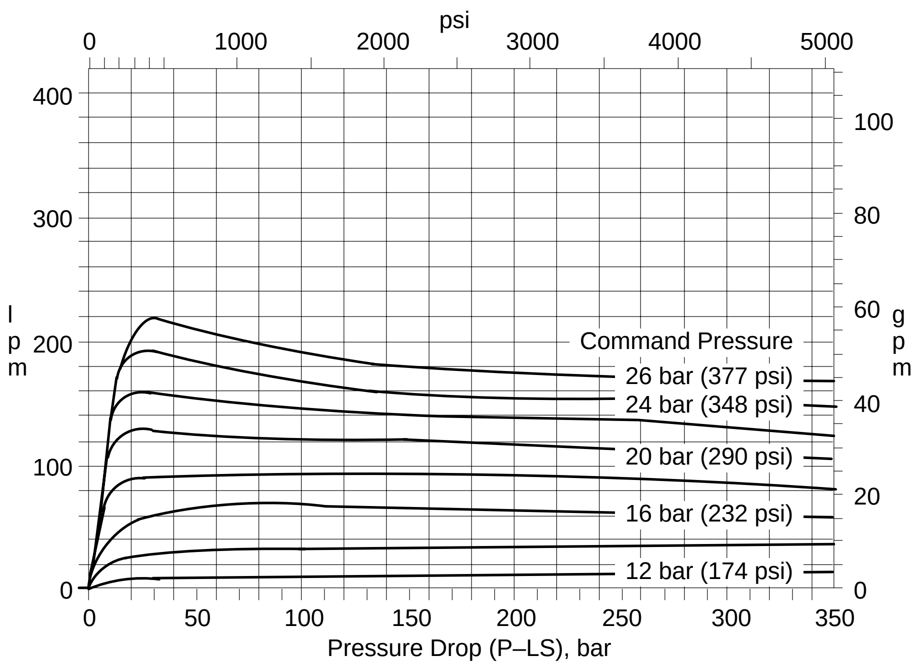


Figure 9b

Operating Valve Section

Pressure control meter-in element S****

This element (Figure 10) is similar to the *flow control element*, except the *pressure control spool* has a feedback piston on each end. The meter-in chamber pressure acts on the area of the piston and opposes the pilot pressure opening the spool. The result is that, for a given input signal (pilot pressure), the flow decreases as the load pressure increases until the maximum pressure is reached at zero flow. By changing the input signal, the maximum load pressure can be changed.

For a constant load pressure, changing the input signal will change the velocity of the load. This feature provides the operator with a good "feel" for the system by responding to changes in load pressure. For example, when driving a load at a given speed, if an obstacle is encountered, the load will slow or even stop. This response, which is typical of traditional open center bypass control valves, gives the operator better control of the system.

The pressure control spool also increases the system damping ratio, which affects system stability and response. By selecting the appropriate feedback piston size (diameter), the system damping ratio can be tailored to the application.

(Click here for feedback piston diameters in the model code.)
The larger the feedback piston, the greater the increase in the damping ratio due to the pressure control spool.

The pressure-flow relationship is shown in the Q-P diagrams on the following three pages. The slope of the constant-pilot-pressure lines is dependent on feedback piston diameter. The flow is independent of load pressure at zero load pressure, so a constant pilot pressure line will intercept the Q axis at the same point, regardless of its slope.

The meter-in chambers are drained by an orifice to the pilot pressure ports in a manner similar to the S*0** flow control spool.

If serviced in the field, care must be taken to ensure the smooth end of the feedback piston is inserted into the spool.

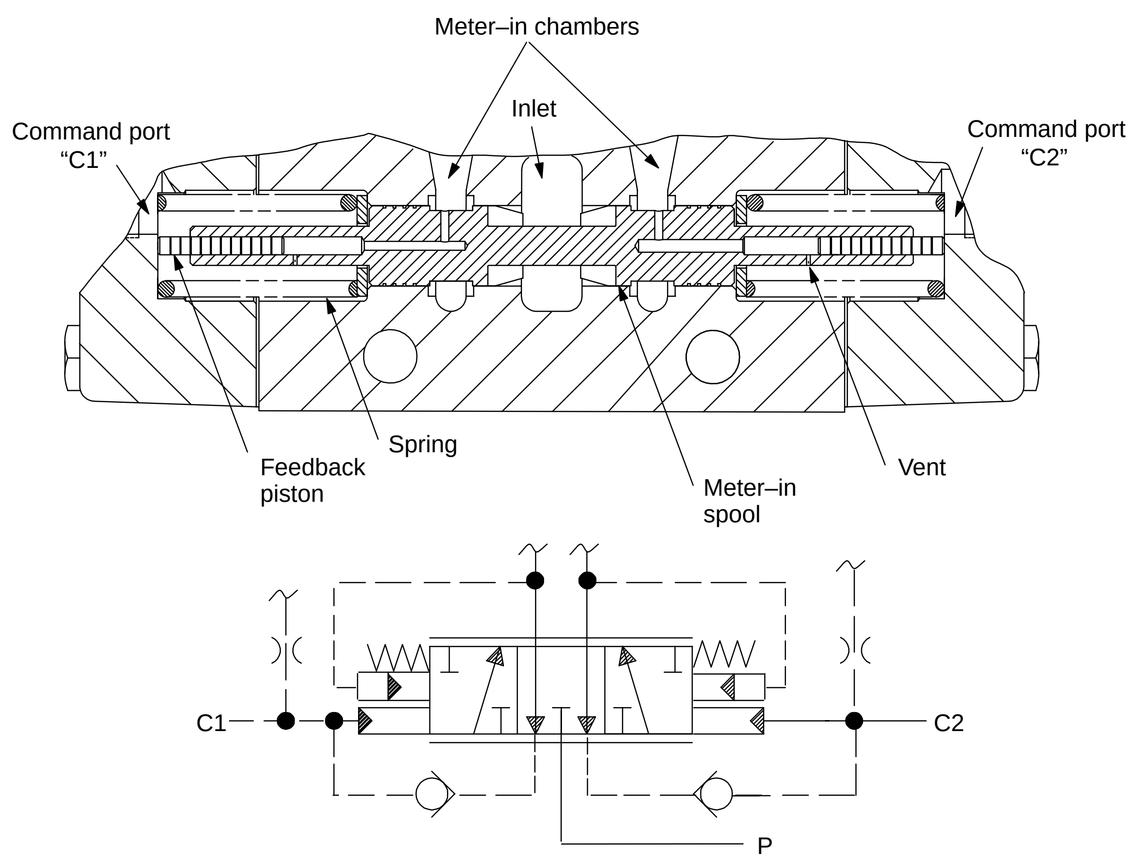


Figure 10

CMX100 Meter-In Pressure Control Spool
Pressure vs. Flow
Model "S206" Meter-in Element

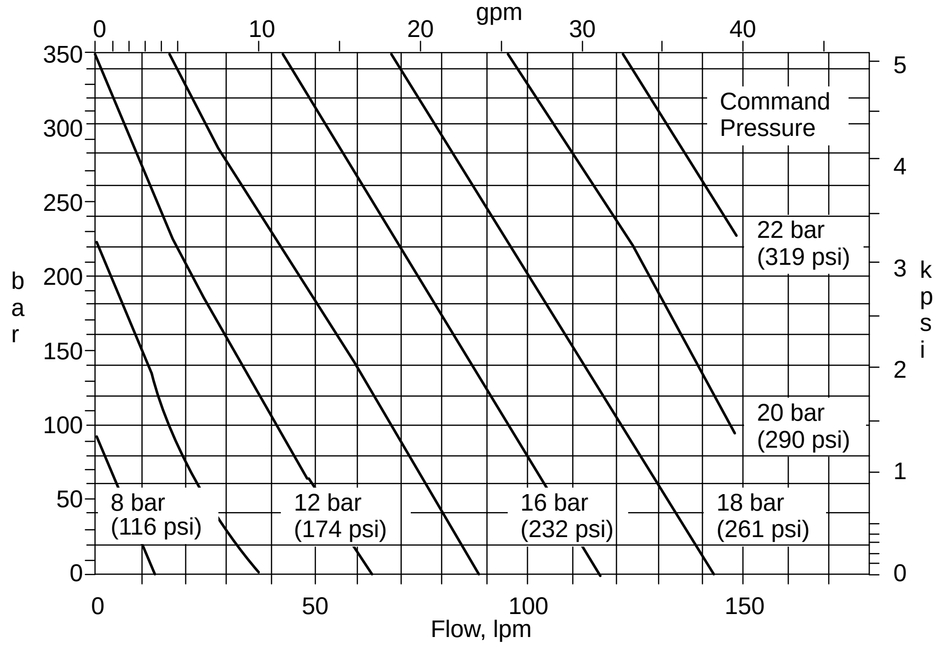


Figure 11a

CMX100 Meter-In Pressure Control Spool
Pressure vs. Flow
Model "S406" Meter-in Element

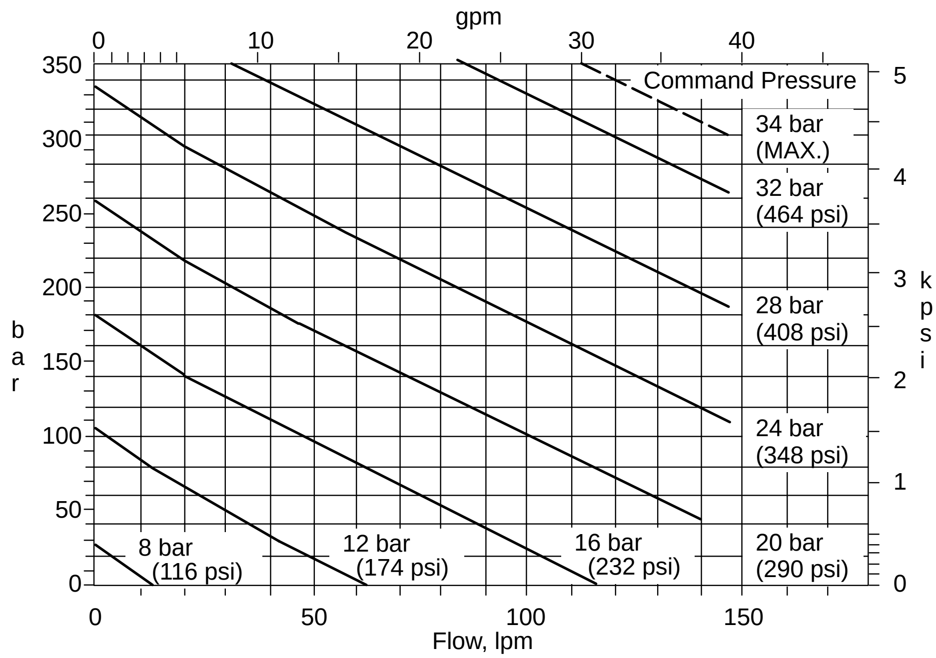


Figure 11b

Operating Valve Section

CMX160 Meter-In Pressure Control Spool
Pressure vs. Flow
Model “S206” Meter-in Element

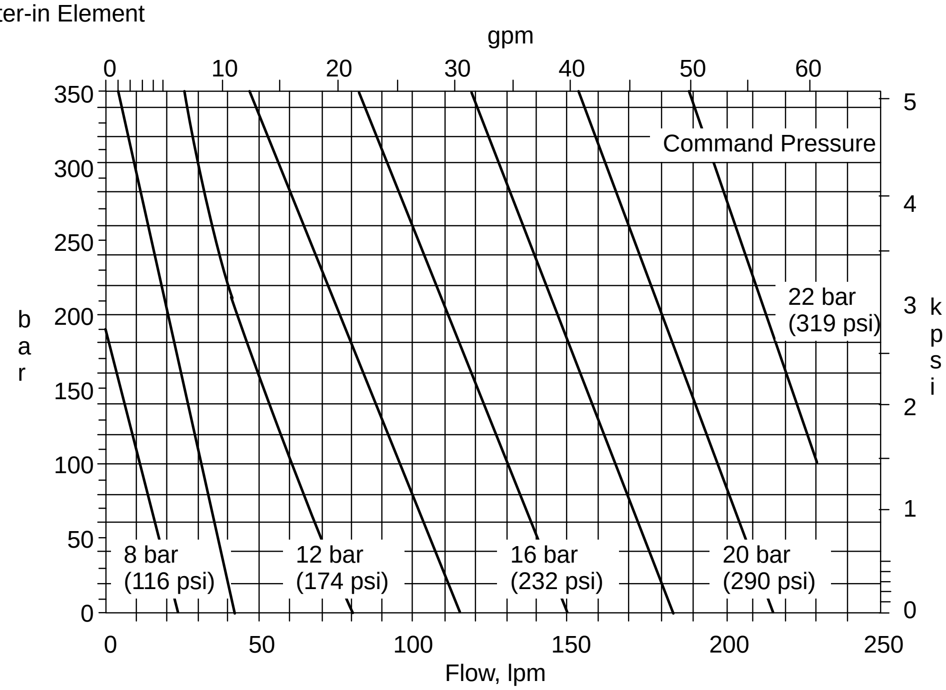


Figure 12a

CMX160 Meter-In Pressure Control Spool
Pressure vs. Flow
Model “S406” Meter-in Element

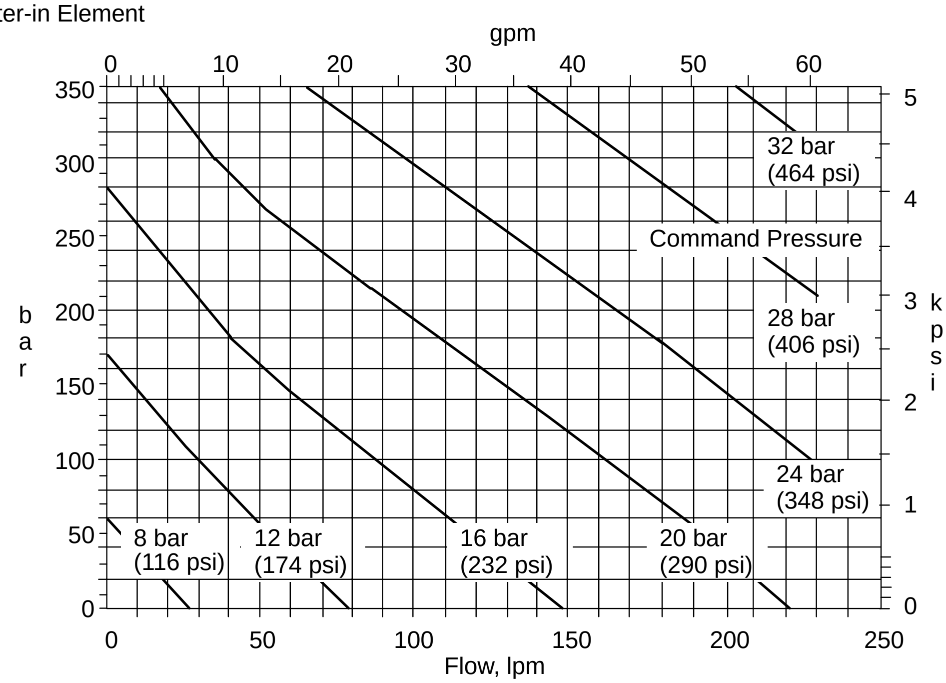


Figure 12b

Operating Valve Section

CMX160 Meter-In Pressure Control Element
Pressure vs. Flow
Model “S506” meter-in element

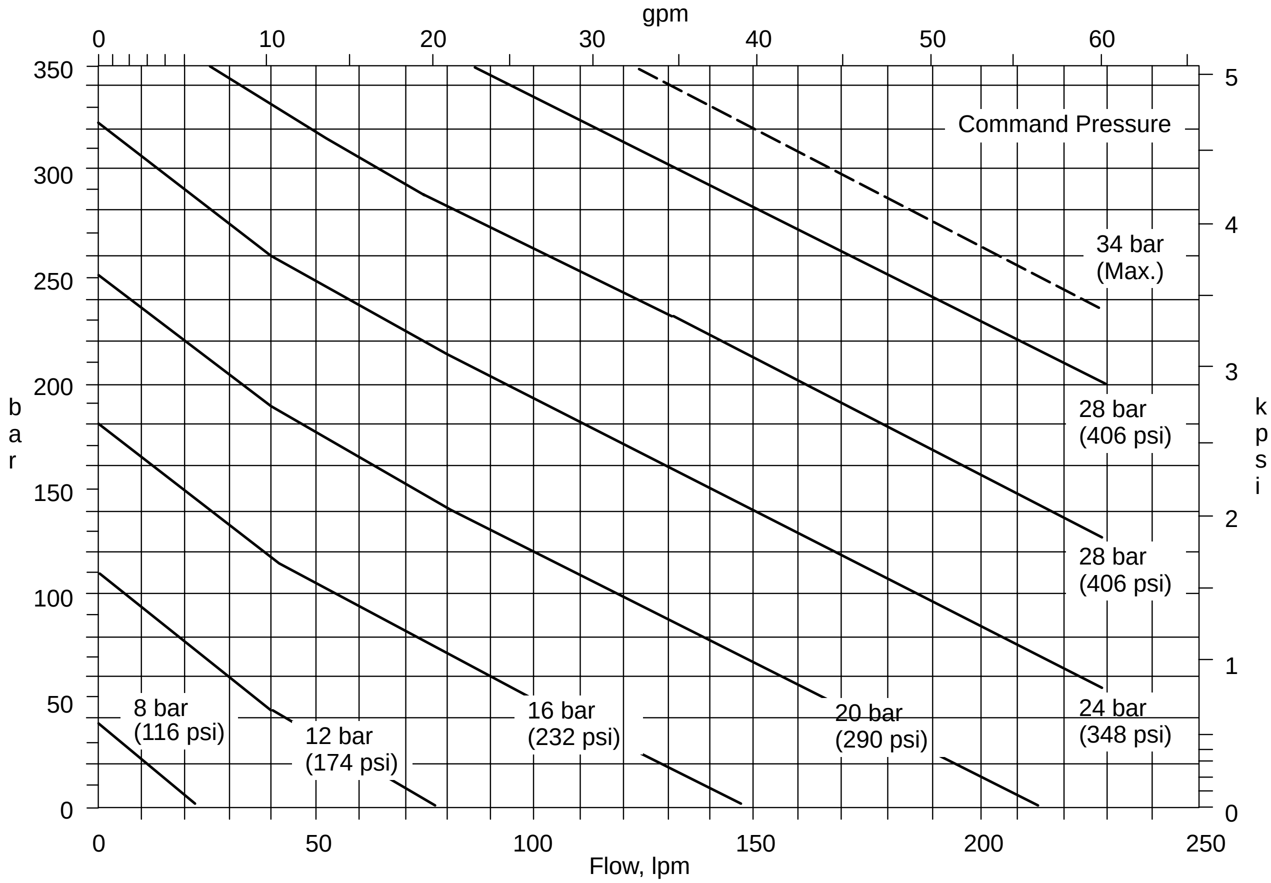


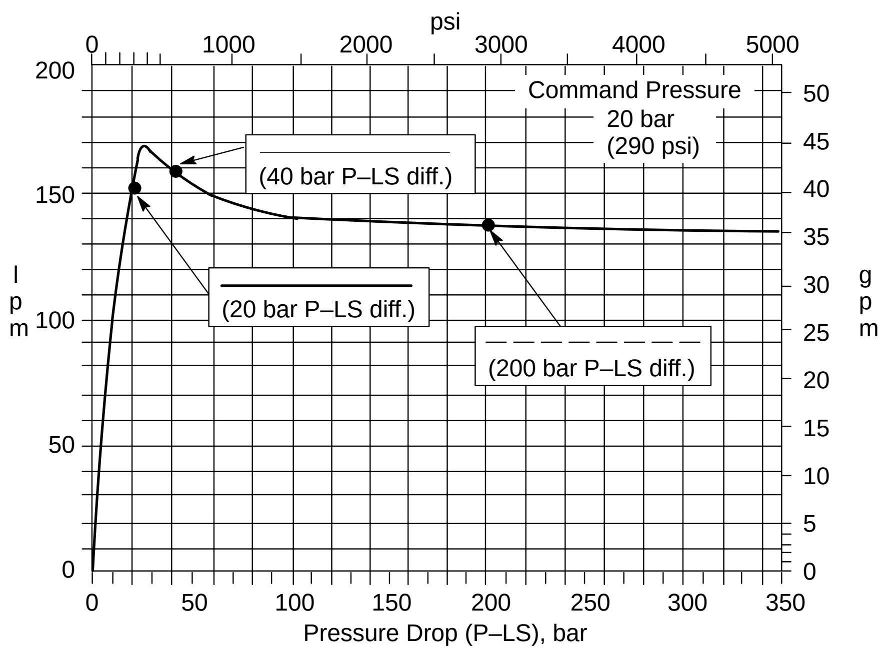
Figure 12c

Operating Valve Section

"S***" spool pressure compensation

The pressure control spool is pressure compensated by flow forces to provide constant flow independent of supply pressure, to minimize function interference. Since the spool does respond to load pressure and the pressure compensation curve is not perfectly flat, changes in load pressure will cause slight changes in the pressure flow relationship, as shown below (Figure 13).

CMX100 Meter-In Pressure Compensation
Model "S406" meter-in element



CMX100 Meter-In Pressure Control Spool
Model "S406" meter-in element

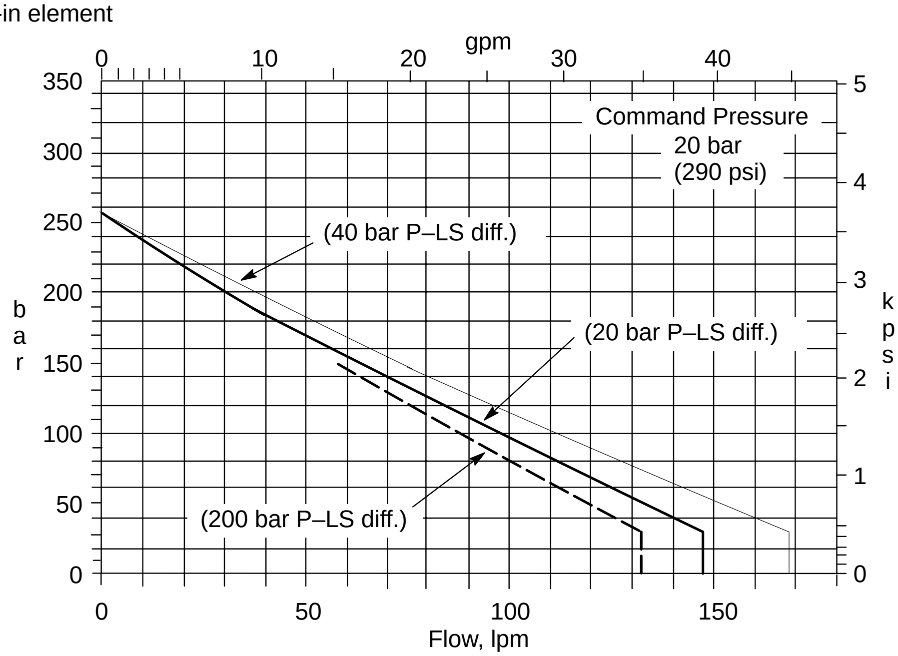


Figure 13

Operating Valve Section

Flow limitation orifice

Flow to a work function can be limited by the installation of a restricting orifice in the pump supply port of the valve section. Since the orifice will restrict flow to all sections downstream, its use is normally limited to the last valve in a bank. The orifice is only effective if the limited flow function is the highest pressure function for the pump. The orifice reduces the pressure drop across the meter-in element, while the pump maintains a constant pressure differential between pressure and load sensing. The flow limitation orifice is available as a special order only.

CMX160 Meter-In Pressure Control Element
5.5 Dia. Flow Limitation Orifice
Model "S506" Meter-in Element

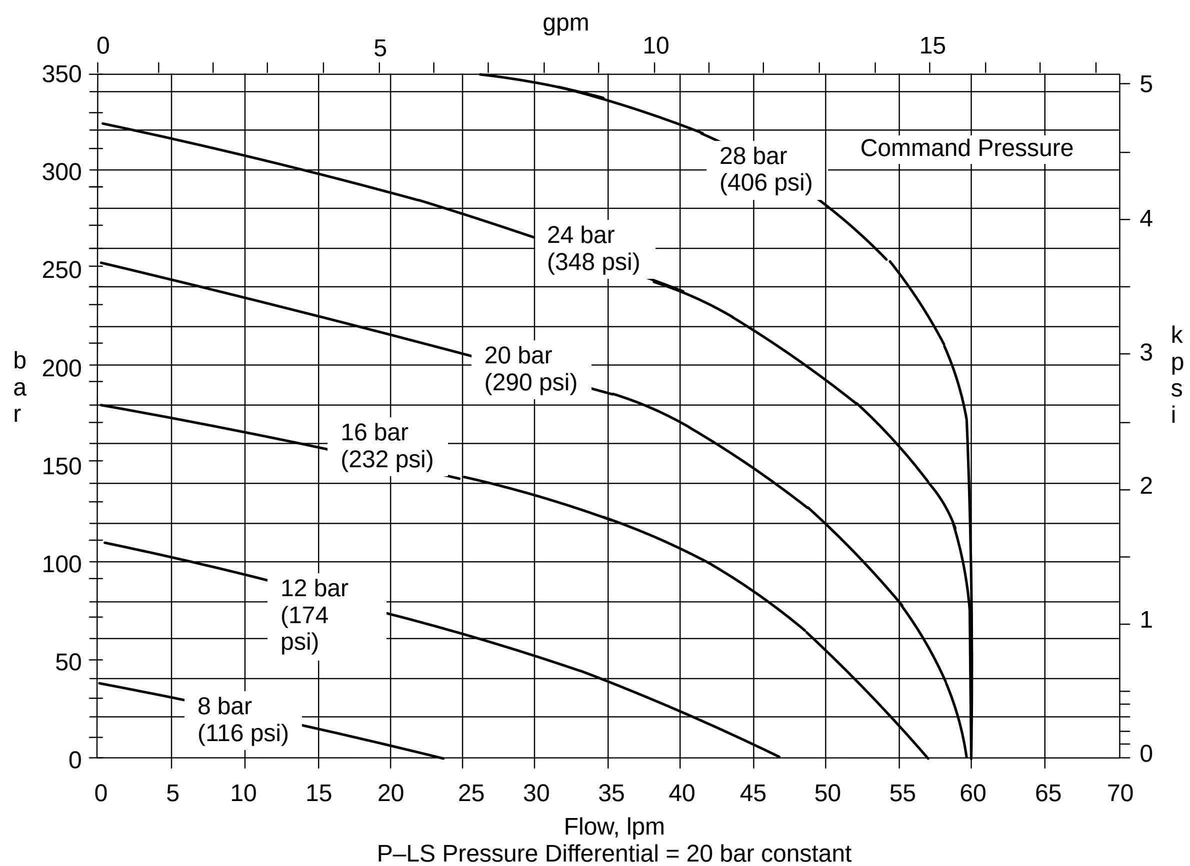


Figure 14a

Meter-In Flow Limitation
Orifice Selection Chart
Maximum Flow vs. Inlet Orifice Diameter

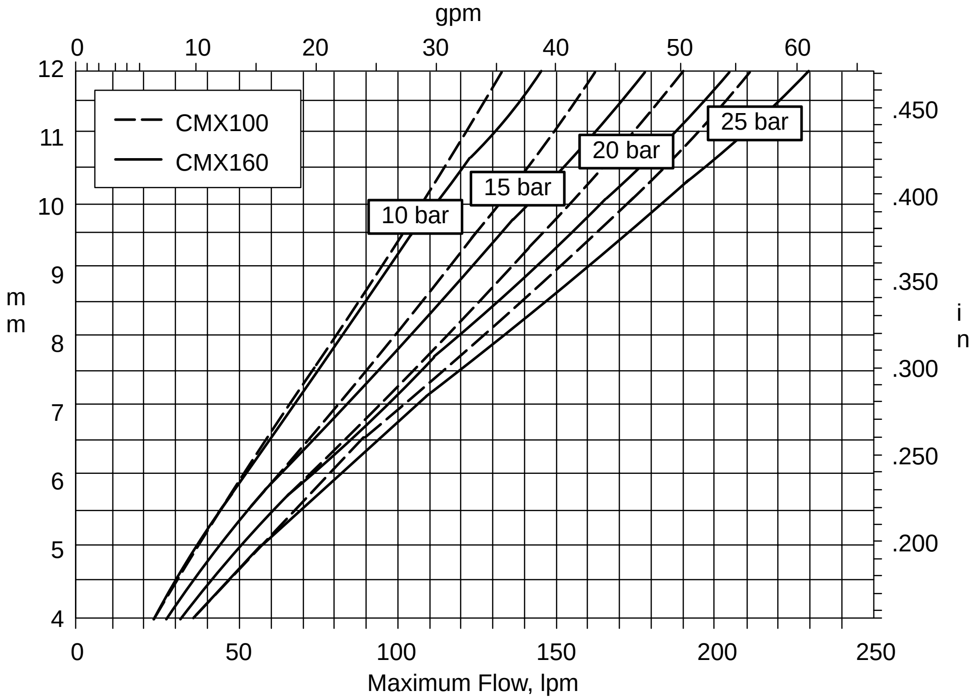


Figure 14b

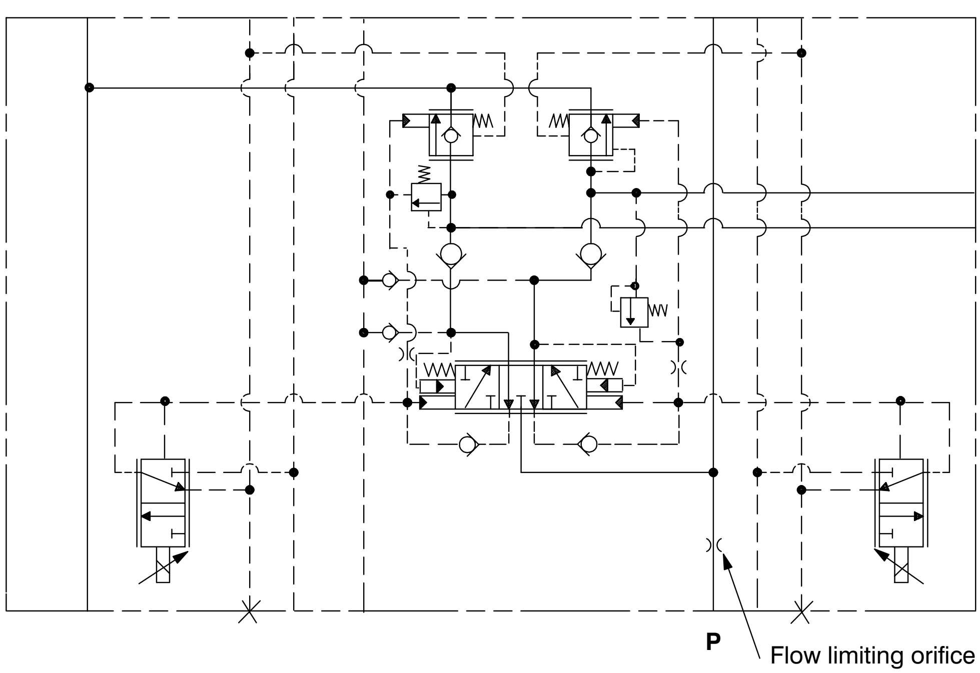


Figure 14c

Load sensing check valves – standard design

The -25 design CMX sectional valves are equipped with load sense check valves (Figure 15) that are different from the load sense shuttle valves provided on earlier models. The function of the load sense check valves is to supply the highest active load pressure to the load sense passage, while isolating lower pressure meter-in chambers from the load sense passage. The load drop check valves prevent the load pressure from overrunning loads or inactive (neutral) sections from reaching the meter-in chambers. When one or more of the sections in a valve bank is energized, the highest meter-in pressure is presented to the load sense port, which in turn controls the pump output pressure.

The load sensing pumps supplied by Vickers normally produce an output pressure between 13.8 bar (200 psi) and 41.4 bar (600 psi) above the load sense pressure. When all the sections are centered (or whenever the meter-in load sense signal decreases), all the load sense check valves close, trapping fluid in the load sense passage. A provision to vent this trapped fluid must be provided to allow the load sense signal to decay and the pump output pressure to return to standby. Valve bank end covers are available with a provision to vent the load sense port to drain.

Click here to see model code.

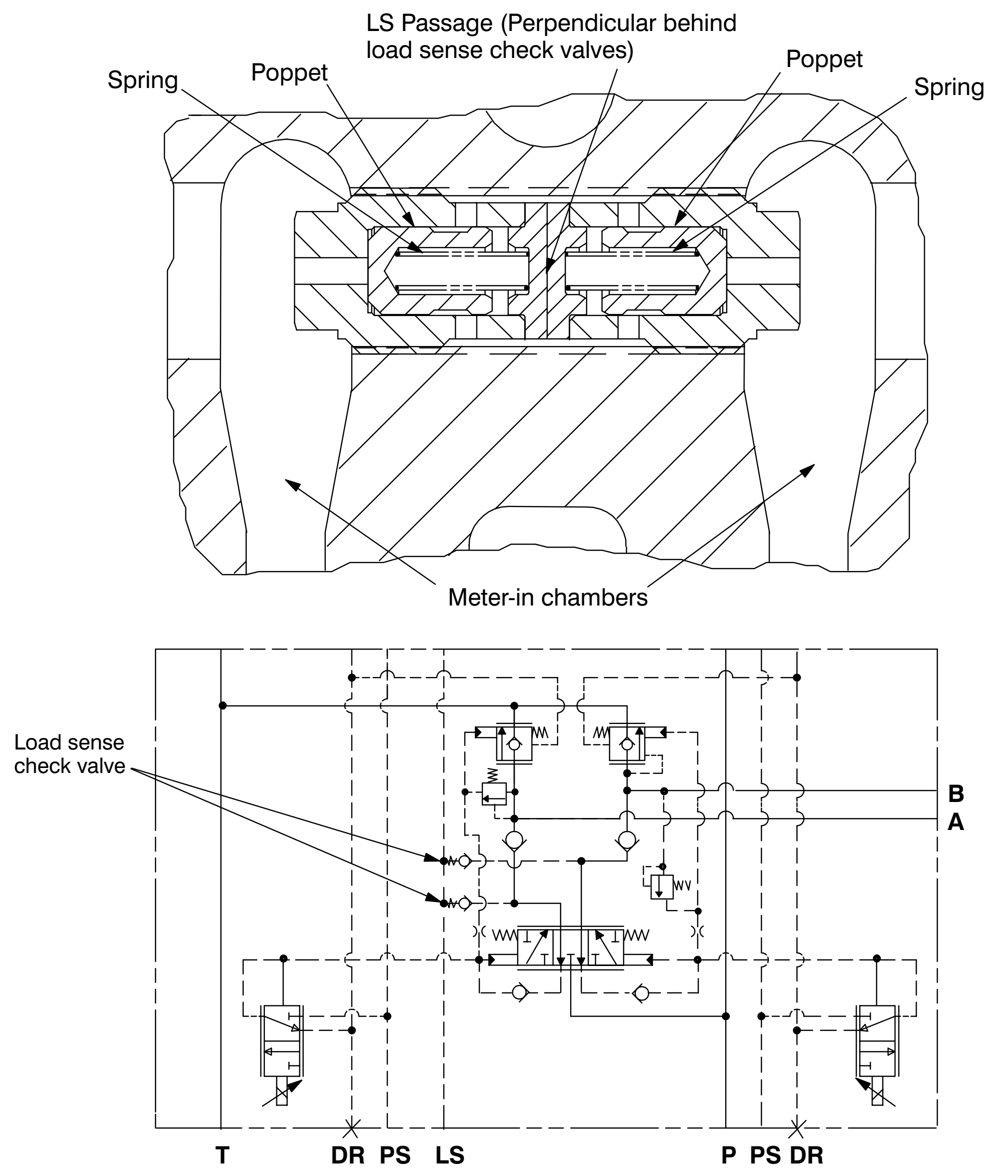


Figure 15

Operating Valve Section

On systems which utilize the 0.5 mm bleed orifice, it is recommended for optimum performance that the orifice be located at the end of the valve bank opposite the pump connection. On multiple valve bank systems, the load sense connections should be made in series, with the orifice located as far from the pump as possible. On mid–inlet valve banks, the load sense-to-pump connection should be made at one end cover, and the bleed orifice located at the opposite end cover. The reasons for the above recommendations are as follows:

Flow in the load sense passage to the load sense bleed orifice causes a pressure drop through each section. The cumulative effect of the pressure drop through each section can be significant, especially at higher load sense pressures, higher fluid viscosities, and when many sections are present. The higher load sense pressures cause a higher bleed flow rate, and higher fluid viscosities (such as cold oil) cause a higher pressure drop. If the bleed flow is toward the pump load sense port (Figure 16b), the pressure drop subtracts from the load sense signal. For example, assume a 200 bar (2900 psi) load, and a pump load sense setting of 13.8 bar (200 psi). When the valve is energized, the 200 bar is presented to the load sense passage. If flow to the bleed orifice causes a pressure loss of 0.7 bar (10 psi) per section, and there are eight sections between the valve and the pump, then the pump will sense a load sense signal of 194.4 bar (2820 psi), and maintain an output pressure of 194.4 + 13.8 = 208.2 bar, which is only 8.2 bar (119 psi) above the load pressure. The result will be slower operation for that function. If the bleed flow is away from the pump load sense (Figure 16a), then the actual load sense pressure is supplied to the pump without flow induced pressure losses, and consistent performance can be achieved.

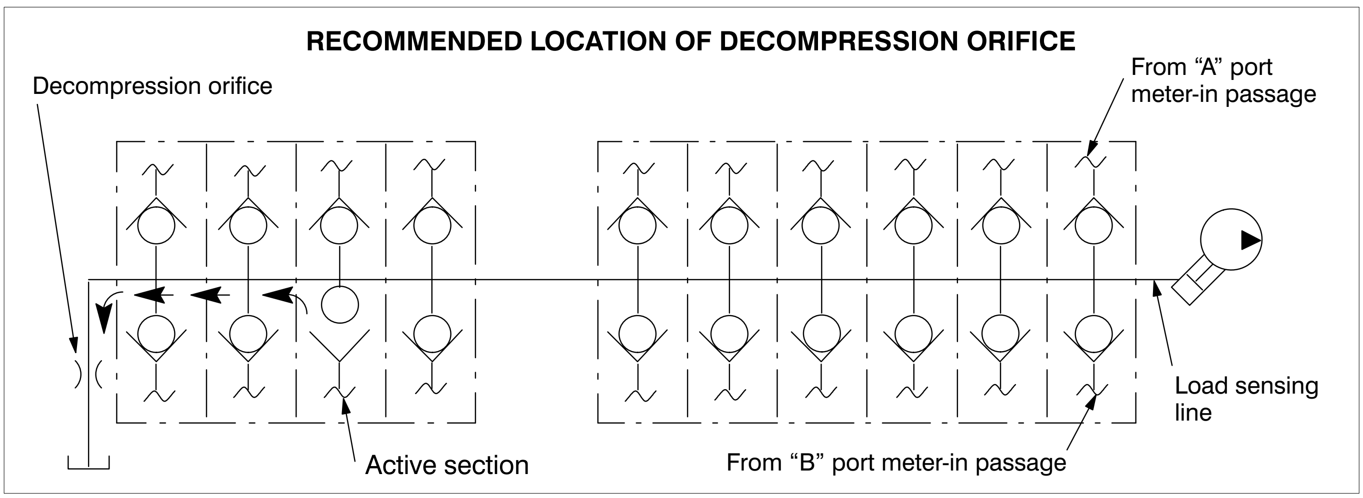


Figure 16a

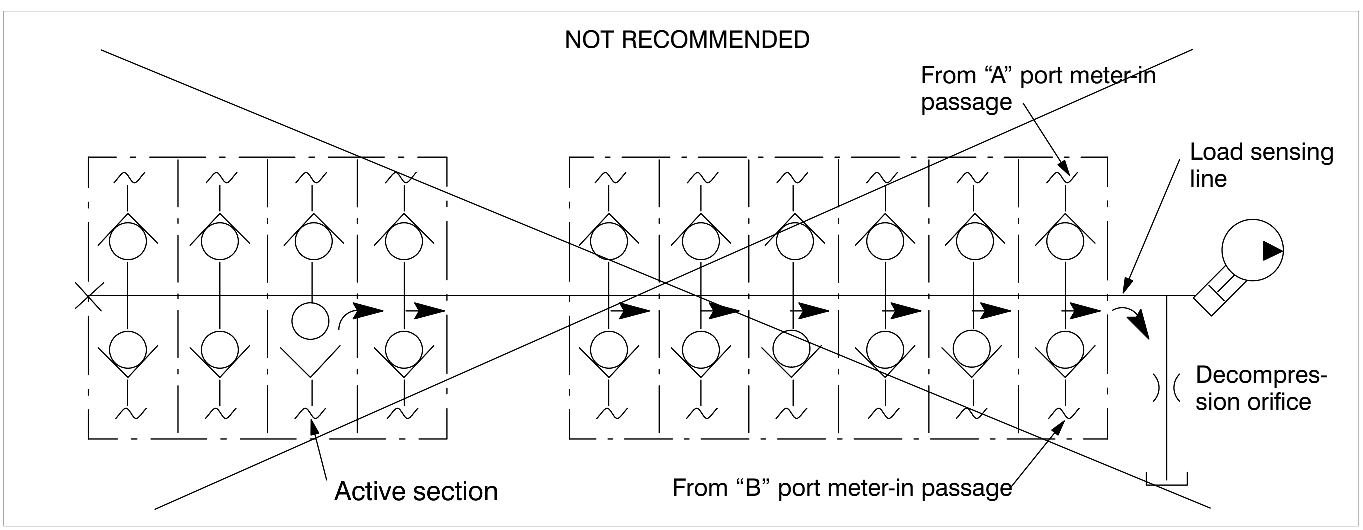


Figure 16b

Load drop check valves – standard

The load drop check valves (Figure 17) isolate the meter–in spool and the load sense check valves from the actuator ports. This feature makes it possible to maintain very low cylinder port leakage independent of meter-in spool-to-bore clearance. Therefore, meter-in spool-to-bore clearances are relatively large, minimizing hysteresis and making meter-in spools fully interchangeable.

Bleed orifice

Certain applications, such as brake release circuits and counterbalance circuits, require low actuator port pressure to be maintained in neutral. Load drop check valves with a bleed orifice are available to vent fluid trapped in the actuator ports to the meter-in chambers. This feature requires a meter-in element with drain orifices and is available as a special order only.

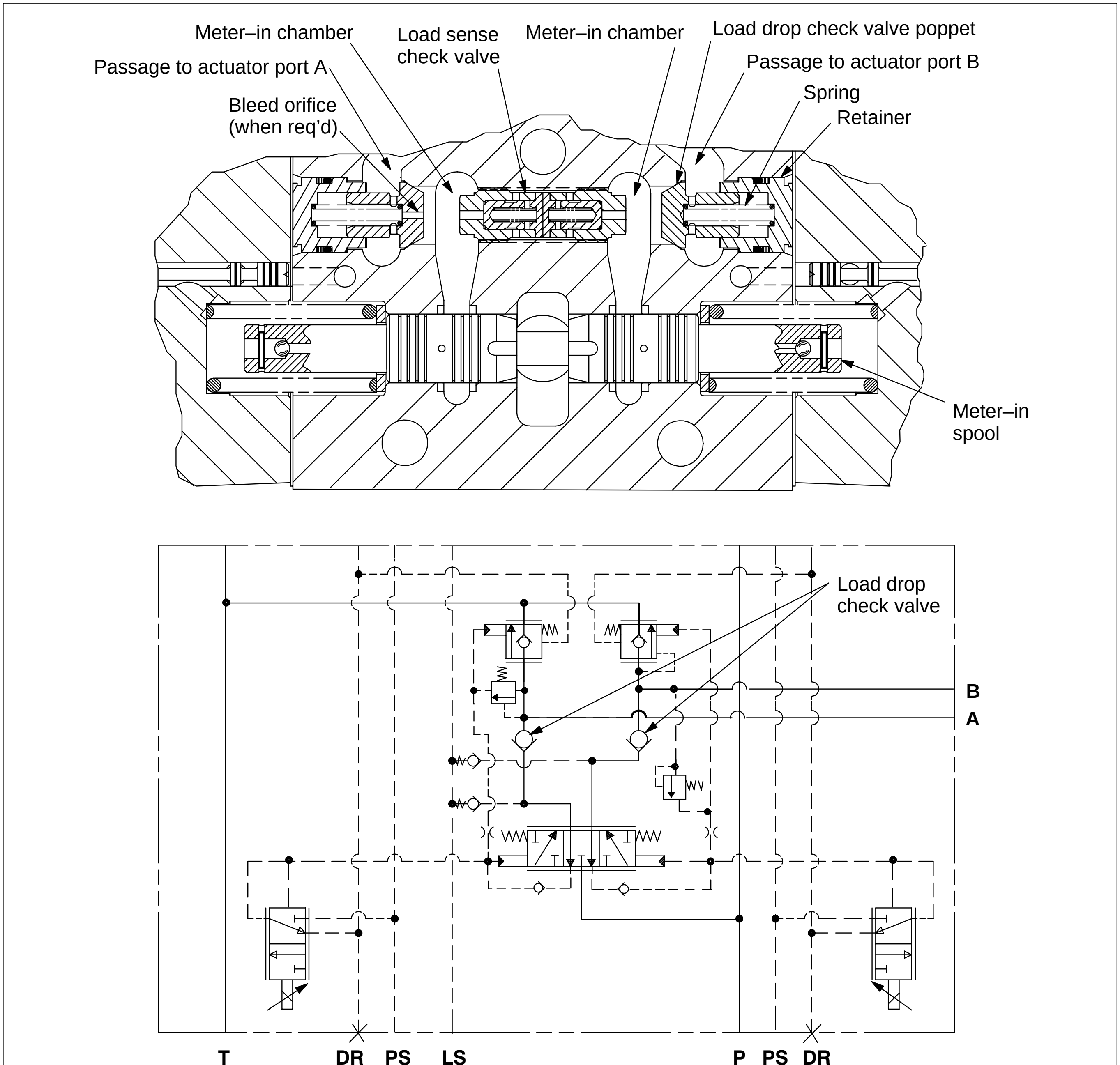


Figure 17

CMX Sectional Valve Load Drop Check
Flow vs. Pressure Drop

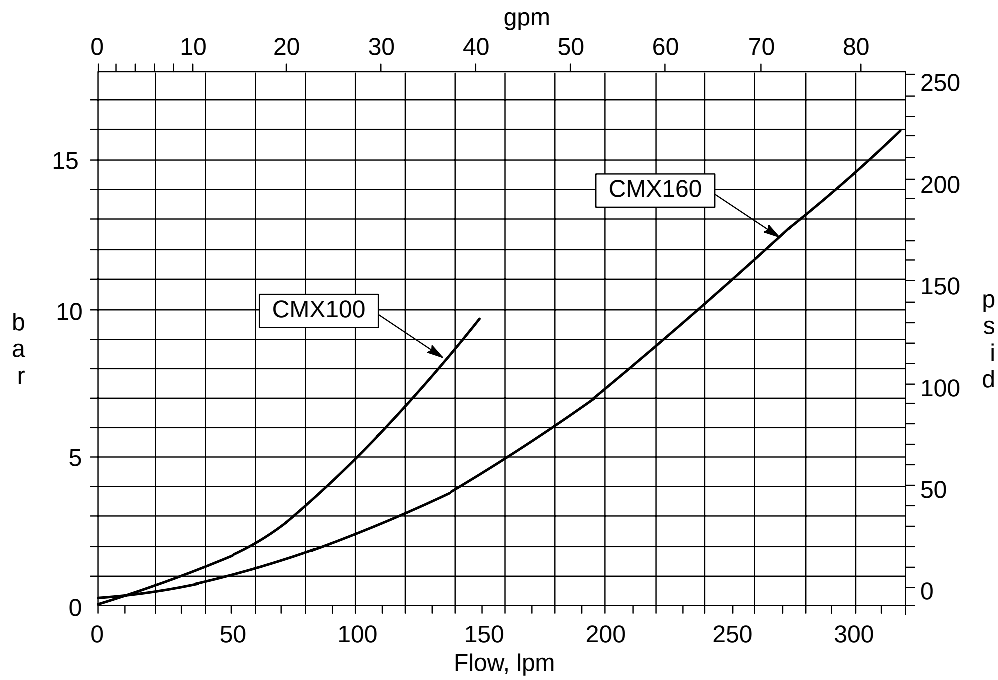


Figure 18

Operating Valve Section

Meter-out elements

Meter-out control is achieved by using a pilot poppet-stem along with a modulating meter-out poppet to form a simple hydromechanical bleed servo (Figure 19). Actuator port pressure acts on the annular differential area between the major outside diameter of the meter-out poppet and the meter-out poppet skirt (or seat) diameter, and tends to push the meter-out poppet open. The pressure in the spring chamber acts on the full major O.D. area of the meter-out poppet, and tends to close the meter-out poppet. When the meter-out element is closed, the pressure in the spring chamber is equalized to actuator port pressure via a 0.75 mm (.030 in.) orifice in the meter-out poppet. Since the pressure in the spring chamber is only partially offset by the actuator port pressure acting on the annular area, the meter-out poppet remains closed provided tank pressure is below actuator port pressure.

To open the meter-out poppet, pilot pressure applied to the meter-in spring chamber is transmitted by a passage in the control cap gasket to the meter-out piston. The force against the meter–out piston moves the poppet-stem from its seat and against the opposing spring, opening a passage from the meter-out spring chamber to the tank passage. Fluid then passes from the actuator port through the orifice in the meter-out poppet to the spring chamber and then to tank. This flow develops a pressure differential across the orifice in the meter-out poppet, which subtracts from the actuator port pressure, reducing the meter-out spring chamber pressure. When the pressure in the meter-out spring chamber falls low enough, the actuator port pressure acting on the annular area will overcome the meter-out spring chamber pressure and open the meter-out poppet, moving it toward the poppet stem. This motion will tend to close the poppet-stem against its seat, reducing the flow-induced pressure drop across the orifice and increasing the pressure in the meter-out spring chamber.

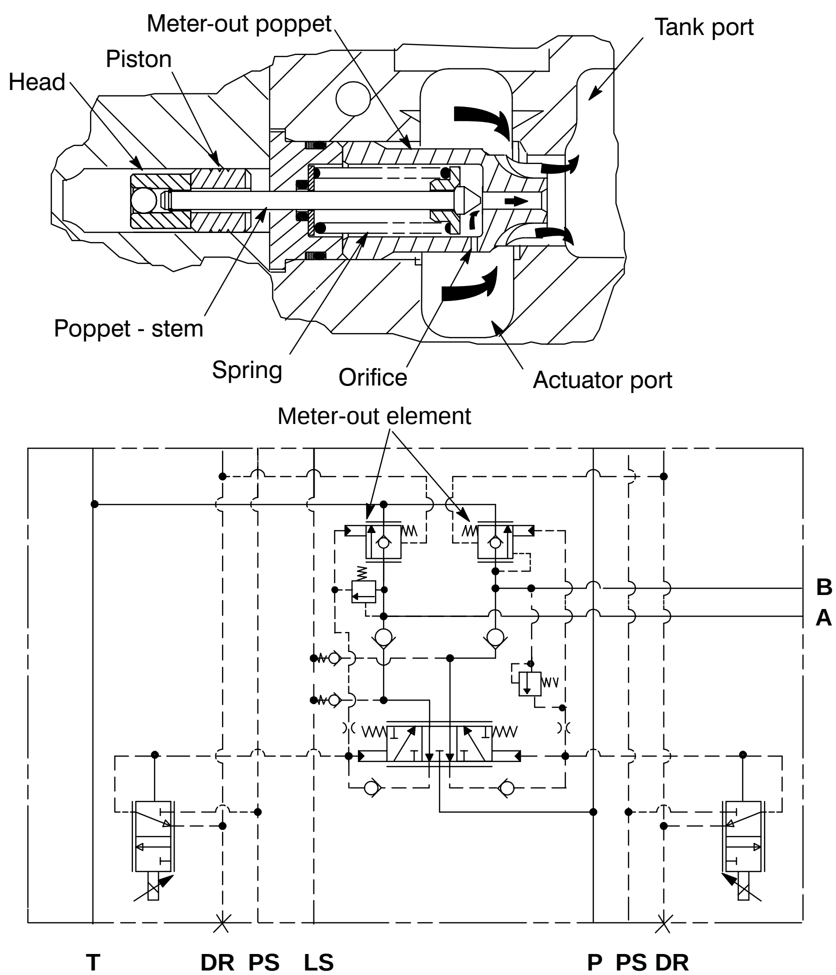


Figure 19. The meter-out element is not pressure compensated, so interaction problems with the meter-in element are avoided.

Operating Valve Section

The meter-out poppet will assume a position where the poppet stem-to-seat restriction is such that the reduced pressure in the meter-out spring chamber balances the forces on the meter-out poppet. The net effect is that the meter-out poppet follows the poppet-stem position. The movement of the poppet-stem is controlled only by the pilot signal and the spring it moves against. The position feedback gain of the meter-out poppet is high, so a small change in position of the meter-out poppet away from the balanced-force position results in a large increase in forces acting to return the meter-out poppet to the balanced-force position. These forces are high compared to flow forces, so the meter-out poppet will not close prematurely due to flow forces.

Several different meter-out poppets are available which provide different area gains. A high gain poppet (low ΔP at rated flow) provides better control when lowering a light load. A low gain poppet (high ΔP at rated flow) provides better control when lowering heavy loads.

Meter-out poppets are rated according to the actuator port to tank pressure drop in bar across the poppet at the valve's rated flow with the poppet fully opened. Performance data is shown below and on the following three pages.

CMX100 Meter-out Flow vs. Command
"S03" (3 bar) Meter-out High Gain Poppet

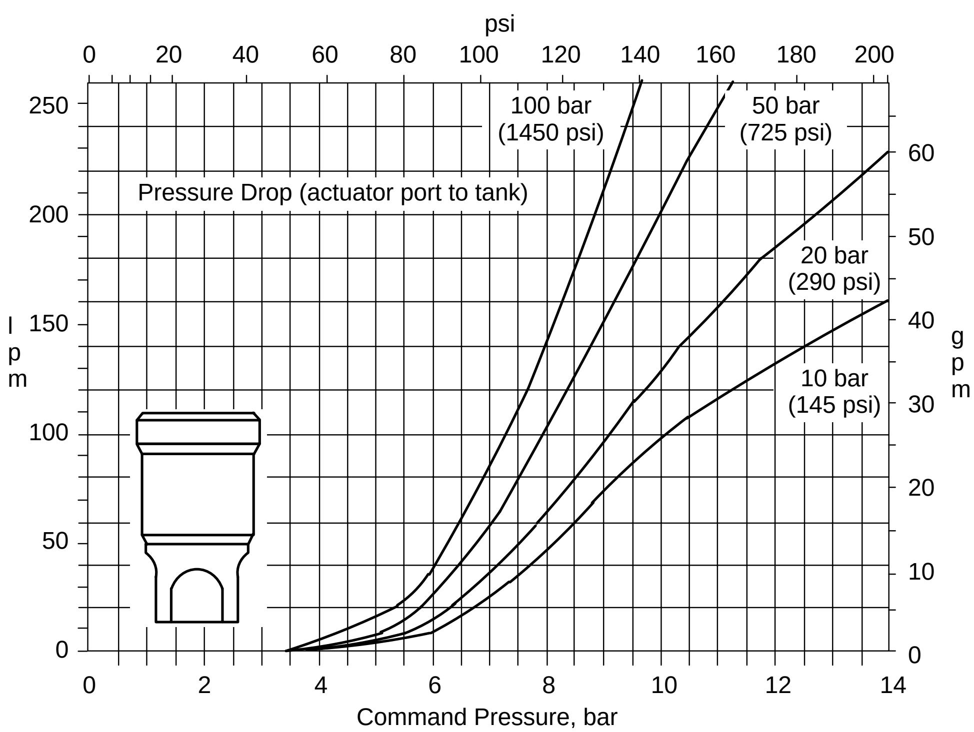


Figure 20a

CMX100 Meter-out Flow vs. Command
“S14” (14 bar) Meter-out Medium Gain Poppet

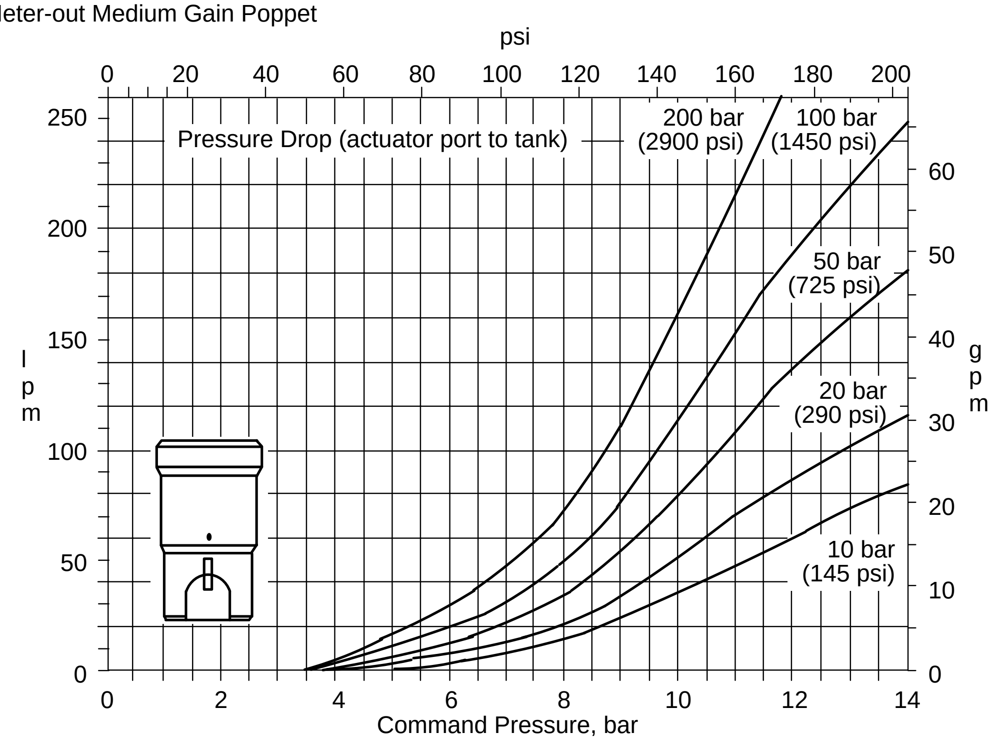


Figure 20b

CMX100 Meter-out Flow vs. Command
“S90” (90 bar) Meter-out Low Gain Poppet

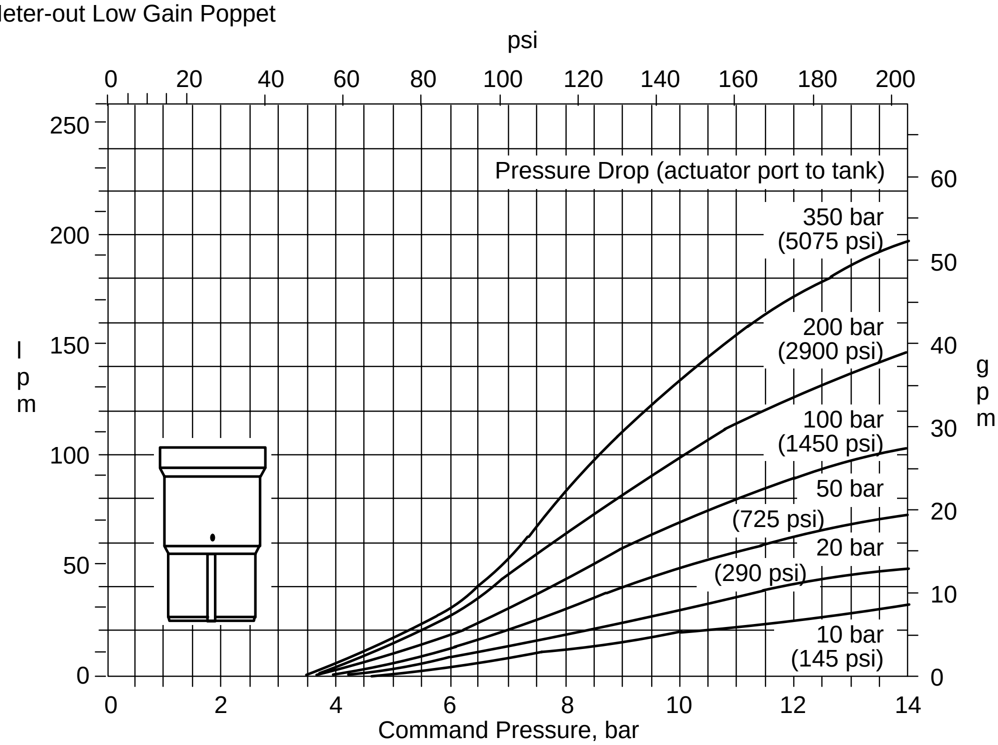


Figure 20c

Operating Valve Section

CMX160 Meter-out Flow vs. Command
"S04" (4 bar) Meter-out High Gain Poppet

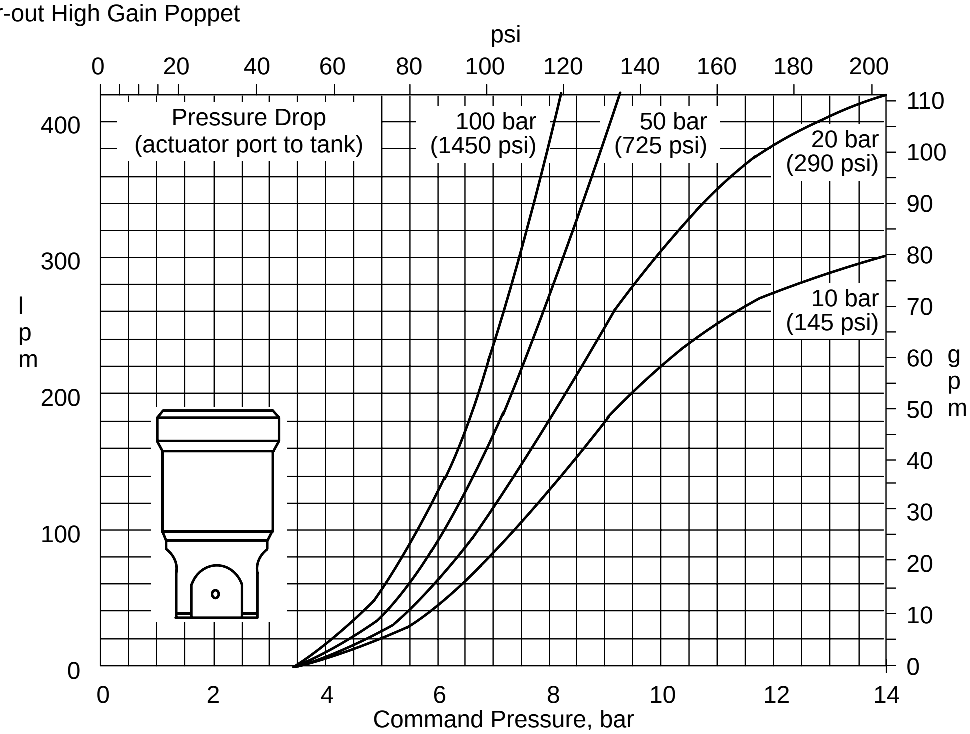


Figure 21a

CMX160 Meter-out Flow vs. Command
"S07" (7 bar) Meter-out High Gain Poppet

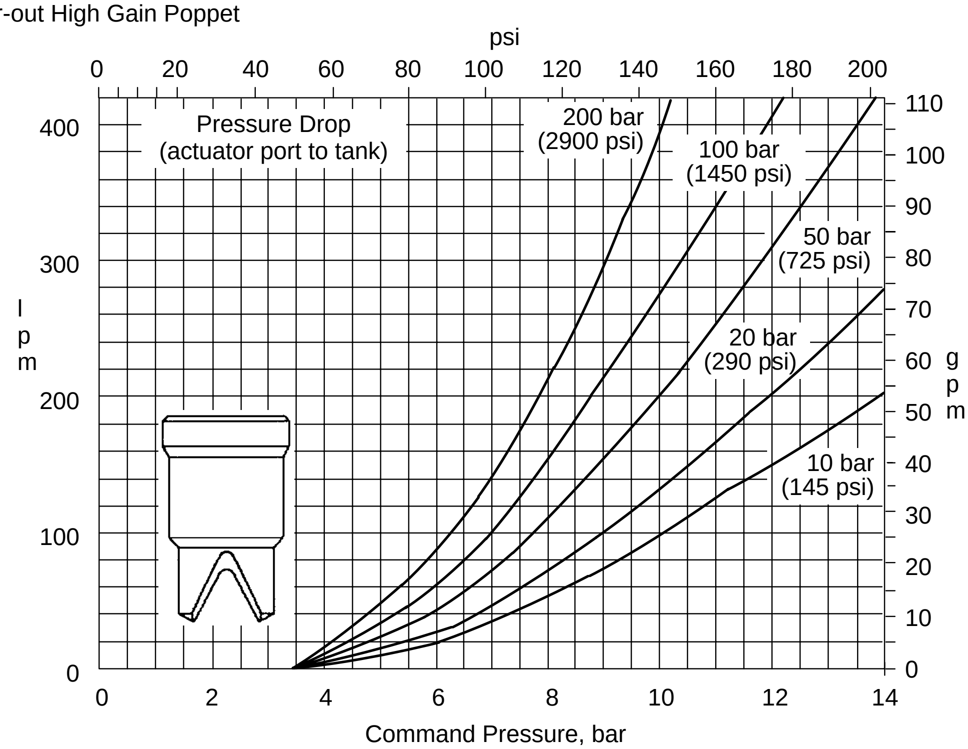


Figure 21b

Operating Valve Section

CMX160 Meter-out Flow vs. Command
"S14" (14 bar) Meter-out Medium Gain Poppet

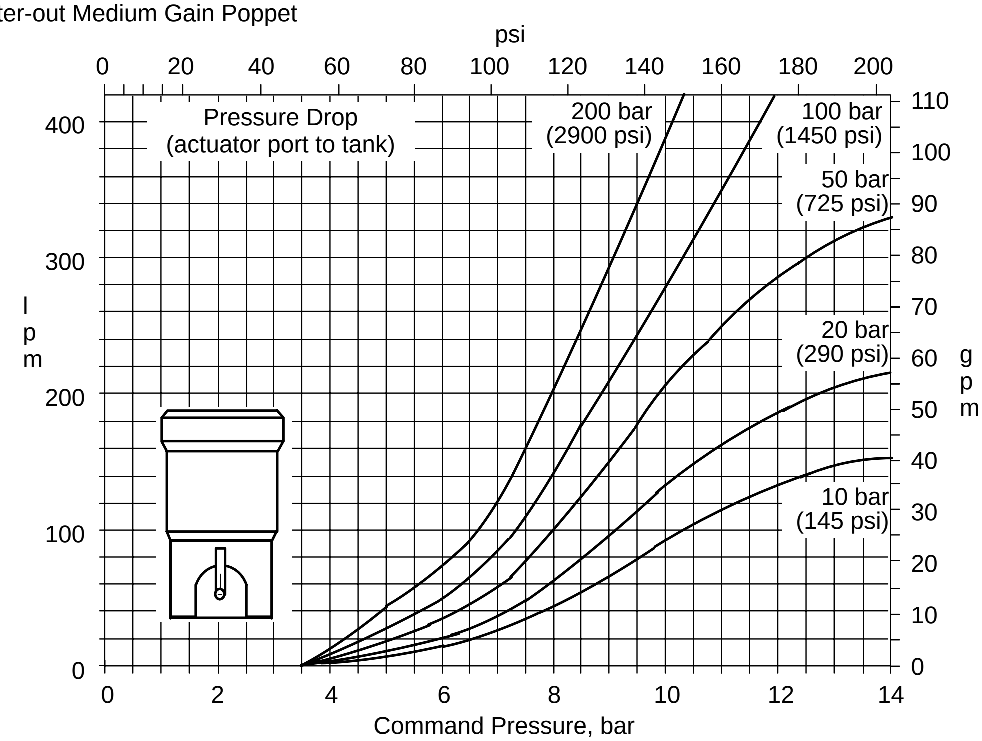


Figure 21c

CMX160 Meter-out Flow vs. Command
"S56" (56 bar) Meter-out Low Gain Poppet

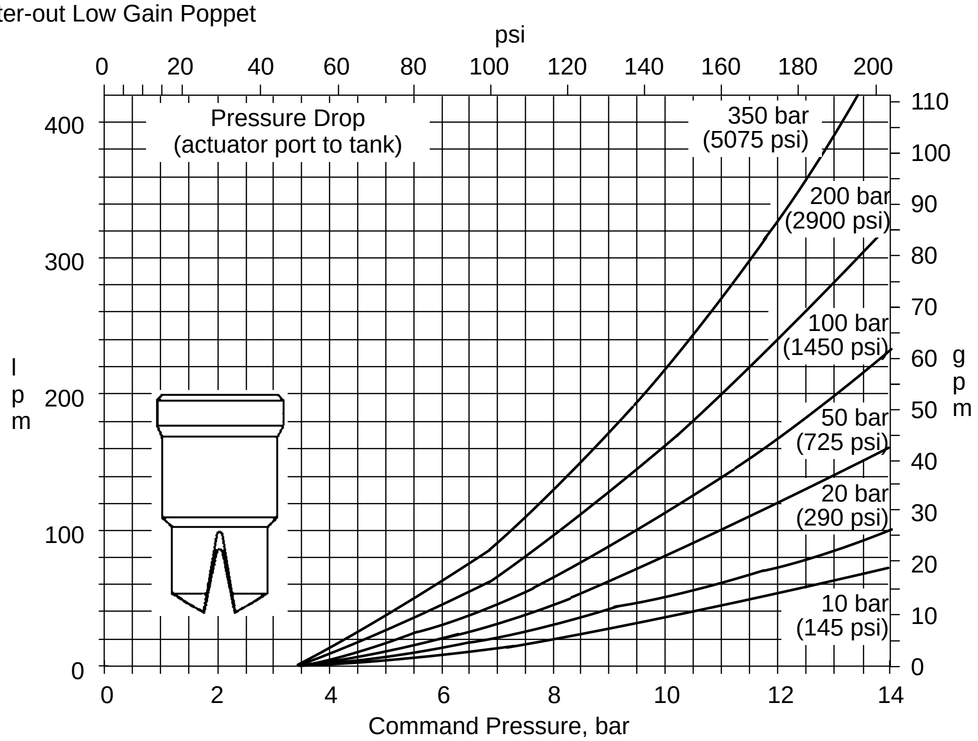


Figure 21d

Anticavitation check valves – standard

Cavitation protection is normally provided by reverse flow through the meter-out poppets. In this mode, tank pressure above the actuator port pressure, acting on the meter-out poppet skirt area, opens the meter-out poppet. Tank pressure is maintained by a back pressure check in the tank line. Performance (flow vs. pressure drop) is shown in Figure 22 below and on the following page.

For meter-out load pressures above 70 bar sufficient momentum exchange occurs, due to the high velocity jet from an actuator port exhausting fluid impinging upon the opposite meter-out poppet, to cause the opposite actuator port pressure to be higher than the tank pressure. This phenomenon is fairly complex, since the opposite port pressure is a function of the load pressure, load speed (or flow rate), the tank port pressure, the area gains of both meter-out poppets (poppet types) and the cylinder area ratio.

The following example is illustrative: for a CMX160 lowering A to T a load of 138 bar (2000 psi), 160 lpm (42 USgpm), 1:1 area ratio, open tank (no back pressure check valve), a type "56" meter-out poppet in the A port, and a type "07" poppet in the "B" port; the "B" port pressure is 12.9 bar (187 psi) and the tank port pressure is 0.5 bar (7 psi). For the same conditions with a 2:1 area ratio, the "B" port pressure would be 7.6 bar (110 psi) and the tank pressure would be 0.7 bar (10 psi).

CMX100 Anti-Cavitation Check Valves
Standard (Reverse Flow Thru M–O Poppets)
Flow vs. Pressure Drop (T → A)

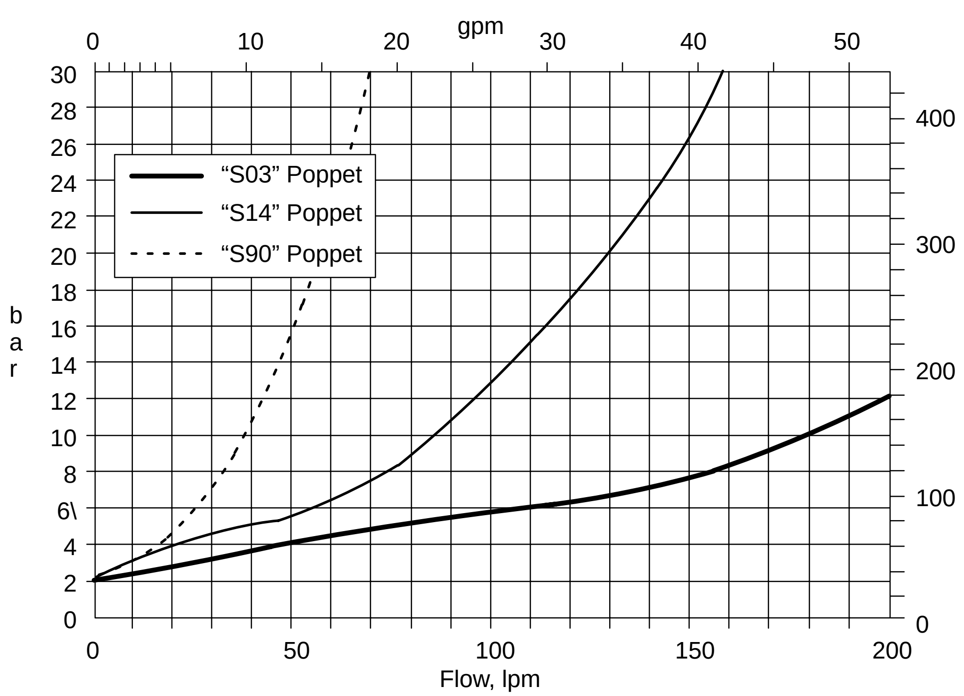


Figure 22a

CMX160 Anti-Cavitation Check Valves
Standard (Reverse Flow Thru M–O Poppets)
Flow vs. Pressure Drop (T → A)

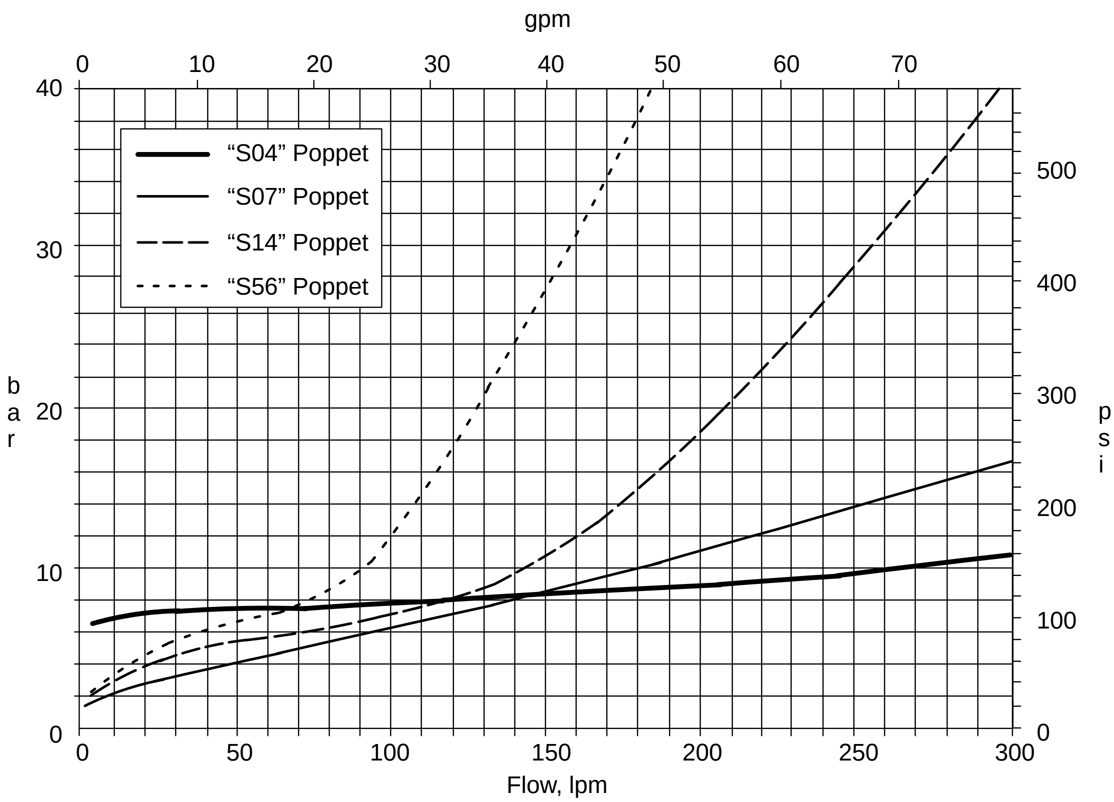


Figure 22b

Operating Valve Section

The meter-out poppet will remain closed when the tank pressure is above the actuator port pressure and the meter-out servo is piloted open. In this case, the poppet-stem opens and fluid enters the spring chamber from tank. The orifice in the meter-out poppet restricts the flow leaving the spring chamber, so the spring chamber pressure is nearly equal to the tank pressure. Since the actuator port pressure is lower than tank, the force on the annular area of the meter-out poppet due to actuator port pressure is less than the opposing force due to tank pressure in the spring chamber, and the meter-out poppet closes and remains closed. Cavitation can occur under these conditions, which normally occur only if the "float" feature is used, or when reversing the direction of a moving load.

(Click here for float feature.)

Special meter-out poppets are available with check valves which prevent reverse flow into the meter-out spring chamber and subsequent uncontrolled closing of the meter-out poppet. (Not available for CMX160 "07" and "56" M-O poppets.)

Anticavitation module

For applications that require minimal back pressure in the tank port, a bolt-on module (Figure 23) is available that provides anticavitation performance superior to the meter-out poppet. This module is only available on models with the SAE 4-bolt flange. Modules are available with single and dual anti-cavitation check valves. Figure 24, on th folloeing page, shows typical performance data.

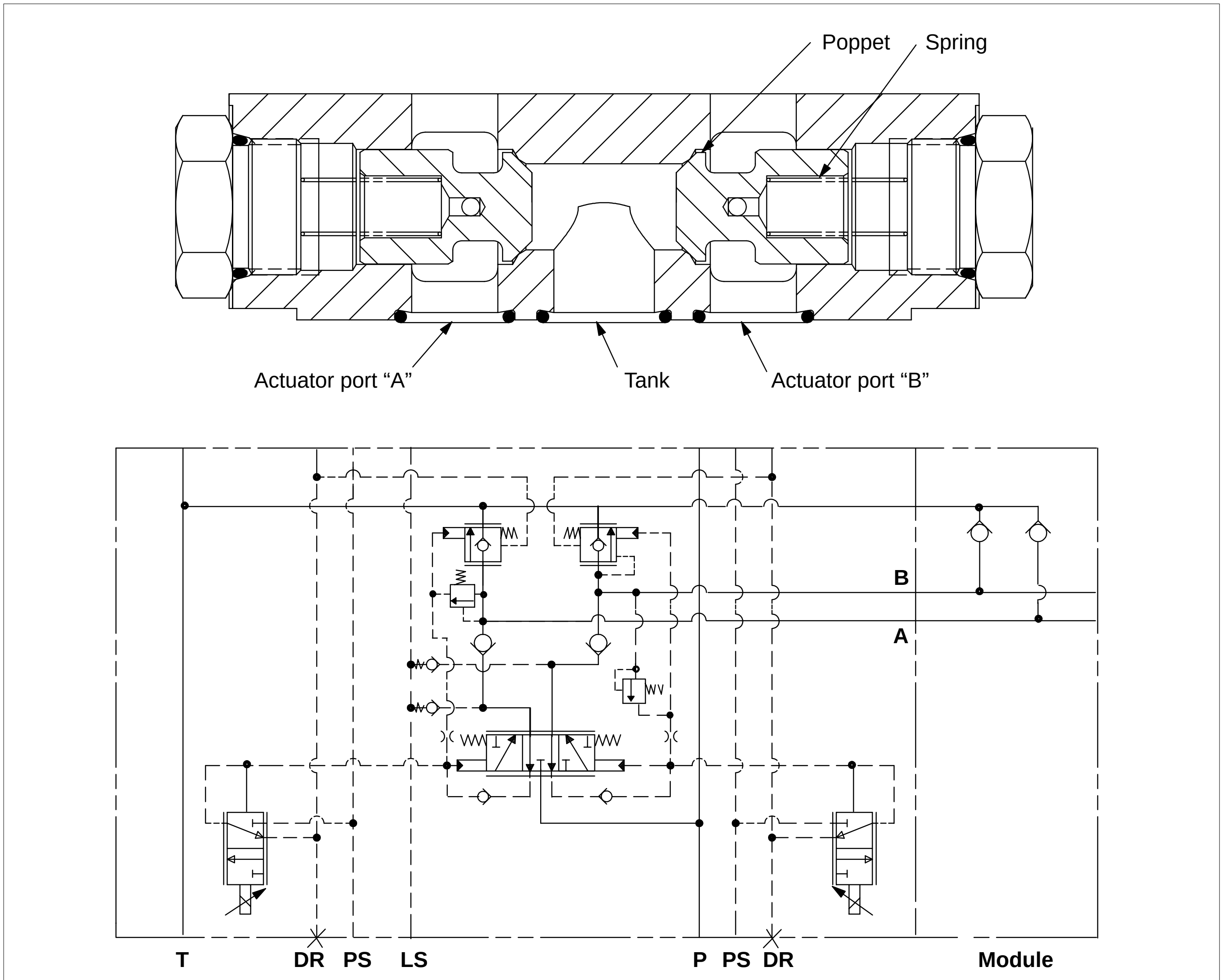


Figure 23

CMX Anti-Cavitation Check Module
Flow vs. Pressure Differential (T → A)

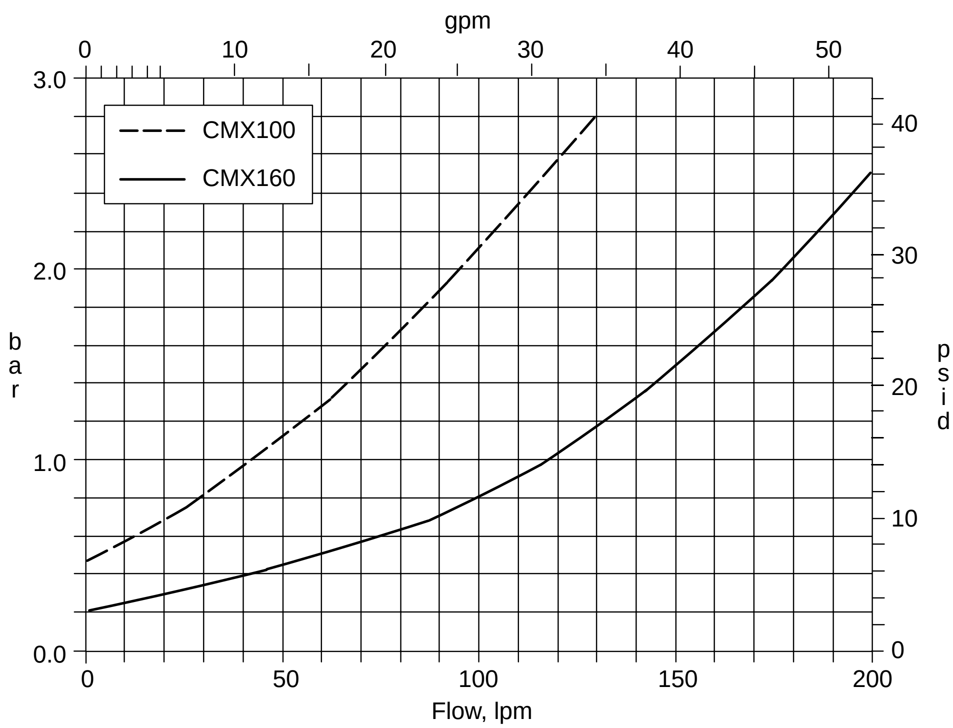


Figure 24

Operating Valve Section

Float function

A feature inherent in the CMX valves is the float function capability which is similar to the fourth position float function on manual spool type mobile control valves. To activate the float function, both control ports are energized at the same time to the same pressure. This action pilots open both meter-out elements, while the meter-in spool remains centered due to the balanced pilot pressures. Pressure drop from actuator port to actuator port will depend on the meter-out poppet types employed and the cylinder area ratio.

To prevent cavitation caused by the uncommanded closing of the meter-out poppets, meter-out poppets with the reverse flow check valve or an anti-cavitation module should be used.

Click here for information on anti-cavitation check valves.

Click here for information on the anti-cavitation module.

Figure 25 gives performance data for typical applications.

CMX160 "Float" Performance
Flow vs. Pressure Drop (B → A)
Flow B → T → A (T Blocked)

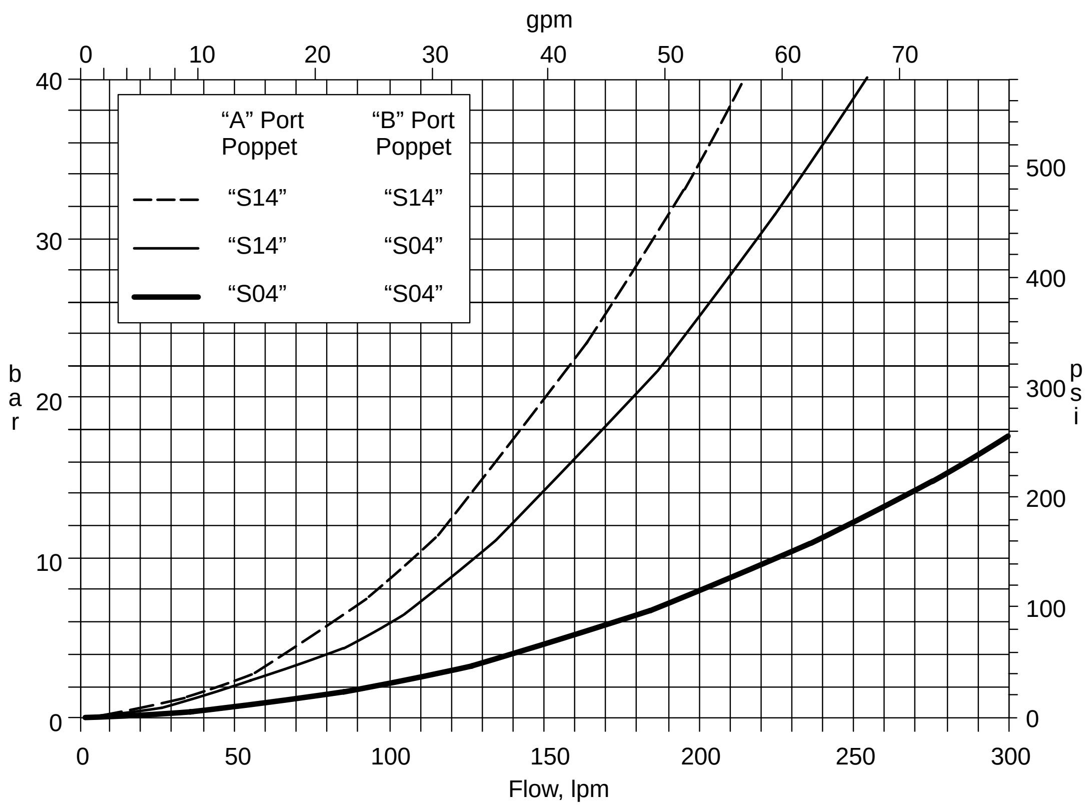


Figure 25

Operating Valve Section

Meter-out spool

A version of the CMX that replaces the meter-out poppets with a spool is available.

(Click here to see model code.) This version does not provide meter-out metering, load holding or relief valve protection. This version can be used with counterbalance valve circuits. Two meter-out spool versions are available; one is open in neutral, the other provides restricted flow to tank in neutral. The restriction is equivalent to a 0.75 mm (.030 in.) orifice.

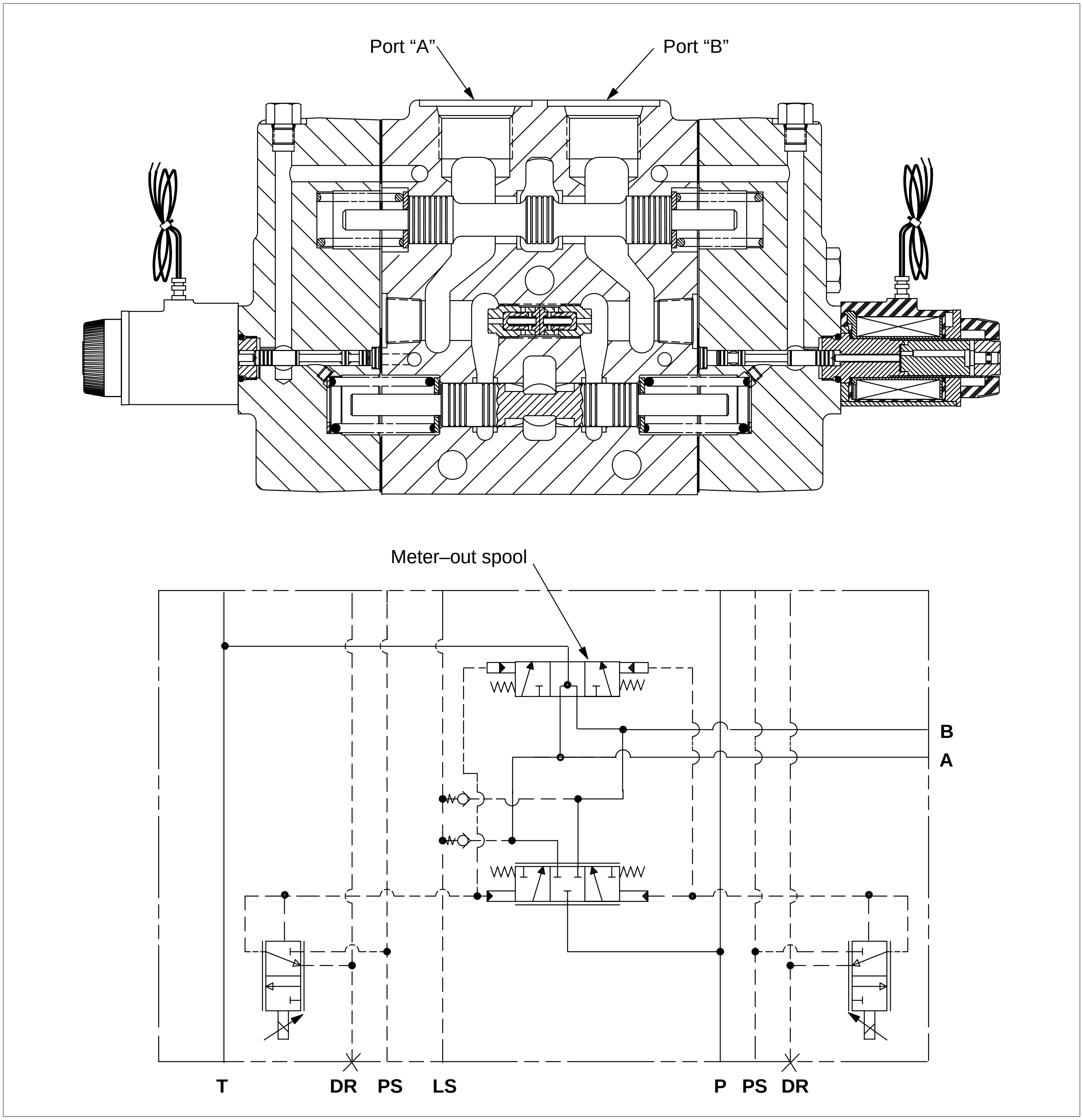


Figure 26

Operating Valve Section

CMX100 Meter-out Spool Performance
Flow vs. Pressure Differential A-T
Flow A → T

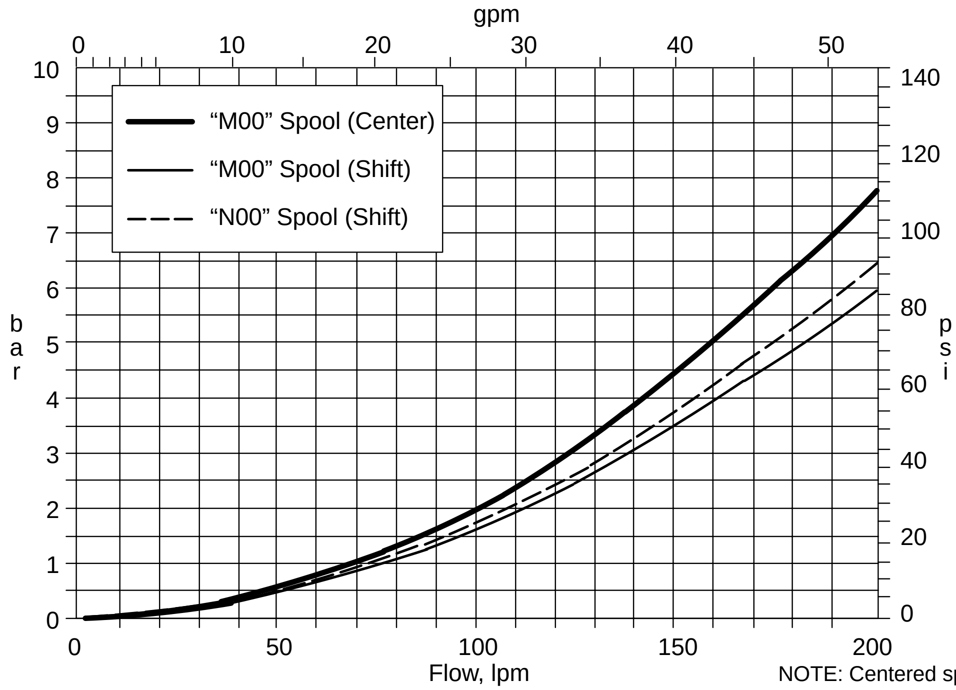


Figure 27a

NOTE: Centered spool malfunctions at flows above 200 lpm.

CMX100 Meter-out Spool Performance
Flow vs. Pressure Differential A-B
Flow A → T → B (T Blocked)

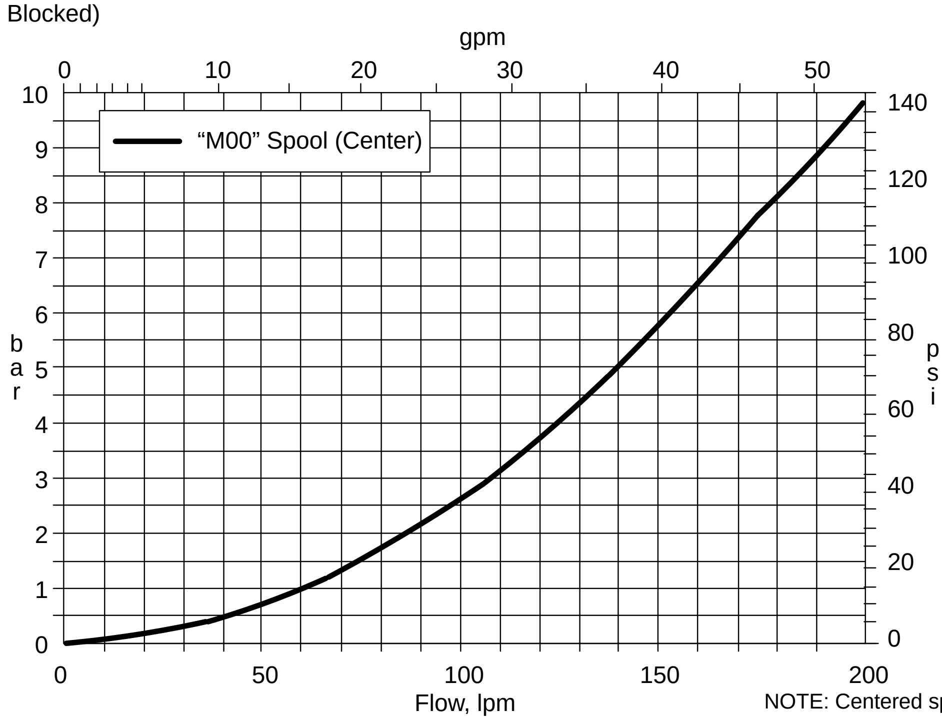


Figure 27b

NOTE: Centered spool malfunctions at flows above 200 lpm.

Operating Valve Section

Actuator port relief valve

The actuator port relief valve uses a pilot stage to provide a pilot signal to the meter-out servo that, in turn, opens the meter-out poppet to relieve fluid to tank.

The relief valve pilot stage consists of a poppet, seat and spring (Figure 28). When actuator port pressure overcomes the relief valve spring force, the relief valve poppet moves off its seat and fluid flows into the passage in the control cap gasket (on hydraulic models, the relief valve poppet seat is incorporated into the load drop check retainer). This is the same passage that communicates the meter-in spring chamber to the meter-out piston. A restriction in the control cap gasket is located in this passage between the relief valve poppet and the meter-in spring chamber (between the relief valve poppet and reducing valve on electrohydraulic models). Flow from the relief valve through the restriction causes pressure to build on the relief valve side of the restriction and is transmitted directly to the meter-out piston, which in turn opens the meter-out servo and meter-out poppet, relieving pressure in the actuator port. The relief valve setting is adjustable by shimming the pilot poppet spring, or by using an optional adjustable relief valve. Relief valve override characteristics are given in Figures 29 and 30 on the following four pages.

Adjustable relief valves are factory preset at 210 bar (3000 psi). The adjustment range is from 100 to 290 bar (1450 to 4200 psi). Adjustment sensitivity is 45 bar (650 psi) per turn of the adjusting screw.

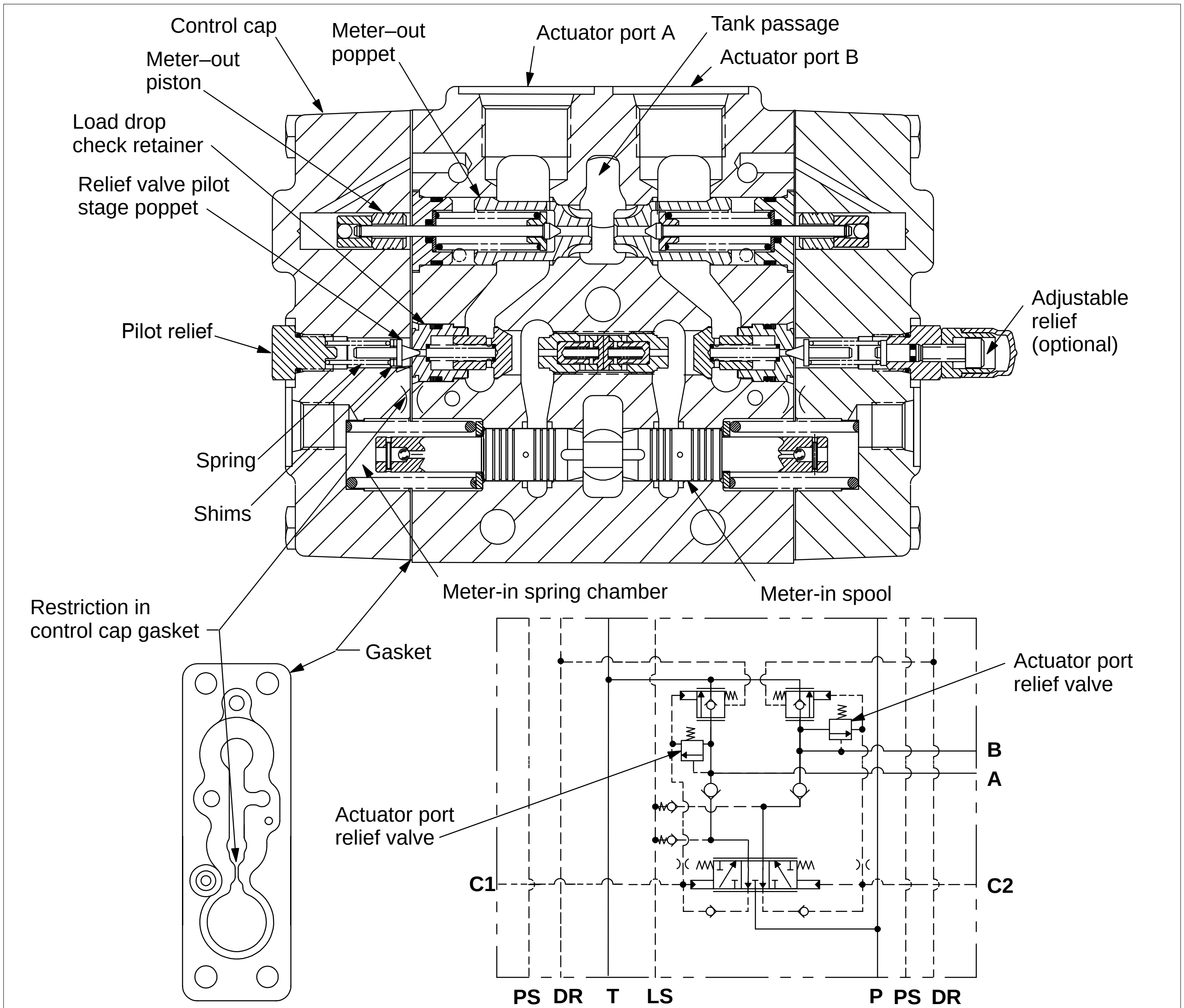


Figure 28

Operating Valve Section

CMX100 Sectional Valve
Relief Valve Override
"S03" Meter-out Poppet

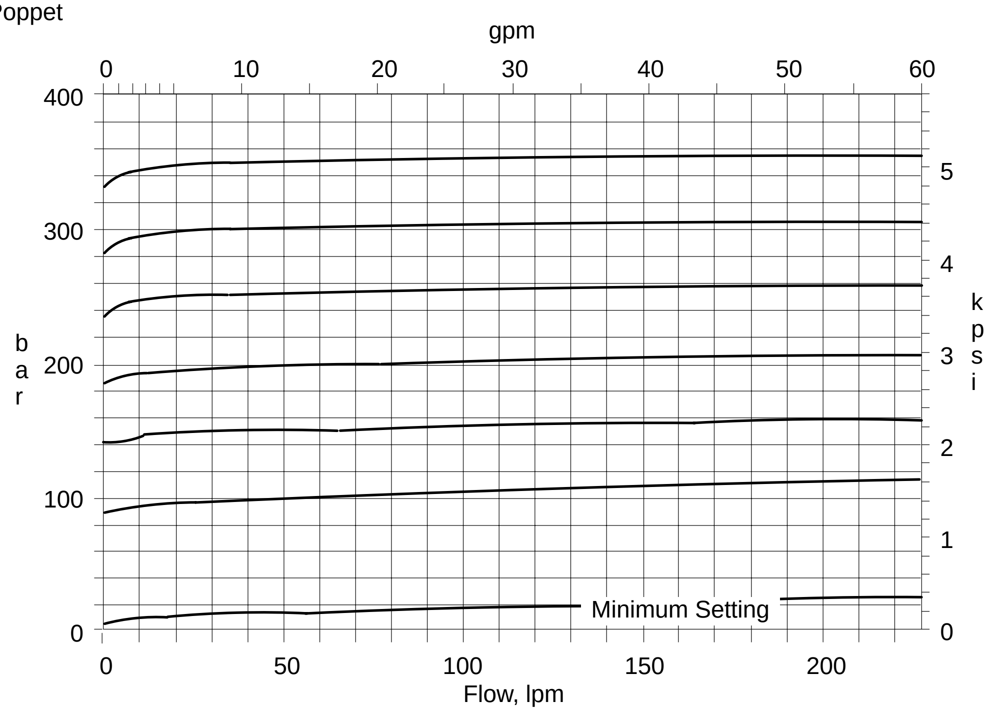


Figure 29a

CMX100 Sectional Valve
Relief Valve Override
"S14" Meter-out Poppet

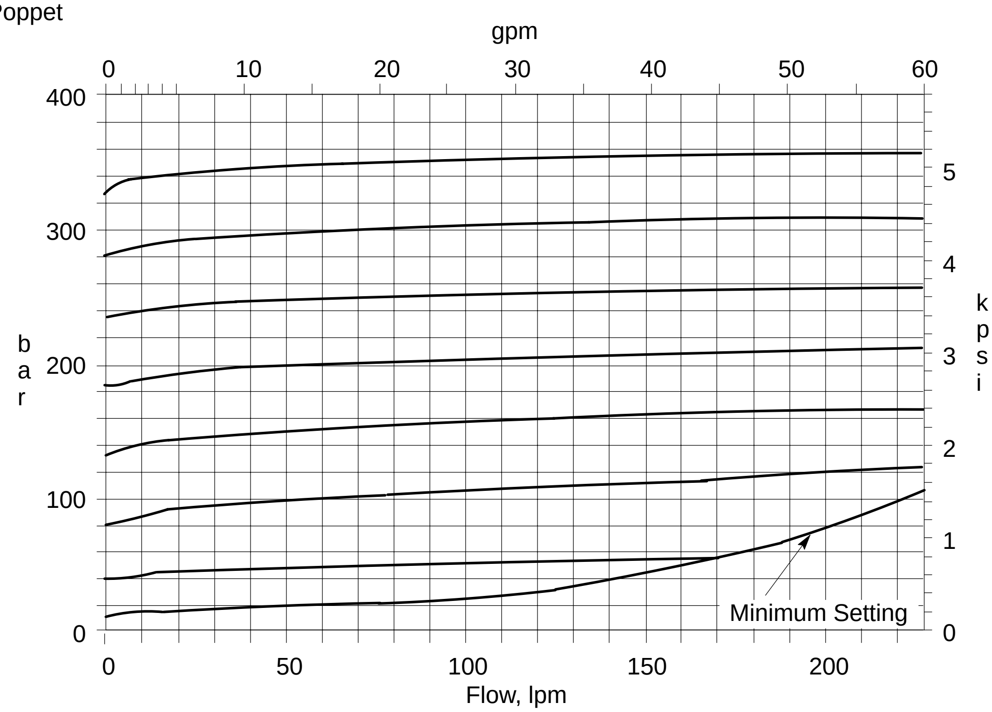


Figure 29b

Operating Valve Section

CMX100 Sectional Valve
Relief Valve Override
"S90" Meter-out Poppet

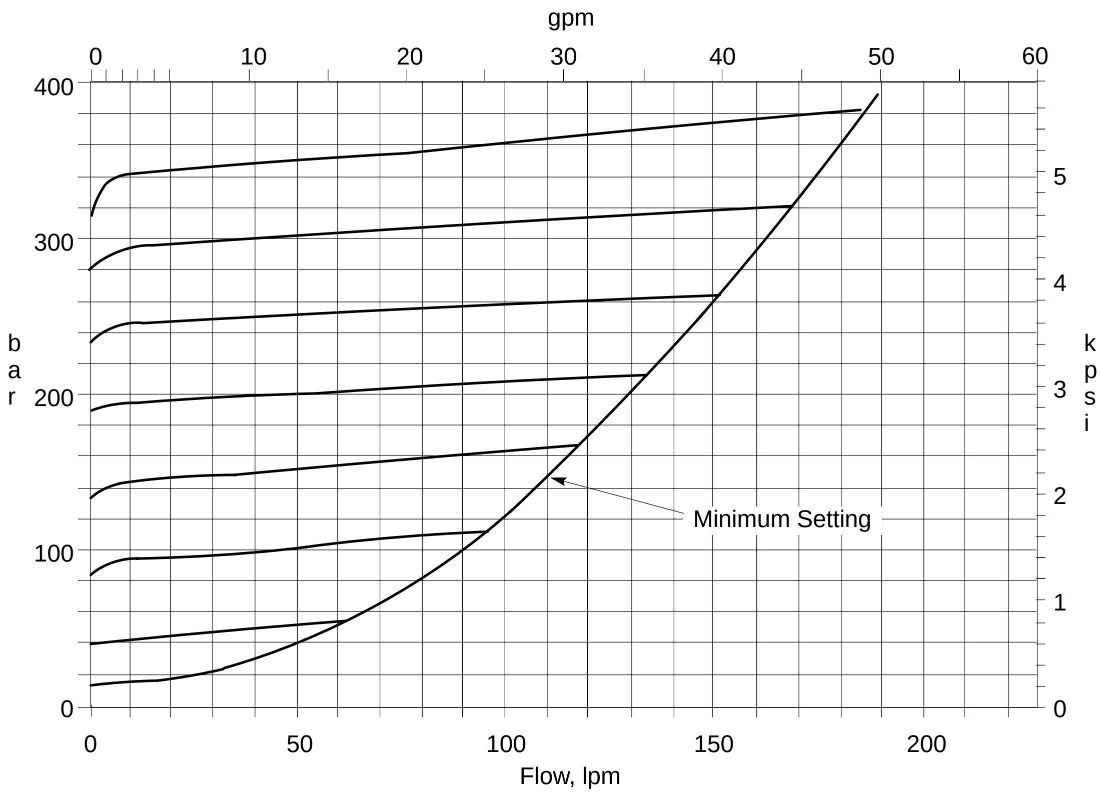


Figure 29c

Operating Valve Section

CMX160 Sectional Valve
Relief Valve Override
"S04" Meter-out Poppet

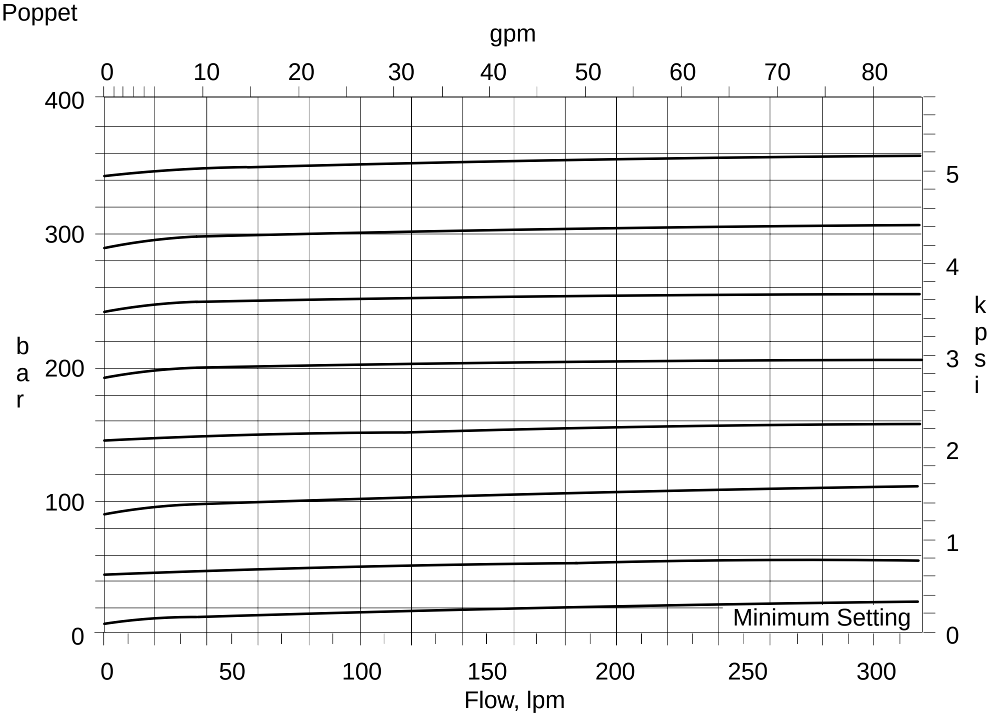


Figure 30a

CMX160 Sectional Valve
Relief Valve Override
"S07" Meter-out Poppet

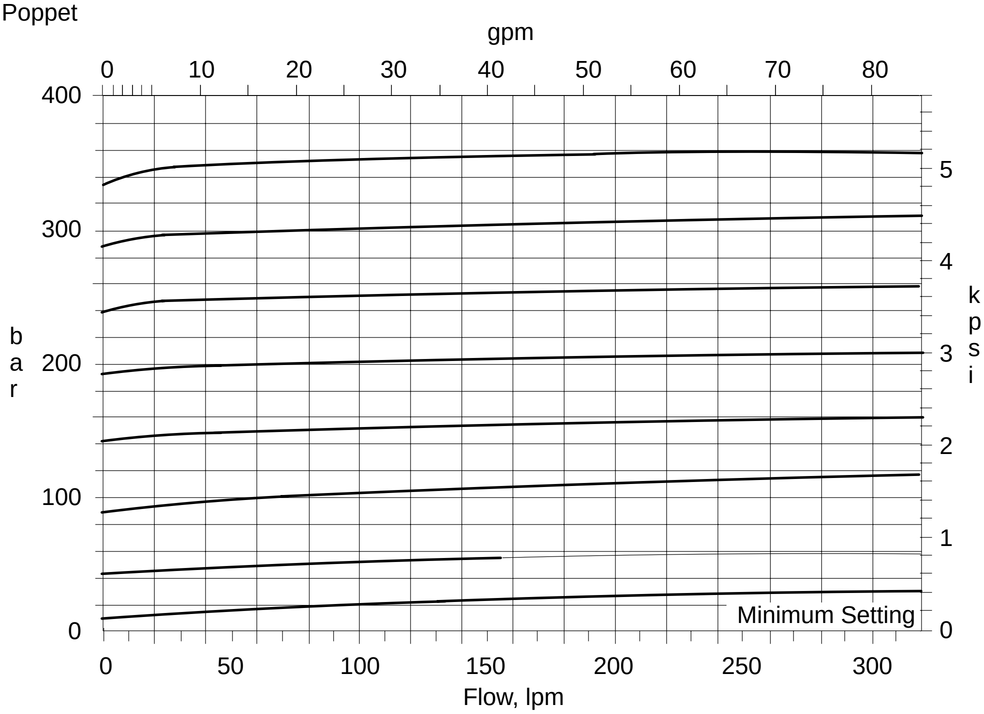
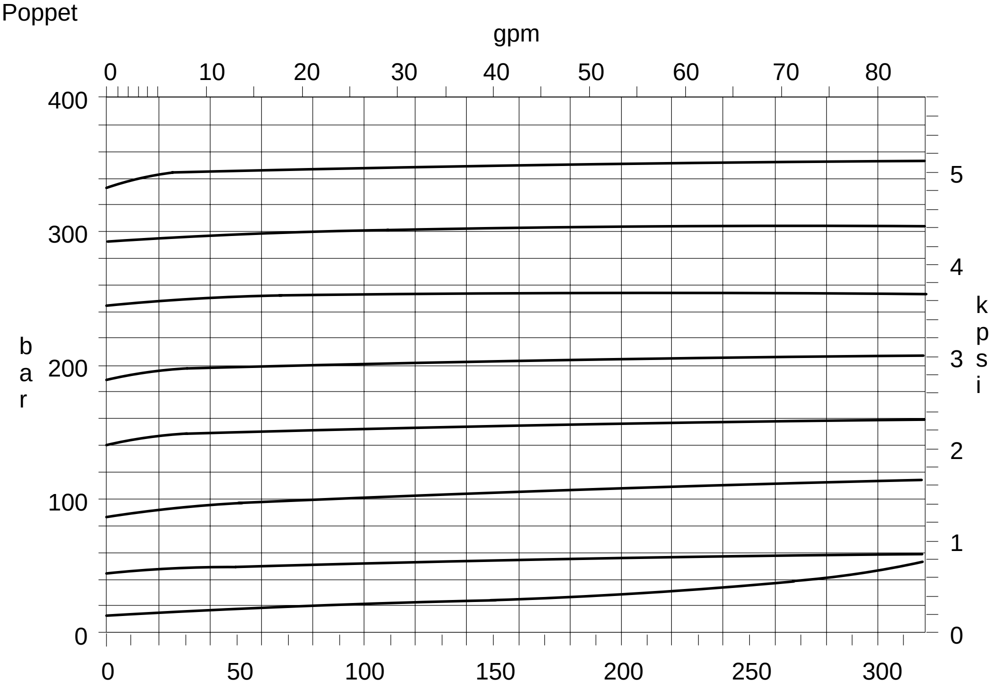


Figure 30b

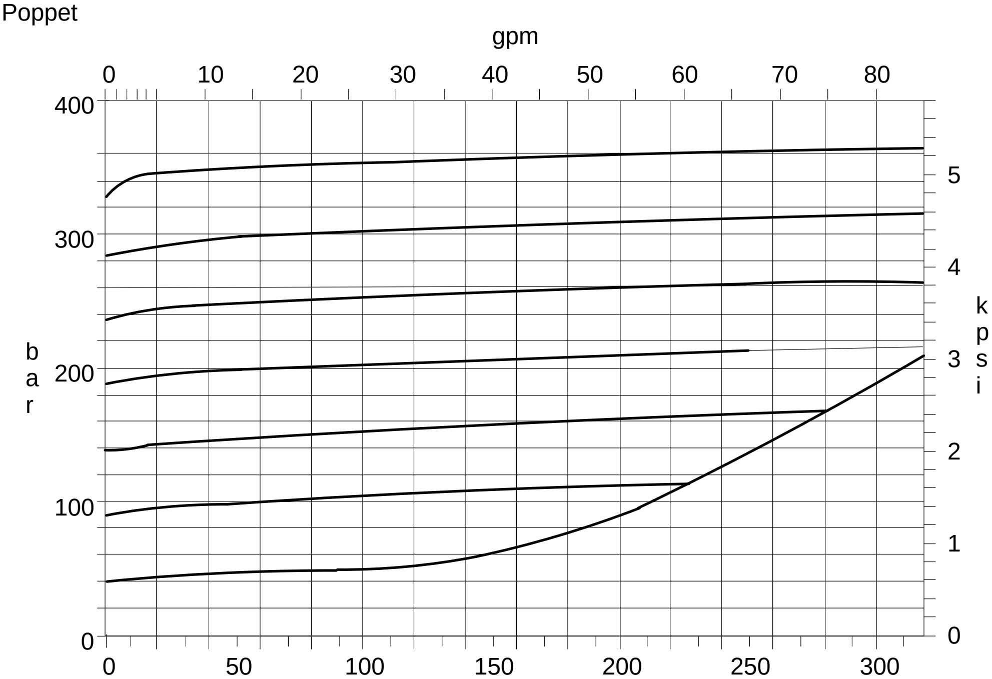
Operating Valve Section

CMX160 Sectional Valve
Relief Valve Override
“S14” Meter-out Poppet



Flow, lpm
Figure 30c

CMX160 Sectional Valve
Relief Valve Override
“S56” Meter-out Poppet



Flow, lpm
Figure 30d

Operating Valve Section

Hydraulic actuation

Pilot pressure is supplied to each section via two #6 SAE O-ring boss ports located on each control cap. Pilot drain connections must be made external to the reservoir. External drain is always the preferred configuration and MUST be used if tank pressure is high due to the installation or a back pressure check valve, or if high pressure transients ("spikes") are likely.

It is important to note that the meter-out servo is referenced to the valve bank drain, while the meter-in spool is referenced to the opposite port command pressure. This requires the HRC drain pressures to be considered, since different drain pressures for the valve bank and the HRC will alter meter-in and meter-out phasing. Ideally, both the HRC and the CMX valve bank should be drained directly to the reservoir via generously sized lines.

Hydraulic actuation data is given below.

Pilot Pres-sure	M/O bar (psi)	M/I "06" Spring bar (psi)	M/I "12" Spring bar (psi)
Crack	4.2 (61)	6.2 (90)	11.4 (165)
Rated flow	13.8 (200)	15.5 (225)	20.7 (300)

Tolerance: ±1 bar

Pilot Requirements:

Pressure:	34 bar (500 psi) max.
Flow:	12 lpm (3 USgpm) recom.
Filtration:	25 microns or finer

Required shift volume (displacement):

Metering	CMX100	CMX160
M/I (neutral to full stroke)	1.63 cc	2.56 cc
M/O	1.01 cc	2.56 cc

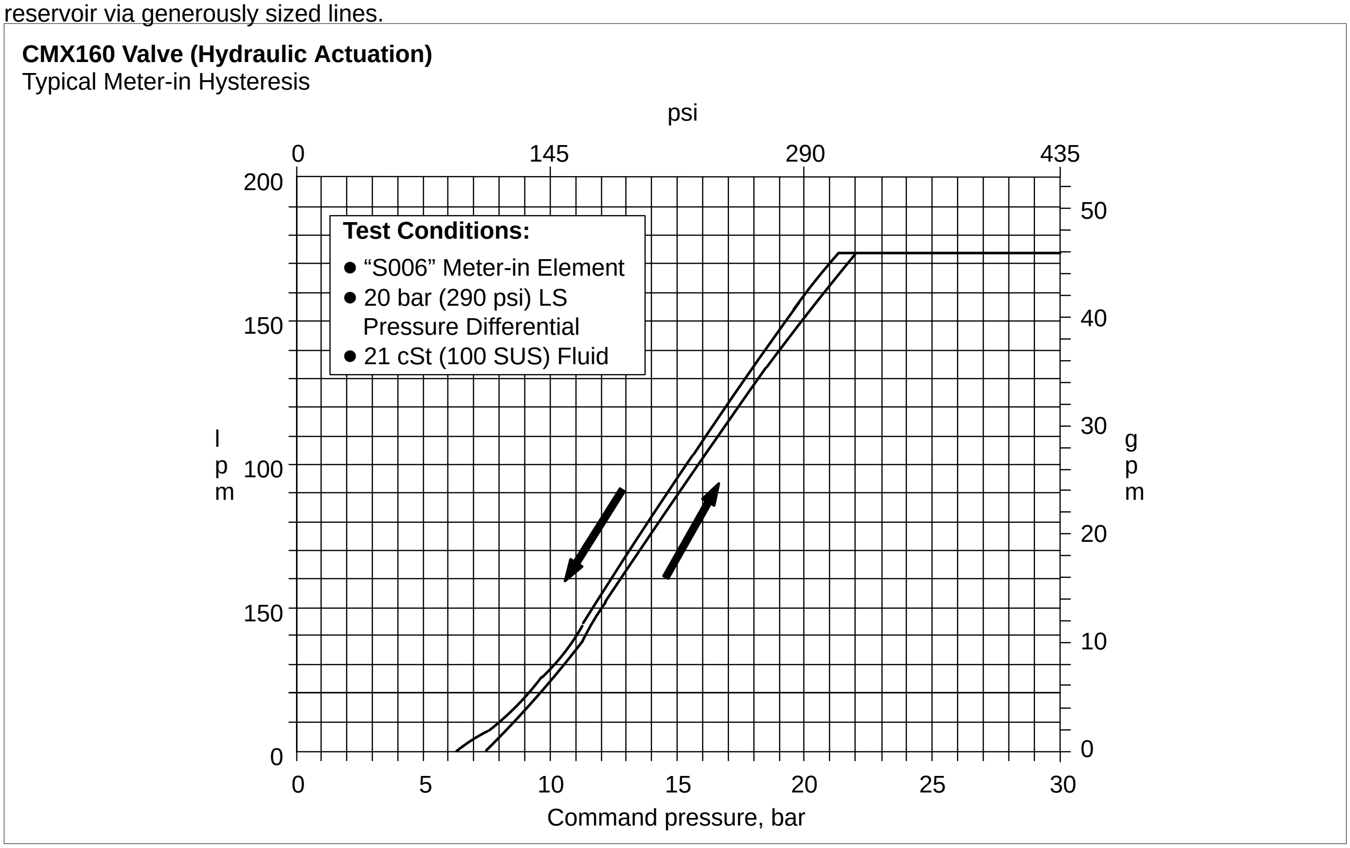


Figure 31a

CMX160 Valve (Hydraulic Actuation)
Typical Meter-out Hysteresis
Command Pressure vs. M-O Flow

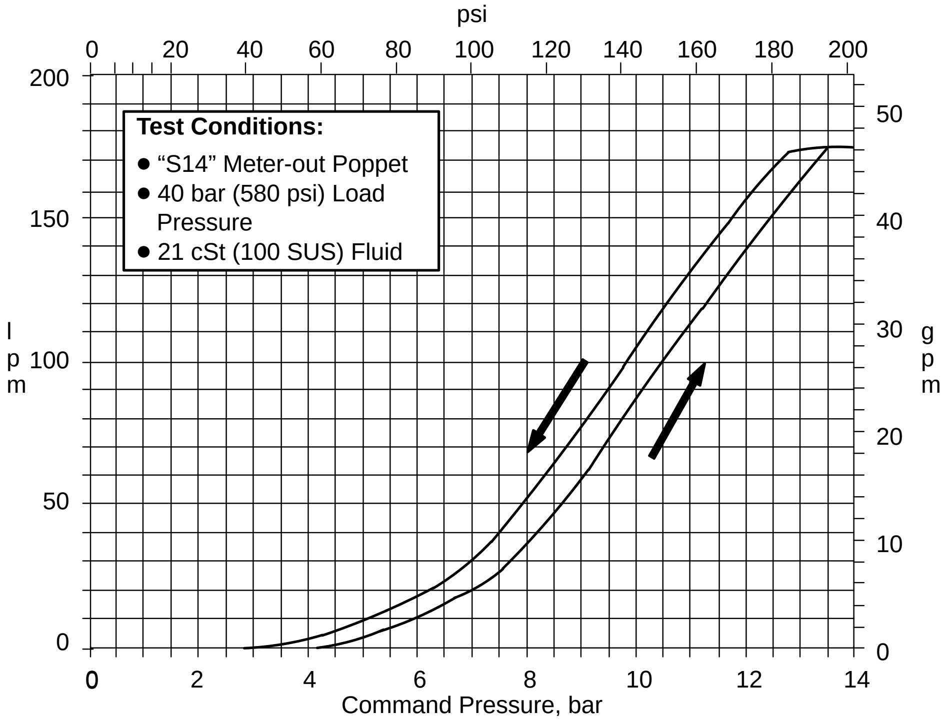


Figure 31b

Electrohydraulic actuation

Electrohydraulic CMX sectional valves operate on the same principles as the hydraulic valves, with the addition of an electrohydraulic proportional reducing valve (Figure 32) to convert an electrical input signal to a proportional command pressure signal that operates the valve. The solenoid provides an output force proportional to the input current that acts on the solenoid end of the pilot spool.

When the solenoid is energized, the pilot spool is moved away from the solenoid, closing the command port to tank and opening the pilot supply to the command port. Command port pressure is supplied to the feedback end of the pilot spool through the passage in the end cap gasket. When the feedback pressure begins to balance the solenoid force, the pilot spool closes the pilot supply passage.

As the command pressure rises (due to leakage), the feedback pressure overcomes the solenoid, and the pilot spool moves to open the control port to tank. The pilot spool modulates to balance the feedback pressure against the solenoid output force, thus providing an output pressure proportional to the solenoid input current. The pilot spool and bore are designed for zero overlap, so deadband is minimized.

The pressure output serves as the command pressure to actuate the CMX meter-in and meter-out elements. The signal to the solenoid should be conditioned to a pulse width modulated voltage or current signal. DC power, up to the coil rating, may also be used for "on-off" operation.

Supply Voltages:	12/24 VDC
Maximum Current:	1.4/.7 AMP
Recommended PWM Freq. :	100 Hz

Solenoids are available with DIN standard 43650 plugs, Metri-Pack® connector, or flying leads.

Valves are available with either internal or external pilot supply. On models with the internal pilot option, pilot pressure is supplied to the proportional reducing valve by an internal passage that is connected to the system supply passage in the inlet body. These models require that the minimum system pressure be maintained to the specified limits to assure proper valve actuation.

Electrohydraulic CMX valves may be operated manually in the event of electrical control failure by depressing the manual override pin, located on the end of each solenoid, with a screwdriver or similar tool.

Operating Valve Section

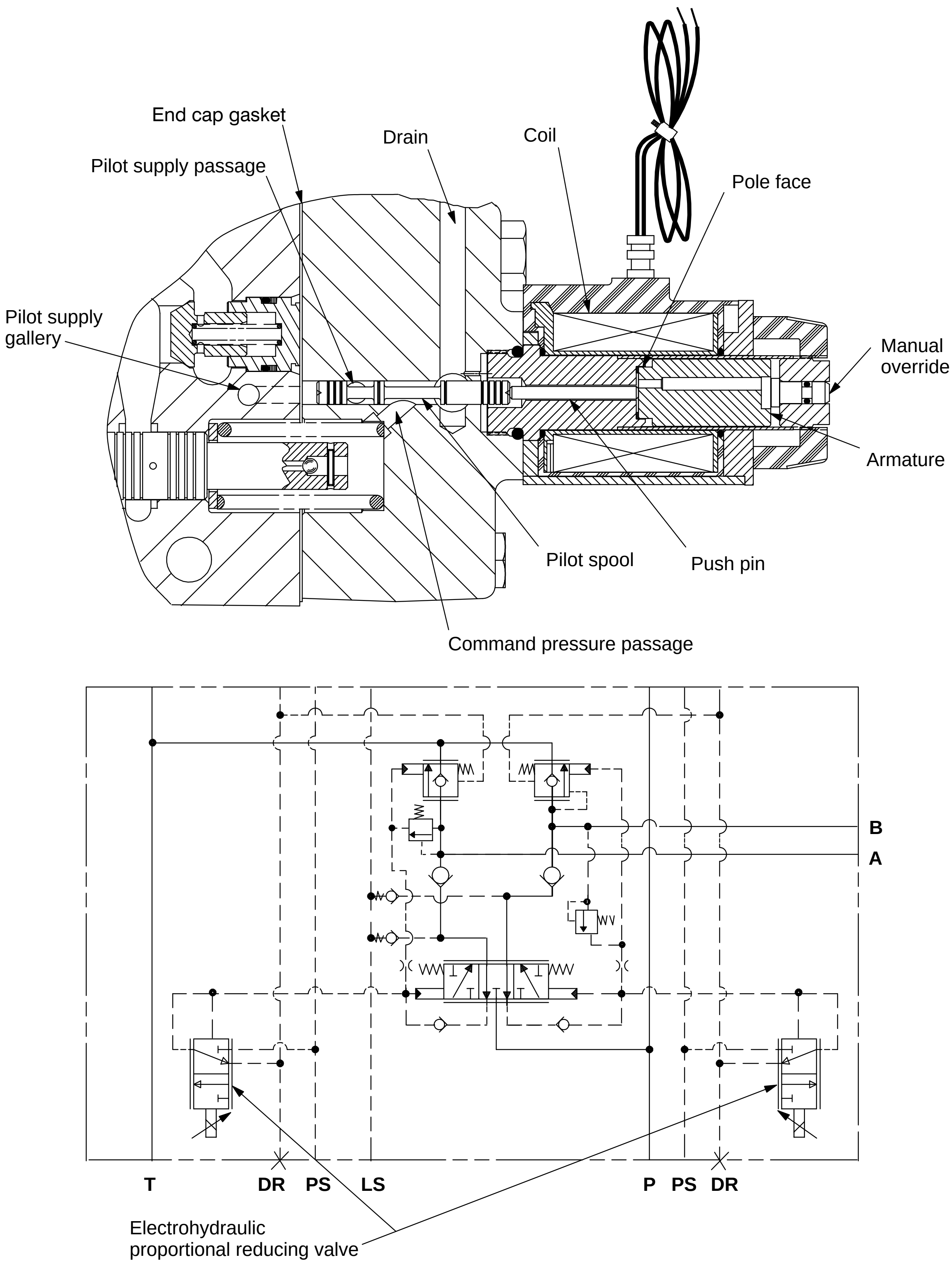


Figure 32

Operating Valve Section

Electrohydraulic actuation

Internal pilot supply

Minimum *system* pressure:

Valves with Type “06” meter-in spring – 19 bar (275 psi)

Valves with Type “12” meter-in spring – 24 bar (350 psi)

External pilot supply

Minimum pressure:

Valves with Type “06” meter-in spring – 19 bar (275 psi)

Valves with Type “12” meter-in spring – 24 bar (350 psi)

Since both electrohydraulic reducing valves are referenced to a common drain via the end cover, drain pressure is not critical. Either an internal drain to tank or an external drain (preferred) is available.

(Click here to see model code.).

If high pressure transients are present in the tank line, an external drain should be used to avoid function interaction. If the tank pressure is above 8.6 bar (125 psi), an external drain should be used to avoid exceeding the pressure rating for the pilot passages (35 bar [500 psi]).

Under certain operating conditions (high inlet pressure, fully shifted, and open relief valve), pilot drain flow can be as high as 4 lpm (1 USgpm) for each active section. Total anticipated drain flow must be considered when sizing drain lines.

Electrohydraulic Reducing Valve for CMX Control Pressure
Output Pressure vs. Command Current

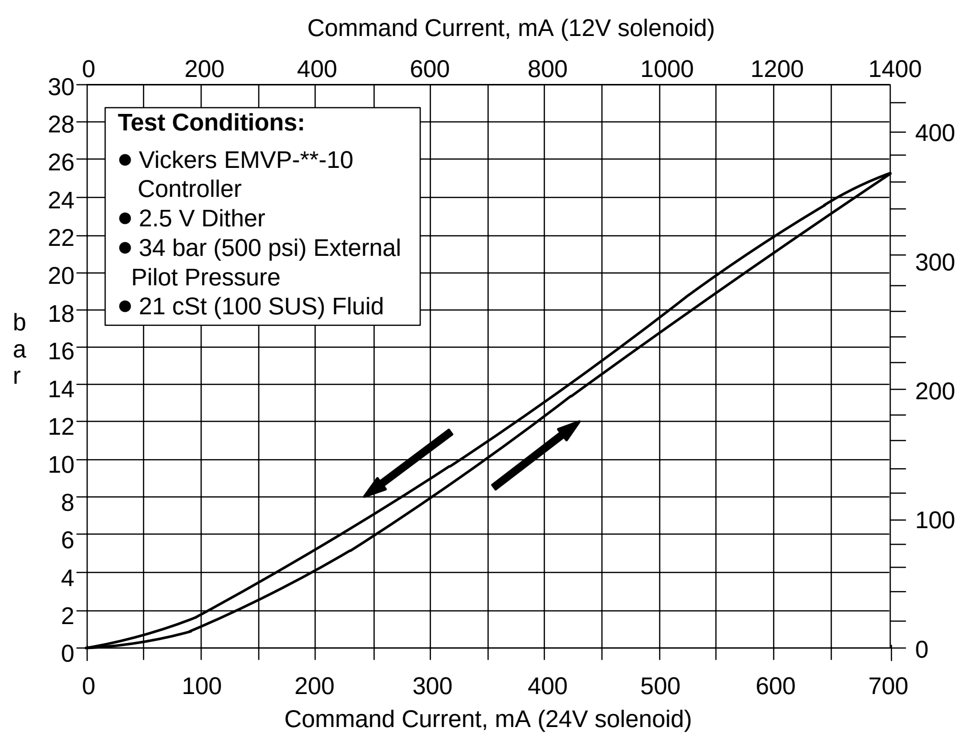


Figure 33

CMX100 Relief Valve Response
Actuator Port Pressure vs. Time

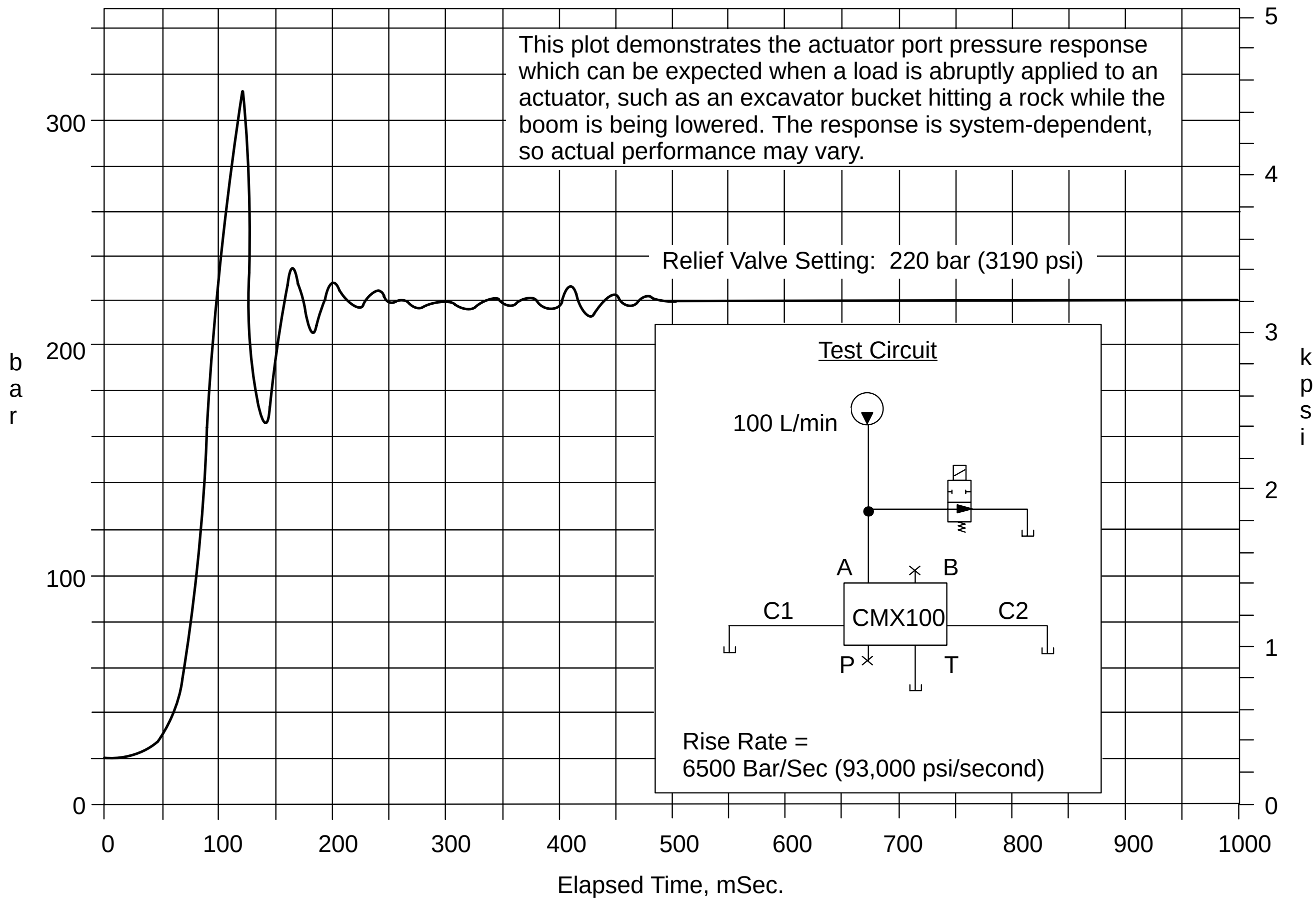


Figure 34a

CMX100 Relief Valve Response
Actuator Port Pressure vs. Time

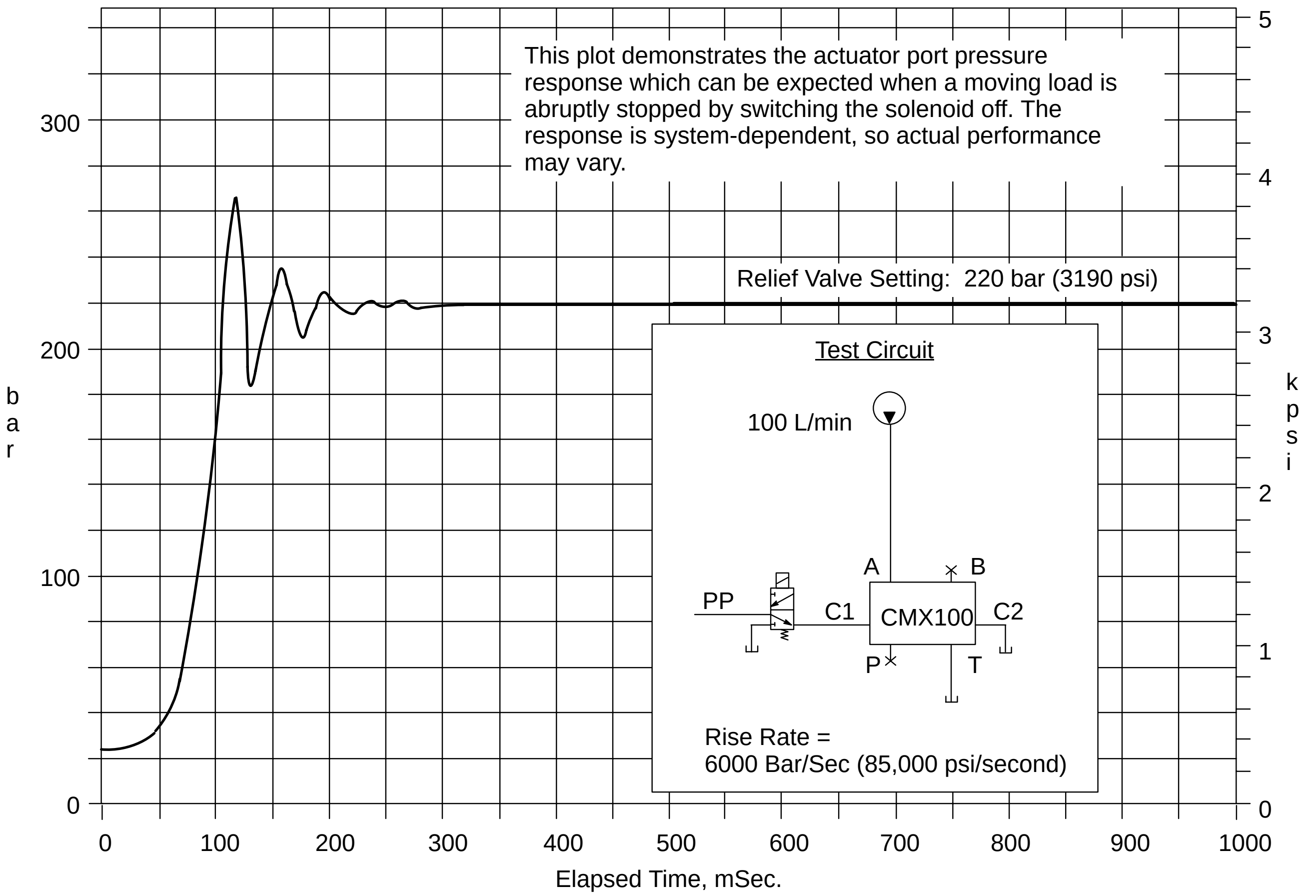


Figure 34b

Operating Valve Section

CMX100 Relief Valve Response
Actuator Port Pressure vs. Time

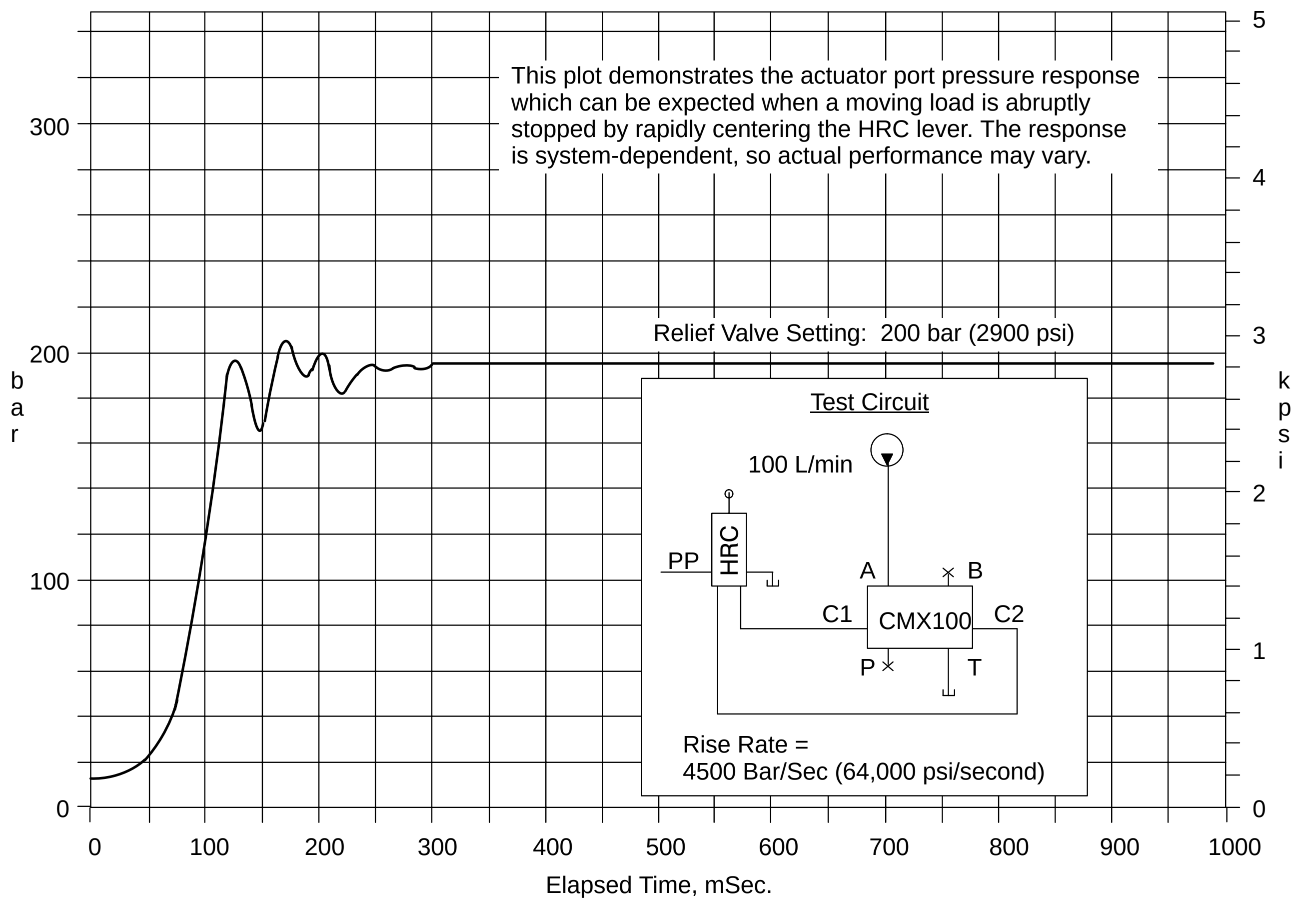


Figure 34c

Special Features

Meter-in pressure limitation

In this version (Figure 35), the orifice restriction in the control cap gasket is relocated to the inlet to the meter-in spring chamber.

This feature limits meter-in flow at a preset actuator port pressure.

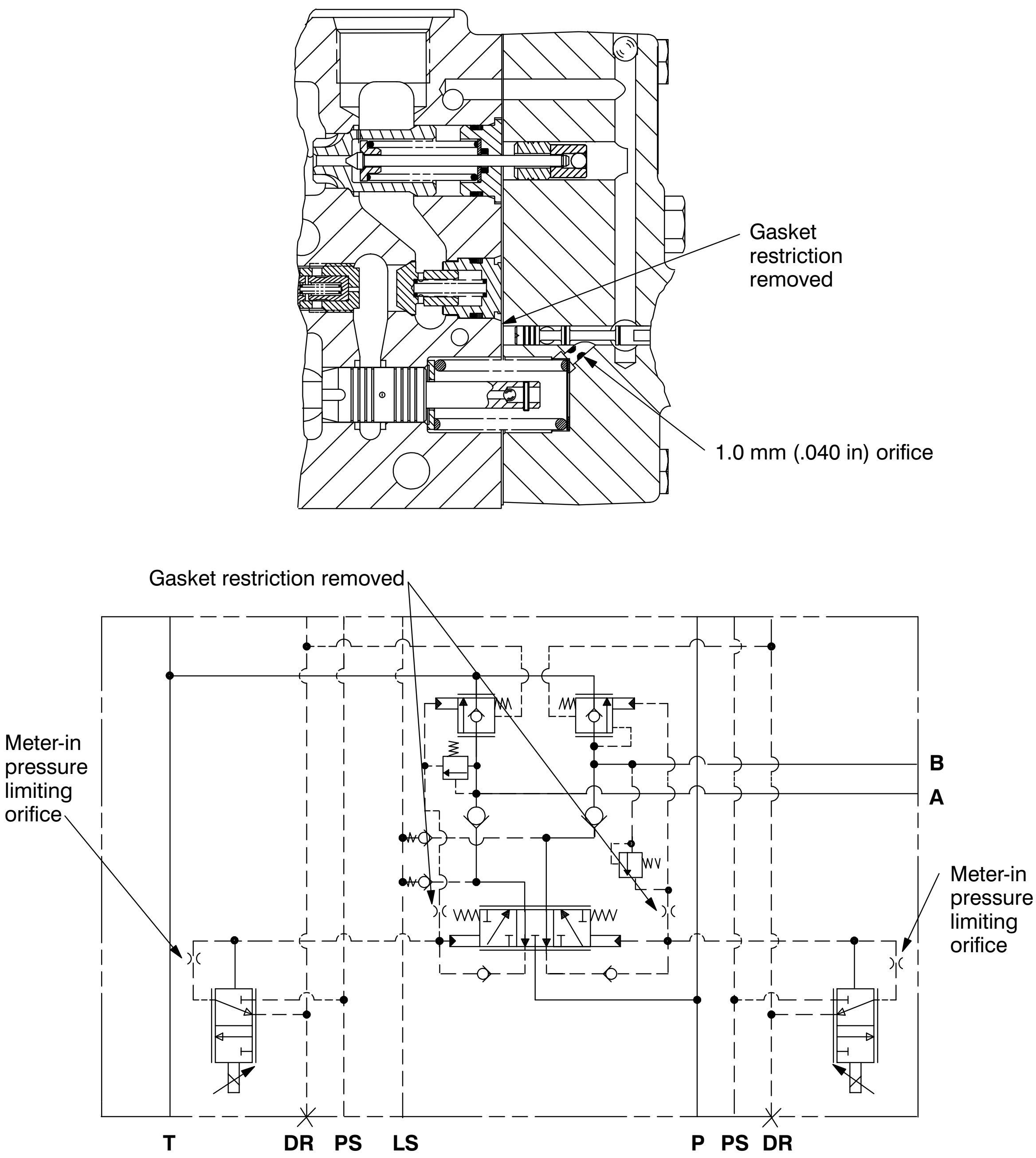


Figure 35

Special Features

Meter-in pressure limitation

Meter-out poppet version (with port relief valves)

In valves with meter-out poppets, the port relief functions in the normal manner. But because the orifice has been relocated, the relief valve pilot stage also applies pilot pressure to the meter-in spool, which tends to oppose the command pressure. For example, assume we are driving a clamp cylinder "P" to "A". When the cylinder fully clamps, the "A" port relief setting is reached, and the pilot stage opens and builds pilot pressure to open the meter-out element. This pilot pressure also acts on the meter-in spool opposing the command pressure and tending to close the meter-in spool, which reduces the meter-in flow.

Since a pilot pressure of 4.2 bar (62 psi) is required to open the meter-out poppet, a significant reduction in flow, equivalent to 4.2 bar (62 psi) command pressure, through the meter-in spool will occur before the meter-out poppet opens. From the meter-in command vs. flow diagrams on page 9, the reduction in flow is about 50 lpm (13 USgpm) for the CMX100, and about 70 lpm (18 USgpm) for the CMX160.

The total amount of closing depends on the command signal and is limited by the relief valve override. When the meter-out element is opened enough to pass the full meter-in flow, further increase in relief valve pilot signal will not occur and, in turn, further shutoff of the meter-in is not possible. In Figure 36 the diagram shows the resulting inlet flow as the load pressure changes while the command current is fixed.

The meter-in pressure limitation feature limits horsepower losses through the open relief valves of a function with relief settings below the system pressure setting. It is particularly effective for swing functions where the relief valves are set to limit maximum torque. On these applications, with a moving load, meter-in pressure limitation can prevent any losses over an open port relief valve. The meter-in pressure limitation feature should be used with caution on functions where an overrunning gravity load is possible. With certain combinations of meter-out poppets and cylinder area ratios, uncommanded movement may occur. The use of the meter-in pressure limitation feature must be approved by Vickers Systems Engineering Department

CMX100 Meter-in Pressure Limitation
Actuator Port Pressure vs. Inlet Flow
"S14" M-O Poppet, Blocked Actuator Ports

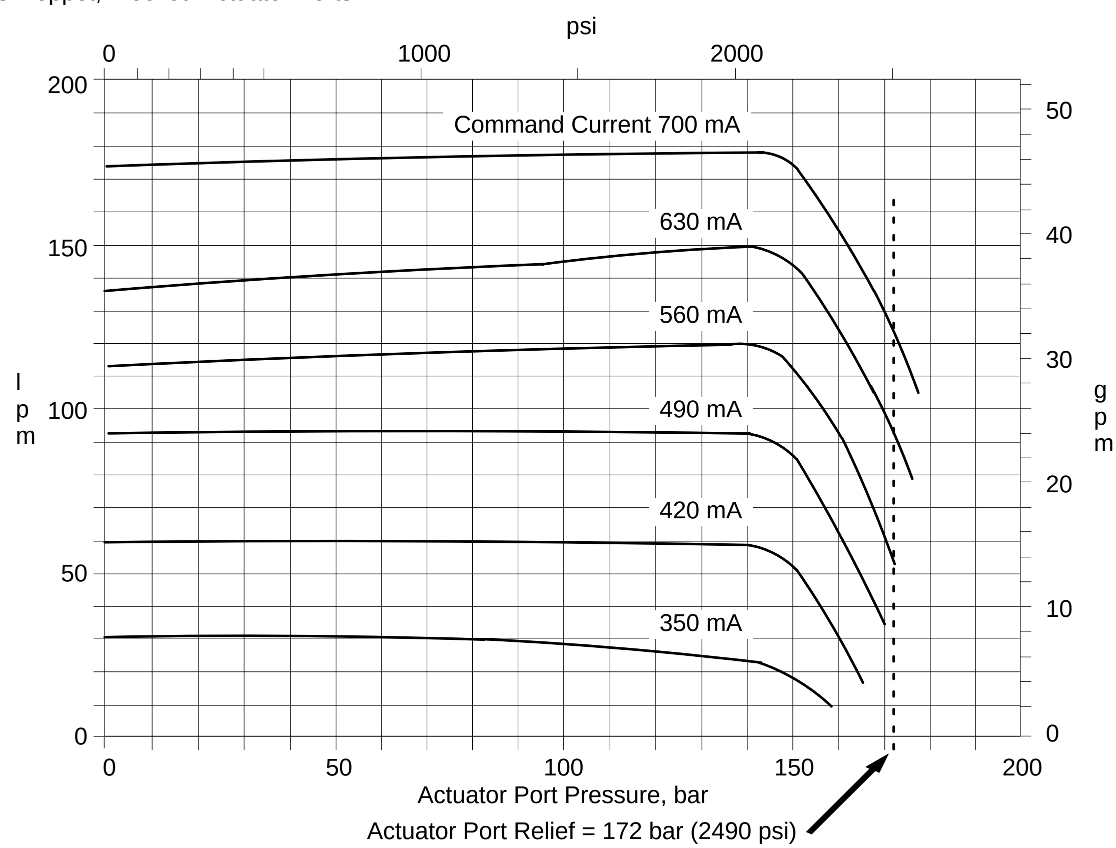


Figure 36

Special Features

Meter-in pressure limitation

Meter-out spool version (no actuator port relief)

In valves with the meter-out spool option (Figure 37), a relief valve pilot stage is added (no relief pilot stage is present in the standard configuration), and the orifice is located in the inlet to the meter-in spring chamber. When the pilot stage opens, the resulting pilot signal is applied to both the meter-in and the meter-out spools, opposing the command pilot pressure and tending to close both spools. Due to the phasing of the meter-in and meter-out spools (the meter-in requires a higher pilot pressure to crack), the meter-in spool will completely shutoff flow before the meter-out spool will port fluid to tank. Thus, virtually no horsepower is lost when the function is stalled. This feature controls the maximum pressure to a function at a setting below the system pressure setting. For a profile of actuator port pressure versus command pressure, see Figure 38.

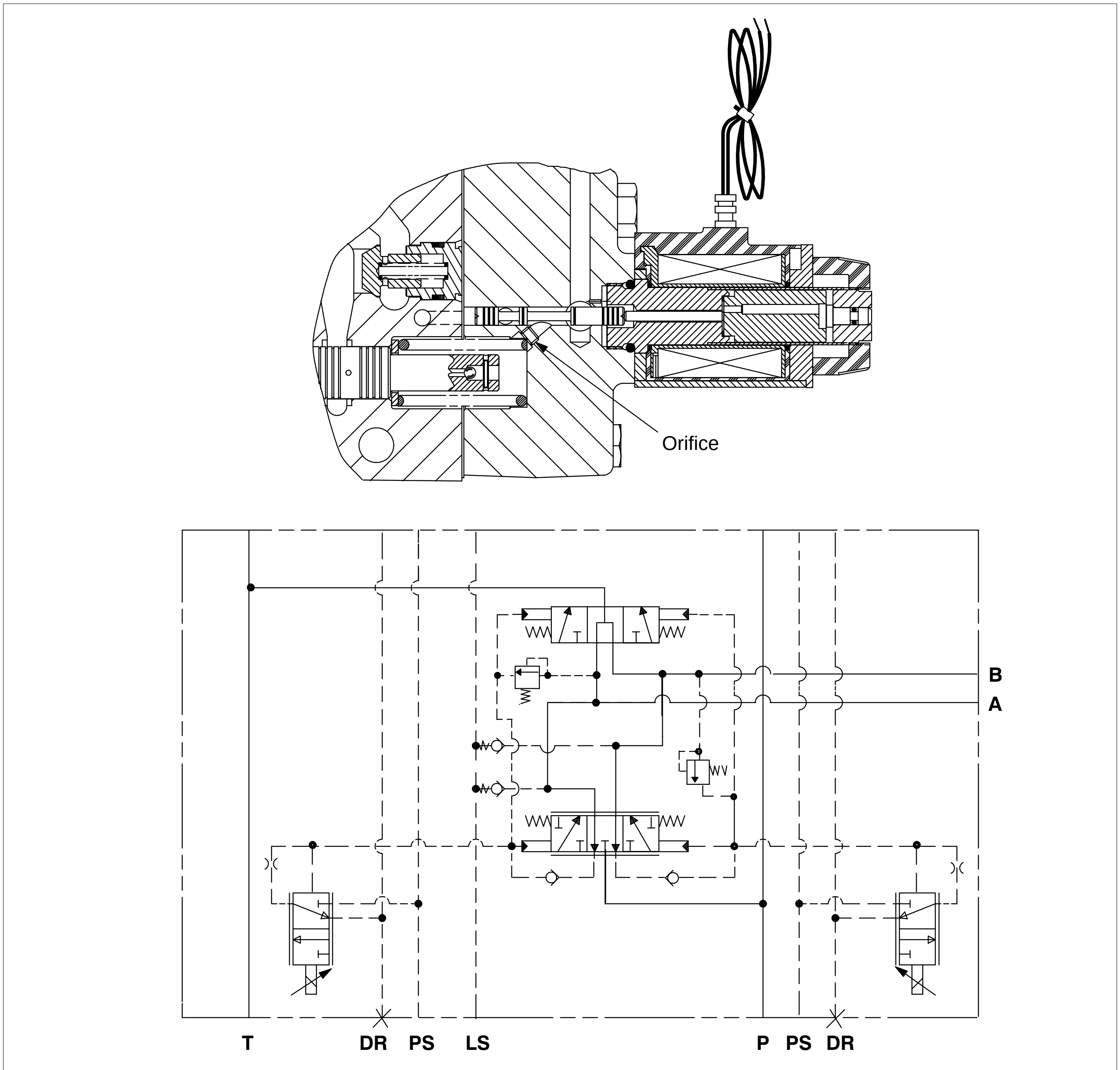


Figure 37

Special Features

CMX100 Meter-in Pressure Limitation
Model "SP006-M0009" (M-O Spool Version)
Actuator Port Pressure vs. Command Pressure

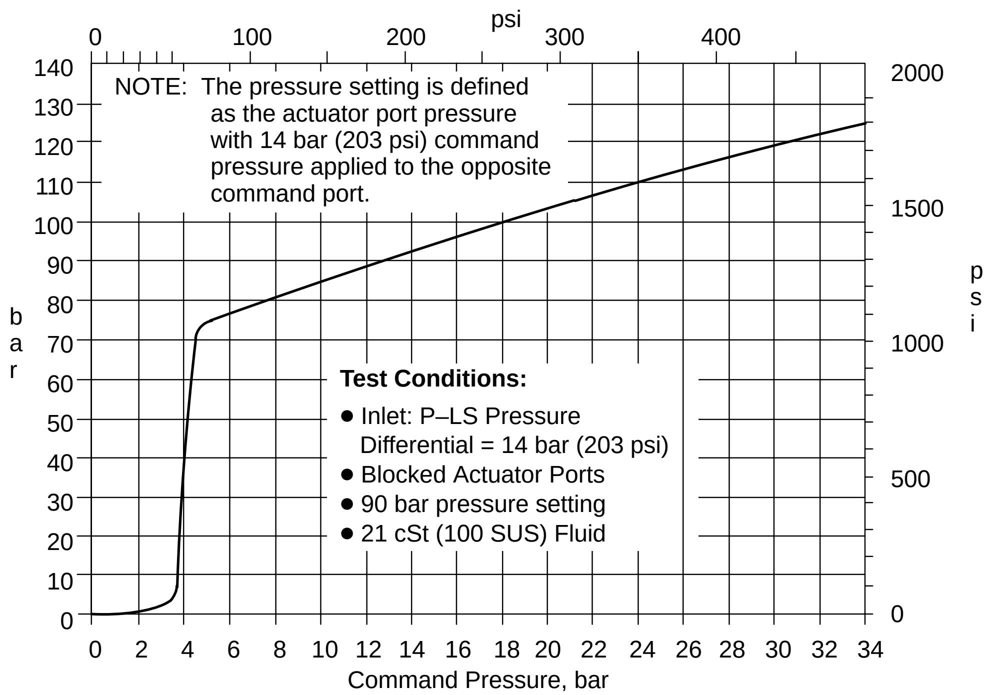


Figure 38

Swing drive with free coast

This function utilizes a meter-out spool and a pressure controlling meter-in element. Combining these features provides acceleration control with minimal braking. Typical applications include swing drives and propel functions where braking control is not required or is accomplished by a mechanical brake.

High flow single acting CMX

This option extends the flow range for the CMX valve on applications requiring only a three-way valve (Figure 39, following page). The meter-in spool is spring biased to one end of its bore, and as it is piloted open, it ports fluid first to the "A" port then to both cylinder ports simultaneously. The meter-out poppets remain closed when lifting. For lowering, the meter-in spool remains closed.

For superior metering while lowering, different gain meter-out poppets can be selected.

Both actuator ports must be connected together externally by the user or by an optional bolt-on block. The optional bolt-on block is available only on the flange port sections. An option is available which uses only one meter-out poppet when a large meter-out flow area is not required.

The dual poppet meter-out version is not available for the electrohydraulic narrow body "S2" sections.

Click here to see meter-in vs. command pressure curve.

Click here to see meter-in pressure compensation curve.

Special Features

High Flow, Single Acting CMX

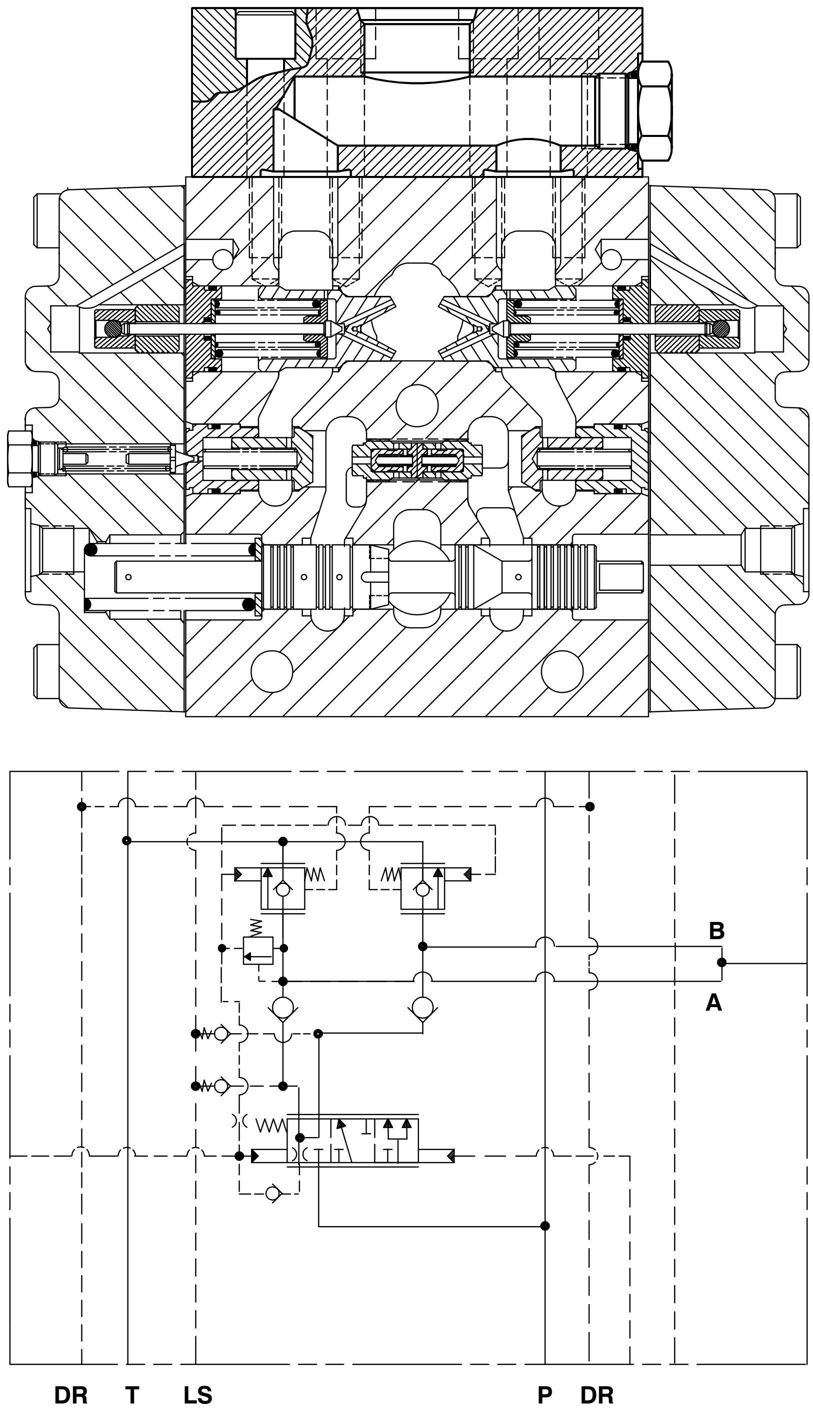


Figure 39

CMX Single Acting Meter-in Flow vs. Command
at 20 bar P-LS Pressure Differential

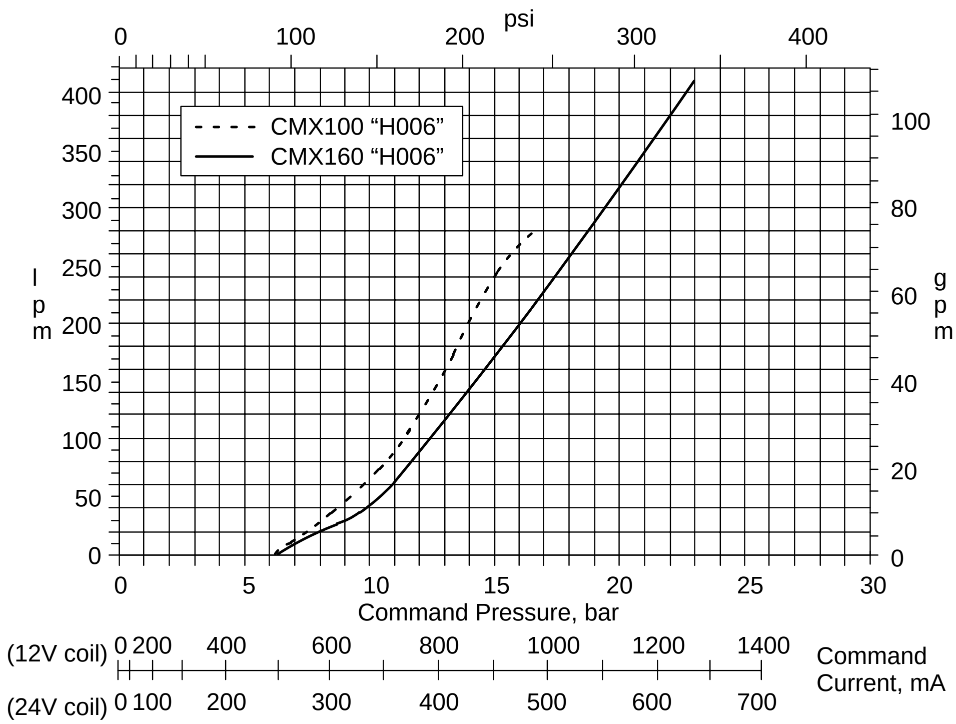


Figure 40a

Special Features

CMX100 Single Acting Meter-in Element
Pressure Compensation
Model "H006" Meter-in Element

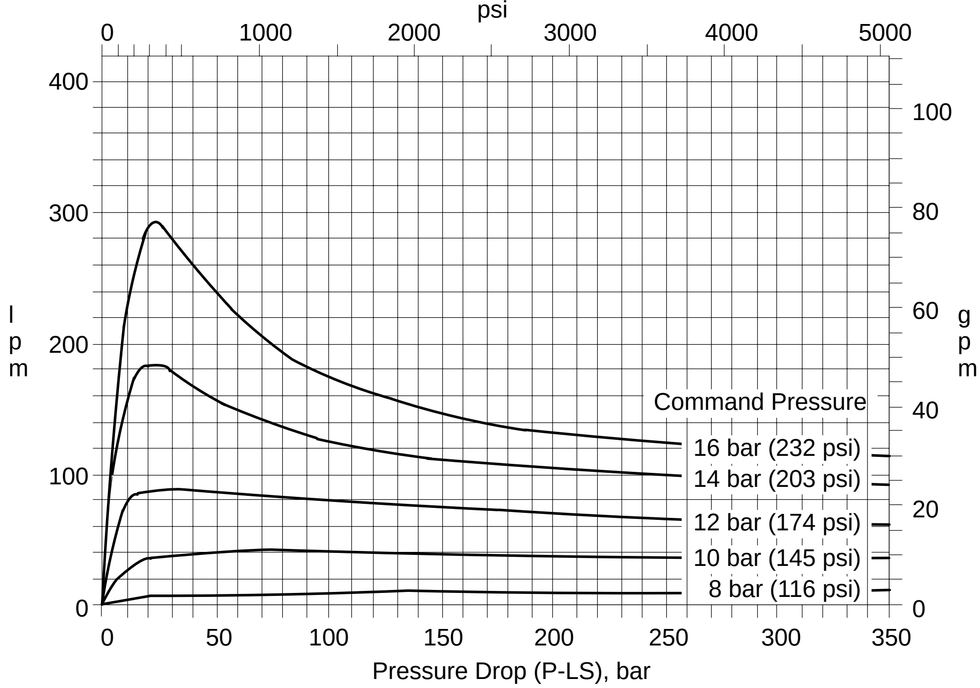


Figure 40b

CMX160 Single Acting Meter-in Element
Pressure Compensation
Model "H006" Meter-in Element

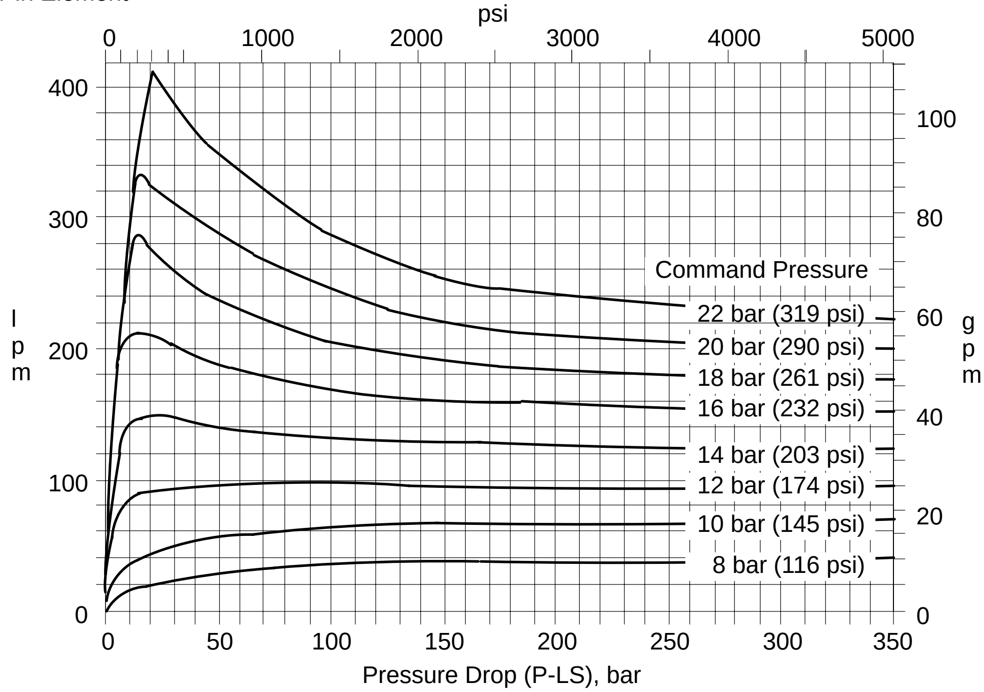


Figure 40c

Special Features

Swing drive with pressure controlled braking

This feature provides meter-in pressure control, proportional pressure controlled braking through the command pressure system, and blocked actuator ports in neutral. To achieve proportional braking, the meter-out element is operated only by a special relief valve pilot circuit (Figure 41). (High gain meter out is recommended because of relief valve override characteristics.)

The relief valve setting is controlled by the command pressure, which is accomplished by a piston that is acted upon by command pressure to oppose the spring load on the relief valve pilot poppet. As the command pressure increases, the actuator port pressure required to open the relief valve poppet decreases, effectively decreasing the relief valve setting. Thus when driving a load, the relief valve setting is at a minimum, typically about 8 bar (116 psi). To brake the load, the pilot pressure is decreased, which increases the relief valve setting. The pilot pressure is decreased until the desired braking pressure is achieved.

Note: The adjustable relief valve option is not available with swing drive valve sections.

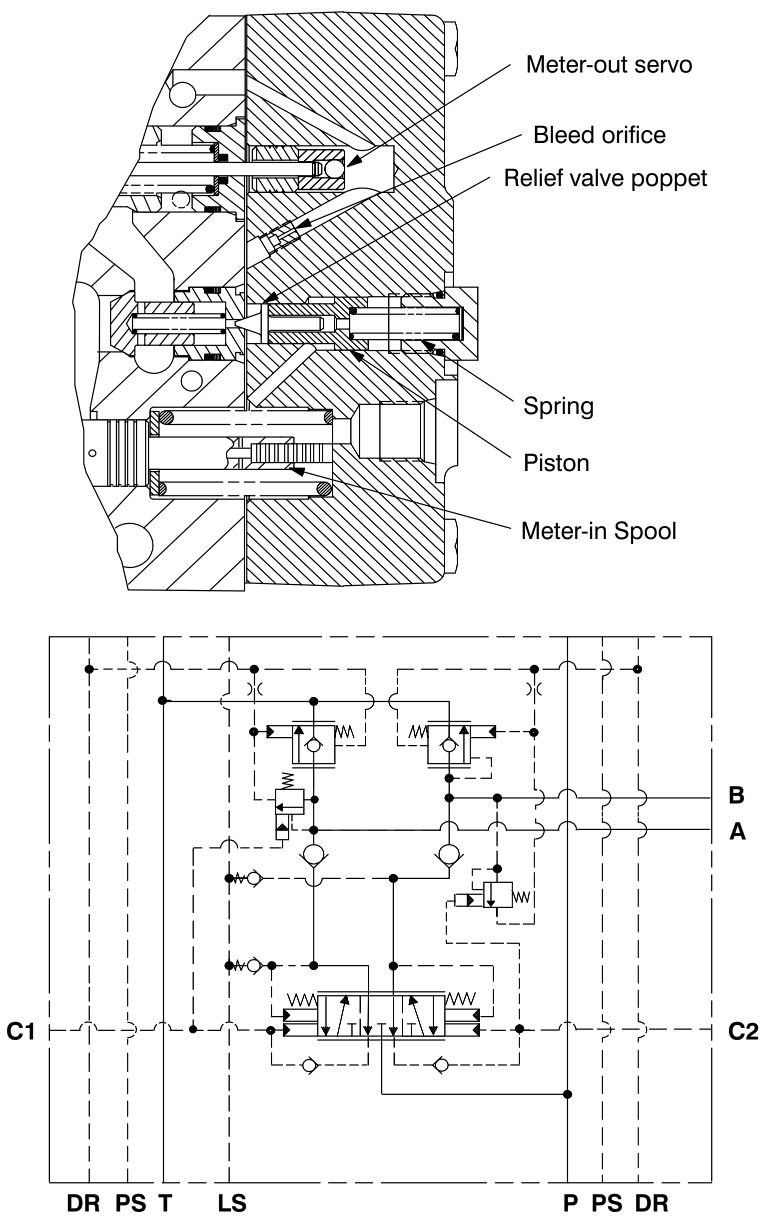


Figure 41

Special Features

Performance characteristics of the meter–out pressure control valve can be plotted using Q-P diagrams. Figure 42a is the Q–P diagram for the CMX100 “S406” meter–in spool. Figure 42b is the Q-P (relief valve override) diagram of the “P03” relief valve for various command pressures and a relief valve setting of 208 bar. Combining these diagrams yields Figure 42c (See Figure 42e for CMX160 version). Note that the back pressure from the opposite actuator port relief valve has been subtracted from the constant-pilot-pressure lines, so the pressure scale is the pressure drop across the valve’s actuator ports. Now, for a given flow and command pressure, the pressure available to drive or brake the load can be extracted. If an assumed steady state load curve is added (Figure 42d), the chart can be used to determine the required command pressure to drive the load at a given speed; or, the equivalent braking pressure (braking pressure plus the load curve) can be obtained.

To illustrate the operation of the valve, assume the load is at rest and the valve is in neutral. Figure 42d shows a braking pressure of 185 bar at point A, which is the relief valve setting, and the pressure that must be imposed by an external load to move the load. As pilot pressure is applied, pressure begins to be applied to the actuator at point B. When the load pressure is overcome at point C, the load begins to move. If the pilot pressure is increased to 20 bar, the load will accelerate along the 20 bar pilot pressure line until the output pressure equals the steady-state load pressure at point E. Note that the pressure available to accelerate the load is the output pressure at any given flow and pilot pressure minus the steady state load pressure.

To slow or stop the load, the command pressure is reduced. If the command pressure is reduced to 16 bar (point F), the load will continue to be driven but at a pressure below the steady-state load curve. The load will slow along the 16 bar line until the steady state load curve is intersected at G point. If the command pressure is further reduced to 8 bar, the load will brake until the load stops. Here, the effective deceleration pressure at any given speed is the braking pressure plus the steady-state load pressure.

By modulating the command signal, the operator has complete proportional control of swing driving and braking pressures. This control provides smooth, precise control of high inertia swing drives.

CMX100 Meter-in Pressure Control Spool
Pressure vs. Flow
Model “S406” Meter-in Element

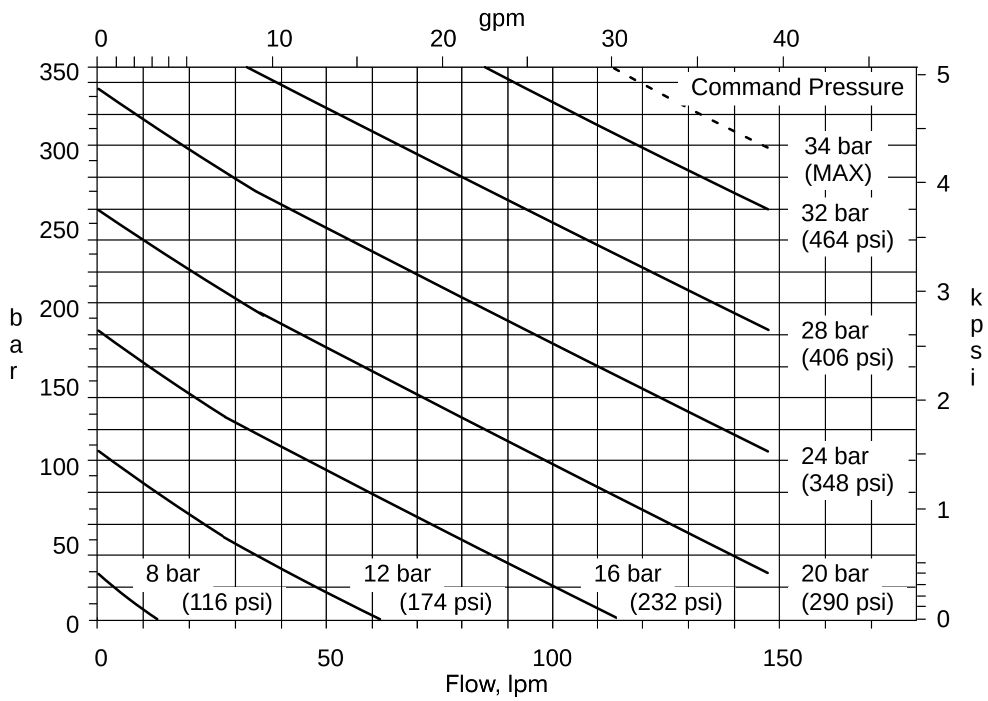


Figure 42a

CMX100 Meter-out Pressure Control
Relief Valve Override
Model “P03” Meter-out Element

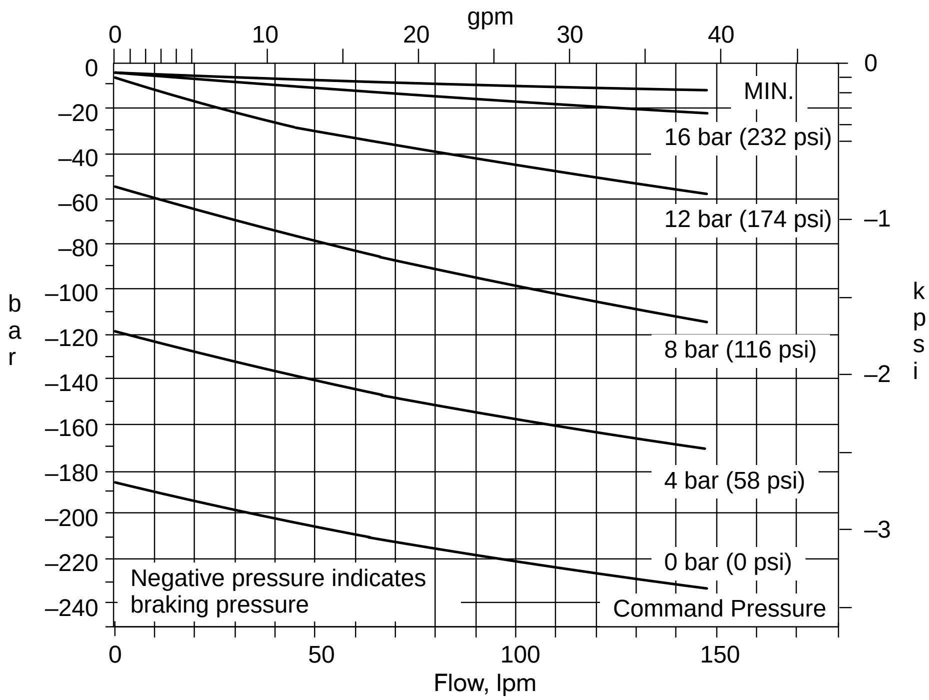


Figure 42b

CMX100 Pressure Control Valve
Pressure vs. Flow
Model “S406-P03”

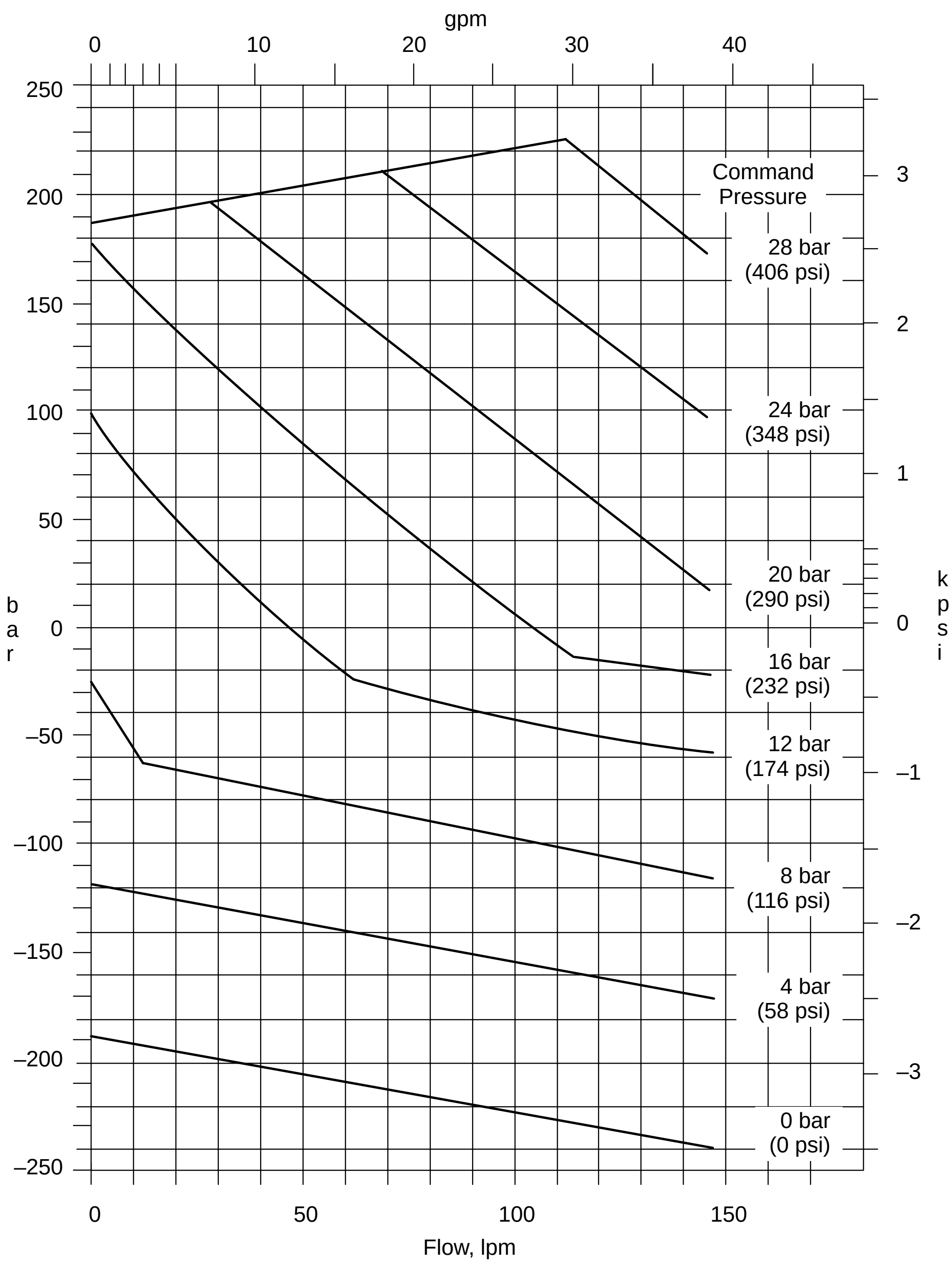


Figure 42c

CMX100 Pressure Control Valve
Pressure vs. Flow
Model "S406-P03"

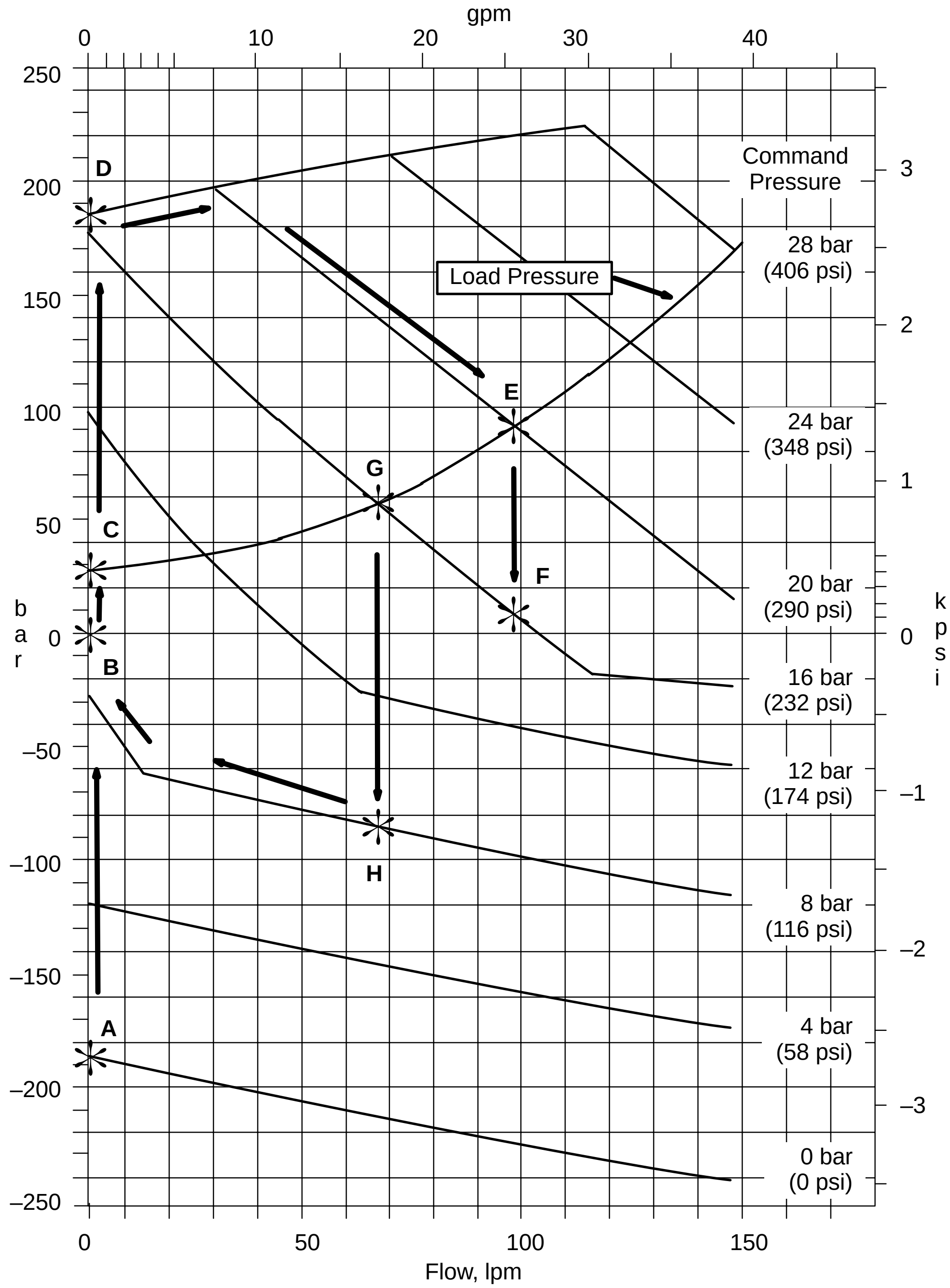


Figure 42d

CMX160 Pressure Control Valve
Pressure vs. Flow
Model “S506-P04”

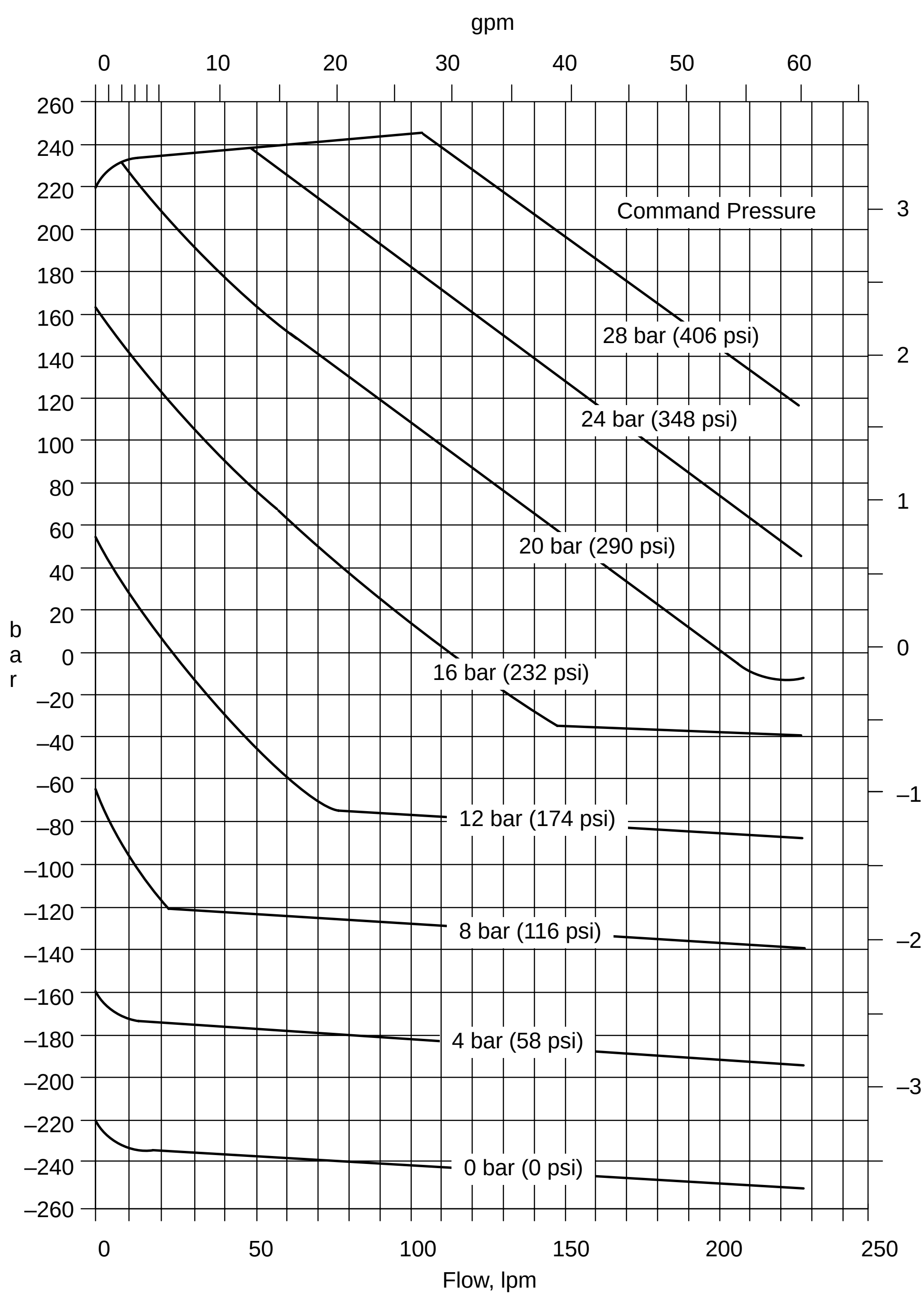


Figure 42e

Special Features

Free coast (type "F" meter-out)

This option provides a free coast or float operation in neutral. This is accomplished by a passage between the meter-out spring chamber and the corresponding meter-in chamber (Figure 43). In neutral, pressure in the meter-in chamber is low; thus, the meter-out spring chamber pressure is low, and the meter-out poppet will open when the relatively light spring force of the meter-out servo stem is overcome. During commanded operation, a check valve prevents flow from the meter-in chamber to the meter-out spring chamber. Single "F" meter-out models hold the load in one direction but not the other. The A*****F and B*****F models hold the load in one direction but not the other. Dual "F" meter-out models give a free coast or float feature in both directions.

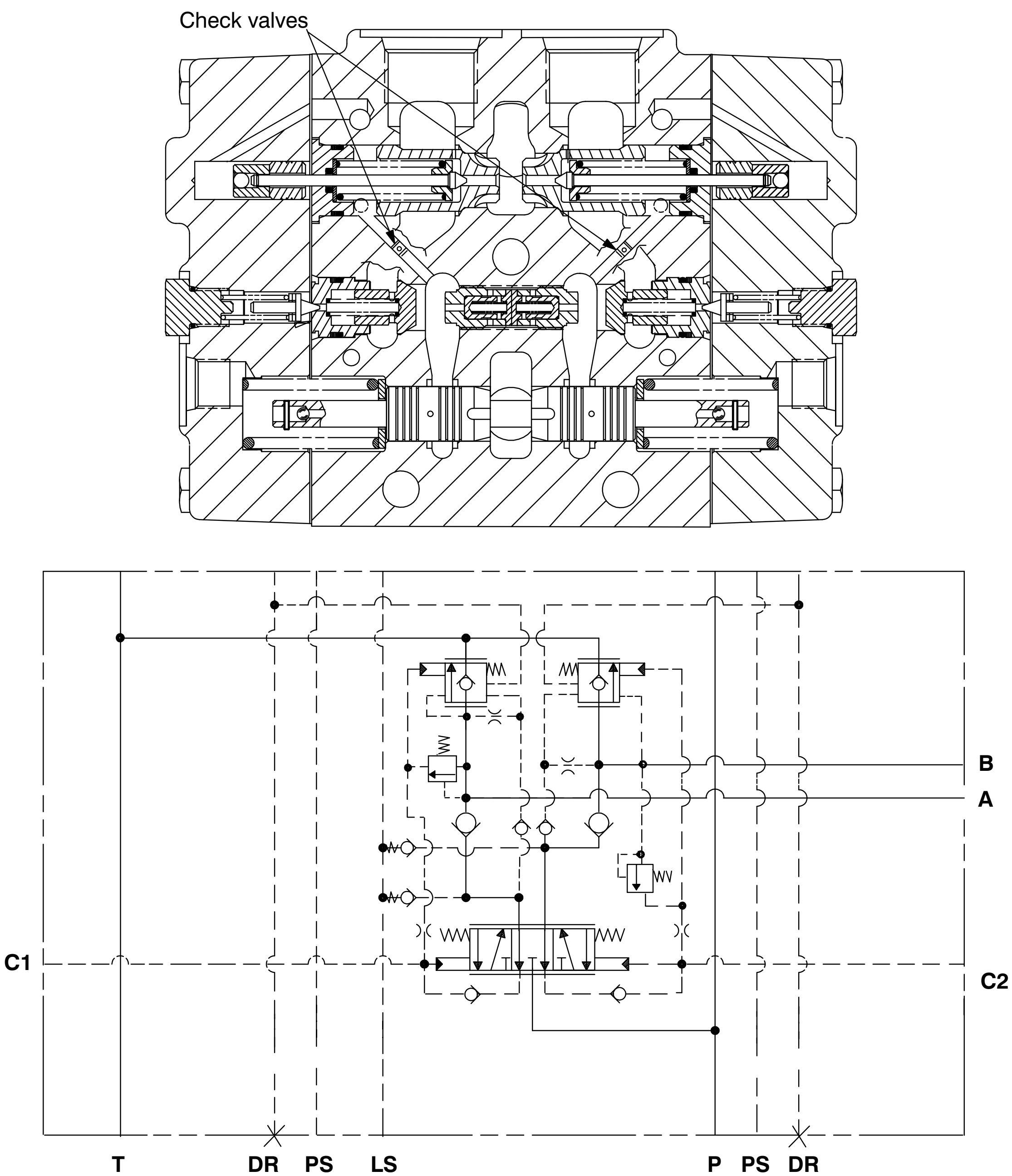


Figure 43

CMX100 Free Coast Performance
"F03" Meter-out Poppet
Flow vs. Pressure Differential

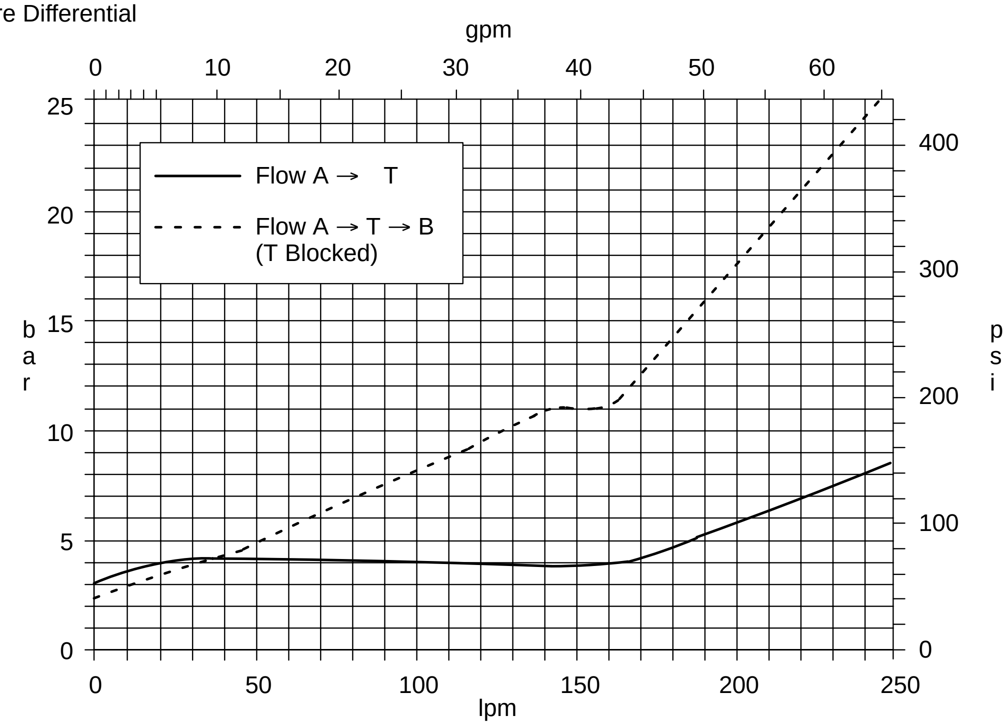


Figure 44

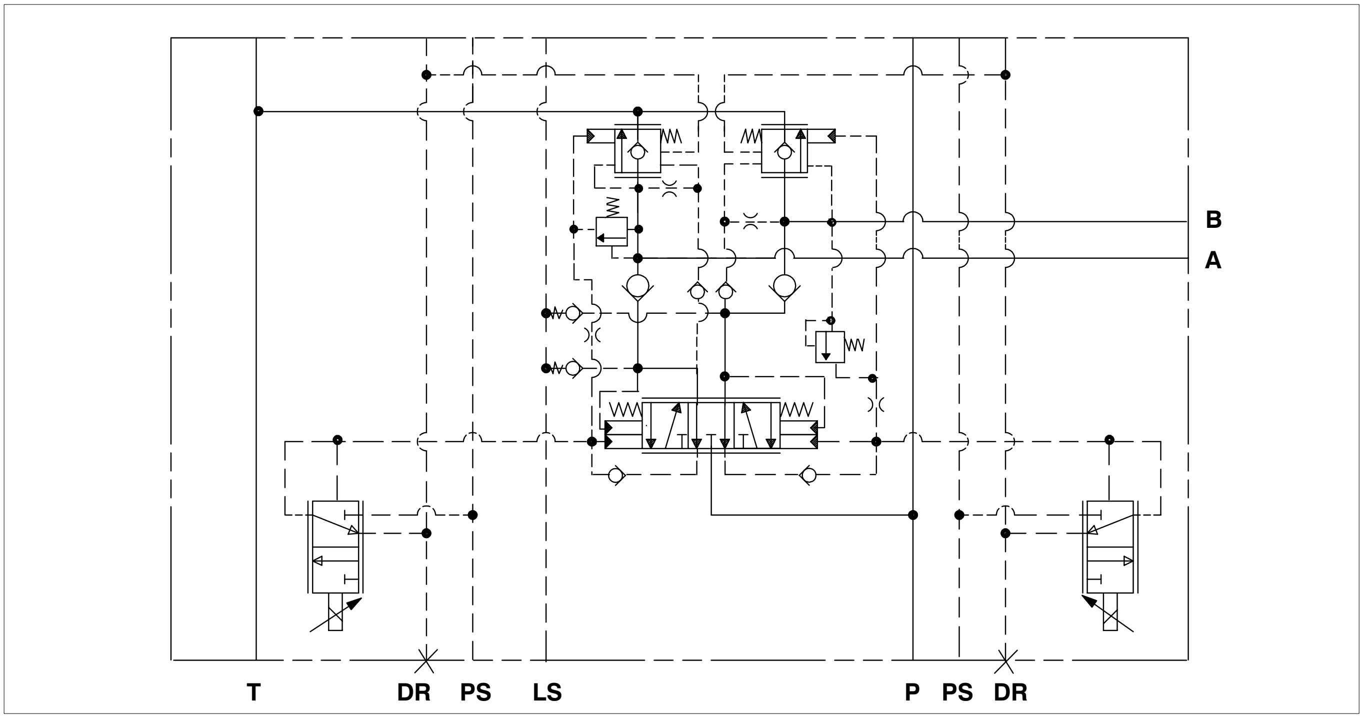


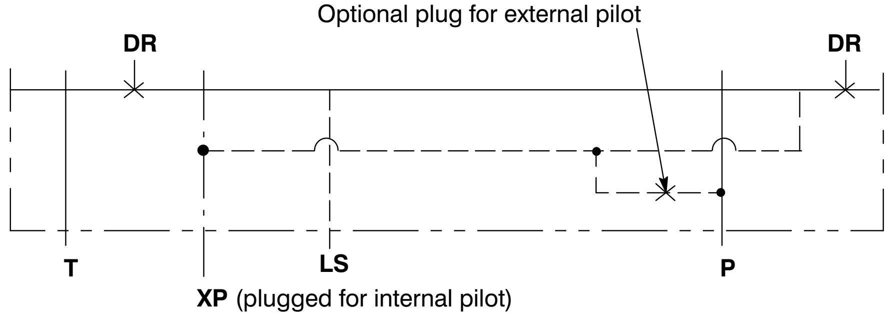
Figure 45. Swing Drive with Free Coast
(Utilizing meter-out poppets and a pressure controlling meter-in element)

Inlet Bodies

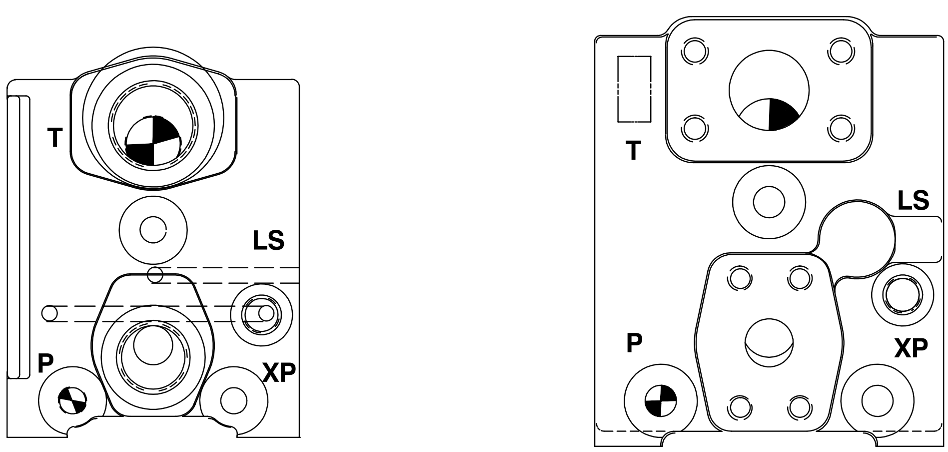
Standard end inlet body

The standard inlet body (Figure 46) provides connections for pump, tank and load sense. On electrohydraulic valve banks, a connection is also provided for pilot supply, which may be internal or external. For internal pilot supply, an internal passage connects the pilot supply to the pressure port. For external pilot supply, this connecting passage is blocked by a 1/4-28 UNF set screw (.125 in. hex key) accessible through the pump port, and the "XP" external connection is made through a #6 SAE O-ring boss port (.5625-18 UNF-2B thread).

Click here to see other port sizes.



Schematic of standard end inlet



CMX100 CMX160

Figure 46

End inlet body with load sensing relief valve (CMX100 only)

This inlet body (Figure 47) is designed for use with fixed displacement pumps to provide a combined function similar to a variable displacement load sensing pump, but at a lower system cost. In addition to the system connections for pressure, tank, optional load sense and optional external electrohydraulic pilot supply, the inlet section incorporates a load sensing relief valve that maintains inlet pressure at a fixed level above load sense pressure and limits maximum inlet pressure to a preset value.

The load sensing relief valve uses a balanced spool concept to control inlet pressure. Load sense pressure from the valve bank is admitted to the spring chamber via a 1.27 mm (.050") orifice. Load sense pressure plus the spring load is balanced against the inlet pressure on the opposite end of the spool. When the load sense pressure plus spring force is overcome by the inlet pressure, the spool opens allowing inlet flow to tank, thus controlling inlet pressure. When the pre-set maximum pressure is reached in the spring chamber, the pilot poppet opens, limiting the spring chamber pressure (and then the inlet pressure) since the LS flow into the spring chamber is controlled by the .050" orifice. Note that the pre-set maximum pressure must be matched to the spring(s) used, so the spools are not interchangeable.

Two springs are available, which may be used separately or as a nested pair to give three inlet-to-load sense pressure differential settings: 10 bar (145 psi), 16 bar (232 psi) and 26 bar (377 psi). The load sensing relief valve is rated at 250 bar pressure (3625 psi). An optional solenoid operated unloading valve is also available which provides a direct path to tank when pump "standby" pressure is not desired. The unloading valve provides a 4.7 bar (68 psi) pressure differential at 100 lpm (26 USgpm) and is open "P" to "T" when the solenoid is de-energized. The unloading valve is pressure rated at 205 bar (3000 psi).

An optional external load sense connection is available for special applications. Load sense connections from other valve banks should be made at the end cover when a load sense decompression orifice is used to decompress the load sense passage. The load sense decompression orifice should be located as far as possible from the load sensing relief valve.

Click here to see orifice location diagram.

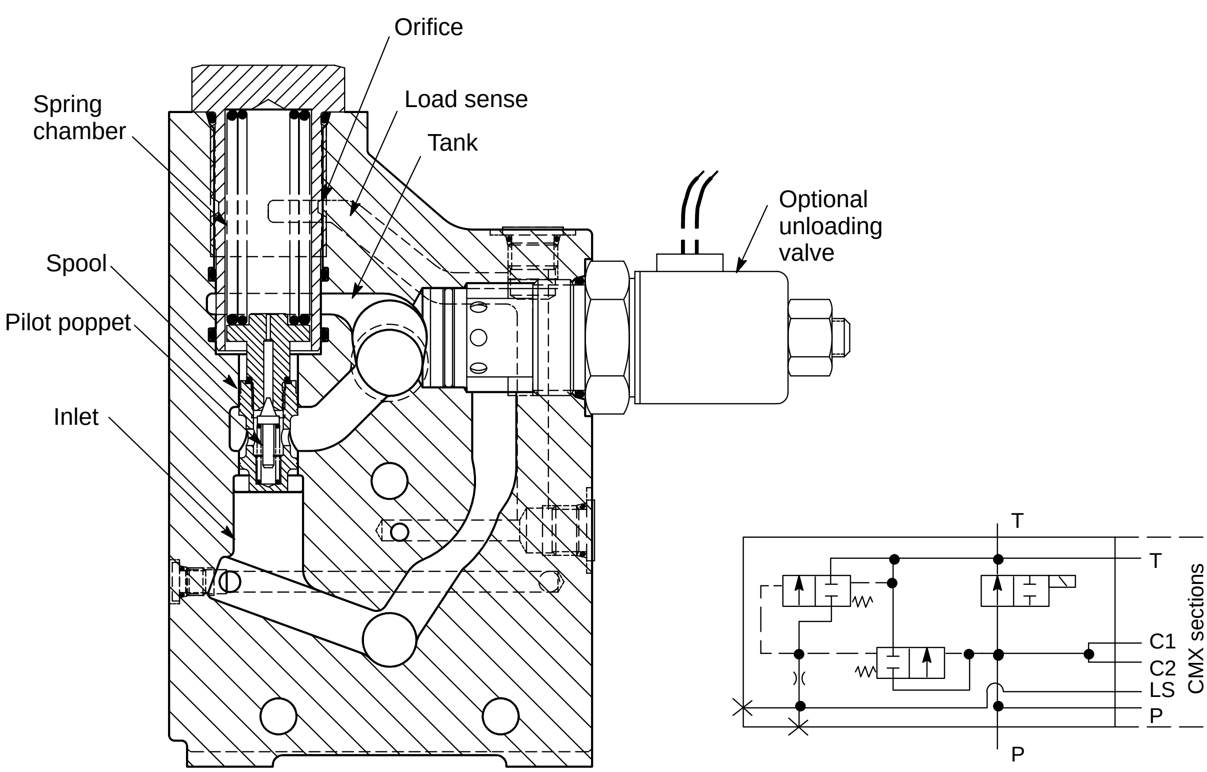


Figure 47

Inlet Bodies

CMX160/100 mid-inlet

The mid-inlet (Figures 48 and 49) facilitates the use of CMX160 and CMX100 valve sections in the same valve bank. The CMX160 sections are mounted on one side of the mid-inlet, and the CMX100 sections are mounted on the opposite side. System pressure and tank connections are made in the middle of the valve bank, rather than on the end.

Standard mid-inlet

The standard mid-inlet (Figure 48) provides connections for pump, tank and external pilot supply (for electrohydraulic valves). Internal pilot supply is available by omitting a set screw plug in a connecting passage between the pump port and pilot supply passage, and plugging the external port. Load sense and external drain connections for mid-inlet valve banks are made at the end covers.

CMX160/100 Mid-Inlet

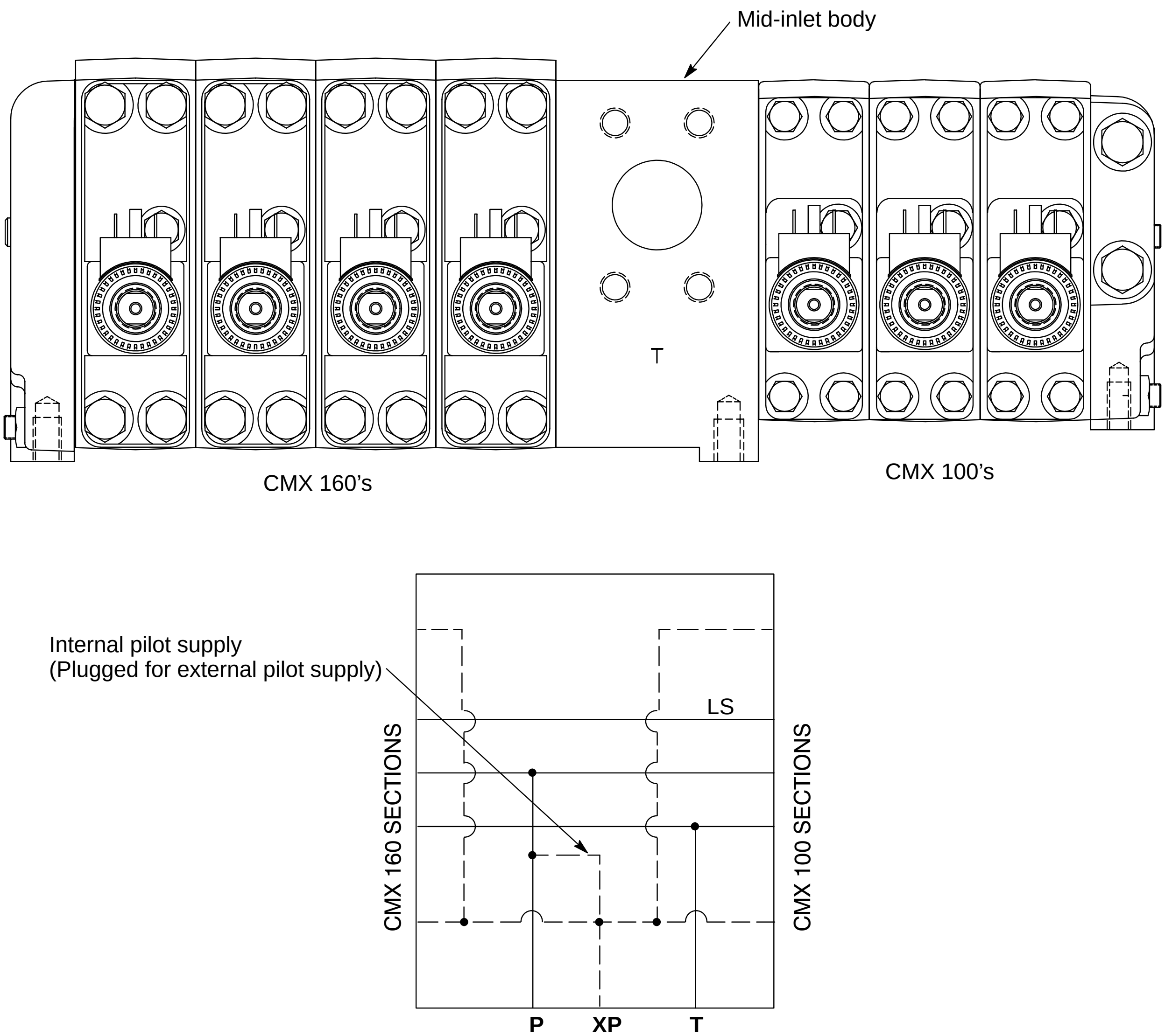


Figure 48

Inlet Bodies

Mid-inlet and CMX100-PC** end inlet with reducing valve and anticavitation make-up flow

This mid-inlet (Figure 49) incorporates two reducing/relieving cartridges to provide pilot supply pressure and tank port make-up flow. The reduced pilot supply pressure can be supplied internally to electrohydraulic sections and/or ported externally to HRC pilot supply ports. The tank port make-up flow is directed to the tank passage to maintain a minimum tank pressure under all operating conditions.

Make-up flow is an anti-cavitation feature. It is required in circuits where an overrunning load is causing an actuator to move and draw more fluid from the tank port than is being returned by the opposite actuator port, and a check valve in the tank line prevents fluid from being drawn from tank. (A swing function powered by a hydraulic motor is a typical circuit that requires make-up flow.) The reducing valve should be set 0.69 bar (10 psi) below the back pressure check valve setting.

The CMX100-PC** end inlet is derived from the mid-inlet body. It does not contain machining for mounting CMX160 sections. All other features apply as described for the mid-inlet with reducing valve and anticavitation make-up flow cartridges.

CMX160/100 Mid-Inlet

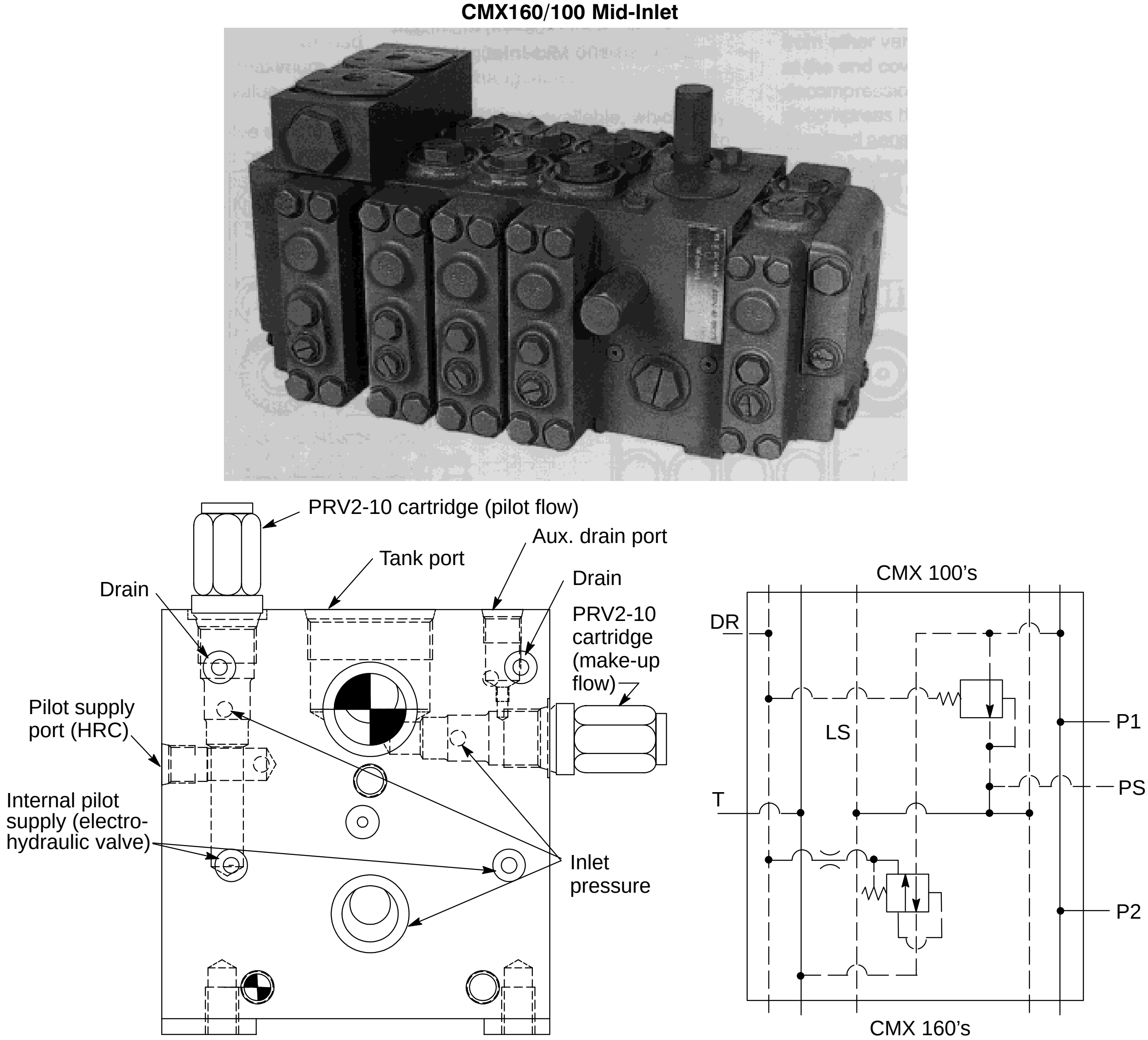


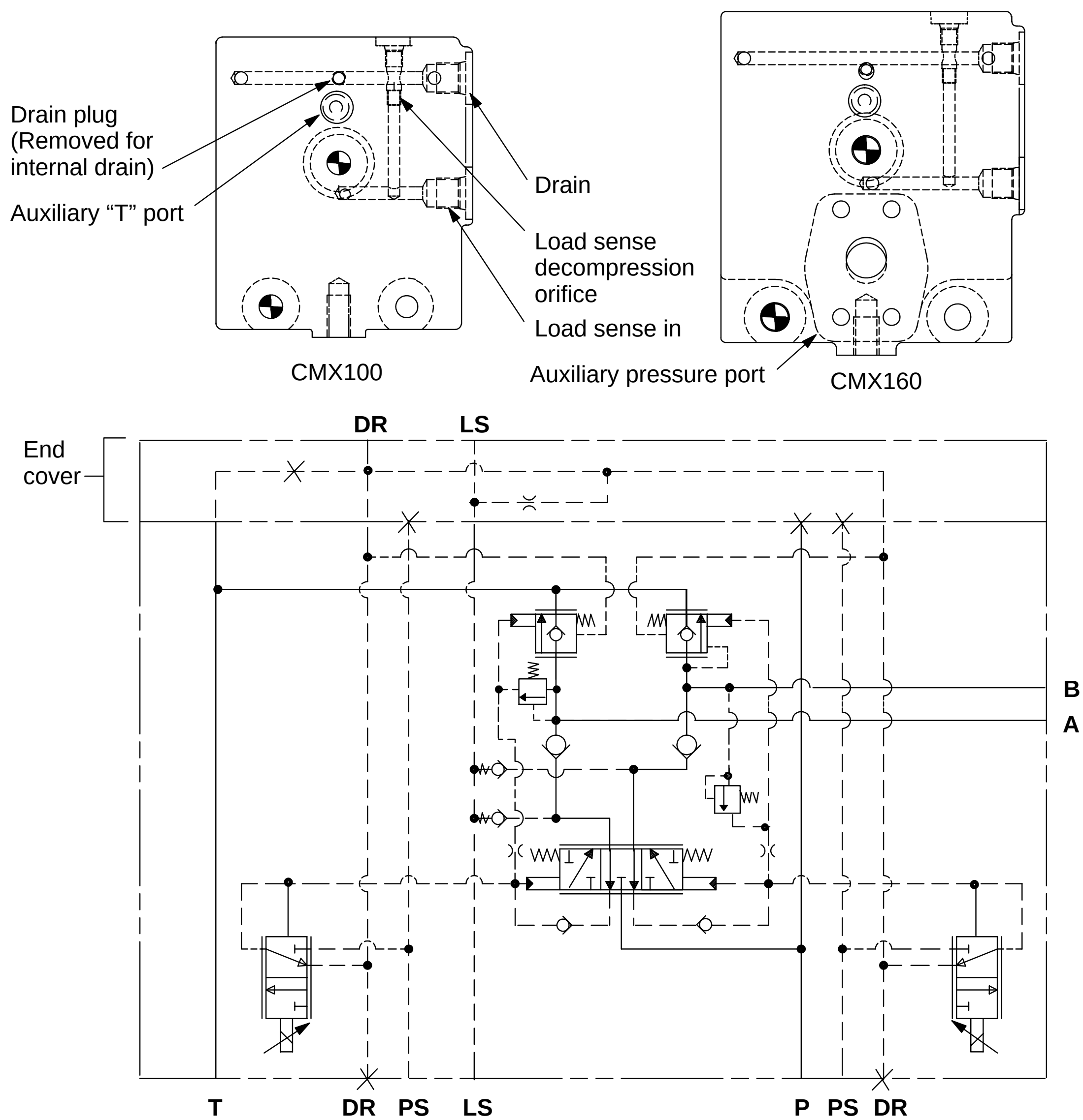
Figure 49

End Cover

An end cover (Figure 50) is required to terminate each valve bank. The end cover provides a passage that connects the control cap drain galleries from either side of the valve body.

Additionally, several optional features are located in the end cover:

Optional Feature	Function
Internal/external drain	Provides choice of internal or external drain. Click here and see “Actuation” pages.
Auxiliary load sense	Provides load sense series connection for multiple valve banks. Click here to see “Load Sensing Check Valves”.
Load sense decompression orifice	Provides load sense decompression to drain via a 0.50 mm (.020”) screened orifice.
Auxiliary “P” Port	Augments “P” port in inlet body for special applications. Click here to see size chart.
Auxiliary “T” Port	Augments “T” port in inlet body for special applications. Click here to see size chart.



End cover (shown with load sense decompression orifice and external drain)

Figure 50

Model Codes

Operating Section

CMX 100 - F 3 - A S D 0 06 -S 03 C 25 - B S D 0 12 - S 14 C 28 -E G U0 - 25

CMX	100	F	3	A	S	D	0	06	S	03	C	25	B	S	D	0	12	S	14	C	28	E	G	U0	25
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

1 Valve Series

Load sensing
Pressure compensated

2 Valve Series

100 – 100 l/min (26 USgpm) rated flow
160 – 160 l/min (42 USgpm) rated flow

3 Port Configuration

S – Threaded port SAE O-ring connection
W – Wide body threaded port SAE O-ring connection
F – Flanged port Code 62 SAE 4-bolt high pressure
G – Flanged port Code 61 SAE 4-bolt standard pressure

4 Construction

2 – Sectional
3 – Sectional with module (requires F or G ports). See code position 12 for module designator.

5 Port Designation “A”

6 Meter-in Function

S – Standard
P – Standard with pressure limitation, CMX100 only
L – Low flow, 0-40 l/min (0-11 USgpm), CMX100 only
H – Single acting high flow (up to twice rated flow)

7 Meter-in Designators

N – No vents in meter-in spool
D – Vented meter-in spool (standard)

8 Pressure Feedback Piston Dia.*

0 – No piston (flow control spool)
2 – 1.6 mm (pressure control spool)
4 – 3.6 mm (pressure control spool) CMX100 only
5 – 4.5 mm (pressure control spool) CMX160 only

9 Meter-in Cracking Pressure

06 – 6.3 bar (90 psi)
12 – 11.6 bar (168 psi)

10 Meter-out Function

S – Standard
P – Pressure control (must have external drain). When P is designated in position 10 & position 19, positions 11 & 20 must be “03” for a CMX100 and “04” for a CMX160.
F – Free coast
M – Meter-out spool - fully open to tank in neutral (CMX100 only)
N – Meter-out spool - restricted opening to tank in neutral (CMX100 only)
V – Standard with externally vented port relief

11 Meter-out Element

(ΔP @ rated flow)

00 – Meter-out spool, CMX100 only
03 – 3 bar (44 psi), CMX100 only
04 – 4 bar (58 psi), CMX160 only
07 – 7 bar (102 psi), CMX160 only
14 – 14 bar (203 psi)
56 – 56 bar (812 psi), CMX160 only
90 – 90 bar (1305 psi), CMX100 only

12 Meter-out Special Features

(Leave blank when module is not required.)

A – Anti-cavitation valve T to A
B – Anti-cavitation valve T to B
C – Anti-cavitation valve T to AB
H – High flow module (requires high flow meter-in function)

13 Meter-out Port Relief

(Relief setting)

00 – Without pilot relief
10-38 – Consecutive numbers representing 100 bar (1450 psi) to 380 bar (5512 psi) in increments of 10 bar (150 psi) e.g. 14 is 140 bar.
99 – Externally adjustable relief** (factory set to 207 bar (3000 psi).

14 Port Designation “B”

15 - 22 Repeat positions 6-13 for positions 15-22

Equivalent positions (6 & 15) and (7 & 16) must be identical designators. Also, positions 10 & 19 must be identical when a meter-out spool is required.

23 Actuation

E – Electrohydraulic
H – Hydraulic (must have external drain in end cover)

24 Solenoid Voltage

(Electrohydraulic actuation only – leave blank for hydraulic actuation.)

G – 12 V DC
H – 24 V DC

25 Electrical Connectors

(Leave blank for hydraulic actuation.)

FL – Flying leads
U0 – DIN 43650 Spade plug only
U1 – DIN 43650 Complete
MP –Metri-pack®

26 Design Number

* When a pressure feedback piston is indicated in positions 8 & 17 together with a “P” in positions 10 & 19, relief settings below 140 bar (2030 psi) will result in excessive leakage.
** Not available with pressure control meter-out; i.e. P03*99 and P04*99 are not possible.

Valve Banks with End Inlet

CMX 100 - S E - SFS - F T X - M - 25 - Assy. number

CMX 100	S	E	SFS	F	T	X	M	25	Assy. number
1	2	3	4	5	6	7	8	9	10

1 **Valve Series**

2 **Inlet**
(Click here for port sizes.)

S – SAE straight thread – CMX100 only
F – SAE 4-bolt flange, Code 62, CMX160 only
G – SAE 4-bolt flange, Code 61, CMX160 only
L – Load sense inlet – CMX100 only – SAE straight thread

** Load sensing pressure differential in bar
10 – 10 bar (145 psi)
16 – 16 bar (232 psi)
26 – 26 bar (377 psi)

* Unloading solenoid valve, flying leads only
N – None
G – 12 VDC
H – 24 VDC

** Unloading relief valve setting:
With solenoid valve;
Range 10–210 bar (145–3000 psi)
Range codes 01–21 × 10 = pressure setting in bar.
Example: L16G18
Without solenoid valve;
Range 10–250 bar (145–3625 psi)
Range codes 01–25 × 10 = pressure setting in bar.
Example: L16N24

PC** – Inlet body with pressure reducing valve and anticavitation make-up flow – CMX100 only – SAE straight thread

10 – Pressure reducing valve only. Standard setting is 28 bar (400 psi).
2* – Make-up flow valve only. Indicate desired pressure setting; e.g., 2B.
A – 3,5 bar (50 psi)
B – 7 bar (100 psi)
C – 10,5 bar (150 psi)
3* – Both pressure reducing valve – 28 bar (400 psi) – and make-up flow valve. Indicate desired pressure setting with appropriate letter as shown above; e.g., 3A.

Examples:
CMX100-PC10
CMX100-PC2B
CMX100-PC3C

3 **Pilot Supply**

H – Hydraulic
N – Internal pilot supply – electrohydraulic
E – External pilot supply – electrohydraulic

4 **Operating Section**
One required for each section, up to eight sections. Letter indicates section port configuration; i.e., S, W, F or G.

5 **End Cover**

C – Without LS (load sense) port, LS decompression orifice or external relief vent port
F – With LS port and 0,5 mm (0.020 in.) LS decompression orifice
L – With LS port only
VV – With LS port and external relief vent port. Only used with “V” meter-out function.

6 **Auxiliary Ports in End Cover**
(Click here for port sizes.)

P – Aux. P port
T – Aux. T port or gage port
S – Aux. P & T ports

7 **Drain**
(end cover)

X – External drain port open
N – Internally drained

8 **Mounting Holes**

U – Inch threads
M – Metric threads

Click here for thread sizes.

9 **Design Number**

10 **Assembly Number**

Assigned by Vickers

Model Codes

Valve Banks with Mid-inlet

CMX 160 - F S X - SSSFS - MS 10 E X - 100 - SSSS - C T N - U - 25 - Assy. #

1 (CMX 160) – 2 (F) – 3 (S) – 4 (X) – 5 (SSSFS) – 6 (MS) – 7 (10) – 8 (E) – 9 (X) – 10 (100) – 11 (SSSS) – 12 (C) – 13 (T) – 14 (N) – 15 (U) – 16 (25) – 17 (Assy. #)

1 CMX160 Valve Series

2 End Cover (CMX160)

C – Without LS (load sense) port, LS decompression orifice or external relief vent port
F – With LS port and 0,5 mm (0.020 in.) LS decompression orifice
L – With LS port only
V – With LS port and external relief vent port. Only used with "V" meter-out function.

3 Auxiliary Ports in End Cover

P – Auxiliary "P" port
T – Auxiliary "T" port or gage port
S – Auxiliary "P & T" ports

4 Drain
(CMX160 end cover)

X – External drain port open
B – Blocked drain (both internal & external drains plugged
N – Internally drained

5 Valve Operating Section (CMX160)

One letter required per section, up to 8 sections. Letter indicates valve section port configurations; i.e., S, W, F or G.

6 Mid-inlet*

MS – SAE straight thread ports with provision for cartridge valves
MG – SAE 4-bolt flange ports (code 61) with no provision for cartridge valves

7 Mid-inlet Cartridge Valve(s)

00 – No cartridge valves
10 – Pilot supply valve. Standard setting is 28 bar (400 psi).
2* – Make-up flow valve pressure setting. Indicate desired setting, e.g., 2B.
  A - 3,5 bar (50 psi)
  B - 7 bar (100 psi)
  C - 10,5 bar (150 psi)
3* – Pilot supply valve – 28 bar (400 psi) – and make-up flow valve (Indicate desired pressure setting with appropriate letter as shown above; e.g., 3A).

8 Pilot Supply for Hydraulic Remote Controllers

E – External pilot port open
H – External pilot port plugged

9 Drain
(mid-inlet)

X – External drain port open (MS mid-inlet only)
B – Blocked drain (both internal & external drains plugged)

10 CMX100 Valve Series

11 Valve Operating Section (CMX100)

One letter required per section, up to 8 sections. Letter indicates valve section port configuration; i.e., S, W, F or G.

12 End Cover (CMX100)

C – Without LS (load sense) port, LS decompression orifice or external relief vent port
F – With LS port and 0,5 mm (0.020 in.) LS decompression orifice
L – With LS port only
V – With LS port and external relief vent port. Only used with "V" meter-out function.

13 Auxiliary Ports in End Cover

P – Auxiliary "P" port
T – Auxiliary "T" port or gage port
S – Auxiliary "P & T" ports

14 Drain
(CMX100 end cover)

X – External drain port open
B – Blocked drain (both internal & external drains plugged
N – Internally drained

15 Mounting Holes

U – Inch thread size. End covers, 1 hole each. Mid-inlet, 2 holes.
M – Metric thread size. End covers, 1 hole each. Mid-inlet, 2 holes.

16 Design Number

17 Assembly Number

Assigned by Vickers

* MG mid-inlet can be internally or externally piloted. MS mid-inlet *must* be either externally piloted or include a pilot supply valve.

Port and Mounting Hole Sizes

Dimensions in mm (inch) – valve banks with end inlet and end cover

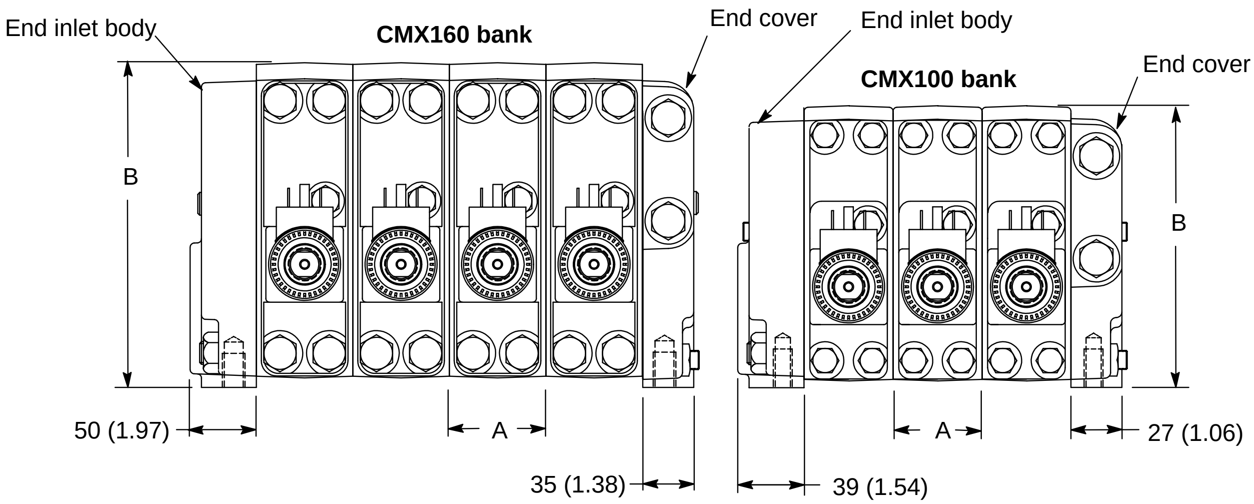
Model Series	Actuator Ports	Pressure Port (Inlet Cover)	Tank Port (Inlet Cover)	Pilot, Load Sensing, Deceleration, External Drain & Cooling Ports	Valve Mounting Holes (3 Places)◆		Auxiliary "P" Port	Auxiliary "T" or Gage Port
					Metric	Inch		
CMX100-F	12,7 (.50) diameter††	(1.0625-12)**	(1.3125-12)**	(.5625-18)**	M10×1,5-6H 20,0 deep	.4375-14 UNC-2B .75 deep	(.5625-18)**	(.5625-18)**
CMX100-G	12,7 (.50) dia.†	(1.0625-12)**	(1.3125-12)**	(.5625-18)**	M10×1,5-6H 20,0 deep	.4375-14 UNC-2B .75 deep	(.5625-18)**	(.5625-18)**
CMX100-S/W	(1.0625-12)**	(1.0625-12)**	(1.3125-12)**	(.5625-18)**	M10×1,5-6H 20,0 deep	.4375-14 UNC-2B .75 deep	(.5625-18)**	(.5625-18)**
CMX160-F	19 (.75) dia.††	19 (.75) dia.††	31,8 (1.25) diameter†	(.5625-18)**	M12×1,75-6H 18,0 deep	.5000-13 UNC-2B .71 deep	19 (.75) diameter††	(.5625-18)**
CMX160-G	19 (.75) dia.†	25 (1.00) dia.†	31,8 (1.25) diameter†	(.5625-18)**	M12×1,75-6H 18,0 deep	.5000-13 UNC-2B .71 deep	25 (1.00) diameter†	(.5625-18)**
CMX160-S/W	(1.3125-12)**	25 (1.00) dia.†	31,8 (1.25) diameter†	(.5625-18)**	M12×1,75-6H 18,0 deep	.5000-13 UNC-2B .71 deep	25 (1.00) diameter†	(.5625-18)**

** SAE straight-thread O-ring connection.
† SAE 4-bolt flange, standard pressure series (code 61).
†† SAE 4-bolt flange, high pressure series (code 62).

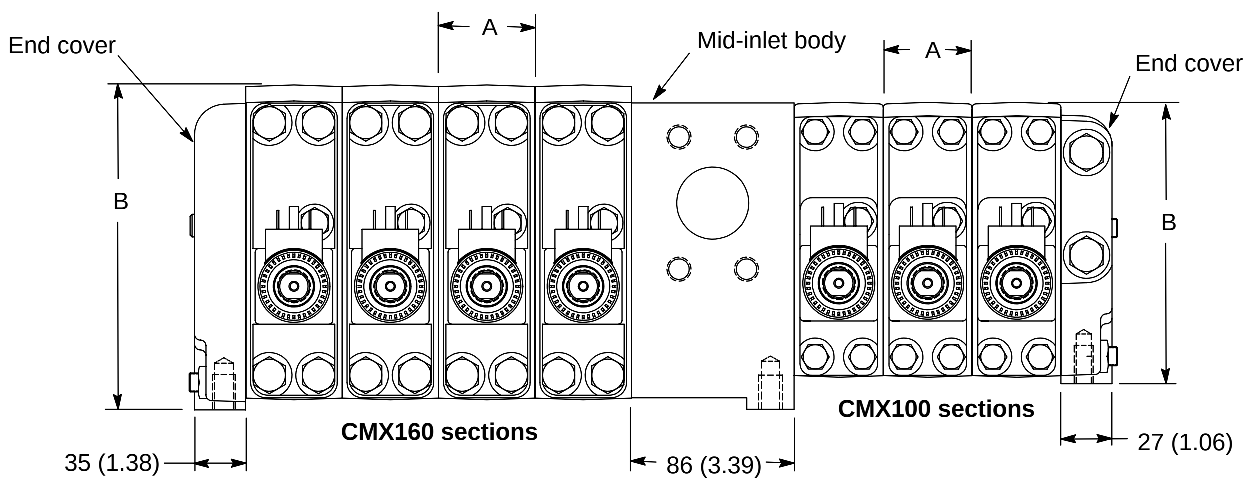
◆ Valve banks with end inlet have three mounting holes: two in inlet body and one in end cover. Valve banks with mid-inlet have four mounting holes: two CMX160-size holes in mid-inlet body, one CMX160-size hole in one end cover and one CMX100-size hole in the other end cover.

Valve Bank Dimensions

Typical End-inlet Valve Banks



Typical Mid-inlet Valve Bank



Model Series	Dimensions, Millimeter (Inch) – Operating Sections			
			C (length, not shown)	
	A (width)	B (height)	Hydraulic Actuation	Electrohydraulic Actuation
CMX100-S2	47 (1.85)	149 (5.87)	201 (7.9)	366 (14.4)
CMX100-F2/G2/W2	59 (2.32)	144 (5.67)	201 (7.9)	366 (14.4))
CMX160-S2	51 (2.01)	172 (6.77)	243 (9.6)	386 (15.2)
CMX160-F2/G2/W2	75 (2.95)	165 (6.50)	243 (9.6)	386 (15.2)

NOTE: Valve sections with different types of actuation, and/or different pressure ratings and port connections, can be used in the same valve bank.
Click here for additional information on section sizes and pressure ratings.
See preceding page for port and mounting hole sizes.