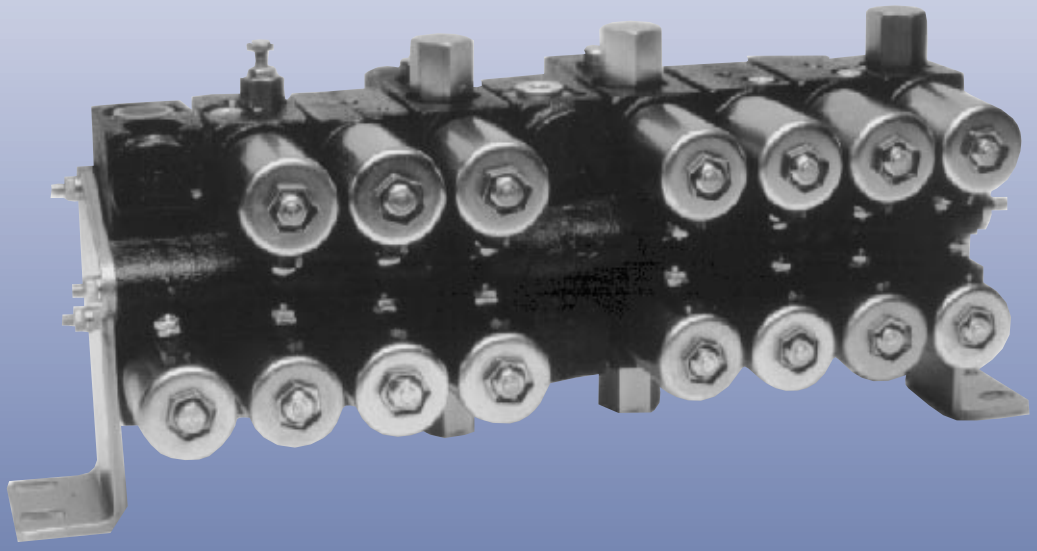
ZMC and ZMV

dukes fluid power



Electrohydraulic Valves

Technical Information

General Description

ZMC stack valves and ZMV proportional valves can be applied with pumps and various actuators to transfer and control hydraulic power.

ZMC valves are solenoid-operated stack valves used to control the direction of hydraulic fluid flow to motors, cylinders, and other remote actuators.

ZMC valves use a unique through-tube design to transfer fluid from module to module in the stack. The solenoid pilot valves are a reliable three piece design. Solenoids are water resistant with several terminations and voltages available.

The solenoid-operated pilot valves supply pilot flow to the larger directional control spools and poppets. This allows for full pressure to shift these spools wher the pilot valve is energized.

ZMV valves are solenoid-operated proportional flow controls used to control the amount of flow to a hydraulic actuator.

The ZMV proportional valves are stand-alone designs that are controlled by a pulse width modulated (PWM) signal. Electronic controllers are also available to satisfy system requirements.

ZMV and ZMC valves - Solutions for Low Flow Applications

Complete Line of Directional Control Valves

Optional Spools to Satisfy Diverse Applications

Proven Reliability & Performance

Modular Product Design

ZMC and ZMV Electrohydraulic Valves
Technical Information
Contents

Product Features

A Complete Family

- Wide Range of Options
- System Flexibility -
  Normally Open, Normally Closed, and Field Convertible Valve Assemblies
- Standard Housing and Mounting Patterns for Stacking Any Module
- Pressure Controls for System Protection
- Pilot-Operated Checks for Load Holding

Performance

- Pressure to 210 bar (3000 psi)
- Flows to 38 l/min (10 gpm)
- Fast Response Times
- Low Leakage Spools
- Low Pressure Drop
- Pilot Operation

World Product

- Sold Worldwide
- Mobile and Stationary Markets

Proven Technology

- Unique Product Features
- Unique Assembly and Testing Methods Increases Reliability
- Stack Design Lowers Installation Cost
- Electrohydraulic Proportional Valves For Infinitely Variable Flow
- Custom Module Designs for Unique Applications

Reliability / Durability

- Long Service Life
- Continuous Duty Solenoids

Technical Specifications

Design

Stackable and stand alone two-stage, pilot-operated valves in gray iron housings with hardened steel spools.

Mounting Configuration

Foot or plate mountings available for horizontal or vertical configuration

Installation Position

The valves may be mounted in any orientation.

Electrical Connections

Several terminations and voltages to choose from (see page 32).

Port Connections

All ports are standard SAE O-ring boss ports. See Order Code (p. 6) or Outline Drawings (p. 45) for specific port sizes.

Stack Size

One to eight valve modules per stack.

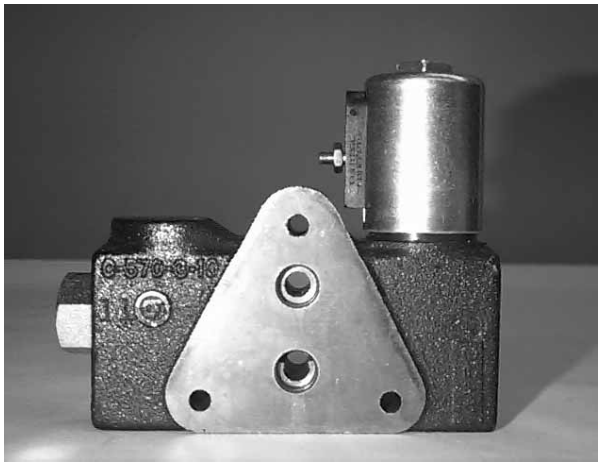
Corrosion Resistance

Iron housing are painted black. Other external parts are zinc plated.

Technical Data:

	ZMC Stack Valves	ZMV Proportional Valves
Maximum Pressure Rating	210 bar 3000 psi	210 bar 3000 psi
Flow Rating	38 l/min 10 gpm	38 l/min 10 gpm
Minimum Working Pressure	20 bar 300 psi	Not Applicable
Response Time	0.010 to 0.75 sec	Not Applicable
Weight per Module	2.6 to 4.2 kg 5.7 to 9.2 lb	4.2 kg 9.2 lb
Spool Leakage (at 210 bar [3000 psi])	164 cm^3/min 10 in^3/min	2.0 cm^3/min 0.5 in^3/min
Poppet Leakage	2 drops/min	Not Applicable
Electrical Current Range for Continuous Duty Coils	0.83 to 1.5 Amp (±20% Voltage Tolerance)	0 to 1.0 Amp (±20% Voltage Tolerance)
Temperature Range: Buna-N Seals Viton Seals	 -35°/120°C [-30°/250°F] -25°/205°C [-15°/400°F]	 -35°/120°C [-30°/250°F] -25°/205°C [-15°/400°F]
Hydraulic Fluid	Any general hydraulic fluid	Any general hydraulic fluid
Filtration	10 micron nominal	10 micron nominal

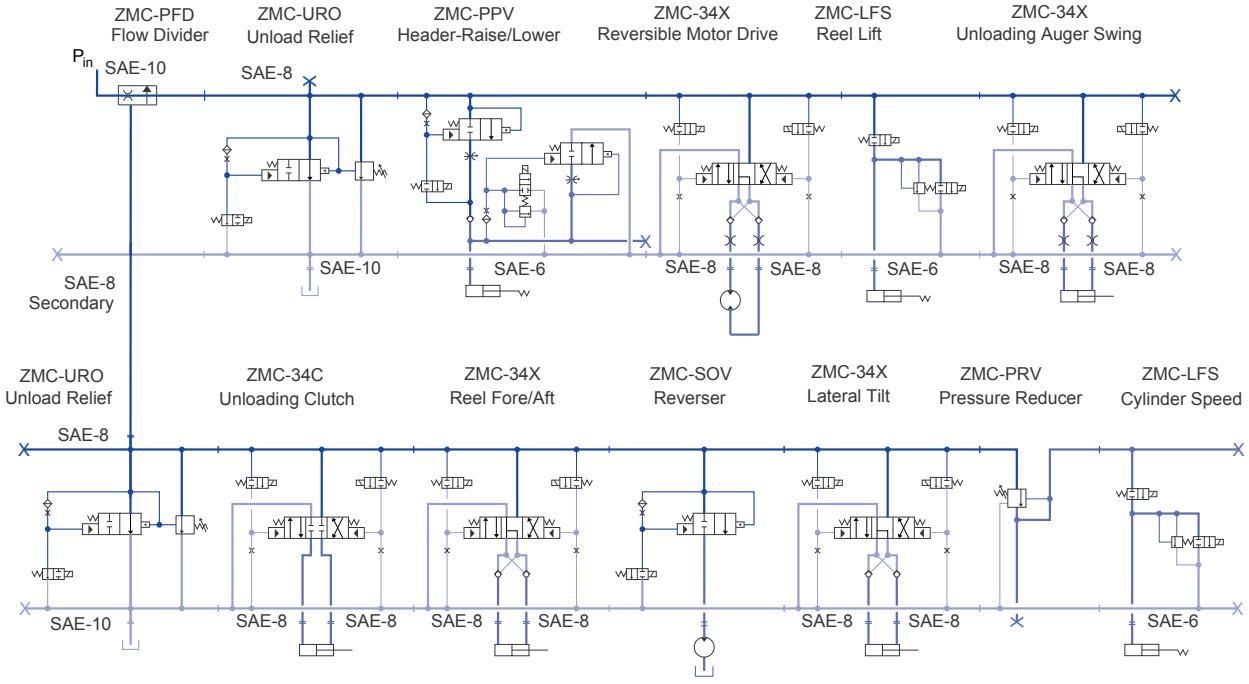
The ZMC series offers flexibility for designing an electrohydraulic system to meet your exact requirements. It is comprised of a family of solenoid-operated valve modules, each designed for the optimum control of a particular function. All ZMC modules share a common mounting and porting pattern. This allows a ZMC valve stack using any combination of modules to be assembled for an exact application. With ZMC modules, a single hydraulic power source (i.e. pump) can supply multiple actuating requirements.



Normally open and normally closed configurations are available for most valves. Field convertible configurations are available for the unload valves. If the ZMC stack is in a normally open mode, a ZMC unload valve (ZMC-UVx or ZMC URx) is used as a system inlet and bypass module.

Typical ZMC Stack

This typical ZMC stack consists of several modules to operate a grain harvesting combine's auxiliary functions. Header control and unloading auger operation are examples of auxiliary functions controlled by the valve stack in the schematic below. Any combination of ZMC modules could be included to customize the valve stack for a particular application.



ZMC - UVO Module: 2-Position/2-Way Normally Open Unload Valve

Description

The UVO module is a two-position, two-way solenoid-operated poppet valve. This module allows a stack assembly to operate in an open center configuration. This reduces power consumption by unloading flow to tank when it is not required by the actuator.

The UVO module is normally open. It is designed for low pressure drop at high flows.

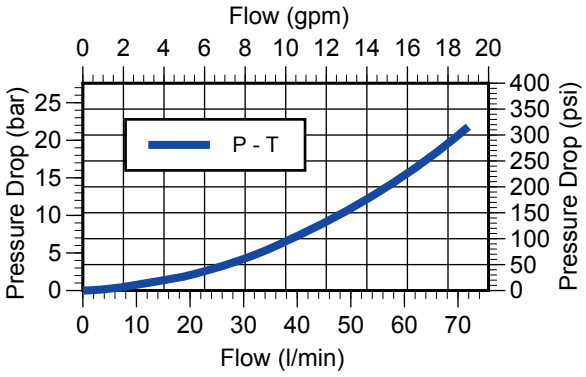
Operation

The valve will dump flow to tank when the solenoid is de-energized. When the valve is energized the pilot will block flow and build pressure in the spring chamber of the main poppet, forcing it closed. Then flow can be ported through the pressure gallery to another valve and the hydraulic function.

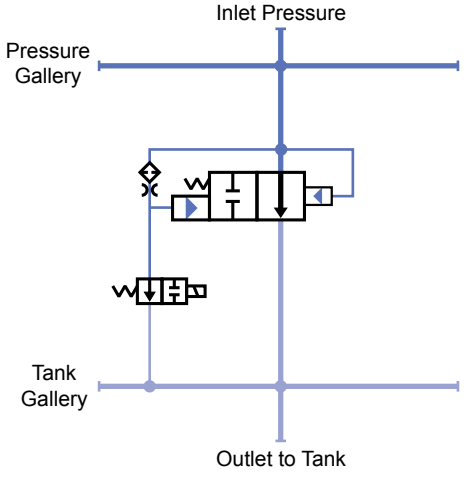
Specifications

Weight		2.6 kg 5.7 lb
Ports:	**Pressure**	#8 SAE 3/4–16
	Tank	#10 SAE 7/8–14
Response Time (sec)		
Coil Duty:		Continuous
Closed to Open		0.060
Open to Closed		0.015

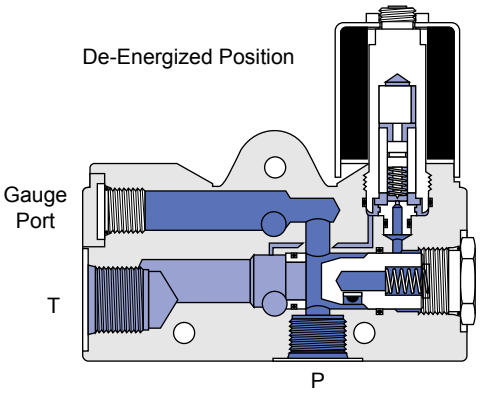
UVO Pressure Drop Curve



UVO Schematic



UVO Cut-away



ZMC - UVC Module:
2-Position/2-Way Normally Closed Unload Valve

Description

The UVC module is a two-position, two-way solenoid-operated poppet valve. This module allows a stack assembly to operate in an closed center configuration.

The UVC module is normally closed. It is designed for low pressure drop at high flows.

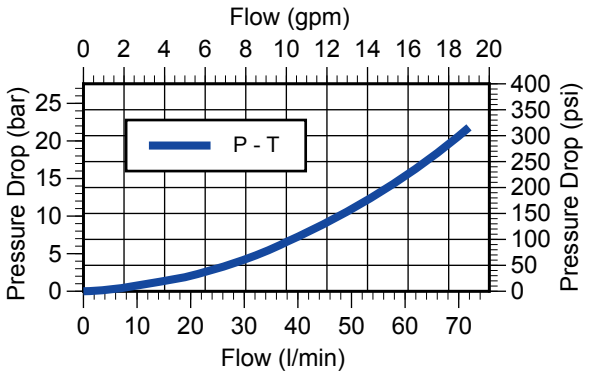
Operation

The valve will dump flow to tank when the solenoid is energized. When the valve is de-energized the pilot will block flow and build pressure in the spring chamber of the main poppet, forcing it closed. Flow can then be ported through the pressure gallery to another valve and the hydraulic function.

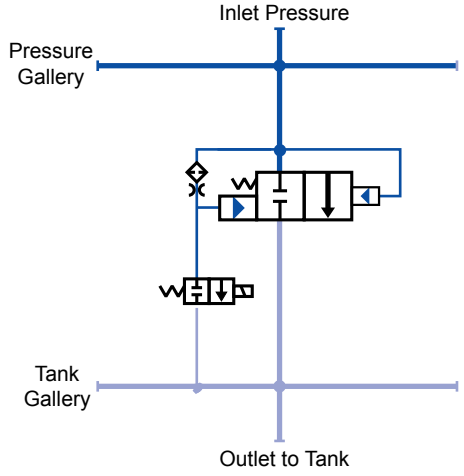
Specifications

Weight		2.6 kg 5.7 lb
Ports:	**Pressure**	#8 SAE 3/4–16
	Tank	#10 SAE 7/8–14
Response Time (sec)		
	Coil Duty:	Continuous
	Closed to Open	0.060
	Open to Closed	0.015

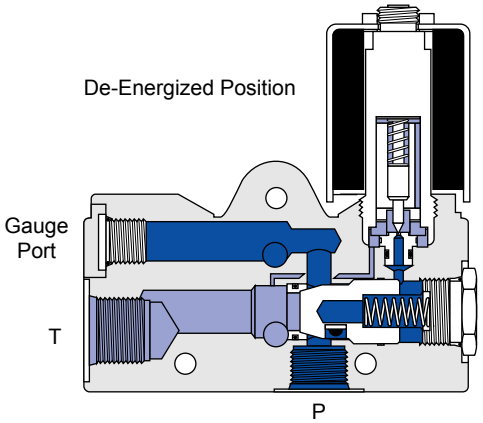
UVC Pressure Drop Curve



UVC Schematic



UVC Cut-away



ZMC - UVF Module: 2-Position/2-Way Field Convertible Unload Valve

Description

The UVF module is a two-position, two-way solenoid-operated poppet valve. This module allows a stack assembly to operate in an open center or closed center configuration.

The UVF module's normal mode is field convertible. A field conversion adjustment screw allows it to be changed between a normally open and a normally closed configuration. The initial setting is open.

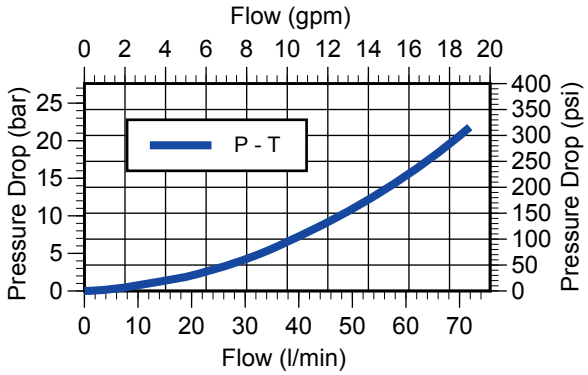
Operation

The valve will dump flow to tank when the solenoid is de-energized. When the valve is energized the pilot will block flow and build pressure in the spring chamber of the main poppet, forcing it closed. Then flow can be ported through the pressure gallery to another valve and the hydraulic function.

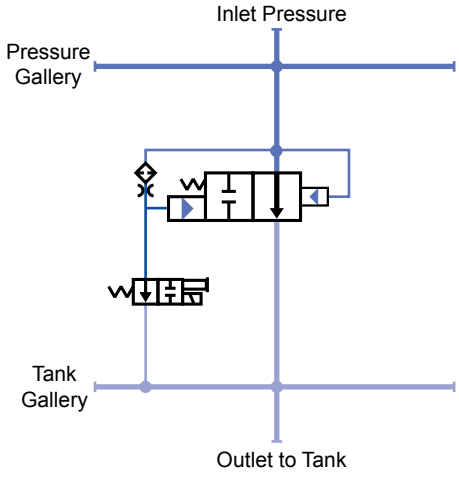
Specifications

Weight		2.6 kg 5.7 lb
Ports:	**Pressure**	#8 SAE 3/4–16
	Tank	#10 SAE 7/8–14
Response Time (sec)		
	Coil Duty:	Continuous
	Closed to Open	0.060
	Open to Closed	0.015

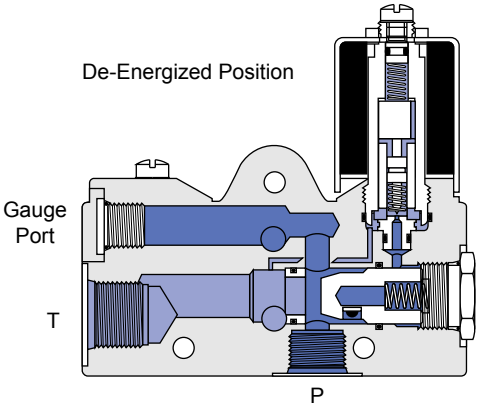
UVF Pressure Drop Curve



UVF Schematic



UVF Cut-away



ZMC - URO Module: 2-Position/2-Way Normally Open Unload Valve with Integral Relief

Description

The URO module is a two-position, two-way solenoid-operated poppet valve with an integral cartridge-style relief valve. This module allows a stack assembly to operate in an open center configuration. This reduces power consumption by unloading flow to tank when it is not required by the actuator. It includes a relief valve for system pressure protection.

The URO module is normally open. It is designed for low pressure drop at high flows.

Operation

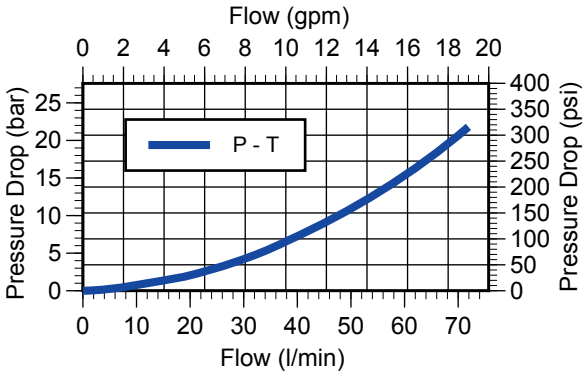
The module will dump flow to tank when the solenoid is de-energized. When the valve is energized the pilot will block flow and build pressure in the spring chamber of the main poppet, forcing it closed. Then flow can be ported onward to another valve and the mechanical application.

The pilot-operated relief valve is a full flow valve that will open at any time pressure is higher than the valve setting. The valve pressure setting is based on a 38 l/min (10 gpm) flow rate. It is set with an adjustable screw and available with a tamper-proof cap.

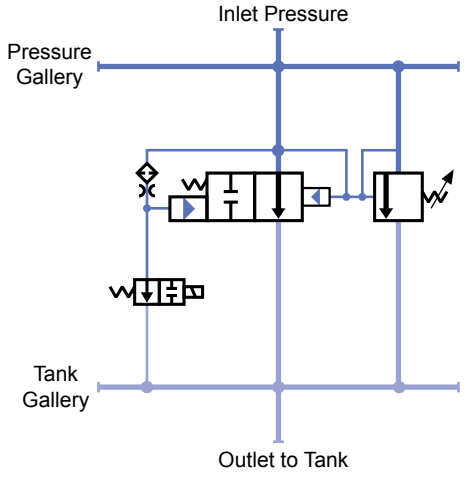
Specifications

Weight		2.6 kg	5.7 lb
Ports:	**Pressure**	#8 SAE 3/4–16	
	Tank	#10 SAE 7/8–14	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.090	0.090
	Closed to Open	0.020	0.030
Relief Valve Setting		20 - 200 bar	300 - 3000 psi

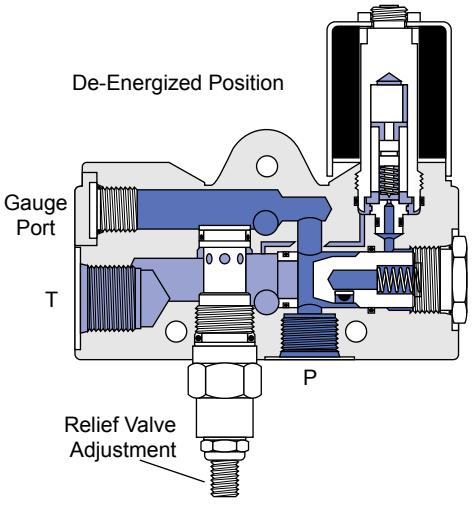
URO Pressure Drop Curve



URO Schematic



URO Cut-away



ZMC - URF Module:
2-Position/2-Way Field Convertible Unload Valve with Integral Relief

Description

The URO module is a two-position, two-way solenoid-operated poppet valve with an integral cartridge-style relief valve. This module allows a stack assembly to operate in an open center configuration. This reduces power consumption by unloading flow to tank when it is not required by the actuator. It includes a relief valve for system pressure protection.

The URF module's normal mode is field convertible. A field conversion adjustment screw allows it to be changed between a normally open and a normally closed configuration. The initial setting is open.

Operation

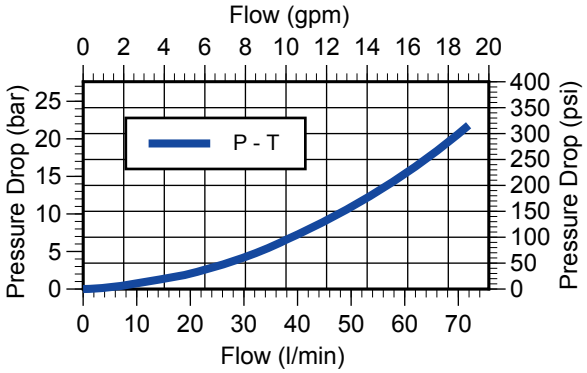
The module will dump flow to tank when the solenoid is de-energized. When the valve is energized the pilot will block flow and build pressure in the spring chamber of the main poppet, forcing it closed. Then flow can be ported onward to another valve and the mechanical application.

The pilot-operated relief valve is a full flow valve that will open at any time pressure is higher than the valve setting. The valve pressure setting is based on a 38 l/min (10 gpm) flow rate. It is set with an adjustable screw and available with a tamper-proof cap.

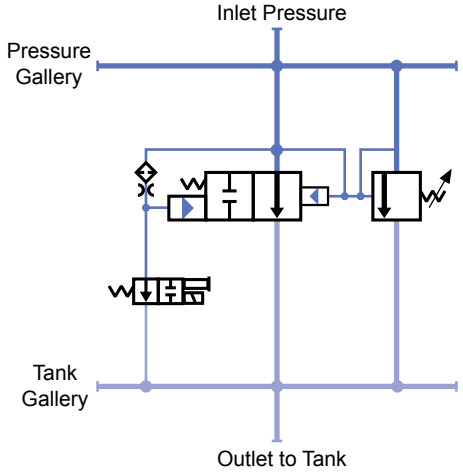
Specifications

Weight		2.6 kg	5.7 lb
Ports:	**Pressure**	#8 SAE 3/4–16	
	Tank	#10 SAE 7/8–14	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.090	0.090
	Closed to Open	0.020	0.030
Relief Valve Setting		20 - 200 bar	300 - 3000 psi

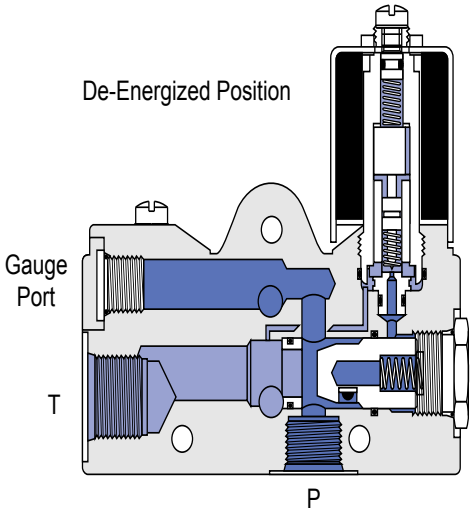
URF Pressure Drop Curve



URF Schematic



URF Cut-away



ZMC - PRV Module: Pressure Reducing Valve

Description

The PRV module contains a cartridge-style, pilot-operated pressure-reducing and -relieving valve. This valve provides a reduced pressure in all modules in the stack downstream of the PRV. This pressure is maintained regardless of flow.

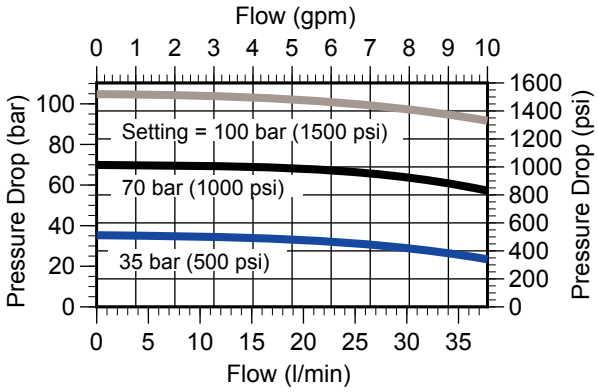
Operation

The valve is normally open to flow downstream. When the pressure setting of the valve is reached the valve will close to stop flow while maintaining the reduced pressure downstream. If downstream pressure rises above this setting, the valve will open and relieve that pressure to tank.

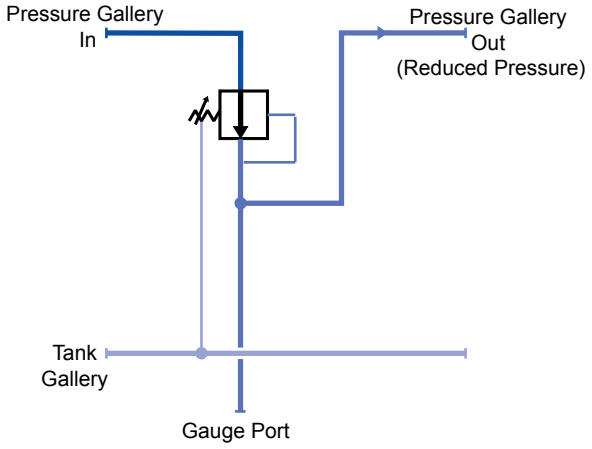
Specifications

Weight	2.3 kg	5.0 lb
Leakage	11.5 cm^3/min	0.7 in^3/min
Pressure Setting Range	35 - 200 bar	500 - 3000 psi

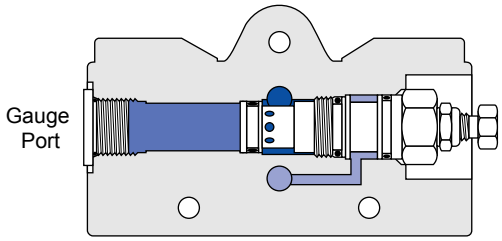
PRV Pressure Drop Curve



PRV Schematic



PRV Cut-away



ZMC - PFD Module: Priority Flow Dividing Valve

Description

The PFD module is used to split flow into two parts (e.g. for two sections of stack). The priority flow is constant and sent through the priority pressure gallery. This flow is pressure compensated to maintain constant priority flow regardless of load pressure. Excess flow is ported through the secondary pressure gallery for use in another set of valves or it can be sent through an optional external port.

Operation

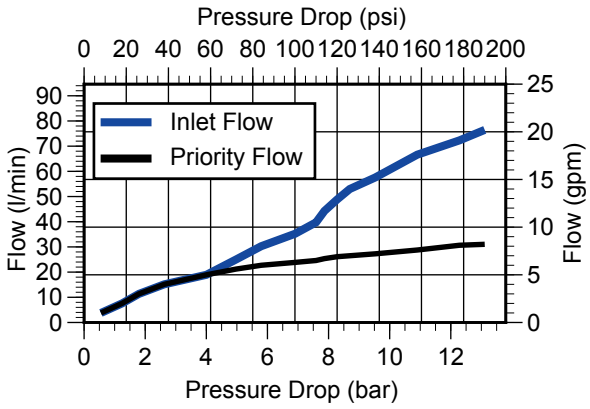
Inlet flow passes through the orifice at the end of the spool and passes through the spool center and out to the priority pressure gallery. The pressure drop across this orifice causes the spool to shift right against the spring. The spool then meters excess flow to the secondary port.

Specifications

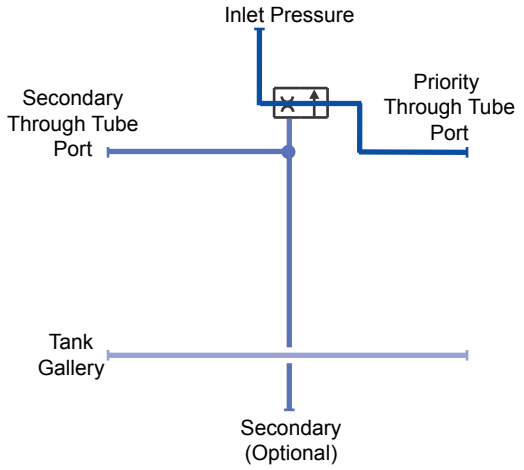
Weight		2.5 kg	5.5 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Secondary*	#8 SAE 3/4–16	
Compensating Pressure		15 bar	250 psi

* optional

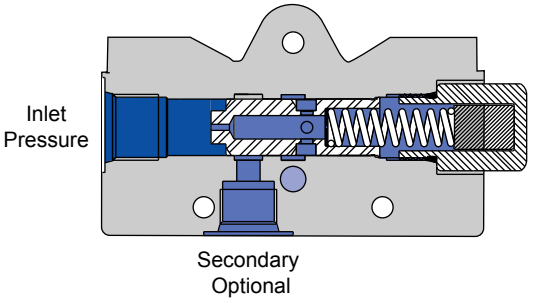
PFD Pressure Drop Curve



PFD Schematic



PFD Cut-away



ZMC - DPV Module: 3-Position/3-Way Demand Priority Valve

Description

The DPV module is a priority flow control valve. It is used to supply priority flow to a steering valve. Excess flow is bypassed to the module pressure gallery. This module also contains a dynamic load sense port which can be connected to a steering motor load sense port. This allows the motor to demand flow from the valve when it is required.

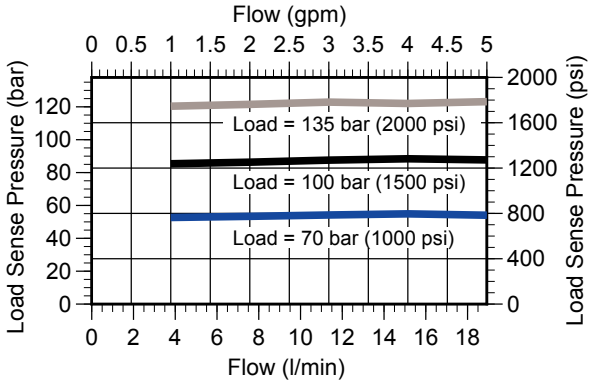
Operation

When no flow is required by the steering motor, the load sense line is connected to the tank through the motor and the priority flow is blocked. Priority port pressure causes the spool to shift, diverting flow to the valve module's pressure gallery. When steering flow is required, a variable orifice in the external steering motor's load sense line narrows sending a pressure signal to the spring end of the spool. This causes the spool to shift diverting a portion of the flow to the priority port. The amount of priority port flow is controlled by the load sense line pressure. Priority port pressure is limited by an externally adjustable relief cartridge connected to the load sense line.

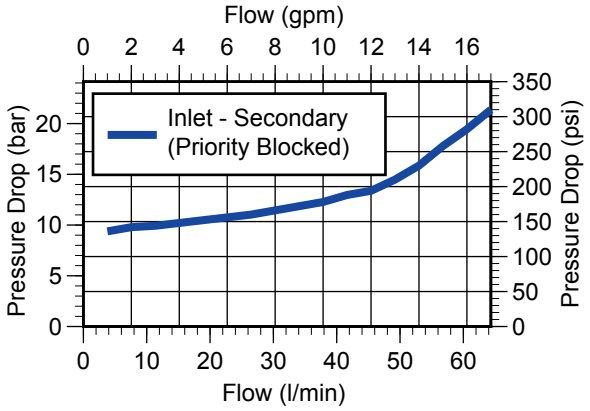
Specifications

Weight		3.9 kg	8.5 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Priority	37° Flare JIC #8	
	Load Sense	#4 SAE 7/16–20	
Priority Pressure		200 bar	3000 psi
Rated Flow	**Pressure**	64 l/min	17 gpm
	Priority	19 l/min	5 gpm

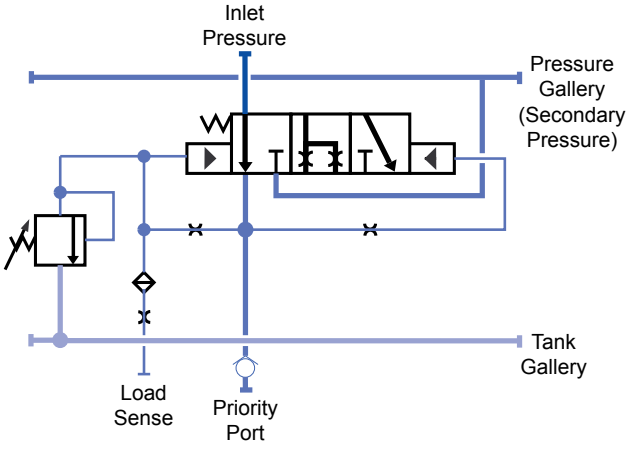
Load Sense Pressure vs. Priority Flow



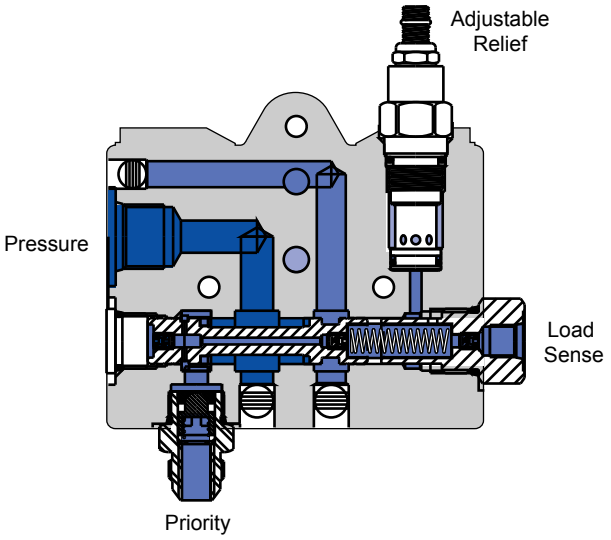
DPV Pressure Drop Curve



DPV Schematic



DPV Cut-away



ZMC - SOV Module: 2-Position/2-Way Pilot-Operated Poppet Valve

Description

The SOV module is a normally closed two-position, two-way solenoid-operated poppet valve. It is commonly used to control flow to a motor or other unidirectional actuators.

It is designed for low pressure drop and minimal leakage.

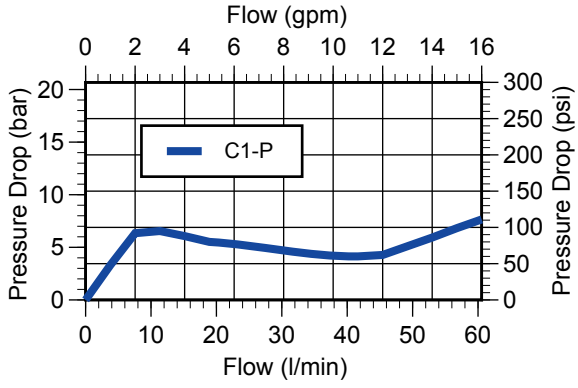
Operation

The valve is spring-biased closed. Energizing the solenoid will allow the pilot valve to open which drains the poppet spring chamber. Inlet flow overcomes the spring and opens the poppet. Flow is then channeled through the work port.

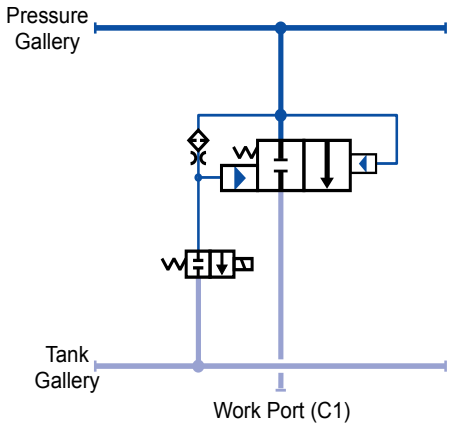
Specifications

Weight		2.6 kg	5.7 lb
Ports:	**Work**	#10 SAE 7/8–14	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.010	0.015
	Closed to Open	0.070	0.060

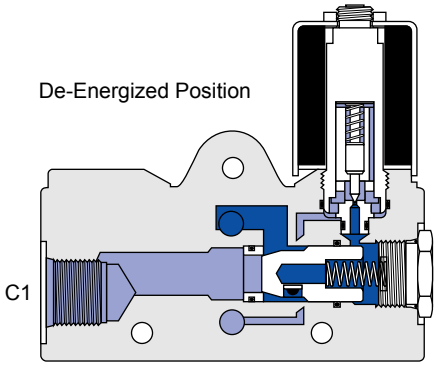
SOV Pressure Drop Curve



SOV Schematic



SOV Cut-away



ZMC - 240 Module:
2-Position/4-Way Criss-Cross Pilot-Operated Spool Valve

Description

The 240 module is a two-position, four-way spool valve. It is commonly used as directional control for dual-acting clutch cylinders.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

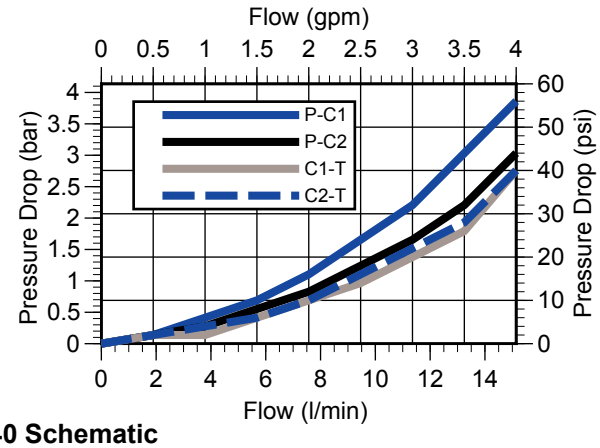
Operation

The spool is spring-biased to one flow path. Energizing the solenoid will allow the pilot valve to open which supplies inlet pressure to the other end of the spool. This pressure will overcome the spring and shift the spool.

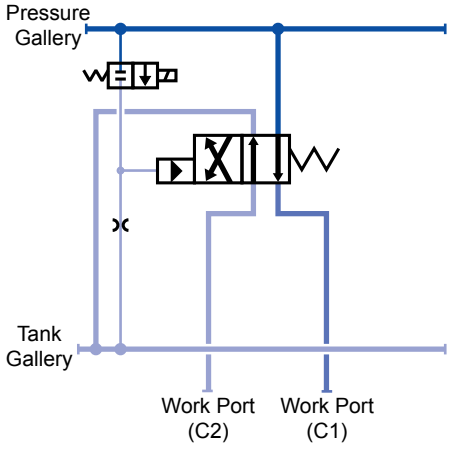
Specifications

Weight		2.7 kg	6.0 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.050	0.070
	Closed to Open	0.150	0.115

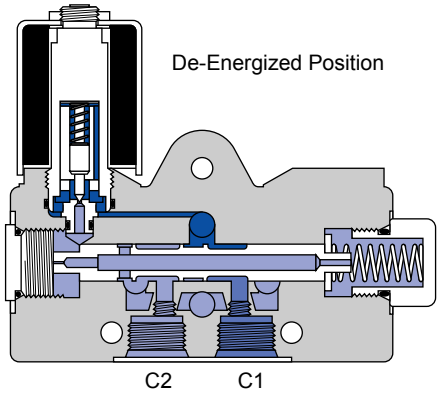
240 Pressure Drop Curve



240 Schematic



240 Cut-away



ZMC - 24C Module:
2-Position/4-Way Closed Center Pilot-Operated Spool Valve

Description

The 24C module is a two-position, four-way spool valve. The valve is closed in de-energized mode. It is commonly used for dual-acting, spring-returned cylinders, or unidirectional motors.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

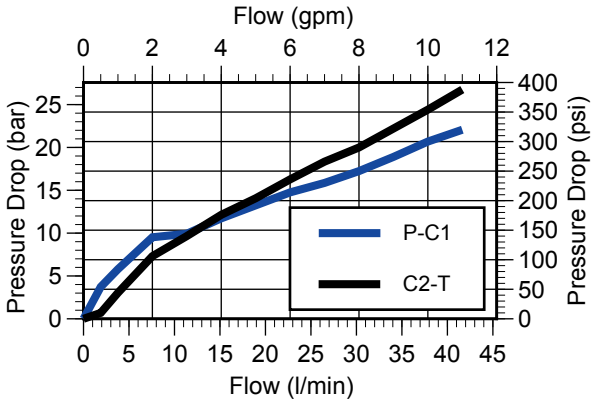
Operation

The spool is spring-biased to a center-blocked position. Energizing the solenoid will allow the pilot valve to open which supplies inlet pressure to one end of the spool. This pressure will overcome the spring and shift the spool.

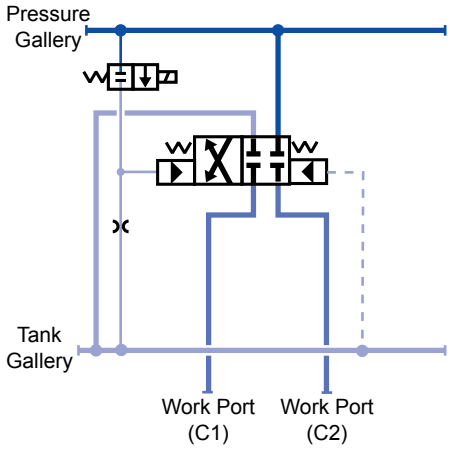
Specifications

Weight		2.7 kg	6.0 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.050	0.070
	Closed to Open	0.150	0.115

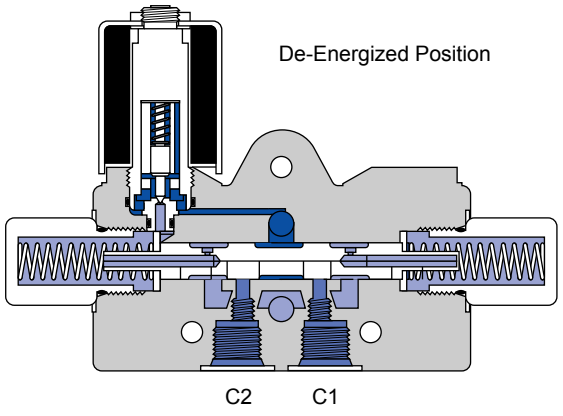
24C Pressure Drop Curve



24C Schematic



24C Cut-away



ZMC - 340 Module:
3-Position/4-Way Figure Four Pilot-Operated Spool Valve

Description

The 340 module is a three-position, four-way solenoid-operated spool valve. It is commonly used as directional control for dual-acting cylinders or bidirectional motors.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

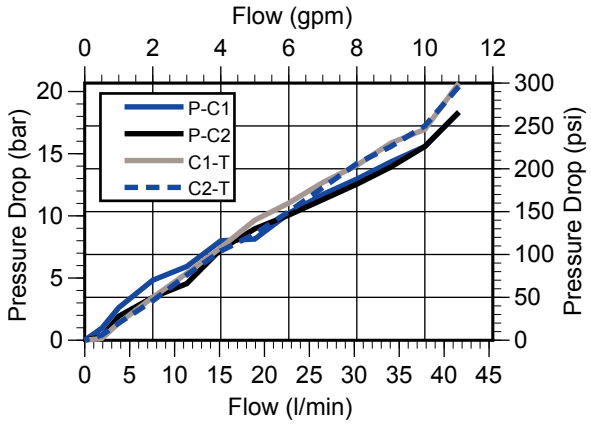
Operation

The spool is spring-biased to the center position. Energizing either solenoid will allow the pilot valve to open which supplies inlet pressure to one end of the spool. This pressure will overcome the centering spring and shift the spool. The dual-solenoid design allows flow to be channeled in either direction.

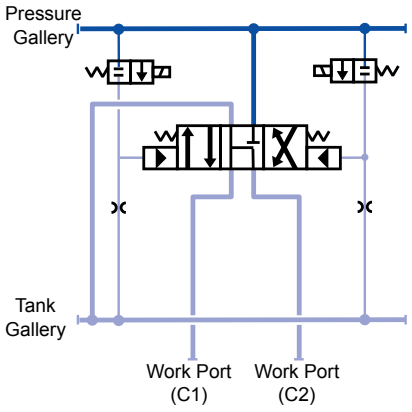
Specifications

Weight		2.8 kg	6.1 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.065	0.100
	Closed to Open	0.085	0.085

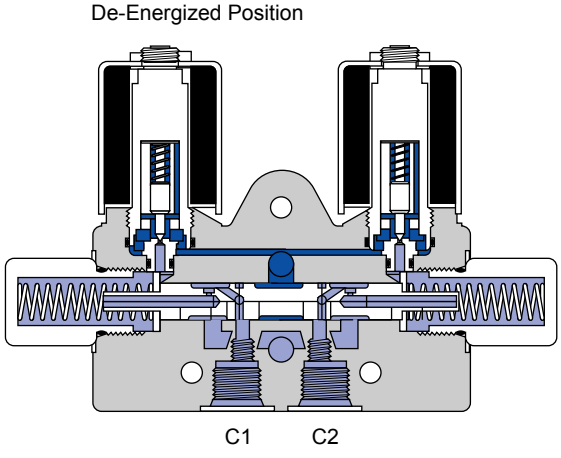
340 Pressure Drop Curve



340 Schematic



340 Cut-away



ZMC - 34C Module:
3-Position/4-Way Closed Center Pilot-Operated Spool Valve

Description

The 34C module is a three-position, four-way solenoid-operated spool valve. It is commonly used as directional control for dual-acting cylinders or bidirectional motors.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

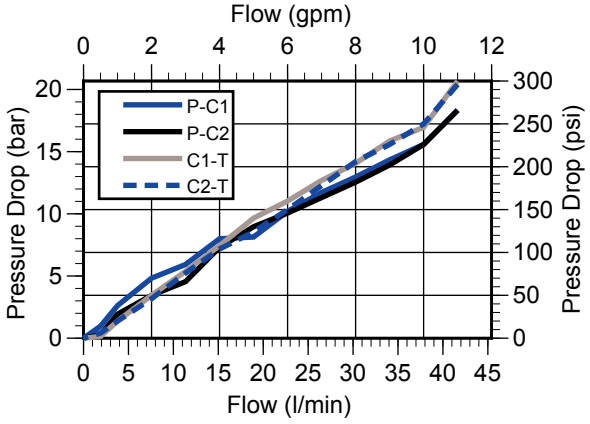
Operation

The spool is spring-biased to the center-blocked mode. Energizing either solenoid will allow the pilot valve to open which supplies inlet pressure to one end of the spool. This pressure will overcome the centering spring and shift the spool. The dual-solenoid design allows flow to be channeled in either direction.

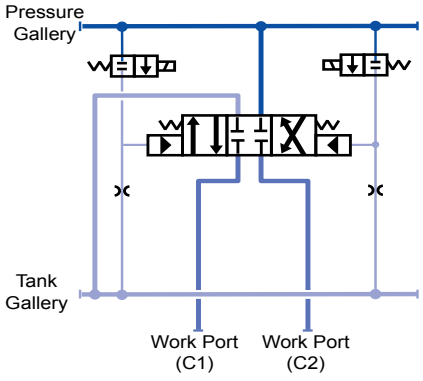
Specifications

Weight		2.8 kg	6.1 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.065	0.100
	Closed to Open	0.085	0.085

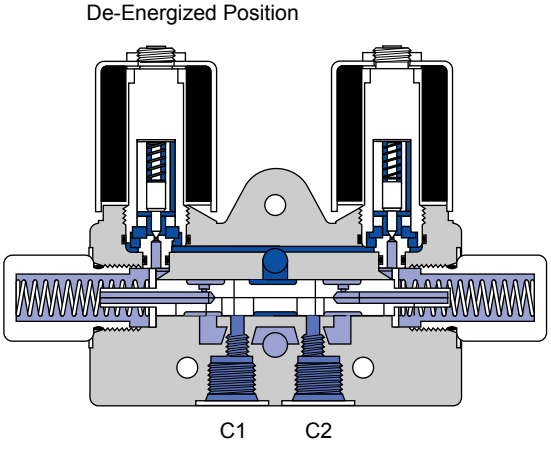
34C Pressure Drop Curve



34C Schematic



34C Cut-away



ZMC - 34X Module:
3-Position/4-Way Figure Four Pilot-Operated Spool Valve with P-O Checks

Description

The 34X module is a four-way, three-position solenoid-operated spool valve with single or dual pilot-operated checks for load holding. It is commonly used as directional control for dual-acting cylinders or bidirectional motors.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

Operation

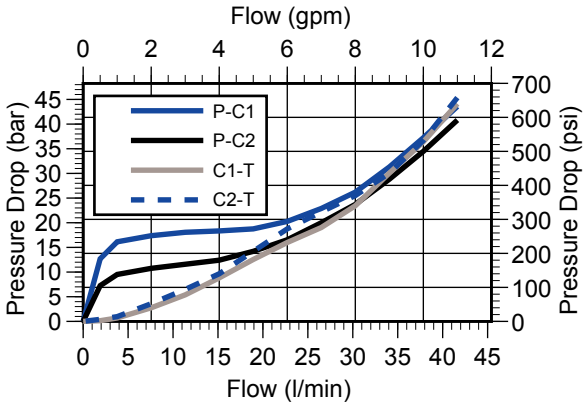
The spool is spring-biased to the center position. Energizing either solenoid will allow the pilot valve to open which supplies inlet pressure to one end of the spool. This pressure will overcome the centering spring and shift the spool. The dual-solenoid design allows flow to be channeled in either direction.

The pilot-operated checks are poppet style valves designed for low leakage. The checks will open when pilot pressure is 1/5 of the load pressure plus the spring crack pressure. Standard crack pressure is 7 bar (100 psi).

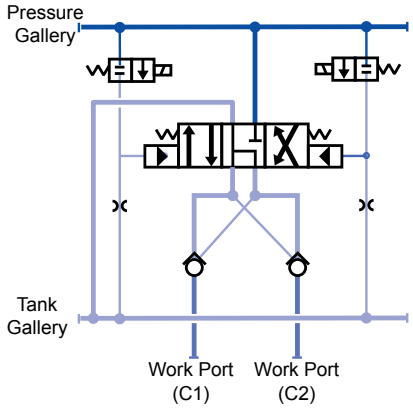
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.070	0.100
	Closed to Open	0.095	0.090
Pilot Ratio		5:1	
Crack Pressure		7 bar	100 psi

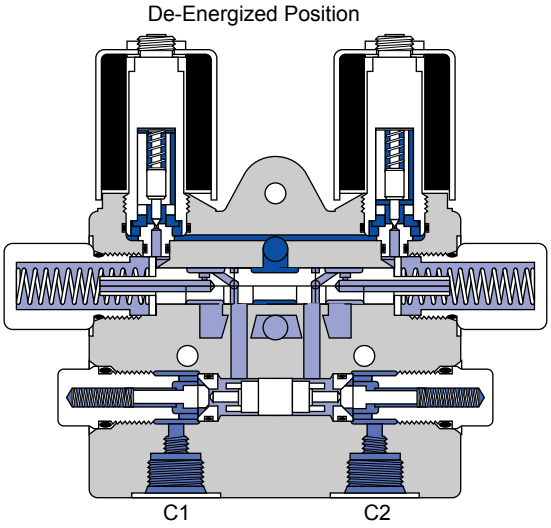
34X Pressure Drop Curve



34X Schematic



34X Cut-away



ZMC - 34Y Module:
3-Position/4-Way Closed Center Pilot-Operated Spool Valve with P-O Checks

Description

The 34Y module is a four-way, three-position solenoid-operated spool valve with single or dual pilot-operated checks for load holding. It is commonly used as directional control for dual-acting cylinders or bidirectional motors.

This module is designed to accept orifice plugs or unidirectional orifice plates in the work ports. Please see page 37 for information on selecting orifice size.

Operation

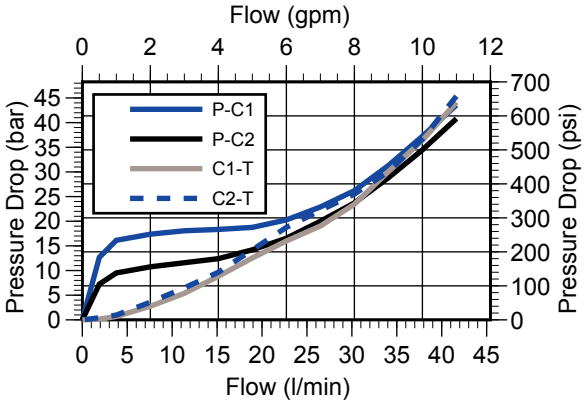
The spool is spring-biased to the center-blocked position. Energizing either solenoid will allow the pilot valve to open which supplies inlet pressure to one end of the spool. This pressure will overcome the centering spring and shift the spool. The dual-solenoid design allows flow to be channeled in either direction.

The pilot-operated checks are poppet style valves designed for low leakage. The checks will open when pilot pressure is 1/5 of the load pressure plus the spring crack pressure. Standard crack pressure is 7 bar (100 psi).

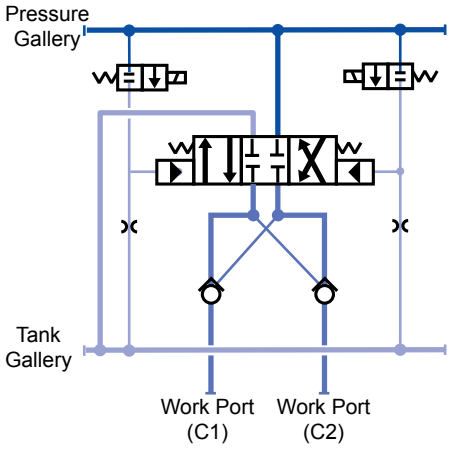
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Work**	#8 SAE 3/4–16	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.070	0.100
	Closed to Open	0.095	0.090
Pilot Ratio		5:1	
Crack Pressure		7 bar	100 psi

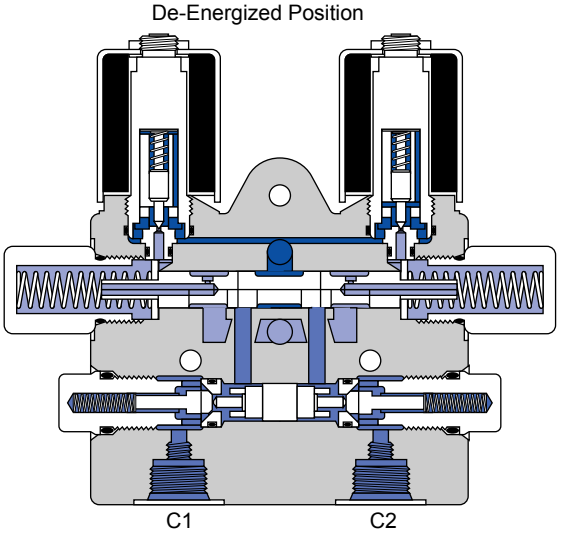
34Y Pressure Drop Curve



34Y Schematic



34Y Cut-away



ZMC - PPV Module:
3-Position/3-Way Normally Closed Pilot-Operated Poppet Valve

Description

The PPV module is a three-position, three-way poppet valve. It is commonly used as directional control for single-acting cylinders.

This module also contains built in pressure protection for the work port, poppet type checks on the outlet, and two manually adjustable flow controls for the raise and lower functions.

The PPV module is designed with poppets to offer minimal leakage (2 drops/min) and low pressure drop.

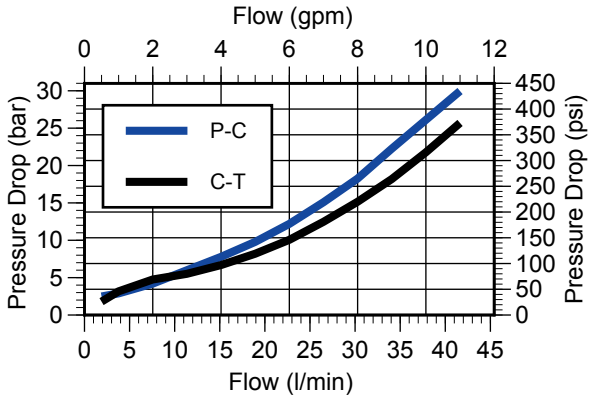
Operation

The poppets are spring-biased closed. Energizing either solenoid will open the pilot valve which will vent the main poppet spring chamber. Pressure will overcome the spring and shift the poppet open. Energizing the Raise poppet will pressurize the work port. Energizing the Lower poppet will depressurize the work port.

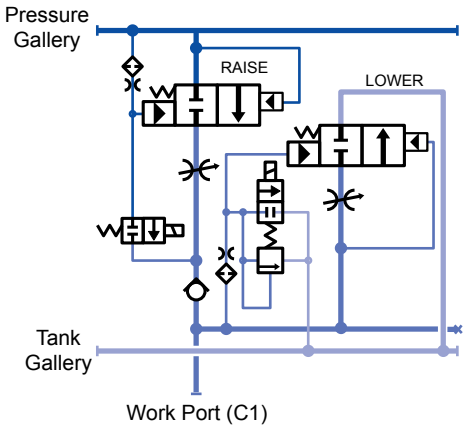
Specifications

Weight		2.8 kg	6.1 lb
Ports:	**Work**	#6 SAE 9/16–18	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Open to Closed	0.050	0.145
	Closed to Open	0.090	0.070

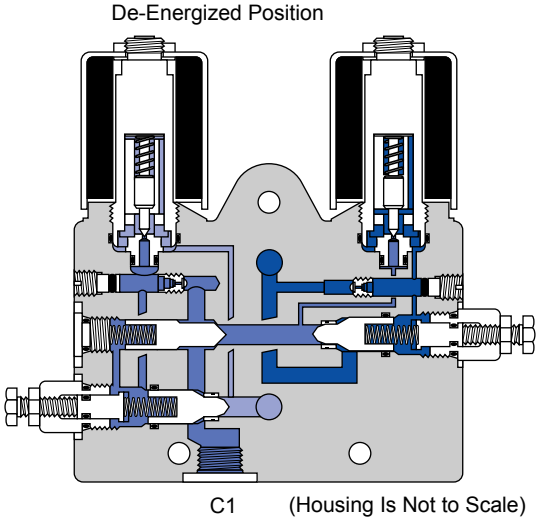
PPV Pressure Drop Curve



PPV Schematic



PPV Cut-away



ZMC - LFS Module: Standard Low Flow Valve

Description

The LFS module is a three-way, three-position solenoid-operated poppet valve. It is commonly used as directional control for single-acting cylinders with low flow requirements. This module also contains pressure protection for the work port.

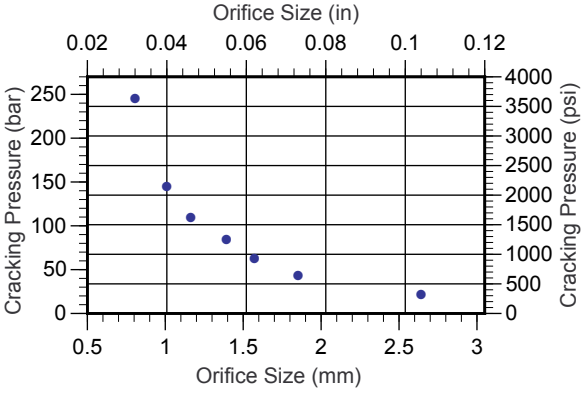
Operation

The direct-acting poppets are spring-biased closed. Energizing the solenoid will open the poppets and allow flow to or from the work port.

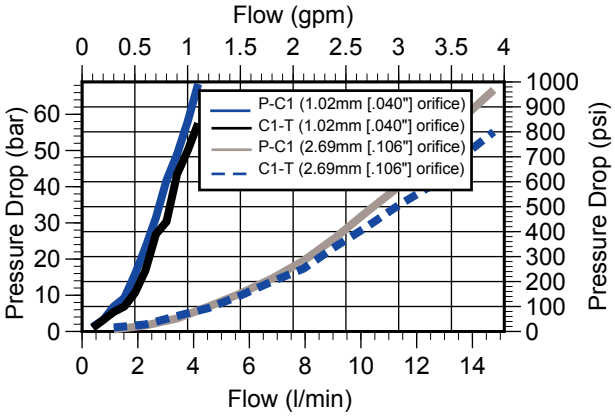
Specifications

Weight		3.1 kg	6.9 lb
Ports:	**Work**	#4 SAE 7/16–20	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Raise	.015	.03
	Lower	.415	.57

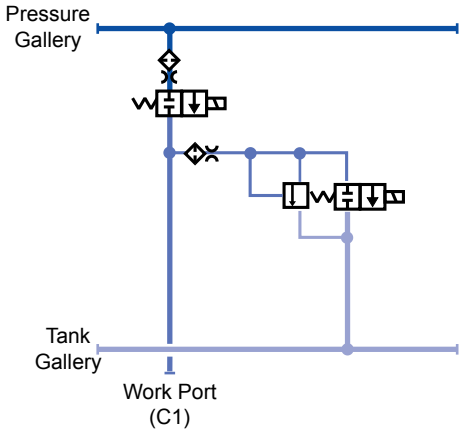
LFS Cracking Pressure Curve



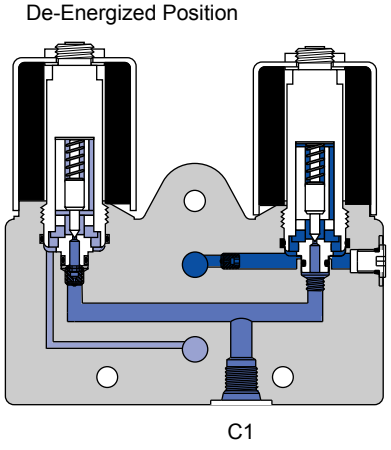
LFS Pressure Drop Curve



LFS Schematic



LFS Cut-away



ZMC - LFH Module: High Pressure Low Flow Valve

Description

The LFH module is a three-way, three-position solenoid-operated poppet valve. It is commonly used as directional control for single-acting cylinders with low flow requirements. It has a higher cracking pressure for use with higher pressure flows. This module also contains pressure protection for the work port.

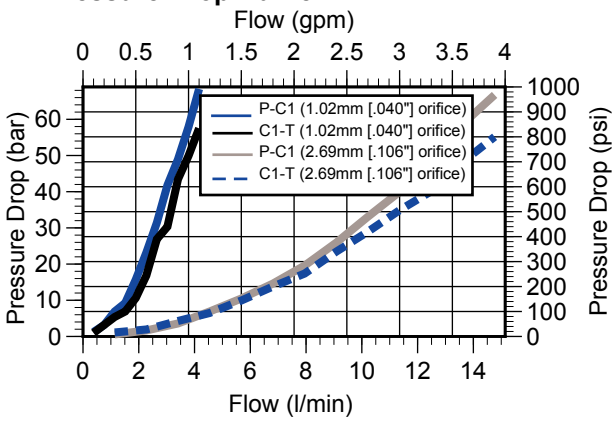
Operation

The direct-acting poppets are spring-biased closed. Energizing the solenoid will open the poppets and allow flow to or from the work port.

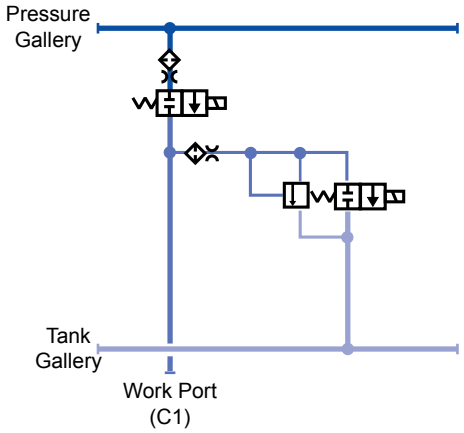
Specifications

Weight		3.1 kg	6.9 lb
Ports:	**Work**	#4 SAE 7/16–20	
Response Time (sec)			
	Coil Duty:	Intermittent	Continuous
	Raise	.15	N/A
	Lower	.75	N/A

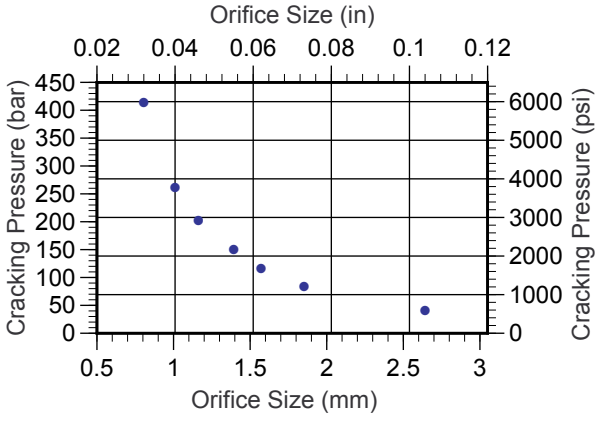
LFH Pressure Drop Curve



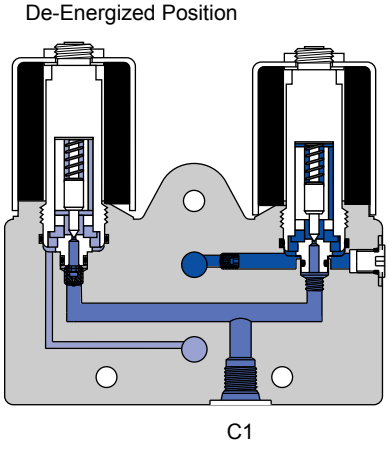
LFH Schematic



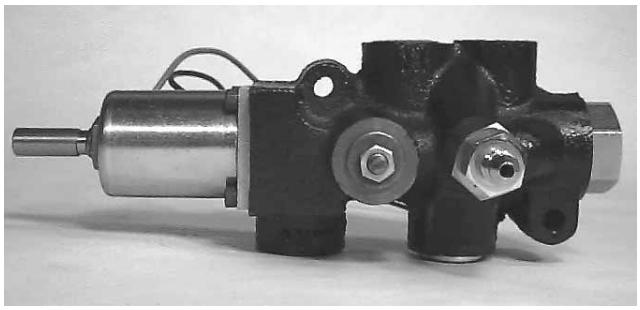
LFH Cracking Pressure Curve



LFH Cut-away



Description



ZMV modules are electronic proportional valve assemblies used to control flow to a motor or other type of actuator. They include pressure compensation to accurately control flow regardless of load pressure. A manually adjustable override is available to bypass the proportional electrical valve. ZMV modules are stand alone units and are not stackable.

ZMV modules are available in open center (21O and 21P) and closed center (21C and 21L) valve configurations. The open center module can include a Power Beyond port to channel excess flow to another function (21P). The closed center module can come with load sensing capability (21L).

Typical applications include variable motor speed circuits on combines, salt spreader applications on trucks, and hydraulic motor conveyers.

Operation

The module's pilot valve is spring-biased normally closed. When a pulse width modulated (PWM) signal of 35 to 100 Hz is applied to the solenoid, the valve will open proportionally to the current. The compensating spool maintains a constant pressure drop across the pilot valve (or manual valve) and therefore pressure compensates the priority flow.

A potentiometer and electronic driver on page 35 or a joystick control on page 36 may be used to supply the valve input signal.

ZMV-21O: Open Center Proportional Flow Control Valve

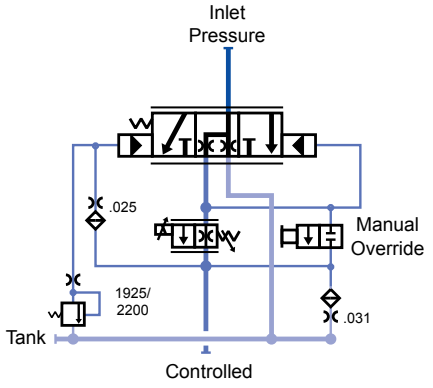
Description

The ZMV 21O valve is designed for open center systems (e.g. fixed displacement pumps). Controlled flow is pressure compensated. Excess flow is always bypassed to tank.

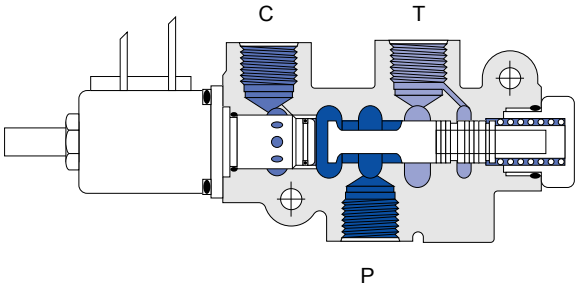
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Controlled	#10 SAE 7/8–14	
	Tank	#10 SAE 7/8–14	
PWM Frequency Range		35 - 100 Hz	
PWM Current Range		0 - 1.2 Amps	
Flow:	**Pressure**	76 l/min	20 gpm
	Controlled	38 l/min	10 gpm

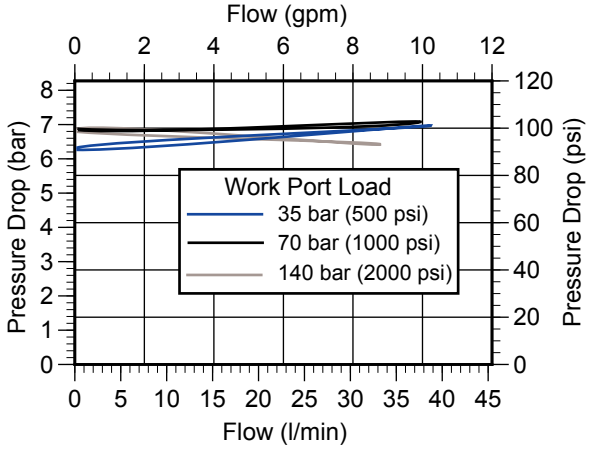
21O Schematic



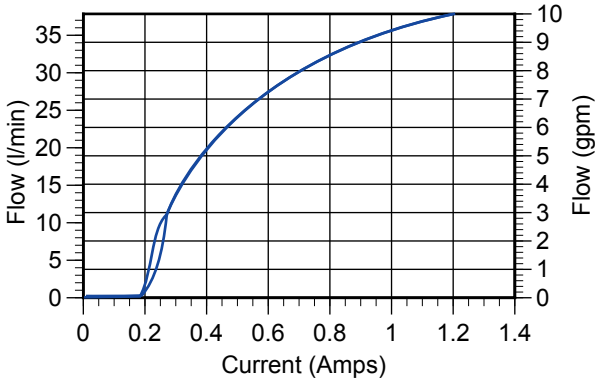
21O Cut-away



21O Pressure Drop vs Flow Curve



21O Flow vs Current Hysteresis Curve



ZMV-21P: Open Center Proportional Flow Control Valve with Power Beyond

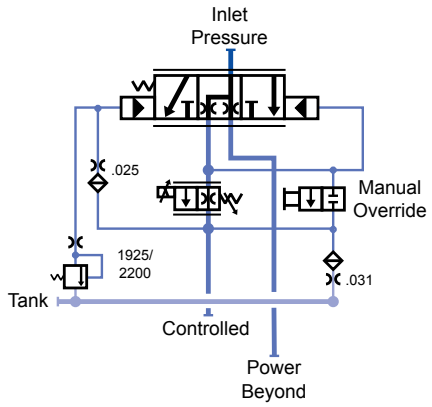
Description

The ZMV-21P valve is designed for open center systems (fixed displacement pumps). Controlled flow is pressure compensated. A bypass function unloads excess flow to the Power Beyond port. This flow is not pressure compensated.

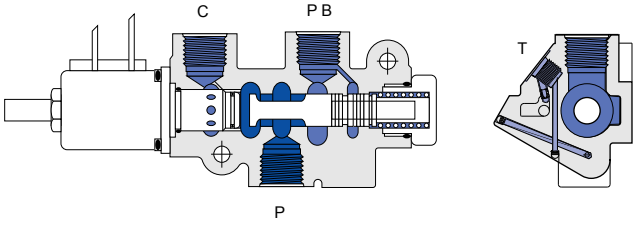
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Controlled	#10 SAE 7/8–14	
	Power Beyond	#10 SAE 7/8–14	
	Tank	#4 SAE 7/16–20	
PWM Frequency Range		35 - 100 Hz	
PWM Current Range		0 - 1.2 Amps	
Flow:	**Pressure**	76 l/min	20 gpm
	Controlled	38 l/min	10 gpm

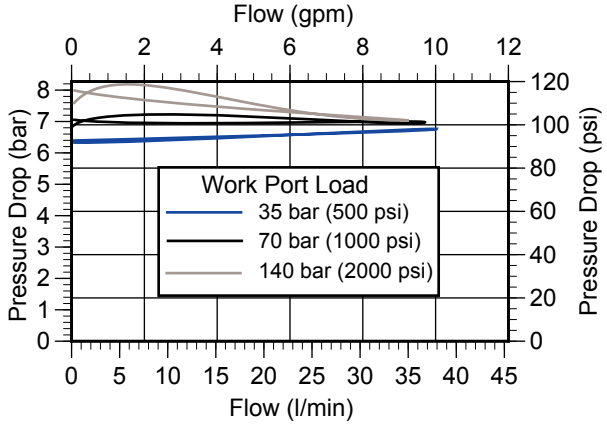
21P Schematic



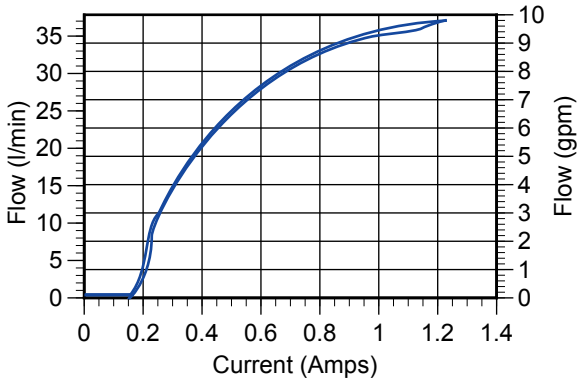
21P Cut-away



21P Pressure Drop vs Flow Curve



21P Flow vs Current Hysteresis Curve



ZMV-21C: Closed Center Proportional Flow Control Valve

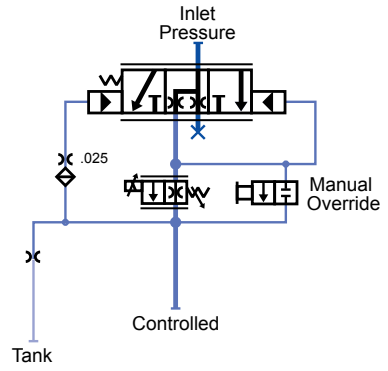
Description

The ZMV-21C valve is designed for closed center systems (variable displacement pumps).

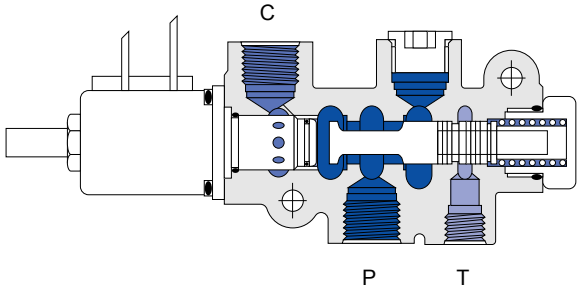
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Controlled	#10 SAE 7/8–14	
	Tank	#6 SAE 9/16–18	
PWM Frequency Range		35 - 100 Hz	
PWM Current Range		0 - 1.2 Amps	
Flow:	**Pressure**	76 l/min	20 gpm
	Controlled	38 l/min	10 gpm

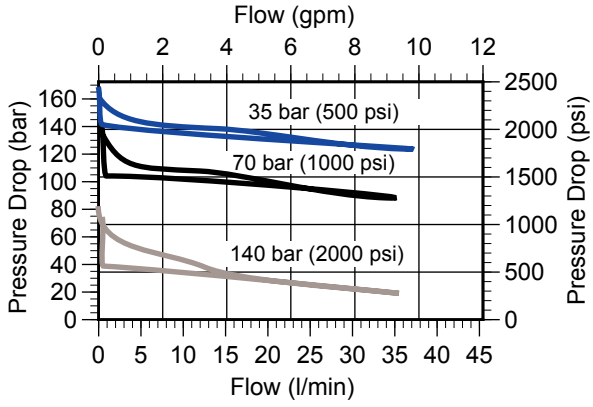
21C Schematic



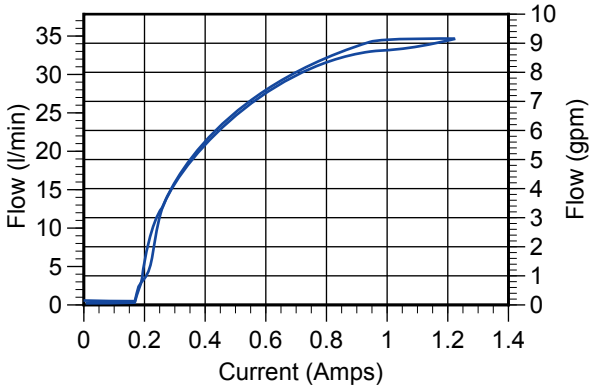
21C Cut-away



21C Pressure Drop vs Flow Curve



21C Flow vs Current Hysteresis Curve



ZMV-21L: Closed Center Load-Sensing Proportional Flow Control Valve

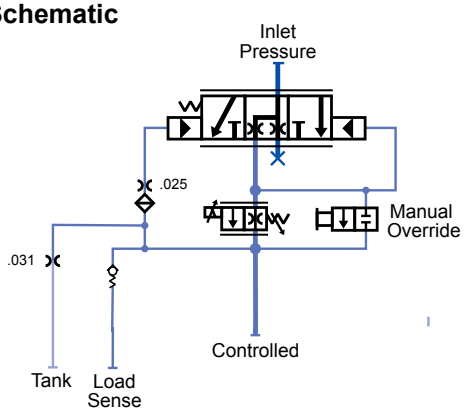
Description

The ZMV-21L valve is designed for closed center load sense systems (variable displacement pumps).

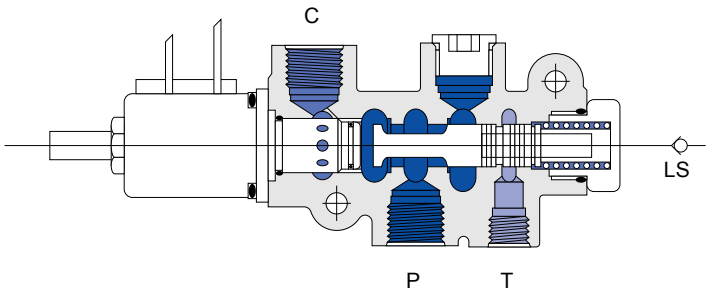
Specifications

Weight		4.2 kg	9.2 lb
Ports:	**Pressure**	#10 SAE 7/8–14	
	Controlled	#10 SAE 7/8–14	
	Load Sense	#6 SAE 9/16–18	
	Tank	#6 SAE 9/16–18	
PWM Frequency Range		35 - 100 Hz	
PWM Current Range		0 - 1.2 Amps	
Flow:	**Pressure**	76 l/min	20 gpm
	Controlled	38 l/min	10 gpm

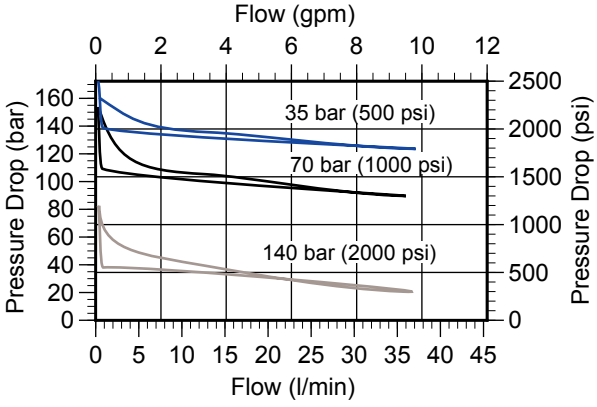
21L Schematic



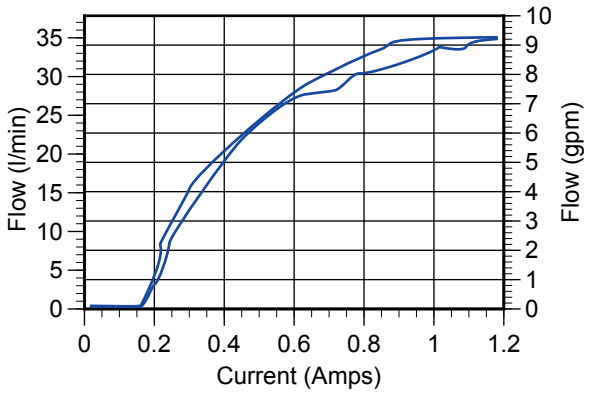
21L Cut-away



21L Pressure Drop vs Flow Curve



21L Flow vs Current Hysteresis Curve



Solenoids

General Description

ZMC and ZMV valves utilize the same solenoid design. This two piece design consists of an encapsulated coil and a metal enclosure.

Several terminations, voltages, and diodes are available. Intermittent solenoids are used to improve response time. Consult duty cycle ratings when using intermittent duty solenoids.

Specifications

Resistance and Wattage:

Continuous duty coil at 20° C (70° F):

Coil Duty:	Continuous		Intermittent	
Duty Voltage (VDC)	Resistance (Ω)	Power (W)	Resistance (Ω)	Power (W)
6	3.6	10	--	--
12	14.5	10	3.6	40
24	57.2	10	14.5	40

Duty Rating:

Rated voltage at 50°C (120°F):

Continuous Duty	±20%
Intermittent Duty	±20%

Temperature Range:

Class H, -40°C to 82°C (-40°F to 180°F)

Lead Wires:

20 gauge, 18” long

Encapsulating Material:

Cyglass

Arc Suppression Diode (Optional):

IN4004

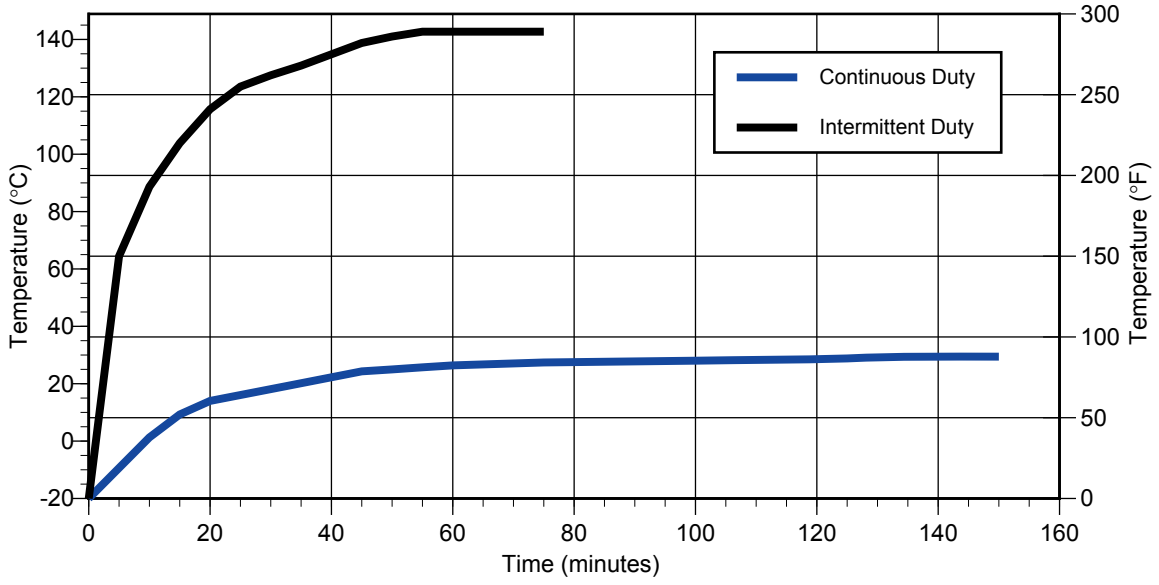
Coil Nut Torque:

ZMC Valves	7.3 Nm	65 in•lbf
ZMV Valves	2.8 Nm	25 in•lbf

110VAC solenoids are internally rectified. They are rated for reverse voltage spikes of 400 volts maximum.

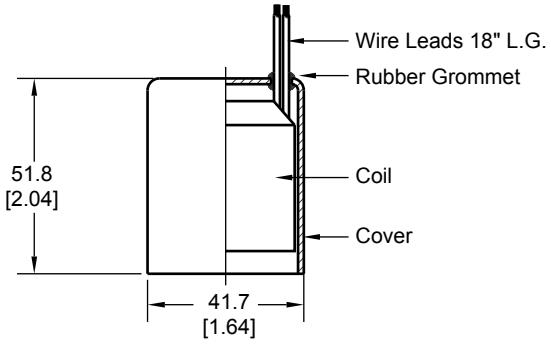
Standard solenoids are not hermetically sealed. Contact QCC regarding applications requiring waterproof solenoids.

Solenoid Temperature Rise Curve

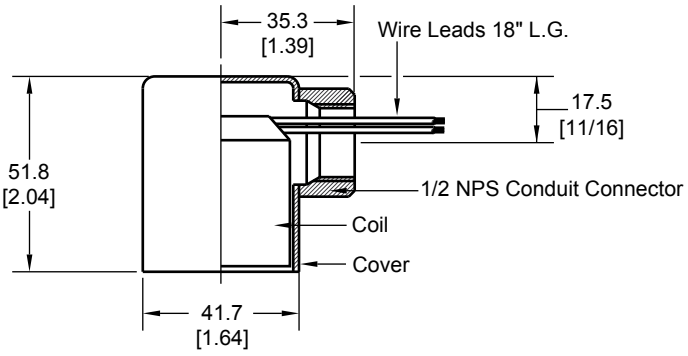


Solenoid Outline Drawings

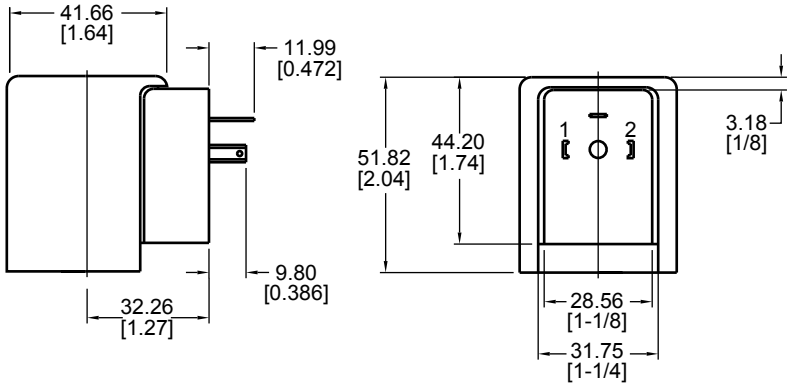
A variety of solenoids are available to choose from. See the Order Code on page 6 for available voltages. (Mating connectors are not included with solenoid.)



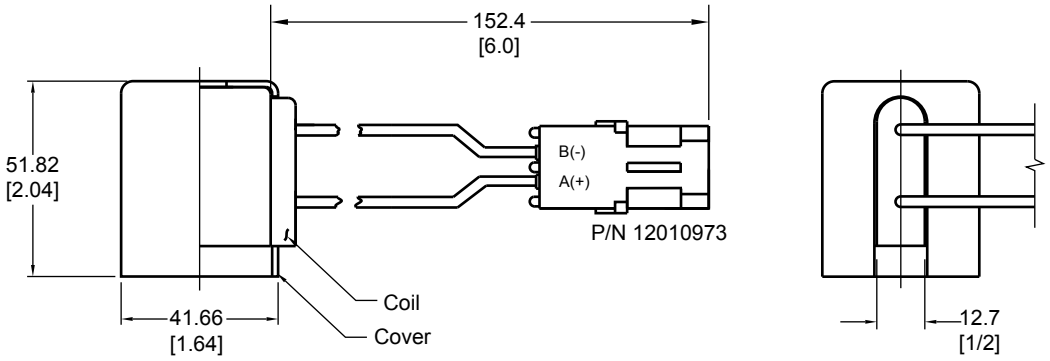
Grommet / Wire Leads



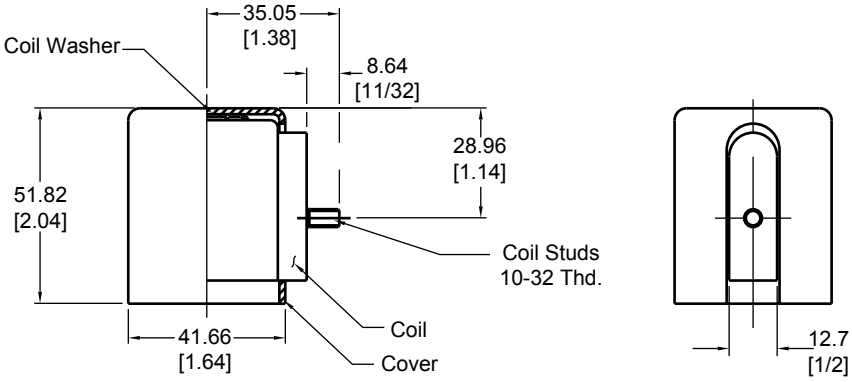
Conduit / Wire Leads



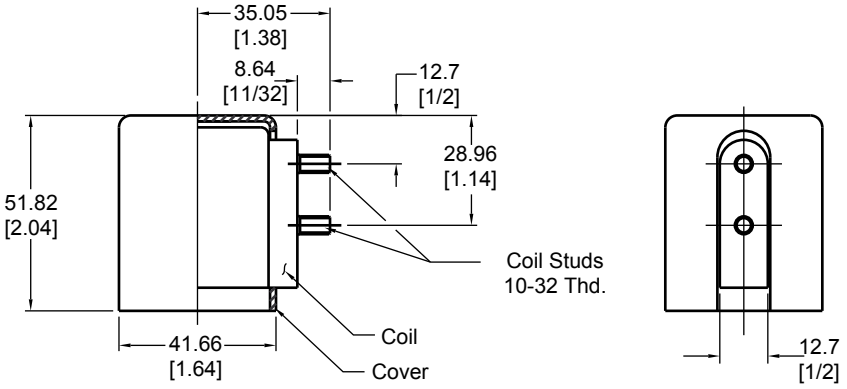
DIN 43650



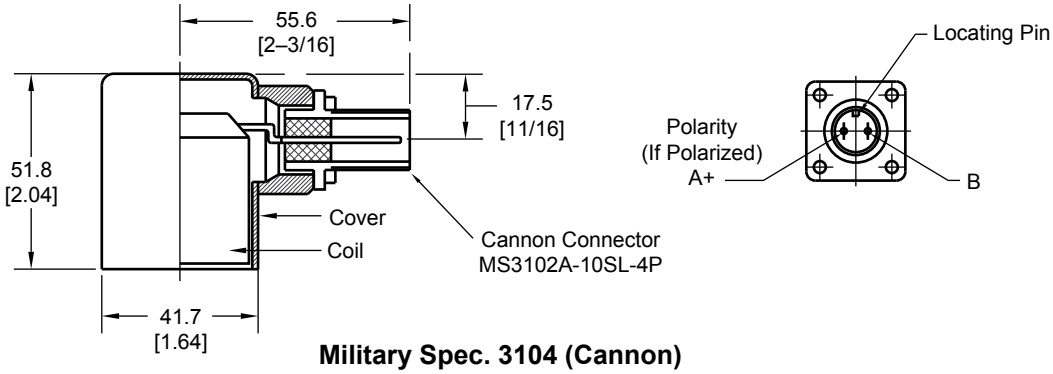
Weather Pack 12010973



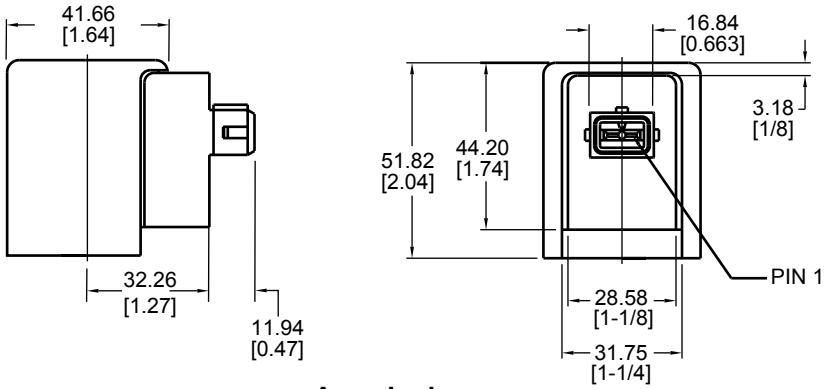
Single Stud



Double Stud



Military Spec. 3104 (Cannon)



Amp Junior

Control Device Options

SCA-35: Single Channel Amplifier

Description

The SCA-35 single channel amplifier is designed to optimize the performance of ZMV series pressure-compensated flow control valves in handling flows from 4 to 38 l/min (1 to 10 gpm).

The SCA-35's current feedback provides low hysteresis by compensating for fluctuations in input voltage and solenoid resistance. Output overload and arc suppression diode protection is included in the SCA-35. However, arc suppression is also recommended for the valve's coil.

The SCA-35 is fully encapsulated for protection against humidity, vibration, and shock.

Operation

The control signal to the driver is generated by a potentiometer or an analog signal. The amplifier provides no output until the control input is greater than 1% of the internal reference voltage (+5 VDC).

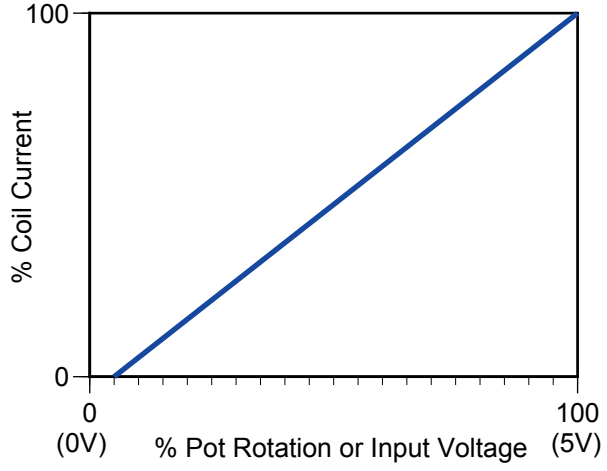
A 2Ω, 2.25 watt resistor with 292of travel is available from QCC (P/N K10197, Knob P/NK04860).

This system allows the operator to turn off the valve without switching input power. The addition of optional resistors allows the driver to maximize the resolution of the set point potentiometer. These may be fixed resistors or a variable potentiometer.

Specifications

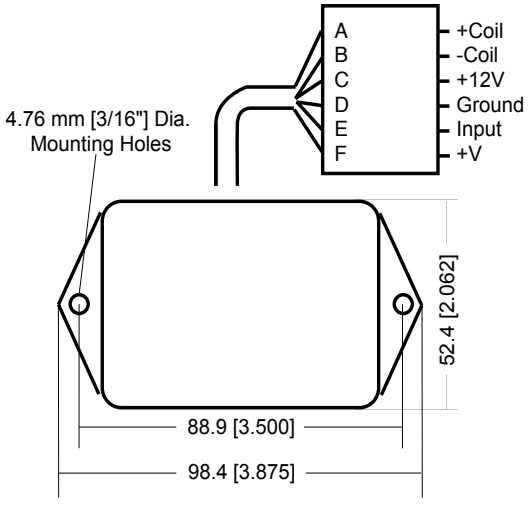
Supply Voltage	9.6 - 16.0 VDC	
Operating Frequency	35 Hz	
Maximum Continuous Output Current	1.1 Amp	
Input signal	>2 kΩ, 0-5 VDC, >1 Amp	
Connections (Mating Connectors must be ordered separately.)	Packard Weatherpack 6 pin mating connector (P/N 12015799).	
Weight	0.26 kg	0.57 lb
Package Dimensions	99 x 54 x 39 mm	3.9 x 2.1 x 1.5 in
Mounting Orientation	any	
Temperature Range	-40 to 85°C	-40 to 185°F

Output vs. Input



Note: No Output from 0 - .05V

Outline Dimensions



Electronic Control Handle: MCH41CL2287

Description

This panel mount control handle is designed to operate the ZMV series flow control valves. It is enclosed in a plastic case and includes a non-locking knob and friction-held control.

Combined with any ZMV valve, this driver will provide a complete pressure compensated flow control system to handle 4 to 38 l/min (1 to 10 gpm).

The control handle's current feedback provides repeatability by compensating for fluctuations in input voltage and solenoid resistance. Output overload and arc suppression protection is included in the control handle. However, arc suppression is also recommended for the coil.

Operation

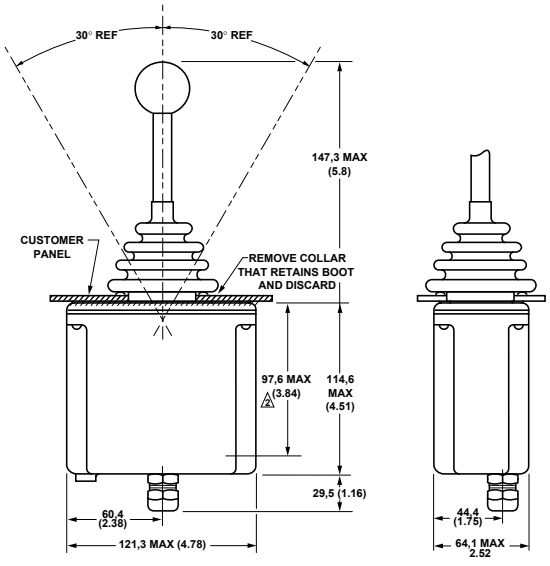
The control signal to the driver is generated by a potentiometer located in the control handle. The amplifier provides no output until the control input is greater than 1% of the internal reference voltage (+5 VDC). This allows the operator to turn off the valve without switching input power.

Specifications

Supply Voltage	9.6 - 16.0 VDC	
Operating Frequency	100 Hz	
Maximum Output Current	1.1 Amp	
Input signal	> 2 kΩ, 0-5 VDC, > 1 Amp	
Connections Mating connectors are not included.	Packard Weatherpack 6 pin mating connector (P/N 12015799)	
Weight	0.26 kg	0.57 lb
Temperature Range	-40 - 85°C	-40 - 185°F

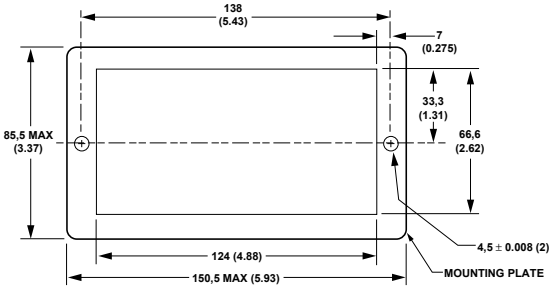
Outline Drawings

For other control handle options consult SAS BLN 95-9049



PANEL MOUNT

SIDE VIEW OF ALL PANEL MOUNT

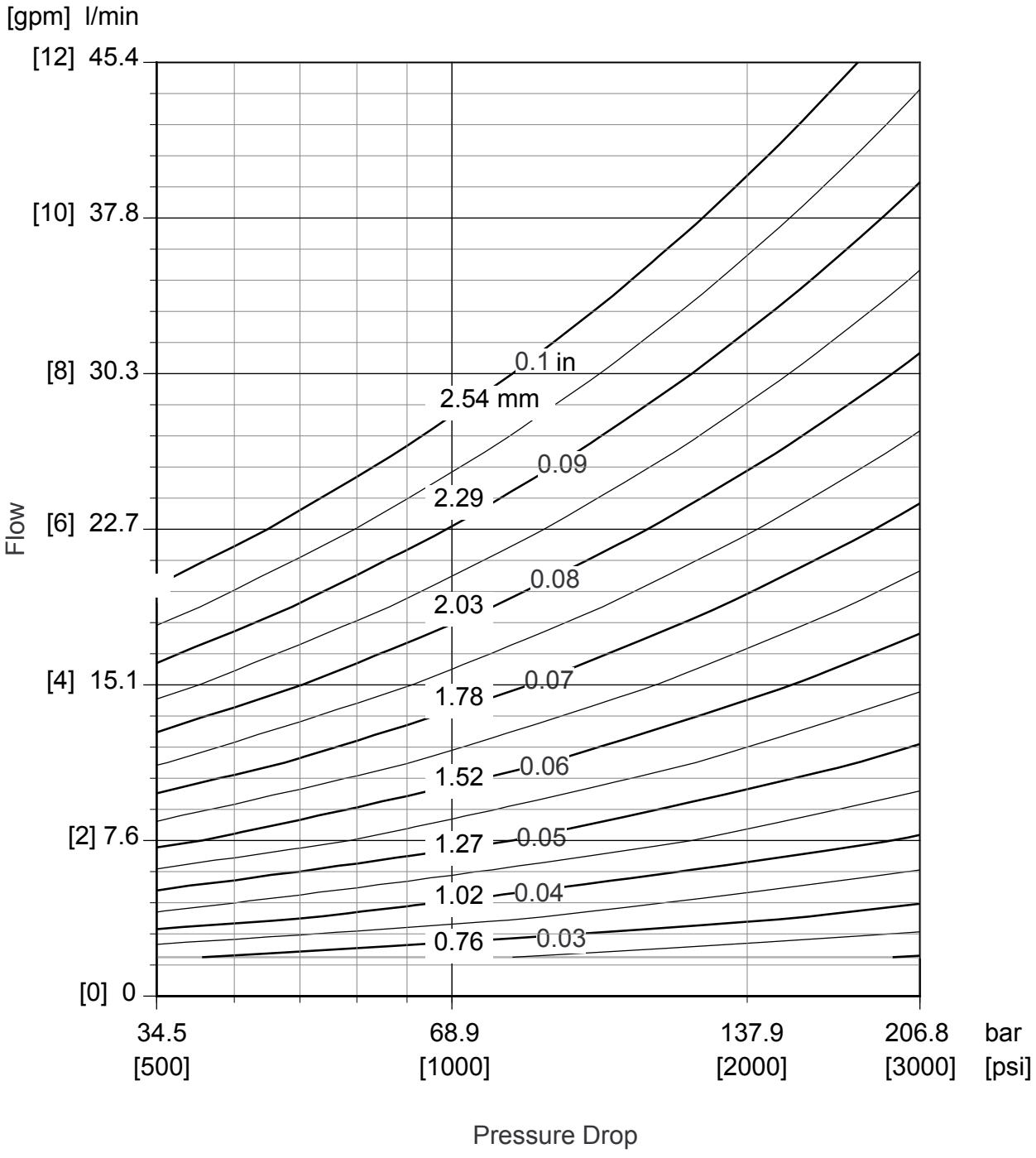


PANEL CUTOUT AND MOUNTING PLATE

Orifice Plugs / Plates

Standard threaded orifice plugs are available to mount in the ZMC-240, 24C, 340, 34C, 34X, and 34Y modules. Orifice plates are also available to place in the work ports of the above modules. Below are graphs showing the orifice size required based on the flow and pressure drop desired.

Orifice Size for Specific Flow and Pressure Drop



Required Assembly Hardware

Through Tubes / Plug Tubes

All ZMC modules utilize common pressure and tank galleries running through the length of the valve stack. Each through tube includes two sets of O-rings and back up rings for elimination of leakage between the modules.

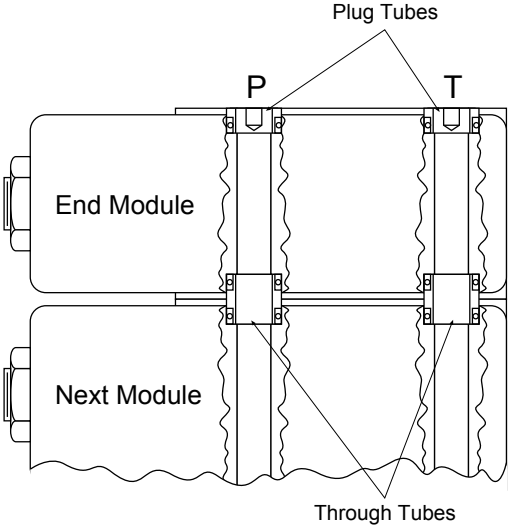
Three tie bolts are used in each ZMC valve stack to join the modules together. The through tubes assist in aligning the modules into the stack. This eliminates the spool binding that occurs due to over torquing the tie bolts or mounting to uneven surfaces.

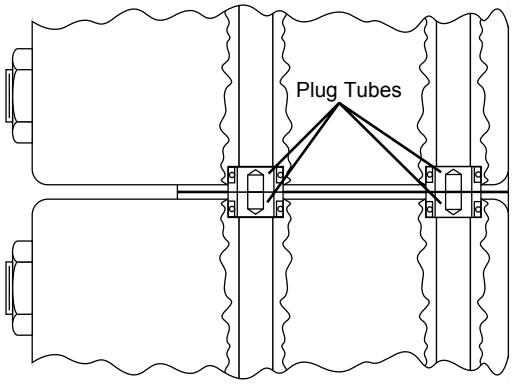
Plug tubes are used to seal the pressure and tank galleries at the end of the valve stack. To add modules to an assembled valve stack the plug tubes can be removed and replaced by a through tube to accommodate additional modules.

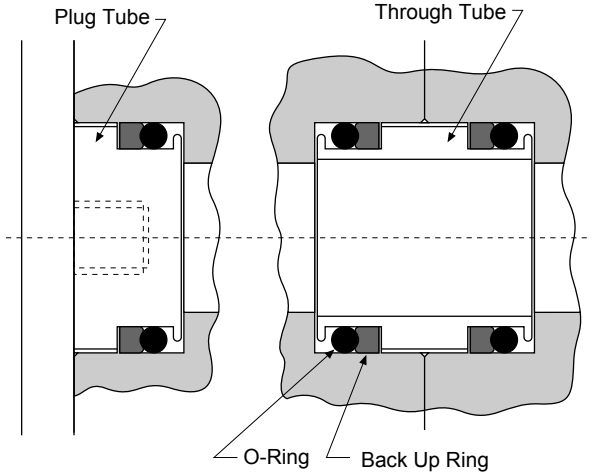
Plug tubes can also be used to isolate a particular module's pressure and/or tank gallery from the rest of the stack.

Tube Part Numbers

Plug Tube	Z2819006
Standard Through Tube	Z2812011
Long Through Tube	Z2812012







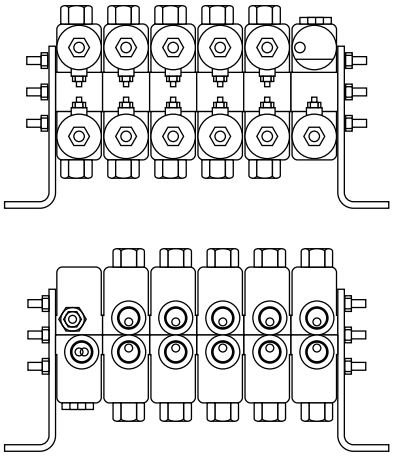
Stacking Configurations

Valve assemblies can be mounted in any direction, but for clarity a valve stack with “L” brackets is referred to as **“Horizontal”** and a stack without “L” brackets as **“Vertical”** (see figures).

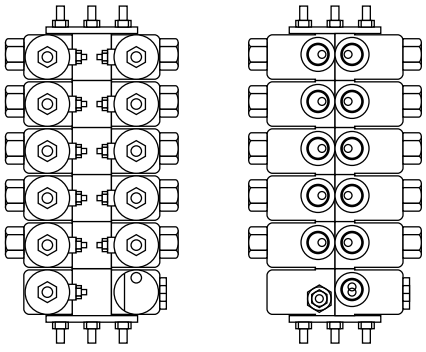
"L" feet mounting brackets and end plates are provided to support the complete stack. The brackets are stamped from steel and zinc plated. Tie bolts are used to fasten the stack together. Pressure and tank connections are made either through the appropriate end caps or through the Unload modules (UVx, URx). Plug tubes are inserted in the end modules to seal the pressure and tank galleries.

An alternative mounting style is to use the tie bolts to fasten the valve stack to a customer-supplied metal plate.

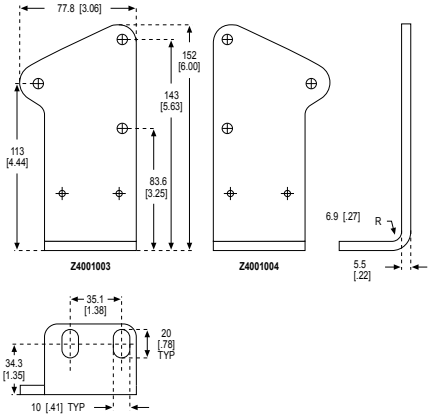
All ZMC modules can also be utilized as stand alone line mount valves.



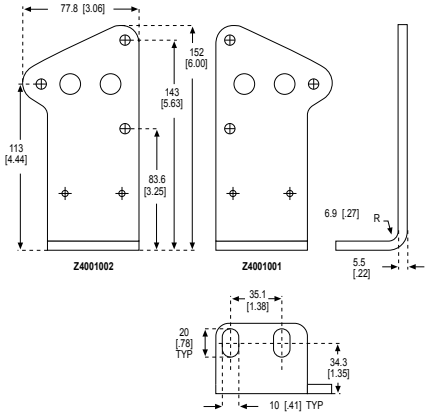
"Horizontal" Stack Assembly



"Vertical" Stack Assembly



"L" Mounting Bracket



"L" Mounting Bracket with Port Access

Stacking Kits

Currently six stacking kit configurations are offered. These are listed in tables on the following pages.

Stack Type	Hardware	Table
Horizontal	Two Mounting Brackets, No End Caps	A
Horizontal	Two Mounting Brackets, One End Cap with Ports Right	B
Horizontal	Two Mounting Brackets, One End Cap with Ports Left	C
Horizontal	Two Mounting Brackets, Two End Caps with Ports	D
Vertical	Two End Plates, One Tapped	E
Vertical	One Tapped End Plate, One End Cap with Ports	F

These stacking kits include all the hardware to assemble up to eight individual valve modules into a single valve stack. "End caps *with ports*" must be ordered separately due to individual port requirements. The standard end cap is P/N Z4001010, this has two SAE-8 ports (see page 45 for others).

For vertical stacks, tapped end plates eliminate the need for nuts and washers at the end of the stack.

The tapped end plates are attached to the stack via the through-bolt.

A stacking kit part number is determined as follows:

1. Decide if a **Horizontal** or **Vertical** configuration (described above) is required.
2. Determine if an end cap *with ports* is required. If no unload module (UVx, URx) is used, an end cap *with ports* must be used. This allows the pressure and tank lines to be connected to the valve stack.
3. Go to the table that corresponds to the configuration required. Under the column indicating the correct number of modules choose the corresponding part number for either a factory-assembled stack or an unassembled stack kit.

Factory assembled stacks will be completely assembled and pressure-tested as a stack. A single "stack" part number will be generated for reordering.

When ordering please supply either the stack part number or all module order codes (page 6) and corresponding stacking kit part numbers.

Table A: Horizontal Configuration, Two Mounting Brackets, No End Caps

Number of Modules in Stack			1	2	3	4	5	6	7	8
Factory Assembled Stacking Kit P/N			Z6917001	Z6917002	Z6917003	Z6917004	Z6917005	Z6917006	Z6917007	Z6917008
Unassembled Stacking Kit P/N			Z6911001	Z6911002	Z6911003	Z6911004	Z6911005	Z6911006	Z6911007	Z6911008
PART NUMBER	DESCRIPTION									
Z2812011	THRU-TUBE		-	2	4	6	8	10	12	14
Z2812012	LONG THRU-TUBE		-	-	-	-	-	-	-	-
Z2819006	PLUG TUBE		4	4	4	4	4	4	4	4
Z8229001	HEX NUT		3	3	6	6	6	6	6	6
Z8230001	LOCKWASHER		6	6	6	6	6	6	6	6
Z4001004	RIGHT BRACKET		1	1	1	1	1	1	1	1
Z4001003	LEFT BRACKET		1	1	1	1	1	1	1	1
TIE-RODS	(in) LENGTH (mm)									
Z8240009	3	76.2	3	-	-	-	-	-	-	-
Z8240016	4-3/4	120.6	-	3	-	-	-	-	-	-
Z8208001	7-1/4	184.2	-	-	3	-	-	-	-	-
Z8208008	9	228.6	-	-	-	3	-	-	-	-
Z8208015	10-3/4	273.0	-	-	-	-	3	-	-	-
Z8208022	12-1/2	317.5	-	-	-	-	-	3	-	-
Z8208029	14-1/4	361.9	-	-	-	-	-	-	3	-
Z8208036	16	406.4	-	-	-	-	-	-	-	3

NUMBER OF PIECES PER KIT

Table B: Two Mounting Brackets, One End Cap with Ports Right, Horizontal Configuration

Number of Modules in Stack			1	2	3	4	5	6	7	8	
Factory Assembled Stacking Kit P/N			Z691800 01	Z691800 02	Z691800 03	Z691800 04	Z691800 05	Z691800 06	Z691800 07	Z691800 08	
Unassembled Stacking Kit P/N			Z691200 01	Z691200 02	Z691200 03	Z691200 04	Z691200 05	Z691200 06	Z691200 07	Z691200 08	
PART NUMBER	DESCRIPTION										
Z2812011	THRU-TUBE		-	2	4	6	8	10	12	14	NUMBER OF PIECES PER KIT
Z2812012	LONG THRU-TUBE		2	2	2	2	2	2	2	2	
Z2819006	PLUG TUBE		2	2	2	2	2	2	2	2	
Z8229001	HEX NUT		3	3	6	6	6	6	6	6	
Z8230001	LOCKWASHER		6	6	6	6	6	6	6	6	
Z4001003	LEFT BRACKET		1	1	1	1	1	1	1	1	
Z4001001	PORTED RIGHT BRACKET		1	1	1	1	1	1	1	1	
TIE-RODS	(in) LENGTH (mm)										
Z8240016	4-3/4	120.6	3	-	-	-	-	-	-	-	
Z8240022	6-5/16	160.3	-	3	-	-	-	-	-	-	
Z8208001	7-1/4	184.2	-	-	3	-	-	-	-	-	
Z8208008	9	228.6	-	-	-	3	-	-	-	-	
Z8208018	11-1/2	292.1	-	-	-	-	3	-	-	-	
Z8208025	13-1/4	336.5	-	-	-	-	-	3	-	-	
Z8208032	15	381.0	-	-	-	-	-	-	3	-	
Z8208039	16-3/4	425.4	-	-	-	-	-	-	-	3	

Table C: Two Mounting Brackets, One End Cap with Ports Left, Horizontal Configuration

Number of Modules in Stack			1	2	3	4	5	6	7	8	
Factory Assembled Stacking Kit P/N			Z692200 01	Z692200 02	Z692200 03	Z692200 04	Z692200 05	Z692200 06	Z692200 07	Z692200 08	
Unassembled Stacking Kit P/N			Z691600 01	Z691600 02	Z691600 03	Z691600 04	Z691600 05	Z691600 06	Z691600 07	Z691600 08	
PART NUMBER	DESCRIPTION										
Z2812011	THRU-TUBE		-	2	4	6	8	10	12	14	NUMBER OF PIECES PER KIT
Z2812012	LONG THRU-TUBE		2	2	2	2	2	2	2	2	
Z2819006	PLUG TUBE		2	2	2	2	2	2	2	2	
Z8229001	HEX NUT		3	3	6	6	6	6	6	6	
Z8230001	LOCKWASHER		6	6	6	6	6	6	6	6	
Z4001004	RIGHT BRACKET		1	1	1	1	1	1	1	1	
Z4001002	PORTED LEFT BRACKET		1	1	1	1	1	1	1	1	
TIE-RODS	(in) LENGTH (mm)										
Z8240016	4-3/4	120.6	3	-	-	-	-	-	-	-	
Z8240022	6-5/16	160.3	-	3	-	-	-	-	-	-	
Z8208001	7-1/4	184.2	-	-	3	-	-	-	-	-	
Z8208008	9	228.6	-	-	-	3	-	-	-	-	
Z8208018	11-1/2	292.1	-	-	-	-	3	-	-	-	
Z8208025	13-1/4	336.5	-	-	-	-	-	3	-	-	
Z8208032	15	381.0	-	-	-	-	-	-	3	-	
Z8208039	16-3/4	425.4	-	-	-	-	-	-	-	3	

Table D: Two Mounting Brackets, Two End Caps with Ports, Horizontal Configuration

Number of Modules in Stack			1	2	3	4	5	6	7	8	
Factory Assembled Stacking Kit P/N			Z691900001	Z691900002	Z691900003	Z691900004	Z691900005	Z691900006	Z691900007	Z691900008	
Unassembled Stacking Kit P/N			Z691300001	Z691300002	Z691300003	Z691300004	Z691300005	Z691300006	Z691300007	Z691300008	
PART NUMBER	DESCRIPTION										
Z2812011	THRU-TUBE		-	2	4	6	8	10	12	14	NUMBER OF PIECES PER KIT
Z2812012	LONG THRU-TUBE		4	4	4	4	4	4	4	4	
Z2819006	PLUG TUBE		-	-	-	-	-	-	-	-	
Z8229001	HEX NUT		3	3	6	6	6	6	6	6	
Z8230001	LOCKWASHER		6	6	6	6	6	6	6	6	
Z4001001	PORTED RIGHT BRACKET		1	1	1	1	1	1	1	1	
Z4001002	PORTED LEFT BRACKET		1	1	1	1	1	1	1	1	
TIE-RODS	(in) LENGTH (mm)										
Z8240016	4-3/4	120.6	3	-	-	-	-	-	-	-	
Z8240022	6-5/16	160.3	-	3	-	-	-	-	-	-	
Z8208004	8	203.2	-	-	3	-	-	-	-	-	
Z8208015	10-3/4	273.0	-	-	-	3	-	-	-	-	
Z8208022	12-1/2	317.5	-	-	-	-	3	-	-	-	
Z8208029	14-1/4	361.9	-	-	-	-	-	3	-	-	
Z8208036	16	406.4	-	-	-	-	-	-	3	-	
Z8208043	17-3/4	450.8	-	-	-	-	-	-	-	3	

Table E: Two End Plates, One Tapped, Vertical Configuration

Number of Modules in Stack			1	2	3	4	5	6	7	8	
Factory Assembled Stacking Kit P/N			Z692000001	Z692000002	Z692000003	Z692000004	Z692000005	Z692000006	Z692000007	Z692000008	
Unassembled Stacking Kit P/N			Z691400001	Z691400002	Z691400003	Z691400004	Z691400005	Z691400006	Z691400007	Z691400008	
PART NUMBER	DESCRIPTION										
Z2812011	THRU-TUBE		-	2	4	6	8	10	12	14	NUMBER OF PIECES PER KIT
Z2812012	LONG THRU-TUBE		-	-	-	-	-	-	-	-	
Z2819006	PLUG TUBE		4	4	4	4	4	4	4	4	
Z8229001	HEX NUT		-	-	3	3	3	3	3	3	
Z8230001	LOCKWASHER		3	3	3	3	3	3	3	3	
Z4001007	END PLATE		1	1	1	1	1	1	1	1	
Z4001006	TAPPED END PLATE		1	1	1	1	1	1	1	1	
TIE-RODS	(in) LENGTH (mm)										
Z8240009	3	76.2	3	-	-	-	-	-	-	-	
Z8240016	4-3/4	120.6	-	3	-	-	-	-	-	-	
Z8208001	7-1/4	184.2	-	-	3	-	-	-	-	-	
Z8208008	9	228.6	-	-	-	3	-	-	-	-	
Z8208015	10-3/4	273.0	-	-	-	-	3	-	-	-	
Z8208022	12-1/2	317.5	-	-	-	-	-	3	-	-	
Z8208029	14-1/4	361.9	-	-	-	-	-	-	3	-	
Z8208036	16	406.4	-	-	-	-	-	-	-	3	

Table F: One Tapped End Plate, One End Cap with Ports, Vertical Configuration

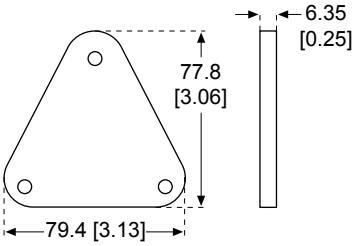
Number of Modules in Stack			1	2	3	4	5	6	7	8	
Factory Assembled Stacking Kit P/N			Z6921001	Z6921002	Z6921003	Z6921004	Z6921005	Z6921006	Z6921007	Z6921008	
Unassembled Stacking Kit P/N			Z6915001	Z6915002	Z6915003	Z6915004	Z6915005	Z6915006	Z6915007	Z6915008	
PART NUMBER	DESCRIPTION										
Z2812011	THRU-TUBE		2	4	6	8	10	12	14	16	NUMBER OF PIECES PER KIT
Z2812012	LONG THRU-TUBE		-	-	-	-	-	-	-	-	
Z2819006	PLUG TUBE		2	2	2	2	2	2	2	2	
Z8229001	HEX NUT		-	-	3	3	3	3	3	3	
Z8230001	LOCKWASHER		3	3	3	3	3	3	3	3	
Z4001007	END PLATE		-	-	-	-	-	-	-	-	
Z4001006	TAPPED END PLATE		1	1	1	1	1	1	1	1	
TIE-RODS	(in) LENGTH (mm)										
Z8240015	4-1/2	114.3	3	-	-	-	-	-	-	-	
Z8240022	6-5/16	160.3	-	3	-	-	-	-	-	-	
Z8208004	8	203.2	-	-	3	-	-	-	-	-	
Z8208011	9-3/4	247.6	-	-	-	3	-	-	-	-	
Z8208018	11-1/2	292.1	-	-	-	-	3	-	-	-	
Z8208025	13-1/4	336.5	-	-	-	-	-	3	-	-	
Z8208032	15	381.0	-	-	-	-	-	-	3	-	
Z8208039	16-3/4	425.4	-	-	-	-	-	-	-	3	

Module Identification

Each valve module includes a nameplate affixed to the housing. This information includes:

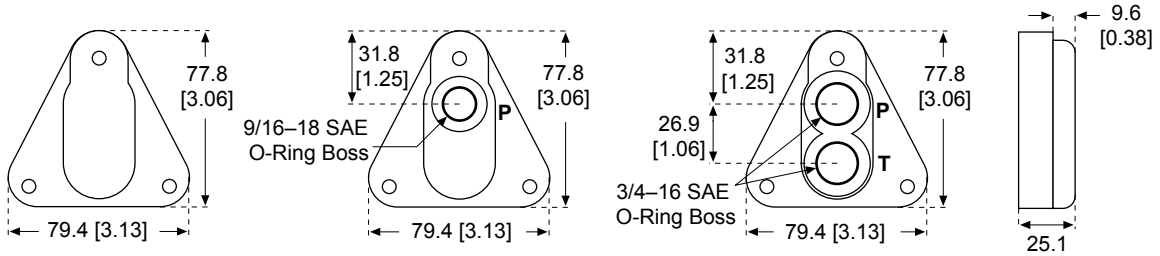
Model Number: This defines the specific unit.

Serial Number: This is used to identify the manufacturing location, build date, and the sequence in the build.



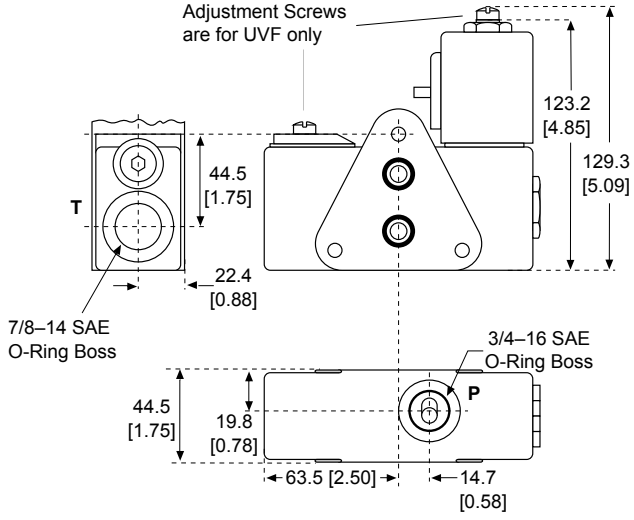
Z4001007—Thru Holes
Z4001006—1/4-20 Tapped Holes

END PLATES

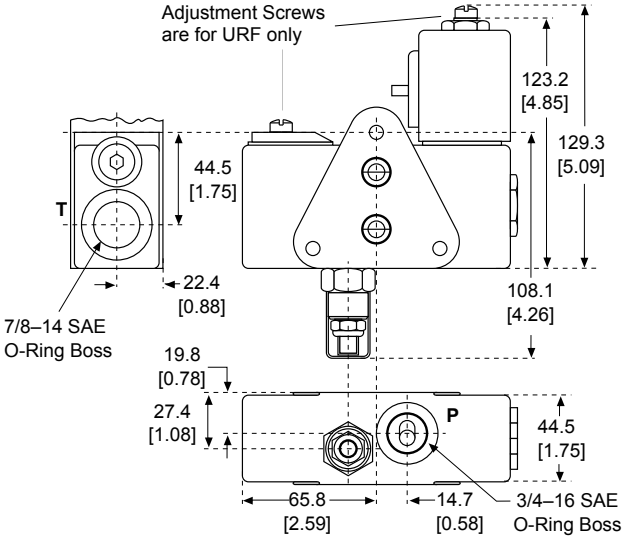


Z5013004 Z4001009 Z4001010

END CAPS

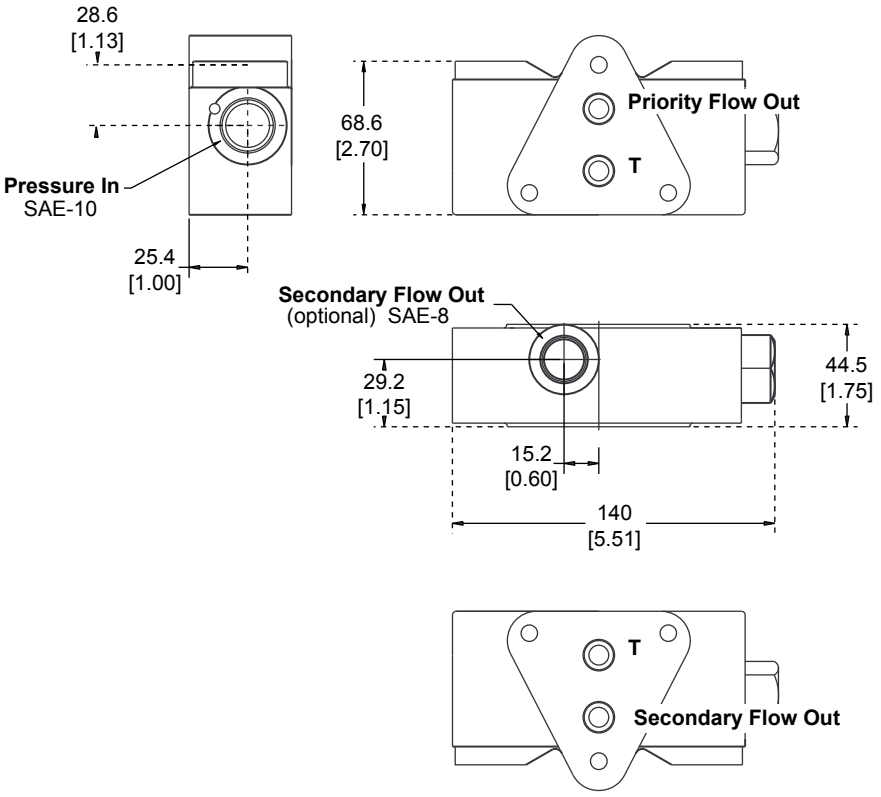


ZMC-UVO, ZMC-UVC, ZMC-UVF



ZMC-URO, ZMC-URF

Outline Drawings



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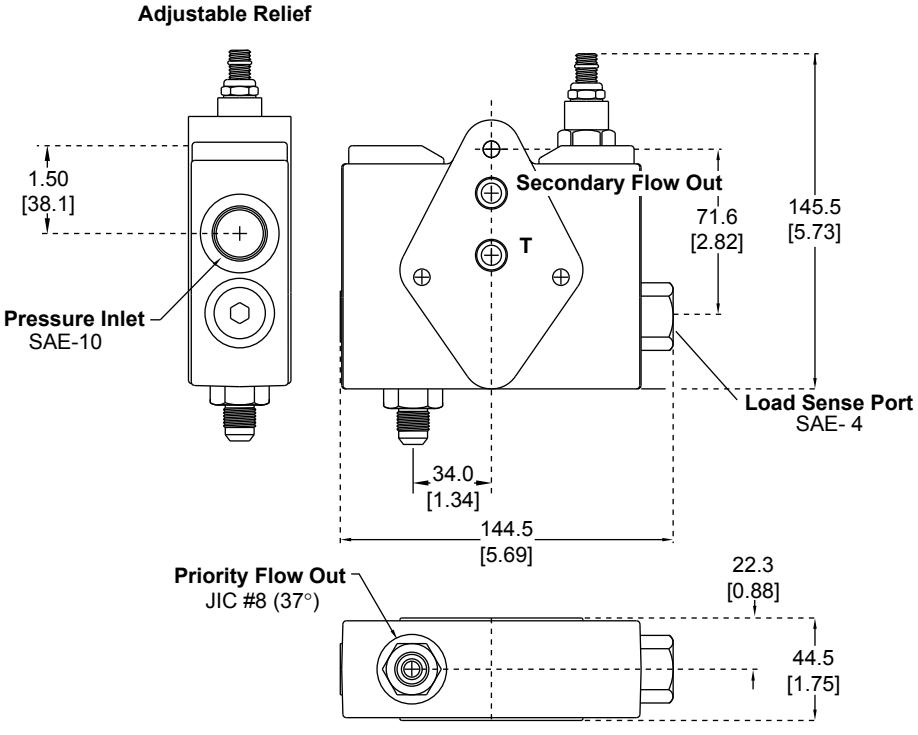
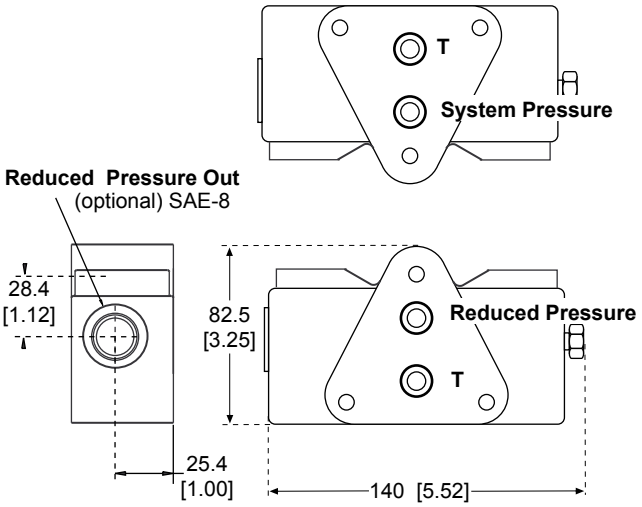
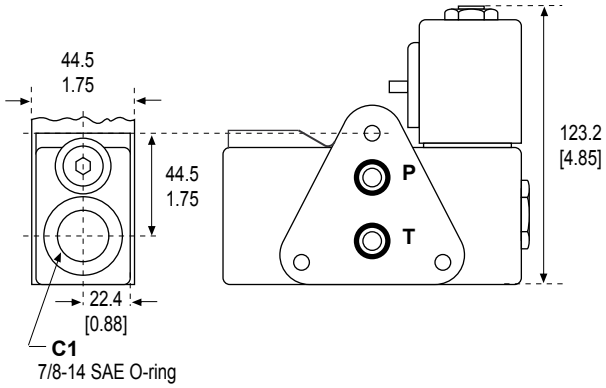


ZMC-DPV

Outline Drawings



ZMC-PRV



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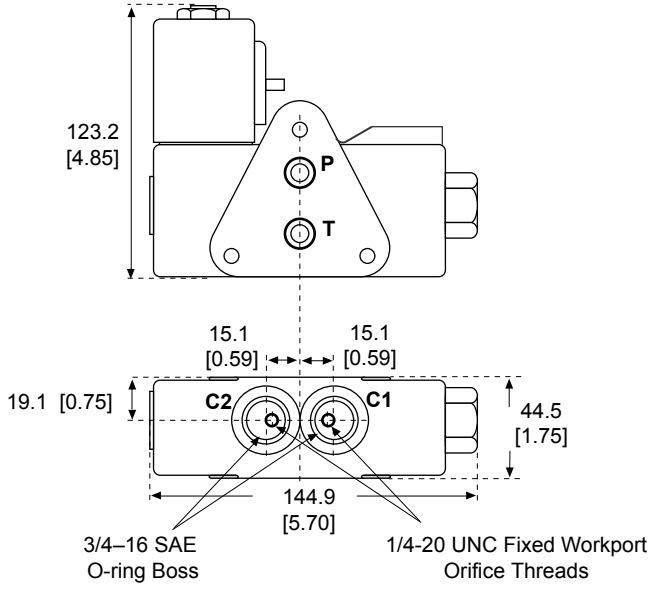

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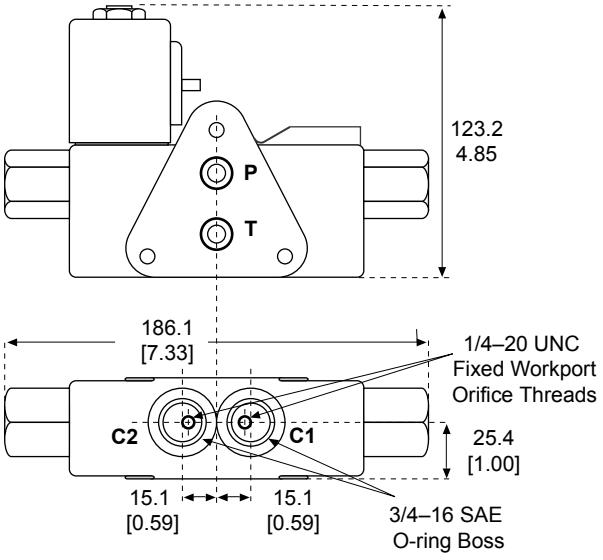

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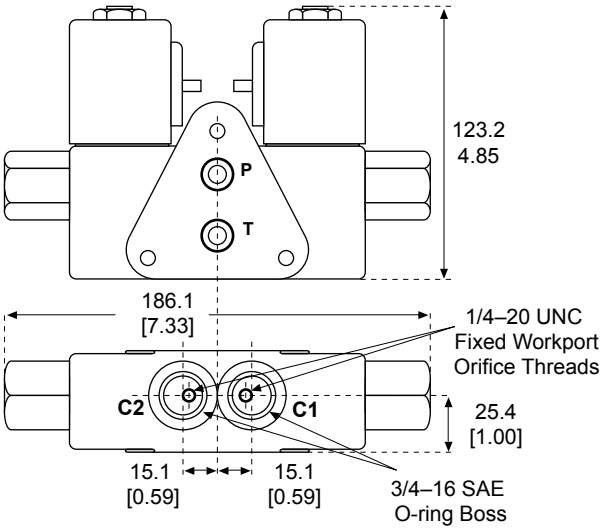
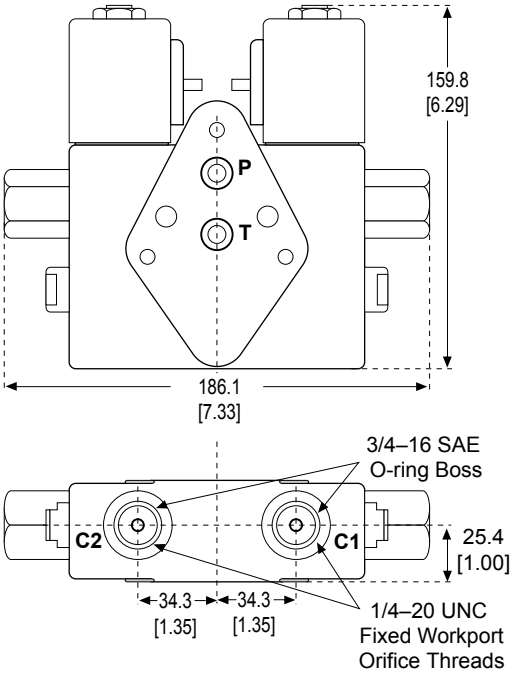
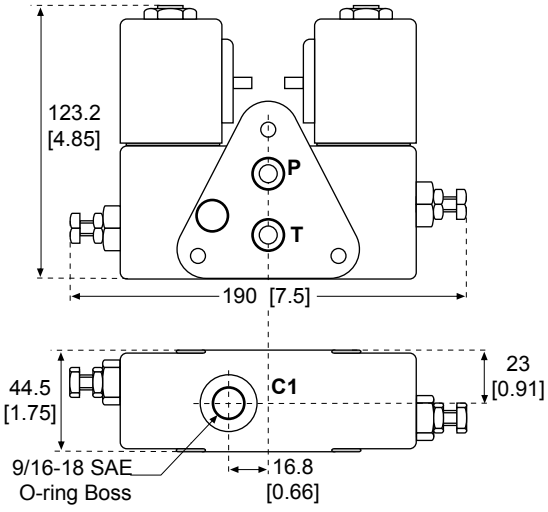


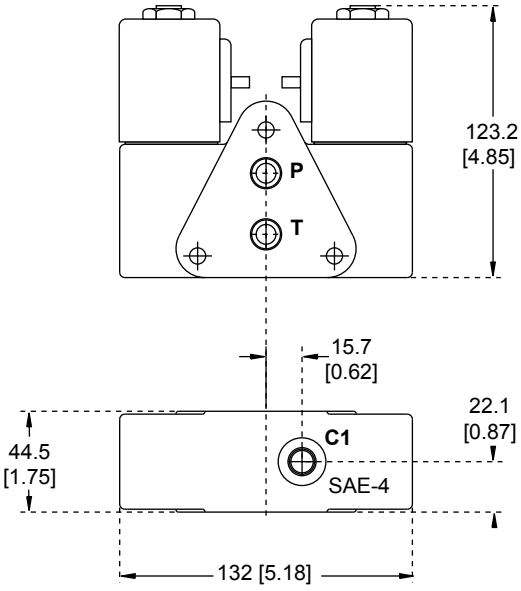
ZMC-340, ZMC-34C



ZMC-34X, ZMC-34Y



ZMC-PPV



ZMC-LFS, ZMC-LFH

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