

ACCUMULATOR CHARGING VALVES

Single charging valves, dual charging valves,
and load sensing charging valves



Versatile, High-performance
Accumulator Charging Valves



ZF Off-Highway Solutions Minnesota Inc. designs, manufactures, and markets hydraulic components, controls, and brake systems, primarily for off-highway markets.

Many of the world's largest Off-Highway OEMs value the knowledgeable staff at ZF Off-Highway Solutions Minnesota Inc. and work with us to make their products better. Our custom-engineered products are designed with the customer requirements as the primary driver. It is our intent to help customers build their systems with our expertise in hydraulic components, braking systems, and controls. Our goal is to meet or exceed our customers' expectations in every aspect of our business.

ZF Off-Highway Solutions Minnesota Inc. continuously strives for improvement, while remaining a quality leader in our field. We are a successful, customer driven business. We look forward to working with you!

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You will find the current edition at www.mico.com

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Applications



Forestry Equipment



Agricultural Equipment



Heavy Construction Equipment



Swing Drive Equipment



Mining Equipment



In-Plant & Warehouse Equipment



Airport Support Vehicles

Accumulator Charging Valves

The same dependability, safety, and performance that goes into every ZF Off-Highway Braking Solutions Minnesota Inc. braking product also goes into our accumulator charging valves. This is an important consideration when you select a source of supply for your fluid power needs.

The accumulator charging Valves presented in this catalog are designed for vehicles that are equipped with other hydraulic power devices in either open center, closed center, or load sensing hydraulic systems. This design feature eliminates the need for a separate hydraulic fluid system.

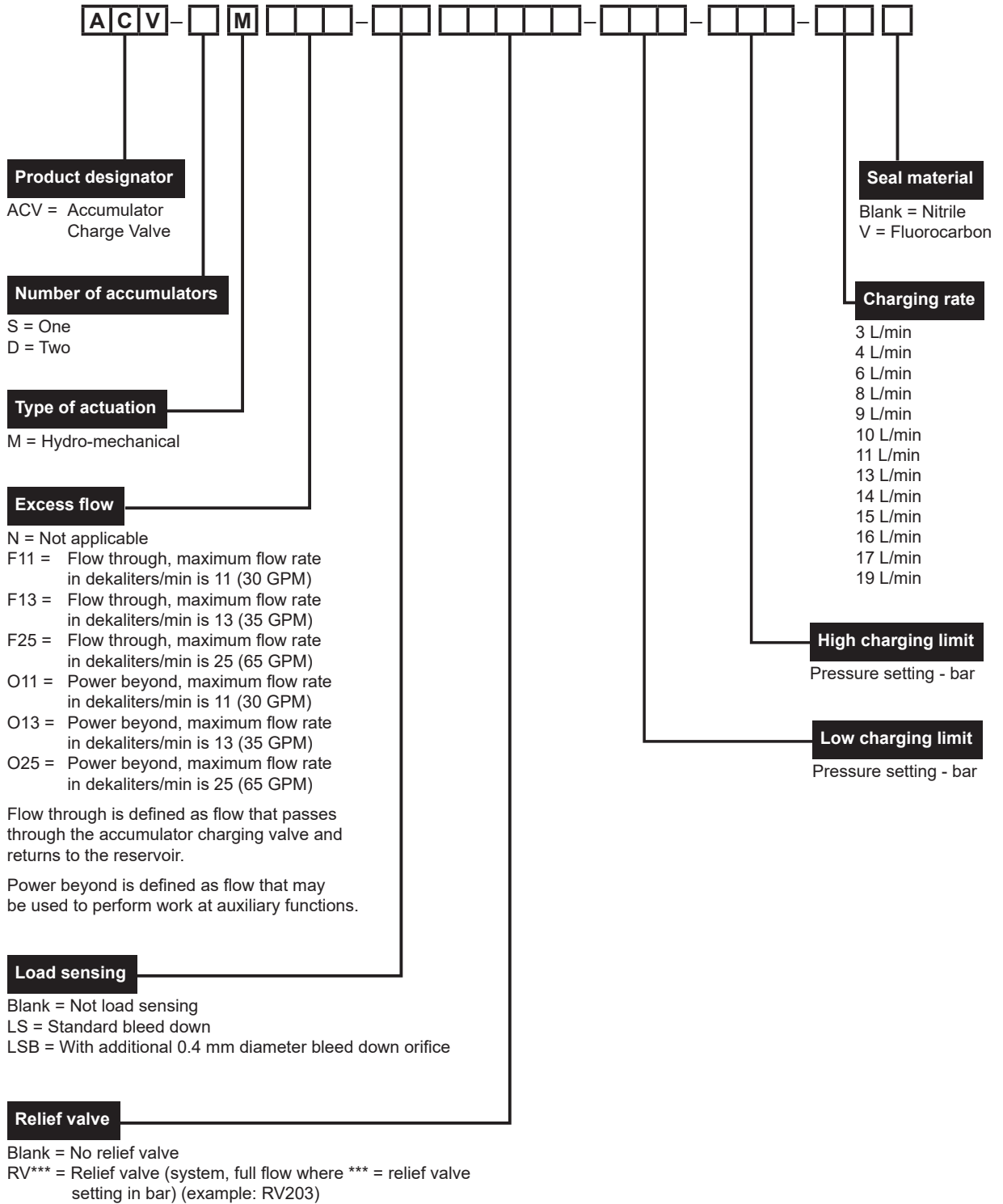
Unless specified, all valves in this catalog are used with mineral base hydraulic oil. Consult ZF Off-Highway Braking Solutions Minnesota Inc. when using other fluids. Dimensional drawings shown may vary slightly between similar units and are to be used for reference purposes only.

Complete the appropriate Application Data Sheet online, www.mico.com, and submit to sh-applications.NMN@ZF.com. The ZF Off-highway Solutions Minnesota Inc. Applications Department will analyze your specifications and based on your input recommend an accumulator charging valve suitable for your requirements.

NOTE: Not all possible code combinations listed on this page are attainable.

Accumulator Charging Valve Catalog Code

(catalog code reference for pages 7-21)



Single Accumulator Charging Valves



PRINCIPLES OF OPERATION

These Single Accumulator Charging Valves are designed for installation in an open-center hydraulic system between the pump and its relief valve and the downstream secondary hydraulic devices; for example, a power steering control valve and cylinder installed in the same hydraulic circuit.

These single accumulator charging valves supply oil to an accumulator from an open center circuit on demand. This is accomplished at a preset rate, L/min (GPM), at a selected pressure and is constant within the preset pressure limits.

The flow to the downstream secondary hydraulic devices will be reduced when the accumulator is charging. This does not noticeably affect the operation of these components. Full system pressure is available to the downstream secondary hydraulic devices at all times provided oil delivery and pressure from the pump and relief valve are not impeded.

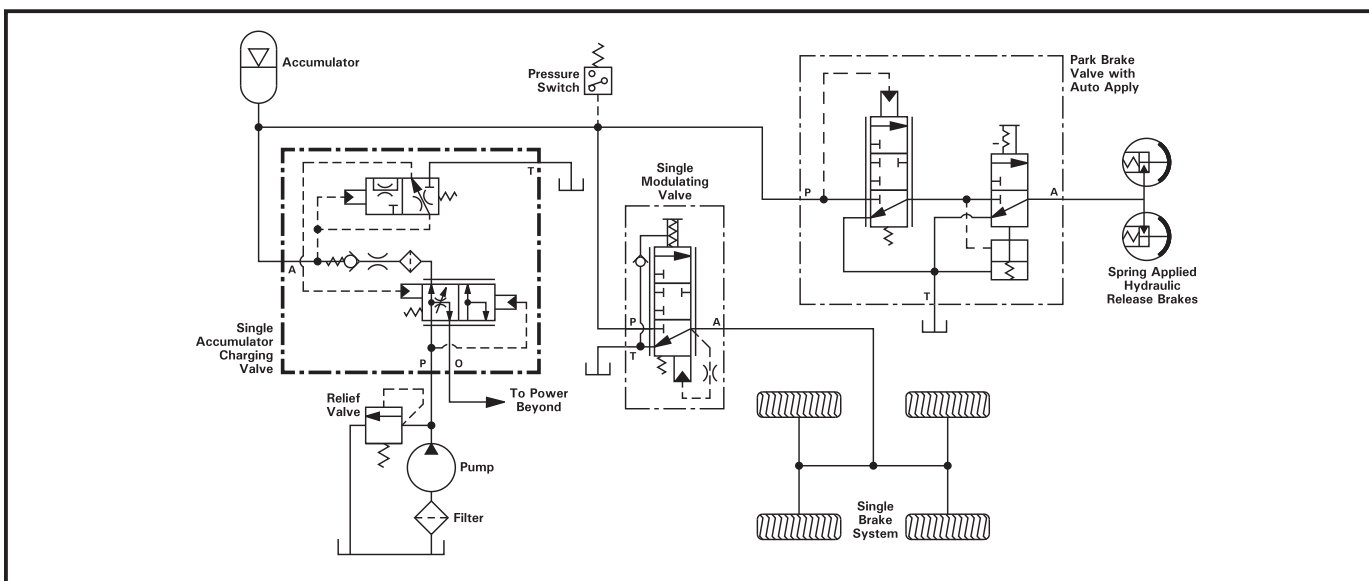
The accumulator charging flow rates and upper and lower accumulator pressure limits are set at the time of manufacture.

ZF Off-Highway Solutions Minnesota Inc. also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

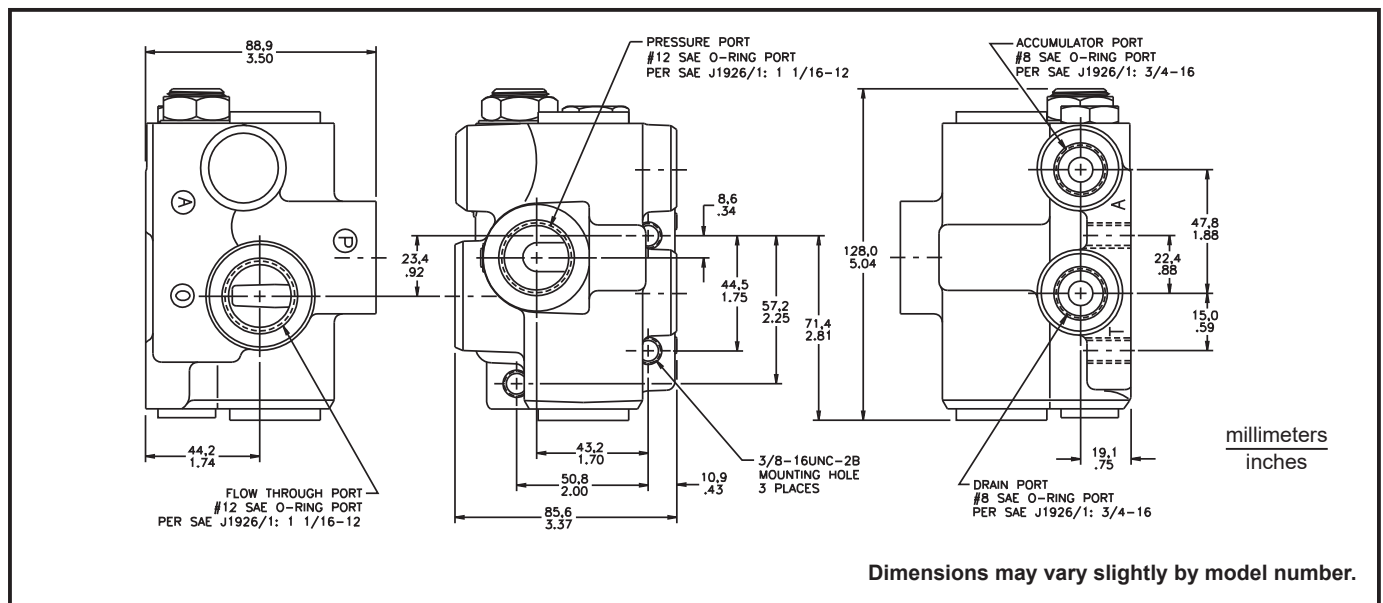
FEATURES

- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time
- Designed for mobile equipment with varying pump flows
- Flow rates to 113 L/min (30 GPM)

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
06-463-008	ACV-SMO11 - 67 - 95 - 10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-463-010	ACV-SMO11 - 41 - 90 - 10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
* 06-463-012	ACV-SMO11 - 94 - 124 - 6	± 2.6	(± 37)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-014	ACV-SMO11 - 55 - 76 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-016	ACV-SMO11 - 83 - 103 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-018	ACV-SMO11 - 145-190-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-020	ACV-SMO11 - 128-159-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-022	ACV-SMO11 - 155-186-10	± 3.5	(± 25)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-024	ACV-SMO11 - 103-128-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-026	ACV-SMO11 - 103-138- 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-028	ACV-SMO11 - 94 - 124 - 10	± 2.6	(± 37)	± 3.5	(± 50)	± 1.9	(± 0.5)
* 06-463-032	ACV-SMO11 - 103-128-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-034	ACV-SMO11 - 124-152- 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-036	ACV-SMO11 - 114-138-17	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-038	ACV-SMO11 - 86 - 124 - 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-040	ACV-SMO11 - 114-138-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-044	ACV-SMO11 - 86 - 124 - 4	± 3.5	(± 50)	± 3.5	(± 50)	± 1.1	(± 0.3)
06-463-048	ACV-SMO11 - 103-138- 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-050	ACV-SMO11 - 117-145- 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
* 06-463-052	ACV-SMO11 - 114-138- 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-054	ACV-SMO11 - 72 - 103 - 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-056	ACV-SMO11 - 93 - 124 - 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-058	ACV-SMO11 - 114-138- 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-060	ACV-SMO11 - 45 - 60 - 3	± 1.7	(± 25)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-463-064	ACV-SMO11 - 128-159- 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-066	ACV-SMO11 - 48 - 90 - 6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-463-078	ACV-SMO11 - 116-159-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)

* Water emulsion models

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 206.8 bar (3000 PSI)
 Power beyond flow capacity 7.5 to 113 L/min (2 to 30 GPM)
 Flow through pressure drop 4.8 bar at 56.8 L/min (70 PSI at 15 GPM)
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Dual Accumulator Charging Valves



PRINCIPLES OF OPERATION

These Dual Accumulator Charging Valves perform essentially the same functions as the single charging valves. When the dual accumulator charging valves are used in a split hydraulic brake system each individual axle is separately controlled. These dual charging valves charge both accumulators. The primary advantage of dual charging valves are that if half of the brake system fails the remaining half will continue to function.

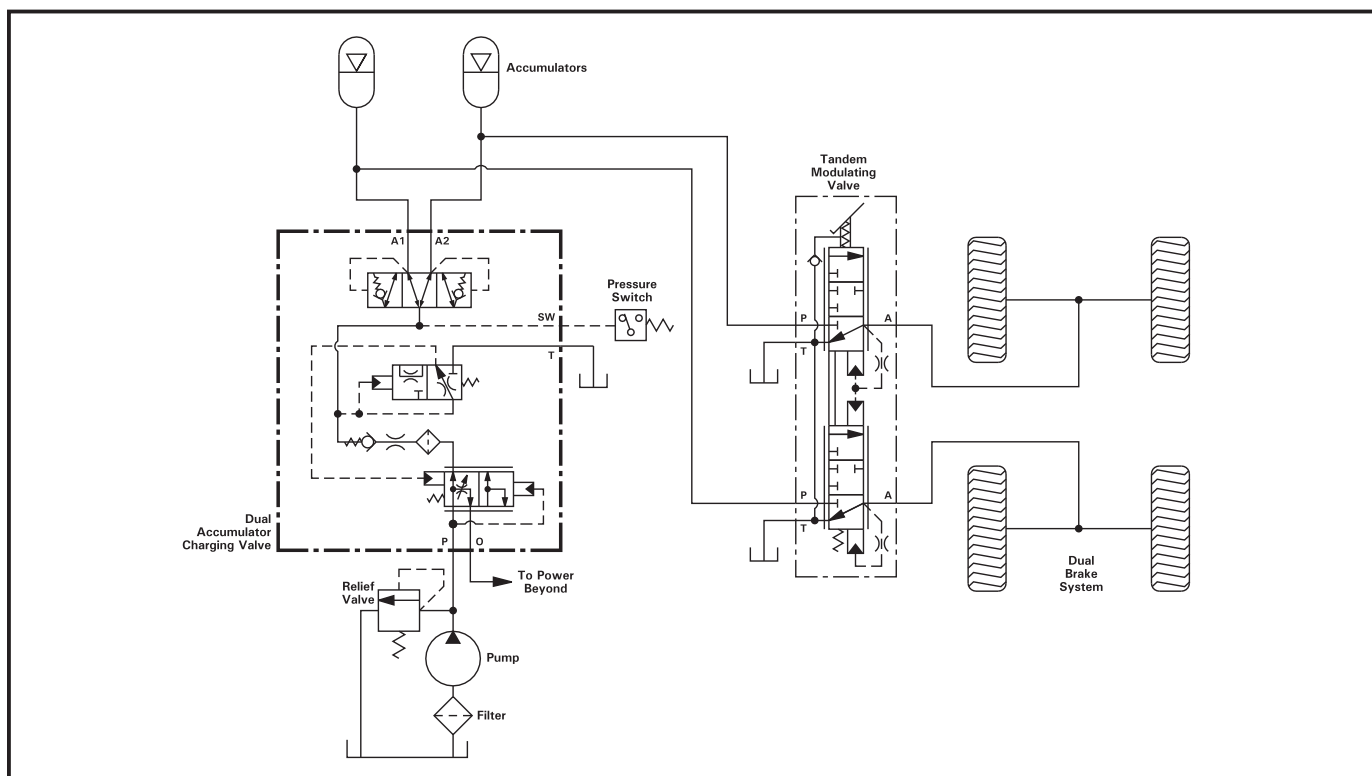
These dual charging valves charge the accumulators from the open center circuit upon demand and within its preset operating charge rate and maximum pressure. Other charge rates and pressures are available upon request.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

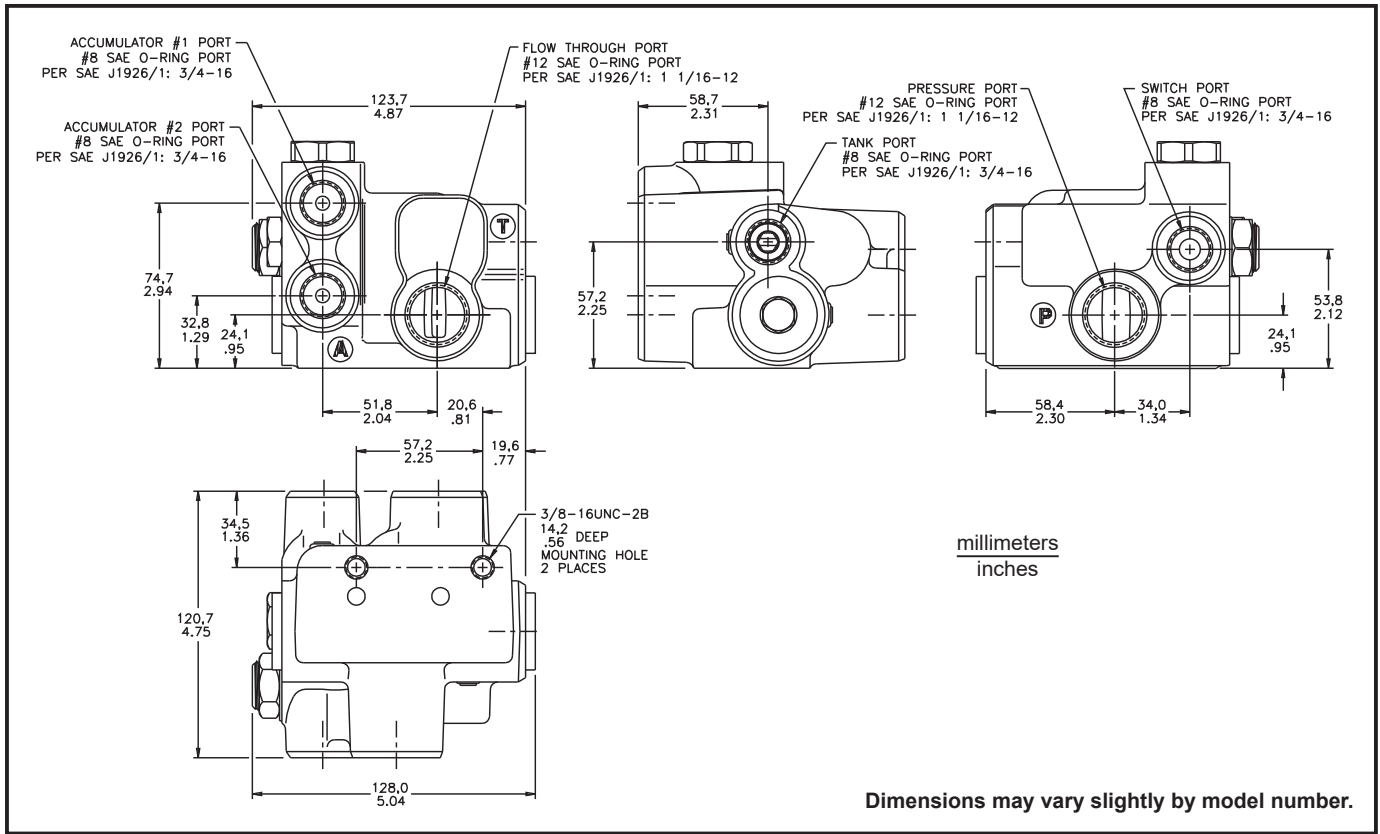
FEATURES

- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time
- Designed for mobile equipment with varying pump flows
- Pressure switch port senses the lower pressure of the two accumulators
- Flow rates to 113 L/min (30 GPM)

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
06-463-200	ACV-DMO11-128-159-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-202	ACV-DMO11-155-190-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-204	ACV-DMO11-114-138-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-206	ACV-DMO11-86-124-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-208	ACV-DMO11-117-145-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-210	ACV-DMO11-103-128-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-212	ACV-DMO11-86-103-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-214	ACV-DMO11-64-83-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-216	ACV-DMO11-93-114-3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-218	ACV-DMO11-95-124-6	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-222	ACV-DMO11-148-179-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-224	ACV-DMO11-138-166-6V	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-226	ACV-DMO11-86-103-3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-228	ACV-DMO11-145-179-3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)
06-463-230	ACV-DMO11-114-138-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-234	ACV-DMO11-138-166-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-250	ACV-DMO11-148-179-10V	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 206.8 bar (3000 PSI)
 Power beyond flow capacity 7.5 to 113 L/min (2 to 30 GPM)
 Flow through pressure drop 4.8 bar at 56.8 L/min (70 PSI at 15 GPM)
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Single Accumulator Charging Valves with Relief Valve



PRINCIPLES OF OPERATION

The Single Accumulator Charging Valves with Relief Valve incorporate a main system relief valve. This valve was developed for installation in an open center hydraulic system between the pump and the downstream secondary hydraulic devices; for example, a power steering control valve and cylinder installed in the same hydraulic circuit.

These valves supply oil to the system accumulator from an open center circuit on demand. This is accomplished at a preset rate L/min (GPM) at a selected pressure and is relatively constant within the preset pressure limits.

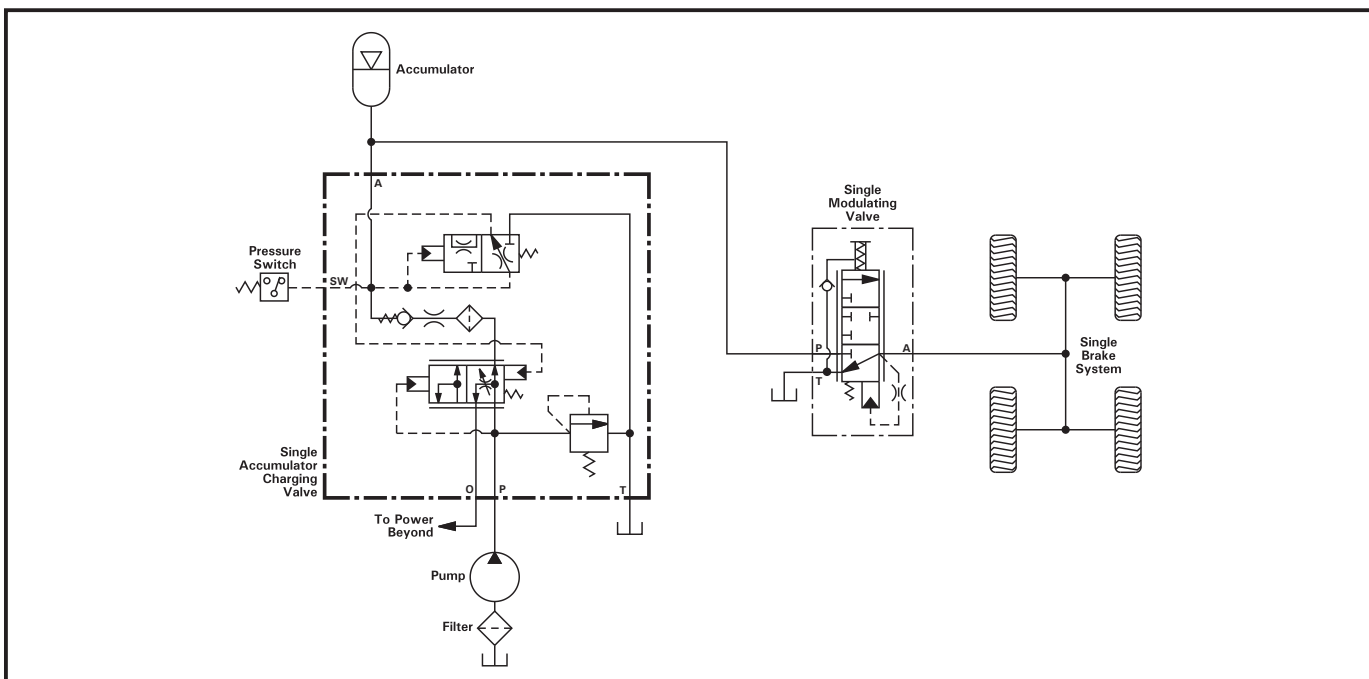
The flow to the downstream secondary hydraulic devices will be reduced when the accumulator is charging. This does not noticeably affect the operation of these components. Full system pressure is available to the downstream secondary hydraulic devices at all times provided oil delivery and pressure from the pump is not impeded. Maximum system pressure is set by an integral relief valve.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

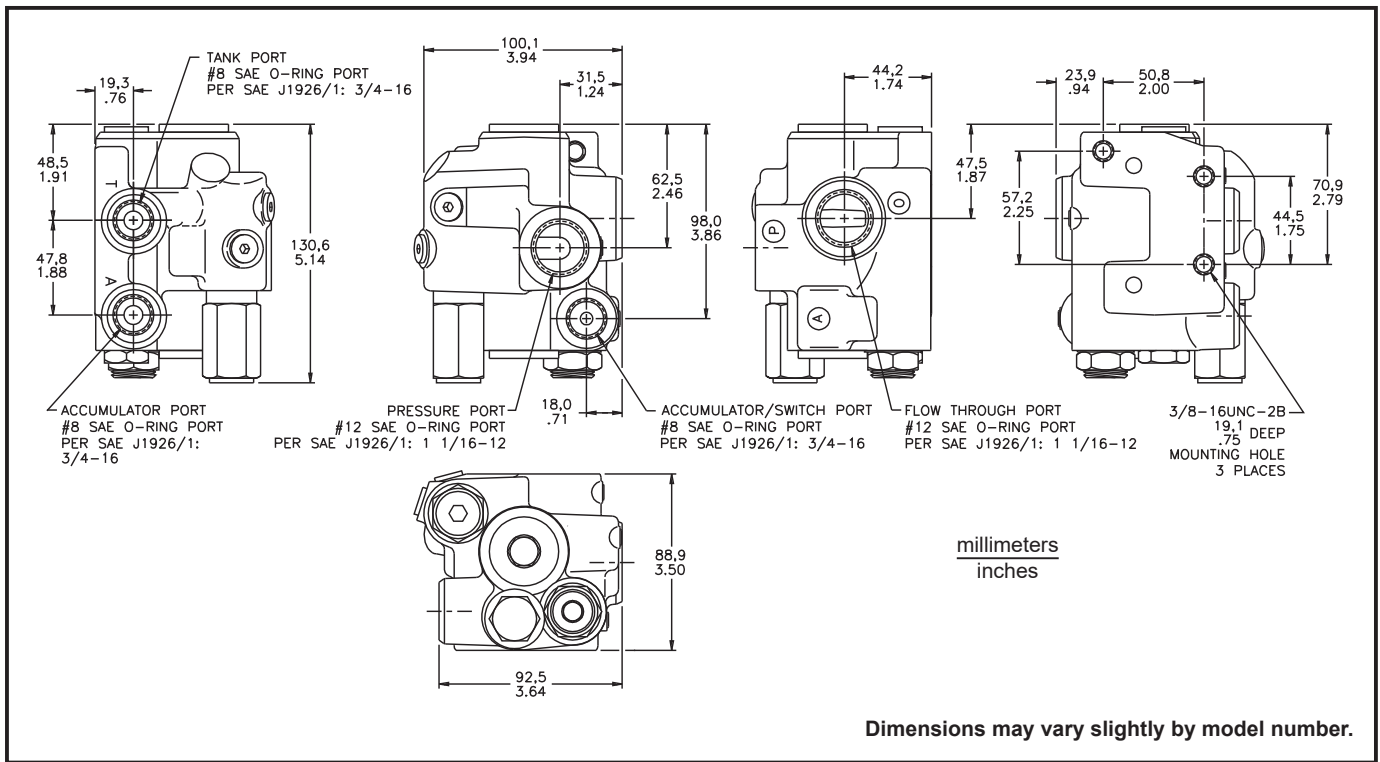
FEATURES

- Incorporated pump relief valve
- Direct acting relief valve for reliability and fast action
- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time
- Designed for mobile equipment with varying pump flows

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance		Relief Valve Setting Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)	bar	(PSI)
06-463-302	ACV-SMO11 - RV172 - 86 - 124 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-304	ACV-SMO11 - RV190 - 86 - 124 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-306	ACV-SMO11 - RV138 - 83 - 103 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-308	ACV-SMO11 - RV172 - 103 - 138 - 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-312	ACV-SMO11 - RV203 - 153 - 186 - 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-314	ACV-SMO11 - RV203 - 128 - 159 - 6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-318	ACV-SMO11 - RV203 - 128 - 159 - 17	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-320	ACV-SMO11 - RV121 - 86 - 107 - 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)	± 3.5	(± 50)
06-463-324	ACV-SMO11 - RV172 - 128 - 159 - 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)	± 3.5	(± 50)
06-463-328	ACV-SMO11 - RV172 - 110 - 134 - 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 206.8 bar (3000 PSI)
 Power beyond flow capacity 7.5 to 113 L/min (2 to 30 GPM)
 Flow through pressure drop 4.8 bar at 56.8 L/min (70 PSI at 15 GPM)
 Relief valve flow capacity 76 L/min (20 GPM)
 Relief valve setting 206.8 bar (3000 PSI) maximum
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Dual Accumulator Charging Valves with Relief Valve



PRINCIPLES OF OPERATION

The Dual Accumulator Charging Valves with Relief Valve incorporate a main system relief valve. This valve was developed for installation in an open center hydraulic system between the pump and downstream secondary hydraulic devices; for example, a power steering control valve and cylinder installed in the same hydraulic circuit.

These valves supply oil to the system accumulators from an open center circuit on demand. This is accomplished at a preset flow rate and is constant within the preset pressure limits.

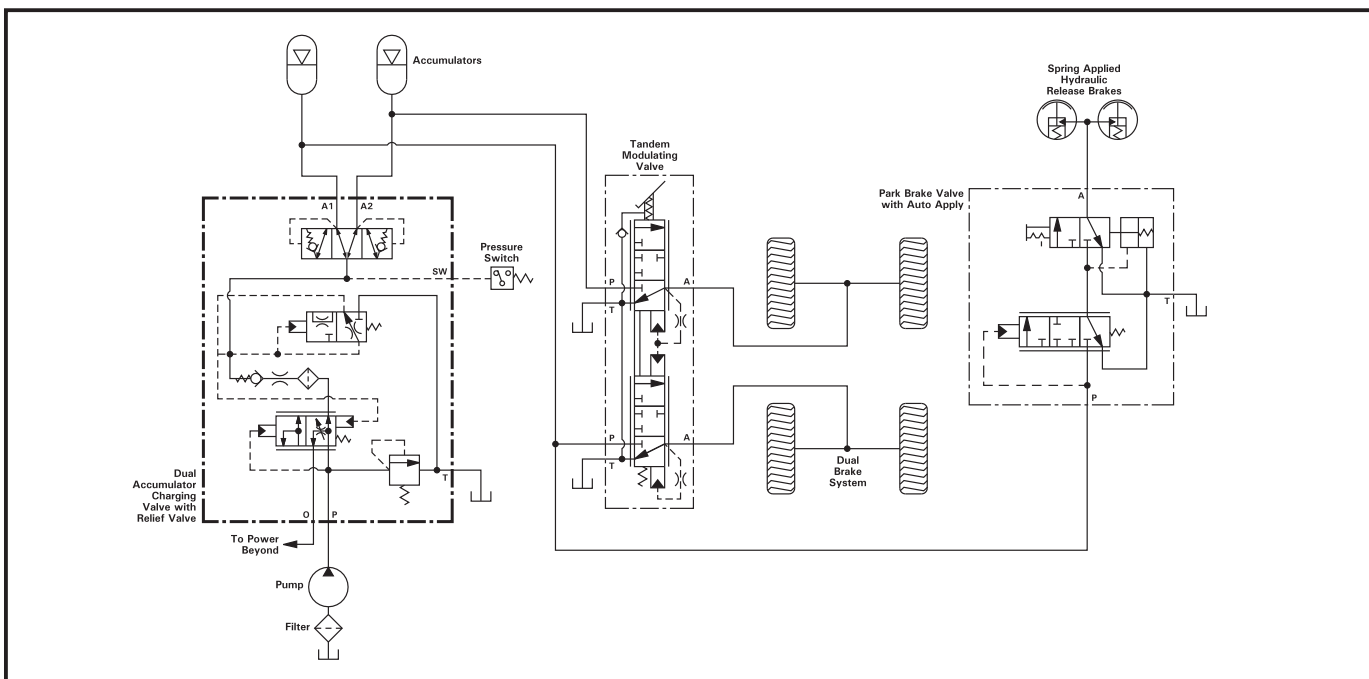
The flow to downstream secondary hydraulic devices will be reduced for a short time when the accumulator is charging. This does not noticeably affect the operation of these components. Full system pressure is available to the downstream secondary hydraulic devices at all times provided oil delivery and pressure from the pump is not impeded. Maximum system pressure is set by an integral relief valve.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

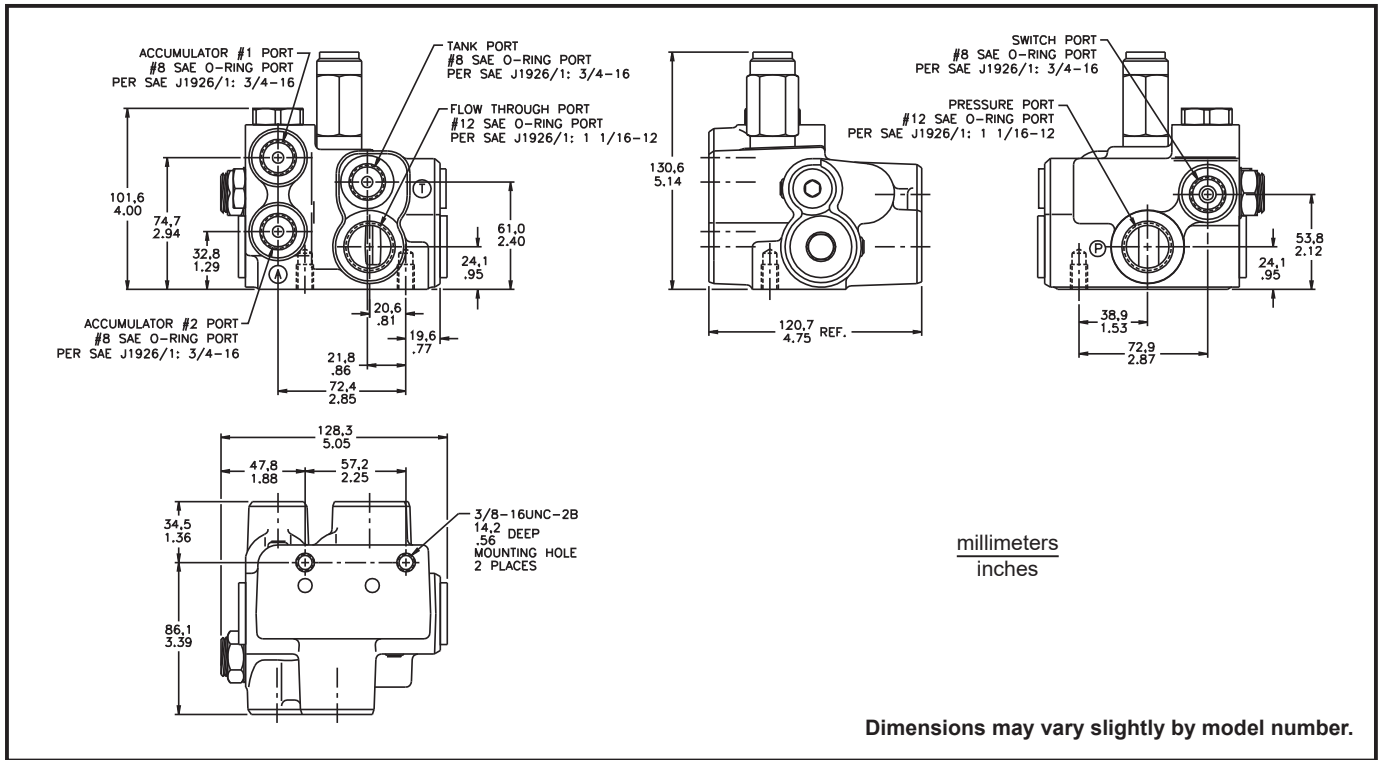
FEATURES

- Incorporated pump relief valve
- Pilot operated relief valve for reliability and fast action
- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time
- Designed for mobile equipment with varying pump flows
- Flow rates to 113 L/min (30 GPM)

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance		Relief Valve Setting Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)	bar	(PSI)
06-463-415	ACV -DMO11 -RV138- 86 - 103- 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-424	ACV -DMO11 -RV203-155- 18 - 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-425	ACV -DMO11 -RV203-147- 176- 14	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-426	ACV -DMO11 -RV202-150- 181- 3	± 3.5	(± 50)	± 3.5	(± 50)	± 0.1	(± 0.25)	± 3.5	(± 50)
06-463-432	ACV -DMO11 -RV172-126- 155- 10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-434	ACV -DMO11 -RV145-103-128-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)
06-463-440	ACV -DMO11 -RV210-138-193-19	± 3.5	(± 50)	± 3.5	(± 50)	± 3.8	(± 1.0)	± 3.5	(± 50)
06-463-496	ACV -DMO11 -RV207-140-189-10	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)	± 3.5	(± 50)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure (unless otherwise indicated) to 206.8 bar (3000 PSI)
 Power beyond flow capacity 7.5 to 113 L/min (2 to 30 GPM)
 Flow through pressure drop 4.8 bar at 56.8 L/min (70 PSI at 15 GPM)
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Load Sensing Accumulator Charging Valves (single)



PRINCIPLES OF OPERATION

The Load Sensing Accumulator Charging Valves operate in a flow and pressure-on-demand system. The control section of these valves send a pilot signal to a pressure compensated load sense pump when fluid is required. It maintains reserve volume and pressure in the accumulator, allowing the pump to stand by when there is no demand for fluid.

These charging valves are normally used in single systems in conjunction with one accumulator and single brake valve.

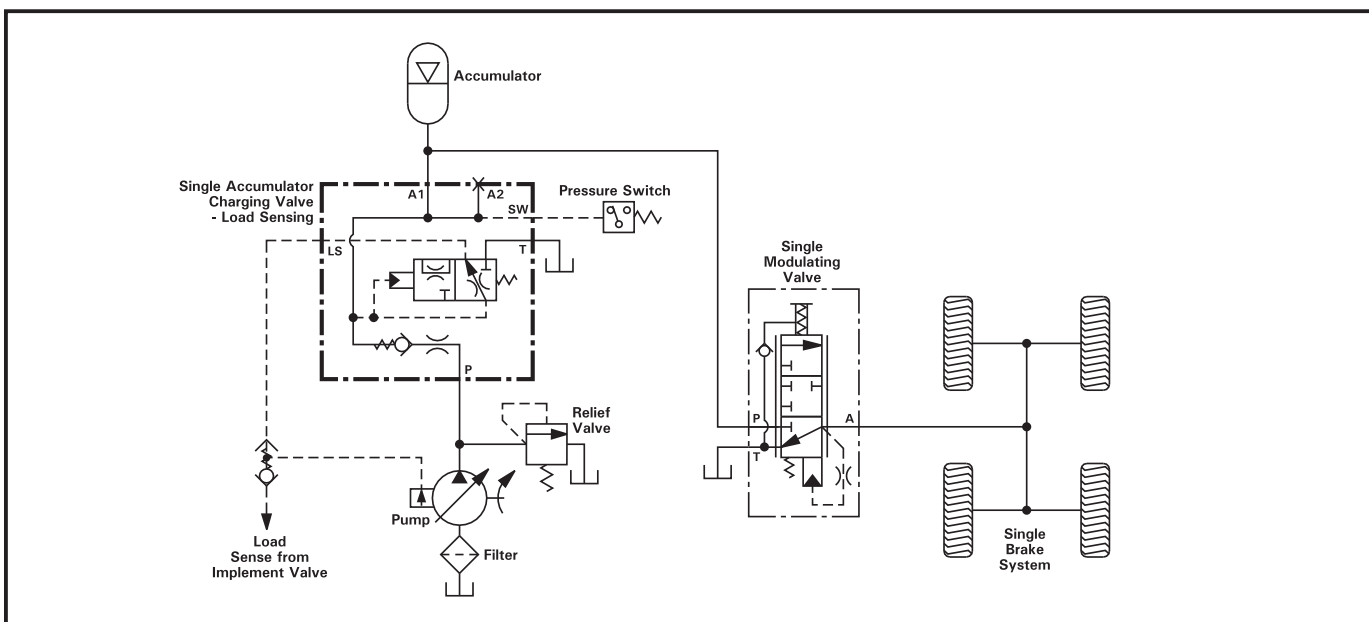
The charge rate and upper and lower accumulator pressure limits are set at the time of manufacture. Various charge rates, high and low limit settings and pressure ranges between high and low limits are available to conform to specific customer requirements.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

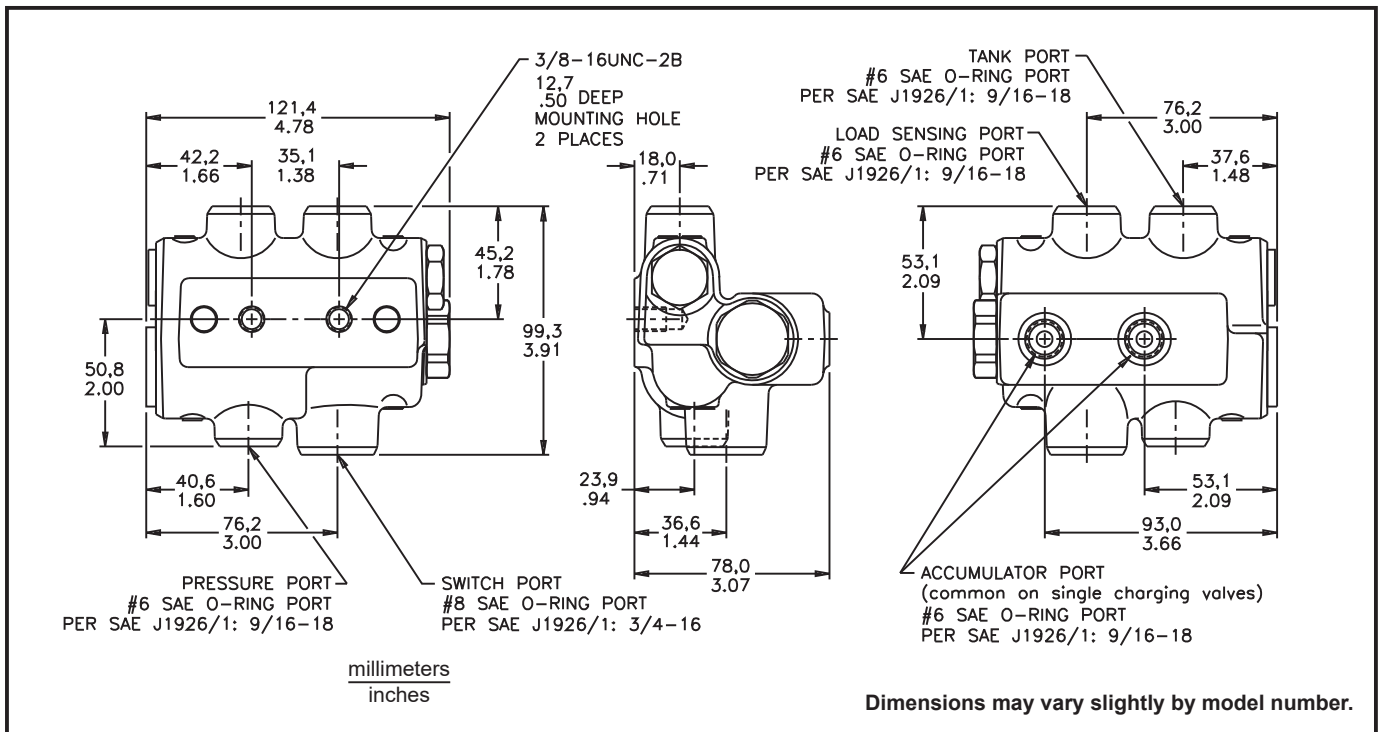
FEATURES

- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time

Typical Circuit Schematic (Single)



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
06-463-102	ACV-SMN-LSB-74-107-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-106	ACV-SMN-LSB-104-129-10	± 2.6	(± 37)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-463-108	ACV-SMN-LSB-117-159-11	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-110	ACV-SMN-LSB-116-141-11	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-112	ACV-SMN-LSB-117-159-15	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-114	ACV-SMN-LSB-93-114-11	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-116	ACV-SMN-LSB-83-103-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-136	ACV-SMN-LS-128-166-15	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-158	ACV-SMN-LSB-153-186-11	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)

Consult our Applications Department for other available models and application detail.

NOTE: Model numbers with LSB catalog code designation are designed for use in load sense systems with pumps that do not have a bleed down orifice.

PERFORMANCE DATA

System pressure to 206.8 bar (3000 PSI)
 Flow through capacity not applicable
 Flow through pressure drop not applicable
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Load Sensing Accumulator Charging Valves (dual)



PRINCIPLES OF OPERATION

The Load Sensing Accumulator Charging Valves operate in a flow and pressure-on-demand system. The control section of these valves send a pilot signal to a pressure compensated load sense pump when fluid is required. It maintains reserve volume and pressure in the accumulators, allowing the pump to stand by when there is no demand for fluid.

These charging valves are used in split systems with two or more accumulators and a tandem or dual brake valve.

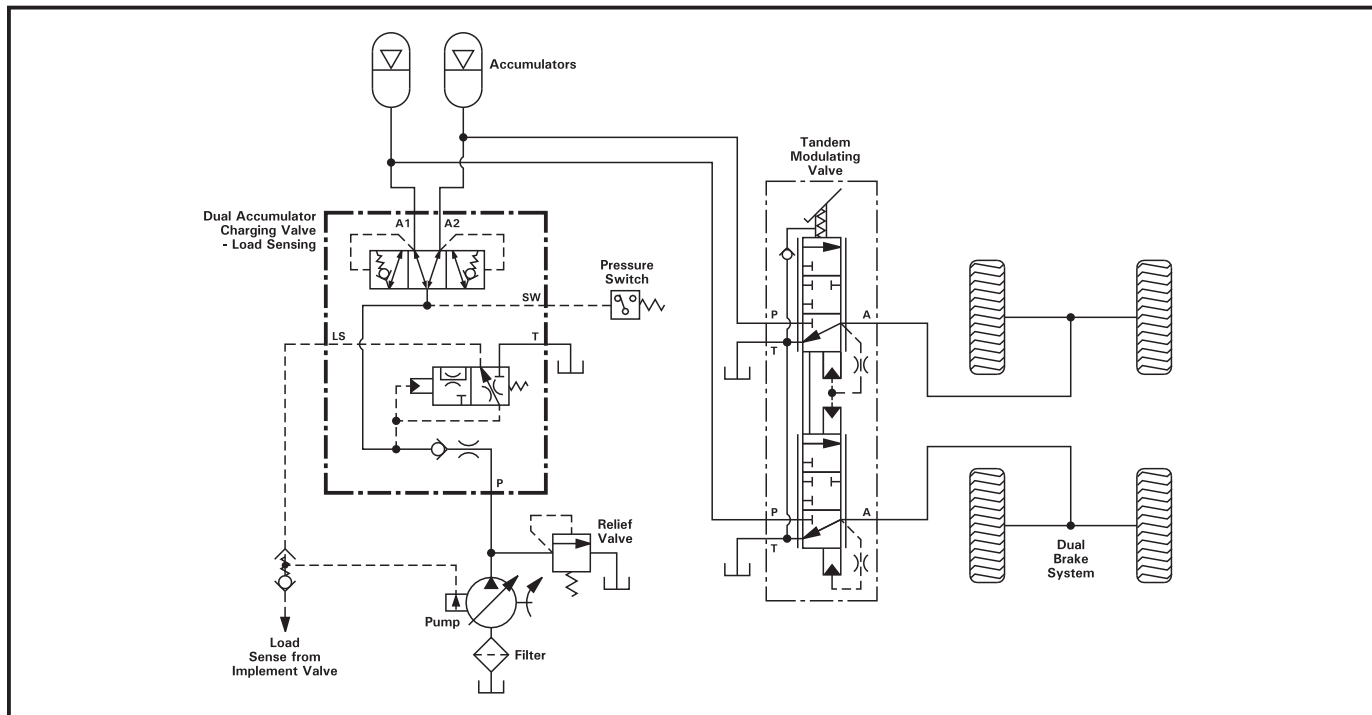
The charge rate and upper and lower accumulator pressure limits are set at the time of manufacture. Various charge rates, high and low limit settings and pressure ranges between high and low limits are available to conform to specific customer requirements.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

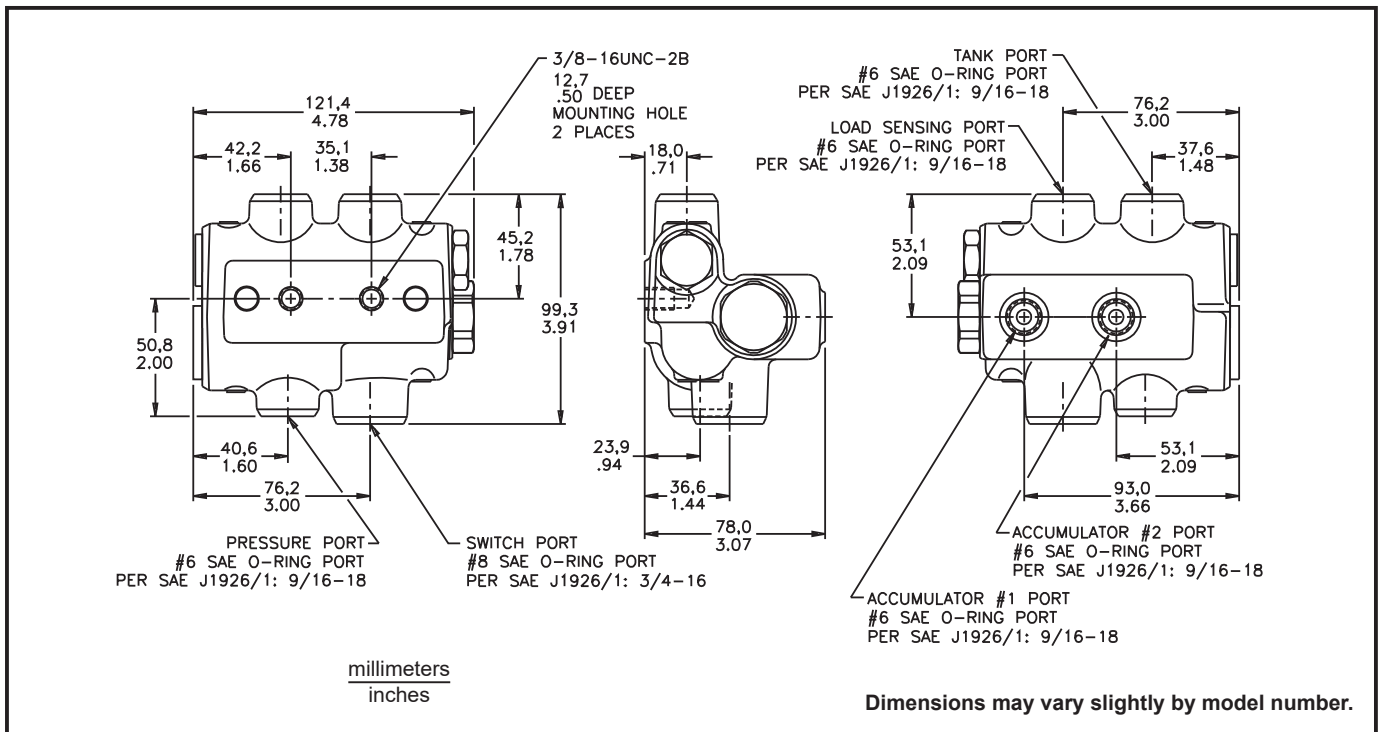
FEATURES

- Uses power developed in the main hydraulic system
- Remotely mounted from brake valves
- Snap action control section promotes positive unloading of the pump
- Designed to improve efficiency by having no continuous drain of oil to reservoir
- Large variety of pressure ranges between high and low limits are available in order to reduce pump cycle time
- Pressure switch port senses the lower pressure of the two accumulators

Typical Circuit Schematic (Dual)



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
06-463-100	ACV-DMN-LSB-55-78-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-463-118	ACV-DMN-LS-128-159-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-122	ACV-DMN-LSB-119-145-11V	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-126	ACV-DMN-LS-86-114-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-128	ACV-DMN-LS-155-190-16	± 3.5	(± 50)	± 3.5	(± 50)	± 2.8	(± 0.75)
06-463-148	ACV-DMN-LSB-86-114-8	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-156	ACV-DMN-LS-128-159-13	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-162	ACV-DMN-LS-145-176-13	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-164	ACV-DMN-LSB-128-159-13	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-166	ACV-DMN-LSB-166-186-6	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)
06-463-184	ACV-DMN-LSB-128-159-13	± 3.5	(± 50)	± 3.5	(± 50)	± 1.9	(± 0.5)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 206.8 bar (3000 PSI)
 Flow through capacity not applicable
 Flow through pressure drop not applicable
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Single Accumulator Charging Valves (high flow)



PRINCIPLES OF OPERATION

The Single Accumulator Charging Valves may be used in an open center hydraulic system in conjunction with an accumulator and a modulating brake valve or other hydraulic components.

These charging valves control the charging rate of the accumulator and the pressure of the fluid in the accumulator. These valves automatically halt the charging when the accumulator pressure reaches its high limit.

When the accumulator pressure reaches its low limit, these charging valves divert a small amount of fluid from the main open center hydraulic system to charge the accumulator.

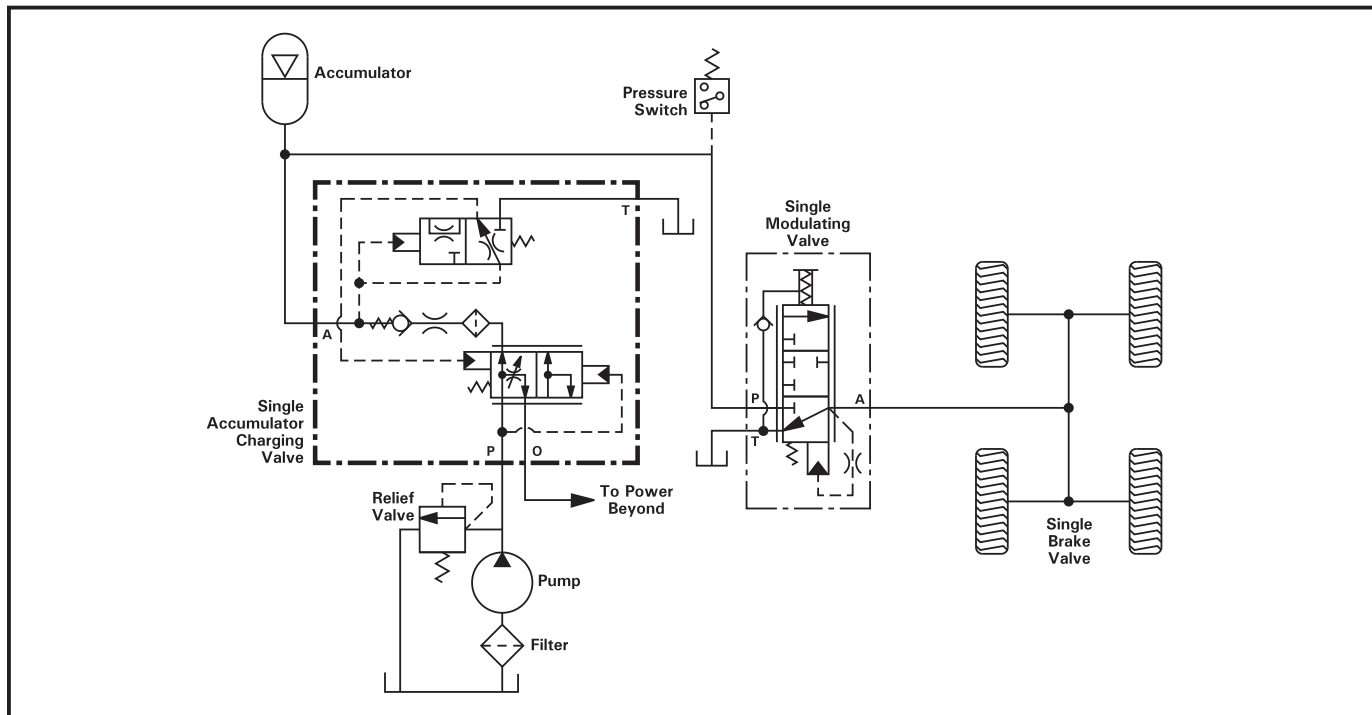
These valves charge the accumulator from the open center circuit upon demand and within its preset operating charge rate and maximum pressure. Other charge rates and pressures may be available upon request.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

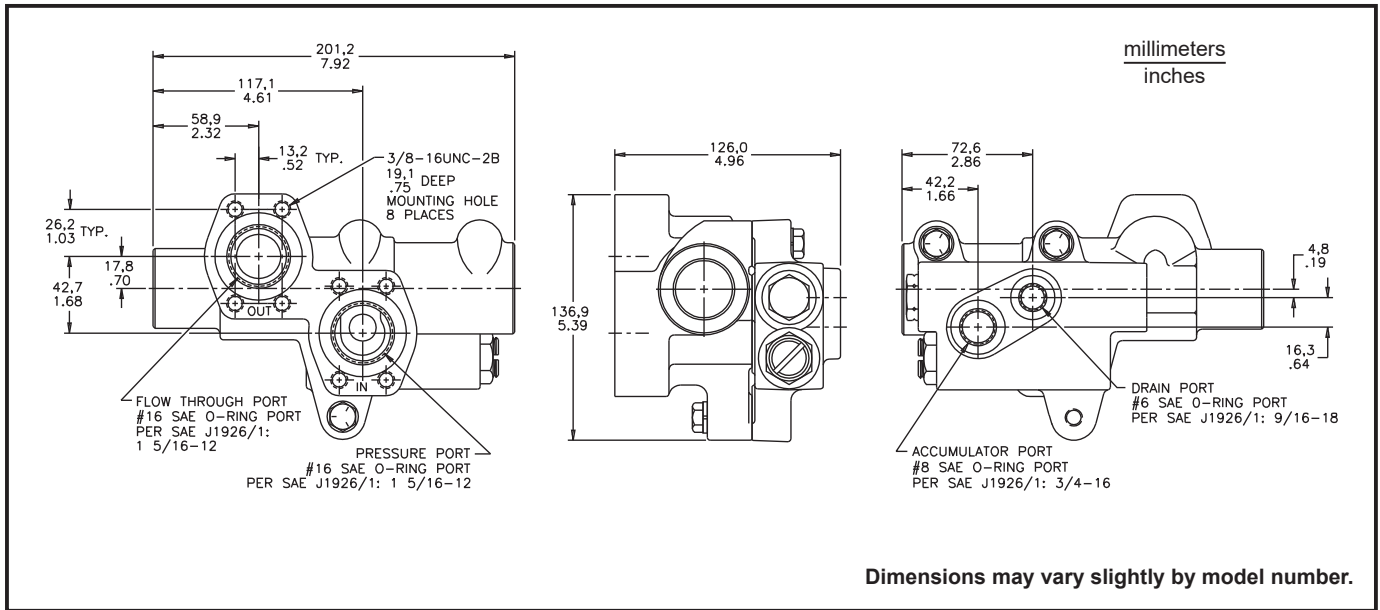
FEATURES

- Uses power developed in the main hydraulic system
- May be remotely mounted from brake valves
- Settings are adjusted at the time of manufacture to conform to specific customer requirements
- Flow rates up to 246 L/min (65 GPM)

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
* 06-460-202	ACV-SMO25-148-178-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-210	ACV-SMO13-117-145-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-224	ACV-SMO13-131-159-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-226	ACV-SMO13-66-83-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
* 06-460-230	ACV-SMO13-124-152-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-238	ACV-SMO25-55-79-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-242	ACV-SMO13-145-172-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-244	ACV-SMO13-83-103-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-248	ACV-SMO13-116-145-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-254	ACV-SMO13-83-103-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-256	ACV-SMO13-100-128-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-258	ACV-SMO13-97-121-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-268	ACV-SMO13-66-93-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)
06-460-270	ACV-SMO13-110-138-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-276	ACV-SMO13-83-103-10	± 3.5	(± 50)	± 1.7	(± 25)	± 2.3	(± 0.6)

* Pressure port and flow through port conform to SAE 1 inch split flange.

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 186.2 bar (2700 PSI)
 Power beyond flow capacity 132 to 246 L/min (35 to 60 GPM) (split flange models only)
 Flow through pressure drop 1.4 bar at 132 L/min (20 PSI at 35 GPM)

2.8 bar at 246 L/min (40 PSI at 65 GPM) (split flange models only)

Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

Dual Accumulator Charging Valves (high flow)



PRINCIPLES OF OPERATION

These Dual Accumulator Charging Valves perform essentially the same functions as the single charging valves. When the dual accumulator charging valves are used in a split hydraulic brake system each individual axle is controlled separately by a modulating valve and an accumulator. These valves charge both accumulators. The primary advantage of the dual charging valves over the single charging valves are that if half of the brake system fails the remaining half will continue to function.

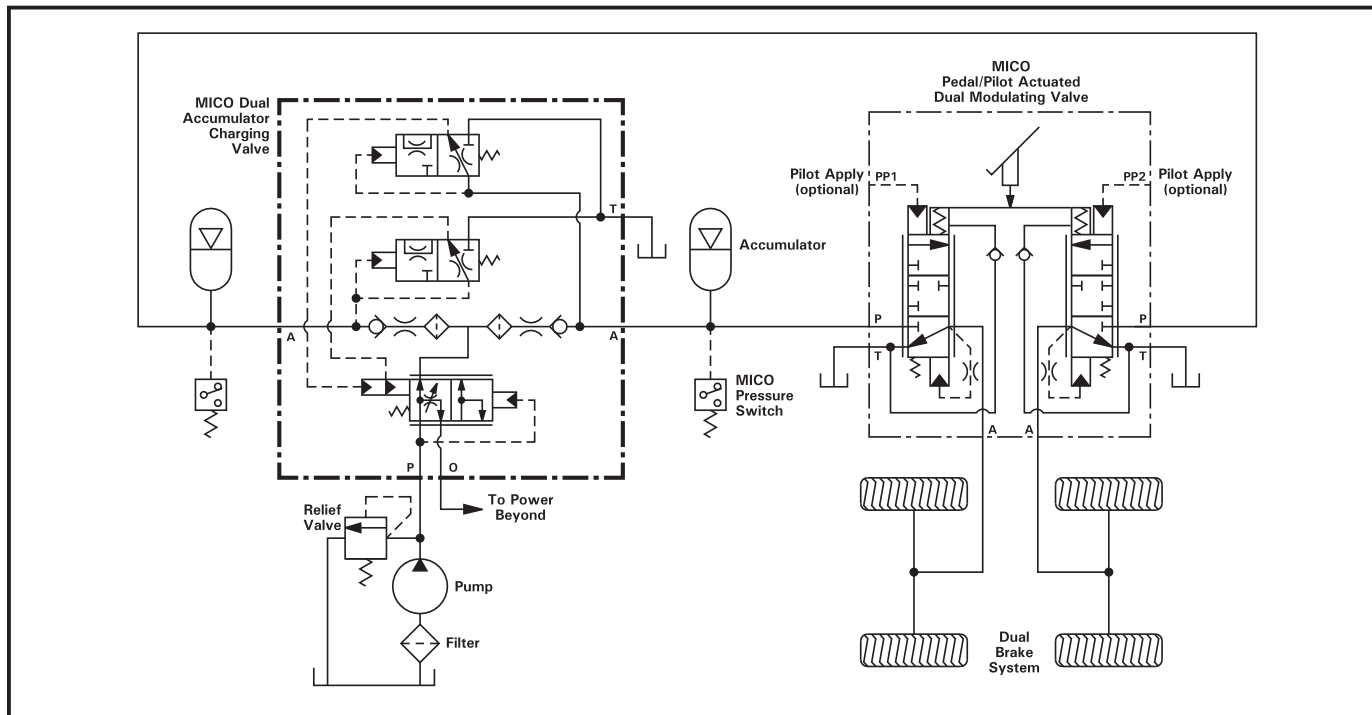
These valves charge the accumulators from the open center circuit upon demand and within its preset operating charge rate and maximum pressure. Other charge rates and pressures are available upon request.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

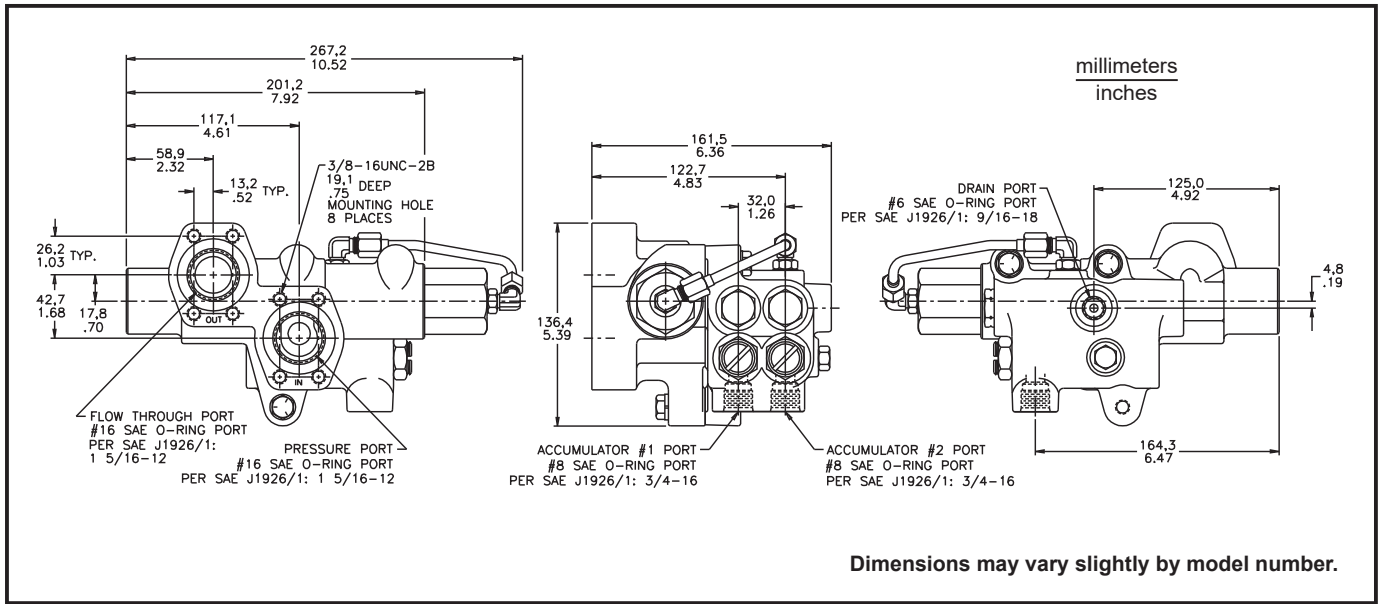
FEATURES

- Uses power developed in the main hydraulic system
- May be remotely mounted from brake valves
- Full system pressure is available to the power steering or secondary devices at all times
- Flow rates to 246 L/min (65 GPM)

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Catalog Code (refer to page 5)	Low Limit Tolerance		High Limit Tolerance		Accumulator Charging Rate Tolerance	
		bar	(PSI)	bar	(PSI)	L/min	(GPM)
06-460-216	ACV -DMO13 - 48 - 69 -3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-218	ACV -DMO13 - 97 - 124-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-222	ACV -DMO13 - 131-159-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-252	ACV -DMO13 - 97 - 124-6	± 3.5	(± 50)	± 1.7	(± 25)	± 1.9	(± 0.5)
06-460-264	ACV -DMO13 - 126-153-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)
06-460-292	ACV -DMO13 - 131-159-3	± 3.5	(± 50)	± 1.7	(± 25)	± 0.1	(± 0.25)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

System pressure to 186.2 bar (2700 PSI)
 Power beyond flow capacity 132 to 246 L/min (35 to 65 GPM) (split flange models only)
 Flow through pressure drop 1.4 bar at 132 L/min (20 PSI at 35 GPM)
 2.8 bar at 246 L/min (40 PSI at 65 GPM) (split flange models only)
 Accumulator capacity is determined from brake line pressure, displacement and number of power-off emergency brake applications.

Full Power Brake Valves



PRINCIPLES OF OPERATION

The Full Power Brake Valves use the hydraulic power developed for the power steering system to actuate the vehicle's brakes, eliminating the need for a separate power brake unit or separate hydraulic system fluid.

These valves control the charging rate of the accumulator, the pressure of the fluid in the accumulator, and the flow and pressure of the fluid to the brakes.

All hydraulic fluid from the hydraulic pump system flows through the valve. When the accumulator pressure reaches its low limit, the valve diverts a small amount of fluid from the main open center hydraulic system to charge the accumulator. It automatically halts the charging when accumulator pressure reaches its high limit.

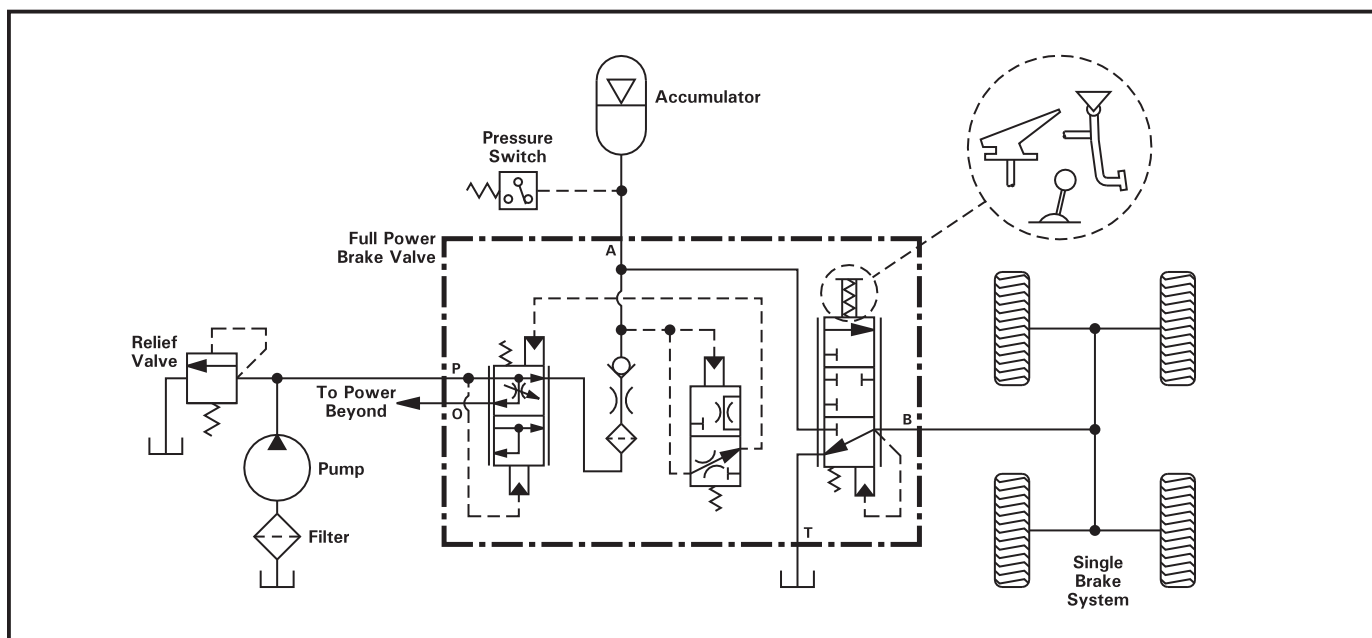
Actuation of the valve provides output pressures to the brakes in direct proportions to the pedal effort applied.

ZF Off-Highway also offers a complete line of hydraulic pressure switches for your application. Contact us for more information.

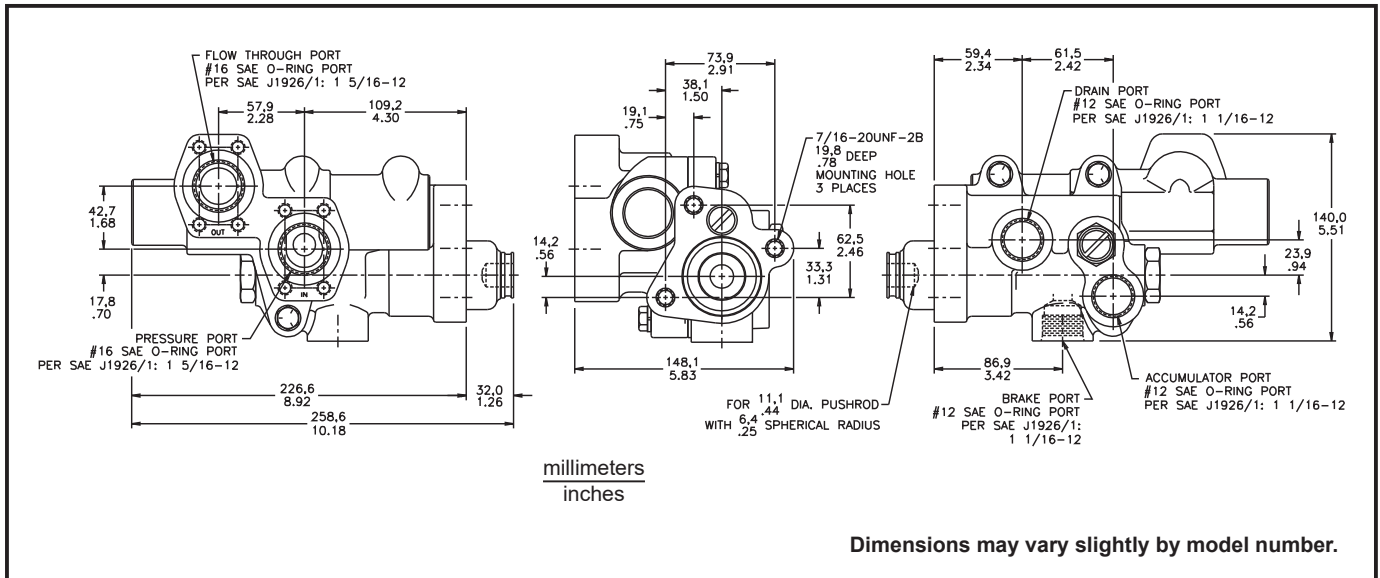
FEATURES

- Readily adaptable to both hydraulic and mechanical brakes
- Uses power developed in main hydraulic system
- Brake response much faster than air brakes
- Provides limited power-off braking through pressure and volume stored in the accumulator

Typical Circuit Schematic



Typical Valve



SPECIFICATIONS

Model Number	Maximum Brake Pressure Setting		Nominal Accumulator Charging Rate		Nominal High Limit		Nominal Low Limit		Push Rod Force at Maximum Pressure	
	bar	(PSI)	L/min	(GPM)	bar	(PSI)	bar	(PSI)	N	(lb)
06-460-800	44.8 ± 3.5	(650 ± 50)	6.4 ± 1.9	(1.7 ± 0.5)	89.6 ± 1.7	(1300 ± 25)	41.4 ± 3.5	(600 ± 50)	1690	(380)
06-460-810	108.6 ± 1.7	(1575 ± 25)	9.8 ± 2.3	(2.6 ± 0.6)	124.1 ± 1.7	(1800 ± 25)	96.5 ± 3.5	(1400 ± 50)	3692	(830)
06-460-814	103.4 ± 3.5	(1500 ± 50)	6.4 ± 1.9	(1.7 ± 0.5)	131.0 ± 1.7	(1900 ± 25)	106.9 ± 1.7	(1550 ± 25)	3514	(790)
06-460-816	108.6 ± 1.7	(1575 ± 25)	9.8 ± 2.3	(2.6 ± 0.6)	124.1 ± 1.7	(1800 ± 25)	96.5 ± 3.5	(1400 ± 50)	3692	(830)
06-460-820	44.8 ± 3.5	(650 ± 50)	9.8 ± 2.3	(2.6 ± 0.6)	89.6 ± 1.7	(1300 ± 25)	41.4 ± 3.5	(600 ± 50)	1690	(380)
06-460-830	98.3 ± 5.2	(1425 ± 75)	6.4 ± 1.9	(1.7 ± 0.5)	103.4 ± 1.7	(1500 ± 25)	82.7 ± 3.5	(1200 ± 50)	3514	(790)
06-460-832	65.5 ± 3.5	(950 ± 50)	6.4 ± 1.9	(1.7 ± 0.5)	103.4 ± 1.7	(1500 ± 25)	82.7 ± 3.5	(1200 ± 50)	2358	(530)
06-460-838	106.9 ± 5.2	(1550 ± 75)	6.4 ± 1.9	(1.7 ± 0.5)	148.2 ± 5.2	(2150 ± 75)	110.3 ± 3.5	(1600 ± 50)	3514	(790)
06-460-848	70.7 ± 1.7	(1025 ± 25)	6.4 ± 1.9	(1.7 ± 0.5)	113.8 ± 1.7	(1650 ± 25)	93.1 ± 3.5	(1350 ± 50)	2624	(590)
06-460-852	98.3 ± 5.2	(1425 ± 75)	2.8 ± 0.1	(0.75 ± 0.25)	103.4 ± 1.7	(1500 ± 25)	82.7 ± 3.5	(1200 ± 50)	1335	(300)
06-460-854	103.4 ± 3.5	(1500 ± 50)	2.8 ± 0.1	(0.75 ± 0.25)	134.4 ± 3.5	(1950 ± 50)	106.9 ± 3.5	(1550 ± 50)	1335	(300)
06-460-860	75.8 ± 5.2	(1100 ± 75)	9.8 ± 2.3	(2.6 ± 0.6)	93.1 ± 1.7	(1350 ± 25)	75.8 ± 3.5	(1100 ± 50)	2669	(600)
06-460-894	22.4 ± 1.0	(325 ± 15)	9.8 ± 2.3	(2.6 ± 0.6)	89.6 ± 1.7	(1300 ± 25)	41.4 ± 3.5	(600 ± 50)	1601	(360)
06-460-900	18.6 ± 1.0	(270 ± 15)	9.8 ± 2.3	(2.6 ± 0.6)	89.6 ± 1.7	(1300 ± 25)	41.4 ± 3.5	(600 ± 50)	712	(160)
06-460-950	134.4 ± 3.5	(1950 ± 50)	6.4 ± 1.9	(1.7 ± 0.5)	165.5 ± 3.5	(2400 ± 50)	134.5 ± 3.5	(1950 ± 50)	1335	(300)
06-460-956	25.9 ± 1.7	(375 ± 25)	2.8 ± 0.1	(0.75 ± 0.25)	89.6 ± 1.7	(1300 ± 25)	43.1 ± 1.7	(625 ± 25)	1890	(425)
06-460-958	34.5 ± 3.5	(500 ± 50)	6.4 ± 1.9	(1.7 ± 0.5)	89.6 ± 1.7	(1300 ± 25)	60.3 ± 3.5	(875 ± 50)	1335	(300)
06-460-960	41.4 ± 3.5	(600 ± 50)	9.8 ± 2.3	(2.6 ± 0.6)	120.7 ± 3.5	(1750 ± 50)	56.9 ± 3.5	(825 ± 50)	2825	(635)

Consult our Applications Department for other available models and application detail.

PERFORMANCE DATA

Flow through capacity to 137 L/min to 246 L/min (35 to 65 GPM) (split flange models only)
 Flow through pressure drop. 1.4 bar at 132 L/min (20 PSI at 35 GPM)
 2.8 bar at 246 L/min (40 PSI at 65 GPM) (split flange models only)
 Accumulator pressure, maximum to 189.6 bar (2750 PSI)
 Accumulator charging rate. 1.9 to 12.1 L/min at 69.0 bar (0.5 to 3.2 GPM at 1000 PSI) in three ranges
 Actuating push rod stroke 5.56 mm to 10.67 mm (0.219 in to 0.420 in) depending on model number
 Accumulator capacity is determined from brake line pressure, displacement, and number of power-off emergency brake applications.

USEFUL FORMULAS

$$\text{Piston Area (in}^2\text{)} = \pi (3.1416) \times r^2 \text{ (in)}$$

$$\text{Piston Radius (in)} = \sqrt{\frac{\text{Area (in}^2\text{)}}{\pi (3.1416)}}$$

$$\text{Force (lb)} = \text{Piston Area (in}^2\text{)} \times \text{Line Pressure (PSI)}$$

$$\text{Piston Area (in}^2\text{)} = \frac{\text{Force (lb)}}{\text{Line Pressure (PSI)}}$$

$$\text{Line Pressure (PSI)} = \frac{\text{Force (lb)}}{\text{Piston Area (in}^2\text{)}}$$

$$\text{Volume (in}^3\text{)} = \text{Piston Area (in}^2\text{)} \times \text{Stroke (in)}$$

$$\text{Piston Area (in}^2\text{)} = \frac{\text{Volume (in}^3\text{)}}{\text{Stroke (in)}}$$

$$\text{Stroke (in)} = \frac{\text{Volume (in}^3\text{)}}{\text{Piston Area (in}^2\text{)}}$$

$$\text{Volume (gallons)} = \text{Flow Rate (GPM)} \times \text{Time (min)}$$

$$\text{Flow Rate (GPM)} = \frac{\text{Volume (gallons)}}{\text{Time (min)}}$$

$$\text{Time (min)} = \frac{\text{Volume (gallons)}}{\text{Flow Rate (GPM)}}$$

$$\text{Flow Rate (GPM)} = \frac{\text{Pump Displacement (cir*)} \times \text{Pump RPM}}{231**}$$

$$\text{Pump displacement (cir)} = \frac{\text{Flow Rate (GPM)} \times 231}{\text{Pump RPM}}$$

$$\text{Pump RPM} = \frac{\text{Flow Rate (GPM)} \times 231}{\text{Pump Displacement (cir)}}$$

$$\text{PTO/Pump RPM} = \text{PTO \% Engine Speed} \times \text{Engine RPM}$$

$$\text{PTO \% Engine Speed} = \frac{\text{PTO/Pump RPM}}{\text{Engine RPM}}$$

$$\text{Engine RPM} = \frac{\text{PTO/Pump RPM}}{\text{PTO \% Engine Speed}}$$

$$\text{Horsepower} = \frac{\text{Flow Rate (GPM)} \times \text{Line Pressure (PSI)}}{1714 \times \% \text{ Pump Efficiency}}$$

$$\text{Horsepower} = \frac{\text{Torque (lb}\cdot\text{ft)} \times \text{RPM}}{5252}$$

$$\text{Torque (lb}\cdot\text{ft)} = \frac{\text{Horsepower} \times 5252}{\text{RPM}}$$

$$\text{RPM} = \frac{\text{Horsepower} \times 5252}{\text{Torque (lb}\cdot\text{ft)}}$$

* cir = cubic inches per revolution

** 231 cubic inches = 1 U.S. gallon

About ZF Friedrichshafen AG

ZF is a global technology company supplying systems for passenger cars, commercial vehicles and industrial technology, enabling the next generation of mobility.

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