



# PRODUCT GUIDE



HYDRAULIC AND ELECTROHYDRAULIC BRAKING SYSTEMS  
BRAKES, BRAKE ACTUATION, VALVES, CONTROLS



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# What we offer. . .

- ▶ **Your Satisfaction**
- ▶ **Engineering Excellence**
- ▶ **Manufacturing Expertise**
- ▶ **World Class Service**

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.

Product lines:

- ▶ Actuators
- ▶ Brakes
- ▶ Brake Locks
- ▶ Controls
- ▶ Cylinders
- ▶ Master Cylinders
- ▶ Valves

ZF continuously strives for improvement, while remaining a quality leader in our field. We have been a successful, customer driven business for over 70 years. We look forward to working with you!

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# CALIPER DISC BRAKES

ZF Caliper Disc Brakes are either a floating or fixed design. Models are available for use with both brake fluid and mineral base hydraulic oil.

ZF Caliper Disc Brakes are ideal for providing primary, emergency, and secondary braking for applications in the agriculture, construction, mining, airport support, and forestry industries.



**515 SERIES CALIPERS** are a floating type design. They mount over a rotor disc using either pins or shoulder bolts. One side of the caliper is actuated to provide clamping force.



### Spring Apply Caliper Disc Brakes

#### 515 Series

Floating design. Belleville springs apply these brakes and hydraulic pressure releases them. Used with 5/16 to 1/2 inch thick rotor disc of 6 inch diameter or larger. Used as parking and/or emergency brake.



### Mechanical Apply Caliper Disc Brakes

#### 515 Series

Floating design. Mechanical lever and cam system applies and releases these brakes. Uses a 5/16 to 1/2 inch thick rotor disc of 6 inch diameter or larger. Ideal for secondary, emergency, and industrial applications.



### Hydraulic Apply Caliper Disc Brakes

#### 515 Series

Floating design. Modulated hydraulic pressure applies and releases these brakes. Uses a 5/16 to 1/2 inch thick rotor disc of 6 inch diameter or larger. Provides braking for applications in the agriculture, construction, mining, and forestry industries.

**520 SERIES CALIPERS** are a fixed type design. Each side of the caliper contains a piston that actuates to provide clamping force.



### Hydraulic Apply Caliper Disc Brakes

#### 520 Series

Fixed caliper designs with 2 3/8 inch diameter opposing pistons. Uses a 1/2 inch thick rotor disc of 9 to 36 inch diameter. Uses modulated hydraulic pressure source to apply the brake.



### Hydraulic Apply Caliper Disc Brakes

#### 520 Series

Fixed caliper designs with 2 1/2 inch diameter opposing pistons. Uses a rotor disc of 9 inch to unlimited diameter. Can be used with straight rail to provide full lining to surface contact. Uses modulated hydraulic pressure source to apply the brake.



### Hydraulic Apply Caliper Disc Brakes

#### 520 Series

Fixed design split caliper with 2 1/4 inch diameter opposing pistons. Uses a 1 inch thick rotor disc of 15 inch diameter or larger. Has a lining retractor mechanism to maintain lining to rotor disc clearance while the brake is not applied. Used in service braking applications.



### Hydraulic Apply Caliper Disc Brakes

#### 520 Series

Fixed caliper designs. Lightweight aluminum housing with 2 1/2 inch diameter opposing pistons. Uses 1/2 inch thick rotor disc of 10 to 24 inch diameter. Mounts flush with torque member. Large surface area linings can be replaced without separating housing halves. Uses modulated hydraulic pressure source to apply the brake.



### Hydraulic Apply Caliper Disc Brakes

#### 520 Series

Fixed design split caliper with 3 1/2 inch diameter opposing pistons. Standard 1/2 inch thick spacer can be replaced to allow for desired rotor disc thicknesses with diameters of 12 to 36 inch. Large surface area linings can be replaced without separating housing halves.

**530 SERIES CALIPERS** are a floating type design that use Belleville springs to apply the brake and hydraulic pressure to release it. Models are available with hydraulic apply. One side of the caliper is actuated to provide clamping force.



### Spring Apply Caliper Disc Brakes

#### 530 Series

Floating design. Belleville springs apply this type brake and hydraulic pressure releases it. Uses a 5/16 to 1/2 inch thick rotor disc of 9 inch diameter or larger. Used as parking and/or emergency brake.



### Hydraulic Apply Caliper Disc Brakes

#### 530 Series

Floating design. Modulated hydraulic pressure applies and releases this brake. Uses a 1/2 inch thick rotor disc of 9 inch diameter or larger. Used as parking and/or emergency brake.



## MULTIPLE DISC BRAKES

ZF Multiple Disc Brakes are fully enclosed units that use coil springs and multiple friction discs to produce braking torque. These brakes are applied by coil springs and released using hydraulic pressure. Maximum brake torque is achieved when hydraulic release pressure is zero. These brakes are self-applying in that any function which reduces hydraulic release pressure will begin to initiate brake clamping force.

Multiple disc brakes are manufactured using high strength ductile iron housings with nitrile case and shaft seals to keep outside contaminants from entering the brake. Spline shafts are constructed of heat-treated 8620 steel and available in a number of different configurations. Available in SAE A, B, C, or D mounts with torque ranges from 113 to 2825 N·m (1000 to 25,000 lb·in) and release pressures from 6.9 to 34.5 bar (100 to 500 PSI).

Typical applications include a parking brake function or braking of a motor on man lifts, scissor lifts, winches, swing drives, and other low speed vehicles and equipment.



### A-Mount Multiple Disc Brakes

#### Modular Design

Large diameter spline shaft virtually eliminates spline battering. Low release pressures make these brakes ideal for use with closed loop hydrostatic systems. Unique balanced piston design.



### B-Mount Multiple Disc Brakes

#### Narrow Design

Dry design B-Mount brakes are extremely compact. Some models available with optional pressure override feature for limited service braking. Non-metallic or sintered bronze friction materials also available. Wet option available for some models.



### C-Mount Multiple Disc Brakes

#### Modular Design

Modular brakes have low release pressures. Ideal for use with closed loop hydrostatic systems. Numerous mounting configurations available. Unique balanced piston design. Wet versions are also available.



### D-Mount Multiple Disc Brakes

#### Modular Design

Simple four-bolt mounting configurations. Models for either wet design or dry design applications. Unique balanced piston design. Low release pressures make these brakes ideal for use with closed-loop hydrostatic systems.



### Compact Wheel Mount Multiple Disc Brakes

These dry design, compact wheel mount brakes with integral hub, allows for direct mounting of the wheel hub to the brake. Tapered and keyed shafts are available. Closed input or motor input mounting face available. A wet brake option with pressure override (service braking) is also available. High radial loading capacity makes these brakes ideal for vehicles such as scissor lifts.



### Large Wheel Mount Multiple Disc Brakes

#### Motor Input

The dry wheel mount brake design provides for direct mounting of the wheel to the tapered and keyed output shaft of the brake. Closed input designs also available.



### Driveline Multiple Disc Brakes

Driveline multiple disc brakes with wet design. Has tapered roller bearings for high radial and thrust loads. Developed to retrofit drum/caliper driveline parking brakes. Features a lining wear indicator port. Internal through-shaft designs available.



### Closed Output Motor Brakes

Low cost brakes with high torque capacity. Mates with Parker Nichols and Danfoss through-shaft motors.



### Posi-torque Winch Brakes

#### Modular Design

Designed primarily for use on hydraulically driven winch systems. These brakes combine the benefits of one-way winching, positive load positioning and "run-away" protection.



### Pressure Override Brakes

#### Modular Design

Modulated with automotive type master cylinder or hydraulic valve for service braking. Parking brake function included. B or C mount available. Wet versions are also available.

NOTE: ZF Off-Highway Solutions Minnesota Inc. custom-engineers products for specific applications. Not all products are listed in this brochure. Please call us for additional information.



# MASTER CYLINDERS

ZF Master Cylinders are single piston, straight-bore type with a return spring, and are available with or without an integral reservoir. Most cylinders are available as brake fluid or mineral base hydraulic oil models and in a variety of mounting styles.

ZF Two-stage Master Cylinders are integrally designed to incorporate the advantage of a large piston for fluid volume and a small piston for high pressure. Transfer from the volume piston to the pressure piston is accomplished by means of a metered pressure relief valve.

Two-stage Master Cylinders are commonly used on equipment that require larger volumes than provided by conventional master cylinders.

Boosted Master Cylinders are used on machinery that requires higher pressures than typically provided by master cylinders or two-stage master cylinders.



### Straight Bore Master Cylinders

Cylinders have a 1 inch bore diameter and a 1.13 inch or 1.44 inch effective stroke.



### Straight Bore Master Cylinders

Cylinders have a 1 inch bore diameter and a 1.44 inch effective stroke.



### Straight Bore Master Cylinders

Cylinders have a 1.75 inch bore diameter and a 1.44 inch effective stroke.



### Straight Bore Master Cylinders

Cylinders have a 1.5 inch bore diameter and a 1.5 inch effective stroke.



### Straight Bore Master Cylinders

Cylinders have a 0.75 inch bore diameter and a 1.3 inch effective stroke.



### Two-stage Master Cylinders

Bore combinations for these cylinders are 1.25 inch over 0.75 inch or 1.375 inch over 0.875 inch. The effective stroke is 1.25 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.5 inch over 0.75 inch or 1.5 inch over 0.875 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.75 inch over 0.875 inch, 1.75 inch over 1 inch, or 1.75 inch over 1.125 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.75 inch over 1 inch or 1.75 inch over 1.125 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.75 inch over 1 inch or 1.75 inch over 1.125 inch. Effective stroke is 1.44 inch.

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## SLAVE AND WHEEL CYLINDERS

ZF Hydraulic Slave Cylinders and Wheel Cylinders are small bore, short stroke cylinders used for remote clutch and brake actuation. They are available in a variety of strokes, mountings, and bores. Most cylinders are available as brake fluid or mineral base hydraulic oil models.

These cylinders are used in industrial applications for holding, clamping, and latching. They are also used in off-highway applications.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.75 inch over 1 inch or 1.75 inch over 1.125 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.5 inch over 0.75 inch or 1.5 inch over 0.875 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 1.75 inch over 1 inch or 1.25 inch over 1.125 inch. Effective stroke is 1.44 inch.



### Two-stage Master Cylinders

Bore diameters for these cylinders are 2.25 inch over 1 inch or 2.25 inch over 1.125 inch. Effective stroke is 2 inch.



### Open Center Boosted Master Cylinders

Permits the brake system to develop up to twice the hydraulic pressure present in the main hydraulic system. Bore diameter is 1.62 inch and effective stroke is 1.5 inch.



### Boosted Dual Master Cylinders (with steering assist)

Cylinders are used to modulate output pressures up to 1500 PSI. Intended for brake systems with brake assisted steering.



### Slave Cylinders

Cylinders have a 0.62 inch bore diameter and models with 2.06, 2.15, or 2.44 inch effective strokes.



### Slave Cylinders

Cylinders available with 0.62, 0.75, 1, or 1.06 inch bore diameters and 0.5, 0.75, or 1 inch effective strokes.



### Slave Cylinders

Cylinders have a 1 inch bore diameter and a 1.75 inch effective stroke.



### Wheel Cylinders

Cylinders available with 1.38, 1.5, or 1.75 inch bore diameters and 0.82 or 1.32 inch effective strokes.



### Drive Axle Cylinders

Cylinders provide hydraulic control to apply and release axle brakes. For use with a variety of CNH Power Components drive axles.

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## TWO FLUID ACTUATORS

The ZF Two Fluid Actuators combine a booster section with a master cylinder section in a single unit. These actuators allow the booster section to use one type of fluid and the master cylinder section another. This feature enables the booster section to be powered by an existing mineral base hydraulic oil circuit while maintaining use of DOT brake fluid in the rest of the system.

With the same pedal effort, ZF Two Fluid Actuators provide higher output pressure than non-boosted master cylinders.



### Boosted Straight Bore Master Cylinders

Can develop brake line pressure up to 1800 PSI. Master cylinder bore diameters available as 1.25, 1.5, 1.75, or 2.25 inch.



### Boosted Two-Stage Master Cylinders

Can develop brake line pressures up to 2500 PSI. Two-stage master cylinder bore diameter combinations are 1.75 inch over 0.875 inch, 1.75 inch over 1 inch, 1.75 inch over 1.25 inch, or 2.25 inch over 1.25 inch.



### Boosted Straight Bore Master Cylinders

Can develop brake line pressure up to 1650 PSI. Master Cylinder bore diameters available as 1.25, 1.5, 1.75, or 2.25 inch.



### Boosted Tandem Straight Bore Master Cylinders

Can develop brake line pressure up to 1600 PSI. Master Cylinder bore diameters available as 1.25 or 1.75 inch.



### Power Brake Actuator

Compact cylinders designed for use on vehicles equipped with open center hydraulic system. The system requirements are a supply of 0.7 to 4 GPM at 335 PSI to obtain the set brake limit pressure. Master cylinder bore diameter is 1.06 inch. Use hydraulic oil only.





## AIR/HYDRAULIC ACTUATORS

ZF Air/Hydraulic Actuators combine a large surface area air chamber with a smaller diameter bore master cylinder or actuator. They allow the use of a pressurized air source to produce high hydraulic pressure.

Air/hydraulic actuators can be used on a variety of vehicles and industrial applications within the construction, material handling, mining, forestry, and agriculture markets.

Unique application: A towed vehicle that is hydraulically braked and equipped with an air/hydraulic actuator can utilize the air-actuated brakes of the vehicle that is towing it.



**Air/Hydraulic Actuators**  
(master cylinder with air chamber)

Master cylinders are single acting with one piston. Bore diameter is 1.25 inch and effective stroke is 1.38 inch. Air chamber is 12 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(actuator with air chamber)

Bore diameter of 1.75 inch and effective stroke of either 2.13 or 2.44 inch. Air chambers are 20 in<sup>2</sup> and 36 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(master cylinder with air chamber)

Conventional master cylinder and air chamber. Bore diameter is 1.75 inch and effective stroke is 2.25 or 2.45 inch. Air chambers are 30 in<sup>2</sup> and 36 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(actuator with air chamber)

Actuator has single acting piston. Provides either one of two pressure sources to operate a slave cylinder, brake, or other device. Bore diameters are 1.13 and 1.5 inch and effective stroke is 1.44 inch. Air chambers are 12 in<sup>2</sup>, 24 in<sup>2</sup>, and 30 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(master cylinder with air chamber)

Large straight bore master cylinder. Bore diameter is 1.75 inch and effective stroke is 1.75 inch. Air chamber is 12 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(actuator with air chamber)

Actuator has single acting piston. Bore diameter is 1.5 inch and effective stroke is 1.44 inch. Air chamber is 24 in<sup>2</sup>.



**Air/Hydraulic Actuators**  
(master cylinder with air chamber)

Internal valving enhances bleeding and extends normal service life of the primary seal. Actuator has 1.5 inch bore diameter and 2 inch effective stroke. Air chamber sizes from 20 in<sup>2</sup> to 36 in<sup>2</sup>. Designed with a built-in stroke indicator.

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## REMOTE ACTUATORS

ZF Remote Actuators are typically used to actuate a brake or clutch from two locations when two master cylinders are used. They prevent the transfer of fluid from one system to another system.

These actuators are available in hand, foot, or hydraulically operated models. They can be used in combination with a remote reservoir to accommodate accessibility.

Pressure intensifiers are ideal for applications where a low pressure hydraulic source is available and a small displacement of high pressure hydraulic fluid is required.



### Remote Actuators (hydraulically operated)

Actuated by a remote hydraulic pressure source such as a master cylinder. Bore sizes of 1 or 1.5 inch available with effective stroke of 0.47, 0.52, 1, or 2.25 inch.



### Remote Actuators (hydraulically operated)

Mechanical devices which link the vehicle hydraulics with the brake system. Available in two different bore sizes and are capable of displacing 1.77 to 2.9 in<sup>3</sup> per side.



### Remote Actuators (hand control operated)

Non-ratchet type lever with clevis and linkage arrangement exerts force on actuator push rod. When application pressure is released the floating piston assembly is forced back by a return spring. Rugged heavy-duty construction.



### Remote Actuators (hand control operated)

Ratchet type lock-release mechanism in the handle locks lever in position. When application pressure is released, actuator piston assembly is forced back by a return spring. Rugged heavy-duty construction.



### Remote Actuators (pedal operated)

Actuators have a bore of 1.25 inch and an effective stroke of 1.87 inch. Designed for use with optional remote fluid reservoir.



### Remote Actuators (pedal operated)

Actuators have a 1.25 inch bore and effective displacement of 1 inch. Right side and centered pedal models available.



### Remote Actuators (pedal and linkage operated)

Actuators have a 1.25 or 1.5 inch bore and effective stroke of 1.44 inch. Actuated by various types of mechanical linkage.



### Pressure Intensifiers

Output to input pressure ratios of 1:1, 2:1, 5:1, and 9:1. Ideal for disc brake applications and various industrial applications. Assist section and cylinder section can use different fluid types.

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## BRAKE LOCKS

ZF Brake Locks are to be used in conjunction with a vehicle's mechanical parking brake. They function as a supplemental brake holding device and are not intended to be used for prolonged parking.

All ZF Brake Locks include a low pressure warning switch. The switch is connected to a visual and audible alarm to alert the operator of an unsafe reduction in locked brake pressure.

Several types of brake locks are available for use on single, dual, split, or anti-lock brake systems.



### 691 Brake Lock Systems

These systems lock hydraulic pressure in the service brakes to supplement the vehicles mechanical parking brake. They can also function as an interlock to apply pressure to the service brakes when other vehicle mounted equipment is being used.



### Cable Locks

Functionally the same as lever locks and twist locks. The cable lock is cable operated for remote mountings when space under the dash is limited.



### Dual Cable Locks

Dual locks have a pair of independent one-way check valves. They can provide 4-wheel lockup for hydraulic dual brake systems or rear wheel ABS, as well as 2-wheel lockup for hydraulic 3 and 4 channel ABS.



### Electric Brake Locks

Installed directly into the vehicle's service brake system. Activated by a flip of a toggle switch located within reach of the operator. When the brakes are applied, the brake lock acts as a one-way check valve and holds pressure in the brakes until the lock is released and brakes are manually applied.



### Lever Locks

Lever locks are one-way check valves which lock fluid under pressure in the selected brakes. Hand operation leaves the operator's feet free for clutch and throttle pedal operation.



### Surge Brake Lockout

Acts as an electrically activated check valve between a trailer's surge actuator and wheel brakes. Allows the trailer to be backed-up and not have the trailers brakes apply. Can be controlled semi-automatically or manually.



### Twist Locks

Functionally the same as a lever lock. The twist lock has a rotary action handle. The push rod is sealed and lubricated with silicone grease for tough environmental applications.

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# MODULATING BRAKE VALVES

ZF Modulating Hydraulic Power Brake Valves provide directional control of brake system pressure. They also provide the operator with a “pedal feel” proportional to brake system pressure.

These valves are designed for use with vehicles that are equipped with other hydraulic power devices. This feature eliminates the need for a separate power brake unit or separate hydraulic fluid system.

There are single valves for single brake systems, tandem valves for split brake systems, valves with pilot sections, and reverse modulating valves.

ZF offers modulating valves in a spool design and a poppet design. Although there are inherent benefits to both, the spool design provides lower hysteresis while the poppet design provides very low leakage.

Modulating valves can be operated a variety of ways including: pedal, lever, cam, pilot pressure, and electro-mechanical devices.



### Single Modulating Valves (spool design)

When used with a properly sized accumulator and ZF Accumulator Charge Valve, can provide normal and emergency power-off braking in a variety of open center, closed center, and load sensing hydraulic systems.



### Tandem Modulating Valves (spool design)

Operates similar to the single modulating valves, except two independent pressure outputs are provided. If either half of a dual brake system fails, the other half will continue to provide braking function.



### Tandem Modulating Valves with pilot (spool design)

Pilot apply valves are similar to the tandem modulating valves above, however, they include a pilot apply section. The pilot apply provides an additional method for brake application through a hydraulic signal from a remote location.



### Reverse Modulating Valves (spool design)

Reverse modulating valves are used in negative braking systems for controlled actuation of a spring apply/hydraulic release service brake. As the pedal is applied, pressure to the brake is reduced causing the brake to engage.



### Modulating Valves (poppet design)

The poppet design modulating valves provide the same basic functions as the spool design modulating valves. They do have some inherent design benefits such as high flow rate capabilities at high modulating pressures and low internal leakage.



### Reverse Modulating Valves (poppet design)

Having the benefits of a poppet design valve, these reverse modulating valves function the same as the spool design reverse modulating valve. As the pedal is applied, output pressure is reduced.



### Dual Power Brake Valves for Steering Assist

Provides steering assist power braking with one pedal applied or full power braking with both pedals applied. Patented design produces equally balanced brake pressures when both pedals are applied.



### Hystat Brake Valves

Developed to de-stroke the hydrostatic transmission and then apply the vehicle brakes. As the valve is released, the brakes release and the hydrostatic transmission re-engages.



### Relay Valves

Allow remote actuation of brake pressure with a hydraulic pilot signal. Various reaction areas in combination with several input areas can provide a wide variety of input to output pressures.



### Hydraulic over air Relay Valves

Modulate air brake pressure to control an air braked trailer from a hydraulically braked towing vehicle that has an air power source.





## ACCUMULATOR CHARGING VALVES

ZF Accumulator Charging Valves supply oil to an accumulator from an open center circuit on demand at a preset rate.

ZF has accumulator charging valves for use in open center hydraulic systems and load sensing hydraulic systems. Some models have a built-in relief valve to limit the main hydraulic system pressure.



### Full Power Brake Valves

Integrates the function of an accumulator charge valve with a modulating valve. Excess flow may be used to power other hydraulic functions. Thus, eliminating the need for a separate power brake unit or hydraulic system fluid.



### Park Brake Valves (with auto apply)

Provides added safety for operator and vehicle by controlling actuation of a spring apply, hydraulic release park brake. Can sense accumulator brake pressure and automatically apply the brakes at a predetermined pressure. They can also be operated manually.



### Single Accumulator Charging Valves

Designed for installation in open center hydraulic systems, these valves use an internal spool valve to control hydraulic system flow to pressurize an accumulator.



### Dual Accumulator Charging Valves

Essentially the same functions as the single accumulator charging valves, these valves monitor accumulator pressure and control hydraulic system flow to pressurize accumulators from two independent accumulator ports.



### Single and Dual Accumulator Charging Valves (with relief)

The function of charging valves with relief is the same as either the single or dual charging valves above. However, a main hydraulic system relief valve is incorporated.



### Single and Dual Accumulator Charging Valves - Load Sensing

Used in load sensing hydraulic circuits. Load sensing charging valves send a load sense signal to a load compensated pump. The charging function is the same as the single or dual charging valves.



### Single and Dual Accumulator Charging Valves - Load Sensing (unloading)

Solenoid feature is desirable in cold start conditions and marginal horsepower applications. It allows the machine to be started without immediately charging accumulators. Available for single or dual accumulator charging.



### Gear Pump integrated with Single or Dual Accumulator Charging Valve

An integrated package that features a ZF Accumulator Charging Valve and hydraulic pump. The accumulator charging function is the same as the single or dual charging valves.

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# HYDRAULIC THROTTLE CONTROLS & SWITCHES

ZF Throttle Controls are used to hydraulically control mechanical throttles in applications where the design flexibility of hydraulics offers the machine designer advantages not available with other systems.

ZF has a complete line of pressure, vacuum, and temperature switches. There are both elastomer diaphragm and piston style pressure switches. We also offer a differential pressure switch.



CONTROLS



## Hydraulic Throttle Controls

Control engine throttle position from a remote location using hydraulics when mechanical linkage is prohibitive. Includes pedal, actuator, reservoir, and slave cylinder.



## Ratchet Handle Controls

These hand lever controls provide locking ratchet and release control for a variety of applications. Can be attached to remote actuators or cables.



## ZF Pressure Switches

These are high-pressure, surge resistant piston style switches. They are heavy-duty, high impulse pressure resistant switches.



## ZF Pressure Differential Switches

Differential switches sense differential pressure and are typically connected to the front and rear portions of split brake systems. If either side of the brake system fails, the switch activates a warning signal, which will stay on until the brakes are released.



## NASON Pressure Switches

Most NASON pressure switches feature a long life elastomer diaphragm and a high quality snap action switch. Both low and high-pressure models are available.



## NASON Vacuum Switches

All of NASON vacuum switches feature a long life elastomer diaphragm and a high quality snap action switch. Factory preset and field adjustable models are available.



## NASON Temperature Switches

Bi-metal immersion, snap disc, and bellows mechanism type switches are available. All are factory preset as well as shock and vibration resistant.

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## ELECTROHYDRAULICS

ZF offers electrohydraulic components, which include a variety of electronic pedal configurations and sensing options, and a variety of electrohydraulic brake valves.

Typical applications for these products are drive-by-wire, electrohydraulic braking, machines with multiple operator stations, remote control operation, or propel and inching pedals for hydrostatic drive systems.



### Electronic Pedals with Brake Valve Interface

Designed for use in electrohydraulic brake and/or electronic throttle control applications. Provides force feedback proportional to pedal rotation. A rotary sensor provides one or more analog outputs that are proportional to pedal rotation. A variety of pedal configurations and sensing options are available.

### EBV Series Electrohydraulic Brake Valves

Full power valves for modulating output pressures up to 207 bar (3000 PSI) in proportion to the input current. As part of a full power brake system, EBV series valves provide hydraulic power for normal and emergency power-off braking in electrohydraulic braking, anti-lock brake systems, and traction control systems.



## RELATED PRODUCTS

ZF offers additional products such as pressure gauges, remote fluid reservoirs, and check valves.



### Quadrigages™

Devices used to measure hydraulic, air, and vacuum pressure. The Quadrigage™ performs four gauge functions using three separate gauges. Depending on the Quadrigage™ model, the low pressure gauge measures vacuum to 30 inches Hg, as well as positive pressure to either 0 to 150 or 0 to 300 PSIG. The medium pressure gauge measures pressure to either 0 to 600 or 0 to 1000 PSIG. The high pressure gauge measures pressure to either 0 to 3000, 0 to 4000, 0 to 5000, or 0 to 6000 PSIG.



### Digital Pressure Gauges

A versatile and economical gauge that meets ASME B40.7 standards. 1/2 percent terminal point accuracy, pressure range of 0 to 10,000 PSI, nine engineering units of measure, back-lighting, and more.



### Fluid Reservoirs

These fluid reservoirs can be mounted directly or remotely to a variety of actuators in many types of hydraulic systems. Two styles of fluid reservoirs are available, a rust proof metal design and a high strength fire resistant translucent polyallomer design.



### In-line Residual Check Valves

Residual check valves allow free flow of hydraulic system fluid in one direction while maintaining a slight residual fluid pressure from the opposing side.



### Check Valve Assembly

The check valve assembly is a compact, self-contained unit that includes a check valve and an inverted shuttle valve. Used in full power brake systems that require stored energy in two separate accumulator circuits.

NOTE: ZF Off-Highway Solutions Minnesota Inc. custom-engineers products for specific applications. Not all products are listed in this brochure. Please call us for additional information.



## MARKETS

In the global market of the 21st century, We have worked hard to develop strong business relationships all over the world. ZF has specialized in creating high-quality braking solutions for the Off-Highway market and will continue to do so as the needs of the world evolve. Our global population is growing rapidly, creating more development and higher demands for efficient machinery in Agriculture, Construction, Mining, Military, and other related fields.



MARKETS

**VISIT [MICO.COM](http://MICO.COM)**

for the most up-to-date  
product literature.



## **BRAKES**

Caliper Disc Brake Catalog  
84-515-535

MICO® Multiple Disc Brake Catalog  
84-500-001

## **BRAKE ACTUATION**

Master Cylinder Catalog  
84-001-001

Slave and Wheel Cylinder Brochure  
80-100-001

Brake Actuators for OEM Drive Axles Product  
Bulletin  
80-460-034

Two Fluid Actuator Catalog  
84-460-007

Air/Hydraulic Actuator Catalog  
84-460-006

Remote Actuator Catalog  
84-460-001

Brake Lock Application Guide  
80-950-152

## **VALVES**

Hydraulic Brake Valves Catalog  
84-466-001

Accumulator Charging Valve Catalog  
84-463-001

## **CONTROLS**

Pressure Switches  
Product Bulletin  
80-950-011

Pressure Differential Switch  
Product Bulletin  
80-580-011

Heavy-Duty Ratchet Handle  
Product Bulletin  
80-950-028

Hydraulic Throttle Control  
Product Bulletin  
80-460-033

NASON Switch Catalog  
84-580-001

## **ELECTROHYDRAULICS**

Electrohydraulic Brake Valve EBV-S12 Series  
Product Bulletin  
80-100-031

## **RELATED PRODUCTS**

Quadrillage™ Product Bulletin  
80-740-001

Digital Pressure Gauge Brochure  
80-740-005

Fluid Reservoir Product Bulletin  
80-920-001

In-line Residual Check Valve  
Product Bulletin  
80-920-001

Check Valve Assembly Product Bulletin  
80-463-015

## **MARKETS**

Application Illustrations Catalog  
84-950-025



## 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.

ZF allows vehicles to see, think and act. In the four technology domains of Vehicle Motion Control, Integrated Safety, Automated Driving, and Electric Mobility, ZF offers comprehensive product and software solutions for established vehicle manufacturers. Learn more at [ZF.com](http://ZF.com).

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