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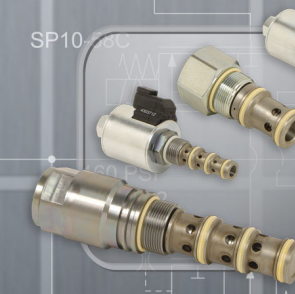
HydraForce India LLC (India): Foreign Company
Registration Number F04941

HydraForce Hydraulics Ltd. (U.K.): Reg. in Cardiff.; Reg.
No. 2286591 ISO 9001 and ISO 14001



HydraForce valve and manifold products comply with the European Council and Parliament RoHS directive 2002/95/EC limiting the use of hazardous substances. For all other products, consult factory.

HYDRAFORCE
POWER FORWARD



Load Sense Drain



Electro Hydraulic CONTROL SOLUTIONS

for Wheel Loaders



TABLE OF CONTENTS



Load-Handling -
Load-Sense EH Boost, Park Brake, Grapple, Tool Carrier and Attachment.....**Pages 10-11**

- Increased functionality
- Wide range of adaptable solutions for precise control
- Low leakage load-holding
- Stand-alone or custom manifold designs
- Flow capabilities up to 380 lpm/100 gpm



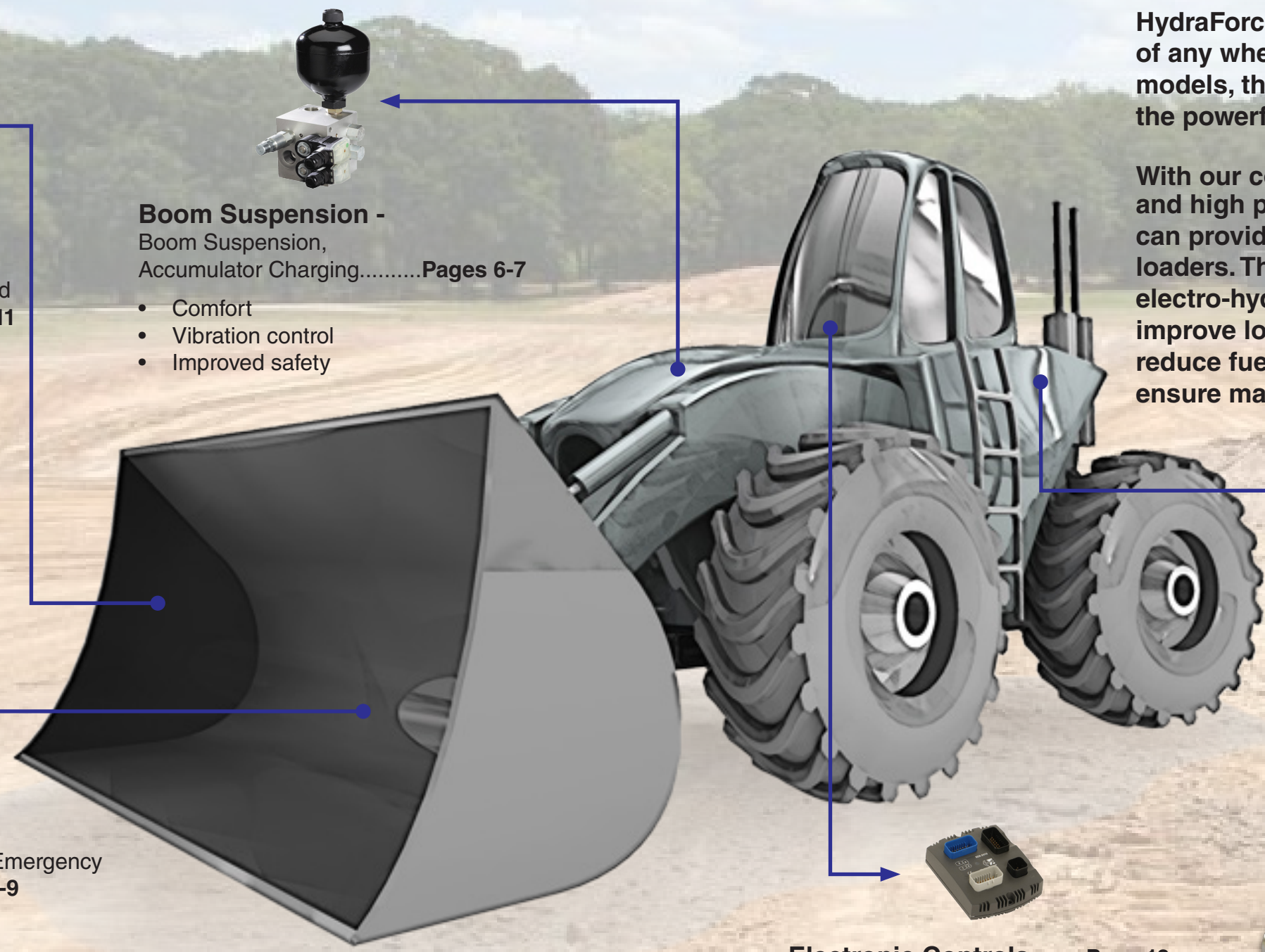
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Boom Suspension, Accumulator Charging.....**Pages 6-7**

- Comfort
- Vibration control
- Improved safety



Main Controls -
Bucket, Brakes, Steering and Emergency Steering.....**Pages 8-9**

- Low leakage load holding
- Dual accumulator charging
- Meter in/meter out functionality
- Bridge circuit technology



HydraForce hydraulic controls can enhance the capability of any wheel loader – from the compact 80 horsepower models, through the mid-range 80 to 200 HP models, up to the powerful 250 HP and above machines.

With our comprehensive line of cartridge valves, manifolds, and high performance electronic controls, HydraForce can provide numerous custom control solutions for wheel loaders. This brochure shows some easy ways to apply electro-hydraulics on wheel loaders to minimize vibration, improve load-handling performance, increase efficiency, reduce fuel consumption, optimize operator comfort, and ensure machine safety.



Powertrain - Transmission, Cooling, Clutch.....**Pages 4-5**

- Clutch engage/disengage
- Accurate clutch pressure control
- 10,000,000 cycle life testing
- 1,000 hours salt spray rating
- IP69K waterproof coil



Electronic Controls.....Page 13

- Rugged & reliable
- Hardware & software
- Easy to program
- Flexible configurations



The HydraForce Difference.....Page 12

- Highest quality guaranteed
- Speed to market
- Flexible and responsive
- Over 600 combined years of cartridge development experience
- Leading edge technology



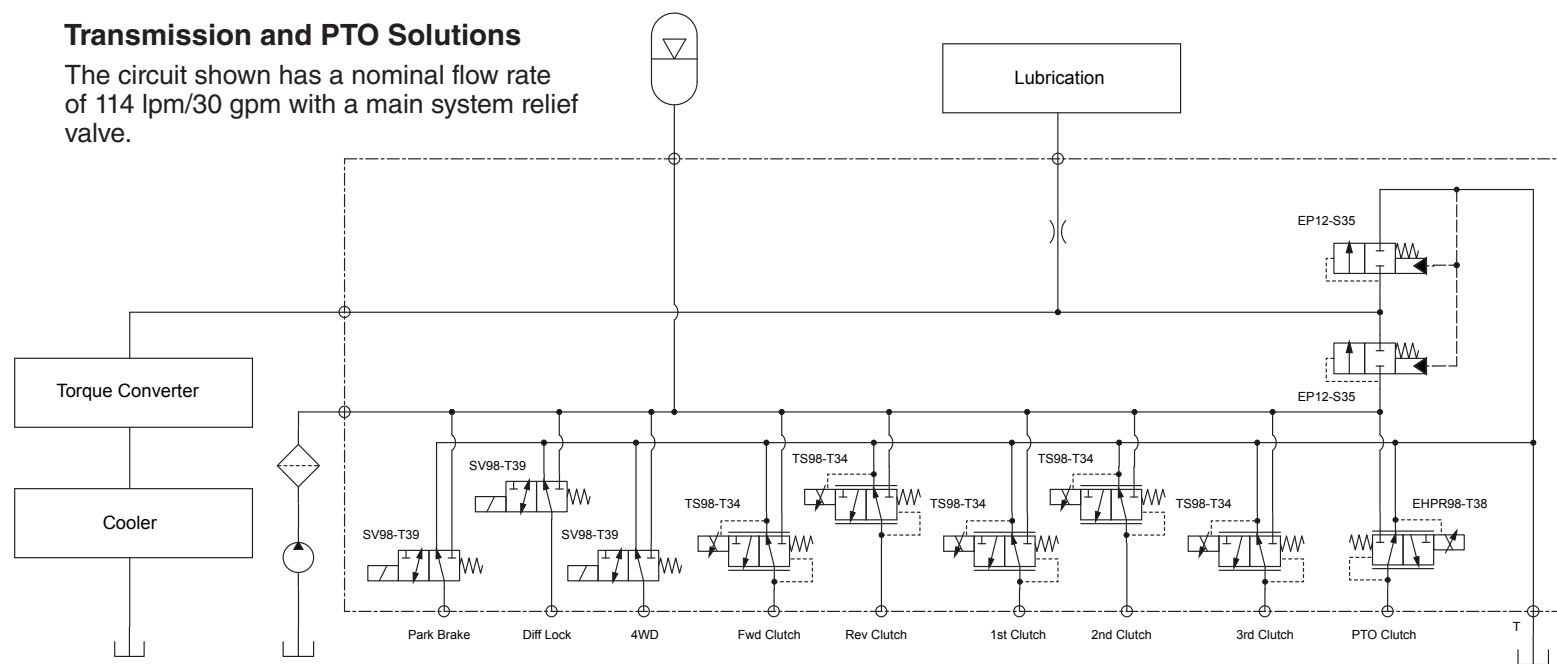
POWERTRAIN

Transmission PTO Control Cooling Clutch



Transmission and PTO Solutions

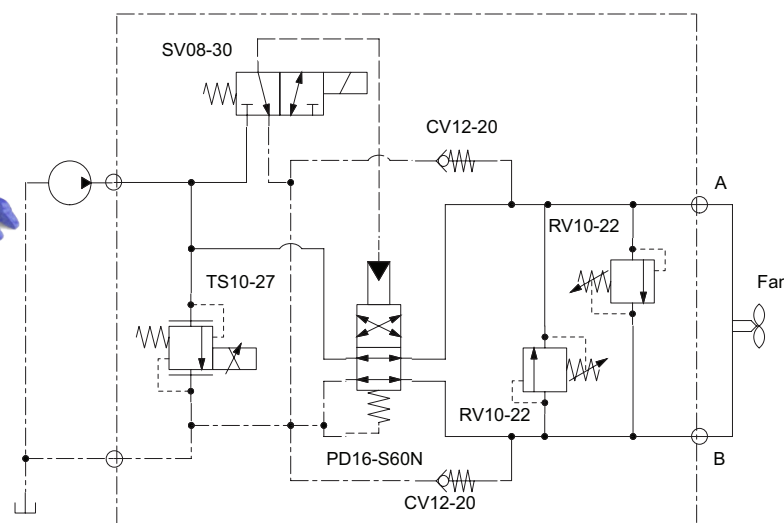
The circuit shown has a nominal flow rate of 114 lpm/30 gpm with a main system relief valve.



- Clutch engage / disengage, Power Shift
- Accurate clutch pressure control
- Main system pressure regulation
- Diff. Lock engage / disengage
- PTO control



Fan Drive Solution

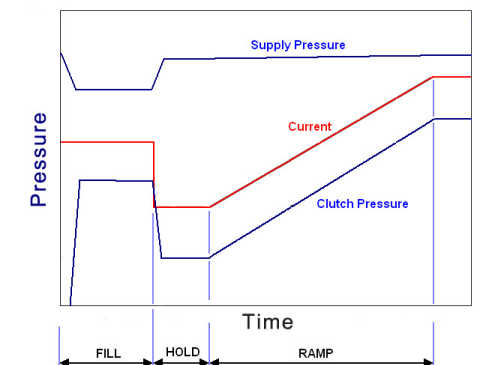


- Solutions available for flows up to 190 lpm (50 gpm)
- Fail safe high or low
- Lubrication pressure control
- Preconfigured controls available
- Reduce horsepower consumption

Optimize wheel loader powertrain systems with hydraulic cartridge valves and manifolds with programmable controllers.

Synchronize control of transmission clutch, PTO, and engine speed with the HydraForce CoreTek-controller. Its programming software is available as a free download from the HydraForce web site. The ECU electronic controller (circuit at right) can synchronize proportional valves, such as the TS98-34, to regulate forward, reverse and multiple clutch actuation with smooth and accurate control of pressure. Clutch fill characteristics can be custom-programmed. PTO control can be accomplished with the EHPR98-T38 proportional valve.

Clutch Engagement Performance (TS98-T34)



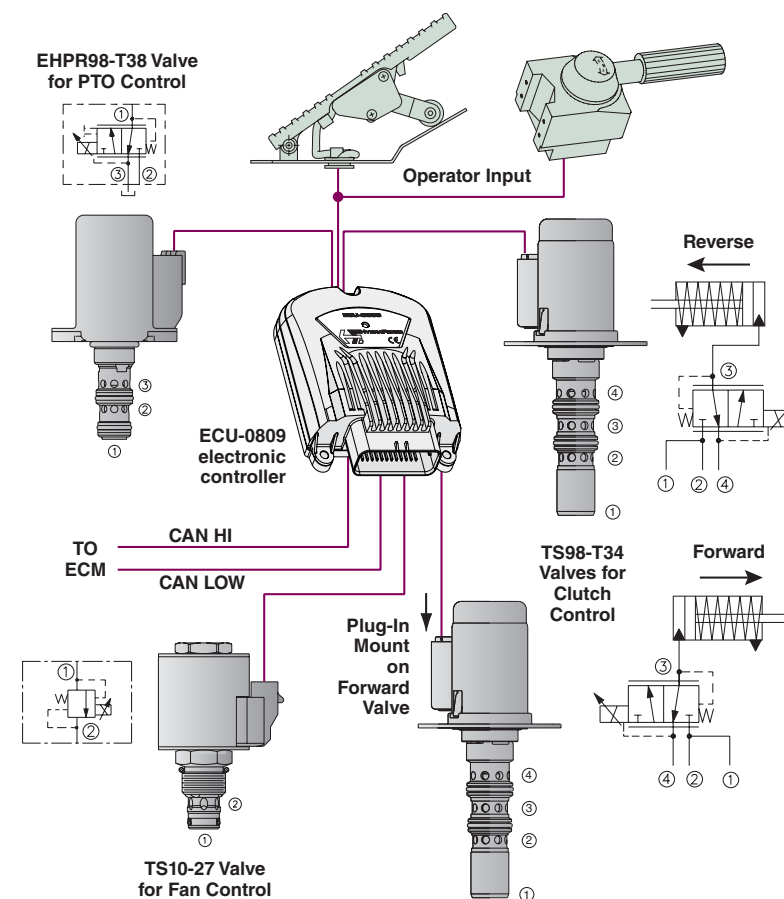
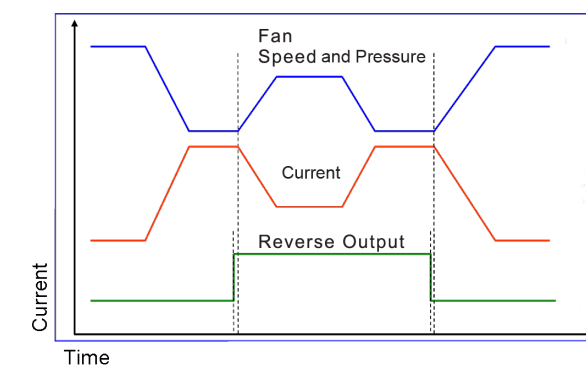
Quiet down that fan drive...

Fan drives controlled by hydraulic cartridge valves are quieter and run on less horsepower than mechanical fan drives, providing greater fuel economy for wheel loaders.

Control valves with multiple temperature inputs can be used to provide variable fan speed control depending on air temperature, load, and cooling requirements. If the radiator gets clogged, two-position, four-way solenoid valves can automatically reverse fan direction.

Electronic control of the hydraulic cooling system can be achieved using either an EFDR-type programmable valve driver or an ECU electronic controller.

Fan Output Performance



BOOM SUSPENSION

Boom Suspension Accumulator Charging



Boom Suspension Solutions

HydraForce suspension systems improve load-handling performance for wheel loaders and also enhance operator comfort by reducing vibration and improving ride control. Optimal combinations of cartridge valves in customized manifolds that feature an integral accumulator allow for smooth suspension of the boom.

How Boom Suspension Works

In a wheel loader, the boom suspension basically functions as a shock absorber for the bucket, creating a smoother ride for the operator.

Boom suspensions have the following benefits:

- Improved wheel contact with the ground, which helps steering and stopping.
- Load “floats” over terrain, allowing higher transport speed, fewer repairs and downtime and increased productivity.
- Reduced vibration with loaded or unloaded bucket, fulfilling Vibration Directive 2002.44.EC and improving driver comfort.

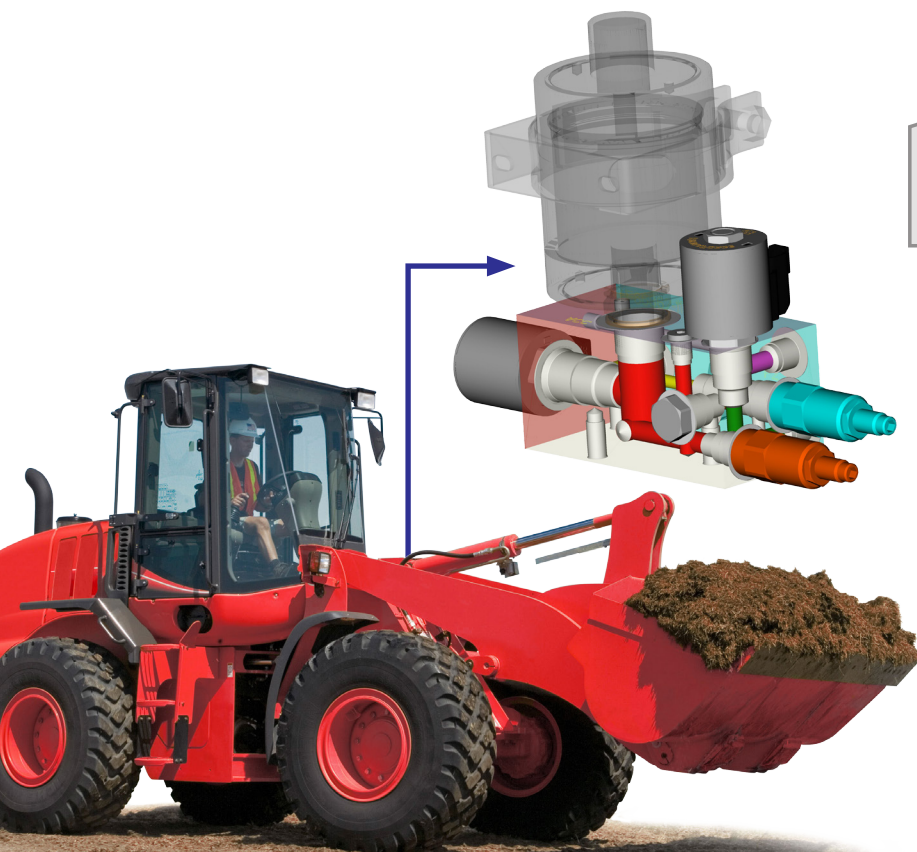


Figure 1: Without Boom Suspension

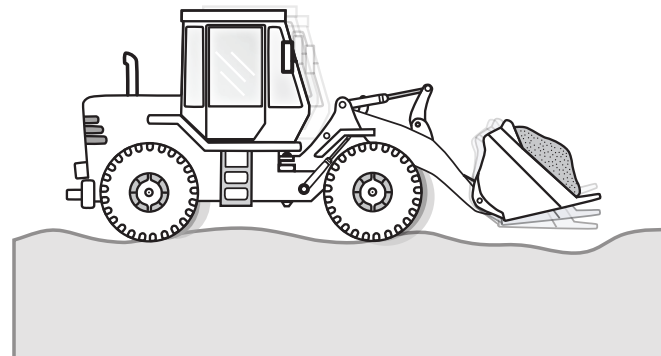
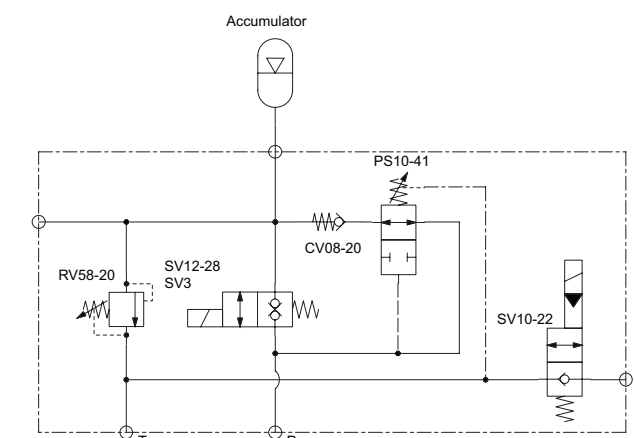
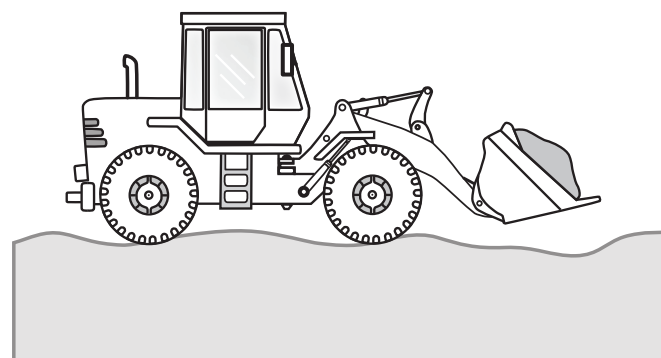


Figure 2: With Boom Suspension



Example: Basic Boom Suspension

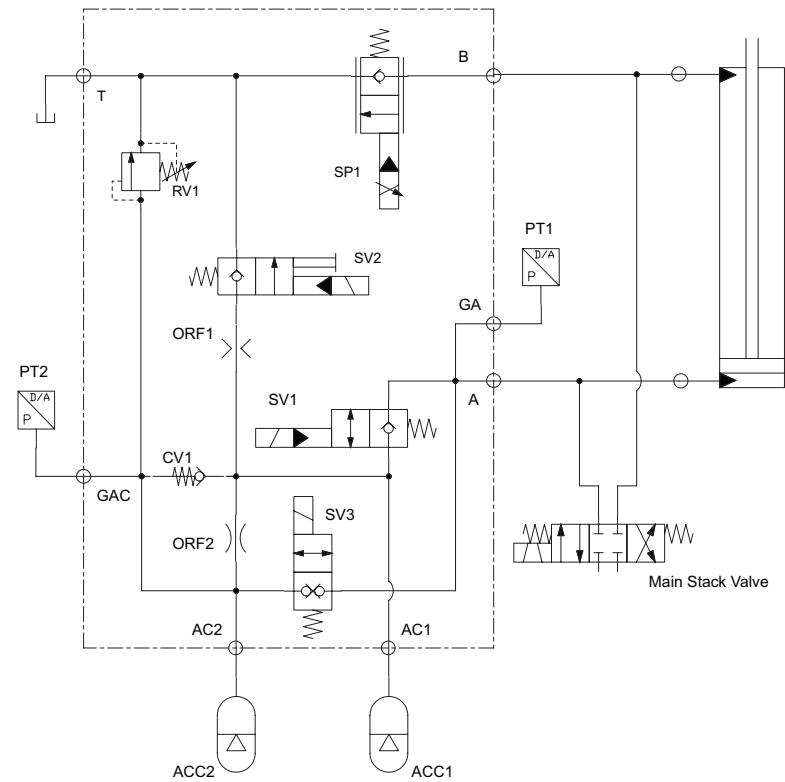
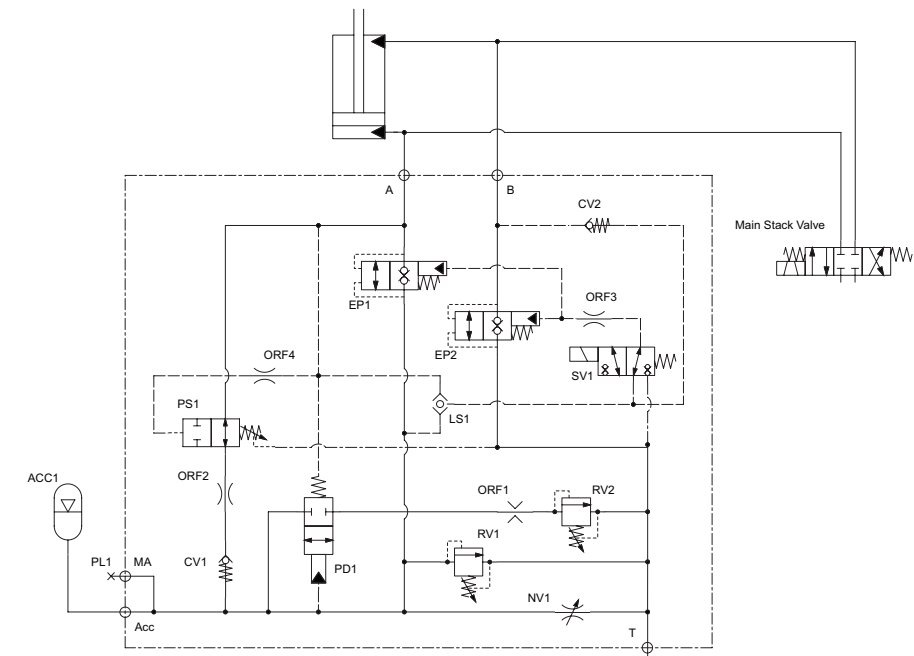
This manifold consists of solenoid valves SV12-28, SV10-22, pilot-operated relief valve with a reverse flow check and RV58-20A, a sequence valve with external pilot and drain with integral sensing PS10-41A and a check valve CV08-20.

Ride control solutions fall into two categories: Passive or Active.

Passive Boom Suspension

In a passive system, everything is pre-set – accumulator volume, pre-charge pressure and damping characteristics.

Height control and spring rate are set according to load. The suspension can then be switched on or off. When on, damping is preset to a “best fit” constant. This solution features a dedicated PED-rated relief valve for accumulator protection and low pressure drop/ high flow HyPerformance™ logic elements for low damping pressure, and easy on/off pressure adjustment.



Active Boom Suspension

In an active system, at least one parameter is variable and can be changed depending on conditions.

Damping and spring rate can be adjusted in real time with a more sophisticated adaptive or active suspension system, which continuously adapts to the conditions of terrain, speed, etc. Fast, precise, repeatable valve response with low hysteresis is essential. HydraForce can provide fully customizable programming algorithms and hydraulic controls for a broad range of boom suspension solutions.



MAIN CONTROLS

Bucket Brakes
Steering
Emergency Steering



HydraForce offers valves that are well-suited to the unique needs of Dynamic Accumulator Charging Circuits which are commonly used in conjunction with steering and braking units. Hydraulic braking systems are common on wheel loaders and towable implements. These circuits require a delicate balance between the priority flow steering and braking sections of the application, while simultaneously allowing excess flow to be diverted to tank or various auxiliary functions.

A typical circuit provides priority flow for the steering orbital while maintaining a predetermined range of pressure in the accumulator(s), to ensure adequate supply of oil for up to 7 brake depressions in the case of power loss. If one accumulator fails, the LS10-41 will shift over to protect the operational one. The ECxx-42 provides priority flow in required amount while allowing excess flow to be used for auxiliary functions.

Primary Functions

Primary Functions are the basic / standard control circuits, such as Steering and Braking.

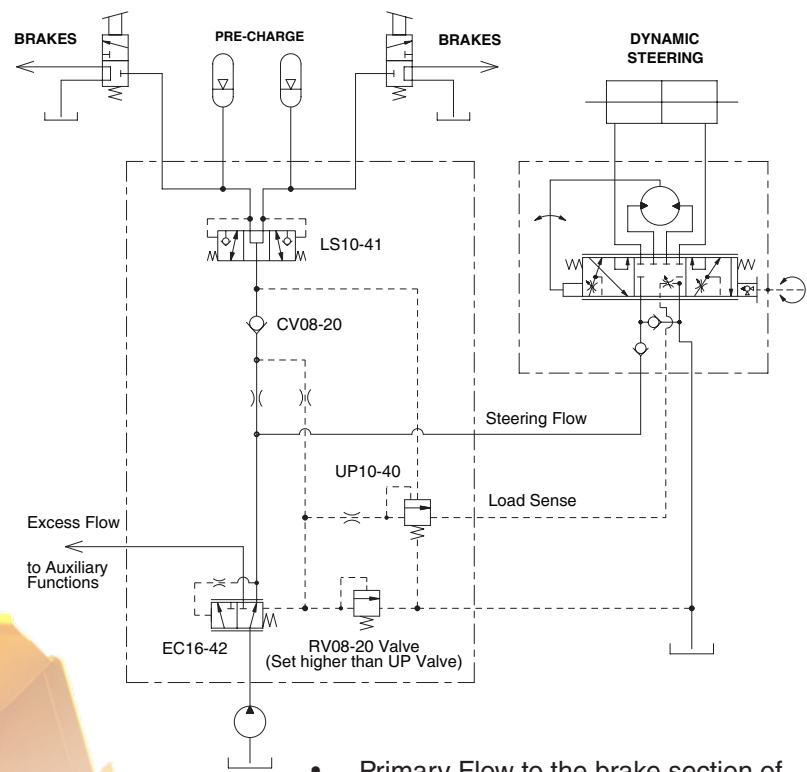
Steering / Braking

These functions have priority over all other hydraulic demands. HydraForce manufacture a range of priority on demand pressure compensators with dynamic load sensing for fast response. With 7 different models of priority on demand pressure compensator valves (ECxx-43), the rated flow capacities range from 34 lpm to 530 lpm (9 gpm to 140 gpm).

Dual Accumulator Charging

HydraForce inverted shuttle valve LS10-41 provides additional safety when using dual accumulators. In the event of one accumulator failing (i.e. a ruptured bladder, etc.), the failed accumulator is isolated from the rest of the circuit, allowing the second accumulator to supply steering / braking.

Primary Steering and Brake Solution



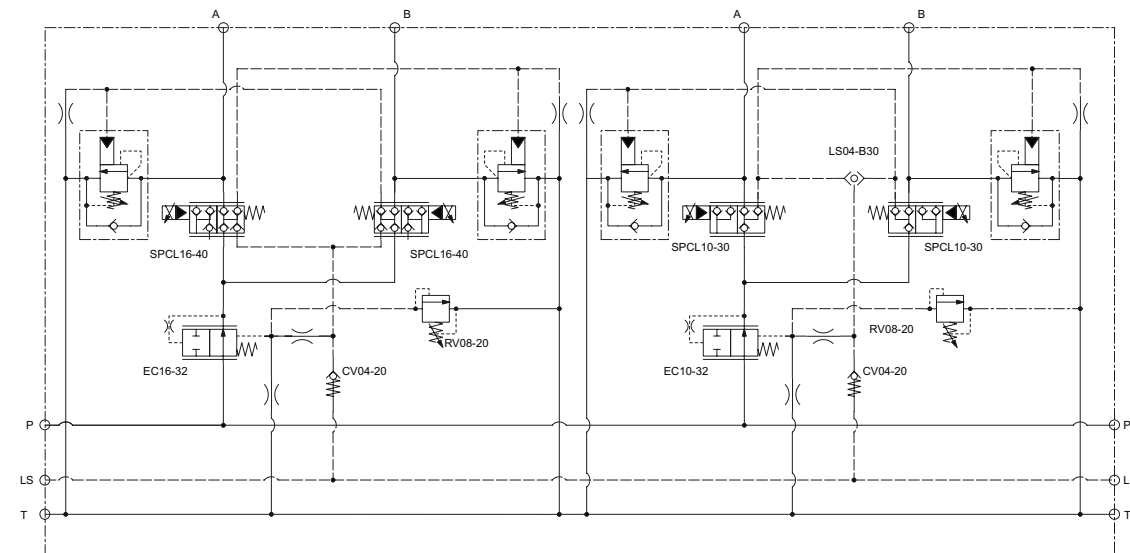
- Primary Flow to the brake section of the circuit
- Auxiliary Flow diverted to the directional function

Directional Bridge

Load-holding bridge circuits provide the advantage of independent meter-in and meter-out timing with integral load sensing and pilot signaling, with minimal leakage. Circuit complexity, size and cost are minimized by using multi-function cartridge valves.

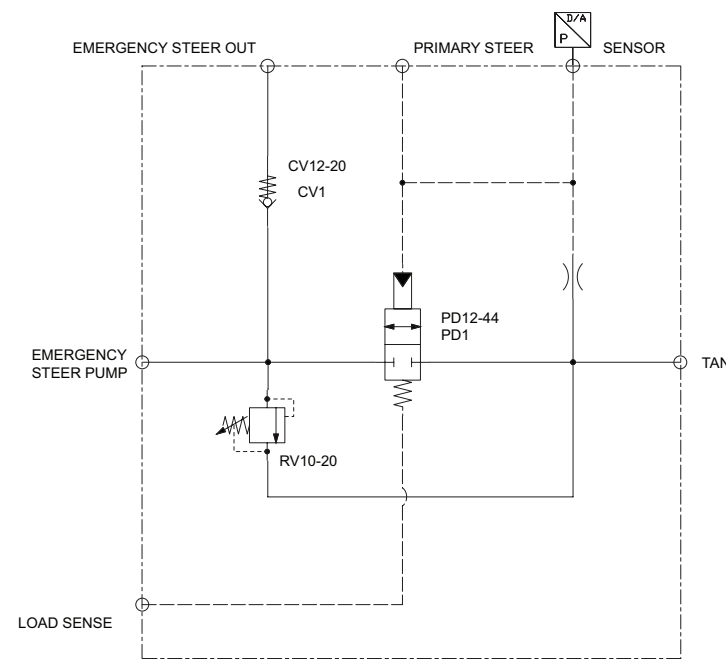
Use a bridge circuit to give priority control for lift and lower functions on wheel loaders.

Directional Bridge Circuit for Compact Wheel Loader

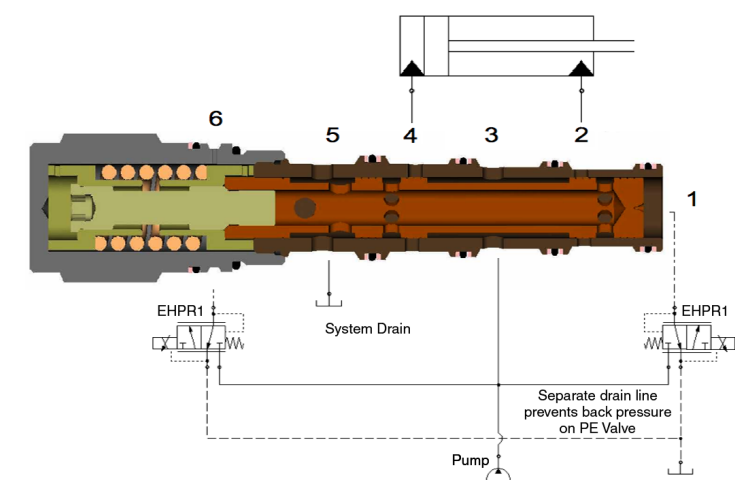


Emergency Steering

Emergency steering is used to enable steering in the event the engine dies or the brakes fail. The circuit below shows one-way hydraulic cartridge valves can be used in a load-sensing emergency steering circuit.



EHPR series valves are designed to electrohydraulically pilot PE Series cartridge directional valves or other spool-operated controls. This cross-section shows the inner workings of a pilot-operated proportional valve (PE) and how it works with the EHPR valves in a circuit.





LOAD-HANDLING

Bucket
Grapple
Tool Carrier and Attachment
Traction Control



Wheel loaders are known for their versatility and today's generation of machines can handle a great variety of auxiliary functions with an assortment of attachments, including grapples, forks, and specialized buckets to handle loads from sand to snow.

Load-handling and other auxiliary functions can be done with greater speed and power with the right hydraulic controls.

Pilot Valves Guide the Flow

Just as wheel loaders perform a multitude of functions, HydraForce pilot valves guide a multitude of flows. These valves have an integral, waterproof solenoid coil.

SV98-T39, T40

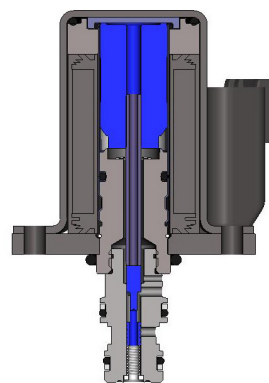
For low pressure pilot systems or power shift transmission control, the SV98-T39 and SV98-T40 valves are an economical choice. The T39 is a three-way valve and the T40 is a four-way.

EHPR98-T33, T35 and T38

These proportional pressure control valves come in several sizes to control from 4 lpm (1.05 gpm) to 18 lpm (5 gpm) and two pressure ranges - 10.3 bar (1500 psi) or 241 bar (3500 psi). They are drop-in style, flange mounted, direct-acting, and can be infinitely adjusted using a variable electric input.

TS98-T34

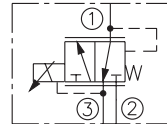
For demanding applications with high flow, the TS98-T34 pressure reducing valve can be used as a pressure limiting device. It's a spool-type, drop-in proportional pressure reducing/relieving valve that can be infinitely adjusted.



EHPR Reducing/Relieving Proportional Control

EHPR98-T33

3.8 lpm/1 gpm
241 bar/3500 psi
Max. Reducing Pressure: 31 bar/450 psi



EHPR98-T35

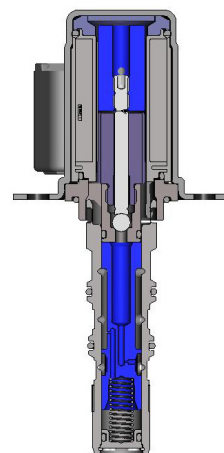
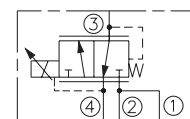
5.7 lpm/1.5 gpm
103 bar/1500 psi
With the '-T35A' option, 241 bar/3500 psi performance can be achieved.
Max. Reducing Pressure: 20 bar/290 psi

EHPR98-T38

19 lpm/5 gpm
241 bar/3500 psi
Max. Reducing Pressure: 31 bar/450 psi

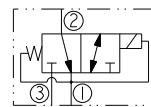
EH Reducing/Relieving Proportional Control

TS98-T34
30 lpm/8 gpm
30 bar/435 psi

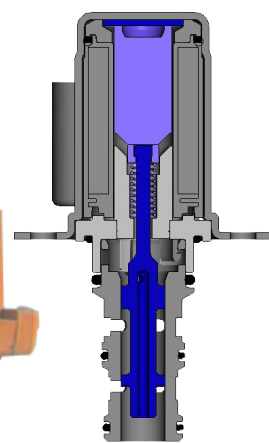
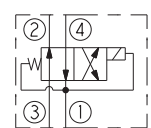


Solenoid Selector Valves

SV98-T39
30 lpm/8 gpm
45 bar/650 psi



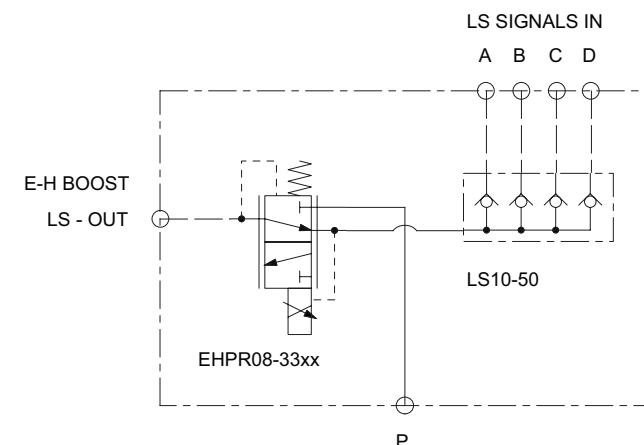
SV98-T40
30 lpm/8 gpm
45 bar/435 psi



Load Sense Boost

Higher flows and shorter response times are possible with load sense boosting. When lower flows are adequate for the job, reduce standby pressures to save power.

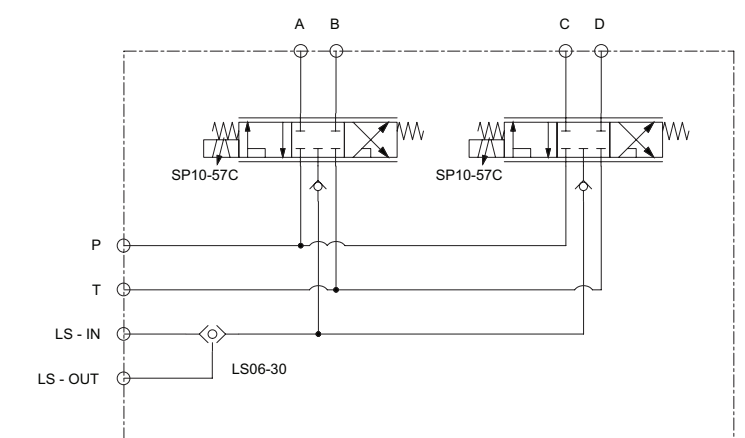
Load Sense Boost Circuit



Tool Carrier and Attachment

Hydraulic quick couplers allow wheel loaders the option to change attachments or tools. This Tool Carrier Attachment circuit has built-in load-sensing.

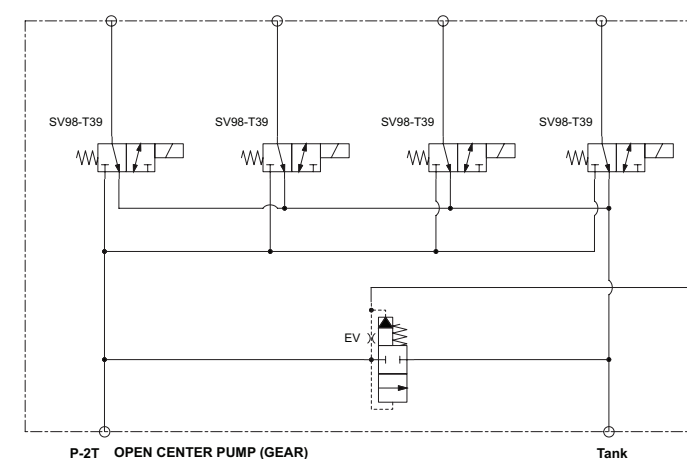
Tool Carrier and Attachment Circuit



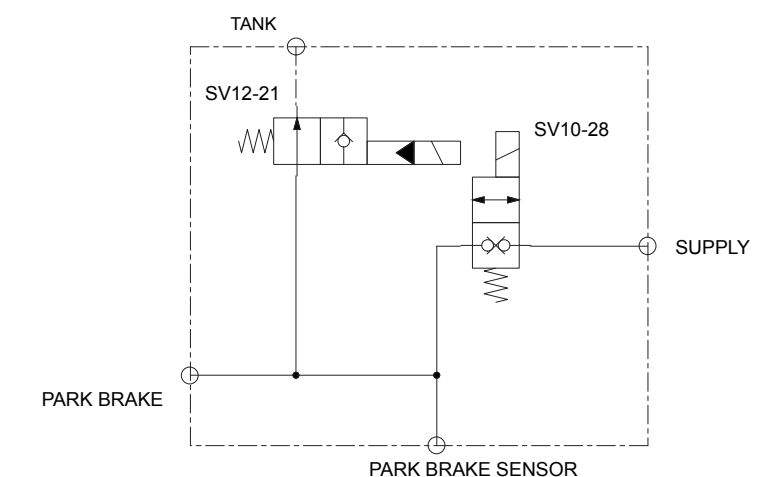
Pilot Selector

Customize the speed of actuation with a Pilot Selector Circuit. Pilot valves can be used to control the pressure and flow of hydraulic fluid to a series of directional valves. In the circuit below, a vented spool-type logic element (EV) controls the pressure provided by an open center gear pump to a series of four solenoid valves (SV).

Pilot Selector Circuit



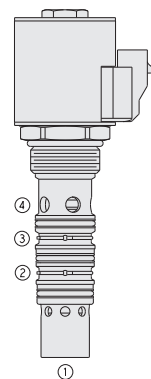
Loader Park Brake Circuit



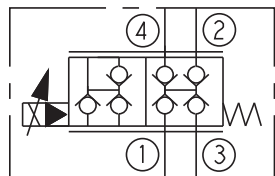
Double blocking SV10-28 provides low leakage load holding to ensure park brake stays enabled.



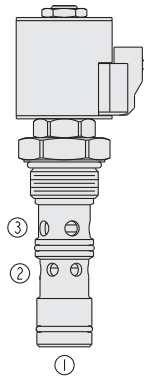
VALVES AND ELECTRONIC CONTROLS



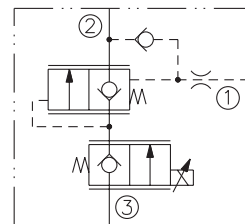
SPCL16-40
Proportional Directional Control,
4-Port, Normally Closed with Check
Isolated Load Sense



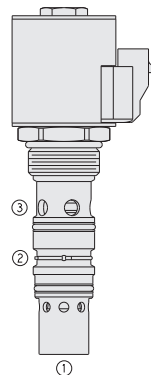
Flow: 152 lpm/40 gpm
Pressure: 250 bar (3625 psi)



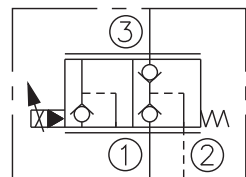
HSPEC16-30
Proportional Flow Control Valve with
Integral Compensator



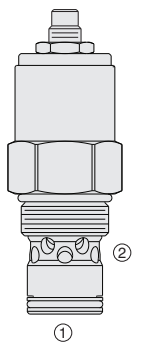
Flow: 132 lpm/35 gpm
Pressure: 350 bar (5075 psi)



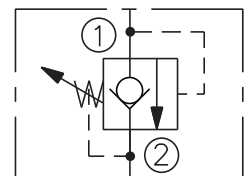
SPCL16-32
Solenoid-operated, 3-port,
normally-closed, proportional,
poppet type



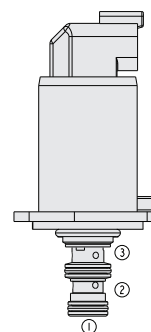
Flow: 152 lpm/40 gpm
Pressure: 250 bar (3625 psi)



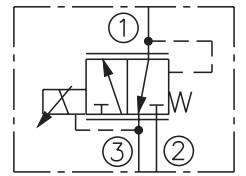
RVCV56-20
Relief, Directing Acting Poppet with
Reverse Flow Check



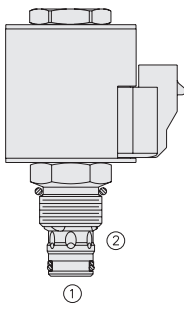
Flow: 115 lpm/30 gpm
Pressure: 420 bar (6100 psi)



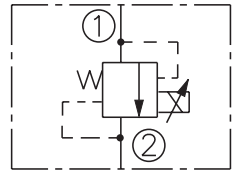
EHPR98-G3x
Proportional, Reducing / Relieving,
Drop-in



Flow: 4-6 lpm/1-4 gpm
Pressure: 20-30 bar (290-435 psi)



TSxx-27
Proportional Pressure Control, Pilot-
Operated Relief



Flow: up to 189 lpm/50 gpm
Pressure: 241 bar (3500 psi)

Our Breadth of Product

As the largest manufacturer of hydraulic cartridge valves in the world, HydraForce offers an extensive range of solenoid, electro-proportional, directional, flow, and pressure control valves. Last year, more than 200 new valves were introduced, including many high pressure and multi-function models. Cartridge valves for flow rates up to 379 lpm/100 gpm and operating pressures up to 350 bar/5,000 psi are sold individually, with housings or in manifold blocks. Valves can be custom-designed or standard product.

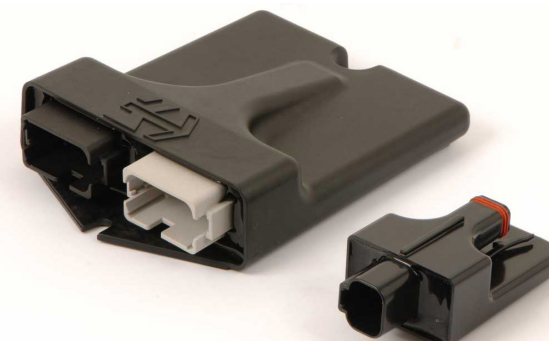
HydraForce designs, manufactures and supports valve, manifold and accessory products supported by heavy duty electronic machine control capabilities.

To request a free hydraulic integrated circuit (HIC) consultation, please visit:
<http://info.hydraforce.com/Free-Custom-Circuit-Consultation/>

CORETEK™ Programmable Machine Controllers

It's easy to add electronic control to your hydraulic application with the HydraForce CoreTek line of electronic control units (ECUs) and electronic valve drivers (EVDs).

CoreTek electronic controllers are tough to the core -- designed to withstand the environmental demands of mobile, off-highway equipment applications. With flexible input and output configuration, CoreTek controllers can easily be customized for a wide variety of applications, including fan control, transmission and timed control applications, and more.



ECUs - Electronic Control Units

Model ECU-2415

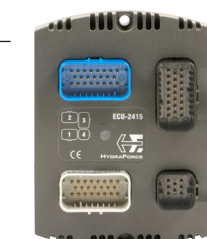
Up to 39 digital, pulse, current measuring feedback and analog inputs along with 24 outputs consisting of up to 24 PWM or digital high-side drivers.

Model ECU-2820

Up to 52 inputs and 28 outputs consisting of up to 24 PWM or digital high-side drivers and up to four digital low-side drivers.

Model ECU-0809

Features 8 flexible sourcing outputs, 9 flexible inputs, and 4 feedback inputs. This controller is built on a powerful 32-bit microprocessor and features a diagnostic indicator, unlimited F-RAM and CAN capability.



ECU 2415 and 2820



ECU 0809

EVDs - Electronic Valve Drivers

EVDs are compact, economical and reliable electronic drivers for proportional solenoid valves. They mount directly onto the solenoid coil and are configurable using HF-Impulse software on a computer and serial cable or CAN to USB adapter.

EVD-0101A

One input and one output. Input can be accepted from analog or digital operator interface devices.

EVD-0201A

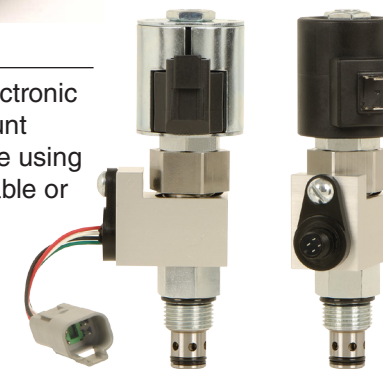
One or two outputs and one input that can be accepted from analog or SAE J1939 operator interface devices.

COMING SOON - ECDR-0506A

Features six configurable inputs and five PWM outputs. This larger valve driver will be able to provide precise, repeatable control of four proportional valves and one on/off solenoid. LED signal will provide quick status check. The CAN-capable ECDR-0506A is configured with HF-Impulse software.

HF-Impulse Configuration Software

HydraForce has developed an easy-to-use configuration platform - HF-Impulse, available for free download from the HydraForce Electronics Portal at www.hydraforce.com/electronics. HF-Impulse allows you to flash devices with the latest firmware and configure all parameters for operation. You can configure any CoreTek electronic controller using HF-Impulse.



Sensor Valves

Select HydraForce valves can be ordered with an integral position sensing option capable of transmitting an on or off signal. This new sensing solution was designed for interchangeable use with existing HydraForce cartridge valves, is compatible with manual override options and uses an industry standard cavity.

Heavy Duty Sensors

HydraForce has accurate sensors designed for off-road applications.

Our temperature sensors are thermistor style with padded resistors.

ERT 120 – Output Signal: 5427.9 to 436.3 ohms

Our pressure sensors have 1% total error band accuracy, are IP67 rated.

ERP035 – for pressure ranges up to 35 bar (500 psi)

ERP414 – for higher pressures up to 414 bar (6000 psi)



OUR STORY



Our Story

The HydraForce story began in 1985 when the company was founded near Chicago by several partners who saw the mobile equipment industry's need for quality hydraulic cartridge valves and manifolds delivered in a timely and responsive manner. They also saw the potential for engineering innovation and design flexibility offered by cost-effective and space-saving cartridge valves and hydraulic integrated circuits.

Since its founding, HydraForce continues to be a privately held company as it has grown to several manufacturing locations in North America, Europe and Asia, with a network of 120 stocking distributors who can offer local support across the globe.

To maintain our core competency of speed to market, HydraForce has invested in application technical support tools including i-Design, our free hydraulic system design software, which integrates seamlessly with 3rd party simulation software, monthly webinars on new products and application tips, and an online product catalog.

All HydraForce products carry a five-year limited warranty against defects in material and workmanship.

HydraForce Vision

To Be An Independent Provider Of Innovative Technical Solutions That Can Change The World

Mission Statement

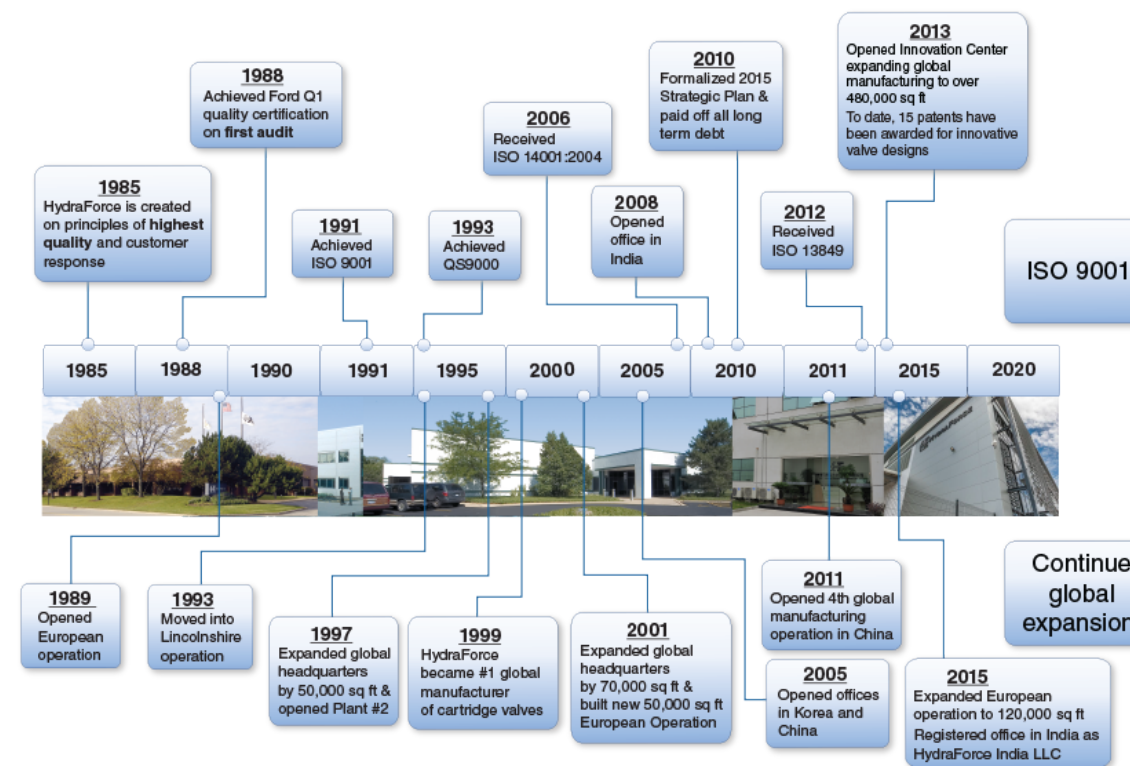
To Provide Our Customers With The Highest Quality Hydraulic Valves And The Most Responsive Customer Support In The World

Our Quality and Manufacturing Guarantee

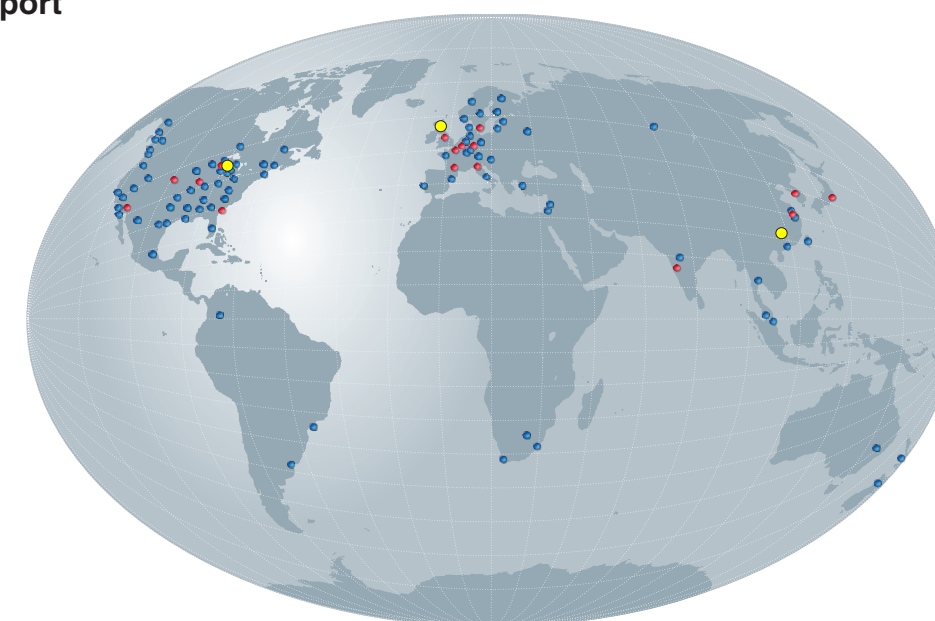
All three HydraForce plants in North America, Europe and Asia follow the same manufacturing processes and standards to ensure global consistency in product quality.

- All products 100% tested
- Use of Lean and Six Sigma practices
- New product introduction tools such as:
 - Advanced Product Quality Planning (APQP)
 - Production Part Approval Process (PPAP)
 - Failure Mode and Effect Analysis (FMEA)
 - Statistical Process Control (SPC)
- Continuous improvement through Kaizen
- Responsive delivery with Kanban throughput system

HydraForce Timeline



Worldwide Support



● • MANUFACTURING ● • TECHNICAL SALES ● • DISTRIBUTION & SUPPORT

