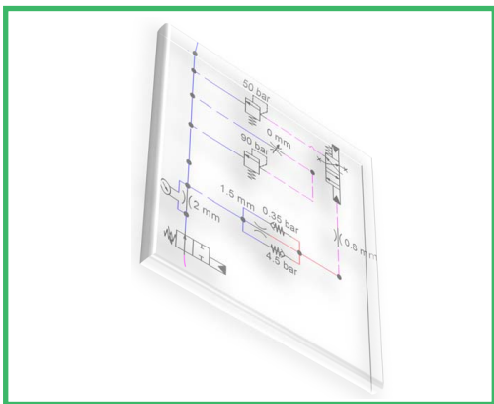


Symbols Booklet



Hydraulic Symbols

“Circuit diagrams are an aid to facilitate the understanding of the design and description of installations so that, by having unified representations, confusion and error can be avoided during planning, manufacturing, installation and maintenance.”

–ISO1219

This booklet has been designed to assist in the understanding of hydraulic fluid power symbols.

The book is a guideline only and though based on ISO 1219, some symbols do differ from the international standard.

When drawing diagrams it is important that the symbol represents the component in a way that people can understand.

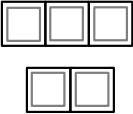


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Shapes

Description	Symbol	Information
Squares & Rectangles Single		Pressure control valves Some flow control valves
Squares & Rectangles Multiple		Directional control valves Each box is a position of the valve
Diamonds		Fluid Conditioning apparatus
Large Circles		Rotary motion Pumps & Motors
Smaller Circles		Visible indicators Removable orifices



Line Types

Many organisations use their own standards for line types. A key should be available

Description	Symbol
APT Standard for line types	Pressure / Working  Return  Drain  Pilot  Load Sense 
ISO Standard for line types and colours	Pressure  Return  Drain  Pilot  Working 
Connecting Intersection	ISO  APT  Other 
Non-Connecting Cross over	ISO  APT  Other 



Manifolds & Connections

Description	Symbol	Information
Group Boxes		Everything within the box is part of one assembly. All ports should be labelled
	P = Pressure T = Tank A & B = Working Ports X = Pilot line Y = Drain M = Test Point	Port labels (General guide)
Connections		Plugs
		Quick connect coupling
		Quick Connect - couplings shown connected (Free flow both ways)
		Rotary connection (3 hoses)
		Rotary connection (Multiple hoses)



Indicators

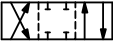
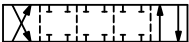
Any device with a visible display in a system

Description	Symbol	Information
Basics		All indicators are contained within a circle symbol
Pressure related (arrow in circle)		Pressure Gauge
		Differential pressure gauge
Indicator (any type)		(EG filter blockage indicator)
Fluid related		Flow Meter
		Level Indicator
		Temperature Indicator
Mechanical Related		Speed Gauge (Thru shaft)
		Speed Gauge
		Power Gauge



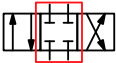
DCV's

Valve examples and guidelines only

Description	Symbol	Information
Positions are represented by boxes		Three Position (Add boxes for additional positions)
		Two Position
Valve ports are represented by connections to one valve envelope at a time		3 ports
		4 ports
		5 port option
		7 port option
Valve transient positions are represented by dashed lines on the boxes		2 position valve with Positive overlap
		2 Position valve with Negative overlap
		3 position closed centre valve with positive overlap
		3 Position open centre valve with negative overlap



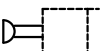
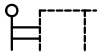
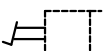
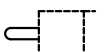
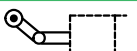
DCV'S -Continued

Description	Symbol	Information
Common 4/3 valve centre positions (Many other options are available)		Closed or Blocked
		Open
		Float or Motor
		Tandem
Positive sealing poppet valves		Check valves represent a positive seal (3 port valve)
Proportional valves Infinitely variable through their positions		2 Port (These valves generally have spool notches)
		3 Port
Valves with restricted flow paths		4/3 valve with restricted float centre
		2/2 with restriction



DCV Operators

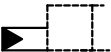
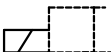
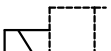
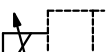
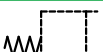
DCV detail not given, blank box shown for connection

Description	Symbol	Information
Mechanical Activation		Generic manual activation symbol
		Generic manual - Rotary activation
		Push Button
		Pull
		Lever
		Foot Pedal
		Plunger
		Roller cam
		Roller cam for one direction only
		Manual override with hydraulic pilot



DCV Operators - Continued

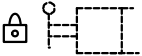
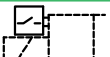
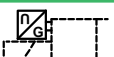
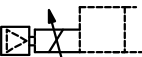
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Description	Symbol	Information
Pilot Activation		Hydraulic (Liquids)
		Pneumatic (Gases)
Solenoid Activation		Push Solenoid
		Pull Solenoid
		Push and Pull Solenoid
		Electro hydraulic
		Proportional Solenoid
Other Activations		Spring
		Variable Spring
		Thermal



DCV Operator Accessories

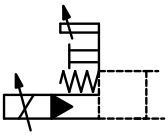
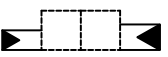
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Description	Symbol	Information
Holding controllers		Detent (2 detents shown. For more; add additional notches.)
		Manual lockout
		Stroke limiter / spool stop
Feedback		Mechanical feedback (Shown with electro hydraulic control)
		Limit Switch
		Linear Variable Differential Transducer (LVDT)
		Proportional solenoid with closed loop monitoring
Electronic Pilot additions		External Pilot oil supply
		External pilot drain
		External pilot oil supply and drain

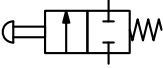
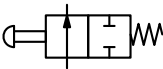
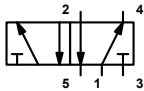
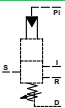


DCV Operator Additional

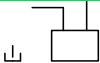
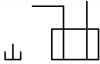
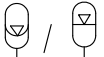
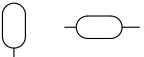
DCV detail not given, blank box shown for connection

Description	Symbol	Information
Multiple Operators		For any additional control mechanisms, extend the DCV end line to fit additional controls Example shows: Proportional solenoid controlling internal hydraulic pilot, with stroke limiter, spring return and manual override.
Random Operators		Atmospheric reference (Spring chamber)
		Differential pilot areas (one drawn larger than the other)
		Alternative pilot symbol
		Torsion bar

DCV Porting

Description	Symbol	Information
Connections are drawn with the valve de-energised		At rest / de-energised position
		Energised position
HYDRAULIC valve port connection labels		2 Port
		4 Port
PNEUMATIC valve port connection labels		5 Port (Alternative: P = 1, A & B = 2 & 4, EA & EB = 3 & 5)
		3 Port
Other Valve Port labelling		All port labelling shall reflect the physical markings of existing manifold ports

Tanks & Reservoirs

Description	Symbol	Information
Hydraulic tanks		Vented
		Pressurised (Often the physical shape is drawn)
		Connection Above Fluid Level
		Connection Below Fluid Level
Hydraulic Accumulator		Generic
		Gas / Spring / Weight
		Bladder / Diaphragm
		Piston type
Pneumatic Reservoir		Single or multiple port connections



Electronic Sensors - On/Off Types

DCV detail not given, blank box shown for connection

Description	Symbol	Information
Switches (used in conjunction with some other sensor)		Normally closed
		Normally Open
		Dual Switching (normally open)
		Multiple switches (In this case four normally open)
Applications		Level Switch
		Temperature switch
		Proximity switch
		Pressure switch (Middle symbol is the most common)
		Differential Pressure switch (With Filter)



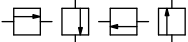
Electronic Sensors - Variable Outputs

Description	Symbol	Information
Transducers		* = Input Signal ** = Output Signal
	Input Signal Letter Identifications	F or Q = Flow rate G = Gauging position or length L = Level P = Pressure S = Distance or Speed T = Temperature W = Weight
		Analogue output signal (Pressure sensor)
		Digital output signal (Pressure Sensor)
Other Variable output devices		Flow Meters
		Power Meter
		Torque Meter
		RPM Sensor



Pressure Controls

With many variations, only basic rules are shown

Description	Symbol	Information
Basic		Pressure controls use only a single box with two port connections
		Relief valves are normally closed
		Reducing Valves are normally open
		Reducer Reliever valves incorporate three ports
		Valves can be drawn in any orientation that remains square
Direct Acting Valves		With internal drain (2 port valve)
		With internal drain (2 port valve)
		With External Drain (3 port valve)
		With External Drain (3 port valve)
		With atmospheric reference (vented spring chamber)

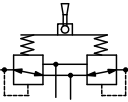
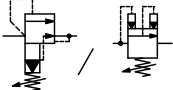


Pressure Controls - Continued

Description	Symbol	Information
Pilot Operated Valves (Applicable to all pressure control valves)		Internal drain (Relief valves only)
		External Drain
		With Vent Port
		Alternative pilot operated valve with vent port
		Vent and Drain port
Proportional type valves		Direct Acting
		Direct Acting through a spring
		Solenoid + Pilot
		With manual override
		With closed loop position control of solenoid

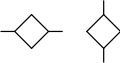


Pressure Controls - Continued

Description	Symbol	Information
Variations		External Pilot control
		Dual pilot opening (Motion control type valves)
		Reducer Reliever
		Joystick Twin mechanically controlled pressure reducer/reliever valves
		Foot Pedal
		Kick Down Relief
		Sequence (3 port valve) (direct acting shown)
		Insensitive to back pressure
		Relief with inbuilt anti- cavitation check valve

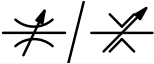
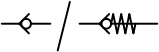
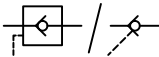
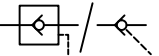


Fluid Conditioners

Description	Symbol	Information
Basics		All fluid conditioners are contained within diamonds
		Connecting ports are at opposite tips of the diamond
		Additional connections may be for separate fluid mediums (water)
Applications		Filter (Dashed line across flow path)
		Cooler
		Heater
		Heat Exchanger - Water
		Heat Exchanger - Air
Breathers		Standard
		Pressurised tank



Flow Controls

Description	Symbol	Information
Basic		Orifice
		Sharp edged orifice
		Adjustable orifices
		Flow control with bypass check
Check Valves		Generic types
		Variable Spring (Setting should be included)
		Pilot to Open
		Pilot to Close
		Pilot to open check valve with vent
		Pilot check with atmospheric vent

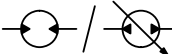


Flow Controls - Continued

Description	Symbol	Information
Pressure Compensated Flow Controls (Arrow across flow path, or arrow head in flow direction)		Restrictive type, basic symbols
		Restrictive type complex symbol
		Priority type basic symbols
		Priority type complex symbol
Shuttle Valves		Shuttle Valves
Ball Valves		Open position
		Closed position
		3 way type
Flow Divider Combiners		Rotary type
		Pressure compensated types

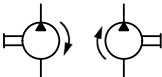
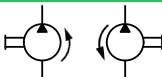


Pumps & Motors

Description	Symbol	Information
Basic symbols		All continuous rotary devices are represented by circles
		All devices with limited rotation use semi circles
		Arrows pointing out = Pump (produces flow)
		Arrows pointing in = Motor (consumes flow)
Direction		Single arrow = single direction
		Dual arrow = Bidirectional
Displacement		Fixed
		Variable
Accessories		Case drains should be at 45° to the port connections
		Shaft connections are at 90° to the port connections

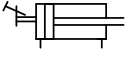
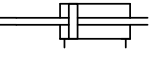
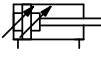


Pumps & Motors - Continued

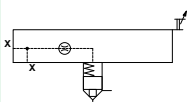
Description	Symbol	Information
Pump Specific		Pressure Compensated
		Load Sensing
		Electronic displacement control
		Hand pump
Motor specific		Pilot controlled displacement
Rotation direction (Arrows always drawn opposite to shaft)		Right hand, Clockwise
		Left Hand, Counter clockwise
Primary energy source		Electric motor
		Combustion engine
Drive connections		Clutch assembly



Cylinders

Description	Symbol	Information
Single Acting Cylinders		Single acting cylinder
		Single acting cylinder with spring return
		Telescopic cylinder (2 stage)
Double Acting Cylinders		Double acting cylinder
		Cylinder with stroke limiter
		Dual rod cylinder
		Cylinder with fixed cushion on retract
		Cylinder with dual adjustable cushions
Variations		Diaphragm cylinder
		Rod-less cylinder

Slip In Cartridges

Description	Symbol	Information
Basic Symbols		2 port 1:1 ratio
		2 port, reverse flow available
		1: ≤ 0.7 ratio
		1: ≥ 0.7 ratio
Control methods		Internal pilot 'A' port
		Internal pilot 'B' port
		External pilot (Pilot port connection is at top)
Accessories		With replaceable control orifice
		Control cover with pilot ports, replaceable orifice and adjustable stroke limiter. (Logic cartridge also shown)

APT TRAINING SCHEMATIC SYMBOLS BOOKLET

This booklet is designed to be a guide to the more commonly used symbols on a hydraulic schematic.

The symbols are based on ISO1219 but may differ to reflect more common industry acceptable standards.

There is more than one way to draw symbols and lay out a schematic diagram.

The overall purpose of a schematic should never change though:

“Circuit diagrams are an aid to facilitate the understanding of the design and description of installations so that, by having unified representations, confusion and error can be avoided during planning, manufacturing, installation and maintenance.”

We hope this guide helps you to understand and draw schematic diagrams.

Please contact us for any training requirements you may require in regards to fluid power systems or check out our website:

www.apthydraulics.com.au

