A Glossary of Hydraulics

A glossary of the key terms you will encounter when working with hydraulic systems.

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Hydraulics Online e-book series: Sharing our knowledge of all things hydraulic

About Hydraulics Online

Hydraulics Online is a leading, award-winning, ISO 9001 accredited provider of customer-centric fluid power solutions to 130 countries and 24 sectors worldwide.

Highly committed employees and happy customers are the bedrock of our business.

Our success is built on quality and technical know-how and the fact that we are 100% independent – we provide truly unbiased advice and the most optimal solutions for our customers. Every time.
Hydraulics is an engineering discipline based on the science of fluid mechanics.

As you might expect, you will encounter many scientific concepts and terms when talking about the science of hydraulics.

What’s more, the practical application of hydraulics and the creation of hydraulic systems introduces further new terms relating to system parts and components.

In this e-book, we seek to explain some of the key terms you can expect to encounter when working with hydraulics and hydraulic systems.

At Hydraulics Online, we always seek to explain your choices about system specifications and the choice of parts clearly. We recognise that our customers come to us with differing levels of technical knowledge – from highly qualified engineers to absolute beginners.

Whether you seek detailed technical help from us or know exactly what you need, we always work hard to make you fully aware of your choices, and this book is part of that process.
ABRASION: External damage (to the hose assembly) caused by rubbing on a foreign object, wearing away by friction.

ABSOLUTE: A measure that at its zero or base point, has a complete absence of the entity being measured.

ABSOLUTE PRESSURE: The indicated value of the weight of the earth’s atmosphere. At sea level this value is approximately 14.65 pounds per square inch (psi). Absolute pressure is zero-referenced against a perfect vacuum, so it is equal to gauge pressure plus atmospheric pressure.

ABSOLUTE VISCOSITY: The ratio of shear stress to shear rate. It is a hydraulic fluid’s internal resistance to flow.

ABSORPTION: The integration of one material into another.

ACCUMULATOR: A container or vessel, normally cylindrical, which stores hydraulic fluid or gas under pressure for future release. Used as an energy source or to absorb hydraulic shock. Designed to increase or relieve pressure in the hydraulic system. Common types of hydraulic accumulator are: piston, bladder and diaphragm. Click here for more information on hydraulic accumulators.

ACCURACY: The ability of the system to achieve the desired output.

ACTUATOR: A device in which power is transferred from one pressurized medium to another without intensification, the hydraulic components such as hydraulic cylinders, hydraulic motors and hydraulic rotary actuators that directly help convert hydraulic energy into mechanical energy.
**ADAPTER**: A device used to align the shaft of a rotary device (e.g. an electric motor) with the shaft of a hydraulic pump to maintain radial and parallel shaft alignment. Fittings can vary in size and material to change an end fitting from one type or size to another.

**ADDITIVE**: A chemical added to a hydraulic fluid to impart new properties or to enhance those which already exist.

**AERATION**: Air trapped in the hydraulic fluid. Excessive aeration causes the hydraulic fluid to appear milky and can lead to erratic systems performance. See our article on air contamination in hydraulic systems.

**AIR BLEEDER**: A device (either manual or automatic) for the removal of air trapped in the pipeline.

**AIR BREATHER**: A device permitting air movement between the atmosphere and the hydraulic component in which it is installed, containing a fine mesh filter element to prevent contaminants from entering the hydraulic component. Normally attached to the top of a reservoir or tank to allow air to pass in and out.

**AIR, COMPRESSED**: Air at any pressure greater than atmospheric pressure.

**AIR INCLUSION**: The ambient atmosphere forced or trapped into the hydraulic system during connection of quick-release coupling halves.

**AIR-COOLED HEAT EXCHANGER**: A hydraulic component in a hydraulic system that relieves excessive heat with cool air.

**AIR-OPERATED ACCUMULATOR**: A hydraulic component used to store hydraulic fluid. The air-operated accumulator increases and relieves hydraulic pressure through the use of an inflatable bag. Also called a gas-loaded accumulator.
**AIR-OVER-OIL INTENSIFIER**: A hydraulic component that is powered by compressed air. Compressed air exerts force on a piston, which magnifies pressure as the hydraulic fluid escapes to smaller conductors and actuators.

**AMBIENT**: Of or relating to the immediate surroundings. The current condition of temperature, humidity and atmospheric pressure.

**AMBIENT NOISE LEVEL**: The noise level in the surrounding area while the machine or component concerned is not operating. Background noise.

**AMPLIFIER**: An electronic device used to increase the strength of the signal or input voltage fed into it to modify the signal into a driving voltage or current at a different level.

**AMPLITUDE OF SOUND**: The magnitude or volume of sound.

**ANALOG(UE) DEVICE**: An electronic device that requires or produces an infinitely variable signal (voltage or current) in response to a state change within the device.

**ANALOG(UE) SIGNAL**: An AC or DC voltage or current signal that represents continuously variable physical quantities (e.g., voltage, current, pressure, temperature, or speed). Any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity, i.e. analogous to another time varying signal.

**ANODISE (ANODIZE)**: An electrolytic process used to increase the thickness of the natural oxide layer on the surface of metal parts; to deposit protective or cosmetic coatings in a variety of colours on metal. Primarily used on aluminium.

**ANNULAR AREA**: A ring shaped area, often referring to the net effective area of the rod slide of a cylinder piston, i.e. the piston area of the rod.

**ANTI-FOAM AGENT**: One of two types of additives used to reduce foaming in petroleum products.
ASPERITIES: Microscopic projections on metal surfaces resulting from normal surface-finishing processes.

ATMOSPHERIC PRESSURE: The weight of the atmosphere. Atmospheric pressure refers to the amount of pressure exerted by the air at any specific location. Sea level pressure is approximately 14.7 pounds per square inch (psi) which equates to 1.01 bar.

ATTENUATION: The gradual loss in intensity of any kind of flux (current) through a medium.

ATTENUATOR: A variable resistive device used to reduce current or voltage.
BACK CONNECTED: A condition or state whereby pipe connections are on normally unexposed hydraulic equipment surfaces.

BACK PRESSURE: The level of pressure on the downstream or return side of a system or component.

BACK-UP RING: A fabric or plastic device used with an O-ring or other gasket to prevent the O-ring or gasket being forced out into an adjacent space or crevice.

BAFFLE: A plate or mechanical device designed to restrain or regulate the flow of a fluid. A separator found in a reservoir, tank or chamber to divert fluid flow in specific direction(s) for de-aeration of moving fluid.

BALL VALVE: A hydraulic valve that uses a spherical obstruction to stop and start hydraulic flow or divert the flow of fluid in a passage. A ball valve is usually rotated 90 degrees; to open and close. Provides a rugged and reliable sealing surface. Metal to metal sealing resist injury from contamination.

BAR: The measure of pressure in the metric system. One bar = 14.5 psig.

BARB: The portion of fitting inserted into a hose, usually comprised of two or more radial serrations or ridges designed to form a redundant seal between the hose and fitting.

BEND RADIUS: The radius of the bent section of the hose measured to the innermost surface of the curved portion. Often referred to as the minimum bend radius.

BLADDER: A separator or diaphragm, usually found in a chamber to aid the separation of two fluids or gases. Also see ACCUMULATOR or click here for our hydraulic accumulators page.
**BLEEDER (BLEED VALVE):** A device for removal of pressurized fluid. Used for the removal of air from an oil system.

**BLEED-OFF:** To divert a controlled, specific portion of a pump delivery directly to the hydraulic reservoir.

**BODY HALF:** Other nomenclature “female half”, “coupler”, “socket”. The receptacle portion of a quick-action coupling which normally includes the mechanism to lock the two quick-action coupling halves together.

**BOOSTER:** A hydraulic component that converts low hydraulic pressure from a large linear actuator into high pressure in a small linear actuator. Also called intensifiers, boosters are usually two different-sized hydraulic cylinders connected by a common piston.

**BORE:** The internal diameter of a tube, hose or pipe.

**BOUNDARY LUBRICATION:** A form of lubrication between two rubbing surfaces without the development of a full fluid lubricating film.

**BRAKE VALVE:** A device used in the exhaust line of a hydraulic motor to prevent both over-speeding when an over-running load is applied to the motor shaft and also excessive pressure build-up when decelerating or stopping a load.

**BRAZING:** The process of joining metals using a non-ferrous filler metal that has a melting point lower than that of the metals to be joined.

**BREAK AWAY:** Automatic separation of a quick-action coupling when an axial separation force is applied.

**BREAK-AWAY CLAMP:** A clamping device that holds the quick-action coupling sleeve, allowing the body to move forward upon disconnect within either a single-acting or double-acting sleeve or backward upon connection within a double-acting sleeve.
**BREATHER, AIR:** A device permitting air movement between the atmosphere and the hydraulic component in which it is installed while preventing contaminants from entering the hydraulic component.

**BRINELLING:** Indentation marks (dimples) or grooves worn into the shoulder of the quick-action coupling male half by the locking (detent) balls in the female half.

**BULK MODULUS:** The measure of a hydraulic fluid's resistance to compressibility.

**BURST PRESSURE:** The pressure at which a device (pipe, tube or hose) fails, losing its ability to contain pressure. Normally 4 times working pressure.

**BYPASS:** A secondary passage for the flow of fluid.
A glossary of hydraulics

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CAM: A circular component of a hydraulic piston pump that is mounted off-centre and moves pistons when rotated.

CAP, BLIND END: A hydraulic cylinder end closure that completely covers the bore area.

CAP, ROD END: The hydraulic cylinder end enclosure that covers the differential area between the bore area and the piston rod area.

CARTRIDGE: The replaceable element of a fluid filter. The pumping unit from a vane pump, composed of rotor, ring, vanes and one or both side plates.

CARTRIDGE VALVE: A valve that is inserted into a standard size cavity in a manifold block and is held in place with either self-contained screw threads or a cover secured with bolts. May be slip-in or screw-in types. Perform directional, pressure or flow control functions.

CASE DRAIN LINE: The line or passage from the internal cavity of a pump or other component that will carry fluid leakage from the device to a low pressure reservoir or tank.

CAVITATION: A gaseous condition that occurs in hydraulic pumps when existing space is not filled by available fluid and the pressure is reduced to the vapour pressure. Cavitation will deteriorate the hydraulic oil and cause erosion of the inlet metal.

CENTRIFUGAL FORCE: A force directed outward and away from the centre of a rotating object.

CERTIFICATE OF CONFORMITY: A certificate or document usually signed and dated.
CHAMBER: A compartment within a hydraulic component / unit. May contain elements to aid in the operation or control of a unit, e.g. spring or drain chamber.

CHARGE: Also known as “supercharge”. The process of replenishing a hydraulic system above atmospheric pressure or filling an accumulator with fluid under pressure. See PRE-CHARGE PRESSURE.

CHARGE PRESSURE: The pressure at which replenishing fluid is forced into the hydraulic system (above atmospheric pressure).

CHARGING ASSEMBLY: A system of valves and passages allowing the addition or deletion of gas to the gas chamber of an accumulator without discharging any existing gas.

CHECK VALVE: A hydraulic control valve that allows fluid to flow in one direction, yet prevents back-flow in the opposite direction.

CIRCUIT: A combination of components, devices and passages that form a working set of logic for a particular application.

CIRCUIT, OPEN: A hydraulic circuit in which return fluid is directed to the reservoir.

CIRCUIT, PILOT: Used to control a main circuit or component.

CIRCUIT, REGENERATIVE: Used to increase hydraulic cylinder speed by directing rod end discharge to the piston side of the hydraulic cylinder. Can be incorporated into directional control valve as fourth position.

CLEVIS: A "U" shaped mounting device that contains a common pin hole at right angle or normal to the axis of symmetry through each extension.

CLOSED-CENTRE CIRCUIT / SYSTEM: A hydraulic system in which the hydraulic pump continually operates against a load, even in the neutral condition. A circuit in which flow through the system is blocked in neutral and pressure at the pump outlet is maintained at the maximum pressure control setting.
**CLOSED CENTRE VALVES:** This type of hydraulic valve is used in a hydraulic system where the hydraulic valve blocks the flow of hydraulic oil from the hydraulic pump into an accumulator. The accumulator is used to store the hydraulic oil under pressure. This hydraulic valve takes the pressure off the hydraulic pump and in neutral locks the hydraulic cylinder in place with no load on the hydraulic pump.

**CLOSED CIRCUIT:** A piping arrangement in which the hydraulic pump output, after passing through other hydraulic components, returns directly to the pump inlet.

**CLOSED LOOP:** In a control system, a type of control that has an input signal and a feedback of the result of the input signal which is used to modulate the input signal automatically. See OPEN LOOP.

**COEFFICIENT OF FRICTION:** A relative measure of the surface lubricity, or reduction in friction of a lubricant.

**COLLAR:** The portion of a fitting compressed by swaging or crimping to seal the hose onto the fitting to create a permanent attachment. Also known as a ferrule.

**COMBUSTIBLE LIQUID:** A liquid having flash point at or above +100 degrees F (37.8 degrees C)

**COMMAND SIGNAL:** An external signal to which the servo must respond.

**COMPENSATOR CONTROL:** A displacement control for variable pumps and motors which alters displacement in response to pressure changes in the system as related to its adjusted pressure setting.

**COMPLETE COUPLING:** Other nomenclature hydraulic "coupling", "quick-action coupling". The two separate quick-action coupling halves connected together.

**COMPONENT:** A single hydraulic or electrical unit.
COMPOUND GAUGE: A visual indicator of pressure that is set for 'zero' psi at atmospheric pressure and includes a dial which will continue to indicate the level of pressure above or below atmospheric pressure.

COMPRESSIBILITY: The change in volume of a unit of volume of a hydraulic fluid when subjected to a unit change of pressure.

COMPRESSION: The name used to describe the change in pressure in a hydraulic system from low pressure to an elevated pressure. The change in pressure is usually made in a controlled amount of time to cause an even application of energy into the system. See DECOMPRESSION.

CONDITIONING: The exposure of a device or specimen under specified conditions, e.g. temperature, humidity for a specified period of time before testing.

CONDUCTIVE: The ability to transfer to electrical potential.

CONDUCTOR: The hydraulic components such as pipes, tubes, and hoses that convey liquids throughout a hydraulic system.

CONNECT UNDER PRESSURE: Ability to connect coupling halves with internal pressure applied to either or both coupling halves.

CONNECTOR: A mechanical device used to attach two pieces of tubing together or to attach a piece of tubing to a connector.

CONTAMINANT: Any material or substance which is unwanted or adversely affects the fluid power system or hydraulic components, or both. Contaminants may be solid particles, liquids or gases.

CONTROL VALVES: Used to harness the power of a hydraulic system. The three basic types of hydraulic control valves are tandem centre, open centre (motoring spool), and closed centre. Both the tandem centre and the closed centre types are available in a three-way or four-way valve. By opening or closing valves, you can control how much or in what direction a hydraulic piston moves. Valves can also control many pistons working with each other at the same time.
**CONTROLLED FLEXING:** Occurring when a hose is being flexed regularly e.g. in the case of connections to moving components.

**COOLER:** A mechanical device used to transfer heat from a fluid to air or another fluid. Normally constructed of finned tubes with one fluid on the inside and the other fluid or air on the outside of the tubes. See HEAT EXCHANGER.

**CORROSION:** The process by which material degrades by chemical or electrochemical means.

**CORROSION INHIBITOR:** Additive for protection of wetted metal surfaces from chemical attack by water or other contaminants.

**CORROSION RESISTANCE:** The ability of a hydraulic fluid to resist rust and deterioration within the hydraulic components of a hydraulic system.

**COUNTERBALANCE VALVE:** A valve used to balance the weight of a machine or a “dead load” by creating a back pressure in the system cylinders that is big enough to hold or “counter” the weight. A counterbalance valve is normally closed and is opened by internal pressure in the counterbalance valve or from a separate source of fluid, that is connected to the opposite end of the balanced cylinder.

**COMPRESSIBILITY:** The change in volume of a unit of volume of a hydraulic fluid when subjected to a unit change of pressure.

**COMPRESSION:** The name used to describe the change in pressure in a hydraulic system from low pressure to an elevated pressure. The change in pressure is usually made in a controlled amount of time to cause an even application of energy into the system. See DECOMPRESSION.

**CONDITIONING:** The exposure of a device or specimen under specified conditions, e.g. temperature, humidity for a specified period of time before testing.

**CONDUCTIVE:** The ability to transfer to electrical potential.
**CYCLE-MOTION**: Movement from normal to extreme position and return.

**CYLINDER**: A hydraulic actuator constructed of a plunger or piston inside a cylindrical housing. The piston or plunger operates because of pressurized liquid and converts fluid power into linear mechanical force and motion.

**CYLINDER, ADJUSTABLE STROKE**: A hydraulic cylinder equipped with adjustable stops at one end to limit piston travel.

**CYLINDER CAP**: A hydraulic cylinder end closure which completely covers the bore area.

**CYLINDER CAPACITY, EXTENDING**: Volume required for one full extension of the hydraulic cylinder.

**CYLINDER CAPACITY, RETRACTING**: Volume required by one full retraction of the hydraulic cylinder. (Generally, less than extending)

**CYLINDER; DEPTH CONTROL**: A mechanical or hydraulic device, adjustable, for limiting hydraulic cylinder stroke.

**CYLINDER; DOUBLE ACTING**: A hydraulic cylinder which can apply force and motion to the moveable element in either direction. See double-acting cylinder.

**CYLINDER, NON-ROTATING**: A hydraulic cylinder in which the relative rotation of the cylinder housing and the piston and piston rod, plunger, or ram, is fixed.

**CYLINDER; REPHASING**: A hydraulic cylinder design which permits the use of two or more hydraulic cylinders in series, automatically synchronizing hydraulic cylinder position at the end of each stroke.

**CYLINDER; SINGLE-ACTING**: A hydraulic cylinder which can apply force to the moveable element in only one direction.

**CYLINDER, TANDEM**: Two or more hydraulic cylinders with interconnected piston assemblies.
**CYLINDER, TELESCOPIC, DOUBLE ACTING:** A hydraulic cylinder with one closed end and a telescoping movable shaft at the other end. When fluid flow is applied to a port in the closed end, the telescoping shaft extends until all collars or pistons reach their limit. When fluid is applied to the shaft end port, the shaft will retract into the chamber until all the pistons or collars reach their closed end limits. The cylinder will produce an output force at the shaft end in proportion to its internal area multiplied times the pressure potential of the fluid power system.

**CYLINDER, TELESCOPIC, SINGLE-ACTING:** When fluid flow is applied to a port in the closed end, the telescoping shaft extends until all collars or pistons reach their limit. When an external weight is applied to the shaft end, the shaft will retract into the chamber until all the pistons or collars reach their closed end limits. The cylinder will produce an output force at the shaft end in proportion to its internal closed end area multiplied times the pressure potential of the fluid power system. See telescopic hydraulic cylinders.

**CYLINDER THRUST:** The push of a hydraulic cylinder in pounds: Thrust = Piston Area (in.) x Pump Pressure (PSI) or Thrust = bore diameter squared x .78 x PSI
DEAD TIME: A real, definite delay between two related actions, measured in units of time.

DEAD-WEIGHT ACCUMULATOR: A hydraulic component used to store hydraulic fluid. The dead-weight accumulator increases and relieves pressure through the use of a weighted vertical piston. See hydraulic accumulators.

DEBURR: The removal of ragged edges from the inside diameter of a fitting or hose end. An essential task to ensure a good seal.

DECOMPRESSION: The change in pressure in a hydraulic system from elevated pressure to a lower pressure. Such a change in pressure is normally made in a controlled amount of time to cause an even release of energy in the system.

DELIVERY: The volume of fluid discharged by a pump in a given time, usually expressed in gallons per minute (gpm).

DEMULSIBILITY: Ability of an oil to separate from water. The resistance of a hydraulic fluid to emulsification, or how well a hydraulic fluid resists mixing with water.

DETENT: A spring device which maintains the spool of a hydraulic directional control valve in position.

DETENT RELEASE: A mechanical, hydraulic or electrical device for releasing the detent.

DE-VENT: To close the vent connection of a pressure control valve, allowing the valve to operate at its adjusted pressure setting.
DE-WAXING: Removal of paraffin wax from lubricating oils to improve low temperature properties.

DIFFERENTIAL CYLINDER: Any hydraulic cylinder in which the two opposed pistons are not equal.

DIFFERENTIAL PRESSURE: The value of pressure measured as the absolute difference between the inlet pressure and outlet pressure.

DIRECT CURRENT: A steady level of electrical current that only flows in one direction in a circuit.

DIRECTIONAL VALVE: A hydraulic valve whose main function is to prevent or direct flow through particular channels.

DIRT CAPACITY: The volume or weight of particles that a strainer or filter will hold at the limit of its operation.

DIRT TOLERANCE: An indication of the internal clearance of a hydraulic pump. Hydraulic pumps with high dirt tolerance have the most clearance, are the least efficient, and allow the most backflow. Hydraulic pumps with low dirt tolerance have the least amount of clearance, are the most efficient, and allow little to no back-flow.

DISPLACEMENT: The amount of liquid transferred from the inlet of the hydraulic pump to the outlet in a single revolution. Displacement can be fixed or variable.

DOG-LEG ASSEMBLY: Two hose assemblies joined by a common elbow.

DOUBLE-ACTING CYLINDER: A hydraulic cylinder which can apply force and motion to the moveable element in either direction.

DOUBLE-ACTING SLEEVE: Other nomenclature “two-way sleeve”. Allows one hand push-to-connect or pull-to-disconnect convenience when the quick-action coupling female half is clamp or bulkhead mounted and connected to a hose.

DOWNSTREAM: The passage beyond a device, normally at the outlet of direction of flow.
DRAIN: A passage in, or line from, a hydraulic component which returns leaked fluid to the reservoir or a vented manifold.

DRIFT: The amount of movement of a device after a pre-set condition has been applied. Normally drift is measured with varying temperature, although drift may also be plotted against any variable, such as humidity, etc.

DRIVE GEAR: The gear in a hydraulic gear pump that is attached to the driving mechanism. The drive gear turns the driven gear.

DRIVEN GEAR: The gear in a hydraulic gear pump that is rotated by the drive gear.

DRIVING MECHANISM: A component of a hydraulic gear pump that rotates the driving gear.

DUROMETER HARDNESS: A measure of elastomer hardness by use of a durometer.

DUST CAP: A removable device that protects the male tip half when disconnected from the female coupling half. Excludes contamination.

DUST PLUG: A removable device that protects the female body half when disconnected from the male tip half. Excludes contamination.
ECCENTRIC WALL: A wall of varying thickness.

EFFICIENCY: The ratio of output to input. Volumetric efficiency of a pump is the actual output, in gallons per minute, divided by the theoretical or design output. The overall efficiency of a hydraulic system is the output power divided by the input power. Efficiency is usually expressed as a percentage.

EFFUSION: The escape, usually of gases, through a medium.

ELASTOMER: Polymeric materials, including natural rubber or thermoplastic, that will soften when heated.

ELECTRIC MOTOR: An electro-mechanical device that converts electrical power into rotary motion. The resultant power output is measured in horsepower.

ELECTRO-HYDRAULIC SERVO VALVE: A servo-valve which is capable of continuously controlling hydraulic output as a function of an electrical input.

ELEMENT: See FILTER ELEMENT.

ELONGATION: The increase in length expressed as a percentage of the original length.

EMULSIFIER: An additive that promotes the formation of a stable mixture, or emulsion, of oil and water.

EMULSION: Intimate mixture of oil and water, generally of a milky or cloudy appearance.
**EP ADDITIVE:** Lubricant additive that prevents sliding metal surfaces from seizing under conditions of extreme pressure (EP).

**EROSION:** Degradation of a surface resulting from a mixture of fluid and air or fluid and dirt particles passing over the surface at the same time as a change in pressure occurs.

**EXHAUST LINE:** A passage or channel that is open to the atmosphere. Normally used in systems using pressurized air or gases which may then be dispensed into the atmosphere.
**FATIGUE**: The weakening or deterioration of a material occurring when a repetitious or continuous application of stress causes strain which can lead to failure.

**FEEDBACK**: Part of a closed loop system which monitors back information about the condition under control for comparison.

**FEEDBACK LOOP**: Any closed circuit consisting of one or more forward elements and one or more feedback elements.

**FILLER CAP**: A mechanical device which provides an access for filling a reservoir or tank. Normally equipped with a fine screen to strain out dirt particles.

**FILTER**: A device, used to house a filter element, incorporated into a hydraulic system to remove contaminants from the hydraulic oil. See hydraulic filters.

**FITTING**: A connector or closure for fluid power lines and passages.

**FLOAT SPOOL**: A spool valve design which connects all ports to the tank (return) port, usually in a detented fourth position, allowing a hydraulic cylinder or hydraulic motor to “float”.

**FLOW CHECKING**: Other nomenclature “ball checking”, “lock-up”, “check-off”. Occurs when the male tip half valve closes during high flow conditions, such as when quickly lowering a heavy loader.

**FLOW CONTROL VALVE**: A type of hydraulic valve consisting of a needle valve and a check valve placed in close proximity in a common body. Flow control valves regulate the flow of hydraulic fluid.
**FLOW DEMAND**: The amount of fluid movement in a hydraulic system that is required to perform a specific job or type of work.

**FLOW DIVIDER**: A mechanical device used to divide the fluid in a passage into two or more separate fluid streams. See hydraulic flow dividers.

**FLOW RATE**: The volume, mass or weight of a fluid passing through a given point in a given time. Flow rate is commonly measured in gallons per minute (gpm).

**FLOW SWITCH**: A digital device that opens or closes a contact when a pre-set flow passes over the sensing element.

**FLOW, TURBULENT**: A flow situation in which fluid particles move in a random matter.

**FLOWMETER**: An analogue device which indicates the volume of fluid passing through its interior passage. The output signal may be a visual one or a low level electrical signal.

**FLUID FRICITION**: Friction due to the viscosity of fluids. The measure of the resistance of flow of fluid in a passage, measured in psi (pounds per square inch) or other measures of pressure. Fluid friction results in increased fluid temperature and loss of work potential in the fluid power system.

**FLUID MOTOR**: A mechanical device that transforms the flow of pressurized fluid into rotary motion.

**FLUID POWER**: Energy transmitted and controlled through use of a pressurized fluid.

**FLUID POWER SYSTEM**: The transmission and control of power through the use of fluid pressure. A system of components that use a pressurized fluid to transfer energy (do work).

**FLUID STABILITY**: Resistance of a fluid to permanent changes in properties.
**FLUID VELOCITY:** The speed of fluid through a cross section expressed in length divided by time.

**FIRE-RESISTANT FLUID:** Hydraulic oil used especially in high temperature or hazardous applications.

**FLOW, LAMINAR:** A flow situation in which fluid moves in parallel laminar or layers.

**FORCE:** The measure of the result of pressurized fluid acting upon a chamber in a fluid power system. Normally the measure is in pounds and is most often used to state the force in pounds that will be available at the rod of a cylinder when acted upon by pressurized fluid from a fluid power system. The system of units normally used are square inches, pounds per square inch, and pounds.

**FORCE MULTIPLICATION:** The exponential increase in available power usually associated with tools and power transmission systems.

**FOUR-WAY:** A term used to describe a valve that has four ports, normally a pressure (inlet) port, a return (tank) port, an ‘A’ (‘1′) work port and a ‘B’ (‘2′) work port. Used to change direction of a cylinder or other output device.

**FOUR-WAY SPOOL VALVE:** A spool valve that allows the reversal of hydraulic fluid flow. A four-way spool valve has five ports.

**FOUR-WAY VALVE, MANUALLY & DIRECT OPERATED:** A valve having a four way functional capability that may be manually activated to directly control the operating spool. Movement of the spool from one extreme end to the other extreme end reverses the flow paths of the ports. See FOUR-WAY.

**FOUR-WAY VALVE, PROPORTIONAL CONTROL & DIRECT OPERATED:** A valve having a four way functional capability that may be proportionately actuated by a solenoid to control the operating spool in infinite resolution. Movement of the spool from extreme end to extreme end completely reverses the flow paths of the ports. See FOUR WAY.
FOUR-WAY VALVE, SOLENOID & DIRECT OPERATED: A valve having a four way functional capability that may be solenoid activated to directly control the operating spool. Movement of the spool from extreme end to extreme end reverses the flow paths of the ports. See FOUR WAY.

FOUR-WAY VALVE, SOLENOID & PILOT OPERATED: A valve having a four way functional capability that may be solenoid activated to directly control the operating spool which then controls a secondary, larger spool. Movement of the secondary spool from one extreme end to the other extreme end reverses the flow paths of the ports. See FOUR WAY.

FREQUENCY: The number of times a given action occurs in a unit of time.

FRONT CONNECTED: The case where piping connections are on normally exposed surfaces of hydraulic components.

FULL FLOW: A filter in which all the fluid must pass through the filter element or medium.

FULL-FLUID-FILM LUBRICATION: Presence of a continuous lubricating film sufficient to completely separate two surfaces.
**GAS-LOADED ACCUMULATOR**: A hydraulic component used to store hydraulic fluid. The gas-loaded accumulator increases and relieves pressure through the use of an inflatable bag. Also called an air-operated accumulator.

**GATE VALVE**: A two-way hydraulic valve that may be opened or closed to either allow or prohibit the flow of hydraulic fluid. The gate valve consists of a plate-like obstruction that is raised and lowered into place to control the flow of hydraulic fluid. Often designed so that when open, the opening of the passage is not restricted, but there will be some small pressure loss.

**GAUGE**: An instrument or device for measuring, indicating, or comparing a physical characteristic, such as pressure or volume.

**GAUGE PRESSURE**: A term used to state that any pressure stated is corrected for atmospheric pressure. Normally abbreviated “psig” – (pounds per square inch gauge).

**GEAR**: A circular toothed component that engages, rotates, and transmits power to another circular toothed component when rotated.

**GEAR PUMP**: A hydraulic pump that uses meshed gears that rotate and move liquid through a hydraulic system.

**GEAR-ON-GEAR PUMP**: A hydraulic pump that creates pressure in a hydraulic system through the interaction of two toothed gears that are located adjacent to one another. One gear rotates and drives the other gear.
GEAR-WITHIN-GEAR PUMP: A hydraulic pump that creates pressure in a hydraulic system through the interaction of two toothed gears that are located one inside of the other. A gear with external teeth rotates and drives the internal gear.

GEROTOR: A gear-within-gear pump that consists of an inner gear with one less tooth than the outer gear.

GLAND: A mechanical device that is used to contain a seal, O-ring or gasket in a specified space to result in a leak-proof connection between two or more mechanical components.

GLOBE VALVE: A two-way valve that may be opened or closed to adjust the flow of hydraulic fluid, between and including, fully on and fully off. The globe valve consists of a circular plug and a tapered seat. Usually manually operated so that the flow of fluid must make a non-straight turn inside the valve body which results in a loss of pressure across the valve when open, which is bigger than the loss across a gate valve.

GROUND: A reference point of zero in electrical circuits to which all circuit voltages are compared. Also, ‘grounding’ a device means to make connections to an earth ground for safety purposes.
**HEAD:** Vertical distance measured between two stages in a liquid. The measure of pressure at the base or other reference point of a column of fluid. Usually measured in feet of water.

**HEAT EXCHANGER:** A device which transfers heat through a conducting wall from one fluid to another. (Typically to cool a system.) Hydraulic components that help relieve the excessive heat that builds up in a hydraulic system. See COOLER.

**HEAT RESISTANCE:** The ability to resist deterioration caused by raised temperatures.

**HORSEPOWER:** The measure of energy used when describing the normal power level in a system. The horsepower required to drive a hydraulic pump is dependent on both pressure and output in GPM. The higher the pressure, or greater the volume, the more Horsepower (HP) required. As a rule of thumb, a 1000 PSI (pounds per square inch) pump will require 1 Horsepower (HP), for the first gallon per minute and 3/4 HP each gallon per minute after that. Doubling the pressure or output volume will require 4 time the input HP. The maths: Input HP = GPM x PSI / 1714

**HOSE:** A type of hydraulic fluid conductor that joins other hydraulic components usually in a non-linear fashion, used to transport fluid between components in a fluid power system. Hose bends and flexes and is the most versatile hydraulic conductor.

**HUNTING:** The tendency for a system to oscillate continuously.

**HYDRAULIC ACTUATOR:** The piece of machinery that receives pressure from the energized fluid and then converts it to motion and mechanical force.
HYDRAULIC BALANCE: The condition or state of equal opposed hydraulic forces acting on a part in a hydraulic component.

HYDRAULIC CONTROL: A control which is actuated by hydraulically induced forces.

HYDRAULIC CYLINDERS: Hydraulic cylinders transform the pressure and oil flow in a hydraulic system into work or mechanical force. They are used where linear motion is required to move something. Hydraulic cylinders are usually double-acting, that is, oil under pressure can be applied to either side of the piston to provide movement in either direction. Single acting hydraulic cylinders are sometimes used where the weight of the load is used to return the hydraulic cylinder to the closed position.

HYDRAULIC FLUID: A liquid such as oil or water that is used to generate power in a hydraulic system.

HYDRAULIC INTENSIFIER: A hydraulic component that converts low pressure from a large linear actuator into high pressure in a small linear actuator. Also called boosters, intensifiers are usually two different-sized hydraulic cylinders connected by a common piston.

HYDRAULIC MOTOR: A device which converts the energy from liquid flow into mechanical motion. However, instead of a hydraulic cylinder (force moving linear) the hydraulic motor uses hydraulic pressure to rotate. In terms of how it’s built, a motor is like a pump. But, when it’s operated oil enters the hydraulic motor and turns the shaft. The speed of a hydraulic motor is dependent on the amount of oil supplied by the hydraulic pump and the torque is dependent on the amount of pressure supplied. See hydraulic motors.

HYDRAULIC POWER: Power derived from the motion and pressure of a liquid, such as water or oil. See FLUID POWER.

HYDRAULIC POWER UNIT: Any device used to create kinetic energy within a hydraulic system. Motors and manual energy are both sources of power in hydraulic power units.
**HYDRAULIC PUMP:** A device that converts mechanical force and motion into fluid power; used to move liquids in a hydraulic system.

**HYDRAULIC TESTER:** A device used to troubleshoot and check hydraulic powered system components.

**HYDRAULIC VALVE:** A device used to regulate fluid distribution in hydraulic applications.

**HYDRAULICS:** The science dealing with the transmission of force through the medium of a contained fluid.

**HYDROKINETICS:** Engineering science relating to the energy of liquids in motion.

**HYDROPNEUMATICS:** The combination of hydraulic and pneumatic fluid power.

**HYDROSTATICS:** Engineering science relating to the energy of liquids at rest.

**HYDROSTATIC TESTING:** The use of liquid to test a hose or hose assembly for leakage, twisting ad/or changes in hose length.

**HYDROSTATIC TRANSMISSION:** Combination of one or more hydraulic pumps and motors forming a unit.
IMMISCIBLE: Incapable of being mixed without separation of phases.

IMPEDEANCE: The combination of AC and DC resistance in a circuit measured in ohms.

IMPULSE: An application of force in such a way that sudden strain or movement is produced, e.g. hydraulic pressure applied in a hose.

INHIBITOR: An additive that improves the performance of a petroleum product through the control of undesirable chemical reactions.

INSULATOR: A material that blocks the flow of current which is used for a short circuit and shock prevention.

INTAKE LINE: A passage at a component’s inlet port, normally at the inlet port of a pump.

INTENSIFIER: Hydraulic components that convert the low pressure from a large linear actuator into high pressure in a small linear actuator. Intensifiers are usually two different-sized hydraulic cylinders connected by a common piston. Also called a booster. See an introduction to hydraulics.

INTERCHANGE: The ability of a quick-action coupling half from one hydraulic manufacturer to fit and function with a mating half from another hydraulic manufacturer without assurance of equal pressure containment rating or performance.

INTERFACE: That portion of the male tip (nipple) half that establishes and controls interchangeability.
A glossary of hydraulics

**Jj**

**Joule:** A unit of work, energy, or heat. 1 J (joule) = 1 Nm (Newton meter).

**Kk**

**Kinematic Viscosity:** Absolute viscosity of a fluid divided by its density at the same temperature of measurement.

**Kinetic Energy:** Energy that a substance or body has by virtue of its mass (weight) and velocity.
LAG: The preferred engineering term for delay in response (usually in degrees).

LAMINAR FLOW: Slow movement of fluid in a passage in a relatively straight path along the centre line of the passage.

LEVEL SWITCH: An electro-mechanical device which senses the level of fluid in a chamber and opens or closes a digital switch to indicate a change of state. See LEVEL TRANSMITTER.

LEVEL TRANSMITTER: An electro-mechanical device which senses the level of fluid in a chamber and produces an analogue signal that corresponds with the change of state in the chamber. See LEVEL SWITCH.

LEVERAGE: A gain in output force over input force by sacrificing the distance moved. Mechanical advantage or force multiplication.

LIFT: The extent of the capability of a pump to raise fluid from a lower to higher level at its inlet port without damage to the pump. Normally expressed in feet of water.

LINE: A connection (pipe, tube or hose) between components; a passage for fluid or gas transfer.

LINEAR ACTUATOR: A device for converting hydraulic energy into linear motion; an actuator that directs force in a straight line. A hydraulic cylinder is a linear actuator.

LIQUID LEVEL GAUGE: A gauge used to visually indicate the fluid level in a reservoir or tank.

LOAD: The amount of force or pressure placed on a hydraulic system.
LOCKING BALLS: Other nomenclature “detent balls”. Normally found in the female half of the quick-action coupling, they align with the shoulder groove on the mating male half providing a durable locking mechanism while allowing both coupling halves to swivel and align easily.

LOOP INSTALLATION: The assembly is installed in a loop or “U” shape and is most often used when frequent and/or large amounts of motion are involved.

LUBRICATOR: A device that adds controlled or entered amounts of lubricant into an air system.

LUBRICITY: Ability of an oil or grease to lubricate. The property that diminishes friction and increases smoothness and slipperiness.
**MANIFOLD:** A conductor that provides multiple connection ports. A fabricated system of passages to which various components are attached to form a working assembly or sub-assembly. See hydraulic manifolds.

**MANUAL CONTROL:** A control actuated by the operator.

**MANUAL OVERRIDE:** A way of manually actuating an automatically-controlled device.

**MASS FLOW RATE:** The mass of fluid per unit of time passing through a given cross-section of a flow-passage in a given direction.

**MECHANICAL ACCUMULATOR:** A hydraulic component that transfers mechanical energy to trapped fluids. Mechanical accumulators include dead-weight and spring-loaded accumulators.

**MECHANICAL CONTROL:** A control actuated by cams, gears, linkages, screws or other mechanical elements.

**MECHANICAL POWER:** Energy created by the physical interaction of instruments or tools.

**METER-IN:** To regulate the amount of fluid flow into an actuator or system. MICRON: 1/1000th of a millimetre or 0.00003937 inches. The measure used to determine the particle size of contaminants in a fluid system.

**MICRON RATING:** The size, in microns, of the particles a filter will remove.

**MISCIBLE:** Capable of being mixed in any concentration without separation of phases.
**MOTOR:** A device which converts hydraulic energy into rotary motion and force, either fixed or variable.

**MUFFLER:** A mechanical device for reducing gas flow noise, by providing a complex path for exhaust of air from a pressurised chamber.
**NEEDLE VALVE:** A two-way valve that may be opened or closed to block or adjust the flow of hydraulic fluid between, and including, fully on and fully off. The needle valve consists of a sharp conical obstruction that is extended or retracted to block or allow flow. Normally designed so that the flow of fluid must make a non-straight turn inside the valve body which results in a desired loss of pressure across the valve when open which is greater than the loss across a gate valve.

**NEWTON:** A unit of force based on the unit of mass, Kg (kilogram), multiplied by the acceleration, m/s² (meters per second per second) which produces Kgm/s², called the Newton. 1 N = 1 Kgm/s² = 0.1225 lbs. (F) — (pounds force).

**NEWTONIAN FLUID:** Fluid whose viscosity does not change with rate of flow.

**NIPPLE:** The internal member or portion of a hose fitting.

**NITROGEN:** An inert gas used to serve as an energy source for accumulators or to be used as a cleaning agent when pure, nonexplosive gases are required.

**NON-NEWTONIAN FLUID:** A fluid in which shear stress is not proportional to shear rate.

**NON-PETROLEUM BASED OIL:** A hydraulic fluid that contains no petroleum. Non-petroleum based oils are ideal for hydraulic systems that are used near a fire hazard.
“O” RING: A circular seal made from synthetic material.

OPEN-CENTRE CIRCUIT / SYSTEM: A hydraulic system in which the flow of the pump has a free-flow passageway through the system and back to the reservoir, while in the neutral condition.

OPEN-CENTRE VALVES: One in which all ports are interconnected and open to each other in the centre or neutral position. Open centre hydraulic valves are the same as the tandem centre, except that in the neutral position all lines are connected back to the reservoir. The primary use of this system is to prevent “shock” loading when the valve is placed in neutral. This takes pressure off the hydraulic motor. This system is used in situations where the operating device needs to be moved by hand.

OPEN CIRCUIT: A circuit in which there is no complete path for electrical current flow.

OPERATING PRESSURE: The maximum pressure that a system or component will experience during operation at the maximum expected fluid pressure.

OUTPUT: The output of a hydraulic pump (gallons per minute, or GPM) is related directly to its operating speed. The pressure of a hydraulic pump is determined by its manufactured capabilities.

OUTPUT STAGE: A spool or other device that is controlled by a torque motor or smaller spool.

OXIDATION: The absorption of oxygen into fluid and the plating of the oxygen/fluid mixture onto metal surfaces.

OXIDATION INHIBITOR: Substance added in small quantities to petroleum products to increase its oxidation resistance.
PACKING: A sealing device consisting of bulk deformable material or one or more mating deformable elements, reshaped by manually adjustable compression to obtain and maintain effectiveness.

PARTICLE: A piece of contamination or debris found in a fluid.

PARTICLE COUNT: The number of particles, grouped by size, in a fluid sample of specified size.

PASSAGE: A hole through which fluid passes in a fluid power system.

PETROLEUM-BASED OIL: A hydraulic fluid developed from petroleum. Petroleum-based oils are the most common hydraulic fluids.

PH (PHASE): A term used to describe the quantity of cyclic electrical power sources in a high voltage system. Most commonly 1 phase or 3 phase.

PHASE SHIFT: A time difference between the input and output signal of a control unit or system, usually measured in degrees.

PHOSPHATE ESTER FLUID: A hydraulic oil (fluid) that is made from an ester base. A synthetic fluid, manufactured to specific characteristics. Will not normally support combustion if heated to a specific temperature.

PILOT LINE: A passage in a fluid power system that is used to carry a fluid at a pressure lower than the normal operating pressure to aid the controlled shifting of spool valves.

PILOT OPERATED CHECK VALVE: A special check valve that may be opened against a check load by applying pilot pressure from a secondary source to open the check to free reverse flow.
PILOT PRESSURE: The pressure in the pilot circuit.

PILOT VALVE: A valve applied to operate another valve or control. The controlling stage of a two-stage valve.

PIPE / PIPING: A type of hydraulic fluid conductor that joins other hydraulic components usually in a straight line and on a permanent basis. When you are connecting up a hydraulic system, use the tubing or pipe that is capable of handling heavy pressures and loads required by the hydraulic system. Pipes should have a minimum number of bends and fittings, should be securely fastened and clean. Iron pipes are not recommended because they have particles that will flake off and contaminate a hydraulic system.

PISTON: A device used for converting hydraulic power to mechanical energy. A rod inside a hydraulic cylinder that is moved by hydraulic pressure. In hydraulic pumps, the piston is responsible for pushing down and pulling up the ram.

PISTON BARREL: A rotating cylindrical mechanism that houses the pistons in a hydraulic piston pump.

PISTON PUMP: A hydraulic pump that uses pistons driven by a rotating swash plate or cam to move fluid through a hydraulic system.

PISTON RING: A metal ring that is used to seal high pressure fluid inside a passage to prevent (limit) leakage across the passage. Usually found in cylinders.

PISTON SHOE: The swivelling end portion of a piston that maintains contact with the swash plate in a piston pump.

PLATING: A material, usually metal applied to another metal by electroplating to reduce corrosion.

PLUNGER CYLINDER: A hydraulic cylinder in which the movable element has the same cross-sectional area as the piston rod.

POLAR COMPOUND: A chemical compound whose molecules exhibit electrically positive characteristic at one extremity and negative characteristics at the other.
POPPET: The part of a type of valve that blocks flow when it closes against a seat.

POPPET VALVE: Machined, self aligning valve that incorporates an elastomer to provide a positive seal upon disconnection, no low pressure leakage, and generally provides higher flow that a ball valve.

PORT: The internal or external terminus of a passage. The point where the fitting is attached.

PORT BLEED: A port that provides a passage for the purging of gas from a hydraulic system or hydraulic component.

PORT, CYLINDER: A port that provides a passage to or from an actuator.

PORT, EXHAUST: A port that provides a passage to the atmosphere.

POSITIVE DISPLACEMENT: A characteristic of a pump or motor when a constant volume is delivered for each revolution or stroke.

POSITIVE DISPLACEMENT PUMP: A hydraulic pump that continues to discharge fluid as long as it is powered.

POUNDS PER SQUARE INCH (PSI): A unit of pressure that measures the amount of load pressure per inch. Pounds per square inch is abbreviated “psi”.

POUR POINT: Lowest temperature at which an oil or distillate fuel is observed to flow.

POWER: Work per unit of time measured in horsepower (hp) or watts (W).

POWER PACK / UNIT: A hydraulic power pack is a combination of hydraulic pump, pump drive, reservoir, controls and conditioning components to supply (integral) hydraulic power to a hydraulic system.

POWER SUPPLY: The term used to describe a fluid power source.

PRE-CHARGE PRESSURE: The pressure of compressed gas in an accumulator prior to the admission of the liquid.
**PRE-FILL VALVE:** A valve that is arranged so its inlet port is connected to a reservoir or tank in such a way that fluid will flow from the inlet of the valve into a cylinder or ram when opened. When closed, the valve must close off the ram or cylinder from the reservoir or tank to permit application of high pressure from another source on the cylinder side of the valve. Most commonly used to fill large rams on presses to take up non-operating stroke.

**PRESSURE:** The force per unit area, usually expressed in pounds per square inch (psi), bars, or atmospheres.

**PRESSURE, BACK:** The pressure encountered on the downstream or return side of a component.

**PRESSURE, BURST:** The pressure that creates loss of fluid through the component envelope, resulting from failure.

**PRESSURE COMPENSATOR:** A hydro-mechanical device fitted to a pump or other flow producing / controlling device that reduces flow when pressure rises and increases flow as pressure decreases, to pre-set limits.

**PRESSURE CONTROL VALVE:** An adjustable control valve that regulates pressure in a hydraulic system.

**PRESSURE, CRACKING:** The pressure at which a pressure operated valve begins to pass fluid.

**PRESSURE DIFFERENTIAL:** The difference (drop) in pressure between any two points in a system or component.

**PRESSURE DIFFERENTIAL SWITCH:** A digital device that opens or closes a switch when the internal pressure differential changes. Most often used to detect clogging of filter elements.

**PRESSURE GAUGE:** A visual indicator of pressure that is set for ‘zero’ psi at atmospheric pressure and includes a dial that indicates the pressure level above atmospheric pressure. See VACUUM GAUGE and COMPOUND GAUGE.
**PRESSURE LINE:** A passage used to take fluid from the source of flow to various operating elements of a fluid power system. Rated for pressure at the maximum expected pressure of the system.

**PRESSURE, MAXIMUM RATED:** The maximum pressure at which a hydraulic component should be operated on a continuous basis, usually the relief valve setting at maximum flow rate.

**PRESSURE, OPERATING:** The pressure at which a hydraulic system is operated.

**PRESSURE OVERRIDE:** The measure of pressure increase over the nominal setting of a device when additional fluid flow is passed over the device after it initially opens.

**PRESSURE, PEAK:** The maximum pressure encountered in the operation of a hydraulic component.

**PRESSURE PLATE:** A side plate in a vane pump or motor cartridge on the pressure port side.

**PRESSURE, RATED:** The qualified operating pressure which the hydraulic manufacturer recommends for a component or a system.

**PRESSURE REDUCING VALVE:** A pressure control valve whose primary purpose is to limit outlet pressure.

**PRESSURE RELIEF VALVE:** A non-adjustable control valve that regulates pressure in a hydraulic system. A pressure relief valve is a safety device and is required on all hydraulic systems. Once adjusted, the pressure relief valve opens whenever the pressure goes beyond the value set and allows oil to flow back to the reservoir.

**PRESSURE, SHOCK /SPIKE:** The pressure existing in a wave moving at sonic velocity. The peak value of a sudden increase in pressure in a hydraulic system producing a shock wave.

**PRESSURE, STATIC:** The pressure in a fluid at rest.
PRESSURE SWITCH: A digital device that opens or closes a switch when the internal pressure changes state.

PRESSURE TRANSDUCER: An analogue device that produces a change in voltage or current when the internal pressure changes state. Normally a fast response device for use in servo control systems. See PRESSURE TRANSMITTER.

PRESSURE TRANSMITTER: An analogue device that produces a change in voltage or current when the internal pressure changes state. Normally a slow acting device for use in display systems where update time is not crucial.

PRESSURE, WORKING: The pressure at which the working device normally operates.

PRESSURE VESSEL: A container that holds fluid under pressure.

PRIME MOVER: The component of a hydraulic system that powers the main pump.

PROGRAMMABLE LOGIC CONTROLLER (PLC): A valve which controls and varies pressure, flow, direction, acceleration and deceleration from a remote position. They are adjusted electrically and are actuated by proportional solenoids rather than by a force or torque motor. The output flow is proportional to the input signal. A PLC provides moderately accurate control of hydraulic fluid.

PROOF PRESSURE: A non-destructive level of pressure at which a component or fluid passage will not give during testing of the internal pressure. Normally twice working pressure.

PROPORTIONAL FLOW: The condition, in a filter, where part of the flow passes through the filter element in proportion to the pressured drop.

PROPORTIONAL VALVE: A valve which controls and varies pressure, flow, direction, acceleration and deceleration from a remote position. Adjusted electrically and actuated by proportional solenoids rather to the input signal and provides moderately accurate control of hydraulic fluid.
**PUMP**: A mechanical device used to move liquids and gases; The building block of any hydraulic system. The four most common designs are the vane pump, gear pump, gerotor pump and piston pump. All are well suited to common hydraulic uses with the piston design best suited for higher pressures. The variable displacement type is particularly well suited in circuits using hydraulic motors where variable speeds and the ability to reverse is needed.

**PUMP, FIXED DISPLACEMENT**: A mechanical device that creates a flow of fluid when its shaft is rotated in the proper direction and when its inlet is connected to a chamber filled with fluid (a reservoir or tank). The outlet port may be connected to a passage leading to a fluid power system or exhausted into another chamber that is at a higher pressure. The higher pressure chamber must be equipped with a pressure limiting device. The output flow rate is fixed by the pump displacement per revolution.

**PUMP, VACUUM**: Creates a pressure that is lower than atmospheric pressure at its inlet when the shaft is rotated. The outlet port is normally connected to a higher pressure chamber or atmosphere.

**PUMP, VARIABLE DISPLACEMENT**: The output flow rate is fixed by the pump displacement per revolution but can be varied by the operator in a manual or servo controlled system, depending on the design.
QUICK-ACTION COUPLING: A device to join or separate fluid lines without the use of tools or special devices.

QUICK-ACTION COUPLING, BALL LOCKING TYPE: A quick-action coupling which is connected and disconnected by applying an axial force to move an external sleeve. This sleeve motion allows detent balls in the female half to engage or disengage into a groove in the mating male tip (nipple) half.

QUICK-ACTION COUPLING, DOUBLE SHUT OFF: A quick-action coupling with a shut-off valves in both mating halves.

QUICK-ACTION COUPLING, NON-VALVED: Other nomenclature “straight-through”. A quick-action coupling without a shut-off valve in either half.

QUICK-ACTION COUPLING, SINGLE SHUT OFF: A quick-action coupling with a shut-off valves in one half only.

QUICK-ACTION COUPLING, THREADED TYPE: A quick-action coupling that has threads on both mating halves and is connected or disconnected by the rotation of the sleeve on the body half with respect to the male tip.
**RACK-AND-PINION ACTUATOR:** A hydraulic rotary actuator that directs energy in a circular motion through the use of a toothed piston that turns a toothed gear.

**RAM:** A hydraulic mechanism that uses the kinetic energy of a flowing liquid to force a small amount of the liquid to a reservoir contained at a higher level.

**RAMP:** The rate of change of a specific output, e.g. the ramp of a pressure compensator.

**RAMP MODULE:** An electronic device that controls the rate of rise of a servo or proportional valve by using capacitors to limit the rate of voltage or current change to the servo or proportional valve.

**RATED FLOW:** The maximum flow assigned to a specific component as the maximum desired flow at which the device will function properly.

**RATED PRESSURE:** The maximum pressure at which a device is designed to operate.

**RATIO-OF-AREAS PRINCIPLE:** A physical law governing hydraulic intensifiers stating that a given pressure in a larger hydraulic cylinder can be intensified by the same pressure exerted in a smaller hydraulic cylinder. In general, the ratio of areas is inversely proportioned to the ratio of pressures, meaning the larger area has a smaller pressure and the smaller area has a larger pressure.

**RECIPROCATION / RECIPROCATING MOTION:** Movement characterized by repeatable back-and-forth action.
**REDCING VALVE:** An adjustable hydraulic control valve that regulates pressure in a particular zone of a hydraulic system. A valve that decreases the downstream pressure (at the valve outlet) in order to control the flow and therefore the outlet pressure to some pre-set level. Normally accomplished by balancing the outlet pressure against a precision spring.

**REGENERATIVE CIRCUIT:** A piping arrangement for a differential type cylinder in which discharge fluid from the rod end combines with pump delivery to be directed into the head end.

**REGULATOR:** A term used to describe a valve or device that limits the pressure in a passage.

**RELIEF VALVE:** A non-adjustable hydraulic control valve that regulates pressure in a hydraulic system. When a critical pressure is exceeded, the hydraulic relief valve releases or exhausts flow present at its inlet port to another chamber of lower pressure potential through its outlet port.

**REPLENISH:** The addition of fluid to maintain a full hydraulic system.

**RESERVOIR:** A container for the storage of liquid in a hydraulic system. The size of a reservoir will depend on the capacity of the hydraulic system, as well as what is required by the hydraulic system. The reservoir should contain a large volume of oil and should provide ample oil to the hydraulic pump.

**RESISTANCE:** In hydraulics, the condition created by an obstruction or restriction in the flow path.

**RESTRICTOR:** A device that reduces the cross-sectional flow area.

**RETURN LINE:** A passage that is used to route fluid to a reservoir or tank after use in another function.

**REVERSING VALVE:** A four-way directional valve used to reverse a double-action cylinder or reversible motor.
**REVOLUTIONS PER MINUTE (RPM) RPM:** A unit of measurement that indicates the number of revolutions a hydraulic pump component makes in one minute.

**REYN:** The standard unit of absolute viscosity in the English system. It is expressed in pounds-seconds per square inch.

**ROTARY ACTUATOR:** An actuator that directs force in a circular motion.

**ROTARY JOINT:** A connector or fitting that is equipped with seals or ‘o’ rings that allow it to rotate while passing one or more fluid paths through sealed internal passages.
SAE PORT: A threaded hole and stud system used to attach fittings to a hydraulic component or manifold. Sealed with an ‘o’-ring or gasket.

SAFETY FACTOR: The measure or ratio of burst pressure to rated pressure under specified static pressure and temperature conditions. See BURST PRESSURE.

SCRAPER RING: A synthetic or metal ring fitted to the shaft of a cylinder to remove particles from the shaft thus preventing them from entering the cylinder seal chamber.

SEAL: A device which prevents or controls the escape or passage of hydraulic fluid.

SEQUENCE: The order of a series of operations or movements. To divert flow to achieve a subsequent operation or movement.

SEQUENCE VALVE: A hydraulic control valve that allows hydraulic fluid to flow into another area of the hydraulic system once a critical pressure has been achieved. A valve that is normally closed or normally open and changes to the opposite state when pilot pressure is applied to its spring chamber at a preset pressure level. Normally used to initiate a secondary set of operations in a system, based on application of the pilot signal.

SERVO CONTROL: A type of electronic system used for finite, analogue control of a function.

SERVO VALVE: A hydraulic valve that modulates output as a function of an input command.
**SHANK:** The portion of a fitting inserted into the bore of a hose.

**SHEAR RATE:** The rate at which adjacent layers of fluid move with respect to each other, usually expressed as reciprocal seconds.

**SHEAR STRESS:** The frictional force overcome by sliding one layer of fluid along another, as in any fluid flow.

**SHEilded Retainer:** Other nomenclature “valve shield”. Protects valving from high velocity flow, preventing flow checking. Used primarily on agricultural interchange quick-action couplings.

**SHOCK LOAD:** Sudden extreme pressure increases within a hydraulic system.

**SHUTTLE VALVE:** A valve with three ports and a common ball or spool check valve. When flow is applied at either of the two inlet ports, the third or output port receives flow from the higher pressure inlet port.

**SILENCER:** A device for reducing gas flow noise. Noise is decreased by tuned resonant control of gas expansion.

**SILt:** Fine particles of debris. Usually found in vessels or chambers with limited, if any, circulation, e.g. the bottom of a reservoir or tank.

**SINGLE-ACTING CYLINDER:** A hydraulic actuator that directs energy in one direction.

**SINGLE-ACTING SLEEVE:** Other nomenclature “one-way sleeve”. Making a connection requires manually pushing the sleeve backward or pulling the body forward when mounted in a breakaway clamp, inserting the male tip, then allowing the sleeve to return to its original position. Allows pull-to-disconnect convenience when the coupling is mounted in a breakaway clamp. Sleeve Lock Prevents accidental disconnection. An arrangement which provides an additional lock which must be actuated prior to the retraction of the locking sleeve.

**SOCKET:** The external part of a hose fitting, often used to describe screw-together reusable fittings.
**SOLENOID**: A coil of (usually copper) metallic wire, wound around a bobbin to magnetize the bobbin and produce linear motion of a companion spool when electricity is applied.

**SPILLAGE**: Occurs upon disconnection of the quick-action coupling. This is the fluid trapped between the mating seal and the valve seal of the mating halves.

**SPOOL**: A term loosely applied to almost any moving cylindrically shaped part of a hydraulic component which moves to direct flow through the component.

**SPOOL VALVE**: A hydraulic valve that controls the direction of hydraulic fluid flow. A spool valve consists of cylindrical spools that alternately block and open channels in the hydraulic system.

**SPRING-LOADED ACCUMULATOR**: A hydraulic component used to store hydraulic fluid. The spring-loaded hydraulic accumulator increases and relieves pressure through the use of a spring-loaded piston.

**STABILITY**: The ability of a system to maintain control when subjected to severe outside disturbances.

**STATIC BEHAVIOUR**: How a control system, or an individual component, operates under fixed conditions.

**STATIC HEAD**: A measurement of pressure that exists when no fluid flow exists in a passage. The static head is normally expressed in feet of water.

**STRAINER**: A series of wire or fabric meshes bonded together by caps or perforated cylinders and fitted into hydraulic system passages to strain particles from fluid passed through the passage.

**STROKE**: The length of travel of a piston or plunger. To change the displacement of a variable displacement pump or motor.

**SUB-PLATE**: A metal base or auxiliary ported plate for mounting hydraulic components.
**SUCTION LINE:** A passage that leads from a reservoir or tank to the inlet port of a pump.

**SUMP:** A reservoir.

**SUPERCHARGE:** To replenish a hydraulic system above atmospheric pressure.

**SURFACTANT:** Surface-active agent that reduces inter-facial tension of a liquid.

**SURGE FLOW / PRESSURE:** A transient, short-term rise of flow or pressure over the normal expected working pressure.

**SWASH PLATE:** A flat, angled component of a hydraulic piston pump that moves the pistons when rotated.

**SWITCH:** A digital device which closes or opens a discrete set of contacts at a pre-set condition.

**SWIVEL JOINT:** A connector or fitting with seals or o-rings that allow partial rotation while passing a fluid path through a sealed internal passage.

**SYNTHETIC FLUID:** A hydraulic oil (fluid) made from a synthetic base and manufactured to specified characteristics. A synthetic fluid will not normally combust if heated to a specific temperature.

**SYSTEM PRESSURE:** See operating pressure.
TANDEM-CENTRE VALVES: Using tandem centre valves when in a neutral position bypasses the flow of hydraulic oil to the return line. This is used to hold the hydraulic cylinder/piston in position with no load on the pumps. With this system the hydraulic pump is running constantly to keep a ready supply of hydraulic oil, but as long as the hydraulic cylinder/piston is not in operation the hydraulic pump is working under no pressure or load. This system keeps wear and tear on the hydraulic pump down to a minimum.

TANK: See reservoir.

TEMPERATURE SWITCH: A digital device that opens or closes a switch when the internal temperature changes state to a pre-set temperature limit.

THERMAL BUILD-UP: Hydraulic pressure caused by expansion of the fluid due to heat from an external source such as sunlight.

THREE WAY: A term used to describe a valve that has three ports, normally a pressure (inlet) port, a normally closed (n.c.) port and a normally open (n.o.) port. Used to block or open a common flow passage.

THREE WAY VALVE, MANUALLY AND DIRECT OPERATED: A valve with a three way functional capability that may be manually activated to directly control the operating spool. Movement of the spool from extreme end to extreme end reverses the flow paths of the ports.

THREE WAY VALVE, PROPORTIONAL CONTROL AND DIRECT OPERATED: A hydraulic valve with a three-way functional capability that may be proportionately actuated by a solenoid to control the operating spool in infinite resolution. Movement of the spool from extreme end to extreme rod completely reverses the flow paths of the ports.
THREE WAY VALVE, SOLENOID AND DIRECT OPERATED: A hydraulic valve with a three way functional capability that may be solenoid activated to directly control the operating spool. Movement of the spool from extreme end to the other reverses the flow paths of the ports.

THREE WAY VALVE, SOLENOID AND PILOT OPERATED: A valve with three-way functional capability that may be solenoid activated to directly control the operating spool which then controls a secondary, larger spool. Movement of the secondary spool from extreme end to extreme end reverses the flow paths of ports.

THREE-WAY SPOOL VALVE: A spool valve with three ports.

TIE ROD: A metal rod used to prevent two or more components from separating. Normally used to restrain the end plates of cylinders against the cylinder tube.

TIP HALF: Other nomenclature “male tip”, “nipple”, “plug”, “male half”.

TORQUE: The force exerted in rotation. The measure of force applied to a lever arm. Normally expressed in pounds/feet (lb/ft) or pounds/inches (lb/in).

TORQUE CONVERTER: A rotary fluid coupling that is capable of multiplying torque.

TRANSUDER: An analogue device that produces a change in signal level during state changes. Normally used for high speed control systems.

TRAPPED PRESSURE: Pressurized fluid trapped behind closed valving in one of the quick-action coupling mating halves.

TUBE: A type of hydraulic fluid conductor that joins other hydraulic components usually in a non-linear fashion. Despite being stronger than pipe, tubing is easily bent. Tube is available in varied wall thickness and is measured by its outside diameter.

TURBINE: A rotary device that is powered by the force of a moving fluid against blades or vanes.
**TWO WAY**: A term used to describe a valve that has two ports, normally a pressure (inlet) port and an outlet port. Used to open or close a flow passage. May be configured as normally closed (n.c.) or normally open (n.o.).

**TWO WAY VALVE, SOLENOID AND DIRECT OPERATED**: A valve with two-way functionality that may be solenoid activated to directly control the operating spool. Movement of the spool from extreme end to extreme end opens or closed the flow paths of the ports.

**TWO WAY VALVE, SOLENOID AND PILOT OPERATED**: A valve with a two-way functional capability that may be solenoid activated to directly control the operating spool which then controls a secondary, larger spool. Movement of the secondary spool from extreme end to extreme end opens or closes the flow paths of the ports.

**TWO WAY VALVE, MANUALLY AND DIRECT OPERATED**: A valve with two-way functionality that may be manually activated to directly control the operating spool. Movement of the spool from extreme end to extreme end opens or closed the flow paths of the ports.
UNBALANCED VANE PUMP: A hydraulic pump that consists of a rotor mounted off-centre in a circular cavity. As the rotor spins, vanes trap and move hydraulic fluid.

UNDERLAP: The position of a spool and body in a servo valve or other spool valve wherein the spool is displaced a specified amount (the underlap) to expose two adjacent cavities to each other.

UNLOAD: To release flow (usually directly to the reservoir), to prevent pressure being imposed on the system or portion of the system.

UNLOADING VALVE: A valve that is normally closed and opens from a separate fluid source on rising pressure that is balanced against a precision spring. Unloading valves are installed in hydraulic systems using accumulators. The function of this hydraulic valve is to “unload” the pump of pressure until such time as a device on the hydraulic system, such as a hydraulic cylinder, actually begins operation. In this way, the hydraulic pump is allowed to operate without load (pressure) until it is needed. The unloading valve is not intended to replace the pressure relief valve. In fact, the pressure setting of the unloading valve is much lower than the setting on the pressure relief valve.
VACUUM: The state of negative pressure. Pressure less than atmospheric pressure. A hydraulic pump works by creating a vacuum in the closed hydraulic system.

VACUUM GAUGE: A visual indicator of pressure that is set for 'zero' psi at atmospheric pressure and includes a dial which will continue to indicate the level of pressure below atmospheric pressure.

VALVE: A device used in a fluid power system which is used to control fluid flow rate, direction, or pressure.

VALVE, CLOSED CENTRE TYPE: Has the inlet port blocked from the outlet and works in neutral.

VALVE, DIRECTIONAL CONTROL: A valve whose primary function is to direct or prevent flow through selected passages.

VALVE, FOUR-WAY: A 4 port valve (in, out and 2 work) used with double acting hydraulic cylinders, bi-directional hydraulic motors.

VALVE, FLOW CONTROL: A valve whose primary function is to control flow rate.

VALVE, FLOW DIVIDING: A valve which divides the flow from a single source into two or more branches.

VALVE, LOAD CHECK (LIFT CHECK): A device which prevents a load from dropping when a valve is shifted, until ample pressure and flow is available to hold or move the load.

VALVE, OPEN CENTRE: Has the inlet port connected to the outlet (tank) port in neutral.
**VALVE, PARALLEL TYPE:** A multiple spool valve in which the inlet oil is connected to all spools simultaneously. If more than one spool is actuated, the function requiring the lowest pressure will operate first.

**VALVE POSITION, DETENT:** A predetermined position maintained by a holding device acting on the flow-directing elements of a directional control valve.

**VALVE POSITION, NORMAL:** The valve position when signal or actuating force is not being applied.

**VALVE, POWER BEYOND (HIGH PRESSURE CARRYOVER):** A sleeve attachment which permits the oil flow from one valve (when in neutral) to be used by another valve downstream. Hence, a 3-spool valve could be connected to a 2-spool valve to create a 5-spool valve. The first valve takes priority and must have a separate outlet port to return oil from an activator back to the reservoir.

**VALVE RETAINER:** Provides the valve stop. Its precise location allows maximum flow when mating quick-action halves are connected.

**VALVE, SERIES PARALLEL TYPE:** A multiple spool valve which has all spools connected to the open centre passage in neutral. However, when actuated, the upstream valve takes full priority. The return oil is directed to downstream spools as in a series type valve.

**VALVE, THREE-WAY:** A 3 port valve (in, out, work) normally used with a single acting hydraulic cylinder or uni-directional motor.

**VALVE, TWO-WAY:** A 2 port valve with inlet and outlet ports.

**VALVE, TWO, THREE, FOUR POSITION:** The number of positions in which a hydraulic valve can be positioned.

**VALVE, SERIES TYPE:** A multiple spool valve in which the return oil from the first spool is directed to the inlet of the second spool (and from the second to the third, etc.). This type of valve permits simultaneous operation of two or more functions with the same oil flow. However, the total pressure requirements of all functions are accumulative.
VALVE, SEQUENCE: A valve whose primary function is to direct flow in a predetermined sequence.

VALVE SEAT: That area of the quick-action coupling that comes in contact with either the ball or poppet valve, allowing a positive sealing surface. Shape and surface varies with valve style.

VANE: A retractable spring-loaded mechanism that extends radially from the centre of a hydraulic pump rotor.

VANE ACTUATOR: A hydraulic rotary actuator that directs energy in a circular motion through the use of a pivoting mechanism.

VANE PUMP: A hydraulic pump that uses a flat protrusion to trap and move liquid through a hydraulic system.

VAPOR PRESSURE: The measure of pressure at which a specific fluid will change to a gas.

VARIABLE: A factor or condition which can be measured, altered or controlled, e.g: temperature, pressure, flow, liquid level, humidity, weight etc.

VARIABLE-DISPLACEMENT PUMP: A hydraulic pump that can be adjusted to increase or decreases the amount of liquid that is moved in one pump cycle.

VELOCITY: The speed of fluid flow through a hydraulic line. Expressed in feet per second (fps), inches per second (ips), or meters per second (mps). Also, the speed of a rotating component measure in resolutions per minute (rpm).

VELOCITY PRESSURE: Pressure in a hydraulic system caused by kinetic energy.

VENT: To remove trapped air from a component or permit the opening of a pressure control valve by opening its pilot port (vent connection) to atmospheric pressure. An air breathing device on a fluid reservoir.
VENT VALVE: A valve that may be manually opened to allow air or fluid or a combination of both to be exhausted into a lower pressure chamber or to the atmosphere.

VISCOSITY: A measure of internal friction or the hydraulic fluid's resistance to flow. As temperature increases, viscosity decreases.

VOLUME: The size of a space or chamber in cubic units. The term is also loosely applied to the output of a pump in gallons per minute.
WAFER VALVE: A two-way valve that may be opened or closed to block the flow of fluid in a passage. Normally manually operated, but may be automated, especially for larger sizes. Normally designed so that when open, the opening of the passage is only restricted by the thickness of the wafer. There will be some pressure loss.

WATER GLYCOL FLUID: A hydraulic fluid that is comprised of a mix of distilled or other pure water and glycol to form a fluid that has enough lubricity to function as a fluid power fluid, but is relatively fire-resistant, i.e. will not support combustion.

WATT’S LAW: States that when one amp. of current flow through a device with one volt voltage drop, one watt of power is dissipated in the form of heat (P = I x E). Find more in our technical reference section.

WIPER RING: A rubber or other synthetic seal that is fitted around a moving shaft to form a low pressure seal. Normally used to prevent fluid from entering the sealed volume.

WIRE REINFORCED: A hose containing wires to give added strength, increased dimensional stability, crush resistance.

WORK: The transfer of power from one state to another. The movement of weight over a specified distance.

WORKING PRESSURE: The maximum pressure to which a hose will be subjected, including momentary surges in pressure, which can occur during service.
Hydraulics today

Today, hydraulics can be found in almost all walks of life – as evidenced by the diverse range of businesses with whom we work.

Hydraulics Online has been involved with projects as diverse as underwater cable laying to rocket launches! Products and systems that we have sold can be found in construction equipment, emergency vehicles, mobility solutions, university projects and even fairground rides!

Some of our projects have been to restore and protect the ground-breaking hydraulic projects of the past – such as our work with Heritage Concorde to restore the hydraulic systems which power this spectacular aircraft’s iconic droop nose.
Some of the projects we work on push the boundaries of hydraulics – finding new applications for this versatile branch of science within the technologies of tomorrow. In 2017, we were lucky enough to work with a student team from the University of Edinburgh called HypED.

HypED developed a Hyperloop pod for entry into Elon Musk’s global competition to find a design for the pods which would run on his ground-breaking Hyperloop transport system.

Hyperloop is a new mode of transport in which pressurised capsules will move at very high speeds on an air cushion along pressurised tubes. The HypED team chose to use hydraulics in the braking system for their pod and turned to us to help.

HypED president, Adam Anyszewski said, ‘We had our idealistic design of how we wanted it to work, and then Hydraulics Online helped us take it from an idea on paper to an actual design that can be manufactured effectively. They have been very, very helpful because they had the knowledge of the available parts, the connections, all the safety requirements, and aspects of the design we weren’t aware of. Basically, they helped us to take it from concept to a working design that achieved the functionality in a safe and certified manner.’

The HypED team were one of just 24 teams who were invited to participate in the final of Space-X’s 2017 Hyperloop competition on a scale track in California. For all the team at Hydraulics Online, it was an incredibly exciting project to be involved with – it’s fantastic to see how this ancient technology still has an important role to play in innovative projects like Hyperloop that are redefining the future.
As a science and engineering discipline, hydraulics does come with its own vocabulary – but this needn’t be frightening, even for a newcomer to the subject.

This glossary has been designed to cover some of the core terms and parts you will encounter when working with hydraulic systems.

If you need further clarification about any of the terms contained within this glossary when working on hydraulic system design, or when specifying or ordering hydraulic parts or equipment, we recommend that you contact our helpful technical team who are always on hand to answer your questions.

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