

**NOMENCLATURE, AIRCRAFT HYDRAULIC AND PNEUMATIC SYSTEMS**Issued 10-1-49  
Revised 12-15-56

1. **INTRODUCTION:** The purpose of this nomenclature guide is to promote more uniform and specific nomenclature throughout the airframe industry. Terms listed and defined are applicable to parts, aspects and characteristics of aircraft hydraulic and pneumatic fluid power systems and their components.

Usage of nomenclature, insofar as practicable, which conforms to definitions contained herein will serve to promote clarity and avoid misunderstanding. Some recommendations are made for restriction of terms which have become somewhat ambiguous or are considered less desirable than recommended nomenclature. Use of terms not defined herein is recommended only where those contained herein may not be applicable or adequate.

No recommendation is intended as to restriction of use of other vocabulary, as appropriate, in descriptive literature or textbooks.

Definitions are arranged alphabetically under sections as follows:

2. BASIC DEFINITIONS AND STANDARD TERMINOLOGY
3. VALVE DESCRIPTION AND ATTRIBUTES
4. STANDARD MARKINGS

2. **BASIC DEFINITIONS AND STANDARD TERMINOLOGY:**

**ACCUMULATOR:** A closed container for pressure storage of fluid energy.

**Accumulator, Compensating:** An accumulator which, in addition to its high pressure volume, incorporates low pressure volumetric capacity which will accommodate a like volume of fluid to that discharged from the high pressure chamber. The sum of the volumes of the high and low pressure chambers remains constant.

**Accumulator, Cylindrical:** An accumulator in which the fluid is separated from the compressible medium by means of a piston operating in a cylindrical container.

**Accumulator, Flexible Separator:** An accumulator in which the fluid is separated from the compressible medium by means of a flexible bladder or diaphragm.

**Accumulator, Hydraulic:** An accumulator in which the stored operating medium is hydraulic fluid.

**Accumulator, Hydro-Pneumatic:** An accumulator in which the stored operating medium is hydraulic fluid, pressurized by means of compressed gas.

**ACTUATOR:** A device for converting fluid energy into mechanical energy.

**Actuator, Hydro-Mechanical:** A hydraulically actuated mechanism which incorporates mechanical linkage for modification of output.

**Actuator, Rotary:** A device for converting fluid energy into mechanical energy in the form of rotary motion which is limited in angular travel, as distinguished from a motor which can produce continual rotation.

Section 7C of the SAE Technical Board rules provides that: "All technical reports, including those approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

-2-

Actuator, Servo: An integral servo valve and hydraulic actuator for use in a control system.

BARREL: A cylindrical component of an actuating cylinder, accumulator, etc. in which a piston or sealed separator moves.

CHOKE: A flow restriction in which the length of the reduced area passage is of sufficient magnitude that fluid viscosity becomes of major importance in determining pressure drop.

CLOSED CENTER: In a hydraulic system, when no service is actuated the system is closed to flow, as distinguished from an open center system. A closed center system may utilize a continuous pressure supply, as with a variable displacement pump, or an intermittent pressure supply by means of unloader valve, motor driven pump or pump by-passing provisions.

CONNECTOR: Not recommended, except to describe provision for an electrical connection; see FITTING.

CYLINDER, ACTUATING: (Sometimes called "Jack", "Ram" or "Strut") - A linear motion device in which the thrust or force is proportional to the effective cross-sectional area and the pressure differential.

Cylinder, Balanced: An actuating cylinder in which the effective thrust producing area is equal in both directions.

Cylinder, Double Acting: A cylinder with provisions for applying fluid pressure at each end, and thus capable of exerting a force in either direction.

Cylinder, Fixed End: A cylinder which is held in a rigid position.

Cylinder, Flight Control: An actuating cylinder designed for in flight actuation of aerodynamic surfaces.

Cylinder, Rotating End: A cylinder mounted to permit limited rotary movement about a fixed point.

Cylinder, Single Acting: A cylinder in which fluid pressure is introduced in one end so that fluid force is exerted in one direction only. Gravity, spring forces, or other means are used to accomplish the return stroke.

Cylinder, Swivel End: A cylinder with one or both ends provided with a joint which not only allows oscillation of the cylinder but which also incorporates stationary fluid connections.

Cylinder, Transfer: A device for transmitting fluid pressure from one circuit to another without intermixture of fluid between the circuits.

DASHPOT: A snubbing device within a fluid operated unit which operates at the extremity of the stroke by displacing operating fluid through a restricted passage, as sometimes used in an actuating cylinder.

FILTER: A device serving to remove solid particles from a flowing fluid by passing it through a porous element.

-3-

Filter, Line Type: A filter designed for installation in a fluid line and having a case capable of withstanding the operating pressure of the line, usually system pressure.

Filter, Reservoir Type: A filter to be housed within the shell of a reservoir for purification of the return flow to the reservoir, usually applied to the filter element alone.

Filter, Vent Type: A filter for installation in an atmospheric vent line.

FITTING: Not recommended; except in relation to fluid passage attaching devices of the nature used external to operating components; see FITTING, TUBE.

Fitting, Tube: A self-contained detachable device including a fluid passage for attaching or connecting fluid carrying lines.

FLIGHT CONTROL COMPONENT: (Actuator, Cylinder, Valve, etc.) - A component used in a system controlling in flight actuation of aerodynamic surfaces.

FLOW: Rate of fluid movement, usually expressed in GPM.

Flow, Calibrated: In a unit which controls or limits rate or quantity of flow, that rate or quantity of flow for which the unit is calibrated or adjusted. When calibration is related to specific conditions, the condition of calibration must be stated. Example, a restrictor may be calibrated to pass 1 GPM at 1500 psi pressure differential.

Flow Proportioner: A device which automatically maintains a relatively constant ratio between the portions of dividing or combining flow passing through it regardless of differences in pressure between the portions. A flow proportioner may operate only with combining flow, dividing flow or with both.

Flow Divider: A flow proportioner which operates only with dividing flow.

Flow Equalizer: A flow proportioner in which the portions are equal.

Flow, Rated: The nominal maximum operating flow, applicable where control of that flow rate is not basic. Example, a one way restrictor valve with a calibrated flow of 1 GPM at 1500 psi pressure differential may have a rated flow of 3.5 GPM in the reverse or free flow direction.

FLUID, OPERATING: The medium or fluid to be used in a unit or system.

FOUR-WAY: Not recommended; see VALVE, DIRECTIONAL CONTROL.

FUSE: A device which automatically shuts off flow in a line in event of downstream system rupture.

Fuse, Quantity Measuring: A fuse which closes when more than a predetermined quantity of fluid has passed through it.

Fuse, Return Flow: A fuse which closes both pressure and return lines when the ratio between the flows deviates beyond a predetermined value.

-4-

GASKET: The flexible sealing element in a stationary or static fluid seal.

GLAND: The cavity or space provided for the accommodation and operation of an elastic packing or gasket for sealing of a fluid vessel or compartment.

INTENSIFIER: A device which converts an input pressure to a higher output pressure which is proportional to its input pressure.

LEAKAGE: Flow through a passage which is in a nominally closed position or at a location which normally should permit no flow, usually of relatively small magnitude.

LINE: A tube, pipe or hose which acts as a conductor of fluid.

Line, Bleed: A line, selectively open to overboard, which serves only for removing foreign substances from a system or unit, as for removal of entrapped air from a hydraulic circuit.

Line, Drain: A line returning leakage fluid independently to reservoir or return circuit. Also, a line selectively open to overboard for removing fluid from the system.

Line, Pilot: A line which acts as a conductor of control actuating fluid.

Line, Pressure: A line which conducts fluid from the pressure source to a control unit or units.

Line, Return: A line which conducts working fluid back to the reservoir.

Line, Supply: A line which conducts a fluid supply, as from a reservoir to a pump.

Line, Vent: A line which is continuously open to atmosphere.

MOTOR, HYDRAULIC: A device for converting liquid fluid energy into mechanical energy in the form of continual rotary motion of a mechanical member.

ONE-WAY: Not recommended; except as a modifier of such items as restrictor valves.

OPEN CENTER: In a hydraulic system, when no service is actuated the system is open to flow, completing the circuit through the control units back to reservoir. An open center system will normally employ a fixed displacement pump.

ORIFICE: A short fluid passage which produces a substantial reduction in flow by virtue of its cross-sectional area. A true orifice has zero length.

PACKING: The flexible sealing element in a fluid seal which is subject to sliding motion.

PATTERN, FLOW: The paths of fluid flow connecting various ports in a given valve position.

PISTON: A cylindrical part which slides in a cylinder or barrel and serves to transfer force to or from the enclosed fluid.

-5-

PISTON ROD: A coaxial column or rod, attached to or integral with a piston, which serves to transmit force between the piston and another mechanical member.

PORT: An opening at a surface of a component incorporating provisions for attachment of a fluid carrying passage, line, fitting or removable plug.

POSITION, VALVE: The position of the valve mechanism which determines the flow pattern.

PRESSURE: Normally used as a modifier to designate a portion of a system or unit which is normally exposed to system pressure. The term "Pressure" is considered to mean gage pressure, as defined below, except where otherwise specified.

Pressure, Absolute: True pressure, as related to a complete vacuum.

Pressure, Burst: The test pressure which a component or system must withstand without rupture.

Pressure Drop: The reduction in fluid pressure due to flow. When applied to a fluid control unit, pressure drop is measured between given ports of the unit at a given flow and does not include the loss in fittings which are installed in ports. (Normally, the value applicable to a complete flow pattern at rated flow, unless otherwise stated.)

Pressure, Gage: Pressure as related to ambient atmospheric pressure.

Pressure, Minimum Operating: That pressure below which a mechanism may not operate (as in a pilot operated valve, which requires a certain minimum pressure for operation).

Pressure, Output: In a pressure control device, such as a pressure reducer or power brake valve, the pressure which will be produced at the outlet port. In a pressure modulating unit, as in a brake valve, the output pressure should be specified as maximum or the range stated.

Pressure, Proof: The pressure which a component must withstand as a production inspection test without damage, normally related to rated pressure.

Pressure, Rated: The nominal maximum input or operating pressure.

Pressure, Reseat: In a valve which closes itself against pressure, as in a check valve or relief valve, that pressure at which the valve will close itself so that flow rate recedes to a certain specified leakage.

Pressure, Surge: The maximum magnitude of a transient pressure rise.

PUMP: A device for converting mechanical energy into fluid energy.

Pump, Fixed Displacement: A pump whose delivery at a fixed RPM and output pressure cannot be varied, and which delivers a relatively constant volume of fluid per cycle.



-6-

Pump, Variable Delivery: A pump whose delivery can be controlled independently of RPM by varying the output volume per cycle.

Pump, Mechanical Volume Control: A variable delivery pump whose output per cycle is controlled by external mechanical means.

Pump, Pilot Control: A variable delivery pump whose output is controlled by the pressure at a control port.

Pump, Pressure Volume Control: A variable delivery pump whose output is controlled by its discharge pressure.

RAM: Not recommended; see PISTON.

RESERVOIR: A container for operating fluid supply.

Reservoir, Pneumatic: A pressure storage chamber in which pneumatic pressure energy may be accumulated and from which it may be withdrawn.

SCHEMATIC: A flow diagram of a fluid unit or system of units including all interconnections.

SEEPAGE: Not recommended; see LEAKAGE.

SEPARATOR: The movable or flexible member in a fluid container, such as an accumulator or reservoir, the function of which is to prevent intermixture of fluids, such as air and hydraulic fluid.

SERVOCYLINDER: A servo actuator having such an integral follow-up mechanism that its final output may be made a function of the input signal to its control valve.

SERVO SYSTEM: A control system in which power operated or assisted control is maintained through feedback from an output sensing mechanism in such a manner that the resulting position or force is a function of input control signal.

SETTING: In an adjustable or calibrated unit (such as a relief valve, pressure switch or flow control device), operating characteristics which result from an adjustment or setting.

SLAVE OPERATED: Pressure operated, so as to position in a manner equivalent to rigid mechanical inter-lock, by means of a master or control unit.

SLEEVE: In general, a hollow cylindrical member used to line a housing to impart different metallurgical properties to the rubbing surface than those inherent in the housing. In a slide valve, the hollow cylindrical member which directly affects the flow pattern through its relative position to an internal slide or spool.

SLIDE: In a slide valve, the moving member which directly affects the flow pattern, usually cylindrical and internal to a sleeve, see also SPOOL.

SPOOL: The internal member of cylindrical slide valve which directly affects the flow pattern through its relative position to a surrounding sleeve.

-7-

SURGE: A transient rise of fluid pressure in a system, usually of extremely short duration.

SWITCH, PRESSURE: A device which opens or closes an electrical circuit at a given fluid pressure.

SWIVEL: A rotatable fluid connection.

Swivel Fitting: A fitting, directionally adjustable without lateral movement, usually retained by a flange, and not free to rotate in service.

Swivel Joint: A fluid connection which is free to rotate in service, usually under pressure.

TANK: Not recommended; see RESERVOIR.

THREE-WAY: Not recommended; see VALVE, SELECTOR and VALVE DESCRIPTION AND ATTRIBUTES.

TORQUE, VALVE: The maximum actuating moment required at a given fluid pressure (usually rated pressure) to move the valve mechanism from one position to another.

TWO-WAY: Not recommended; except as modifier in such items as VALVE, RESTRICTOR.

VALVE: A device for directing, regulating or stopping flow or regulating pressure in a fluid system, usually through the operation of one or more movable members.

Note: Valve configuration and function are highly varied, some operating units being combinations of more than one valve and sometimes incorporating features of more than one type of unit. Description of a given valve will often require use of a combination of terms defining basic type(s), function and method of actuation. Listing of valves is grouped by functional type, AUTOMATIC, SEMI-AUTOMATIC, CONTROL. See also SECTION 3, VALVE DESCRIPTION AND ATTRIBUTES and SECTION 4, STANDARD MARKINGS.

VALVE, AUTOMATIC: A valve in which operation is controlled entirely by action of fluid which passes through it.

Valve, Blowoff: A valve which releases fluid to overboard when its setting is exceeded.

Valve, Check: A valve which allows free flow of fluid in one direction only and prevents flow in the opposite direction.

Valve, Flow Regulating (Flow Regulator): A valve which limits flow in a line to a predetermined value, irrespective of variation in pressure differential caused by back-pressure or working against load.

Valve, Pressure Reducing (Pressure Reducer): A valve which reduces any inlet pressure to a pre-determined maximum outlet pressure regardless of flow or inlet pressure.

-8-

Valve, Pressure Regulating (Unloader Valve): A valve which directs flow from pump port to system port until pressure at the system port, or a control port, reaches cut-out pressure. The valve then opens and diverts flow from pump port to return port until system pressure recedes to cut-in pressure.

Valve, Pressure Relief: A valve which limits maximum pressure in a circuit by releasing excess to return on the basis of differential pressure between pressure and return ports. A pressure relief valve must be able to accommodate full rated flow of the line size for which it is constructed.

Valve, Priority: A valve whose relief pressure is independent of downstream pressure and which opens and permits free flow when both upstream and downstream pressures exceed its setting. A priority valve also permits free reverse flow. Normal use of a priority valve is to provide pressure priority to one sub-circuit over another.

Valve, Relief: A valve automatically releasing pressure higher than its setting; see VALVE, PRESSURE RELIEF and VALVE, THERMAL RELIEF.

Valve, Restrictor: A valve whose function is to produce a relatively high pressure drop in a fluid circuit by means of a reduced flow area or orifice.

Valve, Restrictor, Adjustable: A restrictor valve having provisions for external adjustment.

Valve, Restrictor, One-Way (Restrictor Check Valve): A restrictor valve which permits free flow in the reverse direction.

Valve, Restrictor, Two-Way: A restrictor valve which restricts flow in either direction, usually through a fixed orifice.

Valve, Shuttle: A 3-port valve with one outlet and two inlet ports which automatically connects the "Outlet" port to the "Inlet" port having the higher pressure and blocks the "Inlet" port having the lower pressure.

Valve, Surge Damping (Surge Damper): A valve whose function is to reduce surge pressures during intermittent flow.

Valve, Thermal Relief: A valve designed to bypass only the additional volume caused by thermal expansion of the fluid, i.e., no appreciable flow required.

VALVE, SEMI-AUTOMATIC: A valve incorporating automatic operation subject to external control.

Valve, Brake: A valve for control of wheel brake actuating pressure. A brake valve is usually a mechanically or pressure operated variable pressure reducing valve with provision for opening orake pressure outlet port to "Return" when outlet pressure exceeds the pressure setting at the moment.

Valve, Controllable Check: A two position manually operated valve which functions as a conventional check valve in one position, but permits free flow in either direction when actuated to the other operating position.

Valve, Lock: A pressure operated controllable check valve, sometimes known as a "Counter Balance Valve" or "Ratchet Valve".



-9-

VALVE, CONTROL: A valve in which flow pattern or rate is controlled by external means.

Valve, Directional Control: A selector valve having four working ports; "Pressure", "Return" and two "Cylinder" or "Load" ports; and a reversible flow pattern.

Valve, Dump: A two position control valve having two or more ports with all ports blocked in "Off" position and all ports interconnected in "On" position.

Valve, Selector: A control valve having more than one flow pattern. A selector valve will have a minimum of three working ports.

Valve, Servo: A directional control valve which infinitely modulates flow or pressure as a function of its input signal.

Valve, Servo, Electro-Hydraulic: A hydraulic servo valve, the operation of which is controlled by an electrical input signal.

Valve, Shutoff: A two port, two position valve which opens or closes a fluid passage. A shutoff valve may be reversible, operating equally well with pressure at either port or non-reversible, performing satisfactorily only with pressure entering at one of its ports.

### 3. VALVE DESCRIPTION AND ATTRIBUTES:

CLOSED CENTER: No position allows flow from "Pressure" to "Return" port; "Pressure" port blocked in "Off" position.

CLOSED NEUTRAL: In a directional control valve, "Cylinder" or "Load" ports are blocked in "Neutral" or "Off" position.

INTERFLOW: Flow between ports of a valve at intermediate positions (between established positions) which is not in accordance with nominal or intended flow pattern.

NORMALLY CLOSED: In a valve which repositions itself to a given or normal position when external actuation is removed, "Pressure" port is blocked when valve is deactivated or deenergized.

NORMALLY OPEN: In a valve which repositions itself to a given or normal position when external actuation is removed, "Pressure" port is connected to an outlet port when valve is deactivated or deenergized.

NUMBER OF PORTS: The number of working ports will be designated. Additional ports such as control or drain ports should be designated separately.

NUMBER OF POSITIONS: The number of established operating positions, including "Off" position. Not normally applied to servo valves.

OPEN CENTER: A valve designed for use in an open center system. It will have an "Off" position in which the pressure supply is passed through the valve to "Return" or to other parts of the system.