

**ADVANCE HYDRAULICS TECHNOLOGIES AND THEIR MODERN  
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**ABSTRACT:** Advance hydraulics provides excellent products and services for the customers in the automotive, construction and manufacturing industries. This paper discusses the various components from the field of electro hydraulic proportional and control techniques, as well as to provide information concerning the application engineering concerned together with a certain amount of theoretical basics. In order to keep the explanations to a generally understandable level, proportional valves and closed-loop proportional valves are dealt with together in same paper in order to make it easier to differentiate between these two closely related techniques.

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**Keyword:** proportional valve, programmable logic control (PLC), close loop proportional valves, linear amplifier & torque amplifier technique and mobile hydraulics.

**I. INTRODUCTION**

In the advance hydraulics, Hydraulics has always have closely interlink with electrical and electronics control techniques. And to an ever increasing degree, combined system is now also being applied in the area of mobile hydraulics. two techniques deals separately during the design and project engineering stages. The combination of these two systems is regarded as a single unit during trouble shooting and repair. The hydraulic proportional valves are currently used in a wide range of application involving high proportional control system.

The two techniques are becoming more and more closely interlinked with each other particularly where electro-hydraulic proportional and closed loop control techniques are concerned. For this reason it is advisable for not only the hydraulic engineers but also the electrical and electronics engineers who are active in this sector to concern them with the particular "partner technology".

**II. ADVANCE HYDRAULICS TECHNOLOGY**

The technologies used in the advanced hydraulic systems are

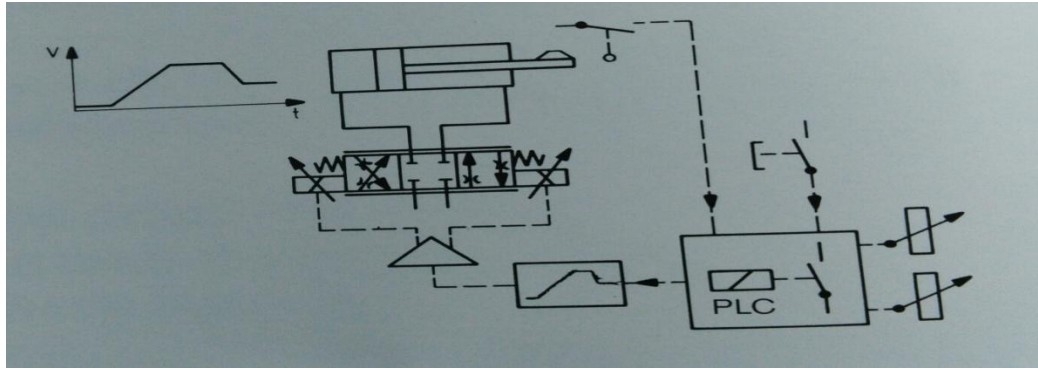
1. Electro-hydraulics systems
2. Proportional valve techniques
3. Closed-loop proportional valve techniques
4. Linear amplifiers and torque amplifiers
5. Continuously operating valve techniques

**2.1 Electro-hydraulics systems:**

These are systems using mechanically adjustable on-off valves and flow-control valves together with pressure switches and limit switches etc. the electronic signal processing uses relay techniques or programmable control(PLC).

Normally in conventional electro-hydraulics systems changes of direction and changes in hydraulic quantities of pressure and volumetric flow are abrupt when they are triggered by electric signals. This results in switching shocks and pressure peaks which often lead to premature wear. The control of transient functions such as acceleration and transient functions such as acceleration and deceleration for instance is usually very complicated and necessitates the use of mechanical cum tacks switching valves are not always able to compared with the demands made by modern-day electro-hydraulic drive techniques.

There is a strict delineation between the two mediums hydraulic engineering and electrical engineering. This is bridged during project-engineering work commissioning and troubleshooting using circuit diagrams and function charts.



**Figure 1. Electro-hydraulic system with PLC control**

## **2.2 Proportional valve techniques:**

This is defined as analog control engineering using proportional valves and the appropriate electronic amplifiers. The set point values for the pressure, volumetric flow and direction are inputted by analog electrical signals (voltages). Transient functions are controlled by means of ramp generators. The processed set point values are called in by the machine controller which is now a day usually in the form of a programmable logic controller (PLC).

Using this technology, highly sophisticated problems solutions can be implemented, and above all acceleration and deceleration can be optimally controlled.

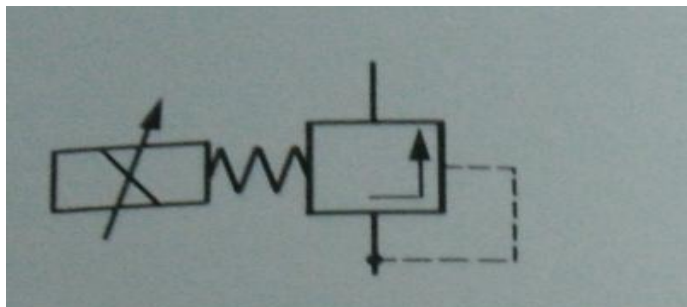
Proportional valves normally operate as control elements in the open control loop. The open loop action is the essential characteristics of these elements i.e, no feedback and no corrective measures taken place between the individual steps and the individual components. The connection between the output signal and the input signal is given by the transfer response of the individual elements in the chain. If errors occurs in this chain these automatically becomes part of the output signal. Such errors occur due to leakage currents, compressibility of the medium, friction zero-point displacement linearly errors, and wear. The most important disturbance affecting speed or velocity is the variation of load on the motor and on the cylinder. This is in part compensated for by using pressure compensators to control the pressure drop at the throttle points.

### **2.2.1 IMPORTANT COMPONENTS OF PROPORTIONAL VALVE THECNQUES**

The important components of proportional valve techniques are

#### ➤ **Proportional Pressure Valves:**

basically speaking, these are electrically adjustable pressure control valves in which the manual adjusting device has been replaced by an electrically positioning drive, the so called proportional solenoid.

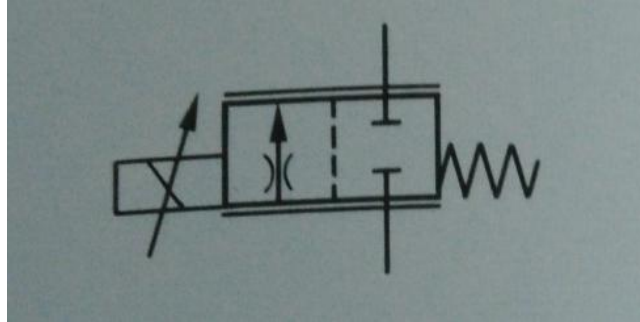


**Figure 2. Proportional Pressure Valve**

#### ➤ **Proportional Throttle Valves:**

these are electrically adjustable throttle valves designed on the basis of sliding spool valves with precision metering notches. The classical symbol is usually replaced by a symbol which has been derived from that

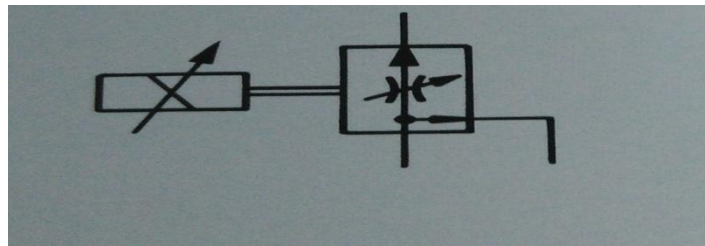
for a directional control valve. The double lines at top and bottom of the symbol indicate the continuously variable transition characteristics.



**Figure 3. Proportional Throttle Valve**

➤ **Proportional Flow Control Valves**

Pressure compensated flow control valves are comprised of proportional throttle valves and directional control valves in combination which pressure compensators.



**Figure 4. Proportional Flow Control Valve**

### 2.2.2 Classification OF Proportional Valves

Proportional valves classified into 2 types

- a. Proportional valves without position control
- b. Proportional valves without position control

**a. Proportional valves without position control:**

Proportional valves links between the electric and the hydraulics. All the hydraulic position converted into electrical current I.

**b. Proportional valves with position control:**

In order to increase the adjusting accuracy, while at the sometime reducing the influence of the disturbances and improving the hysteresis, it has proved expedient to monitor the solenoid armature position and use this as the actual valve in a closed control loop so that system deviations can be continuously corrected.

### 2.3 Closed-loop proportional valves techniques:

This is defined as control techniques using closed-loop proportional valves, continuously operating sensors for actual valves acquisition and electronic valves amplifiers.

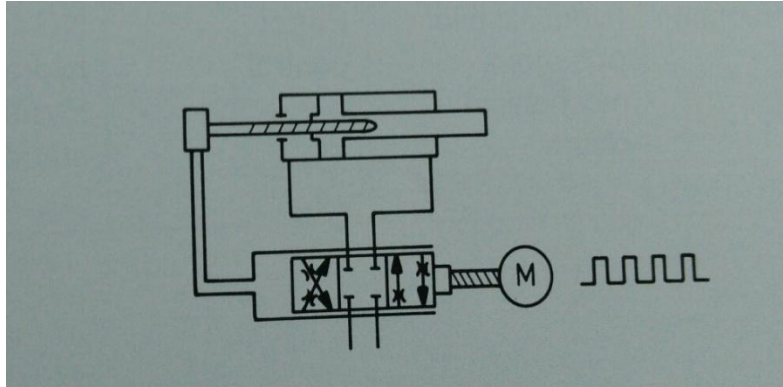
The electrical machine control is responsible for the program sequence (set point configuration). In the control loop the output signal is permanently monitored by measuring devices and compared with the controlling the system deviation

(error) resulting from this set point/actual valve comparison is converted in to the manipulated variable which is used by the control element to continuously correct the error.

The demand which are made upon the control element in the closed control loop, that is upon the closed-loop proportional valve (servo valve), usually be fulfilled by a conventional proportional valve.

#### **2.4 Linear amplifiers and torque amplifiers technique:**

Linear and torque amplifiers are a special form of closed-loop positioning drives. In this case the set point valve is inputted by stepping motor and the actual valve is fed mechanically to the control element a mechanical follow-up valve, through a threaded spindle.



*Figure 5. Linear Amplifiers And Torque Amplifiers Technique*

#### **2.5 Electro-hydraulic continuously operating valve techniques:**

The term “electro-hydraulic continuously operating valves” applies to device which convert a changing electrical input signal into a continuously variable hydraulics output signals this makes it a generic term which applies to both conventional proportional valves, as well as the closed-loop proportion valves and servo valves.

When considering the designs of the various types the fact that the different manufactures apply widely varying constructions makes it practically impossible to make a strict distinction between them. The steady-state and dynamic parameters according to which the valves are allocated to their particular fields of applications are of decisive importance when distinguishing between them.

This means that for the first time a substitute is now available for the expensive and highly precision, but at the same time very expensive and highly sensitive servo valves which for decades have held a dominant position at the front of electro-hydraulic control system engineering.

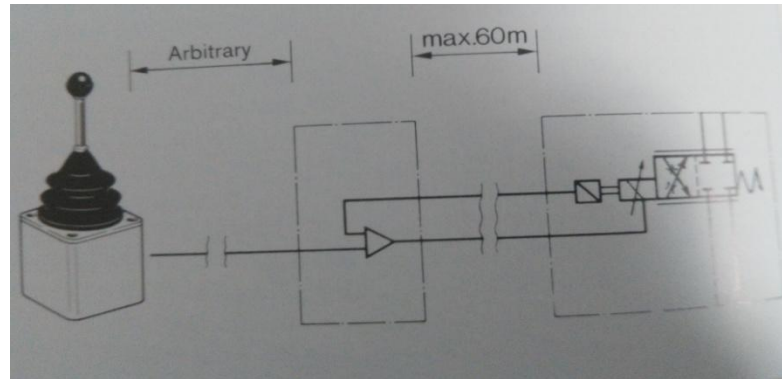
### **III. ADVANTAGES**

1. Fast and accurate position control can be achieved.
2. Large load capacity with almost high accuracy and precision.
3. Smooth movement can be controlled by proportional valves techniques
4. Automatic lubricating provision to reduce to wear
5. Division and distribution of hydraulic force are easily performed
6. Limiting and balancing of hydraulic force are easily performed
7. Ability to perform repetitive, routine tasks.
8. Ability to handle highly complex operations.

### **IV APPLICATIONS**

1. Remote Controls:  
There are infinitely variable electrically remote-controlled versions of the various proportional valves available in the form of pressure, throttle, or directional control valves. The distance between the proportional amplifier and the valve is

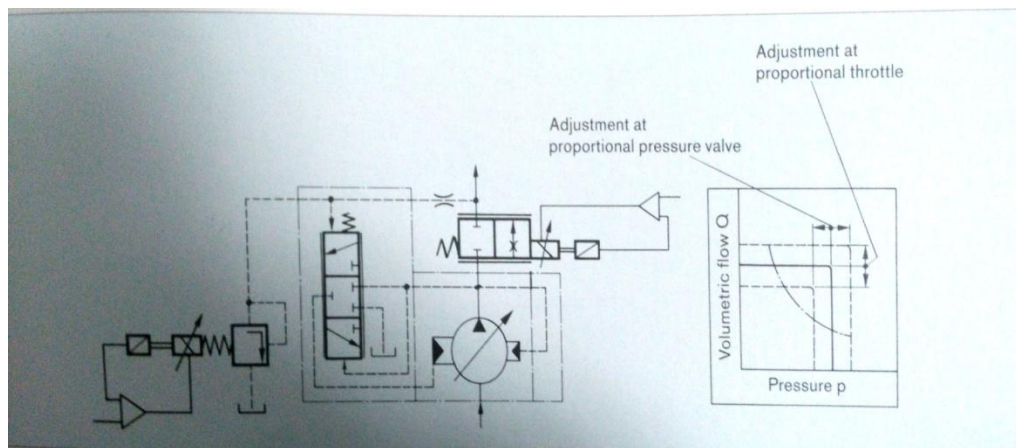
limited to app 60 mts (actual valve cable).whereas the distance between the proportional amplifier is practically unlimited “joy-stick”.



**Figure 6. Remote Control Using Closed Loop Proportional Valve**

2. Control Of Variable Displacement Pump:

Using proportional valves, it is possible to implement the electrical control of both variable-displacement pumps equipped with flow controllers, as well as of combined flow control/pressure control device. this enables every point in the p/q diagram to be converted and the characteristics curves of the power controller for instance can be electrically preprogrammed.

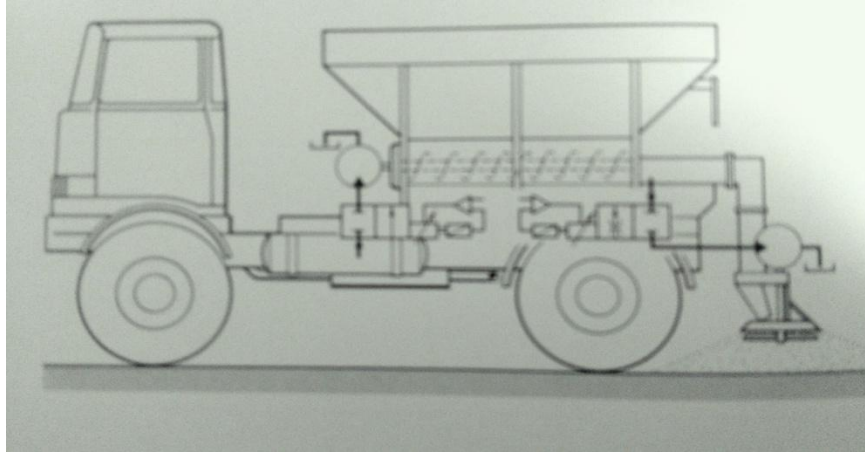


**Figure 7. Control Of Variable Displacement Pump**

3. Salt-spreading vehicle:

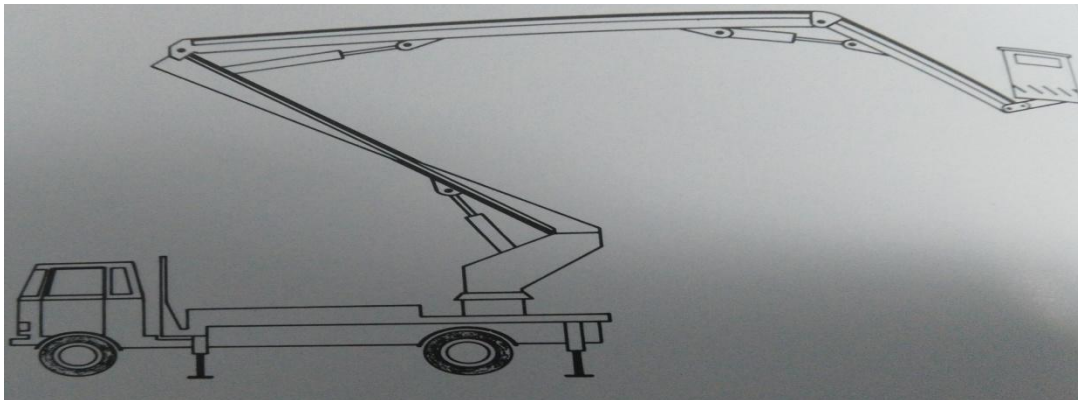
Spreading vehicle is a good example of the proportional valves techniques.





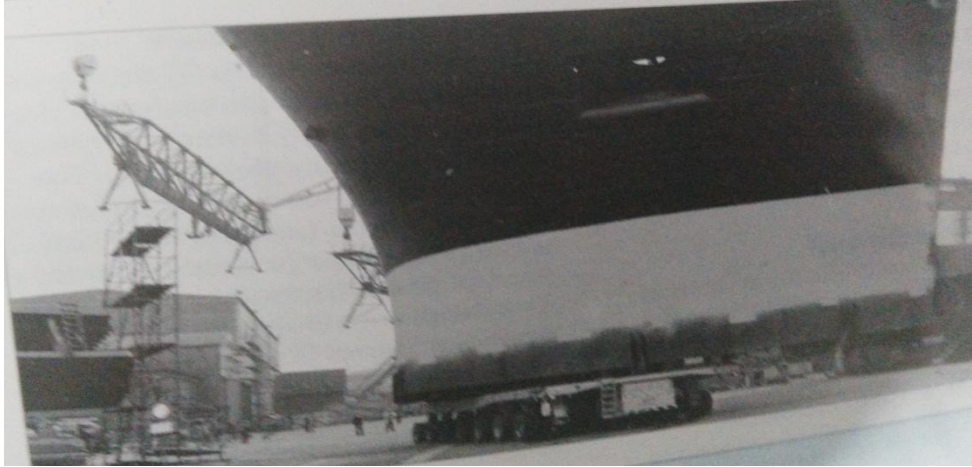
**Figure 8. Salt-Spreading Vehicle**

4. Lift platform: switched directional control valves are used to control the hydraulic motors and the extension or retraction of the individual cylinders. Their speeds are controlled through proportional flow control valves.



**Figure 9. Weight Lifting Machine**

5. Injection molding machine:  
Various advance hydraulic equipment are used in the injection molding system some of them are volumetric flow is controlled by the metering notch. Closed loop proportional valve are used in this injection molding system.
6. Molding pressure control: in the case of particularly strongest requirements on the work piece precision it is possible to control the material pressure at the center of the mold.
7. Machine tool: The linear motions of the feed drive are best performed electro-hydraulically.
8. Thin sheet straightening plate: A continuous sheet steel strip runs through the straightening plant.
9. Hydrostatic blower drive:  
The hydrostatic blower drive is a practical solution for the optimum cooling of the large size internal combustion machinery ship etc. in which proportional pressure control valve by means of a bypass throttle.
10. Steering Heavy-load transporters



**Figure 10. Steering Heavy-Load Transport**

11. Hitch control for agriculture tractors.
12. Advanced linear proportional control of a pressure valves on electrical pressure cooker.

#### **V. CONCLUSION:**

The advance hydraulic plays an important role in the industrial and mobile application. The interfacing of the PLC and advance hydraulic technique can replace the manual operation in to automation system. Fast and accurate position control can be achieved with the closed loop proportional control system. Fluid mechanics provides the theoretical foundation for hydraulics, which focuses on the engineering uses of fluid properties. In fluid power, hydraulics are used for the generation, control, and transmission of power by the use of pressurized liquids. Hydraulic topics range through some part of science and most of engineering modules, and cover concepts such as advance hydraulic techniques such as proportional valve technique, close loop proportional valve techniques, Linear amplifiers and torque amplifiers, Continuously operating valve techniques and there role in modern application.

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