Lecture 38

# PNEUMATIC CONTROL VLAVES

**Learning Objectives**

**Upon completion of this chapter, Student should be able to**

- Define the function of a valve
- Classify the valves
- Identify the DCVs as per ISO designation
- Explain the various types of Directional control valves
- Explain the various method of valve actuation
- Describe the function of various Non return valves
- Understand the working of quick exhaust valves
- Differentiate pressure control valve and sequence valve

## 1.1 VALVES

Valve are defined as devices to control or regulate the commencement, termination and direction and also the pressure or rate of flow of a fluid under pressure which is delivered by a compressor or vacuum pump or is stored in a vessel.

Values of one sort or another, perform three main function in pneumatic installation

- They control the supply of air to power units, example cylinders
- They provide signal which govern the sequence of operation
- They act as interlock and safety devices

The type of valve used is of little importance in a pneumatic control for most part. What is important is the function that can be initiated with the valves, its mode of actuation and line connection size, the last named characteristics also determining the flow size of the valve. Valves used in pneumatics mainly have a control function that is when they act on some process, operation or quantity to be stopped. A control function requires control energy, it being desirable to achieve the greatest possible effect with the least effort. The form of control energy will be dictated by the valve's mode of actuation and may be manual, mechanical, electrical hydraulic or pneumatic.

Valve available for pneumatic control can be classified into four principal groups according to their function:

1. Direction control valve
2. Non return valves
3. Flow control valves
4. Pressure control valves

## 1.2 DIRECTION CONTROL VALVES

Pneumatic systems like hydraulic system also require control valves to direct and regulate the flow of fluid from the compressor to the various devices like air actuators and air motors. In order to control the movement of air actuators, compressed air has to be regulated, controlled and reversed with a predetermined sequence. Pressure and flow rates of the compressed air to be controlled to obtain the desired level of force and speed of air actuators.

The function of directional control valve is to control the direction of flow in the pneumatic circuit. DCVs are used to start, stop and regulate the direction of air flow and to help in the distribution of air in the required line.

### 6.2.1 TYPES OF DIRECTION CONTROL VALVES

Directional valves control the way the air passes and are used principally for controlling commencement, termination and direction of air flow. The different classification scheme of the pneumatic cylinders are given below

1. Based on construction

    i) Poppet or seat valves

        - Ball seat valve
        - Disc seat valve
        - Diaphragm Valves

    ii) Sliding spool valves

        - Longitudinal slide valve
        - Suspended spool valves
        - Rotary spool valves

2. Based on the Number of ports

i) Two way valves

ii) Three way valves

iii) Four way valves

3. Based on methods of actuation

i) Mechanical

ii) Electrical

iii) Pneumatic

4. Based on Size of the port

Size refers to a valve's port size. The port sizes are designated as M5, G1/8, and G1/4 etc. M refer to Metric thread, G refer to British standard pipe (BSP) thread.

5. Based on mounting styles

i) Sub base

ii) Manifold

iii) In-line

iv) Valve island

### 6.2.1.1 ISO DESIGNATION OF DIRECTION CONTROL VALVES

Valves are represented by symbols because actual construction is quite complex. A symbol specifies function of the valve, method of actuation, no of ports and ways. Pneumatic symbols have been standardised in ISO 1219-1:2006. (Fluid power systems and components – Graphic symbols and circuit diagram). Another standard ISO 1219-2:1995 establishes the rules for drawing diagrams of fluid power systems using symbols from ISO 1219-1. Port designations are described in ISO 5599.

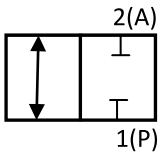
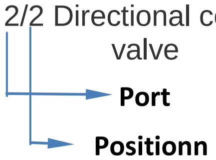
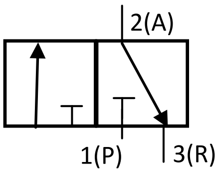
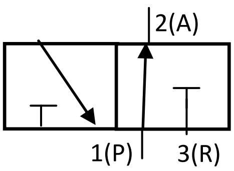
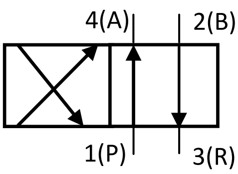
**Port markings:** As per the ISO 5599, ports are designated using a number system. Earlier, a letter system was used to designate a port. Table 1.1 gives port markings.

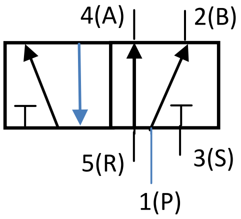
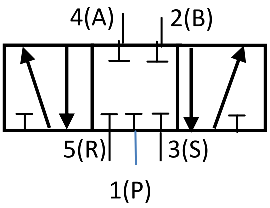
| **Port** | **Old (Letter) system** | **ISO (Number) System** | **Remarks** |
|---|---|---|---|
| Pressure port | P | 1 | Supply port |
| Working port | A | 2 | 3/2 DCV |
| Working ports | A, B | 4, 2 | 4/2 or 5/2 DCV |
| Exhaust port | R | 3 | 3/2 DCV |
| Exhaust ports | R, S | 5,3 | %/2 DCV |
| Pilot ports | Z or Y | 12 | Pilot line (flow 1-2) |
| Pilot  ports | Z | 14 | Pilot line (flow 1-4) |
| Pilot ports | Z or Y | 10 | Pilot line (no flow) |
| Internal pilot ports | Pz, Py | 81, 91 | Auxiliary pilot line |

Table 1.1: Port Markings of Direction Control Valve

**Ports and position:** DCVs are described by the number of port connections or ways they control. For example: Two way, three – way, four way valves. Table 1 shows the Port markings of DCVs and Table 1.2 shows commonly used DCVs with old and new designations.

Table 1.2: Port designation of DCV

| Port and position | |
|---|---|
|   | 2/2 Directional control valve   |
|   | 3/2 Directional control valve (normally closed) |
|   | 3/2 Directional control valve (normally open) |
|   | 4/2 Directional control valve |

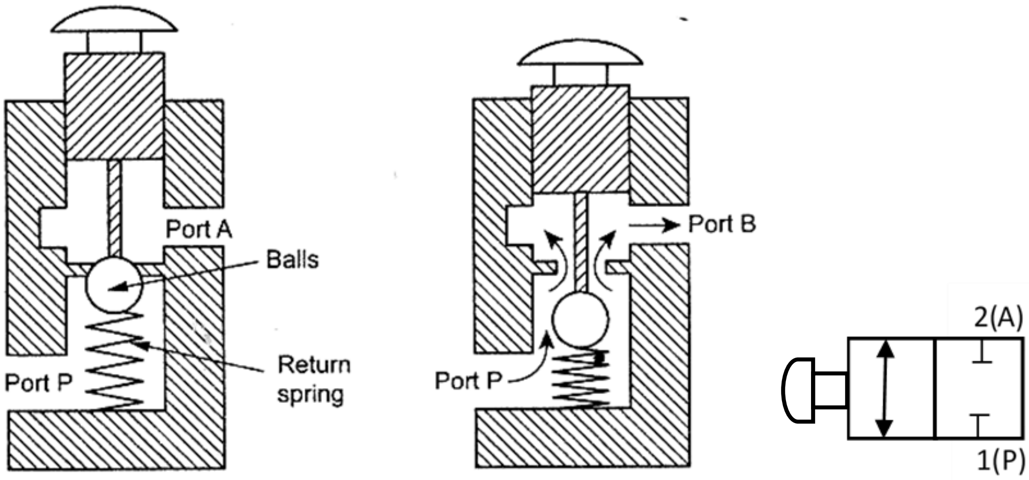
| | |
|---|---|
|  | 5/2 Directional control valve |
|  | 5/3 Directional control valve |

### 1.2.1.2 POPPET DIRECTION CONTROL VALVES

There are two different types of poppet valves, namely ball seat valve and disc seat valve.

**A.Ball seat valve.**

In a poppet valve, discs, cones or balls are used to control flow. Figure 1.1 shows the construction of a simple 2/2 normally closed valve. If the push button is pressed, ball will lift off from its seat and allows the air to flow from port P to port B. When the push button is released, spring force and air pressure keeps the ball back and closes air flow from port P to port B. Valve position are shown in Figure 1.1(a) 1.1 (b)   1.1(C)




*(a) Poppet position 1*   *(b) Poppet position 2*   **(c) Symbol**

Figure 1.1 Two/Two Ball seat Poppet valve

**B. Disc seat poppet valve**

Figure 1.2 shows the construction of a disc type 3/2 way DCV. When push button is released, ports 1 and 3 are connected via hollow pushbutton stem. If the push button is pressed, port 3 is first blocked by the moving valve stem and then valve disc is pushed down so as to open the valve thus connecting port 1 and 3. When the push button is released, spring and air pressure from port 1 closes the valve.. Comparison between Ball seat and disc seat valve is given in Table 1.3

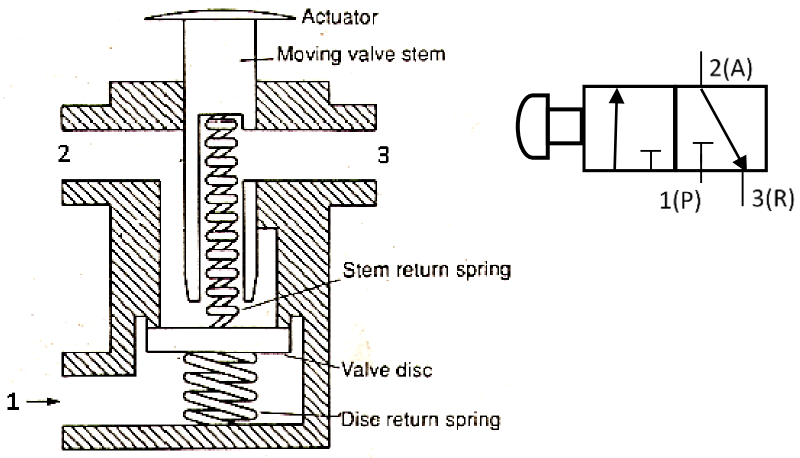



**Figure 1.2** Disc seat poppet valve

**Advantages of poppet valves are as follows**

i) Response of poppet valve is very fast- short stroke to provide maximum flow opening
ii) They give larger opening (larger flow) of valves for a small stroke
iii) The valve seats are usually simple elastic seals so wear is minimum
iv) They are insensitive to dust and dirt and they are robust, seats are self cleaning
v) Maintenance is easy and economical.
vi) They are inexpensive
vii) They give longer service life: short stroke and few wearing parts give minimum wear and maximum life capabilities

**Disadvantages of poppet valves are as follows**

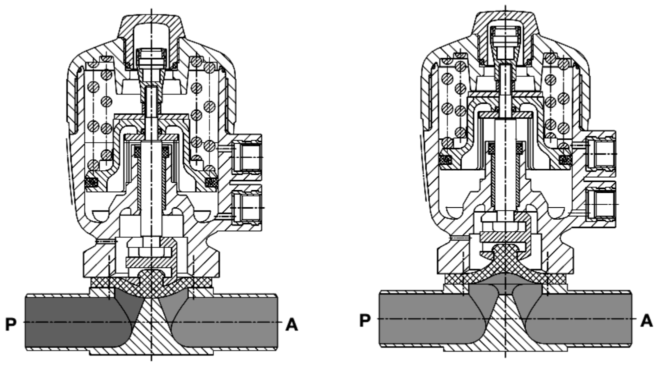
i) The actuating force is relatively high, as it is necessary to overcome the force of the built in reset spring and the air pressure.
ii) They are noisy if flow fluctuation is large.

Table 1.3 Comparison of Ball seat and Disc seat valves

| *Ball seat valves* | *Disc seat valve* |
|---|---|
| They are inexpensive | Offer large area and lift required is very small |
| They are relatively small in size | Time response is good |
| Insensitive to dirt and dust | Insensitive to dirt and dust |
| Can be operated manually or mechanically | Can be actuated manually , mechanically, electrically or pneumatically |

**C.Diaphragm valves**

The diaphragm between the actuator and valve body hermetically isolates the fluid from the actuator. The valves are maintenance-free and extremely robust and can be retrofitted with a comprehensive range of accessories, e.g. electrical position feedback, stroke limitation or manual override. **Figure 1.4** shows unactuated and actuated position of diaphragm valves.




a) Unactuated b) actuated

**Figure 1.4** Diaphragm valve: unactuated position, actuated position

**Closed position:** When de-energized, the valve is closed by spring action

**Open position:** If the actuator is pressurized by the control pressure, it simultaneously lifts the control piston and the valve spindle to open the valve.

**6.2.1.3 SPOOL DIRECTION CONTROL VALVES**

**A. Hand operated 3/2 DCV**

The cross sectional views of 3/2 DCV (normally closed) based on spool design is shown below. When the valve is not actuated, port 2 and 3 are connected and port 1 is blocked. When the valve is actuated then port 2 and 1 are connected and port 3 is blocked.

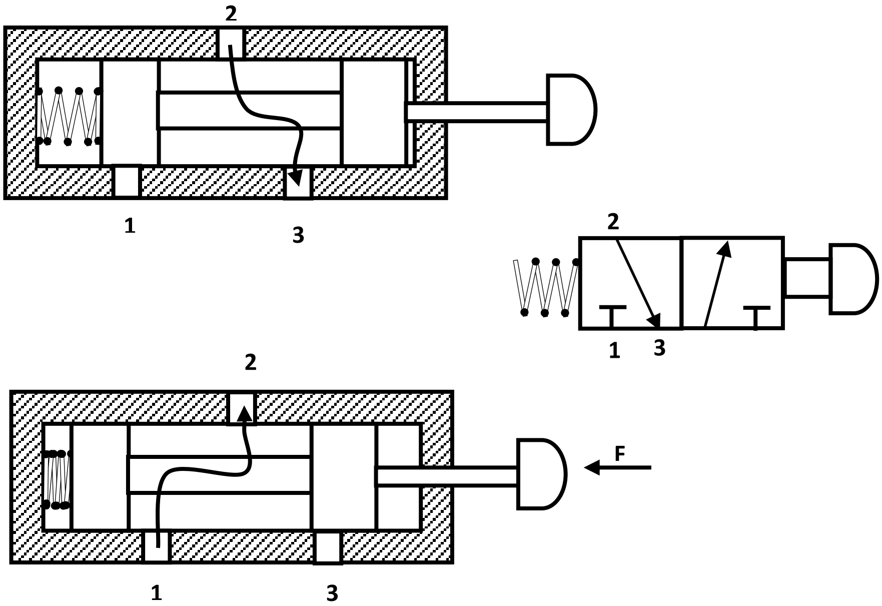



Figure 1.5 3/2 Directional control valve (Normally closed)

Figure 1.5 shows schematic diagram of 3/2 spring operated valve. There are three ports common port, normally open port and normally closed. When the valve is not actuated, there is flow from NO port to common port. When the valve is actuated there is flow from NC to common port.

**B.Pneumatically actuated 3/2 DCV**

The cross – sectional views of pneumatically actuated NC type 3/2 DCV in normal position and actuated positions are shown in the Figure 1.7

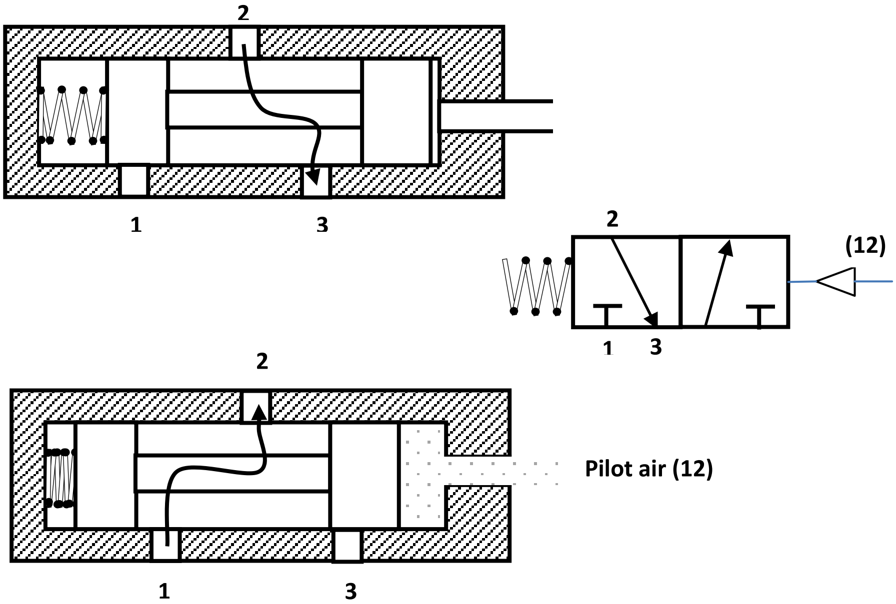



Figure 1.7 3/2 Directional control valve (pneumatically operated)

In normal position, the working port (2) is closed to the pressure port (1) and open to the exhaust port (3). When the compressed air is applied through the pilot port (12), the spool is moved against the spring. In the actuated position, the working port (2) is open to the pressure port(1) and closed to the exhaust port(3). Thus, the application of the compressed air to the port 12 causes the pressure port (1) to be connected to the working port (2).

Pneumatically actuated valves have following advantages

i. Great flexibility for use in simple as well as complex control system
ii. Adaptability for use in safety circuits.
iii. Various control functions can be easily incorporated as and when required
iv. Feedback signals from sensors can be applied conveniently for the purpose of controlling the pilot ports of these main valves. This means existing pneumatically actuated control circuits can be modified easily to incorporate any additional control requirement.

**C.Pneumatically actuated 4/2 DCV**

The valve shown in Figure 1.9  is a 4/2 way valve pneumatically operated DCV. Switch over is effected by direct application of pressure. If compressed air is applied to pilot spool through control port 12, it connects port 1 with 2 and 4 is exhausted through port 3. If the pilot pressure is applied to port 14, then 1 is connected with 4 and line 2 exhausted through port 3. On disconnecting the compressed air from the control line, the pilot spool remains in its current position until spool receives a signal from the other control side.

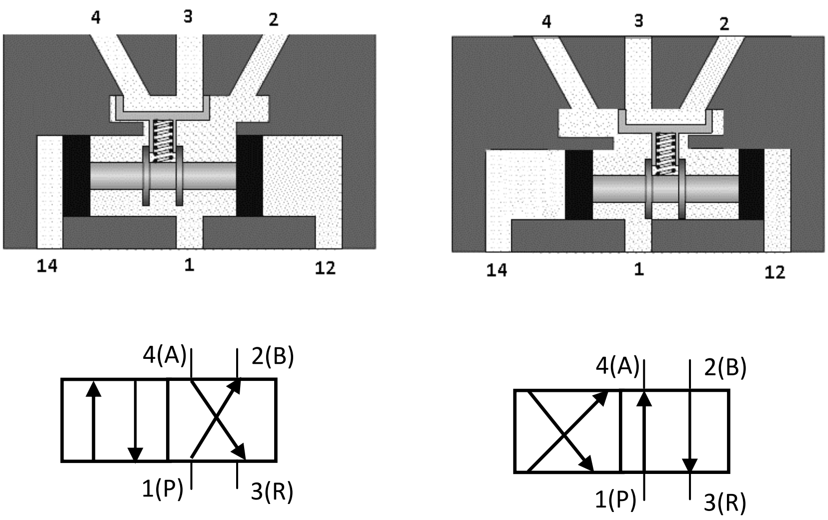



Figure 1.9 Schematic diagram of 4/2 way valve

### D. Suspended Disc Direction Control Valves

This valve is quite similar to 4/2 way spool valve. Schematic diagram is shown in Figure 1.11. In this design disc is used instead of a spool. This suspended disc can be moved by pilot pressure or by solenoid or by mechanical means.  In this design, main disc connects port 1 to either port 4 or 2. The secondary seat discs seal the exhaust port 3 whichever is not functional. These values are generally provided with manual override to manually move the cylinder.

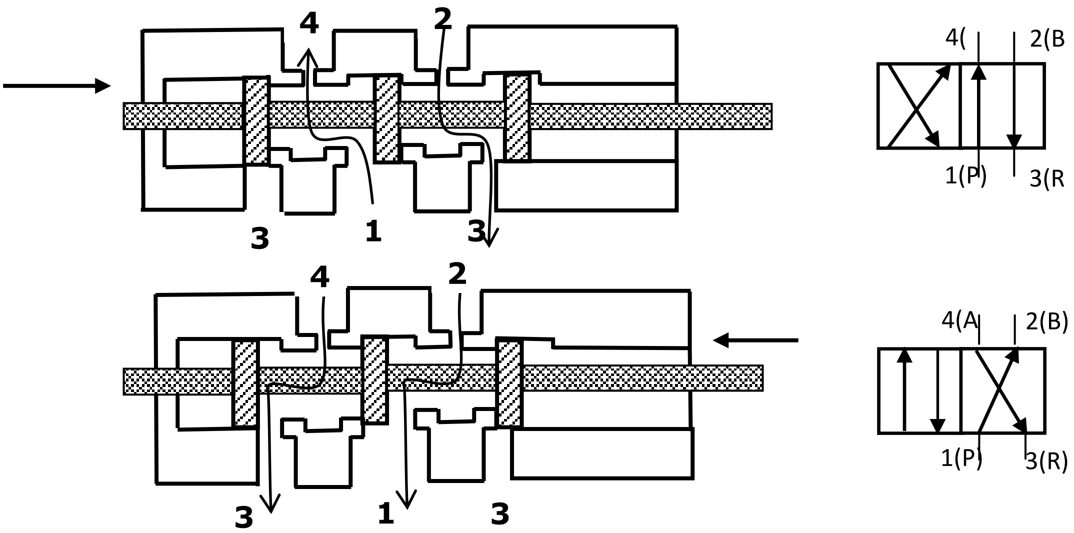



Figure 1.11 4/2 Directional control valve (suspended disc type)

Figure 1.12 below shows 5/2 way valve which uses suspended disk instead of spool. In spool type valve, spool controls the opening and closing of ports. In this type, suspended disc controls the opening and closing of ports. This suspended disc can be moved by pilot pressure at port 14 or port 12.  When the pilot pressure acts through port 14. The ports 1 - 2 and 4 - 5 are connected and 3 is blocked. When the air is given to pilot line 12, then 2 - 3 and 4 -1 are connected and 5 is blocked

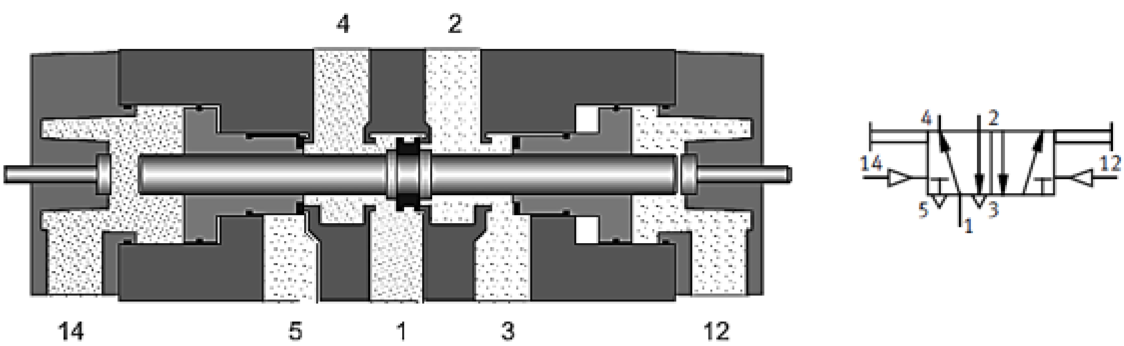



Figure 1.12 5/2 Directional control valve (suspended disc type)

**Advantages**

i) They have short actuation movement

ii) They are quick to operate because of small switching movement

iii) If signals are applied at both ports, first signal will be dominant

**Disadvantages**

i) Construction of the valve is complex

ii) Expensive

**E.Rotary valves**

The rotary spool directional control valve (Figure 1.13) has a round core with one or more passages or recesses in it. The core is mounted within a stationary sleeve. As the core is rotated within the stationary sleeve, the passages or recesses connect or block the ports in the sleeve. The ports in the sleeve are connected to the appropriate lines of the fluid system.

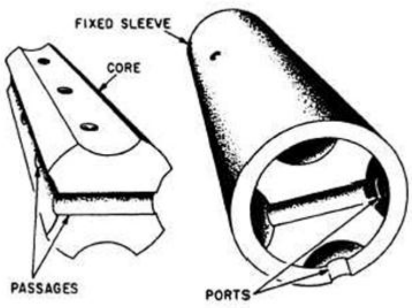



Figure 1.13 Parts of a rotary spool directional control valve.

Figure 1.14 shows the construction of a rotary spool directional control valve. We connect different ports by rotating the handle. By rotating the handle, core gets connected to different holes to give the required configuration of the valve. This type of the valve can be directly mounted on panel using bolt.

Figure 1.15 shows three different position of the core when the handle is rotated. Left most envelope of DCV connects P to B and A to T. Middle envelope of DCV blocks all ports. Right most envelope of DCV connects P to A and T to B.

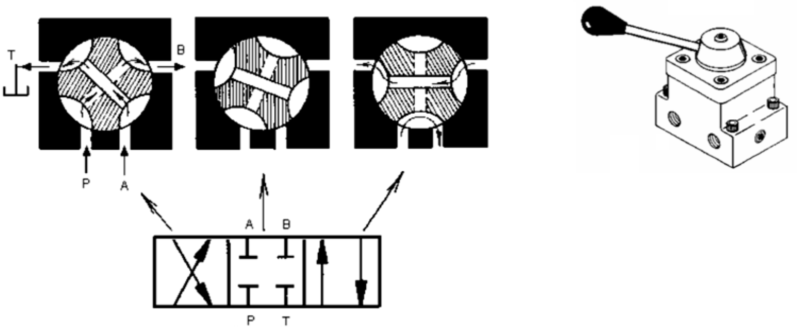



Figure 1.15 Three different positions of 4/3 way rotary spool directional control valve.

Table 1.4 shows schematically the different position of core and sleeve for various middle position of 4/3 way Direction control valve.

Table 1.4 Different position of core and sleeve for various mid position of 4/3 DCV

<table>
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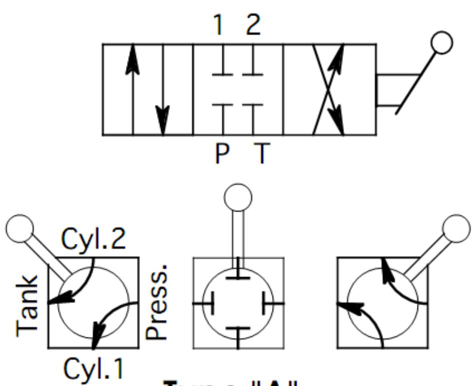
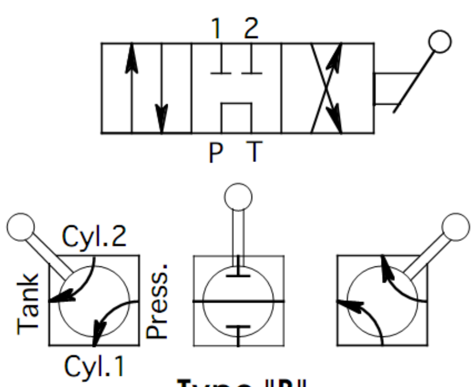
<td>

Type "A"</td>
<td>

Type "B"</td>
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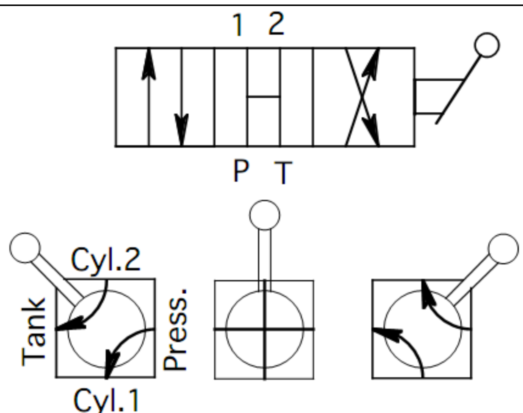
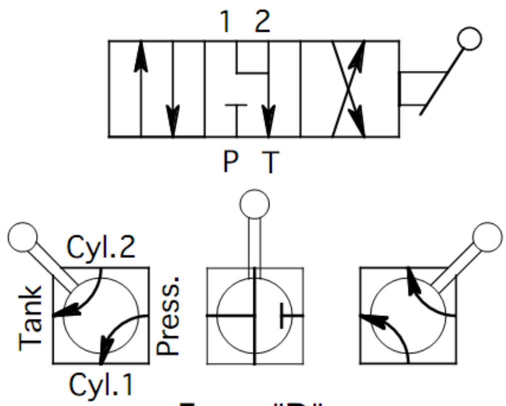
<td>

Type "E"</td>
<td>

Type "D"</td>
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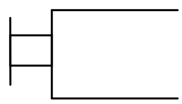
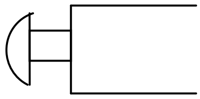
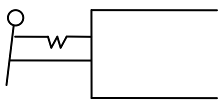
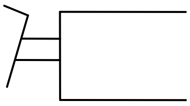
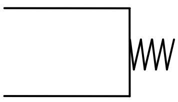
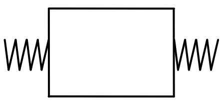
### 6.2.1.5 METHODS OF ACTUATION.

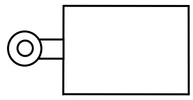
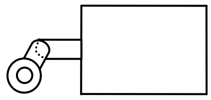
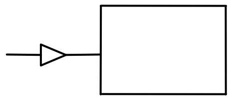
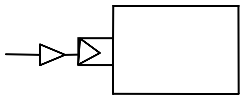
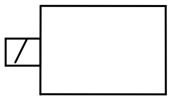
The methods of actuation of pneumatic directional control valves depend upon the requirements of the task. (Table 1.5) The types of actuation vary;

- manually actuated
- mechanically actuated
- pneumatically actuated
- electrical
- combined actuation

The symbols of the methods of actuation are detailed in DIN ISO 1219. When applied to a directional control valve, consideration must be given to the method of initial actuation of the valve and also the method of return actuation. Normally these are two separate methods. They are both shown on the symbol on either side of the position boxes. There may also be additional methods of actuation such as manual overrides, which are separately indicated.

Table 1.5 Methods of actuation

| Type of actuation | Type of control | Symbol |
|---|---|---|
| Manual | General |  |
| | Pushbutton |  |
| | Detent lever operated |  |
| | Foot pedal |  |
| Mechanical | Spring return |  |
| | Spring centered |  |

| | | |
|---|---|---|
| | Roller operated |  |
| | Idle roller |  |
| Pneumatic | Direct |  |
| | Indirect, pilot operated |  |
| Electrical | Single solenoid |  |
| | Double solenoid |  |
| Combined | Double solenoid with pilot operated |  |

**1.2.1.7 BASED ON MOUNTING STYLES**

Directional control valves can be mounted in two ways; inline and subplate.

Inline means that there are threaded connections in the valve itself. Fittings are screwed directly into the valve. This method has several disadvantages. Each time the valve is disconnected there is the possibility of damaging the valve by stripping the threads. The threads will also wear each time the unit is disconnected, causing contamination and an increased possibility of leakage. In the subplate method, the bottoms of the valves have unthreaded connections. The valve is then attached to a subplate that has matching connections.

The subplate has the threaded connection to which the fittings are attached. Sealing at the valve /subplate interface is accompanied through the use of o-rings, which fit into small recesses around the DCV ports. The subplate methods results in less leakage, less contamination, and a smaller probability of doing damage to the valve during assembly and disassembly. Valve replacement is simpler and less time – consuming task.

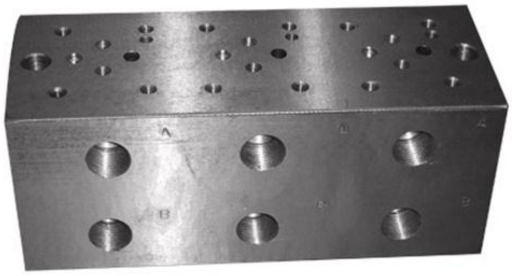


Figure 1.34 Manifold for three valves

### 1.2.2 NON RETURN VALVES

Non return valves permit flow of air in one direction only, the other direction through the valve being at all times blocked to the air flow. Mostly the valves are designed so that the check is additionally loaded by the downstream air pressure, thus supporting the non-return action.

Among the various types of non-return valves available, those preferentially employed in pneumatic controls are as follows

i) Check valve
ii) Shuttle valve
iii) Restrictor check valve
iv) Quick exhaust valve
v) Two pressure valve

#### A. Check valve

The simplest type of non-return valve is the check valve (Figure 1.35 (a)) , which completely blocks air flow in one direction while permitting flow in the opposite direction with minimum pressure loss across the valve. As soon as the inlet pressure in the direction of free flow develops a force greater than that of the internal spring, the check is lifted clear of the valve seat. The check in such valve may be plug, ball, plate or diaphragm.

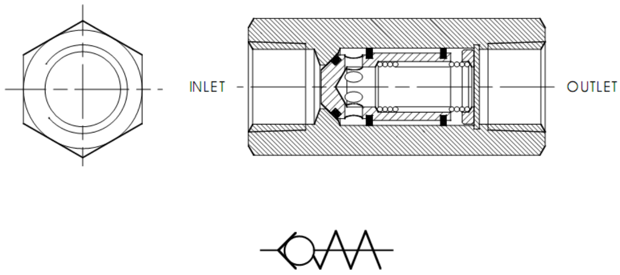



Figure 1.35 Check valve

**B. Shuttle valve**

It is also known as a double control valve or double check valve. A shuttle valve has two inlets and one outlet. At any one time, flow is shut off in the direction of whichever inlet is unloaded and is open from the loaded inlet to the outlet (Figure 1.36). A shuttle valve may be installed, for example, when a power unit (cylinder) or control unit (valve) is to be actuated from two points, which may be remote from one other.

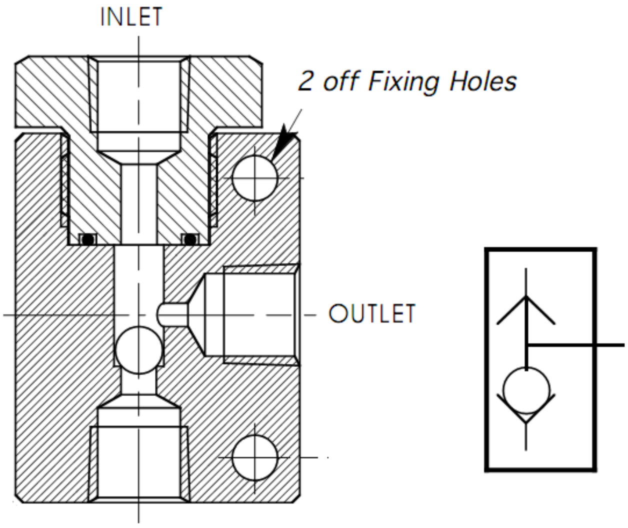



Figure 1.36 Shuttle valve

C. **Restrictor check valve**

It also termed speed control valve for pneumatic applications are actually hybrid type of unit. By reason of their throttling function they are flow control valves and they are indeed used as flow control valves in pneumatics.  Incorporation of check function also makes them non –return valves and it is as such that they are generally classified.

Usually the throttle of a restrictor check valve is adjustable so as to permit regulations of air flow through the valve. Throttling function is effective only in one direction of flow, while in the other direction free flow is provided through the check.(Figure 1.37). When restrictor check valves are used to control the speed of pneumatic cylinders, differentiation is made between supply-air and exhaust air-throttling.

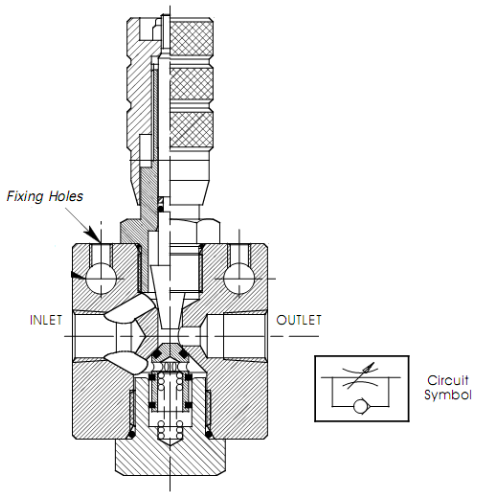



Figure 1.37 Functional diagram of restrictor check valve.

**D. Quick Exhaust Valves**

A quick exhaust valve is a typical shuttle valve. The quick exhaust valve is used to exhaust the cylinder air quickly to atmosphere. Schematic diagram of quick exhaust valve is shown in Figure 1.38. In many applications especially with single acting cylinders, it is a common practice to increase the piston speed during retraction of the cylinder to save the cycle time. The higher speed of the piston is possible by reducing the resistance to flow of the exhausting air during the motion of cylinder. The resistance can be reduced by expelling the exhausting air to the atmosphere quickly by using Quick exhaust valve.

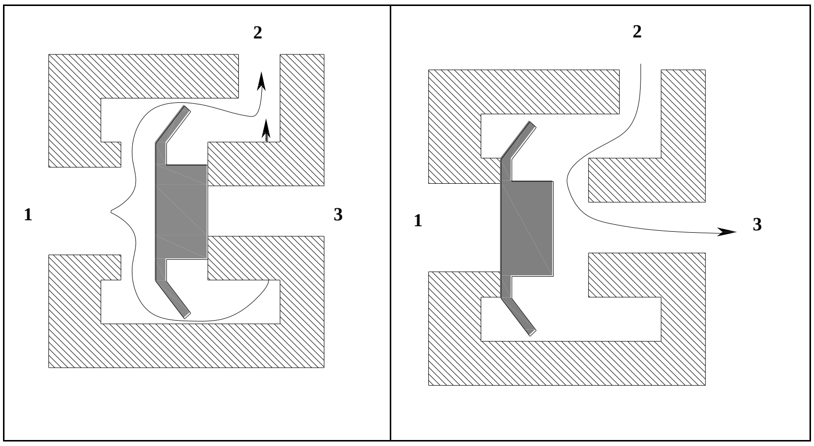



Figure 1.38 Functional diagram of quick exhaust valve.

The construction and operation of a quick exhaust valve is shown in Figure 1.38. It consist of a movable disc (also called flexible ring) and three ports namely, Supply port 1, which is connected to the output of the final control element (Directional control valve). The Output port, 2 of this valve is directly fitted on to the working port of cylinder. The exhaust port, 3 is left open to the atmosphere

**Forward Motion:** During forward movement of piston, compressed air is directly admitted behind the piston through ports 1 and 2 Port 3 is closed due to the supply pressure acting on the diaphragm. Port 3 is usually provided with a silencer to minimise the noise due to exhaust.

**Return Motion:** During return movement of piston, exhaust air from cylinder is directly exhausted to atmosphere through opening 3 (usually larger and fitted with silencer) .Port 2 is sealed by the diaphragm. Thus exhaust air is not required to pass through long and narrow passages in the working line and final control valve

Typical applications of quick exhaust valves for single acting and double acting cylinders are shown in Figure 1.39

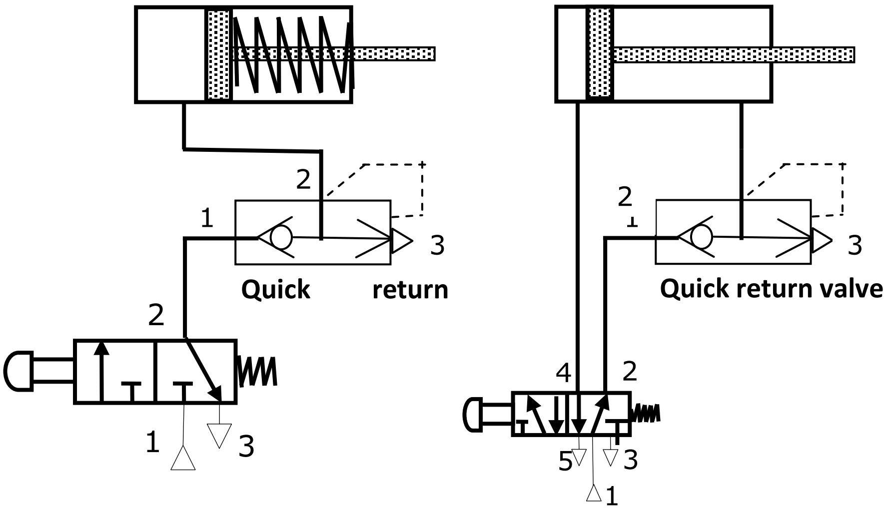



Figure 1.39 Application of quick exhaust valve.

**E. Two Pressure Valve**

This valve is the pneumatic AND valve. It is also derivate of Non Return Valve. A two pressure valve requires two pressurised inputs to allow an output from itself. The cross sectional views of two pressure valve in two positions are given in Figure 1.40 As shown in the figure, this valve has two inputs 12 and 14 and one output 2. If the compressed air is applied to either 12 or input 14, the spool moves to block the flow, and no signal appears at output 2. If signals are applied to both the inputs 12 and 14, the compressed air flows through the valve, and the signal appears at output 2.

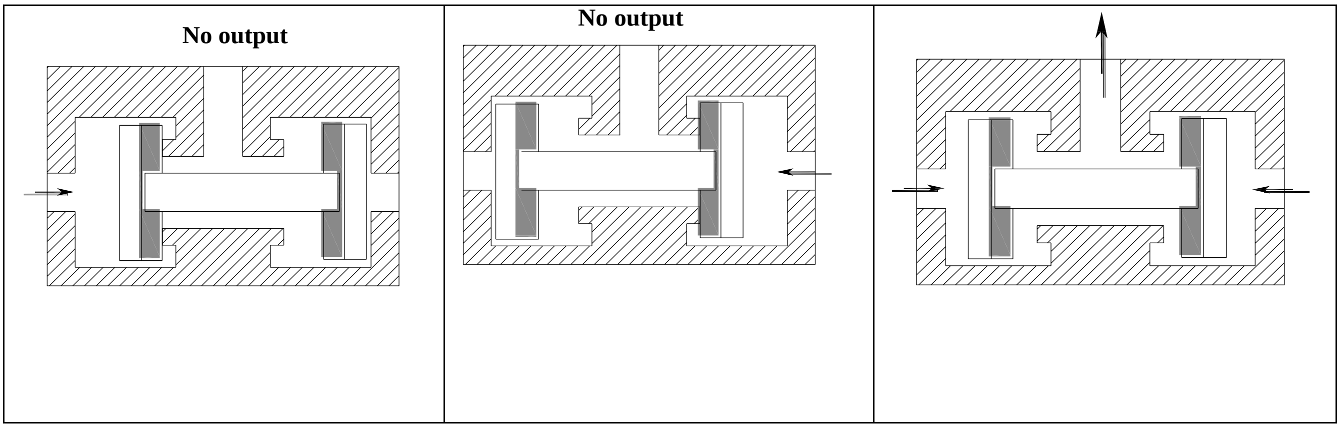



Figure 1.40 Two pressure valve.

### 1.2.3 FLOW CONTROL VALVES

Function of a flow control valve is self –evident from its name. A flow control valve regulates the rate of air flow. The control action is limited to the air flow passing through the valve when it is open, maintaining a set volume per unit of time. Figure 1.41(a) shows a variable restrictor type flow control valve (manifold type). Figure 1.41(b) shows a variable restriction type flow control valve (inline type). Figure 1.42 shows another design of Flow control valve, in which flow can be set by turning the knob.

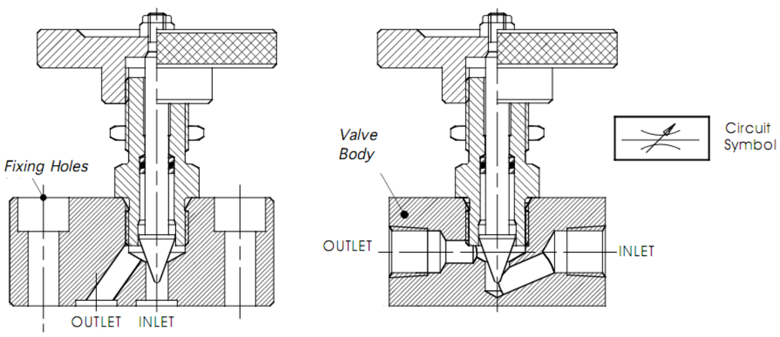



Figure 1.41 Flow control valve a) manifold b) inline

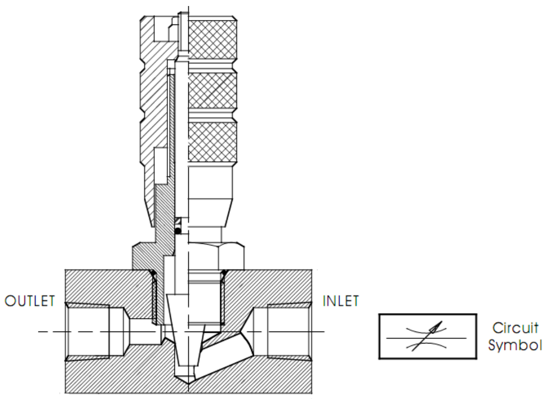



Figure 1.42 Flow control valve (adjustable)

### 1.2.4 PRESSURE CONTROL VALVE.

Compared with hydraulic systems, few pressure control valves are brought into use in pneumatics. Pressure control valves control the pressure of the air flowing through the valve or confined in the system controlled by the valve.

There are three types of pressure control valves

1. Pressure limiting valve

2. Pressure sequence valve
3. Pressure regulator or pressure reducing valve

**A.Pressure limiting valve.**

Prevents the pressure in a system from rising above a permissible maximum. Construction feature of pressure limiting valve is shown in Figure 1.43. It is a standard feature of compressed air production plant but is hardly ever used in pneumatic controls. These valves perform a safety relief function by opening to the atmosphere if a predetermined pressure is exceeded in the system, thus releasing the excess pressure. As soon as the pressure is thus relieved to the desired figure, the valve closed again by spring force.

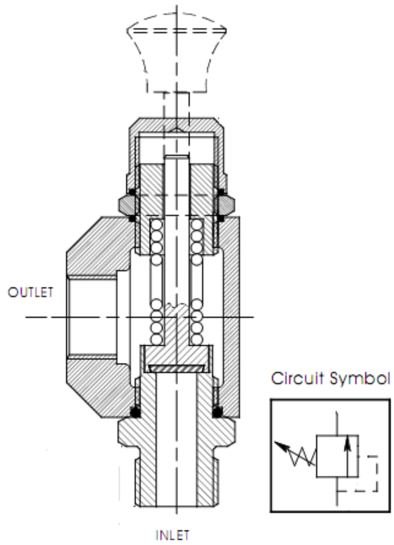



Figure 1.43 Pressure limiting valve

**B.Pressure sequence valve**

Function of the sequence valve is very similar to that of a pressure limiting valve. It is however used for a different purpose. Outlet of the pressure sequence valve remains closed until pressure upstream of it builds up to a predetermined value. Only then the valve opens to permit the air from inlet to outlet. Sequence valve must be incorporated into a pneumatic control where a certain minimum pressure must be available for a given function and operation is not be initiated at any pressure lower than that. There are also used in systems containing priority air consumers, when other consumers are not to be supplied with air until ample pressure is assured.

**C.Pressure reducing valve or regulator**

Pressure regulators, commonly called pressure-reducing valves, maintain constant output pressure in compressed-air systems regardless of variations in input pressure or output flow. Regulators are a special class of valve containing integral loading, sensing, actuating, and control components. Available in many configurations, they can be broadly classified as general purpose, special purpose, or precision. Three dimensional view of pressure reducing valve is shown in Figure 1.44

General-purpose or utility regulators have flow and regulation characteristics that meet the requirements of most industrial compressed-air applications. Such regulators provide long service life and relative ease of maintenance at competitive prices. Precision regulators are for applications where regulated pressure must be controlled with close tolerances. Such regulators are used when the outcome of a process or the results of a test depend on accurate pressure control.

Special-purpose regulators often have a unique configuration or special materials for use with fluids other than compressed air. Regulator construction can range from simple to complex, depending on the intended application and the performance requirements.

However, the principle of operation and the loading, actuating, and control components are basic to all designs. Most regulators use simple wire coil springs to control the downstream pressure. Various size springs are used to permit regulation of the secondary pressure within specific ranges. Ideally, the required pressure should be in the center one-third of the rated outlet pressure range. At the lower end of the pressure range, the spring loses some sensitivity; at the high end, the spring nears its maximum capacity.

Regulators can use either a piston or diaphragm to sense downstream pressure. Diaphragms are generally more sensitive to pressure changes and react more quickly. They should be used where sensitive pressure settings are required (less than 0.0025 bar). Pistons, on the other hand, are generally more rugged and provide a larger effective sensing area in a given size regulator. The functional difference between precision and general-purpose regulators is the degree of control accuracy of the output pressure. Output pressure accuracy is determined by the droop due to flow changes (regulator characteristics).

Pressure droop is most pronounced when the valve first opens. Factors contributing to droop are: load change with spring extension, effective area change with diaphragm displacement, and unbalance of area forces on the valve. The amount that output pressure changes with variations in supply pressure is called the regulation characteristic and is influenced by the ratio of diaphragm area to valve area and the degree of valve unbalance.

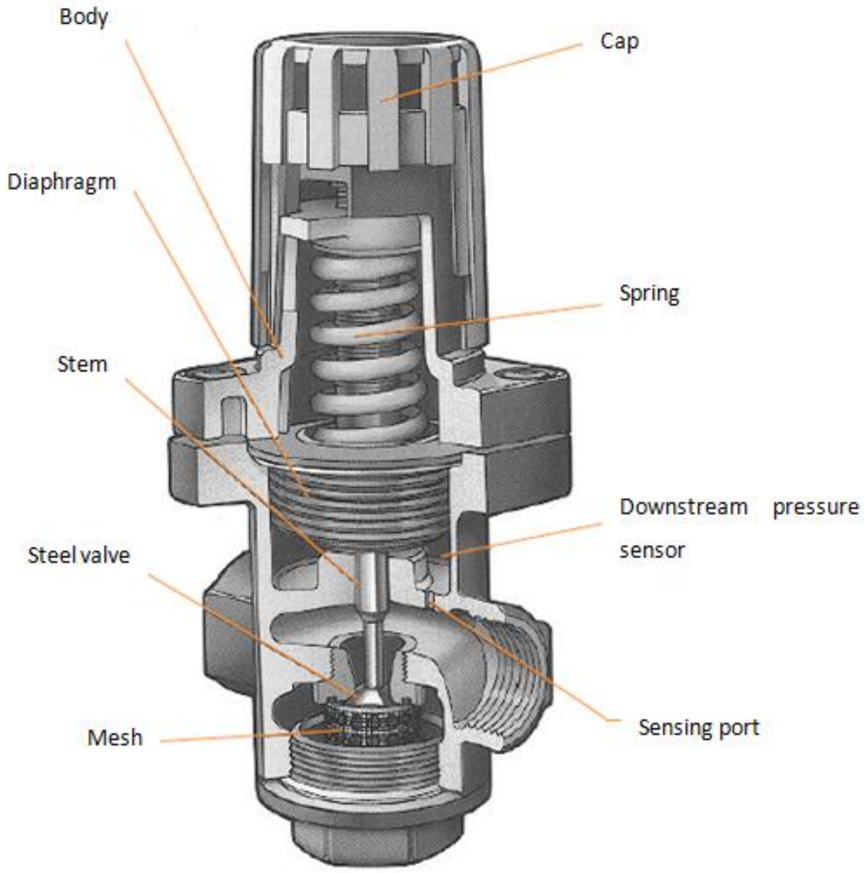



Figure 1.44 Three dimensional figure of pressure regulating valve.

When selecting a pressure regulator, the important factors to consider are:

1. Normal line pressure.

2. Minimum and maximum regulated pressure required: Regulators can have a broad adjustment range and may require a specific spring or accessory to match the requirements. Also, minimum and maximum pressure should be within the middle third of the regulator range.

3. Maximum flow required at regulated pressure.

4. Pipe size: Not all regulators are available in all pipe sizes; note where adapters are required. Also, pipe size should be consistent with flow requirements.

5. Regulator adjustment frequency: A number of different adjusting methods are possible. When selecting a regulator, consider the location, application, adjusting method, and user.

6. Degree of pressure precision required.

7. Accessories or options include gages and panel mounting.

8. Environmental or fluid conditions that could be incompatible with materials used in the regulator.
9. Special features such as high relief or remote control.
10. The consequences of a regulator malfunction or failure: A damper or relief valve might be needed to protect personnel or equipment. Also, dead-end service or intermittent actuation may require positive valve shutoff, bleed units, or close control of pressure-relief points. Filters, lubricators, relief devices, and other system options should be considered in the selection process.

**Objective Type Questions**

1. Valves are defined as devices to control, or regulate the commencement and -------of air
2. On resetting valves, for example those equipped with a return spring, the -----position is the position assumed by the moving parts of the valve when it is connected but not actuated.
3. Direct control of a valve means that valve is caused to operate directly by actuating element without any -----------elements being operated.
4. ----------------automatically limit flow to a single direction at the point where they are installed in an air line.
5. In pressure regulating valve inlet pressure is ----------than the outlet pressure.

6. Poppet valves give --------- stroke and few wearing parts give minimum wear

7. The quick exhaust valve is used to exhaust the cylinder air quickly to -----------------
8. compared with hydraulic systems, -----varieties of pressure control valves are used in pneumatics

9. As per ISO 1219-1:2006 designation, number 12 or 14 indicate ------------- ports

10. In rotary spool directional control valve , rotating part is called ----- and stationary part is called-----

11. The two most common basic flow control devices used in a pneumatic system are fixed-sized orifices and _____ valves.

12.The meter ----flow-control circuit is the preferred method to use for controlling the operating speed of cylinders in pneumatic circuits.

**State True or False**

1. Restrictor check valves are non return valves which are also employed as flow control valves.

2. Quick exhaust valves are designed to decrease the position speed in the cylinder

3 spring force set on a pressure limiting valve or sequence valve corresponding to minimum permissible or minimum desired pressure of the controlled fluid.

4. Ball seat valves ensure perfect sealing at all times in pneumatic circuit

5. Two way valves are used where a pure straightway function is required, that is when downstream equipment does not need exhausting to the atmosphere via this valve.

6. The pressure sequence valve holds the working pressure largely constant.

7. Two pressure valve is the pneumatic OR valve

8. Shuttle valve is the pneumatic OR valve.

9. Pressure loss in manifold type valve is more than inline type valves

10. Suspended disc type valve has very long actuation movement

## Review Questions

1. List the function of a pneumatic Valve?

2. How can we classify the pneumatic valves?

3. How can we classify Direction control valve( DCV)

3. How do 2/2 way differ from 4/2 way pneumatic Direction control valve

4. What are the advantages of poppet valve over ball valve

5. Explain the working of 3/2 Direction control valve with a neat sketch

6. Explain the working of 5/3 Direction control valve with a neat sketch

7. Mention few applications of 4/3 Direction control valve

8. Differentiate between Rotary valve and spool type valve

9. How do you classify Non return valves?

10. Mention few applications of Non return valves

11. Explain with the help of neat sketch the construction and working of quick exhaust valves

12. How do you classify Pressure control valves?

13. Explain the difference between pressure limiting valve and sequence valve

14. Explain the working of pressure limiting valve

15. Compare and contrast two way valve and shuttle valve. Mention its application.

## Answers

### Fill in the Blanks

1. direction
2. neutral
3. intermediate
4. Non return valves
5. higher
6. Shorter
7. atmosphere.

8.few
9. pilot
10. core/sleeve
11. Needle
12 Out

### State True or False

1. True
2. False
3. False
4. False
5. True
6. True
7. False
8. True
9. False
10. False