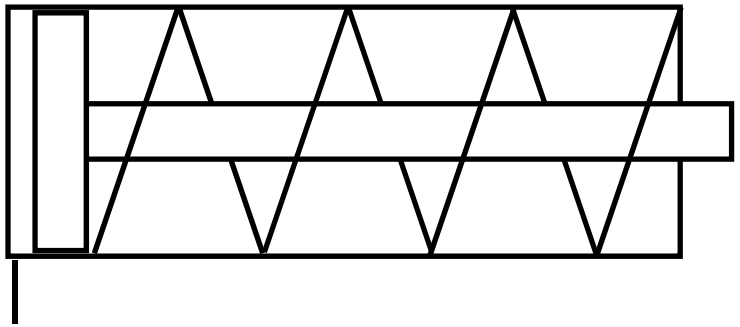
Pneumatic Actuators

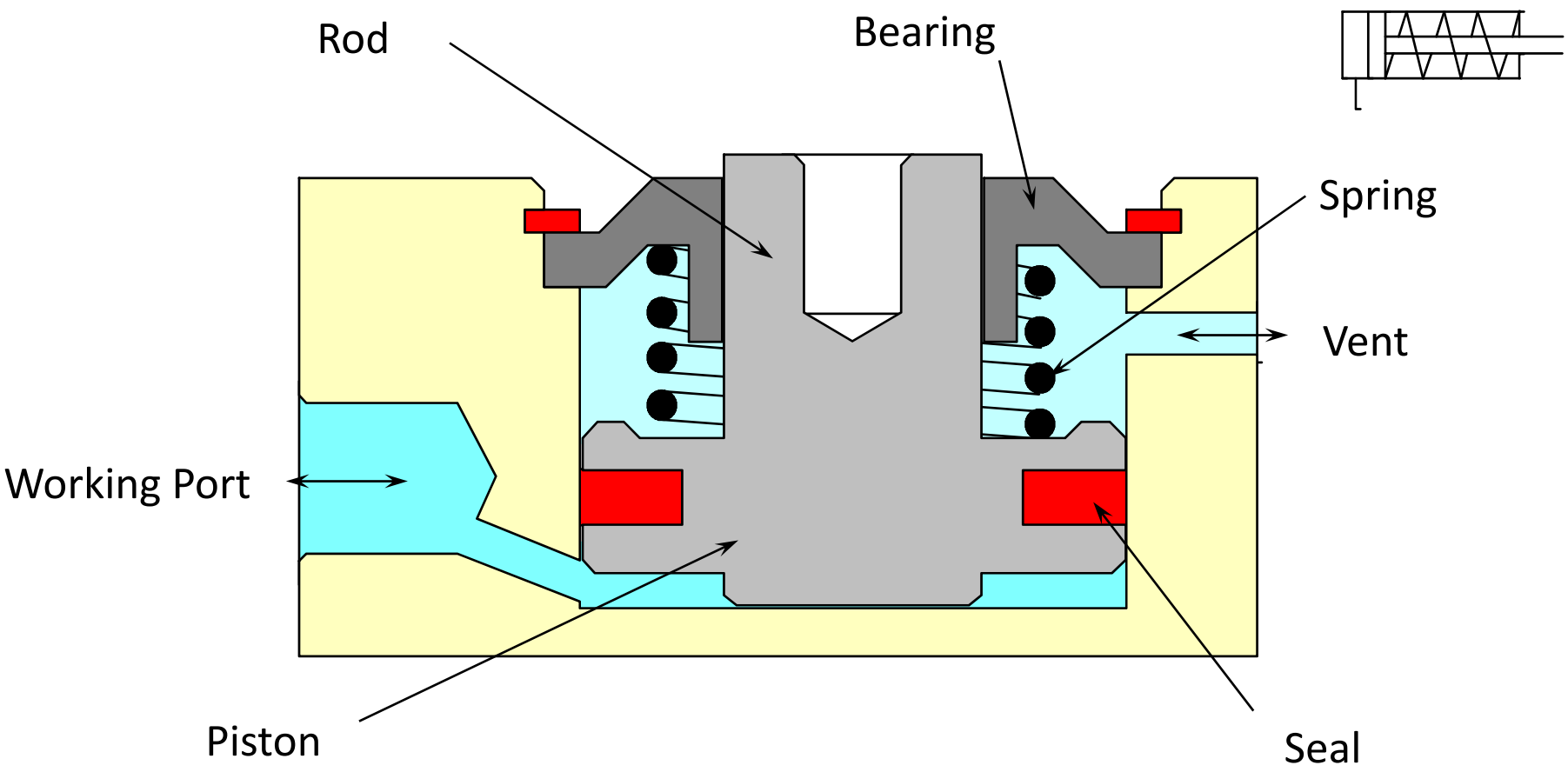


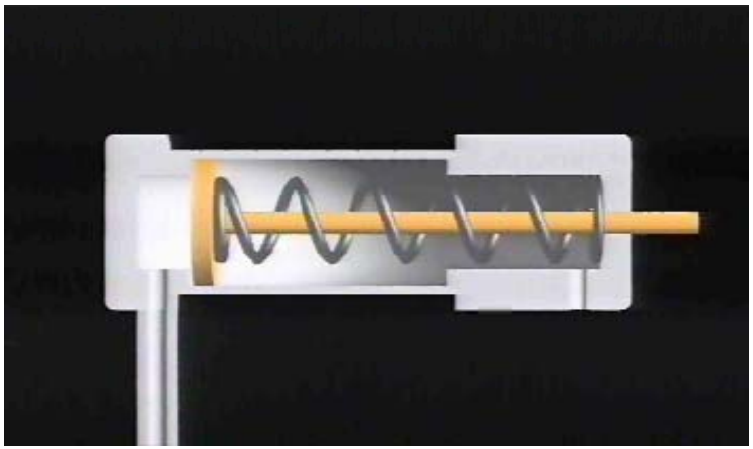
Single Acting Cylinder

Advance stroke by pressure

Return stroke by spring

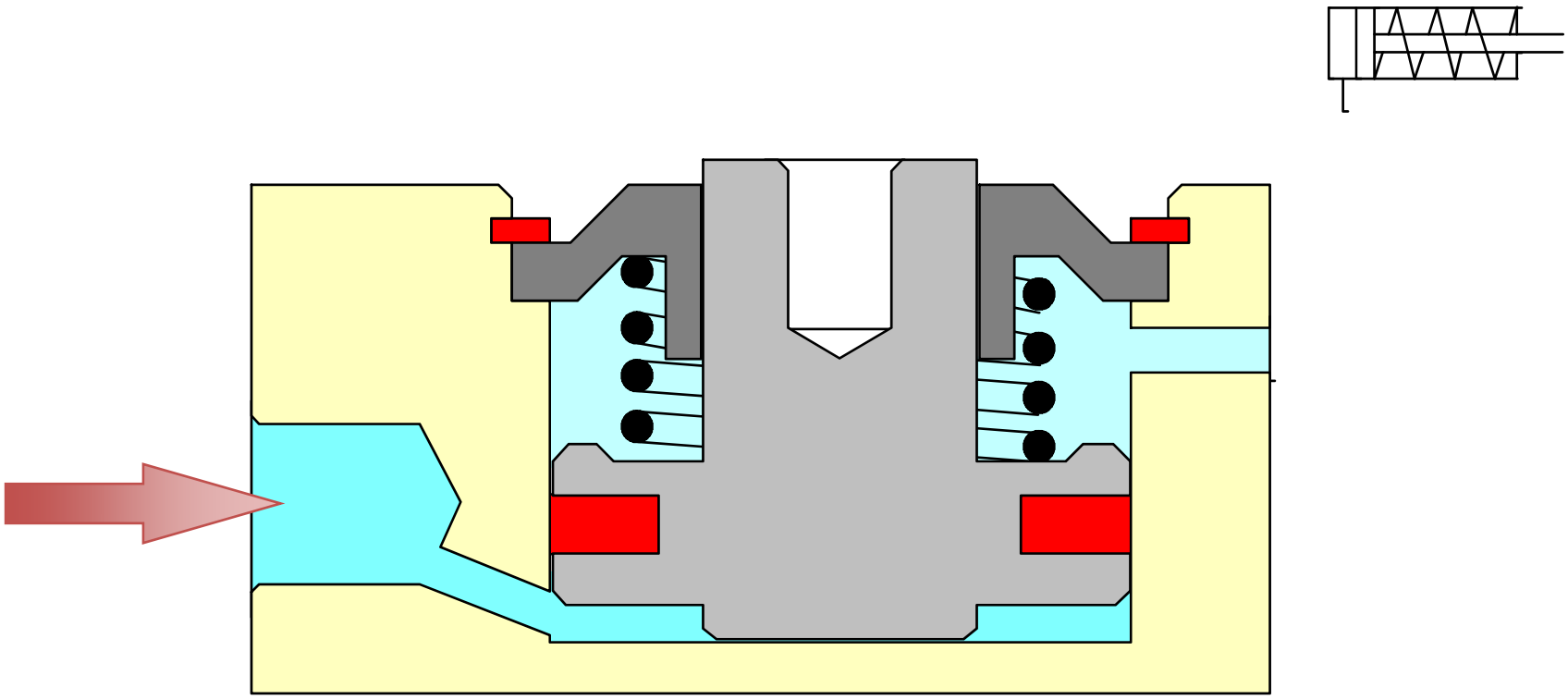
Single Acting Cylinder



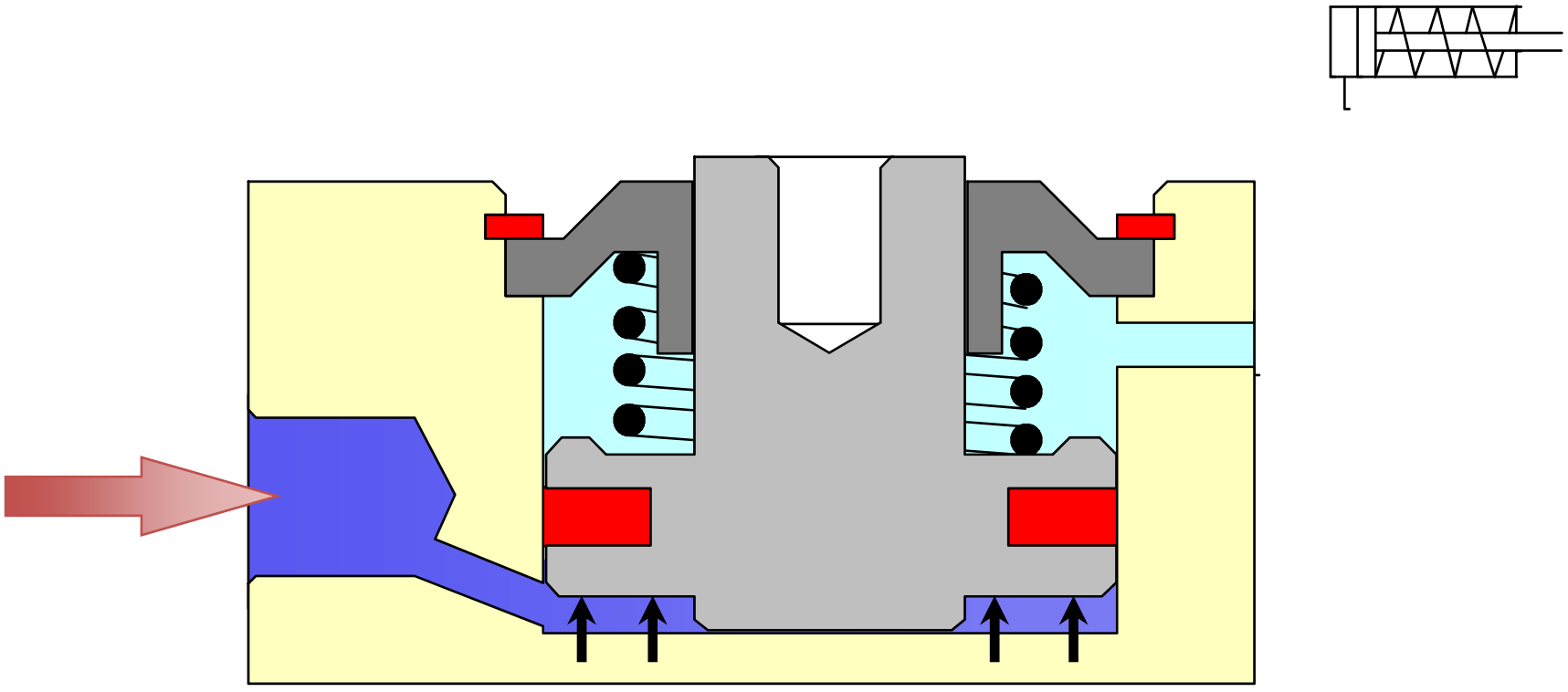


Construction of Single Acting Cylinder

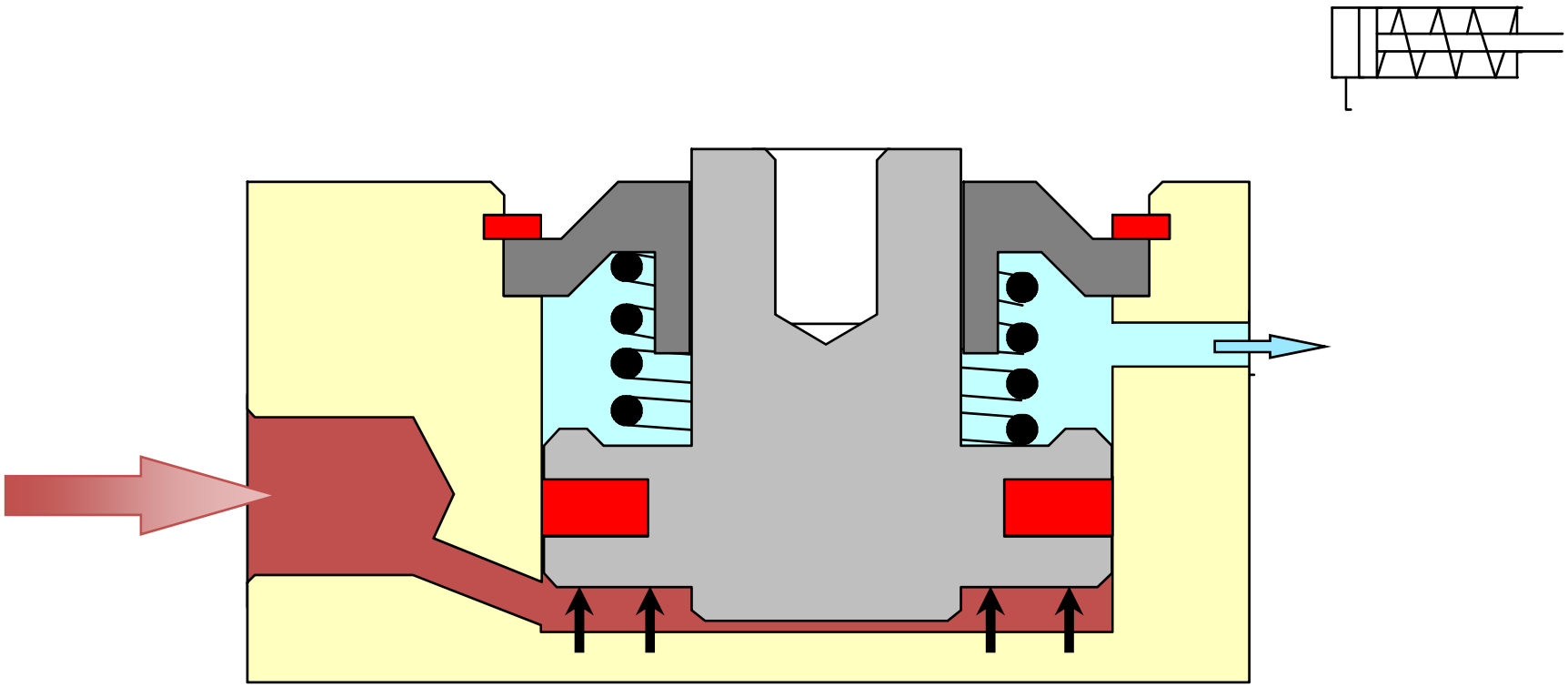
Single Acting Cylinder



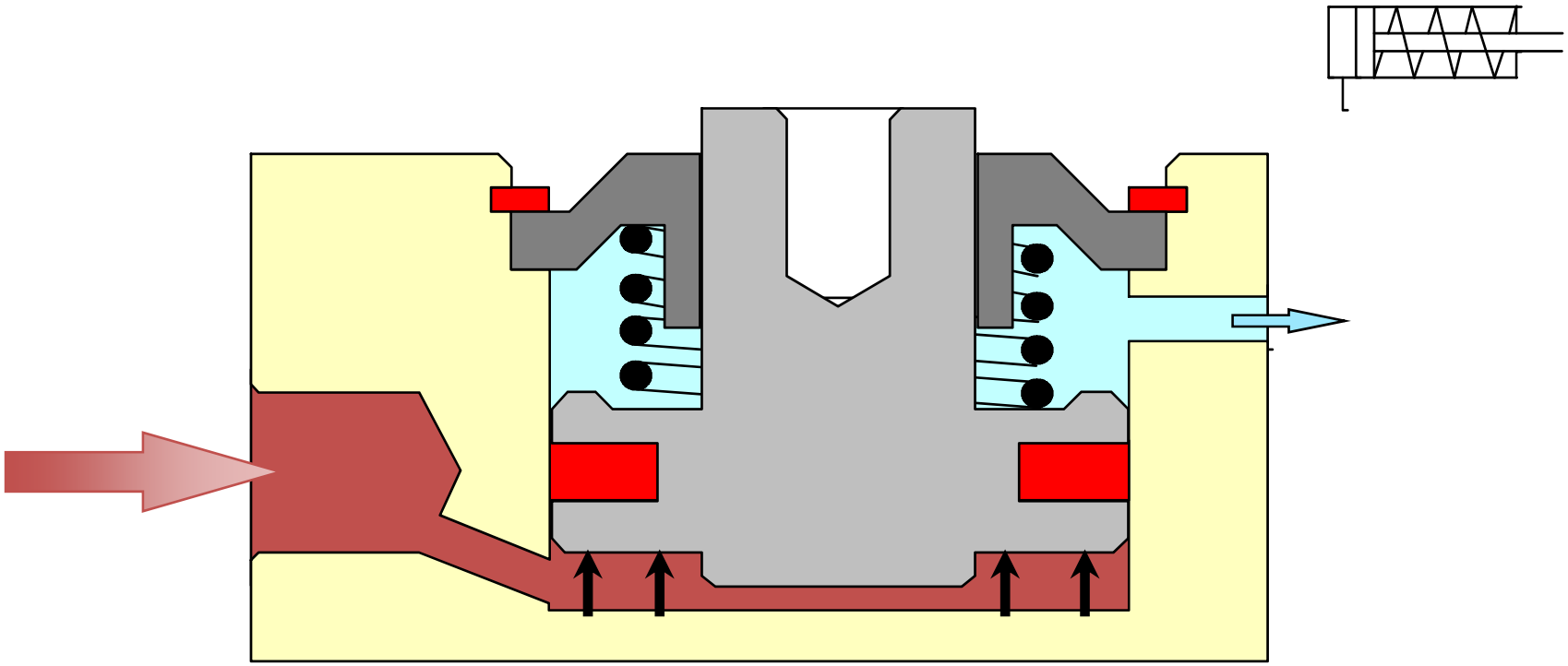
Single Acting Cylinder



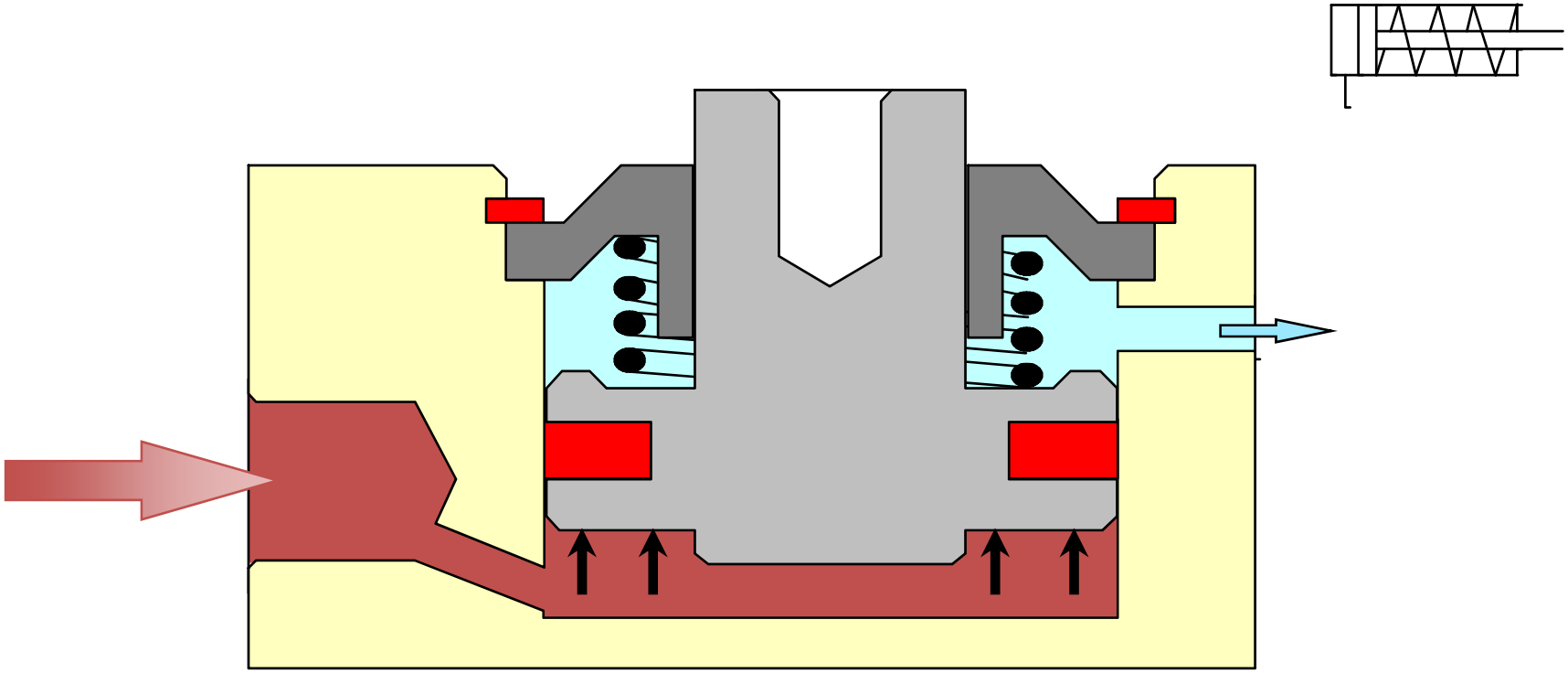
Single Acting Cylinder



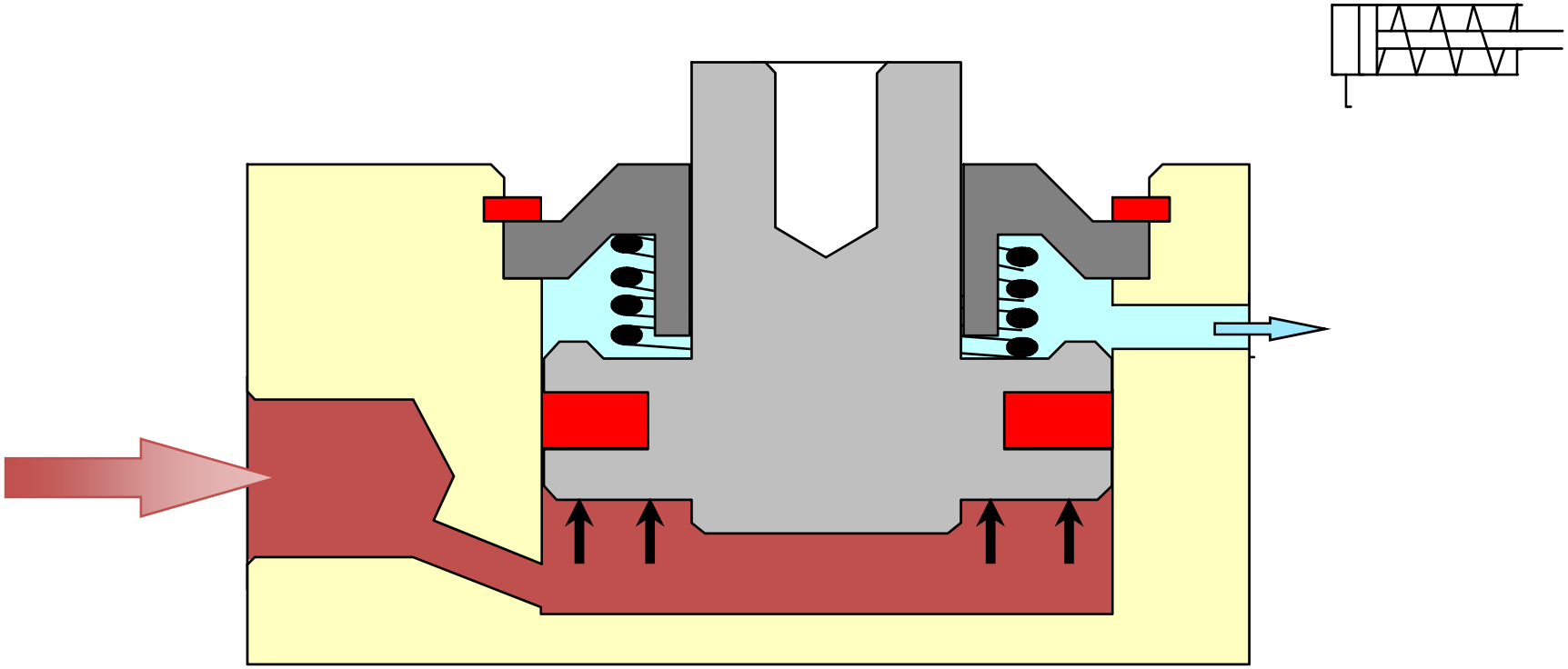
Single Acting Cylinder



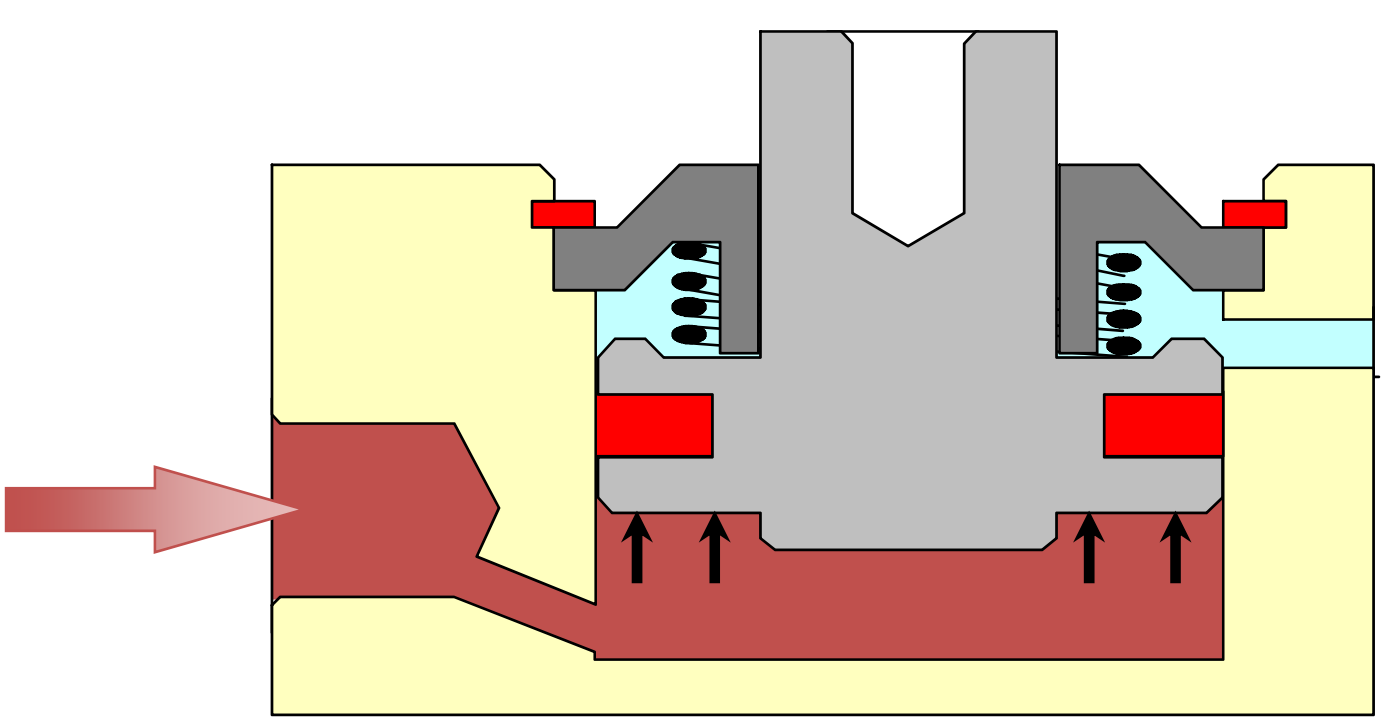
Single Acting Cylinder

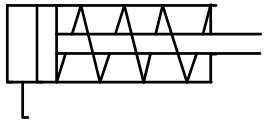


Single Acting Cylinder

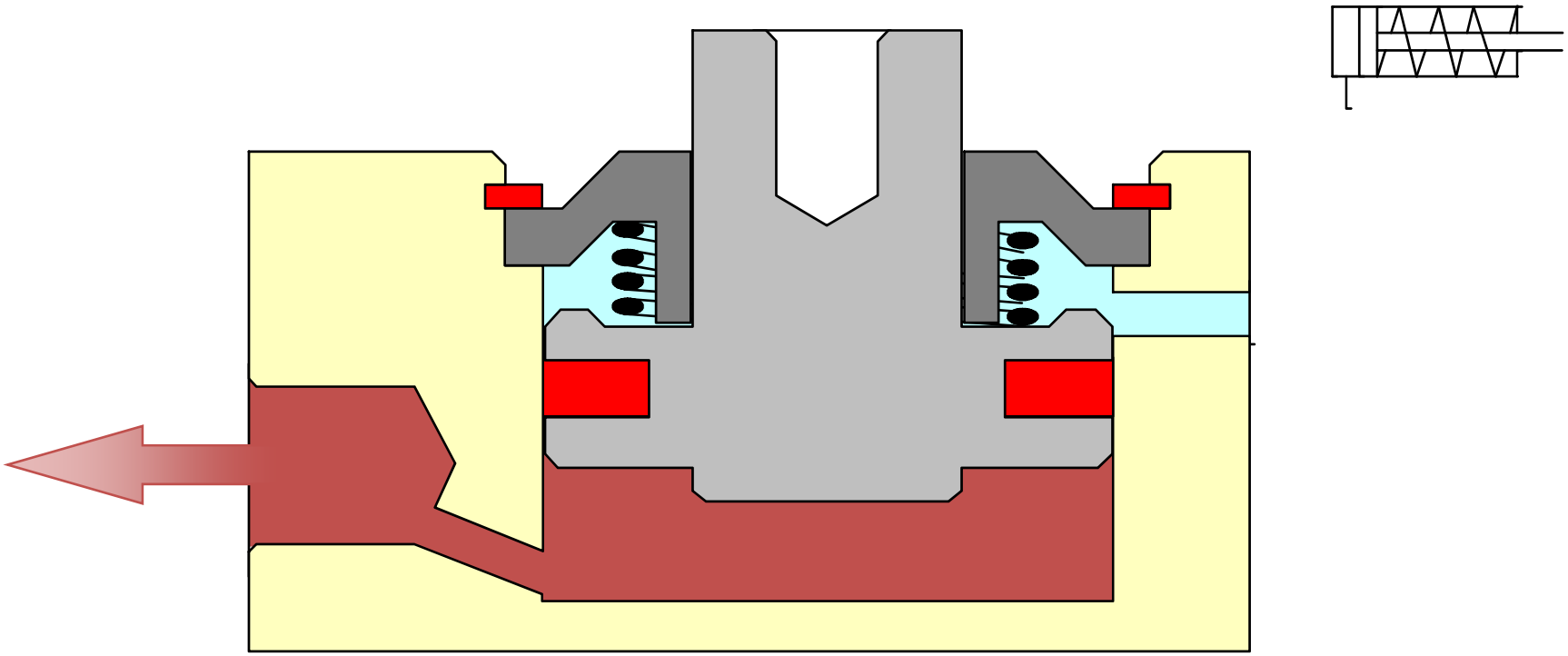


Single Acting Cylinder

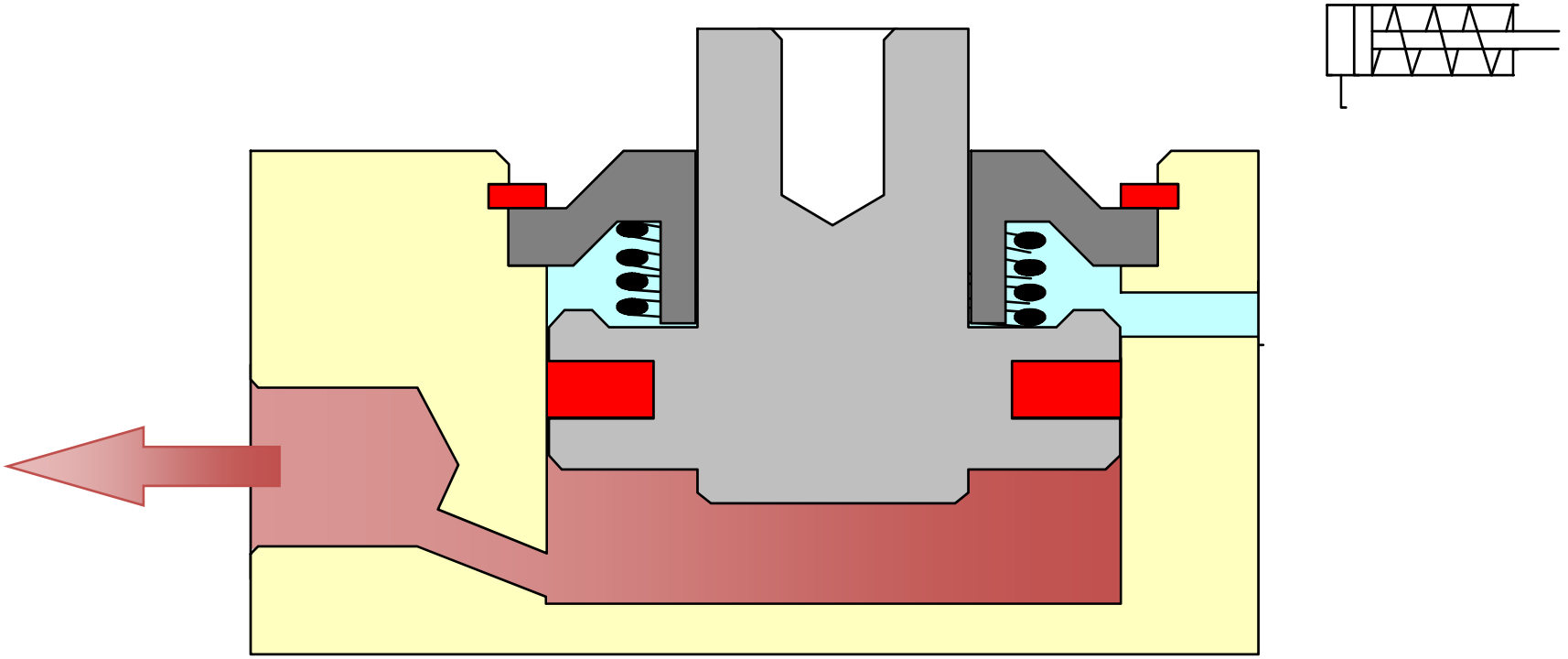




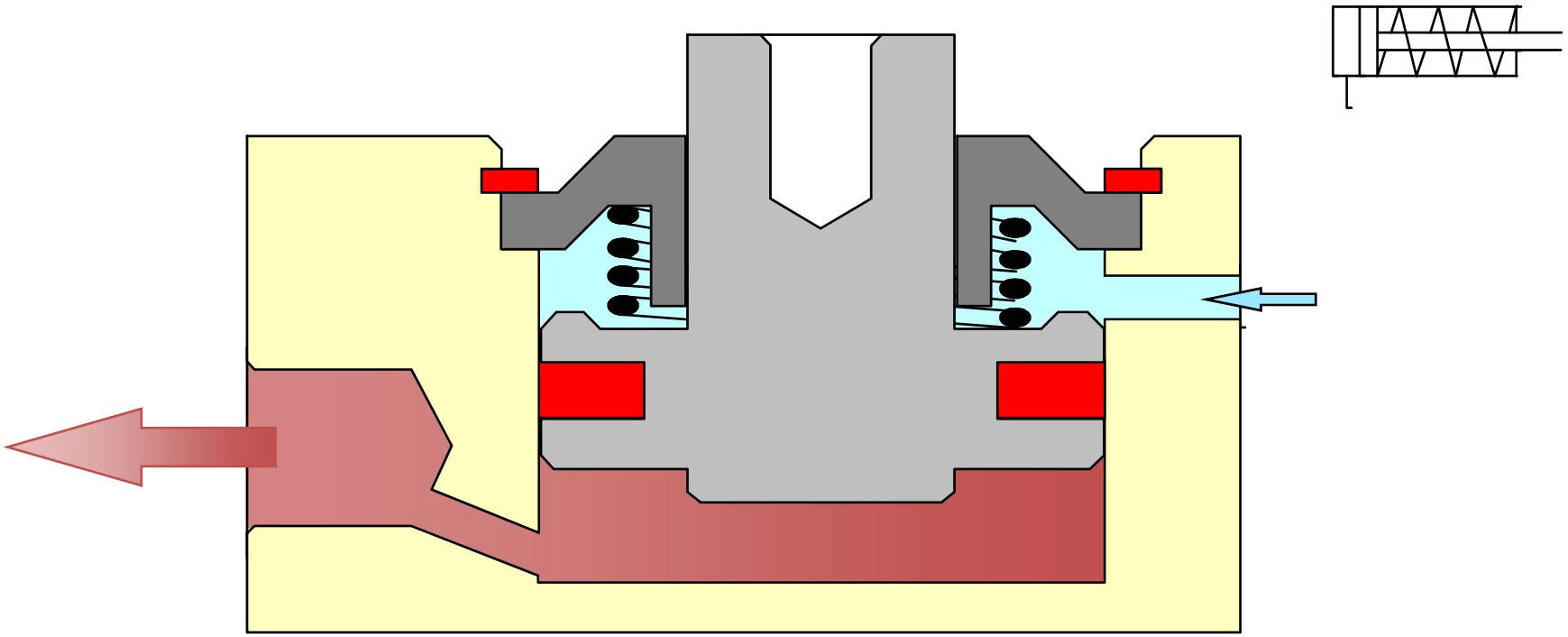
Single Acting Cylinder



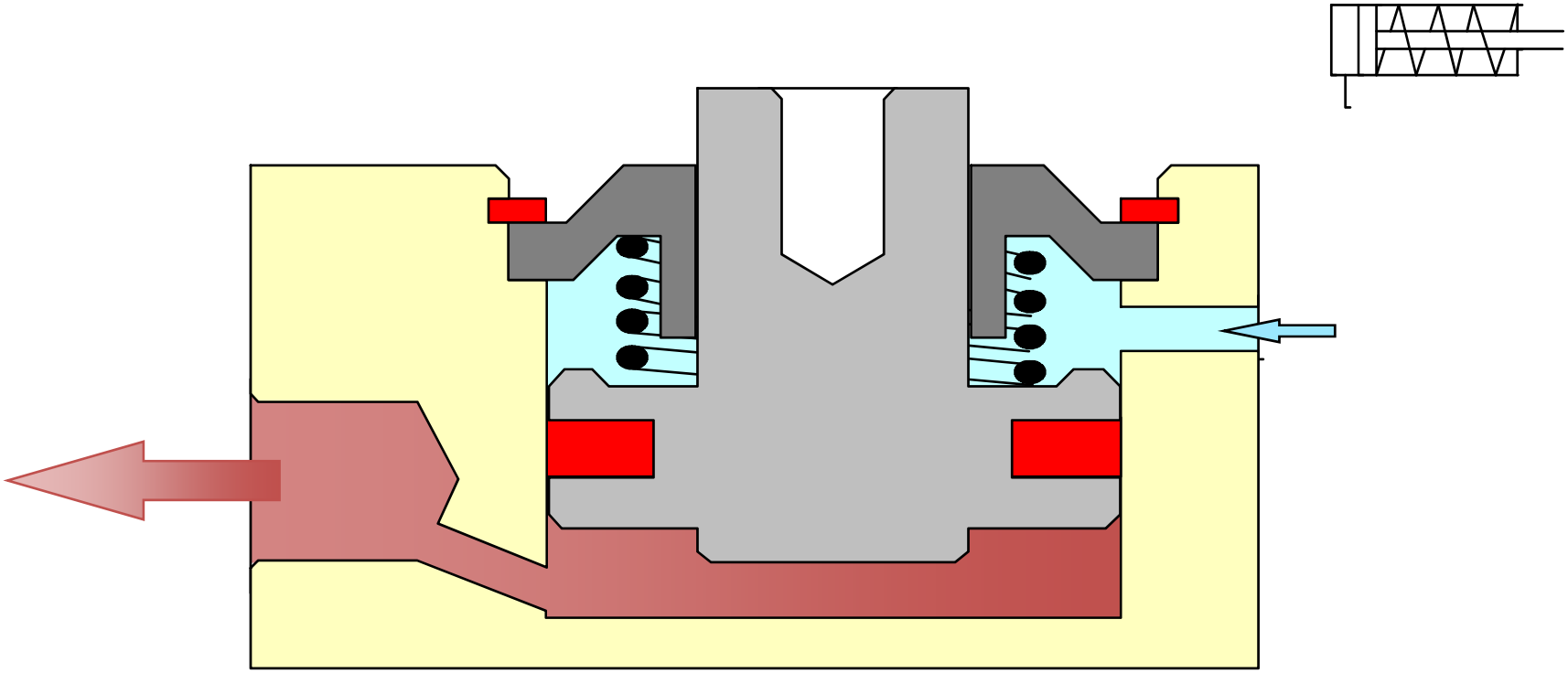
Single Acting Cylinder



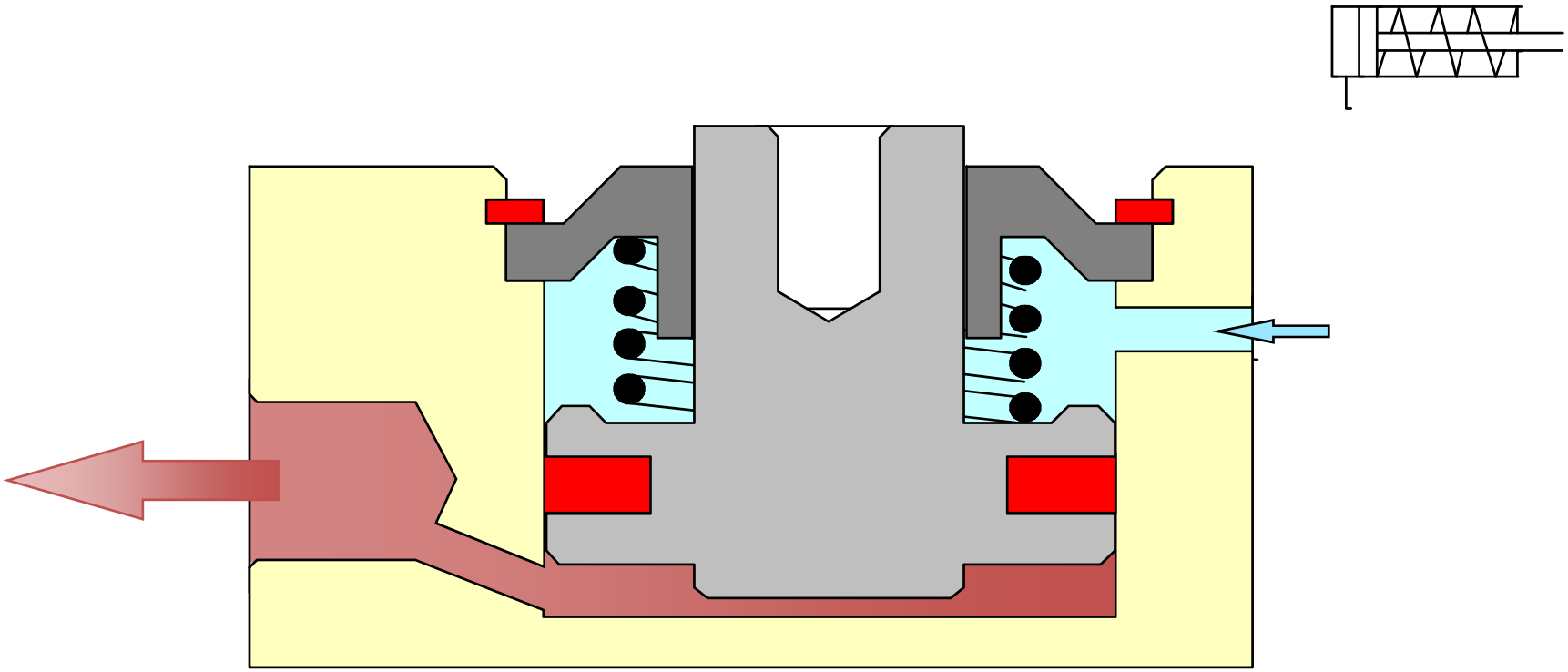
Single Acting Cylinder



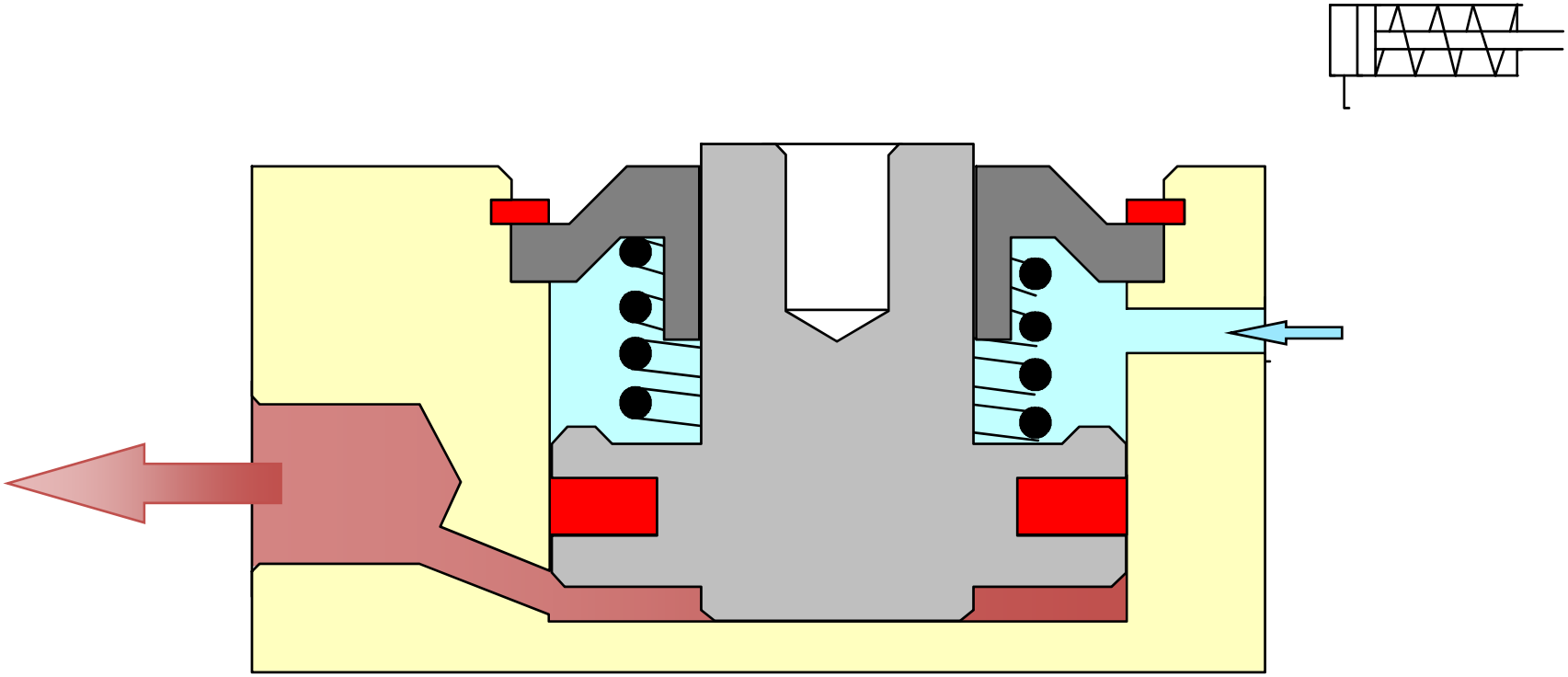
Single Acting Cylinder



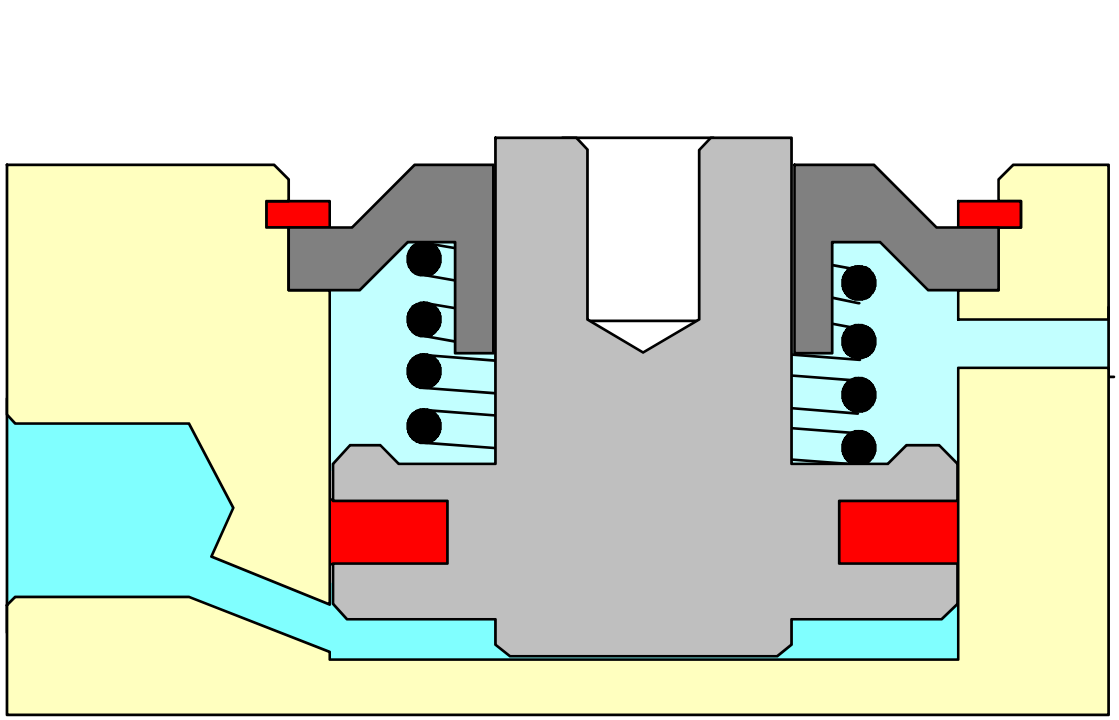
Single Acting Cylinder

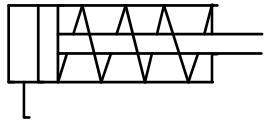


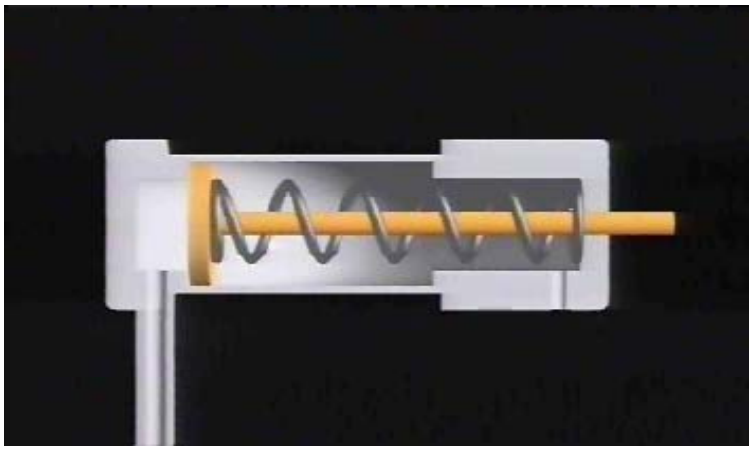
Single Acting Cylinder



Single Acting Cylinder

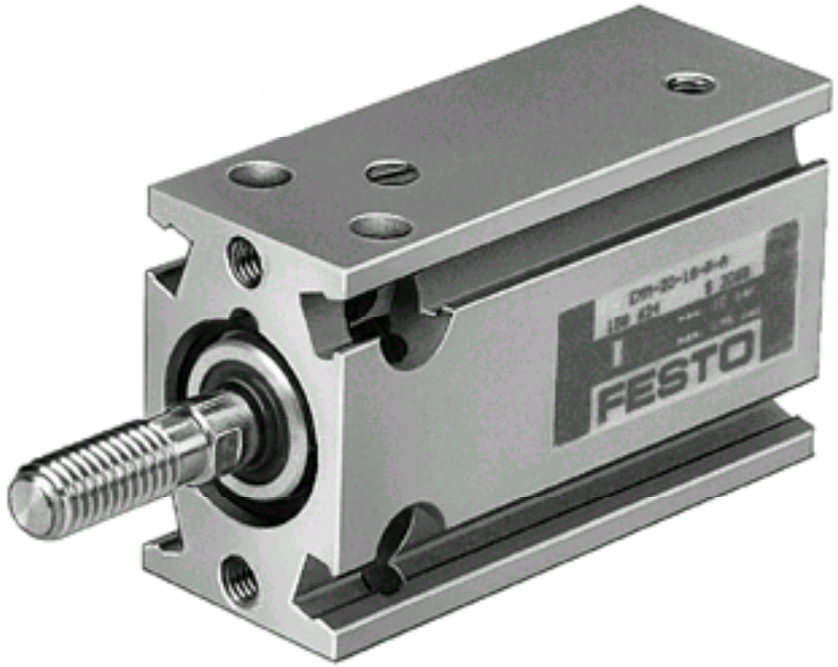






Operation of Single Acting Cylinder

Single Acting Cylinder



Piston Diameter	10mm	to	32mm
Stroke Lengths	5mm	to	50mm

5 Groups of Valves

Directional Control Valve

Flow control valve

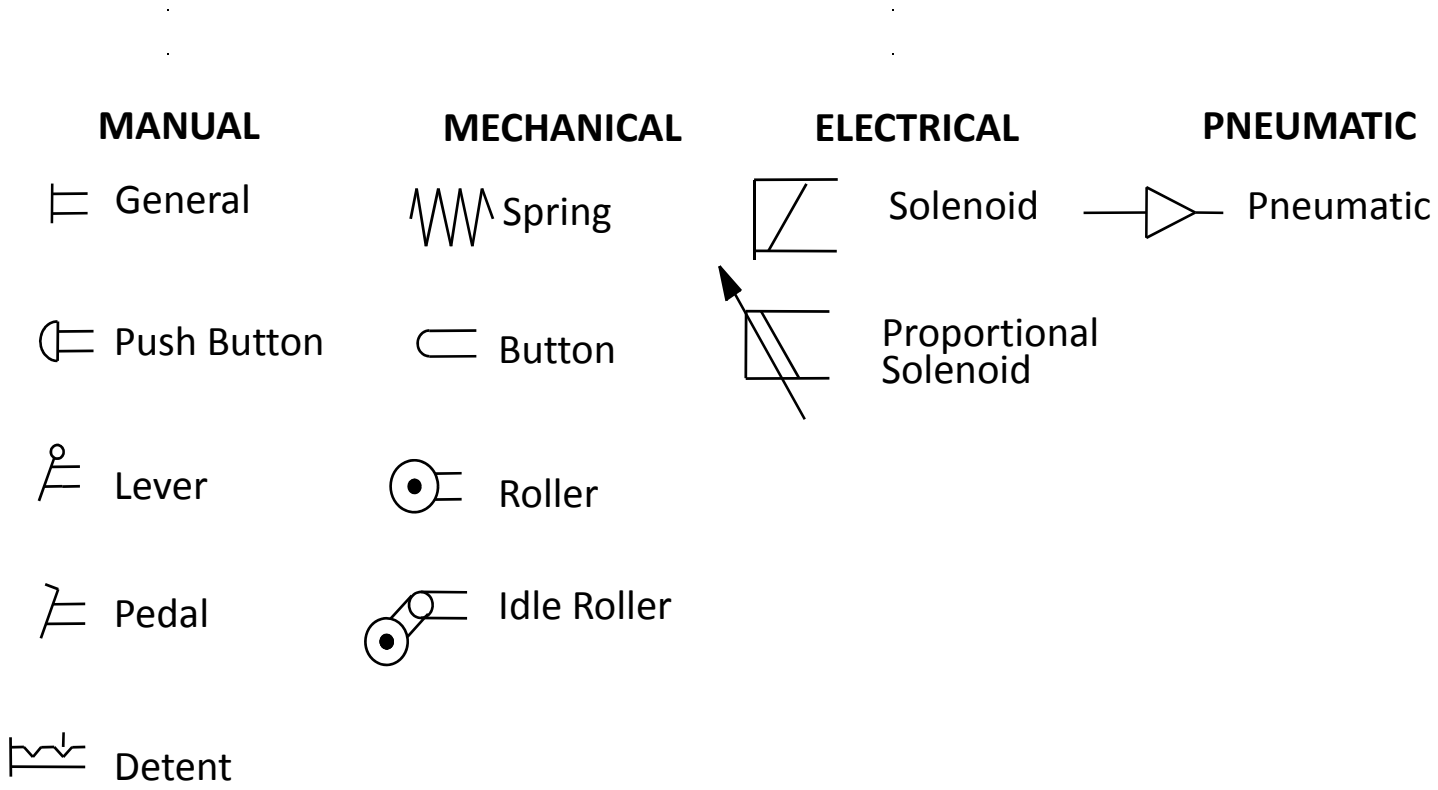
Non-return valves

Pressure valves

Combination valves

Valve Symbol Elements

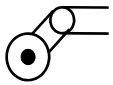
Actuation methods



Actuation Method

Roller

Lever

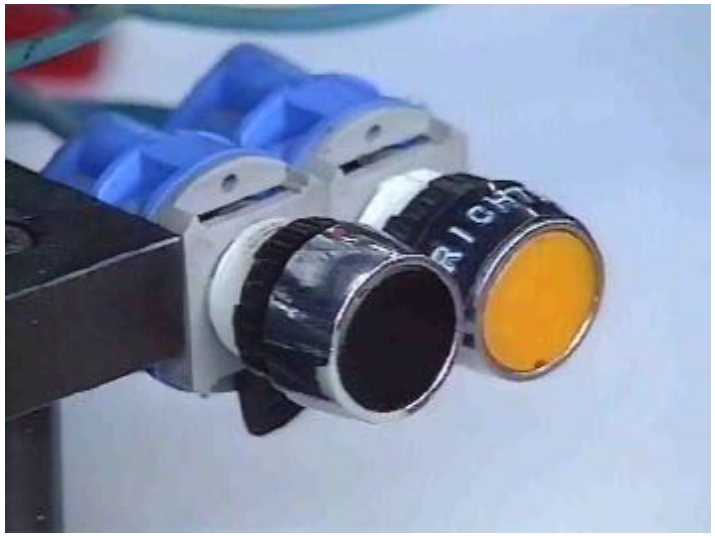


Idle Roller

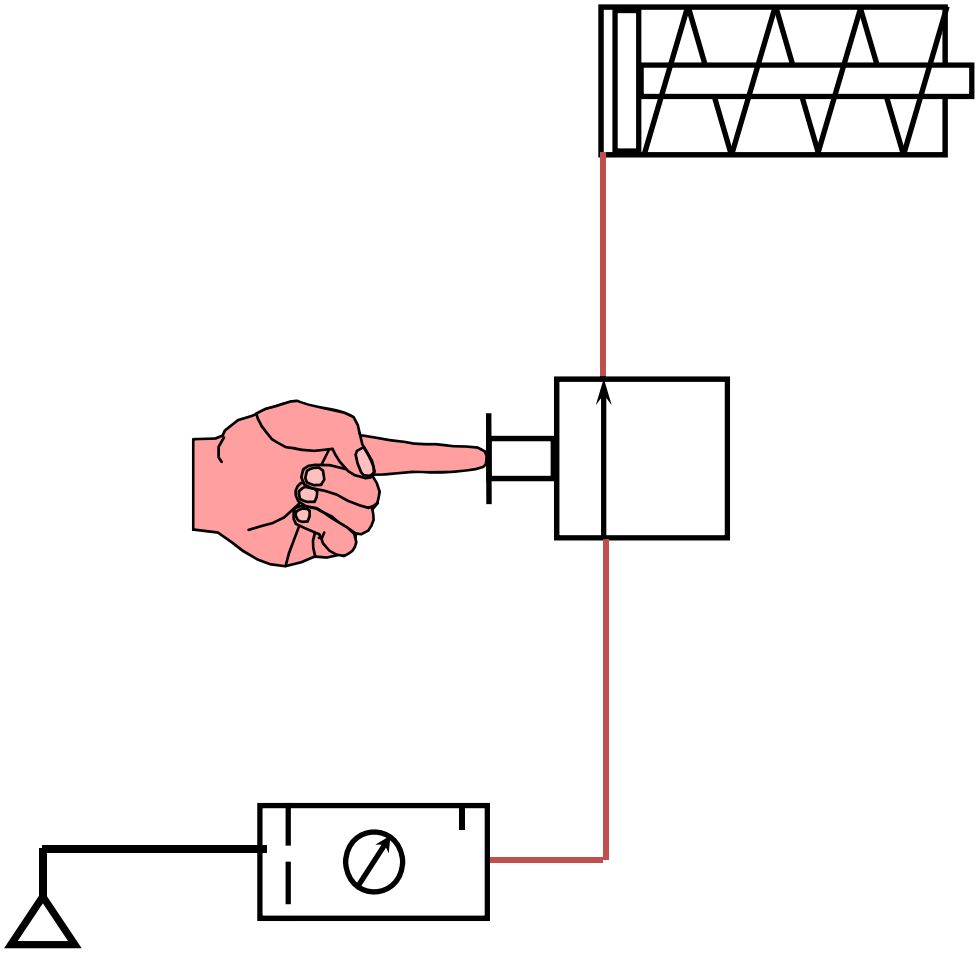
Pedal

Detent

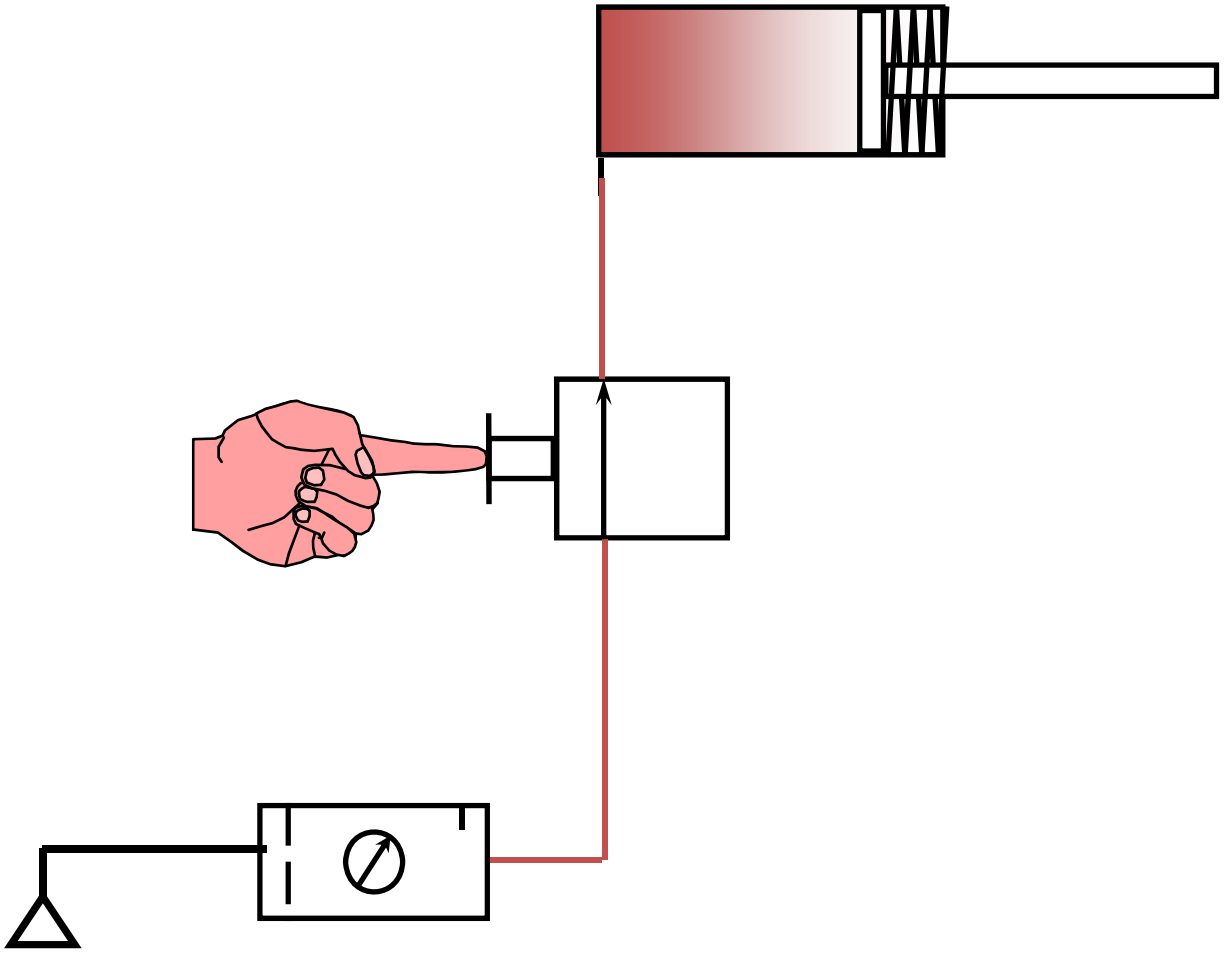
Types of Actuation



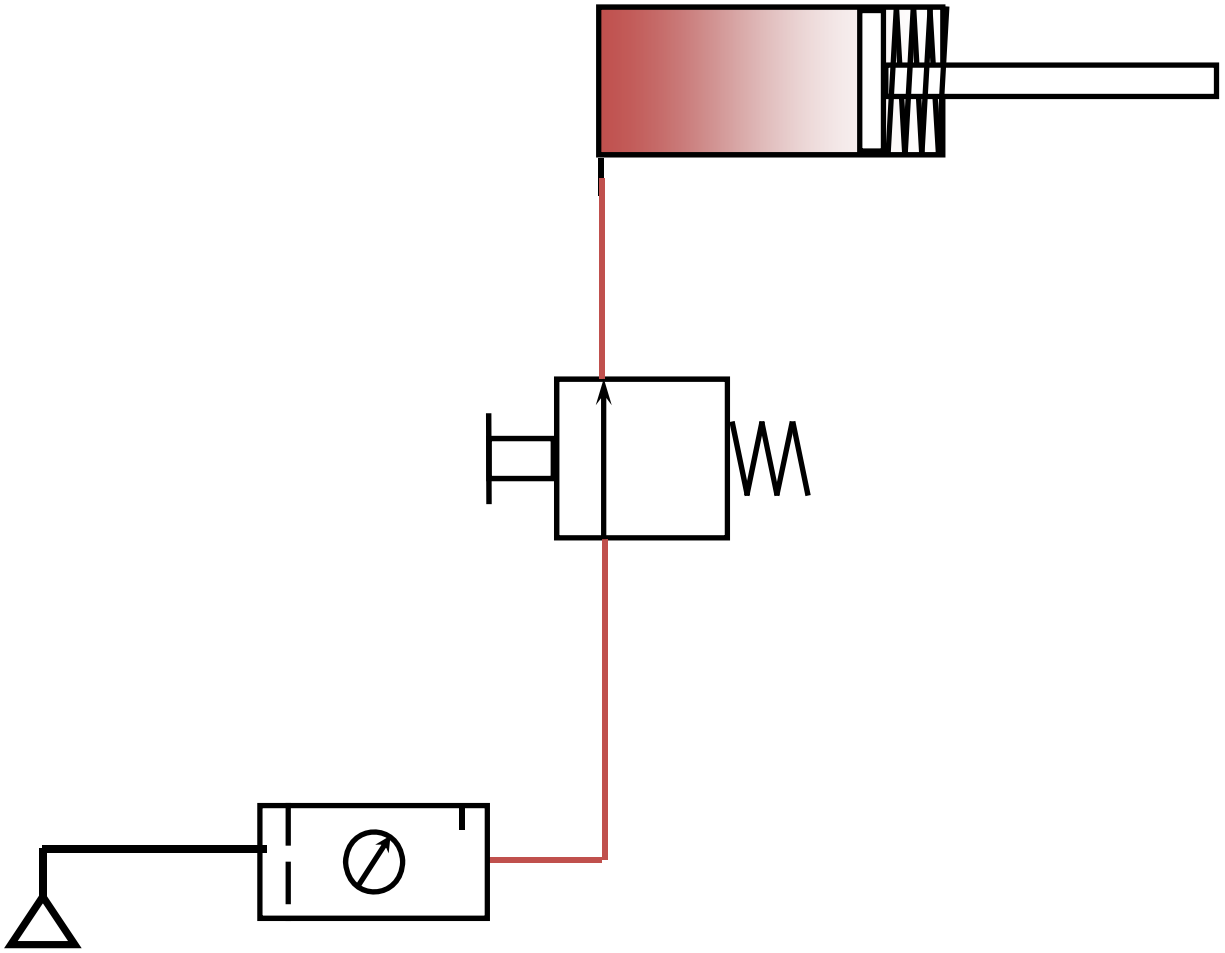
Valve Symbols



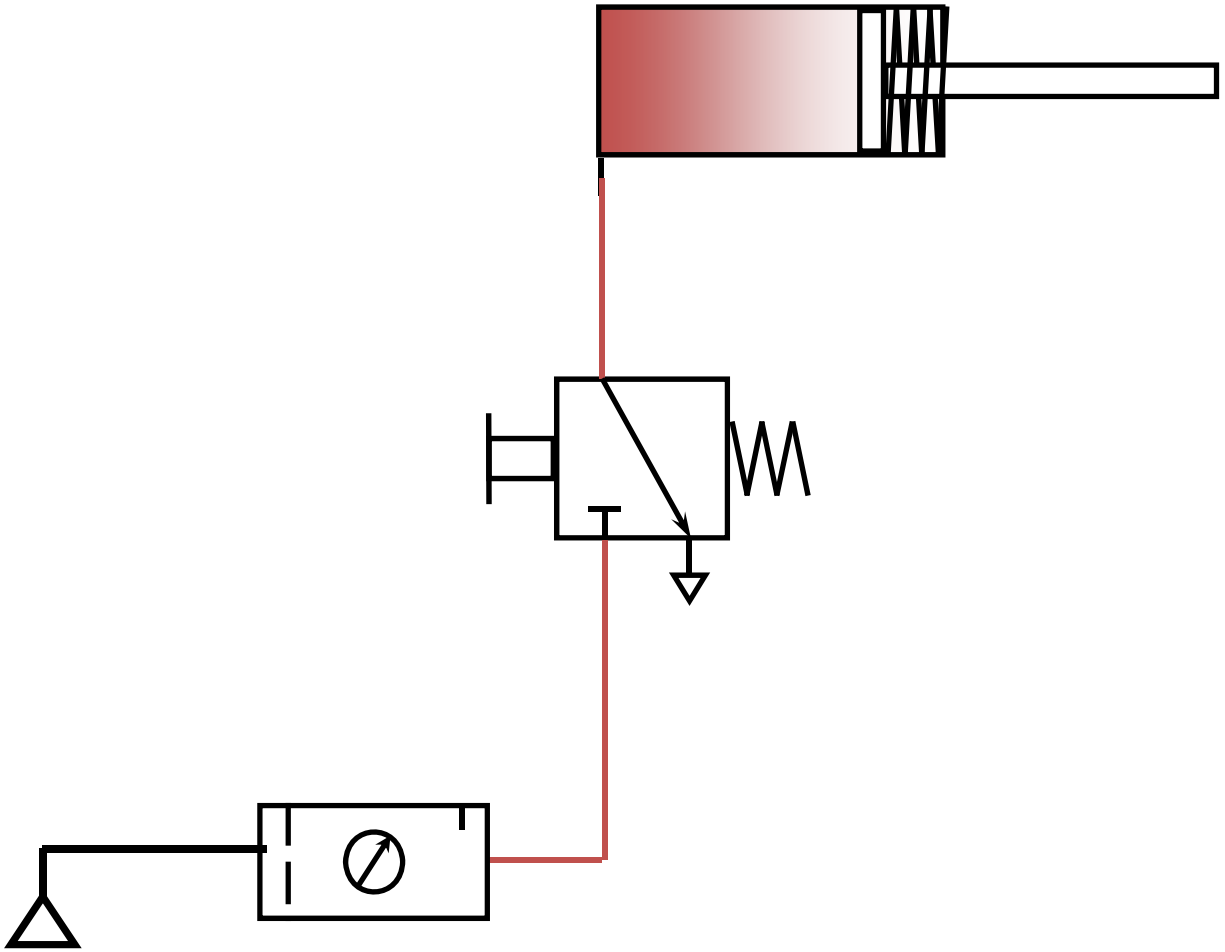
Valve Symbols



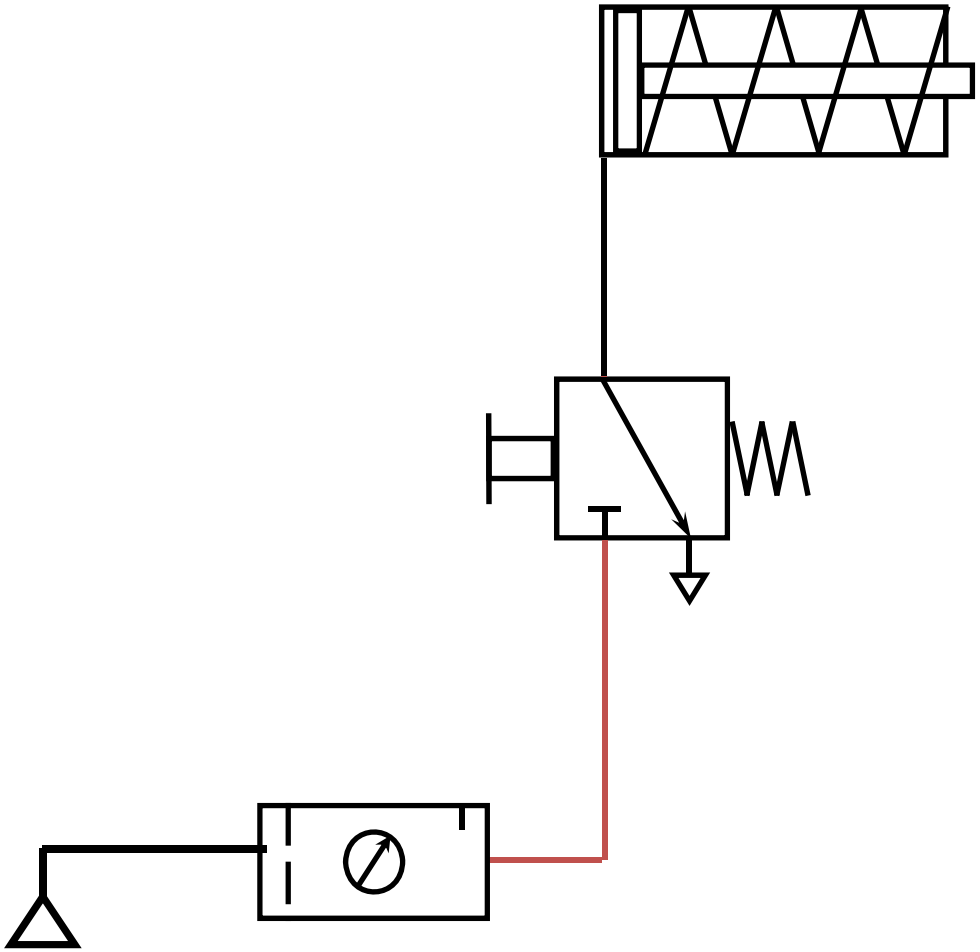
Valve Symbols



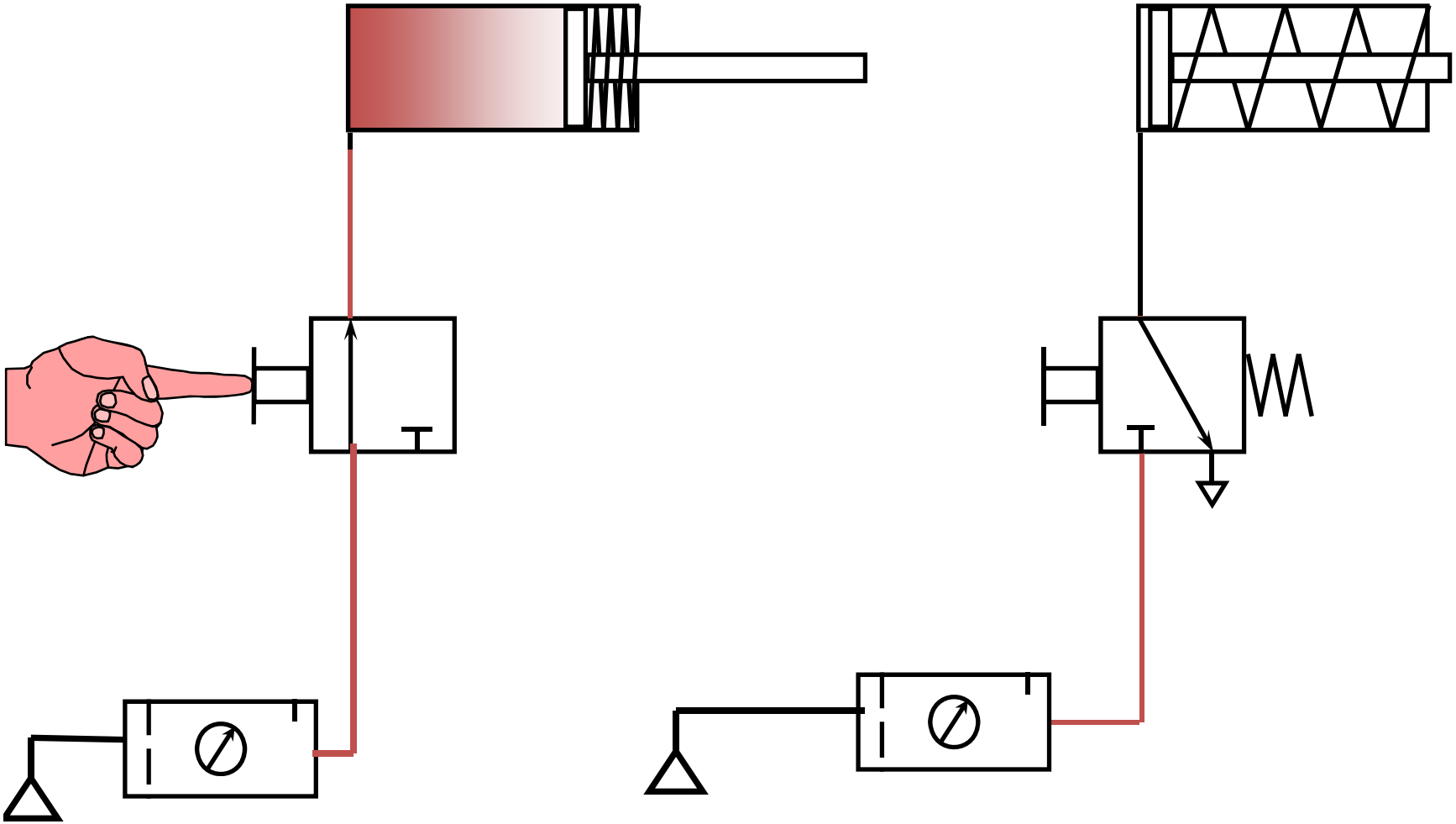
Valve Symbols



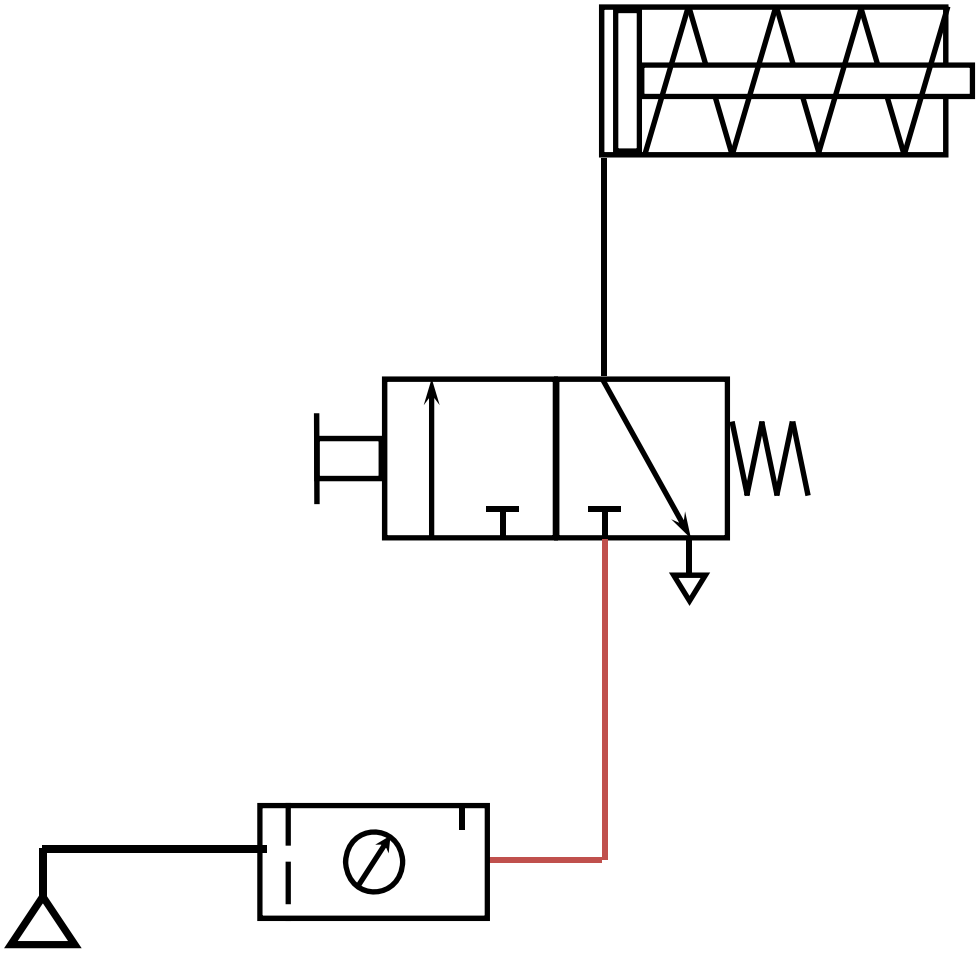
Valve Symbols



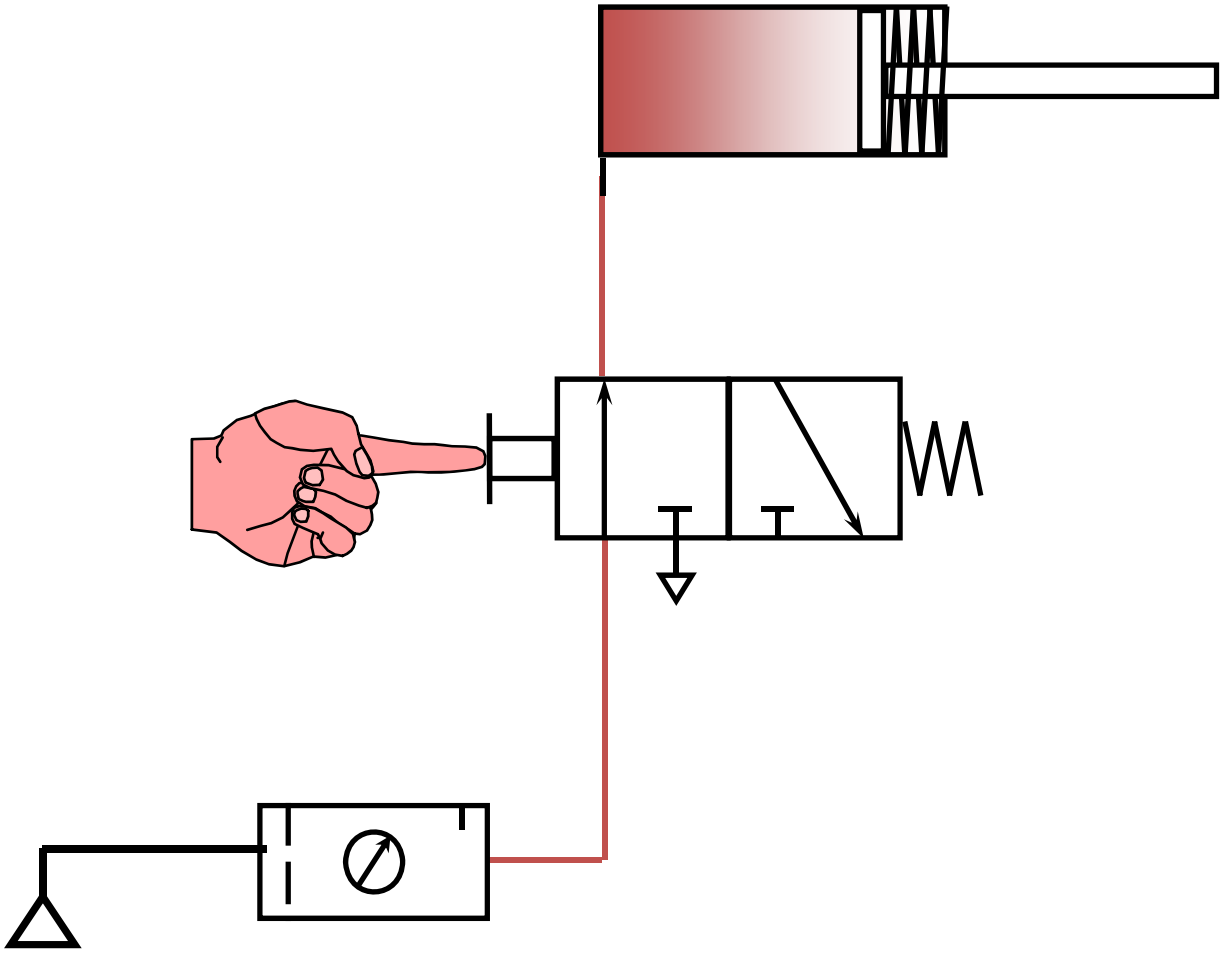
Valve Symbols



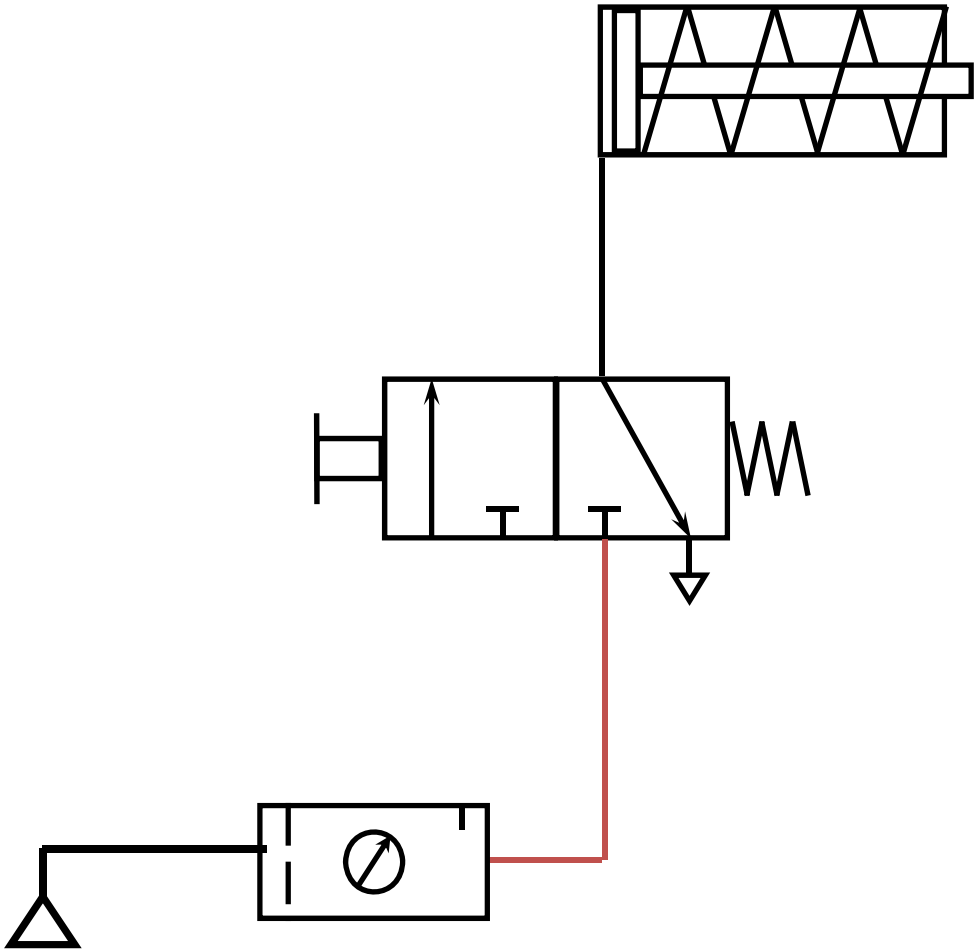
Valve Symbols



Valve Symbols



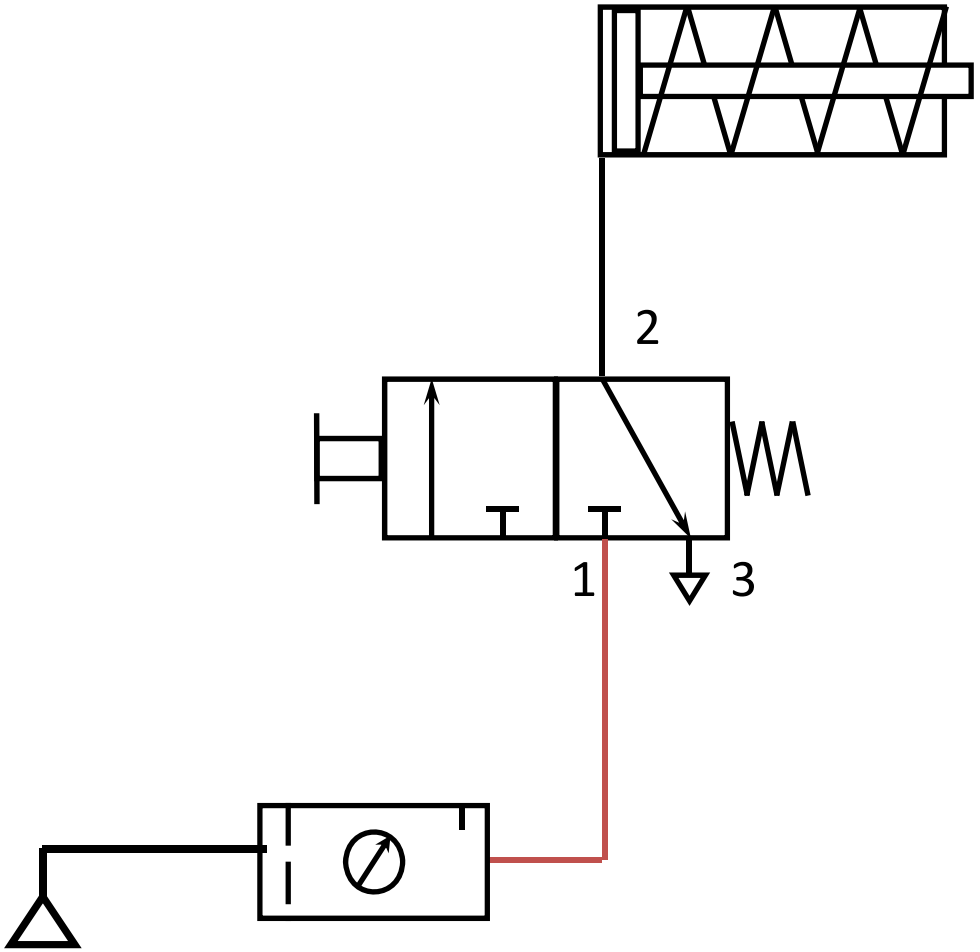
Valve Symbols



Numbering of Ports

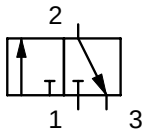
	ISO 5599	ISO 1219
Supply	1	P
Output	2,4	A,B
Exhaust	3,5	R,S
Pilot Lines	12,14	X,Y

Valve Symbols



3/2 Way Valve

3/2 Way Valve



3 ports

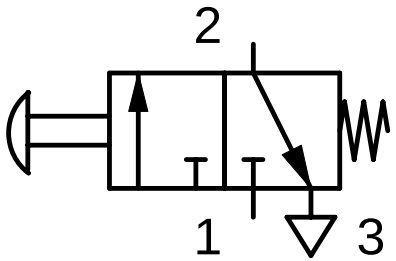
Operation :

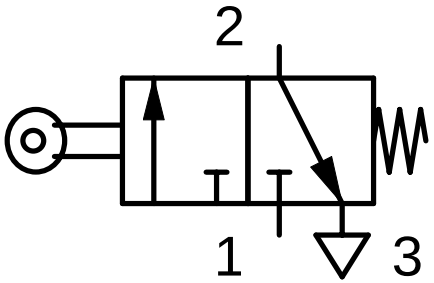
Block and allow air signal in a single passage

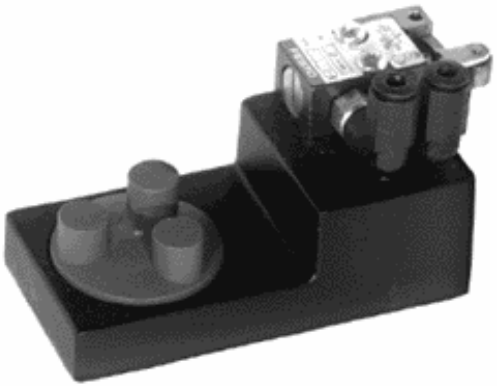
Valve Description

Description of Valve

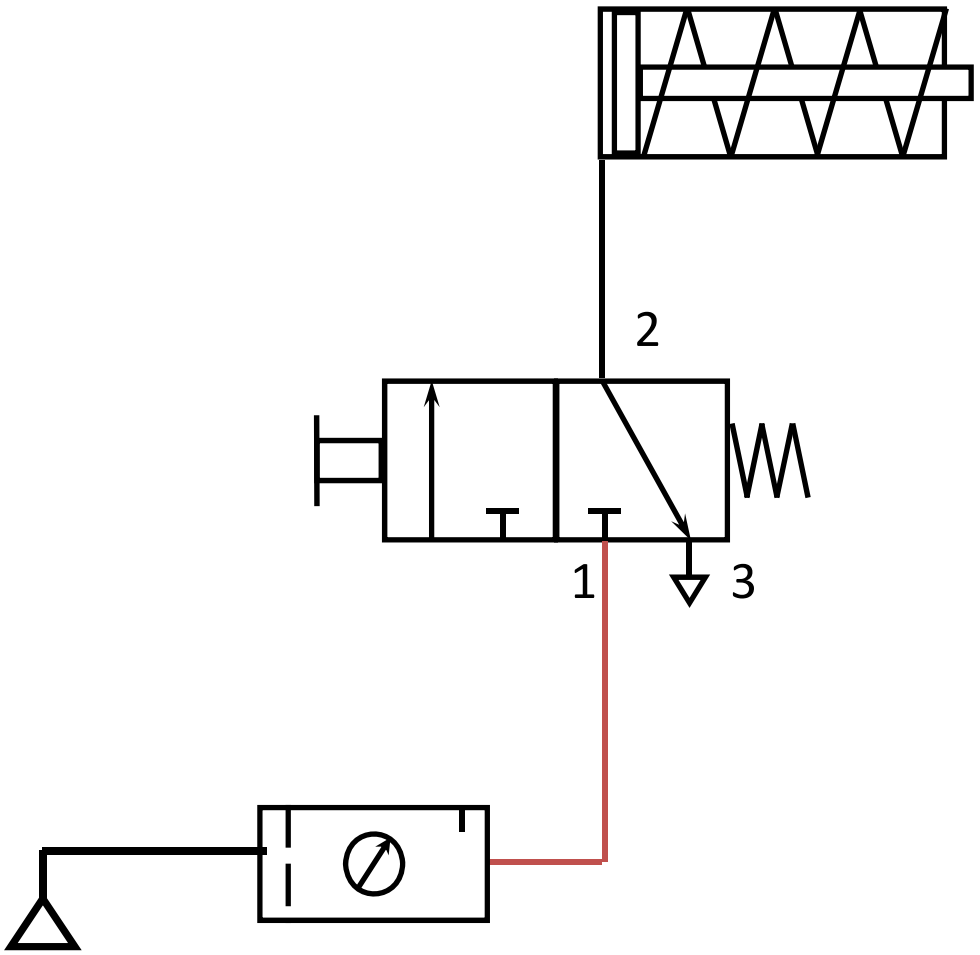
- Number of Ports
- Number of Positions
- Method of Actuation
- Method of Return Actuation
- Normal Position


2
1
3


2
1
3



Valve Symbols



3/2 Way Valve

Push Button Actuated

Spring Returned

Normally Closed

Design Principles

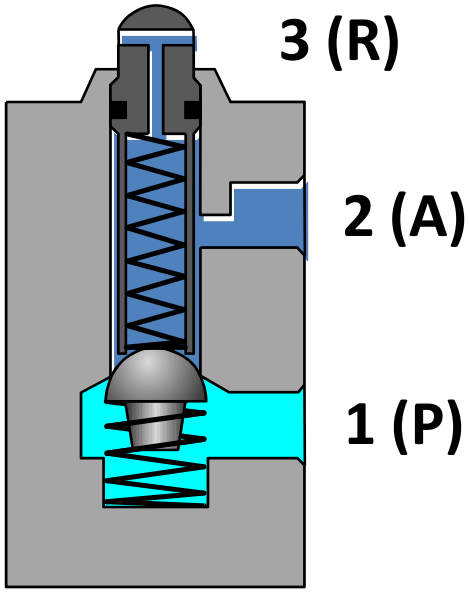
The Design of Control Valves are Categorized as

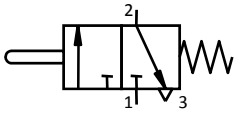
- Poppet Valves
  - » Ball Seat
  - » Disc Seat
- Slide Valves
  - » Longitudinal Slide (Spool)

Poppet valves

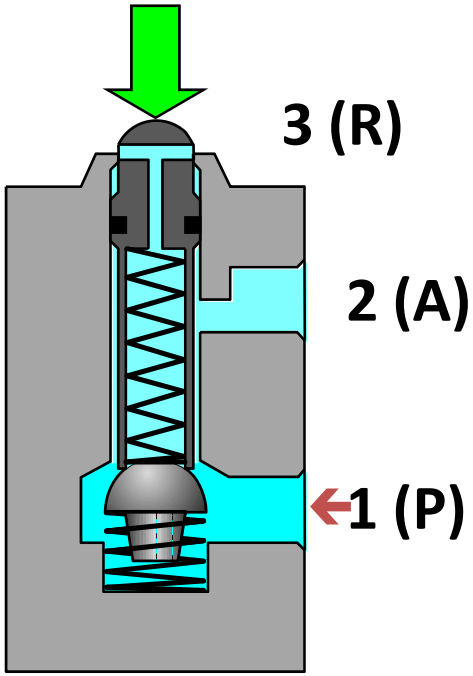
- Ball or Disk Seats
- Less Friction
- Long Service Life
- Large Actuating Force
- Cheap

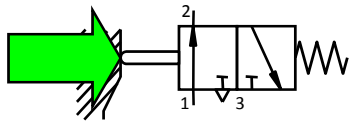
3/2-way valve ball seat, normally closed





3/2-way valve ball seat, normally closed



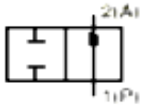


Number of ports

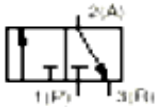
Number of switching positions

2/2-way valve

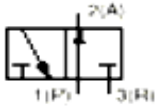
3/2-way valve, normally closed



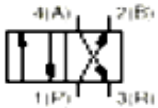
3/2-way valve, normally open

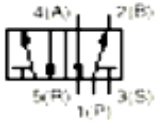


4/2-way valve



5/2-way valve

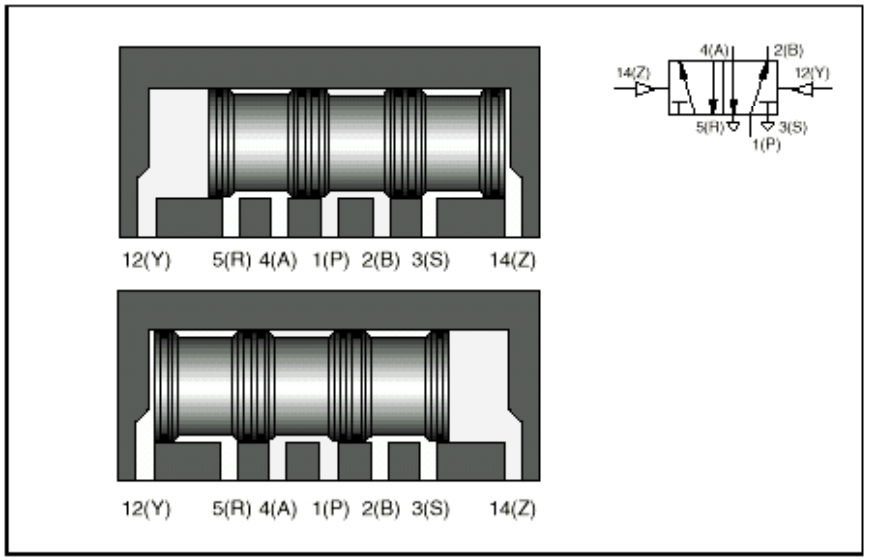


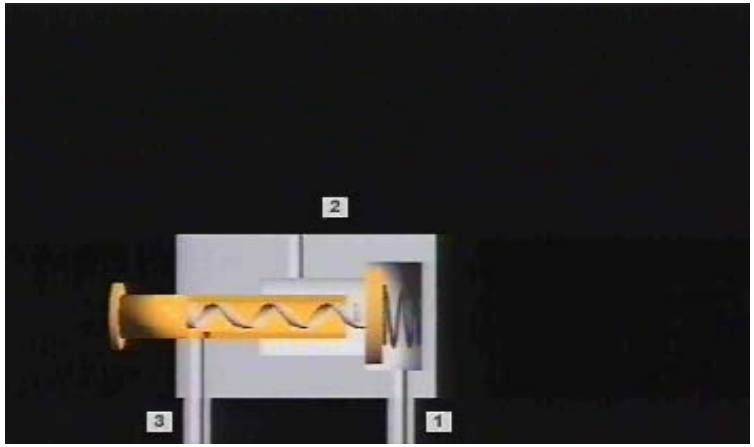


Slide valves

- Sliding Spool
- High Friction
- Low Actuating Force

Slide valves





Control of Single Acting Cylinder with a 3/2 Way Valve

Exercise

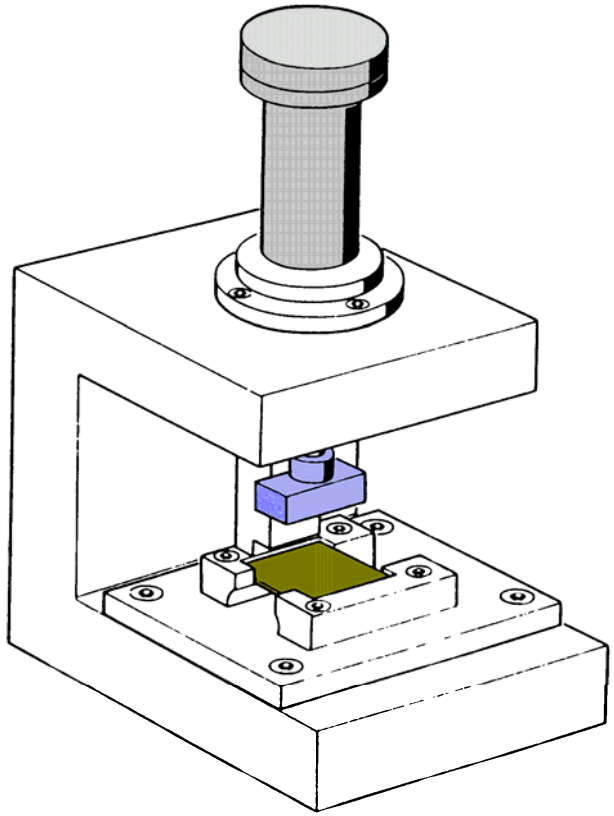
Exercise 1

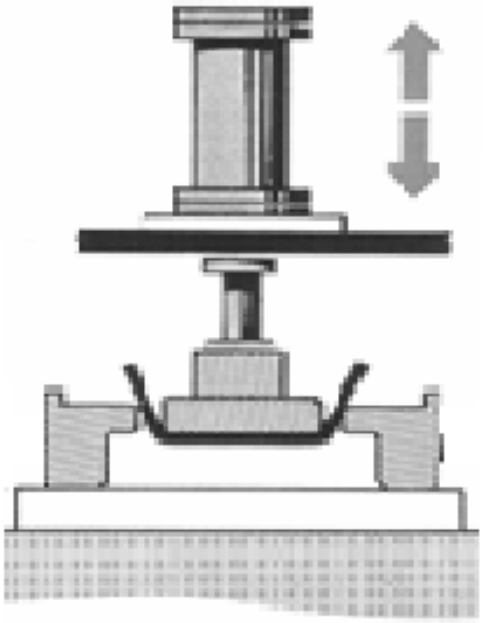
PROBLEM:

Sheet metals are to be U-formed using a single acting cylinder.
The start signal is to be given using a pushbutton.

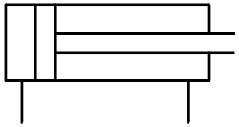
METHOD:

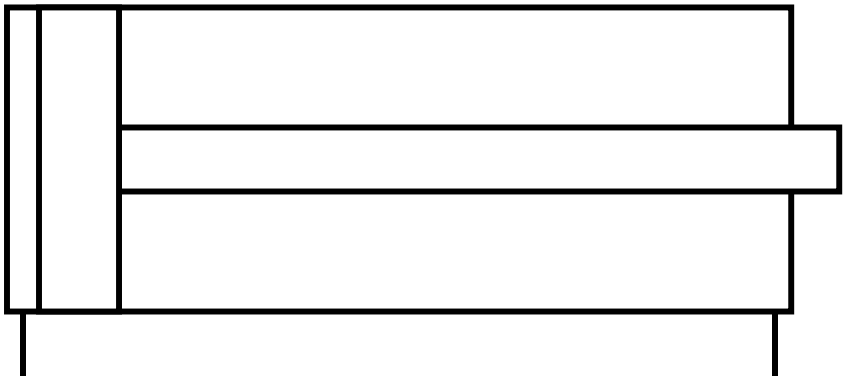
a. Direct actuation
b. Indirect actuation





Double Acting Cylinder

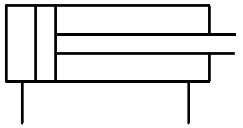


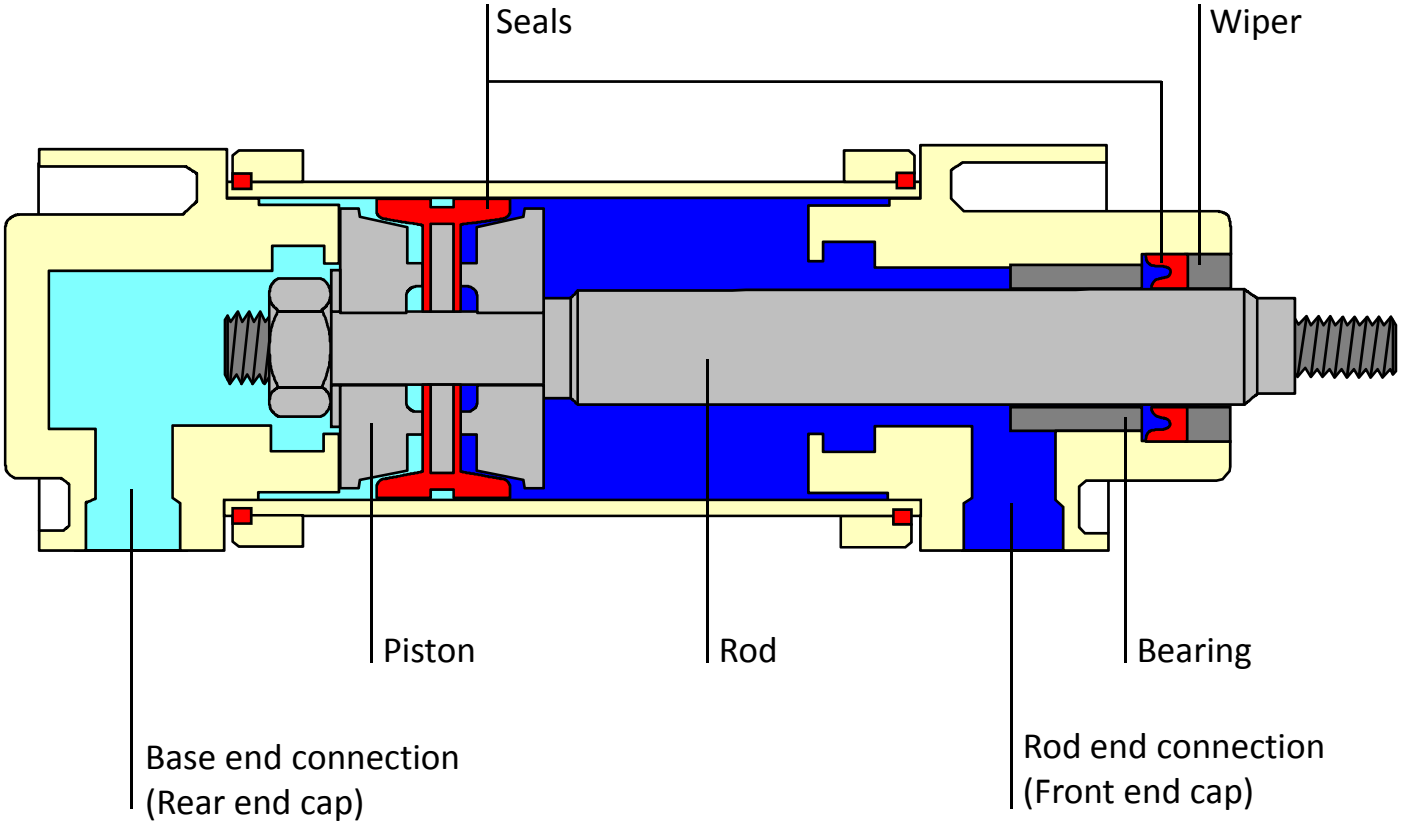


Double Acting Cylinder

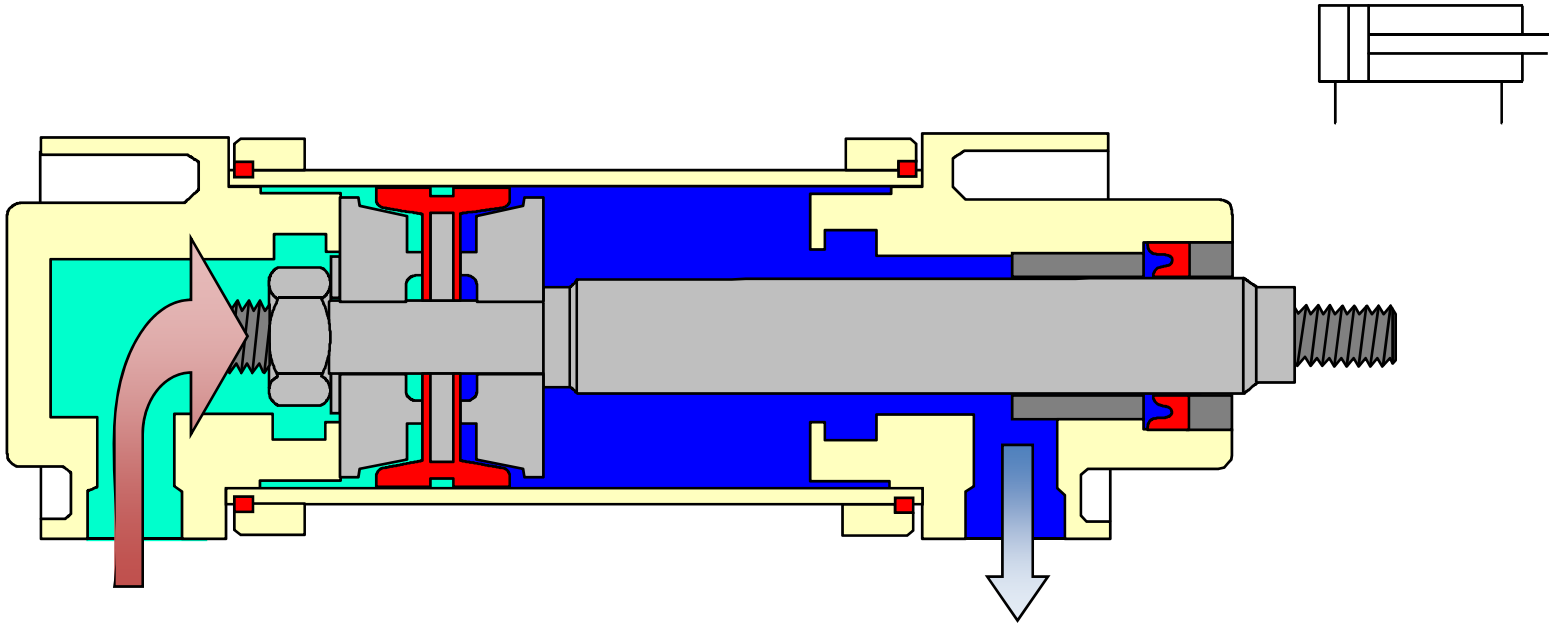
Advance and Return stroke by pressure

Double acting cylinder

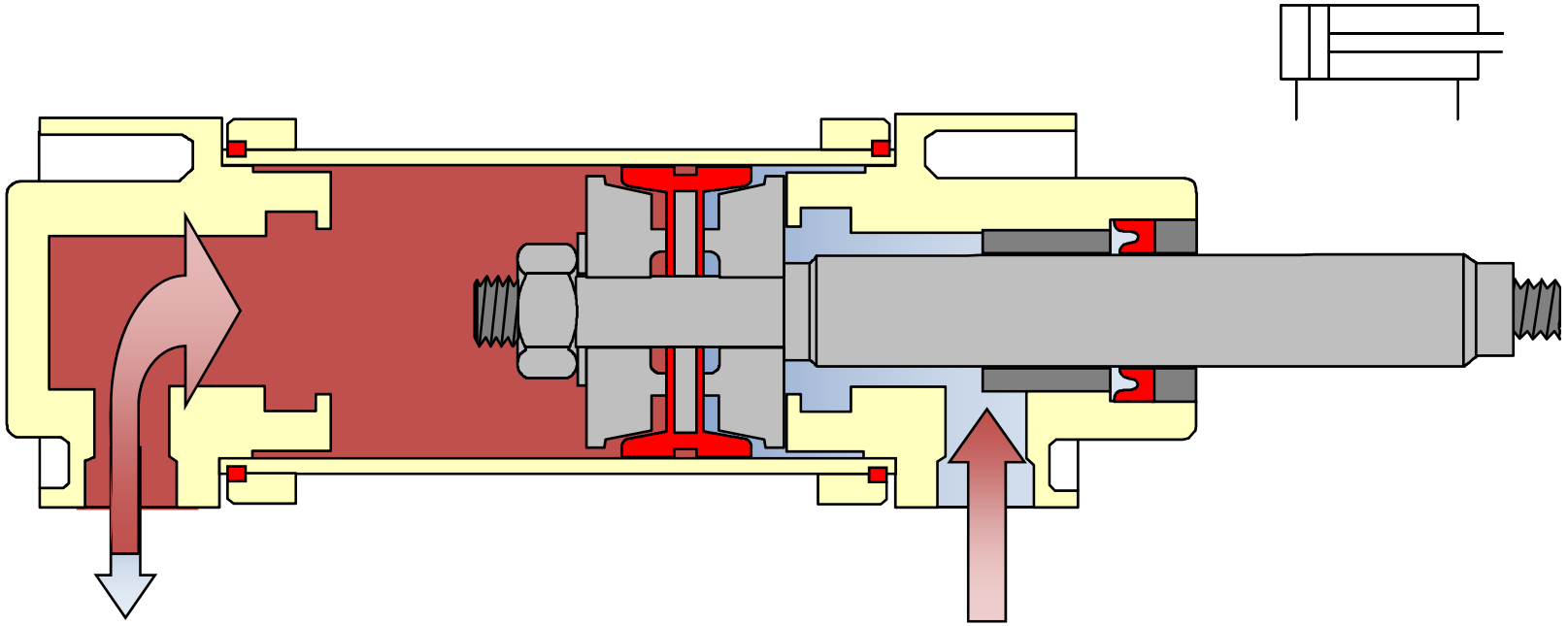




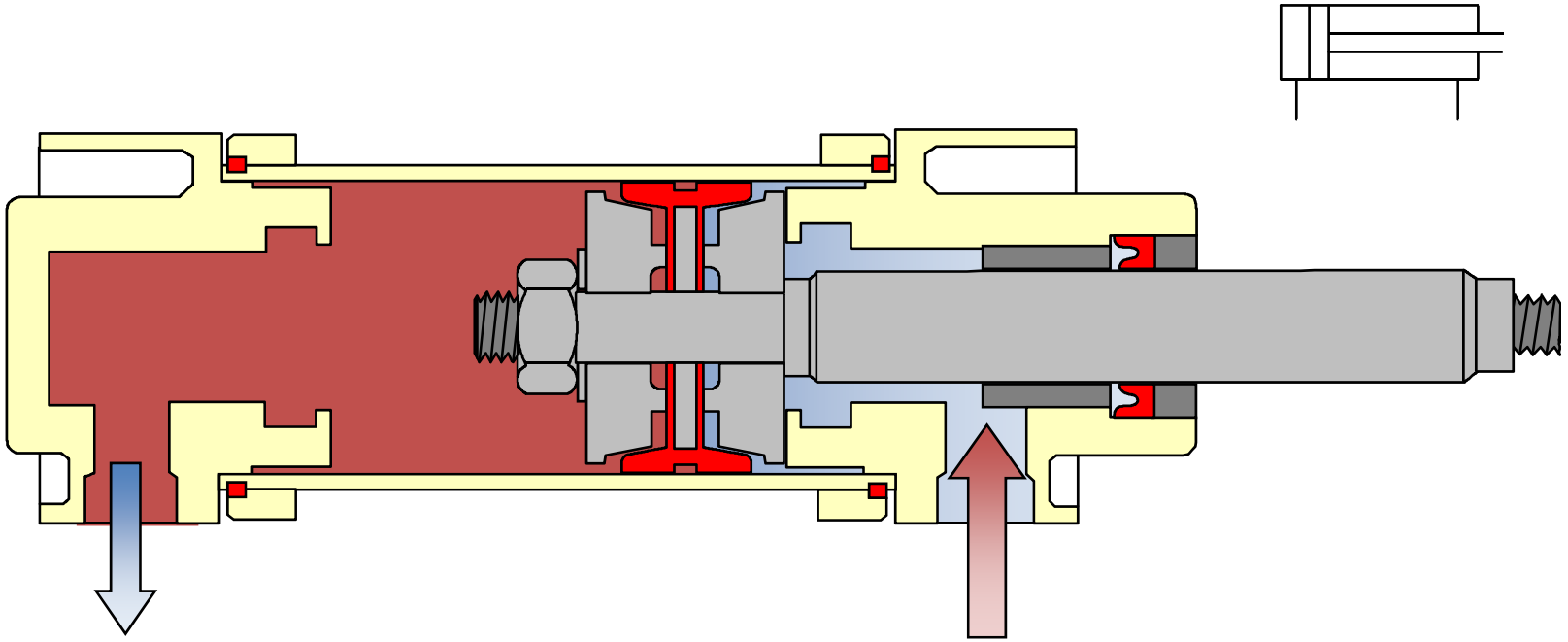
Double Acting Cylinder



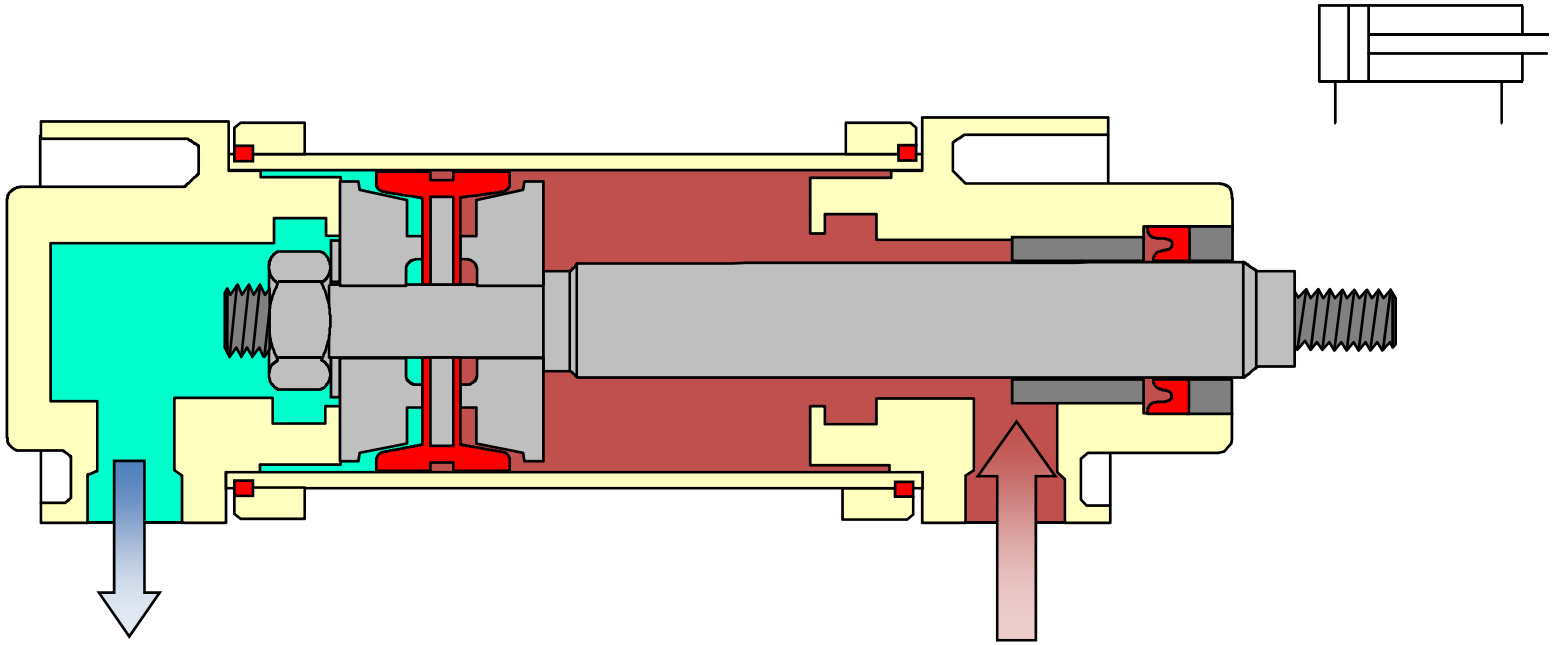
Double Acting Cylinder

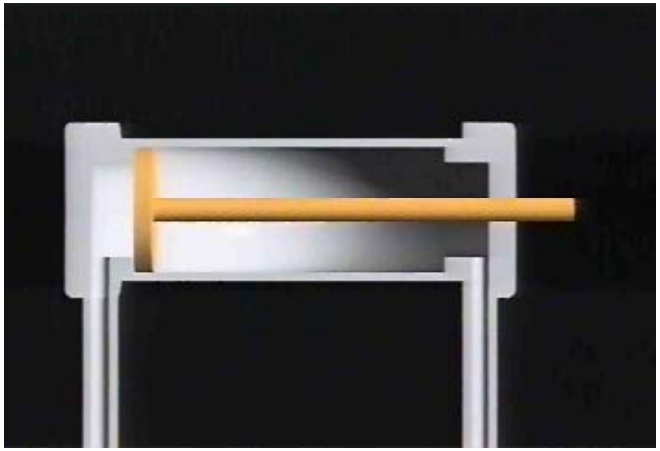


Double Acting Cylinder

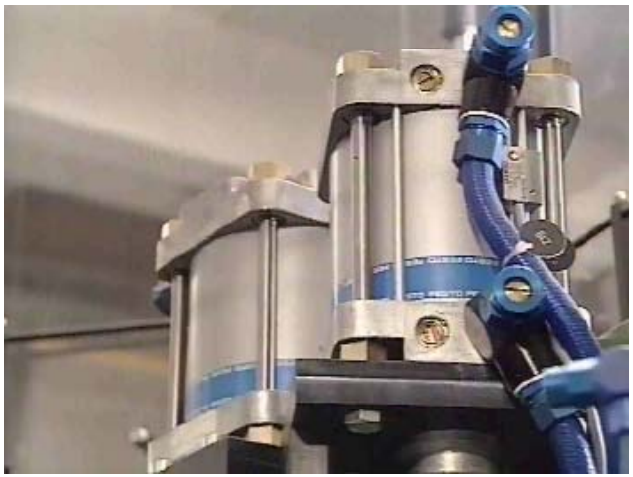


Double Acting Cylinder





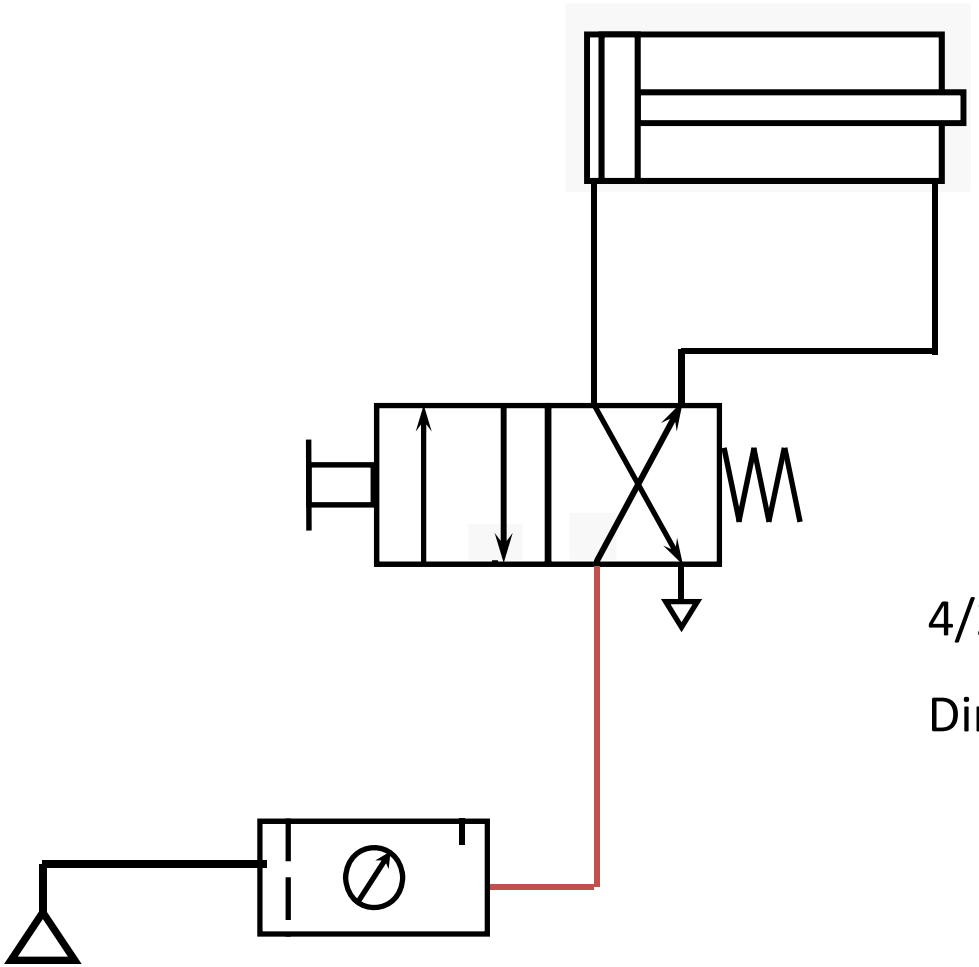
Double Acting Cylinder
(Principle)



Double Acting Cylinder
(Principle)

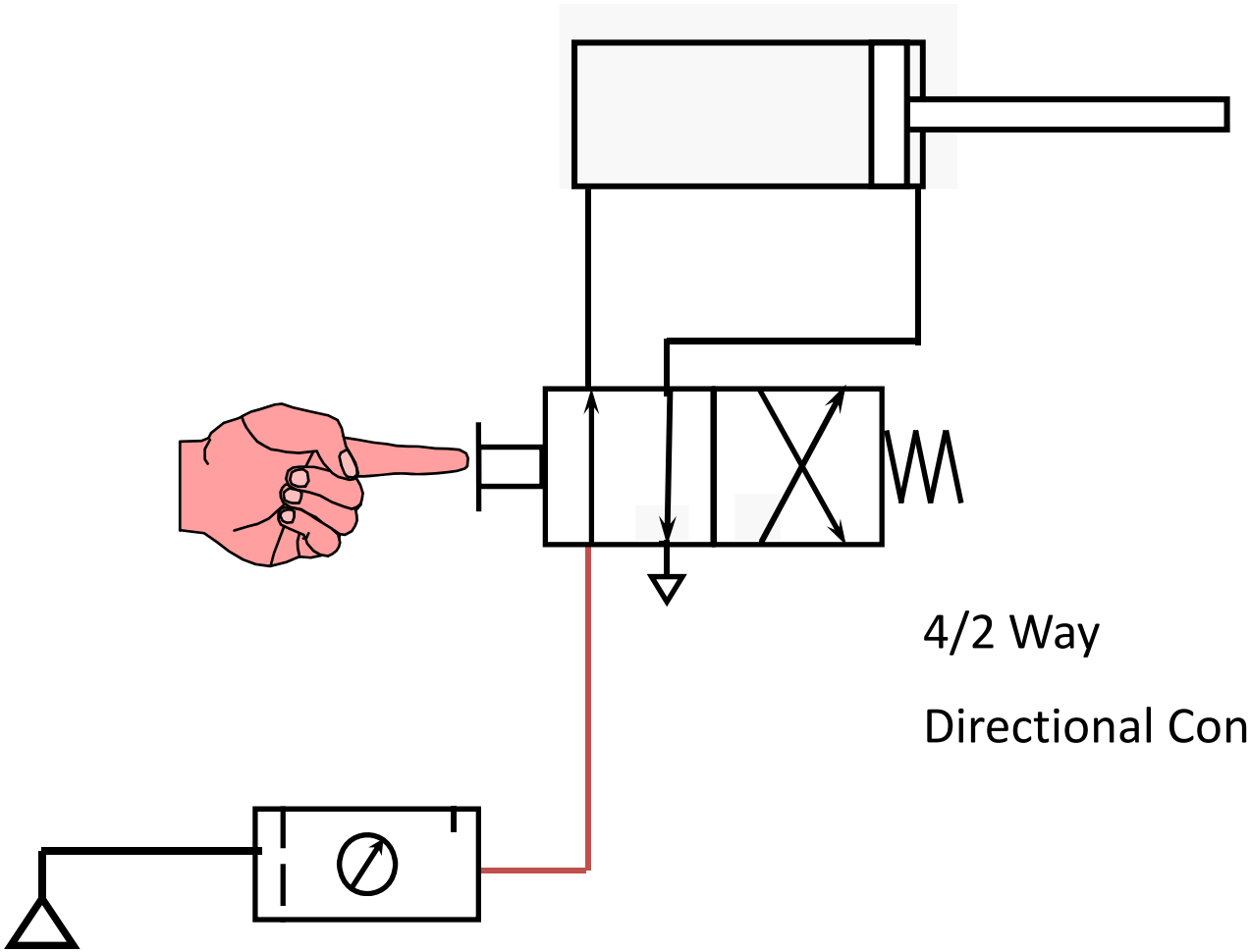
VALVES

Control of a Double Acting Cylinder



4/2 Way

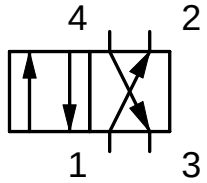
Directional Control Valve



4/2 Way

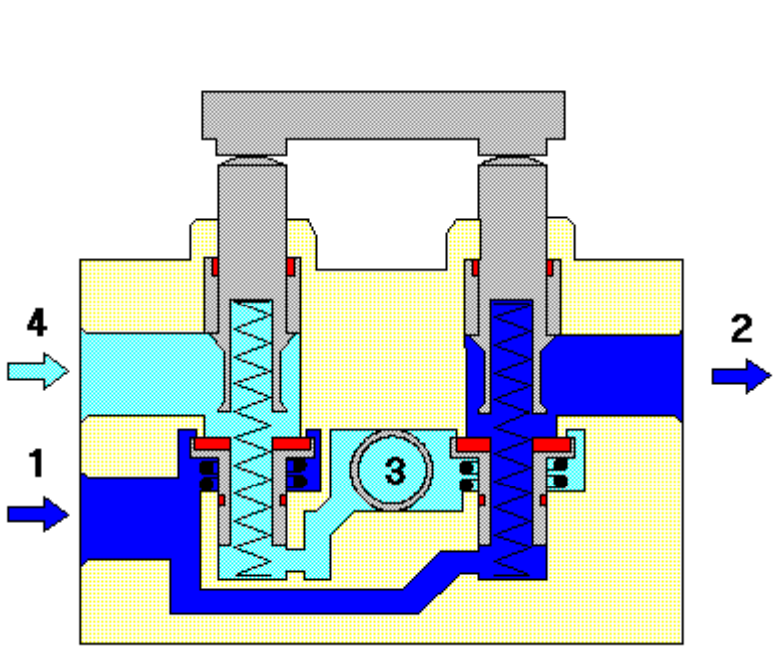
Directional Control Valve

4/2 Way Valve

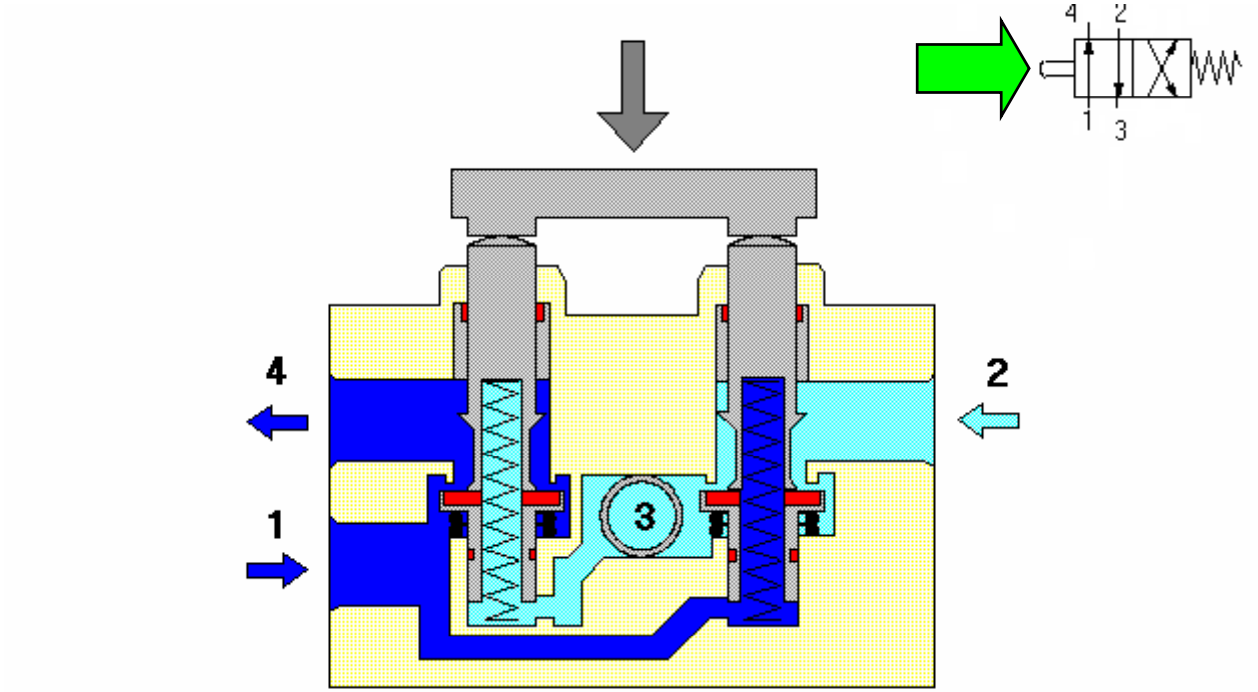


Operation :

Control air direction in dual passage

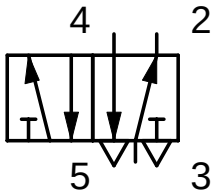


4 / 2 way valve, disc seat, unactuated



4 / 2 way valve, disc seat, actuated

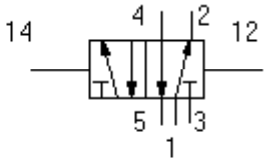
5/2 Way Valve

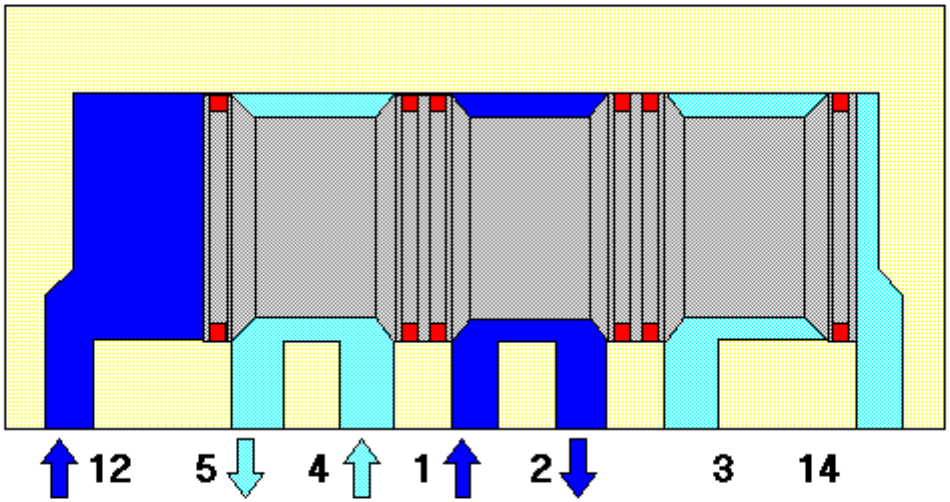


5 ports

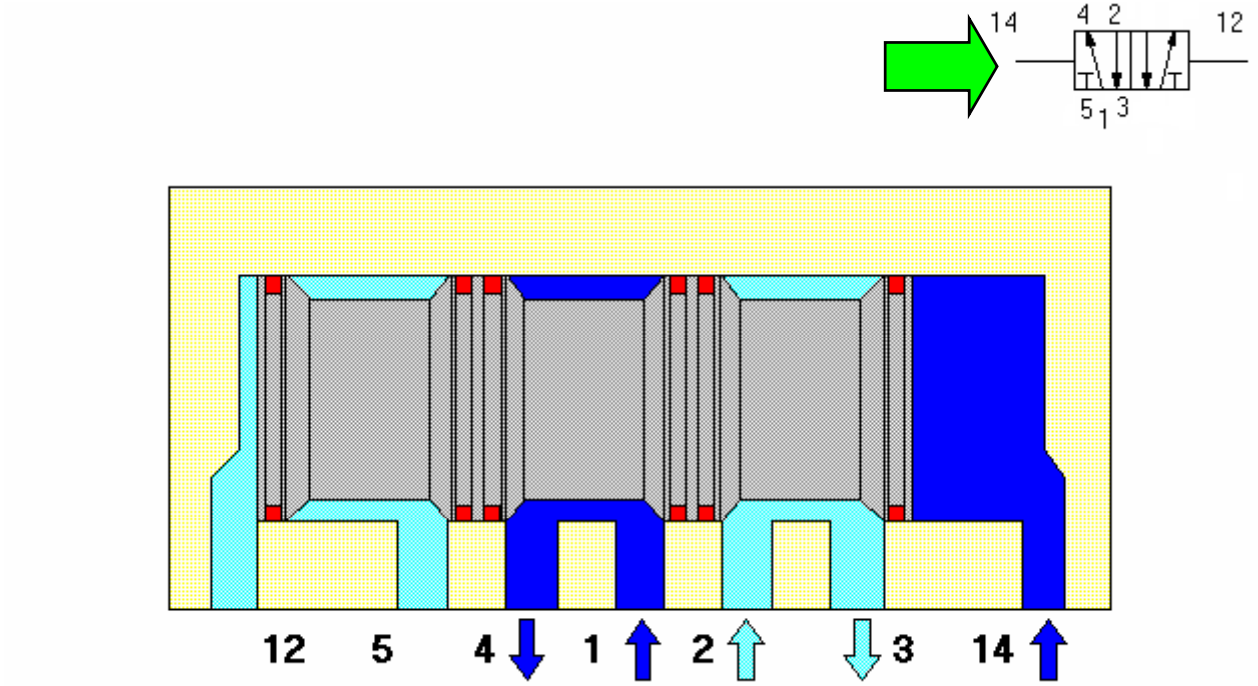
Operation :

Control air direction in dual passage

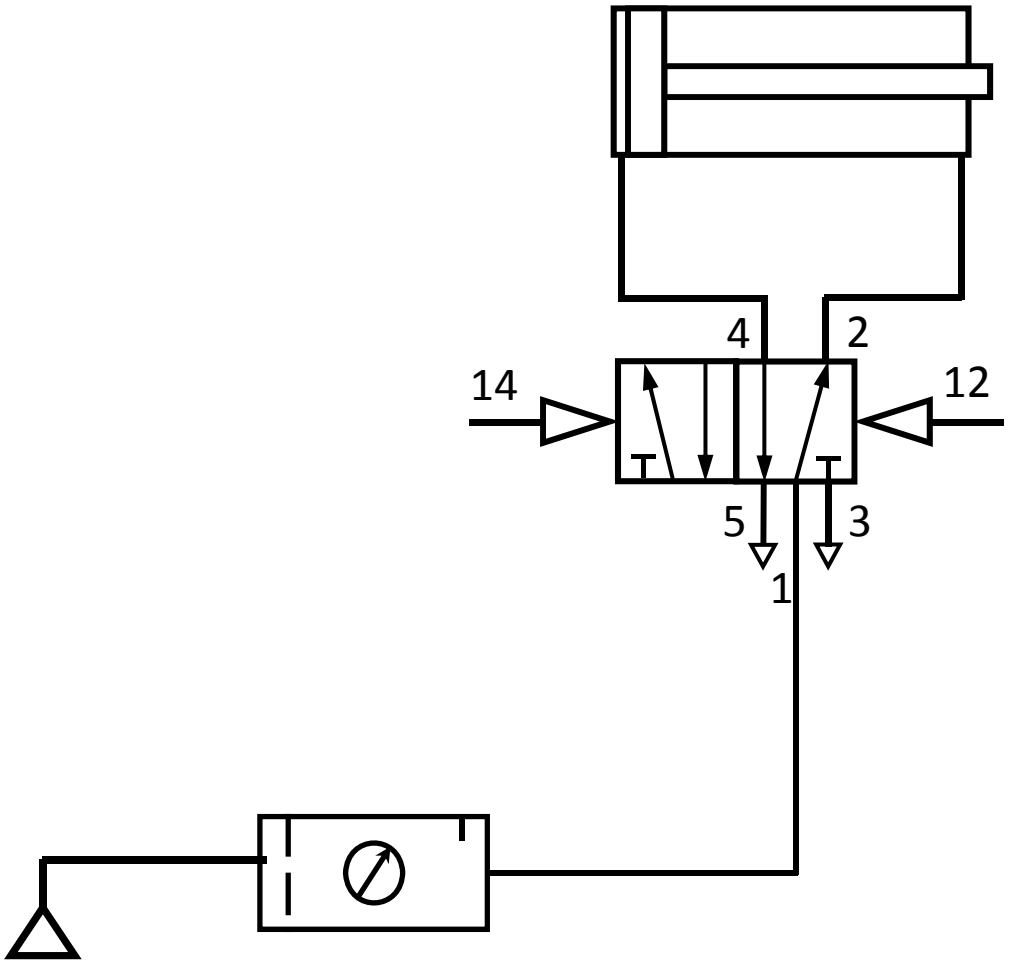


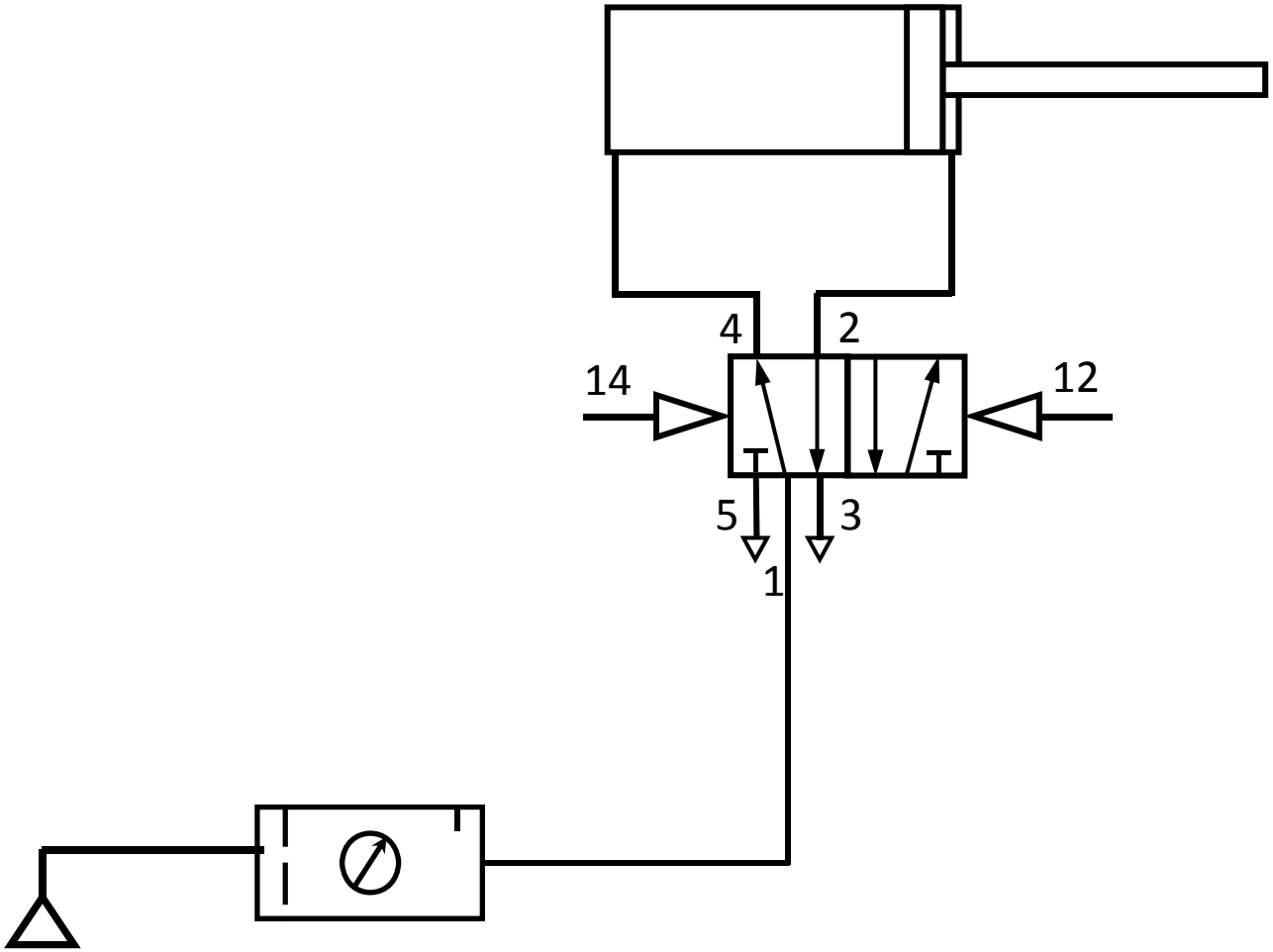


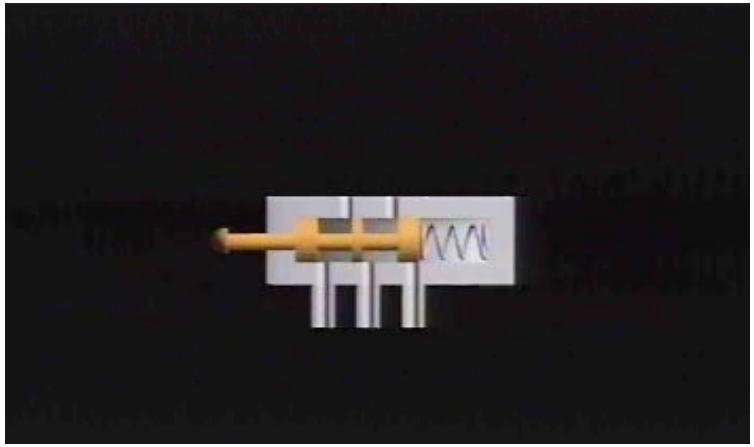
5 / 2 way valve, longitudinal slide principle



5 / 2 way valve, longitudinal slide principle


4
2
14
12
5
3
1


4
2
14
12
5
3
1

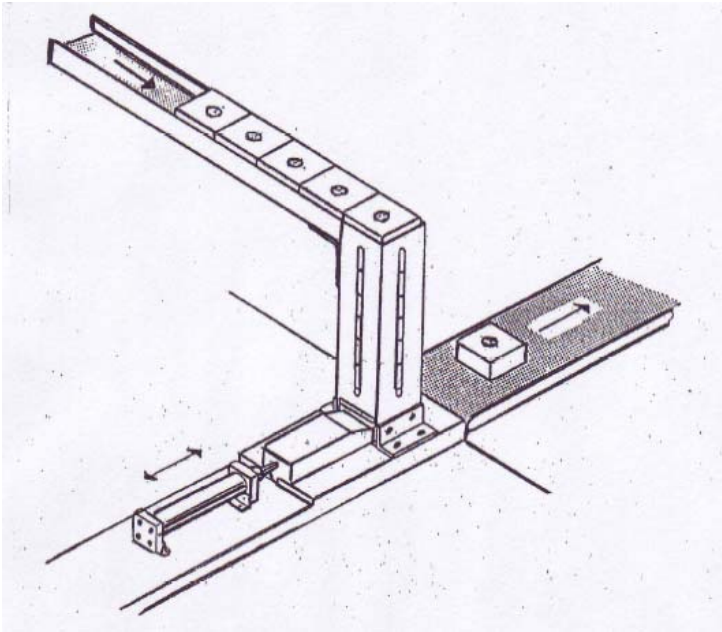


Direct Control of Double Acting Cylinder with 5/2 Way Valve

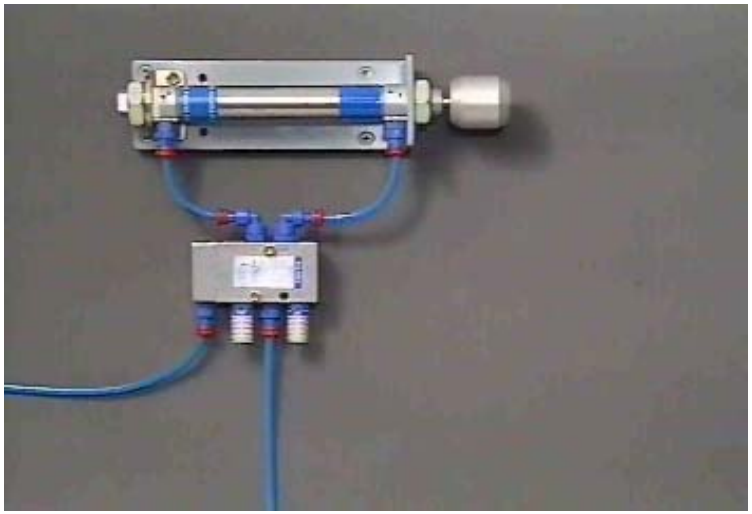
Exercise 2

PROBLEM:

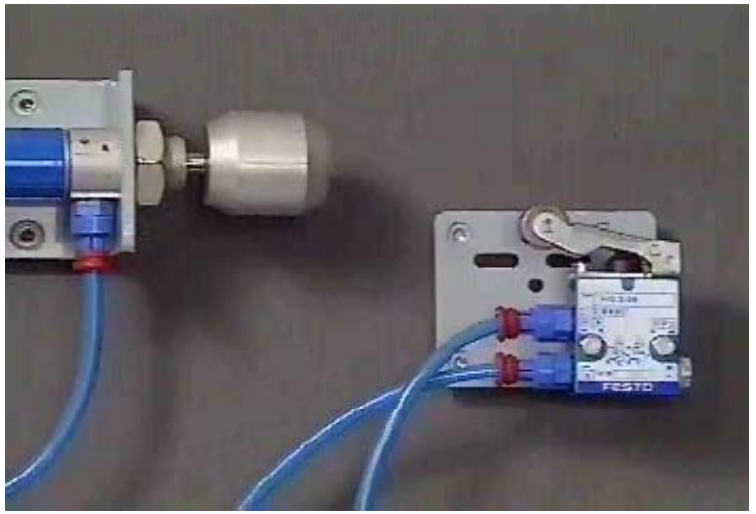
a) The piston is to extend when a pushbutton is pressed and return immediately to its start position when the pushbutton is released.
(Continuous actuation)



b) The piston is to extend when a pushbutton is pressed and return automatically to its start position after reaching full extension.
(impulse actuation)



Control of Double Acting Cylinder



Control of Double Acting Cylinder

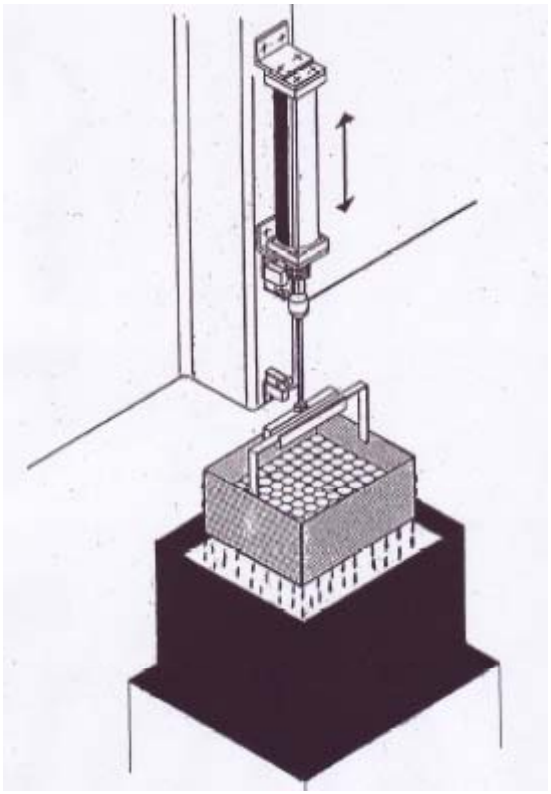
(Impulse Actuation)

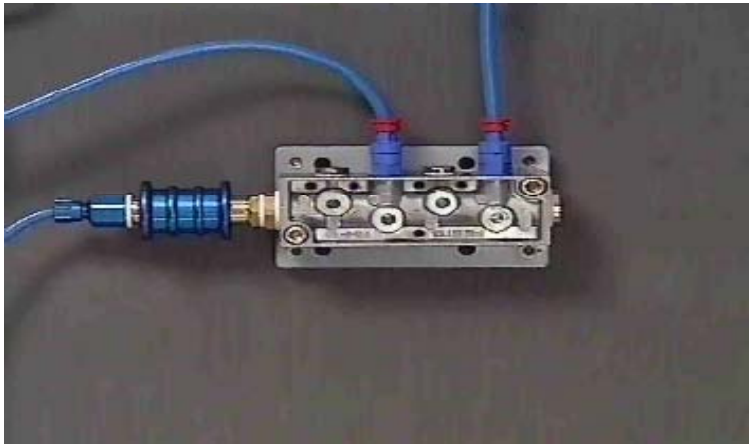
Exercise 3

PROBLEM:

A container of washers is to be dipped in and out of the cleaning bath. The "START" and *STOP" for this continuous movement is to be achieved by actuating a pushbutton each.

On actuating the stop pushbutton the container should stop at the top.





Control of Double Acting Cylinder

(Continuous Cycle with Push Button)

Valves Groups

Directional Control Valve

Flow control valve

Non-return valves

Pressure valves

Combination valves

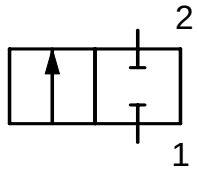
- Directional control valves influence the path taken by an air stream.

- **Types of Directional Control Valve**

  - **2/2 Way Valve**
  - **3/2 Way Valve (Covered)**
  - **4/2 Way Valve**
  - **5/2 Way Valve (Covered)**
  - **5/3 Way Valve**

• Directional Control Valve

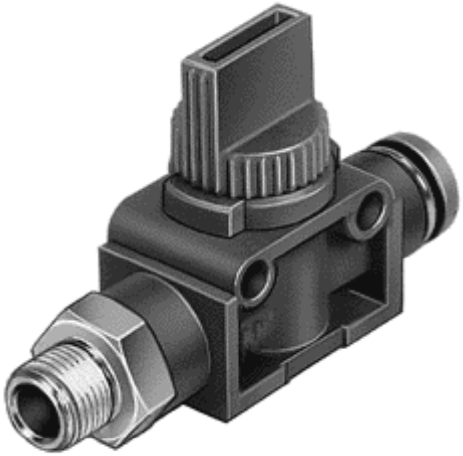
2/2 Way Valve



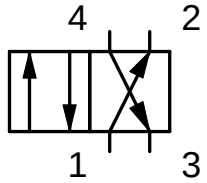
2 ports

Operation :

Used as a shut-off valve



4/2 Way Valve



Operation :

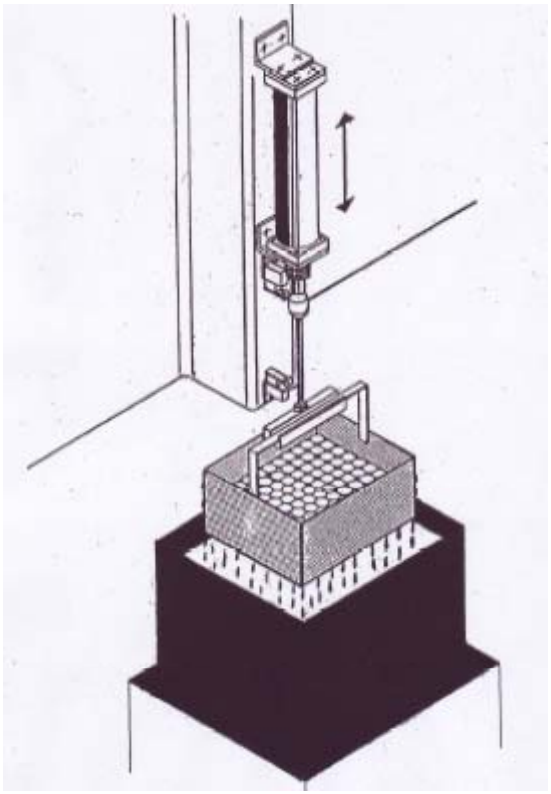
Control air direction in dual passage

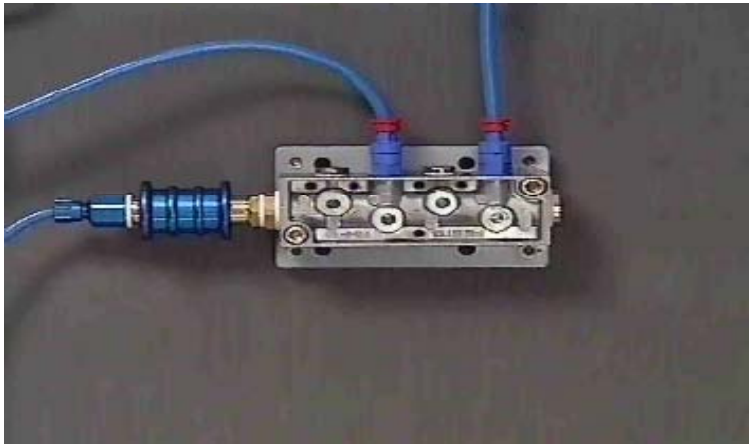
Exercise 3

PROBLEM:

A container of washers is to be dipped in and out of the cleaning bath. The "START" and *STOP" for this continuous movement is to be achieved by actuating a pushbutton each.

On actuating the stop pushbutton the container should stop at the top.

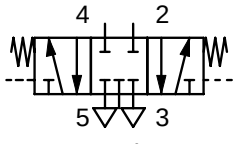




Control of Double Acting Cylinder

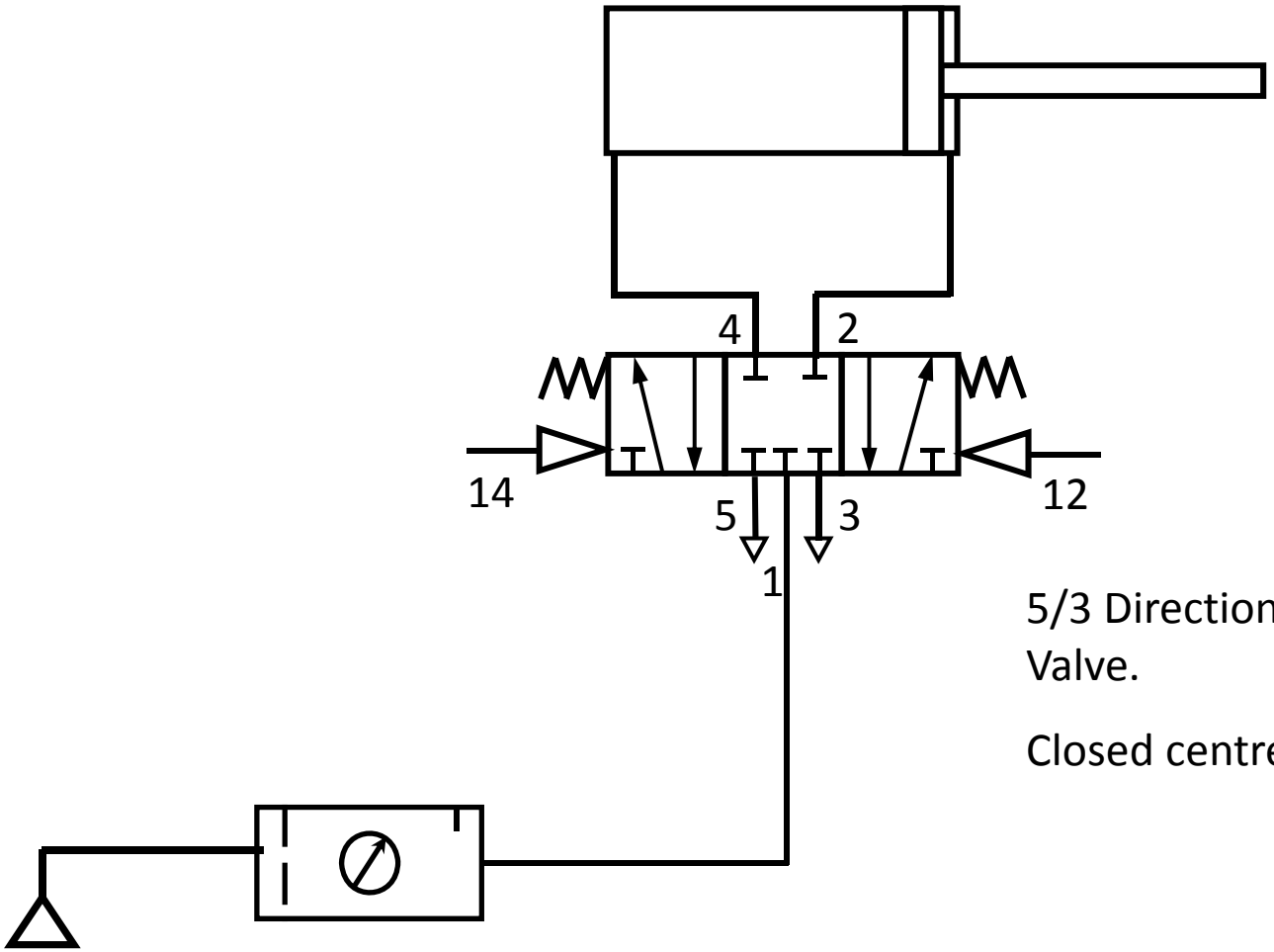
(Continuous Cycle with Push Button)

5/3 Way Valve



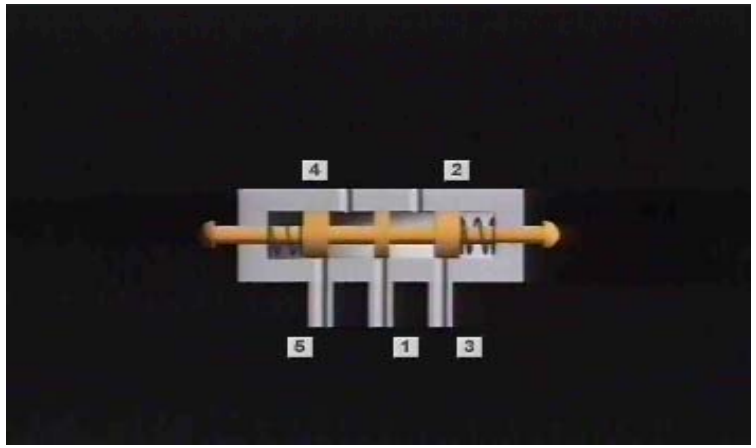
Operation :

Allows piston rod to be stopped at any position



5/3 Directional Control Valve.

Closed centre position



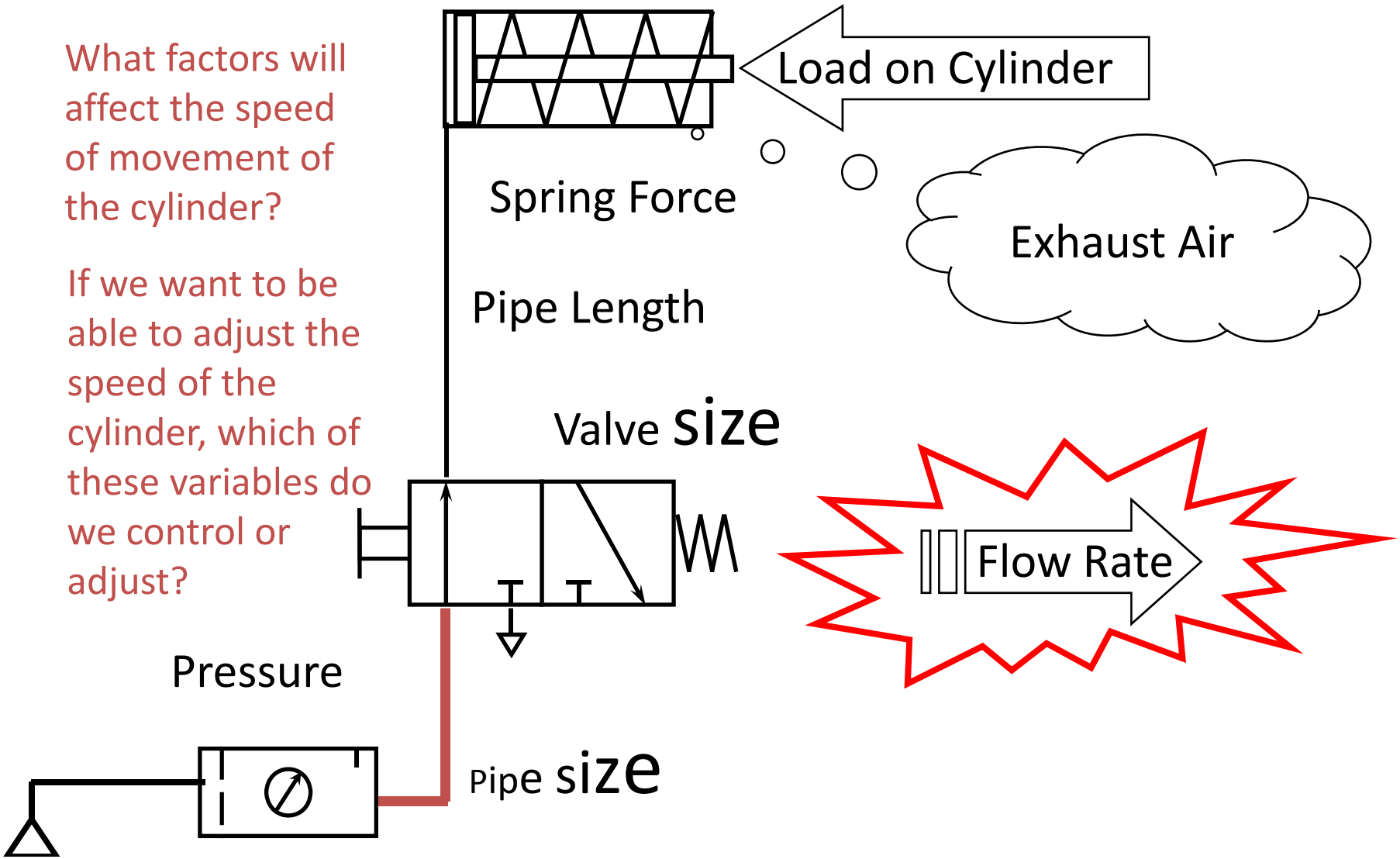
Animation of 5/3 Way Valve

Application of 5/3 Way Valve

End of Directional Control Valve

What factors will affect the speed of movement of the cylinder?

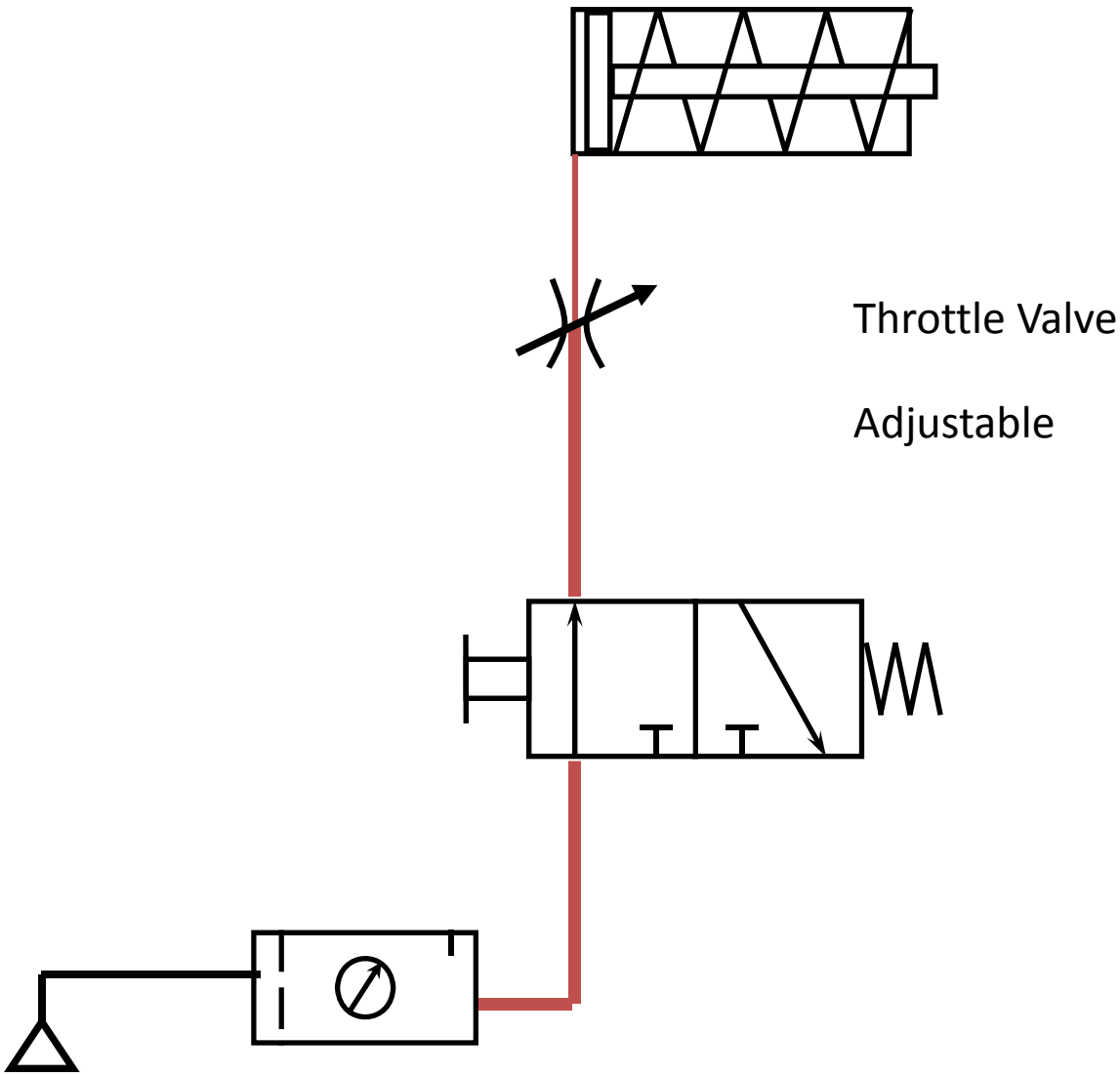
If we want to be able to adjust the speed of the cylinder, which of these variables do we control or adjust?

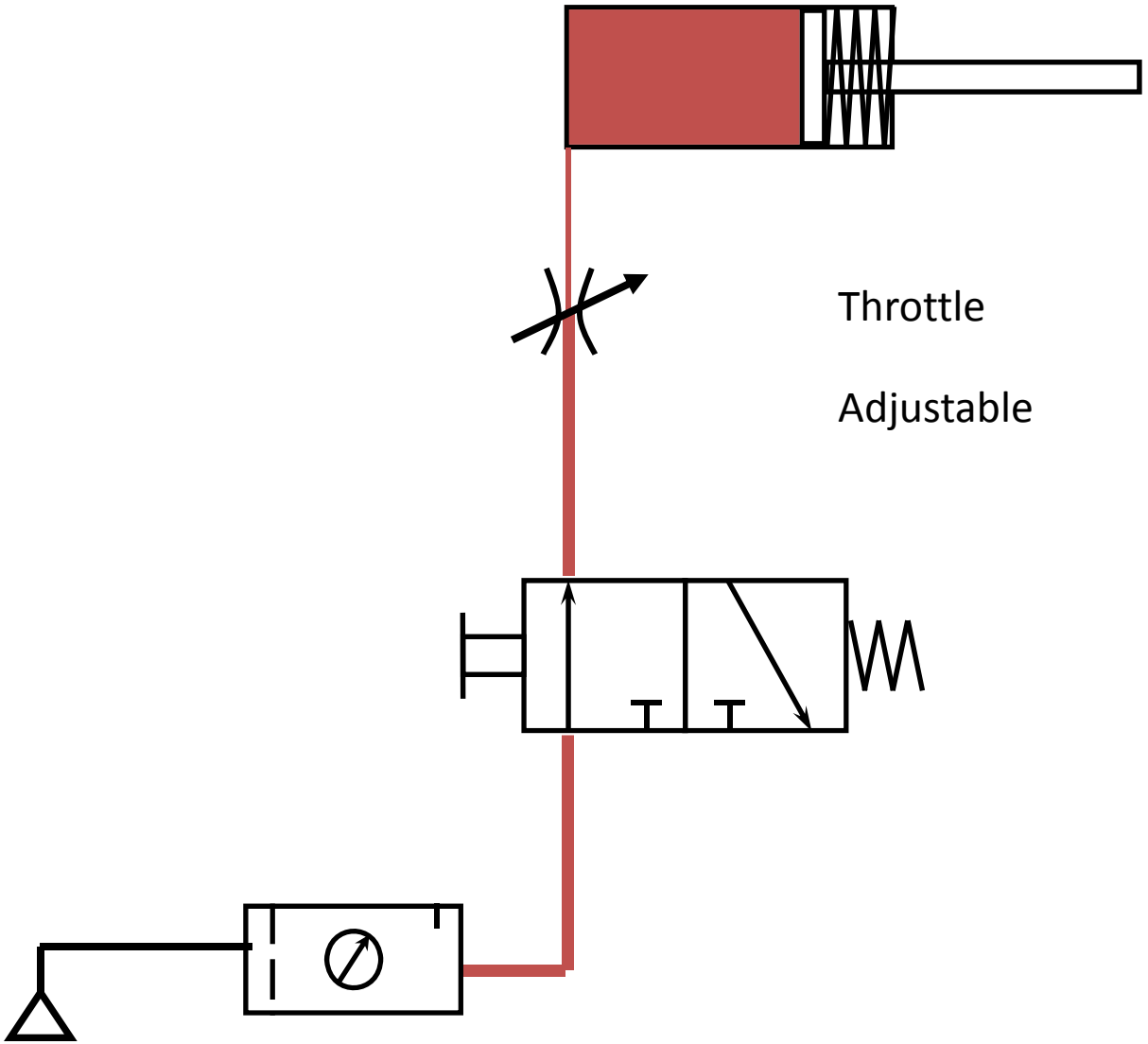


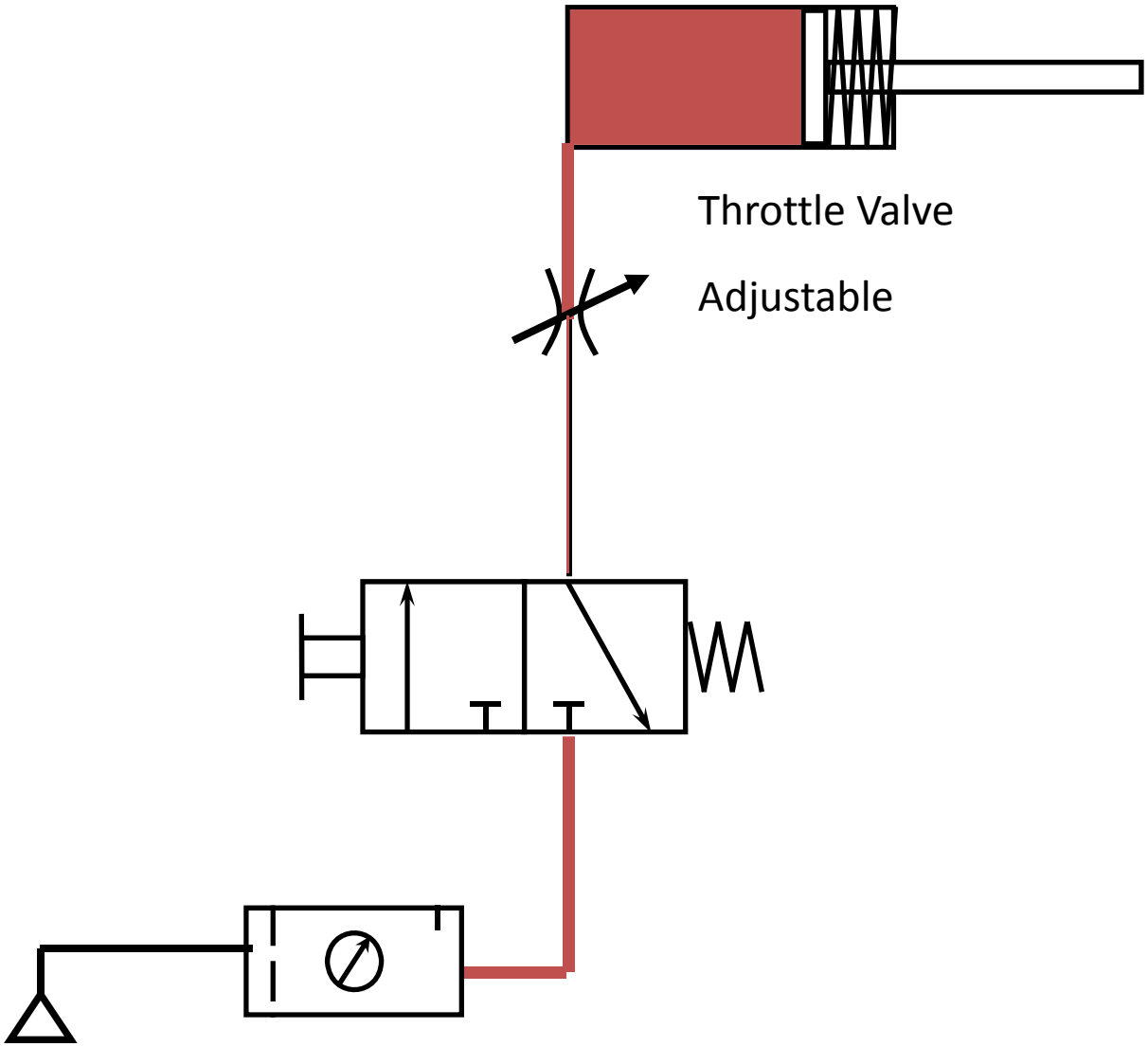
Flow Control Valve

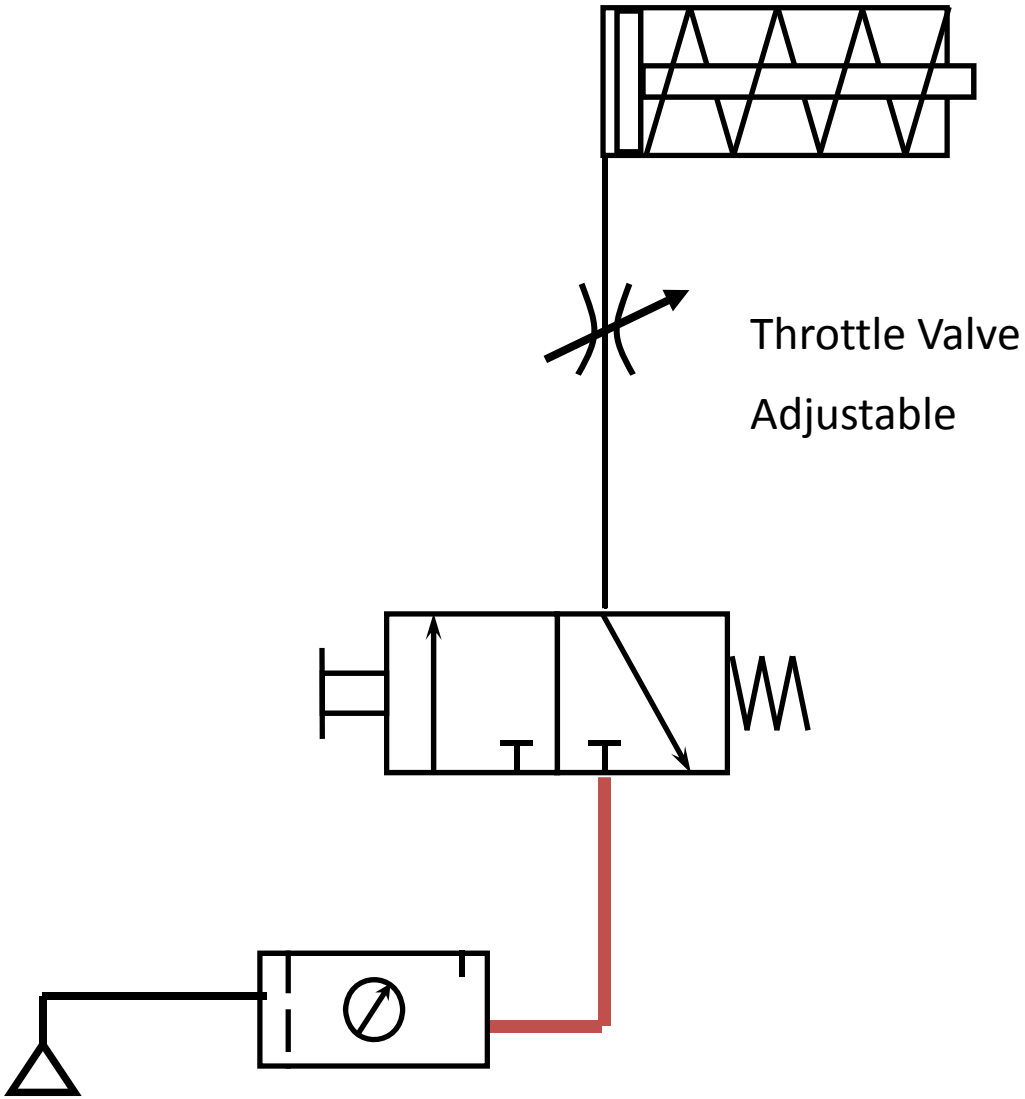
Flow control valve

- Regulate the flow of air in pneumatic system
- Types of flow control valve
  - Throttle Valve
  - One Way Flow Control Valve

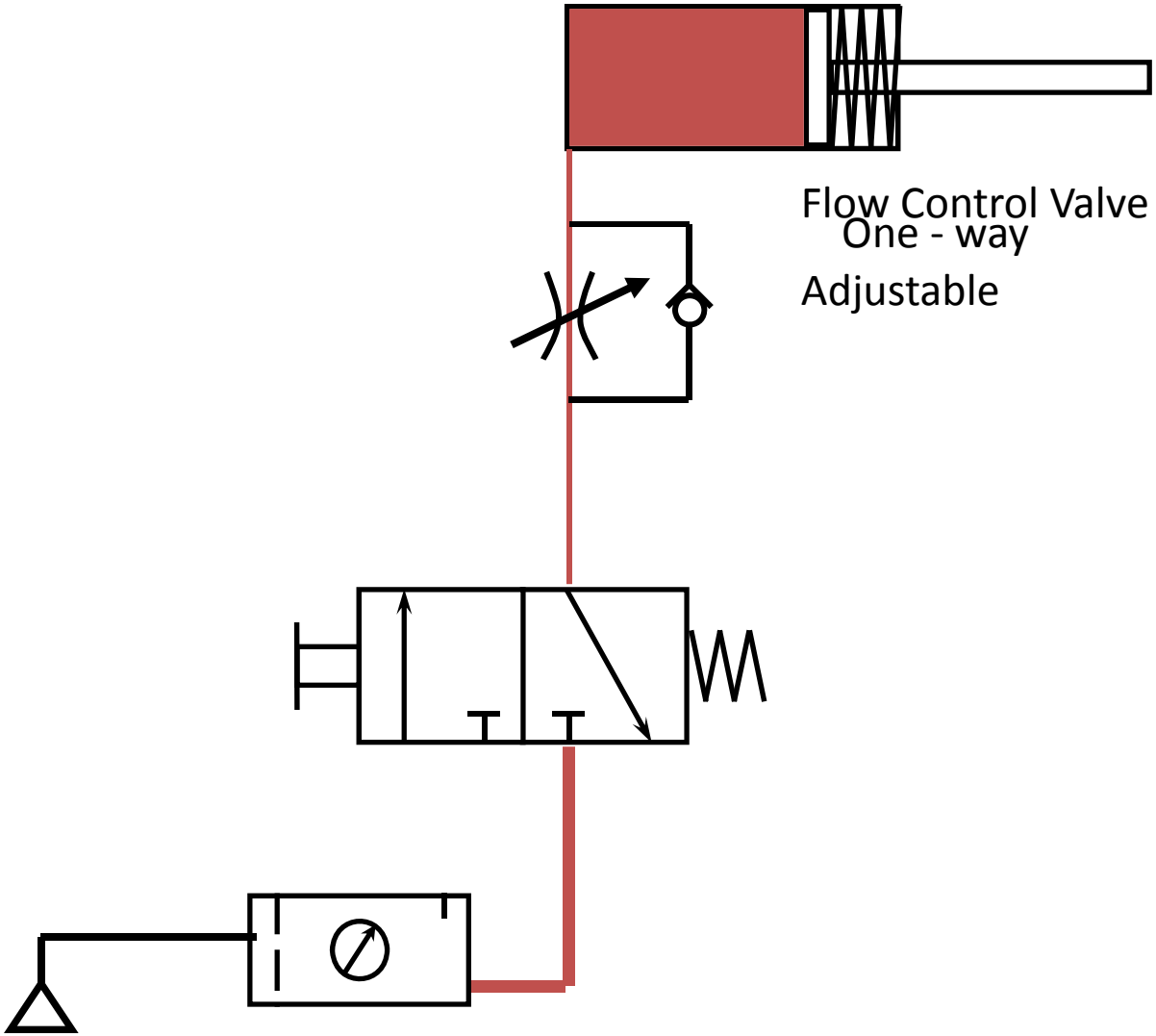

Throttle Valve
Adjustable

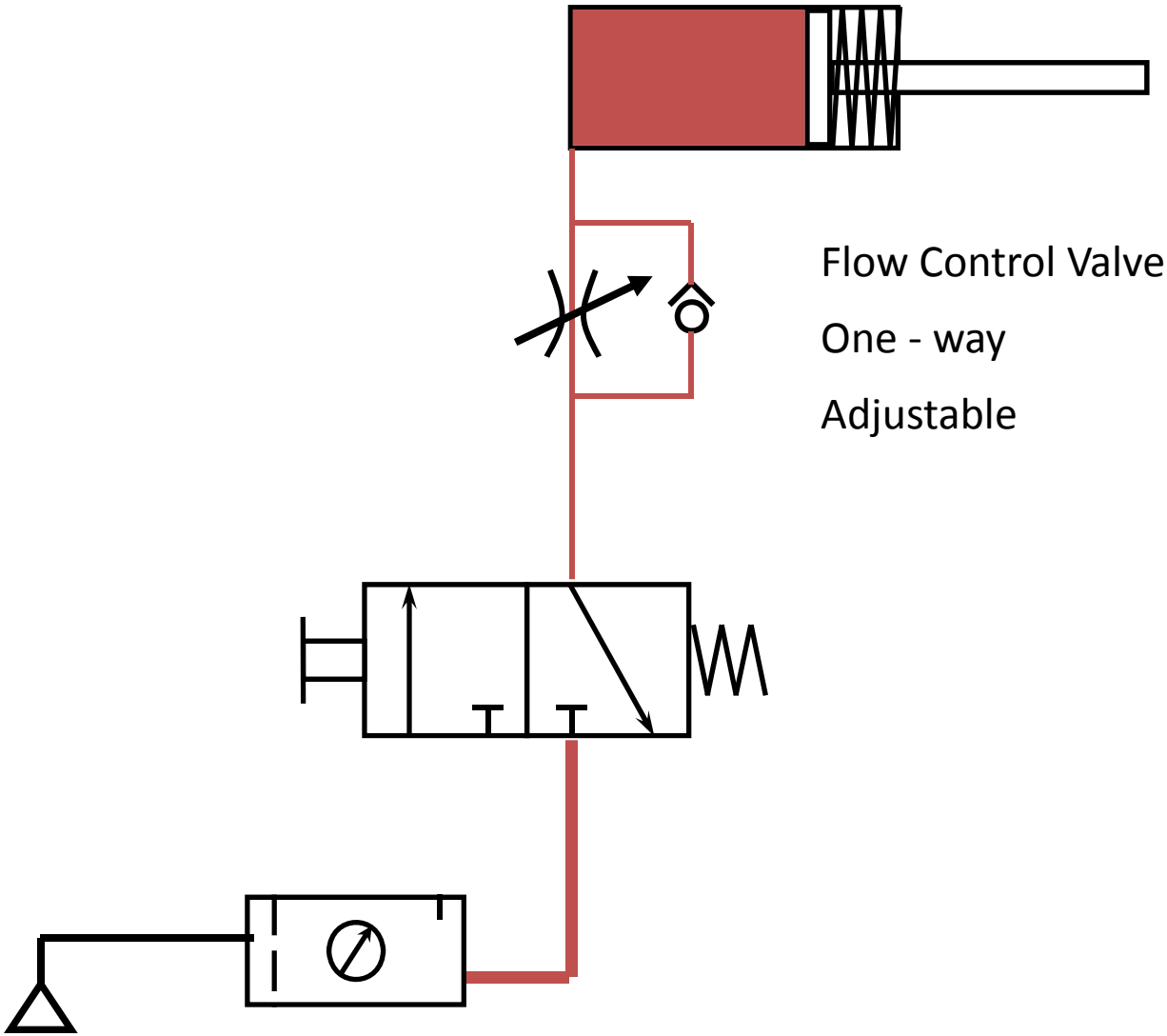

Throttle
Adjustable

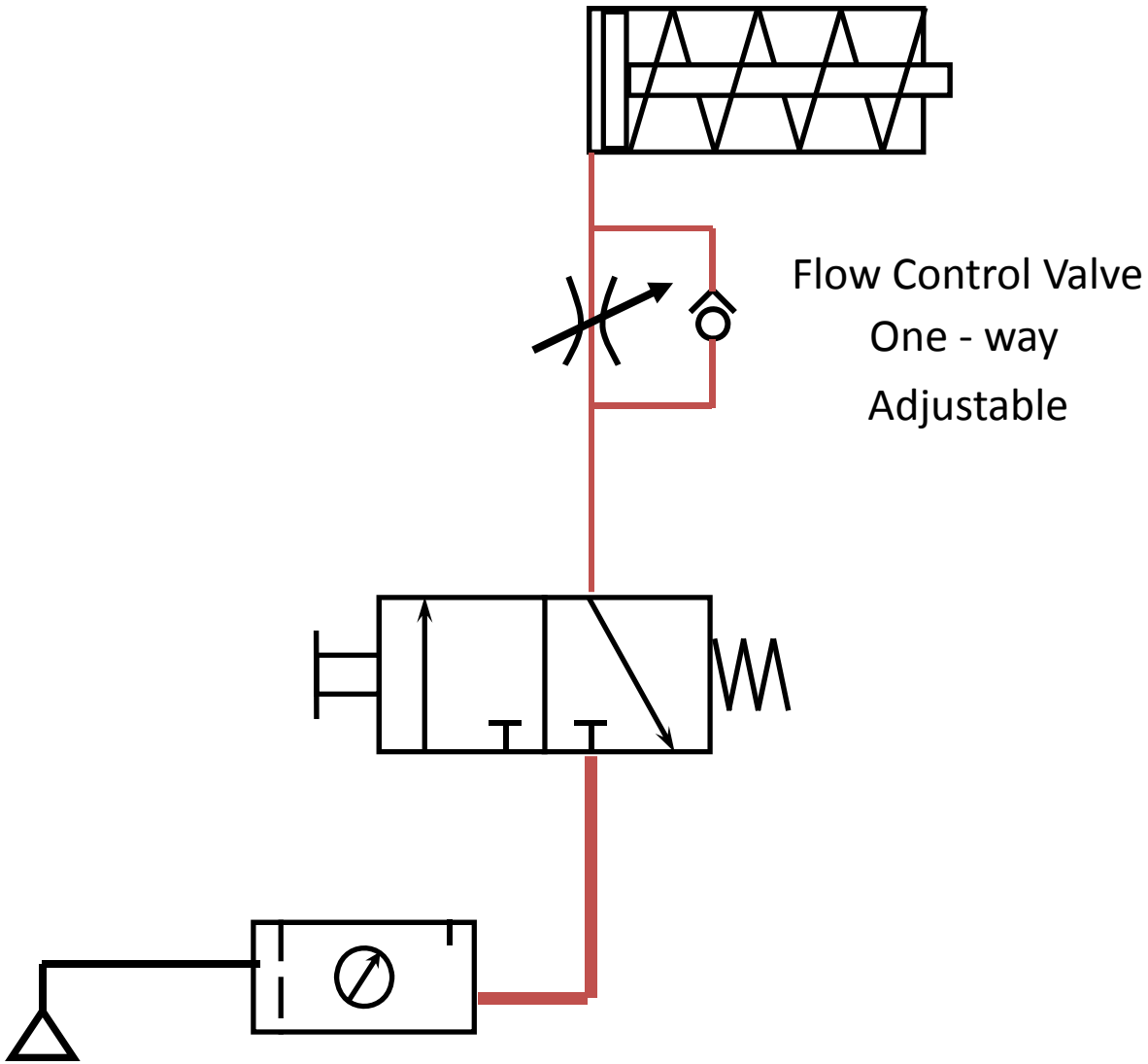

Throttle Valve
Adjustable

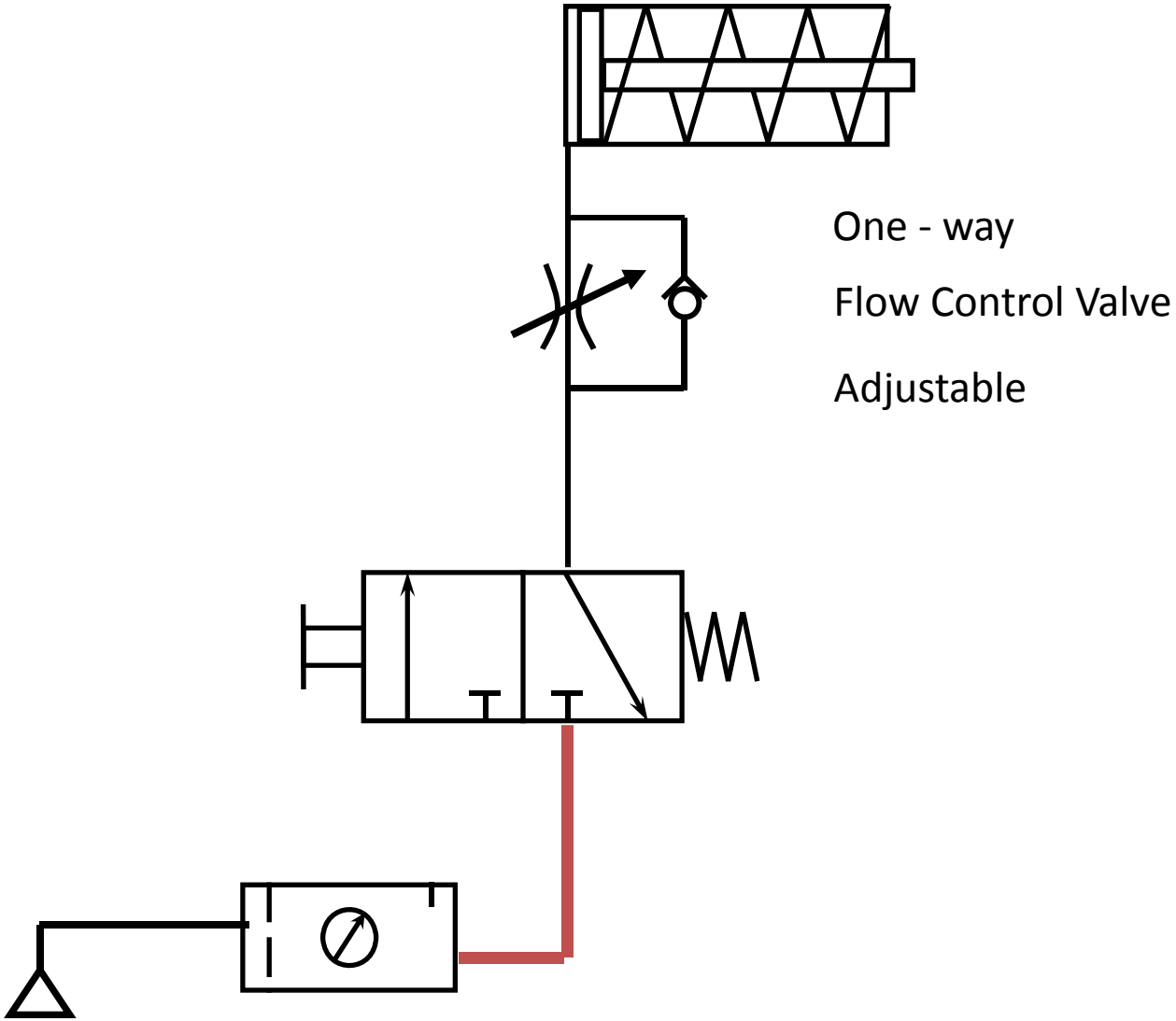

Throttle Valve
Adjustable

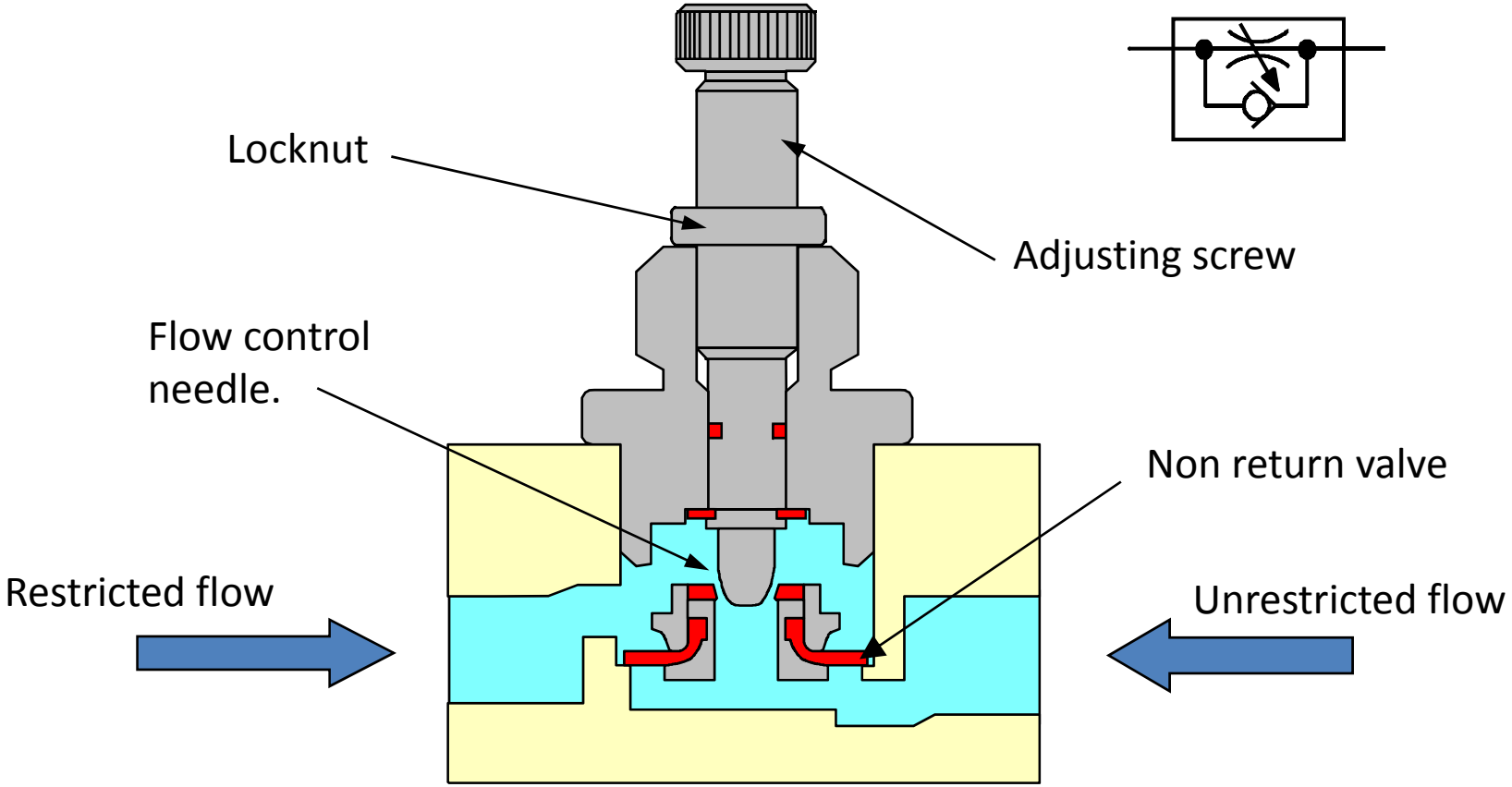
How to perform one way flow control?


Flow Control Valve
One - way
Adjustable


Flow Control Valve
One - way
Adjustable


Flow Control Valve
One - way
Adjustable


One - way
Flow Control Valve
Adjustable



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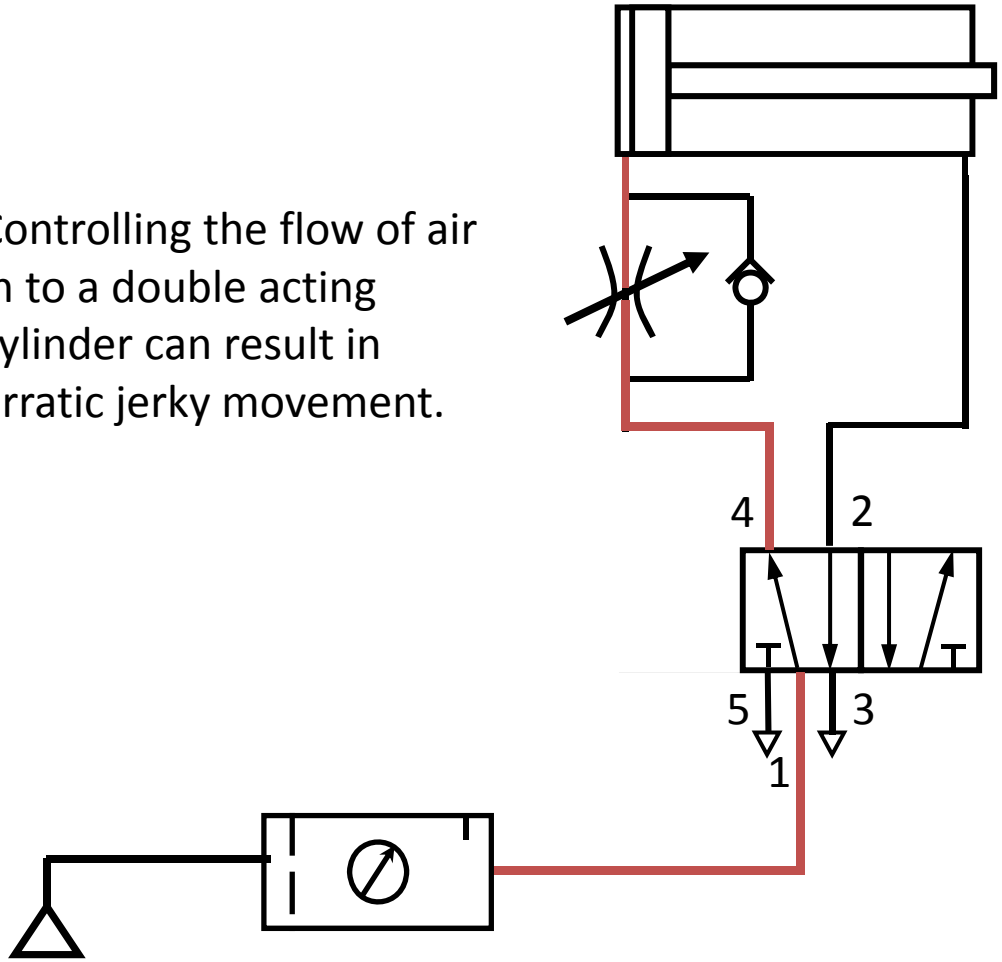
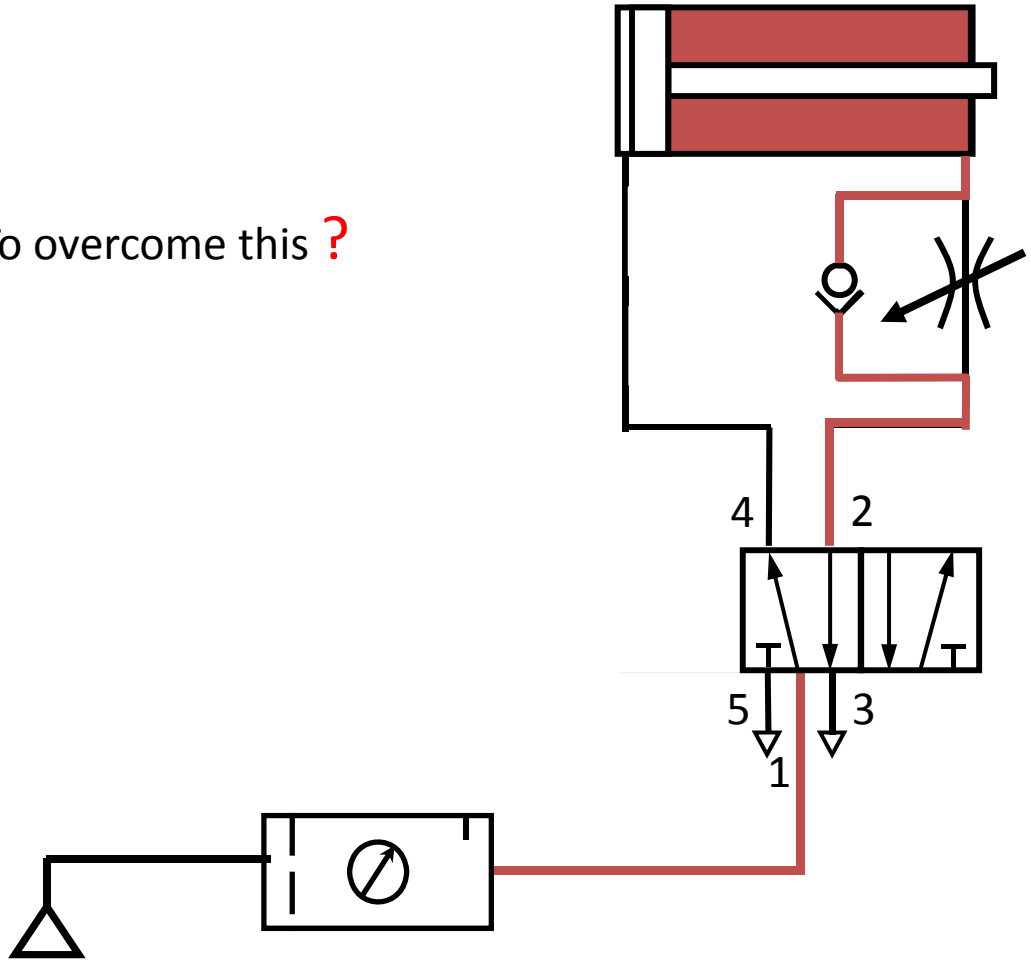
One way flow control valve

Controlling Extension Speed

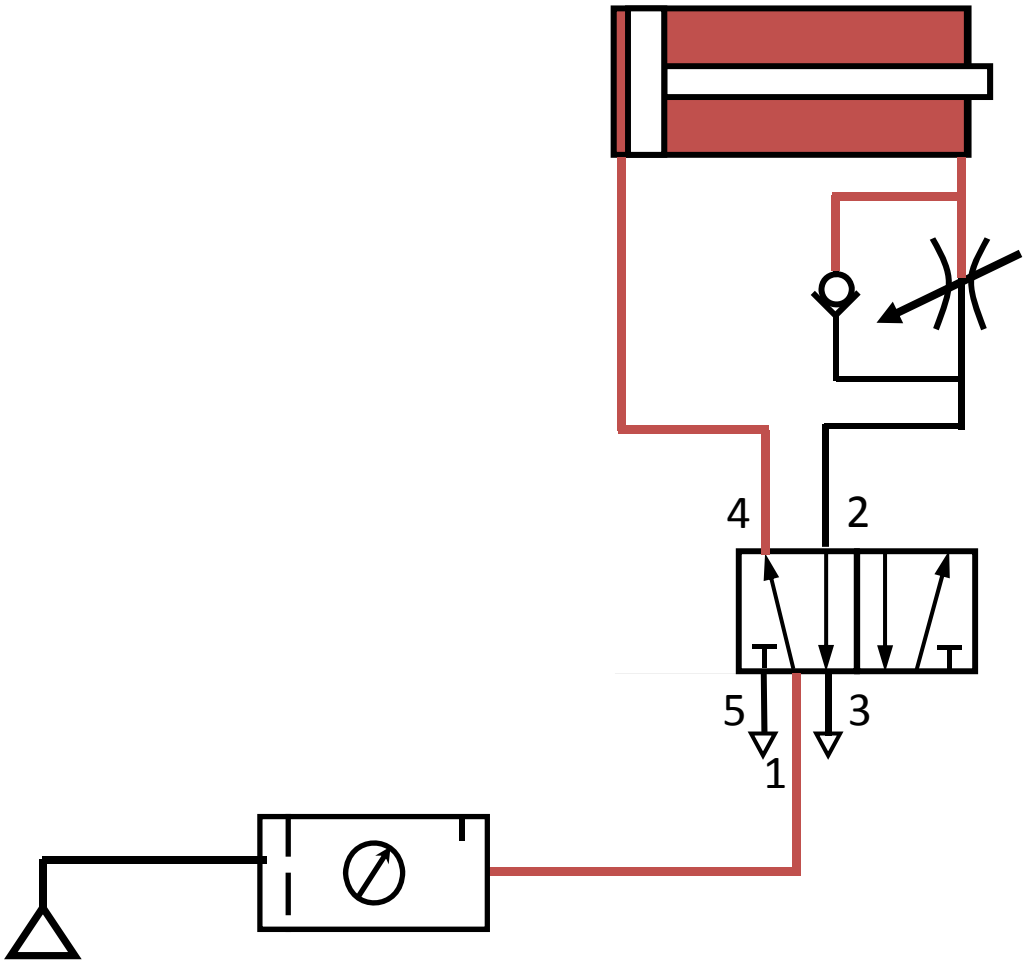
Controlling the flow of air in to a double acting cylinder can result in erratic jerky movement.



To overcome this ?



The flow control valve is used to control the air pushed out of the cylinder



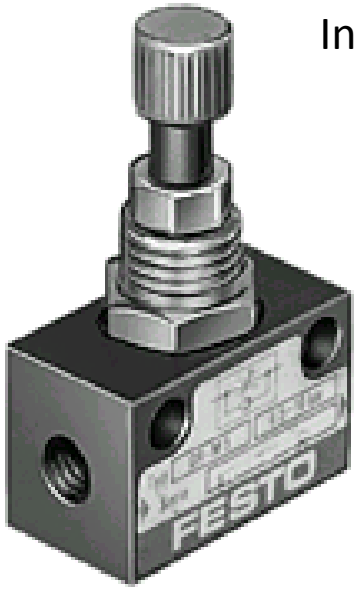
The flow control valve is used to control the air pushed out of the cylinder

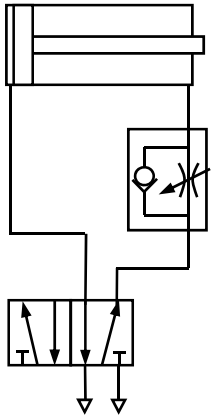
Result:-

Smoother movement
More consistent control

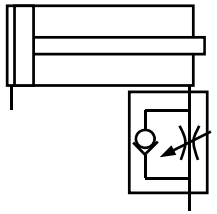
Flow control valves can be positioned

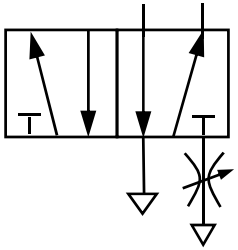
In - line



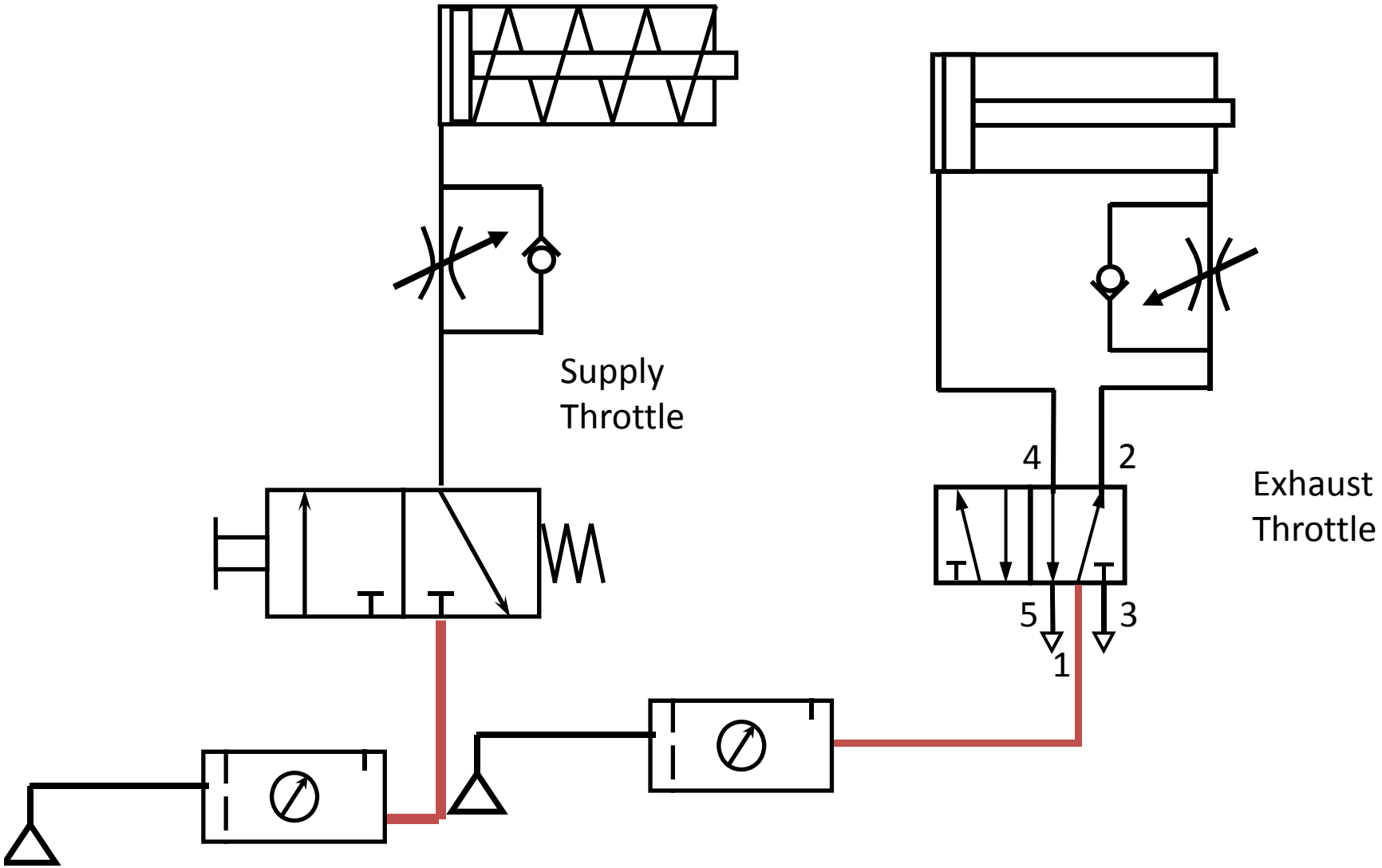


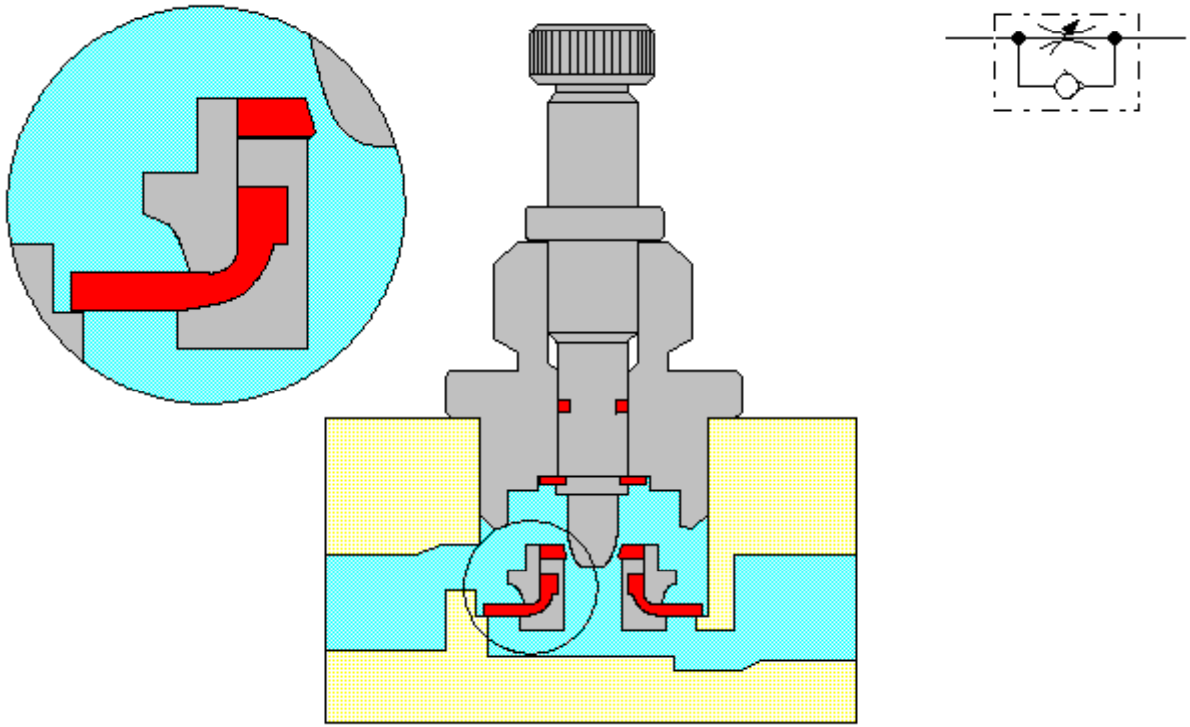
In to the
Cylinder port



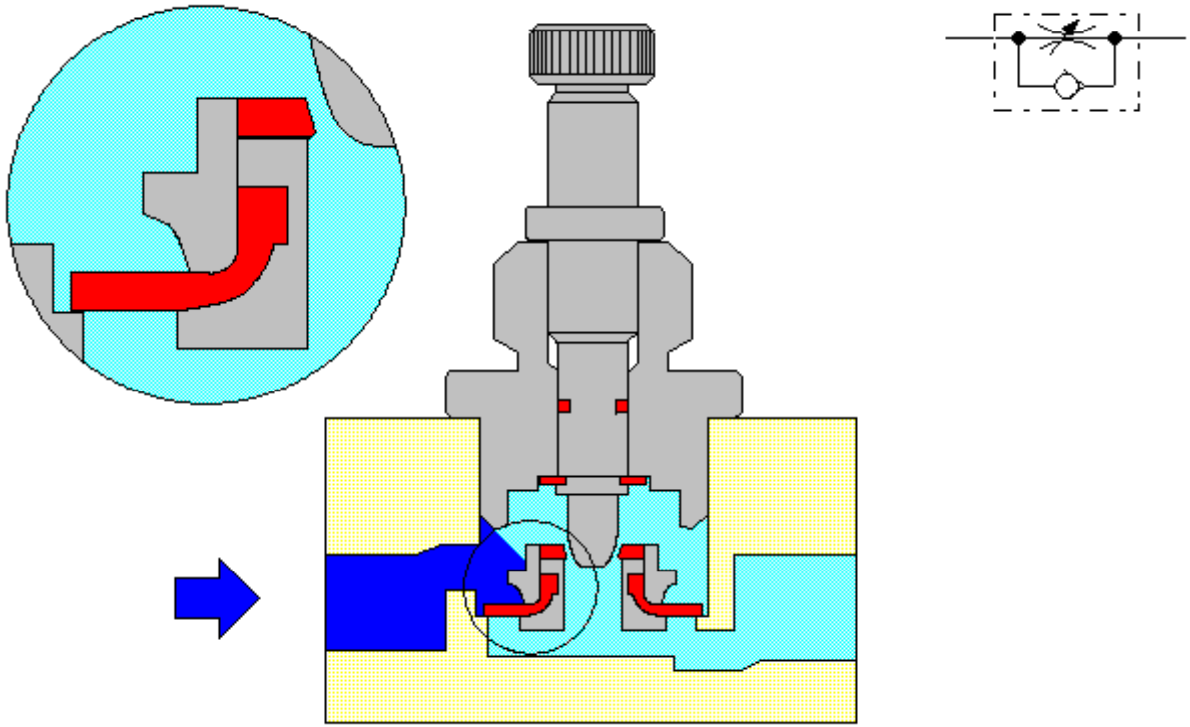


Exhaust Port on
control valve

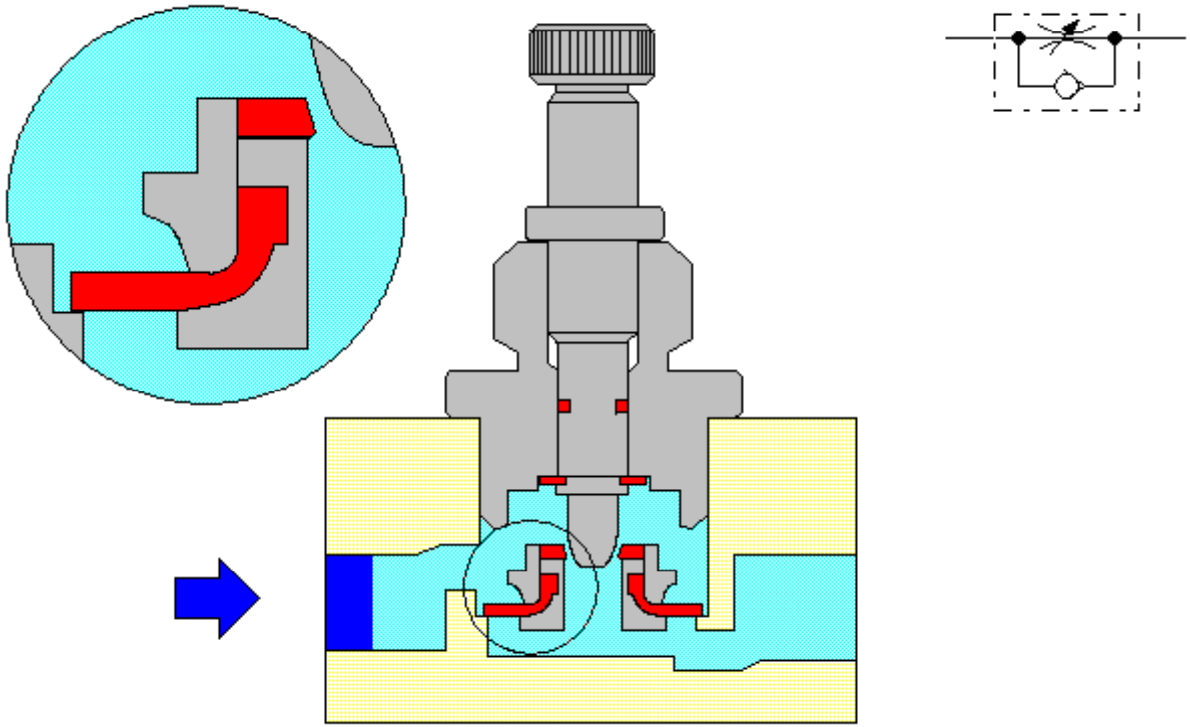

Supply
Throttle
4
2
Exhaust
Throttle
5
3
1



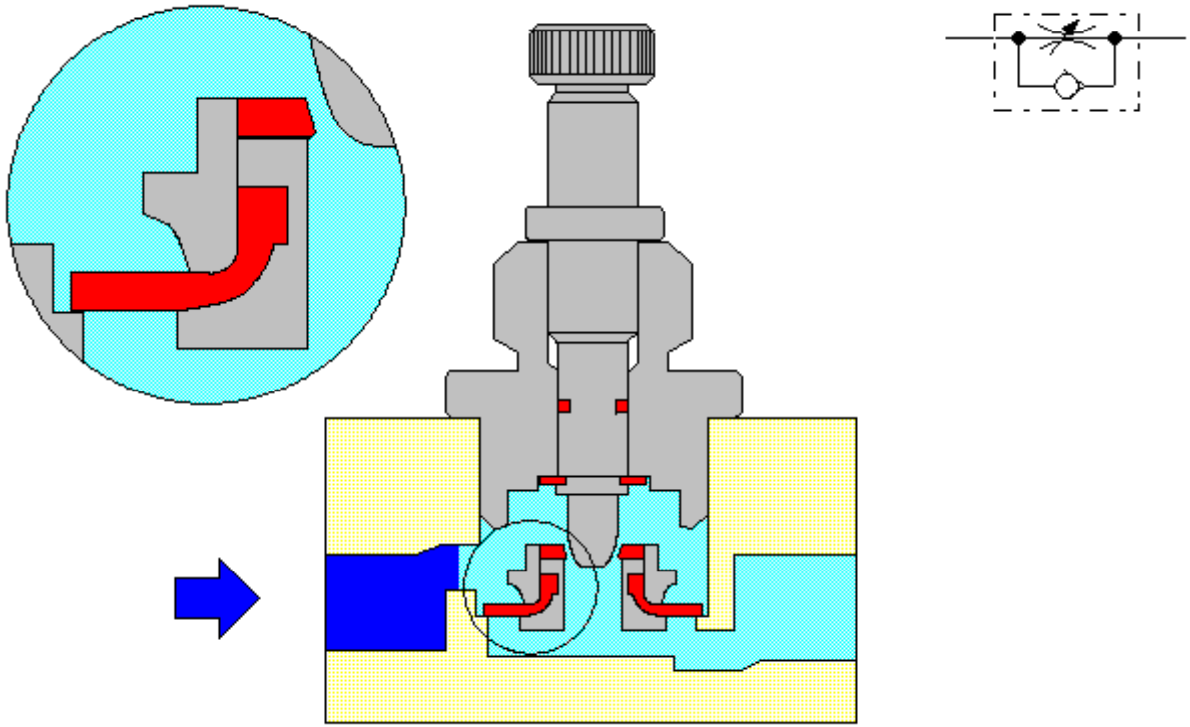
One way flow control valve



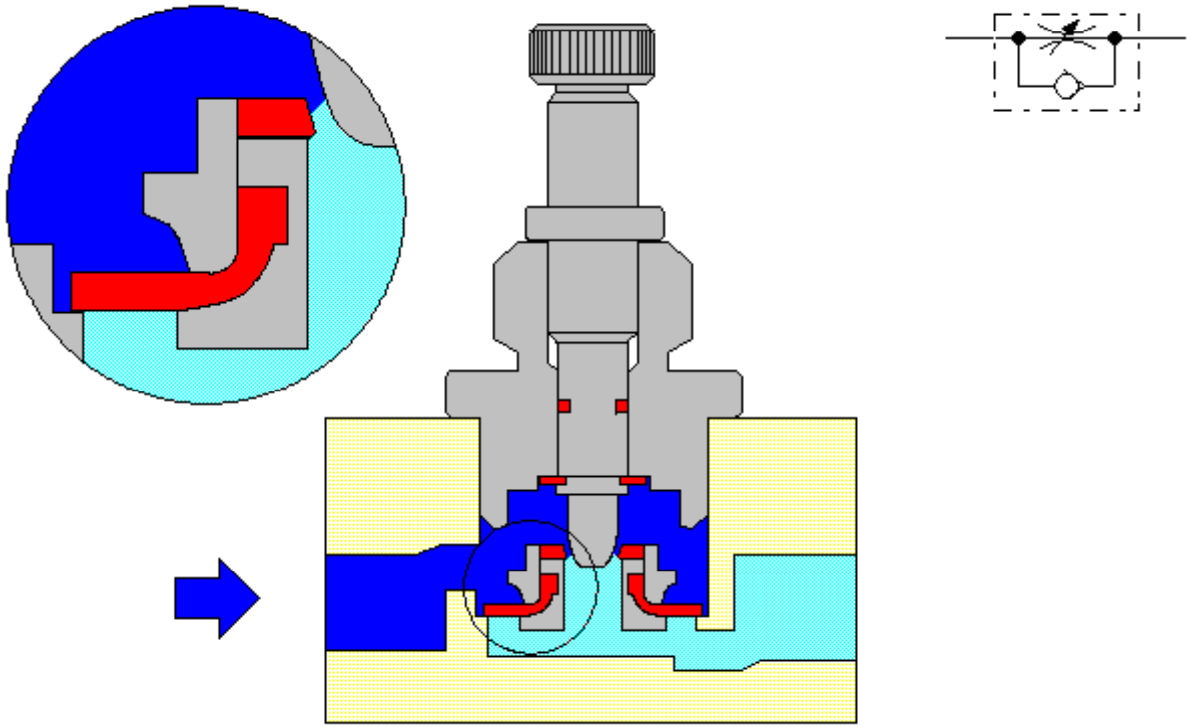
One way flow control valve



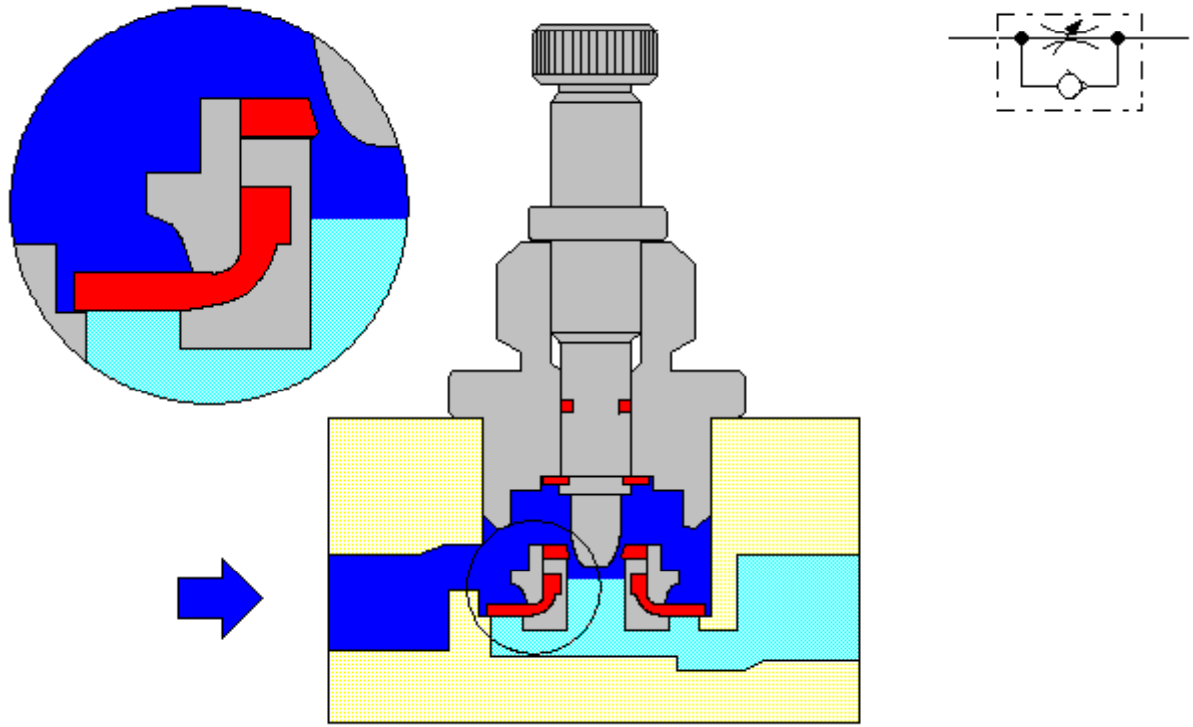
One way flow control valve



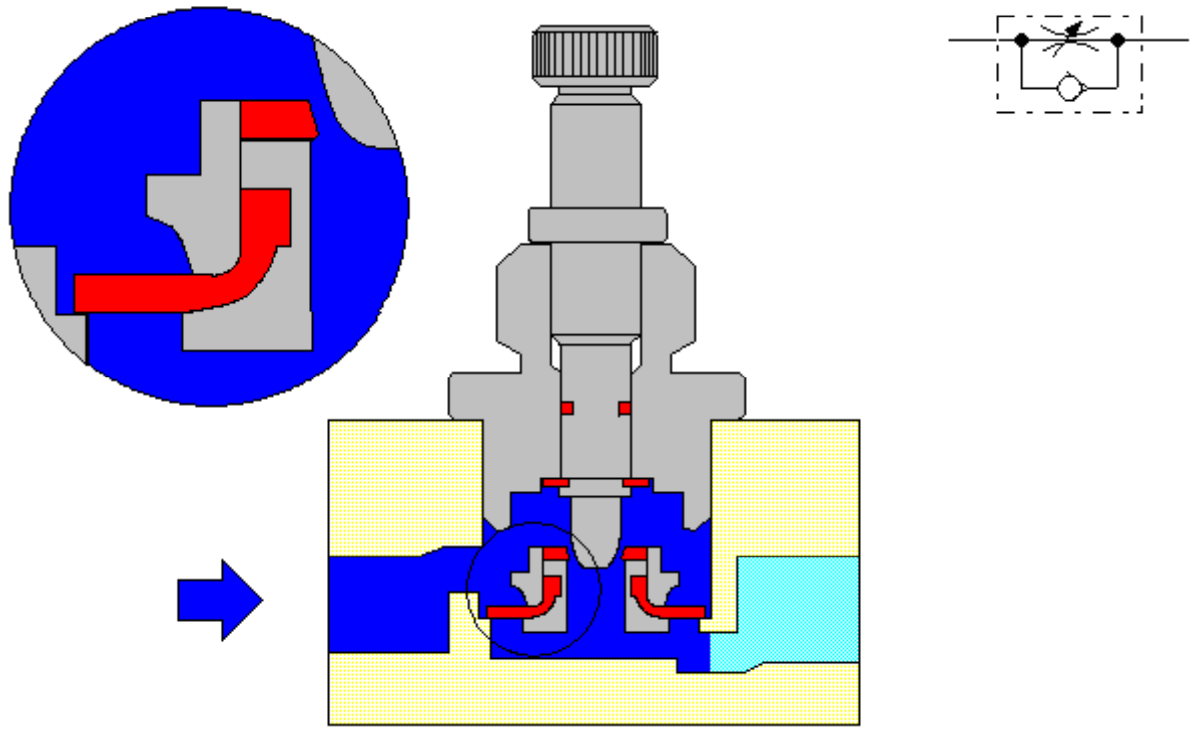
One way flow control valve



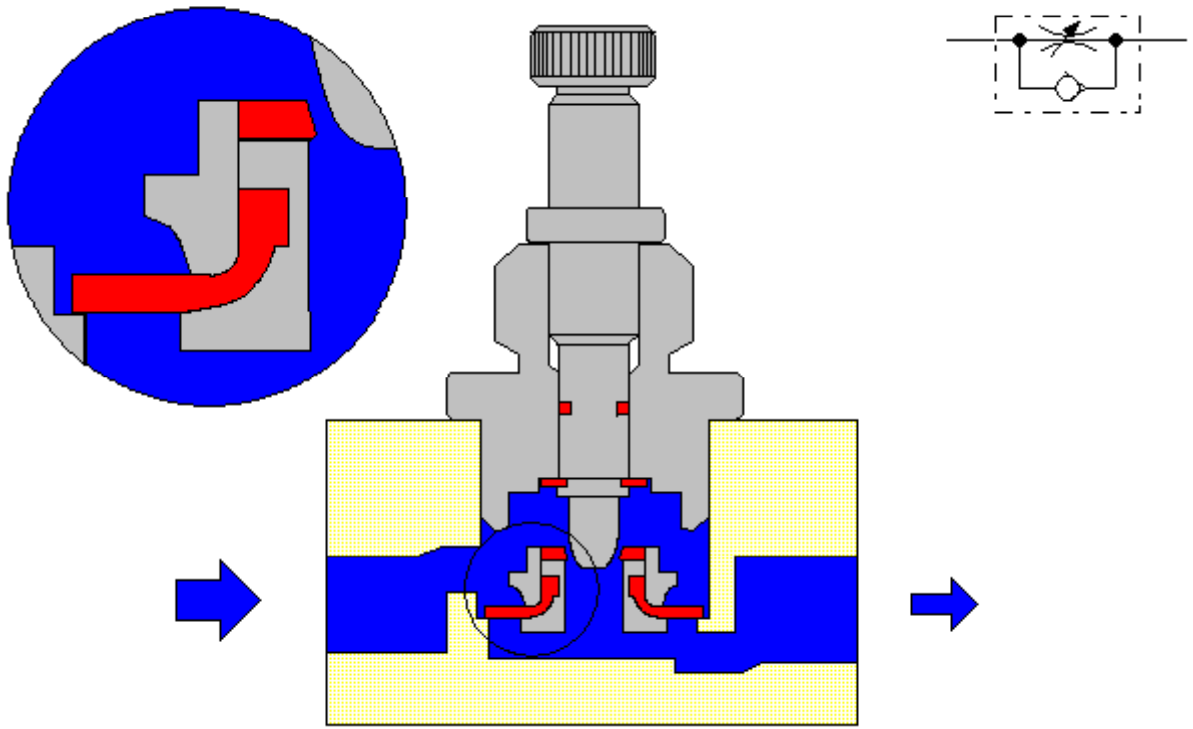
One way flow control valve



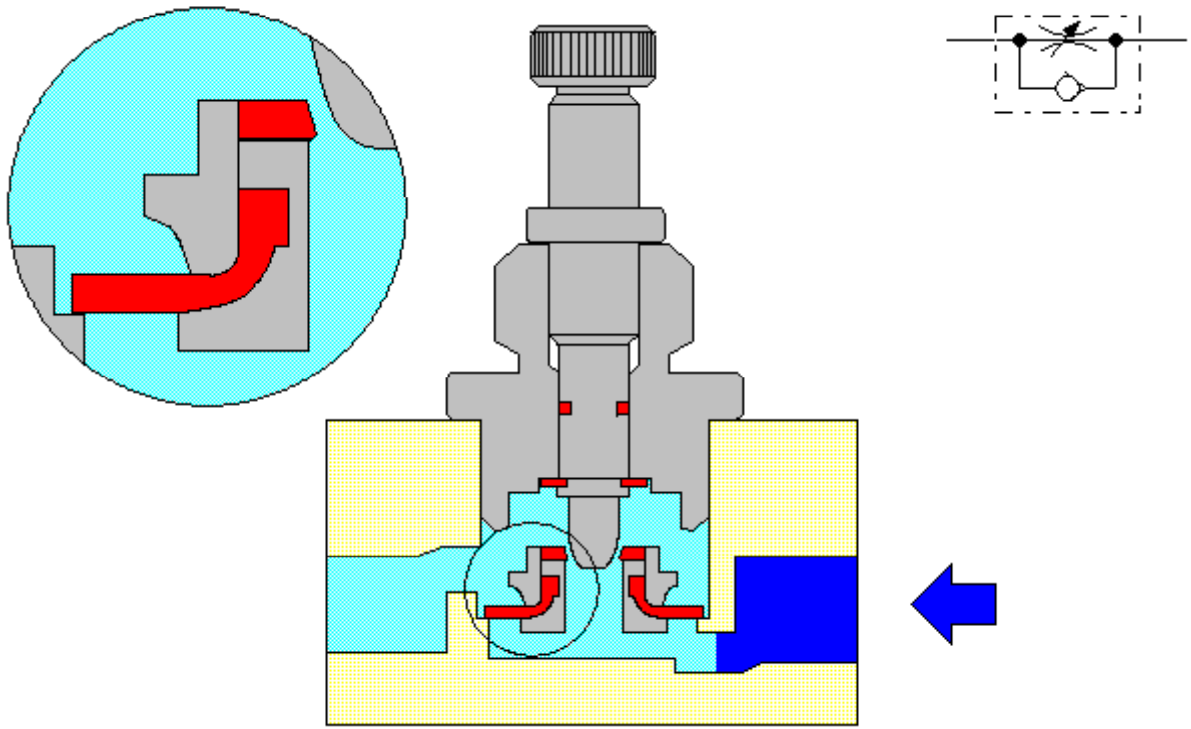
One way flow control valve



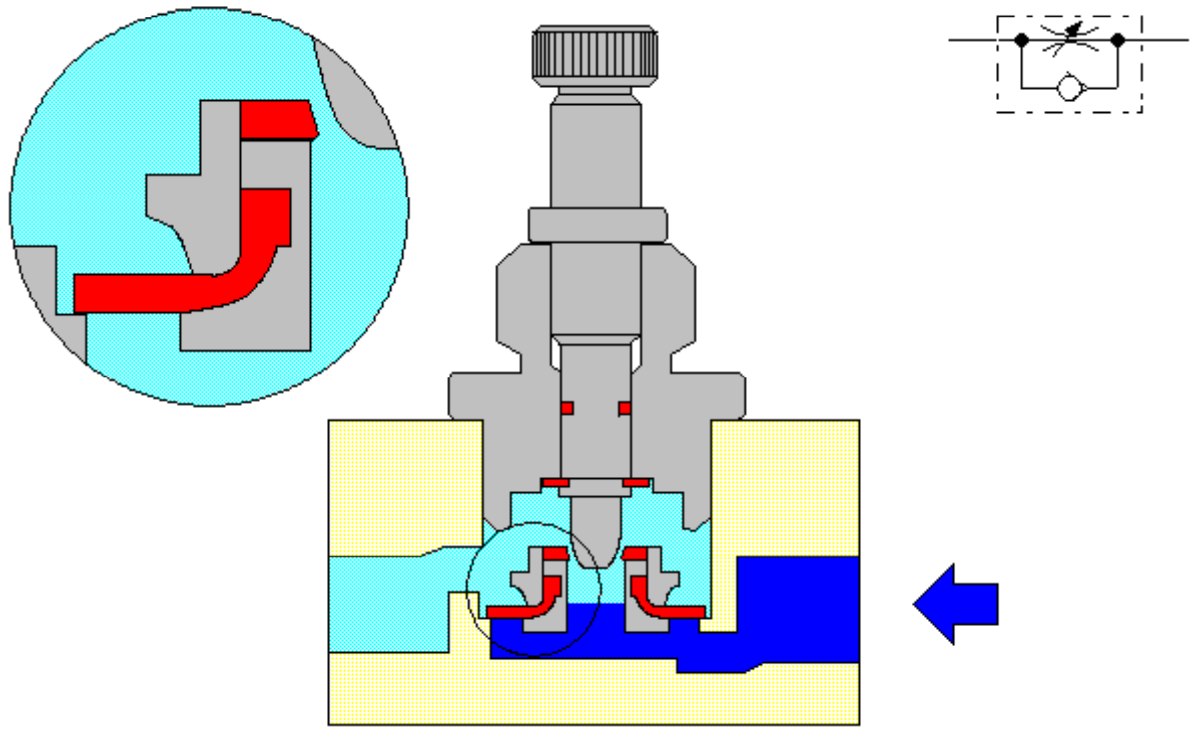
One way flow control valve



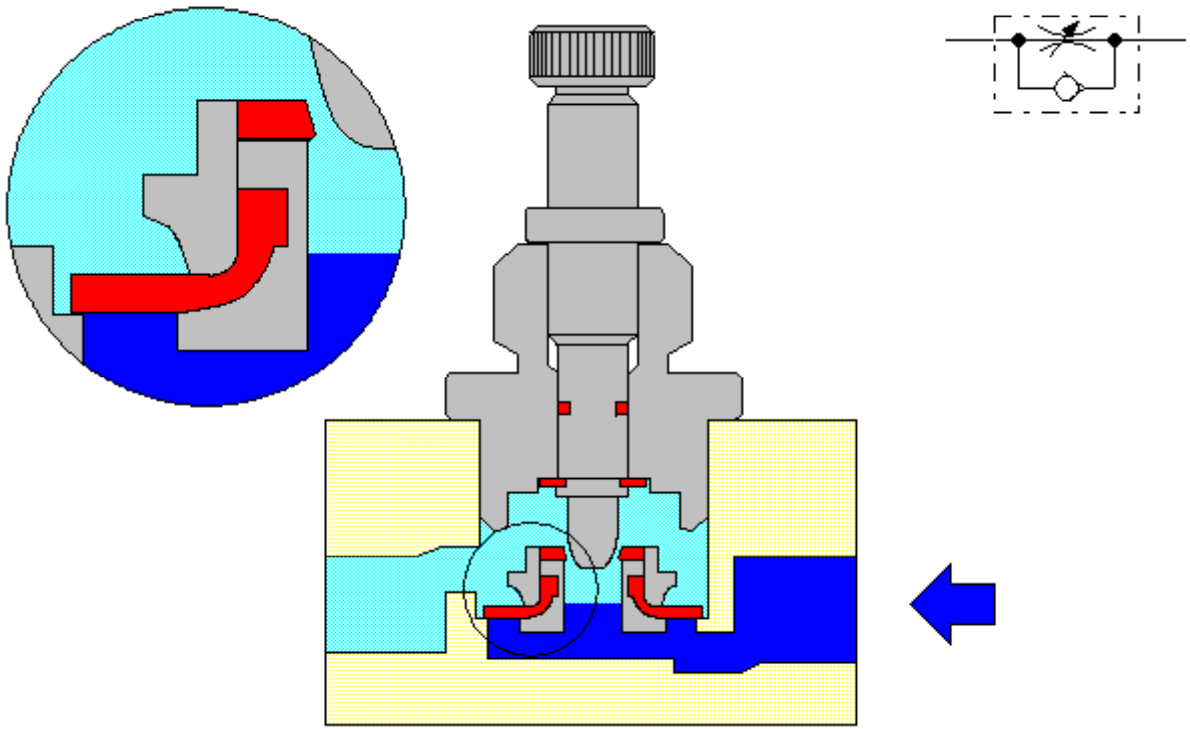
One way flow control valve



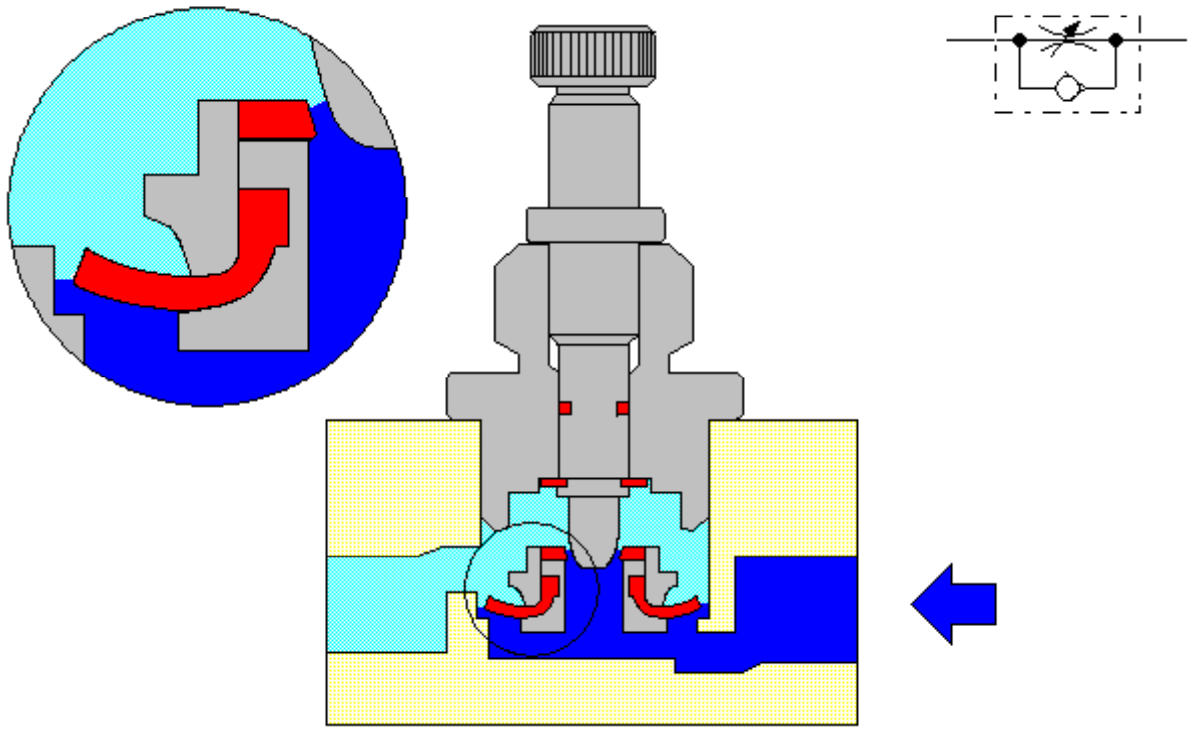
One way flow control valve



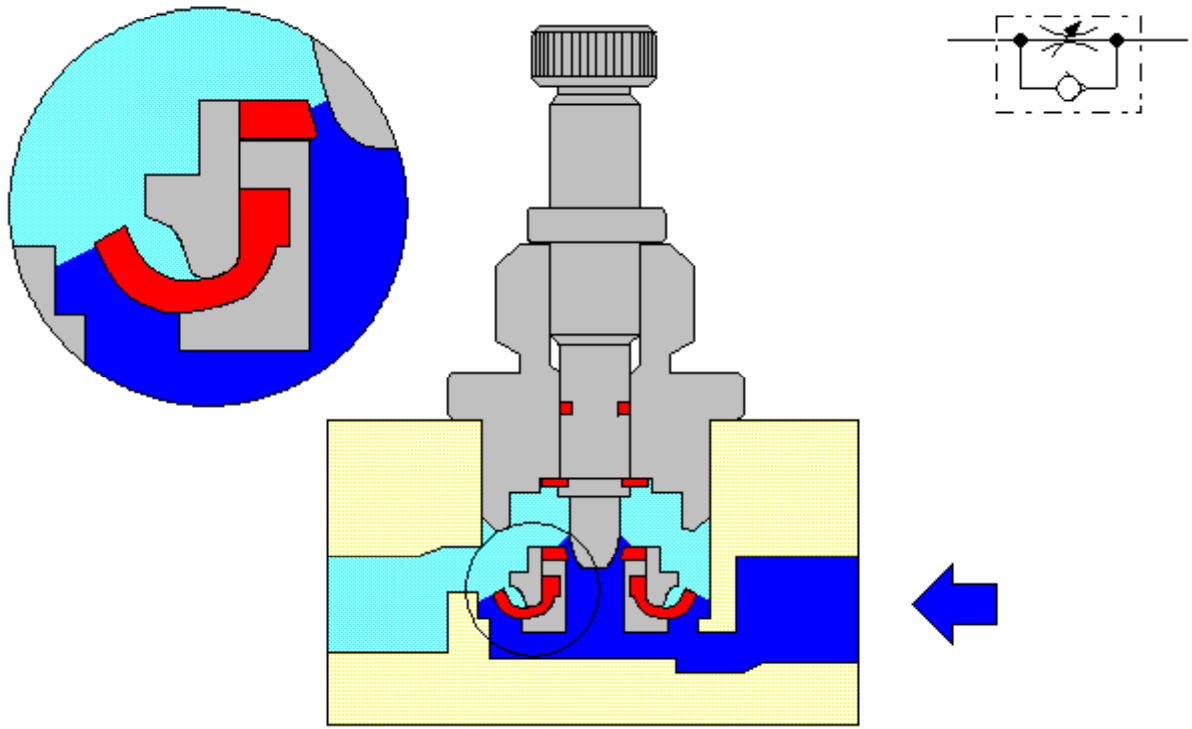
One way flow control valve



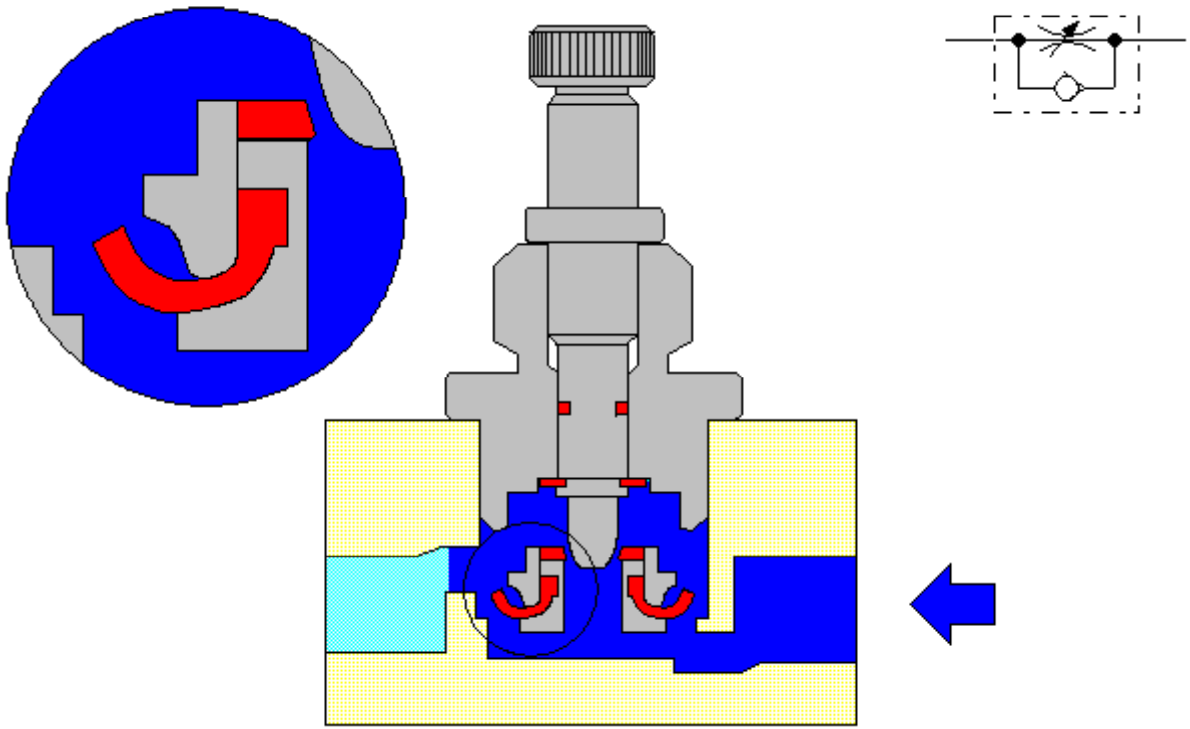
One way flow control valve



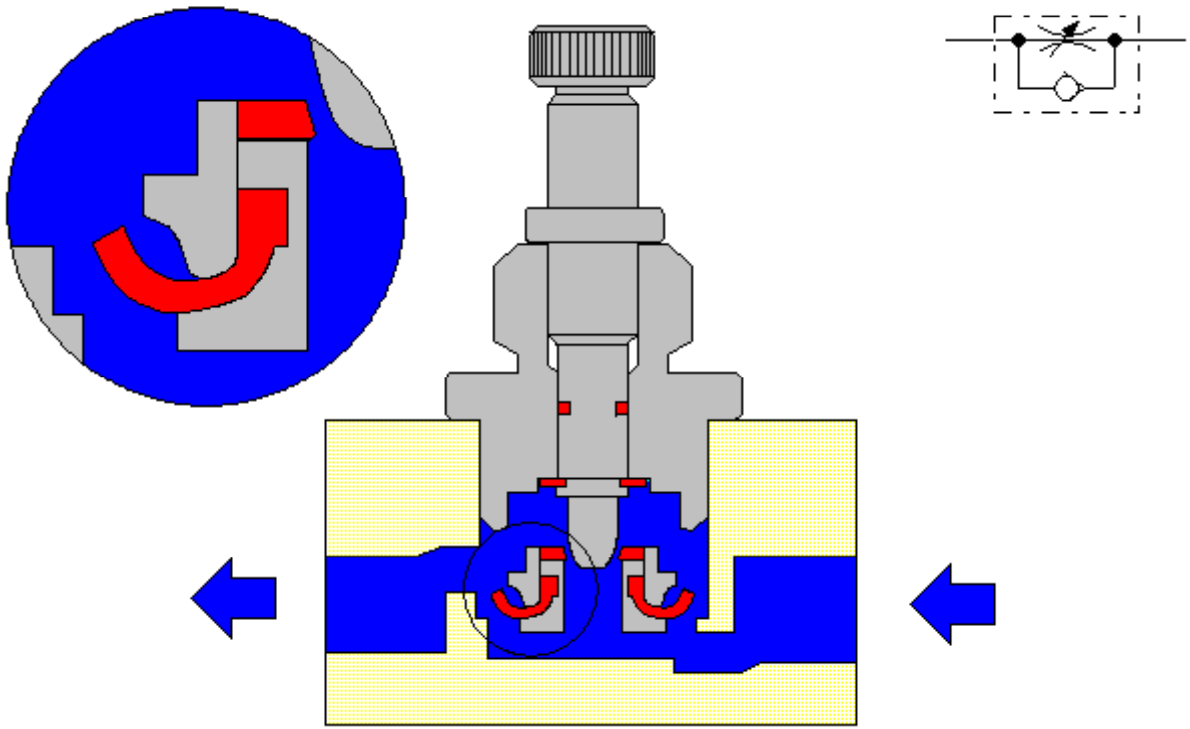
One way flow control valve



One way flow control valve



One way flow control valve



One way flow control valve