

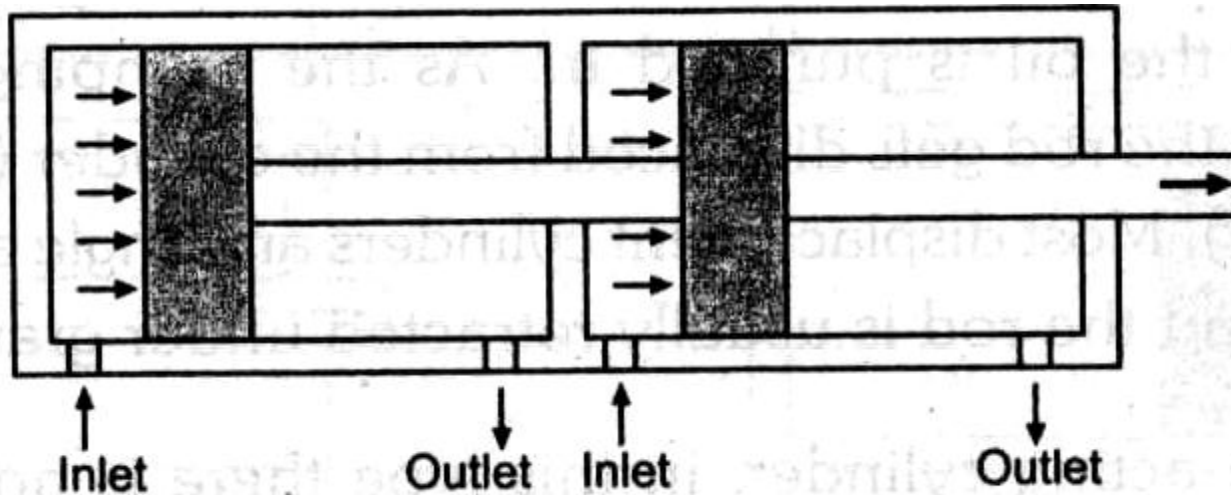


# Unit II Class IV

Tandem cylinder  
Rodless cylinder  
Telescopic cylinder  
Cylinder Cushioning mechanism



# TANDEM CYLINDER



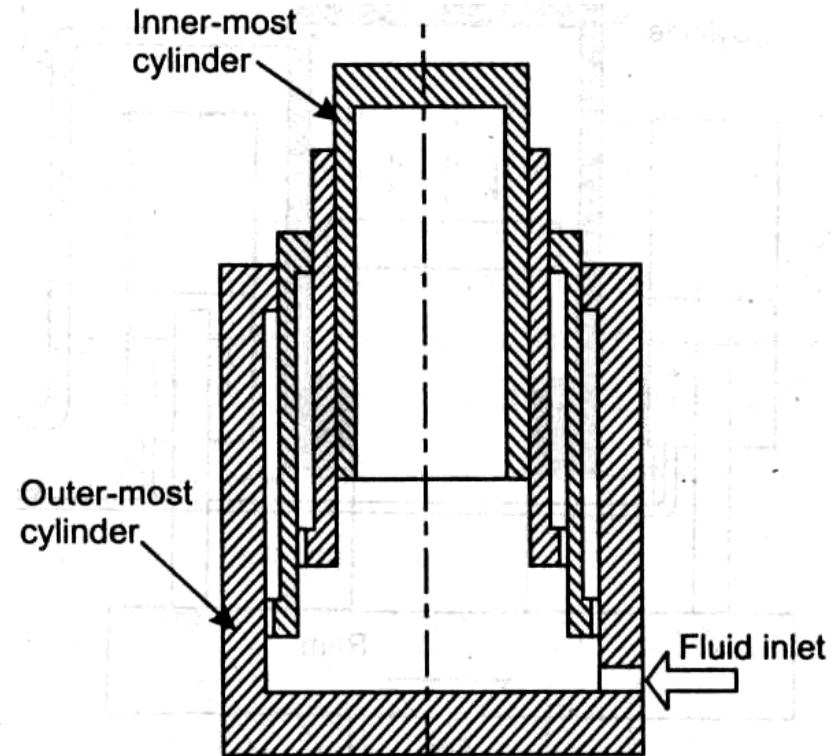
(a) *Extesnion*

- Also known as combination cylinder
- Two separate pistons are mounted on same rod
- Two double acting cylinders are connected in series
- Suitable for higher force (2 cylinders –twice force) generation with smaller cylinders
- High volume of oil is required to drive the cylinders



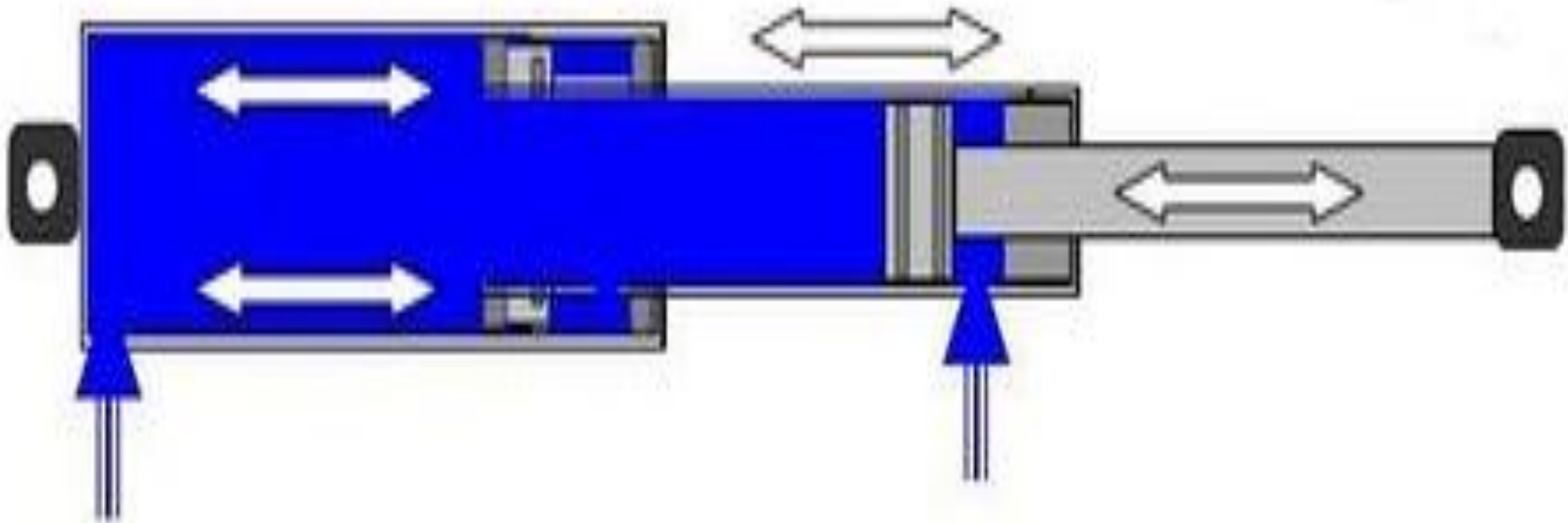
# TELESCOPIC CYLINDER

- Multiple cylinders mounted concentrically within one another
- Suitable for longer strokes with shorter retraction
- Operates on displacement principle
- Stop rings limit the movement of each section
- When the cylinder extends, all the sections move together until the outer section is prevented from further extension by its stop ring
- Remaining sections continue out-stroking until the second outermost section reaches the limit of its stroke and so on until all sections are extended, the innermost one being last of all
- For a given input flow rate, the speed of operation will increase in steps as each successive section reaches the end of its stroke
- For a specific pressure the load lifting capacity reduces for each successive section





Telescoping Hydraulic Cylinder is actually two or three cylinders in one to extend stroke

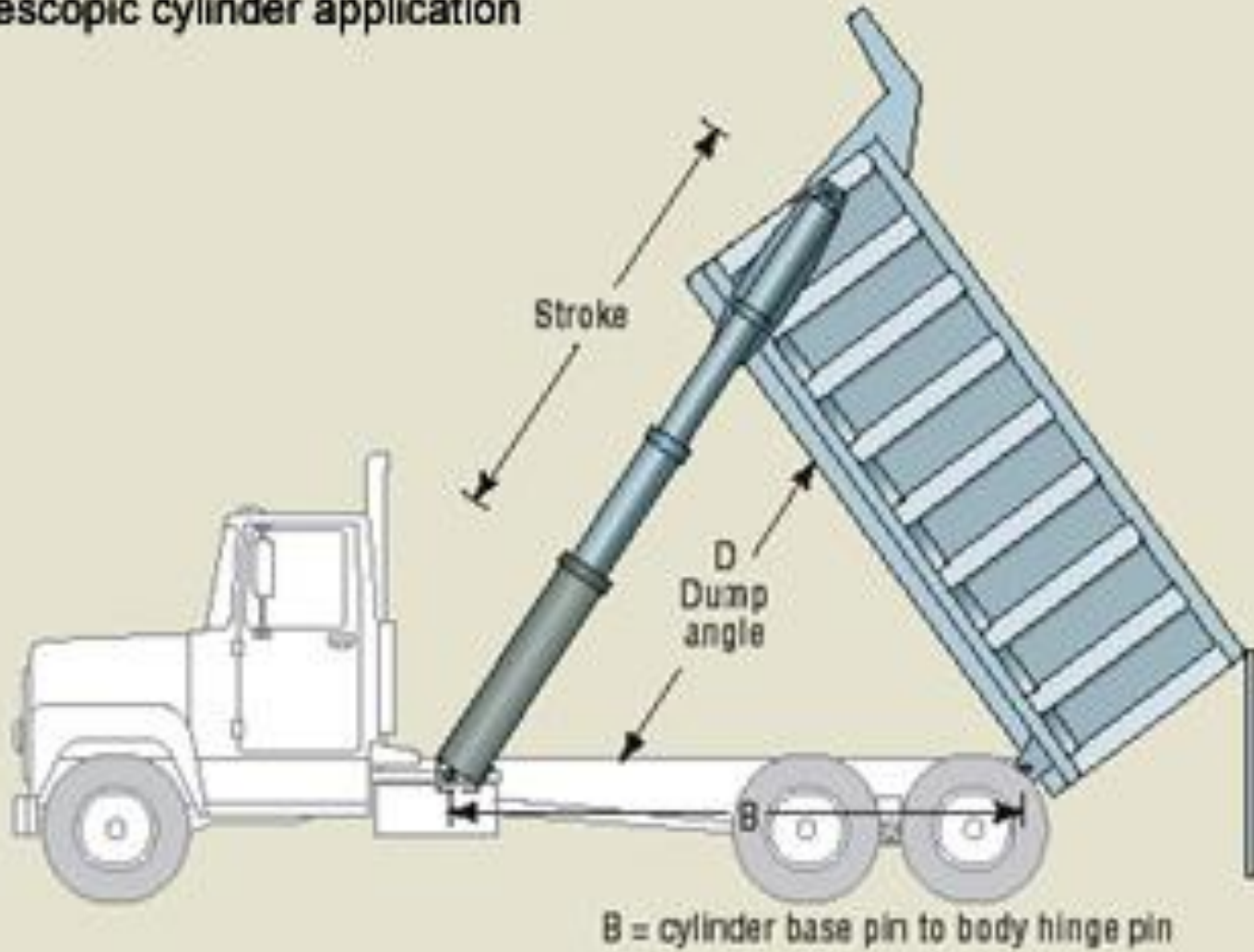


Variable Air pressure signal applied at top of cylinder

Fixed Air Pressure Air Pressure Cushion OR Mechanical Coil Return Spring pressure applied at



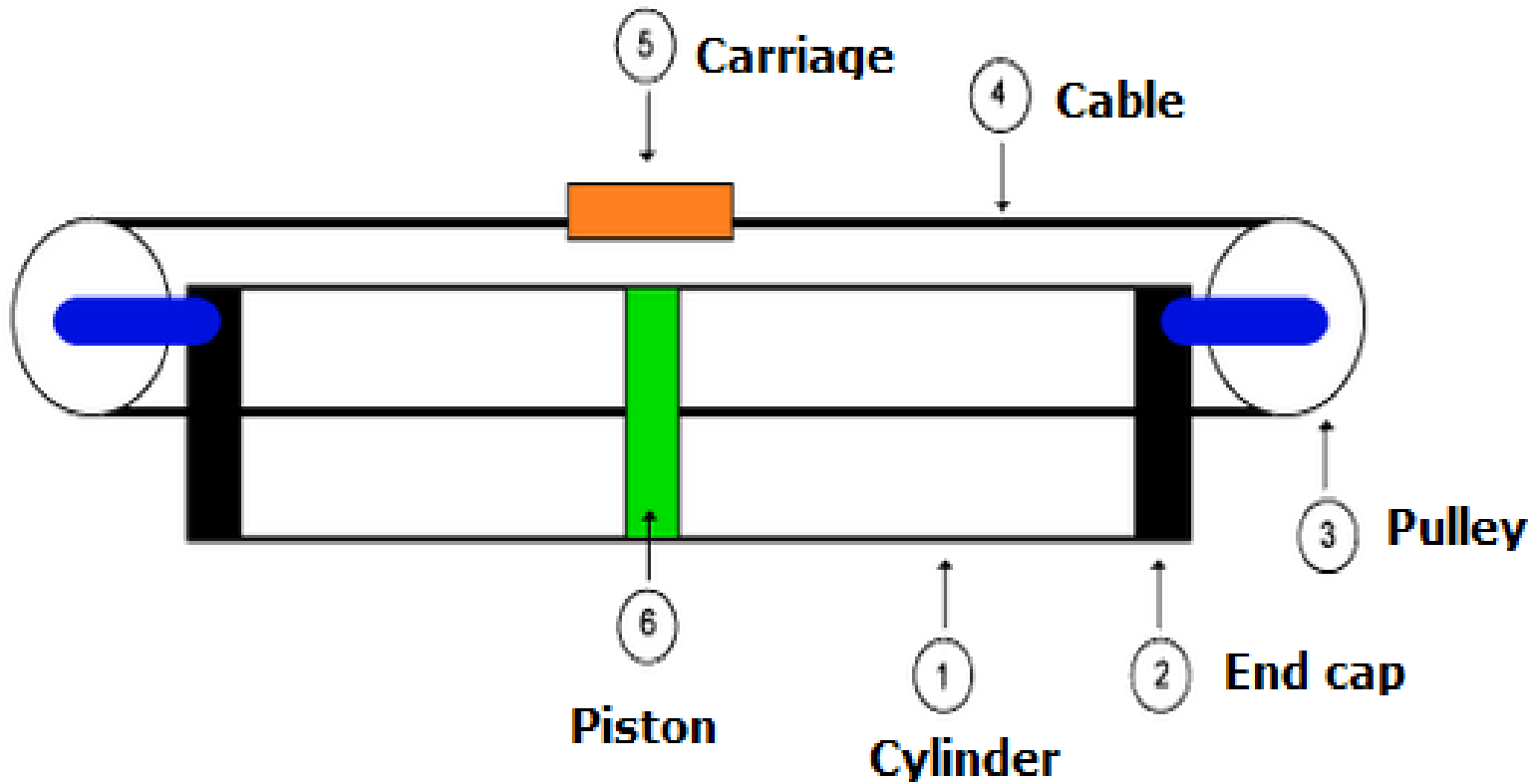
## Telescopic cylinder application





# Rodless cylinders

- Conventional double acting cylinders require space to house the cylinder and space to carry out the work.
- Three different operational principles are used for the construction of rodless cylinders:
  - sealing band cylinder with slotted cylinder barrel
  - cylinder with magnetically coupled slide
  - band or cable cylinder

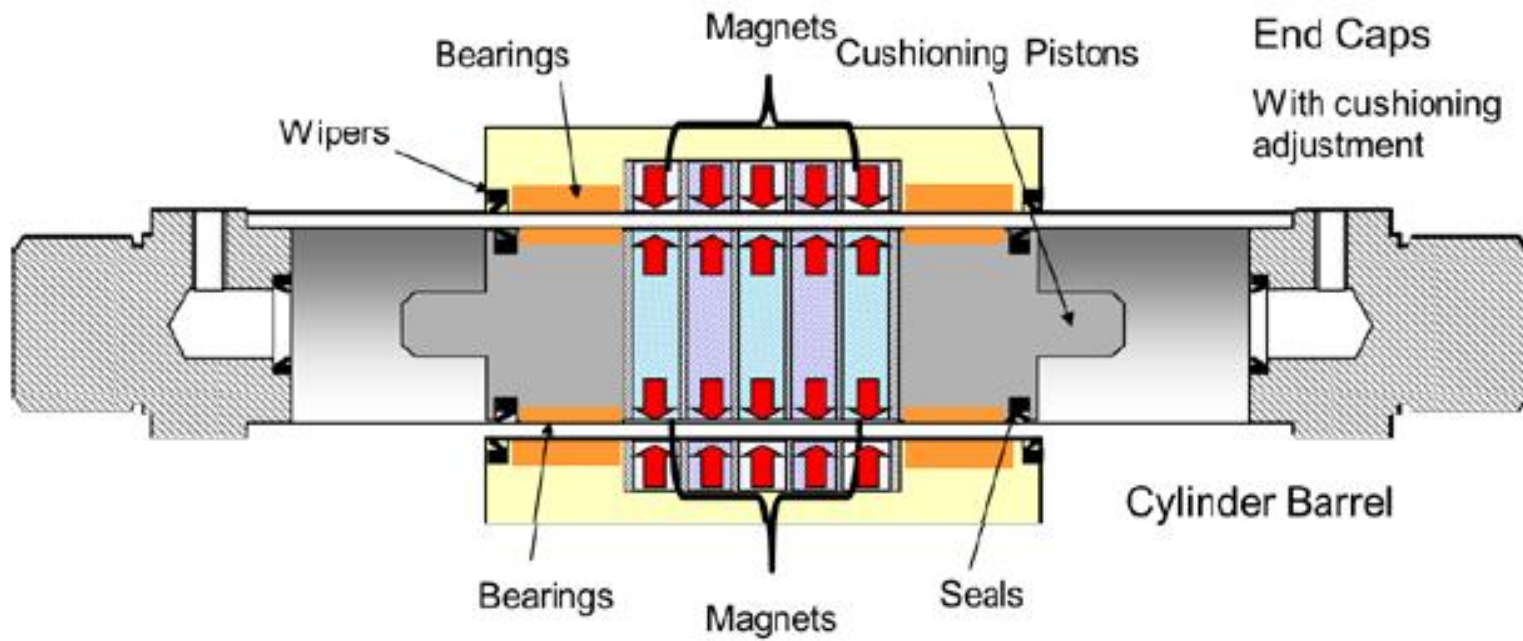




# Cylinder with magnetic coupling

- This double-acting pneumatic linear actuator (rodless cylinder) consists of a cylindrical barrel, a piston and 2 slides. The piston in the cylinder is freely movable according to pneumatic actuation, but there is no positive external connection.
- The piston and the slide are fitted with a set of annular permanent magnets. Thus, a magnetic coupling is produced between slide and piston.
- As soon as the piston is moved by compressed air the slide moves synchronously with it. The cylinder barrel is hermetically sealed from the outer slide since there is no mechanical connection. There are no leakage losses.







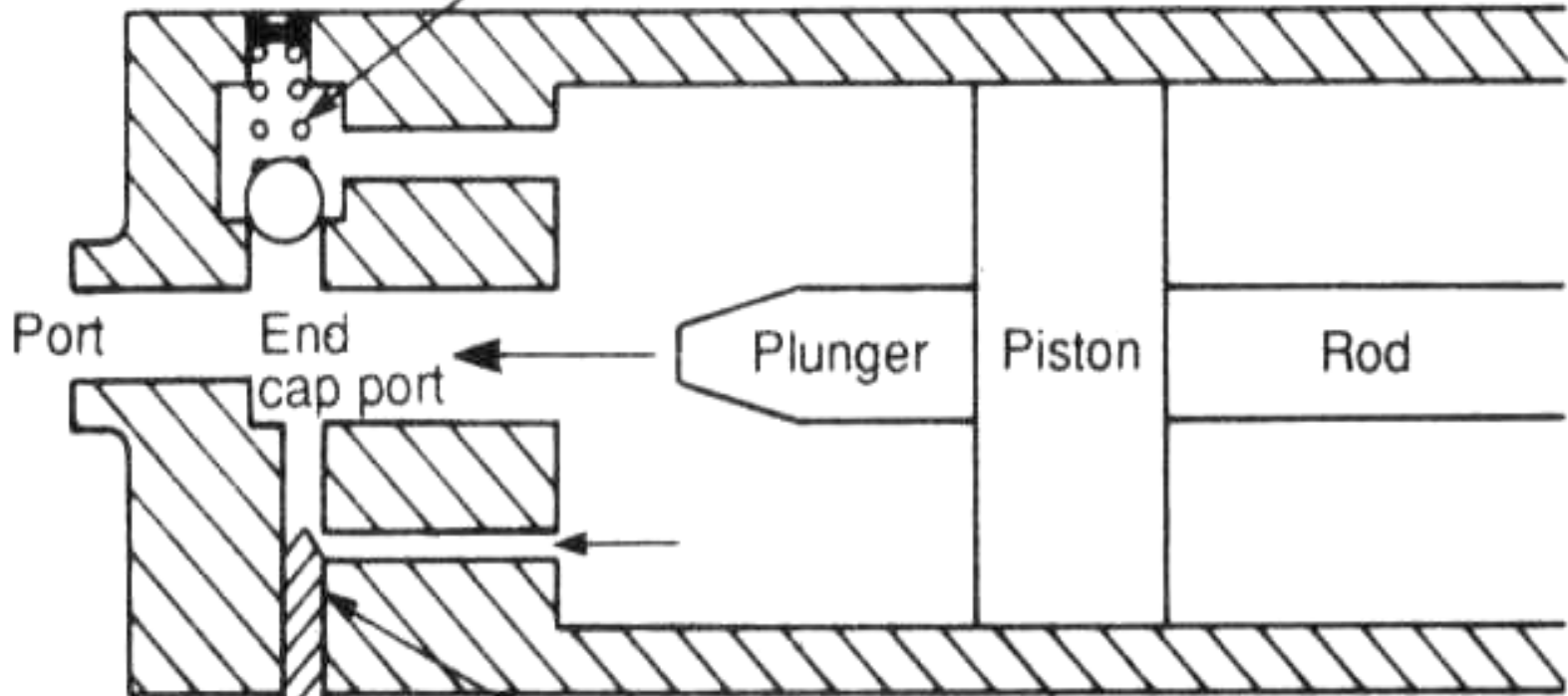
# COUSHIONED CYLINDER



- End caps (base cap) have to withstand shock loads (fluid pressure or from kinetic energy of the moving parts) at extremes of piston travel
- Reduction of shock loads with the help of cushion valves build in end caps
- Exhaust fluid flow is unrestricted until plunger enters the cap
- As plunger enters end cap port fluid experiences blockage, passes through deceleration valve (adjustable needle valve) which in turn reduces speed & the end of travel impact
- Deceleration valve is adjustable to allow the deceleration rate to be set
- A check valve is included in the end cap to bypass the deceleration valve & give near full flow as the cylinder extends



Check valve gives full flow while extending



Port

End cap port

Plunger

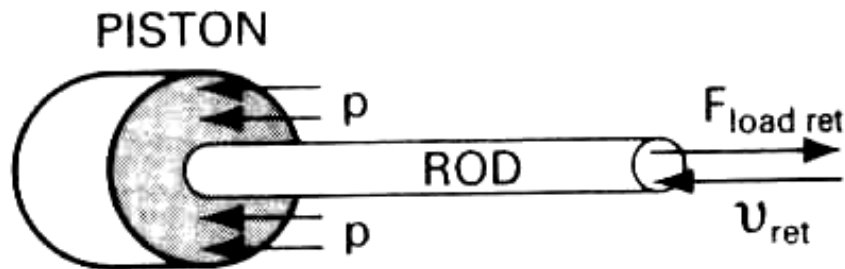
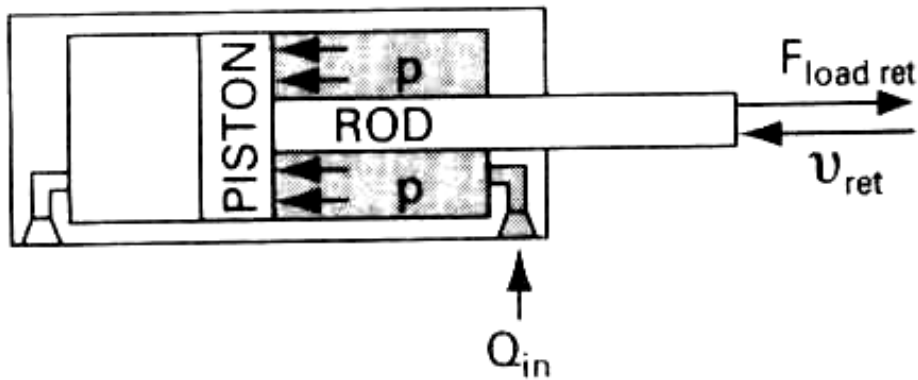
Piston

Rod

Needle valve

Needle valve setting determines deceleration

Plunger seals end cap port, exhaust flows via needle valve



DURING RETRACTION, ONLY THE ANNULAR AREA AROUND THE ROD ( $A_p - A_r$ ) WHICH IS SHOWN SHADED, IS EXPOSED TO FLUID PRESSURE.

$$F_{ret}(N) = p(\text{Pa}) \times (A_p - A_r)m^2$$

$$v_{ret}(m/s) = \frac{Q_{in}(m^3/s)}{(A_p - A_r)m^2}$$

*Extension force is greater than the retraction force for the same operating pressure*  
*Retraction velocity is greater the extension velocity for the same input flow rate*

$$\text{Power (HP)} = \frac{v_p(\text{ft/s}) \times F(\text{lb})}{550} = \frac{Q_{in}(\text{gpm}) \times p(\text{psi})}{1714}$$

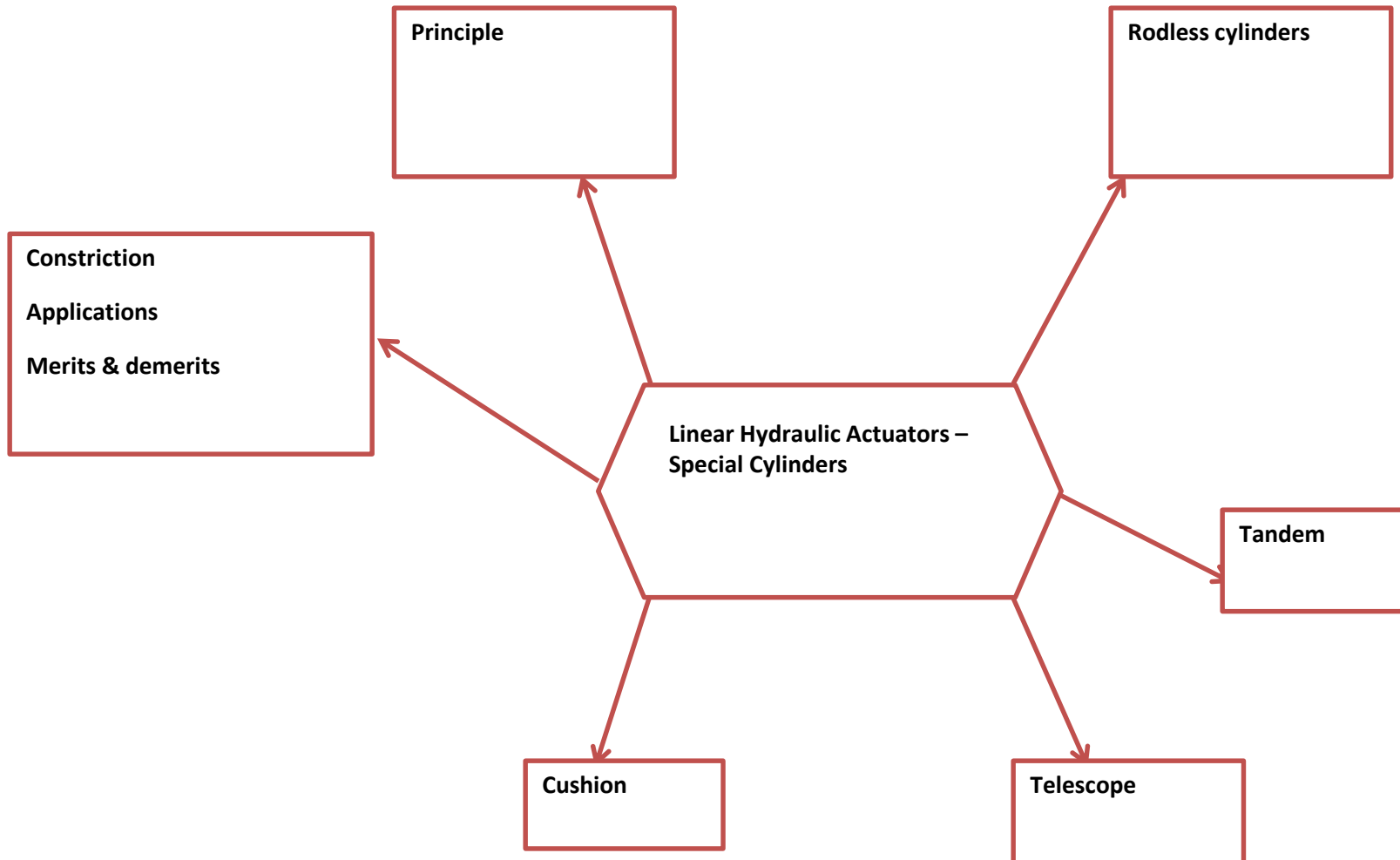
$$\text{Power (kW)} = v_p(m/s) \times F(kN) = Q_{in}(m^3/s) \times p(kPa)$$



# Questions



1. What is meant by cylinder cushioning ?
2. What is the purpose of a cylinder cushion ?
3. What is a telescopic cylinder ? When do you use it ?
4. What are tandem cylinders ? When are they normally used ?
5. What do you mean by double-rod cylinders ?





# Summary

- Telescopic cylinder is used to produce long strokes
- Rodless cylinder is used to produce short strokes
  - sealing band cylinder with slotted cylinder barrel
  - cylinder with magnetically coupled slide
  - band or cable cylinder
- Tandem cylinder combine two or more piston with a single rod.
- Cylinder cushions are used to reduce the impact of the piston on the cylinder casing
  - Fixed
  - Adjustable



# Assessment



1. A double rod end cylinder with the same pressure at either end can have:  
A. equal force and speed in both directions of travel.      B. higher force in one direction of travel.  
C. either of the above.  
D. Slower speed in both direction
  
2. With the same pressure at either end a single rod end cylinder has:  
A. equal force in both directions of travel.      B. more force extending.      C. more force retracting.  
D. Less force in both directions of travel
  
3. Cable cylinders are:  
A. twice as long as their stroke.      B. three times as long as their stroke.      C. slightly longer than their stroke..
  
4. Tandem cylinders can have almost \_\_\_\_\_ the force as a single cylinder.  
A. One time      B. Twice      C. three times      D. four times
  
5. A cylinder with an actual 2:1 rod in a regeneration circuit will:  
A. extend twice as fast as retract.      B. extend and retract at the same speed.      C. cannot regenerate a 2:1 rod cylinder.





# Answer



1. A double rod end cylinder with the same pressure at either end can have:  
A. equal force and speed in both directions of travel.      B. higher force in one direction of travel.  
**C. either of the above.**  
D. Slower speed in both direction
  
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# Higher Order Question

- Rolls of paper are lifted into a calender by a lifting device. The lifting device is driven by a plunger cylinder (single-acting cylinder). When the hydraulic power pack is switched on, the pump output flows directly to the cylinder. A 2/2-way valve, which is closed in its normal position, is fitted in a branch line leading to the tank. A non-return valve is used to ensure that the pump is protected against the oil back-pressure. A pressure relief valve is fitted upstream of the non-return valve to safeguard the pump against excessive pressures.