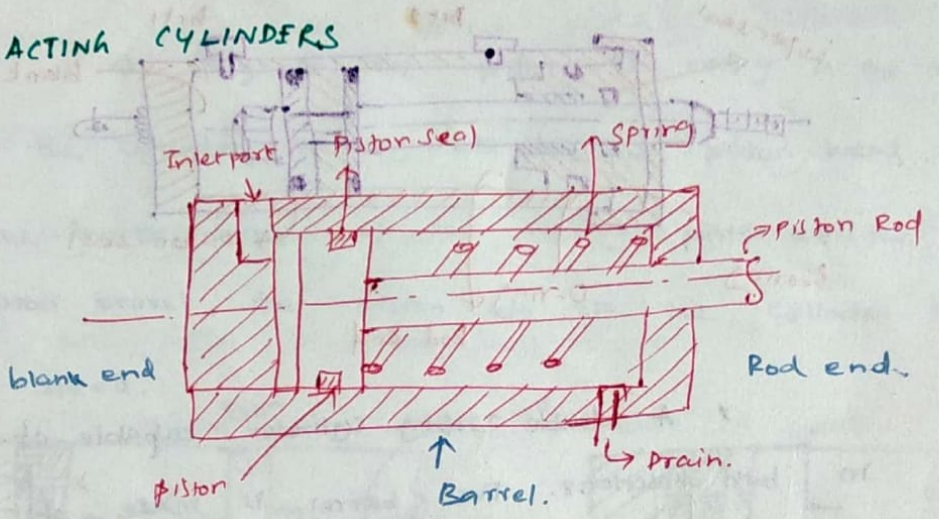
HYDRAULIC ACTUATORS.

SINGLE ACTING CYLINDERS



* It consists of a piston inside a cylindrical housing called a barrel.

* Attached to one end of the piston is a rod which extends outside.

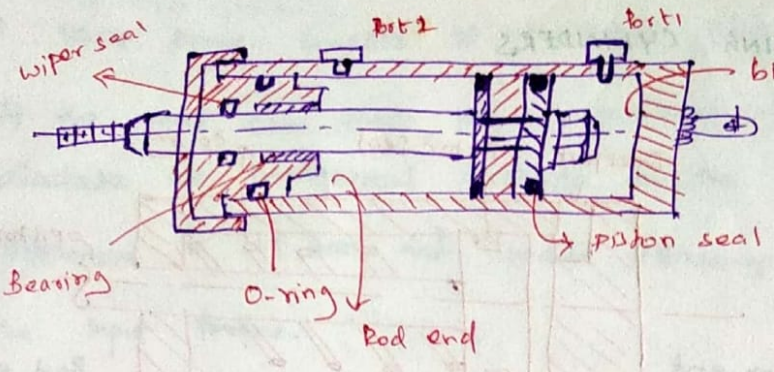
* At the other end [blank end] is a port for the enterence and the exit of oil.

* A single acting cylinder can exert a force only in the extending direction, as fluid from the pump enters through the blank end of the cylinder.

* It do not hydraulically retract.

* Retraction is accoumplished by using gravity (or) by the inclusion of a compression spring at the rod end.

DOUBLE ACTING CYLINDER.



* A double acting cylinder capable of delivering forces in both directions. The barrel is made of seamless steel tubing, honed to a fine finish on the inside surface.

* Piston made of ductile iron contains U cup packings to seal the leakage b/t the piston and the barrel.

* The ports are located in the end caps which are secured to the barrel by the rods.

* The load of the piston rod at the neck is taken by a rod bearings, which is made of brass (or) bronze.

* A rod wiper is provided at the end of the neck to prevent foreign particles and dust from entering into the cylinder along with the piston rod.

SPEED OF HYDRAULIC CYLINDER

* Each and every cylinder has its own economical and practicable range of speed.

* Speed of cylinder increased a set value of (max) limit. Sudden stop of cylinder creates shock load on the piston head, piston rock and other mech. parts. causing serious of damage.

* High speed → less accuracy.

* The maximum speed of the piston rod is limited by the rate of fluid flow in and out of the cylinder and ability of the cylinder to withstand the impact forces which occur when the piston movement is arrested.

* In an uncushioning cylinder it is normal to limit the maximum piston velocity to 6 m/min.

* The value is increased to 12 m/min for a cushioning cylinder and 45 m/min is permissible with high speed cylinders.

A → Blank end area $= \frac{\pi D^2}{4}$

a → piston rod area $= \frac{\pi d^2}{4}$

Rod end area $= \frac{\pi}{4}(D^2 - d^2)$.

(i) When piston rod is extending.

Piston velocity $v_E = \frac{Q}{A} = \frac{q_E}{(A-a)}$

$q_E = \frac{Q(A-a)}{A}$ (or) $Q\left(\frac{D^2-d^2}{D^2}\right)$

Fluid leaving < fluid entering.

(ii) When piston rod is retracting

$v_R = \frac{Q}{(A-a)} = \frac{q_R}{A}$

$q_R = Q\frac{A}{A-a}$

fluid leaving > fluid entering.

CYLINDER THRUST

Static Thrust

Static Thrust developed by a hydraulic cylinder is the product of pressure and area.

$$\text{Forward thrust} = P_1 A - P_2 (A - a)$$

$$= P_1 \left(\frac{\pi D^2}{4} \right) - P_2 \left(\frac{\pi D^2}{4} - \frac{\pi d^2}{4} \right)$$

$$= \frac{\pi}{4} \left[P_1 D^2 - P_2 (D^2 - d^2) \right]$$

$$\text{Retract Thrust} = P_2 (A - a) - P_1 A$$

$$= \frac{\pi}{4} \left(P_2 (D^2 - d^2) - P_1 D^2 \right).$$

DYNAMIC THRUST

In dynamic app the load inertia, load friction, Seal friction etc. must be allowed while calculating the dynamic thrust.

* As a first approximation the dynamic thrust can be taken as 0.9 times the static thrust.

* For accurate calculation, the co-efficient of Static and dynamic friction should be taken into consideration

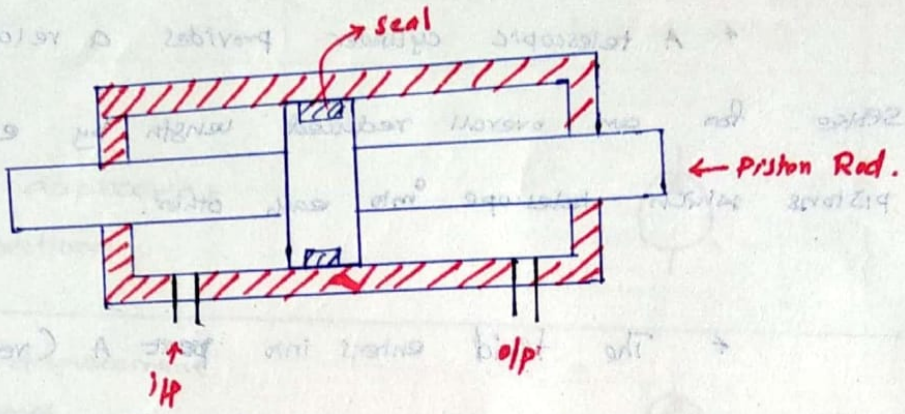
CYLINDER POWER

$$= \frac{P Q}{60 \times 1000} \text{ kW}$$

P → Pressure
Q → flow.

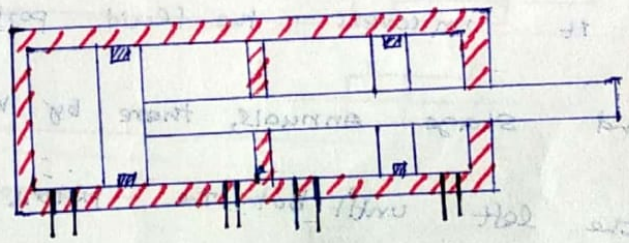
SPECIAL TYPE CYLINDERS.

DOUBLE ROD CYLINDER



Double rod cylinder is a cylinder with a single piston and a piston rod extending from each end. This cylinder allows work to be performed at either (or) both ends. It may be desirable where operating speed and return speed are equal.

TANDEM CYLINDER

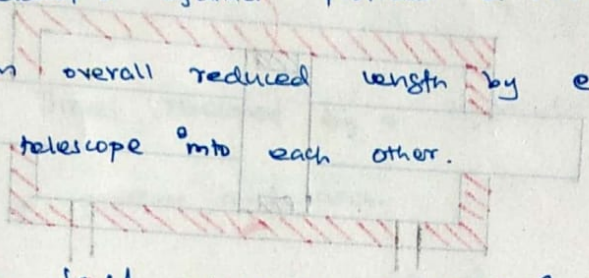


* Tendam cylinder design has two cylinders mounted in line with position connected by a common pistor rod.
* These cylinders provide increased output force when the bore size of a cylinder is limited.
* But the length of the cylinder is more than a std cylinder and also requires a larger flow rate to achieve a speed because flow must go to both pistons.

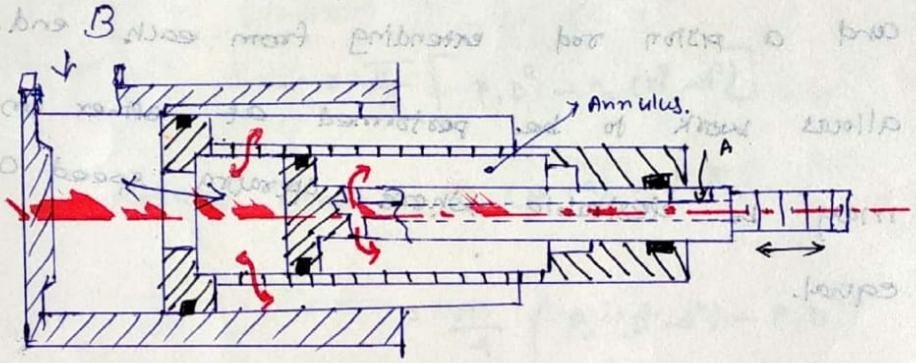
TELESCOPING CYLINDERS

* App. long work strokes

* A telescopic cylinder provides a relatively long working stroke for an overall reduced length by employing several pistons which telescope into each other.



* The fluid enters into port A (retraction) passes through the hollow piston rod into the annulus behind the first stage piston.



* The first stage piston is forced to the left until it uncovers the fluid ports connecting this with the second stage annuals, there by moving the larger piston to the left until both the pistons are fully retracted into the body of the cylinder.

* Extension the fluid flow enters in to the port B. After that oil will expand when the every stage cylinder, reach its max. extension.