

Q- For non-viscose fluid, find the power required to actuate the piston to get 2750 psi with an 8.5 second stroke at 6.5 gal/minute at outlet.

Let the velocity of the fluid at the exit point is v , and the area of cross section is A then the displacement of the fluid per unit time will be v and the volume of the fluid flowing per second $\Delta Q/\Delta t$ is given by

$$\Delta Q/\Delta t = A*v \quad \text{----- (1)}$$

As the rate of volume flow is given,

Let the pressure of the fluid at exit is P then the force on the fluid in the exit will be
 $F = P*A$

And hence the power given to the fluid to drive it will be

$$\text{Power} = F * v = P * A * v$$

Substituting v from equation 1 we get

$$\text{Power} = P * A * \frac{1}{A} * \frac{dQ}{dt}$$

Or $\text{Power} = P * \frac{dQ}{dt}$

As the fluid is non-viscous the power required to drive the fluid is coming from the power delivered to the piston, hence input power will also be given by

$$\text{Input Power} = P * \frac{dQ}{dt}$$

Or $= (2790 \text{ psi}) * (6.5 \text{ gal} / \text{min})$

Or $= (2790 \text{ lb} / \text{ft}^2) * \left(6.5 * \frac{231 \text{ in}^3}{60 \text{ s}} \right) = (2790 \text{ lb} / \text{ft}^2) * \left(6.5 * \frac{231 \text{ ft}^3}{60 \text{ s} * 12^3} \right)$

Or $= 40.405 (f * \text{lb} / \text{s}) = 40.405 / 550 \text{ hp} = 7.35 * 10^{-2} \text{ hp}$

1 horse power = 550 ft-lb/sec

The gallon is taken as USA fluid gallon.