

# Shigley's Mechanical Engineering Design | (10th Edition)

Chapter 8, Problem 6P

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## Problem

The press shown for Prob. 8-5 has a rated load of 5000 lbf. The twin screws have Acme threads, a diameter of 2 in, and a pitch of  $\frac{1}{4}$  in. Coefficients of friction are 0.05 for the threads and 0.08 for the collar bearings. Collar diameters are 3.5 in. The gears have an efficiency of 95 percent and a speed ratio of 60:1. A slip clutch, on the motor shaft, prevents overloading. The full-load motor speed is 1720 rev/min.

- (a) When the motor is turned on, how fast will the press head move?  
 (b) What should be the horsepower rating of the motor?

## Step-by-step solution

### Step 1 of 6

Given data:

Diameter of the power screw,  $d = 2$  in

Pitch of the screw,  $P = 0.25$  in

Load acting on the screw,  $F = 5000$  lbf

Coefficient of friction of collar,  $f_c = 0.08$

Coefficient of friction of thread,  $f_t = 0.05$

Diameter of collar,  $d_c = 3.5$  in

Speed ratio of the gears is 60 : 1

Speed of the load motor,  $N = 1720$  rev/min

Efficiency of the gears is, 95 %

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### Step 2 of 6

a)

Given that speed ratio,  $\left( \frac{\text{Speed of Motor}}{\text{Speed of Press Head}} \right) = 60 : 1$

Therefore, Speed of press head is,

$$N = \frac{\text{Speed of Motor}}{\text{Speed Ratio}}$$

$$N = \frac{1720}{60}$$

$$N = 28.67 \text{ rev/min}$$

Linear speed of press head is given by,

$$v = N \times l$$

$$v = 28.66 \times 0.25 \quad (l = P \text{ for single threaded screws})$$

$$v = 7.167 \text{ in/min}$$

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## Step 3 of 6

b)

The rated load is given for twin screws.

Therefore, the rated load for single screw is,

$$F = \frac{5000}{2}$$

$$F = 2500 \text{ lbf/screw}$$

$$\text{Major diameter } (d_m) = d - \frac{P}{2}$$

$$= 2 - \frac{0.25}{2}$$

$$= 1.875 \text{ in}$$

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## Step 4 of 6

The angle between acme threads,  $2\alpha = 29^\circ$ Therefore,  $\sec \alpha = 1.033$ 

For raising the load or for tightening a screw or bolt

$$T_R = \frac{Fd_m}{2} \left( \frac{l + \pi f_i d_m \sec \alpha}{\pi d_m - f_i l \sec \alpha} \right)$$

$$T_R = \left( \frac{(2500 \text{ lbf}) \times (1.875 \text{ in})}{2} \right) \left( \frac{(0.25 \text{ in}) + \pi \times 0.05 \times (1.875 \text{ in}) \times 1.033}{\pi \times (1.875 \text{ in}) - 0.05 \times (0.25 \text{ in}) \times 1.033} \right)$$

$$T_R = 2343.75 \times \left( \frac{0.5542}{5.8776} \right) \text{ lbf-in}$$

$$T_R = 220.99 \text{ lbf-in}$$

$$T_R = 221 \text{ lbf-in}$$

[Comments \(3\)](#)

## Step 5 of 6

Torque due to collar friction is given by,

$$T_C = \frac{F f_c d_c}{2}$$

$$T_C = \frac{2500 \times 0.08 \times 3.5}{2}$$

$$T_C = 350 \text{ lbf-in}$$

[Comment](#)

## Step 6 of 6

$$\text{Total torque } (T_{total}) = T_R + T_C$$

$$= 221 + 350$$



$$= \frac{571 \times 2}{60 \times 0.95}$$

$$= 20.035 \text{ lbf-in}$$

Power rating of the motor is given by,

$$H = TN$$

$$H = \frac{\left( \frac{20.035}{12} \text{ lbf-ft} \right) \times 2\pi \times (1720 \text{ rpm})}{33000}$$

$$H = 0.5467 \text{ HP}$$

$$\boxed{H = 0.55 \text{ HP}}$$

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Was this solution helpful?

52

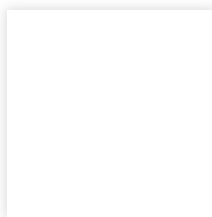
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## Recommended solutions for you in Chapter 8

### Chapter 8, Problem 27P

From your experience with Prob. 8-26, generalize your solution to develop a turn-of-nut equation where  $N_t$  = turn of the nut from...

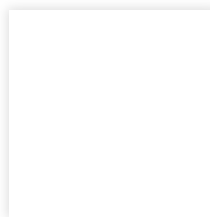
[See solution](#)



### Chapter 8, Problem 67P

The bolted connection shown in the figure uses SAE grade 8 bolts. The members are hot-rolled AISI 1040 steel. A tensile shear...

[See solution](#)



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