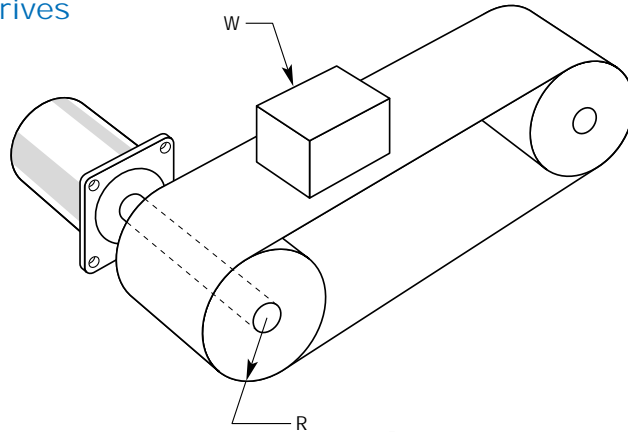


Tangential Drives



R- Radius

W – Weight (include weight of belt or chain)

W(P) – Weight of pulley or material

F – Breakaway force

V – Linear velocity

CT – Coupling type

SL – Side load

R = _____ inches

W = _____ ounces

W(P) _____ ounces

F = _____ ounces

V = _____ inches/sec

CT = _____

SL = _____

Tangential Drive Formulas

$$T_{\text{Total}} = T_{\text{Load}} + T_{\text{Pulley}} + T_{\text{Belt}} + T_{\text{Motor}} + T_{\text{Friction}}$$

$$T_{\text{Total}} = \frac{1}{g} (J_{\text{Load}} + J_{\text{Pulley}} + J_{\text{Belt}} + J_{\text{Motor}}) \frac{\omega}{t} + T_{\text{Friction}}$$

$$J_{\text{Load}} = W_L R^2$$

$$J_{\text{Pulley}} = \frac{W_P R^2}{2} \quad (\text{Remember to multiply by 2 if there are 2 pulleys.})$$

$$J_{\text{Belt}} = W_B R^2$$

$$T_{\text{Friction}} = FR$$

$$\omega = \frac{V}{R}$$

Where:

T = torque, oz-in (gm-cm)

ω = angular velocity, radians/sec

t = time, seconds

W_L = weight of the load, oz

W_P = pulley weight, oz

W_B = belt or rack weight, oz

F = frictional force, oz (gm)

R = radius, in (cm)

V = linear velocity

g = gravity constant, 386 in/sec²

ρ = density, oz/in³

Problem

What torque is required to accelerate a 5-lb load to a velocity of 20 inches per second in 10 milliseconds using a flat timing belt? The motor drives a 2-inch diameter steel pulley 1/2-inch wide. The timing belt weighs 12 oz. Load static friction is 30 ozs. Motor rotor inertia is 10.24 oz-in.²

$$J_{\text{Load}} = W_L R^2 = 5 \text{ lb} \times 16 \frac{\text{oz}}{\text{lb}} \times (1 \text{ in})^2 = 80 \text{ oz-in}^2$$

$$J_{\text{Pulley}} = \frac{2(\pi L \rho R^4)}{2} = \pi \times 0.5 \text{ in} \times (4.48 \text{ oz/in}^3) (1 \text{ in})^4 = 7.04 \text{ oz-in}^2$$

$$J_{\text{Belt}} = W_B R^2 = 12 \text{ oz} (1 \text{ in})^2 = 12 \text{ oz-in}^2$$

$$T_{\text{Friction}} = F \times R = 30 \text{ oz} \times 1 \text{ in} = 30 \text{ oz-in}$$

$$\omega = \frac{V}{R} = 20 \frac{\text{in}}{\text{sec}} \times \frac{1 \text{ rad}}{1 \text{ in}} = 20 \frac{\text{rad}}{\text{sec}}$$

$$T_{\text{Total}} = \frac{1}{386} (80 + 7.04 + 12 + 10.24) \frac{20}{.01} + 30$$

$$T_{\text{Total}} = 596.2 \text{ oz-in}$$