Given: Diameter (d): 55 mm
Rotational Speed (N): 480 rpm
Maximum Shear Stress (S_S): 40 MPa

Find: Power (P): The rate of work done, measured in kilowatts (kW).

For Line Shafts: $$S_S = \frac{16\,T}{\pi\,D_o^{\,3}}$$

$$40\frac{N}{mm^2} = \frac{16\,T}{\pi\,(55\,mm)^3}$$

$$T = 1,306,706.194\,N - mm$$

Then; $$P = \frac{2\pi TN}{60}$$

$$P = \frac{2\pi(1,306,706.194\,N{-}mm)\left(\frac{1\,m}{1,000\,mm}\right)\left(\frac{1\,kN}{1,000\,N}\right)(480\,rpm)}{60}$$

$$P = 65.6822\,kW$$

This shaft is capable of driving a 65 kW (approx. 88 horsepower) motor or generator. If the load is increased beyond this point, the internal stress will rise above 40 MPa, risking deformation. stress of 40 MPa is quite conservative for industrial steel shafts (which often have yield points above 200 MPa). This suggests the design has a Factor of Safety of roughly 4 or 5, making it highly reliable for continuous industrial use where sudden load spikes might occur.