Roller Mill Drive System Analysis

# 1. Assumptions

* Driver (hammer) speed N1 = 700 rpm.
* Roller speed N2 = 280 rpm (given).
* Hammer pulley diameter (driver) D1 = 10 in = 254.0 mm.
* Driven pulley diameter (roller) D2 = 25 in = 635.0 mm (calculated from speeds).
* Roller geometry: 55 mm diameter, 130 mm length, 1 mm gap.
* Bulk density of grain/flour: 750 kg/m³.
* Fill (nip) factor: f = 0.6.
* Assumed pulley center distance: C = 500 mm.
* Specific energy for roller milling: 20 kWh/ton.
* Steel density: 7850 kg/m³.

# 2. Pulley Diameters (mm)

Driver (hammer) pulley: 254.0 mm

Driven (roller) pulley: 635.0 mm

# 3. Belt Length

Calculated using open-belt formula with center distance C = 500 mm:

Belt length L ≈ 2469 mm

# 4. Belt Wrap Angles

Small pulley (driver): 135.21°

Large pulley (driven): 224.79°

# 5. Roller Peripheral Speed

Roller surface speed ≈ 1.61 m/s

# 6. Theoretical Roller Mill Capacity

Ideal mass flow rate (nip-fill): ≈ 169.8 kg/h

# 7. Power and Torque

Estimated shaft power: ≈ 3.396 kW

Torque at 280 rpm: ≈ 115.84 N·m

# 8. Roller Mass and Centrifugal Force

Roller mass (solid steel): ≈ 2.425 kg

Centrifugal force at 280 rpm: ≈ 57.32 N

# 9. Summary

* Driver pulley D1 = 254.0 mm
* Driven pulley D2 = 635.0 mm
* Belt length ≈ 2469 mm
* Wrap angle (small pulley) ≈ 135.21°
* Roller speed ≈ 1.61 m/s
* Theoretical capacity ≈ 169.8 kg/h
* Power requirement ≈ 3.396 kW
* Torque ≈ 115.84 N·m
* Roller mass ≈ 2.425 kg
* Centrifugal force ≈ 57.32 N

# 10. Notes and Recommendations

1. If 'A40' was intended to represent a belt length (40 in), it's too short for these pulley sizes.
2. Wrap angle of 135° is generally acceptable; if it drops below 120°, consider a tensioner/idler.
3. Practical throughput is typically 10–60% of theoretical capacity.
4. Use a motor with at least 1.25× service factor. A 4–5 kW motor is recommended.
5. To improve accuracy, measure actual motor power and update calculations.