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FORMULA SHEET

1. BELT DRIVES

$$1.1 \quad N_1 \times D_1 = N_2 \times D_2$$

$$1.2 \quad \text{Belt speed} = \frac{\pi DN}{60} \quad \text{where } N \text{ is in r/min}$$

$$1.3 \quad \text{Belt speed} = \frac{\pi(D+t) \times N}{60} \quad (t = \text{belt thickness})$$

$$1.4 \quad \text{Belt mass} = \text{area} \times \text{length} \times \text{density} \quad (A = \text{thickness} \times \text{width})$$

$$1.5 \quad \text{Speed ratio} = \frac{\text{diameter of driven pulley}}{\text{diameter of driving pulley}}$$

$$1.6 \quad \text{Belt length (flat belt)} = [(D + d) \times 1,57] + 2 \times \text{centre distance}$$

$$1.7 \quad \text{Open belt length} = \frac{\pi(D+d)^2}{2} + \frac{(D-d)^2}{4c} + 2c$$

$$1.8 \quad \text{Crossed belt length} = \frac{\pi(D+d)^2}{2} + \frac{(D+d)^2}{4c} + 2c$$

$$1.9 \quad \text{Ratio between tight side and slack side} = \frac{T_1}{T_2}$$

$$1.10 \quad \text{Power (P)} = \frac{(T_1 - T_2) \pi DN}{60} \quad \text{where } N \text{ is in r/min}$$

T_1 = force in tight side

T_2 = force in slack side

$T_1 - T_2$ = effective force (T_e)

$$1.11 \quad \text{Power (P)} = (T_1 - T_2) \times V \quad \text{where } V = \text{belt speed in m/s}$$

$$1.12 \quad \text{Power (P)} = \frac{2\pi NT}{60} \quad \text{where } N \text{ is in r/min}$$

$$1.13 \quad \text{Width} = \frac{T_1}{\text{permissible tensile force}}$$

2. STRESS AND STRAIN

$$2.1 \quad \text{Stress} = \frac{\text{force}}{\text{area}} \quad \text{or} \quad \left(\sigma = \frac{F}{A} \right)$$

$$2.2 \quad \text{Strain } (\epsilon) = \frac{\text{change in length}(\Delta L)}{\text{original length}(L)}$$

2.3 Young's modulus (E) = $\frac{\text{stress}}{\text{strain}}$ or $\left(\frac{\sigma}{\varepsilon}\right)$

2.4 Area of a round bar = $A = \frac{\pi d^2}{4}$

2.5 Area of a pipe = $A = \frac{\pi(D^2 - d^2)}{4}$

2.6 Area of a square bar = $A = L^2$ or $A = L \times W$

3. HYDRAULICS

3.1 Pressure (P) = $\frac{\text{force (F)}}{\text{area (A)}}$

3.2 Volume = (cross-sectional area) $\times$ stroke length

3.3 Work done = force $\times$ distance

4. KEYS AND KEYWAYS

4.1 Width of key = $\frac{\text{diameter of shaft}}{4}$

4.2 Thickness of key = $\frac{\text{diameter of shaft}}{6}$

4.3 Length of key = $1,5 \times \text{diameter of shaft}$

4.4 Standard taper for taper key = 1 in 100 or 1 : 100

5. LEVERS

5.1 Mechanical advantage (MA) = $\frac{\text{load (W)}}{\text{effort (F)}}$

5.2 Velocity ratio (VR) = $\frac{\text{input movement}}{\text{output movement}}$

5.3 Input movement (IM) = effort $\times$ distance moved by effort

5.4 Output movement (OM) = load $\times$ distance moved by load

6. GEAR DRIVES

6.1 $N_1 \times D_1 = N_2 \times D_2$

6.2 Power (P) = $\frac{2\pi NT}{60}$

- 6.3 Gear ratio = $\frac{\text{product of number of teeth on driven gears}}{\text{product of number of teeth on driving gears}}$
- 6.4 $\frac{N_{\text{input}}}{N_{\text{output}}} = \frac{\text{product of number of teeth on driven gears}}{\text{product of number of teeth on driving gears}}$
- 6.5 Torque = force × radius
- 6.6 Torque transmitted = gear ratio × input torque
- 6.7 Module (m) = $\frac{\text{pitch-circle diameter (PCD)}}{\text{number of teeth (T)}}$
- 6.8 $N_1 T_1 = N_2 T_2$
- 6.9 Pitch-circle diameter (PCD) = $\frac{\text{circular pitch (CP)} \times \text{number of teeth (T)}}{\pi}$
- 6.10 Pitch-circle diameter (PCD) = m × T
- 6.11 Outside diameter (OD) = m(T + 2)
- 6.12 Outside diameter (OD) = Pitch-circle diameter (PCD) + 2 module
- 6.13 Addendum = module (m)
- 6.14 Dedendum = 1,157 m or Dedendum = 1,25 m
- 6.15 Cutting depth = 2,157 m or Cutting depth = 2,25 m
- 6.16 Clearance = 0,157 m or Clearance = 0,25 m
- 6.17 Circular pitch (CP) = m × π
- 6.18 Centre distance between gear A and gear B = $\frac{(\text{PCD})_A}{2} + \frac{(\text{PCD})_B}{2}$

7. SCREW THREADS

- 7.1 Pitch diameter = outside diameter – $\frac{1}{2}$ pitch
- 7.2 Pitch circumference = π × pitch diameter
- 7.3 Lead = pitch × number of starts
- 7.4 Height of screw thread = 0,866 × pitch
- 7.5 Depth of screw thread = 0,613 × pitch

8. INDEXING

8.1 Cincinnati dividing head table for milling machine

Cincinnati index plate											
Side 1	24	25	28	30	34	37	38	39	41	42	43
Side 2	46	47	49	51	53	54	57	58	59	62	66

8.2 Indexing = $\frac{40}{n}$ (where n = number of divisions)