VR = velocity ratio
v_b = belt speed
CD = center distance (in)
ø = random angle that helps solve for the wrap angle (°)
θ = angle of wrap (°)
s = arc length (length of belt/chain wrap on sprocket)
d = distance (or span) (belt/chain length that is tangent to sprockets)
L_p = belt/chain total length
H_{in} = input power (hp)
P_{des} = power (hp)
P_{rated} = rated power (hp)
SF = service factor

1.3 Flat Belts

1.3.1 Nomenclature

F_1 = taut-side tension
F_2 = slack-side tension
F_c = centrifugal tension
F_i = initial tension
f = maximum coefficient of friction
T = transmitted torque
w = weight per foot (lb/ft)
V = belt speed (ft/min)
H = transmitted power (hp)
b = belt width (in)
t = belt thickness (in)
γ = specific weight (lb/in^3)
$(F_1)_a$ =largest allowable tension
F_a = allowable tension/unit width
C_P = pulley correction factor (tab. 17-4)
C_V = velocity correction factor (p. 889)
H_{nom} = nominal (rated) power
H_a = design power
K_s = service factor
n_d = design safety factor
n_f = factor of safety
n = angular velocity (rpm)

1.3.2 Formulae

$\Delta F = (F_1)_a - F_2 = \frac{2T}{d}$
$F_1 - F_2 = \frac{2T}{d}$
$F_1 = F_c + \frac{2F_i e^{f\phi}}{e^{f\phi}+1}$
$F_2 = F_c + \frac{2F_i}{e^{f\phi}+1}$

$\frac{F_1 - F_c}{F_2 - F_c} = e^{f\phi}$

$F_c = \frac{w}{32.17\,\mathrm{ft/s^2}} \left(\frac{V}{60\,\mathrm{s/min}}\right)^2$

$F_i = \frac{F_1 + F_2}{2} - F_c = \frac{T}{d} \frac{e^{f\phi}+1}{e^{f\phi}-1}$

$H = \frac{(F_1 - F_2)V}{33{,}000\,(\frac{\mathrm{ft\,lb}}{\mathrm{min}})/\mathrm{hp}}$

$w = 12\,\mathrm{in/ft}\,\gamma b t$

$(F_1)_a = bF_a C_P C_V$

$H_d = H_{\mathrm{nom}} K_s n_d$

$H_a = H_{\mathrm{nom}} K_s n_d$

$n_{\mathrm{fs}} = \frac{H_a}{H_{\mathrm{nom}} K_s}$

$T = 63025 \frac{H_{\mathrm{nom}} K_s n_d}{n} = 63025 \frac{H_d}{n}$

$f' = \frac{1}{\phi} \ln\left(\frac{(F_1)_a - F_c}{F_2 - F_c}\right)$

$\mathrm{dip} = \frac{C^2 w}{96\,\mathrm{in/ft} F_i}$

$F_1 = (F_1)_a$ at operation limit

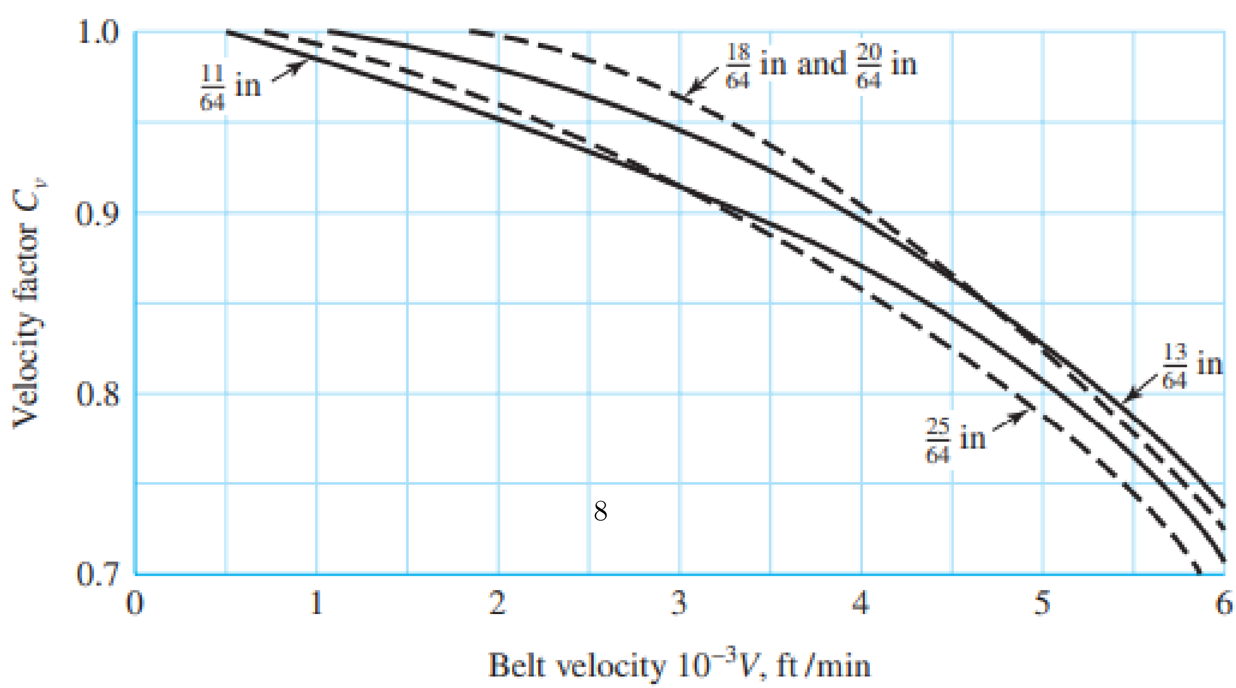
require $f' < f$

1.3.3 Tables for Constants

Table 17–2 Properties of Some Flat- and Round-Belt Materials. (Diameter = d, thickness = t, width = w)

Material	Specification	Size, in	Minimum Pulley Diameter, in	Allowable Tension per Unit Width at 600 ft/min, lbf/in	Specific Weight, lbf/in^3	Coefficient of Friction
Leather	1 ply	$t = \frac{11}{64}$	3	30	0.035–0.045	0.4
		$t = \frac{13}{64}$	$3\frac{1}{2}$	33	0.035–0.045	0.4
	2 ply	$t = \frac{18}{64}$	$4\frac{1}{2}$	41	0.035–0.045	0.4
		$t = \frac{20}{64}$	6[a]	50	0.035–0.045	0.4
		$t = \frac{23}{64}$	9[a]	60	0.035–0.045	0.4
Polyamide[b]	F–0[c]	$t = 0.03$	0.60	10	0.035	0.5
	F–1[c]	$t = 0.05$	1.0	35	0.035	0.5
	F–2[c]	$t = 0.07$	2.4	60	0.051	0.5
	A–2[c]	$t = 0.11$	2.4	60	0.037	0.8
	A–3[c]	$t = 0.13$	4.3	100	0.042	0.8
	A–4[c]	$t = 0.20$	9.5	175	0.039	0.8
	A–5[c]	$t = 0.25$	13.5	275	0.039	0.8
Urethane[d]	$w = 0.50$ in	$t = 0.062$	See Table 17–3	5.2[e]	0.038–0.045	0.7
	$w = 0.75$ in	$t = 0.078$		9.8[e]	0.038–0.045	0.7
	$w = 1.25$ in	$t = 0.090$		18.9[e]	0.038–0.045	0.7
	Round	$d = \frac{1}{4}$	See Table 17–3	8.3[e]	0.038–0.045	0.7
		$d = \frac{3}{8}$		18.6[e]	0.038–0.045	0.7
		$d = \frac{1}{2}$		33.0[e]	0.038–0.045	0.7
		$d = \frac{3}{4}$		74.3[e]	0.038–0.045	0.7

[a]Add 2 in to pulley size for belts 8 in wide or more.
[b]*Source: Habasit Engineering Manual,* Habasit Belting, Inc., Chamblee (Atlanta), Ga.
[c]Friction cover of acrylonitrile-butadiene rubber on both sides.
[d]*Source:* Eagle Belting Co., Des Plaines, Ill.
[e]At 6% elongation; 12% is maximum allowable value.



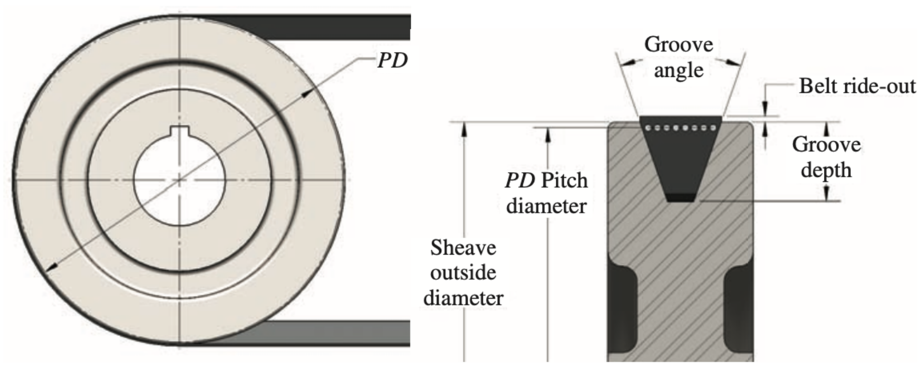
$C_v = 1$ for polyamide and urethane belts

Table 17–4 **Pulley Correction Factor C_P for Flat Belts***

	Small-Pulley Diameter, in					
Material	**1.6 to 4**	**4.5 to 8**	**9 to 12.5**	**14, 16**	**18 to 31.5**	**Over 31.5**
Leather	0.5	0.6	0.7	0.8	0.9	1.0
Polyamide, F–0	0.95	1.0	1.0	1.0	1.0	1.0
F–1	0.70	0.92	0.95	1.0	1.0	1.0
F–2	0.73	0.86	0.96	1.0	1.0	1.0
A–2	0.73	0.86	0.96	1.0	1.0	1.0
A–3	—	0.70	0.87	0.94	0.96	1.0
A–4	—	—	0.71	0.80	0.85	0.92
A–5	—	—	—	0.72	0.77	0.91

1.4 V-Belt Drives

1.4.1 Anatomy



1.4.2 Design Selection

1. Compute the design power

   (a) Find the service factor based from this table: