LAMPIRAN

Lampiran 1. Tabel Massa Jenis Material

Average properties of common engineering materials*

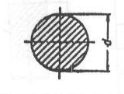
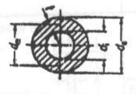
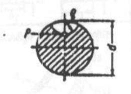
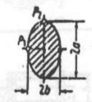
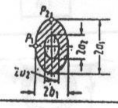
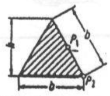
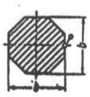
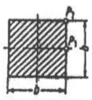
Material	Density, Mg/m^3	Ultimate strength, MPa			Yield strength,† MPa		Modulus of elasticity, GPa	Modulus of rigidity, GPa	Coefficient of thermal expansion, $10^{-6}/°C$	Elongation in 50 mm, %	Poisson's ratio
		Tension	Compression**	Shear	Tension	Shear					
					SI Units						
Steel											0.27–0.3
Structural, ASTM-A36	7.86	400	—	—	250	145	200	79	11.7	30	
High strength, ASTM-A242	7.86	480	—	—	345	210	200	79	11.7	21	
Stainless (302), cold rolled	7.92	860	—	—	520	—	190	73	17.3	12	
Cast iron											0.2–0.3
Gray, ASTM A-48	7.2	170	650	240	—	—	70	28	12.1	0.5	
Malleable, ASTM A-47	7.3	340	620	330	230	—	165	64	12.1	10	
Wrought iron	7.7	350	—	240	210	130	190	70	12.1	35	0.3
Aluminum											0.33
Alloy 2014-T6	2.8	480	—	290	410	220	72	28	23	13	
Alloy 6061-T6	2.71	300	—	185	260	140	70	26	23.6	17	
Brass, yellow											0.34
Cold rolled	8.47	540	—	300	435	250	105	39	20	8	
Annealed	8.47	330	—	220	105	65	105	39	20	60	
Bronze, cold rolled (510)	8.86	560	—	—	520	275	110	41	17.8	10	0.34
Copper, hard drawn	8.86	380	—	—	260	160	120	40	16.8	4	0.33
Magnesium alloys	1.8	140–340	—	165	80–280	—	45	17	27	2–20	0.35
Nickel	8.08	310–760	—	—	140–620	—	210	80	13	2–50	0.31
Titanium alloys	4.4	900–970	—	—	760–900	—	100–120	39–44	8–10	10	0.33
Zinc alloys	6.6	280–390	—	—	210–320	—	83	31	27	1–10	0.33
Concrete											0.1–0.2
Medium strength	2.32	—	28	—	—	—	24	—	10	—	
High strength	2.32	—	40	—	—	—	30	—	10	—	
Timber‡ (air dry)											
Douglas fir	0.54	—	55	7.6	—	—	12	—	4	—	
Southern pine	0.58	—	60	10	—	—	11	—	4	—	
Glass, 98% silica	2.19	—	50	—	—	—	65	28	80	—	0.2–0.27
Graphite	0.77	20	240	35	—	—	70	—	7	—	
Rubber	0.91	14	—	—	—	—	—	—	162	600	0.45–0.5

*Properties may vary widely with changes in composition, heat treatment, and method of manufacture.
**For ductile metals the compression strength is assumed to be the same as that in tension.
†Offset of 0.2%.
‡Loaded parallel to the grain.

Sumber: Aaron D.Deutshman, dkk, *Machine design*, Macmillan publishing Co.,Inc. New York :1975

Lampiran 2. Tabel Tahanan Momen Torsi

Tabelle 7. Torsionsflächenmomente I_t und -widerstandsmomente W_t (Torsi)

	Querschnitt	I_t	W_t	Bemerkungen
1		$\frac{\pi d^4}{32} = I_p$	$\frac{\pi d^3}{16} = W_p$	τ_{max} am Umfang
2		$\frac{\pi (d_a^4 - d_i^4)}{32} = I_p$ Für geringe Wanddicken, d.h. $\left(\frac{t}{d_m}\right)^2 \ll 1$: $\pi d_m^3 t/4$	$\frac{\pi (d_a^4 - d_i^4)}{16 d_a} = W_p$ $\pi d_m^2 t/2$	τ_{max} am Umfang
3		$\frac{\pi d^4}{32} = I_p$	$\frac{W_p}{\lambda} = \frac{\pi d^3}{16\lambda}$ $\lambda = \frac{2-\xi}{1-2\xi^2+(16/3\pi)\xi^3}$ Für kleine ξ: $\lambda \approx 2$	τ_{max} am Kerbgrund (in P) $\xi = \frac{\varrho}{d/2}$
4		$\frac{\pi a^3 b^3}{a^2+b^2} = \frac{\pi n^3 b^4}{n^2+1}$	$\frac{\pi a b^2}{2} = \frac{\pi n b^3}{2}$	Voraussetzung: $a/b = n \geq 1$ τ_{max} in P_1 In P_2: $\tau_2 = \tau_{max}/n$
5		$\frac{\pi n^3 (b_1^4 - b_2^4)}{n^2+1}$	$\frac{\pi n (b_1^4 - b_2^4)}{2 b_1}$	Voraussetzung: $a_1/b_1 = a_2/b_2 = n \geq 1$ τ_{max} in P_1 In P_2: $\tau_2 = \tau_{max}/n$
6		$\frac{b^4}{46{,}19} \approx \frac{h^4}{26}$	$\frac{b^3}{20} \approx \frac{h^3}{13}$	τ_{max} in Mitte der Seiten (P_1) In den Ecken (P_2): $\tau_2 = 0$
7		$0{,}133 b^2 A = 0{,}115 b^4$	$0{,}217 b A = 0{,}188 b^3$	τ_{max} in Mitte der Seiten (P)
8		$0{,}130 b^2 A = 0{,}108 b^4$	$0{,}223 b A = 0{,}185 b^3$	τ_{max} in Mitte der Seiten (P)
9		$0{,}141 b^4$	$0{,}208 b^3$	τ_{max} in Mitte der Seiten (P_1) In den Ecken (P_2): $\tau_2 = 0$

Sumber: Aaron D.Deutshman, dkk, *Machine design*, Macmillan publishing Co.,Inc. New York :1975.

Lampiran 3. Tabel Tahanan Momen Bending

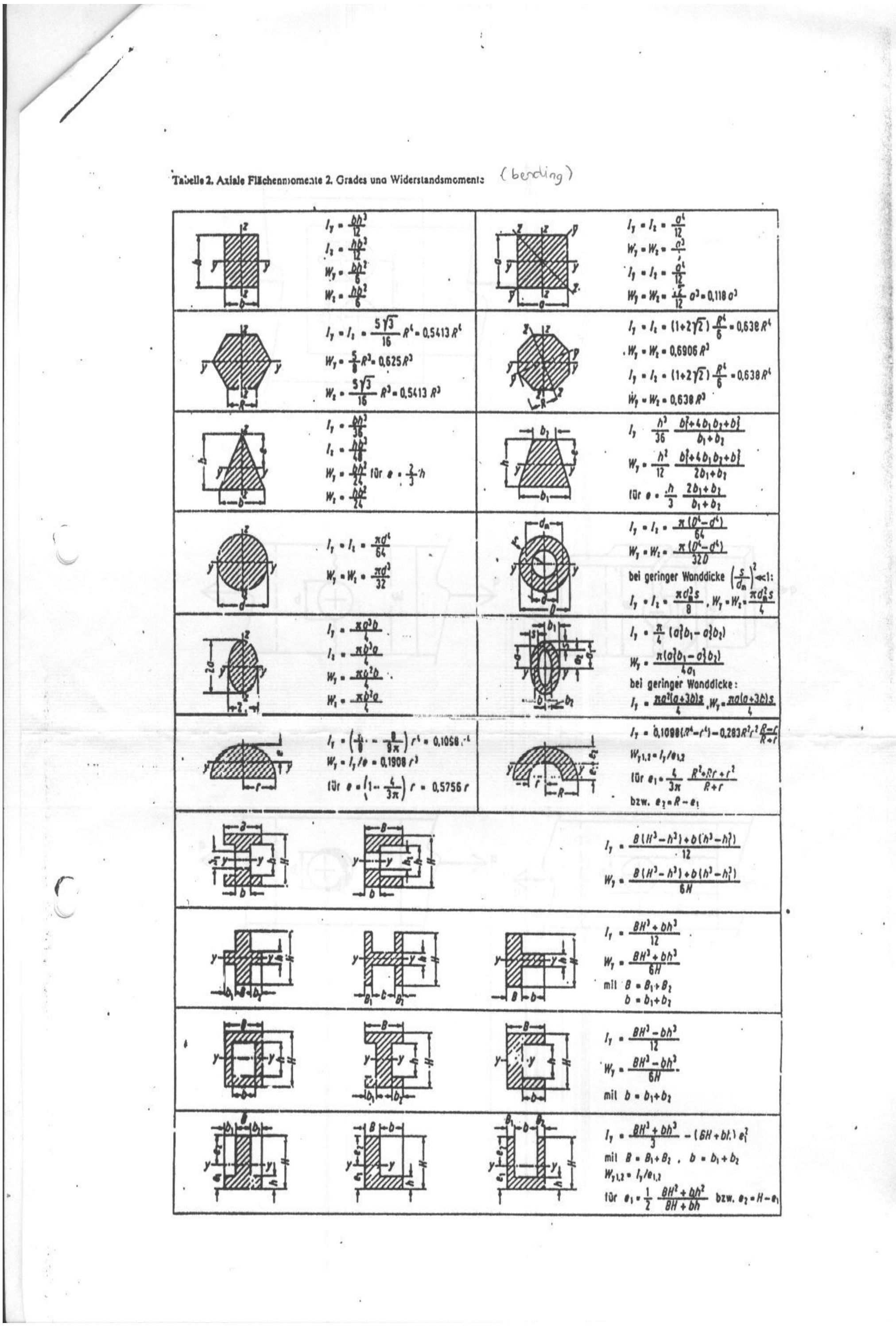


Tabelle 2. Axiale Flächenmomente 2. Grades und Widerstandsmomente (bending)

$I_y = \frac{bh^3}{12}$ $I_z = \frac{hb^3}{12}$ $W_y = \frac{bh^2}{6}$ $W_z = \frac{hb^2}{6}$	$I_y = I_z = \frac{a^4}{12}$ $W_y = W_z = \frac{a^3}{6}$ $I_y = I_z = \frac{a^4}{12}$ $W_y = W_z = \frac{\sqrt{2}}{12} a^3 = 0,118 a^3$
$I_y = I_z = \frac{5\sqrt{3}}{16} R^4 = 0,5413 R^4$ $W_y = \frac{5}{8} R^3 = 0,625 R^3$ $W_z = \frac{5\sqrt{3}}{16} R^3 = 0,5413 R^3$	$I_y = I_z = (1+2\sqrt{2}) \frac{R^4}{6} = 0,638 R^4$ $W_y = W_z = 0,6906 R^3$ $I_y = I_z = (1+2\sqrt{2}) \frac{R^4}{6} = 0,638 R^4$ $W_y = W_z = 0,638 R^3$
$I_y = \frac{bh^3}{36}$ $I_z = \frac{hb^3}{48}$ $W_y = \frac{bh^2}{24}$ für $e = \frac{2}{3} h$ $W_z = \frac{hb^2}{24}$	$I_y = \frac{h^3}{36} \frac{b_1^2+4b_1b_2+b_2^2}{b_1+b_2}$ $W_y = \frac{h^2}{12} \frac{b_1^2+4b_1b_2+b_2^2}{2b_1+b_2}$ für $e = \frac{h}{3} \frac{2b_1+b_2}{b_1+b_2}$
$I_y = I_z = \frac{\pi d^4}{64}$ $W_y = W_z = \frac{\pi d^3}{32}$	$I_y = I_z = \frac{\pi (D^4-d^4)}{64}$ $W_y = W_z = \frac{\pi (D^4-d^4)}{32D}$ bei geringer Wanddicke $\left(\frac{s}{d_m}\right)^2 \ll 1$: $I_y = I_z = \frac{\pi d_m^3 s}{8}$, $W_y = W_z = \frac{\pi d_m^2 s}{4}$
$I_y = \frac{\pi a^3 b}{4}$ $I_z = \frac{\pi b^3 a}{4}$ $W_y = \frac{\pi a^2 b}{4}$ $W_z = \frac{\pi b^2 a}{4}$	$I_y = \frac{\pi}{4} (a_1^3 b_1 - a_2^3 b_2)$ $W_y = \frac{\pi (a_1^3 b_1 - a_2^3 b_2)}{4 a_1}$ bei geringer Wanddicke: $I_y = \frac{\pi a^2 (a+3b) s}{4}$, $W_y = \frac{\pi a (a+3b) s}{4}$
$I_y = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right) r^4 = 0,1098 r^4$ $W_y = I_y / e = 0,1908 r^3$ für $e = \left(1 - \frac{4}{3\pi}\right) r = 0,5756 r$	$I_y = 0,1098 (R^4 - r^4) - 0,283 R^2 r^2 \frac{R-r}{R+r}$ $W_{y1,2} = I_y / e_{1,2}$ für $e_1 = \frac{4}{3\pi} \frac{R^2+Rr+r^2}{R+r}$ bzw. $e_2 = R - e_1$
$I_y = \frac{B(H^3-h^3)+b(h^3-h_1^3)}{12}$ $W_y = \frac{B(H^3-h^3)+b(h^3-h_1^3)}{6H}$	
$I_y = \frac{BH^3+bh^3}{12}$ $W_y = \frac{BH^3+bh^3}{6H}$ mit $B = B_1+B_2$ $b = b_1+b_2$	
$I_y = \frac{BH^3-bh^3}{12}$ $W_y = \frac{BH^3-bh^3}{6H}$ mit $b = b_1+b_2$	
$I_y = \frac{BH^3+bh^3}{3} - (BH+bh) e_1^2$ mit $B = B_1+B_2$, $b = b_1+b_2$ $W_{y1,2} = I_y / e_{1,2}$ für $e_1 = \frac{1}{2} \frac{BH^2+bh^2}{BH+bh}$ bzw. $e_2 = H - e_1$	

Sumber: : Aaron D.Deutshman, dkk, *Machine design*, Macmillan publishing Co.,Inc. New York :1975.

Lampiran 4. Pasak

TABLE 11–1 Key size vs. shaft diameter

Nominal shaft diameter		Nominal key size		
			Height, H	
Over	To (incl.)	Width, W	Square	Rectangular
5/16	7/16	3/32	3/32	
7/16	9/16	1/8	1/8	3/32
9/16	7/8	3/16	3/16	1/8
7/8	$1\frac{1}{4}$	1/4	1/4	3/16
$1\frac{1}{4}$	$1\frac{3}{8}$	5/16	5/16	1/4
$1\frac{3}{8}$	$1\frac{3}{4}$	3/8	3/8	1/4
$1\frac{3}{4}$	$2\frac{1}{4}$	1/2	1/2	3/8
$2\frac{1}{4}$	$2\frac{3}{4}$	5/8	5/8	7/16
$2\frac{3}{4}$	$3\frac{1}{4}$	3/4	3/4	1/2
$3\frac{1}{4}$	$3\frac{3}{4}$	7/8	7/8	5/8
$3\frac{3}{4}$	$4\frac{1}{2}$	1	1	3/4
$4\frac{1}{2}$	$5\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$	7/8
$5\frac{1}{2}$	$6\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	1
$6\frac{1}{2}$	$7\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$
$7\frac{1}{2}$	9	2	2	$1\frac{1}{2}$
9	11	$2\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{3}{4}$
11	13	3	3	2
13	15	$3\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$
15	18	4		3
18	22	5		$3\frac{1}{2}$
22	26	6		4
26	30	7		5

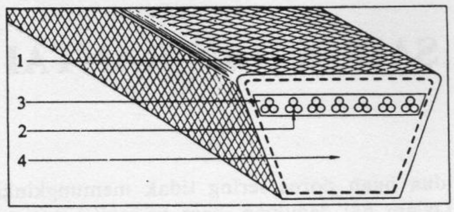
Source: Reprinted from ANSI Standard B17.1-1967(R98), by permission of the American Society of Mechanical Engineers.

Note: Values in nonshaded areas are preferred. Dimensions are in inches.

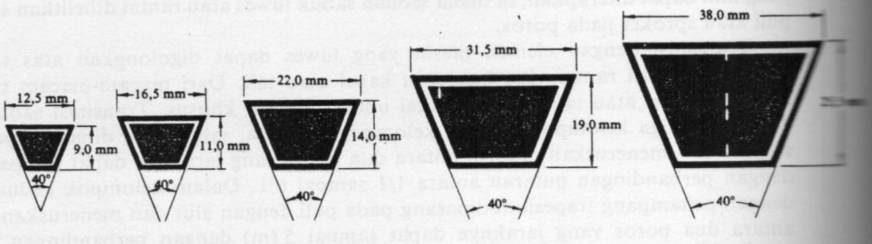
Sumber: Aaron D.Deutshman, dkk, *Machine design*, Macmillan publishing Co.,Inc. New York :1975.

Lampiran 5. Grafik V-*belt*

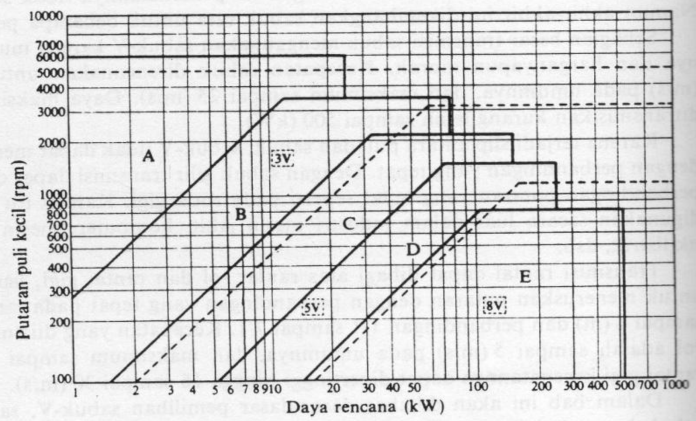
164 Bab 5. Sabuk Dan Rantai



Gbr. 5.1 Konstruksi sabuk-V.



Gbr. 5.2 Ukuran penampang sabuk-V.



Gbr. 5.3 Diagram pemilihan sabuk-V.

tegangan yang relatif rendah. Hal ini merupakan salah satu keunggulan sabuk dibandingkan dengan sabuk rata.

Dalam Gambar 5.2 diberikan berbagai proporsi panampang sabuk-V yang umum dipakai.

Atas dasar daya rencana dan putaran poros penggerak, penampang sabuk-V sesuai dapat diperoleh dari Gambar 5.3. Daya rencana dihitung dengan mengalikan daya yang akan diteruskan dengan faktor koreksi dalam Tabel 5.1. Diameter nominal puli-V dinyatakan sebagai diameter d_p (mm) dari suatu lingkaran di mana lebar alur ... di dalam Gambar 5.4 menjadi l_0 dalam Tabel 5.2. Transmisi sabuk-V hanya dapat

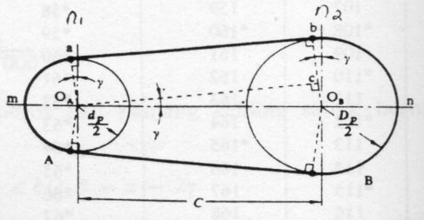
Sumber: Sularso & Suga, Kiyokatsu. (1985). Dasar perencanaan dan pemilihan mesin. Jakarta: PT. Pradnya Paramita.

Lampiran 6. Tabel Panjang V-*belt* Standart

168 Bab 5. Sabuk Dan Rantai

Tabel 5.3 (b) Panjang sabuk-V standar.

Nomor nominal		Nomor nominal		Nomor nominal		Nomor nominal	
(inch)	(mm)	(inch)	(mm)	(inch)	(mm)	(inch)	(mm)
10	254	45	1143	80	2032	115	[illegible]
11	279	46	1168	81	2057	116	[illegible]
12	305	47	1194	82	2083	117	[illegible]
13	330	48	1219	83	2108	118	[illegible]
14	356	49	1245	84	2134	119	[illegible]
15	381	50	1270	85	2159	120	[illegible]
16	406	51	1295	86	2184	121	[illegible]
17	432	52	1321	87	2210	122	[illegible]
18	457	53	1346	88	2235	123	[illegible]
19	483	54	1372	89	2261	124	[illegible]
20	508	55	1397	90	2286	125	[illegible]
21	533	56	1422	91	2311	126	[illegible]
22	559	57	1448	92	2337	127	[illegible]
23	584	58	1473	93	2362	128	[illegible]
24	610	59	1499	94	2388	129	[illegible]
25	635	60	1524	95	2413	130	[illegible]
26	660	61	1549	96	2438	131	[illegible]
27	686	62	1575	97	2464	132	[illegible]
28	711	63	1600	98	2489	133	[illegible]
29	737	64	1626	99	2515	134	[illegible]
30	762	65	1651	100	2540	135	[illegible]
31	787	66	1676	101	2565	136	[illegible]
32	813	67	1702	102	2591	137	[illegible]
33	838	68	1727	103	2616	138	[illegible]
34	864	69	1753	104	2642	139	[illegible]
35	889	70	1778	105	2667	140	[illegible]
36	914	71	1803	106	2692	141	[illegible]
37	940	72	1829	107	2718	142	[illegible]
39	965	73	1854	108	2743	143	[illegible]
39	991	74	1880	109	2769	144	[illegible]
40	1016	75	1905	110	2794	145	[illegible]
41	1041	76	1930	111	2819	146	[illegible]
42	1067	77	1956	112	2845	147	[illegible]
43	1092	78	1981	113	2870	148	[illegible]
44	1118	79	2007	114	2896	149	[illegible]

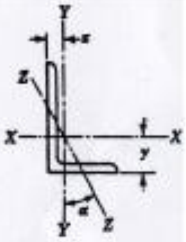


Gbr. 5.5 Perhitungan panjang keliling sabuk.

Sumber: Sularso & Suga, Kiyokatsu. (1985). Dasar perencanaan dan pemilihan mesin. Jakarta: PT. Pradnya Paramita.

Lampiran 7. Tabel Properti Profil L Siku

TABLE B-5 PROPERTIES OF EQUAL ANGLE SECTIONS: SI UNITS



Size and thickness (mm)	Theoretical mass (kg/m)	Area (mm²)	Axis X–X and Axis Y–Y: I (10^6 mm⁴)	$S = \frac{I}{c}$ (10^3 mm³)	$r = \sqrt{I/A}$ (mm)	x or y (mm)	Axis Z–Z: $r = \sqrt{I/A}$ (mm)
200 × 200 ×30	87.1	11 100	40.3	290	60.3	60.9	39.0
×25	73.6	9 380	34.8	247	60.9	59.2	39.1
×20	59.7	7 600	28.8	202	61.6	57.4	39.3
×16	48.2	6 140	23.7	165	62.1	55.9	39.5
×13	39.5	5 030	19.7	136	62.6	54.8	39.7
×10	30.6	3 900	15.5	106	63.0	53.7	39.9
150 × 150 ×20	44.0	5 600	11.6	110	45.5	44.8	29.3
×16	35.7	4 540	9.63	90.3	46.0	43.4	29.4
×13	29.3	3 730	8.05	74.7	46.4	42.3	29.6
×10	22.8	2 900	6.37	58.6	46.9	41.2	29.8
125 × 125 ×16	29.4	3 740	5.41	61.5	38.0	37.1	24.4
×13	24.2	3 080	4.54	51.1	38.4	36.0	24.5
×10	18.8	2 400	3.62	40.2	38.8	34.9	24.7
×8	15.2	1 940	2.96	32.6	39.1	34.2	24.8
100 × 100 ×16	23.1	2 940	2.65	38.3	30.0	30.8	19.5
×13	19.1	2 430	2.24	31.9	30.4	29.8	19.5
×10	14.9	1 900	1.80	25.2	30.8	28.7	19.7
×8	12.1	1 540	1.48	20.6	31.1	28.0	19.8
×6	9.14	1 160	1.14	15.7	31.3	27.2	19.9
90 × 90 ×13	17.0	2 170	1.60	25.6	27.2	27.2	17.6
×10	13.3	1 700	1.29	20.2	27.6	26.2	17.6
×8	10.8	1 380	1.07	16.5	27.8	25.5	17.7
×6	8.20	1 040	0.826	12.7	28.1	24.7	17.9
75 × 75 ×13	14.0	1 780	0.892	17.3	22.4	23.5	14.6
×10	11.0	1 400	0.725	13.8	22.8	22.4	14.6
×8	8.92	1 140	0.602	11.3	23.0	21.7	14.7
×6	6.78	864	0.469	8.68	23.3	21.0	14.8
×5	5.69	725	0.398	7.32	23.4	20.6	14.9
65 × 65 ×10	9.42	1 200	0.459	10.2	19.6	19.9	12.7
×8	7.66	976	0.383	8.36	19.8	19.2	12.7
×6	5.84	744	0.300	6.44	20.1	18.5	12.8
×5	4.91	625	0.255	5.45	20.2	18.1	12.9
55 × 55 ×10	7.85	1 000	0.268	7.11	16.4	17.4	10.7
×8	6.41	816	0.225	5.87	16.6	16.7	10.7
×6	4.90	624	0.177	4.54	16.9	16.0	10.8
×5	4.12	525	0.152	3.85	17.0	15.6	10.8
×4	3.33	424	0.125	3.13	17.1	15.2	10.9
×3	2.52	321	0.096	2.39	17.3	14.9	11.0
45 × 45 ×8	5.15	656	0.118	3.82	13.4	14.2	8.76
×6	3.96	504	0.094	2.98	13.7	13.4	8.79
×5	3.34	425	0.081	2.53	13.8	13.1	8.82
×4	2.70	344	0.067	2.07	13.9	12.7	8.87
×3	2.05	261	0.052	1.58	14.1	12.4	8.93
35 × 35 ×6	3.01	384	0.042	1.74	10.5	10.9	6.81
×5	2.55	325	0.036	1.49	10.6	10.6	6.83
×4	2.07	264	0.030	1.22	10.7	10.2	6.86
×3	1.58	201	0.024	0.940	10.8	9.86	6.91
25 × 25 ×5	1.77	225	0.012	0.724	7.39	8.06	4.87
×4	1.44	184	0.010	0.599	7.50	7.71	4.87
×3	1.11	141	0.008	0.465	7.63	7.35	4.89

Sumber: Pytel, Andrew. (1987). *Strength of Material, 4th Edition*. New York : Harper Collins Publisher.

Lampiran 8. ***Worm Gear*** **UH**

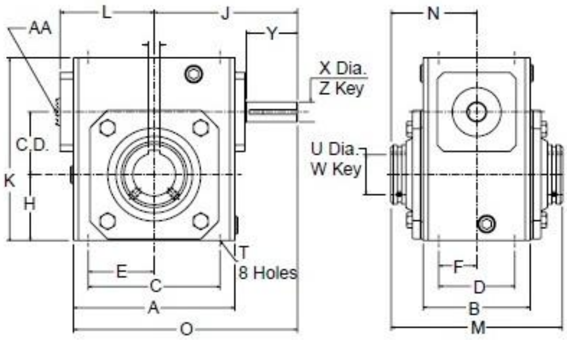
Morse

Worm Gear Reducers

RAIDER Plus

Style UH

Hollow – Basic Unit



Sumber: Katalog umum Morse *Worm Gear Reducer.*

Lampiran 9. Tabel Dimensi *Worm Gear* UH

Morse

Worm Gear Reducers

RAIDER Plus

Dimensions (Inches) for Style "UH"

C.D.	Basic Unit★	A	B	C	D	E	F	H	J	K	L	M	N	O
1.33	133UH	4.00	2.88	3.25	2.00	1.63	1.00	1.72	4.03	4.66	2.12	5.31	2.66	6.03
1.54	154UH	5.13	3.69	4.19	2.75	2.09	1.38	1.91	4.69	5.38	2.75	6.44	3.22	7.25
1.75	175UH	4.81	3.38	4.19	2.75	2.09	1.38	2.06	4.68	5.75	2.75	5.70	2.85	7.09
2.06	206UH	5.50	3.75	5.00	2.88	2.50	1.44	2.28	5.06	6.38	3.00	6.44	3.22	7.73
2.37	237UH	6.13	4.06	5.00	2.88	2.50	1.44	2.50	5.44	6.94	3.56	6.31	3.16	8.51
2.62	262UH	7.12	4.44	6.38	3.38	3.19	1.69	2.94	6.23	8.00	3.69	6.88	3.44	9.79
3.00	300UH	8.50	5.50	7.00	4.00	3.50	2.00	3.25	7.00	8.88	4.50	8.38	4.19	11.25
3.25	325UH	8.50	5.00	7.50	4.00	3.75	2.00	3.50	7.06	9.38	4.50	8.50	4.25	11.31
3.75	375UH	9.50	6.38	8.50	4.75	4.25	2.38	3.88	8.38	10.44	5.74	9.63	4.81	13.13
4.50	450UH	10.88	7.38	9.56	5.81	4.78	2.91	4.50	9.59	11.94	6.42	11.13	5.56	15.09
5.16	516UH	12.50	7.38	11.00	5.81	5.50	2.91	5.31	10.69	13.75	7.42	11.31	5.66	16.94
6.00	600UH	14.50	8.13	12.75	6.38	6.38	3.19	6.50	11.75	16.50	8.25	12.63	6.31	19.00

C.D.	T		OUTPUT BORE ✚		INPUT SHAFT				Stock Ratios marked "x"									Wt. Lbs.
			U +.0015 -.0000	W Keyway	X +.000 -.001	Y	Z Key											
	Size	Deep					Sq.	Lgth.	5	10	15	20	25	30	40	50	60	
1.33	5/16-18	.50	.6250	3/16 x 3/32	.500	1.81	.125	1.38	x	x	x	x	x	x	x	x	x	14.0
1.54	5/16-18	.50	1.0000	1/4 x 1/8	.625	1.69	.188	1.25	x	x	x	x	x	x	x	x	x	20.0
1.75	5/16-18	.61	1.0000	1/4 x 1/8	.625	1.81	.188	1.50	x	x	x	x	x	x	x	x	x	23.0
2.06	3/8-16	.61	1.4375	3/8 x 1/8	.625	1.81	.188	1.50	x	x	x	x	x	x	x	x	x	28.0
2.37	3/8-16	.60	1.4375	3/8 x 1/8	.750	1.94	.188	1.31	x	x	x	x	x	x	x	x	x	44.0
2.62	3/5-16	.58	1.9375	1/2 x 1/8	.750	2.31	.188	1.88	x	x	x	x	x	x	x	x	x	54.0
3.00	7/16-14	.80	2.1875	1/2 x 3/16	.875	2.26	.188	1.31	x	x	x	x	x	x	x	x	x	76.0
3.25	7/16-14	.80	2.1875	1/2 x 3/16	.875	2.31	.188	1.63	-	x	x	x	x	x	x	x	x	79.0
3.75	1/2-13	1.00	2.4375	5/8 x 3/16	1.000	2.91	.250	1.75	-	x	x	x	x	x	x	x	x	109.0
4.50	5/8-11	1.00	2.9375	3/4 x 1/4	1.125	3.48	.250	2.50	-	x	x	x	x	x	x	x	x	140.0
5.16	5/8-11	1.00	3.4375	7/8 x 1/4	1.250	3.75	.250	2.56	-	x	x	x	x	x	x	x	x	222.0
6.00	5/8-11	1.00	3.9375	1 x 1/4	1.500	3.75	.375	2.94	x	x	x	x	x	x	x	x	x	321.0

Sumber: Katalog umum Morse *Worm Gear Reducer.*

Lampiran 10. *Properties* Stainless Steel 316

STEEL STAINLESS, WROUGHT

316

Chemical Composition (AISI)

[illegible]	Mn %	Si %	P %	S %
[illegible]	[illegible] max	1.00 max	.040 max	.030 max

[illegible]	Ni %	Mo[1] %	Se %	Zr %
[illegible]	[illegible]/14.00	2.00/3.00	–	–

[illegible]	Cb %	Al %
[illegible]	–	–

[illegible] Estab. per Nat'l Prod. Auth. Order M52.

[illegible] Type 316 with Mo, is more resistant to some [illegible] sulphite liquor, etc., and is preferred to 18:8.

Technological Properties

Forging temp	2100 to 2300F
Annealing temp	1850 to 2050F (Cool rapidly)
Hardening temp	Hardens by cold work only
Freezing point	2500 to 2550F or 1370 to 1400C
Machinability	Poor – Tough
Weldability	Good
Scaling temp, oxidizing	1650F
Drawability	Good
Stress relieving	400 to 750F

Physical Properties

Density, at 70F	0.288 lb/cu in. (7.98 S.G.)
Specific heat, cal/gm at 212F	0.118
Specific resistivity, microhm/cm³ at 70F	74 or 29.2/in.³
Magnetism, annealed	Nonmagnetic

Coef. of Thermal Expansion

Temp Range		Coefficient × 10⁻⁶ per deg F	per deg C
32-212F	0-100C	8.9	16.0
-600F	-316C	9.0	16.2
-1000F	-538C	9.7	17.5
-1200F	-649C	10.3	18.5
-1500F	-816C	11.1	19.98

Thermal Conductivity

[illegible] °F at	212F	9.4
	932F	12.4

Mechanical Properties

	Test Temp	Tensile Strength M psi	Yield Strength M psi 0.2% offset	Elong 2 in. %	Red Area %	Hard BHN	Rock Hard	End Lt M psi Fatigue	Impact Resist. Izod Ft Lbs
[illegible] annealed	–	80-90	30-40	50-60	70	150	B-78 to B85	38-39	110
[illegible] annealed and cold drawn	–	90	60	45	65	190	–	40	–
Effect of Temp	70F	82.5	–	–	–	–	–	–	–
	200	77	–	–	–	–	–	–	–
	300	75	–	–	–	–	–	–	–
	400	74	–	–	–	–	–	–	–
	500	73.5	–	–	–	–	–	–	–
	600	73	–	–	–	–	–	–	–
	700	72.5	–	–	–	–	–	–	–
	800	71.5	–	–	–	–	–	–	–
	900	70	–	–	–	–	–	–	–
	1000	67.5	–	–	–	–	–	–	–
	1100	63	–	–	–	–	–	–	–
	1200	56.5	–	–	–	–	–	–	–
	1300	46.5	–	–	–	–	–	–	–
	1400	35	–	–	–	–	–	–	–
	1500	27	–	–	–	–	–	–	–
	1600	22	–	–	–	–	–	–	–
	1700	18.5	–	–	–	–	–	–	–

Modulus of Elasticity, E in psi 28.0 × 10⁻⁶ in tension

Creep Strength (M psi)[1]

Temp	Stress for 1% creep in 10,000 hrs
[illegible]F	25.0, 24[2]
[illegible]	18.2
[illegible]	12.7
[illegible]	7.9
[illegible]	2.8

[1] [illegible] Steel Products Manual
[2] [illegible] Metals Handbook

Stress-Rupture Strength (M psi)

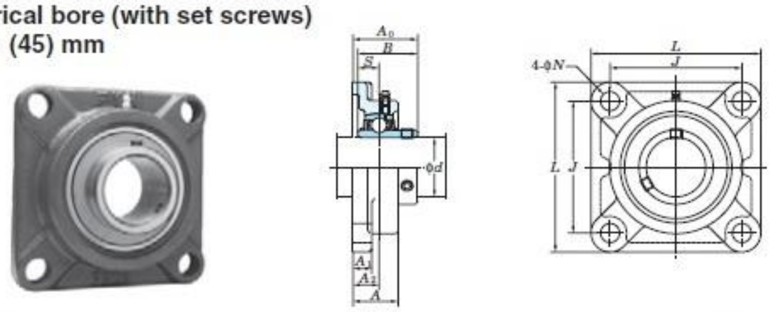
Temp	1,000 hr	100,000 hr
1000F	–	–
1100	33	–
1200	25	12.5
1300	17	9
1350	–	–
1400	11	4.2
1500	7	1.5
1600	4	–
1700	–	–
1800	1.3	–

63

Sumber: Samuel L. Hoyt. (1954). Asme *Handbook Metals Properties*. New York: McGRAW-HILL BOOK COMPAN, INC.

Lampiran 11. Tabel Dimensi *Pillow Block* UCF

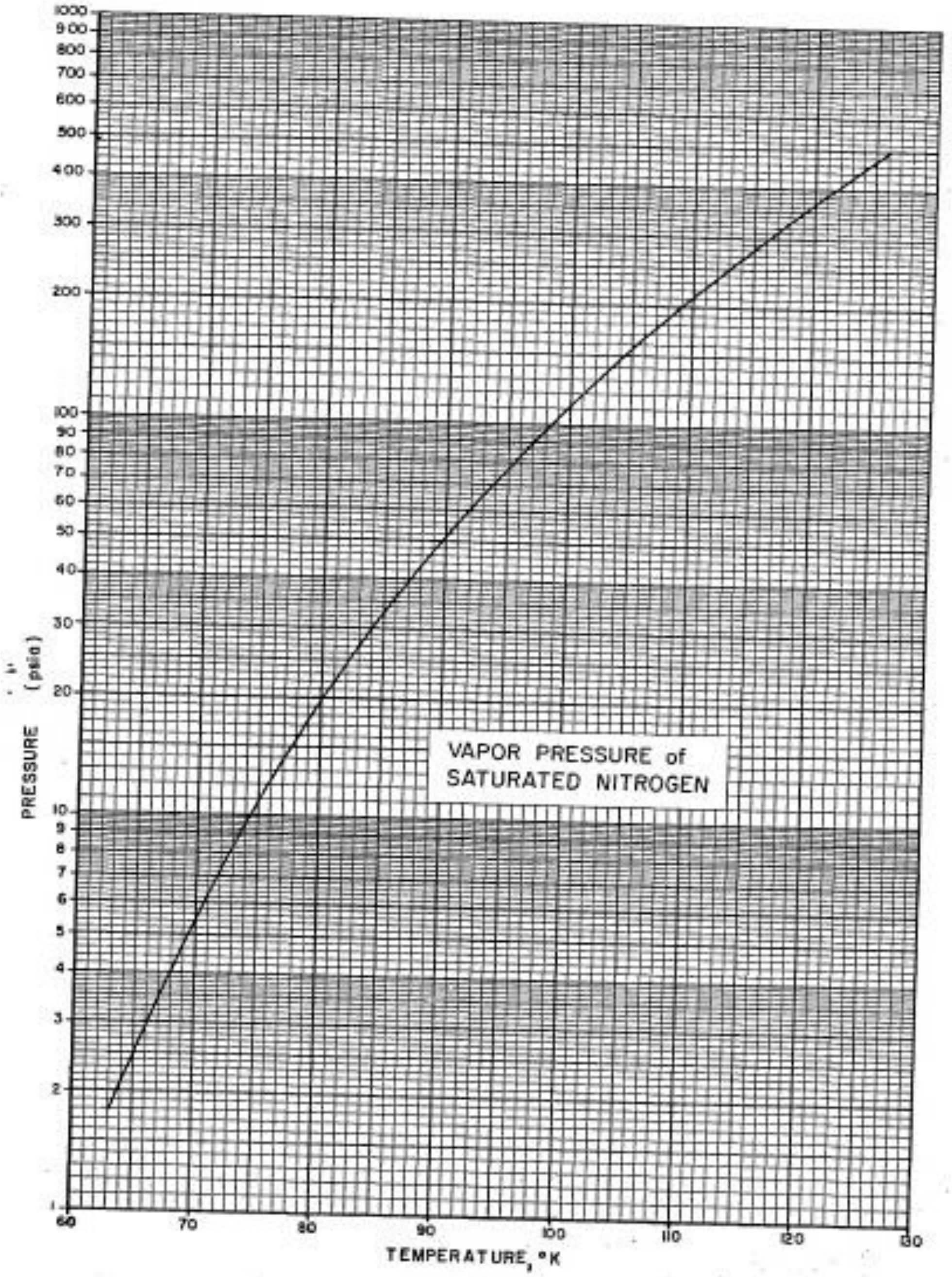
UCF
Cylindrical bore (with set screws)
d 12 ~ (45) mm



Shaft Dia. d mm	Shaft Dia. d inch	L (inch / mm)	A	J	N	A_1	A_2	A_0	B	S	Bolt Size (inch / mm)	Standard Unit No.	Standard Housing No.	Standard Bearing No.
12 15 17 20	1/2 5/8 3/4	3 3/8 86	1 25.5	2 33/64 64	15/32 12	7/16 11	19/32 15	1 5/16 33.3	1.220 31	0.500 12.7	3/8 M10	UCF201 UCF201-8 UCF202 UCF202-10 UCF203 UCF204-12 UCF204	F204	UC201 UC201-8 UC202 UC202-10 UC203 UC204-12 UC204
25	7/8 15/16 1	3 3/4 95	1 1/16 27	2 3/4 70	15/32 12	1/2 13	5/8 16	1 13/32 35.8	1.343 34.1	0.563 14.3	3/8 M10	UCF205-14 UCF205-15 UCF205 UCF205-16	F205	UC205-14 UC205-15 UC205 UC205-16
	1	4 1/4 108	1 3/16 30	3 17/64 83	15/32 12	1/2 13	45/64 18	1 19/32 40.2	1.500 38.1	0.626 15.9	3/8 M10	UCFX05 UCFX05-16	FX05	UCX05 UCX05-16
	1	4 11/32 110	1 5/32 29	3 5/32 80	5/8 16	1/2 13	5/8 16	1 17/32 39	1.496 38	0.591 15	1/2 M14	UCF305 UCF305-16	F305	UC305 UC305-16
30	1 1/8 1 3/16 1 1/4	4 1/4 108	1 7/32 31	3 17/64 83	15/32 12	1/2 13	45/64 18	1 19/32 40.2	1.500 38.1	0.626 15.9	3/8 M10	UCF206-18 UCF206 UCF206-19 UCF206-20	F206	UC206-18 UC206 UC206-19 UC206-20
	1 3/16 1 1/4	4 19/32 117	1 11/32 34	3 5/8 92	5/8 16	9/16 14	3/4 19	1 3/4 44.4	1.689 42.9	0.689 17.5	1/2 M14	UCFX06 UCFX06-19 UCFX06-20	FX06	UCX06 UCX06-19 UCX06-20
	–	4 29/32 125	1 1/4 32	3 47/64 95	5/8 16	19/32 15	45/64 18	1 23/32 44	1.693 43	0.669 17	1/2 M14	UCF306	F306	UC306

Sumber: Katalog Umum FYH *Pillow Block* dan *Bearing* (2013).

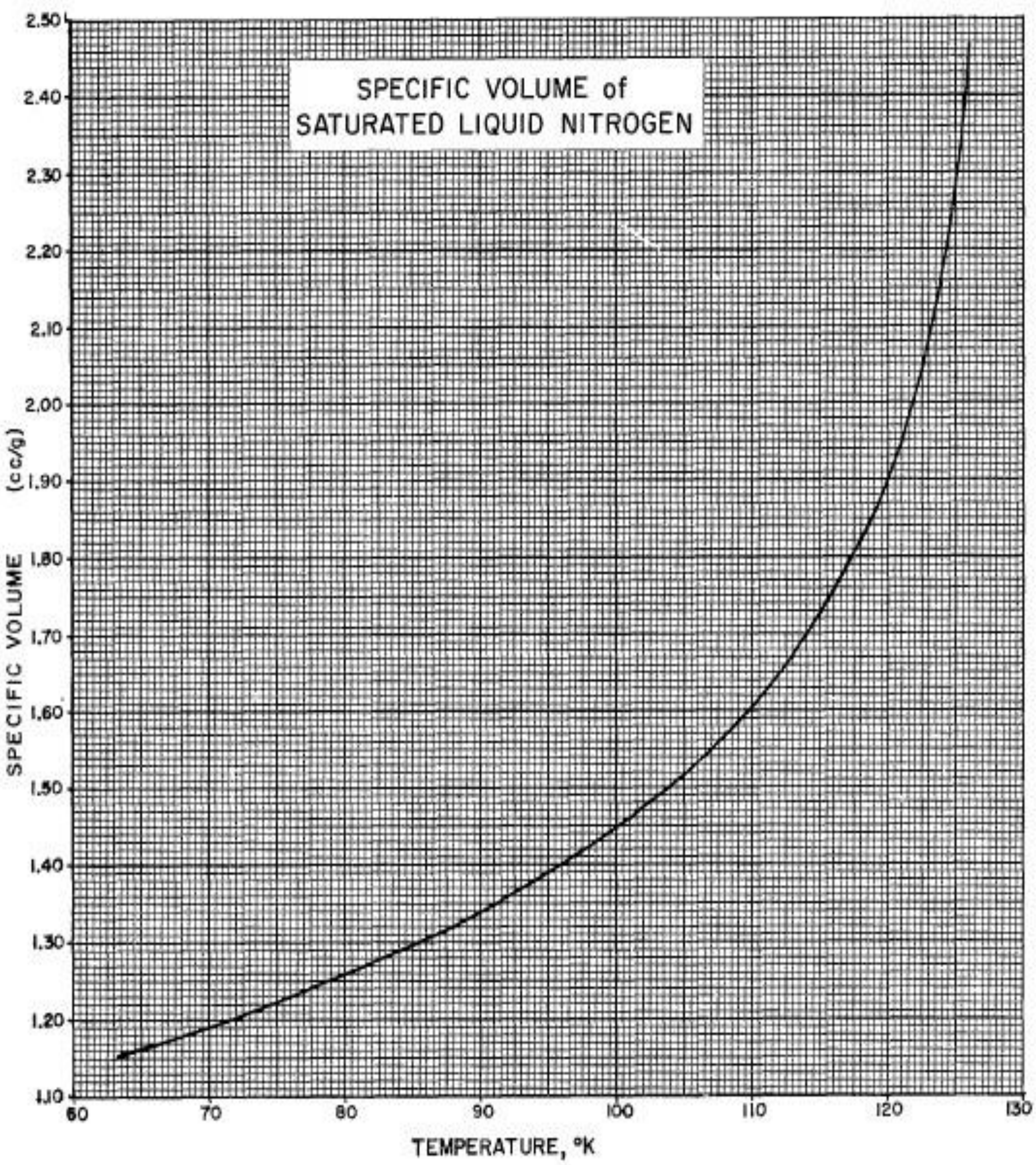
Lampiran 12. Grafik Sifat Termodinamika Nitrogen Uap



VI-A-1.3

Sumber: Thomas R. Strobridge. (1962). *National Bereau of Standards Technical Note*. Washington: UNITED STATES DEPARTMENT OF COMMERECE OFFICE OF TECHNICAL SERVICE.

Lampiran 13. Grafik Sifat Termodinamika Nitrogen Cair



Sumber: Thomas R. Strobridge. (1962). *National Bereau of Standards Technical Note*. Washington: UNITED STATES DEPARTMENT OF COMMERECE OFFICE OF TECHNICAL SERVICE.