Steel Shaft Inertia

Table No. 1

For 1 Inch of Length

Dia (inches)	WK^2 (lb-in^2)	Dia (inches)	WK^2 (lb-in^2)	Dia (inches)	WK^2 (lb-in^2)	Dia (inches)	WK^2 (lb-in^2)	Dia (inches)	WK^2 (lb-in^2)	Dia (inches)	WK^2 (lb-in^2)
.25	.00011	3	2.304	7	66.816	10	277.92	13	803.52	19	3611.52
.375	.00055	3.5	4.176	7.25	77.04	10.25	306.72	13.25	858.24	20	4433.76
.5	.00173	3.75	5.472	7.5	87.984	10.5	338.4	13.5	924.48	21	5389.92
.75	.00864	4	7.056	7.75	100.656	10.75	371.52	13.75	995.04	22	6492.96
1	.0288	4.25	9.072	8	113.904	11	407.52	14	1068.48	23	7757.28
1.25	.072	4.5	11.376	8.25	128.88	11.25	444.96	14.25	1147.68	24	9195.84
1.5	.144	5	17.28	8.5	144	11.5	486.72	14.5	1229.75	25	10827.36
1.75	.288	5.5	25.488	8.75	162.72	11.75	529.92	14.75	1317.6	26	12666.24
2	.432	6	36	9	182.88	12	576	15	1404	27	14731.2
2.25	.72	6.25	42.624	9.25	203.04	12.25	626.4	16	1815.84	28	17036.64
2.5	1.152	6.5	49.68	9.5	223.2	12.5	679.84	17	2314.08	29	19604.16
2.75	1.584	6.75	57.888	9.75	252	12.75	735.84	18	2910.24	30	22452.48

To calculate inertia (WK^2) for a given component multiply the WK^2 in the table by the length or thickness.

Example:

Determine the WK^2 for a 2 inch shaft that is 10 inches long.

From the table for a 2 inch diameter the WK^2 is .432.

$WK^2 = .432 \times 10 = 4.32$

To calculate the WK^2 for hollow shafts, subtract the WK^2 of the inside diameter from the WK^2 of the outside diameter then multiply by the length.

To calculate the WK^2 of a component not made from steel, multiply the WK^2 from Table 1 by the multiplier from Table 2.

Table No. 2

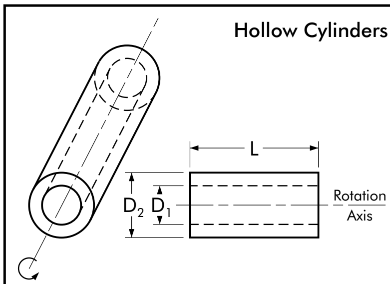
Inertia Conversion Chart

Material	Multiplier
Aluminum	.35
Bronze	1.05
Iron	.92
Nylon	.17
Powdered Metal	
Bronze	.79
Iron	.88

WK^2 Values of Common Geometric Shapes

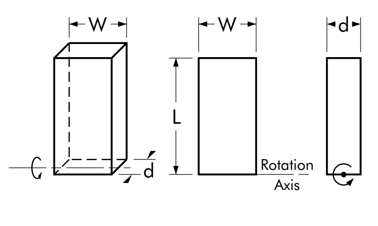
Table No. 3

Hollow Cylinders



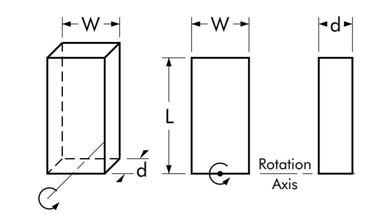
$WK^2 = .09806pL(D_2^4 - D_1^4)$

Rectangular Bars



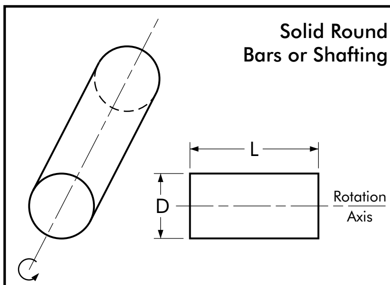
$WK^2 = pLWd\left(\frac{d^2 + 4L^2}{12}\right)$

Rectangular Bars or Blades



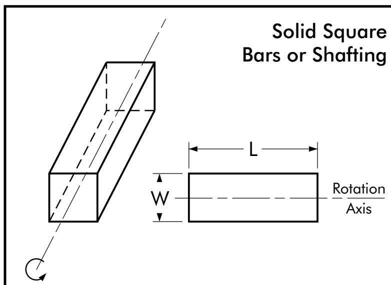
$WK^2 = pLWd\left(\frac{4L^2 + W^2}{12}\right)$

Solid Round Bars or Shafting



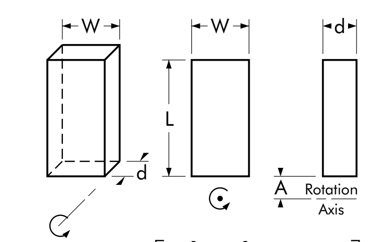
$WK^2 = .09806pLD^4$

Solid Square Bars or Shafting



$WK^2 = .16704pLW^4$

Offset Rectangular Bars or Blades



$WK^2 = pLWd\left[\left(\frac{4L^2 + W^2}{12}\right) + A^2 + AL\right]$

Table No. 4

Material Weight

Factor – p (lbs./Cu. In.)

Material	Factor	Material	Factor	Material	Factor
Aluminum	.0924	Cast Iron	.26	Magnesium	.0628
Bronze	.32	Copper	.318	Steel	.282

Table No. 5 — Clutch Coil Data

Model	DC Volts	W Resistance (Cold)	DC Amps (Cold)
303	6	4.24	1.42
	12	16.45	.73
	24	61.2	.39
	90	797	.11
304	6	3.62	1.66
	12	10.8	1.11
	24	47.9	.50
	90	687	.13
305	6	1.02	5.87
	12	3.60	3.34
	24	14.5	1.65
	90	219	.41
306	6	1.14	5.29
	12	4.40	2.73
	24	18.3	1.31
	90	300	.30
307	6	.68	8.76
	12	2.72	4.41
	24	11.5	2.08
	90	187	.48
308	6	1.11	5.41
	12	2.64	4.55
	24	10.6	2.27
	90	159	.57
308HQ	6	.33	18.2
	12	1.31	9.14
	24	3.49	6.89
	90	88.1	1.02
310	6	.53	11.2
	12	2.79	4.3
	24	9.27	2.58
	90	153	.59
310HQ	6	.2	30.1
	12	.79	15.1
	24	3.61	6.65
	90	54.5	1.65
312	6	1.05	5.71
	12	4.24	2.83
	24	16.93	1.42
	90	264	.34
312HQ	6	.14	42.1
	12	.67	17.9
	24	2.79	8.60
	90	46.3	1.94
315	6	.81	7.44
	12	3.58	3.35
	24	14.32	1.68
	90	219	.41
315HQ	6	.45	13.32
	12	1.72	6.98
	24	7.53	3.19
	90	122	.74
"C" Faced Products			
CBP & CP-22 CBP & CP-32	6	2.52	2.38
	12	7.65	1.60
	24	30.41	.79
	90	484	.19
CBP-125 CP-125	6	.68	8.76
	12	2.93	4.1
	24	11.52	2.08
	90	187	.48

Table No. 6 — Brake Coil Data

Model	DC Volts (Cold)	W Resistance (Cold)	DC Amps
303	6	4.24	1.42
	12	16.45	.73
	24	61.2	.39
	90	797	.11
304	6	3.62	1.66
	12	10.8	1.11
	24	47.9	.50
	90	687	.13
305	6	1.02	5.87
	12	3.60	3.34
	24	14.5	1.65
	90	219	.41
307	6	.68	8.76
	12	2.72	4.41
	24	11.50	2.08
	90	187	.48
308	6	.81	7.38
	12	2.16	5.56
	24	9.48	2.53
	90	159	.57
310	6	.52	11.4
	12	2.19	5.47
	24	8.83	2.72
	90	149	.60
312	6	.50	12.12
	12	2.66	4.51
	24	10.3	2.33
	90	162	.56
315	6	.89	6.76
	12	3.42	3.51
	24	13.15	1.83
	90	200	.45
315HQ	6	.42	14.44
	12	1.53	7.83
	24	6.69	3.59
	90	110	.82
"C" Faced Products			
BP-22 BP-32	6	2.52	2.38
	12	7.65	1.60
	24	30.41	.79
	90	484	.19
BP-125	6	.68	8.76
	12	2.72	4.41
	24	11.52	2.08
	90	187	.48

Values in Table 5 and 6 ±10%.

Table No. 1 **Coil Time Constants**

Unit Size	Build Up to 63% of Current	Build Up to 80% Rated Torque	Decay Time to 1 % Rated Torque
Rotating Field and Flange Mounted Brakes			
303	.018	.032	.016
304	.034	.055	.031
305	.055	.068	.028
307	.099	.124	.019
308	.076	.135	.056
310	.125	.215	.068
312	.188	.232	.088
315	.252	.368	.092
Stationary Field			
303	.024	.034	.016
304	.033	.080	.031
305	.058	.077	.028
306	.126	.200	.087
307	.063	.124	.049
308	.048	.131	.032
308HQ	.186	.233	.098
310	.105	.124	.119
310HQ	.155	.144	.141
312HQ	.127	.159	.154
315	.240	.280	.161
315HQ	.282	.329	.189

Coil build up times can be reduced by more than 50% with the use of overexcite controls.

Table No. 2 **Overhung Load Capacity (Lbs)**

Model	Output RPM 900	1200	1800	3600
303	60	55	50	40
304	100	90	80	60
305	180	165	145	115
307	365	345	290	220
308	385	350	305	240
310	320	300	260	205
315	575	525	455	–

Note: The overhung load above is measured at the center of the shaft keyway.

Table No. 3 **Load Correction Factor (Ins)**

Model	Factor at n inches in or out from CL of Keyway –2	–1	CL	+1	+2
303	–	2.06	1.0	.66	–
304	3.78	1.58	1.0	.73	.575
305	1.78	1.27	1.0	.81	.685
307	–	1.25	1.0	.83	.70
308	1.48	1.19	1.0	.86	.775
310	1.34	1.14	1.0	.885	.795
315	1.26	1.11	1.0	.91	.830

$$OHL @ n = OHL_{CL} \times \text{Load Factor}$$

Table No. 4 **Weight (Lbs.) and Inertia (lb. in²) Data**

Part	303 Wt	303 WK²	304 Wt	304 WK²	305 Wt	305 WK²	306 Wt	306 WK²	307 Wt	307 WK²	308 Wt	308 WK²	310 Wt	310 WK²	312 Wt	312 WK²	315 Wt	315 WK²
Sheave Clutches																		
Rotor and Quill Assembly	–	–	1.56	22	–	–	8.6	40	–	–	14.7	115	20.6	262	–	–	–	–
Armature & Hub (less sheave)	–	–	1.51	2	–	–	6.4	29	–	–	13.1	68	17.9	130	–	–	–	–
Stationary Field																		
Flange Mtd. Clutch-rotor & hub	.41	.3	1.23	2.19	–	–	7.7	40	–	–	13.3	112	13.5	167	26.3	537	3.0	850
Brg. Mtd. Clutch - rotor & hub	.31	.2	1.31	2.08	2.83	5.73	7.7	40	6.60	40	13.3	112	13.5	167	26.3	537	–	–
Field Assy. - Flange Mtd. Field	.86	–	1.79	–	–	–	5.6	–	6.35	–	15.2	–	10.3	–	22.9	–	27.0	–
Field Assy. Brg. - Mtd. Field	.70	–	1.44	–	3.05	–	4.3	–	6.25	–	15.1	–	10.3	–	28.9	–	–	–
Splined Armature	.15	.2	.42	.88	.95	3.32	6.4	22	–	–	4.4	44	5.8	94	9.0	199	13.8	497
Rotating Field and Flange Mounted Brakes																		
Magnet Assembly	.53	–	2.0	–	3.18▲	12	–	–	–	–	7.7	82	10.9	196	18.6	495	27.3	1197
Armature Assy. - pin drive	–	–	–	–	1.45	6	–	–	–	15.24	5.0	47	7.3	105	10.7	228	14.7	518
Armature Hub - pin drive	–	–	–	–	.93	3	–	–	–	2.30	2.0	7	4.0	29	7.3	50	8.7	94
Splined Armature	.18	.2	.42	.89	.95	3	–	–	–	18.39	4.4	44	5.8	94	9.0	199	13.8	497
Splined Hub	.12	.03	.15▼	.05	.78	2	–	–	–	1.21	2.4	5	5.1	22	9.2	44	9.2	44
Slip Ring Hub	–	–	–	–	.74	2	–	–	–	–	3.1	16	4.7	26	6.6	537	9.2	107
Slip Ring	–	–	–	–	.61	3	–	–	–	–	1.7	22	1.7	22	1.7	22	1.7	22
Split Taper Bushing	–	–	–	–	.75	.3	–	–	–	–	1.1	1	3.3	5	9.0	18	9.0	18
Drive Pins	–	–	–	–	–	–	–	–	–	–	.16	–	.16	–	.16	–	.16	–

NOTE: ▲ Outside mounted weight is 3.4 lbs.

▼ For bore sizes .875 and larger, hub weight is .35 lbs. and WK^2 is .150 lb. in^2.