■ ENGINEERING DATA

SPROCKET PITCH DIAMETERS

The following table (based on chordal pitch) shows the correct sprocket pitch diameters for all types of chains having a taut, uniform pitch of one inch. Sprocket pitch diameters for other uniform chain pitches are directly proportional to the chain pitch. To determine sprocket pitch diameters for any other chain pitch, multiply the tabular diameter by the chain pitch used.

Dimensions are in inches.

No. or Teeth “N”	Pitch Diameter	No. or Teeth “N”	Pitch Diameter	No. or Teeth “N”	Pitch Diameter	No. or Teeth “N”	Pitch Diameter
4	1.4142	28	8.9314	52	16.5621	76	24.1985
5	1.7013	29	9.2491	53	16.8802	77	24.5166
6	2.0000	30	9.5668	54	17.1984	78	24.8349
7	2.3048	31	9.8844	55	17.5166	79	25.1532
8	2.6131	32	10.2023	56	17.8349	80	25.4713
9	2.9238	33	10.5201	57	18.1527	81	25.7896
10	3.2361	34	10.8379	58	18.4710	82	26.1079
11	3.5494	35	11.1558	59	18.7891	83	26.4261
12	3.8637	36	11.4737	60	19.1073	84	26.7442
13	4.1786	37	11.7916	61	19.4254	85	27.0626
14	4.4940	38	12.1096	62	19.3737	86	27.3807
15	4.8097	39	12.4276	63	20.0619	87	27.6989
16	5.1258	40	12.7455	64	20.3800	88	28.0170
17	5.4422	41	13.0635	65	20.6981	89	28.3355
18	5.7588	42	13.3815	66	21.0136	90	28.6537
19	6.0755	43	13.6995	67	21.3347	91	28.9724
20	6.3925	44	14.0175	68	21.6528	92	29.2901
21	6.7095	45	14.3356	69	21.9710	93	29.6082
22	7.0276	46	14.6536	70	22.2890	94	29.9268
23	7.3439	47	14.9717	71	22.6073	95	30.2447
24	7.6613	48	15.2898	72	22.9256	96	30.5628
25	7.9787	49	15.6079	73	23.2438	97	30.8811
26	8.2962	50	15.9269	74	23.5620	98	31.1994
27	8.6138	51	16.2441	75	23.8802	99	31.5177
						100	31.8362

CONVERSION TABLE

Fraction	Decimal	Millimeters	Fraction	Decimal	Millimeters
1/64	.015625	.3969	33/64	.515625	13.0969
1/32	.03125	.7938	17/32	.53125	13.4938
3/64	.046875	1.1906	35/64	.546875	13.8907
1/16	.0625	1.5875	9/16	.5625	14.2876
5/64	.078125	1.9844	37/64	.578125	14.6844
3/32	.09375	2.3813	19/32	.59375	15.0813
7/64	.109375	2.7781	39/64	.609375	15.4782
1/8	.125	3.1750	5/8	.625	15.8751
9/64	.140625	3.5719	41/64	.640625	16.2719
5/32	.15625	3.9688	21/32	.65625	16.6688
11/64	.171875	4.3656	43/64	.671875	17.0657
3/16	.1875	4.7625	11/16	.6875	17.4626
13/64	.203125	5.1594	45/64	.703125	17.8594
7/32	.21875	5.5563	23/32	.71875	18.2563
15/64	.234375	5.9531	47/64	.734375	18.6532
1/4	.250	6.3500	3/4	.750	19.0501
17/64	.265625	6.7469	49/64	.765625	19.4470
9/32	.28125	7.1438	25/32	.78125	19.8438
19/64	.296875	7.5406	51/64	.796875	20.2407
5/16	.3125	7.9375	13/16	.8125	20.6376
21/64	.328125	8.3344	53/64	.828125	21.0345
11/32	.34375	8.7313	27/32	.84375	21.4313
23/64	.359375	9.1282	55/64	.859375	21.8282
3/8	.375	9.5250	7/8	.875	22.2251
25/64	.390625	9.9219	57/64	.890625	22.6220
13/32	.40625	10.3188	29/32	.90625	23.0188
27/64	.421875	10.7157	59/64	.921875	23.4157
7/16	.4375	11.1125	15/16	.9375	23.8126
29/64	.453125	11.5094	61/64	.953125	24.2095
15/32	.46875	11.9063	31/32	.96875	24.6063
31/64	.484375	12.3032	63/64	.984375	25.0032
1/2	.500	12.7001	1	1.000	25.4001

ENGINEERING DATA

STANDARD KEY AND SETSCREW SIZES

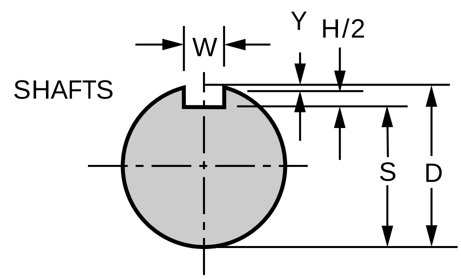
Keyseats and Keys

Drawings and formulas at right illustrate how the depth and width of standard keyseats in shafts and hubs are determined. Refer to explanation of symbols.

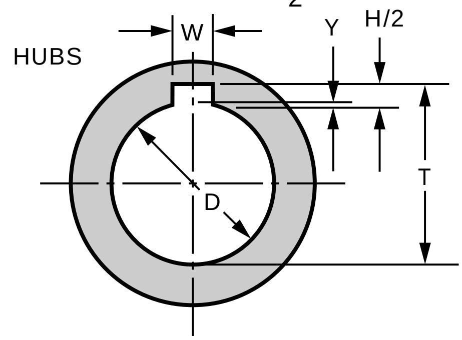
Symbols:

C = Allowance or clearance for key (normally .005" for parallel keys).
D = Nominal shaft or bore diameter, inches
H = Nominal key height, inches
W = Nominal key width, inches
Y = Chordal height, inches

$$T = \frac{D - \sqrt{D2 - W2}}{2}$$



$$S = D - Y - \frac{H}{2}$$



$$T = D - Y + \frac{H}{2} + C$$

STANDARD KEYWAY AND SETSCREW SIZES

Dimensions are in inches.

Shaft Diameters Over	Shaft Diameters Thru	Key W x H/2	Set Screw	Shaft Diameters Over	Shaft Diameters Thru	Key W x H/2	Set Screw	Shaft Diameters Over	Shaft Diameters Thru	Key W x H/2	Set Screw	Shaft Diameters Over	Shaft Diameters Thru	Key W x H/2	Set Screw
7/16	9/16	1/8 x 1/16	#10	1 3/4	2 1/4	1/2 x 1/4	1/2	4 1/2	5 1/2	1 1/4 x 5/8	7/8	11	13	3 x 1	1
9/16	7/8	3/16 x 3/32	1/4	2 1/4	2 3/4	5/8 x 5/16	1/2	5 1/2	6 1/2	1 1/2 x 3/4	1	13	15	3 1/2 x 1 1/4	1
7/8	1 1/4	1/4 x 1/8	5/16	2 3/4	3 1/4	3/4 x 3/8	5/8	6 1/2	7 1/2	1 3/4 x 3/4	1	15	18	4 x 1 1/2	1
1 1/4	1 3/8	5/16 x 5/32	3/8	3 1/4	3 3/4	7/8 x 7/16	3/4	7 1/2	9	2 x 1 3/4	1	18	22	5 x 1 3/4	1
1 3/8	1 3/4	3/8 x 3/16	3/8	3 3/4	4 1/2	1 x 1/2	3/4	9	11	2 1/2 x 7/8	1	22	26	6 x 2	1
												26	30	7 x 2 1/2	1

MINIMUM SHAFT CENTER DISTANCE

At least 120° wrap is desirable. The minimum center distance to assure 120° wrap may be found by using the following equation:

$$\mathbf{CDp} = \frac{N - n}{3.1}$$

On ratios of less than 3:1, wrap will always be at least 120° in a two sprocket system. The minimum center distance to avoid interference between the two sprockets is:

$$\textbf{Min. CDp} = \frac{N + n}{6} + 1$$

Where: **CDp** = center distance in pitches
N = number of teeth on driven sprocket
n = number of teeth on driver sprocket

Use the larger value of CDp for your center distance.

Feet of center distance =

$$\frac{\text{Center Distance (pitches) x Chain Pitch (Ins.)}}{12}$$

ENGINEERING DATA

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■ ENGINEERING DATA

MINIMUM CHAIN LENGTH

The approximate chain length may be obtained using this formula:

$$\mathbf{Lp} = 2CDp + \frac{N + n}{2} + K$$

Where: **Lp** = Length of chain, in Pitches
CDp = Distance between shaft centers, in Pitches
N = Number of teeth on DriveN sprocket
n = Number of teeth on DriveR sprocket
K $= .0258 \times \frac{(N - n)^2}{CDp}$

Feet of chain =

$$\frac{\text{Chain Length (pitches) x Pitch of Chain (Ins.)}}{12}$$

POWER AND CYCLE CALCULATIONS

Horsepower

$$\mathbf{HP} = \frac{T\ (RPM)}{63000}$$

$$\mathbf{HP} = \frac{P\ (FPM)}{33000}$$

Where: **T** = Torque (Inch-Lb.)
P = Net chain pull (lbs.)
RPM = Shaft speed (Rev./Minute)
FPM = Chain speed (Ft./Minute)

Chain Speed (In FPM)

$$\mathbf{FPM} = \frac{\text{RPM (no. of teeth) (pitch in inches)}}{12}$$

Number of Cycles of Chain Operation

A cycle is defined as one complete traverse of a given link around the sprockets and back to its starting point. The number of cycles a chain has been operated can be calculated as follows:

$$\mathbf{Total\ Cycles} = \frac{\text{(no. of teeth) (RPM) (60) (HR)}}{\text{(no. of Pitches in Chain)}}$$

Where: **HR** = Total operating time (hours)

Catenary Tension

The tension in the chain on the slack side, caused by the catenary sag of the unsupported chain, can be calculated from the following formula:

$$\mathbf{T} = \frac{B^2 \times W}{96\ CS} + \frac{W \times CS}{12}$$

Where: **T** = Chain tension due to cantenary sag (lbs.)
B = Center Distance (inches)
W = Weight of chain (lbs./ft.)
CS = Catenary sag (inches)

Catenary tension for a chain weighing one pound per foot is shown in the accompanying table. To find the tension in a chain weighing "W" pounds per foot, multiply the listed value by "W".

CATENARY TENSION – POUNDS

Dimensions are in inches.

Center Distance	Amount of Catenary Sag																	
	.125	.25	.375	.50	.75	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
10	8.3	4.2	2.8	2.1	1.5	1.1	0.7	0.6	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.1	1.2	1.4
20	33.3	16.7	11.1	8.4	5.6	4.3	2.3	1.6	1.4	1.3	1.2	1.2	1.2	1.2	1.3	1.3	1.5	1.6
30	75.0	37.5	25.0	18.8	12.6	9.5	4.9	3.4	2.7	2.3	2.1	1.9	1.8	1.8	1.8	1.8	1.8	1.9
40	133.3	66.7	44.5	33.4	22.3	16.8	8.5	5.8	4.5	3.8	3.3	3.0	2.8	2.6	2.5	2.4	2.4	2.4
50	208.3	104.2	69.5	52.1	34.8	26.1	13.2	8.9	6.8	5.6	4.8	4.3	3.9	3.6	3.4	3.2	3.0	3.0
60	300.0	150.0	100.0	75.0	50.1	37.6	18.9	12.8	9.7	7.9	6.8	5.9	5.4	4.9	4.6	4.1	3.8	3.7
70	408.3	204.2	136.1	102.1	68.1	51.1	25.7	17.3	13.1	10.6	9.0	7.9	7.0	6.4	5.9	5.3	4.8	4.5
80	533.3	266.7	177.8	133.4	89.0	66.8	33.5	22.5	17.0	13.8	11.6	10.1	9.0	8.2	7.5	6.6	5.9	5.5
90	675.0	337.5	225.0	168.8	112.6	84.5	42.4	28.4	21.4	17.3	14.6	12.6	11.2	10.1	9.3	8.0	7.2	6.6
100	833.3	416.7	277.6	208.4	139.0	104.3	52.3	35.0	26.4	21.3	17.9	15.5	13.7	12.3	11.3	9.7	8.6	7.8
110	1008.0	504.2	336.1	252.1	168.1	126.1	63.2	42.3	31.8	25.6	21.5	18.6	16.4	14.8	13.4	11.5	10.2	9.2
120	1200.0	600.0	400.0	300.0	200.1	150.1	75.2	50.3	37.8	30.4	25.5	22.0	19.4	17.4	15.8	13.5	11.9	10.7
130	1406.0	704.2	469.5	352.1	234.8	176.1	88.2	58.9	44.3	35.6	29.8	25.7	22.7	20.3	18.4	15.7	13.7	12.3
140	1633.0	816.7	544.5	408.4	272.3	204.3	102.3	68.3	51.4	41.3	34.5	29.8	26.2	23.4	21.3	18.0	15.8	14.1
150	1875.0	937.5	625.0	468.8	312.6	234.5	117.4	78.4	58.9	47.3	39.6	34.1	30.0	26.8	24.3	20.5	17.9	16.0
160	2133.0	1067.0	711.1	533.4	355.6	266.8	133.5	89.1	67.0	53.8	44.9	38.7	34.0	30.4	27.5	23.2	20.2	18.0
170	2408.0	1204.0	802.8	602.1	401.5	301.1	150.7	100.6	75.6	60.6	50.7	43.6	38.3	34.2	30.9	26.1	22.7	20.1
180	2700.0	1350.0	900.0	675.0	450.1	337.6	168.9	112.8	84.7	67.9	56.8	48.8	42.9	38.3	34.6	29.1	25.3	22.4
190	3008.0	1504.0	1003.0	752.1	501.5	376.1	188.2	125.6	94.3	75.6	63.2	54.3	47.7	42.5	38.4	32.2	28.0	24.8
200	3333.0	1667.0	1111.0	833.4	555.6	416.8	208.5	139.1	104.5	83.8	69.9	60.1	52.8	47.0	42.5	35.7	30.9	27.4

① For chain weighing one pound per foot.

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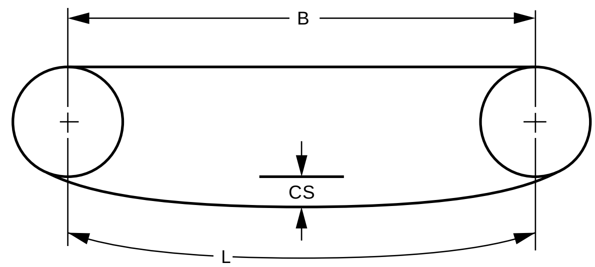
Catenary Sag

The return strand of a chain normally has some slack. This slack results in a sag, called catenary sag, of the chain. This sag must be of the correct amount if the chain is to operate properly. If the return strand is too tight (too little catenary sag), the load and the wear on working parts will be excessive. If the return strand is too loose, vibration and unwanted chain flexure will result. A chain that is properly installed will permit flexing of the return strand by hand. This flexure, measured from a straight line, should not be less than about 3% of the horizontal center distance. The amount of catenary sag that will be present can be calculated as follows:

$$\mathbf{CS} = \sqrt{.375\,BE}$$

Where: **CS** = Catenary sag (inches)
L = Return strand length (inches)
B = Center distance (inches)
E = Excess chain, L – B (inches)

Depending on the combination of chain pitch, sprocket center distance, and number of teeth in the sprockets, there will always be excess chain in the system. The catenary sag resulting from this excess chain for various sprocket center distances is given in the table below.



ENGINEERING DATA

CATENARY SAG

Dimensions are in inches.

Center Distance	Excess Chain																	
	.063	.125	.188	.250	.313	.375	.438	.500	.625	.750	.875	1.00	1.50	2.00	2.50	3.00	3.50	4.00
10	0.5	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.5	1.7	1.8	1.9	2.4	2.7	3.1	3.4	3.6	3.9
20	0.7	1.0	1.2	1.4	1.5	1.7	1.8	1.9	2.2	2.4	2.6	2.7	3.4	3.9	4.3	4.7	5.1	5.5
30	0.8	1.2	1.5	1.7	1.9	2.1	2.2	2.4	2.7	2.9	3.1	3.4	4.1	4.7	5.3	5.8	6.3	6.7
40	1.0	1.4	1.7	1.9	2.2	2.4	2.6	2.7	3.1	3.4	3.6	3.9	4.7	5.5	6.1	6.7	7.2	7.7
50	1.1	1.5	1.9	2.2	2.4	2.7	2.9	3.1	3.4	3.8	4.1	4.3	5.3	6.1	6.8	7.5	8.1	8.7
60	1.2	1.7	2.1	2.4	2.7	2.9	3.1	3.4	3.8	4.1	4.4	4.7	5.8	6.7	7.5	8.2	8.9	9.5
70	1.3	1.8	2.2	2.6	2.9	3.1	3.4	3.6	4.1	4.4	4.8	5.1	6.3	7.2	8.1	8.9	9.6	10.2
80	1.4	1.9	2.4	2.7	3.1	3.4	3.6	3.9	4.3	4.7	5.1	5.5	6.7	7.7	8.7	9.5	10.2	11.0
90	1.5	2.1	2.5	2.9	3.2	3.6	3.8	4.1	4.6	5.0	5.4	5.8	7.1	8.2	9.2	10.1	10.9	11.6
100	1.5	2.2	2.7	3.1	3.4	3.8	4.1	4.3	4.8	5.3	5.7	6.1	7.5	8.7	9.7	10.6	11.5	12.2
110	1.6	2.3	2.8	3.2	3.6	3.9	4.2	4.5	5.1	5.6	6.0	6.4	7.9	9.1	10.2	11.1	12.0	12.8
120	1.7	2.4	2.9	3.4	3.8	4.1	4.4	4.7	5.3	5.8	6.3	6.7	8.2	9.5	10.6	11.6	12.5	13.4
130	1.7	2.5	3.0	3.5	3.9	4.3	4.6	4.9	5.5	6.0	6.5	7.0	8.6	9.9	11.0	12.1	13.1	14.0
140	1.8	2.6	3.1	3.6	4.1	4.4	4.8	5.1	5.7	6.3	6.8	7.2	8.9	10.2	11.5	12.5	13.6	14.5
150	1.9	2.7	3.2	3.8	4.2	4.6	5.0	5.3	5.9	6.5	7.0	7.5	9.2	10.6	11.9	13.0	14.0	15.0
160	1.9	2.7	3.4	3.9	4.3	4.7	5.1	5.5	6.1	6.7	7.2	7.7	9.5	11.0	12.2	13.4	14.5	15.5
170	2.0	2.8	3.5	4.0	4.5	4.9	5.3	5.6	6.3	6.9	7.5	8.0	9.8	11.3	12.6	13.8	14.9	16.0
180	2.1	2.9	3.6	4.1	4.6	5.0	5.4	5.8	6.5	7.1	7.7	8.2	10.1	11.6	13.0	14.2	15.4	16.4
190	2.1	3.0	3.7	4.2	4.7	5.2	5.6	6.0	6.7	7.3	7.9	8.4	10.3	11.9	13.3	14.6	15.8	16.9
200	2.2	3.1	3.8	4.3	4.8	5.3	5.7	6.1	6.8	7.5	8.1	8.7	10.6	12.2	13.7	15.0	16.2	17.3

NOTE: Values above and to the right of the heavy stepped line represent 3% or greater sag.

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WEIGHTS AND CONVEYING CHARACTERISTICS OF MATERIALS

Table (A) lists CEMA material class descriptions and corresponding codes referred to in Table (B). Table (B) lists typical values. Some materials, particularly ores, vary widely. Weight and angle or repose depend largely on the size distribution in a given material. Degree of aeration may be important factor in density of very fine material. Angle of repose may increase with the percentage of fines as well as the angularity of the particles. Fines carry most of the moisture content, which is often the controlling factor. For these reasons, the values given can only be approximate.

TABLE A – CEMA MATERIAL CLASS DESCRIPTION

	Material Characteristics	Code
SIZE	Very fine – 100 mesh and under	A
	Fine – 1/8 inch and under	B
	Granular – Under 1/2 inch	C
	Lumpy – containing lumps over 1/2 inch	D
	Irregular – string, interlocking, mats together	E
FLOWABILITY ANGLE OF REPOSE	Very free flowing – angle of repose less than 20°	1
	Free flowing – angle of repose 20 degrees to 30°	2
	Average flowing – angle of repose 30° to 45°	3
	Sluggish – angle of repose 45° and over	4
ABRASIVENESS	Non-abrasive	5
	Abrasive	6
	Very abrasive	7
	Very sharp – cuts or gouges belt covers	8
MISCELLANEOUS CHARACTERISTICS (Sometimes more than one of these characteristics may apply.)	Very dusty	L
	Aerates and develops fluid characteristics	M
	Contains explosive dust	N
	Contaminable affecting use of saleability	P
	Degradable, affecting use of saleability	Q
	Gives off harmful fumes or dust	R
	Highly corrosive	S
	Mildly corrosive	T
	Hygroscopic	U
	Interlocks or mats	V
	Oils or chemicals present – may affect rubber products	W
	Packs under pressure	X
	Very light and fluffy – may be wind swept	Y
	Elevated temperature	Z

TABLE B – CONVEYING PROPERTIES OF MATERIALS

Material	Lbs. per Cu. Ft.	Angle of Repose	Recom'd Max. Inclin.	Code	Material	Lbs. per Cu. Ft.	Angle of Repose	Recom'd Max. Inclin.	Code
Alfalfa meal	17	45°	–	B46Y	Carbon black, powder	4-7	30-44°	–	*A35Y
Alum, fine	45-50	30-44°	–	B35	Carborundum, 3" and under	100	20-29°	–	D27
Alum, lumpy	50-60	30-44°	–	D35	Casein	36	30-44°	–	B35
Alumina	50-65	22°	10-12°	B27M	Cast iron chips	90-120	45°	–	C46
*Aluminum chips	7-15	45°	–	E46Y	Cement, Portland	72-99	30-44°	20-23°	A36M
Aluminum hydrate	18	34°	20-24°	C35	Cement, Portland, aerated	60-75	–	–	A16M
Aluminum oxide	70-120	29°	–	A27M	Cement, rock (see limestone)	100-110	–	–	D36
Aluminum silicate	49	30-44°	–	B35S	Cement clinker	75-95	30-40°	18-20°	D37
Aluminum sulphate	54	32°	17°	D35	Chalk, lumpy	75-85	45°	–	D46
Ammonium chloride, crystalline	45-52	30-44°	–	B36S	*Charcoal	18-25	35°	20-25°	D36Q
Ammonium nitrate	45	30-44°	–	*C36NUS	Chrome ore (chromite)	125-140	30-44°	–	D37
Ammonium sulphate, granular	45-58	44°	–	*C35TU	Cinders, blast furnace	57	35°	18-20°	*D37T
Asbestos, ore or rock	81	30-44°	–	D37R	Cinders, coal	40	35°	20°	*D37T
Asbestos, shred	20-25	45°	–	E46XY	Clay, calcined	80-100	–	–	B37
Ashes, coal, dry, 3" and under	35-40	45°	–	D46T	Clay, dry, fines	100-120	35°	20-22°	C37
Ashes, coal, wet, 3" and under	45-50	45°	–	D46T	Clay, dry, lumpy	60-75	35°	18-20°	D36
Ashes, fly	40-45	42°	20-25°	A37	Coal, anthracite, sized	55-60	27°	16°	C26
Ashes, gas-producer, wet	78	–	–	D47T	Coal, bituminous, mined 50 mesh and less	50-54	45°	24°	B45T
Asphalt, binder for paving	80-85	–	–	C45	Coal, bituminous, mined and sized	45-55	35°	16°	D35T
Asphalt, crushed, 1/2" and under	45	30-44°	–	C35	Coal, bituminous, mined, run of mine	45-55	38°	18°	D35T
Bagasse	7-10	45°	–	E45Y	Coal, bituminous, stripping, not cleaned	50-60	–	–	D36T
Bakelite and similar plastics, powdered	35-45	45°	–	B45	Coal, lignite	40-45	38°	22°	D36T
Barite	180	30-44°	–	B36	Coke, loose	23-35	30-44°	18°	B37QVT
Barium carbonate	72	45°	–	A45	Coke, petroleum calcined	35-45	30-44°	20°	D36Y
Barium oxide	150-200	–	–	A46	Coke breeze, 1/4" and under	25-35	30-44°	20-22°	C37Y
*Bark, wood, refuse	10-20	45°	27°	E45VY	Compost	30-50	–	–	E45ST
Basalt	80-103	20-28°	–	B26	Concrete, cinder	90-100	–	12-30°	D46
Bauxite, ground, dry	68	20-29°	20°	B26	Copper ore	120-150	30-44°	20°	*D37
Bauxite, mine run	80-90	31°	17°	E37	Copper sulfate	75-85	31°	17°	D36
Bauxite, crushed, 3" and under	75-85	30-44°	20°	D37	Cork, granulated	12-15	–	–	C45
*Bentonite, crude	35-40	42-44°	–	D36X	Corn, shelled	45	21°	10°	C25NW
Bentonite, 100 mesh and under	50-60	42°	20°	A36XY	Cottonseed cake, crushed	40-45	30-44°	–	B35
Boneblack, 100 mesh and under	20-25	20-29°	–	A25Y	Cottonseed cake, lumpy	40-45	30-44°	–	D35W
Bonechar	27-40	30-44°	–	B36	Cottonseed meal	35-40	35°	22°	B35W
Bonemeal	50-60	30-44°	–	B36	Cottonseed meats	40	30-44°	–	B35W
Borate of lime	60	30-44°	–	A35	Cryolite, dust	75-90	30-44°	–	A36
Borax, 1/2" screenings	55-60	30-44°	–	C36	Cryolite, lumpy	90-100	30-44°	–	D36
Borax, 3" and under	60-70	30-44°	–	D35	Cullet	80-120	30-44°	20°	D37Z
Boric acid, fine	55	20-29°	–	B26T	Diatomaceous earth	11-14	30-44°	–	A36MY
Brewer's grain, spent, dry	25-30	45°	–	C45	Dicalcium phosphate	40-50	45°	–	A45
Brewer's grain, spent, wet	55-60	45°	–	C45T	Disodium phosphate	25-31	30-44°	–	B36QT
Calcium carbide, crushed	70-80	30-44°	–	D36N	Dolomite, lumpy	80-100	30-44°	22°	D36
Carbon, activated, dry, fine	8-20	20-29°	–	B26Y	Earth, as excavated – dry	70-80	35°	20°	B36
Carbon black, pelletized	20-25	25°	–	B25Q	Earth, wet, containing clay	100-110	45°	23°	B46

*May vary considerably. Consult your Rexnord representative.

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ENGINEERING DATA

TABLE B – CONVEYING PROPERTIES OF MATERIALS – (CONT'D.)

Material	Lbs. per Cu. Ft.	Angle of Repose	Recom'd Max. Inclin.	Code
Ebonite, crushed 1/2" and under	65-70	30-44°	–	C35
Emery	230	20-29°	–	A27
Epson salts	40-50	30-44°	–	B35
Feldspar, 1/2" screenings	70-85	38°	18°	B36
Feldspar, 1 1/2" to 3" lumps	90-110	34°	17°	D36
Ferrous sulfate	50-75	–	–	C36
Filter press mud, sugar factory	70	–	–	A15
Flue dust, boiler house, dry	35-40	20°	–	A17MTY
Fluorspar, 1/2" screenings	85-105	45°	–	C46
Fluorspar, 1 1/2" to 3" lumps	110-120	45°	–	D46
Foundry refuse, old sand cores, etc.	70-100	30-44°	–	D37Z
Fuller's earth, dry	30-35	23°	–	B26
Fuller's earth, oily	60-65	20-29°	–	B26
Fuller's earth, oil filter, burned	40	20-29	–	B26
Fuller's earth, oil filter, raw	35-40	35°	20°	*B26
Glass batch, wool and container	80-100	30-44°	20-22°	D38Z
Glue, pearl	40	25°	11°	C25
Grain, distillery, spent, dry	30	30-44°	–	E35WY
Grain, distillery, spent, wet	40-60	45°	–	C45V
Granite, 1/2" screenings	80-90	20-29°	–	C27
Granite, 1 1/2" to 2" lumps	85-90	20-29°	–	D27
Granite, broken	95-100	30-44°	–	D37
Graphite, flake	40	30-44°	–	C35
Gravel, bank run	90-100	38°	20°	
Gypsum, 1/2" screenings	70-80	40°	21°	C36
Gypsum, 1 1/2" to 3" lumps	70-80	30°	15°	D36
Guano, dry	70	20-29°	–	B26
Hops, spent, wet	50-55	45°	–	E45T
Ice, crushed	35-45	19°	–	D16
Ilmenite ore	140-160	30-44°	–	B37
Iron ore	100-200	35°	18-20°	*D36
Iron ore pellets	116-130	30-44°	13-15°	D37Q
Iron sulfide	120-135	30-44°	–	D36
Kaolin clay, 3" and under	63	35°	19°	D36
Lactose	32	30-44°	–	A35PX
Lead arsenate	72	45°	–	B45R
Lead ores	200-270	30°	15°	*B36RT
Lead oxides	60-150	45°	–	B45
Lead oxides, pulverized	200-250	30-44°	–	A36
Lead sulfide	240-260	30-44°	–	A36
Lignite, air-dried	45-55	30-44°	–	*D35
Lime, ground, 1/8" and under	60-65	43°	23°	B35X
*Lime, hydrated, 1/8" and under	40	40°	21°	B35MX
Lime, hydrated, pulverized	32-40	42°	22°	A35MXY
Lime, pebble	53-56	30°	17°	D35
Limestone, agricultural, 1/8" and less	68	30-44°	20°	B36
Limestone, crushed	85-90	38°	18°	C36X
Magnesium chloride	33	40°	–	C45
Magnesium sulfate	40-50	30-44°	–	
Malt, dry, whole	27-30	20-29°	–	C25N
Malt, wet or green	60-65	45°	–	C45
Manganese dioxide	80	–	–	*
Manganese ore	125-140	39°	20°	*D37
Manganese sulfate	70	30-44°	–	C37
Marble, crushed 1/2" and under	80-95	30-44°	–	D37
Marl	80	30-44°	–	C37
Mica, flakes	17-22	19°	–	B16MY
Mica, ground	13-15	34°	23°	*B36
Milk, malted	30-35	45°	–	A45PX
*Molybdenite, powdered	107	40°	25°	B35
Molybdenum ore	107	40°	–	B36
Nickel-cobalt, sulfate ore	80-150	30-44°	–	*D37T
Oil cake	48-50	45°	–	D45W
Oxalic acid crystals	60	30-44°	–	B35SU
Oyster shells, ground, under 1/2"	50-60	30-44°	–	C36T
Oyster shells, whole	80	30-44°	–	D36TV
Paper pulp stock	40-60	19°	–	*E15MV
Peanuts, in shells	15-24	30-44°	–	D35Q
Peanuts, shelled	35-45	30-44°	–	C35Q
Phosphate, acid, fertilizer	60	26°	13°	B25T
Phosphate, triple super, ground fertilizer	50-55	45°	30°	B45T
Phosphate rock, broken, dry	75-85	25-29°	12-15°	D26
Phosphate rock, pulverized	60	40°	25°	B36
Polystyrene pellets	35	23°	–	B25PQ
Potash salts, sylvite, etc.	80	20-29°	–	B25T
Potassium carbonate	51	20-29°	–	B26
Potassium chloride, pellets	120-130	30-44°	–	C36T
Potassium nitrate	76-80	20-29°	–	C26T
Potassium sulfate	42-48	45°	–	B36X
Pumice, 1/8" and under	40-45	45°	–	B47
Pyrites, iron, 2" to 3" lumps	135-145	20-29°	–	D26T
Pyrites, pellets	120-130	30-44°	–	C36T
Quartz, 1/2" screenings	80-90	20-29°	–	C27Z
Quartz, 1 1/2" to 3" lumps	85-95	20-29°	–	D27Z
Rock, crushed	125-145	20-29°	–	D26
Rock, soft, excavated with shovel	100-110	30-44°	22°	D36
Rubber, pelletized	50-55	35°	22°	D35
Rubber, reclaim	25-30	32°	18°	D35
Salicylic acid	29	–	–	B25U
Salt, common dry, coarse	40-55	–	18-22°	C36TU
Salt, common dry, fine	70-80	25°	11°	D26TUW
Salt cake, dry, coarse	85	36°	21°	B36TW
Salt cake, dry, pulverized	60-85	20-29°	–	B26NT
Sand, bank, damp	105-130	45°	20-22°	B47
Sand, bank, dry	90-110	35°	16-18°	B37
Sand, core	65	41°	26°	B35X
Sand, foundry, prepared	80-90	30-44°	24°	B37
Sand, foundry, shakeout	90-100	39°	22°	D37
Sand, silica, dry	90-100	20-29°	10-15°	B27
Sandstone, broken	85-90	30-44°	–	D37
Sawdust	10-13	36°	22°	*B35
Sewage sludge, moist	55	30-44°	–	B36
Shale, broken	90-100	20-29°	–	D26QZ
Shale, crushed	85-90	39°	22°	C36
Shellac	80	45°	–	C45
Shellac, powdered or granulated	31	–	–	B35PY
Sinter	100-135	35°	–	*D37
Slag, blast furnace, crushed	80-90	25°	10°	A27
Slag, furnace, granular, dry	60-65	25°	13-16°	C27
Slag, furnace, granular, wet	90-100	45°	20-22°	B47
Slate, crushed, 1/2" and under	80-90	28°	15°	C36
Slate, 1 1/2" to 3" lumps	85-95	–	–	D26
Soap beads or granules	15-25	30-44°	–	C35Q
Soda ash, briquettes	50	22°	7°	C26
Soda ash, heavy	55-65	32°	19°	B36
Soda ash, light	20-35	37°	22°	A36Y
Sodium aluminate, ground	72	30-44°	–	B36
Sodium aluminum sulfate	75	30-44°	–	A36
Sodium antimonate, crushed	49	31°	–	C36
Sodium nitrate	70-80	24°	11°	*D25
Sodium phosphate	50-65	37°	–	B36
Soybeans, whole	45-50	21-28°	12-16°	C27NW
Starch	25-50	24°	12°	*B25
Steel chips, crushed	100-150	30-44°	–	D37WZ
Steel trimmings	75-150	35°	18°	E37V
Sugar, raw, cane	55-65	45°	–	B46TX
Sugar, refined, granulated, dry	50-55	30-44°	–	B35PU
Sugar, refined, granulated, wet	55-65	30-44°	–	C35X
Sugar, beet pulp, dry	12-15	20-29°	–	C26
Sugar, beet pulp, wet	25-45	20-29°	–	C26X
Sugar cane, knifed	15-18	45°	–	E45V
Sulfate, crushed, 1/2" and under	50-60	30-44°	20°	C35NS
Sulfate, 3" and under	80-85	30-44°	18°	D35NS
Taconite, pellets	116-130	30-44°	13-15°	D37Q
Talc, 1/2" screenings	80-90	20-29°	–	C25
Talc, 1 1/2" to 3" lumps	85-95	20-29°	–	D25
Titanium dioxide	140	30-44°	–	B36
Titanium sponge	60-70	45°	–	E47
Tobacco scraps	15-25	45°	–	D45Y
Tobacco stems	15	45°	–	E45Y
Traprock, 1/2" screenings	90-100	30-44°	–	C37
Traprock, 2" to 3" lumps	100-110	30-44°	–	D37
Trisodium phosphate, granular	60	30-44°	11°	B35
Trisodium phosphate, pulverized	50	40°	25°	B35
Vermiculite, expanded	16	45°	–	C45Y
Vermiculite ore	70-80	–	20°	D36Y
Walnut shells, crushed	35-45	30-44°	–	B37
Wood chips	10-30	45°	27°	E45WY
Wood chips, hogged, fuel	15-25	45°	–	D45
Zinc concentrates	75-80	–	–	B26
Zinc ore, crushed	160	38°	22°	*
Zinc ore, roasted	110	38°	–	C36
Zinc oxide, heavy	30-35	45-55°	–	A45X
Zinc oxide, light	10-15	45°	–	A45XY

*May vary considerably. Consult your Rexnord representative.

■ ENGINEERING DATA

ENGINEERING CONSTANTS

28.8 = equivalent mol. wgt. of air
288,000 Btu per 24 hr. = 1 ton of refrigeration
29.921 in. Hg at 32° F = atm. press.
299 792 458 m/s = velocity of light (c)
3 ft. = 1 yard
30 in. Hg at 62° F = atmos. press. (very closely)
31 (31.5 for some substances) gallons = 1 barrel
3.1416 = π (Greek letter "pi") = ratio circumference of circle to diameter = ratio area of circle to square of radius
32 deg. F = freezing point of water = 0° C.
32 = atomic wgt. sulphur (S)
32 = mol. wgt. oxygen gas (O_2)
32.16 feet/sec^2 = acceleration of gravity (g)
3.2808 ft. = 1 meter
33,000 ft.-lb. per min. = 1 hp.
33.947 ft. water at 62° F = atm. press.
3,415 Btu = 1 kw-hr.
3.45 lb. steam "f.&a. 212" per sq. ft. of heating surface per hr. = rated boiler evaporation.
34.56 lb. = wgt. air to burn 1 lb. hydrogen (H)
35.314 cu. ft. = 1 cu. meter
3.785 liters = 1 gal.
39.2° F (4° C) water is at greatest density
39.37 in. = 1 meter = 100 cm = 1000 mm
3.9683 Btu = 1 kg calorie
4,000 Btu (4,050) = cal. val. of sulphur (S)
4.32 lb. = wgt. air req. to burn 1 lb. sulphur (S)
0.433 lb. per sq. in. = 1 ft. of water at 62° F
43,560 sq. ft. = acre
44 = mol. wgt. carbon dioxide (CO_2)
0.45359 kg. = 1 lb.
–460°F (459.6°F) = absolute zero.
0.47 Btu per pound per °F = approx. specific heat of super-heated steam at atm. press.
0.491 lb. per sq. in. = 1 in. Hg at 62° F
5.196 lb. per sq. ft. = 1 in. water at 62° F
5,280 ft. = 1 mile
53.32 = R, a constant for air, expansion equation: PV = MRT
550 ft.-lb. per sec. = 1 hp.
57.296° = 1 radian (angle)
58.349 grains per gal = 1 gram per liter
59.76 lb. = wgt. 1 cu. ft. water at 212° F
61.023 cu. in. = 1 liter
62,000 Btu = cal. val. (higher) hydrogen (H)
0.62137 miles = 1 kilometer
0.062428 lb. per cu. ft. = 1 kg per cu. meter
62.5 (62.355) lb. = wgt. 1 cu. ft. water at 62° F
645 mm^2 = 1 sq. in.
7,000 grains = 1 lb.
0.0735 in. Hg at 62° F = 1 in. water at 62° F
746 (745.7) watts = 1 hp.
7.5 (7.4805) gal. = 1 cu. ft.
760 millimeters Hg = atm. press. at 0° C
0.07608 lb. = wgt. 1 cu. ft. air at 62° F and 14.7 per sq. in.
778 (777.5) ft.-lb. = 1 Btu (work required to raise 1 lb. water 1° F)
0.7854 (= 3.1416 ÷ 4) x diameter squared = area circle
8 = lb. oxygen required to burn 1 lb. hydrogen (H)
8.025 (= square root of 2g) x square root of head (ft.) = theoretical velocity of fluids in ft. per sec.
0.08073 lb. = wgt. 1 cu. ft. air at 32° F and 14.7 lb. per sq. in.
8⅓ (8.3356) lb. = wgt. 1 gal. water at 62° F
8,760 hr. = 1 year of 365 days
88 ft. per sec. (min.) = 1 mile per min. (hr.)
9 sq. ft. = 1 sq. yard
0.0929 sq. meters = 1 sq. ft.
970.4 Btu = Latent heat of evap. of water at 212° F

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■ ENGINEERING DATA

STRENGTH OF MATERIALS
HARDNESS AND STRENGTH COMPARISON TABLES

Hardened Steel and Hard Alloys

C 150 kg	A 60 kg	D 100 kg	15-N 15 kg	30-N 30 kg	45-N 45 kg	Diamond Pyramid Hardness 10 kg	Knoop Hardenss 500 g & over	Brinell Hardness 3000 kg	Tensile Strength Approx. Only	
ROCKWELL			SUPERFICIAL							
BRALE	BRALE	BRALE	N BRALE	N BRALE	N BRALE				ksi	MPa
65	84.0	74.5	92.0	82.0	72.0	820	846	–	–	–
64	83.5	74.0	–	81.0	71.0	789	822	–	–	–
63	83.0	73.0	91.5	80.0	70.0	763	799	–	–	–
62	82.5	72.5	91.0	79.0	69.0	739	776	–	–	–
61	81.5	71.5	90.5	78.5	67.5	716	754	–	–	–
60	81.0	71.0	90.0	77.5	66.5	695	732	614	314	2160
59	80.5	70.0	89.5	76.5	65.5	675	710	600	306	2110
58	80.0	69.0	–	75.5	64.0	655	690	587	299	2060
57	79.5	68.5	89.0	75.0	63.0	636	670	573	291	2010
56	79.0	67.5	88.5	74.0	62.0	617	650	560	284	1960
55	78.5	67.0	88.0	73.0	61.0	598	630	547	277	1910
54	78.0	66.0	87.5	72.0	59.5	580	612	534	270	1860
53	77.5	65.5	87.0	71.0	58.5	562	594	522	263	1815
52	77.0	64.5	86.5	70.5	57.5	545	576	509	256	1765
51	76.5	64.0	86.0	69.5	56.0	538	558	496	250	1720
50	76.0	63.0	85.5	68.5	55.0	513	542	484	243	1675
49	75.5	62.0	85.0	67.5	54.0	498	526	472	236	1630
48	74.5	61.5	84.5	66.5	52.5	485	510	460	230	1585
47	74.0	60.5	84.0	66.0	51.5	471	495	448	223	1540
46	73.5	60.0	83.5	65.0	50.0	458	480	437	217	1500
45	73.0	59.0	83.0	64.0	49.0	446	466	426	211	1460
44	72.5	58.5	82.5	63.0	48.0	435	452	415	205	1415
43	72.0	57.5	82.0	62.0	46.5	424	438	404	199	1375
42	71.5	57.0	81.5	61.5	45.5	413	426	393	194	1335
41	71.0	56.0	81.0	60.5	44.5	403	414	382	188	1295
40	70.5	55.5	80.5	59.5	43.0	393	402	372	182	1255
39	70.0	54.5	80.0	58.5	42.0	383	391	362	177	1220
38	69.5	54.0	79.5	57.5	41.0	373	380	352	171	1180
37	69.0	53.0	79.0	56.5	39.5	363	370	342	166	1145
36	68.5	52.5	78.5	56.0	38.5	353	360	332	162	1115
35	68.0	51.5	78.0	55.0	37.0	343	351	322	157	1080
34	67.5	50.5	77.0	54.0	36.0	334	342	313	153	1050
33	67.0	50.0	76.5	53.0	35.0	325	334	305	148	1020
32	66.5	49.0	76.0	52.0	33.5	317	326	297	144	990
31	66.0	48.5	75.5	51.5	32.5	309	318	290	140	965
30	65.5	47.5	75.0	50.5	31.5	301	311	283	136	935
29	65.0	47.0	74.5	49.5	30.0	293	304	276	132	910
28	64.5	46.0	74.0	48.5	29.0	285	297	270	129	885
27	64.0	45.5	73.5	47.5	28.0	278	290	265	126	865
26	63.5	44.5	72.5	47.0	26.5	271	284	260	123	850
25	63.0	44.0	72.0	46.0	25.5	264	278	255	120	830
24	62.5	43.0	71.5	45.0	24.0	257	272	250	117	810
23	62.0	42.5	71.0	44.0	23.0	251	266	245	115	795
22	61.5	41.5	70.5	43.0	22.0	246	261	240	112	775
21	61.0	41.0	70.0	42.5	20.5	241	256	235	110	760
20	60.5	40.0	69.5	41.5	19.5	236	251	230	108	745

Soft Steel, Grey and Malleable Cast Iron

B 100 kg	G 150 kg	15-T 15 kg	30-T 30 kg	45-T 45 kg	A 60 kg Rock-well	Knoop Hard-ness 500 g & over	Brinell Hardness 3000 kg		Tensile Strength Approx. Only	
ROCKWELL		SUPERFICIAL					500 kg	3000 kg		
1/16" Ball	1/16" Ball	1/16" Ball	1/16" Ball	1/16" Ball	BRALE		10 mm Ball	D.P.H. 10 kg	ksi	MPa
100	82.5	93.0	82.0	72.0	61.5	251	201	240	116	790
99	81.0	92.5	81.5	71.0	61.0	246	195	234	112	770
98	79.0	–	81.0	70.0	60.0	241	189	228	109	750
97	77.5	92.0	80.5	69.0	59.5	236	184	222	106	730
96	76.0	–	80.0	68.0	59.0	231	179	216	103	710
95	74.0	91.5	79.0	67.0	58.0	226	175	210	101	695
94	72.5	–	78.5	66.0	57.5	221	171	205	98	675
93	71.0	91.0	78.0	65.5	57.0	216	167	200	96	660
92	69.0	90.5	77.5	64.5	56.5	211	163	195	93	640
91	67.5	–	77.0	63.5	56.0	206	160	190	91	625
90	66.0	90.0	76.0	62.5	55.5	201	157	185	89	615
89	64.0	89.5	75.5	61.5	55.0	196	154	180	87	600
88	62.5	–	75.0	60.5	54.0	192	151	176	85	585
87	61.0	89.0	74.5	59.5	53.5	188	148	172	83	570
86	59.0	88.5	74.0	58.5	53.0	184	145	169	81	560
85	57.5	–	73.5	58.0	52.5	180	142	165	80	550
84	56.0	88.0	73.0	57.0	52.0	176	140	162	78	540
83	54.0	87.5	72.0	56.0	51.0	173	137	159	77	530
82	52.5	–	71.5	55.0	50.5	170	135	156	75	520
81	51.0	87.0	71.0	54.0	50.0	167	133	153	74	510
80	49.0	86.5	70.0	53.0	49.5	164	130	150	72	500
79	47.5	–	69.5	52.0	49.0	161	128	147	71	490
78	46.0	86.0	69.0	51.0	48.5	158	126	144	70	480
77	44.0	85.5	68.0	50.0	48.0	155	124	141	68	470
76	42.5	–	67.5	49.0	47.0	152	122	139	67	460
75	41.0	85.0	67.0	48.5	46.5	150	120	137	66	455
74	39.0	–	66.0	47.5	46.0	147	118	135	–	–
73	37.5	84.5	65.5	46.5	45.5	145	116	132	–	–
72	36.0	84.0	65.0	45.5	45.0	143	114	130	–	–
71	34.5	–	64.0	44.5	44.5	141	112	127	–	–
70	32.5	83.5	63.5	43.5	44.0	139	110	125	–	–
69	31.0	83.0	62.5	42.5	43.5	137	109	123	–	–
68	29.5	–	62.0	41.5	43.0	135	107	121	–	–
67	28.0	82.5	61.5	40.5	42.5	133	106	119	–	–
66	26.5	82.0	60.5	39.5	42.0	131	104	117	–	–
65	25.0	–	60.0	38.5	–	129	102	116	–	–

NOTE: Hardness and Strength Comparison Tables can only be approximate. They depend on a number of assumptions, such as metal being homogeneous and having certain hardening characteristics. Therefore, these tables are provided only for comparing different hardness scales with each other and with strength in a general way.

Strength of Materials*

MATERIAL	ULTIMATE STRENGTH						Yield Point		MODULUS OF ELASTICITY	
	Tension		Compression		Shear				psi x 10^6 (million psi)	Pa x 10^9 (GPa)
	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa		
Gray Cast Iron (average) Class 20	22	152	90	620	–	–	–	–	14	96
Gray Cast Iron (good) Class 30	32	221	115	790	–	–	–	–	16	110
Gray Cast Iron (high-str) Class 40	43	296	150	1030	–	–	–	–	20	138
Malleable Iron, Grade 32510	55	379	–	–	40	276	36	248	25	172
Malleable Iron, Grade 35018	58	400	–	–	42	290	40	276	25	172
Malleable Iron, Grade 60004	88	606	–	–	62	427	66	455	25	172
Wrought Iron	48	331	46	317	40	276	25	172	27	186
Cast Steel Med. Carbon	70	483	70	483	50	345	38	262	30	207
Steel: Structural A 36	60	413	60	413	45	310	36	248	29	200
1020 cold finished	70	483	70	483	50	345	50	345	29	200
HSLA (Cor-Ten, Tri-Ten, etc.)	80	550	80	550	56	386	55	379	29	200
1035 cold finished	85	586	85	586	63	434	65	448	29	200
4140 cold finished	110	758	110	758	70	483	85	586	29	200
Stressproof	132	910	132	910	79	545	100	690	29	200
Aluminum 30003-0 – annealed	16	110	16	110	11	–	6	–	10	69
Aluminum 5052-0 – annealed	28	193	28	193	18	124	13	90	10.2	70
Aluminum 5052-H34 hard	38	262	38	262	21	145	31	214	10.2	70
Aluminum 6061-0 – annealed	18	124	18	124	12	83	8	55	10	69
Aluminum 6061-T6 hard	42	290	42	290	27	186	37	255	10	69
Brass, Naval, annealed	57	393	57	393	38	262	25	172	15	103
Bronze, commercial	37	255	37	255	28	193	10	69	17	117

*Typical values; minimum or "guaranteed" values would be at least 10% less.

ENGINEERING DATA

EXPANSION TEMPERATURE AND COLOR

Expansion of Bodies by Heat

The coefficient of linear expansion (ε) is the change in length, per unit of length, for a change of one degree of temperature. The coefficient of surface expansion is approximately two times the linear coefficient, and the coefficient of volume expansion, for solids, is approximately three times the linear coefficient.

A bar, free to move, will increase in length with an increase in temperature and will decrease in length with a decrease in temperature. The change in length will be εtl, where (ε) is the coefficient of linear expansion, (t) the change in temperature, and (l) the length. If the ends of a bar are fixed, a change in temperature (t) will cause a change in the unit stress of $E\varepsilon t$, and in the total (stress of) $AE\varepsilon t$, where A is the cross-sectional area of the bar and (ε) the modulus of elasticity.

The table below gives coefficients of linear expansion for 10,000,000 degrees (or 10^7 times the value indicated above).

Example: A piece of ferritic malleable iron is exactly 40 inches long at 60° Fahrenheit. Find the length at 90° Fahrenheit, assuming the ends are free to move.

$$\text{Change of length} = \varepsilon tl = \frac{59 \times 30 \times 40}{10^7} = 0.0007 \text{ inches}$$

The length at 90° Fahrenheit is 40.007 inch.

Example: A piece of ferritic malleable is exactly 40 inches long, ends are fixed.
If the temperature increases 30° Fahrenheit, what is the resulting change in unit stress?

$$\text{Change in unit stress} = E\varepsilon t = \frac{29{,}000{,}000 \times 59 \times 30}{10^7} = 5133 \text{ pounds per square inch}$$

COEFFICIENTS OF LINEAR EXPANSION

Substance	Expansion		Substance	Expansion	
	per 10^7 °F	per 10^7 °C		per 10^7 °F	per 10^7 °C
Aluminum	123-134	221-241	Plastics (acetal, acrylic, nylon, etc.)	445-500	800-900
Brass & Bronzes	90-118	162-212		(may be half these values if glass reinforced)	
Carbides & Ceramets	25-46	45-83			
Cast Iron (gray & ductile)	56-88	102-122	Polyethylene	900-1200	1600-2200
Chromium	34	61	Porcelain	20	36
Concrete	59-79	106-142	Rubber	428	770
Copper	90-98	162-176	Sandstone	55-61	99-110
Glass (plate, crown, flint, soda lime)	44-50	79-90	Silver	108	194
Glass (ferrosilicate, pyrex)	18	32	Slate	48-58	86-104
Granite	40-47	72-85	Solder	134	241
Ice	283	509	Stainless Steel		
Lead & Alloys	157-163	283-293	Ferritic & Martinsitic	52-66	94-119
Limestone	33-50	59-90	Austentic & Cast	83-104	149-187
Magnesium & Alloys	140-180	252-324	Steel, High Carbon & Alloy	73-84	131-151
Malleable Iron, Ferritic	59	106	Steel, Low Carbon	56-67	101-121
Malleable Iron, Pearlitic	75	135	Tin	116	209
Masonry	31-53	56-95	Titanium & Alloys	45-60	81-108
Phenolics	90-180	160-320	Wood	24-36	43-65
Plaster	92	166	Zinc	141	254

HIGH TEMPERATURES JUDGED BY COLOR*

Color	Temperature °F	Color	Temperature °F
Dark blood red, black red	990	Orange, free scaling heat	1650
Dark red, blood red, low red	1050	Light orange	1725
Dark cherry red	1175	Yellow	1825
Medium cherry red	1250	Light Yellow	1975
Cherry, full red	1375	White	2200
Light cherry, light red	1550		

*This table associating color and temperature of iron or steel is due to White and Taylor.