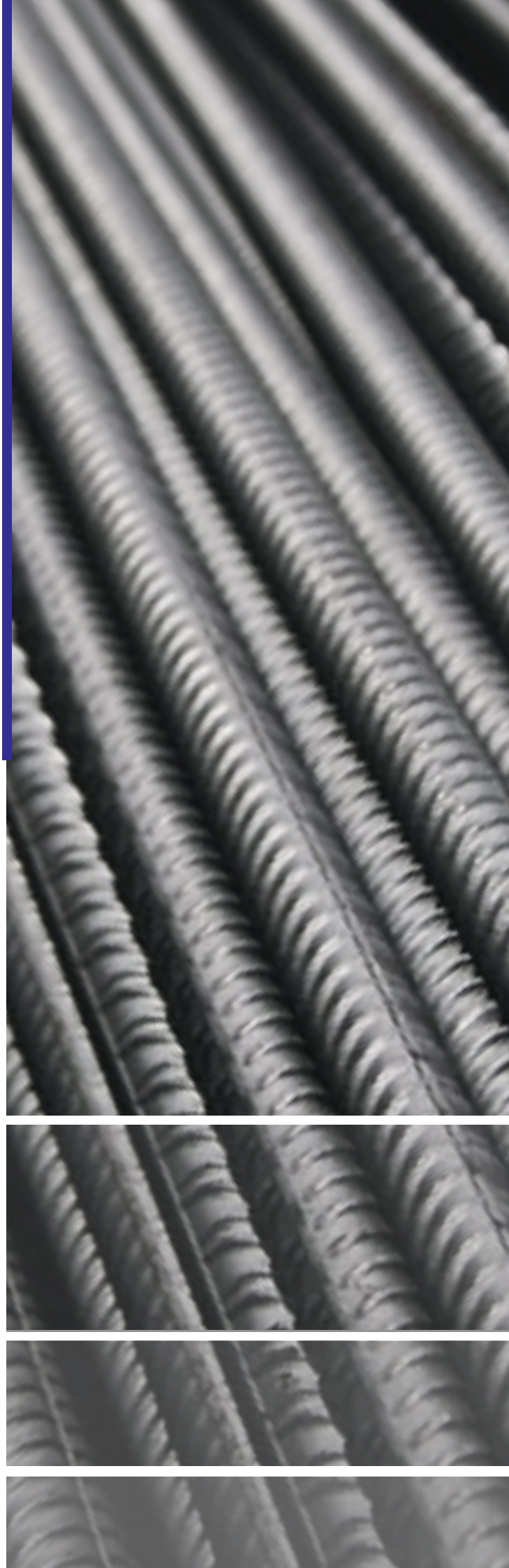
STEEL BARS



Hot Rolled Steel Bars For The Reinforcement Of Concrete (Standard Specification)

Chemical Composition and Mechanical Properties (For Deformed Bars and Plain Round Bars)

Chemical Composition

Standard	Grade	Chemical Composition				
		C% max	S% max	P% max	N% max	CE% max
MS 146:2000 (Hot Rolled Steel Bars)	Grade 250 (Plain Round Steel Bars)	0.25	0.06	0.06	0.012	0.42
	Grade 460 (Deformed Bars)	0.25	0.05	0.05	0.012	0.51
	Grade 500 (Deformed Bars)	0.30	0.05	0.05	0.012	0.51
BS 4449:1997 (Hot Rolled Steel Bars)	Grade 250 (Plain Round Steel Bars)	0.25	0.06	0.06	0.012	0.42
	Grade 460 A (High Yield Steel Bars)	0.25	0.05	0.05	0.012	0.51
	Grade 250 (High Yield Steel Bars)	0.25	0.05	0.05	0.012	0.51

Mechanical Properties

Standard	Grade	Mechanical Properties				
		Yield Strength - N/mm² (Min)	Tensile Strength - N/mm² (Min)	Min. Elongation (Gauge Length L) 5.65 VSO	Bend Test	
MS 146:2000 (Hot Rolled Steel Bars)	Grade 250 (Plain Round Steel Bars)	250	Actual YS x 1.05	22% (L=5d)	Bend Angle (2d) Rebend (2d)	=180° =1st bend 180°
	Grade 460 (Deformed Bars)	460	Actual YS x 1.05	12% (L=5d)	Bend Angle (3d) Rebend (5d)	=180° =1st bend 45° Rebend 23°
	Grade 500 (Deformed Bars)	500	Actual YS x 1.05	12% (L=5d)		
BS 4449:1997 (Hot Rolled Steel Bars)	Grade 250 (Plain Round Steel Bars)	250	Actual YS x 1.15	At fracture 22%	Rebend (2d)	=1st bend 45° 2nd bend 23°
	Grade 460 A (High Yield Steel Bars)	460	Actual YS x 1.05	At fracture 12% At Max. force 2.5%	Rebend (5d)	=1st bend 45° 2nd bend 23°
	Grade 250 (High Yield Steel Bars)		Actual YS x 1.08	At fracture 14% At Max. force 5%		

JIS Standard, Chemical Composition and Tensile Properties

Angle Bar, Flat Bar, Round Bar and Squre Bar

Type	Specification	Chemical Composition (Ladle Analysis)			Tensile Properties						Bend Test
					Yield Stress N/mm² (min)		Yield Strength (N/mm²)	Elongation			
		C%	P%	S%	t ≤ 16	16 < t ≤ 40		t ≤ 5	5< t <≤ 16	5 > 16	
Angle Bar Flat Bar Round Bar Square Bar	JIS G 3101 (2004) Class 2 SS 41 OR SS 400	-	0.05	0.05	245 min.	235 min.	400 to 510	21%	17%	21%	Bending Angle 180° Inside Radius 1.5t* Test Piece No.1

Note : t* = Thickness in mm

Weight Table for Steel Bar

Nominal Diameter (mm)	9	10	12	16	20	22	25	28	32	40
Cross-Sectional Area (mm²)	63.6	78.5	113.1	2.011	314.2	380.1	490.9	615.8	804.2	1256.6
Cross-Sectional Area (cm²)	0.636	0.785	1.131	0.636	3.142	3.801	4.909	6.158	8.042	12.566
Kg Per Meter Run	0.499	0.616	0.888	1.579	2.466	2.984	3.854	4.834	6.313	9.864
Pieces per Bundle (12m)	168	138	96	54	34	28	22	18	14	9
Nominal Weight (MT per Bundle)	1.006	1.020	1.023	1.023	1.006	1.003	1.017	1.044	1.061	1.065
Deviation over and under the nominal mass per meter run (%)	± 6.5	± 6.5	± 4.5	± 4.5	± 4.5	± 4.5	± 4.5	± 4.5	± 4.5	± 4.5

Standard Strength is 12m.

Dimensions and Properties

Flat Bars For General Structural Purpose

Section Size		Unit Weight	Section Area
Thickness	Width	M	A
mm	mm	kg / m	cm²
3.0	12.0	0.283	0.36
3.0	16.0	0.377	0.48
3.0	19.0	0.447	0.57
3.0	25.0	0.589	0.75
3.0	32.0	0.754	0.96
3.0	38.0	0.895	1.14
3.0	50.0	1.178	1.50
3.0	65.0	1.530	1.95
3.0	75.0	1.770	2.25
3.0	100.0	2.360	3.00
4.5	12.0	0.424	0.54
4.5	16.0	0.565	0.72
4.5	19.0	0.671	0.85
4.5	25.0	0.883	1.13
4.5	32.0	1.134	1.44
4.5	35.0	1.240	1.58
4.5	38.0	1.342	1.71
4.5	44.0	1.554	1.98
4.5	50.0	1766	2.25
4.5	65.0	2.296	2.93
4.5	75.0	2.649	3.38
4.5	100.0	3.553	4.50
5.0	25.0	0.981	1.25
5.0	50.0	1.963	2.50
6.0	12.0	0.565	0.72
6.0	16.0	0.754	0.96
6.0	19.0	0.895	1.14
6.0	25.0	1.178	1.50
6.0	32.0	1.507	1.92
6.0	35.0	1.650	2.10
6.0	38.0	1.790	2.28
6.0	40.0	1.880	2.40
6.0	44.0	2.072	2.64
6.0	50.0	2.355	3.00
6.0	65.0	3.062	3.90
6.0	75.0	3.533	4.50
6.0	90.0	4.239	5.40
6.0	100.0	4.710	6.00
6.0	125.0	5.888	7.50
6.0	150.0	7.065	9.00
6.0	175.0	8.240	10.50
6.0	200.0	9.420	12.00
6.0	250.0	11.775	15.00
6.0	300.0	14.130	18.00
8.0	25.0	1.570	2.00
8.0	32.0	2.010	2.56
8.0	38.0	2.390	3.04
8.0	44.0	2.760	3.52
8.0	50.0	3.140	4.00
8.0	65.0	4.080	5.20
8.0	75.0	4.710	6.00
8.0	90.0	5.650	7.20
8.0	100.0	6.280	8.00
8.0	125.0	7.850	10.00
8.0	150.0	9.420	12.00
8.0	200.0	12.560	16.00

Section Size		Unit Weight	Section Area
Thickness	Width	M	A
mm	mm	kg / m	cm²
9.0	19.0	1.342	1.71
9.0	25.0	1.766	2.25
9.0	32.0	2.261	2.88
9.0	35.0	2.473	3.15
9.0	38.0	2.685	3.42
9.0	44.0	3.109	3.96
9.0	50.0	3.533	4.50
9.0	65.0	4.592	5.85
9.0	75.0	5.299	6.75
9.0	90.0	6.359	8.10
9.0	100.0	7.065	9.00
9.0	125.0	8.831	11.25
9.0	150.0	10.590	13.50
9.0	180.0	12.717	16.20
9.0	200.0	14.130	18.00
9.0	230.0	16.250	20.70
9.0	250.0	17.663	22.50
9.0	300.0	21.195	27.00
12.0	25.0	2.355	3.00
12.0	32.0	3.014	3.84
12.0	35.0	3.297	4.20
12.0	38.0	3.580	4.56
12.0	40.0	3.770	4.80
12.0	44.0	4.145	5.28
12.0	50.0	4.710	6.00
12.0	65.0	6.123	7.80
12.0	75.0	7.065	9.00
12.0	90.0	8.478	10.80
12.0	100.0	9.420	12.00
12.0	125.0	11.775	15.00
12.0	150.0	14.130	18.00
12.0	180.0	16.956	21.60
12.0	200.0	18.840	24.00
12.0	230.0	21.666	27.60
12.0	250.0	23.550	30.00
12.0	280.0	26.576	33.60
12.0	300.0	28.260	36.00
16.0	25.0	3.140	4.00
16.0	32.0	4.192	5.12
16.0	38.0	4.773	6.08
16.0	44.0	5.526	7.04
16.0	50.0	6.280	8.00
16.0	65.0	8.164	10.40
16.0	75.0	9.420	12.00
16.0	90.0	11.304	14.40
16.0	100.0	12.560	16.00
16.0	125.0	15.700	20.00
16.0	150.0	18.840	24.00
16.0	180.0	22.608	28.00
16.0	200.0	25.120	32.00
16.0	230.0	28.888	36.80
16.0	250.0	31.400	50.00
16.0	280.0	35.168	44.80
16.0	300.0	37.680	48.00
18.0	50.0	7.065	9.00
18.0	75.0	10.590	13.50

Section Size		Unit Weight	Section Area
Thickness	Width	M	A
mm	mm	kg / m	cm²
18.0	100.0	14.130	18.00
18.0	125.0	18.663	22.50
18.0	150.0	21.195	27.00
18.0	200.0	28.260	36.00
18.0	225.0	31.793	40.50
18.0	250.0	35.325	45.00
18.0	275.0	38.850	49.50
18.0	300.0	42.390	54.00
19.0	38.0	5.668	7.22
19.0	44.0	6.563	8.36
19.0	50.0	7.458	9.50
19.0	65.0	9.695	12.35
19.0	75.0	11.186	14.25
19.0	90.0	13.424	17.10
19.0	100.0	14.915	19.00
19.0	125.0	18.644	23.75
19.0	150.0	22.373	28.50
19.0	180.0	26.847	34.20
19.0	200.0	29.830	38.00
19.0	230.0	34.305	43.70
19.0	250.0	37.288	47.50
19.0	280.0	41.762	53.20
19.0	300.0	44.745	57.00
22.0	50.0	8.635	11.00
22.0	65.0	11.226	14.30
22.0	75.0	12.953	16.50
22.0	90.0	15.543	19.80
22.0	100.0	17.270	22.00
22.0	125.0	21.588	27.50
22.0	150.0	25.905	33.00
22.0	180.0	31.086	39.60
22.0	200.0	34.540	44.00
22.0	230.0	39.721	50.60
22.0	250.0	43.175	55.00
22.0	280.0	48.356	61.00
22.0	300.0	51.810	66.00
25.0	50.0	9.813	12.50
25.0	65.0	12.756	16.25
25.0	75.0	14.719	18.75
25.0	90.0	17.663	22.50
25.0	100.0	19.625	25.00
25.0	125.0	24.531	31.25
25.0	150.0	29.438	37.50
25.0	180.0	35.325	45.00
25.0	200.0	39.250	50.00
25.0	230.0	45.138	57.50
25.0	250.0	49.063	62.50
25.0	280.0	54.950	70.00
25.0	300.0	58.875	75.00
32.0	100.0	25.120	32.00
32.0	125.0	31.400	40.00
32.0	150.0	37.680	48.00
32.0	180.0	45.220	57.60
32.0	200.0	50.240	64.00
32.0	280.0	70.340	89.60
32.0	300.0	75.360	96.00

Note : Calculated based on 1kg= 2.2046 lb and 1m=3.2808 feet

Dimensions and Properties

Square Bars For General Structural Purpose

Section Size	Calculated Weight M		Side Length L		Section Area A		Moment Of Inertial	Radius Of Gyration	Modulus Of Section
mm	kg / m	lb / ft	mm	in	cm^2	in^2	in^4	in	in^3
9	0.636	0.427	9	0.354	0.81	0.1256	-	-	-
10	0.785	0.527	10	0.393	1.00	0.1550	-	-	-
12	1.130	0.759	12	0.470	1.44	0.2232	-	-	-
16	2.010	1.351	16	0.630	2.56	0.3968	0.0132	0.181	0.0415
18	2.543	1.709	18	0.709	3.24	0.5022	0.0209	0.205	0.0592
19	2.834	1.904	19	0.748	3.61	0.5596	0.0262	0.217	0.0696
20	3.140	2.110	20	0.787	4.00	0.6200	-	-	-
22	3.800	2.553	22	0.866	4.84	0.7502	0.0468	0.252	0.108
25	4.906	3.297	25	0.984	6.25	0.9688	0.0783	0.283	0.159
28	6.154	4.135	28	1.102	7.84	1.215	0.1230	0.319	0.223
30	7.065	4.747	30	1.181	9.00	1.395	0.1620	0.343	0.275
32	8.038	5.401	32	1.260	10.24	1.587	0.2100	0.362	0.333
35	9.616	6.462	35	1.378	12.25	1.899	0.3000	0.398	0.436
36	10.174	6.837	36	1.417	12.96	2.009	0.3360	0.409	0.475
38	11.335	7.617	38	1.496	14.44	2.238	0.4180	0.433	0.558
44	15.198	10.213	44	1.732	19.36	3.001	-	-	-
50	19.625	13.187	50	1.969	25.00	3.875	1.252	0.567	1.269
55	23.746	15.957	55	2.165	30.25	4.689	1.833	0.626	1.690
60	28.260	18.990	60	2.362	36.00	5.580	2.595	0.681	2.197
65	33.166	22.287	65	2.559	42.25	6.549	3.580	0.740	2.795
70	38.465	25.847	70	2.756	49.00	7.595	4.805	0.795	3.491
75	44.156	29.672	75	2.953	56.25	8.719	6.342	0.854	4.290
80	50.240	33.760	80	3.150	64.00	9.920	8.192	0.909	5.205
85	56.716	38.111	85	3.346	72.25	11.20	10.450	0.965	6.224
90	63.585	42.727	90	3.543	81.00	12.56	13.141	1.024	7.384
95	70.846	47.606	95	3.740	90.25	13.99	16.312	1.079	8.726
100	78.500	52.750	100	3.937	100.0	15.50	20.012	1.138	10.191
110	94.985	63.827	110	4.331	121.0	18.76	29.309	1.252	13.547
120	113.040	75.960	120	4.724	144.0	22.32	41.562	1.362	17.575
130	132.165	88.811	130	5.118	169.0	26.20	57.177	1.476	22.334
140	154.860	104.061	140	5.512	196.0	30.38	76.877	1.591	27.888
150	176.625	118.687	150	5.906	225.0	34.88	101.381	1.705	34.295
160	200.960	135.039	160	6.229	256.0	39.68	131.195	1.819	41.295

Deformed Bars For General Structural Purpose

Section Size mm	Calculated Weight (M) kg / m	Cross Sectional Area (A) cm^2
9	0.499	0.6363
10	0.617	0.7855
12	0.888	1.131
13	1.042	1.327
14	1.208	1.540
16	1.578	2.011
18	1.998	2.545
19	2.226	2.836
20	2.466	3.142
22	2.984	3.802
24	3.551	4.524
25	3.853	4.909
26	4.168	5.310
28	4.833	6.158
29	5.185	6.606
30	5.549	7.070
32	6.313	8.044
35	7.552	9.622
38	8.902	11.34
40	9.860	12.57

Note : Calculated based on 1kg= 2.2046 lb and 1m=3.2808 feet

Dimensions and Properties

Rounds Bars For General Structural Purpose

Size	Diameter		Calculated Weight (M)			Section Area (A)		Moment Of Inertial (I)	Radius Of Gyration (i)	Modulus Of Section (s)
	mm	in	kg / m	kg / ft	lb / ft	cm^2	in^2	in^4	in	in^3
6	6	0.236	0.222	0.0677	0.1492	0.2828	0.0437	0.0002	0.0591	0.0012
7	7	0.276	0.302	0.0921	0.2029	0.3849	0.0598	0.0002	0.0709	0.0018
8	8	0.315	0.395	0.1204	0.2654	0.5027	0.0779	0.0005	0.0787	0.0031
9	9	0.354	0.499	0.1521	0.3353	0.6363	0.0984	0.0007	0.0906	0.0043
10	10	0.394	0.617	0.1881	0.4146	0.7855	0.1219	0.0012	0.0984	0.0061
11	11	0.433	0.746	0.2274	0.5013	0.9505	0.1473	0.0017	0.110	0.0079
12	12	0.472	0.888	0.2707	0.5967	1.131	0.1750	0.0024	0.118	0.0104
13	13	0.512	1.042	0.3176	0.7002	1.327	0.2059	0.0034	0.130	0.0134
14	14	0.551	1.208	0.3682	0.8117	1.540	0.2385	0.0046	0.138	0.0165
15	15	0.591	1.387	0.4228	0.9320	1.767	0.2744	0.0060	0.150	0.0201
16	16	0.630	1.578	0.4810	1.060	2.011	0.3118	0.0077	0.157	0.0244
17	17	0.669	1.782	0.5432	1.197	2.270	0.3516	0.0099	0.169	0.0293
18	18	0.709	1.998	0.6090	1.343	2.545	0.3949	0.0125	0.177	0.0348
19	19	0.748	2.226	0.6785	1.496	2.836	0.4395	0.0154	0.189	0.0409
20	20	0.787	2.466	0.7516	1.657	3.142	0.4865	0.0190	0.197	0.0482
21	21	0.827	2.719	0.8288	1.827	3.464	0.5372	0.0228	0.209	0.0555
22	22	0.866	2.984	0.9095	2.005	3.802	0.5891	0.0276	0.217	0.0641
23	23	0.906	3.261	0.9940	2.191	4.155	0.6448	0.0329	0.228	0.0726
24	24	0.945	3.551	1.082	2.386	4.524	0.7015	0.0392	0.236	0.0830
25	25	0.984	3.853	1.174	2.589	4.909	0.7606	0.0461	0.248	0.0934
26	26	1.024	4.168	1.270	2.801	5.310	0.8237	0.0538	0.256	0.106
27	27	1.063	4.494	1.370	3.020	5.726	0.8876	0.0627	0.268	0.118
28	28	1.102	4.833	1.473	3.248	6.158	0.9539	0.0726	0.276	0.132
29	29	1.142	5.185	1.580	3.484	6.606	1.024	0.0834	0.287	0.146
30	30	1.181	5.549	1.691	3.729	7.070	1.096	0.0956	0.295	0.162
31	31	1.220	5.925	1.806	3.981	7.549	1.169	0.109	0.307	0.179
32	32	1.260	6.313	1.924	4.242	8.044	1.247	0.124	0.315	0.196
34	34	1.339	7.127	2.172	4.789	9.080	1.408	0.158	0.335	0.236
35	35	1.378	7.552	2.302	5.075	9.622	1.492	0.177	0.346	0.257
36	36	1.417	7.990	2.435	5.369	10.18	1.577	0.198	0.354	0.279
38	38	1.496	8.902	2.713	5.982	11.34	1.758	0.245	0.374	0.329
40	40	1.575	9.864	3.007	6.628	12.57	1.949	0.303	0.394	0.383
42	42	1.654	10.875	3.315	7.308	13.86	2.149	0.368	0.413	0.444
44	44	1.732	11.936	3.638	8.021	15.21	2.356	0.442	0.433	0.510
46	46	1.811	13.045	3.976	8.766	16.62	2.576	0.529	0.453	0.583
48	48	1.890	14.204	4.329	9.545	18.10	2.806	0.627	0.472	0.665
50	50	1.969	15.413	4.698	10.357	19.64	3.045	0.738	0.492	0.751
55	55	2.165	18.650	5.685	12.532	23.76	3.682	1.079	0.543	0.995
60	60	2.362	22.195	6.765	14.914	28.28	4.382	1.528	0.591	1.294
65	65	2.559	26.048	7.940	17.503	33.19	5.144	2.105	0.642	1.648
70	70	2.756	30.209	9.208	20.300	38.49	5.966	2.835	0.689	2.056
75	75	2.953	34.679	10.570	23.303	44.18	6.850	3.724	0.740	2.526
80	80	3.150	39.457	12.027	26.514	50.27	7.794	4.829	0.787	3.069
85	85	3.346	44.543	13.577	29.932	56.75	8.794	6.150	0.839	3.680
90	90	3.543	49.938	15.221	33.557	63.63	9.860	7.736	0.886	4.369
95	95	3.740	55.640	16.959	37.388	70.89	10.99	9.610	0.937	5.138
100	100	3.937	61.651	18.791	41.428	78.55	12.18	11.795	0.984	5.992
105	105	4.134	67.971	20.718	45.674	86.60	13.42	14.342	1.035	6.957
110	110	4.331	74.598	22.738	50.128	95.05	14.73	17.273	1.083	7.994
115	115	4.528	81.534	24.852	54.788	103.9	16.10	20.637	1.134	9.092
120	120	4.724	88.778	27.060	59.656	113.11	17.53	24.504	1.181	10.374
125	125	4.921	96.330	29.362	64.731	122.73	19.02	28.829	1.232	11.716
130	130	5.118	104.191	31.758	70.013	132.75	20.58	33.634	1.280	13.181
135	135	5.315	112.360	34.248	75.503	143.16	22.19	39.159	1.331	14.768
140	140	5.512	120.837	36.832	81.199	153.96	23.87	45.405	1.378	16.415
145	145	5.709	129.622	39.509	87.102	165.2	25.60	52.132	1.429	18.246
150	150	5.906	138.716	42.281	93.213	176.7	27.40	59.820	1.476	20.199
160	160	6.299	157.828	48.107	106.056	201.1	31.17	77.357	1.575	24.531
170	170	6.693	178.173	54.308	119.727	227.0	35.19	98.498	1.673	29.431
180	180	7.087	199.751	60.885	134.227	254.5	39.45	123.72	1.772	34.966
190	190	7.480	222.562	67.838	149.555	283.6	43.95	153.75	1.870	41.068
200	200	7.874	246.606	75.166	165.712	314.2	48.70	188.59	1.969	47.903

Note : Calculated based on 1kg= 2.2046 lb and 1m=3.2808 feet