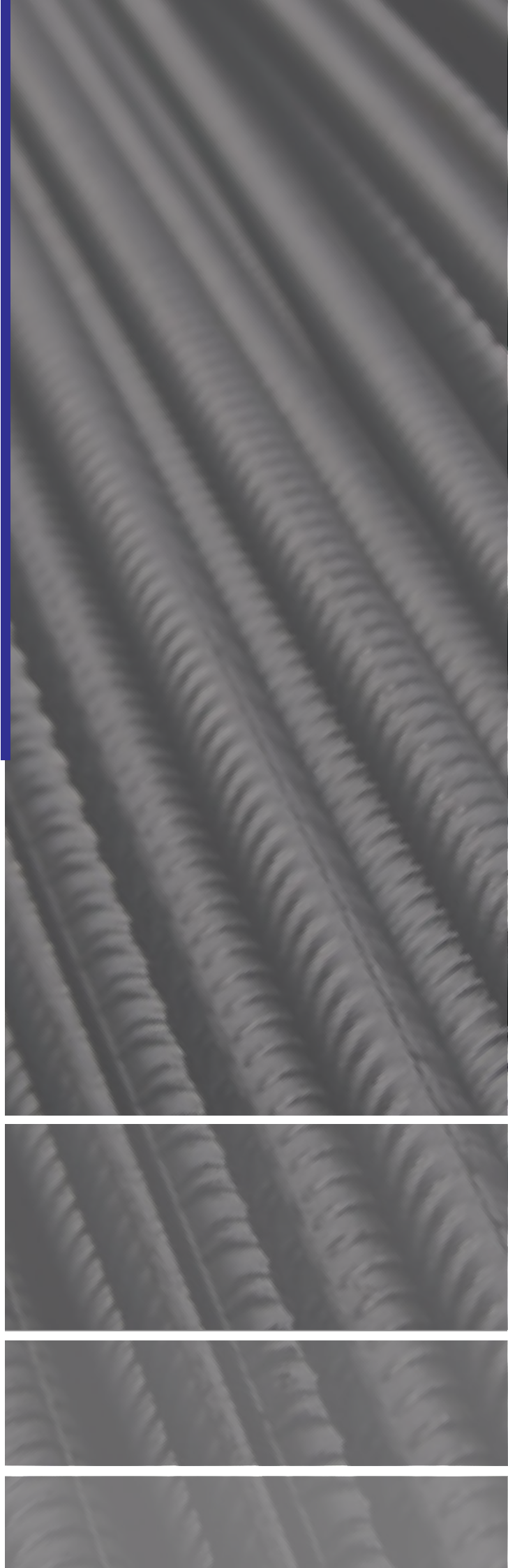


STEEL BARS



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 (Bars)	Grade 250	0.25	0.06	0.06	0.012	0.42
	Grade 460		0.05	0.05	0.012	0.51
	Grade 500	0.30	0.05	0.05	0.012	0.51
BS 4449:1997 (Hot Rolled Steel Bars)	Grade 250	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	0.25	0.05	0.05	0.012	0.51

Mechanical Properties

Standard	Grade	Mechanical Properties			
		Yield Strength - N/mm ² (Min)	Tensile Strength - N/mm ² (Min)	Min. Elongation 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) =180° Rebend (2d) =1st bend 180°
	Grade 460 (Deformed Bars)	460	Actual YS x 1.05	12% (L=5d)	Bend Angle (3d) =180° Rebend (5d) =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 Square Bar

Type	Specification	Chemical Composition (Ladle Analysis)			Tensile Properties						Bend Test
		C%	P%	S%	Yield Stress N/mm ² (min)		Yield Strength (N/mm ²)	Elongation			
					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 (mm ²)	63.6	78.5	113.1	2.011	314.2	380.1	490.9	615.8	804.2	1256.6
Cross-Sectional Area (cm ²)	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	Section Size		Unit Weight	Section Area	Section Size		Unit Weight	Section Area
Thickness	Width	M	A	Thickness	Width	M	A	Thickness	Width	M	A
mm	mm	kg / m	cm ²	mm	mm	kg / m	cm ²	mm	mm	kg / m	cm ²
3.0	12.0	0.283	0.36	9.0	19.0	1.342	1.71	18.0	100.0	14.130	18.00
3.0	16.0	0.377	0.48	9.0	25.0	1.766	2.25	18.0	125.0	18.663	22.50
3.0	19.0	0.447	0.57	9.0	32.0	2.261	2.88	18.0	150.0	21.195	27.00
3.0	25.0	0.589	0.75	9.0	35.0	2.473	3.15	18.0	200.0	28.260	36.00
3.0	32.0	0.754	0.96	9.0	38.0	2.685	3.42	18.0	225.0	31.793	40.50
3.0	38.0	0.895	1.14	9.0	44.0	3.109	3.96	18.0	250.0	35.325	45.00
3.0	50.0	1.178	1.50	9.0	50.0	3.533	4.50	18.0	275.0	38.850	49.50
3.0	65.0	1.530	1.95	9.0	65.0	4.592	5.85	18.0	300.0	42.390	54.00
3.0	75.0	1.770	2.25	9.0	75.0	5.299	6.75	19.0	38.0	5.668	7.22
3.0	100.0	2.360	3.00	9.0	90.0	6.359	8.10	19.0	44.0	6.563	8.36
4.5	12.0	0.424	0.54	9.0	100.0	7.065	9.00	19.0	50.0	7.458	9.50
4.5	16.0	0.565	0.72	9.0	125.0	8.831	11.25	19.0	65.0	9.695	12.35
4.5	19.0	0.671	0.85	9.0	150.0	10.590	13.50	19.0	75.0	11.186	14.25
4.5	25.0	0.883	1.13	9.0	180.0	12.717	16.20	19.0	90.0	13.424	17.10
4.5	32.0	1.134	1.44	9.0	200.0	14.130	18.00	19.0	100.0	14.915	19.00
4.5	35.0	1.240	1.58	9.0	230.0	16.250	20.70	19.0	125.0	18.644	23.75
4.5	38.0	1.342	1.71	9.0	250.0	17.663	22.50	19.0	150.0	22.373	28.50
4.5	44.0	1.554	1.98	9.0	300.0	21.195	27.00	19.0	180.0	26.847	34.20
4.5	50.0	1.766	2.25	12.0	25.0	2.355	3.00	19.0	200.0	29.830	38.00
4.5	65.0	2.296	2.93	12.0	32.0	3.014	3.84	19.0	230.0	34.305	43.70
4.5	75.0	2.649	3.38	12.0	35.0	3.297	4.20	19.0	250.0	37.288	47.50
4.5	100.0	3.553	4.50	12.0	38.0	3.580	4.56	19.0	280.0	41.762	53.20
5.0	25.0	0.981	1.25	12.0	40.0	3.770	4.80	19.0	300.0	44.745	57.00
5.0	50.0	1.963	2.50	12.0	44.0	4.145	5.28	22.0	50.0	8.635	11.00
6.0	12.0	0.565	0.72	12.0	50.0	4.710	6.00	22.0	65.0	11.226	14.30
6.0	16.0	0.754	0.96	12.0	65.0	6.123	7.80	22.0	75.0	12.953	16.50
6.0	19.0	0.895	1.14	12.0	75.0	7.065	9.00	22.0	90.0	15.543	19.80
6.0	25.0	1.178	1.50	12.0	90.0	8.478	10.80	22.0	100.0	17.270	22.00
6.0	32.0	1.507	1.92	12.0	100.0	9.420	12.00	22.0	125.0	21.588	27.50
6.0	35.0	1.650	2.10	12.0	125.0	11.775	15.00	22.0	150.0	25.905	33.00
6.0	38.0	1.790	2.28	12.0	150.0	14.130	18.00	22.0	180.0	31.086	39.60
6.0	40.0	1.880	2.40	12.0	180.0	16.956	21.60	22.0	200.0	34.540	44.00
6.0	44.0	2.072	2.64	12.0	200.0	18.840	24.00	22.0	230.0	39.721	50.60
6.0	50.0	2.355	3.00	12.0	230.0	21.666	27.60	22.0	250.0	43.175	55.00
6.0	65.0	3.062	3.90	12.0	250.0	23.550	30.00	22.0	280.0	48.356	61.00
6.0	75.0	3.533	4.50	12.0	280.0	26.576	33.60	22.0	300.0	51.810	66.00
6.0	90.0	4.239	5.40	12.0	300.0	28.260	36.00	25.0	50.0	9.813	12.50
6.0	100.0	4.710	6.00	16.0	25.0	3.140	4.00	25.0	65.0	12.756	16.25
6.0	125.0	5.888	7.50	16.0	32.0	4.192	5.12	25.0	75.0	14.719	18.75
6.0	150.0	7.065	9.00	16.0	38.0	4.773	6.08	25.0	90.0	17.663	22.50
6.0	175.0	8.240	10.50	16.0	44.0	5.526	7.04	25.0	100.0	19.625	25.00
6.0	200.0	9.420	12.00	16.0	50.0	6.280	8.00	25.0	125.0	24.531	31.25
6.0	250.0	11.775	15.00	16.0	65.0	8.164	10.40	25.0	150.0	29.438	37.50
6.0	300.0	14.130	18.00	16.0	75.0	9.420	12.00	25.0	180.0	35.325	45.00
8.0	25.0	1.570	2.00	16.0	90.0	11.304	14.40	25.0	200.0	39.250	50.00
8.0	32.0	2.010	2.56	16.0	100.0	12.560	16.00	25.0	230.0	45.138	57.50
8.0	38.0	2.390	3.04	16.0	125.0	15.700	20.00	25.0	250.0	49.063	62.50
8.0	44.0	2.760	3.52	16.0	150.0	18.840	24.00	25.0	280.0	54.950	70.00
8.0	50.0	3.140	4.00	16.0	180.0	22.608	28.00	25.0	300.0	58.875	75.00
8.0	65.0	4.080	5.20	16.0	200.0	25.120	32.00	32.0	100.0	25.120	32.00
8.0	75.0	4.710	6.00	16.0	230.0	28.888	36.80	32.0	125.0	31.400	40.00
8.0	90.0	5.650	7.20	16.0	250.0	31.400	50.00	32.0	150.0	37.680	48.00
8.0	100.0	6.280	8.00	16.0	280.0	35.168	44.80	32.0	180.0	45.220	57.60
8.0	125.0	7.850	10.00	16.0	300.0	37.680	48.00	32.0	200.0	50.240	64.00
8.0	150.0	9.420	12.00	18.0	50.0	7.065	9.00	32.0	280.0	70.340	89.60
8.0	200.0	12.560	16.00	18.0	75.0	10.590	13.50	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 in ⁴	Radius Of Gyration in	Modulus Of Section in ³
	kg / m	lb / ft		in	cm ²	in ²			
	0.636	0.427		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) mm ²
	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



			()			(A)		(l)	(i)	(s)
			kg / m							
				0.0677						
				0.0921						
				0.1204						
				0.1521						
				0.1881						
				0.2274	0.5013		0.1473	0.0017		0.0079
				0.2707	0.5967		0.1750	0.0024		0.0104
				0.3176	0.7002		0.2059	0.0034		0.0134
				0.3682	0.8117		0.2385	0.0046		0.0165
				0.4228	0.9320		0.2744	0.0060		0.0201
								0.0077		0.0244
								0.0099		0.0293
								0.0125		0.0348
								0.0154		0.0409
								0.0190		0.0482
							0.5372			
							0.5891			
							0.6448			
							0.7015			
							0.7606			
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
			14.204		9.545					
			15.413		10.357					
			18.650		12.532					
			22.195		14.914					
			26.048		17.503					
				9.208						
				10.570						
				12.027						
				13.577						
				15.221						
					37.388			9.610		
					41.428			11.795		
					45.674			14.342		
					50.128			17.273		
					54.788			20.637		
						113.11				10.374
						122.73				11.716
						132.75				13.181
						143.16				14.768
						153.96				16.415
								52.132		
								59.820		
								77.357		
								98.498		
								123.72		
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