

Chapter 10
Miscellaneous Field Data

SPECIFIC WEIGHTS AND GRAVITIES

Table 10-1. Specific weights and gravities

SUBSTANCE	WEIGHT LB PER CU FT	SPECIFIC GRAVITY	SUBSTANCE	WEIGHT LB PER CU FT	SPECIFIC GRAVITY
Aluminum, cast, hammered	165	2.55-2.75	Hay and straw (bales)	20	0.70-1.15
Copper, cast rolled	556	8.8-9.0	Paper	58	
Iron, cast, pig	450	7.2	Stone, quarried, piles		
Lead	710	11.37	Basalt, granite, gneiss	96	
Magnesium alloys	112	1.74-1.83	Greenstone, hornblende	107	
Steel, rolled	490	7.85	Limestone, marble, quartz	90	
Limestone, marble	165	2.5-2.8	Sandstone	82	
Sandstone, bluestone	147	2.2-2.5	Shale	92	
Riprap, limestone	80-85		Excavations in water		
Riprap, sandstone	90		Clay	80	
Riprap, shale	105		River mud	90	
Glass, common	156	2.4-2.6	Sand or gravel	60	

Table 10-1. Specific weights and gravities (continued)

SUBSTANCE	WEIGHT LB PER CU FT	SPECIFIC GRAVITY	SUBSTANCE	WEIGHT LB PER CU FT	SPECIFIC GRAVITY
Excavations in water (continued)			Sand gravel, dry, packed	100-120	
Sand or gravel and clay	65		Sand gravel, wet	118-120	
Soil or gravel and clay	70		Water, 4° C (max density)	62.428	1.0
Stone riprap	65		Water, ice	56	0.88-0.92
Timber, US, seasoned (moisture content by weight 15-50%)			Masonry, ashlar		
Soft wood	25	40	Granite, syenite, gneiss	165	2.3-3.0
Medium wood	40	63	Limestone, marble	160	2.3-2.8
Hard wood	55	87	Sandstone, bluestone	140	2.1-2.4
Asphaltum	81	1.1-1.5	Masonry, brick		
Petroleum, gasoline, and diesel	42	0.66-0.69	Pressed brick	140	2.2-2.3
Tar, bituminous	75	1.20	Common brick	120	1.8-2.0
Cement, portland, loose	94		Soft brick	100	1.5-1.7
Cement, portland, set	183	2.7-3.2	Masonry, concrete		
Clay, damp, plastic	110		Cement, stone, sand	144	2.2-2.4
Clay, dry	63		Masonry, dry rubble		
Earth, dry, loose	76		Granite, syenite, gneiss	130	1.9-2.3
Earth, dry, packed	96		Limestone, marble	125	1.9-2.1
Earth, moist, loose	78		Sandstone, bluestone	110	1.8-1.9
Earth, moist, packed	96		Masonry, mortar, rubble		
Sand gravel, dry, loose	90-105		Granite, syenite, gneiss	155	2.2-2.8
			Limestone, marble	150	2.2-2.6
			Sandstone, bluestone	130	2.0-2.2

CONSTRUCTION MATERIAL

Electrical Wire

Convert load to amperes required by using formula:

$$\text{amperes} = \frac{\text{total wattage required}}{\text{voltage}} = \frac{\text{voltage}}{\text{resistance (ohms)}} = \frac{745.7 \times \text{horsepower}}{\text{voltage}}$$

Enter Table 10-2 or 10-3 using computed amperes and distance to load to obtain wire size. This procedure is used when power is to be furnished to a specific load such as a motor or a group of lights (See FM 20-31 for more details.)

Table 10-2. Wire sizes for 110-volt single-phase circuits

FOR 110V CIRCUIT DISTANCE TO LOAD IN FEET										
LOAD IN AMPS	50	75	100	125	150	200	250	300	400	500
15	$\frac{10}{12}$	$\frac{8}{10}$	$\frac{8}{10}$	$\frac{6}{8}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$
20	$\frac{10}{12}$	$\frac{8}{10}$	$\frac{6}{8}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$
25	$\frac{8}{10}$	$\frac{6}{8}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$
30	$\frac{6}{10}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$
40	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$

FOR 110V CIRCUIT DISTANCE TO LOAD IN FEET										
LOAD IN AMPS	50	75	100	125	150	200	250	300	400	500
50	$\frac{4}{8}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{300}{3/0}$
60	$\frac{4}{6}$	$\frac{2}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{350}{4/0}$
70	$\frac{4}{6}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{2}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{2/0}$	$\frac{300}{4/0}$	$\frac{400}{250}$
80	$\frac{4}{6}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{350}{4/0}$	$\frac{500}{250}$
90	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{1}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{300}{3/0}$	$\frac{400}{250}$	$\frac{500}{300}$
100	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{300}{3/0}$	$\frac{350}{4/0}$	$\frac{500}{250}$	$\frac{600}{350}$

10—ALUMINUM WIRE

12—COPPER WIRE

Table 10-3. Wire sizes for 220-volt three-phase circuits

FOR 220V CIRCUIT DISTANCE TO LOAD IN FEET										
LOAD IN AMPS	100	200	300	400	500	600	700	800	900	1,000
15	$\frac{12}{12}$	$\frac{8}{10}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{1}{3}$
20	$\frac{10}{12}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{0}{2}$
25	$\frac{8}{10}$	$\frac{6}{8}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{2/0}{1}$
30	$\frac{6}{10}$	$\frac{4}{6}$	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{3/0}{0}$
40	$\frac{4}{8}$	$\frac{4}{6}$	$\frac{2}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{4/0}{2/0}$

10—ALUMINUM WIRE
12—COPPER WIRE

FOR 220V CIRCUIT DISTANCE TO LOAD IN FEET										
LOAD IN AMPS	100	200	300	400	500	600	700	800	900	1,000
50	$\frac{4}{8}$	$\frac{3}{4}$	$\frac{1}{3}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{300}{3/0}$
60	$\frac{4}{6}$	$\frac{2}{4}$	$\frac{0}{2}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{2/0}$	$\frac{250}{3/0}$	$\frac{300}{4/0}$	$\frac{350}{4/0}$
70	$\frac{4}{6}$	$\frac{1}{3}$	$\frac{2/0}{2}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{2/0}$	$\frac{300}{3/0}$	$\frac{300}{4/0}$	$\frac{350}{4/0}$	$\frac{400}{250}$
80	$\frac{4}{6}$	$\frac{1}{3}$	$\frac{2/0}{1}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{300}{4/0}$	$\frac{350}{4/0}$	$\frac{400}{250}$	$\frac{500}{250}$
90	$\frac{2}{4}$	$\frac{0}{2}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{250}{3/0}$	$\frac{300}{4/0}$	$\frac{350}{4/0}$	$\frac{400}{250}$	$\frac{500}{300}$	$\frac{500}{300}$
100	$\frac{2}{4}$	$\frac{0}{2}$	$\frac{3/0}{0}$	$\frac{4/0}{2/0}$	$\frac{300}{3/0}$	$\frac{350}{4/0}$	$\frac{400}{250}$	$\frac{500}{250}$	$\frac{500}{300}$	$\frac{600}{350}$

Lumber Data

Table 10-4. Properties of southern pine

NOMINAL SIZE	ACTUAL SIZE DRESSED	AREA OF SECTION IN SQ IN	WEIGHT PER FOOT (LB)
2 x 4	1 3/8 x 3 3/8	5.89	1.63
4 x 4	3 3/8 x 3 3/8	13.14	3.64
2 x 6	1 3/8 x 5 3/8	9.14	2.53
6 x 6	5 3/8 x 5 3/8	31.64	8.76
2 x 8	1 5/8 x 7 1/2	12.19	3.38
4 x 8	3 3/8 x 7 1/2	27.19	7.55
6 x 8	5 3/8 x 7 1/2	42.19	11.72
8 x 8	7 1/2 x 7 1/2	56.25	15.58
2 x 10	1 3/8 x 9 1/2	15.44	4.28
6 x 10	5 3/8 x 9 1/2	53.44	14.84
10 x 10	9 1/2 x 9 1/2	90.25	25.00
2 x 12	1 3/8 x 11 1/2	18.69	5.18
3 x 12	2 3/8 x 11 1/2	30.19	8.39
6 x 12	5 3/8 x 11 1/2	64.69	17.96
8 x 12	7 1/2 x 11 1/2	86.25	23.89
10 x 12	9 1/2 x 11 1/2	109.25	30.26
2 x 14	1 3/8 x 13 1/2	21.94	6.09
3 x 14	2 3/8 x 13 1/2	35.44	9.84
6 x 14	5 3/8 x 13 1/2	75.94	21.09
10 x 14	9 1/2 x 13 1/2	128.25	35.53
14 x 14	13 1/2 x 13 1/2	182.25	50.48
2 x 16	1 5/8 x 15 1/2	25.19	7.00
3 x 16	2 5/8 x 15 1/2	40.69	11.30
8 x 16	7 1/2 x 15 1/2	116.25	32.20
12 x 16	11 1/2 x 15 1/2	178.25	49.37
14 x 16	13 1/2 x 15 1/2	209.25	57.96
16 x 16	15 1/2 x 15 1/2	240.25	66.55
4 x 18	3 3/8 x 17 1/2	63.44	17.62
8 x 18	7 1/2 x 17 1/2	131.25	36.36
12 x 18	11 1/2 x 17 1/2	201.25	55.75

NOTE: In some species 5 1/2" is the dressed size for nominal 6" x 6" and larger.

Fasteners

Table 10-5. Wood screw diameters

SIZE	DIAMETER-D INCHES	D' INCHES ¹
1/2 inch—No. 4	1105	0122
3/4 inch—No. 8	1631	0266
1 inch—No. 10	1894	0359
1 1/2 inch—No. 12	2158	0466
2 inch—No. 14	2421	0586
2 1/2 inch—No. 16	2684	0720
3 inch—No. 18	2947	0868

Table 10-6. Nail and spike sizes

SIZE	LENGTH IN	COMMON				FINISHING		FLOORING	
		DIAMETER (D)				GAGE	NO /LB	GAGE	NO /LB
		GAGE	NO /LB	INCHES	D3/2				
3D	1 1/4	14	568	.0800	0226	15 1/2	807		
4D	1 1/2	12 1/2	316	.0985	0309	15	584		
6D	2	11 1/2	181	.1130	0380	13	309	11	157
8D	2 1/2	10 1/4	106	.1314	0476	12 1/2	189	10	99
10D	3	9	69	.1483	0570	11 1/2	121	9	69
12D	3 1/4	9	63	.1552	0611	11 1/2	113	8	54
16D	3 1/2	8	49	.1620	0652	11	90	7	43
20D	4	6	31	.1920	0841	10	61	6	31
30D	4 1/2	5	24	.2070	0942				
40D	5	4	18	.2253	1066				
60D	6	2	11	.2625	1347				
SPIKES						NOTE: To avoid splitting, nail diameters should not exceed one-seventh of the thickness of lumber to be nailed.			
7"	7"	5/16"		5/16"	1750				
8"	8"	3/8"		3/8"	2295				
9"	9"	3/8"		3/8"	2295				
10"	10"	3/8"		3/8"	2295				
12"	12"	3/8"		3/8"	2295				

Formula to find approximate number of nails required.
 Number of pounds (12D to 60D, framing) = D/6 x BF/100
 Number of pounds (2D to 12D, sheathing) = D/4 x BF/100
 Where D = size of desired nail in pennies
 BF = total board feet to be nailed

SOIL CONVERSION

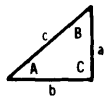
Table 10-7 Soil conversion factors

SOIL TYPE	INITIAL SOIL CONDITION	CONVERTED TO:		
		IN PLACE	LOOSE	COMPACTED
Sand	In Place		1.11	95
	Loose	90		86
	Compacted	1.05	1.17	
Loam	In Place		1.25	90
	Loose	80		72
	Compacted	1.11	1.39	
Clay	In Place		1.43	90
	Loose	70		63
	Compacted	1.11	1.59	
Rock (blasted)	In Place		1.50	1.30
	Loose	67		87
	Compacted	77	1.15	

TRIGONOMETRIC FUNCTIONS AND GEOMETRIC FIGURES

Table 10-8. Trigonometric functions

RIGHT TRIANGLE							
GIVEN	TO FIND						
	A	B	C	a	b	c	AREA
a, b	$\tan A = \frac{a}{b}$	$\tan B = \frac{b}{a}$	90°			$\sqrt{a^2 + b^2}$	$\frac{ab}{2}$
a, c	$\sin A = \frac{a}{c}$	$\cos B = \frac{a}{c}$	90°		$\sqrt{c^2 - a^2}$		$\frac{a}{2} \sqrt{c^2 - a^2}$
A, a		$90^\circ - A$	90°		$a \cot A$	$\frac{a}{\sin A}$	$\frac{a^2 \cot A}{2}$
A, b		$90^\circ - A$	90°	$b \tan A$		$\frac{b}{\cos A}$	$\frac{b^2 \tan A}{2}$
A, c		$90^\circ - A$	90°	$c \sin A$	$c \cos A$		$\frac{c^2 \sin 2A}{4}$



$$a^2 = c^2 - b^2$$

$$\sin A = a/c$$

$$b^2 = c^2 - a^2$$

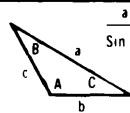
$$\cos A = b/c$$

$$c^2 = a^2 + b^2$$

$$\tan A = a/b$$

Table 10-8. Trigonometric functions (continued)

OBLIQUE TRIANGLE							
GIVEN		TO FIND					
	A	B	C	a	b	c	AREA
a b c	$\cos \frac{A}{2} \sqrt{\frac{s(s-a)}{bc}}$	$\cos \frac{B}{2} \sqrt{\frac{s(s-b)}{ac}}$	$\cos \frac{C}{2} \sqrt{\frac{s(s-c)}{ab}}$				$\sqrt{s(s-a)(s-b)(s-c)}$
a, A, B			$180^\circ - (A + B)$		$\frac{a \sin B}{\sin A}$	$\frac{a \sin C}{\sin A}$	$\frac{a^2 \sin B \sin C}{2 \sin A}$
a, b, A		$\sin B = \frac{b \sin A}{a}$				$\frac{b \sin C}{\sin B}$	
a, b, c		$\tan A = \frac{a \sin C}{b - a \cos C}$				$\sqrt{a^2 + b^2 - 2ab \cos C}$	$\frac{ab \sin C}{2}$



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$b^2 = a^2 + c^2 - 2ac \cos B$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$S = \frac{a \cdot b \cdot c}{2}$$

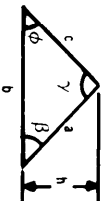
Table 10-8 Trigonometric functions (continued)

DEGREE OF ANGLE	SINE	COSECANT	TANGENT	COTANGENT	SECANT	COSINE	DEGREE OF ANGLE
0	.000		.000		1.000	1.000	90
1	.017	57.30	.017	57.29	1.000	1.000	89
2	.035	28.65	.035	28.64	1.001	.999	88
3	.052	19.11	.052	19.08	1.001	.999	87
4	.070	14.34	.070	14.30	1.002	.998	86
5	.087	11.47	.087	11.43	1.004	.996	85
6	.105	9.567	.105	9.514	1.006	.995	84
7	.122	8.206	.123	8.144	1.008	.993	83
8	.139	7.185	.141	7.115	1.010	.990	82
9	.156	6.392	.158	6.314	1.012	.988	81
10	.174	5.759	.176	5.671	1.015	.985	80
11	.191	5.241	.194	5.145	1.019	.982	79
12	.208	4.810	.213	4.705	1.022	.978	78
13	.225	4.445	.231	4.331	1.026	.974	77
14	.242	4.134	.248	4.011	1.031	.970	76
15	.259	3.864	.268	3.732	1.035	.966	75
16	.276	3.628	.287	3.487	1.040	.961	74
17	.292	3.420	.306	3.271	1.046	.956	73
18	.309	3.236	.325	3.078	1.051	.951	72
19	.326	3.072	.344	2.904	1.058	.946	71
20	.342	2.924	.364	2.747	1.064	.940	70
21	.358	2.790	.384	2.605	1.071	.934	69
22	.375	2.669	.404	2.475	1.079	.927	68
23	.391	2.559	.424	2.356	1.086	.921	67
24	.407	2.459	.445	2.246	1.095	.914	66
25	.423	2.366	.466	2.145	1.103	.906	65
26	.438	2.281	.488	2.050	1.113	.899	64
27	.454	2.203	.510	1.963	1.122	.891	63
28	.469	2.130	.532	1.881	1.133	.883	*62
29	.485	2.063	.554	1.804	1.143	.875	61
30	.500	2.000	.577	1.732	1.155	.866	60
31	.515	1.942	.601	1.664	1.167	.857	59
32	.530	1.887	.625	1.600	1.179	.848	58
33	.545	1.836	.649	1.540	1.192	.839	57
34	.559	1.788	.675	1.483	1.206	.829	56
35	.574	1.743	.700	1.428	1.221	.819	55
36	.588	1.701	.727	1.376	1.236	.809	54
37	.602	1.662	.754	1.327	1.252	.799	53
38	.616	1.624	.781	1.280	1.269	.788	52
39	.629	1.589	.810	1.235	1.287	.777	51
40	.643	1.556	.839	1.192	1.305	.766	50
41	.656	1.524	.869	1.150	1.325	.755	49
42	.669	1.494	.900	1.111	1.346	.743	48
43	.682	1.466	.933	1.072	1.367	.731	47
44	.695	1.440	.966	1.036	1.390	.719	46
45	.707	1.414	1.000	1.100	1.414	.707	45

Table 10.9 Geometric figures and formulas

- (1) Any triangle
 $A = \frac{1}{2}bh$

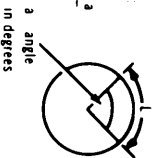
or $\sin \gamma = \frac{c \sin \phi}{a}$



- (4) Segment of circle

$$A = \frac{\pi r^2 \alpha}{360} - \frac{r^2 \sin \alpha}{2}$$

$$L = \frac{2\pi r \alpha}{360}$$

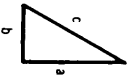


α angle
 in degrees

SEGMENT
 CHORD

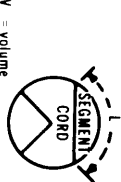
α angle
 in degrees

- (2) Right triangle
 $a = \sqrt{c^2 - b^2}$
 $b = \sqrt{c^2 - a^2}$
 $c = \sqrt{a^2 + b^2}$



- (5) Sector of circle

$$A = \frac{rL}{2} = \frac{\pi r^2 \alpha}{360}$$



$V =$ volume

$A =$ area

$h =$ height

$b =$ length of base

$c =$ hypotenuse

$C =$ circumference

$V =$ volume

$r =$ radius

$D =$ diameter

$\pi = 3.1416$

$L =$ length of arc

$K =$ length of cord

- (3) Circle



$$A = \pi r^2$$

$$A = 0.7854 D^2$$

$$C = \pi D$$

- (6) Regular polygons: The area of any regular polygon (all sides equal, all angles equal) is equal to the product of the square of the lengths of one side and the factors. Example problem: Area of a regular octagon having 6-inch sides is $6 \times 6 \times 4.828$, or 173.81 square inches. See factors in table.

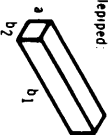
POLYGON FACTORS			
NO. OF SIDES	FACTOR	NO. OF SIDES	FACTOR
3	0.433	8	4.828
4	1.000	9	6.182
5	1.720	10	7.694
6	2.598	11	9.386
7	3.654	12	11.196

- (9) Cube:
 $V = b^3$



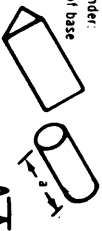
- (10) Rectangular parallelepiped:

$$V = ab_1b_2$$



- (11) Prism or cylinder:

$V = a \times$ area of base



- (12) Pyramid or cone:

$$V = (1/3)a \times$$
 area of base



- (7) Rectangle and parallelogram

$$A = ab$$



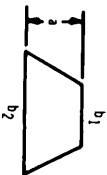
- (13) Sphere:

$$V = (4/3) \pi r^3$$

$$A = 4\pi r^2$$



- (8) Trapezoid:
 $A = \frac{1}{2}a(b_1 + b_2)$



CONVERSION FACTORS

Unit

Table 10-10. Conversion factors

MULTIPLY	BY	TO OBTAIN
acres	43.560	square feet
acres	4.047	square meters
acres	1.562×10^{-3}	square miles
acres	5645.38	square varas
acres	4.840	square yards
acre—feet	43.560	cubic—feet
acres	100	square meters
atmospheres	76.0	cms of mercury
atmospheres	29.92	inches of mercury
atmospheres	33.90	feet of water
atmospheres	14.70	pounds per sq inch
board—feet	144 sq in x 1 in	cubic inches
BTU	0.2520	kilogram—calories
BTU	777.5	foot—pounds
BTU	2.928×10^{-4}	kilowatt—hours
BTU per min	0.02356	horsepower
BTU per min	0.01757	kilowatts
BTU per min	17.57	watts
bushels	1.244	cubic feet
centares	1	square meters
centigrams	0.01	grams
centiliters	0.01	liters
centimeters	0.3937	inches
centimeters	0.01	meters
centimeters	393.7	mils
centimeters	10	millimeters
centimeters—grams	10^{-5}	meter—kilograms
centimeters—grams	7.233×10^{-5}	pound—feet
cms of mercury	0.01316	atmospheres
cms of mercury	0.4461	feet of water
cms of mercury	136.0	kgs of sq meter
cms of mercury	27.85	pounds per sq foot

MULTIPLY	BY	TO OBTAIN
cms of mercury	0.1934	pounds per sq inch
cms per second	0.6	meters per min
circular mils	0.7854	square mils
cord—feet	4 ft x 4 ft x 1 ft	cubic feet
cords	8 ft x 4 ft x 4 ft	cubic feet
cubic cms	6.102×10^{-2}	cubic inches
cubic cms	10^{-6}	cubic meters
cubic cms	2.642×10^{-4}	gallons
cubic cms	10^{-3}	liters
cubic feet	2.832×10^4	cubic cms
cubic feet	1.728	cubic inches
cubic feet	0.02832	cubic meters
cubic feet	0.03704	cubic yards
cubic feet	7.481	gallons
cubic feet	28.32	liters
cubic feet per min	472.0	cubic cms per sec
cubic feet per min	0.1247	gallons per sec
cubic feet per min	0.4720	liters per sec
cubic feet per min	62.4	lb of water per min
cubic inches	16.39	cubic cms
cubic inches	5.787×10^{-4}	cubic feet
cubic inches	0.01732	quarts (liq)
cubic meters	10^6	cubic cms
cubic meters	35.31	cubic feet
cubic meters	1.308	cubic yards
cubic meters	264.2	gallons
cubic yards	27	cubic feet
cubic yards	0.7646	cubic meters
cubic yards	202.0	gallons
cubic yards per min	0.45	cubic feet per sec
cubic yards per min	3.367	gallons per sec

Table 10-10. Conversion factors (continued)

MULTIPLY	BY	TO OBTAIN
decigrams	0.1	grams
deciliters	0.1	liters
decimeters	0.1	meters
degrees (angle)	60	minutes
degrees (angle)	0.01745	radians
degrees (angle)	3600	seconds
dekagrams	10	grams
dekaliters	10	liters
dekameters	10	meters
drams	1.772	grams
drams	0.0625	ounces
ergs	9.486×10^{-11}	BTU
fathoms	6	feet
feet	0.3048	meters
feet	36	varas
feet	1/3	yards
feet of water	0.4335	pounds per sq inch
feet per min	0.5080	centimeters per sec
feet per min	0.01667	feet per sec
feet per min	0.01136	miles per hour
feet per sec	1.097	kilometers per hour
feet per sec	0.5921	knots per hour
feet per sec	18.29	meters per min
feet per sec	0.6818	miles per hour
feet per 100 feet	1	percent grade
foot—pounds	1.286×10^{-3}	BTU
foot—pounds	1.356×10^7	ergs
foot—pounds	5.050×10^{-7}	horsepower—hours
foot—pounds	3.241×10^{-4}	kilogram—calories
foot—pounds	3.766×10^{-7}	kilowatt—hours
foot—pounds per min	1.286×10^{-3}	BTU per min
foot—pounds per min	3.030×10^{-5}	horsepower

MULTIPLY	BY	TO OBTAIN
foot—pounds per min	3.241×10^{-4}	kg—calories per min
foot—pounds per min	2.260×10^{-5}	kilowatts
furlongs	40	rods
gallons	3785	cubic cms
gallons	0.1337	cubic feet
gallons	231	cubic inches
gallons	3.785×10^{-3}	cubic meters
gallons	4.951×10^{-3}	cubic yards
gallons per min	2.228×10^{-3}	cubic feet per sec
gills	0.1183	liters
grains (troy)	1	grains (av)
grains (troy)	0.06480	grams
grains (troy)	0.04167	pennyweights (troy)
grams	980.7	dynes
grams	15.43	grains (troy)
grams	10^{-3}	kilograms
grams	10^3	milligrams
grams	0.03527	ounces
grams	0.03215	ounces (troy)
grams	2.205×10^{-3}	pounds
grams—calories	3.968×10^{-3}	BTU
gram—cms	2.344×10^{-8}	kilogram—calories
gram—cms	10^{-5}	kilogram—meters
grams per cm	5.600×10^{-3}	pounds per inch
grams per cu cm	62.43	pounds per cubic foot
hectares	2.471	acres
hectares	1.076×10^5	square feet
hectograms	100	grams
hectoliters	100	liters
hectometers	100	meters
hectowatts	100	watts

Table 10-10. Conversion factors (continued)

MULTIPLY	BY	TO OBTAIN
horsepower	42.44	BTU per min
horsepower	33.000	foot—pounds per min
horsepower	550	foot—pounds per sec
horsepower	1.014	horsepower (metric)
horsepower	10.70	kg—calories per min
horsepower	0.7457	kilowatts
horsepower	745.7	watts
inches	2.540	centimeters
inches	10^3	mils
inches	.03	varas
inches	0.03342	atmospheres
inches of mercury	1.133	feet of water
inches of mercury	70.73	pounds per sq foot
inches of water	0.002458	atmospheres
inches of water	0.07355	inches of mercury
inches of water	0.5781	ounces per sq inch
inches of water	5.204	pounds per sq foot
inches of water	0.03613	pounds per sq inch
joules	9.486×10^{-4}	BTU
joules	10^7	ergs
joules	0.7376	foot—pounds
joules	2.390×10^{-4}	kilogram—calories
joules	0.1020	kilogram—meters
joules	2.778×10^{-4}	watt—hours
kilograms	980.665	dynes
kilograms	10^3	grams
kilograms	2.2046	pounds
kilograms	1.102×10^3	tons (short)
kilogram—calories	3.968	BTU
kilogram—calories	3088	foot—pounds
kilogram—calories	1.588×10^{-3}	horsepower—hours

MULTIPLY	BY	TO OBTAIN
kg—calories	1.162×10^{-3}	kilowatt—hours
kg—calories per min	0.06972	kilowatts
kg—meters	9.302×10^{-3}	BTU
kg—meters	9.807×10^7	ergs
kgs per cubic meter	10^{-3}	grams per cubic cm
kgs per cubic meter	0.06243	pounds per cubic foot
kgs per sq meter	9.678×10^{-5}	atmospheres
kgs per sq meter	3.281×10^{-3}	feet of water
kgs per sq meter	2.896×10^{-3}	inches of mercury
kgs per sq meter	0.2048	pounds per sq foot
kgs per sq meter	1.422×10^{-3}	pounds per sq inch
kiloliters	10^3	liters
kilometers	10^5	centimeters
kilometers	3281	feet
kilometers	10^3	meters
kilometers	0.6214	miles
kilometers per hour	0.5396	knots per hour
kilowatts	56.92	BTU per min
kilowatts	4.425×10^4	foot—pounds per min
kilowatts	1.341	horsepower
kilowatts—hour	3415	BTU
kilowatts—hours	2.655×10^6	foot—pounds
knots	1.853	kilometers per hour
knots	1.152	miles per hour
links (engineer's)	12	inches
links (surveyor's)	7.92	inches
liters	10^3	cubic cms
liters	0.2642	gallons
liters	1.057	quarts (liq)
liters per min	5.885×10^{-4}	cubic feet per sec
liters per min	4.403×10^{-3}	gallons per sec

Table 10-10. Conversion factors (continued)

MULTIPLY	BY	TO OBTAIN
meters	100	centimeters
meters	3 2808	feet
meters	39.37	inches
meters	10^{-3}	kilometers
meters	10^3	millimeters
meters	1.0936	yards
microns	10^{-6}	meters
miles	5280	feet
miles	1 6093	kilometers
miles	1760	yards
miles per hour	1 467	feet per sec
miles per hour	1 6093	kilometers per hour
miles per hour	0 8684	knots per hour
milliers	10^3	kilograms
milligrams	10^{-3}	grams
milliliters	10^{-3}	liters
millimeters	0.1	centimeters
millimeters	0 03937	inches
millimeters	39.37	mils
mils	0 002540	centimeters
mils	10^{-3}	inches
minutes (angle)	$2 909 \times 10^{-4}$	radians
minutes (angle)	60	seconds (angle)
myriagrams	10	kilograms
myriameters	10	kilometers
myriawatts	10	kilowatts
nautical miles	1 152	miles
nautical miles	2027	yards
ounces	8	drams
ounces	437.5	grains
ounces	28.35	grams
ounces	0 0625	pounds

MULTIPLY	BY	TO OBTAIN
ounces (fluid)	1 805	cubic inches
ounces (troy)	480	grains (troy)
ounces (troy)	31.10	grams
ounces (troy)	20	pennyweights (troy)
ounces (troy)	0 08333	pounds (troy)
perches (masonry)	24.75	cubic feet
pints (dry)	33.60	cubic inches
pints (liq)	28.87	cubic inches
pounds	444.823	dynes
pounds	453.6	grams
pounds	16	ounces
pounds	32.17	poundals
pound—feet	$1 356 \times 10^7$	centimeter—dynes
pound—feet	13.825	centimeter—grams
pound—feet	0 1383	meter—kilograms
pounds of water	0 01602	cubic feet
pounds of water	27.68	cubic inches
pounds of water	0 1198	gallons
pounds per cubic foot	16.02	kgs per cubic meter
pounds per cubic inch	27.68	grams per cubic cm
pounds per foot	1 488	kgs per meter
pounds per sq foot	0 01602	feet of water
pounds per sq foot	4 882	kgs per sq meter
pounds per sq inch	0 06804	atmospheres
pounds per sq inch	2 307	feet of water
pounds per sq inch	2 036	inches of mercury
pounds per sq inch	703.1	kgs per square meter
pounds per sq inch	144	pounds per sq foot
quadrants (angle)	90	degrees
quadrants (angle)	5400	minutes
quadrants (angle)	1 571	radians
quarts (dry)	67.20	cubic inches
quarts (liq)	57.75	cubic inches

Table 10-10. Conversion factors (continued)

MULTIPLY	BY	TO OBTAIN
radians	57.30	degrees
radians	3438	minutes
radians	0.637	quadrants
reams	500	sheets
revolutions	360	degrees
revolutions	4	quadrants
revolutions	6.283	radians
revs per min	6	degrees per sec
revs per min	0.1047	radians per sec
revs per min	0.01667	revs per sec
revs per min per min	1.745×10^{-3}	rads per sec per sec
revs per min per min	0.01667	revs per min per sec
revs per min per min	2.778×10^{-4}	revs per sec per sec
revs per sec	360	degrees per sec
revs per sec	6.283	radians per sec
rods	16.5	feet
seconds (angle)	4.848×10^{-6}	radians
square centimeters	0.1550	square inches
square centimeters	100	square millimeters
square feet	2.296×10^{-5}	acres
square feet	0.3290	square meters
square feet	3.587×10^{-8}	square miles
square feet	1296	square varas
square feet	1/9	square yards
square inches	6.452	square cms
square inches	6.944×10^{-3}	square feet
square kilometers	247.1	acres
square kilometers	10.76×10^6	square feet
square kilometers	10^6	square meters
square kilometers	0.3861	square miles
square kilometers	1.196×10^6	square yards
square meters	2.471×10^{-4}	acres
square meters	10.764	square feet

MULTIPLY	BY	TO OBTAIN
square meters	3.861×10^{-7}	square miles
square meters	1.196	square yards
square miles	640	acres
square miles	27.88×10^6	square feet
square miles	2.590	square kilometers
square miles	3.613.040.45	square varas
square miles	3.098×10^6	square yards
square yards	2.066×10^{-4}	acres
square yards	9	square feet
square yards	0.8361	square meters
square yards	3.228×10^{-7}	square miles
square yards	1.1664	square varas
steradians	0.1592	hemispheres
steres	10^3	liters
temp (degs C) + 273	1	abs temp (degs C)
temp (degs C) + 17.8	1.8	temp (degs F)
temp (degs F) + 460	1	abs temp (degs F)
temp (degs F) - 32	5/9	temp (degs C)
tons (long)	1016	kilograms
tons (long)	2240	pounds
tons (metric)	10^3	kilograms
tons (metric)	2205	pounds
tons (short)	907.2	kilograms
tons (short)	2000	pounds
tons (short) per sq ft	9765	kgs per sq meter
tons (short) per sq ft	13.89	pounds per sq inch
tons (short) per sq ft	1.406×10^6	kgs per sq meter
tons (short) per sq in	2000	pounds per sq inch
Varas	2.7777	feet

Table 10-10. Conversion factors (continued)

MULTIPLY	BY	TO OBTAIN
watts	0.05692	BTU per min
watts	10^7	ergs per second
watts	44.26	foot-pounds per min
watts	1.341×10^{-3}	horsepower
watts	10^2	kilowatts
watt-hours	3.415	BTU
weeks	168	hours
yards	91.44	centimeters
yards	3	feet
yards	36	inches
yards	0.9144	meters

NOTE: See FM 5-35 for additional conversion factors.

English Metric

Table 10-11. Conversion English metric system

ONE UNIT (BELOW) ↓ EQUALS →	MM	CM	METERS	KM
MM (Millimeters)	1.	0.1	0.001	0.000.001
CM (Centimeters)	10.	1	0.01	0.000.01
Meters	1,000	100	1.	0.001
KM (Kilometers)	1,000,000	100,000	1,000	1

ONE UNIT (BELOW) ↓ EQUALS →	GM	KG	METRIC TON
GM (Gram)	1.	0.001	0.000.001
KG (Kilograms)	1,000	1.	0.001
Metric Tons	1,000,000	1,000	1.

UNITS OF CENTIMETERS

CM	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.10
Inch	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.31	0.35	0.39

FRACTIONS OF AN INCH

Inch	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2
CM	0.16	0.32	0.48	0.64	0.79	0.95	1.11	1.27

Inch	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
CM	1.43	1.59	1.75	1.91	2.06	2.22	2.38	2.54

Table 10-11. Conversion - English metric system (continued)

LENGTH								
	INCHES	FEET	YARDS	METERS	METERS	METERS	METERS	CENTI-METERS
1	0.62	1.61	1.09	0.91	3.28	0.30	0.39	2.54
2	1.24	3.22	2.19	1.83	6.56	0.61	0.79	5.08
3	1.86	4.83	3.28	2.74	9.84	0.91	1.18	7.62
4	2.49	6.44	4.37	3.66	13.12	1.22	1.57	10.16
5	3.11	8.05	5.47	4.57	16.40	1.52	1.97	12.70
6	3.73	9.66	6.56	5.49	19.68	1.83	2.36	15.24
7	4.35	11.27	7.66	6.40	22.97	2.13	2.76	17.78
8	4.97	12.87	8.75	7.32	26.25	2.44	3.15	20.32
9	5.59	14.48	9.84	8.23	29.53	2.74	3.54	22.86
10	6.21	16.09	10.94	9.14	32.81	3.05	3.93	25.40
20	12.43	32.19	21.87	18.29	65.62	6.10	7.87	50.80
30	18.64	48.28	32.81	27.43	98.42	9.14	11.81	76.20
40	24.85	64.37	43.74	36.58	131.23	12.19	15.75	101.60
50	31.07	80.47	54.68	45.72	164.04	15.24	19.68	127.00
60	37.28	96.56	65.62	54.86	196.85	18.29	23.62	152.40
70	43.50	112.65	76.55	64.00	229.66	21.34	27.56	177.80
80	49.71	128.75	87.49	73.15	262.47	24.38	31.50	203.20
90	55.92	144.84	98.42	82.30	295.28	27.43	35.43	228.60
100	62.14	160.94	109.36	91.44	328.08	30.48	39.37	254.00

Example: 2 inches = 5.08CM

WEIGHT						
	OUNCES	GRAMS	POUNDS	KILOGRAMS	POUNDS	GRAMS
1	1.10	0.91	2.20	0.45	0.04	28.4
2	2.20	1.81	4.41	0.91	0.07	56.7
3	3.31	2.72	6.61	1.36	0.11	85.0
4	4.41	3.63	8.82	1.81	0.14	113.4
5	5.51	4.54	11.02	2.67	0.18	141.8
6	6.61	5.44	13.23	2.72	0.21	170.1
7	7.72	6.35	15.43	3.18	0.25	198.4
8	8.82	7.26	17.64	3.63	0.28	226.8
9	9.92	8.16	19.84	4.08	0.32	255.2
10	11.02	9.07	22.05	4.54	0.35	283.5
20	22.05	18.14	44.09	9.07	0.71	567.0
30	33.07	27.22	66.14	13.61	1.06	850.5
40	44.09	36.29	88.18	18.14	1.41	1,134.0
50	55.12	45.36	110.23	22.68	1.76	1,417.5
60	66.14	54.43	132.28	27.22	2.12	1,701.0
70	77.16	63.50	154.32	31.75	2.47	1,984.5
80	88.18	72.57	176.37	36.29	2.82	2,268.0
90	99.21	81.65	198.42	40.82	3.17	2,551.5
100	110.20	90.72	220.46	45.36	3.53	2,835.0

Example: 28 pounds = 9.07 kg + 3.63 kg = 12.70 kg

Table 10-11. Conversion - English metric system (continued)

VOLUME						
CU METERS			CU FT	CU METERS	CU FT	CU YD
CU YD			CU FT	CU METERS	CU FT	CU YD
CU FT	CU YD	CU METERS	CU FT	CU METERS	CU FT	CU YD
1	0.037	0.028	27.0	0.76	35.3	1.31
2	0.074	0.057	54.0	1.53	70.6	2.62
3	0.111	0.085	81.0	2.29	105.9	3.92
4	0.148	0.113	108.0	3.06	141.3	5.23
5	0.185	0.142	135.0	3.82	176.6	6.54
6	0.212	0.170	162.0	4.59	211.9	7.85
7	0.259	0.198	189.0	5.35	247.2	9.16
8	0.296	0.227	216.0	6.12	282.5	10.46
9	0.333	0.255	243.0	6.88	317.8	11.77
10	0.370	0.283	270.0	7.65	353.1	13.07
20	0.741	0.566	540.0	15.29	706.3	26.16
30	1.111	0.850	810.0	22.94	1059.4	39.24
40	1.481	1.133	1080.0	30.58	1412.6	52.32
50	1.852	1.416	1350.0	38.23	1765.7	65.40
60	2.222	1.700	1620.0	45.87	2118.9	78.48
70	2.592	1.982	1890.0	53.52	2472.0	91.56
80	2.962	2.265	2160.0	61.16	2825.2	104.63
90	3.333	2.548	2430.0	68.81	3178.3	117.71
100	3.703	2.832	2700.0	76.46	3531.4	130.79

Example: 3 cu yd = 81.0 cu ft

Time

Table 10-12. Time distance conversion

MILES PER HOUR	KNOTS	FEET PER SECOND	KILOMETERS PER HOUR	METERS PER SECOND
1	0.8684	1.4667	1.609	0.447
2	1.74	2.93	3.22	0.894
3	2.61	4.40	4.83	1.34
4	3.47	5.87	6.44	1.79
5	4.34	7.33	8.05	2.24
6	5.21	8.80	9.66	2.68
7	6.08	10.27	11.27	3.13
8	6.95	11.73	12.87	3.58
9	7.82	13.20	14.48	4.02
10	8.68	14.67	16.09	4.47
15	13.03	22.00	24.14	6.71
20	17.37	29.33	32.19	8.94
25	21.71	36.67	40.23	11.18
30	26.05	44.00	48.28	13.41
35	30.39	51.33	56.33	15.64
40	34.74	58.67	64.37	17.88
45	39.08	66.00	72.42	20.12
50	43.42	73.33	80.47	22.35
55	47.76	80.67	88.51	24.59
60	52.10	88.00	96.56	26.82
65	56.45	95.33	104.61	29.06
70	60.79	102.67	112.65	31.29
75	65.13	110.00	120.70	33.53
100	86.84	146.67	160.94	44.70

US EQUIPMENT AND WEAPONS CHARACTERISTICS

Vehicle Dimensions and Classifications

Table 10-13. Vehicle dimension and classification

NOMENCLATURE	HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	MILITARY LOAD CLASS (C)	MAX SPEED (MPH)
AVLB	200	158	439	59	30
Carrier, Cargo 6-ton, M548	116	110	248	13	43
Carrier, Command Post, M577A1	106	106	226.5	13	8
Carrier, Mortar, 81MM, M125A1	86.5	106	191.5	13	40
Carrier, Mortar, 107MM, M106A1	86.5	113	194	14	40
Carrier, Personnel, M113A2	86.5	106	191.5	13	40
Cavalry, Fighting Vehicle, M3	118	126	258	24	45
Crane, Boom, 20-ton RT	163	128	522	30	35
Crane, 25-ton Hydraulic, MT 250	118	97	542	31	45
Dozer, D7 w/ blade	120	137	230	28	6.2
Howitzer, 155MM (SP), M109A3	130	143	355	28	35
Howitzer, 8 in (SP), M110A2	135	140	392	29	32
Infantry Fighting Vehicle, M2	118	126	258	24	45
Improved Tow Vehicle, M2	132	106	180	13	42
Loader, Scoop, 2 1/2 C7, w/ o roll cage	102	102	300	20	—
MLRs	108	115	274	27	36
M992 CATV (FAAS V)	127	125	269	28	35
Tank, Combat 105MM, M1	118	145	332	60	45
Tank, Combat 105MM, M48A5	129.5	143	325	54	30
Tank, Combat 105MM, M60A1	129.5	143	325	54	30
Tank, Combat 105MM, M60A2	130.5	143	300.5	57	30
w/ Mine Roller (10-ton)	130.5	160	439	79	5

NOMENCLATURE	HEIGHT (IN)	WIDTH (IN)	LENGTH (IN)	MILITARY LOAD CLASS (C)	MAX SPEED (MPH)
Tank, Combat 105MM, M60A3	130	143	325	55	30
Trailer, Low Bed, 25-ton, M172	67	115	416	9	—
Trailer, Water (400 gal), M149 (w/o water)	76.5	82.5	83	4	—
Truck, Ambulance, 1/4-ton, M713	77	71	143	3	65
Truck, Ambulance, 1 1/2-ton, M792	91	84	227	5	55
Truck, Cargo (HEMTT), M977	108	97	403	16	55
Truck, Cargo, 1 1/4-ton, M880	95	85	221	4	60
Truck, Cargo, 2 1/2-ton, M35A2	112	96	278.5	8	56
Truck, Cargo, 5-ton 6x6, M54A2	116	97	315	15	54
Truck, Cargo, 8-ton 4x4, M520	134	108	384	21	30
Truck, Dump, 5-ton 6x6, M930	111	98	282	17	30
Truck, Fuel (2,500 gal), M559	134	108	391	23	30
Truck, Tanker (HEMTT), M978	108	97	403	15	55
Truck, Tractor, 20-ton, M920	144	132	320	15	—
Truck, Utility, 1/4-ton, M151A2	71	64	133	3	65
Truck, Wrecker, 5-ton 6x6, M816	114	98	356	18	52
Truck, Wrecker, 10-ton 4x4, M553	134	108	401	23	30
Vehicle, Cmbt Earth Mover, M9	110	150	246	18	30
Vehicle, Cmbt Engineer, M728 (CEV)	128	146	351	57	30
Vehicle, (light) Recovery, M578	130.5	124	250	25	37
Vehicle, (med) Recovery, M88A1	123.5	135	325.5	55	31

NOTE: Military load classification is for laden cross country or off highway (C).

Expedient Vehicle Classification

In an emergency temporary vehicle classification can be accomplished by using expedient classification methods. The vehicle should be reclassified by the analytical method as outlined in TM 5-312 or by reference to FM 5-36 as soon as possible to obtain a permanent classification number.

Wheeled. Expedient classification for wheeled vehicles may be accomplished by the following methods:

- Compare the wheel and axle loadings and spacings of the unclassified vehicle with those of a classified vehicle of similar design and then assign a temporary class number.
- Assign a temporary class number using the formula:

TEMPORARY CLASS (wheeled vehicles) = $0.85 W_T$

Where: $W_T = \frac{A_T P_T N_T}{2,000}$

and W_T = gross weight of vehicle in tons

A_T = average tire contact area in square inches (tire in contact with hard surface)

P_T = tire pressure in psi

N_T = number of tires

NOTE: The tire pressure may be assumed to be 75 psi for 2½-ton vehicles or larger no tire gage is available. For vehicles having unusual load characteristics or odd axle spacings, a more deliberate vehicle classification procedure as outlined in STANAG 2021 is required.

Tracked. Expedient classification for tracked vehicles may be accomplished by the following methods:

- Compare the ground contact area of the unclassified tracked vehicle with that of a previously classified vehicle to obtain a temporary class number.
- Assign a temporary class number using the formula.

TEMPORARY CLASS (tracked vehicles) = W_T

Where W_T = gross weight in tons

The gross weight of the tracked vehicle (W_T) can be estimated by measuring the total ground contact area of the tracks (square feet and equaling this to the gross weight in tons.

Example: An unclassified tracked vehicle has a ground contact area of 5,500 square inches. Therefore, the area is about 38.2 square feet, and the class of the vehicle is 38.2 or 39, since ground contact area in square feet equals the approximate weight of a tracked vehicle in tons which is approximately equal to class number.

Nonstandard combinations. The class number of nonstandard combinations of vehicles may be obtained expeditiously as follows:

Combination class = $0.9 (A + B)$ if $A + B \leq 60$

Combination class = $A + B$ if $A + B > 60$

A = Class of first vehicle

B = Class of second vehicle

Adjustment for other than rated load. An expedient class may be given to overloaded or under loaded vehicles by adding 10 or subtracting the difference in loading in tons from the normally assigned vehicle class. The expedient classification number is marked with a standard vehicle class sign to indicate temporary classification as shown in Figure 10-1.

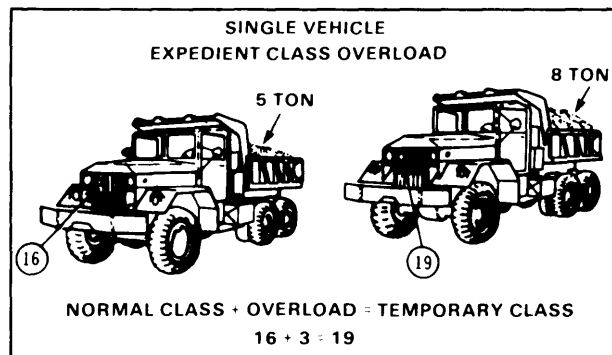


Figure 10-1. Expedient class overload

Weapons Systems Characteristics

Table 10-14. Infantry weapons

WEAPON	UNLOADED WEIGHT LB	TYPE OF FEED	METHOD OF OPERATION	CYCLIC (C)/ OR MAX (M) RATE OF FIRE	MAX. MAX EFFECTIVE RANGE (METERS)	AMMUNITION PACK	AMMUNITION WEIGHT (LB) (PACKED)	BASIC LOAD OF AMMO PER SOLDIER WPN	REMARKS
Pistol M1911A1 Cal 45	2 1/2	7 Rd Magazine	Recoil semiauto	35-42 (M)	1 500-50	50 Rds/Box 20 Box/Can 2 Cans/Case	113	21	
Rifle M14 M14 A1 7.62MM	9.84 12 12	20 Rd Magazine	Gas semiauto and auto	700-750 (C)	3 725-460 3 725-700 (SA) 460 (A)	5 Rd Clip 12 Clips/Band 7 Band/Can 2 Cans/Case	69	160 160/760	Selector must be installed/bipod available when used as automatic rifle
Rifle M16 A2 5.56MM	6 1/2	30 Rd Magazine	Gas semiauto and auto	700-800	2 653-460	10 Rd Clips 14 Clips/Band 6 Band/Can 2 Cans/Case	85	210	May be issued with a bipod when used as automatic rifle
Saw Squad Automatic Weapon	22 0	200 Rd Links and M16 Magazine	Belt or magazine fed-gas operated	725 RPM	1 000-800	200 Linked Box (rds) M16 Magazine	9 5	600	Most accuracy firing from prone position with the tripod
Machine gun M60 7.62MM	23	Belt-metallic split link	Gas auto	550 (C)	3 725-1 100	220/Belt 1 Belt/Can 4 Cans/Box	75	2 200	Effective range based on gunners ability
Machine gun HB M2 Cal	MG 84 MT-44	Belt-metallic split link	Recoil semiauto and auto	450-500	6 000-725 AA /1.830 gnd	105/Belt 1 Belt/Can 2 Cans/Case		2 100 wpn	Used in antiaircraft or ground role
Shotgun riot type 12 gage pump	7 1/2	5 Rd Tube	Manual (pump)	5	Depends on type of shot	12 Carton 20 Carton/Case	45	10	
Grenade launcher M79/M203 40MM	6 3	Single shot	Percussion	2 4	400/150-ft tgt /250-area tgts	12/Band 12 Band/Box	9/Bandoleer	30	Minimum safe range Combat 31M Trng 80M Arm distance 14-28M Effective burst radius 5M

Table 10-14 Infantry weapons (continued)

WEAPON	UNLOADED WEIGHT LB	TYPE OF FEED	METHOD OF OPERATION	CYCLIC (C) OR MAX (M) RATE OF FIRE	MAX-MAX EFFECTIVE RANGE (METERS)	AMMUNITION PACK	AMMUNITION WEIGHT (LB) (PACKED)	BASIC LOAD OF AMMO PER SOLDIER WPN	REMARKS
MAW M47 medium antitank Dragon	31.9	Single shot	Recoilless auto rifle	1	1,000		25.2	By TOE	Back blast danger zone 30M Caution zone 20M
M57 90MM Recoilless Rifle	37.5	Single shot	Recoilless semiauto	1	Stationary target 2,100 300M moving target 2,100 200M	Canister antitank antipersonnel		By TOE	Back blast danger zone 28M Caution zone 15M
Hand Grenade Frag M67 M68 WP M34	1 1 1/2		Electrical impact fuze 4-6 sec delay		Approx 25M depen dent on throwing distance of individual	1 Ctn 20 Ctns Box	2 Grenade	4	Bursting Radius 15M 15M 25M (60 sec burn time)
Mine antipersonnel M18 A1 Claymore	3.5		Controlled electric or tripwire detonation	One shot	250-50	1 Kit (com plete) 6 Kits Ctn	6.8	10 Non Div Engr Bn 2 Track Veh (Mech Div Engr Bn) 15 Div Engr Bn	When employed with tripwire must be treated as a mine and its location re corded and reported Directional frag 60 sector with 50M radius 16M lethal zone (back and sides) and 100M back blast danger zone
Rocket Heat M72A1 (LAW) 66MM	4.7	Single shot throw away	Manual	1 shot	1,000-200	5 Ctn 3 Ctns Box	27 1/2 120	By TOE	Back blast area 15M danger zone 25M caution zone Front site graduated to 225M M72 issued as ammunition Weight is load

Table 10-14. Infantry weapons (continued)

WEAPON	UNLOADED WEIGHT LB	TYPE OF FEED	METHOD OF OPERATION	CYCLIC (C)/ OR MAX (M) RATE OF FIRE	MAX/MAX EFFECTIVE RANGE (METERS)	AMMUNITION PACK	AMMUNITION WEIGHT (LB) (PACKED)	BASIC LOAD OF AMMO PER SOLDIER WPN	REMARKS
Rocket Launcher M202 and M202 A1 4 Tube 66MM (FLAME)	11.5	4 Rd Clip	Recoilless semiauto	1 clip	200 pt lgts 750/area lgts 20 minimum	4 Rds/Clip 4 Clips/Box	15.1 ea 122		M74 rocket is a flame encapsulated rd. 5.5-13M arming range Bursting radius 20M Backblast zone 40M
Portable Flame Thrower ABC. M9 7	25	Fuel propelled by gas under pressure	Manual	5-8 seconds continuous	40-50	4 gal of thickened fuel	25	Ignition cyl-8. Peptizer-1 gal thickener-10 lb	
Self-propelled Flame Thrower M132 A-1	21,000	Fuel propelled by gas under pressure	Electrical	32 seconds for continuous discharge	150-170	200 gal of thickened fuel	1,260		Includes weight of M113 personnel carrier
Mortar M29 with mount M23 A2 81MM	Barrel 28 Bipod 40 Sight 4 Base 26	Muzzle loading by hand	Drop fire	12 (M) for 2 min	4,512/4,512	1/per carton 4 ctns/box	20 ea	120	Effective bursting area 25 x 20M
Mortar M30 with mount M24 A1 4.2 in	Barrel 157 Bridge 170 Base 193 Standard 60 Rotorator 90	Muzzle loading by hand	Drop fire	18 (M) for 1 min or 9 per min for 5 min	920 minimum 5,650/5,650 max	1 rd./per ctn HE illum smoke gas	27 26 28 24	160	40 x 20 40-90 seconds WP H. HD. and HT

Table 10-15. US tank weapons

WEAPON	WEIGHT (TONS)	MAX SPEED		CRUISING RANGE		ROUNDS ABOARD	TYPE AMMO	MAX OPEN DIRECT FOR RANGE (METERS)*
		(MPH)	(KPH)	(MILES)	(KILOMETERS)			
105 MM Gun Tank M1	60	45	72	275	440	55		
105 MM Gun Tank M60A1	53	30	48	310	500	63	APDS-T APFSDS-T HEAT-T HEP-T	3 000 4 000 4 000
105 MM Gun Tank M48A5	54	30	48	310	500	43	WP-T APERS-T	1 200 Point Tgt 3 600 Area Tgt 1 200 Point Tgt 3 600 Area Tgt 200-4 000
152 MM Gun Tank M60A2	57.2	30	48	280	451	48 Msi-Conv 13 33	Missile Cannister HEAT-MP	3 000 400 1 600 Hard Tgt 2 900 Area Tgt
165 MM Gun Tank M728 (engr cbl veh)	57	30	48	280	451	30	HEP-T	1 000

Table 10-16. US Antiarmor missiles

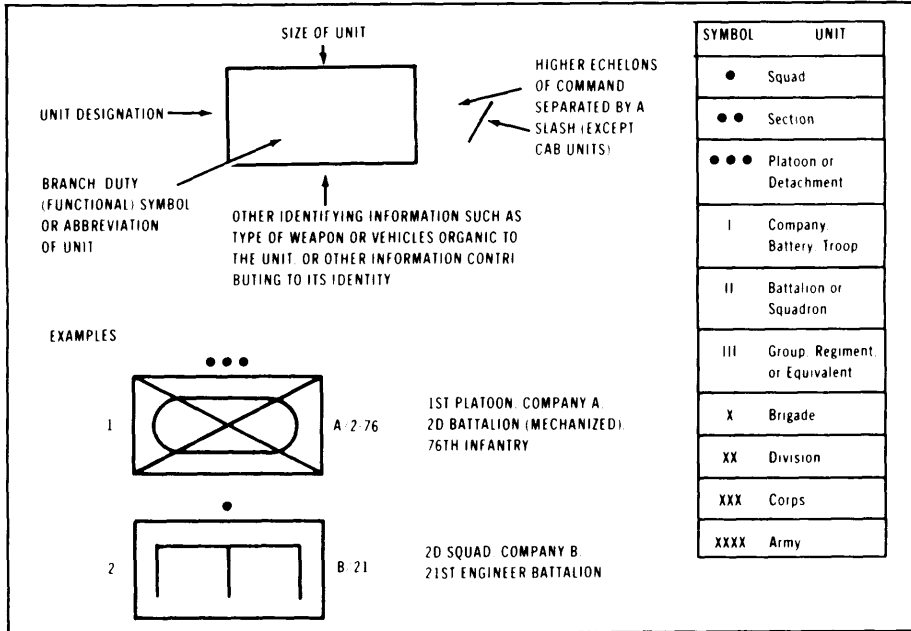
MISSILE	PRIME MOVER	WEIGHT (LB)	GUIDANCE LINKAGE	ROUNDS ABOARD	RANGE (METERS)
Shillelagh	M60A2 Tank	61.3 (round only)	Infrared	13	3,000 max 800 min
TOW	M113A1 Guided Missile Carrier or Improved TOW Vehicle (ITV) AH-1S Atk Hel	40 (round only)	Wire	10 8	3,000 max 65 min 3,750 max 65 min
Dragon	Individual Soldier or Mounted on M113A1	32 (carry weight) 25.2 (round only)	Wire	6	1,000 max 65 min

Table 10-17 US field artillery and air defense weapons

WEAPON	RDS ON VEH	RDS ON CARRIER	RANGE METERS	WEIGHT POUNDS	TIME TO EMPLACE MIN	MAX RATE OF FIRE NO OF RDS FIRST 3 MIN	SUSTAINED FIRE RDS PER HR	NO OF WEAPONS PER UNIT	AMMUNITION	
									TYPES	FUZES
105 MM How Towed M102	Sit Dep	NA	11 500	3 170	2	30	180	Inf Div. Airborne / Air Assault Div Corps Bn 18	WP. HE. HEAT. CML. Illum. SMK. ICM. APERS. HEP	Quick Delay VT. Time Concrete Piercing
155 MM How Towed M114A1 A2	48	NA	14 600	12 700	3 5	12	60	Inf Div Bn Corps Bn 18	FASCAM HE WP	Quick Delay VT Time Concrete Piercing
155 MM How SP M109A1	28	96	18 100 24 000 (RAP)	53 940	0 5	12	60	Armd and Mech Div Bn Corps Bn 18	CML Illum SMK	
155 MM How SP M109A2 /A3	36	96	18 000 24 000 (RAP)	53 940	0 5 (RAP)	12	20	Armd and Mech Bn Corps Bn 18	Nuc ICM RAP	
155 MM How Towed M198	48	NA	24 000 30 000 (RAP)	15 500	5	12	Variable	TBD	CLGP	
8 Inch How SP M102A2	2	36	22 900 30 000 (RAP)	62 500	2 5	4 5	30	Inf Div Btry 4 Armd / Inf Div Bn. Corps Bn 12	HE Nuc CML ICM SPOT	
Vulcan CM 741	2 100	4 200	1 200 AD 4 500 Surface	26 000	NA	3 000	NA	Bn 24	HEI HEIT SD	PD

OPERATIONAL SYMBOLS

Table 10-18. Unit symbols



SYMBOL	UNIT
●	Squad
●●	Section
●●●	Platoon or Detachment
I	Company Battery Troop
II	Battalion or Squadron
III	Group, Regiment, or Equivalent
X	Brigade
XX	Division
XXX	Corps
XXXX	Army

Table 10. 19 Unit identification symbols

























Airborne	
Air Defense	
Airmobile	
Antiaarmor	
Armor	
Armored Cavalry	
Army Aviation	
Attack Helicopter	
Bridging	
Cavalry or Reconnaissance	
Chemical	
Engineer	
Field Artillery	

Table 10-19 Unit identification symbols (continued)

Infantry	
Light	
Maintenance	
Mechanized	
Medical	
Military Police	
Mountain	
Petroleum Supply	
Quartermaster	
Signal/Communications	
Transportation	

Obstacles

Obstacles are divided into four types: point, demolitions, linear, and minefields. The following obstacle indicators can be superimposed on either point or linear obstacle symbols. (More detailed symbology is required for use by engineers and low level tactical commanders, and also for use in target folders, minefield records, and instructional manuals.)

Table 10.20. Obstacle symbols













DESCRIPTION	SYMBOL				
Abatis					
Booby trap					
Ac or antiairborne obs Demolitions					
Planned target demolition					
Prepared demolition state 1 (safe) (passable)					
Prepared demolition state 2 (passable)					
Fired demolition					
Road block completed					
Proposed rd br dm1					
Atomic demolition					
Antitank ditch Linear (A rectangle need not be used when the obstacle is drawn to scale on the overlay. Teeth point toward the enemy.)	<table border="0"> <tr> <td>▽▽▽</td> <td>▼▼▼</td> </tr> <tr> <td>Planned</td> <td>Completed</td> </tr> </table>	▽▽▽	▼▼▼	Planned	Completed
▽▽▽	▼▼▼				
Planned	Completed				
Unspecified Minesfields Indicators Antipersonnel mine	 				

Table 10-20. Obstacle symbols (continued)














Antipersonnel mine connected to tripwire	
Rows of antipersonnel mines	
Antitank mine	
Row of antitank mines	
Antitank mine with antihandling device	
Directional mine (arrow points in direction of main effect)	
Mine cluster	
Mine, type unspecified	
Conventional _____	
A planned minefield consisting of unspecified mines	
A completed minefield consisting of unspecified mines	
Scatterable minefield (DTGs used for self-destruct mines)	
Conventional minefield thickened with scatterable mines	
Conventional row mining (outline drawn to scale)	

Table 10-20. Obstacle symbols (continued)



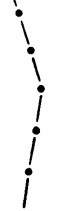

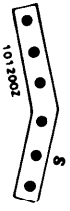

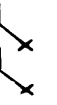





<p>Nuisance minefield</p> <p>Phony</p>	
<p>Phony minefield</p> <p>Protective</p>	
<p>Protective minefield</p>	
<p>Antitank ditch reinforced with antitank mines</p> <p>Tactical</p>	
<p>Tactical minefield of scatterable antitank mines, effective till 101200Z</p> <p>Completed antitank minefield (drawn away from the location and connected by a vector)</p>	
<p>Antitank obs, type unspecified</p>	
<p>Stakes, roll, antitank ditch, or similar obs</p>	
<p>Tetrahedron, dragon's teeth and other similar obs:</p> <p>a. Fixed</p>	
<p>b. Fixed and prefabricated</p>	
<p>c. Movable</p>	
<p>d. Movable and prefabricated</p>	
<p>Antitank obs consisting of ditch, wall, and stakes</p>	

Table 10-20 Obstacle symbols (continued)

Strong point	
Fortified area	
Demolished area	
Inundation	
Underwater obs (booby traps)	
Wire:	
a. Unspecified type	XXXXXX
b. Concertina, single	lllell
c. Concertina, multiple	lllell
d. Single fence	*-*-*
e. Double fence	**-*-***
f. Double apron fence	-*****-
g. Low wire fence	-XXXXX-
h. High wire fence	XXXXXX

Table 10-20 Obstacle symbols (continued)









Tripwire	Crossings	
Assault		
Ferry		
Ford		
Ford with difficulty		
Gap or bridge		
Lane		
Raft site		

Table 10-21 Weapon symbols

	LIGHT	MEDIUM	HEAVY
Air defense gun			
Antitank gun			
Antitank missile, self-propelled			
Antitank rocket launcher			
Flamethrower			
Gun in air defense role, self-propelled			
Gun in antitank role			
Howitzer			
Machine gun automatic weapon			
Mortar			
Multibarrel rocket launcher			
Surface-to-air missile			
Surface-to-surface missile			