FM 10-13

DEPARTMENT OF THE ARMY FIELD MANUAL

QUARTERMASTER REFERENCE DATA

HEADQUARTERS, DEPARTMENT OF THE ARMY

SEPTEMBER 1957

FIELD MANUAL
No. 10–13

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *24 September 1957*

QUARTERMASTER REFERENCE DATA

*This manual supersedes FM 10–13, 15 August 1950.

CHAPTER 1
INTRODUCTION

1. Purpose

This manual provides statistical information and data for use in planning and performing quartermaster operations. It contains logistical reference data on supplies and equipment pertinent to every-day functioning of the Quartermaster Corps.

2. Scope

This manual provides planning data on subsistence, quartermaster general supplies and equipment, petroleum, packaging and crating, transportation, and recovery and disposition activities. The manual also gives measurements, conversions, and equivalents useful to quartermaster activities.

3. Modification

a. Information contained in this manual reflects policies. Policies are subject to modification which results in the publication of changes. Users of this manual are requested to submit recommendations for changes or corrections to the Commanding General, Quartermaster Training Command, Fort Lee, Va. The format for submitting recommended changes is contained in AR 310–3.

b. The material presented herein is applicable without modification to atomic and nonatomic warfare.

4. Classes of Supply

Supplies are all items necessary for the equipment, maintenance, and operation of a military command; supplies include subsistence, clothing, equipment, arms, ammunition, fuel, storage, materials, repair parts, and machinery of all kinds. The following are the classes of supply used by the Department of the Army:

a. Class I Supplies. Supplies, such as rations and forage, which are consumed by humans and animals at an approximate uniform daily rate under all conditions.

b. Class II Supplies. Supplies, such as clothing, weapons, and vehicles, for which allowances are fixed by tables of allowances, tables of organization and equipment, or other issue authorization documents.

c. Class III Supplies. Supplies, such as fuels and lubricants for all purposes except aviation, including gasoline for all vehicles, diesel oil, fuel oil, and coal.

d. Class III (A) Supplies. Aviation fuels and lubricants.

e. Class IV Supplies. Supplies and equipment for which allowances are not prescribed or which are not otherwise classified.

f. Class IV (A) Supplies. Complete airplanes, airplane equipment, and all repair parts and supplies required to maintain a complete airplane.

g. Class V Supplies. Ammunition, pyrotechnics, antitank mines, and chemical warfare agents.

5. Federal Supply Classification System

The Federal Supply Classification (FSC) System divides items of supply into broad commodity groups; each group is subdivided into classes, which cover similar commodities. For example, Group 84, Clothing and Individual Equipment, contains Classes 8405, Men's Outerwear; 8410, Women's Outerwear; 8415, Special Purpose Clothing; and 8420, Men's Underwear and Nightwear. A complete listing of FSC groups and classes is found in SB 708–401, SB 708–402, and SB 708–403.

6. Supply Manuals

Department of the Army supply manuals furnish supply classification codes, identification numbers, category numbers, stock numbers, item names and identifications, units of issue, expendability, illustrations, prices, parts allowances, stockage guide data, cross-references, and other supply operational information required by Army activities to carry out their assigned responsibilities. Each technical service supply manual series lists all items of supply for which the particular technical service is responsible. Quartermaster Corps supply manuals are described and indexed in DA Pam 310–30.

CHAPTER 2
SUBSISTENCE

7. Ration Data

Table I provides information on rations.

Table I. Ration Data

Type	Contents per package or case	Weight per package or case (lbs)	Average weight per ration or packet, including packaging (lbs)	Volume per package or case (cu ft)	Average volume per ration or packet, including packaging (cu ft)	Average calories per ration
Ration, field A[1]	----------	--------	6.0	--------	0.183	4,200
Ration, operational B[2]	----------	--------	6.0	--------	0.127	4,400
Ration, small detachment, 5 persons.[3]	5 rations	28.5	5.8	1.1	0.2	3,600
Ration, combat, individual.[4]	6 rations	38	6.5	1.2	0.2	3,600
Ration, trail, frigid, individual.[5]	8 rations	34	4.0	1.6	0.2	4,400
Ration supplement, spice pack.[6]	----------	47	--------	1.9		
Ration supplement, sundries pack (1 pack per 100 men).[7]	4 rations	24	4.8	.85	--------	3,600
Ration, individual, combat, meal type.	----------	20	--------	1.1		
Ration supplement, aid station (makes 205 8-oz drinks).[8]	24 packets	29	1.1	1.1	--------	800
Food packet, assault, individual.[9]	24 packets	34	1.5	0.7	--------	2,000
Food packet, survival, arctic, SA.[10]	24 packets	36	1.5	0.7	--------	1,700
Food packet, survival, tropic, ST.[11]						

[1] Ration, field A, is the basic field ration. It consists of approximately 200 items, including such perishables as fresh and frozen meats, vegetables, and fruit. It is intended for use primarily under stable conditions and during static phases of military operations when normal cooking and refrigeration facilities are available. It should be issued in preference to any other type of ration whenever it is available and circumstances permit its use. Components, weight, and volume of this ration vary.

[2] Ration, operational B, is designed for use whenever mess facilities and personnel are available and where NO perishable foods are issued. The use of canned or dried items, together with the use of staple items, constitute this ration. Components, weight, and volume of this ration vary. SB 10–495 contains information concerning the breakdown of this ration.

[3] Ration, small detachment, 5 persons, consists of nonperishable precooked food which may be eaten hot. It is intended to be used where organized messing is not possible but when feeding in small groups is possible.

[4] Ration, combat, individual, consists of nonperishable precooked food which may be eaten hot or cold; it is carried and prepared by the individual soldier. This ration is intended for use when the tactical situation is so unstable that messing in small groups is not possible and no kitchen facilities are available.

[5] Ration, trail, frigid, individual, is designed for use in extremely cold climates by small patrols or trail teams under conditions where resupply is impossible.

[6] Ration supplement, spice pack, consists of an assortment of spices, condiments, and leavening agents to supplement 1,000 operational rations B and to provide facility for issue in the field. The spice pack varies in weight and cubage, being tailormade to different situations, to be scaled with the B ration.

[7] Ration supplement, sundries pack, consists of comfort items such as toilet articles, tobacco, and candy, serving as a supplement to operational ration B, for the issue of these items before the establishment of adequate sales facilities.

[8] Ration supplement, aid station, is designed to provide special nourishment in the form of hot stimulating beverages for combat zone casualties at aid and clearing stations.

[9] Food packet, assault, individual, is packaged so that it may be carried by the individual; it is provided troops in the initial assault phase of combat, when food is required that is lightweight, highly palatable, and conveniently carried by the individual. The food packet should not be used for other than the phase of battle for which it is designed—specifically, a period not exceeding 30 hours and during which a soldier cannot receive complete rations through planned resupply.

[10] Food packet, survival, arctic, SA, is designed for survival kits carried aboard aircraft operating over arctic regions. The packets are carried in the emergency kit which forms a part of the ejection seat in modern combat aircraft. Packets are carried in the emergency kits for passengers aboard transport aircraft.

[11] Food packet, survival, tropic, ST, is designed to be carried in survival kits of aircraft operating over tropical regions. The packet is composed of palatable foods of high caloric density to be used only for survival conditions and not as a regular ration.

8. Time Element in Class I Supply

Table II may be used as a guide in estimating the time required to distribute and process rations from the class I distributing point to the using unit. Time elements vary, depending on supply capabilities and type of ration issued.

Table II. Time Element in Class I Supply

Work	Daylight (minutes)	Dark (minutes)
Unloading rations for one division at class I distributing point and preparing for distribution to regiments or separate battalions.	120	150
Distribution of class I supplies to regiment by higher echelon at one distributing point.	30	30
Distribution of class I supplies to separate battalion by higher echelon or similar unit.	15	15
Preparation of 1 day's class I supplies for issue at regimental or battalion class I distributing point.	30	60
Distribution by regimental supply agencies of one field ration (transfer of loads) to kitchens.	15	20
Kitchens to be taken off trucks, set up, and made ready to begin cooking (or vice versa).	20	20
Division of one ration into three meals at kitchens	15	20
Kitchens (starting hot) to cook and prepare for serving a hot meal.	120	150
Kitchens to prepare a cold noon meal, the issue of meal to take place usually coincident with serving of breakfast.	60	90
Serving a hot meal to men from a kitchen truck when majority of men are served at the truck.	45	60
Serving a hot meal to men by means of carrying parties, assuming that kitchen truck is not farther than 1,000 yards in rear of company.	90	120

9. Ration Breakdown Chart

The ration breakdown chart (table III) is useful for making accurate computations of issue. In using the chart, it is recommended that a straightedge or rule be used. For example, assume a ration strength of 2,187 men. One of the items to be issued is evaporated milk at 32 cans per 100 men. Place the lower guide along the line marked 32 on the left. Now take the amount at the intersection of the 2,000 strength column, which is 640; next, at the intersection of 100, which is 32; next at the intersection of 80, which is 25.6; and then, at the intersection of 7, which is 2.24. The total is 699.84 cans, allowance for 2,187 men.

10. Subsistence Storage Data

Table IV may be used as a guide for storage of subsistence in temperate regions.

Amount of issue per one hundred (100) men	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
0.5	.005	.01	.015	.02	.025	.03	.035	.04	.045	.05	.075	.11	.125	.15	.175	.2	.225	.25	.275	.3	.325	.35	.375	.4	.42	.45	.475	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	10	15	20	25	30	35	40	45	50	55	60	65	70
1	.01	.02	.03	.04	.05	.06	.07	.08	.09	.1	.15	.2	.25	.3	.35	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85	.9	.95	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100	110	120	130	140
2	.02	.04	.06	.08	.1	.12	.14	.16	.18	.2	.3	.4	.5	.6	.7	.8	.9	1.	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	4	6	8	10	12	14	16	18	20	40	60	80	100	120	140	160	180	200	220	240	260	280
3	.03	.06	.09	.12	.15	.18	.21	.24	.27	.3	.45	.6	.75	.9	1.05	1.2	1.35	1.5	1.65	1.80	1.95	2.1	2.25	2.4	2.55	2.7	2.85	3	6	9	12	15	18	21	24	27	30	60	90	120	150	180	210	240	270	300	330	360	390	420
4	.04	.08	.12	.16	.2	.24	.28	.32	.36	.4	.6	.8	1.	1.2	1.4	1.6	1.8	2.	2.2	2.4	2.6	2.8	3.	3.2	3.4	3.6	3.8	4	8	12	16	20	24	28	32	36	40	80	120	160	200	240	280	320	360	400	440	480	520	560
5	.05	.1	.15	.2	.25	.3	.35	.4	.45	.5	.75	1.	1.25	1.5	1.75	2.	2.25	2.5	2.75	3.	3.25	3.5	3.75	4.	4.25	4.5	4.75	5	10	15	20	25	30	35	40	45	50	100	150	200	250	300	350	400	450	500	550	600	650	700
6	.06	.12	.18	.24	.3	.36	.42	.48	.54	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6	12	18	24	30	36	42	48	54	60	120	180	240	300	360	420	480	540	600	660	720	780	840
7	.07	.14	.21	.28	.35	.42	.49	.56	.63	.7	1.05	1.4	1.75	2.1	2.45	2.8	3.15	3.5	3.85	4.2	4.55	4.9	5.25	5.6	5.95	6.3	6.65	7	14	21	28	35	42	49	56	63	70	140	210	280	350	420	490	560	630	700	770	840	910	980
8	.08	.16	.24	.32	.4	.48	.56	.64	.72	.8	1.2	1.6	2.	2.4	2.8	3.2	3.6	4.	4.4	4.8	5.2	5.6	6.	6.4	6.8	7.2	7.6	8	16	24	32	40	48	56	64	72	80	160	240	320	400	480	560	640	720	800	880	960	1040	1120
9	.09	.18	.27	.36	.45	.54	.63	.72	.81	.9	1.35	1.8	2.25	2.7	3.15	3.6	4.05	4.5	4.95	5.4	5.85	6.3	6.75	7.2	7.65	8.1	8.55	9	18	27	36	45	54	63	72	81	90	180	270	360	450	540	630	720	810	900	990	1080	1170	1260
10	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.	1.5	2.	2.5	3.	3.5	4.	4.5	5.	5.5	6.	6.5	7.	7.5	8.	8.5	9.	9.5	10	20	30	40	50	60	70	80	90	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
11	.11	.22	.33	.44	.55	.66	.77	.88	.99	1.1	1.65	2.2	2.75	3.3	3.85	4.4	4.95	5.5	6.05	6.6	7.15	7.7	8.25	8.8	9.35	9.9	10.45	11	22	33	44	55	66	77	88	99	110	220	330	440	550	660	770	880	990	1100	1210	1320	1430	1540
12	.12	.24	.36	.48	.6	.72	.84	.96	1.08	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6.	6.6	7.2	7.8	8.4	9.	9.6	10.2	10.8	11.4	12	24	36	48	60	72	84	96	108	120	240	360	480	600	720	840	960	1080	1200	1320	1440	1560	1680
13	.13	.26	.39	.52	.65	.78	.91	1.04	1.17	1.3	1.95	2.6	3.25	3.9	4.55	5.2	5.85	6.5	7.15	7.8	8.45	9.1	9.75	10.4	11.05	11.7	12.35	13	26	39	52	65	78	91	104	117	130	260	390	520	650	780	910	1040	1170	1300	1430	1560	1690	1820
14	.14	.28	.42	.56	.7	.84	.98	1.12	1.26	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.	7.7	8.4	9.1	9.8	10.5	11.2	11.9	12.6	13.3	14	28	42	56	70	84	98	112	126	140	280	420	560	700	840	980	1120	1260	1400	1540	1680	1820	1960
15	.15	.3	.45	.6	.75	.9	1.05	1.2	1.35	1.5	2.25	3.	3.75	4.5	5.25	6.	6.75	7.5	8.25	9.	9.75	10.5	11.25	12.	12.75	13.5	14.25	15	30	45	60	75	90	105	120	135	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100
16	.16	.32	.48	.64	.8	.96	1.12	1.28	1.44	1.6	2.4	3.2	4.	4.8	5.6	6.4	7.2	8.	8.8	9.6	10.4	11.2	12.	12.8	13.6	14.4	15.2	16	32	48	64	80	96	112	128	144	160	320	480	640	800	960	1120	1280	1440	1600	1760	1920	2080	2240
17	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.53	1.7	2.55	3.4	4.25	5.1	5.95	6.8	7.65	8.5	9.35	10.2	11.05	11.9	12.75	13.6	14.45	15.3	16.15	17	34	51	68	85	102	119	136	153	170	340	510	680	850	1020	1190	1360	1530	1700	1870	2040	2210	2380
18	.18	.36	.54	.72	.9	1.08	1.26	1.44	1.62	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18	36	54	72	90	108	126	144	162	180	360	540	720	900	1080	1260	1440	1620	1800	1980	2160	2340	2520
19	.19	.38	.57	.76	.95	1.14	1.33	1.52	1.71	1.9	2.85	3.8	4.75	5.7	6.65	7.6	8.55	9.5	10.45	11.4	12.35	13.3	14.25	15.2	16.15	17.1	18.05	19	38	57	76	95	114	133	152	171	190	380	570	760	950	1140	1330	1520	1710	1900	2090	2280	2470	2660
20	.2	.4	.6	.8	1.	1.2	1.4	1.6	1.8	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20	40	60	80	100	120	140	160	180	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
21	.21	.42	.63	.84	1.05	1.26	1.47	1.68	1.89	2.1	3.15	4.2	5.25	6.3	7.35	8.4	9.45	10.5	11.55	12.6	13.65	14.7	15.75	16.8	17.85	18.9	19.95	21	42	63	84	105	126	147	168	189	210	420	630	840	1050	1260	1470	1680	1890	2100	2310	2520	2730	2940
22	.22	.44	.66	.88	1.1	1.32	1.54	1.76	1.98	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11.	12.1	13.2	14.3	15.4	16.5	17.6	18.7	19.8	20.9	22	44	66	88	110	132	154	176	198	220	440	660	880	1100	1320	1540	1760	1980	2200	2420	2640	2860	3080
23	.23	.46	.69	.92	1.15	1.38	1.61	1.84	2.07	2.3	3.45	4.6	5.75	6.9	8.05	9.2	10.35	11.5	12.65	13.8	14.95	16.1	17.25	18.4	19.55	20.7	21.85	23	46	69	92	115	138	161	184	207	230	460	690	920	1150	1380	1610	1840	2070	2300	2530	2760	2990	3220
24	.24	.48	.72	.96	1.2	1.44	1.68	1.92	2.16	2.4	3.6	4.8	6.	7.2	8.4	9.6	10.8	12.	13.2	14.4	15.6	16.8	18.	19.2	20.4	21.6	22.8	24	48	72	96	120	144	168	192	216	240	480	720	960	1200	1440	1680	1920	2160	2400	2640	2880	3120	3360
25	.25	.5	.75	1.	1.25	1.5	1.75	2.	2.25	2.5	3.75	5.	6.25	7.5	8.75	10.	11.25	12.5	13.75	15.	16.25	17.5	18.75	20.	21.25	22.5	23.75	25	50	75	100	125	150	175	200	225	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
26	.26	.52	.78	1.04	1.3	1.56	1.82	2.08	2.34	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7	13.	14.3	15.6	16.9	18.2	19.5	20.8	22.1	23.4	24.7	26	52	78	104	130	156	182	208	234	260	520	780	1040	1300	1560	1820	2080	2340	2600	2860	3120	3380	3640
27	.27	.54	.81	1.08	1.35	1.62	1.89	2.16	2.43	2.7	4.05	5.4	6.75	8.1	9.45	10.8	12.15	13.5	14.85	16.2	17.55	18.9	20.25	21.6	22.95	24.3	25.65	27	54	81	108	135	162	189	216	243	270	540	810	1080	1350	1620	1890	2160	2430	2700	2970	3240	3510	3780
28	.28	.56	.84	1.12	1.4	1.68	1.96	2.24	2.52	2.8	4.2	5.6	7.	8.4	9.8	11.2	12.6	14.	15.4	16.8	18.2	19.6	21.	22.4	23.8	25.2	26.6	28	56	84	112	140	168	196	224	252	280	560	840	1120	1400	1680	1960	2240	2520	2800	3080	3360	3640	3920
29	.29	.58	.87	1.16	1.45	1.74	2.03	2.32	2.61	2.9	4.35	5.8	7.25	8.7	10.15	11.6	13.05	14.5	15.95	17.4	18.85	20.3	21.75	23.2	24.65	26.1	27.55	29	58	87	116	145	174	203	232	261	290	580	870	1160	1450	1740	2030	2320	2610	2900	3190	3480	3770	4060
30	.3	.6	.9	1.2	1.5	1.8	2.1	2.4	2.7	3.	4.5	6.	7.5	9.	10.5	12.	13.5	15.	16.5	18.	19.5	21.	22.5	24.	25.5	27.	28.5	30	60	90	120	150	180	210	240	270	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4200
31	.31	.62	.93	1.24	1.55	1.86	2.17	2.48	2.79	3.1	4.65	6.2	7.75	9.3	10.85	12.4	13.95	15.5	17.05	18.6	20.15	21.7	23.25	24.8	26.35	27.9	29.45	31	62	93	124	155	186	217	248	279	310	620	930	1240	1550	1860	2170	2480	2790	3100	3410	3720	4030	4340
32	.32	.64	.96	1.28	1.6	1.92	2.24	2.56	2.88	3.2	4.8	6.4	8.	9.6	11.2	12.8	14.4	16.	17.6	19.2	20.8	22.4	24.	25.6	27.2	28.8	30.4	32	64	96	128	160	192	224	256	288	320	640	960	1280	1600	1920	2240	2560	2880	3200	3520	3840	4160	4480
33	.33	.66	.99	1.32	1.65	1.98	2.31	2.64	2.97	3.3	4.95	6.6	8.25	9.9	11.55	13.2	14.85	16.5	18.15	19.8	21.45	23.1	24.75	26.4	28.05	29.7	31.35	33	66	99	132	165	198	231	264	297	330	660	990	1320	1650	1980	2310	2640	2970	3300	3630	3960	4290	4620
34	.34	.68	1.02	1.36	1.7	2.04	2.38	2.72	3.06	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.	18.7	20.4	22.1	23.8	25.5	27.2	28.9	30.6	32.3	34	68	102	136	170	204	238	272	306	340	680	1020	1360	1700	2040	2380	2720	3060	3400	3740	4080	4420	4760
35	.35	.7	1.05	1.4	1.75	2.1	2.45	2.8	3.15	3.5	5.25	7.	8.75	10.5	12.25	14.	15.75	17.5	19.25	21.	22.75	24.5	26.25	28.	29.75	31.5	33.25	35	70	105	140	175	210	245	280	315	350	700	1050	1400	1750	2100	2450	2800	3150	3500	3850	4200	4550	4900
36	.36	.72	1.08	1.44	1.8	2.16	2.52	2.88	3.24	3.6	5.4	7.2	9.	10.8	12.6	14.4	16.2	18.	19.8	21.6	23.4	25.2	27.	28.8	30.6	32.4	34.2	36	72	108	144	180	216	252	288	324	360	720	1080	1440	1800	2160	2520	2880	3240	3600	3960	4320	4680	5040
37	.37	.74	1.11	1.48	1.85	2.22	2.59	2.96	3.33	3.7	5.55	7.4	9.25	11.1	12.95	14.8	16.65	18.5	20.35	22.2	24.05	25.9	27.75	29.6	31.45	33.3	35.15	37	74	111	148	185	222	259	296	333	370	740	1110	1480	1850	2220	2590	2960	3330	3700	4070	4440	4810	5180
38	.38	.76	1.14	1.52	1.9	2.28	2.66	3.04	3.42	3.8	5.7	7.6	9.5	11.4	13.3	15.2	17.1	19.	20.9	22.8	24.7	26.6	28.5	30.4	32.3	34.2	36.1	38	76	114	152	190	228	266	304	342	380	760	1140	1520	1900	2280	2660	3040	3420	3800	4180	4560	4940	5320
39	.39	.78	1.17	1.56	1.95	2.34	2.73	3.12	3.51	3.9	5.85	7.8	9.75	11.7	13.65	15.6	17.55	19.5	21.45	23.4	25.35	27.3	29.25	31.2	33.15	35.1	37.05	39	78	117	156	195	234	273	312	351	390	780	1170	1560	1950	2340	2730	3120	3510	3900	4290	4680	5070	5460
40	.4	.8	1.2	1.6	2.	2.4	2.8	3.2	3.6	4.	6.	8.	10.	12.	14.	16.	18.	20.	22.	24.	26.	28.	30.	32.	34.	36.	38.	40	80	120	160	200	240	280	320	360	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600
41	.41	.82	1.23	1.64	2.05	2.46	2.87	3.28	3.69	4.1	6.15	8.2	10.25	12.3	14.35	16.4	18.45	20.5	22.55	24.6	26.65	28.7	30.75	32.8	34.85	36.9	38.95	41	82	123	164	205	246	287	328	369	410	820	1230	1640	2050	2460	2870	3280	3690	4100	4510	4920	5330	5740
42	.42	.84	1.26	1.68	2.1	2.52	2.94	3.36	3.78	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21.	23.1	25.2	27.3	29.4	31.5	33.6	35.7	37.8	39.9	42	84	126	168	210	252	294	336	378	420	840	1260	1680	2100	2520	2940	3360	3780	4200	4620	5040	5460	5880
43	.43	.86	1.29	1.72	2.15	2.58	3.01	3.44	3.87	4.3	6.45	8.6	10.75	12.9	15.05	17.2	19.35	21.5	23.65	25.8	27.95	30.1	32.25	34.4	36.55	38.7	40.85	43	86	129	172	215	258	301	344	387	430	860	1290	1720	2150	2580	3010	3440	3870	4300	4730	5160	5590	6020
44	.44	.88	1.32	1.76	2.2	2.64	3.08	3.52	3.96	4.4	6.6	8.8	11.	13.2	15.4	17.6	19.8	22.	24.2	26.4	28.6	30.8	33.	35.2	37.4	39.6	41.8	44	88	132	176	220	264	308	352	396	440	880	1320	1760	2200	2640	3080	3520	3960	4400	4840	5280	5720	6160
45	.45	.9	1.35	1.8	2.25	2.7	3.15	3.6	4.05	4.5	6.75	9.	11.25	13.5	15.75	18.	20.25	22.5	24.75	27.	29.25	31.5	33.75	36.	38.25	40.5	42.75	45	90	135	180	225	270	315	360	405	450	900	1350	1800	2250	2700	3150	3600	4050	4500	4950	5400	5850	6300
46	.46	.92	1.38	1.84	2.3	2.76	3.22	3.68	4.14	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.	25.3	27.6	29.9	32.2	34.5	36.8	39.1	41.4	43.7	46	92	138	184	230	276	322	368	414	460	920	1380	1840	2300	2760	3220	3680	4140	4600	5060	5520	5980	6440
47	.47	.94	1.41	1.88	2.35	2.82	3.29	3.76	4.23	4.7	7.05	9.4	11.75	14.1	16.45	18.8	21.15	23.5	25.85	28.2	30.55	32.9	35.25	37.6	40.95	42.3	44.65	47	94	141	188	235	282	329	376	423	470	940	1410	1880	2350	2820	3290	3760	4230	4700	5170	5640	6110	6580
48	.48	.96	1.44	1.92	2.4	2.88	3.36	3.84	4.32	4.8	7.2	9.6	12.	14.4	16.8	19.2	21.6	24.	26.4	28.8	31.2	33.6	36.	38.4	41.8	43.2	45.6	48	96	144	192	240	288	336	384	432	480	960	1440	1920	2400	2880	3360	3840	4320	4800	5280	5760	6240	6720
49	.49	.98	1.47	1.96	2.45	2.94	3.43	3.92	4.41	4.9	7.35	9.8	12.25	14.7	17.15	19.6	22.05	24.5	26.95	29.4	31.85	34.3	36.75	39.2	42.65	44.1	46.55	49	98	147	196	245	294	343	392	441	490	980	1470	1960	2450	2940	3430	3920	4410	4900	5390	5880	6370	6860
50	.5	1.	1.5	2.	2.5	3.	3.5	4.	4.5	5.	7.5	10.	12.5	15.	17.5	20.	22.5	25.	27.5	30.	32.5	35.	37.5	40.	43.5	45.	47.5	50	100	150	200	250	300	350	400	450	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000
51	.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	4.59	5.1	7.65	10.2	12.75	15.3	17.85	20.4	22.95	25.5	28.05	30.6	33.15	35.7	38.25	40.8	44.35	45.9	48.45	51	102	153	204	255	306	357	408	459	510	1020	1530	2040	2550	3060	3570	4080	4590	5100	5610	6120	6630	7140
52	.52	1.04	1.56	2.08	2.6	3.12	3.64	4.16	4.68	5.2	7.8	10.4	13.	15.6	18.2	20.8	23.4	26.	28.6	31.2	33.8	36.4	39.	41.6	45.20	46.8	49.4	52	104	156	208	260	312	364	416	468	520	1040	1560	2080	2600	3120	3640	4160	4680	5200	5720	6240	6760	7280
53	.53	1.06	1.59	2.12	2.65	3.18	3.71	4.24	4.77	5.3	7.95	10.6	13.25	15.9	18.55	21.2	23.85	26.5	29.15	31.8	34.45	37.1	39.75	42.4	46.05	47.7	50.35	53	106	159	212	265	318	371	424	477	530	1060	1590	2120	2650	3180	3710	4240	4770	5300	5830	6360	6890	7420
54	.54	1.08	1.62	2.16	2.7	3.24	3.78	4.32	4.86	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.	29.7	32.4	35.1	37.8	40.5	43.2	46.9	48.6	51.3	54	108	162	216	270	324	378	432	486	540	1080	1620	2160	2700	3240	3780	4320	4860	5400	5940	6480	7020	7560
55	.55	1.1	1.65	2.2	2.75	3.3	3.85	4.4	4.95	5.5	8.25	11.	13.75	16.5	19.25	22.	24.75	27.5	30.25	33.	35.75	38.5	41.25	44.	47.75	49.5	52.25	55	110	165	220	275	330	385	440	495	550	1100	1650	2200	2750	3300	3850	4400	4950	5500	6050	6600	7150	7700
56	.56	1.12	1.68	2.24	2.8	3.36	3.92	4.48	5.04	5.6	8.4	11.2	14.	16.8	19.6	22.4	25.2	28.	30.8	33.6	36.4	39.2	42.	44.8	48.6	50.4	53.2	56	112	168	224	280	336	392	448	504	560	1120	1680	2240	2800	3360	3920	4480	5040	5600	6160	6720	7280	7840
57	.57	1.14	1.71	2.28	2.85	3.42	3.99	4.56	5.13	5.7	8.55	11.4	14.25	17.1	19.95	22.8	25.65	28.5	31.35	34.2	37.05	39.9	42.75	45.6	49.45	51.3	54.15	57	114	171	228	285	342	399	456	513	570	1140	1710	2280	2850	3420	3990	4560	5130	5700	6270	6840	7410	7980
58	.58	1.16	1.74	2.32	2.9	3.48	4.06	4.64	5.22	5.8	8.7	11.6	14.5	17.4	20.3	23.2	26.1	29.	31.9	34.8	37.7	40.6	43.5	46.4	50.3	52.2	55.1	58	116	174	232	290	348	406	464	522	580	1160	1740	2320	2900	3480	4060	4640	5220	5800	6380	6960	7540	8120
59	.59	1.18	1.77	2.36	2.95	3.54	4.13	4.72	5.31	5.9	8.85	11.8	14.75	17.7	20.65	23.6	26.55	29.5	32.45	35.4	38.35	41.3	44.25	47.2	51.15	53.1	56.05	59	118	177	236	295	354	413	472	531	590	1180	1770	2360	2950	3540	4130	4720	5310	5900	6490	7080	7670	8260
60	.6	1.2	1.8	2.4	3.	3.6	4.2	4.8	5.4	6.	9.	12.	15.	18.	21.	24.	27.	30.	33.	36.	39.	42.	45.	48.	52.	54.	57.	60	120	180	240	300	360	420	480	540	600	1200	1800	2400	3000	3600	4200	4800	5400	6000	6600	7200	7800	8400
61	.61	1.22	1.83	2.44	3.05	3.66	4.27	4.88	5.49	6.1	9.15	12.2	15.25	18.3	21.35	24.4	27.45	30.5	33.55	36.6	39.65	42.7	45.75	48.8	52.85	54.9	57.95	61	122	183	244	305	366	427	488	549	610	1220	1830	2440	3050	3660	4270	4880	5490	6100	6710	7320	7930	8540
62	.62	1.24	1.86	2.48	3.1	3.72	4.34	4.96	5.58	6.2	9.3	12.4	15.5	18.6	21.7	24.8	27.9	31.	34.1	37.2	40.3	43.4	46.5	49.6	53.7	55.8	58.9	62	124	186	248	310	372	434	496	558	620	1240	1860	2480	3100	3720	4340	4960	5580	6200	6820	7440	8060	8680
63	.63	1.26	1.89	2.52	3.15	3.78	4.41	5.04	5.67	6.3	9.45	12.6	15.75	18.9	22.05	25.2	28.35	31.5	34.65	37.8	40.95	44.1	47.25	50.4	54.55	56.7	59.85	63	126	189	252	315	378	441	504	567	630	1260	1890	2520	3150	3780	4410	5040	5670	6300	6930	7560	8190	8820
64	.64	1.28	1.92	2.56	3.2	3.84	4.48	5.12	5.76	6.4	9.6	12.8	16.	19.2	22.4	25.6	28.8	32.	35.2	38.4	41.6	44.8	48.	51.2	55.4	57.6	60.8	64	128	192	256	320	384	448	512	576	640	1280	1920	2560	3200	3840	4480	5120	5760	6400	7040	7680	8320	8960
65	.65	1.3	1.95	2.6	3.25	3.9	4.55	5.2	5.85	6.5	9.75	13.	16.25	19.5	22.75	26.	29.25	32.5	35.75	39.	42.25	45.5	48.75	52.	56.25	58.5	61.75	65	130	195	260	325	390	455	520	585	650	1300	1950	2600	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100
66	.66	1.32	1.98	2.64	3.3	3.96	4.62	5.28	5.94	6.6	9.9	13.2	16.5	19.8	23.1	26.4	29.7	33.	36.3	39.6	42.9	46.2	49.5	52.8	57.1	59.4	62.7	66	132	198	264	330	396	462	528	594	660	1320	1980	2640	3300	3960	4620	5280	5940	6600	7260	7920	8580	9240
67	.67	1.34	2.01	2.68	3.35	4.02	4.69	5.36	6.03	6.7	10.05	13.4	16.75	20.1	23.45	26.8	30.15	33.5	36.85	40.2	43.55	46.9	50.25	53.6	57.95	60.3	63.65	67	134	201	268	335	402	469	536	603	670	1340	2010	2680	3350	4020	4690	5360	6030	6700	7370	8040	8710	9380
68	.68	1.36	2.04	2.72	3.4	4.08	4.76	5.44	6.12	6.8	10.2	13.6	17.	20.4	23.8	27.2	30.6	34.	37.4	40.8	44.2	47.6	51.	54.4	58.8	61.2	64.6	68	136	204	272	340	408	476	544	612	680	1360	2040	2720	3400	4080	4760	5440	6120	6800	7480	8160	8840	9520
69	.69	1.38	2.07	2.76	3.45	4.14	4.83	5.52	6.21	6.9	10.35	13.8	17.25	20.7	24.15	27.6	31.05	34.5	37.95	41.4	44.85	48.3	51.75	55.2	59.65	62.1	65.55	69	138	207	276	345	414	483	552	621	690	1380	2070	2760	3450	4140	4830	5520	6210	6900	7590	8280	8970	9660
70	.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.	10.5	14.	17.5	21.	24.5	28.	31.5	35.	38.5	42.	45.5	49.	52.5	56.	60.5	63.	66.5	70	140	210	280	350	420	490	560	630	700	1400	2100	2800	3500	4200	4900	5600	6300	7000	7700	8400	9100	9800
71	.71	1.42	2.13	2.84	3.55	4.26	4.97	5.68	6.39	7.1	10.65	14.2	17.75	21.3	24.85	28.4	31.95	35.5	39.05	42.6	46.15	49.7	53.25	56.8	61.35	63.9	67.45	71	142	213	284	355	426	497	568	639	710	1420	2130	2840	3550	4260	4970	5680	6390	7100	7810	8520	9230	9940
72	.72	1.44	2.16	2.88	3.6	4.32	5.04	5.76	6.48	7.2	10.8	14.4	18.	21.6	25.2	28.8	32.4	36.	39.6	43.2	46.8	50.4	54.	57.6	62.2	64.8	68.4	72	144	216	288	360	432	504	576	648	720	1440	2160	2880	3600	4320	5040	5760	6480	7200	7920	8640	9360	10080
73	.73	1.46	2.19	2.92	3.65	4.38	5.11	5.84	6.57	7.3	10.95	14.6	18.25	21.9	25.55	29.2	32.85	36.5	40.15	43.8	47.45	51.1	54.75	58.4	63.05	65.7	69.35	73	146	219	292	365	438	511	584	657	730	1460	2190	2920	3650	4380	5110	5840	6570	7300	8030	8760	9490	10220
74	.74	1.48	2.22	2.96	3.7	4.44	5.18	5.92	6.66	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3	37.	40.7	44.4	48.1	51.8	55.5	59.2	63.9	66.6	70.3	74	148	222	296	370	444	518	592	666	740	1480	2220	2960	3700	4440	5180	5920	6660	7400	8140	8880	9620	10360
75	.75	1.5	2.25	3.	3.75	4.5	5.25	6.	6.75	7.5	11.25	15.	18.75	22.5	26.25	30.	33.75	37.5	41.25	45.	48.75	52.5	56.25	60.	64.75	67.5	71.25	75	150	225	300	375	450	525	600	675	750	1500	2250	3000	3750	4500	5250	6000	6750	7500	8250	9000	9750	10500
76	.76	1.52	2.28	3.04	3.8	4.56	5.32	6.08	6.84	7.6	11.4	15.2	19.	22.8	26.6	30.4	34.2	38.	41.8	45.6	49.4	53.2	57.	60.8	65.6	68.4	72.2	76	152	228	304	380	456	532	608	684	760	1520	2280	3040	3800	4560	5320	6080	6840	7600	8360	9120	9880	10640
77	.77	1.54	2.31	3.08	3.85	4.62	5.39	6.16	6.93	7.7	11.55	15.4	19.25	23.1	26.95	30.8	34.65	38.5	42.35	46.2	50.05	53.9	57.75	61.6	66.45	69.3	73.15	77	154	231	308	385	462	539	616	693	770	1540	2310	3080	3850	4620	5390	6160	6930	7700	8470	9240	10010	10780
78	.78	1.56	2.34	3.12	3.9	4.68	5.46	6.24	7.02	7.8	11.7	15.6	19.5	23.4	27.3	31.2	35.1	39.	42.9	46.8	50.7	54.6	58.5	62.4	67.3	70.2	74.1	78	156	234	312	390	468	546	624	702	780	1560	2340	3120	3900	4680	5460	6240	7020	7800	8580	9360	10140	10920
79	.79	1.58	2.37	3.16	3.95	4.74	5.53	6.32	7.11	7.9	11.85	15.8	19.75	23.7	27.65	31.6	35.55	39.5	43.45	47.4	51.35	55.3	59.25	63.2	68.15	71.1	75.05	79	158	237	316	395	474	553	632	711	790	1580	2370	3160	3950	4740	5530	6320	7110	7900	8690	9480	10270	11060
80	.8	1.6	2.4	3.2	4.	4.8	5.6	6.4	7.2	8.	12.	16.	20.	24.	28.	32.	36.	40.	44.	48.	52.	56.	60.	64.	69.	72.	76.	80	160	240	320	400	480	560	640	720	800	1600	2400	3200	4000	4800	5600	6400	7200	8000	8800	9600	10400	11200
81	.81	1.62	2.43	3.24	4.05	4.86	5.67	6.48	7.29	8.1	12.15	16.2	20.25	24.3	28.35	32.4	36.45	40.5	44.55	48.6	52.65	57.6	60.75	64.8	69.85	72.9	76.95	81	162	243	324	405	486	567	648	729	810	1620	2430	3240	4050	4860	5670	6480	7290	8100	8910	9720	10530	11340
82	.82	1.64	2.46	3.28	4.1	4.92	5.74	6.56	7.38	8.2	12.3	16.4	20.5	24.6	28.7	32.8	36.9	41.	45.1	49.2	53.3	57.4	61.5	65.6	70.7	73.8	77.9	82	164	246	328	410	492	574	656	738	820	1640	2460	3280	4100	4920	5740	6560	7380	8200	9020	9840	10660	11480
83	.83	1.66	2.49	3.32	4.15	4.98	5.81	6.64	7.47	8.3	12.45	16.6	20.75	24.9	29.05	33.2	37.35	41.5	45.65	49.8	53.95	58.1	62.25	66.4	71.55	74.7	78.85	83	166	249	332	415	498	581	664	747	830	1660	2490	3320	4150	4980	5810	6640	7470	8300	9130	9960	10790	11620
84	.84	1.68	2.52	3.36	4.2	5.04	5.88	6.72	7.56	8.4	12.6	16.8	21.	25.2	29.4	33.6	37.8	42.	46.2	50.4	54.6	58.8	63.	67.2	72.4	75.6	79.8	84	168	252	336	420	504	588	672	756	840	1680	2520	3360	4200	5040	5880	6720	7560	8400	9240	10080	10920	11760
85	.85	1.7	2.55	3.4	4.25	5.1	5.95	6.8	7.65	8.5	12.75	17.	21.25	25.5	29.75	34.	38.25	42.5	46.75	51.	55.25	59.5	63.75	68.	73.25	76.5	80.75	85	170	255	340	425	510	595	680	765	850	1700	2550	3400	4250	5100	5950	6800	7650	8500	9350	10200	11050	11900
86	.86	1.72	2.58	3.44	4.3	5.16	6.02	6.88	7.74	8.6	12.9	17.2	21.5	25.8	30.1	34.4	38.7	43.	47.3	51.6	55.9	60.2	64.5	68.8	74.1	77.4	81.7	86	172	258	344	430	516	602	688	774	860	1720	2580	3440	4300	5160	6020	6880	7740	8600	9460	10320	11180	12040
87	.87	1.74	2.61	3.48	4.35	5.22	6.09	6.96	7.83	8.7	13.05	17.4	21.75	26.1	30.45	34.8	39.15	43.5	47.85	52.2	56.55	60.9	65.25	69.6	74.95	78.3	82.65	87	174	261	348	435	522	609	696	783	870	1740	2610	3480	4350	5220	6090	6960	7830	8700	9570	10440	11310	12180
88	.88	1.76	2.64	3.52	4.4	5.28	6.16	7.04	7.92	8.8	13.2	17.6	22.	26.4	30.8	35.2	39.6	44.	48.4	52.8	57.2	61.6	66.	70.4	75.8	79.2	83.6	88	176	264	352	440	528	616	704	792	880	1760	2640	3520	4400	5280	6160	7040	7920	8800	9680	10560	11440	12320
89	.89	1.78	2.67	3.56	4.45	5.34	6.23	7.12	8.01	8.9	13.35	17.8	22.25	26.7	31.15	35.6	40.05	44.5	48.95	53.4	57.85	62.3	66.75	71.2	76.65	80.1	84.55	89	178	267	356	445	534	623	712	801	890	1780	2670	3560	4450	5340	6230	7120	8010	8900	9790	10680	11570	12460
90	.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.	13.5	18.	22.5	27.	31.5	36.	40.5	45.	49.5	54.	58.5	63.	67.5	72.	77.5	81.	85.5	90	180	270	360	450	540	630	720	810	900	1800	2700	3600	4500	5400	6300	7200	8100	9000	9900	10800	11700	12600
91	.91	1.82	2.73	3.64	4.55	5.46	6.37	7.28	8.19	9.1	13.65	18.2	22.75	27.3	31.85	36.4	40.95	45.5	50.05	54.6	59.15	63.7	68.25	72.8	78.35	81.9	86.45	91	182	273	364	455	546	637	728	819	910	1820	2730	3640	4550	5460	6370	7280	8190	9100	10010	10920	11830	12740
92	.92	1.84	2.76	3.68	4.6	5.52	6.44	7.36	8.28	9.2	13.8	18.4	23.	27.6	32.2	36.8	41.4	46.	50.6	55.2	59.8	64.4	69.	73.6	79.2	82.8	87.4	92	184	276	368	460	552	644	736	828	920	1840	2760	3680	4600	5520	6440	7360	8280	9200	10120	11040	11960	12880
93	.93	1.86	2.79	3.72	4.65	5.58	6.51	7.44	8.37	9.3	13.95	18.6	23.25	27.9	32.55	37.2	41.85	46.5	51.15	55.8	60.45	65.1	69.75	74.4	80.05	83.7	88.35	93	186	279	372	465	558	651	744	837	930	1860	2790	3720	4650	5580	6510	7440	8370	9300	10230	11160	12090	13020
94	.94	1.88	2.82	3.76	4.7	5.64	6.58	7.52	8.46	9.4	14.1	18.8	23.5	28.2	32.9	37.6	42.3	47.	51.7	56.4	61.1	65.8	70.5	75.2	80.9	84.6	89.3	94	188	282	376	470	564	658	752	846	940	1880	2820	3760	4700	5640	6580	7520	8460	9400	10340	11280	12220	13160
95	.95	1.9	2.85	3.8	4.75	5.7	6.65	7.6	8.55	9.5	14.25	19.	23.75	28.5	33.25	38.	42.75	47.5	52.25	57.	61.75	66.5	71.25	76.	81.75	85.5	90.25	95	190	285	380	475	570	665	760	855	950	1900	2850	3800	4750	5700	6650	7600	8550	9500	10450	11400	12350	13300
96	.96	1.92	2.88	3.84	4.8	5.76	6.72	7.68	8.64	9.6	14.4	19.2	24.	28.8	33.6	38.4	43.2	48.	52.8	57.6	62.4	67.2	72.	76.8	82.6	86.4	91.2	96	192	288	384	480	576	672	768	864	960	1920	2880	3840	4800	5760	6720	7680	8640	9600	10560	11520	12480	13440
97	.97	1.94	2.91	3.88	4.85	5.82	6.79	7.76	8.73	9.7	14.55	19.4	24.25	29.1	33.95	38.8	43.65	48.5	53.35	58.2	63.05	67.9	72.75	77.6	83.45	87.3	92.15	97	194	291	388	485	582	679	776	873	970	1940	2910	3880	4850	5820	6790	7760	8730	9700	10670	11640	12610	13580
98	.98	1.96	2.94	3.92	4.9	5.88	6.86	7.84	8.82	9.8	14.7	19.6	24.5	29.4	34.3	39.2	44.1	49.	53.9	58.8	63.7	68.6	73.5	78.4	84.3	88.2	93.1	98	196	294	392	490	588	686	784	882	980	1960	2940	3920	4900	5880	6860	7840	8820	9800	10780	11760	12740	13720
99	.99	1.98	2.97	3.96	4.95	5.94	6.93	7.92	8.91	9.9	14.85	19.8	24.75	29.7	34.65	39.6	44.55	49.5	54.45	59.4	64.35	69.3	74.25	79.2	85.15	89.1	94.05	99	198	297	396	495	594	693	792	891	990	1980	2970	3960	4950	5940	6930	7920	8910	9900	10890	11980	12870	13860
100	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	15.	20.	25.	30.	35.	40.	45.	50.	55.	60.	65.	70.	75.	80.	86.	90.	95.	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12100	13000	14000
105	1.05	2.1	3.15	4.2	5.25	6.3	7.35	8.4	9.45	10.5	15.75	21.	26.25	31.5	36.75	42.	47.25	52.5	57.75	63.	68.25	73.5	78.75	84.	89.25	94.5	99.75	105	210	315	420	525	630	735	840	945	1050	2100	3150	4200	5250	6300	7350	8400	9450	10500	11550	12600	13650	14700
200	2.	4.	6.	8.	10.	12.	14.	16.	18.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	170.	180.	190.	200	400	600	800	1000	1200	1400	1600	1800	2000	4000	6000	8000	10000	12000	14000	16000	18000	20000	22000	24000	26000	28000
300	3.	6.	9.	12.	15.	18.	21.	24.	27.	30.	45.	60.	75.	90.	105.	120.	135.	150.	165.	180.	195.	210.	225.	240.	255.	270.	285.	300	600	900	1200	1500	1800	2100	2400	2700	3000	6000	9000	12000	15000	18000	21000	24000	27000	30000	33000	36000	39000	42000

7256

Table III. Ration Breakdown Chart

(Strength)

Table IV. Subsistence Storage Data Nonperishables

Item	Unit	Safe storage life	
		70° F.	90° F.
Apples, dehydrated	Can	7–12	3–6
Applesauce	Can	20 to 24	12 to 15
Apricots	Can	20 to 24	12 to 15
Apricots, dried	Carton*	3 to 6	1 to 2
Asparagus	Can	24 to 30	12
Bacon, sliced	Can	18	12
Baking powder	Package*	Indefinite	Indefinite
Beans:			
Kidney, dry	Bag*	30 to 36	18
Lima	Can	30 to 36	18
Snap	Can	30 to 36	18
White, dry	Sack*	30 to 36	18
Beef:			
Corned	Can	36 to 48	24
Roasted	Can	36 to 48	24
Beef and corn	Can	36 to 48	24
Beef and macaroni with cheese sauce	Can	36 to 48	24
Beef and peas with gravy	Can	36 to 48	24
Beef and vegetables	Can	36 to 48	24
Beef with gravy	Can	36 to 48	24
Beets	Can	24 to 36	12 to 15
Beverage base:			
Lemon	Can	48	24
Orange	Can	48	24
Bouillon cubes	Can	24	10 to 12
Bread, white	Can	24	18
Cabbage, dehydrated	Can	7 to 12	5 to 6
Candy:			
Chocolate, ration	Carton*	12 to 36	16 to 18
Hard	Can	36 to 48	18 to 24
Pecan, nut, roll	Can	36 to 48	24
Starch jellies, ration	Carton*	36 to 48	18 to 24
Carrots	Can	30 to 36	18
Catsup, tomato	Can	6 to 12	3 to 6
Cereals:			
Prepared	Carton*	36	24
Wheat, farina	Can	36 to 48	18
Cheese, American, processed	Can	30 to 36	10 to 12
Cherries, red, sour, pitted	Can	7 to 12	3 to 4
Chicken, boned	Can	36 to 48	24
Chicken and noodles	Can	36 to 48	24
Chicken and vegetables	Can	36 to 48	24
Chicken or turkey, boned, solid pack	Can	36 to 48	30 to 36
Chili con carne, without beans	Can	24 to 30	18 to 24
Chili powder	Package*	24	6 to 9

For footnotes see page 11.

Table IV. Subsistence Storage Data Nonperishables—Continued

Item	Unit	Safe storage life	
		70° F.	90° F.
Cinnamon, ground	Container*	24	6 to 9
Cloves, whole	Container*	24	6 to 9
Cocoa:			
Powder	Carton*	36 to 40	18
Sirup	Can	24 to 36	12 to 18
Coffee:			
Green	Sack*	48 to 60	24
Instant	Can	60	30 to 36
Roasted and ground	Bulk*	7 days	3 days
Roasted and ground	Can or Carton*	7 to 12	5 to 6
Cookies:			
Oatmeal with chocolate chips	Can	36 to 48	24
Sandwich type	Can	36	18 to 24
Corn:			
Cream style	Can	12 to 24	7 to 9
Whole grain style	Can	30 to 36	18
Cornmeal	Package*	12 to 18	12
Cornstarch	Package*	Indefinite	Indefinite
Crackers, graham	Package*	20 to 24	10 to 12
Crackers, soda, salted	Package*	20 to 24	10 to 12
Cranberries, dehydrated	Can	7 to 12	3 to 4
Cranberry sauce	Can	18 to 24	9 to 12
Dessert powder:			
Gelatin base	Can	12 to 24	10 to 12
Starch base	Can	36 to 48	18
Eggs, whole, dry	Can	24 to 36	6 to 12
Figs	Can	20 to 24	12 to 15
Figs, dried	Can	10 to 12	5 to 6
Flavoring, imitation:			
Maple	Bottle**	Indefinite	Indefinite
Vanilla	Bottle**	Indefinite	Indefinite
Flour, wheat, hard	Bag*	9 to 12	3 to 4
Frankfurters	Can	18 to 24	18
Frankfurters and beans	Can	36 to 48	24
Fruit cake	Can	36 to 48	18 to 24
Fruit cocktail	Can	20 to 24	12 to 15
Garlic	Container*	24	6 to 9
Grapefruit, segments	Can	7 to 12	3 to 4
Ham, chunks	Can	30	24
Ham, fried	Can	30	24
Ham and eggs, chopped	Can	18 to 24	12 to 18

For footnotes see page 11.

Table IV. Subsistence Storage Data Nonperishables—Continued

Item	Unit	Safe storage life	
		70° F.	90° F.
Ham and kidney beans in sauce	Can	36 to 48	24
Ham and potatoes with gravy	Can	30	24
Hamburgers	Can	36 to 48	24
Horseradish, dehydrated	Jar*	36 to 48	6 to 12
Hot sauce	Jar*	36 to 48	6 to 12
Jam:			
Cherry	Can	12 to 18	5 to 6
Peach	Can	18 to 24	10 to 12
Pineapple	Can	18 to 24	10 to 12
Strawberry	Can	12 to 18	5 to 6
Jelly:			
Blackberry	Can	18 to 24	10 to 12
Crabapple	Can	18 to 24	10 to 12
Grape	Can	18 to 24	10 to 12
Juices:			
Grape	Can	6 to 9	2 to 3
Grapefruit and orange unsweetened	Can	6 to 9	2 to 3
Orange	Can	6 to 9	2 to 3
Pineapple	Can	6 to 9	2 to 3
Tomato	Can	6 to 9	2 to 3
Luncheon meat	Can	30	24
Macaroni	Carton*	18 to 24	10 to 12
Macaroni, spaghetti and vermicelli	Carton*	18 to 24	10 to 12
Malted milk powder	Can	12 to 24	9 to 12
Margarine	Can	24	3 to 12
Marmalade	Can	18 to 24	10 to 12
Meatballs and beans in tomato sauce	Can	24 to 30	18
Meat and noodles	Can	36 to 48	24
Meringue powder	Can	24	12 to 18
Milk, evaporated	Can**	12	6
Milk, product, dry	Can	10 to 12	5 to 6
Milk solids, dry, nonfat	Drum	12 to 24	9 to 12
Monosodium glutamate	Package*	Indefinite	Indefinite
Mustard:			
Ground	Carton*	24	6 to 9
Prepared	Bottle or jar**	18	12
Noodles, egg	Carton*	18 to 24	10 to 12
Nutmeg, ground	Container	24	6 to 9
Onions, dehydrated, sliced	Can	7 to 12	5 to 6
Parsley, dehydrated	Can	36 to 48	6 to 12

For footnotes see page 11.

Table IV. Subsistence Storage Data Nonperishables—Continued

Item	Unit	Safe storage life	
		70° F.	90° F.
Peaches	Can	24 to 36	12 to 15
Peaches, dried	Can	7 to 12	3 to 4
Peanuts, roasted, shelled	Can	18 to 24	10 to 12
Peanut butter	Can	18 to 24	10 to 12
Pears	Can	20 to 24	12 to 15
Pears, dried	Can	7 to 12	3 to 4
Peas	Can	30 to 36	18
Pepper, black, ground	Box*	36 to 48	6 to 12
Pickles, cucumber:			
Dill	Can; jar**	7 to 12	5 to 6
Sweet	Can; jar**	12 to 24	10 to 12
Pineapple	Can	20 to 24	12 to 15
Pineapple and rice	Can	24 to 36	18
Plums	Can	7 to 12	3 to 4
Pork sausage, links	Can	18 to 24	18
Pork steaks	Can	24 to 30	18
Potatoes:			
Sweet	Can	24 to 36	18
Sweet, dehydrated	Can	12 to 24	7 to 9
White	Can	24 to 48	7 to 9
White, dehydrated	Can	24 to 48	7 to 9
Pound cake	Can	48	24 to 36
Prunes, dried	Can	12 to 24	7 to 9
Pudding, steamed	Can	24 to 36	12 to 18
Raisins, seedless	Can	12 to 24	7 to 9
Rice, parboiled	Bag*	48	24 to 36
Sage, rubbed	Package*	24	6 to 9
Salad oil	Can	12	6 to 9
Salmon	Can	12 to 24	6 to 12
Salt, table	Carton*	Indefinite	Indefinite
Sauerkraut	Can	7 to 12	5 to 6
Shortening compound	Can	18 to 24	12 to 15
Sirup	Can	12 to 24	10 to 12
Soup:			
Chicken noodle, dehydrated	Can	12 to 24	7 to 9
Condensed, assorted	Can	12 to 18	6 to 8
Grean pea, dehydrated	Can	12 to 24	7 to 9
Soup and gravy base	Can	24	12 to 18
Spaghetti:			
With ground meat	Can	24 to 30	18
With meat balls	Can	24 to 30	18
Spinach	Can	24 to 36	12 to 15
Steak, beef	Can	36 to 48	24

For footnotes see page 11.

Table IV. Subsistence Storage Data Nonperishables—Continued

Item	Unit	Safe storage life	
		70° F.	90° F.
Sugar:			
Brown	Carton or bag*	Indefinite	Indefinite
Refined, granulated	Carton or bag* or	Indefinite	Indefinite
Powdered	Carton bag*	Indefinite	Indefinite
Tea	Can,	12 to 18	12
Tea, instant	Can Jar, or packet	36	16
Tomatoes	Can	7 to 12	5 to 6
Tomato paste	Can	7 to 12	5 to 6
Tuna	Can	12 to 24	6 to 12
Tuna and noodles	Can	12 to 24	6 to 12
Turkey, boned, solid pack	Can	36 to 48	30 to 36
Vinegar	Bottle**	18 to 24	12 to 18
Vinegar, dry	Jar*	36 to 48	24 to 36
Worcestershire sauce	Bottle*	36 to 48	6 to 12
Yeast, bakers active, dry	Can	7 to 12	3 to 6

* Items must be stored in covered storage.
** Items must be stored in covered storage under freezing conditions.

11. Perishable Subsistence Storage Data

Table V may be used as a guide for determining the proper storage temperatures for items of perishable subsistence and the approximate safe storage life of items at the temperatures given.

Table V. Safe Storage Periods—Perishable Subsistence

Item	Best storage temperature (degrees F.)	Approximate storage life
Apples	32	2 to 3 months
Apricots	32	7 to 10 days
Artichokes:		
Jerusalem	32	2 to 5 months
Glove	32	7 to 14 days
Asparagus	32	3 to 4 weeks
Avocados	40–55	4 weeks
Bananas	60–68	7 to 10 days

Table V. Safe Storage Periods—Perishable Subsistence—Continued

Item	Best storage temperature (degrees F.)	Approximate storage life
Beans:		
Green or snap	32	2 to 4 weeks
Lima	32	2 to 4 weeks
Beets:		
Bunch	32, 33	10 to 14 days
Topped	32, 33	1 to 3 months
Blackberries	32	7 to 10 days
Broccoli	32, 33	7 to 10 days
Brussels sprouts	32, 33	3 to 4 weeks
Butter (frozen)	−10–0	1 year
Butter (fresh)	35	2 months
Cabbage	32, 33	3 to 4 months
Carrots:		
Bunch	32, 33	7 to 10 days
Topped	32, 33	4 to 5 months
Cauliflower	32, 33	2 to 3 weeks
Celery	32, 33	2 to 4 months
Cheese	32	3 to 4 months
Cherries	32	10 to 14 days
Corn, sweet	32	3 to 5 days
Cranberries	36–40	1 to 3 months
Cucumbers	40–50	10 to 14 days
Currants	32, 33	10 to 14 days
Dates	30–32	7 to 10 days
Dewberries	32	7 to 10 days
Eggplant	40–50	7 to 10 days
Eggs:		
Shell	29–31	9 months
Shell, farm cooler	40–55	1 to 2 weeks
Frozen	−10–0	3 to 4 months
Dried, whole	35	6 months
Dried, yolk	35	6 months
Dried, spray albumen	35	6 months
Endive (escarole)	32	2 to 3 weeks
Figs, fresh	65–75	5 to 7 days
Fish:		
Fresh	33–40	1 to 3 days
Frozen	−10–0	3 to 4 months
Frozen juice concentrates:		
Grape	0	1 year
Grapefruit	0	1 year
Lemon	0	1 year
Orange	0	1 year
Frozen-pack fruits	−10–0	6 to 12 months
Frozen-pack vegetables	−10–0	6 to 12 months

Table V. Safe Storage Periods—Perishable Subsistence—Continued

Item	Best storage temperature (degrees F.)	Approximate storage life
Garlic, dry	32	6 to 8 months
Gooseberries	31, 32	3 to 4 weeks
Grapefruit	32–34	6 to 8 weeks
Grapes:		
American-type	31, 32	3 to 8 weeks
European-type	30, 31	3 to 6 months
Ice cream	0	7 to 10 days
Lard (wighout antioxidant)	32, 33	4 to 8 months
Leeks	32	1 to 3 months
Lemons	50	1 to 3 months
Lettuce	32, 33	2 to 3 weeks
Limes	45–48	6 to 8 weeks
Loganberries	31, 32	7 to 10 days
Margarine	35	1 year
Meats:		
Bacon, smoked	32	7 to 12 days
Bacon, frozen	0	6 to 8 months
Beef:		
Dried	0	3 to 6 months
Fresh	32	1 to 6 weeks
Frozen	−10–0	9 to 12 months
Corned	0	3 to 6 months
Hams and shoulders:		
Fresh	32	7 to 12 days
Frozen	−10–0	6 to 8 months
Canned	0	1 year
Cured	32	1 to 2 months
Lamb:		
Fresh	32	5 to 12 days
Frozen	−10–0	8 to 10 months
Liver	0	6 to 9 months
Pork:		
Fresh	32	3 to 7 days
Frozen	−10–0	4 to 8 months
Sausages:		
Smoked	32	7 to 12 days
Fresh	32	3 to 5 days
Frozen	−10–0	2 to 3 months
Veal:		
Fresh	32–34	5 to 10 days
Frozen	−10–0	3 to 4 months
Melons:		
Casaba and Persian	36–40	4 to 6 weeks
Honeydew and honeyballs	36–38	2 to 4 weeks
Muskmelons	32–34	7 to 10 days
Watermelons	36–40	2 to 3 weeks

Table V. Safe Storage Periods—Perishable Subsistence—Continued

Item	Best storage temperature (degrees F.)	Approximate storage life
Milk	32–35	3 days
Onions	32	6 to 8 months
Oranges	32–34	8 to 10 weeks
Parsnips	32	2 to 4 months
Peaches	32	2 to 4 weeks
Pears	32	2 to 3 months
Peas, green	32	1 to 2 weeks
Peppers, sweet	32	4 to 6 weeks
Persimmons	32	2 to 3 weeks
Pineapples:		
Mature green	50–60	3 to 4 weeks
Ripe	40–45	2 to 4 weeks
Plums	32	3 to 8 weeks
Potatoes, white Irish	38–40	8 to 10 weeks
Poultry:		
Fresh	32	1 week
Frozen	−10–0	8 to 10 months
Prunes	32	3 to 8 weeks
Pumpkins	50–55	2 to 6 months
Quinces	32	2 to 3 months
Radishes	32	2 to 4 months
Rabbit:		
Fresh	32	1 to 5 days
Frozen	−10–0	0 to 6 months
Raspberries	32	7 to 10 days
Rhubarb	32	2 to 3 weeks
Rutabagas	32	2 to 4 months
Salsify	32	2 to 4 months
Spinach	32	10 to 14 days
Squashes	50–55	2 to 6 months
Strawberries	32	7 to 10 days
Sweet potatoes	50–60	4 to 6 months
Tomatoes:		
Mature green	50–70	3 to 5 weeks
Ripe	40–50	7 to 10 days
Turnips	32	4 to 5 months
Yeast:		
Compressed	34–38	15 to 21 days
Dry granulated	40–50	2 to 3 months

12. Canned Food Data

Data on cans most commonly used in the canning of fruits and vegetables are shown in table VI. The "can equivalents" columns of table VI indicate the number of cans needed to equal each of the cans designated in the "type of can" column. Table VII gives the case equivalents of the more commonly used cans. The No. 2 and the No. 2½ case equivalents may be obtained by dividing the number of cans per case (col 5, table VI) of the can to be converted by 24 and multiplying the result by the can equivalent.

Table VI. Dimensions, Capacities, and Conversion Factors of Cans

Type of can	Dimensions*	Water capacity at 68° F. (oz)	Can equivalents			Cans per case
			No. 2	No. 2½	No. 10	
6Z	202 x 308	6.08	0.295	0.203	0.056	48
8Z short	211 x 300	7.93	.386	.266	.072	48, 72
8Z tall	211 x 304	8.68	.422	.291	.079	36, 48, 72
No. 1 square			.84	.58	.145	24
No. 1 picnic	211 x 400	10.94	.532	.367	.100	48
No. 211 cylinder	211 x 414	13.56	.660	.455	.124	24
No. 300	300 x 407	15.22	.741	.511	.139	24, 36, 48
No. 1 tall	301 x 411	16.70	.813	.561	.153	48
No. 303	303 x 406	16.88	.821	.566	.154	24 or 36
No. 303 cylinder	303 x 509	21.86	1.060	.731	.200	24
12Z vacuum			.72	.50	.142	24
No. 2 vacuum	307 x 306	14.71	.716	.50	.134	24
No. 2	307 x 409	20.55	1.000	.689	.188	24
No. 2 cylinder	307 x 512	26.4	1.284	.886	.241	24
No. 2½	401 x 411	29.79	1.450	1.000	.272	24
No. 3			.171	1.18	.347	24
No. 3 vacuum	404 x 307	23.9	1.162	.80	.218	24
No. 3 cylinder	404 x 700	51.7	2.515	1.735	.472	12
No. 5	502 x 510	59.1	2.8744	1.983	.540	12
No. 10	603 x 700	109.43	5.325	3.673	1.000	6

* The first group of digits in this column represents the outside diameter of the can; the second group, the height of the sealed can. The first digit of each group represents inches; the second and third digits of each group represent sixteenths of an inch. For example, the 6Z can is 2 5/16 inches in diameter and 3 3/16 inches in height.

Table VII. Case Equivalents

Type of can	Case equivalents		
	No. 2	No. 2½	No. 10
6Z (48)†	0.59	0.40	0.43
8Z tall (48)†	.84	.58	.63
8Z tall (72)†	1.27	.87	.95
8Z short (48)†	.77	.53	.58
8Z short (72)†	1.16	.80	.86

For footnote see page 16.

Table VII. Case Equivalents—Continued

Type of can	Case equivalents		
	No. 2	No. 2½	No. 10
No. 1 (picnic) (48)†	1.06	.73	.80
No. 1 tall (48)†	1.63	1.12	1.22
No. 1 square (24)†	.84	.58	.63
No. 211 cylinder (48)†	1.32	.91	.99
No. 300 (24)†	.74	.51	.56
No. 303 (24)†	.82	.57	.62
No. 303 (36)†	1.23	.85	.92
No. 303 cylinder (24)†	1.06	.73	.80
12Z vacuum (24)†	.72	.50	.56
No. 2 (24)†	1.00	.69	.75
No. 2 cylinder (24)†	1.284	.87	.96
No. 2 vacuum (24)†	.716	.50	.56
No. 2½ (24)†	1.45	1.00	1.09
No. 3 (24)†	1.71	1.18	1.28
No. 3 cylinder (12)†	1.26	.87	.94
No. 3 vacuum (24)†	1.16	.80	.86
No. 10 (6)†	1.33	.92	.99

† Number of cans per case.

13. Determining Cubic Feet in Ton of Hay

The average number of cubic feet per ton of hay depends upon the period of time the hay has been stacked. Table VIII may be used as a guide.

Table VIII. Cubic Feet in Ton of Hay

Time in stack	Cubic feet per ton
30 days or less	589.6
30 to 60 days	581.5
60 to 155 days	541.9

14. Perishable Subsistence Components—Weights and Cubes

Table IX provides information on weights and cubes of perishable subsistence components. It may be used as a guide for planning the build-up of perishable subsistence components. The table supplies information on the supplementation of the Standard B Ration with perishable items in oversea areas, both in the communications zone and combat zone.

a. Phases. The numbers 1 through 13 in the table represent 13 different perishable ration phases. It is anticipated that upon mobilization, situations will exist locally wherein cold storage facilities are already available or will soon be built. The phase which can be selected is

	1			2			3			4			5		
	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet
FREEZE:															
Beef, boneless	81.67	89.84	2.4500	116.66	128.33	3.5000	139.99	153.99	4.2000	139.99	153.99	4.2000	139.99	153.99	4.2000
Chicken				20.00	22.00	.7440	20.00	22.00	.7440	20.00	22.00	.7440	20.00	22.00	.7440
Fish															
Ham, smoked				48.00	51.84	1.2912	48.00	51.84	1.2912	48.00	51.84	1.2912	48.00	51.84	1.2912
Liver, beef															
Pork loins															
Sausage, xc franks															
Frankfurters															
Turkey, EVISC															
Veal															
Bacon															
Butter													10.00	11.67	.2500
Total M/Rations (1,000 men 1 day)	81.67	89.84	2.4500	184.66	202.17	5.5352	207.99	227.83	6.2352	207.99	227.83	6.2352	217.99	239.50	6.4852
Per man per month*	2.49	2.74	.07	5.63	6.17	.17	6.34	6.95	.19	6.34	6.95	.19	6.65	7.30	.20
CHILL:															
Apples										11.00	12.43	.3960	11.00	12.43	.3960
Oranges										13.33	14.41	.4212	13.33	14.41	.4212
Grapefruit															
Lemons															
Cabbage															
Carrots															
Celery															
Eggs, shell										31.50	38.49	1.4679	47.25	57.75	2.2019
Total M/Rations (1,000 men 1 day)										55.83	65.33	2.3851	71.58	84.59	3.0191
Per man per month*										1.70	1.99	.07	2.18	2.58	.09
VENT:															
Onions															
Potatoes										75.00	81.00	2.2350	75.00	81.00	2.2350
Total M/Rations (1,000 men 1 day)										75.00	81.00	2.2350	75.00	81.00	2.2350
Per man per month*	(*)									2.29	2.47	.07	2.29	2.47	.07
TOTAL FREEZE AND CHILL:															
M/Rations (1,000 men1 day)	81.67	89.84	2.4500	184.66	202.17	5.5352	207.99	227.83	6.2352	263.82	293.16	8.5203	289.57	324.09	9.5043
Per man per month	2.49	2.74	.07	5.63	6.17	.17	6.34	6.95	.19	8.04	8.94	.26	8.83	9.88	.29
GRAND TOTAL:															
M/Rations (1,000 men 1 day)	81.67	89.84	2.4500	184.66	202.17	5.5352	207.99	227.83	6.2352	338.82	374.16	10.7553	364.57	405.09	11.7393
Per man per month*	2.49	2.74	.07	5.63	6.17	.17	6.34	6.95	.19	10.33	11.41	.33	11.12	12.35	.36

	6			7			8			9			10		
	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet
FREEZE:															
Beef, boneless	139.99	153.99	4.2000	186.66	205.33	5.6000	245.00	269.50	7.3500	245.00	269.50	7.3500	245.00	269.50	7.3500
Chicken	20.00	22.00	.7440	40.00	44.00	1.4880	34.00	37.40	1.2648	34.00	37.40	1.2648	34.00	37.40	1.2648
Fish															
Ham, smoked	48.00	51.84	1.2912	48.00	51.84	1.2912	48.00	51.84	1.2912	48.00	51.84	1.2912	48.00	51.84	1.2912
Liver, beef															
Pork loins															
Sausage, xc franks															
Frankfurters															
Turkey, EVISC															
Veal															
Bacon															
Butter	10.00	11.67	.2500	10.00	11.67	.2500	30.00	35.00	.7500	30.00	35.00	.7500	30.00	35.00	.7500
Total M/Rations (1,000 men 1 day)	217.99	239.50	6.4852	284.66	312.84	8.6292	357.00	393.74	10.6560	357.00	393.74	10.6560	357.00	393.74	10.6560
Per man per month*	6.65	7.30	.20	8.68	9.54	.26	10.89	12.01	.33	10.89	12.01	.33	10.89	12.01	.33
CHILL:															
Apples	11.00	12.43	.3960	11.00	12.43	.3960	11.00	12.43	.3960	11.00	12.43	.3960	33.00	37.30	1.1880
Oranges	13.33	14.41	.4212	13.33	14.41	.4212	13.33	14.41	.4212	13.33	14.41	.4212	40.00	43.24	1.2640
Grapefruit															
Lemons															
Cabbage															
Carrots															
Celery															
Eggs, shell	62.50	76.39	2.9125	62.50	76.39	2.9125	62.50	76.39	2.9125	125.00	152.78	5.8250	125.00	152.78	5.8250
Total M/Rations (1,000 men 1 day)	86.83	103.23	3.7297	86.83	103.23	3.7297	86.83	103.23	3.7297	149.33	179.62	6.6422	198.00	233.32	8.2770
Per man per month*	2.65	3.15	.11	2.65	3.15	.11	2.65	3.15	.11	4.55	5.48	.20	6.04	7.12	.25
VENT:															
Onions															
Potatoes	75.00	81.00	2.2350	150.00	162.00	4.4700	150.00	162.00	4.4700	300.00	324.00	8.9400	300.00	324.00	8.9400
Total M/Rations (1,000 men 1 day)	75.00	81.00	2.2350	150.00	162.00	4.4700	150.00	162.00	4.4700	300.00	324.00	8.9400	300.00	324.00	8.9400
Per man per month*	2.29	2.47	.07	4.58	4.94	.14	4.58	4.94	.14	9.15	9.88	.27	9.15	9.88	.27
TOTAL FREEZE AND CHILL:															
M/Rations (1,000 men1 day)	304.82	342.73	10.2149	371.49	416.07	12.3589	443.83	496.97	14.3857	506.83	573.36	17.2982	555.00	627.06	18.9330
Per man per month	9.30	10.45	.31	11.33	12.69	.37	13.54	15.16	.44	15.44	17.49	.53	16.93	19.13	.58
GRAND TOTAL:															
M/Rations (1,000 men 1 day)	379.82	423.73	12.4999	521.49	578.07	16.8289	593.83	658.79	18.8557	806.33	897.36	26.2382	855.00	951.06	27.8730
Per man per month*	11.59	12.92	.38	15.91	17.63	.51	18.12	20.10	.58	24.59	27.37	.80	26.08	29.01	.85

	EUCOM-WW 11			KOREA 1952 MEN			FULL "A" RATION		
	11			12			13		
	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet	Net Weight (lbs)	Packaged Weight (lbs)	Packaged Cubic Feet
FREEZE:									
Beef, boneless	301.40	331.54	9.0420	342.50	376.75	10.2750	NOTE "B" IS APPLICABLE WHERE NO FIGURES ARE SHOWN		
Chicken	34.00	92.40	3.1248	84.00	92.40	3.1248			
Fish				20.00	22.00	.5200			
Ham, smoked	82.50	98.18	2.7225	82.50	98.18	2.7225			
Liver, beef				23.33	25.45	.7209			
Pork loins	30.00	33.00	.6600	30.00	33.00	.6600			
Sausage, xc franks	8.34	9.43	.3170	8.34	9.43	.3170			
Frankfurters	10.00	11.50	.1850	10.00	11.50	.1850			
Turkey, EVISC				64.00	68.98	2.7712			
Veal	21.40	23.11	.4965	45.00	48.60	1.0440			
Bacon	62.10	77.28	2.6889	62.10	77.28	2.6889			
Butter	30.00	35.00	.7500	30.00	35.00	.7500			
Total M/Rations (1,000 men 1 day)	629.74	711.44	19.9867	801.77	898.57	25.7793	1213	1360	41.30
Per man per month*	19.21	21.70	.61	24.45	27.41	.79	37.00	41.88	1.26
CHILL:									
Apples	33.00	37.30	1.1880	112.50	127.17	4.0500	NOTE "B" IS APPLICABLE WHERE NO FIGURES ARE SHOWN		
Oranges	40.00	43.24	1.2640	112.50	121.62	3.5550			
Grapefruit	50.00	53.95	1.6700						
Lemons				18.91	20.90	.6297			
Cabbage				45.00	52.80	2.1510			
Carrots				30.00	33.33	1.0200			
Celery				30.00	34.80	1.5540			
Eggs, shell	125.00	152.78	5.8250	183.60	224.40	8.5558			
Total M/Rations (1,000 men 1 day)	248.00	287.27	9.9470	532.51	615.02	21.5155	777	897	37.40
Per man per month*	7.56	8.76	.30	16.24	18.76	.66	23.70	27.36	1.14
VENT:							NOTE "B" APPLICABLE		
Onions	42.00	46.67	1.4280	42.00	46.67	1.4280			
Potatoes	362.00	398.20	11.4574	362.00	398.20	11.4754			
Total M/Rations (1,000 men 1 day)	404.00	444.87	12.9034	404.00	444.87	12.9034	582	641	19.70
Per man per month*	12.32	13.57	.39	12.32	13.57	.39	17.75	19.55	.60
TOTAL FREEZE AND CHILL:									
M/Rations (1,000 men1 day)	877.74	998.71	29.9337	1334.28	1513.59	47.2948	1990	2257	78.70
Per man per month	26.77	30.46	.91	40.69	46.17	1.45	60.70	19.24	2.40
GRAND TOTAL:									
M/Rations (1,000 men 1 day)	1281.74	1443.58	42.8371	1738.28	1958.46	60.1982	2572	2898	98.40
Per man per month*	39.09	44.03	1.30	53.01	59.74	1.84	78.45	88.79	3.00

Table IX. Weights and Cubes of Perishable Component Buildup for Planning Purposes
(PER 1,000 RATIONS)

Estimated progressive buildup of perishable ration components, following an operation where no perishables are utilized.

This table is a guide for use in computing perishable ration component requirements and storage data for war plans and operational projects.

* Based on 30½ day month.

Note "A". Packaged weights and cubes for phases 1 through 12 are based on Part II, SM 10–1–8900.

Note "B". Weights and cubes for phase 13 (Full A Ration) are based on the average requirement of three packaged cubic feet per month. Breakdown between Freeze, Chill, and Vent will vary according to specific "A" Menu).

dependent upon the troop strength and storage facilities. For example, some areas will have facilities capable of supporting phase 13; others may have facilities sufficient only of supporting phase 3; others may be able to support phase 9. It is expected that supplementation of the Standard B Ration will begin as phase 1. The selection of items is based on experience gained during World War II, and indicates the most desirable items at the most desirable frequency of issue.

b. Storage Requirements. When prefabricated refrigeration is to be considered, cube and square footage must be known; whereas, when fixed refrigeration warehouses are to be used, calculations should include square footage unless the ceiling height is known. If the ceiling height is known, both should be included. As a rule of thumb, 65 percent of the available net cubage is usable if stocking is to be by hand (5 ft–6 ft); 75 percent if stocking is to be by forklift truck (10 ft) (SR 30–20–10).

c. Interpretation of Issue Amounts. All information for subsistence is expressed in the table as pounds per 1,000 rations. This figure is selected for utility. For example, 1,000 rations can be used as the requirement for 1,000 men for 1 day and from that easily projected to 10,000, 100,000, or 1,000,000. Likewise, for menu planning, it means food for 100 men for 10 days. For menu planning purposes, multiplying by 3 will provide the requirement for 1 month for 100 men (100 x 10 x 3). For phase 1, the allowance of boneless beef is 81.67 pounds for 1,000 rations or 81.67 pounds for 100 men for 10 days, which when multiplied by 3 gives 245 pounds for 100 men for a 30-day period. To the subsistence officer, the net weight given as pounds per 1,000 rations for each item provides the basis for subsistence planning.

CHAPTER 3

QUARTERMASTER GENERAL SUPPLIES AND EQUIPMENT

15. Initial Issue, Replacement, and Consumption

a. Initial Issue. The initial issue of equipment is the supply of an item approved for issue to troops or other using agencies that have not previously been supplied such equipment. Initial issue consists of issues to inductees, issues to newly activated units, issues of new standard items, issues arising from increases in allowances due to changes in tables of organization and equipment and tables of allowances, items approved for issue in excess of the quantity authorized in approved tables, and items approved for issue to units for which there are no approved tables.

b. Replacement Issue. The replacement issue of equipment is that portion of the issues made to using agencies which replaces equipment previously supplied in order that the standards of efficiency prescribed by the Department of the Army may be maintained. Such issue consists of replacement of unserviceable equipment and replacement of losses due to wearing out beyond economical repair, abandonment, destruction, enemy action and pilferage.

c. Expendable Item. An expendable item is an item which is normally expended or used up beyond recovery in the use for which it was designed or intended.

d. Replacement Factors.

(1) The replacement factors for clothing and individual equipment represent the quantity of an item required for issue to each using individual each month regardless of the allowance in effect for the item. To obtain a quantitative replacement requirement for an item for 1 month, the factor for an individual item is multiplied by the number of individuals for whom the item is authorized during that month. This quantitative replacement requirement is valid whether each using individual is allowed one or more than one unit of the item.

(2) The replacement factors for all other items represent the quantity of the item required each month to replace each unit of the item authorized to be in use. To obtain a quantitative replacement requirement for an item for 1 month, the factor

is multiplied by the total number of units of the item authorized to be in use during that month.

e. Consumption Rate. A consumption rate represents the average quantity of an item expended during a given time interval by a specified number of users. Typical bases of consumption rates are pounds per using individual per day or quantity per 1,000 men per month. To obtain a quantitative consumption requirement for a quartermaster item for 1 month, the consumption rate is multiplied by the average number of using individuals (in thousands) during the month.

f. Sources of Replacement Factors and Consumption Rates. SB 10–38 provides a tabulation of peacetime replacement factors and consumption rates for standard quartermaster items of supply. SB 10–496 provides a tabulation of wartime replacement factors and consumption rates for standard quartermaster items of supply. Replacement factors and consumption rates given in SB 10–38 are used for the following purposes:

(1) The computation of replacement quantities needed for the establishment, within the supply control system, of the overall requirements of the Department of the Army.

(2) The computation of stockage objectives and requisitioning objectives for the continental United States and oversea commands.

(3) The editing of requisitions for materiel intended for replacement and consumption and all other authorized documents relating to replacement and consumption supply, as applicable.

(4) A guide in the determination of requirements for replacement and consumption quantities of items authorized for local procurement.

16. Tentage

Data on standard tents are given in tables X and XI.

Table X. Data on Standard Tents

Type of tent	Size			No. of men accommodated	Weight (lbs)		Bulk in storage (cu ft)		Remarks
	Floor dimensions	Height of ridge	Height of side wall		Tent only	Pins and poles	Tent only	Pins and poles	
Tent, arctic, 10-man, FWWMR, OD.	6-sided each side 8′6″	8′6″	3′	10	68	8	7.10	0.20	A 6-sided pyramidal tent supported by a telescopic center pole, this tent provides shelter for 10 men operating in extremely cold and cold-wet areas. The tent has a stovepipe opening and a fire-resistant liner for insulation purposes.
Tent, assembly, M–1942, FWWMR, OD.	40′ x 80′	21′	8′	80 (quarters). 500 (seated)	1,100	655	23.3	16.9	This is a large circus-type tent, with a rectangular center section and hip-roofed ends. The top is made in four sections that lace together. The side walls also have four sections which may be rolled up or removed when weather conditions permit. This tent is authorized for chaplains in the field or for other purposes, such as lectures or the showing of motion pictures. The tent also may be

									used for storage, truck maintenance, quartering personnel, housing the M–1945 mobile bakery unit, and other authorized uses.
Tent, command post, M–1945, FWWMR, OD.	10′ x 13′9″	9′	5′6″	3	165	92	6.3	3.6	The central part of this tent is A-shaped. The ends are hip-roofed, with converging side walls. A liner is provided for insulation, and wall screens for insect protection. The tent can be completely blacked out. It is used in theaters of operation to provide office shelter for staff sections of the several command echelons. When necessary, it may be used for quartering of three persons. It also may be used as a battalion aid station since the blackout vestibule is long enough to accommodate a litter and bearers.

Table X. Data on Standard Tents—Continued

Type of tent	Size			No. of men accommodated	Weight (lbs)		Bulk in storage (cu ft)		Remarks
	Floor dimensions	Height of ridge	Height of side wall		Tent only	Pins and poles	Tent only	Pins and poles	
Tent, frame-type, insulated, sectional, with floor, M-48.	Basic size, 16′ x 16′; extendible in length by 4′ intermediate	8′	Semi circular in cross section	4–6	556 (canvas components)	1,696 (wood & metal components)	Total 250*		This is a general-purpose vehicle-portable frame-type tent designed for use in cold climates. It is constructed of insulated blankets supported on laminated wooden arches. The floor units are insulated boxes which, when locked together in pairs, also serve as packing cases for other components of the tent.
Tent, general-purpose, large, FWWMR, OD.	18′ x 52′	12′	5′6″	24	Tent: 420 Liner 155	245	60.2	8.8	The tent is hip-roofed, square ended and rectangular in shape. It is used when a large tent is needed for storage or shelter. It may be used as a small bakery or hospital ward. The tent has 2 entrances, one at each end. Two curtains, attached to each end and near the door entrances, slide

along a double wire cable at the eave to open or shut the door. Four screened vinyl plastic windows equipped with blackout flaps are located on each side of the tent below the eave. The tent deck has ventilators at each end. Further ventilation can be obtained by leaving the door curtains open. The canvas is suspended on a webbing framework, which carries the stress and supports the canvas. The tent is pitched with the center pole placed 2 feet off center to create an unobstructed aisle extending the length of the tent. The tent is equipped with a liner with both fabric and screening side walls. The liner provides additional insulation in cold climates, and ventilation and insect protection when the tent and fabric liner side walls are rolled up in hot climates.

*Includes tents and pins. This tent has no poles.

Table X. Data on Standard Tents—Continued

Type of tent	Size			No. of men accommodated	Weight (lbs)		Bulk in storage (cu ft)		Remarks
	Floor dimensions	Height of ridge	Height of side wall		Tent only	Pins and poles	Tent only	Pins and poles	
Tent, general-purpose, medium, FWWMR, OD.	16′ x 33′	10′	5′6″	12	Tent: 255 Liner 90	200	Tent: 12.7 Liner 8.0	6.3	A hip-roofed tent similar in size to the limited standard tent, squad, M–1945, which it replaces. The tent is designed to satisfy general-purpose requirements, such as storage, personnel housing, fire direction centers, and mess tents. Each end is provided with a 4-foot-wide door, formed by two curtains which are opened and closed by sliding along a double wire at the eaveline. Screened vinyl plastic windows equipped with blackout flaps are located on each side. The tent deck has ventilators at each end and insulated stovepipe openings near the ridge. The guyline stress is carried by a webbing frame sewed in the

									tent. The tent is equipped with a liner with both fabric and screening side walls; the liner provides additional insulation in cold climates and ventilation and insect protection when tent and fabric liner side walls are rolled up in hot climates.
Tent, hexagonal, lightweight M–1950, FWWMR, OD.	6-sided each side 6′7½″ long	Peak 8′6″	2′	5–7	40	8.0	3.6	.2	A 6-sided pyramidal tent supported by a telescopic pole, this tent provides shelter for troops operating in extremely cold and cold-wet areas. The tent has a stovepipe opening and a fire-resistant liner for insulation purposes. It may be manpacked.
Tent, sectional, hospital, FWWMR, OD.	18′ x 53′	12′	6′	24	770	217	31.5	12.2	A rectangular, hip-roofed, square-end tent, made in sections that may be put together in various combinations. The tent normally consists of two end and three middle sections, with a vestibule at each end, and is equipped with a liner for insulation, detachable screening side walls for protection against insects, and a sod

Table X. Data on Standard Tents—Continued

Type of tent	Size			No. of men accommodated	Weight (lbs)		Bulk in storage (cu ft)		Remarks
	Floor dimensions	Height of ridge	Height of side wall		Tent only	Pins and poles	Tent only	Pins and poles	
Tent, sectional, hospital, FWWMR, OD.—Continued									cloth. High side walls allow maximum use of interior floor space and inside aisles for litter passage, while sectional construction permits extension to any desired length. Used with field hospital units, as a hospital ward or as a surgical operating room.
Tent, kitchen, flyproof, M–1948, FWWMR, OD.	18′ x 12′	9′ stack 12′	6′ stack 9′	----------	202	217	14.2	11.8	This tent is used as a shelter during the cooking and serving of food in the tropics. It is a rectangular A-type, square-end tent. The back portion of the tent forms a stack higher than the rest of the tent. The side and front walls may be guyed out, forming awnings on the sides and front. A wall screen which snaps to the tent provides an insectproof closure on sides and front

								when the walls are raised. The tent may be completely blacked out.
Tent, maintenance shelter, FWWMR, OD.	18′2″ x 26′9½″	13′7¾″	5′6″		500	Frame 755	26.3	58	This tent is used by the Ordnance Corps in theaters of operations for the repair of tanks and trucks. It looks like a wall tent but can be erected over a steel frame, which eliminates the use of interior poles and permits entrance of vehicles. A section of the roof may be lowered by means of slide fasteners operated by ropes to give a 10- by 10-foot opening, through which heavy equipment may be moved by a crane outside the tent. Six ground cloths are provided with each tent to form a floor for men working under vehicles.
Tent, mountain, 2-man, FWWMR, OD and white.	54″ x 82″	43″	Triangular in cross section	2	6	3.6	0.5	0.2	A man-packed, lightweight housing for two men, designed to be used in cold-climate operations, particularly in mountainous areas when ordinary means of transportation are not available for bringing in heavier types of tentage.

Table X. Data on Standard Tents—Continued

Type of tent	Size			No. of men accommodated	Weight (lbs)		Bulk in storage (cu ft)		Remarks
	Floor dimensions	Height of ridge	Height of side wall		Tent only	Pins and poles	Tent only	Pins and poles	
Shelter, half, tent, WWMR.	64″ x 84″ (approximately, for two shelter halves joined).	43″	Triangular in cross section.	2	3	1	.3	.1	This shelter half is one-half a small tent. Two shelter halves joined together form a tent providing shelter for two men. The shelter half is carried by each man as part of the field pack.
Tent, wall, large, FWWMR, OD.	14′6″ x 14′	11′	4′6″	6–8	130	145	5.8	3.1	Used as a hospital ward for pack medical units. Also used as an officers' mess, for storage of supplies, or for quartering personnel.
Fly, tent, wall, large, FWWMR, OD.	21′6″ x 14′5″	----------	----------	----------	50	----------	1.6	------	The fly is suspended above the deck of the tent to lower the temperature within the tent. It may be pitched independently of the tent to provide quick shade and shelter. It can be used for field kitchens.
Tent, wall, small, FWWMR, OD.	8′10″ x 9′2″	8′6″	3′9″	2	55	60	3.4	4.1	This tent is used mainly for the shelter of officers when in the field and not in combat. It may also be used as a

Fly, tent, wall, small, FWWMR, OD.	15′6″ x 9′4″	----------	----------	----------	23	----------	0.7	------	field first-aid station, command post, or a small storage tent. The fly is suspended above the deck of the tent to lower the temperature within the tent. It may be pitched independently of the tent to provide quick shade and shelter. It can be used for field kitchens.

Table XI. Allowances of Heating Equipment Per Tent

Type of tent	Heating equipment		
	Stove, tent, M–1941	Heater, tent, gasoline	Stove, yukon
Tent, arctic, 10-man, FWWMR, OG			1
Tent, assembly, M–1942, FWWMR, OD	4		
Tent, command post, M–1945, FWWMR, OD	1		
Tent, frame-type, insulated, sectional, with floor, M–1948.	1 or 2		
Tent, general-purpose, large, FWWMR, OD	3		
Tent, general-purpose, medium, FWWMR, OD	2		
Tent, hexagonal, lightweight, M–1950, FWWMR, OD			1
Tent, sectional, hospital, FWWMR, OD	*3		
Tent, kitchen, flyproof, M–1948, FWWMR, OD			
Tent, maintenance shelter, FWWMR, OD		1	
Tent, mountain, 2-man, FWWMR, OD and white			
Shelter half, tent, WWMR			
Tent, wall, large, FWWMR, OD	1		
Tent, wall, small, FWWMR, OD	1		

* The sectional hospital tent is usually erected with three center sections. One tent stove for each additional center section used should be added.

17. Refrigeration Supplies

a. Requirements.

(1) Each man will require approximately 3.32 cubic feet of refrigerated storage space per month of supply.

(2) Where ice is required, ice requirements are approximately 2 pounds per man per day.

b. Refrigeration Equipment. Table XII gives information on refrigeration equipment.

Table XII. Data on Refrigeration Equipment

Item	Name	Manufacturer, model No.	Federal stock No.	Storage capacity (cu ft)	Weight (lb)		Dimensions uncrated (in.)	Kind of power	Remarks
					Net	Shipped			
1	Refrigerator, mechanical, commercial, portable chest type.	York	4110–025–9039	25	2,600	3,600	94⅛ x 39¼ x 61$\frac{1}{16}$	Gasoline	This refrigerator is equipped with holdover plates set for 10° F. in 1944 models and for 0° to 40° F. in later models. It is designed for the shipment and limited storage of frozen beef and for occasional use as mess refrigerator by isolated units of less than company strength. Two refrigerators may be mounted on a 2½-ton truck or one on a 1-ton trailer. This refrigerator operates in transit.
		Universal	4110–289–2022	25	2,460	-------	94 x 38 x 57	Gasoline	
2	Refrigerator, mechanical, commercial, complete unit, reach-in type.	(Various)	4110–194–1572	65	950	2,285	90 x 36 x 78	Electric	This refrigerator is designed for use as organizational mess equipment and operates on 115-volt, 60-cycle, single-phase alternating current. It is designed for general storage and is not suitable for storage of frozen foods.

Table XII. Data on Refrigeration Equipment—Continued

Item	Name	Manufacturer, model No.	Federal stock No.	Storage capacity (cu ft)	Weight (lb)		Dimensions uncrated (in.)	Kind of power	Remarks
					Net	Shipped			
3	Refrigerator, mechanical, commercial, portable walk-in type.	Brown SPE–12	4110–222–2195	150	1,940	-------	101 x 76⅝ x 71¼	Gasoline	This is a heavy, rugged refrigerator designed for severe outdoor use with low maintenance. It contains a fully automatic blower-type refrigerating system with a temperature range from 10° to 40° F. It may be used as a temporary organizational storage warehouse or for shipment of foods by truck or ship. It can be mounted on a 2½-ton truck and will operate in transit.
4	Refrigerator, mechanical, commercial, complete unit, prefabricated, sectional, walk-in type.	----------	4110–194–1578	320	3,670	-------	96 x 96 x 94	Electric	This refrigerator is a general-storage refrigerator designed to maintain a 35° F. temperature while operating under conditions where the ambient temperature is 100° F. The refrigerator contains an air-cooled condensing unit operated by a 1-horsepower motor. This refrigerator is intended for erection within existing structures and is not to be

									used as a separate building. It is provided with one walk-in door and is not compartmented.
5	Refrigerator, mechanical, commercial, complete unit, prefabricated, sectional, walk-in type.	----------	4110–194–1579	405	5,533	--------	96 x 120 x 94	Electric	Same as item 4 except for size and storage capacity.
6	Refrigerator, mechanical, commercial, complete unit, prefabricated, sectional, walk-in type.	----------	4110–194–1583	1,310	13,119	--------	288 x 120 x 94	Electric	Same as item 4 except for size, storage capacity, and has three doors.
7	Refrigerator, mechanical, commercial, complete unit, prefabricated, walk-in type.	----------	4110–194–1584	1,650	13,575	--------	360 x 120 x 94	Electric	Same as item 6 except for size and storage capacity and for the fact that the refrigerator is equipped with a 1-horsepower condensing unit and a 2-horsepower condensing unit. The two condensing units operate independently of each other; the 1-horsepower unit provides refrigerant for one section of the refrigerator and the 2-horsepower unit for the other two sections.
8	Refrigerator, prefabricated, with refrigerating equipment.	----------	4110–203–4658	845	--------	--------	192 x 120 x 94	Electric	This refrigerator is a general storage refrigerator designed to maintain a 35° F. temperature while operating under conditions up to 100° F. This refrigerator is intended for

Table XII. Data on Refrigeration Equipment—Continued

Item	Name	Manufacturer, model No.	Federal stock No.	Storage capacity (cu ft)	Weight (lb)		Dimensions uncrated (in.)	Kind of power	Remarks
					Net	Shipped			
8	Refrigerator, prefabricated, with refrigerating equipment—Continued.								erection within existing structures and is not to be used as a separate building. It is provided with two walk-in doors.
9	Refrigerator, mechanical, commercial, complete unit, prefabricated, sectional, walk-in type.	----------	4110–197–5901	2,000	--------	--------	348 x 126 x 114	Electric	This refrigerator is designed for erection within existing structures or to be otherwise sheltered and protected. It is equipped with evaporator plates capable of maintaining a 0° F. temperature while operating in an ambient temperature of 110° F. with a wet bulb condition of 80° F. A 3-horsepower condensing unit is used to furnish power to the refrigerator system and it operates from a 220-volt, 60-cycle, 3-phase electric motor.
10	Refrigerator, mechanical, commercial, complete unit, prefabricated, sectional, walk-in type.	----------	4110–197–5902	4,000	16,000	29,182	696 x 126 x 114	Electric	Same as item 9 except for size and storage capacity and for the fact that the refrigerator is powered by a 7½ horsepower motor.

11	Refrigerator, prefabricated, without refrigerating equipment.	SPE–17 No. 1	4110–240–1178	600	3,218	6,300	111 x 94 x 153	----------	This warehouse is designed for use with an externally mounted refrigerating unit which is capable of maintaining a temperature of 0° to 35° F. during normal operation. It may be erected inside an existing structure or used as a separate building.
12	Refrigerator, prefabricated, without refrigerating equipment.	----------	4110–240–1176	1,800	10,060	--------	297 x 94 x 153	----------	Same as item 11 except that this warehouse is divided into two rooms and requires two condensing units for normal operation.
13	Ice cream plant, portable, 2½–40 gallons.	Tecknicraft X101–Q–10–QM	4110–254–4734	40 gallons	1,590	2,490	104 x 35 x 51	Electric	This ice cream plant has a freezer capacity of 2½ gallons and a hardening cabinet capacity of 40 gallons. It has an attached electric generator and an electrical connection for operation from an outside power source.
14	Ice cream plant, portable, 2½–40 gallons, with electric motor and gasoline engine.	Mills	4110–170–8233	40 gallons	1,300	1,880	79 x 36 x 56	Gasoline and electric	This ice cream plant has a self-contained gasoline engine and an electric motor. It has a freezer capacity of 2½ gallons and a hardening cabinet capacity of 40 gallons.

Table XII. Data on Refrigeration Equipment—Continued

Item	Name	Manufacturer, model No.	Federal stock No.	Storage capacity (cu ft)	Weight (lb)		Dimensions uncrated (in.)	Kind of power	Remarks
					Net	Shipped			
15	Ice cream plant, portable, 2½–40 gallons.	Lang #1000 Thompson #601, #603	4110–170–8230 4110–170–8231 4110–230–2228	40 gallons	1,250	1,912	88 x 41 x 56	Electric	Models #1000 and #601 are designed to operate from a 208-volt, 60-cycle, 3-phase current generator; Model 603 operates from a 220-volt generator. They have a freezer capacity of 2½ gallons and a hardening cabinet capacity of 40 gallons.
16	Refrigerating unit, electric-motor-driven 1/3-ton capacity.	US Thermo Q–15–E	4110–360–0156	----------	523	783	28 x 38 x 46	Electric	This is an externally mounted refrigerating unit designed to operate on 220-volt, 60-cycle, single-phase alternating current. It is fastened to the cabinet wall by means of four bolts located at the corners of the cabinet. Air circulation inside of the cabinet is obtained by the use of a blower fan mounted to the rear of the evaporator.
17	Refrigerating unit, gasoline-engine-driven, 1/3-ton capacity.	US Thermo Q–15–G	4110–360–0157	----------	700	965	33 x 38 x 60	Gasoline	Same as item 16 except that this unit is operated by a self-contained 2-cylinder gasoline engine.

18	Refrigerating unit, gasoline-engine-driven, ½-ton capacity.	US Thermo K–10 US Thermo CO–Q–5	4110–360–0159 (for QST–120 semi-trailer) 4110–360–0158 (for model TVR BQ 5 semi-trailer)	-------	720	1,311	60 x 46 x 36	Gasoline	These refrigerating units are designed for use with the 7½-ton lightweight refrigerator semitrailer. They are powered by 2-cylinder gasoline engines and the air is circulated inside the semitrailer by means of a blower fan mounted to the rear of the evaporator.
19	Refrigeration unit, mechanical, panel type, gasoline driven engine, 12,000 Btu per hour capacity, skid mounted, for refrigerated warehouse.	US Thermo MQ–51	4110–391–3207	-------	1,310	2,317	45 x 51 x 76	Gasoline	This refrigerating unit is designed for use with the prefabricated refrigerated warehouses described in items 11 and 12. Item 11 requires one condensing unit, item 12 requires two condensing units. It is a completely automatic unit powered by a 4-cylinder Crosley engine.
20	Semitrailer, refrigerator, 7½-ton, 2-wheel, lightweight.	Brown TVR–BQ 5	2330–255–8066 (6-V lighting system)	700	6,430	7,150	275 x 95 x 130	----------	These semitrailers are special-purpose cargo carriers adapted to the transportation of perishable material. Their refrigeration units (item 21) are ex-

Table XII. Data on Refrigeration Equipment—Continued

Item	Name	Manufacturer, model No.	Federal stock No.	Storage capacity (cu ft)	Weight (lb)		Dimensions uncrated (in.)	Kind of power	Remarks
					Net	Shipped			
20	Semitrailer, refrigerator, 7½-ton, 2-wheel, lightweight.—Continued.	Brown QST-120	2330–255–8065 (6- and 24-V lighting system)	-------	6,600	7,320	275 x 96 x 130	----------	ternally mounted on the front of the semitrailer and are capable of maintaining a temperature range of 0° F. to 35° F. during normal operation. The refrigeration unit can be completely removed and replaced in half an hour. These semitrailers can be towed by a standard 4- to 5-ton truck tractor.
		Thompson. M349-A1	2330–289–6798						
		Kentucky M349	2330–289–6469						

18. Special-Purpose Vehicles and Equipment

Data on special-purpose vehicles and equipment are given in table XIII.

Table XIII. Data on Special-Purpose Vehicles and Equipment

Name	Weight (lbs)	Dimensions (in.)			Cubage (cu ft)	Remarks
		Length	Width	Height		
a. Bath.						
(1) Bath unit, field, mobile, 24-showerhead, Model 2B–24.	3,800	105	72	57	249	This unit is an insulated and jacketed, oil-fired, welded steel fire tube boiler, with a hinged water back for preheating the water. It is designed to deliver approximately 1.8 to 2 gallons of warm bathing water per minute to each of the 24 showerheads. The unit is mounted on a 2-wheel trailer.
(2) Bath unit, field, mobile, 24-showerhead, Cleaver-Brooks Model EC–8D.	4,115	150	70	57.5	350	This bath unit is a self-contained liquid-fuel-fired water heater designed to supply approximately 1.6 gallons of warm bathing water per minute to each of the 24 showerheads. It is mounted on a 2-wheel trailer.
(3) Bath unit, field, mobile, 24-showerhead, M–1950.	5,600	151	72	67	421.6	This unit is an oil-fired boiler with a water back and heat exchangers. It is designed to deliver approximately 2 gallons of warm bathing water per minute to each of the 24 showerheads. It is mounted on a 2-wheel trailer.

Table XIII. Data on Special-Purpose Vehicles and Equipment—Continued

Name	Weight (lbs)	Dimensions (in.)			Cubage (cu ft)	Remarks
		Length	Width	Height		
b. Laundry.						
(1) Laundry, mobile, 2-trailer type:						This mobile laundry unit consists of a washer trailer with water heater, washer and extractor; and a tumbler trailer with a tumbler-dryer, engine and generator. These two trailers, used together, furnish complete laundering facilities with a capacity of 120 pounds dry weight per hour.
Trailer No. 1	4,300	168	78	84	637	
Trailer No. 2	4,200	168	78	84	637	
(2) Laundry, portable, skid-mounted, small detachment.	418	27.5	26	32	13	This unit consists of two laundry skids and a separately mounted, gasoline-engine-driven generator on a metal base. The washer skid includes the water heater, washer, and extractor. The tumbler skid includes the tumbler-dryer, and air heater. The capacity of the unit is approximately 50 pounds dry weight per hour.
c. Reclamation and maintenance:						
(1) Trailer, clothing repair, 2-wheel	4,400	108	67	66	277	The equipment consists of an electric generator, 6 sewing machines, 1 darning machine, and 1 button machine, plus all the accessories and auxiliary equipment for a complete clothing repair operation. It is carried on a 2-wheel trailer with a payload capacity of 2,950 pounds.

						When in position, it rests on wheels and leveling jacks, and in travel is towed by any vehicle equipped with standard Army-type pintle.
(2) Trailer, textile repair, 2-wheel	4,400	108	67	66	277	The equipment consists of 2 light sewing machines, 2 medium sewing machines, 1 darning machine, 1 overedge machine, and all the accessories and auxiliary equipment necessary for the field repair of canvas items. It is carried on a 2-wheel trailer with the same general characteristics as that used for the clothing repair units.
(3) Trailer, shoe-repair, 2-wheel	4,700	108	67	66	277	The equipment consists of a stitching and finishing machine, sole cutter, skiving machine, patching machine, 6 jacks, 1 electric generator, and all the accessories and auxiliary equipment necessary for a complete shoe repair operation. The unit is carried on a 2-wheel trailer with the same general characteristics as that used for the clothing repair unit.
d. Bakery.						
(1) Field bakery, portable, M–1942:						A section of the M–1942 portable field baking equipment consists of two M–1942 field bake ovens; four pot-type burners; a dough-mixing machine, gasoline-motor-driven; nine folding bread racks; 48 pans, baking and roasting; fermentation cans; tents; tables; and all necessary small accessories.
Oven	1,100	63	34	78	97	
Dough-mixing machine	525	20	39	46	21	
Gasoline engine	49	16.5	13⅝	16.5	2	
Water heater	45	30				

Table XIII. Data on Special-Purpose Vehicles and Equipment—Continued

Name	Weight (lbs)	Dimensions (in.)			Cubage (cu ft)	Remarks
		Length	Width	Height		
(2) Bakery unit, mobile, M–1945:						This unit consists of one mixing and makeup machinery trailer, two oven trailers, two 36-pan proofing cabinets, five dough troughs, two generator trailers, one flour sifter, folding bread racks, wheel conveyors, tents, and tables. Motive power is provided by trucks.
Mixing and makeup machine trailer.	11,000	197	88	111	1,114	
Oven trailer	6,520	200	90	84	875	
Flour sifter	190	36	36	65	49	
Proofing cabinet (36-pan)	386	70	28	70	79	
Dough trough	230	78	36	22	36	
Generator trailer	3,660	144	70	76	444	

CHAPTER 4

PETROLEUM

19. Petroleum Products Commonly Used in Theater of Operations

A tabulation of standardized fuels and lubricants that have been approved for procurement and use in Army equipment may be found in SB 38–5–3. In accordance with the policy of gasoline conversion, AR 754–9130–1 prescribes the limitations on the use of automotive-type gasoline. Table XIV provides data on commonly used petroleum products.

Table XIV. Petroleum Products Data[1]

Product	Specific gravity	API[2] gravity	Pounds per U.S. gallon
Aviation gasoline (100/130)	.7121	67.2	5.928
Aviation gasoline (115/145)	.7012	70.3	5.837
Automotive combat gasoline	.7332	61.5	6.103
Jet fuel (JP–4)	.7949	46.5	6.618
Kerosene	.8155	42.0	6.790
Diesel fuel (40 cetane)	.8448	36.0	7.034
Lubricating oil, engine	.8927	27.0	7.434
Navy special fuel oil	.9465	18.0	7.882
Avlube	.8888	27.7	7.401

[1] Averages.
[2] American Petroleum Institute.

20. Petroleum Conversion Factors

Table XV may be used for the conversion of weights and measures in handling petroleum products.

Table XV. Petroleum Conversion Factors

Multiply—	By—	To obtain—
Barrels	5.61	Cubic feet
Barrels	42.0	Gallons
Barrels	6.29	Kiloliters
Cubic feet	7.48	Gallons

Table XV. Petroleum Conversion Factors—Continued

Multiply—	By—	To obtain—
Cubic feet	0.1782	Barrel
Cubic feet	0.025	Ton, measurement
Cubic feet	0.01	Ton, register
Cubic inches	0.0043	Gallon
Gallons	231.0	Cubic inches
Gallons	0.1337	Cubic foot
Gallons	3.7854	Liters
Gallons	0.0238	Barrel
Gallons (gasoline)	6.103	Pounds
Gallons (gasoline)	0.0031	Ton, short
Gallons (gasoline)	0.0033	Ton, measurement
Gallons (gasoline)	0.0027	Ton, long
Gallons (gasoline)	0.0026	Ton, metric
Gallons (oil)	7.434	Pounds
Kiloliters	0.159	Barrel
Liters	0.2642	Gallon
Pounds	0.1639	Gallon (gasoline)
Pounds	0.1345	Gallon (oil)
Tons, long	367.21	Gallons (gasoline)
Tons, measurement	303.03	Gallons (gasoline)
Tons, measurement	1.0	Ton, short (grease)
Tons, measurement	0.1086	Ton, short (gasoline)
Tons, measurement	1.4285	Tons, short (gasoline in drums)
Tons, measurement	1.2048	Tons, short (oil in drums)
Tons, measurement	40.0	Cubic feet (gasoline)
Tons, metric	373.10	Gallons (gasoline)
Tons, short	327.8	Gallons (gasoline)
Tons, short (gasoline)	0.9195	Ton, measurement
Tons, short (gasoline in drums)	0.7	Ton, measurement
Tons, short (grease)	1.0	Ton, measurement
Tons, short (oil in drums)	0.83	Ton, measurement

21. Expansion and Contraction of Petroleum Products

Because volumes of petroleum products increase or decrease in direct proportion to temperature increase or decrease, accurate temperature of a product must be taken at the time of gaging and the measured quantity corrected to the standard temperature of 60° F. When gaging large quantities, it is often necessary to take several temperature readings at various levels and average these readings to determine the true average temperature of the product. Table XVI specifies the number of readings necessary and the points at which readings should be taken for various depths of product.

Table XVI. Procedural Data for Petroleum Product Temperature Measurements

Depth of product	Minimum No. of temperature measurements	Measurement levels
More than 15 feet	3	3 feet below top surface of product, middle of product, and 3 feet above bottom surface of product.
10 feet to 15 feet	2	3 feet below top surface of product, and 3 feet above bottom surface of product.
Less than 10 feet	1	Middle of product.

22. Volume Correction for Petroleum Products

a. To convert a measured volume of product at observed temperature to corresponding volume at 60° F., it is first necessary to determine the API gravity group number corresponding to the product (table XVII).

b. Table XVIII gives conversion factors for the various API groups at observed temperatures. Multiply the volume at observed temperature by the appropriate conversion factor to obtain corresponding volume at 60° F. For example, 100 gallons of automotive combat gasoline (group 3) at an observed temperature of 80° F., is converted to corresponding volume at 60° F. by multiplying by the factor 0.9879. The result is 98.79 gallons at 60° F.

Table XVII. API Gravity Groups

Group No.	Coefficient of expansion	Corresponding degrees API	Range of group (degrees API/60°)	Products normally in group
0	.00035	6	Up to 14.9	Heavy crude oils
1	.0004	22	15.0 to 34.9	Light crude oils Residual fuel oils Lubricating oils
2	.0005	44	35.0 to 50.9	Kerosene Heavy diesel fuels Solvents Jet fuels
3	.0006	58	51.0 to 63.9	Motor gasolines Light diesel fuels
4	.0007	72	64.0 to 78.9	Aviation gasolines
5	.0008	86	79.0 to 88.9	Liquefied gases
6	.00085	91	89.0 to 93.9	
7	.0009	97	94.0 to 99.9	

Table XVIII. Volume Correction Table for Petroleum Products

Observed temperature °F.	Group number and API gravity range at 60° F.							
	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API	64.0–78.9° API	79.0–88.9° API	89.0–93.9° API	94.0–100.0° API
	Factor for reducing volume to 60° F.							
0	1.0211	1.0241	1.0298	1.0362	1.0419	1.0478	1.0501	1.0532
1	1.0208	1.0237	1.0293	1.0356	1.0412	1.0470	1.0493	1.0523
2	1.0204	1.0233	1.0288	1.0350	1.0405	1.0462	1.0484	1.0514
3	1.0201	1.0229	1.0283	1.0344	1.0399	1.0454	1.0476	1.0506
4	1.0197	1.0225	1.0278	1.0338	1.0392	1.0446	1.0468	1.0497
5	1.0194	1.0221	1.0273	1.0332	1.0385	1.0438	1.0460	1.0488
6	1.0190	1.0217	1.0268	1.0326	1.0378	1.0430	1.0451	1.0479
7	1.0186	1.0213	1.0263	1.0320	1.0371	1.0423	1.0443	1.0470
8	1.0183	1.0209	1.0258	1.0314	1.0364	1.0415	1.0435	1.0462
9	1.0179	1.0205	1.0253	1.0308	1.0357	1.0407	1.0427	1.0453
10	1.0176	1.0201	1.0248	1.0302	1.0350	1.0399	1.0418	1.0444
11	1.0172	1.0197	1.0243	1.0296	1.0343	1.0391	1.0410	1.0435
12	1.0169	1.0193	1.0238	1.0290	1.0336	1.0383	1.0402	1.0427
13	1.0165	1.0189	1.0233	1.0284	1.0329	1.0375	1.0393	1.0418
14	1.0162	1.0185	1.0228	1.0278	1.0322	1.0367	1.0385	1.0409
15	1.0158	1.0181	1.0223	1.0272	1.0315	1.0359	1.0377	1.0400
16	1.0165	1.0177	1.0218	1.0266	1.0308	1.0351	1.0369	1.0391
17	1.0151	1.0173	1.0214	1.0260	1.0301	1.0343	1.0360	1.0383
18	1.0148	1.0168	1.0209	1.0253	1.0294	1.0336	1.0352	1.0374
19	1.0144	1.0164	1.0204	1.0247	1.0287	1.0328	1.0344	1.0365
20	1.0141	1.0160	1.0199	1.0241	1.0280	1.0320	1.0335	1.0356
21	1.0137	1.0156	1.0194	1.0235	1.0273	1.0312	1.0327	1.0347
22	1.0133	1.0152	1.0189	1.0229	1.0266	1.0304	1.0319	1.0338
23	1.0130	1.0148	1.0184	1.0223	1.0259	1.0296	1.0310	1.0330
24	1.0126	1.0144	1.0179	1.0217	1.0253	1.0288	1.0302	1.0321
25	1.0123	1.0140	1.0174	1.0211	1.0246	1.0280	1.0294	1.0312
26	1.0119	1.0136	1.0169	1.0205	1.0239	1.0272	1.0285	1.0303
27	1.0116	1.0132	1.0164	1.0199	1.0232	1.0264	1.0277	1.0294
28	1.0112	1.0128	1.0159	1.0193	1.0225	1.0256	1.0269	1.0285
29	1.0109	1.0124	1.0154	1.0187	1.0218	1.0248	1.0260	1.0276
30	1.0105	1.0120	1.0149	1.0181	1.0211	1.0240	1.0252	1.0268
31	1.0102	1.0116	1.0144	1.0175	1.0204	1.0232	1.0244	1.0259
32	1.0098	1.0112	1.0139	1.0169	1.0197	1.0224	1.0235	1.0250
33	1.0095	1.0108	1.0134	1.0163	1.0190	1.0216	1.0227	1.0241
34	1.0091	1.0104	1.0129	1.0157	1.0183	1.0208	1.0219	1.0232
35	1.0088	1.0100	1.0124	1.0151	1.0176	1.0200	1.0210	1.0223
36	1.0084	1.0096	1.0119	1.0145	1.0169	1.0192	1.0202	1.0214
37	1.0081	1.0092	1.0114	1.0139	1.0162	1.0184	1.0193	1.0205
38	1.0077	1.0088	1.0109	1.0133	1.0155	1.0176	1.0185	1.0197
39	1.0074	1.0084	1.0104	1.0127	1.0148	1.0168	1.0177	1.0188

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.							
	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API	64.0–78.9° API	79.0–88.9° API	89.0–93.9° API	94.0–100.0° API
	Factor for reducing volume to 60° F.							
40	1.0070	1.0080	1.0099	1.0121	1.0141	1.0160	1.0168	1.0179
41	1.0067	1.0076	1.0094	1.0115	1.0134	1.0152	1.0160	1.0170
42	1.0063	1.0072	1.0089	1.0109	1.0127	1.0144	1.0152	1.0161
43	1.0060	1.0068	1.0084	1.0103	1.0120	1.0136	1.0143	1.0152
44	1.0056	1.0064	1.0079	1.0097	1.0113	1.0128	1.0135	1.0143
45	1.0053	1.0060	1.0075	1.0091	1.0106	1.0120	1.0126	1.0134
46	1.0049	1.0056	1.0070	1.0085	1.0099	1.0112	1.0118	1.0125
47	1.0046	1.0052	1.0065	1.0079	1.0091	1.0104	1.0110	1.0116
48	1.0042	1.0048	1.0060	1.0073	1.0084	1.0096	1.0101	1.0107
49	1.0038	1.0044	1.0055	1.0067	1.0077	1.0088	1.0093	1.0099
50	1.0035	1.0040	1.0050	1.0061	1.0070	1.0080	1.0084	1.0090
51	1.0031	1.0036	1.0045	1.0054	1.0063	1.0072	1.0076	1.0081
52	1.0028	1.0032	1.0040	1.0048	1.0056	1.0064	1.0067	1.0072
53	1.0024	1.0028	1.0035	1.0042	1.0049	1.0056	1.0059	1.0063
54	1.0021	1.0024	1.0030	1.0036	1.0042	1.0048	1.0051	1.0054
55	1.0017	1.0020	1.0025	1.0030	1.0035	1.0040	1.0042	1.0045
56	1.0014	1.0016	1.0020	1.0024	1.0028	1.0032	1.0034	1.0036
57	1.0010	1.0012	1.0015	1.0018	1.0021	1.0024	1.0025	1.0027
58	1.0007	1.0008	1.0010	1.0012	1.0014	1.0016	1.0017	1.0018
59	1.0003	1.0004	1.0005	1.0006	1.0007	1.0008	1.0008	1.0009
60	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
61	0.9997	0.9996	0.9995	0.9994	0.9993	0.9992	0.9992	0.9991
62	0.9993	0.9992	0.9990	0.9988	0.9986	0.9984	0.9983	0.9982
63	0.9990	0.9988	0.9985	0.9982	0.9979	0.9976	0.9975	0.9973
64	0.9986	0.9984	0.9980	0.9976	0.9972	0.9968	0.9966	0.9964
65	0.9983	0.9980	0.9975	0.9970	0.9965	0.9960	0.9958	0.9955
66	0.9979	0.9976	0.9970	0.9964	0.9958	0.9952	0.9949	0.9946
67	0.9976	0.9972	0.9965	0.9958	0.9951	0.9944	0.9941	0.9937
68	0.9972	0.9968	0.9960	0.9951	0.9944	0.9935	0.9932	0.9928
69	0.9969	0.9964	0.9955	0.9945	0.9936	0.9927	0.9924	0.9919
70	0.9965	0.9960	0.9950	0.9939	0.9929	0.9919	0.9915	0.9910
71	0.9962	0.9956	0.9945	0.9933	0.9922	0.9911	0.9907	0.9901
72	0.9958	0.9952	0.9940	0.9927	0.9915	0.9903	0.9898	0.9892
73	0.9955	0.9948	0.9935	0.9921	0.9908	0.9895	0.9890	0.9883
74	0.9951	0.9944	0.9930	0.9915	0.9901	0.9887	0.9881	0.9874
75	0.9948	0.9940	0.9925	0.9909	0.9894	0.9879	0.9873	0.9865
76	0.9944	0.9936	0.9920	0.9903	0.9887	0.9871	0.9864	0.9856
77	0.9941	0.9932	0.9916	0.9897	0.9880	0.9863	0.9856	0.9847
78	0.9937	0.9929	0.9911	0.9891	0.9873	0.9855	0.9847	0.9838
79	0.9934	0.9925	0.9906	0.9885	0.9866	0.9846	0.9839	0.9829

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.							
	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API	64.0–78.9° API	79.0–88.9° API	89.0–93.9° API	94.0–100.0° API
	Factor for reducing volume to 60° F.							
80	0.9930	0.9921	0.9901	0.9879	0.9859	0.9838	0.9830	0.9820
81	0.9927	0.9917	0.9896	0.9873	0.9851	0.9830	0.9822	0.9811
82	0.9923	0.9913	0.9891	0.9866	0.9844	0.9822	0.9813	0.9802
83	0.9920	0.9909	0.9886	0.9860	0.9837	0.9814	0.9805	0.9792
84	0.9916	0.9905	0.9881	0.9854	0.9830	0.9806	0.9796	0.9783
85	0.9913	0.9901	0.9876	0.9848	0.9823	0.9798	0.9788	0.9774
86	0.9909	0.9897	0.9871	0.9842	0.9816	0.9790	0.9779	0.9765
87	0.9906	0.9893	0.9866	0.9836	0.9809	0.9781	0.9771	0.9756
88	0.9902	0.9889	0.9861	0.9830	0.9802	0.9773	0.9762	0.9747
89	0.9899	0.9885	0.9856	0.9824	0.9795	0.9765	0.9753	0.9738
90	0.9896	0.9881	0.9851	0.9818	0.9787	0.9757	0.9745	0.9729
91	0.9892	0.9877	0.9846	0.9812	0.9780	0.9749	0.9736	0.9720
92	0.9889	0.9873	0.9841	0.9806	0.9773	0.9741	0.9728	0.9711
93	0.9885	0.9869	0.9836	0.9799	0.9766	0.9733	0.9719	0.9702
94	0.9882	0.9865	0.9831	0.9793	0.9759	0.9724	0.9711	0.9693
95	0.9878	0.9861	0.9826	0.9787	0.9752	0.9716	0.9702	0.9683
96	0.9875	0.9857	0.9821	0.9781	0.9745	0.9708	0.9694	0.9674
97	0.9871	0.9854	0.9816	0.9775	0.9738	0.9700	0.9685	0.9665
98	0.9868	0.9850	0.9811	0.9769	0.9731	0.9692	0.9676	0.9656
99	0.9864	0.9846	0.9806	0.9763	0.9723	0.9684	0.9668	0.9647
100	0.9861	0.9842	0.9801	0.9757	0.9716	0.9675	0.9659	0.9638
101	0.9857	0.9838	0.9796	0.9751	0.9709	0.9667	0.9651	0.9629
102	0.9854	0.9834	0.9791	0.9745	0.9702	0.9659	0.9642	0.9620
103	0.9851	0.9830	0.9786	0.9738	0.9695	0.9651	0.9633	0.9610
104	0.9847	0.9826	0.9781	0.9732	0.9688	0.9613	0.9625	0.9601
105	0.9844	0.9822	0.9776	0.9726	0.9684	0.9634	0.9616	0.9592
106	0.9840	0.9818	0.9771	0.9720	0.9673	0.9626	0.9608	0.9583
107	0.9837	0.9814	0.9766	0.9714	0.9666	0.9618	0.9599	0.9574
108	0.9833	0.9810	0.9761	0.9708	0.9659	0.9610	0.9590	0.9565
109	0.9830	0.9806	0.9756	0.9702	0.9652	0.9602	0.9582	0.9555
110	0.9826	0.9803	0.9751	0.9696	0.9645	0.9593	0.9573	0.9546
111	0.9823	0.9799	0.9746	0.9690	0.9638	0.9585	0.9565	0.9537
112	0.9819	0.9795	0.9741	0.9683	0.9630	0.9577	0.9556	0.9528
113	0.9816	0.9791	0.9736	0.9677	0.9623	0.9569	0.9547	0.9519
114	0.9813	0.9787	0.9731	0.9671	0.9616	0.9561	0.9539	0.9510
115	0.9809	0.9783	0.9726	0.9665	0.9609	0.9552	0.9530	0.9500
116	0.9806	0.9779	0.9721	0.9659	0.9602	0.9544	0.9521	0.9491
117	0.9802	0.9775	0.9717	0.9653	0.9595	0.9536	0.9513	0.9482
118	0.9799	0.9771	0.9712	0.9647	0.9587	0.9528	0.9505	0.9473
119	0.9795	0.9767	0.9707	0.9641	0.9580	0.9519	0.9495	0.9464

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.							
	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API	64.0–78.9° API	79.0–88.9° API	89.0–93.9° API	94.0–100.0° API
	Factor for reducing volume to 60° F.							
120	0.9792	0.9763	0.9702	0.9634	0.9573	0.9511	0.9487	0.9454
121	0.9788	0.9760	0.9697	0.9628	0.9566	0.9503	0.9478	0.9445
122	0.9785	0.9756	0.9692	0.9622	0.9559	0.9495	0.9469	0.9436
123	0.9782	0.9752	0.9687	0.9616	0.9552	0.9487	0.9461	0.9427
124	0.9778	0.9748	0.9682	0.9610	0.9544	0.9478	0.9452	0.9418
125	0.9775	0.9744	0.9677	0.9604	0.9537	0.9470	0.9443	0.9408
126	0.9771	0.9740	0.9672	0.9598	0.9530	0.9462	0.9435	0.9399
127	0.9768	0.9736	0.9667	0.9592	0.9523	0.9454	0.9426	0.9390
128	0.9764	0.9732	0.9662	0.9585	0.9516	0.9445	0.9417	0.9381
129	0.9761	0.9728	0.9657	0.9579	0.9508	0.9437	0.9409	0.9371
130	0.9758	0.9725	0.9652	0.9573	0.9501	0.9429	0.9400	0.9362
131	0.9754	0.9721	0.9647	0.9567	0.9494	0.9420	0.9391	0.9353
132	0.9751	0.9717	0.9642	0.9561	0.9487	0.9412	0.9383	0.9344
133	0.9747	0.9713	0.9637	0.9555	0.9480	0.9404	0.9374	0.9334
134	0.9744	0.9709	0.9632	0.9549	0.9472	0.9396	0.9365	0.9325
135	0.9740	0.9705	0.9627	0.9542	0.9465	0.9387	0.9357	0.9316
136	0.9737	0.9701	0.9622	0.9536	0.9458	0.9379	0.9348	0.9307
137	0.9734	0.9697	0.9617	0.9530	0.9451	0.9371	0.9339	0.9297
138	0.9730	0.9693	0.9612	0.9524	0.9444	0.9362	0.9330	0.9288
139	0.9727	0.9690	0.9607	0.9518	0.9436	0.9354	0.9322	0.9279
140	0.9723	0.9686	0.9602	0.9512	0.9429	0.9346	0.9313	0.9270
141	0.9720	0.9682	0.9597	0.9506	0.9422	0.9338	0.9304	0.9260
142	0.9716	0.9678	0.9592	0.9499	0.9415	0.9329	0.9296	0.9251
143	0.9713	0.9674	0.9587	0.9493	0.9407	0.9321	0.9287	0.9242
144	0.9710	0.9670	0.9582	0.9487	0.9400	0.9313	0.9278	0.9232
145	0.9706	0.9666	0.9577	0.9481	0.9393	0.9304	0.9269	0.9223
146	0.9703	0.9662	0.9572	0.9475	0.9386	0.9296	0.9261	0.9214
147	0.9699	0.9659	0.9567	0.9469	0.9379	0.9288	0.9252	0.9204
148	0.9696	0.9655	0.9562	0.9462	0.9371	0.9279	0.9243	0.9195
149	0.9693	0.9651	0.9557	0.9456	0.9364	0.9271	0.9234	0.9186
150	0.9689	0.9647	0.9552	0.9450	0.9357	0.9263	0.9226	0.9177

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.				Observed temperature °F.	Group number and API gravity range at 60° F.		
	Group 0	Group 1	Group 2	Group 3		Group 0	Group 1	Group 2
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API		0–14.9° API	15.0–34.9° API	35.0–50.9° API
	Factor for reducing volume to 60° F.					Factor for reducing volume to 60° F.		
150	0.9689	0.9647	0.9552	0.9450	200	0.9520	0.9456	0.9303
151	0.9686	0.9643	0.9547	0.9444	201	0.9516	0.9452	0.9298
152	0.9682	0.9639	0.9542	0.9438	202	0.9513	0.9448	0.9293
153	0.9679	0.9635	0.9537	0.9432	203	0.9509	0.9444	0.9288
154	0.9675	0.9632	0.9532	0.9426	204	0.9506	0.9441	0.9283
155	0.9672	0.9628	0.9527	0.9419	205	0.9503	0.9437	0.9278
156	0.9669	0.9624	0.9522	0.9413	206	0.9499	0.9433	0.9273
157	0.9665	0.9620	0.9517	0.9407	207	0.9496	0.9429	0.9268
158	0.9662	0.9616	0.9512	0.9401	208	0.9493	0.9425	0.9263
159	0.9658	0.9612	0.9507	0.9395	209	0.9489	0.9422	0.9258
160	0.9655	0.9609	0.9502	0.9389	210	0.9486	0.9418	0.9253
161	0.9652	0.9605	0.9497	0.9382	211	0.9483	0.9414	0.9248
162	0.9648	0.9601	0.9492	0.9376	212	0.9479	0.9410	0.9243
163	0.9645	0.9597	0.9487	0.9370	213	0.9476	0.9407	0.9238
164	0.9641	0.9593	0.9482	0.9364	214	0.9472	0.9403	0.9233
165	0.9638	0.9589	0.9477	0.9358	215	0.9469	0.9399	0.9228
166	0.9635	0.9585	0.9472	0.9351	216	0.9466	0.9395	0.9223
167	0.9631	0.9582	0.9467	0.9345	217	0.9462	0.9391	0.9218

168	0.9628	0.9578	0.9462	0.9339	218	0.9459	0.9388	0.9213
169	0.9624	0.9574	0.9457	0.9333	219	0.9456	0.9384	0.9208
170	0.9621	0.3570	0.9452	0.9327	220	0.9452	0.9380	0.9203
171	0.9618	0.9566	0.9447	0.9321	221	0.9449	0.9376	0.9198
172	0.9614	0.9562	0.9442	0.9314	222	0.9446	0.9373	0.9193
173	0.9611	0.9559	0.9437	0.9308	223	0.9442	0.9369	0.9188
174	0.9607	0.9555	0.9432	0.9302	224	0.9439	0.9365	0.9183
175	0.9604	0.9551	0.9428	0.9296	225	0.9436	0.9361	0.9178
176	0.9601	0.9547	0.9423	0.9290	226	0.9432	0.9358	0.9173
177	0.9597	0.9543	0.9418	0.9283	227	0.9429	0.9354	0.9168
178	0.9594	0.9539	0.9413	0.9277	228	0.9426	0.9350	0.9163
179	0.9590	0.9536	0.9408	0.9271	229	0.9422	0.9346	0.9158
180	0.9587	0.9532	0.9403	0.9265	230	0.9419	0.9343	0.9153
181	0.9584	0.9528	0.9398	0.9259	231	0.9416	0.9339	0.9148
182	0.9580	0.9524	0.9393	0.9252	232	0.9412	0.9335	0.9143
183	0.9577	0.9520	0.9388	0.9246	233	0.9409	0.9331	0.9138
184	0.9574	0.9517	0.9383	0.9240	234	0.9405	0.9328	0.9133
185	0.9570	0.9513	0.9378	0.9234	235	0.9402	0.9324	0.9128
186	0.9567	0.9509	0.9373	0.9228	236	0.9399	0.9320	0.9123
187	0.9563	0.9505	0.9368	0.9221	237	0.9395	0.9316	0.9118
188	0.9560	0.9501	0.9363	0.9215	238	0.9392	0.9313	0.9113
189	0.9557	0.9498	0.9358	0.9209	239	0.9389	0.9309	0.9108
190	0.9553	0.9494	0.9353	0.9203	240	0.9385	0.9305	0.9103
191	0.9550	0.9490	0.9348	0.9197	241	0.9382	0.9301	0.9098
192	0.9547	0.9486	0.9343	0.9190	242	0.9379	0.9298	0.9093
193	0.9543	0.9482	0.9338	0.9184	243	0.9375	0.9294	0.9088
194	0.9540	0.9478	0.9333	0.9178	244	0.9372	0.9290	0.9083
195	0.9536	0.9475	0.9328	0.9172	245	0.9369	0.9286	0.9078

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.				Observed temperature °F.	Group number and API gravity range at 60° F.		
	Group 0	Group 1	Group 2	Group 3		Group 0	Group 1	Group 2
	0–14.9° API	15.0–34.9° API	35.0–50.9° API	51.0–63.9° API		0–14.9° API	15.0–34.9° API	35.0–50.9° API
	Factor for reducing volume to 60° F.					Factor for reducing volume to 60° F.		
196	0.9533	0.9471	0.9323	0.9166	246	0.9365	0.9283	0.9073
197	0.9530	0.9467	0.9318	0.9159	247	0.9362	0.9279	0.9068
198	0.9526	0.9463	0.9313	0.9153	248	0.9359	0.9275	0.9063
199	0.9523	0.9460	0.9308	0.9147	249	0.9356	0.9272	0.9058
200	0.9520	0.9456	0.9303	0.9141	250	0.9352	0.9268	0.9053

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.	
	Group 0	Group 1		Group 0	Group 1		Group 0	Group 1
	0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API
	Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.	
250	0.9352	0.9268	285	0.9236	0.9138	320	0.9122	0.9010
251	0.9349	0.9264	286	0.9233	0.9135	321	0.9118	0.9007
252	0.9346	0.9260	287	0.9230	0.9131	322	0.9115	0.9003
253	0.9342	0.9257	288	0.9227	0.9127	323	0.9112	0.9000
254	0.9339	0.9253	289	0.9223	0.9124	324	0.9109	0.8996
255	0.9336	0.9249	290	0.9220	0.9120	325	0.9105	0.8992
256	0.9332	0.9245	291	0.9217	0.9116	326	0.9102	0.8989
257	0.9329	0.9242	292	0.9213	0.9113	327	0.9099	0.8985
258	0.9326	0.9238	293	0.9210	0.9109	328	0.9096	0.8981
259	0.9322	0.9234	294	0.9207	0.9105	329	0.9092	0.8978
260	0.9319	0.9231	295	0.9204	0.9102	330	0.9089	0.8974
261	0.9316	0.9227	296	0.9200	0.9098	331	0.9086	0.8971
262	0.9312	0.9223	297	0.9197	0.9094	332	0.9083	0.8967
263	0.9309	0.9219	298	0.9194	0.9091	333	0.9079	0.8963
264	0.9306	0.9216	299	0.9190	0.9087	334	0.9076	0.8960
265	0.9302	0.9212	300	0.9187	0.9083	335	0.9073	0.8956
266	0.9299	0.9208	301	0.9184	0.9080	336	0.9070	0.8952
267	0.9296	0.9205	302	0.9181	0.9076	337	0.9066	0.8949
268	0.9293	0.9201	303	0.9177	0.9072	338	0.9063	0.8945
269	0.9289	0.9197	304	0.9174	0.9069	339	0.9060	0.8942
270	0.9286	0.9194	305	0.9171	0.9065	340	0.9057	0.8938
271	0.9283	0.9190	306	0.9167	0.9061	341	0.9053	0.8934
272	0.9279	0.9186	307	0.9164	0.9058	342	0.9050	0.8931
273	0.9276	0.9182	308	0.9161	0.9054	343	0.9047	0.8927
274	0.9273	0.9179	309	0.9158	0.9050	344	0.9044	0.8924
275	0.9269	0.9175	310	0.9154	0.9047	345	0.9040	0.8920
276	0.9266	0.9171	311	0.9151	0.9043	346	0.9037	0.8916
277	0.9263	0.9168	312	0.9148	0.9039	347	0.9034	0.8913
278	0.9259	0.9164	313	0.9145	0.9036	348	0.9031	0.8909
279	0.9256	0.9160	314	0.9141	0.9032	349	0.9028	0.8906
280	0.9253	0.9157	315	0.9138	0.9029	350	0.9024	0.8902
281	0.9250	0.9153	316	0.9135	0.9025	351	0.9021	0.8899
282	0.9246	0.9149	317	0.9132	0.9021	352	0.9018	0.8895
283	0.9243	0.9146	318	0.9128	0.9018	353	0.9015	0.8891
284	0.9240	0.9142	319	0.9125	0.9014	354	0.9011	0.8888

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.	
	Group 0	Group 1		Group 0	Group 1		Group 0	Group 1
	0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API
	Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.	
355	0.9008	0.8884	390	0.8896	0.8760	425	0.8784	0.8637
356	0.9005	0.8881	391	0.8892	0.8756	426	0.8781	0.8633
357	0.9002	0.8877	392	0.8889	0.8753	427	0.8778	0.8630
358	0.8998	0.8873	393	0.8886	0.8749	428	0.8775	0.8626
359	0.8995	0.8870	394	0.8883	0.8746	429	0.8772	0.8623
360	0.8992	0.8866	395	0.8880	0.8742	430	0.8768	0.8619
361	0.8989	0.8863	396	0.8876	0.8738	431	0.8765	0.8616
362	0.8986	0.8859	397	0.8873	0.8735	432	0.8762	0.8612
363	0.8982	0.8856	398	0.8870	0.8731	433	0.8759	0.8609
364	0.8979	0.8852	399	0.8867	0.8728	434	0.8756	0.8605
365	0.8976	0.8848	400	0.8864	0.8724	435	0.8753	0.8602
366	0.8973	0.8845	401	0.8861	0.8721	436	0.8749	0.8599
367	0.8969	0.8841	402	0.8857	0.8717	437	0.8746	0.8595
368	0.8966	0.8838	403	0.8854	0.8714	438	0.8743	0.8592
369	0.8963	0.8834	404	0.8851	0.8710	439	0.8740	0.8588
370	0.8960	0.8831	405	0.8848	0.8707	440	0.8737	0.8585
371	0.8957	0.8827	406	0.8845	0.8703	441	0.8734	0.8581
372	0.8953	0.8823	407	0.8841	0.8700	442	0.8731	0.8578
373	0.8950	0.8820	408	0.8838	0.8696	443	0.8727	0.8574
374	0.8947	0.8816	409	0.8835	0.8693	444	0.8724	0.8571
375	0.8944	0.8813	410	0.8832	0.8689	445	0.8721	0.8567
376	0.8941	0.8809	411	0.8829	0.8686	446	0.8718	0.8564
377	0.8937	0.8806	412	0.8826	0.8682	447	0.8715	0.8560
378	0.8934	0.8802	413	0.8822	0.8679	448	0.8712	0.8557
379	0.8931	0.8799	414	0.8819	0.8675	449	0.8709	0.8554
380	0.8928	0.8795	415	0.8816	0.8672	450	0.8705	0.8550
381	0.8924	0.8792	416	0.8813	0.8668	451	0.8702	0.8547
382	0.8921	0.8788	417	0.8810	0.8665	452	0.8699	0.8543
383	0.8918	0.8784	418	0.8806	0.8661	453	0.8696	0.8540
384	0.8915	0.8781	419	0.8803	0.8658	454	0.8693	0.8536
385	0.8912	0.8777	420	0.8800	0.8654	455	0.8690	0.8533
386	0.8908	0.8774	421	0.8797	0.8651	456	0.8687	0.8529
387	0.8905	0.8770	422	0.8794	0.8647	457	0.8683	0.8526
388	0.8902	0.8767	423	0.8791	0.8644	458	0.8680	0.8522
389	0.8899	0.8763	424	0.8787	0.8640	459	0.8677	0.8519

Table XVIII. Volume Correction Table for Petroleum Products—Continued

Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.		Observed temperature °F.	Group number and API gravity range at 60° F.	
	Group 0	Group 1		Group 0	Group 1		Group 0	Group 1
	0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API		0–14.9° API	15.0–34.9° API
	Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.			Factor for reducing volume to 60° F.	
460	0.8674	0.8516	475	0.8627	0.8464	490	0.8580	0.8413
461	0.8671	0.8512	476	0.8624	0.8461	491	0.8577	0.8410
462	0.8668	0.8509	477	0.8621	0.8457	492	0.8574	0.8406
463	0.8665	0.8505	478	0.8618	0.8454	493	0.8571	0.8403
464	0.8661	0.8502	479	0.8615	0.8451	494	0.8568	0.8399
465	0.8658	0.8498	480	0.8611	0.8447	495	0.8565	0.8396
466	0.8655	0.8495	481	0.8608	0.8444	496	0.8562	0.8393
467	0.8652	0.8492	482	0.8605	0.8440	497	0.8559	0.8389
468	0.8649	0.8488	483	0.8602	0.8437	498	0.8556	0.8386
469	0.8646	0.8485	484	0.8599	0.8433	499	0.8552	0.8383
470	0.8643	0.8481	485	0.8596	0.8430	500	0.8549	0.8379
471	0.8640	0.8478	486	0.8593	0.8427			
472	0.8636	0.8474	487	0.8590	0.8423			
473	0.8633	0.8471	488	0.8587	0.8420			
474	0.8630	0.8468	489	0.8583	0.8416			

23. Factors Influencing Petroleum Requirements

The factors influencing petroleum consumption are as follows:

a. Displacement. By measuring the distance the center of an organization is to be moved, one can find how many miles each vehicle in an organization will have to move. Cross-country battle consumption is estimated at two and one-half times the consumption of movements over roads.

b. Vehicle-Per-Mile Consumption. Gasoline consumption per mile varies with the type of vehicle employed. Hence, it will be necessary to determine the number of each type of vehicle used for the movement.

c. Distance of Supply Installations. Certain vehicles of the organization must make round-trip supply movements. Since only 20 percent of the vehicles will make such movements, the estimated requirements of the supply vehicles may be obtained by multiplying the distance moved by the number of gallons required to move the organization and then taking 20 percent of the result.

d. Service. Supplemental daily requirements must be considered for the movement of vehicles within bivouac areas and on reconnaissance, the warming up of engines, and abnormal periods of low-gear operation. Under average conditions of operation, weather, road, and terrain, the

requirements can be estimated by using the consumption necessary to move all vehicles 10 miles over roads.

e. Loss Factor. When operating in a combat zone, an additional 10 percent of the total consumption figure should be included in the estimate to cover evaporation, spillage, and small combat losses.

f. Housekeeping. Additional daily requirements exist for administrative vehicles, kitchens, gasoline-powered equipment, and maintenance and testing of engines. When the organization is not on the march, these requirements are groupd in a composite daily requirement for the organization. When the organization is on the move, these factors, with the exception of kitchen requirements, are included in displacement and service factors. The kitchen requirement is figured on a daily consumption of 15 gallons per kitchen.

24. Petroleum Consumption Factors

Table XIX may be used as a guide for estimating petroleum consumption by Army vehicles and aircraft.

Table XIX. Petroleum Consumption Factors

a. Vehicles.

Vehicle	Vehicle fuel tank capacity (gal.)	Fuel [1] per 100 miles (gal.)	Oil [1] per 100 miles (gal.)	Gear lubricant per 100 miles (lb)	Miscellaneous greases per 100 miles (lb)
Car, armored, light, M8	56	19	1.5	.5	1
Car, armored, utility, M20	54	19	1.5	.5	1
Car, half-track, M2	60	30	1.9	.5	1
Car, half-track, M2A1	60	34	1.7	.5	1
Car, 5-passenger, light sedan	16	5.8	.2	.1	.1
Car, 5-passenger, medium sedan.	17	6	.2	.1	.1
Car, 7-passenger, heavy sedan.	20	7	.2	.1	.1
Carriage, motor, multiple gun, M16A1.	60	34	1.8	1.0	2.4
Carriage, motor, twin, 40-mm gun, M19A1.	110	135	2.2	1.0	2.5
Carriage, motor, 76-mm gun, M18.	165	110	3.3	2.1	1.5
Carriage, motor, 105-mm how, M37.	110	110	2.7	1.5	2.5
Carriage, motor, 155-mm gun, M40.	195	195	3.7	1.5	1.5
Carriage, motor, 155-mm how, M41.	110	111	4.0	1.5	2.4
Carriage, motor, 8-inch how, M43.	195	195	5.0	1.5	3.0
Carrier, cargo, M29	35	20	1.5	.8	.5
Carrier, cargo, amphibian, M29C.[2]	35	23	1.5	1.0	.5

For footnotes see page 58.

Table XIX. Petroleum Consumption Factors—Continued

Vehicle	Vehicle fuel tank capacity (gal.)	Fuel [1] per 100 miles (gal.)	Oil [1] per 100 miles (gal.)	Gear lubricant per 100 miles (lb)	Miscellaneous greases per 100 miles (lb)
Carrier, cargo, amphibian, M76(T46E1).	60	30	2.2	.8	1.5
Carrier, half-track, M9A1	60	34	1.5	.5	1
Carrier, half-track, mortar, 81-mm, M21.	60	34	1.4	.5	1
Carrier, 4.2-inch mortar, Tr., T84.	130	130	2.0		2.0
Compressor, air, trk-mtd	40	13.3	.3	.5	.3
Crane, truck mounted, ¾-yd capacity.	50	40	.4	.8	.4
Grader, road, mtzd, diesel	27	72	.8	12.5	2.0
Gun, twin 40-mm, SP, M42 (T141).	140	140	4.0	1.5	2.0
Gun, 155-mm, SP, T97	350	234	4.0	1.7	2.8
Howitzer, 105-mm, SP, T98E1.	174	200	4.1	1.5	2.5
Howitzer, 155-mm, SP, M44 (T99E1).	150	200	3.9	1.5	2.5
Howitzer 8-inch, SP, T108	350	234	4.0	1.7	2.8
Landing Vehicle, tracked, MK4.[3]	140	L71 W140	3.6	1.5	3.0
Landing Vehicle, tracked, armored, MK4.[3]	106	L70 W140	2.7	1.5	3.0
Landing Vehicle, tracked, armored, MK5.[3]	106	L71 W140	3.0	1.5	3.0
Motorcycle, solo	3.5	2.4	.2	.1	.1
Motor, scooter	2.0	2.0	.2	.1	.1
Shop Equipment, Mtzd, GP	45	20	.4	.8	.4
Tank, light, M24	110	110	2.6	1.5	2.5
Tank, 76-mm gun, M4A1	172	172	3.7	1.5	2.5
Tank, 76-mm gun, M4A3	175	207	2.9	1.5	3.0
Tank, 76-mm gun, T41E1 (M41).	140	140	3.7	1.5	2.5
Tank, 90-mm gun, M26 & M26A1.	186	248	2.9	1.5	2.7
Tank, 90-mm gun, M46 & M46A1.	232	290	5.2	1.5	2.8
Tank, 90-mm gun, M47	232	290	5.6	1.5	2.5
Tank, 90-mm gun, M48	215	295	5.1	2	1
Tank, 105-mm how, M4A3	175	207	2.9	1.5	3.0
Tank, 105-mm how, M45	190	241	3.7	1.5	2.5
Tank, 120-mm gun, T43E1	280	350	5.2	1.5	2.5
Tank, flame thrower, T67	215	295	5.1	2.0	1.0
Tractor, cargo, M8E1 & M8E2.	225	125	3.8	1.5	3.0
Tractor, high-speed, 13-ton, M5.	80	53	2.0	1.5	2.0
Tractor, high-speed, 18-ton, M4.	125	125	2.1	1.5	2.0

For footnotes see page 58.

Table XIX. Petroleum Consumption Factors—Continued

Vehicle	Vehicle fuel tank capacity (gal.)	Fuel [1] per 100 miles (gal.)	Oil [1] per 100 miles (gal.)	Gear lubricant per 100 miles (lb)	Miscellaneous greases per 100 miles (lb)
Tractor, high-speed, 38-ton, M6.	300	330	2.8	1.5	2.0
Truck, utility, ¼-ton, 4 x 4	17	6	.2	.2	.2
Truck, ¾-ton, 4 x 4	24	12	.2	.3	.3
Truck, 1½-ton, 4 x 4	30	13.3	.3	.5	.3
Truck, 1½-ton, 6 x 6	30	12.5	.3	.5	.3
Truck, amphibian, 2½-ton, 6 x 6 (DUKW).[4]	40	16.7	.6	.9	.3
Truck, 2½-ton, 6 x 6, M35	50	18	.4	.8	.4
Truck, 2½-ton, 6 x 6, M135	56	22.2			
Truck, 2½-ton, 6 x 6, M211	56	17.2			
Truck, 4-ton, 6 x 6	60	34	.6	1.2	.8
Truck, wrecker, 4-ton, 6 x 6	60	34	.6	1.2	.8
Truck, 5-ton, 6 x 6, M41	70	25	.6	.9	.8
Truck, 5-ton, 6 x 6, M54	78	32.3	.8	.4	.5
Truck, medium wrecker, 5-ton, 6 x 6, M62.	78	37	.8	.4	.5
Truck, prime mover, 6-ton, 6 x 6.	75	50	.9	.7	1.0
Truck, heavy wrecker, 6-ton, 6 x 6, M1A1.	100	40	.9	.8	1.0
Truck, prime mover, 7½-ton, 6 x 6.	160	40	.8	.8	1.0
Truck, crane, M2	100	66.7	.7	.7	.5
Truck, gun, lifting, heavy, 4 x 4, front, M249.	140	100			
Truck, gun, lifting, heavy, 4 x 4, rear, M250.	140	100			
Truck-tractor, 4- 5-ton (7-ton semitrailer).	60	22	.6	1.2	.8
Truck-tractor, 5-ton, 6 x 6, M52.	110	34	.6	.9	.8
Truck-tractor, 5- 6-ton (10-ton semitrailer).	110	34	.8	1.0	.9
Truck-tractor, 12-ton, 6 x 6, M26 & M26A1.	120	100	1.5	.9	1.1
Vehicle, armored infantry, tracked, M59.	130	130	2.0	---	2.0
Vehicle, armored infantry, tracked, M75 (T18E1).	150	130	3.2	---	2.5
Vehicle, armored, utility, M39.	165	110	2.0	1.5	2.5
Vehicle, tank recovery, M32-series.	175	155	4.0	1.5	2.5
Vehicle, recovery, heavy, M51.	385	296	4.1	2.0	2.5

[1] For arctic winter operations, increase amounts by 25 percent.
[2] In water, the weasel, M29C, uses 2½ gallons of fuel per hour.
[3] In water, use 0.6 mile per gallon.
[4] In water, use 1.3 miles per gallon.

Table XIX. Petroleum Consumption Factors—Continued

b. Aircraft.

Type	Crusing speed (knots)	Fuel tank capacity (gal.)		Fuel		Oil (gal. per hr)	Gear lubricant (gal. per hr)			Grease (lb per hr.)
		Fully serviced	Usable fuel	Type used	Amount (gal. per hr)		1065	SAE 10	OGR Oil 6086	
H–13C	60	32	31.84	100/130	15	.3750	----------	.0075	----------	.1940
H–13D & E	60	29	28.87	100/130	15	.3750	----------	.0075	----------	.1940
H–13G	60	43	*40	100/130	15	.3750	----------	.0075	----------	.1940
H–19C	70	190	185	100/130	33	.7500	.0600	----------	----------	.4366
H–19D	70	189	162.5	100/130	35	.7500	.0600	----------	----------	.4366
H–21	90	304	302	100/130	85	(**)	(**)	(**)	(**)	(**)
H–23	60	28	25	100/130	15	.3750	----------	----------	.0100	.1977
H–25	70	150	150	100/130	31	.8750	.0400	----------	----------	.0658
L–19	85	42	41	80	10	.3750	----------	----------	----------	.0010
L–20	100	95	95	100/130	22	1.0000	----------	----------	----------	.300
L–23	140	134.4	134	80	26	.7500	----------	----------	----------	.0425
LC–126	110	83	80	80	15	.5000	----------	----------	----------	.0200

* W/o litter; 35.6 w/litter.

** Information not available.

25. Per-Man-Per-Day Method of Estimating Petroleum Requirements

The per-man-per-day method of estimating petroleum requirements is used in the early planning stages when definite information is not available on the number and types of vehicles. Because of the variables in organizational makeup, this method is seldom used below army level and never below corps level; although, once established for a given theater, the figure may be used for requisitioning purposes by smaller units. The gallons-per-man-per-day method is to be used as a guide only and not as a substitute for more exact computation. The consumption in gallons per man per day in various theaters would necessarily vary with terrain, climate, ratio between land and amphibious operations, and the employment of units using special vehicles and equipment. The figures given in table XX should be adjusted to fit each particular area as soon as experience shows any variance between these planning factors and actual usage. To compute estimated petroleum requirements, multiply troop strength by factors listed in table XX.

Table XX. Per-Man-Per-Day Method of Estimating Petroleum Requirements

a. Army Class III Supplies

Product	Gallons per man per day	Pounds per man per day
Mogas (90%)	3.000	18.309
Diesel (4%)	0.132	0.928
Engine oil (3%)	0.099	0.714
Gear lubricants (1%)	0.033	0.250
Grease (expressed in lbs)		0.066
Total		20.267

*b. Army Class IIIA Supplies**

Avgas 100/130	0.300	1.778
Avlube oils	0.003	0.22

* Air Force requirements for Class IIIA supplies must be obtained from the appropriate Air Force command.

26. Per-Vehicle-Per-Mile Method of Estimating Petroleum Requirements

The per-vehicle-per-mile method of estimating petroleum requirements is a more accurate method than the per-man-per-day method. It is used in operational stages when the numbers and types of vehicles are known. An example of estimating petroleum requirements using the per-vehicle-per-mile method is given below.

a. Problem. An army corps, consisting of three infantry divisions

and one armored division, is to make an assault on a target estimated to take 2 days. During the 2 days, the corps will first travel 60 miles to bivouac at the rear area boundary and then 15 miles in combat zone, with 10 miles under cross-country battle conditions. Estimate the fuel requirements for the 2 days.

b. Solution. Known transportation for infantry division (ROCID):

33	Tanks	@	1.7	gallons per mile	56
42	Tanks	@	2.9	gallons per mile	122
633	Trucks	@	.06	gallons per mile	38
1,205	Trucks	@	.224	gallons per mile	270
68	Motor carriages	@	1.3	gallons per mile	88
191	Tracked vehicles	@	1.25	gallons per mile	239
					813
	Multiply by 3 (number of divisions)				2,439

Known transportation for armored division (ROCAD):

360	Tanks	@	2.75	gallons per mile	990
865	Trucks	@	.06	gallons per mile	52
507	Trucks	@	.18	gallons per mile	91
37	Trucks	@	.22	gallons per mile	8
40	Motor carriages	@	1.5	gallons per mile	60
538	Tracked vehicles	@	1.7	gallons per mile	915
					2,116
	Total gallons for 1 mile, all divisions				4,555
	Total gallons for 75 miles				341,625
	Plus 10 miles cross country				432,725

(4,555 × 10 × 2 = 91,100)

27. Unit Method of Estimating Petroleum Requirements

The unit method is used on divisional or unit level for planning petroleum requirements when a number of typical divisions or units are to make a mass movement over roads. Table XXI gives an average consumption figure for moving a typical division, including all equipment and division trains, over 1 mile of road. When the division is not on the march, an average consumption of 4,000 gallons per day is used to cover administrative vehicles, power equipment, and kitchens for each division. When figured separately, each kitchen is estimated to consume 15 gallons per day. For further information, see FM 101–10.

Table XXI. Unit Method of Estimating Petroleum Requirements

Division	To move all vehicles 1 mile				Gasoline capacity	No. of organic fuel cans	No. of organic kitchens
	Vehicle fuel (gals.)	Engine oils (gals.)	Gear lube (lbs)	Miscellaneous greases (lbs)			
Airborne (ROTAD)	177.76	5.08	5.03	4.17	56,727	4,408	60
Armored (ROCAD)	2,123.6	66.2	38.0	43.3	585,701	29,041	98
Infantry (ROCID)	926.6	17.8	15.36	11.96	133,139	10,931	165

28. Experience Tables for Estimating Petroleum Requirements

The most accurate method of estimating petroleum requirements is based upon weekly experience tables, which more exactly reflect the variables of weather, terrain, organizational strength, and operational vehicles and equipment. These tables, when submitted weekly by each unit and compiled at the next higher headquarters, may be used for all levels of petroleum planning, and the figures used in the man-per-day, vehicle-per-mile, or unit methods can be adjusted accordingly. An allowance of 5 percent in tonnage is usually added for auxiliary equipment, such as ranges, and generators. Lubricants are estimated as a percentage, based on experience, of total gasoline reuqirements. A typical experience table may be developed as follows (table XXII):

Table XXII. Experience Tables for Estimating Petroleum Requirements

Vehicles		Total mileage for week	Gasoline		Lubricating Oil		Gear Lubes		Greases	
Number	Type		Per unit mile	Gallons	Percent factor	Gallons	Percent factor	Gallons	Percent factor	Pounds
400	Tank-type	28,000	1.0	28,000	4	1,120	1.5	420	2.5	700
320	Halftrack	22,400	.3	6,720	4	273	3.0	202	4.0	273
4,000	Trucks	96,800	.2	19,360	2	387	1.0	193	2.0	387
3,000	Auto-units	108,900	.1	10,890	3	327	1.5	163	1.5	163
	Total petroleum consumption for week ending		-----	64,970	-----	2,107	-----	978	-----	1,523

29. Storage

a. Bulk.

(1) *Permanent tanks.*

(*a*) *Description.* Bulk petroleum is usually stored at bulk storage facilities in bolted-steel tanks ranging in capacity from 100 to 10,000 barrels or more (42 U. S. gals. equal 1 barrel). Pressure and vacuum-release valves are supplied with all sizes of tanks. Table XXIII gives information on the gallon and barrel capacity, shipping weights, and cubages of the more common sizes of bolted-steel tanks.

Table XXIII. Data on Bolted-Steel Tanks

Approximate inside diameter (ft)	Height (ft)	Capacity (gals.)	Capacity (barrels)	Approximate net weight (lbs)	Cubic feet (packed)	Approximate gross weight crated (lbs)	Approximate volume displacement (cu ft)
9′2″	8	4,200	100	2,750	80	3,196	210
15′4″	8	10,500	250	5,600	--------	6,510	260
21′6″	8	21,000	500	9,760	144	11,712	350
29′8″	8	42,000	1,000	17,080	218	20,496	470
29′8″	24	126,000	3,000	27,840	--------	33,408	850
38′8″	24	210,000	5,000	39,000	890	44,000	1,064
54′11″	24	420,000	10,000	77,300	2,015	92,100	1,600

(*b*) *Measurement of liquid in vertical cylinder.* The contents in U. S. gallons of a vertical cylindrical tank, such as a steel storage tank, may be calculated by use of equation $V = \pi r^7 h$ (7.481).

Note. V = Volume (U.S. gallons).
π = 3.1416.
r = Radius in feet.
h = Height of liquid level (innage) in feet.
7.481 = Conversion factor to U.S. gallons.

(2) *Temporary tanks.* Temporary tanks are used to store small quantities of petroleum products for relatively short periods. They are generally used at forward petroleum supply points but can also be used wherever required in the petroleum supply system (table XXIV).

(*a*) *Collapsible tanks.* The 900-, 3,000-, and 10,000-gallon collapsible liquid fuel tanks are constructed of heavy fabric impregnated with petroleum-resistant rubber. Each tank is equipped with a hose and valve assembly through which it is filled and emptied. The light weight and compactness of the tanks facilitate their transportation to forward areas for petroleum storage.

(*b*) *Skid-mounted tanks.* There are two types of skid-mounted fuel tanks: the 1-compartment 600-gallon tank; and the 1- and 2-compartment 750-gallon tank (limited standard). The tanks are of welded steel construction and are equipped with inlet and outlet fittings and pressure vent. Two 600-gallon tanks can be carried in the bed of a standard 2½-ton 6 x 6 cargo truck.

Table XXIV. Skid-Mounted and Collapsible Tanks for Petroleum Products

Item description	Dimensions of filled tanks (ft)			Weight (lbs)			Cubic feet[a]		No. that can be carried on a 2½-ton truck
	Length	Width	Height	Empty	Filled[b]	Crated	Crated	Rolled up	
Tank, metal skid-mounted, 600-gallon capacity.	6	6	4	800	4,500	1,800	223	------	[c]2
Tank, metal, skid-mounted, 750-gallon capacity (ltd std):									
One - compartment.	6	6	4⅜	1,000	5,600	2,000	237	------	1
Two - compartment.	6	6	4⅜	1,100	5,700	2,100	237	------	1
Tank, fabric, collapsible, 900-gallon capacity.	6	6½	3	165	5,650	195	14	14	33
Tank, fabric, collapsible, 3,000-gallon capacity.	20	6½	3	228	18,500	265	22	22	22
Tank, fabric, collapsible, 10,000-gallon capacity.[d]	42	12	4	800	61,800	950	30	30	5

[a] Average.
[b] Filled with gasoline; weights increase when filled with heavier petroleum products.
[c] Only one tank can be carried on a 2½-ton truck for off-highway transportation.
[d] Tank assembly contains a 4-inch hose manifold, which weighs 660 pounds and has a storage volume of 49 cubic feet.

b. Packaged.

(1) *Dimensions of containers.* Table XXV gives weights, dimensions, and planning factors of standard petroleum containers. For storage and pipeline computations, bulk petroleum is usually measured in barrels of 42 gallons each or in long tons. For packaged petroleum products, ocean shipping is based on the measurement ton (40 cu ft). The capacity of vehicles for carrying filled containers is based upon authorized loads. When overloads are authorized, these quantities may be increased to the cubic capacity of each vehicle or to 100 percent overload, whichever limit is reached first.

Table XXV. Data on Standard Petroleum Containers

Container	Empty weight (lbs)	Average weight when filled (lbs)					Dimensions (in.)			Cubic feet		Packages[1]		Capacity of vehicles for carrying filled containers[1]	
		Gasoline, automotive combat[2]	Kerosene	Diesel fuel	Lubricating oil, engine	Grease	Length	Width or diameter	Height	Actual	Planning factor	Short ton	Measurement ton	1½-ton truck or trailer[2]	2½-ton truck[2]
55-gallon drum, 16-gage (std).[3]	70	400	443	457	479	------	------	23 7/16	35 1/16	8.8	11.18	5.01	3.58	7	12
55-gallon drum, 16-gage (ltd std).	78	401	438	451	472	------	------	24 1/8	34 3/4	9.2	11.71	4.98	3.42	7	12
5-gallon can, gasoline	10.5	41	------	------	------	------	13 3/4	6 3/4	18 1/2	0.99	1	48	40	73	122
5-gallon cylindrical drum	11	------	45.2	46.2	49.2	66	------	11 1/2	13 9/16	0.81	1	40.7	40	71	101
Case, twenty-four 1-quart cans.	15	------	------	------	59.6	------	18	13	12	1.6	2	33.5	20	50	83
Case, six 5-quart cans	20	------	------	------	75.7	------	22	14	10	1.8	2	26.4	20	40	66
35-pound pail[4]	5.25	------	------	------	43.1	40.25	------	12	13 1/4	.87	1	49.6	40	75	124
120-pound drum	16	------	------	------	139.7	136	------	14 7/8	26 3/4	2.7	3.4	14.7	11.76	22	36

[1] Data for 55-gallon drums and 5-gallon gasoline can are based on average weight of automotive combat gasoline; data on 35-pound pail and 120-pound drum are based on average weight of grease; data on all other containers are based on average weight of lubricating oil, engine.

[2] Capacity of vehicles for carrying filled containers may be increased up to cubic capacity or 100 percent overload (whichever is reached first) when vehicles are in use on highways and roads.

[3] The standard 55-gallon drum (Specification PPP–D–729, Amendment No. 1) has an authorized capacity of 54 gallons for products with flash point of less than 80° F., or 55 gallons over 80° F. The specification shows maximum capacity of 57.75 gallons. The drum is identified by the letter "O" embossed on the head of the drum.

[4] Data based on average empty weight of class 1 pail. The average empty weight of the class 2 pail is 5.75 pounds.

(2) *Layout of stacking areas.* It is extremely important to prevent the possibility of error in product identification. One of the most effective means of accomplishing this is to provide exclusive stacking areas for each product and type of package. This also aids in taking inventory. Exact layout and size of stacking area must be determined by evaluation of the local conditions and normal safety requirements. In order that the entire stock of one product will not be lost by attack or fire, where a large concentration of supplies is to be stored, there should be adequate dispersion. This is best accomplished by using a "block" system of segregation (TM 10–1101).

(*a*) *Aisles and firebreaks.* Adequate space should be provided for aisles and firebreaks within the stacking area. Between units of several 55-gallon drums, 4 to 5 feet for aisles should be provided. Wider aisles should be planned to accommodate the equipment, where heavy handling equipment is to be used in stacking the drums. Aisles, 15 to 50 feet wide, should be provided between sections of several units of containers. Firebreaks, 50 to 150 feet wide, should be provided around blocks of several sections.

(*b*) *Typical layouts.* In a typical layout of a stacking area for 5-gallon cans, each block might be composed of nine 50-foot-square sections with 30-foot aisles between sections. In a typical block layout of a stacking area for 55-gallon drums, blocks are composed of 55-foot-square sections rather than 50-foot-square sections, and each section is divided into 6 parallel units with 4-foot aisles between units.

30. Transportation

a. Tanker. Ship tankers range in capacity from 6,500 to 700,000 barrels and in speed from 5 to 18 knots. The T–2 class, with an average capacity of 138,000 barrels (or 5,796,000 gals.), is the most commonly used military tanker.

b. Pipeline. Pipelines should be utilized whenever possible to transfer bulk liquids from one storage dispensing point to another as they are the most efficient overland means for this task. There are four standard pipelines with nominal inside diameters as follows:

(1) *4-inch.* This line has a normal design capacity of 355 barrels (14,910 gals.) per hour.

(2) *6-inch.* This line has a normal design capacity of 785 barrels (32,970 gals.) per hour.

(3) *8-inch.* This line has a normal design capacity of 1,355 barrels (56,910 gals.) per hour.

(4) *12-inch.* This line has a normal design capacity of 7,150 barrels (300,300 gals.) per hour.

c. Pump Units.

(1) *Four-inch, 4-stage pump unit.* The 4-inch, 4-stage pump unit consists of a gasoline-engine power unit and a 4-stage centrifugal pump. It is used with 4- and 6-inch pipelines. At 1,800 revolutions per minute, the unit will pump 785 barrels per hour against 463 feet of head of 0.725 specific gravity gasoline. The maximum working pressure to which the pump may be subjected is 750 pounds per square inch or 2,390 feet of head of 0.725 specific gravity gasoline (63.7° API).

(2) *Six-inch, 2-stage pump unit.* The 6-inch, 2-stage pump unit consists of a gasoline-engine power unit and a 2-stage centrifugal pump which may be connected either in series or parallel. It is used with pipelines of 8-inch nominal diameter and larger or in booster pump stations. The unit can pump 1,730 barrels per hour at 380 feet of head of 0.725 specific gravity gasoline when operated with stages in series. When operating with stages in parallel, the unit has a capacity ranging from 2,860 barrels per hour at 160 feet of head to 3,570 barrels per hour at 170 feet of head. The maximum working pressure to which the pump may be subjected is 700 pounds per square inch, or 2,230 feet of head of 0.725 specific gravity gasoline (63.7° API).

(3) *Six-inch, single-stage, self-priming pump unit.* The 6-inch, single-stage, self-priming pump unit consists of a gasoline-engine power unit and a single-stage, self-priming centrifugal pump. The unit has two main uses: it serves as a *feeder pump* to supply the required suction pressure at the No. 1 pump station on the pipeline; and it serves as a *transfer pump* at tank farms and loading, unloading, and dispensing installations. It can pump 715 barrels per hour at 200 feet of head of 0.725 specific gravity gasoline. It provides a suction lift of approximately 30 feet at 50° F., and 3 feet at 135° F. The maximum working pressure to which the pump may be subjected is 207 pounds per square inch, or 660 feet of head of 0.725 specific gravity gasoline (63.7° API).

d. Motor. Bulk petroleum products are transported by motor in 5,000-gallon semitrailers and in 600-gallon skid-mounted tanks mounted on standard military vehicles such as 2½-ton trucks. Packaged petroleum products, such as drums, cans, and pails, are transported by standard military vehicles.

e. Rail. Tank cars, when available, are used to move bulk petroleum. The cars are metal cylindrical tanks, varying in capacity from 6,000 to 13,000 gallons. The United States Army 40-ton tank car has a nominal capacity of 9,900 gallons. Boxcars are used to transport packaged petroleum products. The dimensions of an average United States railway boxcar are 40½ feet long, 9 feet high, and 8½ feet wide. With

an average capacity of 20 to 50 short tons, such a boxcar can transport 1,300 filled or 2,500 empty 5-gallon containers, or 135 filled or 235 empty 55-gallon drums. Temporary storage tanks may be mounted on flatcars and gondolas and used to transport bulk petroleum products. Use of collapsible tanks for this purpose, however, should be limited to emergency situations (table XXVI).

Table XXVI. Transporting Filled Temporary Storage Tanks by Rail and Motor[1]

Type of transport	600-gallon skid-mounted tank		900-gallon collapsible tank[2]		3,000-gallon collapsible tank[2]	
	No. tanks	Total gal.	No. tanks	Total gal.	No. tanks	Total gal.
Motor:						
Truck:						
2½-ton, 6 x 6	2	1,200	1	900	0	0
5-ton, 6 x 6	2	1,200	1	900	0	0
Semitrailer, stake and platform:						
5-ton, 2-wheel	[3]1	[3]750	[3]1	[3]900	0	0
10-ton, 2-wheel	[3]3	[3]2,250	3	2,700	1	3,000
Rail:						
Gondola, 40-ton, low side.	6	4,500	5	4,500	1	3,000
Flatcar, 80-ton	7	5,250	6	5,400	2	6,000

[1] Based upon average cargo limits of typical military motor and rail carriers, and weight of tanks when filled with gasoline. Information pertains to on-or-off highway use, except that only one 600-gallon skid-mounted tank can be carried off the highway.

[2] Collapsible tanks are used to transport petroleum products in emergencies only.

[3] When overloads are authorized, one tank, filled, may be added to the load as given.

31. Handling and Testing Equipment

a. Engine-Driven Pumps. The 50- and 225-gpm gasoline dispensers are used to package bulk petroleum products in the field for issue to using units. They can also be used to transfer bulk petroleum products from one storage tank into another (table XXVII).

(1) *50-gpm dispenser.* The 50-gpm dispenser consists of a single-cylinder, 4-cycle, air-cooled gasoline engine, a self-priming, nonrecirculatory centrifugal pump, suction and discharge hose, two 1½-inch dispensing nozzles, and a carrying case. The unit is capable of pumping 50 gallons per minute against a 100-foot discharge head. One unit is issued as a component with the fuel-can-and-drum-cleaning machine. A hose and fitting kit, consisting basically of two Y-fittings, four discharge hose, and four 1-inch dispensing nozzles, is used when operating the 50-gpm dispenser to fill 5-gallon cans.

(2) *225-gpm dispenser.* The 225-gpm dispenser consists of a twin-cylinder, 4-cycle, air-cooled gasoline engine, a self-priming, nonrecirculatory centrifugal pump, suction hose, a discharge hose header system, twelve 1-inch dispensing nozzles, and a skid-mounted skeletal steel frame. The dispenser is capable of pumping 225 gallons per minute against a 50-foot discharge head.

b. Vehicular mounted dispensers.

(1) The truck, gasoline tank, 2½-ton, 6 x 6, LWB (1,200-gal. capacity) is equipped with a rotary, positive displacement pump. The pump on the M49 tank truck has a capacity of 80 gallons per minute; that on the M217 has a capacity of 60 gallons per minute. The pump is operated from power takeoff through front, intermediate, and rear drive shafts mounted under the tank body. A strainer body with strainer is incorporated in the pump for filtering fuel loaded or discharged through the pump. Discharge is through the delivery gate valve located under the pump compartment.

(2) The semitrailer, gasoline tank, 12-ton, 4-wheel, M131 (5,000-gal. capacity) is equipped with a self-priming, centrifugal pump with a 7⅞-inch impeller. The pump has a capacity of 250 gallons per minute. The pump is mounted on the right end of the platform in the rear cabinet. It is driven by the auxiliary engine through a flexible coupling and a bearing-mounted shaft. This shaft is inclosed in a shaft housing. The pump is connected by a cutoff gate valve and piping to the rear manifold. The pump discharge outlet is located at the top of the pump.

c. Hand-Operated Pumps. The three hand-operated petroleum products pumps are used primarily at the organizational level to dispense petroleum products from 55-gallon drums into 5-gallon cans or into

vehicle fuel tanks, and lubricating oil into smaller containers. Each pump is equipped with dispensing hose and nozzle or discharge outlet (table XXVII).

(1) *Rotary-type pump.* The dispensing pump, hand driven, rotary, for gasoline or kerosene, 12-gpm, is operated by a revolving crank and can deliver about 12 gallons per minute.

(2) *Piston-type pump.* The dispensing pump, hand driven, piston type, w/20-foot hose, 15-gpm is a lever-type fuel-dispensing pump, of reciprocating design. The pump, equipped with filter and water separator, is operated by a push-pull lever and can deliver approximately 15 gallons per minute. It is particularly suited for fueling aircraft and ground vehicles, and is classified standard for all except arctic use.

(3) *One-quart oil pump.* The dispensing pump, hand driven, piston type, 1 quart per stroke, is operated by a crank and delivers 1 quart per stroke. It is used to dispense lubricating oil.

d. Cleaning Machine. The fuel-can-and-drum cleaning machine consists of two sedimentation tanks equipped with 5-gallon-can-cleaning equipment, two 55-gallon-drum-cleaning assemblies, suction hose, pressure hose, and a 50-gpm dispenser. The machine is capable of cleaning about 4,000 5-gallon cans or 800 55-gallon drums in an 8-hour operating day (table XXVII).

e. Testing Equipment. Petroleum-testing equipment is used by specially trained personnel to maintain quality control of petroleum products used by the Army (table XXVII).

(1) *Testing kit.* The portable petroleum-testing kit is used to perform a limited number of quality control and identification tests in the field. It is designed to be carried in any organizational vehicle, and for short distances by two men. In addition to the test apparatus it contains sampling and gaging equipment.

(2) *Mobile laboratory.* The mobile petroleum laboratory is housed in a van-type, 8½-ton, 2-wheeled semitrailer. It contains the testing equipment and apparatus necessary for making the standard qualitative tests on petroleum products. Some of the units are equipped with a specially designed knock engine for determining octane ratings of gasoline-type fuels. The utility equipment includes a space heater, air compressor, vacuum pump, and water pump. A 4- to 5-ton tractor truck is used to pull the trailer on land. For air transport aboard a C–119 cargo aircraft the front and rear dollies must be removed. The laboratory is designed to operate with an auxiliary, trailer-mounted, 30-kilovolt-ampere, 125–250-volt, alternating-current, 3-phase, 60-cycle generator unit M7A1 weighing 4,500 pounds, dimensions of which are 130 inches long, 62 inches wide, and 84 inches high.

Table XXVII. Handling and Testing Equipment

Equipment	Dimensions (in.)			Weight (lb)	Cubage (crated) (cu ft)	Suction hose			Discharge hose		
	Length	Width	Height			Quantity	Diameter (in.)	Length (ea) (ft)	Quantity	Diameter (in.)	Length (ea) (ft)
Cleaning machine, fuel can and drum:[1]											
a. One sedimentation tank, uncrated	94	37	36	625		3	1½	25	2	1½	50
b. Both sedimentation tanks, crated	102	45	88	1,950	238	3	1½	25	2	1½	50
Petroleum laboratory, mobile	382	96	118	19,000							
Petroleum testing kit	36	20	21	175	15						
Dispensing pump, hand-driven, rotary, for gasoline or kerosene, 12-gpm.			58	40					1	1	6
Dispensing pump, hand-driven, piston type, w/20-foot hose, 15 gpm.	9	6	[2]45	[3]12	5.2				1	1¼	20
Dispensing pump, hand-driven, piston type, 1 quart per stroke.			52	35							
Pumping assembly, flammable, gasoline-dispensing, liquid, bulk transfer, gasoline-engine-driven, capacity:											
a. 50-gpm:											
(1) Model 4059CA	28½	22	44	380	25.6	2	1½	25	2	1½	50
(2) Model 9117CA	40	34	21¾	410	26.7	2	1½	25	2	1½	50
b. 225-gpm—standard type	95	45	52	2,665	215	2	3	50	1	3	25
									12	2	25
									12	1	25

[1] Figures do not include those for 50-gpm—dispenser, which is issued in separate crate.

[2] Minus handle.

[3] Pump only.

CHAPTER 5
WAREHOUSING

32. Estimating Requirements

The average net usable space in any warehouse may be estimated roughly as 60 percent of the total gross space. This leaves roughly 24 percent for aisles, lost space, and other factors and an additional 16 percent as a safety factor.

a. Determining Square Foot Allocation. To determine the number of square feet of floor space required to store 1 ton, divide the weight in pounds per ton by the allowable floor load. To determine the total number of square feet required, multiply the number of tons of supplies to be stored by the square feet per ton. For example, assume that the floor load allowed per short ton of supplies is 250 pounds per square foot. Then the approximate net storage space required per ton is 8 square feet (2,000 ÷ 250). The total number of square feet of storage space for 40 tons (assumed) would be 320 (40 x 8).

b. Determining Maximum Stacking Height. Assume that certain supplies (40 tons) consist of 50-pound boxes and that each box occupies 3.5 square feet of floor space, 250 pounds per square foot being the allowable floor load. Then the load per square foot is approximately 14.3 pounds (50 ÷ 3.5). The approximate number of boxes to be stored in one column would be 17 (250 ÷ 14.3).

c. Floor Loading.

(1) Safe warehouse floor loads are normally determined by reference to the building plans on which the floor capacities in pounds per square foot are usually designated. In all cases where building plans are not available or where the plans do not indicate safe floor loads or where the accuracy of the stated floor loads is doubtful, the installation engineer must be brought in to establish floor load capacity.

(2) Loading on floors should be distributed so that the weight bearing on any single square foot does not exceed the load capacity of that square foot. For instance, a 16- by 16-foot warehouse bay, with a safe load capacity of 250 pounds per square foot, may be evenly loaded to a total of 64,000 pounds (16 x 16 x 250).

(3) In certain instances, overloading of portions of a floor area to compensate for adjacent vacant or underloaded portions is permissible and is recommended whenever space is limited. The following may be used as a guide to safe overloading:

(*a*) In wood frame construction, where the normal storage space of a floor area is reduced by narrow aisles, the remaining storage space may be overloaded by an amount equal to the capacity of the aisles provided that the aisle runs at right angle to the floor support and that the excess load is uniformly distributed over the remaining portion of the bay. For example, a 16- by 16-foot bay whose safe floor capacity is 250 pounds per square foot can be loaded to a total of 64,000 pounds. A fire aisle 2 feet wide running the full length of the bay would reduce the storage space by 32 square feet, leaving a remaining area of 224 square feet for storage. Provided that this aisle runs at right angle to the floor supports, the remaining area could safely be loaded at the uniform rate at 64,000 divided by 224 or approximately 285 pounds per square foot. When the aisle runs parallel to the floor supports or is used for the transportation of supplies or the movement of mechanical equipment, compensation will not be made and the remaining space in the bay will not be loaded beyond the rated space capacity.

(*b*) In wood frame construction, when a bay is to be loaded unequally, it can normally be loaded to its full capacity provided that no part is overloaded in excess of 20 percent and that the dividing line of the unequal loading is at right angle to the floor support—that is to say, that the floor joists run out from the underloaded portion and through the overloaded portion. For example, a 16- by 16-foot bay with a total safe load capacity of 64,000 pounds may be loaded on the side of a line at right angle to the floor joists with 38,400 pounds of supplies and on the other side with 25,600 pounds. If the dividing line of unequal loading runs parallel to the floor support, the maximum load per square foot may not exceed the rated safe load.

(*c*) In reinforced concrete flat slab construction, where a portion of the floor is left unloaded in order to provide aisle space or for other reasons, the remaining portion of the floor can sustain an overload provided it does not exceed 33⅓ percent over any appreciable portion of the floor.

(4) The maximum capacity of forklift trucks which may be safely operated on a warehouse floor of a given live load can be determined as follows:

(*a*) Floors having a safe live load capacity of 250 pounds per square foot will in general support with safety the operation

of loaded forklift trucks whose capacity does not exceed 4,000 pounds. The floor space adjacent to aisles over which the trucks travel will not be loaded beyond its rated safety load and no other concentrated loads will be permitted in aisles when the trucks are operating.

(*b*) Forklift trucks exceeding 4,000-pound capacity will be divided into two classes in determining floor safety for their operation. First, trucks having close spacing of wheels or tricycle arrangement of wheels, or narrow trucks with short wheelbase, require that each individual floor be analyzed to determine whether the trucks can operate safely. Second, trucks having a width of 3 feet or greater and a wheelbase of 5 feet or greater may operate safely in reinforced concrete buildings or steel frame buildings with reinforced concrete floor slabs, on floors designed for 350 pounds per square foot or where the framing can support a concentrated load of 2,500 pounds distributed over an area 2.5 feet square.

(*c*) An allowance for impact of 15 percent of the total truck load will be added in all computations for determining safe loads on floors.

33. Storage Data

Computations used in table XXVIII are gross and include aisles and fire aisles. They are based on 8-foot stacks. An example of the use of the computations follows: To determine the amount of covered storage space required to maintain a 10-day level of supply of field ration A for 15,000 men, refer to *a* in table XXVIII, from which the figure .0556 is obtained. Multiply .0556 by 15,000 and the result is 834 square feet for 1 day. For a 10-day level of supply, 834 square feet multiplied by 10 equals 8,340 square feet. The same procedure is applied to determine the amount of open or refrigerated space required. In determining the amount of open storage space, a dispersion factor should be applied to the open storage space computed from table XXVIII. A dispersion factor of 40 square feet per 1 square foot storage space is usually required for protection against aircraft. For example, assume that three stacks are being set up in open storage and that the number of square feet of storage space in the stacks is as follows: 200, 250, and 300—a total of 750 square feet. To disperse the stacks properly, 40 square feet of space is allowed for each foot of storage space. Therefore, 750 square feet multiplied by 40 square feet equals 30,000 square feet of area required for open storage. Local conditions, terrain features, and natural camouflage may alter the dispersion factor considerably. In many instances, a greater or smaller dispersion factor may be applied, depending upon the conditions prevailing at a given site.

*Table XXVIII. Storage Space Requirements (Sq Ft)**

Type of supply	Covered	Open	Refrigerated	Total
a. Per man per day.				
Field ration A	.0556	.0415	.0264	.1235
Operational ration B	.0329	.0493		.0822
Clothing and equipage	.0146	.0019		.0165
Regulated items	.0014	.0007		.0021
Total	.1045	.0934	.0264	.2243
b. Per man per 30 days.				
Field ration A	1.668	1.245	.792	3.705
Operational ration B	.987	1.479		2.466
Clothing and equipage	.438	.057		.495
Regulated items	.042	.021		.063
Total	3.135	2.802	.792	6.729
c. Per 20,000 men per day.				
Field ration A	1,112	830	528	2,470
Operational ration B	658	986		1,644
Clothing and equipage	292	38		330
Regulated items	28	14		42
Total	2,090	1,868	528	4,486
d. Per 20,000 men per 30 days.				
Field ration A	33,360	24,900	15,840	74,100
Operational ration B	19,740	29,580		49,320
Clothing and equipage	8,760	1,140		9,900
Regulated items	840	420		1,260
Total	62,700	56,040	15,840	134,580

* Temperate zone.

34. Paulins

a. Types.

(1) *Canvas.* Canvas paulins for ordinary storage requirements are normally provided in four sizes—20 by 20 feet, 20 by 40 feet, 12 by 17 feet, and 17 by 40 feet. Other sizes currently in use, when worn out, will be replaced by one of the above sizes. Consideration must be given to the sizes of paulins available before determining the size of the stacks to be made.

(2) *Paper.* Brown-skin or paper paulins are most commonly procured in size 15 by 60 feet. Actually this size is made up of five 3- by 60-foot sections sewed together with overlapping seams. Various other sizes may be procured or cut by the using agency. Brown-skin or paper paulins have the ad-

vantage of being much lighter than other covers, but care must be taken to place them rather than pull them over the stack. Paper paulins require more care in lashing to eliminate the possibility of tearing by the wind.

b. Computing Paulin Requirements for Covering Stacks. Generally, two paulins will be necessary to cover a stack. The following formulas are useful in computing the relationships of stack sizes and paulin coverages.

One-half of paulin length equals the *stack length.*

One-third of paulin length equals the *stack width.*

Paulin width—($3\sqrt{\frac{1}{2}}$ of the stack width + 3) equals the *side wall height.*

The length multiplied by the width of the stack equals the *square feet* of ground space occupied.

In using the formula for computing *side wall height,* the following square roots may be used:

$\sqrt{1}$ equals 1.0000
$\sqrt{2}$ equals 1.4142
$\sqrt{3}$ equals 1.7321
$\sqrt{4}$ equals 2.0000
$\sqrt{5}$ equals 2.2361
$\sqrt{6}$ equals 2.4495
$\sqrt{7}$ equals 2.6458
$\sqrt{8}$ equals 2.8284
$\sqrt{9}$ equals 3.0000
$\sqrt{10}$ equals 3.1623

35. Materials Handling Equipment

a. Forklift Trucks.

(1) *Description.* A forklift truck is a front-wheel drive, rear-wheel steer materials handling vehicle designed to load, unload, transport, and stack unit loads of supplies either indoors or outdoors. A forklift truck normally used for interior warehouse duty is equipped with cushion (solid rubber) tires and a forklift truck normally used for outdoor storage is equipped with pneumatic tires. The load is carried on the front of the truck on a 2-tined fork and lift carriage assembly that is raised and lowered by a hydraulic lifting mechanism. The forks and their supporting frame (upright assembly) can be tilted forward or backward from the vertical to assist in picking up loads and balancing lifted loads in transit.

(2) *Capacity.* Forklift truck capacity is rated on the weight of

the load that can be carried and the height to which the load can be lifted. The lifting heights range from 100 to 210 inches. A forklift truck used for interior warehouse duty has a lifting capacity of 2,000 to 6,000 pounds and one used for outdoor storage has a lifting capacity of 4,000 to 15,000 pounds.

(3) *Power.* A forklift truck may be powered by a gasoline engine or a battery-driven electric motor. A truck equipped with a gasoline engine may be used for either indoor or outdoor storage and a truck equipped with an electric motor is designed exclusively for indoor operation. In a gasoline-engine-driven forklift truck, power developed by the engine may be transmitted to the drive axle and wheels by means of a conventional clutch and transmission or by such a special device as a fluid coupling or an electro-magnetic drive unit. On a model identified by the letters RS, the engine has been modified by the use of radio-suppression devices.

(4) *Hydraulic mechanism.* A hydraulic mechanism is provided on both gasoline- and battery-powered forklift trucks as the means of lifting the forks and lift carriage on which the palletized loads are placed. On trucks designed primarily for indoor warehousing operations, the hydraulic mechanism normally allows a free lift of several feet—free lift being the distance the forks may be moved upward before extension of the inner slides beyond the top of the mast increases overall truck height. Such design results in the more effective use of available storage space and allows loads to be tiered in closed top trucks and boxcars as well as under balconies and other low-ceilinged areas. Hydraulic equipment is also used to provide trucks designed for outdoor operation with hydraulic (power) steering and hydraulic (power) braking.

(5) *Application.* The primary advantage of the forklift truck is its extreme flexibility. The most successful and efficient use of the truck is in handling palletized unit loads of 2,000 pounds or more. It is often used, however, to move items that cannot be palletized because of their size or shape. The forklift truck enables maximum use of cubic space, simplifies inventories and inspections, and permits rapid relocation of supplies. The full potentialities of the truck may be realized when it is used in conjunction with a tractor-trailer train whenever the horizontal distance the load is to be carried is more than 250 feet.

(6) *Types and capacities.* Types and capacities of forklift trucks are given in tables XXIX and XXX.

Table XXIX. Types and Capacities of Solid or Semisolid Rubber-Tired Forklift Trucks

Load capacity (lbs)	Lift height capacity (in.)	Collapsed mast height (in.)	Free lift (in.)	Fork length (in.)	Power	
					Gasoline	Battery
2,000	100	68	42	36	(*)	(*)
2,000	127	83	57	36	(*)	(*)
4,000	100	68	42	40	(*)	(*)
4,000	127	83	42	40	(*)	(*)
4,000	144	91	57	40	(*)	(*)
6,000	100	68	42	40	(*)	
6,000	127	83	57	40	(*)	(*)
6,000	168	113	6	40	(*)	(*)

Table XXX. Types and Capacities of Pneumatic Rubber-Tired Forklift Trucks

Load capacity (lbs)	Lift height capacity (in.)	Collapsed mast height (in.)	Free lift (in.)	Fork length (in.)
2,000	127	83	57	36 or 40
4,000	144	91	57	40
6,000	127	83	57	40
6,000	168	115	6	40
*10,000	210	150	2	48
15,000	210	153	2	48

* Limited standard.

b. Warehouse Tractors.

(1) *Description.* A warehouse tractor is a front-wheel steer, rear-wheel drive, self-propelled vehicle. Warehouse tractors are available in two distinct types: 3-wheel models with a short turning radius and 4-wheel models which may be equipped with dual wheels. Either type may be equipped with solid rubber or pneumatic tires.

(2) *Power.* Warehouse tractors may be powered by gasoline engines or battery-driven electric motors. Those powered by gasoline engines may be equipped with solid rubber or pneumatic tires for indoor and outdoor operation. Those powered by battery-driven electric motors are normally equipped with solid rubber tires for indoor operation exclusively. Gasoline-powered models may vary in capacity from 2,000- to 7,500-pound drawbar pull; electric-powered models from 2,000- to 4,000-pound drawbar pull.

(3) *Use.* The warehouse tractor has sufficient power to pull loads of a practical size, yet it is small and maneuverable enough to move in the limited space of warehouses and storage areas. This tractor may be used for direct drag-towing of materials

along the floor on skids, for pulling one or two trailers, or for towing a train of 6 to 25 trailers. Where the volume of materials and the regularity of schedules warrant its use, the trailer train is the most practical and economical method of moving materials with a warehouse tractor. In this system the tractor acts as a locomotive for a trackless train of trailers. The train moves through the storage area, spotting trailers at intervals where they are to be used and picking up trailers that are to be moved.

(4) *Types, capabilities, and capacities.* Types, capabilities, and capacities are given in table XXXI.

Table XXXI. Types, Capabilities, and Capacities of Warehouse Tractors

Drawbar pull (lb)	No. of wheels	Type tires
Gasoline-powered:		
2,600	4	Pneumatic
4,000	4	Pneumatic
7,500	4	Pneumatic
Electric-powered:		
2,000	3	Solid
4,000	4	Solid

c. *Wheeled Cranes.*

(1) *Description.* The wheeled crane is a power-driven, mobile unit that can operate in limited spaces to lift, transport, and deposit materials that cannot be readily handled by other types of materials handling equipment. The crane may be equipped with solid rubber or pneumatic tires or a combination of these, depending upon the type of power provided. Those equipped with solid rubber tires are normally used for indoor storage operations. They may have either front or rear wheel drive.

(2) *Types.* Wheeled cranes are available in two types—fixed boom and sluing boom. The fixed boom crane is usually mounted on a standard tractor unit with the boom projecting over the front wheels. On this type, the boom is an integral part of the crane frame and can be swung only by steering the tractor in which it is mounted. The sluing boom crane is usually a specially designed, self-propelled vehicle that may be called a crane truck. On this type, the boom and hoisting unit are so mounted that they may be swung without moving the crane chassis. On the fixed boom type, the hoisting and topping units are mounted at the rear of the tractor where the controls are easily accessible to the operator. Weights are set in the rear of the frame, or in the rear wheels to counterbalance lifted loads. On the sluing boom type, most of the load is

supported by the drive wheels, a design that allows the engine to be placed in the rear of the unit as a part of the counterweight.

(3) *Power.* Wheeled cranes may be powered by gasoline engines or by battery-driven electric motors. Those powered by gasoline may be equipped with either solid rubber or pneumatic tires and usually have a capacity from 6,000 to 10,000 pounds. Those powered by battery-driven electric motors are normally equipped with solid rubber tires and normally have a capacity of 6,000 pounds.

(4) *Use.* Wheeled cranes are designed with varying capacities and can handle most lifting jobs found in storage areas. The crane is particularly useful because it handles loads which are of shapes and sizes that are moved with difficulty. It can reach loads in places inaccessible to other types of materials handling equipment and is flexible in use because it lifts and carries. It is small and compact and can be used in limited spaces and in the congested aisles found in small warehouses and storage areas.

d. Straddle Trucks.

(1) *Description.* The straddle truck is a gasoline-engine-driven materials handling vehicle with a high, inverted framework that enables it to pass over and straddle the load to be picked up and transported. The motor and the operator's compartment are located at the top of the vehicle. The 4 wheels are located at the extreme corners of the truck and bear the frame on 4 vertical shafts, or masts. All 4 wheels, which may be steered, are equipped with pneumatic tires. The straddle truck is capable of speeds up to 35 miles per hour and may be used on highways as well as in storage areas. The truck has a capacity of 30,000 pounds.

(2) *Use.* The straddle truck was originally designed to handle lumber, and while this remains a principal use, the truck may be used to carry such items as girders, rods, and pipes. It may also be used for carrying containers of bulk materials, awkward-shaped packages, and heavy materials which other industrial trucks would have difficulty moving.

e. Warehouse Trailers.

(1) *Description.* Warehouse trailers are not self-propelled and must be used in conjunction with some other form of materials handling equipment. Usually they are 4-wheeled caster-type loading devices. They are made either of steel or wood, depending on the size of load to be carried. They may be equipped with solid or pneumatic tires. Solid tires are used for indoor warehouse duty while pneumatic tires are used for outside warehouse duty. Steering may be of caster or fifth wheel type.

(2) *Use.* Warehouse trailers are generally used with tractors to form the tractor-trailer system of warehouse work. When loads cannot be permanently palletized or easily moved with the forklift trucks, it is best to load on trailers and haul with tractor. Trailers are useful in warehouses where loads must be constantly moved.

(3) *Types and capacities.* Types and capacities are given in table XXXII.

Table XXXII. Types and Capacities of Warehouse Trailers

Type	Load capacity (lbs)	Platform size		Tires
		Width (in.)	Length (in.)	
Caster steering	4,000	36	84	Solid
Fifth wheel steering	6,000	48	108	Pneumatic
Fifth wheel steering	20,000	72	144	Solid

f. Powered Conveyors.

(1) *Description.* A power-belt conveyor is a continuous motor-driven belt supported in a frame, designed to move materials horizontally or up an incline. In the frame, the belt is supported either by idling rollers or steel plates, spaced between the driving rollers. The conveyor consists of a driving section with the power unit, normally an electric motor, built into the frame and as many driven sections as may be required. The power-belt conveyor is a portable unit, the frame being supported by casters or wheels. The belt may move at a speed of 200 feet per minute, but the most common speed for practical package handling is approximately 100 feet per minute. This type conveyor is capable of moving packages up an incline of about 25 percent, and if materials are to be moved up a steeper incline, supporting cleats must be added to the belt.

(2) *Use.* Power-belt conveyors may be used to load and unload trucks and freight cars, to move packages from one level to another, and to help in stacking and piling in warehouses. They may be inserted as sections in gravity-type conveyors to act as pushers. They can handle cartons and boxes as well as bags. When both the upper and lower sections of the belt are used, the same conveyor can move materials in opposite directions simultaneously.

(3) *Types.* The following standard types of power-belt conveyors are available:

(*a*) Conveyor, belt, portable, power unit, electric, 20-foot driving section.

(*b*) Conveyor, belt, portable, 20-foot driven section.

CHAPTER 6
PACKAGING AND PACKING

36. Processing, Packaging, and Packing

a. Cleaning. Articles subject to corrosion or other deterioration must be cleaned thoroughly in order that the preservative which is to be applied later may be effective. Cleaning may be accomplished by use of any applicable process, the most common of which are the processes and combinations of processes listed in (1) through (16) below. The choice of a cleaning process is determined by such factors as the degree of cleanliness required, the type of contaminant on the article, and the nature of the article's material content.

(1) *Any petroleum solvent.* Removal of oil and grease from certain objects may be accomplished by immersing them in a petroleum solvent such as Stoddard solvent (dry cleaners' naphtha).

(2) *Single petroleum solvent in two steps.* When a high degree of cleanliness is required, two tanks of the same solvent are employed. One tank is used for initial cleaning; the other, for rinsing.

(3) *Single petroleum solvent applied by scrubbing or wiping.* The article is cleaned by applying the petroleum solvent with a brush or cloth. This method is employed for items too large to be immersed in the solvent tank or items where patch or spot cleaning only is desired.

(4) *Two-solvent immersion with perspiration removal.* The item is first immersed in a petroleum solvent to remove oil and grease; then, in an approved perspiration solvent to remove inorganic matter such as salts; and finally in another petroleum solvent tank for purposes of rinsing.

(5) *Solvent spray.* The petroleum solvent is sprayed on the part. The force of the spray also removes insoluble particles on the item. If perspiration salts are believed present, a perspiration solvent spray is then used. A petroleum solvent rinse must be employed after use of the perspiration solvent spray.

(6) *Vapor-degreasing solvent.* The article is suspended in the vapors emitted from a boiling tank of a chlorinated solvent. This method removes contamination so completely that pre-

servative must be immediately applied to prevent the swift deterioration or corrosion that can occur as an aftermath.

(7) *Perspiration and fingerprint removal.* Immersion in perspiration removal solvent must be followed by rinsing in petroleum solvent unless the perspiration solvent is methanol.

(8) *Alkaline immersions.* Alkaline immersions containing soaps or wetting agents are appropriate. The immersion must be followed by a hot water rinse.

(9) *Alkaline spray.* The soap or wetting agent should not be used in the alkaline spray as it causes undesirable foaming. The use of a simple one-compound cleaner is recommended. Hot water rinse should follow.

(10) *Alkaline electro-cleaning.* This method can be used only if proper equipment is available.

(11) *Emulsion soak.* The emulsion solvent is a mixture of emulsifier and solvent. The soaking should be followed by a cold water spray and hot water rinse.

(12) *Emulsion spray.* The spray accomplishes the cleaning and rinsing process in one operation.

(13) *Steam cleaning.* Steam is applied under pressure to clean the surface.

(14) *Sand blasting.* Sand propelled by air pressure cleans the surface.

(15) *Vapor blast* (liquid honing). Vapor containing abrasive particles is directed at high pressure at the surface to be cleaned.

(16) *Soft grit blast.* Relatively soft abrasives, which are air-pressure propelled at high velocity, are directed at the surface to be cleaned.

b. Removing Rust. Where necessary, remove rust with abrasive cloth, crocus cloth, or corrosion removing compound (metal cleaner, condition and rust remover), as applicable. In using any of the above methods, make sure that all surfaces to which the rust remover was applied are thoroughly rinsed with a solvent which will remove all of the cleaning agent. This is important as most rust removers contain chemicals which can harm metals if allowed to remain for an extended period of time.

c. Drying.

(1) Immediately after cleaning, the item should be thoroughly dried to evaporate cleaning solutions and to remove any residue moisture.

(2) Acceptable methods of drying are—

(*a*) Prepared compressed air.

(*b*) Oven.

(*c*) Infra-red lamps.

(*d*) Wiping.

d. Preservation and Unit Protection.

(1) Unit protection procedures should be performed as a continuous operation whenever possible.

(2) A choice of procedure for unit protection is determined by the nature of the material and the degree of protection required.

(3) There are six basic methods of preservation which are not independent of each other but may be used as submethods or combinations to meet the requirement of a specific problem.

(*a*) Preservative coating (with greaseproof wrap when required).

(*b*) Water-vaporproof package (contains 7 submethods or procedures).

(*c*) Strippable protective coating (contains 3 submethods or procedures).

(*d*) Water-resistant package with or without preservative (contains 5 submethods or procedures).

(*e*) Water-vaporproof package including desiccant and with preservative when required (contains 5 submethods or procedures).

(*f*) Package for mechanical and physical protection only.

(4) Where it is necessary to paint, apply rust-inhibitive synthetic primer to surface before painting.

(5) Where it is not necessary to paint, apply rust-preventive film on the item.

(6) Apply a greaseproof paper wrap to keep soft drying corrosion preventive film on the item. This wrap is not mandatory if a hard drying preservative is used and allowed to dry. Wrapping should be suitably secured.

(7) Select shipping container as applicable, considering maximum allowable size of container, weight of contents, and practicability of the container for the prescribed level of packaging or packing; that is, suitability for immediate use, domestic storage, or oversea shipment.

(8) Use cushioning materials (wood, excelsior, crepe cellulose wadding, hair felt, flexible corrugated paper) for such conditions as protection of finished surfaces against abrasion, protection of small projections on articles, filling of voids, and so on. Materials used directly against finished surfaces must be chemically neutral and free from abrasive qualities.

(9) Block, brace, fasten, or otherwise secure articles that do not fill the shipping containers so as to prevent movement in the container. Blocking and/or bracing shall not be secured to the outer container by means of end-grain nailing. Portions of the blocking and/or bracing coming in direct contact with unpainted or preserved surfaces shall be covered with a greaseproof waterproof material. Brace by fastening wood or steel members to the shipping box in one direction, crosswise, or by

cutting out portions of braces or supports to fit around a part of the machine. Bracing makes the article virtually a part of the box itself. Apply bracing to a part or parts of the article that will not be damaged by impact or by a blow sufficient to distort the box.

(10) Articles such as machines or sub-assemblies should, when possible, be bolted to the container. In bolting, attach the article rigidly to the base of the container with the bolts running through the skid and container base.

(11) Use linings for textile bags, barrels, and drums where necessary to give protection against sifting, contamination, and entrance or loss of water.

(12) Where necessary for waterproofing, use lining for boxes, crates, and other containers. Linings should be in bag form unless panel linings are required because of interior bracing and blocking.

e. Levels of Packing and Preservation. The Department of Defense has established uniform levels of packing and preservation for the Armed Forces. The application of these levels depends upon known use and storage factors as presented in AR 740–15.

(1) *Levels of preservation and packaging.*

(*a*) *Level A—military package.* Level A is preservation and packaging which provides protection against corrosion, deterioration, and physical damage during shipment, handling, indeterminate storage, and worldwide redistribution.

(*b*) *Level B—limited military package.* Level B is intermediate between levels A and C (below) and includes meeting of preservation and packaging requirements which are developed as a modification of the military package or as a separate entity for use under specific conditions.

(*c*) *Level C—minimum military package.* Level C is preservation and packaging which provides adequate protection against corrosion, deterioration, and physical damage during shipment from supply source to the first receiving activity which will put the property to immediate use. The supplier's commercial practices may be considered as conforming to level C if they meet the requirements of this level.

(2) *Levels of packing.*

(*a*) *Level A—military pack.* Level A is packing which will protect goods during shipment, handling, indeterminate storage, and worldwide distribution.

(*b*) *Level B—limited military pack.* Level B is packing which protects goods against damage during multiple domestic shipments, handling, and covered storage.

(*c*) *Level C—minimum military pack.* Level C is packing which protects against damage during direct shipment from the

supply source to the first receiving activity for immediate use. Generally, this level conforms with the applicable carrier's rules and regulations and may be the supplier's commercial practice if this practice meets the requirements of this level.

37. Types of Interior Containers

The types of interior containers are—

a. Fiberboard interior boxes.
b. Folding cartons.
c. Setup boxes.
d. Fiberboard cans and tubes.
e. Greaseproof, waterproof bags.
f. Metal interior containers.
g. Glass containers, plastic containers, and collapsible metal tubes.
h. Kraft paper bags.
i. Linings for textile bags, barrels, and drums.

38. Types of Exterior Containers

The types of exterior containers are as follows:

a. Sheathed nailed wood crates.
b. Unsheathed nailed wood crates.
c. Wood-cleated plywood boxes.
d. Nailed wood shipping boxes (styles 2, 2½, 3, 4, 5, and 6).
e. Wirebound shipping boxes.
f. Fiberboard shipping boxes.
g. Wood-cleated solid fiberboard boxes.
h. Tight barrels.
i. Slack barrels.
j. Slack kegs.
k. Metal drums.
l. Metal cans and pails.
m. Plywood drums.
n. Fiberboard drums.
o. Laminated shipping bags.
p. Multiwall paper shipping sacks.
q. Textile shipping bags.
r. Bales and bundles.
s. Pallets.
t. Skids.

39. Selecting Containers

a. General. The factors governing the selection of shipping containers are type of load, kinds of corrosion preventive and inner packaging used, and method of transportation to be employed.

b. Types of Loads. The type of load is determined by the weight,

size, fragility, and shape of the contents. There are three types of loads: easy, average, and difficult.

(1) *Type 1, easy loads.* Easy loads include the following:

(*a*) Articles of low or moderate density prepacked in one inner container which completely fills, supports, and adds rigidity to all surfaces of the shipping box; for example, cans or cartons packed in an inner container that completely fills the outer shipping box.

(*b*) A single article that contacts and supports all surfaces of the shipping box and has sufficient strength, even though not boxed, to withstand forces encountered in transportation and handling, but which requires the protection of a box to prevent scratching or marring. Examples are wood or metal chests, tool kits, and boxed sturdy instruments packed in a shipping box.

(*c*) Articles that are not easily damaged by shock or puncture and are durable enough to withstand the forces encountered in transportation and handling. Examples are clothing and textiles.

(2) *Type 2, average loads.* Average loads include the following:

(*a*) Moderately concentrated place-packed articles packed directly in the outer shipping box and providing support at several points on each surface of the shipping container. Examples are canned goods, books, paper, battery jars, light and medium weight cut-to-length tubing, and other place-packed articles.

(*b*) Two or more completely or partially filled packages packed into an outer shipping box and supporting all surfaces of the box. Examples are cartons containing small hardware, bolts and nuts, nails, screws, washers, electrical cords, outlet boxes, switches, fuse plugs, door knobs, breast drills, footwear, small jars, bottles, or prepackaged articles such as cosmetics, polish, toothpaste, or shaving cream.

(*c*) Glass bottles not exceeding one-half-gallon capacity, separated by partitions providing adequate protection and individually cushioned with liners and pads. Examples are bottles containing beverages, cleaning fluids, catsup, sirup, pickles, and peanut butter.

(*d*) Articles of light or medium concentration, packed in excelsior, paper wadding, or similar packing material, completely filling the box. Examples are chinaware, enamelware, aluminum ware, glassware, pottery, or molded plastics.

(3) *Type 3, difficult loads.* Difficult loads include the following:

(*a*) One or more partially filled containers packed into and completely filling an outer shipping box but not sufficiently sturdy to provide substantial support to its surfaces. Ex-

amples are partially filled cartons containing hardware, bolts, nuts, nails, screws, and washers.

(*b*) Articles of moderate concentration packed in bulk, or place-packed articles of heavy concentration, completely filling the shipping box, or loads of heavy concentration packed in excelsior, paper wadding, or similar packing material, and completely filling the box. Examples are porcelain insulators packed in bulk, firebrick, castings, heavy stampings or machine parts packed in excelsior, coiled metal tubing, or heavy metal tubing cut to length.

(*c*) Bulk (jumble-packed) shipments of small, highly concentrated articles which pack tightly and completely fill the box. Examples are small nuts and bolts, washers, nails, cotter pins, rivets, or wood screws.

(*d*) Irregular-shaped articles that do not support the inner surfaces of the shipping box or articles attached to one or more surfaces of the box, or articles that do not completely fill the box and require bracing, blocking, cushioning, or floating. Examples are adding machines, typewriters, lawn mowers, small motors, generators, machined parts, or assemblies.

(*e*) Glass bottles or jugs exceeding one-half gallon capacity, separated by partitions and cushioned with liners and pads. Examples are containers of cider, vinegar, and soda fountain sirup.

(*f*) Fragile, dangerous, or other articles that require a high degree of protection from puncture, shock, or distortion of the container. Examples are delicate scientific instruments, weighing scales, heavy mirrors, framed and glassed pictures, drugs, and explosives.

(*g*) Highly concentrated loads. Examples are bar solder, steel balls, welding rods, steel chain, or metal sheets.

(*h*) Articles of high density which partially fill the box and which may exert highly concentrated force on one or more surfaces of the box, permitting excessive shifting of the contents. Examples are well points, large gears, long heavy bolts and nuts, crank shafts, axle shafts, solid bar stock, drive shafts, automobile springs, bolts and nuts, track spikes, drop forgings, or rough castings.

40. Strapping

a. In addition to being used as reinforcement for blocking and bracing, strapping is employed as a reinforcement for exterior containers. Only tempered high tensile strapping and wire may be used for container reinforcement.

b. Each military container specification has a section or appendix devoted to closure and strapping. It is very important that the instructions contained in these publications be observed.

c. The following precautions are advisable for strapping reinforcement to boxes, wood, nailed.

(1) Use strapping of correct type conforming to the appropriate Federal specifications.

(2) Use strapping of correct size and strength as determined from tables XXXIII and XXXIV.

(3) Use correct number of straps depending upon the weight of contents and stype of shipping container.

(4) Locate strapping correctly.

(*a*) All straps should be applied at right angle to the edges of the box over which they pass and should be drawn tight so as to sink into the wood at the edges. Straps should be applied just prior to shipment whenever practicable.

(*b*) If two or more straps are used, the distance between end straps and the ends of the box should be approximately one-sixth the length of the box. The intermediate straps should be spaced equally between the end straps.

(*c*) When style 2, 2½, 3, 4, or 5 boxes are used, two or more straps should be applied girthwise. When the outside length of the box exceeds 36 inches, 3 or more straps should be applied girthwise so that the distance between straps is not more than 24 inches.

(*d*) When style 6 boxes are used, one strap should be applied lengthwise, or around the top, bottom, and end. After this strap has been applied, two additional straps should be applied girthwise.

Table XXXIII. Minimum Sizes of Flat Metal Bands for Various Weights of Boxes

Net weight of contents of box (lbs)	Dimensions of flat metal bands when different Nos. of bands are used	
	One or two bands (in.)	Three or more bands (in.)
Less than 70	⅜ x 0.015	⅜ x 0.015
70 to 125	⅜ x 0.020	⅜ x 0.020
126 to 175	½ x 0.020	½ x 0.020
176 to 250	⅝ x 0.020	⅝ x 0.020
251 to 400	¾ x 0.020	¾ x 0.020
401 to 1,000	----------	¾ x 0.023

Table XXXIV. Minimum Sizes of Round Wire for Various Weights of Boxes

Net weight of contents of box (lbs)	Size of wire when different numbers of wires are used			
	One or two bands		Three bands	
	100,000 psi tensile strength (diam in in. and gage)	140,000 psi tensile strength (diam in in. and gage)	100,000 psi tensile strength (diam in in. and gage)	140,000 psi tensile strength (diam in in. and gage)
Less than 70	0.0720 (15 gage)	0.0625 (16 gage)	0.0720 (15 gage)	0.0625 (16 gage)
70 to 125	0.0800 (14 gage)	0.0720 (15 gage)	0.0800 (14 gage)	0.0720 (15 gage)
126 to 175	0.0915 (13 gage)	0.0800 (14 gage)	0.0915 (13 gage)	0.0800 (14 gage)
176 to 250	0.0915 (13 gage)	0.0915 (13 gage)	0.0915 (13 gage)	0.0915 (13 gage)
251 to 400	0.1055 (12 gage)	0.0990 (12½ gage)	0.0915 (13 gage)	0.0915 (13 gage)
401 to 1,000			0.1055 (12 gage)	0.0990 (12½ gage)

41. Woods

a. Species. The species of wood that may be used for lumber for nailed wood boxes are classified in groups as indicated in table XXXV. When a group is specified, any species in that group may be used. Species of groups 1 and 2 may be used in combination. Species of groups 3 and 4 may also be used in combination. Species of groups 1 and 2 will not be used in combination with species of groups 3 and 4.

Table XXXV. Species of Wood

Group 1

Alder, red	Fir, California red	Pine, ponderosa (western yellow)
Aspen (popple)	Fir, grand	Pine, red (Norway)
Basswood	Fir, noble	Pine, sugar
Buckeye	Fir, silver	Pine, white
Cedar	Fir, white	Poplar, yellow
Chestnut	Magnolia	Redwood
Cottonwood	Pine, eastern white	Spruce
Cypress	Pine, jack	Willow
Fir, alpine	Pine, lodgepole	
Fir, balsam		

Group 2

Douglas fir	Larch, western	Tamarac
Hemlock	Pine, southern	

Table XXXV. Species of Wood—Continued

	Group 3	
Ash, black	Cherry	Sycamore
Ash (cabinet texture)	Elm, soft	Tupelo, water
Blackgum	Maple, soft	
	Sweetgum (red gum)	
	Group 4	
Ash, white (rough texture)	Elm, rock	Maple, hard
Beech	Hackberry	Oak
Birch	Hickory	Pecan
	Locust	

b. Group Characteristics. The above groups are set up so that each one is limited to woods with similar characteristics of importance to box design. These characteristics include density, flexural and compression strength, stiffness, shock absorption, and nail-holding power. Variations of the characteristics of woods within any one group are not great enough to interfere with their use in box design. Box designs should be based on the characteristics of each group of woods.

c. Use of Groups. In general, the density of woods increases in order from group 1 to group 4. There is the same progressive increase from group 1 to group 4 in strength, nail-holding power, and the other characteristics indicated above. Therefore, for a box of the same dimensions designed to carry a stated load under given conditions, the required thickness of boards is greatest when woods of group 1 are used and least when woods of group 4 are used. Likewise, to provide the total nail-holding power required for a box, more nails, longer nails, nails of a larger diameter, or a combination of these must be used if woods of group 3 are used instead of woods of group 4, or of group 2 instead of group 3.

d. Lumber Standards. The lumber used in the manufacture of nailed wooden boxes must meet the following standards:

(1) Lumber will be seasoned to a moisture content of not more than 18 percent nor less than 7 percent of its oven-dry weight.
(2) Pieces will be cut to length and dressed on at least one side.
(3) Pieces will be free from all defects that materially weaken them, expose the contents of the box to damage, or interfere with the prescribed fabrication or nailing.
(4) No knot will have a diameter exceeding one-third of the width of the piece.

42. Nails

a. Types of Nails. In the manufacture of wooden boxes, three types of nails are generally used: They are the cement coated standard box,

the cooler, and the sinker types. The cooler and the sinker are identical except for the head. The head of a cooler is flat on the underside, while the head of a sinker is slightly smaller and cone-shaped on the underside. The cement coated standard box nail is the same length as the cooler or the sinker but is smaller in diameter.

b. Coated Nails. Nails used in the making of boxes may be bright or cement-coated. If two boards are to be fastened together with nails and the nails clinched in the under board, bright nails may be used. If two boards are to be fastened together with nails not clinched, cement-coated nails should be used. Cement-coated nails frequently have from 50 to 100 percent more nail-holding power than bright nails of the same penny weight size.

c. Nailing.

(1) If the desired nail is not available, one size smaller shall be used and nails spaced one-fourth inch closer than is required for the size of nail substitutes (tables XXXVI, XXXVII, and XXXVIII).

(2) When the top and bottom are nailed to the sides, the nails will be spaced between 6 and 8 inches apart.

(3) When cleats are nailed to the ends of the box they shall pass through the cleat (or bottom) and be clinched not less than one-eighth inch.

Table XXXVI. Size and Weight of Cement-Coated Box Nails

Size	Length (in.)	Diameter (in.)	Head (in.)	Approximate No. per pound
(1) *Coolers.*				
4-penny	1 3/8	.0800	7/32	488
5-penny	1 5/8	.0860	15/64	364
6-penny	1 7/8	.0915	1/4	275
7-penny	2 1/8	.0990	17/64	212
8-penny	2 3/8	.1130	9/32	144
9-penny	2 5/8	.1130	9/32	127
10-penny	2 7/8	.1205	19/64	104
(2) *Corkers.*				
4-penny	1 3/8	.0860	7/32	392
6-penny	1 7/8	.0990	1/4	232
8-penny	2 3/8	.1205	9/32	129
9-penny	2 5/8	.1205	9/32	114
10-penny	2 7/8	.1350	5/16	84
12-penny	3 1/8	.1350	5/16	77
16-penny	3 3/8	.1483	11/32	59
20-penny	3 7/8	.1770	3/8	36
(3) *Sinkers.*				
4-penny	1 3/8	.0800	13/64	488
5-penny	1 5/8	.0860	7/32	364
6-penny	1 7/8	.0915	15/64	275
7-penny	2 1/8	.0990	1/4	212
8-penny	2 3/8	.1130	17/64	142

Table XXXVI. Size and Weight of Cement-Coated Box Nails—Continued

Size	Length (in.)	Diameter (in.)	Head (in.)	Approximate No. per pound
9-penny	2 5/8	.1130	17/64	130
10-penny	2 7/8	.1205	9/32	104
12-penny	3 1/8	.1350	5/16	77
16-penny	3 1/4	.1483	11/32	61
20-penny	3 3/4	.1770	3/8	37
(4) *Standard.*				
4-penny	1 3/8	.0670	13/64	710
5-penny	1 5/8	.0720	7/32	536
6-penny	1 7/8	.0860	1/4	306
7-penny	2 1/8	.0860	1/4	268
8-penny	2 3/8	.0990	17/64	186
9-penny	2 5/8	.0990	17/64	167
10-penny	2 7/8	.1130	19/64	118

Table XXXVII. Size and Weight of Bright (Uncoated) Standard Box and Common Nails

Size	Length (in.)	Diameter (in.)	Head (in.)	Approximate No. per pound
(1) *Standard.*				
4-penny	1 1/2	.0800	7/32	473
5-penny	1 3/4	.0800	7/32	406
6-penny	2	.0990	17/64	236
7-penny	2 1/4	.0990	17/64	210
8-penny	2 1/2	.1130	19/64	145
9-penny	2 3/4	.1130	19/64	132
10-penny	3	.1280	5/16	94
12-penny	3 1/4	.1280	5/16	88
(2) *Common.*				
4-penny	1 1/2	.0985		316
5-penny	1 3/4	.0985		271
6-penny	2	.113		181
7-penny	2 1/4	.113		161
8-penny	2 1/2	.131		106
9-penny	2 3/4	.131		96
10-penny	3	.1483		69
12-penny	3 1/4	.1483		63

Table XXXVII-Continued. *Size of Nails and Spacing for Nailing Top and Bottom to Sides*

Thickness of side (in.)	Group I wood	Group II wood	Group III and IV wood
Under 3/4	No nailing permitted	No nailing permitted	No nailing permitted
3/4 to 7/8	7d	6d	5d
15/16 to 1 1/16	8d	7d	

Table XXXVIII. Spacing of Nails[1]

Size of nails	Spacing[2] (in.)	
	When driven into side grain of end	When driven into end grain of end
6-penny or smaller	2	1¾
7-penny	2¼	2
8-penny	2½	2¼
9-penny	2¾	2½
10-penny	3	2¾
12-penny	3½	3
16-penny	4	3½
20-penny	4½	4

[1] Except the nailing of top and bottom of sides.

[2] The spacing of cement-coated nails fastening the sides, tops, or bottoms to the ends and cleats shall not be greater than that given in this table. When, because of small knotholes or checks in the nailing end, it is necessary to exceed this spacing, the distance between any two adjacent nails shall not be greater than 1½ times the spacing given in this table.

43. Nails and Lumber for Types of Loads and Groups of Wood

Information on nails and lumber for boxes for different types of loads and groups of woods is given in table XXXIX.

Table XXXIX. Nails and Lumber for Different Types of Loads and Groups of Woods

a. Type 1 (Easy) and Type 2 (Average) Loads.

(1) *Groups 1 and 2 woods.*

Weight of contents of box (lbs)	Style of box*	Minimum thickness of sides, tops, and bottoms of box (in.)	Minimum thickness of ends of box (in.)	Minimum thickness and width of cleats (in.)	Size of nail for nailing sides, tops, and bottoms to ends and cleats** (penny)	
					Group 1 woods	Group 2 woods
To 50	4 or 5	3/8	5/8	5/8 x 1¾	6	5
51 to 100	4 or 5	7/16	3/4	3/4 x 2¼	7	6
101 to 250	4 or 5	9/16	3/4	3/4 x 2¼	8	7
101 to 250	2, 2½ or 3	9/16	5/8	5/8 x 2¼	8	7
251 to 400	4 or 5	11/16	25/32	25/32 x 2⅝	9	8
251 to 400	2, 2½ or 3	11/16	3/4	3/4 x 2⅝	9	8
401 to 600	2, 2½ or 3	25/32	25/32	25/32 x 2⅝	9	8

See footnotes at end of table, p. 96.

Table XXXIX. Nails and Lumber for Different Types of Loads and Groups of Woods—Continued

(2) *Groups 3 and 4 woods.*

Weight of contents of box (lbs)	style of box*	Minimum thickness of sides, tops, and bottoms of box (in.)	Minimum thickness of ends of box (in.)	Minimum thickness and width of cleats (in.)	Size of nail for nailing sides, tops, and bottoms to ends and cleats** (penny)	
					Group 3 woods	Group 4 woods
To 100	4 or 5	7/16	5/8	5/8 x 1 3/4	5	5
To 100	2, 2 1/2 or 3	7/16	5/8	5/8 x 1 3/4	5	5
101 to 250	4 or 5	1/2	3/4	3/4 x 2 1/4	6	5
101 to 250	2, 2 1/2 or 3	1/2	5/8	5/8 x 1 3/4	5	5
251 to 400	4 or 5	5/8	13/16	13/16 x 2 3/4	7	6
251 to 400	2, 2 1/2 or 3	5/8	3/4	3/4 x 2 3/4	6	5
401 to 600	2, 2 1/2 or 3	11/16	13/16	13/16 x 2 3/4	7	6
601 to 800	2, 2 1/2 or 3	3/4	13/16	13/16 x 2 3/4	8	7
801 to 1000	2, 2 1/2 or 3	7/8	1 1/16	1 1/16 x 3 3/8	9	8

b. Type 3 (difficult) Loads.

(1) *Groups 1 and 2 woods.*

Weight of contents of box (lbs)	Style of box*	Minimum thickness of sides, tops, and bottoms of box (in.)	Minimum thickness of ends of box (in.)	Minimum thickness and width of cleats (in.)	Size of nail for nailing sides, tops, and bottoms to ends and cleats** (penny)	
					Group 1 woods	Group 2 woods
To 100	4 or 5	1/2	3/4	3/4 x 2 1/4	8	7
To 100	2, 2 1/2 or 3	1/2	5/8	5/8 x 2 1/4	7	6
101 to 250	4 or 5	5/8	25/32	25/32 x 2 5/8	8	7
101 to 250	2, 2 1/2 or 3	5/8	3/4	3/4 x 2 1/4	8	7
251 to 400	4 or 5	3/4	1 1/16	1 1/16 x 3 1/4	10	9
251 to 400	2, 2 1/2 or 3	3/4	3/4	1 1/16 x 3 1/4	9	8
401 to 600	2, 2 1/2 or 3	25/32	25/32	1 1/16 x 3 1/4	9	8
601 to 800	2, 2 1/2 or 3	13/16	1 1/16	1 1/16 x 3 1/4	10	9
801 to 1000	2, 2 1/2 or 3	1 1/16	1 5/16	1 5/16 x 4 1/8	12	12

See footnotes at end of table, p. 96.

Table XXXIX. Nails and Lumber for Different Types of Loads and Groups of Woods—Continued

(2) *Groups 3 and 4 woods.*

Weight of contents of box (lbs)	Style of box*	Minimum thickness of sides, tops, and bottoms of box (in.)	Minimum thickness of ends of box (in.)	Minimum thickness and width of cleats (in.)	Size of nail for nailing sides, tops, and bottoms to ends and cleats** (penny)	
					Group 3 woods	Group 4 woods
To 50	4 or 5	5/16	5/8	5/8 x 1 3/4	5	5
51 to 100	4 or 5	3/8	5/8	5/8 x 1 3/4	5	5
101 to 250	4 or 5	1/2	11/16	11/16 x 2 1/4	6	5
101 to 250	2, 2 1/2 or 3	1/2	5/8	5/8 x 2 1/4	6	5
251 to 400	4 or 5	9/16	3/4	3/4 x 2 1/4	6	6
251 to 400	2, 2 1/2 or 3	9/16	11/16	11/16 x 2 1/4	6	6
401 to 600	2, 2 1/2 or 3	5/8	3/4	3/4 x 2 1/4	6	6

* When minimum thickness shown is exceeded, nail sizes will be increased.

** Where depth of cleated-style box is 5 inches or less, each side and each end will be made from one piece, and the thickness of ends will not be less than the combined thickness of the end and cleat specified above.

CHAPTER 7
TRANSPORTATION

44. Motor Transportation

Information on motor transportation is given in tables XL and XLI.

Table XL. Vehicle Capacities for Cargo and Men and Equipment

Vehicle	Cargo[a]		Men and equipment[a]
	Poor, rough road	Good, hard surfaced road	
Truck, ¼-ton	----------	----------	[b]3
Truck, ¾-ton	----------	----------	[b]8
Truck, 1½-ton	----------	----------	[b]15
Truck, 2½-ton 6 x 6 LWB:			
With trailer	3½ tons	5 tons	25
Without trailer	2½ tons	5 tons	25
Truck, 2½-ton 6 x 6 SWB:			
With trailer	3½ tons	5 tons	18
Without trailer	2½ tons	5 tons	18
Truck, 2½-ton 6 x 6 COE, 15- or 17-foot body (no trailer).	2½ tons	5 tons	30
Truck-tractor, 5-ton, w/10-ton semitrailer	(°)	10 tons	40
Truck-tractor, 5-ton, w/2,000-gallon tank, semitrailer.	(°)	2,000 gallons	(°)

[a] Trucks carrying either cargo or men and equipment—not both.
[b] Represents men, excluding driver.
[c] Not generally used.

Table XLI. Pertinent Data for Army Vehicles

Vehicle	Weight: (1) Net (2) Payload (3) Gross	Shipping Dimensions: Length (in.)	Width (in.)	Height (in.)	Cubic feet	Square feet	Capacity: (1) Fuel (2) Crankcase	Miles per gallon	Crusing range (miles)
Motorcycle, solo, chain driven	(1) 537 (2) 200 (3) 737	88	36¼	41	78	80	(1) 3½ gal. (2) 3 qt.	42	147
Automobile, sedan, light, 5-passenger	(1) 3,275 (2) 775 (3) 4,050	195⅞	72¾	69⅜	575	99	(1) 16 gal. (2) 6 qt.	17	270
Automobile, sedan, medium, 5-passenger.	(1) 3,700 (2) 850 (3) 4,550	208½	76⅛	63½	583	110	(1) 17 gal. (2) 5½ qt.	16	270
Truck, utility, ¼-ton, 4 x 4, M38	(1) 2,625 (2) 1,200 (3) 3,825	133	62	52	266	57	(1) 13 gal. (2) 5 qt.	17	220
Truck, cargo, ¾-ton, 4 x 4, M37	(1) 5,700 (2) 2,000 (3) 7,700	189	74	92	503	95	(1) 24 gal. (2) 4 qt.	9	215
Truck, cargo, 5-ton, 6 x 6, M41, w/winch.	(1) 19,835 (2) 10,000 (3) 30,185	309¾	96	111⅛	1,912	206	(1) 70 gal. (2) 18 qt.	4	280
Truck, medium wrecker, 4-ton, 6 x 6	(3) 21,700	291⅝	99½	116	1,946	202	(1) 60 gal. (2) 16 qt.	3	180
Truck, tractor, 5- to 6-ton, 4 x 4	(1) 11,950 (2) 8,270 (3) 20,220	203	94	109	1,035	132	(1) 62 gal. (2) 14 qt.	4.5	280
Trailer, cargo, ¼-ton, 2-wheel	(1) 550 (2) 500 (3) 1,050	78	56	42	116	42			

Trailer, cargo, 1-ton, 2-wheel	(1) Steel, 1,490 Wood, 1,300 (2) 2,000 (3) Steel, 3,490 Wood, 3,300	145½	71⅛	73	438	72			
Trailer, tank, water, 1-ton, 2-wheel, 250-gal.	(1) Aluminum, 1,350 Steel, 1,500 (2) 2,000 (3) Aluminum, 3,350 Steel, 3,500	136½	71⅛	70	347	68			
Truck, cargo, 1½-ton, 6 x 6	(1) 7,545 (2) 3,000 (3) 10,545	224	86	104½	1,165	138	(1) 30 gal. (2) 5 qt.	9	270
Truck, cargo, 2½-ton, 6 x 6, M135	(1) 12,330 (2) 5,000 (3) 17,330	267	88	105	1,428	163	(1) 56 gal. (2) 11 qt.	4	224

45. Rail Transportation

Information on rail transportation is given in tables XLII through XLVII.

Table XLII. Capacities of Standard United States Military Railway Cars

Type of car	Gage	Capacity[1] (tons)	Weight empty (tons)	Inside dimensions		
				Length	Width	Height
Box	4′8½″	20	9	23′9½″	7′7½″	6′5″
Box	3′3⅜″	30	15	34′6″	7′1″	6′1″
Box	3′6″	30	15	34′6″	7′1″	6′1″
Box	4′8½″	40	20	39′9″	8′0″	6′9″
Gondola, high-side	4′8½″	20	8	23′9½″	7′6″	[2]4′0″
Gondola, high-side	3′6″	30	10	34′6″	6′11½″	[2]4′0″
Gondola, low-side	3′3⅜″	30	9	34′6″	6′11″	[2]1′6″
Gondola, low-side	4′8½″	40	18	40′6½″	7′6″	[2]1′6″
Flat	4′8½″	56	17.5	40′9″	8′5″	
Tank, 9,900-gallon	4′8½″	40	20	37′2″	[3]6′9″	
Tank, 5,000-gallon	3′6″	30	16	27′6″	[3]5′6″	
Refrigerator	4′8½″	35	21	32′8″	6′11″	6′6″

[1] Capacity for personnel may be computed on a basis of 8 square feet per man and equipment for those cars suitable for this purpose.

[2] Height of sides.

[3] Diameter.

Table XLIII. Data Pertaining to United States Passenger Cars

Car	Length (ft)	No. of sections	Maximum seating		Maximum sleeping, 2 men per berth	Sleeping capacity	
			2 men per double seat[1]	3 men per 2 double seats[1]		3 men per section	1 man per berth
Day coach[2]	65–75	None	60–70	45–52	None	None	None
Tourist pullman	65–75	13–16	52–64	39–48	52–64	39–48	26–32
Standard pullman[3]	65–80	12–16	53–64	40–48	53–64	40–48	27–32

[1] Seat having capacity for two men.

[2] Limited number of steel coaches 70 feet long or over available.

[3] Twelve sections and drawing room or 16 sections and no drawing room.

*Table XLIV. Data on United States Freight Cars**

Type of car	Capacity		Weight empty (tons)	Inside dimensions		
	Tons	Cubic feet		Length	Width	Height
Box	30	2,750	18	36′	8′6″	9′
Box	40	3,100	20	40′6″	8′6″	9′
Box	50	3,100	24	40′6″	8′6″	9′
Gondola	50	1,570	22	40′	9′11″	4′
Gondola	70	1,920	25	48′	10′	4′
Flat	40	-------	18	40′	9′	
Flat	50	-------	20	45′	9′	
Flat	70	-------	25	50′	9′	
Tank, 8,000-gallon	40	-------	20	33′	6′6″	

See footnotes at end of table, p. 101.

Table XLIV. Data on United States Freight Cars—Continued

Type of car	Capacity		Weight empty (tons)	Inside dimensions		
	Tons	Cubic feet		Length	Width	Height
Tank, 10,000-gallon	50	-------	24	33′	7′2″	
Refrigerator	30	2,570	28	40′6″	8′2″	7′2″
Refrigerator	40	2,570	30	40′6″	8′2″	7′6″
Stock	30	2,625	20	36′	8′6″	8′6″
Automobile	40	3,100	20	40′6″	8′6″	9′
Automobile	50	3,850	25	50′6″	8′6″	9′
Baggage	-------	-------	45	60′	9′1″	8′
Caboose	-------	-------	20	27′6″	8′2″	7′
Diner	-------	-------	90	78′6″	8′6″	8′6″

* There are no "standard" data applicable for all commercial freight cars. Figures given here are for some types in common use. The Offiical Railway Equipment Register, published by the Railway Equipment & Publication Co., 424 W. 33d St., New York, N. Y., shows by individual car initials and numbers the marked capacity, length, dimensions and cubic capacity of all American railway cars used to transport freight.

Table XLV. Maximum Bulk Loading for Standard United States Freight Cars

Item	Capacity of car (tons)					
	Actual			Rated		
Ammunition	30	40	50	30	40	50
Blankets, baled	27	32	40	30	40	50
Bread	19	24	30	30	40	50
Canned goods, boxed	30	36	45	30	40	50
Cement	30	40	50	30	40	50
Clothing, baled	27	32	40	30	40	50
Flour	30	40	50	30	40	50
Gravel	30	40	50	30	40	50
Harness and saddlery	18	20	30	30	40	50
Hay, baled	15	20	25	30	40	50
Iron, corrugated	30	40	50	30	40	50
Meat	15	24	35	30	40	50
Motor vehicle parts	24	28	40	30	40	50
Oats	18	24	30	30	40	50
Pails	30	40	50	30	40	50
Rifles, in chests	30	40	50	30	40	50
Sand	30	40	50	30	40	50
Sandbags	30	40	50	30	40	50
Stone, any form	30	40	50	30	40	50
Sugar	30	40	50	30	40	50
Tentage	15	20	30	30	40	50
Ties, railway	19	26	32	30	40	50
Tools:						
Engineer	30	40	50	30	40	50
Truck	30	40	50	30	40	50
Wire:						
Barbed	30	40	50	30	40	50
Telephone	30	40	50	30	40	50

Table XLVI. Dimensions and Capacities of British Railway Wagons

Type of wagon or car	Capacity						Inside dimensions (ft)		
	British tons	Men at 8 square feet per man w/ equipment	Animals, L-draft, 22 inches, average width	Square feet	Cubic feet	Tare weight (British tons)	Length	Width	Height to sill
Covered goods: 4-wheel	----	16	8	133	838	7	17.3	7.7	6.3
Short	10	23	12	185	1,164	8	24	7.7	6.3
Covered goods: 4-wheel. Short	20	29	15	231	1,355	9.5	30	7.7	6.3
Open high-sided, 4-wheel, short.	10	16	18	128	589	6.7	17.1	7.5	4.6
Open high-sided: 4-wheel. Short	20	21	11	168	806	9.7	21.5	7.8	4.8
Open low-sided: 4-wheel. Short	10	16	------	128	371	6	17.1	7.5	2.9
Open low-sided, 4-wheel.	20	28	------	220	462	7.8	24.7	8.9	2.1
Open flat: 4-wheel. Short	10	------	------	117	-------	5.3	16.0	7.3	
Open flat: 4-wheel	20	------	------	173	-------	7.8	23.0	7.5	
Bogie	30	------	------	304	-------	15.0	40.5	7.5	
Bogie	35	------	------	356	-------	15.8	47.5	7.5	
Bogie	40	------	------	390	-------	18.5	52.0	7.5	
Open, well, 4-wheel.	20	------	------	179	-------	8.5	21.0	8.5	
Refrigerator, 4-wheel.	10	------	------	107	749	9.9	[1]14.8	[1]7.2	[2]7.0
Livestock	10	18	9	142	994	8.4	18.5	7.7	7.0
Tank or cistern	10	------	------	[3]2,860	-------	8.8	17.2	[4]6.0	
Tank or cistern	14	------	------	[3]4,000	-------	([5])	17.4	7.2	
Tank or cistern	20	------	------	[3]5,000	-------	([5])			
Tank or cistern	40	------	------	[1]10,000	-------	([5])			
War flats bogie	50	------	------	340	-------	18.7	40.0	8.5	
Brake vans, 4-wheel.	25	------	------	158	1,264	25.0	24.0	6.6	8.0

[1] In well.
[2] With ice chambers.
[3] Gallons.
[4] Inside diameter.
[5] Not available.

Table XLVII. Maximum Bulk Loading for British Freight Cars

Article	Tons	Article	Tons
Ammunition	10	Iron, corrugated and scrap, lead	10
Ballast	10	Mail, canteen stores, etc	5
Barbed wire	10	Meat, frozen	7
Blankets, baled	7	Medical stores	8
Bread and biscuits	6	Oats	8
Canned goods and potatoes, etc	8	Ordnance stores, general	5
Cement	10	Parts, motor vehicle	8
Clothing, baled	7	Petrol, in tins or cases	7
Coal	10	Railroad material (excluding ballast).	9
Coke	5	Rifles, in chests	10
Engineer supplies, general	7	Sandbags	6
Flour	7	Sugar beans, etc	9
Gravel, road stone, etc	10	Timber, ties, hut section, and tentage.	6
Harness and saddlery	6	Tools and telephone wire	10
Hay, compressed, baled	5		
Hay, steamed, pressed	3		

46. Water Transportation

Data concerning United States cargo ships are given in tables XLVIII and XLIX.

Table XLVIII. Data Concerning United States Cargo Ships

Data	Liberty	Victory		C1B	C1–M–AV1 (coaster)	C4 mariner	T2E (tanker)	T3 (tanker)	ZET1 (converted Liberty tanker)
		VC2	VC3						
Gross register tonnage	7,100	7,600	7,600	6,800	3,860	9,200	10,200	9,910	7,000
Overall length (ft)	442	455	455	418	339	564	524	502	442
Breadth (ft)	57	62	62	60	50	76	68	68	57
Speed, sustained (knots)	11	15½	16½	14	11	20	14½	15½	11½
Draft, loaded to summer freeboard (ft)	28	28	28	24	22	30	30	30	28
Deadweight tonnage	10,800	10,600	10,850	9,280	5,000	13,419	16,760	16,562	10,800
Measurement tonnage space:									
Dry cargo	11,500	11,750	11,750	11,400	5,675	18,418			
Refrigerated cargo					275	30,254			
Barrel cargo capacity							141,000	134,000	65,000
Number of holds	5	5	5	5	4	7	9	9	9
Ton capacity of heaviest boom	5	5	10	5	5	10	5	5	5

Table XLIX. Hatch Capacity of the Liberty Ship and C4 Mariner

Capacity below deck	Hatch 1	Hatch 2	Hatch 3	Hatch 4	Hatch 5	Hatch 6	Hatch 7
a. Liberty Ship:							
(1) Hatch dimensions	33′9″ x 20′	35′ x 20′	20′ x 20′	35′ x 20′	35′ x 20′		
(2) Cargo space in measurement tons:							
(*a*) Hold	900	2,300	1,500	1,300	1,300		
(*b*) Between decks	1,000	1,100	600	700	800		
(*c*) Deep tanks	140	270	460				
b. C4 Mariner:							
(1) Hatch dimensions	24′3″ x 18′6″	30′ x 24′	40′ x 30′	40′ x 30′	40′ x 30′	40′ x 30′	25′ x 30′
(2) Cargo space in measurement tons:							
(*a*) Hold	305	637	1,284	1,578	401	1,646	856
(*b*) Between decks	855	1,596	2,504	2,506	1,454	965	627
(*c*) Deep tanks					953	298	

47. Aerial Supply

The Quartermaster General has the responsibility for issuing and maintaining the parachutes, aerial delivery containers, and heavy-drop kits used in phase I of an airborne assault and in resupply operations. To fulfill this responsibility, a quartermaster parachute supply and maintenance company is included in the organization of each airborne division. In addition, a quartermaster aerial supply company and a quartermaster air equipment repair and depot company may be attached to a headquarters and headquarters detachment, quartermaster battalion.

a. Aerial Delivery Methods. The methods used for aerial delivery of supplies and equipment by parachute may vary with the type of aircraft available, the scope of the supply operation, and the type of equipment to be dropped.

(1) *Heavy cargo extraction system.* The heavy cargo extraction method is designed to deliver ready-to-use equipment and supplies. The system requires heavy-drop techniques using special equipment to contain the load, extract it from the open rear of cargo aircraft in flight, suspend it during the drop, and protect it from damage when it lands. To accomplish these objectives, the load is lashed to a heavy platform and padded against shock. The parachutes are attached, and the load is positioned and tied down in the cargo compartment of the aircraft. As the aircraft approaches the drop zone, all tie-downs are released with the exception of one safety strap which secures the load until the drop is made. Over the drop zone, a pilot parachute is released, deploying an extraction parachute. The extraction parachute, in turn, cuts the one remaining strap, pulls the load out of the aircraft, and deploys the main cargo parachutes, which suspend the load during the descent. When the load lands, a release assembly frees the cargo parachutes. Then, with the parachutes released, the equipment may be derigged and put into action within a few minutes after landing.

(2) *Door-load delivery.* The door-load delivery system is the simplest form of aerial delivery and requires the least preparation, but it is limited to small packages and small supply missions. The packages are placed in the doorway and pushed from the aircraft over the drop zone. The parachute static line can be attached to an anchor line cable or a tie-down ring near the door of the aircraft. The door-load system is adaptable to any type of aircraft that can accommodate the load and provide an opening for ejection.

(3) *Pararack delivery.* The pararack delivery system is an adaptation of the bomb rack system, employing release stations and bomb shackles. Aerial delivery containers can be attached to the bomb shackles and released by the pilot. It may be used

for small supply operations employing transport-type aircraft or light army aircraft fitted with bomb release stations under the fuselage or wings.

(4) *Monorail delivery.* The purpose of monorail delivery is to deliver with the assaulting airborne troops up to 10,000 pounds of rations, ammunition, weapons, and other items needed by combat troops. It is normally used in C–119 aircraft. The system consists of a single rail located at the top center of the fuselage running the full length of the cargo compartment. To the rail is attached trolleys. Each of these trolleys carry a 500-pound bundle or container. The trolleys are pulled along the rail by a cable. Silver-colored metal balls make it possible for the cable to propel the trolleys along the rail. There is a parachute attached to the container and from the parachute a static line is attached to the anchor line cable. At the forward part of the cargo compartment, in the floor, are paratainer doors. The containers are pulled to this point where they are released from the trolleys and fall through the paratainer doors. A static line deploys the parachutes. The entire system requires 7½ seconds to complete a drop of 20 bundles or containers. This system is for use during the assault phase of an airborne operation. It is not normally used for large-scale aerial resupply.

(5) *Gravity system.* The gravity (wheeled conveyor jettison) system is used to deliver the A22 aerial delivery container. Roller skate conveyors are placed on the floor of the aircraft and several A22 containers, attached to plywood skids, are placed on the conveyors. A tie-down assembly consisting of three straps holds the last container on the aircraft. All other containers rest against the last container; when the last container is freed, all containers roll from the aircraft. With the aircraft flying in a tail-down attitude and the restraining straps removed or cut from the rear of the load, gravity does all the work and the containers roll from the aircraft. To cut the restraining straps, a system of parachutes and deployment weight is used. The deployment weight is attached outside of the aircraft at the extreme rear. The pilot releases this weight as he reaches the drop zone. The weight pulls out a pilot chute which in turn pulls out a release parachute. The release parachute has a release line with three knives attached. The knives rest against one of each of the three restraining straps. When pressure is applied to the release line by the release parachute, it pulls on the knives, cutting the restraining straps, freeing the load, and allowing gravity to go to work.

b. Types of Aircraft, Cargo Parachutes, Aerial Delivery Containers, and Heavy-Drop Kits. Parachute delivery of supplies and equipment will usually employ C–119 type aircraft to facilitate ejection or extraction of

loads through the open rear of the cargo compartment. Tables L through LIII give data on types of aircraft, cargo parachutes, aerial delivery containers, and heavy-drop kits.

Table L. Aircraft Data

Aircraft	Basic[1]	Maximum takeoff[2]	Maximum landing	Allowable cargo (1,000-mile radius)
C–46	32,000	50,000	45,000	13,000
C–47	17,000	28,000	26,000	5,000
C–54	40,500	72,000	66,000	26,000
C–74	85,000	165,000	160,000	49,910
C–82	33,600	54,000	50,000	10,100
C–97	78,000	148,000	128,000	40,000
C–119	42,500	72,600	59,900	17,000
C–123	31,000	54,000	59,300	14,500
C–124	100,000	175,000	160,000	45,000

[1] Weight of plane without fuel, crew, or cargo.

[2] Maximum takeoff weight is the weight estimated within the confines of (1) load and fuel space limitations and (2) minimum practical strength and performance requirements.

Table LI. Cargo Parachute Data

Type	Diameter (ft)	Load capacity (lbs)	Use	Packed weight (lbs)	Cubage (cu ft)
G–1A	24	300	A–4, A–5, A–6.	25	1
G–13	32 (nominal)	500	A–7A, A–21 containers.	45	2
G–12	64	2,200	A–22 containers.	126	4
G–11A	100	3,500	Heavy drop.	250	10

Table LII. Aerial Delivery Container Data

Type	Capacity (lbs)	Delivery system	Type loads	Container weight (lbs)
A–4	200	Door-load, pararack, monorail.	Medical supplies, rations, clothing, miscellaneous supplies.	27
A–5	300	Door-load, pararack, monorail.	Weapons, ammunition.	43
A–6	300	Door-load, pararack, monorail.	Medical supplies, signal supplies, rations.	17
A–7A	500	Door-load, monorail, pararack.	Ammunition, water cans, rations, fuel drums.	8
A–21	500	Door-load, monorail.	Weapons, ammunition, rations.	31
A–22	2,200	Gravity (wheeled-conveyor jettison system).	Rations, ammunition, petroleum, oil and lubricants, water.	58

Table LIII. Heavy-Drop Kit Data

Aerial delivery kit	No. of C–11A parachutes	Length of platform (ft)	Total weight (kit and equipment, rigged) (lbs)
¼-ton truck	2 G–11A's or 3 G–12's	11	4,221
¾-ton truck	2	15	7,732
2½-ton truck	4	22	15,667
105-mm howitzer	2	15	6,535
40-mm AA gun	2	15	7,485
M55 gun (trailer mount)	2	11	5,052
M29C carrier	2	15	6,895
6,000-lb. load-bearing platform (miscellaneous loads).*	1, 2, or 3	12	3,500 to 10,000

* All information on this kit depends upon the type load and/or equipment and supplies loaded on the platform.

CHAPTER 8
RECOVERY AND DISPOSITION ACTIVITIES

48. Military Cemeteries

a. Size. The size of military cemeteries is not fixed but is dependent on requirements. An acre of average land (43,560 sq ft) will accommodate approximately 6 standard plots (5,772 sq ft per plot), providing space for 864 grave sites, including aisle and border requirements.

b. Grave Site Requirements.

(1) *Plot.* A plot consists of 12 rows of 12 graves each. Linear measurements are 52 feet wide and 111 feet from front to rear. A 12½-foot aisle is maintained between the front and rear of adjoining plots, an 11-foot aisle is maintained between the lateral borders of adjoining plots.

(2) *Row.* A row consists of 12 graves. Linear measurements are 52 feet wide and 9½ feet from front to rear.

(3) *Grave.* A grave is dug 6½ feet long, 2½ feet wide, and 3½ feet deep. Intervals between graves are 2 feet laterally from the edges of adjoining graves and 3 feet longitudinally between the front and rear of adjoining graves. Under normal conditions, one man can dig a grave in 2 to 3 hours.

49. Mass Burials

The grave site for a mass burial will contain no individual graves. It will consist, rather, of a varied number of rows. Each row will be 3½ feet deep and can be any length, provided it is straight and contains no obstructed graves. If, in digging a row, an obstruction is encountered, that row will be ended and new row started. Remains will be buried shoulder to shoulder in the row, with no space between remains.

CHAPTER 9

MEASUREMENTS, CONVERSIONS, AND EQUIVALENTS

50. Measurements

Tables LIV through LXI give information on measurements.

Table LIV. Linear Measure

16½ feet	=	1 rod
5½ yards	=	1 rod
320 rods	=	1 mile
1,760 yards	=	1 mile
5,280 feet	=	1 mile

Table LV. Square Measure

144 square inches	=	1 square foot
9 square feet	=	1 square yard
4,840 square yards	=	1 acre
70 yards square	=	1 acre (approx)
43,560 square feet	=	1 acre
640 acres	=	1 square mile
272¼ square feet	=	1 square rod

Table LVI. Cubic Measure

1,728 cubic inches	=	1 cubic foot
27 cubic feet	=	1 cubic yard

Table LVII. Nautical Measure

6 feet	=	1 fathom
100 fathoms	=	1 cable length (ordinary)
120 fathoms	=	1 cable length (U. S. Navy)
6,080.2 feet	=	1 nautical mile

Table LVIII. Dry Measure

1 pint	=	33.6 cubic inches
2 pints	=	1 quart
1 quart	=	67.2 cubic inches
8 quarts	=	1 peck
1 peck	=	537.6 cubic inches
4 pecks	=	1 bushel
1 bushel	=	2,150.42 cubic inches

Table LIX. Fluid Measure

16 fluid ounces (U. S. A.)	=	1 pint
20 fluid ounces (Britain)	=	1 pint (British)
2 pints	=	1 quart
4 quarts	=	1 gallon
1 gallon	=	8½ pounds (approx)
1 pint	=	4 gills

Table LX. Measurement of Surfaces and Solids

Circumference of a circle	=	Diameter times 3.1416
Area of a triangle	=	Base times altitude divided by 2.
Area of a square or an oblong	=	Length times breadth.
Area of a circle	=	Square of the diameter times .7854. or Square of the radius times 3.1416.
Area of the sector of a circle	=	Length of the arc times the radius divided by 2.
Area of any right-lined figure of four or more unequal sides	=	Division of the figure into triangles, finding of the area of each triangle, and adding of the areas.
Area of an ellipse	=	Long axis times the short axis times .7854.
Surface of a cone or a pyramid	=	One-half of slant height times perimeter of base plus area of base.
Surface of a cube	=	Sum of areas of all the sides.
Surface of a sphere	=	Square of the diameter times 3.1416.
Cubic content of a prism or cylinder	=	Area of the base times the height.
Cubic content of a cone or a pyramid	=	1/3 (area of base times altitude).
Surface of a prism or a cylinder	=	Area of 2 ends plus (length times perimeter).
Cubic content of a cube	=	Length times breadth times depth.
Cubic content of a sphere	=	Cube of the diameter times .5236.

Table LXI. Weights and Measures of Various Nations

Country	Weight or measure	American equivalent
Argentina	Arroba	25.32 lbs
	Baril	20.077 gals.
	Cuadra	4.2 acres
	Frasco (liq)	2.509 qts (liq)
	Libra	1.013 lbs
	Pie	0.947 ft
	Quintal	101.28 lbs
	Vara	34.094 in.
Australia	Weights and measures of Great Britain.	
Austria	Joch	1.422 acres
	Klafter	2.074 yds
Belgium	Last	85.134 bu
Bolivia	Marc	0.507 lbs
Borneo	Picul	135.64 lbs
Brazil	Arroba	32.379 lbs
	Quintal	120.54 lbs
Canada	Weights and measures of Great Britain.	
Celebes	Picul	135.64 lbs
Central America	Centore	4.263 gal.
	Fanega	1.574 bu
	Libra	1.014 lbs
	Manzana	1.727 acres
	Vara	32.913 in.
Chile	Fanega	2.753 bu
	Libra	1.014 lbs
	Quintal	101.41 lbs
	Vara	32.913 in.
China	Catty	1.333 lbs
	Ch'ih	12.6 in.
	Li	1,890 ft
	Picul	133.333 lbs
	Tael Kuping	575.64 grains (troy)
	Tsun	1.26 in.
Cuba	Libra	1.014 lbs
	Vara	33.386 in.
Denmark	Centner	110.23 lbs
	Mil	4.68 mile
	Mil (geographic)	4.61 mile
	Pund	1.102 lbs
	Tende (grain)	3.948 bu
	Tondeland	1.36 acres
	Viertel	1.701 gal.
Dutch Guiana	Livre	1.089 lbs
Ecuador	Fanega	1.574 bu
Egypt	Ardeb	5.619 bu
	Cantar	99.05 lbs
	Feddan	1.04 acres
	Oke	2.805 lbs
	Pic	22.83 in.

Table LXI. Weights and Measures of Various Nations—Continued

Country	Weight or measure	American equivalent
France	Tonne	2,204.62 lbs
Federated Malay States	Bongkal	832.0 grains
Germany	Klafter	2.074 yds
	Last	4,409.+ lbs
(Bremer)	Centner	127.5 lbs
(Brunswick)	Centner	117.5 lbs
(Prussia)	Centner	113.34 lbs
Great Britain	Comb	4.128 bu
	Gallon	1.2 U. S. gal.
	Last	82.56 bu
	Load (timber)	50 cu. ft
	Cwt (hundred weight)	112.0 lbs
	Quart (liq)	1.2 U. S. qts (liq)
	Quart (dry)	1.03 U.S. qts (liq)
	Quarter	8.256 bu
	Sack (flour)	280 lbs
	Stone	14 lbs
	Wey	41.282 bu
Greece	Drachma (new)	1 metric gr
	Livre	1.1 lbs
	Mina (old)	2.202 lbs
	Oke	2.82 lbs
Guatemala	Fanega	1.53 bu
	Libra	1.014 lbs
	Vara	32.909 in.
Honduras	Milla	1.149 mile
	Vara	32.953 in.
Hongkong	Catty	1.333 lbs
	Picul	133.333 lbs
Hungary	Joch	1.067 acres
India:		
(Bombay)	Candy	569 lbs
(Madras)	Candy	500 lbs
	Maund	82.285 lbs
	Ser	2.204 lbs
Iran	Jarib	2.471 acres
Israel	Rottle	6.35 lbs
Japan	Bu	0.12 in.
	Catty	1.32 lbs
	Cho	2.451 acres
	Ken	5.97 ft
	Koku	5.119 bu
	Kwamme	8.267 lbs
	Se	.024 acres
	Shaku	11.93 in.
	Sho (liq)	1.91 qts (liq)
	Sun	1.193 in.
	Tan	.25 acres
	To	2.05 pks.
	Tsubo	35.58 sq ft
Java	Catty	1.36 lbs
	Picul	136.16 lbs

Table LXI. Weights and Measures of Various Nations—Continued

Country	Weight or measure	American equivalent
Luxemburg	Fuder	264.18 gal.
Malacca	Catty	1.36 lbs
Malta	Barrel (customs)	11.2 gal.
	Caffisco	5.4 gal.
	Cantaro	175 lbs
	Salm	8.2 bu
Mexico	Baril	20.078 gal.
	Fanega	2.577 bu
	Frasco (liq)	2.5 qts (liq)
	Libra	1.014 lbs
	Quintal	101.47 lbs
	Vara	32.99 in.
Morocco	Artel	1.12 lbs
	Cantar	112 lbs
Nicaraugua	Manzana	1.742 acres
	Milla	1.159 mile
	Vara	33.057 in.
Norway	Centner	110.23 lbs
Paraguay	Arroba	25.32 lbs
	Cuadra (lin)	94.7 yds
	Cuadra (sq)	1.85 acres
	League	4.633 acres
Peru	Libra	1.014 lbs
	Quintal	101.43 lbs
	Vara	31.913 in.
Philippines	Picul	139.44 lbs
Poland	Garnice	1.056 gal.
	Vloka	41.5 acres
Portugal	Almude	4.422 gal.
	Li'ra	1.012 lbs
Russia	Arshin (lin)	28 in.
	Arshin (sq)	5.44 sq ft
	Berkovets	361.128 lbs
	Chetvert	5.957 bu
	Dessiatine	2.699 acres
	Food	36.113 lbs
	Funt	0.9 lbs
	Sajene	7 ft
	Vedro	2.707 gal.
	Verst	0.633 mile
Spain	Arroba	4.263 gal.
	Fanega	16 gal.
	Frail (rais's)	50 lbs
	Pie	0.914 ft
	Quintal	101.43 lbs
Sumatra	Bouw	7,096.5 sq meters
	Catty	2.12 lbs
Sweden	Centner	93.7 lbs
	Skalpund	0.937 lbs
	Tunna	4.5 bu
	Tunnland	1.22 acres

Table LXI. Weights and Measures of Various Nations—Continued

Country	Weight or measure	American equivalent
Thailand	Catty (standard)	1.333 lbs
	Catty	2.667 lbs
	Coyan	2,645.5 lbs
Turkey	Cantar	124.45 lbs
	Oke	2.828 lbs
	Pik	27.9 in.
United States	Acre	4,840 sq yds
	Bushel	4 pk
	Fathom	6 ft
	Foot:	
	Linear	12 in.
	Square	144 sq in.
	Cubic	1,728 cu in.
	Gallon	4 qts
	Mile:	
	Linear	5,280.0 ft
	Square	640.0 acres
	Ounce:	
	Avdp	437.5 gr
	Troy	480 gr
	Peck	8 qts
	Pennyweight	24 gr
	Pound:	
	Avdp	7,000 gr
	Troy	5,760 gr
	Pint:	
	Liquid	4 gills
	Quart	2 pts
	Rod:	
	Linear	16.5 ft
	Square	272.25 sq ft
	Ton:	
	Long	2,240 lbs
	Short	2,000 lbs
	Yard:	
	Linear	3 ft
	Cubic	27 cu ft
	Square	9 sq ft
Uruguay	Cuadra	1.82 acres
	Fanega	3.888 bu
	Libra	1.014 lbs
Venezuela	Fanega	3.334 bu
	Libra	1.014 lbs
Zanzibar	Frasila	35 lbs

51. Conversions

Tables LXII through LXX give information on conversions.

Table LXII. Conversions of Volume

Unit	Cubic feet	Imperial gallon	U. S. gallon	Liters	U. S. quarts
One cubic foot =	----------	6.229	7.481	23.32	29.92
One imperial gallon =	.16054	----------	1.2010	4.546	4.804
One U. S. gallon =	.13368	.8327	----------	3.7854	4.000
One liter =	.03532	.2201	.2642	----------	1.0567

Table LXIII. Conversions of Weight

a. Metric to United States.

Metric		United States
Millier (tonneau, metric ton)	=	2,204.6 pounds
Quintal	=	220.46 pounds
Myriagram	=	22.046 pounds
Kilogram	=	2.2046 pounds
Hectogram	=	3.5274 ounces
Decagram	=	.3527 ounces
Gram	=	15.432 grains
Decigram	=	1.5432 grains
Centigram	=	.1543 grains
Milligram	=	.0154 grains

Table LXIII. Conversions of Weight—Continued

b. Tons and Kilograms.

Unit	Long tons	Metric tons	Short tons	Kilograms	Pounds	Cubic feet
One long ton	--------	1.0160	1.1200	1,016.0	2,240.0	
One metric ton	0.9842	--------	1.1023	1,000.0	2,204.6	
One short ton	.8929	.9072	--------	907.2	2,000.0	
One kilogram	--------	--------	--------	----------	2.2	
One measurement ton	--------	--------	--------	----------	----------	40.0

Table LXIV. Conversions of Length

Metric		United States
Myriameter	=	6.2137 miles
Kilometer	=	.62137 mile
Hectometer	=	328 feet 1 inch
Decameter	=	393.7 inches
Meter	=	39.37 inches
Decimeter	=	3.937 inches
Centimeter	=	.3937 inch
Millimeter	=	.03937 inch

Table LXV. Conversions of United States Measures to Metric Measures

United States (or imperial)	Conversion factor	Metric
Acres	0.4047	Hectares
Cubic feet	.0283	Cubic meters
Cubic inches	16.3872	Cubic centimeters
Cubic inches	.0164	Liters
Cubic yards	.7646	Cubic meters
Feet	.3048	Meters
Feet per second	18.288	Meters per minute
Gallons (U. S.)	3.7854	Liters
Gallons (imp)	4.543	Liters
Grains	.0648	Grams
Hundredweights	.508	Quintals
Inches	2.54	Centimeters
Inches	.0254	Meters
Inches	25.4001	Millimeters
Miles	1.6093	Kilometers
Miles per hour	.447	Meters per second
Ounces (avdp)	28.349	Grams
Ounces (avdp)	.02835	Kilograms
Pints (U. S.)	.4732	Liters
Pints (imp)	.568	Liters
Pounds (avdp)	.45359	Kilograms
Square feet	.0929	Square meters
Square inches	6.4516	Square centimeters
Square miles	2.590	Square kilometers
Square yards	.8361	Square meters
Yards	.914	Meters

Table LXVI. Conversions of Metric Measures to United States Measures

Metric	Conversion factor	United States (or imperial)
Centimeters	0.3937	Inches
Cubic centimeters	.0610	Cubic inches
Cubic meters	35.3144	Cubic feet
Cubic meters	1.3079	Cubic yards
Grams	15.4324	Grains
Grams	.03527	Ounces (avdp)
Hectares	2.4710	Acres
Kilogram	2.2046	Pounds (avdp)
Kilograms	35.2739	Ounces (avdp)
Kilometers	.62137	Miles
Liters	61.025	Cubic inches
Liters	.2642	Gallons (U. S.)
Liters	.220	Gallons (imp)
Liters	2.1134	Pints (U. S.)
Liters	1.76	Pints (imp)
Meters	3.2808	Feet
Meters	39.37	Inches

Table LXVI. Conversions of Metric Measures to United States Measures—Continued

Metric	Conversion factor	United States (or imperial)
Meters	1.0936	Yards
Meters per minute	.0547	Feet per second
Meters per second	2.237	Miles per hour
Metric ton	2,204.6	Pounds
Millimeters	.0393	Inches
Quintals	1.97	Hundredweights
Square centimeters	.155	Square inches
Square kilometers	.3861	Square miles
Square meters	1.1960	Square yards
Square meters	10.764	Square feet

Table LXVII. Conversions of Temperature

Centigrade = 5/9 (F. − 32)
Fahrenheit = 9/5C. + 32
Centigrade = 5/4R.
Reaumur = 4/5C.
Fahrenheit = 9/4R. + 32
Reaumur = 4/9 (F. − 32)

Table LXVIII. Cloth Conversions

(To find square yards, multiply the length of the cloth in yards by the conversion factor of its width.)

Width of cloth (inches)	Conversion factor	Width of cloth (inches)	Conversion factor	Width of cloth (inches)	Conversion factor
21½	.5972	31½	.8750	41½	1.1528
22	.6111	32	.8889	42	1.1667
22½	.6250	32½	.9028	42½	1.1806
23	.6339	33	.9167	43	1.1944
23½	.6528	33½	.9306	43½	1.2083
24	.6667	34	.9444	44	1.2222
24½	.6806	34½	.9583	44½	1.2361
25	.6944	35	.9722	45	1.2500
25½	.7083	35½	.9861	45½	1.2639
26	.7222	36	1.0000	46	1.2778
26½	.7361	36½	1.0139	46½	1.2917
27	.7500	37	1.0278	47	1.3056
27½	.7639	37½	1.0418	47½	1.3194
28	.7778	38	1.0556	48	1.3333
28½	.7917	38½	1.0694	48½	1.3472
29	.8056	39	1.0833	49	1.3611
29½	.8194	39½	1.0972	49½	1.3750
30	.8333	40	1.1111	50	1.3889
30½	.8472	40½	1.1250	50½	1.4028
31	.8611	41	1.1389	51	1.4167

Table LXVIII. Cloth Conversions—Continued

Width of cloth (inches)	Conversion factor	Width of cloth (inches)	Conversion factor	Width of cloth (inches)	Conversion factor
51½	1.4306	59	1.6389	73	2.0278
52	1.4444	59½	1.6528	74	2.0556
53½	1.4583	60	1.6667	75	2.0833
53	1.4722	61	1.6944	76	2.1111
53½	1.4861	62	1.7222	78	2.1667
54	1.5000	63	1.7500	80	2.2222
54½	1.5139	64	1.7778	82	2.2778
55	1.5278	65	1.8056	84	2.3333
55½	1.5417	66	1.8333	88	2.4444
56	1.5556	67	1.8611	90	2.5000
56½	1.5694	68	1.8889	96	2.6667
57	1.5833	69	1.9167	100	2.7778
57½	1.5972	70	1.9444	108	3.0000
58	1.6111	71	1.9722		
58½	1.6250	72	2.0000		

Table LXIX. Rope Conversions

a. Standard Lay—Manila, Sisal, and Jute.

Diameter (inches)	Pounds per foot	Feet per pound
3/16	.015	66.6
1/4	.020	50.0
5/16	.029	34.5
3/8	.041	24.4
7/16	.053	18.9
1/2	.075	13.3
9/16	.104	9.61
5/8	.133	7.50
3/4	.167	6.00
13/16	.195	5.13
15/16	.225	4.45
1	.270	3.71
1 1/16	.313	3.20
1 1/8	.360	2.78
1 1/4	.418	2.40
1 5/16	.480	2.09
1 1/2	.600	1.67
1 5/8	.744	1.34
1 3/4	.895	1.12
2	1.08	.926
2 1/4	1.46	.685
2 5/8	1.91	.524
3	2.42	.414
3 1/4	2.99	.335
3 5/8	3.67	.273
4	4.36	.230

Table LXIX. Rope Conversions—Continued

b. Tent Lay.

(1) *Manila and sisal.*

Diameter (inches)	Pounds per foot	Feet per pound
¼	.018	55.6
5/16	.026	38.5
⅜	.037	27.0
½	.068	14.7
⅝	.120	8.33
¾	.150	6.67

(2) *Manila.*

1	.243	4.12
1¼	.377	2.65

(3) *Cotton.*

3/16	.014	71.4
¼	.023	43.5
5/16	.036	27.8
⅜	.053	18.9
½	.087	11.5
⅝	.154	6.49
¾	.196	5.10

(4) *Jute.*

¼	.020	50.0
5/16	.029	34.5
⅜	.041	24.4
½	.075	13.3
⅝	.133	7.5
¾	.167	6.0

c. Cotton.

(1) *Twisted.*

⅛	.005	200.0
3/16	.011	90.0
¼	.019	52.0
⅜	.043	23.5
½	.074	13.5
¾	.167	6.0
1	.285	3.5

Table LXIX. Rope Conversions—Continued

(2) *Braided.*

Diameter (inches)	Pounds per foot	Feet per pound
1/8	.005	200.0
5/32	.011	90.0
3/16	.017	58.8
7/32	.021	47.6
1/4	.025	40.0
5/16	.040	25.0
3/8	.053	18.9
1/2	.091	11.0

Table LXX. Miscellaneous Conversions

Multiply—	By—	To obtain—
Acres	43,560	Square feet
Acres	4,047	Square meters
Btu	778	Foot-pounds
Cubic feet	7.481	Gallons (U. S.)
Feet per minute	.01137	Miles per hour
Feet per second	.6818	Miles per hour
Gallons (U. S.)	.1337	Cubic feet
Gallons (imp)	.1605	Cubic feet
Gallons (U. S.)	.8327	Gallons (imp)
Gallons (imp)	1.201	Gallons (U. S.)
Inches	.02778	Yards
Knots	1.1516	Miles per hour
Miles	5,280	Feet
Miles per hour	88	Feet per minute
Miles per hour	1.467	Feet per second
Miles per hour	.8684	Knots
Quires	25	Sheets
Reams	500	Sheets
Rods	5.5	Yards
Square yards	.0002066	Acres
Stones	14	Pounds
Tons, long	2,240	Pounds
Tons, short	2,000	Pounds
Tons, long	1.12	Tons, short
Tons, short	.893	Tons, long
Tons, long	2.464	Tons, ship
Tons, ship	40	Cubic feet
Tons, register	100	Cubic feet

52. Equivalents

Table LXXI gives information on shipping equivalents.

Table LXXI. Shipping Equivalents

Weight	Equivalent
Average short ton of military supplies with stowage.	2.2 ship (measurement) tons
Average short ton of military supplies without stowage.	1.9 ship (measurement) tons
Average long ton of military supplies with stowage.	2.464 ship (measurement) tons
Ship (measurement) tonnage	$\frac{\text{Bale cubic capacity}}{40}$
Deadweight tonnage	.85 ship (measurement) tonnage
Effective deadweight tonnage	.80 deadweight tonnage
Deadweight tonnage	1.5 gross registered tonnage
Gross tonnage	.6 deadweight tonnage*
Net tonnage	.4 deadweight tonnage*

* Approximate relation of freight ships of 10,000 deadweight tons.

53. Decimal Equivalents of Fractions

Table LXXII contains information on decimal equivalents of fractions.

Table LXXII. Decimal Equivalents of Fractions

Inches	Inches	mm	Inches	Inches	mm
	1/64	.015625	.397	25/64	.390625	9.922
1/32		.03125	.794	13/32	.40625	10.319
	3/64	.046875	1.191	27/64	.421875	10.716
1/16		.0625	1.587	7/16	.4375	11.113
	5/64	.078125	1.984	29/64	.453125	11.509
3/32		.09375	2.381	15/32	.46875	11.906
	7/64	.109375	2.778	31/64	.484375	12.303
1/8		.125	3.175	1/2	.5	12.700
	9/64	.140625	3.572	33/64	.515625	13.097
5/32		.15625	3.969	17/32	.53125	13.494
	11/64	.171875	4.366	35/64	.546875	13.890
3/16		.1875	4.762	9/16	.5625	14.287
	13/64	.203125	5.159	37/64	.578125	14.684
7/32		.21875	5.556	19/32	.59375	15.081
	15/64	.234375	5.953	39/64	.609375	15.478
1/4		.25	6.350	5/8	.625	15.875
	17/64	.265625	6.747	41/64	.640625	16.272
9/32		.28125	7.144	21/32	.65625	16.669
	19/64	.296875	7.541	43/64	.671875	17.065
5/16		.3125	7.937	11/16	.6875	17.462
	21/64	.328125	8.334	45/64	.703125	17.859
11/32		.34375	8.731	23/32	.71875	18.256
	23/64	.359375	9.128	47/64	.734375	18.653
3/8		.375	9.525	3/4	.75	19.050

Table LXXII. Decimal Equivalents of Fractions—Continued

Inches		Inches	mm	Inches		Inches	mm
	49/64	.765625	19.447		57/64	.890625	22.622
25/32		.78125	19.844	29/32		.90625	23.019
	51/64	.796875	20.240		59/64	.921875	23.415
13/16		.8125	20.637	15/16		.9375	23.812
	53/64	.828125	21.034		61/64	.953125	24.209
27/32		.84375	21.431	31/32		.96875	24.606
	55/64	.859375	21.828		63/64	.984375	25.003
7/8		.875	22.225	1		1.	25.400

Inches in decimals of a foot

1/16	3/32	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729
1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

54. Functions of Numbers

Table LXXIII gives information on functions of numbers.

Table LXXIII. Functions of Numbers

Number	Square	Cube	Square root	Logarithm	Number	Square	Cube	Square root	Logarithm
1	1	1	1.0000	0.00000	24	576	13824	4.8990	1.38021
2	4	8	1.4142	.30103	25	625	15625	5.0000	1.39794
3	9	27	1.7321	.47712	26	676	17576	5.0990	1.41497
4	16	64	2.0000	.60206	27	729	19683	5.1962	1.43136
5	25	125	2.2361	.69897	28	784	21952	5.2915	1.44716
6	36	216	2.4495	.77815	29	841	24389	5.3852	1.46240
7	49	343	2.6458	.84510	30	900	27000	5.4772	1.47712
8	64	512	2.8284	.90309	31	961	29791	5.5678	1.49136
9	81	729	3.0000	.95424	32	1024	32768	5.6569	1.50515
10	100	1000	3.1623	1.00000	33	1089	35937	5.7446	1.51851
11	121	1331	3.3166	1.04139	34	1156	39304	5.8310	1.53148
12	144	1728	3.4641	1.07918	35	1225	42875	5.9161	1.54407
13	169	2197	3.6056	1.11394	36	1296	46656	6.0000	1.55630
14	196	2744	3.7417	1.14613	37	1369	50653	6.0828	1.56820
15	225	3375	3.8730	1.17609	38	1444	54872	6.1644	1.57978
16	256	4096	4.0000	1.20412	39	1521	59319	6.2450	1.59106
17	289	4913	4.1231	1.23045	40	1600	64000	6.3246	1.60206
18	324	5832	4.2426	1.25527	41	1681	68921	6.4031	1.61278
19	361	6859	4.3589	1.27875	42	1764	74088	6.4807	1.62325
20	400	8000	4.4721	1.30103	43	1849	79507	6.5574	1.63347
21	441	9261	4.5826	1.32222	44	1936	85184	6.6332	1.64345
22	484	10648	4.6904	1.34242	45	2025	91125	6.7082	1.65321
23	529	12167	4.7958	1.36173	46	2116	97336	6.7823	1.66276

Table LXXIII. Functions of Numbers—Continued

Number	Square	Cube	Square root	Logarithm	Number	Square	Cube	Square root	Logarithm
47	2209	103823	6.8557	1.67210	74	5476	405224	8.6023	1.86923
48	2304	110592	6.9282	1.68124	75	5625	421875	8.6603	1.87506
49	2401	117649	7.0000	1.69020	76	5776	438976	8.7178	1.88081
50	2500	125000	7.0711	1.69897	77	5929	456533	8.7750	1.88649
51	2601	132651	7.1414	1.70757	78	6084	474552	8.8318	1.89209
52	2704	140608	7.2111	1.71600	79	6241	493039	8.8882	1.89763
53	2809	148877	7.2801	1.72428	80	6400	512000	8.9443	1.90309
54	2916	157464	7.3485	1.73239	81	6561	531441	9.0000	1.90849
55	3025	166375	7.4162	1.74036	82	6724	551368	9.0554	1.91381
56	3136	175616	7.4833	1.74819	83	6889	571787	9.1104	1.91908
57	3249	185193	7.5498	1.75587	84	7056	592704	9.1652	1.92428
58	3364	195112	7.6158	1.76343	85	7225	614125	9.2195	1.92942
59	3481	205379	7.6811	1.77085	86	7396	636056	9.2736	1.93450
60	3600	216000	7.7460	1.77815	87	7569	658503	9.3274	1.93952
61	3721	226981	7.8102	1.78533	88	7744	681472	9.3808	1.94448
62	3844	238328	7.8740	1.79239	89	7921	704969	9.4340	1.94939
63	3969	250047	7.9373	1.79934	90	8100	729000	9.4868	1.95424
64	4096	262144	8.0000	1.80618	91	8281	753571	9.5394	1.95904
65	4225	274625	8.0623	1.81291	92	8464	778688	9.5917	1.96379
66	4356	287496	8.1240	1.81954	93	8649	804357	9.6437	1.96848
67	4489	300763	8.1854	1.82607	94	8836	830584	9.6954	1.97313
68	4624	314432	8.2462	1.83251	95	9025	857375	9.7468	1.97772
69	4761	328509	8.3066	1.83885	96	9216	884736	9.7980	1.98227
70	4900	343000	8.3666	1.84510	97	9409	912673	9.8489	1.98677
71	5041	357911	8.4261	1.85126	98	9604	941192	9.8995	1.99123
72	5184	373248	8.4853	1.85733	99	9801	970299	9.9499	1.99564
73	5329	389017	8.5440	1.86332	100	10000	1000000	10.0000	2.00000

55. Trigonometric Functions

Table LXXIV gives information on natural trigonometric functions.

Table LXXIV. Natural Trigonometric Functions

Angle	Sin.	Cosec.	Tan.	Cotan.	Sec.	Cos.	
0°	0.000	---------	0.000	---------	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°
	Cos.	Sec.	Cotan.	Tan.	Cosec.	Sin.	Angle

Vable LXXIV. Natural Trigonometric Functions—Continued

Angle	Sin.	Cosec.	Tan.	Cotan.	Sec.	Cos.	
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	.249	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	1.542	.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	1.000	1.414	.707	45°
	Cos.	Sec.	Cotan.	Tan.	Cosec.	Sin.	Angle

APPENDIX I

REFERENCES

DA Pam 108–1	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.
DA Pam 310–1	Index of Administrative Publications.
DA Pam 310–2	Index of Blank Forms.
DA Pam 310–3	Index of Training Publications.
DA Pam 310–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310–5	Index of Graphic Training Aids and Devices.
DA Pam 310–7	Index of Tables of Organization and Equipment, Tables of Organization, Type Tables of Distribution, and Tables of Allowances.
DA Pam 310–30	Index of Supply Manuals, Quartermaster Corps.
DA Pam 320–1	Dictionary of United States Military Terms for Joint Usage.
AR 310–3	Preparation and Processing.
AR 320–50	Authorized Abbreviations.
AR 711–60	Supply Replacement Factors and Consumption Rates for Army Materiel.
AR 740–15	Preservation, Packaging and Packing.
AR 743–41	Shed and Open Storage of Supplies.
AR 754–9130–1	Utilization of Automotive Gasoline.
SR 30–20–10	Refrigerated Warehouse Facilities Fixed and Prefabricated.
SR 320–5–1	Dictionary of United States Army Terms.
FM 3–8	Chemical Corps Reference Handbook.
FM 5–34	Engineer Field Data.
FM 5–35	Engineers' Reference and Logistical Data.
FM 8–55	Medical Field Manual—Reference Data.
FM 20–15	Tents and Tent Pitching.
FM 21–5	Military Training.
FM 21–6	Techniques of Military Instruction.
FM 21–15	Care and Use of Individual Clothing and Equipment.
FM 21–30	Military Symbols.

FM 101–10	Staff Officers' Field Manual: Organization, Technical, and Logistical Data.
TM 9–2800	Military Vehicles.
TM 10–250	Storage of Quartermaster Supplies.
TM 10–706	Field Bakery, Portable, M1942.
TM 10–1101	Petroleum-Handling Operations.
TM 10–1103	Quartermaster Petroleum Handling Equipment.
TM 10–1405	Bath Unit, Field, Mobile, 24-Showerhead.
TM 10–1619	Quartermaster Materials Handling Equipment.
TM 10–1680A	Laundry, Mobile, Two-Trailer Type, Trailer No. 1 Washer Trailer TLMW–51 & PLMW–51A, Trailer No. 2 Tumbler Trailer TLMT–51 & PLMT–51A.
TM 10–1699A–E	Bakery Unit, Mobile, M–1945 (components).
TM 38–230	Preservation, Packaging, and Packing of Military Supplies and Equipment.
TM 743–200	Storage and Materials Handling.
SB 10–38	Peacetime Replacement Factors and Consumption Rates, Quartermaster Corps.
SB 10–495	Standard "B" Ration for the Armed Forces.
SB 10–496	Wartime Replacement Factors and Consumption Rates, Quartermaster Corps.
SB 38–5–3	List of Standard Lubricants, Hydraulic Fluids, Liquid Fuels, and Preservative Materials Used by the Department of the Army.
SB 38–8–1	Storage of Army Supplies and Equipment in Shed and Open Storage.
SB 38–100	Preservation, Packaging and Packing Materials, Supplies and Equipment Used by the Army.
SB 708–401	Federal Supply Classification, Part I.
SB 708–402	Federal Supply Classification, Part II.
SB 708–403	Federal Supply Classification, Part III.
	Index of Specifications and Standards Used by Department of the Army, Military Index Volume II.

APPENDIX II

QUARTERMASTER TOE UNITS

10–17 Quartermaster Company, Infantry Division.
10–22 Headquarters and Headquarters Detachment, Quartermaster Group.
10–45 Armored Quartermaster Battalion, Armored Division.
10–46 Headquarters and Headquarters Detachment, Armored Quartermaster Battalion.
10–47 Quartermaster Supply Company, Armored Quartermaster Battalion.
10–48 Quartermaster Field Service Company, Armored Quartermaster Battalion.
10–67 Quartermaster Service Company.
10–77 Quartermaster Petroleum Supply Company.
10–127 Quartermaster Parts Company.
10–147 Quartermaster Bakery Company.
10–157 Quartermaster Sales Company.
10–167 Quartermaster Laundry Company.
10–187 Quartermaster Salvage Company.
10–197 Quartermaster Subsistence Supply Company.
10–227 Quartermaster Clothing and General Supplies Depot Company.
10–237 Quartermaster Reclamation and Maintenance Company, Semimobile.
10–247 Quartermaster Refrigeration Company.
10–257 Quartermaster Bath Company, Semimobile.
10–277 Quartermaster Company, Amphibious Support Brigade.
10–297 Quartermaster Graves Registration Company.
10–337 Airborne Quartermaster Parachute Supply Company.
10–338 Quartermaster Parachute and Maintenance Detachment, Airborne Corps.
10–357 Quartermaster Subsistence Depot Company.
10–367 Quartermaster Supply Depot Company.
10–377 Quartermaster Petroleum Depot Company.
10–407 Quartermaster Aerial Supply Company.
10–417 Quartermaster Air Equipment Repair and Depot Company.
10–419 Quartermaster Special Forces Parachute Rigging Detachment.
10–427 Quartermaster Mechanical and Metal Repair Company.

10–437 Quartermaster Clothing and Textile Repair Company.
10–500 Quartermaster Service Organization.
10–521 Headquarters and Headquarters Company, Quartermaster Depot.
10–536 Headquarters and Headquarters Detachment, Quartermaster Battalion.
20–20 Labor Supervision Organization.

INDEX

[AG 321 (11 July 57)]

By Order of *Wilber M. Brucker*, Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

DCSPER	Units org under fol TOE:
ACSI	10–17
DCSOPS	10–22
DCSLOG	10–45
ACSRC	10–46
Technical Stf, DA	10–47
Technical Stf Bd	10–48
USCONARC	10–67
US ARADCOM	10–77
OS Maj Comd	10–127
MDW	10–157
Armies	10–167
Corps	10–187
Div	10–197
USATC	10–227
Brig	10–237
Regt/Gp	10–247
Bn	10–257
Ft & Camps	10–277
USMA	10–297
Svc Colleges	10–337
Br Svc Sch	10–338
PMST Sr Div Units	10–357
PMST Jr Div Units	10–367
PMST Mil Sch Div Units	10–377
Gen Depots	10–407
Sup Sec, Gen Depots	10–417
QM Depots	10–419
RTC	10–427
Mil Dist	10–437
MAAG	10–521
Mil Mis	10–536

NG: State AG; units—same as Active Army.

USAR: Same as Active Army.

For explanation of abbreviations used, see AR 320–50.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1957—440515