JOINT TARGET GROUP, WASHINGTON, D. C.
— GENERAL ANALYSIS —

M
MUNITIONS
18 JUNE 1945

MILITARY STORES
MUNITIONS

SECRET
By Authority of
The Commanding General
Army Air Forces
18 JUNE 1945 (Date) GJ Orig (Initials)

Published in Office of AC/AS Intelligence, A. A. F., by Combined Personnel of U. S. and British Services for the use of Allied Forces

File No. 15,011

MILITARY STORES
MUNITIONS

I. CURRENT DEVELOPMENTS

A. REQUIREMENTS AND SUPPLY

There have been no material recent changes in either the requirements or supply situations with respect to Japanese military ammunition and explosives.[1]

B. CHARACTERISTICS OF THE INDUSTRY

1. Extent and Location

To date 47 important ammunition and/or explosive storage areas, many of which are incidental to explosive manufacturing or ammunition loading establishments, have been definitely located and assigned target numbers. Fifteen to 20 additional small ammunition or explosive storage areas have been observed but disregarded as having only slight potential target value. Of the 47 storage targets 30 are located on Honshu, 6 on Kyushu, and 11 on the Asiatic continent.

Only 15 of these 47 targets are purely storage areas. Seventeen targets are primarily manufacturing plants producing military explosive materials, but including also incidental storage facilities which contain explosives and may possibly in some cases also contain finished ammunition. An additional 15 targets are primarily shell, bomb, or component loading establishments with incidental storage of considerable size. Characteristically, nearly every explosive manufacturing or loading establishment either includes, or has affiliated with it, a certain amount of either stored ammunition or explosive material.

The apparent geographic pattern of stored ammunition and explosives in Japanese territory is as follows:

a. One group of 30 storage areas is scattered along the E Honshu coast in a belt extending SW from N of Tokyo to Hiroshima, with concentrations in and near the cities of Tokyo, Nagoya, and Osaka.

b. A second group of 6 storage areas is dispersed along the E and W coasts of Kyushu near the cities of Nobeoka, Omuta, Oita, and Sasebo.

c. A third group of 11 continental storage areas may be found near the cities of Mukden, Fushun, Kirin, and Chinchow in Manchuria, and Konan and Heijo in Korea.

The above described geographical pattern may not be truly representative of all Japanese ammunition-explosive storage areas. The observed pattern is explained largely by the fact that aerial photography available for inspection follows the same geographic pattern. All air cover available through March 1945 was inspected, but by this date only a small part of the total area of Japan had been covered by aerial reconnaissance.

[1] Ammunition, as used in this paper, includes bombs, grenades, and rockets as well as shells.

2. Size and Integration with Manufacturing Plants

Ammunition and explosive storage areas checked to date vary considerably in size. A large area is defined as one which contains more than 45 medium to large size revetted or dispersed buildings. A medium area is defined as one which contains between 25 and 45 medium or large size revetted or dispersed buildings. A small area is one containing less than 25 revetted or dispersed buildings of medium to large proportions.

On this basis, 23 of the 47 major ammunition or explosive storage areas are large size; 13 are medium, while 11 classify as small.

A cross classification of these storage areas, by extent of storage facilities and principal purpose of each installation, is given in Table I.

TABLE I
Japanese Ammunition Storage Areas, By Size and Major Function

Major Function		Total	Size: Large	Medium	Small
Storage	Japan	10	3	3	4
	Continent	5	2	2	1
Explosive Mfg.	Japan	13	10a	2c	1
	Continent	4	2b	2	
Loading	Japan	13	6	4	3
	Continent	2		1c	1
Totals	Japan	36	19	9	8
	Continent	11	4	5	2
GRAND TOTALS		47	23	14	10

a—Including 3 not certain (Inadequate air cover)
b—Including 1 not certain (Inadequate air cover)
c—Not certain (Inadequate air cover)

C. EFFECTS OF AIR ATTACK TO DATE

To date no large attacks on ammunition or explosive storage areas either in Japan proper or on the continent N of Shanghai have been made. Very slight damage to a few storage areas has been caused by bombs aimed at aircraft and urban area targets.

D. CURRENT PRINCIPAL TARGETS

The major known storage areas are listed in Table II. The relative potential importance of each area for air attack will obviously depend not only on its character and size, as shown in this table, but also upon the geographic relationship between each potential storage target and the scene of impending military operations.

II. RELATION TO MILITARY STRENGTH

A. REQUIREMENTS

Japan's requirements for ammunition and explosives will obviously depend on the future character of the war. This is uncertain, but the probable general order of magnitude of ammunition requirements may be calculated by making reasonable postulates as to future strength and dispositions of the Japanese military forces, and by drawing inferences therefrom.

The Japanese may feel able to defend their home islands with as few as 30 divisions. In active defensive operations, these divisions might, on the average, expend 1 unit of fire per month. (Two units of fire per month constitute a "division-month" of ammunition supply — sufficient for the heaviest type of combat.) Under these assumptions, the average ammunition consumption by the entire Japanese ground force defending the home islands might be about 15 division-months per month. Under such conditions of active defensive operations, Japan would require in the home islands about 180 division-months supply of ammunition, i.e. 360 units of fire or 1,800,000 tons of intermediate steel, derived either from stocks or new production, in order to sustain combat for a year.

Requirements for continental defense can be calculated in a similar manner. If Japan can maintain a potential front-line force of 20 divisions in Manchuria, the requirements for one year's resistance will be 120 division-months of ammunition, i.e., 240 units of fire or 1,200,000 tons of intermediate steel.

B. SUPPLY

It is currently estimated that the Japanese have, both in Japan proper and on the continental portion of the Inner Zone, i.e. in North China, Manchuria, and Korea, about 175 division-months' supply of ammunition. This supply, if maintained intact, e.g. not lost to Allied air action, and fully utilized, i.e. fired rather than captured intact by Allied ground action or not brought to the front because of collapse of the transportation system, should prove adequate, when supplemented by new production at a rate of about 5 division-months per month, to sustain resistance for more than a year in the home islands alone or for 1 year in the home islands plus an additional 3 months on the mainland.

C. MILITARY EFFECTS OF ATTACK ON SUPPLY

Since Japan is believed presently to be producing no more than 5 division-months' supply of ammunition per month, it is clear that under the assumption that decisive land combat is not too long delayed existing ammunition stocks weigh much more heavily than possible future ammunition production in determining the possible length of Japanese resistance to Allied ground action. A steady drain on ammunition supplies, equal monthly either to a substantial part of current production, or to a small portion of stored reserves will be steadily required for training. If these non-combat requirements are regarded as deducted from potential production, it is likely that only 3 to 4 division-months' supplies per month, or 36 to 48 division-months in a year, can be added to stored reserves, even in the absence of any land combat. If training requirements are viewed as deductible from stocks, a view which accords more closely with actual practice, stocks still contribute more to Japanese potential reserve ammunition strength a year hence than does production in the same interval. This may be illustrated by the following calculations:

POTENTIAL JAPANESE RESERVE AMMUNITION STRENGTH, 1 YEAR HENCE

(in division-months of supply)

Present ammunition reserve strength.....	175 div. mo.
Add: Production for 1 yr. at 5 div. mo. per mo.	60 div. mo.
Less: Requirements for training for 1 yr.....	12–24 div. mo.
Equals: Potential strength 1 yr. hence assuming no ground fighting in interim.....	211–223 div. mo.

Production contributes only a little more than 1/4 to this potential future strength; nearly 3/4 of the total originates in stocks already existing.

It may thus be concluded that air attack against ammunition stocks which succeeded in destroying between 50% and 70% of these reserves, might reduce the possible length and severity of Japanese resistance by almost an equivalent proportion of the total period of resistance.

III. CHARACTERISTICS OF AMMUNITION AND EXPLOSIVE STORAGE

A. LOCATION OF INSTALLATIONS

Ammunition storage is widely dispersed throughout Japan proper and the continent. Conclusive statements on the exact geographical pattern are not possible pending more complete photo coverage. It is now estimated that of the total Japanese reserve supplies of ammunition, estimated at 175 division-months, at least 50 division-months, or nearly 30%, are stored on the continent.

B. CONCENTRATION

It is believed that 80% of the Japanese Empire reserve supplies of ammunition are now contained in no more than 100 storage areas, about 30 of which are presumably on the continent. The 50 largest storage areas probably contain a fairly high proportion of the total reserve stocks, perhaps as much as 70%.

C. EXPOSURE TO URBAN AREA ATTACK

All the large ammunition and/or explosive storage areas are outside urban areas. A few small to medium storage areas may be found in urban locations such as near the old established arsenals in NW Tokyo.

D. INTEGRATION OF STORAGE AND MANUFACTURING

Storage of munitions in Japan is closely associated with explosive manufacturing and shell loading. Probably no more than ⅓ of all storage areas are entirely separate from manufacturing activity.

IV. PHYSICAL VULNERABILITY AND WEAPON RECOMMENDATIONS

A. PHYSICAL CHARACTERISTICS OF STORAGE AREAS

Ammunition falls into two classes, *fixed,* in which the projectile is attached to the propellant cartridge, and *separate loading*. The first normally includes all sizes smaller than 155 mm. In Japanese practice both types are stored in combustible containers, of wood for large calibers or of cardboard for the smaller.

Central ammunition stores in Japan consist of storage areas made up of collections of storage units. The storage units appear to be well standardized. Each unit consists of a light wood or steel framed shed with average dimensions about 40 feet x 90 feet (maximum observed 70 feet x 140 feet) with a light roof to protect the stores. These sheds may be well dispersed for protection, or may be surrounded by earth embankments about 120 feet x 180 feet on average. In the dispersed installations (seldom found in Japan proper but common on the continent) the degree of builtupness is of the order of ½%. The density in the installations with earth embankments (typical of Japan proper) is of the order of 8%. (These comprise nearly ½ of all installations examined.)

The highly built up installations vary in size. A small one contains less than 25 units (average about 15), a medium one contains from 25 to 45 units, while a large installation has more than 45 (average about 70).

B. PHYSICAL VULNERABILITY

Ammunition stores (not including bombs) are vulnerable to incendiary, to HE, and to strafing attack. The HE contained in projectiles is not particularly easy to initiate. The propellant, however, will burn readily and is comparatively easy to ignite. This will result in complete loss of stores. This, with the combustible nature of the packing make ammunition a good incendiary target. (This does not apply to bomb stores, whose susceptibility to fire is very small.)

Since no operational evidence is at hand as to the number of small IB's required to start a self supporting fire in a storage unit (3500 sq. feet) it is assumed that eight M50 IB or an equal weight of M69 IB are needed. This assumption is believed to be conservative. On this basis, it is possible to determine the densities required for various proportions of total number of units destroyed.

Ammunition is also vulnerable to strafing and to attack by small HE bombs (20-lb F and 100-lb GP). Strafing is considered too hazardous to the attacker to be recommended, except against isolated ammunition dumps. HE attack is fairly effective, even when only a part of a unit is destroyed, since the remaining material is likely to be injured somewhat, and in any event will have to be separated from the remnants of that destroyed—a very difficult and hazardous occupation. Both the 20-lb F and the 100-lb GP can be used against ammunition stores (the latter is also effective against bomb stores). The 20-lb F is not recommended against stores under roofs. An analysis of tests made by the Ordnance Officer, 12th AF[1] indicates that the effective area of the 20-lb F against stored ammunition is about 300 sq. feet and of the 100-lb GP about 1500-2000 sq. feet. From these figures it appears that one 100-lb GP or five 20-lb F per storage unit is required for effective attack. From this, it appears that HE attack will require from two to three times the weight of IB attack for equal effect.

[1] 1st and 2nd Reports, Ord. Off. HQ 12 AF "Tests of American Bombs Against German Ammunition Dumps," 15 June and 5 Aug 1944 (Conf.).

C. WEAPON RECOMMENDATIONS AND WEIGHT OF ATTACK

Weapons recommended are the following:

(1) AN-M50 4-lb IB
(2) AN-M69 6-lb IB
(3) 100-lb GP fuzed 0.01/ND
(4) 20-lb F (not recommended against covered stores)

Densities needed are given in Table I for various expected proportions of the total number of units destroyed.

TABLE III

Ground Density (Tons/1,000,000 sq ft) for 30, 50, and 70% Expected Destruction of Storage Units

Weapon	F=0.3	0.5	0.7
M50-4#IB or M69-6#IB	2	4	6
100#GP or 20#F	5	10	17

JOINT TARGET GROUP
Washington, D. C.
GENERAL LOCATION MAP

MILITARY STORES

MUNITIONS

CONFIDENTIAL

SHEET M–M1
DATE . . . . . 28 May 1945

MS–M

MS–M
MAPS & TABLES

Kawagoe Branch of Tokyo No. 1 Arsenal 90:17 - 2095
Ordnance Storehouse Ammunitions 90:17 - 201
Army Central Clothing Depot 90:17 - 202
Ordnance Supply Depot 90:17 - 203
Army Arsenal & Military Gunpowder Works 90:17 - 205
Tama Branch of Tokyo No. 2 Arsenal 90:17 - 2089
TOKYO
Haramachida Explosives Works 90:17 - 2230
Kami-Seya Munitions Storage 90:17 - 2087
YOKOHAMA
TOKYO WAN
Japan Military Goods Co., Tomioka Plant 90:17 - 899
Navy Arsenal 90:17 - 1336
Japan Steel Co., Yokohama Plant 90:17 - 2042
SAGAMI WAN
YOKOSUKA
Yokosuka Arsenal & Armament Works 90:17 - 282
STATUTE MILES 0 10 20

U S S R
KARAFUTO
HOKKAIDO
Sapporo
Muroran
Hakodate
Kirin Munitions Storage 93:2 - 374
Ssupingkai Munitions Storage 93:3 - 373
North Mukden Arsenal 93:3 - 370
Mukden Arsenal 93:3 - 46
Mukden
Fushun Explosives Plant No. 2 93:3 - 372
Fushun Explosives Plant No. 1 93:3 - 371
Chinchow Munitions Storage 93:3 - 375
North Mukden Munitions Storage 93:3 - 369
Tatung
Tatung Explosives Works 83:13 - 181
Chosen Nitrogen Explosives Factory 84:2 - 2
Tientsin
Dairen
Heijo Army Arsenal 84:3 - 61
J A P A N
Sendai
Niigata
Iwahana Factory Iwahana Arsenal 90:13 - 2043
Fukaya Branch of Tokyo No. 2 Arsenal 90:13 - 2088
Iybrii Munitions Storage 90:13 - 2228
H O N S H U
Fukaya Branch of Tokyo No. 2 Arsenal S.W. Section 90:13 - 2238
Tokyo
Yokohama
See Tokyo Inset Map
Nippon Explosives Works 90:20 - 1138
Nagoya
Toyokawa Naval Arsenal 90:21 - 1653
Waji Munitions Storage 90:21 - 2090
Toyohashi Army Base and Arsenal 90:21 - 1224
Uji Powder Factory 90:23 - 1169
Takahashi Munitions Storage 90:27 - 2232
Toyotomi Explosives Works 90:27 - 2233
Kobe
Osaka
Hirakata Explosives Works 90:25 - 2199
Kokura Munitions Storage 90:25 - 2090
Kure
Saijo Explosives Works 90:30 - 2229
Kakogawa
Eta Island Munition Storage No. 1 90:30 - 2226
Eta Island Munition Storage No. 2 90:30 - 2227
Fusan
Yawata
Fukuoka
SHIKOKU
East Omuta Explosives Works 90:35 - 2093
Saseho Munitions Storage 90:36 - 2231
Sasebo Fuel Munitions Depot 90:36 - 762
KYUSHU
Nagasaki
Arao Branch of Tokyo No. 2 Arsenal 90:35 - 2094
Sakanoichi Branch of Tokyo No. 2 Arsenal 90:33 - 2092
Nobeoka Plant of Nippon Nitrogen Explosives Co. 90:33 - 1311
Rakan Plant of Nippon Nitrogen Explosives Co. 90:33 - 1312
Kagoshima
Shanghi
C H I N A
KOREA
Tsingtao
Y E L L O W S E A
S E A O F J A P A N
NORTH PACIFIC OCEAN
104° 108° 112° 116° 120° 124° 128° 132° 136° 140° 144° 148°
48° 44° 40° 36° 32°
35° 30'

Published in Office of AC/AS, Intelligence AAF by Combined Personnel of U. S. & British Services for the use of Allied Forces.

Prepared by AERONAUTICAL CHART SERVICE by U. S. C. & G. S., July 1945

STATUTE MILES
100 0 100 200 300 400 500

CONFIDENTIAL

File No. 15,911

File No. 15,900

JOINT TARGET GROUP, WASHINGTON, D. C.
SUMMARY TABLE

SHEET . . . . . MS-M—ST
DATE . . . . . 18 June 1945

MILITARY STORES
MUNITIONS

Target	Name of Target	Primary Function
	JAPAN	
90:20-196	Chigusa Factory, Nagoya Arsenal	ML(SS)
90:17-201	Ordnance Storehouse—Ammunition (Tokyo)	MS(ML)
90:17-203	Ordnance Supply Depot (Tokyo)	LS?
90:17-205	Army Arsenal & Military Gunpowder Works (Tokyo)	LL(MS)
90:17-899	Japan Military Goods Co., Tomioka Plant	LL(SS)
90:20-1138	Nippon Explosives Works (Taketoyo)	LE(SS)
90:23-1169	Uji Powder Factory	LE(MS)
90:21-1224	Toyohashi Army Base & Arsenal	SS(SL)
90:27-1281	Dai Nippon Celluloid Co. (Aboshi)	SE(SS)
90:33-1311	Nobeoka Plant of Nippon Nitrogen Explosives Co	LE(MS)
90:33-1312	Raikan Plant of Nippon Nitrogen Explosives Co	ML(SS)
90:17-1336	Navy Arsenal (Hiratsuka)	LE(MS)
90:21-1653	Toyokawa Naval Arsenal	LL(MS)
90:20-1691	Takaki Factory, Nagoya Arsenal	SL
90:25-1723	Hirakata Factory, Osaka Army Arsenal	LL
90:30-1891	Japan Steel Co., Hiroshima Plant	ML
90:17-2042	Japan Steel Co., Yokohama Plant	SL(SS)
90:13-2043	Iwahana Factory, Tokyo Arsenal	LE(MS)
90:17-2087	Kami-Seya Munitions Storage	LS
90:13-2088	Fukaya Branch of Tokyo No. 2 Arsenal	LE(MS)
90:17-2089	Tama Branch of Tokyo No. 2 Arsenal	LE(MS)
90:21-2090	Waji Munitions Storage	MS
90:25-2091	Kakogawa Munitions Storage	SS(SL)
90:17-2092	Sakanoichi Branch of Tokyo No. 2 Arsenal	LL(MS)
90:35-2093	East Omuta Explosives Works	ME(SS)
90:35-2094	Arao Branch of Tokyo No. 2 Arsenal	LE(MS)
90:17-2095	Kawagoe Branch of Tokyo No. 1 Arsenal	LE?(MS?)
90:25-2199	Hirakata Explosives Works	LE?(MS?)
90:30-2226	Eta Island Munitions Storage No. 1	SS
90:30-2227	Eta Island Munitions Storage Area No. 2	SL?(SS?)
90:30-2228	Yorii Munitions Storage	MS
90:30-2229	Saijo Explosives Works	ME(SS)
90:17-2230	Haramachida Explosives Works	LL(MS)
90:36-2231	Sasebo Munitions Storage	LS
90:27-2232	Takahashi Munitions Storage	SS
90:27-2233	Toyotomi Explosives Works	ML(SS)
	CONTINENT	
84:2 -2	Chosen Nitrogen Explosives Factory	LE(MS)
93:3 -46	Mukden Arsenal	MS
84:3 -61	Heijo Army Arsenal	SS
84:6 -213	Eitoho Munitions Plant	SL(SS)
93:3 -369	North Mukden Munitions Storage	LS
93:3 -370	North Mukden Arsenal	ML?(SS?)
93:3 -371	Fushun Explosives Plant No. 1	ME(SS)
93:3 -372	Fushun Explosives Plant No. 2	ME(SS)
93:3 -373	Ssupinkai Munitions Storage	MS
93:2 -374	Kirin Munitions Storage	LE?(MS?)
93:3 -375	Chinchow Munitions Storage	LS

First Letter

L—Large—over 45 revetted or dispersed buildings
M—Medium—25-45 revetted or dispersed buildings
S—Small—under 25 revetted or dispersed buildings

Second Letter

S—Storage Area
E—Explosive Mfgr.
L—Loading Plant

( )—Secondary Function
?—Inadequate photographic coverage to support a firm conclusion.