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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

16 February 1946

RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Effectiveness of Japanese AA Fire.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, dealing with Target O-44 of Fascicle O-1 of reference (a), is submitted herewith.

2. The investigation of the target and the preparation of the report were accomplished by Lt. Comdr. E. Delmar-Morgan, RNVR, assisted by Lt.(jg) D.H. Jackson, USNR.

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Captain, USN

30661

EFFECTIVENESS OF JAPANESE AA FIRE

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE O-1, TARGET O-44

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ORDNANCE TARGETS

EFFECTIVENESS OF JAPANESE AA FIRE

Neither the information obtained from the Japanese Army or Navy can be considered reliable. The information from the Navy is probably more reliable than that obtained from the Army. The data from the Navy, however, is mostly from their ground batteries, since records of planes shot down by ships at sea are still more unreliable, and few figures have been quoted.

There is little doubt that the Japanese relied to a large degree on hypothetical cases for analysis, rather than practical methods with sleeve targets or the like, and it is doubtful whether much real value would have been obtained from their records if they had been available.

It can therefore be said with considerable confidence, resulting from interrogations, that their methods of analysis were greatly inferior to those existing in Allied naval establishments.

TABLE OF CONTENTS

REFERENCES

Location of Target:

Japanese Naval Technical Department, TOKYO.

Japanese Personnel Interviewed:

Commander Jiro ICHINOI, IJN.

Captain Nizo IWASHIMA, IJN, chief planning and executive officer in Ordnance Section, Japanese Naval Technical Department.

LIST OF ENCLOSURES

(A) Report on Japanese Army AA Fire.

LIST OF ILLUSTRATIONS

INTRODUCTION

The effectiveness of AA fire in the ultimate sense can only be expressed by the number of planes shot down. The analysis of the fire to bring down these planes follows next in order of importance and is a natural corrollary to the effectiveness. It is not only very difficult to provide an analysis which gives a true picture for those who are to read and digest it, but it is even difficult for those who prepare such analyses not to mislead themselves.

Even with all available records and the best scientific equipment for analysis such as exists in the U.S.A., the task of analyzing AA fire is formidable. When, therefore, the effectiveness and analysis of Japanese AA fire is to be considered, it becomes even more difficult when all records are said to have been destroyed.

The information which has been obtained comes from two sources: the Army and the Navy. All of it is scanty, but it has been impossible to obtain further details. The material received from the Army is contained in Enclosure (A) and has been only slightly altered from its original form.

THE REPORT

A. EFFECTIVENESS OF JAPANESE NAVAL AA FIRE

1. There is no available information on the number of aircraft shot down by ships in various engagements (except for the carrier ZUIKAKU quoted later), but there are some figures on the effectiveness of naval batteries on the ground.

In using Type 95 system (Kosha Sochi) and Type 2 control (See NavTech-Jap Report, "Japanese Anti-Aircraft Fire Control", Index No. O-30) at less than 8000 meters range and less than 3000 meters height, 150 rounds per plane appears to be the generally accepted figure for the 12.7cm guns.

For the 25mm machine guns at less than 2000 meters range and less than 1000 meters height, a figure of 1500 rounds is quoted.

During interrogations it was stated that beyond the ranges quoted fire was completely ineffective, and that the only result of attempting such fire was to waste ammunition. Another comment was that that without a director and its computing devices, fire was completely ineffective. This was found to be true especially with 12.7cm guns and 25mm machine guns. At any rate, the Japanese thought that their "course and speed" sights were better than nothing at all.

2. There is no doubt that the Japanese Navy, during and after the Bougainville Island engagement, was extremely short of ammunition and as a result:

a. The number of rounds per plane decreased.

b. Fewer planes were shot down. (This is a broad assumption; it seeming reasonable that there would have been a few accurate shots even when the fire was believed to be uneconomical.)

Because of the shortage of ammunition, 10 rounds per plane were used for the 25mm machine gun against diving targets at less than 1000 meters. It was stated, furthermore, that U.S. planes invariably followed a set course of attack which made AA fire much easier and accounted to some degree for this phenomenal figure.

Another startling figure is the claim of 500 for the number of planes shot down at about the time of the Guam operations. This is placed at 7 rounds per plane with the 25mm machine gun. To obtain this result, fire was held until the targets were within 800 meters range.

3. One other case of U.S. plane maneuvers was cited, and this was at Rabaul when the Japanese Fleet was making port and was attacked by low flying bombers. The Japanese state that the ships were steaming in line ahead, and that the attacking planes passed on a parallel course before making their bombing run. While on this course, at a range of 1000 meters, the Japanese opened fire, and many planes were shot down.

4. The only specific case quoted for a particular ship was in the South Seas Battle. The carrier ZUIKAKU claimed 20 planes. ZUIKAKU had three twin 12.7cm guns controlled by two Type 94 directors (Koshaki) and 60 or 70 of the 25mm machine guns. In this instance, 150 rounds per plane for the 12.7cm armament was claimed, and 1000 rounds for the 25mm for ranges between 1000 and 2000 meters. (These figures seem to substantiate those already quoted.)

5. In an attempt to obtain more details to analyze the performance of AA fire, various remarks made by the Japanese are quoted to give an indication of their opinion:

a. No planes are claimed by 10cm, 12cm or 12.7cm batteries at a range of more than 8000 meters, and the best results are claimed for 4000 meters and under.

b. For medium ranges between 4000 and 7000 meters, the 10cm Type 98 gun was considered to be the most satisfactory.

c. For targets taking avoiding action ("jinking"), no claims are made at all.

B. METHOD OF ANALYZING THE EFFECTIVENESS OF JAPANESE AA FIRE

"x, y, and z:" These values are range, lateral, and vertical probable dispersions from a point. They are obtained by plotting a curve of dispersion values obtained over a period of years from practical experience and finding the probability value (since the plot results in a probability curve). This point is found where a vertical line, bisecting the area bounded by the coordinates and the curve, strikes and intersects the curve.

"a, b, and c:" These values represent the range, lateral, and vertical "effective" zone or actual danger zone, and are obtained by adding corrections (ballistic residual velocity etc.) to values obtained by ground experiments (statical explosion tests).

It is admitted that a measure of effectiveness leaves much room for argument and discussion due to the assumptions which must be made. The present standard set up for Japanese analysis is taken as follows:

The "effective" distance is that distance at which at least three pieces of shell will penetrate a wooden plate one meter square and 6cm thick as observed from ground statical explosion tests.

"l, m, and n:" These values are range, lateral, and vertical effectiveness and are represented as a function of $\frac{a}{x}$, $\frac{b}{y}$, and $\frac{c}{z}$ respectively. In actual practice, probability tables were used to obtain this value instead of calculations.

There are two methods in the application of the effectiveness values l, m, and n. One method regards the surface area of a plane to be a point and considers the target as being shot down when this point enters the effective zone.

The other method takes into account the surface area of the plane. This area is visualized as a square moving horizontally through the sky. Since there does exist this physical area, effectiveness values may be added to this area by dividing the vertical and lateral values equally on each side and placing total range value at the front.

In actual practice, these two methods were used as a comparison in an attempt to determine an absolute value of effectiveness.

The following example indicates the application of these calculations. This example is based on the extreme limits of the 12.7cm gun effectiveness and is the only actual data available.

Taking Range = 8000 meters
Height = 3000 meters

From a table, values of a = 14 m, b = 15 m, and c = 15 m are obtained. Then, from another table, are found the values x = 200 m, y = 18 m, and z = 18 m.

Now:

$$\frac{a}{x} = \frac{14}{200} = 0.07$$

$$\frac{b}{y} = \frac{15}{18} = 0.83$$

$$\frac{c}{z} = \frac{15}{18} = 0.83$$

Using these figures we obtain from the probability tables:

$$l = 0.0377$$

$$m = 0.2843$$

$$n = 0.2843$$

Then l x m x n = 0.0029 or total effectiveness. In other words, in 1000 shells, three may be expected to hit the target (1000 x 0.0029 equals approximately three).

ENCLOSURE (A)

REPORT ON JAPANESE ARMY AA FIRE

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LIAISON COMMISSION (TOKYO)
FOR THE
IMPERIAL JAPANESE DEMOBILIZATION MINISTRIES

S 803

4 February 1946

To: Colonel F. P. Munson, GSC, G-2
GHQ, SCAP.

Subject: Information Concerning Effectiveness of Japanese Army AA Fire.

Complying with the request dated 15 January 1946, made by Officer-in-Charge, Technical Department, NavTechJap, on the subject matter, we wish to inform you as enclosed herewith.

ss//
A. YAMAMOTO
Committee Member

ENCLOSURE (A), continued

Information Concerning Effectiveness of Japanese Army AA Fire (2 February 1946).

(a) Effectiveness of Japanese AA Fire.

	Maximum height (m)	Effective height (m)	Radius of rupture (m)
15cm AA	20,000	16,000	30
12cm AA	15,000	12,000	15
8cm AA	10,000	8,000	7
7cm AA old	9,000	7,000	
new	10,000	8,000	

	Effective Range			
Height (m)	15cm AA	12cm AA	8cm AA	7cm AA
15,000	11,800			
12,000	13,900	8,500		
8,000	14,800	11,300	7,100	4,400
6,000	14,300	11,400	8,300	6,600
4,000	13,300	10,700	8,400	6,900
2,000	11,000	9,100	7,200	5,700
100	3,700	3,000	2,400	1,800

(Figure 1 shows the data graphically.)

(b) Records of U.S. planes shot down by Army AA Batteries.

Table for the number of B-29's shot down or damaged in the following various districts during the period between June 1944 and May 1945.

District	Total No. Raiding Planes	Results		Raiding Planes Shot Down or Damaged (%)
		Shot Down	Damaged	
Tokyo and Yokohama	3,017	176	403	19
Nagoya	1,382	26	192	15
Osaka and Kobe	952	50	119	18
North Kyushu	420	9	21	7
South Kyushu	83	20	1	26
Total	5,854	281	736	17

Note: This table is based on the investigation made by the 1st General Army Headquarters as of June, 1945.

(c) Records of planes shot down by long, medium, and short range AA fire and the number of planes and types of planes damaged at various stages of plane flight path (i.e., approach, dive, pull-out, and retirement.).

For lack of records pertaining to this question, no definite answer is possible, but it seems that the Japanese Army shot down most planes, in all probability, at medium range (height 3000m - 5000m) and damaged them when approaching.

ENCLOSURE (A), continued

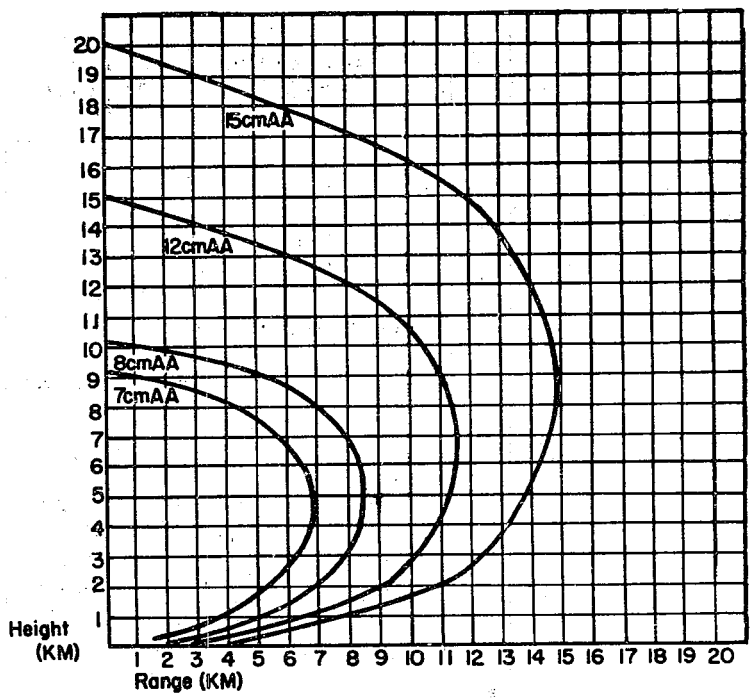

Figure 1

EFFECTIVE RANGE FOR EACH HEIGHT AA GUNS

(d) Records or estimates of number of rounds per plane for different size guns.

No material on each size gun is available, but the attached table has been compiled giving the number of rounds expended for planes shot down or damaged in Japan proper. Statistics of results in battle from April, 1945 to August of the same year, won by the AA batteries under the control of the First General Army, is as follows:

	Large	Small
Average number of shells used for shooting down or damaging a plane.	84	40
Average number of shells fired at a raiding plane.	11	
Average percentage of the raiding planes shot down or damaged.	13 %	

ENCLOSURE (A), continued

(e) Method of analyzing effectiveness of AA fire.

	Item	7cm AA	8cm AA	12cm AA	15cm AA
1	Rate of firing (sec)(the time required for firing 4 shells)	6	6	12	18
2	Ratio of rate of firing (based on 15cm)	3	3	1.5	1
3	Radius of rupture (m)	5	7	15	30
4	Volume of rupture (m^3)	125	343	3,375	27,000
5	Ratio of volumes and radius of rupture based on 7cm	1	2.7	27	215
6	Ratio of column 5 to column 2 based on 7cm as unity	1	2.7	13.5	71.6
7	Weight of shell (kg) (except charge)	5.260	7.430	19,343	41.000
8	Ratio of weight to bursting charge	1	1.4	3.7	7.8
9	Ratio of column 8 to column 2 based on 7cm as unity	1	1.4	1.85	2.6

That is, the effectiveness of AA fire is estimated on the basis of effectiveness of one shell and rate of fire as shown in the table. It is also affected by radius of rupture as given in (a).