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From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.
Subject: Target Report - Japanese Illuminating and Colored
Burst Projectiles.
Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering the design and manufacture of Japanese projectiles as outlined by Target O-11 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 Commander G.R. Dolan, RN, assisted by Mr. H.H. Moore. Lt.(jg) K.C. Lamott, USNR, acted as interpreter.


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O-11

**JAPANESE ILLUMINATING
AND COLORED BURST PROJECTILES**

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

FASCICLE O-1, TARGET O-11

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ORDNANCE TARGETS

JAPANESE ILLUMINATING AND COLORED BURST PROJECTILES

Starshells, which were used without parachutes by the Japanese Navy, were known by three different names, one of which was very similar to the name used for illuminating shells (with parachute). At the end of the war illuminating shells were replacing starshells, which were obsolescent.

Successful colored burst projectiles had been produced in five colors. White and black bursts are easy to produce and contain no new information. The secret of the Japanese success with other colors was their use of red phosphorous as an ingredient in the filling.

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REFERENCES

Location of Target:

Japanese Naval Headquarters, TOKYO.

Kure Naval Arsenal.

Yokosuka Naval Arsenal.

Sagami Naval Arsenal.

Hiratsuka Powder Factory.

Japanese Personnel Interviewed and Who Assisted in Gathering Data.

Technical Captain YAGIMA, connected with design of projectiles in the Navy Technical Department of the Navy Ministry.

Technical Captain MITSUI, in charge of experiments at Kure Naval Arsenal.

Technical Commander NOSE, employed at Sagami Arsenal and Hiratsuka Powder Factory on explosives and chemical work.

These three officers are all capable and intelligent. In addition, every Japanese interviewed in connection with any ammunition investigation was questioned as to his knowledge of colored burst projectiles, but except for Captain MITSUI and Commander NOSE, without success.

INTRODUCTION

The main difficulty in obtaining information on the most interesting subject in this report (Colored Burst Projectiles) was to find a Japanese officer or civilian who knew anything about the colored burst projectiles or was even able to say either where they had been made, or who would be likely to know anything about them.

It was not until about eight weeks after investigations had been started that any lead was obtained, and by that time practically all the officers and civilians who might have been connected closely with this project had been demobilized and had returned to their homes or taken up civilian occupations. During the same period continual destruction of explosive stores gathered from the passages and caves used as magazines had been going on, while the absence of lights in many of these caves made the task of finding samples extremely slow and difficult.

The only two Japanese officers found to have any knowledge of the colored burst projectiles gave slightly different descriptions of the filling but confirmed one another in their emphasis on the fact that success with colored burst projectiles lay in the use of red phosphorous as an ingredient in the filling as well as the color dye.

Unfortunately neither of these two officers seemed to be at all certain of the final appearance of the projectiles, and the impression was that they had not actually seen the projectiles produced for service use after they had been painted.

THE REPORT

A. Answers to particular questions in "Intelligence Targets Japan" (DNI) of 4 Sept. 1945, Target O-11.

In the Japanese Navy, the term Seidan or Hoseidan or Shomeidan A means starshell (without parachute); the term Shomeidan B means illuminating projectile (with parachute); and the term Chakushokudan means colored burst projectile.

The old type starshell was painted bluish-gray. The illuminating projectiles were painted red. It was stated by various Japanese officers, who claimed to be rather vague in their memories, that the colored burst projectiles were painted black with a red nose and had a figure stenciled on them, either 1, 2, 3, 4, or 5 depending on the color of the burst.

The phosphorous-filled incendiary projectiles were designated "common projectiles, Model 4." Incendiary-shrapnel projectiles were painted red, for distinction from common projectiles, which were normally painted maroon.

B. Color Markings.

Color markings for projectiles used by the Japanese Navy were as follows:

1. Armor-piercing projectiles were white. A green nose meant that the projectile was filled; a red tip to the green nose indicated that the base was fused.
2. Common projectiles were maroon.
3. Illuminating projectiles were red.
4. Incendiary projectiles were red.
5. Practice projectiles were black.
6. Practice projectiles converted from other shells were black with yellow nose.
7. Target shells were green.
8. Old-type illuminating projectiles (starshells) were bluish gray.
9. Colored burst projectiles are believed to have been black with a red nose.
10. Smoke shells were orange.

C. Colored Burst Projectiles.

Information about colored burst projectiles for anti-aircraft fire was difficult to obtain owing to the secrecy with which they were surrounded. These projectiles, after manufacture, did not have any distinguishing mark on them by which ship's company could tell what color they would produce. Instead, numbers were stenciled on them and the arsenals were ordered to supply shells with certain numbers to any particular ship.

Experiments were carried out by naval technicians in 1931 in an attempt to produce colored bursts with anti-aircraft projectiles, but these were failures, and the experiments ceased. Their object was to produce a dif-

ferent colored burst for each ship's projectiles to simplify the spotting control and to enable the spotting officer on any particular ship to distinguish the bursts from his own guns when more than one ship was firing at the same aircraft.

The technical departments were asked to reopen these experiments in 1944 and they decided that the chief difficulty was to produce a cloud which would give the same color impression whether the sun was shining through it or reflected off it. The fundamental idea they employed was to produce a cloud of white particles to each of which a small portion of dye was attached. Their method of achieving this result was to include a proportion of red phosphorus and the requisite dye in the burster cavity. When the shell burst, the phosphorus was dispersed and very quickly formed phosphorus-pentoxide in the form of a cloud of small white particles. The phosphorus-pentoxide, being extremely hygroscopic immediately took up moisture from the atmosphere and at the same time took up the finely dispersed dye, so that in effect each particle of phosphorus-pentoxide had a smaller particle of moisture and dye attached to it. If the sun was behind the burst, it shone through the particles of phosphorus-pentoxide, which are translucent, and, shining through the moisture and dye, gave the required color effect. If the sunlight was reflected from the burst, it was well reflected from the particles of phosphorus-pentoxide and shone through the particles of dye, giving the same color effect. The Japanese claim that the better colors were visible clearly and distinctly up to maximum gun range. The best colors were red, black, and white, with blue not quite so good, and yellow rather poor.

The proportion of mixed phosphorus and dye to explosive was about one to four by weight, and about 30% to 60% by volume.

Composition of colored burst

- Red - red dye (rhodamine) - 90%
red phosphorus - 10%
- White - red phosphorus only, in addition to main explosive of picric acid or tri-nitro-anisol 60% aluminium powder 40%
- Black - main explosive 90% (TNA or TNT)
naphthalene 10%
- Blue - methylene blue 90%
red phosphorus 10%
- Yellow - para-amino-azo, benzene 90%
- Orange - red phosphorus 10%

These colored burst projectiles were manufactured for 12.7cm guns and were used in target practices. The gunnery officer of ISE (later gunnery officer of YAMATO for three weeks) stated that he considered that these colored burst projectiles were very satisfactory in concentrated anti-aircraft fire against targets, but that no opportunity had arisen for trying them in concentration of fire in service against enemy aircraft.

These colored burst projectiles were given a storage test for one year at a temperature of 35°C, after which they were tested in a functioning trial and functioned entirely satisfactorily.

There are two distinct descriptions of the manner of filling the projectiles. One was given at KURE by Captain MITSUI, in charge of experiments

and research, and the other was given by Commander NOSE, who was associated with the fillings of these colored burst projectiles at Hiratsuka Powder Factory and Sagami Arsenal.

Captain MITSUI stated that the front of the projectile cavity was filled with the H. E. main charge of tri-nitro-anisol, and that behind this was a canister containing 30 grams of red phosphorus fitting into a recess in the dye powder, which filled the remainder of the rear of the cavity.

Commander NOSE on the other hand was very definite in a statement that the dye and the red phosphorus were mixed and filled into a canister that fitted in the rear part of the projectile cavity, and that the main H. E. charge was changed from tri-nitro-anisol to picric acid.

It is possible that Captain MITSUI's remarks refer to the experimental stage, and that Commander NOSE's remarks refer to the first production stages.

It is not considered probable that many of these projectiles had been produced by the end of the war, and all efforts to locate samples have failed. This fact is possibly due in part to the secrecy that was imposed in connection with them and in part to the color markings. If, as reported, they were painted black with a red nose, they may well have been destroyed or even shipped back to the United States as army projectiles, since in many of the caves used as magazines army and naval projectiles were stowed in the same system of intercommunicating passages and caves, and often in the same cave.

YOKOSUKA, KURE, IKEGO, and outlying magazines as well as Sagami Arsenal and Hiratsuka Powder Factory have been searched for these projectiles, but without success. Two types of containers were found at Sagami Arsenal, however, and the Captain in charge of the Arsenal (Captain TSURUJO) stated that they were the containers for colored burst projectiles. One of each type of container was opened. One type contained a yellow dye which could not be ignited in a small fire of sticks. The other contained rhodamine red dye apparently containing a small proportion of phosphorus, as it could be ignited and gave traces of characteristic fumes. Samples of each type of container have been forwarded to the United States.

D. Nomenclature and Classification of Naval Ammunition.

The various names, types, numbers, etc., of naval ammunition will be found in the following reports:

NavTechJap Report, "Japanese Navy Ammunition Cases for 5cm and Larger Caliber Guns," Index No. O-14.

NavTechJap Report, "Japanese Naval Projectile Fuzes," Index No. O-17.

NavTechJap Report, "Japanese Projectiles - General Types," Index No. O-19.