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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
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22 January 1946

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

Subject: Target Report - Japanese Insulation Materials.

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

1. Subject report, covering Target E-23 of Fascicle E-1 of reference (a), is submitted herewith.
2. The investigation of the target and the target report were accomplished by Lieut. P.D. Lacy, USNR.



C. G. GRIMES
Captain, USN

RESTRICTED

E-23

JAPANESE INSULATION MATERIALS

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

FASCICLE E-1, TARGET E-23

JANUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ELECTRONICS TARGETS

JAPANESE INSULATION MATERIALS

Prior to 1943 the Japanese had no high-grade ceramic insulation material for radio frequency use. Development had been started about 1937, but was not completed until the middle of 1942.

High moisture absorption and high dielectric loss at high frequencies were found in the ceramics available prior to and in the first year and a half of the war. During 1943, several plants at SETO began large-scale production of the various forms of Japanese "Steatite."

High dielectric constant materials using titanium dioxide became available in small quantities in 1943. The dielectric constants were 80 and 100; the grade having the lower temperature coefficient had the constant of 80. A very high dielectric constant (epsilon-2000) material consisting of titanium dioxide, barium oxide, and calcium oxide was developed, but had not been put into production by the end of the war.

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REFERENCES

Location of Target:

Nippon Electric Company, TOKYO.

Electro-Chemical Laboratory, TOKYO.

Second Naval Technical Institute, Meguro Branch, TOKYO.

Japanese Personnel Interviewed:

Dr. S. KOMAGATE, Research Engineer, Electro-Chemical Laboratory.

Mr. Isao TAKASAKI, Ceramics Development Engineer, Nippon Electronic Company.

Vice Adm. T. NAWA and Staff, Second Naval Technical Institute.

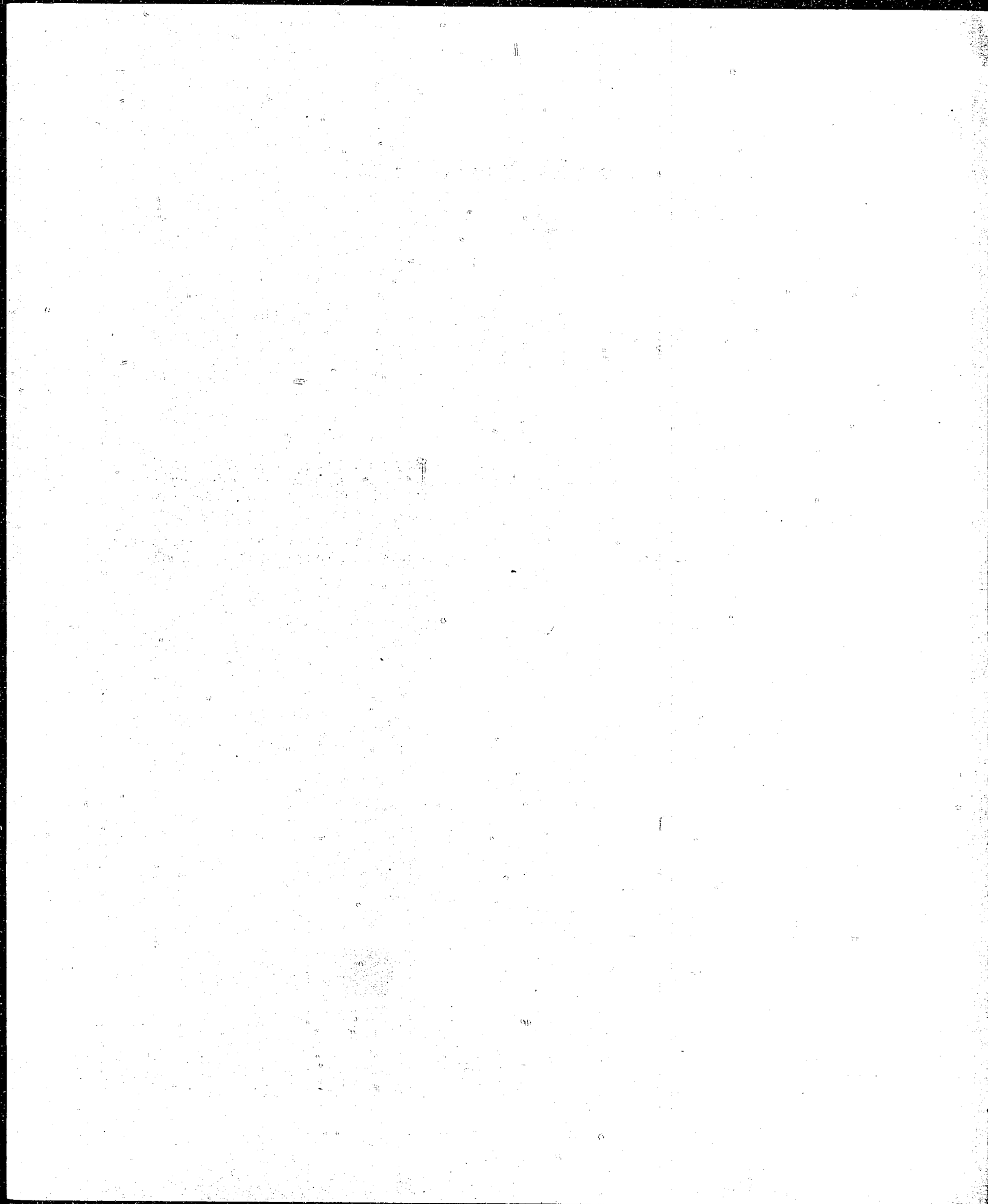
LIST OF ENCLOSURES

- (A) List of Japanese Documents Forwarded through ATIS to the Washington Document Center.

INTRODUCTION

This report on Japanese insulation materials is confined to those materials not otherwise covered in other electronics reports prepared by the Mission. The scope of the report, therefore, is limited to ceramic and titanium dioxide products.

Data for the report was obtained from Japanese development engineers, from naval technical personnel, and from documents furnished by these individuals.



THE REPORT

A. Insulation Materials - General.

This report covers ceramic and titanium dioxide products used as insulation materials in electronic equipments. Bakelite, oils, resins, polymers, quartz, and glasses used as insulation materials are discussed in NavTechJap reports, "Japanese Radio, Radar, and Sonar Equipment", Index No. E-17; "Japanese Electronic Equipment Construction Materials", Index No. E-19; "Japanese R. F. Transmission Lines, Wave Guides, Wave Guide Fittings and Dielectric Materials" Index No. E-20, and "Japanese Electronics - Miscellaneous", Index No. E-30.

B. Ceramic Insulation.

High-grade ceramics for electronic use were not available in JAPAN before 1943. Prior to and in the first year and a half of the war, bakelite and ordinary glazed porcelain were generally used. Development of high-grade ceramics was completed by several companies in the summer of 1942. Most of the development work was done by company laboratories in the TOKYO area. The processes were turned over to production plants, the majority of which are located at SETO (the center of the ceramics industry), near NAGOYA.

In JAPAN, steatite is called by individual company trade names. Some of these names are:

"Teson" (Nippon Electric Co.)
 "Zettite" (Kawahashi Manufacturing Co.)
 "Tidentite" (Tokyo Shibaura Electric Co.)
 "Noprite" (Migasa Electric Corp.)

In this report, except when reference is made to a specific product, the general term "steatite" will be used.

Tests comparing the various manufacturers' products were performed in June 1942 at the Naval Aviation Branch Laboratory. The results of these tests follow:

<u>Trade Name</u>	<u>Resistance</u> (megohms)	<u>Dielectric Loss</u> (tan delta)	<u>Dielectric</u> <u>Constant</u>
Teson	22,090	0.00095	4.9
Tidentite	39,100	0.00168	5.3
Tidentite (new)	102,000	0.00113	
Zettite	204,000	0.00056	4.8
Noprite	143,000	0.00063	5

The dielectric loss and dielectric constant in the above reported tests were measured at ten megacycles. Later comparative test results are not available; however, laboratory control test records through 1943 for Nippon Electric Company's product, Teson, were examined. These records showed the following average values: dielectric constant of about 6.0 and a loss at ten megacycles (tan delta) of about 0.0008.

Nippon Electric Company continued development of its product. Recent tests on highest quality Teson gave the following results:

<u>Frequency</u>	<u>Dielectric Constant</u>	<u>Dielectric Loss (tan delta)</u>
75 MC	6.3	0.00028
150 MC	6.3	0.0003
300 MC	6.4	0.00035
600 MC	6.6	0.0003 to 0.0004

The above tests were obtained by Lecher wire measurements.

The documents listed in Enclosure (A) of this report contain additional data on the effect of moisture, mechanical properties, and constructional tolerances.

C. Titanium Dioxide Insulation Products.

The development and initial production of titanium dioxide insulation material paralleled that of steatite. Production was started in 1943. The dielectric loss of the high-"epsilon" materials was about tan delta 0.001. The dielectric constant of the low temperature coefficient material was about 70, while the other grade attained a value of about 100. The direct current volume resistivity of both these grades was about 10^{13} ohm-centimeters.

A very high-"epsilon" insulation material had been developed by the Electro-Chemical Laboratory of TOKYO. This material had a dielectric constant of 2000 and a loss of tan delta of 0.008 at 10 MC. The composition was: 82% titanium dioxide, 10% calcium oxide, and 8% barium oxide. This material had not been put into production at the end of the war.

ENCLOSURE (A)

LIST OF JAPANESE DOCUMENTS FORWARDED THROUGH ATIS TO THE WASHINGTON DOCUMENT CENTER

<u>NavTechJap Document No.</u>	<u>ATIS No.</u>	<u>Title</u>
ND 21-6199	3456	Experiments on deterioration of steatite cable insulations due to sea water.
ND 21-6201	3458	Comparative test results of Japanese manufactured steatite.
ND 21-6218	3464	Studies on temperature characteristics of high frequency insulators (First Report): Characteristic surface resistance of steatite.
ND 50-400Cb	3930	Report on tests of general characteristics: Teson #1.
ND 50-4001b	3931	Results of measurements on steatite.
ND 50-4002	3932	Table of construction tolerance: Teson #1.