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Report of

Test on Insulating Material Steatite No. 1

Submitted by

The Star Porcelain Co.

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## AUTHORIZATION

1. This problem was authorized by Bureau of Ships letter reference (a). References (b) and (c) are also pertinent.

### References:

- (a) Bureau of Ships letter S67/61 (480-V) of July 24, 1942 to NRL
- (b) Bureau of Ships letter S67/61 (480V)
- (c) Specifications RE 13A 317F

## OBJECT OF TEST

2. The object of the test was to determine whether the samples of Steatite No. 1 submitted by The Star Porcelain Company comply with reference (c) for Grade F or G insulating material.

3. The dry and wet loss factors were determined by measurements made at 1000 kc, in compliance with paragraph 2 of reference (b), paragraph 6-1 of reference (c), and in accordance with A.S.T.M. Standards on Testing Electrical Insulating Materials of December 1941. The wet loss factor was measured after the samples had been immersed in distilled water for 48 hours.

4. Moisture absorption measurements were made in accordance with paragraph 6-2 of reference (c).

CONCLUSIONS

It is concluded:

(a) That the three samples of No. 1 Steatite submitted by The Star Porcelain Company comply with reference (c) for Grade G insulating material and that the moisture absorption does not exceed 0.10%

RECOMMENDATIONS

It is recommended:

(a). That No. 1 Steatite submitted by The Star Porcelain Co.,  
be approved as Grade G ceramic insulating material.

## DESCRIPTION OF MATERIAL UNDER TEST

5. The three samples numbered 429, 430 and 431 by NRL were approximately six inches square and 1/4 inch in thickness.

## METHOD OF TEST

6. Physical measurements of the samples were made with micrometers and a metric rule; the electrical measurements, by the parallel substitution method of susceptance variation. The dielectric properties were determined from these data.

7. The standard measuring circuit consists of the following equipment:

1000 kc crystal controlled master oscillator power amplifier, assembled by NRL.

NRL Standard inductance No. 6.

General Radio quartz insulated precision condenser, Type 722-Q, serial No. 460.

General Radio vacuum tube voltmeter, Type 726-A, serial No. 1483.

8. The factor of merit of the variable capacitor is stated by the manufacturer to be better than  $0.003 \times 10^{-12}$  Farads. The factor of merit of the entire test circuit is better than  $1.11 \times 10^{-12}$  Farads or one C.G.S. electrostatic unit. The effective Q of the entire measuring circuit is approximately 344 units, measured at 1000 kc.

9. The dry loss factor was determined by allowing the test samples to come to a static equilibrium of ambient temperature and relative humidity with that of the standard measuring circuit, which is assumed to occur in about 24 to 48 hours. Each sample was made into a capacitor by applying foil to both surfaces with petroleum oil. The factors of merit of the standard circuit with and without the samples were measured and each expressed as the ratio of total effective conductance to the resonant angular velocity. The difference between the two factors thus measured is equal to the factor of merit of the sample. When the conductance of the sample is small and can be neglected in comparison with its susceptance, the power factor

is equal to the ratio of the factor of merit to the capacitance. The capacitance is equal to the difference in reading of the standard, taken at resonance, with and without the sample; provided, the residual inductance (L) of standard capacitor is sufficiently small to make  $W^2LCs$ , negligible as compared to unity.

10. The dielectric permittivity (K) was determined from physical measurements made upon the sample, as outlined in A.S.T.M. Standards. The loss factor is defined as the product of the power factor and the dielectric permittivity. The wet loss factor was determined in a similar manner after the samples had been immersed in distilled water for a period of 48 hours in compliance with reference (c).

11. The moisture absorption tests were carried out on newly fractured pieces as detailed in paragraph 6-2 of reference (c) where the newly fractured surface was approximately 50% of the unfractured surface of each sample. The samples were soaked in distilled water at room temperature for 100 hours during which time the water was boiled for a period of 1 hour during the first 25th, 49th and 74th hours. At the end of 100 hours the samples were removed from the water, carefully dried with filter paper and weighed immediately. The samples were then placed in a desiccating compartment for a period of 96 hours after which time the samples were weighed dry.

#### DATA RECORDED DURING TEST

12. The data recorded during test are given in Tables I and II.

#### PROBABLE ERROR IN RESULTS

13. The error in the determination of the power factor is not greater than 2%, while that of the loss factor is not greater than 3%. The error in the determination of the weight in the moisture absorption test is approximately 0.00125%.

The data relating to dielectric properties have been corrected for the fringing of the dielectric flux external to the periphery of the electrodes.

Corrections to include the residual errors in the standard measuring circuit have not been applied to this data.

## RESULTS OF TEST

14. Results of tests are given in Tables I and II and may be summarized as follows: The data recorded in Table I show that the sample numbered 429 complies with paragraph 6-1 of reference (c) for Grade F insulating material. That samples numbered 430, 431 comply with paragraph 6-1 of reference (c) for Grade G insulating material. That the average Grade of all three samples is Grade G.

15. Table II shows that sample numbered 429 passed the moisture absorption test as detailed in paragraph 6-2 reference (c) since the gain in weight was 0.006% and does not exceed 0.10%.

## CONCLUSIONS

16. It is concluded:

(a) That the three samples of No. 1 Steatite submitted by The Star Porcelain Company comply with reference (c) for Grade G insulating material and that the moisture absorption does not exceed 0.10%.

TABLE I

## Dielectric Properties of #1 Steatite

Star Porcelain Co.

| NRL<br>No. | Dielectric Constant |      | Power Factor |       | Loss Factor |      | Grade |
|------------|---------------------|------|--------------|-------|-------------|------|-------|
|            | Dry                 | Wet  | Dry          | Wet   | Dry         | Wet  |       |
| 429        | 5.86                | 5.84 | 0.122        | 0.226 | 0.715       | 1.32 | F     |
| 430        | 5.86                | 5.84 | .122         | .147  | .715        | .859 | G     |
| 431        | 5.86                | 5.89 | .131         | .147  | .768        | .865 | G     |

TABLE II

## Moisture Absorption Test

| NRL<br>NO. | Weight in gr. |        | Gr.<br>Gain | %<br>Gain |
|------------|---------------|--------|-------------|-----------|
|            | Dry           | Wet    |             |           |
| 429        | 45.992        | 45.995 | 0.003       | 0.006     |