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NAVY DEPARTMENT

Report of Test

on

SX-1 and TX Insulating Material

Submitted by Louthan Manufacturing Co.

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AUTHORIZATION

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

References:

- (a) BuShips ltr. July 24 to NRL S67/61
- (b) BuShips ltr. S67/61 (480V)
- (c) Specifications RE 13A 317F

OBJECT OF TEST

2. The object of test was to determine whether the samples of TX-10% and SX 1-6% ceramic insulating material submitted by the Louthan Manufacturing Co., comply with reference (c) for Grade F or G insulating material.

ABSTRACT OF TEST

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. standard 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. The moisture absorption measurements were made in accordance with paragraph 6-2 of reference (c) except that the wet weight was determined after the sample had soaked in distilled water for 100 hours. The samples were then wiped dry and weighed. They were then placed in a desiccating chamber and allowed to remain there for 96 hours after which the samples were again weighed, which data represents the dry weight.

CONCLUSIONS

It is concluded:

(a) That the three samples of TX-10% insulating material submitted by the Louthan Manufacturing Co., comply with reference (c) for Grade F insulating material.

(b) That the moisture absorption for the TX-10% does not exceed 0.10%.

(c) That the three samples of SX 1-6% insulation material submitted by the Louthan Manufacturing Company do not comply with reference (c) for either Grade F or G insulating material.

(d) That SX 1-6% insulating material does not comply with paragraph 6-2 of reference (c) since the gain in weight was 0.18%.

RECOMMENDATIONS

It is recommended:

(a) That the samples of TX-10% insulating material submitted by the Louthan Manufacturing Co. be approved as Grade F insulating material.

DESCRIPTION OF MATERIAL UNDER TEST

5. The three samples of TX-10% of Body X, Titanium A, Numbered 435, 436, and 437 by Naval Research Laboratory, were approximately 14 cm square and 1 cm thick. The three samples of SX 1-6% Body X 10 Titanium A, numbered 438, 439, and 440 by Naval Research Laboratory, were approximately 15-1/2 cm square and 0.6 cm. thick.

METHOD OF TEST

6. Physical measurements of the samples were made with micro-meters 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 Naval Research Laboratory.

Naval Research Laboratory 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 0.003×10^{-12} Farads. The factor of merit of the entire test circuit is better than 1.11×10^{-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 sample 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 the standard capacitor is sufficiently small to make WZLCs 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 immediately weighed. 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 these data.

RESULTS OF TEST

14. Results of test are given in Tables I and II and may be summarized as follows: The data reported in Table I show that the wet loss factor of all three sample of TX-10% Body X or 10% Titanium A comply with paragraph 6-1 of reference (c) for an average Grade F insulating material. Table I also shows that the wet loss factor of material SX 1-6% does not comply with paragraph 6-1 of reference (c) for either Grade F or G insulating material.

15. Table II shows that sample numbered 435 passed the moisture absorption test since the gain in weight was only 0.004%. Also that sample numbered 438 does not pass the moisture absorption test since the gain in weight was 0.18%.

CONCLUSIONS

It is concluded:

(a) That the three samples of TX-10% insulating material submitted by the Louthan Manufacturing Co., comply with reference (c) for Grade F insulating material.

(b) That the moisture absorption for the TX-10% does not exceed 0.10%.

(c) That the three samples of SX 1-6% insulation material submitted by the Louthan Manufacturing Company do not comply with reference (c) for either Grade F or G insulating material.

(d) That SX 1-6% insulating material does not comply with paragraph 6-2 of reference (c) since the gain in weight was 0.18%.

TABLE I
Dielectric Properties
Louthan Manufacturing Co.

NRL No.	Dielectric Constant		Power Factor		Loss Factor		Grade
	Dry	Wet	Dry	Wet	Dry	Wet	
TX - 10%							
435	8.76	8.82	0.122	0.103	1.07	0.915	G
436	8.61	8.69	.107	.144	.922	1.25	F
437	8.98	8.98	.081	.139	.727	1.25	F
SX 1-6%							
438	5.30	5.73	0.239	6.48	1.27	37.	-
439	5.35	5.43	.272	1.34	1.45	7.3	-
440	5.32	5.64	.295	5.23	1.57	29.	-

TABLE II
Moisture Absorption Test

NRL No.	Weight in Gr.		Gr. Gain	% Gain
	Dry	Wet		
435	51.189	51.191	.002	0.004
438	46.325	46.410	.085	.18