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NAVY DEPARTMENT
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Report of
Test of Insulating Material E-1499
Submitted by

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WASHINGTON, D.C.

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AUTHORIZATION

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

References: (a) BuShips Ltr. S67/61 (12-19-DR6)
21 December 1940 to NRL.
(b) Specifications RE 13A 317F.
(c) NRL report R 1693 of 10 February 1941.
(d) NRL Ltr. S67/61 of 4 April 1941 to
BuShips.

OBJECT OF TEST

2. The object of the test was to determine whether the five samples of Type E-1499 insulating material (mottled blue) submitted by the Westinghouse Electric and Manufacturing Company comply with specifications, reference (b), for grade F or G insulating material, and to determine the relative machineability and suitability for naval use.

ABSTRACT OF TEST

3. The samples were tested for loss factor, and moisture absorption, as required in reference (b). They were also tested for their relative machineable properties in compliance with reference (a).

CONCLUSIONS

It is concluded:

(a) That Westinghouse insulating material E-1499 complies with specifications, reference (b), as regards moisture absorption test, and also as grade G insulating material with respect to the loss factor test.

(b) That these Westinghouse samples are much superior in their relative machineability as compared to Victron samples of approximately the same grade of insulating material.

RECOMMENDATIONS

(a) It is recommended that the insulating material E-1499, submitted by Westinghouse Electric and Manufacturing Company be approved as grade G insulating material as regards its electrical properties.

(b) It is further recommended that Naval use of the subject material be restricted as necessary to avoid softening due to elevated temperatures.

DESCRIPTION OF MATERIAL UNDER TEST

4. Five samples of type E-1499 insulating material, numbered 301 to 305, inclusive, and measuring approximately 4" in diameter and 1/4" in thickness, were tested.

METHOD OF TEST

5. The dry loss factor was determined by measuring the samples as they were received, then cleaning the surface with ether and drying in an oven for a few hours at 60° C. The samples were then soaked in distilled water for 96 hours, after which their surfaces were wiped dry and the wet loss factor determined as per paragraph 6-1 of reference (b). The measurements were made at a frequency of 300 kcs. in accordance with appendix of reference (c).

6. Moisture absorption tests were carried out on newly fractured pieces as detailed in paragraph 6 of reference (b) where the newly fractured surface was approximately 50% of the unfractured surface of each sample. The samples were first dried at 60° C. for 24 hours and accurately weighed. They were then immersed in distilled water at room temperature for 100 hours during which time the water temperature was raised to 60° C. for a period of one hour, during the 1st, 25th, 49th and 73d hours. The 60° C. temperature was requested in reference (a) since this material softens at a temperature of 80° C. At the end of the 100 hour period the samples were removed from the water, carefully dried with special filter paper, and weighed immediately.

7. The relative machineability of this material was determined as follows: Sufficient samples of this material E-1499 were forwarded to the machine shop for drilling, boring, sawing, milling and sweeping. Comparative data were obtained with reference to a random sample of Victron obtained from the shop, the same operations being performed on this material as were performed on the Westinghouse material.

8. The relative machineability and general suitability of insulating material E-1499 for naval use was tested in the following manner:

Two specimens 304 and 305 were machined as follows:

1. Drill one hole, and thread to size 6/32 t.p.i.
2. Drill one hole, and thread to size 1/4"/20 t.p.i.
3. Counterbore one hole 1/2" in diameter and 1/16" deep.
4. Saw 1/2" strip full length of sample (Band Saw).
5. Mill a slot 1/8" deep and 1/2" wide for the full length of sample (4").

6. Sweep one ring 2" x 1-1/2" outside and inside diameter, respectively, and drill and tap through this ring using machine tap 4/40 t.p.i. around the periphery 1/8" from edge.

9. The same operations were performed on a random sample of Victron from the stock room of the machine shop.

DATA RECORDED DURING TEST

10. Data recorded during the test are given in the appended tables numbered I, II and III.

PROBABLE ERROR IN RESULTS

11. The error in the determination of the loss factor is approximately 3%. The error in the determination of the weight for the moisture absorption test is not more than .00125%.

RESULTS OF TEST

12. Results of tests are given in Tables I, II and III, and may be summarized as follows:

All samples tested pass specifications, reference (b), with respect to loss factor and moisture absorption tests as regards grade G insulating material. The dry dielectric constant is found to be about 14% higher than the values reported for this material in reference (b) of reference (a) above, while the dry power and loss factors are found about equal to those of the reference.

The relative machineable properties of this material show it to be nearly two times easier to work than the random sample of Victron with which it is compared.

13. With reference to the six machine operations contained in Method of Test the following comments are summarized as follows:

On the Westinghouse material the slot has a definite width with respect to the width of the slotting cutter used in the machining operation. That is, it measures very close to the width of the cutter used, while in the Victron sample the edge is badly torn and the width is much greater than the clearance ordinarily customary for a milling cutter operation. The ring that was swept from the Victron random sample showed no cracks around its periphery the day the samples were received from the machine shop, but overnight many minute cracks made their appearance. The #4/40 t.p.i. tapping done in this ring is very poor, more so at the edge where the machine tap first enters the drilled hole. These threads are mostly broken away at the entrance, while in the same size ring of the Westinghouse material the tap starts immediately to thread and the threads are clean cut to the addendum

line of the tap which is the peak of the thread tip of the tapped hole. The tapping in the Westinghouse samples of the larger pitch diameter are as well defined as the 4/40 t.p.i. in the same sample, which is not true in the Victron sample.

14. Reference (d) advises against the use of this material in transmitters at elevated temperatures.

CONCLUSIONS

15. It is concluded:

(a) That Westinghouse insulating material E-1499 complies with specifications, reference (b), as regards moisture absorption test, and also as grade G insulating material with respect to the loss factor test.

(b) That these Westinghouse samples are much superior in their relative machineability as compared to Victron samples of approximately the same grade of insulating material.

TABLE I

Dielectric Properties

Sample No.	Dielectric Constant		Power Factor %		Loss Factor %		Grade
	Dry	Wet	Dry	Wet	Dry	Wet	
301	2.84	2.96	0.046	0.119	0.132	0.352	G
302	2.88	2.92	0.046	0.119	0.132	0.347	G
303	2.86	3.00	0.027	0.099	0.077	0.297	G
Specification limit, not over 1%							G

TABLE II

Moisture Absorption

Sample No.	Weight g.		Gain %
	Dry	Wet	
301	37.386	37.392	0.016
Specification limit			0.1%

TABLE III

Machining Time (Paragraph 8)

Operation	Time - Samples 304-305 Westing- house E-1499	Time - Victron Random Sample
1 } 2 } 3 }	7' 00"	10' 00"
4	1' 15"	1' 25"
5	1' 20"	1' 45"
6	9' 00"	17' 30"
	18' 35" - 1115 seconds	30' 40" - 1840 seconds