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NRL Report No. R-1245.
Test of Alsimag 35 and 196.

REPORT NO. R-1245

DATE 9 March 1936

SUBJECT

Test of Alsimag 35 and 196.



BY

NAVAL RESEARCH LABORATORY
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BuEng. Problem MI-10

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report
on
Test of Alsimag 35 and 196.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

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AUTHORIZATION

1. This problem was authorized by Bureau of Engineering letter reference (a), and other pertinent correspondence is listed as references (b) to (e).

Reference: (a) BuEng. ltr. S67/61-L5(9-27-W8) of 15 October 1935.
(b) Specifications RE 13A 317F.
(c) BuEng. ltr. S67/61-L5(9-27-W8) of 22 January 1936.
(d) NRL Report No. R-1117.
(e) Cmdt. N.Yd. Washington ltr. NY5/S67/T-544 EO of 28 February 1936 to BuEng.(Copy to NRL).

OBJECT OF TEST

2. The object of this test was to determine if Alsimag insulating material bearing the identifying numbers 35 and 196 complies with specifications RE 13A 317F for grades F or G ceramic insulation and if they are suitable for Naval use.

ABSTRACT OF TEST

3. The loss factor was determined on the samples of the two materials after they had been immersed in distilled water for 96 hours. Measurements were also made on dry samples to determine the change in loss factor due to immersion.

4. Samples of these materials were accurately weighed both after drying, and after soaking in distilled water for 100 hours, to determine the amount of moisture absorbed.

5. Strength tests (compression and bending) were conducted at the Navy Yard, Washington, and the results are incorporated in this report as requested in reference (c).

Conclusions

(a) Alsimag 35 does not comply with specifications, reference (b), with respect to loss factor for either grade F or G insulating material.

(b) An extruded sample of Alsimag 35 did not comply with the moisture absorption requirement but all other samples tested met this specification.

(c) Alsimag 196 did not comply with specifications, reference (b), with respect to either loss factor or moisture absorption for either grade F or G insulating material.

(d) Alsimag 196 when dry has an unusually low loss factor; Alsimag 35 when dry has a low loss factor.

(e) Neither of these materials is considered to be suitable for Naval use as grade F or G insulation.

Recommendations

(a) It is recommended that Alsimag 35 and Alsimag 196 be considered unsuitable for Naval use as grade F or G insulating material, due to excessive loss when wet. No objection is seen to the use of these materials where no exposure to atmospheric conditions can occur, as for example, wholly inside vacuum tubes.

DESCRIPTION OF MATERIAL UNDER TEST

6. The material under test consisted of discs of Alsimag 35 and Alsimag 196 submitted by the American Lava Corporation. The discs were 3 inches in diameter and 1/8 inch thick. (Several samples of Alsimag 35 received in August 1934 were also subjected to test and the results are included in this report.) See Tables No. 3 and No. 4 for material used in strength tests.

METHOD OF TEST

7. The loss factor was determined on samples after they had been soaked in distilled water for 96 hours and then carefully wiped dry. The procedure and computations employed are given in detail in paragraph 7(a) of reference (d). The frequency at which these measurements were made was approximately 360 kilocycles.

8. The moisture absorption test was carried out as detailed in paragraph 6-2 of reference (b). Samples were dried for 24 hours at 120°C. and accurately weighed. They were then immersed in distilled water for 100 hours during which time the water was boiled for one hour on four occasions. The weight was again obtained within a few minutes after the samples had been removed from the water and their surfaces thoroughly wiped with a clean dry cloth.

DATA RECORDED DURING TEST

9. The data recorded during the test, or values computed from these data, are given in Tables No. 1 and No. 2 covering tests at this Laboratory, and in Tables No. 3 and No. 4 covering tests at the Navy Yard, Washington.

PROBABLE ERROR IN RESULTS

10. The error in the determination of the loss factor is not more than 10%. This amount allows for errors in the determination of the frequency at which the measurements were made and in the measurement of capacity and effective resistance of the sample. The error in the determination of the weight of the samples in the moisture absorption test is not greater than 0.0002 grams. Probable errors in the strength tests are not known.

RESULTS OF TEST

11. These samples were tested for compliance with paragraphs 6-1 (loss factor) and 6-2 (moisture absorption) of reference (b). The results of the test for the determination of loss factor are given in Table No. 1. Those obtained in the moisture absorption test are given in Table No. 2.

12. From these data the following observations may be made:

- (a) Alsimag 35 has a loss factor, after soaking as required by these specifications, which varies widely with the sample tested from a low to an excessively high value (see column 8 of Table No. 1). The loss factor of sample No. 1, which is a 3 inch disc, is greater than the value allowed for either grade of insulating material covered by these specifications. The loss factor of sample No. 5, which is an extruded plate, is excessively high, having the value of 39.5; that of sample No. 2, a disc, and of sample No. 7, an extruded plate, lie within the limits for grade F material.
- (b) Alsimag 35 when dry has a low loss factor as shown in column 7 of Table No. 1. However, no dry test was required by the specifications.
- (c) Alsimag 196, after having been immersed in water as required, has a loss factor greatly in excess of that allowed for ceramic materials by these specifications. Two of these samples had such a high loss that when they were placed in a circuit as the dielectric in a condenser, it was impossible to make a resistance measurement due to inability to obtain an indication of resonance on a sensitive meter with a circuit tightly coupled to a power oscillator. After these samples had air dried for some time the loss in one of them was still too great to be measured while the loss factor of the other had a magnitude of 34, or approximately five times the maximum allowed for grade F material. Sample No. 3 of this material had a loss factor of 43 after having been immersed 72 hours.
- (d) The loss factor of Alsimag 196 when dry was unusually low as determined by measurements on sample No. 3 of this material before immersion.
- (e) The moisture absorption of Alsimag 35 was satisfactorily low except that of the extruded sample No. 5 which is ten times the limit stated in paragraph 6-2 of the governing specifications. The moisture absorption of the discs (samples No. 9 and No. 10) submitted at the same time as sample No. 5 and of those just received was within the specified limits.
- (f) The moisture absorption of Alsimag 196 was excessive as observed on samples No. 4 and No. 5 of this material in which the percentage gain in weight due to soaking 100 hours is 23 and 30 times, respectively, the limit set in paragraph 6-2 of these specifications.

13. The results obtained in the strength tests are given in Tables No. 3 and No. 4 as furnished by the Navy Yard, Washington.

CONCLUSIONS

14. Alsimag 35 does not comply with specifications, reference (b), with respect to loss factor for either grade F or G insulating material.

15. An extruded sample of Alsimag 35 did not comply with the moisture absorption requirement but all other samples tested met this specification.

16. Alsimag 196 did not comply with specifications, reference (b), with respect to either loss factor or moisture absorption for either grade F or G insulating material.

17. Alsimag 196 when dry has an unusually low loss factor; Alsimag 35 when dry has a low loss factor.

18. Neither of these materials is considered to be suitable for Naval use as grade F or G insulation.

Table No. 1.

LOSS FACTOR DATA ON ALSIMAG 35 and 196.

	Sample No.	Dielectric Constant		Power Factor % of a Radian		Loss Factor	
		Dry	Wet	Dry	Wet	Dry	Wet
Alsimag 35	1		5.5		1.99		10.9
Alsimag 35	2		5.5		1.16		6.4
Alsimag 35	3	5.4		.24		1.29	
Alsimag 35	4	5.4		.22		1.19	
Alsimag 35	5*	5.1	5.6	.36	7.06	1.83	39.5
Alsimag 35	6*	5.3	5.3	.28	.55	1.48	2.9
Alsimag 196	1	Loss while wet too large to measure.					
Alsimag 196	2	Loss while wet too large to measure.					
Alsimag 196	2**		5.9		5.77		34.0
Alsimag 196	3	5.1	5.6	.05	7.68	.26	43.0***

* These samples are 3 inches by 6 inches by 1/4 inch extruded plates, received August 1934.

** Sample had air dried several hours.

*** Sample had been immersed 72 hours.

Table No. 2.

MOISTURE ABSORPTION BY WEIGHT OF ALSIMAG 35 and 196.

	<u>Sample No.</u>	<u>Weight in Grams</u>		<u>Gain in Weight</u>	
		<u>After Drying</u>	<u>After Soaking</u>	<u>Grams</u>	<u>Per Cent.*</u>
Alsimag 35	5**	38.79	39.21	0.42	1.07
Alsimag 35	7	37.006	37.018	0.012	.03
Alsimag 35	8	35.305	35.333	0.028	.08
Alsimag 35	9***	39.84	39.84	0.00	0.0
Alsimag 35	10***	36.71	36.72	0.01	0.03
Alsimag 196	4	37.92	38.79	0.87	2.3
Alsimag 196	5	37.57	38.70	1.13	3.0

* Maximum gain in weight allowed, .10 per cent.

** This fragment is a part of sample 5 shown in Table No. 1.

*** These fragments are from 3-1/2 inches by 1/4 inch discs received August 1934.

Table No. 3.

COMPRESSION TESTS.

<u>Identifi- cation</u>	<u>Dimension of Specimen</u>		<u>Load spalling took place</u>	<u>Load rupture occurred</u>	<u>Remarks</u>
			<u>P.S.I.</u>	<u>P.S.I.</u>	
	in.	in.			
#35 unglazed	1.121 dia	x 1.125	35900	51200	
#35 "	1.110 "	x 1.125	42600	58700	57600
#35 "	1.112 "	x 1.125	47400	63100	
#35 glazed	1.112 "	x 1.125	61800	82200	
#35 "	1.113 "	x 1.125	65800	73700	77,730
#35 "	1.117 "	x 1.125	68100	77300	
#196 unglazed	1.147 "	x 1.125	72800	85300	84,600
#196 "	1.150 "	x 1.125	65500	77900	
#196 "	1.130 "	x 1.125	76000	90600	
#35 "	1.116 "	x 6.0	51100	54300	
#35 "	1.123 "	x 6.0	17200	22200	Ends were not parallel. Specimen deflected.
#35 unglazed	1.119 "	x 6.0	57000	74500	
#196 unglazed	1.123 "	x 6.0	92000	106800	
#196 "	1.126 "	x 6.0	26100	27700	Ditto.
#196 "	1.135 "	x 6.0	41000	41000	
#35 glazed	1.123 "	x 6.0	58600	67800	
#35 "	1.124 "	x 6.0	37300	46300	56,480
#35 "	1.125 "	x 6.0	49000	55300	

Table No. 4.

BEND TEST (DEFLECTION).

*Modulus
of rupture*
↓

<u>Identifi- cation</u>	<u>Dimension of Specimen</u>	<u>Load to Rupture</u>	<u>Maximum Deflec- tion</u>	<u>Maximum Fibre Stress P.S.I.</u>	<u>Maximum Bending Moment</u>	<i>AVE</i>
	in. in.					
#35 unglazed	1.121 dia x 6.0	2860#	0.010 in.	20650	2860 in.lbs.)	
#35 "	1.110 " x 6.0	1450#	0.006 "	10830	1450 " "	}
#35 "	1.121 " x 6.0	2700#	0.010 "	19500	2700 " "	
#35 glazed	1.122 " x 6.0	3270#	0.010 "	23600	3270 " "	
#35 "	1.123 " x 6.0	3170#	0.011 "	22850	3170 " "	
#35 "	1.123 " x 6.0	2360#	0.009 "	17000	2360 " "	
#196 unglazed	1.134 " x 6.0	1780#	0.007 "	12450	1780 " "	
#196 "	1.134 " x 6.0	1860#	0.009 "	13100	1860 " "	
#196 "	1.146 " x 6.0	2960#	0.011 "	20100	2960 " "	

Distance between supports 4.0 inches - Load concentrated at center.
NOTE: Tension and torque tests impracticable.