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NAVY DEPARTMENT
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Report on
Retest of Style A Wire Wound Resistors
(Grade 1, Class II)
submitted by
The International Resistance Company

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WASHINGTON, D. C.

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Humidity Test Data

Table 1

AUTHORIZATION

1. The work reported herein was authorized by Bureau of Engineering letter, reference (a). Other pertinent correspondence is listed as references (b) to (d).

- References: (a) BuEng let.S67/63/L5(11-1-W8) of 27 Apr.1938.
(b) Specifications RE 13A 372J.
(c) NRL Report No. R-1406, "Test of International Wire Wound Resistors."
(d) IRC letter of 12 March 1938 to BuEng.

OBJECT OF TEST

2. The object of the test was to determine whether the style A wire wound resistors submitted by the International Resistance Company in conjunction with reference (d) comply with specifications, reference (b), as grade 1, class II resistors, and are suitable for Naval use. (Style Z units of this grade and class were recommended for approval in reference (c).)

ABSTRACT OF TEST

3. Since these units are identical to those reported in reference (c) except for improvement in the protective coating as stated in reference (d), they were tested only to determine the effects of humidity, that is the effect of salt water immersion and the strength of the finished units and of the ferrule securing after the immersion test. Data on other tests as required by specifications, reference (b), are included in reference (c) and are considered as applying to these units.

Conclusions

(a) These style A resistors comply fully with the humidity resisting requirements of the governing specifications for grade 1, class II qualification. (Other characteristics of this style of resistor are covered by reference (c) as well as style Z units of the same classification.)

(b) These style A resistors are considered thoroughly suitable for Naval use as grade 1, class II units.

Recommendations

(a) It is recommended that these style A resistors be considered suitable for Naval use as grade 1, class II resistors. (See reference (c) for recommendations on style Z of the same manufacture and classification.)

DESCRIPTION OF MATERIAL UNDER TEST

4. The material under test consisted of six style A wire wound cement coated 50,000 ohm resistors manufactured by the International Resistance Company and submitted for test to supersede the similar set of samples reported in reference (c) which failed to pass the salt water immersion test. These resistors have a very dark gray coating with a dull finish. The identification applied to them by the manufacturer to distinguish them from those with coatings which were less resistant to humidity effects is not known.

METHOD OF TEST

5. The resistors were operated for six hours at a voltage of approximately 1350 volts, after which they were subjected to repeated cycles of salt water immersion as detailed in paragraph 13-3(13) of reference (b), which consists in transferring the resistor while heated to its specified hot spot temperature of 125° C into a vessel of saturated salt water at a temperature of 100° C. After two hours it is transferred to a 0° C salt water bath in which it is left for two hours. It is then rinsed in fresh water, the surface wiped dry and an air stream applied for approximately ten seconds to remove water from inside the winding tube. At the end of two hours' heating by means of the same potential as before, the resistance was again determined by the volt-ammeter method and compared with the value obtained before immersion. This immersion test cycle was repeated eleven times on these resistors. The strength of the finished units was determined by noting the pounds pressure necessary to damage a unit when it is supported 1/8 inch in from the ends of the ferrules and a measured pressure applied at the middle of the tube. The strength of the ferrule securing was tested by applying a torque of 5-inch pounds at the ferrules. A metal strip bent at one end in the form of a loop was clamped around the ferrule by means of screws sufficiently tight to prevent rotation of the loop on the ferrule and a known weight was applied at a proper distance along the metal strip to produce the desired torque. The strength of the finished units and of the ferrule securing were both determined after the completion of the immersion test.

DATA RECORDED DURING TEST

6. The data recorded during the test or that computed therefrom are given under RESULTS OF TEST and in the table appended.

DISCUSSION OF PROBABLE ERRORS

7. The hot spot temperature was determined to $\pm 5^{\circ}$ C. The torque applied to the ferrules was accurate to $\pm 1/2$ pound. The resistance measurements are correct to $\pm 1/2\%$.

RESULTS OF TEST

8. As stated under OBJECT OF TEST, these samples were submitted and tested for qualification as grade 1, class II units; that is,

they must withstand nine humidity test cycles and are to be operated at a hot spot temperature not exceeding 125° C. Since these units are submitted only to determine improvement in the protective coating over that used on the similar samples which are the subject of reference (c), this report covers the results of the tests relating only to humidity effects. The results of the several tests are given below.

9. Resistance to the Effects of Excessive Humidity (Par.13-3(13) of reference (b)) All six of these style A resistors satisfactorily withstood eleven salt water immersion test cycles. The change in resistance was very slight and for the first nine immersions was in no case as great as 2%. This performance is considered to be unusually good. Upon completion of the test the surfaces of the units appeared to be in good condition. Sparking inside the ceramic tube was noted in the case of samples 1, 2, and 3 during the first few minutes after the potential was applied to the resistors immediately following the rinsing and drying after the first immersion, but when the power had been applied sufficiently long to dry out the units thoroughly, the sparking ceased.

10. Strength of Finished Units (Par.13-3(9) of reference (b)) In the test upon two samples to determine the strength of the units when supported on their ferrules, one unit was damaged by the application of 530 pounds at its center, and the other by 540 pounds which indicate an extremely strong unit. In both cases the break occurred at the ferrules; that is, the ceramic insert which is molded into the ferrule and cemented into the end of the winding tube broke off about 1/4 inch from the spacer ring, and the end of the tube was fractured.

11. Strength of Ferrule Securing (Par.13-3(14) of reference (b)) The ferrules of these samples withstood a torque of 10-inch pounds without damage after the immersion test, while the requirement is that they withstand 5-inch pounds. The ceramic insert on which the ferrule and spacer ring are molded extends approximately 1 inch inside the winding tube to which it is cemented.

12. This report may be considered as a supplement to reference (c) to which reference is made for test data on other items of the specifications for this make and class of resistor.

CONCLUSIONS

13. These style A resistors comply fully with the humidity resisting requirements of the governing specifications for grade 1, class II qualification. (Other characteristics of this style of resistor are covered by reference (c) as well as style Z units of the same classification.)

14. These style A resistors are considered thoroughly suitable for Naval use as grade 1, class II units.

Table 1

Humidity Test Data

on

International Resistance Company
50,000 ohm Resistors, Style A, Grade 1, Class II

Sample No.	Per Cent Change in Resistance Due to Immersion										
	1st cycle	2nd cycle	3rd cycle	4th cycle	5th cycle	6th cycle	7th cycle	8th cycle	9th cycle	10th cycle	11th cycle
1	-.76	-.99	-1.09	-.99	-1.80	-.95	-1.85	+1.19	+1.19	-3.08	-.66
2	-.77	-.99	-1.09	+1.10	-1.83	+1.19	0	+1.19	+1.19	-1.85	+1.25
3	-.69	-.10	+1.10	+1.10	+1.10	+1.98	+1.10	+1.20	+1.20	+1.92	+3.24
4	-.77	+1.20	-1.09	+1.10	+1.10	+1.19	0	+1.19	+1.19	-1.89	-.68
5	-.76	-.99	-1.09	-.09	-1.10	-.95	-1.85	+1.19	+1.19	-3.08	-2.55
6	-.76	-.99	-.09	+1.19	+1.19	-.10	-1.85	+1.19	+1.19	-1.85	+1.32

NOTE: The resistance of all samples at 28° C was between 50,400 and 51,100 ohms.