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NAVY DEPARTMENT

Report of Test

on

Thermostats - Mercurial Type

Submitted by

Electric Glass Company,
Hatboro, Pennsylvania

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Authorization: BuShips ltr. S65-4(355) of 23 December 1941

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Distribution:
BuShips (6)

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TABLE OF CONTENTS

APPENDICES

AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and other references pertinent to this problem are listed as references (b) and (c).

References: (a) BuShips ltr. S65-4(355) of 23 December 1941
(b) Specifications 17F11 (Int.) of September 3, 1940
(c) BuEng Drwg. No. 4663-L-Alt.6

OBJECT OF TEST

2. The object of this test was to determine conformance of the sample thermostats with the specifications, reference (a), and their suitability for Naval use.

ABSTRACT OF TEST

3. The sample thermostats were set up at this Laboratory in a standard Navy fire alarm circuit where their performance was carefully observed for compliance with the specifications. An inspection of the samples to determine compliance in the matter of materials, design, and workmanship, concluded the test.

CONCLUSIONS

(a) The subject thermostats, manufactured by the Electric Glass Company, Hatboro, Pennsylvania, comply with the specification, reference (b), in all instances except for the color of the insulating jacket of the lead wire to the lower expansion chamber contact, which jacket is yellow instead of orange.

(b) If the orange color is essential to the wiring scheme, provision should be made to effect this change. The color scheme is otherwise considered satisfactory.

RECOMMENDATIONS

(a) It is recommended that the subject thermostats be given type approval as types GM 105° F. and GS 150° F. subject to satisfactory correction or waiver of exception noted under "Conclusions".

DESCRIPTION OF MATERIAL UNDER TEST

4. Eight (8) of the subject thermostats were submitted for test, four (4) type GM-105° F. and four (4) type GS-150° F. They are gas filled, mercurial straight glass tube type. Each is provided with three platinum wires; the bottom one in contact with the mercury column at all temperatures above 0° F., the middle one at all temperatures above 32° F. and the upper one at operating temperatures only, connected to three bands, see photograph Plate (1), made of fine copper wire covered with a layer of solder. Three General Electric Flamenol #18-19 strand copper wire leads with Thomas and Betts Sta.-Kon lugs equivalent to Navy type 1841-L-36 are soldered to the bands. The yellow colored insulated lead wire is connected to the 0° F. platinum contact, the black to the 32° F. contact, and the white to the operating temperature contact. Expansion chambers are provided for the mercury so designed as to prevent damage resulting from over-temperature and recession of mercury into reservoir at temperatures below 0° F.

METHOD OF TEST

5. Each thermostat was connected in a standard Navy fire alarm circuit, reference (c), and tested for accuracy of the fire alarm contact by immersing the bulb completely in a constantly stirred bath of S.A.E. 30 oil maintained at 5° F. below the rated operating temperature of the thermostat for a period of 5 minutes; and then raising the temperature of the bath at approximately 1° F. per minute until the thermostat closed the fire alarm circuit.

6. The accuracy of the supervisory circuit contact was obtained for each thermostat when connected as in paragraph 5 by "conditioning" for 5 minutes in a bath maintained at 35° F. and then cooling until the circuit opened.

7. The position of the mercury column at 0° F. was observed for each thermostat when the bulb was totally immersed in a bath at 0° F.

8. Following tests for accuracy of contact placement, each thermostat was tested to determine any damage occurring when subjected to an over-temperature test consisting of immersing the bulb in a bath maintained at 175° F.

9. The time lag of operation of each thermostat was next determined. Each thermostat was "conditioned" for 5 minutes in a bath maintained 5° F. below its rated operating temperature and then transferred rapidly (time necessary for transfer in all instances did not exceed 1 second) to a bath maintained 5° F. above its rated operating temperature. The time from the instant of immersion of the bulb in the latter bath until closing of the fire alarm circuit was determined with a stopwatch.

10. Each thermostat was subjected to an arcing test which consisted of making and breaking 50 times a standard Navy fire alarm circuit to which sufficient D.C. potential was applied to cause 70 milliamperes to flow.

11. Each thermostat was placed in a centrifuge and subjected to various acceleration values up to and including 25 G applied in a direction parallel to the mercury column and away from the bulb. Acceleration values were computed using as a radius the distance from the axis of rotation to the end of the mercury column in the capillary tube at room temperature, 75° F.

12. A shock test was made on each thermostat when mounted on a Navy Standard Shock Machine in latest case located 6" below the anvil with thermostat in the vertical plane bulb down consisting of 20 blows of 250 ft.lbs. each.

13. Another accuracy test following centrifuge and shock was conducted as described under Paragraph 5.

14. A final test to determine maximum values of centrifugal force necessary to part the mercury column was made as described under Paragraph 11.

15. The test was concluded by an inspection of the subject thermostats to determine compliance with the specification in regard to design, construction, materials and workmanship.

RESULTS OF TESTS

16. The results of tests, conducted in the order indicated, are given by Table 1.

11. Each thermostat was placed in a centrifuge and subjected to various acceleration values up to and including 25 G applied in a direction parallel to the mercury column and away from the bulb. Acceleration values were computed using as a radius the distance from the axis of rotation to the end of the mercury column in the capillary tube at room temperature, 75° F.

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RESULTS OF TESTS

16. The results of tests, conducted in the order indicated, are given by Table 1.

TABLE 1

Thermo-stat Number	Accuracy Fire Alarm Contact °F (1)	Accuracy Supervisory Contact °F (2)	Accuracy Mercury Column at 0°F (3)	Over Temperature Test at 175°F (4)	Time Lag Seconds (5)	Arcing Test (6)	Centri-fuge 25G (7)	Shock Test (8)	Accuracy Following (7) and (8) °F (9)	Max. G's Withstood (10)
GM-105										
A	105.70	31.5	Satisfactory	Satisfactory	13.6	Complied	Complied	Satis-factory	105.44	45
B	104.22	31.1	"	"	12.0	"	"	"	104.02	45
C	104.28	30.7	"	"	12.1	"	"	"	104.13	45
D	105.86	31.0	"	"	13.8	"	"	"	105.46	35
GS-150										
E	151.39	31.2	"	"	9.3	"	"	"	151.13	50
F	149.76	31.5	"	"	7.3	"	"	"	149.52	35
G	149.62	30.7	"	"	7.1	"	"	"	149.52	50
H	149.54	30.8	"	"	6.6	"	"	"	149.97	45

Notes: 1. Values given under numbers (1), (2) and (9) are averages of 5 readings; those under number (5) of 8 readings.
2. Numbers indicate order in which tests were conducted.

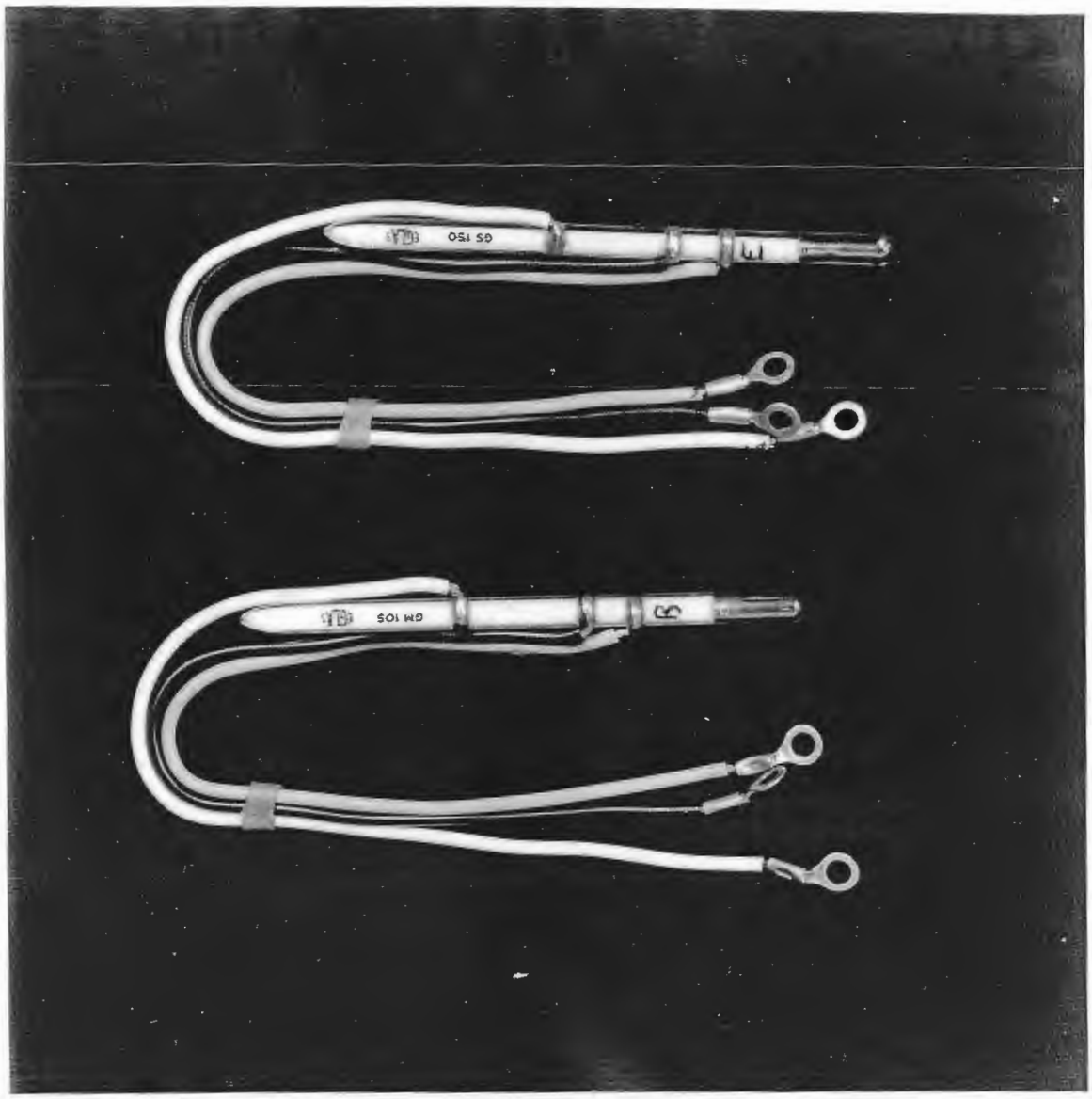

PLATE 1