

6 December 1939

NRL Report No. B-1580

NAVY DEPARTMENT

Report of

Test on Thermostats - Mercurial Type  
Manufactured and Submitted

by

Philadelphia Thermometer Company  
Philadelphia, Pa.

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
Washington, D.C.

Number of Pages: Text - 5 Plates - 1

Authorization: Bueng. ltr. S65-4/L5(8-18-Ds) of 26 August 1939.

Date of Test: November and December 1939.

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Photograph of one of each type of Thermostat  
submitted for test..... PLATE 1

## AUTHORIZATION FOR TEST

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

Reference: (a) Bueng.ltr. S65-4/L5(8-18-Ds) of 26 August 1939.  
(b) Bueng.ltr. S65-4/L5(8-31-Ds) of 12 September 1939.  
(c) Specification 17Fl1(INT) of 15 August 1938.  
(d) Bueng. drawing 9-S-4732-L-Alt.6.

## OBJECT OF TEST

2. The object of this test was to determine the suitability of the thermostats for fire alarm equipment for Naval vessels and compliance with reference (c).

## ABSTRACT OF TEST

3. Each thermostat as submitted was set up in this Laboratory in a standard Navy fire alarm circuit and closely observed for accuracy of operation while under test for conformance with reference (c).

Conclusions

- (a) The subject thermostats, manufactured by the Philadelphia Thermometer Company, comply with the specification except for the lead wires not being in accordance with the requirements of sub-paragraph E-3L. The wires furnished are apparently covered with red rubber.

Recommendations

- (a) It is recommended that the sample thermostats be given type approval as types GM-105 and GS-150, subject to the use of approved lead wires.

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## DESCRIPTION OF MATERIAL UNDER TEST

4. Nine (9) of the subject thermostats were submitted for test, four (4) type GM(105°F) and five (5) type GS(150°F). The thermostats are of the gas filled, mercury in glass, type. Each thermostat is provided with three platinum contacts which terminate on the outside in metal rings formed by fine copper wires covered with a layer of solder. For connecting the thermostat in its respective circuit, three flexible lead wires, soldered to the metal rings, are provided. The lower lead wire is in contact with the mercury column at all temperatures above 10°F. (approx.). The middle lead wire is in contact with the mercury column at temperatures above 32°F. The top lead wire is not in contact with the mercury column until the operating point of the thermostat is reached. Each thermostat is protected against damage by temperatures up to 175°F. by providing an expansion chamber above the alarm contact. The thermostats are so designed that the mercury does not totally recede into the bulb at 0°F.

## METHOD OF TEST

5. Each thermostat as submitted was first tested for accuracy of operation by connecting it in a standard Navy fire alarm circuit and immersing its bulb for a period of five (5) minutes in a circulating oil bath at a constant temperature of 5°F. below the rated operating temperature of the thermostat. After this conditioning period, the temperature of the bath was raised at a rate of approximately 1°F. per minute until the operating point of the thermostat was reached.

6. Next, each thermostat was tested for time lag by transferring it from the conditioning bath to another bath held at a constant temperature 5°F. above the rated operating temperature of the thermostat. The time between immersion in the second bath and the closing of the alarm circuit was recorded.

7. Each thermostat was then operated 50 times while connected to a standard fire alarm panel and breaking the load of that circuit.

8. The thermostats were then placed in a centrifuge at a room temperature of approximately 70°F. and subjected to an acceleration value of 25G in the direction parallel to the side of and away from the bulb. The acceleration value was computed, using as a radius the distance from center to the end of the mercury column in the capillary tube.

9. Following this, the accuracy test covered by paragraph 5 was repeated, in order to determine whether any change in the operating points of the thermostats had occurred.

10. Next, each thermostat was tested to determine whether the circuit between the lower and the middle contacts would open at 32°F. It was then tested at 0°F. to observe how far the mercury column receded into the bulb.

11. In order to determine the ability of the thermostats to withstand over-temperatures, the bulb of each was immersed in a circulating oil bath having a temperature of 175°F.

12. The shock integrity of the thermostats was determined by placing each in the latest type mounting, Bureau of Engineering Drawing 9-S-4732L Alt.6, and subjecting it to 20 shocks of 250 foot pounds each, applied on a Navy standard shock machine. During this test, the thermostat was mounted in the normal position, bulb down.

13. The test was concluded by subjecting each thermostat to various acceleration values in a centrifuge until the mercury column parted.

RESULTS OF TEST

14. The test results which follow were obtained when the samples were tested in the order required by the specification.

Thermo- stat No.	Accuracy Note 1	Lag in Seconds Note 2	Time Note 3	Load Test Note 4	Centri- fuge test at 25G Note 4	Accuracy following load test Note 1	Shock Test 20-250 foot lb. Blows Note 5	Super- visory Contact O°F. Note 5	Position of mer- cury at O°F. Note 4	Centri- fuge Value withstood G Note 4	Centri- fuge Value failed G Note 4	Over- tempera- ture test at 175°F.
TS 105	104.58°F.	5.74		satis- factory	column remained intact	104.32°F.	satis- factory	32.62°F	satis- factory	100	125	satis- factory
TS 106	104.16°F.	7.11		"	"	104.36°F.	"	33.0°F	"	125	150	"
TS 107	104.96°F.	6.49		"	"	104.82°F.	"	33.48°F	"	75	100	"
TS 108	104.22°F.	6.94		"	"	104.42°F.	"	33.32°F	"	100	125	"
TS 100	148.50°F.	5.73		"	"	148.16°F.	"	32.48°F	"	50	75	"
TS 101	149.50°F.	6.45		"	"	149.56°F.	"	31.58°F	"	75	100	"
TS 102	148.34°F.	4.91		"	"	148.0°F.	"	32.56°F	"	100	125	"
TS 103	148.50°F.	4.86		"	"	148.28°F.	"	31.98°F	"	100	125	"
TS 104	148.82°F.	5.85		"	"	148.88°F.	"	31.76°F	"	50	75	"

- Note: 1. Required accuracy GM-105° + 1°F, GS-150° + 2°F. Values given are averages of 5 readings.  
 2. Maximum time lag allowed is 45 seconds. Values given are averages of 6 readings.  
 3. A standard fire alarm panel was used for the load test.  
 4. Required value of acceleration is 25G.  
 5. Required accuracy + 2°F. at 32°F. Values given are averages of 5 readings.



CONCLUSIONS

15. The subject thermostats, manufactured by the Philadelphia Thermometer Company, comply with the specification except for the lead wires not being in accordance with the requirements of sub-paragraph E-3L. The wires furnished are apparently covered with red rubber.

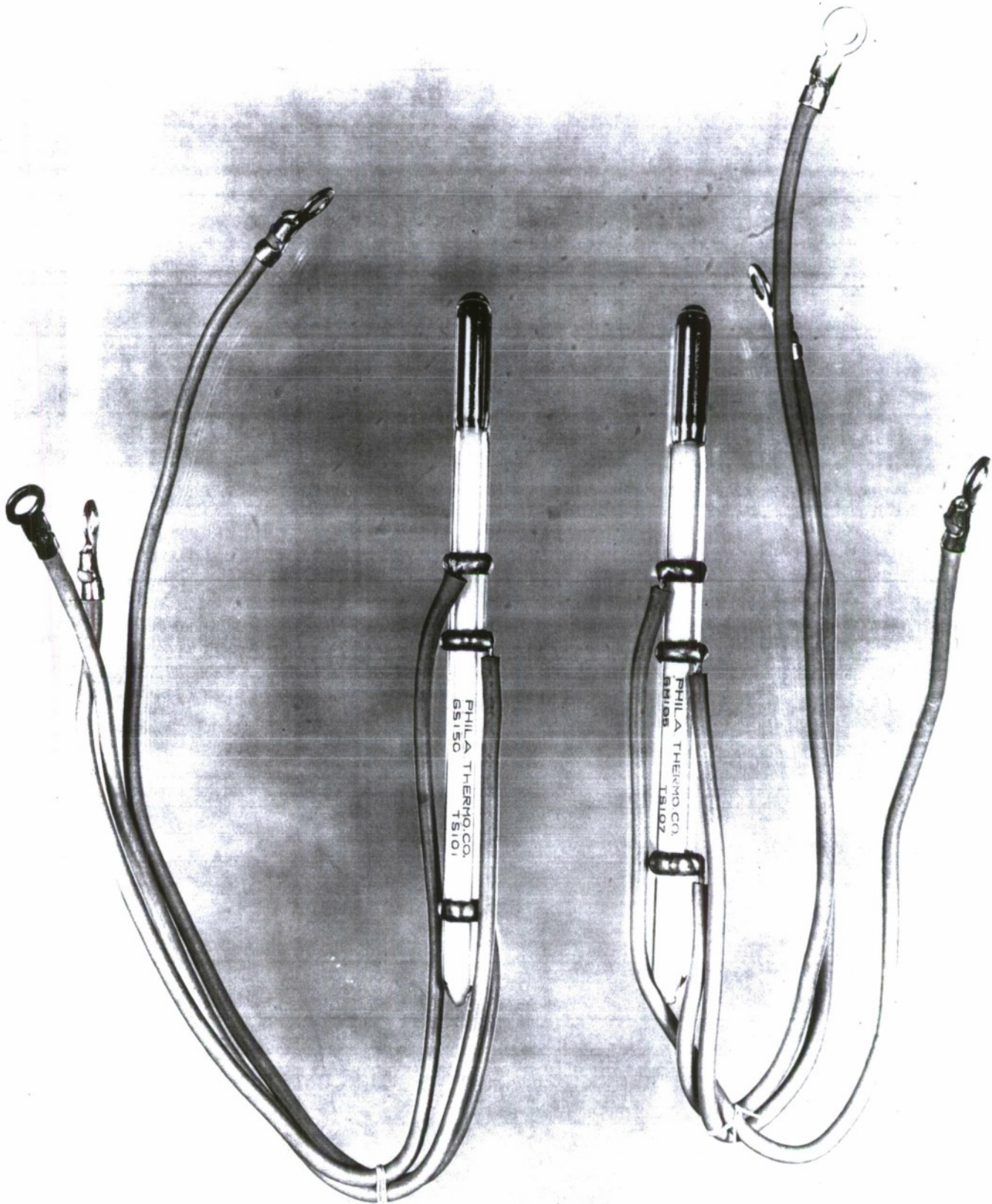


Plate 1