

8 January 1935

NRL Report No.B-1110

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report of

Test on Thermostats - Mercurial Type
Manufactured and Submitted
by
H.B. Instrument Company
Philadelphia, Pa.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 5 Plates - 2
Authorization: BuEng ltr. L5/NPL(2-27-Ds) of 27 March 1934.
Date of Test: December, 1934.

Prepared by: W. B. Roberts, Sr. Engr. Aide,
Chief of Section.

Reviewed by: W. M. Haynsworth, Lieutenant, USN

Approved by: H. R. Greenlee, Captain, USN
Director.

Distribution:
BuEng. (5)

Distribution Unlimited

mbe

Approved for
Public Release

TABLE OF CONTENTS

<u>SUBJECT</u>	<u>PAGE</u>
1. AUTHORIZATION FOR TEST.....	1
2. OBJECT OF TEST.....	1
3. ABSTRACT OF TEST.....	1
(a) Conclusions.....	1a
(b) Recommendations.....	1a
4. DESCRIPTION OF MATERIAL UNDER TEST.....	2
5. METHOD OF TEST.....	2
6. RESULTS OF TEST.....	4
7. COMMENTS ON RESULTS OF TEST.....	5
8. CONCLUSIONS.....	5

Appendices

Photograph of one of each type of thermostat submitted for test.....	Plate 1
Photograph of set-up for testing thermostat.....	Plate 2

AUTHORIZATION FOR TEST

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

Reference: (a) BuEng. ltr. L5/NPL4(2-27-Ds) of 27 March 1934.
(b) Navy Department Specifications SGS-(65)-25,
modified by schedule 9947.
(c) Bureau of Engineering Dwg. 9-S-4732L.

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 (b).

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 Navy Department Specifications SGS-(65)-25, modified by Schedule 9947.

CONCLUSIONS

(a) These thermostats, as at present manufactured by the H. B. Instrument Company and covered by this report, are not considered satisfactory for installation in Naval fire alarm systems due to their failure to comply with the specifications, reference (b).

(b) Although the thermostats failed to comply with the specifications, the results of the test indicate that the manufacturer could, with minor modifications, produce thermostats suitable for the Naval service. For details covering failures see results of test, paragraph 14.

RECOMMENDATIONS

(a) In view of the failure of the thermostats to meet the requirements of the specifications, reference (b), it is recommended that they be not approved for the Naval service.

DESCRIPTION OF MATERIAL UNDER TEST

4. Twelve of the subject thermostats were submitted for test. Of these, four type (GM-105°F) and four type (GS-150°F) were tested. The thermostats are of the gas filled, mercury in glass, type. Each thermostat is provided with three (3) 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 orange lead wire is in contact with the mercury column at all temperatures above 10°F (approx.). The green lead wire is in contact with the mercury column at temperatures above 32°F. The white 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 212°F. by providing an expansion chamber above the alarm contact.

DESCRIPTION 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 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 in the fire alarm circuit and breaking a load of 0.050 amperes.

8. The thermostats were then placed in a centrifuge at a room temperature of approximately 70°F and subjected to an acceleration value of 25 G in the direction parallel to the side of and away from the bulb. The acceleration value was computed, using as a radius 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 point 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 to observe how far the mercury column receded into the bulb. Both tests were made with the use of alcohol baths, cooled by "dry ice".

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 212°F.

12. The shock integrity of the thermostats was determined by placing each in the latest type mounting, Bureau of Engineering Drawing 9-S-1732L and subjecting it to a shock of 20-150 foot pound blows 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 by means of a centrifuge. The value at which the mercury column parted was recorded.

14. RESULTS OF TEST

	Accuracy of (Average of 5 readings)		Time Lag (4.5 Seconds Max.)	Load Operations Test - 50		Centrifuge Test (250)	Accuracy of (Aver. of 5 readings)		Shock 20-150 ft. lb. blown	Test at 212°F		Test at 32°F		Centrifuge Centrifuge (Failed)		Serial No.
	5 readings	Max.		Satisfactory	Satisfactory		Satisfactory	factory		Satisfactory	factory	at 0°F	at 32°F	100 G	125 G	
Type GM (105°F + 1°F)	1	105.1	10.0	Satisfactory	Satisfactory	105.4	Satisfactory	factory	"	Satisfactory	factory	"	"	100 G	125 G	2401
	2	105.6	11.0	"	"	105.2	"	"	"	"	"	"	"	100 G	125 G	2402
	3	105.7	11.0	"	"	106.5	"	"	"	"	"	"	"	125 G	150 G	2403
	4	105.8	8.0	"	"	105.2	"	"	"	"	"	"	"	100 G	125 G	2404
Type GS (150°F + 20°F)	1	150.3	10.4	"	"	149.9	"	"	"	"	"	"	"	125 G	150 G	2042
	2	150.5	13.4	"	"	150.1	"	"	"	"	"	"	"	75 G	100 G	2043
	3	149.6	13.2	"	"	149.0	"	"	"	"	"	"	"	100 G	125 G	2406
	4	148.2	20.0	"	"	150.2	"	"	"	"	"	"	"	100 G	125 G	2407

* Non-conformance with specifications.

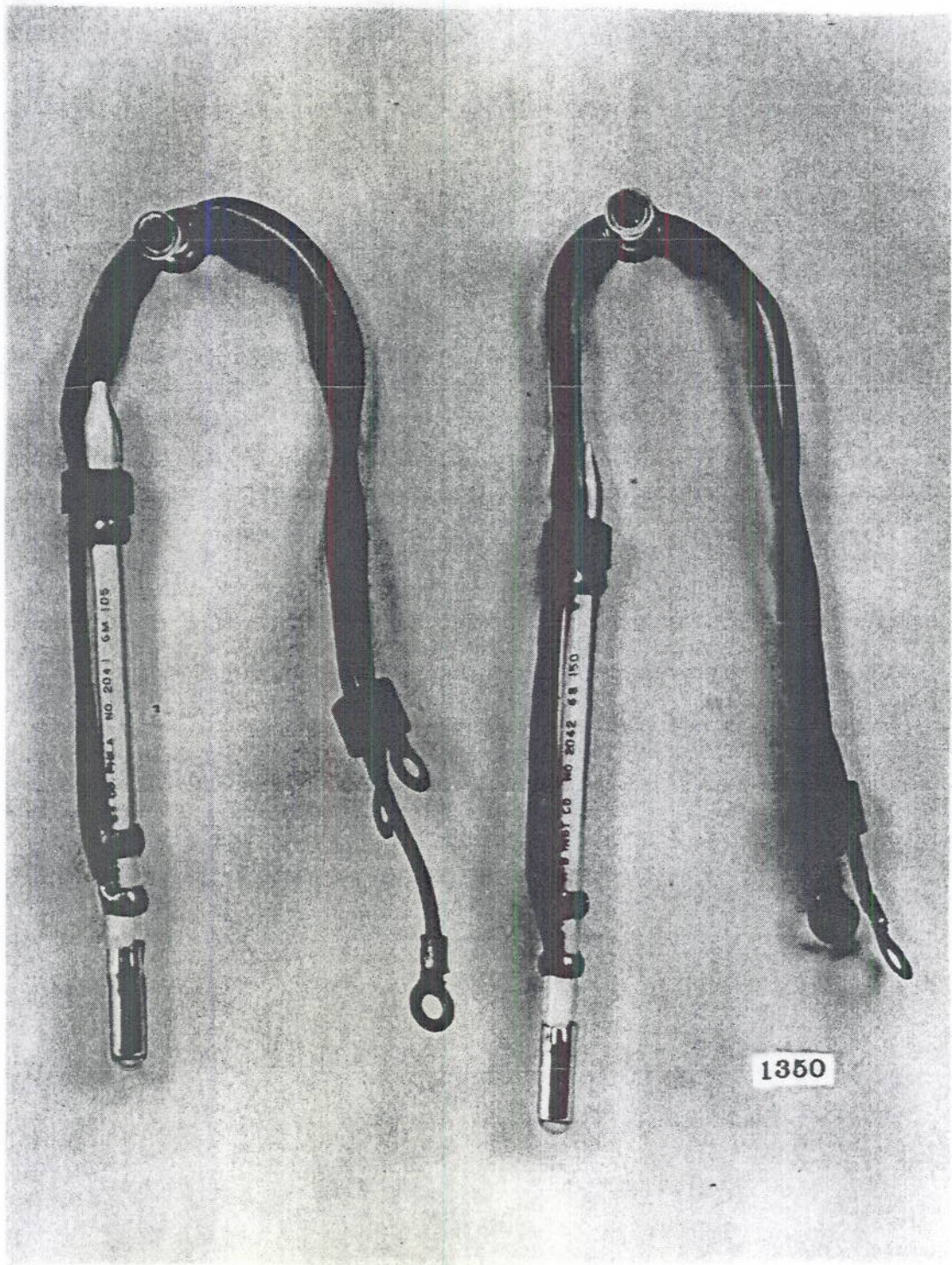


PLATE 1

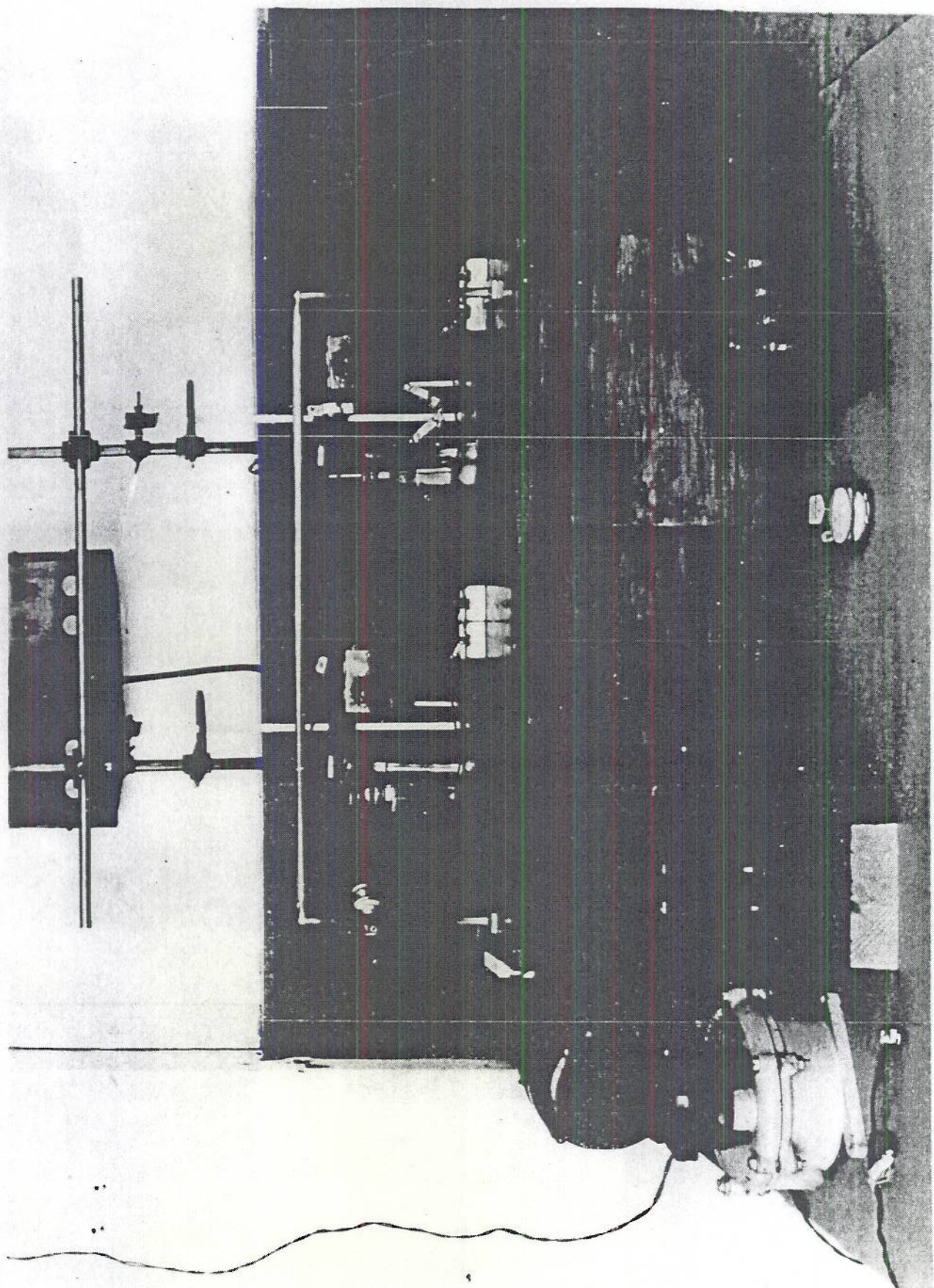


PLATE 2