

NAVY DEPARTMENT  
BUREAU OF ENGINEERING

Report on

Test of Bi-Metallic Thermostats.

Walter Kidde and Company Exhibitor.

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D.C.

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Prepared by: \_\_\_\_\_  
W. B. Roberts, Senior Engineering Aide.  
(Chief of Section).

Reviewed by: \_\_\_\_\_  
W. M. Haynsworth, Jr., Lieutenant, USN.

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

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### AUTHORIZATION FOR TEST

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

Reference: (a) BuEng. ltr. S65-4/L5(9-13-Ds) of 22 September 1934.  
(b) Navy Department Specifications SGS(65)25 of 1 March 1934, modified by Schedule 9947.

### OBJECT OF TEST

2. The object of this test was to determine how closely the thermostats meet the requirements of specifications, reference (b), and their suitability for installation in Navy fire alarm systems.

### ABSTRACT OF TEST

3. The sample thermostats were tested in accordance with Navy Department Specifications, reference (b), insofar as they were applicable.

## Conclusions

(a) These bi-metallic thermostats, as submitted by Walter Kidde and Company and covered by this report, are not satisfactory for installation in Navy fire alarm systems because of their present construction and failure to comply with Navy Department Specifications SCS(65)25. Although these thermostats may be modified to give more accurate operation and to include supervisory contacts, they require approximately two inches of the tube to be exposed to the surrounding air. Should this tube be broken, there is great possibility of an arc occurring between the metallic parts. The intensity of this arc would depend entirely upon the condition of the circuit at the time of breakage. This is a great disadvantage as compared with the present Navy, mercury filled, glass tube type, which, when the exposed glass bulb is broken, expels the mercury from the tube but produces no arc.

It has always been the practice of the Navy to prohibit the installation, in magazines, of any electrical equipment that might possibly cause an arc.

Recommendations TESTS UNDER TEST

(b) Due to failure of the thermostats to comply with the specifications, it is recommended that they be not approved for installation in Navy fire alarm systems.

The thermostats were first connected in a standard Navy fire alarm circuit and then lowered for five (5) minutes in a circulating oil bath having a temperature of 5° F. below its rated operating point. The temperature was then raised at approximately 1° F. per minute until the thermostat operated and closed the alarm circuit, at which time the operating point was recorded.

Tests were also made to determine the speed of operation of the thermostats and their ability to open the circuit fifty times without change in operating temperature within the tolerance given for their respective ratings. The test was concluded by subjecting one of each type of thermostat to 100 vibrations per minute, at an amplitude of 0.003125 for a period of one hour, to determine whether vibration would close the contacts and operate the alarm circuit.

Results of tests were also made to determine the speed of operation of the thermostats and their ability to open the circuit fifty times without change in operating temperature within the tolerance given for their respective ratings. The test was concluded by subjecting one of each type of thermostat to 100 vibrations per minute, at an amplitude of 0.003125 for a period of one hour, to determine whether vibration would close the contacts and operate the alarm circuit.

RESULTS OF TESTS

Serial Number	Rated Temperature by Manufacturer (°F.)	Operating Points in Oil Bath - °F. (Day's 105 ± 1.0°F., 150 ± 2.0°F.)	Average Operating Point °F.	Speed Test (Day's 105 ± 1.0°F., 150 ± 2.0°F.)
2872*	106.0	106.3 107.0 108.0 107.0 117.4	110.156*	-
6068	106.0	101.1 101.0 101.0 101.5 101.0 101.6	101.206*	15.5
3652	152.0	153.2 151.7 153.2 151.8 152.4 152.5	152.506*	20.0
6872	150.0	152.4 147.4 150.9 153.0 150.8 152.5	152.836*	15.0

\* Failed to operate at 115° F. several times before actual test was started.

\*\* Non-compliance with specifications.

Dimensions of thermostat: Length - 2.175; diameter - 0.935.

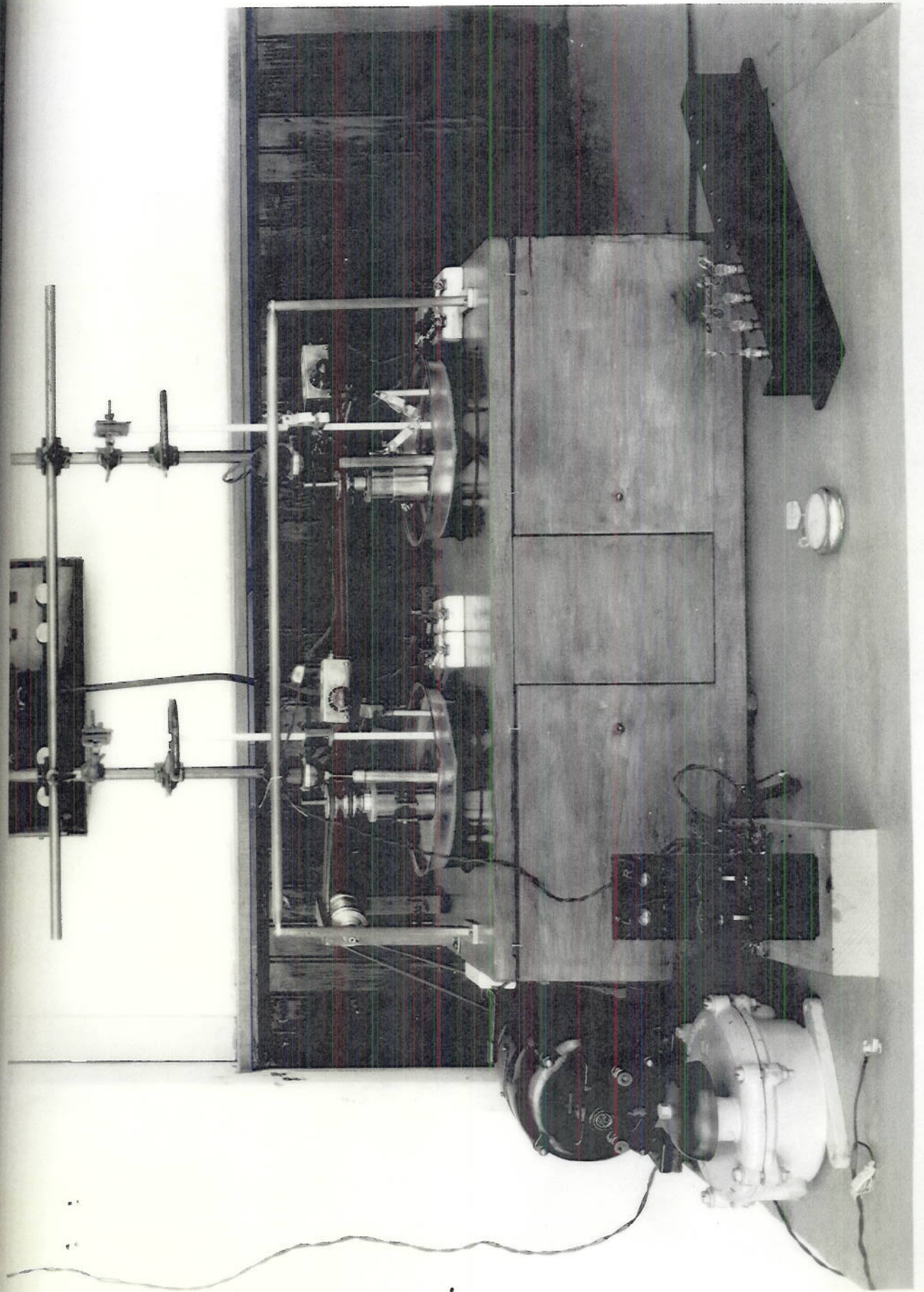


PLATE I

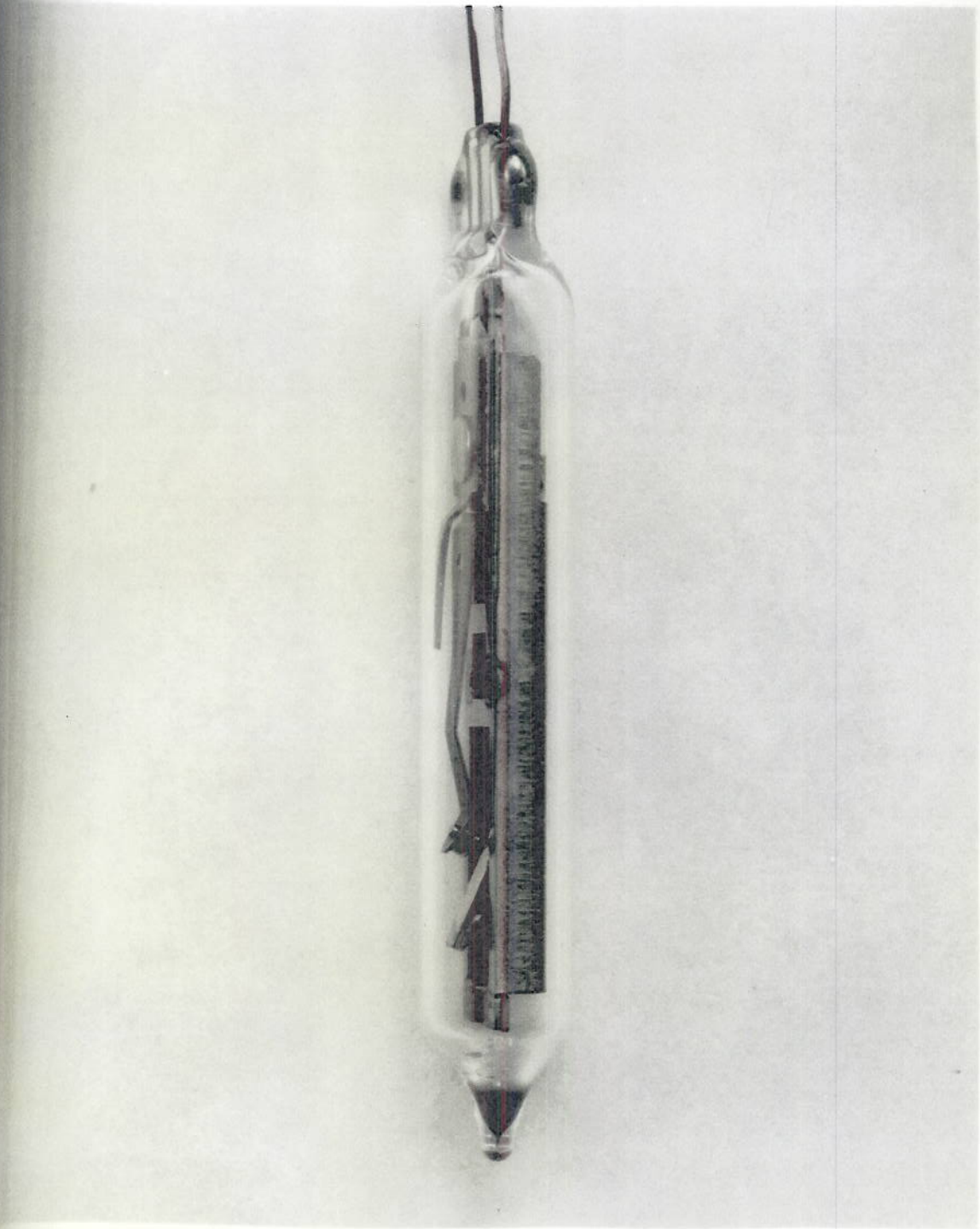


PLATE 2

DESCRIPTION OF MATERIAL UNDER TEST

4. Four samples of each type of thermostat were submitted, two in commercial type mountings and two unmounted. Each thermostat has two normally open contacts, one fixed, the other mounted on a bi-metallic strip permanently adjusted for operating temperature. The unit is sealed in a glass tube containing hydrogen gas. Two solid lead wires are brought out at one end of the glass tube for connecting in its respective circuit. A photograph of the bi-metallic thermostat is shown on Plate 2.

METHOD OF TEST

5. Each thermostat was first connected in a standard Navy fire alarm circuit and then immersed for five (5) minutes in a circulating oil bath, having a temperature of 5° F. below its rated operating point. The temperature was then raised at approximately 1° F. per minute until the thermostat operated and closed the alarm circuit, at which time the operating point was recorded.

Tests were also made to determine the speed of operation of the thermostats and their ability to open the circuit fifty times without change in operating temperature within the tolerance given for their respective ratings. The test was concluded by subjecting one of each type of thermostat to 300 vibrations per minute, at an amplitude of 0.03125 for a period of one hour, to determine whether vibration would close the contacts and operate the alarm circuit.

RESULTS OF TEST

6.

Serial Number	Rated Temperature by Manufacturer (°F.)	Operating Points in Oil Bath - °F. (Req'd.: 105 ± 1° F., 150 ± 2° F.)						Average Operating Point °F.	Speed Test (Req'd. 45 sec. max.) Seconds.
4072*	104.0	105.0	106.3	107.0	120.0	107.0	117.4	110.45**	-
6088	106.0	101.1	101.0	101.0	101.5	101.0	101.6	101.20**	12.5
5952	152.0	153.4	151.7	153.2	151.8	152.4	152.5	152.50**	40.0
6072	150.0	152.4	147.4	150.9	153.0	150.8	152.5	152.83**	15.5

\* Failed to operate at 115° F. several times before actual test was started.

\*\* Non-compliance with specifications.

Dimensions of thermostat: Length - 2"375; diameter - 0"354.

7. Of the four samples tested, none complied with the specifications with respect to accuracy of operation.

8. These thermostats are of the open circuit type having two contacts, while the mercurial type thermostats, at present required for Navy fire alarm circuits, have three contacts which are necessary for a supervised circuit.

9. While under the vibration test of 300 vibrations per minute, at an amplitude of 0.03125, both types of thermostats closed the circuit intermittently when nearing their operating points.

10. No further tests were made on the subject material, as the specifications do not apply to this type of thermostat.

11. No tests were made on the thermostats submitted in commercial mountings, because the test equipment is designed for testing unmounted thermostats.

#### CONCLUSIONS

12. These bi-metallic thermostats, as submitted by Walter Kidde and Company and covered by this report, are not satisfactory for installation in Navy fire alarm systems because of their present construction and failure to comply with Navy Department Specifications SGS(65)25. Although these thermostats may be modified to give more accurate operation and to include supervisory contacts, they require approximately two inches of the tube to be exposed to the surrounding air. Should this tube be broken, there is great possibility of an arc occurring between the metallic parts. The intensity of this arc would depend entirely upon the condition of the circuit at the time of breakage. This is a great disadvantage as compared with the present Navy, mercury filled, glass tube type, which, when the exposed glass bulb is broken, expels the mercury from the tube but produces no arc.

13. It has always been the practice of the Navy to prohibit the installation, in magazines, of any electrical equipment that might possibly cause an arc.