11 January 1940 NRL Report No. B-1584

NAVY DEPARTMENT

Report of Test

on

Contact Makers, Type L, Class I

and Type N, Class I, (Remote Switching),

Manufactured and Submitted by Viking Instruments, Inc.,

Stamford, Connecticut

FR-1584

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Authorization: BuEng. ltr. SS198-200/S65 (7-18-Df) of 19 August 1939 to IM, Groton, Connecticut (cc to INM, NY).

Date of Test: December 1939 to January 1940.

Tested by: _____
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Approved by: _____
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Distribution:
BuEng. (5)

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APPENDICES

AUTHORIZATION FOR TEST

1. Under reference (a), the subject samples of contact makers were forwarded to this Laboratory for suitability tests as outlined by reference (b). However, due to previous unsatisfactory tests and non-compliance with the specification, the Bureau orally requested that a complete qualification test be conducted and reported in the usual manner. Other references pertinent to this problem are listed as references (c) to (e), inclusive.

Reference: (a) INM, NY ltr. EN8-5/725-31(A-3)212 of 27 November 1939 to Director, NRL.
(b) BuEng. ltr. SS198-200/S65 (7-18-Df) of 19 August 1939 to IM, Groton, Conn. (cc to INM, NY).
(c) Specification 17C16(INT) of 1 February 1939.
(d) Mfr's Drwg. 4998 P, Type L, Class I contact maker.
(e) Mfr's Drwg. 5085 T, Type N, Class I contact maker.

OBJECT OF TEST

2. The object of this test was to determine how closely the sample Type L, Class I contact maker and the Type N, Class I remote-switching contact maker comply with tests for qualification under specification, reference (c), and their suitability for Naval use.

ABSTRACT OF TEST

3. The contact makers were set up at this Laboratory in suitable test equipment where their performance was carefully observed for compliance with the requirements. An inspection of the samples to determine compliance in the matter of materials, design, and workmanship concluded the test.

Conclusions

(a) The subject contact makers were found to be satisfactory and of good workmanship and design, except in the following respects:

(1) Electrical clearance between terminals, pc. 14, and adjusting nut, pc. 26, of the Type L contact maker is not satisfactory.

(2) Electrical clearance between terminals, pc. 24, and frame, pc. 1, of the Type N contact maker is not satisfactory.

(3) The sensitive bulb, pc. 14, of the Type N contact maker is of unidentified material and is sealed with solder at the end which is inserted in the engine cooling system. These dissimilar metals can, under unfavorable conditions, cause electrolysis and result in the failure of the seal.

(4) The operating point of the Type N, Class I, contact maker changed 4.2°F. as a result of the shock and vibration tests. This exceeds the 2.5°F. tolerance of the specification.

(b) The Type N, Class I, remote-switching contact maker checks with manufacturer's drawing, reference (e). However, the construction and materials of the sensitive element, pc. 14, and compensating elements, pc. 13, are not given.

(c) The drawing, reference (d), forwarded by Inspector of Naval Material, New York, does not cover the modification to prevent pulsation. This change was partly covered by a later drawing of the same number forwarded by the manufacturer with a description of the modification.

Recommendations

(a) It is recommended that both types of contact makers be approved for Naval use subject to the correction of the deficiencies outlined under "Conclusions," and satisfactory check tests.

(b) It is further recommended that, as the adjustment of the contact makers is somewhat unconventional, complete instructions be attached to the inside of the case covers.

DESCRIPTION OF MATERIAL UNDER TEST

4. The Type L, Class I contact maker is shown by photograph, Plate 1, and covered by drawing, reference (d). It is designed to close a circuit when the engine oil pressure drops below a predetermined setting (0 to 15 lbs.). A pulsation stop, pc. 30, is provided and threads into the top of the bellows housing through which the push rod works. The bellows head makes contact with the lower end of the sleeve just above the operating point, so that further movement is prevented. A 0.5 microfarad, 600 volt, d.c. condenser shunts the "micro-switch."

5. The adjustment of the contact maker is made in accordance with Note 8 of reference (d).

6. The Type N, Class I, remote-switching contact maker is shown by photograph, Plate 2, and covered by drawing, reference (e). It embodies a bellows, operated by the pressure developed in a metal expansion bulb, located at the end of the capillary tubing. The bellows, tubing, and expansion chamber are partly filled with liquid and are permanently sealed. The expansion bulb is provided with a packing gland (3/4-inch IPS male thread) for connecting into the system. A normally open "micro-switch" is so suspended that it may be raised by the operating bellows when the operating point is greatly exceeded. It is raised and lowered by two auxiliary bellows, designed to maintain the distance between the switch and the operating bellows and compensate for various ambient temperatures. A 0.5 microfarad, 600 volt, d.c. condenser shunts the "micro-switch."

METHOD OF TEST

7. Each sample was set up in the usual testing equipment and subjected to the tests in the order outlined in paragraph F-2 of the specification, reference (c). When the Type "N" contact maker was tested at several ambient temperatures, all but about one foot of capillary tubing and the sensitive bulb were at the specified temperature.

RESULTS OF TESTS

8. The data obtained during the period of the tests were as follows:

Requirements	Test Values	
	Type L	Type N
Contact load: Switch shall be capable of breaking a load of 4 amperes, 0.5 P.F., 115 volts.	Complied	Complied
Endurance test: Shall operate 48 hours at the following rates: Type L - "On" 2 sec., "off" 2 sec. Type N - One cycle each 5 min.	Complied	Complied

Requirements	Test Values	
	Type L	Type N
Operation range: Shall be adjustable over a range of 0 to 15 lbs./sq.in. for Type L; 100 to 225°F. for Type N.	0.75 to 15 lbs.	94 to 228°F.
Accuracy: Operating point shall not vary more than: ±1/2 lb. for Type L; ±2-1/2°F. for Type N.	Complied, see Table 1.	Complied, see Table 2.
Shock and vibration tests: Paragraph F-2e.	Complied, see Table 1.	*Did not comply. See Table 2 for operation following test.
Dielectric: Shall withstand 1500 volts, a.c., for 1 minute between electrical parts and ground.	Complied	Complied
Insulation resistance: Shall be not less than 10 megohms at 500 volts.	200+ megohms by 1000 volt "megger."	200+ megohms by 1000 volt "megger."
Overpressure test: Type L shall withstand 15 pressure cycles of 200 lbs./sq.in. for 10 seconds applied at a rate not exceeding 200 lbs./sq.in./sec.	Complied, see Table 1.	---
Expansion chamber requirements: Expansion chamber of the Type N shall be designed for operation when submerged in a liquid at or less than 50 lbs./sq.in. It shall be of corrosion resisting material or material suitably treated to prevent corrosion when exposed to hot salt water.	---	Withstood 50 lbs./sq.in. *See "Conclusions" for corrosion resistance.
Overtemperature test: Expansion chamber of the Type N shall be subjected to a temperature of 300°F. for 5 minutes without damage.	---	Complied
Watertight integrity: Shall be submerged under 3 feet of water for 1 hour without the entry of water into the case.	Complied	Complied

Requirements	Test Values	
	Type L	Type N
Clearance: There shall be not less than 1/4-inch between electrical circuits and ground unless separated by at least 1/8-inch of approved insulating material.	*Less than 1/4-inch between pcs. 14 and 26.	*Less than 1/4-inch between pcs. 1 and 24.
Length of capillary tubing: Shall be as specified in contract or order.	---	12-1/2 feet
Weight: Not specified.	5 lbs. 13 oz.	6 lbs. 6 oz.

*Denotes failure to comply with the specification.
--- Requirement does not apply.

CONCLUSIONS

9. The subject contact makers were found to be satisfactory and of good workmanship and design, except in the following respects:

(a) Electrical clearance between terminals, pc. 14, and adjusting nut, pc. 26, of the Type L contact maker is not satisfactory.

(b) Electrical clearance between terminals, pc. 24, and frame, pc. 1, of the Type N contact maker is not satisfactory.

(c) The sensitive bulb, pc. 14, of the Type N contact maker is of unidentified material and is sealed with solder at the end which is inserted in the engine cooling system. These dissimilar metals can, under unfavorable conditions, cause electrolysis and result in the failure of the seal.

(d) The operating point of the Type N, Class I, contact maker changed 4.2°F. as a result of the shock and vibration tests. This exceeds the 2.5°F tolerance of the specification.

10. The Type N, Class I, remote-switching contact maker checks with manufacturer's drawing, reference (e). However, the construction and materials of the sensitive element, pc. 14, and compensating elements, pc. 13, are not given.

11. The drawing, reference (d), forwarded by Inspector of Naval Material, New York, does not cover the modification to prevent pulsation. This change was partly covered by a later drawing of the same number forwarded by the manufacturer with a description of the modification.

TABLE 1

Type L - Class I - Contact Maker

Operating Points During Tests (Lbs./sq.in.)

Condition and Ambient Temperature	Contacts Closed	Contacts Opened	Differential
At start of test: at 77°F.	5.60	5.65	0.05
at 42°F.	5.45	5.65	0.20
at 95°F.	5.60	5.70	0.10
at 158°F.	5.60	5.80	0.20
After endurance at 68°F.	5.7	5.75	0.05
After shock test at 68°F.	5.7	5.8	0.10
After vibration test at 68°F.	5.67	5.82	0.15
After overpressure test at 68°F.	5.8	5.95	0.15

NOTE: Estimated accuracy of pressure gauge is ±0.1 lb.

TABLE 2

Type N - Class I - Remote Switching Contact Maker

Condition	Ambient Temperature °F.	Operating Point at .1-.2°F/min. °F.	Change from Original Operating Point °F.	Operating Point at 5°F/min. °F.	Lag in °F.	Total Change from Original Operating Point °F.
At start of test.	105	157.9	---	159.5	1.6	+1.6
	50	155.8	-2.1	157.9	2.1	0
	72	156.8	-1.1	159.1	2.3	+1.2
	158	157.6	-.3	159.3	1.7	+1.4
After endurance and hydrostatic tests.	76	158.0	+.1	---	---	+.1
After shock and vibration tests.	76	153.8	-4.2	---	---	-4.1
OFF Point after shock and vibration tests.	76	151.4 (2.4° differential)	---	---	---	---

NOTE: Results given are the average of 5 readings. Individual readings showed but little variation. Most of this was believed due to variations in the test equipment.

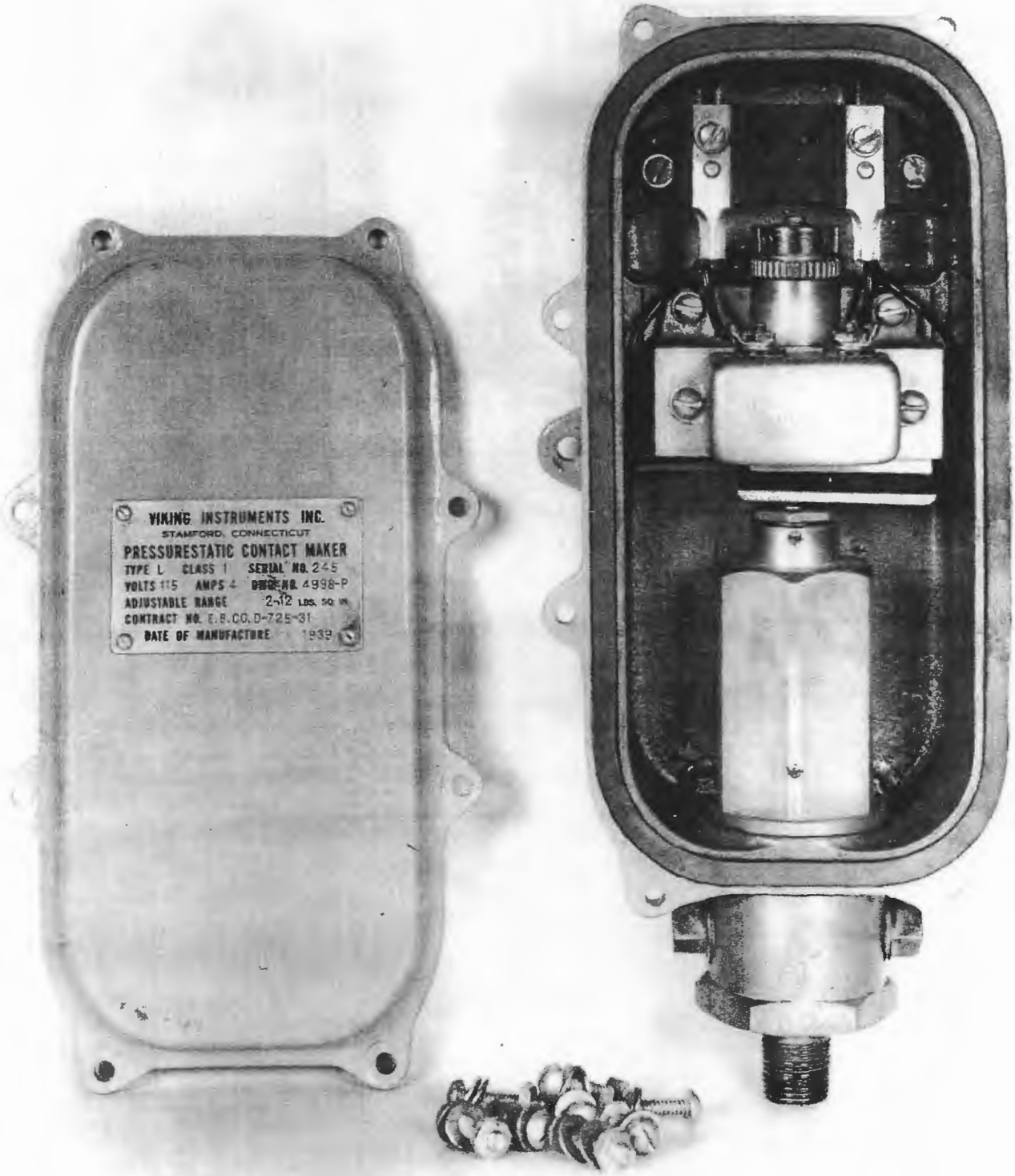
VIKING INSTRUMENTS INC.
STAMFORD, CONNECTICUT
PRESSURESTATIC CONTACT MAKER
TYPE L CLASS 1 SERIAL NO. 245
VOLTS 115 AMPS 4 DWG. NO. 4998-P
ADJUSTABLE RANGE 2-12 LBS. SQ. IN.
CONTRACT NO. E.B.CO.D-725-31
DATE OF MANUFACTURE 1939

Plate 1

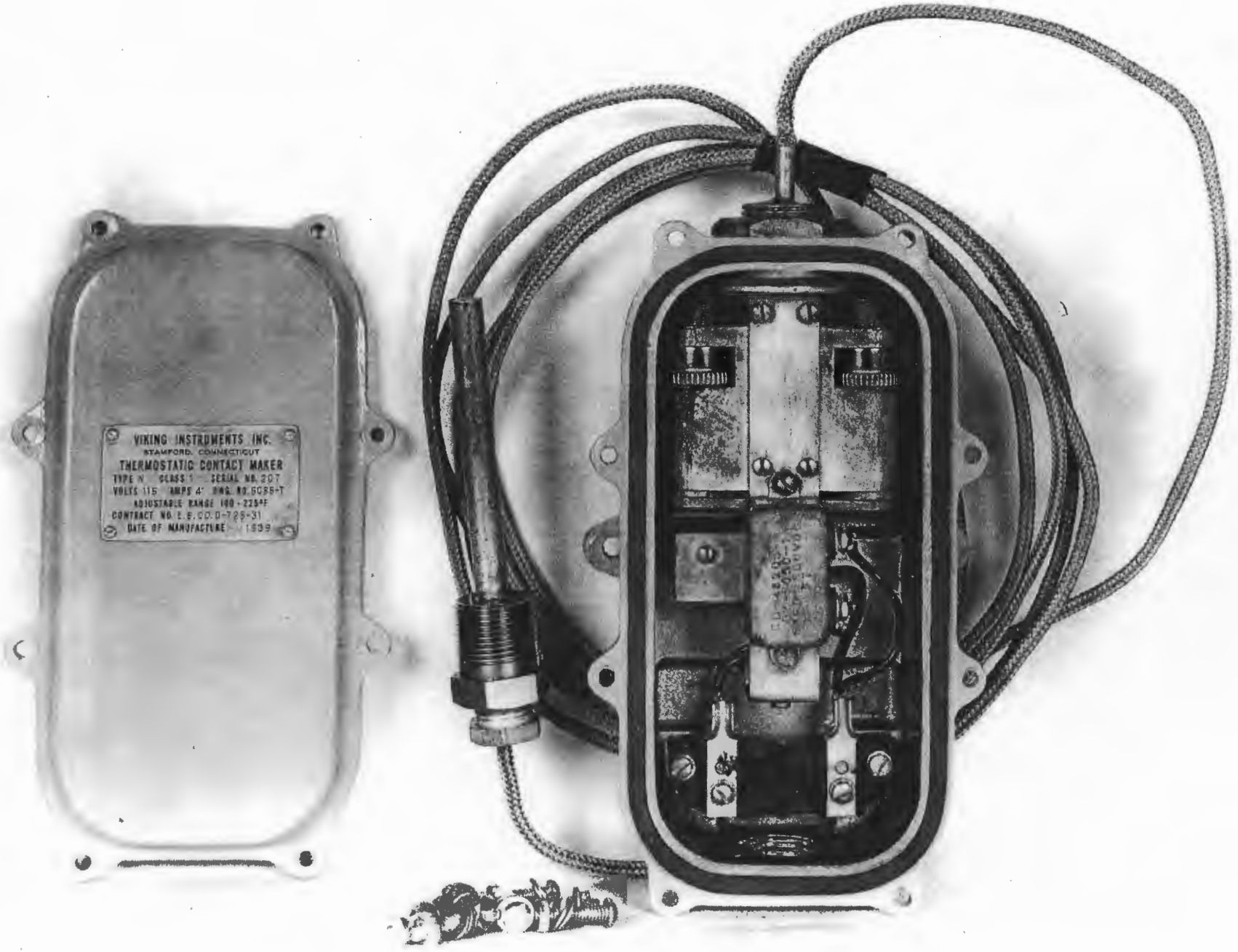
VIKING INSTRUMENTS INC.
STAMFORD, CONNECTICUT
THERMOSTATIC CONTACT MAKER
TYPE N CLASS 1 SERIAL NO. 207
VOLTS 115 AMPS 4 DWG. NO. 5085-T
ADJUSTABLE RANGE 180 - 225°F
CONTRACT NO. E.S.C.D. 0-726-31
DATE OF MANUFACTURE 1939

Plate 2