

NRL Report No. B-1184
Switch - Door Operated - Type IV
Manufactured by Portsmouth Navy Yard.

REPORT NO. B-1184

DATE 20 August 1935

FR-1184

SUBJECT

Switch - Door Operated - Type IV

Manufactured by

Portsmouth Navy Yard.



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NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report of Test

on

Switch - Door Operated - Type IV

Manufactured by

Portsmouth Navy Yard.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

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AUTHORIZATION

1. This test was authorized by reference (a) and another additional reference pertinent to this problem is listed as reference (b).

Reference: (a) BuEng. ltr. S62-2(S)/L5 of 5 July 1935.
(b) BuEng. Drwg. 9-S-4811-L. Alt. 0.

OBJECT OF TEST

2. The object of this test was to determine the suitability of the switch for the Naval Service, as a device for operation of battle lights, located in the compartments above decks, and its conformance with reference (b) and the usual specifications for Interior Communication equipment.

ABSTRACT OF TEST

3. The door switch, as received for test, was set up at this Laboratory in a test circuit under its rated load and voltage, specified in reference (b), and closely observed for its operating characteristics and conformance with the usual specifications required for Interior Communication equipment.

(a) Conclusions

This door switch, as manufactured by the Portsmouth Navy Yard, under suitability tests for the Naval Service proved to be satisfactory in all instances with the exception of the required endurance test of 50,000 operations, at the rate of 10 operations per minute, under rated load and voltage. However, if modified in accordance with "COMMENTS," paragraph 25, the subject material would be satisfactory for use in the Naval Service.

(b) Recommendations

It is recommended that this material be approved for use in the Naval Service subject to correction of defect, noted under "COMMENTS," paragraph 25 of this report.

DESCRIPTION OF MATERIAL UNDER TEST

4. The door switch is enclosed in a cast aluminum alloy watertight case, provided with two bosses for accommodating standard Navy terminal tubes, one boss embodying packing gland assembly for lever arm shaft and four lugs for mounting. By removing the watertight cover secured to the case with eight 10/24 round head, steel machine screws equipped with nuts and washers, cadmium plated, all parts of the switch can be easily reached.

5. The unit consists of a two-pole, single throw switch, having each pair of contacts shunted with a 0.5 mfd. condenser equipped with flexible leads and enclosed in a cylindrical metal case.

6. The switch embodies four contacts, two stationary and two movable. The coin silver stationary contacts are of the spring-mounted plunger type and provided with shunts for preventing the springs from carrying the greater part of the current.

7. Each stationary contact is enclosed in a cylindrical tube which is an integral part of the brass strip to which the line terminal is attached. Six terminals are secured to a molded phenolic insulating base of an approved design.

8. The movable contacts are also of coin silver but are rigidly mounted on a molded phenolic insulating block which, in turn, is mounted to the lever arm. Their respective terminal screws are connected to these contacts with flexible lead wires.

9. The lever arm is attached to the shaft which extends through a packing gland into the case and is provided with a bearing in a cast projection in the opposite side.

10. The switch is held in the open position by a coil spring, encircling the shaft and bearing against an internal boss on the case.

11. The operating lever is secured to the external end of the shaft by means of a steel tapered pin and is provided with two fixed stops to limit its travel.

12. When installed as a door operated switch, the switch opens the lighting circuits when the watertight door is opened. When the door is closed, the operating lever moves the contact lever arm down, the upper contacts forcing the lower contacts into their holders for approximately 0.06, thereby assuring good contact, especially when subjected to shock.

13. The total weight of the switch is 3 pounds and 10 ounces.

14. For details of switch design, see Bureau of Engineering Drawing 9-S-4811-L-Alt.0.

15. A schematic wiring diagram of the test circuit is shown on Plate 2.

METHOD OF TEST

16. The subject switch as received from the Bureau was first tested for the required 50,000 operations at the specified non-inductive load of 5 amperes, 120 volts, a.c., 60 cycles. The switch, during this test, was operated at the rate of 10 operations per minute by means of a motor-operated plunger. A Veeder counter, attached to the operating shaft recorded the number of operations.

17. Upon failure of the original lead wires, during the required 50,000 operations, the test was stopped and two "Belden Braid" copper leads (1624 cm) were substituted. The test was then resumed and was continued until the switch had operated 65,000 times at its rated load, with the new leads installed.

18. Next, the switch was placed on a Bureau of Engineering shock stand and tested for ruggedness and operating characteristics while under shocks of 250 foot pounds. During this test, the switch was connected in the circuit under the same conditions as when tested for the required 50,000 operations. It was mounted on the shock machine panel in the vertical plane, four inches below the point of impact of the shock. The shocks tended to move the switch away from the panel.

19. The complete unit was then placed, for a period of two hours, in a compartment having a constant temperature of 150°F, specified in reference (b), to determine any abnormal changes in the capacities of the condensers or leakage of the impregnating compound from the condenser containers.

20. Each condenser was then subjected to a potential of 500 volts, d.c., for a period of 5 seconds, applied between the terminal to determine its dielectric strength.

21. Following this, all of the current carrying parts were tested for their insulation resistance and dielectric strength.

22. The unit was then assembled and placed in a tank of salt water to a depth of 3 feet, for a period of 12 hours, to determine its watertightness.

23. The test was concluded with a careful inspection of the materials, workmanship, and general assembly of the equipment.

RESULTS OF TEST

<u>24.</u>	<u>Specifications</u>	<u>Requirements</u>	<u>Test Results</u>
	Voltage	120 volts	120 volts
	Current	Alternating	Alternating
	Frequency	60 cycle	60 cycle

<u>Specifications</u>	<u>Requirements</u>	<u>Test Results</u>
Contact load	5 amperes, non-inductive.	5 amperes, non-inductive.
Endurance	Shall withstand 50,000 operations at the rate of 10 operations per minute, under rated load and voltage.	First failure occurred after 3,000 operations. Second failure occurred after 3,300 operations. Both failures were due to the use of unsuitable flexible lead wires.*
Shock test	Switch shall be capable of withstanding 20 blows of 250 ft.lbs.each, while mounted in the vertical plane. Switch to be tested in both the open and closed position.	Shocks applied as specified. Lights did not flicker under this test nor were any parts broken.
Stability of condensers at over-temperature.	No abnormal changes shall occur in the capacity of the condensers, or leakage of compound from their containers, when exposed to a temperature of 150°F.	An average increase of 0.025 mfd. occurred in the capacities, but no leaks occurred in the condenser containers.
Condenser over-voltage test.	Condenser shall be capable of withstanding 500 volts, d.c., for a period of 5 seconds without injury.	Specified voltage applied without injury to condensers.
Insulation resistance.	Shall not be less than 5 megohms between any electrical part to ground when measured with a 1000 volt megger.	All measurements showed that the units tested have an insulation resistance of approximately 200 megohms.
Dielectric.	Shall be capable of withstanding 1240 volts, a.c., 60 cycle, applied for one minute between all current carrying parts and case without breakdown occurring.	Specified voltage applied and no breakdown occurred.

<u>Specifications</u>	<u>Requirements</u>	<u>Test Results</u>
Watertight integrity.	Complete unit shall be watertight after having been submerged in salt water to a depth of 3 feet for a period of 12 hours.	Test satisfactory, no leaks occurring.
Condenser.	Shall have a capacity of 0.5 mfd.	Average of two condensers 0.475 mfd.
Contact material.	Coin silver.	Coin silver.
Force required to operate switch.	Not greater than 2 lbs. 8 oz.	2 lbs. 8 oz.

* Denoted failure to comply with specifications.

COMMENTS ON RESULTS OF TEST

25. The switch under test for endurance failed to withstand the required 50,000 operations due to the use of unsuitable lead wires, connecting the stationary terminals to the movable contacts. One lead wire broke after 3,000 operations, the other broke after 3,300 operations. However, this defect was corrected by substituting two "Belden Braid" flexible leads (1624 cm) siezed with No. 40 cotton thread from each end and entirely covered with black lacing twine. With this modification the switch operated satisfactorily 65,000 times under its rated load and voltage without failures occurring.

26. The coin silver contacts, at the conclusion of the test, were in good condition and showed no excessive pitting.

27. Under shocks of 250 foot pounds, the switch proved to be rugged and maintained its circuit at the instant the shock was applied. With the switch open and the lamp circuit energized shocks of 250 foot pounds did not close the switch momentarily.

28. For the Bureau's information, the subject switch, equipped with the "Belden Braid" lead wires which satisfactorily withstood 65,000 operations without failures occurring, is being delivered to the Bureau.

CONCLUSIONS

29. This door switch, as manufactured by the Portsmouth Navy Yard, under suitability tests for the Naval Service proved to be satisfactory in all instances with the exception of the required endurance test of 50,000 operations at the rate of 10 operations per minute under rated load and voltage. However, if modified in accordance with "COMMENTS," paragraph 25, the subject material would be satisfactory for use in the Naval Service.

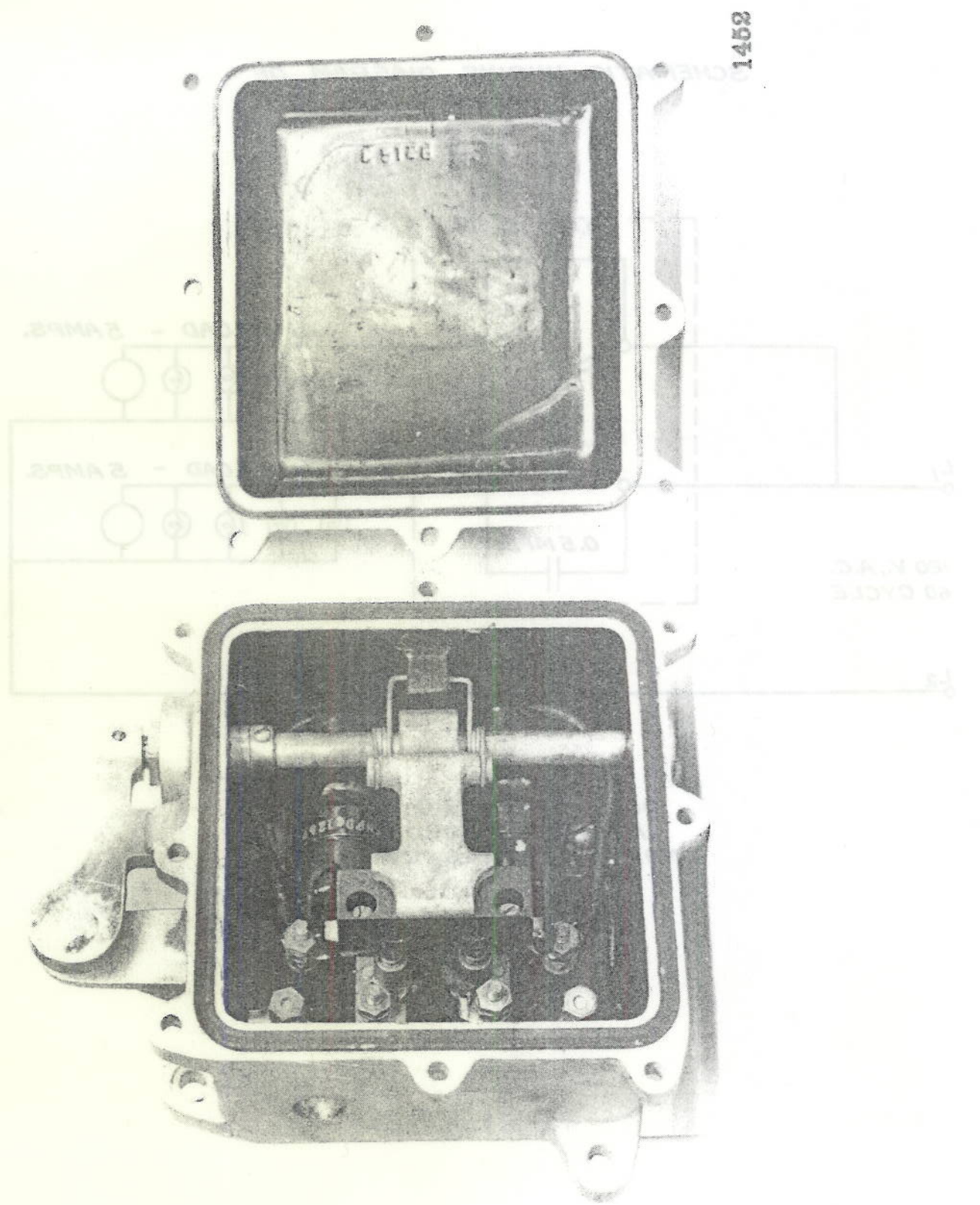
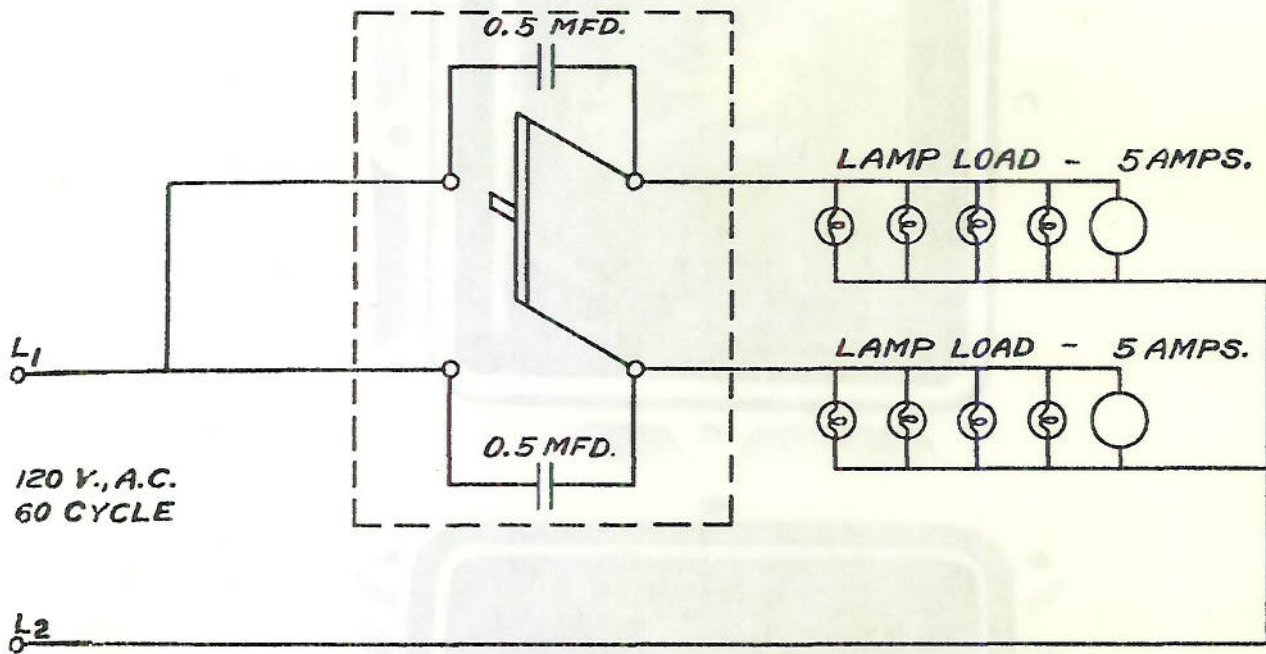


PLATE 5

Plate 1

**SCHEMATIC WIRING DIAGRAM OF
TEST CIRCUIT**



**DOOR OPERATED SWITCH
MANUFACTURED BY
PORTSMOUTH NAVY YARD.**