

Report No. R-1025  
Test of "Agastat" Time Delay Relay.

FR-1025

REPORT NO. R-1025

DATE 12 February 1934

SUBJECT

REPORT ON TEST OF "AGASTAT" TIME DELAY RELAY

*SB7/24/35 2-12*



BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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*Problem  
M13-1*

867/24(480b)

FR-1035

SEP 30 1942

From: The Chief of the Bureau of Ships.  
To: The Director, Naval Research Laboratory, Anacostis, D.C.  
SUBJECT: Radio - Bureau of Ships Problem M13-1, Closing of.

Reference:

- (a) BuShips ltr. 867/24(480K) of Feb. 17, 1942 to NRL.
- (b) NRL ltr. report 867/24 of May 14, 1942 to BuShips.

1. Subject problem, having been completed and reported, is hereby closed.

A. B. Chamberlain  
By Direction of /  
Chief of Bureau

Distribution Unlimited

Approved for  
Public Release

S67/24(480-K)

X-367/66

*McKesson*  
*Reilly*  
Kr-Ka-H-480-eju

5/9/42

MAY 8 1942

From: The Chief of the Bureau of Ships.  
To: The Director, Naval Research Laboratory,  
Anacostia, D. C.

SUBJECT: Radio - Switches, Antenna - Two Sample Switches  
Submitted by Powercraft Corporation, St. Louis,  
Missouri, Manufacturer - Test of Two Switch-  
Handle Insulators for Above - Problem Number  
M-13-1 To Cover Testing.

Reference:

- (a) BuShips ltr. S67/24(480-K) dated February 14, 1942 to NRL forwarding two samples of Powercraft Corporation Antenna Switch, Cat. No. B-338, for tests and BuEng. Dwg. RE-61AA-249F, dated July 23, 1941.
- (b) NRL ltr. report S67/24, TDH:rb, dated February 25, 1942 to BuShips covering tests of above switches.
- (c) BuShips ltr. S67/24(480-K) dated March 6, 1942 to Powercraft Corporation forwarding information contained in reference (b).
- (d) Powercraft Corporation ltr. to BuShips dated May 1, 1942 confirming the forwarding to BuShips of two switch-handle insulators.

Enclosure:

- (A) (s.c.) One (1) carton containing two switch-handle insulators for type BB Cat. No. B-338 Powercraft "Silver Ball" Antenna Switches.

1. It is suggested that enclosure (A) be tested to ascertain whether the new design insulator eliminates the internal corona found to exist when the former type of insulator was used, and described in paragraph 2 of reference (b), and determine whether the new design insulator is suitable for use with the aforementioned switch in conjunction with the Navy Model TAQ series of radio transmitting equipments.

2. Problem No. M-13-1 with priority AAA will cover the conducting of the above described tests.

L. J. McKesson  
By direction

- - -

S67/24(480-K)

Enclosure 1

From: The Chief of the Bureau of Ships.  
 To: Powercraft Corporation,  
 103 Park Avenue, New York, N. Y.  
 Attention: M. Malcolm Mac Gregor

VIA: INSPECTOR OF NAVAL MATERIAL,  
 30 Church Street, New York, N. Y.

SUBJECT: Radio - Report on Test of Two Sample Antenna Switches  
 Submitted by Powercraft Corporation, St. Louis,  
 Missouri, Manufacturer - Test of Two Switch - Handle  
 Insulators for above - Approval of Switch Handle  
 Insulators.

## Reference:

- (a) Powercraft Corp. ltr. to BuShips dated May 1, 1942.
- (b) Powercraft Corp. ltr. to Buships dated May 5, 1942.
- (c) BuShips ltr. S67/24(480-K) dated March 6, 1942 to Powercraft Corporation, re: test of subject switches.

## Enclosure:

- (A) One copy of Naval Research Laboratory Report, Anacostia, D.C., to BuShips S67/24, TDH:st dated May 14, 1942.

1. The Bureau approves the new design switch-handle insulators for use with your Catalogue #B-338, Type BB switch in Navy shore radio installations where the radio frequency voltage does not exceed 40 kilovolts.

2. The Bureau does not approve your new design of catalog Number B-338, Type BB antenna switch, with new design switch handle insulators, for shipboard installations until mechanical modifications as outlined in paragraph 4 of enclosure (A) are met.

3. The use of the contents of this letter and enclosed report, either in whole or in part, for advertising or publicity purposes is not authorized.

- - -

## Copy to:

BuSanda, Washington, D. C.  
 RINSMAT, Railway Exchange Bldg., St. Louis, Mo.  
 INSMAT, Chicago, Ill.

S67/24

TDH:st

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D. C.

From: Naval Research Laboratory.  
To: Bureau of Ships.

Subject: Radio- Report on Test of Two Sample Antenna  
Switches Submitted by Powercraft Corporation,  
St. Louis, Missouri, Manufacturer - Test of  
Two Switch-Handle Insulators for Above -  
BuShips Prob. No. M-13-1.

## Reference:

- (a) BuShips ltr. S67/24(480-K) of May 8, 1942  
to NRL.
- (b) BuShips ltr. S67/24(480-K) of February 17, 1942  
to NRL.
- (c) NRL ltr. S67/24 of February 25, 1942 to BuShips.

1. In accordance with reference (a), the two sample antenna switches, manufactured by Powercraft and submitted to the Naval Research Laboratory by the Bureau of Ships, were subjected to tests with the new design switch-handle insulators to determine their suitability for use in conjunction with the Navy Model TAQ Series of radio transmitting equipments.

2. Voltage tests were conducted up to 52 kilovolts at 175 kc similar to those reported in reference (c). During the course of the tests there were no indications of internal corona in the switch-handle insulator. After the switch was subjected to 52 kilovolts at 175 dc for 10 minutes, the top of the switch-handle insulator became only slightly warm. Therefore, the new design switch-handle insulators may be considered satisfactory for use with these switches in conjunction with the TAQ Series of radio transmitting equipments.

3. Since these new design switch-handle insulators weigh approximately twice as much as the original design insulators, tests were made again to ascertain the suitability of these switches when subjected to shock and vibration. On shock, when subjected to momentary peak accelerations of approximately 250 g, there was no tendency for the switches to leave their positions. Vibration tests showed that in the open position the switch showed no tendency to unlock and close.

In the closed position the switch still creeps open, although not as rapidly as before, due to the increased weight of the switch-handle insulators. It is recommended that detents be incorporated in the switch tip to eliminate this trouble.

4. The above tests indicate that both switches are suitable for use with Model TAQ Transmitters from a voltage breakdown and corona standpoint. For shipboard installations, mechanical modifications are still necessary to prevent the switches from creeping open under vibration and to eliminate excessive vibration and wear in the switch-handle pull-out mechanism.

5. The switch-handle insulators are being held at the Naval Research Laboratory subject to the Bureau of Ships' orders.

R. J. Walker,  
By direction.

*Problem  
File*

No-K-H-480-hcc

2-16-42

X-567/66

17

**From:** The Chief of the Bureau of Ships.  
**To:** Director, Naval Research Laboratory.  
**SUBJECT:** Radio - Switches, Antenna - Test of Two  
 Sample Switches Submitted By Powercraft  
 Corporation, Saint Louis, Missouri, Manu-  
 facturer - Assignment of Problem Number  
 N-13-1 To Cover Testing.

**ENCLOSURE:**

(A) (a.o.) Two (2) boxes each containing one sample  
 of Powercraft Corporation Antenna Switch  
 Catalog No. B338, Type S.S., Apparas -  
 200, Volts 15000.

(B) (h.v.) Bureau of Engineering Drawing NE-61AA-249F  
 revision "F" dated July 28, 1941.

1. Enclosure (A) was submitted to the Bureau  
 by the manufacturer for inspection and test in connection  
 with the possible procurement and use of the subject  
 type of antenna switch by various interested Navy radio  
 activities.

2. It will be noted that the sample switches  
 have been submitted with dummy insulators supporting  
 the switch blade and stationary contact, and Navy type  
 61176 stand-off insulators as shown on enclosure (B)  
 should be substituted therefor. Two samples of this  
 type of insulator are available at the Bureau if required  
 by the Laboratory for this application. It will also  
 be noted that one sample switch has fewer exposed sharp  
 edges on its mechanism than does the other, and that both  
 switches have silver inserts at several of the contact-  
 ing surfaces to provide a low resistance junction.

3. It is suggested that the Laboratory conduct  
 tests on the two sample switches to determine their

667/22(480-A)

*Problem  
File*

480b

✓  
Ka-K-R-480-hcc

2-16-42

17

X-667/66

From: The Chief of the Bureau of Ships.  
To: Director, Naval Research Laboratory.

SUBJECT: Radio - Switches, Antenna - Test of Two  
Sample Switches Submitted By Powercraft  
Corporation, Saint Louis, Missouri, Manu-  
facturer - Assignment of Problem Number  
N-13-1 To Cover Testing.

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2. It will be noted that the sample switches  
have been submitted with dummy insulators supporting  
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type of insulator are available at the Bureau if required  
by the Laboratory for this application. It will also  
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switches have silver inserts at several of the contact-  
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3. It is suggested that the Laboratory conduct  
tests on the two sample switches to determine their

12 February 1934

Report No. R-1025  
Bu.Eng No. MI3-1

NAVY DEPARTMENT  
BUREAU OF ENGINEERING

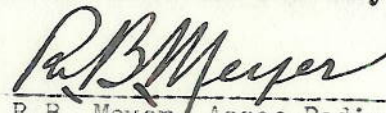
REPORT ON

Test of "Agastat" Time Delay Relay.

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D.C.

Number of Pages: Text - 4      Tables - 4  
Authorization: BuEng.let. S67/24/L5(9-2-W8) of 1 February 1934.  
Date of Test: Tests conducted February 5, 1934, to February 8, 1934.

Reported by:



R.B. Meyer, Assoc. Radio Engr.



R.A. Gordon, Asst. R. Engr.

Approved by:



H.R. Greenlee, Captain, USN,  
Director.

Distribution:

BuEng. (5)

## AUTHORIZATION

1. The test of the "Agastat" time delay relay manufactured by the American Gas Accumulator Company was authorized by the Bureau of Engineering on 1 February, 1934, letter S67/24/L5(9-2-W8) to the Director, Naval Research Laboratory.

Reference: (a) BuEng.let. S67/24/L5(9-2-W8) of 9/6/33 to NRL.  
(b) NRL Test Report RE-1007 dated 9/25/33.  
(c) BuEng.let. S67/24/L5(9-2-W8) of 2/1/34 to NRL.

## OBJECT

2. The object of the test was to determine:
- (a) The suitability of the "Agastat" relay for Naval use.
  - (b) The effects of temperatures in excess of 35° C. upon the operation of the relay, a previous relay having failed to operate at temperatures above 35° C. as reported in ref.(b).
  - (c) The effects of temperature increase on the resistance of the relay coil to determine if the gas or the magnet coil was affected primarily to cause the failure of the relay.

3. The performance of the materials under test may be summarized as follows:

- (a) The "Agastat" relay functioned satisfactorily over a range of temperatures of 4° C. to 60° C. At temperatures in excess of 60° C. the action of the relay was irregular and not considered satisfactory.

Note: Due to the limitations of the refrigerating system used in these tests, a temperature of 0° C. could not be obtained.

4. In view of the test results it may be concluded that:

- (a) The "Agastat" relay in the form in which it was resubmitted is suitable for Naval use in locations where the ambient temperature does not exceed 60° C.
- (b) It may be assumed that the "Agastat" relay will function successfully at temperatures down to 0° C. since no sign of failure was detectable when operating at a temperature of 4° C.

## RECOMMENDATIONS

In view of the facts determined from this test it is recommended that the Bureau approve of the "Agastat" relay for use in Naval radio transmitting equipment providing the following modifications are made:

- (a) That the coil supports be secured by means of brass screws and lock nuts or lock washers so that the coil may readily be removed for replacement.
- (b) That the parts used in the fabrication of the relay be made of non-corrosive materials or that the materials used be so treated as to prevent corrosion or rust.

The relay is of type "A" and is recommended for use in the following dimensions:

Width 2-1/2"  
Depth 2-1/2"  
Height 3"

- (1) The contacts of the "Agastat" relay are of silver and are of sufficient size to carry the rated current (6 amperes) without heating. This was determined from the fact that no contact trouble was experienced during the test in which the relay was broken 5165 times.
- (2) The relay case is of steel, as are also the mounting studs and coil supports. The exterior of the case was finished with a coating of baked crystalline lacquer. The interior of the case had no protective coating and showed some signs of rust. The various parts of the assembly are in general riveted together which precludes the possibility of removing the relay coil for repair without considerable difficulty. The contacts, however, can be removed readily for replacement.
- (3) The gas chamber is of brass while the flexible membrane appears to be treated leather, or some special fabric closely resembling leather. The timing of the relay is not readily adjustable after it is received from the manufacturer.

7. The circuit used in test of the relay was identical with that used with the first sample relay and is illustrated in Figure 11, 100(1).

8. Tables No. 1, 2 and 3, appended hereto, are a record of tests of the "Agastat" relay. In these tests an auxiliary relay was used to break the coil circuit of the "Agastat" relay and a test circuit was so connected as to cause the contacts of the relay to break the full rated load of 6 amperes. The timing was checked approximately every fifteen minutes by means of a solenoid operated plunger in conjunction with a stopwatch. Reference is further had to Tables 1, 2 and 3 which show that the "Agastat" relay functions satisfactorily between the

## MATERIALS UNDER TEST

5. The materials under test were a sample "Agastat" time delay relay manufactured by the American Gas Accumulator Company.

- (a) This relay is the second sample to be submitted for test, the first sample being rejected as unsatisfactory as previously mentioned and reported in ref.(b).

## METHOD OF TEST

6. The "Agastat" relay was subjected to a careful inspection and the following facts were noted:

- (a) The relay is of rugged and compact construction and is of the following dimensions:

Width	2-1/2"
Depth	2-1/2"
Height	5"

- (b) The contacts of the "Agastat" relay are of silver and are of sufficient size to carry the rated current (6 amperes) without heating. This was determined from the fact that no contact trouble was experienced during the test in which the load was broken 5165 times.
- (b) The relay case is of steel, as are also the mounting studs and coil supports. The exterior of the case was finished with a coating of baked crystalline lacquer. The interior of the case had no protective coating and showed some signs of rust. The various parts of the assembly are in general riveted together which precludes the possibility of removing the relay coil for repair without considerable difficulty. The contacts, however, can be removed readily for replacement.
- (d) The gas chamber is of brass while the flexible membrane appears to be treated leather, or some special fabric closely resembling leather. The timing of the relay is not readily adjustable after it is received from the manufacturer.

7. The circuit used in test of the relay was identical with that used with the first sample relay and is illustrated in Plate II, ref.(b).

8. Tables No. 1, 2 and 3, appended hereto, are a record of tests of the "Agastat" relay. In these tests an auxiliary relay was used to break the coil circuit of the "Agastat" relay and a load circuit was so connected as to cause the contacts of the relay to break the full rated load of 6 amperes. The timing was checked accurately every fifteen minutes by means of a solenoid operated plunger in conjunction with a stopwatch. Reference to Tables No. 1, 2 and 3 shows that the "Agastat" relay functions satisfactorily between the

ambient temperatures of 4° and 60° C. At 65° C. and above, the relay makes intermittent contact.

9. Table No. 4, appended hereto, is a record of an additional test of the "Agastat" relay. This test was to determine what effect the increase of ambient and coil temperatures had on the resistance of the solenoid coil. A condition of continuous operation was given the relay for this test, that is, the relay coil was energized continuously during the test, the break feature not being utilized. Reference to Table No. 4 shows that for an ambient temperature of 65° C. and the coil temperature of 92° C. that the magnetizing current of the coil had been reduced .006 amperes. Thus, with an ambient temperature increase of 231%, and a coil temperature increase of 373%, the magnetizing current was reduced 9%. Thus, the voltage energizing the coil being of a constant value and the energizing current being reduced by temperature effect 9%, the increase of the resistance of the coil was 10.3%, this is not considered as being unwarranted and is believed to be well within operating characteristics for this type of coil.

10. The results of the test for temperature effect on the coil indicates that the failure of the relay to make contact at temperatures in excess of 60° C. is due to expansion of the gas in the plunger chamber.

#### DATA RECORDED

11. Tables No. 1, 2 and 3 record the data obtained during tests to determine the effect of variations in ambient temperature upon the "Agastat" relay. Table No. 4 covers the test conducted to determine the effect of increased temperature upon the **resistance** of the solenoid coil of the relay.

#### DISCUSSION OF PROBABLE ERRORS IN RESULTS

12. All practicable precautions were taken to eliminate errors from the results of the test. The timing cycle was checked by means of an electrically operated plunger actuating a stopwatch. Thermometers, whose calibrations had been checked, were used for determining the ambient temperature and coil temperature. A magnetic counter was used to record the number of breaks made by the relay contacts and an accurate ammeter was used to adjust the load broken by the relay contacts. An accurate voltmeter and milliammeter were used to record the voltage across the relay coil and the magnetizing current flowing through the coil. When it was discovered that the "Agastat" relay operated intermittently at 65° C., several checks were made at this temperature in order to verify the results.

#### RESULTS

13. The results of the test indicate that the "Agastat" relay will give satisfactory operation at temperatures as high as 60° C.

14. A feature of the "Agastat" construction is its small size which would permit its being mounted in more restricted locations than is possible with other commercial type relays.

DISCUSSION

15. The tests conducted with the two "Agastat" relays submitted indicate that extreme care must be exercised in the manufacture of the units to prevent too great an amount of gas from being introduced into the control chamber. In order that no danger be incurred from the use of this type of relay in the Naval Service, it is believed that all relays should be capable of successful operation at temperatures up to 70° C.

Time	Temperature, degrees C.	Time	Temperature, degrees C.
1030	15.5	11	15
1043	15.8	12	15
1100	15.0	13	15
1115	22.0	14	15
1130	23.0	15	15
1145	15.0	16	15
1200	30.0	17	15
1215	30.0	18	15
1230	31.0	19	15
1245	31.2	20	15
1300	33.6	21	15
1315	37.2	22	15
1330	38.3	23	15
1345	43.0	24	15
1400	51.2	25	15
1415	53.0	26	15
1430	50.0	27	15
1445	52.5	28	15
1500	54.0	29	15
1515	54.2	30	15
1530	54.4	31	15
1545	55.1	32	15
1600	54.5	33	15
1615	50.0	34	15

TABLE No. 1

Test Record of "Agastat", 115 volt, 60 cycle, Time Delay Relay.

Timing - 15 second. Contacts breaking 6 amperes.  
(5 February 1934).

Time	Ambient Temperature, Degrees C.	Time Cycle Seconds	Number of Breaks
1030	15.5	15	0
1045	15.8	15	65
1100	15.9	15	119
1115	22.0	15	179
1130	23.0	15	234
1145	26.0	15	304
1200	32.0	15	360
1215	32.0	15	417
1230	31.0	15	450
1245	34.2	15	516
1300	33.6	15	575
1315	37.2	15	634
1330	39.3	15	692
1345	43.0	15	754
1400	51.2	15	813
1415	53.0	15	874
1430	50.0	15	921
1445	52.5	15	1001
1500	54.0	15	1070
1515	54.2	15	1127
1530	54.4	15	1193
1545	55.1	15	1249
1600	54.5	15	1312
1615	54.0	15	1344
1630	4.0	13.5	3052
1645	4.0	13.5	3114
1650	4.0	13.5	3175

\*Timing cycle changed to 14 seconds between 11.5° and 14.0° C.

\*\*Timing cycle changed to 13.5 seconds between 4.1° and 4.5° C.

TABLE No. 2

Test of "Agastat", 115 volt, 60 cycle, Time Delay Relay.

Timing - 15 seconds. Contacts breaking 6 amperes.  
(6 February 1934)

Time	Ambient Temperature, Degrees C.	Time cycle seconds	Number of breaks
930	20.0	15.0	1344
945	22.0	15.0	1410
1000	24.0	15.0	1482
1015	23.0	15.0	1541
1030	18.2	15.0	1601
1045	14.0	15.0	1668
1100	11.5	*14.0	1730
1115	10.0	14.0	1793
1130	8.5	14.0	1859
1145	8.0	14.0	1925
1200	7.0	14.0	1988
1230	6.0	14.0	2130
1245	5.5	14.0	2190
1300	5.2	14.0	2255
1315	5.0	14.0	2319
1330	5.0	14.0	2385
1345	4.6	14.0	2454
1400	4.5	14.0	2518
1415	4.5	14.0	2589
1430	4.1	**13.5	2650
1445	4.1	13.5	2718
1500	4.0	13.5	2783
1515	4.0	13.5	2848
1530	4.0	13.5	2914
1545	4.0	13.5	2982
1600	4.0	13.5	3052
1615	4.0	13.5	3114
1630	4.0	13.5	3175

\*Timing cycle changed to 14 seconds between 11.5°  
and 14.0° C.\*\*Timing cycle changed to 13.5 seconds between 4.1°  
and 4.5° C.

TABLE No. 3

Test of "Agastat", 115 volt, 60 cycle, Time Delay Relay.

Timing - 15 seconds. Contacts breaking 6 amperes.  
(7 February 1934)

Time	Ambient Temperature Degrees C.	Timing cycle seconds	Number of breaks
900	49.0	15	3175
930	60.0	15	3400
1000	*65.0	15	3642
1030	54.0	15	3900
1100	51.0	15	4103
1130	45.0	15	4330
1200	48.0	15	4800
1230	51.0	15	4931
1300	54.5	15	5055
1330	**71.0	15	5165

\* Relay making intermittent contact before 65° C was recorded.

\*\* Relay making intermittent contact before 65° C was recorded and continuing intermittent contact up to maximum temperature of 71° C.