

1 August 1938

NRL Report No.B-1463

FR-1463

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report of Test

on

Samples of Horns, Types H-3, H-4
submitted by

Federal Electric Company
Chicago, Illinois

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UNLIMITED

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 7 Plates - 3
Authorization: BuEng.ltr. S65-4/L5(6-20-Ds) of 28 June 1938
Date of Test: July 1938
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Distribution:
 BuEng. (5)

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Photograph of both samples set up for test.	Plate 1
Photograph of type H-3 horn unit removed from case.	Plate 2
Photograph of type H-4 horn unit removed from case.	Plate 3

AUTHORIZATION FOR TEST

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

Reference: (a) Bueng. ltr. S65-4/L5(6-20-Ds) of 28 June 1938.
(b) Specifications 17S11(INT) of 15 February 1938.

OBJECT OF TEST

2. The object of this test was to determine conformance of the sample horns with specifications reference (b), and their suitability for Naval use.

ABSTRACT OF TEST

3. The sample horns were set up at this Laboratory in suitable test circuits 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 sample horns, manufactured and submitted by Federal Electric Company, Chicago, Illinois, failed to comply with the following requirements of the specifications, reference (b).

Type H-3

- (1) The nickel-chromium diaphragm was found fractured at the end of the endurance test.
- (2) The allowable temperature rise of the winding was exceeded by 6.2° C.
- (3) The case is tapped for 1/2-inch terminal tubes instead of 3/4-inch.
- (4) SICP wire is not used.
- (5) The brass trumpet threads into aluminum instead of steel.
- (6) The mounting bracket is not cast integral with the case.
- (7) Drain holes are not provided for the diaphragm chamber.

Type H-4

- (1) The allowable power consumption was exceeded by 5.6 watts.
 - (2) The case is tapped for 1/2-inch terminal tubes instead of 3/4-inch.
 - (3) SICP wire is not used.
 - (4) The brass trumpet threads into aluminum instead of steel.
 - (5) The mounting bracket is not cast integral with the case.
 - (6) Drain holes are not provided for the diaphragm chamber.
 - (7) The weight is 1 pound, 9 ounces in excess of that allowed.
- (b) These horns are of a type in which the entire unit must be free to vibrate for a satisfactory signal. When the horns were mounted rigidly, the sound pressure output dropped to a very low level, and the frequency was considerably lowered. Photograph, Plate 1, shows the samples set up, for endurance test. It will be noted that two of the mounting screws on the type H-4 horn were omitted in order to permit free vibration of the entire unit. The mounting for the type H-3 permitted free vibration but is not con-

sidered satisfactory. It is possible that these horns will be considerably damped by the installation of cables. To avoid this, the cables should enter the case at a point of minimum vibration.

(c) It is not known to what extent the sound characteristics will be affected if the usual drain holes are provided in the diaphragm chamber.

Recommendations

(a) It is recommended that the sample horns in their present form be not approved for Naval use, because of the deficiencies noted under "Conclusions" of this report.

DESCRIPTION OF MATERIAL UNDER TEST

4. The type H-3 horn, shown by Plates 1 and 2, was manufactured by the Federal Electric Company, Chicago, Illinois. It is of the vibratory type and is designed for 115 volts, direct current.

5. The mechanism is mounted on a removable cover, which is secured to the case by six machine screws. Both cover and case are of cast aluminum. The case is provided with two bosses, tapped for 1/2-inch terminal tubes. The horn is finished with gray paint over a coating of zinc chromate paint. A bracket, designed to permit free vibration of the horn, is provided for mounting.

6. The magnetic circuit consists of a three pole laminated core and a laminated armature. The armature is mounted on a supporting spring and is linked to the diaphragm by means of a bolt. A single form wound coil is provided.

7. The contacts are actuated by a nut located on the armature bolt and are protected by a 0.1 microfarad, 600 volt, paper condenser.

8. The coil can be replaced by disassembling the horn and removing the armature. The chassis is of formed steel, plated for resistance to corrosion.

9. The diaphragm is of inconel and vibrates at the amplitude of the armature.

10. The H-4 horn is identical to the H-3 except that it operates from 115 volts, a.c., 60 cycles due to a transformer which is provided to reduce the voltage to 8.5. The armature is not laminated. The contacts are protected by a 0.95 microfarad 1000 V metal-cased condenser.

METHOD OF TEST

11. The subject horns, as received, were first tested to obtain the electrical and acoustical characteristics. They were then placed on a standard Bureau of Engineering shock stand and subjected to 20 blows of 250 foot pounds each, under conditions specified in paragraph F-2g of the specifications.

12. They were next tested for resistance to vibration, on a Navy standard 3 foot pound vibration machine, and subjected to six tests, of 30 minutes each, at 100, 150, 200, 250, 300, and 350 blows per minute.

13. Following this, they were tested for endurance by operating them 1500 cycles, of "one minute on" and "one minute off", the first

half of the test at an ambient temperature of 60° C. and the second half at 0° C. During this test, the temperature rise of each horn was determined by the resistance method.

14. They were next tested for inclination, operation at over and under voltage and frequency, dielectric strength and insulation resistance, splashproof integrity, and resistance to corrosion.

15. The tests were concluded with an inspection of the horns for conformance with the specifications pertaining to design and quality of workmanship and materials.

RESULTS OF TEST

16. The test results obtained were as follows:

<u>Requirements</u>	<u>Test Values</u>	
	<u>Type H-3</u>	<u>Type H-4</u>
Voltage: 115 volts.	115 volts.	115 volts.
Current:	Direct	Alternating
Amperes: Not specified	0.31 Amps.	0.54 Amps.
Watts: Not over 40	36.65 V.A.	* 45.6 watts
Power factor: Not less than 40%.	- - -	73.4%
Weight: Not over 8 pounds	5 lbs, 1 ounce	* 9 lbs., 9 ounces
Pitch of Note: Shall be resonated so as to produce a signal easily distinguished from that of the Type H-1 and H-2 horns as specified in subparagraph E-4b.	700 C.P.S.	350 C.P.S.
Sound output: Shall be not less than 75 decibels at 18 ft. in a sound proof room.	75 db	84 db
Shock integrity: Shall withstand 20 blows of 250 foot pounds each, under conditions specified under paragraph F-2g.	Complied	Complied
Vibration tests: Shall be mounted on the Navy standard 3 foot pound vibration machine and subjected to six tests of 30 minutes each, at 100, 150, 200, 250, 300, and 350 blows per minute.	Operated satisfactorily during and after the tests.	Operated satisfactorily during and after the tests.

RequirementsTest ValuesType H-3Type H-4

Endurance: Shall be operated "one minute on" and "one minute off" for a period of 1500 cycles, the first half at an ambient temperature of 60° C. and the second half at 0° C.	*Operated satisfactorily during the test. Diaphragm was found fractured at end of the test.	Operated satisfactorily during the test.
Temperature rise: Shall not exceed 45° C. at any time during the endurance tests.	*51.2° C.	25.9° C. in vibrator coil. 30.6° C. in transformer winding.
Dielectric: Shall withstand a dielectric test of 1480 volts, 60 cycles, for a period of one minute.	Complied	Complied.
Insulation resistance: Shall not be less than 5 megohms, with 500 volt megger, after the dielectric test.	100 megohms	100 megohms
Dissimilar materials: Brass shall not be in contact with aluminum.	*The trumpets of both horns thread into aluminum covers.	
Wire: Type SICP shall be used.	*Not used	*Not used
Inclination: Shall operate in any position when supplied with $\pm 10\%$ rated voltage and frequency.	Complied	Complied
Splashproof integrity: Shall be splashed with a 1-inch stream of water, under a pressure head of 35 feet, played from a hose at a distance of 5 feet, for 5 minutes without any water entering the case.	Complied	Complied
Salt spray test: Shall be subjected, under ultra-violet light, to a 20% salt spray at 55° C. for a period of 3 minutes, followed by an air	Both samples complied except that the trumpet locknuts showed considerable rust.	

Requirements

Type H-3

Test Values

Type H-4

blast at 55° C. for 3 minutes, the cycle being repeated for a period of 100 hours. Shall show no serious corrosion and shall operate satisfactorily at the end of the test.

* Denotes failure to comply with the specifications.

CONCLUSIONS

17. The sample horns, manufactured and submitted by Federal Electric Company, Chicago, Illinois, failed to comply with the following requirements of the specifications, reference (b).

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18. These horns are of a type in which the entire unit must be free to vibrate for a satisfactory signal. When the horns were mounted rigidly, the sound pressure output dropped to a very low level, and the frequency was considerably lowered. Photograph, Plate 1, shows the samples set up for endurance test. It will be noted that two of the mounting screws on the type H-4 horn were omitted in order to permit free vibration of the entire unit. The mounting for the type H-3 permitted free vibration, but is not considered satisfactory.

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19. It is not known to what extent the sound characteristics will be affected if the usual drain holes are provided in the diaphragm chamber.

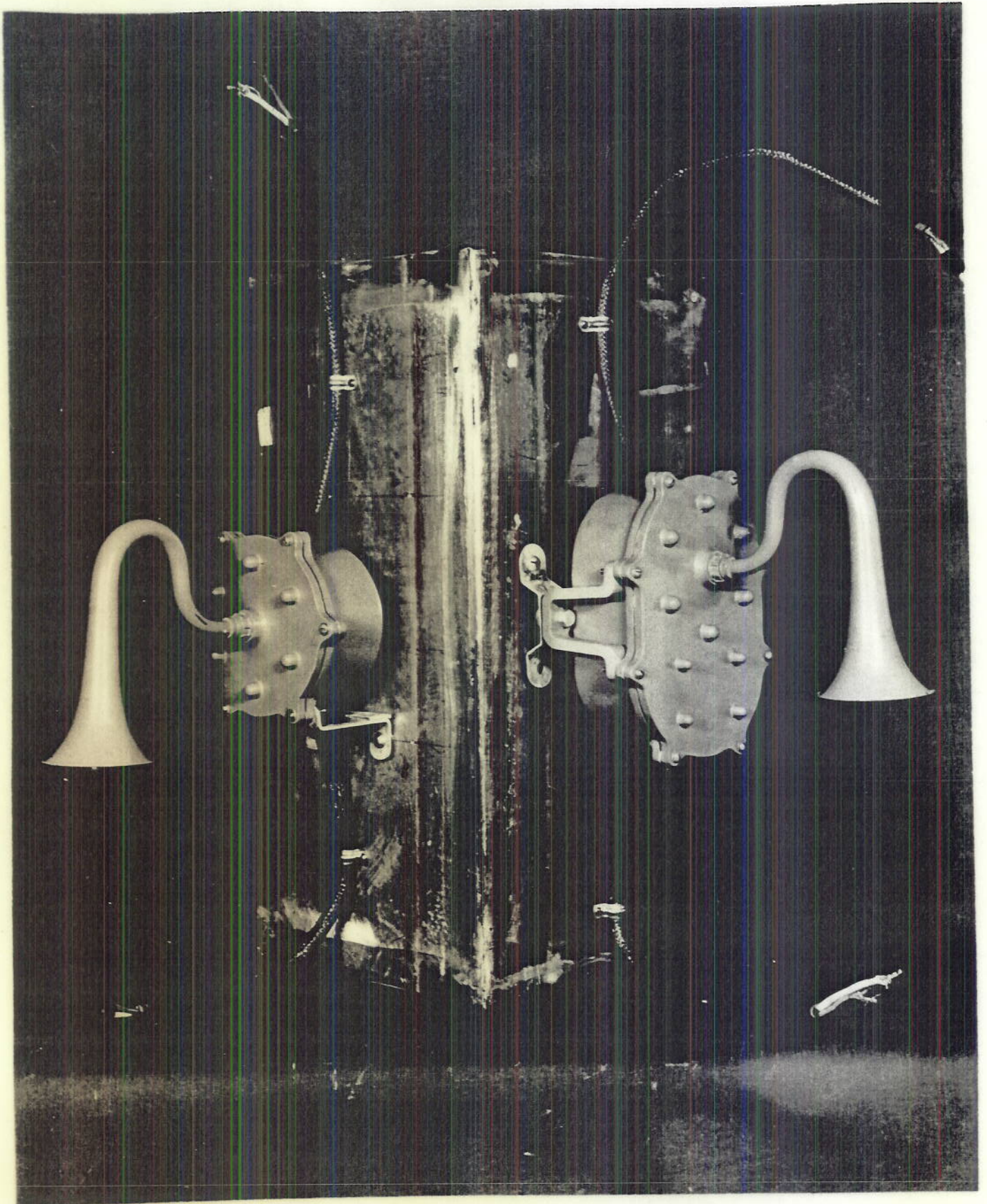
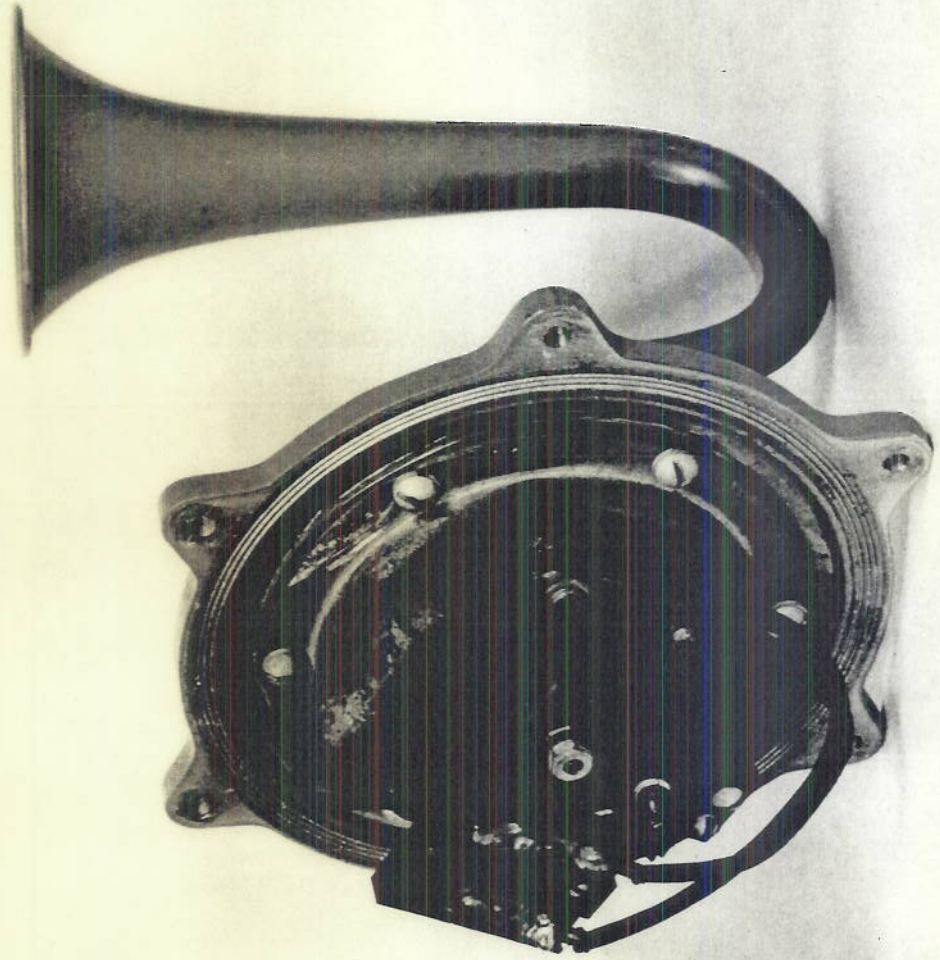
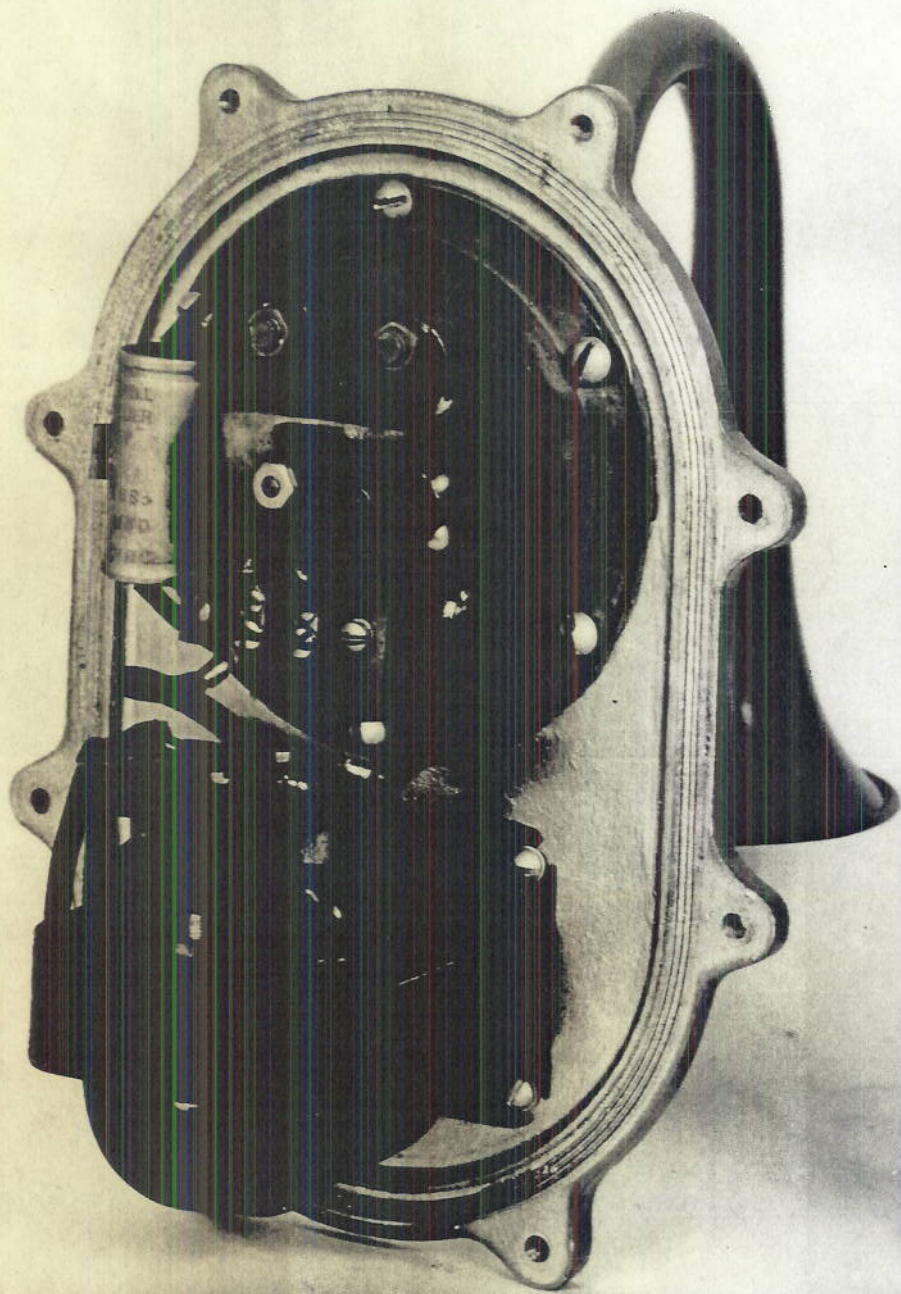


Plate 1



Type H-3



Type H-4