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BUREAU OF ENGINEERING  
NAVY DEPARTMENT

Report of

Test on Valve, Solenoid Operated,  
for Air Horns.

Manufactured and Submitted By  
Clark Cooper Company.

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D. C.

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Authorization: Bueng.let. CV5/S65(12-10-Ds) of 23 December 1935.

Date of Test: March 1936, to April 1936.

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AUTHORIZATION FOR TEST.

1. This test was authorized by reference (a) and other additional references pertinent to this problem are listed as references (b) and (c).

Reference: (a) Bu.Eng. ltr. CV5/S65-(12-10-Ds) of 23 Dec. 1935.  
(b) NRL ltr. S65-4/L5 of 14 January 1936.  
(c) Clark Cooper ltr. to Bu.Eng., via INM, Phila., Pa., of 27 February 1936.

OBJECT OF TEST.

2. The object of this test was to determine whether the manufacturer had corrected defects in the design of the valve, as reported under reference (b), and its conformance with the remainder of the specifications, outlined in paragraph 17 of this report.

ABSTRACT OF TEST.

3. The modified solenoid operated valve, submitted under reference (c), resulted from comments under NRL letter, reference (b). It was set up at this Laboratory in an air line, having a maximum pressure of 150 lbs. per square inch, and carefully observed while under test for compliance with the specifications, outlined in paragraph 17. Particular attention was given the operation of the valve under adverse conditions, such as lowering the solenoid voltage to 103.5 volts, at a frequency of 65 cycles, while applying an air pressure of 150 lbs. per square inch to the valve.

#### DESCRIPTION OF MATERIAL UNDER TEST.

4. This valve and duplex air horn were manufactured by the Clark Cooper Company, 153-159 Jefferson Street, Philadelphia, Pennsylvania, and are intended for use on the YORKTOWN (CV5) and ENTERPRISE (CV6).

5. The valve, type EC-344, is designed for operation from a supply of 115 volts, a.c., 60 cycles, at an air pressure of 150 pounds per square inch.

6. It is of the solenoid plunger type, the plunger being made up of laminated sheet iron and enclosed in a watertight cylinder of non-magnetic material, the upper part of which contains an iron stationary pole piece, slotted and equipped with a shading coil to reduce chattering.

7. The lower part of the plunger contains a renewable pad of semi-hard molded rubber composition, located in a cylindrical brass case. A  $\frac{1}{4}$ " threaded brass rod extends from this assembly through the upper part of the valve and is threaded into the laminated plunger. The upper part of the valve acts as a guide for the assembly containing the composition pad and also houses a phosphorous bronze coil spring which forces the pad against the valve seat.

8. Surrounding the watertight plunger cylinder is a solenoid winding equipped with lead wires for connecting to the terminal block.

9. The unit is enclosed in a cast-iron watertight case, the lower half of which contains a terminal box equipped with a removable cast BE cover having raised lettering.

10. The valve housing is of two-piece construction and is threaded into the lower portion of the cast iron case, which forms part of the magnetic circuit. A gasket is provided at this point to insure watertightness.

11. To insure proper installation, the pressure side of the valve is marked "IN."

12. Further details in the construction and design of the valve are given by Plates 1 and 2.

#### METHOD OF TEST.

13. First, the sample valve was connected to the duplex air horn, as shown on Plate 1, and tested for endurance by operating it one minute, every alternate minute, for 48 hours at its rated voltage and air pressure. This test was made in a compartment having an ambient temperature of 40°C (104°F) and the temperature rise of the solenoid winding was obtained, using the resistance method.

14. Next, the valve was tested for operation when inclined 30° from the vertical plane in all directions. During this test, the ambient temperature was 40°C (104°F) and the solenoid was supplied with a potential of 103.5 volts, at a frequency of 65 cycles. The air pressure applied to the valve was 150 pounds per square inch. In addition, the solenoid was tested for operation at 10% over and under normal voltage at normal frequency.

15. Following this, the valve was mounted on a Bureau of Engineering shock stand and given 20 blows of 250/pounds, while the solenoid was energized  
foot

and de-energized, to determine its shock integrity. The air pressure applied during this test was 150 lbs. per square inch.

16. The test was concluded with the usual tests for current consumption, power factor, insulation resistance, dielectric strength and watertight integrity.

RESULTS OF TEST.

17. The data obtained during the tests follow:

Requirements

Test Values

Voltage: 115 volts

115 volts.

Amperes: Not specified

0.438 amperes

Frequency: 60 cycles

60 cycles

Watts: Not specified

26.6 watts

Power Factor: Not less than 30%

52.88%

Endurance: Solenoid shall be operated at rated voltage and frequency, one minute, every alternate minute, for 48 hours, while valve is supplied with an air pressure of approximately 150 lbs. per square inch.

Valve operated satisfactory under conditions specified.  
NOTE: The horn was not tested in view of previous approval.

Shock Integrity: Valve shall withstand 20 blows of 250 foot pounds, without damage.

Satisfactory, no horn blasts occurring when solenoid was de-energized.

Insulation resistance: Shall be not less than 5 megohms between any current carrying part and ground, when measured with 1000 volt megger.

The minimum insulation resistance by 1000 volt megger was approximately 100 megohms.

Dielectric strength: Shall withstand 1230 v. a. c., 60 cycles, for a period of one minute, applied between all current carrying parts and ground.

Satisfactory, no breakdowns occurring.

Temperature rise of solenoid winding: Shall not exceed 30°C at ambient temperature of 40°C, when operated one minute, every alternate minute, for 8 hours.

The temperature rise was 18.5°C by the resistance method.

## Requirements

**Inclination:** Valve shall operate satisfactorily when inclined  $30^{\circ}$  from the vertical plane in all directions, at rated air pressure, with an applied voltage of 10% over and under normal.

**Watertight Integrity:** Case shall not leak when submerged in salt water to a depth of 3 feet for a period of 12 hours.

**D. C. Resistance:** Not specified.

**Protection of solenoid against absorption of moisture:** Impregnated with insulating varnish and baked.

**Terminal block:** To be of phenolic material, equipped with terminal lugs.

**Pitch of note of duplex horns:** Not specified.

**Sound Output:** Not specified.

**Audibility range in still air in the open:** Not specified.

**Case material:** Not specified.

**Valve material:** Not specified.

**Assembly screws and nuts:** Steel, cadmium plated.

**Gasket material:** Not specified.

## Test Values

Valve operated satisfactorily under conditions specified.

NOTE: The valve also operated satisfactorily when the solenoid voltage was lowered to 103.5 volts at a frequency of 65 cycles.

Satisfactory, no leaks occurring.

12.64 ohms at ambient temperature of  $40^{\circ}\text{C}$ .

Impregnated with insulating varnish and baked.

Phenolic block equipped with lugs as specified.

630 CPS, using General Radio Type 513-B Oscillator.

Sound output of the duplex horn, at an air pressure of 105 lbs. per sq.in. at input of valve, was 103 decibels. Measurement made in a sound-proof room, using a General Radio Noise Meter located 18 ft. from and on the axis of the horn.

Approximately 2800 yards.

NOTE: Computed from decibel output given.

Cast iron, finished in battleship gray.

Cast brass, finished in battleship gray.

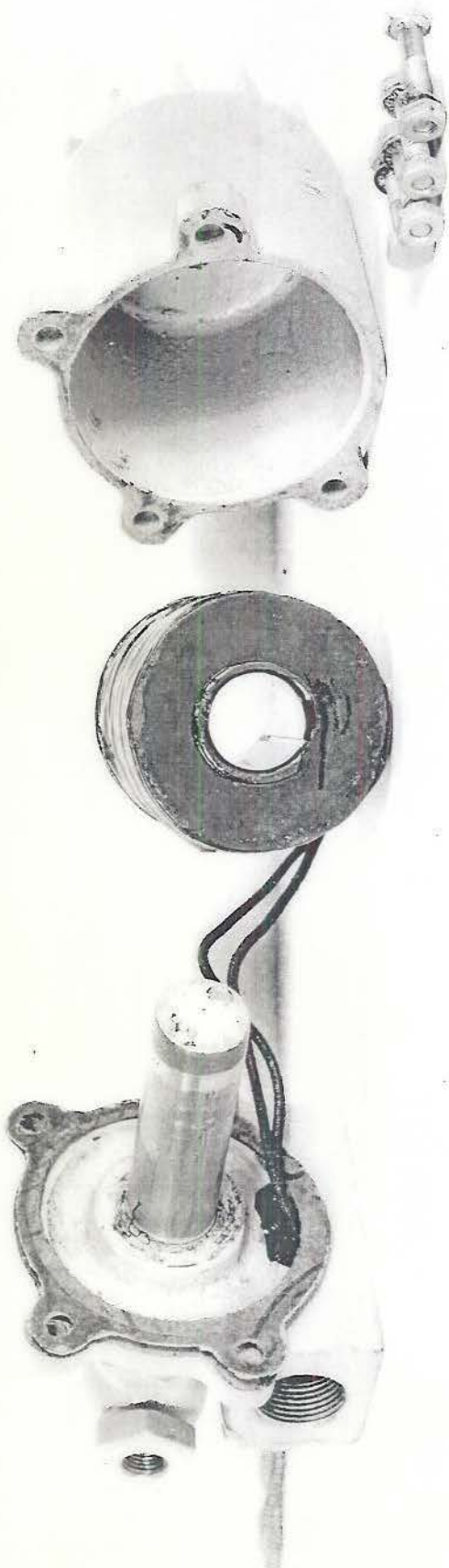
Steel hex head through bolts cadmium plated, used on solenoid housing and steel round head machine screws, cadmium plated, on terminal box cover.

Flat gaskets, similar to "Velumoid," used, except under terminal box cover where flat rubber is provided.



Plate 1

1635



1619