

12 March 1935

NRL Report No. B-1133

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report of

Test on Telegraph Key and Sounder Equipment

J.H. Bunnell Company,
Exhibitor.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
Washington, D.C.

Number of Pages: Text - 5 Plates - 2.
Authorization: BuEng.let. S65-4/L5(2-23-Ds) of 26 February 1935.
Date of Test: March 1935.

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Distribution:
BuEng. (5)

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AUTHORIZATION FOR TEST

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

Reference (a) BuEng.let. S65-4/L5(2-23-Ds) of 26 February 1935.

(b) Requisition - Eng.joint NSA and NIRA, 1115 NSA-247 NIRA. Contractor J.H. Bunnell and Company, 81 Prospect Avenue, Brooklyn, N.Y.

OBJECT OF TEST

2. The object of this test was to determine the suitability of the keys and sounders, submitted by J.H. Bunnell and Company, for the Naval Service and their compliance with Navy Department specifications, given in reference (b).

ABSTRACT OF TEST

3. The keys and sounders were set up at this Laboratory and connected in accordance with diagram shown on Bureau drawing CA 39 S-65-403 - Alteration 3, Circuit KS. They were then carefully observed for their operating characteristics while under test for compliance with the specifications.

CONCLUSIONS

- (a) The subject material is of good design and workmanship and complied with all of the major requirements of the specifications. With slight changes, as given in paragraphs 15, 16, 17, 18, 19 and 20 of this report, it would be suitable for use in the Naval Service.

RECOMMENDATIONS

- (a) In view of the keys and sounders complying with all of the major requirements of the specifications, reference (b), and additional tests given by this Laboratory, it is recommended that they be approved for the Naval Service, subject to comments, paragraphs 15, 16, 17, 18, 19 and 20 of this report.
- (b) Inasmuch as this type of key and sounder requires 6 volts, direct current, for operation, it is suggested that where alternating current is available the Bureau consider the use of small transformer rectifier units, shown on plate 2, as a substitute for battery supply. The current and voltage values obtained from a test set-up at this Laboratory are also given on plate 2. The full wave rectifier unit used on this test was a Westinghouse "Rectox", copper oxide, style 598134, rated 10 volts, 1 ampere, d.c. output. Copper oxide units can be obtained from several manufacturers in a variety of ratings and protected against sprays and high humidities. The Westinghouse Company states that life tests lasting six years have failed to show any limitation in the life of the rectifying elements of their rectifier units.

DESCRIPTION OF MATERIAL UNDER TEST

4. Three sample key and sounder sets were submitted for test. Each set consists of one sending key, having a short circuiting lever, one sounder, and two line terminals, mounted on an insulating base of phenolic material completely wired.

5. The telegraph key is of the legless type having an operating lever and trunnions made of steel. The trunnion bearings are adjustable and are provided with jamb nuts for locking. The key movements are adjustable by means of knurled head screws and lock nuts. The key frame is of brass and the key knob is of phenolic insulating material. The key contacts are made of silver and are replaceable. A spring and adjusting screw are provided for returning the key to the open position. All of the exposed parts are protected with nickel plating.

6. The sounder is of conventional design and operates on 6 volts, direct current. The sounder bar is made of aluminum and has an adjustable screw for limiting its downward stroke. A coil spring, equipped with a locking adjustment screw is attached to one end of the sounder bar for holding it in the upper position when the magnet is de-energized. The bar is mounted in a brass yoke by means of steel trunnions. A sound is produced when the adjustable screw on the bar strikes the anvil on its downward stroke and another sound is produced when it returns to its normal position. The yoke, brass anvil, and the magnets are mounted on a brass sounding plate.

7. The magnetic circuit is of the "U" type, made of soft steel, each leg supporting a coil wound with No. 28 enameled wire and having a resistance of 9.75 ohms at 77°F. Each winding is insulated from its case and has a coil head of insulating material forced on each end. A hard rubber sleeve surrounds the winding for protection against injury and moisture. The armature, also made of soft steel, is attached to the sounder bar, directly above the pole pieces, by means of a round head steel screw provided with a washer. All parts except the aluminum bar are protected with nickel plating. As received, the key and sounder windings were connected in series.

METHOD OF TEST

8. The three sample key and sounders were first connected in a circuit simulating Service conditions and tested for operating characteristics on normal operating voltage (6 volts) and 75% of normal voltage, (4.5 volts).

9. Next, they were tested for operation when inclined 30° from the normal position at 75% of normal voltage, (4.5 volts).

10. For determining the shock integrity of the key and sounder sets, one was mounted on a Bureau of Engineering shock stand and given 20 hammer blows of 50 foot pounds each, while mounted in the following positions:

- (a) Normal position (base horizontal).
- (b) Inclined forward 30°.
- (c) Inclined backward 30°.

11. The temperature rise of the series sounder windings was obtained by the resistance method after connecting them to a supply of 6 volts for 4 consecutive hours at an ambient temperature of 26.5°C.

12. The test was concluded with the usual insulation resistance, dielectric strength, current consumption and a general inspection of materials.

13. As the Bureau formerly preferred sounders that operated on 115 volts, 60 cycles a.c., and later decided to substitute 6 volt direct current models, after the a.c. sounders proved unsatisfactory in the Service, a transformer rectifier circuit was set up at this Laboratory to determine the practicability of operating the subject 6 volt direct current sets from a 115 volt, 60 cycle a.c. supply. Units such as this would eliminate the use of batteries for circuits 1 KS and 2 KS.

RESULTS OF TEST

14.	<u>Specifications</u>	<u>Requirements</u>	<u>Test Values</u>
	Voltage	6 volts	6 volts
	Current	Direct	Direct
	Amperes (1 sounder)	Not specified	0.31 amperes
	Inclination	Shall operate satisfactorily when inclined 30° from the normal position at 75% of normal voltage.	Satisfactory operation at 4.5 volts.
	Shock integrity	Key contacts shall not close or the sounder reproduce a signal due to the applied shock of 20-50 foot pound blows in the following positions: (a) Shock stand vertical. (b) Shock stand inclined forward 30°. (c) Shock stand inclined backward 30°.	Satisfactory when in normal and inclined positions.

<u>Specifications</u>	<u>Requirements</u>	<u>Test Values</u>
Temperature rise of the series windings.	Not specified.	13.57°C at ambient of 26.5°C after being connected to 6 volts d.c. for 4 hours.
Insulation resistance.	Not specified.	100 megohms by 500 V. megger.
Dielectric.	Not specified.	No breakdown occurred when 500 volts a.c. 60 cycle was applied between all current carrying parts to ground.
Dimensions.	Not specified.	Length - 7"00 Width - 4"50 Height - 3"75
Weight (1 sounder).	Not specified.	1 lb. 13 oz.

COMMENTS

15. The key and sounder sets comply with the requirements of the specifications, reference (b), with the exception of the following paragraphs.

16. The specifications require that four terminals be furnished with each key and sounder. The samples submitted have only two terminals. This was brought to the Bureau's attention and it was decided that three terminals would be sufficient; one to be connected to one contact of the key, one to one side of the sounder winding, and the other to the other side of the sounder winding and the remaining key contact. This modification would necessitate increasing the size of the protective covering.

17. The present line terminal lugs extend from the base and almost touch the surface on which the set is resting. The use of recessed lugs would prevent accidental short-circuiting of these terminals.

18. In order to prevent the assembling screws and nuts from becoming loose, due to vibration, all counterbored holes should be filled with an approved insulating compound which will not soften at a temperature of 54.4°C.

19. The aluminum sounding bar should be coated with lacquer or insulating varnish for protection against corrosion.

20. Although the specifications require the magnetic core to be of silicon steel, it is not considered necessary as this requirement was obviously intended for a.c. sounders.

21. The shorting lever should be removed from all keys when these sets are used on circuits similar to circuit KS.

22. It is suggested that the manufacturer include "6 volts d.c." on the name plate of each instrument.

CONCLUSIONS

23. The subject material is of good design and workmanship and complied with all of the major requirements of the specifications. With slight changes, as given in paragraphs 15, 16, 17, 18, 19 and 20 of this report, it would be suitable for use in the Naval Service.



PLATE I

