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NAVY DEPARTMENT

Report of

Test on Head Telephone Receivers, Type 49016
Head Bands, Type 49028 and Diaphragms Type 49033

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Submitted by

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AUTHORIZATION

1. This problem was authorized by reference (a). References (b) and (c) are also pertinent.

References:

- (a) BuShips ltr. to NRL S67/49(480-K) dated 22 May 1942
- (b) Specifications RE 13A 511B
- (c) NRL Report No. R-1066

OBJECT OF TEST

2. The object of the test was to determine whether these head telephone receivers, head bands, and diaphragms comply with the requirements of reference (b).

ABSTRACT OF TEST

3. The receivers were tested to determine the following characteristics:

- (a) Compliance with specifications as to dimensions and materials.
- (b) Operation at high energy input (50 milliwatts).
- (c) Effect of mechanical shock.
- (d) D.C. resistance.
- (e) Impedance at the frequency of primary resonance.
- (f) Efficiency factor at the frequency of primary resonance.
- (g) Primary resonance frequency.
- (h) Magnitude of secondary resonance peak.
- (i) Band width of primary resonance peak.
- (j) Band width of secondary resonance peak.
- (k) Effect of humidity on sensitivity.
- (l) Effect of humidity on insulation resistance.
- (m) Effect of humidity on materials.

CONCLUSIONS

It is concluded:

- (a) That the insulation resistance is 50% lower than the minimum value specified by paragraph 6-10 of reference (b), and that voltage breakdown may be expected below 500 volts.
- (b) That the terminal set screws are too short to properly secure the phone cord tips.
- (c) That the type number is not engraved or stamped on the head set.
- (d) That the extra sample diaphragms are identical with those in the sample receivers.
- (e) That the sample submitted for test under contract 49016 will comply with reference (b) and be suitable for naval use when these minor faults have been corrected.

Recommendations

It is recommended:

(a) That the head telephone receivers, head bands, and diaphragms be considered suitable for Naval use, when the insulation resistance is made to conform with paragraph 6-11 of reference (b), when the proper length of terminal set screw is furnished, and when the type number is properly stamped or engraved on the head set.

Description of Material Under Test

4. Five pairs of low impedance head telephone receivers, Navy type 49016, numbered 226 to 235 inclusive by the Naval Research Laboratory, six extra diaphragms, Navy type 49033, and one head band, Navy type 49028, were submitted for test by the Dictograph Sales Corporation of New York. No telephone cords were received for test.

Method of Test

5. The physical dimensions of the receivers, extra diaphragms and head band were recorded. Each receiver was allowed to fall a distance of 4 feet on a composition covered concrete floor, 12 consecutive times for mechanical shock test. The direct current resistance of each receiver was measured on a wheatstone bridge.

6. The acoustical and electrical properties were measured on the artificial ear with 0.10 volt a.c. applied to each receiver. This method is described in paragraph 5 of reference (c).

7. The following instruments were used for these tests:

Leads & Northrup Wheatstone Bridge Type No. 5300 Serial No. 374910
Ballantine Voltmeter, Model 300, Serial No. 310
General Radio Interpolation Oscillator Type 617-C Serial No. 145
General Radio Impedance Bridge Type 650-A Serial No. 1555
General Radio megohm Bridge, Type 544B Serial No. 246
General Radio Attenuator Type 329-J Serial No. 136
General Radio Battery operated amplifier type 514-A Serial 91
Special Humidity test cabinet

8. The impedance of each receiver, at its peak response frequency, was calculated from the measured value of effective reactance and resistance. The power input was computed from the known input voltage, effective impedance and the power factor of the impedance angle. The efficiency factor in bars squared per microwatt was computed from the measured acoustic output pressure and the electrical input power of each receiver. The insulation resistance between the receiver coils and cases were determined with a megohm bridge. The insulation resistance of two receivers were tested with 500 volts on the megohm bridge; the other eight, with 100 volts.

9. The currents required to produce six milliwatts and fifty milliwatts at the primary resonant frequencies were computed. These values were applied to five of the telephones to determine whether sufficient clearance was provided between the pole pieces and diaphragms.

Data Recorded during Test

10. The data recorded during tests are given in Tables I and II.

Discussion of Probable Errors

11. The errors in the results of test are estimated to be within the following limits:

| | |
|---|-------------------|
| Receiver dimension measurement accuracy | + 0.200 inches |
| Length of head band | + 1/8 inches |
| Radius of yoke of head band | + 1/16 inches |
| D. C. resistance | + 0.3 ohms |
| Impedance (as defined above) | + 3.0% |
| Frequency | + 3.0 cycles/Sec. |
| Efficiency factor | unknown |
| Secondary resonance peak | + 0.2 decibels |
| Relative humidity of 90% | + 2.0% |
| Temperature of 50° C | + 1.0 C |
| Final sensitivity after humidity test | + 0.2 decibels |

12. In compiling the data of Table II, the probable error of measurement was not taken into consideration. If the observed data was found to be within the limits of reference (b), the respective tests of each receiver was assigned a passing "weight".

Results of Test

13. In accordance with paragraph 7-4 and 7-5 of reference (b), each receiver was marked on each test listed. These results are tabulated and totaled in Table II; the average mark per receiver is 90.8% which is better than the acceptable minimum of 90% as required by paragraph 7-6 of reference (b).

14. The insulation resistance of each sample is less than 50 megohms, the minimum required by paragraph 6-10 of reference (b); the data of column (j) in Table I indicate wide latitudes of deviation from the specification among the receivers under test. Paragraph 6-10 of reference (b) stipulates a maximum test of 500 volts and a minimum of 100 volts. The insulation of the first two samples tested, Naval Research Laboratory Nos. 227 and 230, was ruptured with the application of 500 volts. Therefore, a test voltage of 100 volts was used to determine the insulation resistance of the eight remaining samples. A megohm bridge was employed for this test. The data of column (i), Table II, indicates that the final sensitivity of these two receivers, was not affected by the broken insulation.

15. One of the pole pieces of one receiver was slightly rusted as a result of the humidity test. The diaphragm of another

collected a small amount of rust which was easily wiped off.

16. The head telephone receivers comply with the mechanical requirements of reference (b) with the exception of the input terminal set screws. The effectiveness of the clamping action is not such as to allow much tolerance in the diameter of the cord tips.

17. The head bands do not bear the type number as required by reference (b).

18. Two samples, Naval Research Laboratory No. 226 and 228, failed to meet the requirements of reference (b) in final sensitivity after the humidity run; this is indicated in column (i) of Table II. These receivers showed a decrease greater than four decibels in response at the primary resonant frequency: Naval Research Laboratory No. 226, 7.5 decibels at 1212 cycles per sec.; Naval Research Laboratory No. 228, 8.4 decibels at 1155 cycles per second.

Conclusions

It is concluded:

(a) That the insulation resistance is 50% lower than the minimum value specified by paragraph 6-10 of reference (b), and that voltage breakdown may be expected below 500 volts.

(b) That the terminal set screws are too short to properly secure the phone cord tips.

(c) That the type number is not engraved or stamped on the head set.

(d) That the extra sample diaphragms are identical with those in the sample receivers.

(e) That the sample submitted for test under contract 49016 will comply with reference (b) and be suitable for Naval use when these minor faults have been corrected.

TABLE I

Data on Head Telephone Receivers Type 49016

Letters in the column headings correspond to Par. 7-4 of reference (b).

| NRL SAMPLE NO. | D.C.Res. ohms (a) | Impedance ohms (c) | Efficiency Factor (d) | Peak Freq. cyc les (e) | Sec. Peak db below Pri. (f) | Pri. Band Width % + 4 db - (g) | Sec. Band Width % + 8 db + (h) | Insul. Res. Megohms (j) |
|----------------------|-------------------------|--------------------------|-----------------------------|------------------------------|-----------------------------------|---|---|-------------------------------|
| 226 | 34.0 | 378 | 3350 | 1226 | 4.2 | 15.7 | 34.9 | 18.7 |
| 227 | 34.0 | 326 | 2740 | 1140 | 4.1 | 14.2 | 31.8 | 30x10 ⁻⁶ |
| 228 | 33.7 | 326 | 2160 | 1163 | 4.8 | 16.8 | 34.6 | 9.1 |
| 229 | 33.8 | 320 | 2310 | 1177 | 4.4 | 14.8 | 36.9 | 10.8 |
| 230 | 34.0 | 321 | 1975 | 1160 | 4.5 | 11.5 | 33.7 | 500 x 10 ⁻⁶ |
| 231 | 33.9 | 309 | 1510 | 1138 | 4.9 | 12.3 | 32.3 | 20.0 |
| 232 | 34.0 | 345 | 1930 | 1160 | 7.4 | 11.2 | 39.8 | 5.2 |
| 233 | 33.3 | 306 | 1635 | 1185 | 7.9 | 12.0 | 70.0 | 7.9 |
| 234 | 33.6 | 322 | 1600 | 1167 | 5.0 | 14.6 | 37.9 | 7.1 |
| 235 | 33.6 | 326 | 2160 | 1170 | 5.5 | 10.8 | 42.4 | 2.3 |

TABLE II
Table of "Weights" for Head Telephone Receiver Type 49016

Letters in the column headings correspond to Par. 7-4 of reference (b).

| Sample No. | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | Total |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| 226 | 2 | 5 | 20 | 20 | 0 | 2 | 0 | 0 | 0 | 0 | 5 | 54 |
| 227 | 2 | 5 | 20 | 20 | 20 | 2 | 0 | 2 | 20 | 0 | 5 | 96 |
| 228 | 2 | 5 | 20 | 20 | 20 | 2 | 0 | 2 | 0 | 0 | 5 | 76 |
| 229 | 2 | 5 | 20 | 20 | 20 | 2 | 0 | 2 | 20 | 0 | 5 | 96 |
| 230 | 2 | 5 | 20 | 20 | 20 | 2 | 2 | 2 | 20 | 0 | 5 | 98 |
| 231 | 2 | 5 | 20 | 20 | 20 | 2 | 2 | 2 | 20 | 0 | 5 | 98 |
| 232 | 2 | 5 | 20 | 20 | 20 | 2 | 2 | 2 | 20 | 0 | 5 | 98 |
| 233 | 2 | 5 | 20 | 20 | 20 | 2 | 2 | 2 | 20 | 0 | 5 | 98 |
| 234 | 2 | 5 | 20 | 20 | 20 | 2 | 2 | 2 | 20 | 0 | 5 | 98 |
| 235 | 2 | 5 | 20 | 20 | 20 | 2 | 0 | 2 | 20 | 0 | 5 | 96 |
| Failures | 0 | 0 | 0 | 0 | 20 | 0 | 10 | 2 | 40 | 20 | 0 | 90.8 |

average
total
weight

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