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Buships Problem M10-11

NAVY DEPARTMENT

Report of Test on

Head Telephone Receivers, Type 49016; Head Bands,
Type 49028; Diaphragm, Type 49033; Cord,
Type 49012-C; and Plug, Type 49034A

Submitted by

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AUTHORIZATION

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

References:

- (a) Buships ltr to NRL S67/49 (480-K) of 22 May 1942
- (b) Buships ltr to Commandant, Navy Yard, New York, S67/49 (957) of 20 November 1942
- (c) Specifications RE 13A 511B
- (d) NRL ltr to Buships S67/49 (541) of July 15, 1943

OBJECT OF TEST

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

ABSTRACT OF TEST

3. Tests were made in accordance with the following abstract.

(a) The receivers were tested to determine the following:

- (1) Compliance with specifications as to dimensions and materials
- (2) Operation at high energy input (50 milliwatts)
- (3) Effect of mechanical shock
- (4) D.C. Resistance
- (5) Impedance at the frequency of primary resonance
- (6) Efficiency factor at the frequency of primary resonance
- (7) Primary resonant frequency
- (8) Magnitude of secondary resonant peak
- (9) Band width of primary resonant peak
- (10) Band width of secondary resonant peak
- (11) Effect of humidity on sensitivity
- (12) Effect of humidity on materials

(b) The head bands, cords, and plugs were tested to determine whether they comply with the specifications for their materials and mechanical construction.

CONCLUSIONS

It is concluded:

- (a) That the receivers failed to comply with reference (c) in the following respects:
 - (1) The case material completely failed the shock test.
 - (2) Certain case dimensions do not conform to those specified.
 - (3) The impedances were found to be less than the specified minimum.
 - (4) The efficiency factors were found to be less than the specified minimum.
 - (5) The primary peak frequencies were found to be greater than the maximum permitted.
 - (6) The difference between the primary and secondary peak sensitivities exceeds the specified maximum.
- (b) That the headbands meet the specifications.
- (c) That the cords meet the specifications.
- (d) That the plugs meet the specifications.

RECOMMENDATIONS

It is recommended:

- (a) That the receiver caps and cases be more ruggedly constructed of more suitable material in order to provide greater resistance to mechanical shock. Case material type CFI-10 is preferred as shown in reference (d).
- (b) That those mechanical dimensions deviating from the specifications be corrected.
- (c) That the electrical construction be changed so that the receiver impedances, efficiency factors, primary resonant frequencies and relative primary and secondary resonant sensitivities conform to reference (c).

MATERIAL UNDER TEST

4. The material under test consisted of six head telephone receivers, type 49016; three head bands, type 49028; six diaphragms, type 49033; three cords, type 49012-C; and three plugs, type 49034A, all manufactured by the Dictograph Sales Corporation, New York.

METHOD OF TEST

5. The receivers were tested as outlined in reference (c) except for the completion of the humidity tests. All tests involving receiver output were made with a constant closed circuit voltage across the receiver. A brief discussion of some of the tests follows and reference (c) may be referred to for further discussion of the tests.

- (a) The receivers were carefully inspected as to dimensions and material according to paragraphs 4-2, 4-3, 4-4, and 4-7, of reference (c).
- (b) The mechanical shock test was made in conformance with paragraphs 5-9 and 6-2 of reference (c).
- (c) The d-c resistance was measured on a Wheatstone bridge.
- (d) The presence of distortion in the output of the headphones supplied with fifty milliwatts of power was observed by means of an oscilloscope.
- (e) The impedance of the receivers at the frequency of primary resonance was determined by measuring the inductance and "Q" on a General Radio Co., type 650-A impedance bridge. The a.c. resistance was computed from the X/Q and the value of R thus obtained was used in calculating Z . The value of Z thus obtained agreed closely with the measured value of E/I .
- (f) The efficiency factor (bars squared per microwatt) was determined by measuring the watts input to the telephone, $E^2/Z \times P.F.$ and converting the electrical output of the artificial ear into terms of pressure developed at the microphone by means of curves supplied by the Bell Telephone Laboratories.
- (g) The primary resonant frequency f_0 was determined by varying the frequency of the constant supply voltage and measuring the output of the artificial ear.

- (h) The magnitudes of the primary and secondary peaks were determined by measuring the headphone output by means of the artificial ear at the peak frequencies.
- (i) The band width of the primary resonant peak, (f_0), was determined by finding frequencies f_1 and f_2 on each side of the peak, 4 db down, and calculating the band width in per cent from the equation: Band Width = $(f_1 - f_2)/f_0$. This procedure was repeated for points 8 db down from the primary resonant db at f_0 .
- (j) The band width of the secondary resonance peak was determined in a manner similar to that of (i) above excepting the fact that frequencies greater and less than the secondary resonance frequency were measured 3 db less than the db at the secondary peak frequency.
- (k) The effect of humidity on materials was determined by inspection following exposure.

DATA RECORDED DURING TEST

6. Certain data are recorded in Table I. Other data are recorded in RESULTS OF TESTS.

PROBABLE ERROR OF RESULTS

7. The errors in the determination of the various values are estimated to be within the values given below.

(a) Dimensions	\pm .002 inch
(b) D.C. Resistance	\pm 0.5 ohm
(c) Impedance	\pm 18 %
(d) Frequency	\pm 2 cycles
(e) Efficiency Factor	\pm 18 %
(f) Peak Outputs	\pm 0.2 db.
(g) Temperature	\pm 0.5 °C

APPARATUS

8. The equipment used in the tests included the following:
- (a) Bell Telephone Laboratories Artificial Ear with Type 1-AS condenser microphone
 - (b) Bell Telephone Laboratories Volume Indicator

- (c) General Radio Co. Interpolation Oscillator, Type 617-A, Serial No. 37
- (d) General Radio Co. Type 329-J Attenuation Box
- (e) Ballantine Electronic Voltmeter, Model 300, Serial No. 310
- (f) General Radio Company Impedance Bridge, Type 650-A, Serial No. 1555
- (g) Hewlett-Packard Audio Signal Generator, Model 205AG
- (h) Dumont Cathode-Ray Oscillograph Type 208, Serial No. 438
- (i) General Radio Co., Sound Analyzer Type 760-A, Serial No. 287
- (j) General Radio Co. Wave Analyzer Type 736-A, Serial No. 118
- (k) Weston D.C. Milliammeter, Model 322, Serial No. 4748
- (l) Leeds & Northrup Wheatstone Bridge, No. 5300, Serial No. 474910
- (m) Weston Milliammeter, Model 269, Serial No. 57693
- (n) Weston a.c. Microammeter, Model 600, Serial No. 5182

RESULTS OF TEST

9. Certain observed and computed data are given in Table I for those receivers tested. The receiver marked with NRL number 251 so completely failed the shock test that any other measurements made upon it were considered inconclusive. According to paragraph 7-7 of reference (c) failure of two phones on any one of the items of test constitutes a failure of the lot. The tests conducted showed all six phones tested to fail the shock test. As a consequence the establishment of a table of weights was considered unwarranted and extraneous.

10. The following comments on the results of the tests refer to the similarly numbered paragraphs in the specifications, i.e., reference (c).

- 4-1 The receivers were of the permanent magnet type.
- 4-2,3 The receivers do not entirely conform to the mechanical specifications.
- 4-4,5,6 The receivers conformed to these requirements.
- 4-7 The humidity tests on the receivers were not completed, however, the case and cap materials were found to have a high resistance to humidity and the d-c resistances were little affected by the humidity test.
- 4-8 The receivers were found capable of being driven at 50 milliwatts input without the diaphragms striking the pole faces.

- 4-9 Diaphragms conformed to these dimensions, but only one side was protected by a humidity-resistive coating.
- 4-10,11,12 The receivers, headbands and cords were found to conform to these requirements.
- 6-2 As a result of the shock test all six receivers tested showed cracks in their cups and/or cases.
- 6-3 D-C resistances are shown in Table I. These measurements were made at 26.4°C and 26.3°C and after being corrected to 20°C were found to conform to specifications.
- 6-4,5,6,7,8,9 The phone impedances, efficiency factors, primary peak frequencies, the relative primary and secondary resonant peaks, and the primary and secondary resonant peak band widths are shown in Table I.

CONCLUSIONS

11. It is concluded:

- (a) That the receivers failed to comply with reference (c) in the following respects:
- (1) The case material completely failed the shock test.
 - (2) Certain case dimensions do not conform to those specified.
 - (3) The impedances were found to be less than the specified minimum.
 - (4) The efficiency factors were found to be less than the specified minimum.
 - (5) The primary peak frequencies were found to be greater than the maximum permitted.
 - (6) The difference between the primary and secondary peak sensitivities exceeds the specified maximum.
- (b) That the headbands meet the specifications.
- (c) That the cords meet the specifications.
- (d) That the plugs meet the specifications.

TABLE I

 DICTOGRAPH HEADPHONE CHARACTERISTICS
 (Type 49016)

NRL Sample Number	D.C. Res. (Ohms)	Impedance (Ohms)	Efficiency Factor	Primary Peak Frequency (Cycles)	Sec. Peak d.b. below Pri. Peak d.b.	Pri. Peak Band Width %	Sec. Peak Band Width %
251 *	34.9					4 db down	3 db down
252	35.1	209.6	1129	1241	3.4	13.9	25.8
253	34.4	211.2	890.6	1260	4.1	11.1	34.1
254	34.5	216.3	470.6	1318	1.3	19.0	28.5
255	34.7	220.3	1010	1212	2.7	14.2	27.4
256	34.8	115.5	523.8	1265	2.4	13.6	30.8

* This sample was completely destroyed in the drop test.