REPORT NO. R-2049

DATE August 4, 1943

SUBJECT

# Test on Head Telephone Receivers, Type 49016; Head Bands, Type 49028; Diaphragms, Type 49033; Telephone Cord and Plug Type C-49064

by

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WASHINGTON 20, D. C.

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NAVY DEPARTMENT

BUREAU OF SHIPS

Report of

# Test on Head Telephone Receivers, Type 49016; Head Bands, Type 49028; Diaphragms, Type 49033; Telephone Cord and Plug Type C-49064

Manufactured by TELEPHONICS CORPORATION, N.Y., N.Y.
Navy Contract N140s-8246A

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WASHINGTON, D. C.

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vs

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APPENDICES

AUTHORIZATION

1. This problem was authorized by reference (a). Reference (b) directed the Navy Yard, New York to forward to the NRL for test, three sets of head telephones delivered to the Yard from the Dictograph Sales Corporation under contract N140s-8247A. The subject telephone headsets manufactured by the Telephonics Corporation of New York, N.Y., were received from the Navy Yard, New York. This report is forwarded because it is believed the results of tests will be of interest. The governing specifications are listed as references (c), (d), and (e). References (f) and (g) are also pertinent.

References:
(a) Bushipe ltr S67/49 (480-K) of May 22, 1942.
(b) Bushipe order EN28/38237 of Nov. 20, 1942 to Commandant, Navy Yard, New York.
(c) Specification RE 13A 511B.
(d) Specification RE 49AA 141E.
(e) Specification RE 49AA 120B.
(f) Bell System Technical Journal, Vol. XI, PP. 293-317, April 1932.
(g) NRL Report No. R-1066.

OBJECT OF TEST

2. The object of the tests was to determine how closely the head telephone receivers, headbands and cords conform to the specifications.

ABSTRACT OF TEST

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

(a) Compliance with specifications as to dimensions and materials.
(b) Effect of mechanical shock.
(c) D.C. resistance.
(d) Operation at high energy input (50 milliwatts).
(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 these Telephonics Corporation head telephone receivers do not meet the requirements of the governing specifications with respect to resistance to humidity and mechanical shock.

(b) That the primary peak frequency of the receivers is adversely affected by exposure to humidity.

(c) That the headbands meet the specifications.

(d) That the cords do not meet the specifications with respect to the number of strands.

## RECOMMENDATIONS

It is recommended:

(a) That the caps and cases be strengthened to provide more resistance to mechanical shock.

(b) That means be provided to render the receivers more resistant to the effects of humidity.

(c) That the cords be altered to conform to specifications.

MATERIAL UNDER TEST

4. The material under test consisted of six head telephone receivers type 49016; three head bands, type 49028; three diaphragms, type 49033; and three cords and plugs, type C-49064, all manufactured by the Telephonics Corporation, New York. These were submitted by the Navy Yard, New York in lieu of Dictograph head telephones.

METHOD OF TEST

5. The receivers were tested in all respects as outlined in reference (c), except for the order in which tests were made. The mechanical shock tests were made last. All tests involving receiver output as a function of frequency were made with a constant closed circuit reference voltage across the receiver. A brief discussion of some of the tests follows and reference (c) may be referred to for a more extended description. Reference (g) may also be referred to for a further discussion of certain of the tests.

(a) The receivers were carefully inspected as to dimensions and materials 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 input level at which contact between the diaphragm and pole pieces occurred was determined by connecting an oscilloscope across the receiver input and observing the appearance of distortion of the waveform.

(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 formula X/Q and the value of R thus obtained was used in calculating Z. The value of Z thus determined agreed closely with the measured value of E/I.

(f) The efficiency factor bars$^2$/microwatts 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 Labs.

(g) The primary resonant frequency $f_o$ was determined by varying the frequency of current supplied the telephone at a constant voltage, and measuring the output of the artificial ear with the volume indicator.

(h) The magnitude of the secondary resonant peak was determined in the same manner as (g) above.

(i) The band width of the primary resonance peak was determined by finding points $f_1$ and $f_2$ on each side of the peak, 4 db down, and recording the frequency at these points. The band width is expressed as $(f_1 - f_2)/f_o$ in per cent. This procedure was repeated for points 8 db down.

(j) The band width of the secondary resonance peak was determined in a similar manner to that of (i) above.

(k) The effect of humidity on sensitivity was determined by comparing the outputs of the telephones at a given input and frequency, measured before and after exposure to humidity applied according to paragraph 5-10 of reference (c).

(l) The effect of humidity on insulation resistance was determined by measurement at 100 volts on a General Radio Co. type 544-B megohm bridge.

(m) The effect of humidity on materials was determined by inspection following exposure.

DATA RECORDED DURING TEST

6. Certain data are recorded in Table I and Plates 2 and 3. 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:

| | | |
|---|---|---|
| Dimensions | ± 0.002 | inch |
| D.C. Resistance | ± 0.5 | ohm |
| Impedance | ± 18 | % |
| Frequency | ± 2 | cycles/sec. |
| Efficiency Factor | ± 18 | % |
| Peak Outputs | ± 0.2 | db |
| Humidity | ± 10 | % |
| Temperature | ± 0.5 | °C |

8. The equipment used in the tests included the following:

(a) Bell Telephone Laboratories Artificial Ear, described fully in reference (f), and type 1-AS condenser microphone.
(b) Bell Telephone Laboratories volume indicator.
(c) General Radio Co. Interpolation Oscillator, type 617-A, Ser. No. 37
(d) General Radio Co. type 329-J attenuation box.
(e) Ballantine Electronic Voltmeter, Model 300, Ser. no. 310*
(f) General Radio Co. Impedance Bridge, Type 650-A, Ser. No. 1555.
(g) Hewlett-Packard Audio Signal Generator, Model 205 AG.
(h) Dumont Cathode-Ray Oscillograph, Type 208, Ser. No. 438.
(i) General Radio Co., Sound Analyzer Type 760-A, Ser. No. 287.
(j) General Radio Co., Wave Analyzer Type 736-A, Ser. No. 118.
(k) General Radio Co., Megohm Bridge Type 544-B, Ser. No. 246.
(l) Weston D.C. milliammeter, Model 322, Ser. No. 4748.
(m) Leeds & Northrup Wheatstone Bridge, No. 5300, Ser. No. 474910.
(n) Weston milliammeter, Model 269, Ser. No. 57693.
(o) Weston a.c. microammeter, Model 600, Ser. No. 1081255*

RESULTS OF TEST

9. Certain observed or computed test data are given in Table I for each of the six receivers. In Table 2 the "weights" obtained by each receiver in the tests listed in paragraph 7-5 of reference (c) are tabulated, together with the total "weight" of each receiver and the average total "weight" of the six receivers. In compiling Table 2, the probable error of measurement was taken into consideration, so that any receiver is considered to have passed the test if the observed value after being adjusted by the amount of the probable error lies within the limits. The average mark achieved by the receivers was 90.3.

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

4-1 The receivers were of the permanent magnet type.

4-2) The receivers conformed to the requirements as to materials
4-3) and dimensions.

4-4 The magnet bobbins were wound with enameled wire. They were not adequately protected from the entrance of moisture.

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*Calibrated against Laboratory Standards prior to use in subject tests.

4-5) The receivers conformed to these requirements.
4-6)

4-7 All samples appeared to be adversely affected by exposure to humidity. The magnet bobbins appeared slightly discolored. Corrosion of the lug terminals took place in samples 245, 246 and 249. The primary resonant frequencies of four of the samples were no longer within the specification when remeasured after exposure. Primary peak frequencies after exposure were as follows:

| Sample No. | Frequency |
|---|---|
| 245 | 1069 |
| 246 | 1243 |
| 247 | 962 |
| 248 | 685 |
| 249 | 1198 |
| 250 | 879 |

4-8 Operation at high energy input was satisfactory.

4-9 Diaphragms conformed to these dimensions, but only one side was protected by a humidity-resistive coating.

4-10 Cords and plugs conformed to the requirements of reference (e) except that each conductor contained only 12 strands.

4-11 Headbands conformed to the requirements of reference (d) except that the coiled spring which performs the locking function was too loose to have any control in one sample, and relatively loose in two others.

4-12 The cords, receivers, and headbands were properly marked.

6-2 As a result of the shock test, the magnet mounting of sample no. 250 became loosened, the caps of two other samples cracked, and the center hole of one other cap was chipped.

6-3 D-C resistances are shown in Table I. These measurements were made at 25°-30°C. When corrected for temperature the values are within the specification.

6-4 Impedances are shown in Table I.

6-5 Efficiency factors are shown in Table I.

6-6 Primary resonant peak frequencies are shown in Table I.

6-7 Secondary peak frequencies are shown in Table I.

6-8 Primary peak band widths are shown in Table I.

6-9 Secondary peak band widths are shown in Table I.

6-10 Losses in sensitivity due to humidity were as follows:

| Sample No. | Db. Loss |
|---|---|
| 245 | -3.35 |
| 246 | -1.95 |
| 247 | -1.55 |
| 248 | -9.85 |
| 249 | -3.15 |
| 250 | -7.75 |

6-11 Insulation resistances are shown in Table I.

6-12 The lugs of two samples showed evidence of corrosion after exposure to humidity. Several of the horseshoe magnets appeared tarnished.

## CONCLUSIONS

It is concluded:

(a) That these Telephonics Corporation head telephone receivers do not meet the requirements of the governing specifications with respect to resistance to humidity and mechanical shock.

(b) That the primary peak frequency of the receivers is adversely affected by exposure to humidity.

(c) That the headbands meet the specifications.

(d) That the cords do not meet the specifications with respect to r of strands.