

15 November 1935

NRL Report No. R-1217
BuEng. Problem M10-4

FR-1217

NAVY DEPARTMENT
BUREAU OF ENGINEERING

Report of

Test of Head Telephone Receivers, Type CW49003.

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Number of Pages: Text - 4 Tables - 2

Authorization: BuEng. ltr. NOs-42525 (8-26-W8) of 28 August 1935.

Date of Test: 15 October to 8 November 1935.

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Distribution:
BuEng. (10)

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AUTHORIZATION

1. This work was authorized by references (a) and (b). Other pertinent correspondence is listed as references (c) to (e).

- Reference: (a) BuEng. ltr. NOs-42525 (8-26-W8) of 28 August 1935.
(b) BuEng. ltr. C-NP14 (10-15-W8) of 17 October 1935.
(c) BuEng. Specifications RE 13A 511A.
(d) NRL Report No. R-1066.
(e) NRL Report No. R-1213.

OBJECT OF TEST

2. The object of the test was to determine if the high impedance head telephone receivers submitted by the Graybar Electric Company in conjunction with Contract No. 42525 comply with the governing specifications, reference (c).

ABSTRACT OF TEST

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

- (a) D.C. resistance.
- (b) Results of mechanical shock.
- (c) Impedance at the frequency of primary resonance.
- (d) Efficiency factor at the frequency of primary resonance.
- (e) Frequency of primary resonance.
- (f) Magnitude of secondary resonant peaks.
- (g) Band width of the primary resonant peak.
- (h) Band width of the secondary resonant peak.
- (i) Effect of humidity on sensitivity.
- (j) Effect of humidity on insulation resistance.
- (k) Effect of humidity on materials.

CONCLUSIONS

(a) These receivers comply with the governing specifications in all respects except that the average primary band width 4 db and 8 db down from the peak is somewhat broader than that specified and except that the primary peak frequency of one more receiver than 20% of those tested was slightly outside the prescribed band. The average mark achieved by the receivers in the test is 89.4.

(b) These receivers are considered suitable for Naval use.

RECOMMENDATION

(a) It is recommended that these head telephone receivers be considered suitable for Naval use.

MATERIAL UNDER TEST

4. The material under test consisted of 10 pairs of high impedance head telephone receivers manufactured by the Western Electric Company and submitted by the Graybar Electric Company. They bear the type number CW49003.

METHOD OF TEST

5. The receivers were tested in all respects as outlined in specifications, reference (c). A general description of the method of test involving the use of the artificial ear equipment is given in reference (d), paragraph 5.

DATA RECORDED DURING TEST

6. The data recorded during the test, or values computed therefrom, are given in Table 1.

PROBABLE ERROR OF RESULTS

7. The error in the measurement of d.c. resistance is less than ± 1 ohm. The error in the determination of impedance is not greater than $\pm 5\%$. That in the determination of the frequency at which measurements were made is not more than ± 3 cycles. The error in the determination of the efficiency factor, into the calculation of which a number of factors enter, is probably less than 10%, but is assumed to be 15%. The error in the determination of the band widths is assumed to be 1/2%. The error in the measurement of insulation resistance is less than 5 megohms.

RESULTS OF TEST

8. Certain observed or computed test data are given in Table 1 for each of the 20 receivers. In Table 2, the weight obtained by each receiver in each of the tests outlined in paragraph 7-4 of reference (c) is tabulated, together with the total weight for each receiver and the average mark of the lot of 20 receivers. In compiling Table 2, the probable error of measurement was taken into consideration and the proper allowance made, with the result that any receiver is considered to have passed the test if the observed value, after being adjusted by an amount corresponding to the probable error, lies within the limits. For example, receiver No. 72 has a computed efficiency factor less than the 900 required, but when the observed value is increased by 15% (the allowed error), it becomes more than 900 and therefore this receiver is given full weight for this characteristic.

9. The following comments on the results of the test refer to the similarly numbered paragraphs in specifications, reference (c):

6-1. The d.c. resistance of all receivers except No. 79 was between 1050 and 1100 ohms. The resistance of No. 79 at

20°C was 1103 ohms, whereas 1100 ohms is the upper limit. This is considered quite satisfactory, even though this receiver was given a weight of zero on this test.

- 6-2. Every receiver withstood the shock test without any visible loosening or damage to any parts except that in No. 85 one of the coils was found to be loose after this test. Examination showed that the extension of the pole underneath the coil which connects to the magnet and which serves to retain the coil in position was broken. This coil was held in place only by the connecting wires and the receiver was therefore not in a normal condition for the tests which followed.
- 6-3. The impedance of all except two of the receivers was within 10% of 10,500 ohms; that of these two was slightly high, even after the 5% allowance for error in measurement had been applied (see Table 1, column (c)).
- 6-4. The efficiency factor of 95% of the receivers was above the lower limit of 900 bars squared per microwatt after applying the probable error to the computed values.
- 6-5. The primary resonant peak was within the 1000 to 1200 cycle band in 75% of the receivers. Of the 5 receivers having the primary resonant peak outside this band, 4 exceeded the limits by not more than 34 cycles and, when the caps were replaced on two of these (No. 72 and No. 76) following the humidity test, the peak frequency was within the specified limits (see Table 1, column (e) and next to last column).
- 6-6. The secondary resonant peak was not as much as 4 db below the primary resonant peak in 20% of the receivers. In these cases the secondary peak was from 2.3 to 3.5 db below the primary peak.
- 6-7. The band width of the primary peak 4 db down from the peak lies outside of the tolerance (10-15% of the primary peak frequency) in 55% of the receivers; the band width 8 db down lies outside the tolerance (20-25% of the primary peak frequency) in 85% of the receivers. The actual values are given in column (g) of Table 1, from which it may be observed that the primary peak is usually broader than that detailed in the specifications.
- 6-8. The band width of all secondary resonant peaks conforms to the requirements of the specifications.
- 6-9. The loss of sensitivity due to the humidity test as determined at the frequency of maximum response was in all cases less than 4 db. As indicated in the last column of Table 1,

the humidity exposure had practically no effect on the sensitivity of these receivers.

- 6-10. The insulation resistance between the winding and the case after the humidity exposure was greater than 100 megohms in all cases.
- 6-11. No metal parts of the receivers showed excessive rust or corrosion, nor was the insulating material damaged by the humidity exposure, except that minute rust spots were visible on the diaphragms of receivers No. 73, No. 80 and No. 82. While the peak frequency of receivers No. 73 and No. 80 was brought down from 1400 cycles to 970 and 1032 cycles respectively by rubbing the diaphragms smooth around the edge, yet from Table 1 it will be noted that the primary resonant peak of these two receivers was high before the humidity exposure. It may therefore be concluded that the effect of the humidity test was merely to make still higher an already excessively high peak frequency and that the diaphragm edges were probably not smooth when received (see Table 1, column (e), and next to last column). The diaphragms in these receivers are all coated with the usual enamel or lacquer on both surfaces.

10. The telephone cords supplied with these receivers are the same as those favorably commented upon in reference (e), paragraph 10.

CONCLUSIONS

11. These receivers comply with the governing specifications in all respects except that the average primary band width 4 db and 8 db down from the peak is somewhat broader than that specified and except that the primary peak frequency of one more receiver than 20% of those tested was slightly outside the prescribed band. The average mark achieved by the receivers in the test is 89.4.

12. These receivers are considered suitable for Naval use.

TABLE 1

DATA ON HEAD TELEPHONE RECEIVERS, TYPE CW49003.

(Letters in column headings correspond to
those in Par. 7-4 of Specifications
RE 13A 511A)

Sample Test No.	Imped- ance (ohms) (c)	Eff. Factor (d)	Peak Freq. (cycles) (e)	Primary Band Width %		After Humidity Test	
				4 db (g)	8 db	Peak Freq.	Loss of Sens. (i)
72	11,370	805	983	16.6	25.3	997	0.6
73	12,275	887	1305	7.1	15.9	1400 ^x	-1.7
74	11,330	1725	1050	16.0	32.0	1138	-1.0
75	9,870	1155	1041	20.3	36.6	1002	-1.1
76	10,520	1180	980	18.4	37.5	1021	-1.9
77	12,240	731	1222	13.3	23.4	1142	1.5
78	9,860	1313	1004	18.0	38.0	1055	-1.2
79	10,270	824	1009	19.7	47.1	1099	-3.3
80	12,020	1007	1234	11.4	20.9	1405 [*]	-3.6
81	10,260	1240	1000	15.7	34.6	1020	0.0
82	10,260	1250	1045	15.3	30.4	1187	-1.3
83	10,580	1475	1016	16.8	32.5	997	0.2
84	10,900	1505	1086	15.3	29.2	1115	1.5
85	11,940	797	1166 [#]	8.9	17.2	997 [#]	-2.0
86	11,110	1618	1028	15.2	30.4	1038	0.8
87	10,930	940	1016	15.5	34.6	1028	0.5
88	10,920	1300	1034	15.1	34.3	1042	-0.9
89	10,520	1605	1064	13.5	26.3	1053	0.5
90	11,020	1250	1010	15.9	34.3	1019	0.7
91	10,400	1260	1025	14.9	30.0	1047	0.0

x After minute rust spots removed from edge of diaphragm, frequency equals 970.

* After minute rust spots removed from edge of diaphragm, frequency equals 1032.

Peak frequency varied due to loose coil, probably result of shock test.
(See Paragraph 9, subparagraph 6-2.)

TABLE 2

TABLE OF WEIGHTS

HEAD TELEPHONE RECEIVERS, TYPE CW49003.

(Letters in column headings correspond to those in Par. 7-4 of Specifications RE 13A 511A.)

Sample Test No.	D.C.R. (a)	Shock (b)	Impedance (c)	Eff. (d)	Peak Freq. (e)	Sec. Peak (db) (f)	Pri. Band Width 4 db (g)	Sec. Band Width 3 db (h)	Loss of Sens. (i)	Ins. Res. (j)	Eff. of Humidity (k)	Total Weight
72	2	5	20	20	0	0	1	2	20	2	5	77
73	2	5	0	20	0	2	0	2	20	2	0	53
74	2	5	20	20	20	2	0	2	20	2	5	98
75	2	5	20	20	20	2	0	2	20	2	5	98
76	2	5	20	20	0	0	0	2	20	2	5	76
77	2	5	0	0	0	2	1	2	20	2	5	40
78	2	5	20	20	20	0	0	2	20	2	5	96
79	0	5	20	20	20	0	0	2	20	2	5	94
80	2	5	20	20	0	2	1	2	20	2	0	75
81	2	5	20	20	20	2	0	2	20	2	5	98
82	2	5	20	20	20	2	0	2	20	2	5	99
83	2	5	20	20	20	2	0	2	20	2	5	98
84	2	5	20	20	20	2	1	2	20	2	5	99
85	2	0	20	20	20	2	0	2	20	2	5	93
86	2	5	20	20	20	2	1	2	20	2	5	99
87	2	5	20	20	20	2	1	2	20	2	5	99
88	2	5	20	20	20	2	1	2	20	2	5	99
89	2	5	20	20	20	2	1	2	20	2	5	99
90	2	5	20	20	20	2	0	2	20	2	5	98
91	2	5	20	20	20	2	1	2	20	2	5	99
Average												89.4
% Failures	5	5	10	5	25	20	85	0	0	0	10	