MILITARY
SPECIFICATION

MIL-M-13189A(SigC)
27 July 1954
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MICROPHONE ELEMENTS, CARBON AND EARPHONE ELEMENTS, MAGNETIC (FOR TELEPHONE AND RADIO USE)

1. SCOPE

1.1. This specification covers requirements for a carbon microphone element and magnetic earphone elements for use in specific telephone and radio applications. The carbon microphone element has a nominal impedance of 28 ohms. The magnetic earphone elements have impedances of 128, 256 or 3,000 ohms, ±15 percent, as required for intended application.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, and drawings of the issue in effect on date of invitation for bids form a part of this specification.

SPECIFICATIONS

FEDERAL

NN-B-591	Boxes; Fiberboard, Wood-Cleated.
NN-B-621	Boxes; Wood, Nailed And Lock Corner.
QQ-S-571	Solder; Soft (Tin, Tin-Lead And Lead Silver).
UU-T-111	Tape; Paper, Gummed (Sealing And Securing).
LLL-B-631	Boxes; Wood, Wirebound.
PPP-B-601	Boxes; Wood, Cleated-Plywood.
PPP-B-676	Boxes, Set-Up, Paperboard.

MILITARY

JAN-P-106	Packaging And Packing For Overseas Shipment - Boxes, Wood, Nailed.
MIL-P-116	Preservation, Methods of.
JAN-P-120	Packaging And Packing for Overseas Shipment - Cartons, Folding, Paperboard.
JAN-T-152	Treatment, Moisture And Fungus-Resistant, Of Communications, Electronic, And Associated Electrical Equipment: General Process For.
MIL-V-173	Varnish, Moisture And Fungus-Resistant, For The Treatment of Communications, Electronic And Associated Electrical Equipment.
JAN-W-583	Wire, Magnet.
MIL-T-10513	Tropicalization of Materials Used in Signal Corps Equipment.
MIL-L-10547	Liners, Case, Waterproof.

U.S. ARMY

72-53	Finished (For Ground Signal Equipment).

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures And Tables for Inspection by Attributes.
MIL-STD-129	Marking For Shipment And Storage.

DRAWINGS

SIGNAL CORPS

SC-D-16286	Standard Cycle For Moisture-Resistance Treatment Of Component Parts.
SC-D-19999	Standard Extreme-Temperature Cycle.
SC-C-22546	Cap, Receiver.
SC-C-22547	Cap, Transmitter.
SC-B-22556	Transmitter.
SC-B-105976	Receiver.
SC-F-105992	Handle, Handset Assembly.

(Copies of specifications, standards, and drawings required by contractors in connection with specific procurement functions should be obtained from or as directed by the contracting officer. Both the title and identifying number or symbol should be stipulated when requesting copies.)

2.2 Other publications. - The following documents form a part of this specification. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

AMERICAN STANDARDS ASSOCIATION PUBLICATIONS

Z 24.4/164	Calibration of Standard Pressure Microphones.
Z 24.9/186	Coupler Calibration of Earphones.

(Application for copies should be addressed to the American Standards Association, Incorporated, 70 East Forty-Fifth Street, New York 17, New York.)

3. REQUIREMENTS

3.1 Construction.- The carbon microphone element and magnetic earphone elements shall be constructed in accordance with the requirements of this specification and shall be capable of passing the tests of Section 4.

3.2 Parts, materials, and processes; general.-

3.2.1 Selection.- Parts, materials, and processes shall be:

(a) As called for by this specification, and such as to enable the equipment to meet specified performance and other requirements.

(b) In conformance with the applicable documents referenced in this specification. The particular types, classes, grades, characteristics, composition, construction, etc., selected under the applicable documents shall enable compliance with specified equipment performance and other requirements.

3.2.2. Ratings.- Ratings and derated values of parts and materials shall not be exceeded when the equipment is subjected to specified service conditions. (See 3.3). Derating methods described by applicable specifications or standards shall be used.

3.2.3 Insulation material.- Insulation material shall not support rapid combustion. The material used shall be sufficiently rigid and free from cold flow to maintain its function when the equipment is subjected to the service conditions and tests in Section 4.

3.2.4 Plastic material.- Where not machined, plastic material shall have the original smooth or polished surfaces. Surfaces that have been sawed, cut, punched, or otherwise machined shall be as smooth as practicable in accordance with good manufacturing practice for the kind of material used and the intended application.

3.2.5 Metals.- The metals used shall be of the proper alloy and hardness necessary to provide the required strength and rigidity with the maximum strength to weight ratio. Magnetic materials shall represent the latest commercial developments in alloys to obtain flux densities.

3.2.5.1 Corrosion resistant metals.- Materials shall be of corrosion-resisting types or shall be suitably processed to resist corrosion in accordance with Specification 72-53. Gold, nickel, chromium, rhodium, corrosion-resisting steel (12 percent or more chromium), tin, lead-tin alloys or sufficiently thick platings of these metals are satisfactory without additional protection or treatment other than buffing or cleaning. Aluminum, magnesium, brass, iron, steel (except as above), cadmium and zinc require additional protection in accordance with Specification 72-53.

3.2.5.2 Dissimilar metals.- Unless sutiably protected against electrolytic corrosion, no dissimilar metals having an electrolytic potential difference greater than 0.4 volt between them when immersed in 3 percent sodium choride solution shall be used in intimate contact with each other. Specifically, in terms of metals most generally used in electronic equipment, this precludes the use of:

(1) Copper alloys against aluminum alloys or zinc base alloys.

(2) Corrosion-resisting ferrous alloys against aluminum alloys or zinc base alloys.

(3) Magnesium alloys against platings of silver, platinum, nickel or zinc.

Where it is necessary that any of the above cominations be assembled in intimate contact with each other, they shall be protected in accordance with Specification 72-53.

3.2.6 Wire, magnet.- Unless otherwise specified in a referenced document, magnet wire shall conform to Specification JAN-W-583.

3.2.7 Soldering.-

3.2.7.1 Solder.- Solder used for electrical connections shall be composition Sn60 conforming to Specification QQ-S-571.

3.2.7.2 Flux and cleaning agents.- No acid or acid salts shall be used in preparation for or during soldering; however, exception is permitted for preliminary tinning of electrical connections and for tinning or soldering mechanical joints not used to complete electrical circuits, but in no case shall acid or acid salts be used where they can come in contact with insulation material. Where acid or acid salts are used, as permitted above, they shall be completely neutralized and removed immediately after use. Flux for soldering of electrical connections shall be rosin and alcohol, or rosin and turpentine.

3.2.7.3 Process.-There shall be no sharp points or rough surfaces resulting from insufficient heating. The solder shall feather out to a thin edge, indicating proper flowing and wetting action, and shall not be crystallized, overheated, or under heated. The minimum necessary amount of flux and solder shall be used for electrical connections. The soldering shall be so accomplished that no rosin remains on the joint or in the proximity of the joint. Any means employed to remove an unavoidable excess of flux shall not incur the risk of loose particles of flux, brush bristles, or other foreign material remaining in the equipment. Insulation material that has been subjected to heating during the soldering operation shall be undamaged and parts fastened thereto shall not have become loosened.

3.2.8 Cleaning.- Metal parts, after fabrication, shall be cleaned in accordance with good commercial practice, or as specified in an applicable document. Cleaning processes shall have no visible or latent deleterious effect on the equipment. Corrosive material shall be removed completely before parts are assembled in the equipment. After assembly, components shall be cleaned thoroughly and shall be free from particles of solder, flux and other foreign material. If necessary, such cleaning shall also be performed before final assembly of components.

3.2.9 Wiring.-All wiring shall be neat, sturdy and as short as possible.

3.2.9.1 Terminations.- All wires shall be securely fastened at their terminations, and shall not depend upon solder for mechanical strength. All textile insulation ends shall be varnished or otherwise treated to prevent fraying. Varnish used shall be in accordance with Specification MIL-V-173.

3.2.10 Tropicalization.- The assembled elements shall be treated in accordance with Specification JAN-T-152. Before being assembled in the equipment, materials, and parts shall be treated in accordance with Specification MIL-T-10513. All surfaces of material not inherently fungus inhibiting shall be treated.

3.3 Service conditions.- At the conclusion of the service conditions tests specified in 4.7.1 through 4.7.5 there shall be no evidence of breakage, warpage, cracking, loosening of parts, corrosion or other physical, electrical or acoustical degradation sufficient to interfere with proper transmission or reception. The degradation in response from the original values shall not exceed 4 db for carbon microphone elements and 3 db for magnetic earphone elements as a result of any or all of the service conditions tests. The test conditions shall be as follows:

3.3.1 Temperature.- Continuous exposure at ±160°F and at -80°F at any orientation when tested in accordance with 4.7.3.

3.3.2 Moisture resistance.- Relative humidity up to 100 percent including condensation caused by temperature changes when tested in accordance with 4.7.2.

3.3.3 Resistance to impact.- Six drops of 3 feet in accordance with test of 4.7.4.

3.3.4 Vibration.- Vibration in accordance with the test of 4.7.5.

3.3.5 Immersion.- Immersed for 10 minutes to a covering depth of 6 inches in accordance with test of 4.7.1.

3.4 Carbon microphone element.-

3.4.1 Design and construction, general.- The design and construction of the carbon microphone element shall be such that it will be inherently stable in mechanical, electrical, and acoustical characteristics. It shall not be necessary to condition the microphone element by any special procedure before it is ready for use. It shall be in accordance with the best manufacturing design and practice to meet the requirements and tests of this specification.

3.4.1.1 Carbon.- The carbon granules used in the microphone element shall be of a grade, quality, size and shape suitable in every respect for the particular application. Only non-contaminated carbon shall be used in the microphone element.

3.4.1.1.1 All surfaces of the carbon chamber which are in contact with the carbon granules shall be suitably plated with gold. The plated surfaces shall be free from porosity and thoroughly cleaned before assembly. The design of the carbon chamber shall be such as to preclude migration of carbon granules into areas adjacent to the carbon chamber.

3.4.1.2 Dimensions.- Carbon microphone elements shall conform to all dimensional requirements of Drawing SC-B-22556.

3.4.2 Performance.-

3.4.2.1 Response.- Carbon microphone elements shall meet the following response requirements when tested as specified in 4.5.1.1.4.

3.4.2.1.1 When the microphone element is in the vertical position and subjected to the sound pressure of 28 dynes per cm^2, in the 600 to 1600 c.p.s. frequency band, its output shall be not less than 57 db above one millivolt.

3.4.2.1.2 When the microphone element is in the vertical position and subjected to the sound pressure of 28 dynes per cm^2, in the 2000 to 3000 c.p.s. frequency band, its output shall be not less than 60 db above one millivolt.

3.4.2.1.3 With the microphone element in the vertical position, the difference between the 2000 to 3000 c.p.s. output minus the 600 to 1600 c.p.s. output shall be not less than -1 db nor more than +5 db.

3.4.2.1.4 The variation in output in the three positions, for either the 600 to 1600 c.p.s. frequency band or the 2000 to 3000 c.p.s. frequency band, shall not exceed 5 db.

3.4.2.1.5 The maximum unagitated current referred to in 4.5.1.1.4.9.1 shall not exceed 0.325 ampere.

3.4.2.1.6 The maximum agitated current referred to in 4.5.1.1.4.9.2 shall not exceed 0.125 ampere.

3.4.2.2 Thermal noise.- The maximum thermal noise developed by individual microphone elements, subjected to the test of 4.5.1.2, shall be within the following limits:

(a) New microphone elements: 0.126 microvatt
(b) Aged microphone elements: 3.98 microvatts

The maximum resistance of an aged microphone element shall be not more than twice the maximum resistance of the same microphone element prior to the vibration test.

3.5 Magnetic earphone elements.-

3.5.1 Design and construction, general.- The design and construction of the magnetic earphone elements shall be such that they will be inherently stable in mechanical, electrical, and acoustical characteristics. The magnetic earphone elements shall be in accordance with the best manufacturing design and practice to meet the requirements and tests of this specification.

3.5.1.1 The wire used in the construction of the coil of the earphone elements shall be double formex not smaller in diameter than #41 AWG. The coil shall be suitably impregnated with moisture-and-fungus-proofing in accordance with Specification JAN-T-152.

3.5.1.2 The assembled earphone elements shall be free from foreign bodies such as iron filings.

3.5.1.3 The air gap between the diaphragm and pole pieces shall have a minimum dimension of 0.007 inch. The stability of the air gap shall be independent of the housing.

3.5.1.4 The material used for the diaphragm shall be permendur or some other equivalent magnetic material, suitably protected against corrosion, which will enable the earphones to meet all the performance requirements of this Specification.

3.5.1.5 Dimensions.- The magnetic earphone elements shall comply with all dimensional requirements of Drawing SC-B-105976.

3.5.2 Performance.-

3.5.2.1 Response.- The minimum sound pressure developed by the magnetic earphone elements at 1000 c.p.s., when tested at 50 microwatts input power as specified in 4.5.2.1, shall be not less than 95 db above 0.0002 dyne per cm^2. The available power response frequency characteristic of each earphone shall be within the following limits:

Frequency Range c.p.s.	Deviation from 1000 c.p.s. db	
600-1600	+3	-3
1600-3000	+8	-8

3.5.2.1.1 The maximum difference in sound pressure output (for any earphone element) at any two frequencies within the range of 600 to 2700 c.p.s and differing by 100 c.p.s. shall not exceed 3.5 db.

3.5.2.1.2 The 1000 c.p.s. response of the earphone element at 6 microwatts input power as specified in 4.5.2.1.1 shall be not less than 85.8 db above 0.0002 dyne per cm^2.

3.5.2.2 Overload.- When tested as specified in 4.5.2.3 the earphone element shall exhibit no evidence of rattling or distortion.

3.5.2.3 Dielectric strength and leakage resistance.- With the earphone element tested as specified in 4.5.2.4 there shall be no evidence of insulation breakdown. The insulation resistance shall not be less than one megohm between points indicated in 4.5.2.4.

3.5.2.4 Magnetic stability.- After subjection of the earphone element to the treatment described in 4.5.2.5 the degradation in response of the earphone element at each test frequency shall be not more than 2 db below the values initially obtained in 4.5.2.1.

3.5.2.5 Impedance.- The impedance of the magnetic earphone elements shall be 128, 256 or 3000 ohms ±15 percent as specified in the contract or order.

3.6 Preproduction samples.-

3.6.1 Quantities of preproduction samples.- After award of Contract, the following preproduction samples shall be furnished for Government inspection and approval. (see 6.2)

12 each of every type magnetic earphone element on order.
12 each of carbon microphone element on order.

3.6.2 Compliance with specified requirements.-

3.6.2.1 Preproduction samples shall meet specified requirements, shall be made and assembled by tools and methods that will be used for quantity production, and shall be accompanied by a statement to that effect. (See 3.6.2.3 for exception.)

3.6.2.2 Approval of preproduction samples shall not be construed as a waiver of any specified requirement. After being released to the contractor (see 3.6.4), preproduction samples to be offered as units on contract shall be refabricated by the contractor if necessary to meet specified requirements.

3.6.2.3 When deviation from 3.6.2.1 is unavoidable, the preproduction samples may be submitted for approval provided that the accompanying statement describes in detail each nonconforming feature, reason therefore, and manner in which it will be corrected in production of equipment on contract.

3.6.3 Test data.- The preproduction samples shall be accompanied by test data showing compliance with specified performance. The test data shall comprise an engineering report giving test procedure, observations, and other data, calculations, test results, and essential details of the testing equipment (manufacturer's model, serial number, date of calibration, and the like).

3.6.4 Reference standards.- After preproduction samples have been approved and returned to the contractor's plant, they shall be kept intact in custody of the Government inspector until released by him. They shall be used as reference standards to resolve any differences of opinion regarding interpretation of specified requirements.

3.7 Marking.- Marking shall conform to Specification MIL-M-13231.

3.7.1 Serial numbers.- Serial numbers under Specification MIL-M-13231 are not required.

3.8 Interchangeability.- Corresponding elements on contract shall be physically and functionally interchangeable without modification thereof or of other items with which the elements are used.

3.9 Workmanship.- Workmanship shall comply with the requirements of 3.2.3 through 3.2.5, 3.2.7 through 3.2.10, 3.4.1 through 3.4.1.2, 3.5.1 through 3.5.1.5, 3.7 through 3.8, and the following: The elements shall be free of foreign materials, loose solder, excess rosin, and potential short circuits. Crimped joints shall be smooth and free of sharp edges or projections and waterproof membranes shall be free of punctures. Elements shall be free of abrasions or scratches in plating and tropicalization material, causing exposure of unprotected metal.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of inspection.- Inspection shall be classified as follows:

(a) Preproduction inspection
(b) Acceptance inspection

4.2 Preproduction inspection.- Preproduction inspection shall consist of the group A inspection and nondestructive group B and group C inspection specified in tables I,II, and V, respectively. Other nondestructive inspection on preproduction samples may be performed to determine compliance with specified requirements. Preproduction inspection will normally be performed in this order: (1) vibration, (2) resistance to impact, and (3) immersion; other preproduction inspection may precede, follow, or be interspersed between the foregoing.

4.3 Acceptance inspection.- Acceptance inspection shall consist of group A, group B, and group C inspection as specified in 4.3.1 through 4.3.3.2. (See 6.3.1.) Group B inspection shall normally be performed on lots that have passed group A inspection and on samples selected from units that have been subject to and met the group A inspection. In addition, group C inspection shall normally be performed on sample units that have been subjected to and met group B inspection. However, the order may be varied when the Government considers it more practical to select separate samples for group B or Group C inspection, or both.

4.3.1 Group A inspection.- Group A inspection (including sampling) shall conform to table I and Standard MIL-STD-105. Group A inspection shall be performed in any order which is satisfactory to the Government inspector, except that the talk test (4.6) shall be last.

Table I - Government group A inspection

Inspection or Test	Requirement Par.	Test Par.	AQL Major	AQL Minor
Carbon microphone element				
Visual and mechanical		4.4	1%	4%
Response	3.4.2.1	4.5.1.1.4	1% *	-
Talk	-	4.6	1%	-
Magnetic earphone element				
Visual and mechanical	-	4.4	1%	4%
Response	3.5.2.1	4.5.2.1	)1%	
Dielectric strength and leakage resistance	3.5.2.3	4.5.2.4	)for)group	
Talk	-	4.6	1%	

* All electrical defects shall be classified as major.

4.3.2 Group B inspection.- Group B inspection shall conform to table II.

4.3.2.1 Sampling for group B.- Sampling shall be conducted in accordance with table II. Sample units shall be selected, without regard to their quality, by the Government inspector. Unless otherwise specified, normal inspection shall be used at the start of the contract. If the number of defective sample units from a lot exceeds the acceptance number specified in the sampling plan, the lot shall be rejected. Disposition of rejected product (sample units and lots) shall be in accordance with Standard MIL-STD-105 and 4.3.5.

4.3.2.2 Order of inspection within group B.- Group B inspection shall be performed in any order which is satisfactory to the Government inspector.

4.3.2.3 Procedure in case of failure.- When a lot is rejected, the contractor shall immediately investigate the cause of failure and shall report to the Government inspector the results thereof and details of the corrective action taken. If the contractor and Government inspector cannot agree on the effectiveness of the corrective action, the matter shall be referred to the contracting officer for resolution.

Table II - Government group B inspection

Inspection or test	Requirement Par.	Test Par.	Group B plans	Table
Carbon microphone element				
Thermal noise	3.4.2.2	4.5.1.2	B-4	III
Magnetic earphone element				
Impedance	3.5.2.5	4.5.2.2	)B-2	
Overload	3.5.2.2	4.5.2.3	)for	IV
Magnetic stability	3.5.2.4	4.5.2.5	)group	

Table IIIa Group B-4 sampling plans

Lot size /&	Reduced /# Inspection		Normal /# Inspection		Tightened /# Inspection	
	Sample size	Acceptance number	Sample size	Acceptance number	Sample size	Acceptance number
9 to 25, incl.	2	0	2	0	4	0
26 to 65, incl.	2	0	2	0	4	0
66 to 180, incl.	3	1	3	1	7	1
181 to 500, incl.	3	1	7	2	11	2
501 to 1,300, incl.	3	1	11	3	16	3
1,301 to 3,200, incl.	7	2	16	4	21	4
3,201 to 8,000, incl.	7	2	21	5	27	5
8,001 to 22,000, incl.	11	3	27	6	32	6
22,001 and over	11	3	32	7	32	6

/& For lot sizes under 9, the sample size shall be at the option of the Government but not more than 2, and the acceptance number shall be 0.

/# Normal, tightened, or reduced inspection shall be used in accordance with the following: (Part "b" of this table lists valued for limits A, B, and C, referenced below.)

(1) Calculate the estimated process average from the formula 100 P/N; where P equals the number of defective units found in N sample units, and N equals the number of sample units included in the estimated process average. The Government will determine the number of consecutive sample units to be used to estimate the process average.

(2) Except as stated in (3) below, use normal inspection as long as the process average is between limits A and C.

(3) Change to tightened inspection whenever the process average becomes equal to or greater than limit A, or whenever a lot fails to pass.

(4) Return to normal inspection from tightened inspection when two lots in succession pass tightened inspection, and the process average becomes less than limit B.

(5) Change to reduced inspection whenever the process average becomes less than limit C.

(6) Return to normal inspection from reduced inspection when the process average becomes equal to or greater than limit C.

Table IIIb - Group B-4 limits of the process average

N	Limit A %	Limit B %	Limit C %	N	Limit A %	Limit B %	Limit C %
10	34.27	23.63	*	130-144	18.90	15.95	7.10
11	33.28	23.14	*	145-159	18.59	15.79	7.41
12	32.42	22.71	*	160-179	18.32	15.66	7.68
13	31.65	22.33	*	180-199	18.01	15.51	7.99
14	30.98	21.99	*	200-249	17.76	15.38	8.24
15-16	30.37	21.68	*	250-299	17.25	15.13	8.75
17-18	29.31	21.16	*	300-349	16.88	14.94	9.12
19-20	28.43	20.72	*	350-399	16.60	14.80	9.40
21-23	27.68	20.34	*	400-449	16.36	14.68	9.64
24-26	26.73	19.86	*	450-499	16.17	14.59	9.83
27-29	25.94	19.47	0.06	500-549	16.01	14.50	9.99
30-34	25.28	19.14	0.72	550-599	15.87	14.43	10.13
35-39	24.37	18.68	1.63	600-649	15.75	14.37	10.25
40-44	23.63	18.32	2.37	650-699	15.64	14.32	10.36
45-49	23.03	18.01	2.97	700-749	15.54	14.27	10.46
50-59	22.51	17.76	3.49	750-799	15.46	14.23	10.54
60-69	21.68	17.34	4.33	800-849	15.38	14.19	10.62
70-79	21.04	17.02	4.96	850-899	15.31	14.15	10.69
80-89	20.52	16.76	5.48	900-949	15.24	14.12	10.76
90-99	20.09	16.54	5.91	950-999	15.18	14.09	10.82
100-114	19.73	16.36	6.27	1000	15.13	14.06	10.87
115-129	19.27	16.14	6.73				

* Number of sample units included in estimated process average is insufficient for reduced inspection.

N - Number of sample units in estimated process average.

Table IVa .-Group B-2 sampling plans

Lot size /&	Reduced /# Inspection		Normal /# Inspection		Tightened /# Inspection	
	Sample size	Acceptance number	Sample size	Acceptance number	Sample size	Acceptance number
9 to 25, incl.	2	0	2	0	4	0
26 to 65, incl.	2	0	3	0	6	0
66 to 180, incl.	7	1	7	1	17	1
181 to 500, incl.	7	1	17	2	28	2
501 to 1,300, incl.	7	1	28	3	41	3
1,301 to 3,200, incl.	17	2	41	4	53	4
3,201 to 8,000, incl.	17	2	53	5	66	5
8,001 to 22,000, incl.	28	3	66	6	81	6
22,001 and over	28	3	81	7	81	6

/& For lot sizes under 9, the sample size shall be at the option of the Government but not more than 2, and the acceptance number shall be 0.

/# Normal, tightened, or reduced inspection shall be used in accordance with the following: (Part "b" of this table lists values for limits A, B, and C, referenced below.)

(1) Calculate the estimated process average from the formula 100 P/N; where P equals the number of defective units found in N sample units, and N equals the number of sample units included in the estimated process average. The Government will determine the number of consecutive sample units to be used to estimate the process average.

(2) Except as stated in (3) below, use normal inspection as long as the process average is between limits A and C.

(3) Change to tightened inspection whenever the process average becomes equal to or greater than limit A, or whenever a lot fails to pass.

(4) Return to normal inspection from tightened inspection when two lots in succession pass tightened inspection, and the process average becomes less than limit B.

(5) Change to reduced inspection whenever the process average becomes less than limit C.

(6) Return to normal inspection from reduced inspection when the process average becomes equal to or greater than limit C.

Table IVb .-Group B-2 limits of the process average

N	Limit A %	Limit B %	Limit C %	N	Limit A %	Limit B %	Limit C %
10	18.78	11.89	*	130-144	8.82	6.91	1.18
11	18.14	11.57	*	145-159	8.62	6.81	1.38
12	17.58	11.29	*	160-179	8.45	6.72	1.55
13	17.09	11.04	*	180-199	8.25	6.62	1.75
14	16.65	10.82	*	200-249	8.08	6.54	1.92
15-16	16.25	10.63	*	250-299	7.76	6.38	2.24
17-18	15.57	10.29	*	300-349	7.52	6.26	2.48
19-20	15.00	10.00	*	350-399	7.33	6.16	2.67
21-23	14.51	9.76	*	400-449	7.18	6.09	2.82
24-26	13.90	9.45	*	450-499	7.05	6.03	2.95
27-29	13.39	9.19	*	500-549	6.95	5.97	3.05
30-34	12.96	8.98	*	550-599	6.86	5.93	3.14
35-39	12.37	8.68	*	600-649	6.78	5.90	3.22
40-44	11.89	8.45	*	650-699	6.71	5.85	3.29
45-49	11.50	8.25	*	700-749	6.65	5.82	3.35
50-59	11.16	8.08	*	750-799	6.59	5.80	3.41
60-69	10.63	7.81	*	800-849	6.54	5.77	3.46
70-79	10.21	7.60	*	850-899	6.50	5.75	3.50
80-89	9.87	7.44	0.13	900-949	6.45	5.73	3.55
90-99	9.59	7.30	0.41	950-999	6.41	5.71	3.59
100-114	9.36	7.18	0.64	1000	6.38	5.69	3.62
115-129	9.06	7.03	0.94				

* Number of sample units included in estimated process average is insufficient for reduced inspection.

N - Number of sample units in estimated process average.

4.3.3 Group C inspection.- Group C inspection shall be as listed in Table V.

4.3.3.1 Sampling for group C.- Two of each type element on order shall be selected each month for each group C inspection, without regard to their quality, by the Government inspector.

4.3.3.2 Noncompliance.- If a sample unit fails group C inspection, the contractor shall immediately investigate the cause of failure and shall report to the Government inspector the results thereof and details of the corrective action taken on the process and affected portion of product. If the Government inspector does not consider that the corrective action will enable the product to meet specified requirements, or if the contractor cannot determine the cause of failure, the matter shall be referred to the contracting officer.

Table V - Government group C inspection

Inspection or test	Requirement Paragraph	Test Paragraph
Immersion	3.3.5	4.7.1
Moisture-resistance	3.3.2	4.7.2
Temperature	3.3.1	4.7.3
Resistance to impact	3.3.3	4.7.4
Vibration	3.3.4	4.7.5

4.3.4 Reinspection of conforming group B and group C sample units.- Unless otherwise specified, sample units which have been subjected to and passed group B or group C inspection, or both, may be accepted on contract, provided that they are re-subjected to and pass group A inspection after repair of all visible damage.

4.3.5 Disposition of nonconforming product.- When defective sample units or rejected lots are resubmitted or affected portion of product is submitted for acceptance, such product shall be suitably tagged or identified by equivalent means to indicate the cause of failure and means employed to correct the fault. The record shall be presented to the Government when the product is submitted and shall become the property of the Government.

4.3.6 Testing assembly.- All inspecting and testing, except visual and mechanical, shall be performed with the carbon microphone element and magnetic earphone element assembled in a handset handle in accordance with Drawing SC-D-105992, with proper caps in accordance with Drawings SC-C-22546 or SC-C-22547, or assembled in the housing in which it will be used, unless otherwise specified.

4.4 Visual and mechanical.- Elements shall be examined thoroughly for workmanship, physical dimensions and tolerances, for mechanical fit, correct markings, application of specified fungus and tropicalization treatment, and miscellaneous defects. Visual and mechanical defects shall be classified by the Government as major or minor in accordance with the definitions of Standard MIL-STD-105.

4.5 Performance tests.-

4.5.1 Carbon microphone elements.-

4.5.1.1 Response.- The response test of carbon microphone element shall be conducted by using the test circuit in accordance with Figure 1. The transformer shall be Western Electric Company repeating coil No. D-96016, or equal, with a loss not to exceed 1 db, and it shall not vary more than 0.2 db over a frequency range of 600 to 3000 c.p.s. The performance values shall be corrected to compensate for the transformer loss. The variable resistor shall be adjusted to present a 10 ohm circuit when measured between the terminals which lead to the battery, and with the carbon microphone element short-circuited.

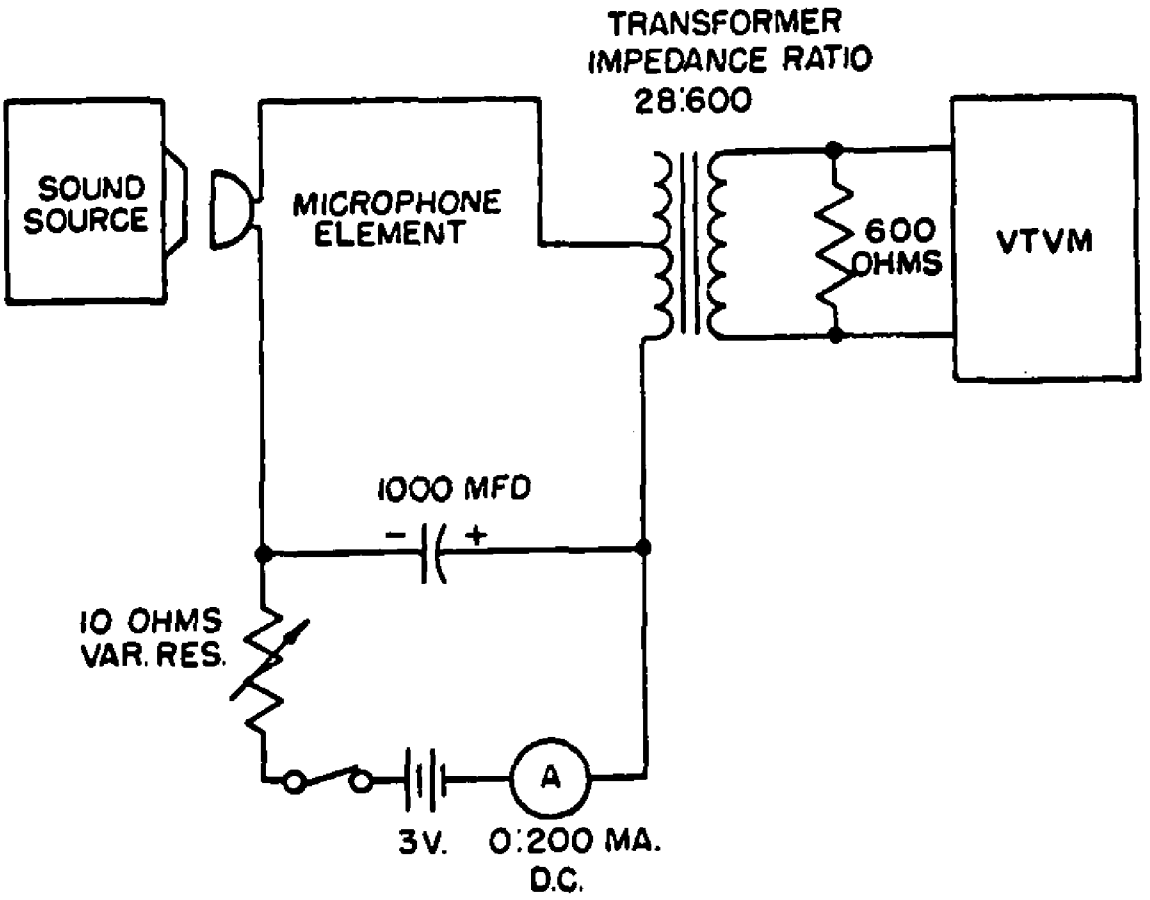
4.5.1.1.1 Test equipment.- The test equipment shall be as follows:

4.5.1.1.1.1 Vacuum tube voltmeter.- A Ballantine vacuum tube voltmeter, Model 300, or its equivalent, having a flat frequency response from 100 to 10,000 c.p.s. shall be used to measure the output voltage of the carbon microphone elements. It must be capable of measuring voltages from 0.001 volt r.m.s. to 10 volts r.m.s. or more. The input impedance of the voltmeter shall be not less than 0.5 meghom.

4.5.1.1.1.2 Sound source.- A suitable sound source such as Western Electric Company No. 555W artificial voice, or its equivalent, shall be used for the response test. The percent harmonic distortion of the sound output of the sound source shall not exceed 5 percent at any test frequency.

4.5.1.1.1.3 Audio oscillator.- A beat frequency oscillator such as Clough-Brengle Company, Model 282A, or its equivalent, shall be used.

4.5.1.1.1.4 Test fixture.- The test fixture employed to hold the carbon microphone element under test, shall support the carbon microphone element, assembled in its housing, coaxially with the sound source, and with an air space of 1/4 inch between the extreme end of the sound source and the cap of the carbon microphone element. The construction of the test fixture shall be such as to permit rotation of the sound source and the carbon microphone element, (for conditioning purpose), through 360 degrees in a vertical plane, parallel to the diaphragm of the carbon microphone element. The test apparatus shall also permit rotation of the sound source and the carbon microphone element through 180 degrees in a vertical plane, perpendicular to the diaphragm of the carbon microphone element.



RESPONSE TEST CIRCUIT
CARBON MICROPHONE ELEMENT

FIG-1

4.5.1.1.2 Sound pressure calibration.- A Western Electric Company No. 640AA condenser microphone, or its equivalent, with its protective grid, shall be used for setting up the sound pressure level for performing the response measurements. The condenser microphone shall be calibrated by the reciprocity method in accordance with the proposed "Calibration of Standard Pressure Microphones," A.S.A. Standard Z24.4/164. The plane of the protective grid of the condenser microphone shall be located parallel to and 1/4 inch from the face of the sound source, and the geometrical center line of the grid shall coincide with the center line of the face of the sound source. The electrical input to the sound source shall be adjusted to provide a sound pressure in the frequency bands of 600-1600 c.p.s. and 2000-3000 c.p.s. of 28 dynes per cm^2 at the grid of the condenser microphone. The electrical output of the condenser microphone shall be measured with a Ballantine electronic voltmeter, Model 300, or equal, as described in 4.5.1.1.1.1.

4.5.1.1.3 Agitation provided by the sound source.- The agitation provided by the sound source shall consist of two bands of frequencies, applied successively, one covering the range of 600 to 1600 c.p.s. and another covering the range of 2000 to 3000 c.p.s. These band frequencies shall be obtained by impressing on the input terminals of the sound source a voltage whose frequency varies at a constant rate in cycles per second, from the lower to the upper frequency limit specified and returning to the lower limit. The cycles of frequency change shall occur at the rate of approximately 6 per second and the voltage shall be of uniform intensity at all frequencies within the band. The sound pressure output of the sound source working into a free sound field measured 1/4 inch from the face of the sound source shall be 28 dynes per square centimeter.

4.5.1.1.4 Testing procedure.-

4.5.1.1.4.1 Shake the carbon microphone element vigorously in all directions before mounting it in the fixture. Locate the carbon microphone element assembled in its housing as specified in 4.5.1.1.1.4 and connect it in the test circuit shown in Figure I with the battery switch open. Place the sound source so that its face is in the vertical plane. Rotate the microphone element and sound source about their axes through an arc of approximately 270 degrees and back to the original position, two times at a regular uniform rate of appoximately one complete cycle, (270 degrees and back), in two seconds. Position the test apparatus so that the diaphragm of the carbon microphone element is in the vertical plane.

4.5.1.1.4.2 Close battery switch and apply a conditioning tone of 600 to 1600 c.p.s at a sound pressure of 6 db above 28 dynes per cm^2 for 3 seconds.

4.5.1.1.4.3 Apply the 600 to 1600 c.p.s. test tone of 28 dynes per cm^2 for 3 seconds and then measure the output delivered to the load resistance.

4.5.1.1.4.4 Open the battery switch and position the sound source so that its face is in the vertical plane. Rotate the microphone element and sound source about their axes through an arc of approximately 270 degrees and back to the original position, two times at a regular uniform rate of approximately one complete cycle, (270 degrees and back), in 2 seconds. Position the test apparatus so that the diaphragm of the microphone element is in the vertical plane.

4.5.1.1.4.5 Close the battery switch and apply a conditioning tone of 2000 to 3000 c.p.s. at a sound pressure of 6 db above 28 dynes per cm^2 for 3 seconds.

4.5.1.1.4.6 Apply the 2000 to 3000 c.p.s. test tone of 28 dynes per cm^2 for 3 seconds and then measure the output delivered to the load resistance.

4.5.1.1.4.7 The response requirements for the microphone element for the 600 to 1600 c.p.s. frequency band the 2000 to 3000 c.p.s. frequency banc is specified in 3.4.2.1.1 through 3.4.2.1.3.

4.5.1.1.4.8 The test procedure described in 4.5.1.1.4.1 through 4.5.1.1.4.6 shall be repeated with the exception that the response of the microphone element shall be obtained with the microphone element located respectively in the face up (-90 degrees from vertical) and face down (+90 degrees from vertical) positions. The positional requirements of the microphone element are as specified in 3.4.2.1.4.

4.5.1.1.4.9 The following limits apply to the microphone element current when tested in a circuit in accordance with Figure I:

4.5.1.1.4.9.1 When the microphone element is unagitated, the current shall not exceed the value specified in 3.4.2.1.5, at any time during a period of 10 consecutive minutes.

4.5.1.1.4.9.2 When the microphone element is agitated as described in 4.5.1.1.4.3 and 4.5.1.1.4.6 the current shall not exceed the value specified in 3.4.2.1.6.

4.5.1.2 Thermal noise.-

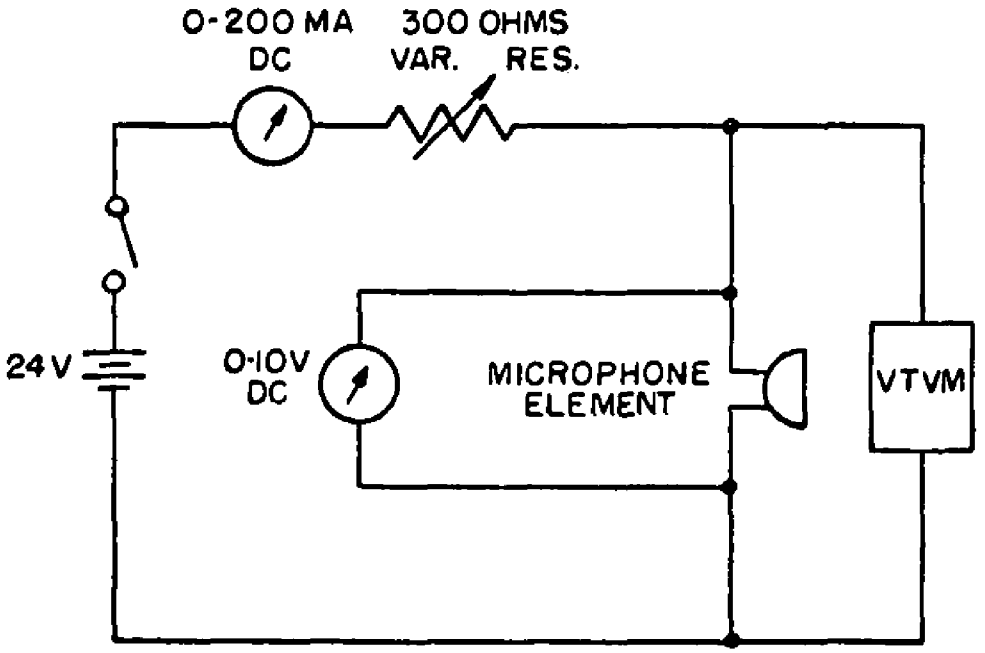
4.5.1.2.1 The testing circuit shall be in accordance with Figure 2. The microphone element shall be located in a place which is sufficiently free from noise and vibration so that the microphone element thermal noise measured, results only from disturbances generated within the microphone element.

4.5.1.2.2 The test shall consist of connecting the microphone element in the circuit, adjusting the variable resistor to obtain a d.c. current of 125 milliamperes, speaking into the microphone element in a normal tone of voice for ten seconds (or agitating it in some equivalent manner), then allowing it to remain in the circuit for one minute; thermal noise and resistance to be determined as per 4.5.1.2.3 and 4.5.1.2.4.

4.5.1.2.3 The thermal noise for the test (paragraph 4.5.1.2.2 above) shall be taken as the power determined by the following formula:

$$P = \frac{V_{ac}^2}{V_{dc}/I_{dc}}$$

Vac shall be taken as the maximum deflection of the vacuum-tube voltmeter occurring during the period from five seconds after the agitation is completed until the end of the test. Vdc and Idc shall be obtained at approximately the same time.



THERMAL NOISE CIRCUIT
CARBON MICROPHONE ELEMENT

FIG-2

4.5.1.2.4 The resistance for the test shall be taken as the maximum resistance, (determined from the Vdc and Idc readings), occurring during the periods from five seconds after the agitation is completed until the end of the test.

4.5.1.2.5 The limits of thermal noise of individual microphone elements, at any angle of microphone elements diaphragm relative to the vertical, shall be as specified in 3.4.2.2. The maximum resistance of an aged microphone element shall be as specified in 3.4.2.2. An aged microphone element shall be defined as having been subjected to the vibration test of 4.7.5.

4.5.2 Magnetic earphone elements.-

4.5.2.1 Response.- The magnetic earphone element located in its housing shall be connected in series with a non-inductive resistance equal in value to its nominal impedance: 128 ohms, 256 ohms, or 3000 ohms as specified in the bid request or order. By means of a General Radio Company Audio Oscillator Type 913-B or equal, a voltage shall be maintained across this series combination to present electrical input power to the magnetic earphone element of 50 microwatts.

4.5.2.1.1 Available power-response-frequency measurements shall be made, starting at 600 c.p.s. and extending to 3000 c.p.s. in sufficient detail to establish definitely the shape of the frequency response curve. One reading shall also be obtained at 1000 c.p.s. with the electrical input power to the magnetic earphone element of 6 microwatts.

4.5.2.1.2 The earphone element shall be tested while located on a 6 c.c. coupler, with a good seal between the earphone cap and the coupler. To insure a good seal a weight of one kilogram shall be placed on the back of the earphone housing. The sound pressure developed by the earphone element in the 6 c.c. cavity shall be measured and expressed in db above 0.0002 dyne per cm^2 .

4.5.2.1.3 Response measurements shall be made in accordance with "Coupler Calibration of Earphones," American Standards Association, Standard Z24.9/1B6. A Western Electric Company No. 640AA condenser microphone, or equivalent, shall be used for measuring sound pressure. The condenser microphone shall be calibrated by the reciprocity method in accordance with the proposed "Calibration of Standard Pressure Microphones," American Standards Association, Standard Z24.4/164.

4.5.2.1.4 The magnetic earphone elements shall meet the requirements specified in 3.5.2.1 through 3.5.2.1.2.

4.5.2.2 Impedance.- The magnetic earphone elements shall be measured while located on a 6 c.c. coupler as specified for the response test. Connect the magnetic earphone element, in series with a non-inductive resistance at least 100 times the rated impedance of the magnetic earphone element, to a source of alternating voltage at 1000 c.p.s. Adjust the source voltage to obtain an r.m.s. voltage across the magnetic earphone element specified as follows:

Rated impedance of Magnetic earphone elements (ohms)	R.M.S. Voltage across Magnetic earphone element (volt)
128	0.057
256	0.080
3000	0.275

Replace the magnetic earphone element with a variable non-inductive resistance, and without changing the source voltage, adjust the variable resistance to obtain the same voltage as for the magnetic earphone element. The ohmic value of the resistance necessary to obtain the r.m.s. voltage reading shall be considered, as the impedance of the magnetic earphone element. The impedance of the magnetic earphone element at 1000 c.p.s. shall conform to the requirements specified in 3.5.2.5.

4.5.2.3 Overload.- The earphone element shall be connected to a source of voltage whose frequency varies over the range of 600 to 2500 c.p.s. The voltage of the source shall be adjusted to provide a power of 1 milliwatt over the specified frequency range, into a resistive load equal in value to the nominal impedance of the earphone element. The element shall then be substituted for the load resistance and the element placed in close proximity to the ear. The earphone element shall then meet the requirements specified in 3.5.2.2.

4.5.2.4 Dielectric strength and leakage resistance.- The earphone element shall be subjected to a dielectric test of 500 volts d.c., or 500 volts r.m.s., 60 cycle a.c., for a period of 5 seconds, between the element terminals and metal parts which are intended to be insulated. The earphone element shall then meet the requirements as stipulated in 3.5.2.3.

4.5.2.5 Magnetic stability.- Subject the magnetic earphone element to 6 successive discharges of opposite polarities from a 10.0 microfarad condenser charged to 1230 volts. After this treatment, the earphone element frequency response shall be as specified in 3.5.2.4.

4.6 Talk test.- Carbon microphone elements and magnetic earphone elements shall be properly assembled and subjected to a talk test in an equivalent telephone circuit for satisfactory transmission performance. The telephone circuit shall be connected to an artificial line, such as an artificial 19 gauge cable variable from 0 to 32 miles, to be adjusted to the convenience of the inspector. The Government inspector may test carbon microphone elements and magnetic earphone elements for compliance with the applicable requirements of 4.5.1 and 4.5.2 after the talk test in the event of doubt as to satisfactory performance.

4.6.1 When either carbon microphone elements or magnetic earphone elements are procured separately, the counterpart (an approved sample) of the equipment being tested: i.e., the magnetic earphone element used in the test circuit when carbon microphone elements are under test and vice versa, shall be of a type (approved sample) which has been found to meet the requirements of this specification.

4.7 Service conditions tests.-

4.7.1 Immersion.- The carbon microphone elements and magnetic earphone elements shall be installed in a suitable housing and immersed to a covering depth of 6 inches for a period of 10 minutes. Upon removal, the excess water shall be removed from the carbon microphone elements and magnetic earphone elements by shaking.

4.7.1.1 After treatment as specified in 4.7.1 the carbon microphone elements and magnetic earphone elements shall meet the requirements of 3.3.

4.7.2 Moisture-resistance.-

4.7.2.1 Test procedure.- The carbon microphone elements and magnetic earphone elements shall be installed in a suitable housing and subjected to continuous cycling for ten 24 hour cycles. Temperature, relative humidity, and the period of time for each portion of the cycle shall conform to Drawing SC-D-16286.

4.7.2.1.1 At the completion of the test the carbon microphone elements and magnetic earphone elements shall meet the requirements of 3.3.

4.7.3. Temperature.- Subject the carbon microphone elements and magnetic earphone elements, installed in a suitable housing, to one temperature cycle as described in Drawing SC-D-1997[illegible]. At the completion of the test, the carbon microphone elements and magnetic earphone elements shall meet the requirements of 3.3.

4.7.4 Resistance to impact.- Subject the carbon microphone elements and magnetic earphone elements, installed in a suitable housing, to 6 drops at random position, on concrete, from a height of three feet. At the completion of the test the microphone elements and earphone elements shall meet the requirements of 3.3.

4.7.5 Vibration.- The carbon microphone elements and magnetic earphone elements, installed in a suitable housing, shall be tested as follows:

(a) The equipment shall be fastened on a vibration table that can be controlled within 10 percent of the specified amplitude. The vibration table shall provide approximately sinusoidal vibration.

(b) The equipment shall be vibrated successively in three mutually perpendicular directions (handset located in vertical plane, horizontal plane face up, and horizontal plane face down), over a frequency range of 10 to 55 cycles per second, in 1-cycle-per second steps. The total excursion shall be constant at 1/32 inch. The equipment shall ve vibrated for a total of 5 hours with at least one hour of vibration in each of the 3 directions.

(c) Simulated aging of carbon microphone elements.- During the vibration test, a.d.c. power source, in series with a variable resistor and milliameter, shall be connected to the carbon microphone element to provide current of approximately 60 milliamperes d.c., applied alternately 5 seconds ON and 5 seconds OFF for the duration of the test.

4.7.5.1 At the conclusion of the test, the carbon microphone elements and magnetic earphone elements shall meet the requirements of 3.3.

4.8 The provisions of paragraph 4.6.1 are also applicable to the service conditions test of 4.7.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging.-

5.1.1 Domestic, immediate use.- Carbon microphone elements, and magnetic earphone elements, shall be preserved and packaged to afford protection against deterioration and damge during shipment.

5.1.2 Domestic limited storage.- Carbon microphone elements, and magnetic earphone elements, shall be packaged in accordance with Specification MIL-P-116, as follows:

5.1.2.1 Carbon microphone elements and Magnetic earphone elements.- Package each unit individually Method III as follows: Cushion each unit by wrapping in flexible corrugated paper. Secure cushioning with suitable tape. Place the cushioned item within a close-fitting Kraft envelope. Properly seal closure. Packaged items bearing the same stock number, shall be placed together within a close-fitting, folding carton or set-up box, conforming to Specifications JAN-P-120 or PPP-B-676 respectively. Seal entire closure with gummed paper tape, conforming to Specification UU-T-111. The net weight of contents shall not exceed 5 pounds.

5.1.3 Military overseas.-Preserve and package carbon microphone elements and magnetic earphone elements, in accordance with procedures specified for designated methods as prescribed in Specification MIL-P-116 as follows:

5.1.3.1 Carbon microphone elements and magnetic earphone elements.- Package each unit individually Method III, following procedures as specified in 5.1.2.1.

5.2 Packing.-

5.2.1 Domestic immediate use.- The carbon microphone elements, and the magnetic earphone elements shall be so packed as to insure arrival at destination in satisfactory condition and in containers complying with Consolidated Freight Classification Rules at lowest rates.

5.2.2 Domestic limited, storage.- The carbon microphone elements and magnetic earphone elements, shall be packed in suitable quantity, packaged as specified in 5.1.2.1 within a wood cleated fiberboard, wood cleated plywood, corrugated fiberboard or nailed wood box conforming to Specifications NN-B-591, PPP-B-601, LLL-B-631 or NN-B-621. The gross weight shall not exceed 65 pounds for fiberboard boxes and 200 pounds for plywood or wood boxes. Closure shall be made in accordance with the applicable box specifications.

5.2.3 Military overseas.- The carbon microphone elements, and magnetic earphone elements shall be packed in suitable quantity, packaged as specified in 5.1.3.1 within a wood cleated plywood or nailed wood box, conforming to the requirements of Specifications PPP-B-601 or JAN-P-106 respectively. The shipping container shall be lined with a waterproof case liner, conforming to Specification MIL-L-10547. The approximate gross weight of any exterior shipping container shall not exceed 150 pounds. Close the shipping container, as specified in the appendix of the applicable box specification.

5.2.4 Shipping containers shall be strapped in conformance with the requirements of the appendix of the applicable container specification only for direct shipment to ports.

5.3 Marking for shipment.- Interior packages and exterior shipping containers shall be marked in accordance with applicable provisions of Standard MIL-STD-129.

6. NOTES

6.1 Intended use.- This specification is intended for use in design, construction and testing of carbon microphone elements and magnetic earphone elements used in specific telephone and radio applications.

6.2 Ordering data.- Procurement documents should specify the following:

(a) Title, number and date of specification.
(b) Elements required and impedance of earphone element when magnetic earphone elements are on order.
(c) Whether domestic or overseas shipment is required.
(d) Samples required (See 3.6.1).
(e) Marking and shipping of samples.

6.3 Contractual requirements.- It is recommended that the following be included in the contract:

6.3.1 Additional inspection.- It should be understood that additional nondestructive examination and testing of equipment may be performed by the Government when considered necessary to determine compliance with this specification and other applicable documents. Accordingly, the Government inspector may withdraw materials, parts, subassemblies, or components temporarily from production for such inspection performed either at a Government laboratory or the contractor's plant.

6.4.2 Waiver of preproduction samples.- When items for which preproduction samples are required are currently in production on a Government order, the contractor may apply to the contracting officer for waiver of preproduction samples on the new order. Any request for waiver should be made by the prime contractor and should include a statement indicating that: the specified samples have been submitted and approved on the current contract; production of the item under the new order will be concurrent with, or follow without interruption, production on the current order and will be at the same plant; and current production is in strict compliance with specified requirements for the new equipment except for such deviations as may be authorized on the current order. These deviations should be described in the statement. Waiver of preproduction samples may be contingent on renegotiation of the contract to reflect the saving in cost to the contractor.

6.4 Government laboratory check of calibration.- At the discretion of the contracting officer, the inspector may forward several earphone or microphone elements to a Government laboratory for check tests. These earphone or microphone elements should be accompanied by the results of the inspector's tests of the same items on the contractor's test equipment. In case of discrepancies, the results of the Government laboratory tests shall be final and the necessary correction factors shall be applied to the results of tests on the manufacturer's test equipment.

6.5 Group C inspection.- Approval to ship may be withheld, at the discretion of the Government inspector, pending the decision from the contracting officer on the adequacy of corrective action. (See 4.3.3.2.)