INCH-POUND
MIL-DTL-16225C
w/AMENDMENT 2
4 September 2026
SUPERSEDING
MIL-DTL-16225C
w/AMENDMENT 1
5 January 2016

DETAIL SPECIFICATION

LOUDSPEAKER, PERMANENT MAGNET, BLASTPROOF AND SUBMERSIBLE, NAVY TYPE 49546

Inactive for new design after 26 August 1999.

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers a blast proof, submersible loudspeaker unit capable of reproducing audio signals, when operated in conjunction with Naval communications receiving sets and associated audio frequency amplifiers.

2. APPLICABLE PUBLICATIONS

2.1 General. The publications listed in this section are specified in sections 3 and 4 of this specification. This section does not include publications cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, the users of this document are cautioned that they must meet all specified requirements of publications cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government publications.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these publications are those cited in the solicitation or contract.

FEDERAL STANDARDS

FED-STD-H28 - Screw-Thread Standards for Federal Services

FEDERAL SPECIFICATIONS

TT-C-490 - Chemical Conversion Coatings and Pretreatments for Metallic Substrates (Base for Organic Coatings)

Since Navy-EC is the Navy custodian for this document, all Navy review activities should forward their comments directly to DLA Weapons Support (Columbus). Beneficial comments, recommendations, additions, deletions, clarifications, etc., and any data that may improve this document should be sent to: DLA-CC, DLA Weapons Support, ATTN: VAI, P.O. Box 3990, Columbus, Ohio 43218-3990 or emailed to sound@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A
FSC 5965
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-15090	-	Enamel, Equipment, Light-Gray (Navy Formula No. 111)
MIL-DTL-21981	-	Electronics Equipment, Nomenclature, Serial Numbers and Identification Plates: Requirements for
MIL-DTL-24643/23	-	Cable, Electrical, -4 Degrees Fahrenheit (-20 Degrees C) to +221 Degrees Fahrenheit (+105 Degrees C), 300 Volts, Type LSTTSU

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-108	-	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-202	-	Electronic and Electrical Component Parts

(Copies of these publications are available online at https://quicksearch.dla.mil/qsSearch.aspx.)

2.2.2 Other Government publications. The following other Government publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these publications are those cited in the solicitation or contract.

DRAWINGS

BUREAU OF SHIPS, CAGE 80064

RE-C-49041	-	Loudspeaker, Navy Type 49546

(Users who require copies of this publication(s), in connection with an open solicitation or contract award, are first directed to DIBBS and cFolders. If the user has obtained a publication and has a technical issue/problem, a resolution or new copy may be obtained from the procuring activity as directed by the contracting officer. Or, an email may be sent to dscc.cddwgs@dla.mil. The Requestor must justify their requirement, by providing all of the following information:

* Contract or Solicitation number.
* Material Number (s) [NSN's]
* Company Name.
* Company Address & CAGE."
* “Attention to” contact information [Originator name/telephone-extension/email]).

2.3 Non-Government publications. The following publications from a part of this document to the extent specified herein. Unless otherwise specified, the issues of these publications are those cited in the solicitation or contract.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 10012	-	Quality Management – Requirements for Measurement Management Systems
ISO/IEC 17025	-	General requirements for the competence of testing and calibration laboratories

(Copies of these publications are available online at https://www.iso.org.

GLOBAL ELECTRONICS ASSOCIATION

IPC J-STD-004	-	Requirements for Soldering Fluxes
IPC J-STD-005	-	Requirements for Soldering Pastes
IPC J-STD-006	-	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications

(Copies of these publications are available online at https://www.electronics.org/.

2.4 Order of precedence. Unless otherwise noted herein or the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.1.1 First article sample. Two (2) first article samples shall be furnished for the tests.

3.2 Material and parts. Material and parts shall be as specified on U. S. Navy Drawing RE-C-49041. Material and parts not specified shall be capable of withstanding the tests specified herein.

3.3 Salt spray. The loudspeaker shall withstand the test specified in 4.4.7. Following the test, there shall be no evidence of corrosion, electrical damage, or mechanical damage.

3.4 Application. The loudspeaker shall be suitable for open bridge and other exterior installations and operation on Naval combatant ships of all types. This requirement stipulates that the loudspeaker shall be capable of operating under conditions of shock, vibration, roll and pitch, gunblast, and wide ranges of ambient temperature and humidity incidental to such installations and use.

3.5 Design. The loudspeaker unit specified herein shall be of the radial, reflex horn type.

3.5.1 Major parts. The loudspeaker unit shall include the following major parts.

a. Magnetic, blastproof driver unit complete with diaphragm-voice coil assembly.
b. Hermetically sealed matching input transformer.
c. Volume control.

3.5.2 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.6 Electrical requirements (see 4.4.3).

3.6.1 Frequency range. The loudspeaker shall be capable of reproducing, articulately and audibly, frequencies within the range of 200 to 5,000 Hertz (Hz). There shall be no serious resonance peaks of such amplitude as to materially affect the quality of response over the operating range or to cause rattling. The frequency response shall be within the limits shown on figure 1, when tested with a decibel meter at an angle of 90 degrees off the sound axis (see figure 2).

3.6.2 Power handling capacity. The loudspeaker shall be capable of handling input power up to 10 watts. It shall also be capable of continuous operation at the specified maximum input level without producing rattles or causing deleterious effects to the windings of the voice coil or to any other parts of the loudspeaker. The maximum input level shall be considered to be 10 watts at 1,000 Hz.

3.6.3 Input impedance. A transformer, capable of handling 10 watts, shall be included in each unit, which shall provide for changing the input impedance from 600 ohms to 1,200, 1,800, 2,400, or 3,000 ohms when the impedance is measured at 1,000 Hz. A tolerance of ±10 percent will be permitted on these impedance values.

3.6.4 Acoustical efficiency. The acoustical efficiency of the loudspeaker shall be such that, with an input of 1.00 watt to the voice coil with the frequency varied between 950 and 1,300 Hz, the acoustical pressure shall average at least 1 Pascal (Pa) along the sound axis, at least 0.9 Pa at 10 degrees off the axis, and at least 0.7 Pa at 25 degrees off the axis. These values shall be based upon pressure measurements on the sound axis made at a distance of 6 feet from the mouth of the loudspeaker and off-axis measurements made at four equally spaced points around the periphery of a circle whose plane is normal to the sound axis with the points of measurements 6 feet from the center of the loudspeaker mouth (see figure 2).

3.6.5 Volume control. The loudspeaker shall be provided with a volume control having the following characteristics:

3.6.5.1 Minimum attenuation. Minimum attenuation shall occur in the full clockwise position of the control.

3.6.5.2 Maximum attenuation. Maximum attenuation shall occur in the full counter-clockwise position of the control and shall be at least 30 decibels (dB) below the audio output at the minimum attenuation position of the control, for all audio frequencies.

3.6.5.3 Attenuation and shaft rotation. The attenuation with respect to shaft rotation shall be linear within ±6 dB over approximately three-quarters of the range. The attenuation shall be spread over not less than 75 percent of the angular rotation of the control.

3.6.6 Distortion. Distortion shall not exceed 10 percent r.m.s., when measured at the frequencies specified in 4.4.4.

3.6.7 Acoustical quality. The loudspeaker shall withstand the acoustical quality test specified in 4.4.5. During this test, there shall be no buzzing, rattling, or other spurious sounds in the acoustic output of the loudspeaker, which will degrade the quality of reproduced speech.

3.6.8 Insulation resistance. Insulation resistance shall be not less than 100 megohms, when measured with a 500-volt source as specified in 4.4.6.

3.7 Mechanical details and construction.

3.7.1 Dimensions. The dimensions and external physical characteristics of the loudspeaker shall be in accordance with Drawing RE-C-49041.

3.7.2 Weight. The weight of the loudspeaker unit, including transformer and volume control, shall not exceed 10.5 pounds.

3.7.3 Mounting. The loudspeaker shall be designed for mounting to any vertical surface, such as bulkheads, or to the overhead by the addition of a right angle bracket. It is not required that the contractor provide the right angle bracket.

3.7.4 Terminal tube entrance. A cable clamp shall be provided on the interior of the mounting base to support all incoming audio lines. The entrance for the terminal tube shall be enclosed and protected against the entrance of moisture, and shall be so constructed as to permit ready access to the terminals for the connection of the leads. Entering tube and cable will be Government-furnished.

3.7.5 Volume control adjustment. The volume control shall be recessed so that the shaft shall be flush with the enclosure surfaces. Provision shall be made for screwdriver adjustment of the volume control through an opening in the loudspeaker housing. The volume control opening shall be so constructed as to maintain the watertight security of the complete loudspeaker unit.

3.7.6 Finish. The loudspeaker shall be thoroughly cleaned and covered with a protective coating in accordance with TT-C-490. This shall be followed by two coats of high quality semi-gloss alkyd enamel. The color shall be light gray, and shall match the standard chip of formula III in accordance with MIL-DTL-15090.

3.7.7 Terminals. All terminals necessary for connecting the audio source to the attenuator pad shall be provided on the matching transformer. The transformer terminals shall be suitable for connecting type M24643/23-01UN, LSTTSU-1½ inch cable conductors in accordance with MIL-DTL-24643/23. All screws employed as parts of terminals for securing cable leads or other similar applications shall be of the 'captive' type. Staking or 'upsetting' the ends of the threaded shanks of such screws shall be considered as meeting these requirements.

3.7.8 Threaded parts. All threaded parts shall be in accordance with FED-STD-H28, and shall have the specified fit after plating or other coatings (see 3.2).

3.7.9 Solder. Solder shall be solid or rosin flux cored in accordance with composition Sn97Pb3 of J-STD-004, J-STD-005, and J-STD-006.

3.7.9.1 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of loudspeaker components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.3).

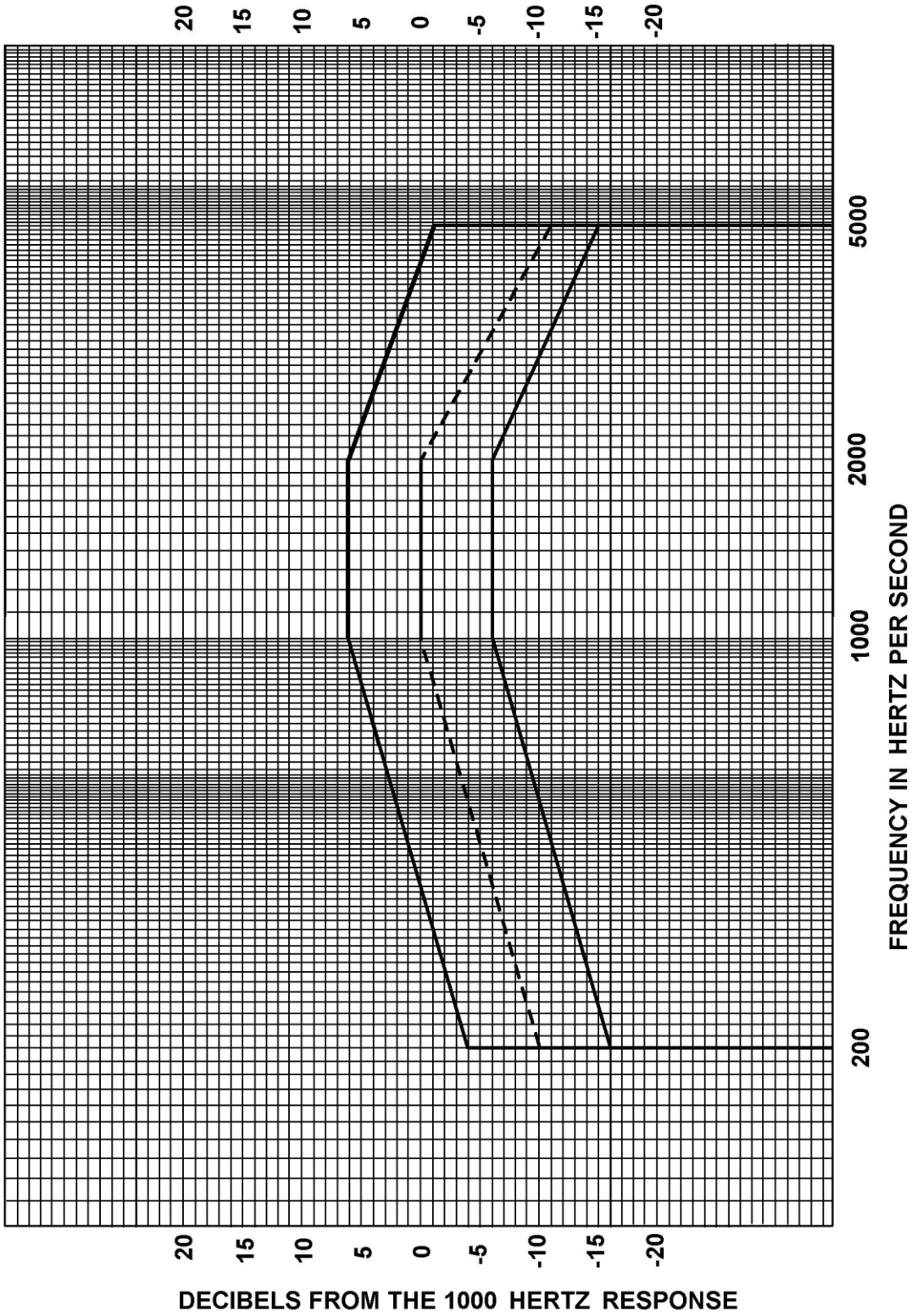

FIGURE 1. Limits for loudspeaker frequency response.

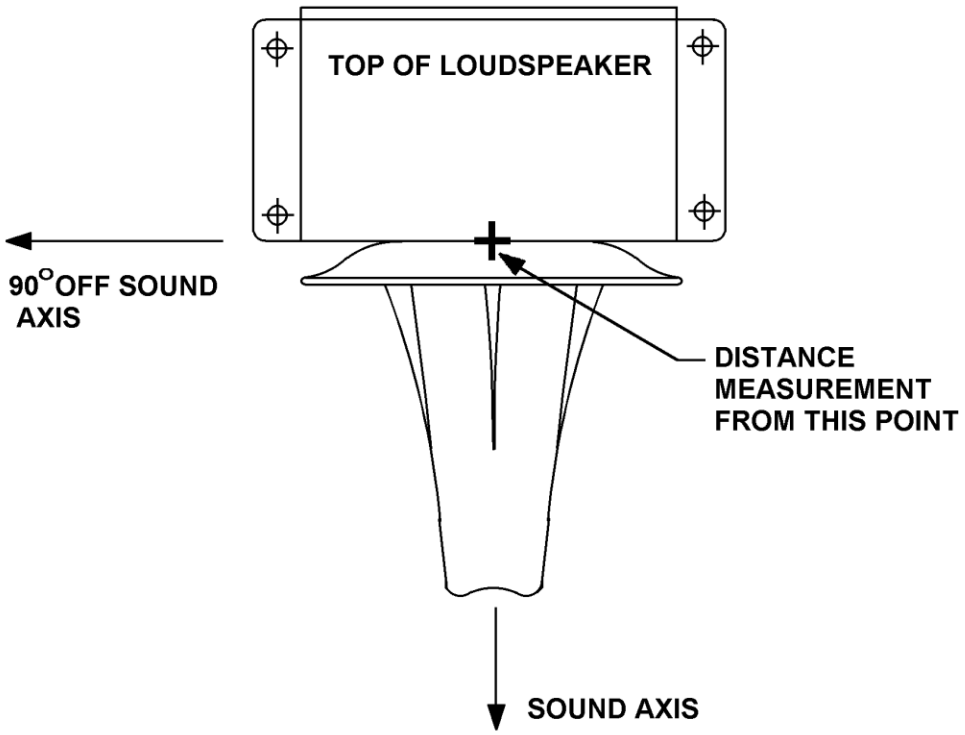

FIGURE 2. Orientation in acoustical tests.

3.8 Operating conditions. The loudspeaker unit shall be designed for intermittent or continuous operation, without damage, under the adverse conditions normally encountered in installations exposed to the weather aboard naval combatant ships, and shall be capable of normal operation after prolonged periods of storage and transportation from one location to another. Such operation shall be predicated on satisfactory performance, within the limits permitted herein and under the following specified conditions.

3.8.1 Submergence. There shall be no degradation of the acoustical characteristics after the loudspeaker has been subjected to the submergence tests of 4.4.8.

3.8.2 Temperature cycling. The loudspeaker shall not be damaged nor the operational performance degraded, when restored to the operating temperature range after being exposed for long periods in the non-operating temperature range of –62 degrees C to +70 degrees C. (see 4.4.10).

3.8.3 Shock and vibration. The loudspeaker shall be designed to withstand the mechanical shocks and vibrations normally encountered aboard ship. The loudspeaker shall successfully withstand the tests of 4.4.9.

3.8.4 Service blastproof and gun blastproof (see 4.4.11). The loudspeaker shall be service blastproof and gun blastproof, under the following specified conditions .

3.8.4.1 Service blastproof. The loudspeaker shall be capable of being exposed, and shall not be damaged during the exposure to 10 (ten) service charge blasts of a 5-inch, 25 or 380-caliber gun. The unit shall be elevated at least 6 feet above the ground and located 21.5 feet (for the 25-caliber gun) or 25 feet (for the 38-caliber gun), from the gun muzzle in the plane through the muzzle perpendicular to the gun axis, and shall be oriented to face the gun muzzle.

3.8.4.2 Gun blastproof. The loudspeaker shall not be damaged when exposed (in addition to the service blasts of 3.8.4.1) to 30 (thirty) service charge blasts of a 5-inch, 25- or 38-caliber gun. The unit shall be located as specified in 3.8.4.1, except that the distance from the muzzle shall be 12 feet (for the 25-caliber gun) or 14 feet (for the 38-caliber gun).

3.9 Nomenclature and serial numbers. Nomenclature and serial numbers should be requested in accordance with the procedures specified in MIL-DTL-21981.

3.10 Identification plates. Identification plates shall be in accordance with Drawing RE-C-49041.

3.11 Workmanship. Workmanship shall be such that the finished product shall meet all of the requirements of this specification.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2).
b. Conformance inspection (see 4.3).

4.1.1 Calibration of Inspection equipment. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ISO 10012 and ISO/IEC 17025.

4.2 First article inspection. Two (2) first article samples shall be made and assembled by the manufacturer with tools and methods that, as far as practicable, are the same as those which will be used for quantity production of the product. The manufacture of the loudspeaker for a Government contract, prior to approval of the first article sample, shall be at the manufacturer's risk.

4.2.1 General. First article samples shall be subjected to the examination and tests specified in table I.

TABLE I. First article inspection.

First article tests	Requirement paragraph	Test paragraph
Visual, dimensional and mechanical examination	3.5, 3.5.1, 3.7.1 to 3.7.8, incl., and 3.10	4.4.2
Input impedance	3.6.3	4.4.3
Insulation resistance	3.6.8	4.4.6
Frequency range	3.6.1	4.4.3
Power handling	3.6.2	4.4.3
Volume control	3.6.5	4.4.3
Acoustical efficiency	3.6.4	4.4.3
Distortion	3.6.6	4.4.4
Salt spray	3.3	4.4.7
Temperature cycling	3.8.2	4.4.10
Shock and vibration	3.8.3	4.4.9
Service and gunblast	3.8.4	4.4.11
Submergence	3.8.1	4.4.8

4.3 Conformance inspection.

4.3.1 Lot. All loudspeakers offered for delivery at one time shall be considered a lot for purposes of sampling and inspection.

4.3.2 Conformance inspection. Conformance inspection shall consist of the examination and tests specified in 4.3.2.1, 4.3.2.2, and 4.3.3. The samples shall be subjected to the tests in the order shown.

4.3.2.1 Acoustical quality test. Each loudspeaker shall be subjected to the acoustical quality test specified in 4.4.5. If any loudspeaker fails this test it shall be rejected.

4.3.2.2 Group A inspection. Group A inspection shall consist of the inspections specified in table II, in the order shown.

4.3.2.2.1 Sampling plan. A sample of parts shall be randomly selected in table III. If one or more defects are found, the lot shall be rescreened and defects removed.

4.3.2.2.2 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for re-inspection. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE II. Group A inspection.

Tests	Requirement paragraph	Test paragraph
Visual, dimensional and mechanical examination	3.5, 3.5.1, 3.7.1 to 3.7.8 incl.,and 3.10	4.4.2
Volume control	3.6.5	4.4.3
Input impedance	3.6.3	4.4.3
Insulation resistance	3.6.8	4.4.6

TABLE III. Group A and group B sampling plans.

Lot size			Sample size	
			Group A	Group B
2	to	8	Entire lot	3 1/
9	to	25	13 1/	3
26	to	50	13	5
51	to	90	13	6
91	to	150	13	7
151	to	280	20	10
281	to	500	29	11
501	to	1,200	34	15
1,201	to	3,200	42	18
3,201	to	10,000	50	22
10,001	to	35,000	60	29
35,001	to	150,000	74	29
150,001	to	500,000	90	29
over 500,000			102	29

1/ Inspection sample size shall not exceed lot size.

4.3.3 Group B tests. The group B tests shall consist of those specified in table IV.

4.3.3.1 Sampling plan. A sample of parts shall be randomly selected in table III. If one or more defects are found, the lot shall be rescreened and defects removed.

4.3.3.2 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for re-inspection. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE IV. Group B tests.

Tests	Requirement paragraph	Test paragraph
Frequency range	3.6.1	4.4.3
Power handling	3.6.2	4.4.3
Volume control	3.6.5	4.4.3
Acoustical efficiency	3.6.4	4.4.3
Distortion	3.6.6	4.4.4

4.4 Test procedures.

4.4.1 Test conditions. Unless otherwise specified herein, all measurements and tests shall be made at room ambient temperature, pressure, and humidity.

4.4.2 Visual, dimensional, and mechanical examination. Loudspeakers shall be examined visually, dimensionally, and mechanically to determine conformance with this specification.

4.4.3 Electrical tests. Tests shall be conducted to determine conformance with the requirements of 3.6.1 to 3.6.5, inclusive.

4.4.4 Distortion (see 3.6.6). The distortion test shall be performed on the loudspeaker. A constant voltage having a route mean square (rms) value to provide rated power at 1,000 Hz shall be applied to the loudspeaker, and the measurements shall be made at 300 and 5,000 Hz

4.4.5 Acoustical quality (see 3.6.7). The acoustical quality test shall be performed on each loudspeaker. A constant voltage having an rms value to provide rated power at 1,000 Hz shall be applied to the 600-ohm input terminals, and the frequency varied continuously from 300 to 5,000 Hz.

4.4.6 Insulation resistance (see 3.6.8). The voice coil shall be disconnected from the circuit before the insulation resistance of the loudspeaker is measured. The insulation resistance shall be measured between all circuit conductors and metal parts of the loudspeaker. The insulation resistance shall be measured with a 500-volt source.

4.4.7 Salt spray test. The loudspeaker shall be subjected to a salt spray test as specified in method 101, condition A of MIL-STD-202. Following this test, the unit shall meet the requirements of 3.3.

4.4.8 Submergence (see 3.8.1). The loudspeaker shall be subjected to the 15-foot 24-hour submergence test, in accordance with MIL-STD-108.

4.4.9 Shock and vibration (see 3.8.3). The loudspeaker shall be subjected to:

a. The grade A, class I, type A test, while mounted on a adapter in accordance with figure titled "Large floating shock platform", as specified in MIL-S-901.
b. The type I (Environmental) vibration test as specified in MIL-STD-167-1.

4.4.10 Non-operating temperature. The loudspeaker shall be subjected to the following non-operating temperature cycle to determine conformance to 3.8.2.

a. With the loudspeaker set up for test in a temperature-controlled room, reduce room temperature to –62 degrees C and hold to within +0 and –5 degrees C of that temperature, for at least 3 days.
b. Increase room temperature to +70 ±3 degrees C and maintain that temperature, for at least 4 hours.
c. Reduce room temperature to +25 ±2 degrees C and maintain that temperature, for at least 4 hours.

4.4.11 Service and gunblast tests. The loudspeaker shall be subjected to the service and gunblasts specified in 3.8.4. When required (see 6.2), these tests will be performed upon units furnished by the manufacturer.

4.4.12 Design tests. The bureau or agency concerned may authorize modifications of these tests as may be necessary to suit this design and to guard against any weaknesses (noted in the first article samples) being reflected in production units.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DOD or in-house contactor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Products delivered under this specification are intended for use in naval communications receiving sets and associated audio frequency amplifiers.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification.
b. Whether service and gunblast tests are required (see 4.4.11).
c. Packaging requirements (see 5.1).
d. First article inspection, when required (see 3.1).

6.3 Tin whisker growth (see 3.7.9.1). The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM B545 (Standard Specification for Electrodeposited Coatings of Tin).

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website http://www.epa.gov/osw/hazard/wastemin/priority.htm. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see 3).

6.5 Subject term (key word) listing.

Acoustic quality
Attenuation
Speech intelligibility

6.6 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

CONCLUDING MATERIAL

Custodians:
Navy – EC
DLA – CC

Preparing activity:
DLA – CC

(Project 5965-2026-012)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST at https://assist.dla.mil/.