

INCH-POUND

MIL-DTL-12606E
 29 June 2000
 SUPERSEDING
 MIL-L-12606D
 22 October 1979

DETAIL SPECIFICATION

LOUDSPEAKER, PERMANENT MAGNET (UNENCASED, 3-INCH AND 4-INCH DIAMETER CONE,
 2-WATT; FUNGUS-, AND IMMERSION-RESISTANT),
 TYPE LS-445/U, M12606-01, AND M132606-02

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

1. SCOPE

1.1 Scope. This specification covers type LS-445/U, M12606-01 and M12606-02, unencased, permanent magnet loudspeakers with a 2-watt normal (4-watt peak) input. These loudspeakers are fungus-, and immersion-resistant, and have a voice coil impedance of 8 +/-1 ohms. The cone and spider are made of polyamide-based phenolic material (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents 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, document users are cautioned that they must meet all specified requirements cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

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 documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

- | | | |
|----------|---|--|
| L-P-513 | - | Plastic Sheet, Laminated, Thermosetting, Paper-Base, Phenolic-Resin. |
| FF-S-92 | - | Screw, Machine Slotted, Cross-Recessed or Hexagon Head. |
| QQ-A-591 | - | Aluminum Alloy Die Castings. |
| QQ-C-576 | - | Copper Flat Products With Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machined Edges, (Plate, Bar, Sheet, and Strip). |
| QQ-S-571 | - | Solder, Tin Alloy; Tin-Lead Alloy, and Lead Alloy. |

DEPARTMENT OF DEFENSE

- | | | |
|-------------|---|--|
| MIL-DTL-512 | - | Treatment, Moisture- and Fungus-Resistant, of Communications, Electronic and Associated Electrical Equipment. |
| MIL-S-901 | - | Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements For. |
| MIL-C-5541 | - | Chemical Conversion Coatings on Aluminum and Aluminum Alloys. |
| MIL-L-12632 | - | Loudspeaker, Permanent Magnet (Encased, 2 Watt, Fungus-Gunblast-, and Immersion Resistant), General Specification For. |
| MIL-F-14072 | - | Finishes for Ground Electronic Equipment. |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, Attn: VAI, 3990 East Broad Street, Columbus, Ohio, 43216-5000 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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STANDARDS

FEDERAL

- FED-STD-H28 - Screw-Thread Standards for Federal Service.
- FED-STD-595 - Colors.

DEPARTMENT OF DEFENSE

- MIL-STD-202 - Test Method Standard, for Electronic and Electrical Component Parts.
- MIL-STD-1344 - Test Methods for Electrical Connectors.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of documents, which are DoD adopted, are those listed in the issue DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI/Y14.5 - Dimensioning and Tolerancing.
- ANSI-Z540-1 - Calibration Laboratories and Measuring and Test Equipment – General Requirement.

(Applications for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10017).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM B152 - Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.

(Applications for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

- Standard 219 - Loudspeaker Measurements, Recommended Practice For.

(Applications for copies should be addressed to the Institute of Electrical and Electronic Engineers (IEEE), Service Center, Post Office Box 1331, 445 Hoes Lane, Piscataway, NJ 08654-1331.)

INTERNATIONAL ORGANIZATION FOR STANDARDS (IOS)

- ISO-10012-1 - Quality Assurance Requirements for Measuring Equipment, Metrological Confirmation System for Measuring Equipment.

(Application for copies should be addressed to American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA-MW10001 - Magnet Wire.

(Application for copies should be addressed to Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5776.)

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. REQUIREMENTS

3.1 Qualification. Loudspeakers furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List (QPL) before contract award (see 4.5 and 6.3).

3.2 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the loudspeaker to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.2.1 Metals.

3.2.1.1 Aluminum. Aluminum shall conform to composition 13 of QQ-A-591.

3.2.1.2 Copper. Copper shall conform to QQ-C-576.

3.2.1.3 Dissimilar metals. There shall be no intermetallic contact of dissimilar metals. Where it is necessary that any combination of dissimilar metals be assembled, an interposing material shall be used which is compatible to each metal. Compatibility of intermetallic contacting surfaces is defined in MIL-F-14072.

3.2.2 Solder. Solder shall conform to composition Sn60 of QQ-S-571.

3.2.3 Wire. Magnet wire shall conform to NEMA-MW1000, MW-15-C.

3.2.4 Screws. Screws shall conform to FF-S-92.

3.3 Design and construction. The loudspeaker shall be of the design, construction, and physical dimensions specified herein (see figures 1, 2, and 3).

3.3.1 Threaded parts. All threaded parts shall be in accordance with FED-STD-H28. Where practical, all threads shall conform with the coarse-thread series. The fine-thread series shall be used only for applications that might show a definite advantage through their use. Where a special diameter-pitch combination is required, the thread shall be of American National Form and of any pitch between 16 and 36 which is used in the fine-thread series.

3.3.2 Finishes. Finishes shall be in accordance with MIL-F-14072, type 1 (exposed). Final color shall be No. 24084 (olive drab) conforming to FED-STD-595. Aluminum alloy baskets may be chemical conversion film per MIL-C-5541, exposure 1, alodine per MIL-F-14072.

3.3.3 Adhesives. Water soluble adhesives shall not be used.

3.3.4 Terminal board. The terminal board for the voice coil wire lead terminations shall be made of laminated plastic sheet conforming to L-P-513 and shall provide two solder-type terminals to permit the soldering to two No. 24 AWG wires on each terminal. Terminals shall be copper or copper-base alloy and shall be solder coated.

3.3.4.1 Terminal board marking. The terminal board shall have a distinctive red mark adjacent to one terminal which shall be visible with the terminal board mounted in place (see figure 1).

3.3.5 Moisture- and fungus-resistant treatment. Parts that are not fungus resistant shall be treated in accordance with MIL-T-152.

3.4 Performance requirements.

3.4.1 Voice coil polarity. When tested as specified in 4.7.2, the voice coil shall move in a direction away from the magnet.

3.4.2 Voice coil impedance. When tested as specified in 4.7.3, the voice coil impedance shall be 8 ± 1 ohms.

3.4.3 Dielectric withstanding voltage. When tested as specified in 4.7.4, there shall be no arcing or breakdown of the voice coil insulation.

3.4.4 Acoustic quality. When loudspeakers are tested as specified in 4.7.5, there shall be no buzzes, rattles, or other spurious sounds that would impair the quality of reproduced audio signal in the output.

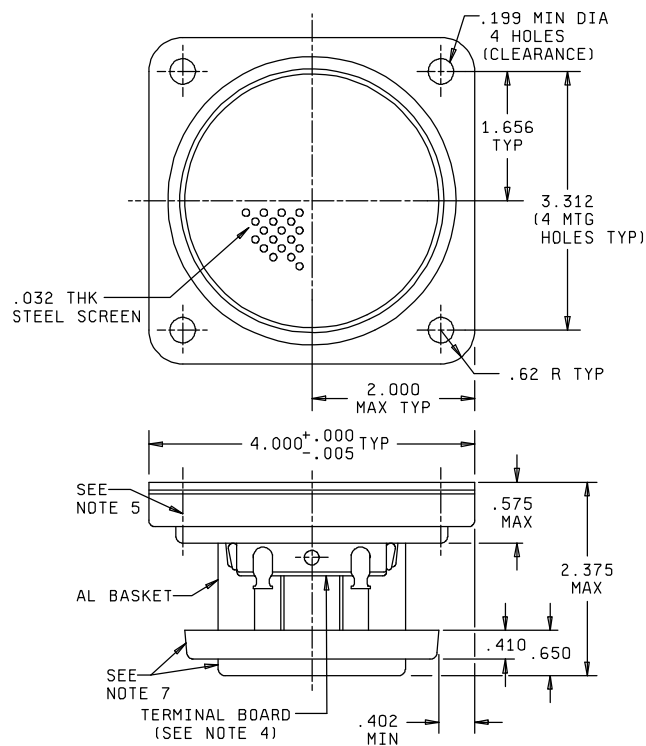
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3.4.5 Frequency response.

3.4.5.1 LS-445/U and M12606-02. When tested as specified in 4.7.6.1, the frequency response between 750 to 1,250 Hz shall be not less than 95 decibels (dB) relative to 0.0002 dynes per square centimeter. The response levels between 300 to 7,000 Hz shall be within the limits shown on figure 4, except that sharp peaks and dips may extend beyond these limits provided that the width of the extension is not greater than 1/10 octave at the limit.

3.4.5.2 M12606-01. When tested as specified in 4.7.6.2, the frequency response between 750 to 1,250 Hz shall not be less than 93 decibels (dB) relative to 0.0002 dynes per square centimeter. The response levels between 400 to 6,000 Hz shall be within the limits shown on figure 5, except that sharp peaks and dips may extend beyond these limits provided that the width of the extension is not greater than 1/10 octave at the limit.

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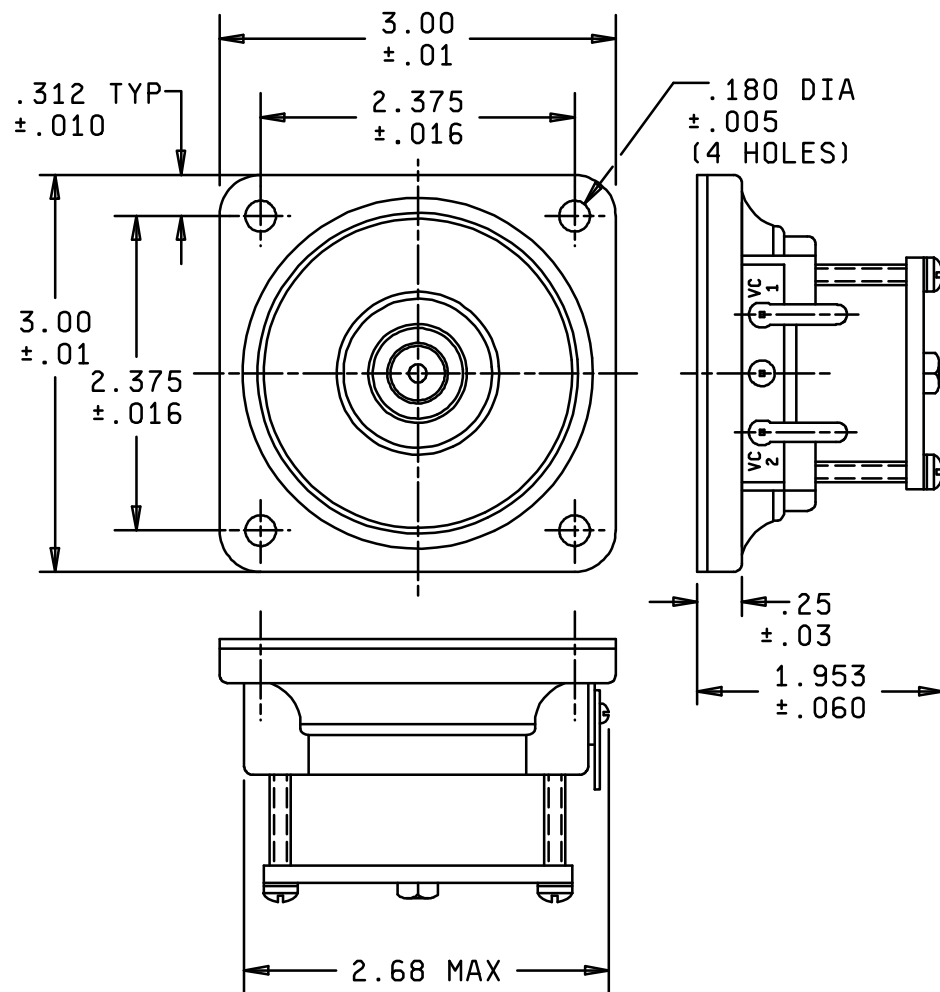
Inches	mm
.005	.13
.032	.81
.199	5.05
.62	15.7
.402	10.21
.410	10.41
.575	14.60
.650	16.51
1.656	42.06
2.000	50.80
2.375	60.32
3.312	84.12
4.000	101.60

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are $xx \pm .02$ (.5 mm) and $xxx \pm .005$ (.13 mm).
4. Mark terminal board with a red mark near positive terminal.
5. Four mounting holes, with No. 10-24 UNC-2B threads CSK 90 x .03 deep, both sides of basket only.
6. "TYP" is defined in 6.6.
7. Configuration is optional.

FIGURE 1. Type LS-445/U loudspeaker (see 6.4).

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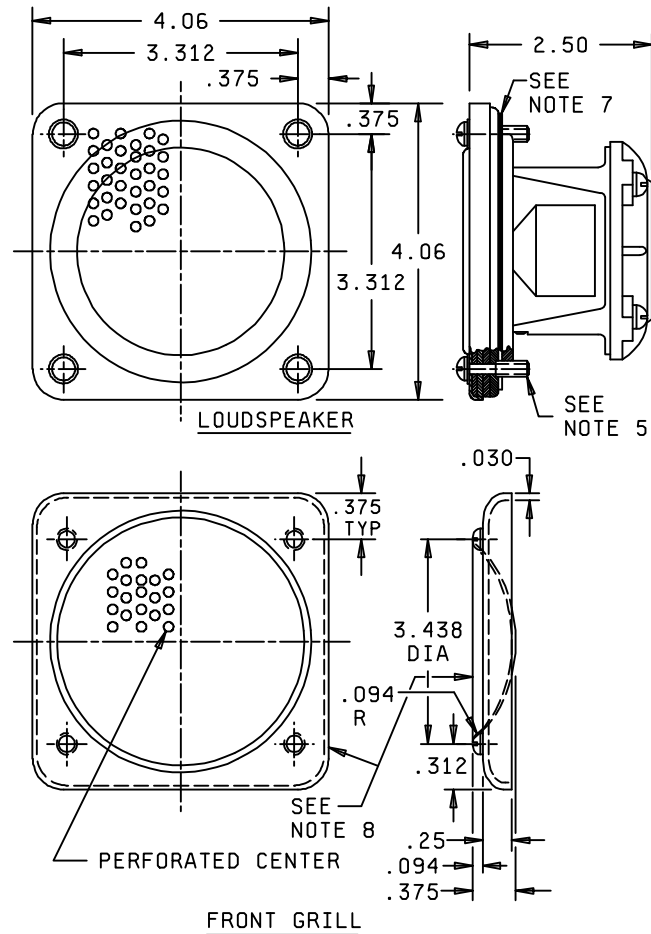
Inches	mm	Inches	mm
.005	.13	.25	6.4
.010	.25	.312	7.92
.016	.41	1.953	49.61
.03	.8	2.375	60.32
.060	1.52	2.68	68.1
.180	4.57	3.00	76.2

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are $xx \pm .02$ (.5 mm) and $xxx \pm .005$ (.13 mm).
4. Mark terminal board with a red mark near positive terminal.
5. "TYP" is defined in 6.6.
6. Configuration is optional.

FIGURE 2. M12606-01 (see 6.4).

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Inches	mm	Inches	mm
.030	.76	.375	9.52
.094	2.39	.75	19.0
.190	4.83	2.50	63.5
.20	5.1	3.312	84.12
.312	7.92	3.438	87.33
		4.06	103.1

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are $xx \pm .02$ (.51mm) and $xxx \pm .005$ (.13 mm).
4. Mark terminal board with a red mark near positive terminal.
5. Four mounting holes, with No. 10-24 UNC-2B threads CSK 90 x .03 deep, both sides of basket only.
6. "TYP" is defined in 6.6.
7. Gasket shall be made of Neoprene, durometer -50, color -black.
8. Grill shall be made of steel, cold rolled sheet, cond. 4, regular bright finish.
9. Configuration is optional.

FIGURE 3. M12606-02 (see 6.4).

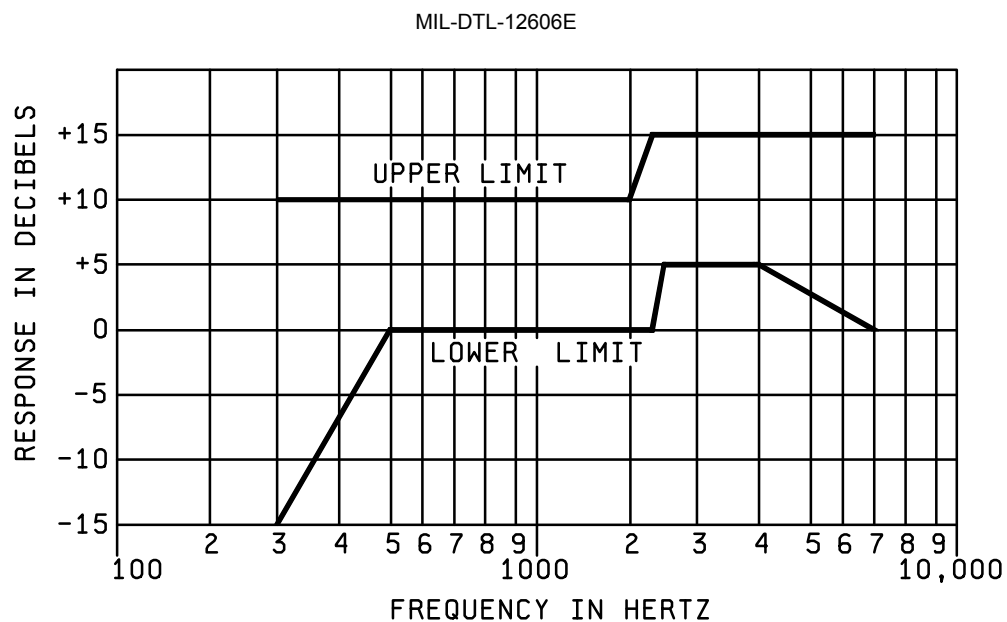


FIGURE 4. Frequency response limits for LS-445/U and M12606-02

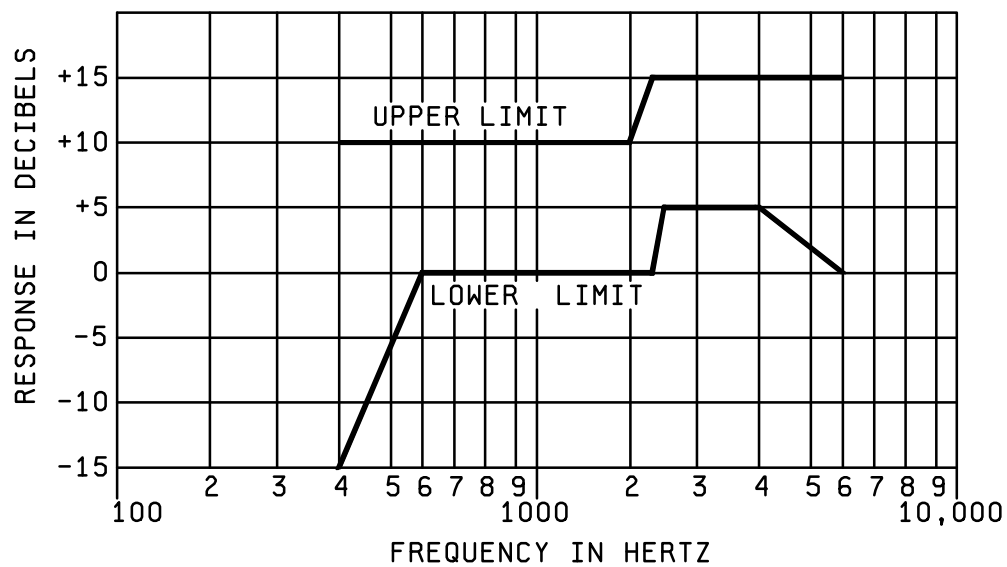


FIGURE 5. Frequency response limits for M12606-01.

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3.4.6 Harmonic distortion. When tested as specified in 4.7.7, the total harmonic distortion in the acoustic output of the loudspeaker shall not exceed 5 percent:

3.4.7 Immersion resistance. When tested as specified in 4.7.8, there shall be no buzzing, rattling, or other spurious sounds in the acoustic output of the loudspeaker; the frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6 respectively; and there shall be no damage to the loudspeaker.

3.4.8 Endurance. When tested as specified in 4.7.9, the frequency response shall be as specified in 3.4.5, and there shall be no damage to the loudspeaker.

3.4.9 Cold resistance. When tested as specified in 4.7.10, there shall be no buzzing, rattling, or other spurious sounds in the acoustic output of the loudspeaker during the test. The frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6 respectively, following the test; and there shall be no damage to the loudspeaker.

3.4.10 Heat resistance. When tested as specified in 4.7.11, there shall be no buzzing, rattling, or other spurious sounds in the acoustic output of the loudspeaker during the test. The frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6 respectively, following the test; and there shall be no damage to the loudspeaker.

3.4.11 Moisture resistance. When tested as specified in 4.7.12, the frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6, respectively, and there shall be no loosening and deformation of parts or other damage to the loudspeaker.

3.4.12 Bounce. When tested as specified in 4.7.13, the frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6, respectively, and there shall be no loosening or deformation of parts or other damage to the loudspeaker.

3.4.13 Shock. When tested as specified in 4.7.14, the frequency response and harmonic distortion shall be as specified in 3.4.5 and 3.4.6, respectively, and there shall be no loosening or deformation of parts or other damage to the loudspeaker.

3.5 Marking. The loudspeaker shall be permanently and legibly marked in accordance with MIL-STD-1285 with the type number (see 1.1) and the manufacturer's name and symbol. Marking shall remain legible after all tests.

3.6 Workmanship. The loudspeaker shall be processed in such a manner as to be uniform in quality and shall be free from defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspection. 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 10012-1 and ANSI Z540-1. The inspection requirements specified herein are classified as follows:

- a. Materials inspection (see 4.3).
- b. Qualification inspection (see 4.5).
- c. Verification of qualification (see 4.5.5).
- d. Conformance inspection (see 4.6).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the "General Requirements" of MIL-STD-1344 and MIL-STD-202.

4.3 Material inspection. Materials inspection shall consist of certification support by verifying data that the materials listed in table I, used in fabricating the loudspeaker, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE I. Materials inspection.

Material	Requirement paragraph	Applicable specification
Aluminum	3.2.1.1	QQ-A-591
Copper	3.2.1.2	QQ-C-576
Solder	3.2.2	QQ-S-571
Wire	3.2.3	NEMA-MWI000
Screws	3.2.4	FF-S-92
Plastic	3.3.4	L-P-513

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4.4 Inspection conditions and preconditioning.

4.4.1 Conditions. Unless otherwise specified herein, all inspection shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202. All acoustical testing shall be made in an acoustic chamber, which is equivalent to the free field acoustic environment per IEEE Standard 219.

4.4.2 Bounce preconditioning. The loudspeaker shall be placed in any convenient position on the table of a package tester as made by the L.A.B. Corporation, Skaneateles, New York (or equal). The package tester, shafts in phase, shall have a speed so that it is just possible to insert a 1/32-inch thick strip of material under one corner or edge of the loudspeaker to a distance of 3 inches as the loudspeaker bounces. The loudspeaker shall be subjected to 1 minute of this bounce preconditioning. After the bounce preconditioning, the loudspeaker shall not be repaired, adjusted, cleaned, or otherwise changed prior to the qualification or quality conformance inspection.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.5.1 Sample size. Six loudspeakers shall be subjected to qualification inspection.

4.5.2 Inspection routine. The sample shall be subjected to the inspection specified in table II, in the order shown. All sample units shall be subjected to the inspections of group I. The sample shall then be divided equally into two groups of 3 units each and subjected to the inspections for their particular group.

TABLE II. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph
<u>Group I</u>		
Visual and mechanical examination	3.2, 3.3, 3.5, and 3.6	4.7.1
Voice coil polarity	3.4.1	4.7.2
Voice coil impedance	3.4.2	4.7.3
Dielectric withstanding voltage	3.4.3	4.7.4
Acoustic quality	3.4.4	4.7.5
Frequency response	3.4.5	4.7.6
Harmonic distortion	3.4.6	4.7.7
<u>Group II</u>		
Immersion resistance	3.4.7	4.7.8
Endurance	3.4.8	4.7.9
<u>Group III</u>		
Cold resistance	3.4.9	4.7.10
Heat resistance	3.4.10	4.7.11
Moisture resistance	3.4.11	4.7.12
Bounce	3.4.12	4.7.13
Shock	3.4.13	4.7.14

4.5.3 Failure. One or more failures shall be cause for refusal to grant qualification approval.

4.5.4 Disposition of sample units. Sample units which have been subjected to qualification inspection shall not be delivered on the contract or order.

4.5.5 Verification of qualification. To retain qualification, the contractor shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial report date. The report shall consist of:

- a. A summary of the results of the tests performed for inspection of product for delivery group A and B, indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

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- b. A summary of the results of tests performed for periodic inspection, group C, including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed during the 12-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 12-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 12-month period that the inspection data indicated failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during 2 consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit the loudspeaker for testing in accordance with the qualification inspection requirements.

4.5.6 Extent of qualification. Qualification for LS-445/U may be extended to cover qualification of M12606-02.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection.

4.6.1.1 Inspection lot. An inspection lot shall consist of all loudspeakers produced under essentially the same conditions and offered for inspection at one time. Any of the three styles of loudspeakers (LS-445/U, M12606/01, or M12606/02) can be combined in an inspection lot.

4.6.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table III, in the order shown.

4.6.1.2.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table IV. Each inspection sample shall include a proportional quantity from each of the different styles (LS-445/U, M12606/01, or M12606/02) produced and to be tested. If one or more defects are found, the lot shall be rescreened and defects removed.

4.6.1.2.2 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 reinspection. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

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TABLE III. Group A and group B inspections.

Inspection	Requirement paragraph	Method paragraph
<u>Group A</u>		
Visual and mechanical examination	3.2, 3.3, 3.5, and 3.6	4.7.1
Voice coil polarity	3.4.1	4.7.2
Voice coil impedance	3.4.2	4.7.3
Dielectric withstanding voltage	3.4.3	4.7.4
Acoustic quality	3.4.4	4.7.5
<u>Group B</u>		
Frequency response	3.4.5	4.7.6
Harmonic distortion	3.4.6	4.7.7

4.6.1.3 Group B inspection. Group B inspection shall consist of the inspection specified in table III, and shall be made on sample units which have been subjected to and have passed group A inspection.

4.6.1.3.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table IV. Each inspection sample shall include a proportional quantity from each of the different styles (LS-445/U, M12606/01, or M12606/02) produced and to be tested. If one or more defects are found, the lot shall be rescreened and defects removed.

TABLE IV. Group A and group B sampling plans.

Lot size			Sample size	
			Group A	Group B
2	to	8	Entire lot	3
9	to	15	13	3
16	to	25	13	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
500,001	and	over	102	29

4.6.1.3.2 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 reinspection. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.3.3 Disposition of sample units. Sample units, which have passed all the group B inspection, may be delivered on the contract or order, if the lot is accepted and the sample units are still within specified electrical tolerances.

4.6.2 Periodic inspection. Periodic inspection shall consist of group C. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.6.2.1.4) delivery of products which have passed groups A and B shall not be delayed pending the results of the periodic inspection.

4.6.2.1 Group C inspection. Group C inspection shall consist of the inspections specified in table V, in the order shown. Group C inspection shall be made on sample units selected from inspection lots, which have passed the groups A and B inspections.

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4.6.2.1.1 Sampling plan. Group C inspection shall be performed once every 12 months on 6 sample units selected, without regard to their quality, from units produced during the preceding 6 month period or each 1,000 units, whichever occurs first. Each inspection sample shall include approximately the same number of loudspeakers from each of the different styles (LS-445/U, M12606/01, or M12606/02) produced and to be tested. The sample shall be divided equally into two groups and subjected to the tests of subgroups 1 and 2 of table V.

TABLE V. Group C inspection.

Inspection	Requirement paragraph	Method paragraph
<u>Subgroup 1 (3 sample units)</u>		
Immersion resistance	3.4.7	4.7.8
Endurance	3.4.8	4.7.9
<u>Subgroup 2 (3 sample units)</u>		
Cold resistance	3.4.9	4.7.10
Heat resistance	3.4.10	4.7.11
Moisture resistance	3.4.11	4.7.12
Bounce	3.4.12	4.7.13

4.6.2.1.2 Failures. If one or more units fail to pass group C inspection, the sample shall be considered to have failed.

4.6.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract or order.

4.6.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc, and which are considered subjected to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.7 Methods of inspection.

4.7.1 Visual and mechanical examination. The loudspeaker shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.2, 3.3, 3.5, and 3.6). Unless otherwise specified (see 6.2), the defects shall be classified as specified in table VI.

4.7.2 Voice coil polarity (see 3.4.1). A dc potential of 3 to 10 volts shall be applied to the voice coil terminals, with positive polarity applied to the terminal adjacent to the red mark, and the direction of motion of the voice coil shall be observed.

4.7.3 Voice coil impedance (see 3.4.2). The loudspeaker shall be supported on the side opposite the cone. There shall be no obstruction within 3 feet of the front of the cone. Voice coil impedance shall then be determined as specified in 4.7.3.1, 4.7.3.2 or by test equipment capable of determining the ratio of input voltage to input current at a given frequency, at the option of the manufacturer.

4.7.3.1 Direct reading method. The voice coil terminals shall be connected in series with a $10 \pm .10$ -ohm resistor R_s across the output of a low impedance 1000-Hz signal source (E_s) (see figure 6). A voltmeter shall be placed across R_s , and E_s set so that E_{R_s} equals $1 \pm .01$ volt. A voltmeter shall be placed across R , and E_s set so that E_R equals $1 \pm .01$ volt. The voltmeter shall be removed, placed across the voice coil terminals, and a reading taken. The voltmeter reading should be multiplied by 10, to determine the impedance in ohms. (The voltmeter will measure the impedance divided by 10.)

4.7.3.2 Resistance to substitution method. The voice coil terminals shall be connected in series with a variable resistance across the output of a low impedance 1000-Hz signal source. The voltage drops across the voice coil and the variable resistor shall be determined with an electronic voltmeter. The value of the variable resistor shall be adjusted until the voltage drops are equal, and the resistance of the variable resistor shall then be measured with a resistance bridge or other suitable equipment. The voice coil impedance shall be considered as numerically equal to the measured value of resistance of the variable resistor.

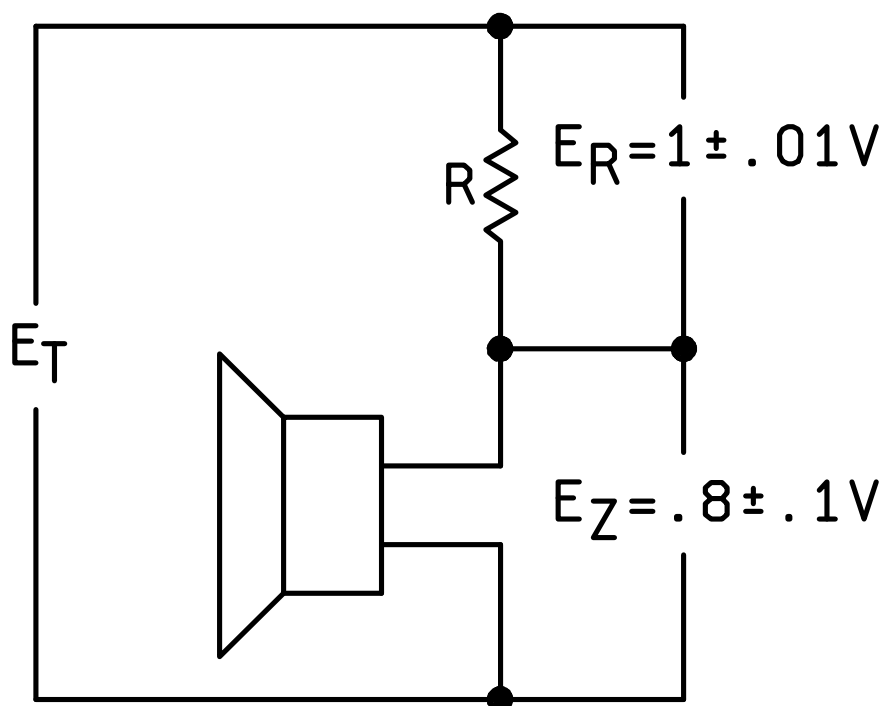
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TABLE VI. Classification of defects for visual and mechanical examination.

Defect type	Classification	
	Major	Minor
Dimensions	Dimensions not as specified.	---
Materials and finish	Materials not as specified. Wrong or incomplete finish. Large amounts of flaking, peeling, or chipping of finish.	Scratches, cuts, abrasions, etc., causing exposure of base metal, or relatively small amount of flaking, peeling, or chipping.
Parts	Missing parts. Inoperative, improperly assembled, or defective parts which could cause the loudspeaker to fail in service. Wrong parts.	Defective parts which would reduce efficiency of use, but not cause failure in service. Cracks or chipped surfaces having no effect on the functioning, assembly, maintenance, or life of the loudspeaker.
Marking	Marking missing, illegible, or incorrect.	Marking dirty or smudged, but legible.
Foreign objects	Any metallic foreign object, not firmly attached ^{1/} , which could cause a short circuit, or acoustical malfunctioning of the loudspeaker. Any nonmetallic foreign object such as insulation, dirt, or phenolic chips which could cause acoustical malfunctioning of the loudspeaker.	Any metallic or nonmetallic foreign object, which affects appearance but which could not cause acoustical malfunctioning of the loudspeaker.
Soldering	Improper wrap - less than 1/2 turn. Unsoldered joint-solder not applied where intended. Insufficient solder - Minimum dimension of solder bridge less than twice the diameter of the wire of less than 3/32 inch, whichever is greater. Entire area of contact between wire and terminal not joined by solder bridge. Cold solder joint - Chalky appearance, lacks metallic luster, presents rough "pile-up" appearance; movement of wire or solder upon pick application. Rosin joint - Presence of excess rosin; relative movement of wire or solder upon pick application. Insulation in terminal hole - Solder over insulation; no appearance of visible wire contour.	Improper wrap - 1/2 turn or more, but less than one turn. Excess solder - Build-up solder on joint greater than necessary for good soldering, usually resulting in obliteration of wire contour. Cold solder joint - Chalky appearance, lacks metallic luster, presents rough "pile-up" appearance; no relative action between wire and solder upon pick application.
Wiring	Broken strands - More than 20 percent, except in a 70-strand conductor, more than 2 broken strands. Insulation burned, abraded, pinched, or deteriorated between two or more conductors, resulting in a potential short circuit. Taut wire - Wire exhibits no slack and subsequent breakage may occur due to stress on terminal or part. Insulation frayed to the extent that a potential short circuit exists.	Broken strands - 20 percent or less. In a 7-strand conductor, 2 broken strands. Insulation burned, abraded, pinched, or deteriorated, with exposure of bare wire, but short circuit not possible. Taut wire - Slight stress on conductor, but not possibility of subsequent breakage.

^{1/} Foreign objects that cannot be dislodged by the moderate application of pressure with a pick or spudger shall be considered firmly attached.

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FIGURE 6. Measurement of impedance by direct reading method.

4.7.4 Dielectric withstanding voltage (see 3.4.3). The loudspeaker shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

- a. Test voltage – 400 volts.
- b. Nature of potential – 60 Hz, AC.
- c. Points of application – The test voltage shall be applied between one of the voice coil terminals and the loudspeaker frame; simultaneously, the voice coil shall be excited with a minimum of 2.85 volts root mean square (rms) at 300 Hz.

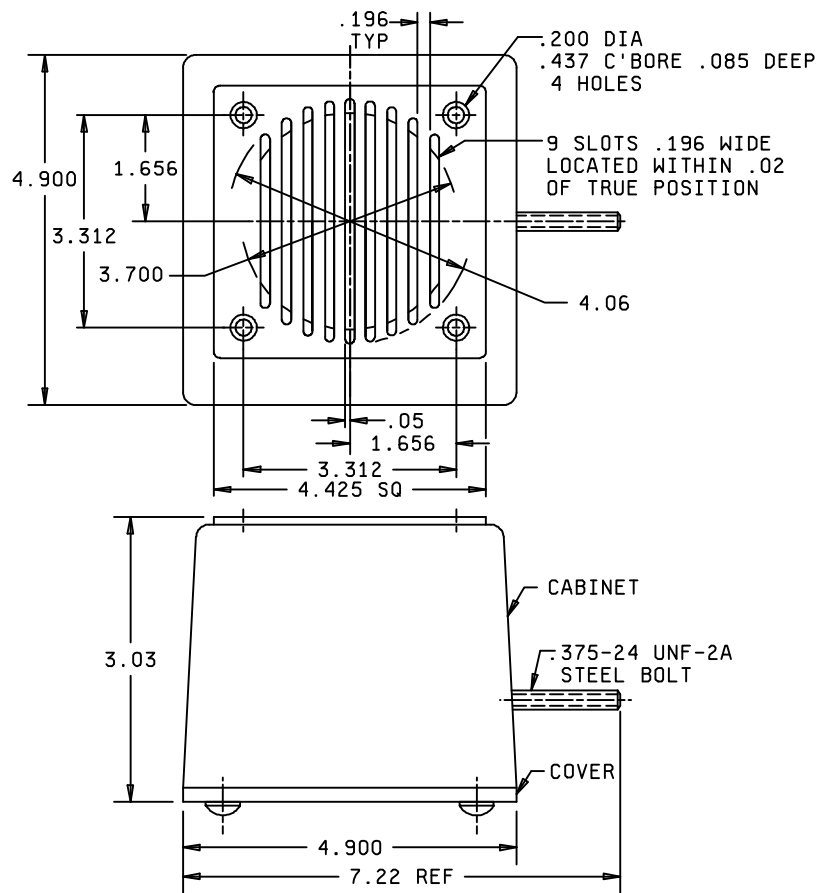
4.7.5 Acoustic quality (see 3.4.4). A constant voltage having a rms value of $4.00 \pm .1$ volts shall be applied to the voice coil terminals and the frequency varied continuously from 300 to 7,000 Hz and back to 300 Hz. For M12606-01, the frequency shall be varied continuously from 400 to 6,000 Hz and back to 400 Hz.

4.7.6 Frequency response.

4.7.6.1 Type LS-445/U and M12606-02 (see 3.4.5.1). The loudspeaker shall be mounted in a test cabinet (see figure 7) and placed 3 feet from a calibrated Western Electric Type 640AA (or equal) condenser microphone and amplifier. The microphone shall be placed on the axis of the loudspeaker. A constant voltage having a rms value of $4.00 \pm .1$ volts shall be applied to the voice coil terminals and the frequency varied continuously from 300 to 7,000 Hz. The acoustic output shall be recorded on a direct-writing strip graph chart using an automatic plotter or curve tracer, with a minimum writing speed of 10 inches per second and a maximum chart speed of 30 inches per minute. Or, at the option of the manufacturer, point-to-point measurements may be made, every 50 Hz from 300 to 600; every 100 Hz from 600 to 1,500 Hz; every 250 Hz from 1,500 to 2,000 Hz; every 100 Hz from 2,000 Hz to 2,500 Hz; every 250 Hz from 2,500 to 3,000 Hz; every 500 Hz from 3,000 to 7,000 Hz, with the data record and a graph drawn (see figure 4).

4.7.6.2 M12606-01 (see 3.4.5.2). The loudspeaker shall be mounted in a closed 5 x 5 x 3 inch test cabinet with suitable 2-3/4 inch diameter loudspeaker opening and placed 3 feet from a calibrated Western Electric Type 640AA (or equal) condenser microphone and amplifier. The microphone shall be placed on the axis of the loudspeaker. A constant voltage having a rms value of $4.00 \pm .1$ volts shall be applied to the voice coil terminals and the frequency varied continuously from 400 to 6,000 Hz. The acoustic output shall be recorded on a direct-writing strip graph chart using an automatic plotter or curve tracer with, a minimum writing speed of 10 inches per second and a maximum chart speed on 30 inches per minute. Or, at the option of the manufacturer, point-to-point measurements may be made every 50 Hz from 400 to 600 Hz; every 100 Hz from 600 to 1,500 Hz; every 250 Hz from 1,500 to 2,000 Hz; every 100 Hz from 2,000 to 2,500 Hz; every 250 Hz from 2,500 to 3,000 Hz; and every 500 Hz from 3,000 to 6,000 Hz, with the data recorded and a graph drawn (see figure 5).

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Inches	mm	Inches	mm
.02	.51	1.656	42.09
.05	1.27	3.03	76.96
.085	2.16	3.312	84.12
.196	4.98	3.700	93.98
.200	5.08	4.06	103.12
.437	11.10	4.425	112.40
		4.900	124.46
		7.22	183.39

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerances are .xx ± .02 (.51 mm) and .xxx ± .005 (.13 mm).

FIGURE 7. Test cabinet (see 6.5).

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4.7.7 Harmonic distortion (see 3.4.6). The loudspeaker shall be mounted in its appropriate test cabinet. A constant voltage having a rms value of $4.00 \pm .1$ volts at discrete frequencies of 750, 2,000 and 4,000 Hz ± 10 percent shall be applied to the voice coil terminals of loudspeaker types LS-445/U and M12606-02. A constant voltage having a rms value of $4.00 \pm .1$ volts at discrete frequencies of 1,000, 2,000, 4,000 Hz ± 10 percent shall be applied to the voice coil terminals of loudspeaker type M12606-01. Harmonic distortion shall be determined by one of the methods specified in 4.7.7.1 or 4.7.7.2.

4.7.7.1 Distortion analyzer method. The total harmonic distortion shall be determined by a distortion analyzer, having the following minimum characteristics:

- a. Frequency range – fundamental frequency from 20 to 20,000 Hz.
- b. Frequency calibration - ± 2 percent from 20 to 20,000 Hz.
- c. Harmonic measurement - ± 3 percent of full scale value for distortion level as low as .5 percent.

4.7.7.2 Sound wave analyzer method. The harmonic distortion in the acoustic output of the loudspeaker at each frequency shall be determined by using a sound wave analyzer. The total harmonic distortion at each frequency shall be determined by the following formula:

$$\text{"PERCENT DISTORTION"} = 100 \times \sqrt{\frac{P_2^2 + P_3^2 + \dots + P_n^2}{P_1^2 + P_2^2 + P_3^2 + \dots + P_n^2}}$$

Where P_1 is the pressure amplitude of the fundamental and P_2 , P_3 , etc., are the pressure amplitudes of the harmonic components in the output.

4.7.8 Immersion resistance (see 3.4.7). The loudspeaker shall be submerged in fresh tap water to a depth of at least 3 feet and maintained at that depth for a period of 24 hours ± 1 hour. The water temperature shall be 65-75°F. At the end of the 24-hour submersion period, the loudspeaker shall be removed from the tank, and shall be drained, wiped, and allowed to dry naturally for 30 minutes ± 5 minutes. At the completion of the 30 minutes ± 5 minutes drying period, the loudspeaker shall be tested in accordance with 4.7.5. The loudspeaker shall be allowed to dry at room ambient conditions for 48 hours ± 1 hour, and shall then be tested in accordance with 4.7.6 and 4.7.7, respectively, and examined for evidence of damage.

4.7.9 Endurance (see 3.4.8). A constant rms voltage of $2.85 \pm .1$ volts, at each of four discrete frequencies, shall be applied to the voice coil terminals continuously for 25 hours ± 1 hour at each selected frequency (100 hours ± 4 hours total). One frequency shall be selected from each of the following frequency ranges, and shall be of a value, which will not coincide with any major resonant frequency of the loudspeaker:

250	-	400 Hz
400	-	500 Hz
1000	-	1500 Hz
2000	-	3000 Hz

After the test, the frequency response shall be determined in accordance with 4.7.6, and the loudspeaker examined for damage.

4.7.10 Cold resistance (see 3.4.9). The loudspeaker shall be placed in a cold chamber and maintained at a temperature of $-80 \pm 0/-5^\circ\text{F}$ for 24 hours ± 1 hour. The temperature shall then be raised to and stabilized at $-65 \pm 0/-5^\circ\text{F}$. A constant rms voltage of $4.00 \pm .1$ volts at a frequency of $300 \pm 25/-0$ Hz shall be applied to voice coil terminals for 5 minutes ± 1 minutes at that temperature and the acoustic output checked for buzzing, rattling, or other spurious sounds. The temperature of the loudspeaker shall then be raised to room ambient conditions and the frequency response and harmonic distortion determined in accordance with 4.7.6 and 4.7.7, respectively, and the loudspeaker examined for damage.

4.7.11 Heat resistance (see 3.4.10). The loudspeaker shall be placed in a heat chamber and maintained at a temperature of $+160 \pm 5/-0^\circ\text{F}$ for a period of 24 hours ± 1 hour. A constant rms voltage $4.00 \pm .1$ volts at a frequency of $300 \pm 25/-0$ Hz shall be applied to the voice coil terminals for 5 minutes ± 1 minutes, while at that temperature and the acoustic output checked for buzzing, rattling, or other spurious sounds. The temperature of the loudspeaker shall then be reduced to room ambient conditions and the frequency response and harmonic distortion determined in accordance with 4.7.6 and 4.7.7, respectively, and the loudspeaker examined for damage.

4.7.12 Moisture resistance (see 3.4.11). The loudspeaker shall be tested in accordance with method 106 of MIL-STD-202. The following details shall apply:

- a. Mounting – Any convenient mounting with the front face of the loudspeaker cone exposed and parallel with the vertical plane.
- b. Polarizing voltage - -Not applicable.

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c. Step 7b – not Applicable.

d. Final measurements – At the completion of the tenth cycle and following a 24 hour ± 1 hour period at $25 \pm 5^\circ\text{C}$ and 50 ± 5 percent relative humidity, the loudspeaker shall be tested for frequency response and harmonic distortion in accordance with 4.7.6 and 4.7.7, respectively, and examined for loose or deformed parts or other damage.

4.7.13 Bounce (see 3.4.12). The loudspeaker shall be mounted on a suitable fixture, without shock mounts, and placed on the table of the package tester as made by the L.A.B. Corporation, Skaneateles, New York (or equal). The fixture shall be constrained from horizontal motion of more than speed by suitable wooden fences. The package tester, shafts in phase, shall be operated at a speed of 285 ± 3 revolutions per minute, for a total of 3 hours ± 15 minutes. The fixture shall be placed on a different side for each one-half hour of test. At the completion of the test, the loudspeaker shall be tested for frequency response and harmonic distortion in accordance with 4.7.6 and 4.7.7, respectively, and examined for loose or deformed parts or other damage.

4.7.14 Shock (see 3.4.13). A total of nine blows shall be applied to the loudspeaker employing the shock testing machine for lightweight equipment, in accordance with MIL-S-901. Three blows shall be applied parallel to each of three principle axes of the loudspeaker. The three blows for each direction are to be with a height of a hammer drop of 1 ft. (30.48 cm), 3 ft. (91.44 cm), and 5 ft (152.40 cm), respectively.

5. PACKAGING

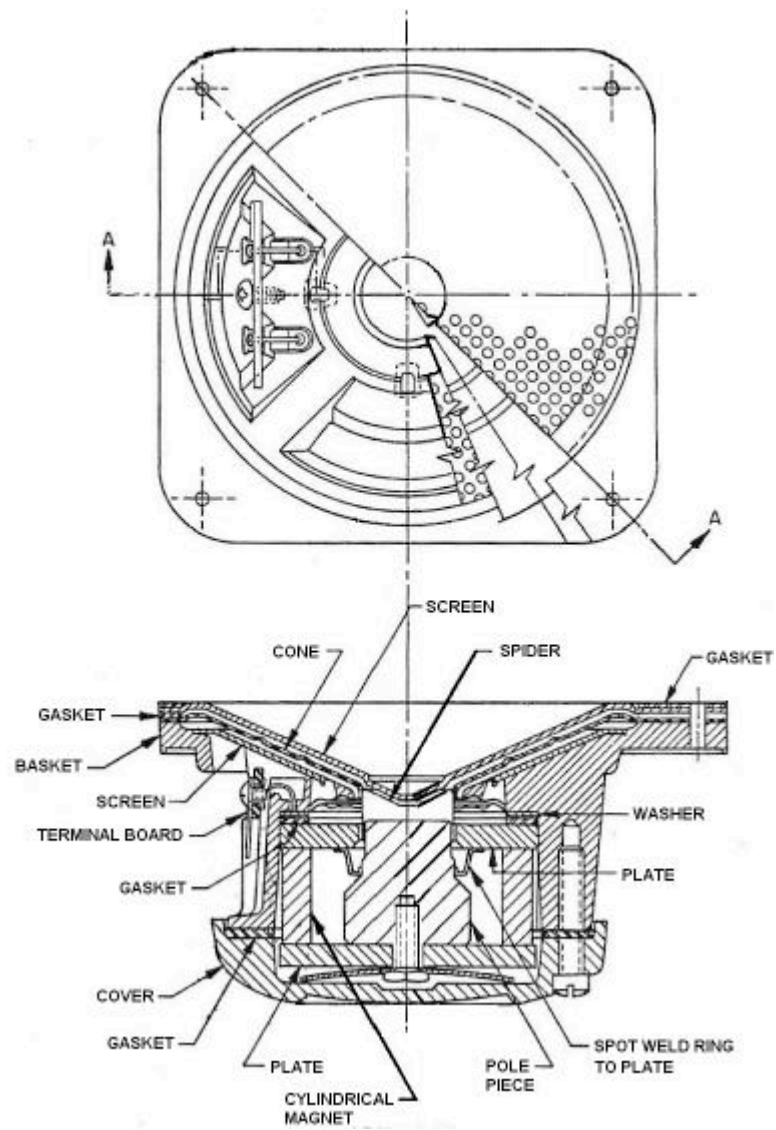
5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military department or Defense Agency, or within the Military Department's System Command. 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. This loudspeaker is primarily intended to be used as part of loudspeakers specified in MIL-L-12632. The loudspeakers covered by this specification are military unique, because they must be able to withstand water immersion for 24 hours and ambient temperatures ranging from -80°F $+160^\circ\text{F}$. Commercial loudspeakers are not designed to withstand such extreme environmental conditions and would experience catastrophic failure.

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SECTION AA

NOTE: This figure is for reference only and is not intended to restrict the design.

FIGURE 8. Acceptable loudspeaker design.

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6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
- c. Packaging requirements (see 5.1).
- d. Applicable document for classification of visual and mechanical defects if other than table VI (see 4.7.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the applicable Qualified Products List QPL-12606, whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts for the products covered by this specification. The activity responsible for the qualified products lists is the Defense Supply Center Columbus (DSCC-VQP), 3990 East Broad Street, Columbus, Ohio 43216-5000.

6.4 Acceptable loudspeaker design. Figure 8 shows an example of an acceptable loudspeaker design.

6.5 Test cabinet. In lieu of the test cabinet specified on figure 7, a cabinet assembly conforming to MIL-L-12632 may be used at the option of the manufacturer.

6.6 Typical. As defined in ANSI Y14.5, the term "typical" means that the dimension or feature applies to the locations that appear to be identical in size and configuration. The tolerance, stated for a dimension labeled "typical", also applies to each identical feature.

6.7 Part or Identifying Number (PIN). The PIN consists of the letter "M" followed by the basic number of this specification (or specification sheet) and a dash number added as follows:



6.8 M12606-02. M12606-02 and LS-445/U are identical, except the M12606-02 has captive mounting screws, a rubber gasket, and a front grill, which overlaps the front of the speaker body.

6.9 Subject term (key word) listing.

Analyzer, sound wave
 Basket
 Coil, voice
 Distortion, harmonic
 Piece, pole
 Screen
 Source, signal
 Spider
 Quality, acoustic

6.10 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. 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 upon the entire content, regardless of the marginal notations and relationship to the last previous issue.

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CONCLUDING MATERIAL

Custodians:

Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:

DLA - CC

Review activities:

Army – AR, AV
Navy - MC
Air Force - 99

(Project 5965-0340)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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1. **DOCUMENT NUMBER**
MIL-DTL-120606E

2. **DOCUMENT DATE**
(YYYYMMDD)
1999MMDD

3. DOCUMENT TITLE

Loudspeaker, Permanent Magnet (Unencased, 3-Inch and 4-Inch Diameter Cone, 2-Watt; Fungus-, and Immersion-Resistant), Type LS-445/U, M12606-01, and M12606-02

4. **NATURE OF CHANGE** (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include zip code)

d. TELEPHONE (Include Area Code)
(1) Commercial
(2) DSN
(if applicable)

7. DATE SUBMITTED
(YYYYMMDD)

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