MIL-L-12606D
25 October 1979
SUPERSEDING
MIL-L-12606C
3 May 1974

MILITARY SPECIFICATION

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

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

1. SCOPE

1.1 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-, gunblast-, 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 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

J-W-1177/GEN	- Wire, Magnet, Electrical
L-P-513	- Plastic Sheet, Laminated, Thermosetting, Paper-Base, Phenolic-Resin.
FF-S-92	- Screw, Machine: Slotted, Cross-Recessed or Hexagon Head.
NN-P-71	- Pallets, Material Handling, Wood, Double Faced, Stringer Construction.
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
QQ-S-781	- Strapping, Steel, and Seals.
PPP-B-585	- Boxes, Wood, Wirebound.
PPP-B-601	- Boxes, Wood, Cleated-Plywood.
PPP-B-621	- Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636	- Boxes, Shipping, Fiberboard
PPP-T-60	- Tape: Packaging, Waterproof
PPP-T-76	- Tape, Packaging, Paper, (For Carton Sealing).

MILITARY

MIL-P-116	- Preservation-Packaging, Methods of.
MIL-T-152	- Treatment, Moisture- and Fungus-Resistant, of Communications, Electronic, and Associated Electrical Equipment.
MIL-W-583	- Wire, Magnet, Electrical.
MIL-S-901	- Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-F-14072	- Finishes For Ground Electronic Equipment.
MIL-C-45662	- Calibration System Requirements.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Communications Research and Development Command, ATTN: DRD-CM-DM Fort Monmouth, NJ 07703, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

STANDARDS

FEDERAL

FED-STD-595 - Colors.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-147 - Palletized Unit Loads for 40" x 48" Pallets.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-794 - Parts and Equipment Procedures for Packaging and Packing of.
MIL-STD-1188 - Commercial Packaging of Supplies and Equipment.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

DRAWINGS

DEPARTMENT OF THE NAVY

SK-N-864 - Simulated Gunblast Producing Equipment.

(Application for copies of SK-N-864 and related drawings to build the simulated gunblast producing equipment, or a quote to perform the gunblast test should be addressed to Naval Electronics Laboratory Center, Code 3400, 271 Catalina Boulevard, San Diego, CA 92152).

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C 20402.)

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

Standard 219 - Loudspeaker Measurements, Recommended Practice For

(Application for copies should be addressed to the Institute of Electrical and Electronic Engineers, Box A, Lenox Hill Station, New York, New York 10021. Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Qualification. Loudspeakers furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (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 class 105, type T of J-W-1177.

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 Handbook 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. X24087 (olive drab) conforming to FED-STD-595.

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 of 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 $\pm$1 ohms.

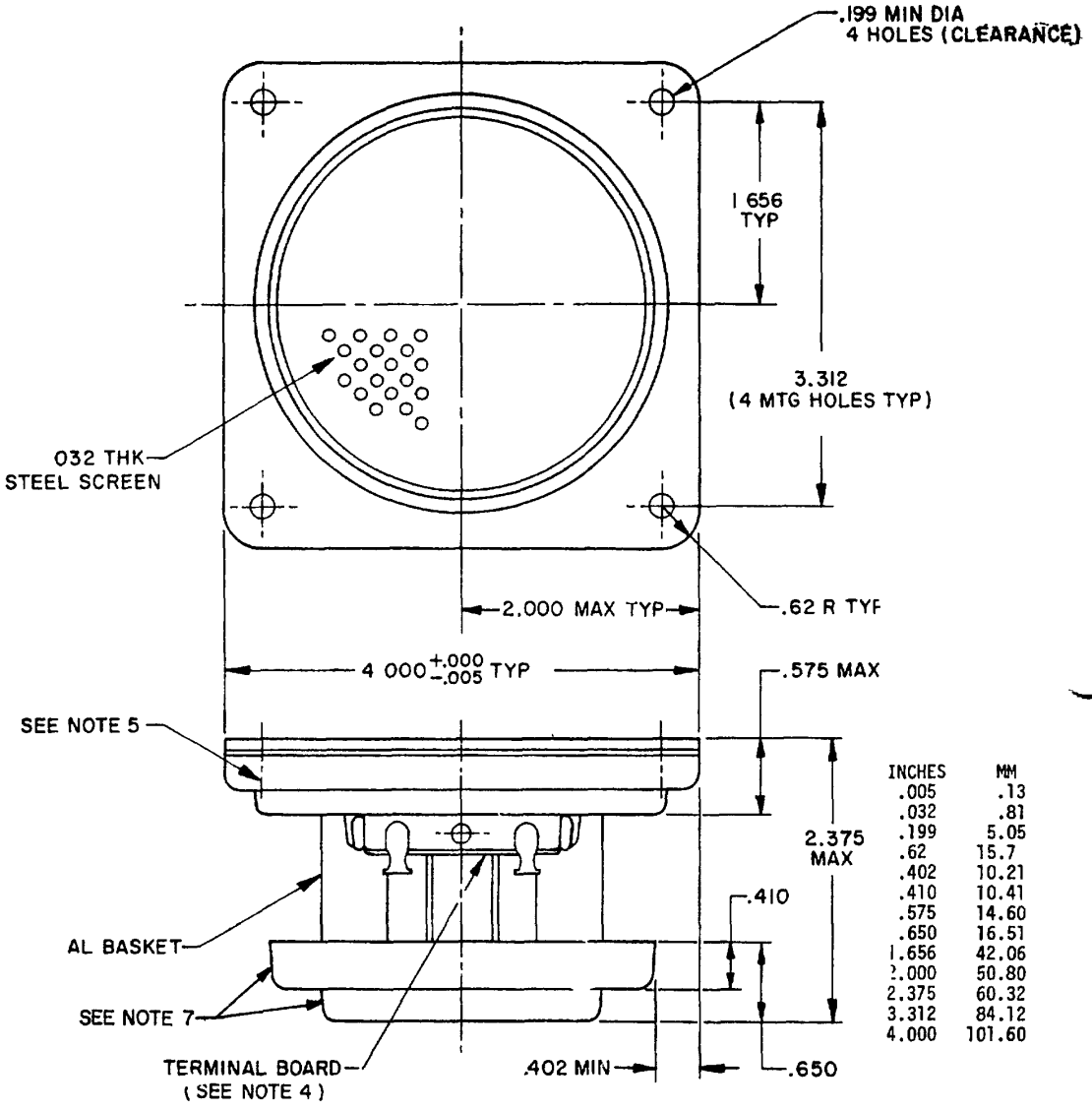
3.4.3 Dielectric withstanding voltage. When tested as specified in 4.7.4, there shall be no arcing or breakdown of the voice coil insulation.

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.

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, and 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.

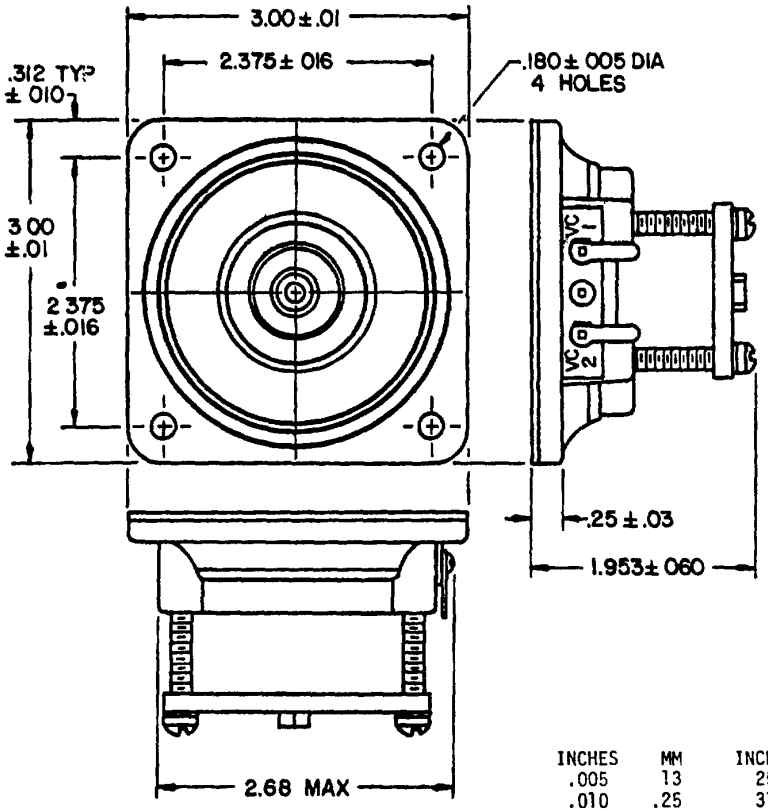
3 4.5 2 M12606-01. When tested as specified in 4.7.6.2, the frequency response between 750 to 1,250 Hz shall not be less than 93 decibels (dB) relative to 0.0002 dynes per square centimeter; and the response levels between 400 to 6,000 Hz shall be within the limits shown on figure 5, except that sharp 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.



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 ±.02 (.5 mm) and xxx ±.005 (.13 mm).
4. Mark terminal board with a red mark near positive terminal.
5. 4 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.

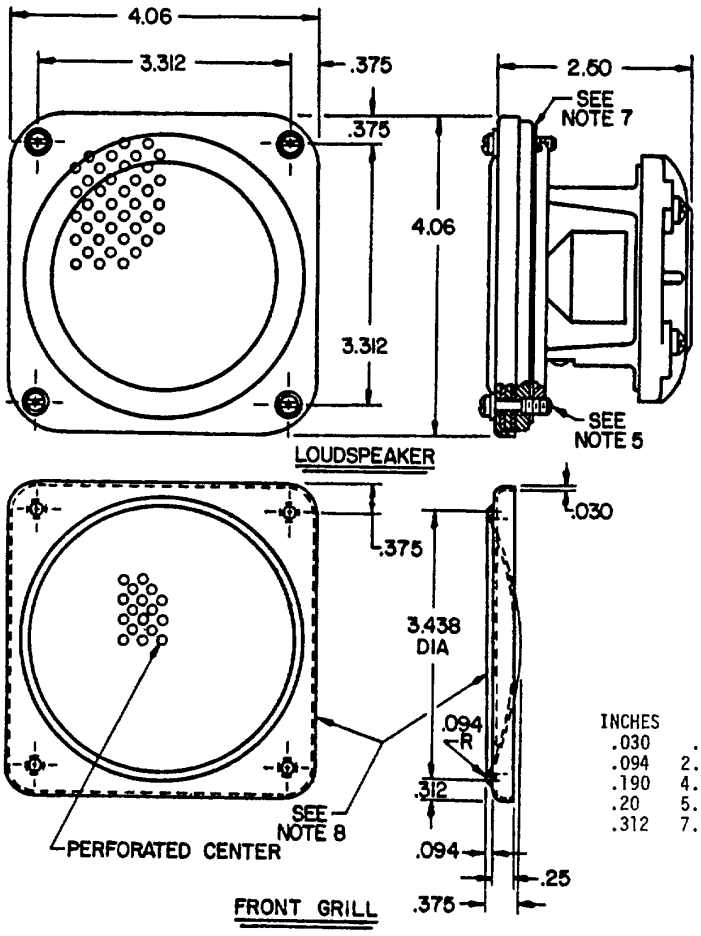
FIGURE 1 Type LS-445/U loudspeaker (see 6.4).



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 ±.02 (.5 mm) and xxx ±.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).



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 ±.02 (5 mm) and xxx ±.005 (.13 mm).
4. Mark terminal board with a red mark near positive terminal.
5. 4 mounting, holes, with 4, .190-24UNC-2A x .75 lg. screws, captive.
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).

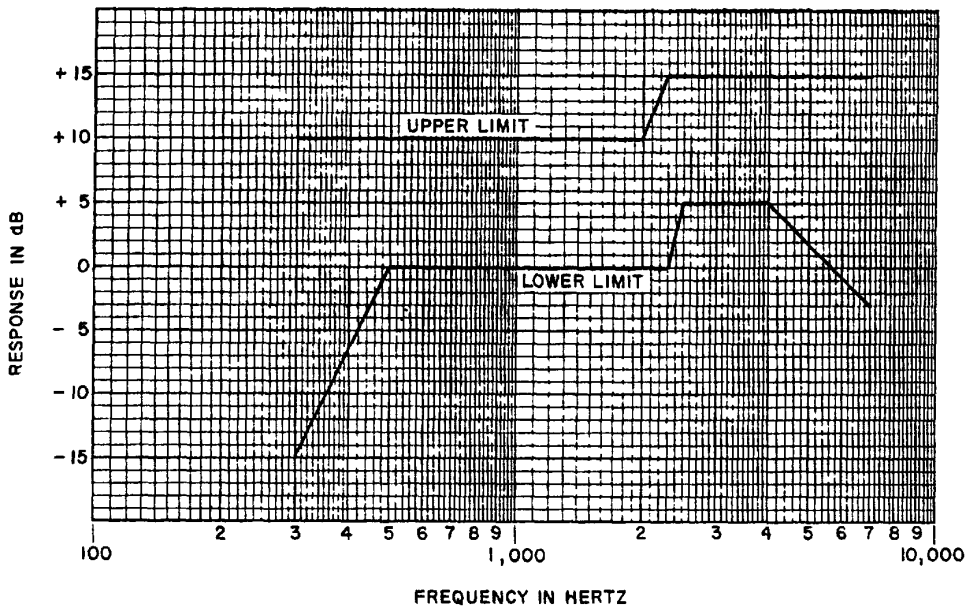


FIGURE 4 Frequency response limits for LS-445/U and M12606-02.

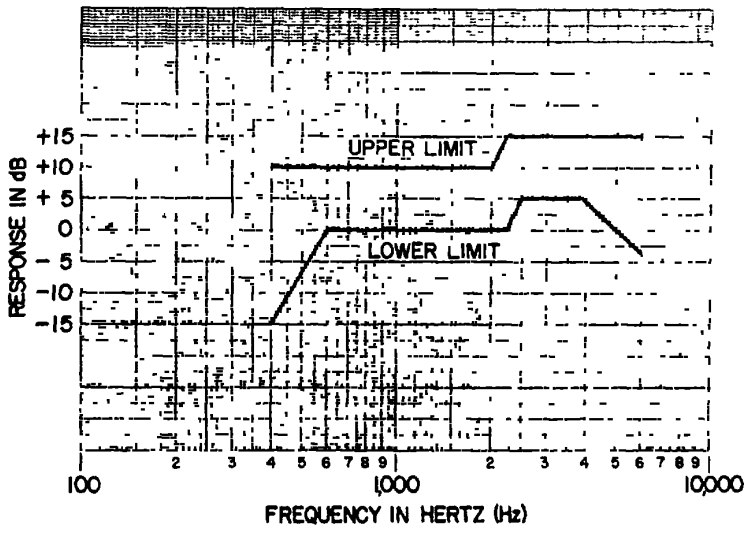


FIGURE 5. Frequency response limits for M12606-01.

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 Gunblast resistance. When tested as specified in 4.7.8, 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 Immersion resistance. When tested as specified in 4.7.9, 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.

3.4.9 Endurance. When tested as specified in 4.7.10, the frequency response shall be as specified in 3.4.5, and there shall be no damage to the loudspeaker

3.4.10 Cold 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 Heat resistance. When tested as specified in 4.7.12, 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.

3.4.12 Moisture resistance 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 Bounce. 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

3.4.14 Shock. When tested as specified in 4 7.15, 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 or symbol Markings 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 QUALITY ASSURANCE PROVISIONS

4 1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities 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 accordance with MIL-C-45662.

a. Materials inspection (see 4 3).

b. Qualification inspection (see 4 5).

c Quality conformance inspection (see 4.6)

4.3 Materials inspection. Materials inspection shall consist of certification supported 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	J-W-1177
Screws- - - - - - -	3.2.4	FF-S-92
Plastic - - - - - -	3.3.4	L-P-513

4.4 Inspection conditions and preconditioning

4.4.1 Conditions Unless otherwise specified herein, all inspections 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 anechoic 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 inspections 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
Group I		
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
Group II		
Gunblast resistance- - - - - - - - - - - -	3.4.7	4.7.8
Immersion resistance - - - - - - - - - - -	3.4.8	4.7.9
Endurance- - - - - - - - - - - - - - - - -	3.4.9	4.7.10
Group III		
Cold resistance- - - - - - - - - - - - - -	3.4.10	4.7.11
Heat resistance- - - - - - - - - - - - - -	3.4.11	4.7.12
Moisture resistance- - - - - - - - - - - -	3.4.12	4.7.13
Bounce - - - - - - - - - - - - - - - - - -	3.4.13	4.7.14
Shock- - - - - - - - - - - - - - - - - - -	3.4.14	4.7.15

4.5.3 Failures. 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 purchase order.

4.5.5 Retention 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 reporting 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.

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 complete 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 occured 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 loudspeakers to 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 MI2606-02.

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 inspections.

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.

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. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II The acceptable quality level (AQL) shall be as specified in table III. Major and minor defects shall be as defined in MIL-STD-105. The classification of defects for the visual and mechanical examination is specified in table VI.

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. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE III. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination	3.2, 3.3, 3.5 and 3.6	4.7.1	1.0	4.0
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	1.0	---
Acoustic quality	3.4.4	4.7.5		

4.6.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table IV, 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. The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-4. The AQL shall be 6.5 percent defective.

TABLE IV. Group B inspection.

Inspection	Requirement paragraph	Method paragraph
Frequency response	3.4.5	4.7.6
Harmonic distortion	3.4.6	4.7.7

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. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

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, 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 these 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.

4.6.2.1.1 Sampling plan. Group C inspection shall be performed once each month on 6 sample units selected without regard to their quality from units produced during the period or each 1,000 units, whichever occurs first. 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
Subgroup 1 (3 sample units)		
Gunblast resistance	3.4.7	4.7.8
Immersion resistance	3.4.8	4.7.9
Endurance	3.4.9	4.7.10
Subgroup 2 (3 sample units)		
Cold resistance	3.4.10	4.7.11
Heat resistance	3.4.11	4.7.12
Moisture resistance	3.4.12	4.7.13
Bounce	3.4.13	4.7.14

4.6 2.1.2 Failures. If one or more sample 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 purchase 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 subject 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 6.3 Inspection of packaging. Except when commercial packaging is specified, the sampling and inspection of the preservation and interior package marking shall be in accordance with the group A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with the quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129. The inspection of commercial packaging shall be as specified in the contract (see 6 2).

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 4 5 ±1 5 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 hand held 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 or 4.7 3 2, 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 ±.10-ohm resistor (R) across the output of a low impedance 1000-Hz signal source (E_T) (see figure 6). A voltmeter shall be placed across R, and E_T set so that E_R equals 1 ±.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 resistor 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 of other suitable equipment. The voice coil impedance shall be considered as numerically equal to the measured value of resistance of the variable resistor.

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 amounts 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	Markings 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-Presense 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 7-strand conductor, more than 2 broken strands. Insulation burned, abrased, 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, abrased, 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 considered to be firmly attached.

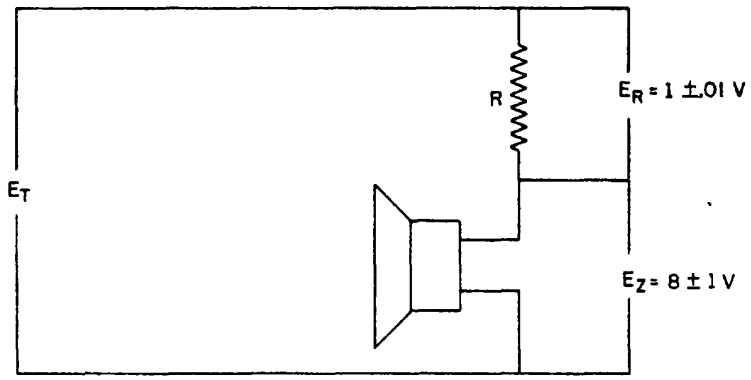


FIGURE 6. Measurement of impedance by direct reading method

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:

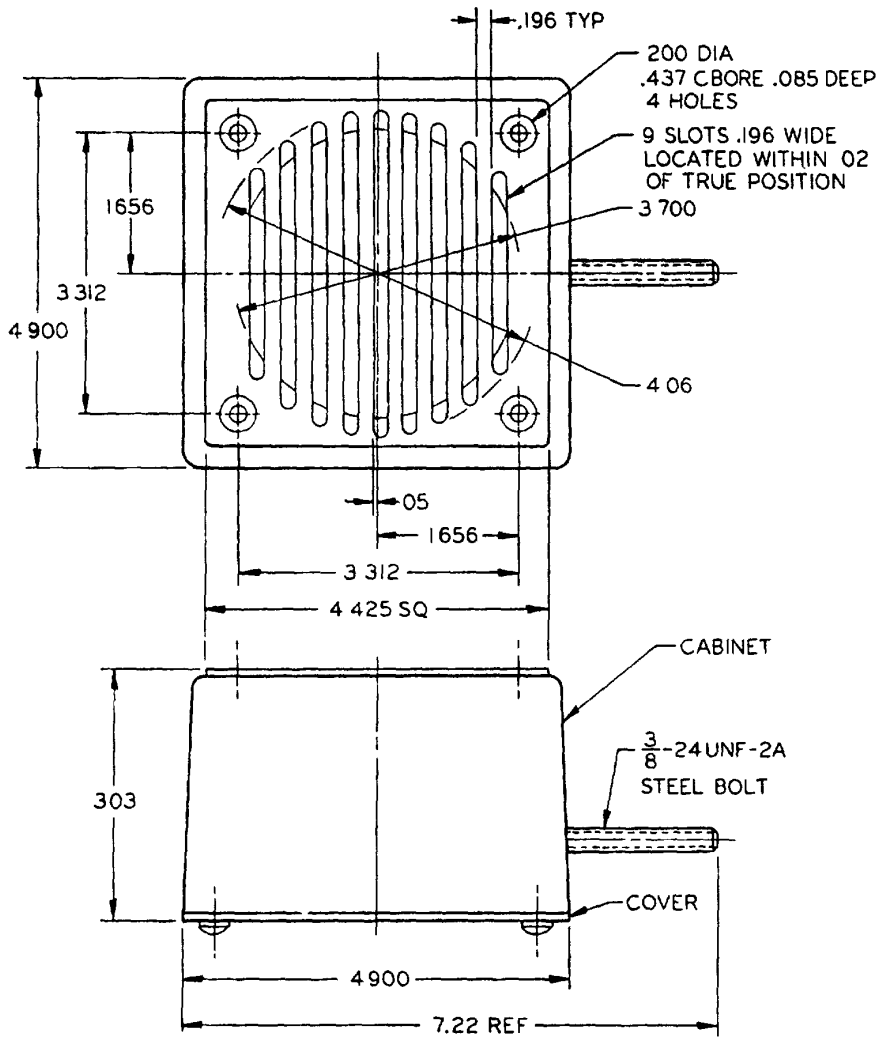
a. Test voltage - 400 volts
b. Nature of potential - 60 Hz, AC.
c. Points of application - The test voltage shall be applied between one of the voice coil terminals and the loudspeaker frame, simultaneously, the voice coil shall be excited with a minimum of 2.85 volts root mean square (rms) at 300 Hz.

4.7.5 Acoustic quality (see 3.4.4). A constant voltage having a rms value of 4.00 ±.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 (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 ±.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 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 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 recorded 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 ±.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 of 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).



INCHES	MM
02	.51
05	1.27
085	2.16
.196	4.98
.200	5.08
437	11 10
1.656	42.09
3 03	76 96
3 312	84 12
3 700	93 98
4 06	103 12
4.425	112 40
4.900	124.46
7.22	183 39

NOTES:
1. Dimesnsions 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).

4.7.7 Harmonic distortion (see 3.4.6). The loudspeaker shall be mounted in a test cabinet (figure 7) and a constant voltage having a rms value of 4.00 ±.1 volts at discrete frequencies of 400, 2000, and 4000 Hz ±10 percent shall be applied to the voice coil terminals. 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 levels 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

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 Gunblast resistance (see 3.4 7). The loudspeaker shall be mounted in a test cabinet (figure 4) and the cabinet mounted on the carriage of the simulated gunblast producing equipment (Drawing SK-N-864). The front edge of the test cabinet shall be positioned in the test plane so that its axis is coincident with that of the explosion chamber The loudspeaker shall be subjected to 30 rounds of blast at a peak pressure of 9.5 pounds per square inch. After the test, the frequency response and harmonic distortion shall be determined in accordance with 4 7 6 and 4 7 7, respectively, and the loudspeaker examined for damage.

4.7 9 Immersion resistance (see 3 4.8). 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 minute 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.

4.7.10 Endurance (see 3.4 9). A constant rms voltage of 2.85 ± 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.

4.7.11 Cold resistance (see 3 4.10) The loudspeaker shall be placed in a cold chamber and maintained at a temperature of $-80\ ^{+0}_{-5}$°F for 24 hours ±1 hour. The temperature shall then be raised to and stabilized at $-65\ ^{+0}_{-5}$°F. A constant rms voltage of 4 00 ± .1 volts at a frequency of $300\ ^{+25}_{-0}$ Hz shall be applied to the voice coil terminals for 5 minutes ± 1 minute 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 7.12 Heat resistance (see 3.4 11). The loudspeaker shall be placed in a heat chamber and maintained at a temperature of +160 $^{+5}_{-0}$°F for a period of 24 hours ±1 hour. A constant rms voltage 4.00 ±.1 volts at a frequency of 300 $^{+25}_{-0}$Hz shall be applied to the voice coil terminals for 5 minutes ±1 minute 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 13 Moisture resistance (see 3 4 12). 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.
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 ±5°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 14 Bounce (see 3 4 13). 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 fixtures 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

4.7.15 Shock (see 3.4.14). 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 (929 03 cm), and 5 ft (152 40 cm), respectively

5 PACKAGING

5 1 Preservation. Preservation shall be level A or C, or as specified (see 6 2)

5 1 1 Level A

5 1 1.1 Cleaning. Loudspeakers shall be cleaned in accordance with MIL-P-116, process C-1

5.1.1.2 Drying Loudspeakers shall be dried in accordance with MIL-P-116

5.1.1.3 Preservatives. Contact preservatives shall not be used.

5.1.1 4 Unit packs. Loudspeakers shall be individually unit packed in accordance with MIL-P-116, submethod IC-2 insuring compliance with the applicable requirements of that specification. The container shall conform to PPP-B-636.

5.1.1 5 Intermediate packs. Intermediate packs are not required.

5.1.2 Level C. The level C preservation for loudspeakers shall conform to the MIL-STD-794 requirements for this level.

5.2 Packing. Packing shall be level A, B, or C, or as specified (see 6.2)

5.2.1 Level A. The packaged loudspeakers shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements In lieu of the closure and waterproofing requirement in the appendix of PPP-B-636, closure and waterproofing shall be accomplished by sealing all seams, corners and manufacturer's joint with tape, two inches minimum width, conforming to PPP-T-60, class 1 or PPP-T-76. Banding (reinforcement requirements) shall be applied in accordance with the appendix to PPP-B-636 using non-metallic or tape banding only.

5.2.2 Level B. The packaged loudspeakers shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirements. Closures shall be in accordance with the appendix thereto

5.2.3 Level C. The level C packing for loudspeakers shall conform to the MIL-STD-794 requirements for this level.

5.2.4 Unitized loads. Unitized loads, commensurate with the level of packing specified in the contract or order, shall be used whenever total quantities for shipment to one destination equal 40 cubic feet or more. Quantities less than 40 cubic feet need not be unitized. Unitized loads shall be uniform in size and quantities to the greatest extent practicable.

5 2.4 1 Level A. Loudspeakers, packed as specified in 5.2.1, shall be unitized on pallets in conformance with MIL-STD-147, load type I, with a fiberboard cap (storage aid 4) positioned over the load.

5.2.4.2 Level B Loudspeakers, packed as specified in 5.2.2, shall be unitized as specified in 5 2.4 1 except that the fiberboard caps shall be class domestic

5.2.4.3 Level C. Loudspeakers, packed as specified in 5.2.3, shall be unitized as specified in MIL-STD-794 except that conformance to MIL-STD-147 is not required.

5.3 Marking In addition to any marking required by the contract (see 6.2), each unit pack, exterior container and unitized load shall be marked in accordance with MIL-STD-129

5.4 General

5.4.1 Exterior containers. Exterior containers (see 5.2.1, 5 2.2 and 5.2.3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable

5 4 2 Packaging inspection The inspection of these packaging requirements shall be in accordance with 4.6.3.

5 4 3 Army procurements.

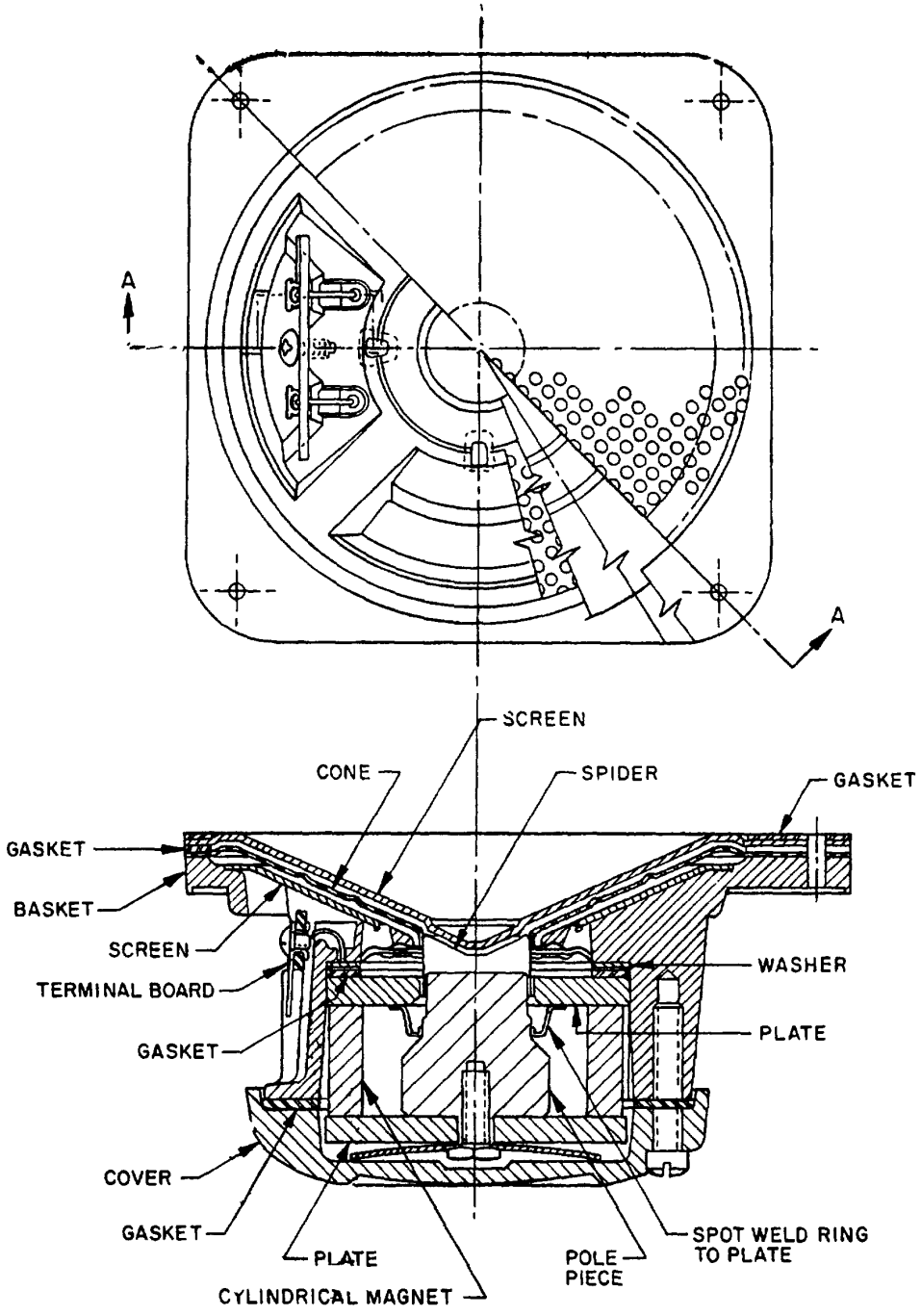
5 4 3.1 Level A (maximum military protection) and Level B (minimum military protection) packing. For level A packing the fiberboard containers shall not be banded but shall be placed in a close fitting box conforming to PPP-B-601, overseas type, PPP-B-621, class 2 style 4 of PPP-B-585, class 3, style 2 or 3 Closure and strapping shall be in accordance with applicable container specification except that metal strapping shall conform to QQ-S-781, type I finish A. When the gross weight exceeds 200 pounds or the container length and width is 48 x 24 inches or more and the weight exceeds 100 pounds, 3 x 4 inch skids (laid flat) shall be applied in accordance with the requirements of the container specification. If not described in the container specification, the skids shall be applied in a manner which will adequately support the item and facilitate the use of material handling equipment. For level B packing, fiberboard boxes shall be weather resistant as specified in level A and the containers shall be banded (see 5.2.1 and 5.2.2).

5.4.3.2 Level A and B unitization. For level A and B unitization softwood pallets conforming to NN-P-71, type IV, size 2 shall be used. Weather resistant fiberboard caps shall also be used for level B unitization. The loads for both levels shall be bonded to the pallets by strapping conforming to QQ-S-781, type I, finish A or shrink film (see 5.2.4.1 and 5.2.4 2).

5.4.3.3 Commercial packaging Commercial packaging (including unit packing, packing and marking) shall be in accordance with MIL-STD-1188.

6. NOTES

6 1 Intended use. This loudspeaker is primarily intended to be used as part of loudspeakers specified in MIL-L-12632.



SECTION AA

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

FIGURE 8. Acceptable loudspeaker design.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.
b. Applicable document for classification of visual and mechanical defects if other than table VI (see 4.7.1).
c. Inspection of commercial packaging (see 4.6.3).
d. Levels of preservation and packing required (see 5.1 and 5.2).
e. Special marking, if required (see 5.3).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the suppliers 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 or orders for the products covered by this specification The activity responsible for the qualified products list is the Electronics Command, Department of the Army, Fort Monmouth, New Jersey 07703. Information pertaining to qualification of products may be obtained from the Naval Electronic Systems Command or the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45444, agent for administration of the qualified products list.

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 MIL-STD-8, 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 number. Consist of the letter "M" followed by the basic number of this specification (or specification sheet) and a dash number added as follows:

M12606 - 01
Basic spec no
Dash no.

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 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes

Custodians:
Army - CR
Navy - EC
Air Force - 85

Review activities:
Army - AR
Navy -
Air Force - 99
DLA - ES

User activities:
Army - AR, AV
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Preparing activity:
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DLA - ES

(Project 5965-0166)

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