

MIL-L-24223C(SH)  
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 SUPERSEDING  
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 (See 6.9)

## MILITARY SPECIFICATION

### LOUDSPEAKER, SHIPBOARD ANNOUNCING SYSTEMS GENERAL SPECIFICATION FOR

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers enclosed permanent magnet loudspeakers for use in 70.7 volt distribution systems on Naval ships.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

#### SPECIFICATIONS

##### FEDERAL

QQ-A-250	- Aluminum and Aluminum Alloy Plate and Sheet General Specification for.
QQ-A-250/8	- Aluminum Alloy 5052, Plate and Sheet.
QQ-A-250/11	- Aluminum Alloy 6061 Plate and Sheet.
QQ-A-591	- Aluminum Alloy Die Castings.
QQ-B-626	- Brass, Leaded and Nonleaded: Rod, Shapes, Forgings, and Flat Products with Finished Edges (Bar and Strip).
TT-E-490	- Enamel Silicone Alkyd Copolymer, Semigloss (For Exterior and Interior Use).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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- MIL-T-27 - Transformers and Inductors (Audio, Power, and High-Power Pulse), General Specification for.
- MIL-C-915 - Cable and Cord, Electrical, for Shipboard Use, General Specifications for.
- MIL-C-915/29 - Cable, Electrical, 1000 Volts, Type DSGU (Including Variation Type DSGA).
- MIL-S-3786 - Switches, Rotary (Circuit Selector, Low-Current Capacity), General Specification for.
- MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
- MIL-P-15024/5 - Plates, Identification.
- MIL-E-16400 - Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore: General Specification for.
- MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts): Packaging of.
- MIL-S-19622 - Stuffing Tubes, Nylon: General Specifications.
- MIL-S-19622/1 - Stuffing Tube Straight, Nylon.
- MIL-A-20222 - Announcing-Equipment, Shipboard.
- MIL-P-23377 - Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant.
- MIL-L-24223/1 - Loudspeaker, Shipboard Announcing Systems Encased, 70.7 Volt, 1 to 5 Volt-Amperes.
- MIL-L-24223/2 - Loudspeaker, Shipboard Announcing Systems Encased, 70.7 Volt, 6 to 15 Volt-Amperes.
- MIL-L-24223/3 - Loudspeaker, Shipboard Announcing Systems Encased, 70.7 Volt, 80 Volt-Amperes.
- MIL-L-24223/4 - Loudspeaker, Shipboard Announcing Systems Encased, High Power, Rotational 70.7 Volt.
- MIL-T-55164 - Terminal Boards, Molded, Barrier, Screw and Stud Types, and Associated Accessories, General Specification for.

## STANDARDS

## MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-454 - Standard General Requirements for Electronic Equipment.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

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2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- Sl.4 - Specification for General Purpose Sound Level Meters.
- Sl.12 - Laboratory Standard Microphones, Specifications For.
- Sl.34 - Engineering Methods for the Determination of Sound Power Levels of Noise Sources for Essentially Field Free Conditions Over a Reflected Plane.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

ELECTRONIC INDUSTRY ASSOCIATION (EIA)

- RS 276 - Dynamic Loudspeakers, Acceptance Testing of.
- RS 278 - Mounting Dimensions for Loudspeakers.
- RS 299 - Recommended Practice for Loudspeaker Measurements.

(Application for copies should be addressed to Electronic Industry Association, 2001 Eye Street NW, Washington, DC 20006.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- 219 - Loudspeaker Measurements, Recommended Practice For.

(Application for copies should be addressed to the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017.)

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

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3.2 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.5).

3.3 Material and parts.

3.3.1 Material and parts selection. When specified in the contract or order, a parts control plan shall be prepared (see 6.2.2). Selection of parts and materials shall be in accordance with MIL-E-16400.

3.3.2 Material. The enclosure and sound passages shall be constructed of aluminum alloy. Die castings material shall be in accordance with QQ-A-591. Paint shall be in accordance with MIL-E-16400.

3.3.2.1 Restricted materials. Mercury, cadmium, asbestos and radio-active materials shall not be used in any part of the assembly or in the manufacturing process.

3.3.2.2 Inert materials. Fungus inert materials shall be in accordance with requirement 4 of MIL-STD-454.

3.3.2.3 Stray magnetic field and materials permeability. When tested as specified in 4.5.4.10 the loudspeaker stray magnetic field and materials permeability shall be in accordance with the applicable specification sheet.

3.3.2.4 Coatings.

3.3.2.4.1 Sheltered. Sheltered coatings shall be in accordance with MIL-E-16400.

3.3.2.4.2 Unsheltered. Unsheltered coatings shall have one coat epoxy primer in accordance with MIL-P-23377, one coat epoxy paint formula 151, and two coats silicone alkyd (haze gray) in accordance with TT-E-490.

3.3.2.5 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3.3 Parts.

3.3.3.1 Transformers. Transformers audio frequency shall be grade 4 or 5, class R or S, life expectancy X in accordance with MIL-T-27. The primary rated root mean square (rms) voltage shall be 70.7 volts.

3.3.3.1.1 Transformer loss. Transformer loss shall be less than 1.5 decibels (dB) when tested as specified in 4.5.2.1.1.

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3.3.3.1.2 Transformer phase relation. When a positive voltage is applied to the "MC 70V +" terminal of the primary, a positive voltage shall appear at the secondary "FULL" and other taps with respect to "COM" terminal. (See wiring diagrams in the applicable specification sheet.)

3.3.3.1.3 Transformer terminals. The transformer shall have solderless connections. Terminals shall be marked as shown on the applicable specification sheet diagram. The solderless connections shall be "tinned" or plated for corrosion resistance in accordance with MIL-E-16400.

3.3.3.1.4 Transformer secondary. The transformer secondary shall be as specified in the applicable specification sheet. Volume adjustment shall be accomplished by changing transformer secondary taps to the speaker element coil, in 6 dB steps. Volume selection shall be as indicated in the applicable specification sheet.

3.3.3.1.5 Transformer dielectric withstanding voltage. The loudspeaker transformer dielectric withstanding voltage shall be 600 volts with more than 20 megohms resistance to core and between windings when tested in accordance with 4.5.2.1.3.

3.3.3.2 Volume control switch. When the specification sheet requires external volume selection, a switch in accordance with MIL-S-3786 shall be used. The counterclockwise end of rotation shall be "OFF". The clockwise end of rotation shall be "FULL" volume. Six positions with 30-degree spacing is required.

3.3.3.3 Input terminal block. A terminal block shall be provided in the part of the enclosure that is mounted. The terminal block shall provide for connecting the incoming ship's lines and shall be marked as shown in accordance with MIL-L-24223/1. Terminal blocks shall be in accordance with MIL-T-55164. Terminal blocks shall withstand the salt fog test specified in 4.5.3.9 without evidence of physical damage or corrosion, or loss of legibility of markings.

3.3.3.4 Identification plate. Loudspeakers shall be furnished with mounted identification plates. The identification plates shall be in accordance with MIL-P-15024 types A, B, F, or H, and shall be attached with mounting screws. The identification plates shall be provided for "normal" service in accordance with MIL-P-15024/5. The following information shall be included on the identification plate:

- (a) Designation "Shipboard Announcing Equipment".
- (b) Nomenclature.
- (c) National stock number.
- (d) Manufacturer's name and address.
- (e) Rated input voltage and power.
- (f) Instruction sheet number (if available).
- (g) Allowance part number (if available).
- (h) Serial number and date manufactured.

3.4 Circuit diagram. The circuit diagram plate shall be in accordance with MIL-P-15024 types A, B, F, or H, and shall be attached with mounting screws. A printed schematic interior wiring diagram of the loudspeaker shall be securely affixed inside the enclosure where it will be easily readable with the cover open. The circuit diagram shall show wire color coding, terminal designations and

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volume selector switch connections, where used. The circuit diagram shall show the proper connections for different lines and the means for adjusting volume.

3.5 Cable entrance. Enclosure cable entrance shall be as specified in the applicable specification sheet. The contractor shall provide the stuffing tubes.

3.6 Environmental exposure. During all environmental exposures the loudspeakers shall be mounted normally and shall be energized and monitored to detect electrical failure. Performance requirements specified in 3.8 shall be met during and after all exposures except during gun blast, icing, immersion and shock exposures. Environmental tests shall be performed using a loudspeaker having external volume control. Acceptance is extended to types that are otherwise identical. Following each environmental test the loudspeaker shall be subjected to the examination of 4.5.1 to determine if there are any defects such as those listed in table III.

3.6.1 Shock. After exposure, the loudspeaker shall meet the shock requirements in accordance with MIL-E-16400 and the performance requirements of 3.8 when tested in accordance with 4.5.3.1. There shall be no visible evidence of cracking, bending or loosening of parts when examined internally and externally in accordance with 3.7 and table III. Cracks or breaks shall be cause for rejection and change of aluminum alloy material.

3.6.2 Temperature, nonoperating. After exposure the loudspeaker shall meet the requirements of 3.8 when tested as specified in 4.5.3.2.

3.6.3 Immersion. The loudspeaker shall meet the requirements of 3.8 when tested as specified in 4.5.3.3.

3.6.4 Icing. Loudspeakers for unsheltered application shall meet the requirements of 3.7 and 3.8 when tested as specified in 4.5.3.6.

3.6.5 Temperature, operating. The loudspeaker shall meet the requirements of 3.8 during and after exposure when tested as specified in 4.5.3.4.1 and 4.5.3.4.2.

3.6.6 Humidity. The loudspeaker shall meet the requirements of 3.8 during and after exposure when tested as specified in 4.5.3.5.

3.6.7 Salt fog. The loudspeaker shall meet the requirements of 3.8 during and after exposure when tested as specified in 4.5.3.9. There shall be no evidence of corrosion internally and externally.

3.6.8 Vibration. The loudspeaker shall meet the requirements of 3.7 and 3.8 during and after exposure when tested as specified in 4.5.1 and 4.5.3.7.1. There shall be no major defects (see 4.4.2.1).

3.6.9 Endurance. The loudspeaker assembly shall meet the requirements of 3.8 during and after completion of the test specified in 4.5.3.8.1. The loudspeaker element fundamental resonance frequency shall not change more than 5 percent when tested as specified in 4.5.3.8 and measured as specified in 4.5.4.11.

3.6.10 Gunblast. Loudspeakers shall withstand gunblast as specified in 4.5.3.10 for all unsheltered shipboard applications.

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3.7 Workmanship. There shall be no equipment defects when examined in accordance with 4.5.1. Workmanship shall conform to MIL-E-16400 and contractors' own quality assurance requirements. Defects shall be classified for acceptance/rejection in accordance with 4.4.2.1 as minimal criteria.

3.8 Performance requirements. Performance requirements shall be as specified in the applicable specification sheet and the following:

3.8.1 Quality of reproduction. There shall be no spurious sounds. The male voice at normal conversational level shall be intelligible when tested as specified in 4.5.4.1.

3.8.2 Loudspeaker element coil.

3.8.2.1 Impedance. The 1000 hertz (Hz) loudspeaker rated impedance shall be  $8 \pm 1$  ohms when tested as specified in 4.5.4.2.1. The direct current (dc) resistance shall equal rated impedance divided by  $1.15 \pm 15$  percent.

3.8.2.2 Polarity. Polarity shall be determined as specified in 4.5.4.2.2. The loudspeaker element coil connection point polarity shall be marked in a durable bold highly visible style.

3.8.2.3 Clearance. The loudspeaker element coil air gap minimum clearance shall be 0.010 inch (see 4.5.4.2.3).

3.8.2.4 Dielectric withstanding voltage. The insulation resistance shall be greater than 20 megohms under dielectric stress when tested as specified in 4.5.4.2.4.

3.8.3 Sound power output. The measured sound power shall be equal to or greater than the sound power output levels specified in the applicable specification sheet when tested as specified in 4.5.4.3.

3.8.4 Minimum sound pressure output. The loudspeakers shall produce at least the minimum rms on axis sound pressure specified in the applicable specification sheet when tested as specified in 4.5.4.4.

3.8.5 Coverage angle. The specified sound coverage angle is the angle at which the sound pressure output has decreased 6 dB from the zero-degree "on" axis value. This angle shall be as specified in the applicable specification sheet when tested as specified in 4.5.4.5.

3.8.6 Frequency response. The frequency versus sound pressure output response shall fall within the limits shown on the applicable specification sheet figure when tested as specified in 4.5.4.6. These limits shall be narrowed as determined from environmental effects testing (see 4.5.3) when performing production inspection tests under room ambient conditions.

3.8.7 Operation at reduced output. The sound pressure output shall be within 1.0 dB of the indicated value below "FULL" output at each selectable level when tested as specified in 4.5.4.7.

3.8.8 Total harmonic distortion. The total harmonic distortion of the sound pressure output shall not exceed 5 percent when tested as specified in 4.5.4.8.

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3.8.9 Peak volt-ampere capacity. Peak volt-ampere capacity shall be as specified in the applicable specification sheet when tested as specified in 4.5.4.9.

3.8.10 Fundamental resonance. The fundamental resonance of the loudspeaker, determined as specified in 4.5.4.11, shall not vary more than 5 percent.

3.9 Maintainability. The following components shall be accessible by opening the enclosure for removal or replacement using common tools without disturbing any other parts:

- (a) Speaker driver
- (b) Speaker cone or horn
- (c) Transformer
- (d) Volume switch

3.10 Drawings. When specified in the contract or order, drawings shall be prepared (see 6.2.2).

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, 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 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.



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

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examination and tests shown in table I. The examination and tests shall be performed in the order listed. A first article test and inspection procedure and first article test and inspection report shall be prepared as specified (see 6.5).

4.3.1 First article sample. Sample size for first article testing shall be four samples.

TABLE I. First article inspection.

Percent of samples to be tested	Failures allowed	Test	Requirement paragraph	Test paragraph
100	0	Examination	3.7	4.5.1
100	0	Materials and parts control	3.3.1	table III
100	0	Performance	3.8 thru 3.8.10	4.5.4 thru 4.5.4.11 (excluding 4.5.4.1.1)
50	0	Shock	3.6.1	4.5.3.1
100 of unfailed sample	1	Post shock		4.5.3.1.1
	-	Environmental (excluding shock)	3.6, 3.6.2 thru 3.6.9	table VI
	-	Performance	3.8 thru 3.8.10	4.5.4 thru 4.5.4.11 (excluding 4.5.4.1.1)
	1	During exposure		
50	0	After exposure		
	1	Examination	3.7	4.5.1
	0	Shock	3.6.1	4.5.3.1
	1	Post shock		4.5.3.1.1

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4.4 Quality conformance inspection.4.4.1 Sampling for quality conformance inspection.

4.4.1.1 Lot. Each equipments defined by the same specification sheet and suitable for delivery under one contract and less than or equal to the quantity requiring group C inspection (see 4.4.4) shall be considered a lot.

4.4.2 Group A sampling and inspection. Group A sampling and inspection shall be as specified in table II, and any additional testing required by the applicable specification sheets. Inspection shall be in accordance with MIL-STD-105 for general inspection level III. The acceptable quality level (AQL) shall be as specified in table II.

TABLE II. Group A inspection and sampling.

Inspection	Requirement paragraph	Test paragraph	AQL (Percent defective)	
			Major	Minor
Examination Material and parts control	3.7	4.5.1	1.0	4.0
	3.3.1	4.5.2	0	
Dielectric withstanding voltage	3.8.2.4	4.5.2.1.3	0.4	
Fundamental resonance	3.8.10	4.5.4.11	1.5	
Frequency response group A	3.8.6	4.5.4.1.1	2.0	

4.4.2.1 Classification of defects. Classification of defects shall be as specified in table III.

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TABLE III. Classification of defects for visual examination.

Classification	Defects
Critical	None defined
Major	
101	Mounting dimensions incorrect.
102	Defective or missing parts which could cause failure of function, system overload or personnel hazard.
103	Marking missing, illegible, or incorrect.
104	Any loose internal foreign object or particles that may interfere with loudspeaker movement or switch operation.
105	Connections, electrical parts missing or oxidized, inaccessibly located.
106	Wiring - incorrect connection, frayed and broken strands, melted or burned or cut insulation. Incorrect color code, interference with assembly or operation of the loudspeaker, excessive bare wire deteriorated insulation.
107	Enclosure - poor coatings, dimensional defects, water does not drain. Bending, cracks. Wrong material or parts.
108	Loss of internal wiring electrical connections or loss of connector connections.
Minor	
201	Clearance dimension increase.
202	Increase in weight.
203	Parts - poor finish and labeling. Items not reducing life expectancy or increasing maintenance frequency.
204	Marking protective coating omitted, smudges, not optimally located. Tags loose.
205	Any loose object that could interfere with the functioning of the loudspeaker or switch.
206	Connections, electrical - incorrectly labeled, inadvertently painted, fastener missing, location changed.
207	Wiring - taut lead, taut lead on opening the enclosure for access. Paint on wire insulation.
208	Enclosure - burrs and fins.

4.4.2.2 Rejected lots. If an inspection lot is rejected, the manufacturer may rework it to correct the defects, or screen out the defective units and resubmit for inspection using tightened inspection in accordance with MIL-STD-105.

4.4.3 Group B inspection. Group B inspection shall consist of inspections specified in table IV and any additional group B inspection required by the applicable specification sheet, and shall be made on speakers which have passed group A inspection. Sampling shall be in accordance with MIL-STD-105, general inspection level III, single sampling plan. The AQL shall be 0.5 percent defective.

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TABLE IV. Group B inspection.

Inspection	Requirement paragraph	Test paragraph
Sound pressure output	3.8.4	4.5.4.4
Transformer loss	3.3.3.1.1	4.5.2.1.1
Loudspeaker element coil impedance	3.8.2.1	4.5.4.2.1
Total harmonic distortion	3.8.8	4.5.4.8 and 4.5.4.8.1

4.4.3.1 Rejected lots. If an inspection lot is rejected, the contractor may rework it using tightened inspection in accordance with MIL-STD-105 to correct the defects and resubmit for reinspection.

4.4.4 Group C inspection. Group C inspection is required at the production quantity specified in the applicable specification sheet or every 5 years, whichever occurs last. Group C inspection shall be in accordance with table V, conducted in the order shown. Sampling shall be either three or six units that have passed group A and group B tests. Shock shall be performed on one of the three units or two of the six sample units.

TABLE V. Group C inspection.

Inspection	Requirement paragraph	Test paragraph
Humidity	3.6.6	4.5.3.5
Operating temperature	3.6.5	4.5.3.4 thru 4.5.3.4.2.2
Salt fog	3.6.7	4.5.3.9 thru 4.5.3.9.2
Dielectric withstanding voltage	3.8.2.4	4.5.4.2.4
Shock (1 of 3 or 2 of 6)	3.6.1	4.5.3.1 and 4.5.3.1.1
Vibration	3.6.8	4.5.3.7 thru 4.5.3.7.2
Endurance	3.6.9	4.5.3.8 thru 4.5.3.8.2
Examination	3.7	4.5.1
Immersion	3.6.3	4.5.3.3 and 4.5.3.3.1
Inert material	3.3.2.2	
Stray magnetic field and materials permeability	3.3.2.3	4.5.4.10
Loudspeaker element coil clearance	3.8.2.3	4.5.4.2.3

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4.4.4.1 Failure. If one or more of the sample of three fails the group C inspection, the lot has failed. If two or more of the sample of six fails the group C inspection, the lot has failed.

4.4.4.1.1 Rejected lots. If lot failure occurs, correction of the entire lot is required. After lot correction, sampling in accordance with 4.4.4 and group C inspection shall be repeated.

4.5 Method of inspection.

4.5.1 Examination. Examination shall be in accordance with MIL-E-16400.

4.5.2 Material and parts inspection. Materials and parts inspection shall include the following:

- (a) Verification of conformity of specifications to the specifications used for the same part in the successful first article.
- (b) Inspection of parts ordering specifications for conformity to successful first article part specifications.
- (c) Contractor parts inspection tests.

4.5.2.1 Transformer.

4.5.2.1.1 Transformer loss. Measure the magnitude of the impedance at 1000 Hz of an 11-ohm dummy load which has a power rating equal to or greater than the loudspeaker associated with the transformer ( $Z_2$ ) (the dummy load can be the loudspeaker voice coil). Measure the magnitude of the impedance at 1000 Hz looking into the transformer primary with the dummy load connected to the secondary "FULL" and "COM" terminals ( $Z_1$ ). Connect a 1000 Hz sine wave source to the primary and adjust its output to 70 volts root mean square ( $V_{rms}$ ) ( $V_1$ ). Measure  $V_2$ , the voltage across the dummy load. Calculate the transformer loss,  $L_T$ , in dB using the following equation:

$$L_T = 10 \text{ Log } ((V_1/Z_1)/(V_2/Z_2))^2$$

4.5.2.1.2 Phase relation. Apply a positive voltage to "MC 70V+" terminal of the primary and observe the direction of deflection of a dc voltmeter connected to the secondary "FULL" tap and the "COM" tap of the secondary.

4.5.2.1.3 Dielectric withstanding voltage. Apply dielectric withstanding voltage from transformer terminals to core and from primary to secondary terminals. Test in accordance with MIL-E-16400.

4.5.2.1.4 Transformer secondary. Record turn ratios and turns for each tap. Derive and report dB steps versus turns and turns ratio.

4.5.2.1.5 Source test. If the contractor is purchasing transformers in accordance with MIL-T-27 that have been tested for the above parameters, and can provide Government accepted test reports for the exact same transformer, then these tests need not be repeated.

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4.5.3 Environmental effects testing. Performance verification as specified in table VI shall be monitored before, during, and after environmental exposure. Shock, icing, nonoperating temperature and gunblast do not require monitoring during exposure. Performance testing during salt fog exposure shall be as specified in 4.5.3.9.1 in lieu of table VI. Performance parameters and the controlled environment shall be monitored. Performance tests shall be performed before and after exposure. The performance parameters shall be measured to a scale necessary to detect the effect of the controlled environment. The Government inspector shall control the movement of the samples during environmental testing. The contractor shall provide lock up stowage facilities for the inspector to store samples during the environmental testing. Loudspeaker performance parameters shall be measured as specified in IEEE 219 before and after environmental exposure. The effect of the controlled environmental parameter on the loudspeaker (see table VI) performance parameters shall be determined and monitored during exposure by repeating the performance tests on site before exposure (under room ambient conditions) then repeating or monitoring of performance during exposure. This effect during exposure shall be added (algebraically) to the post-IEEE 219 test values to determine if requirements are met. The combined effects of the various environmental exposures shall be summed to determine the allowable manufacturing tolerance that will assure the specified performance during combined environmental exposure. These tolerances and their derivation shall be recorded in the first article test report. Performance tests shall be performed before and after exposure.

4.5.3.1 Shock. The first article shock test as specified in MIL-E-16400, shall be performed on a minimum of two loudspeakers. If icing test is required, it shall be performed first. The loudspeaker shall be energized with a 70.7 volt, 10 or more watt source, 1000 Hz signal during each hammer blow.

4.5.3.1.1 Post shock test. The loudspeaker shall be examined externally and internally for evidence of loose or broken parts and cracked material, and tested as specified in table VI.

TABLE VI. Performance verification.

Test	Requirement paragraph	Test paragraph
Examination (post exposure only)	3.7	4.5.1
Performance		
Quality of reproduction	3.8.1	4.5.4.1.1 and 4.5.4.1.2
Sound pressure output	3.8.4	4.5.4.4
Operation at reduced output	3.8.7	4.5.4.7
Total harmonic distortion	3.8.8	4.5.4.8 and 4.5.4.8.1

4.5.3.2 Nonoperating temperature. The loudspeaker shall be exposed for 1 hour at low temperature and 2 hours at the high temperature range specified in the specification sheet. After exposure, the loudspeaker shall be stabilized to room temperature and humidity and tested as specified in table VI.

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4.5.3.2.1 Nonoperating temperature data. The contractor shall provide nonoperating temperature data comparing the performance results of table VI tests before and after exposure.

4.5.3.3 Immersion exposure. Using the same loudspeaker that successfully passed the shock test, totally immerse in 35 parts per 1000 salt water for 1/2 hour. Remove and allow to drain for not more than 15 minutes.

4.5.3.3.1 Post immersion. Immediately after drainage as specified in 4.5.3.3, the tests specified in table VI shall be repeated.

4.5.3.4 Operating temperature.

4.5.3.4.1 Operating high ambient temperature. Expose the loudspeaker for 1 hour in the required range at the high operating temperature specified in the applicable specification sheet. Relative humidity shall be less than 20 percent.

4.5.3.4.1.1 Operating high ambient temperature performance. After the equipment temperature is stable at the high temperature ambient the loudspeaker shall be tested as specified in table VI.

4.5.3.4.1.2 Post operating high ambient temperature. Repeat table VI tests after 1 hour or more at room temperature.

4.5.3.4.2 Operating low temperature. Expose the loudspeaker for 1 hour at the low operating temperature required range specified in the specification sheet. Relative humidity shall be at least 85 percent.

4.5.3.4.2.1 Operating, low temperature performance. While the loudspeaker is at the ambient low temperature the loudspeaker shall be tested as specified in table VI.

4.5.3.4.2.2 Post operating low temperature performance. After the equipment reaches a stable temperature under ambient room conditions the tests specified in 4.5.3.4.2.1 shall be repeated.

4.5.3.5 Humidity. The loudspeaker shall be tested for humidity exposure in accordance with MIL-E-16400.

4.5.3.5.1 Humidity performance. During humidity exposure, the tests specified in table VI shall be repeated after 1 hour.

4.5.3.5.2 Post humidity performance. The tests of 4.5.3.5.1 shall be repeated at room temperature and humidity.

4.5.3.6 Icing. The surfaces of two loudspeakers shall be coated with at least 4.5 pounds per square feet (lb/ft<sup>2</sup>) of ice. Melt the coating away and inspect for physical damage. After icing, the loudspeakers shall be tested in accordance with table VI.

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4.5.3.7 Vibration. Prior to vibration the loudspeaker shall be examined as specified in table VI. The loudspeaker shall be vibrated in accordance with MIL-STD-167-1. The upper vibration frequency shall be 55 Hz. Vibration shall include vibration along the voice coil axis and vibration perpendicular to the voice coil axis.

4.5.3.7.1 Vibration performance. The loudspeaker shall be tested as specified in table VI, during the first hour of the endurance test in accordance with MIL-STD-167-1 while the vibration direction is along the speaker coil axis. During the second hour of the endurance test in accordance with MIL-STD-167-1 the performance tests of table VI shall be repeated with the vibration perpendicular to the speaker coil axis.

4.5.3.7.2 Post vibration performance. The examination and tests of table VI shall be repeated at room ambient conditions.

4.5.3.8 Endurance. Prior to endurance exposure the loudspeaker element fundamental resonance shall be measured under room conditions in accordance with 4.5.4.11. A warbled frequency signal in the 800 to 1250 Hz band (see 4.5.4.4) at 70.7 Vrms shall be applied to the assembly input terminals for 72 hours with the ambient air temperature at 65 degrees Celsius (°C). The signal source shall be rated 4 times the loudspeaker "rated" continuous power.

4.5.3.8.1 Endurance performance. The performance verification tests specified in table VI shall be performed during the last 8 hours of the 72 hours specified in 4.5.3.8.

4.5.3.8.2 Post endurance performance. The examination and tests specified in table VI shall be performed at room ambient conditions. Repeat the resonance measurement of 4.5.4.11.

4.5.3.9 Salt fog. The salt fog test shall be in accordance with MIL-E-16400, procedure I for sheltered application and procedure II for unsheltered application.

4.5.3.9.1 Salt fog performance. During the test specified in 4.5.3.9 exposure, measure the sound pressure output in the 800 to 1250 warble band (see 4.5.4.4) at 25, 50, 75, and 97 hours.

4.5.3.9.2 Post salt fog performance. After the required exposure, the loudspeaker shall be tested in accordance with table VI at room ambient conditions.

4.5.3.10 Gunblast. Gunblast exposure shall be in accordance with MIL-E-16400. The loudspeaker shall be energized at 400 Hz, 35 volts from a 4 (or more) times loudspeaker "rated" watt source. After gunblast exposure the performance tests as shown in table VI shall be conducted. Performance before and after testing shall be compared.

4.5.4 Performance. Unless otherwise specified, a complete assembly shall be used for performance testing to verify conformance to 3.8 and the applicable specification sheet. Loudspeaker acoustical measurements shall be conducted in accordance with IEEE 219, except during environmental exposures.



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4.5.4.1 Quality of reproduction. The following tests shall be performed to determine if the requirements of 3.8.1 are met.

4.5.4.1.1 Production frequency response. Manually sweep a 70.7 volt sinusoidal signal from 200 to 6000 Hz. Observe the loudspeaker output on an oscilloscope having the upper and lower limits marked on the scope face (see 3.8.6).

4.5.4.1.2 Speech intelligibility. Provide microphone and amplifier to connect 200 to 7000 Hz plus or minus 1 dB audio input to the loudspeaker with less than 2 percent distortion over the amplitude range of 70.7 to 1.19 volts. Provide male talkers and male listeners over 35 years old. The sound pressure level at the listener shall be 60 to 70 dBp relative to 0.0002 dynes/cm<sup>2</sup> for a 300 Hz tone. The selected level shall be maintained constant plus or minus 0.5 dB or less regardless of the loudspeaker volume setting. A microphone and amplifier and earphones are required. This system shall have a flat frequency response plus or minus 1 dB over 200 or less to 5000 or more Hz range. Set speaker volume control to minus 12 dB. Record the talkers amplifier output and the loudspeaker output sound pressure. The listener and talker shall not be visible to each other. The talker shall randomly select words from table VII and speak the words into the system and into a tape recorder. The listener shall repeat the word he heard into a microphone amplifier recorder. The talker shall speak a new word every 5 to 7 seconds. The listener shall also write down the word he heard. 50 words are required for first article and group C inspections. 20 words are required for other inspections. The listener must correctly identify 85 percent of the words spoken. Laboratory standard microphones in accordance with ANSI S1.12 shall be used. The test words sets shall be selected from table VII by the Government inspector at the start of testing to prevent any prior knowledge by the participants when doing any nonproduction tests. Production tests (group A) word sets shall be randomly selected by contractor nonparticipants, unless the Government inspector provides them.

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TABLE VII. Speech intelligibility words.

1	rang hang	fang sang	gang bang	14	dill dip	did dim	dig din	27	sud sung	sum sup	sub sun	40	shed fed	bed red	wed led
2	bark hark	park dark	lark mark	15	shook cook	look book	took hook	28	fill fit	fig fib	fin fizz	41	told gold	fold hold	cold sold
3	reel keel	heel feel	eel peel	16	sass sap	sack sag	sat sadd	29	sent tent	rent bent	dent went	42	buff but	bun bug	buck bus
4	tab tap	tan tack	tam tang	17	nun bun	fun gun	run sun	30	pang pad	pan pass	pat path	43	seed seeth	seep seek	seam seen
5	sick sit	sin sip	sing sill	18	pace pay	pave page	pane pale	31	team tear	tease teal	teach teak	44	win tin	pin fin	din sin
6	man math	map mad	mass mat	19	tot hot	lot got	pot not	32	dub dull	duck dun	dug dud	45	beat feat	heat seat	meat neat
7	pup putt	pub pun	puff pug	20	sick pick	tick kick	lick wick	33	beak beam	bead beach	beam beat	46	fame game	same tame	came name
8	mop hop	pop cop	top shop	21	sit fit	kit hit	wit bit	34	gay say	way pay	day may	47	hip rip	tip dip	sip lip
9	pest rest	vest best	west test	22	kiss kill	king kick	kid kit	35	den hen	men ten	pen then	48	bath bat	ban bad	base back
10	cud cub	cuff cup	cut cuss	23	boil oil	soil foil	coil toil	36	saw raw	thaw paw	jaw law	49	cape cave	cake cane	case came
11	sale snale	sane save	same sake	24	big rig	fig jig	wig pig	37	lay lace	lame late	lake lane	50	rave ray	rake raze	race rate
12	just trust	must crust	dust bust	25	peach peace	peat peas	peal peak	38	sale male	tale bale	gale pale	51	sole hole	mole itch	pitch nitch
13	hear heap	heath heat	heal heave	26	pick pin	pig pip	pit pill	39	till kill	will bill	fill hill				

4.5.4.2 Loudspeaker element coil.

4.5.4.2.1 Impedance. Measure the voltage drop across the speaker element for a 1000 Hz signal. Measure the dc resistance of the coil. Compute the reactance and impedance at 1000 Hz.

4.5.4.2.2 Polarity. The loudspeaker element coil polarity shall be in accordance with EIA RS 276. Test does not have to be repeated once determined and shall not be required during environmental exposure.

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4.5.4.2.3 Clearance. Measure and record the air gap clearances. This test shall not be required during environmental exposure.

4.5.4.2.4 Dielectric withstanding voltage. Dielectric withstanding voltage test shall be in accordance with MIL-E-16400 at 300 volts. With the transformer disconnected, apply the voltage from the speaker coil to the speaker magnet and from the speaker coil to the enclosure ground. Record the insulation resistance during the voltage application. This test shall not be required during environmental exposure, but shall be required after exposure, and before any cleaning or adjusting.

4.5.4.3 Sound power output. A 70 Vrms broadband pink noise shall be applied to the normal input terminals. The sound power level shall be measured in accordance with ANSI S1.34, using the technique specified for sound power determination in a free field above a reflecting plane. The measuring band width shall be the "C" weighting network of a type I or II sound level meter as specified in ANSI S1.4. Sound power shall be measured at ten equiangular positions on a hemisphere, including the on axis position. The loudspeaker shall be placed directly on the reflecting surface with the loudspeaker axis perpendicular to it. Record sound power output level for 1 watt input (see 3.8.3).

4.5.4.4 Minimum on axis sound pressure output. A 70 Vrms sinusoidal warbled signal shall be applied to the normal input terminals. The sound pressure output levels re  $0.0002 \text{ dynes/cm}^2$  shall be measured for each of the bands required in the applicable specification sheet. The input frequency in each band shall be warbled. The warble shall be a logarithmic frequency change calibrated in frequency decades per unit of time. The warble frequency shall be 5 to 6 Hz. The output sound pressure shall be measured using a ANSI standard sound level meter C response. Set meter movement to slow speed setting. A 1 hour warm-up of the speaker coil is required prior to start of this test. The microphone shall be located on axis at the distance required in the specification sheet, except when doing 4.5.3 tests in an environmental test chamber. Measure and record volts and amperes input during each warble band test.

4.5.4.5 Loudspeaker coverage angle. Measure the on axis sound pressure as specified in 4.5.4.4 while the speaker is vertically mounted to a rotatable fixture. The speaker shall be rotated about an axis perpendicular to the sound output axis that intersects the sound output axis within 0 to 3 inches of the front face of the loudspeaker. Record the angle of rotation from "on axis" to the angle where the sound level is 6 dB below the "on axis" value. Repeat the measurement in the opposite direction. Rotate the loudspeaker 90 degrees about its output axis (horizontal mount) then repeat the above two measurements. The microphone shall be located at the distance required in the applicable specification sheet. The 800 to 1250 warble band shall be used. The arithmetic average of the two measured angles is the "coverage angle" (see 3.8.5). Test does not have to be repeated once determined and shall not be required during environmental exposure.

4.5.4.6 First article and group C frequency response. A 70 Vrms single frequency sinusoidal signal shall be applied to the input terminals. The signal frequency shall be varied in steps approximately equal to 10 percent of the signal frequency over the range required by the applicable specification sheet. Record the output sound pressure at each step using a 200 (or lower) to 9000 (or higher) band width plus or minus 1 dB system. Graph the recorded

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values at the same resolution or higher resolution than the graphs given in the applicable specification sheet. Include the required upper and lower limits on the graph with the plotted results of the measured response at the same scale (see 3.8.6). Record the amperes and power input at 322 Hz and at 1000 Hz. Compute the power factor.

4.5.4.7 Operation at reduced output. Repeat the test specified in 4.5.4.6 with the loudspeaker volume set to minus 6 dB, minus 12 dB, minus 18 dB, and minus 24 dB as applicable. Record each level on a separate graph including the applicable specification sheet frequency response limits shifted down to the lower volume level for comparison (see 3.8.7). Record the ampere and power input at 322 Hz and 1000 Hz for each level and compute the power factor.

4.5.4.8 Definition of total harmonic distortion. Percent total harmonic distortion in the acoustic output of the loudspeaker is defined as follows:

$$\sqrt{P_2^2 + P_3^2 + \dots + P_n^2}$$

Percent total harmonic distortion =  $\frac{\sqrt{P_2^2 + P_3^2 + \dots + P_n^2}}{P_1}$  X 100

$$\sqrt{P_1^2 + P_2^2 + P_3^2 + \dots + P_n^2}$$

$P_1$  = Fundamental sinusoid

$P_n$  = Harmonics of  $P_1$

4.5.4.8.1 Total harmonic distortion method of measurement. Input a constant amplitude sinusoidal signal with less than 0.2 percent distortion to the normal assembly input terminals. The voltage level shall be as required for rated output power. Measure the percent harmonic distortion of 200, 1000, 2000, and 4000 Hz output sound pressure waves.

4.5.4.9 Peak volt-ampere capacity test. Demonstrate that the loudspeaker can sustain a 10 percent duty cycle signal at the specification sheet required peak volt-ampere capacity for 15 minutes without degradation in performance (see 3.8.9). Repeat 4.5.4.4 sound pressure output to verify conformance.

4.5.4.10 Stray magnetic field. The loudspeaker shall be mounted with the magnet axis horizontal. The stray magnetic field produced by the loudspeaker shall be measured in a horizontal plane 2.5 feet below the center of the loudspeaker magnet. The measuring probe shall be oriented to measure the vertical component of the magnetic field. Sufficient measurements shall be taken to determine the peak value of the stray field in the horizontal plane. The test shall then be repeated once with the loudspeaker tilted forward 10 degrees (magnet axis 10 degrees below horizontal) and once with the loudspeaker tilted 10 degrees to the rear (magnet axis 10 degrees above horizontal). The permeability of material after fabrication shall be determined by placing the indicator (inserted with a 2.0 slug) in contact with each part of the loudspeaker required to be non-magnetic (see 3.3.2.3).

4.5.4.11 Fundamental resonance. The loudspeaker element fundamental resonant frequency shall be determined for the loudspeaker assembly. Fundamental resonance shall be measured in accordance with EIA RS 276.

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4.5.4.11.1 Fundamental resonance preconditioning. Prior to the test of 4.5.4.11 the loudspeakers shall be preconditioned for 1 hour at rated power in accordance with IEEE 219.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for the shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

## 5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.6).

5.1 Preservation, packaging, packing and marking. The equipment shall be preserved and packaged levels A or C; packed level A, B or C as specified (see 6.2.1) and marked in accordance with MIL-E-17555.

## 6. NOTES

6.1 Intended use. This loudspeaker is intended for use in shipboard application wherever a permanent magnet loudspeaker with enclosure is required as a component of shipboard announcing systems.

### 6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of applicable specification sheet.
- (c) When first article is required (see 3.2).
- (d) If cable stuffing tubes are required (see 3.5).
- (e) Preservation, packaging, packing and marking requirements (see 5.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

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<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.3.1	Part control program plan	DI-E-7026	---
3.10	Drawings, engineering and associated lists	DI-E-7031	Level 3

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Supersession data. Certain types of this specification replace types of MIL-A-20222 as follows:

Types of this specification	Replaced types of MIL-A-20222
LS-305( )/SIC	IC/SAA
LS-306( )/SIC	IC/SAG
LS-387( )/SIC	IC/SBA
LS-388( )/SIC	IC/SBG

6.3.1 Type LS-397( )/SIC was formerly designated IC/SDE. Type LS-657( )/SIC was formerly designated IC/SGL.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.4.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.5 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide

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that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.6 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.7 Technical manuals. The requirement for technical manuals should be considered when this specification is cited on a contract. If technical manuals are required, a contract exhibit must be prepared to fully describe statement of work criteria and delivery instructions, and cite the applicable technical manual specification. The technical manuals must be acquired by separate Contract Line Item Number (CLIN) in the contract.

6.8 Subject term (key word) listing.

Gunblast  
Icing  
Magnetic loudspeakers  
Salt fog  
Transformers

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.

Preparing activity:  
Navy - SH  
(Project 5965-N192)

**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-L-24223C{SH}		2. DOCUMENT TITLE LOUDSPEAKER, SHIPBOARD ANNOUNCING SYSTEMS GENERAL SPE	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one) FOR <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
b. ADDRESS (Street, City, State, ZIP Code)			
5. PROBLEM AREAS			
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b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
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