MILITARY SPECIFICATION

BATTERIES, STORAGE, LEAD-ACID GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 This specification establishes the requirements for lead-acid storage batteries.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

O-S-801	Sulfuric Acid, Electrolyte; for Storage Batteries
QQ-A-591	Aluminum Alloy Die Castings

Military

MIL-C-45662	Calibration System Requirements
MIL-P-6063	Packaging of Batteries, Storage, Charged and Dry-Uncharged and Moist, General Specification for

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 9313), Naval Air Engineering Center, Lakehurst, New Jersey 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS (Continued)

Military (Continued)

MIL-S-7742	Screw, Threads, Standard, Optimum Selected Series; General Specification for
MIL-I-45208	Inspection System Requirements

STANDARDS

Federal

FED-STD-595	Colors

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-810	Environmental Test Methods
MS3349	Plug, Electric, Two-Wire, Aircraft Storage Battery
MS3509	Receptacles, Electric, Aircraft Storage Battery
MS14111	Plug, Electric, Two-Wire, Adapter-Connected, Aircraft Storage Battery
MS25182	Plug, Electric, Four-Wire, Aircraft Storage Battery
MS25185	Plug, Venting, Gravity-Controlled, Electrolyte Access Hole, Cell Aircraft Lead-Acid Storage Battery

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

2.1.2 Other Government documents, drawings, and publications. The following other Government documents form a part of this specification to the extent specified herein.

Handbook H28--Screw-Thread Standards for Federal Services.

(Applications for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

American Society for Testing and Materials

ASTM D639-72 (1972)	Testing Battery Containers made from Hard Rubber or Equivalent Materials

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

2.1.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

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 sheets, the latter shall govern.

3.2 Qualification. The batteries and component parts furnished under this specification shall be products which are approved for listing on the applicable Qualified Products List (QPL) at the time set for opening of bids (see 4.3 and 6.4).

3.3 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Design and construction. The battery shall consist of twelve (12) cells contained in one unit completely enclosed by an outer container per applicable specification sheet. For nonmetallic battery containers the inner case shall be an integrally molded part of the container. Two battery terminals, extending through the front of the container shall be enclosed by a quick disconnect receptacle per applicable specification sheet. Cells shall contain the necessary plates, terminal posts, and separators, and shall be secured so that minimal motion of the plates, relative to the container, can occur without degrading performance.

* 3.4.1 State. The batteries shall be furnished in a charged and dry state. Easily removable nonabsorbent, air-tight, and acid resistant filler plugs or sealing tape (for shipping only) shall be installed in/on each vent opening/vent plug, as applicable, by the manufacturer. The shipping plugs or sealing tape shall be removed when the battery is prepared for activation.

3.4.2 Electrolyte. Batteries shall be designed to use electrolyte conforming to O-S-801 Class 3. Unless otherwise specified, the batteries shall be furnished without electrolyte.

* 3.4.3 Container and cover. The battery container and cover shall be of aluminum or steel construction unless otherwise specified in the detail specification sheet, if die cast aluminum is used it shall be in accordance with QQ-A-591.

3.4.4 Sealing. The battery monobloc inner case or cases shall be securely sealed in the container body. In the event that a sealing compound is used for this purpose, it shall be consistent with the requirements of the sealing compound specified in 3.4.15.

3.4.5 Battery terminals. The battery terminals shall consist of either threaded studs with hollow sleeves or a disconnect receptacle in accordance with the type of battery specified.

* 3.4.5.1 Threaded-studs. The studs shall be completely enclosed with an acid resistant material except at the contact points, and shall be fastened to the front of the container as shown in Figure 1. The studs shall be threaded with .3125-18 UNC-2A threads in accordance with MIL-S-7742.

* 3.4.5.1.1 Receptacle adapter. Batteries containing threaded-stud type terminal assemblies shall also contain a receptacle adapter, designed to mate with cannon part number 11751 or equal. The adapter shall be mounted on the front of the battery container as shown on the applicable specification sheet (see Figure 2). The adapter shall be capable of meeting the requirements of 3.5.7.

* 3.4.5.2 Disconnect receptacle. Batteries containing disconnect receptacle terminals shall be designed to mate with a MS25182 connector plug. The receptacle shall be mounted on the front of the battery container as shown on the applicable specification sheet (see Figure 3). The receptacle shall be capable of meeting the requirements of 3.5.7.

3.4.6 Grids. The grids shall be free from open sections or such evidence of cold pouring as cracks, blowholes, or other imperfections which may affect their structural strength. Breaks in those parts of the grids which are used to retain active material are permissible only when the breaks do not modify the strength of the grids or permit the active material to become loosened or separated from the plate.

* 3.4.7 Active material. Reclaimed active material shall not be used. No plate shall have more than two through holes in the active material. Plates shall have no open windows, an open window is a void in the waffle section.

3.4.8 Separator protection. Damage to the separators in each cell, caused by instruments inserted through the filler opening,

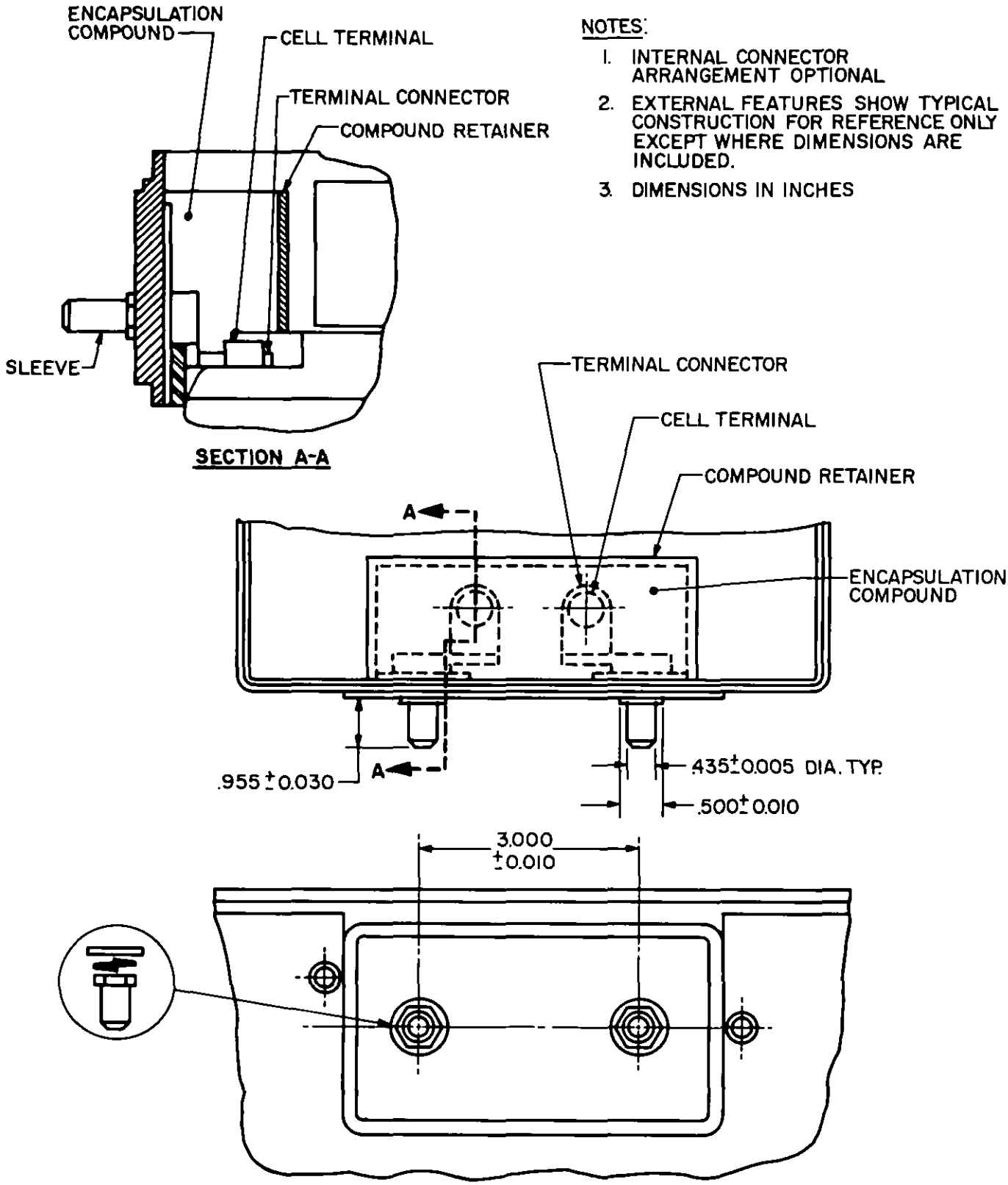
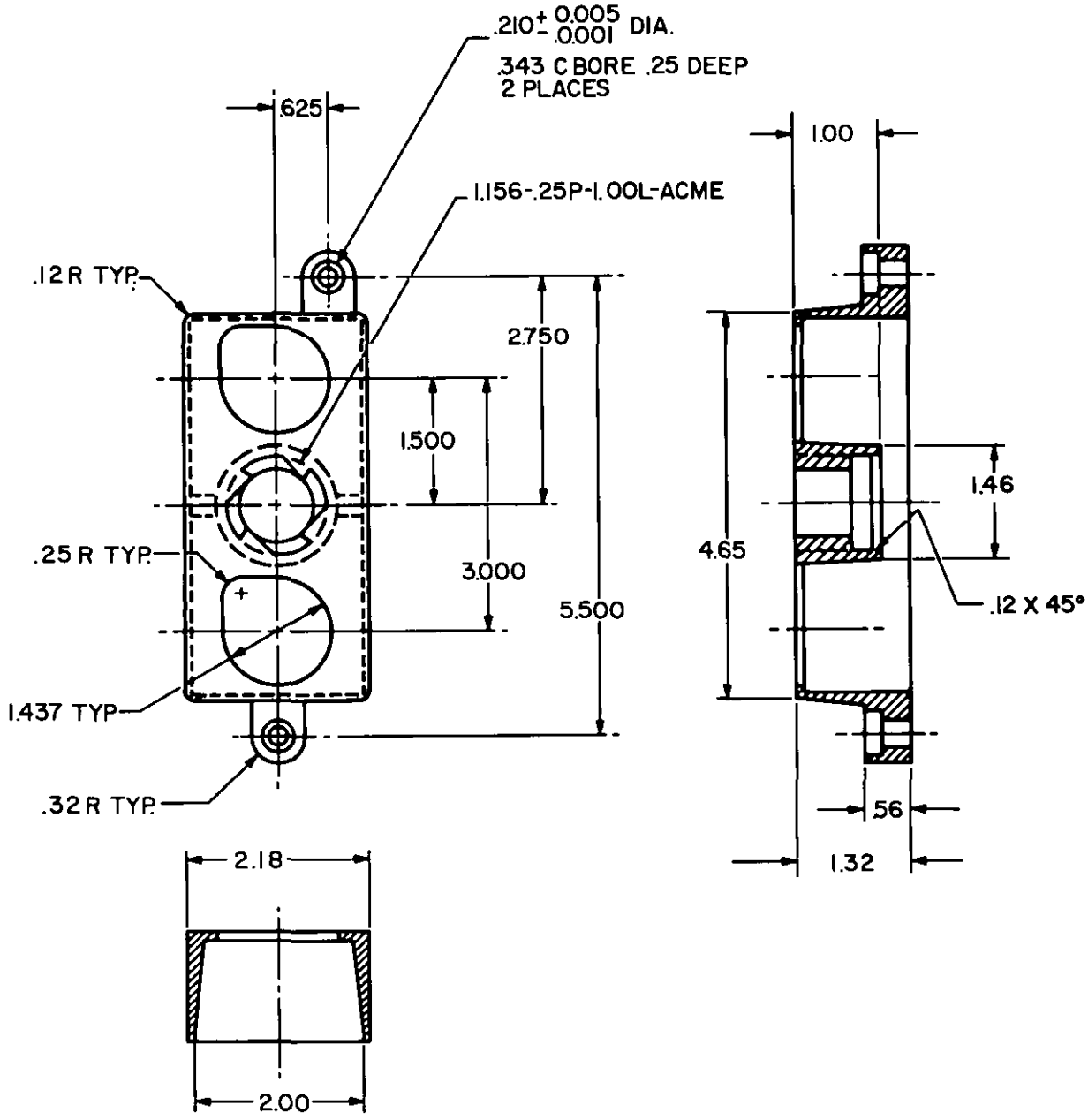
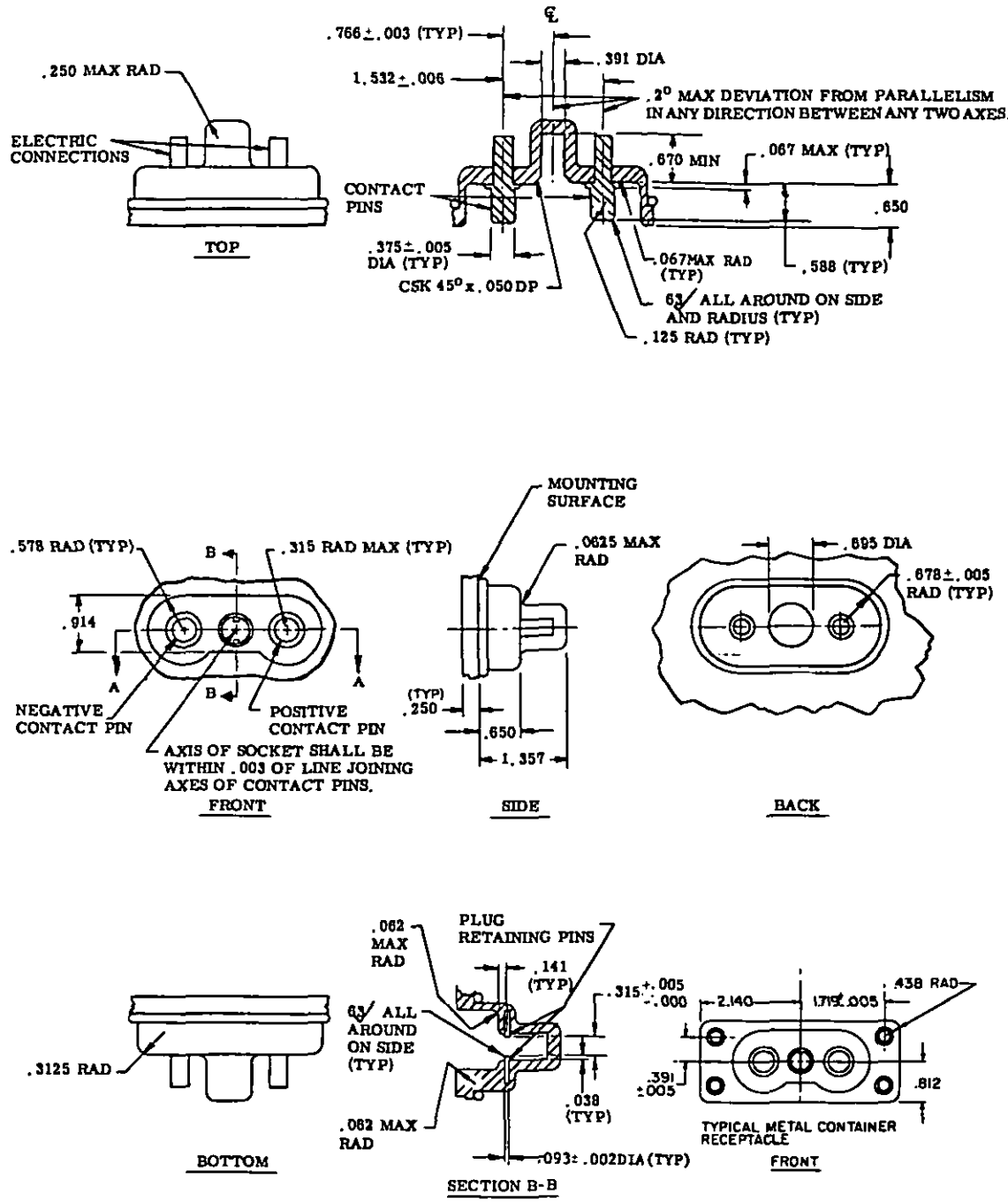


Figure 1. Battery terminal with threaded stud type terminal assembly (see 3.4.5.1).



NOTES:
1. Material or finish to be acid-resistant.
2. Dimensions in inches. Tolerances: X.XX(±0.03 in.), X.XXX(±0.010 in.).
3. Receptacle to case attachment method optional for nonmetallic containers.
4. Draft angles allowed in conformance with commercial die casting practice.

Figure 2. Typical receptacle adapter (see 3.4.5.1.1).



NOTES:

1. Material or finish to be acid-resistant.
2. Dimensions in inches. All tolerances are ±.005 unless otherwise specified.
3. Receptacle to case attachment method optional for nonmetallic containers.
4. MS3509 may be used as reference in the total design of the receptacle.

Figure 3. Typical receptacle (see 3.4.5.2).

shall be prevented by a perforated or slotted baffle or the use of plastic separators. If baffles are used, each one shall be at least 0.025 inch thick and shall be securely held in place without resting or bearing on the grids.

3.4.9 Container cover gasket. A resilient gasket, equivalent to sponge rubber, 0.187 ± 0.015 inch thick by 0.337 ± 0.150 inch wide shall be securely fastened inside the container cover where it will bear against the container body when installed.

3.4.10 Venting. Each battery shall include two vent tubes as shown on the specification sheet and shall be made so that air can enter the battery through either vent tube, flow freely across the tops of the cells, and leave the battery through the other vent tube. The lining or inner surface of the vent tubes shall be securely fastened and acid impervious. The battery shall include a container cover which shall be provided with vent holes if indicated on the applicable specification sheet (3.1). Vent holes in the battery cover and vent tubes in the battery container shall be sealed and constructed so that they may be opened, as required, when the battery is readied for service. The provision for opening the vent tubes shall be located externally.

3.4.11 Cell terminal posts, intercell connectors and terminal connectors.

3.4.11.1 Cell terminal posts. Cell terminal posts shall be constructed of lead-antimony alloy or antimony-lead alloy.

3.4.11.2 Intercell connectors. The connectors between cell terminal posts shall be of the burned-on or welded-on type constructed of lead, lead-antimony alloy or antimony-lead alloy.

3.4.11.3 Terminal connectors. The terminal connectors between the cell posts and the terminal outlets on the container shall be of any conducting metal or alloy (see 3.1). Each terminal connector shall be of sufficient length to eliminate strain at both points of attachment.

3.4.12 Inner cases, cell covers and nonmetallic containers. Inner cases and nonmetallic containers shall be monobloc constructed. All corners and edges shall be beveled or rounded, except at the top of the case. The inner surfaces shall have a smooth finish free from pitting, blowholes, rough spots, scales, blisters, or other deformations. Cell covers shall be constructed of molded compound. They shall have filling holes threaded with a .7500-16 UNF-2B thread, suitable for the venting plugs specified herein. Inner cases, cell covers and nonmetallic containers shall meet the requirements of 3.5.2 and 3.5.3 when subjected to the tests of 4.6.2 and 4.6.3.

* 3.4.13 Venting plugs. Twelve each venting plugs, conforming to MS25185, shall be supplied with each battery. If sealing tape or filler plugs are applied to the vent openings, the venting plugs shall

be contained in a container(s) placed in the manifold area under the battery cover.

* 3.4.14 Interior and exterior finish. The exterior of metallic battery containers, covers, the interior and exterior of metallic disconnect receptacles, and screws, except threaded areas, shall be thoroughly covered with an acid resistant coating which shall meet the requirements of 3.5.1 when subjected to the tests of 4.6.1. If the basic case material will meet the requirements of 3.5.1, acid resistant coating is not required.

3.4.15 Sealing compound. The battery shall be constructed so that all connectors inside of the container shall be enclosed by a one-piece cover or covered with sealing compound. The surface area above the cells, except for the vent holes, reinforcing ribs, and the barricade necessary to cover the connectors, shall be devoid of fasteners which would impede or prevent the cleaning of the surface. The sealing compound shall be an acid proof material which firmly adheres to all other materials which it contacts. The compound after application to the battery, shall have a smooth surface free of blisters, air bubbles, and other indications of poor processing. The compound shall meet the requirements of 3.5.8 when subjected to the tests of 4.6.8.

* 3.4.16 Instructions. The manufacturer shall furnish, packed with each battery, printed instructions for activation and preparation of the battery for use. The instructions shall include suitable warning to remove the filler plugs or sealing tape from the cell vent opening/vent plug when the battery is prepared for activation. Instructions shall be included for marking the date of activation of the battery in the space provided on each battery after the words, "Date Battery Placed in Service."

3.5 Performance.

3.5.1 Physical tests - containers and covers (metallic batteries).

3.5.1.1 Interior finish (high potential). Any arcing or breakdown of the interior shall be cause for rejection when tested per 4.6.1.1.

3.5.1.2 Interior finish (adhesion). The samples shall show no evidence of extreme etching back (over 1/16 of an inch on each side of the scratch), nor shall peeling or chipping occur after testing per 4.6.1.2.

3.5.1.3 Exterior finish (acid resistance). The exterior finish shall show no evidence of whitening, checking, blistering, or a change in hardness after testing per 4.6.1.3.1.

3.5.1.4 Exterior finish (flexibility). Flexing of the panel shall not cause cracking, flaking or loosening of the exterior finish after testing per 4.6.1.3.2.

3.5.2 Physical requirements - inner cases and cell covers (metallic batteries).

* 3.5.2.1 Acid resistance. Inner cases and cell covers, when tested as specified in 4.6.2.1, shall not increase in weight more than 1.5 percent or increase in dimensions greater than 2 percent, and shall show no evidence of blisters, cracks or other visible damage.

* 3.5.2.2 Electrical high potential. Inner cases and their intercell partitions shall be capable of withstanding the specified test voltage for five seconds without showing any signs of flaws, such as metallic veins, hairline cracks, perforations, or burning through when tested per 4.6.2.2.

* 3.5.2.3 Impact resistance. When tested as specified in 4.6.2.3, the minimum impact resistance values for inner cases and cell covers shall be as follows:

Component	Battery Type	Minimum Impact Resistance Value
Inner Case & Cell Cover	Metallic	35 inch-pounds

* 3.5.3 Physical requirements - containers and cell covers (nonmetallic batteries).

3.5.3.1 Electrical high potential. Containers shall be capable of withstanding the specified test voltage for five (5) seconds without showing any signs of flaws, such as metallic veins, hairline cracks, perforations, or burning through when tested per 4.6.3.1.

3.5.3.2 Bulge resistance. When tested as specified in 4.6.3.2, the bulge characteristics of the container in inches of bulge shall not exceed 1/4 inch.

3.5.3.3 Acid resistance. Containers, when tested as specified in 4.6.3.3 shall not increase in weight more than 1.5 percent or increase in dimensions greater than 2 percent and shall show no evidence of blisters, cracks, or other visible damage.

* 3.5.3.4 Impact resistance. When tested as specified in 4.6.3.4, the minimum impact resistance values for nonmetallic battery containers and cell covers shall be as follows:

Temperature	Minimum Impact Resistance Value
85°C	180 inch-pounds
-18°C	150 inch-pounds
-40°C	120 inch-pounds

3.5.4 Visual and mechanical.

3.5.4.1 Color. Unless otherwise specified on the applicable specification sheet, the outside of containers and covers for each battery shall conform to color number 21158 of FED-STD-595.

3.5.4.2 Marking.

* 3.5.4.2.1 Polarity marking. The container body shall be conspicuously and durably marked "+" in red in the location shown on the specification sheets. This marking shall be in relief or engraved.

3.5.4.2.2 Identification marking. Identification data shall be shown on the nameplate in accordance with MIL-STD-130. Location shall be as shown in the applicable specification sheet. The identification data applicable to the battery shall be as follows:

MIL Part No
Type Designation (If applicable)
_____ Volts _____ AH at 1-Hour Rate to 1.5 V/Cell ($27^{\circ} \pm 5^{\circ}C$)
Weight Filled _____ Lbs. Maximum
Specific Gravity: Full Charge 1.285 ± 0.015 at $27^{\circ}C$
National Stock Number
Contract Number
Date and Lot Code
Manufacturer's Name
Date Battery Placed in Service

Example:

MIL-Part No. M83769/1-1
Type Designation - Battery Storage BB-638/U
24 Volts 31AH at 1-Hour Rate to 18V ($27^{\circ} \pm 5^{\circ}C$)
Weight Filled 80 Lbs. Maximum
Specific Gravity: Full Charge 1.285 ± 0.015 at $27^{\circ}C$
National Stock Number - 6140-XX-XXX-XXXX
Contract Number - DLA400-72-D-XXXX
Date and Lot Code - 0472-12
Manufacturer's Name - ABC Battery Co.
Date Battery Placed in Service - 0672

3.5.4.2.3 Date and lot code. The date of manufacture and lot number shall be clearly shown on the nameplate in a code which shall indicate the month and year of manufacture by a four digit number, followed by a dash and the lot number. The first two digits shall indicate the month and the next two indicate the year. Months earlier than the 10th month shall be a single digit preceded by "0." When a battery is completed during the last three working days of a month, the manufacturer is permitted to use either month as the coded month of manufacture. Example code, 0472-12, indicates the battery was manufactured in April 1972 and was the twelfth lot.

* 3.5.5 Dimensions. The batteries shall be measured for conformance to the applicable specification sheets and the Figures of this specification.

* 3.5.6 Internal air pressure. The individual cells of each battery shall be capable of withstanding an internal pressure of 2.25 (± 0.25) pounds per square inch (psi) for a minimum of thirty (30) seconds at 27° ± 5°C. The pressure loss shall not be greater than 0.10 psi.

* 3.5.7 Strength of receptacle. The receptacle and receptacle mounting shall withstand a pullout force of 400 ± 50 pounds and a torsional force of 10 ± 1 foot pounds when tested per 4.6.7. There shall be no damage to the battery caused by this test.

* 3.5.8 Physical integrity at temperature extremes and vibration.

* 3.5.8.1 Sealing compound. The sealing compound shall not flow when subjected to a temperature of 85° ± 2°C, nor separate from any holding surface at -34° ± 2°C under vibration (see 4.6.8).

* 3.5.8.2 Gas tightness of cells. The individual cells shall be capable of withstanding an internal air pressure for a minimum of thirty (30) seconds of 2.25 (± 0.25) pounds per square inch (psi) at 85° ± 2°C without loss of greater than 0.20 psi of pressure (see 4.6.8).

* 3.5.8.3 Vent tubes. The vent tubes shall show no evidence of breaking or cracking when subjected to the testing of 4.6.8, 4.6.13 and 4.6.14.

* 3.5.9 Filled discharge capacity. When tested per 4.6.9, dry-charged batteries shall deliver not less than 30 minutes of service to a cutoff voltage of 1.5 volts per cell when discharged at the 1.0 C rate at 27° ± 5°C.

3.5.10 Weight. The batteries shall be weighed for conformance to the applicable specification sheets.

3.5.11 Capacity. The discharge rates, minimum time of discharge, and final discharge (cutoff) voltage shall be as specified in Table I. The batteries shall develop their full rated capacity at the one-hour rate during three cycles of charge and discharge at the one-hour rate. They shall develop their full rated capacity at the five (5) minute 27° ± 5°C rate; the five (5) hour, 27° ± 5°C rate; and the five (5) minute -18° ± 2°C rate; during three additional cycles of charge and discharge (see 4.6.11).

TABLE I. Capacity performance requirements.

Rate of Discharge Cutoff Volts/Cell	Rate of Discharge Factor	Minimum Time to Cutoff Voltage
1-Hour 1.50 volts/cell at 27° ± 5°C	1.0 C	1 hour
5-Minute 1.20 volts/cell at 27° ± 5°C	6.0 C	5 minutes
5-Hour 1.75 volts/cell at 27° ± 5°C	0.2 C	5 hours
5-Minute 1.20 volts/cell at -18° ± 2°C	6.0 C	3.3 minutes
2-Hour 1.60 volts/cell at 27° ± 5°C	0.5 C	2 hours

* 3.5.12 Environmental tests. The battery, when subjected to tests listed in Table II, shall show no:

a. Dimensional distortion beyond specified limits and no breaking or cracking of cases or covers of both cells and batteries over the temperature range of 85°C to -57°C.

b. Radical current or voltage fluctuations during any discharge period.

c. Mechanical failure of any part.

d. Electrolyte leakage or spilling of electrolyte at any time during the test.

e. Breakdown of insulation, corrosion of metal parts, and no loosening or stripping of protective coating from the battery container or cover.

TABLE II. Environmental tests.

Tests	Test Paragraph
Altitude	4.6.12
Mechanical Shock	4.6.13
Temperature Shock	4.6.14
Salt Fog	4.6.15
Humidity	4.6.16

3.5.13 Altitude. For the discharge test of 4.6.12, the minimum discharge time to the specified cutoff voltage shall be forty-five (45) minutes.

3.5.14 Salt fog. For the discharge of 4.6.15, the minimum discharge time to the specified cutoff voltage shall be forty-five (45) minutes.

3.5.15 Humidity. For the discharge test of 4.6.16, the minimum discharge time to the specified cutoff voltage shall be forty-five (45) minutes.

3.5.16 Cell terminal posts, intercell connectors, terminal connectors. The cell terminal posts, the intercell connectors and the terminal connectors under test shall withstand the discharge without showing evidence of failure. Fusing of any part, detachment of any part or parts, and any sign of physical change shall provide cause for rejection (see 4.6.17).

3.5.17 Life cycling. Batteries, when cycled in accordance with 4.6.18, shall provide no less than sixty-five (65) cycles of charge and discharge in an ambient temperature of $27^{\circ} \pm 5^{\circ}C$ with the battery exposed on all four sides and the top (lid) off to allow free air circulation. During the life test, inability to meet the 1 hour rate discharge requirement for three (3) consecutive discharges shall constitute a failure. No reduction of capacity to less than 100 percent of that specified in Table I for cycles 61 thru 65 shall be permitted. During life cycling, batteries shall operate normally in an upright position, but shall be inverted for 2.5 minutes of discharge during cycle sixty-five (65). The battery shall not exhibit an excessive loss of electrolyte or a change in battery voltage in excess of 0.5 volt as a result of the inversion during cycle sixty-five (65).

* 3.5.18 Sealant test. The maximum allowable seepage of water between the inner case and outer container shall be 20 cubic centimeters when tested in accordance with paragraph 4.6.20.

3.5.19 Electrical leakage. (Nonmetallic containers) Under no circumstances shall any battery exhibit a voltage between either of the terminals and the container when tested according to 4.6.19.1. (Metallic containers) The battery shall not exhibit a leakage current in excess of one milliampere between either of the terminals and the container when tested in accordance with 4.6.19.2.

3.5.20 Workmanship. Batteries shall be processed in such a manner as to be uniform in quality and free from defects that will affect their life, serviceability, or appearance (see 4.6.4).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible

for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the supplier 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 ensure that supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The supplier shall have and maintain an inspection system in accordance with MIL-I-45208.

4.2 Classification of inspections. Inspections shall be classified as follows:

a. Qualification inspection.

1. Inspection of components and materials.

2. Inspection of batteries.

b. Quality conformance inspection.

1. Inspection of product for delivery.

2. Inspection of preparation for delivery.

4.3 Qualification inspection. Qualification inspection shall be performed by the Government on samples of components, materials and batteries furnished by the supplier. The samples shall be representative of the components, materials and batteries proposed to be furnished to the Government under contract, and shall not be produced with the use of any equipment or procedure that will not normally be used in production. Qualification inspection on these samples shall be conducted at a Government test facility, and shall consist of the examinations and tests specified herein and the evaluation of inspection results in relation to applicable requirements. The cost of qualification testing shall be borne by the Government except as noted in 4.3.3.

* 4.3.1 Inspection of components and materials. Qualification samples of applicable components and materials, treated and processed as they would be for the fabrication of finished batteries, shall be inspected in accordance with Table III. All samples shall be marked with identifying information. Test samples for metallic batteries having plastic inner cases and cell covers shall include; one aluminum container, one aluminum cover, two aluminum panels (size and finish per 4.6.1.3), two inner cases, and three whole one-piece cell covers. Test samples for 24-volt nonmetallic batteries shall include; two nonmetallic containers and three whole one-piece cell covers. Test samples for 12-volt nonmetallic batteries shall include; two nonmetallic containers and three cell cover stock specimens (size per 4.6.3.4.2).

* TABLE III. Qualification inspection of components and materials.

Test	Part	Requirement Paragraph	Method of Inspection Paragraph
Interior Finish (High Potential)	Aluminum container	3.5.1.1	4.6.1.1
Interior Finish (Adhesion)	Aluminum container and cover	3.5.1.2	4.6.1.2
Exterior Finish (Acid Resistance)	Aluminum container	3.5.1.3	4.6.1.3
Exterior Finish (Flexibility)	Aluminum panels	3.5.1.4	4.6.1.3
Acid Resistance	Inner case	3.5.2.1	4.6.2.1
Electrical High Potential	Inner case	3.5.2.2	4.6.2.2
Impact Resistance	Inner case and cell cover stock specimen	3.5.2.3	4.6.2.3
Electrical High Potential	Nonmetallic container	3.5.3.1	4.6.3.1
Bulge Resistance	Nonmetallic container	3.5.3.2	4.6.3.2
Acid Resistance	Nonmetallic container	3.5.3.3	4.6.3.3
Impact Resistance	Nonmetallic container	3.5.3.4	4.6.3.4

4.3.2 Inspection of batteries. Four (4) samples each of complete batteries shall be furnished in accordance with Table IV and shall be inspected in the order shown.

* TABLE IV. Qualification inspection of batteries.

Examination and Tests	Sample No.				Requirement Paragraph	Method of Inspection Paragraph
	1	2	3	4		
Visual and Mechanical	X	X	X	X	3.5.4 & 3.5.19	4.6.4
Dimensions	X	X	X	X	3.5.5	4.6.5
Internal Air Pressure	X	X	X	X	3.5.6	4.6.6
Strength of Receptacle			X	X	3.5.7	4.6.7
Physical Integrity at Temperature Extremes and Vibration	X	X			3.5.8	4.6.8
Filled Discharge Capacity			X	X	3.5.9	4.6.9
Weight	X	X	X	X	3.5.10	4.6.10
Capacity	X	X	X	X	3.5.11	4.6.11
Altitude			X	X	3.5.12 & 3.5.13	4.6.12
Mechanical Shock	X	X			3.5.12	4.6.13
Temperature Shock			X	X	3.5.12	4.6.14
Salt Fog	X	X			3.5.12 & 3.5.14	4.6.15
Humidity	X	X			3.5.12 & 3.5.15	4.6.16
Cell Terminal Posts, Intercell Connectors, Terminal Connectors	X	X			3.5.16	4.6.17
Life Cycling (1)			X	X	3.5.17	4.6.18
Sealant Test	X	X	X	X	3.5.18	4.6.20
Electrical Leakage	X	X	X	X	3.5.19	4.6.19
Internal Air Pressure	X	X	X	X	3.5.6	4.6.6

NOTE: For samples 3 and 4:

(1) The first six (6) cycles of life cycling tests are conducted during capacity test (4.6.11).

4.3.2.1 Retention of samples. If the manufacturer becomes qualified the sample batteries on the testing of which his qualification is based will be retained at the Government agency which did the testing as long as he is qualified, and if he receives a contract to furnish such batteries to the Government, they will be disassembled and dissected to determine, as far as possible, that the batteries being furnished under the contract are identical with them.

* 4.3.3 Failure and retest. Failure of a qualification sample to pass any of the examinations or tests specified herein shall be cause for the Government to refuse to conduct additional testing until the defects revealed by inspection have been corrected and the corrective action transmitted to the Government testing agency in writing. With the approval of the Government, a retest may be allowed with a Government designated increase in the number of qualification samples. The cost of retesting shall be borne by the supplier.

4.4 Quality conformance inspection.

4.4.1 Inspection of product for delivery. The supplier shall perform the inspections specified for Groups A and B. This does not relieve the supplier of this responsibility for performing any additional inspection which is necessary to control the quality of the product and to ensure compliance with all specification requirements. The Government will review and evaluate the supplier's inspection procedures and examine his inspection records. In addition, the Government at its discretion may perform any of the specified inspections to verify the supplier's compliance with specification requirements. Test equipment for Government verification inspection shall be made available by the supplier.

4.4.1.1 Lot definitions.

* 4.4.1.1.1 Inspection lot. An inspection lot shall be defined as the quantity of batteries having the same Military Part Number and produced at any one place of manufacture on any one contract submitted at one time to quality conformance inspection. The inspection lot size is optional, however, sample size shall be in accordance with Table VI for Group B inspection and Table VII for Group C inspection.

4.4.1.2 Group A inspection. Each unit of each inspection lot of batteries shall be subjected to the examination and test requirements of Table V.

TABLE V. Group A inspection.

Examination and Tests	Requirement Paragraph	Method of Inspection Paragraph
Visual and Mechanical	3.5.4 & 3.5.20	4.6.4
Internal Air Pressure	3.5.6	4.6.6

* 4.4.1.3 Group B inspections. This inspection, including sampling, shall conform to Table VI with tests conducted in the order shown on the same samples. Group B inspection shall be performed on inspection lots that have passed Group A inspection and on samples selected by the Government inspector from batteries that have been subjected to and met Group A inspection.

* 4.4.1.3.1 Shipment of inspection lots. No shipment, except Group C samples, shall be made until Group B inspection is completed and approved by the Government inspector. Shipment of production batteries from inspection lots that have passed Group A and B inspection requirements and from which Group C samples have been selected by the Government inspector and sent to the Government test facility shall not be held up pending results of Group C inspection performed on those lots provided that Group C samples from the most recent prior inspection lot of the same type of battery have met the Group C test requirements.

* TABLE VI. Group B inspection.

Inspection lot size	Total Number of Samples	
Up to 500 Over 500	5 8	
Examination and Tests	Requirement Paragraph	Method of Inspection Paragraph
Dimensions	3.5.5	4.6.5
Strength of Receptacle	3.5.7	4.6.7
Physical Integrity at Temperature Extremes and Vibration	3.5.8	4.6.8
Weight	3.5.10	4.6.10
Capacity 1/	3.5.11	4.6.11
Cell Terminal Posts, Intercell Connectors Terminal Connectors	3.5.16	4.6.17
Electrical Leakage	3.5.19	4.6.19

For Group B Inspection only.

1/ The batteries shall develop their full rated capacity at the 1-hour rate during three cycles or less of charge and discharge at the 1-hour rate. If a battery has successfully developed its full rated capacity in less than the three allowable 1-hour rate charge-discharge cycles, the manufacturer may at his option and risk omit the remaining 1-hour rate charge-discharge cycles and proceed with the remaining capacity tests on that battery.

* 4.4.1.4 Group C inspection. Group C inspection shall be performed by the Government in accordance with Tables VII and VIII on samples furnished by the contractor at no cost to the Government and with tests conducted in the order shown. Samples shall be randomly selected by the Government inspector from inspection lots so as to be representative of all batteries that have passed Group A inspection. Group C sample batteries in quantities conforming to Table VII shall be selected at the same time as the selection of the Group B samples and shipped by the supplier to the Government test facility within three (3) working days. The cost of Government testing shall be borne by the Government for Defense Logistics Agency procurements and by the supplier for single service procurements (see Section 6).

TABLE VII. Group C sampling.

Inspection Lot Size	Total Number of Samples	Subgroup I	Subgroup II
Up to 500	2	1	1
501 to 3200	4	2	2
3201 to 10,000	8	4	4
10,001 to 35,000	12	6	6
Over 35,000	16	8	8

* TABLE VIII. Group C inspection.

Tests	Requirement Paragraph	Method of Inspection Paragraph
Subgroup I		
Filled Discharge Capacity	3.5.9	4.6.9
Capacity	3.5.11	4.6.11
Mechanical Shock	3.5.12	4.6.13
Salt Fog	3.5.12 & 3.5.14	4.6.15
Humidity	3.5.12 & 3.5.15	4.6.16
Sealant Test	3.5.18	4.6.20
Electrical Leakage	3.5.19	4.6.19
Subgroup II		
Filled Discharge Capacity	3.5.9	4.6.9
Altitude	3.5.12 & 3.5.13	4.6.12
Temperature Shock	3.5.12	4.6.14
Life Cycling	3.5.17	4.6.18
Sealant Test	3.5.18	4.6.20
Electrical Leakage	3.5.19	4.6.19
Internal Air Pressure	3.5.6	4.6.6

* 4.4.1.4.1 Noncompliance. Failure of any sample to pass any Group C test shall be cause for the Government to refuse to accept subsequent inspection lots. The Government test facility shall notify the procuring agency of each Group C failure including details of the failure and characteristics affected. Upon notification by the procuring agency the supplier shall immediately investigate the cause of failure and shall report the results of investigation and details of the proposed corrective action on (1) the process, materials and components, as applicable and (2) all units of product which were manufactured under the same conditions and which the Government considers subject to the same failure. Supplier reports shall be forwarded to the procuring agency with an information copy to the responsible test facility. Final inspection and acceptance of subsequent production lots will be withheld until Government conducted Group C test inspection results show that effective corrective action has been taken. Failure of any sample to pass any Group C test may be cause for the qualifying activity to initiate action to remove the supplier from the Qualified Products List. In this event, requalification shall be at the supplier's expense.

4.4.2 Inspection of preparation for delivery. Preparation for delivery shall be sampled and inspected in accordance with MIL-P-6063 to determine conformance to the requirements of Section 5 of this specification.

4.5 Inspection conditions and equipment.

4.5.1 Standard test condition. All tests of this specification shall be performed in the following conditions unless otherwise specified in the description of the test.

4.5.1.1 Temperature. Prior to the start of each test the ambient temperature and the initial temperature of the battery shall be $27^{\circ} \pm 5^{\circ}C$.

4.5.1.2 Discharges. All discharges shall be made by the constant-current method, and shall be terminated by specified discharge time or cutoff voltage, whichever occurs first, unless otherwise specified in the description of the test.

4.5.1.3 Charging.

* 4.5.1.3.1 Low-rate charging. Prior to discharge, except for the Filled Discharge Capacity Test, each battery shall be charged at the C/10 rate until the battery voltage remains constant or decreases for four consecutive hourly readings (a three-hour period).

4.5.1.3.2 Constant current charging. When charging by the constant current method, the batteries shall be recharged for two (2) hours at a rate which will provide eighty (80) percent of the previous discharge, and three (3) hours at a rate which will provide forty-five (45) percent of the previous discharge.

4.5.1.3.3 Constant potential charging. The battery shall be charged at $27^{\circ} \pm 5^{\circ}C$ at 2.35 ± 0.02 volts per cell for a minimum of two (2) hours or a maximum of five (5) hours or until the current has decreased below 1.0 ampere for a minimum of one (1) hour. The minimum capability of the charger input to the battery shall be 100 amperes.

4.5.1.4 Controlled temperature tests. When a temperature other than $27^{\circ} \pm 5^{\circ}C$ is specified, the battery shall be kept in a chamber maintained at the specified temperature ± 2°C for a minimum of 16 hours unless otherwise specified.

4.5.1.5 Filling and maintenance. No battery shall require the addition of any substance other than distilled water or electrolyte at any time. After the initial filling and the adjustment of electrolyte following the capacity tests of 4.6.11, only the addition of distilled water shall be permitted.

4.5.1.6 Order of tests. The tests on each battery shall be performed in the order in which they appear in Tables IV, VI and VIII.

4.5.1.7 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required inspections. The contractor shall establish and maintain a system for the calibration of all measuring and test equipment in accordance with MIL-C-45662.

4.5.2 Instrument accuracy.

4.5.2.1 Electrical indicating instruments. All voltmeters and ammeters shall be accurate within ± 1 percent of the full-scale reading. The range of analog type meters shall be such that the readings are taken on the upper half of the scale. The sensitivity of voltmeters shall be at least 5000 ohms per volt. Timers shall be accurate within ±0.5 percent.

4.6 Examination and test methods.

4.6.1 Physical tests - containers and cell covers (metallic batteries).

4.6.1.1 Interior finish (high potential). Sample aluminum containers shall be subjected to the following high potential test. A direct-current potential of 1000 ± 50 volts shall be applied between the aluminum container and the interior finish surface. The entire interior of the container shall be tested. The container shall meet the requirements of 3.5.1.1.

4.6.1.2 Interior finish (adhesion). Sample aluminum containers and container covers shall be tested for adhesion of interior finish by the following procedure. A cover or container sample shall be cut with a right-angle cross through the interior finish to the container metal

with a sharp knife. This cross shall be covered with 1.300 minimum specific gravity sulfuric acid, and a watch glass. The sample shall be allowed to stand at room temperature of 27° ± 5°C for forty-eight hours. After the standing period, the acid shall be removed and the test area washed. The scratch or cross shall be inspected for evidence of separation of the interior finish from the metal. This inspection shall consist of an attempt, with a sharp knife, to peel back the cut edges of the interior finish from the metal. Samples tested shall meet the requirements of 3.5.1.2.

4.6.1.3 Exterior finish. The acid resistant coating shall be applied to an aluminum alloy panel, approximately 0.020 of an inch thick approximately four by six inches in size, in the same manner in which it is applied to the battery. The exterior finish of the panel shall be tested for flexibility. The exterior finish of the aluminum container shall be tested for acid resistance.

4.6.1.3.1 Exterior finish (acid resistance). A sample aluminum container shall be air dried for forty-eight hours at a room temperature of 21° to 43°C. The container shall then be placed in a horizontal position and several drops of 1.300 minimum specific gravity sulfuric acid placed on the container. Each drop shall be covered with a watch glass for 24 hours. The acid shall be washed off with tap water and the container allowed to dry for one hour. The spots in contact with the acid shall be inspected at this time and again after twelve hours of drying. The exterior finish shall meet the requirements of 3.5.1.3.

* 4.6.1.3.2 Exterior finish (flexibility). An aluminum alloy panel shall be prepared in an identical manner with that described in 4.6.1.3, placed horizontally in an oven and baked at 85°C for forty-eight hours, then allowed to cool for a minimum of one (1) hour at a room temperature of 27° ± 5°C. These sample panels shall be rapidly bent through 90 degrees over a .250 inch diameter rod. The exterior finish shall meet the requirements of 3.5.1.4.

4.6.2 Physical tests - inner cases and cell covers (metallic batteries.

* 4.6.2.1 Acid resistance. The acid resistance test shall be conducted as specified in ASTM Standard D639-72 to determine conformance to 3.5.2.2. The duration of the test shall be seven (7) days.

* 4.6.2.2 Electrical high potential. Each sample battery inner case and nonmetallic container shall be subjected to an electrical high-potential test which shall be accomplished in a manner to produce an electrostatic field intensity that is uniform over all surfaces of the inner case except for a distance approximately 3/4 inch from the top edges of the case. The specified test voltage of 145 volts, 60 Hz, per 0.001 inch of thickness, at the thinnest section shall be supplied by direct connection across a high-tension transformer rated at not less than 500 watts. Voltages shall be applied for five seconds and may be

measured by the use of needle point spark gaps (1.3 inches gap for 25,000 volts and 0.87 of an inch gap for 18,000 volts). The inner cases and nonmetallic containers shall meet the requirements of 3.5.2.2.

* 4.6.2.3 Impact resistance.

* 4.6.2.3.1 Inner case. The impact resistance test shall be conducted as specified in ASTM Standard D639-72 to determine conformance to 3.5.2.3. During the tests, the inner case shall be positioned in such a manner that the ball will strike the inner case to be tested at a point one-third the way down from the top of the inner case on the centerline of a cell on the front and back of the inner case.

* 4.6.2.3.2 Cell covers. Test specimens consisting of three whole one-piece cell covers shall be impacted on the top surface between any two cells at a distance halfway from the vent well to the edge of the cover. Cell cover impact tests shall be conducted according to ASTM Standard D639-72. The impact resistance values shall meet the specified requirements of 3.5.2.3.

4.6.3 Physical tests - containers and cell covers (nonmetallic batteries).

4.6.3.1 Electrical high potential. Conduct test of nonmetallic containers as outlined in 4.6.2.2 for conformance to 3.5.3.1.

4.6.3.2 Bulge resistance. The bulge resistance test shall be conducted as specified in ASTM Standard D639-72 to determine conformance to 3.5.3.2. The water temperature for this test shall be $71^{\circ} \pm 1^{\circ}C$.

4.6.3.3 Acid resistance. The acid resistance test shall be conducted as specified in ASTM Standard D639-72 to determine conformance to 3.5.3.3.

4.6.3.4 Impact resistance.

4.6.3.4.1 Containers. The impact resistance test shall be conducted as specified in ASTM Standard D639-72 to determine conformance to 3.5.3.4. During the tests, the container shall be positioned in such a manner that the ball will strike the container to be tested at a point one-third the way down from the top of the container on the centerline of a cell on the front and back of the container.

* 4.6.3.4.2 Cell covers. Test specimens for 24-volt nonmetallic batteries shall consist of three whole one-piece covers and shall be impacted on the top surface between any two cells at a distance halfway from the vent well to the edge of the cover. Cell cover impact tests shall be conducted in the same manner as container impact test described in ASTM Standard D639-72 to determine conformance to 3.5.3.4.

4.6.4 Visual and mechanical. Each complete battery shall be examined to verify compliance with 3.5.4.1 and 3.5.4.2 for color and marking respectively. Further, each complete battery, subassembly, and part shall be inspected to determine compliance with 3.5.19 and Table IX for workmanship and construction. Defects shall be identified in accordance with Table IX.

* TABLE IX. Identification of defects

Number	Description
1	Missing or wrong parts or material.
2	Improper assembly causing parts to be inoperative or unsafe in service.
3	Deformed or damaged parts, inoperative or do not function properly in service.
4	Improper machining resulting in sharp burrs or imperfections which would cause parts to be dangerous to handle or cause major difficulty in assembly or maintenance operations.
5	Sand holes, blow holes or other imperfections in castings causing structural weakness.
6	Holes missing, improperly aligned, or unusable because of size or fill.
7	Insulators or insulation missing or damaged so as to affect intended mechanical or electrical use.
8	Marking wrong, missing or illegible.
9	Staking or riveting missing or defective so as to cause probable mechanical or electrical failure.
10	External or internal threads missing, wrong size, or damaged so as to prevent proper use.
11	Sealing missing or defective.
12	Missing, broken, or incomplete welds (resulting in structural weakness).
13	Welds having evidence of poor penetration or poor fusion.
14	Welds containing blow holes, cracks, or slag inclusion.
15	Corrosion which could cause mechanical, operational or electrical failure.
16	Improper color on outside of container or cover.

4.6.5 Dimensions. The batteries shall be measured to determine compliance with the requirements of 3.5.5.

* 4.6.6 Internal air pressure. An internal air pressure of 2.25 ± 0.25 pounds per square inch at 27° ± 5°C shall be applied to each cell of the battery through an air-tight adapter to the filling hole in the cell for five seconds such that adjacent cells are not tested simultaneously. The source of pressure shall be removed and then the pressure measured after a minimum of thirty (30) seconds. Each cell of the battery shall meet the specified requirements of 3.5.6.

4.6.7 Strength of receptacle. A plug conforming to MS3349, MS14111, MS25182 or a plug designed to mate with the typical receptacle adapter shown in Figure 2, shall be engaged with the receptacle of the battery. A tension of 400 ± 50 pounds shall be applied axially to the plug. The tension shall be released and a torque of 10 ± 1 foot-pounds shall be applied to the handle or handwheel of the plug. The battery shall be examined for compliance to the requirement of 3.5.7.

* 4.6.8 Physical integrity at temperature extremes and vibration. The tests shall be conducted as follows:

a. Sample batteries in the charged and dry condition shall be placed in an oven at 85° ± 2°C and maintained at this temperature, in the normal upright position, for six hours. At the end of this time they shall be tilted to an angle of 90° from the normal upright position and maintained at the specified temperature in the new position for a period of five minutes. At the end of this time they shall be returned to the normal upright position and the surface of the sealing compound inspected for free flow of the sealing compound. Any evident movement of the compound in the direction of the angle of tilt should be considered as free flow.

b. While still at 85° ± 2°C, an internal air pressure of 2.25 ± 0.25 pounds per square inch shall be applied to each cell of this battery for thirty (30) seconds. Upon the successful completion of this part of the test, and battery stabilization at room temperature, electrolyte will be added and the battery given a charge in accordance with 4.5.1.3.1.

c. The samples shall then be refrigerated until electrolyte temperature is stabilized at -34° ± 2°C and shall be vibrated at this temperature at 2000 ± 20 cycles per minute with a vertical displacement of 0.040 ± 0.002 of an inch double amplitude for two hours. At the end of this time, visual inspection shall show no sign of major compound fracture and inversion of the battery shall show no signs of dislodging any portions of the sealing compound. A repetition of the air pressure test at 27° ± 5°C per paragraph 4.6.6 shall be conducted.

d. Lift the battery by its vent tubes.

e. The sample batteries shall conform to the specified requirements of 3.5.6 and 3.5.8, as applicable, in steps a, b, c, and d above.

4.6.9 Filled discharge capacity. After the battery has been stabilized at a temperature of 27° ± 5°C, it shall be filled with electrolyte conforming to 3.4.2. The battery shall then be placed on open circuit for two (2) hours, and electrolyte shall be added as necessary to restore the required level. The battery shall then be discharged at the one (1) hour rate to an average of 1.5 volts per cell. The battery shall meet the specified requirements of 3.5.9.

4.6.10 Weight. The batteries shall be weighed to determine compliance with the requirements of 3.5.10.

* 4.6.11 Capacity. Batteries, charged in accordance with 4.5.1.3.1 prior to each discharge, shall be subjected to the following capacity tests in the order shown:

a. Three (3), one-hour rate discharges at an initial electrolyte temperature of 27° ± 5°C prior to charge and discharge. The third one-hour rate shall be terminated upon reaching the cutoff voltage.

b. One (1), five-minute rate discharge at an initial electrolyte temperature of 27° ± 5°C prior to charge and discharge.

c. One (1), five-hour rate discharge at an initial electrolyte temperature of 27° ± 5°C prior to charge and discharge.

d. One (1), five-minute rate discharge at an initial electrolyte temperature of 27° ± 5°C prior to charge and -18° ± 2°C prior to discharge.

e. All discharges shall be conducted at temperatures, currents, and for minimum discharge times or to cutoff voltages specified in Table I. The batteries shall meet the specified requirements of 3.5.11.

f. The six (6) capacity tests, steps a through d, shall be counted as the first six (6) cycles for the life test of 4.6.18.

4.6.12 Altitude. This test shall consist of the following steps:

a. Fully charge the battery per 4.5.1.3.1.

b. Place the battery with cover in place (on open circuit) into a chamber and within 15 minutes lower the chamber pressure and temperature to simulate the ambient condition at 60,000 feet and -18° ± 2°C.

c. Discharge battery at 6.0 C rate for 5 minutes or to a cutoff voltage of 1.2 volts per cell, whichever occurs first.

d. Charge battery at 2.35 ± 0.02 volts per cell under conditions established in step b for two hours.

e. Open circuit battery and within 5 minutes discharge battery at 1.0 C rate for 45 minutes or to a cutoff voltage of 1.50 volts per cell, whichever occurs first.

f. The battery shall meet the specified requirements of 3.5.13 for the discharge of step e.

g. After return of the battery to sea-level conditions and removal of the battery from the altitude chamber, the battery shall be inspected for the specified requirements of 3.5.12.

* 4.6.13 Mechanical shock. The test shall consist of the following steps:

a. Subject the fully charged battery to shock test Procedure 1, Method 516.2, MIL-STD-810, however, the shock with the battery inverted shall be omitted. The shock pulse shape shall be in accordance with Figure 516.2-2 using amplitude (a) and time duration (c). Gravity controlled venting plugs, conforming to MS25185, shall be installed on ground use batteries for this test. No resilient mounting shall be provided.

b. Open-circuit battery for a minimum of one hour.

c. Discharge battery at 6.0 C rate for one (1) minute.

d. Lift the battery by its vent tubes.

e. The battery shall meet the specified requirements of 3.5.8.3 and 3.5.12.

* 4.6.14 Temperature shock. The test shall consist of the following steps:

a. Fully charge the battery per 4.5.1.3.3.

b. Subject the battery to the temperature shock requirements of Procedure 1, Method 503.1, MIL-STD-810 except that the exposure time for each temperature shall be 4(-0 + .5) hours.

c. Lift the battery by its vent tubes at the end of the exposure time for each temperature.

d. Allow the battery to remain on open circuit stand until battery temperature returns to room ambient, $27^{\circ} \pm 5^{\circ}$C.

e. Discharge battery at 6.0 C rate for one (1) minute.

f. The battery shall meet the specified requirements of 3.5.8.3 and 3.5.12.

* 4.6.15 Salt fog. The test shall consist of the following steps:

a. Fully charge the battery per 4.5.1.3.3.

b. Subject the battery to salt fog test Procedure 1, Method 509.1, MIL-STD-810.

c. Remove the battery from the salt fog chamber.

d. Open-circuit battery for one to sixteen hours.

e. Discharge battery at 1.0 C rate to a cutoff voltage of 1.50 volts per cell or for 45 minutes, whichever occurs first.

f. The battery shall meet the specified requirements of 3.5.14 for the discharge of step e.

g. The battery shall meet the specified requirements of 3.5.12.

* 4.6.16 Humidity. The test shall consist of the following steps:

a. Fully charge the battery per 4.5.1.3.3.

b. Subject the battery to the humidity test Procedure 1, Method 507.1, MIL-STD-810.

c. Open-circuit battery for one to sixteen hours.

d. Discharge the battery at the 1.0 C rate to a cutoff voltage of 1.50 volts per cell or for 45 minutes, whichever occurs first.

e. The battery shall meet the specified requirements of 3.5.15 for the discharge of step d.

f. The battery shall meet the specified requirements of 3.5.12.

* 4.6.17 Cell terminal posts, intercell connectors, terminal connectors. Batteries, charged in accordance with 4.5.1.3.3, with their container lids in position, shall be placed in an oven at 49^{0}_{-2}°C and maintained at this temperature for six (6) hours prior to a 1.5 minute discharge at the specified rate in the applicable specification sheet for each battery type. The discharge may be maintained to any terminal voltage necessary for the successful completion of the discharge for the time period specified. For convenience in testing, the rate may be maintained by a booster battery or motor-generator set. The battery shall meet the specified requirements of 3.5.16.

4.6.18 Life cycling. The battery shall be cycled in a free-air ambient of 27° ± 5°C. The batteries shall meet the specified life cycling requirements of 3.5.17.

* 4.6.18.1 Discharging and charging. On life test, the batteries shall be discharged as specified in 4.6.18.2. The discharge shall be made by the constant-current method. The following conditions shall apply:

a. Following the five (5) minute discharge tests, the battery shall remain on open-circuit until the battery temperature stabilizes at 27° ± 5°C.

b. Following the one (1) hour, two (2) hour, and five (5) hour discharge tests, the battery shall be given a one (1) hour open-circuit rest period in an ambient temperature of 27° ± 5°C.

c. Following charging, batteries shall be given a one (1) hour open-circuit rest period in an ambient temperature of 27° ± 5°C except that batteries subjected to the five (5) minute -18°C discharge test shall comply with 4.5.1.4.

d. The charges preceding cycles 1 through 7 and 61 through 65 shall be in accordance with 4.5.1.3.1. The remaining charges during cycling shall be in accordance with 4.5.1.3.2.

e. The battery shall be fully charged following cycle 6 and the specific gravity shall be adjusted in each cell to 1.285 ± 0.010 corrected for 27°C.

4.6.18.2 Cycling. Cycling shall consist of a series of cycles of charge and discharge as specified below, all of which shall be counted as life cycles. Cycling shall be as follows:

Cycle Number	Test	Rate
1-3	1-hour at 27° ± 5°C	1.0 C
4	5-minute at 27° ± 5°C	6.0 C
5	5-hour at 27° ± 5°C	0.2 C
6	5-minute at -18° ± 2°C	6.0 C
7-60	1-hour at 27° ± 5°C	1.0 C
61	5-minute at 27° ± 5°C	6.0 C
62	2-hour at 27° ± 5°C	0.5 C
63	5-minute at 27° ± 5°C	6.0 C
64	2-hour at 27° ± 5°C	0.5 C
65	5-minute at 27° ± 5°C	6.0 C

During cycles 7 thru 60, the batteries shall not require water additions more than once in four (4) consecutive cycles. During life cycle sixty-five (65) when the battery is subjected to the five (5) minute discharge, the battery shall be inverted during the last 2.5 minutes of discharge.

* 4.6.18.3 Shutdown supplement charge. Batteries standing idle for a period exceeding twelve (12) hours (during laboratory shutdowns or over weekends) shall be charged in accordance with 4.5.1.3.1.

4.6.19 Electrical leakage.

4.6.19.1 Nonmetallic containers. The test shall consist of the following steps:

a. Charge the battery in accordance with 4.5.1.3.3.

b. Wipe battery terminals and surrounding areas clean with damp cloth and allow to dry.

c. Connect voltmeter between positive terminal of the battery and the exposed surface of the container.

d. The meter should be initially set to read on its highest voltage range and the range decreased. The meter shall have a full scale deflection range of 2.5 volts or less.

e. Repeat step c between negative terminal and the container.

f. The battery shall meet the specified requirements of 3.5.19.

* 4.6.19.2 Metallic containers. The test shall consist of the following steps:

a. Charge the battery in accordance with 4.5.1.3.3.

b. Wipe battery terminals and surrounding areas clean with damp cloth and allow to dry.

c. Scrape paint from section of container to expose metal.

d. Connect ammeter, maximum ten milliamperes full scale deflection, from positive terminal to exposed container metal and measure current. Digital meters may be used.

e. Measure current from negative to exposed container metal.

f. The battery shall meet the specified requirements of 3.5.19.

* 4.6.20 Sealant test (metallic containers). The test shall consist of the following steps:

a. Tighten all vent plugs so that rubber gaskets seal properly.

b. Fill the manifold area of the battery with water to a depth of 1.0 ± 0.1 inch. On the inside wall of the battery place a mark at the water line.

c. Place the cover on the battery and allow the battery to stand at ambient temperature of 16 ± 0.5 hours.

d. Remove cover and check the water line. If the water line is below the mark made in step b, remove the remaining water from the manifold without tipping or inverting the battery.

e. Blot the surface of the manifold dry with a sponge or absorbent towel.

f. Invert the battery and measure the volume of water that flows from between the inner case and outer container.

g. The battery shall meet the specified requirements of 3.5.18.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging and packing. Preservation and packaging shall be level A or C and packing shall be level A, B, or C as specified in MIL-P-6063 (see 6.2).

* 5.1.1 Preservation, packaging, and packing of test samples. Preservation, packaging and packing of qualification, first article, and Group C samples shall be representative of the preservation, packaging, and packing to be afforded production batteries.

* 5.2 Marking. Interior packages and exterior shipping containers shall be marked on the two largest vertical sides with lettering at least 1/2 inch in height as follows: ROTATE STOCK-USE OLDEST BATTERIES FIRST. Additionally, the packages and containers shall be marked in accordance with the requirements of MIL-STD-129 with the date and lot code (see 3.5.4.2.3) included in the identification marking.

6. NOTES

6.1 Intended use. The batteries covered by this specification are intended for duty in direct-current electrical systems operations at a nominal rating of 28.0 volts and at ampere-hour ratings within the values specified herein. Aeronautical and ground systems and associated equipments are the principle applications in which the batteries are utilized.

6.2 Ordering data. Acquisition documents should specify the following:

a. Identification. The identification of the battery which is desired.

b. Quantity. The quantity and battery type.

c. Specification. The number, date and title of this specification and applicable Military Specification sheet.

d. Amendment. The amendment number and date of the latest amendment to this specification, if any.

e. Preparation for storage. Whether or not preparation for long-term storage is required.

f. Packaging. Selection of applicable levels of preservation, packaging, and packing desired (see Section 5).

6.3 Verification inspection. Verification by the Government will be limited to the amount deemed necessary to determine compliance with the contract and will be limited in severity to the definitive quality assurance provisions established in this specification and the contract. The amount of verification inspected by the Government will be adjusted to make maximum utilization of the contractor's quality control system and the quality history of the product.

6.3.1 Verification of qualification status. At two-year intervals from the date of establishment of the QPL, the preparing agency will review and decide (1) the need for the qualification provision, and (2) the need for testing to retain products on the QPL. In the event testing is not required, each manufacturer shall be requested to forward to the preparing activity certification signed by a responsible official of management, attesting that the listed product(s) is still available from the listed plant, can be produced under the same conditions as originally qualified and meets the requirements of the current issue of the specification. Failure to provide the certification will be cause for removal from the Qualified Products List.

* 6.4 Provisions for 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. In the absence of a Qualified Products List, these same qualification tests shall be conducted as first article or preproduction tests with the prior approval of the qualifying activity. The attention of the supplier 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command; however, information pertaining to qualification of products may be obtained from Weapons Quality Engineering Center, Electrochemical Power Sources Division, ATTN: Code 3052, Naval Weapons Support Center, Crane, Indiana 47522.

6.5 Supersession. This specification and its associated documents supersede MIL-B-6146, MIL-B-6147, MIL-B-6148, MIL-B-6741, AN 3150, AN 3151, AN 3154, MS18045-41, MS18045-42, and MS90379-1.

6.6 Group C inspection costs. The cost of Government testing shall be borne by the Government for Defense Logistics Agency procurements and by the supplier for single service procurements. An estimate of the cost for Government testing for single service procurements, for use by a supplier at time of preparation of bids, may be obtained from the Naval Weapons Support Center, Code 3052, Crane, Indiana 47522.

6.7 International standardization. Certain provisions of this specification are the subject of international standardization agreements (ASCC AIR STANDARD 12/15 and STANAG 3514 AE). When amendment, revision or cancellation of this specification is proposed which will effect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required.

6.8 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

Custodians:
Air Force - 99
Army - ER
Navy - AS

Preparing activity:
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Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current DoDISS.

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5. PROBLEM AREAS

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b. Recommended Wording:

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