INCH-POUND

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MILITARY SPECIFICATION

BATTERY STORAGE, SUPPORT EQUIPMENT GENERAL SPECIFICATION FOR

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

1. SCOPE. This specification covers the general requirements for rechargeable, valve-regulated, maintenance-free, lead acid batteries for use in support equipment. The batteries are nominal 6-volt, 12-volt, and 24-volt batteries.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

O-S-801	-	Sulfuric Acid, Electrolyte; for Storage Batteries.
QQ-S-571	-	Solder, Tin Alloy, Tin-Lead Alloy, and Lead Alloy.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Crane Division, Naval Surface Warfare Center, Code 6092, Bldg. 2949, Crane, IN 47522-5001, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6140

MILITARY

MIL-M-13231 - Marking of Electronic Items.

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-130 - Identification Marking of U. S. Military Property.
MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from Customer Service, Standardization Documents Order Desk, Defense Printing Service, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

SD-6 - Provision Governing Qualification (Qualified Products List).

(Copies of SD-6 are available from Customer Service, Standardization Documents Order Desk, Defense Printing Service, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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

American Society for Testing and Materials (ASTM)

ASTM D 639 - Standard Methods for 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 19103-1187).

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

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

3. REQUIREMENTS

3.1 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.

3.2 Qualification. Batteries furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) at the time of award of contract (see 4.3.1 and 6.4).

3.3 Design and construction. The design, construction, physical dimensions, and mass of the batteries shall conform to the requirements specified below when examined in accordance with the visual and mechanical tests of 4.7.1. Detailed requirements for the individual types of batteries are specified in the applicable specification sheets.

3.3.1 Battery condition. Batteries shall be furnished in the charged condition and shall not require the addition of any substance before being put into or during service. Furthermore, batteries shall not require any maintenance in meeting the provisions of this specification.

3.3.2 Battery containers. The battery container and cover shall be free from pitting, rough spots, scales, blisters, or other deformation. The dimensions and locations of terminals, hold-downs, and name and instruction plates shall conform to the applicable specification sheet (see 3.1).

3.3.3 Dimensions and weight. The dimensions and weights of batteries shall be as shown on the applicable specification sheet (see 3.1).

3.3.4 Handles. When handles are provided, they may be molded as an integral part of the battery container, separately molded and attached to the container, or constructed of non-conducting synthetic cord, resistant to acid. Batteries having permanently affixed handles shall conform to the dimensional requirements of the applicable specification sheet. Batteries equipped with removable handles shall conform to the dimensional requirements of the applicable specification sheet when the handles are removed. Handles are required on batteries over 20 kilograms and may be supplied on any battery at the manufacturer's discretion.

3.3.5 Covers. Covers shall be of the same material used for battery containers. Covers shall be one piece or individual cell design and shall be non-removable from the container. Covers shall be properly seated and level before sealing.

3.3.6 Plate-connecting straps. Plate-connecting straps shall be designed of sufficient size and strength to provide electrical conductivity and mechanical support to the group of connected plates to meet the electrical and physical requirements specified herein. All plates of like polarity in each cell of the battery shall be made integral with their strap by burning or by other means commonly accepted within the industry.

3.3.7 Connectors, intercell. The connectors shall conform to the applicable specification sheet (see 3.1). All intercell connections shall be internal to the battery. The seals between cell terminals and cell container shall be constructed so that no electrolyte leakage occurs during the performance of any tests specified herein. All electrical connections within the battery shall be by surface-to-surface conduction and not through screw threads.

3.3.8 Terminals. All metal parts of the terminals shall be lead, lead-tin, or solder (tin/lead) coated. All battery terminals shall have removable covers utilizing non-conductive materials such as rubber or plastic.

3.3.8.1 Terminal marking. Positive terminals shall be legibly marked and readily recognized by "POS", "P", or "+" and negative terminals by "NEG", "N", or "-". The polarity markings shall be raised or depressed characters of not less than .50 inch high and located as shown on the applicable specification sheet (see 3.1).

3.3.8.2 Battery terminal seals. Battery terminal seals shall be provided to prevent leakage between terminal and cover of the individual cells. If sealing nuts are used, they shall be of lead alloy, and the threads shall be upset during assembly to prevent loosening. If rubber gaskets or bushings are used as a seal, they shall be made in one piece and of uniform thickness.

3.3.9 Vents. Batteries shall not be furnished with removable vents. Batteries shall contain either individual or a ganged arrangement low-pressure venting mechanism and shall be affixed in such a manner that prevents removal. The low-pressure vents shall be designed in a manner to release excessive pressure during overcharge and then reseal after venting. Batteries shall be designed to prevent entry of any spark or flame into the cell container or battery container which could ignite hydrogen gasses.

3.3.10 Antimony. Antimony shall not be used in construction of battery plates covered by this specification, however, antimony may be used in small parts casting as necessary, .

3.4 Materials. Acceptance of any constituent material shall not be construed as a guarantee of the acceptance of the finished product. When deemed necessary by the Government, the battery manufacturer shall supply the Government with a certification of conformity of the material or component. In the absence of certification from the source, a certificate of analysis or certified inspection data will be required (see 4.2.1).

3.4.1 Containers and covers. Battery containers and covers shall be molded from plastic whose chemical, electrical, and physical properties shall conform to ASTM D 639.

3.4.2 Epoxies/sealing compounds. Epoxies and sealing compounds shall not shrink or separate from the holding surfaces nor crack during any of the tests specified herein. The chemical, electrical, and physical properties shall conform to ASTM D 639.

3.4.3 Electrolyte. Electrolyte shall be a solution of sulfuric acid and water. The sulfuric acid shall conform to class 3 of O-S-801. Electrolyte shall be either "absorbed" or "gelled". Batteries shall not contain any "free" electrolyte.

3.4.4 Solder. Solder used in making electrical connections, tinning of copper inserts, and other soldering or tinning operations shall conform to QQ-S-571.

3.4.5 Recovered materials. Unless otherwise specified, the products covered by this specification shall be newly manufactured. All equipment, material, and articles incorporated in the products covered by this specification shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" shall be defined as 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. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt batteries is allowed under this specification.

3.5 Examination.

3.5.1 Corrosion resistance. External and internal metal or component parts of each battery shall show no evidence of cracking, pitting, chipping, scaling, corrosion, or other deleterious effects during or after the performance of any of the tests specified in 4.7.

3.5.2 Marking.

3.5.2.1 Identification marking. The battery shall be marked for identification in accordance with MIL-STD-130. Marking shall be in white or black print in accordance with MIL-M-13231. Lettering height shall be 0.25 inch minimum. Marking for label 1 shown on figure 1 on the applicable specification sheet shall show the following:

BATTERY STORAGE, SUPPORT EQUIPMENT
** VOLTS, MAINTENANCE-FREE

Information Required	Example
MIL part or Identifying Number	****/**
Replaces (include replacement data from applicable battery specification sheet)	Replaces M15072/12
Maximum weight	22 Kg
Cold cranking amperes	300 CCA
Reserve capacity	120 minutes
One-hour capacity rate	**** Ah
National stock number	6140-**-***-****
Contract number	****
Date and lot code	0493-12
Battery Serial Number	****
Manufacturer's name	****
Date battery placed in service	_____

****Fill in applicable information.

3.5.2.2 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 4-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 or the first three working days of the next month, the manufacturer may use either month as the

coded month of manufacture. As an example, code 0493-12 indicates the battery was manufactured in April 1993 and was the twelfth lot. The date and lot code shall also be marked on all interior packages and exterior shipping containers (see 5.2).

3.5.3 Electrical requirements.

3.5.3.1 Internal resistance. Batteries shall exhibit internal resistance not greater than the value shown on the applicable specification sheet.

3.5.3.2 Reserve capacity. When tested in accordance with 4.7.4, the reserve capacity shall be not less than the value specified in the applicable specification sheet.

3.5.3.3 Cold cranking performance at 0°F. When tested as specified in 4.7.5, the battery terminal voltage at the end of 30 seconds shall be not less than 1.2 volts per cell when discharged at the 0°F cold cranking amperes (CCA) rating as specified in the applicable specification sheet.

3.5.3.4 Cold cranking performance at -40°F. When tested as specified in 4.7.5, the battery terminal voltage at the end of 30 seconds shall be not less than 1.2 volts per cell when discharged at one-half of the 0°F CCA rating while maintained at -40°F, as specified in the applicable specification sheet .

3.5.3.5 Charge rate acceptance. When tested as specified in 4.7.6, the battery shall accept at 10 minutes of charge a charge rate not less than 2 percent of the 0°F CCA rating shown in the applicable specification sheet. Additionally, the battery shall deliver not less than 90 percent of the reserve capacity rating as specified in the applicable specification sheet after being charged for four hours while at 30°F.

3.5.3.6 Retention of charge. Batteries shall yield not less than 50 percent of the reserve capacity rating shown in the applicable specification sheet after being stored at a temperature of 105 ± 2°F for a period of 30 days when tested in accordance with 4.7.7.

3.5.3.7 Life cycle. When subjected to the life cycling test as specified in 4.7.8, batteries shall successfully deliver not less than 90 percent of the reserve capacity shown in the applicable specification sheet after cycle 2400, which equates to approximately 3 years of service life. Additionally, during the 30-second discharge of the repetitive cycling, batteries shall maintain a terminal voltage of not less than 1.2 volts per cell.

3.5.3.8 Deep discharge recoverability. When tested as specified in accordance 4.7.9, batteries shall deliver not less than 80 percent of the reserve capacity rating shown in the applicable specification sheet within three cycles of charge and discharge.

3.5.3.9 Short circuit survivability. Batteries shall not exhibit any arcing, flaming, or explosion when tested as specified in 4.7.10. Batteries shall remain electrically intact following the short circuit survivability test. When subjected to the charge and the Reserve Capacity discharge test in 4.7.4, batteries shall perform normally. The battery shall provide not less than 90 percent of the reserve capacity rating of the applicable specification sheet.

3.5.3.10 Battery gas emissions test. When tested in accordance with 4.7.11, the percent of hydrogen concentration shall be not greater than 3.5 percent at all times.

3.5.4 Environmental requirements. When tested in accordance with 4.7.18 and 4.7.19, batteries shall exhibit no:

a. Dimensional distortion beyond limits or cracking of cases or cover of either cells or batteries.

b. Radical current or voltage fluctuation during any test.

c. Mechanical failure of any part.

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

e. Breakdown of insulation, stripping of metal plating from any component part, corrosion of metal parts, or loosening of protective coating from the battery container or cover.

f. Deterioration of battery identification markings.

3.5.5 Physical requirements.

3.5.5.1 Containers.

3.5.5.1.1 Electrical breakdown. When tested as specified in paragraph 4.7.12, the container shall be free of leaks and other imperfections and shall show no evidence of being perforated or burned through. Containers shall withstand an alternating current potential of 100 volts root mean square (rms) per millimeter of thickness without damage.

3.5.5.1.2 Acid resistance. When tested in accordance with 4.7.13, the material's increase in weight shall be not greater than 1.5 percent; its dimensional increase shall not be greater than 2 percent. It shall show no evidence of blisters, cracks, or other visible damage.

3.5.5.1.3 Impact resistance. When tested as specified in 4.7.14, the impact resistance required for containers and covers shall be not less than the values shown below.

Temperature	Minimum Impact Resistance Value
80°F	180 inch-pounds
0°F	120 inch-pounds
-40°F	100 inch-pounds

3.5.5.1.4 Bulge test. When tested as specified in 4.7.15, the bulge resistance for a plastic container shall be not greater than 1/8 inch on each end.

3.5.5.2 Terminal post torque resistance. Tapered terminal posts shall withstand, without damage to the battery, a torque of 250 inch-pounds when tested as specified in 4.7.16. No distortion of the strap and connected plates, nor of the seal between the post and the cell cover, shall be exhibited.

3.5.5.3 Handles. When handles are provided, they shall withstand a force of 1.5 times the weight of the battery when tested in accordance with 4.7.17. No damage to the battery shall be present after testing.

3.5.5.4 Vibration. Batteries shall be capable of withstanding the effects of 4 hours of sinusoidal vibration at 33-35 Hertz (Hz) through an amplitude of 0.045 to 0.050 inch (total excursion of 0.090 to 0.100 inch) without any evidence of mechanical or electrical damage. The battery shall meet the requirements of 3.5.4 when subjected to the vibration test of 4.7.18. Electrically, following the vibration test, the battery shall meet the cold cranking requirement for 0°F. Post vibration examination shall reveal no external or internal physical or mechanical damage.

3.5.5.5 Salt fog. The battery shall meet the requirements of 3.5.4 when subjected to the salt fog test of 4.7.19. Electrically, after exposure to the salt fog environment, the battery shall provide the reserve capacity rating as specified in the applicable specification sheet when subjected to the 25.0 ± 0.1 ampere discharge.

3.5.6 Workmanship. The battery shall be processed in such a manner as to be uniform in quality and shall be free from defects that will affect life, functioning, and appearance. Loose contacts, poor or improper molding or fabrication, damaged or improperly assembled contacts, peeling, flaking or chipping of plating or finish, mechanical damage due to testing environments, nicks or burrs of metal parts of surfaces, or improper or incorrect marking shall not be present. The batteries shall meet these requirements when tested in accordance with 4.7.1.

3.5.7 Special requirements. Batteries shall meet the requirements of any special tests called out on the specification sheet.

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

a. Qualification inspection. A qualification inspection shall consist of tests accomplished on batteries, battery components, and material submitted for qualification (see 4.3).

b. Quality conformance inspection. The quality conformance inspection shall consist of tests conducted on production samples to determine compliance with specification requirements and for qualification verification (see 4.4.1 and 4.5).

4.2.1 Quality system. The contractor shall have and maintain a quality system standard as specified in the contract.

4.3 Qualification inspection.

4.3.1 Qualification inspection. The Government shall perform qualification inspection at a Government test facility (see 6.4) on samples of components, materials, and batteries furnished by the contractor. The samples shall be representative of the components, materials, and batteries proposed to be furnished to the Government under contract. The samples shall not be produced with the use of any equipment or procedure that will not normally be used in production. Qualification inspection of these samples shall consist of the examinations and tests specified herein and the evaluation of inspection results in relation to applicable requirements. The batteries will be considered qualified and will be placed on the Qualified Products List (QPL) upon successful completion of the qualification inspection tests of table I in the order shown. The batteries shall be retained on the QPL as long as the group C samples continue to conform to the requirements of the specification. The requirements of Department of Defense Document SD-6 apply.

4.3.2 Inspection of batteries. Four samples each of complete batteries shall be furnished for inspection in accordance with table I and tested in the order shown. One dry unassembled battery with all parts shall be supplied and will be retained at the Government agency which did the testing. Contractor shall provide the Government test facility (see 6.4) with a certificate of conformance and supporting test data for the containers testing as required in paragraph 3.5.5.1.

4.3.3 Retention of samples. If the manufacturer becomes qualified, the sample batteries on which the qualification is based will be retained at the Government agency which did the testing as long as the manufacturer remains qualified. The sample batteries on which the qualification is based shall become the property of the Government, who may dispose of the samples once the manufacturer is no longer qualified.

4.3.4 Failure and retest. A qualification sample that fails 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 the inspection have been corrected. At the option of the Government test activity, a retest may be allowed with an increase in the number of qualification samples as specified by the qualifying activity. The cost of retesting conducted by the Government shall be borne by the contractor.

4.4 Quality conformance inspection. Quality conformance inspections shall be as specified in table I.

4.4.1 Inspection of product for delivery. The contractor shall perform the inspections specified for quality conformance inspection. This does not relieve the contractor of his 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

TABLE I. Inspection of batteries and order of test.

Order of test	Description of inspection	Requirements paragraph	Inspection method paragraph	Qualification inspection				Quality conformance inspection		
				Qualification sample number				Group A tests	Group C tests	
				1	2	3	4		1	2
1	Visual & mechanical examination	3.3, 3.4, 3.5.2 & 3.5.6	4.7.1	X	X	X	X	X	X	X
2	Dimension	3.3.3	4.7.2	X	X	X	X		X	X
3	Internal resistance	3.5.3.1	4.7.3	X	X	X	X	X	X	X
4	Reserve capacity	3.5.3.2	4.7.4	X	X	X	X		X	X
5	Cold cranking performance @ 0°F	3.5.3.3	4.7.5		X				X	X
6	Cold cranking performance @ -40°F	3.5.3.4	4.7.5			X		2/		
7	Charge rate acceptance	3.5.3.5	4.7.6		X					
8	Retention of charge	3.5.3.6	4.7.7			X				
9	Life cycling	3.5.3.7	4.7.8	X					X	
10	Deep discharge recoverability	3.5.3.8	4.7.9		X					
11	Short circuit survivability	3.5.3.9	4.7.10			X				
12	Battery gas emission test	3.5.3.10	4.7.11				X			
13	Electrical breakdown	3.5.5.1.1	4.7.12		1/					
14	Acid resistance	3.5.5.1.2	4.7.13		1/					
15	Impact resistance	3.5.5.1.3	4.7.14		1/					
16	Bulge test	3.5.5.1.4	4.7.15		1/					
17	Terminal post torque resistance	3.5.5.2	4.7.16	X						X
18	Handles	3.5.5.3 & 3.3.4	4.7.17	X						X
19	Vibration	3.5.5.4	4.7.18				X			
20	Salt fog	3.5.5.5	4.7.19				X			

1/ The contractor shall conduct the following test (see 4.3.2).
2/ The contractor shall conduct the following test at room ambient temperature (see 4.7.5).

review and examine the contractor's inspection procedures and inspection records. Batteries produced under this specification will be accepted upon successful completion of quality conformance (group A) inspection as outlined in table I and provided that group C samples have been shipped to the qualifying activity in accordance with 4.5.

4.4.1.1 Inspection lot definition. An inspection lot shall be defined as the quantity of batteries of any one type, chosen from a completed production run of batteries that are fully assembled and identified in accordance with 3.5.2, produced at any one place of manufacture on any one contract, submitted at one time for quality conformance inspection. Batteries with not more than two consecutive date codes shall appear in a particular inspection lot. A specific date and lot code shall be found in not more than one inspection lot.

4.4.1.2 Quality conformance (group A) inspection. Each unit of each inspection lot of batteries shall be subjected to the examination and test requirements (group A tests) of table I.

4.5 Group C inspection. The qualifying activity shall conduct the group C inspection for production verification on samples furnished by the contractor at no cost to the government in accordance with table I and in the order shown. The contractor shall ship sample batteries in quantities conforming to table II to the qualifying activity within three (3) working days after acceptance of the applicable inspection lots by the Government Quality Assurance Representative (QAR). The QAR shall select samples at random from inspected lots so as to be representative of all batteries that have passed Quality Conformance (acceptance) Inspections. Additionally, the samples shall be in quantities specified in table II and shall not be included in the contract lot size. Shipment of inspection lots that have passed group A (acceptance) inspection requirements shall not be held up pending results of group C inspections performed on samples representing these lots unless samples representing the most recent production lot exhibited failures. If failures were exhibited on the previous production lot, shipment of the subsequent production lot shall be withheld pending results of the first 14 days of group C inspection. Once qualified, production samples successfully passing the acceptance criteria are to be accepted until qualification is officially rescinded. Unless otherwise specified in the contract, the Government shall bear the cost of Government testing (see 6.8).

TABLE II. Group C inspection sampling plan.

Inspection Lot Size	Total Number of Samples
20 thru 500	2
501 thru 2000	4
2001 thru 10000	6
over 10000	8

4.5.1 Non-compliance. Failure of any sample to pass any group C test may be cause for the qualifying activity to initiate action to remove the contractor from the applicable Qualified Products List. The qualifying activity shall notify the procuring agency and the contractor of each group C failure, including details of the failure and characteristics affected. Upon notification by the qualifying activity, the contractor shall immediately investigate the cause of failure and further report the results of the 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 qualifying activity considers subject to the same failure. Contractor reports shall be forwarded to the qualifying activity with an information copy to the procuring agency.

4.5.2 Inspection of preparation for delivery. Preparation for delivery shall be examined for conformance to Section 5. The sample unit shall be one item, one package, or one shipping container.

4.6 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.6.1 through 4.6.6.

4.6.1 Ambient air temperature. Unless otherwise specified, all measurements and tests shall be made in an ambient temperature of 75 ± 5°F at ambient atmospheric pressure and relative humidity.

4.6.2 High and low temperature. Unless otherwise specified, all high and low temperature charge and discharge tests shall be conducted at the temperature indicated in the applicable test paragraph with a storage time of not less than 20 hours before discharge. A tolerance of ± 2°F shall be allowed.

4.6.3 Constant potential charging. Unless otherwise specified, batteries shall be charged at 2.40 volts per cell constant voltage for 2.0 ± 0.05 hours with a charger that has an output current capacity of not less than 25 percent of the CCA rating of the battery being tested.

4.6.4 Boost charge. Any battery that sits idle (open circuit) for periods exceeding 48 hours shall be given a boost charge at 2.40 volts per cell constant voltage for 30 minutes with a charger that has an output current capacity of not less than 25 percent of the CCA rating of the battery being tested. This does not apply to batteries that sit idle (open circuit) for periods exceeding 48 hours during the conduction of a test.

4.6.5 Constant current charging. Charge batteries at the manufacturer's recommended constant current charging rate until the charge voltage remains constant or decreases for four successive readings taken at 30-minute intervals. Charging time shall be a minimum of that which will provide 100 percent of the capacity removed from the battery on the preceding discharge but

shall not exceed 24 hours. Unless otherwise specified, batteries, following charging, shall stand at room temperature for not less than 2 hours before preceding with testing.

4.6.6 Test equipment and inspection facilities. The equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. Test equipment for Government verification inspection shall be made available by the contractor. The contractor shall establish and maintain a system for the calibration of all measuring and test equipment as specified in the contract (see 6.2).

4.7 Examination and test methods. The examinations and tests shall be conducted as described in 4.7.1 through 4.7.19.

4.7.1 Visual and mechanical examination. Examine the batteries to verify that the basic materials, component materials and parts, design and construction, marking, and workmanship are in accordance with all the requirements of 3.3, 3.4, 3.5.2, and 3.5.6.

4.7.2 Dimensions. The batteries shall be measured to determine compliance with the requirements of 3.3.3.

4.7.3 Internal resistance. To determine compliance with 3.5.3.1, measure the internal resistance of the battery using a Hewlett Packard milliohmmeter model 4328A or equivalent. With the battery fully charged in accordance with 4.6.3 measure and record the internal resistance between the negative and positive terminal posts.

4.7.4 Reserve capacity. To determine conformance to 3.5.3.2, the reserve capacity test shall be conducted as follows:

a. Charge the battery before each discharge in accordance with 4.6.3.

b. Discharge the battery, at a temperature of 80 ± 5°F, at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time to the end of the discharge.

c. Repeat steps a and b.

d. Repeat steps a and b.

e. The longest time of discharge obtained from each battery subjected to steps b, c, and d shall represent the reserve capacity of the battery. Exception: if the reserve capacity requirement is met in steps b or c, remaining steps, c and or d, are not required.

4.7.5 Cold cranking performance. The cold cranking performance test shall be conducted at two temperatures to determine compliance with the requirements in 3.5.3.3 and 3.5.3.4. Sample 1 shall be tested at 0°F and sample 2 shall be tested at -40°F as follows:

a. Charge the batteries in accordance 4.6.3, then stabilize in a test chamber at the applicable test temperature for not less than 20 hours.

b. While still in the chamber, discharge the batteries as follows. Discharge sample 1 at the applicable CCA rating specified in the applicable specification sheet for a period of 30 seconds. Discharge sample 2 at a rate equivalent to one-half of the 0°F CCA rating as specified in the applicable specification sheet for a period of 30 seconds.

c. The batteries shall meet the requirements of 3.5.3.3 and 3.5.3.4, respectively.

4.7.6 Charge rate acceptance.

a. Fully charge the battery in accordance with 4.6.3.

b. Discharge the battery at 25 ± 0.1 amperes for a time equal to 0.8 times the reserve capacity obtained during the test in 4.7.4.

c. Stabilize the battery at 30 ± 2°F for not less than 20 hours.

d. When the battery temperature has stabilized, charge the battery at a constant potential equivalent to 2.4 volts per cell. Record the charge rate in amperes at 10 minutes. This rate in amperes shall be the charge rate acceptance. The batteries shall meet the requirements of 3.5.3.5. Continue charging for a total of 4.0 ± 0.1 hours.

e. Remove the battery from the temperature chamber and allow to stand OCV for a minimum of 20 hours.

f. Discharge the battery at 25 ± 0.1 amperes to terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge. The battery shall meet the requirements of 3.5.3.5.

4.7.7 Retention of charge.

a. Charge the battery as specified in 4.6.3.

b. Store the battery for 30 days on open circuit at 105 ± 2°F.

c. At the end of the 30-day stand and without recharging, discharge the battery at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell.

d. Record the discharge time in minutes to the end of the discharge to determine conformance to 3.5.3.6.

4.7.8 Life cycle. To determine conformance to 3.5.3.7, the life cycle test shall be conducted as follows.

a. Charge the battery in accordance with 4.6.5.

b. Allow the battery to stabilize at room ambient temperature.

c. Discharge the battery at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge.

d. Charge the battery in accordance with 4.6.3.

e. Discharge the battery at one-half of the 0°F CCA rating for 30 seconds.

f. Charge the battery at a voltage equivalent to 2.40 volts per cell for 14.5 minutes.

g. Rest on OCV for 15 minutes.

h. Repeat steps (e) through (g) 599 additional times.

i. Recharge the battery in accordance with paragraph 4.6.5.

j. Discharge the battery at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge.

k. Charge the battery in accordance with 4.6.3.

l. Rest on OCV for a minimum of 4 hours.

m. Repeat steps (e) through (l) until the reserve capacity obtained in step (j) is less than 90 percent of the battery rating listed in the applicable specification sheet or until the battery voltage during step (e) decreases to less than 1.2 volts per cell during the 30-second discharge. Batteries shall meet the requirement of paragraph 3.5.3.7.

4.7.9 Deep discharge recoverability.

a. Discharge the battery at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge.

b. Connect a 1.0 ohm resistive load across the battery terminals for a period of 7 days at ambient temperature.

c. Remove the resistive load. Immediately charge the battery at a terminal voltage equivalent to 2.40 volts per cell for 24 hours.

d. Discharge the battery at 25 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge to determine compliance with 3.5.3.8.

e. Repeat steps (c) and (d) if the battery did not develop the required capacity in step (d).

f. Repeat steps (c) and (d) if the battery did not comply with 3.5.3.8 in step (e).

4.7.10 Short circuit survivability.

a. Charge the battery in accordance with 4.6.3.

b. Place the battery within the confines of an environmental chamber or some other enclosure which will reduce the danger which could result from an exploding battery.

c. Prepare a test circuit of total resistance of 1.5 ± 0.1 milliohms per cell as measured at room ambient temperature. The circuit should contain the appropriate mating connections, cabling, a knife switch, current shunt, and ammeter. The equipment utilized in the test circuit should be of sufficient wattage to survive currents that may exceed 2000 amperes.

d. Connect the test circuit to the battery. Measure and record terminal voltage and current for 60 seconds. Disconnect the circuit after 60 seconds. *CAUTION* the operator should take precautions when activating test circuit by using a knife switch because arcing may occur. Furthermore, operator should stand clear of chamber door and windows when connecting the circuit because the battery may explode.

e. Remove the battery from the enclosure and examine for compliance with 3.5.3.9. Allow the battery to stand OCV for a minimum of 6 hours.

f. Charge the battery in accordance with 4.6.3.

g. Discharge the battery at 25.0 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge to determine conformance to the electrical requirement stated in 3.5.3.9.

4.7.11 Battery gas emission.

a. Charge the battery in accordance with 4.6.3.

b. Place the battery into a temperature-altitude chamber that has an internal volume of 15 ± 1.0 cubic feet and a 0.5 ± 0.0225 inch orifice in the chamber wall. The distance between the chamber inside wall and the outside air shall be not greater than 7.8 inches. The battery shall not be located in a recessed area or isolated from the orifice by a partition wall. The chamber temperature shall be 131 ± 2°F.

c. Stabilize battery at 131 ± 2°F, then turn the chamber heaters and coolers off but keep the chamber fan energized.

d. By the means of an orifice tube in the side of the chamber, remove two 1-cubic centimeter air samples from random locations within the chamber with a gas-tight syringe.

e. Charge the battery at a constant potential of 2.66 volts per cell for 1 hour.

f. Repeat step d, then remove the battery from the chamber.

g. Inject each air sample into a Perkin Elmer Sigma 3B gas chromatograph (or equivalent) to detect the percentage of hydrogen. The battery shall meet the requirement of 3.5.3.10.

4.7.12 Electrical breakdown. The battery container shall be filled with lead or aluminum shot or fitted with a close-fitting mandrel or other electrode to within 0.5 inch of the top of the lowest point on the sides, ends, or partitions of the containers. Apply an alternating current potential of 100 volts rms per millimeter of thickness for 15 seconds after reaching full calculated voltage. Voltage shall be supplied by a transformer of not less than 0.5 kilovoltampere capacity. Use the electrodes in a manner that will subject each outer wall and inner partition of the container to the electrode potential. Examine the containers for leaks, imperfections, or other evidence of perforation or burn-through to determine conformance to 3.5.5.1.1.

4.7.13 Acid resistance. Conduct the acid resistance test as specified in ASTM Standard D639-72 to determine conformance to 3.5.5.1.2.

4.7.14 Impact resistance (nonmetallic battery container). An undamaged nonmetallic container shall be permitted to rest not less than 24 hours after manufacture. Before testing, condition the container for 4 hours at each test temperature. Conduct the test at 80 ± 2°F, 0 ± 2°F, and -40 ± 2°F. Determine impact resistance by using a 2 ± 0.5-pound solid steel ball as a free-falling weight. The height of the drop necessary to crack the container on the inside, opposite the point of impact, is the impact value for that section. Find the impact resistance by dropping the weight at the height necessary to produce the minimum impact resistance requirement for the test temperature (see 3.5.5.1.3). The weight shall hit the container only once for each drop. During the test, place the container on a flat steel plate approximately an inch longer and wider than the container. Position the container in such a manner that the ball will strike one-third down from the top of the container and near the centerline of the sides. The container shall meet the requirements of 3.5.5.1.3.

4.7.15 Bulge test. Conduct the bulge test as specified in ASTM Standard D639-72 to determine conformance to 3.5.5.1.4.

4.7.16 Terminal post torque resistance. To determine conformance to 3.5.5.2, apply to each terminal post an increasing torque up to 250 inch-pounds in a direction perpendicular to the axis of the terminal posts and parallel to the top of the battery. Use a torque-indicating wrench or other torque indicating device to apply the force through a fitted battery terminal or other clamping device.

4.7.17 Handles. When provided, subject both battery handles simultaneously to a tension load equal to 1.5 times the battery weight. Apply the tension in the vertical, upward direction. Examine the battery for compliance with the requirements of 3.5.5.3.

4.7.18 Vibration.

a. Charge the battery in accordance with 4.6.3.

b. Mount the battery in the upright position (vertical axis) onto the vibration machine using a hold-down frame similar to that which is used in support equipment.

c. While at an ambient air temperature of 75 ± 5°F, vibrate the battery for 4 hours at a frequency of 2000 to 2100 cycles per minute (33-35 Hz) through an amplitude of 0.045 to 0.050 inch (total excursion of 0.090 to 0.100 inch double amplitude).

d. During the test the battery shall be subjected to a discharge current equivalent to 1/100 of the 0°F CCA rating as listed in the applicable specification sheet. Battery voltage and current shall be monitored and recorded throughout the vibration test.

e. Following vibration, remove the battery from the vibrator and visually examine for evidence of physical or mechanical damage. Charge the battery in accordance with 4.6.3.

f. Subject the battery to the 0°F Cold cranking performance test per 4.7.5. Battery shall comply with the specified requirements for this test.

g. If physical or mechanical damage is detected during the visual examination or if the battery does not meet the specified requirements during the post vibration electrical testing, disassembly inspection shall be performed. During disassembly, battery shall be examined for any damage which occurred as a result of the vibration test.

h. The battery shall comply to the requirements of 3.5.5.4.

4.7.19 Salt fog.

a. Fully charge the battery in accordance with 4.6.3.

b. Subject the battery to the salt fog test of MIL-STD-810, method 509.1, procedure I.

c. Remove the battery from the salt fog chamber. Inspect the battery for compliance with 3.5.4.

d. Open circuit battery for 1 to 16 hours.

e. Discharge the battery at 25.0 ± 0.1 amperes to a terminal voltage equivalent to 1.75 volts per cell. Record the discharge time in minutes to the end of the discharge.

f. The battery shall meet the requirements of 3.5.5.5.

4.7.20 Special tests. Batteries shall be subjected to any special tests called out on the specification sheet.

5. PACKAGING

5.1 Preservation, packaging, and packing. Preservation , packaging and packing shall be as specified in the contract (see 6.2).

5.1.1 Preservation, packaging, and packing of test samples. Preservation, packaging, and packing of qualification and group C samples shall be representative of the preservation, packaging, and packing afforded production batteries.

5.2 Marking. In addition to any special marking required herein (see 3.5.2.2) or by the contract or order (see 6.2), interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. Marking on the shipping containers containing batteries shall include on two faces the words "UP" and "HANDLE WITH CARE" and shall also be marked with the word "FRAGILE".

6. NOTES

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

6.1 Intended use. Batteries covered by this specification are intended primarily for starting, lighting, and ignition service in support equipment. See NAVSO P-3676, Navy Primary and Secondary Batteries: Design and Manufacturing Guidelines, for additional information on lead-acid batteries.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2).

c. Applicable detail specification number, title, and data.

d. Applicable detail specification part number.

e. Number of batteries required.

f. Level of packaging and packing required.

g. Responsibility for inspection, if other than specified (Section 4).

h. Special preparation for delivery requirement, if applicable (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 inspection by the Government will be adjusted to make maximum use of the contractor's quality control system and quality history of the product.

6.4 Provisions for qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the applicable Qualified Products List 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 will be conducted as First Article or Preproduction tests with the prior approval of the qualifying activity. The attention of the contractor is called to these requirements 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 Crane Division, Naval Surface Warfare Center (Code 6092), Crane, Indiana 47522-5001.

6.4.1 Conformance to qualified sample. It is understood that batteries supplied under contract are identical in every respect to the qualification sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample will constitute cause for rejection of the production lot and warrant removal from the Qualified Products List..

6.5 Storage. Nickel-cadmium batteries must not be stored in the same area as lead-acid batteries. The components of the two types of batteries will react violently in case of fire or puncture.

6.6 Disposal. End users will comply with federal, state, and local regulations for disposal of used lead-acid batteries. Such items should be sent to the end user's local Defense Reutilization and Marketing Office, which will dispose of the items via contracts for recycling or other means.

6.7 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.8 Group C costs. Unless otherwise specified in the contract, the cost of Government testing will be borne by the Government for Defense Logistics Agency procurements and by the contractor for single service procurements. An estimate of the cost for Government testing for single service procurements, for use by a contractor at time of preparation of bids, may be obtained from the Crane Division, Naval Surface Warfare Center, Electronics Development Directorate, Electrochemical Power Systems Department, Code 6092, Crane, IN 47522-5060.

6.9 Part or identifying number (PIN). The PIN for batteries acquired to this specification is created as follows: M18013/X-Y with "M18013" representing the specification number, "X" signifying the specification sheet number, and "Y" indicating any variation of the battery on a particular specification sheet.

6.10 Subject term (key word) listing.

Battery, rechargeable
Capacity
Charging
Cold cranking amperes
Connector
Container
Cover
Discharging
Electrolyte
Lead
Lead acid
Maintenance-free
Qualified Products List
Recovered materials
Reserve capacity
Seal
Sulfuric acid
Support equipment

Systems, electrochemical
Terminal
Tests, electrical
Tests, environmental
Valve-regulated
Vent

6.11 International standardization. Certain provisions of this specification are the subject of international standardization agreement (ASCC AIR STANDARD 12/15 and STANAG 3514). When amendment, revision, or cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices to change the agreement or make other appropriate accommodations.

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

Custodians:
Navy - AS
Air Force - 80

Review Activities:
Air Force - 20
Army - AV

Preparing Activity:
Navy - AS

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