INCH-POUND

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PERFORMANCE SPECIFICATION

BATTERIES, NON-RECHARGEABLE, HIGH PERFORMANCE

This specification is approved for use within Army Communications-Electronics Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers non-rechargeable batteries of the non-reserve type composed of electrochemical cells (see 6.1).

1.2 Classification.

1.2.1 Type designation. The type designation of non-rechargeable batteries should be in the following form (see applicable specification sheet). For example:

BA-	5590	A	/U
Component	Battery Type number	Version	Installation indicator
(1.2.1.1)	(1.2.1.2)	(1.2.1.2.1)	(1.2.1.3)

1.2.1.1 Component. Non-rechargeable batteries are identified by the two-letter symbol "BA" followed by a hyphen.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Communications Electronics Command, ATTN: AMSEL-LC-LEO-E-EP, Fort Monmouth, New Jersey 07703, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6135

1.2.1.2 Battery type number. The battery type number identifies the basic design of the battery (see 3.1) and consists of a four digit number.

1.2.1.2.1 Version. When required by the procurement documentation, this letter designation is used to identify some slight modification (i.e., package quantity, additional features, etc.) that does not affect the basic form, fit, or function.

1.2.1.3 Installation indicator. The installation indicator identifies equipment the battery is used in, i.e., /PRC-25 or if "universal", i.e., /U indicates use in various equipment.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

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

(See Supplement 1 for list of associated specifications sheets.)

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

2.2.2 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 specificd, the issues are those cited in the solicitation.

Drawings

SM-D-687888 Connector, Battery, Miniature, Pin Contact, Receptacle fro Electronic Case (Flange Mount)

(Copies of this drawing are available from Commander, Communications Electronics Command, ATTN: AMSEL-LC-P-PST, Fort Monmouth, NJ 07703.)

2.3 Non-Government publications. The following document(s) 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.

UL-1642 Standard for Safety, Lithium Batteries

UL 94, Standard for Safety, Test for Flammability of Plastic Materials for Parts in Devices and Appliances

(Applications for copies should be addressed to the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.)

2.4 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein except for specification sheets, the text of this specification takes precedence. Nothing in this specification, 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 sheets. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.4.

3.3 Materials.

3.3.1 Metals. All metals which do not enter into the basic electrochemical reaction of the cell shall resist, or be treated to resist, corrosion. Protection of metals from corrosion shall be certified.

3.3.1.1 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis shall be provided. When applicable, certification shall be provided.

3.3.2 Compounds - flow or shrinking. When tested as specified in 4.7.14 the insulating, impregnating, potting and sealing compounds shall not flow at high temperature, nor crack or draw away from the sides of a container at low temperature. Any compound used shall be non-flammable and non-toxic. The non-flammable and non-toxic nature of all compounds used shall be certified. Compounds shall not inhibit the operation of any safety features (see 3.4.4.1.and 4.7.10.1).

3.3.2.1 Electrical connection wires and tabs. All electrical connecting wires and tabs for the cells and the battery shall be covered by an insulation with the following characteristics:

Softening temperature: 302°F (150°C) minimum
Lengthwise shrinkage: 3% maximum after application
Thickness: 0.005 inch minimum

The material shall be non-flammable and non-toxic. Certification is required.

3.4 Design and construction. Batteries shall be of the design, construction, physical dimensions, weight, and polarity as specified in the applicable specification sheet. Batteries shall not be constructed using parallel arrangements of cells.

3.4.1 Intercell connections. Intercell connections shall be connected in accordance with the contractor's established procedures. These procedures shall insure that intercell conductors are insulated to prevent or preclude short circuiting within a multi cell battery. Certification is required.

3.4.2 Shelf life. The manufacturer shall certify that the battery is capable of delivering 85 percent of the minimum capacity (see the applicable specification sheet) after 60 months of casual storage.

3.4.3 Insulation resistance (battery terminals and cell series string). Terminals shall be as specified on the applicable specification sheet and insulation resistance of completed batteries and cell series strings shall be not less than 25 megohms when tested as specified in 4.7.8.

3.4.4 Safety Features

3.4.4.1 Containers. Cell containers shall be capable of releasing excess pressure due to heating (in excess of 205°F) or short circuits to prevent explosions and expulsion of cell components. The pressure required to test shall be determined by the contractor using internal cell pressure equivalents between 205°F and 300°F (use of limits within these extremes is permitted). The pressure limits so determined shall be included in the First Article Test Plan along with the calculations used for them. When tested per 4.7.10.1, cell containers shall remain closed at the lower pressure value and shall open only as designed at the higher pressure determined.

3.4.4.2 Cells. Cells shall not burn, emit flame, or explode due to excessive heating, short circuit, or other conditions. This shall be verified when tested per 4.7.10.2, 4.7.10.3, 4.7.10.4 or 4.7.10.5.

3.4.4.3 Overload Protection. When specified (see applicable specification sheet) each battery shall be protected from overload conditions to prevent leakage, bulging, venting, ruptures, or burning of any cell within the battery when subjected to a direct short (see 4.7.10.3). Each

battery shall be protected from bulging, venting, ruptures, leakage, or burning when subjected to the overload discharge rate specified in its applicable specification sheet (see 4.7.10.4). When tested per 4.7.10.4, each battery shall be capable of maintaining the load for a minimum of 10 seconds and shall not leak, vent, bulge, rupture or burn.

3.4.4.4 Abuse Protection. Batteries shall not vent, rupture, burn, leak or bulge when subjected to heat, intermittent discharge, and environmental stress. When subjected to the test in 4.7.10.5: batteries shall not fall below the cut-off voltage, after the initial voltage delay, during the abuse testing predischarge; batteries shall meet the visual and mechanical criteria of Categories 002, 101, and 102 of Table V and the battery voltage requirements of 3.5.1 after heat exposure and after vibration testing; Batteries shall complete a minimum of 30 minutes on the pulse discharge test above cut-off voltage and shall complete the pulse discharge test without experiencing open circuits from any safety devices that may be used before reaching the specified cut-off voltage (see applicable specification sheet).

3.4.5 High temperature protection. When specified in the applicable specification sheet, each battery shall be protected from overtemperature conditions that could result in burning, venting, ruptures, leakage, or bulging of any cell within the battery. This protection will prevent fires, vents, ruptures, leaks, and bulges due to self-heating during discharge. When tested as specified in 4.7.10.4.1, batteries shall not leak, bulge, vent, rupture, or burn.

3.4.5.1 Charge protection. Unless otherwise specified (see applicable specification sheet), each battery or each leg in a multi-section battery shall contain protection that prevents reverse currents in excess of 2.0 milliamperes (see 4.7.10.6).

3.4.5.2 Complete discharge device. Unless otherwise specified (see applicable specification sheet), each battery shall be equipped with a device capable of rendering the battery nonreactive after use so that it will qualify as Non Hazardous Solid Waste for disposal purposes in accordance with Resource Conservation and Recovery Act (RCRA) regulations. The device shall consist of, as a minimum, a load that can discharge the battery within 5 days and an actuator for connecting the load with the cells inside the battery. The device shall provide a visual means for determining the status of the actuator and shall be protected from inadvertent activation. The circuit for the device shall bypass all nonresetable cut-outs and fuses within the battery. When tested per 4.7.10.7, no battery shall have a voltage in excess of 1 volt per cell or 4 volts per section, whichever is less, at the end of the five day storage period. No cell within the batteries shall vent, rupture, leak, bulge, or burn during or after complete discharge.

3.4.6 State of charge. The battery shall contain a state of charge indicator, when specified (see applicable specification sheet). The state of charge indicator shall indicate the highest state of charge when tested prior to capacity testing. During testing per 4.7.17, the indications shall indicate the correct state of charge corresponding to the level of discharge at each stage of the test. After discharge, the indicator shall indicate the lowest level of indication. If any battery fails any one reading, the batteries have failed the test. As a minimum, the state of charge shall be displayed as three distinct ranges of remaining capacity in the battery (see 4.7.17).

Incorporation of more ranges beyond these three is permitted. The minimum three ranges shall be:

1) less than 40 percent
2) 40 to 70 percent
3) greater than 70 percent

3.4.6.1 State of charge indicator. When specified (see applicable specification sheet), the location of the State of Charge Indicator (SOCI) shall be determined by the contractor and shall be uniform throughout contract performance. A label or equivalent that clearly indicates the method for interpreting the SOCI shall be located on the same face of the battery as the SOCI.

3.4.7 Battery enclosure. Battery enclosures shall be built with plastic materials classified HB per UL Standard 94, Test for Flammability of Plastic Materials for Parts in Devices and Appliances, except as otherwise noted herein. The government reserves the right to require verification tests to ensure nonflammable battery enclosures. If the contractor elects to use a material that doesn't have HB classification, then the test of 4.7.11 shall be performed. Enclosure material used shall be non-metallic. When tested per 4.7.11, the test specimen shall self-extinguish within 5 seconds after removal from the flame.

3.4.7.1 Color of enclosures. The plastic sections of the enclosure for each battery shall be uniform in color. The color of exposed surfaces of enclosures shall be lusterless green. Examples of lusterless greens may be found in 6.5. The lusterless green chosen for each battery type on contract shall be identified either in the First Article Test Report (when required by the contract) or in writing to the contracting officer at least thirty days prior to the first delivery.

3.4.8 Connectors. When specified (BA-X599/U, BA-X590/U, and BA-X557/U), connectors shall be as specified on the applicable specification sheet. Location of the connectors shall be verified as specified in 4.7.15. When connected to mating connector SM-D-687888, insertion force shall not exceed 10 pounds and removal force shall be not less than 1.25 pounds. Continuity through the mating connector shall be demonstrated per 4.7.15. Only sockets which are electrically connected shall require electrical contacts. Certifications regarding the connector are required when specified in the applicable specification sheet.

3.4.8.1 Socket strength (BA-X598/U only). After the batteries have been tested as specified in the applicable specification sheet, they shall meet the open-circuit voltage and visual and mechanical requirements (see 3.5.1and Table V).

3.5 Battery voltages.

3.5.1 Battery open-circuit voltage. The open-circuit voltage shall not exceed the maximum voltage specified (see applicable specification sheet and 4.7.2.1).

3.5.2 Battery closed-circuit voltage. The closed-circuit voltage shall be not less than the cut-off voltage specified within 10 seconds under the load specified (see applicable specification sheet and 4.7.2.2).

3.5.3 Cell closed-circuit voltage. When cells are tested as specified in 4.7.12, the voltage shall be above the minimum value specified within 5 seconds (see applicable specification sheet)

3.5.4 Cell series string voltage. When cell series strings are tested as specified in 4.7.12.1, cell series strings shall rise to the cut-off voltage specified for completed batteries in 10 seconds or less (see applicable specification sheet).

3.6 Capacity. When the battery is tested for capacity as specified in 4.7.9 the time required to reach its specified cut-off voltage shall not be less than the minimum capacity requirement specified (see applicable specification sheet). If a voltage delay occurs when the battery is tested for capacity as specified in 4.7.9, the calculated time will start when the battery reaches the voltage specified under “Initial voltage delay” (see applicable specification sheet). The calculated time will end when the battery reaches its cut-off voltage. A failure shall be defined as below:

a. The battery voltage or the voltage of any one section falls below the specified cut-off voltage prior to exceeding the capacity requirement for the specific test (see applicable specification sheet).

b. Any battery on test experiences an open circuit condition prior to completion of any capacity test as specified (see 4.7.9.1.2 through 4.7.9.1.8).

c. Excessive initial voltage delay (see 3.6.1 below).

d. Battery exceeds dimensional tolerances after discharge.

e. Battery bulges, vents, leaks, burns or ruptures at any time during storage or discharge, or after completion of testing.

f. SOCI fails to indicate lowest level of indication after completion of discharge.

3.6.1 Initial voltage delay. When the battery is tested for capacity, the time required at the beginning of discharge for the battery or its sections to meet the specified initial voltage delay value after the load is applied shall be not more than the time specified (see applicable specification sheet and 4.7.9.1.1).

3.7 Cell leakage. Unless otherwise specified (see applicable specification sheet), no cell shall exhibit visual signs of leakage on the seventh day of the test required by 4.7.13. Additionally, no cell shall have a leakage amount that exceeds 0.005% of the total fill weight in the cell upon completion of the test specified in 4.7.13.

3.7.1 Cell forced discharge. After the cells have been tested as specified in 4.7.16, there shall be no leaking, venting, fire, or explosion.

3.8 Vibration. After the batteries have been tested as specified in 4.7.6 they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

3.9 Mechanical shock. After the batteries have been tested as specified in 4.7.5 they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

3.10 Drop test. After the batteries have been tested at each temperature as specified in 4.7.3, they shall meet the battery voltage requirements (see 3.5.1). Batteries shall be visually examined before and after each drop; no cells shall be visible with a multi-cell battery and there shall be no gap along glued or welded seams. Following the battery drop test, battery envelope dimensions (height, width, and length or diameter as applicable) shall be examined by gauging or measuring and the socket/terminals/connector shall have remained within the limits specified (see applicable specification sheet).

3.11 Altitude. After the batteries have been tested as specified in 4.7.7, they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

3.12 Labeling and marking. All labeling and marking shall be clear and legible throughout all the tests specified herein. Labeling and marking shall be black. Where the labeling and marking engraved or die stamped, the text may be the same color as background.

3.12.1 Labels. Each battery shall have a label as specified in the applicable specification sheet. As a minimum, the following information shall be on the label:

BATTERY, NON-RECHARGEABLE, (Chemistry)
Type Designation
(Contract Number)
(Date Code)
Manufacturer's name or Trade name
Manufacturer's location

DO NOT CHARGE, SHORT CIRCUIT, INCINERATE, OR MUTILATE THIS BATTERY OTHERWISE BATTERY MAY VENT OR RUPTURE RELEASING TOXIC MATERIALS

EXAMPLE:

BATTERY, NON-RECHARGEABLE, LITHIUM SULFUR DIOXIDE
BA-5590/U
DAAB05-95-C-1234
0300B
James E. Doe Company
Bruntherman, N.J.

DO NOT CHARGE, SHORT CIRCUIT, INCINERATE OR MUTILATE THIS BATTERY
OTHERWISE BATTERY MAY VENT OR RUPTURE RELEASING TOXIC MATERIALS

NOTE: The code may be placed on the bottom of single-cell batteries.

3.12.1.1 Date Code. The date code shown shall indicate the month, year and week of manufacture of the battery by means of a four-digit number. This shall be followed by a single letter. The first two digits shall indicate the number of the month. The last two digits shall indicate the year. Months earlier than the tenth month shall be a single digit preceded by "0". The letter shall represent the week of the month. The letter "A" shall be used for the first week of the month, "B" for the second week of the month, etc. Sunday shall be considered the first day of a week. Actual date and printed date cannot be more than two days apart.

EXAMPLES:

A battery manufactured during the second week of March 2000 will bear the code "0300B".

A battery manufactured during the third week of November 2002 will bear the code "1102C".

3.12.2 Terminal marking. On batteries having socket-type or connector terminals, all markings shall be as described in the applicable specification sheet and shall appear on the face of the battery bearing the socket or connector. On other type terminals, the terminal markings may appear on the surface with the terminal or the side of the battery, or both. Markings shall indicate clearly the terminals to which they refer.

3.12.3 Complete discharge device label. Unless otherwise specified (see applicable specification sheet), each battery shall have a label affixed to it that provides the actuation procedures for the complete discharge device andany precautions needed to assure both safe and complete actuation. It shall begin with the following:

WARNING
DISCHARGE FOR DISPOSAL
BY DESIGNATED PERSONNEL ONLY

3.13 Cell water content. Water content inside a cell shall not exceed 800 parts per million by weight. The contractor shall certify that this limit is not exceeded throughout production.

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

3.15 Humidity. After the batteries have been tested as specified in 4.7.18, they shall meet the visual and mechanical and battery voltage requirements (see table V and 3.5.1).

4. VERIFICATION

4.1. Test equipment and inspection facilities. Test and measuring equipment and inspection facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required examinations and tests. Unless otherwise specified herein, all examinations and tests shall be performed under the conditions specified in paragraph 4.3 below. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment is required. Calibration standards shall be traceable to the National Institute of Standards Technology (NIST).

4.1.1 Instrument accuracy.

4.1.1.1 Voltmeters and ammeters. All voltmeters and ammeters used in testing the batteries shall be accurate within 1 percent of the full scale value. The sensitivity of voltmeters shall be not less than 10,000 ohms per volt.

4.1.1.2 Resistor tolerance. During all tests involving discharge through a resistance, such resistance shall be accurate within the following percentages:

	Percent
Up to and including 1 megohm	±1.0
Above 1 megohm	±5.0

In determining the resistance used as a test load, the resistance of all continuously operating voltmeters shall be considered as part of the specified load.

4.1.1.3 Power supplies. Power supplies used for discharges specified herein shall be accurate within ±1 percent.

4.1.1.4 Timing. Timing equipment shall be accurate within 0.1 percent when the measured time is greater than 120 seconds. Otherwise, the accuracy shall be 0.5 percent or better.

4.2 Classification of inspection. The examination and testing of batteries shall be classified as follows:

a. First article inspection (see 4.4).

b. Quality conformance inspection (see 4.5).

c. Periodic (annual) inspection (see 4.6).

4.3 Inspection conditions. Except as otherwise specified herein, all examinations and tests shall be performed at a temperature of 80 ±20°F and ambient humidity and atmospheric pressure conditions.

TABLE I - Cell/Component Level Tests and Certifications.

Inspection	Requirement Paragraph	Test Method Paragraph	Sampling Size
Cell, closed circuit voltage	3.5.3	4.7.12	4.4.1.1
Cell leakage	3.7	4.7.13	4.4.1.1
Cell forced discharge	3.7.1	4.7.16	4.4.1.1
Compounds, flow and shrinking	3.3.2	4.7.14	4.7.14
Cell series string insulation resistance	3.4.3	4.7.8	4.4.1.1
Cell series string voltage	3.5.4	4.7.12.1	4.4.1.1
Cell short circuit	3.4.4.2	4.7.10.2	5
Container pressure	3.4.4.1	4.7.10.1	5 containers
Battery Enclosure	3.4.7	4.7.11	Certification or 5 sample enclosures
Cell water content	3.13		Certification
Electrical terminals (BA-X800/U only)	MIL-PRF-49471/11		Certification
Electrical connection wire and tabs	3.3.2.1		Certification
Metals (corrosion protection)	3.3.1, 3.3.1.1		Certification
Compounds (non-flammable, non-toxic)	3.3.2		Certification
Intercell connections	3.4.1		Certification

4.4 First article inspection. First article inspection (when required) shall be performed by the contractor. First article inspection shall be performed on sample units which have been produced with equipment and procedures normally used in production.

4.4.1 Sampling size. The number of batteries required for first article inspections and test shall be in accordance with Table I and II.

4.4.1.1 Cell level sample size. The total number of cells for these tests shall be equal to 4 times the number of cells in a battery (“c”) plus 5 (4c + 5 = x). Use the quantity of 2 cells (c=2) for single cell batteries and test as a series string of two cells. All cells shall be subject to the closed circuit voltage test and the electrolyte leakage test. A quantity of 2c of the cells shall be used to perform the cell forced discharge test on two separate cell strings per 4.7.16. A quantity of 2c cells shall be separated into two equal groups and assembled into cell strings in the same manner employed for production units. Each cell string shall then be subjected to the cell series string insulation resistance and cell series string voltage tests. Cell strings passing this test may then be used in production. The remaining 5 cells shall be subjected to the safety feature test of 4.7.10.2.

4.4.2 Inspection routine. First article inspection shall consist of all the examinations and tests in accordance with Tables I and II. These tests shall be conducted in the order specified for each group. Two sample batteries, untested, are to remain at the contractor's plant and will be available as a standard for comparative purposes. One sample shall be a complete battery; the other shall be open to show the battery assembly. The open sample need not contain active materials.

4.4.2.1 Failure. If one or more sample cells, components, or batteries fail to meet any of the first article requirements and tests, the contractor shall immediately notify the Government of the failure. The contractor shall determine the root cause of the failure and take appropriate corrective action. Once corrective action is taken, the contractor will retest to the extent determined necessary by the government. A description of the failure(s) and corrective action(s) taken shall be included in the first article inspection reports.

TABLE II - First-article inspection and certifications.

Group	No. of Batteries	Examination or Test	Requirement Paragraph	Method or Test Paragraph
I	See 4.4.1.1	Cell/component level tests	Table I	
II	40	Visual-mechanical	3.1	4.7.1
		Battery voltage	3.5	4.7.2
		Battery Insulation Resistance	3.4.3	4.7.8
		Charge protection	3.4.5.1	4.7.10.6
		Dimensions and weight	3.4	4.7.4
		Altitude	3.11	4.7.7
		Vibration	3.8	4.7.6
		Shock	3.9	4.7.5
		Drop	3.10	4.7.3
		Negative terminal insulation (when specified)	3.1 (BA-X567/U only)	MIL-PRF-49471/4
		Positive terminal (when specified)	3.1 (BA-X372/U only)	MIL-PRF-49471/9
IIA	10	"I (and IP 1/)" test	3.6	4.7.9.1.2
IIB	10	"L (and LP 1/)" test	3.6	4.7.9.1.3
IIC	10	"H (and HP 1/)" test	3.6	4.7.9.1.4
IIA/B	20	Watertight integrity test	3.1 (BA-X112/U only)	MIL-PRF-49471/10
IID	10	State of charge	3.4.6	4.7.17
III	60 3/	Visual-mechanical	3.1	4.7.1
	20	Abuse test	3.4.4.4	4.7.10.5
	10	"HT (and HTP 1/)" test	3.6	4.7.9.1.6
	10	"LT (and LTP 1/)" test	3.6	4.7.9.1.5
	10	"IT (and ITP 1/)" test	3.6	4.7.9.1.7
	10	LR1 test 3/	3.6	4.7.9.1.8
IV	40 2/ 4/	Visual-mechanical	3.1	4.7.1
	35	Humidity	3.15	4.7.18
	30	Capacity (I, L, H and IP, LP, and HP 1/)	3.6	4.7.9.1.2 4.7.9.1.3 4.7.9.1.4
	5	Socket Strength (BA-X598/U only)	3.4.8.1	MIL-PRF-49471/2
		Complete discharge device (CDD)	3.4.5.2	4.7.10.7
	5	Connector (when specified)	3.4.8	4.7.15
		Battery Short Circuit	3.4.4.3	4.7.10.3
V 5/	10	Overload tests		
	5	Battery overload test	3.4.4.3	4.7.10.4
	5	Battery overload/high temperature	3.4.5	4.7.10.4.1
VI	2	Untested reference samples		4.4.2
VII	N/A	Certifications		
		Shelf life: ≥85% after 60 months	3.4.2	
		Connector	BA-X599/U, -X590/U & -X557/U	MIL-PRF-49471/1, 49471/3, & 49471/6
		Terminals	BA-X112/U	MIL-PRF-49471/10
		Color of Enclosures: Lusterless Green	3.4.7.1	

1/ When required (BA-X590/U and BA-X557/U only), half of the capacity samples shall be discharged in parallel.

2/ The five fresh batteries in this subgroup shall be combined with Humidity tested batteries, divided, and tested as follows: Three fresh batteries and two humidity tested batteries shall be subjected to the CDD test. Two fresh and three humidity tested batteries shall be subjected to the battery short circuit test.

3/ LR1 test required for all battery types except BA-X567/U and BA-X372/U. For these two battery types, Group III shall consist of 50 samples

4/ Battery short circuit test and CDD test do not apply to either the BA-X567/U or BA-X372/U. For these two types, Group IV shall consist of 30 samples, all of which will receive the Humidity test. ALSO: CDD test does not apply to BA-5368/U or BA-5374/U. For these two types, Group IV shall consist of 35 samples, all of which will receive the Humidity test.

5/ Group V not required for the BA-X567/U or BA-X372/U.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of Groups A, B and C inspection. Test equipment for government verification inspection shall be made available by the contractor, if required.

4.5.1.1 Group A inspection. Each battery on contract or purchase order shall be 100 percent inspected for conformance to the inspections in the order specified in Table III. All failures shall be removed. Discrete lots shall be formed from batteries that pass this inspection.

TABLE III - Group A inspection.

Examination or Test	Requirement Paragraph	Method or Test Paragraph
Visual-mechanical inspection	Applicable specification sheet	4.7.1
Dimensions 1/	Applicable specification sheet	4.7.4.1
Battery voltage	3.5	4.7.2

1/ Battery envelope only: Height, width, and length or diameter as applicable.

4.5.1.2 Group B inspection. Group B inspection shall consist of the tests specified in Table IV in the order shown. Sample size shall be twenty (20) randomly selected samples. Group B inspection shall be performed on sample units from each shipment lot (as defined in 6.4.2) which has been subjected to and passed group A inspection. If any battery fails any group B test, the shipment lot is rejected.

TABLE IV - Group B inspection.

Examination or Test	Requirement Paragraph	Method or Test Paragraph
Weight	Applicable specification sheet	4.7.4
Insulation resistance	3.4.3	4.7.8
Abuse Test	3.4.4.4	4.7.10.5

TABLE V - Classification of visual and mechanical examination defects.

Categories 1/	Defects
001	Improper assembly causing parts to be inoperative or unsafe in service.
002	Electrolyte leaking caused by missing or defective sealing or closure.
101	Deformed or damaged parts which are inoperative or malfunction in service.
102	Contact surfaces obstructed by insulation material so that electrical use is affected. Rust or corrosion on contact surfaces.
103	Battery enclosures - any hole, tear, or rip; any crack with dimension greater than 1/2 inch.
104	Improper jacket closure (i.e., any gap 2/ along glued or welded seams).
105	Location, orientation, polarity and marking of terminals not as specified.
106	Labeling and marking wrong, missing or illegible so that utilization is affected.
107	State of Charge Indicator: When required, SOCI is present and includes operation and interpretation markings. 3/
201	Deformed or damaged parts which do not adversely affect electrical performance.
202	Burrs or imperfections which do not interfere with proper use in operation, assembly or disassembly, or cause unsafe condition in service.
203	Improper marking which doesn't hamper utilization or identification of the battery.

1/ Category 0XX defects are critical, category 1XX are major, and category 2XX are minor. These categories are used to qualify the levels of nonconformances. Critical defects affect safety; major defects affect use; batteries with minor defects may be serviceable with qualification.

2/ A “gap” is defined as any opening along glued or welded seams that goes completely through the enclosure surface to the battery’s interior.

3/ SOCI’s that require activation prior to use shall not be operated during the Visual and Mechanical Inspections per paragraph 4.7.1.

4.5.1.3 Group C inspection. Group C inspection shall consist of (a) HT and HTP (where applicable) capacity test and (b) LT and LTP (where applicable) and (c) IT and ITP (where applicable) capacity test and (d) LR1 test (where applicable). Each capacity test shall be preceded by both the mechanical shock and vibration tests described in paragraphs 4.7.5 and 4.7.6 respectively. The 28-day storage period shall be completed before the mechanical shock and vibration tests are performed.

4.5.1.3.1 Sampling plan. Samples shall be selected at random in accordance with Table VI and shall represent a shipment lot. Sample Size A shall apply to the BA-X567/U of MIL-PRF-49471/4 and to the BA-X372/U of MIL-PRF-49471/9; Sample Size B shall apply to all other battery types covered by this specification. For Sample Size A, one third of the samples shall be used for the LT, one third for the HT, and one third for the IT. For Sample Size B, one fourth shall be used for the LT and LTP (where applicable), one fourth for the HT and HTP (where applicable), one fourth for the IT and ITP (where applicable), and one fourth for the LR1.

4.5.1.3.2 Group C failures. Accept/reject criteria of Table VI shall be used for failures described by paragraph 3.6 (a), (b), (c) and (d). No failures shall be allowed for (e) (see 3.6).

TABLE VI - Group C inspection sampling plan.

Inspection Lot Size	Sample Size A	Sample Size B	Maximum number of defects
500 or less	9	12	0
501-1,200	15	16	0
1,201-10,000	21	24	1
10,001-35,000	33	36	1
35,001 or more	51	52	2

4.6 Group D (annual inspection). Group D inspection, to be performed by the contractor, shall consist of the tests specified in table VII. These tests shall be performed with samples selected annually at a minimum of nine months and a maximum of 12 months after successful completion of first article testing and shall be repeated every 12 months thereafter until contract completion. The government shall be notified immediately if any failures occur. Any failures may result in partial or complete repetition of first article testing, at the government's discretion.

4.6.1 Break in Production. In the event that there is a break in production for a specific battery type that precludes drawing Group D samples, no Group D testing will be required. However, should production recommence under the terms of the same contract after a break for more than 4 months and less than 12 months, Group D shall be added to the Quality Conformance Inspections required for the next delivery. Breaks shall be measured from the date of last delivery to the date when production recommences. Breaks in production for 12 months or longer may require additional testing per the procurement documentation.

TABLE VII - Group D inspection.

Examination or Test	Requirement Paragraph	Test Paragraph	Sample size
Cells			
Electrolyte leakage	3.7	4.7.13	30
Cell forced discharge	3.7.1	4.7.16	2 cell strings 1/
Cell short circuit	3.4.4.2	4.7.10.2	5
Container pressure	3.4.4.1	4.7.10.1	5 Containers
Batteries			20
Humidity	3.15	4.7.18	20
I and IP capacity	3.6	4.7.9.1.2	5
L and LP capacity	3.6	4.7.9.1.3	5
H and HP capacity	3.6	4.7.9.1.4	5
Complete discharge device	3.4.5.2	4.7.10.7	5

1/ The number of cells required is 2 x number of cells in the battery. Use the quantity of 2 cells for single cell batteries. Cells that have passed the electrolyte leakage test may be used.

4.7 Test methods and examination.

4.7.1 Visual and mechanical examination. Batteries shall be examined to determine compliance with all applicable requirements and characteristics as specified herein (see 3.12 and Table V).

4.7.2 Battery voltage.

4.7.2.1 Open-circuit voltage. A direct current voltmeter of appropriate range and sensitivity shall be used to measure the open-circuit voltage (see 3.5.1).

4.7.2.2 Closed-circuit voltage. A direct current voltmeter of proper range and sensitivity shall be used to measure the closed-circuit voltage utilizing the load specified (see 3.5.2). The specified load (see applicable specification sheet) shall be applied for a maximum of 10 seconds.

4.7.3 Drop test. Total samples for this test shall be divided in two with one-half subjected to -20^{o}F and one-half subjected to 130^{o}F. Each battery shall be dropped once from a height of 30 $\pm$2 inches onto a hard surface consisting of concrete. The smallest side of the battery perpendicular to the plane of the connector face and nearest to the connector (where applicable) shall be parallel to the concrete surface and facing downward upon release, but need not be parallel upon impact. In the case of cylindrical batteries, the axis of the cylinder shall be parallel to the concrete surface upon release. The drop test shall be performed on batteries preconditioned at 130^{o}F or -20^{o}F. Tolerances of $\pm$5°F shall apply throughout the storage period. The batteries shall be stabilized a minimum of 4 hours at each test temperature and dropped at the ambient conditions specified in 4.3 within 10 minutes after removal from the temperature

chamber (see 3.10). Open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 upon completion of the drop test. After each drop, battery dimensions shall be inspected and batteries shall be examined as required in 3.10.

4.7.4 Dimensions and weight. Batteries shall be examined by gauging or measuring and by weighing to determine conformance (see applicable specification sheet for specific requirements).

4.7.4.1 Dimensions. All dimensions shall include any coating which may be used, and shall remain within the specified tolerances throughout the required tests. Both minimum and maximum dimensions shall be determined. When box gauges are used, batteries, loaded with a maximum weight of five pounds, shall pass freely through the applicable gauge openings. The dimensions of the box gauge shall be the specified maximum outside dimensions of the battery. Cylindrical battery dimensions shall be checked with a ring gauge meeting the above requirements.

4.7.5 Mechanical shock. Each battery shall be secured to the testing machine by means of a rigid mount. Each battery shall be subjected to a total of two or three shocks of equal magnitude. The shocks shall be applied in each of three mutually perpendicular directions for rectangular configurations or two for cylindrical configurations. Each shock shall be applied in a direction normal to a face of the battery. The faces of the battery are identified by their position in relation to the face which bears the electrical connector. For each shock, the battery shall be accelerated in such a manner that the acceleration at the mid point between the peak and the start of the pulse shall be 75 +/- 20 gravity units. The effective duration of each pulse shall be between 3 and 6 milliseconds. Effective duration shall be measured from the point where the acceleration first reaches one third of the peak acceleration obtained and end when the acceleration passes below the one third value and stays below this value. The peak acceleration shall be a minimum of 125 G; exact value shall be recorded (see 3.9). Upon completion of the shock test open circuit voltage shall be tested for compliance (see 3.5.1) and the batteries shall be examined for the visual and mechanical defects identified in Table V (see 3.9).

4.7.6 Vibration. Each battery shall be tested in accordance with the vibration test method of UL-1642. Upon completion of the vibration test, open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 and the batteries shall be examined for the visual and mechanical defects identified in Table V (see 3.8).

4.7.7 Altitude. Batteries shall be placed in an altitude chamber, in which the pressure is maintained at a value corresponding to an altitude of 50,000 feet and the temperature is kept at 75 $\pm 5^{o}$F, for a period of six (6) hours (see 3.11). Upon completion of the altitude test, open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 and the batteries shall be examined for the visual and mechanical defects identified in Table V (see 3.11).

4.7.8 Insulation resistance (battery terminals and cell series string). Insulation resistance test shall be performed at the inspection conditions of 4.3 above. The insulation resistance shall be measured by applying a direct-current potential of 500 $\pm$20 volts between any two battery

terminals or cell series string terminations not electrically connected and between all ungrounded terminals and the container of the battery or the exterior of the cell string assembly. The insulation resistance of batteries and cell series strings shall be measured by the use of an appropriately sized copper plate making physical contact with the container or cell string assembly. The plate shall be placed with the broad surface against any areas of any surface other than that on which the battery terminals or cell series strings terminations are located (see 3.4.3).

4.7.9 Capacity (see 3.6).

4.7.9.1 Capacity tests. Sample batteries selected for capacity tests specified in the individual specification sheet shall be stored and discharged in air as applicable, in accordance with 4.7.9.2. When specified (see applicable specification sheet), the SOCI shall be checked for operation after completion of the 4-week storage period (where required) and prior to discharge at the conditions specified in 4.3. All batteries shall be discharged to the cut-off voltage specified in the applicable specification sheet; continued discharge to zero volts is necessary only when specified for a given test. The time required to fall to the specified cut-off voltage shall be used to determine the battery capacity. The time required to rise to the specified minimum initial voltage shall not be included in the capacity determination. A continuous temperature recording shall demonstrate the accuracy of the discharge temperature within the discharge chamber. Discharged batteries shall be inspected for the requirements of 3.6d, 3.6e, and 3.6f within 24 hours after completion of the discharge. Batteries shall comply with 3.6 and the applicable capacity requirements of the applicable specification sheet.

4.7.9.1.1 Initial voltage delay. At the start of the capacity discharge test, each battery shall be monitored to determine the time in seconds required for battery closed circuit voltage to rise to the minimum voltage after the specified loads are applied as specified in the individual specification sheets. The device used to monitor the voltage rise to the minimum voltage shall have a scan rate with an interval no greater than 1 second. The time required for each battery to reach the specified initial voltage delay value shall be recorded (see 3.6.1). This requirement does not apply to the LR1 test when required.

4.7.9.1.2 Capacity test I & IP (where applicable). Discharge at +70 $\pm 5^{o}$F without previous storage to zero volts. Force discharge at the conditions and rate for the time specified (see applicable specification sheet).

4.7.9.1.3 Capacity test L & LP (where applicable). Discharge at -20 $\pm 5^{o}$F to cut-off voltage after storage at -20 $\pm 5^{o}$F for a minimum of eight (8) hours.

4.7.9.1.4 Capacity test H & HP (where applicable). Discharge at +130 $\pm 5^{o}$F to cut-off voltage after storage at +130 $\pm 5^{o}$F for a minimum of eight (8) hours.

4.7.9.1.5 Capacity test LT & LTP (where applicable). Discharge at -20 $\pm 5^{o}$F to cut-off voltage after a minimum of 28 cycles of storage at the Desert Cycle conditions of Table VIII followed by a minimum of eight (8) hours at -20 $\pm 5^{o}$F. No load shall be applied during the storage at the Desert Cycle conditions of Table VIII and -20^{o}F prior to discharge test.

4.7.9.1.6 Capacity test HT & HTP (where applicable). Discharge at +130 ±5°F to cut-off voltage after a minimum of 28 cycles of storage at the Desert Cycle conditions of Table VIII followed by a minimum of eight (8) hours at +130 ±5°F. No load shall be applied during the storage at the Desert Cycle conditions of Table VIII or at 130°F prior to discharge test.

4.7.9.1.7 Capacity test IT & ITP (where applicable). Discharge at +70 ±5°F to cut-off voltage after a minimum of 28 cycles of storage at the Desert Cycle conditions of Table VIII and a minimum of eight (8) hours at +70 ±5°F. No load shall be applied during the storage at the Desert Cycle conditions of Table VIII and 70°F prior to discharge test.

4.7.9.1.8 Capacity test LR1 (where applicable). Discharge at +95±5°F after 28 cycles of storage at the Desert Cycle conditions of Table VIII followed by a minimum of 8 hours at +95±5°F. No load shall be applied during the 28 cycles or 8 hours storage periods. Loads shall be as specified in the specification sheets. Multi-sectioned batteries shall be discharged in the series mode only. Discharge shall be at the constant current rate specified to the first voltage cut-off, then at the constant wattage load specified to the second voltage cut-off (see applicable specification sheet). Capacity shall be measured from the time the battery initially reaches the cut-off voltage specified for capacity in the applicable specification sheet until it then falls to the second LR1 cut-off voltage specified.

4.7.9.2 Storage conditions. The storage conditions specified herein shall prevail during storage periods specified. A continuous temperature recording device shall demonstrate the accuracy of the storage temperature. No loads shall be applied at any time during the 4-week storage period (when specified). 50% of the batteries in storage shall be in the inverted position (compared to the other 50%). Batteries shall be inspected for leakage, bulging, venting, rupturing or burning after completing any specified storage period (see 3.6e).

4.7.9.2.1 Discharge. Following stabilization, the batteries shall be discharged at the ambient discharge conditions as specified. There shall be at least a two (2) inch separation between all batteries that are being discharged. All batteries subjected to capacity tests shall be discharged as specified in individual specification sheets. If a State of Charge Indicator is required (see applicable specification sheet), the device shall be checked at the end of each capacity test to insure that it indicates the lowest level of indication.

4.7.9.2.2 Desert Cycle. The conditions specified in Table VIII below shall be used whenever storage at Desert Cycle conditions is required by this specification. Conditions start at 95ºF and hold, ramp up or ramp down to the conditions specified in the table each hour. A tolerance of ±5°F shall be used throughout the specified storage period. Test samples may enter storage at any point in the 24-hour cycle provided they complete the requisite number of cycles. The cycle may be interrupted to allow for adding or withdrawing samples from the chamber provided the chamber is then set to resume the cycle conditions immediately after samples are added or withdrawn.

Table VIII – Desert Cycle (24 hours).

Cum Test Time	Temp °C For reference only	Temp °F	Cum Test Time	Temp °C For reference only	Temp °F
1 Hr.	35	95	13 Hrs.	69	156
2 Hrs.	34	94	14 Hrs.	70	158
3 Hrs.	34	94	15 Hrs.	71	160
4 Hrs.	33	92	16 Hrs.	70	158
5 Hrs.	33	92	17 Hrs.	67	153
6 Hrs.	33	91	18 Hrs.	63	145
7 Hrs.	36	97	19 Hrs.	55	131
8 Hrs.	40	104	20 Hrs.	48	118
9 Hrs.	44	111	21 Hrs.	41	105
10 Hrs.	51	124	22 Hrs.	39	103
11 Hrs.	56	133	23 Hrs.	37	99
12 Hrs.	63	145	24 Hrs.	35	95

4.7.10 Safety Features.

4.7.10.1 Container pressure test – Each cell container subjected to pressure testing shall be fitted with an airtight seal and have its internal pressure raised to a preset value corresponding to a minimum of 205°F (or higher if chosen see 3.4.4.1). The internal pressure shall then be raised to the level corresponding with 300°F (or lower if chosen). Containers tested shall meet the requirements of 3.4.4.1.

4.7.10.2 Cell short circuit test - Each cell subjected to short circuit testing shall be subjected to a short circuit with a minimum length of copper wire No. 16 AWG or larger gauge. Each cell under test shall be stored at 130 $\pm 5^{o}$F for a minimum of 2 hours prior to testing. Each cell shall then be shorted at the ambient conditions specified in 4.3 within 10 minutes after removal from 130 $\pm 5^{o}$F. The short circuit shall be maintained for a minimum of 30 minutes at ambient conditions regardless of the cell's reaction. After the 30 minute period, the short circuit shall be broken. Cells tested shall meet the requirements of 3.4.4.2.

4.7.10.3 Battery short circuit test. When specified (see applicable specification sheet), each battery shall be short circuited by connecting the positive and negative terminals of the battery with the minimum length required of copper wire No. 16 AWG or larger gauge. Batteries with independent multiple sections shall have each section shorted. Short circuit shall be maintained for a minimum of 30 minutes or until the battery under test experiences an open circuit condition caused by its internal protection. After testing, batteries shall be inspected for compliance to the applicable requirements of 3.4.4.2 and 3.4.4.3.

4.7.10.4 Battery overload test - When an overload discharge rate is specified in the applicable specification sheet, this test is required. Batteries shall be discharged at the overload rate specified (see applicable specification sheet). Discharge shall continue until the battery

reaches cut-off voltage, the battery experiences an open circuit, or the battery's internal circuitry limits current to less than the rate specified. Batteries with independent multiple sections shall be loaded in the series mode only. A driving power supply capable of at least 32 volts DC output shall be used to maintain the required load (see applicable specification sheet).Batteries shall meet the applicable requirements of 3.4.4.3.

4.7.10.4.1 Battery overload/high temperature test. When high temperature protection is specified in the applicable specification sheet, this test is required. Batteries shall be stored at 160±5°F for a minimum of 8 hours. Following this storage, batteries shall be loaded while at the same conditions at the overload rate specified (see applicable specification sheet). Discharge shall continue until the battery reaches cut-off voltage, the battery experiences an open circuit, or the battery's internal circuitry limits current to less than the rate specified. Batteries with independent multiple sections shall be loaded in the series mode only. A driving power supply capable of at least 32 volts DC output shall be used to maintain the required load (see applicable specification sheet).

4.7.10.5 Abuse test – Batteries shall be tested as follows:

a. Predischarge. Discharge 10 samples at the rate specified for the Abuse Test predischarge (see applicable specification sheet).
b. Heat. Store all 20 samples at 195±5°F for a minimum of 8 hours.
c. Visually inspect and perform the battery voltage inspection of 4.7.2 (see 3.5.1).
d. Vibration. Subject all 20 samples to the vibration test (see 4.7.6).
e. Visually inspect and perform the battery voltage inspection of 4.7.2 (see 3.5.1).
f. Overload. Select 5 each predischarged and 5 each undischarged samples. Subject these batteries to the Battery Overload Test (see 4.7.10.4).
g. Pulse Discharge. Select 5 each predischarged and 5 each undischarged samples. Subject these batteries to the Pulse Discharge conditions using continuous cycles of 1 minute on the heavy load followed by 4 minutes of moderate load (see applicable specification sheet for loads). Continue discharge until battery voltage drops below the specified cut-off voltage.

4.7.10.6 Charge protection. When charge protection is specified in the applicable specification sheet, this test is required. A DC power supply capable of delivering at least 2.50 milliamperes shall be used. The voltage to be used shall be 32 (+0, -1) volts, plus the open circuit voltage of the battery under test. It shall be electrically connected with low impedance contacts to the connector terminals of series connected strings of the battery to force reverse current flow (charging) through the individual cell string (i.e., positive to positive and negative to negative). This voltage shall be applied for a minimum of 1.0 second. The amount of current flowing shall not exceed the amount specified (see 3.4.5.1).

4.7.10.7 Complete discharge device. When a complete discharge device is required by the applicable specification sheet, this test is required. Operability shall be verified. Ability to discharge a fresh battery after activation of complete discharge

device shall be verified during first article inspection (see 3.4.5.2). After activation, batteries shall be discharged at the ambient conditions specified in 4.3 with a minimum of two inches of space between them for a minimum of five days. Batteries shall meet the requirements specified (see 3.4.5.2).

4.7.11 Battery enclosure. HB classification of the material used to build battery enclosures shall be certified except as noted in 3.4.7. If the material does not have HB classification, then 5 sample enclosures shall be exposed to a flame for 30 seconds. Sample enclosures may be tested alone or in a configuration similar to that of a completed battery, provided there are no active materials in the test samples. The flame used shall meet the criteria of UL 94, paragraphs 5.2, 5.6, 5.8, 7.5.3, and 7.5.4. Samples shall meet the criteria of 3.4.7.

4.7.12 Cell closed-circuit voltage. The cells shall be tested for a maximum of five (5) seconds at the rate specified or until the cell reaches the specified cell minimum voltage (see applicable specification sheet). As an alternative, any current, power, or resistive load that will exceed the current rate resulting from the specified resistive load at the specified minimum voltage (see applicable specification sheet) may be used. Any cell whose voltage is not above the minimum voltage specified within 5 seconds shall be rejected (see 3.5.3).

4.7.12.1 Cell series string voltage. Cell series strings shall be subject to the loads specified for the battery closed circuit voltages (see applicable specification sheet). Voltage values shall be detected using a voltmeter of proper range and sensitivity. Voltage shall rise to the value specified for the battery in the time specified (see 3.5.4).

4.7.13 Cell leakage. If potting substance or cell jackets are applied to the cells, they shall be applied prior to the storage portion of this test. Application of potting substances shall be at the discretion of the contractor provided the decision is uniform for all test samples. Each of the cells shall be weighed prior to and after filling with the electrolyte mixture to the nearest tenth of a milligram and the weight recorded. The cells shall then be stored for one week (7 days or cycles) at the Desert Cycle conditions specified in Table VIII. On the seventh day, the cells shall be tested to determine if leakage has occurred. The cells shall be removed from the temperature cabinet, placed in a desiccator, and cooled at room temperature for at least two hours. Each cell shall be reweighed to the nearest tenth of a milligram. The weight shall be recorded. If leakage is detected during the seventh day of storage, the sample has failed. If there are no failures, all cells shall be placed in the temperature cabinet and stored for three weeks (21 days or cycles) at the Desert Cycle conditions specified in Table VIII. At the completion of this three-week storage period, the cells shall be removed, placed in a desiccator and cooled for at least two hours at room temperature. Each cell shall be weighed to the nearest tenth of a milligram. The weight loss between day 7 and day 28 shall be recorded and used to determine compliance to 3.7.

4.7.14 Flow or shrinking (compounds) (see 3.3.2). Compounds shall be placed in a container, approximately 3 inches wide by 6 inches long by 3/4 inch high, to within 1/2 inch of the top and allowed to cure per contractor's standard procedures. The temperature of the compound within the container shall be raised to +200 $\pm 5^{o}$F and the container shall be held in an

inverted position for 24 hours. Then the compound shall be stored at -40 ±5ºF for eight hours minimum (see 3.3.2).

4.7.15 Connector. Connector location shall be verified by use of mating connector SM-D-687888 mounted on a gauge within the dimensions specified. Mating connector shall be engaged and withdrawn a total of ten times. Maximum engagement force shall be record on the first mating; withdrawal force shall be recorded on the tenth withdrawal. Maximum and minimum engagement forces shall meet the requirements of 3.4.8. Continuity through the mating connector shall be verified during the tenth engagement (see 3.4.8).

4.7.16 Cell forced discharge. A completely discharged cell (cell discharged to 2 volts) is to be forced-discharge in accordance with method 2 of the forced-discharge test of UL-1642 as modified herein. One cell for each cell string shall be discharged at the rate specified (see applicable specification sheet) to a test end voltage of 2 volts. It shall then be connected in series with the appropriate number of fresh cells which shall then be discharged at the rate specified (see applicable specification sheet) for a minimum of the amount of time equal to the I capacity requirement for the battery under test (see applicable specification sheet). For batteries normally connected with independent sections, the cell strings shall be tested in the series mode only (BA-X590/U and BA-X557/U). All cells shall comply with requirements (see 3.7.1).

4.7.17 State of charge. When specified (see applicable specification sheet), location and label (or equivalent) shall be verified (see 3.4.6.1). Five fresh batteries shall be discharged at the 10±1 hour rate to the cut-off voltage specified. If parallel discharge is specified for the battery under test, then two batteries shall be discharged in parallel and three in series configuration. Calculate the average capacity. Discharge five fresh batteries (2 parallel, 3 series, when specified) at the 10±1 hour rate to approximately the middle point of each of the indication ranges beginning with the maximum range and ending with the minimum range. Observe the indication of the state of charge indicator and record the status indication after each partial discharge. Discharge the batteries to zero volts. Observe the indication of the state of charge indicator and record the status indication. Batteries shall comply with the requirements (see 3.4.6). Samples shall be disconnected from the discharge circuit prior to observation of the indication. If the indicator requires activation, follow the instructions on the battery.

4.7.18 Humidity. Batteries shall be placed in a test chamber. The temperature of the chamber shall be raised to 149 ± 4ºF (65 ± 2ºC) and the relative humidity shall be controlled to no less than 95% over a period of 2 hours; these conditions shall be maintained for 6 hours. The temperature shall then be reduced to 86 ± 4ºF (30 ± 2ºC) in sixteen hours while maintaining a relative humidity of no less than 85%. This procedure shall be repeated for a total of 10 cycles. Upon completion of the humidity test, open circuit voltage of 4.7.2.1 shall be tested for compliance to 3.5.1 and the batteries shall be examined for the visual and mechanical defects identified in Table V.

5. PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2e). When the actual packaging of the materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging Activity.

5.2 Non-Dangerous Goods Certified Batteries. Batteries which have been certified in accordance with DOT and UN regulations as Non-Dangerous Goods need not be packaged as Dangerous goods and are exempt from these requirements. Contractors must provide signed certifications with shipping documents.

6. NOTES

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

6.1 Intended use. The primary batteries included are of the non-reserve type composed of electrochemical cells. The batteries are capable of storage and use under wide temperature ranges.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.

b. Applicable specification sheet (see Supplement 1).

c. Complete type designation (see 1.2.1).

d. Requirement for first article testing.

e. Packaging requirements.

f. Government first article test requirements (when applicable).

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

6.3 First article. When a first article inspection is required, the item(s) should be a first article sample. The first article should consist of the number of cells and batteries specified in

table II. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Solicitations should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Definitions.

6.4.1 Non-flammable and non-toxic materials. Non-flammable and non-toxic materials are those materials which will not support combustion, produce smoke, or be capable of emitting toxic fumes when subjected to the environmental conditions specified for the battery. For a full description of the specified environmental conditions, see 4.7.7, 4.7.9.1.2 thru 4.7.9.1.8, 4.7.9.2.2, 4.7.10.4, 4.7.10.4.1, 4.7.10.5, 4.7.11, and 4.7.18.

6.4.2 Shipment lot. The shipment lot is the quantity of batteries (exclusive of the number of batteries required as samples) of any one type, of any one month or less, and produced at any one place of manufacture on any one contract.

6.4.3 Contract lot. The contract lot is the total of all batteries (exclusive of the number of batteries required as samples) of any one type, delivered in one or more shipment lots, under the terms of any one contract.

6.5 Examples of lusterless green. Examples of lusterless green are 34079, 34086, 34087, 34096, 34102, 34127, and 34128 per FED-STD-595.

6.6 Subject term (key word listing).
Battery
Non-rechargeable
Non-reserve

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

Custodians:
Army - CR

Preparing Activity
Army - CR

(Project 6135-0398)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-49471B(CR)	**2. DOCUMENT DATE (YYYYMMDD)** 20001130

3. DOCUMENT TITLE Batteries, Non-Rechargeable, High Performance

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

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Communications-Electronics Command	b. TELEPHONE *Include Area Code)* (1) Commercial (732) 532-9139 (2) AUTOVON 992-9139
c. ADDRESS *(Include Zip Code)* Attn: AMSEL-LC-LEO-E-EP Fort Monmouth, NJ 07703	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman road, Suite 2533 Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888

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