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MILITARY SPECIFICATION

BATTERY, WET, NON-RECHARGEABLE, BA-472()/U

This specification is approved for use by the US Army Electronics Research and Development 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 one type of automatically activated zinc-silver oxide battery, designated as Battery, Wet, Non-Rechargeable, BA-472()/U (see 6.2).

2. APPLICABLE DOCUMENTS

2.1 Government Documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.1), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ERADCOM, ATTN: DELET-R-S, Fort Monmouth, N.J. 07703 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS

Military

MIL-C-5015	Connector, Electrical, Circular Threaded, AN Type General Specification for
MIL-M-10578	Corrosion Removing and Metal Conditioning Compound (Phosphoric-Acid Base)
MIL-M-13231	Marking of Electronic Items
MIL-F-14072	Finishes for Ground Signal Equipment

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-45662	Calibration System Requirements.

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

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

DRAWINGS

SM-D-58979	Gage to Check Maximum Length and Width BA-472/w Battery.
SM-D-165290	Battery, Wet, Primary BA-472()/U Wiring Diagram.
SC-DL-360850	Battery, Wet, Primary BA-472()/U, Drawing and Data List.

INSTRUCTIONS

SPI No. 1G0033	Special Packaging Instruction for Battery, Wet, Non-rechargeable BA-472()/U.

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

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

3. REQUIREMENTS

3.1 Description. Battery, Wet, Primary, BA-472()/U is a zinc-silver oxide battery which can be automatically activated. The battery provides on board power for missiles. The battery shall be subject to installation with heater power applied for continuous periods upward of five (5) years to provide readiness for activation and discharge as specified. The battery and its components shall perform their functions without need for repair or replacement during this period of time. The battery is provided with a heater circuit, thermostat equipped to maintain proper temperature for battery activation and discharge, and with additonal thermostats for rapid warmup from low temperature and for high temperature safety override. The battery is provided with separate circuitry to give warning of low battery temperature and improper condition of the gas generator.

3.2 First article. When specified, a sample shall be subjected to first article inspection (see 4.5 and 6.4). Batteries furnished under this specification shall be a product which has been inspected and passed the first article examinations and tests specified herein.

3.3 Materials. When a definite material is specified, it shall be in accordance with the applicable specification requirement listed in table II. When deemed necessary by the Government, certification from the source of material will be required. In the absence of certification from the source, a certificate of analysis or certified inspection data will be required (see 4.4).

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 in accordance with MIL-F-14072.

3.3.2 Dissimilar metals. When dissimilar metals which would adversely affect battery performance are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided in accordance with MIL-F-14072.

3.4 Design and construction. Battery, Wet, Non-rechargeable, BA-472()/U shall be constructed in accordance with Drawing and Data List SC-DL-360850. Any offered "or equal" item shall be subject to the approval of the contracting officer.

3.4.1 Heater.

3.4.1.1 Heater circuit resistance. The heater circuit resistance when the circuit is closed shall be 125 ohms minimum to 139 ohms maximum. The test of heater thermostat function as specified in 4.7.5.3.1 shall be performed as required.

3.4.1.2 Heater operation. The heater circuit shall (a) operate satisfactorily at any ambient temperature in the range of -65° to 165°F (-53.9° to 73.9°C), (b) be capable of maintaining the battery at proper temperature for activation and discharge in any ambient temperature from -40°F (-40°C) to the heater thermostat set point, nominally 108° to 115°F (42.2° to 46.1°C), and (c) be capable of heating the battery, stored at -40°F (-40°C) temperature without heater power for at least eight (8) hours, to operating temperature within two (2) hours with the battery remaining in -40°F (-40°C) ambient. The heater operating test (see 4.7.5.4) shall be performed for 200 hours.

3.4.2 Heater monitor. The heater monitor circuit shall be open when the battery temperature is 96°F (35.6°C) and above, and shall be closed when the battery temperature is 89°F (31.7°C) and below. The test of monitor thermostat function as specified in 4.7.5.3.1 shall be performed as required.

3.4.3 Gas generator circuit. The resistance of the gas generator circuit shall be 0.3 ohms minimum to 0.75 ohms maximum (see 4.7.3.1).

3.4.4 Battery condition indicator. Each battery shall be provided with a battery condition indicator. An open circuit indication by this indicator shall indicate an unactivated battery (see 4.7.3.1).

3.4.5 Hermetic seal. The battery shall maintain a perfect seal when subjected to conditions outlined herein except the release vent shall operate as required, i.e., it shall not open when the pressure interior to the battery cell structure is less than 0.5 lb/in^2 (3.447×10^3 pascals (Pa)) above the external ambient pressure and shall not fail to open when that pressure differential equals or exceeds 8.0 lb/in^2 (55.152×10^3Pa) (see 4.7.3.3).

3.4.6 Cleaning.

3.4.6.1 Parts. After fabrication parts shall be cleaned in accordance with good commercial practice, or as specified in the applicable document. Cleaning processes shall have no deleterious effect. Corrosive material shall be removed completely before the parts are mounted into or on the battery.

3.4.6.2 Batteries. After assembly, batteries shall be cleaned thoroughly and shall be free from particles of solder, flux, and other foreign material. In addition, when necessary, such cleaning shall also be performed before final assembly of the batteries.

3.4.7 Finish. The battery shall be finished in accordance with MIL-F-14072 and the equipment drawings (see 3.4). The battery electrical connector assembly shall meet the corrosion resistance requirements of MIL-C-5015.

3.4.8 Marking. Marking shall conform to the requirements of MIL-M-13231.

3.4.8.1 Instruction plate. The battery shall be provided with an instruction plate which contains a battery wiring diagram and the non-destructive test procedures (see 4.7.3). The instruction plate may be combined with the name plate.

3.4.9 Soldering.

3.4.9.1 Acid or acid salts. No acid or acid salts shall be used in preparation for or during soldering; but an exception is permitted for preliminary tinning of electrical connections and for tinning or soldering of mechanical joints not used to complete electrical circuits. However, in no case shall acid or acid salts be used where they can come in contact with insulation material. Where acid or acid salts are used, as permitted above, they shall be completely neutralized and removed immediately after use.

3.4.9.2 Process. There shall be no sharp points or rough surfaces resulting from insufficient heating. The solder shall feather out to a thin edge, indicating proper flowing and wetting actions, and shall not be crystallized, overheated, or under heated. The minimum necessary amount of flux and solder shall be used for electrical connections. Any means employed to remove an unavoidable excess of flux shall not incur the risk of loose particles of flux, brush bristles, or other foreign material remaining in the equipment; flux being spread over a larger area; or damage to the equipment. Insulation material that has been subjected to heating during the soldering operation shall be undamaged and parts fastened thereto shall not have become loosened.

3.4.10 Welding. Wherever practicable, welded joints, shall be such that grinding on the finished weld will be unnecessary.

3.4.10.1 Cleaning prior to welding. Surfaces to be welded shall be cleaned in accordance with good commercial practice and shall be free from rust, scale, paint, grease, and other foreign material.

3.4.10.2 Process. Preheating shall be employed where distortion is likely to result from welding. Welds shall have thorough penetration and good fusion and shall be free from scabs, blisters, abnormal pock marks, cracks, voids, slag inclusions, and other harmful defects. Where undesirable internal stresses are likely to result from welding, welded items shall be stress -relieved.

3.4.10.3 Cleaning after welding. Welded assemblies shall be cleaned to remove rust, scale, oxidation products, and excess flux by sand blasting, wire brushing, or other suitable means. Prior to painting, steel parts that have been arc welded or acetylene welded, shall be subjected to vat passivation or a phosphoric acid etch in accordance with MIL-M-10578. Acid used for cleaning shall be completely neutralized and removed.

3.4.11 Weight. The weight of the battery shall be 11.0 $\pm$ 0.5 pounds (5.0 $\pm$ 0.2 kg) (see 4.7.3.2).

3.4.12 Interchangeability. Like units and assemblies shall be physically and functionally interchangeable without modification of such items or of the equipment (see 3.4 and 4.7.4).

3.5 Electrical performance.

3.5.1 Activation. The battery shall be capable of being activated from a 6 $\pm$ 1 volt rms, 60 cycle source. The activating voltage shall be applied for a period of 100 to 250 milliseconds.

3.5.2 Rise time. The rise time for the battery shall be less than 1.0 second (see 4.7.5.5).

3.5.3 Discharge. The battery when discharged under specified conditions, shall be capable of maintaining the voltage limits for the times specified in table I. During all discharge tests, voltage and current readings shall be recorded continuously. The recording equipment shall be demonstrated to have dynamic characteristics such that traces are accurate and readable to within 3/4 of 1% of true value for voltage values over 20 volts and current values over 4 amperes (5.8 ohm load) and 10 amperes (2.2 ohm load). The time of discharge shall be accurate and readable to within 0.01 second or 1% of elapsed time, measured from start of the activation pulse to the battery. Load resistance shall be calculated from this recorded data at sufficient points, such as 0.40, 0.80, 1.00, 1.50, 5.0, 15, 60 and every 120 seconds thereafter, to establish battery performance. Immediately prior to initiation of discharge, standard reference traces shall be recorded to indicate voltage and current value limits. These reference traces shall be kept intact on the same recording paper used for the discharge test.

3.5.4 Activated life. Activated life for the battery shall be not less than the value specified in table I (see 6.5.1).

3.5.4.1 Battery structural integrity and vent operation. The battery case, or parts thereof, shall not rupture or distort and all venting shall be through the battery vent during any discharge test specified herein. Distortion shall mean inability of the battery to fit through the gage per Drawing SM-D-58979 including the 3/32 inch (2.38mm) relieved portions of opposing faces A, B, E and F or outward convexity of battery faces C and D, causing the overall battery case dimensions between faces C and D to exceed 4.30 inches (109.2 mm). (See figure 1). The measurements shall be made within 5 minutes after completion of the test discharge.

TABLE I. Capacity requirements.

Test Condition	Load (ohms)	Minimum Capacity (minutes)	Voltage limits (volts)
Low temperature - shock	2.2	13.5	26.8 to 2/
High temperature - shock	5.8	27.0	28.6 to 3/
High temperature -shock	2.2	10.9	26.8 to 2/
Low temperature - vibration	2.2	11.7	26.8 to 2/
High temperature - vibration	5.8	20.8	28.6 to 3/
High temperature - vibration	2.2	8.5	26.8 to 2/
Low temperature -acceleration	2.2	12.2	26.8 to 2/
High temperature - acceleration	5.8	24.1	28.6 to 3/
High temperature - acceleration	2.2	9.9	26.8 to 2/

1/ The load shall be a fixed resistance load (ohms) with a tolerance of ± 1 percent.

2/ 30.8 volts during the first 1.00 second after initiation of activation signal and 30.0 volts at any time after 1.00 second.

3/ 32.5 volts during the first 2.20 second after initiation of activation signal and 31.6 volts at any time after 2.20 seconds.

3.5.5 Insulation resistance. The insulation resistance of the battery shall exceed 1.0 megohm when tested as specified in 4.7.3.4.

3.6 Service conditions. The battery shall meet the following service conditions in 3.6.1 through 3.6.2.2.

3.6.1 Unactivated. The battery shall show no deleterious effects and shall remain unactivated when subjected to the following tests:

Thermal shock (see 4.7.5.1)
Low-temperature, unactivated (see 4.7.5.2)
High-temperature, unactivated (see 4.7.5.3)

In addition, the exterior of the battery shall not be affected by prolonged exposure, under casual storage, to marine and industrial environment.

3.6.2 Activated.

3.6.2.1 Low temperature. After being subjected to a -40°F (-40°C) temperature for a minimum of 8 hours, the battery shall be capable of meeting the requirements specified in 3.5 when subjected to the tests listed below. The total time from battery activation until completion of each dynamic test schedule, but not including the time required for completion of the discharge of the sample to specified minimum voltage under static environments, shall not exceed sixty (60) minutes.

Acceleration	(see 4.7.5.10)
Shock	(see 4.7.5.6)
Vibration	(see 4.7.5.8)

3.6.2.2 High temperature. After being subjected to a 165°F (73.9°C) temperature for a minimum of 8 hours, the battery shall be capable of meeting the requirements specified in 3.5 when subjected to the tests listed below. The total time from battery activation until completion of each dynamic test schedule, but not including the time required for completion of the discharge of the sample to specified minimum voltage under static environments, shall not exceed sixty (60) minutes.

Acceleration	(see 4.7.5.11)
Shock	(see 4.7.5.7)
Vibration	(see 4.7.5.9)

3.7 Workmanship. Batteries shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects, which shall adversely affect their life, serviceability, interchangeability, or appearance.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the manufacturer. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

4.1.1.1 Instrument accuracy.

4.1.1.1.1 Voltmeters and ammeters. Unless otherwise specified herein, voltmeters and ammeters used in testing the batteries shall be accurate within 1 percent of the full-scale value. The voltmeter and ammeter ranges shall be such that all readings are taken on the upper half of the scale. The sensitivity of voltmeters shall be not less than 10,000 ohms per volt.

4.1.1.1.2 Timing. Timing equipment shall be accurate within 0.5 percent, unless otherwise specified herein.

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

a. Materials inspection (see 4.4)

b. First article inspection (see 4.5)

c. Quality conformance inspection (see 4.6)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202, (see 4.7.1).

4.4 Materials inspection. Materials inspection shall consist of verification by certification from the source that the materials and treatment used in fabrication of the batteries, are in accordance with applicable requirements prior to such fabrication. In the absence of certification from the source, a certificate of analysis or certified inspection data (see 3.3) shall be required as proof of conformance to applicable requirements (see table II).

TABLE II. Materials inspection.

Material or treatment	Requirement paragraph	Applicable specification
Metals	3.3.1	MIL-F-14072
Finish	3.4.7	MIL-F-14072
Marking	3.4.8	MIL-M-13231
Corrosion resistance	3.4.7	MIL-C-5015

4.5 First article inspection. First article inspection shall be performed by the manufacturer, after award of contract and prior to the start of production, at a location acceptable to the Government. It shall be performed on fifty (50) first article samples which have been produced with equipment, processes and procedures normally used in production. First article approval is valid only on the contract under which it has been performed and granted, unless extended by the Government to other contracts (see 3.2).

4.5.1 First article inspection routine. All fifty (50) sample batteries shall be inspected in accordance with 4.4, 4.6.1.2 and 4.6.1.3. Five (5) samples shall then be assigned to each one of the ten (10) test groups set forth in 4.6.1.4.1 and 4.6.1.4.3, and table IV. The testing of each group of five (5) samples shall be performed according to the procedure and sequence stated herein for it. The five (5) samples shall be subjected to their assigned test sequence as a group. The discharge capacity results for each group shall be analyzed as specified in 4.5.2 below.

4.5.2 Analysis of first article test data. The results of each of the ten test groups of table III shall be analyzed as follows:

a. The mean capacity (average service time in minutes to end voltage 1/) shall be established for each of the ten groups.

b. The standard deviation shall be determined for each of the ten groups using the following equation:

$$S = \sqrt{\sum \frac{(X-\bar{X})^2}{N-1}}$$

Where: $\sum (X-\bar{X})^2$ = The sum of the squares of the difference between each individual capacity and the mean capacity.

N = The number of samples subjected to each group.

c. The capacity value in minutes which is equal to the mean capacity minus three standard deviations shall be determined for each of the ten test groups.

d. The first article samples shall be considered acceptable with respect to this analysis if each capacity value calculated in the manner specified above equals or exceeds the appropriate minimum capacity value shown in table I (see 3.5.3).

4.5.3 Failure. If one or more sample batteries fail to meet any of the first article requirements and inspections, or any calculated capacity value for a test group does not comply with the requirement of 4.5.2, the first article sample shall be rejected. The manufacturer shall immediately determine the cause of failure and recommend the necessary corrective action to eliminate future failures. The manufacturer at no additional cost to the Government shall be required to fabricate an additional first article sample lot and subject them to reinspection. A description of the corrective action taken shall be included in the first article inspection report.

4.5.4 Start of production. Government approval to begin production will be given only upon the successful completion of first article inspection. Any production of batteries by the contractor prior to materials inspection (see 4.4) and approval of first article inspection shall be at his own risk.

1/ End voltage is the applicable minimum voltage limit specified in table I.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of Group A, B, and C inspections. Test equipment for Government verification inspection shall be made avaialble by the contractor.

4.6.1.1 Inspection battery lot. An inspection lot shall be considered to consist of one hundred (100) batteries for purposes of production sampling and testing. All batteries in a lot shall be produced and numbered consecutively using identical materials, components and processing methods during fabrication.

4.6.1.2 Group A Inspection. Each unit of an inspection battery lot shall be subjected to the examinations and test listed in table III. Each inspection lot shall be subject to Government verification inspection using the General Inspection levels of MIL-STD-105 and the AQL's listed in table III. This inspection may be performed in any order satisfactory to the procuring activity.

TABLE III. Group A inspection

Examination and test	Requirements Paragraph	Inspection Paragraph	AQL	
			Major	Minor
Visual and mechanical examination	3.4,3.4.6.2, 3.4.7,3.4.8, 3.4.8.1 & 3.7	4.7.2	1%	4%
Non-destructive tests				
Components	3.4.1.1 3.4.2 thru 3.4.4	4.7.3.1	1%	1/
Hermetic Seal	3.4.5	4.7.3.3	1%	
Insulation resistance	3.5.5	4.7.3.4	1%	
Weight	3.4.11	4.7.3.2	1%	
Vent valve function	3.4.5	4.7.3.3.1	1%	

1/ All defects are considered to be major.

4.6.1.3 Group B inspection. Each unit of an inspection lot shall be examined in accordance with 4.7.4 to determine compliance with the requirements of 3.4.12. Each inspection lot shall be subjected to Government verification inspection using special inspec-spection level S-4 with an AQL of 1.0 percent. Group B inspection shall be performed on inspection lots that have passed Group A inspection.

4.6.1.4 Group C inspection. Group C inspection shall consist of the destructive tests specified in table IV. Group C inspection shall be performed on sample units selected from inspection lots which have passed Group A and B inspections.

4.6.1.4.1 Sample for Group C inspection. Ten (10) sample batteries shall be selected at random from each inspection lot of one hundred (100) batteries submitted for quality conformance inspection in accordance with paragraph 4.5. Each of the sample batteries shall be assigned to one of the test group/discharge load combinations shown in table IV in the sequence shown.

TABLE IV. GROUP C inspection.

Destructive test	Requirement Paragraph	Test Group see (4.6.1.4.2)	Load Ohms 1/	Sample Test Sequence
Low temperature, activated shock	3.6.2.1	I	2.2	3
Low temperature, activated shock	3.6.2.1	IA	2.2	10
High temperature, activated shock	3.6.2.2	II	5.8	8
High temperature, activated shock	3.6.2.2	II	2.2	5
Low temperature, activated vibration	3.6.2.1	III	2.2	4
High temperature, activated vibration	3.6.2.2	IV	5.8	7
High temperature, activated vibration	3.6.2.2	IV	2.2	1
Low temperature, activated acceleration	3.6.2.1	V	2.2	6
High temperature, activated acceleration	3.6.2.2	VI	5.8	9
High temperature, activated acceleration	3.6.2.2	VI	2.2	2

1/ The load shall be a fixed resistance load (ohms) with a tolerance of ±1%.

4.6.1.4.2 Sampling for Group C inspection for the last production lot. Toward the end of production on a contract, samples for Group C inspection shall be taken in accordance with the following procedure:

a. If the quantity on contract is such that the last production lot is 31 or more but less than 100 batteries, the number of test samples from the last inspection lot shall be one (1) for each ten (10) batteries and fraction thereof in the lot, randomly selected from the entire lot.

b. If the quantity on contract is such that the last production lot would be less than 31 batteries, such last lot quantity shall be added to the previous lot of 100 batteries for sampling purposes. The number of test samples randomly selected from this expanded last lot shall be one (1) for each eleven (11) batteries and fraction thereof in the lot.

c. Samples from the last lot, as in a or b above, shall be assigned to test groups in the order shown under "Sample test sequence" column in table IV. Sampling as indicated above shall only be permitted at the end of production.

4.6.1.4.3 Test groups. The test groups referenced in table IV shall consist of non-destructive and destructive inspections grouped as specified in table V. The following inspections shall be performed with those listed in table V:

a. In first article and first production lot inspections, each battery assigned to test groups I, II, IV or V shall receive the thermostat operation test of 4.7.5.3.1 after the non-destructive test of 4.7.3 and before the thermal shock test of 4.7.5.1.

b. The thermostat operation test of 4.7.5.3.1 shall be performed on all sample batteries assigned to test groups I or V following high temperature, unactivated test of 4.7.5.3 and preceding rise time test of 4.7.5.5.

c. Following the activated discharge test for each test group sample, battery shall be inspected to determine that its condition indicator has functioned properly and that the requirement of 3.5.4.1 has been met.

TABLE V. Test groups.

Test group	Inspection	Inspection paragraph
I	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Rise time	4.7.5.5
	Low temperature, activated shock	4.7.5.6
IA	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Heater operating life	4.7.5.4
	Rise time	4.7.5.5
	Low temperature, activated shock	4.7.5.6
II	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Rise time	4.7.5.5
	High temperature, activated shock	4.7.5.7
III	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Rise time	4.7.5.5
	Low temperature, activated vibration	4.7.5.8
IV	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Rise time	4.7.5.5
	High temperature, activated vibration	4.7.5.9

TABLE V Test groups - (continued)

Test group	Inspection	Inspection paragraph
V	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature, unactivated	4.7.5.2
	High temperature, unactivated	4.7.5.3
	Rise time	4.7.5.5
	Low temperature, activated acceleration	4.7.5.10
VI	Non-destructive tests	4.7.3
	Thermal shock	4.7.5.1
	Low temperature,unactivated	4.7.5.2
	High temperature,unactivated	4.7.5.3
	Rise time	4.7.5.5
	High temperature, activated acceleration	4.7.5.11

4.6.1.4.4 Noncompliance.

a. Any battery failing to pass a non-destructive test as specified herein shall be rejected. If any battery sample fails to pass a destructive test as specified herein, the lot shall be rejected. The contractor shall suspend all destructive testing and investigate the cause of the failure and shall report the results thereof and details of his proposed corrective action to the government as stipulated elsewhere in the contract.

b. Destructive testing shall be resumed only with the concurrence of the procuring agency that the cause of the failure has been identified and satisfactory and effective corrective action has been instituted.

c. To determine that the cause of the failure has been properly identified and that corrective action is satisfactory and effective, the contractor may, as a minimum and in addition to other tests he may deem necessary, furnish and test two (2) batteries which incorporate the contractor's proposed correction; these are to be subjected to the identical and complete test sequence which was assigned to the sample in which the failure occurred.

d. Further, and following direction by the procuring agency that acceptance testing may be resumed on the contract, three (3) samples to be furnished and tested by the contractor

in addition to the number called for in the lot in which the failure occurred shall be taken at random from the next two production lots incorporating the corrective action and which are submitted for acceptance after the occurance of the test failure. Those next two lots submitted shall each consist of not more than the maximum number of batteries permitted in the failed lot. Unless otherwise specified by the government, four (4) of the samples at random in each of those two lots shall be subjected to the identical and complete test sequence in which the failure occured and the other samples shall be subjected to the balance of the tests specified for the lot in which the failure occured.

e. Nothing stated herein shall be construed to alter the government's absolute right to reject any lot represented by the failed sample.

4.6.2 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of Special Packaging Instruction SPI No. 1G0033 for Battery, Wet, Non-rechargeable BA-472/().

4.7 Methods of inspection.

4.7.1 Testing environment. Battery loads and monitoring instruments shall be at room conditions (see 4.3) at the start of each test. The battery shall be held at the specified temperature for a minimum of 8 hours prior to activation. During discharge the battery shall rest on an insulating material and shall touch no other object except test equipment or leads required for testing.

4.7.1.1 Warm-up time. The heater circuit shall be energized with a 115 ± 5 volts rms, 60 cycle source of power for a period of 2 hours or until the battery thermostats operate (whichever occurs first) prior to activation. At the activation signal the power shall be cut off from the heater circuit.

4.7.1.2 Discharge loads. All battery discharges shall be conducted through fixed resistance loads, as specified in tables I and IV, placed across the positive and negative terminals. The tolerance of each fixed resistance load shall be plus or minus one percent. All activation shall occur with the load circuit closed.

4.7.1.3 Dynamic test fixtures. The construction and use of fixtures for dynamic testing of Battery BA-472()/U shall follow accepted environmental testing practices. The fixtures shall be rigid, free from resonances, and suitable for transmitting the specified force levels to the test specimen or specimens mounted thereon. Battery faces B and F (see figure 1) shall be placed against flat solid walls of the fixture and held by four 3/16 inch (4.76mm) i.e. lockwashers under #10-24x3/4 (609.6mm x 19.05mm) socket head screws, utilizing the mounting holes in the battery flanges. Provision shall be made for use of a close - fitting pin to engage the .203/.204 inch (5.16/5.18mm) diameter hole in the bottom rear battery mounting flange. The fixture wall which contacts battery face B shall be relieved so as not to contact the upper surface of the bottom rear battery mounting flange through which the pin passes. No other surface or part of the battery shall be in contact with the fixture or parts thereof nor shall the battery be otherwise braced or restrained. The centerline of an accelerometer for monitoring vibration force level on each axis shall be within 1 1/4 inches (31.75mm) of the centerline of one of the bottom front tab mounting screw holes. The accelerometer shall be mounted on the fixture wall against which battery face F is placed.

4.7.2 Visual and mechanical examination. Battery, Wet, Non-rechargeable, BA-472()/U shall be examined to determine compliance with all applicable requirements and characteristics as specified for construction, marking, finish and workmanship (see 3.4, 3.4.6.2, 3.4.7, 3.4.8, 3.4.8.1 and 3.7). Classification of defects shall include those listed in table VI.

TABLE VI. Classification of visual and mechanical examination defects.

Classification	Defect
Major	Corroded electrical contacts. Cases which are defectively crimped, cracked or have pin holes. Loose pieces of solder. Foreign materials (dirt, chips, fillings) which adversely affect operations. Markings omitted. Incorrect labeling.
Minor	Scratches, cuts, and abrasions not adversely affecting use.

4.7.3 Non-destructive tests.

4.7.3.1 Battery components. The battery shall be inspected to determine that the various battery components, listed in table VII are within the specified limits.

4.7.3.2 Weight. The battery shall be weighed to the nearest 0.1 pound (0.05 kg) to determine compliance with 3.4.11.

4.7.3.3 Hermetic Seal. The unactivated battery shall be submerged in water at 170° ± 3°F (76.7° ± 1.7°C) to a depth of at least ½ inch (12.7mm) below the surface of the water. The battery shall be inspected for leaks, as indicated by the evolution of air bubbles, continuously throughout a 5 minute period. (see 3.4.5).

4.7.3.3.1 Vent valve function. The battery vent valve shall be tested by slowly applying a vacuum to the battery vent to an amount just sufficient to cause the valve to instantaneously open and close, using care that the gas upstream of the valve is not measurably depleted. The pressure differential at which the valve functions shall comply with the requirement of 3.4.5.

4.7.3.4 Insulation resistance. A 500 ± 50 volt dc potential shall be applied between each battery electrical lead and the battery case, between pins N and P, and between pins F and O to determine compliance with paragraph 3.5.5. This dc test potential shall be applied for not less than one (1) minute for each position.

4.7.4 Interchangeability. All dimensions affecting interchangeability, including those listed below shall be measured and inspected (see 3.4.12). When a listed dimension is not within specified or design limits, it shall be considered a major defect.

a. Maximum length and width of battery.
b. Maximum height of battery.
c. Mounting hole locations.
d. Size of mount holes.

TABLE VII. Battery components.

Components	Pin Assignment (see SM-D-165290)	Requirement Paragraph	Value
Heater Circuit resistance	D-E	3.4.1.1	as specified
Gas Generator circuit resistance	I-J 1/	3.4.3	as specified
Battery condition indicator	F-O	3.4.4	as specified
Heater monitor	G-H	3.4.2	as specified
Output terminals	N-P	-	shall be open circuit and/or 0.0 volts
Strapped	A-L	-	shall be closed circuit
Strapped	B-C	-	shall be closed circuit

NOTE: Remove shorting plug for non-destructive testing. Replace after completion of testing.

1/ CAUTION: ANY INSTRUMENT USED IN TESTING PINS I-J SHALL NOT PRODUCE A CURRENT OUTPUT IN EXCESS OF 10 MILLIAMPERES. THE GAS GENERATOR CIRCUIT RESISTANCE MEASUREMENT SHOULD NOT BE PERFORMED REPEATEDLY ON A SAMPLE BATTERY.

4.7.5 Destructive tests.

4.7.5.1 Thermal shock (see 3.6.1). The battery shall be subjected to five cycles as follows:

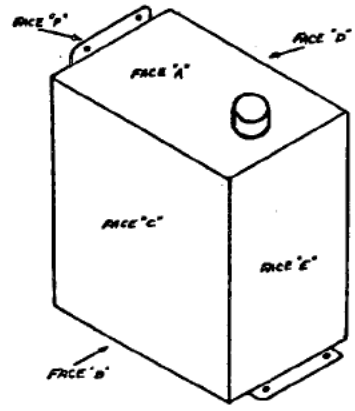
a. Stored at -85° ± 5°F (-65° ± 2.8°C) for a minimum of 6 hours.

b. Immediately stored at +210° ± 5°F (+98.9° ± 2.8°C) for a minimum of 6 hours.

c. Repeat a and b for a total of five cycles.

4.7.5.2 Low temperature, unactivated (see 3.6.1). The battery shall be stored at -85° ± 5°F (-65° ± 2.8°C) for 8 hours. Within 5 minutes after removal from storage temperature, the battery shall be subjected to dynamic testing specified in 4.7.5.2.1 and 4.7.5.2.2.

4.7.5.2.1 Shock. The shock testing to be applied to the battery shall consist of five drops, 60g, 6 to 11 milliseconds (ms) half-sine in each of the positions E-F, F-E, C-D, D-C, B-A and A-B. Position orientation shall be in accordance with figure 1.



NOTES: The axis of the applied force will be specified by naming the two faces which are perpendicular to the axis of the force.

e.g. Vertical axis B-A or A-B

The face which is named first will be the face which is to be placed against the mounting table of the equipment involved. For acceleration the force is directed from the face named last toward the face named first.

Figure 1. Position orientation.

4.7.5.2.2 Vibration (see 3.6.1). The vibration schedule to be applied to the battery in each of the three positions, E-F, B-A and D-C, (see figure 1) shall consist of three parts as shown below:

a. Part 1- 5 to 55 to 5 hertz (Hz) at 0.24 inch (6.10mm) excursion.
b. Part 2- 55 to 2000 to 55 Hz at 40g acceleration
c. Part 3- 5 to 55 to 5 Hz at 0.24 inch (6.10mm) excursion.

Each part of the vibration test shall consist of one smooth sweep to the high limit and return; each sweep shall be of 10 minutes duration. The specimens shall be subjected to a simple harmonic motion having an amplitude varied to maintain a constant peak acceleration of specified g force, the frequency being varied logarithmically between the approximate limits of 55 and 2000 Hz. In the event the manufacturer's vibration equipment is incapable of performing the above dynamic conditions, the alternate procedure for use of linear in place of logarithmic change of frequency, as outlined in MIL-STD-202, Method 204, may be employed.

4.7.5.3 High temperature unactivated. The battery shall be stored at 210° ± 5°F (98.9° ± 2.8°C) for 8 hours. Within 5 minutes after removal from storage temperature, the battery shall be subjected to dynamic testing specified in 4.7.5.2.1 and 4.7.5.2.2.

4.7.5.3.1 Thermostat operation test. The battery shall be stabilized without power to heaters at each of the temperatures listed below. The time for stabilization at each temperature shall be 24 ± 3 hours. At the end of each temperature stabilization period it shall be determined that the monitor and heater circuits (see 3.4.2) are in the proper mode as specified below:

Mode Sequence circuit	Temperature 1/	Monitor circuit	Heater
1	103°+1°F (39.4°±0.6°C)	open	closed
2	121°+1°F (49.4°±0.6°C)	open	open
3 2/	98°+1°F (36.7°±0.6°C)	open	closed
4	88°+1°F (31.1°±0.6°C)	closed	closed 3/

1/ General Requirements of MIL-STD-202 (para 2.2.1(a)) shall be applicable provided that the permitted cyclic variation of temperature with time is sufficiently rapid so that the battery interior will be within the temperature range specified.

2/ At the option of the manufacturer and subject to approval of the procuring activity, mode 3 may be omitted from the sequence except in first article inspection, the first, fifth and every fifth production lot thereafter.

3/ Circuit resistance shall be measured and shall be in the range specified in 3.4.1.1.

4.7.5.4 Heater operation. With the battery stabilized at -65° ± 5°F (-53.9° ± 2.8°C) the thermostat and heater circuit shall be connected to a 115 ± 5 volts rms, 60 cycle source for the time specified in 3.4.1.2. Upon completion of the 200 hour test, the battery shall be tested in accordance with 4.7.5.5 and 4.7.5.6 (test group IA) to determine compliance with the requirement specified in 3.4.12.

4.7.5.5 Rise Time. While performing any of the following activated tests, 4.7.5.6 through 4.7.5.11, the rise time shall be obtained and recorded to determine compliance with the requirement specified in 3.5.2.

4.7.5.6 Low temperature, activated shock. The battery shall be tested in the following manner:

a. Stored for a minimum of 8 hours at -40° ± 5°F (-40°± 3°C) at the conclusion of which, it, still in a -40° ± 5°F (-40° ±3°C) ambient, shall be electrically heated in accordance with 4.7.1.1.

b. Within 5 minutes after the completion of the warm-up period specified in 4.7.1.1, it shall be activated at room temperature (see 4.3) in accordance with the requirement specified in 3.5.1.

c. Immediately it shall be subjected to the following shock conditions:

(1) Two drops, 240g, 6 to 11 milliseconds half-sine, in each of the positions E-F, F-E, C-D and D-C (see figure 1).

(2) Two drops, 60g, 6 to 11 milliseconds half-sine, in each of the positions A-B anbd B-A (see figure 1).

d. During the application of shocks the battery shall be discharged intermittently through a fixed resistance in accordance with table IV. Each intermittent discharge period shall be of 20 seconds duration with the shock applied at the 10 second point. Upon completion of the dynamic testing the discharge shall be continued without interruption to the specified minimum voltage shown in table 1.

e. The test time shall be as specified in 3.6.2.1.

4.7.5.7 High temperature, activated shock. The battery shall be stored for a minimum of 8 hours at 165° ± 5° F (73.9° ± 3°C) and then activated, as specified in 3.5.1 at room temperature (see 4.3), within 5 minutes after removal from storage temperature. The procedure specified in 4.7.5.6, steps c and d, shall be followed. The test time shall be as specified in 3.6.2.2.

4.7.5.8 Low temperature, activated vibration. The battery shall be tested in the following manner:

a. Stored for a minimum of 8 hours at -40° ± 5°F (-40° ±3°C) at the conclusion of which it, still in a -40° ± 5°F (-40° ±3°C) ambient, shall be electrically heated in accordance with 4.7.1.1.

b. Within 5 minutes after completion of the warm-up period specified in 4.7.1.1, it shall be activated at room temperature (see 4.3) in accordance with the requirement specified in 3.5.1.

c. Immediately the battery in each of three positions, E-F, B-A and D-C, (see figure 1) shall be subjected to the three part vibration schedule shown below:

(1) Part 1- 5 to 55 to 5 Hz at 0.24 inch (6.10mm) excursion.

(2) Part 2- 55 to 2000 to 55 Hz at 40g acceleration.

(3) Part 3- 5 to 55 to 5 Hz at 0.24 inch (6.10mm) excursion.

Each part of the vibration test shall consist of one smooth sweep to the high limit and return; each sweep shall be of 5 minutes duration. The specimens shall be subjected to a simple harmonic motion having an amplitude varied to maintain a constant peak acceleration of specified g force, the frequency being varied logarithmically between the approximate limits of 55 and 2000 Hz. In the event the manufacturer's vibration equipment is incapable of performing the above dynamic conditions, the alternate procedure for use of linear in place of logarithmic change in frequency as outlined in MIL-STD-202, Method 204, may be employed.

d. During the application of vibration the battery shall be discharged intermittently through a fixed resistance in accordance with table IV. The intermittent discharge cycle during periods of vibration shall be of 30 seconds duration followed by 2 minutes on open circuit. Upon completion of the dynamic testing the discharge shall be continued without interruption to the specified minimum voltage shown in table 1.

e. The test time shall be as specified in 3.6.2.1.

4.7.5.9 High temperature, activated vibration. The battery shall be stored for a minimum of 8 hours at 165° ± 5°F (73.9° ±3°C) and then activated, as specified in 3.5.1 at room temperature (see 4.3), within 5 minutes after removal from storage temperature. The procedure specified in 4.7.5.8, steps c and d, shall be followed. The test time shall be specified in 3.6.2.2.

4.7.5.10 Low temperature, activated acceleration. The battery shall be tested in the following manner:

a. Stored for a minimum of 8 hours at -40° ± 5°F (-40° ±3°C) at the conclusion of which, it, still in a -40° ± 5°F (-40° ±3°C) ambient, shall be electrically heated in accordance with 4.7.1.1.

b. Within 5 minutes after the completion of the warm-up period specified in 4.7.1.1, it shall be activated at room temperature (see 4.3) in accordance with the requirement in paragraph 3.5.1.

c. Immediately it shall be subjected to the following acceleration schedule in each of the positions specified:

Acceleration force	Time (seconds)	Positions (see figure 1)
240g	45	E-F, F-E, C-D and D-C
60g	45	A-B
30g	45	B-A

Position B-A shall be the second position in the sequence of positions during testing.

d. During the 45 second acceleration period the battery shall be discharged continuously through a fixed resistance in accordance with table IV. Upon completion of the dynamic testing, discharge shall be continued without interruption to the specified minimum voltage shown in table 1.

e. The test time shall be as specified in paragraph 3.6.2.1.

4.7.5.11 High temperature, activated acceleration. The battery shall be stored for a minimum of 8 hours at 165° ± 5°F (73.9° ±3°C) and then activated, as specified in 3.5.1 at room temperature (see 4.3), within 5 minutes after removal from storage temperature. The procedure specified in 4.7.5.10, steps c and d, shall be followed. The test time shall be as specified in 3.6.2.2.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with Special Packaging Instruction SPI No. 1G0033 for Battery, Wet, Non-rechargeable BA-472( )/U.

6. NOTES

6.1 Ordering data. Acquisition documents should specify the following:

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

b. Levels of preservation - packing and packaging (see 5.1).

c. First article pack(s) as follows:

(1) Makeup of pack(s).

(2) Number of each kind of pack to be submitted.

(3) Inspection to be performed thereon.

d. Marking and shipping of samples.

e. Place of final inspection.

6.2 Nomenclature. The parenthesis in the nomenclature will be deleted or replaced by a letter identifying the particular design; for example: BA-472W/U. The manufacturer should apply for nomenclature in accordance with the applicable clause in the contract (see 1.1).

6.3 Verification inspection. Verification inspection 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 utilization of the manufacturer's quality control system and the history of the product.

6.4 First article. When a first article inspection is required, (see 3.2) the item shall be tested and should be a first article sample. The first article should consist of fifty units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, test approval of the documents first article.

6.5 Definitions.

6.5.1 Activated life. Activated life is the elapsed time between the start of the activation signal (see 3.5.1 & 3.5.4) and the time the battery voltage, while on load, first decreases to the minimum voltage value specified in table I.

6.5.2 Rise time. Rise time is the elapsed time between the start of the activation signal (see 3.5.1) and the time the battery terminal voltage, while on load, reaches the minimum voltage value specified in table I. (see 3.5.2).

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

Custodians:
ARMY-ER

Preparing Activity:
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