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MILITARY SPECIFICATION

BATTERY MK 53 MOD 0

SECONDARY TYPE, SILVER-ZINC-ALKALI

This specification has been approved by the Naval Ordnance Systems Command, Department of the Navy

1. SCOPE

1.1 Scope. This specification establishes the requirements for the procurement of Battery Mk 53 Mod 0 Secondary Type, Silver-Zinc-Alkali, Naval Ordnance Systems Command LD 476652. The battery is of one type and one class.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitations for bids or request for proposals form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-S-901	Shock Tests, HI (High Impact); Shipboard Machinery

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-414	Sampling Procedures and Tables for Inspection by Variables for Percent Defective

FSC 6140

DRAWINGS

NAVAL ORDNANCE SYSTEMS COMMAND

LD 476652	Battery, Secondary Type, Mark 53 Mod 0 Assembled, and all parts and subassemblies listed thereon
LD 620045	Shipping (Packing) Condition
Drawing 815578	Wiring Diagram
Drawing 1155115	Identification Plate
Drawing 1373691	Battery Mark 53 Mod 0 Assembled

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposals shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28	Screw-Thread Standards for Federal Services

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20360)

3. REQUIREMENTS

3.1 Description. Battery Mk 53 Mod 0 assembly is a secondary battery of the silver-zinc-alkali type and is used as a source of torpedo propulsion and control power. It is made up of a number of unit cell assemblies interconnected to form two electrically similar propulsion sections which may be connected either in series or parallel. Also, separate unit cells are interconnected to form an auxiliary section. A tray and quick disconnectors complete the assembly.

3.2 General requirements

3.2.1 Preproduction batteries. Unless otherwise specified in the contract or order, preproduction batteries shall be manufactured using the methods, materials, and procedures proposed for the production lot. These batteries will be tested as described in 4.7 herein and are for the purpose of determining that the production item will meet the requirements of this specification. Provision of samples shall be in accordance with Section 4 of this specification.

3.2.2 Materials. All materials and purchased parts entering into the final assembly of the battery shall conform to applicable Federal and Military Specifications and LD 476652. Materials which are not covered by specifications or which are not specifically designated herein shall be of the best quality, of the lightest weight practicable consistent with strength and durability, and entirely suited for the purpose for which intended under all conditions of test and service operation. Recommendations concerning substitution for any part or material specified herein shall be accompanied by a description of the substitute together with evidence to substantiate any claim as to its suitability. At the discretion of the Naval Ordnance Systems Command, test samples may be required to prove the suitability of the proposed substitute.

3.2.2.1 Active and structural material. The total silver content of the active material in all cathodes of the propulsion and auxiliary cells in the battery shall be 700 +3 percent -0 percent troy ounces of silver. The total silver content of the structural components in the entire battery, such as anode and cathode grids, plate straps, terminals, and intercell connectors, shall be 200 +3 percent -0 percent troy ounces of silver. The minimum total silver requirement for active material, 700 troy ounces, and for structural components, 200 troy ounces, shall be met independently. Any proposed excess in either of these requirements shall not be permitted to reduce the minimum requirements of the other. Only silver shall be used for structural material within the envelope of the battery cells.

3.2.2.2 Any cells representing batteries determined not to conform to the minimum requirements of 3.2.2.1 shall be considered cause for rejection of the contract quantity of batteries represented.

3.2.2.3 Sample cells. Twenty cells representing propulsion and 16 cells representing auxiliary sections shall be selected for verification of silver content prior to and during production of any contract quantity of batteries (see 4.1.1.2 and 4.1.1.3).

3.2.2.4 All sample cells (3.2.2.3) shall be delivered as complete cells, without electrolyte, at battery subassembly level.

3.2.2.5 Cell structure. Only silver shall be used for the structural material within the envelope of the cell casings. The grid material of the anodes and cathodes shall consist of a silver expanded mesh, silver mesh screen, or a flat sheet of silver with a minimum of 120 openings per square inch. The tab for each plate shall be integral with the plate or attached to the plate in such a manner as to ensure a positive connection during the useful life of the cell. Each tab shall be insulated by a suitable insulating sleeve or other means to prevent top shorts between plates within the cell. Each tab shall be of sufficient size to ensure maximum conductivity consistent with good design. The positive or negative plates, or both, shall be wrapped as required with separator materials that retard degradation of the plates and resist the effects of migratory plate materials.

3.2.2.6 Government furnished material. When the Government elects to furnish silver the total minimum quantity furnished will be based on the total number of complete batteries and sample cells to be provided for delivery. The quantity of silver furnished shall be calculated on the basis of 3.2.2.1 for a battery containing 60 propulsion and 18 auxiliary cells plus two spare propulsion cells and two spare auxiliary cells (see 3.4.2.2 and 4.2.3.1). Any additional silver used shall be furnished by the contractor.

3.2.3 Finishes, coatings, and dimensions. Finishes, coatings, and dimensions for the battery shall be in accordance with the applicable drawings, specifications, and publications listed in LD 476652. Gray paint, where used on the tray and end castings, shall be of an alkali-proof type to resist the action of spilled electrolyte.

3.2.4 Marking. Marking of the assembled battery shall be in accordance with LD 476652.

3.2.4.1 Serial numbers. Each battery shall bear a serial number which will be assigned upon request by the Naval Underwater Weapons Research and Engineering Station, Newport, Rhode Island 02840, or as specified in the contract, requisition, or order.

3.2.4.2 Terminal markings. The polarity of the battery terminals shall be permanently marked on the terminal block on the end of the battery in accordance with Drawing 1373691.

3.2.4.3 Special battery markings. The forward and aft ends of each battery shall be conspicuously marked with the words "DRY CHARGED" in upper case letters at least one-half inch high.

3.2.5 Gages. The contractor shall provide himself with whatever gages are necessary and adequate to ensure that the material to which this specification applies will meet the dimensional requirements shown on the

applicable drawings. If so stipulated in the contract, order, or requisition, the Government will furnish drawings of pertinent Navy Final Inspection Gages for guidance in the design of the contractor's inspection gages. However, such procedure shall not serve to relieve the contractor of his responsiblity in the design and manufacture of such gages as may be required in the satisfactory fulfillment of the contract requirements, but is intended to facilitate acceptance of all components and assemblies by Navy Final Inspection Gages.

3.2.6 Threads. Unless otherwise specified, all threads shall be in accordance with National Bureau of Standards Handbook H28. The class or fit for threads shall be as specified on the applicable drawings.

3.2.7 Conflicting requirements. Conflicting requirements arising between this specification or any specification, publication, or drawing listed herein shall be referred in writing to the procuring agency or appointed agent for interpretation, clarification, and resolution (or correction).

3.2.8 Manufacturer's instructions. Unless otherwise specified by the procuring agency, each battery shall be accompanied by a set of special instructions for placing the battery in operation and for maintaining the battery in service. These instructions, prepared by the manufacturer, shall in no way conflict with the requirements of this specification and a sample copy of these instructions shall be submitted to the Naval Ordnance Systems Command or its appointed agency prior to submission of the preproduction samples. The contractor may amend these instructions at a later date only with the written approval of the Naval Ordnance Systems Command or its appointed agency.

3.3 Definitions

3.3.1 Vibration. Vibration is a sinusoidal motion defined by amplitude and frequency. Amplitude may refer to displacement or acceleration. The displacement is given in inches peak-to-peak or the corresponding maximum acceleration in gravitational units (g's). The frequency is given in cycles per second (cps).

3.3.2 Shock. Shock is an abrupt change in the motion of a body resulting from the sudden application of a large external force of short duration. Shock, in general, can be defined as a buildup of 90 percent of peak force in less than 0.010 second. Shock is described (a) as a pulse in gravitational units (g's), including duration in milliseconds (ms) and a description of the shock wave form, or (b) in terms of test conditions outlined in MIL-S-901.

3.3.3 Vibration and shock axes. Vibration and shock axes are imaginary straight lines passing through the battery, along which the battery is being vibrated or shocked. The axes of the battery are:

(a) Longitudinal (Forward and aft; ends)

(b) Perpendicular and transverse to (a) (Port and starboard; sides)

(c) Mutually perpendicular to (a) and (b) (Bottom only)

3.3.4 Nonoperating condition. The nonoperating condition of the battery is that condition when the battery is packaged for delivery in accordance with LD 620045 during transportation, storage, and handling.

3.3.5 Ready, nonoperating condition. The ready nonoperating condition of the battery is that condition when the battery is handled or transported in an unpackaged state, with all cells filled to their normal level with electrolyte and fully charged, before or after assembly into a torpedo.

3.4 Performance requirements and product characteristics. The battery shall meet the following performance requirements and product characteristics:

3.4.1 Assembly. The battery shall be assembled and connected as specified in Drawings 815578 and 1373691.

3.4.2 Condition as supplied. The battery shall be assembled and supplied in a dry, charged condition.

3.4.2.1 Filling kit. Each battery shall be supplied with a filling kit to provide a convenient means of properly filling each cell of the battery with the correct quantity of electrolyte. The filling device and drawing(s) thereof shall be approved by the Naval Underwater Weapons Research and Engineering Station, Newport, Rhode Island 02840.

3.4.2.2 Spare cells. Each complete battery shall be supplied with two spare propulsion cells and two spare auxiliary cells in a dry, charged condition.

3.4.2.3 Electrolyte. With each complete battery, electrolyte shall be supplied in 83 individual polyethylene bottles, 62 of which shall each contain the required quantity of electrolyte to properly fill a propulsion cell, and 20 of which shall each contain the required quantity of electrolyte to properly fill an auxiliary cell. A one liter bottle of electrolyte shall also be included.

3.4.3 Weight. The battery, when filled with the normal amount of electrolyte, shall weigh 270 plus or minus 10 pounds.

3.4.4 Dimensions. Dimension of the finished battery shall conform to the requirements of Drawing 1373691.

3.4.5 Capacity. After the electrolyte has been added and a soak time of 24 hours has elapsed, a booster charge may be given the battery. The propulsion cells are charged at a 5-ampere rate and the auxiliary cells at a 2-ampere rate for a period not to exceed four hours, or until the on-charge voltage of the individual cells reaches 2.05 volts, whichever shall occur first.

3.4.5.1 Capacity (high rate). The propulsion and auxiliary sections shall be capable of delivering the current discharge within the voltage limits and for the time duration specified in Figure 1. The temperature of the electrolyte at the start of the discharge period shall be 40 plus or minus 2 degrees F and 75 plus or minus 5 degrees F.

3.4.5.2 Capacity (low rate). The propulsion sections, when connected in series, shall be capable of delivering a minimum of 120 ampere-hours when discharged at 24 plus or minus 1 amperes to an end voltage of 72 volts. The auxiliary section, when connected in series, shall be capable of delivering a minimum of 24 ampere-hours when discharged at 4.8 plus or minus 0.2 amperes to an end voltage of 21.6 volts.

3.4.6 Operational life. After being prepared for service, the battery shall be capable of delivering one 9-minute discharge at 450 plus or minus 5 amperes when the two propulsion sections are series-connected and after being in storage at 75 plus or minus 5 degrees F for 75 plus or minus 2 days without benefit of a refresher charge, or of delivering any combination of six 6-minute discharges at 450 plus or minus 5 amperes when the two propulsion sections are series-connected or 15-minute discharges at 250 plus or minus 5 amperes when the two propulsion sections are parallel-connected, within a six-month period.

3.4.7 Vent cap and filling hole. Each cell shall be provided with a removable venting device that will release gas at a pressure of 5 plus or minus 3 psig. The venting device shall be designed to prevent plugging by carbonate during the useful life of the cell. The filling hole in each propulsion cell shall have a minimum diameter of 1/4 inch, and the filling hole in each auxiliary cell shall have a minimum diameter of 3/16 inch, to allow for filling with a minimum of back pressure. Provided ease of filling is not affected, the filling hole may also serve as a vent hole. The design of the venting device shall be submitted to the Naval Underwater Weapons Research and Engineering Station, Newport, Rhode Island 02840, for approval prior to the submission of preproduction batteries.

3.4.8 Center of gravity. The center of gravity of the battery, when filled with its normal amount of electrolyte, shall be as shown on Drawing 1373691.

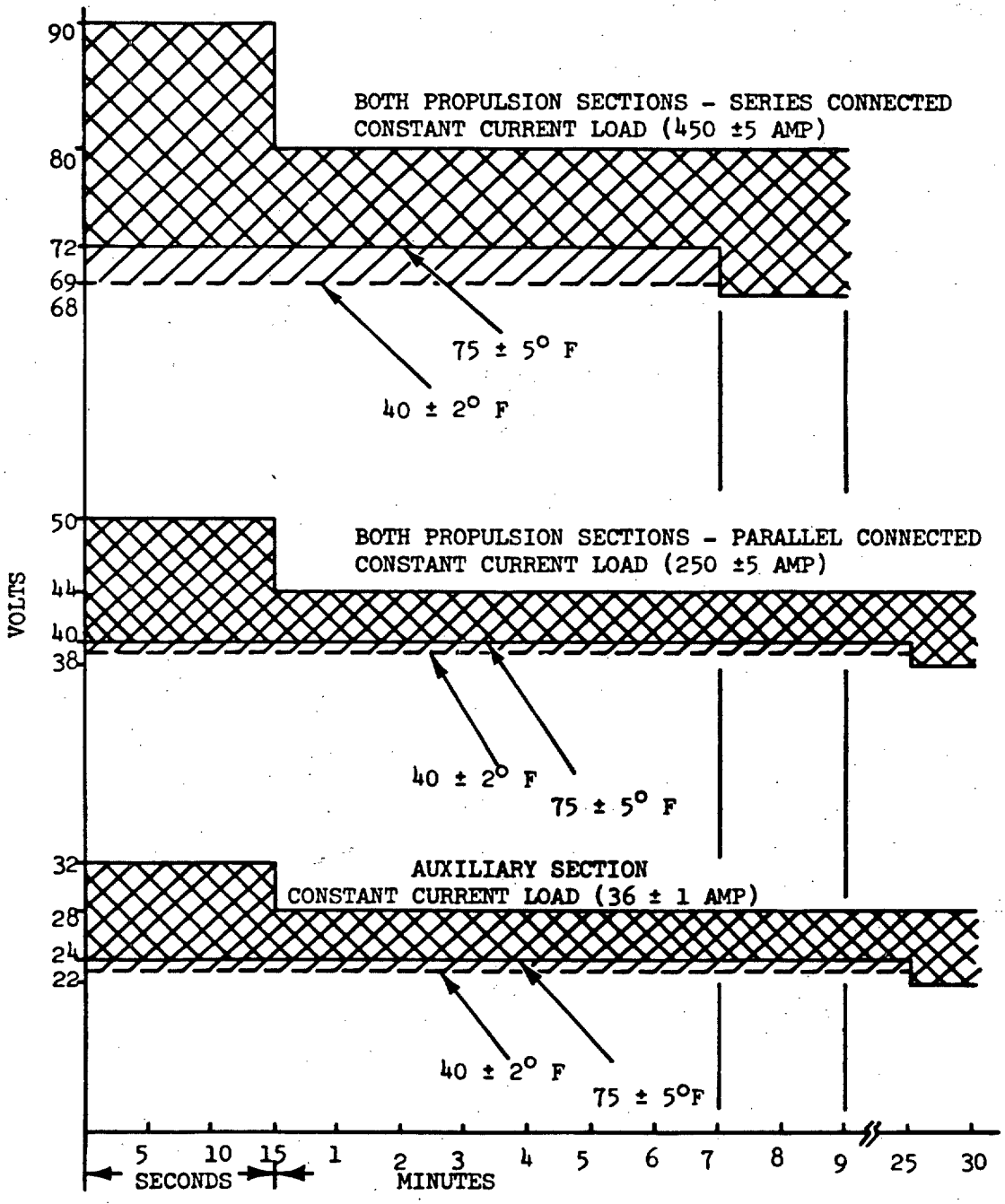

Figure 1. Secondary Battery
Mk 53 Mod 0 Series and Parallel Discharge Curves

3.4.9 Cell pressure test. The individual cells of the battery shall maintain an unbroken seal under an internal pressure of 6 plus or minus 0.5 pounds per square inch gage (psig) over a temperature range of minus 20 degrees F to plus 130 degrees F, when tested as specified in 4.4.3.1.

3.4.10 Leakage. The battery shall be capable of being oriented in any position without loss of electrolyte.

3.4.11 Internal cell resistance. Each cell of the battery, in a dry condition, shall have an internal resistance of at least 1000 ohms.

3.4.12 Cell case material. The cell case material shall be transparent polysulphon, or equal, and be capable of withstanding temperatures up to 300 degrees F without softening.

3.5 Environmental requirements

3.5.1 Vibration, ready, nonoperating condition (3.3.5). The battery shall withstand vibration in accordance with Schedule I (Vibration) in each of the axes of 3.3.3 and thereafter meet the requirements of 3.4.5.

SCHEDULE I (VIBRATION)

Frequency Range	Amplitude	Minimum Test Duration		
		Room Temp.	-20°F	+130°F
10 - 30 cps	0.060 ± 0.006 in.	60 min.	15 min.	15 min.
31 - 60 cps	3g ± 0.3g	60 min.	15 min.	15 min.
61 - 100 cps	3g ± 0.3g	60 min.	15 min.	15 min.

3.5.2 Shock, ready, nonoperating condition (3.3.5). The battery shall withstand shocks in accordance with Schedule II (Shock) on both sides, the bottom, and both ends, and thereafter meet the requirements of 3.4.5.

SCHEDULE II (SHOCK)

Shock Pulses in Each Direction	Peak Magnitude	Minimum Pulse Duration	Pulse Shape
3	30g ± 3g	12 ms ± 2 ms	Approximating a one-half sine wave

3.5.3 Temperature. The battery, in a wet and charged condition, shall be capable of withstanding temperature cycling between minus 20 degrees F and plus 130 degrees F for a period of 14 days, as described in 4.7.4. Thereafter, the battery shall show no damage and shall meet the performance requirements and product characteristics specified herein.

3.6 Cleanup. Prior to and after final assembly, all parts, components and the assembly shall be thoroughly cleaned of loose, spattered or excess solder, metal chips, rosin flux, and other foreign matter.

3.7 Workmanship. The battery, including all parts and accessories, shall be constructed and finished in a manner to ensure compliance with all requirements of this specification. Particular attention shall be paid to cleanliness and neatness of manufacturing operations; the elimination of burrs, wire strands, or projections on electrode surfaces; adequate insulation of electrodes and intercell connectors; and the removal of all burrs and sharp edges. The standards of workmanship exhibited in any approved preproduction sample, subject to any qualifications stated in the Government's notice of approval, shall be determinative of the requirements of the contract relative to workmanship insofar as not specifically covered by applicable specifications.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

4.1.1 Sampling. Unless otherwise specified, and when applicable, the sampling plans and procedures used by the Government inspector in the determination of acceptability of batteries submitted by a supplier for Government inspection shall be in accordance with the provisions set forth in MIL-STD-105.

4.1.1.1 Sampling for destructive tests. Unless otherwise specified, a sample of cells shall be selected in accordance with MIL-STD-414, Inspection Level I (minimum sample size of seven cells). Cells selected shall represent plates which have been constructed from the same batch or mixture of active materials and under significantly similar conditions.

4.1.1.2 Preproduction sample cells. Ten propulsion cells and eight auxiliary cells (3.2.2.3) shall be submitted with preproduction batteries to the specified testing activity.

4.1.1.3 Production sample cells. Ten propulsion cells and eight auxiliary cells (3.2.2.3) shall be randomly selected from 75 percent of any contract quantity of batteries. These cells shall be delivered to the specified testing activity when 75 percent of the contract quantity is completed. These cells shall be analyzed for their silver content (3.2.2.1, 3.2.2.3, and 3.2.2.5).

4.1.1.4 Special marking. The production test cells (4.1.1.3) shall be identified by the highest and lowest serial numbers of the production lot of batteries they represent, legibly marked on each cell.

4.1.1.5 Silver analysis. Unless otherwise specified in the contract or order, the sample cells of 4.1.1.3 shall be submitted to the Government for test and for silver analysis.

4.1.1.6 Quantitative analysis of active cathode material. The method for performing the quantitative analysis of the active cathode material shall be in accordance with the procedures outlined in Naval Ordnance Laboratory, White Oak, Maryland, Report NOLTR 64-214 titled "A Method for the Quantitative Analysis of the Silver Oxide Cathode." The total silver content of the cells shall be quantitatively analyzed.

4.1.2 Preproduction sampling. Unless otherwise specified in the contract, requisition, or purchase order, three complete batteries shall be manufactured using the methods, materials, and procedures proposed for the production lot. These batteries shall be tested as specified in 4.2.2 by an activity assigned by the procuring agency to determine that all requirements of this specification are met by use of production methods. Further production of the battery by the contractor prior to approval of the contracting activity of preproduction batteries shall be at the contractor's risk. Preproduction batteries accepted will not be applied as part of the quantity specified by the contract or order.

4.1.3 Inspection lot size. Unless otherwise specified, the number of units of production in an inspection lot will be as determined by the Government inspector.

4.1.4 Periodic production sampling. Periodic production samples shall be selected from units that have satisfactorily passed the quality conformance tests of 4.4.3.1, 4.4.3.2, and 4.4.3.3. The samples shall be subjected to the tests of 4.7 at an activity designated by the procuring activity. Periodic production sampling shall be as follows:

Step 1. Upon initiation of production, randomly select one unit from each group of 10 units. Upon satisfactory compliance of samples selected from 3 consecutive groups, shift to Step 2.

Step 2. Randomly select one unit from each group of 25 units. Upon satisfactory compliance of samples selected from 3 consecutive groups, shift to Step 3.

Step 3. Randomly select one unit from each group of 50 units. Continue with Step 3 for the balance of the contract or until a defective unit is found.

When a defective unit is found in any group, acceptance of all units on hand shall be withheld and the contractor shall:

(a) Determine the cause of the defect.

(b) Take the necessary actions to correct or eliminate the defect from all units on hand and, if so directed by the procuring activity, from those units previously shipped.

(c) Submit to the procuring activity for approval, the proposed corrective action to prevent recurrence of the defect.

Return to Step 1 and proceed as indicated when inspection is resumed.

4.2 Classification of test. Inspection and testing of the battery shall be classified as follows:

4.2.1 Quality conformance tests. These tests are to be accomplished on each battery being submitted for acceptance under contract. Quality conformance tests shall be performed by the manufacturer. These tests are 4.4.3.1, 4.4.3.2, and 4.4.3.3. Failure in any test shall be cause for rejecting the battery.

4.2.2 Preproduction and periodic production tests. Preproduction and periodic production tests are those which are accomplished on samples

selected as specified in 4.1.2 and 4.1.4 which are representative of the production of batteries after the award of the contract to determine that the lot and production meet the requirements of this specification. These tests are detailed in 4.7. Failure of a sample to comply with test requirements will result in the rejection of the lot.

4.2.3 Destructive tests. These tests are to be accomplished on the sample cells selected in accordance with 4.1.1.1. These tests are defined in 4.5.

4.2.3.1 Disposition of cells used in destructive testing. Silver in cells selected for destructive testing in accordance with MIL-STD-414 shall be provided by the contractor and remain his property.

4.3 Test equipment. The following items of test equipment are required to perform the quality conformance tests set forth in this specification:

4.3.1 Source of low pressure air capable of developing at least six psig, with equipment necessary for pressurizing, sealing off, and monitoring the internal pressure of the battery cell(s) under test.

4.3.2 A dc power source (battery) of 3 to 4-1/2 volts at 0.5 ampere.

4.3.3 Voltmeter, dc, 1000 ohms/volt, 0-15-150 volt range.

4.3.4 Milliammeter, dc, 0-10 ma range.

4.3.5 Resistor, current limiting, 500 ohms, 1/2 watt, carbon.

4.3.6 Load, electrical, capable of withstanding currents specified in Figure 1 and Table I (36, 250, and 450 amperes).

4.3.7 Ammeter, dc, capable of measuring the load currents of 4.3.6.

4.3.8 Apparatus for filling cells with electrolyte.

4.4 Quality conformance inspection. Each battery delivered under contract shall be subjected to the following tests and examinations. Failure to meet any requirements specified herein shall be considered cause for rejection.

4.4.1 Test conditions. Unless otherwise specified, the battery shall be subjected to quality conformance tests under the following conditions:

4.4.1.1 Temperature: Room ambient 65 degrees F to 95 degrees F.

4.4.1.2 Humidity: Room ambient to 95 percent maximum, relative.

4.4.2 Test and inspection equipment and facilities. The manufacturer shall furnish and maintain all necessary test equipment and facilities and shall provide personnel for performing all quality conformance tests. The test equipment shall be adequate in quantity and, when definite requirements are not specified, shall be of sufficient accuracy and quality to permit performance of the required tests.

4.4.3 Test procedure

4.4.3.1 Cell pressure test. Remove the vent valves and apply 6 plus or minus 0.5 psig air pressure to each cell of the battery. (The cells shall be dry during this test.) Seal off the air supply and observe the internal pressure for at least 2 minutes, during which time the pressure drop shall not exceed 0.5 psig. During this test the four sides of the cell case (but not the cell top) may be restrained to prevent cell deformation.

4.4.3.2 Internal short (cell resistance) test. Apply the dc power source (4.3.2) in series with the current-limiting resistor (4.3.5) and the dc milliammeter (4.3.4) across the terminals of the individual cells in the dry condition as in Figure 2. Also connect dc voltmeter (4.3.3) across the same cell terminals. To meet the requirement of 3.4.11, the current in milliamperes, indicated by 4.3.4, shall not exceed in numerical value the voltage indicated by the dc voltmeter. An equivalent commercial ohmmeter is acceptable.

4.4.3.3 Inspection. Inspect the battery, in the dry condition, to ensure the following:

4.4.3.3.1 The polarity of each cell shall be compatible with the polarity established for the entire battery.

4.4.3.3.2 The weight of the battery plus the average weight of the electrolyte required to fill all cells to their normal level shall be 270 plus or minus 10 pounds.

4.4.3.3.3 The requirements for workmanship and dimensions are met.

4.5 Destructive tests

4.5.1 Conditions. The following tests involve destruction of the test sample, and shall be conducted on samples as specified in 4.2.3. Tests

shall be completed within 90 days after filling, and shall be conducted under test conditions specified in 4.4.1. Sample cells shall be placed in service, charged and recharged, as described in the applicable portion of the manufacturer's maintenance instructions referenced in 3.2.8.

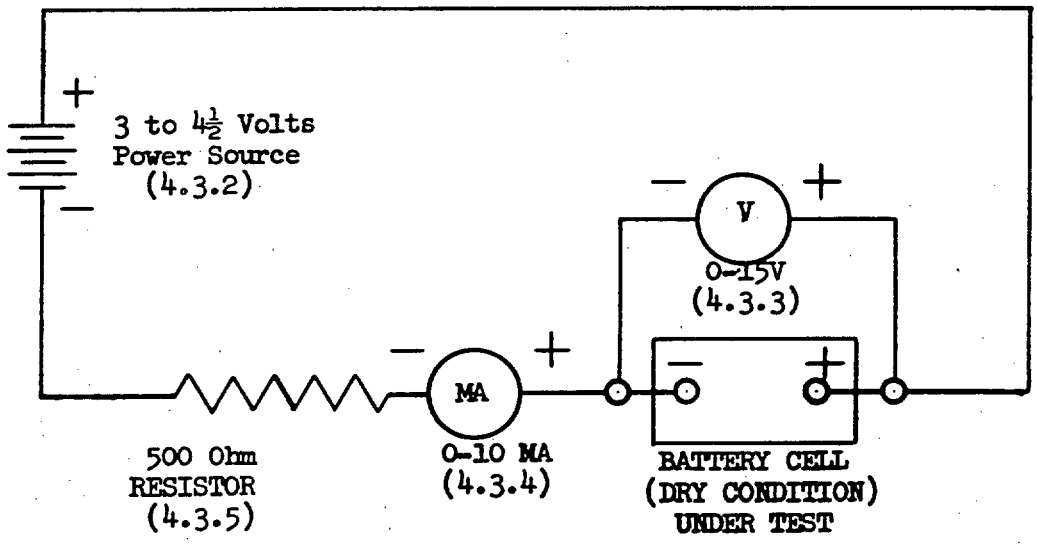

FIGURE 2. CELL RESISTANCE TEST

4.5.2 Capacity. To determine compliance with 3.4.5, the cells selected in accordance with 4.1.1.1 shall be tested as follows:

4.5.2.1 Discharge one fully charged propulsion cell at a 450 plus or minus 5 ampere rate for one 9-minute cycle, as given in Table I, when the electrolyte temperature is at 75 plus or minus 5 degrees F.

Discharge two fully charged propulsion cells connected in parallel at a 250 plus or minus 5 ampere rate for one 30-minute cycle, as given in Table I, when the electrolyte temperature is at 75 plus or minus 5 degrees F.

Discharge one fully charged propulsion cell at a 450 plus or minus 5 ampere rate for one 9-minute cycle, as given in Table I, when the electrolyte temperature is at 40 plus or minus 2 degrees F.

Discharge one fully charged propulsion cell at 24 plus or minus 1 amperes to an end voltage of 1.20 volts. The cell shall deliver 120 ampere-hours before the cell voltage drops below 1.20 volts.

Failure of any cell to meet the performance requirements will result in rejection of the cell lot.

4.5.2.1.1 Discharge the remaining fully charged propulsion cells of the sample at a 450 plus or minus 5 ampere rate for six 6-minute discharge and charge cycles, as given in Table I, when the electrolyte temperature is at 75 plus or minus 5 degrees F. Acceptance or rejection of the cell lot shall be in accordance with MIL-STD-414, Table B-3, AQL 1.0 percent, with one AQL value for upper and lower specification limits combined.

4.5.2.2 Discharge one fully charged auxiliary cell at a 36 plus or minus 1 ampere rate for one 30-minute cycle, as given in Table I, when the electrolyte temperature is at 75 plus or minus 5 degrees F.

Discharge another fully charged auxiliary cell at a 36 plus or minus 1 ampere rate for one 30-minute cycle, as given in Table I, when the electrolyte temperature is at 40 plus or minus 2 degrees F.

Discharge one fully charged auxiliary cell at 4.8 plus or minus 0.2 amperes to an end voltage of 1.20 volts. The cell shall deliver 24 ampere-hours before the cell voltage drops below 1.20 volts.

Failure of any cell to meet the performance requirements will result in rejection of the cell lot.

4.5.2.2.1 Discharge the remaining fully charged auxiliary cells of the sample at a 36 plus or minus 1 ampere rate for six 15-minute cycles, as given in Table I, when the electrolyte temperature is at 75 plus or minus 5 degrees F. Acceptance or rejection of the cell lot shall be in accordance with MIL-STD-414, Table B-3, AQL 1.0 percent, with one AQL value for upper and lower specification limits combined.

4.5.2.3 A cycle is defined as discharge of the unit under test at the current specified in Table I for the period of time specified, followed by recharging, within 48 hours of the next discharge, with not more than 150 percent of the ampere hours used during the original discharge. The manufacturer's maintenance instructions referenced in 3.2.8 will be followed in recharging the cells for further tests.

4.5.3 Stand. Allow the one-cell and two-cell assemblies specified in Table I to stand idle for 75 plus or minus 2 days fully charged. At the end of this standing period, the cells shall meet the pertinent capacity requirements given in Table I.

4.5.4 Leakage. The unit cells, when filled to their normal level with electrolyte and with vent valves in position, shall not leak electrolyte when turned bottom-side up. This test shall be performed within 24 hours after filling and the cell shall remain in the inverted position for a period of 15 minutes minimum.

4.6 Preservation, packaging, and packing. The inspector shall ascertain that the preservation, packaging, and packing of the batteries conform to Section 5 of this specification.

4.7 Preproduction and periodic production inspection. The preproduction and periodic production samples, after satisfactorily passing the quality conformance inspections detailed in 4.4, shall be subjected to the following tests and examinations:

4.7.1 Battery test sequence. Storage batteries, selected in accordance with 4.1.2 and 4.1.4, shall be tested in accordance with Test Sequence I or Test Sequence II, as determined by the testing activity and in accordance with the total number of batteries received.

NOTE: Except for charge-discharge Cycle 5 (which requires a 14-day temperature environment) the other five charge-discharge cycles shall be conducted at 9 to 14 day intervals.

Test Sequence I

(a) Fill with electrolyte and weigh

(b) Charge, Cycle 1

(c) Measure center of gravity, and inversion test

(d) Discharge, Cycle 1 (70°F - 80°F)

(e) Charge, Cycle 2

(f) Vibration

(g) Discharge, Cycle 2* (38°F - 42°F)

(h) Charge, Cycle 3

(i) Discharge, Cycle 3 (70°F - 80°F)

Test Sequence I (Cont'd)

(j) Charge, Cycle 4

(k) Shock

(l) Discharge, Cycle 4* (38°F - 42°F)

(m) Charge, Cycle 5

(n) Temperature

(o) Discharge, Cycle 5 (70°F - 80°F)

(p) Charge and discharge, Cycle 6 (70°F - 80°F)

*NOTE: The storage battery shall be preconditioned at a temperature of 38 degrees to 42 degrees F for a minimum period of 4 hours prior to discharge.

Test Sequence II

(a) Fill with electrolyte and weigh

(b) Charge, Cycle 1

(c) Measure center of gravity

(d) Shock

(e) Vibration

(f) Temperature

(g) Inversion

(h) One 9-minute discharge (70°F - 80°F)

NOTE: The one 9-minute discharge shall be conducted at 75 plus or minus 2 days after the battery has been filled with electrolyte.

Table I - Cell Capacity

Cells Tested	Current Drain in Amperes	Time in Minutes	Minimum 30 sec. Voltage (See Note 1)	Minimum No. of Readings (See Note 2)	Minimum Average Voltage (See Note 3)	No. of Cycles	Initial Electro-lyte Temp. In °F
One propulsion cell	450 ± 5	9	1.13	15	1.25	1	75 ± 5
" " "	"	6	1.13	10	1.25	6	75 ± 5
" " "	"	9	1.08	15	1.23	1	40 ± 2
" " "	"	6	1.08	10	1.23	6	40 ± 2
Two propulsion cells connected in parallel	250 ± 5	30	1.25	50	1.36	1	75 ± 5
" " "	"	15	1.25	25	1.36	6	75 ± 5
" " "	"	30	1.20	50	1.34	1	40 ± 2
" " "	"	15	1.20	25	1.34	6	40 ± 2
One auxiliary cell	36 ± 1	30	1.25	50	1.40	1	75 ± 5
" " "	"	15	1.25	25	1.40	6	75 ± 5
" " "	"	30	1.25	50	1.38	1	40 ± 2
" " "	"	15	1.25	25	1.38	6	40 ± 2

Note 1: This is the minimum voltage requirement 30 seconds after start of discharge.

Note 2: A continuous recording of voltage versus time is acceptable.

Note 3: This is the minimum average voltage over the range calculated from 30 seconds after start of discharge to the end of discharge time specified.

4.7.2 Vibration conditioning

4.7.2.1 Vibration; ready nonoperating condition (3.3.5). To determine compliance with 3.5.1, the battery, less pack and packaging and with normal quantities of electrolyte in each cell, shall be mounted securely on a vibration testing machine to simulate actual installation within a torpedo and shall be subjected to vibrations in accordance with Schedule I of 3.5.1.

During these tests the vibration frequency shall be continuously varied between each of the limits given, at a uniform rate over a three to five minute period, for the duration of the test.

As an alternate method, the battery shall be vibrated at specific frequencies differing by not more than five cps in each of the test axes and covering the entire frequency range and amplitudes of Schedule I. The total test time shall be not less than that of Schedule I and the test times at the specific frequencies shall be equally divided.

At the conclusion of the test the battery shall meet the performance and other requirements of this specification.

4.7.3 Shock conditioning

4.7.3.1 Shock; ready nonoperating condition (3.3.5). To determine compliance with 3.5.2, the battery, less pack and packaging and with normal quantities of electrolyte in each cell, shall be mounted securely on a shock testing machine to simulate actual installation within a torpedo. The battery shall be subjected to three shock pulses in each of the applicable directions along the axes defined in 3.5.2 (three pulses each on the forward and aft ends, three pulses each on the port and starboard sides, and three pulses on the bottom, for a total of 15 shock pulses). At the conclusion of this test, the battery shall be capable of meeting the performance and other requirements of this specification.

4.7.4 Temperature. To determine compliance with 3.5.3, the battery, less pack and packaging, shall be subjected to temperature cycling as follows:

The battery shall be placed in a test chamber in which the temperature ranges from plus 70 degrees F to plus 80 degrees F. The test chamber shall then be heated to plus 130 degrees F plus 0 degrees F minus 5 degrees F within a period of one hour and held at this temperature for a period of five hours. During the following two hours the temperature must decrease uniformly to minus 20 degrees F plus or minus 2 degrees F and be held at this temperature for a seven hour period. During the following one hour period the temperature shall be increased uniformly to 70 degrees F to 80 degrees F and be held at this temperature for an eight hour period. This temperature cycle shall be repeated for 14 consecutive 24-hour periods.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging

5.1.1 Level A

5.1.1.1 Unit preservation and packaging. Not applicable.

5.1.2 Level C

5.1.2.1 Cleaning, drying, preservation, and unit packaging. Cleaning, drying, preservation, and unit packaging shall be in accordance with the manufacturer's commercial practice.

5.1.3 Packaging of sample cells. The test cells (3.2.2.3) shall be packaged for delivery in accordance with the manufacturer's commercial practice (Level C).

5.2 Packing

5.2.1 Level A. The battery shall be packed in accordance with LD 620045.

5.2.2 Level C. The battery, packaged in accordance with 5.1.2.1, shall be packed in accordance with approved commercial packing methods adequate to protect the battery from damage and to ensure safe delivery at destination. The method used shall conform to the applicable carrier rules and regulations and be commensurate with shipping at the lowest practical commercial rate.

5.3 Marking

5.3.1 Normal marking. In addition to any special marking required by the contract or order, unit packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

5.3.2 Serial numbers. Unit packages and shipping containers shall be marked with the serial number of the unit contained within.

6. NOTES

6.1 Intended use. Battery Mk 53 Mod 0 is designed to provide propulsion and auxiliary power for a torpedo.

6.2 Ordering data. Procurement documents should specify the specific title, number, and date of this specification and exceptions to this specification, applicable drawings and other documents, and selection of applicable levels of preservation, packaging, and packing.

6.2.1 All additional samples required because of the failure of any unit(s) to pass prescribed periodic production inspections shall be provided and inspected at the expense of the supplier.

6.3 Levels of preservation and packaging

6.3.1 Level A, military package. This package provides preservation and packaging which will give adequate protection against corrosion, deterioration, and physical damage during shipment, handling, storage, and world-wide distribution.

6.3.2 Level C, minimum military package. This package provides preservation and packaging which will give adequate protection against corrosion, deterioration, and physical damage during shipment from the supply source to a receiving activity for immediate use. This level may conform to the supplier's commercial practice whenever such practice meets the requirements of this level.

6.4 Levels of packing

6.4.1 Level A, military pack. This pack provides adequate protection during shipment, handling, storage, and world-wide distribution.

6.4.2 Level C, minimum military pack. This pack is used only to provide adequate protection during direct shipment from the supply source to the first receiving activity for immediate use. In general, this level will conform to applicable carrier rules and regulations and may be the supplier's regular commercial practice whenever such practice meets the requirements of this level.

6.5 Filling kit. Squeeze-type, polyethylene measuring bottles with threaded or tapered filling nozzles that provide a tight, leak-proof fit when inserted into the filling hole of the individual cells have been generally satisfactory.

6.6 Storage life. The battery, preserved and packaged in accordance with Section 5, is intended to withstand unattended storage for 5 years at temperatures between minus 20 degrees F and plus 110 degrees F and thereafter be capable of meeting the performance requirements and product characteristics of this specification.