UNITED STATES MARINE CORPS
MARINE CORPS RECRUIT DEPOT/EASTERN RECRUITING REGION
PO BOX 19001
PARRIS ISLAND, SOUTH CAROLINA 29905-9580

IN REPLY REFER TO:
DepO 8000.7B
PWO/ESO

JUL 14 2020

DEPOT ORDER 8000.7B

From: Commanding General
To: Distribution List

Subj: LIGHTNING PROTECTION SYSTEMS TEST PLAN

Ref: (a) NAVSEA OP-5, Volume 1, 7th Revision
(b) MCO 8020.10
(c) UFC 3-575-01
(d) NFPA 780

Encl: (1) Introduction to Lightning Protection Systems
(2) Warnings and Testing Procedures (24 month) for Above Ground Magazines (AGM)
(3) Testing Procedures (24 month) for Earth Covered Magazines (ECM)
(4) Testing Procedures for Ready Service Lockers (24 Month)
(5) Visual Inspection Procedures (6 Month)

1. Situation. This Order provides established procedures for conducting visual inspections and electrical resistance testing for all Lightning Protection Systems (LPS) related buildings and structures in support of Ammunition and Explosives (A&E) operations. Lightning protection is required for all ordnance handling, operating and storage facilities or areas.

2. Cancellation.

3. Mission. All visual inspections and electrical resistance testing shall be conducted in a manner which complies with this order.

4. Execution

a. Commander's Intent and Concept of Operations

(1) Commander's Intent. To provide guidance and policy on LPS for buildings and structures that support A&E operations aboard the Depot.

(2) Concept of Operations. Ensure the LPS and grounding systems for all A&E areas are inspected, maintained, repaired, tested and documented to ensure they meet the requirements set forth in the references and this Order.

b. Tasks

(1) Public Works Officer (PWO)

(a) Perform electrical resistance tests on all primary lightning protection systems and secondary grounding systems, including ordnance grounds, static grounds, structural grounds, metal masses, gates, etc., as required. Clearly mark the ordnance test reference point and static grounds when required by the references.

(b) Electrical resistance testing of systems is required every two years. Document and retain six cycles (12 calendar years) of testing results.

(c) Visually inspect all primary LPS (structural ground, metal masses, fences and gates) as required. Spot check electrical equipment and installation when performing visual inspections. Visual inspections are required every six months and must also be forwarded to the ESO.

(d) Provide personnel required to perform visual inspections and electrical resistance testing of lightning protection and ground systems with a grounding system inspection plan and test point location for each facility.

(e) The inspection plan must identify all inspections points and shall be signed by the individual conducting the inspection. Repair immediately all discrepancies found during the inspection. Document all corrective actions and forward to the Explosives Safety Officer (ESO).

(f) Personnel assigned to perform visual inspections and electrical resistance tests on lightning protection systems and secondary grounding systems must have successfully completed the AMMO-29 (Electrical Explosives Safety for Naval Facilities) class. Course and registration information for web-based training/computer-based training (WBT/CBT) or instructor-led training can be found at http://www.dactces.org.

(g) Training must be continually reviewed and updated to ensure required training remains relevant. Assign only certified personnel to perform tests and inspections.

c. Explosive Safety Officer

(1) Monitor the lightning protection and grounding system program.

(2) Review schedule for the lightning protection and grounding system test plan for visual inspections and electrical resistance tests.

(3) Review written test procedures established in this instruction as per changes in the requirements, or major changes in systems.

(4) Review all test data and maintain for five years. Analyze all test data for trend development and to determine that all referenced specifications are met.

(5) Monitor necessary corrective action to correct discrepancies found during inspections or reported by other means by unit/department representatives.

(6) Review drawings with other necessary entities for all new explosive buildings, magazines, new additions and replacement of equipment to ensure all necessary bonding, grounding and lightning protection requirements are included.

(7) In conjunction with Explosive Safety Self Assessments (ESSA's), inspect all bonding, grounding and lightning protection systems installed in explosive operating buildings, storage areas, magazines and workplaces.

(8) Review work requests through the PWO for all testing, and or additional system installation or repair requirements.

d. Facilities Engineering and Acquisition Division Director

(1) Ensure that all drawings for all new explosive buildings, magazines, new additions and replacement of equipment include all necessary bonding, grounding and lightning protection requirements per the references.

(2) Assist other organizations with technical advice.

(3) Provide scaled drawings of each facility in the lightning protection and grounding system test plan as required.

(4) Contact the ESO to review plans prior to installation of or major changes to lightning protection or grounding systems.

(5) Monitor contract work closely to ensure that grounding systems are not painted over, dismantled or damaged by contractors.

(6) Ensure that when new metal doors, door frames, metallic masses (400 square inches or larger), gutters, downspouts, etc., are replaced, the contractor installs or replaces appropriate grounds and test as per requirements identified in the references.

(7) Contact the ESO to review plans prior to installation of or major changes to lightning protection or grounding systems. Ensure that new facilities, with an explosives safety related lightning hazard, have proper lightning protection/grounding systems and are tested as per the references. Notify the ESO to place facilities on the lightning protection and grounding system test plan schedule.

(8) Ensure that no excavation work is performed in the vicinity of ordnance facilities (buildings/magazines) before identifying the location of the primary and secondary ground
girdles.

f. Unit Commanders/Department Heads

(1) Ensure all explosive storage and handling facilities with lightning, electrical, and electrostatic grounding systems are made available to maintenance personnel for inspection, maintenance repairs and testing.

(2) Report any lightning protection or grounding deficiencies, testing requirements or additional system installation or repair requirements to the ESO.

5. Administration and Logistics

a. Recommendations concerning the contents of this Order are invited. Such recommendations will be forwarded to the Chief of Staff (Attn: Safety/ESO), Marine Corps Recruit Depot, Parris Island (MCRDPI), through the appropriate chain of command.

b. An electronic copy of this order can be found on the Depot Safety SharePoint Site under the Shared Documents folder.

6. Command and Signal

a. Command. This Order is applicable to personnel and all activities within MCRDPI involved in any aspect of A&E operations that require lightning protection/grounding systems.

b. Signal. This Order is effective the date signed.

C. J. WILLIAMS
Chief of Staff

Distribution: A

Copy to:
PWO
SAS (ASP)
CO, WFTBn (Ammo Section)
Depot Safety (ESO)

Introduction to Lighting Protection Systems

1. Lightning Protection Systems (LPS) consist of a primary lightning grounding system and a secondary ground girdle. The primary grounding system is equipped with lightning masts and down conductors. These masts are linked together with underground wire cable. The secondary ground girdle is a continuous wire girdle three feet from the building and buried three feet in the earth. These two wire girdles are separately stretched around the structure. The two wire girdles are connected in not less than two places in order to maintain the same potential to each other and they are tested to 25 ohms or less to earth. The girdles serve as a ground for the structure and grounding for the LPS. They are tested by using the three point fall of potential method, using the Test Reference Point (TRP) as the primary ground test point. A calibrated digital test instrument shall be used for testing by qualified maintenance personnel.

2. The secondary ground girdle serves as an earth ground for the structure and all other grounds used in the structure. Bond to the secondary ground girdle shall measure less than 1 ohm resistance. All other buildings' structural steel and all metallic objects within the primary girdle which exceed 400 square inches (both inside and outside) are connected to the ground girdle and shall be at the same potential as the LPS. This prevents side flash and static buildup in and around the facility being protected. Figure 5-4 of reference (a), gives an overview of a typical ordnance handling facility and depicts the fact that all grounds are bonded together at the lowest point to the secondary ground girdle.

3. The instructions contained in this enclosure will assist in the testing of systems on above ground magazines, earth covered magazines, ready service lockers, handling buildings or static grounds (if used) and visual inspection procedures. All results of the 24 month lightning/grounding electrical resistance tests must be recorded and maintained for a minimum of six two-year cycles (12 calendar years). The visual inspection shall follow the check list in enclosure (4) and be performed every six months. The lightning/grounding electrical resistance test and visual inspections will always be accomplished by trained/certified personnel.

4. Maintenance of electrical equipment and installations must be done in accordance with manufacture instructions or during the six month visual inspection described in paragraph 5-8.3 of reference (a), and maintained periodically by qualified personnel. Inspection authorities and maintenance personnel shall exercise extreme care when inspecting and performing maintenance on electrical installations in hazardous (classified) locations.

All explosives contamination shall be removed from the equipment before maintenance is performed. Insulating floor mats and bench covers shall be used as deemed necessary by the local activity to avoid electrical shock hazards. A written record of inspections and maintenance work performed shall be kept for a minimum of six equipment/facilities inspection cycles. Exposed power circuits will not be worked on in a building or room containing exposed explosives.

5. Repairs and replacements to electrical equipment in relation to LPS shall be made only by qualified personnel authorized to do such work. When equipment may have been exposed to contamination from explosives, the contamination must be removed or neutralized before repairs are started. When repairs and replacements are completed, qualified personnel shall inspect the equipment and shall keep a record of the work. Records shall be maintained with LPS documents for six inspection cycles, in accordance with reference (a).

Warnings and Test Procedures (24 Month) for Above Ground Magazines (AGM)

1. DISCONNECT ALL ORDNANCE FROM STATIC GROUNDS PRIOR TO TESTING.

2. ALL INSTRUCTIONS FOR USE OF COMMUNICATION EQUIPMENT IN ORDNANCE AREAS SHALL BE STRICTLY ADHERED TO AT ALL TIMES.

3. An above ground storage magazine (AGM) is typically comprised of a primary lightning protection system and a secondary ground girdle. These grounding/lightning protection systems serve to protect personnel and equipment from the potential of lightning strikes and the build-up and uncontrolled discharge of static electrical charges.

a. Test as follows:

(1) Ensure that the earth ground tester is calibrated and all of its equipment is present and operational.

(2) Locate the wire that bonds the lightning mats together around the building to be tested (primary girdle). The Test Reference Point (TRP) connection should be located in the test well of next to the LPS mast.

(3) Clean a connection point on the wire cable or grounding rod. This is where the earth tester will be connected for the earth test; 25 ohms or less is required. The cleaned area on the wire cable or rod is now called your TRP. Continuity readings will be taken from this point (after the earth ground test). Disconnect all cables from the rod.

(4) Test the TRP (25 ohms or less is required), record the reading and date on the test record sheet and reconnect all cables. Secure the earth connector in its case.

(5) Using a zeroed digital resistance meter with long leads, check for continuity from the TRP to the first lightning mast, from the second mast to the third and so on. A high reading will indicate a break in the wire cable you are reading back through the system. No reading will indicate there is more than one break in the cable linking the masts together.

(6) If the continuity readings from mast to mast are good (less than 1 ohm), record and go to the next step. If breaks were detected, disconnect the wire cable from the mast and run a new continuous cable from mast to mast.

(7) Mast Inspection: The lightning mast shall not be closer than 6 feet to the structure and no further away than 25 feet.

EXAMPLE: Mast 40 feet high 20 feet from the structure 1/2 the height of the mast.

EXAMPLE: Mast 60 feet high 25 feet from the structure, wood mast shall be capped at the top and have two down conductors. The mast shall be high enough to protect the structure from a lightning strike.

(8) Inspection of metallic objects passing through the zone of lightning protection to the building being protected. These objects are usually steam pipes, railroad tracks, etc. These objects shall be bonded prior to entering the lightning protection zone. Bond them to the primary lightning protection wire girdle and make these areas a test point.

NOTE: ELECTRICAL TRANSMISSION LINES AND COMMUNICATIONS LINES SHALL BE BURIED FOR THE LAST 50 FEET PRIOR TO ENTERING THE STRUCTURE.

(9) You have completed the test and inspection on the primary lightning protection system by verifying there is continuity from lightning mast to lightning mast and back to your test reference point. All metallic objects passing through the zone of protection must be connected to the primary lightning protection system. Record all readings as required on the test record sheet.

(10) Locate the ground girdle. According to design it is three feet from the structure and buried three feet in the ground.

NOTE: MOST OF THE TIME THE GROUND CABLE (GIRDLE) CAN BE LOCATED BY SEEING A CABLE RUNNING OUT OF THE GROUND CLOSE TO THE FOOTER AND THEN RUNNING TO THE STRUCTURE OR IT MAY BE LOCATED ON THE FLOOR INSIDE THE STRUCTURE.

(11) Identify all cables around the structure. Run a continuity check from these cables to the primary lightning protection TRP (1 ohm or less is required). If no reading can be established, the secondary and primary girdles are not connected together. First check for grandfather clauses (for older systems). Notify station safety/FMD. Perform repairs as required.

(12) Zero the digital resistance tester if the leads have been changed. Test continuity from the ground girdle to all metallic objects within the primary girdle inside and outside the structure, including windows, doors, conduit, structural overhangs, ladders, etc. Connection shall be 1 ohm or less. Record the readings on the test record sheet.

3. SUMMARY:

a. Maintenance personnel and the ESO will ensure that all readings are recorded on current test records and will check with previous readings for any variations to determine if there are any possible system integrity problems.

b. Maintenance personnel and ESO will file the record for use during the next 24-month test. The record can be used for six 24-month tests. The maintenance personnel will correct any discrepancies discovered during testing and report corrective action to the ESO.

NOTE: ALL METALLIC OBJECTS (400 square inches or more) WITHIN THE PRIMARY GIRDLE OF A PROTECTED ORDNANCE STRUCTURE SHALL BE AT THE SAME POTENTIAL AS THE LIGHTNING PROTECTION SYSTEM.

NOTE: GROUNDS ARE TO BE CONNECTED TO THE GIRDLE AT THE LOWEST POINT OF THE SYSTEM.

Testing Procedures (24 Month) for Earth Covered Magazines (ECM)

1. The concrete construction of an ECM is reinforced with steel bars. Some also have steel casings inside. These reinforcement bars or cases are connected to or are considered the primary lightning protection and grounding system. This forms an umbrella of protection (Faraday Cage) for the ordnance stored inside the structure. This system is tested to 25 ohms or less to a TRP (earth to ground).

a. Test as follows:

(1) Ensure that the earth ground tester or equivalent tester is calibrated and that all of its equipment and cables are present. Follow floor diagram of all the test points to be tested.

NOTE: A RECORD SHEET TO RECORD READINGS AND FLOOR/AREA DIAGRAM WILL BE DRAWN OR A TEMPLATE USED BY THE TESTER.

(2) Locate the ground girdle (if applicable) for the structure. According to design, it is three feet from the structure and buried three feet in the ground (located in test well or under white PVC cap by bulkhead wall).

NOTE: USUALLY, IF THERE IS A GROUND GIRDLE CABLE IT WILL EXTEND OUT OF THE GROUND CLOSE TO THE HEADWALL AND CONTINUE INTO THE STRUCTURE. SOMETIMES THE GROUND CABLE WILL EXTEND OUT OF THE FLOOR INSIDE THE BUILDING.

(3) Clean a connection point on the ground girdle, wire,cable, rod or some point on structural steel. This is where the earth tester will be connected for the earth test (25 ohms or less is required). This cleaned area is called your TRP. Continuity readings will be taken from this point after the earth ground test. Disconnect all cables from ground rod (when used).

(4) Test the ground girdle, record the reading and date on the test record sheet, and reconnect all cables. Secure the earth tester in its case.

(5) Zero a digital resistance tester if the leads have been changed. Test continuity from the TRP to all metallic objects of or around the structure, including doors, conduit, structural overhangs over doors, metal ventilators, security

Testing Procedures (24 Month) for Ready Service Lockers

1. Ready Service Lockers (RSL) are metal safe-like containers used to temporarily store munitions prior to use and are portable or mounted on metal skids.

a. Test as follows:

(1) Ensure that the earth ground tester or equivalent tester is calibrated and that all of its equipment is present. Follow area diagram of all the points to be tested.

NOTE: A RECORD SHEET TO RECORD READINGS AND FLOOR/AREA DIAGRAM WILL BE DRAWN OR A TEMPLATE USED BY THE TESTER.

(2) Locate the ground rods for the container. According to design, it is no more than three feet from the container on opposite corners.

(3) Clean a connection point on the ground rod and connects to the down strap. This is where the earth tester will be connected for the earth test (25 ohms or less is required). This cleaned area on the rod is called your TRP. Continuity readings will be taken from this point after the earth ground tested and disconnect all cables.

(4) Test the ground rod, record the reading and date on the test record sheet, and reconnect all cables. Secure the earth tester in its case.

(5) Zero the digital resister tester. You can now check all the test points as identified on the diagram for that container (less than 1 ohm resistance to the TRP is required). Record the readings on the test record sheet.

2. Maintenance personnel and the ESO will ensure that all readings are recorded on the test record sheet. The ESO will check with previous readings for any variations to determine if there are any possible system integrity problems.

3. Maintenance personnel will submit the record to the ESO for file so it can be used during the next 24-month test. The record can be used for six 24-month tests. Maintenance personnel will correct any discrepancies discovered during testing and forward corrective action to the ESO.

Visual Inspection Procedures (6 Month)

1. Visual inspection shall be conducted every six months.

a. The following procedures will be followed:

(1) Ensure that any large metal objects within the primary grid, or inside of the lightning masts, are connected to the primary ground girdle or bonded to structural steel.

(2) Inspect cables connected to lightning masts to ensure that they are in good condition and are at least 1/0 AWG or larger, made of bare copper wire, are attached to the mast, have no sharp bends in wire, and have no more than 1/3 of the strands are broken. Repair, replace, or install new cables as needed.

(3) On lightning-protected buildings, inspect to see that there are no trees in the protected area.

(4) Randomly inspect all grounding system connections to see that they are secure and free from paint, corrosion, or foreign materials which may impair ground system efficiency. Make repairs as necessary. Inspect both inside and outside of building.

(5) Check to see that all metal masses (400 square inches or larger) are connected to the secondary ground girdle. Examples of masses are metal siding doors, shutters, an
trusses. Repair or add bonding as needed.

(6) Check ordnance ground buses, static ground buses and instrumentation ground buses for clear identification of each, and make sure connections are secure (pull test) and connection points are free from paint, corrosion, or foreign material that may impair the efficiency of the system. Repair if needed.

(7) Check to see that all utilities coming into the buildings are buried the last 50 feet.

(8) Check to ensure all 120 volt single phase receptacles installed outdoors or in wet locations are ground fault circuit interrupters. Repair if needed.

(9) Ensure all metallic conductors, to include those for intrusion detection lines, water, electrical, steam, HVAC lines, and all similar conductive lines are run underground the last 50 feet to the building.

(10) Ensure fences are bonded to lightning protection system if they come within so feet or as determined by NFPA 780. Ensure all fences are grounded every 50 feet if high-tension lines cross fencing, are directly overhead or run parallel to fences. Ensure that fences are grounded at places where personnel may routinely touch the fence and areas where structure and materials are located within 6 feet of the fence.

(11) Review previous test records to ensure fences are bonded from gate post to gate post, gate post to gate, and gate post to secondary ground girdle, if within zone of protection. If outside zone of protection, ensure ground rods are driven on each side of gatepost in place of connecting to secondary girdle.

2. Maintenance personnel will submit the record to the ESO for file so it can be used during the next 24-month test. The record can be used for six 24-month tests. Maintenance personnel will correct any discrepancies discovered during testing and report corrective action to the ESO.