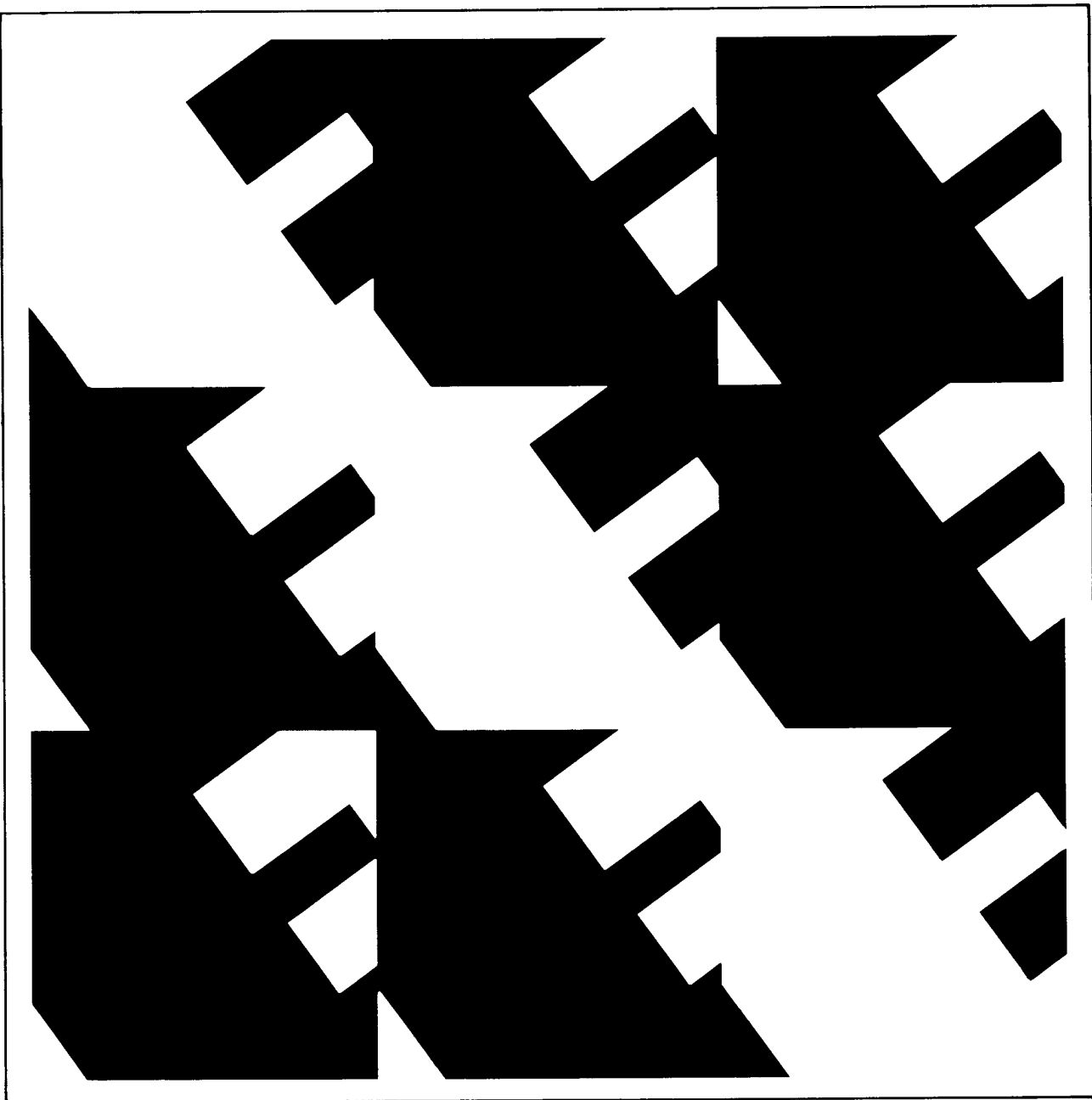


IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations

ANSI/IEEE Std 450-1987



Published by The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017, USA

March 9, 1987

SH10991

An American National Standard

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1. Scope

This recommended practice is limited to providing recommended practices of maintenance, test schedules, and testing procedures that can be used to optimize the life and performance of large lead storage batteries. It also provides guidance to determine when batteries should be replaced. There are other test procedures and replacement techniques used within the industry (especially for smaller substation batteries) which are equally as effective but are beyond the scope of this recommended practice.

Sizing, installation, qualification, other battery types, and application are also beyond the scope of this recommended practice.

This recommended practice does not include any other component of the dc system nor surveillance and testing of the dc system, even though the battery is part of that system. Pre-operational and periodic dc system tests of chargers and other dc components may require that the battery be connected to the system. Details for these tests will depend on the requirements of the dc system and are beyond the scope of this recommended practice.

2. Definitions

The following definitions apply specifically to the subject matter of this recommended practice. For other definitions see Section 3, References.

acceptance test (lead storage batteries). A constant current capacity test made on a new battery to determine that it meets specifications or manufacturer's ratings.

battery rack. A structure used to support a group of cells.

capacity test (lead storage batteries). A discharge of a battery to a designated terminal voltage.

performance test (lead storage batteries). A constant current capacity test made on a battery normally in the "as found" condition, after being in service, to detect any change in the capacity determined by the acceptance test.

service test (lead storage batteries). A special test of the battery's capability, as found, to satisfy the design requirements (battery duty cycle) of the dc system.

terminal connection detail (lead storage batteries). Connections made between rows of cells or at the positive and negative terminals of the battery, which may include lead-plated terminal plates, cables with lead-plated lugs, and lead-plated rigid copper connectors.

3. References

This recommended practice shall be used in conjunction with the following publications:

[1] ANSI/IEEE Std 100-1984, IEEE Standard Dictionary of Electrical and Electronics Terms.¹

[2] ANSI/IEEE Std 308-1980, IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.

[3] ANSI/IEEE Std 323-1983, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

¹ ANSI publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY, 10018.

[4] ANSI/IEEE Std 485-1983, IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations.

[5] ANSI/IEEE Std 494-1974 (R1983), IEEE Standard Method for Identification of Documents Related to Class 1E Equipment and Systems for Nuclear Power Generating Stations.

[6] ANSI/IEEE Std 535-1986, IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations.

[7] ANSI/IEEE Std 946-1985, IEEE Recommended Practice for the Design of Safety Related DC Auxiliary Power Systems for Nuclear Power Generating Stations.

[8] IEEE Std 484-1987, IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations.²

4. Maintenance

4.1 General. Proper maintenance will prolong the life of a battery and will aid in assuring that it is capable of satisfying its design requirements. A good battery maintenance program will serve as a valuable aid in determining the need for battery replacement. Station battery maintenance should be performed by personnel knowledgeable of batteries and the safety precautions involved.

4.2 Safety. The safety precautions listed herein should be followed in station battery maintenance. Work performed on batteries should be done only with the proper and safe tools and with the protective equipment listed.

4.2.1 Methods. Work performed on a battery in service should use methods to preclude circuit interruption or arcing in the vicinity of the battery.

4.2.2 Protective Equipment. The following protective equipment should be available to personnel who perform battery maintenance work:

- (1) Goggles and face shields
- (2) Acid-resistant gloves
- (3) Protective aprons
- (4) Portable or stationary water facilities for rinsing eyes and skin in case of acid spillage

² IEEE publications are available from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ, 08854.

(5) Bicarbonate of soda, mixed 1 lb to one gal water.

4.2.3 Precautions. The following protective procedures should be observed during maintenance:

- (1) Use tools with insulated handles.
- (2) Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.
- (3) Ensure that the load test leads are connected with sufficient length of cable to prevent accidental arcing in the vicinity of the battery.
- (4) All connections to load test equipment should include short-circuit protection.
- (5) Ensure that battery area ventilation is operable.
- (6) Ensure unobstructed egress from the battery area.
- (7) Avoid the wearing of metallic objects such as jewelry.
- (8) Neutralize static buildup just before working on battery by having personnel contact nearest effectively grounded surface.

4.3 Inspections. All inspections should be made under normal float conditions. Specific gravity readings are not meaningful during charge or following the addition of water. Readings should be taken in accordance with the manufacturer's instructions. Refer to the Appendixes for more information.

4.3.1 General. Inspection of the battery on a regularly scheduled basis (at least once per month) should include a check and record of the following:

- (1) Float voltage measured at battery terminal
- (2) General appearance and cleanliness of the battery, the battery rack, and battery area
- (3) Charger output current and voltage
- (4) Electrolyte levels
- (5) Cracks in cells or leakage of electrolyte
- (6) Any evidence of corrosion at terminals, connectors, or racks
- (7) Ambient temperature and condition of ventilation equipment
- (8) Pilot-cell (if used) voltage, specific gravity, and electrolyte temperature

4.3.2 Quarterly. At least once per quarter a general inspection should be augmented as follows. Check and record:

- (1) Specific gravity of each cell
- (2) Voltage of each cell and total battery terminal voltage