

18. Recommended Practice for Vented Standby Battery Backup System Inspection and Maintenance

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Abstract: This recommended practice provides guidelines for inspecting and maintaining rail transit vented standby batteries used for backup dc power.

Keywords: backup battery, backup dc, battery backup, dc power, inspection, maintenance, signal, un-interruptible power supply, UPS, vented battery, vented standby battery

Introduction

(This introduction is not a part of APTA RT-SC-RP-018-03, *Recommended Practice for Vented Standby Battery Backup System Inspection and Maintenance*.)

APTA rail transit safety standards and recommended practices represent an industry consensus on practices for rail transit systems to help achieve a high level of safety for passengers, employees, and the general public. This document was created by and for those parties concerned with its provisions; namely, rail transit systems (operating agencies), manufacturers, consultants, engineers, and general interest groups. This recommended practice provides guidelines for inspecting and maintaining rail transit vented standby battery backup systems.

APTA recommends this practice for:

- Individuals or organizations that inspect, maintain, and/or operate rail transit systems
- Individuals or organizations that contract with others for the inspection, maintenance, and/or operation of rail transit systems
- Individuals or organizations that influence how rail transit systems are inspected, maintained, and/or operated (including but not limited to consultants, designers, and contractors)

The application of any practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of how a rail transit system operates. In such cases, the government regulations override any conflicting practices this document recommends.

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Recommended Practice for Vented Standby Battery Backup System Inspection and Maintenance

1. Overview

1.1 Scope

This document establishes recommended guidelines for inspecting and maintaining rail transit vented standby battery backup systems (also applies to un-interruptible power supplies). This recommended practice does not apply to sealed battery systems, which are generally considered to be maintenance free.

1.2 Purpose

The purpose of this recommended practice is to verify that vented standby battery backup systems and equipment are operating safely and as designed through periodic inspection and maintenance, thereby increasing reliability and reducing the risk of hazards and failures.

2. Definitions and acronyms

For the purposes of this recommended practice, the following definitions and acronyms apply:

2.1 Definitions

2.1.1 ambient temperature: The temperature of liquid or air surrounding any electrical part or device.

2.1.2 battery cell: A unit contained in a battery that produces a direct voltage by converting chemical energy to electrical.

2.1.3 battery terminal voltage: The total voltage measured between the positive and negative battery terminals.

2.1.4 battery terminal: A piece of conductive material used as a point of connection on a battery for attaching the positive or negative leads of a device.

2.1.5 battery: A device that converts chemical energy to electrical energy.

2.1.6 cell terminal: An external connection point on a battery cell of specific polarity.

2.1.7 cell: The smallest, indivisible unit of a battery; the fundamental electrochemical unit.

- 2.1.8 charger output current:** The total amount of current measured at the output of a battery charger unit when connected to one or more batteries.
- 2.1.9 charger output voltage:** The voltage measured at the output of a battery charger unit.
- 2.1.10 charging equipment meter:** A device used for monitoring and measuring the voltage and current outputs of a battery charging unit.
- 2.1.11 corrosion inhibitor:** A substance used on metal surfaces to prevent the chemical action of corrosion.
- 2.1.12 distilled water:** Water that has been purified through an evaporation or condensation process.
- 2.1.13 hazard:** Any real or potential condition that can cause injury, death, or damage or loss of equipment or property.
- 2.1.14 hydrometer:** An instrument that measures the specific gravity of a liquid such as the electrolyte of a storage battery.
- 2.1.15 operations control center (OCC):** A location or locations designed, equipped, and staffed for the purposes of monitoring and controlling RTS activities from a central location or locations. *Syn:* **rail control center, rail operations center, rail service control center.**
- 2.1.16 original equipment manufacturer (OEM):** The enterprise that initially designs and builds a piece of equipment.
- 2.1.17 personal protective equipment (PPE):** All clothing and other work accessories designed to create a barrier against workplace hazards. Examples include safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons, and work boots.
- 2.1.18 pilot cell voltage:** The voltage of a selected cell that is assumed to be the voltage of the entire battery.
- 2.1.19 power supply:** A unit that supplies electrical energy and maintains constant voltage and/or current output within in specific limits.
- 2.1.20 rail transit system (RTS):** The organization or portion of an organization that operates rail transit service and related activities. *Syn:* **operating agency, operating authority, transit agency, transit authority, transit system.**
- 2.1.21 sealed battery system:** A network of batteries sealed to prevent the leakage of its gas or liquid contents.
- 2.1.22 terminal buss bar** A heavy strap or bar normally made of copper, used to carry heavy currents or to make a common connection between several points.

2.1.23 torque wrench: A device that sets, limits, and measures the amount of rotational force.
See also: torque.

2.1.24 torque: A force that produces rotational twisting.

2.1.25 un-interruptible power supply (UPS): A system that provides continuous electrical power and acts as a backup power supply in the event of utility power loss.

2.1.26 vented lead acid battery: A non-sealed storage battery consisting of electrodes immersed in an electrolyte of dilute sulfuric acid. The electrodes contain lead oxides that change their composition as the cell is charged or discharged.

2.1.27 vented standby battery: A storage battery system vented to outside or circulating air that is held in reserve to serve as a backup power source in the event the regular power source fails.

2.1.28 ventilation: The act or process of circulating air for the purpose of exhausting undesired heat, fumes, and/or gases.

2.2 Acronyms

MSDS	material safety data sheets
OCC	operations control center
OEM	original equipment manufacturer
PPE	personal protective equipment
RTS	rail transit system

3. Inspection and maintenance provisions

3.1 Inspection and maintenance frequency

The inspection and maintenance procedures in this recommended practice should be performed

- a) when vented standby battery backup systems or equipment are placed in service
- b) when vented standby battery backup systems or equipment are modified, repaired, or disarranged
- c) at the frequencies recommended in Table 1 below
- d) as otherwise deemed necessary by the RTS

Table 1 – Inspection and maintenance frequency

Backup equipment parts (items for inspection and/or maintenance)	Recommended inspection frequency (minimum)
Case	Monthly (every 30 days)
Corrosion: cell and battery terminal	Monthly
Connections: broken or shorted leads	Monthly
Electrolyte level	Monthly
Electrolyte temperature	Monthly
Pilot cell voltage	Monthly
Float and equalization voltages	Monthly
Charger output voltage and current	Monthly
Ambient temperature and ventilation	Monthly
Apply equalization voltage	Monthly
Specific gravity	Quarterly (every 120 days)
Dust accumulation	Quarterly
Individual cell and battery terminal voltage	Quarterly
Torque terminal buss bar connections	Annually
Clean terminals and apply corrosion inhibitor	Annually

The RTS should determine the need for additional inspection and maintenance frequencies for vented standby battery backup systems. A review of the following factors may be useful in making this assessment:

- OEM-recommended intervals
- Industry experience
- Operating environment/conditions
- Historical data
- Reliability-centered maintenance program development

- Failure analysis
- RTS testing and experience
- Regulatory requirements

The frequency of tasks should comply with applicable federal, state, and local regulations.

3.2 Training

The RTS and/or their maintenance contractors should develop and execute training programs that provide employees with the knowledge and skills necessary to safely and effectively perform the tasks outlined in this recommended practice.

3.3 Materials

The following materials are recommended for inspecting and maintaining vented standby battery backup systems:

- Non-conducting cleaning supplies
- Battery terminal cleaner
- Corrosion inhibitor
- Electrolyte/distilled water
- Additional materials as required by the OEM and/or RTS

3.4 Tools

The following tools are recommended for inspecting and maintaining vented standby battery backup systems:

- Hydrometer*
- Thermometer*
- Digital multi-meter*
- Torque wrench*
- Application brush*
- Battery tester*
- RTS-approved portable radio
- Standard tools carried by maintenance personnel

- Additional tools as required by the OEM and/or RTS

* Calibrate in accordance with OEM and/or RTS requirements.

3.5 Personal protective equipment

Personal protective equipment, as required by the RTS, should be worn at all times during inspection and maintenance.

The following RTS-approved safety/personal protective equipment is recommended for inspecting and maintaining vented standby battery backup systems:

- Safety goggles
- Face shield
- Gloves/chemical resistant
- Apron and sleeves/chemical resistant
- Rubber boots/boot shields
- Emergency eyewash kit
- First-aid kit
- Additional personal protective equipment, as required by the RTS

3.6 Safety

RTS safety rules, procedures, and practices shall be followed at all times during inspection and maintenance.

3.7 Inspection and maintenance procedures

The inspection and maintenance procedures in this recommended practice may be modified for each rail transit system's requirements but should contain the steps listed in Sections 3.7.1-3.7.2 as a minimum.

3.7.1 Inspection

- 3.7.1.1** Notify the operations control center (OCC) and/or other authorities of the inspection activities to be performed.
- 3.7.1.2** Visually inspect equipment for conditions that could adversely affect equipment performance including but not limited to dents, scratches, case damage, frayed wiring, insulation damage/deterioration, loose/broken connections and hardware, rust, corrosion, signs of electrolyte leakage, defective switches or indicators.

- 3.7.1.3** Check electrolyte level and temperature.
- 3.7.1.4** Check pilot cell voltage.
- 3.7.1.5** Check float and equalize voltages in the battery chargers and adjust as necessary, in accordance with RTS recommendations.
- 3.7.1.6** Ensure that charger output voltage and current are within RTS specifications.
- 3.7.1.7** Check the operation of current limits to prevent equipment damage due to excessive overload conditions.
- 3.7.1.8** Check charging equipment meters, temperature measuring equipment and other indicators for proper operation.
- 3.7.1.9** Check ambient temperature and for proper ventilation in areas around components to ensure the free flow of air through and around equipment.
- 3.7.1.10** Perform specific gravity test.
- 3.7.1.11** Check individual cell and battery terminal voltage.
- 3.7.1.12** Notify the OCC and/or other authorities when inspection is complete.

3.7.2 Maintenance

- 3.7.2.1** Notify the OCC and/or other authorities of the maintenance activities to be performed.
- 3.7.2.2** Apply an equalization voltage to the battery bank for two hours or for the time period specified by the RTS.
- 3.7.2.3** Power supplies and subsystem equipment perform more efficiently and allow better heat dissipation when clean. Foreign material or dust should be cleared from equipment with low-pressure air or vacuum.
- 3.7.2.4** Outer surfaces of panels, racks, and cabinets should be cleaned with lint-free rags dampened with a mild detergent solution.
- 3.7.2.5** Torque buss bar terminal connections.
- 3.7.2.6** Clean terminal connectors and apply corrosion inhibitor.
- 3.7.2.7** Notify the OCC and/or other authorities when maintenance activities are complete.

3.8 Correction of deficiencies

Deficiencies identified during vented standby battery backup system inspection and maintenance should be corrected and documented in accordance with OEM and/or RTS requirements.

3.9 Documentation

Inspection and maintenance activities should be documented, reviewed, and filed in accordance with RTS procedures.

Annex A

(informative)

Bibliography

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- [B7] National Fire Protection Association (NFPA) 70.
- [B8] Original equipment manufacturer (OEM) specifications for vented standby battery backup system inspection and maintenance.
- [B9] Rail transit system (RTS) procedures for vented standby battery backup system inspection and maintenance.
- [B10] STD 1 – 8.2 (e) “OSHA Standing Directive.”