



AEROSPACE INFORMATION REPORT

AIR1898™

REV. A

Issued 1992-06
Revised 1998-12
Reaffirmed 2026-02

Superseding AIR1898A

Maintenance of Batteries and Battery Charging and Servicing Facilities

RATIONALE

AIR1898A has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE:

This SAE Aerospace Information Report (AIR) covers, and is restricted to, hands-on servicing/maintenance of industrial lead acid batteries used solely for motive power and exclusively for ground support equipment (GSE). It does not address or pertain to automotive-type SLI (starting-lighting-ignition) batteries or any other types of batteries (such as nickel-cadmium, zinc, or lithium batteries) which may be on-board airport GSE for either motive power or auxiliary uses. Similarly, the battery servicing and charging facilities described herein are those intended exclusively for industrial lead acid batteries.

1.1 Purpose:

This AIR is intended to provide basic information on proper procedures and facilities for handling, charging, and otherwise servicing and maintaining motive power lead acid batteries used in airport GSE. Adherence to these guidelines can help maximize battery life and performance, as well as the overall efficiency and effectiveness of electric GSE at airports. This document also describes (physical) battery servicing facilities in the airport environment.

2. REFERENCES:

1. "Standards for Deep Cycle Battery Chargers" BCI-I-4 Battery Council Int. Standard. "Material Handling (Industrial Truck) Battery Chargers" Standards Publication PV6 1976 and "Determination of Capacity of Lead Acid Industrial Storage Batteries for Motive Power Service," Standard Publication IB 2 1974 National Electrical Manufacturers Association, Washington, D.C.

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2.1 Applicable Documents:

This document is based on, and should be both complemented and supplemented by, the detailed instructions/recommended practices and procedures of the manufacturers and/or suppliers of batteries, chargers, vehicles, and servicing/maintenance facility components. Similarly, this document should be considered in the context of applicable federal, state, and local health, safety, fire, and other pertinent regulations, which are predominant. In particular, Occupational Safety and Health Administration (OSHA) Regulations 1926.403 and 1910.178 specify the federal requirements concerning safe care and charging of storage batteries.

2.2 Definitions:

The following words and terms are most often associated with industrial lead acid batteries, and should be familiar to personnel responsible for proper battery maintenance:

AMPERE (AMP or A): A unit of measurement of electrical current. The current forced through a resistance of 1 Ω by a potential of 1 V is equal to 1 A.

AMPERE-HOUR (A·h) CAPACITY: Ampere-Hour capacity is the number of ampere-hours which a storage battery can deliver under specified conditions such as temperature, rate of discharge, and final voltage.

NOTE: For the purpose of this standard, ampere-hour capacity is determined by a 6 h rate discharge cycle.

CONNECTORS: Molded strips of lead that connect the posts over the top of the cover, where multiple cells are used.

CURRENT: The flow of electricity, normally expressed in amperes.

CYCLE: The cycle of a storage cell or battery is the discharge and subsequent charge of the cell or battery to restore the initial conditions. Life cycle or useful life is the number of times a battery can be discharged-charged before it fails to deliver a minimum of 80% of its rated 6 h capacity.

DEEP DISCHARGE: Removal of up to 80% of the rated capacity of the battery; in practice, it is suggested that a maximum 80% depth-of-discharge be considered the maximum deep discharge level of a battery, even if it is rated at 100% discharge.

DIRECT CURRENT (DC): A direct current is a unidirectional current in which the changes in value are either zero or so small that they may be neglected.

ELECTROLYTE (Component of a Cell): An electrolyte is a conducting medium in which the flow of electric current takes place by the migration of ions. (The electrolyte for a lead-acid storage cell is an aqueous solution of sulfuric acid.)

2.2 (Continued):

ENERGY DENSITY: The ratio of battery energy content in watt-hours to battery weight or volume.

HYDROMETER: An instrument used to measure electrolyte density or specific gravity.

KILOWATT-HOUR (kW·h) Watthour Capacity ÷ 1000: The number of watt-hours that can be delivered under specified conditions as to temperature, rate of discharge, and final voltage.

RATED CAPACITY: The rated capacity of a storage battery is the number of ampere-hours and/or watt-hours which it is capable of delivering when fully charged and under specified conditions of temperature, rate of discharge, final voltage, and specific gravity.

SPECIFIC GRAVITY (of Electrolyte): The specific gravity of an electrolyte is the ratio of the weight of a given volume of electrolyte to the weight of an equal volume of water at a specified temperature.

VOLT (V): A unit of electromotive force; each battery cell produces approximately 2 V.

VOLTMETER: An instrument for measuring battery cells' voltage output.

WATT (W) (1) (General): The unit of power in the International System of units (SI). The Watt is the power required to do work at the rate of 1 joule per second.

WATT-HOUR (Wh): The measure of energy or work accomplished; the product of the rate of work in watts and the time in hours, or the product of ampere-hours x average voltage.

3. LIMITATIONS:

This document is intended as a basic battery maintenance guideline only, and should not supersede battery or charger manufacturers' detailed installation, handling, charging, and maintenance instructions. Service-related problems with batteries, chargers, vehicles, and components that cannot be solved on the job or in on-site maintenance shops should be referred to the manufacturers or their authorized representatives.

4. GENERAL BACKGROUND:

Battery-powered, or electric, GSE is utilized throughout the world by major passenger airlines, regional carriers, fixed-base operators (FBOs), air cargo lines, and the military. It may be used in conjunction with, or in place of, fossil-fuel-powered GSE.

The most widely used types of electric GSE on airport ramps are pushout (tow) tractors, baggage tractors, belt loaders, and cargo transporters and loaders. Many forklift trucks used in off-ramp baggage handling areas are also battery-powered. Cabin-service vehicles, personnel carriers, and other types of GSE may also be battery-powered. A wide range of battery sizes are available to equip these vehicles.

4.1 Electricity Demands:

There are recent instances at several airports where there is a shortage electric capacity or utility power lines to provide sufficient power for battery charging. This is now being actively addressed by local power companies and airport authorities.

4.2 Charging Regimes:

There are basically two regimes for charging batteries:

- a. Opportunity - (Prior to selecting this charging regime, the battery manufacturer should be consulted to ensure that a properly matched charger is used, i.e., smart charger)
- b. Demand

The opportunity method is for active vehicles meaning charging batteries on the vehicle (no removal of battery required) whenever there is a lull in the vehicles' duty cycles. The other method is demand charging, meaning charging batteries when they have reached a maximum 80% depth of discharge (even though they may be rated at 100% depth of discharge), as indicated by the vehicles' dashboard-mounted gauges and/or by actual battery capacity testing with instruments. Whenever possible, battery charging should be performed at night, when activity is normally slow at airports and the significant economies of off-peak-generated electricity may be realized. Details regarding charging regimes may be found in 7.2.

5. BATTERY PRINCIPLES:

5.1 General Electrochemistry:

When two dissimilar materials, in this case lead peroxide and elemental lead, are immersed in a solution of sulfuric acid and water (known as the electrolyte) within a battery, an electromotive force of approximately 2 V per cell is generated. Batteries attain their maximum voltage rating by grouping many cells together, thus creating batteries of 24 V (12 cells), 36 V (18 cells), 48 V, 72 V, and so on.

5.2 Discharge Cycle:

The electrolyte reacts with the lead peroxide in the positive plates and the elemental lead in the negative plates to form lead sulfate on both sets of plates. At the same time, the oxygen from the lead peroxide is disassociated from the positive plates and combines with the hydrogen from the sulfuric acid to form water. As this reaction continues, both the positive and the negative plates become less and less dissimilar, and the sulfuric acid becomes more and more diluted; eventually, the battery becomes discharged in this manner. This reaction, coupled with the pounds of lead and the pounds of sulfuric acid, produce the rated capacity of the battery, which may be measured in kilowatt hours (kW·h) or ampere hours (Amp hours or A·h). The energy available from a battery at any given time is affected by the rate at which energy is discharged from the battery.