

AEROSPACE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard



ARP1816

REV.
B

Issued 1984-09
Revised 1996-07

CHARGER FOR BATTERY POWERED GROUND SUPPORT EQUIPMENT

1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) describes an industrial battery charger, solid state type, hereafter called charger, for use in charging lead acid batteries in ground support equipment.

2. APPLICABLE DOCUMENTS:

(R)

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1817 Battery, Industrial, Lead Acid Type, For Use in Electric Powered Ground Support Equipment

ARP1892 Electrical Connectors for Use in Battery Powered Ground Support Equipment

2.2 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI C84.1-1989 Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

SAE ARP1816 Revision B

2.3 UL Publications:

Available from Underwriter Laboratories, 333 Pfingsten Road, Northbrook, IL 60062.

UL583 Standard for Electrical Battery Powered Industrial Truck

UL1564 Industrial Battery Chargers

2.4 CSA Publications:

Available from Canadian Standards Association, 178 Rexdale Blvd., Rexdale (Toronto), Ontario, Canada M9W 1R3.

CSA C22.2 No. 107.2 M89 Battery Chargers

2.5 IEC Publications:

Available from IEC, 3, rue de Varembe, CH-1211 Geneve 20, Switzerland (Suisse).

IEC-529 Degrees of Protection Provided by Enclosures (IP Code)

3. GENERAL DESCRIPTION:

- 3.1 The charger shall be fully capable of charging a 100% discharged, specified lead acid battery, (R) automatically, without damage, and in the maximum time of 8 h or less.

The charger shall be capable of charging any battery of specified voltage from 80 to 100% of charger rated capacity without adjustment. Each charger shall be completely assembled in a steel case and shall be equipped with properly sized charging cables. Each cable shall have a minimum length of 10 ft (3.05 m) and shall have a properly sized and matched battery connector.

- 3.2 The charger shall have dual voltage transformers with easy to change transformer terminals. Changeover instructions shall be permanently affixed inside the charger in a readily visible location through the open door. The charger shall be supplied to operate satisfactorily from all of the voltages in any of the groups as specified from Table 1. Three phase chargers are recommended:

TABLE 1 - Input Voltages

Group	Voltage	HZ
1	208/240/480	60
2	480/575	60
3	230/400	50

- 3.3 The basic charger shall be UL listed or CSA certified except as modified for outdoor use or other (R) special options.

SAE ARP1816 Revision B

3.4 Adequate overload protection shall be provided in both AC and DC lines.
(R)

3.5 Transformer Construction:

A transformer shall be used as the primary means of minimizing AC shock hazards and the following points shall be considered.

3.5.1 The transformer shall have its primary winding electrically isolated from its secondary winding and shall be varnish impregnated and baked to exclude moisture.

3.5.2 Means shall be provided to prevent the possibility of primary voltage being present in the secondary circuit. This shall be accomplished by either of the following:

3.5.2.1 A grounded electrostatic or Faraday shield shall be placed between the primary and secondary windings. This shield shall be made of copper or aluminum and shall have at least the ampacity of the primary conductor if the primary conductor is smaller than No. 6 AWG (16 mm²). If the primary conductor is No. 6 AWG (16 mm²) or larger, the shield shall have an ampacity of at least 50% of the primary conductor. If foil is used it shall have a thickness of not less than .25 mm (.010 in).

3.5.2.2 Coil winding methods which provide isolation between input and output circuits.

3.6 Nominal control voltage shall be 24 V or less.
(R)

4. REGULATIONS AND EFFICIENCY:

4.1 The charger internal regulation shall compensate for varying AC line and load variations as indicated in ANSI C84.1, 1989 and regulate DC finish voltage to a maximum of $\pm 1\%$.
(R)

4.2 Efficiency over a full charge cycle shall be a minimum of 85% (KWH out/KWH in) for 36 V and above chargers.

4.3 Power factor shall average a minimum of 0.6 over the full range of output (KW in KVA in) for SCR type chargers and 0.9 for ferroresonant chargers.
(R)

5. BATTERY CHARGER CONTROLS:

5.1 The charger is to have a system incorporated to reduce the possibility of battery damage due to over-charging or any other conditions. Failure of any components or group of components shall not cause the charger to operate at its high level for an excessive length of time such as to cause permanent damage to the battery or other components or the charger. The charger shall incorporate a tamper proof design to prevent maladjustment by unauthorized personnel.

5.2 Controls shall be provided to insure that the charger is providing the correct charging rate for the battery during the charging period. Factors to be considered in the design of control systems are:

SAE ARP1816 Revision B

- 5.2.1 The charger shall start automatically upon connection of the battery without operator action.
(R) There shall be sufficient time delay to prevent arcing of the DC power contacts in the battery connector. In the event of AC power interruption the charger shall automatically resume charging when power is restored.
- 5.2.2 The charger shall be capable of charging the battery at a rate to provide a full charge in a specific time period without damage to the battery.
- 5.2.3 Upon reaching full charge the charger will automatically shut off.
- 5.2.4 Provisions shall be included for a manual or automatic equalizing charge.
- 5.2.5 A manual means shall be provided to interrupt the charging cycle by shutting down the charger.
- 5.2.6 Also see SAE ARP1892 on battery connectors.
(R)
- 5.2.7 Other control features may also be included as options. See Section 10.
6. ELECTRICAL COMPONENTS:
- 6.1 Rectification of the charging current shall be accomplished with silicon diodes in full wave
(R) circuitry. Heat sinks shall be provided to prevent any diode from exceeding the manufacturer's temperature rating under maximum load and ambient temperature of 122 °F (50 °C).
- 6.2 All control components shall be rated for continuous duty.
- 6.3 All power transformers shall be insulated to a minimum of Class 180 (replaces Class H).
- 6.4 All diodes, transistors, and control devices shall be protected from damage due to:
- a. All self-generated transients
 - b. Normal externally applied transients
 - c. Turning the charger on or off at any charging rate or with battery disconnected
 - d. Disconnecting the battery at any charging rate
 - e. Shorting the output terminals
 - f. Battery polarity reversal
- 6.5 A means of reading DC charging current shall be provided on the front of the unit.
(R)
- 6.6 The charger shall be equipped with a minimum of 10 ft (3.05 m) of heavy-duty flexible cable (UL583, Section 13.1). The battery cables shall be color coded, red = positive, black = negative, and/or suitably identified.
- 6.7 A pilot light or other means shall be standard on the face of the unit to indicate that the charger is energized.
(R)