SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

SAE ARP1816 REV. C

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(R) Charger for Battery Powered Ground Support Equipment

RATIONALE

A review of ARP 1816B revealed it was outdated and only described an industrial battery charger used to fully charge a 100% discharged battery in a period of 8 hours. Newer technology now allows fast charging of the battery in the truck during idle opportunity time. ARP 1816C was re-written to address chargers used for both charging methods.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) describes two general types of Ground Support Equipment (GSE) battery chargers. The conventional industrial battery charger typically requiring up to 8 hours to recharge a 100% discharged battery, hereafter called “Conventional Charger”. The other type a fast battery charger typically used as an opportunity charger for ground support equipment, hereafter called “Fast Charger”. Recommendations that apply to both types will refer generically to “charger”.

2. REFERENCES

2.1 APPLICABLE DOCUMENTS

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.

2.1.1 ANSI Publications

Available from National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1752, Rosslyn, Virginia 22209, Tel: 703-841-3200, www.nema.org.

ANSI C84.1-1995 Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)

2.1.2 BCI (Battery Council International) Publications

Available from Battery Council International, 401 North Michigan Ave., Chicago, IL 60611-4267, Tel: 312-644-6610, www.batterycouncil.org.

BCIS-16 Standard for Deep Cycle Battery Chargers

BCIS-18 Standard for Deep Cycle Fast Battery Chargers.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/ARP1816C

2.1.3 CSA Publications

Available from CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3, Tel: 416-747-4000, www.csa-international.org.

CAN/CSA-C22.2 NO. 107.2-01 Battery Chargers

2.1.4 UL Publications

Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

UL 1564 Industrial Battery Chargers

2.2 Definitions

2.2.1 Ampacity: The current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

3. GENERAL DESCRIPTION

3.1 Charger

3.1.1 The basic charger shall be UL listed (UL 1564 Industrial Battery Chargers) or CSA certified (CAN/CSA-C22.2 NO. 107.2-01 Battery Chargers) except as modified for outdoor use or other special options.

3.1.2 Adequate overload protection shall be provided in both AC and DC lines.

3.1.3 The charger input voltage shall be single or three-phase and purpose built to match the electrical supply. Dual voltage transformers with easy to change transformer terminals may also be used provided changeover instructions are permanently affixed inside the charger in a readily visible location through the open door. Three phase chargers are recommended.

3.1.4 Nominal control voltage shall be 24 VAC or less.

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

3.1.5.1 The transformer shall have its primary winding electrically isolated from its secondary winding and, if required by UL, shall be varnish impregnated and baked to exclude moisture.

3.1.5.2 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:

3.1.5.2.1 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 mm^2). If the primary conductor is No. 6 AWG (16 mm^2) 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).

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

3.1.6 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 Conventional Charger

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

3.2.2 The Conventional charger shall be capable of charging any battery of specified voltage from 80 to 100% of charger rated capacity without adjustment.

3.2.3 The Conventional charger should meet BCIS-16 Standard for Deep Cycle Battery Chargers.

3.2.4 Adjustments may be necessary on the conventional charger, if not temperature compensated, when the battery's electrolyte temperature goes below 32 °F (0 °C) or above 104 °F (40 °C).

3.3 Fast Charger

3.3.1 The Fast charger shall be capable of automatically recognizing the battery type, size and voltage (within its nameplate rating) GSE battery pack and properly charge without generating excessive heating or causing damage to the battery. The Fast charger shall recognize and properly charge any voltage battery within its nameplate rating, any typical GSE battery capacity within its nameplate rating, and any lead-acid battery type (e.g. flooded or sealed vrla).

3.3.2 The Fast charger shall be temperature compensated.

3.3.3 The Fast charger should meet BCIS-18 Standard for Deep Cycle Fast Battery Chargers.

4. REGULATION AND EFFICIENCY

4.1 The charger internal regulation shall compensate for varying AC line and load variations as indicated in ANSI C84.1-1995 and regulate DC finish voltage to a maximum of ±1%.

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 all other types (ferroresonant, SMPS, etc.).

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:

5.2.1 The charger shall start automatically upon connection of the battery without operator action. 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 Other control features may also be included as options.

6. ELECTRICAL COMPONENTS

6.1 Heat sinks shall be provided to prevent any rectifying power devices or switching devices 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.

6.6 A means of providing the operator current charger status (e.g. charging, complete or fault) shall be provided on the front of the unit.

6.7 A pilot light or other means shall be standard on the face of the unit to indicate that the charger is energized.

7. CABINET

7.1 The charger shall be of unitized construction in a heavy gage steel enclosure having a hinged door, and shall be suitable for floor, wall, or stackable mounting with permanent provision for forklift or hoist handling.

7.2 There shall be no ventilation holes in the top surface unless provision is made to prevent any foreign material from entering the case. The case and components shall be arranged to provide natural convection or self-contained forced air cooling.

7.3 Component layout and cabinet design shall be such that all serviceable components can be easily serviced or removed through the front of the cabinet for maintenance purposes.

7.4 All major components and terminals shall be marked to aid in servicing. Fuse ratings shall be permanently marked to aid in replacement. A schematic and wiring diagram shall be provided with each charger.

7.5 The charger nameplate shall be mounted on the front of the cabinet. The nameplate shall contain the following information:

a. MODEL NUMBER

b. SERIAL NUMBER

c. AC POWER INPUT: VOLTS, AMPS, PHASE, and FREQUENCY

d. NOMINAL DC OUTPUT VOLTAGE

e. RATED DC OUTPUT CURRENT

f. RATED NUMBER OF BATTERY CELLS

g. RATED BATTERY AMPERE HOUR CAPACITY