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Australia



# Battery chargers for stationary batteries



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# Battery chargers for stationary batteries

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## Preface

This Standard was prepared by the Standards Australia Committee EL-005, Secondary Batteries, to supersede AS 4044—1992.

The objective of this document is to provide requirements for the design, safe use and testing of stabilized constant-potential battery chargers that are designed to supply direct current power from an alternating current source, while charging a float-type stationary battery, and which may simultaneously supply power to a connected direct current system load.

The major changes in this edition are as follows:

- (a) Changed references to transformers to refer to mains frequency transformers where used, and added or updated requirements for neutral cable protection.
- (b) Inserted requirements where digital instrumentation is used.
- (c) Relaxed the enclosure design requirements where the charger is installed in restricted access areas.
- (d) Added requirements for test report contents.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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# Australian Standard®

## Battery chargers for stationary batteries

### 1 Scope

This document specifies requirements for stabilized constant-potential battery chargers that are designed to supply direct current power from an alternating current source, while charging a float-type stationary battery, and which may simultaneously supply power to a connected direct current system load.

NOTE [Appendix A](#) provides guidance on information to be supplied by a purchaser.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 5331, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards*

AS 60529, *Degrees of protection provided by enclosures (IP Code)*

AS 61000.6.4, *Electromagnetic Compatibility (EMC), Part 6.4: Generic standards — Emission standard for industrial environments*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3100, *Approval and test specification—General requirements for electrical equipment*

AS/NZS 60076.1, *Power Transformers, Part 1: General (IEC 60076-1, Ed. 3.0 (2011) MOD)*

AS/NZS 61000.6.1, *Electromagnetic Compatibility (EMC), Part 6.1: Generic standards — Immunity for residential, commercial and light-industrial environments*

AS/NZS 61000.6.2, *Electromagnetic Compatibility (EMC), Part 6.2: Generic standards — Immunity standard for industrial environments*

AS/NZS 61000.6.3, *Electromagnetic Compatibility (EMC), Part 6.3: Generic standards — Emission standard for equipment in residential environments*

AS/NZS IEC 61672-1, *Electroacoustics — Sound level meters, Part 1: Specifications*

AS IEC 60038, *Standard voltages*

IEC 60051-2, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 2: Special requirements for ammeters and voltmeters*

IEC 60417, *Graphical symbols for use on equipment*

### 3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

**3.1**  
**actual capacity**  
quantity of electricity in ampere hours (A.h) that can be withdrawn from a cell or battery for a specific set of operating conditions

Note 1 to entry: Operating conditions include discharge rate, temperature, initial state of charge, age and final voltage.

Note 2 to entry: See also *capacity* ([3.5](#)) and *rated capacity* ([3.18](#)).

**3.2**  
**audible noise**  
sound level produced by the battery charger measured in decibels

**3.3**  
**battery**  
unit consisting of one or more cells connected in a series, parallel, or a series-parallel arrangement

**3.4**  
**boost charge**  
charge performed at a higher potential than a float or equalizing charge

Note 1 to entry: A boost charge is applied to partially restore the capacity of a discharged battery at a faster rate than a float charge.

**3.5**  
**capacity**  
***C***  
quantity of electricity in ampere hours (A.h) which a fully charged battery can deliver under specified conditions

Note 1 to entry: The capacity of a cell or battery is denoted by the symbol *C*. As the capacity varies with rate of discharge, the symbol *C* is followed by a numerical suffix giving the rate of discharge. Thus  $C_{120}$  is the capacity in ampere hours (A.h) at the 120 h rate of discharge. The specified temperature is usually 25 °C. The final voltage depends on battery type and conditions of service.

Note 2 to entry: The specified conditions are rate of discharge, final voltage and temperature.

Note 3 to entry: See also *actual capacity* ([3.1](#)) and *rated capacity* ([3.18](#)).

**3.6**  
**cell**  
basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals and usually separators, that is a source of electric energy obtained by direct conversion of chemical energy  
[SOURCE: IEC 60050-482 (IEV), 482-01-01]

**3.7**  
**charge current**  
current flowing into the battery during the charge cycle

**3.8**  
**charger efficiency**  
output power in watts divided by the input power in watts, expressed in percent

**3.9**  
**constant potential charge**  
charge during which the voltage across the battery terminals of the battery charger is maintained at a constant value

**3.10****displacement factor**

ratio of the active power of the fundamental wave to the apparent power of the fundamental wave

**3.11****equalizing charge**

extended charge to ensure complete charging of all the cells in the battery

Note 1 to entry: An equalizing charge is performed at a higher potential than a float charge

**3.12****float charge**

form of battery charging in which a battery is connected to a constant potential charger so that the battery is maintained fully charged and able to supply power to the system

**3.13****float voltage**

minimum constant potential necessary to offset the internal losses of a battery

**3.14****final voltage**

prescribed voltage at which a discharge is considered finished

**3.15****may**

indicates the existence of an option

**3.16****parallel operation**

operation of two or more chargers that are connected to a common direct current load

**3.17****power factor**

ratio of active to apparent power

**3.18****rated capacity**

quantity of electricity in ampere hours (A.h), declared by the manufacturer which a battery can deliver after a full charge under specified conditions

Note 1 to entry: The specified conditions are rate of discharge, final voltage and temperature.

Note 2 to entry: See also *actual capacity* ([3.1](#)) and *capacity* ([3.5](#)).

**3.19****rated output current**

continuous output current, as declared by the manufacturer, that a battery charger can deliver under specified operating conditions

**3.20****remote voltage sensing**

connection of voltage sensing leads between the charger and a remote point in the circuit so that the charger maintains a constant potential at the remote point rather than at its output terminals

Note 1 to entry: For remote voltage sensing, a remote point can be a battery or load.

**3.21****ripple voltage**

alternating voltage component of the voltage output of a battery charger

**3.22****shall**

indicates that a statement is mandatory

**3.23****should**

indicates a recommendation

**3.24****test battery**

battery, of specified capacity, intended for testing battery chargers

## **4 Classification**

A battery charger shall be classified as one or more of the following types:

- (a) *Type 1* — a battery charger suitable for charging a battery with a load connected in parallel.
- (b) *Type 2* — a battery charger suitable for providing supply to a load with or without a battery connected in parallel.
- (c) *Type 3* — a battery charger suitable for providing supply to a load while sharing the load with another battery charger. Type 3 battery chargers shall be able to operate with or without a battery connected in parallel.
- (d) *Type 4* — a battery charger suitable for supplying loads sensitive to electrical noise, for example, communications equipment. A Type 4 battery charger shall be able to operate in parallel with another Type 4 battery charger with or without a battery connected in parallel. The user should specify —
  - (i) the maximum level of electrical noise; and
  - (ii) the method of measurement.

NOTE Appendix B provides guidance on psophometric noise measurement.

## **5 Alternating current input characteristics**

### **5.1 General**

A battery charger shall satisfy all the requirements of this document when supplied with alternating current (a.c.) input, as specified in [Clauses 5.2, 5.3, 5.4](#) and [5.5](#).

NOTE When a battery charger is supplied from a generating set, it may be required to operate with a total harmonic distortion of the supply of up to 20 %.

A high level of distortion can affect the operation of the battery charger. If a high level of supply distortion is expected, the manufacturer should be consulted.

### **5.2 Rated voltage and frequency**

A battery charger shall be suitable for use with a single-phase a.c. supply or a three-phase supply, conforming to the limits specified in AS IEC 60038.

The charger shall be suitable for use with a supply frequency conforming to the limits specified in AS IEC 60038.

### 5.3 Alternating current system earthing

A battery charger shall operate in accordance with this document when supplied by an electrical system earthed in accordance with AS/NZS 3000.

### 5.4 Neutral connection

A battery charger fitted with a mains frequency power transformer and supplied with three-phase a.c. power shall not have its power transformer connected to the neutral of the a.c. supply. The neutral of the a.c. supply may be connected to control circuits.

Where a battery charger is connected to the neutral of the a.c. supply —

- (a) the maximum possible neutral current (under all conditions) of the charger shall be less than the current-carrying capacity of the neutral conductor; or
- (b) a detection device shall be fitted and protection arranged to prevent the neutral current from exceeding the current-carrying capacity of the neutral conductor.

NOTE The third harmonic currents (and odd multiples thereof) are additive to the normal 50 Hz current to be carried. Therefore, it may be necessary for the capacity of a neutral conductor to be greater than that of the associated active conductors.

### 5.5 Unbalanced three-phase supply

A battery charger supplied with three-phase a.c. supply shall be suitable for use when the supply line-to-line voltages are unbalanced by up to 5 %, that is, when the maximum line-to-line voltage is 105 % of the minimum line-to-line voltage.

### 5.6 Power factor

The power factor of a battery charger shall be 0.8 or greater. The power factor of a battery charger shall be measured in accordance with [Appendix C](#).

## 6 Direct current output characteristics

### 6.1 General

Where a battery is connected to the charger, the battery manufacturer should be consulted with regard to suitable charger operating voltages. The charging methods used should be those recommended by the battery manufacturer.

### 6.2 Operating conditions

All the performance requirements of this document shall be met —

- (a) with a.c. input in accordance with [Clause 5](#);
- (b) for the following configurations of battery charger, battery and load —
  - (i) with the battery and load connected for a Type 1 battery charger,
  - (ii) with the battery and load connected, or the load only connected, for a Type 2 battery charger,
  - (iii) in parallel and sharing the load with a nominated charger, and with the battery and load connected or the load only connected for a Type 3 or Type 4 battery charger;
- (c) with remote sensing leads connected, if provided; and

- (d) for environmental conditions in accordance with [Clause 8](#).

## 6.3 Output current

### 6.3.1 Rated output current

The rated output current shall be stated for the battery charger when operating in the float mode and, if applicable, in the boost and equalizing modes.

### 6.3.2 Current limiting

A battery charger shall limit its direct current output to a value at which it is capable of operating continuously, with a. c. input in accordance with [Clause 5](#), and under environmental conditions in accordance with [Clause 8](#). This shall be achieved without the operation of any protective device and shall not result in any damage to the charger.

If the battery manufacturer specifies a recommended or maximum charge current, the battery charger shall contain an adjustable current limiting function which can be set to limit the battery charge current to no more than the specified current.

## 6.4 Output voltage adjustment range

Controls shall be provided to enable continuous adjustment of the direct current (d.c.) output voltage.

The controls shall provide the ranges of voltage adjustment specified in [Clauses 6.4.1](#), [6.4.2](#) and [6.4.3](#) with the output current at both zero and rated values. The controls shall be tested in accordance with [Appendix D](#).

If Boost or Equalize charging modes are provided, the charging period in each mode should be terminated by an automatic adjustable timer that starts timing when the battery charger reaches its pre-set boost or equalizing voltage, as recommended by the battery manufacturer.

### 6.4.1 Float voltage range

A battery charger shall be supplied with a float voltage control with a range of —

- (a) 2.14 V per cell to 2.30 V per cell for lead-acid cells; or
- (b) 1.35 V per cell to 1.47 V per cell for nickel-cadmium cells.

### 6.4.2 Equalizing voltage range

If a battery charger is intended to provide an equalizing charge, it shall be supplied with an equalizing voltage control with a range of 2.25 V per cell to 2.40 V per cell.

NOTE Nickel-cadmium cells are not normally given an equalizing charge.

### 6.4.3 Boost voltage range

If a battery charger is intended to supply a boost charge, it shall be supplied with a boost voltage control with a range of —

- (a) 2.30 V per cell to 2.80 V per cell (or 2.50 V per cell if the charger output is limited to SELV or 60 V d.c.) for lead-acid batteries; or
- (b) 1.55 V per cell to 1.72 V per cell (or 1.57 V per cell if the charger output is limited to SELV or 60 V d.c.) for nickel-cadmium cells.

NOTE Sealed batteries are not normally boost charged.