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| Assets Planning and Delivery GroupEngineering |

DESIGN STANDARD DS 26-45

Type Specification - Battery Charger

For Diesel Engine Battery System

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| VERSION 1REVISION 1 |
| MAY 2022 |

**FOREWORD**

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

[Overview of Western Australia’s Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)](https://www.dmirs.wa.gov.au/sites/default/files/atoms/files/overview_general_regulations.pdf)

Enquiries relating to the technical content of a Design Standard should be directed to the Principal Engineer, Electrical (Power) Section, Infrastructure Design Branch. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Manager, Infrastructure Design Branch

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Any interpretation of anything in this Standard that deviates from the requirements specified in the project design drawings and construction specifications shall be resolved by reference to and determination by the design engineer.

The Corporation accepts no liability for any loss or damage that arises from anything in the Standard including loss or damage that may arise due to the errors and omissions of any person.

REVISION STATUS

The revision status of this standard is shown section by section below.

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| **REVISON STATUS** |
| **SECT.** | **VER./****REV.** | **DATE** | **PAGES REVISED** | **REVISION DESCRIPTION (Section, Clause, Sub-Clause)** | **RVWD.** | **APRV.** |
| **1** | **1/0** | **31.05.17** | **All** | **New** | **NJ** | **MSP** |
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DESIGN STANDARD DS 26-45

Type Specification for Stationary Battery Charger

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# General

## Scope

This Specification covers the requirements for the design, manufacture, assembly, factory testing and delivery for a battery charger that is required to supply direct current power from a single phase alternating current source to a diesel engine starting stationary battery system.

This Specification does not cover any other battery charger systems other than those specified above and is intended for the following valve regulated lead acid batteries:

* AGM type
* flooded type (with caps to top up electrolyte)

This Specification covers only indoor wall or floor mounted battery chargers with a rated output not greater than 2 kVA.

Project specific requirements shall be specified in the Special Requirements section of the Annexure to this Type Specification.

## Definitions

1. AGM – absorbed glass mat
2. Battery - a unit consisting of one or more cells connected in a series, parallel, or a series-parallel arrangement to supply the voltage and current requirements of the load
3. Boost charge - a charge performed at a higher potential than a float or equalizing charge. A boost charge is applied to partially restore the capacity of a discharged battery at a faster rate than a float charge
4. Capacity - the quantity of electricity in ampere hours (Ah) which a fully charged battery can deliver under specified conditions
5. Charger efficiency - the output power in watts divided by the input power in watts, expressed in percent
6. Charging - an operation during which a battery receives electric energy, which is converted to chemical energy, from an external circuit. The quantity of electric energy is known as the charge, and is usually measured in ampere hours
7. Constant voltage charge - a charge during which the voltage across the battery terminals of the battery charger is maintained at a constant value
8. Equalizing charge - an extended charge to ensure complete charging of all the cells in the battery
9. Float charge - a 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
10. Float voltage - the minimum constant potential necessary to offset the internal losses of a battery
11. Final voltage on discharge (end voltage, cut-off voltage) - the prescribed voltage at which a discharge is considered finished
12. LCD - liquid crystal display
13. LED - light-emitting diode
14. Power factor - the ratio of active to apparent power
15. Rated output current - the continuous output current, as declared by the manufacturer, that a battery charger can deliver under specified operating conditions
16. Remote voltage sensing - the connection of voltage sensing leads between the charger and a remote point (such as a battery) so that the charger maintains a constant potential at the remote point rather than at its output terminals
17. Ripple voltage - the alternating voltage component of the voltage output of a battery charger
18. Ripple current - the alternating current component of the current output of a battery charger
19. Stationary battery – a battery operating in a fixed location
20. Test battery - a battery, of specified capacity, intended for testing battery chargers
21. VRLA – valve regulated lead acid

## Project Specific Information

The battery charger shall be in accordance with the requirements of this Specification and the requirements specified on either the attached Annexure or on the attached Principal's drawings.

Reference made in this Specification to the Annexure shall be taken to mean the Annexure or the Principal's drawings whichever is provided.

# Site

The location of and access to the site for the installation of the stationary battery charger shall be as shown in the Annexure.

# Standards

Unless specified otherwise, the workmanship, equipment and materials provided in accordance with this Specification shall comply in design, construction, rating and performance with the current relevant Australian or International Standards and Codes.

AS/NZS 60950.1 (IEC 60950.1) Information technology equipment - General requirements

AS 4044-1992 Battery chargers for stationary batteries

AS 2401.2-1994 Battery chargers for lead-acid batteries - Domestic type. Part 2: Battery chargers for valve-regulated cells

AS 3100-1990 Approval and Test Specification - General Requirements for Electrical Equipment

AS 60269.4 Fuses - Low Voltage fuses - Supplementary requirements for fuse links for the protection of semiconductor devices

AS 60529 Degrees of protection provided by enclosures (IEC 60529)

AS/NZS 3000-2007 Wiring Rules

IEC 60721.3.3 Classification of environmental conditions - Classification of groups of environmental parameters and their severities - Stationary use at weather protected locations

# Work by the Principal

The following work will be carried out by the Principal or by others under the direction of the Principal:

1. mechanical installation of the battery charger in accordance with the Contractor’s instructions
2. installation of battery charger input and output cabling in accordance with the Contractor’s instructions
3. commissioning of battery charger in accordance with the Contractor’s instructions

# Information to be provided by the Contractor

The Contractor shall provide the following documentation in respect to the battery charger within the listed number of days after receipt of the Principal’s order:

1. technical data sheets - 21 days
2. commissioning instructions - 21 days
3. routine test certificates - 21 days
4. comprehensive operating and maintenance manual - 28 days

# Quality Assurance

Electrical equipment and software shall be designed, manufactured and tested under a Quality System certified by an Accredited Authority to be in accordance with AS/NZS ISO 9001 or an approved equivalent.

All software to be installed in equipment being provided under the scope of this Specification shall be developed by the equipment manufacturer and shall have been tested successfully in the manufacturer’s works before delivery in accordance with clause 22.

# Electrical Work

All electrical work shall be performed by appropriately qualified and experienced personnel each of whom shall have a current electrical worker’s license to perform such work.

# EMC Categories

The electromagnetic immunity and emissions from the battery charger shall be in accordance with AS/NZS 61000.6.2 and AS/NZS 61000.6.4.

The battery charger shall be entitled to carry the Australian C-tick in respect to EMC emission.

# Classification

A battery charger shall be classified as Type 2 as defined by AS 4044-1994.

# Installation Environments

The battery charger shall be suitable for installation in the following harsh environmental conditions:

1. Maximum ambient air temperature: 50oC
2. Maximum average ambient air temperature over a 24 hour period: 35oC
3. Minimum ambient air temperature: minus 5oC
4. Relative humidity: 10% to 90%

# Degree of Protection

## Conformal Coating

All circuit boards shall be provided with conformal coatings adequate to provide protection against the ingress of moisture, dust and airborne chemicals in the specified environment without reliance on the equipment enclosure. Conformal coating shall be applied during manufacture at the factory.

## IP Rating

The battery charger shall be supplied within an enclosure having a degree of protection of not less than IP42.

# Input Conditions

## General

A battery charger shall satisfy all the requirements of this Specification when supplied with alternating input current, as specified in Clause 12.2.

## Rated Voltage and Frequency

A battery charger shall be suitable for use with a 240 V single phase, alternating current supply, with a voltage tolerance of ±10%.

The charger shall be suitable for use with a supply frequency of 50 Hz, ± 2.5 Hz.

## Power Factor

When measured in accordance with AS 4044-1992, Appendix C, the power factor of a battery charger shall be 0.8 or greater.

# Output Characteristics

## General

Current limited float charging or temperature compensation of the float voltage in accordance with the battery manufacturer’s recommendation shall be specified to alleviate the risk of thermal runaway.

The nominal voltage rating of the battery bank shall be either 12V or 24V.

The battery manufacturer shall be consulted with regard to suitable operating voltages.

The charging methods used shall be those recommended by the battery manufacturer.

## Temperature Compensation

Temperature compensation shall suit the type of battery installed.

The battery manufacturer shall confirm that appropriate temperature compensation is valid for the battery offered.

# Output Current

## Rated DC Output Current

The manufacturer shall state the rated output current of the battery charger when operating in the float mode and, if applicable, in the boost and equalizing modes.

The minimum rated output current shall be: 0.1x C10 + Maximum Standing Load Current (MSLC)

where MSLC = Standing Load Current (SLC) x design margin of 20%.

This allows for additional battery loads and design variations with equipment.

## Current Limiting

A battery charger shall limit its direct current output to a value at which it is capable of operating continuously. This shall be achieved without the operation of any protective device and shall not result in any damage to the charger.

If the current output of a battery charger can exceed the value recommended by the battery manufacturer, an additional current limiting device should be fitted.

# Output Voltage

The battery charger shall be suitable for voltage specified in Annexure.

# Output Voltage Adjustment Range

Controls shall be provided to enable continuous adjustment of the direct current output.

When tested in accordance with Appendix D of AS 4044-1992, the controls shall provide the ranges of voltage adjustment specified in Clauses 16.1, 16.2 and 16.3, with the output current at both zero and rated values.

## Float Voltage Range

A battery charger shall be supplied with a current limited float charging or float voltage control with a range of:

(a) 2.14 V per cell to 2.30 V per cell for VRLA flooded batteries

(b) suitable for VRLA AGM batteries.

## Equalizing Voltage Range

If a battery charger is specified in the Annexure 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 for VRLA flooded batteries.

Note: An equalizing charge is not required for VRLA AGM cells.

## Boost Voltage Range

If a battery charger is specified in the Annexure to supply a boost charge, it shall be supplied with a boost voltage control with a range of 2.30 V per cell to 2.80 V per cell for VRLA flooded batteries.

Note: A boost charge is not required for VRLA AGM cells.

# Voltage Regulation

A battery charger shall be tested for voltage regulation in accordance with Appendix E in AS 4044-1992. The values determined for both the voltage regulation expressions in Appendix E shall be no more than 1%.

# Overcurrent Protection

The input and output circuits of a battery charger shall both be supplied with overcurrent protection.

# Charger Efficiency

The efficiency of a battery charger shall be determined by measuring the total power at the alternating current input terminals and the direct current voltage and current at the output terminals at maximum rated output voltage, rated output current and nominal input voltage. From the rated values measured, the efficiency shall be calculated in accordance with the following equation:

η [%] = 100 \* (d.c. Output Voltage \* d.c. Output Current) / Input Watts

The battery charger efficiency shall be greater than 80%.

# User Interfaces

## Alarms and Front Panel Indication

The battery charger shall be provided with LED indication on the front panel of the following:

1. Battery charger **On**
2. Battery charger **Alarm**

The battery charger shall be provided with LED or LCD indication on the front panel of the following:

1. Battery charger output failure **Alarm**
2. Low direct current float voltage **Alarm**
3. High DC float voltage **Alarm**
4. AC power failure **Alarm**
5. An **Alarm** shall be provided to indicate loss of supply voltage

Each **Alarm** shall be provided with a voltage-free changeover contact

All adjustable settings (alarm limits, alarm reset, float voltage, temperature compensation etc) shall be able to be set from the front panel of the charger.

## Automatic Shut-down Facilities

1. High DC voltage shut-down.
2. A battery charger shall shut down and lock out if the output voltage exceeds a pre-set value
3. AC power failure
4. The charger shall include a facility to stop charging when the ambient temperature exceeds a specified maximum

## Meters

A battery charger should be supplied with digital or average responding type meters to monitor output voltage and current.

## Serial Communications Type

The battery charger shall be provided with a serial communications link which shall allow remote monitoring of the operating status of the battery charger if specified in the Annexure.

# Tests

The battery charger shall be routine and type tested in accordance with AS 4044-1992 to verify the unit’s functionality.

# Delivery

Once routine tests have been completed satisfactorily, the Contractor shall repack the equipment and deliver the equipment to the Principal’s works or to site as specified in the Annexure.

# Spare Parts

The Contractor shall guarantee to hold in Perth Western Australia one set of complete electronics spare parts for the battery charger.

# Technical Support

The Contractor shall maintain a comprehensive and timely level of technical support in Perth Western Australia for all equipment supplied under the Contract. Such support may be provided by the Contractor per se, or through a local service agent authorised and supported technically by the Contractor.

# Manuals

The Contractor shall supply 3 copies of comprehensive instruction manuals, written in English, pertaining specifically to the works provided under the Contract, and covering the complete operation and maintenance of all equipment supplied.

The manuals shall be printed on high grade A4 sized paper and each shall be bound in a high grade A4 size loose leave binder.

Information included in the manuals shall include:

 (a) Battery charger specification, which shall include the following:

 (i) input and output voltage and current ratings

 (ii) ripple voltage

 (iii) output voltage regulation

 (iv) current limit setting

 (v) input and output protection

 (vi) controls

 (vii) meters

 (viii) maximum ambient temperature

 (b) Installation instructions

 (c) Circuit description

 (d) Schematic diagram

 (e) Operating instructions

 (f) Trouble-shooting guide

 (g) Replaceable parts list

 (h) Routine maintenance requirements

**Annexure to Specification**

**for**

**Stationary Battery Charger**

Project: ………………………………..………………………………………………………….. ……..

Site Location: ……………………………..……………………………………………………………..

Type of Access to Site …………………………….…………………………………………………….

**Equalizing Charge Required** *(Yes/No)* ………………………………………………………………..

**Boost Charge Required** *(Yes/No)* ……………………………………………………………………...

**Allowable Recharge Time** …………………………………………………….……………………… hrs

External load on charger during recharge period *(details)* ………………………………………………

…………………………………………………………………………………………………………....

Battery Charger Location (inside genset enclosure/indoor cubicle) ……………………………...……..

**Communication Link Required** *(Yes/No, type/details)* ………………………………………………..

Operator Interface Panel Required *(Yes/No)* …………………………………………………………….

Special **Requirements** (e.g. aggressive atmosphere, salt air, excessive dust, abnormal vibrations)

……………………………………………………………………………………………………………

Battery Charger Input Power System Specifications

 Type of input over current device (circuit breaker or fuse) ………………………………

 Current rating of input circuit breaker or fuse ……………………………………..…….. Amps

 The nominal voltage rating of the battery bank (12V or 24V) …………….……………...

Battery Details:

 VRLA Battery type ( Flooded/AGM) …………………………………………..…………

 Battery Capacity…… Ah, at ….. hour rate to ………Volts/cell at ………Reference Temperature

 Battery Manufacturer ……………………………………………………………………..

 Diesel Engine Starting Current ………………………………………………………… A

 Number of Starts per Hour ………………………………………………………………..

Battery Mounting

(in same enclosure as Battery Charger or in separate enclosure) ………………………………..……….

**Delivery** (to site or to Principal’s works) ……………………………………………………………..

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| **Type Specification for Stationary Battery Charger****Tender Technical Response Schedule** |
| **Clause No.** | **Subject** | **Noted** | **Compliance** | **Comments** |
|  |  |  | **Yes** | **No** |  |
| 1 | **General** |  |  |  |  |
| 2 | **Site** |  |  |  |  |
| 3 | **Standards** |  |  |  |  |
| 4 | **Work by Principal** |  |  |  |  |
| 5 | **Information by Contractor** |  |  |  |  |
| 6 | **Quality Assurance** |  |  |  |  |
| 7 | **Electrical Work** |  |  |  |  |
| 8 | **EMC Categories** |  |  |  |  |
| 9 | **Classification** |  |  |  |  |
| 10 | **Installation Environment** |  |  |  |  |
| 11 | **Degree of Protection** |  |  |  | IP Rating = |
| 12 | **Input Conditions** |  |  |  |  |
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| 12.2 | Rated Voltage and Frequency |  |  |  |  |
| 12.3 | Power Factor |  |  |  |  |
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