



PROCESS
INDUSTRY
PRACTICES

COMPLETE REVISION
March 2017

Electrical

**PIP ELSAP01
Design and Fabrication of Utility Type
Battery Chargers**

PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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PIP ELSAP01

Design and Fabrication of Utility Type Battery Chargers

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Data Form

ELSAP01-D – Data Sheet for Utility Type Battery Chargers

1. Scope

This Practice describes the minimum requirements for design, fabrication, inspection, testing, shipment, and documentation for an electronically-controlled battery charger used for charging float-type batteries and simultaneously powering the connected utility system loads in indoor unclassified areas.

2. References

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)

- PIP ELSAP01-D - *Data Sheet for Battery Chargers*
- PIP STC01015 - *Structural Design Criteria*

2.2 Industry Codes and Standards

- National Electrical Manufacturers Association (NEMA)
 - NEMA PE 5 - *Utility Type Battery Chargers*
- National Fire Protection Association (NFPA)
 - NFPA 70 - *National Electrical Code (NEC)*
- Underwriters Laboratory, Inc. (UL)
 - UL 489 - *Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures*

3. Definitions

equalizing charge: An extended charge, at an elevated voltage, to a measured end point that is given to a storage battery to ensure the complete restoration of the active materials in all the plates of all the cells

floating charge: A method of operation for storage batteries in which a constant voltage is applied to the battery terminals sufficient to maintain an approximately constant state of charge

ripple voltage: The alternating-voltage component of the unidirectional voltage from a direct current power supply arising from sources within the power supply

battery eliminator: A device that provides direct-current energy from an alternating-current source in place of a battery

4. Requirements

4.1 General

- 4.1.1 The battery charger shall be designed and fabricated in accordance with *NEMA PE 5*.
- 4.1.2 The charger shall provide constant voltage float and equalize charging of the battery bank and, at the same time, deliver 0%–100%-rated current output to a varying on-line load.
- 4.1.3 The charger shall maintain the preset output DC voltage regulation to the connected load with the battery connected to the charger.
- 4.1.4 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, the charger shall be capable of recharging to 90% capacity a completely discharged battery within 8 hours while also supplying the normal load requirements.
- 4.1.5 Consideration must be given to the type of battery being utilized when selecting and specifying a battery charger.

4.2 Operating Environment

- 4.2.1 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, equipment shall be designed to perform satisfactorily under the following ambient conditions:
 - a. Ambient condition within the limits of 0°C (32°F) and 50°C (122°F)
 - b. Altitude of installation does not exceed 3300 feet (1000 m)
 - c. Humidity within the limits of 0 - 95% non-condensing
- 4.2.2 The battery charger shall be located in an indoor unclassified area.
- 4.2.3 When specified on purchaser's *PIP ELSAP01-D* Data Sheet, seismic requirements shall be as specified in *PIP STC01015*, Structural Design Criteria.

4.3 Input and Output Requirements

4.3.1 Input Overcurrent Protection

- 4.3.1.1 An input circuit breaker shall be provided for overcurrent and short-circuit protection, and to provide a means of isolating the input power to the charger.
- 4.3.1.2 The input circuit breaker shall have an interrupting capacity equal to or greater than the available short-circuit current listed on the purchaser's *PIP ELSAP01-D* Data Sheet.
- 4.3.1.3 Molded-case circuit breakers shall be designed and tested in accordance with *UL 489*.

4.3.2 Input Power Supply

The input power supply shall be as specified on the purchaser's *PIP ELSAP01-D* Data Sheet.

4.3.3 AC Line Compensation

The charger shall maintain the specified performance by providing automatic compensation for variations in the AC line voltage as noted in NEMA PE 5.

4.3.4 Input Surge

The input circuits of the charger shall withstand the surge test specified in *NEMA PE 5*.

4.3.5 Output Voltage

The DC output voltage shall be as specified on the purchaser's *PIP ELSAP01-D* Data Sheet.

4.3.6 Output Voltage Regulation

DC output voltage shall be regulated to $\pm 0.5\%$ in the "float" mode and shall be regulated to $\pm 1\%$ in the "equalize" mode for variations of AC line voltage, AC line frequency, ambient temperature and load as noted in NEMA PE 5.

4.3.7 Operation without Battery

The Battery charger shall be a "battery charger/ eliminator" where the charger shall meet all the performance criteria of this Practice with the battery disconnected.

4.3.8 DC Output Ripple

4.3.8.1 When measured at the terminals of a connected battery, the root mean square (RMS) ripple voltage shall not exceed the limits specified in *NEMA PE 5*.

4.3.8.2 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, a filtered charger shall be provided. Filtered chargers shall be specified for valve regulated lead acid batteries.

4.3.9 DC Output Current Limit

A current limit circuit shall be provided and factory-set to meet the requirements noted in NEMA PE 5.

4.3.10 Float Voltage

Controls shall be provided for adjusting the float voltage levels as follows:

- a. Lead-acid battery - 2.15 to 2.35 volts per cell
- b. Nickel-cadmium battery - 1.35 to 1.45 volts per cell
- c. For other battery types, consult battery manufacturer.

4.3.11 Equalize Voltage

Controls shall be provided for adjusting the equalizing voltage levels as follows:

- a. Lead-acid battery - 2.20 to 2.45 volts per cell
- b. Nickel-cadmium battery - 1.50 to 1.60 volts per cell
- c. For other battery types, consult battery manufacturer.

4.3.12 Temperature Compensated Charging

- 4.3.12.1 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, a battery temperature-sensing probe shall be provided for sensing the temperature of a pilot cell.
- 4.3.12.2 The output voltage of the charger shall be automatically adjusted to compensate for changes in battery temperature above or below the standard temperature of 25°C (77°F). The temperature compensation slope (mV/Cell/°C) shall be specified by the battery supplier for the battery type specified on the purchaser's *PIP ELSAP01-D* Data Sheet.

4.3.13 Dynamic Response

If the battery is connected, dynamic response shall be as specified in *NEMA PE 5*.

4.3.14 Start-up Behavior

- 4.3.14.1 The charger shall have "soft-start" characteristics.
- 4.3.14.2 The start-up walk-in feature shall gradually increase the output current to eliminate surges and overshoot.

4.3.15 Abnormal Load Conditions

The charger shall operate into and recover an undamaged zero voltage battery without activating protective devices.

4.3.16 Output Surge Protection

The output circuits of the charger shall withstand the surge test as specified in *NEMA PE 5*.

4.3.17 Output Overcurrent Protection

Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, a two-pole output circuit breaker shall be provided for overcurrent and short circuit protection, as well as a means of disconnecting the charger from the load.

4.3.18 Parallel Operation of Two Chargers

- 4.3.18.1 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, the battery charger shall be designed to permit parallel operation and load sharing between two identical chargers connected to a common battery and load.
- 4.3.18.2 Failure of one charger shall not affect the operation of the other charger or battery by means of a blocking diode or equivalent technology.

4.3.19 Interlocks

- 4.3.19.1 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, the enclosure shall be interlocked to prevent opening or closing of the door unless both input and output protective devices are in the "open" position.

- 4.3.19.2 If enclosure is provided with interlocks, provisions shall be provided inside the enclosure to permit the input device to be closed for diagnostic purposes with the door open.

4.4 Controls

4.4.1 Float/Equalize Timer

- 4.4.1.1 An equalizing timer shall be provided for manually placing the battery on equalizing charge.
- 4.4.1.2 The timer shall have a manually adjustable timing range of at least 0 to 72 hours.

4.4.2 Automatic Equalizing Charge Control

- 4.4.2.1 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, the charger shall be equipped with controls that shall automatically switch to equalizing charge after an AC power interruption of more than 5 minutes.
- 4.4.2.2 The charger shall automatically return to floating charge mode (field adjustable from 0 to 24 hours) after the equalizing charge mode starts.

4.4.3 High-Voltage Shutdown

The charger shall automatically shut down if the output DC voltage reaches (field adjustable up to) 110% of the output voltage setting.

4.4.4 Alarm Reset Button

A momentary pushbutton to reset alarms shall be provided.

4.5 Control Indications

The following control indications shall be provided by LED or LCD on the front panel of the charger enclosure:

- a. Charger on
- b. Floating charge
- c. Equalizing charge

4.6 Alarm Indications - Local

- 4.6.1 The following alarm indications shall be provided by LED or LCD on the front panel of the charger cabinet:
 - a. Positive ground fault
 - b. Negative ground fault
 - c. Charger failure
 - d. Low DC voltage
 - e. High DC voltage
 - f. Overcurrent
 - g. Common
 - h. Cooling fan failure (for force ventilated units)

- 4.6.2 If indicated on the purchaser's *PIP ELSAP01-D* Data Sheet, the following alarm indications shall be provided by LED or LCD on the front panel of the charger cabinet:
- AC input failure
 - Charger over-temperature
 - Equalizing charge mode
 - Battery over-temperature
 - Output breaker open
- 4.6.3 All alarms shall remain latched until manually reset after the alarm condition has been cleared.

4.7 Alarm Indications - Remote

- 4.7.1 A form "C" alarm contact, rated 120 VAC, 5 amps, shall be provided for annunciating all the alarms of Section 4.6 as a common alarm to owner's central alarm-monitoring system.
- 4.7.2 If indicated on the purchaser's *PIP ELSAP01-D* Data Sheet, communication capabilities shall be furnished.

4.8 Panel Meters

4.8.1 Output Voltage and Current

- 4.8.1.1 A digital (LED or LCD) panel meter shall be provided to display the output current and voltage.
- 4.8.1.2 Meters shall have $\pm 1\%$ full-scale accuracy.

4.8.2 Ground Fault Indication

If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, positive and negative ground faults shall be displayed on a common meter by using a switch to show the magnitude of the leakage current.

4.9 Wiring, Cables, and Devices

- 4.9.1 Wiring brought out to terminal blocks shall be permanently identified with heat-shrinkable or sleeve type wire markers.
- 4.9.2 Wire numbers and color codes shall correspond to the numbers and colors shown on the schematic/wiring diagram(s).
- 4.9.3 Terminal blocks shall be provided for connection of external control and alarm wiring. A maximum of two wires per point shall be permitted.
- 4.9.4 All energy-isolating devices (disconnecting means) that are required to perform safe maintenance shall be capable of accepting a lockout device in the "OFF" or disconnected position only.

Comment: An energy-isolating device is a mechanical device that physically prevents the transmission or the release of energy.

- 4.9.5 Each energy-isolating device (disconnecting means) shall be clearly identified to indicate its purpose.

- 4.9.6 Permanent wire supports shall be provided. Adhesive-backing wire supports shall not be permitted.

4.10 Grounding

- 4.10.1 Grounding provisions shall be in accordance with *NFPA 70 (NEC)*.
- 4.10.2 The enclosure shall be provided with a copper equipment grounding connection.
- 4.10.3 The positive and negative DC buses shall be isolated from the earth ground.

4.11 Enclosure

- 4.11.1 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, enclosures shall be manufacturer's standard.
- 4.11.2 Enclosure preference shall be for natural convection cooling.
- 4.11.3 If forced ventilation is used, the enclosures shall be equipped with removable, easily cleanable inlet air filters.
- 4.11.4 Enclosures shall be designed for front access to all components and test points. Parts, test-points, and terminals shall be placed so they are accessible for circuit checking, adjustment, and maintenance without removing any adjacent assembly or component or without posing a shock hazard. Components shall be placed and suitable guards installed so that checking, adjusting, and maintaining control components does not expose workers to energized power components.
- 4.11.5 Handles, screws, and hinges shall be corrosion-resistant.
- 4.11.6 If provided, the enclosure door handle shall have provision to be padlocked.
- 4.11.7 Cable entry shall be as specified on the purchaser's *PIP ELSAP01-D* Data Sheet.
- 4.11.8 Enclosure shall be designed and constructed so that all normal controls are operable with the doors closed.
- 4.11.9 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, space heaters and accessories shall be supplied.

4.12 Painting

Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, finish shall be manufacturer's standard (i.e., method, type, color, etc.).

4.13 Nameplate

- 4.13.1 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, all nameplates shall be manufacturer's standard in accordance with NEMA PE5.
- 4.13.2 Devices shall be marked in accordance with NEMA PE5.
- 4.13.3 A device label shall be provided for each front mounted device. Examples of front mounted devices are relays, meters, and switches.
- 4.13.4 A label shall be provided for each device inside a unit. Examples of inside the unit devices are relays, terminal blocks, fuses, and circuit breakers.
- 4.13.5 Label descriptions shall match the device description or tags on the manufacturer's drawings.

4.14 Testing

- 4.14.1 The battery charger shall be factory-tested in accordance with NEMA PE 5 to demonstrate the performance and the functionality required by this Practice.
- 4.14.2 If specified on the purchaser's *PIP ELSAP01-D* Data Sheet, additional tests shall be performed.
- 4.14.3 Certified test reports shall be furnished.

4.15 Documentation

- 4.15.1 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, one electronic set of documents, including operating manuals, in Adobe PDF format shall be provided.
- 4.15.2 Unless otherwise specified on the purchaser's *PIP ELSAP01-D* Data Sheet, final certified and as-built drawings shall be submitted in Adobe PDF format.
- 4.15.3 Drawings and data requirements shall be as shown in Table 1.

Table 1. Documentation Requirements

A With Bid	B For Review	C Final Certified	D As Built	Description
X				Seismic compliance report where required
X	X	X	X	General layout of equipment, showing all dimensions, weights, location, and outline drawings showing the final assembled configuration
		X		Copies of certified test reports
	X	X	X	One-line diagram, three-line diagram, control schematics and connection wiring diagrams
		X(1)		Installation, operation, maintenance manual and required maintenance schedules
X		X	X	Safety instructions clearly identifying proper and improper operation that might injure personnel and cause damage to operating equipment
Notes: A. These documents shall be provided with the proposal. B. These documents shall be provided for the purchaser's review and authorization to proceed before fabrication. C. These documents shall be provided as part of the final certified document submittal. (1) Equipment shall be shipped with one set of installation, operation, and maintenance manuals. D. Final as -built documents shall be provided within 2 weeks following shipment.				

4.16 Conflict Resolution

Any conflicts between the reference documents shall be identified in writing to the purchaser for resolution. If resolving conflicts, the following order of precedence shall apply:

- a. Purchase order
- b. *PIP ELSAP01-D* Data Sheet
- c. This Practice, *PIP ELSAP01*
- d. Referenced standards



ASSOC. PIP:
ELSAP01

DATA SHEET

ELSAP01-D

UTILITY TYPE BATTERY CHARGERS

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DOCUMENT NO.: _____ ALTERNATE DOCUMENT NO.: _____
 ISSUED FOR: PROPOSAL PURCHASE AS BUILT
 FACILITY NAME/LOCATION: _____
 ITEM NAME: _____ PURCHASER/LOCATION: _____
 ITEM TAG NO.: _____ JOB NO.: _____
 SERVICE: _____ PURCHASE ORDER NO.: _____
 UNIT: _____ SUPPLIER/LOCATION: _____
 P&ID NO.: _____ SUPPLIER ORDER/SERIAL NO.: _____

DATA PROVIDED BY: ● PURCHASER ■ SUPPLIER ◆ SUPPLIER IF NOT BY PURCHASER

REFER TO PIP ELSAP01 FOR GENERAL REQUIREMENTS.

APPLICABLE STATE AND LOCAL CODES:

● **OPERATING ENVIRONMENT (4.2):**

AMBIENT TEMPERATURE: MAX: 50 °C MIN: 0 °C ALTITUDE: <1000 M HUMIDITY: <95 %

OTHER: _____

SEISMIC REQUIREMENTS: PER PIP STC01015, CVC01017, & CVC01018 NOT REQUIRED

OTHER: _____

SEISMIC CERTIFICATE: REQUIRED NOT REQUIRED

OTHER: _____

● **BATTERY TYPE AND LOAD REQUIREMENTS:**

LEAD-CALCIUM LEAD-ANTIMONY NICKEL-CADMIUM MFR. _____

VRLA OTHER: _____

NO. OF CELLS: _____ CAPACITY: _____ AMPS FOR _____ HOURS, TO _____ FINAL VOLTS PER CELL (VPC).

BATTERY RECHARGE TIME (TO 90% CAPACITY) (4.1.4): 8 HOURS

EXTERNAL DC LOAD (EXCLUDING BATTERY): _____ AMPS MAX

DUTY CYCLE DESCRIPTION: _____

SEE ATTACHED DIAGRAM

OTHER: _____

● **CHARGER RATINGS AND REQUIREMENTS:**

AC INPUT (4.3.2): _____ VOLTS _____ PHASE 60 HZ

AVAILABLE SHORT CIRCUIT CURRENT: _____ AMPS RMS SYM (4.3.1.2)

DC OUTPUT RATING (4.3.5): _____ VOLTS DC OUTPUT FILTERING (4.3.8.2): REQUIRED NOT REQUIRED

BATTERY TEMPERATURE SENSING PROBE (4.3.12.1): REQUIRED NOT REQUIRED

■ TEMP. COMPENSATION SLOPE (mV/Cell/°C) (4.3.12.2): REQUIRED NOT REQUIRED

OUTPUT OVERCURRENT PROTECTION (4.3.17): CIRCUIT BREAKER FUSED DISCONNECT

OTHER: _____

PARALLEL OPERATION (4.3.18): REQUIRED NOT REQUIRED

ENCLOSURE INTERLOCKS (4.3.19.1): REQUIRED NOT REQUIRED

AUTOMATIC EQUALIZING CHARGE (4.4.2): REQUIRED NOT REQUIRED

OTHER: _____

NO.	DATE	REVISION DESCRIPTION	BY	APPROVED



ASSOC. PIP:
ELSAP01

DATA SHEET

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UTILITY TYPE BATTERY CHARGERS

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ITEM TAG NO.:

JOB NO.:

REV. DATE:

● **ADDITIONAL ALARM REQUIREMENTS (4.6.2):**

- AC INPUT FAILURE
- EQUALIZING CHARGE MODE
- OUTPUT BREAKER OPEN
- CHARGER OVER TEMPERATURE
- BATTERY OVER TEMPERATURE
- OTHER: _____

● **COMMUNICATION REQUIREMENTS (4.7.2):**

- SERIAL ETHERNET FIBER MODBUS DNP3
- OTHER: _____

● **PANEL METERS:**

- GROUND FAULT INDICATION METER (4.8.2): REQUIRED NOT REQUIRED
- OTHER: _____

● **ENCLOSURE TYPE:**

- ENCLOSURE TYPE (4.11.1): MFR. STD. OTHER: _____
- CABLE ENTRY (4.11.7): SIDE BOTTOM TOP
- PAINT FINISH (4.12): MFR. STD. OTHER: _____
- OTHER: _____

● **SPACE HEATERS (4.11.9):**

- SPACE HEATERS: REQUIRED NOT REQUIRED
- SPACE HEATER ACCESSORIES:
 - THERMOSTAT
 - AMMETER
 - OTHER: _____
 - HUMIDISTAT
 - SPACE HEATER TEST CIRCUIT
- OTHER: _____

● **NAMEPLATES (4.13):**

- MANUFACTURER'S STANDARD
- OTHER: _____
- _____
- _____
- _____

● **TESTING (4.14):**

- ADDITIONAL TESTING (4.14.2): REQUIRED NOT REQUIRED
- REQUIREMENTS: _____
- _____
- _____
- _____
- _____
- _____

