ADDENDUM No. 2 TO THE CONTRACT DOCUMENTS

Project: *Powerhouse 125 VDC Station Service Replacement Project*

Addendum Issue Date: August 3, 2018

Issued for Bid Date: June 19, 2018

Bid Due Date: August 23, 2018, 2:00pm (AK)

Previous Addenda Issued: Addendum 1 on July 20, 2018

Issued By: William Farrell
Electric Power Systems, Inc.
3305 Arctic Blvd., Suite 201
Anchorage, Alaska 99503

Notice to Bidders:

Bidders must acknowledge receipt of this addendum prior to the date set for bid opening by one of the following methods:

(1) By acknowledging receipt of this addendum on the bid submitted.
(2) By fax which includes a reference to the project and addendum number.

The bid documents require acknowledgment individually of all addenda to the drawings and/or specifications. This is a mandatory requirement and any bid received without acknowledgment of receipt of addenda may be classified as not being a responsive bid. If, by virtue of this addendum it is desired to modify a bid already submitted, such modification may be made by fax provided such a fax makes reference to this addendum and is received prior to the opening date specified above.

The contract Documents for the above project are amended as follows (all other terms and conditions remain unchanged):

ITEM 1
Contract: *City of Unalaska Powerhouse 125 VDC Station Service Replacement*
Section: Part 1 – Bidding Requirements, Section 0030.

Sealed bids will now be received until 2:00 p.m. (AKST) on August 23, 2018.

ITEM 2
Contract: *City of Unalaska Powerhouse 125 VDC Station Service Replacement Project*
Section: *Project Drawings*

Drawing No. E3.03 is reissued. See attachments for revised drawing E3.03. The contractor is responsible for providing temporary power to several locations inside the Old Powerhouse prior to the 125VDC outage. Additional field verification and coordination with City personnel will be required in order to perform this work.

ITEM 3
Contract: *City of Unalaska Powerhouse 125 VDC Station Service Replacement*

Section: *Project Drawings*

Drawing M2.08 is reissued. See attachments for revised drawing M2.08.

ITEM 4
Questions from Bidders:

1. Please verify the height and material make of the drop lid ceiling (tile, sheetrock, plywood, etc...) within the control room as stated on Note 4 on drawings A1.01 and Note 2 A1.02.
   Answer: There is a small 4'x4' section of suspended gwb ceiling in the control room in front of the entry door. This section of ceiling is to be demo'ed as part of this contract. There is no other suspended ceiling in the control room. Disregard note number 2.

2. Please verify existing wall type and thickness (sheetrock, concrete, etc…) to be demoed Note 1 on A1.01.?
   Answer: Those walls are framed walls. Not concrete.

3. Please verify what surfaces and color shall be painted.
   Answer: All new (and newly exposed) and modified surfaces.

   New walls shall be painted to match adjacent walls. Contractor shall collect and match paint by utilization of paint chip samples and match to the best of their ability. Submit matched colors for approval.
   - *Control room walls are two tone white and green.*
   - *Battery room walls and ceiling surfaces shall be painted white and floor shall be gray.*
   - *Wall surfaces within the ORC room: are two tone white and green, same as control room.*

4. Please verify number of ceiling penetrations to be grouted per detail on A1.02 with arrow pointing to battery room?
   Answer: For estimating purposes (the holes are covered), use a 12" dia. hole and a 4" dia. hole.

5. Please verify finish of existing ceiling <u>above</u> the battery room ceiling. (The final ceiling in the battery room.)
   Answer: Painted concrete.

6. Please verify battery room dimensions. (Length, Width, Height)
   Answer: New walls are to be in place of demo'ed walls. Align with existing walls to remain such that finishes flush. For estimating purposes:
   Existing Room approximate dimensions: 102.75" to bottom of ceiling x 15'-8" (long) x 8' (wide).
   New room: approximate height dimensions are 142.625" to underside of concrete above.

7. On project plan sheets A1.02 and A1.03 under the LEGEND - Are there new fire extinguishers and semi- recessed cabinets to be provided in this project?
   Answer: There are no new required fire extinguishers. All fire extinguishers shown are existing.

8. Question on Specification Section 078413 – Penetration Firestopping, Part 2- Products, 2.1, A. Fire-Test-Response Characteristics.
   > "Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction."

   Is the intent of the project for the contractor to hire a qualified testing agency for the size and scope of this project?

   Answer: No, testing by a qualified testing agency is not required. Provide fire stopping materials which will meet the requirements of the authorities having jurisdiction based on the application for wall and penetration type.

9. Data sheets are not available on the Enersys website for the items listed on Sheet E3.02 BOM. Please provide more information to assist in obtaining quotes.
   Answer: Some information from Enersys is included with this addendum. Note that it is general in nature and some items in these documents will not pertain to the work in this contract. Bidders should contact Enersys to find local vendor information and to obtain quotes.

10. Please provide a copy of the latest fire alarm inspection report for the facility.
    Answer: See attached.

11. Is the new battery lifter suitable for use with the old batteries?
    Answer: Contact the manufacturer for use with other batteries.

12. Mechanical Sheet M1.02, detail 2 - Existing stack dimensions are indicated as 3'-0" x 2'-10", with the understanding that dimensions should be field verified prior to order. However, the insect screen size is indicated as 6" x 60". Is the 60" screen length required if the stack dimensions are so much smaller?
    Answer: Clarification, the inside clear dimensions for the majority of the stack is approximately 3'-0" x 2'-10". These dimensions are the inside surface of an existing refractory brick lining system. The lining system from the top of the concrete stack down approximately 3.5 feet has been removed leaving only the structural concrete. Inside dimension for structural concrete is approximately 44" x 40" clear at the top of the stack structure outlet. Outside dimensions of the concrete stack structure range from 71.75" x 66.75" to approximately 108" x 108" depending on the record drawing referenced.

13. Drawing E5.11, "Damper Actuators – AHU-1" detail shows cable AC-11. This is not on the cable schedule on E1.10. Please clarify which is correct.
    Answer: On E5.11, change 'AC-11' cable tag to 'CC-13'

14. On project plan sheets M2.08, Detail 1, how is the water heater temperature controlled?
Answer: It's 120VAC control. Previous drawing showed 24VAC. This is now corrected in revised M2.08 (attached to this addendum).

15. As part of our bid we are getting an insurance quote for a Builder's Risk Insurance Policy. The policy questionnaire requests the distance from the OPH to the nearest fire hydrant. Can you provide the distance to the nearest fire hydrant?
Answer: 50 feet. Builders risk insurance will not be required.

16. Sheet M2.08 Detail 4 HVAC Schematic depicts a location for FD-1. The location for this damper appears to be located between the two sets of doors for the entry into the control room. This location may not allow adequate make up air to flow into the battery storage room. Should FD-1 be re-located to a position on the wall to a location outside the area between the two sets of doors?
Answer: Sheet 2.08 Detail 4 is a schematic view of the room for indication of the HVAC process for cooling/heating/ventilation of the control and battery room. Locations identified are approximate. Refer to mechanical sheet 1.01, Detail 2, "Enlarged Mechanical Plan" and project specifications for the specific location and additional guidance for location of mechanical equipment and appurtenances.

17. Plan Sheet E3.11 Note 8 states: "…Test all new and reinstalled fire system components to ensure entire system is properly certified by the authority having jurisdiction." Is it the intent of the project to: A) test the new and reinstalled fire system components and verify that they function properly but not inspect and certify the entire fire alarm system for the Old Powerhouse; or B) test the new and reinstalled fire system components and verify that they function properly through testing and certifying the entire fire alarm system for the Old Powerhouse??
Answer: Only test that the reinstalled fire alarm devices are functioning properly again. A complete test and certification of the entire fire alarm system is not required.

18. Specification Section 230593 Testing, Adjusting and Balancing for HVAC, Part 3-Execution, 3.15 Additional Tests
    a. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
    b. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.
    c. QUESTION: This project has a Substantial Completion date of March 15, 2019 and a Final Completion date of April 15, 2019. Initial TAB procedures will be performed during this time period.

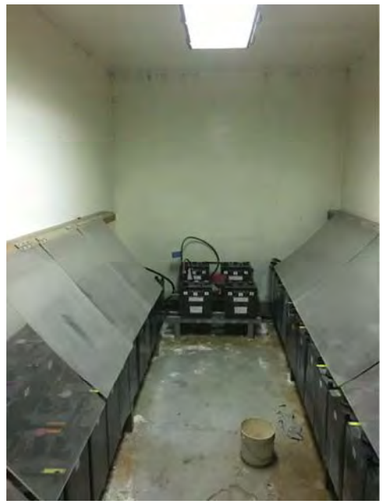
d. Please provide dates for near-peak winter and near-peak summer conditions and whether or not the Initial TAB and 90 Day TAB will fulfill either near-peak winter or near-peak summer conditions.

Answer: Due to the project duration and schedule, near-peak conditions for purposes of the test are not likely to be encountered during construction. The contractor will simulate near peak conditions for the purposes of TAB activities. Contractor will simulate both near peak winter and summer conditions. Document the response of the completed system for correct operation.

Based on a completion date of April 15th, near summertime conditions may be encountered. Review system operation in comparison with operation during simulated conditions to determine if the system is operating as required. Perform additional TAB if the system is not operating as required.

19. On Page 4 of Addendum 1, SUMMARY, Paragraph 2, Second Sentence: "It also requires removal of the existing ceiling and replacement of a wall." Plan Sheet A1.01 Note 1 shows removal of (2) walls to be demolished and replaced: a) the wall separating the battery storage room from the Control Room, and b) the front wall of the battery control room with associated door. Plan Sheet A1.02 depicts (2) walls for new construction.
Answer: Plan sheets are correct in regards to quantity of walls for demolition.

END OF ADDENDUM NO. 2



PICTURE 1: BATTERY ROOM

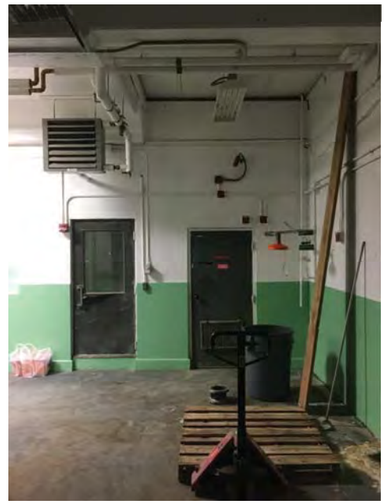
NOTES

1. DEMO 125 VDC BATTERY BANK AND ALL ASSOCIATED COMPONENTS AND ELECTRICAL CONDUIT AND WIRE TO ALLOW THE REMOVAL OF THE EXISTING WALLS AND CEILING. COORDINATE WITH OTHER TRADES AS REQUIRED.
2. DISPOSAL OF BATTERIES ONLY WILL BE BY THE CITY OF UNALASKA. CONTRACTOR IS TO PREPARE BATTERIES FOR LOCAL TRUCK TRANSPORT.
3. DISPOSAL OF ALL OTHER REMAINING MATERIALS IS THE RESPONSIBILITY OF THE CONTRACTOR.
4. REMOVE 24V BATTERY BANK SHOWN IN THE CENTER OF THE ROOM IN PICTURE 1 ABOVE. REINSTALL PRIOR TO PROJECT COMPLETION. ⚠1

PICTURE 2: BATTERY ROOM CEILING

NOTES

1. PICTURE 2 SHOWS A TYPICAL PORTION OF THE CEILING FOR THE BATTERY ROOM. DEMO ALL CONDUITS AS REQUIRED TO ALLOW RECONSTRUCTION OF THE ENTIRE ROOM.



PICTURE 3: OLD POWERHOUSE BATTERY ROOM ENTRANCE

NOTES

1. REMOVE AND REINSTALL FIRE ALARM DEVICES, CONDUIT AND WIRE. COORDINATE WITH MECHANICAL CONTRACTOR.
2. TEST ALL RELOCATED ALARM DEVICES AS REQUIRED BY AHJ IN ORDER TO RE-CERTIFY ALARM SYSTEM.

PICTURE 4: OLD POWERHOUSE DC EQUIPMENT - DEMO

NOTES

1. REMOVE BATTERY CHARGER, CHARGER STAND AND DC PANEL IN ENTIRETY. CONDUIT TO PANEL 'AC-7' IS AVAILABLE FOR REUSE AND MUST BE RECONFIGURED FOR INSTALLATION OF NEW CHARGER.
2. REMOVE 24 VDC BATTERY CHARGER AND JUNCTION BOX. RETIRE ASSOCIATED CONDUITS TO ALLOW INSTALLATION OF NEW EQUIPMENT. CIRCUITS WILL BE RECONNECTED BY OWNER AFTER PROJECT IS COMPLETE. INSTALL JUNCTION BOX(S) OR GUTTER(S) TO PRESERVE THE CONDUCTORS. LABEL ALL CIRCUITS. COORDINATE WORK WITH OWNER PRIOR TO STARTING DEMOLITION.

TEMPORARY POWER NOTES ⚠1

1. PROVIDE TEMPORARY POWER TO THREE LOCATIONS AFFECTED BY THE 125 VDC OUTAGE THAT WILL BE REQUIRED DURING CONSTRUCTION. TEMPORARY POWER IS TO BE 120VAC OR 240VAC. IT CAN BE SOURCED FROM A NEARBY ELECTRICAL PANEL WITH A SPARE BREAKER OR PROVIDED A TEMPORARY FEED FROM A NEARBY RECEPTACLE CIRCUIT OR SIMILAR.
2. THE CONTRACTOR IS REQUIRED TO DETERMINE THE BEST SOURCES FOR TEMPORARY POWER FOR EACH LOCATION.
3. PROVIDE A TEMPORARY POWER PLAN TO THE OWNER FOR REVIEW PRIOR TO COMMENCING WORK.
4. THE PANEL CUTOVERS TO TEMPORARY POWER MUST HAPPEN JUST BEFORE THE 125 VDC OUTAGE STARTS AND WILL REQUIRE ADVANCE COORDINATION TO ENSURE PROPER SUPPORT PERSONNEL ARE ON-SITE.
5. RESTORE 125 VDC POWER TO ALL LOCATIONS ON TEMPORARY POWER AFTER NEW 125 VDC EQUIPMENT IS IN SERVICE. REMOVE ALL TEMPORARY EQUIPMENT AND MATERIALS AND RESTORE ANY MODIFIED AREAS TO EQUAL OR BETTER CONDITION.
6. THE LOCATIONS ARE:
   - 6.1. PLC PANEL IN CONTROL ROOM
   - 6.2. NETWORK PANEL ON SECOND FLOOR IN OLD BREAK ROOM
   - 6.3. FUEL SCADA PANEL NEAR FUEL ROOM.

DEMOLITION

PROJECT: POWER PRODUCTION 125 VDC STATION SERVICE REPLACEMENT
DESIGNER/PROJECT ENGINEER: WILLIAM BROWN-FARRELL/EARL GEORGE - EPS JOB #: 17-0049

NO.	DESIGN/CONSTRUCTION/ASBUILT REVISION	DWN BY/DATE	REVIEWED BY/DATE
0	ISSUED FOR BID	KER/08-19-2018	WBF/08-19-2018

ENG. STAMP

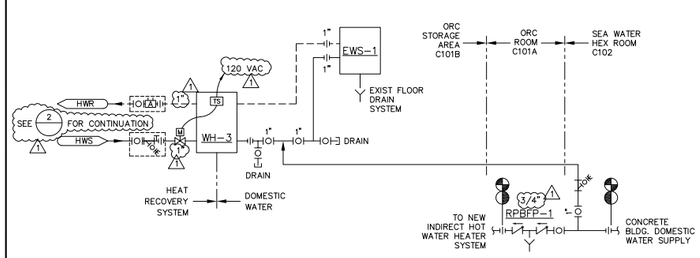
Electric Power Systems Inc.
Consulting Engineers
TEL: (907) 522-1953
FAX: (907) 522-1182
WEB: WWW.EPSINC.COM

NO.	DRAWING NO./SHEET	REFERENCE DRAWING/DETAIL/PLAN/SECTION DESCRIPTION

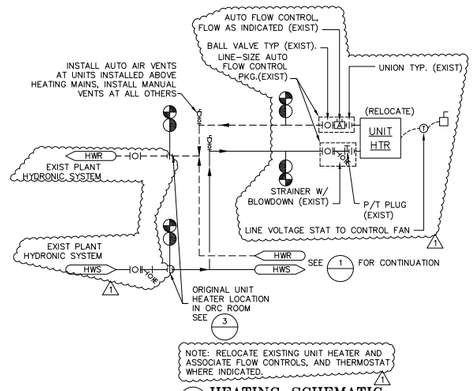
DRAWING NAME:
CITY OF UNALASKA
OLD POWERHOUSE 125VDC STATION SERVICE
DETAILS - DEMO
e3.03.dwg

REF DWG(S):

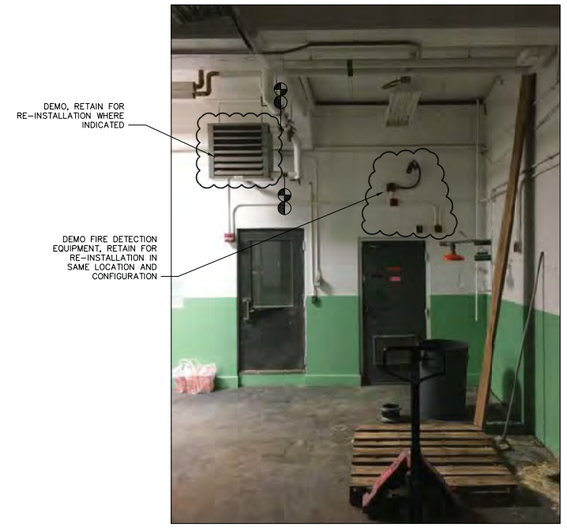
DRAWING NO.: E3.03



1 PLUMBING SCHEMATIC
N.T.S.

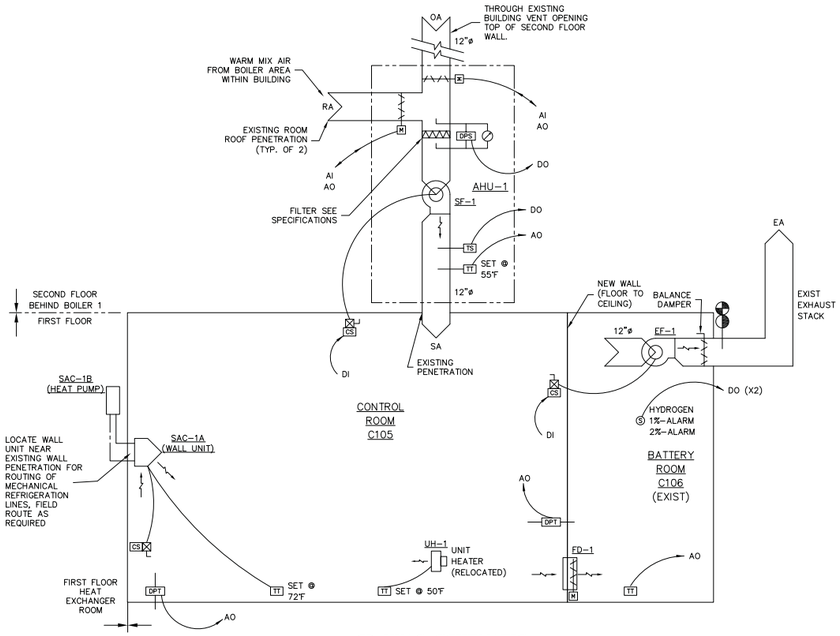


2 HEATING SCHEMATIC
N.T.S.

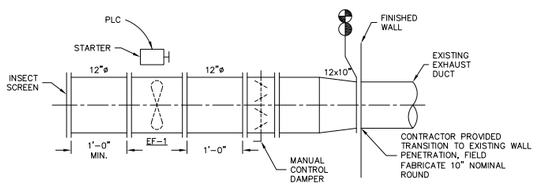


3 ORIGINAL UNIT HEATER (DEMO)
N.T.S.

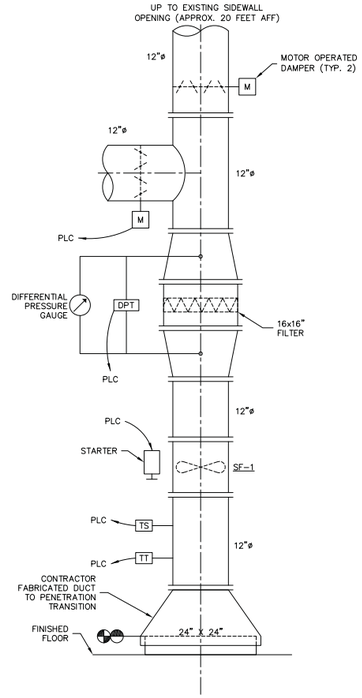
8 CONTROL ROOM EXIST AHU DEMO
N.T.S.



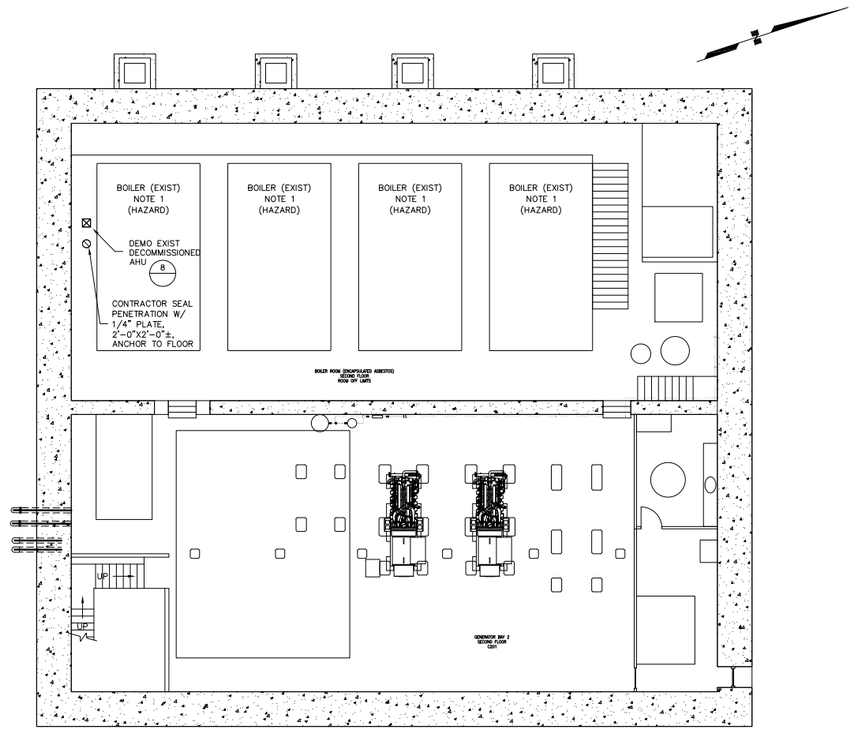
4 HVAC SCHEMATIC
N.T.S.



5 EXHAUST FAN
N.T.S.



6 SUPPLY AIR
N.T.S.



7 SECOND FLOOR MECHANICAL PLAN DETAIL
N.T.S.

NOTES:

1. CONTRACTOR TO SEAL ALL WALL PENETRATIONS (CONDUIT, CABLE, UNUSED, ETC.) WITHIN ROOM WITH INSULATION AND FLASHING (BOTH SIDES)

PROJECT: POWER PRODUCTION 125 VDC STATION SERVICE REPLACEMENT
DESIGNER/PROJECT ENGINEER: WARREN TAYLOR – EPS JOB #: 17-0049

NO.	DESIGN/CONSTRUCTION/ASBUILT REVISION	DWN BY/DATE	REVIEWED BY/DATE
0	ISSUED FOR BID	KER/06-19-2018	WBT/06-19-2018

ENG. STAMP

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FAX: (907) 522-1182
WEB: WWW.EPSINC.COM

NO.	DRAWING NO./SHEET	REFERENCE DRAWING/DETAIL/PLAN/SECTION DESCRIPTION

DRAWING NAME:
CITY OF UNALASKA
OLD POWERHOUSE 125VDC STATION SERVICE
HVAC AND PLUMBING DIAGRAMS
CONCRETE BUILDING
m2.08.dwg

REF DWG(S):

DRAWING NO.: M2.08

SHEET 28 OF 29

C&T FIRE PROTECTION, INC

907 East Dowling, Ste 13
Anchorage, Alaska 99518
(907) 563-3473
www.catfire.com

FIRE ALARM SYSTEM INSPECTION REPORT

SYSTEM STATUS

○ 1 ○ 2 ○ 3 ◉ 4

ADDRESS: *Unalaska AK,*

BLDG NAME: *Old and New Power Plant Buildings* PROTECTED AREA: *Entire Building*

BUILDING REP: *Mike Barber* TYPE OF SERVICE: *ANNUAL INSPECTION*

INSPECTED BY: *Curtis Jones 10-035* INSPECTION DATE: *5/17/2018*

SYSTEM DETAILS

PANEL MANUFACTURER: *SIMPLEX* MODEL NUMBER: *4100U*

FIRMWARE REV/DATE: MONITORING ENTITY: *Unalaska Police and Fire*

INITIATING CIRCUITS: NOTIFICATION CIRCUITS: *4 On-Boar & 4 Booster NAC's*

SIGNALING LINE CIRCUITS: *1* AUXILIARY CIRCUITS: *1 Dieler Power*

SYSTEM TESTS

PRIMARY (MAIN) SUPPLY

A/C VOLTAGE: *120 VAC* BREAKER #: 1

BREAKER LOCATION: *Panel AC3 inside backup gen. room* DEDICATED CIRCUIT? *YES*

SECONDARY (STANDBY) SUPPLY

BATTERY VOLTAGES: **See Battery Report**

CONTROL PANEL (pass - fail - n/a)

LAMPS: *PASS* AUDIBILITY: *PASS* FUNCTIONS: *PASS* TROUBLES: *PASS*

FUSES: *PASS* GROUND CIR: *PASS* STANDBY: *PASS* SUPERVISION: *PASS*

EQUIPMENT / DEVICES

TYPE	TOTAL	PASS	FAIL	N/A	TESTED	COMMENTS
HORN/STROBES	55	55			55	
STROBES						
MANUAL PULL STATIONS	17	17			17	
SMOKE DETECTORS	42	42			42	
HEAT DETECTORS	27	27			27	
DUCT DETECTORS	1	1			1	
SPRINKLER WATERFLOW	2			2		Tested By Others
SPRINKLER SUPERVISORY	5			5		Tested By Others
FLAME DETECTORS	14	14			14	
AHU SHUTDOWNS	1	1			1	
HORNS						
REMOTE FLAME BYPASS	2	2			2	
MONITORING	1	1			1	Unalaska Police and Fire
BEAM SMOKE DETECTOR						
DOOR RELEASE	1		1		1	Switchgear door drop not powered up.
REMOTE ANNUNCIATORS	2	2			2	
SPRINKLER BELL	1			1		
AUX POWER SUPPLY	3	3			3	See Battery Report (Flame Det. Power)
HORN EXPANDER	1	1			1	See Battery Report

INSPECTION DETAILS:

Client Signature _____ Technician _____

Print Name: _____ Date: 5/17/2018

C&T FIRE PROTECTION, INC

907 East Dowling Road Suite 13
Anchorage, Alaska 99518
(907) 563-FIRE (3473)
curtis@catfire.com

BATTERY REPORT

BLDG NAME: *Old and New Power Plant Buildings*

BUILDING REP: *Mike Barber*

TYPE OF SERVICE: *ANNUAL INSPECTION*

INSPECTED BY: *Curtis Jones 10-035*

INSPECTION DATE: *5/17/2018*

ALARM PANEL	AC POWER BREAKER	CHARGIN	STANDBY	LOAD	BATTERY	BATTERY	INSTALL
FACP 2nd Floor IT Closet New Powerhouse	*Panel AC3 (#1) Inside Backup Gen. Room*	*27.6*	*24.56*	*23.8*	*SLA*	*12v 18ah*	*Jun-14*
Booster Power Supply 1st Floor Bay #2 New Power House	*Panel AC4 (#33) Inside Backup Gen. Room*	*27.44*	*26.8*	*25.9*	*SLA*	*12v 7ah*	*Jun-14*
Booster Power Supply 2nd Floor Old Power House	*Panel AC2 (#37) On Wall Next to walk thru opening.*	*27.47*	*26.4*	*25.2*	*SLA*	*12v 7ah*	*Jun-14*
Booster NAC Panel 2nd Floor Old Power House	*Panel AC2 (#37) On Wall Next to walk thru opening.*	*27.46*	*27.2*	*24.5*	*SLA*	*12v 7ah*	*Jun-14*
Booster Power Supply 1st Floor Old Power House	*Panel AC8 (#4)On wall next to booster power supply.*	*27.81*	*26.8*	*25.2*	*SLA*	*12v 7ah*	*Jun-14*

INSPECTION DETAILS:

TECHNICIAN'S SIGNATURE *5/17/2018*

INSTRUCTIONS for ASSEMBLING SEISMIC RACKS

Read all instructions carefully and observe all warnings before installation.

See *Safety, Storage, Installation, Operation and Maintenance Manual*
(Publication US-FL-IOM)

1. GENERAL INFORMATION

EnerSys stationary seismic racks are available for ZONE 2 and ZONE 4 applications, as defined in the Uniform Building Code (UBC) or Network Equipment Building Systems (NEBS). Racks are supplied unassembled. The basic components consist of: frames, cross braces, support rails, side rails and end rails with plastic channels, corner brackets, shims, cell clamp assemblies, foam spacers and assembly hardware.

2. SAFETY PRECAUTIONS

- Assemble racks in accordance with the instructions contained in this document WITHOUT DEVIATIONS.
- Refer to UBC, OSHA, and EPA regulations and local ordinances that pertain to battery installation and storage.
- Refer to the SAFETY PRECAUTIONS contained in Safety, Storage, Installation, Operation and Maintenance Manual *(Publication US-FL-IOM).*
- Racks with front and rear cross braces must have the front braces removed to install cells. DO NOT REMOVE FRONT AND REAR BRACES AT THE SAME TIME. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN CELLS FALLING OFF THE RACK AND CAUSING PERSONAL INJURY.
- On installations where grounding is required for NEC and/or local codes, see instructions for RACK GROUNDING.

3. SERVICE INFORMATION

Should you require installation supervision, service, parts, accessories or maintenance, EnerSys has a service organization to assist with your new rack purchase. Contact your nearest EnerSys representative or call the corporate number listed on the back of this manual and ask for *Reserve Power Service*.

4. INSPECTION OF BATTERY RACK COMPONENTS

Upon receipt, check each package with the packing list to ensure all components and quantities are correct. **If any part has not been received or has been damaged, DO NOT proceed with installation until all parts are available.**

5. INSTALLATION CONSIDERATIONS

If you have any questions concerning the following installation considerations, contact your EnerSys sales representative.

FLOOR LOCATION:

- Consider available floor space, including aisles for cell installation, maintenance, and possible cell replacement. Aisle spacing should be in accordance with the NEC Article 110-16. ALL OTHER APPLICABLE CODE REQUIREMENTS SHOULD ALSO BE CONSIDERED.
- Floor/Platform must be capable of supporting the weight of the battery and rack system, as well as any auxiliary equipment. ALL APPLICABLE CODE REQUIREMENTS SHOULD BE CONSIDERED**.**

- Floor must be reasonably level. Shimming up to 0.25 in. (6 mm) maximum may be used to have support rails level both front-to-back and side-to-side.

SEISMIC RACK LOCATION:

Minimum clearance between these racks and any objects (including walls, equipment and other racks) is to be 4 in. (100 mm). **NO RACKS ARE TO BE BUTTED TOGETHER, END-TO-END OR BACK-TO-BACK.** Inter-rack cable connectors (provided by EnerSys) are based on 4 in. (100 mm) spacing; any length over this is the responsibility of the installer.

6. INSTALLATION EQUIPMENT and SUPPLIES

Before working with the battery system, ensure that you have the tools and equipment listed below.

- Chalk line
- Floor anchors
- Concrete drill (for floor anchors)
- Floor shims (user-supplied)
- Level
- Ohmmeter (for ground testing)
- Open end/box wrenches (SAE dimensions)
- Ratchet set w/ sockets (SAE dimensions)
- Square
- Tape measure
- Torque wrench (10-100 ft-lb.)

TABLE 1 – Torque Specifications

Bolt Diameter		Torque	
in.	mm	ft-lb.	Nm
3/8	9.5	20	27
1/2	12.7	50	68
5/8	15.9	100	136

7. RACK ASSEMBLY

7.1 CROSS BRACE TO FRAME ASSEMBLY

Bolt cross braces to respective frames. Refer to the rack drawing in Figure 7.1 for location.

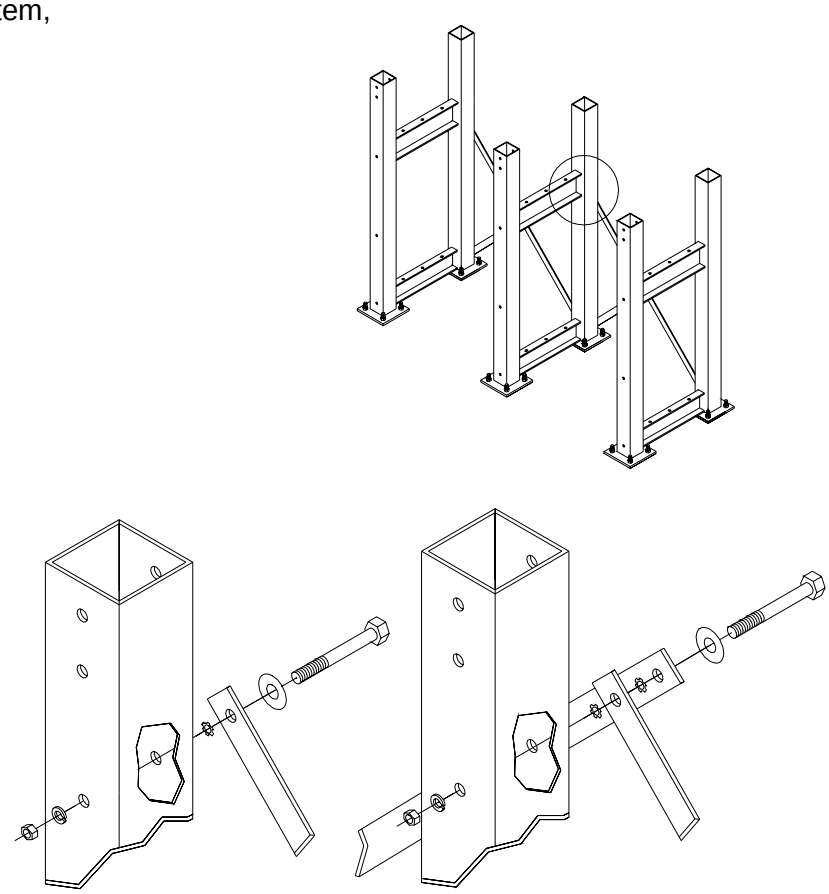

Figure 7.1

7.2 BOLT SUPPORT RAIL TO FRAME ASSEMBLY

NOTE: It is recommended that the support rails of the upper tiers on multi-tier racks not be installed until cells are placed on the lower tiers. DO NOT place cells on the rack at this time. See Figure 7.2.

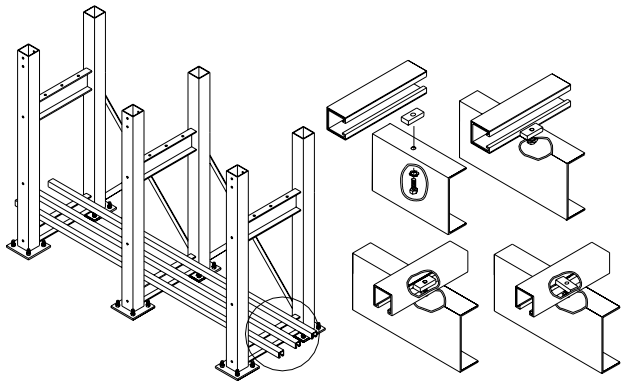

Figure 7.2

7.3 ATTACH PLASTIC CHANNEL TO SUPPORT RAIL ASSEMBLY

Plastic rails are supplied in 3 ft. and 4 ft. lengths. Arrange and cut plastic channels so all unistrut rails are covered. Apply double-sided tape to the surface of each support rail. See Figure 7.3.

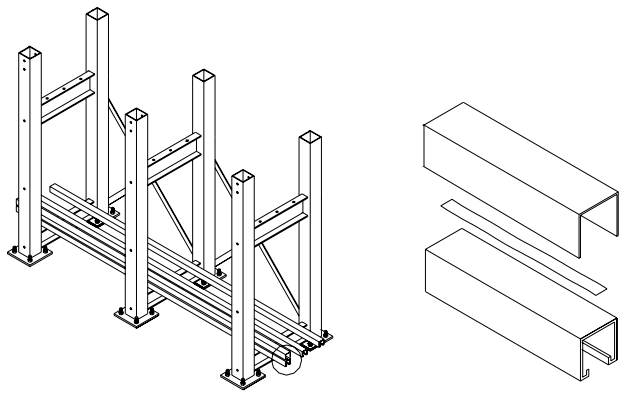

Figure 7.3

7.4 RACK TO FLOOR ANCHORING

Floor anchoring and its design are the responsibility of the installer. All frame holes must be used to maintain seismic certification. **Contact your EnerSys sales representative if you have any questions.**

- Refer to the rack assembly drawing for frame and bolt layout.

Mark locations for anchor bolts using the holes in the bottom of each frame as a template.

- If necessary, move rack to drill and install anchor bolts.
- Recommended minimum concrete f'_c = 3000 psi (21 Mpa).

Drill holes and install anchor bolts as indicated in the manufacturer's instructions.

7.5 CELL INSTALLATION

It is important to know the location and polarity orientation of each cell prior to installation.

- Install rear side rail before installing cells. Locate side rail so overhang is equal on both ends of rack. Install plastic channel.
- Make sure all bolts are torqued as indicated in Table 1 before installing cells.

Refer to *Safety, Storage, Installation, Operation and Maintenance Manual* (Publication US-FL-IOM), provided with batteries, for installation and safety precautions.

NOTE: Install all bottom tier cells and cross braces before cells are installed on other tiers.

The bottom tier should contain the largest number of cells. See Figure 7.5

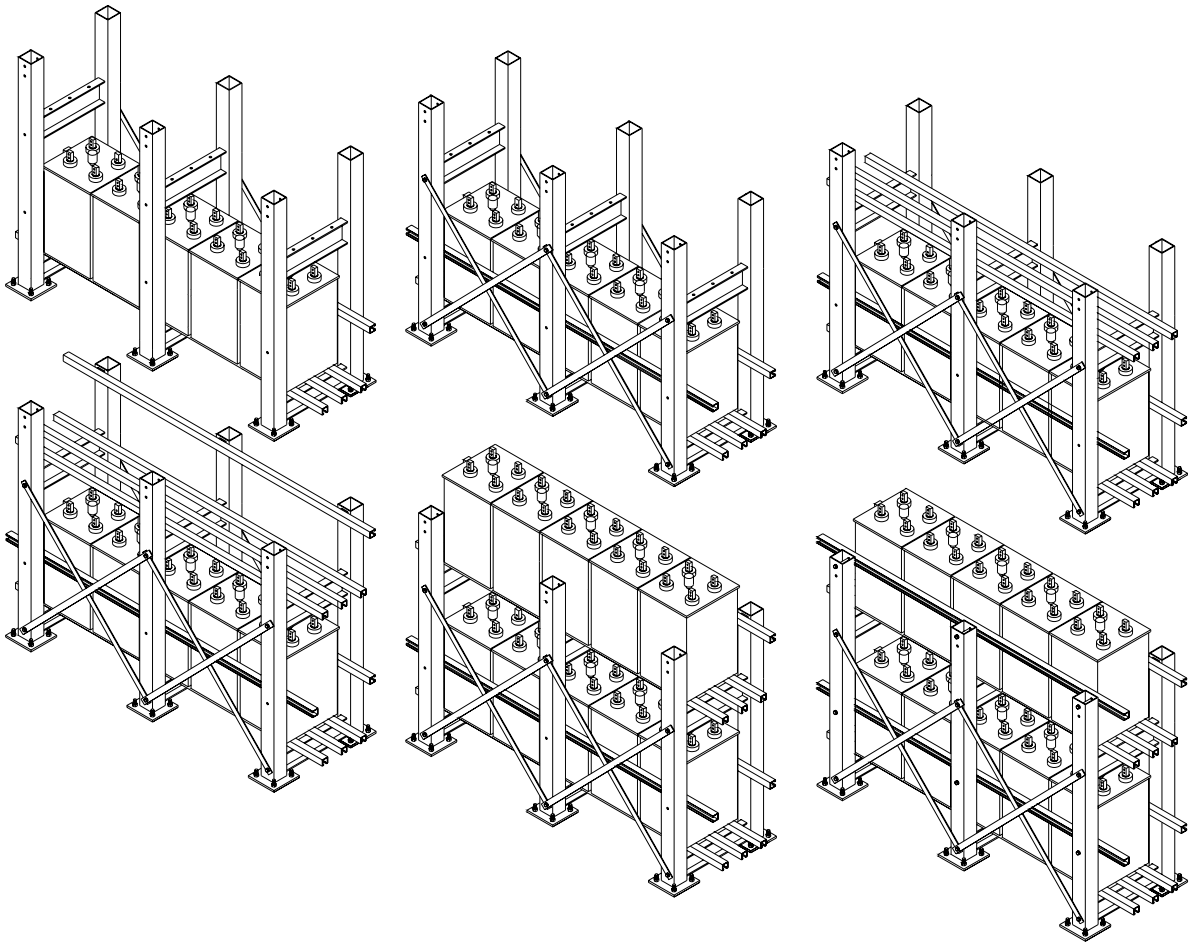

Figure 7.5

7.6 SEISMIC RACK ACCESSORIES

Seismic racks utilize foam spacers, cell clamps, side and end rails, and corner brackets.

- **FOAM SPACERS** - Install foam spacers between batteries (except where cell clamps are located). Black mark should be facing the top of the cell. See Figure 7.6A.

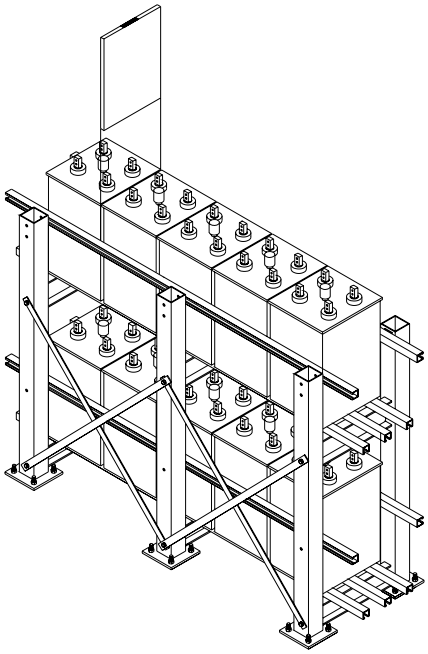

Figure 7.6A

- **SIDE RAIL** - The rear side rail should have been installed previously. Install front side rail. Shimming may be needed to have side rail as close to battery as possible without exerting pressure on the battery jar. Clearance equal to the typical thickness of a business card is allowable between the side rails and battery jar. See Figure 7.6B.

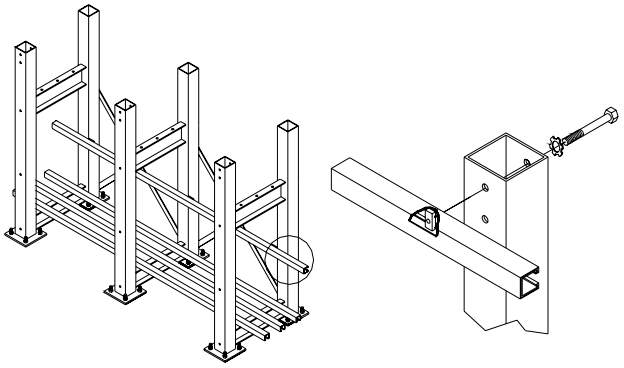

Figure 7.6B

- **CELL CLAMP ASSEMBLY** - Verify cell clamp locations as shown in the rack assembly drawing. Attach cell clamps to side support channels. Foam spacers are not needed between cells that require cell clamps. See Figure 7.6C.

  WHEN TORQUING HEX NUTS ON THREADED ROD, USE CAUTION TO AVOID BENDING CELL CLAMP PLATES AGAINST BATTERY JARS. HOLD THE HEX NUTS BETWEEN PLATES STATIONARY AND TORQUE THE HEX NUT ON THE OUTSIDE OF THE ASSEMBLY.

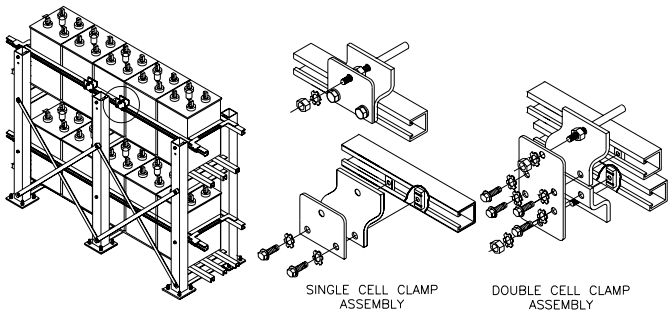

Figure 7.6C

- **RAIL/CORNER BRACKET ASSEMBLY** - Assemble end rails and corner brackets for each end of the rack. Corner brackets are universal. Orientation is determined by frame interference. After torquing bolts, check to make sure no force is being exerted on the battery jar from the side and end rails. Clearance equal to the typical thickness of a business card is allowable between the side and end rails and the battery jar. See Figures 7.6D-1 and 7.6D-2.

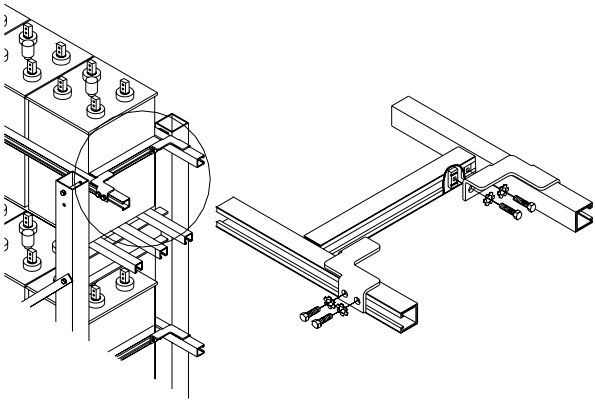

Figure 7.6D-1

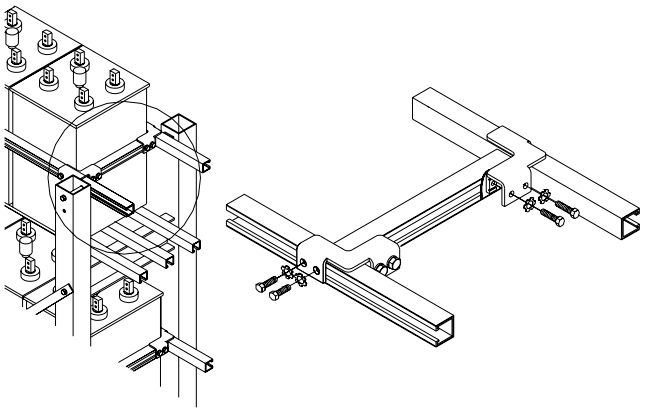

Figure 7.6D-2

- **OPTIONAL CORNER BRACKET ASSEMBLY** - See Figure 7.6E.

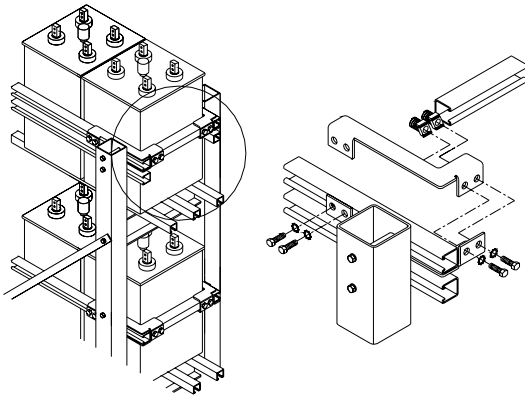

Figure 7.6E

7.7 GROUNDING RACK (OPTIONAL)

On installations where grounding is required for NEC and/or local codes, complete the following steps:

- Install lug and cable as shown in Figure 7.7 (lug and cable not furnished by EnerSys).
- Ohmmeter readings between each component and a common point on frame must indicate continuity to ensure proper grounding.

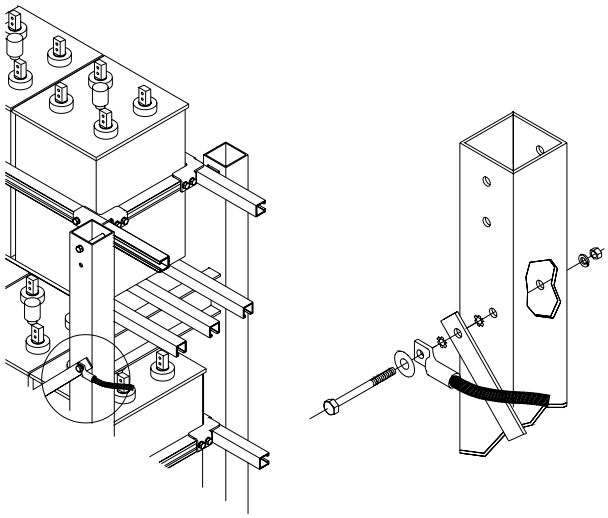

Figure 7.7

8. GLOSSARY OF TERMS

CELL CLAMP ASSEMBLY	Assembly connected to side rails and positioned according to battery weight to help reduce battery movement during a seismic event.
CORNER BRACKETS	Brackets used to attach end rails to side rails to prevent batteries from falling off end of rack during a seismic event.
CROSS BRACE	Bracing used to connect rack frames together.
END RAILS	Attached to corner brackets to prevent batteries from falling off end of rack during a seismic event.
EPA	Environmental Protection Agency
FOAM SPACERS	Spacers used between batteries to prevent batteries from hitting each other during a seismic event.
FRAMES	Main support structure of battery rack.
INTERCELL CONNECTORS	Electrical conductors used to connect adjacent cells on the same row of a rack.
INTER-RACK CABLE CONNECTORS	Electrical conductors used to connect cells on two separate racks.
NEBS	Network Equipment Building Systems
NEC	National Electric Code
OSHA	Occupational Safety & Health Administration
RESERVE POWER SERVICE	EnerSys service and installation group
SHIMS	Metal spacers used to bring side rail close to battery or to level rack due to uneven flooring.
SIDE RAILS	Rails on side of frames used to prevent cells from falling off rack in a seismic event.
SUPPORT RAILS	Rails connected to base of frame to support batteries.
TIER-TO-TIER CABLE	Electrical conductor used to connect cells on one tier to cells on another tier of the same rack.
UBC	Uniform Building Code

Section 58.19 April 2005
Subject to revisions without prior notice. E.&O.E.

Please check our website for literature updates.

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to BSP
to SF

Flooded System Configuration Report

Customer:	N/A	**Prepared By:**	David Cunningham
Location:	N/A	**Phone Number:**	907-360-7100
Date Prepared:	6/6/2017	**Email:**	dave.cunningham@marshcreekllc.com

********** There is 1 string in this system. *********
Information below is per string

Cells:	60 of EC-15	**AZMS Code:**	UJ32
Jar/Cover:	PVC Jar/PVC Cover (FR)	**Seismic Zone:**	UBC Zone 4L, at or Below Grade
Plate Orientation:	Perpendicular	**Rack Style:**	2 Tier
Application:	Switchgear / Utility	**Rack Layout:**	Across an Aisle
String:	1	**Support Rails:**	3 Painted rails per tier or step

Quantity	Part Number	Description
Battery		
60	Contact App Eng-CW	EC-15 Charged & Wet (8.13L x 11.06W)
Accessories - Smart Part Number: S06041172620T300		
1	88330	Thermometer, 30-130 F/0-55 C
1	81332	Hydrometer, 1100-1300 S.G.
1	27717	Hydrometer Holder Kit
60	96300	Flame Arrestor, Blue
1	PRO-SLIDE	Rack Rail Lubricant
1	80136	Cell Lifting Device
112	93256TP	Connector, 13.38x1.50x0.13, 8-Hole, Sn
240	803965	Hardware Pkg, 1/4-20x2.00, (2) per Pkg.
4	90886-048	Cable Assy, 1/0, (2)2-Hole, 1/2 Stud, NEMA Lug, Sn, 48 inches
8	802420TP	Terminal Plate Pkg, 4 Runs, 601320TP, Sn
1	US-FL-IOM	Instruction Manual, Flooded
1	802362	Cell Number Labels, Large, 1-60
1	82854	No-Ox Grease, 16oz, 454g
Rack		
2	UE4L2T132A3RP	Rack, Zone 4L, 2 Tier, 132" long
Spill Containment		
2	WUL 23-136	EnerSys UL System, 23" wide x 136" long
Optional Accessories (Additional charges may apply)		
21	827440	Connector Cover, Clear, 48" Long, No Holes, PVC
21	827512	Connector Cover, Clear, 48" Long, w/Holes, PVC
8	825470	Terminal Plate Cover, 10.75" x 3.50" x 5.50"

Rack Style	Standard Termination
1 Tier	End-to-End (opposite end)
2 Tier	Top-to-Bottom (same end)
3 Tier	Top-to-Bottom (opposite end)
2 Tier / 2 Row	Top (same end)

Rack Style	Standard Termination
2 Step	Top-to-Bottom (same end)
3 Step	Top-to-Bottom (opposite end)
2 Step / 2 Tier	Top (same end)

* **Please call if not standard termination** *

Cables not supplied for "Across Aisle", "L", or "U" Shape configurations

to BSP

Flooded Rack Configuration Report

Customer:	N/A	**Prepared By:**	David Cunningham
Location:	N/A	**Phone Number:**	907-360-7100
Date Prepared:	6/6/2017	**Email:**	dave.cunningham@marshcreekllc.com

********** There is 1 string in this system. **********
Information below is per string

Cells:	60 of EC-15	**AZMS Code:**	UJ32
Plate Orientation:	Perpendicular	**Seismic Zone:**	UBC Zone 4L, at or Below Grade
Number of Jars:	60	**Rack Style:**	2 Tier
Strings:	1	**Rack Layout:**	Across an Aisle
Cells per String:	60	**Support Rails:**	3 Painted rails per tier or step
System Voltage:	120		

Rack Information - per Rack

Qty	Part Number	Capacity	Overall	Depth	Weight	Frames
2	UE4L2T132A3RP	30	132.00	18.50	603	4

Spill Containment

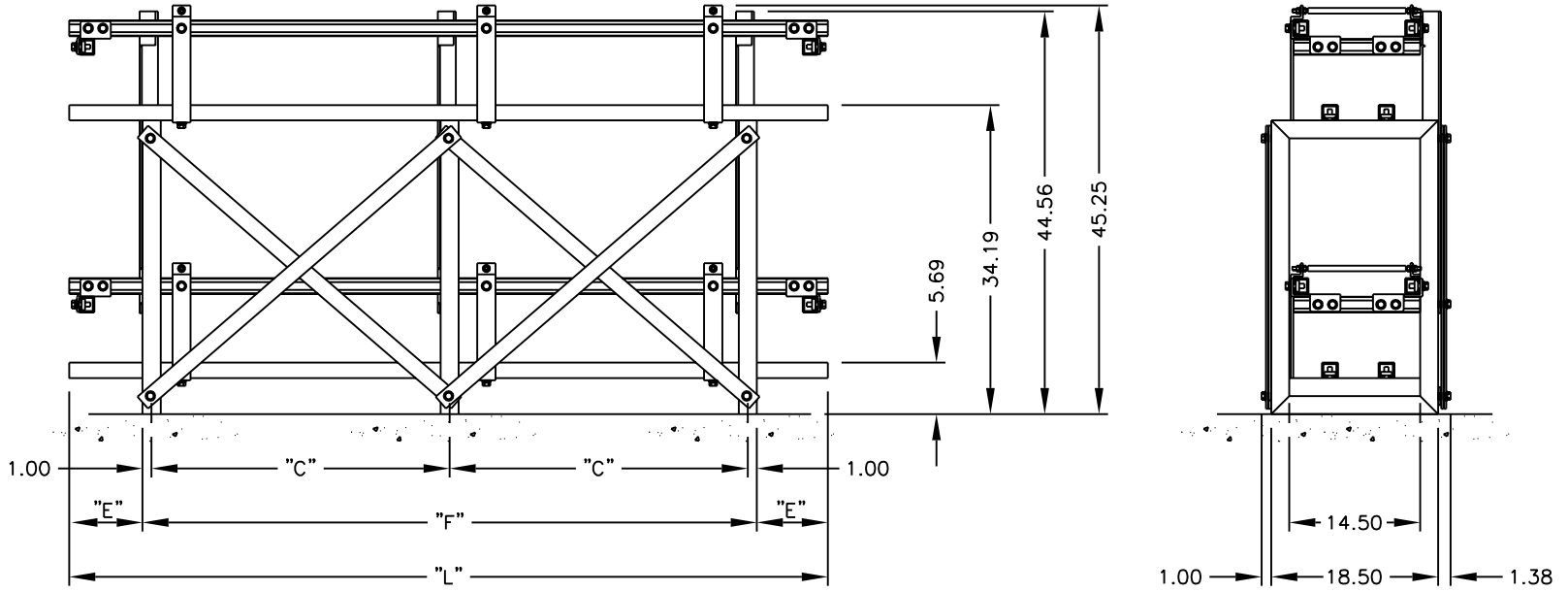
Qty	Part Number	Weight
2	WUL 23-136	179

Floor Loading - per Rack (with Batteries, without Spill Containment)

Contact Weight:	28 Lbs/in^2
Projected / Shadow Weight:	248 Lbs/ft^2

System Weights

Weight of Racks:	1,294 Lbs
Weight of Spill Containment:	359 Lbs
Weight of Batteries:	8,400 Lbs
Total System Weight:	10,053 Lbs



CATALOG NO.	AZMS NO.	"L" (in.)	"F" (in.)	"E" (in.)	"C" (in.)	WT. (lbs.)	# FRAMES
UE4L2T036A	UJ32-036	36.00	26.00	5.00	24.00	263	2
UE4L2T048A	UJ32-048	48.00	32.00	8.00	30.00	283	
UE4L2T060A	UJ32-060	60.00	38.00	11.00	36.00	300	
UE4L2T072A	UJ32-072	72.00	56.00	8.00	27.00	409	3
UE4L2T084A	UJ32-084	84.00	68.00	8.00	33.00	436	
UE4L2T096A	UJ32-096	96.00	68.00	14.00	33.00	453	
UE4L2T108A	UJ32-108	108.00	92.00	8.00	30.00	561	4
UE4L2T120A	UJ32-120	120.00	101.00	9.50	33.00	582	
UE4L2T132A	UJ32-132	132.00	110.00	11.00	36.00	603	
UE4L2T144A	UJ32-144	144.00	122.00	11.00	30.00	711	5
UE4L2T156A	UJ32-156	156.00	134.00	11.00	33.00	736	
UE4L2T168A	UJ32-168	168.00	146.00	11.00	36.00	758	
UE4L2T180A	UJ32-180	180.00	152.00	14.00	30.00	865	6
UE4L2T192A	UJ32-192	192.00	167.00	12.50	33.00	882	
UE4L2T204A	UJ32-204	204.00	182.00	11.00	36.00	905	
UE4L2T216A	UJ32-216	216.00	200.00	8.00	33.00	1011	7
UE4L2T228A	UJ32-228	228.00	200.00	14.00	33.00	1036	
UE4L2T240A	UJ32-240	240.00	218.00	11.00	36.00	1060	

RAIL OPTIONS, IDENTIFIED BY CATALOG NO. SUFFIX:
A – 2 GALVANIZED RAILS PER TIER (STANDARD)
AP – 2 PAINTED RAILS PER TIER
A3R – 3 GALVANIZED RAILS PER TIER
A3RP – 3 PAINTED RAILS PER TIER

TITLE: RACK, UBC ZONE 4L, 2 TIER

EnerSys Power/Full Solutions ™
RESERVE POWER
READING, PA. 19605

BATTERY:	CODE:	REF.:
EA, EC, ES	UJ32	N/A

RACK FAMILY: UE4L2TxxxA

REV. A

DO NOT SCALE DRAWING

DATE: 06/15/2009

AT30 SERIES

Microprocessor Controlled Float Battery Charger

Looking for the world's premium microprocessor controlled float battery charger?

The AT30 is the world's easiest to operate float battery charger. It has over 10 years of proven reliability and has become the industry's "gold standard" for all stationary battery charging applications. We are so confident in our product that we have backed the AT30 with our unrivaled 5 Year Standard Warranty.

SCAN WITH YOUR SMART PHONE FOR HINDLEPOWERINC.COM

CSA C22.2 · NRTL/C · UL 1012/UL 1564 compliant
Seismic qualified
ABS · CE certification available upon request

JF5018

HINDLEPOWER

Quality & Integrity - Our Passion

What is the AT30?

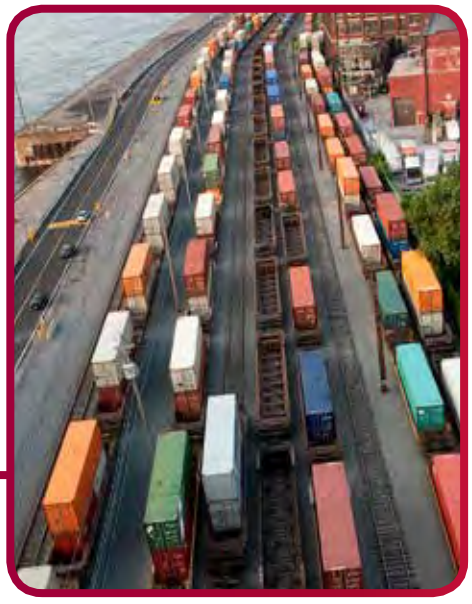
Combining the performance and accuracy of a microprocessor with the reliability of SCR power conversion technology makes the AT Series the standard in stationary battery chargers. AT30s are easy to install, operate and maintain. The AT30 is packed with the most standard features and best warranty in the industry.

What are the most common applications for the AT30?

Utility & Communications
Power Generation
Substations
Microwave Relay Sites
Switchgear

Manufacturing
Emergency DC Power
DC Operated Breakers
Alarm Systems

Commercial
Alarm Systems
Uninterrupted Power Systems
DC Control Systems



Transportation
Signal Systems
Switchgear
Alarm Systems

SPECIFICATIONS & STANDARD FEATURES

SPECIFICATIONS

AC Input

- **Voltage:**
  208 Vac 60Hz
  240 Vac 60Hz
  480 Vac 60Hz
  550-600 Vac 60Hz
  220 Vac 50/60Hz
  380 Vac 50/60Hz
  416 Vac 50/60Hz
- **Input Voltage Tolerance:**
  +10%, -12%
- **Input Frequency Tolerance:**
  ±5%
- **Efficiency:**
  85-90% typical for 130Vdc at 50-100% load

DC Output

- **Voltage Ratings:**
  12, 24, 48, or 130Vdc nominal
- **Current Ratings (Adc):**
  25, 30, 40, 50, 75, 100,125, 150, 200, 250, 300, 400, 500, 600, 800, 1000
- **Continuous Rating:**
  110% rated current at maximum equalize voltage at 50ºC
- **Current Limit Adjustment Range:**
  50% to 110% rated output
- **Voltage Regulation:**
  ±0.25% for line, load and temp. variations
  **Regulation at max. equalize voltages may not meet ±0.25%*
- **Electrical Noise:**
  32dBrnc
- **Ripple:**
  12/24/48Vdc
  - Unfiltered on battery 1% Vrms
  - Filtered on battery 30mVrms
  - Filtered off battery 1% Vrms
  - Battery Eliminator 30mVrms

  130Vdc
  - Unfiltered on battery 2% Vrms
  - Filtered on battery 100mVrms
  - Filtered off battery 2% Vrms
  - Battery Eliminator 100mVrms
- **Surge Withstand Capability:**
  Meets IEEE-472, ANSI C37.90a

Safety and Acceptance

- Meets NEMA PE 5-1996, PE5-1997 (R2003) specifications
- NEMA Type 1 / IP20 standard enclosure

- Third party agency approvals:

- CSA C22.2 compliant (up to and including 400A) - NRTL/C · UL 1012/UL 1564 compliant
- Seismic qualified (5018/5030 cabinet styles only)
- ABS or CE certification available upon request.

- Made in the United States of America

Environmental

- Operating Ambient Temperature 0°F to 122°F (-18°C to 50°C) w/o derating
- Operating Altitude 10,000 feet (3,000 meters) above sea level w/o derating
- Relative Humidity 0% to 95% (without condensation)
- Audible Noise Less than 65 dBA at any point 5ft (1.5m) from any vertical surface of enclosure

STANDARD FEATURES

- 5 Year Product Warranty
- Universal main control board operates in any AT Series charger
- Alarm assembly with local LEDs and summary relay contact for AC Failure, DC Failure, High Vdc, Low Vdc, Positive(+) and Negative(-) ground fault
- High DC voltage shutdown
- Forced load share during parallel operation
- Float/equalize selector switch with indicating lights
- Manual equalize timer (0-255 hr.) with indicating lights
- AC line failure automatic equalize timer (0-255 hr.) with indicating light
- AC On indicating light
- 1% Digital LED meter for Vdc, Adc, timer hours and alarm settings
- 6 pulse rectification
- AC input and DC output circuit breakers
- Membrane front panel
- Front panel controls can be disabled for security
- A redundant analog circuit for LVDC alarm, independent of the microprocessor
- Redundant control loops for higher reliability
- Local or remote voltage sense with redundancy to protect against remote sense failure
- Self-diagnostics
- Input & output MOV surge suppressors
- Reverse polarity protection via free wheeling diodes
- CU-AL I/O compression lugs
- Switchboard wire, UL VW-1
- Enclosure pre-treated using a 5-stage iron phosphate process with baked epoxy powder coating in ANSI 61 gray

Specifications subject to change.

CUSTOMIZE YOUR AT30

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

SUMMARY OF OPTIONS

- DC output filtering: per NEMA PE5 1996, standard and battery eliminator
- Medium & High AIC Breakers
- AC Input/DC output fuses
- Auxiliary alarm relay board
- Copper ground bus
- AC lightning arrestor
- Fungus proofing (tropicalization)
- Static proofing
- Forced load share cable
- Communications module: DNP3 Level 2 or MODBUS protocols
- Battery temp. compensation
- Custom Paint
- NEMA 4 (12) type enclosure w/fan
- NEMA Type 2 Drip Shield
- Barrier type alarm terminal block
- End of discharge alarm
- Battery discharge alarm
- Zero-center ground detection meter
- Analog AC voltmeter
- Analog AC ammeter
- Cabinet heater assembly
- CE marking upon request
- ABS certification upon request
- Fan control contactor
- Custom drawing package (DWG/PDF)
- Mechanical lock for front door

Filtering

STANDARD

Output filtering is essential whenever there is need for low ac ripple and low noise on the dc bus for critical loads. The standard dc output filtering limits ripple to no more than 30mV RMS on 12, 24 & 48Vdc units, and 100mV RMS on 130Vdc units, measured at the battery terminals. This feature meets the specifications of NEMA standard PE5-1996, and is recommended for installations using VRLA or gelled electrolyte batteries.

BATTERY ELIMINATOR

An additional "battery eliminator" feature is also available, meeting the specifications of NEMA standard PE5-1996 with no battery connected, measured at the dc output terminals. This feature is recommended for sites where the battery may occasionally be disconnected from the dc bus for maintenance. Additional filtering is essential to limit ac ripple and noise for critical dc loads.

	ORDERING
FACTORY INSTALLATION **YES**	**Factory Installation use Specification Table on page 11**
AVAILABLE FOR FIELD INSTALLATION **YES**	*Contact factory with serial number of original unit and type of filtering upgrade.*

Medium & High AIC Breaker

This feature provides thermal-magnetic circuit breakers with higher Ampere Interrupting Capacity ratings than the standard. See the tables on Page 11 for medium and high AIC breaker ratings.

	ORDERING
FACTORY INSTALLATION **YES**	**Factory Installation use Specification Table on page 11**
AVAILABLE FOR FIELD INSTALLATION **YES**	*Contact factory with serial number of original unit and type of breaker upgrade for proper field kit parts.*

AC Input and/or DC Output Fuses

Default protection devices for the AT30 are molded case circuit breakers. Fuses may also be ordered to augment them, wired in series with the breakers. Three (3) ac input fuses provide 200 kAIC protection. Two (2) dc output fuses provide 20 kAIC protection. Fuses may also be ordered in conjunction with standard breakers as a cost-saver. If an AT30 is ordered without breakers, fuses must be ordered.

	ORDERING
FACTORY INSTALLATION **YES**	**Factory Installation use Specification Table on page 11**
AVAILABLE FOR FIELD INSTALLATION **YES**	*Contact factory with serial number of original unit and type of fuses (ac and/or dc) for proper field kit parts.*

CUSTOMIZE YOUR AT30

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

Auxiliary Alarm Relay Board

The AT30 features several industry-standard alarms, with individual LED indicators on the front instrument panel, and are accessible to the user via one (1) Summary Alarm contact on the Main Control PC Board. This feature provides a separate user-accessed pc board, featuring discreet two (2) form-C relay contacts for all six (6) alarms.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Specification Table on page 11
AVAILABLE FOR FIELD INSTALLATION **YES**	Field Installation use Part Number Style 5018: *EI0213-02* Style 5030: *EI0213-03* Style 163: *EI0213-04* Style 198: *EI0213-05*

Copper Ground Bus

This option provides a convenient means to tie the AT30 to the site building ground. A copper ground bus bar is provided with an extra CU-AL compression box lug.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Specification Table on page 11
AVAILABLE FOR FIELD INSTALLATION **YES**	Field Installation use Part Number Style 5018: *EI0195-02* Style 5030: *EI0195-03* Style 163: *EI0195-04* Style 198: *EI0195-04*

AC Lightning Arrestor

This options features an industrial-grade surge arrestor in polycarbonate housing, rated for 20,000 Amperes. It is recommended for installations with risk of frequent ac surges, such as high elevations or severe weather.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Specification Table on page 11
AVAILABLE FOR FIELD INSTALLATION **YES**	Field Installation use Part Number *EJ1074-02*

Fungus Proofing

This treatment is also referred to as "tropicalization". It coats electrical components and internal wiring connections with a fungus-resistant, non-conductive film (approx. 1 mil thickness). User termination points are not coated, nor are relay contacts, and any electrical connectors where the spray would interfere with functionality. The application is fully cured at time of shipment.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Specification Tables on pages 10 & 11
AVAILABLE FOR FIELD INSTALLATION **NO**	NOT AVAILABLE FOR FIELD INSTALLATION

Static Proofing

Used in "arid" environments, this treatment coats electrical components and connections with a static-resistant, non-conductive film (approx. 1 mil thickness). User termination points are not coated, nor are relay contacts, and any electrical connectors where the spray would interfere with functionality. The application is fully cured at time of shipment.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Specification Tables on pages 10 & 11
AVAILABLE FOR FIELD INSTALLATION **NO**	NOT AVAILABLE FOR FIELD INSTALLATION

Specifications subject to change.

CUSTOMIZE YOUR AT30

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

Communications

This option allows full remote monitoring of the AT30 and control of the front panel features, using MODBUS or DNP3 Level 2 protocols. Standard serial connections are provided for use with local SCADA systems.

Ethernet or Fiber Optic Modem interfaces are also available for use with the AT Communications option. Contact factory for part number.

	ORDERING
FACTORY INSTALLATION **YES**	Factory Installation use Part Number when ordering 12Vdc: ***EJ5037-01*** 24Vdc: ***EJ5037-02*** 48Vdc: ***EJ5037-03*** 130Vdc: ***EJ5037-04***
AVAILABLE FOR FIELD INSTALLATION **YES**	Field Installation use Part Number 12Vdc: ***EJ5037-11*** 24Vdc: ***EJ5037-12*** 48Vdc: ***EJ5037-13*** 130Vdc: ***EJ5037-14***

Temperature Compensation

Supplied in a kit, this option adjusts the AT30 dc output voltage up or down, in response to battery temperature fluctuations. Temperature is measured by an epoxy-enclosed thermistor. This probe is mounted on or near the battery, and connected by a cable to the Main Control PC Board. It is compatible with both lead-acid and nickel-cadmium batteries, and recommended for VRLA batteries. Cable lengths of 25, 50, 100, and 200 ft are available.

	ORDERING
FACTORY INSTALLATION **NO**	CAN BE ORDERED WITH CHARGER BUT MUST BE FIELD INSTALLED
AVAILABLE FOR FIELD INSTALLATION **YES**	Field Installation use Part Number 25ft: ***EJ5033-00*** 50ft: ***EJ5033-01*** 100ft: ***EJ5033-02*** 200ft: ***EJ5033-03***

Barrier Type Alarm Terminal Blocks

This option features a separate molded phenolic terminal block, wired directly to the Auxiliary Alarm Relay PC Board. It allows the user to connect remote alarm wiring with ring or spade type lugs. The #6-32 binder hear screw terminals are rated for 20A at 150 Vac/Vdc, and accept wire sizes #16 to #14 AWG.

	ORDERING
FACTORY INSTALLATION **YES**	Factory & Field Installation use Part Number when ordering (1) FORM-C: ***EJ5130-01*** (2) FORM-C: ***EJ5130-02***
AVAILABLE FOR FIELD INSTALLATION **YES**	

Mechanical Lock For Front Door

The AT30 front panel controls can be disabled by setting a jumper on the back of the Main Control PC board. For installations where extra security is required, the front instrument panel, or door, can be physically locked closed. This option provides a locking provision on the enclosure, a padlock, and two (2) keys. A fully installed door key lock is also available.

	ORDERING
FACTORY INSTALLATION **YES**	Factory & Field Installation use Part Number when ordering Padlock Style5018: ***EI0215-00*** Padlock Style 5030: ***EI0215-01*** Padlock Style163: ***EI0215-02*** Padlock Style 198: ***EI0215-03*** Keylock Style 5018: ***EI0215-11*** Keylock Style 5030: ***EI0215-12*** Keylock Style 163: ***EI0215-13*** Keylock Style 198: ***EI0215-14***
AVAILABLE FOR FIELD INSTALLATION **Padlock - YES** **Keylock - NO**	

Custom Paint

AT30 NEMA Type 1 enclosures feature an ANSI 61 gray epoxy powdercoat finish. Custom exterior and interior (e.g. semigloss white) colors are available in ANSI, PMS, and RAL color codes to meet specific requirements..

	ORDERING
FACTORY INSTALLATION **YES**	***EI5064-00*** *SPECIFY WHEN PLACING ORDER USING YOUR SPECIFIC PAINT REQUIREMENTS*
AVAILABLE FOR FIELD INSTALLATION **NO**	NOT AVAILABLE FOR FIELD INSTALLATION

CUSTOMIZE YOUR AT30

OPTIONS THAT LET YOU DESIGN YOUR CHARGER EXACTLY HOW YOU NEED IT!

Wall Mounting Brackets or Rack Mounting

AT30 Chargers in Style-5018 enclosures can be wall or rack mounted. Wall-mounting brackets (EI5080-00) are shipped as a field kit. Use of this option increases the vertical footprint of the charger by 14". Anchor bolts are not supplied.

The Style-5018 enclosure is also EIA 23" or 24" rack mountable. Mounting brackets (EI0193-03) are factory installed. Relay rack mounting hardware is not supplied.

FACTORY INSTALLATION
Wall - No
Rack - Yes

AVAILABLE FOR FIELD INSTALLATION
YES

ORDERING
Factory & Field Installation use Part Number when ordering

WALL MOUNTING
Style-5018: ***EI5008-00***

RACK MOUNTING
Style-5018 (23/24in): ***EI0193-03***

NEMA Type 2 Drip Shield

Standard AT30 battery chargers are supplied in NEMA Type 1 vented enclosures. The optional drip shield prevents overhead water and small falling particles from entering the top vented panels, protecting internal equipment from damage. The combined standard enclosure and drip shield meets the NEMA Type 2 specification.

FACTORY INSTALLATION
YES

AVAILABLE FOR FIELD INSTALLATION
YES

ORDERING
Factory & Field Installation use Part Number when ordering

STYLE 5018: ***EI0191-02***
STYLE 5030: ***EI0191-03***
STYLE 163: ***EI0191-04***
STYLE 198: ***EI0191-05***

NEMA Type 4 Cabinet

With this accessory, a fully assembled standard AT30 NEMA-1 vented enclosure is installed within another gasketed, sealed cabinet. The combined assembly meets the NEMA Type 4 (and therefore Type 12 and 13) enclosure specification. All ratings feature forced cooling, with user-supplied 120Vac for the fan.

FACTORY INSTALLATION
YES

AVAILABLE FOR FIELD INSTALLATION
YES

ORDERING
Factory Installation use Part Number when ordering
Style 5018: ***EI5037-00***
Style 5030: ***EI5057-00***
Style 163: ***EB5039-00***
Style 198: ***EB5046-00***

Field Installation use Part Number
Style 5018: ***EI5037-00***
Style 5030: ***EI5057-00***

SUPPLEMENTAL PRODUCT

Fan Control Contactor

Lead-acid batteries produce hydrogen gas. This small wall-mounted external accessory provides a relay contactor to activate a battery installation vent or exhaust fan. Available in 10A or 20A models, the accessory is factory-set to provide relay closure when the AT30 enters into Equalize mode.

FACTORY INSTALLATION
NO

AVAILABLE FOR FIELD INSTALLATION
YES

ORDERING
CAN BE ORDERED WITH CHARGER BUT MUST BE FIELD INSTALLED

Field Installation use Part Number
10 Amp Rating: ***EJ5017-0#***
20 Amp Rating: ***EJ5017-1#***
Contact manufacturer for specific part number

SUPPLEMENTAL PRODUCT

AT-DC Distribution Panel

This product augments AT30 with a customized dc distribution panel for user-specified loads. The AT-DC is configurable to various combinations of main and branch breakers. The AT-DC panel is optimally supplied from the factory, mounted to the AT30 and pre-wired to the charger's dc output terminals. For further details, refer to the AT-DC product literature (JF5032-00).

FACTORY INSTALLATION
YES

AVAILABLE FOR FIELD INSTALLATION
YES

ORDERING
Factory & Field Installation use Part Number when ordering

EJ5110-##

Refer to document **(JF5032-00)** *for model specific part number.*

Specifications subject to change.

AT30 SERIES SPECIFICATION CHART

Electronic File: click chart for printable PDF

DC Output Rating		AC Input Ampere Rating (Based on maximum rms value of the input current delivered to the charger under all operating conditions within manufacturer's specifications)								Battery Charger AC Circuit Breaker Ampere Rating (standard AIC breakers)							
Volts	Amps	208 VAC	220 VAC	240 VAC	380 VAC	416 VAC	440 VAC	480 VAC	600 VAC	208 VAC	220 VAC	240 VAC	380 VAC	416 VAC	440 VAC	480 VAC	600 VAC
12Vdc (12Vdc) Float Adjust 11.0-14.5Vd / (12Vdc) Equalize Adjust 11.7-15.5Vdc	50	5	5	4	3	3	2	2	2	10	10	10	5	5	5	5	15
	75	7	6	6	4	3	3	3	3	10	10	10	5	5	5	5	15
	100	9	8	8	5	5	4	4	4	15	10	15	10	10	5	5	15
	125	12	11	10	6	6	5	5	5	15	15	15	10	10	10	10	15
	150	13	13	12	9	7	6	6	6	20	20	20	15	15	10	10	15
	200	16	16	14	9	9	8	7	6	20	20	20	15	15	10	15	15
	250	22	20	19	12	11	10	9	8	30	25	30	15	15	15	15	15
	300	28	24	24	14	13	12	12	11	35	30	35	20	20	15	15	15
24Vdc (24Vdc) Float Adjust 22.0-29.5Vdc / (24Vdc) Equalize Adjust 23.4-31.0Vdc	50	9	9	8	5	5	6	4	4	15	15	15	10	10	10	10	15
	75	12	11	10	7	6	5	5	5	15	15	15	10	10	10	10	15
	100	16	15	14	9	8	7	7	6	20	20	20	15	15	10	10	15
	125	21	20	18	11	10	9	9	8	30	25	30	15	15	15	15	15
	150	23	24	21	12	12	11	11	10	35	30	35	20	20	15	15	15
	200	27	28	25	16	14	13	13	11	40	35	40	25	25	20	20	15
	250	39	37	34	22	20	19	17	15	50	50	50	30	30	25	25	20
	300	51	44	44	25	23	22	22	19	70	60	70	35	35	30	30	25
	400	59	59	51	34	32	30	27	24	80	80	80	50	50	40	40	35
	500	72	72	63	42	38	36	32	29	90	90	90	60	60	50	40	40
	600	88	87	76	51	46	44	40	35	125	125	125	70	70	60	50	50
	800	122	119	107	67	62	57	55	48	175	175	175	90	90	80	70	70
	1000	152	148	133	84	77	72	68	60	200	200	200	125	125	100	90	80
48Vdc (48Vdc) Float Adjust 44.0-58.0Vdc / (48Vdc) Equalize Adjust 46.8-59.0Vdc	50	15	13	13	8	8	7	7	6	20	20	20	15	15	10	10	15
	75	20	19	16	11	10	10	9	8	25	25	25	15	15	15	15	15
	100	26	25	24	13	13	12	12	10	35	35	35	20	20	15	15	15
	125	35	33	29	19	18	17	15	13	50	50	50	25	25	25	20	20
	150	37	35	32	20	19	18	16	14	50	50	50	25	25	25	20	20
	200	53	50	46	29	27	25	23	20	70	70	70	40	40	35	30	25
	250	69	66	58	38	35	33	30	26	100	100	100	50	50	50	40	40
	300	78	74	68	43	39	37	34	30	100	100	100	60	60	50	50	40
	400	100	96	88	56	51	48	44	39	125	125	125	70	70	60	60	50
	500	128	120	110	70	64	60	55	48	175	175	175	90	90	80	70	70
	600	157	149	135	85	79	75	69	60	200	200	200	125	125	100	90	80
	800	209	198	181	113	106	99	91	79	300	300	300	150	150	125	125	100
	1000	261	248	225	143	132	125	113	99	350	350	350	200	200	175	150	125
130Vdc (130Vdc) Float Adjust 110.0-141.0Vdc / (130Vdc) Equalize Adjust 117.0-143.0Vdc	25	17	16	14	10	9	9	8	7	25	20	25	15	15	15	10	15
	30	20	20	18	12	11	10	9	8	25	25	25	15	15	15	15	15
	40	26	23	22	14	13	12	12	10	35	30	35	20	20	15	15	15
	50	33	30	28	18	16	15	15	12	50	40	50	25	25	20	20	15
	75	48	44	43	26	25	24	22	18	70	60	70	35	35	30	30	25
	100	64	60	57	35	32	30	29	24	100	80	100	50	50	40	40	35
	125	80	75	69	44	40	42	38	33	125	100	125	60	60	60	50	50
	150	93	87	80	52	46	46	42	37	125	125	125	70	70	60	60	50
	200	125	120	110	70	62	60	55	48	175	150	175	100	100	80	70	60
	250	158	150	137	79	72	68	68	59	200	200	200	125	125	100	100	80
	300	180	170	160	93	85	80	80	72	250	225	250	125	125	100	100	100
	400	255	235	220	127	116	110	110	96	300	300	300	175	175	150	150	125
	500	320	300	280	160	148	140	140	120	400	400	400	200	200	200	200	150
	600	378	354	331	200	180	177	169	145	500	500	500	250	250	250	250	200
	800	503	473	439	266	241	233	224	194	N/A	N/A	N/A	350	350	300	300	250
	1000	628	590	547	330	300	291	279	240	N/A	N/A	N/A	450	450	400	350	300

HOW TO SIZE YOUR CHARGER

(simplified formula)

$$\left(\frac{Ah \times 1.R}{t}\right) + L = \text{Continuous Charger Output Rating}$$

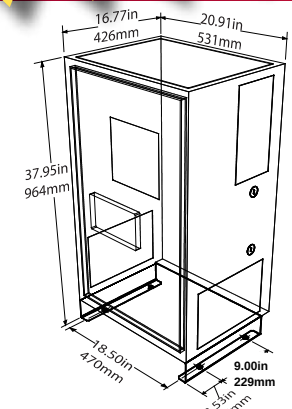
Ah=Ampere hours removed
R= Recharge factor (1 = Pb) or (3 = NiCd)
L= Additional standing load
t= Recharge time in hours

Electronic File: click chart for printable PDF

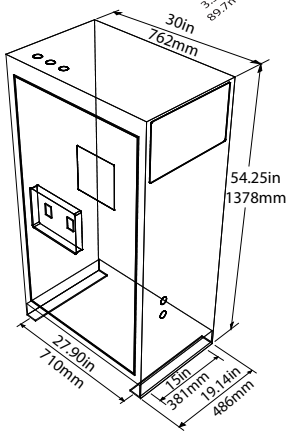
DC Circuit Breaker Rating	Cabinet Style	Approx. Shipping Weights lb.(kg)	Heat Loss Watts (BTU/hr)
80	5018	260 (118)	229 (783)
100	5018	330 (150)	340 (1160)
150	5018	380 (173)	448 (1529)
175	5030	450 (205)	560 (1911)
200	5030	550 (250)	668 (2279)
250	5030	590 (268)	890 (3039)
350	5030	610 (277)	1113 (3799)
400	5030	650 (295)	1327 (4531)
80	5018	280 (127)	289 (987)
100	5018	340 (154)	427 (1457)
150	5018	390 (177)	560 (1911)
175	5030	540 (245)	700 (2309)
200	5030	580 263)	833 (2843)
250	5030	610 (277)	1101 (3759)
350	5030	650 (295)	1376 (4699)
400	5030	690 (313)	1652 (5638)
600	163	1150 (522)	2202 (7518)
700	163	1300 (590)	2730 (9319)
800	163	1530 (694)	3275 (11183)
1200	198	2020 (916)	4367 (14910)
1200	198	2440 (1107)	5459 (18638)
80	5018	310 (141}	398 (1358)
100	5018	390 (177)	584 (1994)
150	5018	500 (227)	762 (2602)
175	5030	550 (250)	953 (3253)
200	5030	600 (272)	1131 (3860)
250	5030	660 (299)	1491 (5091)
350	5030	720 (327)	1864 (6363)
400	5030	760 (345)	2237 (7636)
600	163	1100 (499)	2949 (10068)
700	163	1350 (612)	3686 (12585)
800	198	1600 (726)	4424 (15102)
1200	198	2020 (916)	5898 (20137)
1200	198	2400 (1089)	7373 (25171)
40	5018	370 (168)	361 (1232)
50	5018	380 (172)	416 (1421)
60	5018	390 (177)	532 (1817)
80	5018	400 (182)	647 (2208)
100	5018	490 (222)	928 (3169)
150	5030	650 (295)	1201 (4099)
175	5030	740 (336)	1478 (5045)
200	5030	750 (340)	1773 (6054)
250	5030	820 (372)	2327 (7946)
350	163	1130 (513)	2909 (9932)
400	163	1330 (603)	3436 (11731)
600	163	1580 (717)	4582 (15641)
700	198	2150 (975)	5727 (16552)
800	198	2650 (1202)	6872 (23462)
1200	198	3250 (1474)	9163 (31283)
1200	198	4200 (1905)	11271 (38479)

CABINET STYLES & DIMENSIONS

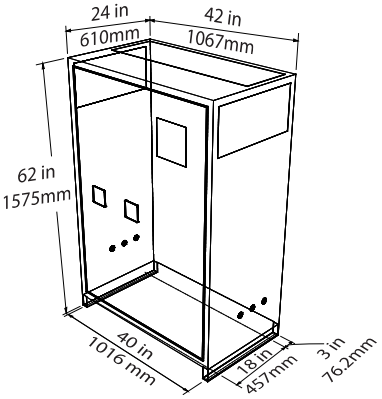
For detailed CAD drawings of all NEMA-1 type enclosures (and optional NEMA-4 (12) type enclosures), please visit the support section of our website www.hindlepowerinc.com



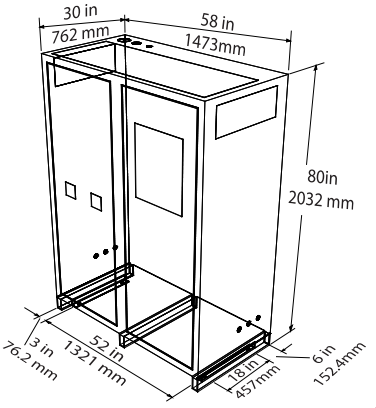
Cabinet Style 5018



Cabinet Style 5030



Cabinet Style 163

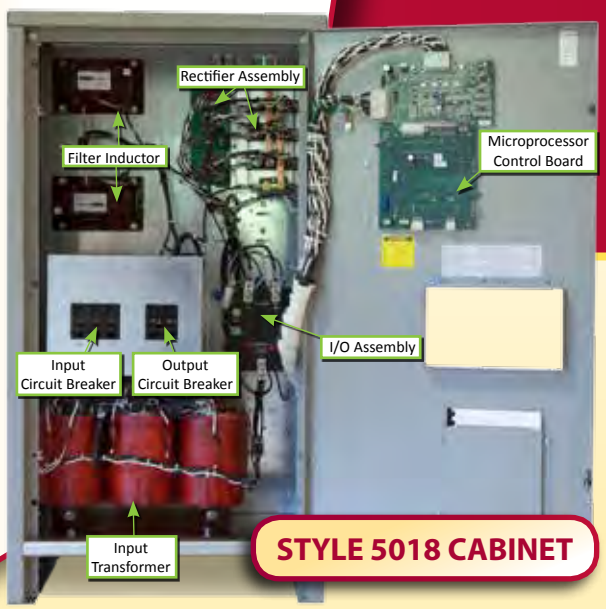


Cabinet Style 198

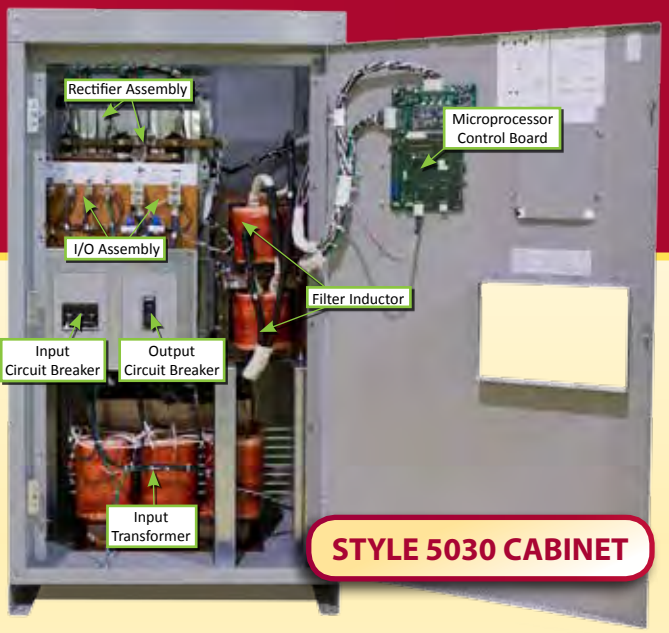
Specifications subject to change.

STANARD INTERNAL LAYOUT BY CABINET STYLE

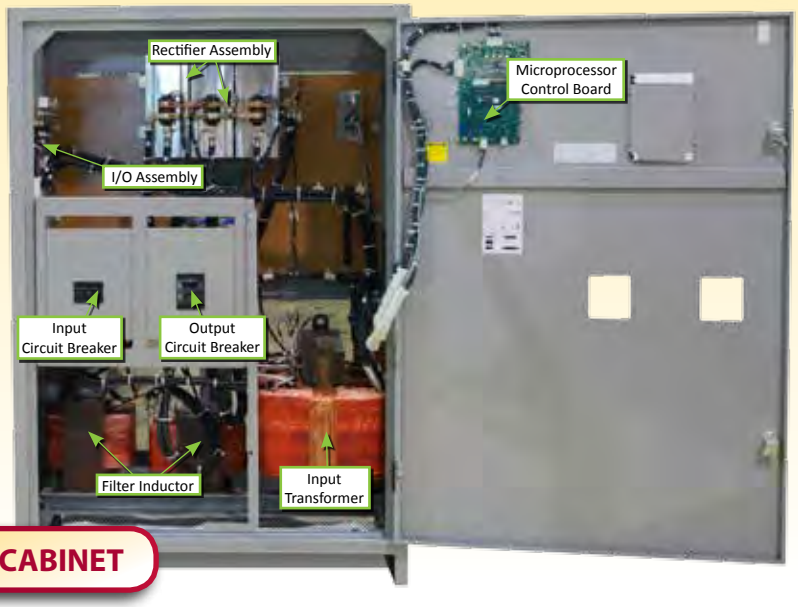
For detailed CAD drawings of all NEMA-1 type enclosures (and optional NEMA-4 (12) type enclosures), please visit the support section of our website hindlepowerinc.com



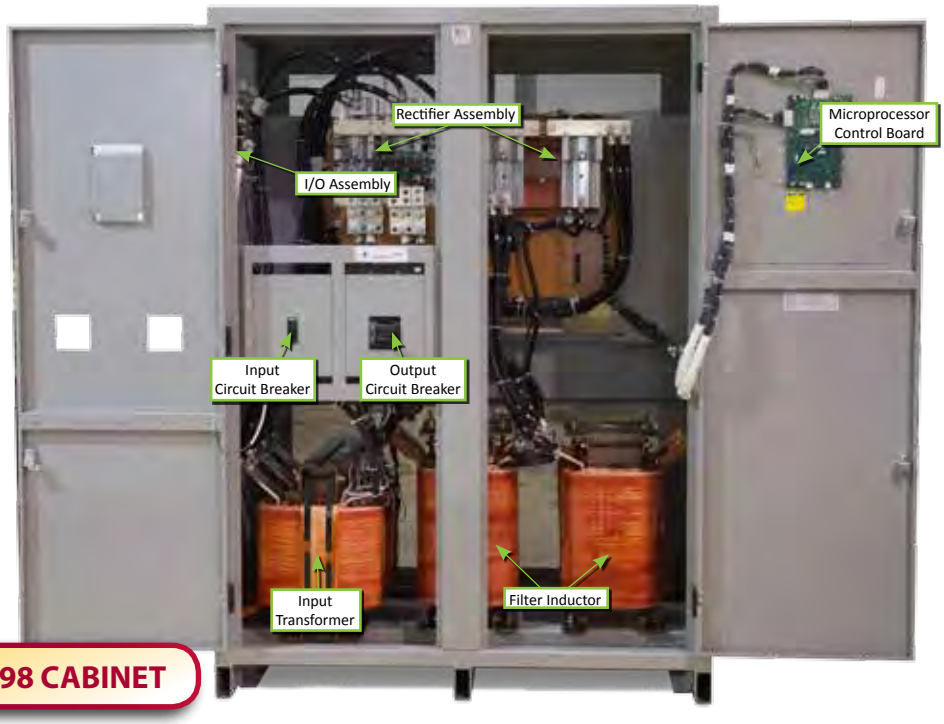
STYLE 5018 CABINET



STYLE 5030 CABINET



STYLE 163 CABINET



STYLE 198 CABINET

AT30 - SPECIFICATION TABLE

	A	B			C			D	E			F	G	H	J	K	L	M	N	P
SAMPLE	AT30	1	3	0	0	5	0	F	4	8	0	S	X	S	X	A	X	X	X	X
YOUR CODE	AT30																			

	DESCRIPTION	CODE	FEATURE
A		AT30	AT30 SERIES
B	Nominal DC Output Voltage	012	12Vdc
		024	24Vdc
		048	48Vdc
		130	130Vdc
C	Nominal DC Output Current	025	25Adc
		030	30Adc
		040	40Adc
		050	50Adc
		075	75Adc
		100	100Adc
		125	125Adc
		150	150Adc
		200	200Adc
		250	250Adc
		300	300Adc
		400	400Adc
		500	500Adc
		600	600Adc
		800	800Adc
		1K0	1000Adc
D	DC Output Filtering	U	Unfiltered
		F	Filtered
		E	Eliminator
E	AC Input Voltage* (3~)	208	208V 60Hz
		240	240V 60Hz
		480	480V 60Hz
		600	550/600V 60Hz
		220	220V 50/60Hz
		380	380V 50/60Hz
		416	416V 50/60Hz

	DESCRIPTION	CODE	FEATURE
F	AC Input Circuit Breaker Rating**	S	Standard AIC
		M	Medium AIC
		H	High AIC
		0	No Breaker
G	AC Input Fuses	F	Installed
		X	Not Supplied
H	DC Output Circuit Breaker Rating**	S	Standard AIC
		M	Medium AIC
		H	High AIC
		0	No Breaker
J	DC Output Fuses	F	Installed
		X	Not Supplied
K	Auxiliary Alarm Relay Board	A	Installed
		X	Not Supplied
L	Copper Ground Bus	G	Installed
		X	Not Supplied
M	AC Lightning Arrestor	L	Installed
		X	Not Supplied
N	Fungus Proofing	F	Applied
		X	Not Supplied
P	Static Proofing	S	Applied
		X	Not Supplied

*** Contact factory for other AC input voltages not listed**

**** If you do not order an AC input or DC output circuit breaker, fuses will be provided.**

Circuit Breaker AC & DC Ratings

STANDARD	*MEDIUM*	*HIGH*
Input: 5kAIC - 120/208/240/480Vac	*Input: 25kAIC - 120/208/240/480Vac*	*Input: 65kAIC - 120/208/240/480Vac*
14kAIC - 600Vac	*18kAIC - 600Vac*	*N/A - 600Vac*
Output: 5kAIC - 125Vdc	*Output: 10kAIC - 250Vdc*	*Output: 20kAIC - 250Vdc*

Specifications subject to change.

OUR UNRIVALED PRODUCT WARRANTY

Standard Warranty

(applies only to product(s) delivered within the United States and Canada)

All HindlePower charger products are warranted to be free from defects in material and workmanship for a period of five (5) years from date of manufacture. During the term of the warranty period: parts, assemblies, or components deemed to be defective will be repaired or replaced at our option, free of charge. All costs related to removal, reinstallation and transportation will be paid by the purchaser/customer and/or operator of the product. Evaluation, repair and/or replacement of any defective part(s) are FOB manufacturer's factory.

This warranty does not cover products or parts that are damaged from improper use or abuse, as determined by HindlePower. Accessory items or additional items carry only their respective manufacturer's warranty. Consumable items (such as fuses and electrolytic capacitors), which wear out under normal use are specifically not covered by this standard warranty. Any consequential damage due to diagnosis or repair by any party other than HindlePower authorized personnel is not covered under this warranty.

NOTE: Requests for returns or claims must be submitted to our Factory Service Center for Return Material Authorization(RMA) instructions and assignment. Returns that do not follow this procedure will not be honored.

Other Products Available from HindlePower:

AT10.1 Microprocessor Battery Charger	***JF5006***	**UMC Universal Maintenance Charger**	***JF5008***
AT Series Options & Accessories	***JF5020***	**Single Cell Charger**	***JF5007***
AT Series Communications Module	***JF5014***	**Mobile DC Power System**	***JF5041***
AT-DC Series Distribution Panel	***JF5032***	**The EPIC Series Console**	***JF5043***
SCR/SCRF Series Utility Battery Charger	***JF5010***	**Best Battery Selector**	***JF5048***

Mobile DC Power System

Universal Maintenance Charger

AT10.1 Microprocessor Battery Charger

The EPIC Series Console

1075 Saint John Street, Easton, PA 18042 • phone:610.330.9000 • www.hindlepowerinc.com

JF5018-00 - **REV. 4C 11-2015**
Specifications subject to change

SAFETY DATA SHEET

Form #: SDS 853020
Revised: AB
Supersedes: AA
ECO #: 1001828

I. PRODUCT IDENTIFICATION

Chemical Trade Name (as used on label):
Lead-Acid Battery, Wet

Synonyms:
Industrial Battery, Traction Battery, Stationary Battery, Deep Cycle Battery

Manufacturer's Name/Address:
EnerSys
P.O. Box 14145
2366 Bernville Road
Reading, PA 19612-4145

Chemical Family/Classification:
Electric Storage Battery

Telephone:
For information and emergencies, contact EnerSys' Environmental, Health & Safety Dept. at 610-208-1996

24-Hour Emergency Response Contact:
CHEMTREC DOMESTIC: 800-424-9300 CHEMTREC INT'L: 703-527-3877

II GHS HAZARDS IDENTFICATION

HEALTH		ENVIRONMENTAL	PHYSICAL
Acute Toxicity (Oral/Dermal/Inhalation)	Category 4	Aquatic Chronic 1	Explosive Chemical, Division 1.3
Skin Corrosion/Irritation	Category 1A	Aquatic Acute 1	
Eye Damage	Category 1		
Reproductive	Category 1A		
Carcinogenicity (lead compounds)	Category 1B		
Carcinogenicity (arsenic)	Category 1A		
Carcinogenicity (acid mist)	Category 1A		
Specific Target Organ Toxicity (repeated exposure)	Category 2		

GHS LABEL:

HEALTH	ENVIRONMENTAL	PHYSICAL
		

Hazard Statements

DANGER!

Causes severe skin burns and serious eye damage.
May damage fertility or the unborn child if ingested or inhaled.
May cause cancer if ingested or inhaled.
Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure.
May form explosive air/gas mixture during charging.
Extremely flammable gas (hydrogen).
Explosive, fire, blast, or projection hazard.
May cause harm to breast-fed children
Harmful if swallowed, inhaled, or contact with skin
Causes skin irritation, serious eye damage.

Precautionary Statements

Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves/protective clothing, eye protection/face protection.
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Contact with internal components may cause irritation or severe burns. Avoid contact with internal acid.
Irritating to eyes, respiratory system, and skin.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood
Avoid contact during pregnancy/while nursing
Keep away from heat./sparks/open flames/hot surfaces. No smoking

III. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Approximate % by Wt.
Inorganic Lead Compound:		
Lead	7439-92-1	60-70
* Antimony	7440-36-0	2
* Arsenic	7440-38-2	0.2
* Calcium	7440-70-2	0.04
* Tin	7440-31-5	0.2
Electrolyte (Sulfuric Acid (H2SO4/H2O))	7664-93-9	10-30
Case Material:		5-10
Polypropylene	9003-07-0	
Polystyrene	9003-53-6	
Styrene Acrylonitrile	9003-54-7	
Acrylonitrile Butadiene Styrene	9003-56-9	
Styrene Butadiene	9003-55-8	
Polyvinylchloride	9002-86-2	
Polycarbonate, Hard Rubber, Polyethylene	9002-88-4	

Other:			
Silicon Dioxide (Gel batteries only)	7631-86-9	1-5	
Sheet Molding Compound	--		
(Glass reinforced polyester)			

Inorganic lead and electrolyte (sulfuric acid) are the primary components of every battery manufactured by EnerSys.
Other ingredients may be present dependent upon battery type. Contact your EnerSys representative for additional information.

IV. FIRST AID MEASURES

Inhalation:

Sulfuric Acid: Remove to fresh air immediately. If breathing is difficult, give oxygen. Consult a physician.
Lead: Remove from exposure, gargle, wash nose and lips; consult physician.

Ingestion:

Sulfuric Acid: Give large quantities of water; do not induce vomiting or aspiration into the lungs may occur and can cause permanent injury or death; consult a physician.
Lead: Consult physician immediately.

Skin:

Sulfuric Acid: Flush with large amounts of water for at least 15 minutes; remove contaminated clothing completely, including shoes. If symptoms persist, seek medical attention. Wash contaminated clothing before reuse. Discard contaminated shoes.
Lead: Wash immediately with soap and water.

Eyes:

Sulfuric Acid and Lead: Flush immediately with large amounts of water for a least 15 minutes while lifting lids. Seek immediate medical attention if eyes have been exposed directly to acid.

V. FIRE FIGHTING MEASURES

Flash Point: N/A **Flammable Limits:** LEL = 4.1% (Hydrogen Gas) UEL = 74.2%

Extinguishing Media: CO_2; foam; dry chemical. Do not use carbon dioxide directly on cells. Avoid breathing vapors. Use appropriate media for surrounding fire.

Special Fire Fighting Procedures:

If batteries are on charge, shut off power. Use positive pressure, self-contained breathing apparatus. Water applied to electrolyte generates heat and causes it to spatter. Wear acid-resistant clothing, gloves, face and eye protection.
But note that strings of series connected batteries may still pose risk of electric shock even when charging equipment is shut down.

Unusual Fire and Explosion Hazards:

Highly flammable hydrogen gas is generated during charging and operation of batteries. To avoid risk of fire or explosion, keep sparks or other sources of ignition away from batteries. Do not allow metallic materials to simultaneously contact negative and positive terminals of cells and batteries. Follow manufacturer's instructions for installation and service.

VI. ACCIDENTAL RELEASE MEASURES

Spill or Leak Procedures:

Stop flow of material, contain/absorb small spills with dry sand, earth, and vermiculite. Do not use combustible materials. If possible, carefully neutralize spilled electrolyte with soda ash, sodium bicarbonate, lime, etc. Wear acid-resistant clothing, boots, gloves, and face shield. Do not allow discharge of unneutralized acid to sewer. Acid must be managed in accordance with local, state, and federal requirements. Consult state environmental agency and/or federal EPA.

VII. HANDLING AND STORAGE

Handling:

Unless involved in recycling operations, do not breach the casing or empty the contents of the battery. Handle carefully and avoid tipping, which may allow electrolyte leakage. There may be increasing risk of electric shock from strings of connected batteries.
Keep containers tightly closed when not in use. If battery case is broken, avoid contact with internal components.
Keep vent caps on and cover terminals to prevent short circuits. Place cardboard between layers of stacked automotive batteries to avoid damage and short circuits.
Keep away from combustible materials, organic chemicals, reducing substances, metals, strong oxidizers and water. Use banding or stretch wrap to secure items for shipping.

Storage:

Store batteries in cool, dry, well-ventilated areas with impervious surfaces and adequate containment in the event of spills. Batteries should also be stored under roof for protection against adverse weather conditions. Separate from incompatible materials. Store and handle only in areas with adequate water supply and spill control. Avoid damage to containers. Keep away from fire, sparks and heat. Keep away from metallic objects could bridge the terminals on a battery and create a dangerous short-circuit.

Charging:

There is a possible risk of electric shock from charging equipment and from strings of series connected batteries, whether or not being charged. Shut-off power to chargers whenever not in use and before detachment of any circuit connections. Batteries being charged will generate and release flammable hydrogen gas.
Charging space should be ventilated. Keep battery vent caps in position. Prohibit smoking and avoid creation of flames and sparks nearby.
Wear face and eye protection when near batteries being charged.

VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (mg/m3) Note: N.E.= Not Established

INGREDIENTS (Chemical/Common Names)	OSHA PEL	ACGIH	US NIOSH	Quebec PEV	Ontario OEL	EU OEL
Lead and Lead Compounds (inorganic)	0.05	0.05	0.05	0.05	0.05	0.15 (b)
Antimony	0.5	0.5	0.5	0.5	0.5	0.5 (b,e)
Arsenic	0.01	0.01	0.002	0.2	0.01	N.E
Calcium	N.E	N.E	N.E	N.E	N.E	N.E
Tin	2	2	2	2	2	N.E
Electrolyte (Sulfuric Acid)	1	0.2	1	1	0.2	0.05 (c)
Polypropylene	N.E	N.E	N.E	N.E	N.E	N.E
Polystyrene	N.E	N.E	N.E	N.E	N.E	N.E
Styrene Acrylonitrile	N.E	N.E	N.E	N.E	N.E	N.E
Acrylonitrile Butadiene Styrene	N.E	N.E	N.E	N.E	N.E	N.E
Styrene Butadiene	N.E	N.E	N.E	N.E	N.E	N.E
Polyvinylchloride	N.E	N.E	N.E	N.E	1	N.E
Polycarbonate, Hard Rubber, Polyethylene	N.E	N.E	N.E	N.E	N.E	N.E
Silicon Dioxide (Gel Batteries Only)	N.E	N.E	N.E	N.E	N.E	N.E
Sheet Molding Compound (Glass reinforced polyester)	N.E	N.E	N.E	N.E	N.E	N.E

NOTES:

(b) As inhalable aerosol
(c) Thoracic fraction
(e) Based on OEL;s Of Austria, Belgium, Denmark, France, Netherlands, Switzerland, & U.K.

Engineering Controls (Ventilation):

Store and handle in well-ventilated area. If mechanical ventilation is used, components must be acid-resistant. Handle batteries cautiously to avoid spills. Make certain vent caps are on securely. Avoid contact with internal components. Wear protective clothing, eye and face protection when filling, charging or handling batteries. Do not allow metallic materials to simultaneously contact both the positive and negative terminals of the batteries. Charge the batteries in areas with adequate ventilation. General dilution ventilation is acceptable.

Respiratory Protection (NIOSH/MSHA approved):

None required under normal conditions. When concentrations of sulfuric acid mist are known to exceed the PEL, use NIOSH or MSHA-approved respiratory protection.

Skin Protection:

If battery case is damaged, use rubber or plastic acid-resistant gloves with elbow-length gauntlet, acid-resistant apron, clothing and boots.

Eye Protection:

If battery case is damaged, use chemical goggles or face shield.

Other Protection:

In areas where sulfuric acid is handled in concentrations greater than 1%, emergency eyewash stations and showers should be provided, with unlimited water supply. Acid-resistant apron. Under severe exposure emergency conditions, wear acid-resistant clothing and boots. Face shield recommended when adding water or electrolyte to batteries, wash hands after handling.

IX. PHYSICAL AND CHEMICAL PROPERTIES

Properties Listed Below are for Electrolyte:

Boiling Point:	203 - 240° F	**Specific Gravity (H2O = 1):**	1.215 to 1.350
Melting Point:	N/A	**Vapor Pressure (mm Hg):**	10
Solubility in Water:	100%	**Vapor Density (AIR = 1):**	Greater than 1
Evaporation Rate: (Butyl Acetate = 1)	Less than 1	**% Volatile by Weight:**	N/A
pH:	~1 to 2	**Flash Point:**	Below room temperature (as hydrogen gas)
LEL (Lower Explosive Limit)	4.1% (Hydrogen)	**UEL (Upper Explosive Limit)**	74.2% (Hydrogen)
Appearance and Odor:	Manufactured article; no apparent odor. Electrolyte is a clear liquid with a sharp, penetrating, pungent odor.		

X. STABILITY AND REACTIVITY

Stability: Stable X Unstable ___

This product is stable under normal conditions at ambient temperature.

Conditions To Avoid: Prolonged overcharge; sources of ignition

Incompatibility: (Materials to avoid)

Sulfuric Acid: Contact with combustibles and organic materials may cause fire and explosion. Also reacts violently with strong reducing agents, metals, sulfur trioxide gas, strong oxidizers and water. Contact with metals may produce toxic sulfur dioxide fumes and may release flammable hydrogen gas.

Lead Compounds: Avoid contact with strong acids, bases, halides, halogenates, potassium nitrate, permanganate, peroxides, nascent hydrogen and reducing agents.

Arsenic compounds: strong oxidizers; bromine azide. NOTE: hydrogen gas can react with inorganic arsenic to form the highly toxic gas-arsine.

Hazardous Decomposition Products:

Sulfuric Acid: Sulfur trioxide, carbon monoxide, sulfuric acid mist, sulfur dioxide, and hydrogen sulfide.

Lead Compounds: High temperatures likely to produce toxic metal fume, vapor, or dust; contact with strong acid or base or presence of nascent hydrogen may generate highly toxic arsine gas.

Hazardous Polymerization:

Will not occur

XI. TOXICOLOGICAL INFORMATION

Routes of Entry:

Sulfuric Acid: Harmful by all routes of entry.

Lead Compounds: Hazardous exposure can occur only when product is heated, oxidized or otherwise processed or damaged to create dust, vapor or fume. The presence of nascent hydrogen may generate highly toxic arsine gas.

Inhalation:

Sulfuric Acid: Breathing of sulfuric acid vapors or mists may cause severe respiratory irritation.

Lead Compounds: Inhalation of lead dust or fumes may cause irritation of upper respiratory tract and lungs.

Ingestion:

Sulfuric Acid: May cause severe irritation of mouth, throat, esophagus and stomach.

Lead Compounds: Acute ingestion may cause abdominal pain, nausea, vomiting, diarrhea and severe cramping. This may lead rapidly to systemic toxicity and must be treated by a physician.

Skin Contact:

Sulfuric Acid: Severe irritation, burns and ulceration.

Lead Compounds: Not absorbed through the skin.

Arsenic Compounds: Contact may cause dermatitis and skin hyper pigmentation.

Eye Contact:

Sulfuric Acid: Severe irritation , burns, cornea damage, and blindness.

Lead Components: May cause eye irritation.

Effects of Overexposure - Acute:

Sulfuric Acid: Severe skin irritation, damage to cornea, upper respiratory irritation.

Lead Compounds: Symptoms of toxicity include headache, fatigue, abdominal pain, loss of appetite, muscular aches and weakness, sleep disturbances and irritability.

Effects of Overexposure - Chronic:

Sulfuric Acid: Possible erosion of tooth enamel, inflammation of nose, throat and bronchial tubes.

Lead Compounds: Anemia; neuropathy, particularly of the motor nerves, with wrist drop; kidney damage; reproductive changes in males and females. Repeated exposure to lead and lead compounds in the workplace may result in nervous system toxicity. Some toxicologists report abnormal conduction velocities in persons with blood lead levels of 50mcg/100 ml or higher. Heavy lead exposure may result in central nervous system damage, encephalopathy and damage to the blood-forming (hematopoietic) tissues.

Carcinogenicity:

Sulfuric Acid: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Group 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid or sulfuric acid solutions contained within a battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product, such as overcharging, may result in the generation of sulfuric acid mist.

Lead Compounds: Lead is listed as a Group 2A carcinogen, likely in animals at extreme doses. Per the guidance found in OSHA 29 CFR 1910.1200 Appendix F, this is approximately equivalent to GHS Category 1B. Proof of carcinogenicity in humans is lacking at present.

Arsenic: Arsenic is listed by IARC as a Group 1 - carcinogenic to humans. Per the guidance found in OSHA 29 CFR 1910.1200 Appendix F, this is approximately equivalent to GHS Category 1A.

Medical Conditions Generally Aggravated by Exposure:

Overexposure to sulfuric acid mist may cause lung damage and aggravate pulmonary conditions. Contact of sulfuric acid with skin may aggravate diseases such as eczema and contact dermatitis. Lead and its compounds can aggravate some forms of kidney, liver and neurologic diseases.

Acute Toxicity:
Inhalation LD50:
Electrolyte: LC50 rat: 375 mg/m3; LC50: guinea pig: 510 mg/m3
Elemental Lead: Acute Toxicity Point Estimate = 4500 ppmV (based on lead bullion)
Elemental Arsenic: No data

Oral LD50:
Electrolyte: rat: 2140 mg/kg
Elemental Lead: Acute Toxicity Estimate (ATE) = 500 mg/kg body weight (based on lead bullion)
Elemental Arsenic: LD50 mouse: 145 mg/kg
Elemental Antimony: LD50 rat: 100 mg/kg

Additional Health Data:

All heavy metals, including the hazardous ingredients in this product, are taken into the body primarily by inhalation and ingestion.
Most inhalation problems can be avoided by adequate precautions such as ventilation and respiratory protection covered in Section 8.
Follow good personal hygiene to avoid inhalation and ingestion: wash hands, face, neck and arms thoroughly before eating, smoking or leaving the worksite. Keep contaminated clothing out of non-contaminated areas, or wear cover clothing when in such areas. Restrict the use and presence of food, tobacco and cosmetics to non-contaminated areas. Work clothes and work equipment used in contaminated areas must remain in designated areas and never taken home or laundered with personal non-contaminated clothing. This product is intended for industrial use only and should be isolated from children and their environment.

The 19th Amendment to EC Directive 67/548/EEC classified lead compounds, but not lead in metal form, as possibly toxic to reproduction.
Risk phrase 61: May cause harm to the unborn child, applies to lead compounds, especially soluble forms.

XII. ECOLOGICAL INFORMATION

Environmental Fate:

Lead is very persistent in soil and sediments. No data on environmental degradation. Mobility of metallic lead between ecological compartments is slow.
Bioaccumulation of lead occurs in aquatic and terrestrial animals and plants but little bioaccumulation occurs through the food chain.
Most studies include lead compounds and not elemental lead.

Environmental Toxicity: Aquatic Toxicity:

Sulfuric acid:	24-hr LC50, freshwater fish (Brachydanio rerio): 82 mg/L
	96 hr- LOEC, freshwater fish (Cyprinus carpio): 22 mg/L
Lead:	48 hr LC50 (modeled for aquatic invertebrates): <1 mg/L, based on lead bullion
Arsenic:	24 hr LC50, freshwater fish (Carrassisus auratus) >5000 g/L.

Additional Information:

· No known effects on stratospheric ozone depletion.
· Volatile organic compounds: 0% (by Volume)
· Water Endangering Class (WGK): NA

XIII. DISPOSAL CONSIDERATIONS (UNITED STATES)

Spent batteries: Send to secondary lead smelter for recycling. Spent lead-acid batteries are not regulated as hazardous waste when the requirements of 40 CFR Section 266.80 are met. This should be managed in accordance with approved local, state and federal requirements. Consult state environmental agency and/or federal EPA.

Electrolyte:

Place neutralized slurry into sealed containers and handle as applicable with state and federal regulations. Large water-diluted spills, after neutralization and testing, should be managed in accordance with approved local, state and federal requirements. Consult state environmental agency and/or federal EPA.

Following local, State/Provincial, and Federal/National regulations applicable to end-of-life characteristics will be the responsibility of the end-user.

XIV. TRANSPORT INFORMATION

U.S. DOT:

The transportation of wet and moist charged (moist active) batteries within the continental United States is regulated by the U.S. DOT through the Code of Federal Regulations, Title 49 (49CFR). These regulations classify these types of batteries as a hazardous material. Refer to 49 CFR, 173.159 for more details pertaining to the transportation of wet and moist batteries.

The shipping information is as follows:

Proper Shipping Name: Batteries, wet, filled with acid
Hazardous Class: 8
UN Identification: UN2794
Packing Group: N/A
Label/Placard Required: Corrosive

Contact your EnerSys representative for additional information regarding the classification of batteries.

49 CFR 173.159(e) specifies that when transported by highway or rail, electric storage batteries containing electrolyte or corrosive battery fluid are not subject to any other requirements of this subchapter, if all of the following are met:

(1) No other hazardous materials may be transported in the same vehicle;
(2) The batteries must be loaded or braced so as to prevent damage and short circuits in transit;
(3) Any other material loaded in the same vehicle must be blocked, braced, or otherwise secured to prevent contact with or damage to the batteries; and
(4) The transport vehicle may not carry material shipped by any person other than the shipper of the batteries.

If any of the above-referenced requirements are not met, the batteries must be shipped as fully-regulated Class 8 Corrosive hazardous materials.

IATA Dangerous Goods Regulations DGR:

The international transportation of wet and moist charged (moist active) batteries is regulated by the International Air Transport Association (IATA). These regulations also classify these types of batteries as a hazardous material. The batteries must be packed according to IATA Packing Instruction 870.

The shipping information is as follows:

Proper Shipping Name: Batteries, wet, filled with acid
Hazardous Class: 8
UN Identification: UN2794

Packing Group: N/A
Label/Placard Required: Corrosive

Contact your EnerSys representative for additional information regarding the classification of batteries.

IMDG:

The international transportation of wet and moist charged (moist active) batteries is regulated by the International Maritime Dangerous Goods code (IMDG). These regulations also classify these types of batteries as hazardous material. The batteries must be packed according to IMDG code pages 8120 and 8121. IMDG Code Packing Instruction P801.

The shipping information is as follows:

Proper Shipping Name: Batteries, wet, filled with acid
Hazardous Class: 8
UN Identification: UN2794

Packing Group: N/A
Label/Placard Required: Corrosive

Contact your EnerSys representative for additional information regarding the classification of batteries.

XV. REGULATORY INFORMATION

UNITED STATES:

EPA SARA Title III:

Section 302 EPCRA Extremely Hazardous Substances (EHS):

Sulfuric acid is a listed "Extremely Hazardous Substance" under EPCRA, with a Threshold Planning Quantity (TPQ) of 1,000 lbs. EPCRA Section 302 notification is required if 1000 lbs or more of sulfuric acid is present at one site (40 CFR 370.10). For more information consult 40 CFR Part 355. The quantity of sulfuric acid will vary by battery type. Contact your EnerSys representative for additional information.

Section 304 CERCLA Hazardous Substances:

Reportable Quantity (RQ) for spilled 100% sulfuric acid under CERCLA (Superfund) and EPCRA (Emergency Planning and Community Right to Know Act) is 1,000 lbs. State and local reportable quantities for spilled sulfuric acid may vary.

Section 311/312 Hazard Categorization:

EPCRA Section 312 Tier Two reporting is required for non-automotive batteries if sulfuric acid is present in quantities of 500 lbs or more and/or if lead is present in quantities of 10,000 lbs or more. For more information consult 40 CFR 370.10 and 40 CFR 370.40

Section 313 EPCRA Toxic Substances:

40 CFR section 372.38 (b) states: If a toxic chemical is present in an article at a covered facility, a person is not required to consider the quantity of the toxic chemical present in such article when determining whether an applicable threshold has been met under § 372.25, § 372.27, or § 372.28 or determining the amount of release to be reported under § 372.30. This exemption applies whether the person received the article from another person or the person produced the article. However, this exemption applies only to the quantity of the toxic chemical present in the article.

Supplier Notification:

This product contains toxic chemicals, which may be reportable under EPCRA Section 313 Toxic Chemical Release Inventory (Form R) requirements. If you are a manufacturing facility under SIC codes 20 through 39, the following information is provided to enable you to complete the required reports:

Toxic Chemical	CAS Number	Approximate % by Wt.
Lead	7439-92-1	60
Electrolyte (Sulfuric Acid (H2SO4/H2O))	7664-93-9	10 - 30
* Antimony	7440-36-0	2
* Arsenic	7440-38-2	0.2
Tin	7440-31-5	0.2

See 40 CRG Part 370 for more details.

If you distribute this product to other manufacturers in SIC Codes 20 through 39, this information must be provided with the first shipment of each calendar year.

The Section 313 supplier notification requirement does not apply to batteries, which are "consumer products".

* Not present in all battery types. Contact your EnerSys representative for additional information.

TSCA:

TSCA Section 8b – Inventory Status: All chemicals comprising this product are either exempt or listed on the TSCA Inventory.

TSCA Section 12b (40 CFR Part 707.60(b)) No notice of export will be required for articles, except PCB articles, unless the Agency so requires in the context of individual section 5, 6, or 7 actions.

TSCA Section 13 (40 CFR Part 707.20): No import certification required (EPA 305-B-99-001, June 1999, Introduction to the Chemical Import Requirements of the Toxic Substances Control Act, Section IV.A).

RCRA:

Spent Lead Acid Batteries are subject to streamlined handling requirements when managed in compliance with 40 CFR section 266.80 or 40 CFR part 273. Waste sulfuric acid is a characteristic hazardous waste; EPA hazardous waste number D002 (corrosivity) and D008 (lead).

CAA:

EnerSys supports preventative actions concerning ozone depletion in the atmosphere due to emissions of CFC's and other ozone depleting chemicals (ODC's), defined by the USEPA as Class I substances. Pursuant to Section 611of the Clean Air Act Amendments (CAAA) of 1990, finalized on January 19, 1993, EnerSys established a policy to eliminate the use of Class I ODC's prior to the May 15, 1993 deadline.

STATE REGULATIONS (US):

Proposition 65:

Warning: Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. Wash hands after handling.

INTERNATIONAL REGULATIONS:

Distribution into Quebec to follow Canadian Controlled Product Regulations (CPR) 24(1) and 24(2).

Distribution into the EU to follow applicable Directives to the Use, Import/Export of the product as-sold.

XVI. OTHER INFORMATION

Revision: AB (04-25-17)

NFPA Hazard Rating for Sulfuric Acid:

Flammability (Red) = 0	Reactivity (Yellow) = 2
Health (Blue) = 3	Sulfuric acid is water-reactive if concentrated.

DISCLAIMER

This Safety Data Sheet is created by the manufacturer to comply with the requirements of 29 CFR 1910.1200. To the extent allowed by law, the manufacturer hereby expressly disclaims any liability to any third party, including users of this product, including, but not limited to, consequential or other damages, arising out of the use of, or reliance on, this Safety Data Sheet.

System Safe℠

RESERVE POWER

Battery and Charger Accessories

Battery Maintenance Tools and Equipment

Accessories

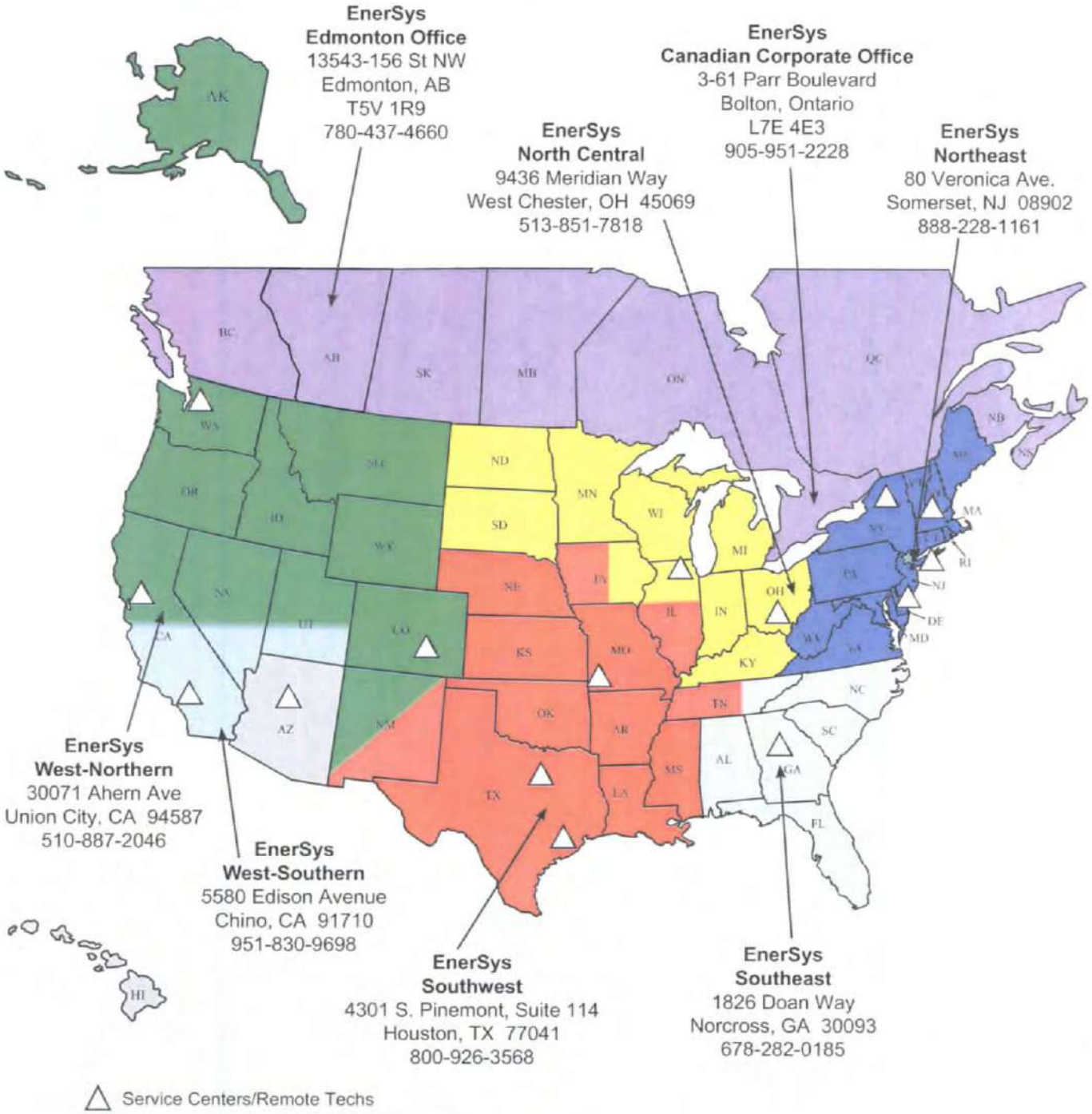
Battery Chargers

Safety Equipment

EnerSys®

Power/Full Solutions

Regional Territories/Locations



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1826 Doan Way
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△ Service Centers/Remote Techs

www.enersys.com

Battery Maintenance Tools and Equipment

Hydrometer
Catalog #81332

- Range 1.100-1.300 with 0.005 (5 point) increment scale
- Portable
- Syringe-type
- Accuracy +/-0.005 sp. gr.

Hydrometer Holder
Catalog #27717

- Acid-resistant drip collector
- Wall or rack mounted
- Mounting hardware included

Digital Hydrometer
Catalog #7084VP-CERT
(Fahrenheit Refractometer)

Battery Acid:
- UofM: spcfc gravity (D20/20)
- Range: 1.095 to 1.400
- Resolution: 0.005
- Precision (+/-): 0.005

Thermometer
Catalog #88330

- Range 30-130˚F/0-55˚C with one degree increments
- Specific gravity correction scale to cover the 50˚ - 104˚F/10˚ - 40˚C range
- Length 10-1/16" (257 mm)
- Rubber bushing slides along thermometer stem so that the instrument may be used with any cell size
- Withdrawal tube port readings or mount permanently in funnel-type flame arrestors

Insulated Tool Kit
Catalog #SPC8346

Includes – wrenches, sockets, pliers, open end wrenches, screwdrivers, hex wrench set and backpack

*Torque wrench calibration certificate included

Pro Alarm Hydrogen Gas Detector

Catalog #801550

- Automatic operation
- Continuous monitoring
- High sensitivity
- High stability
- Microchip self-calibration
- Solid state reliability intrinsically safe - 12-Volt operating voltage
- Easy installation
- Low cost
- Two year warranty

Catalog No.	Accessories
801550	PRO Alarm
801550-DR	PRO Alarm Dual Relay
801550-BOX	Optional Junction Box
801550-REMOTE	Remote Panel Box
801550-14FT	Modular Cable, 14'
801550-25FT	Modular Cable, 25'
801550-50FT	Modular Cable, 50'
801550-60FT	Modular Cable, 60'

PRO Series® Deionizer

Catalog #PSI-94866

Resin removes dissolved minerals from water

600 gallon capacity cartridge replacement is simple

Exclusive battery operated purity light

- Red/Green indicator light tells when cartridge is exhausted
- Operates on two D-Cell batteries that will last for about two years

Produces battery water for a fraction of the cost of bottled water

Replacement Cartridge

Catalog #94866-C

PRO Series®

HYDRO*Fill*™ Watering Cart

Catalog #502056

Easy to maneuver:
Handles like a hand truck

Easy to use:
Instructions right on the unit

On/Off switch located on the rear of the unit

Easy to fill:
Large opening

Charge the unit from any 120VAC outlet with the provided charger

Dependable water source:
We've been selling this pump for nearly two decades

Sturdy 10 gallon polypropylene tank

9' hose attaches to all *PRO Series*® Watering Guns

Sealed cell battery is included

Product Specifications:

- 35" Height, 15" Width; 27 lbs
- 9' output hose
- 8" wheel size

Features:

- Sealed cell battery with 120VAC charger (charge the unit from any 120VAC outlet with the provided charger)
- Completely compatible with 92755-STAT watering gun

Replacement Battery
Catalog #CRT-095

Replacement Charger
Catalog #CRT-035
(for serial # 20062417 or higher)

Replacement Charger
Catalog # PSI-CRT-133
(for serial # 20062416 or lower)

PRO Series® Stationary Battery Watering Gun

Catalog #PSI-92755-STAT

Features:

- Gun operates outside the cell and does not have automatic shutoff
- Cone-shaped nozzle injects water through funnels of the flame arrestor vents, you can service battery without removing vent caps
- Manually adjustable flow throttle

PRO Series®

PRO Series® Watering Cart
EZ Fill™ DC Cart Jr. (8 Gallon or 30.28 liters)

Blue Connector -
Catalog #BWT-NC-5080PNE
Gray Connector -
Catalog #BWT-NC-5080PE

The EZ Fill™ DC Cart Jr. is portable and is great for small and medium jobs. It is lightweight, durable and the two wheeled configuration handles like a piece of luggage. It rolls easily and is powered by a 12 volt battery that is included and mounted in the tank. The charger is also included.

Box size for shipping: 18" x 18" x 24" (457.2 x 457.2 x 609.60 mm)
Approximate shipping weight empty: 28 lbs (12.7 kg)

Replacement Battery
Catalog #BWT-ASJ5157209

Replacement Charger
Catalog #BWT-BC50008 (headphone style connector)

Replacement Charger
Catalog #BWT-BC50009 (barrel style connector)

PRO Series® Watering Cart
EZ Fill™ DC Cart (15 & 25 Gallon)

25 Gallon - Catalog #BWT-NC-5250PNE
15 Gallon - Catalog #BWT-NC-5020PNE

The EZ Fill™ DC Cart is self-contained, providing unlimited range for watering a fleet of batteries. Its rugged, steel construction makes it ideal for any industrial application.
Box size for shipping:
48" x 24" x 24" (1219.20 x 609.60 x 609.60 mm)
Battery included.
Approximate shipping weight empty:
15 gal: 87 lbs (39.46 kg)
25 gal: 97 lbs (43.99 kg)

Replacement Battery
Catalog #0765-2024CONO (EnerSys)

Replacement Charger
Catalog #BWT-BC5000

Deionizer
Catalog #BWT-PW-1800E

Product Specifications:

Deionizer Part#:	BWT-PW-1800E
Input Hose:	6' (1.83 m)
Output Hose:	12' (3.66 m)
Hose Specs:	Braided Hose 5/8" or 15.88 mm in diameter
PSI Rate:	Not to exceed 125 psi
Purity Light:	Requires four batteries (size 389-A)
Replacement Cartridge:	BWT-PWRC-1800
Shipping Weight:	28 lbs (12.7 kg)

Replacement Deionizer Cartridge
Catalog #BWT-PWRC-1800

Replacement Purity Light
Catalog #BWT-PW-LIT2

PRO Series®

Pro Flow™ Portable Watering Carts

Catalog #FRC-BA-MS-105 - 12 VDC Cart (w/ 100-240 VAC Charger)
Catalog #FRC-BA-MS-205 - 100-115 VAC

Portable watering carts are constructed of lightweight yet strong polyethylene plastic, and feature a large 22 gallon holding capacity. They feature a variable speed pump and large refill hole with flip top cover to keep out particles. The DC powered unit includes a 12-volt sealed battery, volt meter and onboard charger. All components are DI water compatible.

Replacement Battery
Catalog #FRC-BD-00607

Replacement Charger
Catalog #FRC-BA-006

Pro Flow™ Deionizer

Catalog #FRC-BA-MS-341
Niagara Deionizer with low pressure bypass
(110-115 VAC Quality Light)

Catalog #FRC-BA-MS-342
(220-240 VAC Quality Light)

Maximizes battery life by removing heavy metals that are present in tap water. The deionizer uses an ion exchange cartridge to filter the water before it enters the battery. Cartridge can be discarded when replacement is necessary. This is determined when output exceeds 50ppm (water quality light will turn red). A low pressure bypass ensures that the deionizer will provide enough pressure and flow to operate your SPW system, even if you forget to change out an old cartridge.

Replacement Cartridge
Catalog #FRC-BA-221

PRO Wash
Battery Rack Neutralizing Cleaner

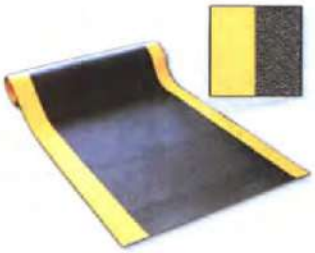
PRO Wash II battery rack neutralizing cleaner with color change	**PRO Wash Plus** battery rack neutralizing cleaner with color change and detergent	**PRO Wash Clear** battery rack neutralizing cleaner
Catalog #94880-4QT 4 Qt. per case with 1 sprayer	Catalog #94881-4QT 4 Qt. per case with 1 sprayer	Catalog #94882-4QT 4 Qt. per case with 1 sprayer
PRO Wipes Reserve Power – 275 per container Catalog #WSC-304-SHDW		

Pro Wipes

Pro Wash Plus

PRO Safety Kits
Catalog #85879

Battery Room Aisle Matting
Catalog #EGD BRMAT



High Voltage Matting
Catalog #EGD HV MAT 1/4

Spill Containment

6 gal kit
Catalog #853620

15 gal kit
Catalog #853615

30 gal kit
Catalog #853610
55 gal kit
Catalog #EGD SCK-55

Catalog No.	Emergency Spill Kits:
853620	6 Gallon kit contains up to 3 gallons of electrolyte spill
853615	15 Gallon kit contains up to 8 gallons of electrolyte spill
853610	30 Gallon kit contains up to 11 gallons of electrolyte spill
EGD SCK-55	55 Gallon kit contains up to 25 gallons of electrolyte spill
Catalog No.	**Neutralizers:**
811542	PRO Absorb neutralizer/ absorber 2.5 gallon jug

With safety and environmental concerns in the work place, EnerSys® has produced products to help you minimize your risk. Environmentally-friendly, cleaning and neutralizing agents not only protect your workers and the environment, and maximize battery life, but will also facilitate compliance.

EnerSys® UL Listed Spill Containment System (WUL)

Catalog # = WUL-Width-Length (Rack width + 2" on each side; length + 2" on each side)
Example: WUL-34-88 (30" x 84" rack)

The EnerSys® UL Recognized Spill Containment Systems are unsurpassed at industrial battery spill containment and control. The features and benefits are exclusive for use in UPS, Telecommunications, Switchgear and Utility applications. The systems are designed for easy installation and retrofit in the acidic conditions of a battery room.

Specifications:

Liner:

- UL Recognized liner has a UL94 VTM-0 Flame retardant rating. The UL94 VTM-0 rating denotes a thin material flame retardant equivalent to UL94-V0
- 14-mil thick liner meets NFPA Class 1, test method 2

Pillows:

- UL Recognized pillows have a UL94 VTM-0 Flame retardant rating Class I Fire Rated per NFPA 101
- Durable square 12" x 12" and rectangular 6" x 24" pillows are constructed of rugged 1/16" thick industrial yellow, heat sealed fabric

EnerSys® Absorption Pillows

Catalog #853070-FR (square 12" x 12")
Catalog #821210-FR (rectangular 6" x 24")

Spill Containment to Fit the Application

EAGLE™ SYSTEM
Catalog #EAGLE WW-LLL

- UL Recognized, corrosive-resistant liner with Class 1 fire rating (NFPA 101)
- Modular Design allows for minor on-site adjustments
- UL Listed Spill containment for stationary lead acid battery systems (VXMB)
- Comes standard with EGD-NABPIL

HAWK™ SYSTEM
Catalog #HAWK WW-LLL

- Fast and easy installation
- Corrosive-resistant liner with Class 1 fire rating (NFPA 101)
- Spill containment for stationary lead acid battery systems
- UL Listed
- Comes standard with EGD-VRLA

CONDOR™ SYSTEM
Catalog #EGS WW-LLL

- Utilizes epoxy floor coating
- Can be configured to fit most applications
- Optional liner with Class 1 fire rating (Condor PLUS)
- Comes standard with EGD-NABPIL
- ***NOTE: Condor is a Non-UL Listed System***

UL-Condor PLUS System also available

Absorption Pillows

Catalog #EGD-NABPIL-FM
(12" x 12")
Catalog #EGD-VRLA-FM
(12" x 12")
Catalog #EGD-SOC-FM
(4" x 24")

Neutralization and absorption pillows for meeting commercial insurance, UL and all federal, state and local codes and regulations as required by authorities having jurisdiction.

- FM approved for Approval Standard 4955 and UL Recognized per UL VXMB2
- Class 1 Fire Rated per NFPA 101

Catalog #EGD-NABPIL-R
(12" x 12")
Catalog #EGD-VRLA-R
(12" x 12")
Catalog #EGD-SOC-R
(4" x 24")

Neutralization and absorption pillows to meet requirements where UL listed products must be used and all federal, state and local codes and regulations must be followed.

- UL Recognized per UL VXMB2
- Class 1 Fire Rated per NFPA 101

PRO Eye Wash

Eyewash
Catalog #PSEW-300
- Large stainless steel push plate
- Self-adjusting regulator to assure a constant, even flow
- ABS dual stream head with pop-off cover

Portable Eyewash
Catalog #PSPEW-700
- 15 minute wash
- Stay-open valve
- ABS dual stream head with pop-off covers

Replacement Eye Wash Bottle
Catalog #811548

Personal Eye Wash Station
Catalog #EGD EYE-PR
- 2-32 oz. replaceable squeeze bottles
- Wall mountable
- Shipping weight 6.9 lbs
- Self-contained (no plumbed water supply required)

Replacement 32 oz. Bottle
Catalog #EGD EYEWSH-REP

Shower Eyewash Assembly
Catalog #PSSEW-500
- Large stainless steel pull rod actuator
- Self-adjusting regulator to assure a constant, even flow
- Galvanized piping
- ABS dual stream head with pop-off covers

Standard Sign Kit (4 Signs)
Catalog #EGD SIGNSSTD

Deluxe Sign Kit (6 Signs)
Catalog #EGD SIGNSDLX

For items not listed in this catalog please call 1-800-EnerSys.

Cabinet

Catalog #EGD CAB/SRS

Features:

- **1 pair of Tyvek body coveralls -** 2XL, Yellow with hood and socks. Protects against light liquid splashes/ contact with acids and alkalis. Tested per ASTM F739
- **1 set - headgear and face shield -** Blue, limited impact face/eye protection. Meets ANSI Z87 Standards and impact resistance of PETG
- **1 pair of goggles -** Clear green, soft PVC body with clear poly lens. Conforms to ANSI Z87.1 for splash model goggles
- **1 pair of rubber gloves -** LG, 13", 26mil, 2-toned safety gloves. Neoprene over natural rubber, ock-lined
- **1 roll of duct tape -** Gray, 1.88" x 10 yds
- **1 pH test kit -** Precision Universal pH indicator paper for aqueous solutions. Accuracy = +/- 1.0 pH
- **5 lbs. Neutrasorb -** *(Acid Absorbent and Neutralizer)*

Specifications:

- Stainless steel cabinet
- Dimensions: 30"H x 13"W x 14"D
- Weight: 35 lbs
- Personnel should be trained prior to use
- 2.75 cu ft cabinet

EnerSys® Breaker Lockout Pouch Kit

Catalog #SPC8402

This kit contains all of the most commonly used circuit breaker lockout devices.

Components:

- 2 - 120V snap-on circuit breaker lockouts (#65387)
- 2 - 120/277V clamp-on breaker lockouts w/cleats (#65396)
- 2 - Universal mult-pole breaker lockouts (#66321)
- 1 - Oversized breaker lockout (#65329)
- 10 - Lockout danger tags (#LT10)
- 1 - 1-1/2" steel lockout hasp (#T220)
- 1- Brady key retaining steel padlock, 3/4" shackle, blue (#143130)
- 1 - Large lockout pouch

ARC Flash Suit

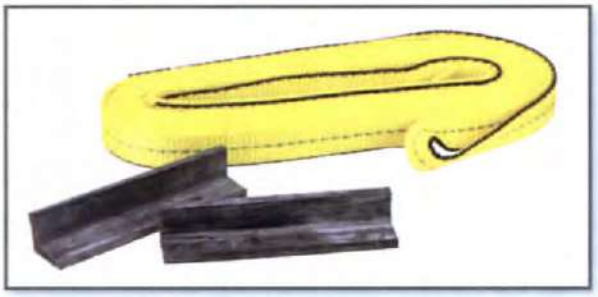
12CAL Rating Arc Flash Kit
with Gloves
(available in sizes M – 5XL)

Catalog #CFRCA12-M-XL
Catalog #CFRCA12-2/3XL
Catalog #CFRCA12-4/5XL

Hydraulic Platform LIft

Catalog #GRA-2MPT7

Technical Specs	
Load Capacity	1000 lb.
Lifting Height Max.	80"
Lifting Height Min.	5-3/4"
Platform Length	30"
Platform Width	32"
Base Legs Inside Dia.	26"
Base Legs Outside Dia.	29-3/4"
Overall Length	44"
Overall Width	32"
Overall Height	92"
Load Center	16"
Powered By	Foot Pump
Frame Material	Steel
Front Caster Dia.	5"
Front Wheel Dia.	5"
Rear Wheel Dia.	4"
Caster Wheel Type	(2) Swivel, (2) Rigid



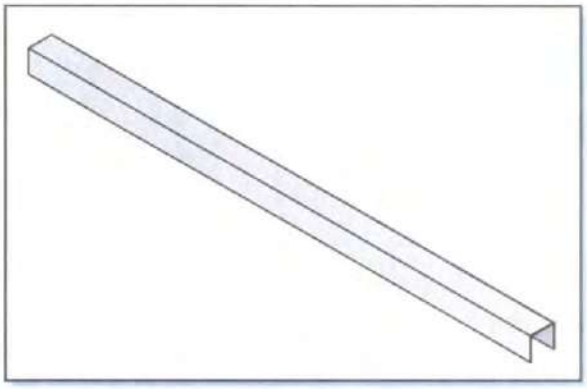
Battery Jar Lifting Device Kit

(strap and rubber bumper)

- Lifting device kits include spreader board or rubber bumper
- Refer to US-FL-IOM for instructions

Catalog No.	Cell Type
92714*	DSG, DU, DX, DXC, GC-M, GT, GU, GUc
62257	EA-5M/9M, EC-5M/9M, ES-5/13
80135	EA-11M/13M, EC-11M/13M, ES-15/21
80136	EA-15M/17M, EC-15M/17M, ES-23/27
80137	EA-19M/21M, EC-19M/21M, ES-29/37
62266	FTA-P, FTC-P

*Choker 800 lbs, Vertical 1100 lbs, Basket 2200 lbs

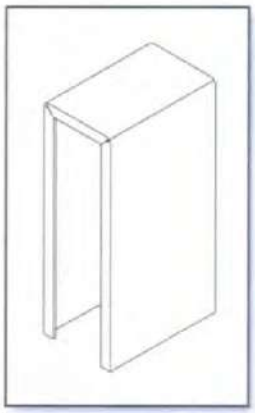


Rack Rail Plastic Channel Cover

- Polyethylene
- Fasten to rails with 806002 double-sided tape, 15ft/roll

Catalog No.	Length	Rail Size
73322	36"	1.63" x 0.81"
73323	48"	1.63" x 0.81"
603930	36"	1.63" x 1.63"
603931	48"	1.63" x 1.63"

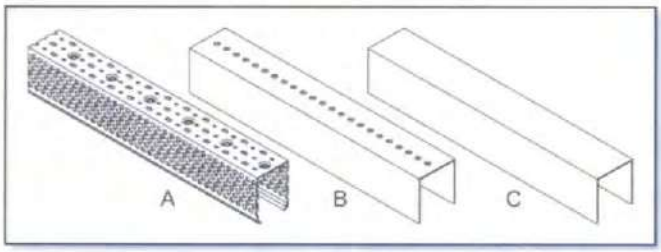
Accessories



Terminal Plate Covers

Catalog No.	Cell Type
825472	CA-M, CC-M, CX-M, DSG-5/7, DU-5/7, DX-5/9, DX-5/9, EA-5M/9M, EC-5M/9M, ES-5/13
825471	DSG-9/13, DU-9/13, DX-11/17, DXC-11/17, EA-11M/13M, EC-11M/13M, ES-15/21, GC-9M/15M, GT-9/13, GU-9/13
825470	DX-19/25, DXC-19/25, EA-15M/17M, EC-15M/17M, ES-23/27
825469	DX-27/35, DXC-27/35, EA-19M/21M, EC-19M/21M, ES-29/37, GC-17M/23M, GT-15/21, GU-15/21, GUc

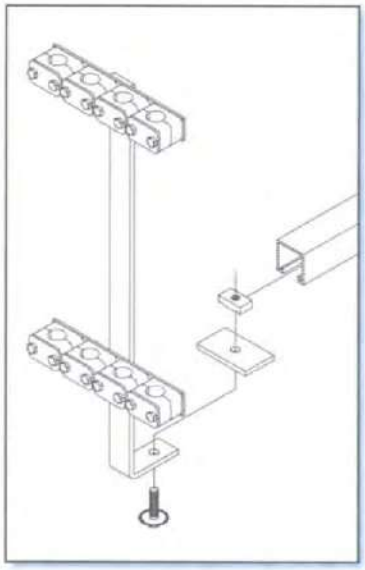
Connector Covers



A: Gray w/holes 72" long - PVC, 28 L.O.I.
B: Clear w/holes 48" long - PVC, 28 L.O.I.
C: Clear w/o holes 48" long - PVC, 28 L.O.I.

	Catalog No.	Cell Type
A	827437	CA-M, CC-M, CX-M, DSG-5/7, DU-5/7, DX-5/9, DXC-5/9
	827438	FTA-P (Perpendicular)
	827439	DSG-9/13, DU-9/13, DX-11/35, DXC-11/35, FTA-P (Parallel), FTC-P, GC-M, GT, GU, GUc
B	827510	CA-M, CC-M, CX-M, DSG-5/7, DU-5/7, DX-5/9, DXC-5/9
	827511	DSG-9/13, DU-9/13, DX-11/35, DXC-11/35, FTA-P, FTC-P, GC-M, GT, GU, GUc
C	827435	CA-M, CC-M, CX-M, DSG-5/7, DU-5/7, DX-5/9, DXC-5/9
	827436	DSG-9/13, DU-9/13, DX-11/35, DXC-11/35, FTA-P, FTC-P, GC-M, GT, GU, GUc

Rack Tier to Tier Cable Supports



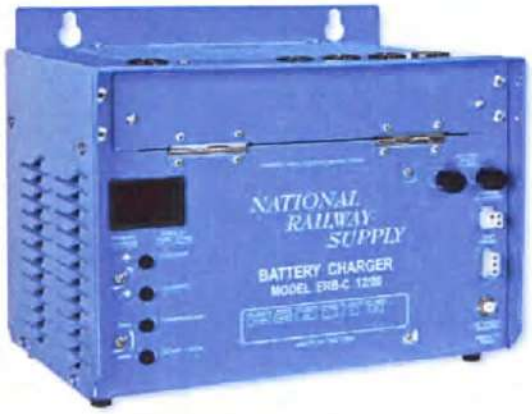
(Double Clamp Shown)

- Mount to the end of the rack support rails, mounting hardware included

Catalog No.	Description
881900	Single clamp, 4 runs of 3/0
881901	Double clamp, 4 runs of 3/0
881903	Double clamp, 6 runs of 3/0
881905	Double clamp, 8 runs of 3/0
80976	Single clamp, 4 runs of 4/0 or 250MCM
881865	Single clamp, 6 runs of 4/0 or 250MCM
94201	Double clamp, 6 runs of 4/0 or 250MCM
881860	Double clamp, 8 runs of 4/0 or 250MCM
806450	Double clamp, 4 runs of 350, 373 or 500MCM
881867	Double clamp, 6 runs of 350, 373 or 500MCM
881868	Double clamp, 8 runs of 350, 373 or 500MCM

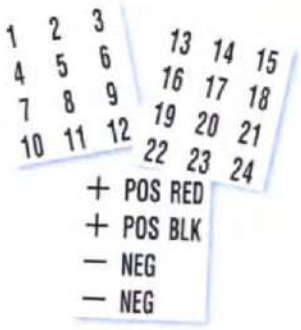
Accessories

ERBC Chargers



Catalog No.
ERB-C 12/20
ERB-C 12/40
ERB-C 24/30
ERB-C 48/15R
ERB-C 120/25R

Cell Numbering Labels



- Acid-resistant
- Adhesive backing
- Each set contains numbers and polarity labels
- Large labels measure 1.50" x 1.25"
- Small labels measure 0.75" x 0.63"

Catalog No.	From - To	Cell Type
802360	Large 1-12	DSG, DU, DX, DXC, EA-M, EC-M, ES, FTA-P, FTC-P, GC-M, GT, GU, GUc
802361	Large 1-24	
802362	Large 1-60	
802363	Large 1-120	
802364	Large 1-240	
802365	Large 1-300	
802370	Small 1-12	CA-M, CC-M, CX-M
802371	Small 1-24	
802372	Small 1-60	
802373	Small 1-120	
802374	Small 1-240	
802375	Small 1-300	

No-Oxide Battery Post Grease

- Corrosion inhibiting

Catalog No.	Quantity
82852	2 oz/57 g tin
82853	8 oz/227 g can
82854	16 oz/454 g can

Rack Rail Lubricant

Catalog #Pro-Slide

- 5.3 oz/150 g tube
- Other than water, this is the only approved rack rail lubricant that will not void the battery warranty

Rack Touch-up Paint

Catalog No.	Size	Color
27D10	1 gal	ANSI 61 gray
27D10-1LT	1 L	ANSI 61 gray
ES132A136	Spray Can	ANSI 61 gray

For items not listed in this catalog please call 1-800-EnerSys.

Accessories

Shipping Plug
(For flooded cells)
Catalog #807070

- Yellow

For shipping use only when arrestor is not in place

Vent Plug
Catalog #83430

- Includes gasket

Withdrawal Tubes
(For flooded cells)

- Includes gasket

Catalog No.	Cell Type
603556	DX, DXC, EA-M, EC-M, ES, FTA-P, FTC-P
603557	GC-M, GT, GU, GUc

Catalog No.	Cell Type
603554*	DSG, DU

*Vent plug (Catalog #83430) must be ordered separately.

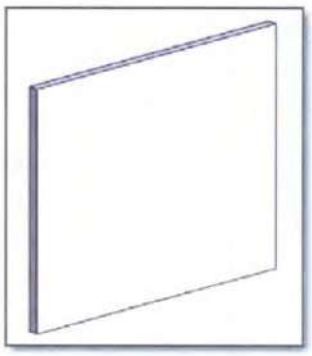
Flame Arrestors

- Funnel type
- Includes gasket and dust cap

Catalog No.	Cell Type
81099	CA-M, CC-M, CX-M
96300	DSG, DU, DX, DXC, EA-M, EC-M, ES
71655	FTA-P
83437	FTC-P, GC-M, GT-9/13, GU, GUc
83022	GU-15/45

Flame Arrestor Dust Caps

Catalog No.	Cell Type
81840	CA-M, CC-M, CX-M, DX, DXC, EA-M, EC, ES, FTC-P, GC-M, GT-9/13, GU
78962	FTA-P, GT-15/45



Seismic Rack Foam Spacers

- Expanded polystyrene foam, 30 L.O.I.
- Standard on all EnerSys® seismic racks

Catalog No.	Cell Type
51076	CA-M, CC-M, CX-M
51079	EA-M, EC-M, ES
806050	DSG, DU, DX, DXC, GC-M, GT, GU, GUc
809570	FTA-P & FTC-P Perpendicular
809571	FTA-P & FTC-P Parallel

Additional Service Features

Turn Key Installations
Telecommunication Power Installation
Planned Maintenance Agreements
Computerized Maintenance Report
Capacity Testing Capability
Installation Certification
Installation Supervision
Battery Monitoring
Battery Removals
Battery and Charger Repairs
Safety and Maintenance Training
24 Hr Emergency Service 1-800-423-9602
Nationwide Coverage
More than 400 Field Personnel
Warehousing and Storage
Parts and Accessories

50 Plus Locations

Call 1-800-EnerSys (1-800-363-7797)
for a location nearest you

To find out more about how we're making battery recycling easier for everyone visit
www.enersys.com
or email us at
recycling@enersys.com

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Fax: +52-818-329-6489

PowerSafe® EC-M

Switchgear, Telecommunications and Utility

Battery Performance Specifications

Visit us at **www.enersys.com**

EnerSys® Power/Full Solutions | RESERVE POWER

Publication No: US-ECM-PS-AA August 2016

PowerSafe® EC-M

Features and Benefits

- Capacity range 215 - 850Ah
- Lead-calcium alloy
- Standard Styrene Acrylonitrile (SAN) jar with flame retardant UL94 V-0 PVC cover; PC flame retardant jar and cover optional
- Thick positive plates maximize performance in long discharge applications
- 20 year life expectancy in float service at 77°F (25°C) ambient temperature

Construction

- 0.34" thick positive plates provide excellent long discharge rates and long life
- Negative plate design enhances high rate performance
- Separator – microporous rubber with "Vitrex" glass fiber retainers
- Electrolyte – dilute sulfuric acid with specific gravity of 1.215 (1.250 available upon request)
- Copper inserted posts
- Slide-Lock™ post seal design
- Flame arrestors – included for increased operational safety

Installation and Operation

- Tin plated copper inter-cell connectors (standard); lead plated optional
- Dual posts for high current carrying capability (EC-15M and above)
- Excellent long discharge and complex duty cycle capability for switchgear applications
- 20 year life expectancy in float service at 77°F (25°C)
- Post design features low resistance copper inserts for high rate performance
- Operating temperature: 32°F (0°C) to 104°F (40°C) Recommended temperature: 68°F (20°C) to 86°F (30°C)

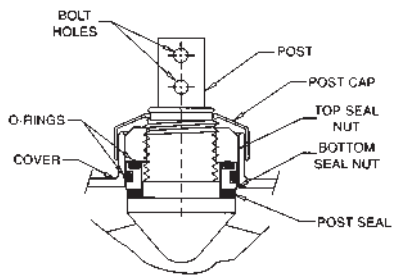
Standards

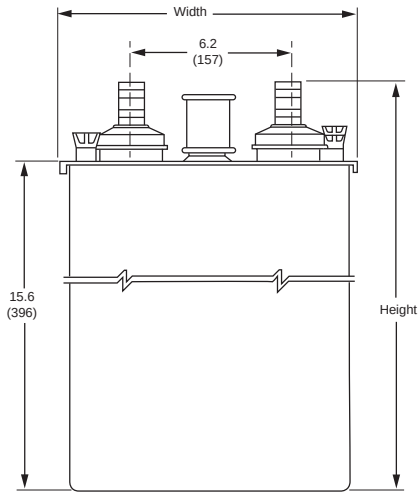
- The management systems governing the manufacture of this product are ISO 9001:2008 and ISO 14001:2004 certified

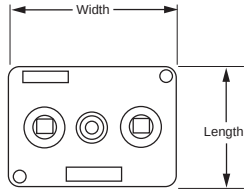
General Specifications

Cell Type	Nominal Ah Capacity*	Nominal Dimensions						Weight - Volumes						Short Circuit Current (Amps)
		Length**		Width		Height		Unpacked		Electrolyte only/1.215 SG				
		in	mm	in	mm	in	mm	lbs	kg	lbs	kg	gal	L	
EC-5M	215	5.1	130	11.0	279	18.7	475	60.9	27.7	20.9	9.5	2.1	7.8	2290
EC-7M	290	5.1	130	11.0	279	18.7	475	71.9	32.7	18.9	8.6	1.9	7.1	3370
EC-9M	365	5.1	130	11.0	279	18.7	475	82.7	37.6	16.9	7.7	1.7	6.4	4420
EC-11M	470	6.6	168	11.0	279	18.7	475	103.8	47.2	24.0	10.9	2.4	9.0	5620
EC-13M	525	6.6	168	11.0	279	18.7	475	113.7	51.7	20.0	9.1	2.0	7.5	6450
EC-15M	620	8.1	206	11.0	279	18.7	475	139.7	63.5	29.0	13.2	2.9	10.8	7530
EC-17M	670	8.1	206	11.0	279	18.7	475	149.6	68.0	26.8	12.2	2.7	10.1	8840
EC-19M	795	10.1	257	11.0	279	18.7	475	175.6	79.8	37.0	16.8	3.7	13.8	9140
EC-21M	850	10.1	257	11.0	279	18.7	475	186.6	84.8	35.9	16.3	3.6	13.5	9760

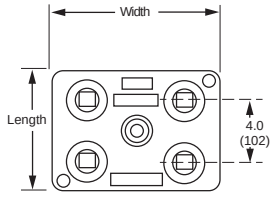
**Nominal Ah capacity is based on an 8 hour rate to 1.75 volts per cell @ 77°F(25°C)*
***00.25" must be added between cells for spacing purposes when calculating total battery rack length.*







EC-M 5,7,9,11 and 13



EC-M 15,17,19 and 21

Rint and Isc

Cell Type	*Resistance Milliohms	Isc Amps
EC-5M	0.875	2290
EC-7M	0.593	3370
EC-9M	0.453	4420
EC-11M	0.356	5620
EC-13M	0.310	6450
EC-15M	0.266	7530
EC-17M	0.226	8840
EC-19M	0.219	9140
EC-21M	0.205	9760

Constant Current

1.215 Specific Gravity

Discharge Rates in Amperes to 1.75Vpc at 77°F (25°C)

Cell Type	Nominal Ah Capacity*	Minutes			Hours									
		1	15	30	1	1.5	2	3	4	5	8	12	24	72
EC-5M	215	253	180	140	100	80	67	52	43	37	27	20	12	6
EC-7M	290	364	266	204	144	113	95	72	59	51	36	27	16	7
EC-9M	365	475	351	269	188	147	122	93	76	65	46	33	20	8
EC-11M	470	594	443	340	239	187	155	118	96	82	58	42	25	11
EC-13M	525	694	511	392	274	214	177	134	109	93	65	47	28	11
EC-15M	620	812	596	455	318	249	207	157	128	110	78	56	33	14
EC-17M	670	925	690	525	364	283	233	176	142	120	84	60	34	14
EC-19M	795	981	741	573	405	318	265	202	165	141	100	72	43	18
EC-21M	850	1068	802	625	443	349	290	220	179	152	106	76	45	18

Discharge Rates in Amperes to 1.81Vpc at 77°F (25°C)

Cell Type	Nominal Ah Capacity*	Minutes			Hours									
		1	15	30	1	1.5	2	3	4	5	8	12	24	72
EC-5M	215	183	150	120	90	73	62	49	41	36	26	20	12	6
EC-7M	290	264	219	175	128	103	87	68	56	48	35	26	16	7
EC-9M	365	344	289	229	166	133	112	86	71	61	44	32	19	8
EC-11M	470	425	364	290	211	169	143	110	91	78	56	41	25	10
EC-13M	525	497	421	334	242	193	162	125	103	88	62	46	27	11
EC-15M	620	589	493	389	282	226	190	147	121	104	74	55	33	14
EC-17M	670	659	567	448	322	256	214	163	134	114	80	58	34	14
EC-19M	795	707	607	487	357	287	242	188	155	133	95	70	42	18
EC-21M	850	774	664	534	395	317	267	206	169	145	103	75	44	18

**Nominal Ah Capacity is based on an 8 hour discharge rate*

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Publication No: US-ECM-PS-AA August 2016

PowerSafe™

data safe™

Safety, Storage, Installation, Operation & Maintenance Manual

Flooded Lead-Acid Batteries
C, D, E, F and G

EnerSys™

Power/Full Solutions

Publication No. US-FL-IOM-AA September 2016

This manual provides instructions regarding safety, storage, installation, operation and maintenance. Failure to observe the precautions as presented may result in injury or loss of life.

GENERAL SAFETY INSTRUCTIONS

Warnings in this manual appear in any of three ways:

Danger

The danger symbol is a lightning bolt mark enclosed in a triangle. The danger symbol is used to indicate imminently hazardous situations, locations and conditions which, if not avoided, WILL result in death, serious injury and/or severe property damage.

Warning

The warning symbol is an exclamation mark in a triangle. The warning symbol is used to indicate potentially hazardous situations and conditions, which, if not avoided, COULD result in serious injury or death. Severe property damage COULD also occur.

Caution

The caution symbol is an exclamation mark enclosed in a triangle. The caution symbol is used to indicate potentially hazardous situations and conditions, which, if not avoided, may result in injury. Equipment damage may also occur.

Other warning symbols may appear along with the Danger, Warning, and Caution symbol and are used to specify special hazards. These warnings describe particular areas where special care and/or procedures are required in order to prevent serious injury and possible death:

Electrical warnings

The electrical warning symbol is a lightning bolt mark enclosed in a triangle. The electrical warning symbol is used to indicate high voltage locations and conditions, which may cause serious injury or death if the proper precautions are not observed.

Explosion warnings

The explosion warning symbol is an explosion mark enclosed in a triangle. The explosion warning symbol is used to indicate locations and conditions where molten, exploding parts may cause serious injury or death if the proper precautions are not observed.

IMPORTANT SAFETY INSTRUCTIONS

DANGER

A battery can present a risk of electrical shock and high short circuit current.

The following precautions should be observed when working with batteries:

1. Verify that the Charging Power Supply to the battery is off and that all power is disconnected from the power source.
2. Remove watches, rings or other metal objects.
3. Use tools with insulated handles to prevent inadvertent shorts.
4. Wear rubber gloves and boots.
5. Do not lay tools or metal parts on top of batteries.
6. Determine if the battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock will be reduced if such grounds are removed during installation and maintenance.
7. Verify circuit polarities before making connections.
8. Disconnect charging source and load before connecting or disconnecting terminals.
9. Vented lead-acid (VLA) batteries can contain an explosive mixture of hydrogen gas. Do not smoke, cause a flame or spark in the immediate area of the batteries. This includes static electricity from the body and other items that may come in contact with the battery.
10. Use proper lifting means when moving batteries and wear all appropriate safety clothing and equipment.
11. Do not dispose of lead acid batteries except through channels in accordance with local, state and federal regulations.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for Flooded Lead-Acid Battery Systems that should be followed during the installation and maintenance of the battery system.

Only a qualified EnerSys service representative who is knowledgeable in batteries and the required precautions should perform servicing of the batteries. Keep unauthorized personnel away from batteries.

Caution — Misuse of this equipment could result in human injury and equipment damage. In no event will EnerSys be responsible or liable for either indirect or consequential damage or injury that may result from the use of this equipment.

Caution — Do not dispose of the batteries in a fire. The batteries may explode.

Caution — Do not mutilate the batteries. Released electrolyte is harmful to the eyes and skin and may also be toxic.

Warning — This unit contains flooded lead acid batteries. Lack of preventative maintenance could result in batteries exploding and emitting gasses and/or flame. An authorized, trained technician must perform annual preventative maintenance.

Warning — Failure to replace a battery before it becomes exhausted may cause the case to crack, possibly releasing electrolyte from inside the battery and resulting in secondary faults such as odor, smoke and fire.

Warning — Installation and servicing of batteries should be performed by personnel knowledgeable about batteries and the required precautions. Keep unauthorized personnel away from the batteries.

Warning — Proper maintenance to the battery system of this unit must be done by a qualified service technician. This is essential to the safety and reliability of your power supply system.

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

1.1 Introduction

EnerSys flooded lead-acid batteries set the benchmark for reliability and durability in flooded lead-acid batteries and battery systems.

1.2 Precautions

BEFORE UNPACKING, STORING, HANDLING, INSTALLING, OPERATING OR PERFORMING MAINTENANCE ON THE FLOODED LEAD-ACID STATIONARY BATTERY SYSTEM

READ

THE FOLLOWING

INFORMATION THOROUGHLY!

It is important to read, understand and strictly follow the instructions in this manual.

If the following precautions are not fully understood, or if local conditions are not covered, contact your nearest EnerSys sales/service representative for clarification, or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

Also, refer to all applicable federal, state and local regulations and industry standards.

YOU SHOULD BE TRAINED IN HANDLING, INSTALLING, OPERATING AND MAINTAINING BATTERIES BEFORE YOU WORK ON ANY BATTERY SYSTEM.

1.3 Service

Should you require installation supervision, service, parts, accessories or maintenance, EnerSys has a nationwide service organization to assist with your new battery purchase.

Please call your nearest EnerSys sales/service representative for more information, or, call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

2.0 SAFETY

2.1 General

All flooded, lead-acid batteries, may leak, release hydrogen gas or cause acid misting. Always follow the generally accepted safety procedures for handling batteries. In addition, it is vitally important that you observe the precautions recommended in this manual.

YOU SHOULD BE **TRAINED** IN HANDLING, INSTALLING, OPERATING AND MAINTAINING BATTERIES BEFORE YOU WORK ON ANY BATTERY SYSTEM.

You MUST understand the risk of working with batteries and BE PREPARED and EQUIPPED to take the necessary safety precautions. If not, contact EnerSys Reserve Power Service.

2.2 Safety Equipment and Clothing

When working with any battery system, be sure you have the necessary tools and safety equipment, including but not limited to:

- insulated tools
- rubber gloves
- fire extinguisher
- rubber apron
- safety goggles
- acid spill cleanup kit
- face protection / face shield
- emergency eye wash and shower, if available

ALWAYS:

- remove all jewelry (i.e., rings, watches, chains, etc.)
- keep sparks, flames and smoking materials away from the battery

NEVER lay tools or other metallic objects on the battery/cell.

Using the correct tools and wearing proper safety equipment will help prevent injury should an accident occur.

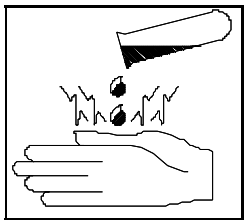
2.3 Safety Precautions

2.3.1 Sulfuric Acid Burns

Batteries are safe when operated and handled properly. However, they do contain sulfuric acid, which can cause burns and other serious injuries.

Always wear protective clothing AND use the correct safety tools.

In case of **SKIN CONTACT** with sulfuric acid, **IMMEDIATELY**



1. **REMOVE** contaminated **CLOTHING**
2. **FLUSH** the area **THOROUGHLY** with **WATER**
3. Get **MEDICAL ATTENTION**, if required.

In case of **EYE CONTACT** with sulfuric acid, **IMMEDIATELY**

1. **FLUSH THOROUGHLY** for at least 15 minutes with large amounts of **WATER**.
2. Get **MEDICAL ATTENTION**.

In case of sulfuric acid **CONTACT WITH CLOTHING OR MATERIAL, IMMEDIATELY**

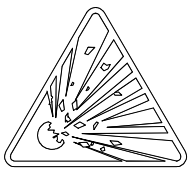
1. **REMOVE** CONTAMINATED CLOTHING
2. Apply a solution of sodium bicarbonate solution (1.0 lb/1.0 gal or 0.5 kg/5.0 liters of water) on the clothing or material.
3. Apply the solution until bubbling stops, then rinse with clean water.

NOTE: In case of a sulfuric acid SPILL, bicarbonate of soda or an emergency spill kit should be within the battery room in accordance with OSHA regulation 1910.178g2.

2.3.2 Explosive Gases

Batteries can generate gases which, when released, can explode, causing blindness and other serious personal injury.

- **Always wear protective clothing and use the correct safety tools.**
- **Eliminate any potential of sparks, flames or arcing.**
- **Provide adequate ventilation. See Appendix.**



IN CASE OF FIRE: To extinguish a fire in a battery room containing lead acid batteries, use CO2, foam, or dry chemical extinguishing media. Do NOT discharge the extinguisher directly onto the battery. The resulting thermal shock may cause cracking of the battery case/cover.

SPECIAL PROCEDURES:

If batteries are on charge, shut off power. Use positive pressure, self-contained breathing apparatus. Water applied to electrolyte generates heat and causes it to splatter. Wear acid-resistant clothing.

TOXIC FUMES:

Burning plastic may cause toxic fumes. Leave area as soon as possible if toxic fumes are present. Wear breathing apparatus if required to remain in the area.

2.3.3 Electrical Shocks and Burns

Multi-cell battery systems can attain high voltage and/or currents. Do NOT touch uninsulated batteries, connectors or terminals. To prevent serious electrical burns and shock, use EXTREME CAUTION when working with the system.

- **Always wear protective clothing and use nonconductive or insulated tools when working with ANY battery system.**
- **Remove all jewelry that could produce a short circuit.**

BEFORE working on the system:

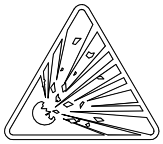
1. Disconnect ALL loads and power sources to the battery. Use appropriate lockout/tagout procedures.

2. If working on an assembled battery system, sectionalize (interrupt the battery in sections) into safe working voltage levels.

3. Check the battery system grounding. Grounding of the battery system is NOT recommended. However, grounding of the rack is recommended.

IF BATTERY SYSTEM IS GROUNDED (system is intentionally grounded by connecting a battery terminal to ground):

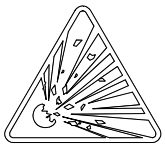
1. a shock hazard exists between all other terminals and ground (i.e., dirt and acid on top of battery cell touching rack).



2. if an unintentional ground developes within the already grounded system, a short circuit may occur and cause cause explosion or fire.

IF BATTERY SYSTEM IS UNGROUNDED (system is NOT grounded):

1. if an unintentional ground develops within the system, an increased shock hazard exists between the terminals and ground.



2. if a second unintentional ground develops within the already unintentionally grounded system, a short circuit may occur and cause explosion or fire.

Therefore, should you be required to work on a grounded battery system, make absolutely sure you use the correct safety precautions, equipment and clothing.

IMPORTANT!!

If you have ANY question concerning safety when working with the battery system, contact your local EnerSys sales/service representative to clarify any of the noted safety precautions, or, call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

3.0 INSPECTING BATTERY SHIPMENT

3.1 General

Precautions have been taken to pack the cells/battery units for shipment to ensure its safe arrival. However, upon receipt, you should inspect for evidence of damage that may have occurred during transit.

WARNING

During inspections, take precautions against electrical shock. You are handling LIVE batteries.

3.2 Visible External Damage

IMMEDIATELY upon delivery (while the carrier representative is still on-site), inventory all materials against the Bill of Lading and inspect for visible external damage.

Check material quantities received against the Bill of Lading, including the number of battery pallets and the number of accessory boxes.

Note any:

- damage to packing material.
- wetness or stains, indicating electrolyte leakage.

If damage is noted:

1. Make a descriptive notation on the delivery receipt before signing.
2. Request an inspection by the carrier.
3. File a damage report.

3.3 Concealed Damage

Within 15 days of receipt (or as soon as practical), unpack the cells and check for concealed damage. Remember, you are handling a **LIVE** battery. Take precautions against a shock hazard. Follow all safety precautions as noted in Section 2.0.

Examine the electrolyte level to ensure that none has been spilled. If electrolyte has been lost in transit and the level is less than 1/2 inch (12 mm) below the top of the plates, add Battery Grade sulfuric acid electrolyte of the nominal operating specific gravity indicated on the cell nameplate, and bring to the low level line on open circuit.

If the electrolyte level is more than 1/2 inch (12 mm) below the top of the plates, request an inspection by a representative of the carrier and file a claim for concealed damage.

> **NOTE:** For export, cells are usually shipped assembled, moist charged with separate electrolyte. Fill when ready to place in service, not before. Refer to Section 12.6, “Filling and Charging Moist-Charged Cells”.

Check the received materials against the detailed packing list to verify receipt of all materials in the quantities specified.

DELAY IN NOTIFYING THE CARRIER MAY RESULT IN LOSS OF YOUR RIGHT TO REIMBURSEMENT FOR DAMAGES. Refer to the Bill of Lading, if, when performing the parts inventory, you are unsure about the appearance of a part.

If you have questions concerning potential damages, contact your local EnerSys sales/service representative, or, call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

4.0 BATTERY STORAGE BEFORE INSTALLATION

4.1 General

Batteries should be unpacked, installed and charged as soon as possible after receipt. However, if this is impractical, follow the instructions below for storing the battery before installation.

Store batteries indoors in a clean, dry and cool location. Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life.

Do NOT stack pallets. DAMAGE MAY OCCUR AND THE WARRANTY WILL BE VOIDED.

4.2 Storage Interval

Do NOT store flooded batteries longer than the following intervals without giving periodic freshening charges. Under higher temperature conditions, greater charging frequency may be required. Use date of battery shipment to determine freshening charge requirements.

- Lead Antimony — every three months
- Lead Calcium — every six months

Storage times exceeding the above may result in plate sulfation, which may adversely affect electrical performance and expected life.

Give the battery a *freshening charge* before the end of the recommended storage interval. See Section 8 for charging information.

Repeat the *freshening charge* for each additional storage interval until the battery is installed.

Maximum total storage time before installation is two years from date of shipment from the factory to the customer. *Freshening charges* are required a minimum of every three to six months during the storage time period, as noted above.

4.3 Advance Preparation

If freshening time interval is likely to be exceeded in storage, make advance preparation to have an adequate charger available and adjacent to an appropriate AC supply voltage. Positioning of the cells to accept the temporary intercell connectors is another consideration of advance planning. Keep cells on styrofoam pads until they are installed on the rack.

Make every effort to get the battery installed and connected to the charger before the expiration of the storage period, thereby avoiding the additional labor cost of preliminary freshening charges.

WARNING

FAILURE TO CHARGE AS NOTED VOIDS THE BATTERY'S WARRANTY.

BEFORE INSTALLATION
READ THIS SECTION THOROUGHLY.

5.0 INSTALLATION CONSIDERATIONS

5.1 General

If you have any questions concerning the installation considerations, contact your EnerSys sales/ service representative. The diagrams shown are general representations and may not depict all models and options.

When planning the system space requirements for the EnerSys flooded stationary batteries, consider the following:

- space
- environment
- temperature
- distance from operating equipment
- ventilation
- battery system configuration
- floor loading
- floor anchoring

Use Table 5.1 to ensure that all requirements for installation location are considered.

TABLE 5.1

CONSIDERATION	RECOMMENDATION
Space	It is recommended that the aisle space provided in front of all racks be a minimum of 36 inches (915 mm). The designer must verify the requirements for aisle space in all applicable local codes or regulations. A minimum of 9 inches (230 mm) is desirable above the tops of the cell posts of the top row of cells to permit access for maintenance or cell removal. Each cell should be accessible for the addition of water and for taking individual cell voltage and hydrometer readings.
Environment	Clean, cool and dry. The location should be selected to keep water, oil, and dirt away from all cells.
Temperature	Ambient temperature between 72^{o} - 78^{o} F (23^{o} - 26^{o} C). Elevated temperatures reduce operating life. Lower temperatures reduce battery performance. Minimize temperature variations between the cells. • To avoid temperature variation between the cells, do NOT locate the battery near HVAC ducts or exhausts, heat sources (i.e., equipment that generates heat) or direct sunlight.

Table 5.1 (continued)	
CONSIDERATION	**RECOMMENDATION**
Ventilation	Adequate ventilation must be provided, so as to prevent hydrogen gas from exceeding a 2% concentration as shown in IEEE 484-1987. Hydrogen accumulation must be limited to less than 2% of the total volume of the battery area. Ventilation must be adequate to ensure that pockets of trapped hydrogen gas do not develop, particularly at the ceiling. See Appendix for additional information
Grounding	It is recommended that the racks be grounded in accordance with NEC and/or local codes.
Codes	Building codes and fire codes may require a spill containment system for battery installations. Please consult local building codes. EnerSys offers spill containment systems. Contact your EnerSys sales/ service representative for more information.
Floor	Reasonably level. Shim up to 1/4 inch (6 mm) maximum to level battery rack or cabinet front to rear and side to side. Capable of supporting the weight of the battery as well as any auxiliary equipment.
Anchoring	Anchoring should meet all local, state, and federal codes and all industry standards. **Floor anchoring and its design are the responsibility of the user.**
Racks	EnerSys flooded stationary batteries designed for racks or cabinets must be installed on racks specifically designed for those batteries by the manufacturer. Use of any other rack design is the responsibility of the user.

5.2 Considerations for Connecting the Battery System to Operating Equipment

The battery has been sized based on a specific load (amps or KW) for a specific run time to a specific end voltage. Consult with the system/equipment supplier to determine these parameters, because battery performance is based on these values, as measured at the battery terminals.

Therefore, ensure that the load cables:

- between the battery and its load are the shortest routing possible to the terminal, allowing sufficient additional cable (about 6 inches/15 cm) for connect/disconnect.
- are the proper size to minimize the voltage drop between the battery output terminals and the load.

To select the proper cable size:

1. Determine the cable size necessary to carry the design load.

2. Calculate the voltage drop of the cable between the battery terminal plate and the operating equipment.

3. Increase cable size to achieve the allowable voltage drop.

Cable selection should create no greater voltage drop than allowed between the battery system and the operating equipment as determined by the equipment/system supplier. Excessive voltage drop will reduce the desired support time of the battery system.

5.3 Considerations for Parallel Installation

If it is necessary to connect the battery system in parallel to obtain sufficient capacity, cable connections to each of the parallel strings are important.

To obtain:

- proper load sharing on the discharge,
- satisfactory recharge, and
- the same float voltage for each string.

cables from the batteries to the load must be:

- as short as possible,
- of equal lengths to the load (do not exceed cable ampacity), and
- of sufficient ampacity.

6.0 UNPACKING AND HANDLING FOR INSTALLATION

6.1 General

Batteries are shipped assembled, charged, and filled with the electrolyte near the low level lines marked on the jar. If the electrolyte level is significantly above the low level line after the battery has been on a long open circuit stand, care must be taken to avoid flooding during the freshening charge. Electrolyte may be removed to the low level line to prevent overflowing.

All accessories for installation and use are supplied as optional prepackaged kits. Cells may be packed in wooden boxes, which must be opened completely and carefully. The cells are then handled as described in Section 6.3.

6.2 Recommended Installation Equipment and Supplies

Before working with the battery system, be sure that you have the proper protective clothing, safety equipment and insulated tools as specified in Section 2.0. Additional equipment for the installation of the battery system is listed in Table 6.1.

TABLE 6.1

EQUIPMENT REQUIRED	CHECK IF ON HAND
Forklift or Portable Lift Crane	
Chalk Line	
Torpedo Level (Plastic)	
Torque Wrench (10-200 in-lbs)	
Torque Wrench (50-100 ft-lbs)	
Drift Pins	
Floor Anchors (User-supplied per battery system and attached stress analysis)	
Floor Shims (User-supplied)	
Insulated 3/8 inch Drive Ratchet Wrench with Minimum 3" Extension With 3/8 inch thru 11/16 inch Sockets	
Insulated Box Wrenches (3/8 inch to 11/16 inch)	
Screwdrivers	
Wipes, Paper or Cloth	
Plastic Bristle Brush or Nonmetallic Cleaning Pad	
Tape Measure (Nonmetallic)	
Safety Equipment and Clothing	
Small Paint Brush	
Standard Allen Wrench Set	
NO-OX-ID Grease	

Be sure you have all the proper protective clothing and safety tools and equipment on hand before starting the installation.

6.3 Cell/Jar Handling

To prevent damage to the cells and personal injury when moving/handling the batteries, follow the procedures in this section. For ease of explanation, lifting/handling instructions are grouped into three categories depending on the size of the units:

See Section 6.3.1 — small cell handling (C)
See Section 6.3.2 — medium cell handling (E and F)
See Section 6.3.3 — large cell handling (D and G)

DO NOT lift any cell by the terminal posts as this will **void the warranty**. When lifting large cells/units with crane, hoist or similar device, use the lifting belt(s) and protective styrofoam shipping cover(s) provided.

DO NOT tamper with the seal nuts on the cell posts as this will **void the warranty**.

6.3.1 Small Cell Handling (C)

1. Lift and move these batteries manually.

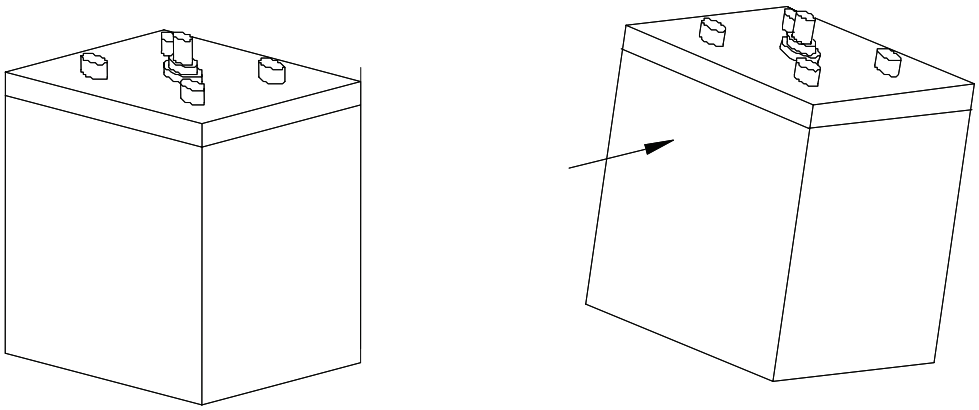
2. Position hands under the bottom of the cell/jar to lift it, and place the cell/unit in the desired location.

6.3.2 Medium Cell Handling (E and F)

Never lift a cell by the posts. Lifting the cell by the post can damage the seals and will **void the warranty**. When lifting medium-size cells, use the lifting belt and protective styrofoam shipping cover provided.

Use a mechanical device, such as a hoist or crane, for lifting.

1. Tilt the cell about 1 inch (25 mm) so as to position the lifting belt. See Figure 6.1.



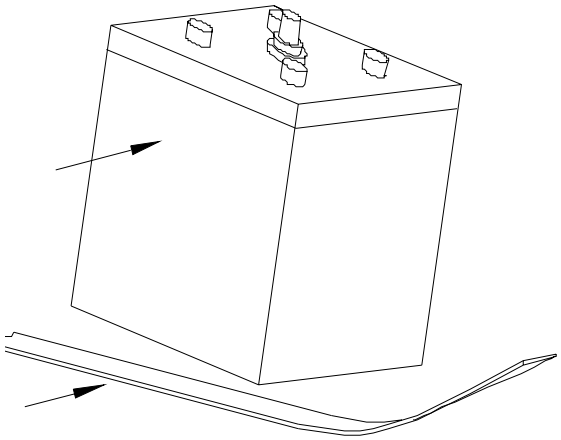
LIFTING MEDIUM-SIZE CELL
Figure 6.1

2. Slide belt underneath cell. See Figure 6.2.

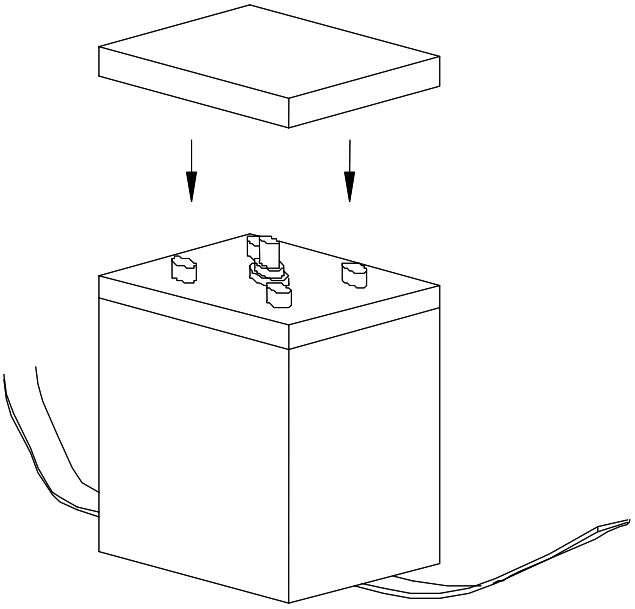
3. Place the styrofoam cover on top of the cell, with the beveled ends up. See Figure 6.3.

4. Bring the end rings of the belt together over the cover and engage the hook of the lifting device in both rings. Always lift vertically and balance the cell. See Figure 6.4.

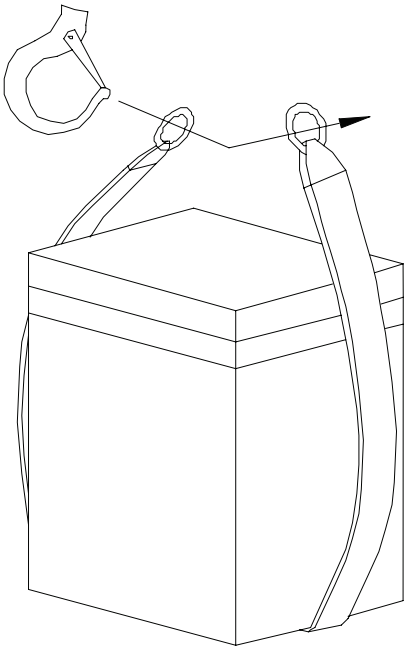
5. Remove the belt and cover after positioning the cell.



LIFTING MEDIUM-SIZE CELL
Figure 6.2



LIFTING MEDIUM-SIZE CELL
Figure 6.3



LIFTING MEDIUM-SIZE CELL
Figure 6.4

6.3.3 Large Cell Handling (D and G)

Cells are shipped on a pallet, with each cell packaged in an individual styrofoam shipping base and top.

Never lift a cell by the posts. Lifting the cell by the posts can damage the seals and will **void the warranty**. When lifting large-size cells, use the lifting belt and protective styrofoam shipping cover provided.

Use a mechanical device, such as a hoist or crane, for lifting.

Each battery shipment includes one lifting belt, about 14 feet (4.3 meters) long x 1 inch (25 mm) wide.

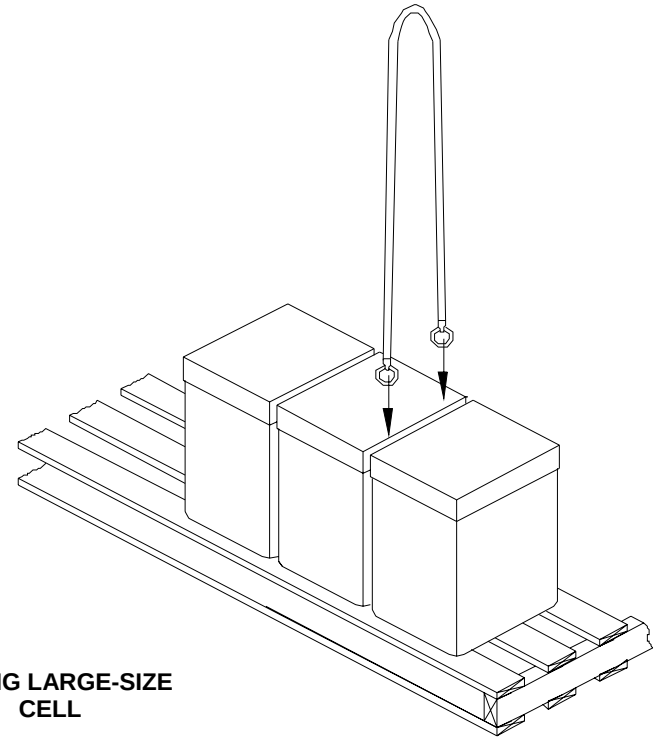
All cells are shipped with a molded styrofoam insert covering the posts and intercell connectors. This insert should remain in place for lifting the cells. As the cell is lifted, the belts will tighten against the shipping top. The belts will cut into the styrofoam. This is desirable, because the indentations created will help to keep the belts positioned and the cell stable.

1. Remove the packaging from around the cells/units, and remove the wooden cleats from the perimeter of the shipping pallet.

2. Leave the molded top insert in place. You will use it in lifting the cell.

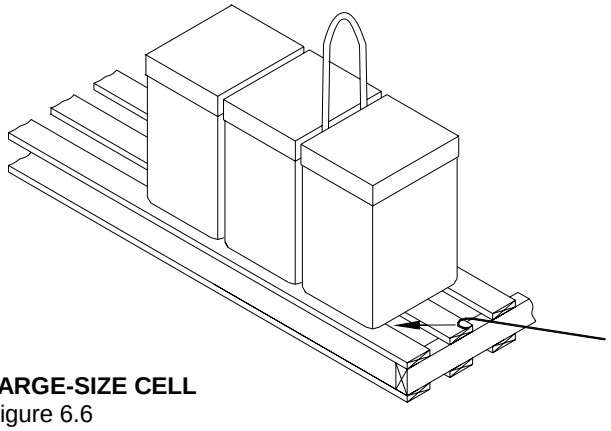
3. Fold the lifting belt in half and push each loop end Down between the cells/units until the loops touch the shipping pallet. See Figure 6.5.

NOTE: Ensure that the straps are placed around the two sides of the cell/unit that will be positioned across



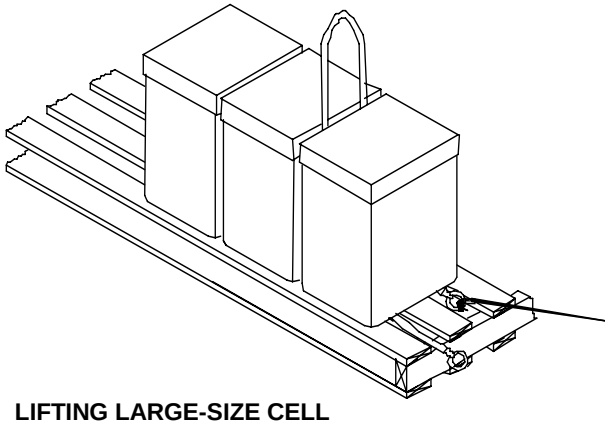
LIFTING LARGE-SIZE CELL

4. Use a 24 inch (600 mm) length of stiff wire with a hook formed on one end. Insert the hook end through the slot between the bottom of the jar and the shipping base (on the opposite side from the belt) and engage one of the loop ends with the hook. See Figure 6.6.



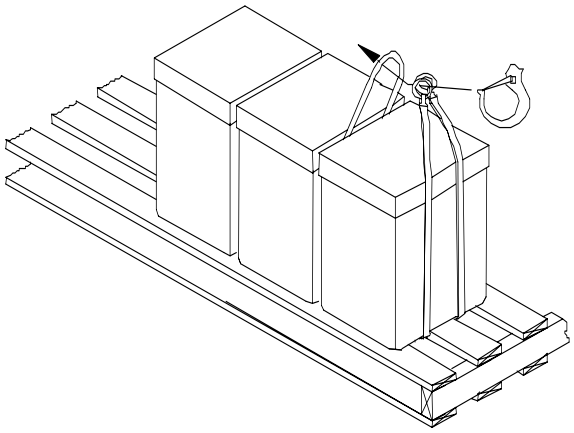
LIFTING LARGE-SIZE CELL
Figure 6.6

5. Pull this loop end of the belt from under the cell and out through the slot. Disengage the wire hook from the loop and again insert the hook through a different slot between the bottom of the jar and the shipping base. See Figure 6.7.



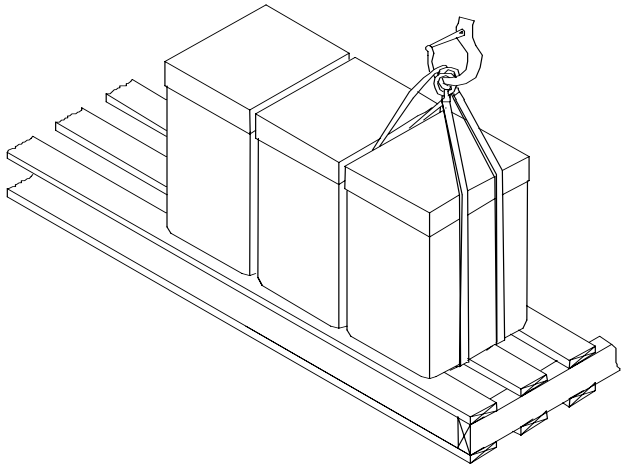
LIFTING LARGE-SIZE CELL
Figure 6.7

6. Engage the other belt loop with the wire hook and pull it out through the slot on the same side. Adjust the belt until the middle loop is even with the loops on the two free ends. See Figure 6.8.



LIFTING LARGE-SIZE CELL
Figure 6.8

7. Place the loops on the two free ends of the belt over the hook of the lifting device, and then place the middle loop over the hook. See Figure 6.9.



LIFTING LARGE-SIZE CELL
Figure 6.9

Be sure the belt is not twisted. Straighten the belts down each side and under the bottom of the cell/unit, so that they are parallel with each other. The space between the belts should be the same as the distance between the belt notches on the edge of the styrofoam. Correct belt spacing is important because it permits removal of the belt after the cell/unit has been placed on the rack rails.

8. Lift cell into position and remove belt.

Exercise extreme care when initially lifting cells and when lowering them into final position on the rack. To prevent one end of the unit from "kicking out," assign one person to steady the unit on a level plane during the entire lifting procedure.

7.0 SYSTEM INSTALLATION

EnerSys flooded batteries are installed on racks that differ in type, size, seismic rating, and configuration. Refer to the *RACK ASSEMBLY DRAWING* and instructions included with the rack shipment for the details of your installation.

7.1 System Layout

Lay out the battery system before installation. Consult Section 5.0 for installation considerations.

1. Locate the system position in the area designated as determined in Section 5.0.

2. Mark the floor with system outline dimensions.

3. Using the *RACK ASSEMBLY DRAWING* and instructions and rack components, locate the position of the floor anchors.

Floor anchors are the responsibility of the owner. Follow the installation instructions of the anchor manufacturer.

The floor must be level. Shimming up to 1/4 inch (6 mm) may be required to have the Battery System fully level.

> **NOTE:** The floor must be capable of supporting the weight of the Battery.

The Battery Rack must be securely anchored to the floor. Anchoring should meet all local, state and/or federal codes and such compliance is the responsibility of the owner. Floor anchoring and its design are the responsibility of the owner. Ensure seismic requirements are considered.

4. Batteries should be kept in the original shipping containers until installed. However, if you must remove the batteries before installation, see the procedures in Section 6.3, “Cell/Jar Handling.”

7.2 Installation Considerations

7.2.1 Installation Precautions

1. Install the system in a well-ventilated location; allow at least 4 inches (10 cm) on all sides for air ventilation and maintenance.

2. Install the unit in a stable, level and upright position which is free of vibration.

3. Install the unit where the ambient temperature is within the correct operating range.

4. Do not install the Battery System in areas that are subject to high humidity.

5. Do not allow direct sunlight to shine on the system.

6. Do not install the Battery System in areas that are subject to contamination, such as high levels of airborne dust, metal particles or flammable gasses.

7. Avoid installation near sources of electrical noise and always make sure that the unit ground is intact to prevent electrical shock and to help reduce electrical noise.

8. Do not install where water, or any other foreign object or substances may get inside the Battery System.

> **NOTE:** Contact your nearest EnerSys sales/service representative when paralleling Battery Systems, to ensure compatibility of mating different batteries. Or, call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

7.2.2 Arrangement

Arrange the cells so that the positive terminal of one cell/jar will be adjacent to the negative terminal of the next cell/jar throughout the battery.

Cells/jars are usually positioned on rack rails with plates perpendicular to the rails. However, F and large G cells are also positioned with plates parallel to the rails.

Take care when positioning cells to ensure that main battery terminals are not close together on step or back-to-back racks.

7.2.3 Spacing

Maintain proper spacing between cells/jars on the rack to provide thermal management and ensure proper fit of hardware connections. Position cells/jars such that a ¼ inch (6mm) is maintained between the covers of adjoining units.

7.3 Battery Installation

To install an EnerSys battery system, follow the procedures below:

1. Install the rack according to the rack assembly information detailed in "*Instructions for Assembling and Maintaining Standard and Seismic Battery Racks*" or "*Instructions for Assembling Seismic Racks*" (included with the rack shipment).
2. Before lifting cells/jars, determine which two sides will be positioned across the rails.
3. Employ the appropriate lifting/handling method for the cells to be installed (as described in Section 6.3).

WARNING

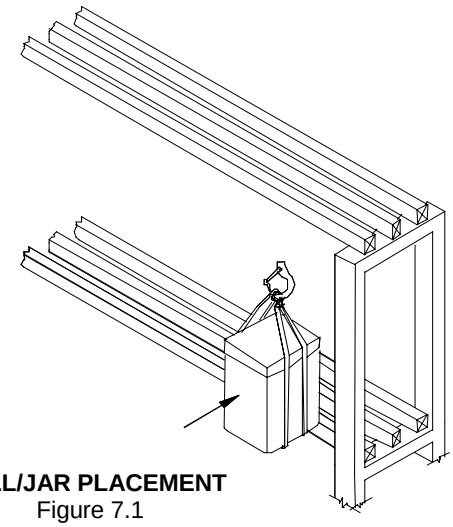
Allowing the cell/unit to drop quickly may damage the internal cell components.

Exercise extreme caution when initially lifting cells and when lowering them into final position on the rack. To prevent one end of the unit from "kicking out," assign one person to steady the unit on a level plane during the entire lifting procedure.

4. Position the first cell/jar on the bottom shelf, centered across the rails. After placement, remove the lifting belt (if used) from the hook and pull the belt from under the module. Also remove any remaining protective packing covers. See Figure 7.1.

WARNING

Improper lifting may result in damage to the module or in personal injury.

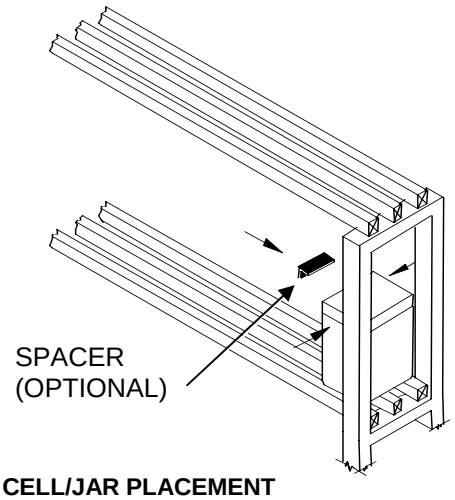


CELL/JAR PLACEMENT
Figure 7.1

To lubricate the rack rails for sliding cells into position, use only EnerSys Pro-Slide or Dow Corning Silicon Compound #111.

When sliding the cells on the lubricated rails, Do NOT push on the center of the cell/unit. Hold the cell by placing hands on the corners of the jar and then push to slide.

5. If provided, place the long rubber angle cell spacer on the mid-point of the cell cover. Position one leg on top of the cover and the other so that it extends down over the edge of the cover to the side where the next cell/jar is to be positioned. See Figure 7.2.

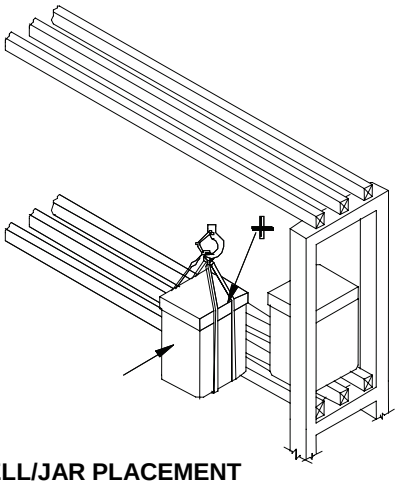


CELL/JAR PLACEMENT
Figure 7.2

6. Lift the next cell/jar to be installed and place it next to the previously installed unit. See Figure 7.3. Be certain to allow proper spacing between cells/jars as outlined in Section 7.2.2. Observe proper polarity orientation.

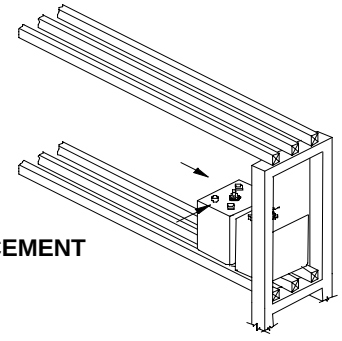
Exercise extreme care when positioning cells. Bumping or scraping a cell against the adjacent cell/unit or rack member may damage the jar material.

Do NOT use any kind of tool to pry cells into position.



CELL/JAR PLACEMENT
Figure 7.3

7. Remove the belt loops (if used) from the lifting hook and pull the belt free from under the unit. Also remove any remaining protective packing covers. See Figure 7.4. Move cell into final position, observing spacing requirements.



CELL/JAR PLACEMENT
Figure 7.4

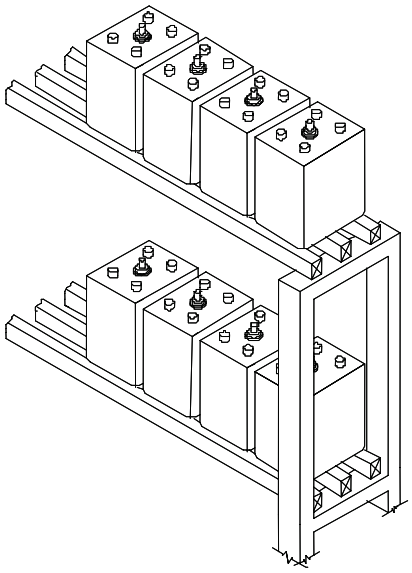
8. Repeat Procedures 5 thru 7 until all units are installed on all tier/steps of the rack. See Figure 7.5.

To lubricate the rack rails for sliding cells into position, use only EnerSys Pro-Slide or Dow Corning Silicon Compound #111.

9. As soon as cells are unpacked and installed on the rack, remove the shipping vent plugs and immediately install the flame arrestors. **DO NOT** attempt to charge cells unless flame arrestors are in place.

Once installed, **DO NOT REMOVE** the flame arrestors. They are provided with a filling funnel for adding water and measuring the electrolyte temperature. Do not permit the lectrolyte level to drop below the bottom of the tube on the flame arrestor. Allowing too low a level defeats the flame arrestor function.

10. Number the cells starting from the positive terminal of the battery. The cell numbers supplied are backed with pressure-sensitive adhesive and should be applied to the rails or the jars. Before applying the cell numbers, clean surfaces according to Procedure 3 in Section 12.1.1.



FULL RACK OF CELLS
Figure 7.5

7.4 Preparing and Installing Connections

The cells are now positioned and ready to be connected.

Before preparing and making the connections, heat NO-OX-ID grease in hot water as necessary to soften for application with a paintbrush.

7.4.1 Terminal Posts

All terminal posts of the cells are greased at the factory to prevent oxidation.

1. Remove the grease with a paper towel.

2. Inspect each terminal post. If discoloration or tarnishing is noted, neutralize the post with sodium bicarbonate and water solution (Section 12.1.2, Procedure 2). Dry thoroughly.

3. Clean the contact surface with a stiff-bristle nonmetallic brush/pad until a clean, bright surface is obtained. Do NOT expose copper.

4. Apply a light coat of NO-OX-ID grease.

7.4.2 Intercell Connectors

The connections are made by bolting the plated copper intercell connectors to the cell posts of opposite polarity on adjacent cells. When more than one intercell connector for each cell is furnished, bolt the connectors on opposite sides of the cell posts.

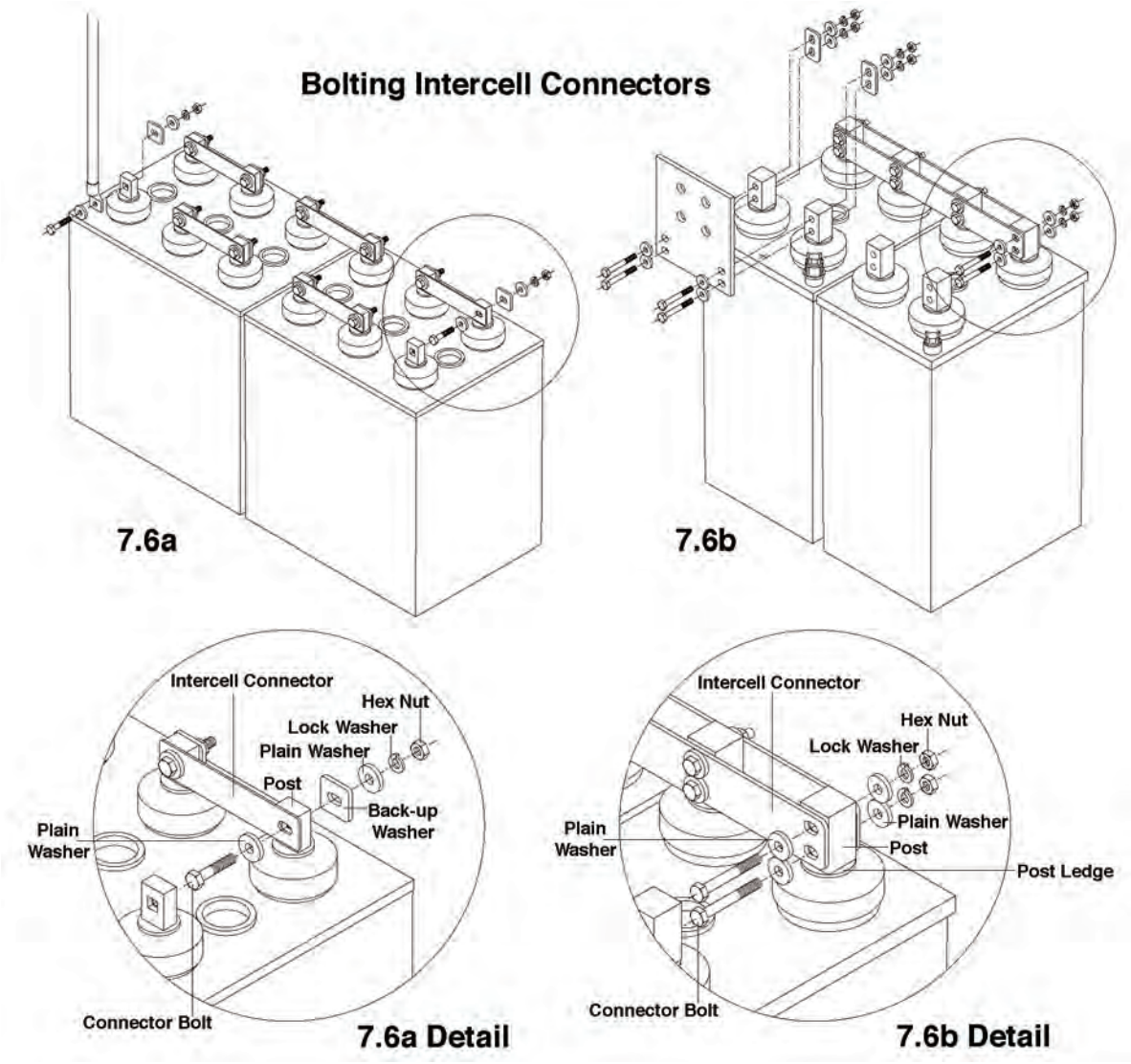
1. Clean the contact surface of the intercell connector using a stiff bristle nonmetallic brush/pad. Use care so as NOT to remove the plating and expose any copper. Note: Tin-plated connectors do not require plating material removal to provide an adequate contact surface, only foreign material removal. Very light brushing and cleaning with a cloth is generally sufficient.

2. With a small paintbrush, apply a light coat of heated NO-OX-ID grease to the contact surface of the intercell connector.

3. Bolt all intercell connectors and assemble as shown in Figures 7.6a, 7.6b and the details. Figure 7.6a is applicable to CA & CC models, Figure 7.6b is a representative diagram for CX, DX, DXC, EA, EC, ES, FTA, FTC, GC, GT, GU.

Certain intercell connectors (such as those for all “G” cells) are furnished with the bolt holes located off-center. Install these connectors so that the bottom edge of the connector does not interfere with the post ledge (Figure 7.6b and the detail).

Stamped flat washers may have one sharp edge. Install with this edge away from the plated copper intercell connector to avoid damaging the plating.



4. Secure all connections finger-tight to allow for some adjustment of position.

5. After all connections are completed, torque all stainless steel connector bolts according to Table 7.1.

TABLE 7.1		
316SS Bolt Size Diameter - Threads/Inch	**Initial Torque Value Inch-Pounds (Newton Meter)**	**Retorque Value Inch-Pounds (Newton Meter)**
1/4 - 20	70 – 75 (8.0 - 8.5)	60 – 65 (7.0 - 7.5)
5/16 - 18	120 – 125 (13.6 - 14.1)	110 – 115 (12.5 - 13.0)
1/2 - 13	130 – 135 (14.7 - 15.3)	120 – 125 (13.6 - 14.1)

Make sure that all bolted battery connections are torqued to the recommended values. The increased resistance of a loose connection can generate heat and become a fire hazard.

6. Apply a light coat of heated NO-OX-ID grease to the bolted connection with a small paintbrush in the area of the terminal post only.

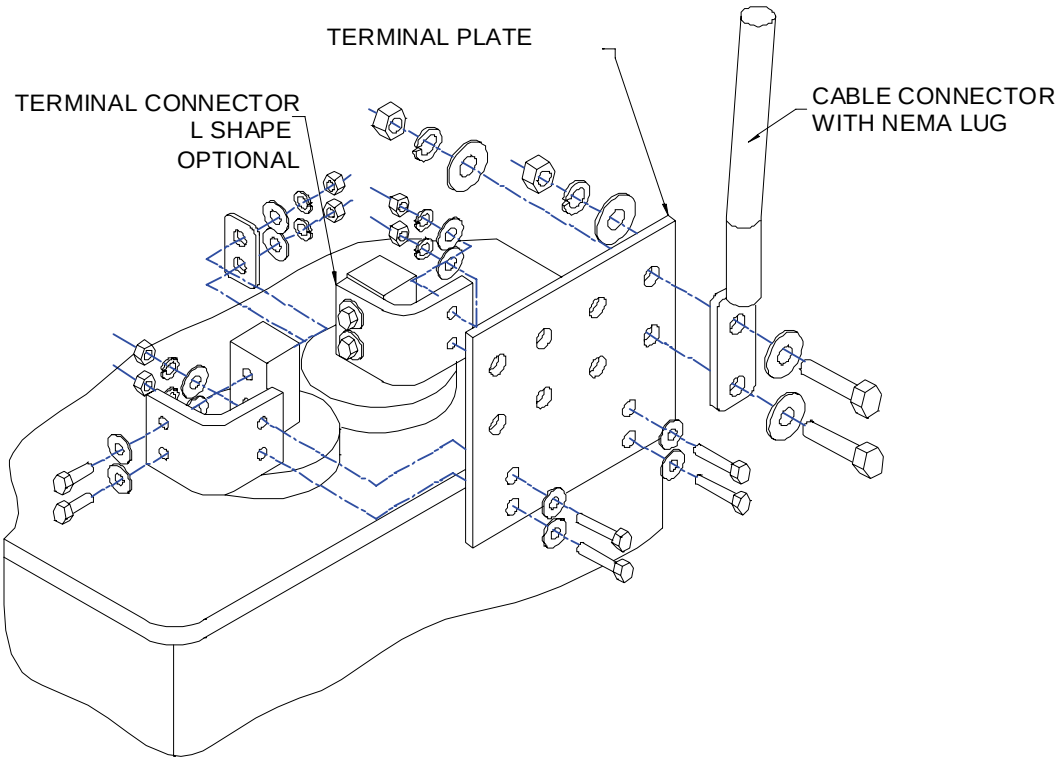
7.4.3 Terminal Plates

Terminal plates are supplied with the battery system to provide a system connection point (except for “C” line). All system connections must be made to the terminal plate and NEVER to the cell terminal post (except for “C” line).

1. Clean the electrical contact areas of the terminal plate, terminal connectors, and cell/jar posts with a stiff-bristle nonmetallic brush/pad until the surface is bright. Be careful not to remove the plating with excessive brushing. A typical terminal plate is illustrated in Figure 7.7.

2. With a small paintbrush, apply a light coating of heated NO-OX-ID grease to contact areas.

3. Install the terminal connectors to cell posts. Tighten all connections according to the torque values in Table 7.1.



TERMINAL PLATE INSTALLATION
Figure 7.7

4. With a small paintbrush, apply a light coat of heated NO-OX-ID grease to the electrical contact areas of the terminal plate.

5. Install the terminal plate to the terminal connectors using the torque values in Table 7.1.

6. Connect the positive lead from the charger to the positive terminal plate of the battery and the negative lead from the charger to the negative terminal plate of the battery. (Some seismic installations have interface connections.)

7. Connectors to battery terminal plates should be flexible since rigid terminal connectors may transmit vibrations or strain to cell posts that could result in loose connections. Support cables so that the cell post does not bear the load.

8. Before activating the charger:

a. Inspect the cell connections of the system to ensure that all cells are connected correctly, POSITIVE (+) to NEGATIVE (-),

b. Measure the voltage across the system terminals. Voltage of the battery should equal approximately 2.06 times the number of cells in the string for 1.215 nominal specific gravity systems and 2.10 times the number of cells in the string for 1.250 nominal specific gravity systems, and

c. Measure and record the resistance of cell-to-cell and cell-to-terminal connections. If the resistance of any connection is more than 10% or 5 μΩ (micro-ohms) whichever is greater, above the average, unbolt and remove the affected connectors and follow the cleaning procedure in Section 12.1.3.
Then remake the connection.

NOTE: Do NOT recalculate the average resistance and do NOT repeat the cleaning procedure.

8.0 INITIAL and/or FRESHENING CHARGE

Batteries lose some initial charge during shipment and storage. Depending on storage time, a battery may require a *freshening charge*. See Section 4.0 for battery storage times.

Before switching on the charger, ensure that shipping vent plugs are removed and flame arrestors are installed.

Do NOT attempt a freshening charge unless the electrolyte levels are near the low level line on open circuit. When necessary, remove electrolyte to that level from cells with high levels.

Most chargers of modern design utilize the principle of constant voltage (potential) charging. The preferred charge method is to use a constant voltage of 2.50 volts per cell times the number of cells. If this voltage is too high for the equipment (load) connected to the DC bus, the use of lower voltage is accceptable. See Table 8.1. Should the charge current cause electrolyte to flood out onto the cover, reduce the charge voltage at once.

Least desirable is to put the battery on at the float voltage - particularly for calcium alloy cells. Equalize charging at 2.33 volts per cell is the minimum acceptable procedure for 1.215 calcium alloy cells.

1. Determine the maximum voltage that may be applied to the system equipment (or maximum charger voltage if load is not yet connected). Refer to the recommendations of the manufacturer/supplier of system equipment, connected to DC bus.

2. Divide the maximum total system voltage by the number of cells (not units) connected in series. This is the maximum volts per cell that may be used for the initial charge.

3. Check the nameplate to determine whether the battery is of a lead-antimony type or a lead-calcium type.

4. Connect battery positive (+) terminal to charger bus positive (+) terminal.

5. Connect battery negative (-) terminal to charger bus negative (-) terminal.

6. Raise the voltage to the maximum value permitted by the equipment as shown in Table 8.1.

Table 8.1 lists the hours of freshening charge to be given **after** charge current has stabilized for 24 hours. Freshen charge must be given at a voltage high enough to cause gassing/mixing of the electrolyte. Do not charge at voltages higher than in Table 8.1.

TABLE 8.1

MINIMUM HOURS OF CHARGE AFTER CURRENT STABILIZATION

Alloy	**Antimony**		**Calcium**		
Sp. Gr.	1.215	1.250	1.215	1.250	1.300
V.P.C.					
2.27	140	210	-	-	-
2.30	100	150	-	-	-
2.33	70	110	140	-	-
2.36	50	78	100	160	-
2.39	35	56	70	110	-
2.42	25	-	50	80	125
2.45	24	-	40	55	85
2.50	22	-	36	50	60
2.60	-	-	30	44	50
2.70	-	-	24	36	44

Table 8.1 applies for cell temperatures between 60^{o} to 90^{o} F (16^{o} to 32^{o} C). For cell temperatures 40^{o} to 59^{o} F (5^{o} to 15^{o} C), use twice the number of hours. For cell temperatures 39^{O} F (4^{O} C) or below, use four times the number of hours.

On “C," “D,” “E,” “F,” and “G” cells, you may insert the thermometer in the funnel of the pilot cell's flame arrestor and leave it there by adjusting the rubber washer to the correct height and leaving off the dust cap. **DO NOT LEAVE thermometers in place in seismic regions.**

7. When charging current has decreased and stabilized (i.e., no further reduction for 24 hours), charge for the hours shown in Table 8.1.

Monitor the battery temperature during the charge. If the battery exceeds 110^{o} F (43^{o} C), stop the charge immediately and allow the temperature to decrease below 100^{o} F (38^{o} C). Failure to follow this warning may result in severe overcharge and damage to the cell/battery.

9.0 OPERATION

9.1 Float Operation

In this type of operation, the battery and the critical load circuits are continuously connected in parallel with a constant voltage charger. The charger must be capable of:

- charging the battery from the discharged condition while supplying the DC power to the connected DC load,
- providing the required constant float voltage, and
- providing voltage for equalizing the battery.

Float voltage sustains the battery in a fully charged condition and makes it available to provide the emergency power required in the event of an AC power interruption or charger failure.

The table below lists the recommended average float volts per cell for nominal specific gravities used in stationary service.

TABLE 9.1

RECOMMENDED AVERAGE FLOAT VOLTS PER CELL FOR NOMINAL SPECIFIC GRAVITIES

Nominal Specific Gravity	Suffix	Average Float Volts per Cell	
		Antimony	Calcium
1.250	B	2.17 - 2.21	2.21 – 2.30
1.215	None	2.15 – 2.20	2.17 – 2.26

An equalizing charge should be given when:

- the temperature corrected specific gravity has fallen more than 10 points (.010).
- one or more cells fall below the following critical voltages on float, corrected for temperature. (Refer to Section 9.4 for equalizing charge.)

TABLE 9.2

MINIMUM TEMPERATURE – CORRECTED FLOAT VOLTAGES

Nominal Specific Gravity	Cell Voltage
1.215	2.13
1.250	2.14

9.2 Hydrometer Readings - Specific Gravity

Specific gravity is a measurement of the density or weight of the electrolyte compared with water (1.000). Specific gravity decreases on discharge and rises again on charge as a result of the electrochemical reaction within the cell.

Because both the cell temperature and the electrolyte level affect the specific gravity reading, they should be recorded at the same time as the gravity reading.

Do not take gravity readings immediately after adding water to the cells. Complete mixing usually takes several days for antimony cells and several weeks for calcium cells. Because of the low charging currents in float service, especially with lead calcium cells, mixing of the electrolyte is a very slow process.

All calcium cells, except “C” size cells, are provided with an electrolyte withdrawal tube, located in the corner of the cell cover adjacent to the positive post(s). Other corner holes are sealed off with plugs. Keep these plugs tightly closed and do not open them to withdraw acid sample.

Antimony cells are not provided with an electrolyte withdrawal tube. To take a specific gravity reading, use the flame arrestor's center funnel. Access this funnel by removing the dust cap of the flame arrestor. **(All the corner holes are sealed with plugs. Keep these plugs tightly closed and do NOT open them to withdraw acid sample.)**

Using the long-stemmed hydrometer (Cat. 81332) will result in sampling of the electrolyte at a point one-third down from the top of the plate. The long stem of the hydrometer must be cut to 7 3/4 inches (200 mm) for "E" cells; to 9 inches (230 mm) for "D" and "F" cells; or 12 inches (300 mm) for "G" cells. At this level the electrolyte gives a reliable indication of the state of charge of a cell.

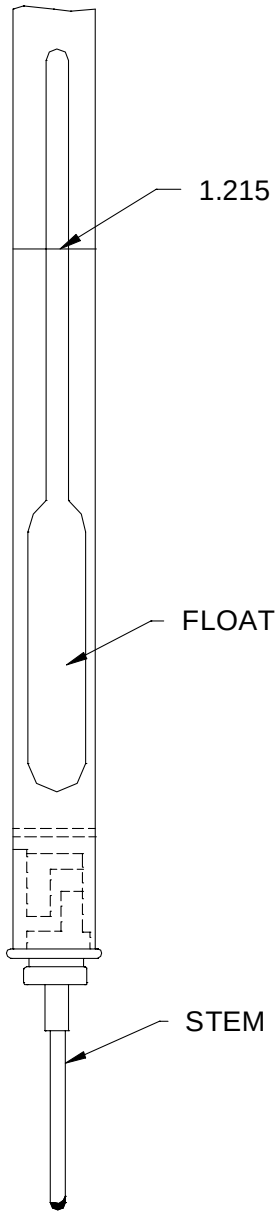
When taking a hydrometer reading, insert the full length of the hydrometer stem into the withdrawal tube hole, so that the base of the stem rests on top of the withdrawal tube.

9.3 Full-Charge Specific Gravity

With the cells fully charged, the electrolyte level at the midpoint between level lines and the cells on float for a minimum of 72 hours, the specific gravity of the electrolyte at 77^{o} F (25^{o} C) should read between the limits on the cell nameplate.

These gravity limits are adjusted at the factory and will not require any further adjusting during the life of the battery unless electrolyte is actually lost from a cell. If electrolyte should accidentally be lost, it should be replaced with electrolyte of the same specific gravity as that in the adjacent cells.

When taking hydrometer readings, hold the hydrometer stem in an upright position so that the hydrometer floats freely and does not touch at either the top or the sides (See Figure 9.1).



Hydrometer
Cat. 81332

Figure 9.1

Periodically clean the hydrometer barrel and float with soap and water for ease of reading and improved accuracy.

Specific gravity readings should be corrected for temperature. For every 3^{o} F (1.67^{o} C) of temperature above 77^{o} F (258^{o} C), add one point (.001) to the hydrometer reading. For every 3^{o} F (1.67^{o} C) of temperature below 77^{o} F (25^{o} C), subtract one point (.001) from the hydrometer reading.

9.4 Equalizing Charge

Under NORMAL conditions an equalizing charge is NOT required. An equalizing charge is a special charge given to a battery when nonuniformity in voltage has developed between cells. It is given to restore all cells to a fully charged condition.

Nonuniformity of cells may result from:

- low float voltage due to improper adjustment of the charger.
- a panel voltmeter that reads high, resulting in a low charger output voltage.
- selection of too low a float voltage.
- variations in cell temperatures in the series at a given time, due to environmental conditions or module arrangement. The maximum cell-to-cell temperature difference is 5˚F (3˚C). If cell temperature is the problem, review the location instructions in Section 5.0 to ensure proper location of the battery system.

9.4.1 Equalizing Charge Method

Constant voltage charging is the method for giving an equalizing charge.

Determine the equalizing voltage based on the maximum voltage allowed by the system equipment connected to the DC bus.

The charge table shown in Table 9.3 lists the minimum hours of equalizing charge to be given after the charging current has stabilized (no further current reduction for 24 hrs).

TABLE 9.3 – MINIMUM HOURS OF CHARGE AFTER CURRENT STABILIZATION

Alloy	Antimony		Calcium		
Sp. Gr.	1.215	1.250	1.215	1.250	1.300
V.P.C.					
2.24	100	160			
2.27	70	110			
2.30	50	78	100		
2.33	35	55	70	110	
2.36	25	28	50	80	125
2.39			35	55	90
2.42			25	40	60
2.45				28	45
2.48					30

Table 9.3 applies for cell temperatures between 60^{o} to 90^{o} F (16^{o} to 32^{o} C). For cell temperatures 40^{o} to 59^{o} F (5^{o} to 15^{o} C), use twice the number of hours. For cell temperatures 39^{o} F (4^{o} C) or below, use four times the number of hours.

NOTE: The voltage of a warm cell will be lower than the average. Its voltage can be corrected for temperature by adding 0.003V for each degree Fahrenheit (0.005 V/^{o}C) that the cell temperature is above the average temperature of the other cells.

During the equalizing charge, monitor the temperature of a pilot cell. It should not rise above 110° F (43° C). If it does, the equalizing voltage should be lowered to 2.20 or 2.25 VPC until the cells cool down to a temperature of 100° F (38° C), or lower.

Failure to follow this warning may result in severe overcharge and damage to the cell/battery. At this point, the equalizing charge may be resumed.

9.5 Operating Temperature

Normal battery life may be expected only when batteries are operated under the following temperature conditions:

TABLE 9.4 – RECOMMENDED BATTERY TEMPERATURES			
Nominal Specific Gravity		**Annual Average Battery Temperature**	**Any Cell Temp. Not To Exceed for More Than 30 Days Per Year**
Calcium	**Antimony**		
1.215 1.250	1.215 1.250	77° F (25° C) 72° F (22° C)	90° F (32° C) 85° F (29° C)

The room air circulation should be adequate to maintain all cells in the battery within 5° F (3° C) of each other.

High temperature increases realized capacity but decreases life expectancy, while low temperatures decrease capacity, but may not affect life expectancy. Table 9.5 shows the relationship between average temperature and battery life.

TABLE 9.5 – RELATIONSHIP OF TEMPERATURE TO BATTERY LIFE			
	% of 8-Hr. Capacity	Antimony Flat Plate	Calcium Flat Plate
Approx. number of cycles at 80% discharge	—	300	50
Average operating Temp. °F		Life Expectancy in Full Float Application (years)	
107	109	6	5
92	105	12	10
77	100	20	20
62	92	22	22
47	83	25	25

10.0 BATTERY TAPS

Connections made to a battery for tapping a certain group of cells to provide a voltage other than the total battery voltage is NOT recommended and can void the warranty. Tapping results in an imbalance of the system during charging and discharging, causing unsatisfactory operation.

11.0 PILOT CELL

One cell in a battery is usually selected as a pilot cell. It becomes an indicator of the general condition of the entire battery with regard to voltage, gravity and temperature. Pilot cell readings serve as an interim indicator between regularly scheduled voltage and gravity readings of the complete battery. The thermometer should be permanently mounted in the pilot cell flame arrestor (except in seismic areas).

Because a small amount of electrolyte may be lost in taking hydrometer readings, you should select a different cell as the pilot cell annually.

Read and record the pilot cell voltage on a monthly basis between regularly scheduled individual cell readings.

12.0 MAINTENANCE

EnerSys also recommends to follow IEEE Std. 450 for the battery maintenance in addition to the following:

12.1 Battery Cleaning

Observe the battery for cleanliness at regular intervals. Keep cell terminals and connectors free of corrosion. Terminal corrosion may adversely affect the performance of the battery, and it could present a safety hazard.

12.1.1 Standard Cleaning

To perform a standard cleaning of the battery, follow the procedure below:

1. Disconnect the battery.
2. Wipe off any accumulation of dust on the cell covers with a cloth dampened with clean water.
3. If the cell covers or jars are damp with spilled electrolyte, wipe with a cloth dampened with a solution of sodium bicarbonate and cold water, mixed in the proportions of 1.0 lb/1.0 gal (0.5 kg/5.0 liter) of water. Follow this by wiping with a cloth dampened in clear water and then wipe dry with a clean cloth.

Do NOT use any type of oil, solvent, detergent, petroleum-based solvent or ammonia solution to clean the jars or covers. These materials will cause permanent damage to the battery jar and cover and will void the warranty.

12.1.2 Corrosion Cleaning

To clean mild corrosion from cell posts, follow the procedure below:

1. Disconnect the battery.
2. Remove corrosion by wiping with a cloth dampened with bicarbonate of soda solution [mix 1 gallon (4l) of water with 1 lb. (500g) of bicarbonate of soda]. Follow with a cloth dampened with clear water.
3. Dry with a clean cloth.
4. With a small paintbrush, apply a light coat of heated NO-OX-ID grease to the entire bolted connection.

12.1.3 Heavy Corrosion Cleaning

If the routine cleaning of bolted connections has been neglected, heavy post corrosion may occur. The performance of the battery under load could be adversely affected, and this condition could present a safety hazard.

To perform the heavy corrosion cleaning, follow the procedure below:

1. Arrange to maintain continuity of the circuit, if required.
2. Unbolt and remove connectors.
3. Apply a solution of bicarbonate of soda and water to the cell posts and connectors to neutralize the corrosion (as described in Section 12.1.2, Procedure 2).
4. Clean the contact surfaces by rubbing the surface of the post or terminal and plated contact surfaces with a stiff-bristle nonmetallic brush/pad. **Exercise care so you do NOT remove the plating on the connectors, terminal plates or lugs, exposing copper.**
5. Recoat the contact surfaces with a thin application of the NO-OX-ID grease, heated to a liquid form and applied with a small paintbrush.
6. Reinstall and tighten connections to appropriate retorque value in Table 7.1.

12.1.4 Cleaning Flame Arrestors

When cells are overfilled with electrolyte (above the high level line) or are excessively overcharged, the diffuser material of the flame arrestor may become partially clogged from electrolyte spray. Replace all flame arrestors having clogged pores or clean the arrestors as follows.

Immerse the flame arrestor several times in a plastic bucket filled with fresh water. After each immersion, eject the water by vigorous shaking or with an air blast. Following the immersion of 15 flame arrestors, dump and refill the bucket with clean water.

Do not use any cleaning or neutralizing agents in the cleaning water, since any dry residue may clog the pores of the diffuser materials.

12.1.5 Replacing or Isolating a Cell

To replace or isolate a cell for maintenance, follow the procedure below.

1. Arrange to maintain the continuity of the circuit, if required.

2. Unbolt and remove connectors.

3. Remove and replace cell OR isolate the required cell.

4. Reinstall and torque connections according to Section 7.4.

12.2 Maintenance Records

A complete recorded history of the battery operation is essential for obtaining satisfactory performance. Good records will show when corrective action is required to eliminate possible charging, maintenance or environmental problems.

Should you have ANY questions concerning how to perform the required maintenance, contact your nearest EnerSys sales/service representative or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

Accumulate and permanently record the following data for review by supervisory personnel so that any necessary remedial action may be taken:

The initial records are those readings taken after the battery has been in regular float service for 3 months (90 days). These should include the battery terminal float voltage and specific gravity reading of each cell corrected to 77^{o} F (25^{o} C), all cell voltages, the electrolyte level, temperature of one cell on each row of each rack, and cell-to-cell and terminal connection detail resistance readings. It is important that these readings be retained for future comparison.

The frequency and types of readings recorded are usually governed by the standard operating procedures and policies of the user. Adequate battery records are an invaluable aid as a check on maintenance procedures, environmental problems, system failures and corrective actions taken in the past.

While specific gravity readings are a good indication of the health of a cell, other readings can be used to indicate relative health. However, it is highly recommended that a supplimental full set of readings on each cell (including specific gravity) be taken approximately two years after service initilization to verify that the floating conditions of the battery are appropriate.

The following schedule is recommended for good maintenance and records.

Monthly

- General appearance and cleanliness
- Charger output amps and volts
- Electrolyte levels
- Cracks in cells or leakage of electrolyte
- Evidence of corrosion at terminals or connectors
- Ambient temperature and condition of ventilating equipment
- Pilot cell voltage, specific gravity and electrolyte temperature
- Evidence of voltage leaks to ground

Quarterly

In addition to the monthly items also obtain and record the following:

- For antimony cells, specific gravity of each cell (optional for calcium cells)
- Voltage of each cell
- Total battery voltage
- Temperature of one cell on each row on each rack
- Randomly select and check 10% of intercell connection resistances

AnnuaIly

In addition to the quarterly items, also do the following:

- Perform detailed visual inspection of each cell
- Check all bolted connections as indicated in IEEE 450 to see if retorquing is required. Tighten all bolted connections to the retorque value specified in Table 7.1. Then obtain and record the connection resistance of cell-to-cell and cell-to-terminal connections.
- Check integrity of rack.

THE ABOVE FREQUENCY OF RECORD TAKING IS THE ABSOLUTE MINIMUM TO PROTECT THE WARRANTY. This data will be required for any warranty claim made on the battery. For system protection and to suit local conditions/requirements, more frequent readings (quarterly) are desirable. A sample record chart is provided. Make a copy of the chart to use for your permanent records.

12.3 Corrective Actions

Low electrolyte levels should be corrected by following the procedures given in Section 12.4 below.

If charger output voltage is not within the recommended voltage range, make adjustments. Then determine the cause of the shift and correct the problem.

Keep cells clean, terminal posts and connectors corrosion-free, and grounds eliminated by following the procedures in Section 12.1.

When cell temperatures deviate more than 5^{o} F (3^{o} C), from each other during an inspection, determine the cause and correct the problem.

When the connection resistance value of any intercell or terminal connection exceeds the installation base value by more than 20%, correct it using the procedures in Section 12.1.3.

12.4 Adding Water

Cells on charge normally show a very gradual lowering of the electrolyte level over a period of time, due to a loss of water from the electrolyte. Hydrogen and oxygen gasses are liberated by electrolysis as a result of charging current. Cells also lose water from normal evaporation at a rate relative to the cell temperature and the humidity.

At regular intervals this water loss must be replaced with distilled, deionized or approved water, so as to maintain the electrolyte level at the mid-point between the high and low level lines marked on the jar while on float.

Cells are equipped with flame arrestors with a filling funnel. Add water through the filling funnel by removing the dust cap, but without removing the flame arrestors from the cell covers.

The best time to add water to the stationary lead-acid battery is when the recharge or equalizing charge is about two-thirds completed. In this condition the electrolyte should be brought up to the high line. Water tends to float on top of the electrolyte for awhile, but the gassing action of the latter part of the charging period will mix the water into the electrolyte. If temperatures may possibly drop below freezing, water should be added at the start of the recharge or equalizing charge to ensure thorough mixing with the acid solution.

Take care to keep the solution level below the top mark of the cell jar's solution level markings while on equalize. Overflow of solution can occur during gassing if too much water is added to the electrolyte.

Under certain conditions some batteries may never require an equalizing charge. These batteries may be watered when required. The mixing of the water with the electrolyte is a very slow process, especially with the low float currents of lead-calcium cells. In these cases realistic specific gravity readings may be obtained only after six or more weeks of charging at float voltages.

In cold climate with unheated battery rooms, water should be added only when the battery temperature is 50^{o} F (10^{o} C), or above.

Never add any special types of powders, solutions or jellies to the batteries.

12.5 Quality of Water

Only distilled, deionized or other approved water (Deionizer Cat. 94866, Watering Gun Cat. 92755) should be added to the battery.

Approved water is water that has been analyzed by a qualified laboratory and found safe for use with lead-acid storage batteries. Local municipal water supplies in the U.S.A. & Canada are usually satisfactory. Obtain an analysis from the local municipality to be sure the results comply with the impurity levels in Table 12.1.

Before drawing water from a tap or spigot, run the water for several minutes to clear metallic impurities from the pipes.

Do not store the water in a metal container. Use a clean container made of glass, rubber or plastic. The container should not have stored anything but water in the past.

The following table shows the maximum allowable impurities:

TABLE 12.1 — BATTERY WATER QUALITY MAXIMUM IMPURITIES

Requirements	Maximum Allowable Limits Parts Per Million (P.P.M.)
Total Solids*	350.0
Fixed Solids*	200.0
Organic and Volatile*	150.0
Iron	4.0
Chloride	25.0
Ammonium (NH_4)	4.0
Nitrates (NO_2)	10.0
Nitrates (NO_3)	10.0
Manganese	0.07
Calcium and Magnesium	40.0

* ASTM Spec. D-1888 Method A or equal

STORAGE BATTERY REPORT - Battery in Float Service

Sheet No. _____

Company _____ Batt. Type _____ Date Installed

Location _____ Pilot Cell No. _____ _____ (rotate as needed)

Battery No. _____ Full Charge Gravity (Range) _____

Monthly								Quarterly											
DATE & INITIALS OF READER	BATT. TERM VOLTS	CHARGER VOLTS	CHARGER AMPS	ACID LEVEL	PILOT CELL HYDROMETER READINGS	TEMPERATURES PILOT CELL	TEMPERATURES ROOM	DATE											
								CELL	VOLTS	HYD. RDG	VOLTS	HYD. RDG	VOLTS	HYD. RDG	VOLTS	HYD. RDG	VOLTS	HYD. RDG
								1											
								2											
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Notes

Quarterly

ADDING WATER
(when required)

Add water after completing hydrometer readings.

Date _____ Quantity _____ Qts.

Annually

Connector Bolts
Retorqued

Record contact resistance readings and any calculations.

Date _____ Range of Resistance Values Intercell Connectors _____

Acceptance Test Results — Date

Performance Test Results — Date

12.6 Filling and Charging Moist-charged Cells

Cells may be received moist-charged. This type of cell should be activated (filled with electrolyte and charged) only when ready to be placed in service. Moist-charged cells are active and contain charge. DO NOT SHORT THE TERMINAL POSTS. Moist-charged cells may be stored for up to five years without deterioration in cool, low-humidity locations (<90^{o} F, <50%H).

To activate the cells, remove and discard the pressure-relief valves and fill the cells to the low level line with an approved grade electrolyte. Mix the electrolyte before use to eliminate stratification.

> **NOTE:** The filling electrolyte specific gravity must be 15 points (.015) less than the cell nominal specific gravity.

When mixing electrolyte, always add acid to water. Pour slowly and stir constantly, to avoid excessive heat or violent chemical reaction.

Allow the battery to stand for four hours after filling. Add additional sulfuric acid of the filling electrolyte specific gravity to bring the electrolyte level up to the low level line. The charge must be started within 12 hours of the initial fill.

Before charging, install the flame arrestors, and then lock in place with one quarter turn clockwise. Then install the dust cap, when provided, on each arrestor.

The preferable way to charge antimony alloy cells is a constant voltage averaging 2.50 volts per cell. For calcium alloy cells, the voltage needs to be 2.70 volts per cell. Charge for the time shown in Table 8.1 after current stabilization.

Methods to accomplish such initial charging are:

- Parallel the battery to reduce the effective number of cells by half when the charger voltage can be reduced significantly to achieve the volts per cell specified above, or
- Charge 80% of the cells on system charger, and use an auxiliary charger to charge the remaining cells, or
- Charge about 80% of the cells from the positive end, using the maximum voltage indicated previously. Then reconnect about 80% of the cells from the negative end, and using maximum voltage indicated, charge until the remaining 20% of the cells that were not charged the first time are fully charged. Do not be concerned if 60% of the cells obtain twice the normal charge; however, they may require some additional water.

If cell temperatures exceed 110^{o} F (43^{o} C), interrupt the charge and wait until the temperature has dropped to 100^{o} F (38^{o} C). Then the charging may be resumed.

Add filling electrolyte, where necessary, so all cells are at the high level line when the activating charge is about two-thirds complete.

At the completion of the charge, the specific gravity of all cells, corrected to 77^{o} F (25^{o} C), should be within the range indicated on the nameplate. At the end of charge, if the specific gravity is higher, remove some electrolyte and replace with water. If lower, remove some electrolyte and replace with electrolyte of higher specific gravity. At some remote locations, electrolyte with higher specific gravity may not be available. In this case, adjust the level with electrolyte instead of water. Measure the specific gravity and keep adjusting the level with electrolyte until a normal specific gravity reading is achieved.

TABLE 12.2
ELECTROLYTE QUALITY
DILUTE SULFURIC ACID (H_2SO_4)
MAXIMUM IMPURITIES

% By Weight	1.250 – 1.300 Sp. Gr.	1.170 – 1.215 Sp. Gr.
Organic Matter	None	None
Platinum (Pt)	None	None
Sulfurous Acid (SO_2)	0.0016	0.0013
Iron (Fe)	0.0020	0.0016
Copper (Cu)	0.0001	0.00008
Zinc (Zn)	0.0016	0.0013
Arsenic (As)	0.00004	0.00003
Antimony (Sb)	0.00004	0.00003
Selenium (Se)	0.0008	0.0006
Nickel (Ni)	0.00004	0.00003
Manganese (Mn)	0.000008	0.000006
Nitrates (NO_3)	0.0002	0.00016
Ammonium (NH_4)	0.0004	0.0003
Chloride (Cl)	0.0004	0.0003
Fixed Residue	0.012	0.009

For test method — See Federal Specification 0S-801 (latest issue)

13.0 TEST PROCEDURES

13.1 Procedure for Battery Capacity Tests

At least 3 days but not more than 7 days before a battery capacity test, give the battery an equalizing charge as described in Section 9.4.

1. Make sure all battery connections are clean, tight and free of corrosion.

2. While the battery is on float, read and record the specific gravity and voltage of each cell, the temperature of at least every tenth cell, and battery terminal float voltage.

3. Disconnect the battery charger and any other load on the battery to be tested.

4. To perform a rate adjusted discharge test, select the discharge rate based upon the critical load and time period. The test discharge current is equal to the rated discharge current divided by the K Factor (see Table 13.1) for the initial battery electrolyte temperature (See IEEE-450-2002 for reference).

5. With the variable load bank having an ammeter in series and a voltmeter across the battery terminals, connect the load, simultaneously starting the timing device. Maintain the correct current while periodically reading and recording total battery voltage. When the minimum total voltage has been reached, it is desirable to read and record each cell voltage including an intercell connector.

6. Observe the battery for intercell connector heating.

7. Calculate the capacity using the following formula:

$$\% \text{ Capacity at } 77^{o} \text{ F } (25^{o} \text{ C}) = \frac{Ta}{Ts} \times 100$$

Where Ta = test discharge time to specified voltage.
Where Ts = rated discharge time to specified voltage.

8. Recharge the battery, preferably using an equalizing charge (Section 9.4) to minimize the recharge time.

K TABLE TABLE 13.1		
Initial Temperature		Factor K
(^{o} C)	(^{o} F)	
16.7	62	1.098
17.2	63	1.092
17.8	64	1.086
18.3	65	1.080
18.9	66	1.072
19.4	67	1.064
20.0	68	1.056
20.6	69	1.048
21.1	70	1.040
21.7	71	1.034
22.2	72	1.029
22.8	73	1.023
23.4	74	1.017
23.9	75	1.011
24.5	76	1.006
25.0	77	1.000
25.6	78	0.994
26.1	79	0.987
26.7	80	0.980
27.2	81	0.976
27.8	82	0.972
28.3	83	0.968
28.9	84	0.964
29.4	85	0.960
30.0	86	0.956
30.6	87	0.952
31.1	88	0.948
31.6	89	0.944
32.2	90	0.940
32.8	91	0.938
33.4	92	0.936

APPENDIX

HYDROGEN EVOLUTION CALCULATION

Significant amounts of hydrogen are evolved only as the battery approaches full charge. The maximum hydrogen evolution rate is 0.000267 cubic feet (7.56×10^{-6} cubic meters) per minute per charging ampere per cell at 77^{o} F (25^{o} C).

To calculate the amount of hydrogen produced, consider an antimony alloy type (flat plate or tubular) battery at a point where it is nearing end of life, or equalize charge at 2.33 VPC.

Float Current demand of
fully charged stationary lead-acid cells.

	Milliamperes per 100 Ah @ 8-hr. rate	
Charge Voltage	Antimony	Calcium
	NEW – OLD	
2.15 vpc	15 – 60	—
2.17 vpc	19 – 80	4
2.20 vpc	26 – 105	6
2.23 vpc	37 – 150	8
2.25 vpc	45 – 185	11
2.27 vpc	60 – 230	12
2.33 vpc	120 – 450	24
2.37 vpc	195 – 700	38
2.41 vpc	300 – 1100	58

NOTE: The above values apply when the electrolyte temperature is 77^{o} F (25^{o} C). The values will double for every 15^{o} F (8^{o} C) of temperature rise. If the temperature drops, the current value will be halved for every 15^{o} F (8^{o} C) decrease. Antimony ranges indicate current increases due to cell aging.

HYDROGEN FORMULA

Formula for hydrogen evolved evolved—$C = \frac{FC}{1000} \times \frac{AH}{100} \times K \times N$

C	=	Cubic feet (cubic meters) of hydrogen per minute
FC	=	Float current per 100 AH (temperature compensated) in milliamperes
AH	=	Ampere hours (nominal 8 hr.)
K	=	Constant = 0.000267 cubic feet (7.56×10^{-6} cubic meters) per minute of hydrogen per Ah.
N	=	Number of cells

EXAMPLE

60 cell GT-41 (3730 AH) near end of life, on equalize at 2.33 VPC at 92^{o} F (33^{o} C) electrolyte temperature

FC = 450 (from table) x 2 for 92^{o} F (33^{o} C) = 900 milliamperes

$C = \frac{900}{1000} \times \frac{3730}{100} \times 0.000267$ cu. ft. (7.56×10^{-6} cu. m.) x 60

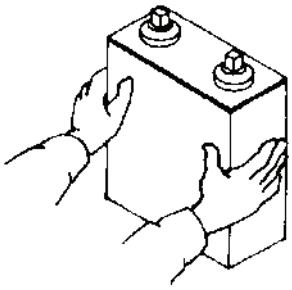
Hydrogen = 0.538 cu. ft. (0.0152 cu. m.) per minute

Assume a room size of 16,000 cu. ft. (452.5 cu. m.) that is allowed a 2% concentration of hydrogen or 320 cu. ft. (9.06 cu. m.). At the above hydrogen evolution rate of 0.538 cu. ft. (0.0152 cu. m.) per minute, it would require 10 hours to reach 2% concentration. Thus with one air change every 10 hours, the hydrogen concentration could be maintained below 2%.

PRECAUTIONS*

1. Do Not bring any heat or flame source near battery.

DO NOT PUSH ON CENTER
TO POSITION BATTERY



USE EDGE OF MODULE
WHEN POSITIONING BATTERY

2. Do Not use any lubricant other than EnerSys Pro-Slide or Dow Corning Silicon Compound #111 to lubricate rails to facilitate sliding of batteries.

3. Do Not lift any cells by the terminal posts.

4. Do Not tamper with seal nuts on the cell post.

5. Do Not remove coating from post or connectors and expose any bare copper.

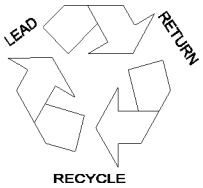
6. Do Not allow cell temperature to exceed 110^{o} F during charging.

7. Do Not clean cell with anything other than water/bicarbonate of soda.

8. Do Not over torque connections.

9. Do Not store EnerSys Lead Antimony batteries for over three months without charge – EnerSys Lead Calcium for over six months without charge, at normal temperatures.

***** These are only a few of the precautions. Please read this manual thoroughly for complete details.



ISO 9000™

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