Standard Module
Installation and Operation Manual

California Proposition 65 Warning:	Battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

LEAD RETURN Pb RECYCLE

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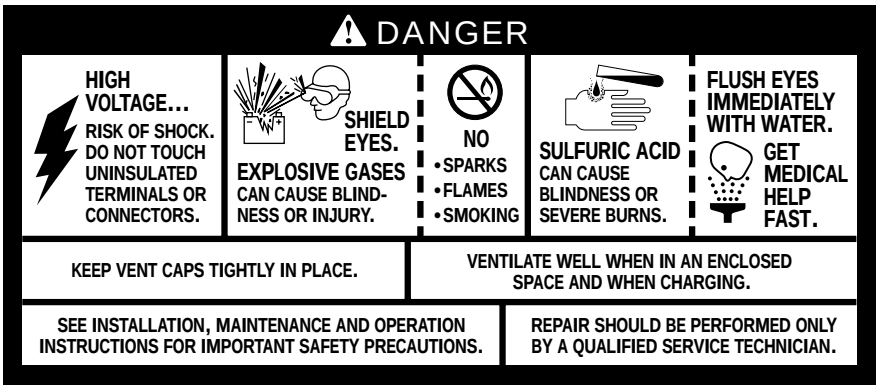

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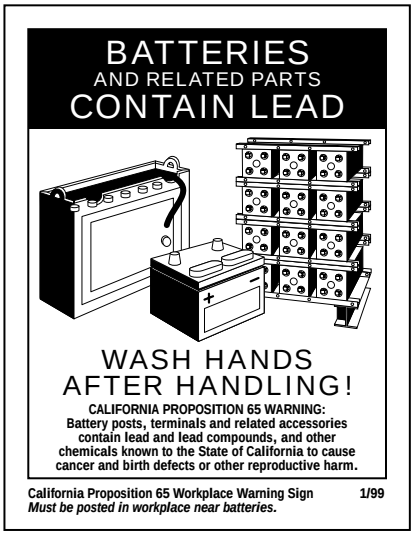

California Proposition 65 Workplace Warning Sign 1/99
Must be posted in workplace near batteries.

SAFETY PRECAUTIONS

Although all valve-regulated batteries have the electrolyte immobilized within the cell, the electrical hazard associated with batteries still exists. **Work performed on these batteries should be done with the tools and the protective equipment listed below.** Valve-regulated battery installations should be supervised by personnel familiar with batteries and battery safety precautions.

Protective Equipment

To assure safe battery handling, installation and maintenance, the following protective equipment should be used.

1. Safety glasses or face shield
2. Acid-resistant gloves
3. Protective aprons and safety shoes
4. Proper lifting devices
5. Properly insulated tools

Procedures

(Always wear safety glasses or face shield when working on or near batteries. Refer to Fig. 1, pg. 3)

The following safety procedures should be followed during installation:

1. These batteries are sealed and contain no free electrolyte. Under normal operating conditions, they do not present any acid danger. However, if the battery jar or cover is damaged, acid could be present. **Sulfuric acid is harmful to the skin and eyes. Flush affected area with water immediately and consult a physician if splashed in the eyes.**
2. **Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.**
3. Do not wear metallic objects, such as jewelry, while working on batteries.
4. Keep the top of the battery dry and clear of tools and other foreign objects.
5. Provide adequate ventilation **(per IEEE standard 1187)** and follow recommended charging voltages.
6. Refer to **Material Safety Data** Sheet for proper extinguishing method. (See Appendix B, Sect. IV, pg. 18.)
7. **Never** remove or tamper with the pressure relief valves. Warranty void if vent valve is removed.
8. Inspect all flooring and lifting equipment for functional adequacy. Specifically review floor-loading capacity.
9. Adequately secure battery modules to the floor.

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Fig. 1

10. Connect support structures to ground system in accordance with applicable codes.

RECEIVING & STORAGE

Receiving Inspection

Upon receipt of the battery and at the time of unloading, each package should be visually inspected for damage. If damage is evident, a more detailed inspection of the entire shipment should be conducted and noted on the bill of lading. Record receipt date and inspection data, and notify the carrier of any damage.

Unpacking

1. Always wear eye protection.
2. Check for visible defects.
3. Check the contents of the package against the packing list. Report any missing parts or shipping damage to your East Penn agent or East Penn Mfg. Co. immediately. (See Fig. 2 and 3, pg. 4.)
4. Never lift the batteries by the terminal posts. Always lift batteries by the module mounting holes with the lifting straps provided. (See Fig. 5, pg. 5.)
5. When lifting batteries, the proper equipment is needed such as a forklift or a portable crane. Always check the lifting capacities of the equipment being used and never lift more than one module at a time by the module mounting holes.

Storage

1. Cells should be stored indoors in a clean, level, dry, cool location. Recommended storage temperatures are 0˚F to 90˚F (–18˚C to 32˚C). Store in a horizontal position only. **Do not store beyond 12 months.**
2. Stored lead-acid batteries self discharge and must be given a boost charge six months from the date of manufacture to prevent permanent performance degradation. **Batteries should not be stored for more than 180 days without applying a boost charge of 2.30 VPC ± .01 volts for a maximum of 24 hours.** Record dates and conditions for all charges during storage.

INSTALLATION

Electric Code for Maintenance Access

Refer to ANSI/NFPA-70 National Electric Code for access and working space requirements around the battery. A minimum of 36" aisle space is recommended in front of the battery for service and inspection.*

NOTE: *Battery system and/or individual module grounding, if required, is the installer's responsibility.*

Floor Anchoring & Module Arrangements

See East Penn Mfg. Co.'s schematic diagram illustration. One is supplied with each shipment. If it cannot be located, contact East Penn Mfg. Co. for a copy. Refer to your delivery number located on the packing slip. This will aid in obtaining the proper drawing.

Module Installations

Assemble modules per the following details. **See Appendix A, pg. 16 & 17, Fig. 29 thru 31 for modules being installed in relay racks.**

NOTE: *Batteries are typically packaged in the reverse order for easy installation: Mounting supports are on top, followed by the bottom most module. (See Fig. 4, pg. 5.)*

CAUTION: Never lift more than one module at a time with the lifting slings. (See Fig. 5, pg. 5.)

1. Unbolt the mounting supports from the top of the battery. Use these bolts to attach channels to first module. Secure mounting supports to the floor. Anchor bolts not included. **(See local building codes for anchor bolt requirements.)**
2. Using the two slings provided, remove the top module and bolt onto the mounting supports. (See Fig. 7, pg. 6 on using the proper lifting equipment.)
3. Remove the next module and bolt onto the first module. Repeat this procedure until the battery is installed to the specified configuration. (See Fig. 6 and 7, pg. 6.)

Each battery is shipped with its own schematic. Make sure the polarity on the batteries matches the drawings.

Fig. 2

Fig. 3

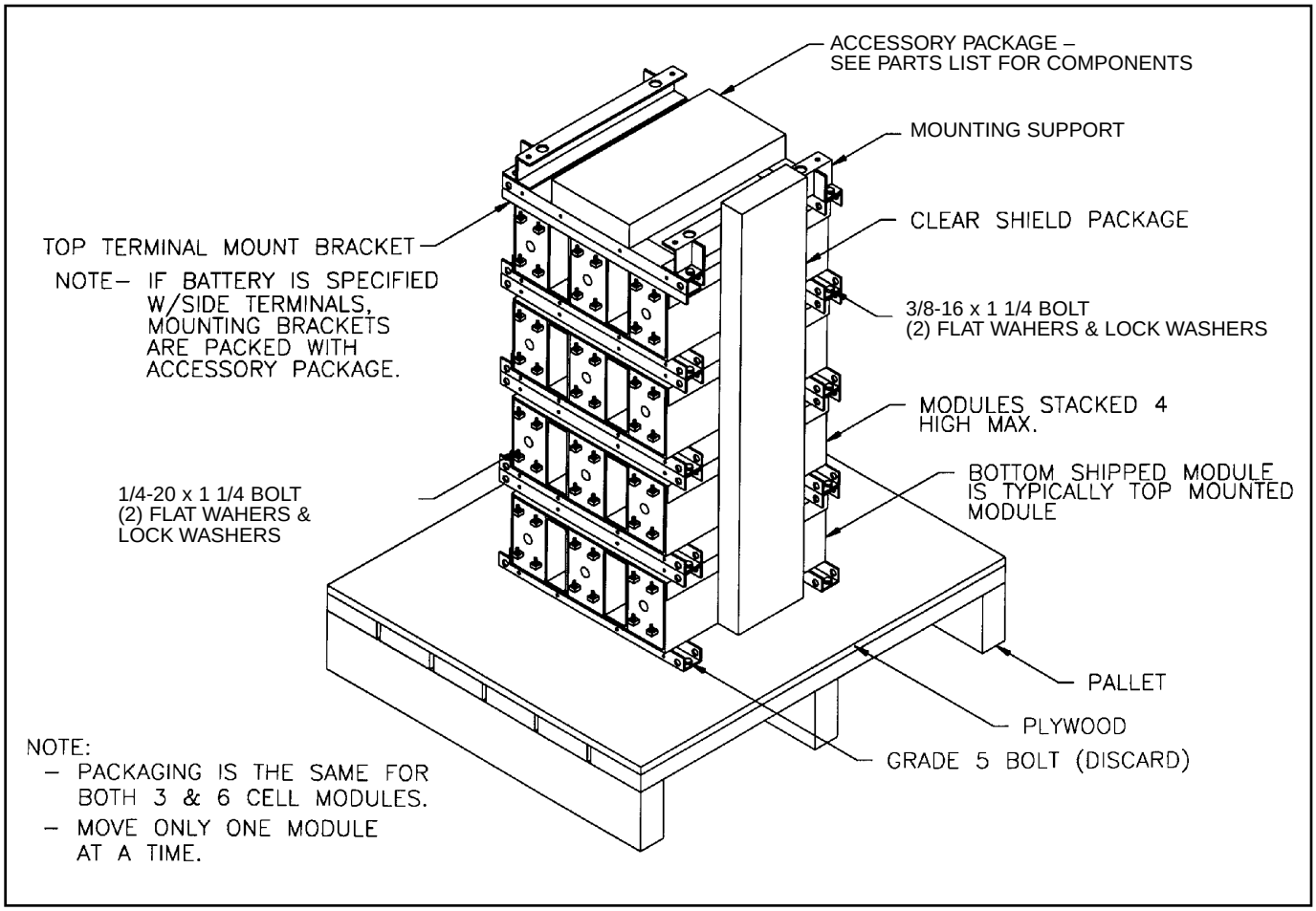

ACCESSORY PACKAGE –
SEE PARTS LIST FOR COMPONENTS
MOUNTING SUPPORT
CLEAR SHIELD PACKAGE
TOP TERMINAL MOUNT BRACKET
NOTE– IF BATTERY IS SPECIFIED W/SIDE TERMINALS, MOUNTING BRACKETS ARE PACKED WITH ACCESSORY PACKAGE.
3/8-16 x 1 1/4 BOLT
(2) FLAT WAHERS & LOCK WASHERS
MODULES STACKED 4 HIGH MAX.
BOTTOM SHIPPED MODULE IS TYPICALLY TOP MOUNTED MODULE
1/4-20 x 1 1/4 BOLT
(2) FLAT WAHERS &
LOCK WASHERS
PALLET
PLYWOOD
GRADE 5 BOLT (DISCARD)
NOTE:
– PACKAGING IS THE SAME FOR BOTH 3 & 6 CELL MODULES.
– MOVE ONLY ONE MODULE AT A TIME.

Fig. 4

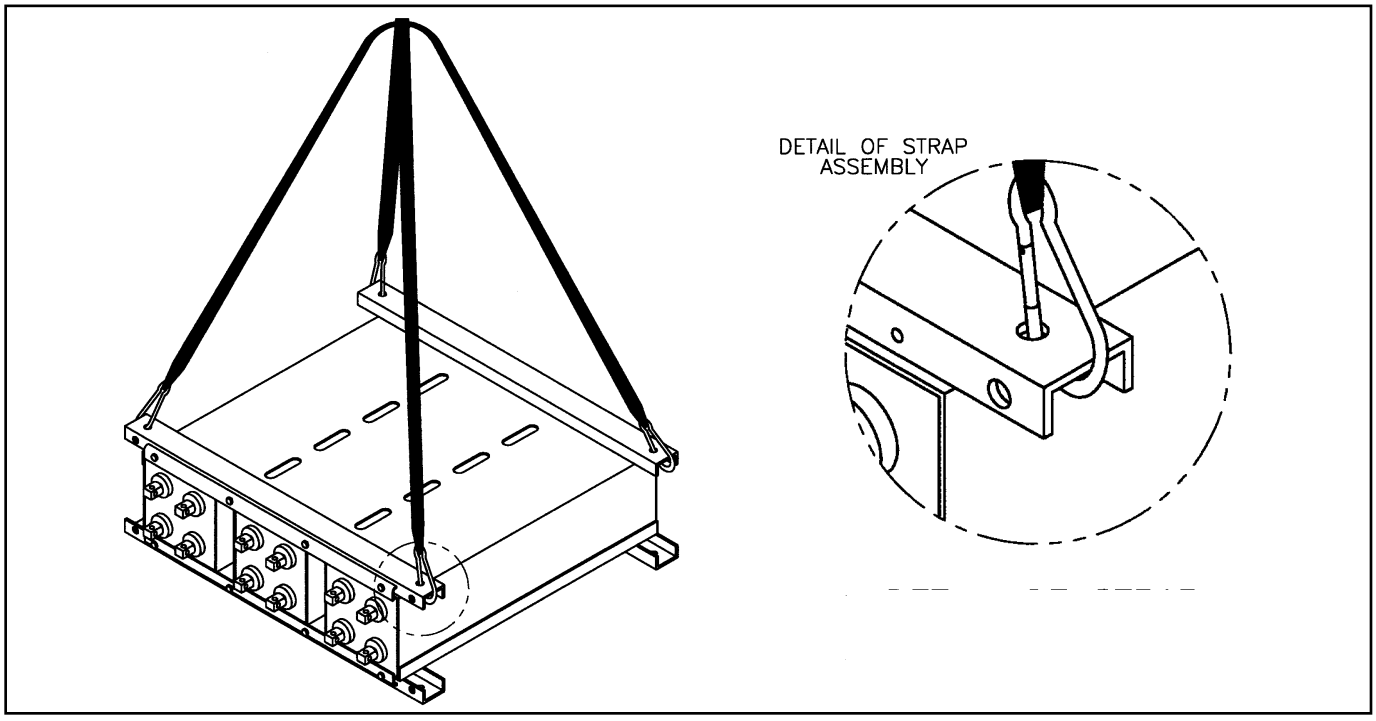

DETAIL OF STRAP ASSEMBLY

Fig. 5

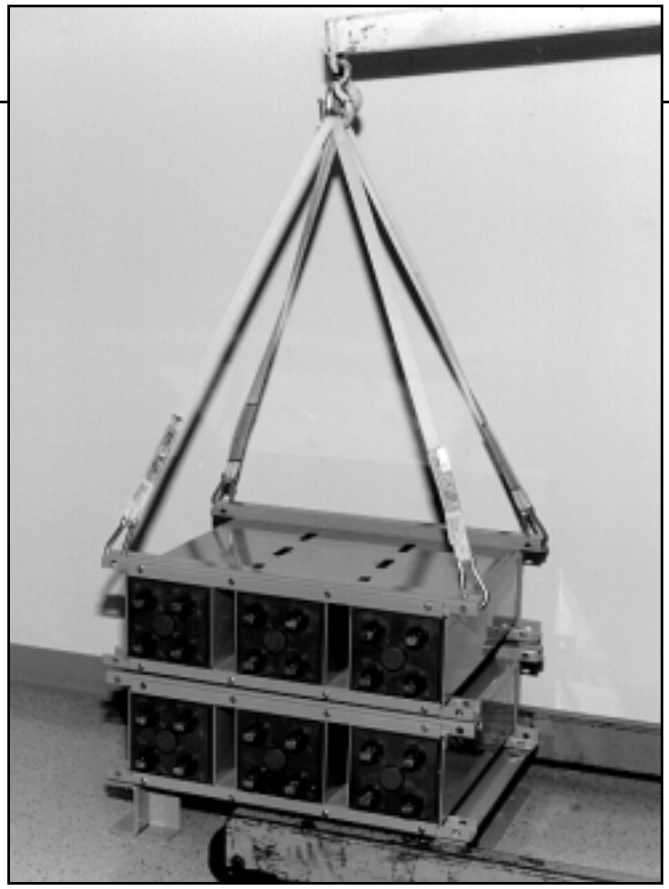
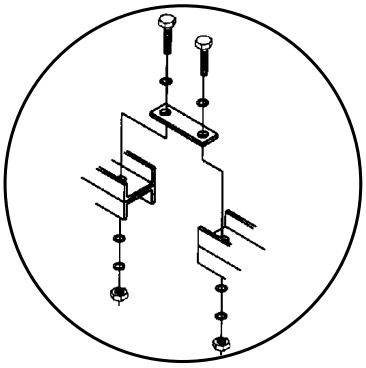


Fig. 6



DETAIL – JOINING
PLATE ASSEMBLY

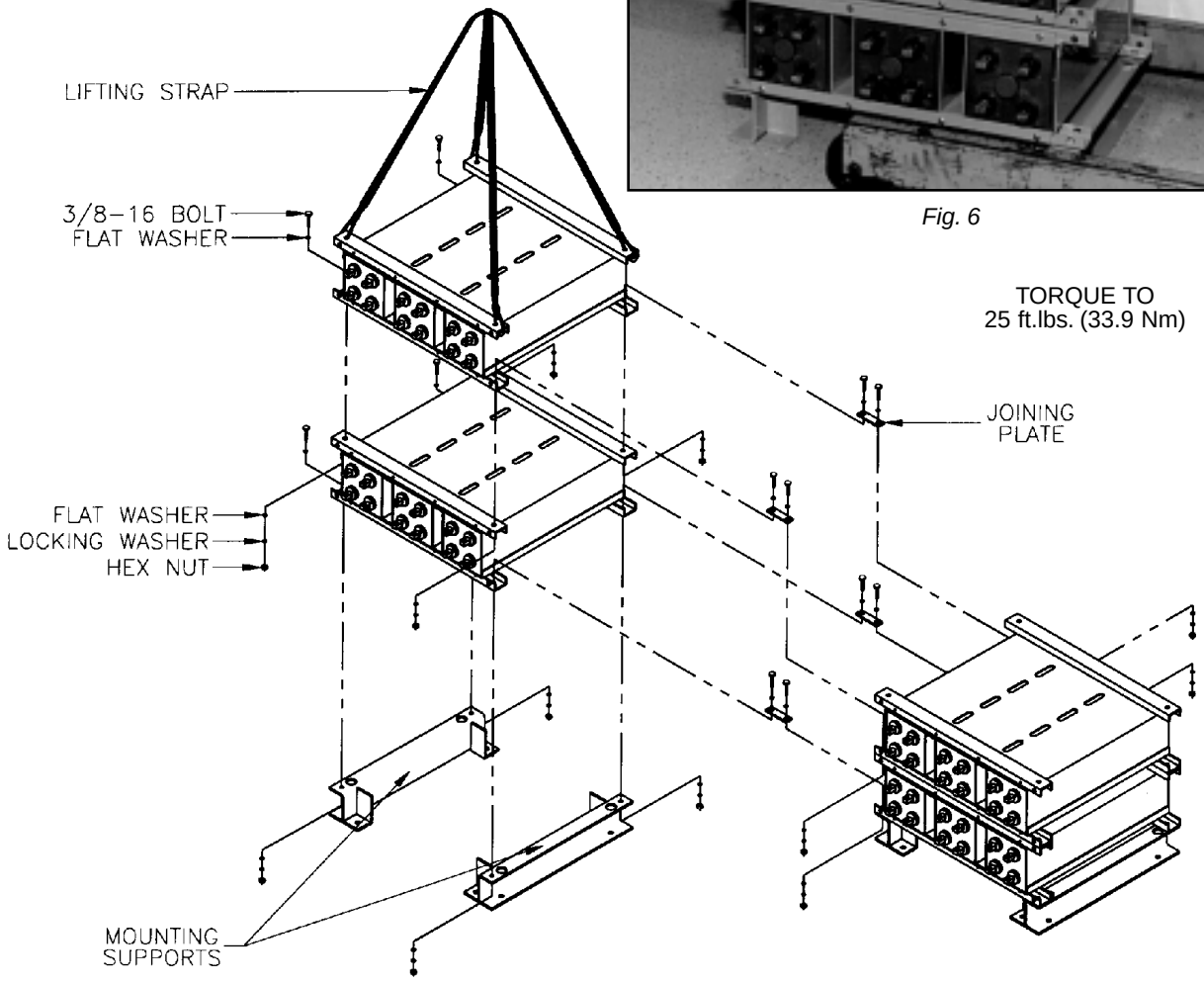


Fig. 7

ELECTRICAL CONNECTION

Connector Assembly

1. The contact surfaces of each individual post on every cell have been cleaned and coated with a thin film of NO-OX-ID “A” grease at the factory. Assure the contact surfaces are free of dust and dirt prior to assembly.
2. The intercell connector surfaces may be cleaned by rubbing gently with a non-metallic brush or pad. Apply a thin film of NO-OX-ID “A” grease which has been supplied.
3. The standard battery is supplied with connector package “S1” requiring 2 connectors per post. Place one connector on each side of the post. Install the connectors loosely to allow for final alignment, then torque to 125 ± 5 inch pounds (14.1 ± .5 Nm). **The installation and direction of the post bolts is important!** (Refer to Fig. 8 and Fig 10, pg. 7 and Fig 11, pg. 8 for proper direction when inserting into posts.)
4. Batteries used in high rate discharge applications require multiple connectors per connection. (Refer to optional connector packages in Fig. 9, pg. 7.)

Terminal Assembly

1. Attach the terminal mounting bracket to the module frame. (Side terminal–see Fig. 12, pg.9, Top terminal – see Fig. 13. pg 9 and Fig. 14, pg.10.)

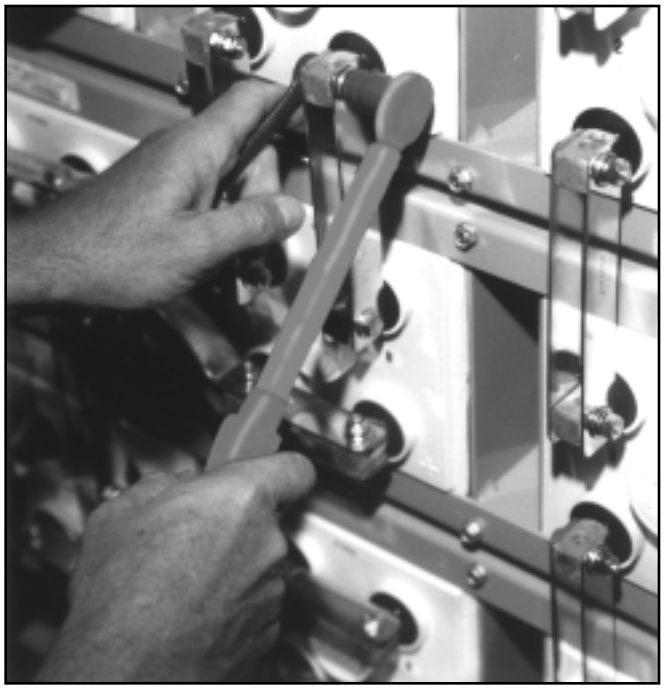


Fig. 8

	Module Connector Packages			
	Standard	Optional		
	S1	S2	S3	S4
Discharge Requirements	≤ 375 amps OR ≤ 700 watts	≤ 750 amps OR ≤ 1400 watts	≤ 1500 amps OR ≤ 2800 watts	≤ 2250 amps OR ≤ 4200 watts
Connectors per Post	(2) 1/16" thick	(2) 1/8" thick	(4) 1/8" thick	(6) 1/8" thick

Fig. 9

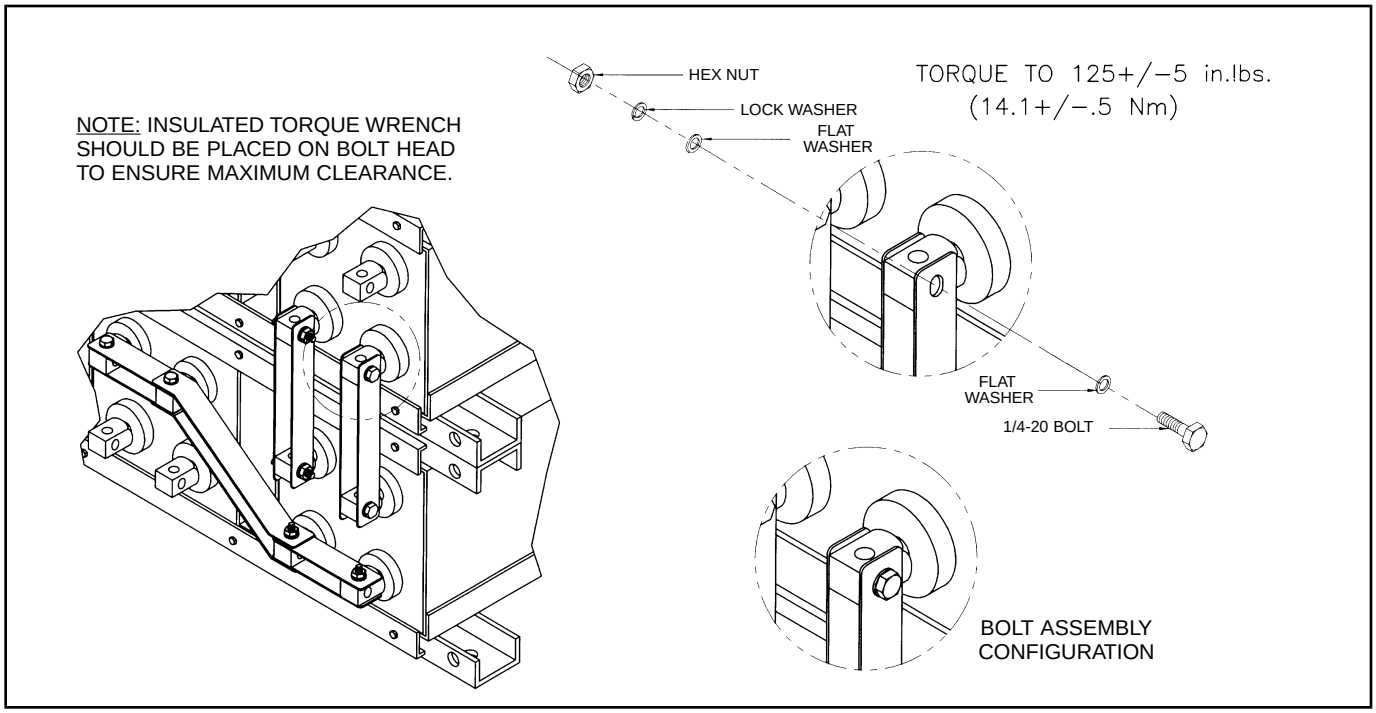


Fig. 10 (Connector Assembly)

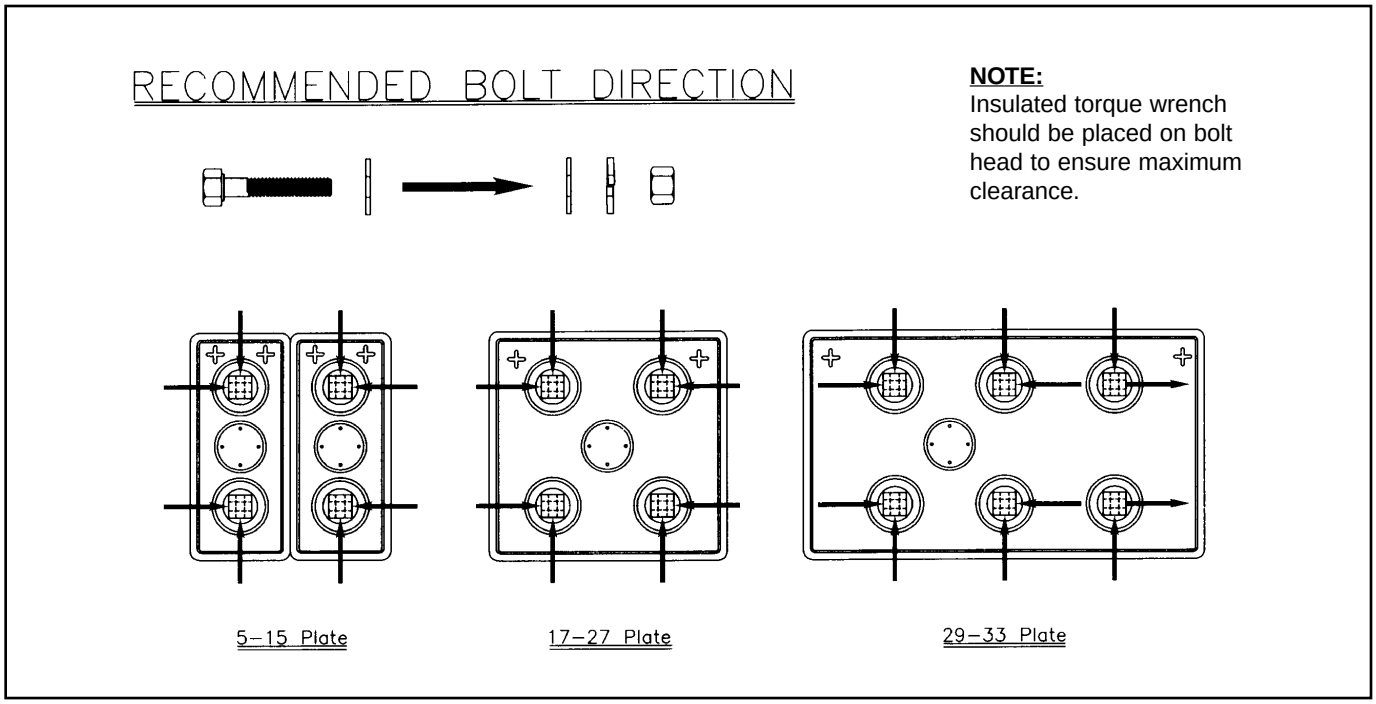


Fig. 11 (Bolt Direction Recommendation)

2. Attach the terminal plates or the terminal connectors to the battery posts and then torque to 125 ± 5 inch-pounds (14.1 ± .5 Nm).
3. For cable connection assembly, (See Fig. 15, pg. 10.)

Final Assembly Check Procedure

1. For future identification of all cells, number individual cells in sequence, beginning with number one (1) at the positive end of the battery. The last cell of the battery is located at the negative output terminal.
2. Read and record the voltages of the individual cells to assure that they are connected properly. The total battery voltage should be approximately equal to the number of cells connected in series multiplied by the measured voltage of one cell. If the measurement is less, recheck the connections for proper polarity. Verify that all cell and battery connections have been properly torqued.
3. Measure and record the intercell connection resistance using a micro-ohms meter. This helps determine the adequacy of initial connection installation and can be used as a reference for future maintenance requirements. Refer to the recording forms in Appendix C of this manual. Review the records of each connection and detail resistance measurements. Clean, remake, and remeasure any connection that has a resistance measurement greater than **10%** of the average of all the same type connections (intercell, intermodule, etc.).
4. Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connection between the battery system and the operating equipment results in maximum total system performance.

Select cable size based on current carrying capability and voltage drop.

Cable size should not provide a greater voltage drop between the battery system and operating equipment than specified. Excessive voltage drop in cables will reduce the desired reserve time and power from the battery system.

Parallel Strings

When paralleling valve-regulated batteries, the capacity, arrangement, and external circuit length should be identical for each battery. Wide variation in the battery circuit resistance can result in unbalanced charging (i.e., excessive charging currents in some batteries and undercharging in others). As a result, cell failures in one battery string and subsequent loss of performance capabilities of that string will result in higher loads in the other parallel string(s), which may exceed the ratings of the battery connections. This can damage the battery system and dramatically shorten battery life.

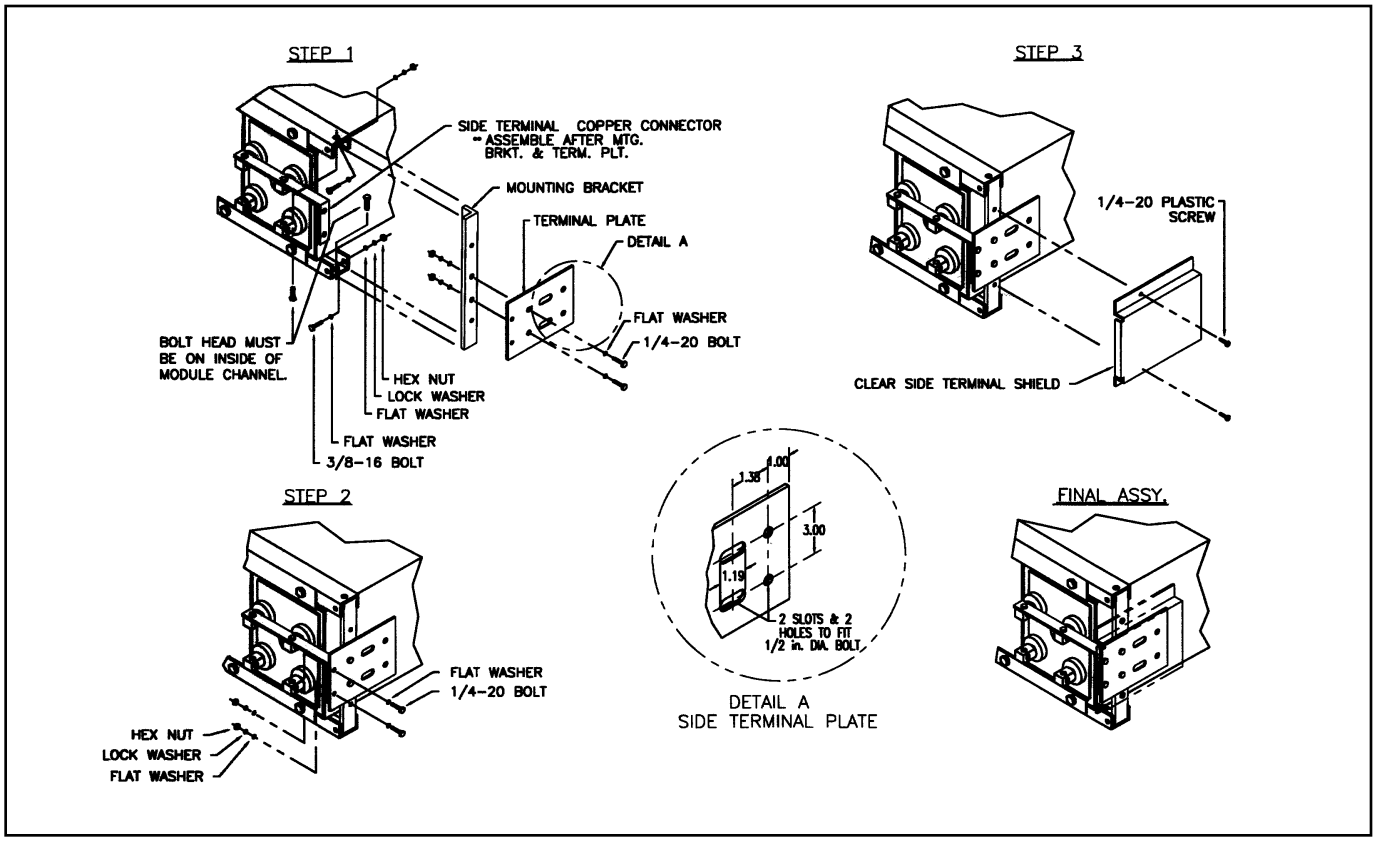


Fig. 12 (Side Terminal Assembly)

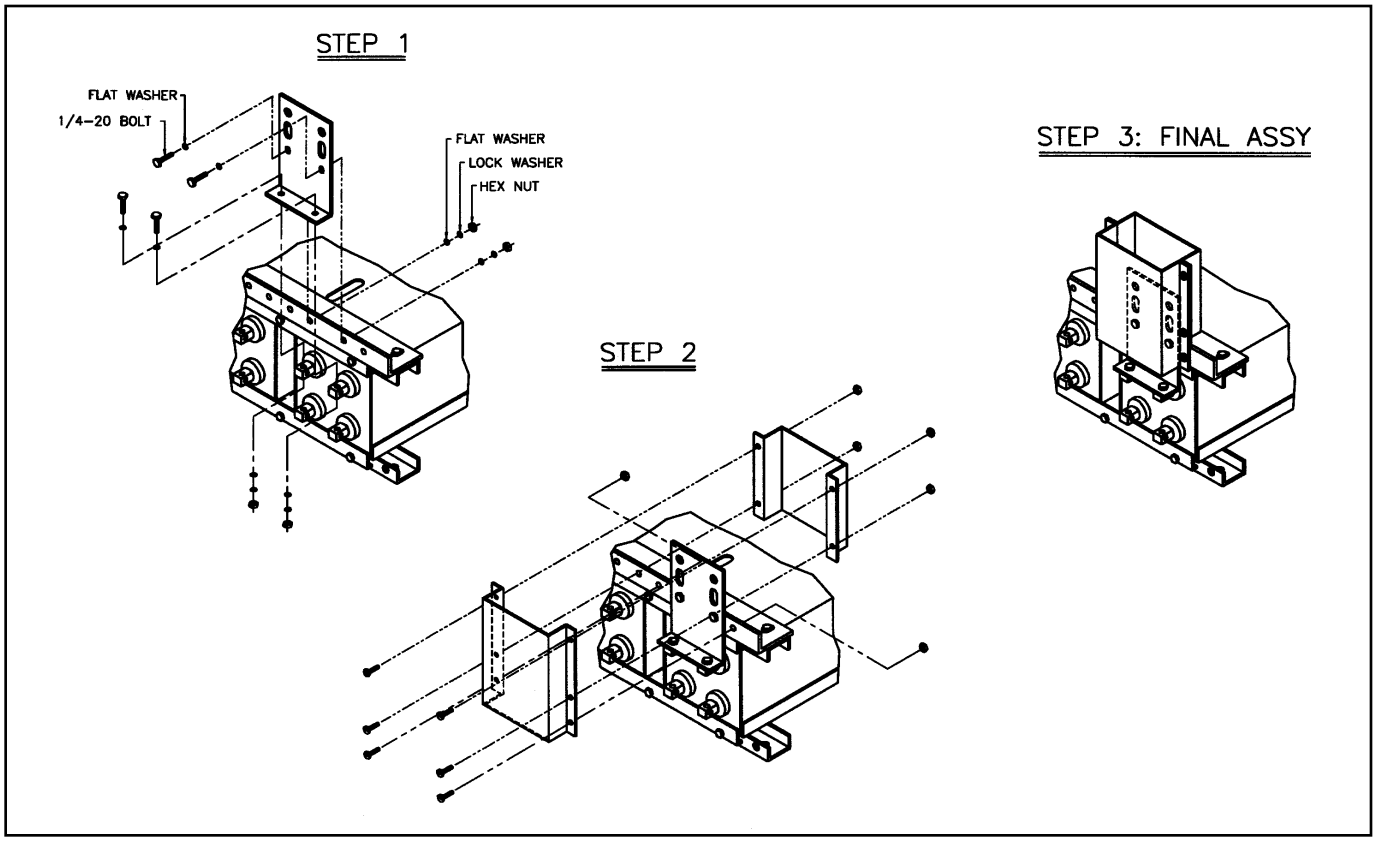


Fig. 13 (Top Terminal Assembly)

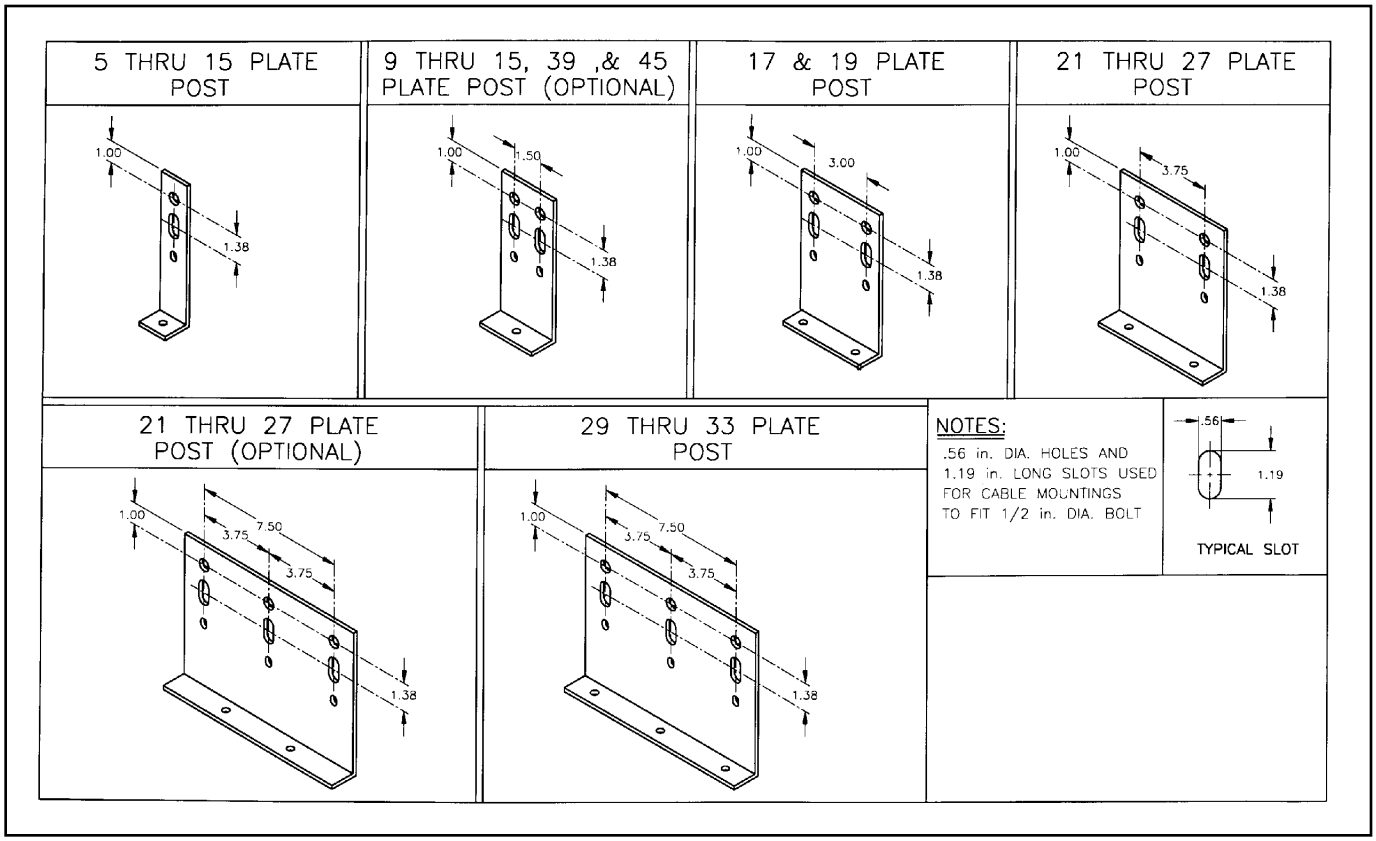


Fig.14 (Top Terminal Assembly)

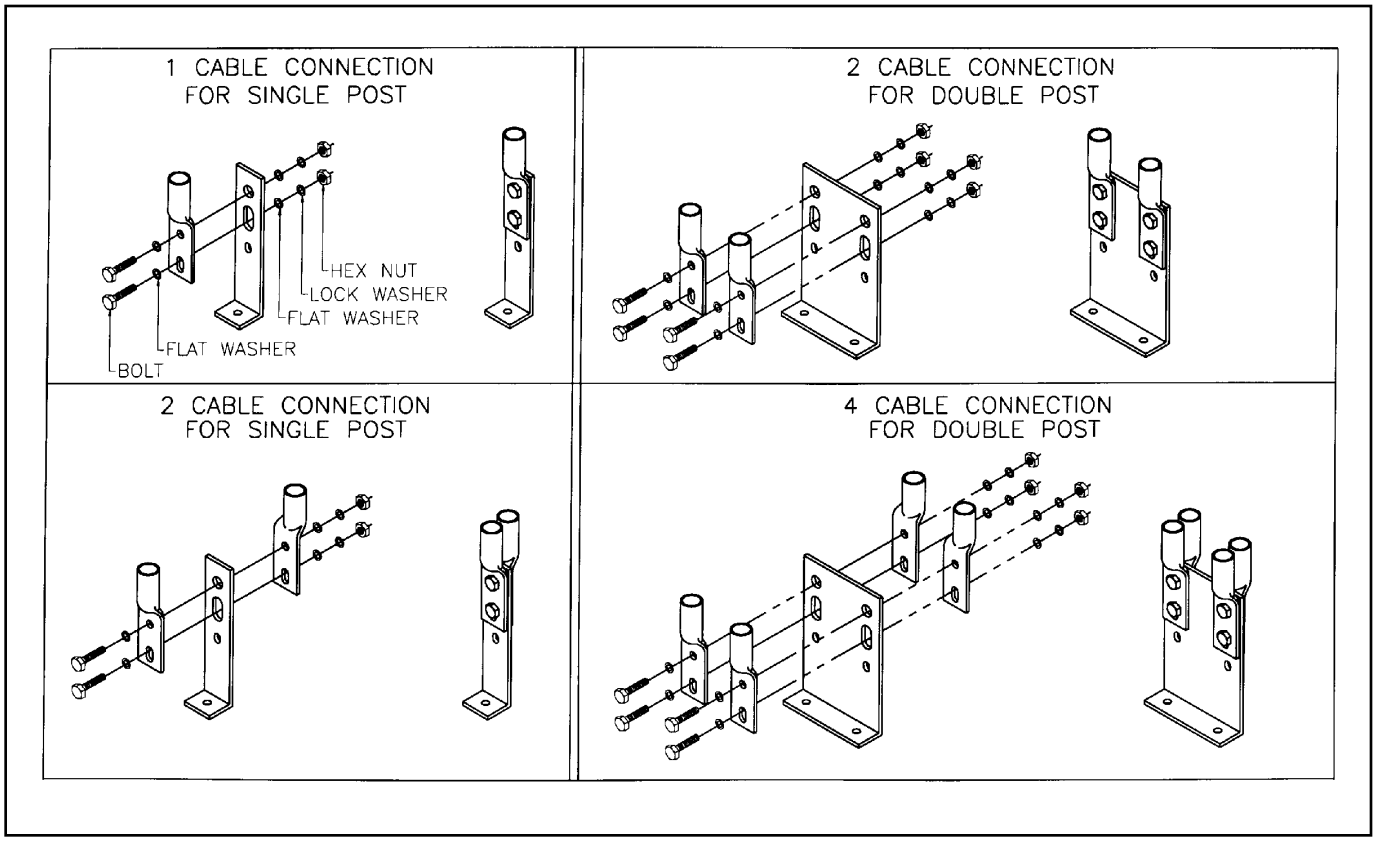


Fig. 15 (Cable Connection Assembly)

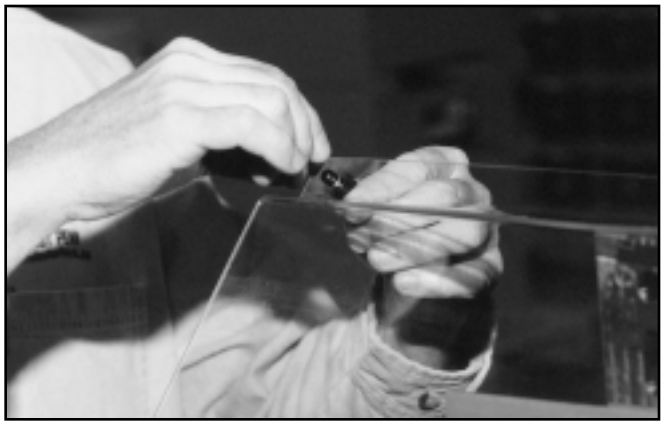


Fig. 16 (Attach Front Shield Standoff)

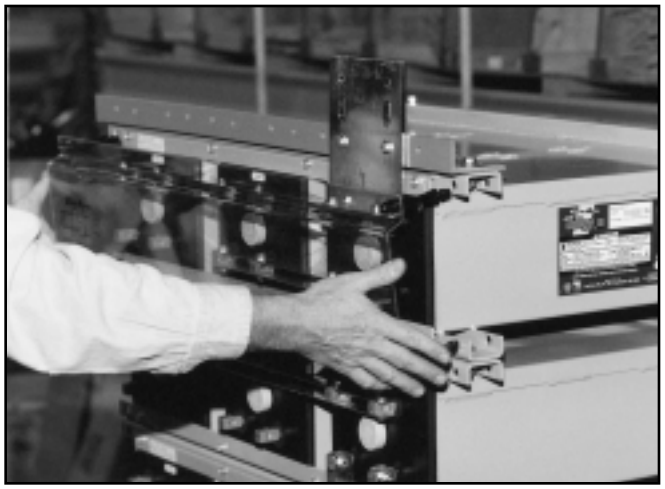


Fig. 17 (Front Shield Assembly)

Module Front Shield Assembly

1. Attach the standoff through the shield and fasten the nuts. (See Fig. 16, pg. 11 and Fig. 20, pg. 12.)

   NOTE: *Use the long standoff for the four corners and the short standoffs for the center holes.*

2. Insert the fully assembled shield standoffs through the holes in the battery module until the standoff locks in place. (See Fig. 17, pg. 11, and Fig. 20, pg. 12.)

Terminal Plate Shield Assembly

For side terminal shield assembly, refer to Fig. 12, pg. 9 and Fig. 18, pg. 11.

For top terminal shield assembly, refer to Fig. 13, pg. 9 and Fig. 19, pg. 11.

Module Top Shield Assembly

For side terminal assembly, attach the top shield to the highest front shield. (Refer to Fig. 18, pg. 11 and Fig. 21, pg. 13.)

For top terminal assembly, cut the top shield to fit between the terminal shields and attach it to the face shield. (See Fig. 19, pg. 11 and Fig. 22, pg. 13.)

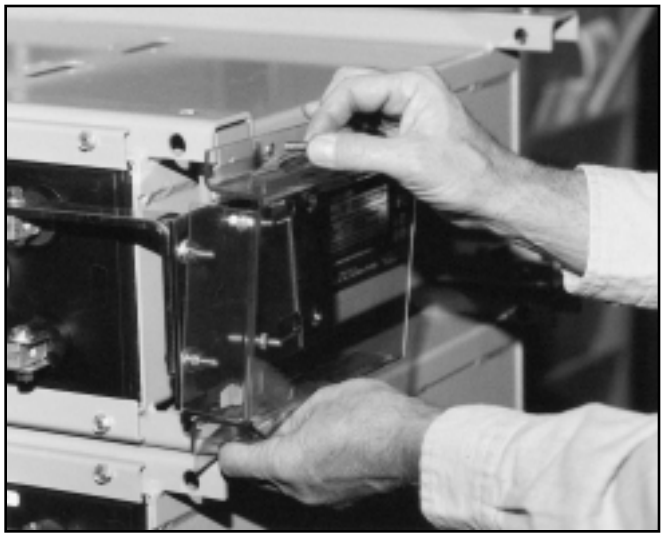


Fig. 18 (Side Terminal Plate Shield Assembly)

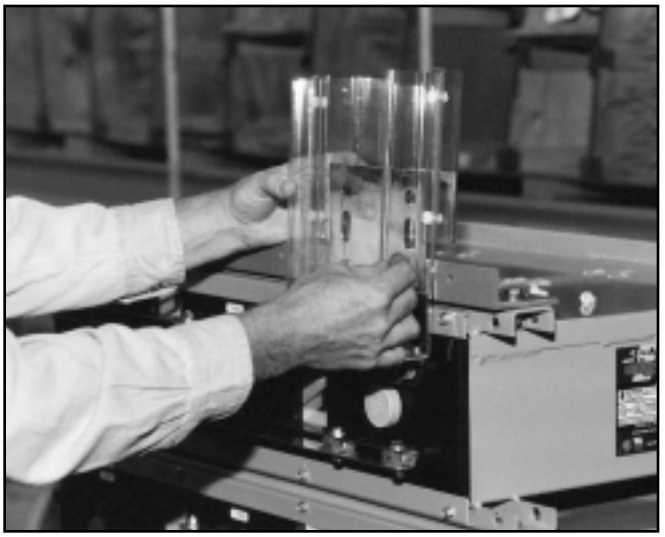


Fig. 19 (Top Terminal Plate Shield Assembly)

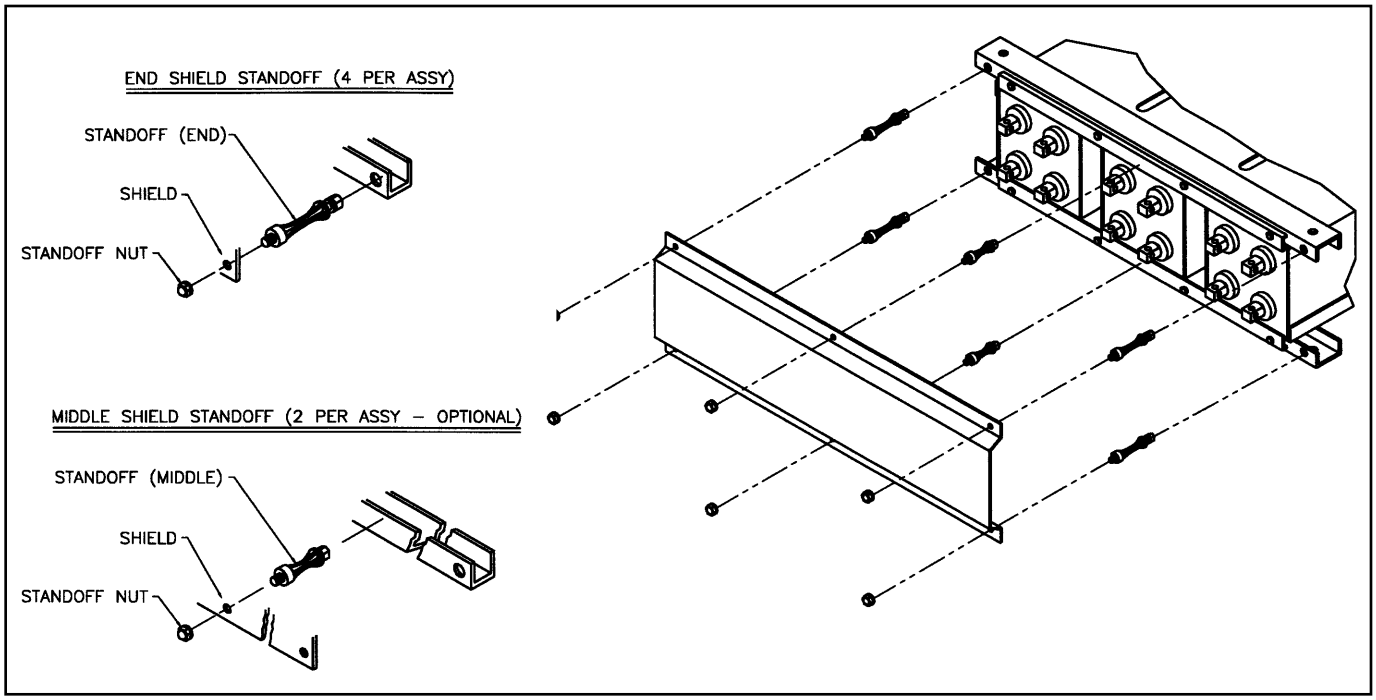


Fig. 20 (Module Front Shield Assembly)

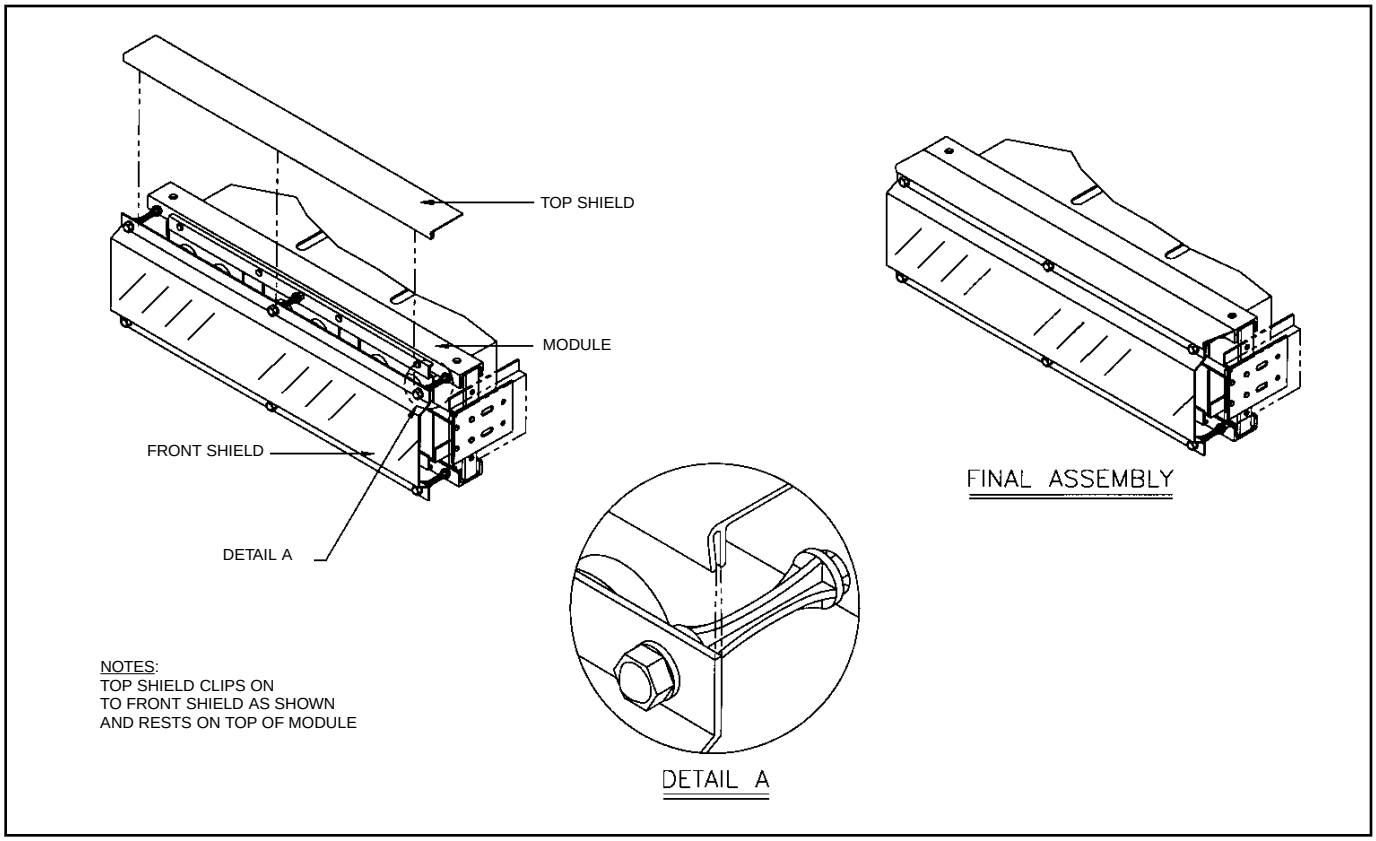


Fig. 21 (Side Terminal Top Shield Assembly)

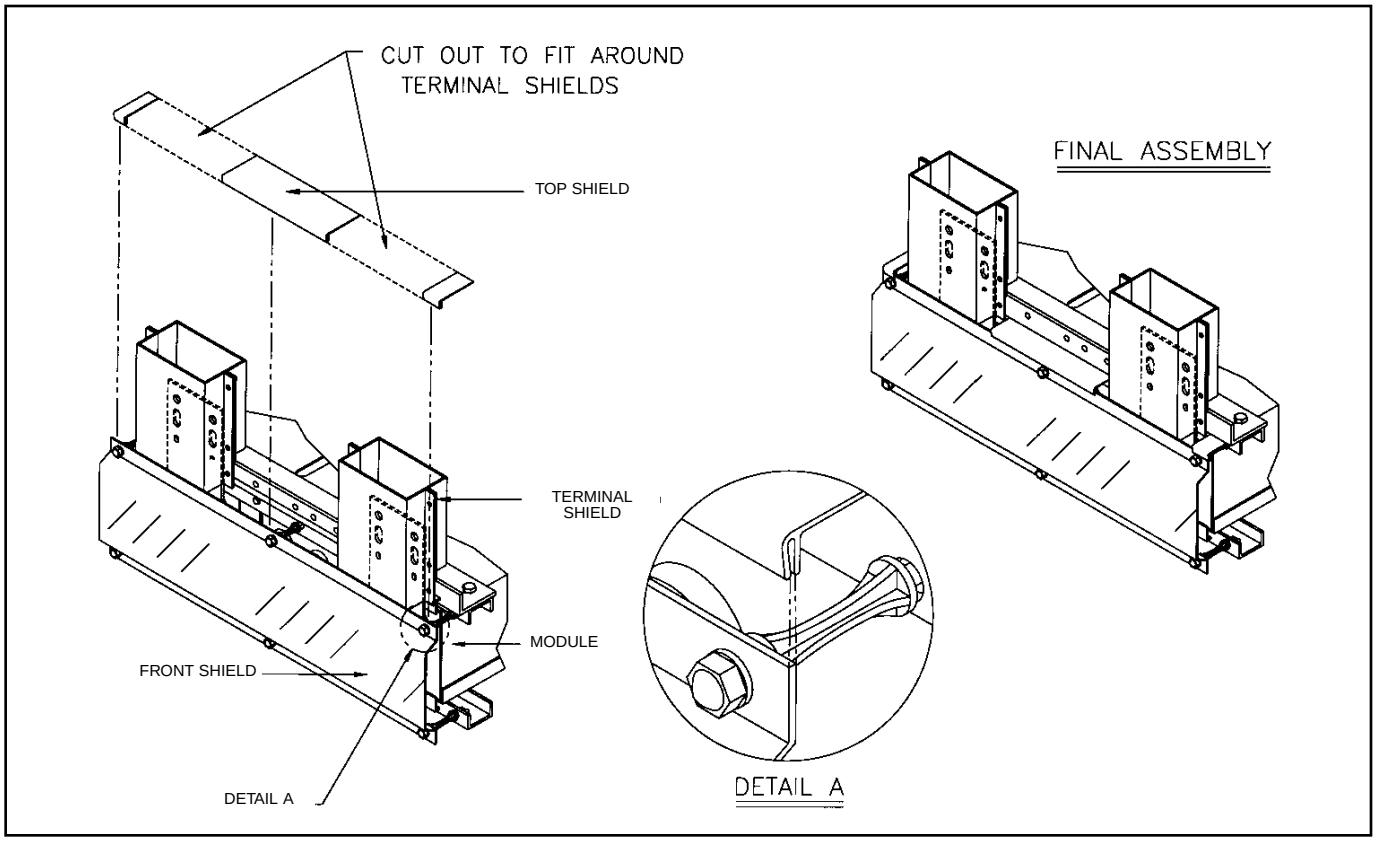


Fig. 22 (Top Terminal Top Shield Assembly)

SYSTEM OPERATIONS

Float Voltages

These batteries are designed for 20-year life when floated at 2.25 ± .01 volts per cell (VPC) at 77˚F (25˚C) or less. The charger must be able to sustain the system voltage within ± .5% volts of the desired level at all times. The desired float voltage varies with the temperature according to the table below.

Operating Temperatures

Temperature Degrees F	Temperature Degrees C	Per Cell Float Voltage ± .01
50˚	10˚	2.25
59˚	15˚	2.25
68˚	20˚	2.25
77˚	25˚	2.25
86˚	30˚	2.25
95˚	35˚	2.23

Equalizing

Upon installation of the battery, an optional boost charge of 2.30 VPC ± .01 volts for a maximum of 24 hours can be applied. **(Note: Verify that the higher battery voltage will not adversely affect the other connected equipment.) If this is done, be sure to reset the charging equipment back to the proper float voltage.** The average battery operating temperature should not exceed 95˚F (35˚C) and never exceed 105˚F (40.5˚C) for more than an eight-hour period.

Operating at temperatures greater than 77˚F (25˚C) will reduce the operating life of the battery. If operating temperatures are expected to remain in excess of 95˚F (35˚C), contact East Penn for recommendations.

RECORD KEEPING

Voltages, Temperatures & Ohmic Readings

Record keeping is an important part of stationary battery maintenance and warranty coverage. This information will help in establishing a life history of the battery and inform the user if and when corrective action needs to be taken. (Refer to Appendix C, Battery Maintenance Report)

While it is acceptable to operate at temperatures less than 77˚F (25˚C), it will require longer charging time to become fully recharged. Also, the capacity will be less at operating temperatures below 77˚F (25˚C).

After installation and when the batteries have been on float charge for one week, the following data should be recorded.

1. Battery terminal voltage
2. Charger voltage
3. Individual cell float voltages
4. Individual cell ohmic readings. Place the meter leads on the positive and negative posts which are furthest from each other on the same cell. (See Fig. 23, pg. 14.)
5. Ambient temperatures
6. Terminal connections should be checked to verify that the installer did torque all connections properly (125 ± 5 in.-lbs.). Micro-ohm readings should be taken across every connection. (Refer to Fig. 24, pg. 14.) Refer to meter manufacturer's instructions for proper placement of probes. If any reading differs by more than **20%** from its initial installation value, re-torque the connection to 125 ± 5 inch-pounds. If the reading still remains high, clean contact surfaces according to Step 2 under Connector Assembly (pg. 7).

Fig. 23

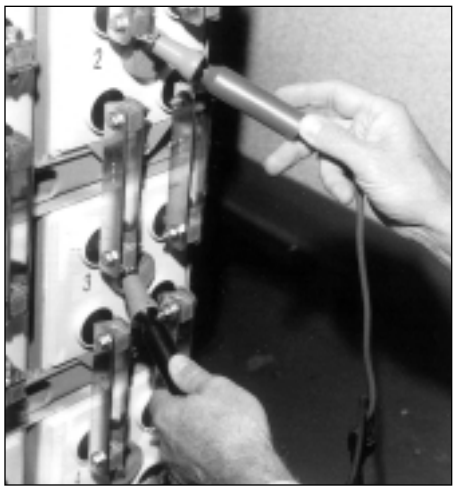


Fig. 24

MAINTENANCE

Always wear eye protection when working on or near batteries. Keep sparks and open flames away from batteries at all times. See Safety Precautions on pg. 3.

Annual Inspection [1]

1. Conduct a visual inspection of the battery.
2. Record the battery terminal voltage.
3. Record the charger voltage.
4. Record the individual cell voltages. Cells should be within ± .05 volts of float voltage.
5. Record individual cell ohmic readings.
6. Record the ambient temperatures.
7. Record all interunit and terminal connection resistances.

[1] Other Maintenance Inspection intervals follow IEEE 1188

Rectifier Ripple Voltage

Acceptable charging ripple (peak to peak) shall be less than 0.5% of the manufacturer's recommended string float voltage and have a duration shorter than 8 milliseconds.

Battery Cleaning

Battery modules and covers should be cleaned with clear water or a mixture of baking soda and water. **Never use solvents to clean the battery.**

Capacity Testing

Capacity tests should not be run unless the battery's operation is questionable. Do not discharge the batteries beyond the specified final voltage. When discharging at higher rates be sure to check the connector chart. (See Fig. 9, pg. 7.) Extra connectors may need to be added to prevent excessive voltage drop. When performing capacity testing and recording data use **IEEE 1188** instructions.

Should it be determined that any individual cell(s) need to be replaced, contact your nearest Unigy II Agent or East Penn Service Center.

CELL REMOVAL PROCEDURE

1. Before removing cells, review Safety Precautions on page 3 of this manual. Contact East Penn Manufacturing Company, Inc. with specific questions or concerns.
2. Refer to Fig. 25 through 28, pg. 15) for specific instructions.

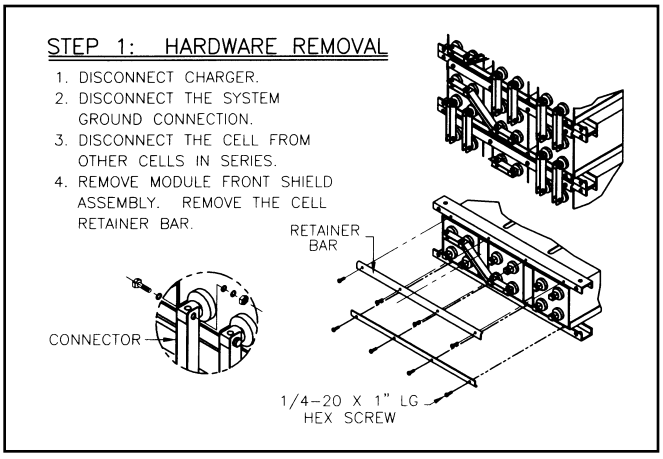


Fig. 25

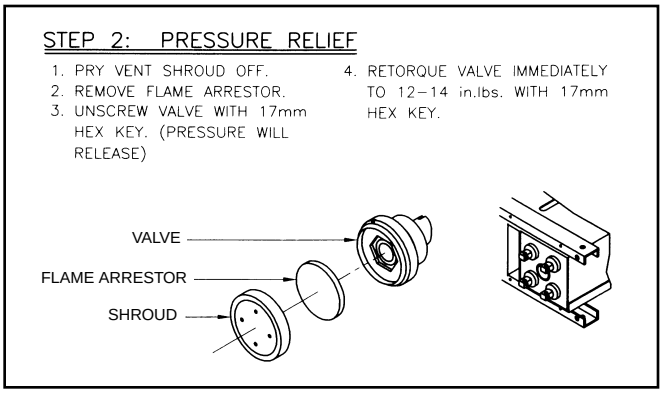


Fig. 26

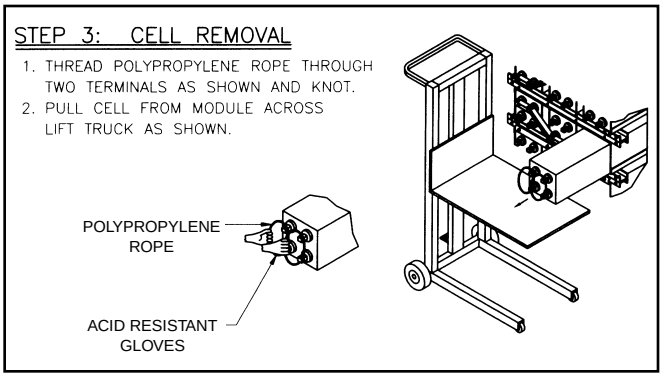


Fig. 27

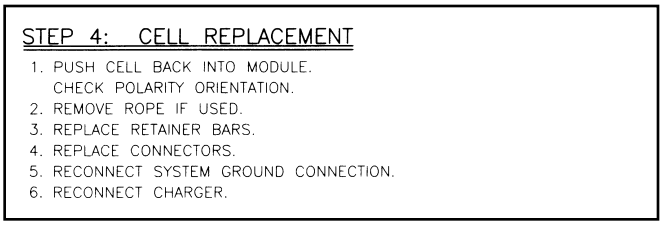


Fig. 28

APPENDIX A

Relay Rack Assembly

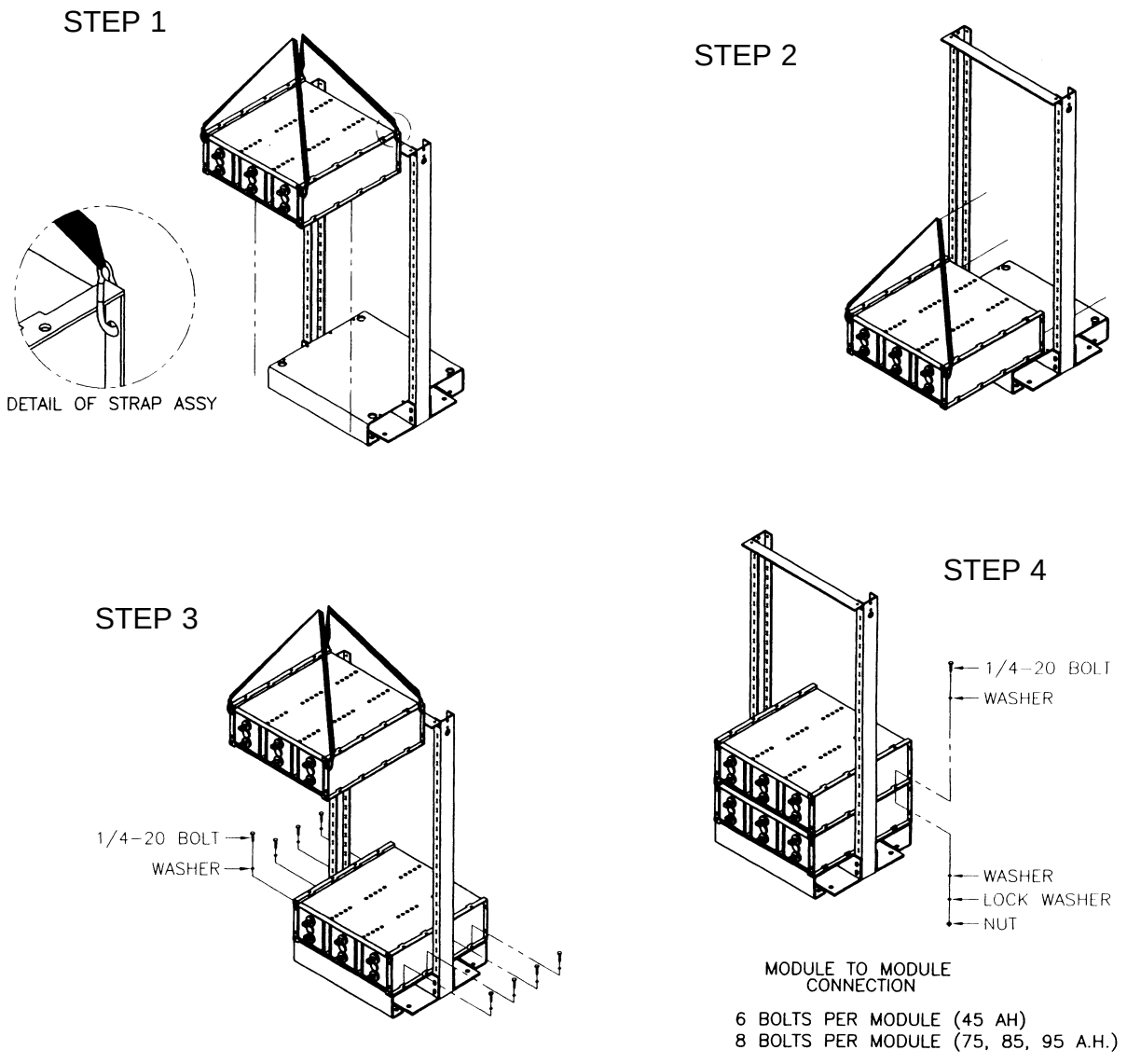
1. Attach the floor mounting brackets to the frame upright. (Refer to Fig. 29, pg. 16 for relay rack assembly.)

   NOTE: If installing battery without relay rack, follow standard module instructions for battery assembly. (Refer to Fig. 30, pg. 17 for assembly instructions.)

2. Insert module base support between the frame uprights (level and anchor). Anchor bolts are not included.
3. Using the lifting slings provided, remove the top module from the shipping pallet and bolt it to the module base support. (Refer to Fig. 29, pg. 16, Steps 1 and 2.) ***CAUTION: Never lift more than one module at a time with the lifting slings.***
4. Remove the next module and bolt it to the first module. Repeat this procedure until the battery is installed to its proper configuration. (Refer to Fig. 29, pg.16, Steps 3 and 4.)

   NOTE: Use the schematic supplied with the battery.

5. Insert the stabilizing bracket and bolt it to the top module. (See Fig.31, pg 17, for instructions.)



RELAY RACK STANDARD MODULE

Fig. 29

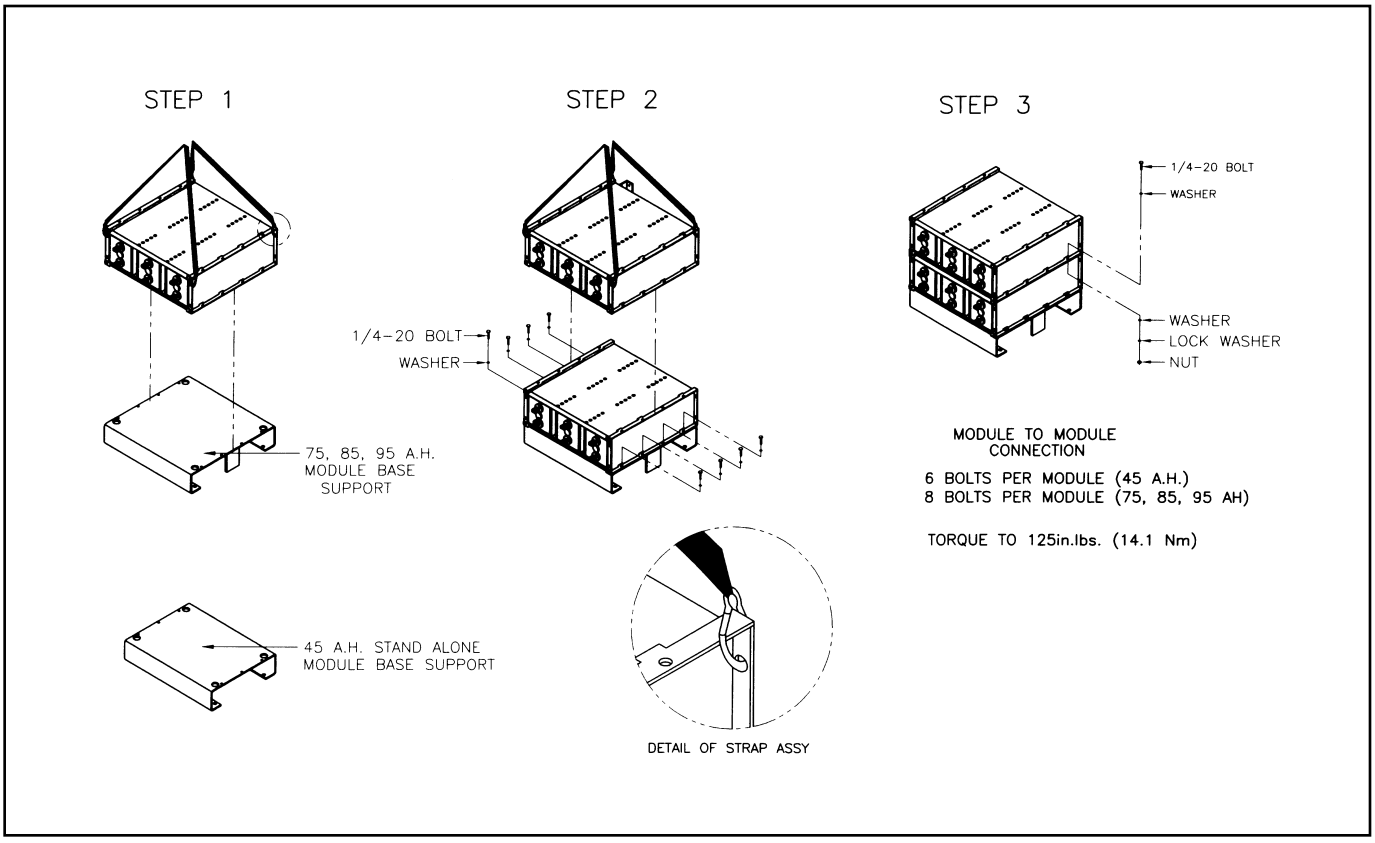

STEP 1
STEP 2
STEP 3
1/4-20 BOLT
WASHER
75, 85, 95 A.H.
MODULE BASE
SUPPORT
45 A.H. STAND ALONE
MODULE BASE SUPPORT
DETAIL OF STRAP ASSY
1/4-20 BOLT
WASHER
WASHER
LOCK WASHER
NUT
MODULE TO MODULE
CONNECTION
6 BOLTS PER MODULE (45 A.H.)
8 BOLTS PER MODULE (75, 85, 95 AH)
TORQUE TO 125in.lbs. (14.1 Nm)

Fig. 30

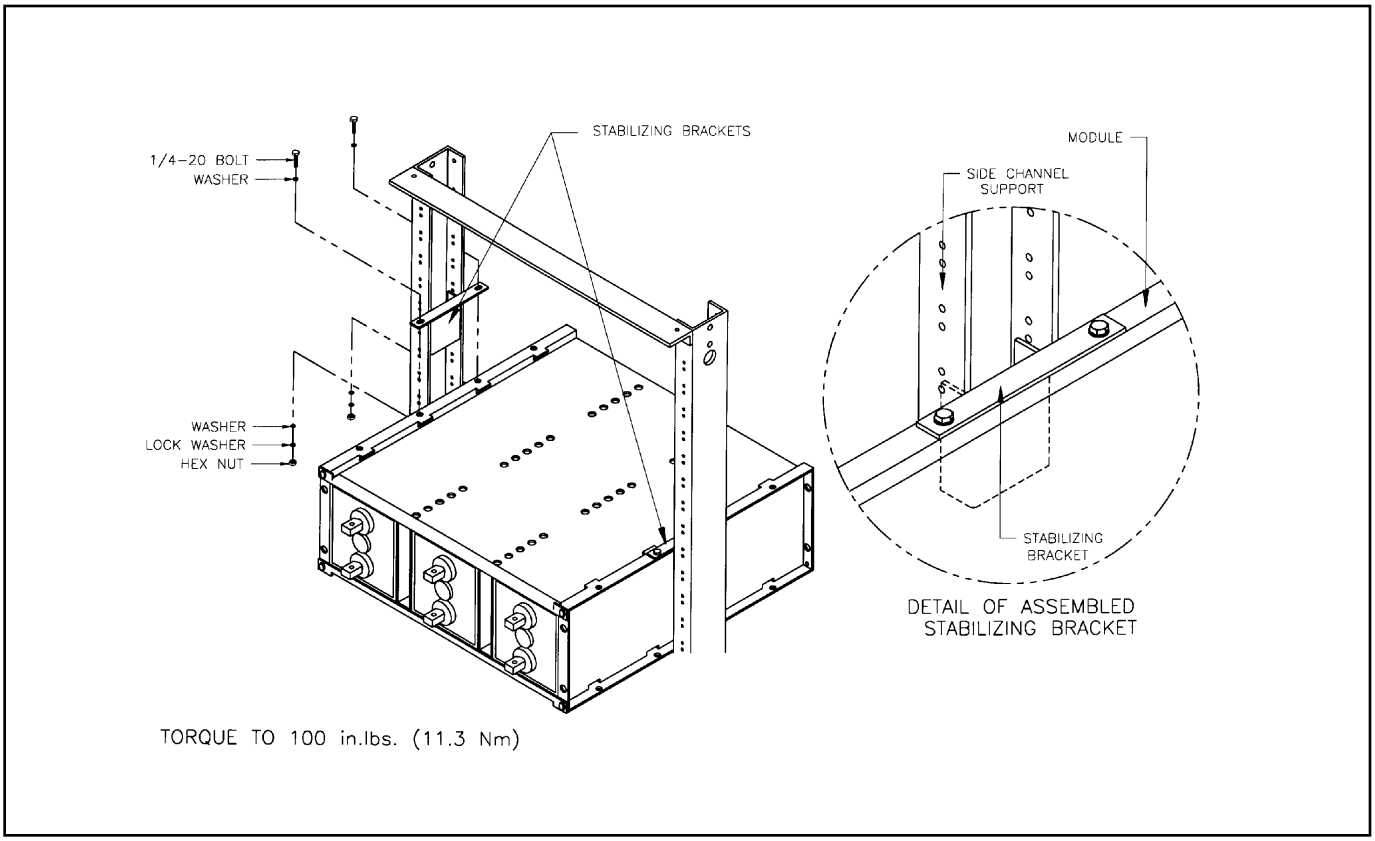

STABILIZING BRACKETS
1/4-20 BOLT
WASHER
WASHER
LOCK WASHER
HEX NUT
MODULE
SIDE CHANNEL
SUPPORT
STABILIZING
BRACKET
DETAIL OF ASSEMBLED
STABILIZING BRACKET
TORQUE TO 100 in.lbs. (11.3 Nm)

Fig. 31

APPENDIX B

– Material Safety Data Sheet –
VALVE REGULATED LEAD-ACID BATTERY –
BATTERY NON-SPILLABLE 49 CFR 173.159 (d)

SECTION I

Manufacturer's Name: East Penn Manufacturing Co., Inc., Deka Road, Lyon Station, PA 19536

Telephone Number for Information: (610) 682-6361 **Date:** September 2001

Emergency Telephone Number: CHEMTREC: 1-800-424-9300 **Trade Name:** Gell; Absorbed Electrolyte,
In Washington D.C. or outside continental U.S., call 1-202-483-7616 Sealed Valve Regulated Non-Spillable Battery

SECTION II
HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components Specific Chemical Identity [Common Name(s)]	OSHA PEL	ACGIH TLV	Range Percent by Weight	Average
Lead, CAS # 7439921	0.05mg/m³	0.05 mg/m³	60–75%	67%
Sulfuric Acid, CAS # 7664939	1.00 mg/m³	1.00 mg/m³	5–15%	10%
Antimony, CAS # 7440360	0.50 mg/m³	0.50 mg/m³	0–0.1%	<0.1%
Arsenic, CAS # 7440382	0.01 mg/m³	0.01 mg/m³	0.01%	<0.1%
Polypropylene, CAS # 9003070	N/A	N/A	2–10%	4%
Calcium, CAS # 7440702	1.0 mg/m³	1.0 mg/m³	0–0.1%	<0.1%
Tin, CAS # 7440315	2.0 mg/m³	2.0 mg/m³	0–0.1%	<0.1%

SECTION III
PHYSICAL/CHEMICAL CHARACTERISTICS

Electrolyte (Sulfuric Acid):

Appearance and Odor: Clear, odorless, colorless liquid
Boiling Point: 235–240°F
Evaporation Rate (Butyl Acetate=1): Less than 1.0
Melting Point: N/A
Solubility in Water: 100%
Specific Gravity (H_2O=1): 1.270–1.330
Vapor Density (Air=1): Greater than 1
Vapor Pressure (mm Hg): 10

SECTION IV
FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used): Non-Flammable **Flammable Limits:** *Hydrogen Gas

Extinguishing Media: Class ABC extinguisher **LEL:** 4% **UEL:** 74%

NOTE: CO_2 may be used, but not directly on the cell. The thermal shock may cause cracking of the battery case(s).

*** Hydrogen gas may be generated during battery charging.**

SECTION V
REACTIVITY DATA

Stability: Stable **Condition to Avoid:** Prolonged overcharging, 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, strong oxidizers and water. Contact with metals may produce toxic sulfur dioxide fumes and may release flammable hydrogen gas.

Hazardous Decomposition of By-Products: Sulfuric Acid: Excessive overcharging or fire may create sulfur trioxide, carbon monoxide, sulfuric acid mist, sulfur dioxide, and hydrogen.

Lead Compounds: Contact with strong acid or base or presence of nascent hydrogen may generate highly toxic arsine gas.

continued

SECTION VI
HEALTH HAZARD DATA

Route(s) of Entry: Not applicable under normal use.

Carcinogenicity: Sulfuric Acid: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid 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 2B carcinogen, likely in animals at extreme doses. Proof of carcinogenicity in humans is lacking at present.

Arsenic: Listed by National Toxicology Program (NTP), IARC, OSHA, and NIOSH as a carcinogen only after prolonged exposure at high levels.

Signs and Symptoms of Exposure: Avoid contact with absorbed electrolyte (sulfuric acid). May cause irritation of eyes, nose and throat. Contact with eyes and skin causes irritation and skin burns. Absorbed electrolyte is corrosive.

Medical Conditions Generally Aggravated by Exposure: Pregnant women and children must be protected from lead exposure.

Health Hazards (Acute and Chronic): Do not open battery, avoid contact with internal components. Internal components include lead and absorbed electrolyte. Electrolyte is corrosive and contact may cause skin irritation and chemical burns.

Emergency and First Aid Procedures (contact with electrolyte):

1. Flush contacted area with large amounts of water for at least 15 minutes. Remove contaminated clothing and obtain medical attention if necessary. Eye wash and/or emergency shower should be readily available.
2. If swallowed, give large volumes of water. **DO NOT** induce vomiting. Obtain medical treatment.

SECTION VII
PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled: Electrolyte material is corrosive. Contains sulfuric acid. Neutralize any spilled material. Reference 1996 North American Emergency Response Guidebook, #154.

Waste Disposal Method: Lead-acid batteries are completely recyclable. For information on returning batteries to East Penn for recycling, contact your East Penn representative. Dispose of any collected material in accordance with local, state or applicable federal regulations.

Precautions to be Taken in Handling and Storing: Store away from reactive material as defined in Section V, Reactivity Data. Place cardboard between layers of stacked batteries to avoid damage and short circuit. Do not allow metallic materials to simultaneously contact both terminals.

Other Precautions: If battery case is broken, avoid direct contact with internal components. Keep away from ignition sources during charging.

SECTION VIII
CONTROL MEASURES

Respiratory Protection (Specific Type): N/A

Ventilation: Must be provided when charging in an enclosed area.

Protective Gloves: Recommended

Eye Protection: Recommended

Other Protective Clothing or Equipment: N/A

Work/Hygienic Practices: Good personal hygiene and work practices are recommended.

SECTION IX
OTHER REGULATORY INFORMATION

NFPA Hazard Rating	Sulfuric Acid	Lead
Health (Blue)	3	3
Flammability (Red)	0	0
Reactivity (Yellow)	2	0

Note: Sulfuric acid is water-reactive if concentrated.

U.S. DOT: The non-spillable lead-acid battery complies with the provisions listed in 49CFR173.159(d); therefore, must not be marked with an identification number, such as UN2800, or a hazard label, such as corrosive. Also, having passed IATA/ICAAO special provision A67, these batteries are not subject to the air dangerous goods regulations.

RCRA: Spent lead-acid batteries are not regulated as hazardous waste when recycled. Spilled sulfuric acid is a characteristic hazardous waste, EPA hazardous waste number D002 (corrosivity).

CERCLA (Superfund) and EPCRA (Emergency Planning and Community Right to Know Act):

a) Reportable quantity (RQ) for spilled 100% sulfuric acid is 1000 lbs.
b) Sulfuric acid is a listed "Extremely Hazardous Substance" under EPCRA with a Threshold Planning Quantity (TPQ) of 1000 lbs.
c) EPCRA reporting required for batteries if sulfuric acid is present in quantities of 500 lbs. or more and/or lead is present in quantities of 10,000 lbs. or more.

California Proposition 65 Warning: Battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

For additional information concerning East Penn Manufacturing Co., Inc. products or questions concerning the content of this MSDS please contact your East Penn representative.

This information is accurate to the best of East Penn Mfg. Co.'s knowledge or obtained from sources believed by East Penn to be accurate. Before using any product, read all warnings and directions on the label.

APPENDIX C

BATTERY MAINTENANCE REPORT

Date _____

Company _____

Address _____

Battery Location and/or Number _____

No. of Cells _____ Type _____ Date Mfg. _____ Date Installed _____

Charger Output _____ Ambient Air Temperature _____ °F

Total Battery Voltage _____ Panel Meter Volts _____ Installer _____

INDIVIDUAL CELL READINGS

Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value	Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value	Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value
1					21					41				
2					22					42				
3					23					43				
4					24					44				
5					25					45				
6					26					46				
7					27					47				
8					28					48				
9					29					49				
10					30					50				
11					31					51				
12					32					52				
13					33					53				
14					34					54				
15					35					55				
16					36					56				
17					37					57				
18					38					58				
19					39					59				
20					40					60				

Remarks and Recommendations _____

_____

_____

_____

Readings Taken By _____

Readings should be taken at installation and at least annually thereafter.
Notation: This form must be completed and submitted with any product warranty claim.

APPENDIX D

UNIGY II Discharge Rates in Amperes to 1.75 VPC Final @ 77˚F (25˚C)												
	CELL TYPE	Nom. A.H. Cap. (8 Hr. Disch. Rate)	24 HRS.	12 HRS.	10 HRS.	8 HRS.	6 HRS.	5 HRS.	4 HRS.	3 HRS.	2 HRS.	1 HR.
45AH	6AVR45-5	90	5	8	10	11	14	16	19	24	32	52
	6AVR45-7	140	7	13	14	17	22	25	29	36	47	78
	6AVR45-9	185	9	17	19	23	29	33	39	48	63	105
	6AVR45-11	230	11	21	24	29	36	41	48	60	79	131
	6AVR45-13	275	14	25	29	34	43	49	58	71	95	157
	6AVR45-15	320	16	29	34	40	50	58	68	83	110	183
75AH	6AVR75-5	160	8	14	16	20	25	28	33	41	54	80
	6AVR75-7	235	12	21	25	29	37	42	50	61	80	121
	6AVR75-9	310	16	28	33	39	49	56	66	82	107	162
	6AVR75-11	390	20	35	41	49	61	70	83	102	134	220
	6AVR75-13	470	23	42	49	59	73	84	100	123	161	242
	6AVR75-15	550	27	50	57	69	86	98	116	143	187	283
	3AVR75-17	630	31	57	66	79	98	112	133	163	214	323
	3AVR75-19	705	35	64	74	88	110	127	150	184	241	364
	3AVR75-21	785	39	71	82	98	122	141	166	204	268	404
	3AVR75-23	865	43	78	90	108	135	155	183	225	295	444
	3AVR75-25	945	47	85	98	118	147	169	200	245	321	485
	3AVR75027	1025	51	92	107	128	159	183	216	265	348	525
	3AVR75-29	1100	55	99	115	138	171	197	233	286	375	554
	3AVR75-31	1175	59	106	123	147	184	211	250	306	402	606
	3AVR75-33	1255	63	113	131	157	196	225	266	327	428	646
85AH	6AVR85-7	265	13	24	27	33	41	47	56	68	90	139
	6AVR85-9	350	17	32	37	44	55	63	74	91	119	185
	6AVR85-11	440	22	40	46	55	68	78	93	114	149	231
	6AVR85-13	530	26	47	55	66	82	94	111	137	179	278
	6AVR85-15	615	31	55	64	77	95	110	130	159	209	324
	3AVR85-17	695	35	63	73	87	109	125	148	182	239	370
	3AVR85-19	785	39	71	82	98	123	141	167	205	268	417
	3AVR85-21	875	44	79	91	109	136	157	185	228	298	463
	3AVR85-23	960	48	87	100	120	150	172	204	250	328	509
	3AVR85-25	1050	52	95	110	131	164	188	222	273	358	555
	3AVR85-27	1135	57	103	119	142	177	204	241	296	387	602
	3AVR85-29	1225	61	111	128	153	191	219	259	319	417	648
	3AVR85-31	1310	65	118	137	164	204	235	278	341	447	694
	3AVR85-33	1400	70	126	146	175	218	250	296	364	477	740
	1AVR85-39	1585	78	142	164	197	245	282	333	410	536	833
	1AVR85-45	1845	92	166	192	230	286	329	389	478	626	972
	1AVR85-51	2095	105	189	219	262	327	376	444	546	715	1111
	1AVR85-57	2360	118	213	247	295	368	423	500	615	804	1250
	1AVR85-63	2625	131	237	274	328	409	470	555	683	894	1388
	1AVR85-69	2890	144	260	301	361	449	517	611	751	983	1527
	1AVR85-75	3145	157	284	329	393	490	564	666	819	1073	1666
	1AVR85-81	3405	170	308	356	426	531	611	722	888	1162	1805
	1AVR85-87	3675	183	332	383	459	572	658	777	956	1251	1944
	1AVR85-93	3935	196	355	411	492	613	705	833	1024	1341	2083
	1AVR85-99	4200	209	379	438	525	654	751	888	1092	1430	2221
95AH	AVR95-7	285	14	26	30	36	45	51	61	76	102	157
	AVR95-9	380	19	34	40	47	60	69	82	102	136	209
	AVR95-11	475	24	43	50	59	74	86	102	127	170	261
	AVR95-13	570	29	52	60	71	89	103	122	152	204	313
	AVR95-15	665	34	60	70	83	104	120	143	178	238	365
	AVR95-17	760	39	69	80	95	119	137	163	203	272	418
	AVR95-19	855	43	77	89	107	134	154	184	228	306	470
	AVR95-21	950	48	86	99	119	149	172	204	254	339	522
	AVR95-23	1045	53	95	109	131	164	189	224	279	373	574
	AVR95-25	1140	58	103	119	142	179	206	245	305	407	626
	AVR95-27	1235	63	112	129	154	194	223	265	330	441	679
	AVR95-29	1330	68	120	139	166	209	240	286	355	475	731
	AVR95-31	1425	72	129	149	178	223	257	306	381	509	783
	AVR95-33	1520	77	138	159	190	238	275	326	406	543	835

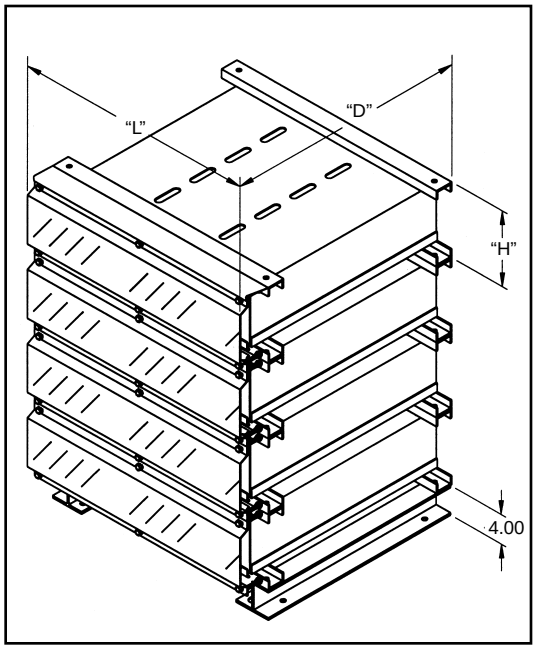
APPENDIX D (continued)

Unigy II Acid Volumes & Weights

TYPE	ELECTROLYTE			PURE ACID POUNDS
	CCs	GALLONS	POUNDS	
45-5	1395	0.37	4.0	1.56
45-7	1955	0.52	5.6	2.18
45-11	3080	0.81	8.8	3.44
45-13	3640	0.96	10.4	4.07
45-15	4200	1.11	12.0	4.69
75-5	2295	0.61	6.6	2.56
75-7	3275	0.87	9.4	3.66
75-9	4215	1.11	12.0	4.71
75-11	5150	1.36	14.7	5.76
75-13	6085	1.61	17.4	6.80
75-15	7025	1.86	20.1	7.85
75-17	7960	2.10	22.8	8.90
75-19	8750	2.31	25.0	9.78
75-21	9835	2.60	28.1	10.99
75-23	10770	2.85	30.8	12.04
75-25	11710	3.09	33.5	13.09
75-27	12643	3.34	36.1	14.13
75-29	13580	3.59	38.8	15.18
75-31	14515	3.83	41.5	16.22
75-33	15455	4.08	44.2	17.27
85-7	3685	0.97	10.5	4.12
85-9	4740	1.25	13.5	5.30
85-11	5795	1.53	16.6	6.48
85-13	6855	1.81	19.6	7.66
85-15	7905	2.09	22.6	8.83
85-17	8965	2.37	25.6	10.02
85-19	10025	2.65	28.7	11.20
85-21	11075	2.93	31.7	12.38
85-23	12135	3.21	34.7	13.56
85-25	13180	3.48	37.7	14.73
85-27	14245	3.76	40.7	15.92
85-29	15300	4.04	43.7	17.10
85-31	16360	4.32	46.8	18.28
85-33	17415	4.60	49.8	19.46
95-7	3592	0.95	10.4	4.35
95-9	4673	1.23	13.5	5.66
95-11	5754	1.52	16.7	6.98
95-13	6835	1.81	19.8	8.29
95-15	7916	2.09	22.9	9.60
95-17	8997	2.38	26.1	10.91
95-19	10078	2.66	29.2	12.22
95-21	11159	2.95	32.4	13.53
95-23	12240	3.23	35.5	14.84
95-25	13321	3.52	38.6	16.15
95-27	14402	3.80	41.8	17.46
95-29	15483	4.09	44.9	18.77
95-31	16564	4.38	48.0	20.08
95-33	17645	4.66	51.2	21.39

MODULE DIMENSIONAL INFORMATION

48-volt assembly with standard covers.



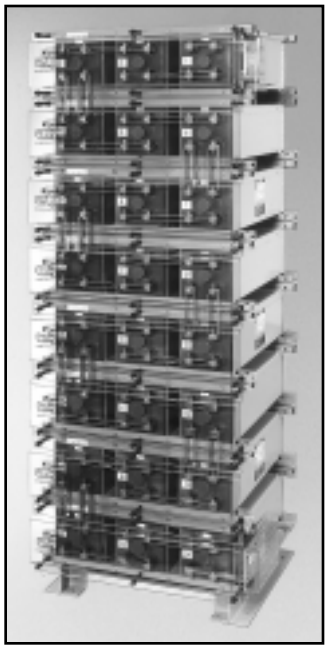


Chart contains dimensions in inches over millimeters and weight in pounds over kilograms.

** Over insulation shield.*

No. of Cells per Module	No. Plts.	L	H	45 Amps per Positive		75 Amps per Positive		85 Amps per Positive		95 Amps per Positive	
				D*	Wt.	D*	Wt.	D*	Wt.	D*	Wt.
6	5	**20.19** 512.8	**8.50** 215.9	**17.50** 444.5	**179** 81	**24.50** 622.3	**259** 117	—	—	—	—
	7	**24.62** 625.4	**8.50** 215.9	**17.50** 444.5	**225** 102	**24.50** 622.3	**330** 150	**27.12** 688.9	**357** 162	**27.12** 688.9	**358** 162
	9	**29.12** 739.7	**8.50** 215.9	**17.50** 444.5	**271** 123	**24.50** 622.3	**397** 180	**27.12** 688.9	**439** 199	**27.12** 688.9	**448** 203
	11	**33.62** 853.9	**8.50** 215.9	**17.50** 444.5	**317** 144	**24.50** 622.3	**471** 214	**27.12** 688.9	**521** 236	**27.12** 688.9	**538** 244
	13	**38.12** 968.3	**8.50** 215.9	**17.50** 444.5	**362** 164	**24.50** 622.3	**542** 246	**27.12** 688.9	**603** 273	**27.12** 688.9	**628** 285
	15	**42.62** 1082.6	**8.56** 217.5	**17.50** 444.5	**408** 185	**24.50** 622.3	**612** 278	**27.12** 688.9	**682** 309	**27.12** 688.9	**719** 326
3	17	**27.62** 701.6	**8.56** 217.5	—	—	**24.50** 622.3	**382** 173	**27.12** 688.9	**428** 194	**27.12** 688.9	**426** 193
	19	**29.88** 758.9	**8.56** 217.5	—	—	**24.50** 622.3	**420** 190	**27.12** 688.9	**472** 214	**27.12** 688.9	**471** 214
	21	**32.10** 815.8	**8.56** 217.5	—	—	**24.50** 622.3	**458** 208	**27.12** 688.9	**508** 230	**27.12** 688.9	**516** 234
	23	**34.38** 873.3	**8.56** 217.5	—	—	**24.50** 622.3	**496** 225	**27.12** 688.9	**557** 253	**27.12** 688.9	**562** 255
	25	**36.62** 930.2	**8.56** 217.5	—	—	**24.50** 622.3	**530** 240	**27.12** 688.9	**598** 271	**27.12** 688.9	**607** 275
	27	**38.88** 987.6	**8.56** 217.5	—	—	**24.50** 622.3	**568** 258	**27.12** 688.9	**639** 290	**27.12** 688.9	**649** 294
	29	**41.12** 1044.5	**8.56** 217.5	—	—	**24.50** 622.3	**606** 275	**27.12** 688.9	**683** 310	**27.12** 688.9	**697** 316
	31	**43.38** 1101.9	**8.56** 217.5	—	—	**24.50** 622.3	**634** 287	**27.12** 688.9	**724** 328	**27.12** 688.9	**739** 335
	33	**45.62** 1158.8	**8.56** 217.5	—	—	**24.50** 622.3	**681** 309	**27.12** 688.9	**770** 349	**27.12** 688.9	**784** 356
1	39	**23.12** 587.2	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**320** 145	—	—
	45	**25.38** 644.7	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**375** 170	—	—
	51	**27.62** 701.6	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**428** 194	—	—
	57	**29.88** 758.9	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**472** 214	—	—
	63	**32.12** 815.9	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**508** 230	—	—
	69	**34.38** 873.3	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**557** 253	—	—
	75	**36.62** 930.2	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**598** 271	—	—
	81	**38.88** 987.6	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**639** 290	—	—
	87	**41.12** 1044.5	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**683** 310	—	—
	93	**43.38** 1101.9	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**724** 328	—	—
	99	**45.62** 1158.8	**8.56** 217.5	—	—	—	—	**27.12** 688.9	**770** 349	—	—

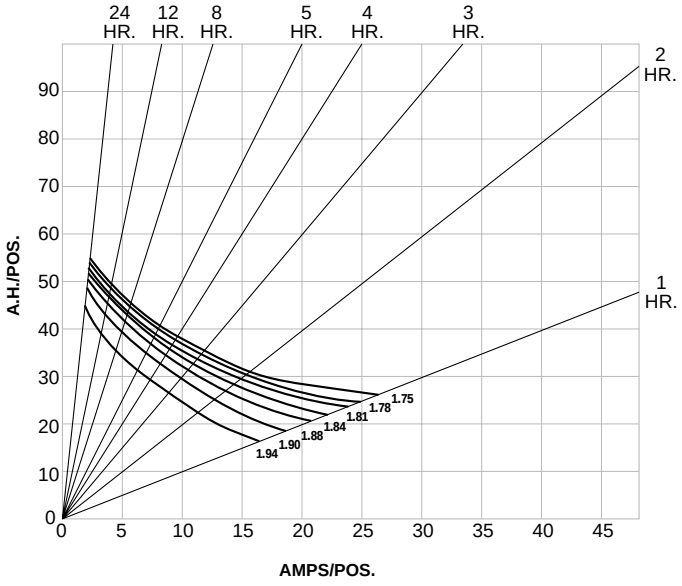
UNIGY II PERFORMANCE CURVES

The following graphs can be helpful in determining the ampere hour capacity and the number of amperes per positive plate for selected battery types at different end voltages from those given in Tables 1, 2 and 3.

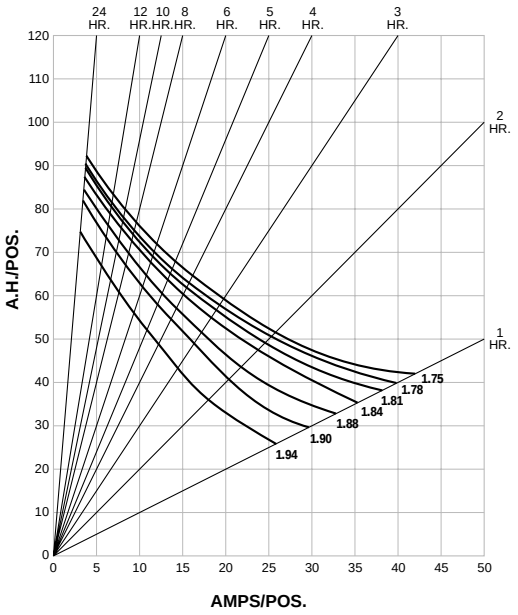
There is one set of performance curves for the 45, 75 and 85 ampere series Unigy II batteries.

To find the ampere hour capacity at a specified end voltage, simply find the intersection of the time and end voltage curves. Multiply this value by the number of positive plates in the specified cell to obtain the cell's A.H. rating. (Note: Cells have one more negative plate than positive plate, i.e., an 3AVR75-33 has 16 positive plates and 17 negative plates.) By aligning this intersection point with the X axis, one can determine the number of amperes per positive plate delivered at the specified discharge rate.

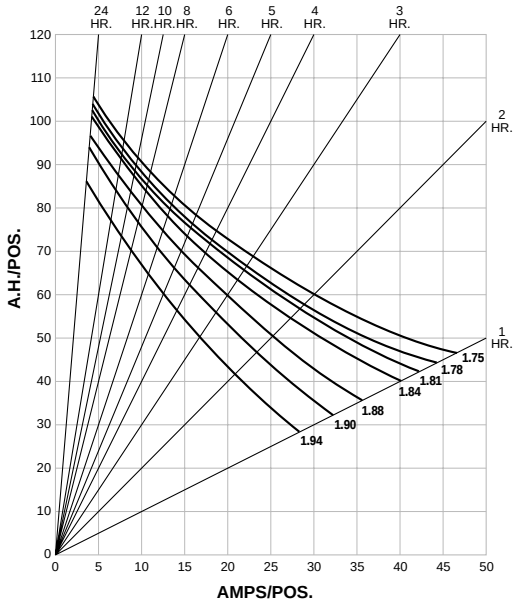
Unigy II 45A Series 1 - 24 Hours



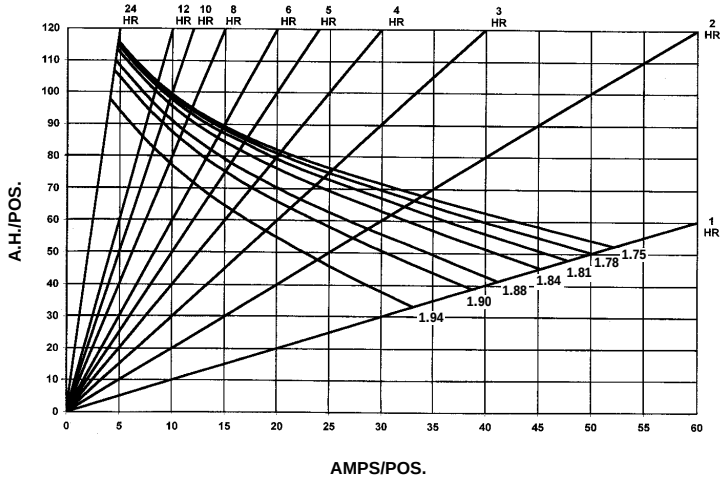
Unigy II 75A Series 1 - 24 Hours



Unigy II 85A Series 1 - 24 Hours



Unigy II 95A Series 1 - 24 Hours



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