OutBack POWER™

an EnerSys company

EnergyCell 1000XLC

Owner's Manual

About OutBack Power

OutBack Power is a leader in advanced energy conversion technology. OutBack products include true sine wave inverter/chargers, maximum power point tracking charge controllers, and system communication components, as well as circuit breakers, batteries, accessories, and assembled systems.

Applicability

These instructions apply to OutBack EnergyCell 1000XLC series batteries only.

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Date and Revision

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Part Number

900-0258-01-00 Rev A

Table of Contents

Important Safety Instructions

READ AND SAVE THESE INSTRUCTIONS!

This manual contains important safety instructions for the EnergyCell battery. These instructions are in addition to the safety instructions published for use with all OutBack products. Read all instructions and cautionary markings on the EnergyCell battery and on any accessories or additional equipment included in the installation. Failure to follow these instructions could result in severe shock or possible electrocution. Use extreme caution at all times to prevent accidents.

WARNING: Personal Injury

- Some batteries can weigh in excess of 100 lb (45 kg). Use safe lifting techniques when lifting this equipment as prescribed by the Occupational Safety and Health Association (OSHA) or other local codes. Lifting machinery may be recommended as necessary.
- Wear appropriate protective equipment when working with batteries, including eye or face protection, acid-resistant gloves, an apron, and other items.
- Wash hands after any contact with the lead terminals or battery electrolyte.

WARNING: Explosion, Electrocution, or Fire Hazard

- Ensure clearance requirements are strictly enforced around the batteries.
- Ensure the area around the batteries is well ventilated and clean of debris.
- Never smoke, or allow a spark or flame near, the batteries.
- Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts.
- Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
- Wear complete eye and clothing protection when working with batteries. Avoid touching bare skin or eyes while working near batteries.
- If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters the eye, immediately flood it with running cold water for at least 20 minutes and get medical attention as soon as possible.
- Never charge a frozen battery.
- Insulate batteries as appropriate against freezing temperatures. A discharged battery will freeze more easily than a charged one.
- If a battery must be removed, always remove the grounded terminal from the battery first. Make sure all devices are de-energized or disconnected to avoid causing a spark.
- Do not perform any servicing other than that specified in the installation instructions unless qualified to do so and have been instructed to do so by OutBack Technical Support personnel.

Additional Resources

These references may be used when installing this equipment. Depending on the nature of the installation, it may be highly recommended to consult these resources.

Institute of Electrical and Electronics Engineers (IEEE) guidelines: IEEE 450, IEEE 484, IEEE 1184, IEEE 1187, IEEE 1188, IEEE 1189, IEEE 1491, IEEE 1578, IEEE 1635, and IEEE 1657 (various guidelines for design, installation, maintenance, monitoring, and safety of battery systems)

Introduction

Audience

This manual is intended for use by anyone required to install and operate this battery. Be sure to review this manual carefully to identify any potential safety risks before proceeding. The owner must be familiar with all the features and functions of this battery before proceeding. Failure to install or use this battery as instructed in this manual can result in damage to the battery that may not be covered under the limited warranty.

EnergyCell 1000XLC

The EnergyCell 1000XLC is a high-performance Valve Regulated Lead-Acid (VRLA) battery designed for long life, fast installation, and low maintenance. Featuring a carbon additive that reduces sulfation on the negative plate, the 1000XLC has exceptional cycle life and a 10-year warranty, combining the benefits of proven lead acid technology with advanced chemistry. The 1000XLC is also designed for safety with minimal offgassing under normal charging conditions and leak-proof engineering. These attributes and more make the 1000XLC an excellent candidate for storing residential or light commercial renewable energy.

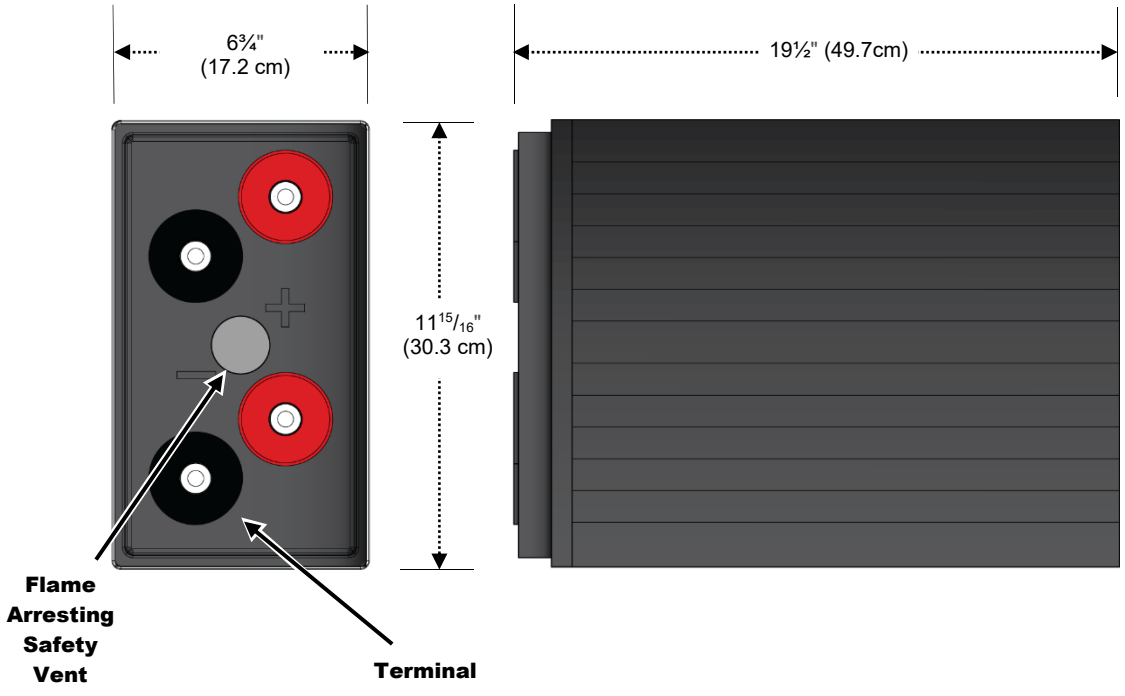

Figure 1 EnergyCell 1000XLC

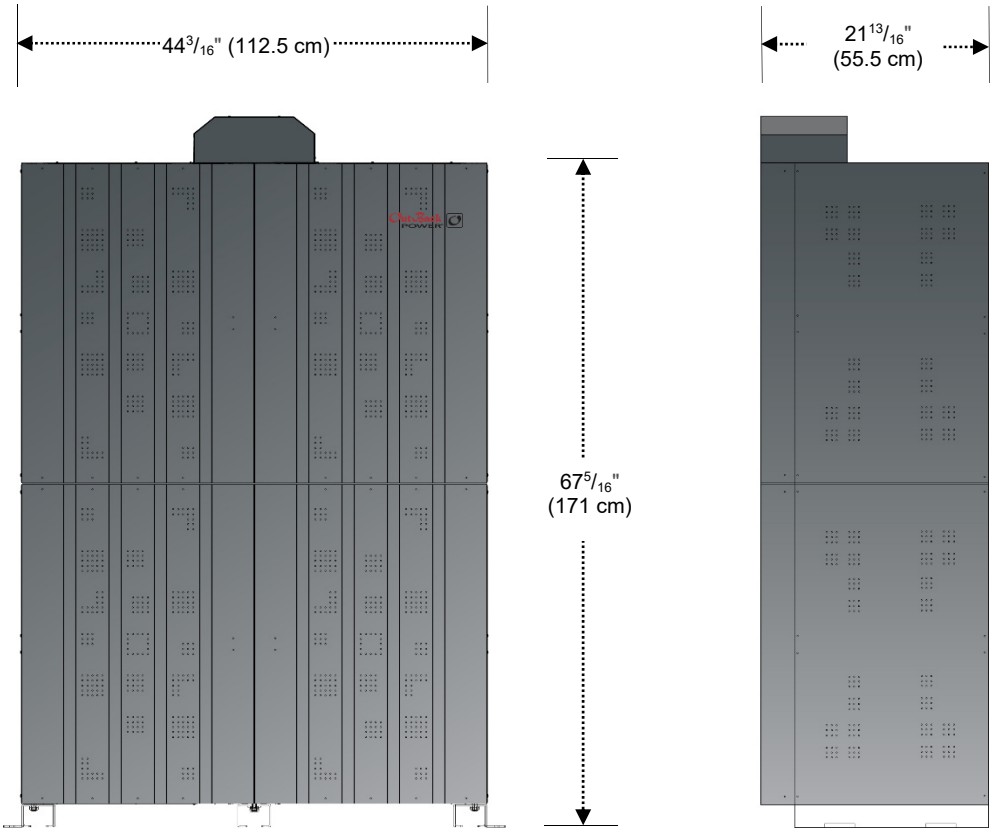

Figure 2 EnergyCell 1000XLC Assembly

IMPORTANT:

The surface supporting the assembled cabinet must be designed to support 27.3 psi (1.92 kg/cm²). Concrete is ideal. Total weight of cabinet assembly with batteries is 4,574 lb (2,075 kg).

Materials Required

Tools (use insulated tools only)

- Digital voltmeter
- Drill
- Hammer
- Level
- Socket wrench
- Torque wrench calibrated in inch-pounds
- Box end wrench
- Battery lifting equipment (eyebolts and straps) and fork lift to lift battery modules
- Rubber gloves
- Full face shield
- Plastic apron
- Portable eyewash
- Spill kit
- Fire extinguisher (class C)

Accessories

- Interconnect bar (included)
- Terminal cover (included)
- Hardware (included)
- Support bars (included)
- Beams (included)
- Insulators (included)
- Upper shield (included)
- Bus bars and safety covers (included)
- Dielectric grease (included)
- Grounding Wire
- Cables

CAUTION: Fire Hazard

Install properly sized battery cabling and interconnect cables. The cable ampacity must meet the needs of the system, including temperature, deratings, and any other code concerns.

Storage and Environment Requirements

Temperatures

- Optimal operating temperature is 77°F (25°C); maximum temperature range is –4° to 104°F (–20° to 40°C).
- Do not allow batteries to freeze, as this will damage them and could result in leakage.
- Do not expose batteries to temperature variations of more than 5°F (3°C). This leads to voltage imbalance between multiple batteries (or between battery cells if there is a temperature differential).
- Batteries should be stored in a cool, dry location.

Self-Discharge

Unlike many conventional batteries, 1000XLC batteries won't discharge significantly over time once charged, even in storage. This is especially true if the batteries are kept relatively cool. Fully charged, the natural ("rest") voltage of 1000XLC batteries is approximately 52.0 Vdc (2.2 volts per cell or Vpc). A battery should have a freshening charge (see page 25) if its rest voltage is below 50.4 Vdc (2.1 Vpc). A battery should not be used if its rest voltage is 48 Vdc (2 Vpc) or lower upon delivery. Contact Outback Power upon receiving a battery in this state.

Storing EnergyCell 1000XLC Batteries

The EnergyCell 1000XLC batteries must be given a freshening charge every 6 months when stored at 77°F (25°C). If stored in higher temperatures, the charge should be more often.

Capacity

Battery capacity is given in ampere-hours or amp-hours (Ah). This is a current draw which is multiplied by the duration of current flow. A draw of *X* amperes for *Y* hours equals an accumulation of *XY* amp-hours.

Because the battery's chemical reaction constantly releases energy, its amp-hour capacity is affected less by lighter loads. The battery has greater capacity under lighter loads.

For example, if the EnergyCell 1000XLC is discharged at the 20-hour rate to a voltage of 1.75 Vpc (a load expected to effectively drain 100% of its capacity in 20 hours), it will be measured to have 972 amp-hours. However, at the 2-hour rate, a heavier load, only 572 amp-hours will be measured. For all tested discharge rates and amp-hours, see Table 3 on page 33.

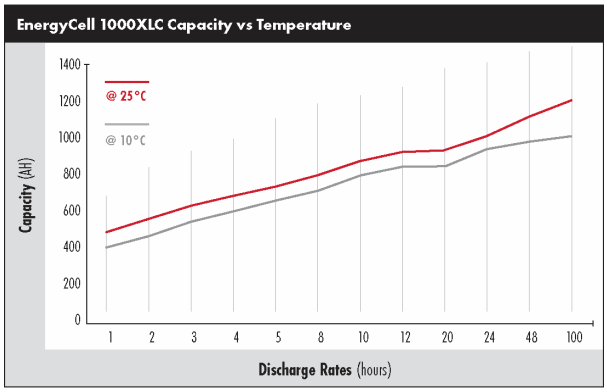

Figure 3 Capacity vs. Temperature

State of Charge

The EnergyCell State of Charge (SoC) can be determined by two methods. One is to measure its voltage. This is accurate only if the batteries are left at rest (no charging or loads) for 24 hours at room temperature (77°F or 25°C). **If these conditions are not met, then voltage checks may not yield usable results.** If they are met, then on average, a battery at 52.8 Vdc (2.2 Vpc) will be at 100% SoC. A rest voltage of 48.8 Vdc (2.03 Vpc) represents roughly 50% SoC.

The more accurate method is to use a battery monitor such as the OutBack FLEXnet DC. Using a sensor known as a shunt, the monitor observes the current through the battery. It keeps a total of amp-hours lost or gained by the battery and can give accurate SoC readings.

The EnergyCell can be discharged and recharged (cycled) regularly to a level as low as 50% depth of discharge (DoD). This is common in a cycling application such as an off-grid system. However, for optimal life, the best practice is to avoid ever discharging below 50%. Lower DoD levels can shorten the battery life.

If operated in a range with consistent charge and discharge to no more than 50% DoD, the EnergyCell 1000XLC will typically deliver 3,800 cycles. With consistently lighter discharge (10 to 30% DoD with proper recharge), the battery may have significantly more cycles.

The graph below indicates the battery's anticipated cycle life.

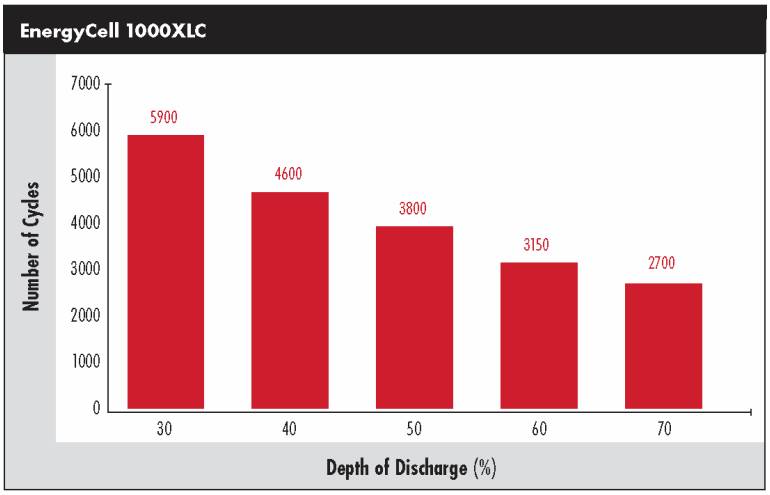

Figure 4 Anticipated Cycle Life

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Installation

System Installation Considerations

CAUTION: Fire Hazard

Failure to ventilate the battery compartment can result in the buildup of hydrogen gas, which is explosive.

- The battery enclosure or room must be well-ventilated. This ventilation protects against accidental gas buildup. All EnergyCell batteries are valve-regulated and do not normally emit noticeable amounts of gas. However, in the event of accidental leakage, the enclosure must not allow the leaked gas to become concentrated.
- The battery enclosure or room must have adequate lighting. This is necessary to read terminal polarity, identify cable color, and view the physical state of the battery as required.
- The battery should be installed with a minimum 36" (91.4 cm) clearance in front. This allows access for testing, maintenance, and any other reasons.

Battery Installation

The EnergyCell 1000XLC is designed for fast modular installation into an assembled cabinet for a 48V battery bank. The batteries come in modules of 6 cells which can be stacked in 4 rows, resulting in a neat, fully enclosed, and non-conductive cabinet. The assembled cabinet is $44^{5}/_{16}$" (112.5 cm) x $67^{5}/_{16}$" (171 cm) x $21^{7}/_{8}$" (55.5 cm). Use powered lifting equipment and the puller kit shown in Figure 9, or if lifting equipment is unavailable remove the batteries from their modules before stacking, then replaced one at a time.

IMPORTANT:

The surface supporting the assembled cabinet must be designed to support 27.3 psi (1.92 kg/cm^2). Concrete is ideal.

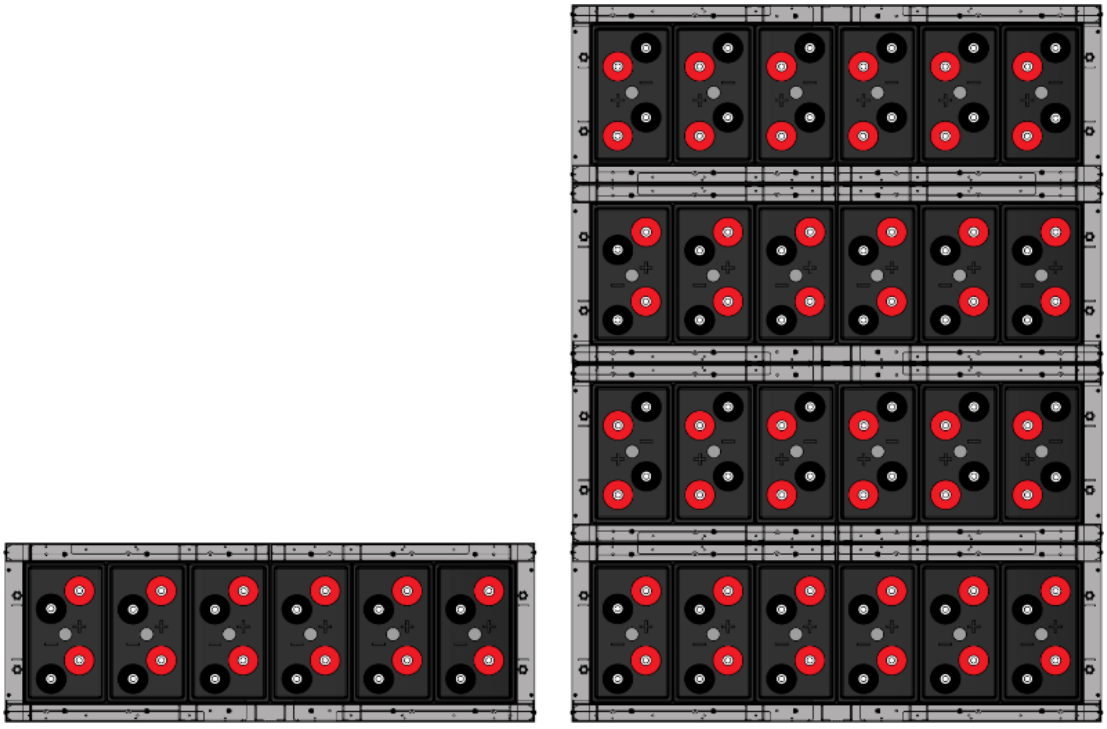


Figure 5 Single Module and Four Module Stack

Pre-Installation Check

Inspect batteries carefully for any physical damage or leaking and check safety vents.

Ensure all batteries in each module are oriented consistently with positive terminals on one side of each battery and negative terminals on the other side.

Installation Procedure

1. Install 4 support bars on module frame and fasten with M5 screws (3 screws per bar). The set of 2 bars closest to the positive battery terminals should be installed adjacent to each other, while the bars closest to the negative terminals should be installed with their outer ends flush with the outer edge of the module frame and a gap in the module center between the two bars.

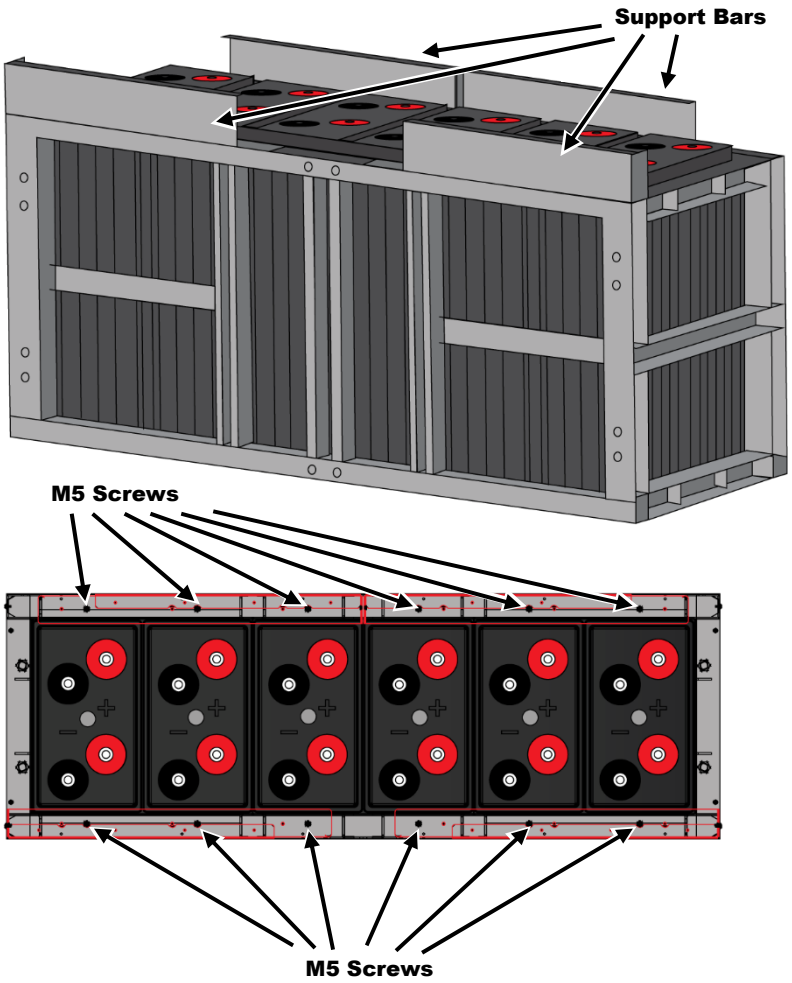


Figure 6 Install Support Bars

2. After installing support bars on each of the 4 modules, number each module #1 to #4. Module #1 will be the bottom module in the stack.
3. Install 3 mounting beams on module #1 (the bottom module) using M12 bolts and M3 screws—note that beams fasten onto the same side of the module frame as the gapped support bars installed previously, which is also the side closest to the negative terminals. On module 1 only, install the baffle board in the gap between the support bars. M12 bolts should be torqued to 42 Nm (428 kgf·cm) while M3 screws should be torqued to 0.63 Nm (6.42 kgf·cm).

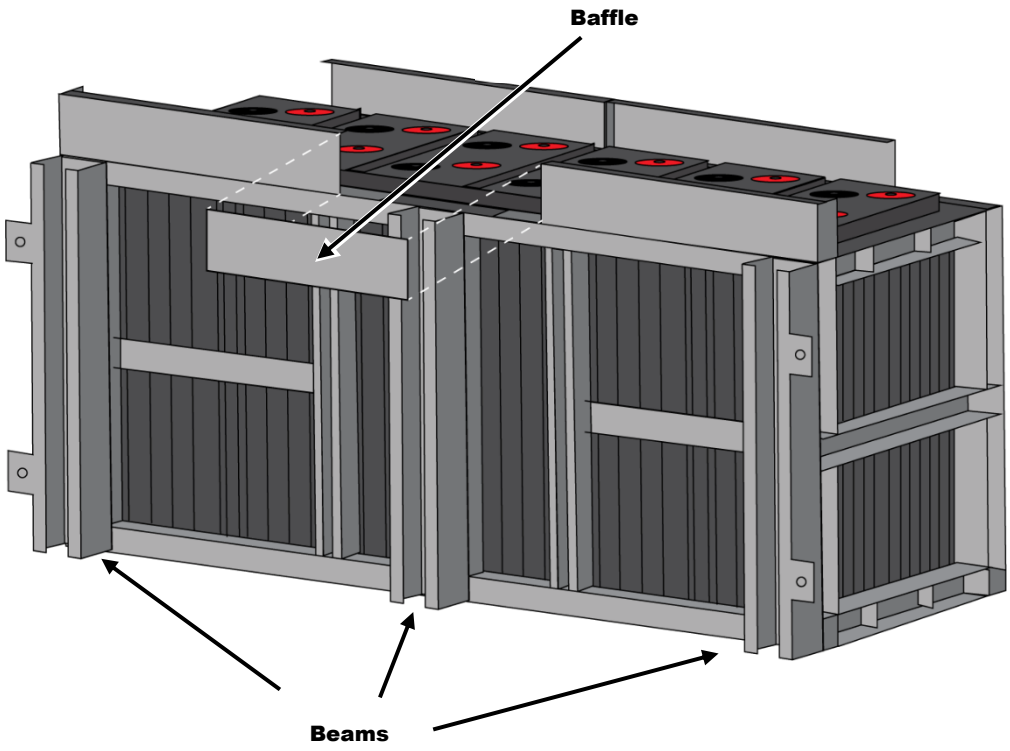


Figure 7 Install Mounting Beams and Baffle on Module #1

4. Anchor module #1, which will be the bottom module of the assembled cabinet, onto a strong and level mounting surface (concrete floor is ideal). Keep at least a 2" (5 cm) gap between the module and any wall to allow air circulation. Follow these steps to anchor the module:

   a. Mark the position of the four mounting holes on the floor and drill a $^{9}/_{16}$" (14 mm) diameter hole 2¾" (70 mm) deep in each of the four positions. Clean any dust or debris from the holes.

   b. Position module #1 so the holes in the metal tabs attached to the outer beams previously fastened to the module frame align with the holes in the floor. Gently hammer an M12 expansion bolt into each hole, stopping when the bolt reaches the bottom of the hole.

   c. Thread a nut onto each bolt and torque to 80 lbf·ft (107.8 N·m or 1100 kgf·cm).

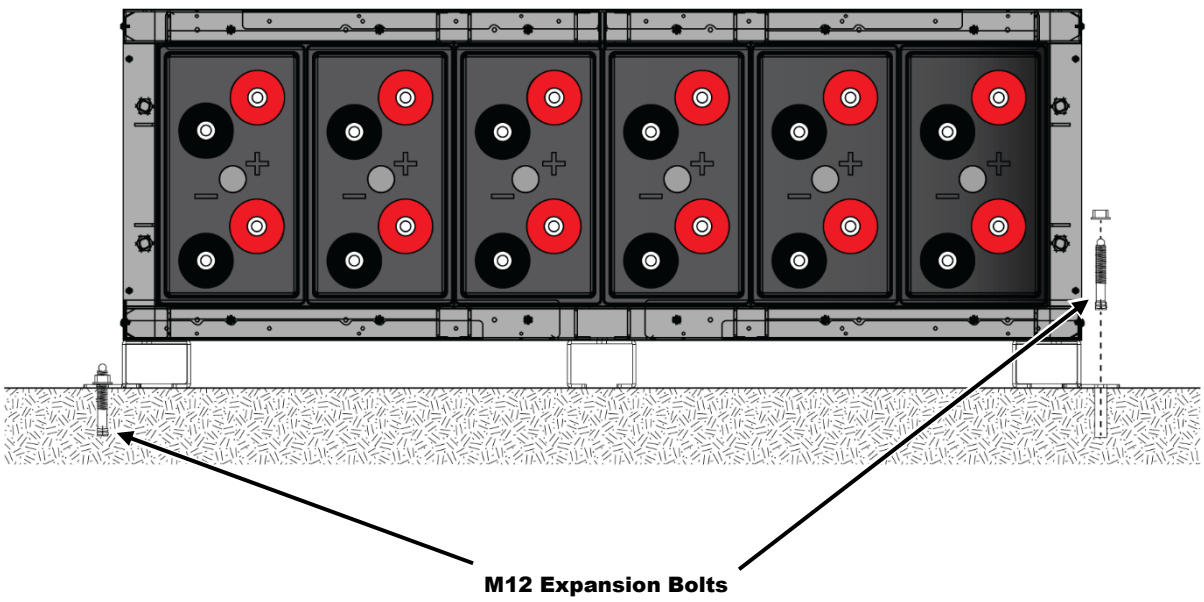


Figure 8 Mount Bottom Module

5. Carefully position module #2 on top of module #1 and secure with M12 bolts. If possible, use a forklift or powered lifting device to lift the module (1,100 lb/500 kg) after attaching a heavy-duty strap to each side of the module using eyebolts (if no powered lift device is available, remove the batteries from the module one by one [200 lb/90 kg], stack the empty module and then insert the batteries). Then repeat with module #3 above module #2. Make sure to follow the alternating battery orientation pattern—module #2 will have a pair of positive terminals on the left side, while module #3 has a pair of negative terminals on the left side.

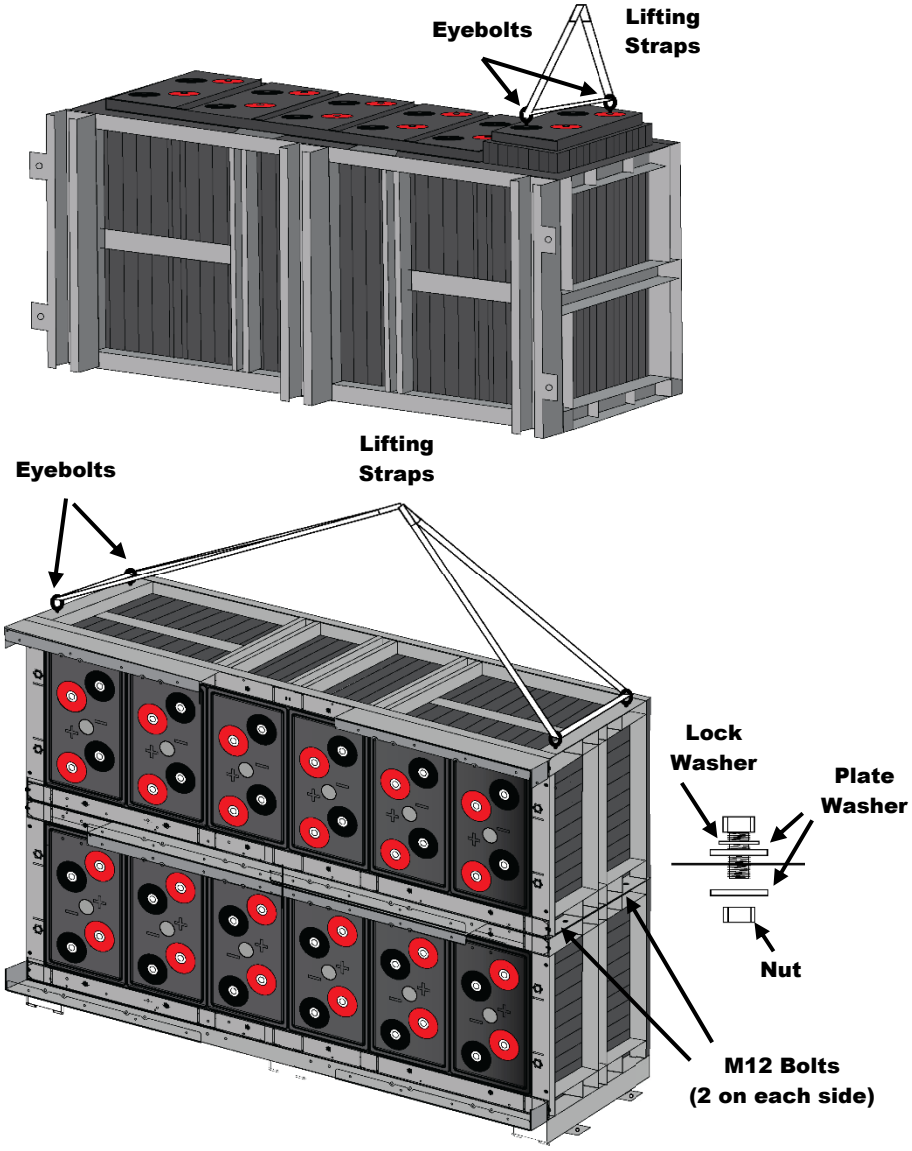


Figure 9 Stack Module #2 on Module #1

6. Before installing the top module #4, install 2 red insulators with M3 screws near the center of the top front of module #4 frame, in the gap between the two support bars installed earlier. Install cover on top of module #4. Then install #4 module on top of module #3.

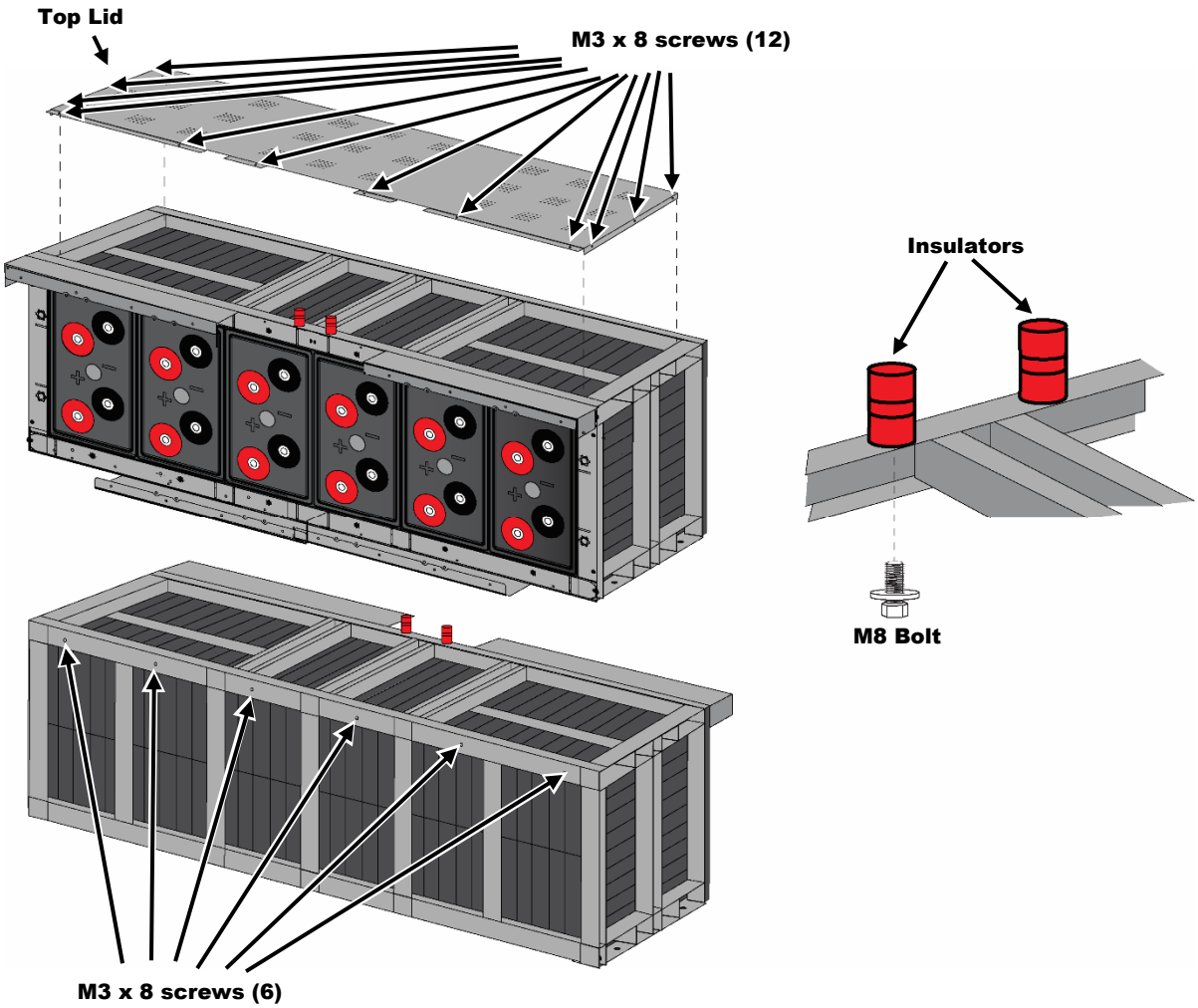


Figure 10 Install Insulators and Top Cover

7. Check again to be sure batteries are correctly positioned with orientation alternating between rows. If correct, the support bars attached to front of modules should be matched, with the center gap between support bars showing where module #2 meets module #3, and the support bars adjacent to each other (no gap) where modules #1 and #2 meet as well as where modules #3 and #4 meet.

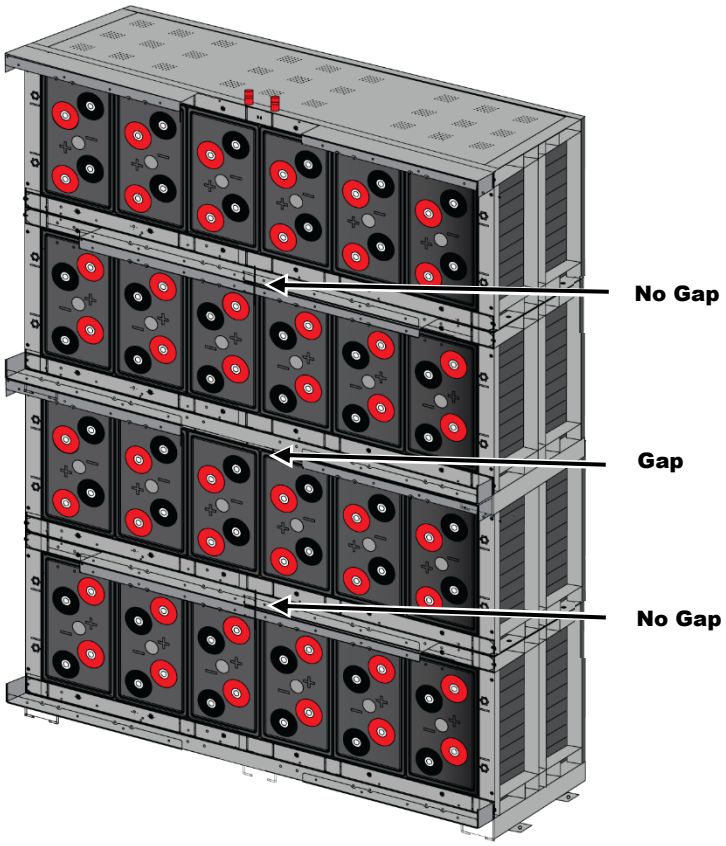


Figure 11 Check Battery Orientation

8. Lightly brush the terminal contact surface areas with a brass bristle brush or the equivalent, then coat with dielectric grease such as NO-OX-ID or NCP-2. Carefully install short bus bars using M10 bolts so that batteries are connected in series. Torque bolts to 28.1 to 33.8 N·m (287 to 344 kgf·cm) or 531 Lbf·in, then place protection covers over each bus bar.

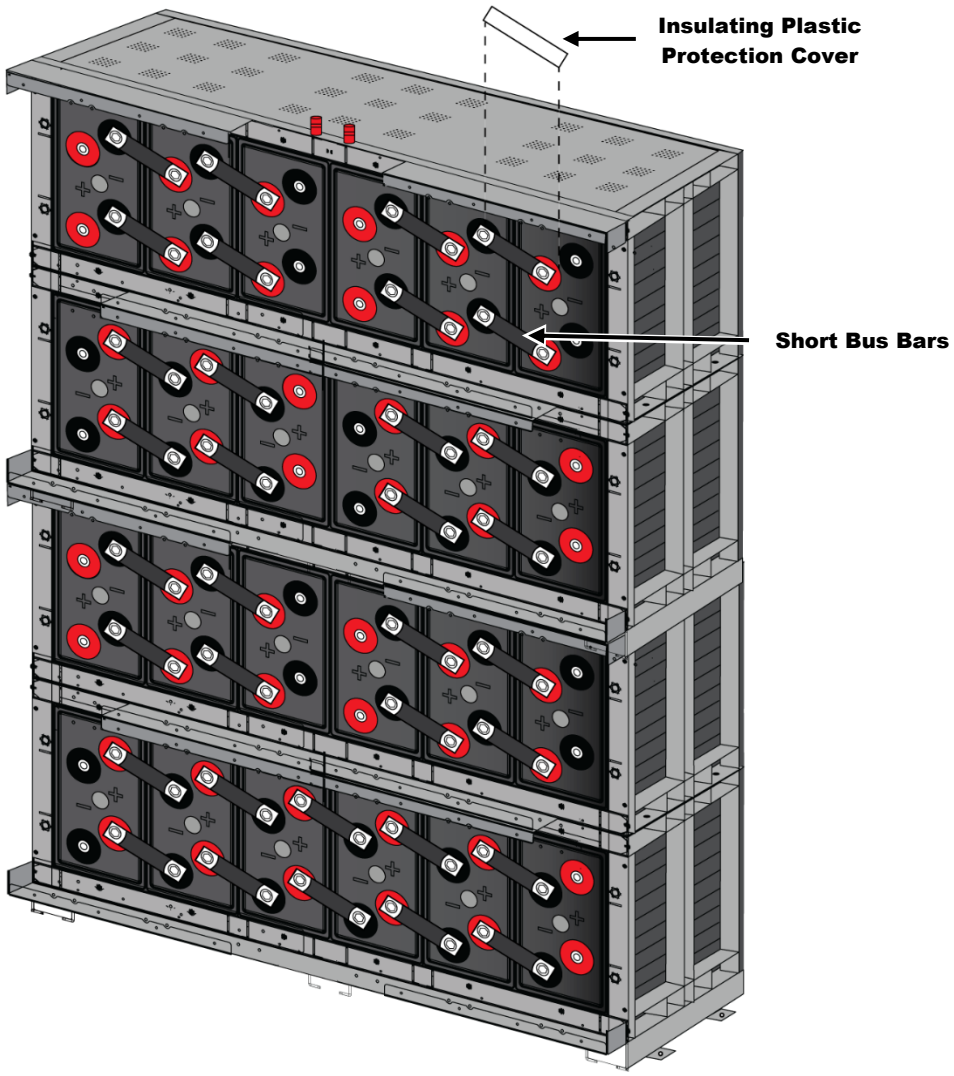


Figure 12 Install Short Bus Bars and Insulating Covers

9. There are 4 different types of long bus bars (A, B, C, and D). Connect these as shown below. Bus bars A and B are secured with M10 bolts, while bus bars C and D are secured with M8 bolts. Torque M10 bolts to 17.2 ± 2.5 N·m (175± 25 kgf·cm) and M8 bolts to 6.2 N·m (63.2 kgf·cm).

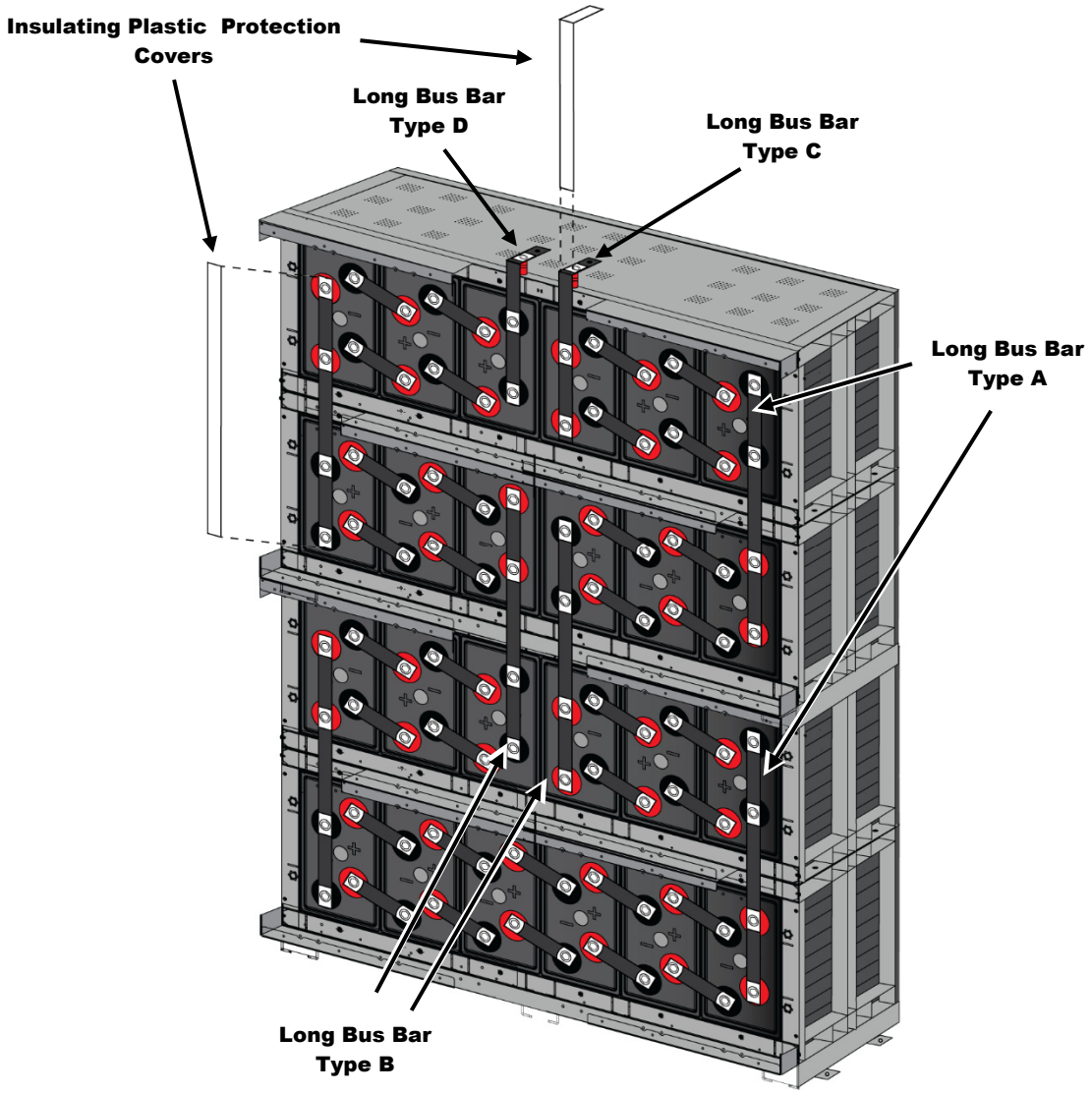
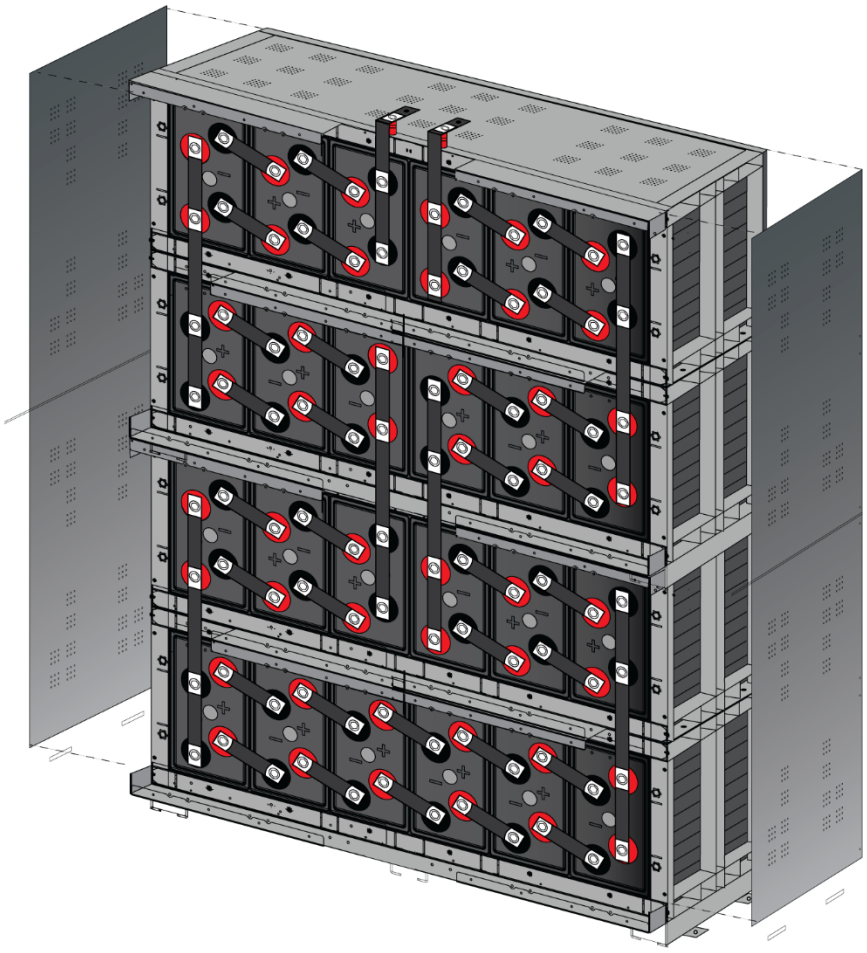


Figure 13 Install Long Bus Bars and Insulating Covers

10. Install side shields using M3 screws. Begin at the back, then proceed to the front, and lastly both sides.



M3 Screws
(16 per side)

Figure 14 Install Long Side Panels

11. Install front cover (4 separate panels).

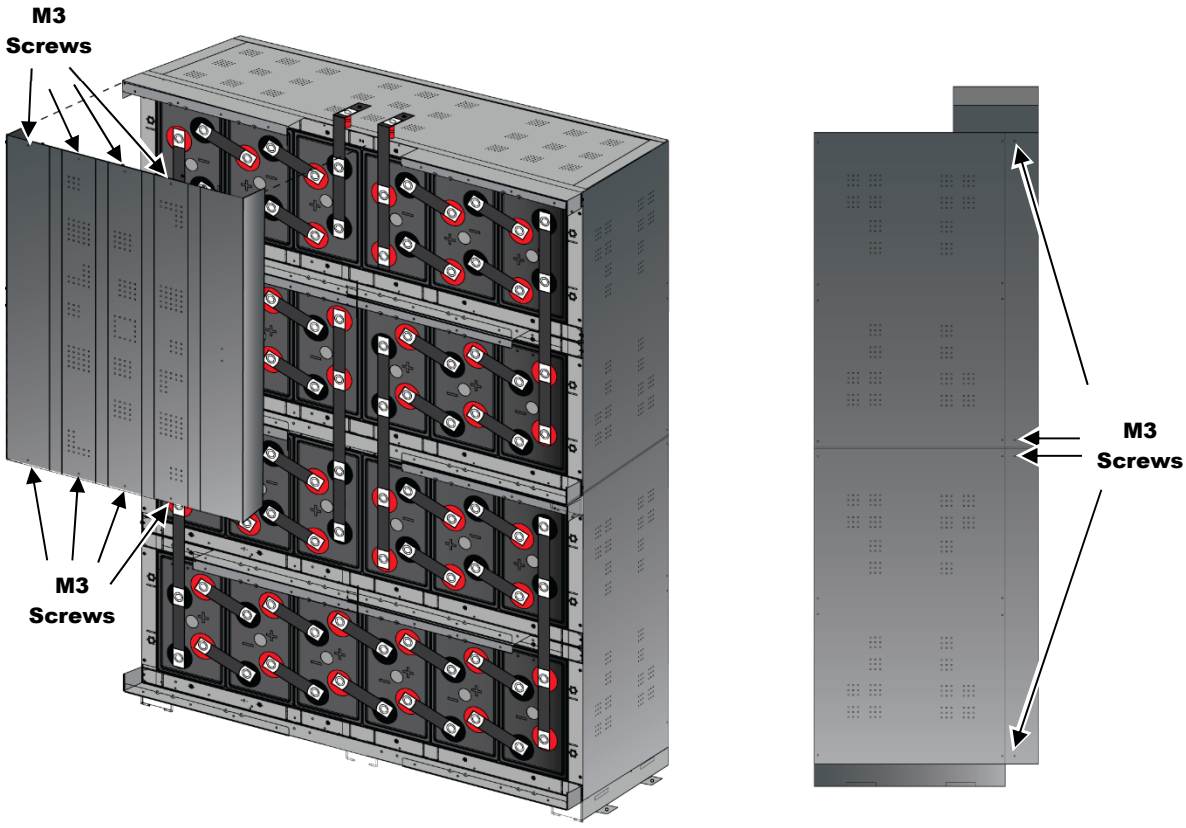


Figure 15 Install Front Cover Panels

12. Install battery cables to the top bus bars using M12 bolts. Install the Equipment Grounding Conductor to the screw provided near the lower rear corner of the side panel.

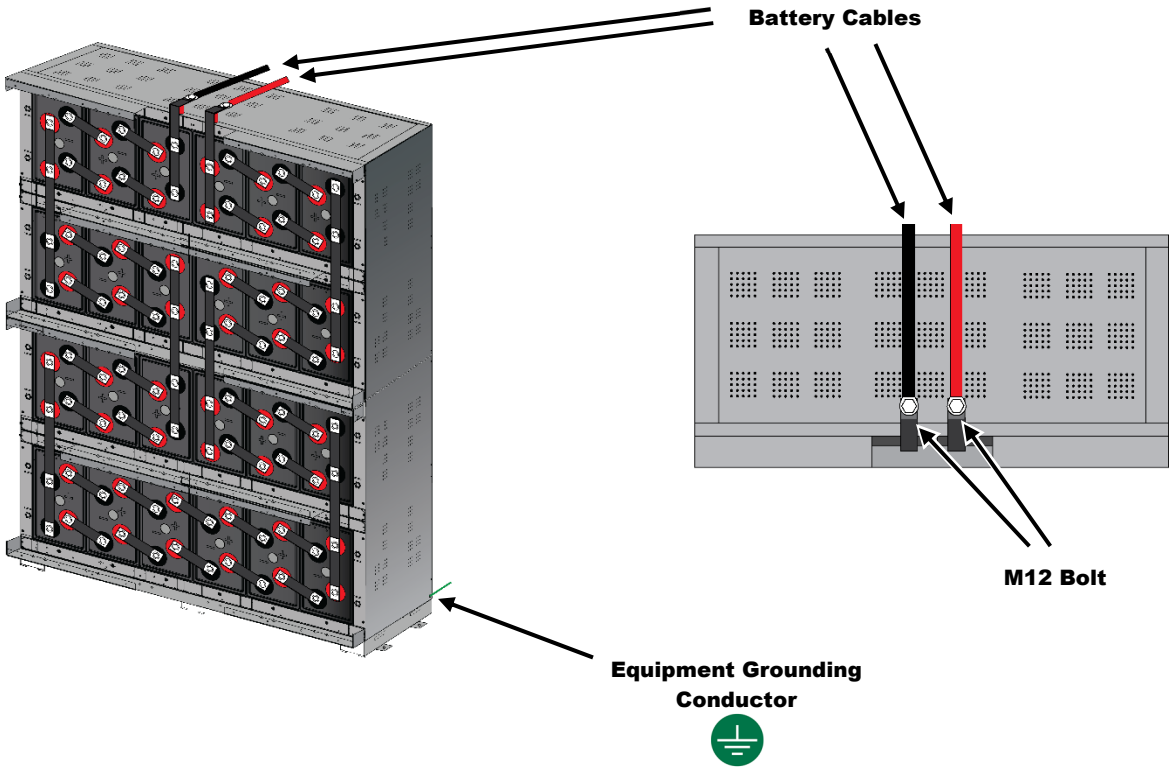


Figure 16 Install Battery Cables

13. Install the bus bar cover on top by locking into place with side tabs and securing with two M3 screws on back side of cover.

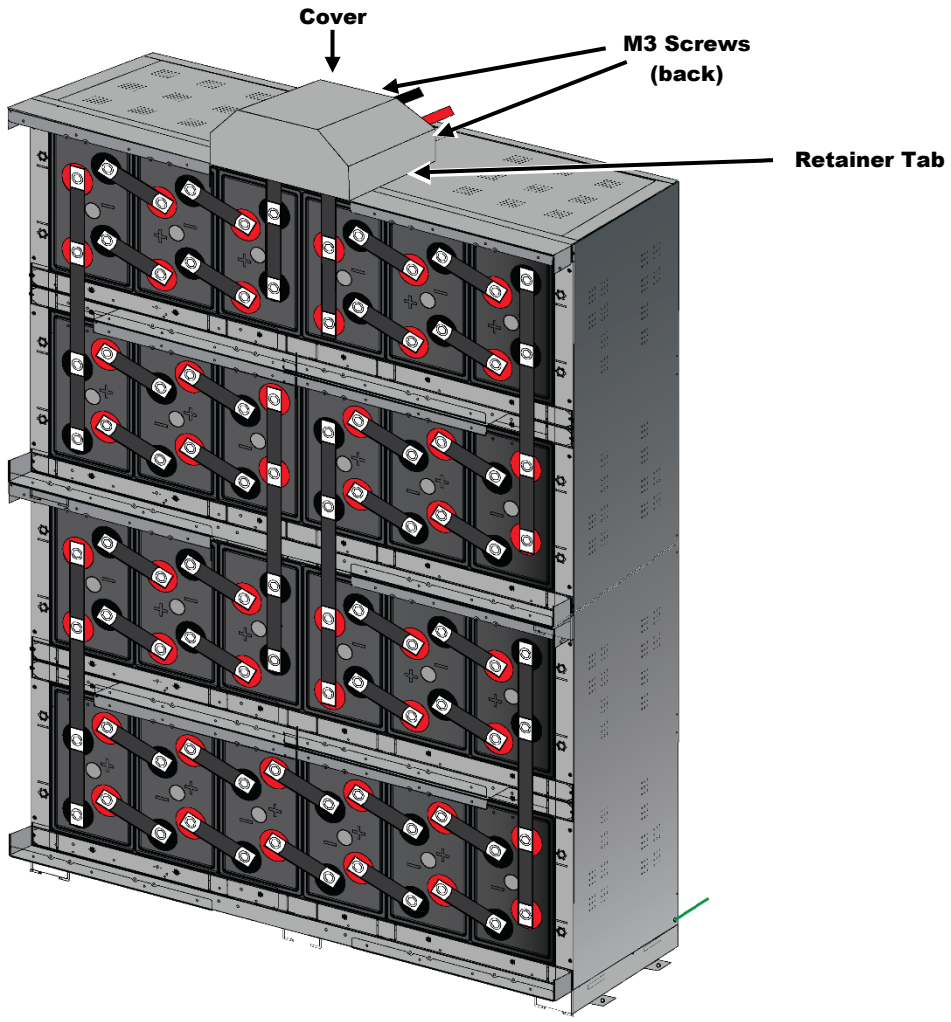


Figure 17 Install Bus Bar Terminal Cover

Operation

Commissioning

After installing the battery bank, measure the overall open circuit voltage of the bank as well as each individual cell, and record these values. If the system voltage is less than 50.6 Vdc (or individual cell voltage less than 2.11 Vpc), apply a freshening charge to the bank as follows:

To apply a freshening charge:

1. Perform a bulk charge with a recommended charge current of 168 Adc but not to exceed the maximum limit of 200 Adc to 58 Vdc (2.42 Vpc).
2. Follow the bulk charge with an Absorb charge at 58 Vdc for 12 hours.
3. Re-measure open circuit voltage. If system voltage is less than 50.6 Vdc (2.11 Vpc) continue to step 4.
4. Proceed with an additional charge for 4 hours using a target voltage of 60 Vdc (2.5 Vpc).

Charging

The XLC1000 battery should be charged using a three-stage charging process.

Bulk Stage

The bulk stage is a constant-current stage. The charge current is maintained at a constant high level (not to exceed 200 Adc per battery) until the voltage reaches 58 Vdc (2.42 Vpc). At the end of the bulk stage the battery will be at 85 to 90% SoC.

At excessive current rates, the battery's conversion efficiency becomes less and it may not become completely charged.

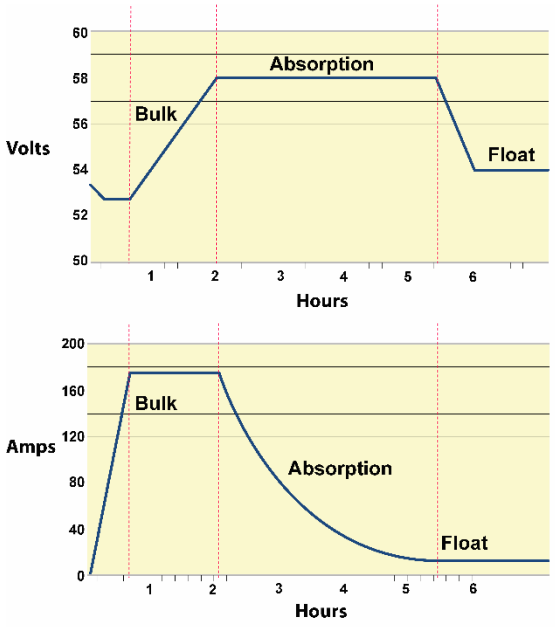


Figure 18 Three-Stage Charging

Absorption Stage

Absorption is a constant-voltage stage. It is established upon reaching the Absorb voltage setting of 58 Vdc (2.42 Vpc). The charger limits the current flow to only what is necessary to maintain this voltage. A high current is required to raise the voltage to the absorption level, but less is required to maintain it there. As long as the absorption level is maintained, the requirement causes a tapering current. The amount of absorption current will vary with conditions, but will typically decrease to a very low number. This "tops off the tank," leaving the battery at 100% SoC. The 1000XLC should undergo a 3.5 hour absorption stage during normal daily use.

Float Stage

The float stage maintains the battery at a full state of charge. Set float between 53 and 54Vdc (2.21 to 2.25 Vpc) for 2 hours.

Equalization

Once every 14 days the batteries should be given an equalization charge to maintain optimal battery health and to compensate the 1-6% loss during daily cycling. The equalization procedure for the 1000XLC involves:

1. Bulk charge with a recommended charge current of 168 Adc but not to exceed the maximum limit of 200 Adc to 58 Vdc (2.42 Vpc).
2. Absorb charge at 58 Vdc for 12 hours. This is to return loss capacity from the previous discharge amount.
   NOTE: If step 2 did not return sufficient capacity to compensate the previous discharge amount, continue to step 3. This may be monitored using OPTICS RE and the FLEXnet DC battery monitor.
3. Proceed to absorb the batteries at 60 Vdc (2.5 Vpc) for an additional 4 hours.

Notes on EnergyCell 1000XLC Charging

If using a battery monitor device such as an OutBack FLEXnet DC, program the charge efficiency to 100%; return amps to between 2-3% CA; and charge voltage to 0.4 Vdc below absorbtion. It is highly recommended to use the 1000XLC in conjunction with a battery monitor such as the FLEXnet DC and OPTICS RE for proper monitoring and data recording. The programming may be use with the following settings:

Amp-Hours:	958 Ah
Charge Time:	1 minute
Charge efficiency:	100%
Return Amps:	19.2 Adc
Charge voltage:	57.6 Vdc

Temperature Compensation

Battery performance will change when the temperature varies above or below room temperature (77°F or 25°C). Temperature compensation adjusts the charging to correct for these changes.

When a battery is cooler than room temperature, its internal resistance goes up, the voltage changes more quickly, and the charger reaches its voltage set points more easily. However, it will not deliver all the required current and the battery will tend to be undercharged. Conversely, when the battery is warmer than room temperature, its internal resistance goes down, the voltage changes more slowly, and the charger does not reach its voltages as easily. It will continue to deliver energy until the set points are reached, but this tends to be far more than required. The battery will be overcharged. (See **Improper Use**.)

To compensate for these changes, a charger used with the EnergyCell battery must have its voltages raised by a specified amount for every degree below room temperature. They must be similarly lowered for every degree above room temperature. This factor is multiplied if additional batteries are in series. Failure to compensate for significant temperature changes will result in undercharging or overcharging which will shorten battery life.

EnergyCell 1000XLC Required Compensation

The factor is 5 mV per cell (0.030 Vdc or 30 mV per battery) per degree C above or below room temperature (77°F or 25°C) when the battery is regularly cycled.

Remote Temperature Sensor

OutBack inverter/chargers and charge controllers are equipped with the Remote Temperature Sensor (RTS) which attaches to the battery and automatically adjusts the charger settings. When the RTS is used, it should be placed on the battery sidewall, as close to the center of the battery (or to the center of the bank) as possible.

The charger determines the RTS compensation factor. Most OutBack chargers are preset to a compensation of 5 mV per cell. If an RTS is not present, if a different charger is in use, or if a different compensation factor is required, it may be necessary to adjust the charger settings manually. The RTS should be checked periodically. Failure to compensate correctly may result in wrong voltages.

Improper Use

CAUTION: Equipment Damage

Read all items below. Maintenance should be performed as noted on page 30. Failure to follow these instructions can result in battery damage which is not covered under the EnergyCell warranty.

CAUTION: Equipment Damage

Do not exceed the specified absorption voltage when charging any EnergyCell battery. Excessive voltage could result in battery damage which is not covered under the EnergyCell warranty.

For any EnergyCell battery, if the charger settings are too high, this will cause premature aging of the battery, including loss of electrolyte due to gassing. The result will be permanent loss of some battery capacity and decreased battery life. This is also true for battery charging that is not compensated for high temperatures.

“Thermal runaway” can result from high ambient temperatures, charging at higher voltages over extended time, incorrect temperature compensation, or shorted cells. When the buildup of internal heat exceeds the rate of cooling, the battery’s chemical reaction accelerates. The reaction releases even more heat, which in turn continues to speed up the reaction. Thermal runaway causes severe heat, gassing, lost electrolyte, and cell damage. It usually requires battery replacement. The process can be halted by turning off the charger. However, if cell damage has occurred, shorted cells may continue to generate heat and gas for some time.

If an EnergyCell battery is not charged completely (or if the settings are too low), it will not reach 100% SoC. Its total capacity will not be available during the next discharge cycle. This capacity will become progressively less and less over subsequent cycles. Long-term undercharging will result in decreased battery life. This is also true for battery charging that is not compensated for low temperatures.

NOTES:

Troubleshooting and Maintenance

Table 1 Troubleshooting

Category	Symptom	Possible Cause	Remedy
Performance	Reduced operating time	Normal life cycle	Replace battery bank when (or before) capacity drops to unacceptable levels.
		Defective cells	Test and replace battery as necessary.
	Excessive voltage drop upon applying load	Excessively cold battery	Carefully warm up the battery.
		Undersized cabling	Increase cable ampacity to match loads.
		Loose or dirty cable connections	Check and clean all connections. Physical damage on terminals may require the battery to be replaced. Replace hardware as necessary.
		Undersized battery bank	Add additional batteries to match loads.
		Defective cells	Test and replace battery as necessary.
External Inspection	Swollen or deformed battery casing; “rotten-egg” or sulfurous odor; battery is hot	Thermal runaway **NOTE**: A modest amount of swelling (or concavity) on the battery case is normal.	**NOTE:** Thermal runaway is a hazardous condition. Treat the battery with caution. Allow the battery to cool before approaching. Disconnect and replace battery as necessary. Address the conditions that may have led to thermal runaway (see page 27).
	Damaged battery casing	Physical abuse	Replace battery as necessary.
	Heat damage or melted grease at terminals	Loose or dirty cable connections	Check and clean all connections. Physical damage on terminals may require the battery to be replaced. Replace hardware as necessary.
Voltage testing	Fully-charged battery displays low voltage	High temperature	Carefully cool the battery. An overheated battery may contribute to thermal runaway.
	Fully-charged battery displays high voltage	Low temperature	Carefully warm up the battery.
	Individual battery charging voltage will not exceed 13.3 Vdc; high float current; failure to support load	Shorted cell	Test and replace battery as necessary. A shorted cell may contribute to thermal runaway.
	Individual battery float voltage exceeds 14.5 Vdc; failure to support load	Open cell	Test and replace battery as necessary.
Current testing	Charging current to series string is zero; failure to support load	Open connection or open battery cell in string	Check and clean all connections. If battery appears to have an open cell, test and replace as needed. Replace hardware as necessary.
	Charging current to series string remains high over time	Batteries require additional time to charge	Normal behavior; no action necessary.
	Charging current to series string remains high with no corresponding rise in voltage	Shorted cell	Test and replace battery as necessary. A shorted cell may contribute to thermal runaway.

Periodic Evaluation

Upon replacement of a battery, all interconnect hardware should be replaced at the same time.

To keep track of performance and identify batteries that may be approaching the end of their life, perform the following tests during on a quarterly basis following commissioning (see page 25). Tests must be made with a high-quality digital meter. Voltages must be measured directly on battery terminals, not on other conductors. All connections must be cleaned, re-tightened, and re-torqued before testing. If a battery fails any test, it may be defective. If this occurs under the conditions of the warranty, the battery will be replaced according to the warranty terms.

Bring the batteries to a full state of charge before performing the following test.

Monthly Battery Inspection

- General appearance and cleanliness of battery, battery rack and battery area.
  - Inspect for contamination by dust.
  - Inspect for loose or corroded connections.
  - If necessary, isolate the string/battery and clean with a damp soft cloth. Do not use solvents or scouring powders to clean the batteries.
- Cracks in cell containers or leakage of electrolyte.
- Any evidence of corrosion at cell terminals, connectors or racks.
- Ambient temperature and condition of ventilation equipment.
- Current and voltage during charge cycle. Measure individual battery voltages at the battery terminal. The measurements should be within 5% of the average.
- Voltage at end of charge cycle. Measure individual battery voltages at the battery terminal. The measurements should be within 5% of the average.
- End of discharge voltage measured at the battery. Measure individual battery voltages at the battery terminal. The measurements should be within 5% of the average.
- Record findings clearly. List the dates for all entries.

Quarterly Battery Inspection

This should include the monthly observations, plus:

- End of charge voltage of every cell and battery terminal voltage measured at battery.
- End of discharge voltage of every cell and battery terminal voltage measured at battery.
- Electrolyte temperature in representative cell(s), typically one cell/tier distributed throughout battery.
- Record findings clearly. List the dates for all entries.

Annual battery inspection

This should include the monthly and quarterly observations, plus:

- Inter-cell / inter-unit connection integrity.
- Retighten terminals to specified torque values. See page 33 for specifications.
- Record findings clearly. List the dates for all entries.

Cell Voltage Records

	Date:	Date:	Date:
Cell 1			
Cell 2			
Cell 3			
Cell 4			
Cell 5			
Cell 6			
Cell 7			
Cell 8			
Cell 9			
Cell 10			
Cell 11			
Cell 12			
Cell 13			
Cell 14			
Cell 15			
Cell 16			
Cell 17			
Cell 18			
Cell 19			
Cell 20			
Cell 21			
Cell 22			
Cell 23			
Cell 24			

NOTES:

Specifications

Table 2 Specifications

	EnergyCell 1000XLC
Cells Per Unit	24
Voltage Per Unit	48V
Optimal Operating Temperature	77°F (25°C)
Maximum Operating Range	–40°F to 122°F (–40°C to 50°C)
Operating Temperature Range (Storage)	–4°F to 104°F (–20° to 40° C)
Operating Temperature Range (Discharging)	–4° to 122° F (–20° to 50° C)
Operating Temperature Range (Charging)	32° to 104° F (0° to 40° C)
Absorb or Equalize Charge Voltage	58 Vdc
Maximum Charge Current	200 Adc
Recommended Charge Current	168 Acd
Charging Temperature Compensation Factor	±5 mV / °C / cell
Relative Humidity	0% to ~95%, non-condensing
Terminal	M10 bolt
Terminal Torque[2]	531 Lbf·in (28.1-33.8 N·m; 287-344 Kgf·cm)
System Weight	~4574 lb (~2075 kg)
System Dimension L x W x H	$21^{13}/_{16} \times 44^{3}/_{16} \times 67^{5}/_{16}$″ (55.5 × 112.5 × 171 cm)
Warranty	10 year standard warranty (refer to warranty statement for more details)

Table 3 2V Ampere Hour Capacity to 1.80 Volts Per Cell at 77˚F (25˚C)

Discharge in Hours:	1	2	3	4	8	10	20	24	48	100
EnergyCell 1000XLC	447	554	630	692	816	848	958	988	1118	1220

Table 4 Weight and Volume of Battery Components

Battery Type:	Battery Weight		Electrolyte Weight		Electrolyte Volume		H2SO4 Weight		Lead Weight	
	(kg)	(lb)	(kg)	(lb)	(ml)	(gal)	(kg)	(lb)	(kg)	(lb)
EnergyCell 1000XLC	73.8	162.73	16.89	37.24	13,799	3.65	5.14	11.33	53.02	116.90

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