Battery Charger Efficiency

Issues with Marine and Recreational Vehicle Battery Chargers

Marine and RV battery chargers differ from power tool and small appliance chargers

CEC Testing assumes all variables are known – battery chemistry, battery size. This is not the case in Marine and RV applications.

- The battery charger manufacturer has no influence on the selection of batteries.
- The battery charger could be used to charge a single battery, single battery bank, multiple batteries or multiple battery banks
- The dominant batteries in these applications are Lead Acid
  - Lead Acid batteries are designed and rated for slower discharge rates than the test methodology in the standard (Less efficient at rapid discharge rates).
  - Few Lead Acid batteries are designed for full discharge, and those are typically less efficient at rapid discharge.
  - Charge and discharge rates have a profound impact on measurable capacity.
  - Final charge can be a slow process (Limited by diffusion of fluids in porous materials) which results in active charging while the test is supposed to be in a float/maintenance mode.

Consumer Electronics vs. Marine Batteries

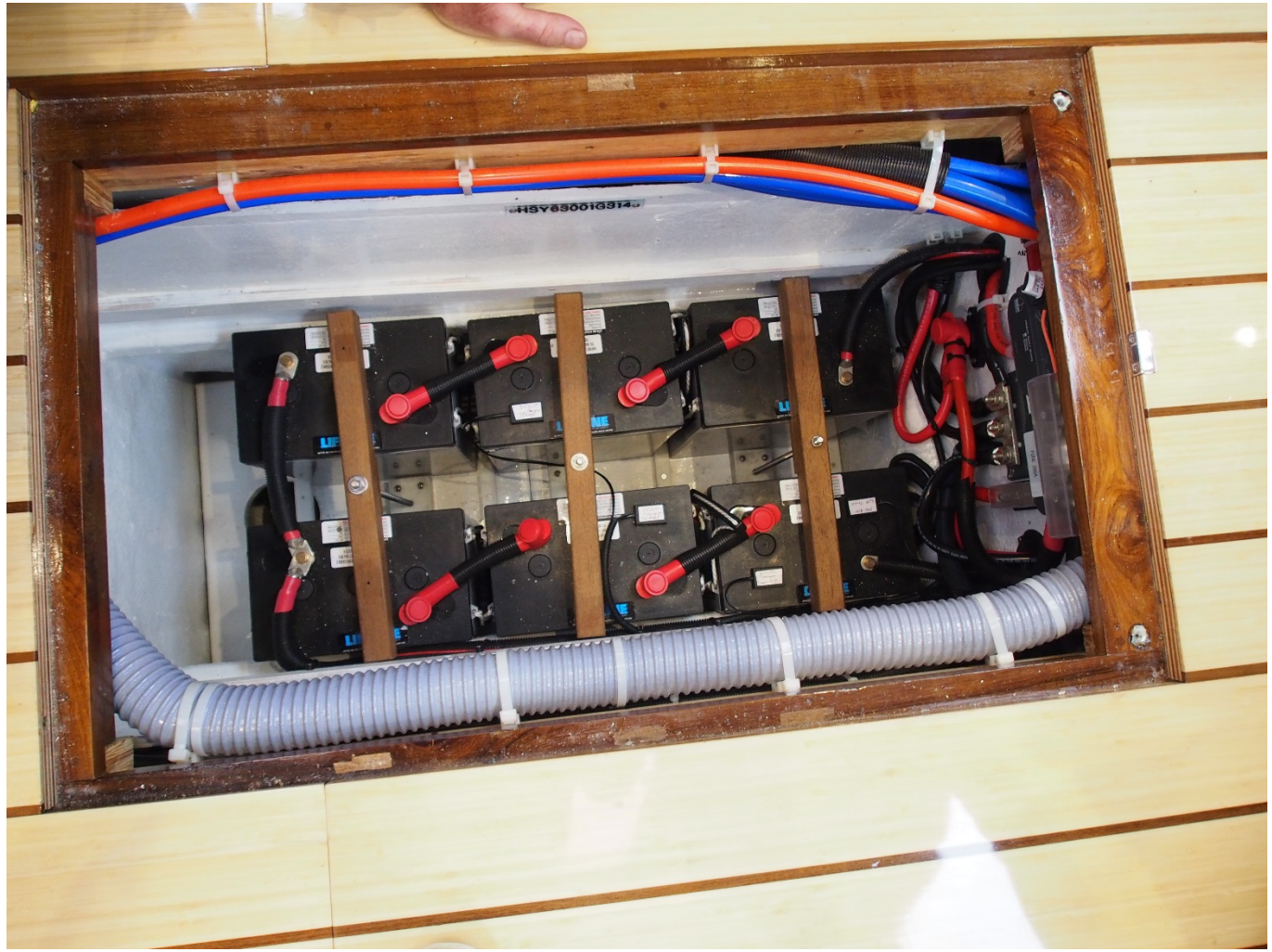
Toothbrush Battery

Cell Phone Battery

Cordless Drill Battery

Marine Battery

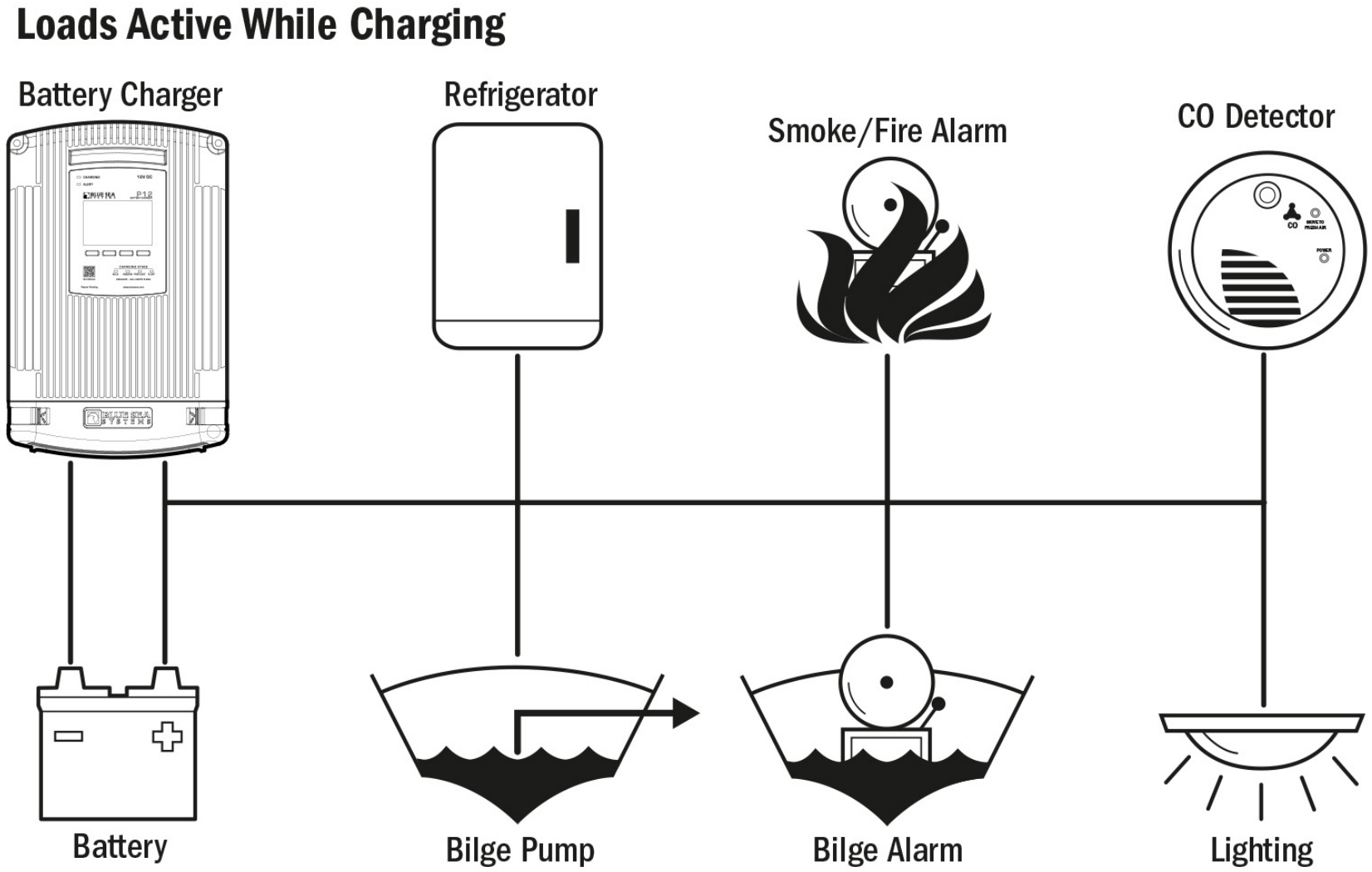
Marine Battery Banks don’t look like power tools!



Marine and RV Chargers Differ from Automotive Chargers

- The core strategy in the CEC standard is to shut down the charger when “charge is complete,” but this conflicts with what is needed for “whole-house” loads (Refrigerators, CO/fire alarm systems, bilge pumps).
- Chargers function as converters/power supplies for active loads
  - Power is supplied directly to DC loads when AC power is available
  - “Float Mode” is continued in order support the loads, which is more efficient than discharging and recharging the batteries.
  - Keeping batteries fully charged and providing power supply to bilge pump and alarm systems is a safety concern in marine applications

Typical Loads also served during charging



Testing to CEC is possible, but deceptive

- Batteries must be carefully chosen to tolerate rapid discharge effectively.
  - Don’t generally represent what is used in the field
- Battery sizes may be limited to what generates best test results
  - Need small enough battery banks to avoid slow tail of charge curve in last four hours of 24 hours
  - Need to use large enough battery banks so that the charge rate is in the efficient part of charge curves
  - These battery sizes may promote less overall charging efficiency in actual use.
- Chargers are permitted to be modified to have a distinct test mode, but are automatically superseded in use when loads are present.

Lead Acid Batteries are Poor Test Instruments
Tests are difficult and non-repeatable

- Battery characteristics are not stationary. Initial cycling of new batteries may improve performance, and additional cycling may degrade it.
- Batteries may have more or less amp-hour capacity than their stated nominal capacity at the time of test.
- Capacity at the 5 hour discharge rate is not readily predicted from the rating at 20 (C20) hour discharge rate used in the industry.
- The rate of discharge that results in matching the discharge time window may take several repetitions to find.