



BATTERY ANALYSIS

Field Testing Process Steps

Battery testing is most effective as a diagnostic resource when employed at established scheduled intervals. When conducting field testing, it is your responsibility to ensure that inspection and test activities are deployed with maximum attention to **safe working practices and established test procedure norms.**

Safety. First.

Battery Handling, Maintenance & Test Procedures

In today's marine & RV equipment operating environments, condition-based battery management and routine field analysis practices have become the norm for assuring performance reliability and return on investment. Equipment technicians and owners increasingly realize that battery and charging system analysis is a critical part of ensuring equipment reliability – when customers are ready to power their recreation time.

Using the attached 3-Point test process, the Safety. First. battery inspection process simplifies battery inspection and testing while producing credible data that help guide equipment owners and users to the best decisions for their system. Periodic battery testing allows for battery data to be collected over the timeline of battery and equipment life – to provide insight about optimizing product life and reliability while reducing maintenance costs.

Success begins when Crown Battery's authorized representatives are certified to conduct the field testing described on the following page, and commit the initiative and resources that are necessary to deploy this program as a product management resource.

AN EFFECTIVE BATTERY MANAGEMENT PROGRAM CAN:

1. Ensure equipment reliability
2. Reduce maintenance costs
3. Lower the total cost of battery ownership
4. Optimize warranty claim management
5. Build stronger customer relationships

SAFETY IS YOUR RESPONSIBILITY!

- ▶ Batteries produce hydrogen gas, which is highly flammable. Keep sparks, flames and cigarettes away from batteries at all times. Maintain good ventilation when working on or charging batteries.
- ▶ When working with batteries you need to wear proper protective gear such as safety glasses, protective footwear and gloves. Remove watches or jewelry and avoid causing sparks with tools.
- ▶ When handling lead-acid batteries, do not tip the product beyond a 45° angle in any direction. Keep vent caps tight and level before and after testing is complete. Do not operate or charge batteries without vent caps secured tightly to the battery.

Product Support & Service

You can reach Crown Battery's Product Support Desk by telephone, 8:00 am - 4:30 pm North American Eastern Standard Time and via email:

SLI Product Support Desk:

+1.419.334.7181 | ext. 50216

+1.419.334.7124 Fax

commercial@crownbattery.com

The Power Behind Performance



Authorized Crown Battery resellers can submit warranty claims to Crown Battery's SLI Product Support Desk via email or fax using the following inspection report. Reports must be submitted with all fields completed. It is the option of Crown Battery to request additional inspection details such as digital photos, manufacturing codes, electrolyte samples or to authorize the return of batteries to Crown Battery's factory for advanced inspection. Please refer to Crown Battery's Limited Warranty Policy for additional details.

The Power Behind Performance



Before you pull away from the dock or garage, Crown Starter, Severe Duty and Deep Cycle Marine & RV batteries are there to power your recreation time. The chemistry and plate design of these batteries are different and formulated for specific applications and use. The purpose of this document is to help you understand the characteristics and best practices for operation and care of the batteries in your equipment so that all of their advantages may be fully realized.

MARINE & RV SEVERE DUTY,
STARTER & DEEP CYCLE BATTERY

Safety. First.



Battery Handling, Maintenance & Test Procedures

SELECTING THE RIGHT BATTERY

Crown Battery manufactures a complete line of flooded batteries for all marine and RV applications. Whatever your application, Crown offers the right battery for your specific needs.

- ▶ **Starter Batteries:** "MAR" series batteries are designed specifically for engine starting. Crown's "MAR" series batteries utilize calcium-lead plate construction and are designed for maintenance-free service. However, the batteries' CleanFit™ vent caps can be removed for warranty or service inspections. Always verify that battery vent caps are secured tightly to the battery during use.
- ▶ **Deep Cycle Batteries:** Crown's "DC / HDC" series batteries are designed to power on-board electrical accessories such as trolling motors, fish-finders, GPS and the like. These marine deep cycle batteries utilize Antimony plate construction and are low-maintenance batteries, so the batteries include removable POD vents to allow safe and easy periodic watering service. Crown deep cycle batteries are designed to withstand the rigors of constant discharge and recharge for optimal performance and longer service life.
- ▶ **Severe Duty Batteries:** Crown's "SD" series batteries are designed to deliver serious engine starting power – coupled with deep cycling service. SD-series batteries utilize a maintenance-free design and will not deliver the same number of cycles as a true deep cycle battery. However, SD batteries are a very good option for watercraft that require maximum engine starting power – and running electrical loads with the engine turned off, or for RV's that primarily rely on the battery for backup house power.



CARE & MAINTENANCE BEST PRACTICES

- ▶ Battery covers, containers and terminals should be kept clean, dry and free of corrosion. Battery vent caps must be secured to the batteries at all times – or removed only for cell or electrolyte inspection.
- ▶ When batteries, terminals or connectors require cleaning, use only biodegradable cleaner-neutralizer solutions that can be safely applied and disposed of through a common sanitary sewer. Clean connectors with a wire brush.
- ▶ If battery electrolyte is spilled onto batteries or the battery compartment area, neutralize it with a cloth moistened with a solution of baking soda and water mixed in the proportion of one pound of baking soda to one gallon of water. When the electrolyte is neutralized, wipe the affected area with a water-moistened cloth to remove all traces of soda.
- ▶ Inspect cable-to-terminal connections to ensure connections are tight and free of corrosion. Battery cables must be intact with no exposed or damaged wires. When connections are complete, clean and tight – apply corrosion preventative treatment materials to the cabled batteries.
- ▶ Preventative maintenance practices should include periodic inspection of fluid levels, battery specific gravity and open circuit voltage. An imbalance of specific gravity and open circuit voltage is usually a sign of improper charging, misapplication, poor maintenance, damaged cell conditions or age.



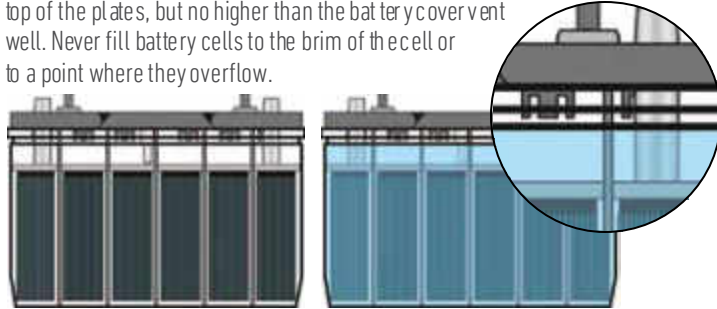
BATTERY CARE AND MAINTENANCE

WATERING SERVICE

Equipment owners and users must be vigilant in performing regular watering service to ensure premium performance and life. There are two conditions when watering can be harmful to your batteries:

- ✔ **Under-Watering**
- ✔ **Over-Watering**

You can prevent watering-service related problems by using the illustration shown here as a reference point – making sure to maintain battery fluid levels above the top of the plates, but no higher than the battery cover vent well. Never fill battery cells to the brim of the cell or to a point where they overflow.



- ▶ USE ONLY DISTILLED or DE-MINERALIZED WATER
- ▶ Never add battery acid, commercial additives or other foreign material to the battery as doing so could damage the battery and void warranty
- ▶ Watering service should occur only after charging service is completed. Watering before charging service can result in overflow of the battery's electrolyte – which is a dangerous condition.

TROUBLESHOOTING

When properly maintained, charged and sized to the application, Crown marine and RV batteries will provide many years of reliable service. However, failure to follow the operating and maintenance guidelines detailed in this best practice guide may result in poor performance or premature failure. The following addresses some of the typical errors in operation and maintenance:

CONDITION:	CHECK FOR:
Poor Battery Performance	Undercharged Battery
	Sulfated Battery
	Cold Operating Environment (Less than 32°F / 0°C Temperature Reduces Usable Battery Capacity)
	Defective Connectors or Cables
	Low Electrolyte
	Old Batteries
	Defective Charge-Level Gauge
Unequal/Low Specific Gravities	Over-filling
	Undercharging
Excessive Water Service	Overcharging
	Container Leak
	Old Batteries
Odor During Charging	Low Electrolyte
	Overcharging
High Temperature	Overcharging
	Battery Overworked
	Opportunity Charging

TEST PROCEDURES

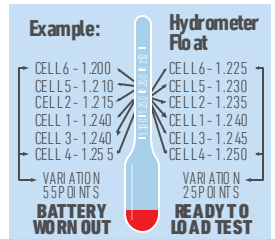
1. Visual Inspection: Check battery age or length of service if available. Inspect battery for damage – when physical damage to the battery container or terminals is present, replace the battery. If none, check the battery's cell electrolyte levels. Fluid levels should be above the top of plates in all cells, and no higher than the top of the fluid level indicator:

If the battery is sufficiently filled with electrolyte – proceed to step 2. If the top of the battery's plates are not covered with liquid, add water only until the top of the plates are covered, replace vent caps and place the battery on charge. Be sure no open flame or spark is near while the battery's vent caps are removed from the battery. When charging service is complete – recheck fluid levels and add water as required.

2. Specific Gravity Inspection: Hydrometer reading of all cells should be at least 1.225 and show less than 50 points difference between high and low.

- ▶ More than 50 points difference: replace the battery.
- ▶ Less than 50 points, but some cells read less than 1.225: recharge the battery.

Replace the vent caps during recharge. Charge the battery using a rate less than 15-amps, until all cells measure a specific gravity of 1.265 to 1.275. If charging won't bring up specific gravity, replace the battery.



State of Charge Level	Specific Gravity
100%	1.265 or Greater
75%	1.225 - 1.235
50%	1.190 - 1.200
25%	1.150 - 1.175
Discharged	1.125 or Less

3. Open Circuit Voltage and Electrical Load Test: Battery open circuit voltage is an effective indication of battery state of charge. Determine the approximate state of charge from the chart below.

State of Charge Level	12 Volt Battery Open Circuit Voltage
100%	12.6 or Greater
75% - 100%	12.4 - 12.6
50% - 75%	12.2 - 12.4
25% - 50%	12.0 - 12.2
0 - 25%	11.7 - 12.0
0%	11.7 or Less

Chart assumes a fully charged specific gravity of 1.265.

Batteries with less than 75% state of charge should be charged before an electrical load test is applied to the battery. When load testing batteries, remove all battery cables, disconnecting the negative cables first. Make sure the battery terminals are free of corrosion or dirt.

Ambient Temperature	15-Second Minimum Voltage
70°F / 21°C and Above	9.5 Volts
50°F / 10°C and Above	9.4 Volts
30°F / -1°C and Above	9.1 Volts
15°F / -9°C and Above	8.7 Volts
0°F / -18°C and Above	8.5 Volts
Below 0°F / -18°C	8.0 Volts

For heavy-duty batteries with threaded stud terminals, attach a lead charging post to the threaded stud terminal before testing. Using a carbon pile load tester or heavy duty adjustable load tester, apply a load test equivalent to 50% of the battery

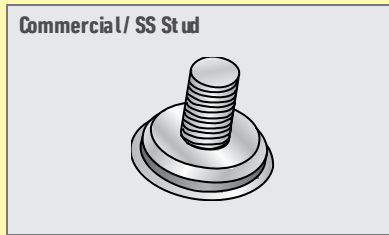
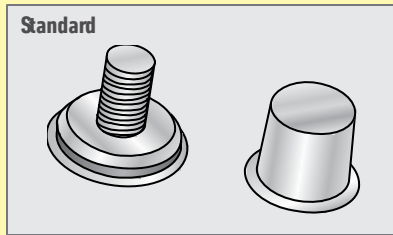
CCA Rating (0°F / -18°C) for 15 seconds; remove the load. Refer to the chart at the left to determine the minimum passing voltage.

If the test voltage is above the minimum, return the battery to service. If test voltage is below the minimum, replace the battery.

Offseason Storage

- ▶ Disconnect the battery's negative cable – or remove the battery from the equipment for indoor storage. Inspect fluid levels (to ensure the top of plates are covered), charge the battery to a full charge condition and verify charge condition using a hydrometer and voltmeter.
- ▶ After charging, top-off battery electrolyte with distilled water if needed. Clean and neutralize the battery container and terminal and store in a clean, dry and secure location. Deep Cycle batteries should not be maintained with offseason maintenance-charging without monthly inspection of battery fluid levels.

AVAILABLE TERMINAL STYLES



FOOTNOTES KEY:

- | | |
|--|--|
| D = Standard Terminal (Dual Automotive / Stainless Steel Threaded Terminal) | J = Includes Handle |
| F = 3/8" x 16 Stainless Steel Threaded | L = Antimony Alloy Construction / Low Maintenance Service |
| H = CleanFit™ Flush Manifold Vented Cover | M = Maintenance-Free Calcium Alloy Construction |
| I = Cover with POD Vent | T = Tight Pack Cell Construction |



LIMITED WARRANTY

- 1. Scope of Limited Warranty:** Free Replacement Period: All Crown batteries are warranted to be free from defects in material and workmanship. Any battery which demonstrates a defect in material and workmanship (discharged or sulfated batteries do not apply) within a Free Replacement Period specified by Crown Battery Manufacturing Company will be replaced or repaired at the option of Crown Battery, free of charge, except for the cost of transportation of the battery. Please reference your current Crown Battery Price Schedule to determine the Free Replacement Period available for Crown Battery's lineup of SLI battery products.
- 2. Limitations:** In all sales other than direct retail sales by the seller of batteries considered to be consumer products to individual consumers, the foregoing warranty is in lieu of all other warranties not expressly set forth herein, whether express, implied or statutory, including those of merchantability or fitness for a particular purpose. The seller's liability for breach of this warranty or for any other purpose is limited, at seller's option, to the replacement of the battery or a refund of the purchase price of the battery. In any event, the seller's maximum liability shall be limited to the refund of the price paid for the battery. **THE SELLER IS NOT RESPONSIBLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL COSTS, INCLUDING ANY EXPENSES FOR INSTALLATION, TOWING, ELECTRICAL SYSTEMS TESTS, CHARGING A BATTERY OR LOSS OF TIME. PLEASE NOTE: SOME STATES DO NOT ALLOW LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, OR EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY HAVE OTHER RIGHTS THAT VARY FROM STATE TO STATE.**
- 3. Exclusions:** The limited warranty does not apply to batteries that are only discharged, have broken containers, covers or damaged terminals, have been frozen, overcharged, sulfated, have foreign material or additive put in the electrolyte, or when evidence of neglect or abuse is present. The warranty does not apply if Crown Battery's proprietary manufacturing code markings have been tampered with or destroyed, if the battery is used in applications for which it is not designed, or if it was installed or charged in reverse. Batteries installed in electric vehicle applications must not be used to run auxiliary loads that are unaccounted for by the battery charging system, and such use will void the warranty.
- 4. Warranty Service:** Return the suspect battery to any factory service center or factory authorized distributor, wholesaler or dealer. If an authorized representative cannot be located, contact Crown Battery's Customer Service Department via phone (+1.419.334.7181) or email (commercial@crownbattery.com). An authorized factory representative will be appointed to perform warranty service.

Because Crown Battery is continually improving its products, specifications are subject to change without notice. The most current specifications are listed on the seller's website at www.crownbattery.com. The information included on the website may amend and supersede the information in this pamphlet. Purchasers are encouraged to visit the website to view the most current specifications.

BATTERY INVENTORY MANAGEMENT

Batteries should be stored in a cool, dry area in an upright position. Store batteries on a solid surface that can safely accommodate their weight. Batteries can be safely stacked two or three layer high by using a secure stacking surface (wafer-board, plywood, etc.) placed between each layer. When stacking batteries in layers, take care to secure battery terminals against short-circuit and to block-and-brace batteries that prevents any movement of the battery group.

Use or sell oldest battery inventory first (First In, First Out). Batteries require periodic stock rotation and service charging to ensure peak performance. Batteries marked with Shipping Date Codes older than 6 months from the current date should be service charged before sale or use. Shipping Date Codes follow a universal code standard.

MONTH			YEAR		
A - January	E - May	I - September	15 - 2015	19 - 2019	23 - 2023
B - February	F - June	J - October	16 - 2016	20 - 2020	24 - 2023
C - March	G - July	K - November	17 - 2017	21 - 2021	25 - 2025
D - April	H - August	L - December	18 - 2018	22 - 2022	26 - 2026

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