



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 automotive, seasonal and heavy duty commercial 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 owners and fleet managers increasingly realize that battery and charging system analysis is a critical part of ensuring work is completed on-time and on-budget.

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 operations. Periodic battery testing allows for battery data to be collected over the timeline of battery and machine life that can be to provide insight about optimizing battery 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 foot-wear 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

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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.

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STARTER BATTERY

Safety. First.

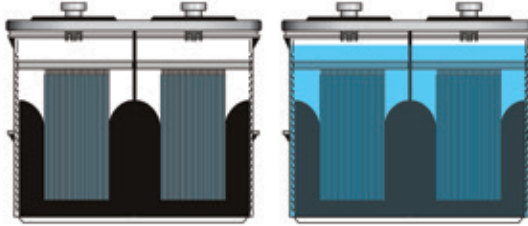


Battery Handling, Maintenance & Test Procedures

HANDLING INSTRUCTIONS:

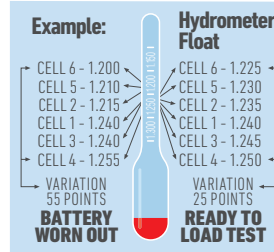
- 1. CAUTION:** All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a flame or spark, the gas may explode violently. When working near batteries, always wear safety glasses, remove watches or jewelry, and avoid causing sparks with tools.
- Battery electrolyte is corrosive and can cause blindness or severe burns. If exposed to battery electrolyte, immediately flush with water and seek medical attention.
- Do not tip a battery beyond a 45° angle in any direction. This could allow battery electrolyte to push through the battery vent assembly – which may cause damage to the battery tray area.

- 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 the electrolyte is accessible via removable vents, check the battery's cell electrolyte levels. Fluid levels should be above the top of plates in all cells, and no higher than the bottom of each cell's vent well 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, 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.

- 2. State-of-Charge Inspection:**
Warning: Check battery fluid conditions only if your battery allows access via removable vents. If the electrolyte is accessible, verify battery state-of-charge by inspecting the specific gravity of the battery electrolyte after charging service is completed. Hydrometer reading of all cells should be at least 1.225 and show less than 50 points difference between high and low.



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

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

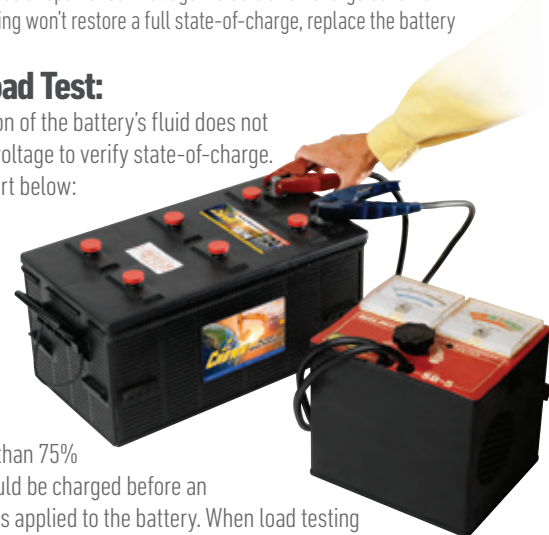
Replace the vent caps during recharge. Charge the battery according to the practices shown on the following page until the battery specific gravities or open circuit voltage indicate a full charge condition. If charging won't restore a full state-of-charge, replace the battery.

- 3. Open Circuit Voltage and Electrical Load Test:**

If the battery's electrolyte is not accessible, or if inspection of the battery's fluid does not verify battery viability – check the battery's open circuit voltage to verify state-of-charge. Determine the approximate state-of-charge from the chart below:

State of Charge Level	12 Volt Battery Open Circuit Voltage	6 Volt Battery Open Circuit Voltage
100%	12.6 or Greater	6.3 or Greater
75% - 100%	12.4 - 12.6	6.2 - 6.3
50% - 75%	12.2 - 12.4	6.1 - 6.2
25% - 50%	12.0 - 12.2	6.0 - 6.1
0 - 25%	11.7 - 12.0	5.95 - 6.0
0%	11.7 or Less	5.95 or Less

Chart assumes a fully charged specific gravity of 1.265.



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

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.

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 above 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.**



BATTERY CARE AND MAINTENANCE

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 layers 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	G – July	11 – 2011	16 – 2016
B – February	H – August	12 – 2012	17 – 2017
C – March	I – September	13 – 2013	18 – 2018
D – April	J – October	14 – 2014	19 – 2019
E – May	K – November	15 – 2015	20 – 2020
F – June	L – December		

For example: L15 = Battery shipped in December 2015

Recommended Charging Practices

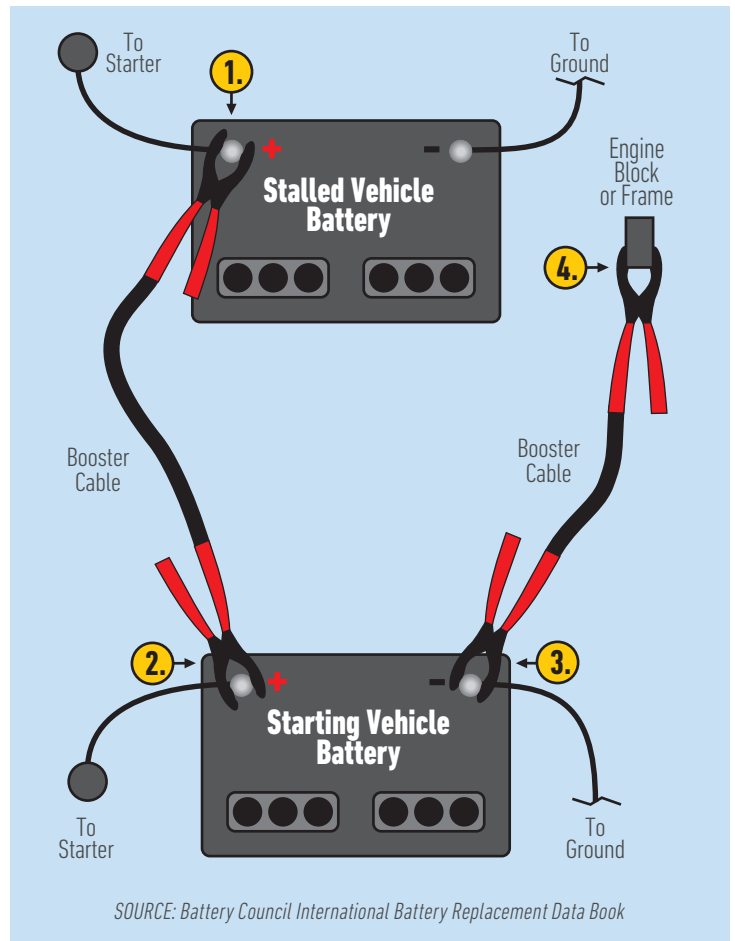
- ▶ Before charging service, refer to the charger manufacturer's instructions for correct charger-to-battery connection and equipment operation.
- ▶ Power off the charger before connection to the battery to avoid sparking.
- ▶ For batteries fitted with threaded stud terminals or GM-type side terminals, use only lead charging posts that ensure a flush lead-to-lead terminal surface contact. Verify that charging posts are securely tightened to the terminal, which will enable safe and effective charging service. Never connect the charger to a stainless steel bolt or stud.
- ▶ To avoid battery explosion, never charge a frozen battery. Frozen batteries should be warmed to room temperature before charging service begins.
- ▶ If the battery's electrolyte is accessible, check battery electrolyte levels to ensure that liquid levels are above the top of the plates in all cells. If plates are not covered, add only enough water to cover plates, replace vent caps and place on charge. Be sure no open flame or spark is near while the battery's vent caps are exposed. After charging, fill with water and replace vent caps on the battery.
- ▶ Charging service should be terminated if batteries become excessively hot or if violent gassing or discharge of electrolyte occurs during charge.
- ▶ Avoid "quick" or "fast" charging batteries in all cases. Limit charger input current to 25% of the batteries reserve capacity minutes rating. Lower current input charges the battery more uniformly and creates less heat, which reduces the possibility of overcharge. Remember: overcharging ruins batteries.
- ▶ Monitor battery state-of-charge throughout the charging period, continuing the charge until a three-hour period shows no additional voltage or tapering of charge current. Refer to page 1 for full-charge voltage and specific gravity points. Refer to page 2 for 100% state-of-charge references.

Recommended Jump-Starting Practices

Refer to the vehicle owner's manual for manufacturer's recommended procedure.

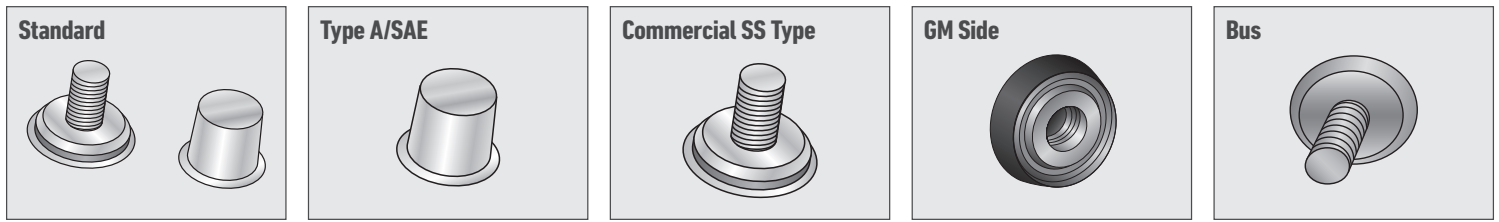
Make it a point to wear personal protective equipment whenever jump-starting batteries – shield your eyes and face at all times, wear heavy-duty protective gloves before touching batteries or jumper cables.

Make certain that battery vent caps are tight and level. Place a heavy cloth over both batteries' vent caps. Keep a safe distance between vehicles involved in jump-starting, making sure vehicles don't come into contact while jump-starting occurs.



1. Connect one end of the booster cable to the positive terminal of the discharged battery.
2. Connect the other end of the positive booster cable to the positive terminal of the assisting battery.
3. Connect one end of the negative booster cable to the negative terminal of the assisting battery.
4. Complete the jump-start connection by securing the other end of the negative booster cable to the engine block of the vehicle having the discharged battery – as far away from the discharged battery as possible. Be aware of safety risks while completing this connection – moving fan blades, belts and fuel lines.

AVAILABLE TERMINAL STYLES



KEY REFERENCES

- | | | |
|--|---|---|
| A = Automotive / SAE Top Terminal | E = GM Side Terminal | J = Battery Fitted with Handle or Lifting Lug |
| B = Bus / Hanging Terminal with Fastener | F = Commercial Threaded Stud Terminal | K = PROeye Fluid Indicator (Option for Gr 24/27/31) |
| C = Dual Automotive / GM Side Terminal Design | H = CleanFit™ Maintenance Free Vented Cover Design | M = Calcium Alloy Construction: Maintenance Free Service |
| D = Standard Terminal (Dual Automotive / Stainless Threaded Terminal) | I = Cover with Raised Vent | T = TightPack 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 (sales@crownbattery.com). An authorized factory representative will be appointed to perform warranty service.



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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.