

CHARGING TIPS (continued)

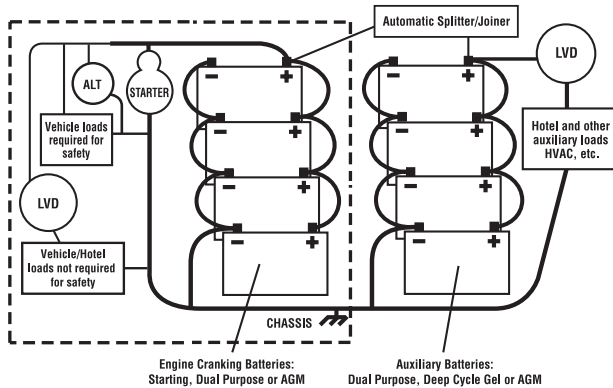
Vehicle charging system voltages are typically much lower than charger voltages. Consequently, recharge in the vehicle will be slower.

AGM Battery Charging Considerations:

Ideal charging varies by application. Many common battery chargers are not fully compatible with AGM batteries, however; they will not ruin the battery if used a few times over the battery's lifetime in a commercial application. Adversely, not all chargers are really AGM compatible and can do significant damage to an AGM battery. Large "wheeled chargers," found in many shops, which exceed 15.4 volts must be avoided.

In the rare occurrence that an AGM battery needs to be charged outside of the commercial vehicle's charging system, charging voltage should be 13.8 – 14.6 @ 77°F (25°C). Not to exceed 30 amps.

COMMERCIAL BATTERY SYSTEMS



Traditional System:

Two to four batteries with sufficient total CCAs to meet engine starting requirements. If the vehicle has significant hotel or other key off loads, cycling batteries (dual purpose) are needed for good life. If vehicle has significant hotel or other key off loads, high capacity is needed as well as sufficient CCAs. An LVD (Automatic Low-Voltage Disconnect) is recommended for starting reliability and battery protection where key off loads may not leave sufficient power for starting. The alternator ultimately generates all the electrical energy used by the vehicle. The alternator must be large enough to restore the energy used from the batteries in a typical day's running period.

Advanced System:

Where key-off electrical energy needs are high, a pack of auxiliary batteries is added. Since these batteries are not used for cranking, they can be discharged more deeply. Since loads can be removed from the starting pack, the starting battery pack can be optimized for the starting duty. An automatic switch joins the packs for charging. The charging system(s) must be large enough to handle the total energy needs in the time available. LVDs are needed for battery protection if not part of the auxiliary loads.

BATTERY STORAGE TIPS

Batteries should be stored in a cool, dry area in an upright position. Never stack batteries directly on top of each other unless they are in cartons. Do not stack more than 3 high (2 high if battery type is heavy commercial).

Test wet batteries every 4–6 months and recharge if necessary. Always test and charge if necessary before installation.

RECYCLE

Did you know lead-acid batteries are virtually 100% recyclable?

They have a higher recycling rate than other waste products such as aluminum, paper, glass and plastic. Be sure to return your used lead-acid battery to a retailer. In most states it is illegal to discard a battery in the trash.



COMMERCIAL BATTERY CARE & MAINTENANCE

IMPORTANT: ALWAYS WEAR EYE PROTECTION!

SAFETY PRECAUTIONS

CALIFORNIA PROPOSITION 65 WARNING
Batteries, 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 and other reproductive harm.
WASH HANDS AFTER HANDLING!

⚠ DANGER/POISON			
WARNING: Follow all safety instructions when handling battery.	 SHIELD EYES. EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.	 NO SPARKS • FLAMES • SMOKING	 SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.
	FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.		
KEEP OUT OF REACH OF CHILDREN. DO NOT TIP. KEEP VENT CAPS TIGHT AND LEVEL. DO NOT OPEN FLUSH COVER BATTERIES!			

ALWAYS WEAR SAFETY GLASSES AND A FACE SHIELD WHEN WORKING ON OR NEAR BATTERIES.

All batteries generate explosive hydrogen gas. Keep sparks, flames and cigarettes away from batteries at all times. Do not connect or disconnect "live" circuits. To avoid creating sparks, always turn charging and testing equipment off before attaching or removing clamps.

ALWAYS DISCONNECT GROUNDED CABLE FIRST AND CONNECT IT LAST TO PREVENT DANGEROUS SPARKS.

Perform all work in a well ventilated area. Never lean directly over a battery while boosting, testing or charging it.

PROTECT YOUR EYES!

Batteries contain corrosive sulfuric acid that can destroy clothing and burn the skin. Neutralize acid spills with a paste made of baking soda and water or large quantities of water.

BE CAREFUL!

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IN-VEHICLE SERVICE AND TESTING

Follow safety precautions — wear proper eye protection.

Prior to any testing, visually inspect the battery. Look for:

- Cracked or broken case or cover
- Loose cable connections
- Leaking case-to-cover seal
- Corrosion
- Damaged or leaking terminals

Neutralize any corrosion with battery cleaner spray or a baking soda/water paste. Scrape or brush off the residue and wash the area with clean water. Following your visual inspection, check the battery's state of charge with a voltmeter.

You must boost charge a weak battery before load testing. (See charging chart under "Charging Tips".) If fully charged, perform a load test. **PROTECT YOUR EYES!**

LOAD TESTING

Follow safety precautions — wear proper eye protection.

First perform an open circuit voltage test, then an adjustable load test. A load test is the best way to determine if the battery is delivering adequate electrical performance. Make sure your variable load tester is working properly.

1. You can't load test a discharged battery. If the voltage is below 12.4, be sure to completely charge it before continuing. Refer to the charging chart under "Charging Tips" section for important information.
2. To avoid sparking and explosive gasses, be sure load tester is OFF and battery is disconnected before hook-up. Use computer memory saver to retain the vehicle's electronic memory while the battery is disconnected.
3. Connect the positive (+) tester clamp to the positive (+) battery terminal. Then connect the negative (-) tester clamp to the negative (-) battery terminal. Always PROTECT YOUR EYES.
4. Set the tester for one-half the battery's 0°F cold crank rating and apply the load for 15 seconds. (If the CCA rating is unknown, use 1/2 of the minimum O.E. battery CCA requirement of the vehicle.)
5. Estimate the internal temperature of the battery to the nearest 10°F. Apply the load for 15 seconds. Note the voltage at 15 seconds with the load on and immediately shut the load off. A reading at least equal to the value from the chart below indicates a good battery.
6. If the battery did not meet the required voltage and if it was not charged in Step 1, completely recharge the battery and repeat the test. If it still fails to meet requirements, replace the battery.

Battery Temp.	12-Volt	6-Volt
70°F (21°C) or above	9.60	4.80
60°F (16°C)	9.50	4.75
50°F (10°C)	9.40	4.70
40°F (4°C)	9.30	4.65
30°F (-1°C)	9.10	4.55
20°F (-6°C)	8.90	4.45
10°F (-12°C)	8.70	4.35
0°F (-18°C)	8.50	4.25

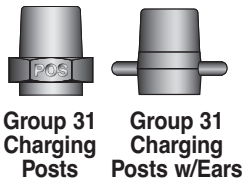
CONDUCTANCE TESTING

Follow safety precautions — wear proper eye protection.

Conductance uses the battery's response to a very small signal in an attempt to predict the effects of a much larger current. Conductance testing is ineffective on a discharged battery. If the battery is known to be discharged or if the tester tells the operator to charge before testing again, the battery must be completely recharged.

1. It may not be required to turn a conductance tester off or on. If off, you must turn on immediately when connected to a battery. Most will turn off automatically if ignored long enough. Some have no battery of their own and get all their power from the battery being tested.
2. Connect the positive (+) tester clamp to the positive (+) battery terminal. Then connect the negative (-) tester clamp to the negative (-) battery terminal. If the battery has more than one pair of terminals (e.g. top posts and side terminals) always perform the testing on the terminals that are used in the vehicle. Use the proper charging adapters for stud or side terminal batteries. Never connect tester to a bolt or stud.
3. Turn on if needed. Enter the requested information. Be sure to distinguish between a CCA rating and a CA or MCA rating. If no rating is available, use the minimum O.E. battery CCA requirement of the vehicle.
4. If the tester says to replace a battery that was tested in the vehicle, repeat the testing after removing the cables and cleaning the posts.

PROPER CHARGING AND TESTING



Group 31 Charging Posts

Group 31 Charging Posts w/Ears

IMPORTANT NOTICE: PROPER CHARGING OF THREADED POST TERMINAL BATTERIES

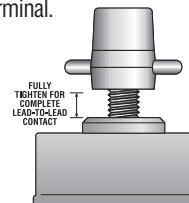
Group 31 Charging Posts should be used to ensure the best testing and charging results for threaded stud terminal batteries. The charging posts will provide a flush lead-to-lead contact. Be sure to tighten the charging post until it is snug and secure. This will allow a strong current to pass from the charging post to the battery terminal.



Battery Nuts



Threaded Stud



DO NOT USE **Stainless Steel Nuts** or the **Threaded Stud** for testing

or charging batteries. They do not provide the necessary lead-to-lead contact, and can reduce your cold cranking amperage (CCA) and state of charge readings. Batteries should be boost charged if the open circuit voltage (voltmeter) reading is below 12.4 volts flooded/ 12.6 volts AGM. See charging chart under "Charging Tips."

CHARGING TIPS

Follow safety precautions — wear proper eye protection.

- Prior to charging, read the manufacturer's instructions for proper charger hook-up and use.
- Turn charger off and disconnect battery prior to hook-up to avoid dangerous sparks. Protect your eyes!
- Continue charging and reduce the rate as needed until a two-hour period results in no increase in voltage or decrease in current.
- If violent gassing or spewing of electrolyte occurs, or the battery case feels hot to the touch, temporarily reduce or halt charging.
- To avoid a battery explosion, *never attempt to charge a frozen battery*. Allow it to warm up to room temperature before placing on charge.
- Warning: Gel and AGM (Absorbed Glass Mat) batteries require a voltage-limited charger. Charging a Gel or AGM battery on a typical shop charger that exceeds 15.4 volts – even one time – may greatly shorten its life.
- Warning: If the electrolyte is accessible, verify that plates are covered before beginning to charge. At the end of charge, add distilled water as needed to bring levels to the proper height. If water is added, charge for an additional 30 minutes to mix. If electrolyte levels are low, but battery is not accessible, remove battery from service.
- The maximum charge rate in amperes should be no more than 1/3 of the battery's reserve capacity minute rating. If the terminal voltage exceeds 16.0 volts while charging, reduce the charge rate.

Recharge Time Using A Typical Charger*

Time (hours) to recharge single flooded battery

Flooded OCV	State of Charge	Charger Maximum Rate			
		50 Amps	30 Amps	20 Amps	10 Amps
12.6 V	100%	R E A D Y T O U S E			
12.4 V	75%	0.6	0.9	1.3	2.5
12.2 V	50%	1.2	1.9	2.7	5.1
12.0 V	25%	1.8	2.9	4.3	7.8
11.8 V	0%	2.5	4.0	5.7	10.7

Recharge Time Using A Typical Charger*

Time (hours) to recharge single AGM battery

AGM OCV	State of Charge	Charger Maximum Rate			
		50 Amps	30 Amps	20 Amps	10 Amps
12.8 V	100%	R E A D Y T O U S E			
12.6 V	75%	0.6	0.9	1.3	2.5
12.3 V	50%	1.2	1.9	2.7	5.1
12.0 V	25%	1.8	2.9	4.3	7.8
11.8 V	0%	2.5	4.0	5.7	10.7

* Charging time depends upon battery age, temperature, capacity and efficiency of charger.

**IMPORTANT: NEVER OVERCHARGE BATTERIES!
EXCESSIVE CHARGING WILL SHORTEN BATTERY LIFE.**