

COMMERCIAL BATTERY CARE & MAINTENANCE

IMPORTANT: ALWAYS WEAR EYE PROTECTION!



SAFETY PRECAUTIONS

⚠ DANGER/POISON

SHIELD EYES.
EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.

NO SPARKS, FLAMES OR 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!

California Proposition 65 Warning: 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 or other reproductive harm. Wash hands after handling.

Warning: Follow all safety instructions when handling 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!**

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 a baking soda/water paste or battery cleaner spray. 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" section.)

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 Temperature	12-Volt	6-Volt
70°F (21°C) or above	9.60	4.80
50°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.

CHARGING TIPS

Follow safety precautions — **WEAR PROPER EYE PROTECTION!**

- ✓ 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 — even one time — may greatly shorten its life.
- ✓ Important: Never overcharge batteries. Excessive charging will shorten battery life.

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.

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. See charging chart under "More Charging Tips."

- ✓ Prior to charging, read the manufacturer's instructions for proper charger hook-up and use.
- ✓ Turn charger off prior to hook-up to avoid dangerous sparks. **PROTECT YOUR EYES!**
- ✓ 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.
- ✓ 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.

MORE CHARGING TIPS (continued from previous column)

RECHARGE TIME USING A SHOP CHARGER*
Time (hours) to recharge single battery

OCV	STATE OF CHARGE	Charger Maximum Rate			
		50 Amps	30 Amps	20 Amps	10 Amps
12.6 V	100%	— READY TO USE —			
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

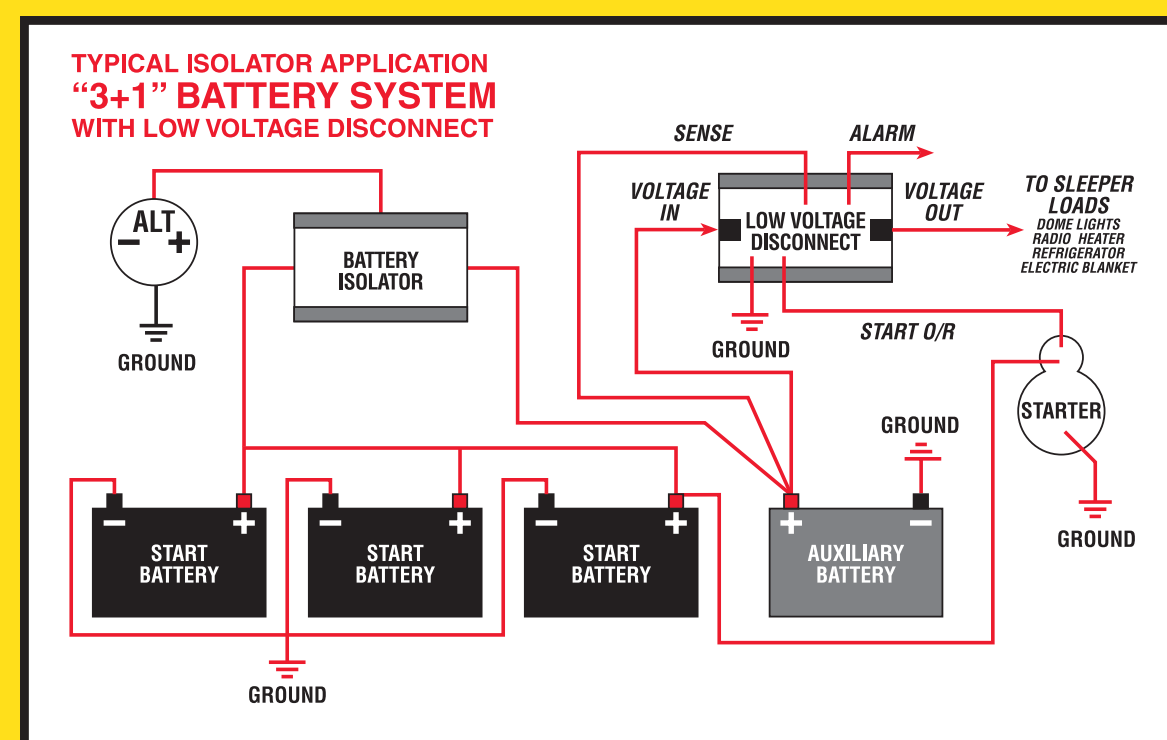
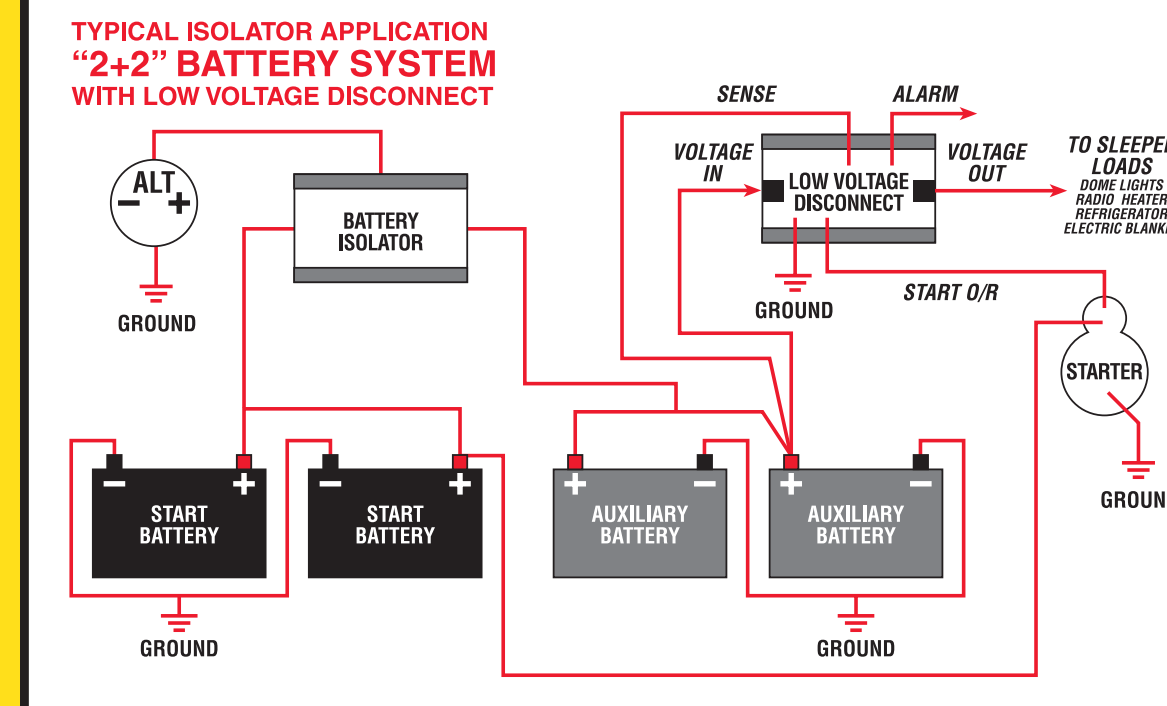
RECHARGE TIME IN VEHICLE (at 14 volts and various currents)
Time (hours) to recharge single battery

OCV	STATE OF CHARGE	Alternator Maximum Rate			
		40 Amps	30 Amps	20 Amps	10 Amps
12.6 V	100%	— READY TO USE —			
12.4 V	75%	2.1	2.2	2.3	3.2
12.2 V	50%	4.1	6.1	8.6	10.6
12.0 V	25%	6.0	10.0	15.0	18.0
11.8 V	0%	12.8	14.8	18.8	21.4

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

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

COMMERCIAL BATTERY SYSTEMS



ROTATE BATTERY STOCK

Use oldest batteries first. Batteries require periodic stock rotation and routine charging. Always rotate stock using the **FIFO (First In, First Out) method...NOT FISH (First In, Still Here).**

Date Code Example: (refer to chart at right)
L2 - Battery shipped November 2002
Always use oldest batteries first.
REMEMBER... WET OR DRY, ALWAYS ROTATE YOUR STOCK!

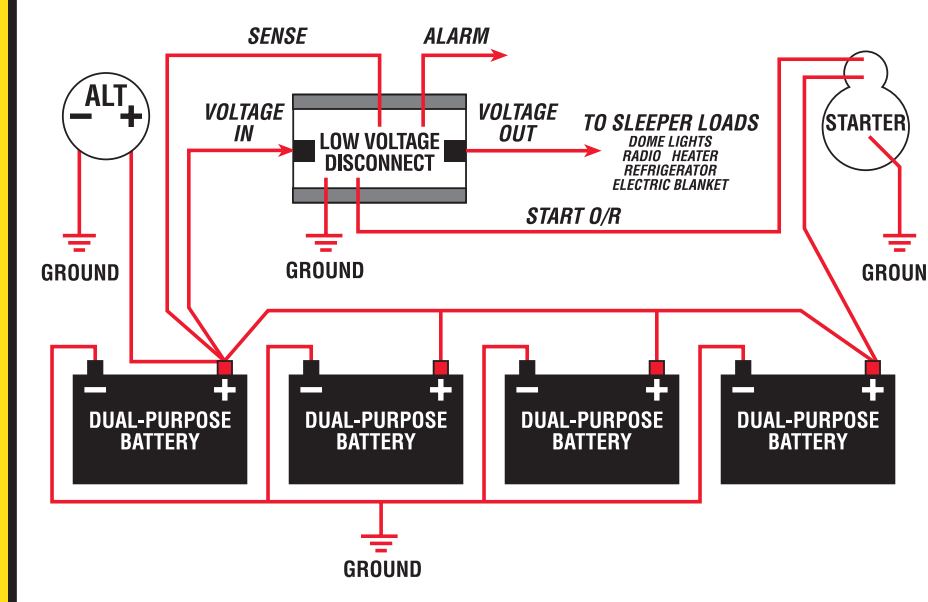
Shipping Date Code	
Month (1997 to present)	Year
A - January	9 - 1999
B - February	0 - 2000
C - March	1 - 2001
D - April	2 - 2002
E - May	3 - 2003
F - June	4 - 2004
G - July	5 - 2005
H - August	6 - 2006
J - September	7 - 2007
K - October	8 - 2008
L - November	9 - 2009
M - December	0 - 2010

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're 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. (See "Charging Tips" and "More Charging Tips" sections.)

TYPICAL LOW VOLTAGE DISCONNECT APPLICATION "4+0" BATTERY SYSTEM



Starting, deep cycle, dual purpose and gel batteries provide several options for today's commercial vehicles. Starting batteries provide the highest cranking capacity for easy starting. Deep cycle batteries supply the reserve power necessary to operate high-tech on-board auxiliary equipment. Dual purpose and gel batteries handle both starting and cycling requirements. The best combination of these batteries depends on each vehicle's power requirements and battery system.

The Low Voltage Disconnect (LVD) in each battery system monitors battery voltage. When battery power falls to a predetermined voltage, the LVD shuts off battery power to the vehicle.

In a 2+2 or 3+1 SYSTEM a battery isolator monitors the auxiliary power batteries. When power falls to 12.1 volts, the isolator shuts off power flow from the auxiliary batteries. This prevents batteries from over-deep discharging, which could result in the need to use an external charger. By shutting off auxiliary power at 12.1 volts, the alternator will still be able to recharge the batteries.

A 2+2 SYSTEM is equipped with two batteries for starting and two batteries for auxiliary power. A 3+1 System has three starting batteries and one auxiliary battery. The benefit of these battery systems is longer and more reliable battery life, which means more "uptime" and productivity for your vehicles.

In a 4+0 SYSTEM all four batteries are used for both starting and auxiliary power. In this case, the LVD cuts off auxiliary power at 12.3 volts, still allowing ample power for starting. When the LVD shuts off the power, no auxiliary battery powered equipment can be used until the driver starts the truck. This eliminates the hassle of emergency road calls due to dead batteries.

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