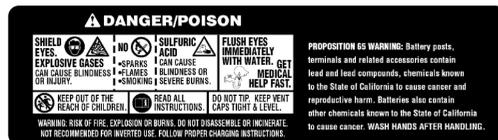


Battery care and maintenance

Safety precautions



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. When testing AGM (absorbed glass mat) batteries, make sure the tester has an AGM setting.

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 gases, 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 one-half the minimum OE 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 at right 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 V battery	6 V battery
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 OE 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!

1. To avoid a battery explosion, never attempt to charge a frozen battery. Allow it to warm up to room temperature before placing on charge.
2. Warning: Gel and AGM batteries require a voltage-limited battery on a typical shop charger that exceeds 15.4 volts — even one time — may charge. Charging a gel or AGM greatly shortens its life.
3. Important: Never overcharge batteries. Excessive charging will shorten battery life. Use proper lead adapters for testing and charging. Never clamp chargers/testers to the threaded stud or to nuts.



4. Prior to charging, read the manufacturer's instructions for proper charger hook-up and use.
5. Turn charger off prior to hook-up to avoid dangerous sparks. Protect your eyes!
6. **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.
7. The maximum charge rate in amperes should be no more than one-third of the battery's reserve capacity minute rating for a maintenance-free flooded battery. If the terminal voltage exceeds 16 volts while charging, reduce the charge rate.
8. Continue charging and reduce the rate as needed until a two-hour period results in no increase in voltage or decrease in current.
9. If violent gassing or spewing of electrolyte occurs, or the battery case feels hot to the touch, temporarily reduce or halt charging.

AGM 12 volt 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 vehicle.

Voltage	State of charge	Group 31 approximate battery charging time guide					
		Charger maximum rate					
Flooded	AGM	50 A	30 A	20 A	10 A		
6 V	12 V	12 V	50 A	30 A	20 A	10 A	
6.3	12.6	12.8 V	100%	Full charge			
6.2	12.4	12.6 V	75%	36 min	54 min	78 min	150 min
6.1	12.2	12.3 V	50%	72 min	155 min	155 min	306 min
6.0	12.0	12.0 V	25%	108 min	174 min	258 min	468 min
5.9	11.8	11.8 V	0%	150 min	240 min	342 min	642 min

Note: For multiple batteries in parallel, multiply by number of batteries.

* Charging time and efficiency depends upon battery age, temperature, capacity and type of charger. A voltage-limited, AGM compatible charger that automatically terminates when battery is fully charged is highly recommended.

Adversely, not all chargers are AGM compatible and can do significant damage to an AGM battery. Avoid using large "wheeled chargers" that exceed 15.4 volts. In the rare occurrence that an AGM battery needs to be charged outside of the vehicle's charging system, charging voltage should be 13.8–14.8 @ 77°F (25°C). Not to exceed 30 amps.

Important: Never overcharge batteries! Excessive charging will shorten battery life.

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)
11-17 — battery shipped November 2017

Remember... wet or dry, always rotate your stock!

Shipping date code	
Month	Year
1 — January	17 — 2017
2 — February	18 — 2018
3 — March	19 — 2019
4 — April	20 — 2020
5 — May	21 — 2021
6 — June	22 — 2022
7 — July	23 — 2023
8 — August	24 — 2024
9 — September	25 — 2025
10 — October	26 — 2026
11 — November	27 — 2027
12 — December	28 — 2028

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" section.)

Battery application chart

Battery temperature	Heavy- and medium-duty truck (Class 6, 7 and 8)
Sleeper cab	Minimum of four (4) Fahrenheit AGM or dual purpose batteries with a low voltage disconnect or battery management system.
Day cab line haul	Starting battery with the number of batteries determined by the CCA capacity.
Day cab delivery	Fahrenheit AGM or dual purpose batteries with the number of batteries per truck determined by the engine CCA requirement.
P & D	Dual purpose batteries with the number of batteries per truck determined by the engine CCA requirement.
Reefer unit	AGM deep cycle or Fahrenheit AGM batteries
HVAC, APU, lift gate	AGM deep cycle or Fahrenheit AGM batteries

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