BATTERY TEST & CHARGING PROCEDURES

FILLER CAP BATTERY

1 VISUAL INSPECTION

When physical damage is present, replace battery. If none, check electrolyte levels.

CRACKED OR BROKEN COVER

SEVERE CORROSION

Fluid should be above top of plates in all cells. If so, proceed to step 2. (Be sure no spark or open flame is near while caps are off.) If not, add water, replace vent caps and charge battery for 15 minutes at 15-25 amps to mix electrolyte. Proceed to step 2.

2 SPECIFIC GRAVITY CHECK

Hydrometer reading of all cells should be at least 1.225 and show less than 0.050 between high and low, at electrolyte temperature of 80°F.

EXAMPLE:

HYDROMETER FLOAT

HYDROMETER

BATTERY WORN OUT

VARIATION 50 POINTS

READY TO LOAD TEST

More than 0.050 difference: replace battery. Less than 0.050, but some cells read less than 1.225: recharge battery*. Replace vent caps, use rate less than 50-amps, until all cells measure proper specific gravity. (If charging won't bring up specific gravity, replace battery.)

NOTE: Not all batteries may be equipped to allow for the following tests - please use as available and necessary.

MAINTENANCE FREE BATTERY

1 VISUAL INSPECTION

When physical damage is present, replace battery and look for cause.

CRACKED OR BROKEN COVER

HYDROMETER

Check for cracked or broken case or cover. Check terminal area for loose or broken parts.

2 HYDROMETER CHECK

MARINE BATTERY

Indicator is a temperature-compensated hydrometer. In normal operation, one of two indications appears:

HYDROMETER

GREEN DOT

Green dot visible. Battery is ready for load test. DO NOT CHARGE. Proceed to step 3.

Replace battery if hydrometer is clear or light yellow and if a cranking complaint exists that is caused by the battery.

HYDROMETER ALL DARK

Dark - No Dot Visible.

Recharge until green dot shows. Shake or tilt battery to obtain green dot. A battery that has set in a completely discharged condition or is extremely cold may not accept current for several hours after starting the charger.
3 Electrical Load Test

Measuring voltage tells only part of the story. A load test should also be performed to accurately determine a battery's condition. One of the most common ways of conducting a load test is with a carbon pile load tester. Batteries can be tested inside or outside of the vehicle. (This should be done by a qualified technician only).

**TEMPERATURE CHECK**

For Filler Cap Batteries: Remove vent caps first, then proceed as directed below. If a blue haze or smoke is seen in any cells during the test, replace the battery.

For Maintenance Free Batteries: Follow directions below. For ACDelco heavy-duty batteries with threaded stud terminals, attach clamp between lead pad and bottom of terminal hex nut.

- If the battery is in the vehicle, remove the battery cables. Always remove the negative cables first.
- Make sure the terminals are free of dirt or corrosion. This can be done with a wire brush or special cleaning tool.
- Connect a voltmeter and the load tester across the battery terminals. Side post batteries may require test adapters. Never use a bolt for testing purposes.
- If the battery has been recharging or is in a vehicle with a functioning recharging system, apply a 300-amp load across the terminals for 15 seconds to remove the surface charge.
- Set the tester to 1/2 CCA value.
- Apply the load to the battery for 15 seconds.
- At the end of the 15 seconds, with the load still applied, read the voltage.

The voltage output greatly depends on the temperature of the battery, as shown in the chart below. Therefore, it is necessary to determine the battery temperature by touch and by the temperature of the surrounding air the battery was exposed to during the last few hours.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Min. Voltage</th>
<th>Temperature</th>
<th>Min. Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>70° F and Above</td>
<td>9.6</td>
<td>15° F</td>
<td>8.8</td>
</tr>
<tr>
<td>50° F</td>
<td>9.4</td>
<td>0° F</td>
<td>8.5</td>
</tr>
<tr>
<td>30° F</td>
<td>9.1</td>
<td>Below 0° F</td>
<td>8.0</td>
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</tbody>
</table>

Service technicians often use automatic battery testers which can test the starting and charging systems as well as the battery.

During a battery load test, the tester will place a load on the battery to simulate a high discharge rate for about 15 seconds, then release to let the battery recover.

The tester will then apply the load again. The tester uses a number of variables including temperature, recovery voltage, and other electrical factors to accurately diagnose the battery.

**Conductance Testers**

When using a conductance type battery tester on side terminal and top stud batteries, certain procedures must be followed to properly assess the battery being tested in order to achieve accurate results. This is particularly important on batteries with higher CCA ratings.

Conductance is a measurement of a battery's current producing capability. This technology can help accurately identify batteries that have reduced performance after being in service. Conductance type battery testers should never be used on a new, never installed battery to determine state of health, state of charge, or CCA rating. New batteries will develop their full performance capabilities only after a period of cycling in a vehicle.
BATTERY TEST & CHARGING PROCEDURES

To check the condition of a new battery prior to installation, ACDelco recommends only measuring open circuit voltage (OCV). An OCV of 12.24V is adequate to provide the power requirements for starting most vehicles under most conditions.

1. Make sure the battery in the tester is not weak or inaccurate readings may result. If the tester indicates low OCV on the batteries being tested when compared to a known good DVOM, or the tester indicates low CCA on the batteries being tested, replace the battery in the tester and test again.

2. When testing side terminal or top stud batteries with a conductance tester, always use lead terminal adapters, such as those provided with most testers. Make sure the terminal adapter makes good contact with the lead pad of the battery or inaccurate readings will result. Basic hand tools may be needed to ensure the terminal is tight.

3. Never use steel bolts/nuts/washers, etc., when testing a side terminal battery with a conductance tester.

4. Never clamp the tester’s leads directly to the studs when testing a top stud battery with a conductance tester.

5. ACDelco ST-1201 side terminal/top stud adapters are for the charging and load testing of batteries only. They should not be used when testing a side terminal or top stud battery with a conductance tester. Inaccurate readings will result due to the coating on the ST-1201 adapters.

Charging ACDelco 60-Series Maintenance-Free Batteries

Water never needs to be added to maintenance-free batteries. The battery cover is sealed and has no filler caps. Small vent holes allow any gases produced to escape. Special battery plates minimize gassing at normal charging currents and also limit the possibility of overcharge damage.

NOTICE
Do not tip a maintenance free battery beyond a 45° angle in any direction. This would allow electrolyte to leak from vent holes.

CALIFORNIA PROPOSITION 65 WARNING:
Batteries, battery posts, terminals, and related accessories contain LEAD and LEAD COMPOUNDS - chemicals known to the State of California to cause cancer and reproductive harm.
Batteries also contain other chemicals known to the State of California to cause cancer.
WASH HANDS AFTER HANDLING!

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. If splashed with acid, immediately flush area with water and seek medical attention.

Charging Procedure

Service bulletins are available for specific battery charging procedures. Fast charging at a high rate of current is not recommended; it may shorten battery life. Slow charging is preferred. General guidelines for charging ACDelco Batteries are given here.

1. Use terminal adapter tools when charging or testing stud or side-terminal batteries outside of the vehicle.

2. Connect charger leads to the terminal studs/nuts when charging or testing stud or side-terminal batteries in the vehicle.

3. Charge rates between three and 10 amps are acceptable as long as the battery terminal voltage does not exceed 16 volts, the electrolyte doesn't spew from the vent holes, or the battery does not feel excessively hot (>125° F). Estimate the battery temperature by feeling the case. Reduce the charging rate, as needed, to reduce terminal voltage, electrolyte gassing or excessive heating.

4. Lightly tap the hydrometer on the battery with the handle of a screwdriver at regular intervals to mix the electrolyte and to dislodge any air bubbles. Look to see if a green dot appears in the hydrometer eye. When you see the dot, the battery is charged at least 65%. In the absence of a hydrometer, use the Amp-Hr table provided.

5. Battery charging requires a charge current (in amperes) for a period of time (in hours). For example, a 10 amp charging rate for five hours would be a 40 ampere hour charge to the battery. General guidelines are:
   - The battery load tests less than 200 amps: 50 amp hour charge
   - The battery load tests greater than 200 amps: 75 amp hour charge
6. The time required for a proper charge will vary according to:
   • Battery size or capacity
   • Electrolyte temperature
   • State of charge
   • Battery age or condition
   • Charger capacity

<table>
<thead>
<tr>
<th>Amp hours</th>
<th>300</th>
<th>275</th>
<th>250</th>
<th>225</th>
<th>200</th>
<th>175</th>
<th>150</th>
<th>125</th>
<th>100</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
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<tbody>
<tr>
<td>36.0</td>
<td>33.0</td>
<td>30.0</td>
<td>27.0</td>
<td>24.0</td>
<td>21.0</td>
<td>18.0</td>
<td>15.0</td>
<td>12.0</td>
<td>9.0</td>
<td>7.0</td>
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<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.0</td>
<td>29.3</td>
<td>26.7</td>
<td>24.0</td>
<td>21.3</td>
<td>18.7</td>
<td>16.0</td>
<td>13.3</td>
<td>10.7</td>
<td>8.0</td>
<td>6.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
<td>0.0</td>
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<tr>
<td>28.0</td>
<td>25.7</td>
<td>23.3</td>
<td>21.0</td>
<td>18.7</td>
<td>16.0</td>
<td>13.3</td>
<td>10.7</td>
<td>8.0</td>
<td>6.0</td>
<td>4.0</td>
<td>3.0</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>24.0</td>
<td>22.0</td>
<td>20.0</td>
<td>18.0</td>
<td>16.0</td>
<td>13.3</td>
<td>10.7</td>
<td>8.0</td>
<td>6.0</td>
<td>4.0</td>
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<td>1.0</td>
<td>0.0</td>
<td></td>
<td></td>
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</tbody>
</table>

*Estimated Charging Hours
(Charge @ 10 amps current)

Reserve Capacity

<table>
<thead>
<tr>
<th>% State of Charge (OCV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Reserve Capacity</td>
</tr>
</tbody>
</table>

*Assumes charger has constant voltage (15.0-16.0) and current steps down as SOC approaches 100%. Charging efficiency estimated to be 75%. Results may vary.

NOTE: Not all batteries may be equipped to allow for the following tests - please use as available and necessary.

Charging AC Delco Filler Cap Batteries

A dry-charge battery has charged plates but contains no electrolyte. These batteries can be stored for long periods but must be filled and charged prior to service.

A wet-charge battery has charged plates and is filled with electrolyte. These batteries lose their charge in storage and must be periodically recharged.

NOTICE
Leave dry-charge batteries in their original shipping cartons; store at 60° F or higher.
Periodic recharging is needed on wet-charge batteries, especially when storage is above 60° F. Store these in cool areas.

The state of charge on filler cap batteries must be checked by measuring the strength of the electrolyte. Specific gravity (exact weight) of the electrolyte provides a measure of its strength. Pure water is lighter than the correct mixture of acid and water. A hydrometer is used to measure the specific gravity of the electrolyte in each battery cell. These readings, adjusted for the temperature of the electrolyte, are used to determine the battery's state of charge.

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. If splashed with acid, immediately flush area with water and seek medical attention.
Charging Procedure

Service bulletins are available for specific battery charging procedures. Fast charging at a high rate of current is not recommended; it may shorten battery life. Slow charging is preferred. General guidelines for charging ACDelco filler cap batteries are given here.

NOTICE
During charging, leave flame arrester vent caps in place. Remove sealed caps and place a cloth over the vent holes to allow gassing.

1. When charging or testing sealed-terminal (nonpost type) batteries, use terminal adapters when the batteries are removed from the vehicle. Connect charger clamps to battery studs/nuts when the batteries are in vehicle.

2. The battery terminal voltage does not exceed 15 volts, the electrolyte doesn't spew from the vent holes, or the battery does not feel excessively hot (>125° F). The charging current may need to be reduced or temporarily stopped to prevent damage to the battery.

3. The battery is fully charged when, after two hours of charging at a low rate, all cells are gassing freely and no change in the electrolyte's specific gravity is noted. Specific gravity should be at least 1.230.
   - Batteries may function, even with specific gravity below 1.230.
   - Emergency boost charging must be followed by full charging.

4. Battery charging requires a charge current (in amperes) for a period of time (in hours).

5. The time required for a proper charge will vary according to:
   - Battery size or capacity
   - Electrolyte temperature
   - State of charge
   - Battery age or condition
   - Charger capacity

NOTICE
After charging has been completed, add water to adjust the electrolyte level in each cell to the bottom of the split ring.

NOTE: Not all batteries may be equipped to allow for the following tests - please use as available and necessary.
The Adapter Kit ST-1201 is available from ACDelco. It is recommended that this adapter kit, or equivalent, be used in charging sealed-terminal batteries when they are out of the vehicle.

When the sealed-terminal battery is in the vehicle, connect the charger's leads to the studs or nuts at the battery's terminals. Post-type batteries need no adapters.

The following basic rules apply to most ACDelco Battery charging situations:

- Charge rates between 3 and 10 amperes are generally satisfactory for any maintenance free battery as long as spewing of electrolyte does not occur or the battery does not feel excessively hot (over 125°F, 52°C). If spewing occurs or temperature exceeds 125°F, the charging rate must be reduced or temporarily halted to permit cooling.

- Battery temperature can be estimated by touching or feeling the battery case.

- The battery is sufficiently charged when the green dot in the built-in hydrometer is visible. No further charging is required. Shake or tilt the battery at hourly intervals during charging to mix the electrolyte and see if the green dot appears.

- For batteries that do not have any eye, stop charging when the charge current goes down to 1-2 amperes or after the calculated end time has been reached. Test the battery using the recommended conductance tester or a load tester.

ACDelco Hydrometer (if equipped)

The time required for a charge will vary because:

- **Size of Battery** - Example: A completely discharged large Heavy-Duty battery requires more than twice the recharging as a completely discharged small Passenger Car battery.

- **Temperature** - Example: A longer time will be needed to charge any battery at 0°F than at 80°F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, then in time, the battery will accept a higher rate as the battery warms.

- **State-of-Charge** - Example: A completely discharged battery requires more than twice as much charge as a one-half-charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

- **Charger Capacity** - Example: A charger which can supply only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.