SERVICE MANUAL SECTION

BATTERY

s08022k, Formerly CTS-5021K

03/31/1996

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1. BATTERY SAFETY

WARNING – To prevent personal injury, do not attempt to service, charge, recharge, or jumper start a battery unless you have read and understand the following information.

1.1. SERVICE PRECAUTIONS

Batteries generate explosive gases. Keep sparks, flames, and burning cigarettes away from immediate area. Explosive gases may escape through battery vents causing an explosive atmosphere. Charge batteries only in well ventilated areas.

Dilute sulfuric acid is the electrolyte used in batteries. Sulfuric acid is poison and will cause severe burns to the skin. Do not handle battery electrolyte, or perform service on batteries unless eye and skin protection is worn. Avoid direct contact with battery electrolyte.

Adequate ventilation must be provided to the battery service area. Explosive mixtures of gas escape from a battery during the charging process. Keep open flame, sparks, or lighted smoking items away from the battery service area.

Follow manufacturer's operating instructions when connecting and operating a battery charging device.

1.2. HANDLING BATTERY ACID (ELECTROLYTE)

Exercise extreme caution to avoid splashing or spilling battery acid (electrolyte). Always wear protective goggles and protective clothing when pouring or mixing battery acid (electrolyte).

If battery acid (electrolyte) is swallowed:

- Drink large quantities of water or milk and consult a physician immediately.

If battery acid (electrolyte) comes in contact with the eye(s):

- Force eye(s) open and flush repeatedly with clean, cool water for at least five minutes. Consult physician immediately.

If battery acid (electrolyte) comes in contact with clothing or vehicle surface:

- Neutralize immediately with a solution of baking soda and water. Flush with clean water.

1.3. PREPARING ELECTROLYTE SOLUTION

When mixing electrolyte to a desired specific gravity, pour the concentrated sulfuric acid into the water, slowly. DO NOT POUR WATER INTO ACID. Spattering may occur due to the extreme heat generated as water contacts the surface of the acid. Stir continually while pouring acid into the water.

1.4. HANDLING BATTERIES

Do not lift batteries by exerting excessive inward pressure on the ends of the case. This inward pressure may cause battery acid (electrolyte) to be expelled through the vents. When a carrier strap is not available, a battery

may be lifted by placing hands at opposite corners. All batteries have detents for lifting. The manufacturers do not want the batteries carried by terminals.

Do not lift or carry a battery in a tipped or sideways position. Battery acid (electrolyte) may leak out causing skin burns, damage to clothing, or damage to vehicle parts.

2. DESCRIPTION

The storage battery is an electro-chemical device. It stores chemical energy. When the battery is connected to an external load such as a starter, the chemical energy is converted into electrical energy and current flows through the circuit.

In a battery, one discharge and the next recharge is called one cycle.

3. BATTERY APPLICATION

There are two classifications of batteries currently being used in International vehicles: HIGH CYCLE (cranking) and DEEP CYCLE (auxiliary) batteries.

3.1. HIGH CYCLE BATTERIES

High cycle (cranking) batteries are designed to withstand frequent cycling (discharge and recharge). High cycle batteries are also designed to deliver large amounts of current for short time periods. A high cycle battery is best suited to the starting circuit for this reason.

3.2. DEEP CYCLE BATTERIES

Deep cycle (auxiliary) batteries are designed to deliver low rates of current for long periods of time. Deep cycle batteries are used to provide electrical power to the accessories when the engine is not running. In this application, the battery is in a very low state of charge before it is recharged. Deep cycle batteries are built with thicker positive grids, denser positive paste, and different negative plate alloys to resist failure due to the high temperature that is generated when recharging a very low battery.

4. BATTERY FUNCTION

The three main functions of the truck battery are to:

1. Supply power to the starter and ignition system so engine can be cranked and started.

2. Supply the extra power required when the vehicle’s load requirements exceed the supply from the charging system.

3. Act as a voltage stabilizer in the electrical system. The battery smooths out or reduces temporarily high (transient voltages) which occur in the vehicle electrical system. These excessively high voltages would damage other components in the electrical system if it were not for the protection provided by the battery.

5. TYPES OF BATTERIES

There are basically three types of batteries currently being used in trucks: filler cap, semi-maintenance free, and maintenance free.

5.1. FILLER CAP

These are lead acid batteries with a high degree of antimony in the grid alloy. They require frequent servicing, especially the need for adding water. Water is added to the battery after removal of cell filler caps.

5.2. SEMI-MAINTENANCE FREE (HYBRID)

These are conventional batteries with reduced amounts of antimony and consequently servicing is somewhat reduced. Water must still be periodically added. Water is added after removing cell caps, which may be hidden under a label or plaque.

5.3. MAINTENANCE FREE

These batteries use lead calcium grid construction without antimony. They never need water, nor are there provisions for adding water.

Batteries are available in several performances, and either post or stud terminal configurations.

6. MAINTENANCE (IN VEHICLE)

The battery is a perishable item and requires attention. With a reasonable amount of care, the life of a battery can be appreciably extended. Neglect and abuse will invariably cause shorter battery service life.

The battery should be inspected at the time of chassis lubrication or other periodic services.

> **WARNING – Batteries expel explosive gases. Keep sparks, flames, burning cigarettes, or other ignition sources away at all times. Always wear safety glasses and a face shield when working near batteries.**

Battery maintenance includes the following:

6.1. BATTERY MAINTENANCE

1. Inspect battery and mounting.

2. If corrosion is found on the terminal posts, remove the cable terminals from the battery (ground cable first) using the proper end wrench and a cable puller.

   A terminal cleaning brush can be used to clean tapered posts and the mating surfaces of the cable clamps. Stud type terminals can be cleaned with a wire brush. The cable terminals should then be cleaned with an acid neutralizing solution of baking soda and water. Clean dirt from the battery top with a cloth moistened with baking soda and water. Then wipe with a cloth moistened with clear water.

3. A wire brush can be used to remove dirt, corrosion or rust from the battery tray or hold down parts.

   After rust is removed, rinse with clear water, dry with air and repaint.

   After cleaning, reinstall battery and hold down parts as instructed under REMOVAL AND INSTALLATION. Coat battery and cable terminals with terminal grease and connect cables to battery terminals. Connect ground cable last.

4. When servicing filler cap batteries, check electrolyte level in all cells. If necessary, add clear water to bring the liquid level to the level indicator. If the battery does not have an indicator, add water to bring the liquid level to 1/2" (13 mm) above the top of the separators. Do not overfill any cell. Maintenance free type batteries do not require addition of water under normal operating conditions. If loss of electrolyte is suspected, check electrolyte level as instructed under TESTING and determine cause for low level.

6.2. CHECKING SPECIFIC GRAVITY

Specific gravity is a unit of measurement for determining the sulfuric acid content of the electrolyte. The specific gravity can be measured directly with a hydrometer (Figure 1).

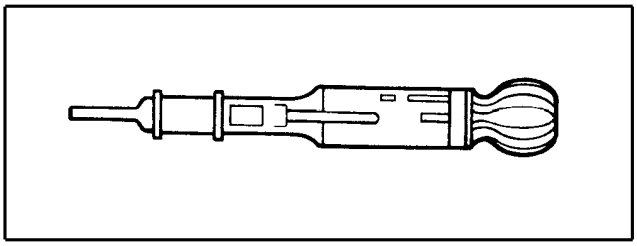

Figure 1 Battery Hydrometer

The state-of-charge of a battery can be determined by the specific gravity of the electrolyte. The recommended fully charged specific gravity of most 12-volt batteries is 1.270 to 1.280 corrected to 26.7'C (80'F).

, The Specific Gravity Readings Table illustrates typical specific gravity values for a cell in various stages of charge. A fully charged specific gravity of 1.265 corrected to 26.7'C (80'F) is assumed.

Specific Gravity Readings

Table 1 Specific Gravity Readings Table

Specific Gravity (Corrected to 26.7'C or 80'F)	State of Charge
1.275	Fully Charged
1.240	75% Charged
1.200	50% Charged
1.170	25% Charged
1.140	Discharged

Using A Hydrometer

The barrel must be held vertically so the float is not rubbing against the side (Figure 2). The electrolyte should be drawn in and out of the hydrometer barrel a few times to bring the temperature of the hydrometer float and barrel to that of the acid in the cell. Draw an amount of acid into the barrel so that with the bulb fully expanded, the float will be lifted free, touching neither the side, top nor bottom stopper of the barrel.

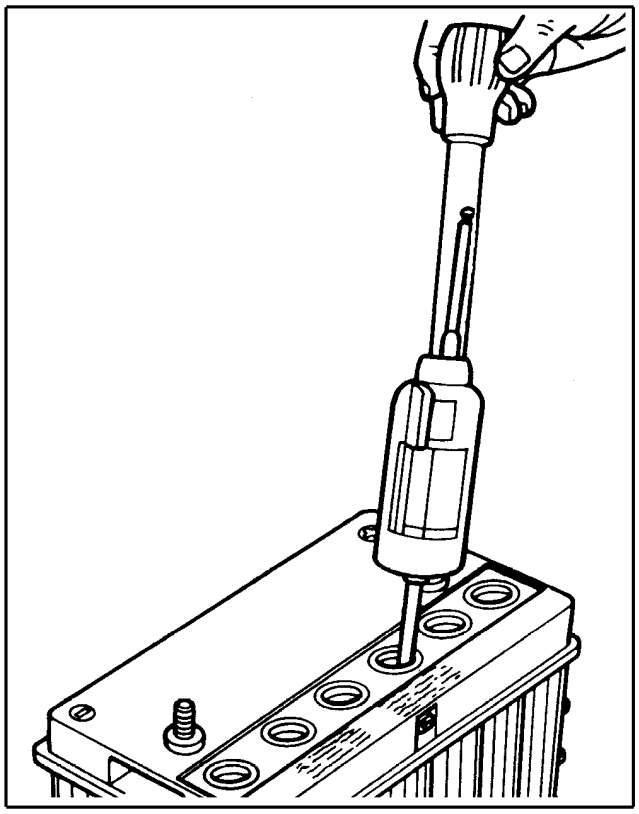

Figure 2 Checking Specific Gravity with a Hydrometer

When reading the hydrometer, your eye should be on a level with the surface of the liquid in the hydrometer barrel. Disregard the curvature of the liquid where the surface rises against the float stem and the barrel due to surface tension. Keep the float clean. Make certain it is not cracked.

Never take a hydrometer reading immediately after water is added to the cell. The water must be thoroughly mixed with the underlying electrolyte, by charging, before hydrometer readings are reliable. If a reading is being taken immediately after the battery has been subjected to prolonged cranking, it will be higher than the true value. The water formed in the plates during the rapid discharge has not had time to mix with the higher specific gravity acid above the plates.

Because there are many different types of battery hydrometers available, always follow manufacturers instructions.

Temperature Correction

Hydrometer floats are calibrated to give a true reading at one fixed temperature only. A correction factor must be applied for any specific gravity reading made when the electrolyte temperature is not 26.7'C (80'F) (Figure 3).

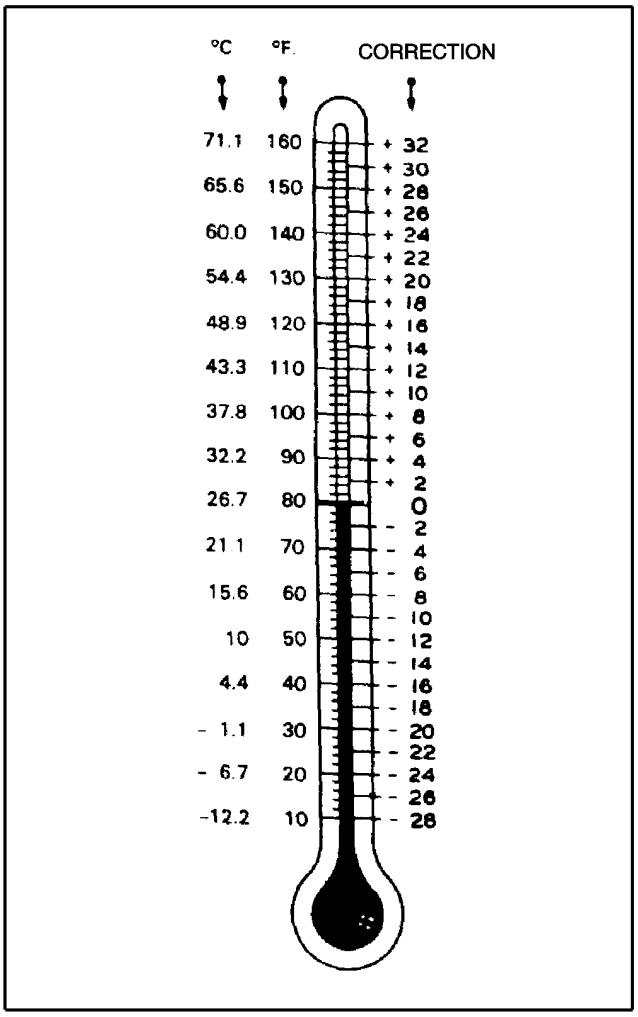

Figure 3 Correcting Specific Gravity

A temperature correction must be used because the electrolyte will expand and become less dense when heated. The float will sink lower in the less dense solutions and give a lower specific gravity reading. The opposite occurs if the electrolyte is cooled. It will shrink in volume, becoming more dense. The float will rise higher and read too high.

A correction factor of .004 specific gravity (sometimes referred to as 4 "points" of "gravity") is used for each 5.5'C (10'F) change in temperature. Four "points of gravity" (.004) are added to the indicated reading for each 5.5'C (10'F) increment above 26.7'C (80'F) and four points are subtracted for each 5.5'C (10'F) increment below 26.7'C (80'F). This correction is important at extremes of temperature because it can become a substantial value.

Figure 3 illustrates the correction for hydrometer readings when the acid temperature is above or below 26.7'C (80'F). For example, in cold weather, a partially discharged battery in a vehicle at 6.7'C (+20'F) might read 1.250 indicating it was almost fully charged. However, when the correction factor is applied, the true value is only 1.226. Electrolyte frequently reaches 43'C (100'F) in service in warm weather. The 1.235 specific gravity reading might indicate too low a state of charge to install in a vehicle or that there is a problem in the electrical system if the battery is in service. However, the true reading of 1.246 may not be unreasonably low depending on the length of storage of the battery or the type of service which it has been experiencing in the vehicle.

7. BATTERY TESTING

A battery test should be performed whenever battery trouble is suspected.

Battery testing will determine if:

7.1. BATTERY TESTING

1. Battery is serviceable.
2. Battery should be recharged before placing it back in service.
3. Battery must be replaced.

A complete battery test, as outlined below, will include these steps:

4. Visual Inspection
5. State of Charge Test
6. Battery Capacity (Load) Test

7.2. VISUAL INSPECTION

Visually inspect the outside of the battery for obvious damage such as cracked or broken case or cover which would allow electrolyte loss. Check for terminal damage. If obvious physical damage is found, replace the battery. If possible, determine the cause of damage and correct.

Filler Cap and Semi-Maintenance Free Batteries

Remove the cell caps and check electrolyte level. On some batteries, a knife blade is used to cut through the top plaque center section on the dotted lines to gain access to the cell caps (Figure 4). After removal of the section of the plaque, individual caps can be unscrewed to allow access to each cell. When reinstalling cell caps after testing, make sure caps are properly seated.

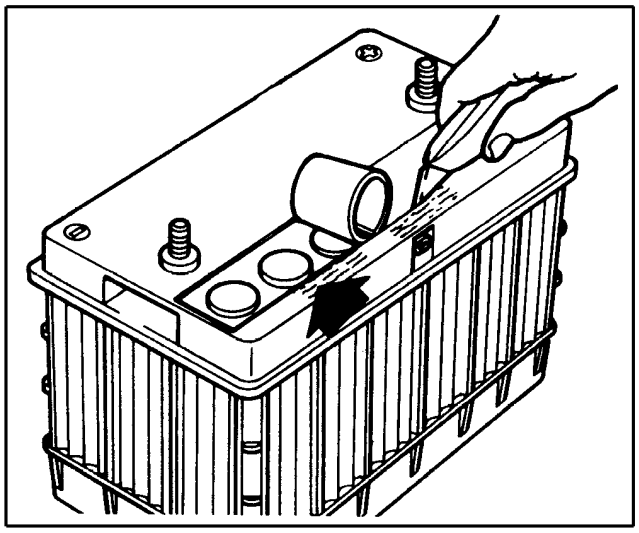

Figure 4 Removing Plaque to Access Cell Caps

If electrolyte level is below the tops of the plates in one or more cells, add distilled water until electrolyte level is 1/2” above the tops of the separators. Charge the battery 15 minutes at 15-25 amperes to mix the water with the electrolyte.

Maintenance Free

A test indicator in the battery cover can be used to determine if the battery can be tested in case of a cranking complaint.

The test indicator (Figure 5) is to be used with accepted diagnostic procedures only. It is not to be used to determine if battery is good or bad. The test indicator is a built-in hydrometer in one cell and provides visual information for battery testing.

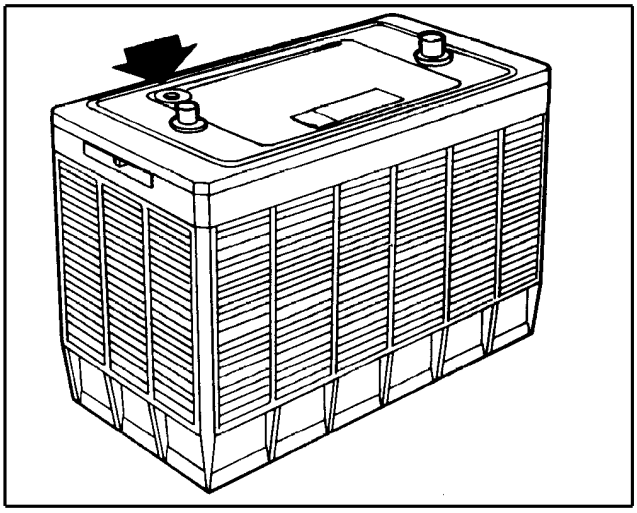

Figure 5 Battery Test Indicator Location

It is important when observing the test indicator that the battery be level and have a clean top to see the correct indication. A light may be required in some poorly-lit areas.

1. GREEN DOT VISIBLE (Figure 6)

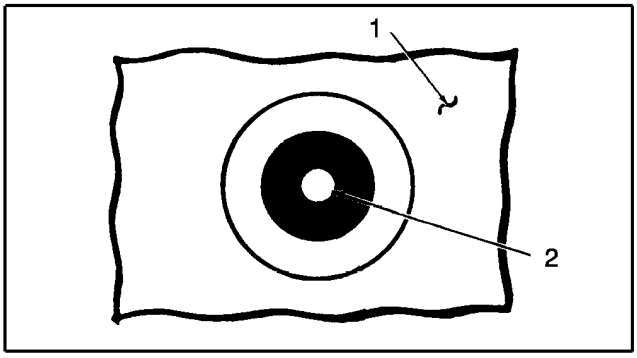

Figure 6 Test Indicator Green Dot Visible

1. BATTERY TOP
2. GREEN DOT

Any green appearance is interpreted as a "green dot," and the battery is ready for testing.

If there is a cranking complaint, the battery should be tested as instructed under TESTING, 7.0. , and the vehicle's charging system should be checked for proper operation and adjustment.

2. GREEN DOT NOT VISIBLE

On occasion, the test indicator may turn light yellow or clear (Figure 7). This indicates a low electrolyte level. Loss of electrolyte level could result from excessive over-charging, a broken case or tipping the battery over 45' on its side.

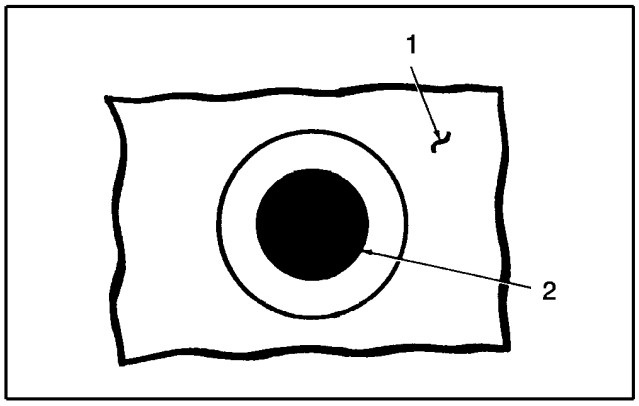

Figure 7 Test Indicator Green Dot Not Visible

1. BATTERY TOP
2. LIGHT YELLOW OR CLEAR

If test indicator shows light yellow or clear, inspect battery and check charging system. Although the battery may be capable of further service, if a cranking complaint has been reported, replace the battery. DO NOT CHARGE, TEST OR JUMP START!

A dark or black eye with the green ball disappearing out of sight indicates a discharged battery, which must be charged before testing or placing into service.

7.3. STATE OF CHARGE TEST

Filler Cap and Semi-Maintenance Free

The battery's state of charge can be determined by the specific gravity (hydrometer) test and the stabilized open circuit voltage test.

Maintenance Free

Maintenance free battery cell caps are sealed. To determine state of charge, check test indicator. If green, proceed to Stabilized Open Circuit Voltage Test.

Specific Gravity (Hydrometer) Test

Perform specific gravity (hydrometer) test on all cells. (Refer to instructions for reading hydrometer under CHECKING SPECIFIC GRAVITY.

1. Measure and record gravity, corrected to 26.7'C (80'F), of each cell. Compare readings obtained with Specific Gravity Readings Table to determine battery's state of charge.

Specific Gravity Readings

Table 2 Specific Gravity Readings Table

Specific Gravity (Corrected to 26.7'C or 80'F)	State of Charge
1.275	Fully Charged
1.240	75% Charged
1.200	50% Charged
1.170	25% Charged
1.140	Discharged

1. If specific gravity readings are 1.225 or higher and are within 50 points (.050 specific gravity) between highest and lowest cells, proceed to Stabilized Open Circuit Voltage Test.

2. If specific gravity readings are low (below 1.225) or vary more than 50 points between highest and lowest cells, recharge battery as instructed under CHARGING and inspect vehicle's electrical system to determine cause for low state of charge.

3. If, after charging, specific gravity readings are within 50 points between highest and lowest cells, proceed to Stabilized Open Circuit Voltage Test. If readings still vary more than 50 points after charging, replace the battery.

Stabilized Open Circuit Voltage Test (All Batteries)

1. If the battery has just been recharged or has been in vehicle service, the surface charge must be removed before an accurate voltage measurement can be made.

2. To remove surface charge, crank engine for 15 seconds. DO NOT allow engine to start. To prevent engine starting:

   a. Diesel Engine: Apply engine stop control or disconnect fuel solenoid valve lead as required to prevent engine start.

      After cranking engine, allow battery to rest for 5 minutes.

3. Connect a voltmeter across battery terminals (Figure 8) and observe reading.

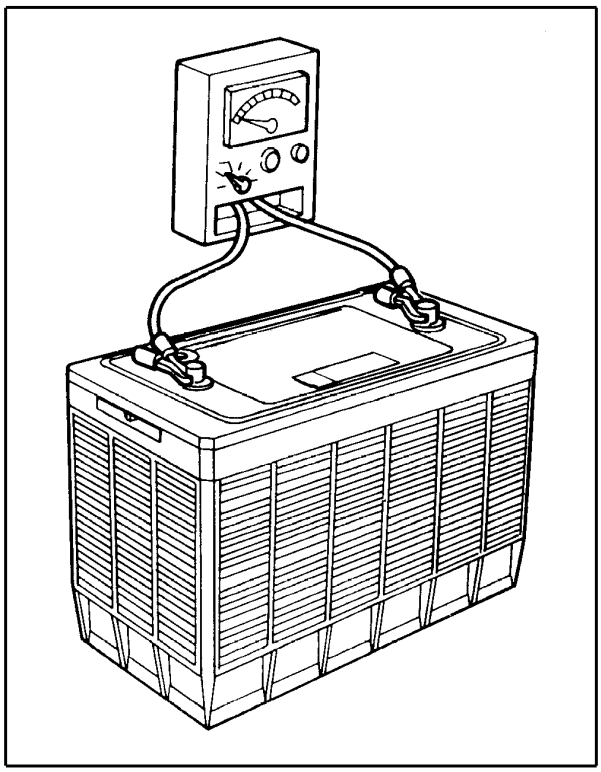

Figure 8 Voltmeter Connection for Stabilized Open Circuit Voltage Test

4. If stabilized voltage is above 12.4 volts, proceed to LOAD TEST.

5. If stabilized voltage is below 12.4 volts, recharge battery as instructed under CHARGING and inspect vehicle's electrical system to determine cause for low state of charge. After charging battery, proceed to LOAD TEST.

7.4. BATTERY CAPACITY (LOAD) TEST

To perform battery capacity (load) test, follow instructions supplied with the test equipment.

Filler Cap and Semi-Maintenance Free

A satisfactory capacity (load) test can be made only when battery electrolyte equals or exceeds 1.225 specific gravity, corrected to 26.7'C (80'F).

Maintenance Free

A satisfactory load test can only be performed when the test indicator green dot is visible and the battery has a stabilized open circuit voltage of 12.4 volts or more.

IMPORTANT – Always follow manufacturer's instructions and precautions when using battery load testing equipment.

8. CHARGING

IMPORTANT – Always follow battery charger manufacturer's instructions.

NOTE – When possible, use a battery charger with alternator or polarity protection that prevents charging the battery in reverse polarity.

The charge a battery receives is equal to the charge rate in amperes multiplied by the time in hours. Thus a five ampere rate applied to a battery for ten hours would be a 50 ampere-hour charge to the battery. To fully recharge a battery, you must replace the ampere-hours or ampere-minutes removed from it, plus an extra 20% charge. This is due to the fact that batteries are not 100% efficient on recharging.

If time is available, lower charging rates in amperes are recommended.

While battery is being charged, periodically measure the temperature of the electrolyte. If the temperature exceeds 51.6'C (125'F) or if violent gassing or spewing of electrolyte occurs, the charging rate must be reduced or temporarily halted. This must be done to avoid damage to the battery.

There are two methods of recharging a battery, the Slow Charge Method and the Fast Charge Method.

NOTE – DO NOT OVERCHARGE batteries. Overcharging causes excessive and needless loss of water from the electrolyte.

8.1. SLOW CHARGING

The Slow Charge method uses a low charging rate for a relatively long period of time. The recommended rate for slow charging is one ampere per positive plate per cell. If the battery has nine plates per cell, normally four of the nine will be positive plates. Therefore, the slow charge rate would be four amperes. Charging periods as long as twenty-four hours may be needed to bring a battery to full charge.

Second method: 1% of the CCA rating 625A = 6.25 amps.

The best method of making certain a battery is fully charged, but not overcharged, is to measure the specific gravity of a cell once per hour. The battery is fully charged when no change in specific gravity occurs over a three hour period or when charging current stabilizes (constant voltage type charger).

If a maintenance free battery is to be recharged overnight (16 hours), a timer or voltage controlled charger is recommended. If the charger does not have such controls, a 3 ampere rate should be used for batteries of 80 minutes or less capacity and 5 amperes for above 80 to 125 minutes reserve capacity batteries. Batteries over 125 minutes reserve capacity should be charged at a rate of 6 amperes.

Batteries that have stood in a discharged condition for long periods of time without a recharge have become sulfated and must be recharged at a low rate to avoid overheating and excessive gassing. It may require two or three days of slow charging to bring a sulfated battery to a fully charged condition. Care should be taken not to overcharge maintenance free type batteries.

Some batteries are so badly sulfated they cannot be restored to normal operating condition, regardless of the rate of charge or the length of time the charge is applied. Therefore, if a battery cannot be restored to a fully charged condition by slow charging, it should be replaced.

8.2. FAST CHARGING

The Fast Charge method provides a high charging rate for a short period of time. The charging rate should be limited to 50 amperes for 12-volt batteries.

The battery generally cannot be fully charged with this method, but will receive sufficient charge (70 to 90%) for practical service. To completely recharge a battery, follow the fast charge with a slow charge until no change in specific gravity occurs over a three hour period.

A battery with electrolyte specific gravity of 1.225 or above should never be charged at a high rate. If the charger has not tapered to a low rate, adjust to a slow charge, preferably at a rate of one ampere per positive plate per cell.

8.3. CHARGING INSTRUCTIONS

Before placing a battery on charge, clean the battery terminals if necessary. Add distilled water sufficient to cover the plates. Fill to the proper level near the end of charge. If the battery is extremely cold, allow it to warm before adding distilled water because the level will rise as it warms. In fact, an extremely cold battery will not accept a normal charge until it becomes warm.

WARNING – NEVER attempt to charge a frozen battery. Charging a frozen battery could result in an explosion, causing serious personal injury or death.

Following instructions of charger manufacturer, connect charger to battery (Figure 9).

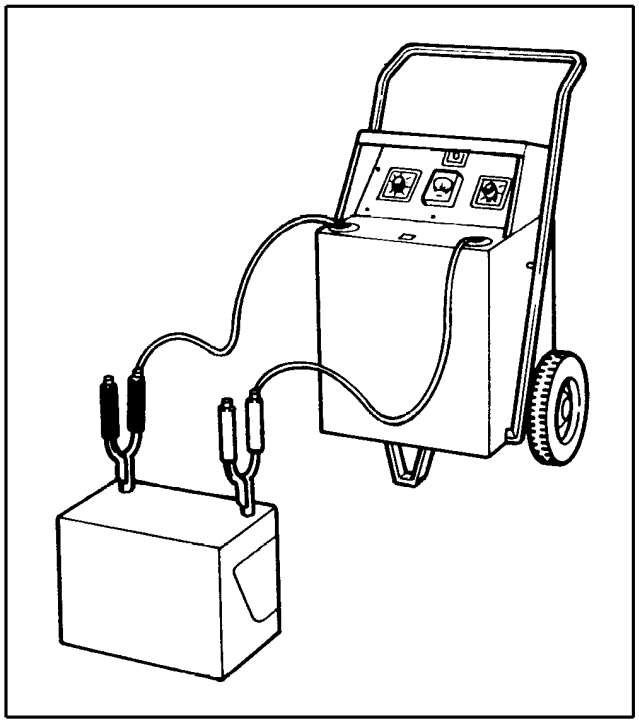

Figure 9 Charging a Battery

Connect the positive (+) charger lead to positive battery terminal and negative (—) lead to negative terminal. If the battery is in the vehicle, connect the negative lead to the engine block if the vehicle has a "negative ground" (negative battery terminal is connected to ground). Connect the positive lead to ground if vehicle has a "positive ground." "Rock" the charger lead clamps to make certain a good connection has been made.

Turn the charger "ON" and slowly increase the charging rate until recommended ampere value is reached.

> **CAUTION – If smoke or dense vapor comes from the battery, shut off the charger and reject the battery. If violent gassing or spewing of electrolyte occurs, reduce or temporarily halt the charging.**

If the engine does not crank satisfactorily when a battery is reinstalled, load test the battery as outlined under TESTING. If the battery passes the "Load Test," the vehicle's fuel, ignition, cranking and charging systems should be checked to locate and correct the problem. If it does not pass the load test, the battery should be replaced.

Battery Charging Checklist

1. Place a wet cloth over battery vents during charging. Leave all filler plugs in place (if so equipped) and tight during charging and load testing.

2. Do not attempt to charge a frozen battery. Allow battery to warm to at least 15.5'C (60'F) prior to engaging the charging device.

3. Be sure the charger is "OFF" when connecting charging cables to battery terminals. Disconnect the charger from its power source if this condition cannot be positively determined.

4. Never break a "live" circuit at the battery terminals, or touch the charger leads when the charger is "ON." This action may cause a spark which could ignite the explosive gases generated during the charging cycle.

5. Turn battery charger "OFF" prior to disconnecting charging leads.

9. EMERGENCY (JUMPER) STARTING

The procedure outlined below should be followed exactly.

> **CAUTION – Both booster and discharged batteries must be treated carefully when using jumper cables. Be careful not to cause sparks.**

> **WARNING – Wear goggles to shield eyes.**

> **WARNING – Any procedure other than that outlined below could result in (1) personal injury by electrolyte squirting out the vent, (2) personal injury or property damage due to battery explosion, (3) damage to the charging system of the booster vehicle or of the immobilized vehicle.**

Make sure booster and discharged batteries are the same voltage.

Make certain the stalled vehicle and the one containing booster battery do not touch. If the two vehicles are in contact, a ground connection could be established which could cause sparking when jumper cables are attached.

9.1. PROCEDURE

1. On both vehicles: Set parking brake. Place transmission in NEUTRAL or PARK. Turn lights, heater and other electrical loads OFF. Make certain ignition key is turned OFF.

2. Determine the placement of the negative (—) and positive (+) terminals of both batteries.

3. Place a damp cloth over the vents of each battery. Make certain the cloth is clear of fan blades, belts and other moving parts (Figure 10).

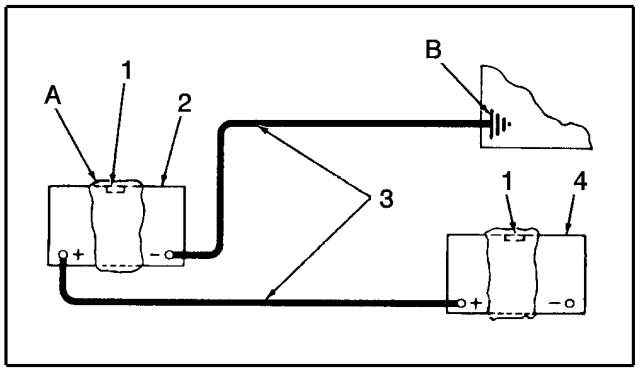

Figure 10 Proper Jumper Cable Connections

A. CLOTH COVERING VENTS (BOTH BATTERIES)
B. GROUND AT LEAST 12 INCHES (30 CM) FROM BATTERY
1. BATTERY VENT LOCATION
2. BOOSTER BATTERY
3. JUMPER CABLES
4. DISCHARGED BATTERY

4. Attach one end of the jumper cable to the positive (+) terminal of the booster battery and the other end of same cable to positive (+) terminal of discharged battery (Figure 10).

5. Attach one end of the remaining jumper cable to the negative terminal of the booster battery and the other end to a ground at least 12 inches (304 mm) from the battery of the vehicle being started (Figure 10). (DO NOT connect directly to the negative post of the dead battery.) The ground connection must provide good electrical conductivity and current carrying capacity.

CAUTION – Take care to be sure the clamps from one cable do not inadvertently touch the clamps on the other cable.

WARNING – Do not lean over the battery when making connections. Avoid touching hazards such as fans, manifolds and spark plug terminals when connecting cables.

6. Be sure everyone is standing away from vehicles. Start the engine of the vehicle with the booster battery. Wait a few minutes, then attempt to start the engine of the vehicle with the discharged battery.

7. Do not operate the starter for more than 30 seconds. Wait at least 30 seconds between starting attempts to allow starter motor to cool. If the engine does not start after several cranking attempts, check to be sure that the clamps are secure. If the engine will not start, refer to the appropriate service manual for troubleshooting procedures.

8. After starting, allow the engine to return to idle speed. Remove ground cable connections from the vehicle with discharged battery. Then remove the other end of the same cable from the booster battery.

9. Remove the other cable by disconnecting from the discharged battery first and then disconnect the opposite end from the booster battery.

10. Remove and discard cloths covering battery vents.

10. BATTERY REMOVAL AND INSTALLATION

10.1. REMOVAL

1. Make sure all electrical loads (lights, ignition, accessories) are turned OFF.

2. Remove battery cover (where used).

3. Note locations of battery positive and negative terminals in relation to surrounding vehicle components. Battery must be installed in the same position.

4. Remove battery cables, ground first.

5. Loosen battery hold-down hardware and remove battery from carrier tray.

6. Inspect battery cables and replace if necessary. Clean cable connector terminals with a wire brush.

   Clean and tighten battery cable ground, starter relay and starter connections.

7. Inspect battery hold-down hardware and battery tray. Replace worn or damaged parts. Remove corrosion with a wire brush and/or wash with a weak solution of baking soda and water. Rinse and dry. Repaint parts if needed to prevent rusting.

Make sure no foreign objects such as stones, bolts, nuts, etc., which could damage battery are left in battery tray.

10.2. INSTALLATION

When replacing the battery, make sure that battery to be installed has sufficient capacity to cover the electrical requirements of the vehicle. Use of an under-capacity battery will result in poor performance and premature battery failure. The original equipment battery can be used as a minimal guide, but is often misleading since the vehicle owner may have installed additional electrical accessories on the vehicle.

Be sure battery is at full charge when installed. If the battery has been in storage for some time or if the installation is being made in sub-freezing temperatures, the battery should be given a boost charge before being installed.

1. Place battery in battery tray with terminals in proper position. Battery should rest level in tray.

2. Install battery hold down hardware and tighten until battery is firm and secure.

> **CAUTION – Do not overtighten battery hold-downs. Overtightening could damage battery resulting in early failure.**

3. Apply a light coat of terminal grease to battery and cable terminals to inhibit corrosion.

4. Connect battery cables to battery. Check for proper battery polarity with respect to the vehicle. "Reversed" polarity may cause serious damage to the electrical system. Connect ground cable last.

   Tighten terminal fasteners as follows: DO NOT OVERTIGHTEN.

Side Terminals:

60-90 in-lbs. or 5-7 ft-lbs. (7-10 N•m)

Top Terminals:

10-15 ft-lbs. (13-20 N•m)

Taper Post Terminals:

50-60 in-lbs. or 4-6 ft-lbs. (5.5-8 N•m)

NOTE – New batteries must be coded to indicate months and year of installation.

5. Start engine and check operation of vehicle's charging system. If necessary, adjust or repair charging system to obtain correct charging output.

6. Install battery cover (where used).

11. ACTIVATING DRY CHARGED BATTERIES

Dry charged batteries provided for replacement installation must be "activated" before they can be used. Following the instructions outlined below will assure proper activation regardless of temperature and conditions of storage.

1. Fill each cell of the battery to the bottom of split ring with the correct battery-grade electrolyte as specified by the manufacturer's instructions. Using higher or lower specific gravity electrolyte than recommended can impair battery performance. Originally filling each cell to just above the top of the separators permits expansion of the electrolyte as battery is boost charged.

2. Gently rock battery. This will help to force out trapped air and to saturate the plates with electrolyte.

3. Boost charge 12-volt batteries at 15 amps (12-volt heavy duty batteries at 30 initial amps) until the specific gravity of the electrolyte is 1.250 or higher and electrolyte temperature is at least 15.5'C (60'F). BOTH CONDITIONS MUST BE MET. If electrolyte bubbles violently while charging, reduce charging rate until excessive bubbling action subsides, then continue charging until 1.250 specific gravity and 15.5'C (60'F)

are reached. If the ambient temperature is 0'C (32'F) or less, it is imperative that the above instructions be followed.

4. Check volume of electrolyte in all cells and adjust to prescribed level with additional electrolyte as required.

   NOTE – Do not add water at this point.

5. Install battery in vehicle as instructed under BATTERY REMOVAL AND INSTALLATION. Be sure of proper polarity.

   Dry charged batteries may be placed in service immediately after activation. However, to insure good performance these additional steps are recommended.

   Check the specific gravity of all cells. Under good storage conditions, the electrolyte specific gravity on activating a dry-charged battery will drop approximately .010 and temperature will rise 4' to 5.6'C (7 to 10'F) within twenty minutes of filling the battery. A battery under these conditions requires little boost charging. However, should the specific gravity drop .030 or more with a corresponding increase in temperature, the negative plates have been oxidized and the battery should be fully recharged before use. Also, the battery should be recharged if one or more cells gas violently after the addition of electrolyte. After electrolyte is added, check the open circuit terminal voltage of the battery. If a 12-volt battery reads less than 10 volts, this indicates a reverse cell or an "open" circuit and the battery should be replaced.

After the dry charged battery has been activated, it must be serviced, handled and kept charged like any other wet battery. After battery has been in service, add only distilled water. DO NOT ADD ACID.