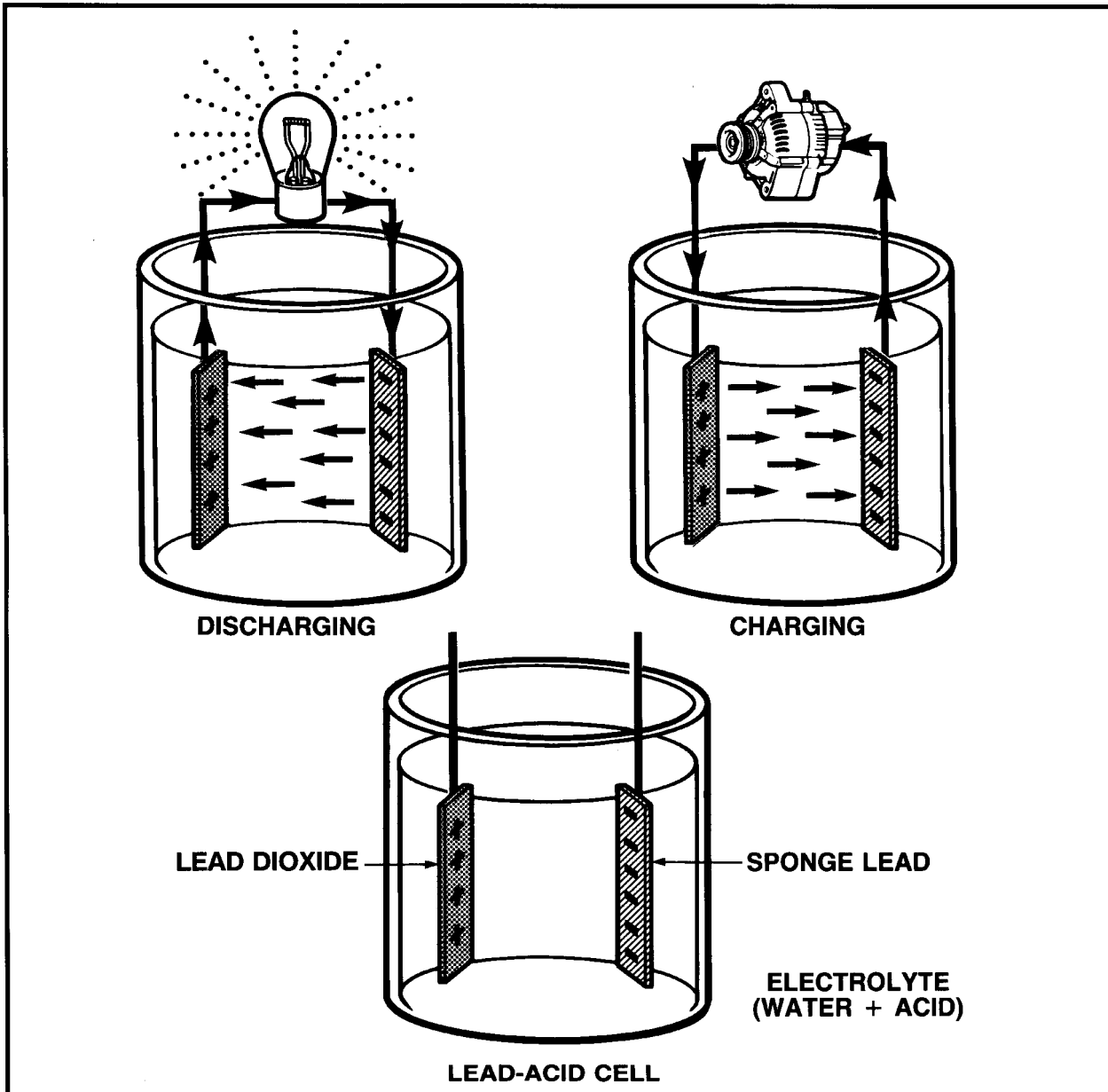


THE BATTERY

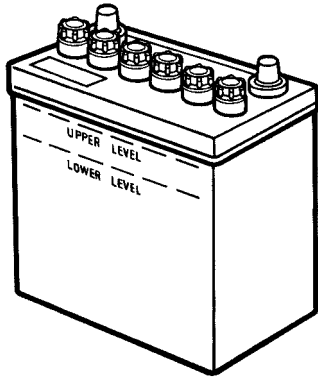
Overhead Transparencies - B & W Masters

THE BATTERY



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Automotive Electronics Training and Resource Site

THE BATTERY

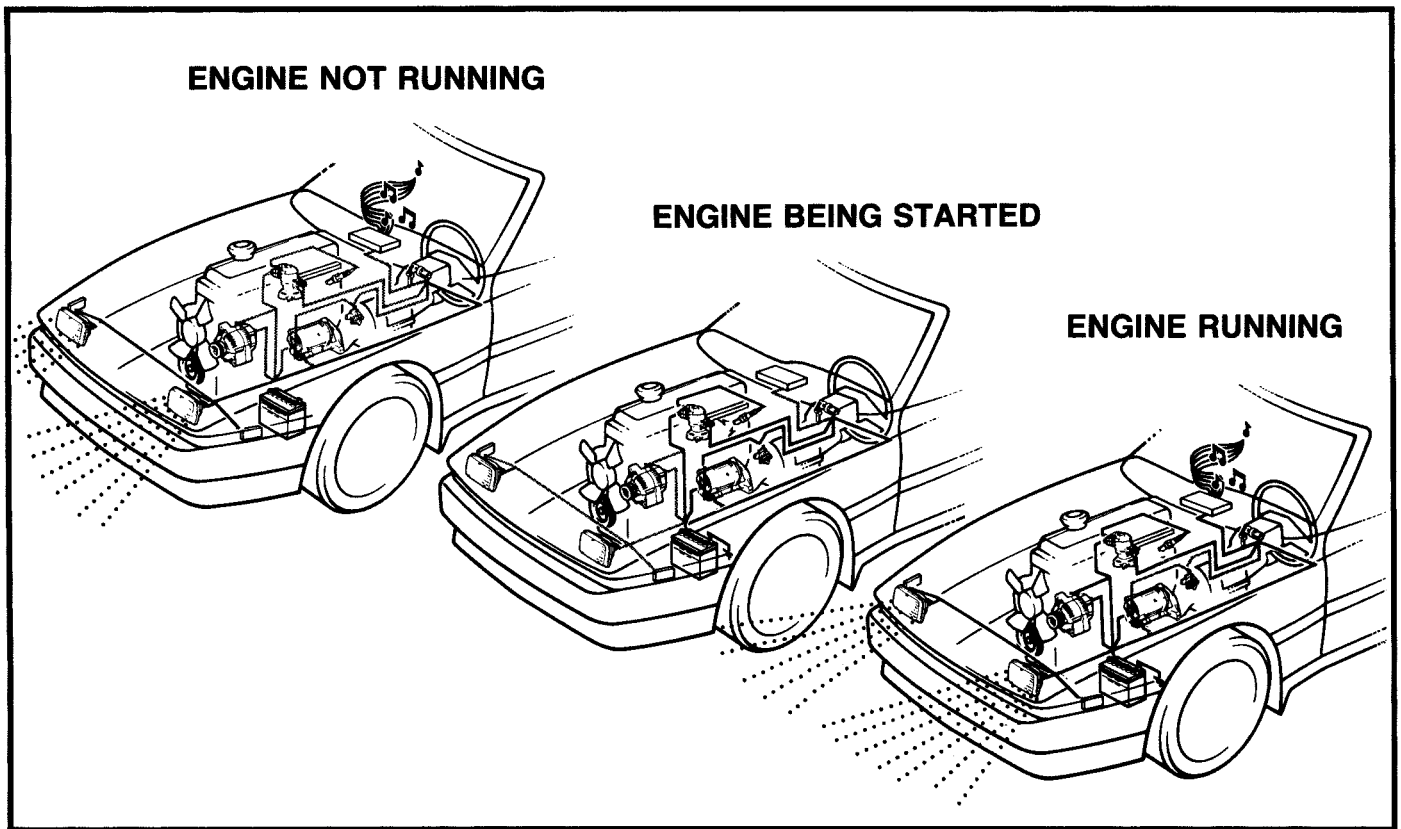


The Battery

The battery converts chemical energy into electrical energy. It is the main source of electrical energy on Toyota vehicles when the engine is not running or is being started. Five systems depend on the energy produced: starting, ignition, charging, lighting, and accessory.

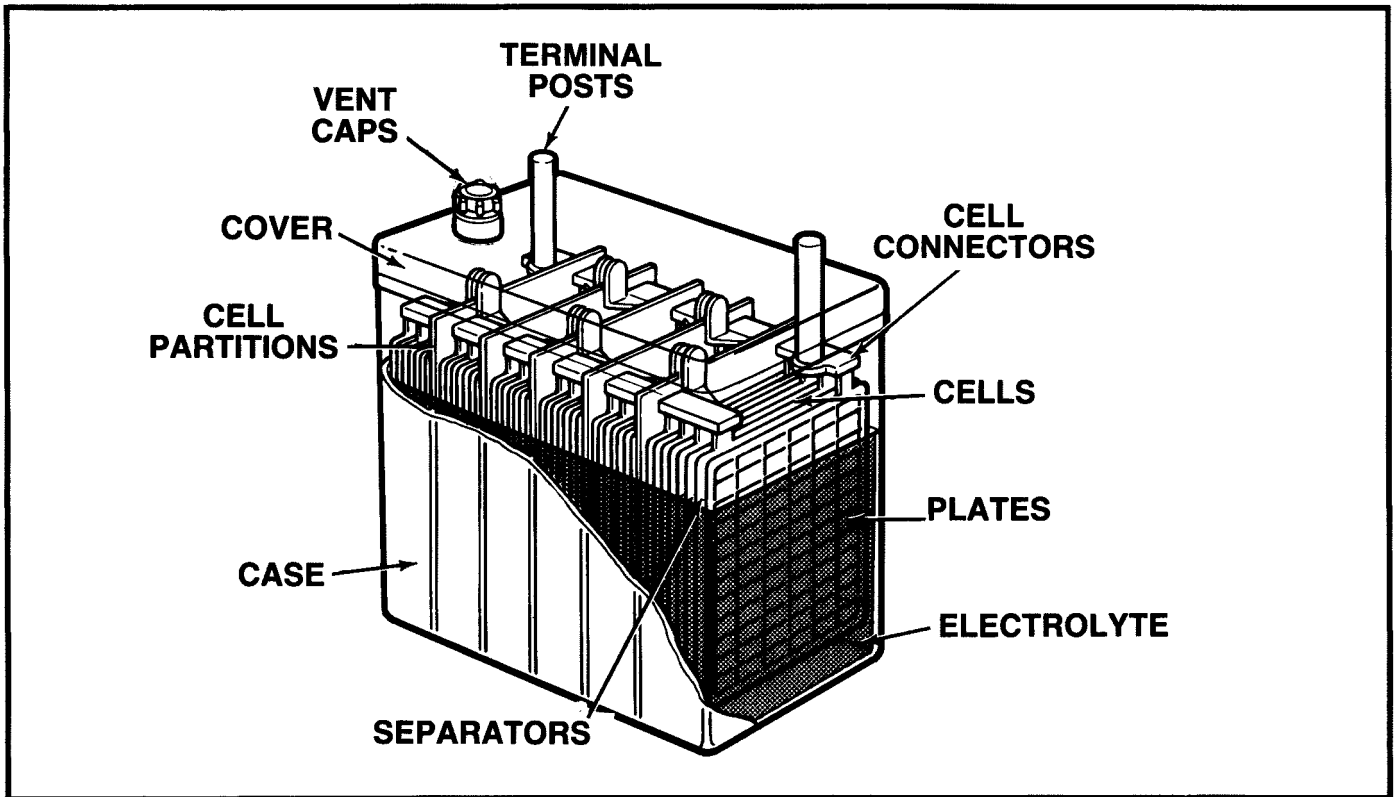
THE BATTERY

BATTERY FUNCTIONS



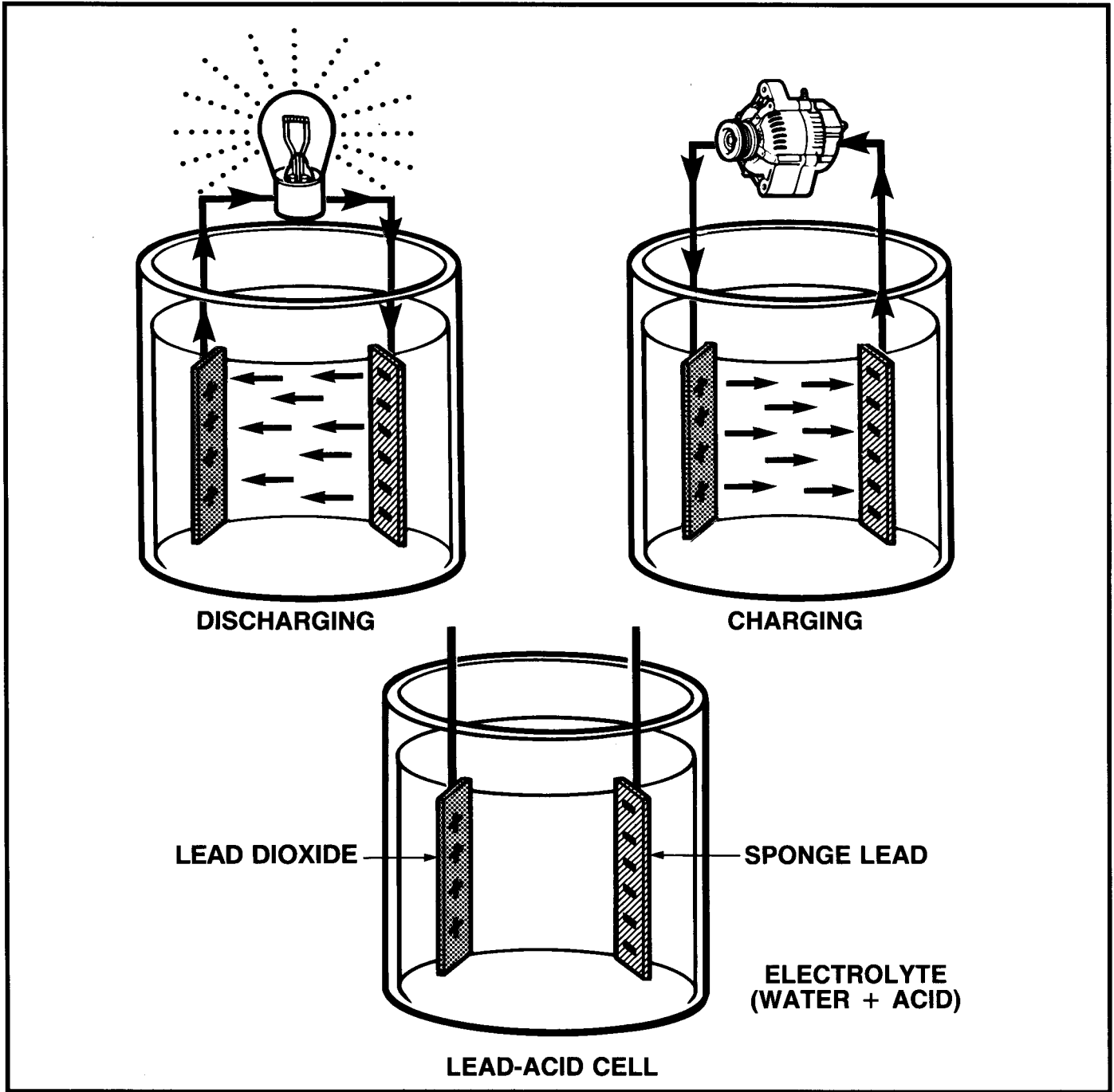
THE BATTERY

BATTERY CONSTRUCTION



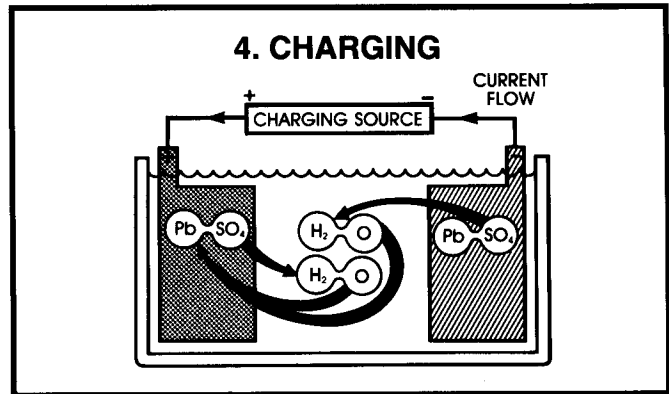
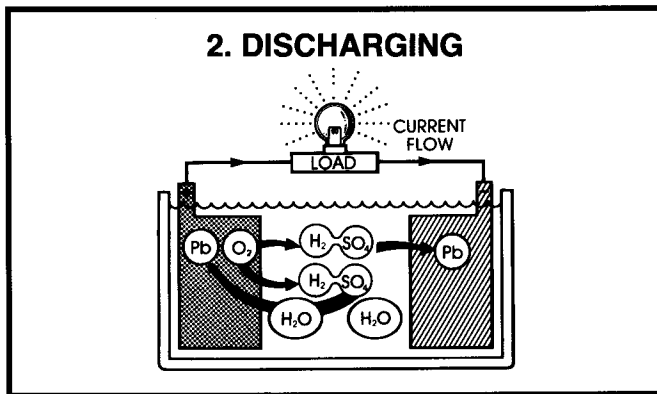
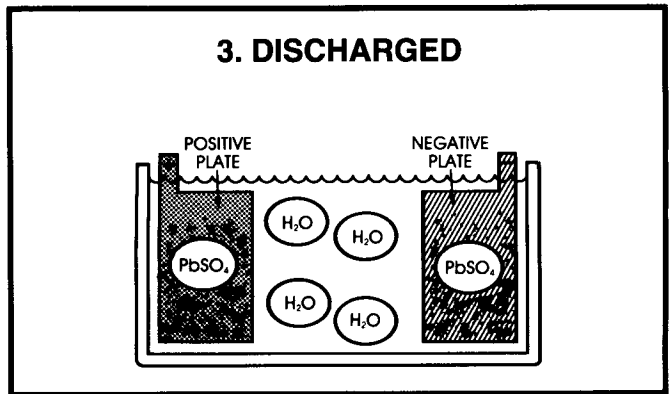
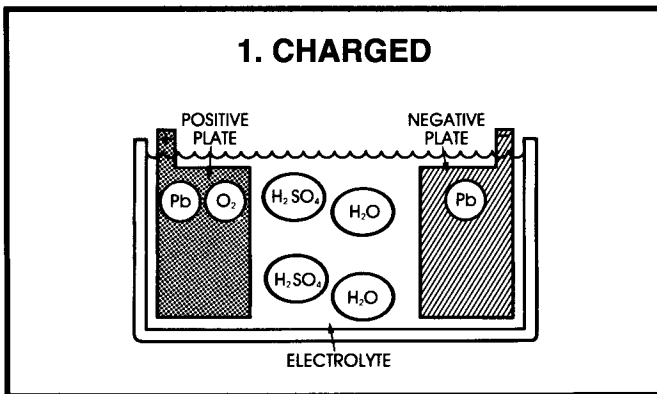
THE BATTERY

CELL THEORY



THE BATTERY

ELECTRO-CHEMICAL REACTION



Capacity Ratings

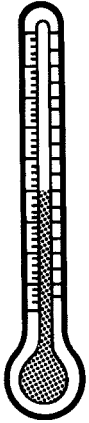
The battery must be capable of cranking the engine and providing adequate reserve capacity. Its capacity is the amount of electrical energy the battery can deliver when fully charged. Capacity is determined by the size and number of plates, the number of cells, and the strength and volume of electrolyte.

The most commonly used ratings are:

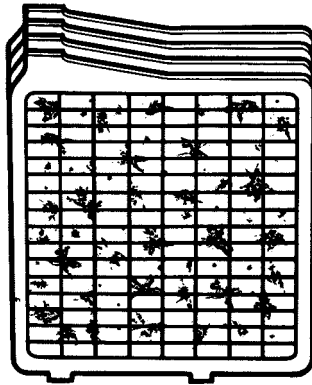
- Cold Cranking Amperes (CCA)
- Reserve Capacity (RC)
- Amp-Hours (AH)
- Power (Watts)

THE BATTERY

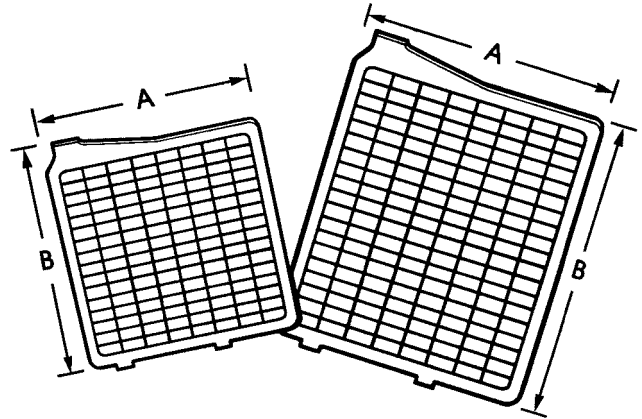
FACTORS AFFECTING CHARGING



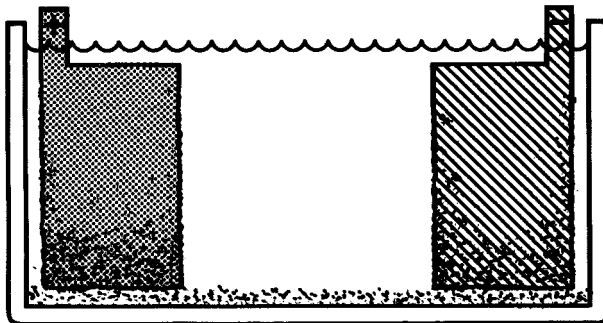
1. TEMPERATURE



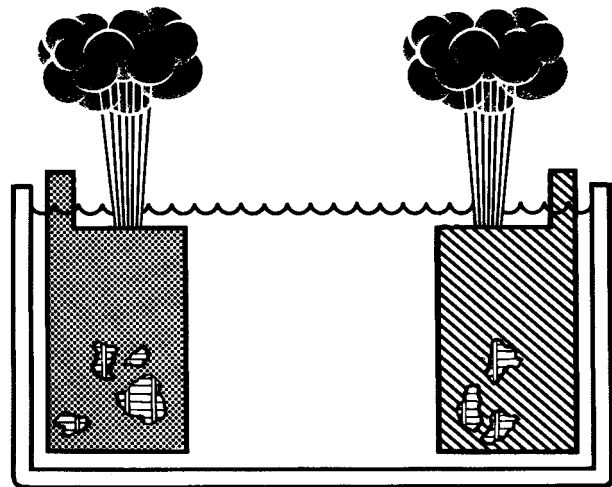
2. STATE-OF-CHARGE



3. PLATE AREA



4. ELECTROLYTE IMPURITIES

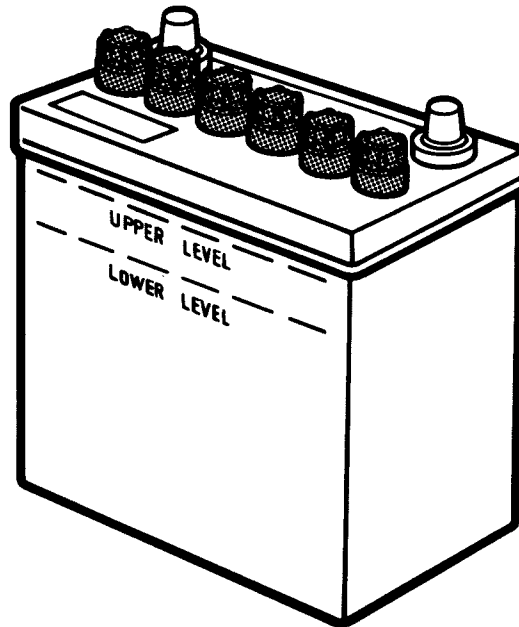


5. GASSING

THE BATTERY

CAUSES OF BATTERY FAILURE

ELECTROLYTE LEVEL: A low electrolyte level exposes active material, and any sulfate hardens and resists chemical action. Loss of electrolyte may be caused by a cracked case, poor maintenance (not adding water when needed), or severe overcharging which causes high internal heat and excessive gassing. Too much electrolyte is just as bad. Overfilling dilutes the electrolyte and spillage may corrode battery terminals.



CORROSION: Spilled electrolyte and condensation from gassing may cause corrosion on terminals, connectors, and metal holddowns/carriers. Such corrosion increases electrical resistance, which reduces available voltage and charging effectiveness. It may also create a current leakage path to allow self-discharge.

CYCLING: Repeated cycling – from fully charged to fully discharged and back – may cause loss of active material from the positive plates. This reduces battery capacity and its useful life.

OVERCHARGING: Overcharging by the vehicle's charging system or separate battery charger causes excessive gassing and high internal heat. Too much gassing can wash active materials off the plates, as well as cause excessive water usage. Too much heat can oxidize the positive plate material and warp the plates.

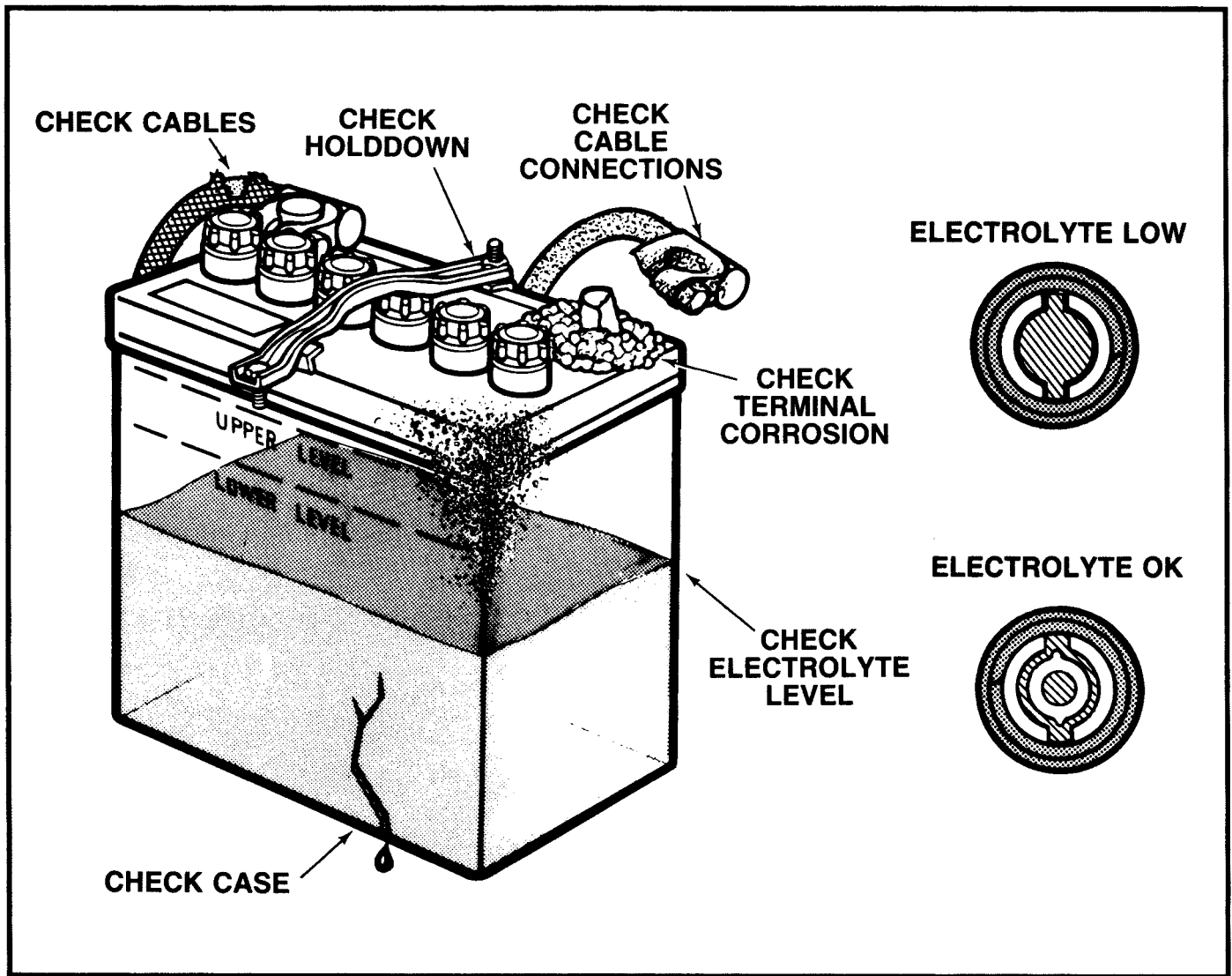
UNDERCHARGING: A faulty charging system will not maintain the battery at full charge. Severe undercharging allows sulfate on the plates to become hard and impossible to remove by normal charging. The weak electrolyte freezes easier. The undercharged battery may fail to crank the engine.

TEMPERATURE: High temperatures from overcharging or engine heat can shorten battery life. Low temperatures can cause freezing of weak electrolyte. At 0°F (-17.8°C), a fully charged battery provides less than half its normal power. At the same time, the cold engine requires twice as much cranking power as it does with normal temperatures. The electrolyte in a fully charged battery will not freeze until -60°F or lower, while the electrolyte in a fully discharged battery will freeze at +18°F.

VIBRATION: A battery must be mounted securely. Vibration can loosen connections, crack the case, and damage internal components.

THE BATTERY

CHECK BATTERY AND ELECTROLYTE



INSPECT/ADJUST DRIVE BELT

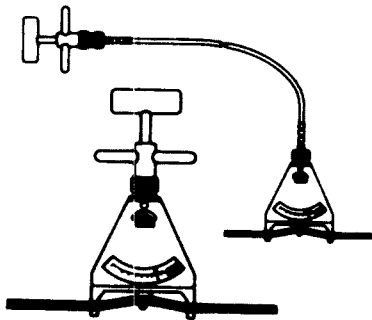


CORRECT

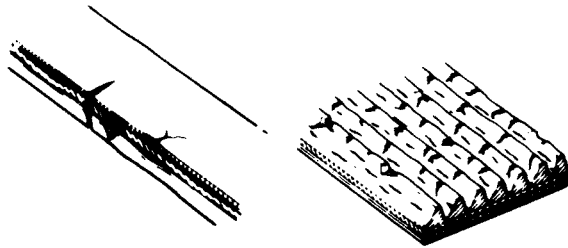


WRONG

**BELT TENSION GAUGE
(NIPPONDENSO)**

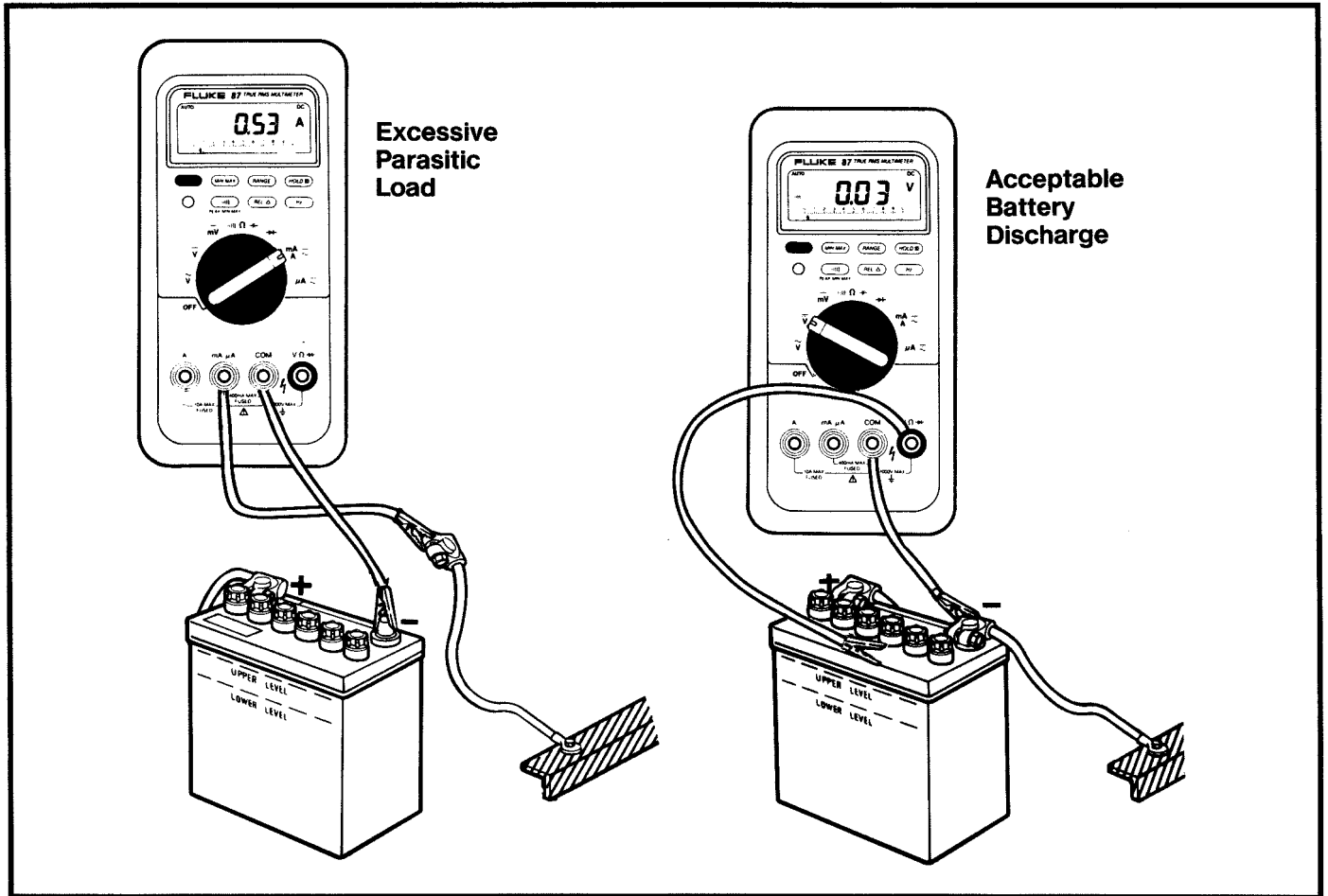


REPLACE



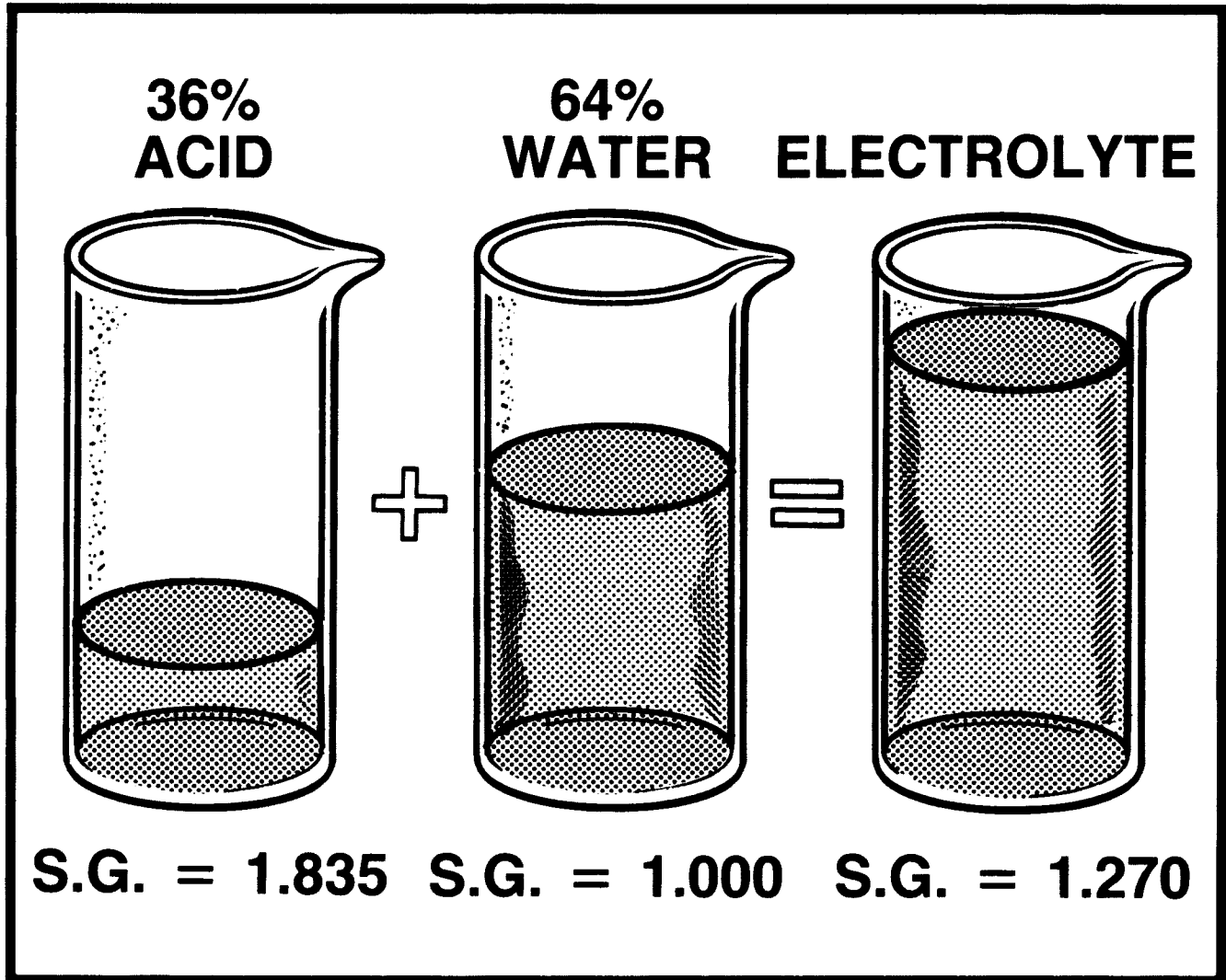
THE BATTERY

CHECK FOR BATTERY DRAIN



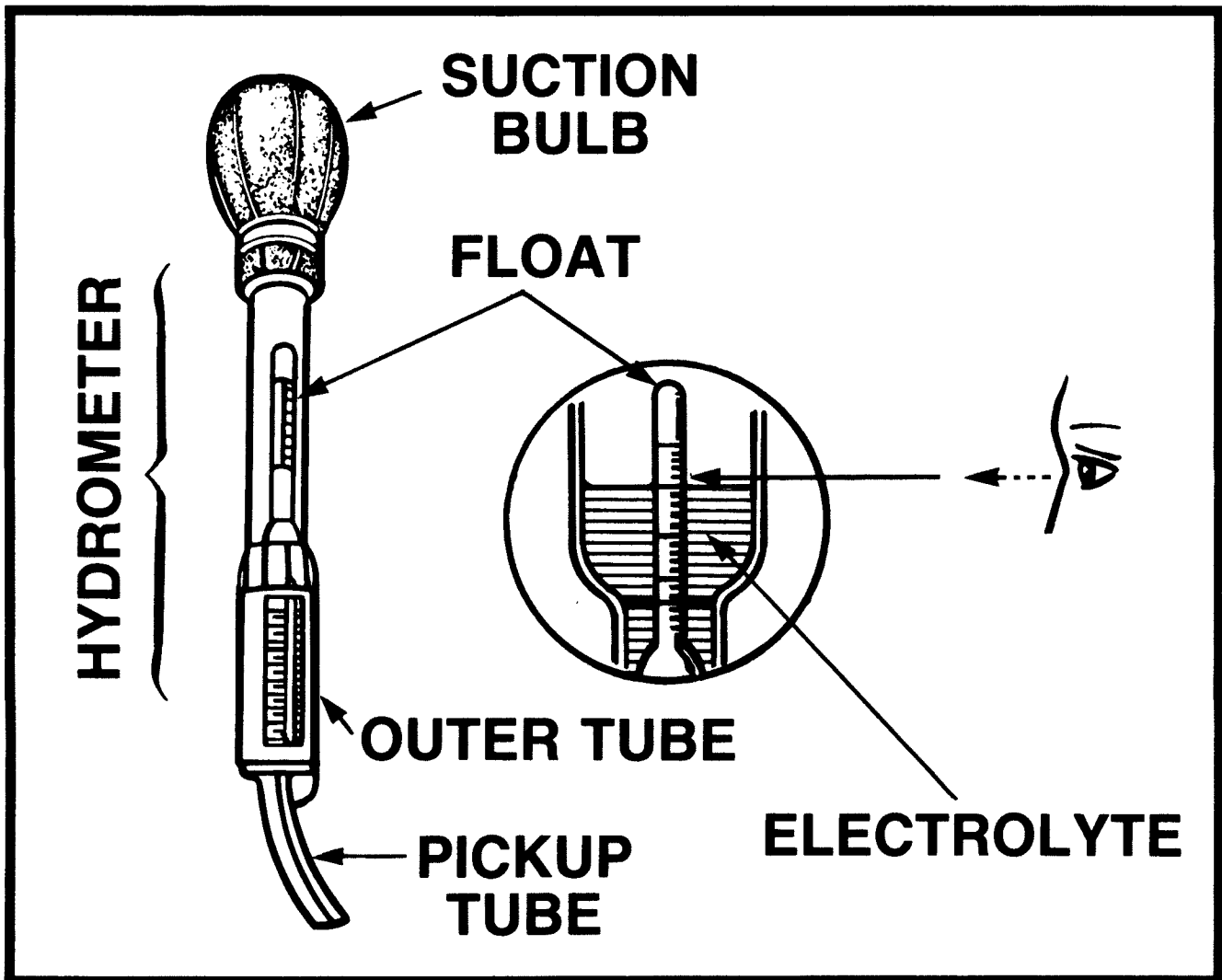
THE BATTERY

SPECIFIC GRAVITY



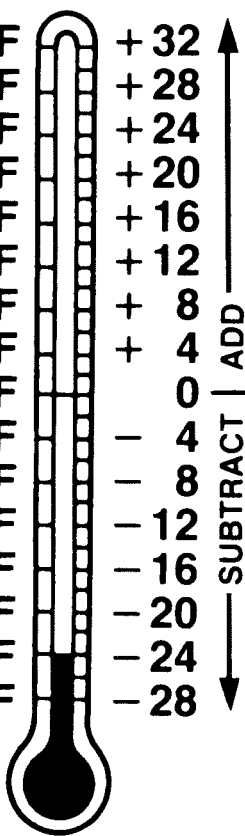
THE BATTERY

STATE OF CHARGE TEST Specific Gravity



THE BATTERY

TEMPERATURE CORRECTION

71C	160F	+ 32	
65.5C	150F	+ 28	
60C	140F	+ 24	
54.5C	130F	+ 20	
49C	120F	+ 16	
43C	110F	+ 12	
37.5C	100F	+ 8	
32.5C	90F	+ 4	
27C	80F	0	
21C	70F	- 4	
15.5C	60F	- 8	
10C	50F	- 12	
4.5C	40F	- 16	
-1C	30F	- 20	
-6.5C	20F	- 24	
-12C	10F	- 28	

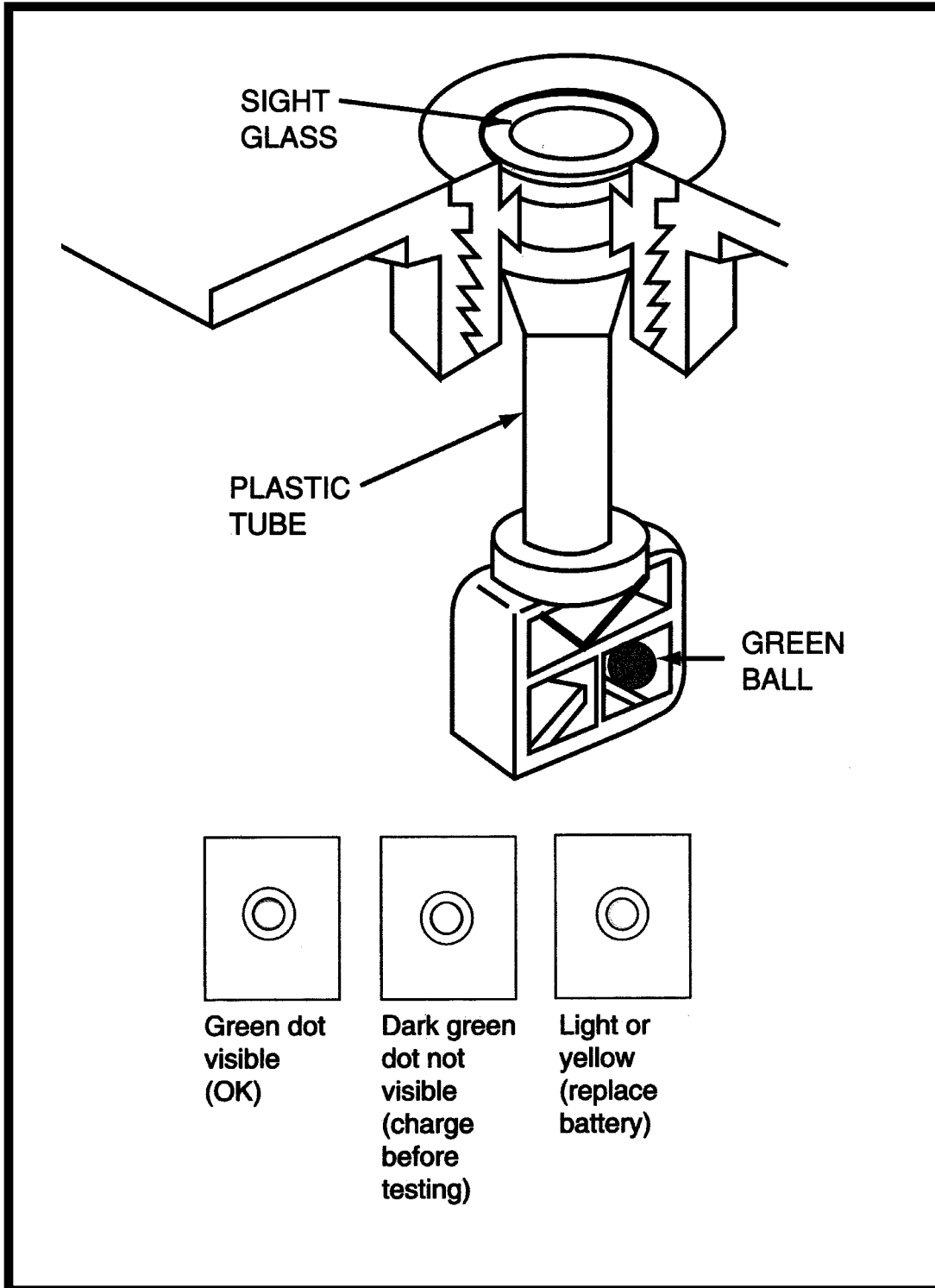
EXAMPLE:
 HYDROMETER READING..... 1.250
 ELECTROLYTE TEMPERATURE..... 40F
 SUBTRACT SPECIFIC GRAVITY..... -.016
 CORRECTED SPECIFIC GRAVITY IS.... 1.234

EXAMPLE:
 HYDROMETER READING..... 1.240
 ELECTROLYTE TEMPERATURE..... 100F
 ADD SPECIFIC GRAVITY..... +.008
 CORRECTED SPECIFIC GRAVITY IS.... 1.248

A FULLY CHARGED BATTERY HAS A SPECIFIC GRAVITY OF ABOUT 1.265.

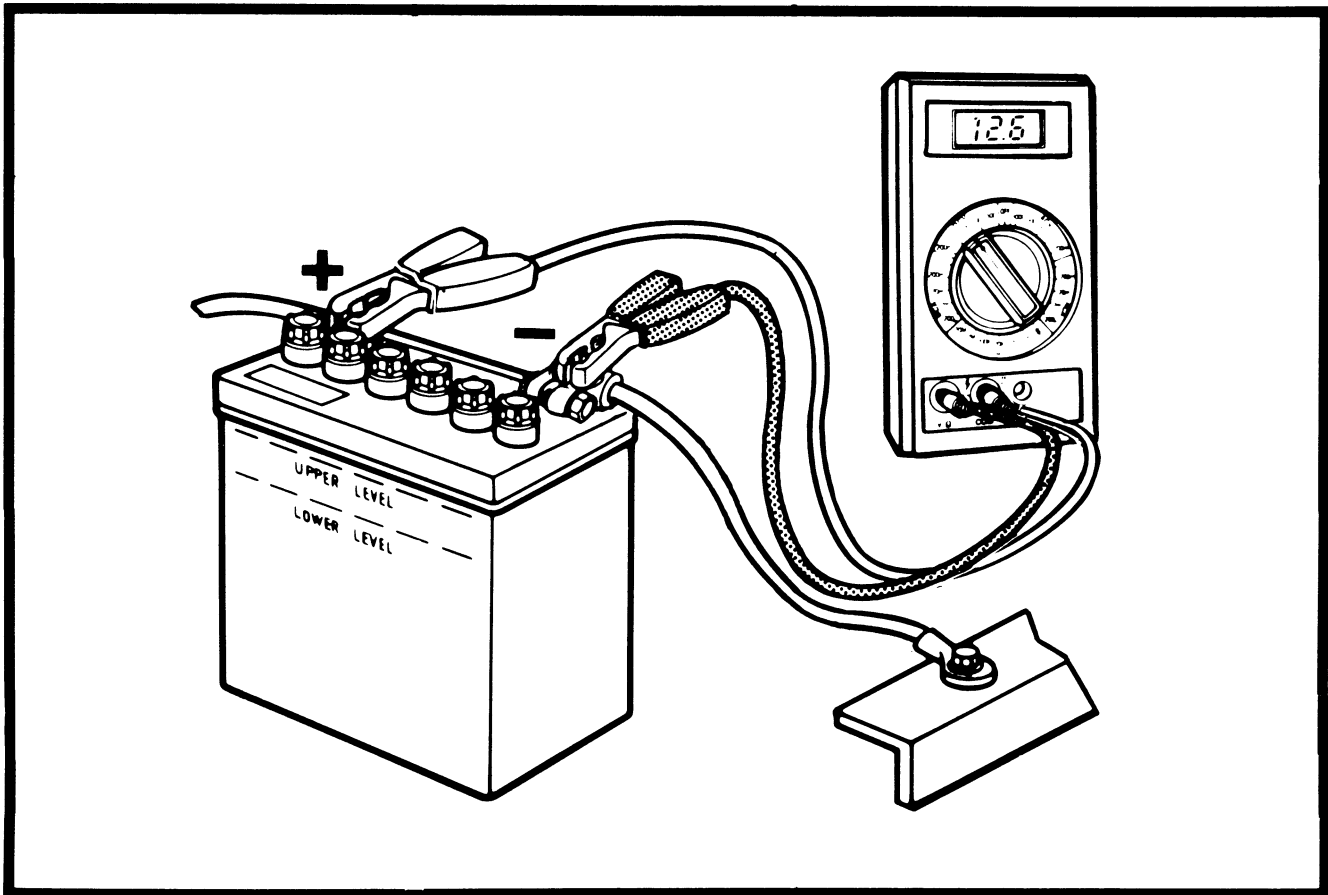
THE BATTERY

BUILT-IN HYDROMETER



THE BATTERY

STATE OF CHARGE TEST Open Circuit Voltage



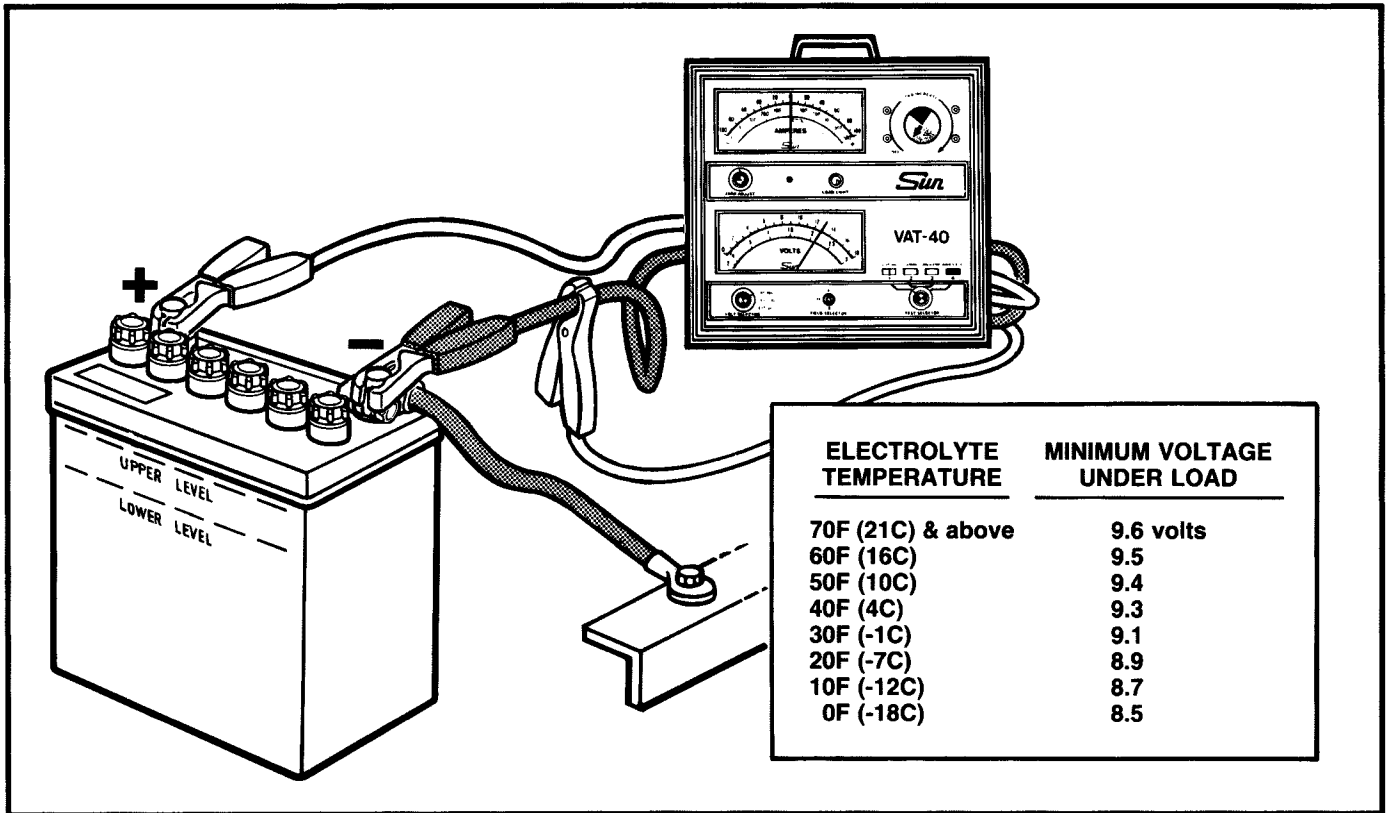
THE BATTERY

STATE OF CHARGE VALUES

STATE OF CHARGE	SPECIFIC GRAVITY*	OPEN-CIRCUIT VOLTAGE
100%	1.265	12.6
75%	1.225	12.4
50%	1.190	12.2
25%	1.155	12.0
DEAD	1.120	11.9

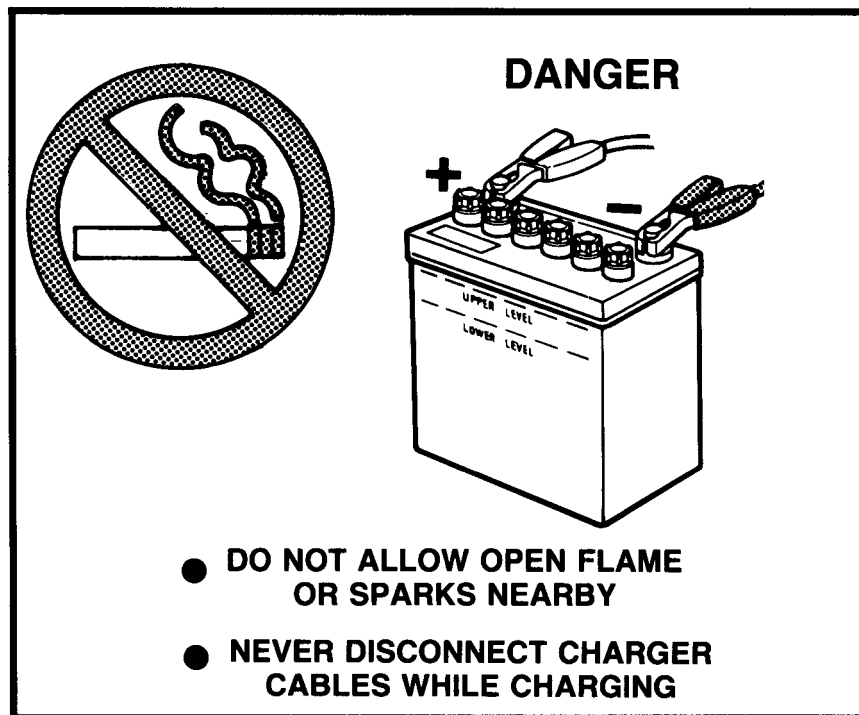
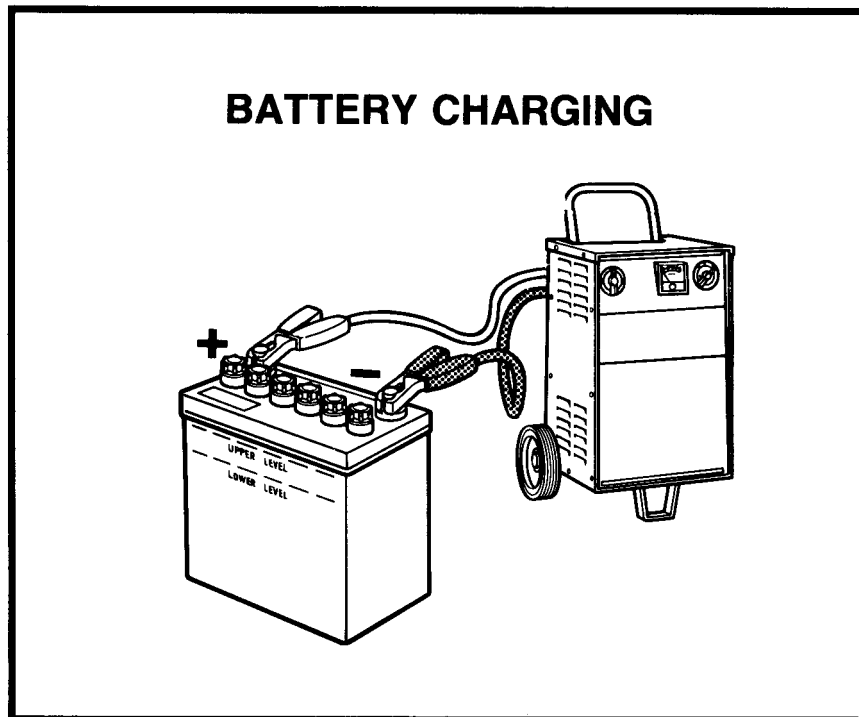
THE BATTERY

HEAVY-LOAD (CAPACITY) TEST



THE BATTERY

BATTERY SERVICE Charging



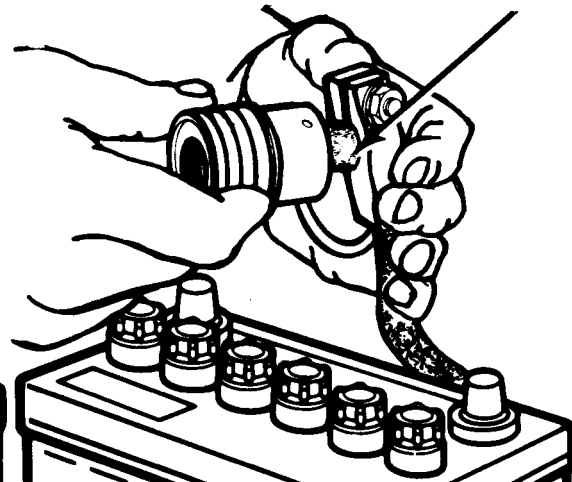
THE BATTERY

BATTERY SERVICE Cleaning Tools

**BATTERY POST
CLEANING TOOL**

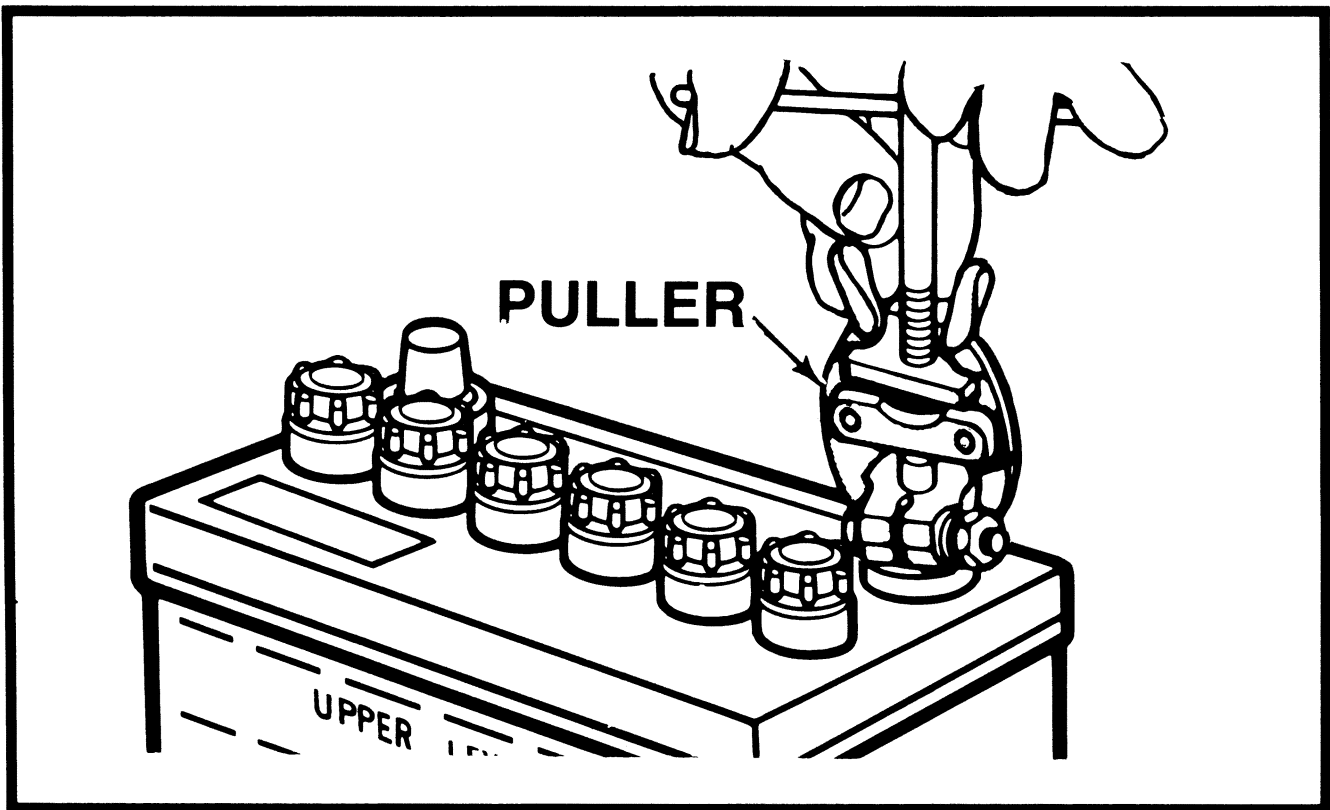


**BATTERY CABLE
CLEANING TOOL**



THE BATTERY

BATTERY SERVICE Removal Tools



BATTERY SERVICE Jumping a Dead Battery

