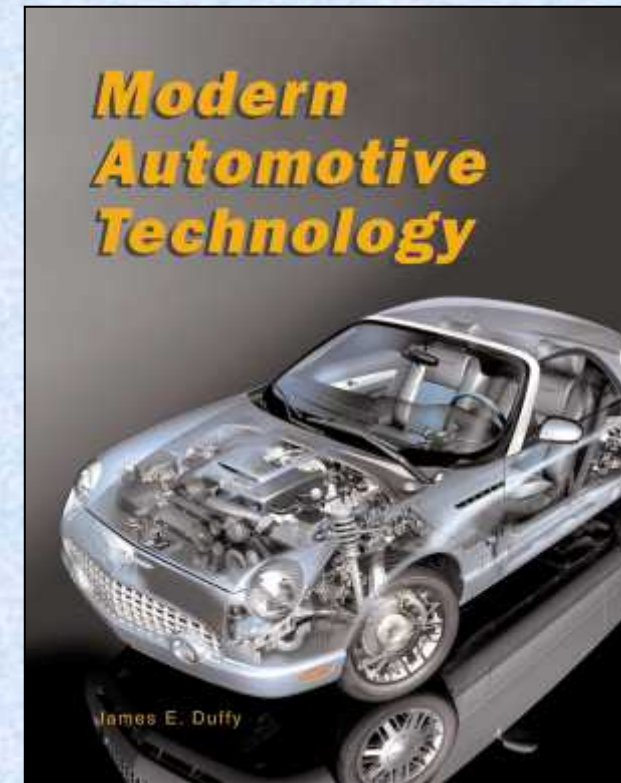


powerpoint for

# Modern Automotive Technology

by

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Tinley Park, Illinois

# **Chapter 30**

# **Battery Testing and Service**

# Contents

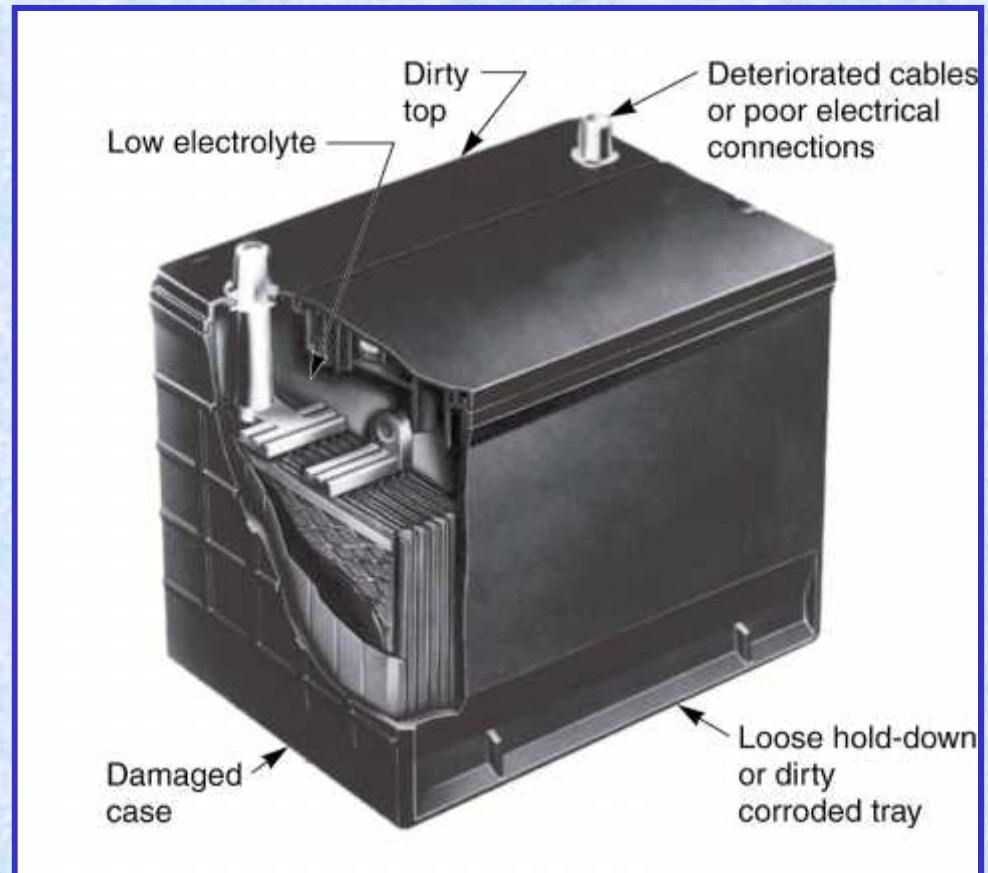
- Battery maintenance
- Jump starting
- Battery load test
- Activating dry-charged batteries
- Removing and replacing a battery

# Battery Maintenance

- Always wear eye protection and safety gloves!**
- Inspect the case and terminals for physical damage
- Check the electrolyte level or indicator eye
- Clean the battery terminal connections
- Clean the battery top
- Check the battery hold-down and tray

# Battery Problems

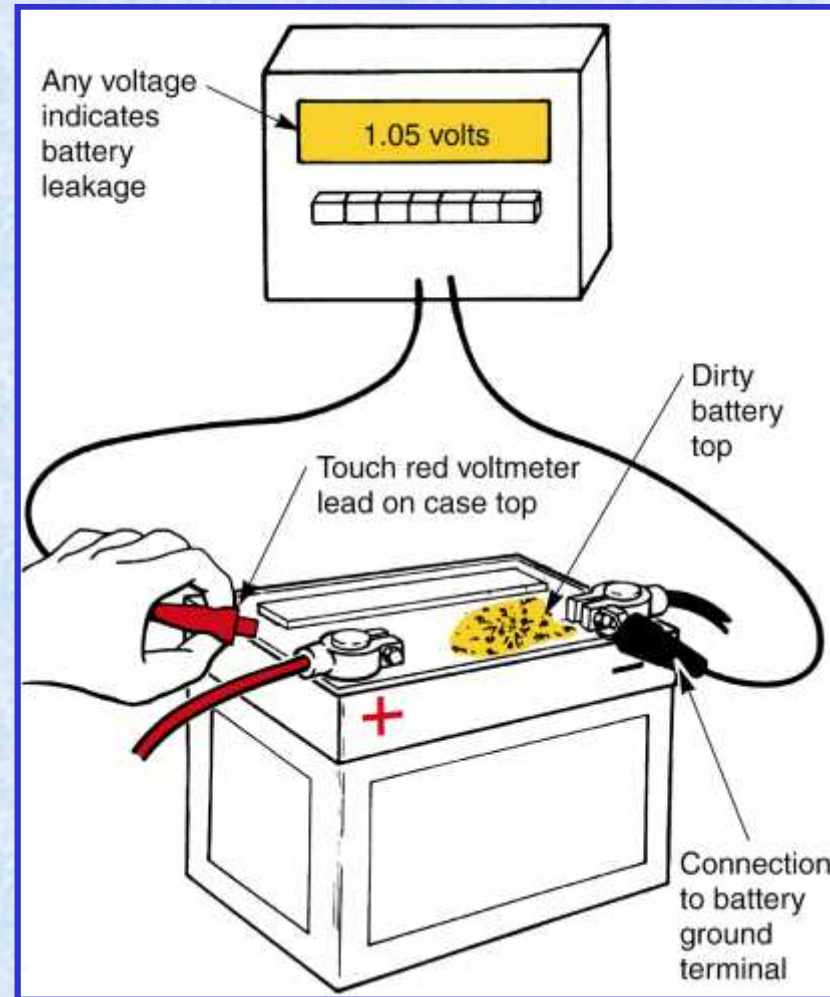
Visually inspect batteries for these kinds of problems



# Battery Leakage Test

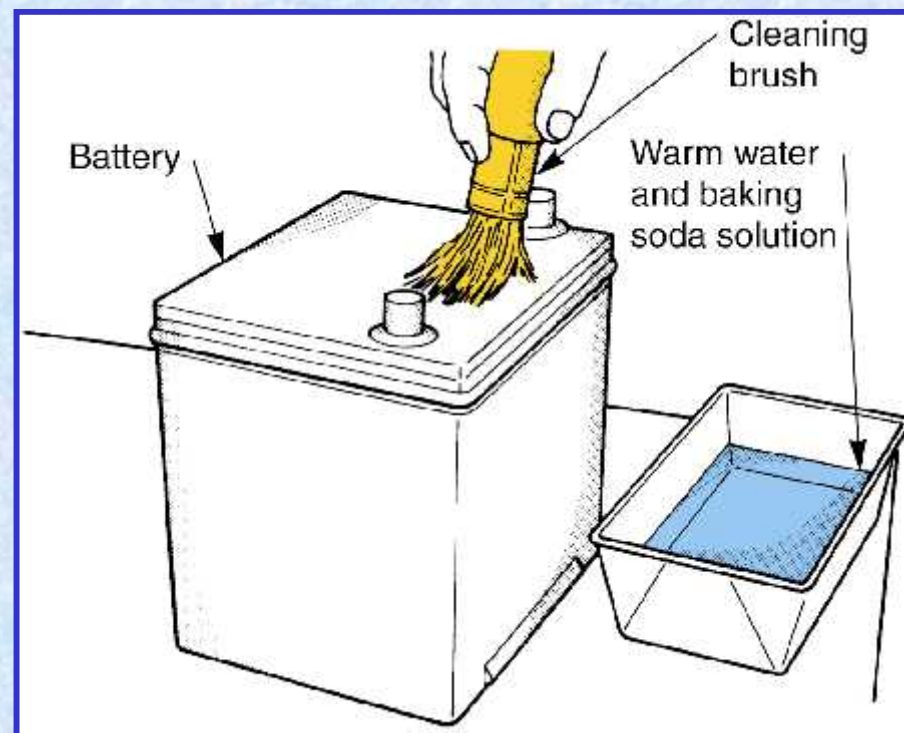
- Checks for current discharge across the top of the battery
- Set a voltmeter to a low voltage range
- Use acid-resistant probes
- Touch the negative lead to the negative terminal
- Using the positive lead, probe the top of the battery
- Clean the battery if voltage is above 0 volts

# Battery Leakage Test



# Battery Cleaning

Wash with baking soda and water, and do not let debris enter filler openings

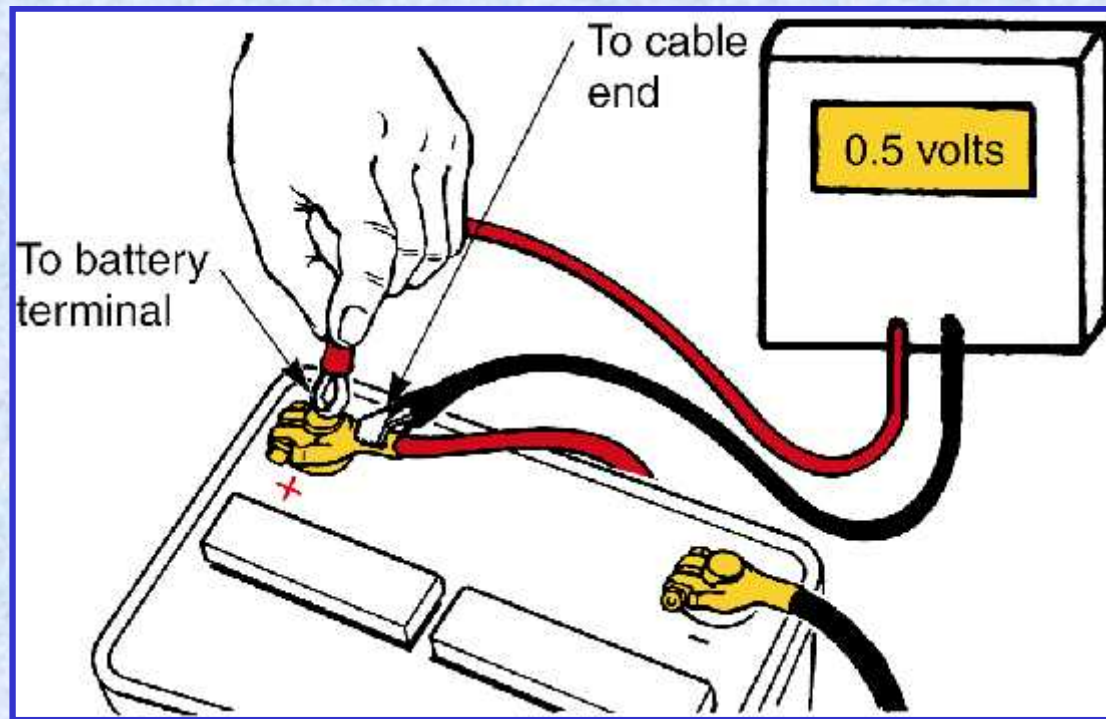




# Battery Terminal Test

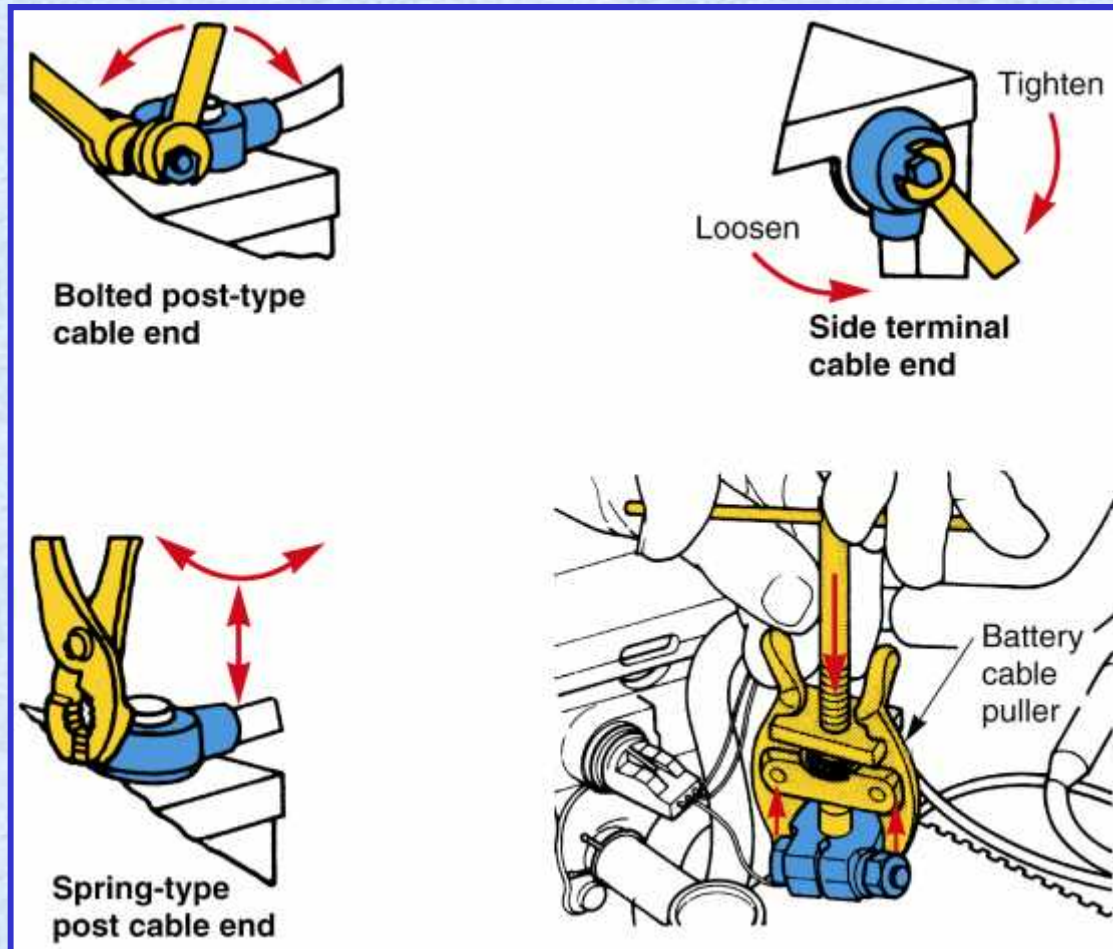
- Check for poor connections between the battery cables and terminals
- Connect the negative voltmeter lead to the cable end
- Connect the positive lead to the battery terminal
- Disable the injection or ignition
- Crank the engine while watching the voltmeter readings
- Clean the connections if the voltage is above 0.5 volts

# Battery Terminal Test

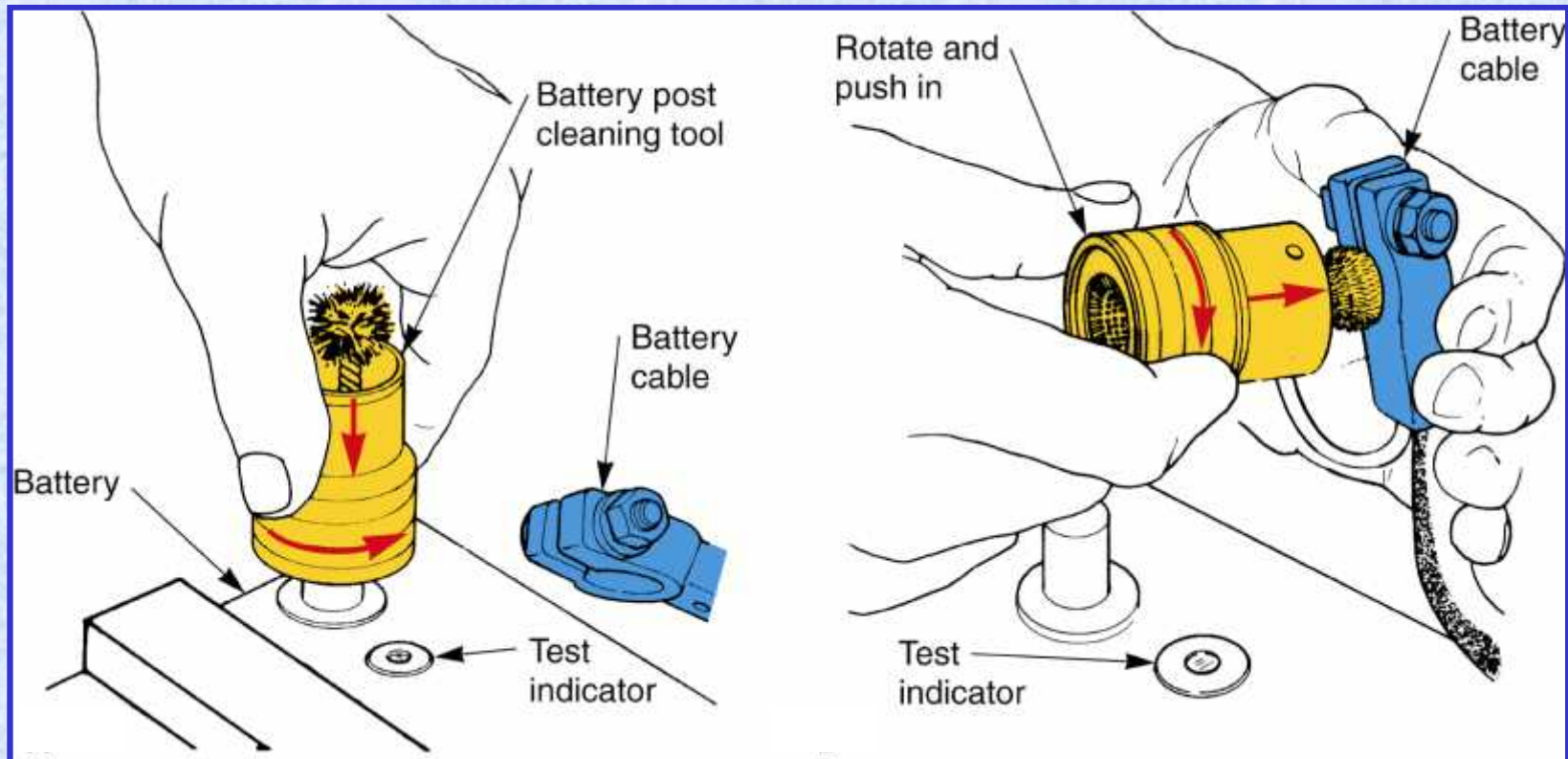


# Removing Battery Cables

Different methods of removal



# Cleaning Battery Posts and Cable Ends

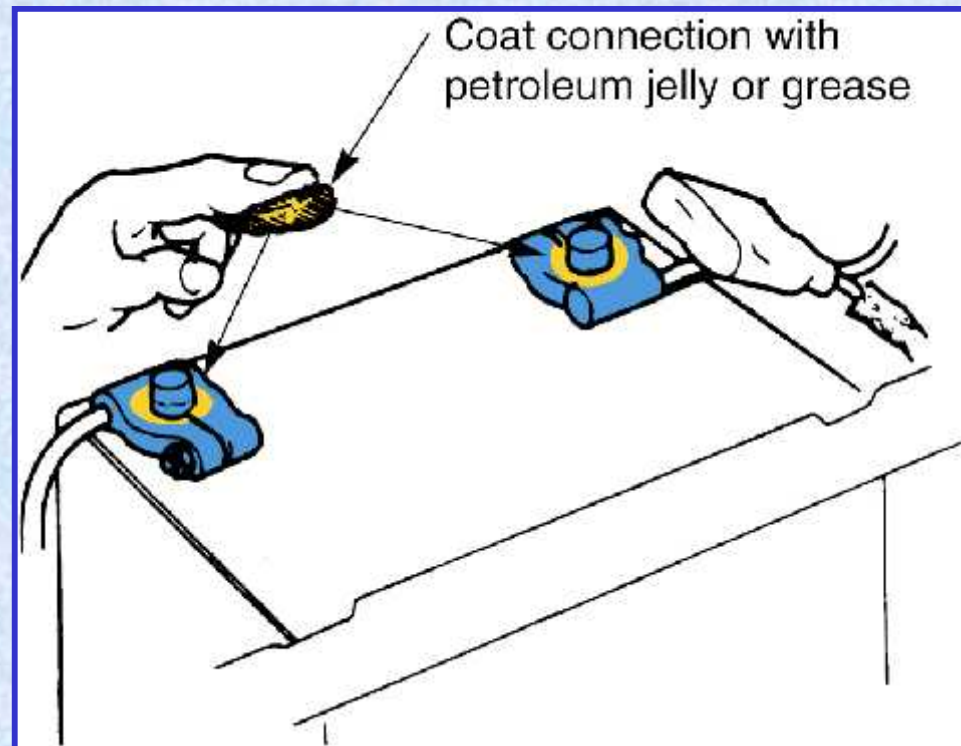


Rotate female end  
of brush on post

Use male end of  
brush on cable end

# Reconnecting Battery Cables

Before reconnecting, coat connection with petroleum jelly or white grease



# Checking Electrolyte Level

- Remove vent caps
- Electrolyte should just cover the top of the battery plates
- Fill ring may be used inside the filler opening
- Fill until even with the fill ring
- Overcharging from a faulty charging system may cause loss of electrolyte!

# Checking Battery Charge

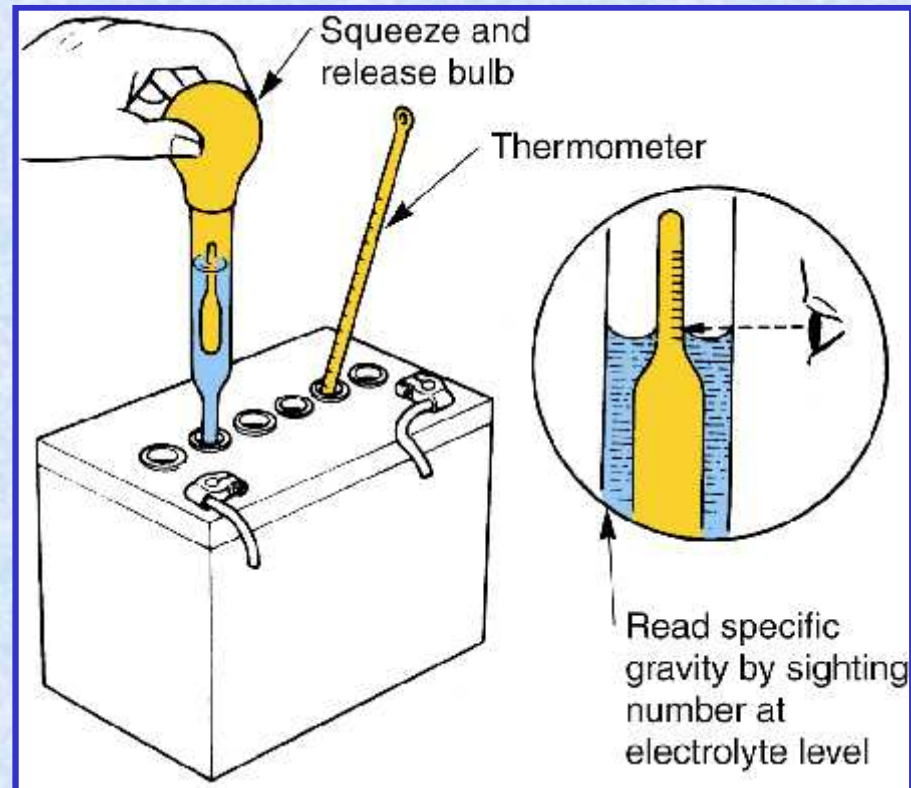
- Common methods of determining state of charge
  - hydrometer check
  - battery voltage test

# Hydrometer Check

- ❑ Measures specific gravity (SG)
- ❑ Compares the weight of electrolyte to the weight of water
- ❑ Water has a SG of 1.0
- ❑ Electrolyte in a fully charged battery is more dense than water and has a SG of 1.265 to 1.299
- ❑ As a battery becomes discharged, the electrolyte has a higher percentage of water and a lower SG



# Hydrometer Check



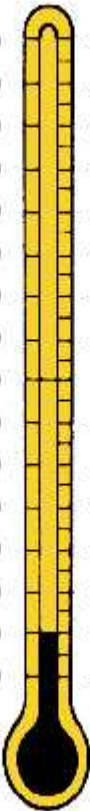
**Do not drip electrolyte**

# Hydrometer Temperature Correction

- ❑ Hydrometer is calibrated at one temperature
- ❑ Above 80°F (27°C), add 0.004 for each 10°F (6°C)
- ❑ Below 80°F (27°C), subtract 0.004 for each 10°F (6°C)

# Hydrometer Temperature Correction

<u>°C</u>	<u>°F</u>	Adjustment factor
71	160	+0.032
65.5	150	+0.028
60	140	+0.024
54.5	130	+0.020
49	120	+0.016
43	110	+0.012
37.5	100	+0.008
32.5	90	+0.004
27	80	0
21	70	-0.004
15.5	60	-0.008
10	50	-0.012
4.5	40	-0.016
-1	30	-0.020
-6.5	20	-0.024
-12	10	-0.028



**Example 1**  
 Hydrometer reading 1.260  
 Electrolyte temperature 20°F (-6.5°C)  
 Subtract specific gravity -0.024  
 Corrected specific gravity is 1.236

**Example 2**  
 Hydrometer reading 1.225  
 Electrolyte temperature 100°F (37.5°C)  
 Add specific gravity +0.008  
 Corrected specific gravity is 1.233

A fully charged relatively new battery has a specific gravity reading of 1.275 plus or minus .010

# Hydrometer Readings

- Specific gravity should be at least 1.265
- Lower readings indicate low charge or a defective battery
- Test all cells
- If the specific gravity in any cell varies excessively from the specific gravity in the other cells, the battery is faulty

# Battery Voltage Test

- Used on maintenance-free batteries
- Connect a voltmeter across the battery terminals
- Turn on headlights for a light load
- Read the meter
- A fully charged battery under a 5 amp load should have a voltage of 12.5 volts

# Battery Voltage Test

This battery is about 100% charged with a 5 amp load



# Battery Voltage versus Specific Gravity

Battery Voltage					
Load on battery (Amps)	Specific Gravity (Percent charge)				
	1.265 (100%)	1.250 (95%)	1.230 (75%)	1.200 (50%)	1.175 (25%)
0	12.7	12.6	12.5	12.4	12.2
5	12.5	12.4	12.3	12.1	11.8
15	12.3	12.2	12.0	11.7	11.3
25	12.1	11.9	11.6	11.2	10.7

This is the range in which most vehicle batteries normally operate in customer service.

At 1.180 and below, starting will be unreliable and function of other circuits may be erratic.

# Cell Voltage Test

- Insert special cadmium (acid resistant) tips of a low voltage meter into each cell
- Test all cells
- Maximum variation between cells should not be more than 0.2 volts

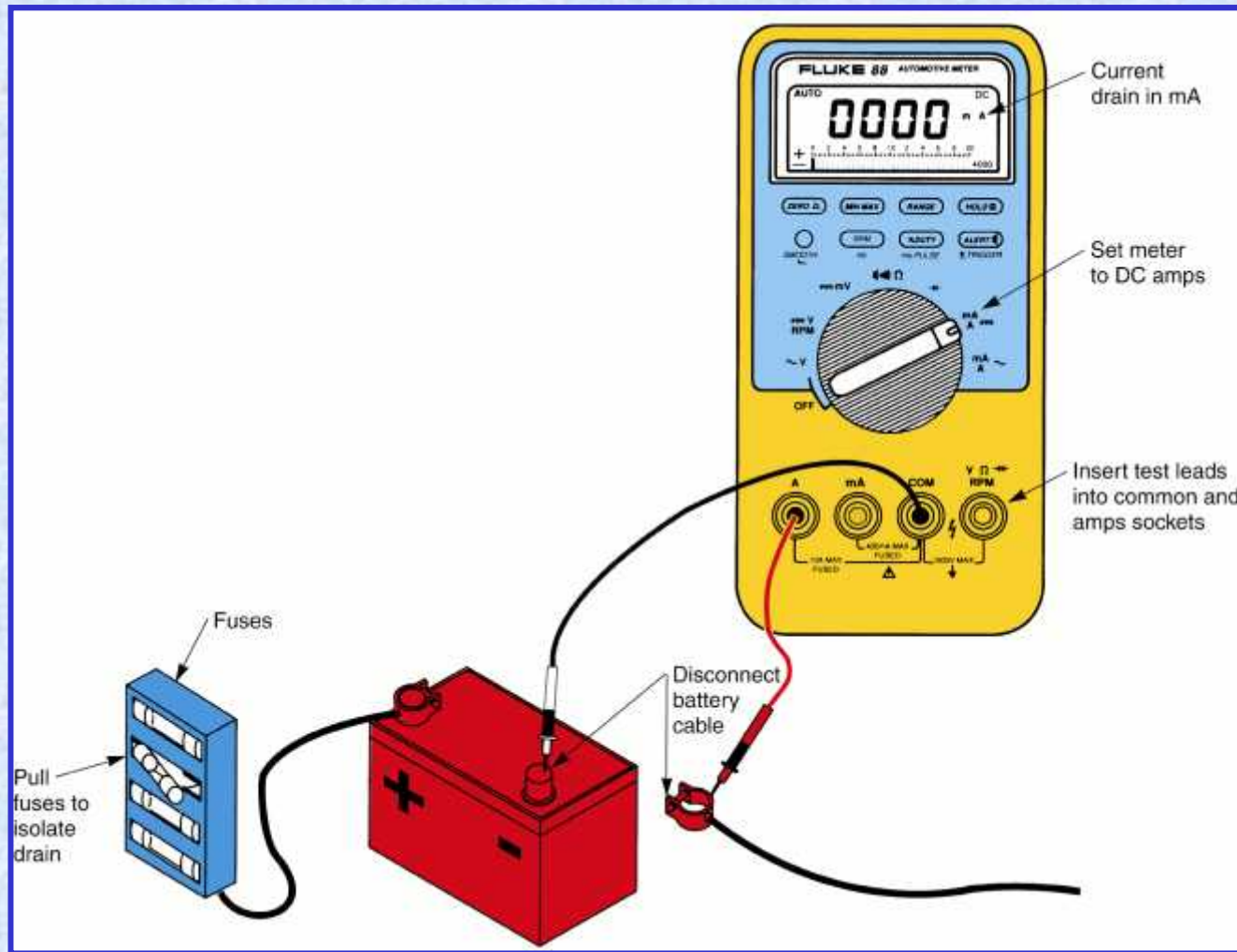


# Battery Drain Test

- ❑ Tests for abnormal current draw with the ignition off
- ❑ Remove the battery cable and connect an ammeter in series in the circuit
- ❑ Disable all the lights and the clock circuit
- ❑ Compare the ammeter reading to specifications
- ❑ If the reading is high, isolate the problem by pulling one fuse at a time

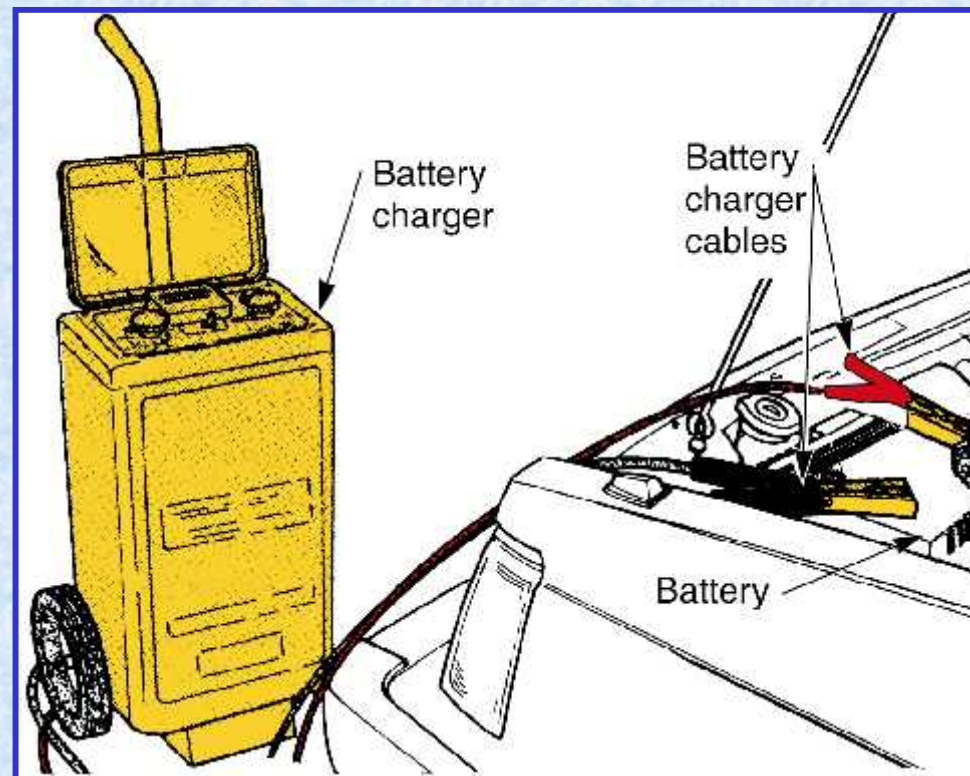
# Battery Drain Test

Typically maximum 10 milliamps (mA)



# Battery Chargers

- ❑ Force current back into the battery to restore the charge on the plates
- ❑ Change 120 volts AC to 14–15 volts DC

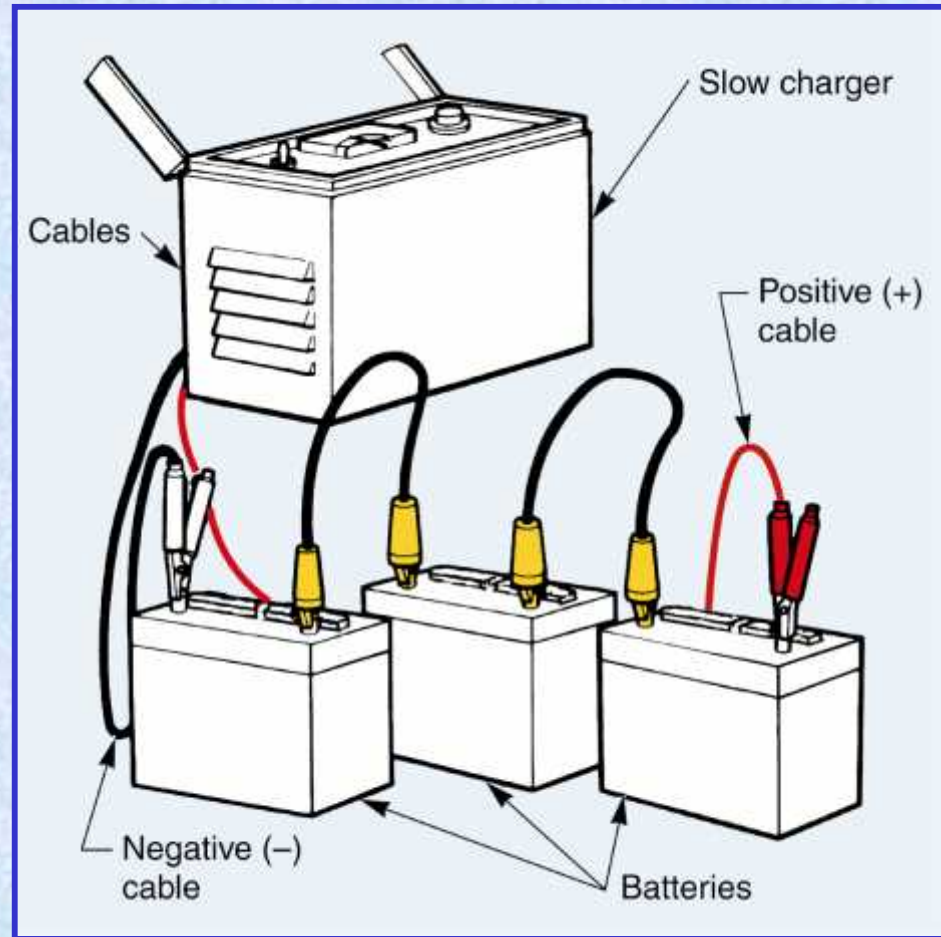


# Slow Charger

- ❑ Often called a trickle charger
- ❑ Feeds a small amount of current into battery
- ❑ Charging time is relatively long (about 12 hours at 10 amperes)
- ❑ Active materials are plated back on the battery plates better than they are during fast charging

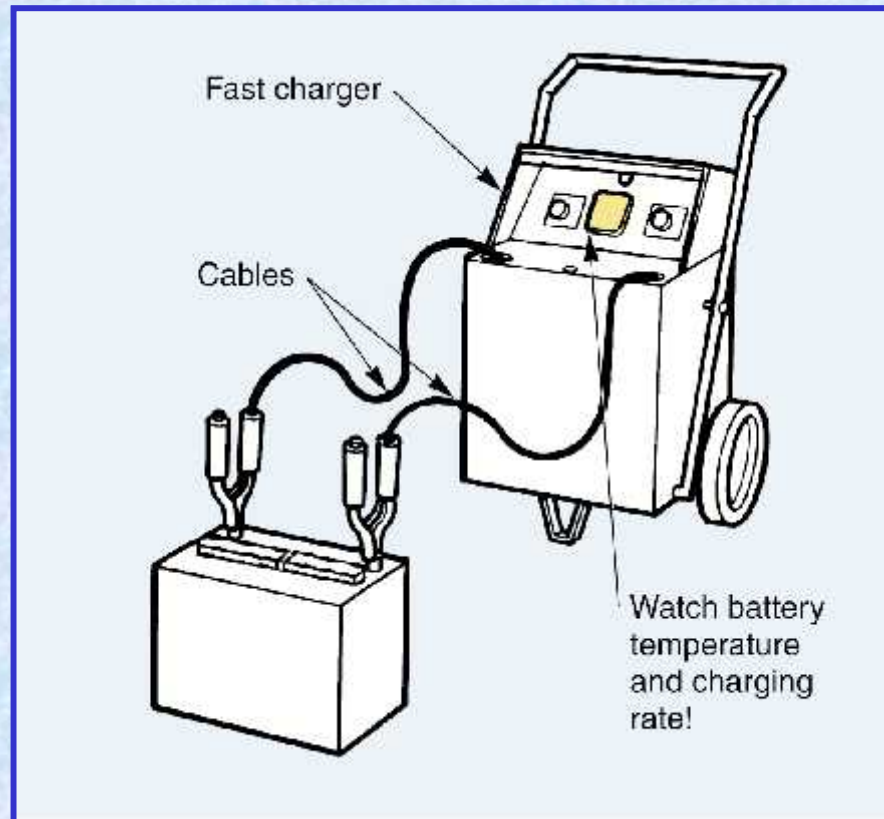
# Slow Charger

Several batteries may be connected



# Fast Charger

- ❑ Forces high current into the battery
- ❑ Allows an engine with a low battery to start in a few minutes

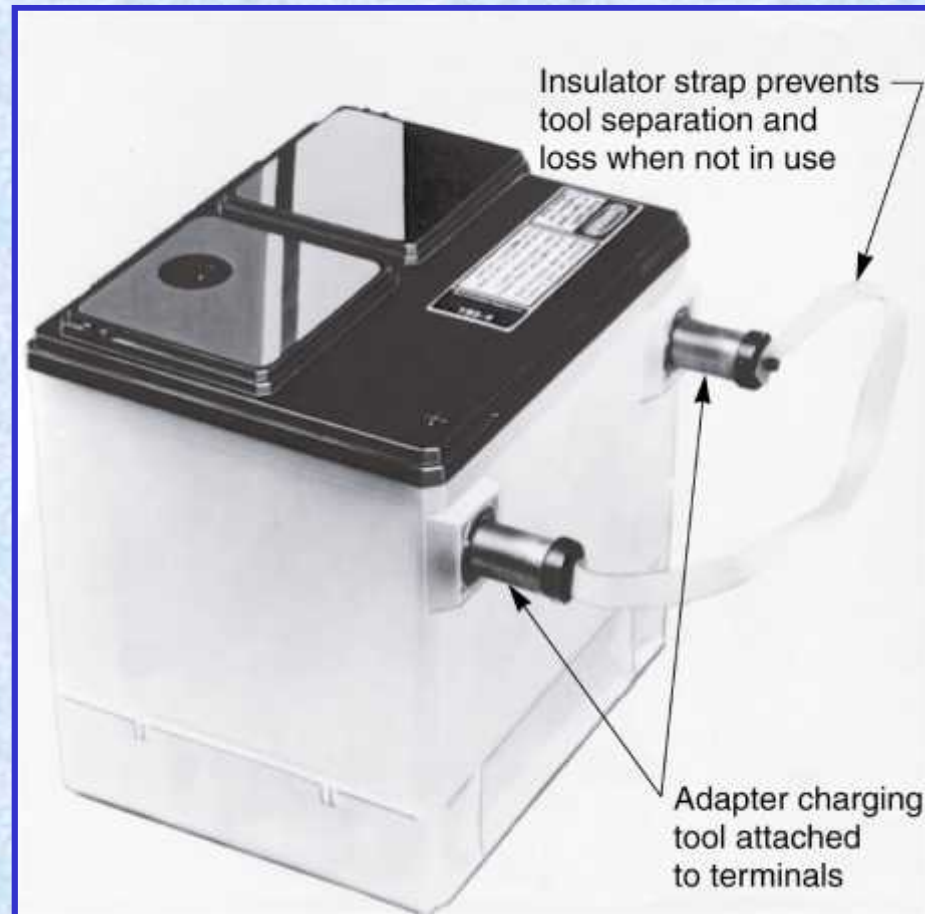


# Charging a Battery

- ❑ Make sure charger is off before connecting to prevent arcing
- ❑ Make sure charger is connected in proper polarity
  - positive lead to positive terminal
  - negative lead to negative terminal
- ❑ Maximum charge rate 35 amperes
- ❑ Maximum battery temperature 125°F (52°C)

# Side Terminal Battery

Use adapters  
when connecting  
charger



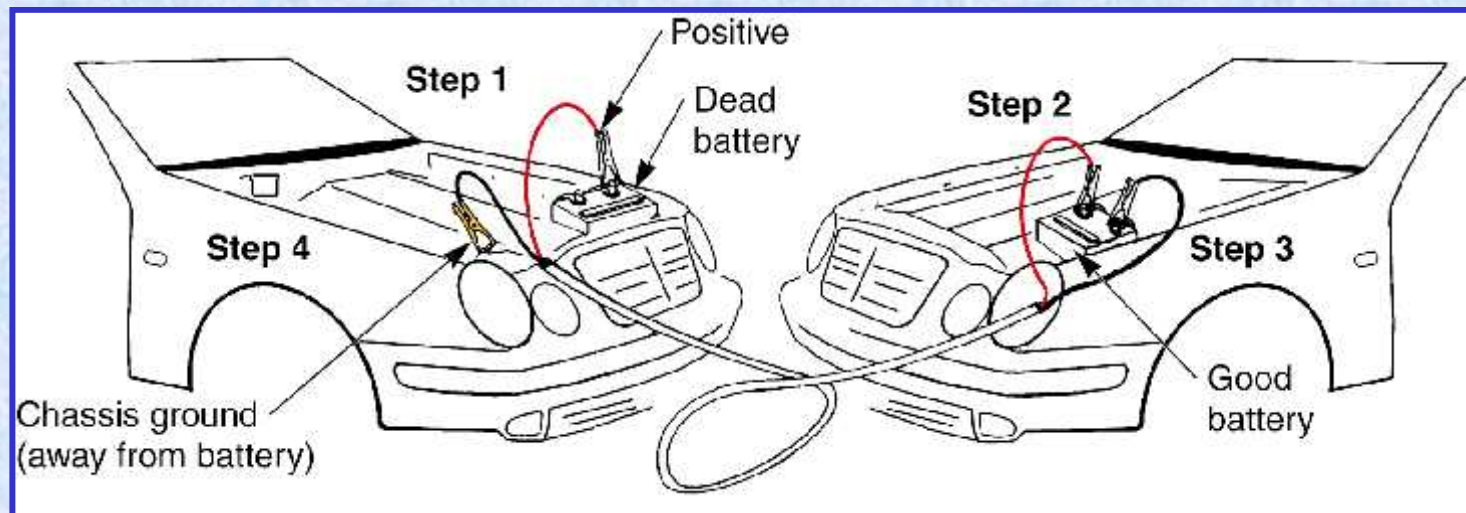


# Jump Starting

- ❑ Connecting a vehicle with a good battery to one with a low battery
- ❑ Connect both positive terminals together with the red jumper cable
- ❑ Connect one end of the black jumper cable to the negative terminal of the good battery
- ❑ Connect the other end of the black jumper cable to a good ground on the vehicle with the dead battery
- ❑ After starting, remove black cable first
- ❑ Avoid arcing near the battery

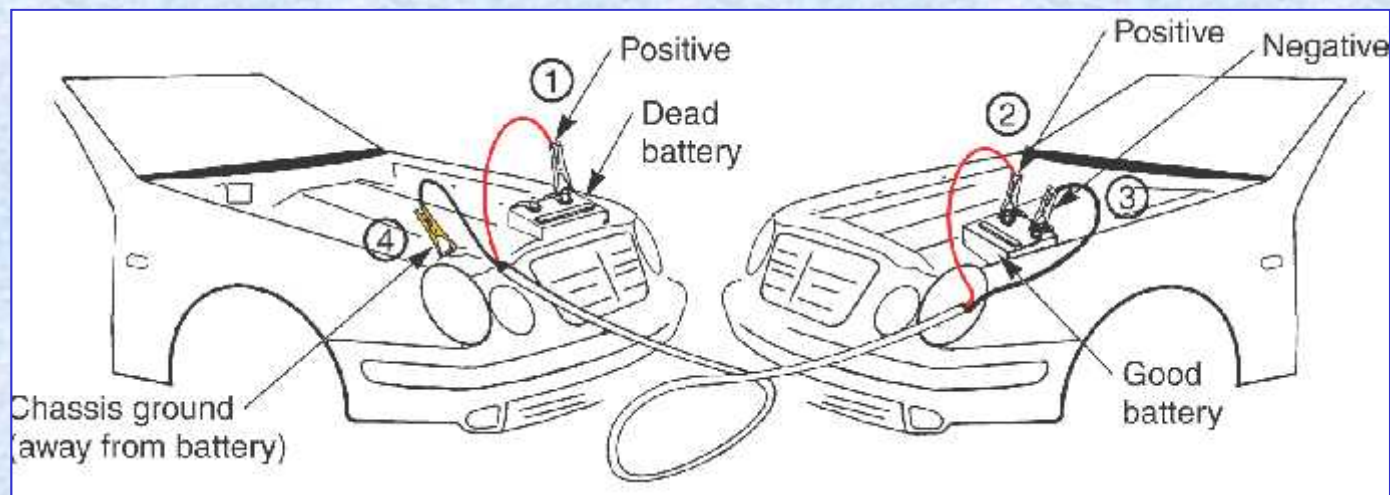
# Jumper Cable Connection

Run the engine in the vehicle with the live battery while cranking the other one



# Jumper Cable Connection

Connect negative jumper to chassis ground to prevent arcing and explosion

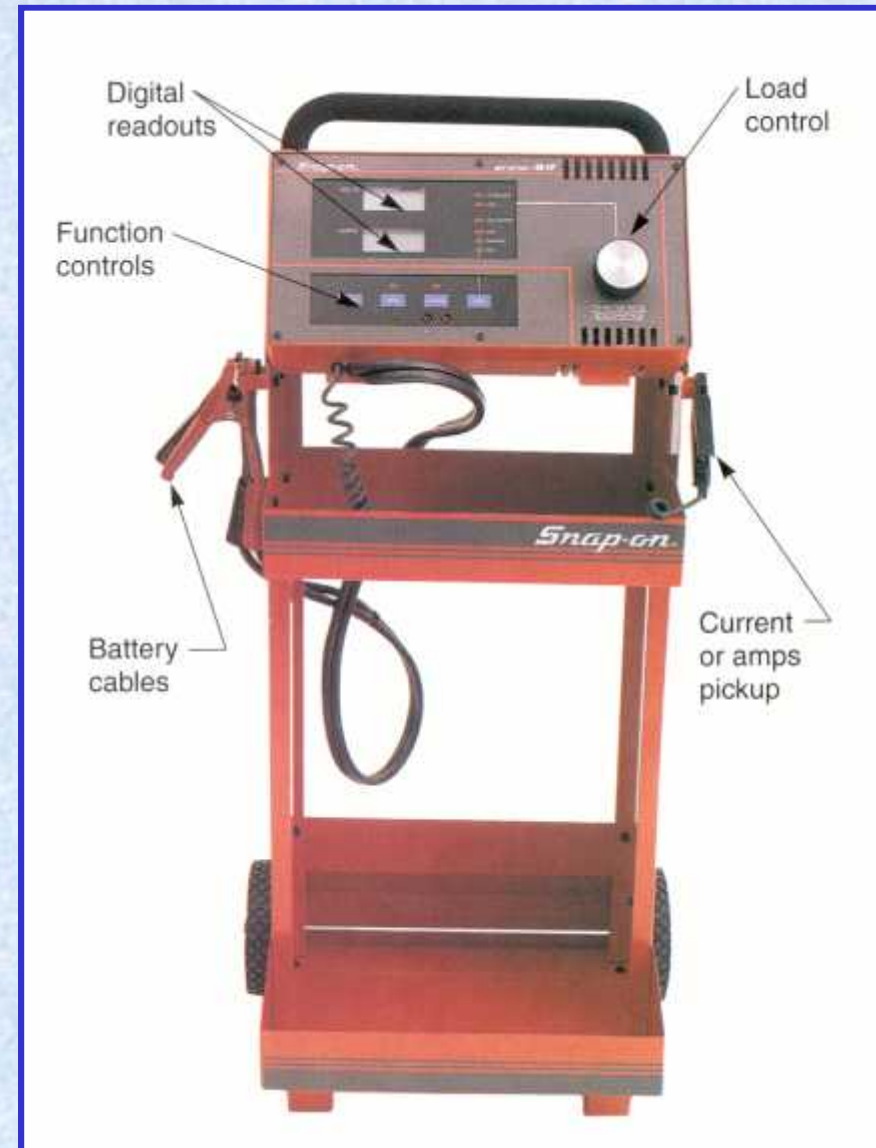


# Battery Load Test

- Measures the current output under load
- Determines actual battery performance
- Used on batteries with open circuit voltage of 12.4 volts or higher

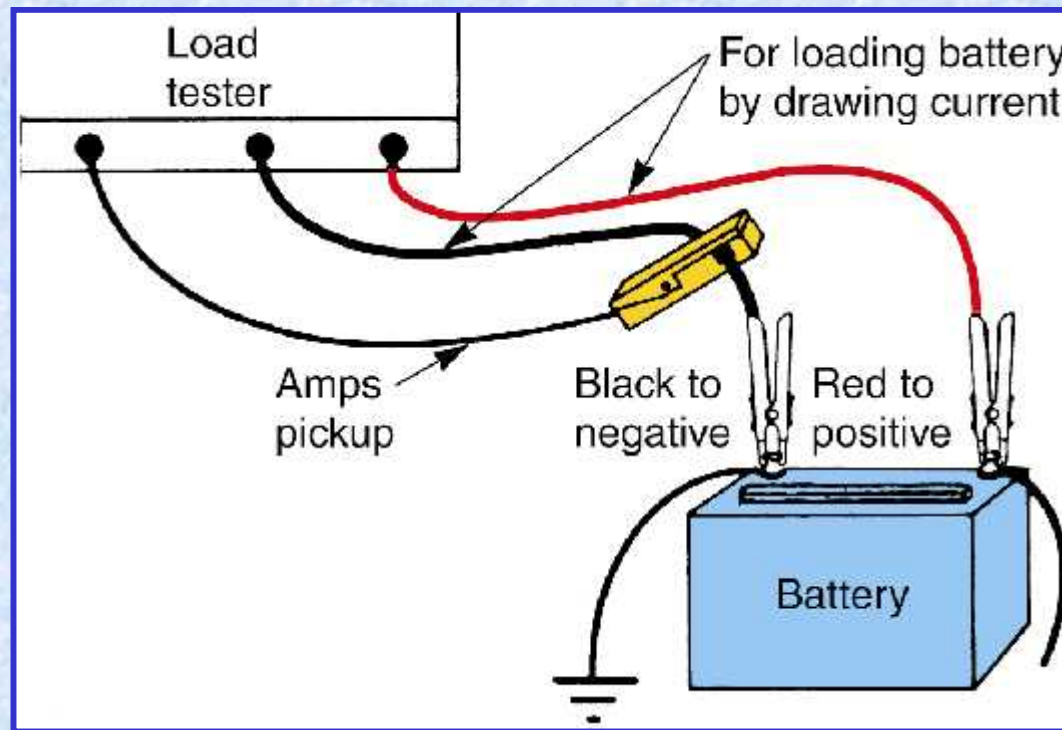
# Load Tester

The most accurate method of determining battery condition



# Load Tester Connection

Large cables load the battery by drawing current through the tester



# Determining Load

- ❑ Three times the amp-hour rating
  - 60 amp-hour battery
  - $60 \times 3 = 180$  amperes
- ❑ One half the cold crank rating
  - 400 CCA
  - $400 \div 2 = 200$  amperes

# Battery Load Chart

Battery ratings			Load test amps
Cold cranking current	Amp-hour (approx.)	Watts	
200	35-40	1800	100 amps
250	41-48	2100	125 amps
300	49-62	2500	150 amps
350	63-70	2900	175 amps
400	71-76	3250	200 amps
450	77-86	3600	225 amps
500	87-92	3900	250 amps
550	93-110	4200	275 amps



# Loading the Battery

- Turn the load control knob until the ammeter reads the correct amperage
- Maintain load for 15 seconds
- Read the voltmeter at 15 seconds
- Minimum 9.5 volts at room temperature

# Load Test Results

If the reading is below the voltage in the chart, the battery is probably bad

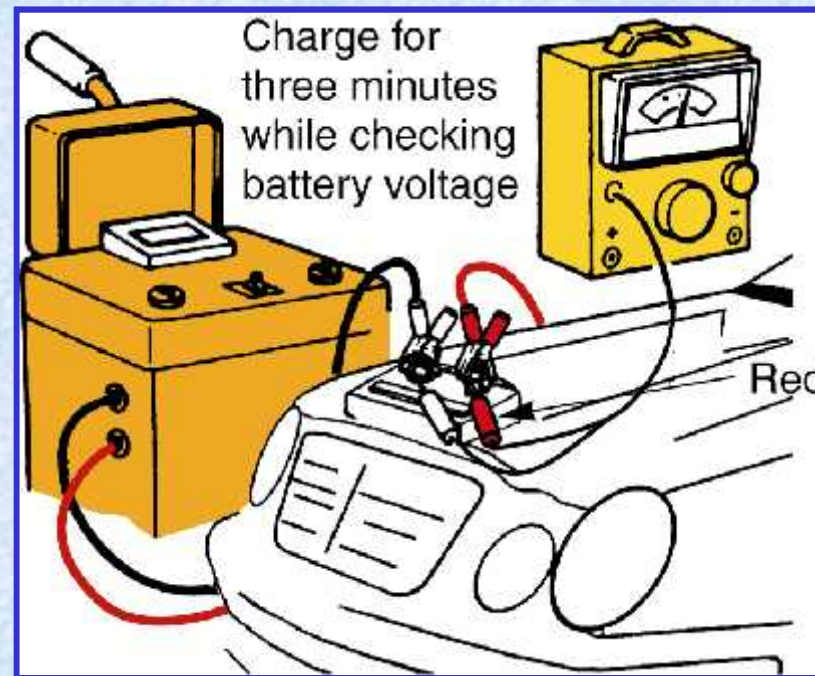
Approximate electrolyte temperature	Minimum acceptable voltage under load for good battery
60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

# 3 Minute Charge Test

- Determines if the battery is sulphated
- Performed if battery load test results were poor
- Charge for 3 minutes at 30–40 amperes
- Test voltage while charging
- If the voltage goes above 15.5 volts, battery should be replaced

# 3 Minute Charge Test

Battery charger and voltmeter are both connected to the battery



# Activating Dry-Charged Battery

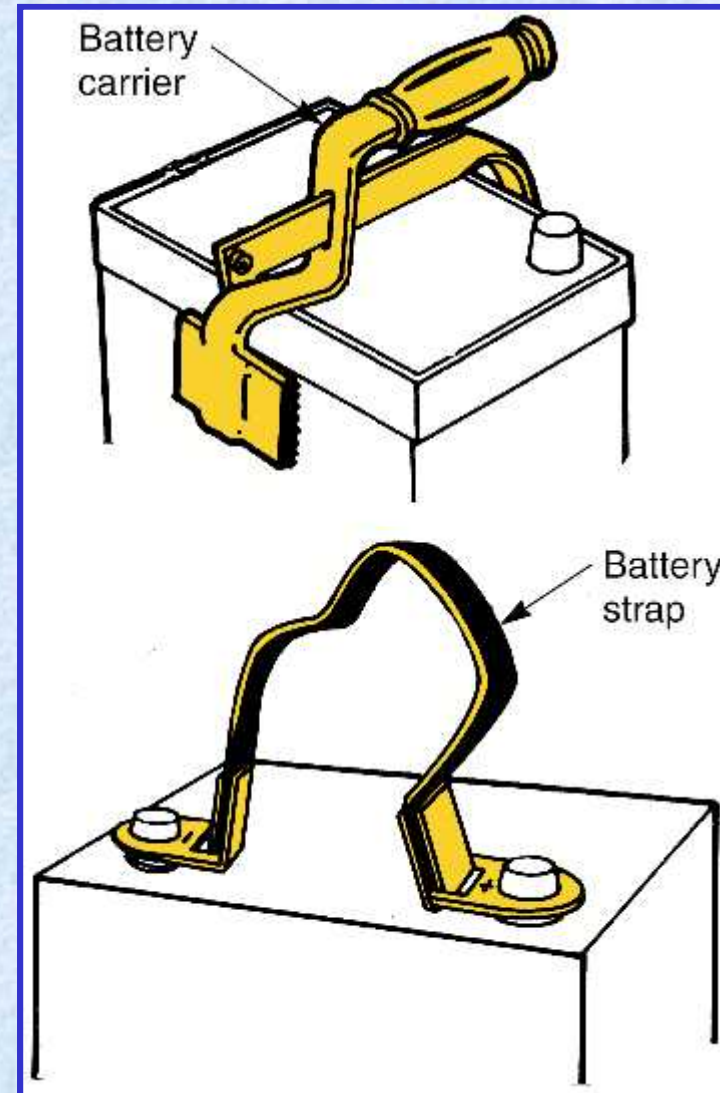
- Wear safety glasses and rubber gloves!
- Remove caps
- Pour electrolyte into each cell until the plates are just covered
- Replace caps
- Charge as recommended

# Removing and Replacing a Battery

- Disconnect the cables, negative first
- Loosen the battery hold-down
- Using a battery strap or carrier, carefully lift the battery out of the tray
- To install, gently place the battery into the tray and tighten the hold-down
- Connect the cables, positive first

# Battery Carriers

If you drop a battery, acid could splash out, causing eye or skin injury



# Battery Installation

Do not overtighten cable terminals

