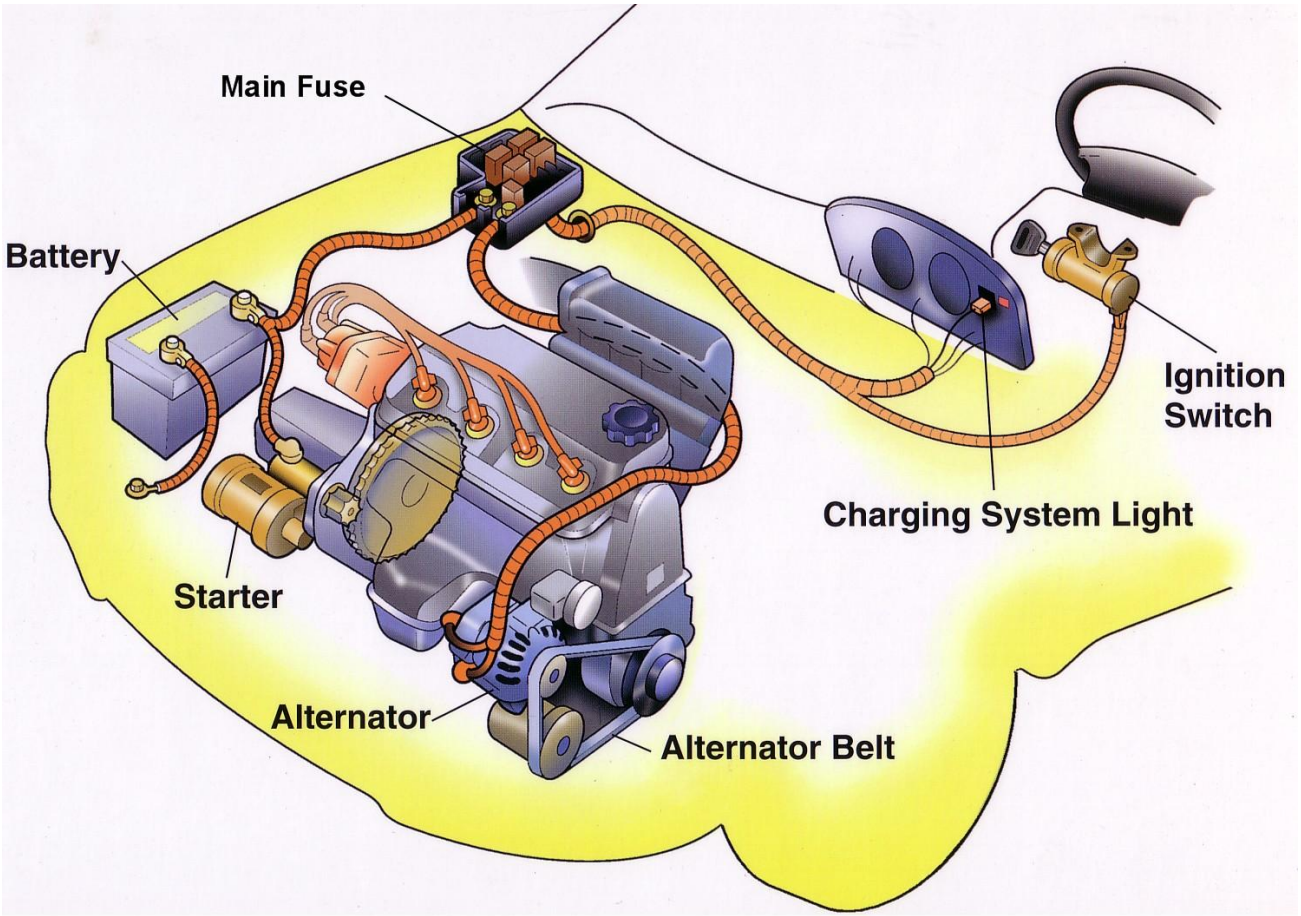
ATASA 5th Batteries

ATASA 5TH Study Guide
Chapter 17 Pages 501-535
Battery Theory & Service
70 Points

Please Read The Summary



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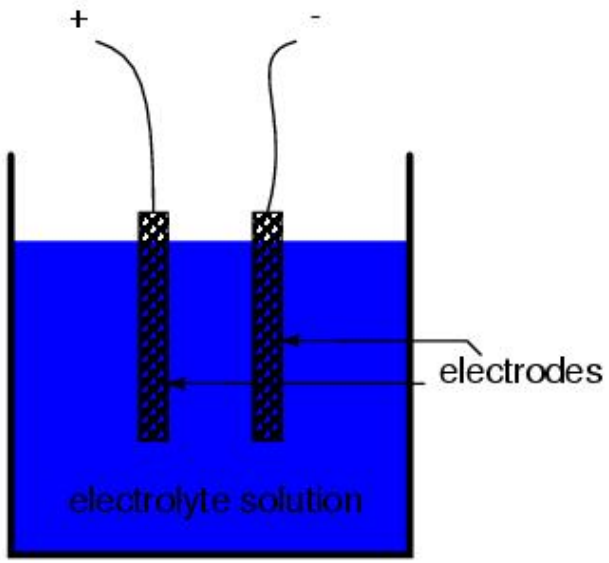
1. Electrical energy in a battery is produced by the _____ _____ that occurs between two dissimilar metal plates surrounded by an _____ solution.

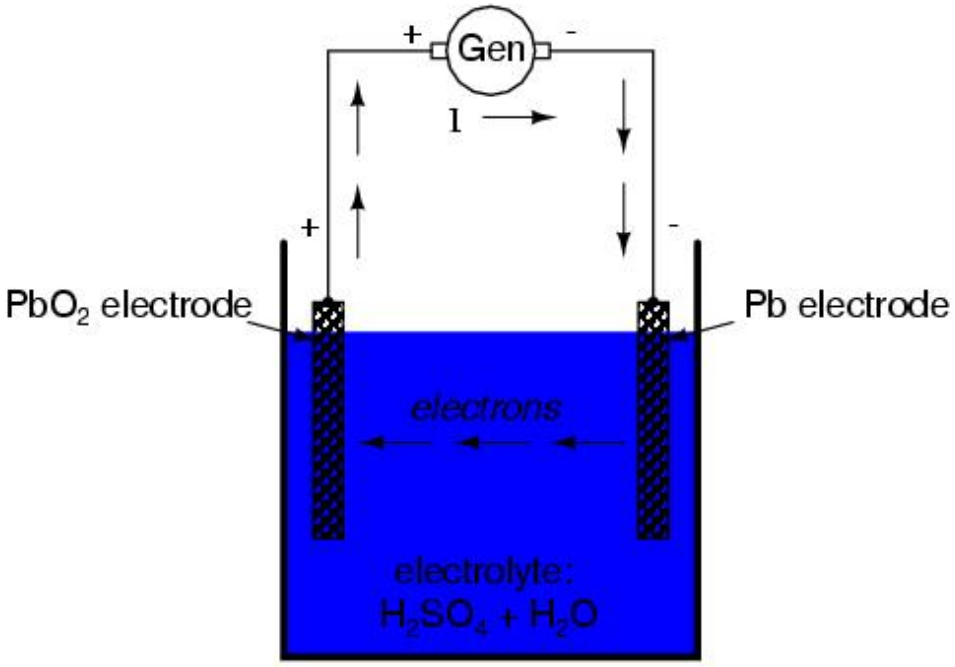
Voltaic cell



The two electrodes are made of different materials, both of which chemically react with the electrolyte in some form of ionic bonding.

Mechanical Reaction, Electrolyte
Chemical Reaction, Electrolyte
Chemical Reaction, Enzyme

Lead-acid cell charging



At (+) electrode: $PbSO_4 + H_2O + O \longrightarrow PbO_2 + H_2SO_4$

At (-) electrode: $PbSO_4 + 2H \longrightarrow Pb + H_2SO_4$

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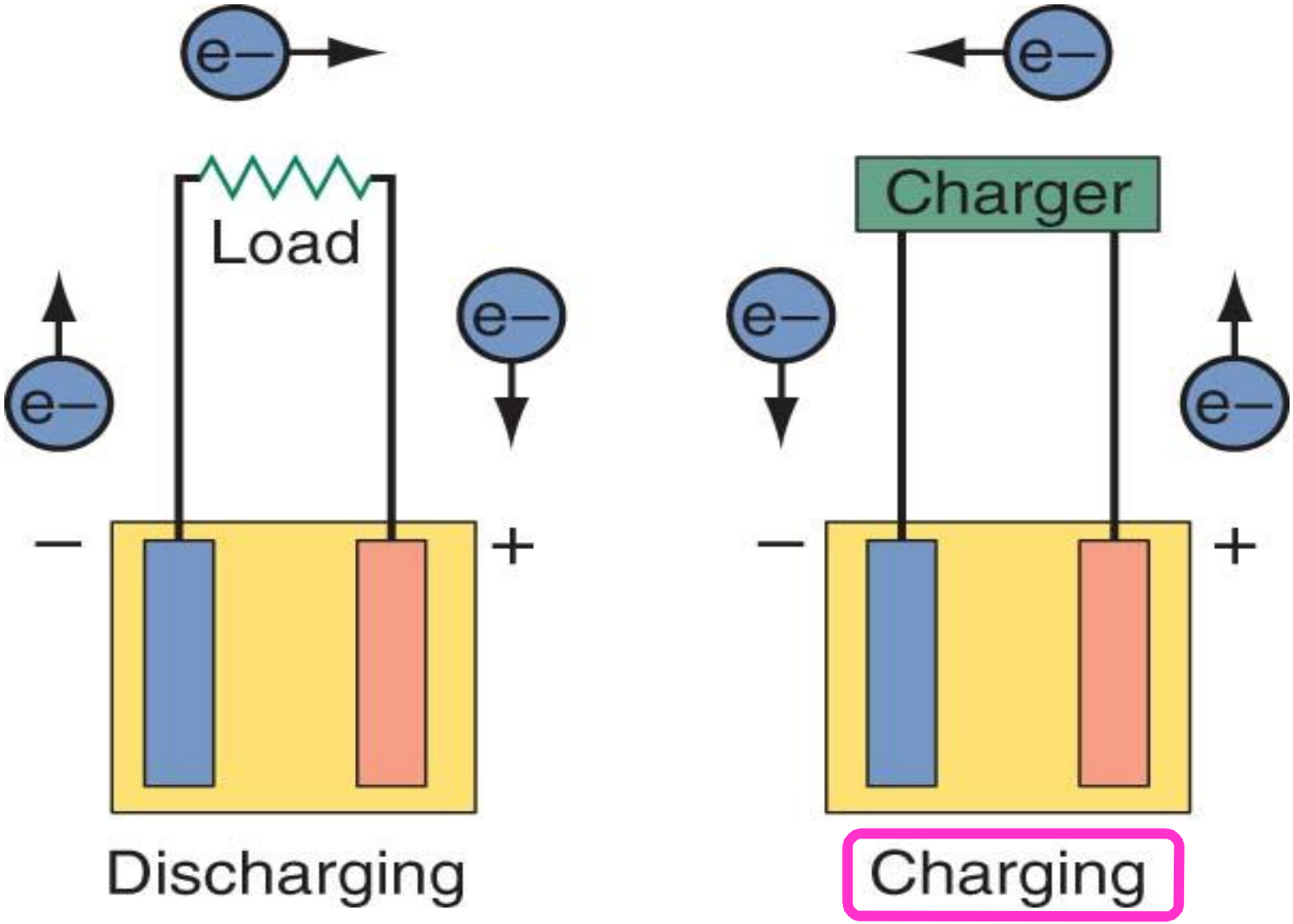
2. When the battery becomes discharged & the chemicals are weak, _____ a battery restores the chemical nature of the cells.

Charging voltage must be higher than the battery's voltage.



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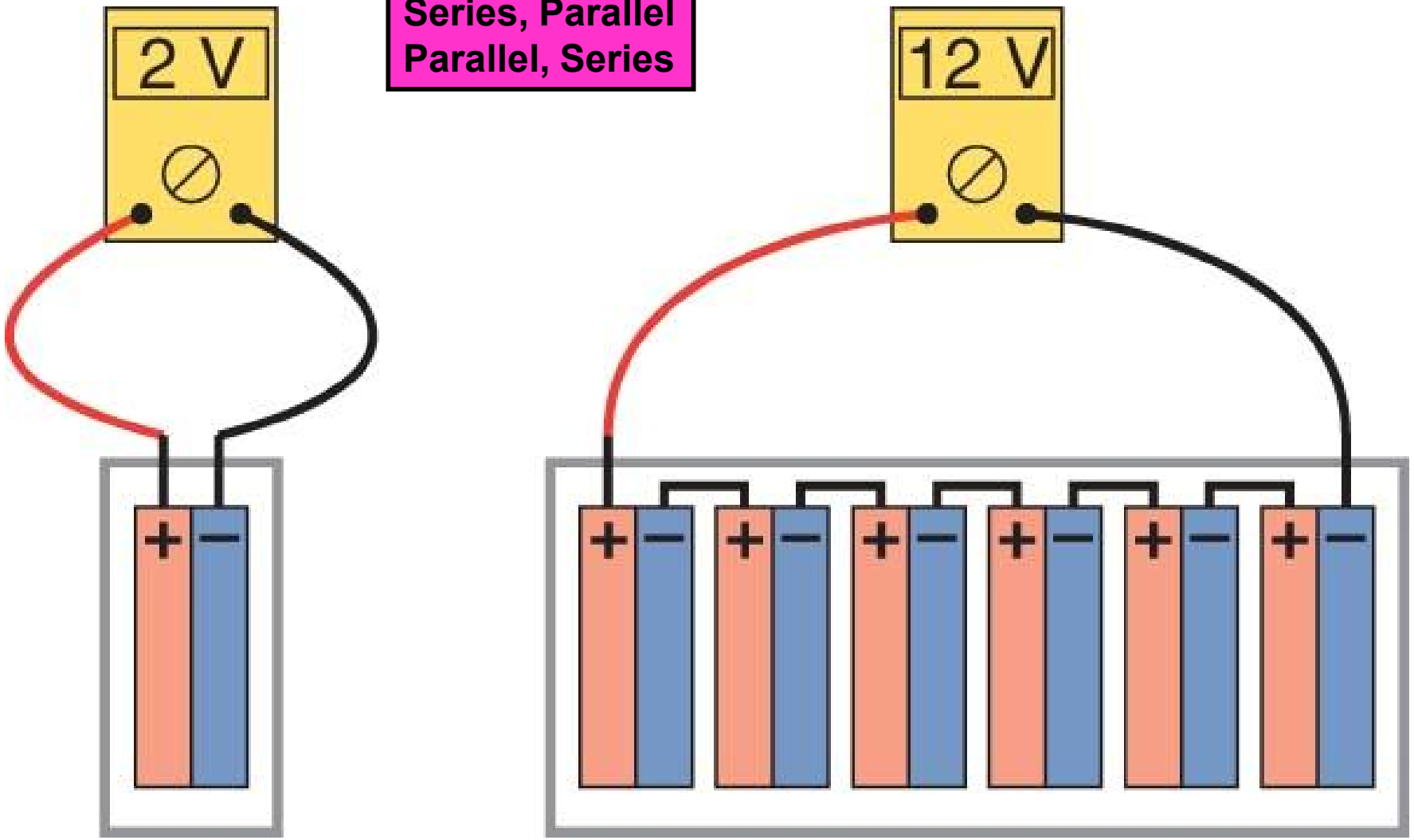
3. Battery cells are connected in _____ to provide higher voltage & connected in _____ to increase the amperages of the pack of cells.

Series, Parallel
Parallel, Series



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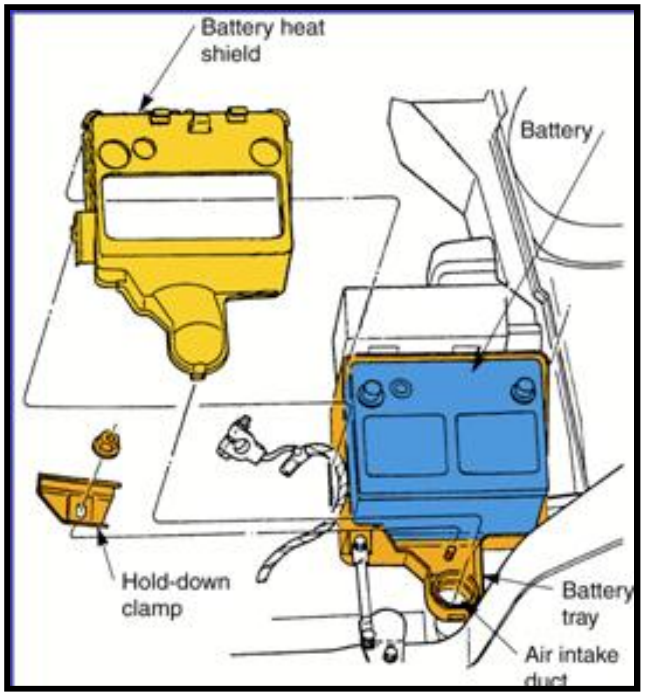
4. Battery _____ and heat shields prevent damage from vibration & under hood temperatures.



Hold-Downs
Zip Ties
Bungee Cords

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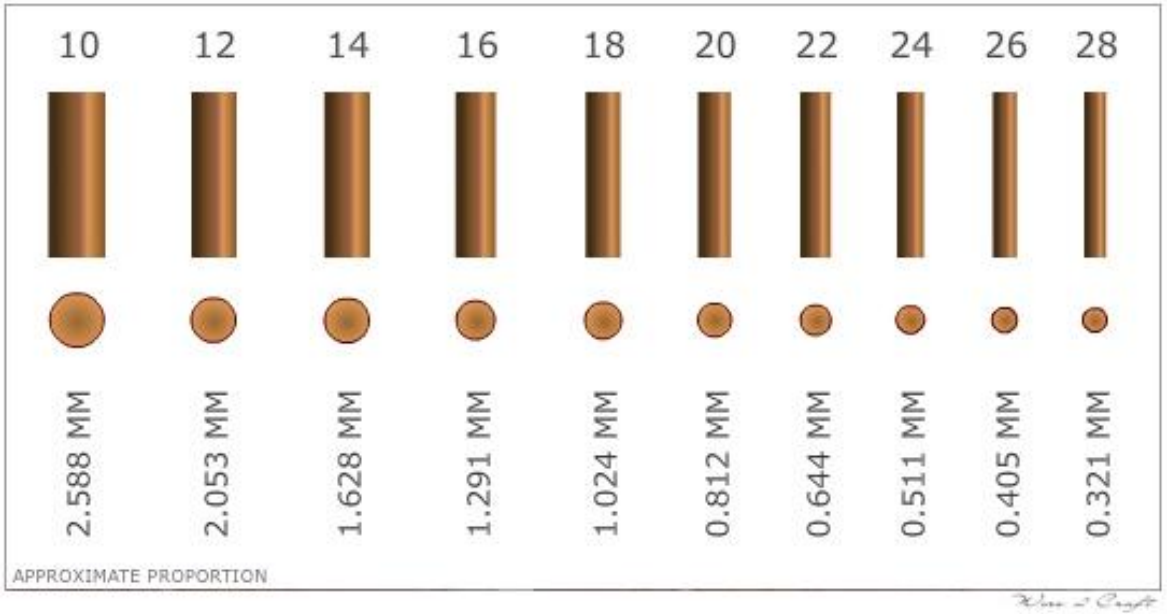
5. Battery cables are normally ___ or ___ gauge.



1 or 2
4 or 6
8 or 10

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6. _____ is the color for positive cables & _____ for negative cables.
_____ is the color for the high-voltage cables use in hybrid vehicles.

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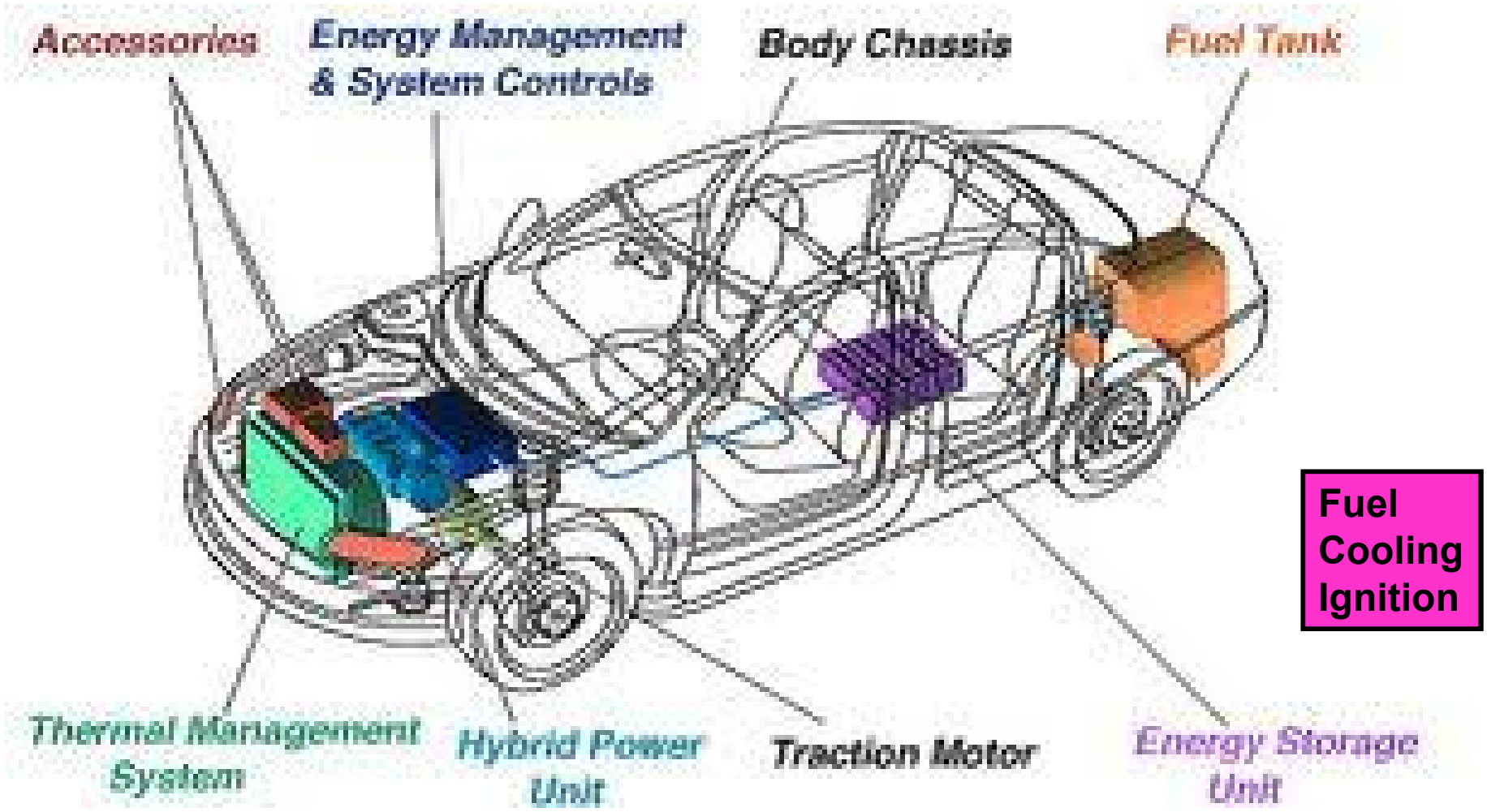
7. High-voltage hybrid vehicle batteries have their own _____ system, including fans, engine coolant circulation, and in some cases, a refrigerant system.



Fuel
Cooling
Ignition

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8. In cold climates, a battery _____ is used to keep the battery warm and working efficiently.

Coolers
De-Icers
Heaters

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9. _____% of all lead-acid batteries from motor vehicles are recycled thanks to the RBRC.

call 2 recycle®

A Rechargeable Battery Recycling Corporation program

20%
50%
98%

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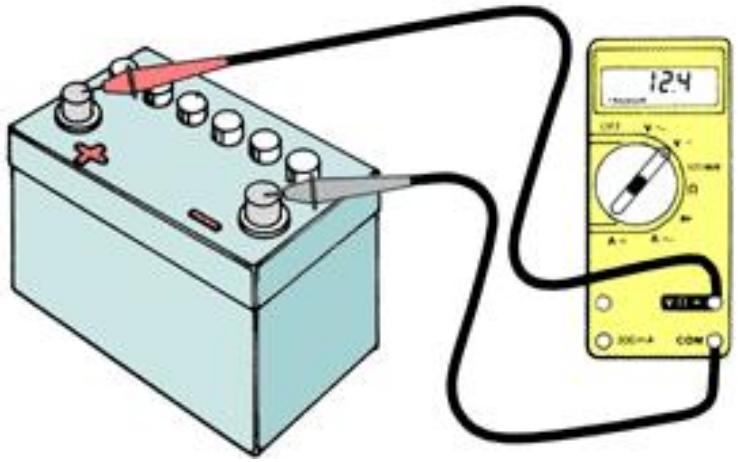
10. _____ _____ _____ is the voltage measured across the terminals when there is no load on the battery.



Parasitic Load
Open Circuit Voltage
Voltage Drop

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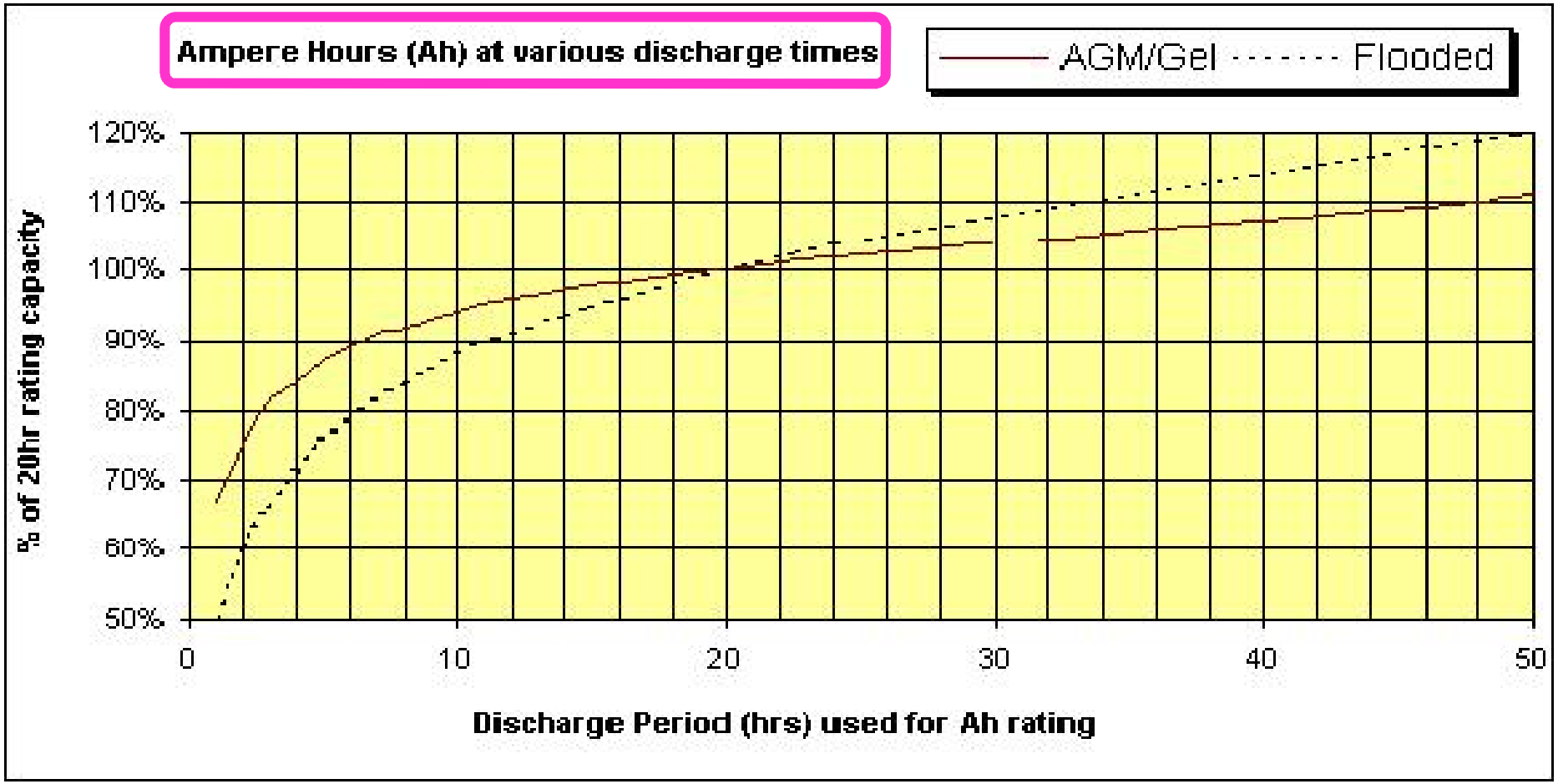
11. The _____-_____ rating is the amount of steady current that a fully charged battery can supply for 20 hours at 80°F without dropping below 10.5 volts.



Amp-Hour : The unit of measure for a battery's electrical storage capacity, obtained by multiplying the current in amps by the time in hours of discharge. Example: A battery delivering 10 amps for 20 hours = 10 amps x 20 hours = 200 AH.

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12. The _____-_____ rating is calculated by AH rating multiplied by battery voltage.

Watt-Hour
What-Hour
Wheat-Hour

The unit of measure for electrical energy. Watt-Hour = Watts x Hours.

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15. The _____ _____ (RC) is the length of time in minutes that a fully charged starting battery at 80°F can be discharged at 25 amperes before dropping below 10.5 volts.

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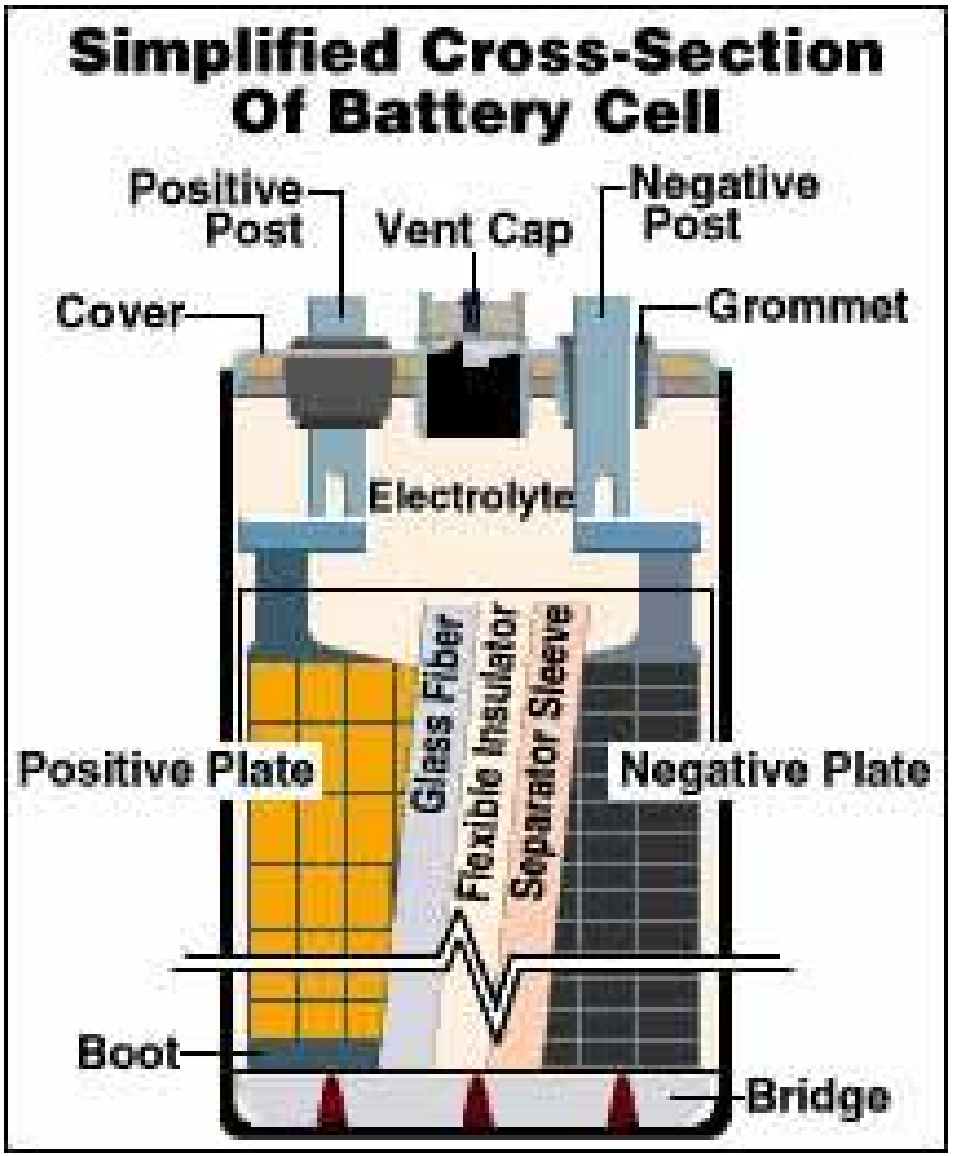
16. _____-_____ batteries are the most commonly ones used as automotive starter batteries.



Absorbed Glass Mat
Gel Cell
Lead-Acid (Flooded Cell)

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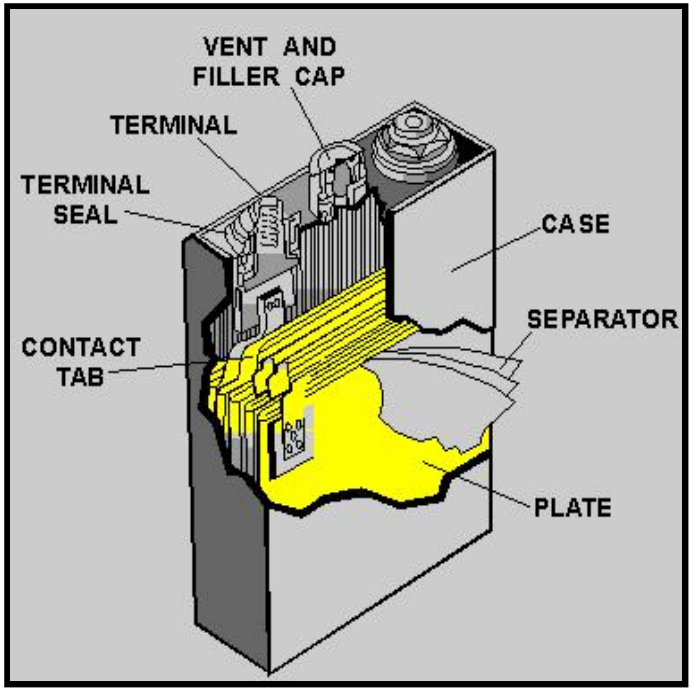
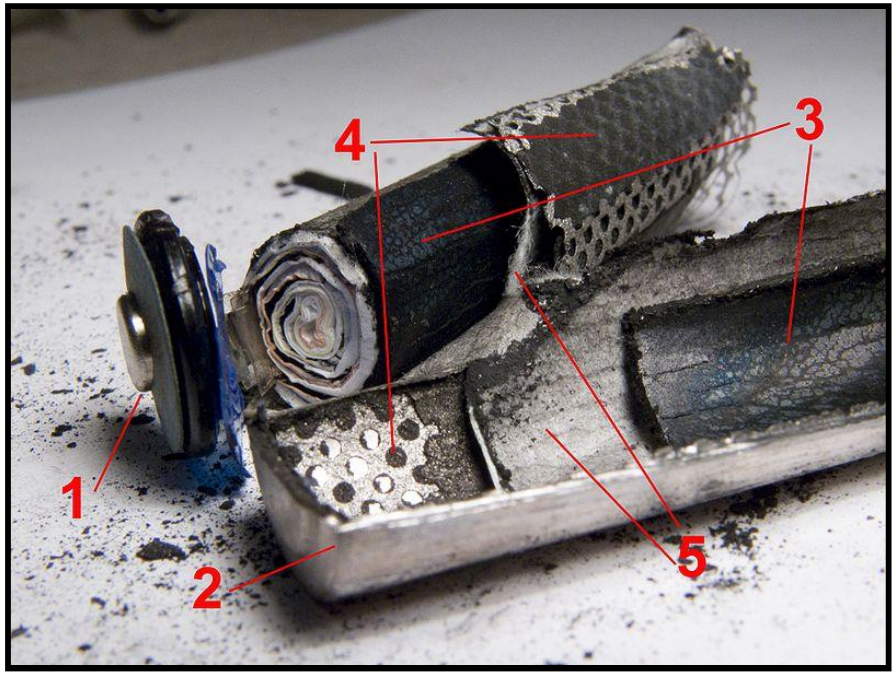
17. _____ batteries are <u>used in power tools</u>, NiMH are more environmentally friendly than NiCad.



<u>NiCad</u>
NiMH
Li-Ion



Popular as NiMh batteries, Nickle-metal hydride batteries are secondary (electrochemical cells) in nature and similar to the nickel-cadmium cells. However, for the negative electrode, these NiMh batteries carry a hydrogen-absorbing alloy instead of cadmium. That is why NiMh batteries are better and more efficient companions than nickel-cadmium cells of equivalent sizes. If we compare lithium-ion cells with NiMh batteries then the volumetric energy density in NiMh batteries will be lower and self discharge capacity will be higher. In the absence of toxic cadmium, <u>NiMh batteries are not hazardous to the environment at all.</u> However, the batteries comprising electrodes are posing environmental impacts. That is why NiMh batteries are recommended to the users and as their improper disposal also will not affect our surroundings.

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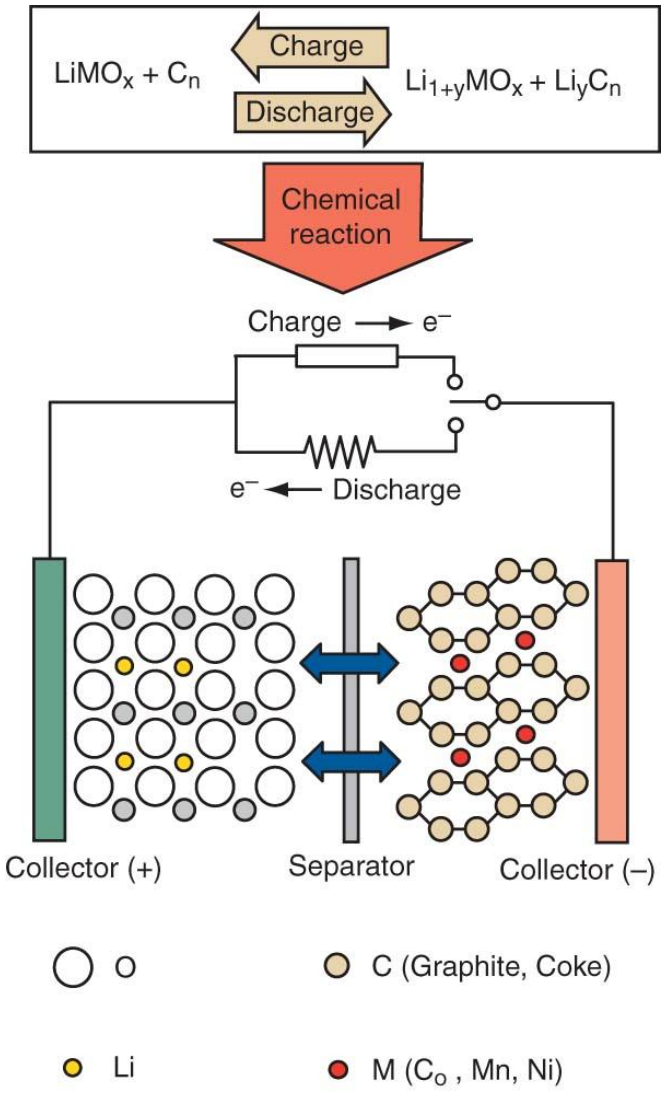
18. _____-_____ (Li-Ion) and _____-_____ (Li-Poly) are the high voltage batteries currently used to power hybrid vehicle traction motors.



This type has technologically evolved from lithium-ion batteries. The primary difference is that the lithium-salt electrolyte is not held in an organic solvent but in a solid polymer composite such as polyethylene oxide or polyacrylonitrile.

The advantages of Li-ion polymer over the lithium-ion design include potentially lower cost of manufacture, adaptability to a wide variety of packaging shapes, and ruggedness.

A compelling advantage of Li-poly cells is that manufacturers can shape the battery almost however they please, which can be important to mobile phone manufacturers constantly working on smaller, thinner, and lighter phones.

Hyundai Motor Company plans to use this battery type in its hybrid electric vehicles. A Li-poly powered Audi A2 covered the record distance of 600 km without recharging on October 26, 2010.

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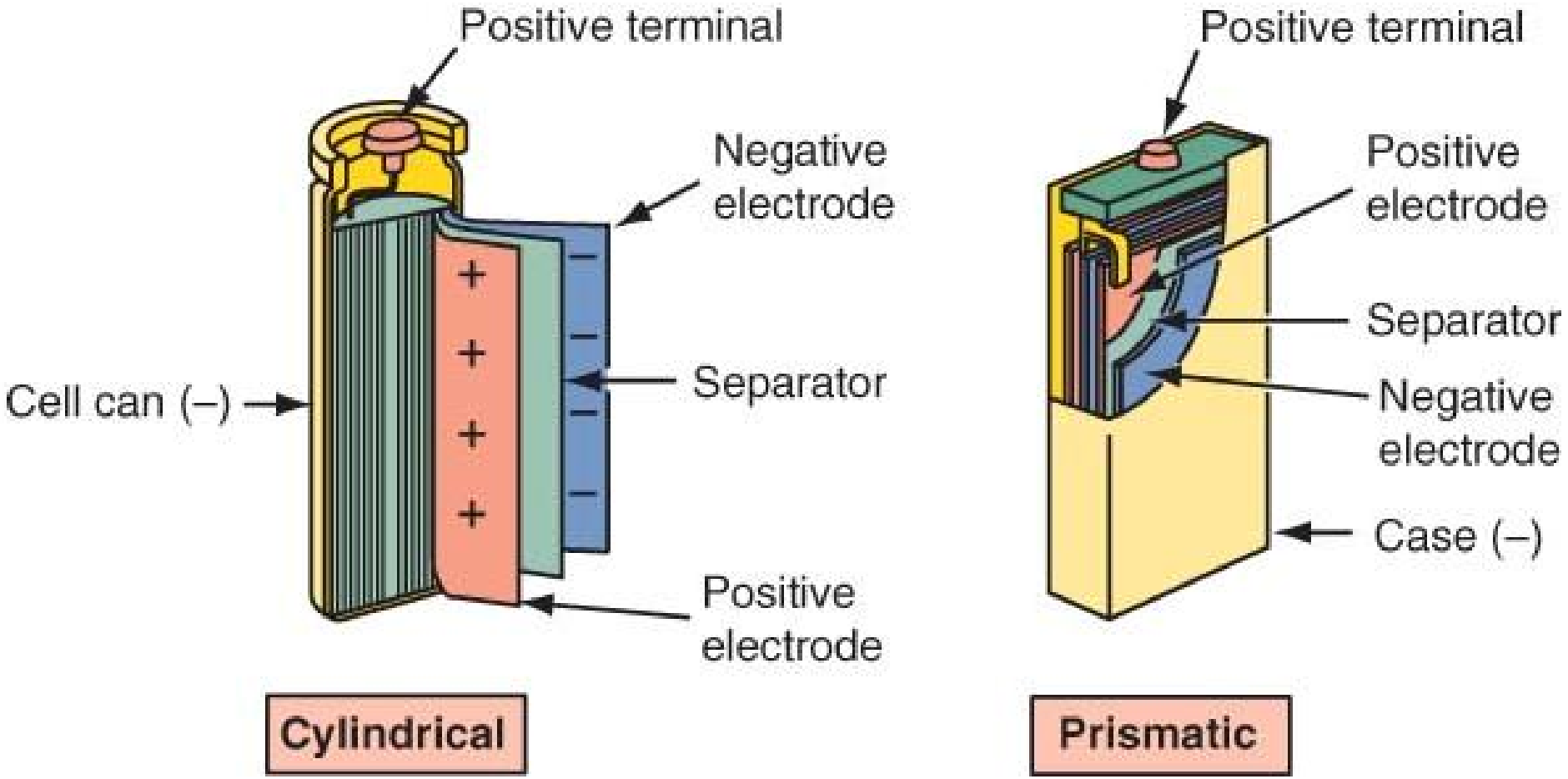
19. High voltage battery cell configuration s can be either _____ or _____.



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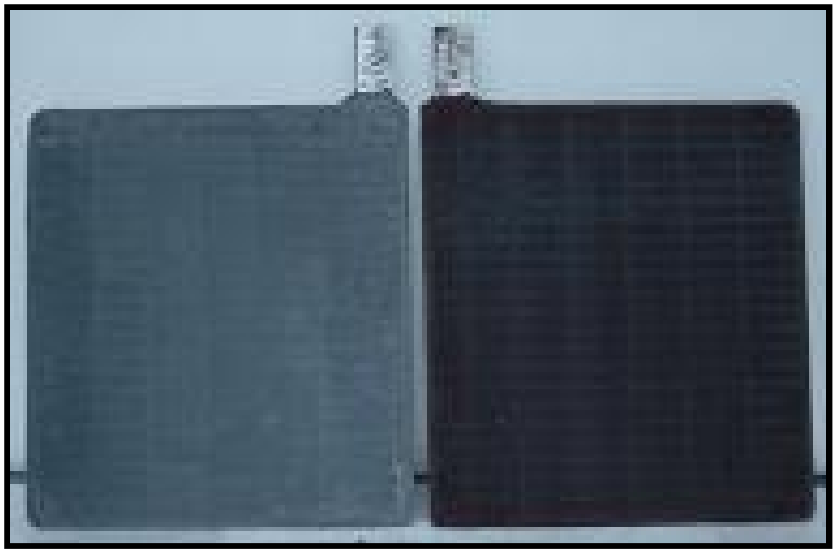
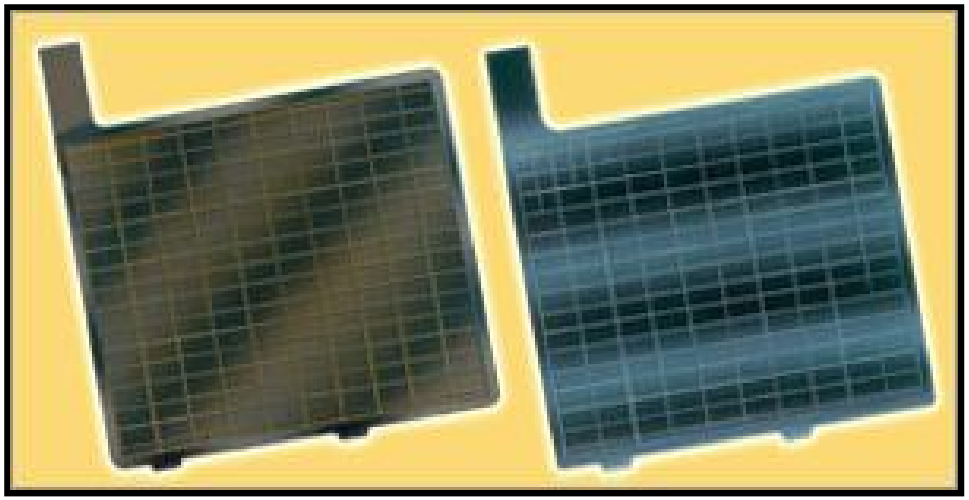
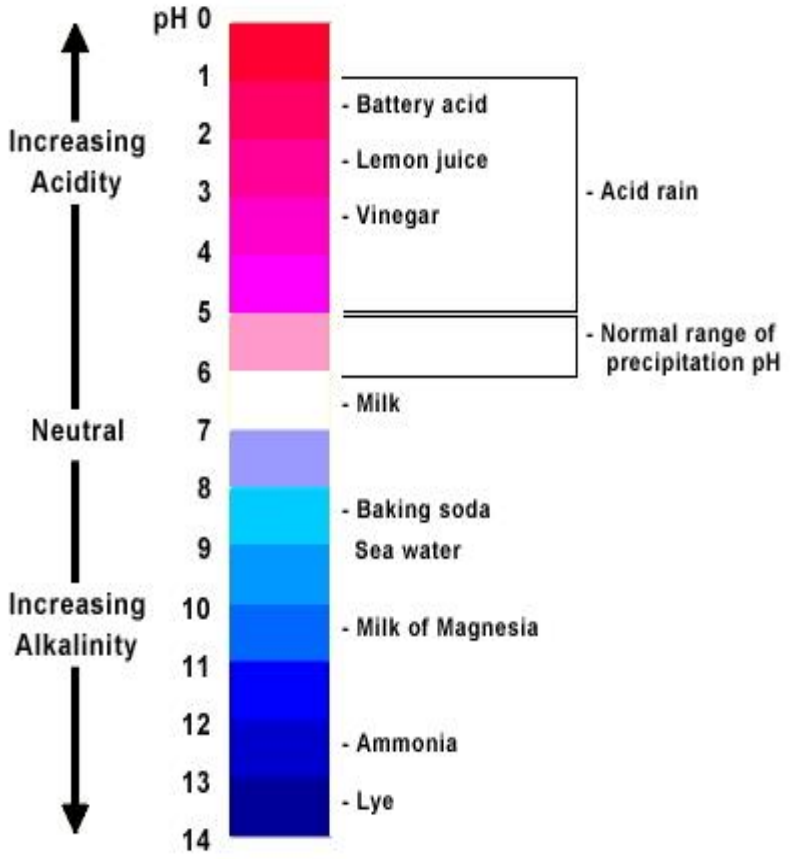
20. Positive plates are filled w/lead _____ & negative plates are pasted w/ _____ lead in a lead-acid starting battery. *This applies to wet cell, absorbed glass mat, and gel cell batteries.*







Peroxide, Sponge
Hydrogen, Mop
Dioxide, Sponge

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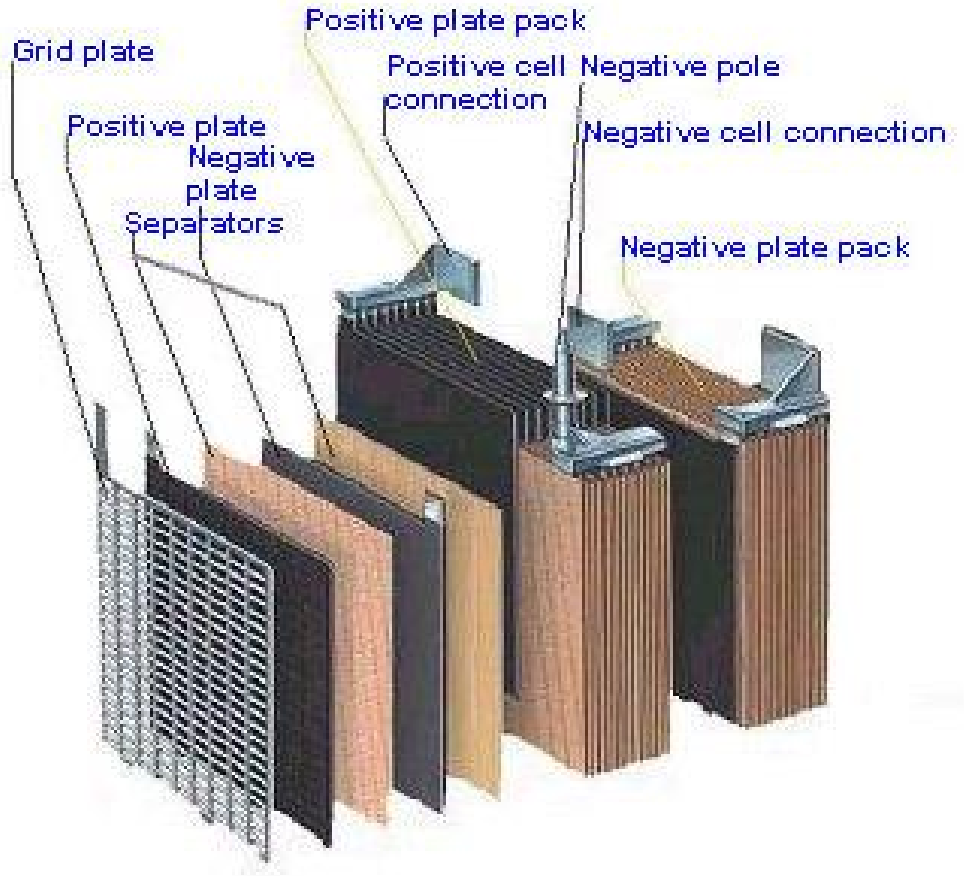
PLATE

The positive battery plates are made from an alloy of low antimony, selenium and arsenic, with silver added for extra corrosion resistance. These features ensure that frequent topping up is not necessary and at the same time the plates have a longer life. Negative Battery Plates are made from an alloy of lead-Calcium which minimizes the maintenance resulting in a maintenance free Battery.



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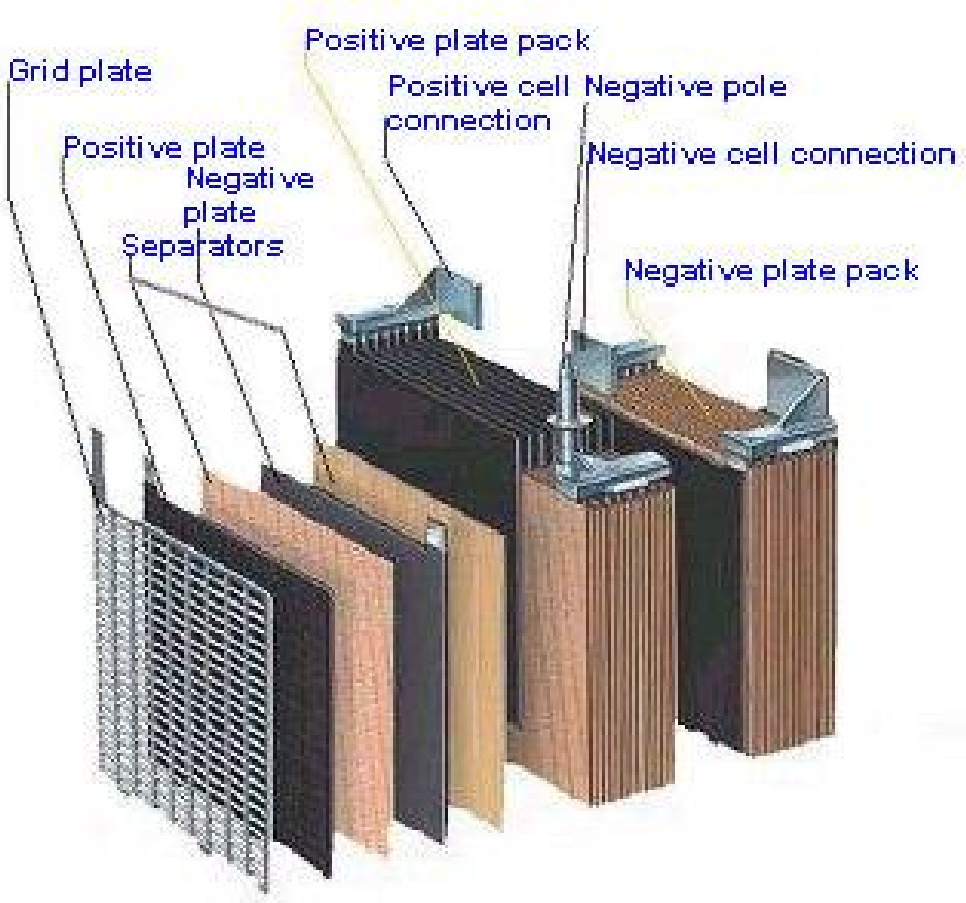
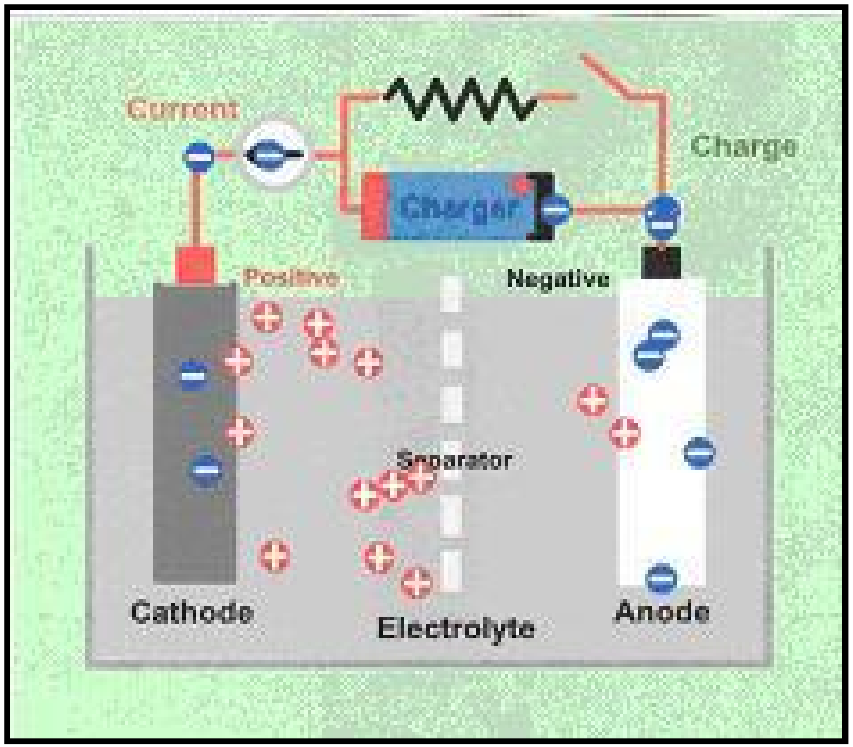
21. *Battery Electrolyte* is made of ___% _____ and ___% _____ acid.

64% H_20 & 36% H_2SO_4
36% H_20 & 63% H_2SO_4
50% H_20 & 50% H_2SO_4





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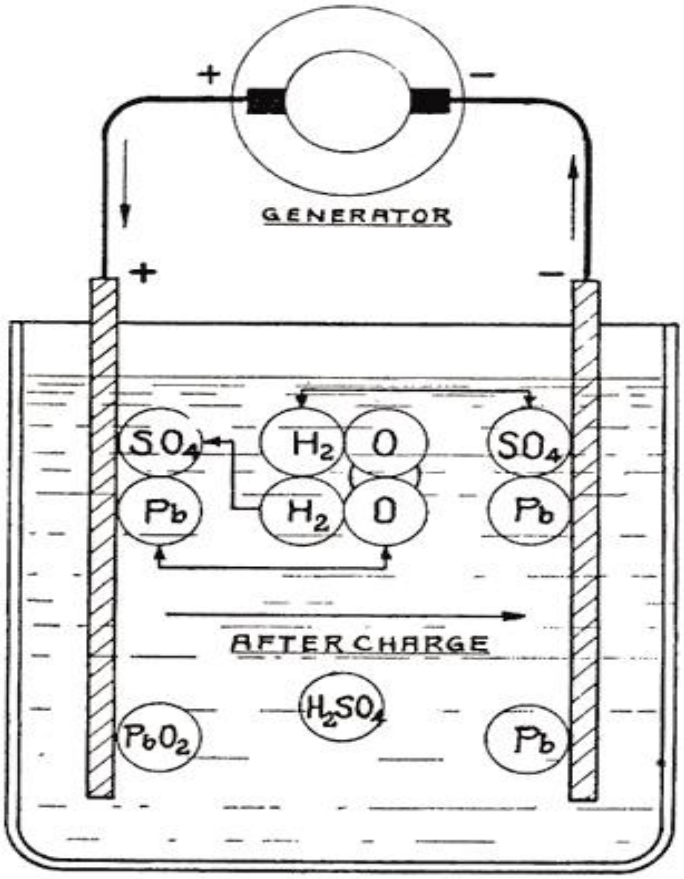
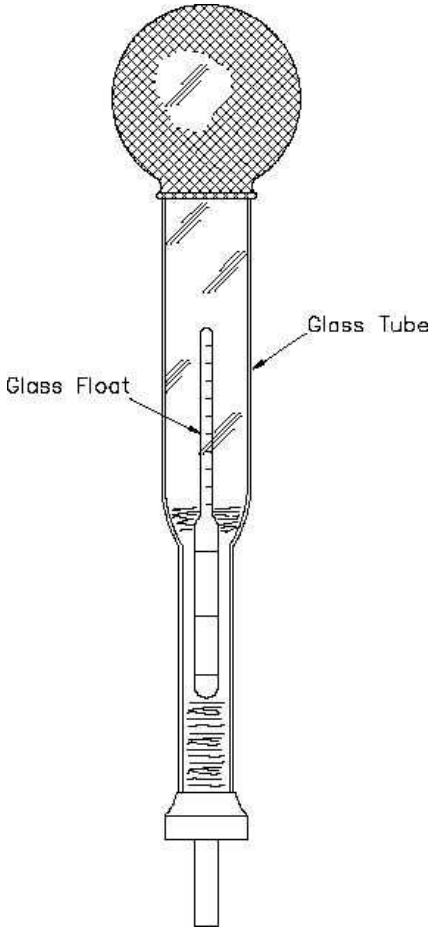
34. _____ _____ (S.G.) is the weight of a given volume of any liquid divided by the weight of an equal volume of water. Water has a specific gravity of 1.000

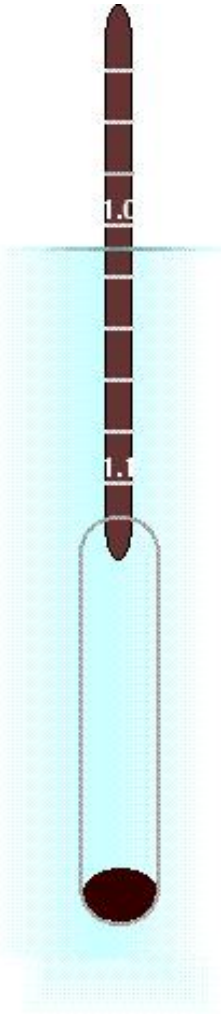
Electrolyte in a fully charged battery has a Specific Gravity of 1.260-1.280.



Chemical Action in a Storage Cell During Charge

Fig. 19





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22. Battery electrolyte is both explosive & corrosive!
***Neutralize* it with _____ _____...or Ammonia (both are bases)**

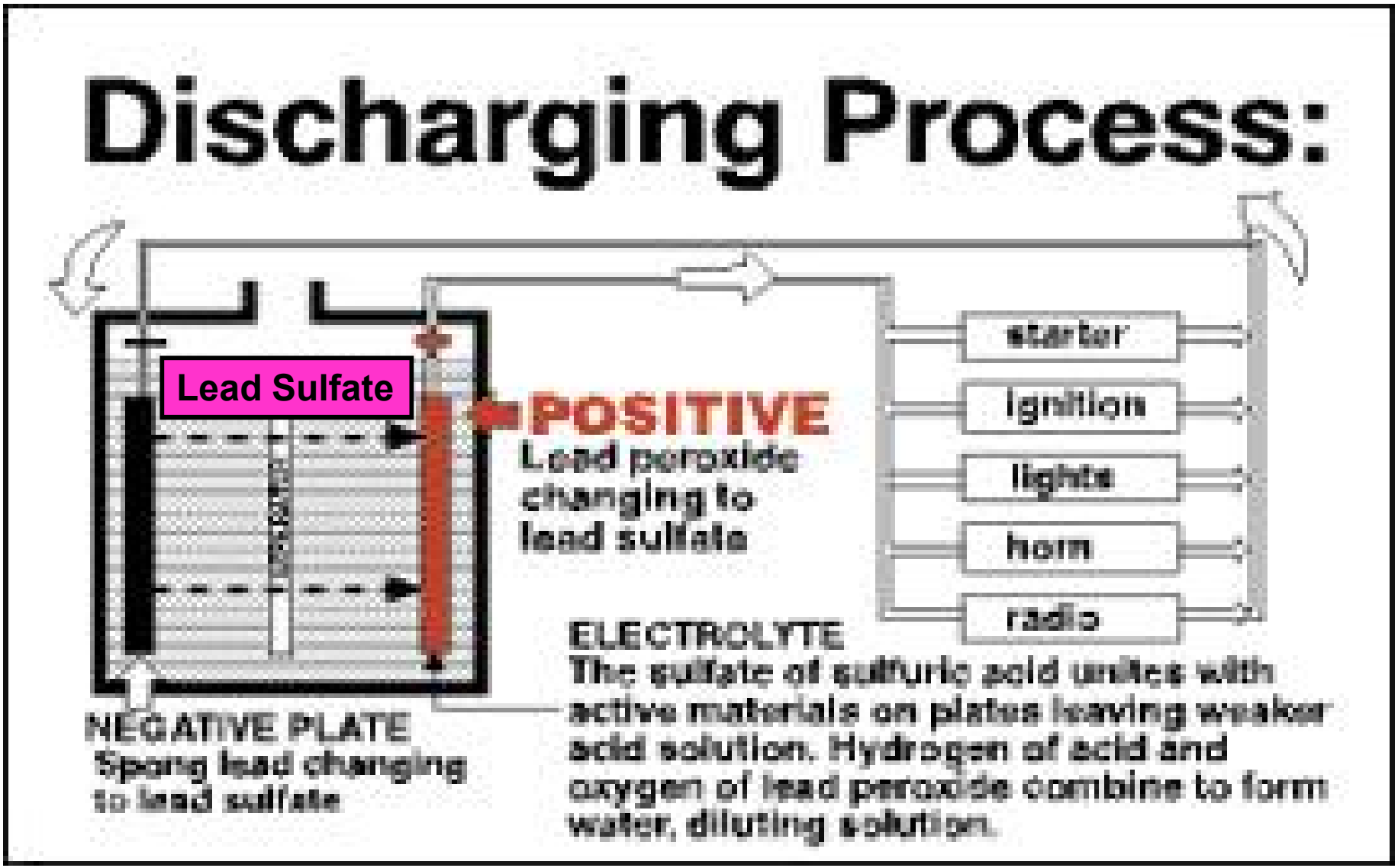
Ammonia Solution:

* 4 ounces clear ammonia

* 24 ounces of water.

Concentration of Hydrogen ions compared to distilled water		Examples of solutions at this pH
10,000,000	pH= 0	Battery acid, Strong Hydrofluoric Acid
1,000,000	pH = 1	Hydrochloric acid secreted by stomach lining
100,000	pH = 2	Lemon Juice, Gastric Acid Vinegar
10,000	pH = 3	Grapefruit, Orange Juice, Soda
1,000	pH = 4	Acid rain Tomato Juice
100	pH = 5	Soft drinking water Black Coffee
10	pH = 6	Urine Saliva
1	pH = 7	"Pure" water
1/10	pH = 8	Sea water
1/100	pH = 9	Baking soda
1/1,000	pH = 10	Great Salt Lake Milk of Magnesia
1/10,000	pH = 11	Ammonia solution
1/100,000	pH = 12	Soapy water
1/1,000,000	pH =13	Bleaches Oven cleaner
1/10,000,000	pH = 14	Liquid drain cleaner

23. When a battery discharges, _____ _____ is formed on the plates & S.G. decreases.



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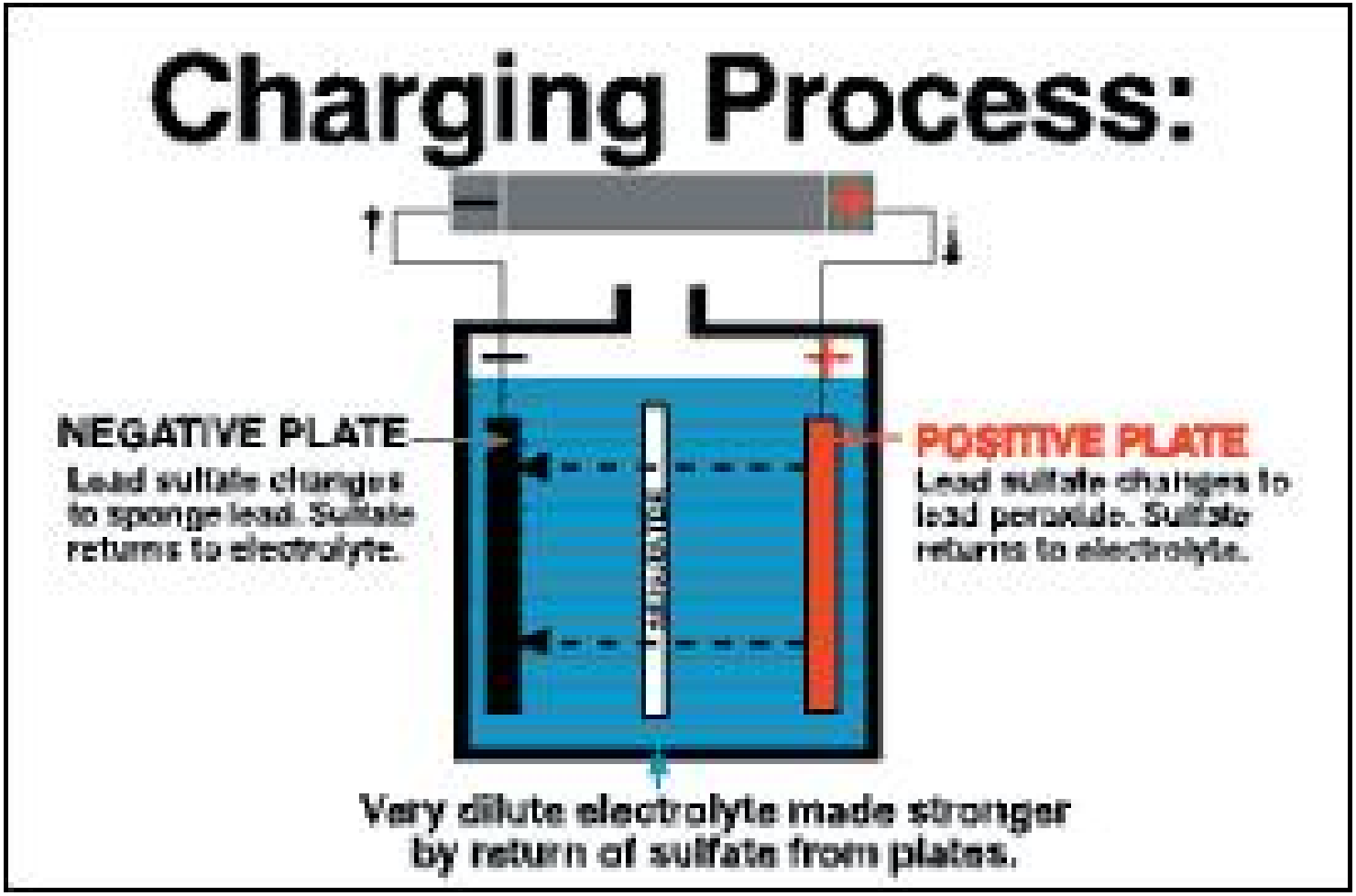
Note: It's normal for a battery to need <u>water</u> added at regular intervals. *H_2SO_4 should never be added.*

Batteries needing water added often are being overcharged!



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Note: The positive post of a battery is larger than the negative post.

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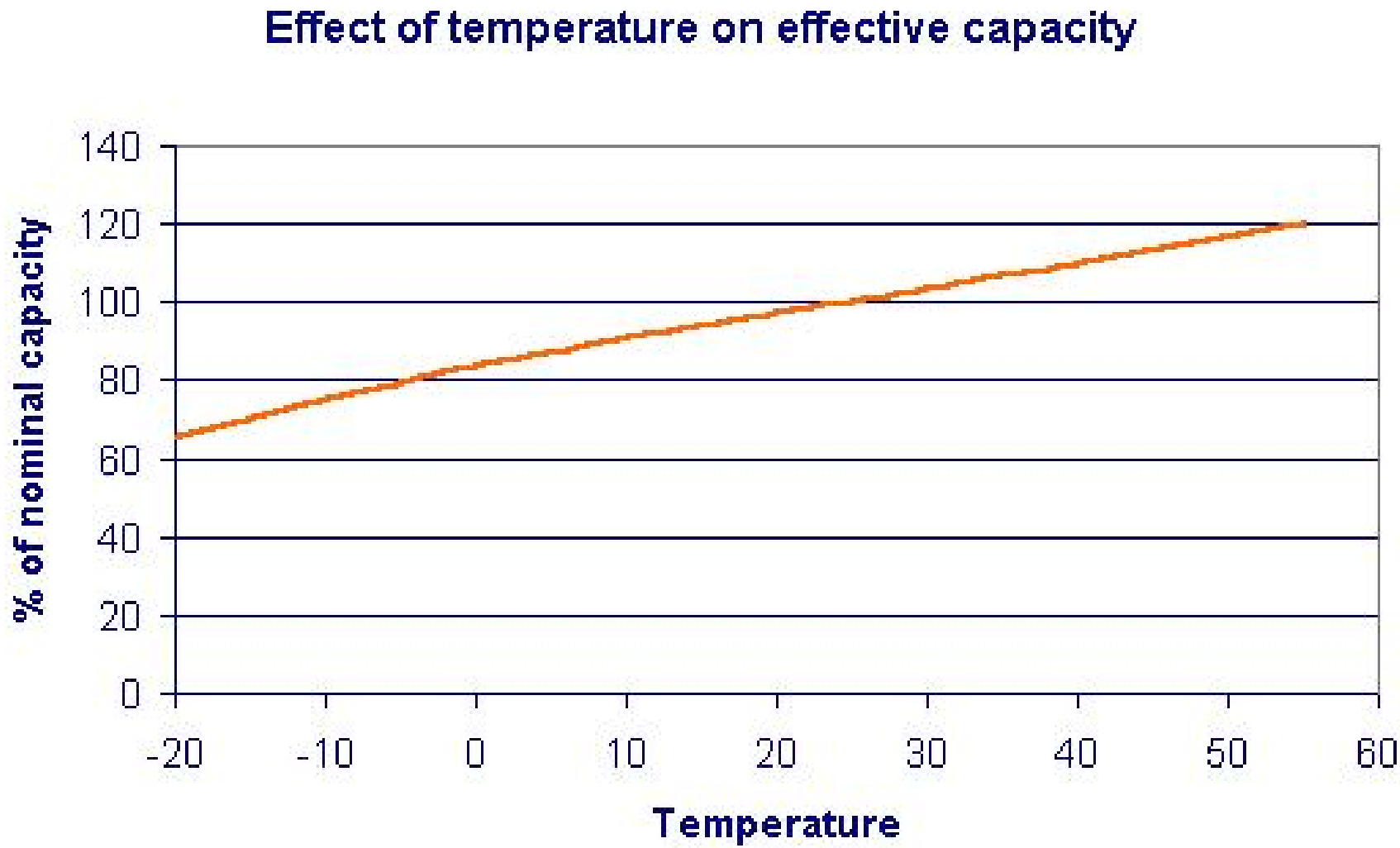
Battery capacity drops during cold temperatures due to slowed chemical reaction.



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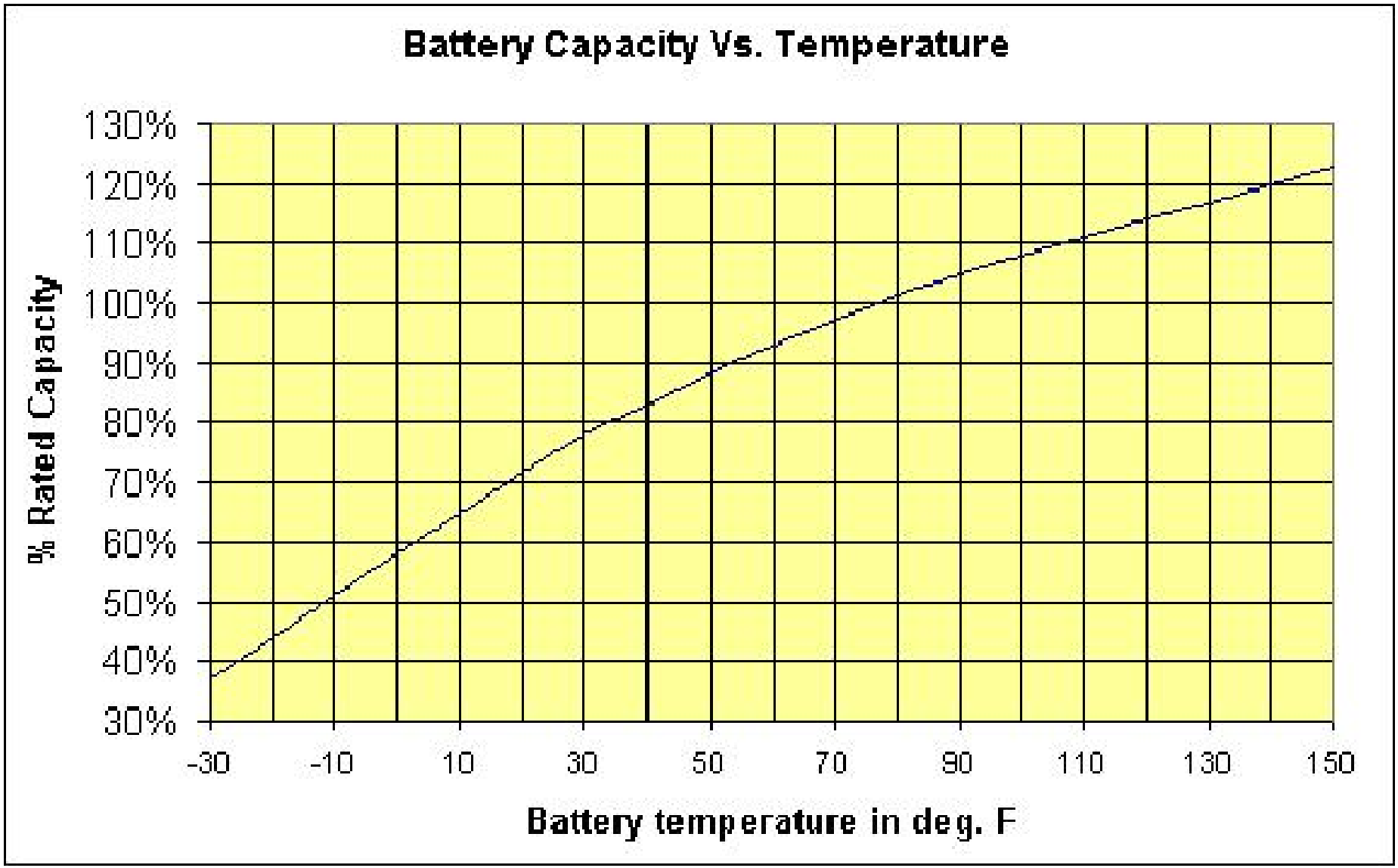
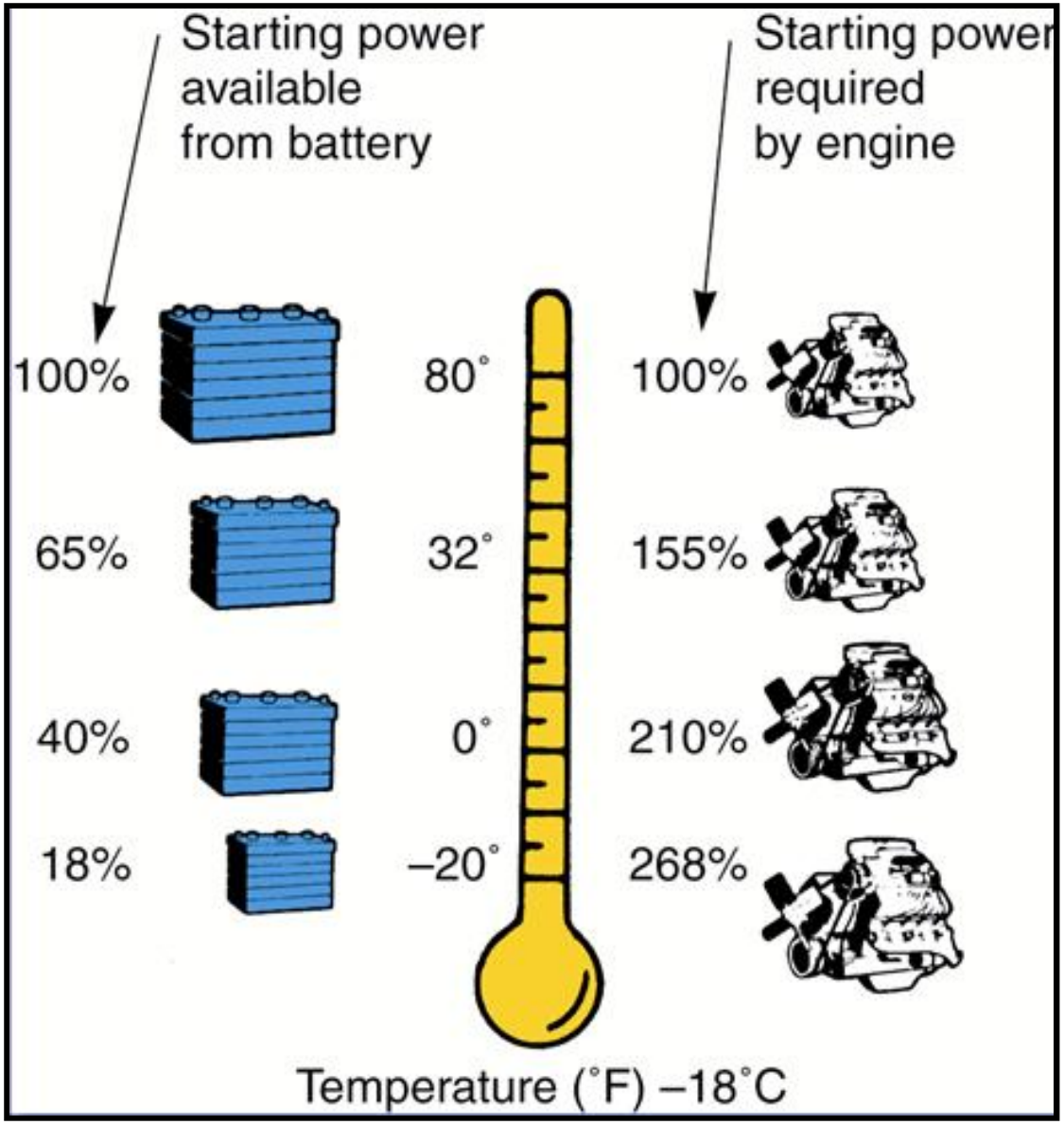


36. As a battery discharges or gets colder, it's specific gravity _____.



Increases
Decreases
Does Not Vary

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13. The _____ _____ _____ (CCA) rating is the most common method of rating automotive starting batteries. It is the load in amps that a battery can deliver for 30 seconds at 0°Fwithout terminal voltage dropping below 7.2 volts.

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14. The _____ _____ (CA) rating is similar, but done at 32°F.
(always higher than CCA)

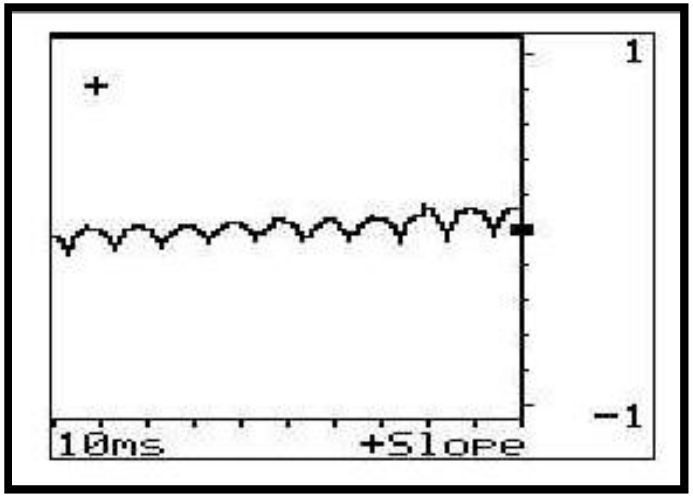
Cranking Amp
Cold Amp
Cranking Amplitude

Fact: When sizing a battery for replacement, match 2 CCA's per cubic inch of engine displacement or 2 CCA's per 16 cc's of displacement.

350 Cu. In. needs at least 700 CCA battery

1600 cc (1.6 liter) needs at least 200 CCA battery

Fact: "Best Practice" is to follow-up battery replacement with a both a parasitic load test and a check for AC diode ripple under a light load, both of which could have caused battery failure.



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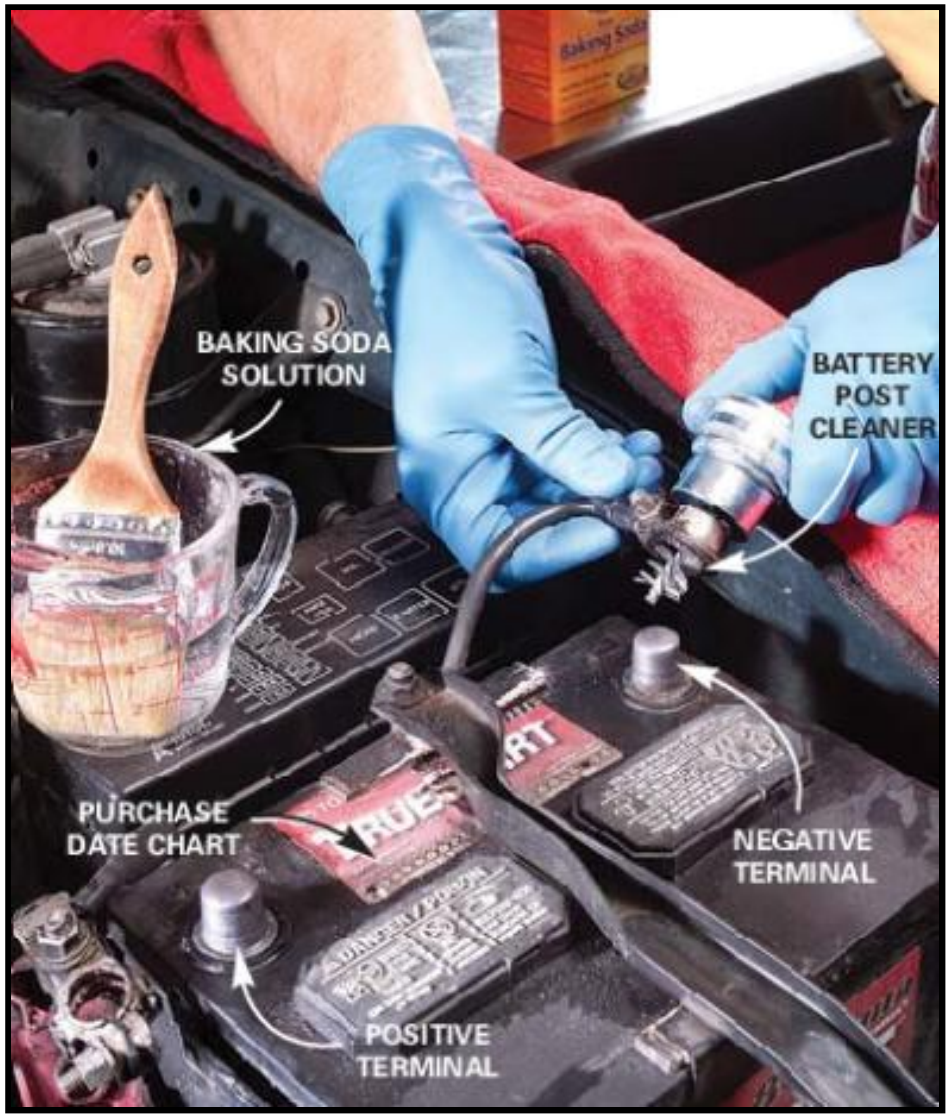
Note: Battery terminal corrosion results from <u>electrolyte</u> condensation during gassing…which takes place during charging.



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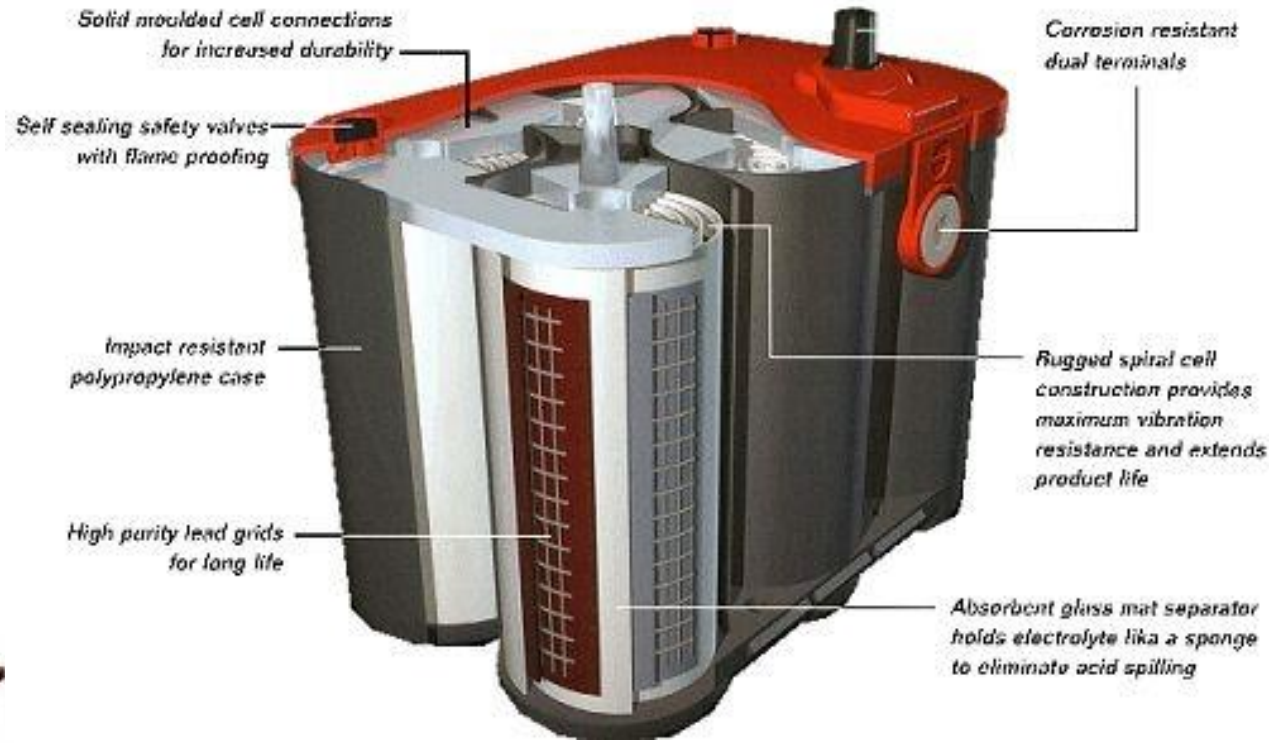
24. A _____ _____ battery is designed to go through many more charge & discharge cycles than a starter battery.
They have thicker and fewer plates.



Lead-Acid
Deep Cycle
Flooded Cell

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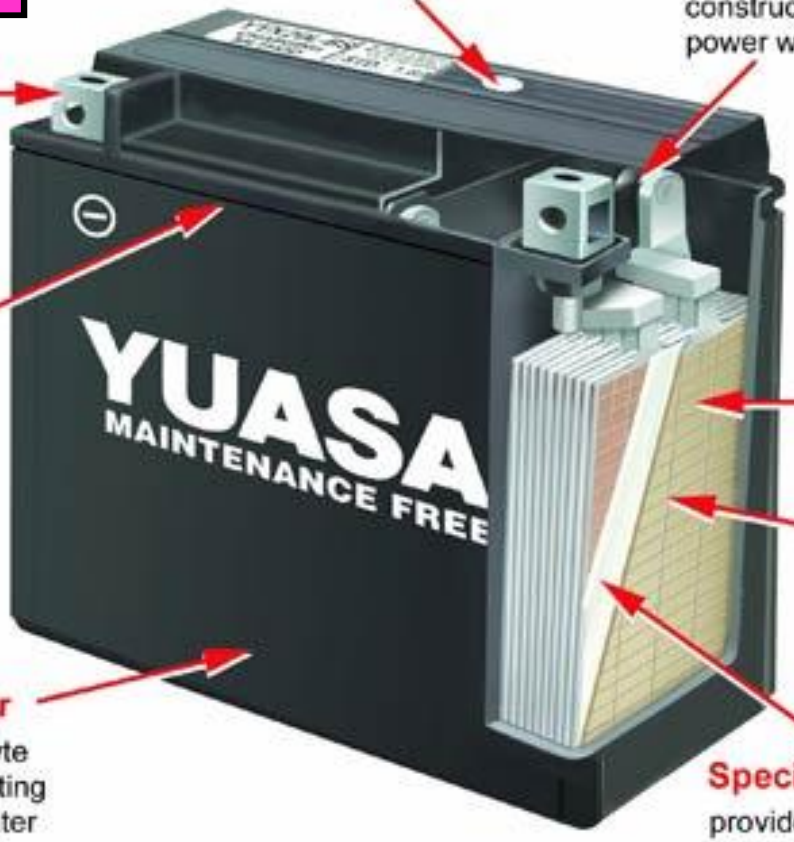
25. A _____-_____ battery experiences little gassing during discharge & recharge cycles.

Maintenance - Free
Deep - Cycle
Lead - Acid



Safety Valve/ Flame Arrestor
relieves excess pressure.

Thru-Partition Construction
provides shorter current path with less resistance than "over the partition" construction – you get more cranking power when you need it.

Patented Sealed Post
prevents acid seepage, reduces corrosion – extends battery life.

Heat Sealed Case to Cover
protects against seepage and corrosion – bonded unit gives extra strength.

Special Active Material
is compounded to withstand vibration, prolong battery life and dependability.

Special Grid Design
withstands severe vibration, assures maximum conductivity.

Polypropylene Cover and Container
assures reserve electrolyte capacity for cooler operating temperatures; gives greater resistance to gas and oil – and impact in extreme weather conditions!

Special Separator
provides virtually maintenance free operation and makes the battery spill-proof. AGM Technology eliminates water loss.

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26. A battery experiences a _____ cycle when it is near totally discharged and then recharged.

Shallow
Medium
Deep

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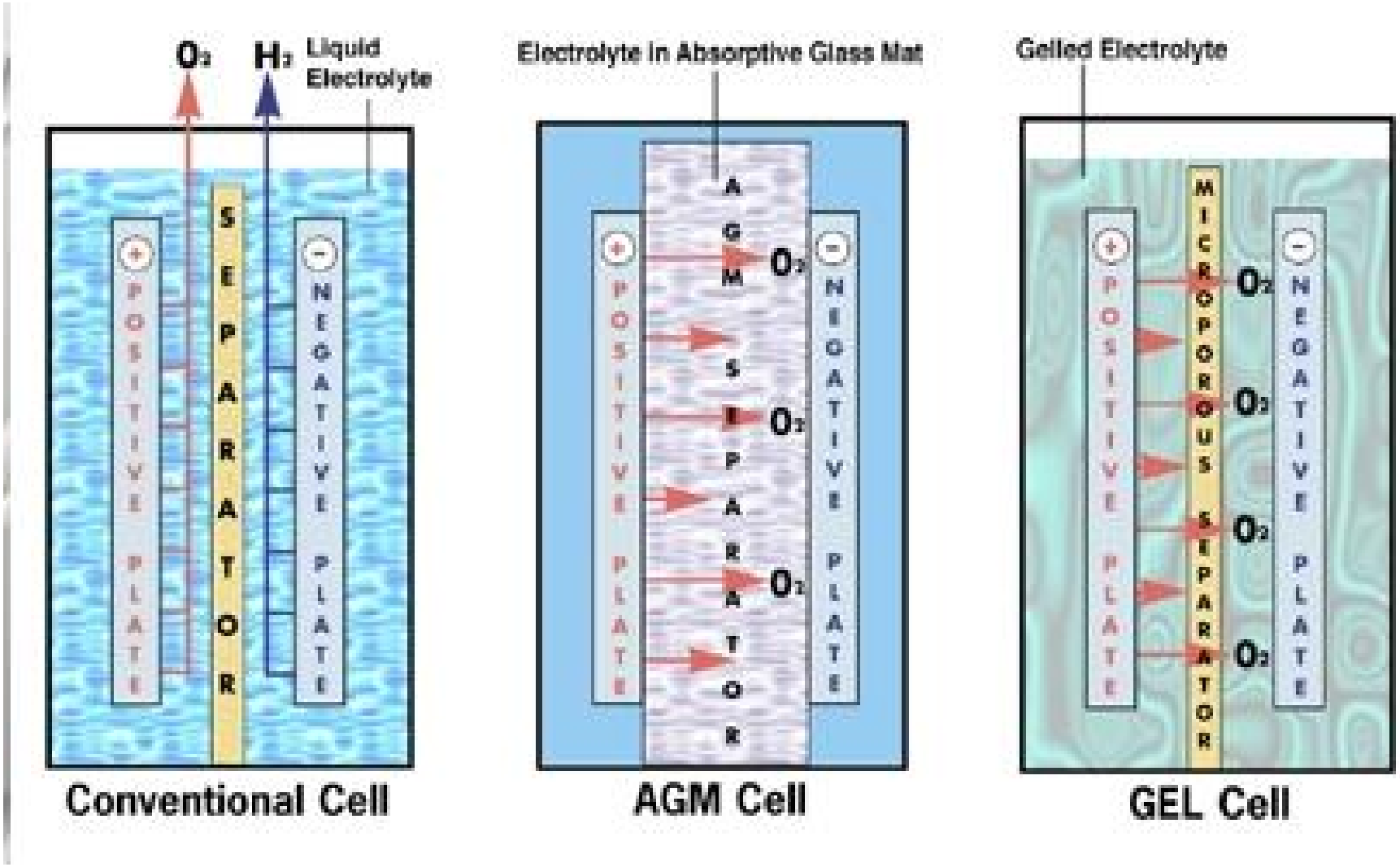
27. A _____ battery is completely sealed, maintenance-free, with gel cell electrolyte.



Recombinant

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28. The electrolyte in an _____ _____ _____ *(AGM)* battery is held in moistened fiberglass matting. AGM batteries are recombinant with minimal gassing during charging.

Absorbed Glazed Material
Absorbed Glass Mat
Adsorbed Glazed Material

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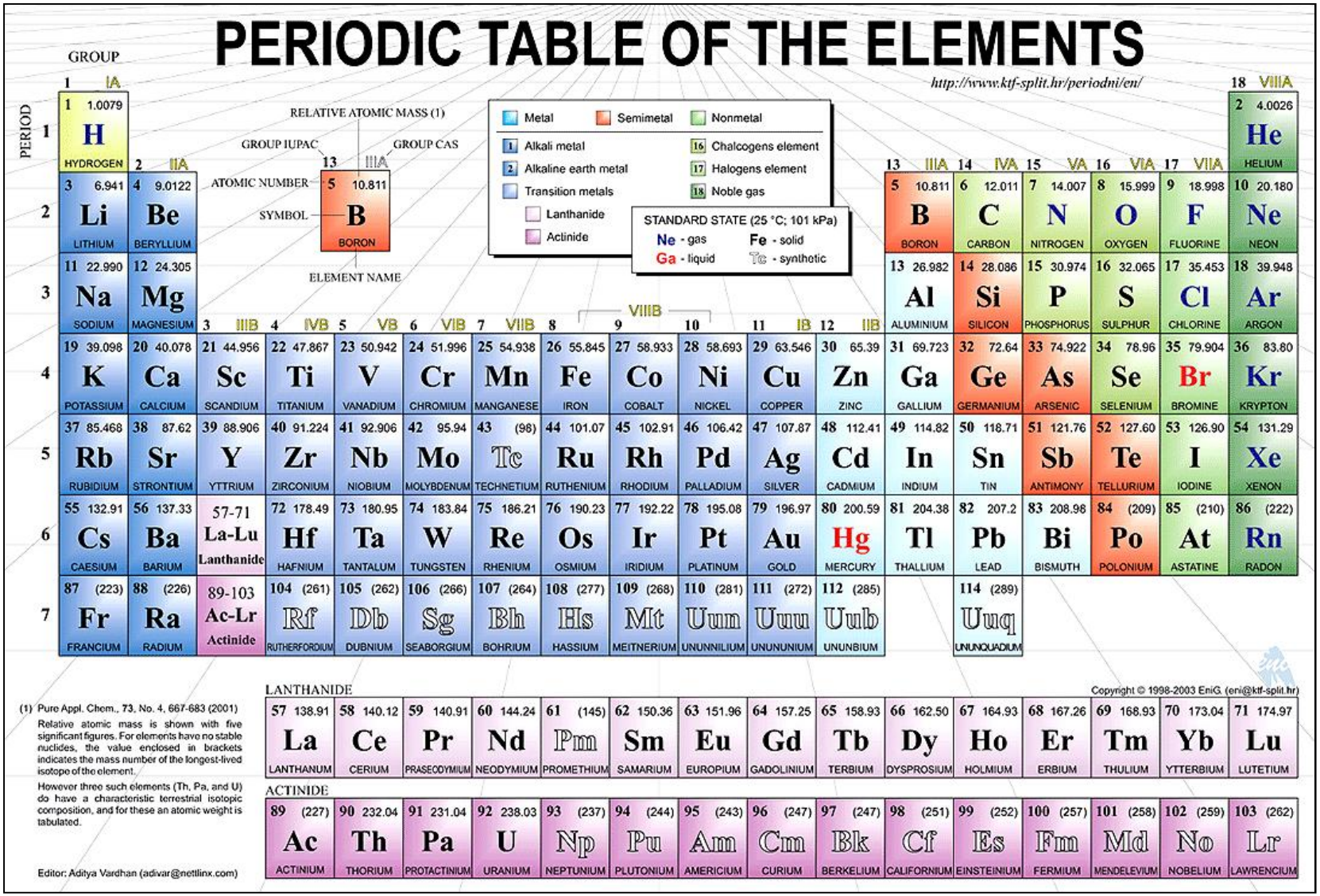
29. During normal use in a recombination battery _____ (H) & _____(0_2) are captured and recombined to form water (H_20) within the electrolyte, eliminating the need to ever add water.



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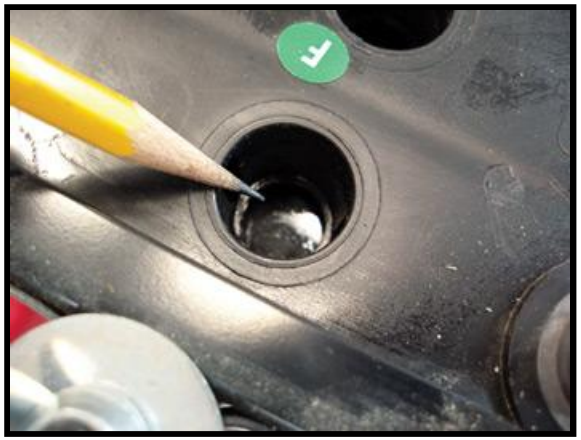
30. Factors that limit battery life are: improper electrolyte _____, _____ temperatures & freezing, corroded connections and self discharge, _____, _____ from undercharging, poor mounting that allows vibration and repeated cycling.

Level, Cold, Overcharging, Sulfation
Level, Hot, Undercharging, Duration
Level, Cold, Recharging, Domination

ATASA 5th Batteries

30. Factors that limit battery life are: improper electrolyte _____, _____ temperatures & freezing, corroded connections and self discharge, _____, _____ from undercharging, poor mounting that allows vibration and repeated cycling.

Level, Cold, Overcharging, Sulfation
Level, Hot, Undercharging, Duration
Level, Cold, Recharging, Domination



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31. Before testing a battery, remove the surface charge by turning on the headlights for ___ minutes.

Battery – State of Charge Test

The first step when conducting starting and charging system tests is to verify that the battery is fully charged.

1. Place the vehicle ignition switch in the OFF position.
2. Turn the Hi-Beams ON for **3 minutes** to dissipate the battery surface charge.
3. Turn the vehicle lights and accessories OFF.
4. Set DMM to DC Volts (range closest to 12 volts).
5. Connect black test lead to battery negative post.
6. Connect red test lead to battery positive post.

- **12.6V or above Fully Charged**
- **12.4 – 12.5 V 50-75% Charged**
- **Under 12.3V Needs charging**

Open circuit voltage	State-of-Charge in %
12.65V	100%
12.45V	75%
12.24V	50%
12.06V	25%
11.89V or less	Discharged

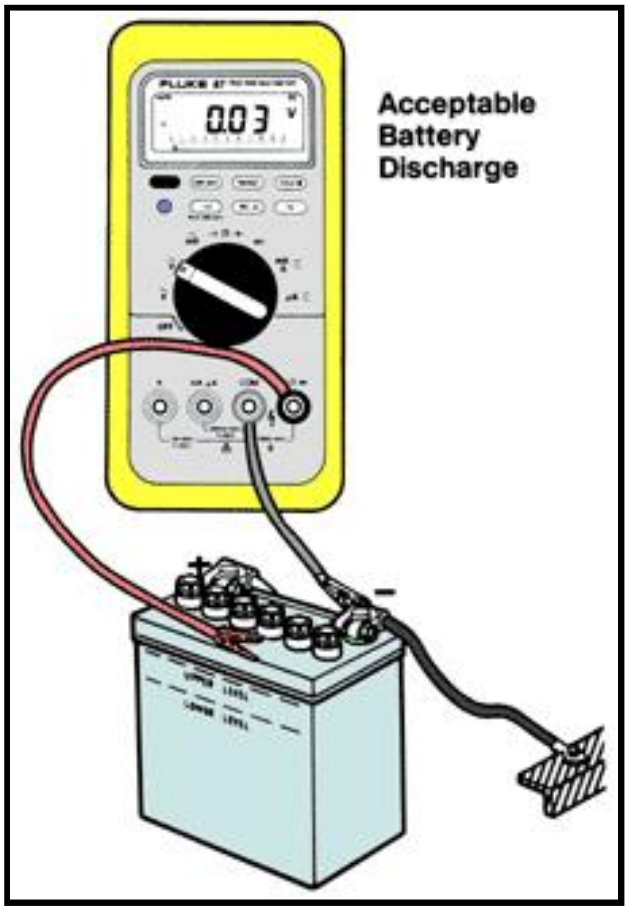
ATASA 5th Batteries

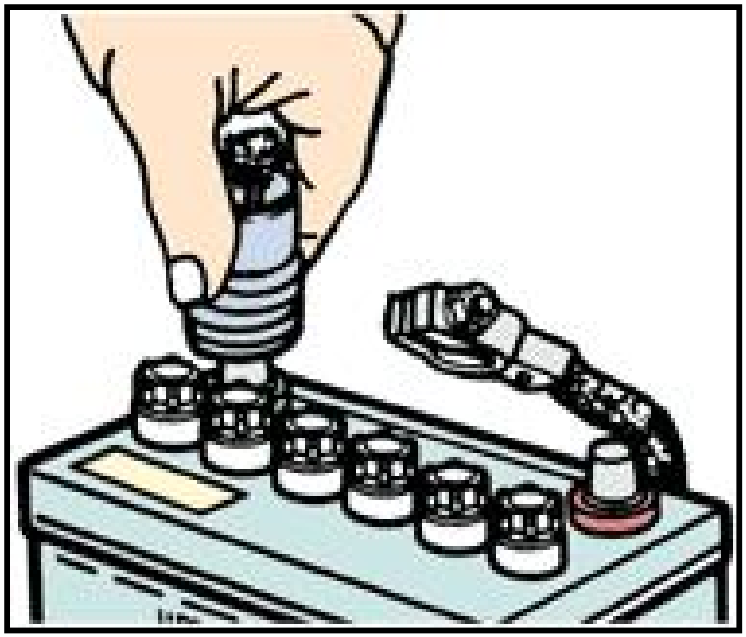
32. Cleaning a battery with _____ _____ & water or ammonia & water neutralizes any acid on the case between the terminals. This reduces the chance of "dirt circuit & corrosion leakage".

ATASA 5th Batteries

33. If battery terminal _____ results from electrolyte condensation during gassing, then recombinant batteries should have less terminal corrosion.

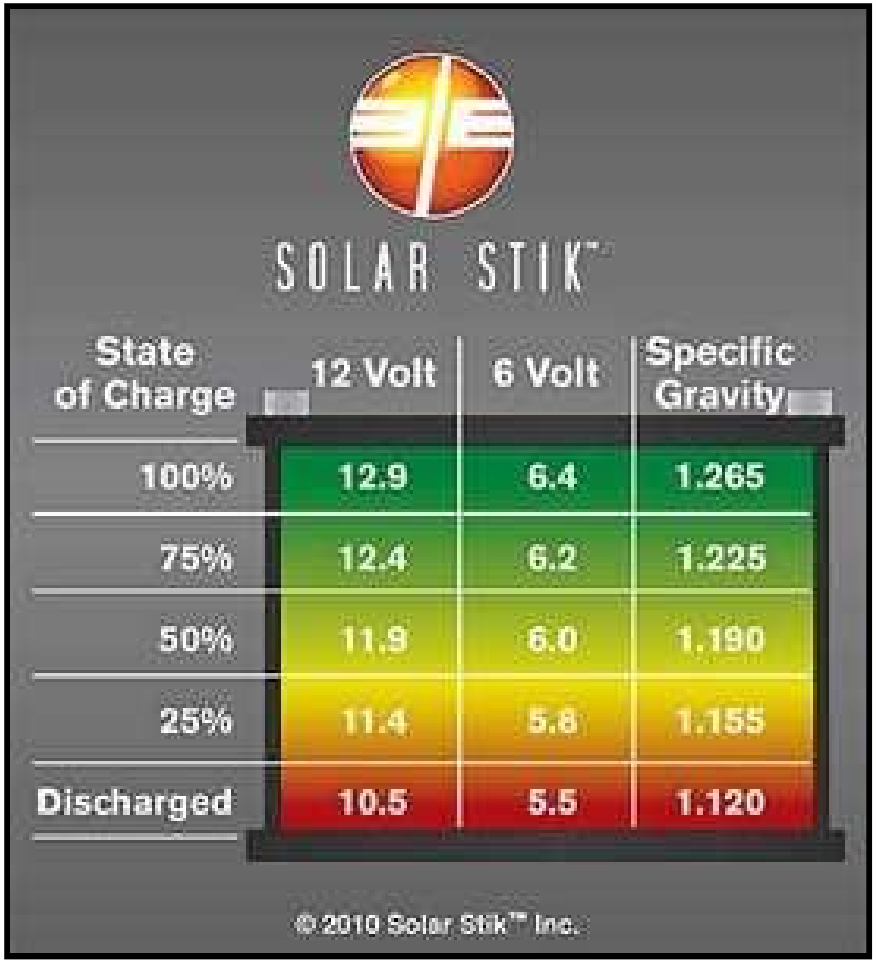
Erosion
Explosion
Corrosion

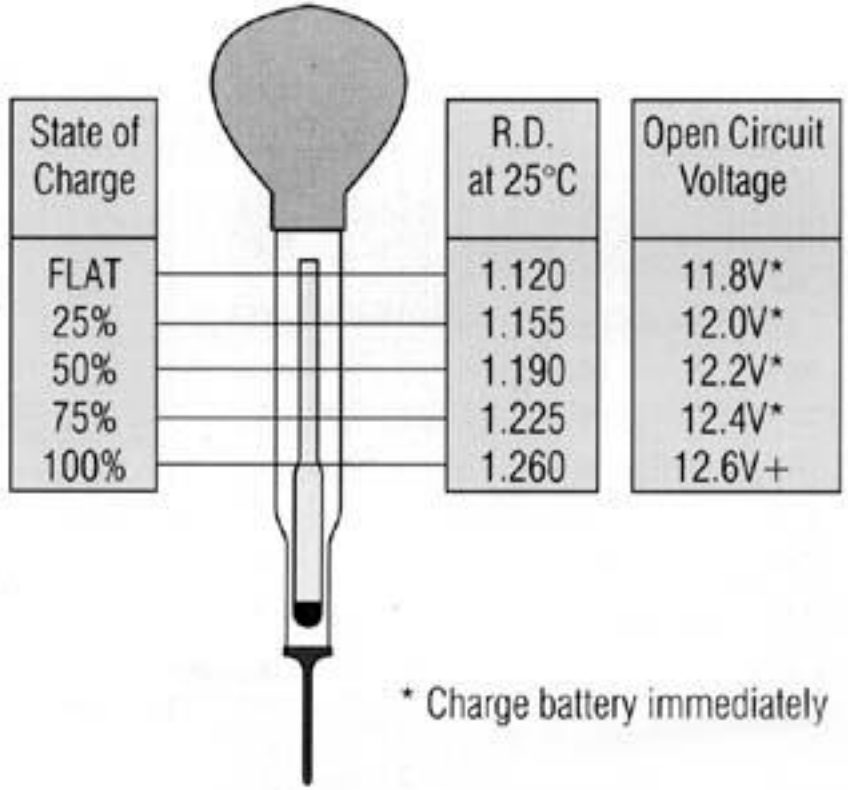




ATASA 5th Batteries

35. A fully charged battery should have a specific gravity of ___ to ___ at 80°F.





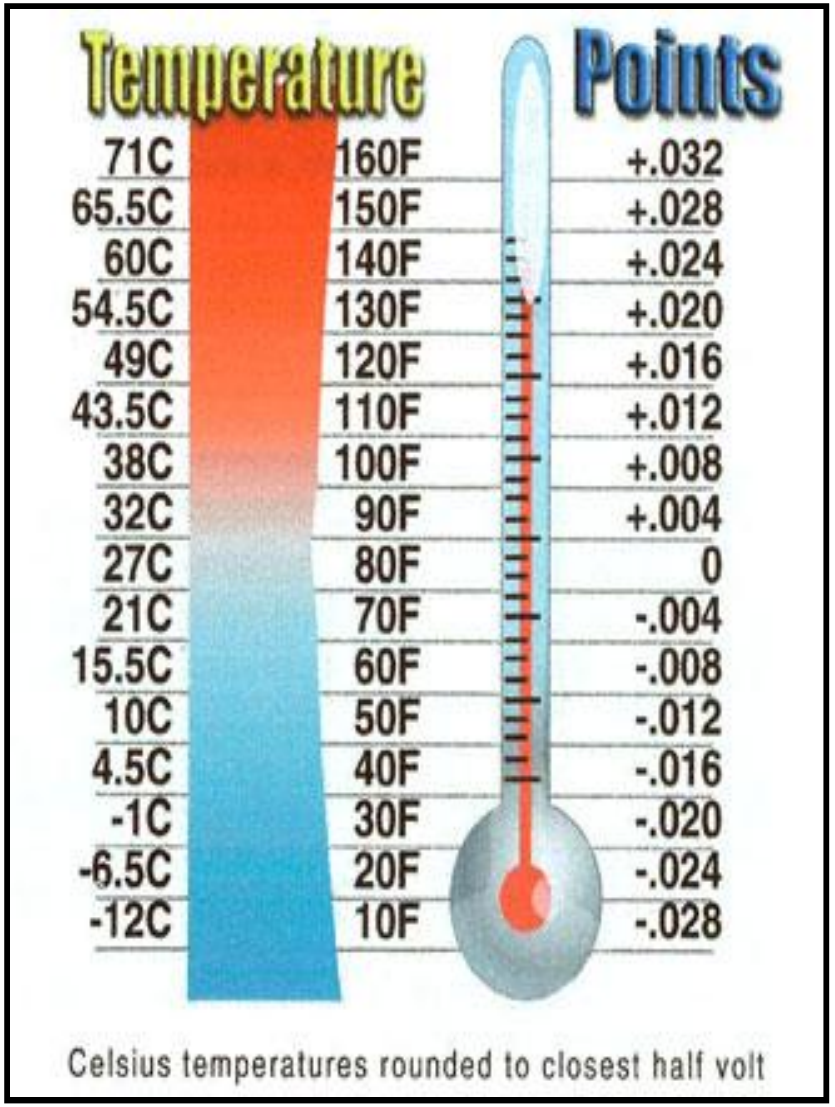
1.260 to 1.280
1.300 to 1.350
1.000 to 1.100

ATASA 5th Batteries

37. Hydrometer readings should not vary more than _____ per cell.
More variance = bad battery.

.050
.500
5.00

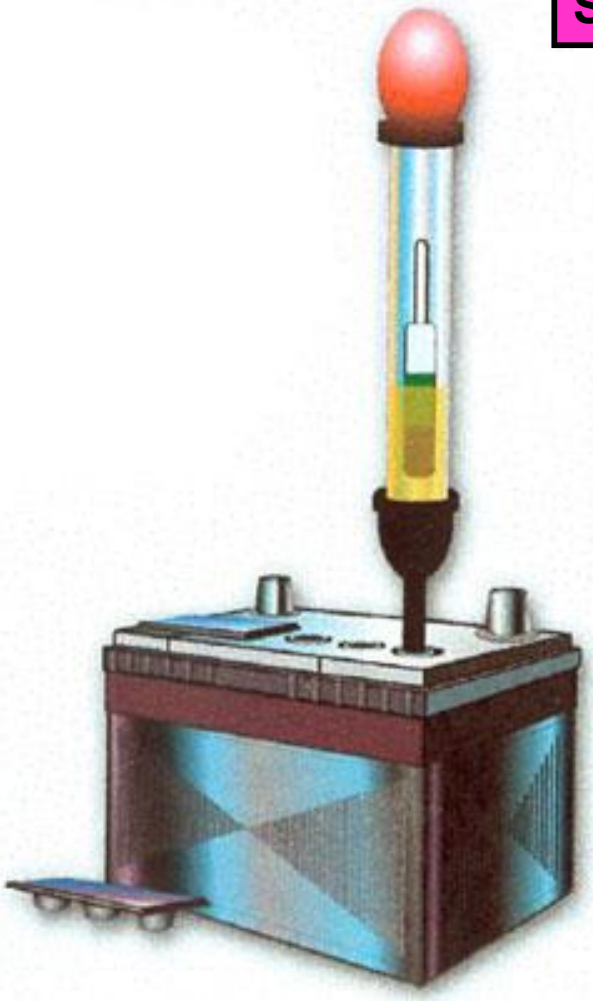
“.050 aka 5 points or 5%”



ATASA 5th Batteries

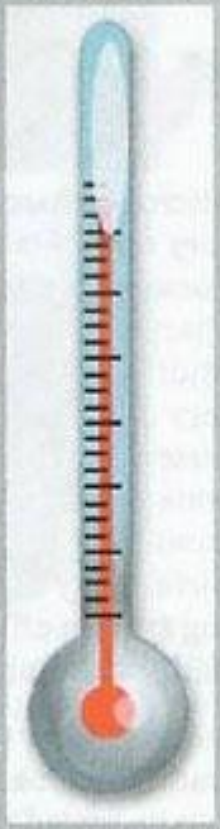
38. Specific gravity is a good indication of the battery's _____ of _____ (SOC).

State of Charge
Sulfation of Charge
Sum of Charge



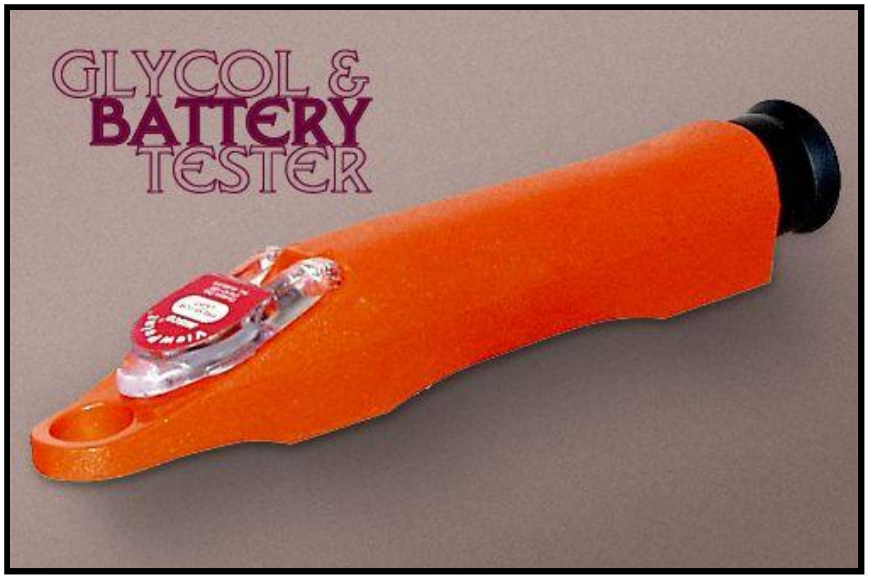
Battery temperature affects performance during the load test. Compensate for changes in battery temperature as follows:

Temperature	Post Voltage
70 degrees F	9.6 Volts
60 degrees F	9.5 Volts
50 Degrees F	9.4 Volts
40 Degrees F	9.3 Volts
30 Degrees F	9.1 Volts
20 Degrees F	8.9 Volts
10 Degrees F	8.7 Volts
0 Degrees F	8.5 Volts



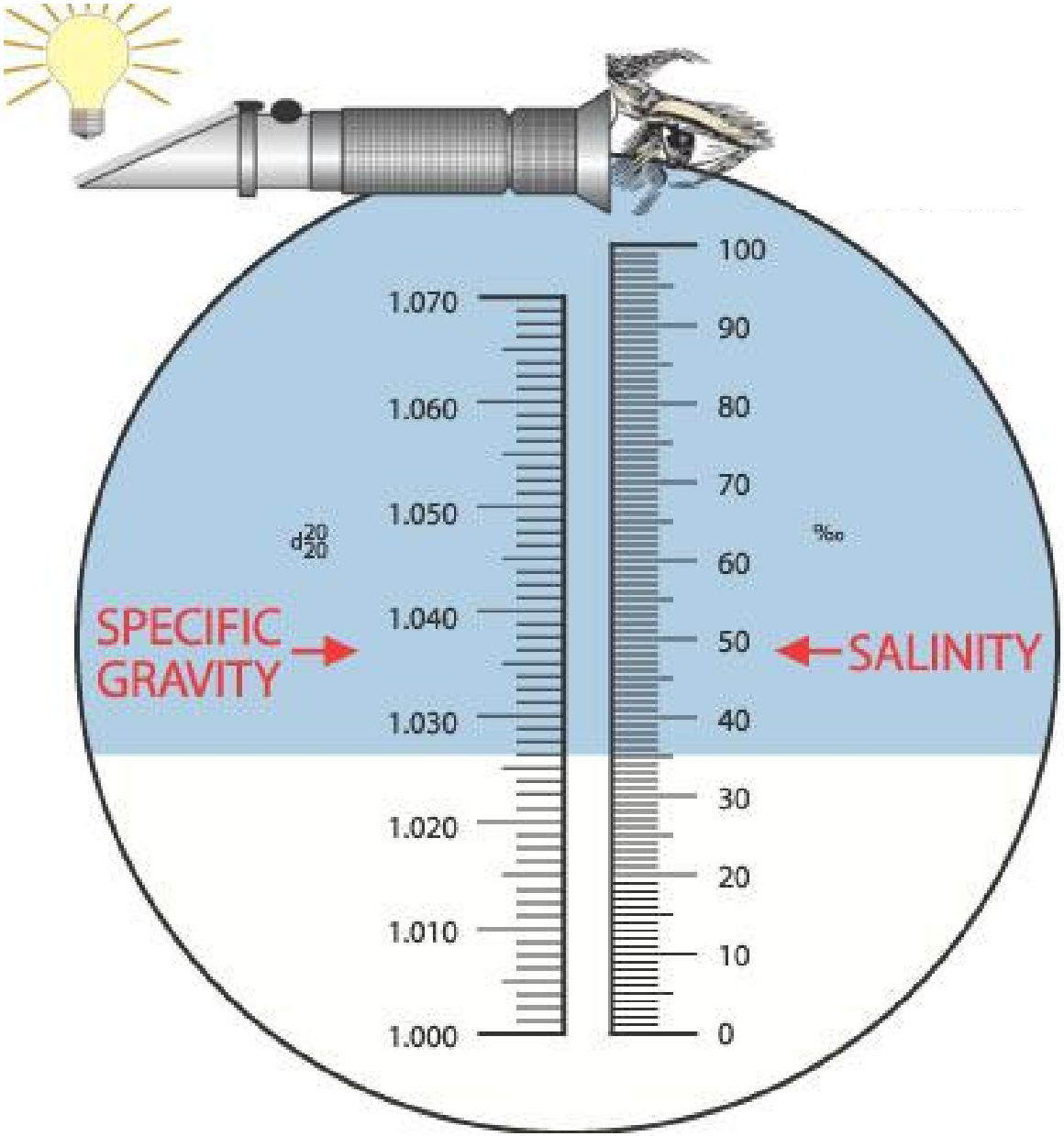
ATASA 5th Batteries

39. The same _____ that is used to check engine coolant can check the specific gravity of battery electrolyte. ***A refractometer uses light refraction though a prism to analyze fluids.***



Refractometer
Hydrometer
Manometer

ATASA 5th Batteries

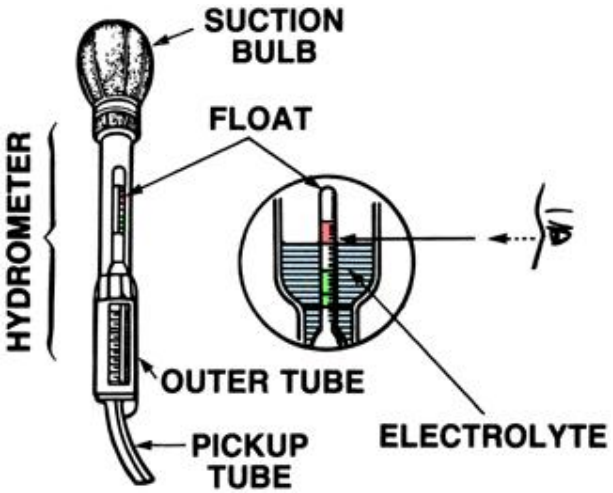


ATASA 5th Batteries

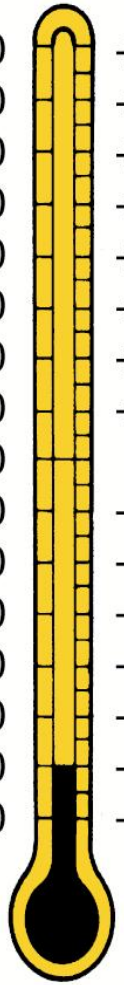
40. A _____ corrected _____ is the most accurate tool for testing the specific gravity of battery electrolyte.

80 F° is the standard test temperature w/ correction.

Temperature Corrected
Temperature Connected
Terminal Corroded



˚C	˚F	Adjustment factor
71	160	+.032
65.5	150	+.028
60	140	+.024
54.5	130	+.020
49	120	+.016
43	110	+.012
37.5	100	+.008
32.5	90	+.004
27	80	0
21	70	–.004
15.5	60	–.008
10	50	–.012
4.5	40	–.016
–1	30	–.020
– 6.5	20	–.024
–12	10	–.028



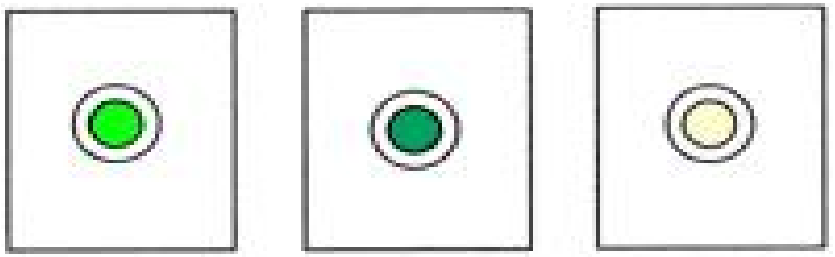
Example 1
Hydrometer reading 1.260
Electrolyte temperature 20˚F (–6.5˚C)
Subtract specific gravity –.024
Corrected specific gravity is 1.236

Example 2
Hydrometer reading 1.225
Electrolyte temperature 100˚F (37.5˚C)
Add specific gravity +.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

ATASA 5th Batteries

41. Some batteries have built-in hydrometer.
Green = ____ White means _____

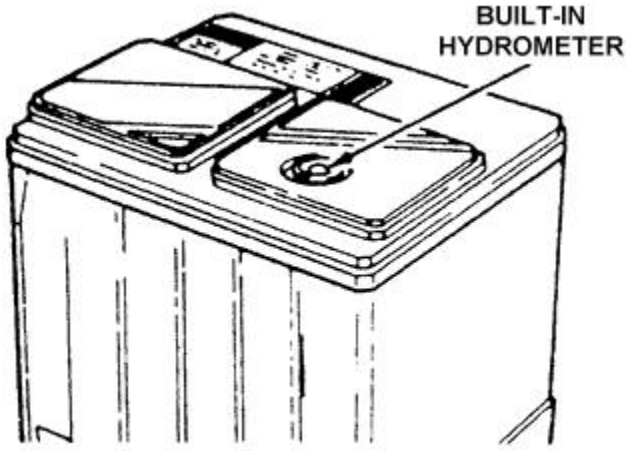


Green dot visible (OK)

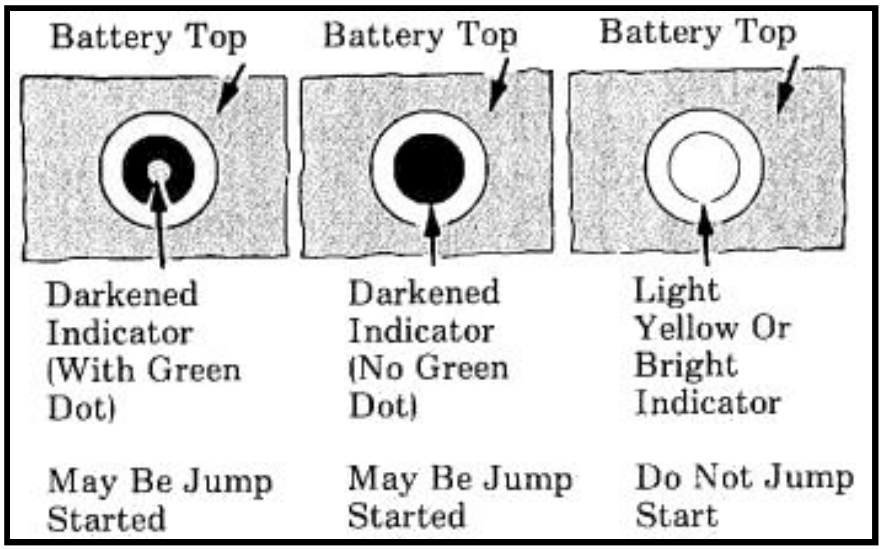
Dark green dot not visible (charge before testing)

Light or yellow (replace battery)

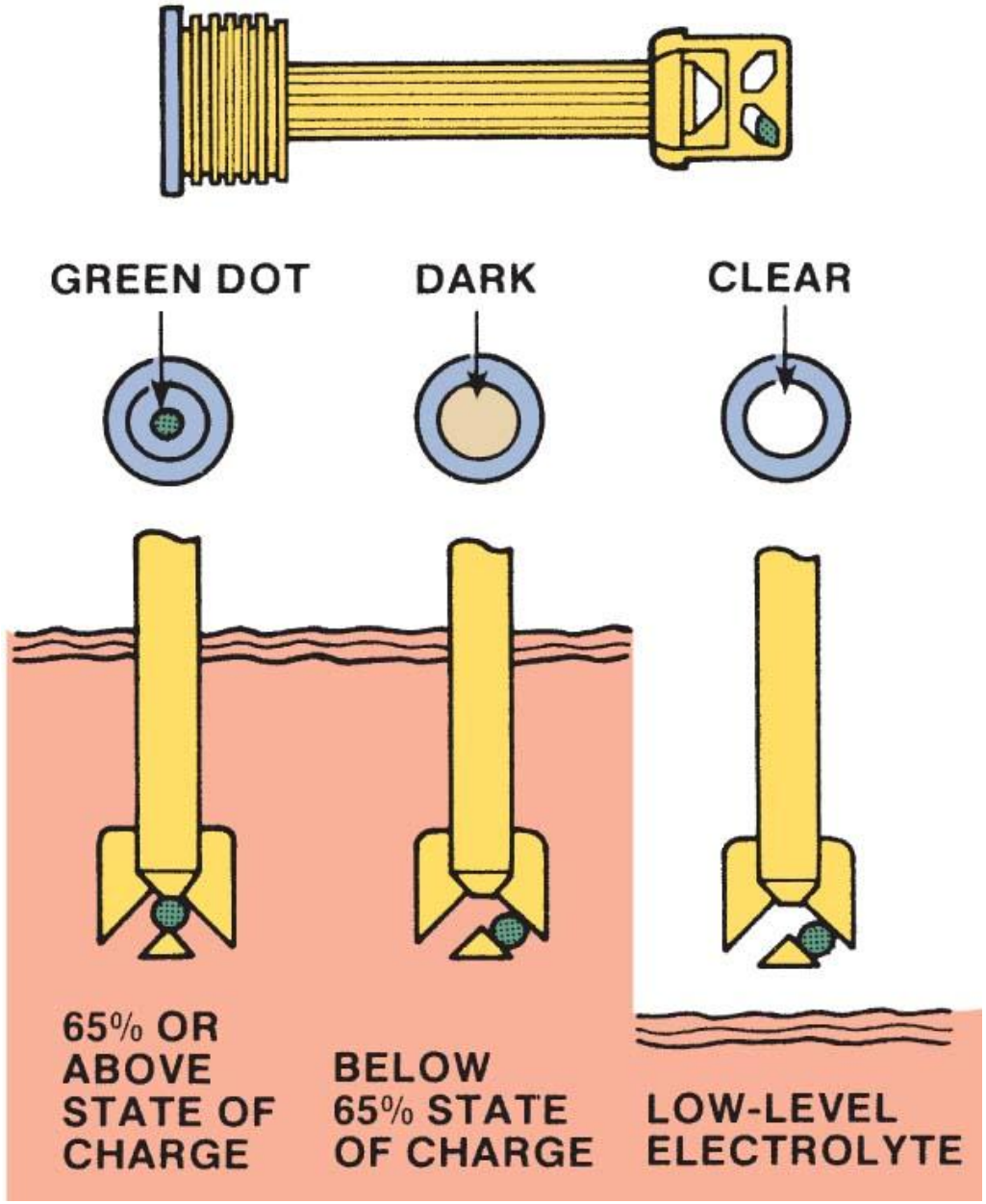
ORANGE also means RECHARGE!



Location of indicator on sealed battery



ATASA 5th Batteries



ATASA 5th Batteries

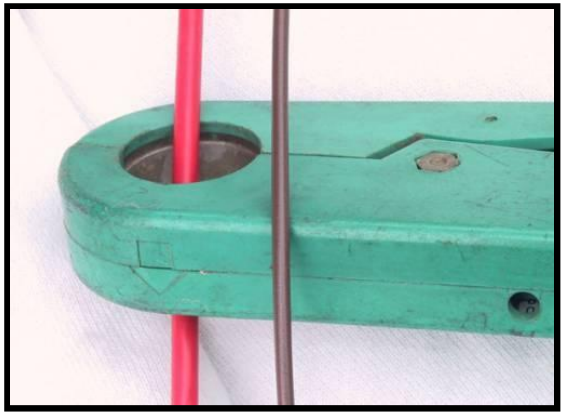
42. Sealed batteries cannot be hydrometer tested for state of charge so either a _____ test (VAT-45) or a *capacitance or conductance* test with the Midtronics® tester must be performed.

Load Road Mode

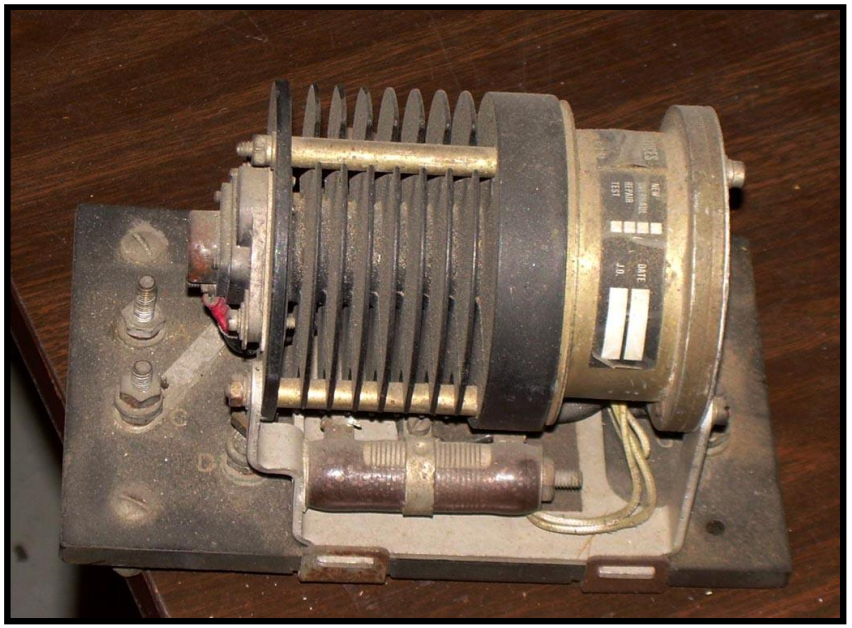
ATASA 5th Batteries

43. A <u>battery capacity or load test</u> is done by draining ___ the CCA rating in amps *(or 3x the A-H rating)* for ___ seconds @70 degrees w/a *carbon pile*. The battery OCV should not fall below ____ volts.

½, 15, 9.6
½, 30, 12
½, 90, 9.6



ATASA 5th Batteries



This is a Carbon Pile Rheostat

ATASA 5th Batteries

ATASA 5th Batteries

44. The conductance test can detect _____ defects, shorts, normal aging, and open circuits. ***These tests are effective in predicting the end of life before the battery fails.*** **"Replace Battery"**

Cell
Plate
Terminal

ATASA 5th Batteries

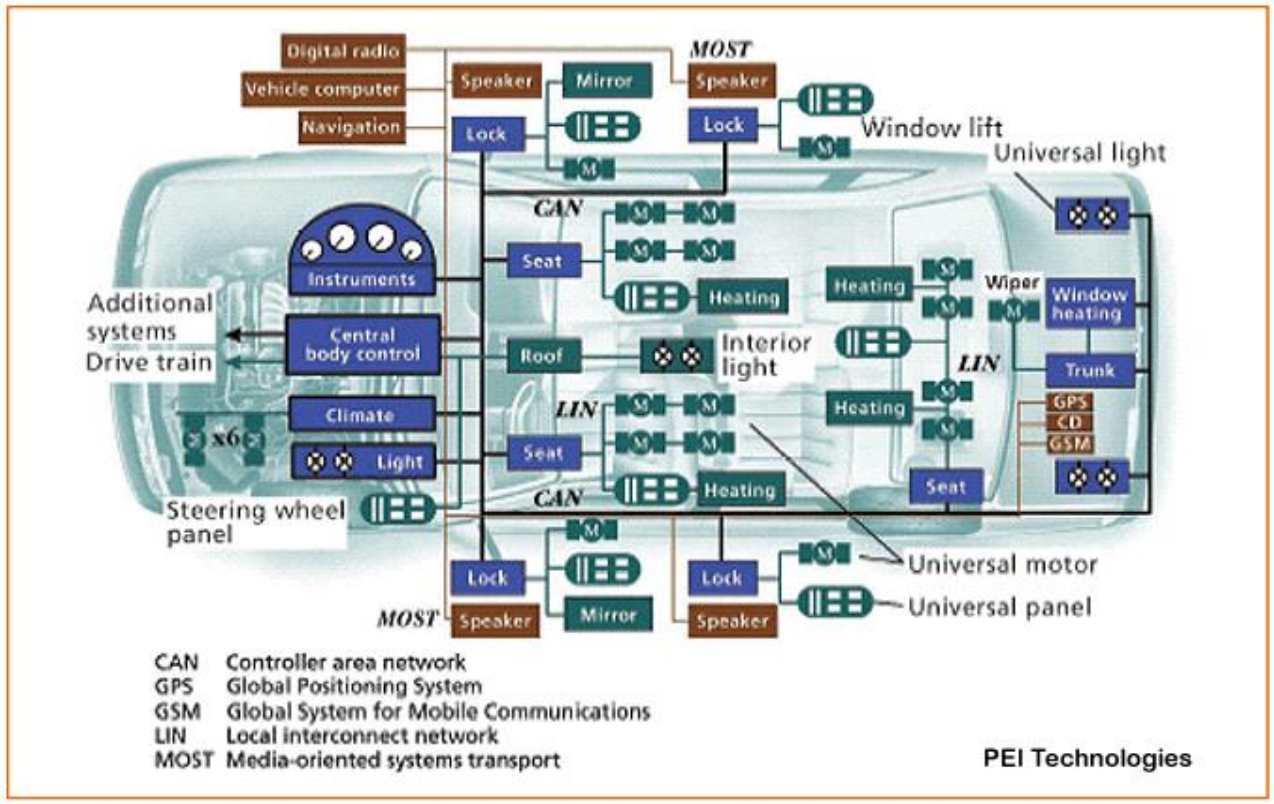
45. A fully charged new battery will have a conductance rating from 110% to 140% of its _____ rating.

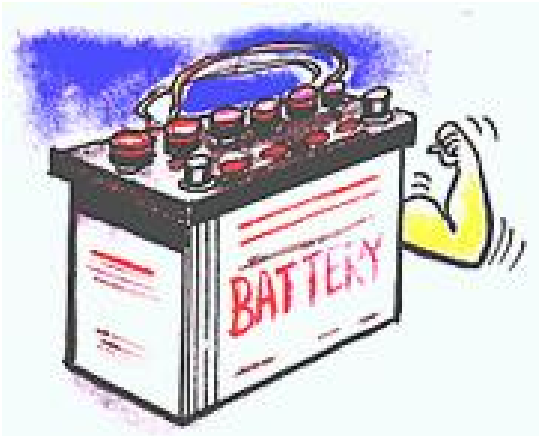
CA
Reserve Capacity
CCA

ATASA 5th Batteries

46. _____ loads are current drains on the battery that exist when the ignition key is off.

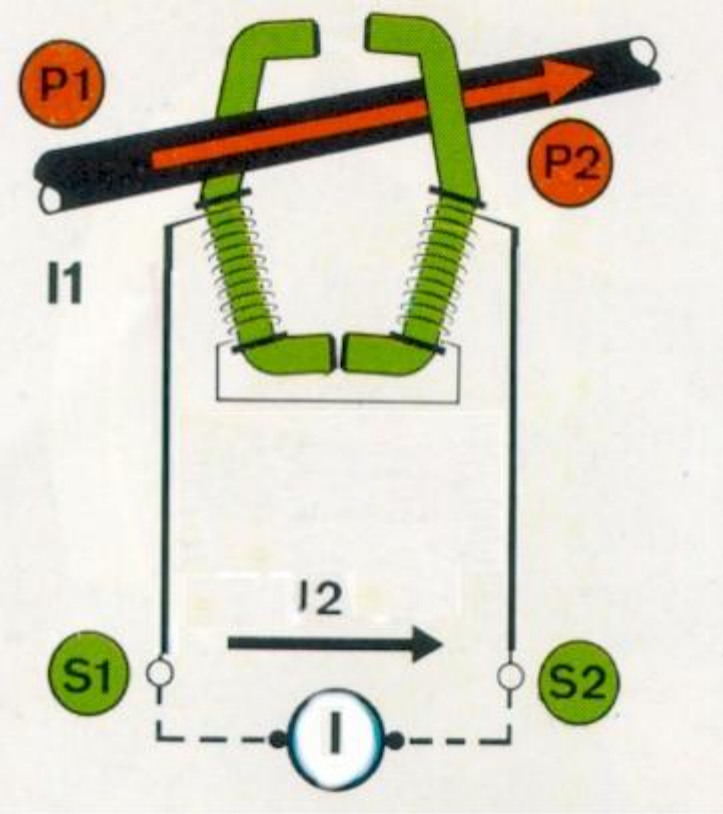
Paralytic
Parasitic
Paramedic

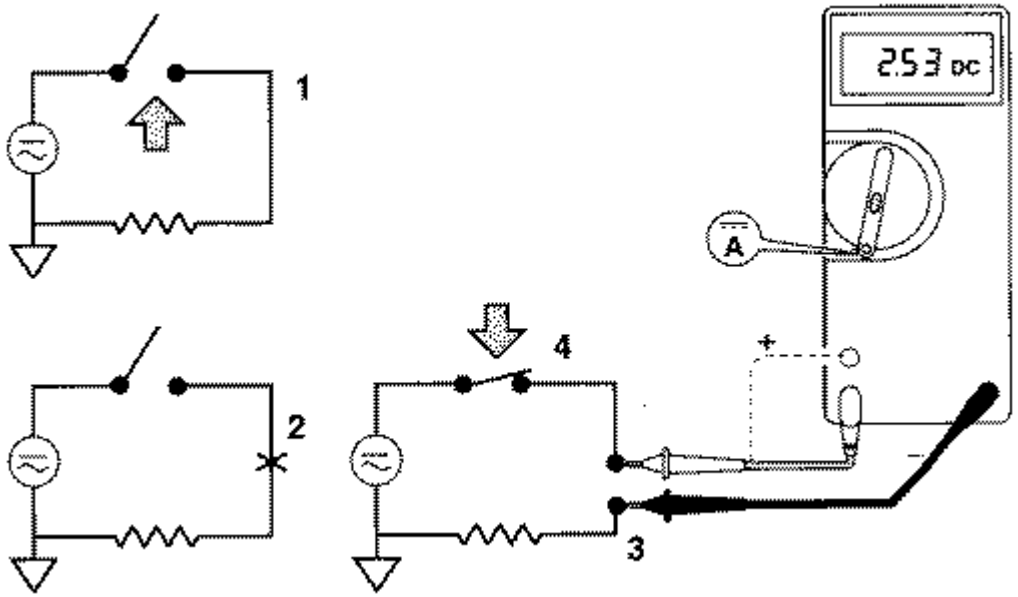




ATASA 5th Batteries

46. _____ loads are current drains on the battery that exist when the ignition key is off.



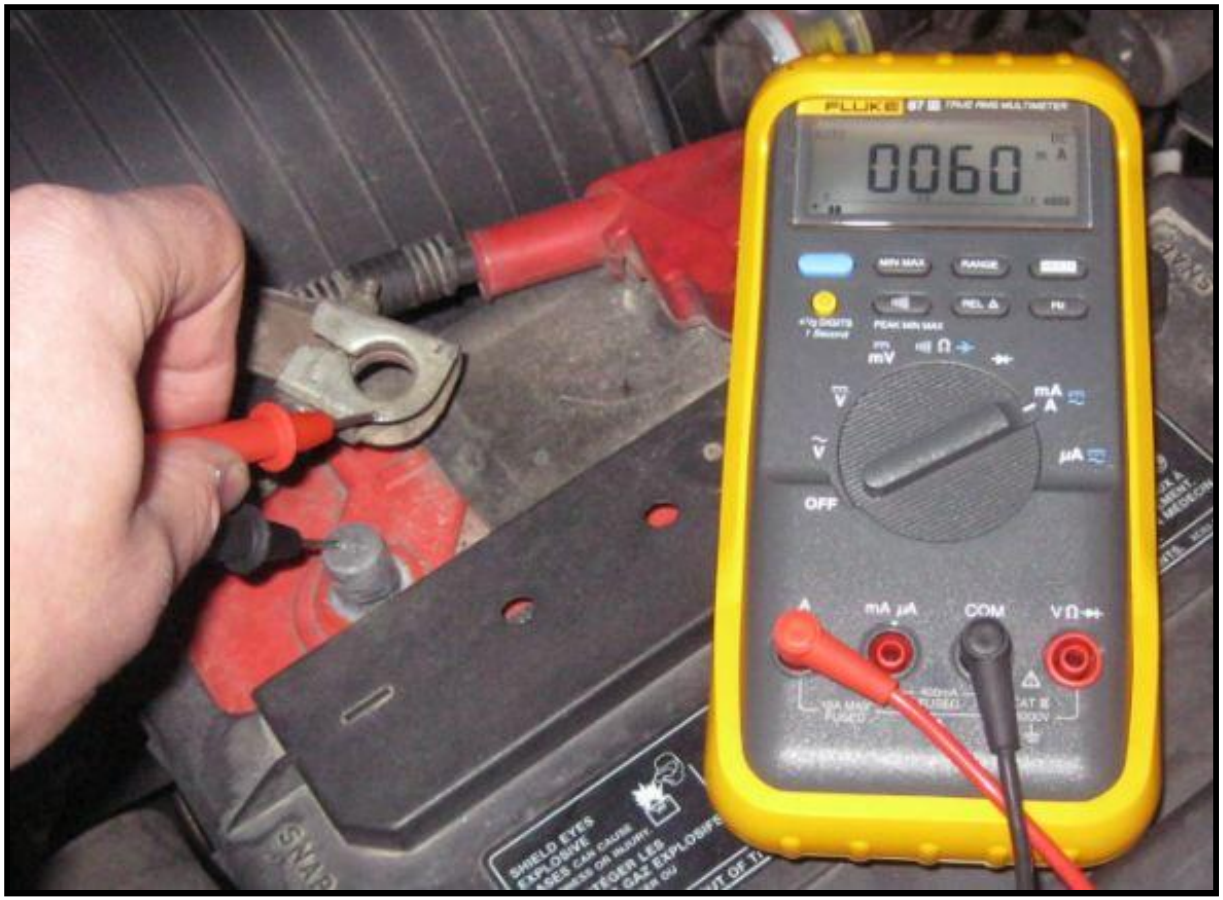


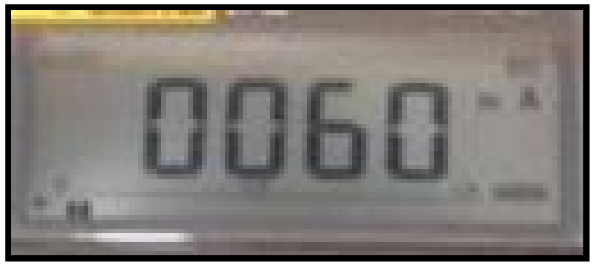
Paralytic
Parasitic
Paramedic

ATASA 5th Batteries

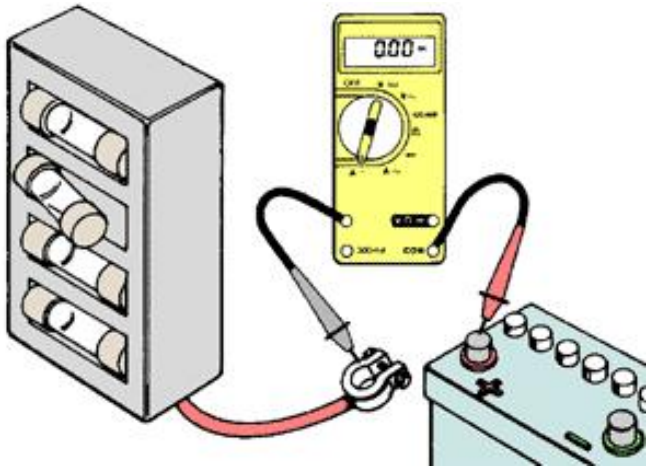
47. A normal <u>parasitic load</u> is about: [ ] 3 mAmp [ ] 30 mAmp [ ] 300 mAmp [ ] 3.0 Amps

Modules have "wake-up times" to periodically monitor conditions, these are planned parasitic loads.



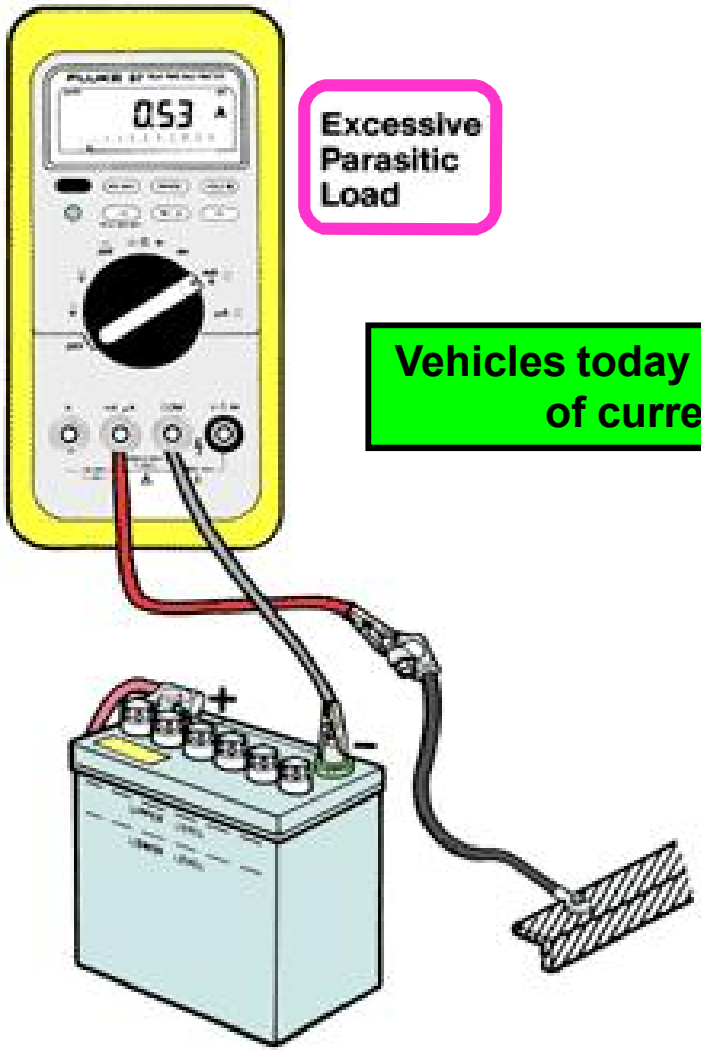


Excessive Parasitic Load



ATASA 5th Batteries

48. Parasitic load is determined by placing an ammeter in _____ with the negative battery cable or by placing a low current _____ probe/clamp around the negative cables.



Parallel, Inductive
Parallel, Conductive
Series, Inductive

Vehicles today typically will draw less <u>than .020 amps</u> (20 milliamps) of current to maintain electronic memories & circuits.

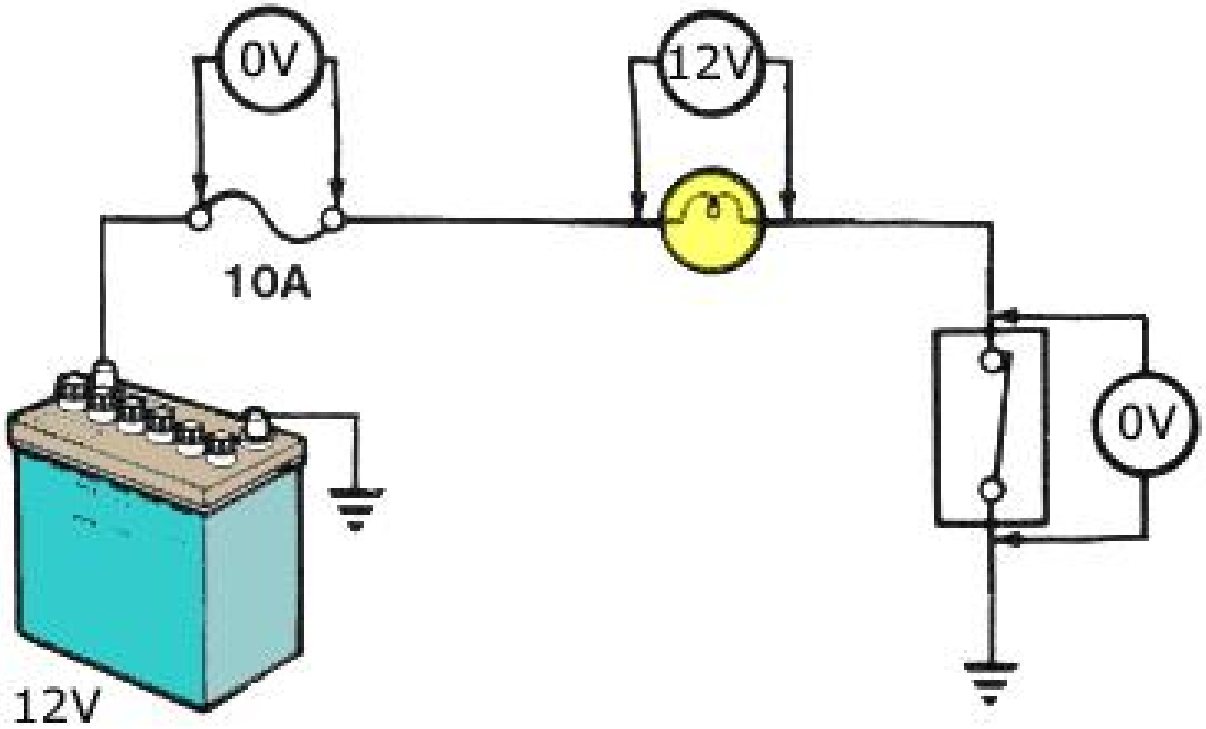
Several devices on a modern vehicle are continuously using small amounts of current to function and retain their memory. Usually, about <u>30mA</u> is all that is necessary to maintain the computer memory after all the various accessories and modules are inactive. This can vary - check the service manual for the vehicle in question.

ATASA 5th Batteries

49. Poor connections and corrosion of cables will cause voltage _____.

Drops
Drips
Increases

50. Test voltage drop under load.
The *normal VD range* is ___ - ___ for connections, wiring, switches



0.0 volts to .9 volts
.1 volts to .2 volts
.5 volts to 1.5 volts

ATASA 5th Batteries

51. Battery chargers are not all the same. There are _____ voltage chargers, _____ or intelligent chargers and slow or _____ chargers.

A trickle charger, also known as a battery trickle charger, is typically a low-current (500–1,500 mA) battery charger.

Constant, Smart, Trickle
Constant, Dumb, Tickle
Constant, Smart, Ripple

An intelligent or smart charger may monitor the battery's voltage, temperature and/or time under charge to determine the optimum charge current at that instant.

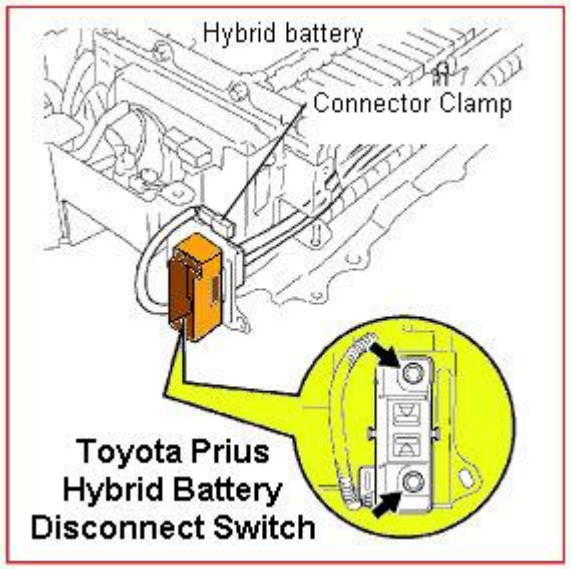
ATASA 5th Batteries

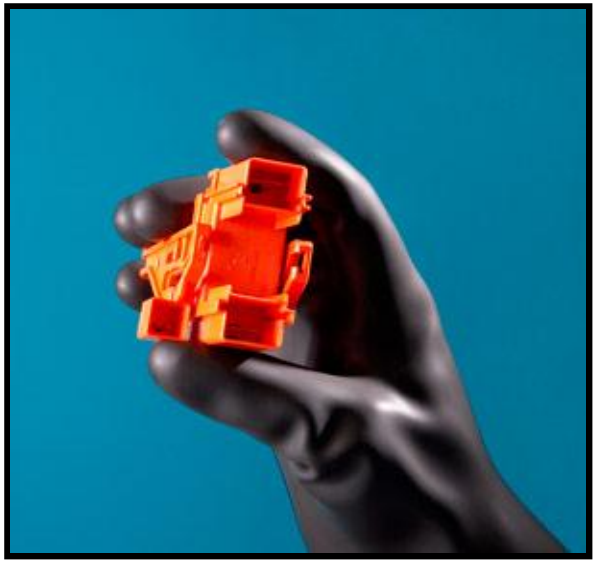
52. Intelligent chargers charge in 3 steps: _____, _____,& _____ rates.

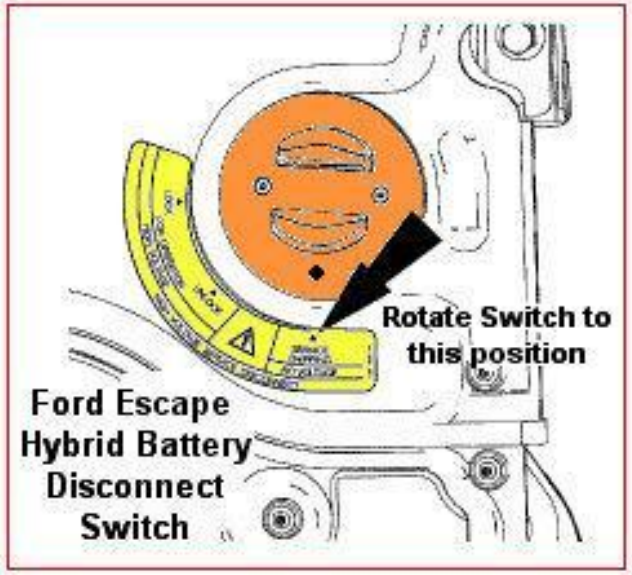
Bulk, Absorption, Float

ATASA 5th Batteries

53. Hybrid vehicles have an orange, high voltage service _____ plug to isolate the system.

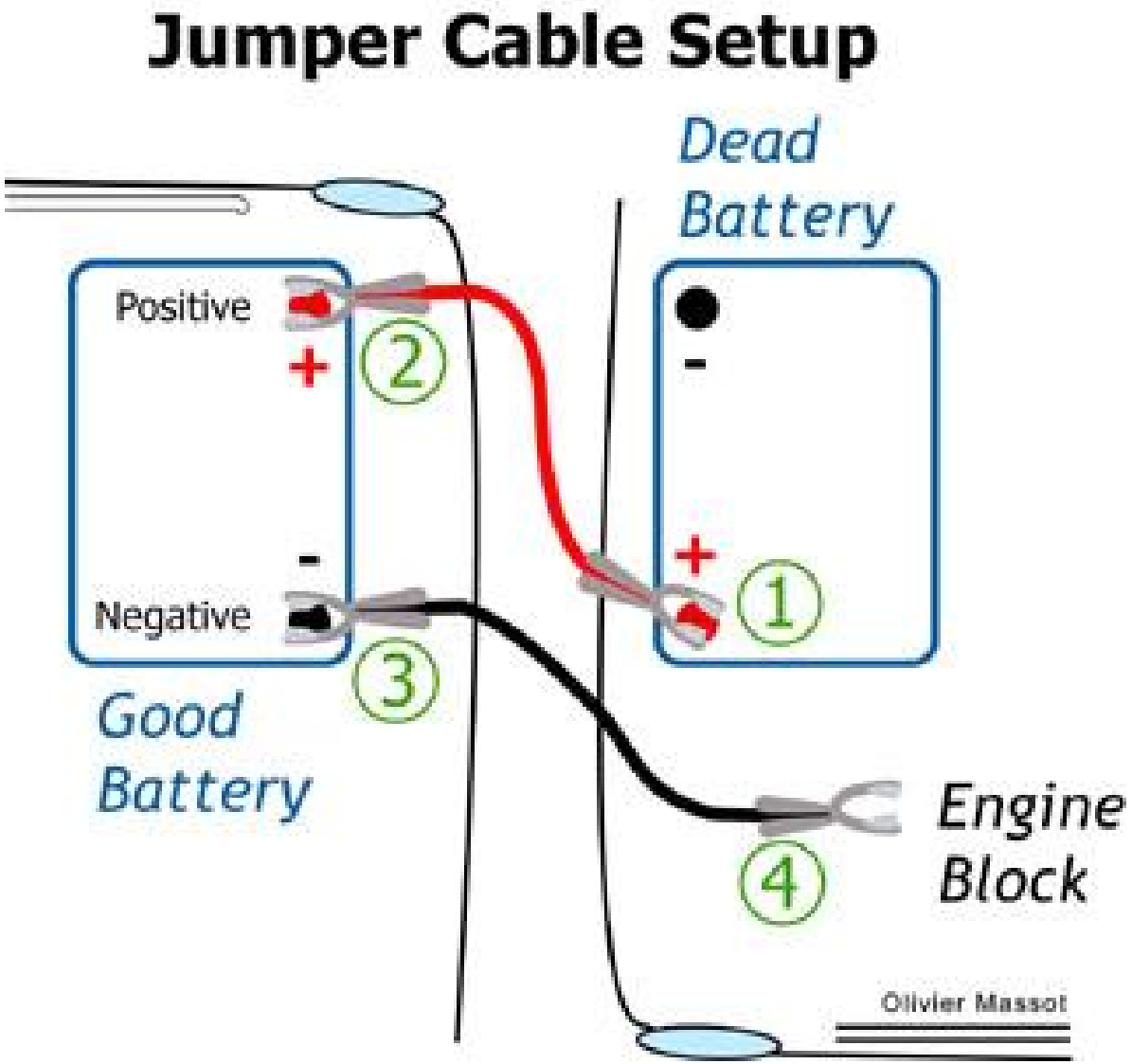






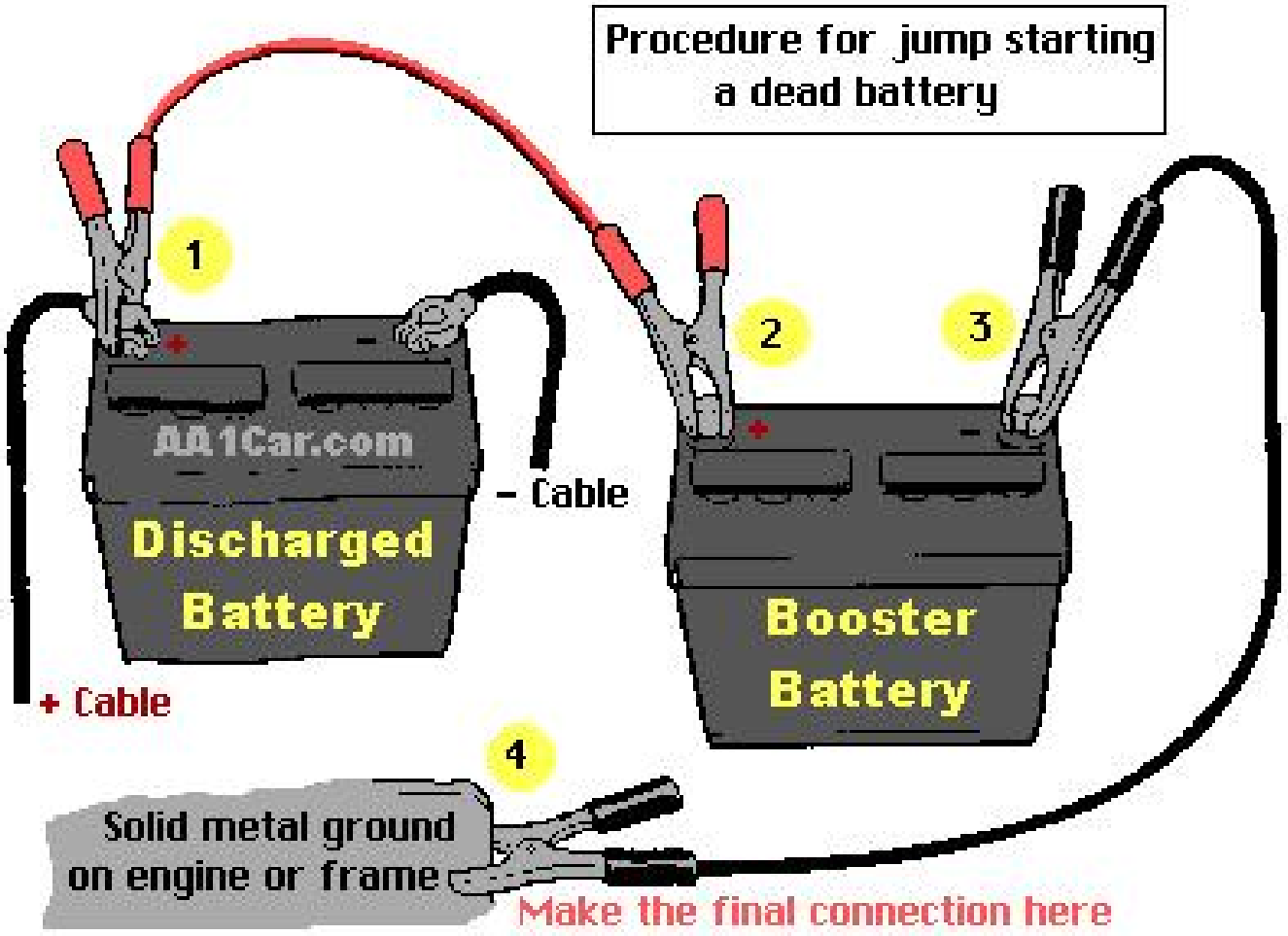
Connect
Disconnect
Reconnect

54. There is a proper sequence for making connections while jump starting.
True or False



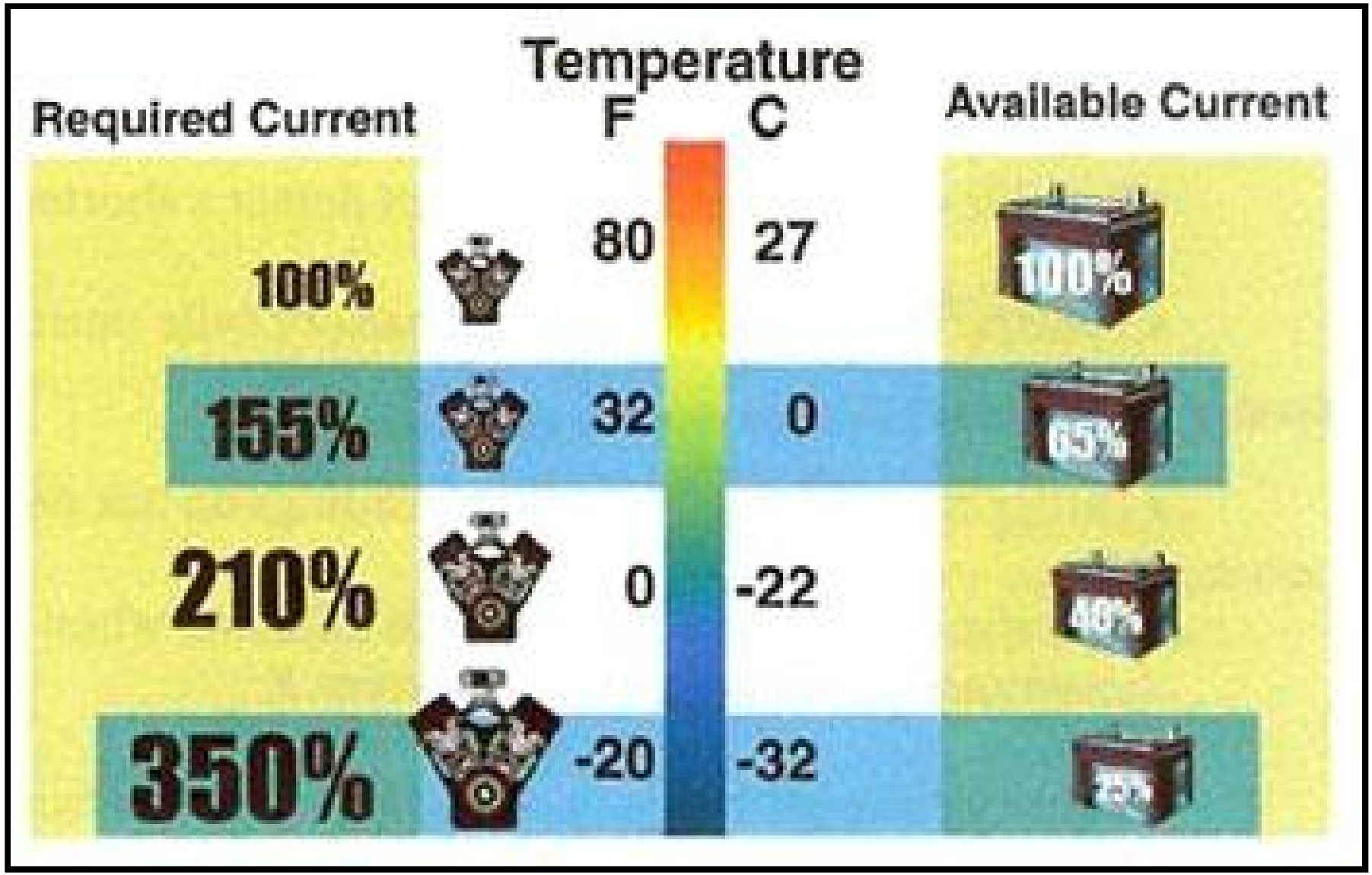
ATASA 5th Batteries

55. After a jumped vehicle is started, let it run for ____ minutes before disconnecting the booster. This puts less of a shock or strain on the jumped vehicle's charging system.



5 minutes
10 minutes
15 minutes

ATASA 5th Batteries



ATASA 5th Batteries

Fixed Load Testers

Both Lincoln fixed load testers are designed for simplicity and durability. They provide fast, accurate testing for both conventional and maintenance-free batteries.

Features:
- 6" color-coded pass/fail meters
- Vinyl-coated clamps
- Acid-proof, vinyl-coated steel cabinets
- Tests batteries, alternators, regulators and cables

Model M97275

- Dual load 275/225 AMP
- Tests 6 and 12 volt batteries

Model M97300

- Extra capacity 300AMP load
- Battery size compensation up to 900 CCA
- Battery Temperature Compensation

Carbon Pile Load Testers

Units designed for high-volume, large-capacity applications. Infinite load adjustments provide fast, accurate test for batteries, alternators, regulators, starters, cables and more.

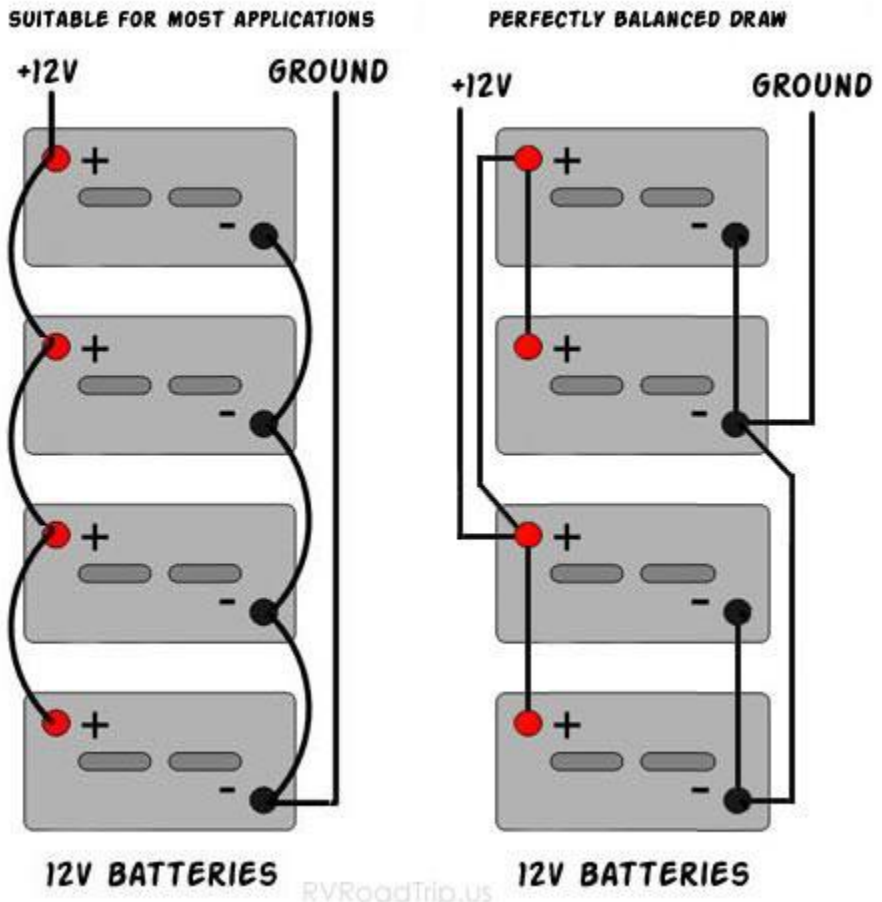
Features:
- Large color-coded pass/fail voltmeter
- AMP meter shows both load AMPs and CCA
- Temperature compensation

Model M97500

- 500 AMP carbon pile load
- Tests 6 and 12 bolt batteries

Model M97800

- 800 AMP carbon pile load
- Tests 6 and 12 volt batteries
- Fan cooled



ATASA 5th Batteries

There are many Carbon Pile Load Testers

ATASA 5th Batteries

ATASA 5th Batteries

Midtronics has become the industry standard for battery testing by continuing to advance their testing technology and providing innovative product solutions. Why do the major automobile manufactures choose

Midtronics testers as required maintenance tools?

Only **Midtronics** offers patented ***conductance technology*** and the conductance testing advantages:

· **SAFE -** no load means no heat or sparks, so its safe for anyone to use anywhere.

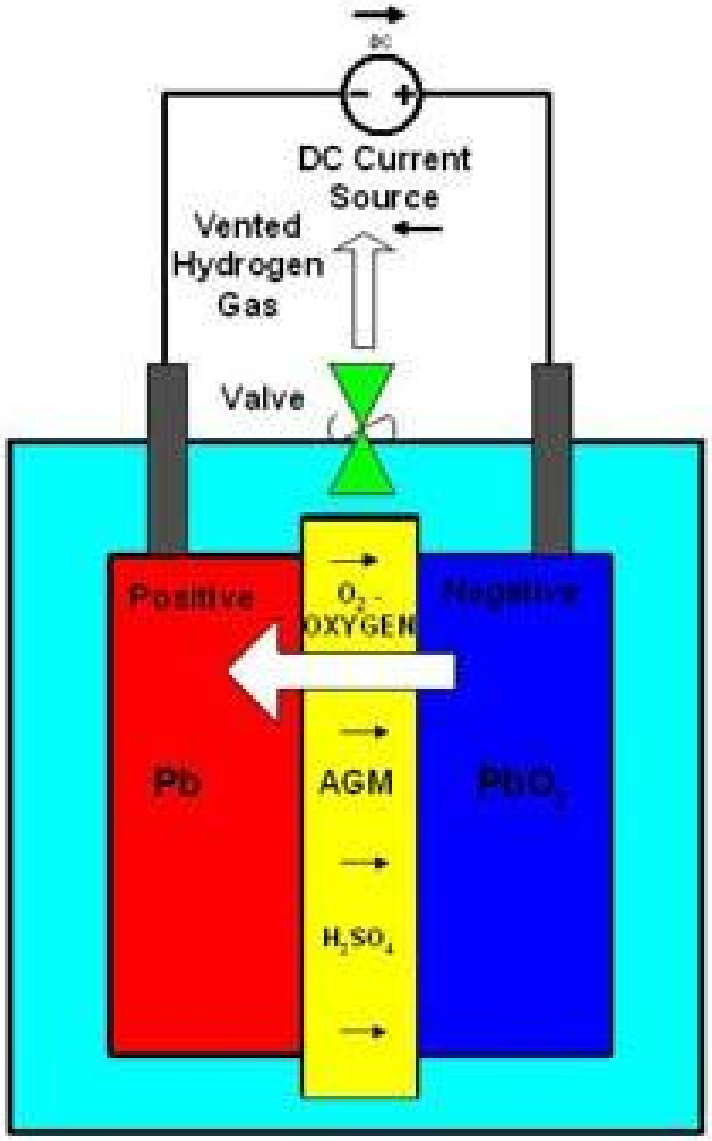
· **FAST -** no one can test a battery faster than Midtronics.

· **FRIENDLY -** easy to use and understand means more accurate testing.

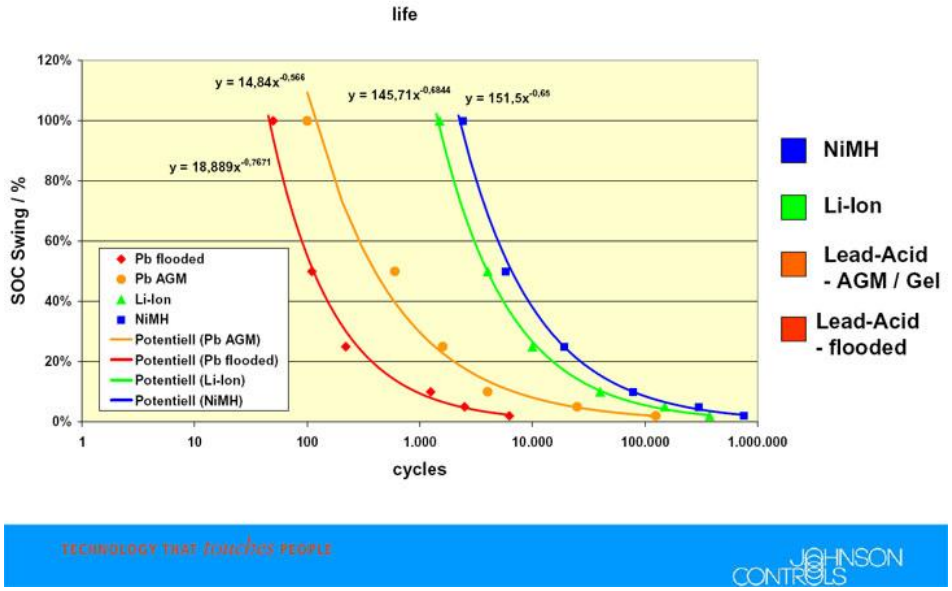
· **PORTABLE -** take it anywhere you need to test.

ATASA 5th Batteries

ATASA 5th Batteries

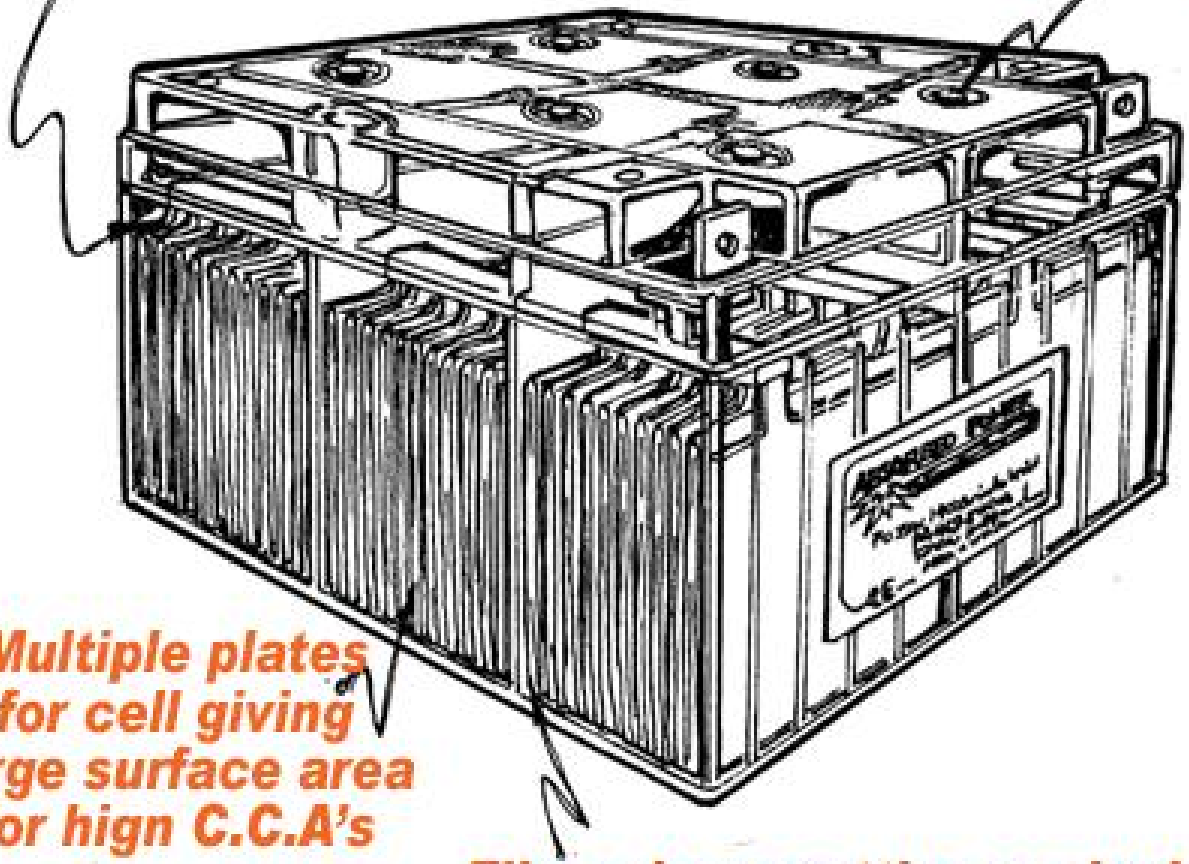


Absorbed Glass Mat Battery



Flooded-Cell & Gel-Cell Batteries

ATASA 5th Batteries

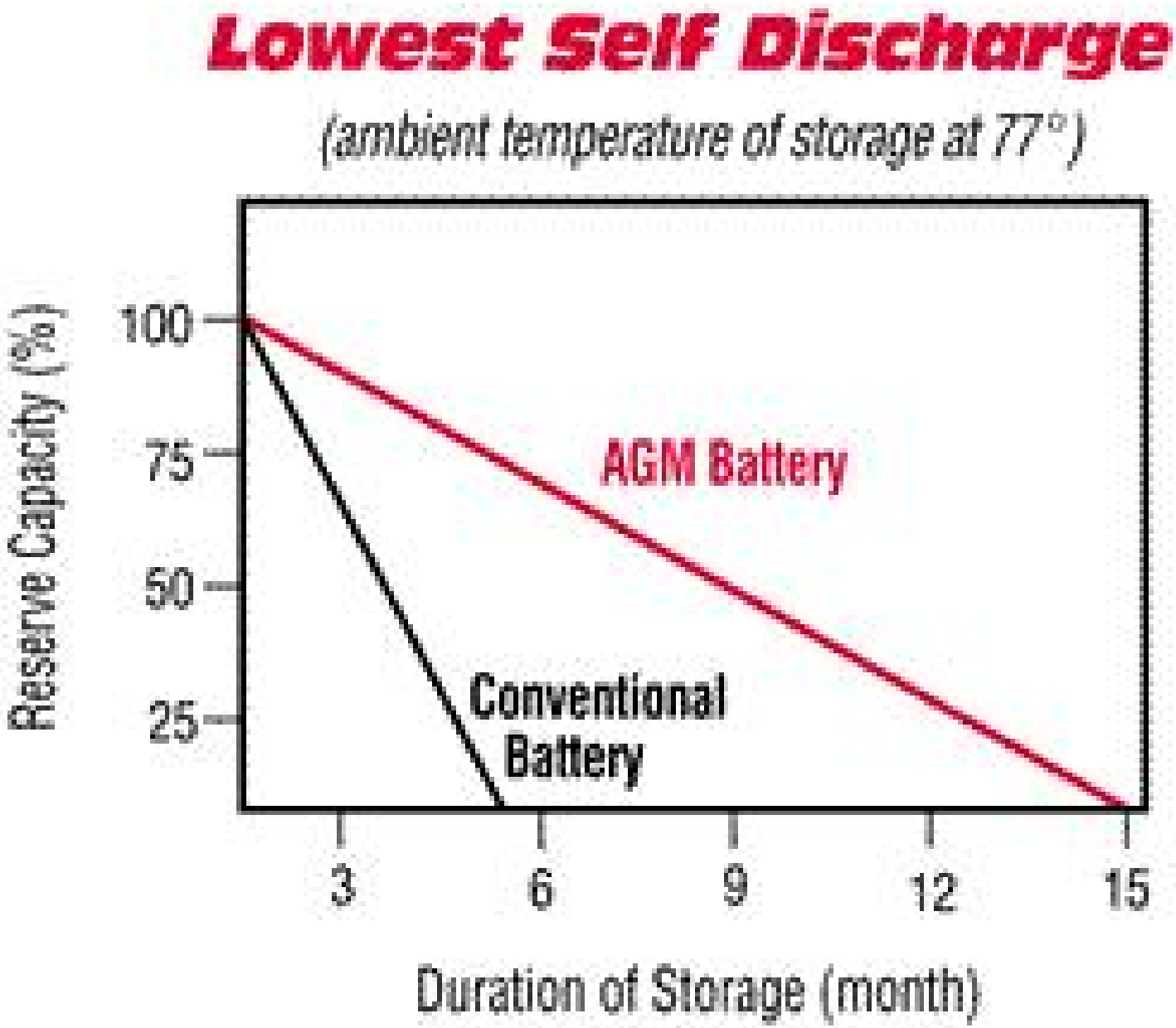


High lead mass for deep cycle capabilities

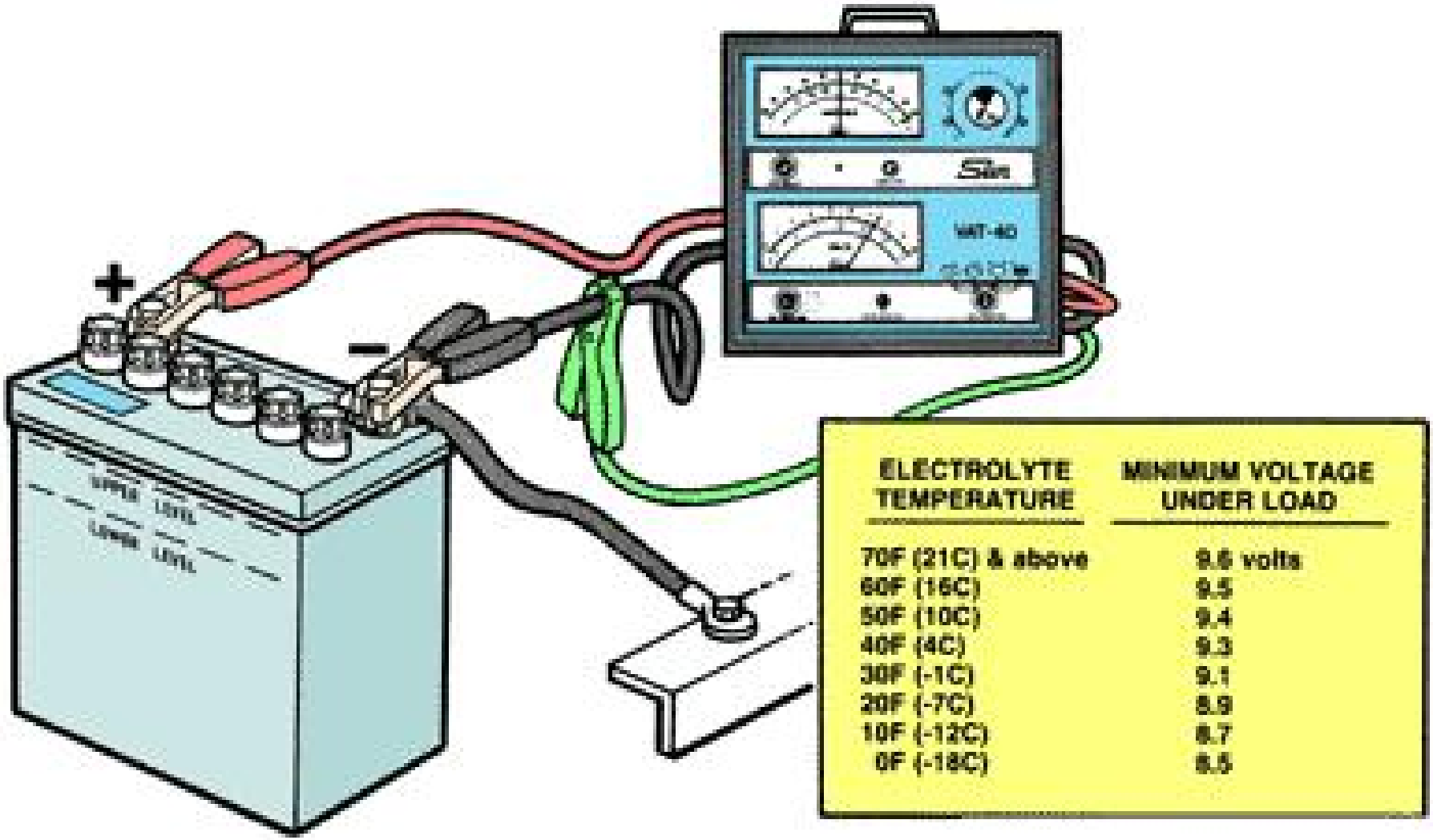
Over-charge pressure relief valves for safety (VRLA.)

Multiple plates for cell giving large surface area for hign C.C.A's

Fibre glass matting packed around & under all plates to allow acid "absorbtion" + vibration resistance


Lowest Self Discharge
(ambient temperature of storage at 77°)
Reserve Capacity (%)
100
75
50
25
AGM Battery
Conventional Battery
3
6
9
12
15
Duration of Storage (month)

ATASA 5th Batteries



ELECTROLYTE TEMPERATURE	MINIMUM VOLTAGE UNDER LOAD
70F (21C) & above	9.6 volts
60F (16C)	9.5
50F (10C)	9.4
40F (4C)	9.3
30F (-1C)	9.1
20F (-7C)	8.9
10F (-12C)	8.7
0F (-18C)	8.5