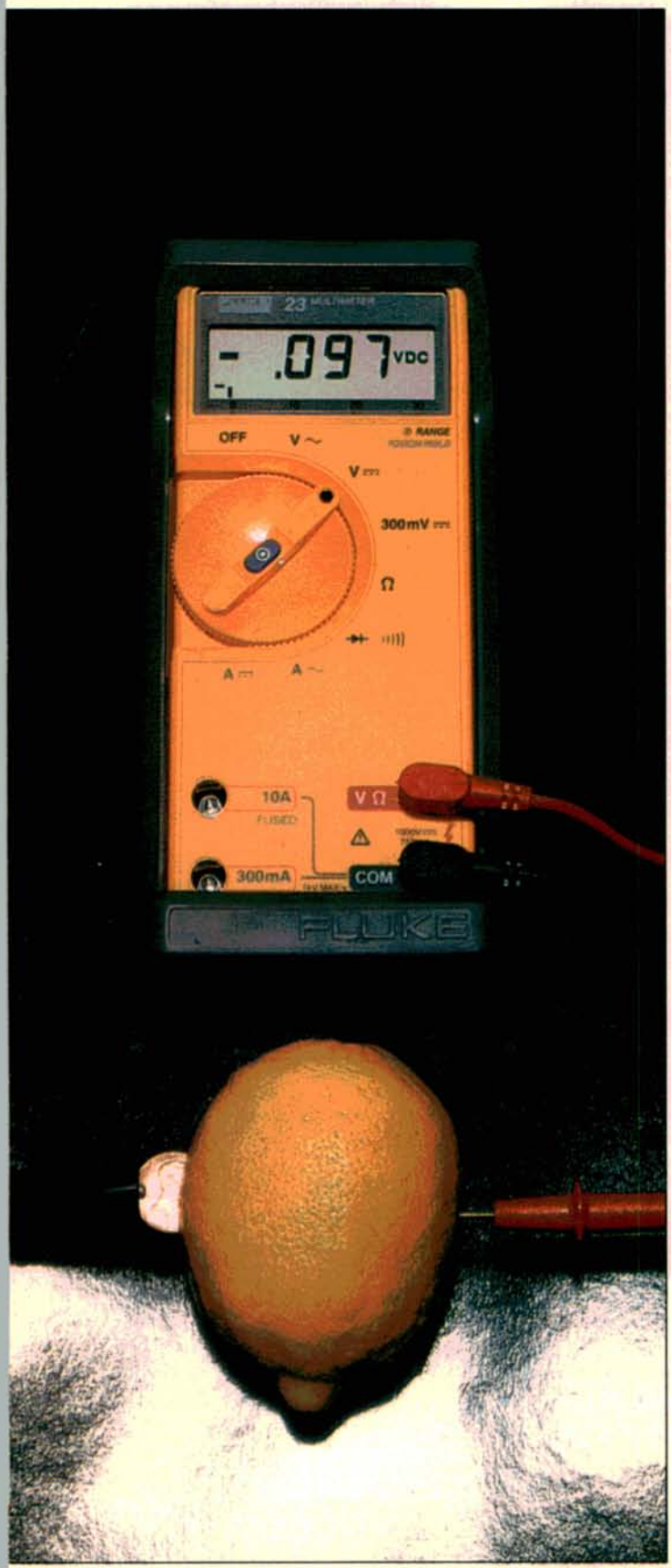

The car battery's a distant cousin to your old science-class penny-and-lemon unit. Here's how you test ''cous.''

TROUBLES

BATTERY SERVICE SAFETY

Sure, it's happened to a lot of us. Some of us remember seeing the spark, some of us don't. We all agree that it happened so fast, we were lucky to keep our wits about ourselves. Although we may joke about it today, those of us who've been splashed with battery acid and/or battery fragments will never forget the bang nor the stench and the burn of the acid nor the panic we felt as we ran for the water.

Admit it, many of us owe our eyesight to the grace of our favorite deity. No more, no less. Just be careful next time, 'cause lightning really can strike twice.

1. **DON'T SMOKE. Never smoke around any battery. Batteries give off hydrogen. Remember the Hindenburg?**
2. **PROTECT YOUR EYES. Always wear eye protection. No exceptions! This is acid. This can blind you. This is serious.**
3. **NEVER CHARGE A FROZEN BATTERY. Not even a little bit! Forget about the boost charger altogether. We're talking potential bomb here.**
4. **WASH YOUR HANDS AFTER THE JOB. It's awfully easy to get that acid on your fingers and then rub it in your eyes. It's no fun in cuts, either.**
5. **CONNECT THE GROUND WIRE LAST. Whenever you jump-start a vehicle, connect the ground wire last and do it away from the battery. A stray spark is as dangerous as that cigarette.**
6. **NEVER BEAT ON A BATTERY. Aside from the danger of throwing a spark, it's a battery, not an anvil.**
7. **USE A DAMP CLOTH. When charging a battery, place a damp cloth over the battery to protect it from stray sparks.**

HOOTING BATTERIES

Customer, start your engine! Click, click, click. There really isn't a good time for a dead battery, is there?

A no-start in freezing weather is a major-league annoyance. Add a costly road service to the icy air and you've got a totally frustrated customer. Heaven help the guy who charged that battery yesterday but didn't test it or the charging system properly and sent the customer on his merry way!

Visual Inspection

When you're troubleshooting a dead battery, begin by cleaning it and looking for case cracks or loose terminal posts. Also check for bowing of the case. Bowing often indicates frozen electrolyte because the electrolyte in a discharged battery is mostly water. Most—and we mean *most*—frozen batteries never recover their full power potential. If the case is bowed out, imagine what the plates look like. Don't take a chance, just replace it.

Removable-Vent Cap Batteries

A specific gravity test is always a good starting place on one of these. Remember to adjust your readings for any temperature variation from the norm of 80 degrees F. Add or subtract four points (.004) for each 10 degrees above or below 80 degrees.

If the cells are uniformly discharged, charge the battery using the accompanying chart (page 55) as a guide. Or, refer to those charts pasted on the sides of most good battery chargers. Uneven readings on a dead battery—say, five cells at 1.250 and one at 1.150—indicate a bad cell. If a variation of 50 points (.050) exists between any two cells, the battery is probably bad.

Don't overcharge or undercharge a battery. If you compare it to steak, we're looking for well-done, not raw or burned to cinders.

If the electrolyte level is low in a battery already in service, add distilled water instead of electrolyte to the battery. Remember, water evaporates from the battery, not electrolyte. Adding electrolyte will give you a "rich" mixture. Sure, specific gravity readings will rise, but they'll be *false* readings. Also, it doesn't do the battery any good in the long run.

If the battery recharges and recharges evenly, remove the surface charge before load-testing. We want that steak or battery well-done, but not still sizzling! You can let the battery stand for a few hours to settle down. A faster way is to apply a 50-amp load to it for five seconds.

Next, load-test the battery to three times its amp-hour rating or to *half* its cold-cranking amps (CCA) rating for 15 seconds. At the end of the 15-second interval, battery voltage must be 9.6 or more at 70 degrees F.

Sealed-Top Batteries

These batteries take a little more time and patience than removable-cap types do. Since you can't start with a specific gravity test, your voltmeter is your best friend here. A battery that's reading less than 12.4 no-load volts must be recharged before it's load-tested. If and when the battery reaches 12.4 volts, knock off the surface charge and load-test it. Use the same numbers and procedure you used for the removable-cap battery

When to Sell a New Battery

While you don't want to replace every dead battery you see, there are times when you'll have to make judgment calls. In marginal cases, the cost of a battery outweighs the cost and inconvenience of a dead battery, period!

Besides, if a dead battery does fully recover, you need to know why it went dead in the first place. Is

there a current drain someplace? Is the alternator up to par? Does the battery have enough CCAs for the car and engine? Look for clues. Turn sleuth and find the real culprit.

Don't forget that the battery's only one part of an entire system. The entire system's got to work properly in order for each part to survive.

Go ahead, start that engine.

Battery Testing Procedures

Step 1: Visual Inspection

START HERE

Inspect Battery for Broken or Cracked Case and Damaged Terminals.

- Case Damage – Battery Unserviceable.
- No Visual Damage — Check Electrolyte Level.
  - Electrolyte Level Above Plates in All Cells – Proceed to Step 2.
  - Electrolyte Level Below Top of Plates in Any Cell – Add Water – Charge Battery. Proceed to Step 2.

Step 2: Hydrometer Test

START HERE

Test Battery with Hydrometer. Record The SP GR Reading for Each Cell, Temperature Corrected to 80°F.*

- 50 Points or More Difference Between Highest and Lowest Reading – Battery Unserviceable.
- Less than 50 Points Difference Between Highest and Lowest Cell.
  - All Cells Above 1.225 SP GR – Proceed to Step 3.
  - If One or More Cells are Below 1.225 SP GR – Charge Battery.
    - If Unable to Obtain 1.225 SP GR – Battery Unserviceable.
    - If All Cells are 1.225 SP GR or Above – Proceed to Step 3.

*For every 10°F below 80°F, subtract 4 points (0.004) from the reading.
For every 10°F above 80°F add 4 points (0.004) to the reading.

Step 3: Load Testing The Battery

1. Battery must have at least 1.225 S.P.G.R. in all cells.
2. For 15 seconds apply a load equal to ½ the cold crank ampere (CCA) rating of the battery.
3. Observe the battery voltage at 15 seconds with the load on.

- Voltage Equal to or Above Chart Value — Return The Battery to Service.
- Voltage Below Chart Value — Replace The Battery

CHARGING PROCEDURE

CAUTION: Wear safety glasses — Battery charging can be dangerous. While being charged, a battery produces a potentially explosive mixture of hydrogen and oxygen gases. Keep sparks, flames and lighted cigarettes away from batteries. The charging area should be well-ventilated. Remember the battery contains SULFURIC ACID. In case of acid contact with the skin, eyes or clothing, FLUSH IMMEDIATELY WITH LARGE AMOUNTS OF WATER. Get medical attention.

1. Preparation of battery — Adjust the level of electrolyte, if necessary, to ⅜" above the top of separators by adding water. DO NOT OVERFILL.
2. Attaching the battery — Attach the battery to be charged to proper leads from charger. Follow instructions and recommendations of charger manufacturer.
3. Charging rate — Almost all battery recharging is done by the use of "fast chargers." Maximum charging rates that should be used, depending on the condition of the battery, should be in accordance with manufacturers' recommendations.
4. Charging Time — The charging time depends on the ampere-hour capacity of the battery, the voltage, battery temperature, and the amount of discharge at the time of charging. The temperature of the battery electrolyte should not exceed 125°F during charging.

Follow the recommendations supplied by your charger manufacturer. If they are not available, use the accompanying table.

VOLTAGE CHART

ESTIMATED ELECTROLYTE TEMPERATURE	MINIMUM REQUIRED VOLTAGE UNDER 15 SEC. LOAD*
70°F (21°C) & Above	9.6
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

*USE ½ THESE VALUES FOR 6 VOLT BATTERIES.

CHARGING TIME IN MINUTES*

Percent State of Charge	Starting Specific Gravity	Based on Starting Charge Rate of 20 Amperes: 20 AH Or Less	25 AH	30 AH	35 AH	Based on Starting Charge Rate of 40 Amperes: 40 AH	45 AH	50 AH	55 AH	60 AH	65 AH	70 AH	75 AH	80 AH	90 AH	100 AH	110 AH
BATTERY SIZE IN AMPERE HOURS**																	
80	1230	12	16	20	23	14	15	17	19	21	22	24	25	27	28	30	34
60	1200	26	33	40	46	27	30	33	36	39	42	45	48	54	62	67	75
40	1170	40	50	59	63	40	45	51	55	60	64	70	75	83	93	105	115
30	1155	46	58	69	81	46	52	58	65	70	76	82	88	97	109	121	135
20	1140	53	66	79	92	54	60	67	74	81	87	95	100	110	121	135	147
10	1125	59	74	89	104	60	67	75	83	90	98	105	112	121	136	151	166
0	1110	66	82	99	115	67	76	85	94	103	112	120	127	135	151	168	186

*For battery temperatures below 32°F increase time by 20 minutes.

**To estimate a battery's 20 hour ampere hour capacity, multiply the reserve capacity (RC) rating by 0.60.

Caution: Do not attempt to charge a frozen battery. Allow the battery to warm to 60°F before placing on charge.