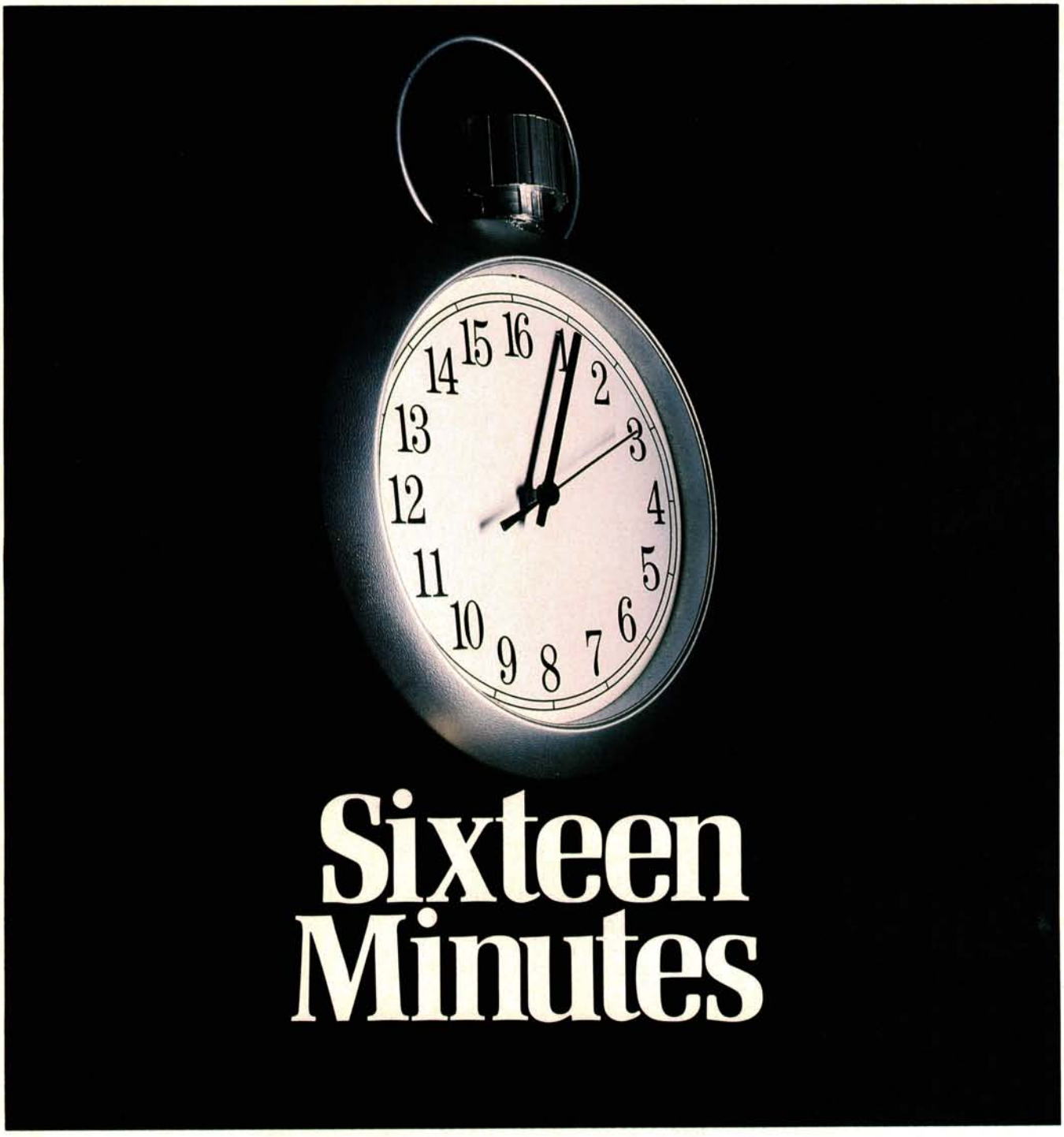


Sixteen Minutes

Have you ever been to the doctor's office, only to have him turn you over to the nurse for some tests before you even have a chance to discuss your problem with him? Then, when all the tests are completed you have about two minutes to talk to him before he heads out for a round of golf? This type of treatment can be annoying, but the tests themselves are very important. The doctor needs information, very basic information about your general state of health before he can determine the exact cause of your illness. The same thing applies to your own diagnostic procedure for electrical problems.

You're the Doctor

When a car comes in with an intermittent (or just plain weird) electrical problem, your first inclination may be to look for the specific cause of the problem,

without running a battery of basic tests. We'll assume that you're not golfing today, and as a result, have enough time to properly discuss the symptoms of the problem with the customer. But once that's done, the next step should be to check the basics: the heartbeat, pulse, blood pressure, and temperature of the electrical system. That way low voltage, a voltage drop on the ground side of the circuit, a weak battery, or insufficient charging rate won't be overlooked as potential causes for the problem.

Sixteen Minutes

Many of these tests have been shown one or two at a time over the past few years in various electrical articles in these pages. But rather than have you hunt through all those old articles looking for a specific test, we've decided to assemble them in one convenient battery of initial tests. These sweet 16 quick tests can be done with simple, inexpensive tools. And since temperature plays such an important role in electrical system operation, some of the tests are done with the engine cold, some with the engine hot.

The tests are fast and easy. Many, if not most, electrical problems are BASIC problems, so you can save yourself a lot of lost motion by eliminating the obvious.

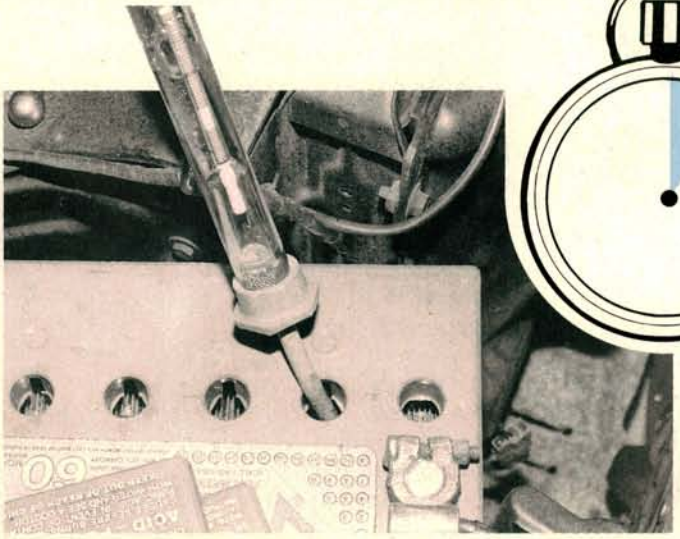
Just to prove my point about these tests being fast and easy, I had the guys at *Import Service* go through this battery of tests on several vehicles, equipped with nothing more than my instructions, a DVOM, and a battery hydrometer. On an average, it took them about a minute for each test, although some were much quicker than that. Compare that to hours spent chasing your tail when a fundamental electrical problem affects all the circuits in the car, and it becomes time well spent.

—By Vince Fischelli

Check Number 1—Check Battery Terminal Post Voltage

DO THIS: With the engine OFF and ignition key OFF, place the DVOM probes across the battery terminals. Do not use an analog meter, it isn't accurate enough. (Beware of surface charge. This is the one possible exception to our 16 minute rule. If the battery was just charged, you'll have no choice but to let the battery sit for about 15 minutes to dissipate any surface charge.)

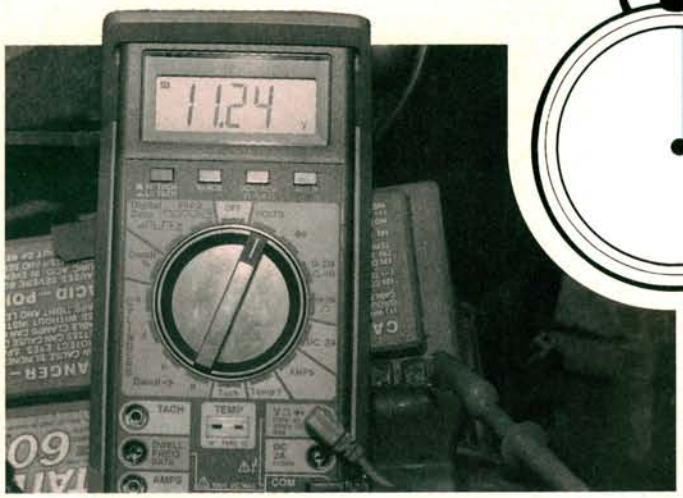
EXPECT THIS: A good battery will read 12.66 volts (fully charged) or 12.45 volts at 75 percent of full charge. A reading of less than 12.45 volts indicates a weak battery charge, low charging voltage, a key off battery drain, or maybe even a car that isn't being driven enough to keep the battery charged.



Check Number 2—Check Specific Gravity of Each Cell

DO THIS: If the battery voltage is less than 12.66 volts, check the specific gravity of each cell using a battery hydrometer. This will tell you if a battery with a low post voltage is defective, or is simply at a low state of charge.

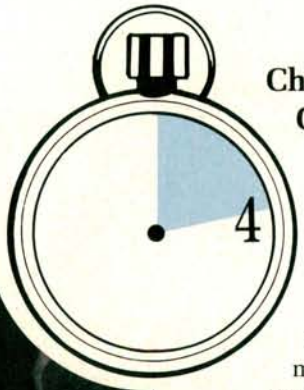
EXPECT THIS: Each cell should have a specific gravity of 1.225-1.270. Look for a cell as much as 50 points lower than the others as an indication that the cell is bad. A bad cell means a bad battery. On sealed top batteries you can't check specific gravity. Just hope for the best when a sealed top battery terminal post voltage is between 12.45 and 12.66 volts.



Check Number 3—Check Battery Voltage During Cranking

DO THIS: Place the DVOM leads across the battery terminals, and crank the engine. If possible, measure the temperature of the battery water. On sealed tops, guesstimate the approximate temperature. (For example, if the car has been indoors all night, use room temperature.)

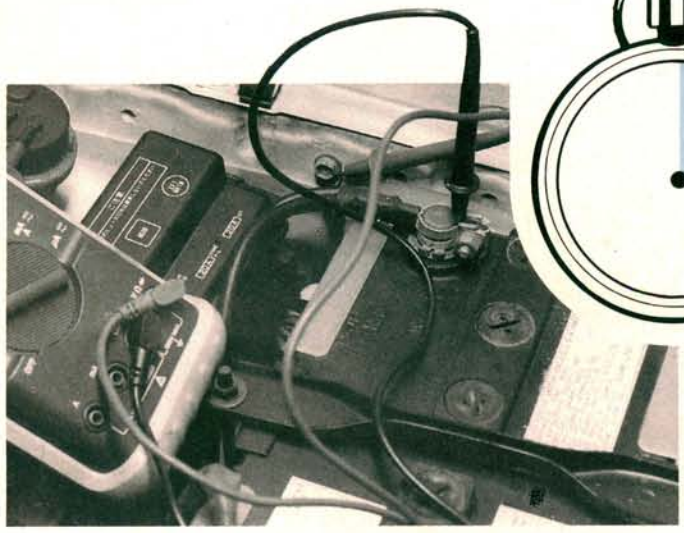
EXPECT THIS: At 70 degrees F, the cranking voltage should not drop below 9.6 volts on a 12 volt system. A reading below 9.6 indicates a weak battery, dragging starter motor, or mechanical resistance. For each 10 degrees F above 70 degrees F, add 0.1 volt to the minimum allowable reading. For each 10 degrees below 70 degrees F, subtract 0.1 volt.

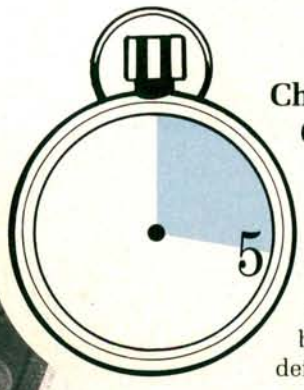


Check Number 4—Check Engine Ground Voltage Drop

DO THIS: Place the DVOM leads between the battery negative terminal and a clean, shiny spot on engine block. Crank the engine.

EXPECT THIS: If the engine ground is good, the measured voltage drop will be below 0.1 volt. A reading above 0.1 volt indicates high resistance, usually caused by a loose or corroded connection. Do not accept a voltage drop greater than 0.3 volt.





Check Number 5—Check Accessory Ground Voltage Drop

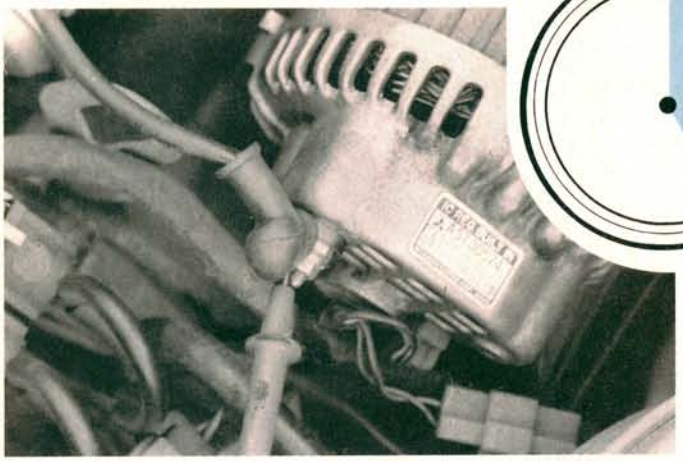
DO THIS: Place the DVOM leads between the battery negative terminal and the metal which makes the accessory ground (the fender well for example). With the engine OFF and the key ON, turn on all the normal accessory loads (high beams, A/C high blower, high speed wipers, rear defroster, and so forth).

EXPECT THIS: Look for a maximum voltage drop of 0.1 volt. A reading above 0.1 volt indicates high resistance usually caused by corrosion or a loose connection. Do not accept a reading above 0.2 volt. Once again, loose or corroded connections will be the most likely cause of a higher than normal voltage drop.

Check Number 6—Check Charging Voltage at the Battery Terminals

DO THIS: Place the DVOM test leads across the battery terminals with the engine running at about 1500 RPM to check the charging voltage.

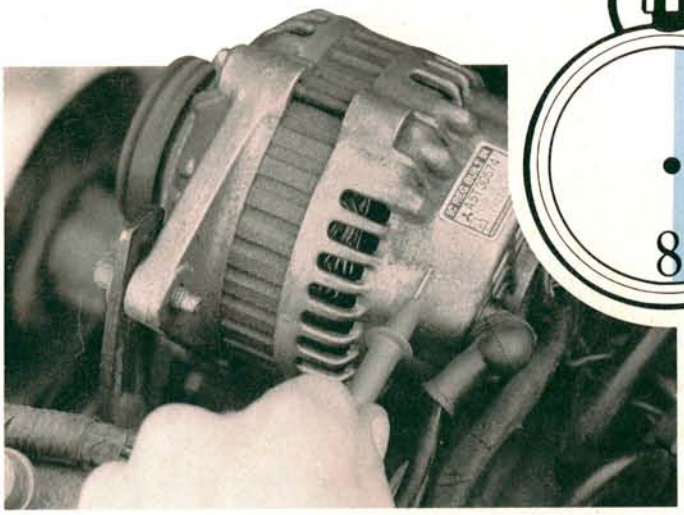
EXPECT THIS: If the charging rate is correct, you will get a reading in the 13.8 to 14.5 volt range. Charging voltage will be slightly higher in cold weather, lower in warm weather. Allow for temperature variations when checking charging voltage.

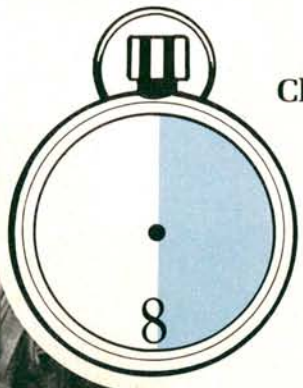


Check Number 7—Checking the Voltage Drop of the (+) Side of the Charging System

DO THIS: Place the DVOM test leads between the battery (+) terminal and the BATT (output) terminal of the alternator. Run the engine at 1500 RPM with accessory loads turned OFF.

EXPECT THIS: In this case the maximum allowable voltage drop is 0.3 volt. Do not accept more than 0.5 volt. Corrosion has begun to degrade the voltage side of the charging system. Clean the connections and retest.





Check Number 8—Check the Voltage Drop of the (-) Side of the Charging System

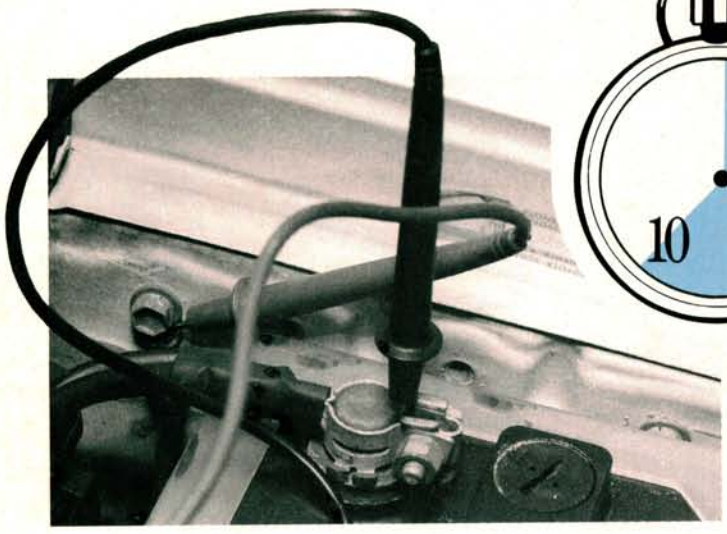
DO THIS: Place the DVOM test leads between the battery (-) terminal and the ground terminal of the alternator. Continue to run the engine at 1500 RPM with accessory loads OFF.

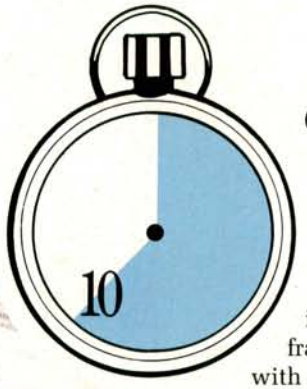
EXPECT THIS: When testing the (-) side of the charging system, the maximum allowable voltage drop is 0.1 volt. Do not accept more than 0.2 volt. Readings higher than 0.2 volt indicate a bad connection, and it's usually caused by—you guessed it—a loose or corroded connection.

Check Number 9—Check Engine Ground Hot Voltage Drop

DO THIS: Place the DVOM leads between the battery negative terminal and the engine block to verify that a good engine ground still exists when the engine gets hot. Let the engine run at 1500 RPM during the test. This is an important step since this is also the ground circuit for some sensors.

EXPECT THIS: The allowable voltage drop for this test is 0.1 volt. Do not accept a reading above 0.2 volt.

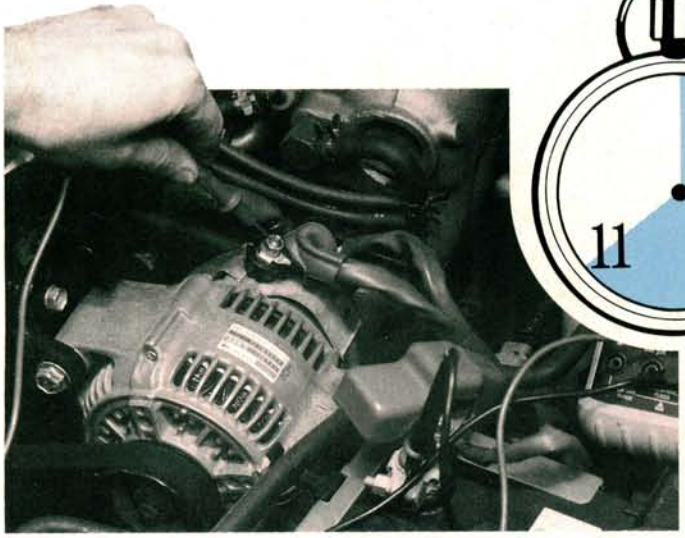




Check Number 10—Check Accessory Ground Hot Voltage Drop

DO THIS: Place the DVOM test leads between the battery negative terminal and the metal providing the accessory ground (fender well, bulkhead, frame rail, etc.), then check the hot accessory ground with accessories turned ON as in Check 5. Let the engine run at 1500 RPM once again. This is also a ground circuit test for some sensors.

EXPECT THIS: The allowable voltage drop for this test is 0.1 volt and should be less than the reading we got when we performed the same test cold back in Check Number 5. Again, don't accept any reading above 0.2 volt without finding and correcting the cause of the high resistance.



Check Number 11—Check the Hot Voltage Drop of the (+) Side of the Charging System

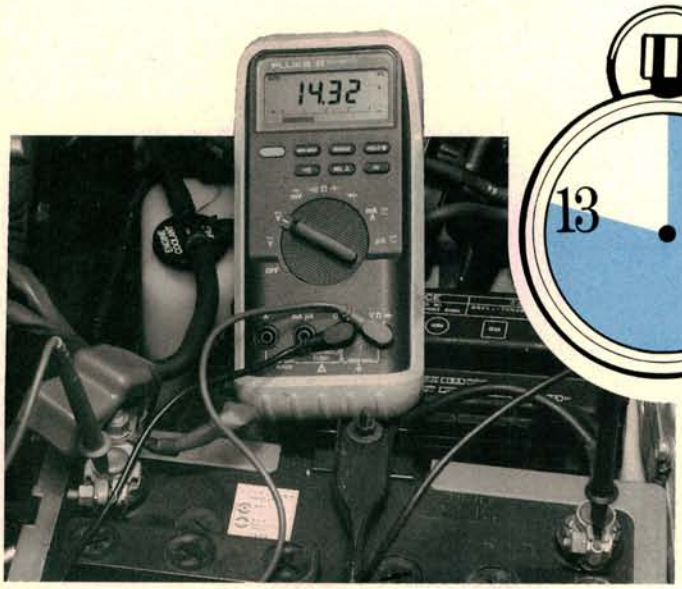
DO THIS: Place the DVOM test leads between the battery (+) terminal and the BATT (output) terminal of the alternator to verify a good connection when hot. Run the engine at 1500 RPM with accessory loads OFF.

EXPECT THIS: In the (+) side of the charging system, a maximum 0.3 volt drop is acceptable. Do not accept a drop over 0.5 volt.

Check 12—Check the Hot Voltage Drop of the (-) side of the Charging System

DO THIS: Place the DVOM test leads between the battery (-) terminal and the ground terminal of the alternator to verify a good ground connection when hot. Run the engine at 1500 RPM with accessory loads OFF.

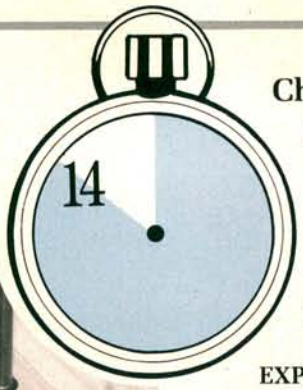
EXPECT THIS: The maximum voltage drop should be 0.2 volt. Do not accept more than 0.2 volt.



Check 13—Check For Normal Charging Voltage at the Battery Terminals—Hot Engine

DO THIS: Place the DVOM test lead across the battery terminals with a hot engine running at 1500 RPM with accessory loads OFF to check charging voltage.

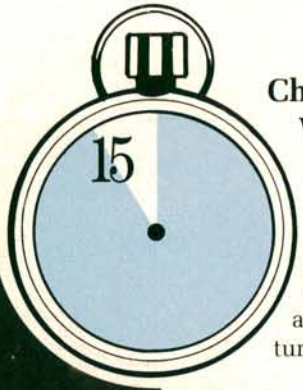
EXPECT THIS: Look for a charging rate of 13.8-14.5 volts. Charging voltage is higher in cold weather, lower in warm weather. The reading should be a little higher than it was in Check 6, since the battery is charged up and doesn't load the alternator down as much.



Check 14—Check For Undercharge Under Full Accessory Load—Hot Engine

DO THIS: Place the DVOM test leads across the battery terminals with all accessories ON (as in Checks 5 and 10). Run the engine at 1500 RPM to check for an undercharge condition.

EXPECT THIS: The charging voltage will be lower under full accessory load, and should normally fall in the 13.1-13.5 volt range. Lower voltage readings will indicate a weak charging system or loose alternator belt. Lower charging may also be caused by a bad diode. In this case, AC current may be riding on top of the DC. Slightly higher readings indicate a strong charging system.



Check 15—Checking For Overcharge With No Accessory Load—Hot Engine

DO THIS: With the DVOM leads still connected across the battery terminals, and a hot engine still running at 1500 RPM, check to see if there is an overcharge condition with accessory loads turned OFF.

EXPECT THIS: Charging voltage will be higher with no accessory loads turned on, and should fall in the 13.8-14.8 volt range (higher when the weather is cold, lower when it's hot). Higher no-load charging rates (in the 14.8-15.0 volt range) indicate a slight overcharge. Above 15.1 volts, look for a bad voltage regulator or connection.

Check 16—Pull Computer Trouble Codes

DO THIS: At this point, proceed with your normal troubleshooting procedures. Access the computer trouble codes (or serial data if available) for the car with the assurance that a basic electrical fault is not causing your problem.

Don't forget the rest of your troubleshooting skills as you eliminate problems with individual circuits and components. And above all, don't forget to charge the customer for having the good sense to eliminate the obvious before chasing after more exotic causes for his problem.

Another shop may waste far more than 16 minutes by sidestepping these fundamental tests.