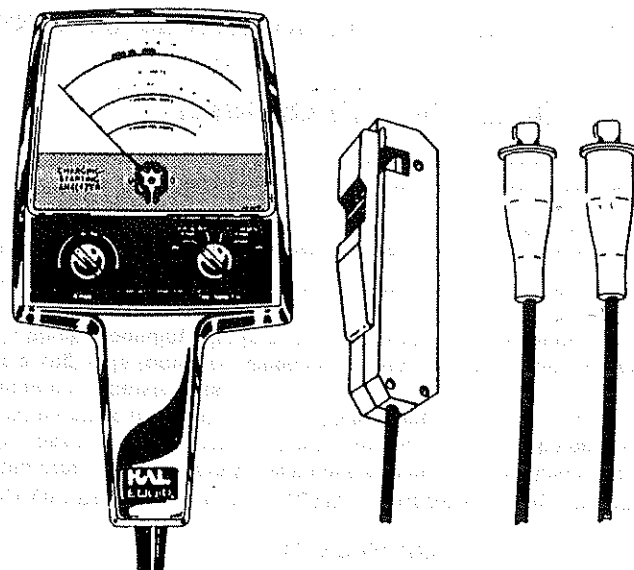


**OPERATING
INSTRUCTIONS**

PROFESSIONAL CHARGING- STARTING ANALYZER



WARNING!

IMPORTANT OPERATING & SAFETY NOTES . . . READ BEFORE PROCEEDING WITH TESTS

1. Always work in a well ventilated area . . . Never start a vehicle's engine in an enclosed area.
2. Never smoke or allow any other open flame to come within 25 feet of the vehicle being tested.
3. Always insure that everyone within close proximity of the vehicle being tested is correctly wearing approved safety/protective glasses before proceeding with any testing or adjustments.
4. Always insure that the vehicle's engine is turned off when connecting or disconnecting any and all test equipment.
5. Always insure that the tester's black grounding clip is connected first during hook-up, and that it is disconnected last when testing is completed.
6. Always exercise extreme caution to insure that hands, arms, clothing and tester leads are kept well away from all moving engine parts.

Due to the inherent dangers associated with even the simplest automotive maintenance procedures, the manufacturer and all parties involved in the distribution and/or sale of this automotive test product will NOT be held liable or responsible, wholly or partially, for any injuries, damages or claims resulting from the performance of testing or adjustment procedures included in this instruction guide and/or the use of this automotive test product.

IMPORTANT NOTICE

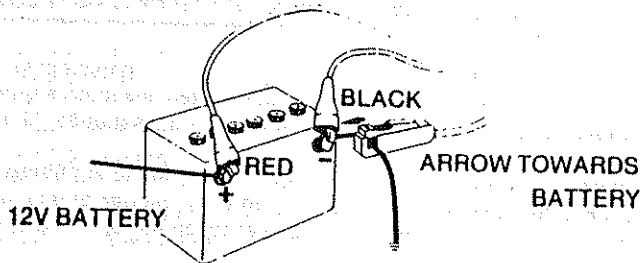
THIS INSTRUMENT DESIGNED TO BE USED ON VEHICLES WITH 12 VOLT ELECTRICAL SYSTEMS AND RESISTIVE IGNITION WIRE ONLY. (Carbon core)

THE TESTING PROCEDURES AND INFORMATION IN THIS MANUAL IS INTENDED AS A GENERAL GUIDE FOR ENGINE TUNE UP AND ADJUSTMENTS ONLY. ALWAYS CONSULT THE VEHICLE MANUFACTURERS SERVICE MANUAL FOR SPECIFIC PROCEDURES. DO NOT ATTEMPT TO SERVICE YOUR VEHICLE WITHOUT FOLLOWING THE VEHICLE MANUFACTURERS INSTRUCTIONS AND SPECIFICATIONS.

GENERAL HOOKUP FOR TESTING

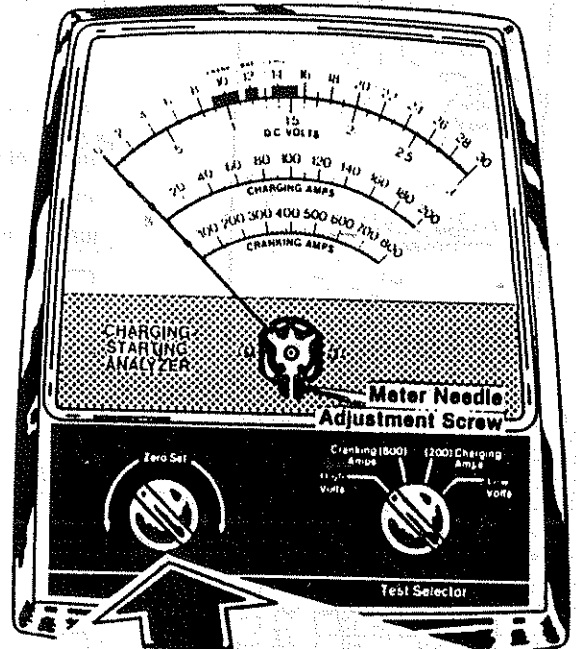
Connect black clip to battery negative (-) post and red clip to battery positive (+) post.

While holding the "Clamp-Amp" sensor away from any electro-magnetic source (alternator, etc.), place analyzer test selector in the "Charging Amps" position and adjust the Amp zero set knob until the meter pointer is at "0" on the "Charging Amps" scale. Clamp the "Clamp-Amp" sensor securely over the negative (-) battery cable, insuring that the arrow on the sensor is pointing towards the battery.



For Voltage tests, use High Volts for battery tests and Low Volts for voltage drop tests.

To test Amps, turn the selector switch to "Cranking" or "Charging" position. (The Clamp-Amp must be connected for Amp testing).



Use this knob to adjust "Amps" to read zero "0" Amps AND Readjust the Amps to zero "0" for each cranking or charging test.

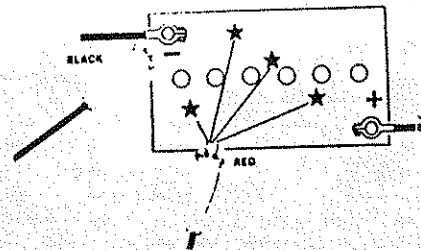
BATTERY TEST

BATTERY LEAKAGE TEST

With the engine off, place your tester's selector in the Low volts position.

Connect the black clip to the negative (-) battery post. Touch the red clip to various parts of the battery top and sides (but not the battery posts or cables) and watch the meter for any volts reading . . . it should read zero at each location.

A volts reading, regardless of how small, indicates leakage. . . to correct it, thoroughly clean the battery with a water and baking soda solution, and re-test. If there is still a reading, battery replacement is indicated.



BATTERY VOLTAGE UNDER LIGHT LOAD

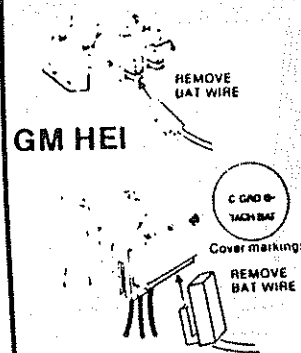
With analyzer in High Volts position, turn ignition switch, heater blower, and high beam headlights on for 30 seconds.

This 30 second preliminary test checks the battery's general condition. If the meter reads below the Battery Zone (under 11.5 volts) the battery will more than likely fail under heavy load tests to be performed later. If low, charge the battery (or replace if defective) before proceeding.

BATTERY CRANKING CAPACITY

To prevent the engine from starting during this test, you must disable the ignition system.

DISABLING IGNITION SYSTEM



Place selector switch in High Volts position to test volts and Cranking Amps position to test Amps.

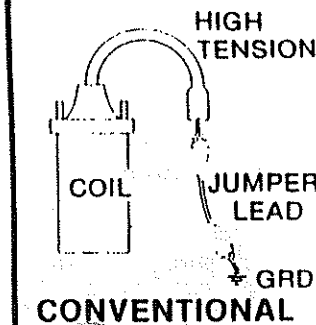
Crank the engine for about 15 seconds, so that you can check the voltage reading while the engine is being cranked.

The meter pointer should read between 9.5 and 11 volts for a 12-volt system, and between 4.7 and 5.5 volts for a 6-volt system. See Table 1.

If the reading is lower than that which is recommended, recharge the battery and repeat the above test. If the reading is again too low, either the cranking motor is drawing excessive current (amps) or the battery is defective. Perform the starter draw test to identify the problem.

If the meter reading is higher than that which is recommended, and the engine cranks slowly, proceed with the "Starting System Voltage Drop Test" to isolate the problem.

If the Cranking Volts reading is in the proper zone (9 volts or more) and the Cranking Amps reading is within limits, the battery and starting circuit is OK. See Table 2.



STARTER CURRENT DRAW TEST

If the Cranking Volts reading is below the proper zone and Cranking Amps reading is within limits or low, the battery is either discharged or defective. Charge the battery (or replace if defective) and re-check before proceeding.

If the Cranking Volts reading is below the proper zone and Cranking Amps reading is high, the problem is in the starting motor area.

If Cranking Volts reading is above the proper zone and Cranking Amps is low, excessive resistance such as poor connections, worn motor brushes, defective cables or solenoid is indicated. To isolate problem, make a Cranking System Voltage Drop Test.

TABLE 1.

AT TEMPERATURE	MINIMUM VOLTAGE
80°	9.6
70°	9.6
60°	9.5
50°	9.4
40°	9.3
30°	9.1
20°	8.9
10°	8.7
0°	8.5

TABLE 2.

ENGINE SIZE			AVERAGE STARTER DRAW
CUBIC INCH	CUBIC CM	LITER	10-SEC CRANKING AMPERAGE*
90	1469	1.5	95
120	1959	2.0	110
150	2450	2.5	125
200	3270	3.3	150
250	4100	4.1	175
300	4900	5.0	200
350	5740	5.7	225
400	6550	6.6	250
450	7380	7.4	275

STARTING SYSTEM VOLTAGE DROP TEST

Voltage drops are measured by connecting a voltmeter in parallel (across) the circuit section under test and then reading the voltmeter while the circuit under test is in operation.

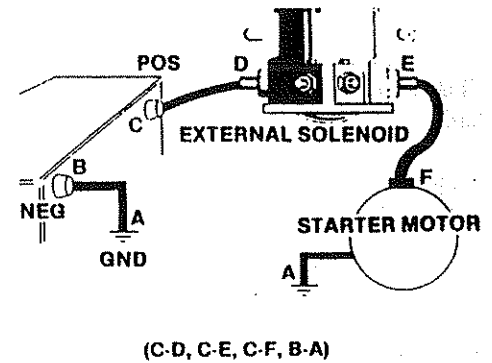
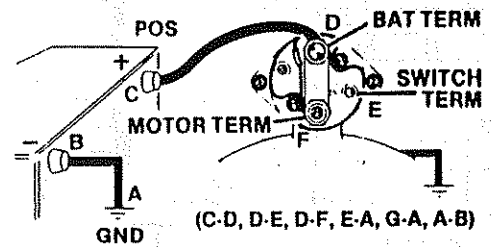
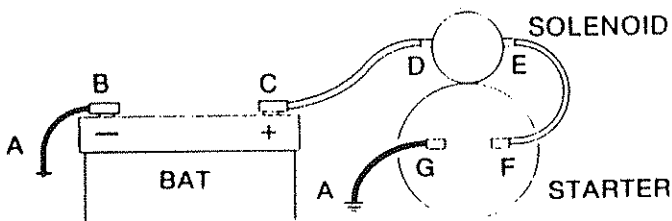
Place analyzer test selector in the Low Volts position.

Connect red clip to positive side and black clip to negative side of parts to be checked.

With Analyzer leads connected as described, crank engine and read meter. Readings should not exceed .2 volt (.5 volt on solenoid). If readings are high, part is bad or the connection is poor.

NOTE: Voltage Drop Test will also work on an engine that will not crank as long as the battery is fully charged and the ignition switch is allowing voltage to the solenoid.

EXAMPLES OF VARIOUS TEST POINTS
A TO B, C TO D, D TO E, E TO F, F TO G, G TO A, ETC.



CHARGING SYSTEM TESTS

Connect analyzer as shown in General Hookup for Testing, place test selector in the High Volts position and with all accessories off, run the engine for two (2) minutes at 1,800 RPM

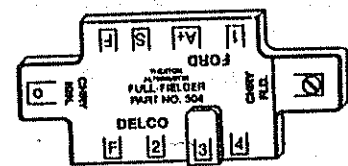
If the volt meter pointer climbs steadily and comes to a halt within a range from 13.1 to 15.5 volts for 12 volt systems, or 6.7 to 7.8 volts for 6 volt systems, the charging system can be presumed to be OK and further testing would be unnecessary. However, to determine the full output capacity of the alternator/generator it will be necessary to full field or bypass the regulator.

NOTE: If the voltage does not climb to 13.1 volts (12 volt systems) check and see if there is adequate charging current at 1800 RPM. When both the volts and the charging current remain low, this is an indication of battery trouble.

If the battery is good and voltage doesn't rise to 13.1 volts (12 volt systems) and the charging current remains low as the RPM is increased to 1800 RPM, this is an indication of alternator trouble.

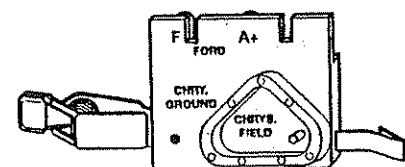
If the meter pointer climbs but stops either below the correct range or above the correct range, or if the meter pointer fluctuates and will not stop, the regulator is probably at fault. Check the battery and tension on all drive belts, look for loose, corroded or damaged battery posts. Look for poor connections at the battery, voltage regulator and alternator/generator. If they are ok, proceed with the alternator or generator test.

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**Full-Fielder
Alternator Test Adapter**

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**Full-Fielder II
Alternator Test Adapter**

ALTERNATOR / GENERATOR OUTPUT TEST

To isolate any problem, it is necessary to separate the regulator from the alternator or generator. Use the following method to bypass the regulator and make (full field) the alternator/generator produce its full rated current.

Turn on high beam headlights, heater blower, etc. for about two minutes. After this 2 minute period, insure that all accessories are turned off and take the regulator out of the system by one of the following methods.

NOTE: CONNECTIONS MUST BE MADE BEFORE STARTING ENGINE EXCEPT FOR GM DELCOTRON ALT. WHICH IS PERFORMED WHILE THE ENGINE IS RUNNING. The adapters will allow easy bypass of most systems.

To bypass the regulator, disconnect the regulator plug and connect the appropriate adapter. **IT IS IMPORTANT THAT THE MANUFACTURERS PROCEDURES BE FOLLOWED AT ALL TIMES.**

For Imported vehicles, refer to the manufacturers service manual. Generally, a Jumper lead from the regulator field terminal to the battery terminal will bypass (full field) the regulator, however extreme caution must be exercised to insure that the proper terminals are used to prevent damage to the alternator.

After the regulator is bypassed (full-fielded) place switch selector into the charging amps position. Start engine and slowly increase engine RPM to reach the alternators output rating.

Do not run this test for more than 20 seconds. Typical 12 volt system output ratings are 30-42 amps for non-airconditioned vehicles and 50-60 amps for air-conditioned.

Insufficient output rate indicates defective alternator or generator. If amps output is OK, regulator repair or replacement is indicated.

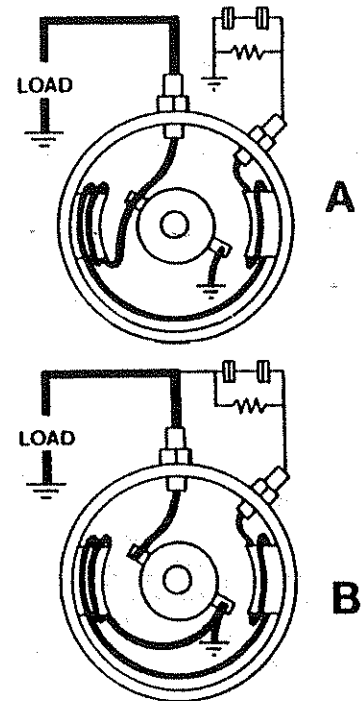
When test is completed, stop engine and replace regulator connectors/wires as necessary.

GENERATOR CHARGING SYSTEMS

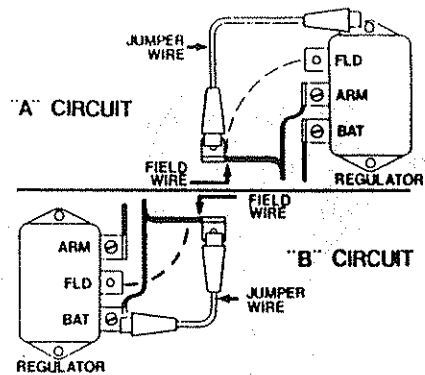
There are two types of generator charging circuits: the "A" circuit and the "B" circuit.

In the "A" circuit, current for the generator field circuit starts at the generator insulated brush, flows through the two field coils to the field terminal on the regulator, through the regulator current and voltage regulator points to ground. This field circuit is said to be externally grounded. That is, it is grounded in the regulator. General Motors, Chrysler Corporation and American Motors frequently use the "A" circuit.

In the "B" circuit, current for the generator field circuit starts in the regulator, flows through the current and voltage regulator points to the field terminal on the regulator, to the generator, through the generator field coils and to ground. This field circuit is said to be internally grounded. That is it is grounded in the generator. Ford generally uses the "B" circuit.



In an "A" circuit, ground the field terminal. If it is a "B" circuit, connect jumper wire from armature terminal to the field terminal. If you don't know which circuit your generator has, try grounding the field first and then try it with the jumper between armature and field. With the correct field connection, run the engine to see if the generator will put out.



Start the engine and while noting the amps reading on the charging amps, slowly increase the engine speed to reach the generator's rated output. DO NOT EXCEED THE RATED OUTPUT OR RUN THIS TEST FOR MORE THAN 20 SECONDS. Typical 12 volt system output ratings are 30 to 42 amps for non-airconditioned vehicles and 50 to 60 amps for air conditioned vehicles.

If the amps reading does reach the generator's rated output, you've isolated the regulator as the cause for the problem. . .adjust, repair, or replace.

If the amps reading does not reach the generator's rated output, you've verified that the generator is at fault and should be serviced or replaced.

At the conclusion of the test, stop the engine and replace the field wire at the regulator.

**Should you ever need to have your analyzer serviced,
contact the manufacturer at this address:**

**KAL EQUIP
9999 Walford Ave.
Cleveland, OH 44102
(216) 651-9200**