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Battery Charging Conditions

The following conditions may be observed during cold-start voltage tests until temperatures of electrical system components stabilize. The time it takes to reach optimum voltage and amps will vary with engine speed, load, and ambient temperature.

Maintenance/Low Maintenance Lead-Acid Battery:

Traditional lead acid batteries require lowest charge voltage of all vehicle battery chemistries. Battery cells must be maintained by periodically topping off with distilled water as required.

Maintenance-free Lead-Acid Battery:

Maintenance-free batteries are similar to Maintenance/Low Maintenance batteries, but may require slightly higher charge voltage.

Deep-cycle/Marine Maintenance-free Battery:

Charge acceptance of these batteries may display characteristics similar to maintenance-free batteries and may charge faster due to generally lower capacity relative to size.

AGM (Absorbed Glass Mat) Maintenance-free Battery:

These dry-cell batteries respond better than standard maintenance-free batteries. If battery state of charge (SOC) drops to 75% or less, batteries should be recharged to 95% or higher separately from engine charging system to avoid damaging charging system components and to provide best overall performance. Charge acceptance of these batteries may display characteristics similar to maintenance batteries, but may require higher charge voltage and will draw significant current (<100 amps) when under 50% SOC.

Lithium Battery:

Lithium batteries have unique charging characteristics that differ from lead acid. These batteries require charging systems configured specifically for lithium battery chemistries. Contact CEN for more information on lithium battery charging systems and components.

Testing Guidelines

Professional service technicians rely on the following guidelines when testing electrical components.

Voltage testing:

- Set meter to proper scale and type (AC or DC).
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure the meter leads touch source area only. Prevent short circuit damage to test leads or source by not allowing meter leads to touch other pins or exposed wires in test area.
- Be sure to use CEN tools designed especially for troubleshooting CEN alternators when available.

Resistance (ohm) testing:

- Set meter to proper scale.
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure meter leads touch source area only. Allowing fingers or body parts to touch meter leads or source during reading may alter reading.
- Be sure reading is taken when source is at 70°F. Readings taken at higher temperatures will increase the reading. Conversely, readings taken at lower temperatures will decrease the reading.
- Be sure to test directly at the source. Testing through extended harnesses or cable extensions may increase the reading.
- "OL" as referenced in this document refers to open circuit: "infinite" resistance, typically in very high kilo- or megaohm range depending on meter and settings.

Diode testing:

- Diodes allow current to flow in one direction only. Typical voltage drop in forward bias can range from 0.1-0.85V. Meter should read OL in reverse bias. Check meter user manual for meter-specific testing guidelines.

Voltage drop testing:

- Measure voltage between B+ on alternator or power source and B- (ground) on alternator or source. Record reading. Move to batteries or other power source and measure again between B+ and B- terminals on battery or other power source. The difference between the two readings represents voltage lost within circuit due to, but not limited to, inadequate cable gauge or faulty connections.
- Voltage drop measurements must be taken with all electrical loads or source operating.

Dynamic/Live testing (Connecting power and ground to component to test operation/function out of circuit):

- Connect jumper leads directly and securely to power source contacts of component being tested.
- Make any connection to power and ground at power supply or battery source terminals. Do not make connection at component source terminals, as that may create an arc and damage component source terminals.



CEN C708 Alternator

Description and Operation

C708 28 V, 330 A alternator is internally rectified. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out. Energize switch activates regulator at E or IGN terminal on regulator. Field coil is then energized. Regulator maintains alternator output voltage at regulated setting as vehicle electrical loads are switched on and off. Alternator output current is self-limiting and will not exceed rated capacity of alternator.

A2-316 regulator furnished with some units has an R or P terminal that can provide an optional AC voltage tap. Regulator also provides overvoltage cutout (OVCO).

A2-316 Regulator

DESCRIPTION AND OPERATION

A2-316 Regulator with OVCO is either attached directly to the outside of alternator or remote-mounted.

Main diagnostic feature of either regulator is tricolored LED next to harness receptacle on regulator. LED works like a voltmeter, measuring charging voltage. See Table 2 on page 4 for diagnostic features and LED explanations.

Regulators with OVCO (overvoltage cutout) will trip at vehicle electrical system voltages **above** 32 volts that exist longer than 3 seconds. OVCO feature detects high voltage and reacts by signaling relay in F+ alternator circuit to open. This turns off alternator (LED is flashing RED light). Restarting engine resets OVCO circuit. Regulator regains control of alternator output voltage.

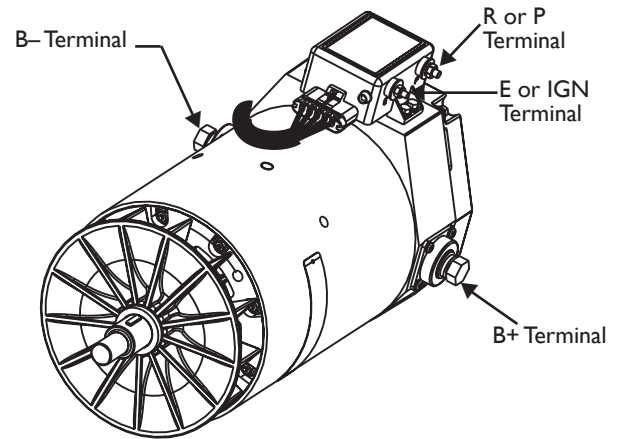


Figure 1 — C708

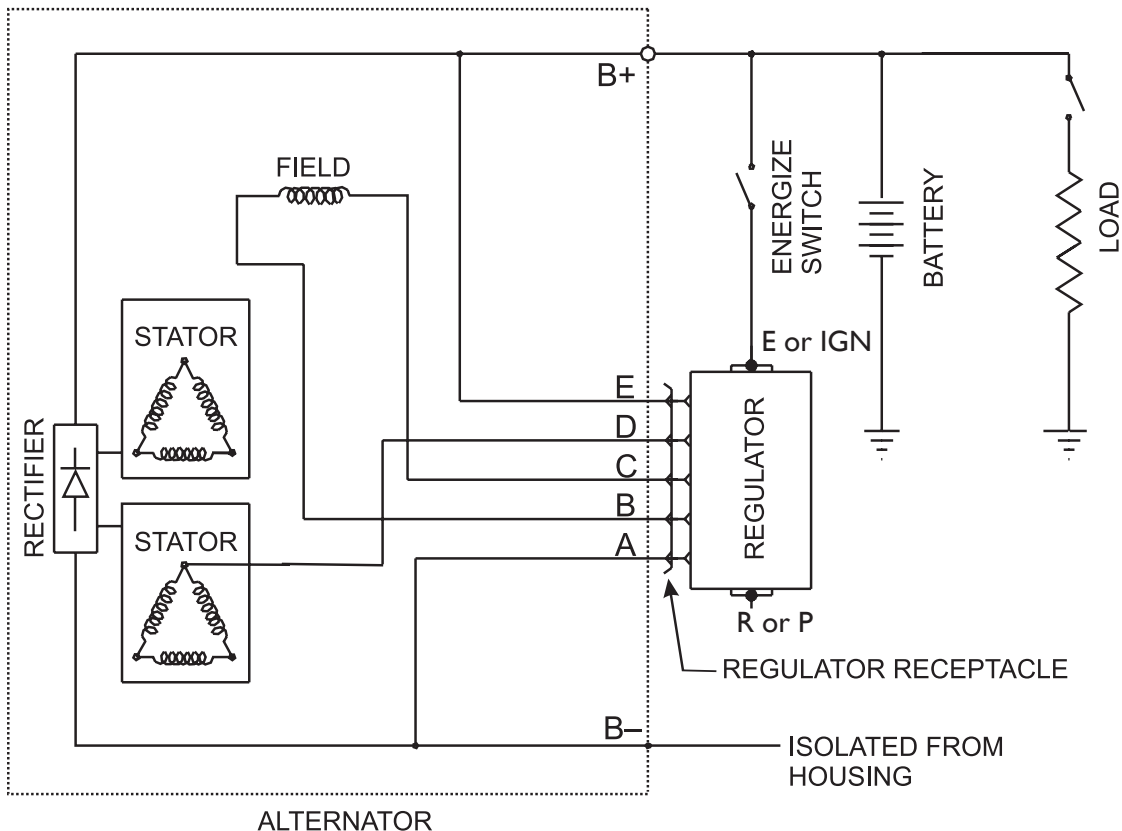


Figure 2 — C708 Alternator with Regulator



Tools and Equipment for Job

- Digital Multimeter (DMM)
- Ammeter (digital, inductive)
- CEN Regulator Bypass Adapter A10-129
- Jumper wire

Identification Record

List the following for proper troubleshooting:

- Alternator model number _____
- Regulator model number _____
- Setpoints listed on regulator _____

Preliminary Check-out

Check symptoms in Table 1 and correct if necessary.

TABLE 1 – System Conditions	
SYMPTOM	ACTION
Low Voltage Output	Check: loose drive belt; low battery state of charge. Check: current load on system is greater than alternator can produce. Check: defective wiring or poor ground path; low regulator setpoint. Check: defective alternator or regulator.
High Voltage Output	Check: wrong regulator. Check: high regulator setpoint. Check: defective regulator. Check: alternator.
No Voltage Output	Check: broken drive belt. Check: battery voltage at alternator output terminal. Check: defective alternator or regulator.
No Air-Conditioning/ Alternator Warning Light On	Check: defective alternator or regulator. Go to Chart 1, page 4.

Basic Troubleshooting

1. **Inspect charging system components for damage**
Check connections at B- cable, B+ cable, and regulator harness. Repair or replace any damaged component before electrical troubleshooting.
2. **Inspect vehicle battery connections**
Connections must be clean and tight.
3. **Determine battery voltage and state of charge**
If batteries are discharged, recharge or replace batteries as necessary. Electrical system cannot be properly tested unless batteries are charged 95% or higher.
4. **Connect meters to alternator**
Connect red lead of DMM to alternator B+ terminal and black lead to alternator B- terminal. Clamp inductive ammeter on B+ cable.
5. **Operate vehicle**
Observe charge voltage.

CAUTION

If charge voltage is above 32 volts, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at high voltage. Go to Table 1 at left.

If voltage is at or below regulator setpoint, let charging system operate for several minutes to normalize operating temperature.

6. **Observe charge volts and amps**
Charge voltage should increase and charge amps should decrease. If charge voltage does not increase within ten minutes, continue to next step.
7. **Battery** is considered fully charged if charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.
8. **If charging system** is not performing properly, go to Chart 3, page 5.

Section 3: Advanced Troubleshooting



Troubleshooting

Shut down vehicle and restart engine. If alternator functions normally after restart, a “no output condition” was normal response of voltage regulator to “high voltage” condition. Inspect condition of electrical system, including loose battery cables, both positive and negative. If battery disconnects from system, it could cause “high voltage” condition in electrical system, causing OVCO circuit to trip.

If you have reset alternator once, and electrical system returns to normal charge voltage condition, there may have been a one time, high voltage spike, causing OVCO circuit to trip.

If OVCO circuit repeats cutout a second time in short succession and shuts off alternator F+ circuit, try third restart. If OVCO circuit repeats cutout, go to Chart 2.

LED COLOR*		STATUS	ACTION
GREEN	Flashing	Alternator and regulator operating normally.	No action required.
AMBER	Flashing	Low system voltage – electrical load exceeds alternator rating at present rotor speed.	When loads decrease or speed increases, LED should flash GREEN. If not, check drive belt and charging system connections.
RED	Flashing	High system voltage – May occur during normal load switching.	If flashing more than 3 seconds, OVCO will trip, disabling charging system.

*Batteries must be charged 95% or higher for accurate LED color.

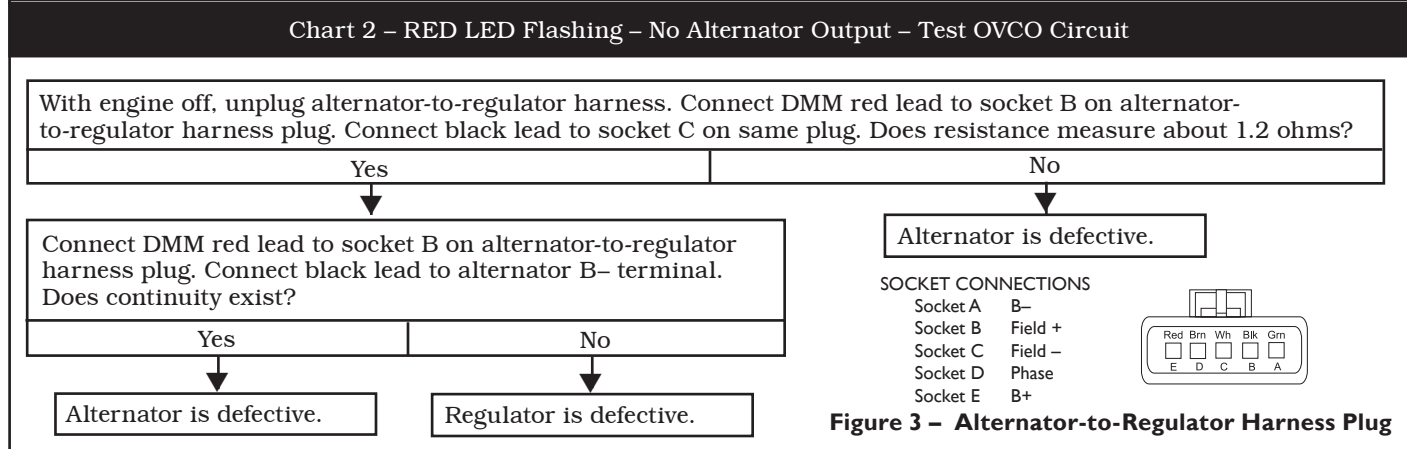
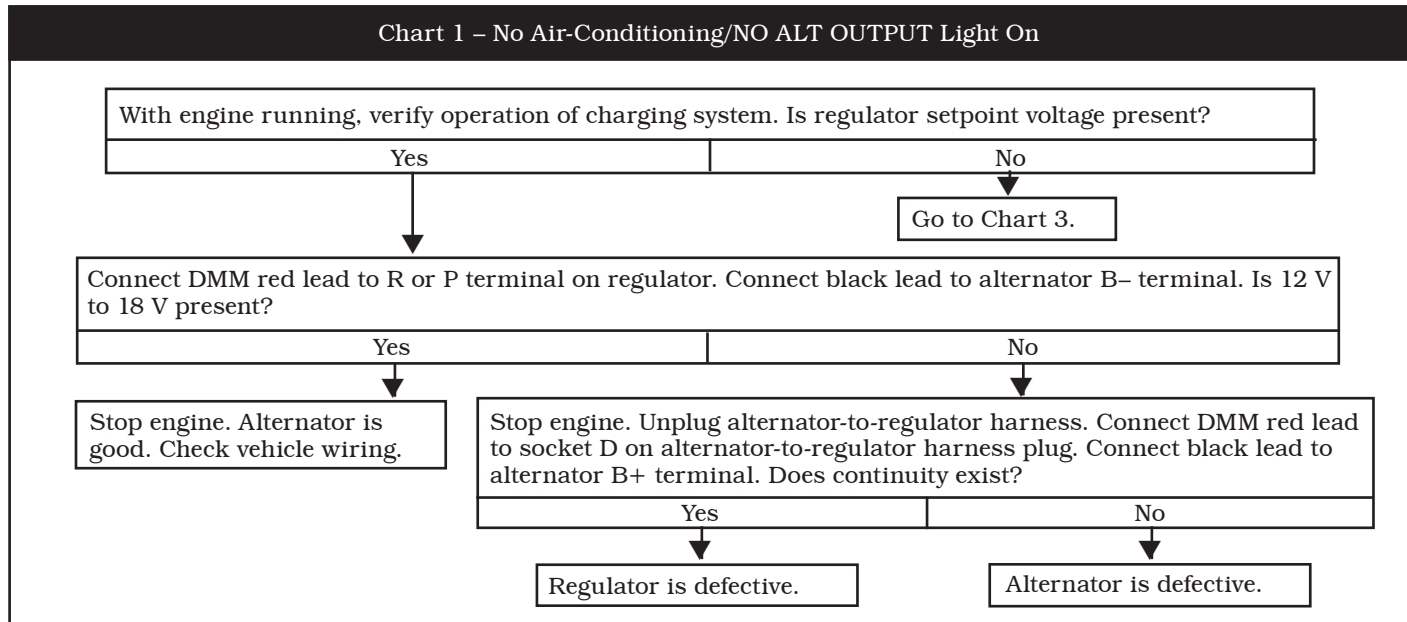
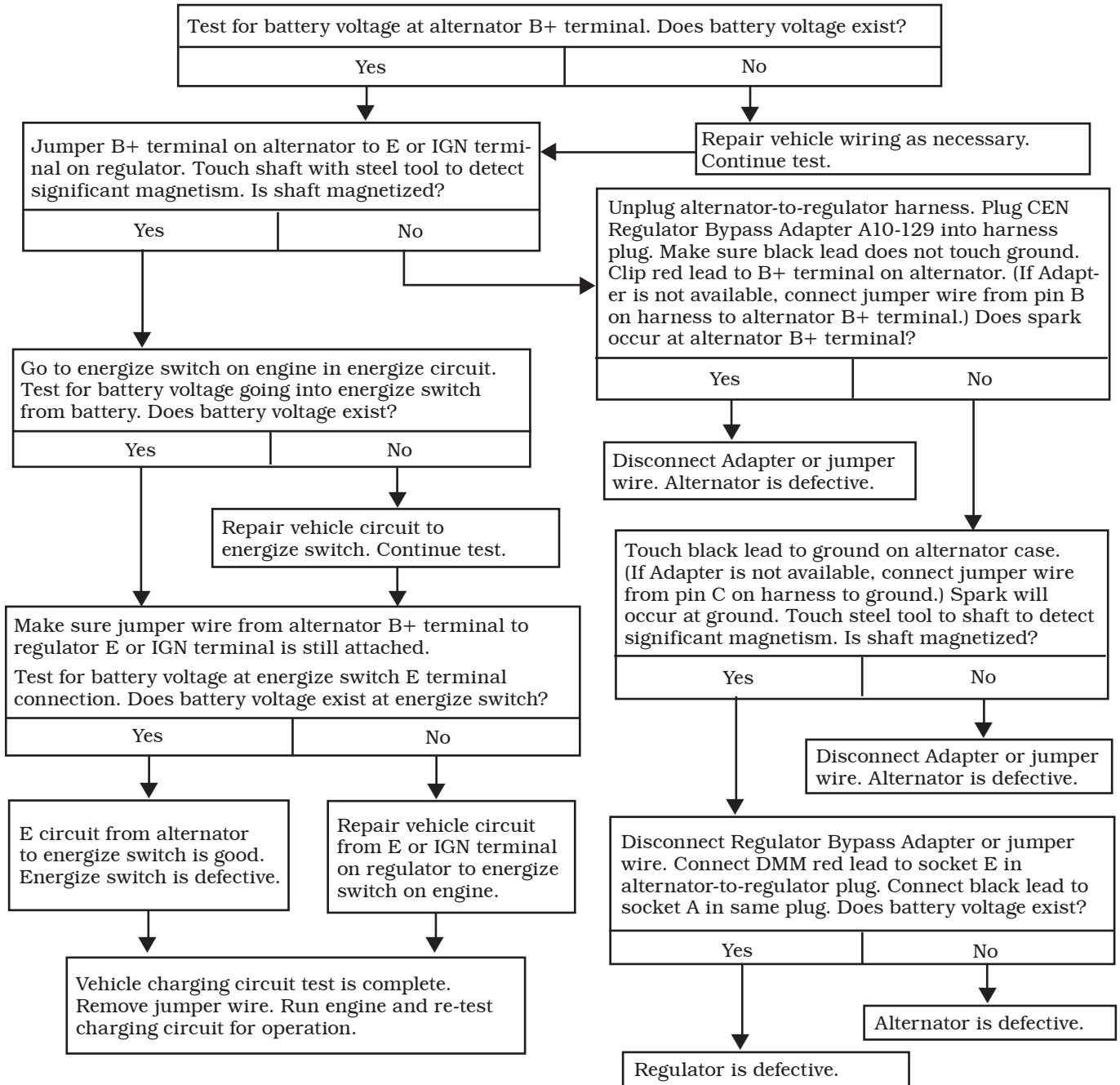




Chart 3 –No Alternator Output – Test Charging Circuit

STATIC TEST – ENGINE OFF, BATTERY SWITCH ON, KEY ON



SOCKET CONNECTIONS

- Socket A B-
- Socket B Field +
- Socket C Field -
- Socket D Phase
- Socket E B+

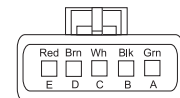


Figure 4 – Alternator-to-Regulator Harness Plug



If you have questions about your alternator or any of these test procedures, or if you need to locate a Factory Authorized Service Distributor, please contact us at:
C. E. Niehoff & Co. • 2021 Lee Street • Evanston, IL 60202 USA
TEL: 800.643.4633 USA and Canada • TEL: 847.866.6030 outside USA and Canada • FAX: 847.492.1242
E-mail us at service@CENiehoff.com