

**PENNTEx FOUR-STEP CHARGING SYSTEM TEST AND GENERAL INFORMATION
WITH A PX-4000, PX-5000, OR PX-6000 VOLTAGE REGULATOR
(IF YOU HAVE A 2009-UP FORD WITH A PX-7000 REGULATOR THIS INFO DOESN'T APPLY)**

PennTex Industries, Inc. is a manufacturer of Heavy Duty Charging Systems, High Idler Devices, and Charging System Monitors. Parts are available nationwide through our network of Warehouse Distributors. This information refers to PennTex 14-volt PX-2, PX-4, and PX-5 model charging systems with a PX-4000, PX-5000 or PX-6000 Voltage Regulator. For other PennTex systems contact us or refer to our web site at www.penntexusa.com.

All PennTex charging systems use an external voltage regulator. They are usually mounted inside the body of the vehicle under the right side of the dash away from moisture and heat. To be sure of the regulator location, follow the charging system harness from the alternator to the regulator. It will be a maximum of 72 inches away because that's how long the harness is. There will be a white or tan pass-through conduit on the charging system harness at the firewall.

All wire colors mentioned here are PennTex charging system wire harness colors. Check these PennTex harness items first: **BLACK (ground)**: check for loose or corroded connections at the engine and the regulator. Ohms on the ground connection should be **ZERO**. **It is recommended that the BLACK regulator ground wire be shortened to 18 inches, a ring terminal added, and attached to a good ground location near the regulator, independent of the alternator ground.** **BLUE & ORANGE (field & stator)**: if possible, actually pull the harness T-connector out of the brush holder and inspect the terminals. Look for corrosion and be sure that one of the brush holder male terminals isn't bent over. Plug the T-connector back in. Check for loose cables at the large alternator posts and repair as required. Check to see if the system will charge now.

Use the **PennTex PX-4000, PX-5000 & PX-6000 Four-Step Charging System Test Form & Full Field Test Form** to check the system condition. For the four-step test, check the system voltages at the regulator connector, with the connector still plugged in. The readings must be taken at the regulator, not at the alternator. **BLUE**: rotor voltage, **ORANGE**: stator voltage, **RED**: battery voltage, **BROWN**: ignition voltage. Get the battery voltage right at the batteries during each step. A difference in voltage readings between the batteries might uncover a problem. All of these tests rely on the ground connections being in good condition. For a second opinion on the voltage readings, fax the test results to 817-590-0398.

During the **first** test, the **RED** wire will show battery voltage. The regulator is tied to the battery at all times through this wire. The other wires should show zero volts or a few millivolts. Note: some bus companies wire the system so there is no voltage on the **RED** wire with the key off. Voltage on the **BLUE** wire could indicate an open rotor or worn-out brushes. Voltage on the **ORANGE** wire might be a diode problem. Voltage on the **BROWN** wire on the first test means the regulator has power to it all the time, and that causes a battery drain. This is a connection problem that needs to be fixed because the **BROWN** wire should only have voltage on it with the key on. The battery voltage should be the same as the **RED** wire voltage, or very close. A bad ground can cause intermittent charging. Make sure the voltage regulator case is securely mounted, and that you've shortened the **BLACK** ground wire to 18 inches.

During the **second** test with the key on and the engine not running, there should be at least 2 volts on the **BROWN** wire. Turning the ignition switch on sends power to the **BROWN** wire, and the regulator then connects the **RED** and **BLUE** wires together. Zero volts on the **BROWN** wire indicate a blown fuse (Gauges fuse usually) or an open circuit in the wire that turns the regulator on. If there's no voltage on the **BROWN** wire with the key on, the system will not charge. The **BLUE** wire voltage should be about one-half volt less than the **RED** wire voltage. The **BLUE** wire is sending voltage to the rotor and magnetizing it. The **RED** wire will again show battery voltage and be slightly less than in the previous test because of electrical system demand. If there is more than a one-volt difference between the voltages on the **RED** wire on the first and second tests, you may have a battery problem. Charge the batteries for 45 minutes and rerun the test. The **ORANGE** wire should show no voltage because the rotor isn't spinning and producing electrical power. Voltage on the **ORANGE** wire on the second test may indicate diode problems. A bad diode will show voltage on the **ORANGE** wire, usually on both the first and second test, even if the voltage on the **ORANGE** on the third test is normal. There may also be an overnight draw on the battery with one or more bad diodes. **NOTE**: on some late model Chrysler products, only the **RED** wire will have battery voltage on it on the first and second tests. The third and fourth tests will have voltages on the four wires like other systems.

During the **third** test, have the engine running at idle with all accessories off. The **BROWN** wire will have somewhere between 2 and 13 volts on it. If there's no voltage on the **BROWN** wire with the engine running, the system will not charge. At idle, the rotor is turning and the stator will put out AC voltage to the **ORANGE** wire coming back to the regulator from the alternator. Ideally, the **ORANGE** wire will have exactly half the voltage of the **RED** wire. If the **ORANGE** wire has 1 or 2 volts less than half the voltage of the **RED** wire, there is a possible stator problem. If the **ORANGE** wire has zero volts, there may be an open rotor or worn-out brushes. If this is the case, there may also be battery voltage on the **BLUE**

wire on the first test. If there is voltage on the BLUE wire on the first test, in addition to no voltage on the ORANGE wire on the third test, that is another indicator of a possible rotor or brush problem. Check for loose connections and continuity on the ORANGE and BLUE wires between the alternator and the regulator. **IMPORTANT:** if the ORANGE wire voltage multiplied by 2 is even a little more than the RED wire voltage, there is a connection problem with the main output cable of the alternator. This could be a loose connection, a burned output post, or other wiring problem.

Do a **Voltage Drop Test** using a voltmeter. Compare the voltage at each connection from the alternator to the batteries looking for a significant drop in voltage through the connections. The drop could come from loose connections or corrosion. Check the BLACK ground connections too. If there is no or very low voltage on the both BLUE and ORANGE wires, check the BLACK ground wire that should now be connected inside the vehicle near the regulator. If the ground is okay, do a Full-Field Test to see if the alternator will charge unregulated. (**Full-Field Test:** disconnect the 4-wire connector at the regulator and jumper the BLUE and RED wires together in the connector. Start the vehicle and let it run for 30 seconds (no longer than 30 seconds) while checking the voltage at the jumper wire. If the voltage stays the same, you have an alternator problem. If the voltage goes up, you have a regulator problem.)

The BLUE wire voltage during the third test is an indication of how hard the alternator is charging. This reading may fluctuate up and down, so set your meter to "average". If the BLUE wire voltage is 8 volts or less, the alternator is working at low output. If the BLUE wire voltage is 10 volts or above, the alternator is working at high output to keep up with charging system demand. A discharged or defective battery could cause this. One dead battery cell can cause a great amperage load. Some Ford auxiliary batteries are mounted underneath on the frame. Because of the work involved with dropping them down for inspection, some don't get regularly checked. Load test with a battery tester capable of testing large truck batteries. Smaller hand-held testers will not be as accurate. We recommend testing the batteries one at a time with any connections between the batteries removed to be sure of an accurate test. There could also be a bad battery isolator. Do a voltage drop test to confirm this. Remember that some isolators can drop as much as one volt between connections and still be good.

The **Fourth** test should be done at about 1000 engine RPM. If the system starts charging now, you have a low engine idle RPM issue or it could be that the vehicle electrical system requirements exceed the output of the charging system. It's believed that charging system demand increases by 15% per year due to corrosion, loose connections, and resistance built up in circuits. Make sure that the normal vehicle idle speed is 700-750 RPM in gear with the AC system on. The red light on the dash may be coming on at idle simply because the engine idle speed is too low. 50 or 100 RPM can be the difference in alternator output at idle.

It is really not unusual for a bus to be built with an electrical system demand as much as the alternator output at idle. When the bus was built, the specification might have called for a smaller alternator to save money. The problem is that the smaller alternator has to work harder. This produces more heat and reduces alternator life. Adding extra batteries to a charging system that isn't producing enough amperage will not fix the problem. Alternator output has to exceed demand.

There might be another PennTex alternator model for your vehicle with higher amperage output at idle. A High Idler System that raises the engine idle speed when the vehicle is in Park might also be considered. For information on upgrades or additions, contact our Sales Department toll-free at 877-590-7366, see our Warehouse Distributor list at www.penntexusa.com, or e-mail us at tech@penntexusa.com.

SPECIAL NOTE: Until October of 2005, all PX-5 PennTex alternators had one positive and one negative connection post. PX-5 alternators built after October 2005 have TWO positive posts. BE SURE to properly identify the type of alternator you are installing. If your PX-5 model number has a "D" in it, such as PX-5TD, PX-520TD, PX-520GD, PX-5GD, PX-5RD, PX-520RD, etc., you have a PennTex alternator with two positive posts. Only a dual positive post PX-5 will have six negative diodes installed in the rear alternator housing. On a dual positive post PX-5, connect the alternator ground cable to a solid engine ground, such as an alternator mount bolt. Positive cables can be connected to either post on a dual positive post PX-5 alternator. DO NOT remove the jumper between the posts. As of February 2009, the only PennTex alternators changed to this dual positive post feature are the PX-5 models. PX-2 & PX-4 models still have one positive and one negative post. See instructions enclosed with your alternator for specific hookup information. If you still aren't sure which model you have, get your new alternator serial number and call PennTex at 877-590-7366.

Be sure to shorten and relocate the BLACK regulator ground wire to no more than 18 inches away from the regulator and independent of the alternator ground. This ground relocation is the result of continued difficulties with good alternator to chassis grounding on OEM and Aftermarket installations, especially on older buses. And if your secondary battery is connected through a solenoid with 6-gauge wire, the solenoid should be removed and the cable upgraded to #2AWG cable or larger. All engine to chassis and body to chassis ground cables should be #2AWG cable or larger. Thanks for choosing PennTex.

02-27-09