

PENNTEx FOUR-STEP CHARGING SYSTEM TEST AND GENERAL INFORMATION FOR A PENNTEx PX-422V SYSTEM WITH A PX-6000 VOLTAGE REGULATOR

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 12-volt model Charging Systems with a PX-6000 Voltage Regulator. To test a PennTex PX-4000, PX-5000 or PX-7000 system, contact us or refer to our web site at www.penntexusa.com/tests.

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. NOTE: some bus manufacturers mount the regulator behind the passenger side headlamp on GM vans. Use a PX-6000A regulator for those applications. 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 (84" away on some Arboc buses). There should 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. On 2007 and older vehicles with a ground wire that went from the regulator to the engine compartment, it is recommended that the BLACK regulator ground wire at the regulator be shortened to 18 inches in length. Attach it to a good ground location near the regulator, independent of the alternator ground.

GRAY & BROWN in the engine compartment: These wires connect the PennTex harness to the OEM harness. In some cases there is a gray connector that plugs in to the OEM alternator connector. In some cases, the gray PennTex harness connector and the OEM harness connector are cut off, and the wires are connected gray to gray and brown to brown.

BLUE (Field) & ORANGE (Stator): inspect the alternator 2-wire pigtail connector and inspect the terminals. Look for corrosion or loose connections. Check for loose cables or discoloration at the alternator output post and repair as required. Inspect the regulator for corrosion or water damage. Look for burned fusible links. Check for two fuses in the PennTex harness about one foot away from the regulator. Check the alternator pulley for blue discoloration that indicates a slipping belt. Check to see if the system will charge now.

Use the PennTex 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: regulator exciter voltage usually through the OEM indicator lamp circuit. 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 your voltage readings, you can fax the test results to the PennTex technical Department at 817-590-0398 or 817-590-0505, or email to tech@penntexusa.com.

During the **First Step**, 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: a few bus companies wire the system through a main shut-off switch so there's 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 the BLACK ground wire is attached to a solid ground.

During the **Second Step** with the key on and the engine not running, there should be some voltage (more than 1.5 volts) on the BROWN wire to energize the regulator. Turning the ignition switch on sends power to the BROWN wire, and the regulator then connects the RED and BLUE wires together. The BLUE wire is sending voltage to the rotor and magnetizing it.

GM vehicles with a PX-6000 Regulator should have 3.3 volts on the BLUE wire on Test Two. This is the 30% duty-cycle voltage that the PCM is looking for. NOTE: other PennTex regulators such as the PX-4000 or PX-5000 allow about .5 volt less than the Red wire voltage on the Blue wire on Step Two. Although the system will probably charge, this higher voltage will set a code on GM vehicles that require a specific reference voltage when the key is turned on. This is because the voltage, usually around 12 volts, is higher than the PCM is looking for. A PX-6000 regulator is needed on these vehicles to provide the proper reference voltage on start-up.

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 regulator won't be energized and the system will not charge. 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 steps, you may have a battery condition 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 step, even if the voltage on the ORANGE on the third step is normal. There may also be an overnight draw on the battery with one or more bad diodes.

During the **Third Step**, 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. Check the system to find out why the BROWN wire has no power.

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, like both numbers are 33% down, there is a possible stator problem. If the ORANGE wire has close to 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 step. If there is voltage on the BLUE wire on the first step, in addition to very low voltage on the ORANGE wire on the third step, that's another indicator of a loss of field continuity from a possible rotor or brush problem.

IMPORTANT: if the ORANGE wire voltage multiplied by two is even a little more than the RED wire voltage, there's 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. Check for loose connections and continuity on the ORANGE and BLUE wires between the alternator and the regulator.

The BLUE wire voltage during the third step is an indication of how hard the alternator is charging. This reading may rapidly fluctuate up and down, so set your meter to "average". If the BLUE wire voltage is close to zero, you may have a rotor or brush problem. If the BLUE wire voltage is 3 to 8 volts, the alternator is working at low output. If the BLUE wire voltage is at 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. Load test with a battery tester capable of testing large truck batteries. Smaller hand-held testers will not be as accurate, but are better than nothing. 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. Some isolators can drop as much as one volt between the in & out connections and still be good.

The **Fourth Step** 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. The engine may benefit from a throttle body cleaning to help this. **NOTE:** Adding extra batteries to a charging system that isn't producing enough amperage will not fix that problem. Alternator output has to exceed demand.

If there is zero or very low voltage on the both BLUE and ORANGE wires, check the 18 inch-long BLACK regulator ground wire that should be connected inside the vehicle near the regulator.

Do a Full-Field Test to see if the alternator will charge with the regulator bypassed. (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 no longer than 20 seconds while checking the voltage at the jumper wire. If the voltage doesn't go up when you are bypassing the voltage regulator, you have an alternator problem. If the voltage does go up, you may have a regulator problem. If you had zero volts or close to that on the Blue Field wire and the Orange Stator wire on steps 1 through 4, but the alternator starts charging when full-fielded, there might be an issue with the rotor.

Do a Voltage Drop Test using a voltmeter along the cables in the charging system. 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.

Manufacturing/ Tech/ Warranty:

7620 Flagstone

Fort Worth, TX 76118

Ph: 817-590-2818

Toll Free: 877-590-7366

Tech Fax: 817-590-0398 or 817-590-0505

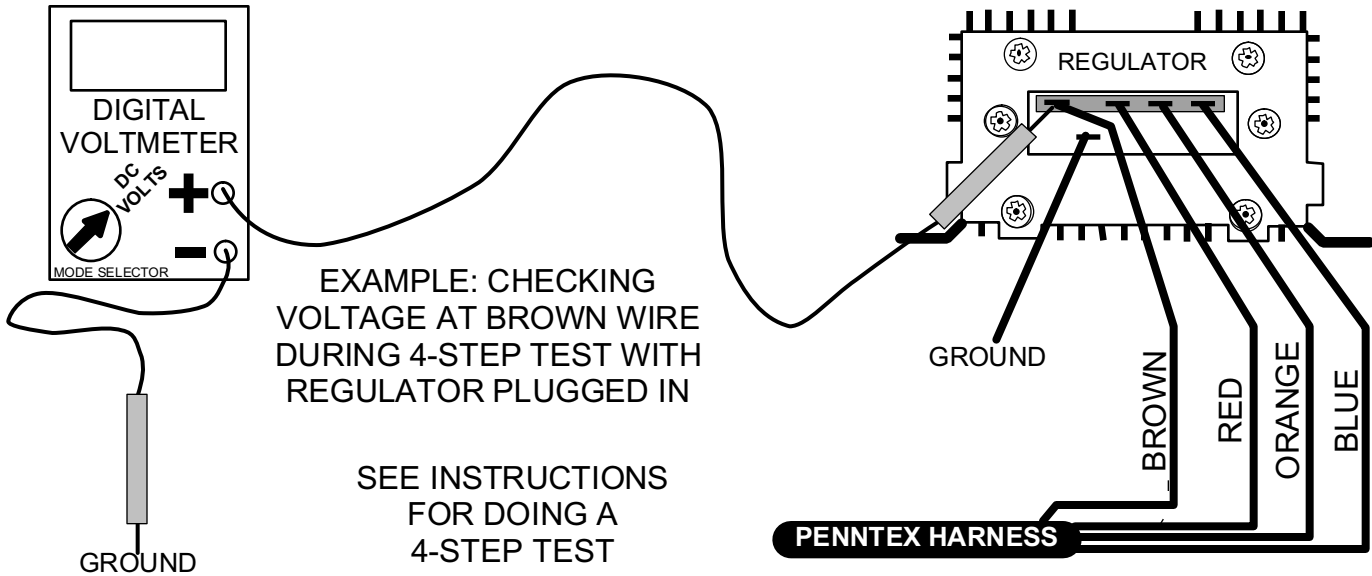
www.penntexusa.com

email: sales@penntexusa.com

tech@penntexusa.com

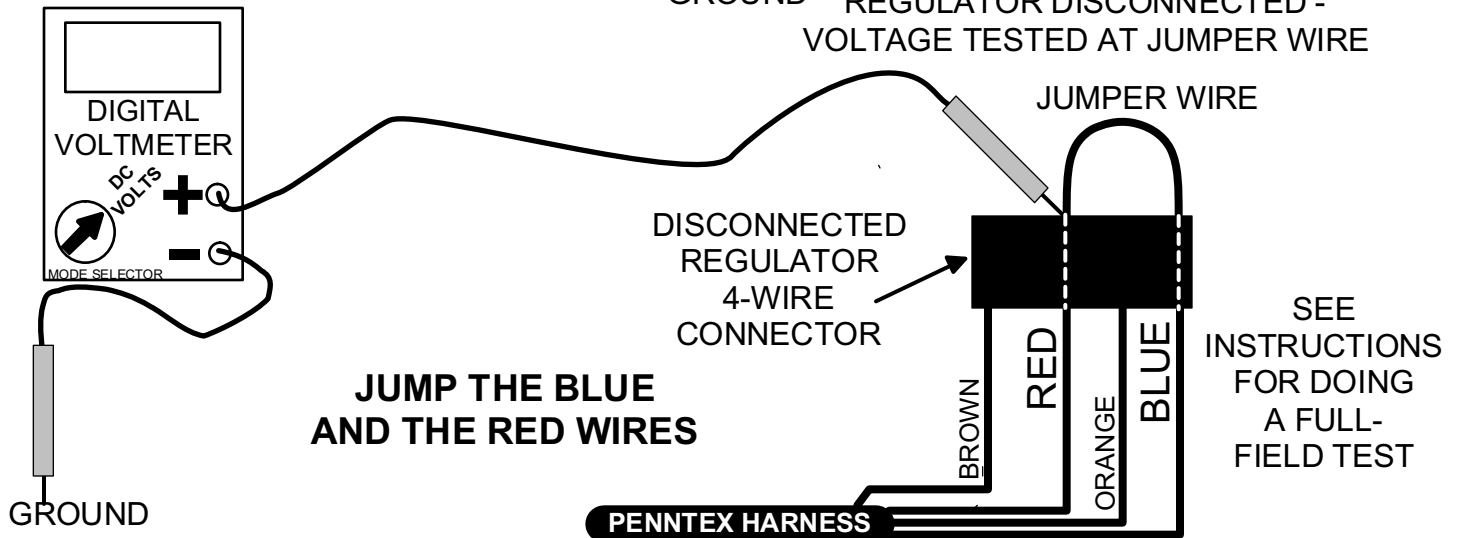
4-STEP & FULL-FIELD TEST BASIC INFORMATION

THE FOUR-STEP TEST IS DONE WITH EVERYTHING PLUGGED IN



THE FULL-FIELD TEST IS DONE AT THE REGULATOR 4-WIRE CONNECTOR WITH IT DISCONNECTED FROM THE REGULATOR

NO VOLTAGE TESTS ARE DONE AT THE DISCONNECTED REGULATOR AT ANY TIME



CHARGING SYSTEM TEST FOR VEHICLES WITH A PX-4000, PX-5000, OR PX-6000 REGULATOR

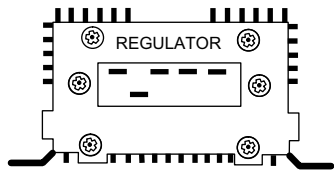


Technical Support Toll Free 1-877-590-7366
 Technical Support Fax 1-817-590-0398
 Parts are available from our Distributors
 See listings on www.penntexusa.com

Contact Name _____
 Phone _____ Ext. _____
 Fax _____
 Testers Name _____
 Alternator Model # _____
 Alternator Serial # _____
 Regulator Model # _____
 Regulator Serial # _____
 Vehicle Mileage _____
 Vehicle Year _____ Make _____ Engine _____
 Vehicle In-Service Date: _____

Describe your charging system problem:

IF YOUR PENNTEX REGULATOR HAS DIFFERENT CONNECTIONS THAN THIS, USE TESTS FOR A PX-7000 REGULATOR.



Locate the external voltage regulator, make sure that everything is properly connected and that the regulator has a good ground. Complete the following chart using a digital voltmeter.

<u>Regulator Terminals</u> ↓	<u>Test # 1</u> Ignition Off Engine Off	<u>Test #2</u> Ignition On Engine Off	<u>Test # 3</u> Ignition On Engine On	<u>Test #4</u> Engine On High Idle
Field Terminal (Blue Wire) "F"	_____volts	_____volts	_____volts	_____volts
Stator Terminal (Orange Wire) "S"	_____volts	_____volts	_____volts	_____volts
Sense Terminal (Red Wire) "A"	_____volts	_____volts	_____volts	_____volts
Ignition Terminal (Brown Wire)	_____volts	_____volts	_____volts	_____volts
Battery Terminal	_____volts	_____volts	_____volts	_____volts

TEST WITH EVERYTHING PLUGGED IN

Ground Terminal:
_____ohms

of Batteries:

Engine Idle :
_____rpm

Engine High Idle:
_____rpm

DID YOU DO A FULL-FIELD TEST? FOR A 2ND OPINION FAX THE TESTS TO 817-590-0398 WHEN COMPLETED.

Note any charging system connections that look overheated or discolored:

PennTex

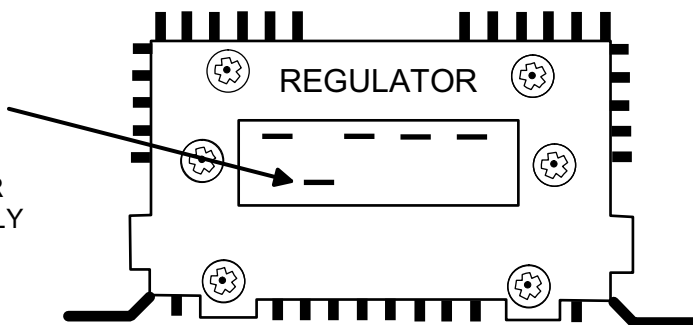
INDUSTRIES, INC.

PX-4000, PX-5000 & PX-6000 REGULATOR

FULL-FIELD TEST

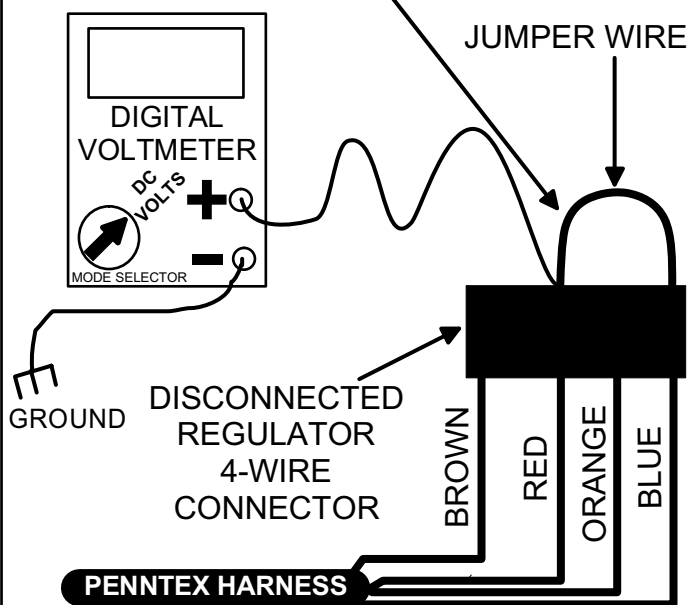
A PX-7000 REGULATOR USES A DIFFERENT TEST

THIS IS A GROUND TERMINAL. DO NOT CONNECT POWER TO THIS TERMINAL OR THE REGULATOR WILL BE PERMANENTLY DAMAGED.



THESE REGULATORS ARE MANUFACTURED IN OUR FT. WORTH, TX PLANT.

YOU MAY SEE A SPARK WHEN CONNECTING THE JUMPER



FULL-FIELD TEST PROCEDURE:

THIS TEST ALLOWS THE ALTERNATOR TO CHARGE UNREGULATED. IF THE ALTERNATOR IS BAD, THE VOLTAGE WILL NOT INCREASE.

- 1) TURN OFF ALL ACCESSORIES.
 - 2) LOCATE THE VOLTAGE REGULATOR.
 - 3) **DISCONNECT THE 4-WIRE CONNECTOR.**
 - 4) JUMP THE BLUE AND RED WIRES.
 - 5) START THE VEHICLE & RUN AT IDLE.
 - 6) AFTER IT RUNS FOR 5 SECONDS, CHECK THE VOLTAGE AT THE RED WIRE.
 - 7) THAT VOLTAGE IS: _____
 - 8) RAISE ENGINE RPM TO 1000 RPM.
 - 9) CHECK VOLTAGE AT RED WIRE.
 - 9) THAT VOLTAGE IS NOW: _____
 - 10) SHUT ENGINE OFF.
 - 11) REMOVE JUMPER WIRE. IT COULD BE HOT.
- NOTE:** DO NOT LET ENGINE RUN MORE THAN 10 OR 15 SECONDS IN FULL-FIELD MODE. DAMAGE TO TEST LEADS OR VEHICLE ELECTRICAL SYSTEM CAN RESULT.

(OLD VOLTMETER BATTERIES WILL AFFECT VOLTAGE READINGS ON SOME METERS)

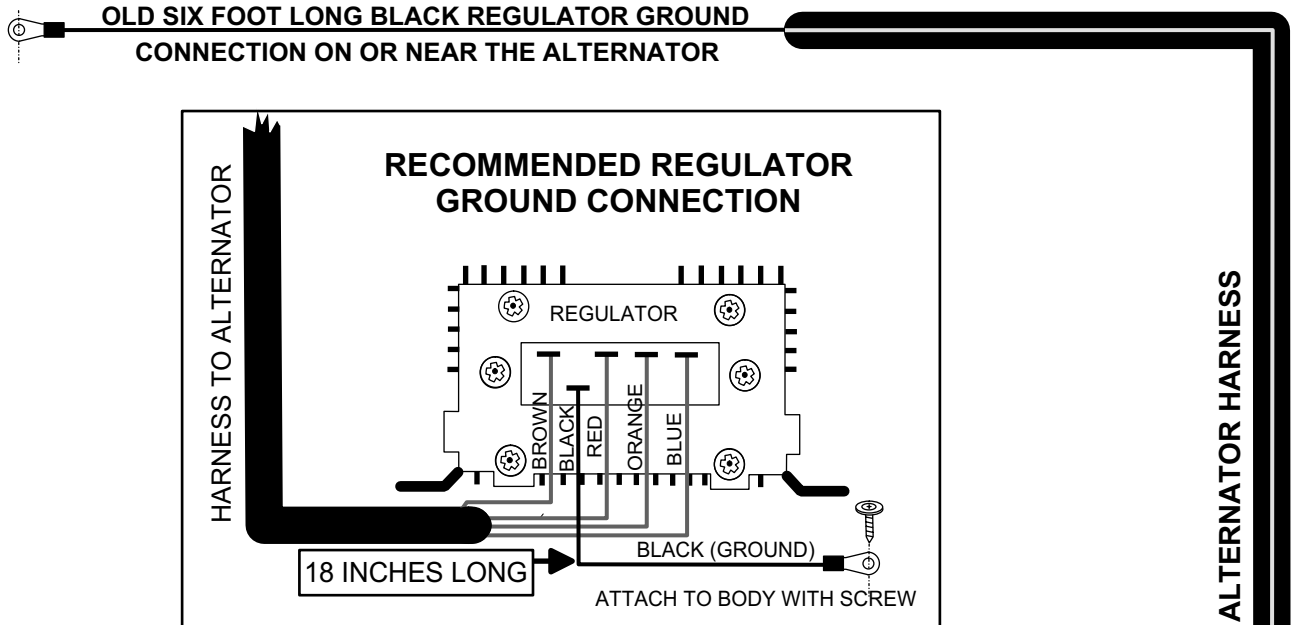
AFTER COMPLETING THIS TEST AND THE FOUR-STEP VOLTAGE TEST, FAX THEM TO OUR TECHNICAL DEPARTMENT AT 817-590-0398.

PENNTEX INDUSTRIES, INC. TECH LINE: 877-590-7366

TECH FAX: 817-590-0398
(ALTERNATE FAX: 817-590-0505)
email: tech@penntexusa.com

RECOMMENDED CHANGE ON ANY PRE-2007 VEHICLE WITH A PENNTEX ALTERNATOR

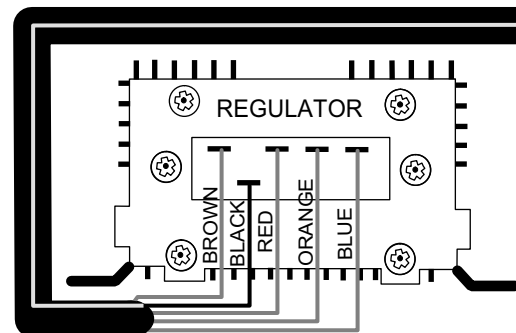
THE PENNTEX REGULATOR GROUND WIRE ATTACHMENT LOCATION HAS CHANGED.



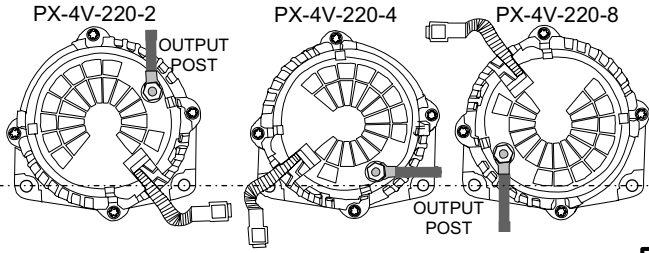
PennTex changed the ground wire hook-up for our regulator harnesses in 2007. A 6-foot long ground wire from the regulator to the alternator has been superseded by a shorter 18-inch regulator ground wire with a self-tapping screw to attach the ground wire ring terminal. This is intended to be a vehicle body ground, closer to the regulator and independent from the alternator ground.

This change is a result of continued difficulties with good alternator-to-chassis grounding on new OEM and Aftermarket installations, and especially on older buses that have developed poor cable connections from age or insufficient maintenance practices. Providing a separate ground connected to the vehicle body will help prevent regulation system damage or malfunction due to poor ground situations, which will decrease vehicle downtime.

If you have any questions, please contact our technical department at 877-590-7366 or by email at tech@penntexusa.com. Thank you for using PennTex products.

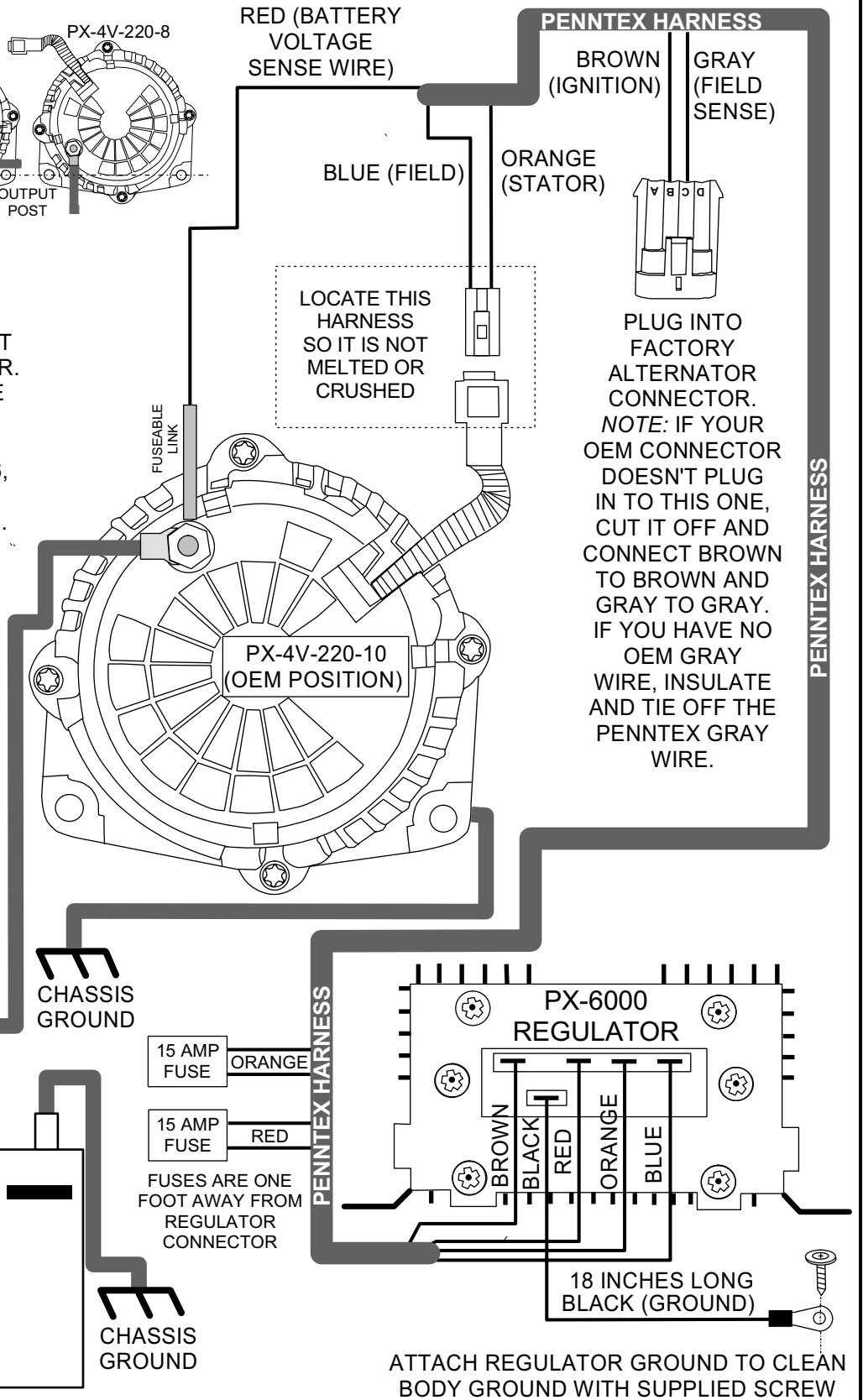


PX-4V-220-2, PX-4V-220-4, PX-4V-220-8, PX-4V-220-10



BEFORE YOU INSTALL THE ALTERNATOR BE SURE IT'S THE CORRECT ONE FOR YOUR APPLICATION. DO NOT ATTEMPT TO RECLOCK THIS ALTERNATOR. DAMAGE MAY RESULT AND THE WARRANTY WILL BE VOIDED.

CALL PENNTEX AT 877-590-7366, FAX US AT 817-590-0505, OR EMAIL AT sales@penntexusa.com.



NOTES:
 THIS IS A GENERIC WIRING SCHEMATIC FOR THE PX-4V-220 ALTERNATOR. THIS DIAGRAM IS NOT SPECIFIC TO ANY CERTAIN MAKE, MODEL, OR ENGINE.
 CHARGING CABLE SIZE: MINIMUM #2 AWG OR LARGER

PennTex INDUSTRIES, INC.
 FT. WORTH, TX MANCHESTER, PA
 877-590-7366 www.penntexusa.com

TITLE/DESC. GENERIC WIRING DIAGRAM FOR PX-4V-220 ALTERNATOR WITH PX-6000 REGULATOR.		
DATE: 06-22-15	DRAWING NUMBER:	REVISION #
DRAWN BY: DMc	UPDATED BY:	CHECKED BY:
SCALE: NONE		PAGE: 1 OF 1