TEC-8C™

(FOR CANADA ONLY)

8-Watt Thermo-Electric Charger
Installation - Operation - Maintenance

PGI International, Ltd.
Excellence Through Innovation

Form IOM-TEC-8C, Revision 10

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Introduction to the TEC-8C

The TEC-8C Thermo-Electric Charger is a natural gas or propane fueled alternative to solar panel systems that are used to power electronic instruments on gas pipelines. In applications where a lead acid battery is used to provide high peak power for short burst requirements (such as for wireless communications at remote monitoring sites), the TEC-8C produces a 12 or 24 volt power source to keep the battery fully charged. The battery's temperature and charge level are continuously monitored and the TEC-8C produces up to 7.3 watts to keep it charged.

Unlike solar panels, the TEC-8C can be installed in almost any location and is unaffected by shade, snow, freezing rain, ice, dust build-up, or birds.

The TEC-8C consumes a small amount of fuel *(3.0 CFH for N.G.* and *1.0 CFH for Propane Gas*) in a flameless oxidizing catalyst to heat the hot side of an array of Peltier thermoelectric modules. The TEC-8C uses the same safe, reliable catalyst technology that has been heating equipment in the natural gas industry for over 35 years.

The self-contained starting system for the TEC-8C catalytic heater makes starting as simple as flipping a switch to turn the system ON, and pressing a button to open the Gas Safety Valve. The other side of the modules are kept cool by natural convection cooled aluminum fins. The temperature difference developed across the modules generates safe electrical power.

- ***More cost-effective than solar panels . . . and the colder it gets, the more cost-effective it becomes***
- ***Runs on natural gas or propane, 0.5 to 15 PSIG***
- ***Microprocessor controlled simple start up and diagnostics***
- ***Integrated temperature compensated charger with remote battery temperature sensor***
- ***Rated Class 1, Division 2, Group D CSA approved***
- ***User configurable operating characteristics***
- ***Status output for remote monitoring***
- **Controller software is field upgradeable**
- ***Modular accessories for H_2S/H_2O filtration, pressure regulation, and batteries***
- ***2" pipe or wall mountable***

The power generated is conditioned by a high efficiency switching power supply to provide the ideal temperature compensated battery charging current and voltage to the battery. Internal diagnostics detect possible system problems and the system status can be remotely monitored using the open collector alarm output.

Factors That Affect Start-Up of TECs

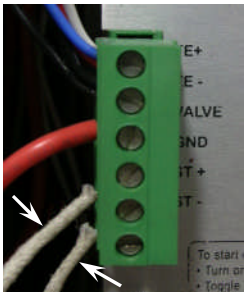
The TEC system start-up is completely dependant upon several factors. What follows is a list of conditions that must be met in order to ensure a quick and reliable start-up. Failure to meet these conditions will result in excessive time required to start the unit. Repeated attempts at start-up may drain the battery voltage to a level below the start-up requirement (11v for a 12v system & 22v for a 24v system).

1. **A clean, dry fuel supply**
   The fuel supply MUST be clean and dry. Use filters and scrubbers if necessary to ensure a clean, dry fuel source. See the ***Accessories*** section in this manual for PGI's Cartridge Filter Unit (CFU-C).

2. **A properly bled fuel line**
   The air in the fuel supply line must be bled as close as possible to the fuel inlet to the TEC. See ***Starting the TEC-8C*** in this manual for bleeding instructions.

3. **Proper ventilation**
   In addition to a clean, dry fuel supply, oxygen must be present at the surface of the heater in order for a catalytic reaction to occur. An air channel exists in the TEC beginning at the air intake vent (located on the bottom of the unit) which allows oxygen to wash over the face of the heater and out the exhaust gas chimney (located on the top of the unit). This air channel MUST be kept open and never taped over or closed by any means. Obstructing either the intake vent or the exhaust chimney will result in an excessive start-up time.

4. **Dry catalyst and diffuser pads**
   TECs that have been stored in a high humidity environment for an extended period of time prior to start-up may accumulate moisture in the catalyst and/or diffuser pads resulting in excessive start-up time. This moisture buildup may be burned out of the pads by simply repeating the start-up process a few times. If that fails, disconnect the starting element lamp leads (WHITE leads connected to ST+ and ST-) and connect them to an external battery. With the gas supply CLOSED, let the starting element heat the pads for 10 or 15 minutes to dry them out. (Polarity is not important.)



5. **Properly charged battery**
   A low battery voltage may not get the starter hot enough to start the catalytic heater. If the battery voltage is less than 11 volts for a 12 volt system, or less than 22 volts for a 24 volt system, re-charge or replace the battery, then restart the TEC. It is important to note that even a "healthy" battery can support only a limited number of attempts at starting without need the need of a recharge.

Factors That Affect the Performance of TECs

The TEC operates by utilizing a catalytic heater to increase the temperature on one side of a Peltier module while natural heat convection cools the opposite side. The amount of current generated by the TEC is directly proportional to the heat flow through the Peltier module and the temperature differential across the module. What follows is a list of conditions that will affect these two factors.

1. **Altitude at which the TEC is operating**
   In order for combustion to occur in a catalytic heater, gas and oxygen must be present at the surface of the heater. The BTU (or heat) output of the heater is dependant upon the amount of gas (in BTUs) and the amount of oxygen present at the surface of the heater.

   The amount of gas is dictated by 1) the BTU density of the supply gas, 2) the pressure of the incoming supply gas to the flow-control orifice, and 3) the size of the hole in the flow-control orifice. The amount of oxygen present at the surface of the heater is dependant upon atmospheric conditions. Every 1000 feet of elevation change above sea level results in 4% less oxygen available in the atmosphere. The amount of oxygen available is also affected by air temperature, air contaminants (like H_2S, if present), and moisture content; however, altitude is the main factor.

   The heater in the TEC is designed to achieve optimal performance at sea level, creating the conditions for proper combustion while not exceeding the allowable temperature limits of the Peltier modules. This factor is required since the worst case Peltier temperature must be considered in order to achieve a good life from the TEC.

   As the TEC is employed at increasingly higher altitudes, the heat output of the heater will be reduced due to the decrease in available oxygen for proper combustion. The reduction in heat output is nominally considered to be 4% for each 1000 feet above sea level. For example, a TEC in service at 8000 feet elevation may emit 8 times 4%, or 32%, less heat from its heater and approximately 32% less power. Note also that the TEC heater will produce a small amount of unburned gas at altitudes above sea level. This is why the TEC should never be employed indoors.

2. **Amount of oxygen available to the heater surface**
   An air channel exists in the TEC beginning at the air intake vent (located on the bottom of the unit) which allows oxygen to wash over the face of the heater and out the exhaust gas chimney (located on the top of the unit). This air channel MUST be kept open and never taped over or closed by any means. If the channel is obstructed at either the intake vent or the exhaust chimney, the heater output and the corresponding power output of the TEC will be reduced.

3. **Low BTU supply gas**
   If the supply gas to the TEC is below 900 BTU/ft.^{3}, the heater output will be reduced as well as the power output. This condition may be accommodated for by ordering the TEC from the factory with an orifice sized for the reduced BTU content gas.

4. **High BTU supply gas**
   Supply gas higher than 1100 BTU/ft.^{3} will cause the heater to run hotter than normal and could damage the Peltier modules, causing the TEC to fail prematurely.

5. **Proximity to other heat sources**
   If the TEC is mounted in close proximity to other heat sources, such as another TEC, the heat from the other source will inhibit the ability of the TEC's finned heat sinks to shed heat. This condition would reduce the temperature differential across the Peltier modules, thus reducing the power output of the unit.

6. **Exposure to direct sunlight**
   Any time the TEC is exposed to direct sunlight, the efficiency of the heat sinks will be reduced and the power output of the TEC will be slightly reduced. Correspondingly, the TEC should increase in efficiency in the absence of direct sunlight.

7. **Dead air location**
   The efficiency of the TEC heat sinks is dependant upon proper air circulation to allow heat to be washed away from the unit. If the TEC is installed in a location that gets no air circulation, the efficiency of the heat sinks will be reduced, causing a reduction in power output.

Diagnostics

Basic operation of the charger can be monitored using either the SA-216 or using the Windows® based TEC-Monitor software. The SA-216 is a hand held terminal with a 2-line by 16-character display and keypad. Typically, each technician who performs service to the TEC, should have access to the diagnostics equipment.

Both methods require the TEC interface cable and can monitor the battery voltage and temperature, the charge current, the Thermo-Electric module's output voltage, its operating modes, and any error codes. Both devices also allow the battery temperature to be trimmed.

Detailed operating instructions for the SA-216 and the Windows® based TEC-Monitor software can be found in PGI form number IOM-TEC-DCA, included with all Thermo-Electric Chargers containing the option code "D".

Specifications

TEC-8C Specifications

Charger Output	Temperature Compensated for 12V Gel Cell
with "V" Option Code	Temperature Compensated for 24V Gel Cell
Output Power	6.5 - 7.3 Watts continuous at 68°F (20°C) ambient
Remote Battery Temperature Sensor	Silicone diode
Alarm	LED Status & NPN Open Collector, 30V max, 200mA max
Transient Protection	Bi-directional TVS 1500 Watts peak pulse power 1 amp PTC Over Current Protection
Electrical Connections	Liquid tight wire fitting, can be removed to allow for 1/2" conduit fitting
Wire Connections	Screw cage clamp, 14 AWG max
Gas BTU Range	900 - 1100 BTU/ft^3 Natural Gas 2400 - 2600 BTU/ft^3 Propane Gas
Fuel Connection	1/4" FNPT, 0.5 to 15 psi
Fuel Consumption	72 ft^3/day Natural Gas 0.66 gal./day Liquid Propane
Operating Temperature Range	-40°C (-40°F) to 43°C (110°F)
Enclosure	304 stainless steel with anodized aluminum cooling fins, NEMA 3R Wall mount or optional 2" pipe mount
Weight	50 pounds

V-964EDT Filter Valve Specifications

Construction	
Valve Body	6061-T6 hard anodized aluminum
Soft Seat	Delrin®
Stem Seal	Teflon® Pressure Core
Stem	316ss
Bonnet	316ss
Handle Assembly	300 series ss
Seal Retainer	316ss
O-Riings	Viton®
Filter	15 micron
1/8" Hex Plug	316ss
Inlet Filter Housing	6061-T6 hard anodized aluminum
Connections	1/8" NPT inlet, 1/4" NPT outlet
Operation Pressure	15 psi max.
Flow Coefficient	0.83 C_v
Operating Temperature Range	-40°C (-40°F) to 204°C (400°F)

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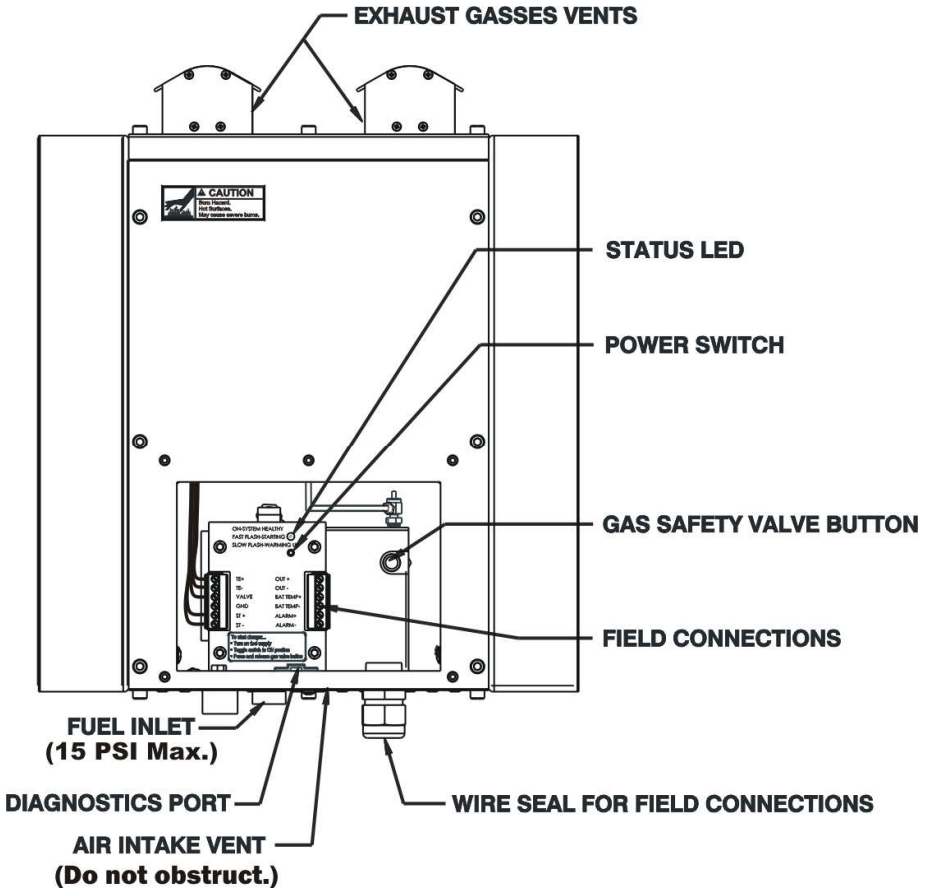
TEC-8C Components



Alarm Contacts

The open collector Alarm output can be used for remote monitoring of the TEC health. When the output is "shorted", the TEC is healthy. If the alarm circuit is "opened", the TEC is not charging the battery and is either OFF or has shutdown. There are several tests performed on the thermal generator system to detect malfunctions and to safely shutdown the system. If the TEC shuts down, the battery will continue to power the connected device for a period of time determined by the battery size and device power requirements.

TEC-8C Installation

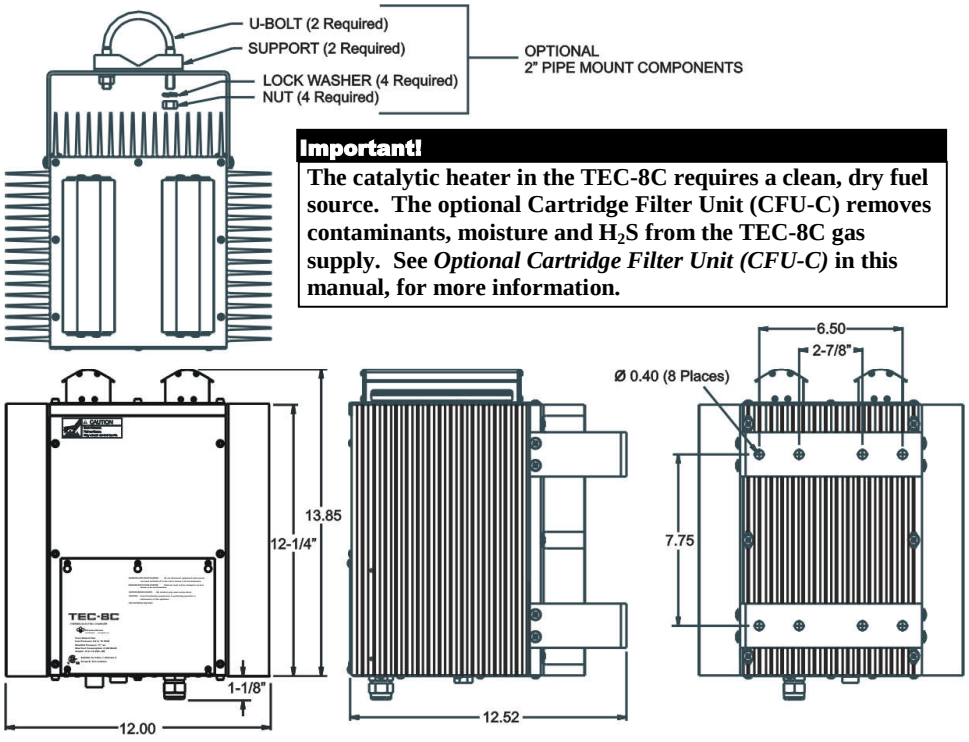
The TEC must be installed upright and in a well-ventilated location. The catalytic heater does not produce harmful carbon monoxide gas, but does need adequate ventilation to ensure oxygen replenishment and removal of any carbon dioxide. Install vertically with the exhaust gas vent on top. The top and bottom vents should be unobstructed to allow fresh air in the bottom and hot gasses out the top.

NOTE: For optimal performance . . .

1. Install the TEC at sea level. The power output decreases 4% for every 1,000 ft. above sea level.
2. Install the TEC in a well-ventilated area. The highest power output is obtained with air circulation on the finned heat sinks.
3. Install the TEC out of direct sunlight. External heat sources reduce the thermal differential across the power-generating modules.
4. Supply the TEC with 900 to 1100 BTU gas. Supply gas with a lower BTU value will reduce power output, but may be compensated for with a larger inlet orifice (consult factory). Conversely, supply gas with a higher BTU value will typically overheat the power-generating modules and lead to premature module failure, but may be compensated for with a smaller inlet orifice (consult factory).

Caution!

The top vent runs hot and may cause severe burns. If installed in a location where contact is possible, protective grills should be used to prevent burns, or the TEC may be raised to restrict access to the top vent.



Important!

The catalytic heater in the TEC-8C requires a clean, dry fuel source. The optional Cartridge Filter Unit (CFU-C) removes contaminants, moisture and H_2S from the TEC-8C gas supply. See *Optional Cartridge Filter Unit (CFU-C)* in this manual, for more information.

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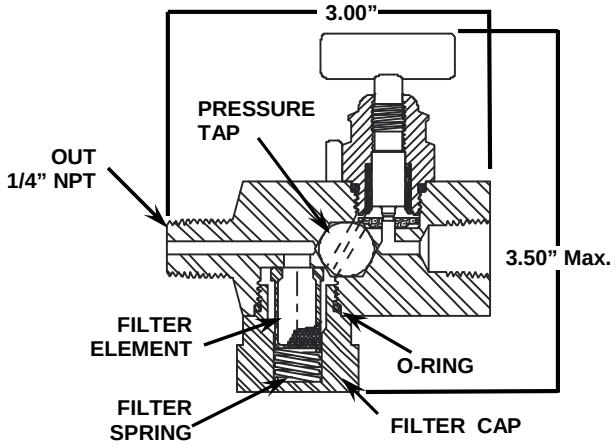
V-964EDT Filter Valve

IMPORTANT!

- **A CSA/UL listed main shut-off valve, such as the V-964EDT, must be installed upstream of all TEC components.**
- **The valve must be able to shut off the gas supply to the TEC-8C without the use of tools and have a downstream test port.**
- **The inside diameter of the supply tubing must be larger than 0.08 inches.**
- **DO NOT USE TEFLON TAPE to seal threaded connections. Small pieces of tape can plug orifices in the low-pressure regulator and heater. Use Loctite® 56747 PST® or equivalent to seal threads.**

Complete V-964EDT specifications are listed in the ***Specifications*** section of this manual.



Optional Cartridge Filter Unit (CFU-C)

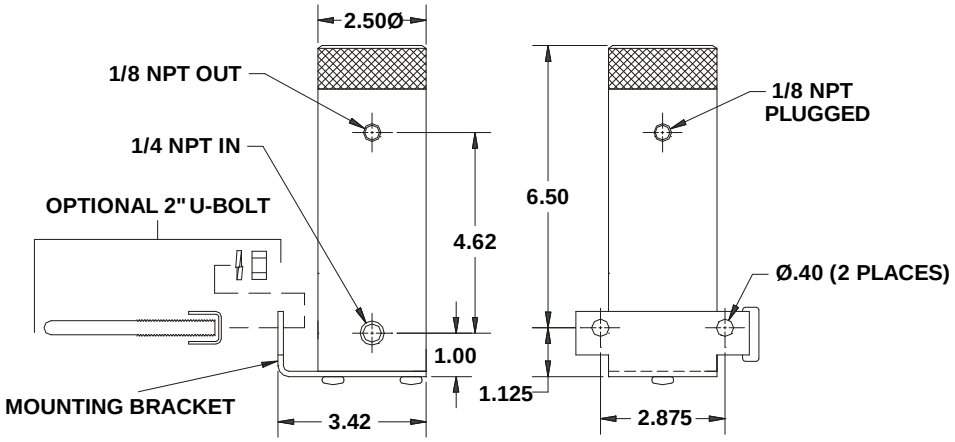
The optional CFU-C will remove contaminants, moisture, and H_2S from the TEC-8C gas supply. The catalytic heater in the TEC-8C requires a clean, dry fuel source and using the CFU-C can extend the life of the catalyst. The CFU-C is outfitted with an AV106S-V-H8 bonnet assembly and a 1/8" NPT drain port to vent any liquids separated from the gas supply.

The gas supply from the regulator pump enters the CFU-C through the 1/4" NPT port on the backside, bottom portion of the scrubber canister. As the gas travels upward through the filter, contaminants are trapped and liquids are dropped to the bottom. The filtered gas is allowed to continue upward to the 1/8" NPT outlet port on the backside, top portion of the canister.

The CFU-C filter life is directly affected by the moisture and H_2S content of the supply gas. For example, a supply gas with a content of 100 PPM H_2S can be expected to perform for 10 months between filter changes. A supply gas with a content of 1000 PPM H_2S can be expected to perform for only 1 month.

Complete CFU-C specifications, including an "approximate life of H_2S filter" graph, are listed in the ***Specifications*** section of this manual.

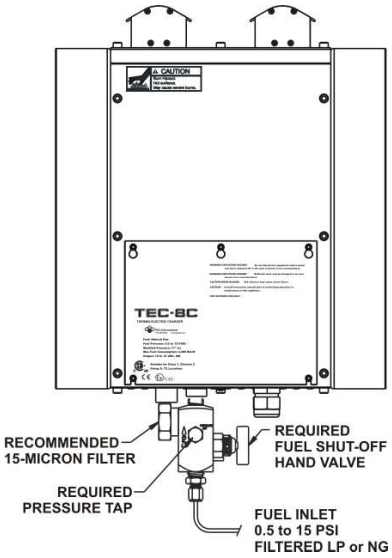
Part Number	Mounting Bracket	2" U-Bolt Assembly
CFU-C	304ss	None
CFU-C-P1	304ss	Carbon Steel
CFU-C-P2	304ss	300 series ss



Fuel Connections

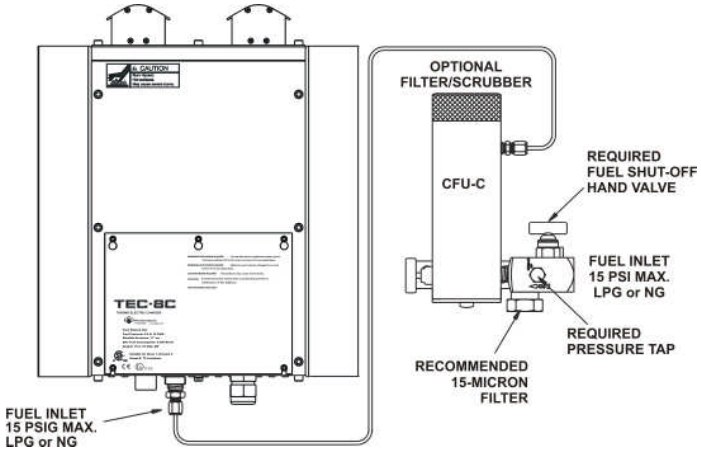
A CSA/UL listed main shut-off valve (such as the V-964EDT) must be installed upstream of all TEC components. The valve must be able to shut off the gas supply to the TEC-8C without the use of tools and have a downstream test port. The V-964EDT must be installed downstream of the High Pressure Regulator as a Main Shut-Off Valve to the TEC-8C. The valve is rated at 15 PSI maximum operating pressure and is outfitted with a 15 micron filter.

Installation with V-964EDT only (0.5 to 15 PSIG Filtered LP or NG)



The optional CFU-C will remove contaminants, moisture, and H_2S from the TEC-8C gas supply. The catalytic heater in the TEC-8C requires a clean, dry fuel source and using the CFU-C can extend the life of the catalyst. The CFU-C is outfitted with an AV106S-V-H8 bonnet assembly and a 1/8" NPT drain port to vent any liquids separated from the gas supply.

Installation with Filter/Scrubber (CFU-C) and V-964EDT (Filter/Scrubber max. Inlet Pressure — 15 PSI)



WARNING!

The fuel supply MUST be clean and dry. Use filters and scrubbers if necessary to ensure a clean, dry fuel source.

Field Wiring Connections

A 20’ cable and a Battery Interface Module is included to interface the TEC-8C to the external battery it will keep charged.

The TEC will not start with a “dead” battery. In order for the TEC to start, the battery to be used must measure greater than 11v for a 12v system, and greater than 22v for a 24v system.

The Battery Interface Module contains a temperature sensor and an over-current protection and should be attached to battery being charged.

A 50’ cable is available by using option code “F” when placing your TEC order. When using the 50’ cable (TE-C85-010-50), refer to installation instructions included with the cable. If not properly installed, as much as 1/2 watt can be lost through the remote battery cable.
NOTE: It is not recommended to run a cable longer than 50 feet.

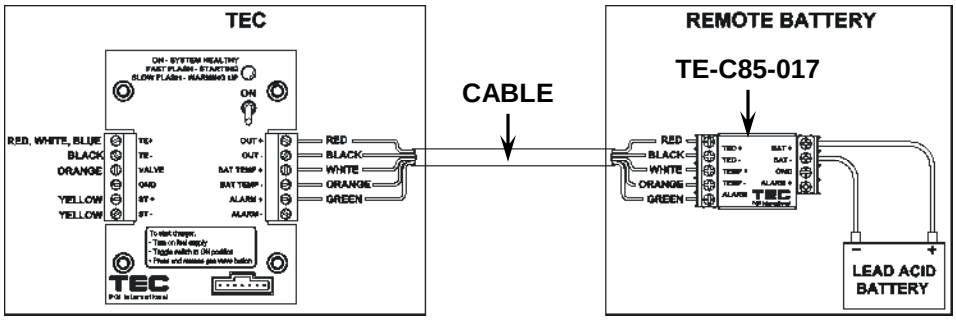
These components may also be purchased separately:

Component	Part Number	Cable Specifications
20’ Cable	TE-C85-010-20	5 Conductor; 20AWG (7x28) Alpha Type 1896/5C
50’ Cable	TE-C85-010-50	7 Conductor; 18AWG (16 x 30) Alpha Type 1898/7C
Battery Interface Module	TE-C85-017	

Cable Installation

WARNING!
Always have the TEC-8C Power Switch in the OFF position and the battery (+) lead disconnected when making field connections.

WARNING!
Always connect the TEC-8C side first, then the remote battery.



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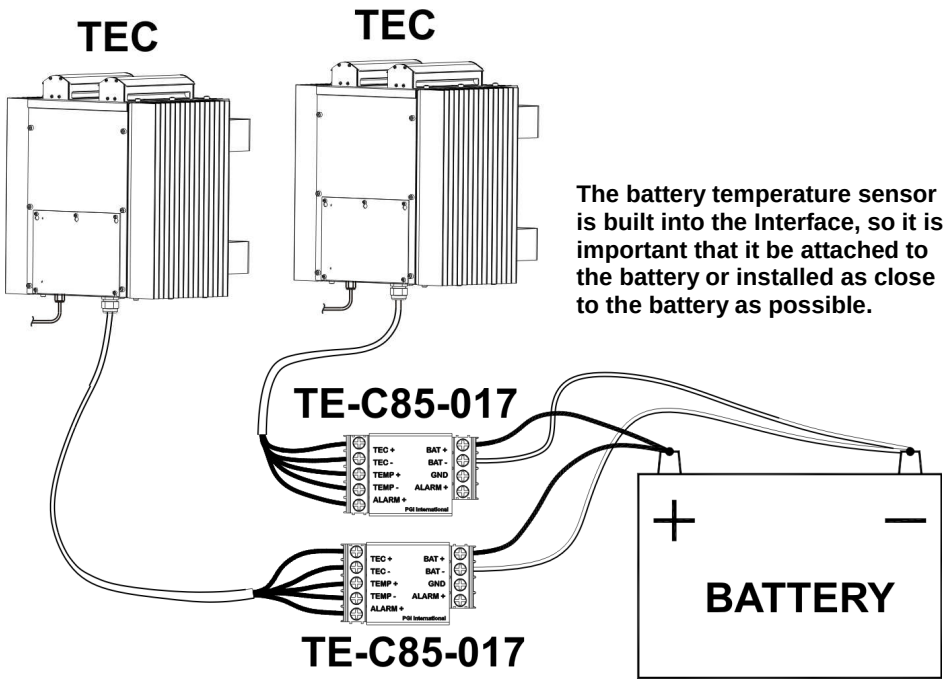
Using Multiple TECs to Charge One Battery

If your battery load is too much for the TEC to keep fully charged, it is possible to connect two or more TEC units to the same battery to increase the charging capacity. For example two TEC-8C units could provide 13 watts of continuous charging capacity.

The TEC Controller uses the battery temperature to accurately determine the battery full charge or setpoint voltage. When connecting multiple TECs to the same battery, each TEC must have its own battery temperature sensor. This is done by connecting a TE-C85-017 Remote Battery Interface for each TEC. **The battery temperature sensor is built into the interface so it is important that it be attached to the battery or installed as close to the battery as possible.**

Since the TECs will be charging the same battery, each TEC should be calibrated so that they display the same battery temperature, and thus will charge to the same full charge or setpoint voltage.



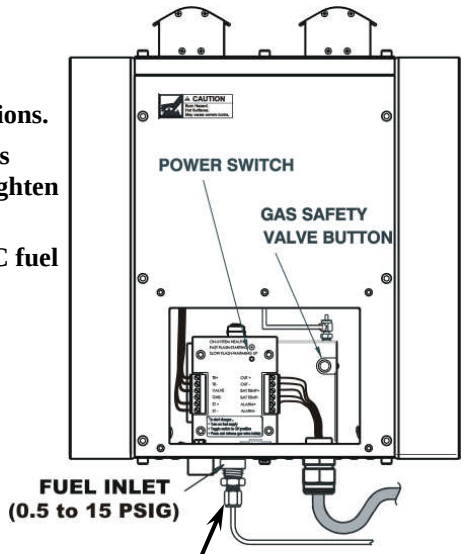
Starting the TEC-8C

Before starting…

- **Check field wiring and all connections.**
- **Bleed the gas supply line as close as possible to the fuel inlet, then re-tighten the fitting.**
- **Test for gas leaks between the TEC fuel inlet and the gas source.**

IMPORTANT!

The air in the gas supply line must be bled as close as possible to the fuel inlet to the TEC-8C.



Loosen the inlet fitting to bleed the system, then re-tighten.

To start the charger . . .

1) Open the main shut-off valve.
2) Toggle the TEC Power Switch to the ON position.
3) With the status LED blinking, press and release the Gas Safety Valve button.

When the Power Switch is toggled ON, the starting element begins to preheat the catalytic heater. Pressing the Gas Safety Valve button opens the valve to allow gas into the heater. The valve is held open by the Controller until either the Power Switch is toggled to the OFF position or the internal diagnostics detects a problem with the system.

When the catalyst reaches the reaction temperature, the heater will begin to warm the ThermoElectric (TE) modules and produce power. After 2 to 3 minutes, or when an increase in the TE voltage is detected, the charger will turn off the starting element and enter a warm up mode.

While starting, the status LED will flash fast. While warming up, the LED will flash slowly. When the TE voltage reaches 4.1 volts, the LED will switch to solid ON, indicating that the system has started and is healthy. It may take up to one hour for the charger to stabilize at its peak power.

The ***Diagnostics*** section of this manual details how to monitor the generator and battery

Shutting Down the TEC-8C

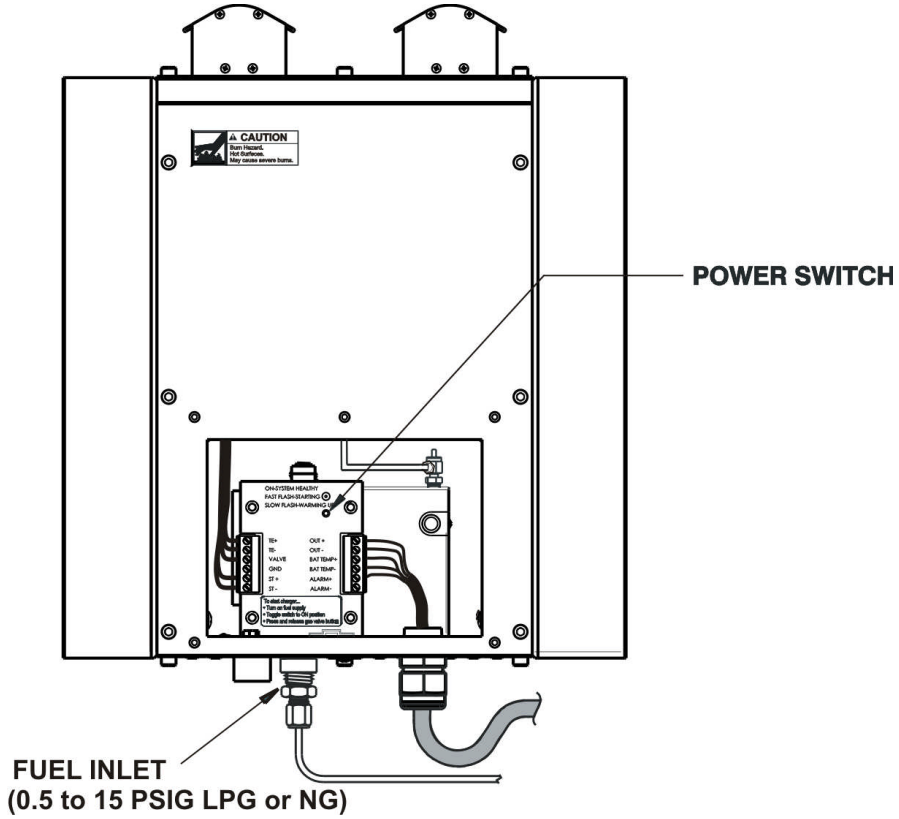
To shut-down the TEC

1. Toggle the Power Switch to the OFF position. The Gas Safety Valve will close automatically.

WARNING!
The Power Switch must be turned to the OFF position <u>BEFORE</u> disconnecting the battery. Otherwise the TEC Gas Safety Valve will not close and the TEC will continue to run.

2. Close the Supply Gas Main Shut-Off Valve.

IMPORTANT!
Close the supply gas main shut-off valve before doing any service to the TEC heating system, or if the unit will be off for an extended time.



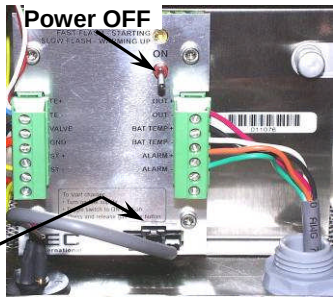
Field Software Upgrades

The TEC software may be upgraded in the field using the **SK-EP-PDU Program Download Utility Kit**. This kit may be installed to upgrade any TEC unit with software at version 6 or higher and hardware at version 5 or higher. The PDU Kit consists of the PDU Cable and a 'Read Only' compact disc containing the program download utility.

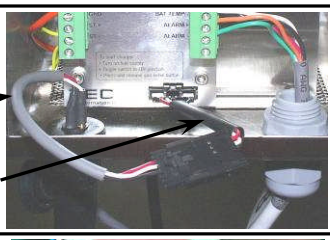
The technician must have access to a Windows® Compatible Computer with an RS232 Serial Port, or a USB Port may be utilized with a USB to Serial/PDA Converter Cable (Part Number TE-C50-104).

After Installing Software to PC . . .

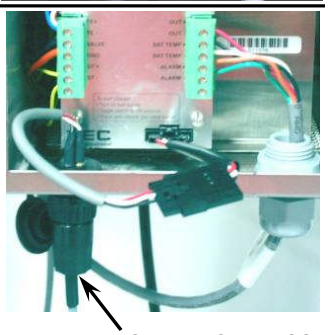
1. Loosen each of the Access Panel screws, using a 7/64" Allen wrench.
2. Slide the Access Panel upward and remove it from the TEC unit.
3. Make sure the Power Switch is in the OFF (down) position.
4. Disconnect the Interface Cable from the Controller.



5. Install the Program Download Utility Cable between the Interface Cable and the Controller.



6. Connect the Diagnostics Cable from the 3-Pin Connector to a Windows® compatible computer.
7. After connecting the Diagnostics Cable, Power ON the TEC unit. The Status Light will go SOLID RED, indicating that the unit is ready for program upgrades.
8. Visit www.pgiint.com to download the appropriate file for your TEC unit: 12 volt or 24 volt.
9. Once the download is complete, power OFF the unit.
10. Remove the PDU Cable and reconnect Interface Cable to the Controller. When the unit is powered ON, the new program will run.



TEC Trouble Shooting

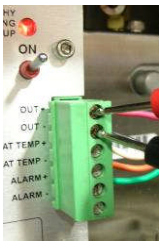
WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be <u>non-hazardous</u>.

PROBLEM

The Controller STATUS LED does not flash when the POWER SWITCH is toggled ON

WHAT TO DO:



- **Use a volt meter to measure the voltage across the OUT+ and OUT– terminals on the TEC Controller Field Wiring Connector.**
  A 12 volt system must measure greater than 11 volts. A 24 volt system must measure greater than 22 volts.
- **Measure the voltage at the battery terminals.**
  If you get a voltage reading at the battery, but not at the OUT+/- terminals on the TEC Controller, it may indicate that the Controller is requiring too much current or that it is shorted.
- Remove one of the WHITE starter wires (ST+ or ST-) and check the OUT+/- voltage again, as shown above. If the voltage returns, and the Status LED is flashing, the starter circuit is shorted. Inspect the WHITE starter wires. If there is no visible damage, return the TEC for factory repair.
- If power is being supplied to the Controller, but the LED does not flash when the Power Switch is in the ON position, replace the TEC Controller circuit board. (Service Kit number **SK-SS-C85-1021-T**.)

TEC Trouble Shooting

WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be non-hazardous.

PROBLEM

While starting the TEC, the Controller STATUS LED flashes for a couple minutes, then flashes slowly (indicating WARMING UP) – but then turns off after several minutes

WHAT TO DO:

- Be sure the TEC Controller POWER SWITCH is in the ON position **BEFORE** pressing the Gas Safety Valve push button.
- Make sure there is no air in the fuel supply line. Bleed out the air in the fuel line by loosening a fitting close to the TEC fuel inlet – especially on new installations. See ***Starting the TEC-8C*** in this manual for bleed location.
- Verify that the fuel BTU content is within the required range. See ***TEC-8C Specifications*** in this manual.
- Check the battery voltage. If the battery voltage is less than 11 volts for a 12 volt system or less than 22 volts for a 24 volt system, re-charge or replace the battery and re-start the TEC.
- Check the fuel supply pressure – the TEC requires 0.5 to 15 PSI.
- Check the operating fuel pressure inside the TEC.
  1) Remove the 1/8" NPT plug in the bottom of the Safety Valve and install an accurate pressure test gauge.
  2) Press and hold the Gas Safety Valve button. The reading must be between 10 and 12 inches of water (0.36 to 0.43 PSIG). If the reading is outside of this range, the Low Pressure Regulator must be replaced. This Regulator is not field replaceable. Please return the TEC for factory repair.
- Inspect the heater orifice fitting. See ***Replacing the Orifice Fitting*** in this manual.
- Evaluate the fuel source. The TEC heater requires a clean, dry fuel source and using a Filter/Scrubber can extend the catalyst life by removing contaminants, moisture, and H_2S from the gas supply. See ***Optional Cartridge Filter Unit*** in this manual..
- **Test the starter…**
  1) Toggle the Controller Power Switch to the OFF position.
  2) Remove the 6-pin connector on the left side of the Controller and measure the resistance across the two WHITE wires.
  3) Verify between 14 and 16 ohms for the 12 volt TEC and 28 to 32 ohms for the 24 volt TEC.

  An open circuit indicates a bad starter element in the heater. Heater starters are not field-replaceable. Return the unit for a factory replacement.
- **Test the starter circuitry…**
  1) Toggle the Controller Power Switch to the ON position.
  2) Measure the voltage across the ST+ and ST- terminals.
  3) Verify the starter voltage is the same as the battery voltage +/- 0.5 volts. The starter voltage can only be measured while the status LED is flashing fast, STARTING.

  If the starter voltage is low, replace the TEC Controller circuit board. (Service Kit number **SK-SS-C85-1021-T**.)

TEC Trouble Shooting

WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be <u>non-hazardous</u>.

PROBLEM

Gas Safety Valve does not appear to stay open

WHAT TO DO:

There are two ways to test the Safety Valve . . .

- **Do an audible test of the Safety Valve . . .**
  1) Turn on the Controller and verify that the Status LED is flashing.
  2) Press and release the Gas Safety Valve button.
  3) Place the working end of a screwdriver (or a piece of wood) on the Safety Valve and place your ear on the opposite end. *SLOWLY* toggle the Power Switch to the OFF position (to reduce the clicking of the switch) and listen for the valve snapping closed.

  If you hear the valve snap to the CLOSED position, the valve circuit is functioning properly.

  If the valve does **<u>not</u>** snap to the Closed position, the Safety Valve must be replaced.

  The Safety Valve is not field replaceable. Please return the TEC for factory repair.

OR . . .

- **Test the electro-magnet inside the Safety Valve . . .**
  1) Make sure the Controller Power Switch is in the OFF position.
  2) Unplug the 6-pin terminal block on the left side of the Controller.
  3) Measure the resistance between the VALVE terminal (ORANGE WIRE) and the TEC enclosure. The resistance should be between 1 and 3 ohms. If the reading is outside this range, return the unit for factory repair.

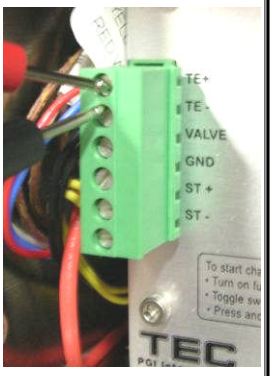
TEC Trouble Shooting

WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be non-hazardous.

PROBLEM

The TEC charging power is low.



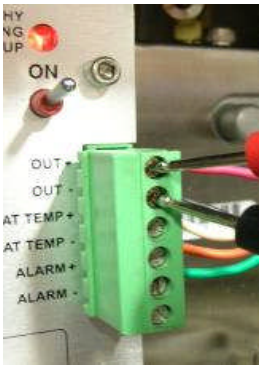
WHAT TO DO:

Measure the TE Voltage across the TE+ and the TE– terminals on the left side of the Controller.

If the TE Voltage is over 4.2 volts DC:

- the battery is near fully charged
- the TEC is in 'TRICKLE' mode
- the TEC charging power cannot be measured at this time

If the TE Voltage is between 4.0 and 4.2 volts DC:



1) Measure the Battery Voltage across the OUT+ and OUT– and record the value.
2) Use a Milli-Amp Clamp Meter to measure the Charge Current. (Place the clamp around the OUT+ wire on the right side of the Controller.)
3) Multiply the Battery Voltage times the Charge Current to get the TEC Charging Power.

(Battery Voltage x Charge Current = TEC Charging Power)

If the TE Voltage is below 4.0 volts DC:

- Make sure the air intake and exhaust vents are unobstructed. (See ***TEC-8C Components*** for locations.)
- Check the fuel supply pressure - the TEC requires 0.5 to 15 PSI.
- Verify that the fuel BTU content is within the required range (See ***TEC-8C Specifications*** in this manual)
- Check the operating fuel pressure inside the TEC.
  1) Remove the 1/8" NPT plug in the bottom of the Safety Valve and install an accurate pressure test gauge.
  2) Press and hold the Gas Safety Valve button. The reading must be between 10 and 12 inches of water (0.36 to 0.43 PSIG). If the reading is outside of this range, the Low Pressure Regulator must be replaced. This Regulator is not field replaceable. Please return the TEC for factory repair.
- Inspect the heater fuel orifice and replace if necessary. (See ***Replacing the Orifice Fitting*** in this manual.)

CONTINUED ON NEXT PAGE . . .

TEC Trouble Shooting

WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be non-hazardous.

PROBLEM

The TEC charging power is low. ***(cont'd.)***

WHAT TO DO:

Measure the Hot Plate temperatures.

See ***Measuring Hot Plate Temperature*** in this manual.

If the hot plate temperatures are found to be above the acceptable limit and the charging power is low, then module failure may have occurred. The unit must be returned to the factory to diagnose module failure.

Low charging power may also be caused by a contaminated catalyst. If this condition is suspected, due to dirty, wet, or H_2S contaminated supply gas, return the TEC for factory repair.

PROBLEM

The battery temperature indicated by the TEC Monitor software or SA-216 terminal is not accurate.

WHAT TO DO:

Check the electrical connections between the TEC Controller and the TEC Remote Battery Interface module. Verify all connections are as shown in the *Cable Installation* section of this manual.

Test the temperature sensor with the Controller power ON, (LED flashing or solid ON).

- Connect a volt meter (positive lead to BAT TEMP+ and negative lead to BAT TEMP-) to measure the voltage across the sensor.
- The voltage will vary with temperature, but should be between 0.3 volts and 0.8 volts. A shorted sensor will read less than 0.1 volts and an open sensor greater than 2.5 volts.

If you find a bad sensor, replace the Battery Interface Module (Service Kit number **SK-TE-C85-017**).

Calibrate the temperature sensor.

- Determine the actual battery temperature, or the temperature inside the battery compartment.
- Using the TEC Monitor software (or SA-216 terminal) – enter the actual temperature to trim the value used by the Controller.
- Verify the temperature reported by the TEC Monitor (or SA-216) is at or near the actual temperature.

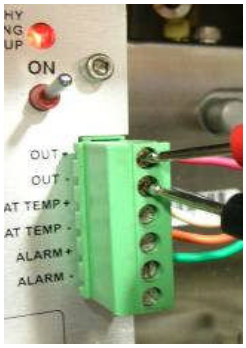
TEC Trouble Shooting

WARNING! WARNING! WARNING! WARNING! WARNING! WARNING!

Do not perform any service on the TEC unless the area is known to be <u>non-hazardous</u>.

PROBLEM

The battery voltage displayed by the TEC Monitor or SA-216 terminal does not match the actual battery voltage.



WHAT TO DO:

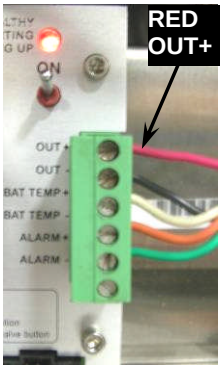
Calibrate the Battery Voltage.

- Measure the Battery Voltage across the OUT+ and OUT- terminals on the right side of the Controller.
- Using the TEC Monitor software – enter the actual Battery Voltage to trim the value used by the Controller.

Verify the Battery Voltage reported by the TEC Monitor is equal to the actual Battery Voltage.

PROBLEM

The TE voltage displayed by the TEC Monitor or SA-216 terminal does not match the TE voltage measured at the TE+/TE- Controller terminals.

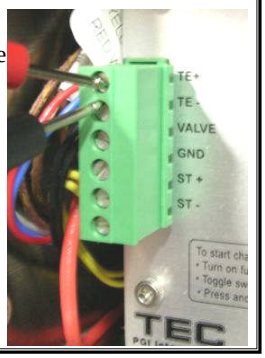


WHAT TO DO:

Calibrate the TE Voltage.

<u>Before calibrating,</u>
<u>the TEC should be completely warmed up.</u>
<u>Warming can take up to an hour.</u>

- Carefully remove the red OUT+ wire from the Controller terminal.
  WARNING – DO NOT ALLOW THE RED LEAD TO SHORT TO OTHER CIRCUITS. PERMANENT DAMAGE COULD OCCUR.
- Measure the TE Voltage across the TE+ and TE- terminals on the left side of the Controller.
- Using the TEC Monitor software – enter the actual TE Voltage to trim the value used by the Controller.
- Verify the TE Voltage reported by the TEC Monitor is equal to the actual TE Voltage.
- Carefully re-install the red OUT+ lead to the Controller terminal.



Measuring Hot Plate Temperature

The TEC-8C has three Hot Plates, only two of which can be monitored (left and right) with an embedded Type K thermocouple. The left Hot plate is tagged with a RED heat shrink at the end of the thermocouple lead and the right Hot Plate with a BLUE heat shrink.

If the Hot Plate temperatures are found to be *above* the acceptable limit and the unit is yielding low power output, then module failure may have occurred. The TEC must be returned to the factory to diagnose module failure.

To measure the Hot Plate temperature . . .

1. Uncoil the Type K thermocouple from the open area inside the TEC enclosure. (The TEC-8C has thermocouples on the left and right Hot Plates.)

2. Using a handheld, digital thermometer (PGI part number P9-082) or equivalent, plug the YELLOW (+) lead into the (+) lead on the thermometer and the RED (-) lead into the (-) lead on the thermometer.

This will give an accurate indication of the temperature of the hot plate.

Checking for Normal Hot Plate Temperature

With the unit in 'Charge' mode (Set-Point higher than the Battery Voltage), not in direct sunlight, and with an ambient temperature of 68°F (20°C), the Hot Plate should be between 295°F (146°C) and 330°F (165°C). If the unit is in 'Trickle' mode (Set-Point equal to or lower than the Battery Voltage), the temperatures may be approximately 20°F (-7°C) hotter.

WARNING!

Excessively high Hot Plate temperatures will lead to premature generator module failure.

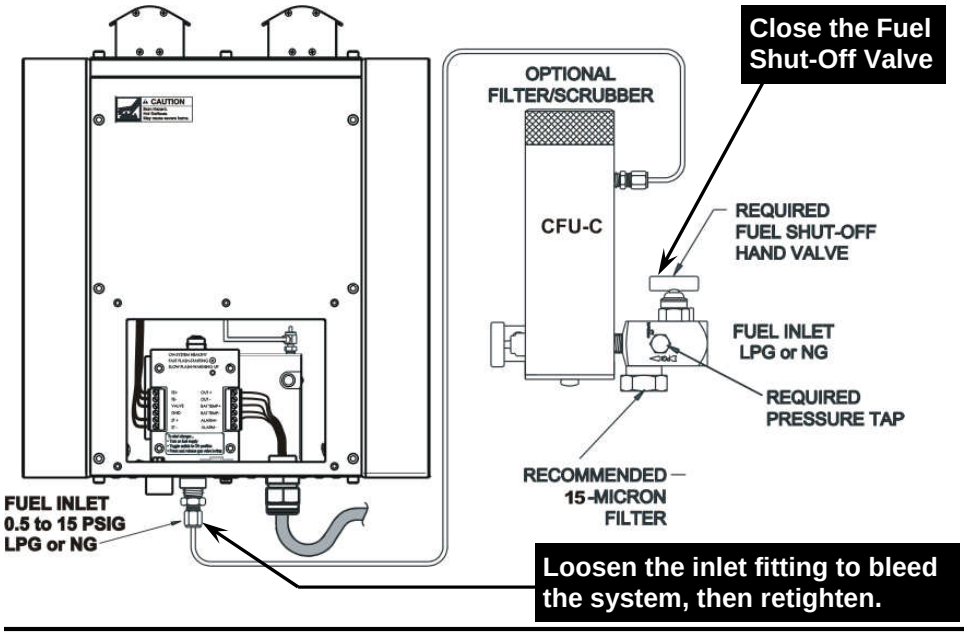
Low Hot Plate Temperature and Loss of Power

Hot Plate temperatures less than 285°F (140°C) may indicate Heater failure due to a contaminated catalyst or a partially clogged orifice.

Supply gas with a low BTU value may also cause low Hot Plate temperature and low power output.

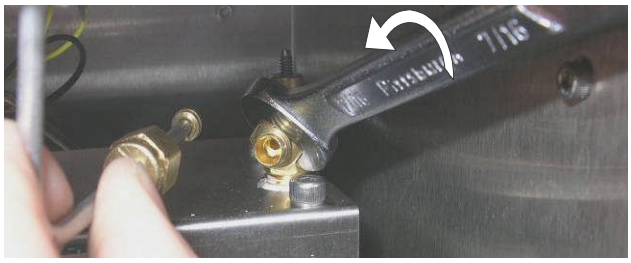
Replacing the Orifice Fitting (PGI Part Number P8-202-N0)

1. Close the Fuel Shut-Off Valve and bleed the system by loosening the inlet fitting.
2. Using a 7/64” Allen wrench, loosen the five screws and remove the Access Panel.
3. Move the POWER SWITCH to the OFF position and disconnect the field connection harness.

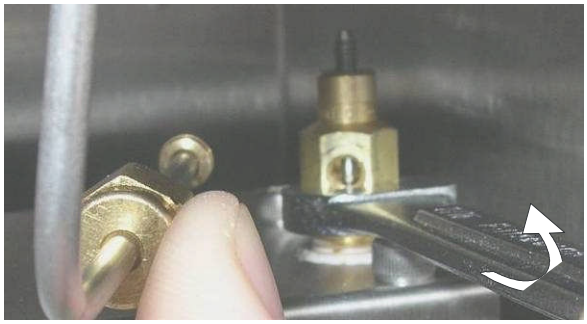


4. Using a 3/8” Open-End wrench, remove the Tubing Nut from the Orifice Fitting.

5. Next, using a 5/16” wrench, remove the Adapter from the Orifice Fitting and retain for re-assembly.



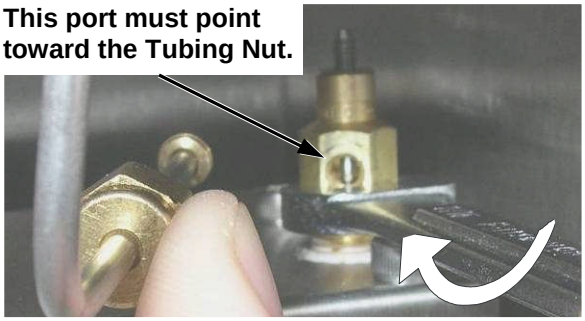
6. Using a 7/16” Open-End wrench, remove the Orifice Fitting and discard.



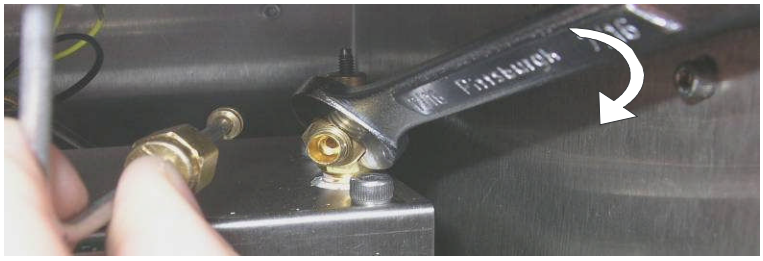
NOTE: The replacement Orifice Fitting has been pre-set at the factory. Do not break the adjustment thread seal.

7. Apply liquid thread sealant to the threads of the new Orifice Fitting.

8. Install the new Orifice Fitting and tighten, making sure that the adapter port points toward the Tubing Nut.



9. Re-install the Adapter into the Orifice Fitting and tighten with the 5/16” wrench.

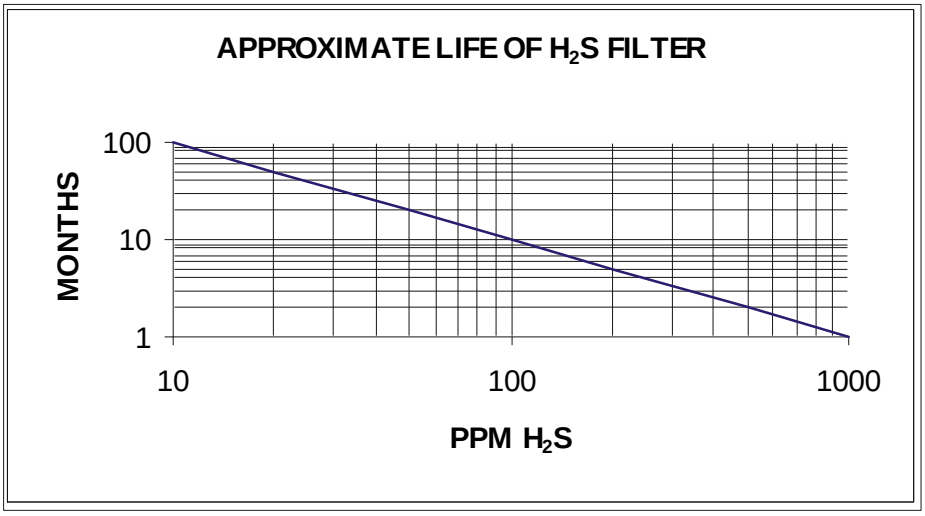


10. **Be sure that the inlet fitting, underneath the unit, has been re-tightened.**
11. Re-install the Tubing Nut and tighten with the 3/8” wrench.
12. Re-connect the Field Connection Harness.
13. See ***Starting the TEC-8C*** to re-test the unit.

Specifications

Optional Cartridge Filter Unit (CFU-C) Specifications

Construction ..... Hard anodized aluminum
Mounting .....304 stainless steel bracket less U-bolt - standard
optional 2” pipe mount
Connections ..... 1/4" NPT inlet, 1/8” NPT outlet
Drain..... Valve operated (1/8” NPT port)
Maximum Operating Pressure ..... 15 psi



Warranty

A. Warranty

PGI International warrants that at the time of shipment the products manufactured by PGI International and sold hereunder will be free from defects in material and workmanship, and will conform to the specifications furnished by PGI International.

B. Warranty Adjustment

1) If any defect within this warranty appears, Buyer shall notify PGI International immediately.

2) PGI International agrees to repair or furnish a replacement for, but not install, any product which within one (1) year from the date of shipment by PGI International shall, upon test and examination by PGI International, prove defective within the above warranty.

3) No product will be accepted for return or replacement without the written authorization of PGI International. Upon such authorization, and in accordance with instructions by PGI International, the product will be returned shipping charges prepaid by Buyer. Replacements made under this warranty will be shipped prepaid. All returns must be shipped in the original packaging.

C. Exclusions from Warranty

1) THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER EXPRESSED OR IMPLIED WARRANTIES OR MERCHANTABILITY, OR FITNESS, OR OTHERWISE.

2) Components manufactured by any supplier other than PGI International shall bear only the warranty made by the manufacturer of that product, and PGI International assumes no responsibility for the performance or reliability of the unit as a whole. Elastomer seals or **battery packs** that require replacement as a result of normal operation are also excluded.

3) In no event shall PGI International be liable for indirect, incidental or consequential damages nor shall the liability of PGI International arising in connection with any products sold hereunder (whether such liability arises from a claim based on contract, warranty, tort or otherwise) exceed the actual amount paid by Buyer to PGI International for the products delivered hereunder.

4) The warranty does not extend to any product manufactured by PGI International which has been subjected to misuse, neglect, improper installation or to use in violation of instructions furnished by PGI International.

5) The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than PGI International's factory or to service performed by persons not expressly approved by PGI International or to specifications not furnished by PGI International.

USER NOTES

CE/ATEX Declaration of Conformity

PGI International, 16101 Vallen Drive, Houston, Texas 77041, ensures and declares that the ThermoElectric Charger (TEC) that it manufactures, consisting of small, hand-operated valves and electrical equipment, will operate safely in a potentially explosive atmosphere pertaining to Group II, Category 3 in accordance to Article 1(2) of the ATEX Directive 94/9/EC. PGI's quality system is ISO 9001 certified and complies with the following Industry Standards and Practices:

- CSA Standard C22.2 No. 0-M91; General Requirements — Canadian Electrical Code, Part II.
- CSA Standard C22.2 No. 0.4-M1982; Bonding and Grounding of Electrical Equipment.
- CSA Standard C22.2 No. 3-M1988; Electrical Features of Fuel-Burning Equipment.
- ANSI Z83.20-2001/CSA 2.34-2001; Gas-Fired Low-Intensity Infrared Heaters.
- Technical Information Letter E-19; Thermo-Electric Generators for use in Class I, Division 2, Group D Hazardous Locations.
- CSA Standard C22.2 No. 213-M1987; Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations.
- CSA Standard C22.2 No. 107.2-01; Battery Chargers.
- UL 1604; Electrical Equipment for Use in Class I and II, Division 2 and Class III Hazardous Locations.
- UL 1012; Power Units Other Than Class 2.

Spence Nimberger, President

PGI International

PGI International, Ltd.

Excellence Through Innovation

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TEC-8C™

(FOR CANADA ONLY)

CSA approved for Class I, Division 2, Group D hazardous locations.

CE approved for Group II, Category 3G

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