



WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings exactly could result in serious injury, death, or property damage.

- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**
- **WHAT TO DO IF YOU SMELL GAS**
 - **Do not try to light any appliance.**
 - **Do not touch any electrical switch; do not use any phone in your building.**
 - **Leave the building immediately.**
 - **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
 - **If you cannot reach your gas supplier, call the fire department.**
- **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**



WARNING

FIRE, EXPLOSION, AND ASPHYXIATION HAZARD

Improper adjustment, alteration, service, maintenance, or installation can cause serious injury or death.

Read and follow installations and precautions in User's Information Manual provided with this appliance.

Installation and service must be performed by a qualified service agency or the gas supplier.

WARNING: For outdoor use only.

Not for use in residential dwellings.

WARNING: Do not attempt to clean catalytic pad.

Follow cleaning instructions accompanying appliance.

NOTICE TO INSTALLER: These instructions shall be left with the consumer.

NOTICE TO CONSUMER: You must read all instructions in the manual and must keep all manuals for future reference.



AVERTISSEMENT

RISQUE D'INCENDIE OU D'EXPLOSION

Si les consignes de sécurité ne sont pas suivies à la lettre, cela pourrait entraîner une utilisation dangereuse, la mort, de graves blessures ou des dommages matériels.

- Ne pas entreposer ni utiliser d'essence ou d'autres vapeurs et liquides inflammables à proximité de cet appareil ou n'importe quelle application.
- **QUE FAIRE SI UNE ODEUR DE GAZ EST DÉTECTÉE**
 - Ne mettre en marche aucun appareil.
 - Ne toucher aucun interrupteur électrique; ne pas utiliser de téléphone dans le bâtiment.
 - Quitter le bâtiment immédiatement.
 - Appeler immédiatement le fournisseur de gaz en utilisant le téléphone d'un voisin. Suivre les instructions du fournisseur de gaz.
 - Si le fournisseur de gaz n'est pas accessible, appeler le service d'incendie.
- Installation et l'entretien doivent être effectués par un installateur ou une entreprise d'entretien qualifié, ou le fournisseur de gaz.



AVERTISSEMENT

RISQUE D'INCENDIE, D'EXPLOSION ET D'ASPHYXIE

Si un réglage, une modification, une réparation, en entretien ou l'installation est effectué de façon inadéquate, cela pourrait causer de graves blessures ou la mort.

Lire et suivre les instructions et les précautions fournies dans le manuel de l'utilisateur accompagnant cet appareil.

L'installation et l'entretien doivent être effectués par un installateur ou une entreprise d'entretien qualifié, ou le fournisseur de gaz.

AVERTISSEMENT: Utiliser uniquement à l'extérieur.

AVERTISSEMENT: N'essayez pas de nettoyer le tampon catalytique. Suivez les instructions de nettoyage accompagnant cet appareil.

AVIS À L'INSTALLATEUR: Ces instructions doivent être remises au consommateur.

AVIS AU CONSOMMATEUR: Vous devez lire toutes les instructions du manuel et conserver tous les manuels pour référence future.



Sentinel

Thermoelectric Generator

OPERATING MANUAL

ETL CLASSIFIED



Intertek
4008107

CLASS I, DIVISION 2, GROUP D, T3 -40°C to 49°C (-40°F to 120°F)

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1 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual provides instructions for the operation and maintenance of the Sentinel Thermoelectric Generator, certified to Class I, Division 2, Group D, T3 -40°C to 49°C [-40°F to 120°F] Hazardous Location. Correct operation and maintenance according to this manual is critical for proper appliance function and safety. Read the following safety warnings and precautions before beginning assembly, installation, or performing any maintenance activities.

1. The installation of the of the Sentinel Thermoelectric Generator must conform with local codes or, in the absence of local codes, with CSA-B149.1 – Natural Gas and Propane Installation Code.
2. When installed, the Sentinel Thermoelectric Generator must be electrically grounded in accordance with local codes, or in the absence of local codes, with CSA C22.1 – Canadian Electrical Code.
3. Keep the Sentinel Thermoelectric Generator area clear and free from combustible materials, gasoline, and other flammable vapours and liquids. Maintain minimum clearances specified in Section 3 of this manual.
4. The Sentinel Thermoelectric Generator consists of sub-systems that combust gaseous fuel which can pose high surface temperature hazards. Operators and service personnel should avoid indicated areas of the generator to avoid burns or clothing ignition when in operation or cooling down.
5. Any guard or other protective device removed for servicing the Sentinel Thermoelectric Generator must be replaced prior to operating the appliance.
6. Installation and repair should be performed by a qualified service technician. The Sentinel Thermoelectric Generator should be inspected before use and at least annually by a qualified service technician. More frequent cleaning may be required as necessary. It is imperative that control compartment, bottom inlet screen, and circulating air passageways of the appliance are kept clean.
7. Do not use the Sentinel Thermoelectric Generator if any part has been under water. Immediately call a qualified service technician to inspect the Sentinel Thermoelectric Generator and to replace any part of the control system and any gas control that has been under water.
8. Inspect and check all gas connections for leaks using a commercially available liquid leak detection fluid after installation or service to any part of the fuel system. Remedy any fuel system leaks prior to starting the Thermoelectric Generator.
9. This appliance contains electrical- and gas-related safety devices as identified throughout this manual. Tampering or rendering inoperative any of these safety devices may result in personal injury or death and possible damage to the appliance and is not permitted under any circumstances.
10. The Sentinel Thermoelectric Generator is designed to combust gaseous fuels which will result in combustion products of heat, carbon dioxide, and water vapour and may contain traces of carbon monoxide, unburnt hydrocarbons, and nitrous oxides. Emissions from combustion will depend on generator set-up and operation as well as the composition of the gas feed. It is imperative that these instructions be followed, and that gas supplied meets Global Power Technologies' gas specifications.
11. Fuel supplied to the Sentinel Thermoelectric Generator must not contain liquids. Liquid hydrocarbons in the fuel supply pose a risk of fire and may result in serious damage to the Thermoelectric Generator and danger for the operator.

12. Do not exceed the fuel pressure stamped on the data plate without factory approval. If fuel pressure exceeds reasonable levels, the power unit may be seriously and permanently damaged.
13. The Sentinel Thermoelectric Generator exhaust can be very hot. Do not touch any of the exhaust components or bring exposed skin near hot exhaust gases.
14. Exhaust gases are toxic and should not be inhaled. The Sentinel Thermoelectric Generator is strictly an outdoor appliance and should never be used indoors. Avoid inhaling exhaust gases while working around or above the Sentinel Thermoelectric Generator.
15. The heater cartridge will become hot during normal operation. Ensure that the Sentinel Thermoelectric Generator has been given enough time to cool, before handling the heater cartridge.
16. The Sentinel Thermoelectric Generator must be installed on or over non-combustible floors.
17. Do not use the Sentinel Thermoelectric Generator if the catalytic pad becomes torn or damaged. Continuous use may result in injury or death due to fire, explosion, or carbon monoxide poisoning. The appliance must be serviced by a licensed and qualified service technician.
18. Installation of this appliance at altitudes above 2,000 ft [610 m] shall be in accordance with local codes, or in the absence of local codes, the National Fuel Gas Code, ANSI Z223.1/NFPA 54 or the National Standard of Canada, Natural Gas and Propane Installation Code, CSA B149.1.
19. The Sentinel Thermoelectric Generator is FOR OUTDOOR USE ONLY.
20. The Sentinel Thermoelectric Generator and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 3.5 kPa (0.5 psi).
21. The Sentinel Thermoelectric Generator must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 0.5 psi [3.5 kPa].
22. The Sentinel Thermoelectric Generator consists of some parts constructed from sheet metal. While every effort is made to ensure that edges have been deburred when manufactured, sharp edges may still exist. Caution must be exercised when handling and use of gloves is recommended.
23. If a hose assembly is used to connect the Sentinel Thermoelectric Generator to the gas supply piping system, inspect the hose assembly before each use of the Sentinel Thermoelectric Generator. The hose assembly must be replaced prior to the appliance being put into operation if there is evidence of excessive abrasion or wear, or if the hose is damaged. The replacement hose assembly shall be as specified by the manufacturer. Properly locate the hose out of pathways where people may trip over it or in areas where the hose may be subject to accidental damage.
24. When the Sentinel Thermoelectric Generator is operating, surface temperatures of the unit can approach temperatures close to 200°C [392°F]. Avoid contact of skin and clothing with the surfaces of the TEG to avoid burns.
25. For any customer connection, use wires rated for at least 100°C [212°F].

1.1 MANUAL ICONS AND SAFETY BANNERS



WARNING!

A banner with the word “WARNING!” below an icon with an exclamation point within a red triangle contain important information that, if not adhered to, can cause personal injury and/or property damage.



CAUTION!

A banner with the word “CAUTION!” below an icon with an exclamation point within a red triangle contain important information that, if not adhered to, can cause damage to the Sentinel Thermoelectric Generator.

NOTE: A banner with the word “NOTE:” contains supplemental information that provide additional insight on specific topics.

1.2 TECHNICALLY QUALIFIED PERSONNEL

This manual contains necessary information for the correct operation of the Sentinel Thermoelectric Generator and is intended for use by technically qualified service technicians. Technically qualified technicians are individuals who are:

- ✓ Knowledgeable and experienced with industrial fuel and electrical equipment.
- ✓ Knowledgeable in national, ANSI, or CSA gas and electrical standards.
- ✓ Familiar with the installation, operation, and maintenance of Thermoelectric Generators (TEG).
- ✓ Have completed the Sentinel TEG training.

1.3 COPYRIGHT, LIABILITY, AND CONTACT INFORMATION

This manual provides instructions for the installation, operation, performance, basic maintenance and troubleshooting of the Sentinel Thermoelectric Generator.

All agreements, assurances, and legal relationships as well as all obligations of GPT, shall be governed by the respective valid purchase contract which is not influenced by the content of this document.

For any technical issues or questions:

Global Power Technologies – Head Office

#16, 7875 – 57 Street SE
Calgary, Alberta
Canada T2C 5K7

Phone: 1-403-236-5556
Fax: 1-403-236-5575
Customer Service/Technical Support: 1-403-720-1190

Copyright

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Liability

The user is expressly warned to consider and adopt all safety precautions that might be indicated by the activities herein and to avoid all potential hazards. The user assumes all risks in connection with such instructions. GPT shall not be liable for any special, consequential, exemplary, or other damages resulting, in whole or part, from the user’s use of, or reliance upon this material.

Comments

GPT has compiled this publication with care, but GPT does not warrant that the information in this publication is free of errors. Comments, criticisms, and suggestions regarding the subject matter are invited. Any errors or omissions in the data should be brought to the attention of GPT. If required, affected pages will be revised and issued.

2 PRODUCT INFORMATION

The Sentinel Thermoelectric Generator is a solid-state appliance that produces electrical power by directly converting heat into electricity. It has no moving parts and is a reliable, low-maintenance source of DC electrical power for applications where regular utilities are unavailable or unreliable.

The Sentinel Thermoelectric Generator features the following:

Power output	
Power Ratings at 20°C [68°F]	8 Watts, for annual maintenance (at sea level)
Electrical	
Adjustment Range	12 Volt Model: 12-15 Volts DC 24 Volt Model: 24-29 Volts DC
Reverse Current Protection	Yes
Output	Terminal block accepts up to 10 AWG wires. Terminal block located in cabinet. Opening for 1/2" conduit in base of cabinet.
Fuel	
Maximum Supply Pressure	172.4 kPa [25 psi]
Minimum Supply Pressure	34.5 kPa [5 psi]
Fuel Connection	1/4" female NPT
Environmental	
Ambient Operating Temperature Continuously Running TEG	Min. -40°C [-40°F] to Max. +49°C [+120°F]
Operating Conditions	Unsheltered Operation
Altitude	Up to 2,000 m [6,562 ft]**
Materials of Construction	
Cabinet	304 Stainless Steel
Mounting Bracket	304 Stainless Steel
Cooling Type	Natural Convection
Catalytic Heater Assembly	Metal Components – 304 Stainless Steel Ceramic wool catalyst pad Ceramic wool insulation
Fuel System	Brass, Aluminum, and Stainless Steel

The above specifications are for standard Sentinel Thermoelectric Generator

NOTE: configurations. Global Power Technologies also offers customized products and systems to accommodate custom voltages, fuel supply systems, and operating temperatures.

*Correction factors need to be applied based on site conditions. See Sections 4 & 5 for details.

**Sentinel can be installed at higher altitudes; Section 4 discusses altitude effect on power output.

2.1 TERMS AND ACRONYMS

The following terms and acronyms are used throughout this manual:

GPT	Global Power Technologies
Thermoelectric Generator (TEG)	An appliance that produces electrical power by directly converting heat to electricity.
Thermoelectric Modules	Portion of the TEG that consists of thermoelectric materials that convert differential temperature to electric energy.
Rated Power	The nominal power that the Sentinel TEG produces when operating in an ambient temperature of 20°C [68°F] at sea level.
BOCL	At Beginning of Catalyst Cartridge Life.
Open Circuit Voltage (OCV)	<p>Voltage at the terminals of the power unit when no current is flowing (open circuit).</p> <p>This open circuit voltage is related to the temperature across the thermoelectric materials inside the Sentinel TEG's power unit.</p> <p>This open circuit voltage is measured at certain ambient temperature, specific altitude, with specific manifold fuel pressure, during factory acceptance testing.</p> <p>Open circuit voltage is used to set-up the TEG during commissioning and annual maintenance. The open circuit voltage is directly related to power output and is used as a baseline measurement to confirm power output.</p>
Manual Shut-off Valve	A manually operated valve in the gas line that is used to turn on or shut off the gas supply to the TEG.
Safety Shut-off Valve	<p>A valve that automatically shuts off the gas supply to the catalytic heater assembly if the source of heat fails.</p> <p>This valve is located inside the instrumentation enclosure and interrupts the flow of gas to the rest of the fuel system/heater.</p> <p>The safety shut-off valve has a plunger that needs to be manually pressed and held down to initiate fuel flow to the system.</p> <p>A thermocouple placed in the heater cartridge keeps this valve open when the system is within the designated temperature range.</p>
Catalytic Heater Assembly	The catalytic cartridge combusts the fuel gas to provide heat without flame using a catalyst-assisted chemical reaction.
Preheater	A hermetically sealed cartridge containing a resistive heating element used to preheat the catalytic pad to initiate the chemical reaction by combusting natural gas.
Instrumentation Enclosure	The main enclosure connected to the front of the TEG that contains the electronics enclosure, access to the catalytic heater assembly, the fuel assembly, and the start-up battery pack.

Electronics Enclosure	The enclosure within the instrumentation enclosure which houses the electronics board and the associated electronics components.
Fuel Filter	A filtering device designed for gas conditioning applications. The fuel filter removes aerosols, contaminants, H ₂ S, moisture, oil, and solids from the supply fuel. The removal of potential contaminants protects and ensures proper function of the catalytic heater and prevents downtime.
Start-up Battery Pack	The battery pack supplies power to the preheater for TEG start-up.
Mounting Pole	A pole recommended for use with the Sentinel TEG for easy and secure mounting of the TEG in the absence of a mounting wall.

2.2 DATA PLATE



 GLOBAL power technologies 16, 7875 - 57 STREET SE CALGARY, ALBERTA, CANADA T2C 5K7 www.globalte.com		CATALYTIC THERMOELECTRIC GENERATOR	
MODEL NUMBER / MODÈLE N°: <input type="text"/>		FUEL TYPE: TYPE DE COMBUSTIBLE: <input type="text"/>	
SERIAL NUMBER / N° DE SÉRIE DU SYSTÈME: <input type="text"/>		GROSS HEATING VALUE: POUVOIR CALORIFIQUE BRUT: <input type="text"/> Btu/ft ³ (MJ/m ³)	
SERVICE REQUEST NO / N° DE DEMANDE DE SERVICE: <input type="text"/>		INPUT RATING: CLASSIFICATION D'ENTRÉE: <input type="text"/> Btu/hr (kW)	
		INLET PRESSURE: PRESSION D'ENTRÉE: <input type="text"/> psi _a (kPa)	
		DESIGN ALTITUDE: ALTITUDE DE CONCEPTION: <input type="text"/> ft (m) _{MAX}	
ETL CLASSIFIED  Intertek 4008107		PREHEATING ELEMENT: ÉLÉMENT DE PRÉCHAUFFAGE: <input type="text"/> VDC W	
This appliance has been evaluated for use in Class I, Division 2, Group D Hazardous (Classified) Locations CL I DIV 2 GR D T3 -40°C(-40°F) ≤ Tamb ≤ 49°C(120°F) ANSI Z33.20-2016 • CSA 2.34-2016 CATALYTIC INFRARED HEATER		INTERNAL IMPEDANCE OF GENERATOR: IMPÉDANCE INTERNE DU GÉNÉRATEUR: <input type="text"/> Ω	
		SYSTEM OUTPUT: PRODUCTION DU SYSTÈME: <input type="text"/> VDC W	
<p>WARNING: Do not open electrical enclosures when an explosive gas atmosphere is present. AVERTISSEMENT: N'ouvrez pas les boîtiers électriques en présence d'une atmosphère explosive gazeuse.</p>			
<p>WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this appliance. AVERTISSEMENT: Une installation, un réglage, une modification, une réparation ou un entretien incorrect peut entraîner des dommages matériels, des blessures ou la mort. Lisez attentivement les instructions d'installation, de fonctionnement et d'entretien avant de procéder à l'installation ou à l'entretien de cet appareil.</p>			
<p>WARNING: For installation on noncombustible floors only.</p> <ul style="list-style-type: none"> • Maintain 900 mm (36 in.) spacing from all combustible materials. • Maintain 900 mm (36 in.) clearance around both sides and front of the unit for service access. • Maintain 900 mm (36 in.) clearance from any obstruction above and below for proper operation. • For installations over 610 m (2000 ft) above sea level, the power output shall be de-rated 4% for each 305 m (1000 ft) of elevation above sea level. 		<p>AVERTISSEMENT: Installer sur un plancher incombustibles uniquement.</p> <ul style="list-style-type: none"> • Maintenez un espacement de 900 mm (36 po) de tous les matériaux combustibles. • Maintenez un dégagement de 900 mm (36 po) autour des côtés et à l'avant pour l'accès pour l'entretien. • Maintenez un dégagement de 900 mm (36 in.) de toute obstruction au-dessus et au-dessous pour un fonctionnement correct. • Pour les installations à plus de 610 m (2000 pi) au-dessus du niveau de la mer, la puissance doit être réduite de 4% pour chaque 305 m (1000 pi) au-dessus du niveau de la mer. 	
<p>WARNING: Do not use appliance if the catalytic pad becomes torn or damaged. Continuous use with a damaged catalytic pad may result in injury or death due to fire, explosion, or carbon monoxide poisoning. The appliance must be serviced by a licensed and qualified service person. AVERTISSEMENT: N'utilisez pas cet appareil si le tampon catalytique est déchiré ou endommagé. Une utilisation continue avec un tampon catalytique endommagé peut entraîner des blessures ou la mort en raison d'un incendie, d'une explosion ou d'un empoisonnement au monoxyde de carbone. L'appareil doit être entretenu par un technicien agréé et qualifié.</p>			
<p>WARNING: Do not attempt to clean catalytic pad. Follow cleaning instructions accompanying appliance. AVERTISSEMENT: N'essayez pas de nettoyer le tampon catalytique. Suivez les instructions de nettoyage accompagnant cet appareil.</p>			
<p>CAUTION: For outdoor use only. ATTENTION: Pour usage extérieur uniquement.</p>		<p>CAUTION: Contact with surface may cause burns. ATTENTION: Tout contact avec surfaces peut cause des brûlures.</p>	
<p>CAUTION: Read and understand product instruction manual before installation, startup, operation and maintenance. ATTENTION: Lisez et comprenez le manuel d'instructions du produit avant l'installation, le démarrage, l'utilisation et l'entretien.</p>			
FACTORY SETTINGS (FOR REFERENCE ONLY)			
OPEN CIRCUIT VOLTAGE AT AMBIENT TEMPERATURE <input type="text"/> V @ <input type="text"/> °F (°C)		ALTITUDE <input type="text"/> ft (m)	
		MANIFOLD FUEL PRESSURE <input type="text"/> in.H ₂ O	

Figure 1 – Data Plate

The data plate shows important information about the Sentinel TEG and can be used as a quick reference point when performing service or contacting GPT. When contacting GPT, indicate both the complete Model Number and Serial Number of your Sentinel TEG. The Sentinel TEG data plate is located on the outside of the instrumentation enclosure door.

Information shown on the data plate:

Model Number	The Sentinel TEG's model number. The Sentinel TEG comes in two different models as follows: <ul style="list-style-type: none"> SENTINEL10-12 — provides 8 Watts at 12V DC BOCL SENTINEL10-24 — provides 8 Watts at 24V DC BOCL
Serial Number	A unique number assigned to the TEG unit by GPT for traceability.
Service Request No.	Number assigned by GPT Customer Service when a Sentinel unit is sent in to GPT for service.
Fuel Type	The Sentinel Thermoelectric Generator is designed for Natural Gas fuel only.
Gross Heating Value	Amount of heat produced by a unit quantity of fuel.
Input Rating	Maximum permitted energy rate to the Sentinel TEG.
Inlet Pressure	Minimum and maximum levels of inlet fuel pressure permitted.
Design Altitude	Maximum permitted altitude that the Sentinel TEG should be operated at.
Preheating Element	Specifies the electrical parameters of the preheating element.
Internal Impedance of Generator	Internal impedance of the thermopile elements used in the Thermoelectric Generator.
System Output	Nominal voltage and power output of the TEG.
Factory Settings:	
Open Circuit Voltage at Ambient Temperature	Open Circuit Voltage and temperature recorded during the factory acceptance test. This is the maximum voltage that can be expected from the TEG under similar conditions.
Altitude	Altitude of the factory where the factory acceptance test was performed.
Manifold Fuel Pressure	Manifold fuel pressure recorded during factory acceptance test.

2.3 FUEL SUPPLY

The Sentinel Thermoelectric Generator is designed for natural gas only. This fuel type is listed on the data plate. Do not use any other type of fuel.

When supplying fuel to the Sentinel TEG:

1. Ensure the fuel pressure is at least 5 psig [34.5 kPag] and will not exceed 25 psig [172.4 kPag].
 - If the supply fuel pressure is expected to vary significantly, use an additional primary regulator to ensure that the input pressure stays relatively constant.
2. Ensure that the fuel used to operate the Sentinel TEG is clean and dry.
3. Use fuel filters in accordance with the product recommendations.
4. Replace the fuel filter cartridges as outlined Section 5.2.1 of this manual to ensure long life of the heater cartridge and prevent premature poisoning of the catalyst.



CAUTION!

Use only natural gas to fuel the Sentinel Thermoelectric Generator.



CAUTION!

Using the Sentinel without fuel filter will void product warranty.

2.4 SPECIFICATIONS FOR GASEOUS FUEL

Gaseous fuels provided to the Sentinel: ⁽¹⁾

1. Shall not contain any particulates larger than 30 µmm diameter, including but not limited to sand, dust, gums, crude oil, and impurities.
2. Shall not have a hydrocarbon dew point in excess of 0°C [32°F] at 25 psig [172.4 kPag].
3. Shall not contain more than 2.7 mg/Sm³ ⁽²⁾ (approx. 4 ppm) of H₂S.
4. Shall not contain more than 2.7 mg/Sm³ ⁽²⁾ (approx. 4 ppm) of Mercaptan Sulphur.
5. Shall not contain more than 2.7 mg/Sm³ ⁽²⁾ (approx. 4 ppm) of Total Sulphur.
6. Shall not contain more than 5% [CO₂] and/or [N₂] by volume, nor vary by more than ± 1% [CO₂] and/or [N₂] during operation.
7. Shall not contain more than 11 mg/Sm³ ⁽²⁾ of water vapour.
8. Shall not contain more than 1% by volume of free oxygen.
9. Shall have a nominal heating value (HHV) of 37 MJ/m³ [1000 BTU/ cu.ft.] ⁽¹⁾
10. Shall not exceed 60°C [140°F] in temperature.

NOTES: (1) For gaseous fuels outside of these specifications, please contact GPT.

(2) At 1 atm and 15°C [59°F].

2.5 ELECTRONICS USER INTERFACE

The Sentinel Thermoelectric Generator includes:

- A preheater which heats up the catalytic pad to the required activation temperature during the start-up period.
- A start-up battery pack that powers the preheater. It also contains a fuse which provides reverse-polarity battery protection.
- Thermoelectric modules that convert heat energy generated from combusting natural gas fuel to electrical energy.
- A circuit board which contains a start-up battery charger, a control circuit to control the preheater, and a DC/DC converter to convert the electrical energy generated by Thermoelectric Modules to 12V/24V DC to power customer loads.

All the electronic components are contained within the electronics enclosure located inside the instrumentation enclosure. User Interface on the main electronics board include:

Buttons and switches:

- Red PREHEAT CYCLE (Preheat Cycle) button (SW500) — engages the preheating element during start-up.
- T.COMP.ON / T.COMP.OFF switch (SW300) — enables and disables the customer output voltage temperature compensation feature of the DC/DC Converter. Also referred to as Temperature Compensation Switch in this manual. For details about this feature refer to Section 4.3.5.
- OCV/RUN toggle switch (SW200) — toggles between RUN and OCV mode;
 - OCV — used during set-up. Toggle to this mode to measure the open circuit voltage.
 - RUN — used when the TEG is operating. Toggle to this mode when set-up is completed and the Sentinel TEG is ready to operate.

Sockets MP200 & MP201:

- [+ VPU –] — to connect a voltmeter to when measuring power unit voltage. The Sentinel TEG open circuit voltage is measured across VPU+ and VPU– while the SW200 toggle switch is set to the OCV position.

Potentiometer:

- VOLTAGE ADJUST potentiometer (RV300) — used to adjust customer output voltage.

Terminal Connections:

- [+ TEG OUT –] — to connect the customer load
- [+ LV ALARM –] — to signal customer the condition of output voltage. These are outputs of a solid-state relay. Low impedance indicates the customer output voltage is in normal range; in this case the LV Alarm LED indicator is off. High impedance indicates the customer output voltage is lower than nominal range, in this case the LV Alarm LED indicator turns on yellow.
- [+ BATTERY –] — to connect the start-up battery pack.

Connectors:

- PREHEATER — to connect the preheating element in the Catalytic Heater Cartridge
- MODULE 1 and MODULE 2 — to connect Thermoelectric Modules in the power unit assembly

LED Status Indicator Lights:

- Green NORMAL VOLTAGE (V Normal) indicator — signals when output voltage is available to the customer load. This indicator activates when the SW200 toggle switch is set to the RUN position and stays on as long as there is voltage available to the customer load.
- Yellow LOW VOLTAGE ALARM (LV Alarm) indicator — signals that the customer output voltage is low, with thresholds based on the Sentinel model. It remains unlit when there is no alarm. Low Voltage Alarm parameters vary between models as follows:
 - 12V Models — alarm turns on when output voltage falls below 11.0 Volts and turns off when voltage rises above 11.5 Volts.
 - 24V Models — alarm turns on when output voltage falls below 22.0 Volts and turns off when voltage rises above 23.0 Volts.
- Red PREHEATER (Preheater) indicator — indicates when the preheating element is turned on and when to apply fuel gas to the Sentinel TEG. Refer to Section 4.2 for full start-up procedures.

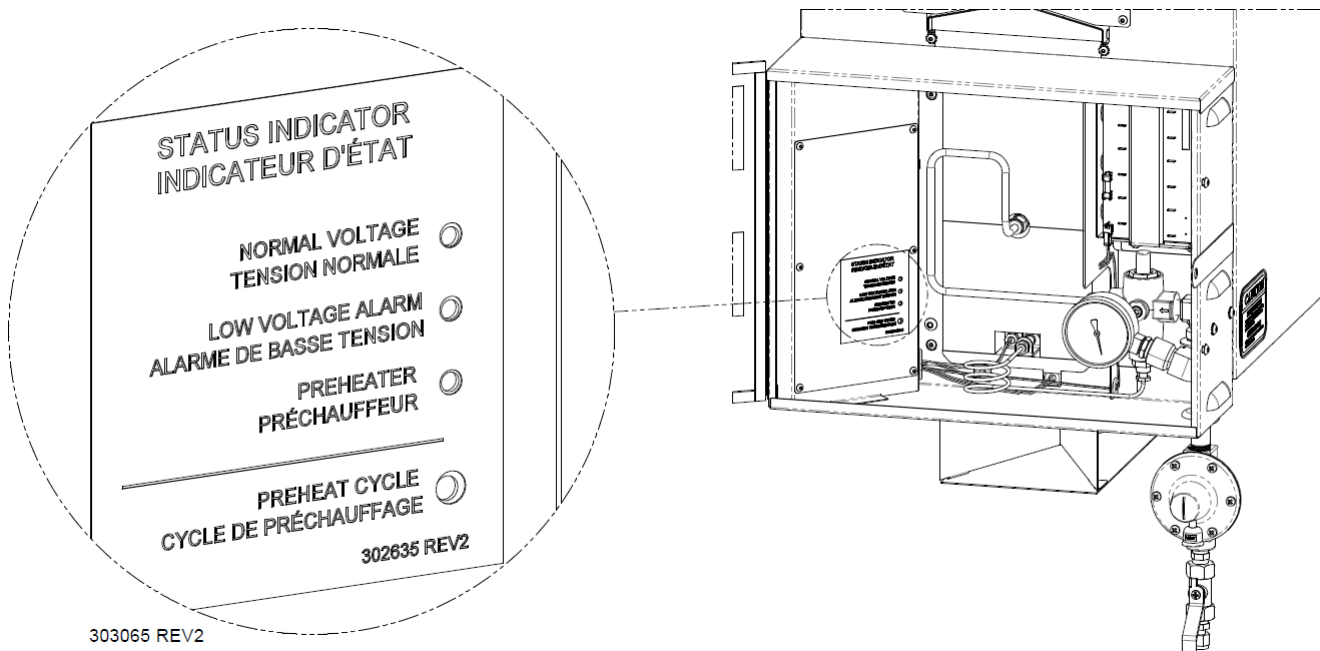
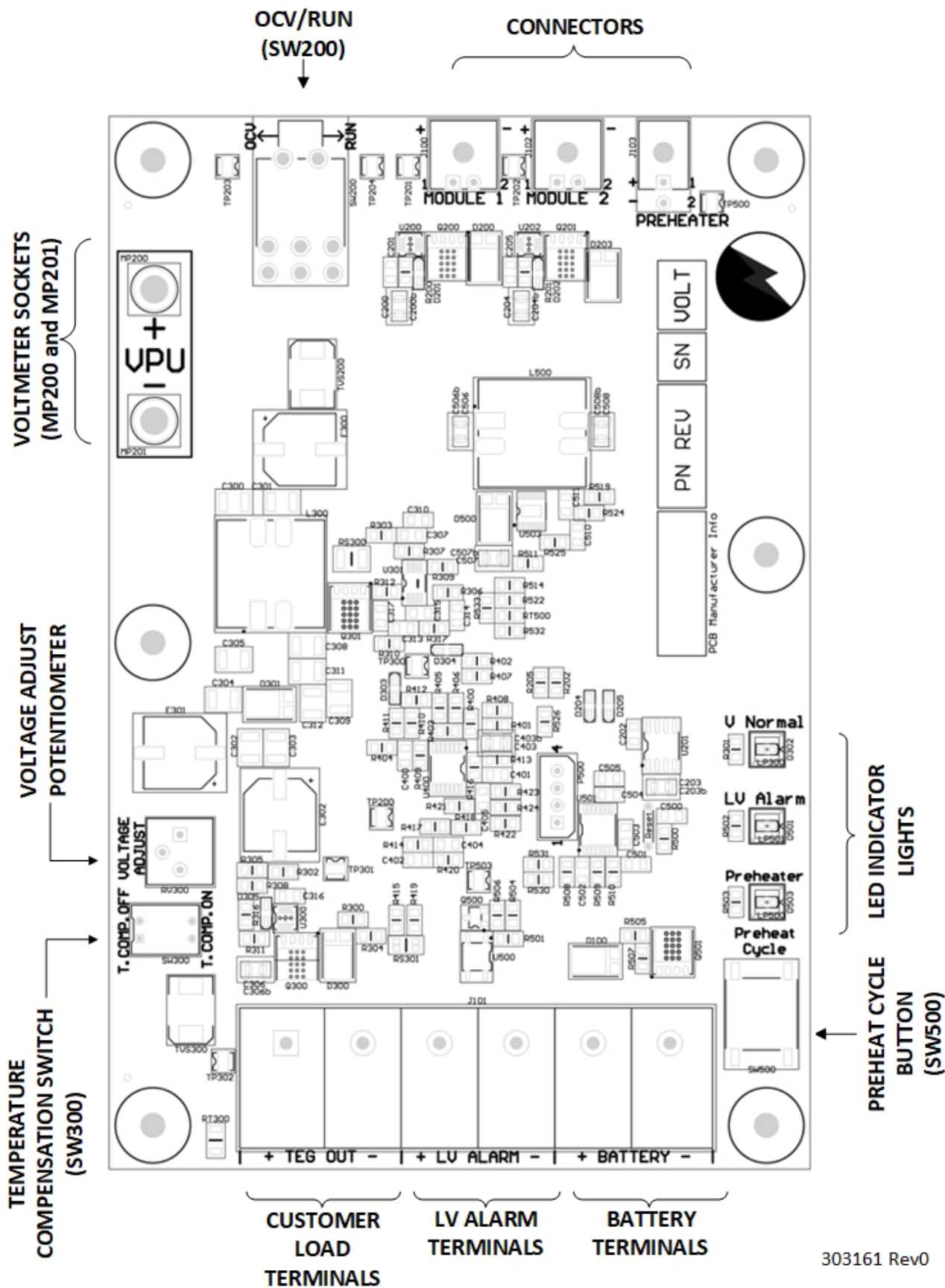


Figure 2 – Status Indicators, with Electronics Enclosure Cover Plate



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Figure 3 – Main Electronics Board User Interface

3 ASSEMBLY AND INSTALLATION



Read all application documentation, including the documentation for equipped options BEFORE starting assembly and installation, or performing service check and maintenance on the Sentinel Thermoelectric Generator.

3.1 PREPARATION

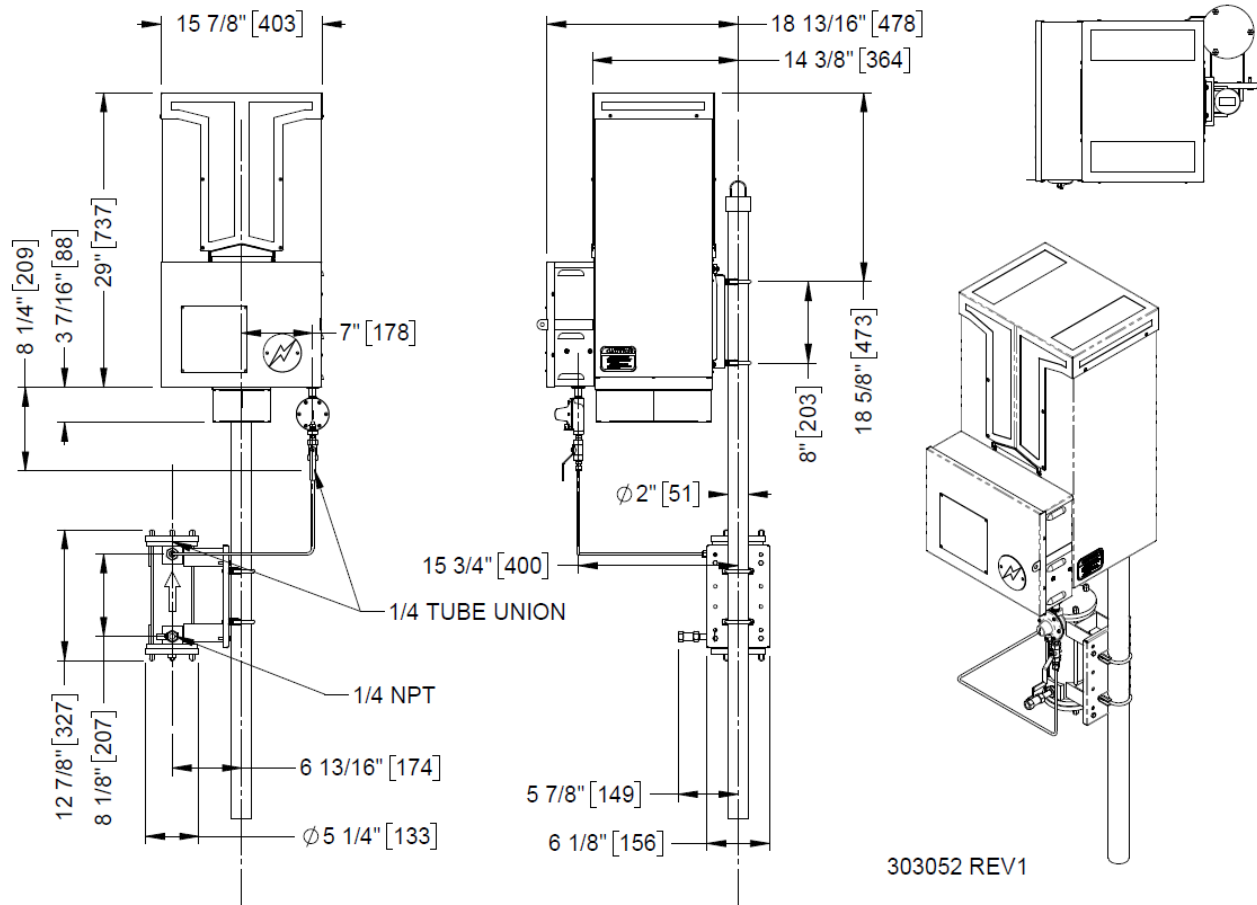


Figure 4 – Sentinel TEG Dimensions

The Sentinel TEG must be installed on a non-combustible surface. Allow a minimum clearance of 36" [900 mm] under the instrumentation enclosure floor, in front and on both sides of the unit, and above the top of the fin duct. Ensure that the Sentinel TEG is positioned high enough to prevent flooding or heavy snowfall from interfering with the flow of cooling air.



Operation of the Sentinel TEG in locations where cooling air flow may be obstructed will cause overheating. Allow a minimum of 36" [900 mm] clearance under the instrumentation enclosure floor, in front and on both sides of the unit, and above the top of the fin duct. Mount the Sentinel TEG high enough to avoid flooding or snow accumulation interfering with the flow of cooling air.

Prepare the following tools and supplies before installing the Sentinel TEG:

- ✓ 1 – DC Voltmeter, accurate to $\pm 0.1V$
- ✓ 2 – Adjustable wrenches that open to 25mm (1 inch)
- ✓ 1 – Hex key set (SAE) including 3/16", 5/32", 1/8", 3/32", 5/64"
- ✓ 1 – #2 Phillips Screwdriver
- ✓ 1 – flat blade screwdriver
- ✓ 1 – Tube bender suitable for 1/4" SS tubing
- ✓ Thread sealant suitable for fuel connections

3.2 UNPACKING AND LIFTING



Check the Sentinel TEG for any signs of damage before beginning assembly. Some damages can make the unit inoperable. Consult Global Power Technologies before operating a TEG with any signs of damage.

Unpack the Sentinel TEG from the shipping crate and inspect the unit for any damage that may have occurred during shipping. Keep the crate until the Sentinel TEG is operational.

- ✓ 1 – Sentinel TEG including an electronics assembly kit, GPT Part Number 303139, taped to the inside floor of the instrumentation enclosure, come with following items:
 - 2 – Ceramic battery fuses (GPT Part Number 302722), *1 spare and 1 to be installed on the start-up battery pack*
 - 2 – Terminal forks, 18-22 AWG, Red, *for low voltage alarm connections [+ LV ALARM –]*
 - 2 – Terminal forks, 14-16 AWG, Blue, *for customer load connections [+ TEG OUT –]*
 - 1 – Terminal ring, 14-16 AWG, Blue, *for customer load connection to grounding terminal inside the electronics enclosure*
 - 1 – Terminal ring, 10-12 AWG, Yellow, *for bonding the site ground to the Sentinel TEG via the ground screw located on the lower left-hand side on the outside of instrumentation enclosure*
 - 1 – Start Assist Tool, *see Section 4.2 for details*
- ✓ 1 – Regulator subassembly and thread sealant (JET-LUBE TF-15)
- ✓ 1 – Fuel filter
- ✓ 2 – Fuel filter cartridges, *for installation in the Fuel filter*
- ✓ 1 – Mounting bracket *for the Fuel filter*
- ✓ 1 – Pack of hardware *required for the Fuel filter*
 - 1 - 1/4" NPT ball valve
 - 1 - 1/4" NPT x 2" long brass nipple
 - 2 - 3/4" MNPT x 1/4" FNPT brass reducer
 - 1- 1/4" tube x 1/4" MNPT SS connector
 - 4 – 1/4-20 x 1" SS hex head bolts
 - 4 – 1/4" SS flat washers
 - 4 – 1/4" SS lock spring washers
 - 4 – 1/4-20 SS hex nuts
- ✓ 4 – 2" U-bolt muffler clamps, *for pole mounting*
- ✓ 1 – 36" long section of 1/4" tubing, *fuel line for Fuel filter to TEG regulator (requires bending on site to suit installation)*

During shipment, the Sentinel TEG is supported by a piece of plywood that is attached to the crate with 4 wood screws to protect the Sentinel TEG during transportation. Remove these 4 wood screws before lifting the Sentinel TEG from the crate.

The Sentinel TEG can be lifted with at least two people. Refer to the weight specifications listed in APPENDIX A — WEIGHT AND DIMENSIONS for reference. The Sentinel TEG can be lifted in either a horizontal or vertical position. If lifting equipment such as a hoist or forklift is available, lifting slings can be used. Two lifting slings are recommended, with one each on the left and right side of the generator such that they are positioned under the fin ducts and instrumentation enclosure from front to back. The slings should be positioned on the bottom on either side of the bottom insulation cover assembly, see Figure 5.

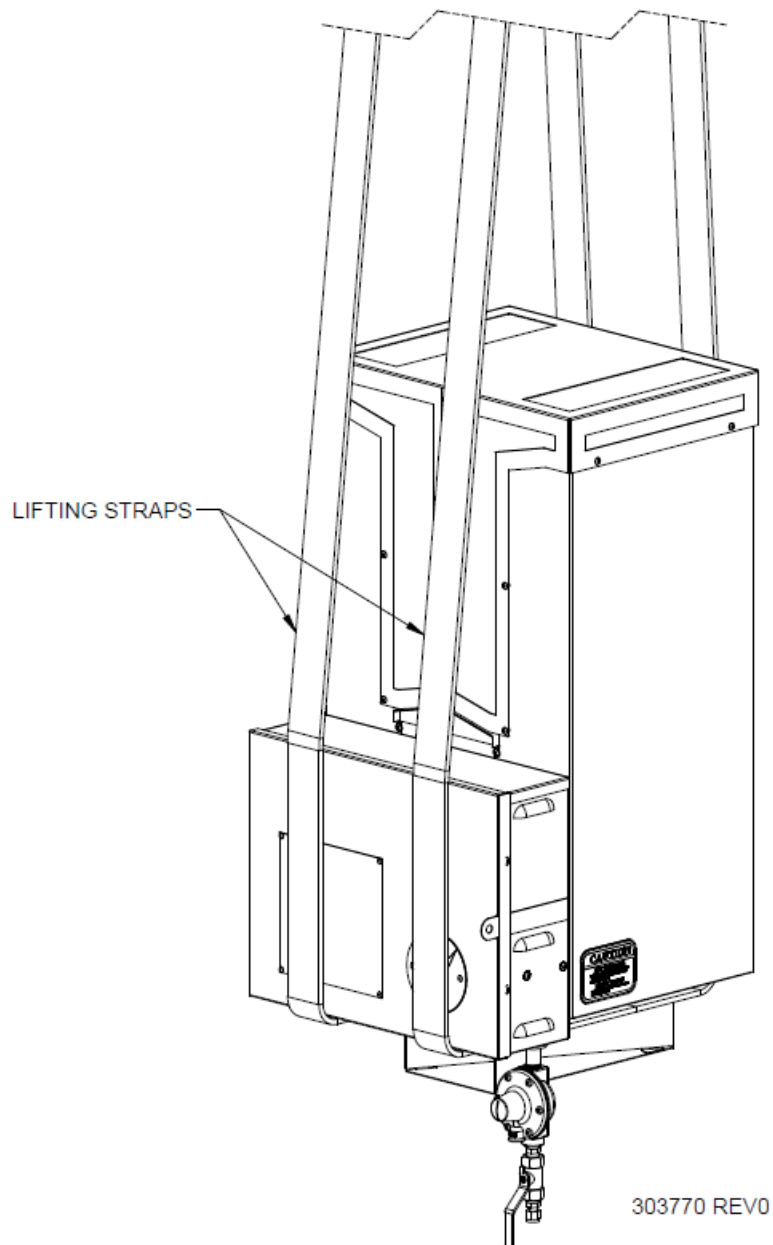


Figure 5 – Lifting Sling Locations

3.3 ASSEMBLY

**WARNING!**

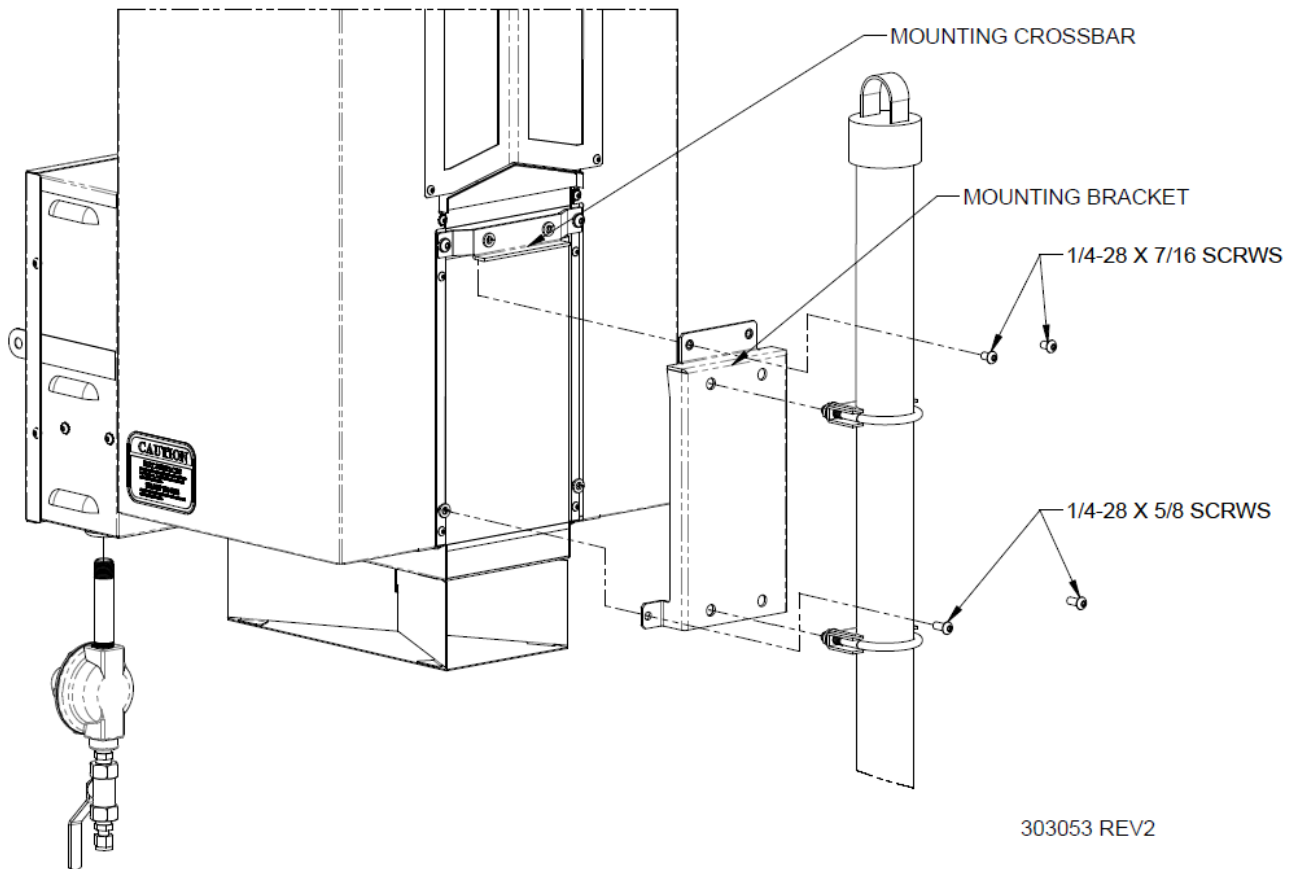
The Sentinel weighs approximately 93 lb. [42.2 kg]. Make sure that the platform, pole, or wall fasteners can support this weight.

The Sentinel TEG comes with a mounting bracket to easily attach the main assembly to a pole or wall.

Separate this mounting bracket, with the supporting plywood, from the back of the Sentinel TEG by removing those four BUTTON SOCKET CAP 1/4-28 machine screws (Refer to Figure 6, two short 1/4-28 x 7/16 screws are fastened on the mounting crossbar, and two long 1/4-28 x 5/8 screws are fastened on the other end of the mounting bracket). Keep these 4 machine screws for mounting.

Remove the supporting plywood from the mounting bracket.

3.3.1 POLE MOUNT



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Figure 6 – Mounting the Sentinel TEG

To mount the system on a pole:

1. Attach the mounting bracket to the 2-inch pole using the supplied U-clamps.
 - a. Remove the locknuts from the end of the U-clamp.
 - b. Attach the U-clamp to the pole and insert the ends of the U-clamp through the holes in the mounting bracket.
 - c. Secure the mounting bracket to the pole by rethreading the locknuts onto the U-clamp.
Ensure the fasteners are fully tight before proceeding to the next step.
2. Attach the Sentinel to the mounting bracket by sliding the mounting crossbar over the mounting bracket tap, as shown in Figure 6 ensuring that the Sentinel is in an upright vertical position.
3. Allow the mounting bracket to take the weight of the Sentinel TEG.
4. Refer to Figure 6, secure the Sentinel TEG to the mounting bracket by replacing those 4 BUTTON SOCKET CAP 1/4-28 machine screws.
Use two 1/4-28 x 7/16 screws to fasten to the mounting crossbar, above the upper U-clamp.
Use two 1/4-28 x 5/8 screws to fasten to the bottom of the mounting bracket on each side of the lower U-clamp.

3.3.2 WALL MOUNT

The Sentinel TEG can also be mounted directly on a flameproof wall. Fasteners for this type of installation are not included with the TEG. When choosing hardware to mount the bracket to a wall, ensure that it is sturdy enough to handle the 93 lb. (42.2 kg) weight of the unit and are of the appropriate length and type. The bracket has been designed to accept 3/8" diameter hardware. Fasten the Sentinel TEG to the bracket using hex-head cap screws in place of the button socket cap screws provided. Hex head screws will allow for the use of an open-end wrench as the low profile of the bracket may not allow for access with a hex key. Hardware needed to affix TEG to bracket:

- ✓ 2 – 1/4-28 x 7/16 hex head screws
- ✓ 2 – 1/4-28 x 5/8 hex head screws



If mounting the Sentinel TEG on a wall, ensure that the wall is flameproof. Mount the Sentinel TEG using hex-head cap screws.

3.4 FUEL FILTER

The Sentinel TEG comes with a fuel filter that must be installed upstream of the appliance regulator. The filter media removes H₂S and moisture from the fuel supply.

3.4.1 FUEL FILTER ASSEMBLY

The fuel filter assembly comes as a kit of parts (see Section 3.2) to be assembled at time of installation.

Assemble fuel filter as shown in Figure 31. Ensure to use thread sealant as described in Figure 10.

3.4.2 FUEL FILTER INSTALLATION

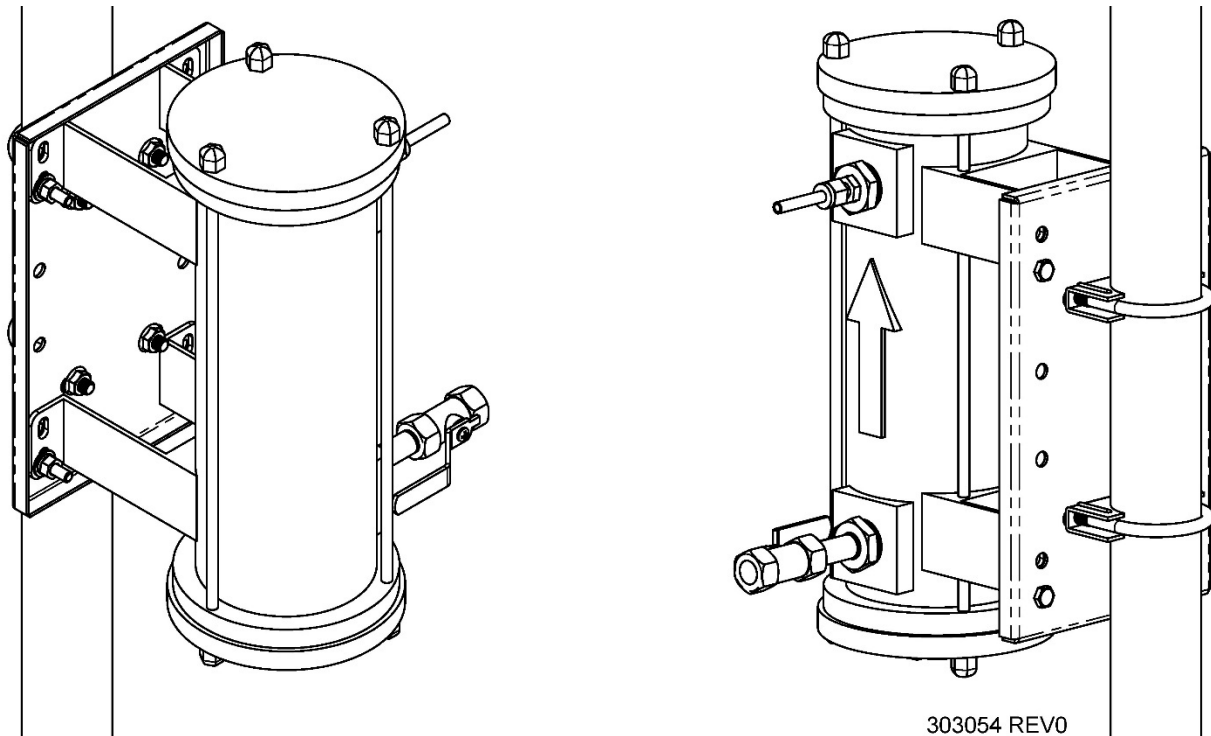


Figure 7 – Mounting the Fuel Filter

Before mounting or connecting the fuel filter to the fuel supply, install two filter cartridges within the fuel filter assembly. Refer to Section 5.2.1 for instructions on filter cartridge installation.

Install the fuel filter in a vertical position with the flow arrow pointing upwards. The fuel filter can be mounted on a wall or pole. For ease of maintenance, mount the fuel filter 12 to 14" from the bottom of the Sentinel TEG.

To mount the fuel filter to a pole:

1. Remove the locknuts from the ends of the two supplied U-clamps.
2. Attach the U-clamps to the pole and insert the ends of the U-clamps through the holes in the fuel filter's mounting bracket.
3. Secure the mounting bracket to the pole by rethreading the locknuts onto the U-clamps. Ensure the fasteners are fully tight before proceeding to the next step.

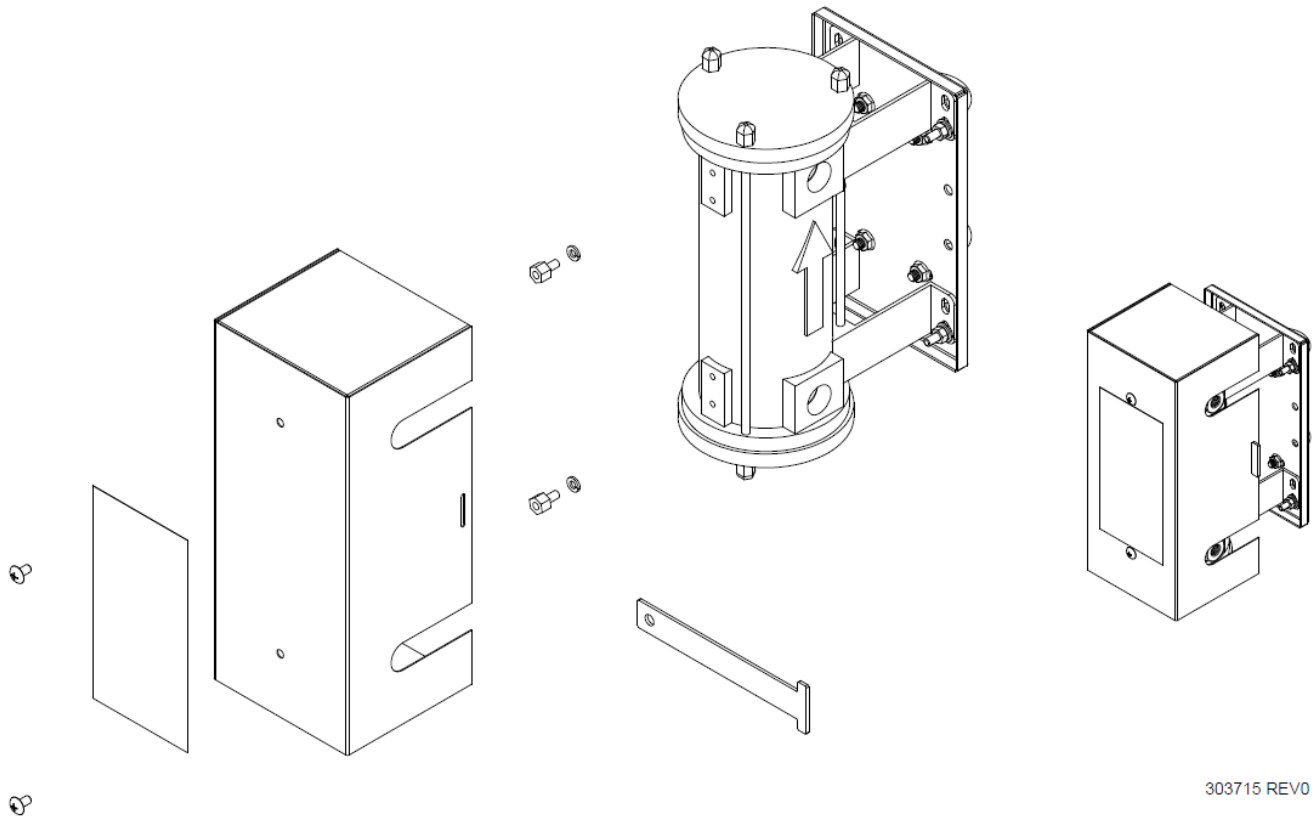
For Sentinel TEGs that are mounted to a wall, install the fuel filter in an upright position with the flow arrow pointing upwards. Allow 12 to 14" of clearance above the filter so that it is easily accessible when replacing the filter cartridges. As with the TEG mounting bracket, the fuel filter bracket has been designed to accept 3/8" diameter fasteners. Ensure the appropriate length and type of fasteners are chosen for the mounting application.



CAUTION!

Using the Sentinel without fuel filter will void product warranty.

For increased security, GPT offers a lockable enclosure to prevent tampering with the fuel filter housing. GPT part number 303657.



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Figure 8 – Sentinel, Fuel Filter Security Cover (Optional)

3.5 INSTALLING THE REGULATOR SUBASSEMBLY

Apply thread sealant to the nipple threads as illustrated in Figure 10 to minimize fuel line contamination. Install the regulator subassembly to the safety shut-off valve through the opening on the floor of the instrumentation enclosure.

3.6 CONNECTING THE FUEL FILTER TO THE TEG

Fuel to the Sentinel TEG is supplied through the fuel filter. Before connecting the fuel supply to the fuel filter, connect the fuel filter to the TEG as follows:

1. Bend the straight section of the supplied 1/4" tubing to suit the distance and arrangement between the outlet of the fuel filter and the inlet to the ball valve on the TEG.
2. Connect and swage one end of the 1/4" tubing to the manual ball valve below the fuel regulator of the Sentinel TEG.
3. Connect and swage the other end of the 1/4" tubing to the Swagelok connector located above the flow arrow of the fuel filter.

3.7 CONNECTING THE FUEL SUPPLY



Use only natural gas to fuel the Sentinel TEG. The inlet pressure to the Sentinel TEG must never exceed 25 psig [172.4 kPag].

Before connecting the fuel supply to the fuel filter, review Section 2.3 and ensure that the supply fuel complies with the Sentinel TEG's standard specifications as outlined in Section 2.4. Use only natural gas as fuel and ensure that inlet pressure will not exceed 25 psig [172.4 kPag].

The fuel supply line connects to the manual shut-off valve on the fuel filter, which is equipped with a 1/4" NPT connector. Fuel line and fittings from the fuel supply to the fuel filter's inlet valve are not included with the TEG.

NOTE: Follow local regulations when installing fuel piping.

Connect the fuel supply to the Sentinel TEG as follows:

1. Inspect fuel lines and fittings to ensure that they are free of foreign materials.
2. Apply thread sealant to the fuel line threads as illustrated in Figure 10 to minimize fuel line contamination.
3. Connect the fuel line to the ball valve at the inlet to the fuel filter, below the flow arrow.
4. Check all joints for leaks using a commercial leak detector fluid such as Snoop®.
5. Purge fuel lines of all air.

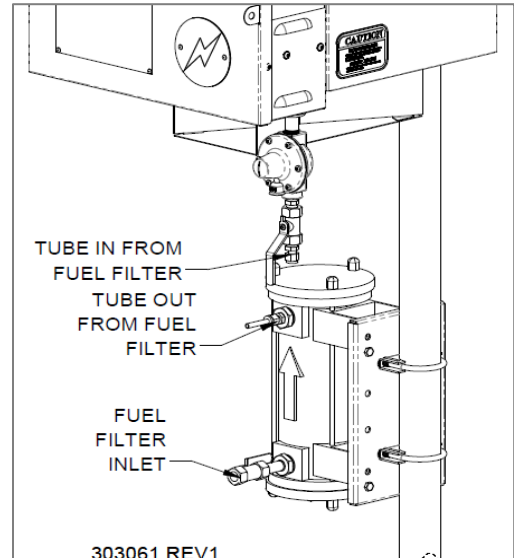


Figure 9 – Fuel Filter Connections

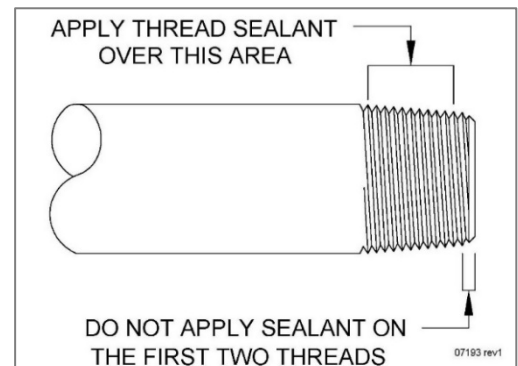


Figure 10 – Applying Thread Sealant

NOTE: Use thread sealant that is approved for use with gaseous fuels. Tape is not recommended.



Check all fuel system fittings for leaks before starting the Sentinel TEG. Check all fittings downstream of the shut-off valve again after start-up when the unit is running.



The Sentinel TEG and its manual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures more than 0.5psig [3.5 kPag].

**CAUTION!**

The Sentinel TEG must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 0.5 psig [3.5 kPag].

3.8 INSTALLING THE START-UP BATTERY FUSE

The start-up battery pack is shipped installed and connected to the main electronics board. The Sentinel TEG is shipped with two ceramic fuses as part of the electronics assembly kit. To activate the start-up battery pack, unpack one of the two fuses from the electronics assembly kit and install it into the fuse slot on the battery board as shown in Figure 11.

The batteries are shipped fully charged; however, they may slowly discharge during shipping. Before starting the TEG, check the battery voltage and ensure that it is greater than 11.8 Volts.

To check the battery voltage, touch the ends of a voltmeter to the [+ BATTERY –] terminals at the bottom of the main electronics board. Refer to Figure 12.

If the battery voltage is too low, then it must be either charged or replaced. If the start-up battery pack is depleted, the Sentinel may be jump-started using the TEG jump start cable offered by GPT. Refer to Section 5.3 for more information.

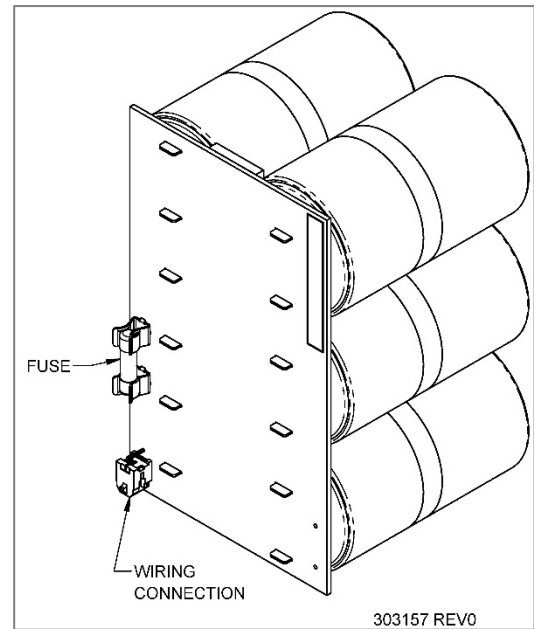


Figure 11 – Installing the Fuse on the Start-up Battery Pack

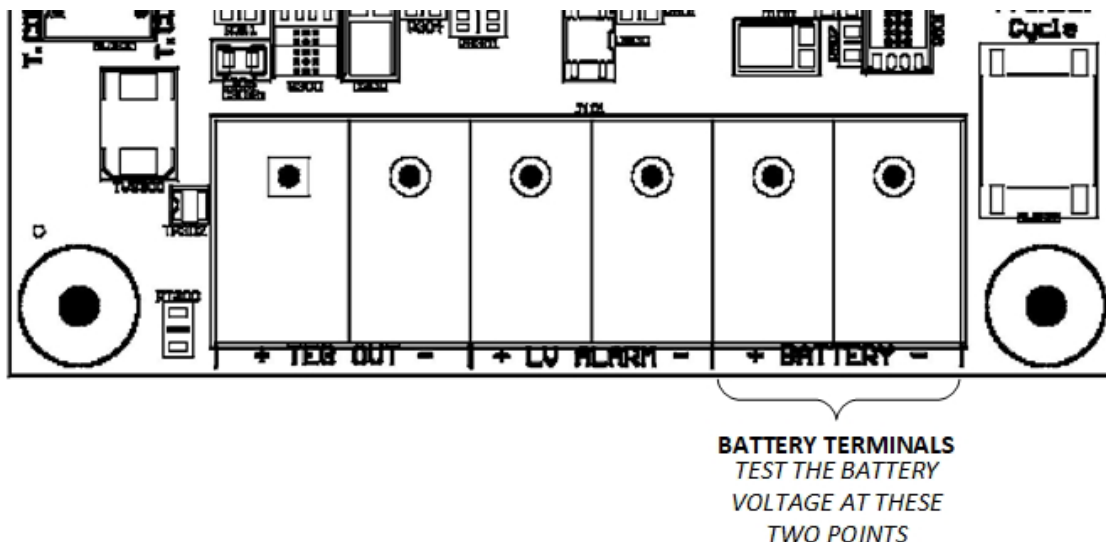


Figure 12 – Main Electronics Board Terminals

4 START-UP AND OPERATION

Before initiating start-up of the Sentinel TEG, calculate the unit's target OCV as referenced in Section 4.1. The result of this calculation will be used in later steps if it is determined that a fuel pressure adjustment is required.

Before adjusting the fuel pressure, allow the Sentinel TEG to run for 90 minutes, then evaluate the OCV. If the OCV is 23.6 VDC or greater and the fuel pressure is below 3.3 in.H₂O after one hour of operation, then no adjustment is required. From the factory, the Sentinel is set to deliver a minimum of 10 Watts of net power to the customer load (BOCL).

4.1 ADJUSTING FOR SITE CONDITIONS AND DETERMINING TARGET OCV



CAUTION!

Do not make any fuel adjustments without first determining the target OCV.

The Sentinel TEG's output power can change depending on the site's ambient temperature and altitude. Its open circuit voltage (OCV) is set at the factory based on the ambient temperature and the factory altitude engraved in the Data Plate (see Figure 1). To accommodate for differences in site ambient temperature and altitude, the Sentinel TEG's fuel pressure is adjusted based on its target OCV. The target OCV is calculated with the formula:

$$\text{Target OCV} = (\text{Factory Set OCV}) \times (\text{Temperature Correction Factor}) \times (\text{Altitude Correction Factor})$$

To use this formula, first determine the site's ambient temperature and altitude correction factors from Section 4.1.1 and 4.1.2 below.

4.1.1 TEMPERATURE CORRECTION FACTOR

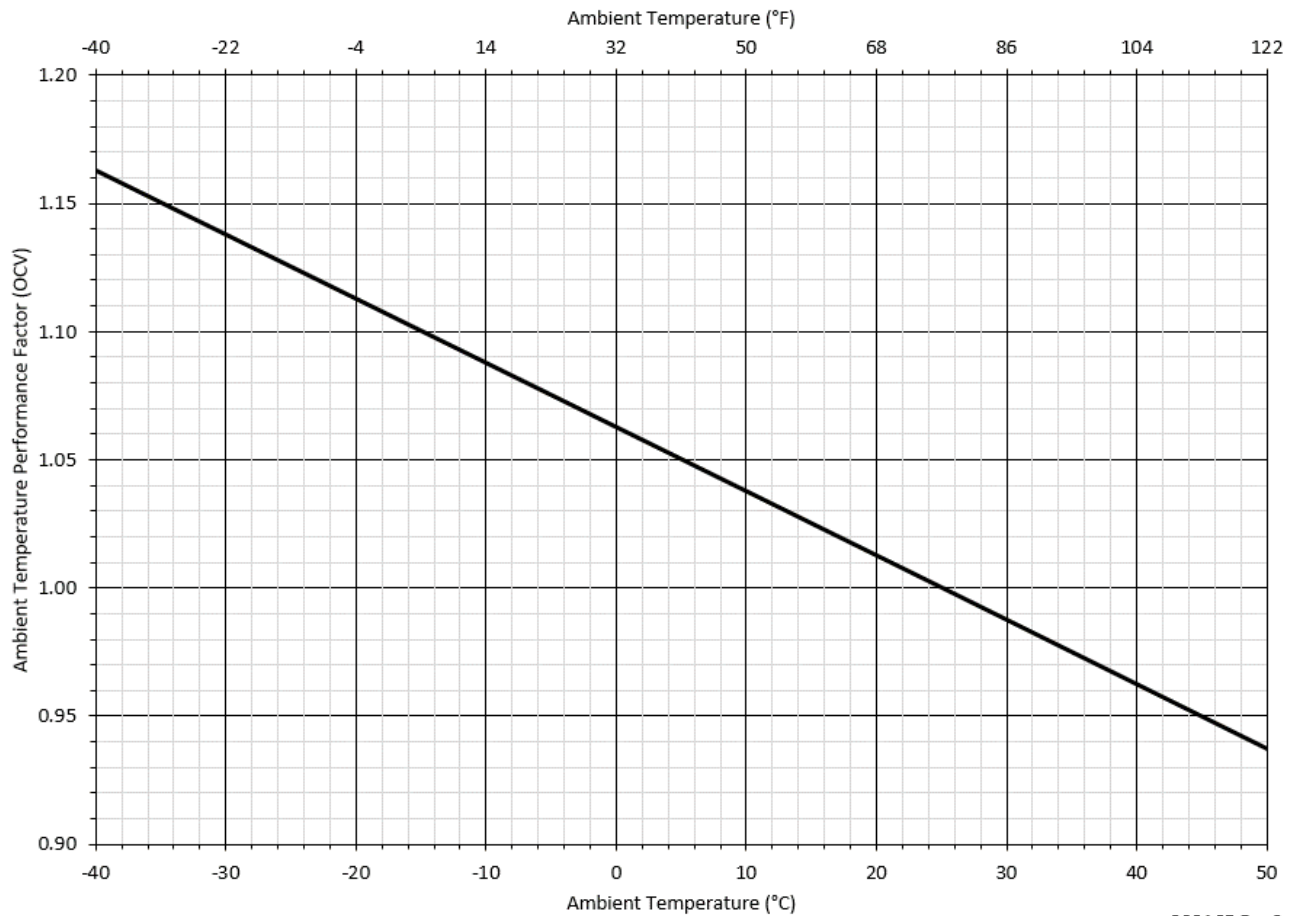


Figure 13 – OCV Ambient Temperature Correction Factor

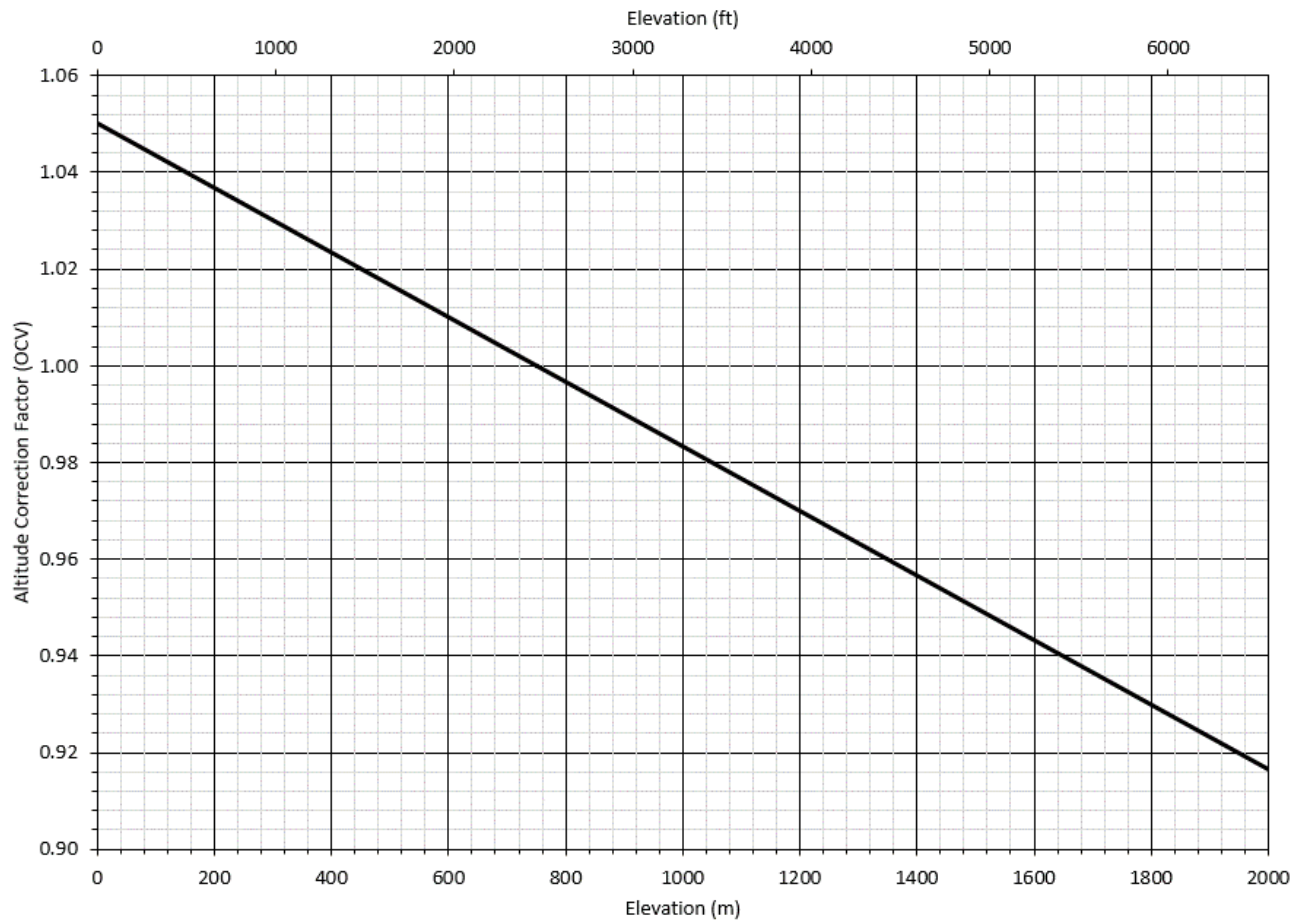
As temperature increases, the Sentinel TEG's power output drops by 0.25% per °C when the ambient temperature rises above 25°C [77°F]. To offset this potential drop in power output, the Sentinel TEG's target OCV must be adjusted to accommodate the site's ambient temperature.

Use the chart in Figure 13 to determine the temperature correction factor for the current ambient temperature. Record the current ambient temperature and ambient temperature correction factor in the Performance Log at the end of this document.

To determine the temperature correction factor for the site's ambient conditions:

1. Find the current ambient temperature on the top or bottom axis of the graph in Figure 13.
 2. From the ambient temperature axis, follow the vertical line up until it touches the curve (diagonal line).
 3. From the point where the ambient temperature line touched the curve, follow the horizontal line to the left to find the ambient temperature correction factor.
 4. Record this number in the Performance Log. This will be used for the target OCV calculation.
- For example: At 5°C, the Ambient Temperature Correction Factor is 1.05.

4.1.2 ALTITUDE CORRECTION FACTOR



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Figure 14 – OCV Altitude Correction Factor

The Sentinel TEG is set at the factory's altitude (see Data Plate in Figure 1). If the site altitude is different from the factory altitude, use the graph in Figure 14 to determine the altitude correction factor.

To determine the altitude correction factor for the site's altitude:

1. Determine the site's altitude and find that number on the graph in Figure 14. The altitude, in meters, is located at the bottom of the graph and the altitude in feet are at the top of the graph.
2. From the altitude axis, follow the line vertically towards the altitude correction factor curve (diagonal line) until the lines intersect.
3. From the point where the site altitude and the curve intersect, follow the horizontal line to the left to find the altitude correction factor.
4. Record this number in the Performance. This will be used for the target OCV calculation.

For example: At 1040m, the Altitude Correction Factor is 0.98.

4.1.3 TARGET OPEN CIRCUIT VOLTAGE CALCULATION

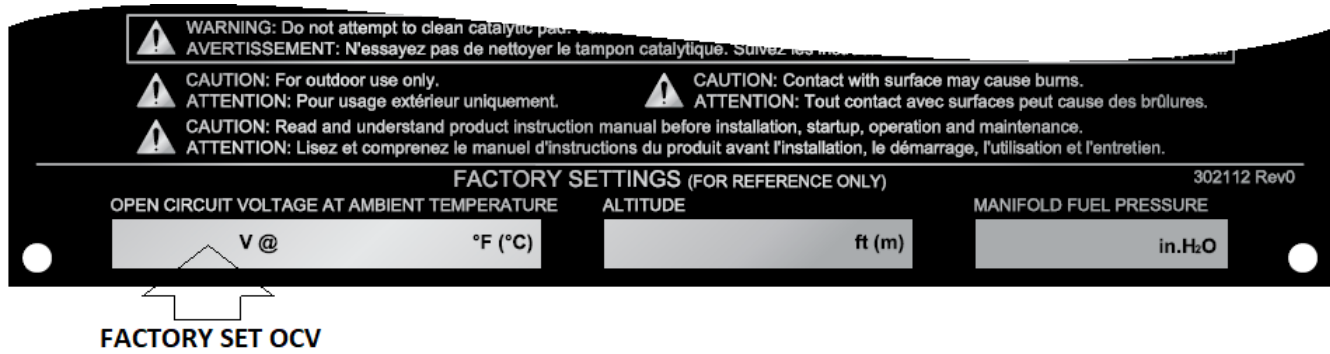


Figure 15 – Data Plate OCV

Once the correction factors have been determined, check the Sentinel TEG's data plate for the factory OCV and calculate the target OCV using the formula:

$$\text{Target OCV} = (\text{Factory Set OCV}) \times (\text{Temperature Correction Factor}) \times (\text{Altitude Correction Factor})$$

Example Calculation:

If:

Data Plate OCV = 24 VDC

Current Ambient Temperature = 35°C → Temperature Correction Factor = 0.975

Altitude = 0m above sea level → Altitude Correction Factor = 1.05

Then:

Target OCV = 24 x 0.975 x 1.05

Target OCV = 24.57 VDC

Note the calculated target OCV in the Performance Log. This will be used during fuel pressure adjustment—Section 4.3.3.

To maximize the longevity of the Sentinel TEG, do not adjust OCV above 26 VDC.



CAUTION!

Operating the Sentinel TEG with OCV above 26 VDC could adversely affect the longevity of the unit. Contact GPT if the Sentinel TEG needs to be set above this point.

4.2 START-UP



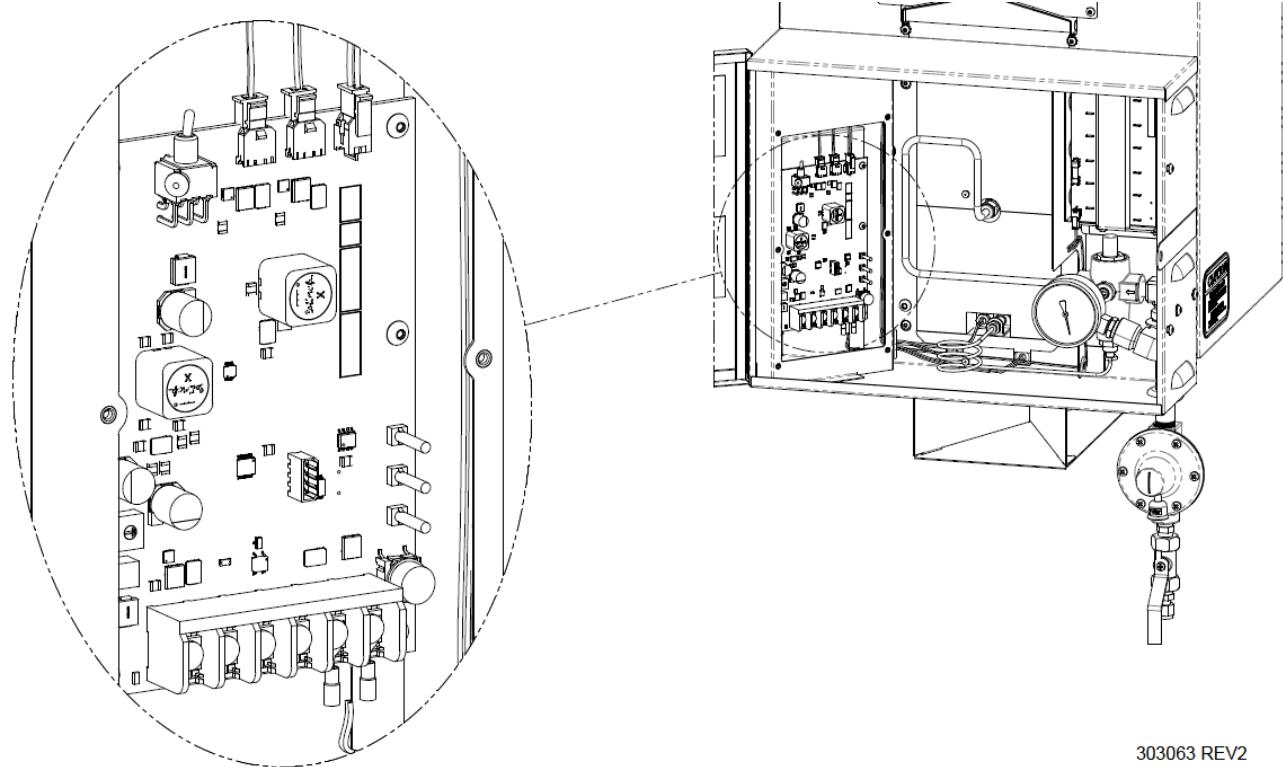
Ensure you are familiar with all sections of this Operating Manual prior to initiating start-up.

Make sure to review and understand this user manual thoroughly, paying special attention to the safety instructions, and perform the following checks before initiating start-up:

- ✓ Inspect the Sentinel for mechanical damage. If damage is found, contact GPT.
- ✓ Confirm that fuel system connections are tight and have been checked for leaks.
- ✓ Confirm that the fuel supply to the Sentinel is natural gas and complies with the gas specification standards outlined in Section 2.4.
- ✓ Ensure that all electrical connections at the main electronics board, catalytic heater assembly face, and start-up battery board are tight and correctly connected.
- ✓ Ensure that the Sentinel TEG has been properly grounded and bonded to the site ground.
- ✓ Inspect the air inlet screen at the bottom of the Sentinel TEG main assembly and ensure that it clean and is free of foreign materials.
- ✓ Confirm that the start-up battery pack is charged, and the fuse is installed—see Section 3.8.



Ensure that no explosive gas hazard is present prior to opening the instrumentation enclosure or servicing the Sentinel TEG. Do not open the instrumentation enclosure if an explosion or gas hazard is suspected.



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Figure 16 – Location of the Main Electronics Board

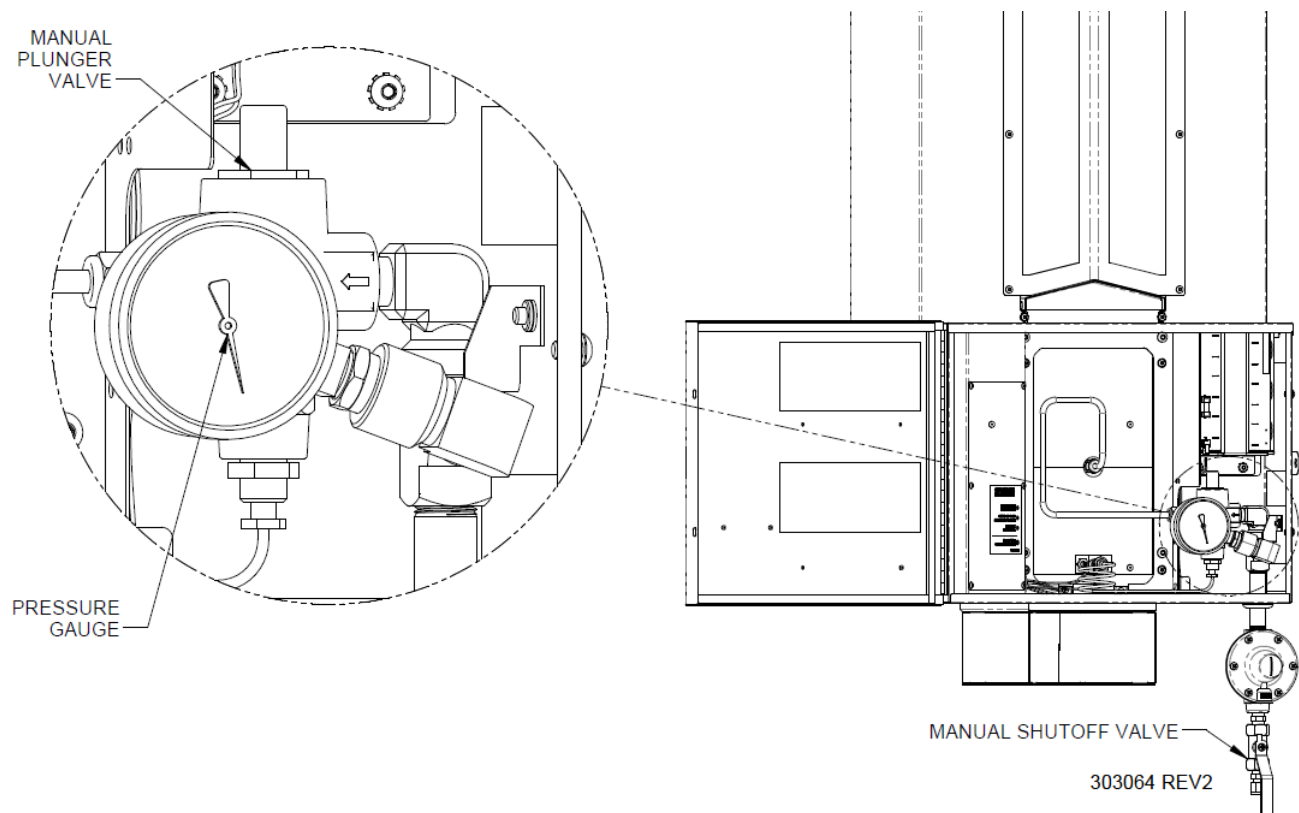


Figure 17 - Fuel System Assembly

Refer to Figure 3, Figure 16 and Figure 17 and follow these steps to start the Sentinel TEG:

1. Remove the electronics enclosure cover plate.
2. Locate the OCV/RUN mode switch, SW200, at the top left of the main electronics board and confirm that the switch is set to OCV.
3. Check that the manual shut-off valve from the fuel supply line to the fuel filter is open.
4. Open the manual shut-off valve located below the Sentinel TEG's regulator. Check the Sentinel TEG pressure gauge, located inside the instrumentation enclosure to ensure that fuel pressure is present.

NOTE: **Close this manual shut-off valve if the Sentinel TEG needs to be shut down.**

5. Press the red Preheat Cycle button located on the bottom right corner of the main electronics board. The red Preheater status indicator LED located above the Preheat Cycle button should turn on.
6. Wait 3 minutes for the catalytic pad in the catalytic cartridge to preheat. The red Preheater status light on the electronics board will blink for 10 seconds after 3 minutes to indicate that it is time to supply fuel.
7. Press and hold the manual plunger on top of the safety shut-off valve. Hold the plunger down until the red Preheater status indicator LED light turns off. A tool is provided by GPT to be wedged between the plunger and the battery bracket, see Figure 18. It is designed such that it cannot be left in place to close the Instrumentation Cabinet door.

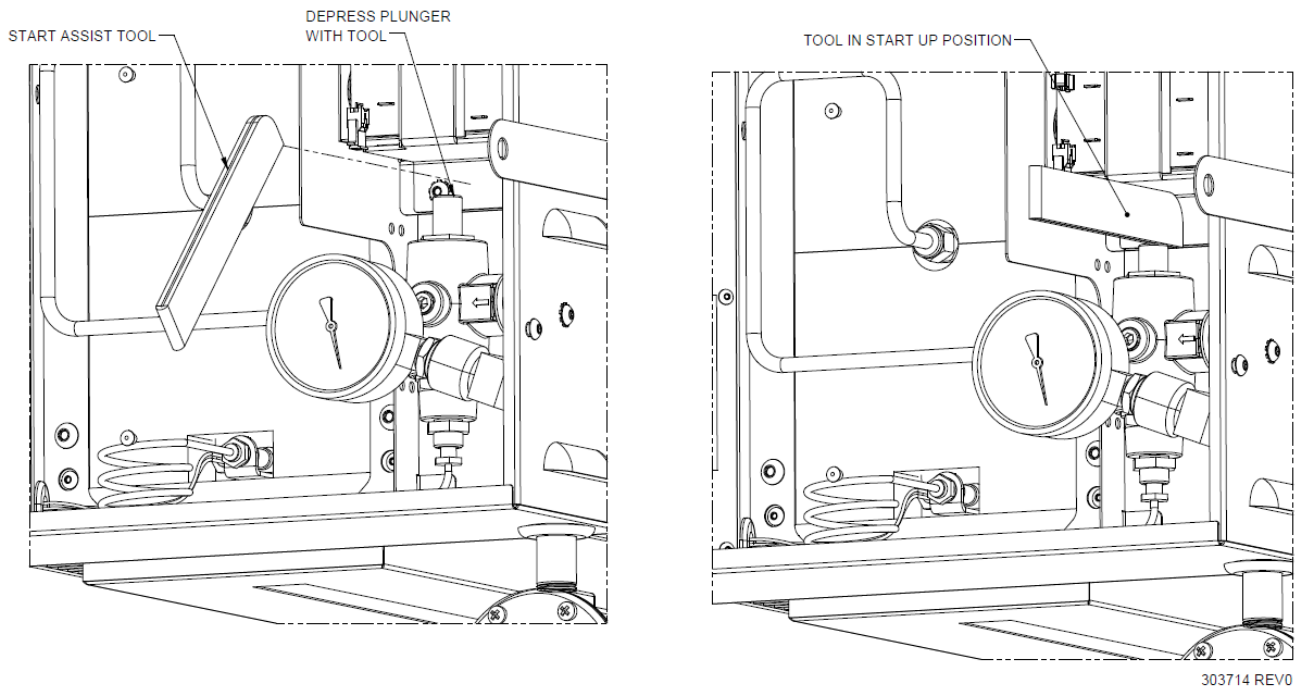


Figure 18 – Sentinel, Start Assist Tool

When the red Preheater status light turns off, remove the Start Assist Tool, and slowly release the plunger while watching the fuel pressure gauge and ensuring that there is no change in pressure as the plunger is being released.

When the catalytic pad is within the designated temperature range, the catalytic reaction should hold the safety shut-off valve open enabling a continuous reaction and maintaining the flow of fuel. If the reaction is interrupted the safety valve will close and disrupt the flow of fuel.

➤ If the safety shut-off valve does not stay open, refer to the Troubleshooting section.

NOTE: If the plunger is released too soon, the safety shut-off valve will close, and fuel will not flow to the system.



Start Assist Tool MUST be removed for normal operation after the start-up sequence.

8. Once the system is running, check all fuel lines for leaks using a commercial leak detection fluid.
 9. 5 minutes after releasing the valve plunger, insert voltmeter leads into the sockets marked [+ VPU –] and ensure that the voltage is slowly increasing.
 10. Wait 45 minutes to 1 hour for the Sentinel TEG to achieve operating temperatures. As the unit powers up, the voltage will climb from zero to the factory set OCV as listed on the data plate.
-



When the TEG is operating, surface temperatures of the unit can approach temperatures close to 200 °C [392°F]. Avoid contact of skin and clothing with the surfaces of the TEG to avoid burns.

4.3 SYSTEM ADJUSTMENTS

4.3.1 OPEN CIRCUIT VS POWER

The Sentinel is configured using open circuit voltage (OCV). Open circuit voltage is the voltage measured by the voltmeter at the sockets marked as [+ VPU –] on the main electronics board, while the OCV/RUN switch, SW200, is set to OCV. The following graph shows the Sentinel TEG's net power output in relation to the OCV.

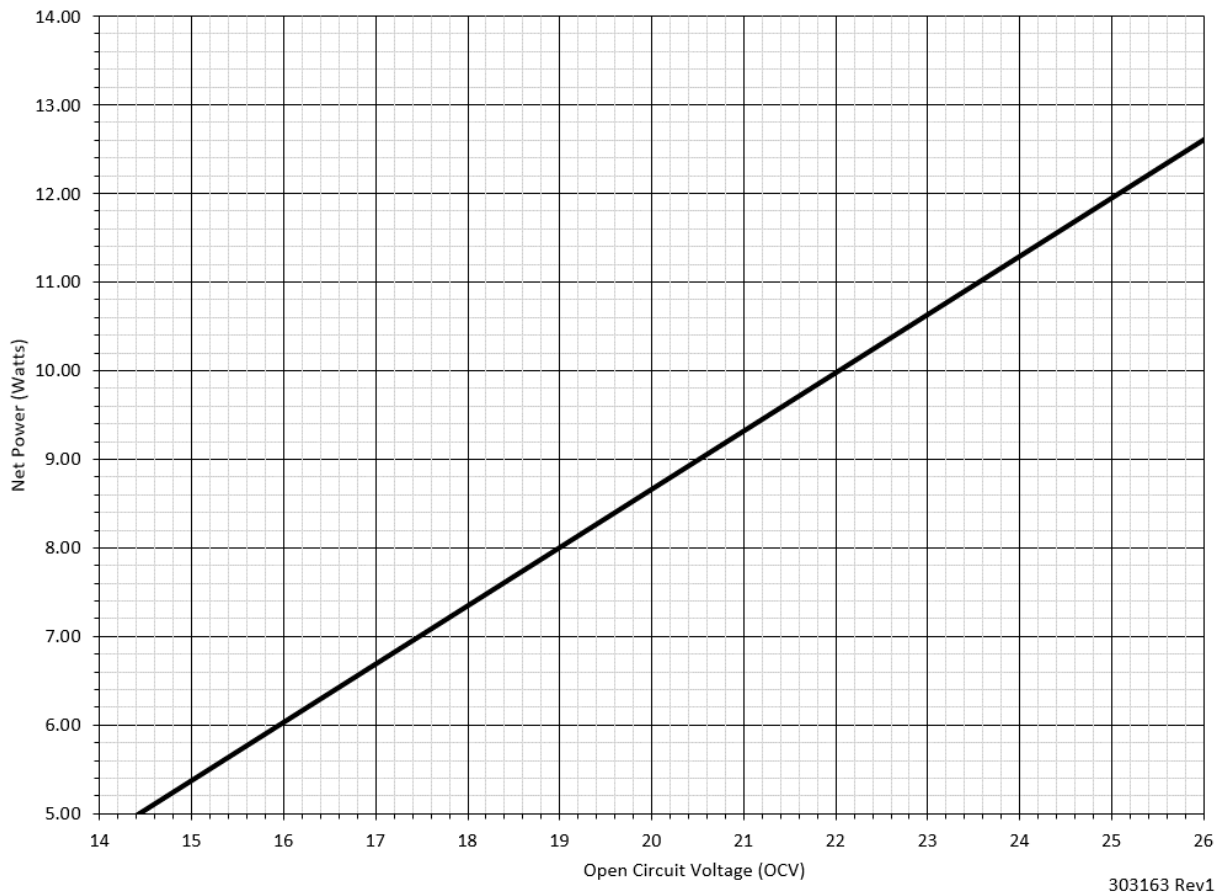


Figure 19 – Sentinel OCV vs. Power

4.3.2 MEASURING OPEN CIRCUIT VOLTAGE



WARNING!

Ensure that no explosive gas hazard is present prior to opening the instrumentation enclosure or servicing the Sentinel TEG. The Sentinel enclosure must not be opened when an explosion or gas hazard may be present.

To measure the Sentinel TEG's open circuit voltage:

1. Confirm that the SW200 toggle switch, is set to "OCV" position.
2. Insert a voltmeter into the voltage terminals (+ VPU –) located on the left side of the main electronics board and measure the OCV.
3. Compare the OCV voltage reading to the calculated target OCV voltage—refer to Section 4.1.
4. If the measured OCV differs by more than 1 VDC from the calculated target OCV, adjust the fuel pressure.

4.3.3 ADJUSTING THE FUEL PRESSURE TO MEET CALCULATED TARGET OCV

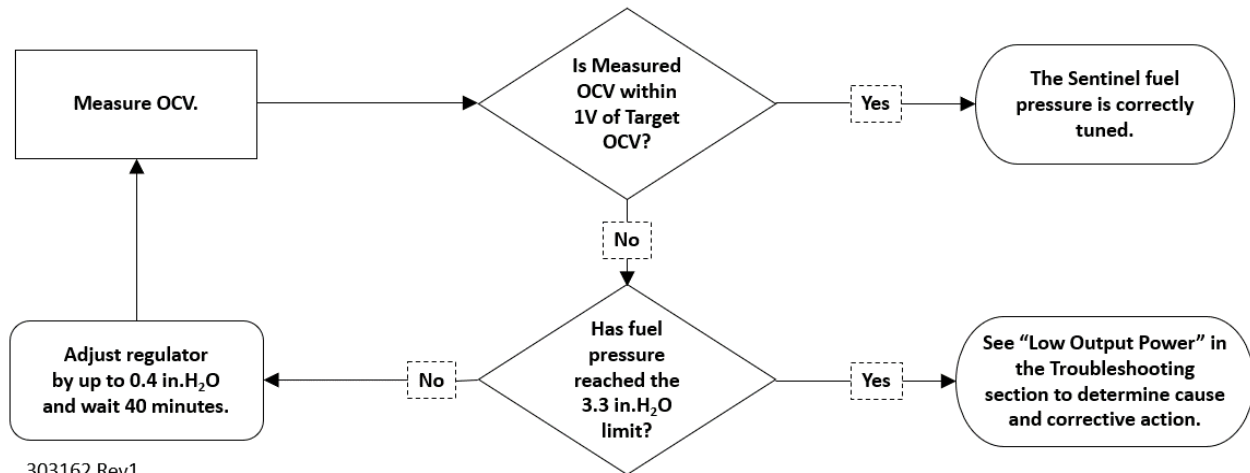


Figure 20 – Fuel Pressure Adjustment

The Sentinel TEG’s fuel pressure factory setting is marked on the data plate as “Manifold Fuel Pressure”. This may need to be adjusted to achieve the target OCV based on site altitude and ambient temperature.

Allow the Sentinel TEG to run for at least 90 minutes before adjusting the fuel pressure. After running for one hour, the TEG’s OCV should be close to 90% of its factory set OCV.



WARNING!

The maximum power output of the Sentinel thermopiles is 12-14 W (gross power). Although it is possible to exceed this, doing so may cause major damage to the TEG. In addition, surface temperature limits may be exceeded if run at higher than recommended fuel pressures, which may lead to unsafe conditions when an explosion or gas hazard is present.

To adjust the fuel pressure:

1. Remove the black cap from fuel pressure regulator.
2. Using a flat blade screwdriver, adjust the spring tension on the regulator by 0.4 in.H₂O and wait 40 minutes for the TEG to stabilize.
 - Turn clockwise to increase the fuel pressure and OCV.
 - Turn counterclockwise to reduce the fuel pressure and OCV.
3. After 40 minutes, read the voltage again and determine if further adjustments need to be made.
 - If the measured OCV is not within 1VDC of the calculated target OCV and fuel pressure has not exceeded at 3.3 in.H₂O, then adjust the fuel pressure by another 0.4 in.H₂O, allow the TEG to stabilize for another 40 minutes, and read the voltage again. Repeat this step until the voltage falls within 1 VDC of the calculated target OCV, or until the regulator has been adjusted to 3.3 in.H₂O, whichever comes first.
 - If the measured OCV is within 1 VDC of the calculated target OCV, the Sentinel TEG is ready to operate.
 - If the TEG’s fuel pressure is at 3.3 in.H₂O and the measured OCV is less than 23.6 VDC, consult the Troubleshooting section and review “Low Output Power” to determine the cause and corrective action.
4. Re-install fuel pressure regulator cap and record final OCV and fuel pressure settings in the Performance Log located at the end of this manual.



Do not exceed 3.3 in.H₂O of fuel pressure adjustment. If OCV is still too low after 3.3 in.H₂O adjustment, let the Sentinel TEG run at the final adjustment setting and check the OCV again at the next maintenance visit.

4.3.4 CUSTOMER OUTPUT VOLTAGE ADJUSTMENT

The customer output voltage can be adjusted using the potentiometer on the main electronics board. To adjust the customer output voltage:

1. Ensure that the SW200 switch, is set to the “RUN” position.
2. Disconnect the customer load by disconnecting the positive wire at the [+ TEG OUT –] terminal.
3. Connect a voltmeter to the [+ TEG OUT –] terminals.
4. Confirm that the SW300 switch is set to the T.COMP.OFF position.
5. Use a small flathead screwdriver to turn the VOLTAGE ADJUST potentiometer. The voltage level on the voltmeter should change as the potentiometer is turned.
6. Set the output voltage based on your site requirements.
7. When finished, remove the voltmeter connection, and reconnect the customer load wire.

4.3.5 ENABLING OUTPUT VOLTAGE TEMPERATURE COMPENSATION

The Sentinel TEG is equipped with a temperature compensation feature which can be used when charging lead-acid station batteries with the TEG. This feature can be enabled by setting the SW300 switch to the T.COMP.ON position. When enabled, the Sentinel TEG’s output voltage will be scaled based on the current ambient temperature.

The voltage scaling is tuned for typical lead-acid station batteries and is 20 mV/°C for 12V Models or 40 mV/°C for 24V Models.

The Sentinel TEG is shipped from the factory with the SW300 switch set to T.COMP.OFF. Before switching the temperature compensation on, confirm that the customer output voltage has been properly calibrated. The VOLTAGE ADJUST potentiometer must be calibrated before turning on the T.COMP switch to ensure accurate temperature compensation.



Ensure precise calibration of the Voltage Adjust potentiometer

12V Model (SENTINEL10-12) — 14.3 V

24V Model (SENTINEL10-24) — 28.6 V

Set the output voltage precisely to the voltage listed above based on the Sentinel model, then set the SW300 switch to the T.COMP.ON position.



Calibrate the potentiometer before setting the SW300 switch to T.COMP.ON. Turning on temperature compensation without first calibrating the potentiometer can lead to overcharged or undercharged station batteries.

4.4 APPLYING THE CUSTOMER LOAD

Once the Sentinel TEG is operating at the calculated target OCV and all adjustments are completed, apply the customer load as follows:

1. Connect the customer load to the [+ TEG OUT –] terminals at the bottom of the main electronics board.
2. If the low-voltage alarm will be used, connect customer wiring to the [+ LV Alarm –] terminals.
3. Set the SW200 switch to the “RUN” position.
4. Re-install the electronics enclosure cover plate.
5. Close the instrumentation enclosure door, then secure it by tightening the two door screws.



WARNING!

Make sure that the cover plate for the electronics enclosure is installed and the instrumentation enclosure door is fastened shut before leaving the site.

4.5 RECORD KEEPING

Your Sentinel TEG is now operating successfully, providing continuous electrical power to the customer load. For ease of maintenance and service, keep a record of the unit's performance using the MAINTENANCE AND PERFORMANCE LOG provided at the end of this manual. Record all parameters each time adjustments are made and when maintenance or service is performed on the unit.

4.6 SHUTDOWN

The Sentinel Thermoelectric Generator is intended for continuous operation where reliable power is required without interruption. If the TEG must be shut down temporarily for servicing or an emergency, close the TEG manual shut-off valve. To ensure there is no voltage present at the screw terminals on the board, turn SW200 to OCV (refer to Figure 3) and disconnect battery connector from battery PCB (refer to Figure 11).

5 MAINTENANCE



Read all product documentation before performing service or maintenance on the Sentinel TEG and ensure that you are thoroughly familiar with the product's sub-systems and key components. Service and maintenance of the Sentinel TEG must be performed by technically qualified personnel as outlined in Section 1.2.

5.1 RECOMMENDED PERIODIC MAINTENANCE

The Sentinel Thermoelectric Generator is a highly reliable, solid-state appliance that requires very little maintenance; however, it should be checked regularly to ensure product longevity. The maintenance frequency on the Sentinel may vary depending on site conditions and usage. As a minimum, perform the following checks and maintenance once per year.

1. Verify Open Circuit Voltage:
 - a. Determine OCV target based on ambient temperature and altitude – refer to Section 4.1.
 - b. Determine OCV degradation due to days of operation – refer to Section 5.1.2.
 - c. Measure OCV – refer to Section 4.3.2.
 - d. Compare measurement and target.
 - e. If the measured OCV differs by more than 1 VDC from the calculated target OCV, adjust the fuel pressure – refer to Section 4.3.3.
 - f. If target OCV cannot be achieved, see Troubleshooting – refer to Section 6.
2. Replace the fuel filter cartridge— refer to section 5.2.1. Remember that fuel outside of the specifications outlined in Section 2.3 may increase service interval.
3. Check all fuel line connections for leaks.
4. Remove any debris, sand or dust from the inlet screen, cooling fins, cabinet, and ducts.
5. Check all bolts and wire connections for tightness.
6. Restart the TEG— refer to section 4.2.

5.1.1 START-UP BATTERY PACK REPLACEMENT INTERVAL

Replace start-up battery pack during an annual maintenance every 5 years of service.

5.1.2 DETERMINING OCV VALUE AFTER CATALYTIC HEATER CARTRIDGE DEGRADATION

To determine OCV value after operating the Sentinel Catalyst Cartridge for some time:

1. Determine correction factors for current site conditions as described in Section 4.1. Correction Factors can be combined into a single value by multiplying the 2 factors. For example: Temperature correction factor = 0.90 and Altitude correction factor = 0.95, overall correction factor = $0.90 * 0.95 = 0.855$.
2. Determine number of days of operation of the Catalyst cartridge – refer to MAINTENANCE AND PERFORMANCE LOG.

Use Figure 21 to determine target OCV based on correction factors and days of operation. For example: using example in step 1, overall correction factor = 0.855 (we will round to 0.85) and days of operation = 250 days. Target OCV based on CF 0.85 line of chart = ~17.6 VDC.

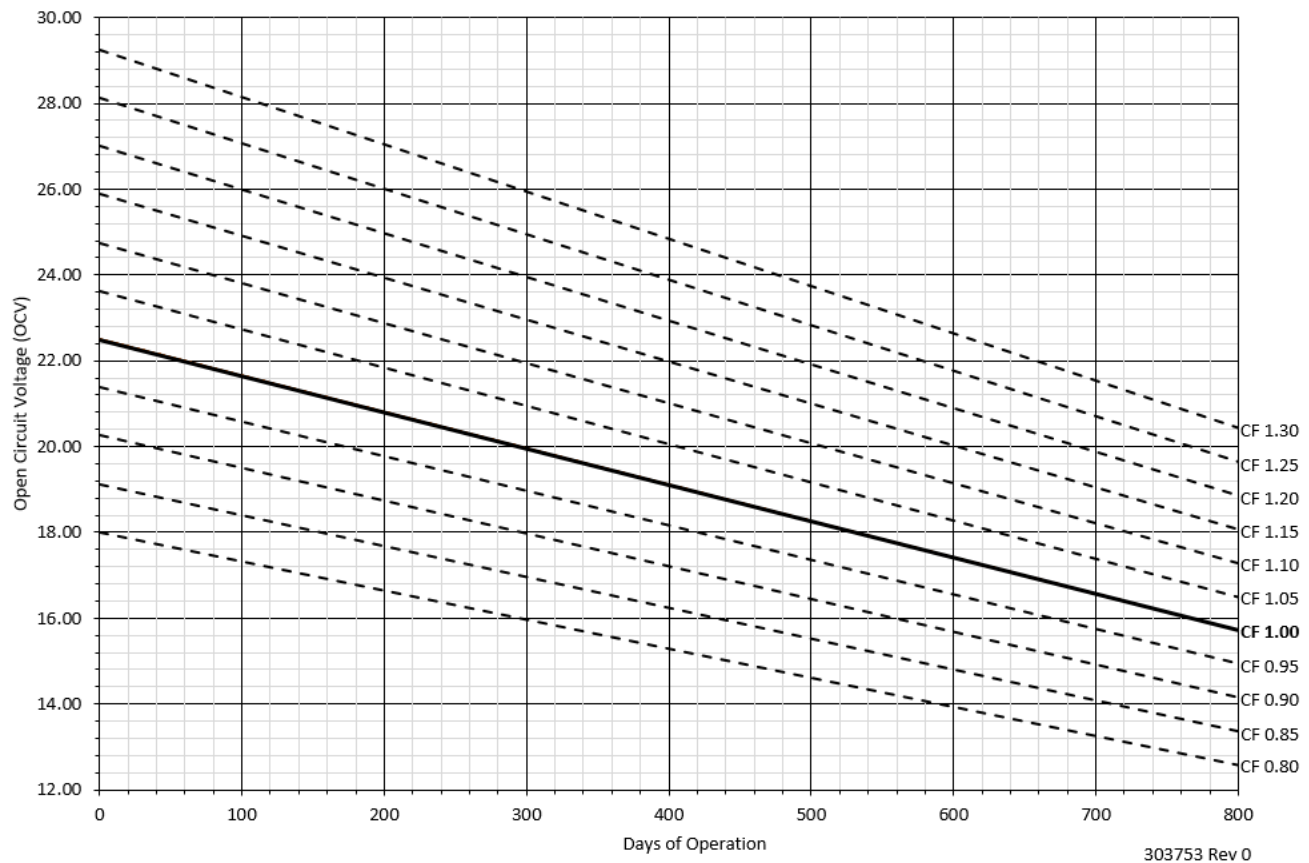


Figure 21 – OCV Degradation vs. Days of Operation

5.1.3 DETERMINING CATALYTIC HEATER CARTRIDGE REPLACEMENT INTERVAL BASED ON LOAD REQUIREMENTS

The heat output of the catalyst cartridge will degrade over time, this will affect power available to the load. To ensure that load requirements are met, the cartridge will need to be replaced periodically. To determine the frequency of replacement, based on site load requirements:

1. Determine correction factors for the site as described in Section 4.1, but use Figure 22 and Figure 23, based on worst case (highest) ambient temperature expected and altitude. For example, peak summer temperatures are expected to be 30°C [86°F], worst case temperature correction factor = 0.98. Combine this factor with your altitude factor by multiplying the 2 factor values.
2. Determine your minimum power requirement for your load.
3. Refer to Figure 24, follow the correction factor line that is most relevant to factor calculated in step 1 until it crosses the power requirement for your site. The x-axis value at this intersection will be the number of days of operation before a catalyst cartridge replacement will be required. For example, overall correction factor determined = 0.90 and minimum load requirement is 7.5 W. Catalytic Heater Cartridge will require replacement after ~360 days.

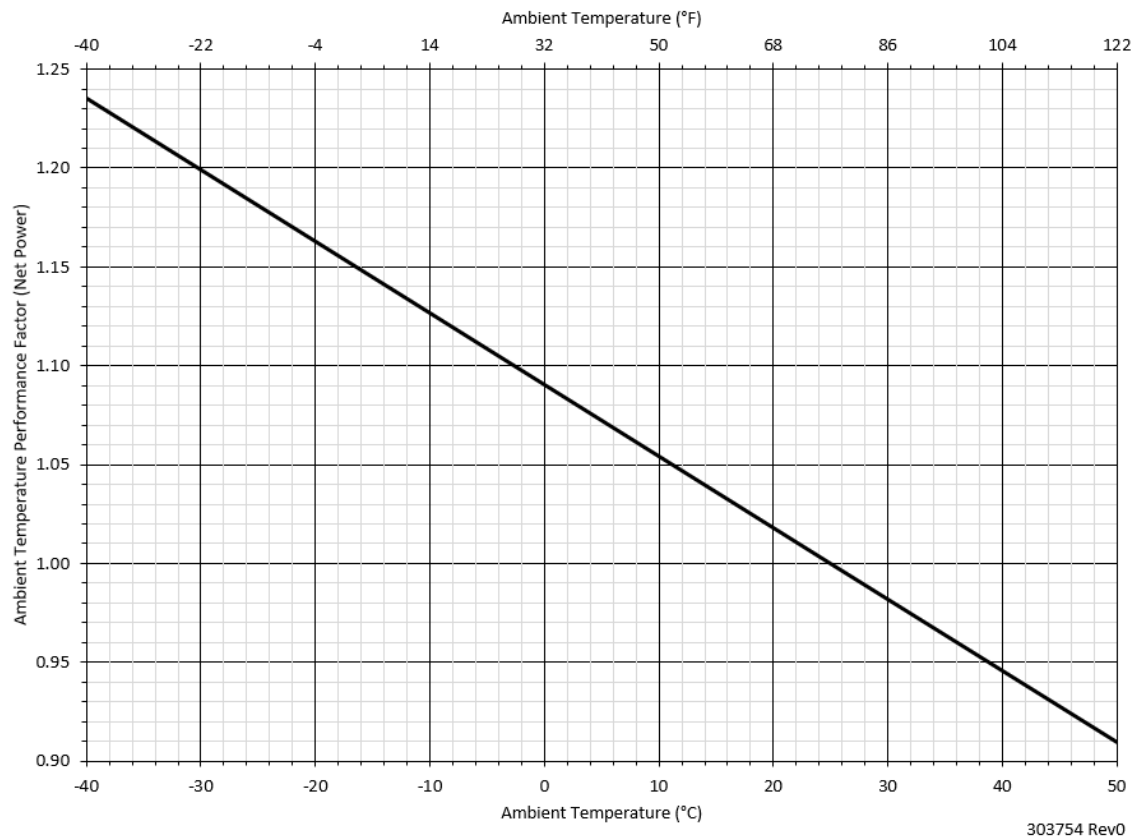


Figure 22 – Net Power Ambient Temperature Correction Factor

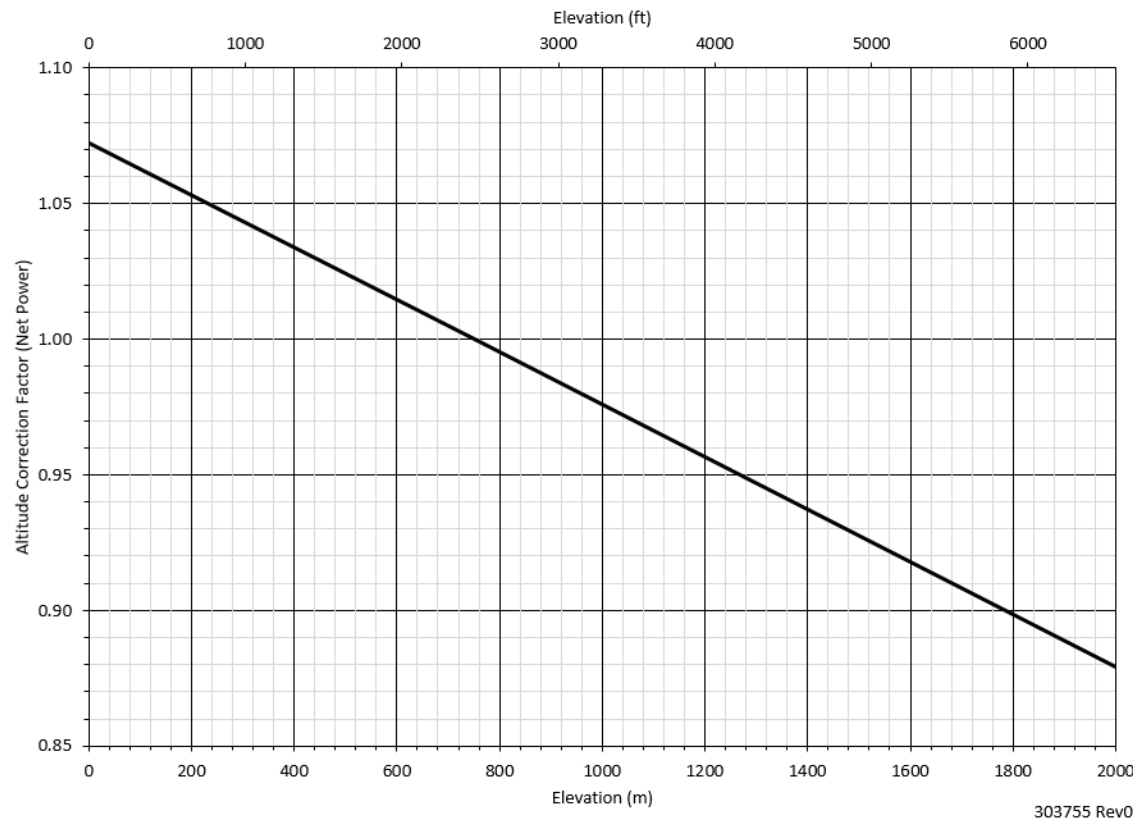


Figure 23 – Net Power Altitude Correction Factor

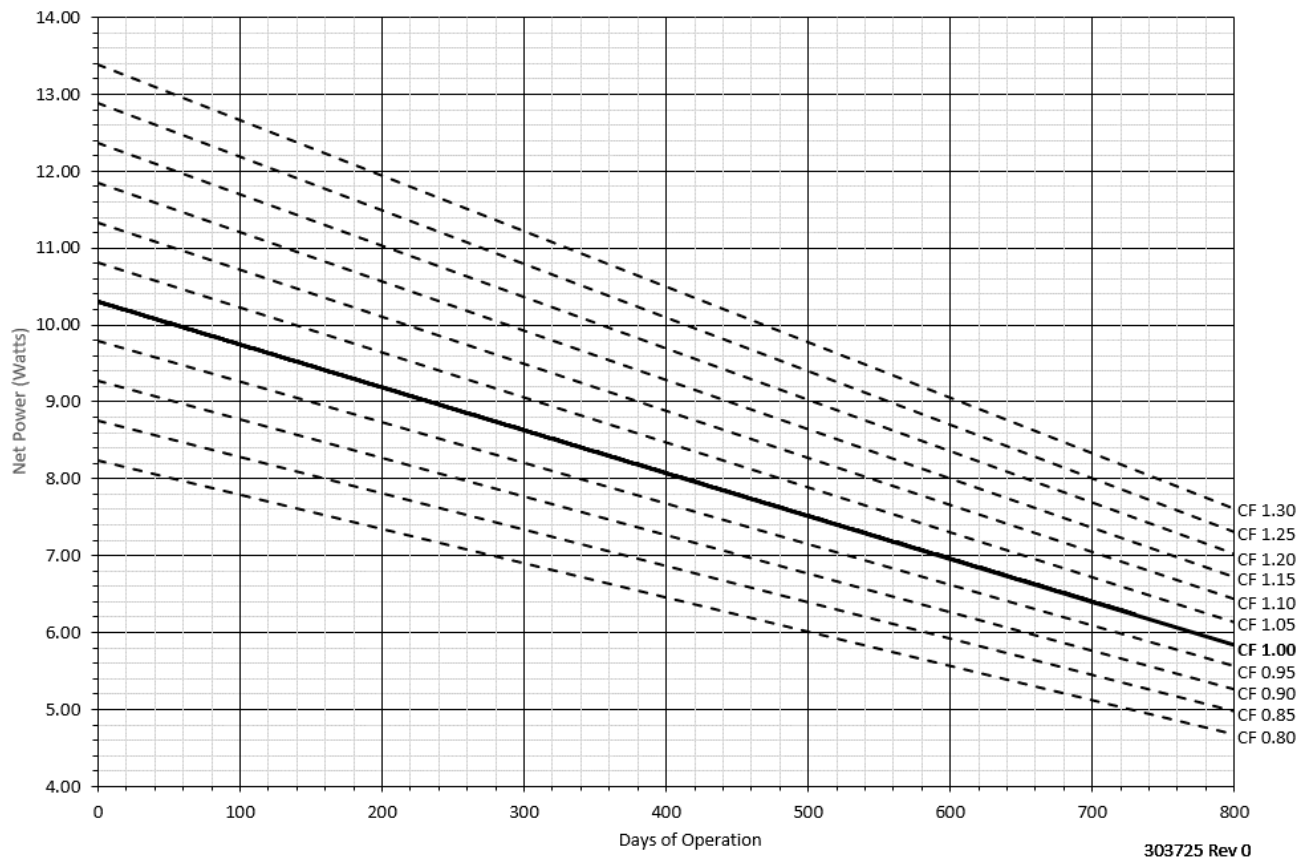


Figure 24 – Sentinel Net Power vs. Days of Operation

Before performing any service or maintenance on the Sentinel TEG:

- ✓ Shut down the unit by closing the manual shut-off valve below the regulator
- ✓ De-classify the area ensuring that there is no explosive gas present before and during service or maintenance activities.
- ✓ De-energize the system by disconnecting the wiring connector from the start-up battery pack.
- ✓ Allow the unit to cool for at least one hour before beginning any service or maintenance activity.



WARNING!

Ensure that no explosive gas hazard is present prior to opening the instrumentation enclosure and performing any service on the Sentinel TEG. The Sentinel enclosure must not be opened when an explosion or gas hazard may be present.

5.2 FUEL SYSTEM MAINTENANCE

5.2.1 FUEL FILTER MAINTENANCE AND CARTRIDGE REPLACEMENT

The Sentinel TEG is equipped with a natural gas scrubbing system to help eliminate contaminants in the fuel supply. To ensure maximum efficiency and longer appliance life, replace the filter cartridges (two of GPT# 302623) once every year.

This annual change-out schedule is based on a possible fuel contaminant of 2.7 mg/Sm^3 (approx. 4 ppm) of H_2S as outlined in the standard specifications in Section 2.4. If the concentration of H_2S in the fuel supply exceeds the standard specification, contact GPT for the appropriate cartridge replacement frequency.

Failure to replace the filter cartridges when required may result in excessive drop in pressure and the possibility of contaminant carry-over to the Sentinel TEG. To order additional filter cartridges, please contact GPT.

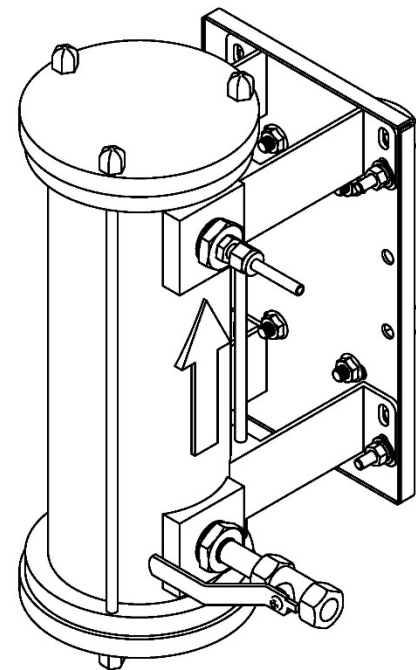
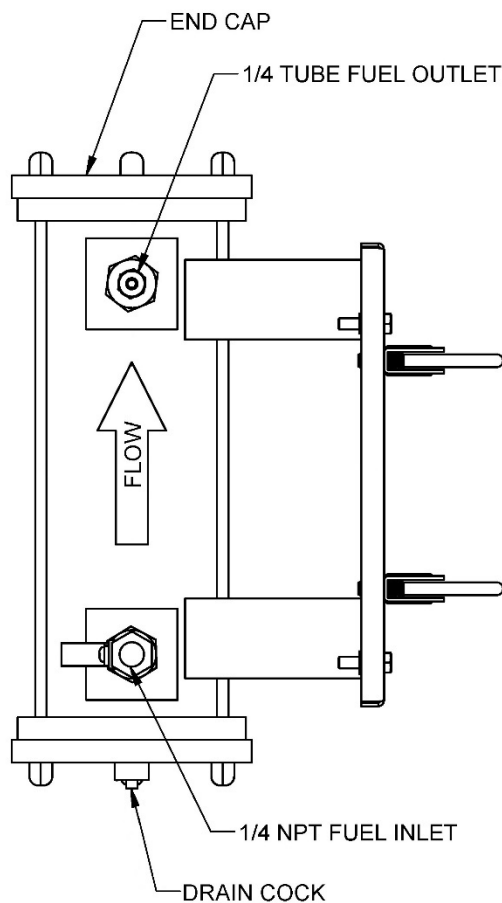
Do not subject the fuel filter to vapours or liquids from synthetic solvents, acetone, methanol, esters, lacquer thinners, phosphates, etc.

Refer to APPENDIX C for SDS of fuel filter replacement cartridges prior to handling and disposal.



WARNING!

Never replace filter cartridge when the unit is under pressure. Always follow safe work procedures when working with high pressures and ensure that pressure has been released from the system before performing work.



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Figure 25 – Changing the Fuel Filter Cartridges

To change the fuel filter cartridges:

1. Close the manual shut-off valve at the fuel supply to the fuel filter.
2. Vent the filter by opening the drain cock located on the bottom of the filter. Make sure that the filter is completely vented and under no pressure before proceeding.
3. Close the manual shut-off valve below the TEG regulator.
4. Remove the end cap on top of the filter by pressing the blue cap down, turning it counterclockwise until the castle nuts align with the slots, and pulling up the cap. Do not loosen the castle nuts.

NOTE: Do not loosen the castle nuts when removing the end cap.



WARNING!

Do no reuse contaminated media.

-
5. Remove the two filter cartridges from the fuel filter unit and dispose them safely.
 6. Insert two new fuel filter cartridges, sewn end down, into the filter unit.
 7. Re-install the end cap, close the drain cock, and open the isolation valves before returning the fuel filter unit to service.
 8. Check all fuel lines for leaks.
-



WARNING!

Ensure that the end cap is securely closed before re-pressurizing the fuel filter.



WARNING!

Always check for fuel system leaks after any fuel system service.

5.3 BATTERY CHARGING AND REPLACEMENT

The start-up battery pack requires at least 11.8 Volts to successfully start the TEG. The start-up battery pack is slowly charged during TEG operation, but a fully depleted battery can take 6 days to recharge. If faster charging is necessary, or if the battery pack won't accept a charge and needs replacement, follow the steps in this section.

5.3.1 EXTERNALLY CHARGING THE START-UP BATTERY PACK

The start-up battery pack can be charged using standard 12 VDC lead-acid battery chargers. Charging current should be limited to 1 Amp or less. Connect the charger to the [+ BATTERY –] terminals on the main electronics board, and then activate the charger. Remove the connections once the battery pack has received a sufficient charge.

5.3.2 JUMP-STARTING THE SENTINEL TEG

If the start-up battery pack is depleted, the Sentinel may be jump-started with an external 12 VDC battery, such as a vehicle battery, using a specialty cable assembly offered by GPT. The jump-start cable is equipped with protective features that ensure the Sentinel and the external battery operate safely. To order the TEG jump-start cable, contact GPT and quote part number 300495. Refer to the application note that ships with the cable for jump-start instructions and diagrams.



Declassify the area before opening the instrumentation enclosure, electronics enclosure, and attempting a jump-start.

5.3.3 REPLACING THE START-UP BATTERY PACK

Replace the start-up battery pack every five years of service. To replace the battery:

1. Disconnect the battery wiring from the connector on the bottom left corner of the battery board.
2. Remove the two screws on the bottom of the battery support bracket while supporting the battery board with one hand. Save the screws for re-installation.
3. Remove the battery support bracket and the start-up battery pack, being careful not to allow the start-up battery pack to fall off.
4. Place the new start-up battery pack in the battery chamber.
5. Attach the battery support bracket to the new start-up battery pack.
6. Secure the battery support bracket with the two #10-32 x 5/16" screws that were previously removed.
7. Reconnect the battery wiring harness to the new battery board.

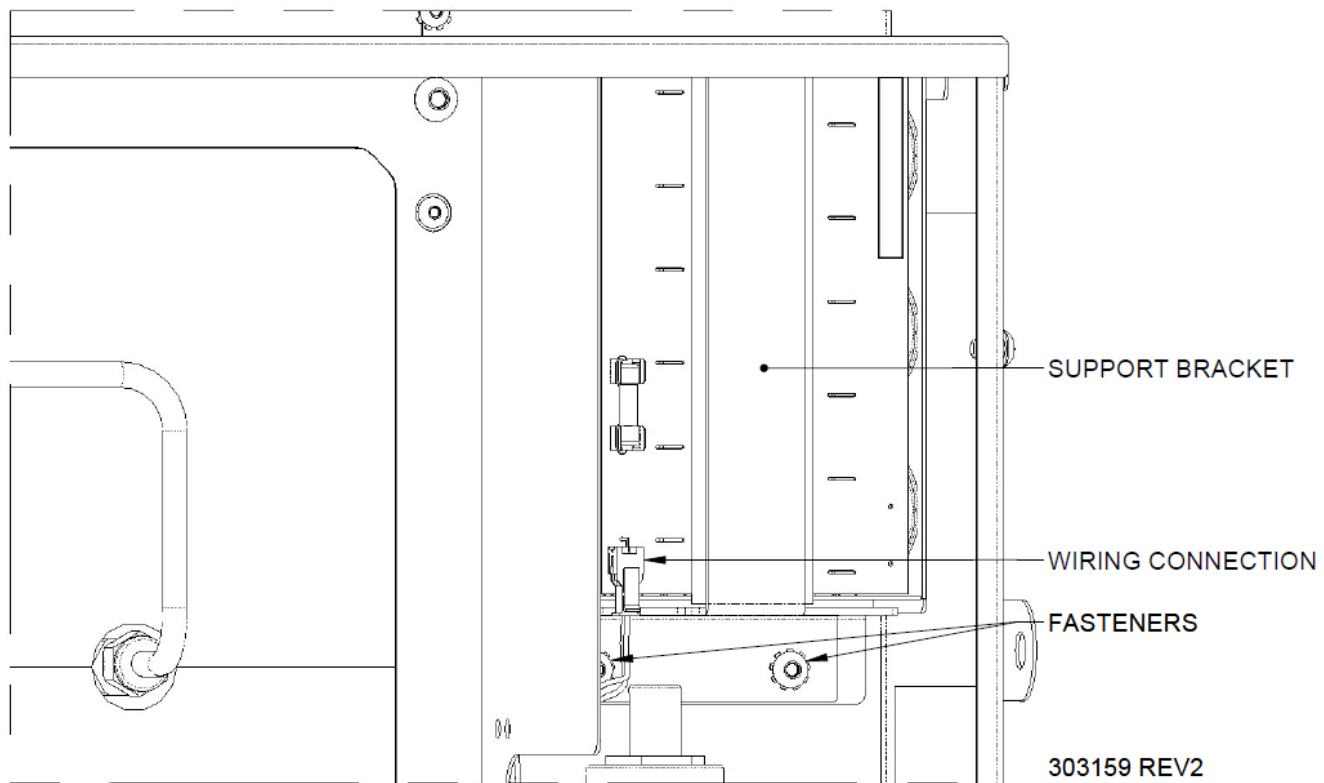
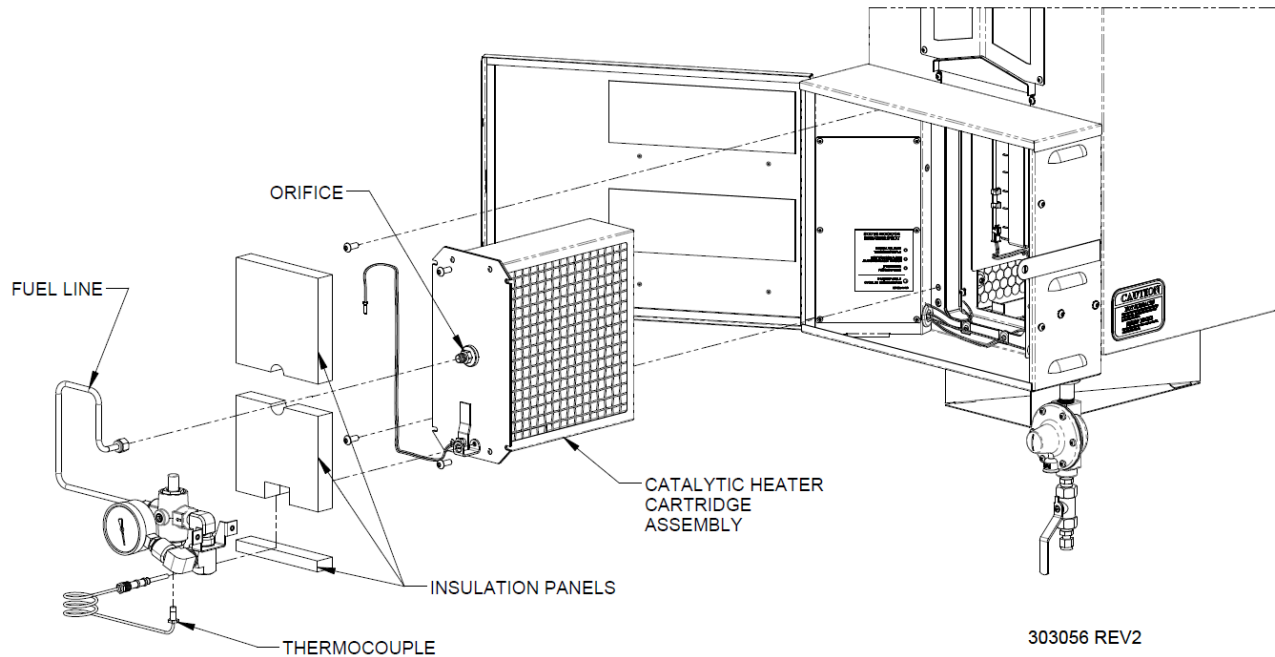


Figure 26 – Start-up Battery Pack Replacement

5.4 CATALYTIC CARTRIDGE ASSEMBLY REPLACEMENT

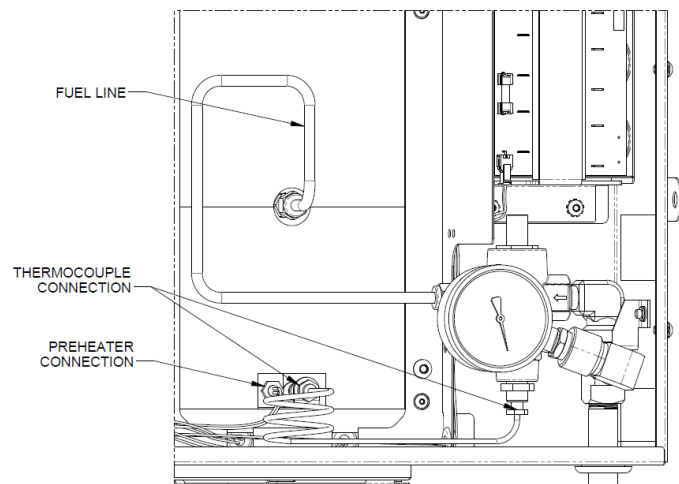


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Figure 27 – Replacing the Catalytic Heater Cartridge

Replace the catalytic heater cartridge on the interval determined from Section 5.1.2:

1. Ensure the heater cartridge has been allowed to cool (~20 minutes) prior to handling.
2. Unplug the 'PREHEATER' wiring connection from the top of the main circuit board. Remove cable ties as necessary, then route the preheater wires back outside of the electronics enclosure.
3. Remove the three insulation panels from the center of the instrumentation enclosure to access the catalytic heater cartridge assembly chamber.
4. Disconnect the fuel line from the orifice in the center of the catalytic heater assembly face and the elbow connector on the safety shut-off valve. Save this for re-installation.
5. Disconnect the thermocouple from the bottom of the catalytic heater assembly face and the bottom of the safety shut-off valve. Save this for re-installation.
6. Remove the four screws securing the catalytic cartridge assembly using a 3/32" hex key.
7. Pull the catalytic heater cartridge assembly out of the catalytic heater chamber.
8. Insert a new catalytic heater cartridge into the catalytic heater chamber, positioned with the two holes on the bottom.
9. Secure the new cartridge using the four #8-32 x 3/8" screws that were previously removed.



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Figure 28 – Catalytic Heater Connections

10. Connect the thermocouple to the connection slot on the bottom of the catalytic heater cartridge face and the bottom of the safety shut-off valve. Ensure the connection to the valve is wrench tight.
11. Connect the fuel line to the fuel orifice and the elbow connector on the safety shut-off valve.
12. Re-install or replace the three insulation panels that were removed at the beginning of this installation. The panels ensure proper insulation of the catalytic heater assembly. Do not run the Sentinel TEG without the insulation panels installed.

**WARNING!**

Ensure that all three insulation panels for the catalytic heater assembly are installed before starting up the Sentinel TEG.

13. Route the replacement preheater wiring connection through the grommet on the bottom-right of the electronics enclosure, and up the side to the top of the circuit board, where the harness plugs in to the receptacle. These wires must be resecured with three cable ties along their length: the first should be tied about 1.5" outside of the electronics enclosure grommet, the second about 2.5" inside the electronics enclosure grommet, and the third tied to the cable tie mount inside the upper portion of the electronics enclosure.

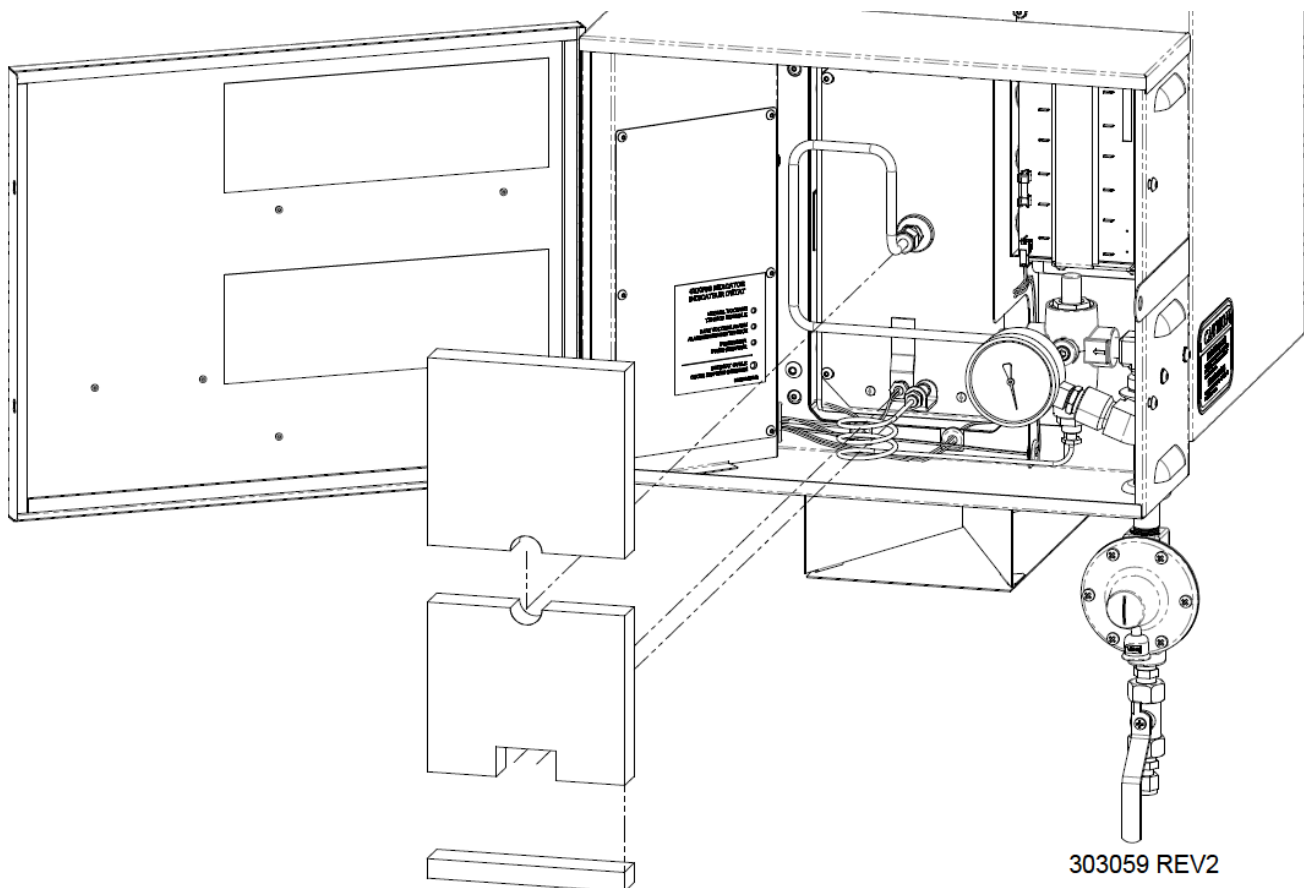


Figure 29 – Catalytic Heater Insulation Panels

6 TROUBLESHOOTING

The table below shows a list of issues that may arise as well as their causes and possible solutions. For any issues or concerns that is not listed below, contact GPT Customer Service at +1-403-720-1190 or customer.service@globalte.com

Problem	Probable Cause	Possible Solution	Lookup Section
Cartridge heater does not react	Air in fuel line	Purge fuel lines of air or attempt restarting the TEG.	3.7
	Supply gas pressure too low	Increase the gas supply to the TEG.	2.3
	Fuel filter dirty	Replace fuel filter element	5.2
	Fuel pressure adjustment incorrect	Adjust the TEG fuel pressure.	4.3.2
	Fuel orifice plugged	Replace the fuel orifice.	5.4
	Fuel orifice size incorrect	Replace the fuel orifice with one of the correct size.	5.4
	Buildup of debris on intake screen	Clean intake screen.	
	Start Up Battery Voltage Low	Charge or replace start up battery.	3.8
		Replace start-up battery fuse.	
	Heater damaged	Contact GPT	
	Preheater faulty	Contact GPT	
Cartridge heater reacts but does maintain reaction.	Supply gas pressure too low	Increase the gas supply to the TEG.	2.3
	Fuel filter dirty	Replace fuel filter element	5.2
	Fuel pressure adjustment incorrect	Adjust the TEG fuel pressure	4.3.2
	Fuel orifice plugged	Replace the fuel orifice	5.4
	Fuel orifice size incorrect	Replace the fuel orifice with one of the correct size.	5.4
	Buildup of debris on intake screen	Clean intake screen	
	Start-up battery voltage low	Charge or replace start up battery	5.3
	Start-up battery voltage low	Charge or replace start up battery	5.3.1, 5.3.3
	Heater damaged	Contact GPT	
	Thermocouple connection to valve not tight	Check/tighten thermocouple connection to valve	5.4

Problem	Probable Cause	Possible Solution	Lookup Section
Low output power	Target OCV incorrect.	Determine required target OCV for present ambient temperature at site and adjust	4.1
	Airflow past cooling fins insufficient	Clean the cooling fins of any debris	
	Fuel filter dirty	Replace fuel filter element	5.2.1
	Fuel orifice plugged	Replace the fuel orifice	5.4
	Fuel orifice size incorrect	Replace the fuel orifice	5.4
	Fuel pressure adjustment incorrect	Adjust TEG fuel pressure	4.3.2
	Buildup of debris on intake screen	Clean intake screen	
	Power units damaged	Contact GPT	
	Heater damaged	Contact GPT	
	Heater cartridge at end of life	Replace heater cartridge	5.4
	Fuel pressure adjustment incorrect	Adjust the TEG fuel pressure	4.3.2
Output power is too high	Output voltage adjustment incorrect	Adjust output voltage potentiometer.	4.3.4
Output voltage is too high	Output voltage adjustment incorrect	Adjust output voltage potentiometer.	4.3.4
Low output voltage	Overloaded TEG	Reduce customer load	
	Heater cartridge at end of life	Replace heater cartridge	5.4

7 PARTS LIST

7.1 ROUTINE REPLACEMENT PARTS

GPT Part #	Part Description	Replacement Frequency
302623	CARTRIDGE, REPLACEMENT, H2S & MOISTURE	Annually (two required)
303747	PARTS KIT, HEATER CARTRIDGE, SENTINEL	As determined in Section 5.1.3
302706	START-UP BATTERY PACK, SENTINEL	Every 5 years
302722	FUSE, CERAMIC 2.5A 250 VAC 5X20MM	As needed (battery fuse)
303282	ORIFICE ASSY W INLET TUBE, 0.056	As needed

NOTE: Filter cartridges and heater cartridges are shipped in sealed packaging and are expected to be stored that way until point of use.

7.2 GENERATOR PARTS

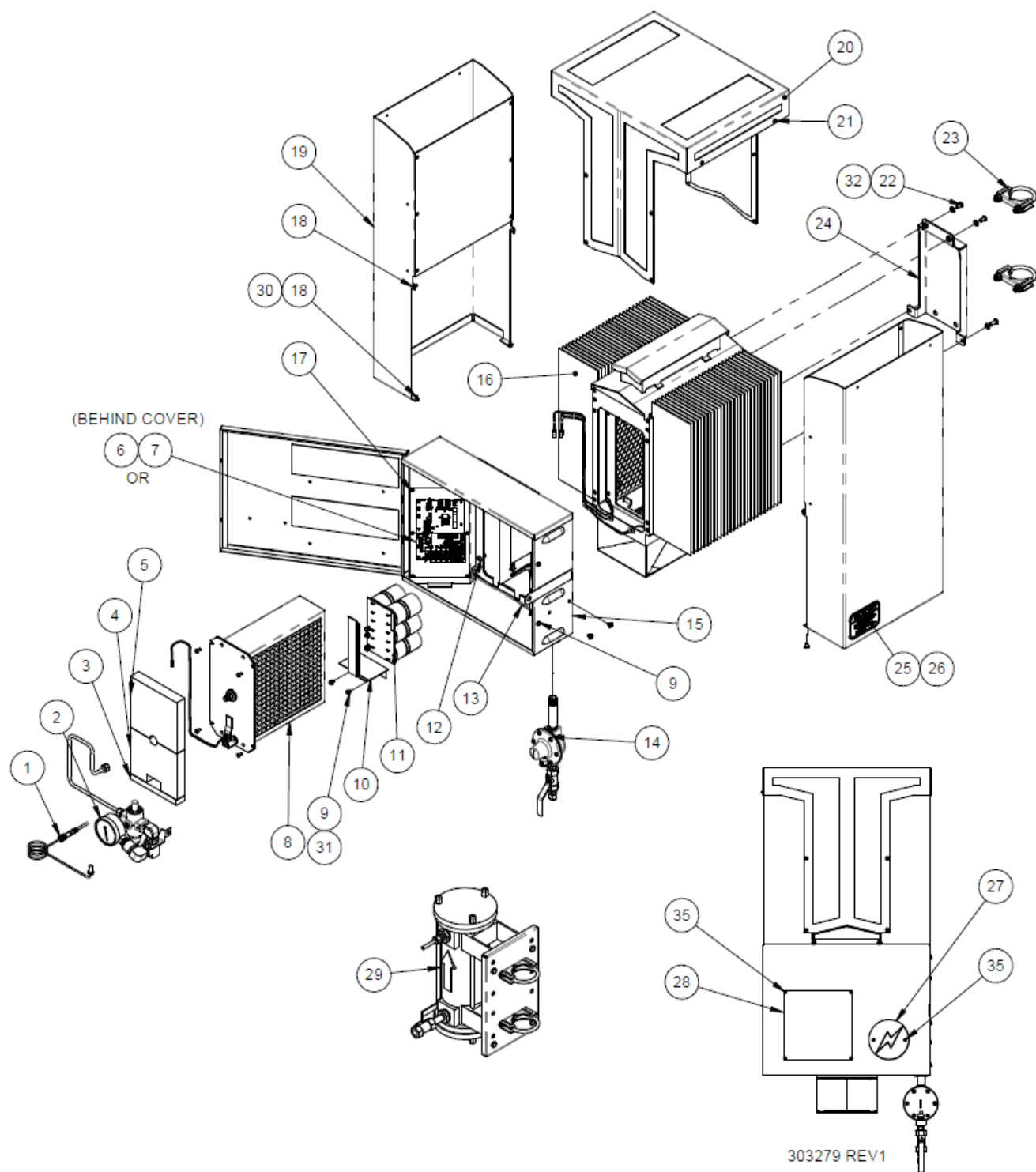
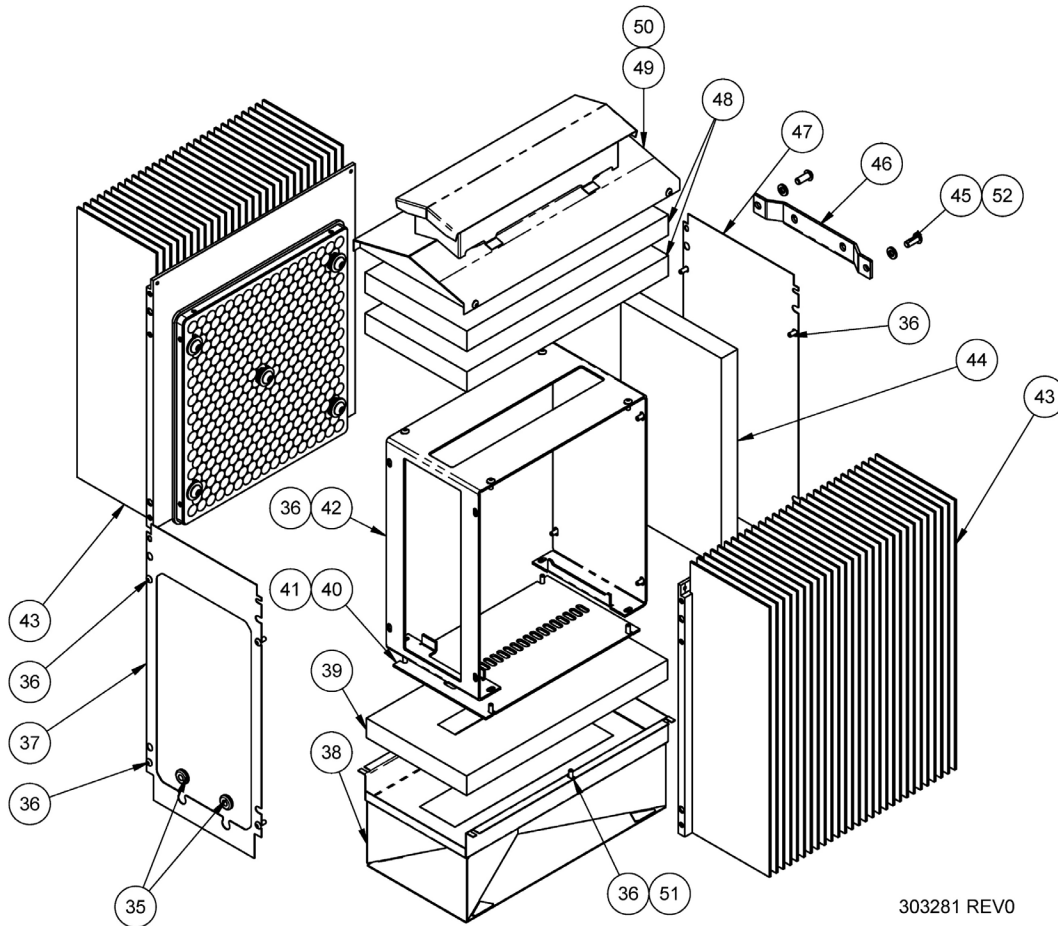


Figure 30 – Parts List, Generator

Item	GPT Part #	Part Description
1	177	THERMOCOUPLE, 24"
2	302341	FUEL SYSTEM, SENTINEL
3	302347	FRONT INSULATION 3
4	302346	FRONT INSULATION 2
5	301331	FRONT INSULATION 1
6	302334	PCBM, 12V 10W CONVERTER, SENTINEL
7	302803	PCBM, 24V 10W CONVERTER, SENTINEL
8	301325	HEATER CARTRIDGE ASSEMBLY
9	302358	SCREW, BH SOC #10-32X0.3125, SS
10	302930	BRACKET ASSY, BATTERY SUPPORT, SENTINEL
11	302706	START-UP BATTERY PACK, SENTINEL
12	302356	SCREW, BH SOC 1/4-28X0.625, SS
13	303086	WIRE HARNESS, BATTERY TO PCBA, SENTINEL 10
14	302639	FUEL TRAIN REGULATOR SUBASSEMBLY
15	301350	INSTRUMENTATION ENCLOSURE ASSEMBLY
16	301356	PRIMARY SUBASSEMBLY
17	302362	SCREW, BH SOC #6-32X0.3125, SS
18	302360	SCREW, BH SOC #8-32X0.375, SS
19	301289	DUCT ASSEMBLY
20	301285	DUCT COVER ASSEMBLY
21	302361	SCREW, BH SOC #8-32X0.25, SS
22	302357	SCREW, BH SOC 1/4-28X0.4375, SS
23	301355	U-BOLT MUFFLER CLAMP, 2IN
24	301299	MOUNTING BRACKET
25	26862	LABEL, CAUTION, HOT SURFACES/SHARP EDGES
26	27229	LABEL, CAUTION, HOT SURFACES/SHARP EDGES, FRENCH
27	683	LABEL, GPT BRANDING
28	302112	CERTIFICATION LABEL
29	302622	FILTER ASSEMBLY, FUEL GAS
30	472	WASHER, LOCK, EXT. #8, SS
31	23437	WASHER, LOCK, EXT. #10, SS
32	541	WASHER, LOCK, SPRING, 1/4, SS
33	303139	CUSTOMER INSTALLATION KIT, SENTINEL
34	54770	CABLE TIE, 4.0" X 0.095" , BLK NYLON
35	393	RIVET, POP, 1/8, SS, .063-.125 GRIP

7.3 PRIMARY SUBASSEMBLY PARTS

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Figure 31 – Parts List, Primary Subassembly

Item	GPT Part #	Part Description
35	302638	GROMMET, 0.438-0.250, MCMaster 9307K13
36	302360	SCREW, BH SOC #8-32X0.375, SS
37	301369	FRONT INSULATION COVER
38	302933	BOTTOM INSULATION COVER ASSY, SENTINEL
39	301321	INLET INSULATION
40	301297	HEATER BODY INLET
41	302359	SCREW, BH SOC #8-32X0.4375, SS
42	301298	HEATER BODY
43	301286	COLLECTOR-SINK ASSEMBLY
44	301332	BACK INSULATION
45	302356	SCREW, BH SOC 1/4-28X0.625, SS
46	301313	MOUNTING CROSSBAR
47	301316	BACK INSULATION COVER
48	301320	EXHAUST INSULATION
49	301366	RAIN CAP WELDMENT
50	302361	SCREW, BH SOC #8-32X0.25, SS
51	472	WASHER, LOCK, EXT. #8, SS
52	541	WASHER, LOCK, SPRING, 1/4, SS

7.4 FUEL TRAIN PARTS

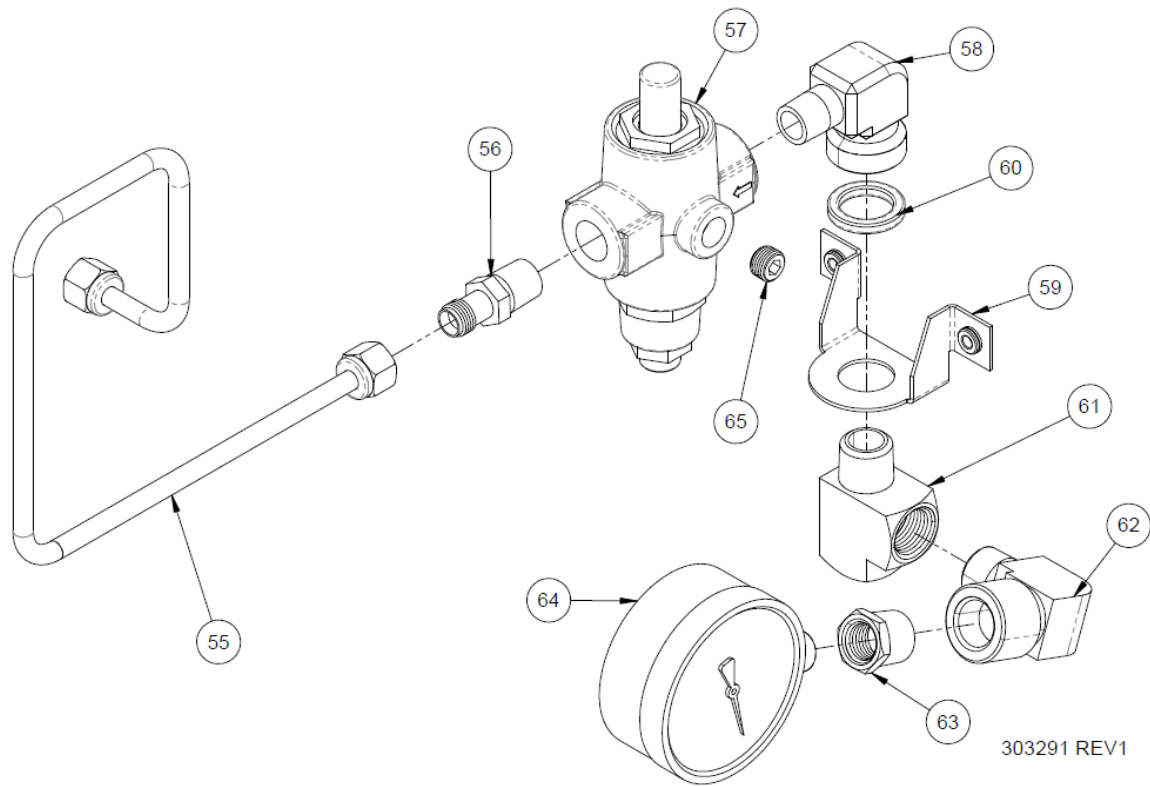
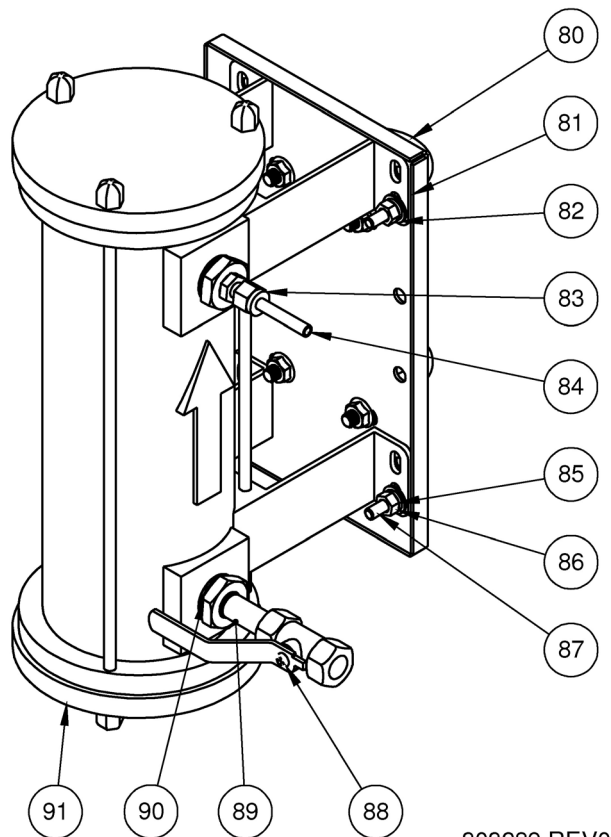


Figure 32 – Parts List, Fuel Train

Item	GPT Part #	Part Description
55	303283	FUEL LINE ASSY, SENTINEL
56	22790	CONNECTOR, 0.25 TB X 0.25 MNPT, 316SS, NO NUT
57	176	VALVE, SHUT-OFF
58	302629	STREET ELBOW, 3/8 NPTF X 1/4 NPTM, BRASS
59	301349	GAS MOUNTING BRACKET - SENTINEL
60	303096	O-RING, X-PROFILE, .688ID, DASH 209, NBR
61	302941	TEE, 3/8NPT, FMF, BRASS
62	302940	STREET ELBOW, 90, 3/8NPT, BRASS
63	302939	REDUCER, 3/8 NPTM X 1/4 NPTF, BRASS
64	302995	GAUGE, PRESS, 0-15 W.C., .25 MNPT, 2.5 OD
65	302942	PLUG, 1/8NPT, FLUSH HEX DRIVE, SS

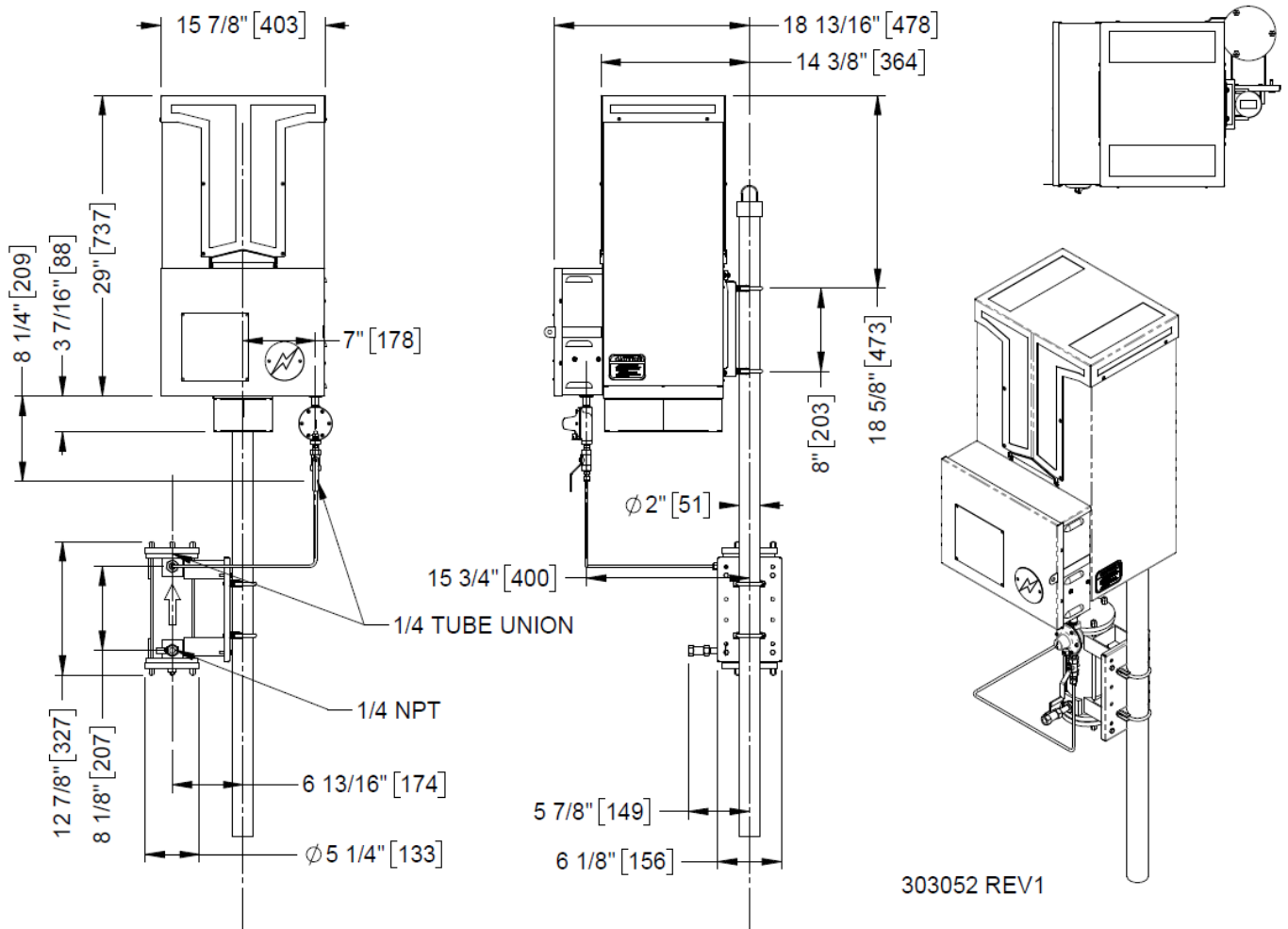
7.5 FUEL FILTER PARTS



303289 REV0

Figure 33 – Parts List, Fuel Filter Assembly

Item	GPT Part #	Part Description
80	301355	U-BOLT MUFFLER CLAMP, 2IN
81	302994	MOUNT, FUEL FILTER
82	557	WASHER, FLAT, 1/4, SS
83	380	CONCTR 1/4TBX1/4 MNPT 316 SS
84	303088	FUEL LINE, FUEL FILTER TO REGULATOR
85	611	NUT, HEX, 1/4-20, SS
86	541	WASHER, LOCK, SPRING, 1/4, SS
87	2413	SCREW, HEX HD, 1/4-20 X 1 SS
88	24653	VALVE, BALL, 1/4" FNPT, BRASS
89	376	NIPPLE, 1/4 NPT X 2" LG.BRASS
90	302641	REDUCER, 3/4 NPTM X 1/4 FNPT, BRASS
91	303090	FLODRI,G25A GAS SCRUBBER ASSY
N/A	302623	CARTRIDGE, REPLACEMENT, H2S & MOISTURE

APPENDIX A — WEIGHT AND DIMENSIONS*Figure 34 – Sentinel TEG Dimensions*

Height	$37 \frac{1}{4}$ " [946 mm]
Width	$15 \frac{7}{8}$ " [403 mm]
Depth	$17 \frac{13}{16}$ " [452mm]
Weight	93 lb. [42.2 kg]

FUEL FILTER DIMENSIONS

Height	$12 \frac{7}{8}$ " [327 mm]
Width	$8 \frac{15}{16}$ " [227 mm]
Depth	$8 \frac{7}{16}$ " [214 mm]
Port to port distance	$8 \frac{1}{8}$ " [207 mm]
Inlet size	1/4" NPT

APPENDIX B — WIRING DIAGRAM

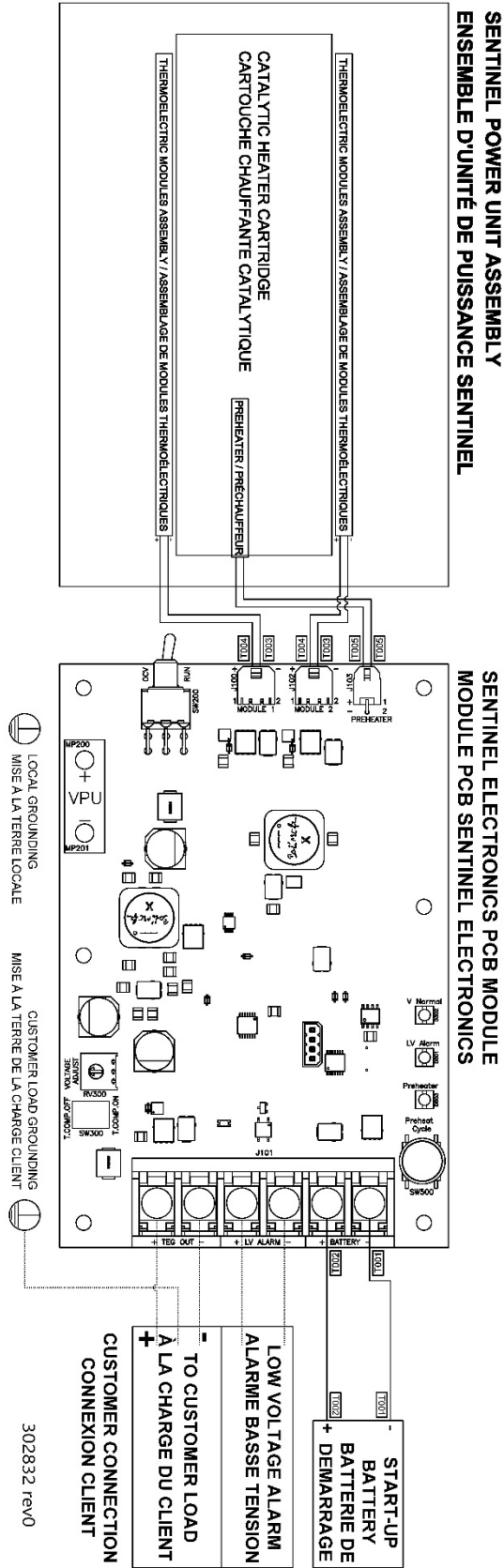


Figure 35 – Sentinel TEG Wiring Diagram

APPENDIX C – FUEL FILTER REPLACEMENT CARTRIDGE SDS**MATERIAL SAFETY DATA SHEET****1. CHEMICAL PRODUCT AND COMPANY INFORMATION**

Product Name: Molsiv Adsorbents 13X 8x12

Product Use: Adsorbent

UOP LLC
25 E. Algonquin Road
Des Plaines, IL 60017-5017
USA
Tel: +1-847-391-3189
Fax: +1-847-391-2953

UOP M.S. S.r.l.
Viale Milanofiori
Strada 1 - Palazzo E1
20090 Assago Mi, Italy
Tel : +39-02-892241
Fax : +39-02-57500145

Emergency Assistance - 24 hour Emergency Telephone Numbers:

USA (UOP LLC) :	+ 1-847-391-2123
USA (CHEMTREC) :	+ 1-800-424-9300
Canada (CANUTEC) :	+ 1-613-996-6666
Outside USA (CHEMTREC) :	+ 1-703-527-3887

2. HAZARDS IDENTIFICATION

Emergency Overview:

Repeated or prolonged exposure may irritate eyes, skin and respiratory system. When first wetted, the product can heat up to the boiling point of water. Flood with water to cool material. Repeated and prolonged inhalation of crystalline silica in the form of quartz from occupational sources may cause cancer.

Form: Beads

Color: Tan

Potential Health Effects:

Primary Routes of Exposure: Contact with skin and eyes. Exposure may also occur via inhalation or ingestion if product dust is generated.

Eye Contact: Dust and /or product may cause eye discomfort and/or irritation seen as tearing and reddening.

Skin Contact: May cause skin irritation. The product gets hot as it first adsorbs water.

Ingestion: The product gets hot as it first adsorbs water. Burns to moist body tissues can result if contact is prolonged.

Inhalation: Exposure to dust particles generated from this material may cause irritation of the respiratory tract. Repeated and prolonged inhalation of crystalline silica in the form of quartz from occupational sources may cause cancer.

Chronic Effects: Prolonged or repeated inhalation may cause lung injury/cancer.

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Carcinogenicity Classification:**International Agency for Research on Cancer (IARC):**

Silicon oxide (synthetic) - Unclassifiable as to carcinogenicity in humans (Group 3).

Inhaled crystalline silica in the form of quartz from occupational sources is carcinogenic to humans (Group 1).

U.S. National Toxicology Program (NTP):

Quartz - Known to be a Human Carcinogen.

U.S. Occupational Safety and Health Administration (OSHA):

Quartz - Known Carcinogen.

American Conference of Governmental Industrial Hygienists (ACGIH):

Aluminum oxide - Not Classifiable as a Human Carcinogen (A4).

Quartz - Suspected Human Carcinogen (A2)

3. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT & CAS NO.</u>	<u>% WEIGHT</u>	<u>ACGIH TLV-TWA</u>	<u>OSHA PEL-TWA</u>	<u>UNITS</u>
Silicon oxide (synthetic) 7631-86-9	< 60	N.E.	15(TD) 5(R)	mg/m ³
Aluminum oxide (non-fibrous) 1344-28-1	< 40	10	15(TD) 5(R)	mg/m ³
Sodium oxide 1313-59-3	< 20	N.E.	N.E.	N.A.
Magnesium oxide 1309-48-4	< 5	10 (I)	15 (Total Particulate)	mg/m ³
Quartz 14808-60-7	< 3	0.025 (R)	TD: 30/(%SiO ₂ +2) RD: 10/(%SiO ₂ +2)	mg/m ³

Note: The OSHA Permissible Exposure Limits (PEL) are determined from the percentage of quartz from airborne samples.

Abbreviations:

N.A.	- Not Applicable	RD	- Respirable Dust	Fu	- Fume	IS	- Insoluble
N.E.	- None Established	R	- Respirable Fraction	I	- Inhalable	FuD	- Fume and Dust
STEL	- Short Term Exposure Limit	F	- Respirable Fibers	TD	- Total Dust	SC	- Soluble Compounds

4. FIRST AID MEASURES

Eye contact: Flush immediately with plenty of water for at least 15 minutes. If eye irritation persists, consult a physician.

Skin contact: Wash off with soap and plenty of water. If skin irritation persists, call a physician.

After inhalation: Remove the victim into fresh air. If symptoms persist, call a physician.

After ingestion: Drink at least 2 glasses of water. Obtain medical attention. Never give anything by mouth to an unconscious person.

Notes to physician: This product is a desiccant and generates heat as it adsorbs water. The used product can retain material of a hazardous nature. Identify that material and treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable extinguishing media: Non-combustible. Use extinguishing media for surrounding fire.

Unsuitable extinguishing media: N.A.

Fire and explosion hazards: The product itself does not burn. The used product can retain material of a hazardous nature. Identify that material and inform the fire fighters.

Special protective equipment: In the case of respirable dust and/or fumes, use self-contained breathing apparatus and dust impervious protective suit.

Flash Point: N.A.

6. ACCIDENTAL RELEASE MEASURES

Personal protection: See Section 8.

Environmental precautions: No special environmental precautions required.

Clean-up: Sweep, shovel or vacuum spilled product into appropriate containers (do not use a vacuum if material has contacted a hydrocarbon material). Pick-up and arrange disposal without creating dust. Never use spilled product. Spilled product should be disposed of in accordance with all applicable government regulations.

7. HANDLING AND STORAGE

Handling: Handle and open container with care. Avoid formation of dust particles. Avoid contact with skin and eyes. Provide an electrical ground connection during loading and transfer operations to avoid static discharge in an explosive atmosphere and to prevent persons handling the product from receiving static shocks. A copy of UOP's booklet, "Precautions and Safe Practices for Handling Zeolite Molecular Sieve Adsorbents in Process Units", can be obtained from your UOP representative at no cost.

Storage: Store in original container. Keep in a dry place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering measures: Where natural ventilation is inadequate, especially in confined areas, use mechanical ventilation, other engineering controls or respiratory protection to prevent inhalation of product dust.

Personal protection equipment: Handle in accordance with good industrial hygiene and safety practice.

Eye protection: Safety glasses or goggles.

Hand protection: Protective gloves.

Skin and body protection: Work uniform and gloves to prevent prolonged contact.

Respiratory protection: In case of insufficient ventilation, wear suitable respiratory equipment. Air-purifying respirator with NIOSH classification N-100 filter or P-100 (or equivalent) if oil/liquid aerosols are present (42 CFR 84).

9. PHYSICAL AND CHEMICAL PROPERTIES

These data do not represent technical or sales specifications.

Form: Beads

Color: Tan

Odor: None

pH: N.A.

Boiling point/range: N.A.

Melting point/range: N.A.

Flash point: N.A.

Autoignition temperature: N.A.

Bulk density: N.D.

Explosion limits: N.A.

Vapor pressure: N.A.

Relative density/Specific Gravity: N.A.

Vapor density: N.A.

Viscosity: N.A.

Water solubility: N.D.

Solubility: N.D.

Abbreviations:

AS	- Aqueous slurry
N.D.	- Not Determined
N.A.	- Not Applicable

10. STABILITY

Stability: Stable.

Hazardous decomposition products: No decomposition if used as directed. Hydrocarbons and other materials that contact the product during normal use can be retained on the product. It is reasonable to expect that decomposition products will come from these retained materials of use.

Conditions/Materials to avoid: Sudden contact with high concentrations of chemicals having high heats of adsorption such as olefins, HCl, etc. When first wetted, the product can heat up to the boiling point of water. Flood with water to cool material.

11. TOXICOLOGICAL INFORMATION**Acute toxicity:**

LD50/oral/rat: > 32 000 mg/kg *

LD50/dermal/rabbit: > 2 000 mg/kg *

LC50/inhalation/rat: No data available.

Chronic toxicity: Classification of Ingredients**EC Carcinogenic:**

Not listed.

Carcinogenicity (ACGIH):

A4 (Aluminum oxide)

A2 (Quartz)

EC Mutagenic:

Not listed.

IARC classification:

Group 3 (Silicon oxide - synthetic)

Group 1 (Quartz)

EC Toxic for Reproduction:

Not listed.

Routes of exposure: Exposure may occur via inhalation, contact with skin and eyes.

Irritation:

Skin (rabbit): Not classified as a skin irritant in animal testing. *

Eye (rabbit): Mild eye irritation. *

Additional product information:

* The toxicological data has been taken from products of similar composition.

Additional component information:

No data available.

12. ECOLOGICAL INFORMATION

Mobility:

No data available.

Biodegradation:

No data available.

Bioaccumulation:

No data available.

Aquatic toxicity:

No data available.

Further Information:

No information available.

13. DISPOSAL CONSIDERATIONS

Provisions relating to waste: EPA - Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Management Regulations.

Disposal information: This product (in its fresh unused state) is not listed by generic name or trademark name in the U.S. EPA's RCRA regulations and does not possess any of the four identifying characteristics of hazardous waste (ignitability, corrosivity, reactivity or toxicity). Materials of a hazardous nature that contact the product during normal use may be retained on this product. The user of the product must identify the hazards associated with the retained material in order to assess the waste disposal options.

14. TRANSPORT INFORMATION

UN-No.:

N.A.

Proper shipping name:

Not applicable.

Packing group:

N.A.

Transport Mode**Class****Additional Information****Remarks**

U.S. DOT:	Not regulated.	Reportable Quantity: Marine Pollutant DOT:	N.A. No	N.A.
ADR/RID:	Not regulated.	Danger Code:	N.A.	N.A.
IMDG:	Not regulated.	Marine pollutant: EmS:	No N.A.	N.A.
IATA:	Not regulated.	Instr. Passenger: Instr. Cargo:	N.A. N.A.	N.A.

15. REGULATORY INFORMATION

United States

Toxic Substances Control Act (TSCA): All the ingredients of this mixture are registered on the TSCA Chemical Substance Inventory.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) Reportable Quantity:
The following component(s) of this product is/are subject to release reporting under 40 CFR 302 when release exceeds the Reportable Quantity (RQ):
-- None --

SARA Title III (Superfund Amendments and Reauthorization Act of 1986):
Section 302 (Extremely Hazardous Substances):
The following component(s) of this product is/are subject to the emergency planning provisions of 40 CFR 355 when there are amounts equal to or greater than the Threshold Planning Quantity (TPQ):
-- None --

Section 313 (Toxic Chemicals):
The following component(s) have been specified as Toxic Chemicals under SARA Section 313 and may be subject to the Toxic Release Inventory (TRI) reporting requirements under 40 CFR 372:
-- None --

The following components are listed in U.S. State Regulations:

State Reg Reference:	State Reg Reference:
California - Proposition 65:	Silica, crystalline
Massachusetts Right-To-Know:	Amorphous silica Aluminum oxide Quartz
New Jersey Right-To-Know:	Silica, amorphous Aluminum oxide Magnesium oxide Silica, quartz
Pennsylvania Right-To-Know:	Silica Aluminum oxide Magnesium oxide Quartz

Note: Other U.S. State Regulations may exist, check your local sources if available or contact the UOP Product Stewardship Manager (see Section 16).

Canada**Canadian Hazardous Products Act:**

This product is classified as a material causing Other Toxic Effects, carcinogenicity - Class D, Division 2, Subdivision A.

Canadian Environmental Protection Act: All the ingredients of this mixture are notified to CEPA and on the DSL (Domestic Substances List).

European Union (EU)

European Inventory of Existing Commercial Chemical Substances: All components of this product are included in EINECS/ELINCS.

Council of European Communities Directive on Classification, Packaging and Labelling of Dangerous Substances/Preparation (67/548/EEC & 1999/45/EC, as amended):

No Dangerous Goods Label Required.

Additional Governmental Inventories

Australia - Inventory of Chemical Substances (AICS): All the ingredients of this mixture appear on the AICS.

China: All the ingredients of this mixture appear on the China Inventory.

Japan - Existing and New Chemical Substances (ENCS): All the ingredients of this mixture appear on the ENCS.

Korea - Existing and Evaluated Chemical Substances (ECL): All the ingredients of this mixture appear on the ECL.

Philippines - Inventory of Chemicals and Chemical Substances (PICCS): All the ingredients of this mixture appear on the PICCS.

16. OTHER INFORMATION

Summary of changes: Revised to ANSI Z-400.1-2004 Format. Logo update. Section 3
Supersedes: March 2004
Prepared by: UOP Health, Safety & Environmental Department

HMIS™ - Hazardous Material Identification System:

HMIS™ Ratings: 0-minimal hazard, 1- slight hazard, 2- moderate hazard, 3- serious hazard, 4- severe hazard.

HEALTH : 1* - * may cause cancer
FLAMMABILITY : 0
REACTIVITY : 1

For additional information concerning this product, contact the following:

**For health, safety and environmental information,
please contact:**

Product Stewardship Manager
UOP LLC
25 E. Algonquin Road
Des Plaines, IL 60017-5017
USA
Tel: +1-847- 391-3189
Fax: +1-847-391-2953

Product Safety Steward Europe
UOP N.V.
Noorderlaan 147
B-2030 Antwerpen
Belgium
Tel: +32-3-5409-971
Fax: +32-3-5417-806

**For technical or purchasing
information, please contact:**

Adsorbent Sales
UOP - Molsiv Dept.
13105 Northwest Freeway
Suite 600
Houston, TX 77040 USA
Tel: +1-713-744-2811
Fax: +1-713-744-2808

PRODUCT EMERGENCIES

If you have a product-related emergency, resulting in an incident such as a spill or release of product or human exposure and need assistance from UOP, please contact the following number :

24-Hour EMERGENCY NUMBER (UOP LLC) : + 1 - 847 - 391 - 2123

The data and recommendations presented in this data sheet concerning the use of our product and the materials contained therein are believed to be accurate and are based on information which is considered reliable as of the date hereof. However, the customer should determine the suitability of such materials for his purpose before adopting them on a commercial scale. Since the use of our products by others is beyond our control, no guarantee, express or implied, is made and no responsibility assumed for the use of this material or the results to be obtained therefrom. Information on this form is furnished for the purpose of compliance with Government Health and Safety Regulations and shall not be used for any other purposes. Moreover, the recommendations contained in this data sheet are not to be construed as a license to operate under, or a recommendation to infringe, any existing patents, nor should they be confused with state, municipal or insurance requirements, or with national safety codes.

**Do not adjust the fuel pressure by more than 3.3 in.H₂O. If the fuel pressure has been adjusted up to 3.3 in.H₂O and the OCV is still higher than target, allow the Sentinel TEG to operate at the last adjusted setting and measure OCV again at the next maintenance visit.*

[illegible]

**Do not adjust the fuel pressure by more than 3.3 in.H₂O. If the fuel pressure has been adjusted up to 3.3 in.H₂O and the OCV is still higher than target, allow the Sentinel TEG to operate at the last adjusted setting and measure OCV again at the next maintenance visit.*