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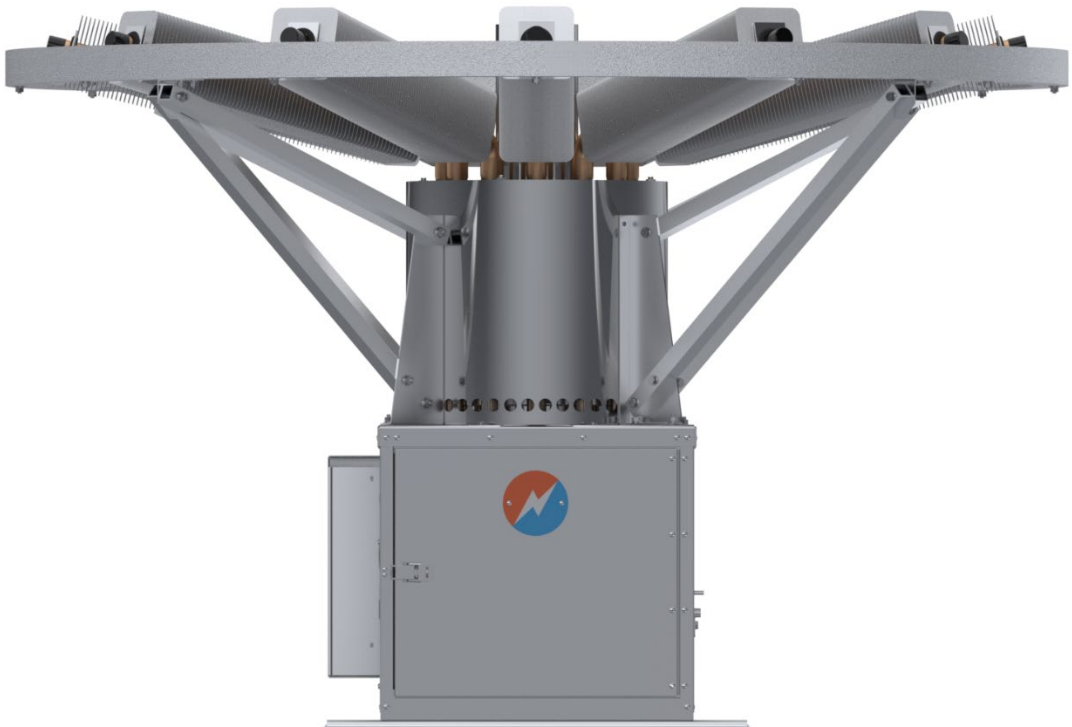

Model 8550-SD

Thermoelectric Generator

OPERATING MANUAL

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1 IMPORTANT SAFETY INSTRUCTIONS

WARNING! **Read all application documentation, including manuals for equipped options, before starting assembly, installation, or performing service check or maintenance on the Thermoelectric Generator.**

SAVE THESE INSTRUCTIONS – This manual contains important instructions for safe installation, operation, and maintenance of the Global Power Technologies Model 8550-SD Thermoelectric Generator with Overtemperature Shutdown.

Read the following safety warnings and pre-cautions before beginning assembly.

1. The installation must conform with local codes, or in the absence or local codes, with the CSA-B149.1, Natural Gas and Propane Installation Code and CSA-B149.2, Propane Storage and Handling Code.
2. The Thermoelectric Generator, when installed, must be electrically grounded in accordance with local codes, or in the absence of local codes, with the Canadian Electrical Code, CSA C22.1.
3. Keep the Thermoelectric Generator area clear and free from combustible materials, gasoline, and other flammable vapours and liquids. Maintain the minimum clearances specified in this manual.
4. Do not use this Thermoelectric Generator if any part has been under water. Immediately call a qualified service technician to inspect the Thermoelectric Generator and to replace any part of the control system and any gas control that has been under water.
5. The Model 8550-SD Thermoelectric Generator contains electrical- and gas-related safety devices as identified throughout this manual. Tampering and rendering inoperative any of these safety devices may result in personal injury or death and possible damage to the equipment and is not permitted under any circumstances.
6. The Thermoelectric Generator is designed to combust gaseous fuels which will result in combustion products including heat, carbon dioxide, and water vapour and may contain traces of carbon monoxide, unburned hydrocarbons, and nitrous oxides. Emissions from combustion will depend on generator set-up and operation as well as the composition of the gas feed. Ensure that gas supplied meets Global Power Technologies' gas specifications.
7. Fuel supplied to the 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 to the operator.
8. Do not exceed the fuel pressure stamped on the Thermoelectric Generator data plate without factory approval. If fuel pressure exceeds reasonable levels, the power unit may be seriously and permanently damaged.
9. The Thermoelectric Generator exhaust can be very hot. Do not touch any of the exhaust components or bring exposed skin near hot exhaust gases.
10. If the Thermoelectric Generator has not been given enough time to cool, the spark electrode can be dangerously hot.
11. The 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. Exercise caution when handling. Wearing gloves is recommended.
12. When the Thermoelectric Generator is operating, surface temperatures of the unit can approach temperatures close to 200°C. Avoid contact of skin and clothing with the surfaces of the Thermoelectric Generator to avoid burns.

1.1 MANUAL ICONS AND SAFETY BANNERS

The following banners are used throughout this manual:

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 TEG.**

NOTE:	**A banner with the word "NOTE:" contains supplemental information that provide additional insight on specific topics within this manual.**

1.2 COPYRIGHT, LIABILITY, AND CONTACT INFORMATION

For any technical issues or questions, contact:

Global Power Technologies – Head Office

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Canada T2C 5K7	Customer Service/Technical Support: 1-403-720-1190

Liability	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 GENERAL INFORMATION

A Thermoelectric Generator (TEG) is solid-state device that produces electrical power by directly converting heat energy into electrical energy. It is a reliable, low-maintenance source of DC electrical power for applications where regular utilities are unavailable or unreliable.

The Model 8550-SD TEG comes equipped with a 6720 Voltage Limiter.

A Cathodic Protection Interface is also available as an option to use with this generator.

Operation and service instructions for both the 6720 Voltage Limiter and the Cathodic Protection Interface option are included in this manual.

The Thermoelectric Generator is designed FOR OUTDOOR USE ONLY.

2.1 TERMS AND ACRONYMS

The following terms and acronyms are used throughout this manual:

Thermoelectric Generator (TEG)	A device that produces electrical power through the direct conversion of heat energy to electrical energy.
GPT	Global Power Technologies
Power Unit	The hermetically sealed portion of the generator that contains the thermoelectric materials.
Matched Load	A condition of load where the load voltage of the generator is one half of the open circuit voltage.
Optimum Load	A condition of load where the power output of the generator is maximized.
Power Conditioner	A broad term used to describe an electronic device attached to the generator that converts, adjusts, limits, or otherwise conditions the output power. This manual uses the terms “Power Conditioner” and “Limiter” interchangeably.
Converter	An electronic device attached between the generator and load that converts one level of DC voltage to another.
Limiter	An electronic device attached between the generator and load that limits the voltage level. This manual uses the terms “Power Conditioner” and “Limiter” interchangeably.
Heat Pipe	A hermetically sealed fluid filled heat transfer device, and its associated cooling fins, used to cool the cold junctions of the Power Unit.
Thermostat	A safety device used to shut down the TEG during a heat pipe overtemperature event.
Rated Power	The power that the TEG will produce at standard temperature and voltage.

Set Power	The power level to which the Power Unit is set up at non-standard temperatures so that it produces Rated Power when the temperature returns to standard.
Thermal Cut-off (TCO)	A safety device used to shut down the TEG during a cabinet overtemperature event.

2.2 DATA PLATE

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

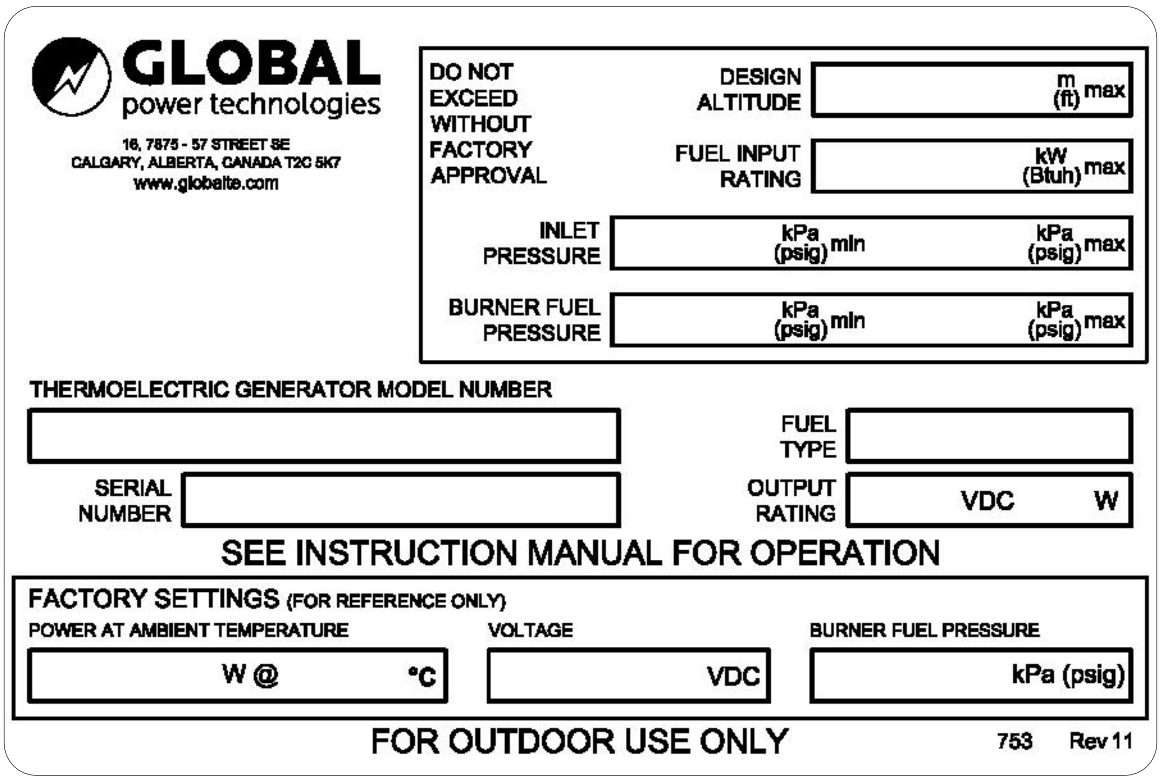

Figure 1 – Data Plate

The information indicated on the data plate are as follows:

Design Altitude	Maximum permitted altitude that the TEG should be operated at.
Fuel Input Rating	Maximum permitted energy rate to the generator.
Inlet Pressure	Minimum and maximum levels of inlet fuel pressure permitted.
Burner Fuel Pressure	Minimum and maximum levels of burner fuel pressure permitted.
TEG Model Number	The TEG's model number. Refer to the model tree on Figure 2 for an explanation of the model number.
Fuel Type	The type of fuel that the TEG's fuel system is designed for and was tested with. L = Propane; N = Natural Gas

Serial Number	A unique number assigned to the TEG unit by GPT for traceability.
Output Rating	Nominal power output of the TEG.
Factory Settings:	
Power Unit at Ambient Temperature	Power Unit power and temperature recorded during the factory acceptance test. This is the maximum power unit power that can be expected from the TEG under similar conditions.
Voltage	Power unit voltage recorded during factory acceptance test.
Burner Fuel Pressure	Burner fuel pressure recorded during factory acceptance test.

The Model 8550-SD TEG's model number can be interpreted as follows:

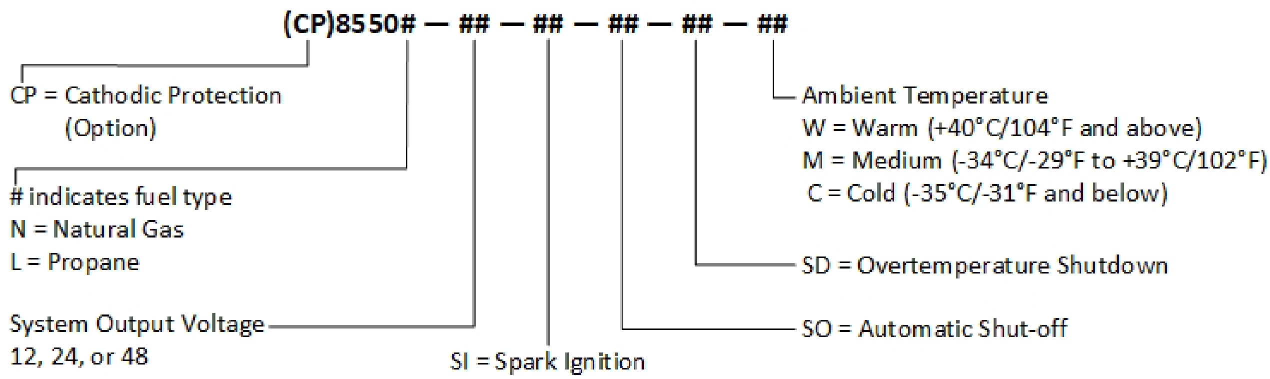

Figure 2 – Model Number Explanation

CAUTION! **Use only the type of fuel that is indicated on the data plate.**

3 INSTALLATION

WARNING! **Read all application documentation, including the documentation for equipped options BEFORE STARTING ASSEMBLY AND INSTALLATION, or performing service check and maintenance on the Thermoelectric Generator.**

3.1 PREPARATION

3.1.1 BASE

Before beginning assembly, ensure that the base where the TEG will be placed is level and does not deviate by more than 3° (0.5 inch per foot or 50 mm per meter).

The Model 8550-SD TEG has an optional stand that allows optimal airflow around the TEG and convenience for operators to perform service checks. If you opted not to purchase the stand, prepare a platform or stand to mount the TEG on. The TEG should be mounted high enough to prevent flooding or heavy snowfall from interfering with the flow of cooling or intake air around the TEG. We recommend a stand that is 36 inches (91 cm) above the ground. Anchor the stand to the base so that it remains stable through inclement weather.

3.1.2 LOCATION

If the TEG will be installed near a building or large objects that may obstruct the flow of wind, choose a site on the windward side at least 45 feet (14 m) away from the building or object, or on the roof if possible.

Always follow local regulations when placing the TEG near buildings and fuel tanks.

3.1.3 FUEL SUPPLY

The fuel system on each TEG unit is designed for either propane or natural gas. Check the Data Plate on inside of the TEG cabinet to verify the type of fuel that is compatible with your TEG.

When preparing the fuel supply to the TEG:

1. Make sure that the fuel is free of moisture or any other type of contamination.
   - ➢ If the fuel is expected to contain moisture or other contaminants, use a filtering or fuel conditioning system. Consult GPT for more information.
2. Make sure that the fuel supply pressure never exceeds 25 psi (172 kPa).
   - ➢ If the supply fuel pressure is expected to vary significantly, use an additional primary regulator to ensure that the input pressure to the Burner Fuel Pressure Regulator stays relatively constant.
3. Make sure that the fuel is appropriate to the environment. If using propane, make the following adjustments if necessary:
   - ➢ In environments with temperatures that fall below 5°C (41°F), use pure methyl hydrate in the ratio of 1:800 by volume as an antifreeze additive.

NOTE: Moisture in the propane may freeze at temperatures below 5°C (41°F).

- In environments with temperatures that fall below -20°C (-4°F), use a liquid withdrawal and vaporization system. Consult GPT for suitable designs before installation.

The fuel consumption of a Model 8550 TEG operating at rated power under standard temperatures conditions is as follows:

Propane:	76.0 L/day (20.1 US gal/day)
Natural Gas:	48.0m^3/day (1695 Sft^3/day)

3.1.4 GASEOUS FUEL STANDARDS

Gaseous fuels provided to Global Power Technologies' thermoelectric generators (TEGs)(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 170 kPa_g (25 psi_g).
3. Shall not contain more than 115 mg/Sm^3 (2) (approx. 170 ppm) of H_2S.(3)
4. Shall not contain more than 60 mg/Sm^3 (approx. 88 pmm) of Mercaptan Sulphur.
5. Shall not contain more than 200 mg/Sm^3 (approx. 294 ppm) of total Sulphur.
6. Shall not contain more than 10% [CO_2] and/or [N_2] by volume, nor vary by more than ± 1% [CO_2] and/or [N_2] during operation.
7. Shall not contain more than 120 mg/Sm3 of water vapour.
8. Shall not contain more than 1% by volume of free oxygen.
9. Shall have a nominal heating value (HHV) of:

Natural Gas:	37 MJ/m^3 (1000 BTU/ cu.ft.) (1)
Propane/LPG:	93 MJ/m^3 (2500 BTU/ cu.ft.) (1)
Butane:	122 MJ/m^3 (3300 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 Global Power Technologies.
(2) At 1 atm and 15°C (59°F).
(3) Contact local representative or Global Power Technologies if H_2S concentration is greater than 170 ppm.

3.2 UNPACKING AND MOUNTING

To prepare for assembly and installation, you will need the following tools and equipment:

- ✓ Two voltmeters with leads and clips able to measure the following ranges:
  - 0-30 ±0.1 V
  - 0-30 ±0.1 mV
  - Customer Load Voltage
- ✓ Two small adjustable wrenches that can open to 5/8 inch (16 mm)
- ✓ A medium flat blade screwdriver
- ✓ A fine flat blade screwdriver
- ✓ A Phillips head screwdriver
- ✓ A 3/8-inch wrench
- ✓ Wire strippers
- ✓ Teflon thread sealant tape

WARNING! **Check the TEG for any signs of damage before beginning assembly and installation. Some damages can make the TEG inoperable. Consult Global Power Technologies before operating a TEG with any signs of damage.**

Do not discard the shipping crate until the TEG is fully operational. Before removing the TEG from the crate:

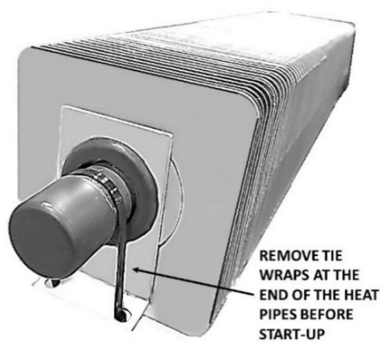

Figure 3 – Heat Pipe Tie Wrap

1. Check the TEG for any damage that may have occurred during shipping. If the TEG shows any sign of damage, contact Global Power Technologies to report it. Do not proceed with the installation.
2. Check and re-tighten any bolts that may have loosened.
3. Remove the tie wraps that clamp the ends of the heat pipes to the support ring.

CAUTION! **Failure to remove the tie wraps can cause the heat pipes to crack when they expand.**

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4. Once the tie wraps have been removed, lift the TEG out of the crate. This must be done by two or more persons. Use the upper ring around the heat pipes, or the frame where the ring is mounted, as lifting points.

NOTE: **If lifting with slings, secure the slings to the upper ring in at least three points in equal distance from one another to ensure that the TEG does not swing or rock during lifting.**

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5. Locate the installation kit with the following parts:

- ✓ Mounting Bolts – 1/4 in x 3/4 in, with nuts and washers (x4)
- ✓ Stand Grounding Set – 3/8 in x 2 in bolt with nuts and washers (x1)
- ✓ Spare Thermal Cut-off (x1)

The following parts can be found inside the TEG cabinet:

- ✓ Shutdown Relay Assembly, includes Thermal Cut-off and Thermocouple
- ✓ Spark Igniter Electrode

6. If the TEG was shipped with the optional TEG stand, assemble the stand as shown on Figure 4 and install it on a stable, level base. If the TEG does not have the stand option and a custom platform or stand has already been installed, confirm that the stand is bolted securely to the base, level and does not deviate by more than 3°, then proceed to the next step.

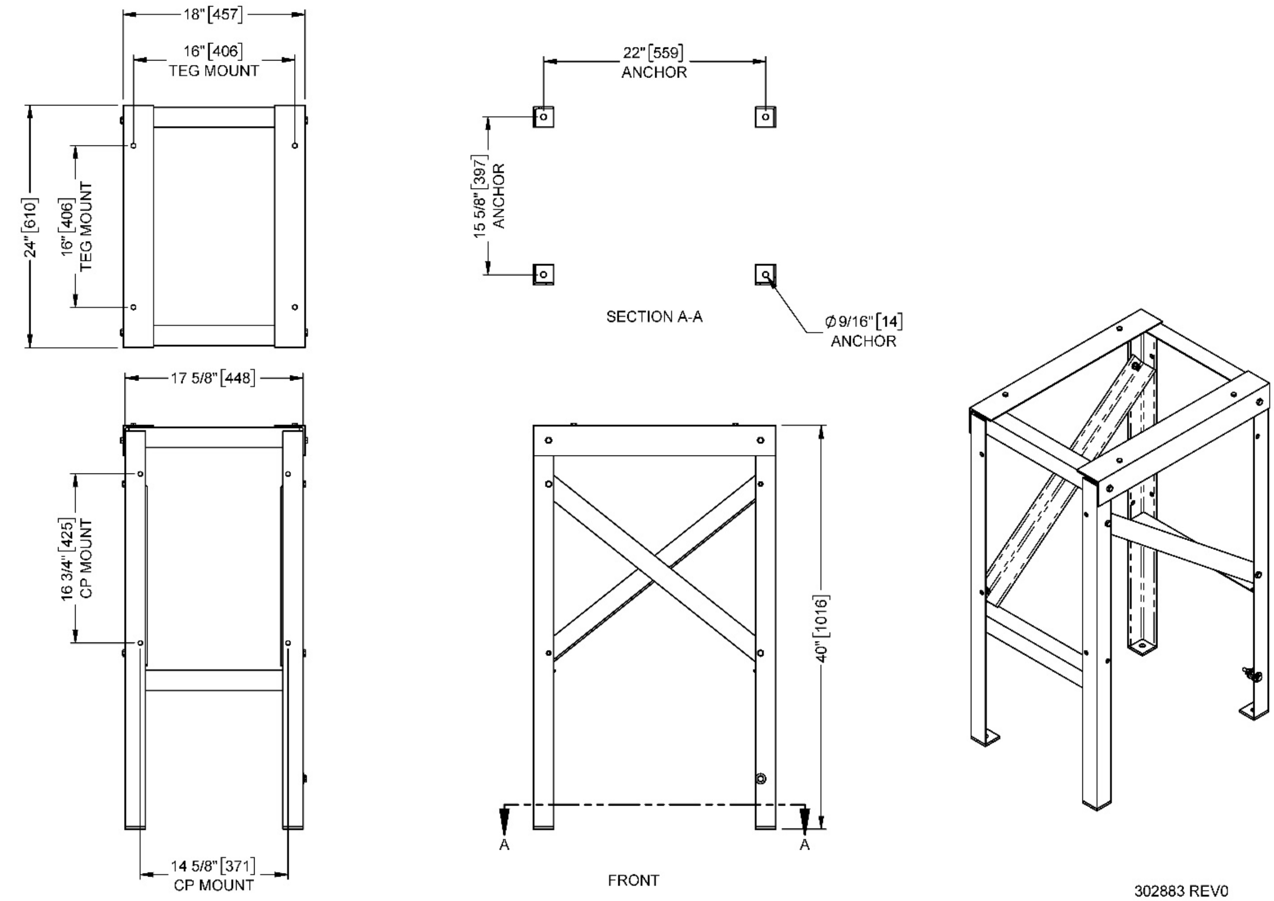


Figure 4 – TEG Stand

WARNING! **Operation of TEG on an unstable or non-level base or in locations where cooling air flow may be obstructed will cause overheating of the TEG.**

3.3 INSTALLING THE RELAY ASSEMBLY

The Shutdown Relay Assembly is shipped inside the TEG cabinet. To install:

1. Thread the male end of the Relay Assembly into the bottom of the Shut-off Valve on the Fuel System. Tighten the joint using a 3/8-inch wrench. **DO NOT OVERTIGHTEN.**
2. Position the Relay with the female end of the assembly pointed towards the back of the cabinet.
3. Carefully fit the male end of the thermocouple into the female end on the Relay Assembly. Tighten the threads using a 3/8-inch wrench, being **CAREFUL NOT TO OVERTIGHTEN.**

NOTE: **Maintain a large radius on the bends of the thermocouple. Be careful NOT TO BREAK the thermocouple at the burner joint.**

4. Verify the connections of the Thermal Cut-off that is in line with the red wire on the Shutdown Relay Assembly. Verify both the mechanical integrity of the connections and the electrical continuity of the Thermal Fuse within.

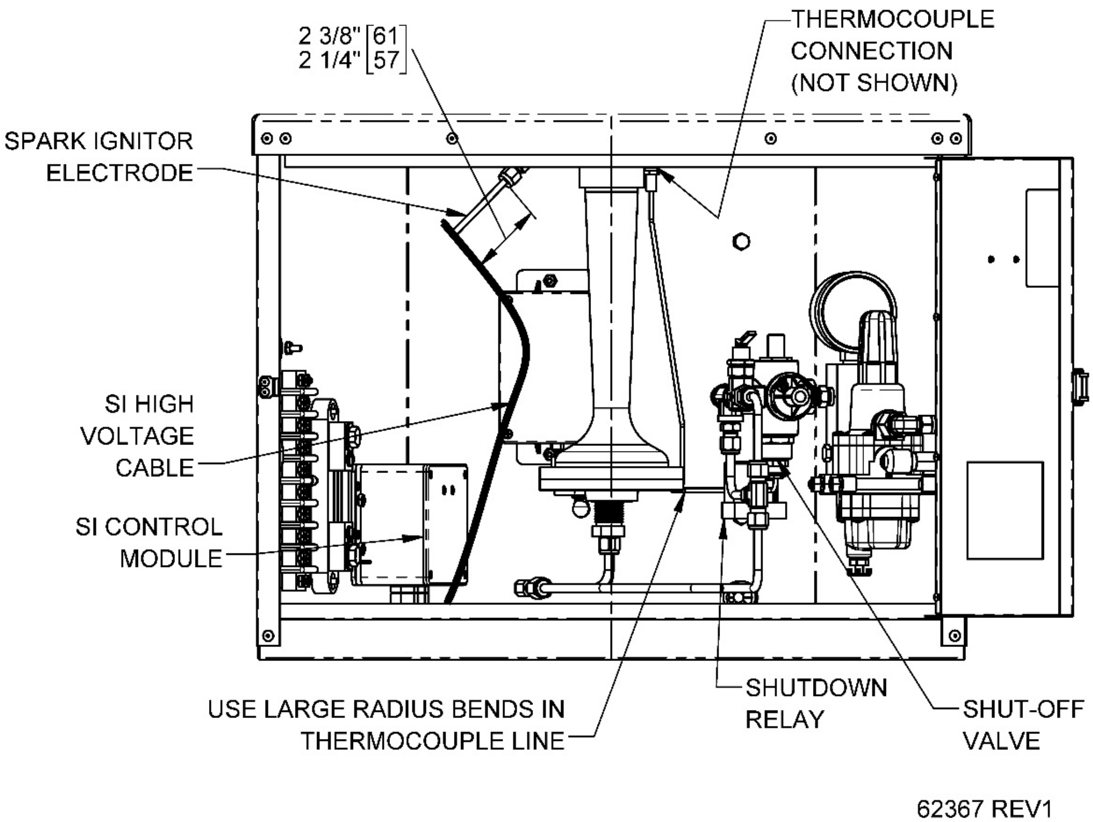


Figure 5 – Installation of Spark Igniter and Fuel Line

3.4 INSTALLING THE SPARK IGNITER ELECTRODE

To install the Spark Igniter Electrode:

1. Slide the Spark Igniter Electrode through the fitting on the bottom of the burner until it touches inside, then pull back by approximately 1/8 inch (3 mm). This should leave 2.24 to 2.40 inches (57 to 61 mm) extruding beyond the fitting, refer to Figure 5.
2. Gently tighten the nut on the fitting to maintain the position of the electrode.
3. Connect the terminal lug of the high-voltage cable to the end of the Spark Igniter Rod.

3.5 CONNECTING THE FUEL SUPPLY

WARNING! **Use only the type of fuel indicated on the data plate. See Section 3.2.**
The maximum inlet pressure to the TEG must never exceed 25 psi (172 kPa).

Before connecting the fuel supply to the TEG, review Section 4.1.3 and ensure that all necessary precautions have been made based on the fuel supply used and the environmental conditions.

Connect the fuel supply as follows:

1. Install a fuel shut-off valve between the TEG and the fuel supply.

NOTE: Follow local regulations when installing fuel piping.

2. Inspect fuel lines and fittings to ensure that they are free of foreign material.
3. Remove the plastic protective cap from the TEG's 1/4-inch NPT male connector.
4. Apply Teflon tape, or other thread sealant, on the male connector as illustrated in Figure 6 to minimize fuel line contamination.

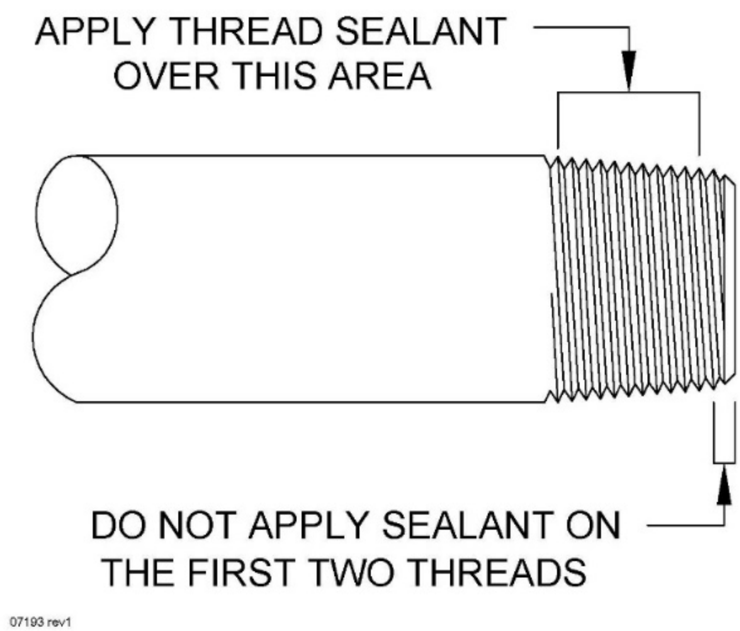


Figure 6 – Applying Thread Sealant

5. Connect the fuel line and check all joints for leaks using a commercial leak detector fluid such as Snoop®.
6. Purge fuel supply lines to the TEG of all air.

3.6 ADJUSTING FOR ALTITUDE

The burner fuel pressure supplied on the TEG, and marked on the data plate, is set for the factory altitude or site elevation of 2460 ft (750 m). At the factory's elevation, the fuel pressure should be in the range of 16 to 22 psi (110 to 150 kPa) for propane or 6 to 10 psi (41 to 69 kPa) for natural gas.

- If the TEG's installation site is at a similar altitude, check the burner fuel pressure and confirm that is has not changed from the factory setting as marked on the data plate.
- If the TEG's installation site is at a different altitude, adjust the burner fuel pressure as follows:
  a) Determine the altitude of the installation site and mark that number on the graph in Figure 7.
  b) From the marked altitude on step a), follow the line vertically towards the curve and stop when you touch the curve. This is the point to where you will adjust your fuel pressure.

c) From the factory altitude marked on the curve, measure the amount of pressure that adjustment is required for your site's altitude by counting vertically from the Factory Elevation mark at 0 psi/kPa. Enter this number on the Start-up Data Sheet.

For example:

If your TEG will be installed at a site with an altitude of 2460 ft (750 m), increase your burner fuel pressure by 2.61 psi (18 kPa) from the factory setting.

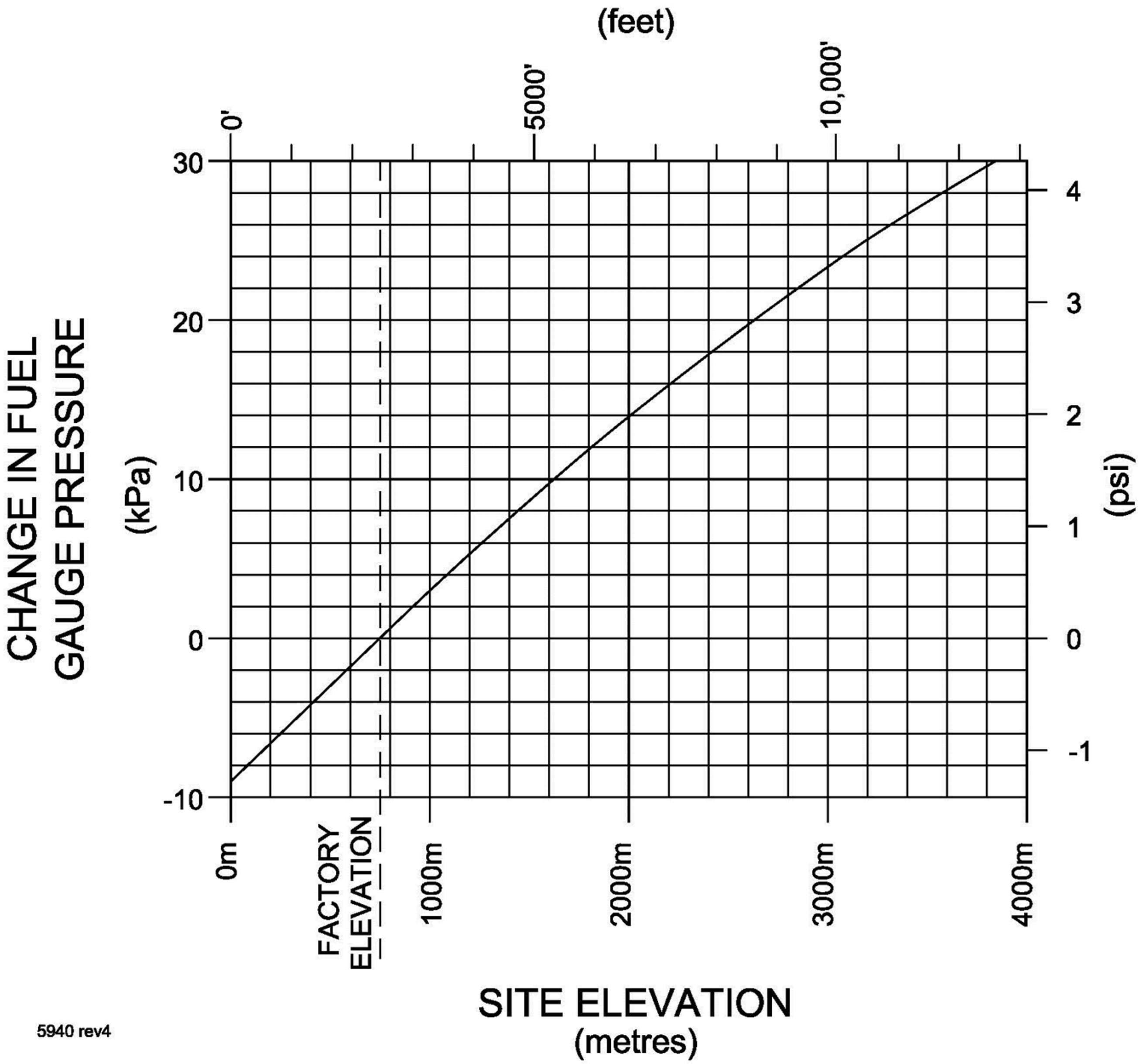


Figure 7 – Altitude Adjustment

4 START-UP AND OPERATION

4.1 IGNITION AND START-UP PROCEDURE

WARNING! **Before initiating start-up, make sure that the Power Unit output wires are connected to the 6720 Voltage Limiter input.**

Before attempting to start the Model 8550-SD TEG, make sure to review and understand the Electrical Output Characteristics in Figure 31 and the Terms and Acronyms in Section 3.1.

Before starting the TEG:

- ✓ Ensure that the fuel system has been properly installed as outlined in Section 4.5.
- ✓ Review the Basic Wiring Diagram in Figure 32, identify the various components and find their location on the TEG system.
- ✓ Review the operations of the 6720 Voltage Limiter in Section 8 and understand how to adjust the voltage.
- ✓ Ensure that the Customer Load is disconnected.

  Remove both the positive and negative load wires at Terminals 2 and 4 of Terminal Block TB-1. This will also need to be done for power adjustments.

NOTE: **Use the Start-up Data Sheet located at the end of this manual during the start-up process. It helps simplify starting, heating up, and making power adjustments.**

4.1.1 DETERMINE SET POWER

Determine the required Set Power before proceeding with Start-up. Set Power is the power to which the TEG must be set at your ambient conditions so that it generates Rated Power when the ambient conditions return to standard. To determine Set Power:

1. Refer to Table 1 or Table 2 and follow these steps to determine the Corrected Air Temperature:
   a) In the first row of figures, where ambient air temperatures at 0 Wind Speed are listed, find the column with the current ambient temperature of the TEG's installation site.
   b) Move down the column to find the cell in the same row as the expected wind speed.
   c) The cell where Air Temperature and Wind Speed meet is the corrected air temperature.

   For example, if the air temperature is 50°F (10°C) and the wind speed is 12.4 mph (20 kph), then the corrected air temperature is 27°F (-3°C).

   Record the corrected air temperature in the Start-up Data Sheet.

Air Temperature (°C)

Wind Speed (kph)

0	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50
5	-27	-21	-16	-11	-6	-1	5	10	16	21	27	32	37	42	47
10	-34	-27	-21	-15	-9	-3	2	9	13	18	24	29	35	40	46
15	-40	-32	-24	-18	-12	-6	-1	4	10	15	21	26	32	37	42
20	-41	-35	-29	-21	-14	-8	-3	2	8	13	19	24	30	35	41
25	-44	-37	-31	-23	-16	-10	-5	0	6	11	17	22	28	33	38
30	-46	-39	-33	-25	-18	-12	-7	-1	4	9	15	20	26	31	37
35	-47	-40	-34	-26	-19	-13	-8	2	3	8	14	19	25	30	36
40	-49	-42	-35	-22	-20	-14	-9	-3	2	7	13	18	24	29	35

Table 1 – Corrected Air Temperature for Wind (in km per hour and °C)

Air Temperature (°F)

Wind Speed (mph)

0	-4	5	14	23	32	41	50	59	68	77	86	95	104	113	122
3.1	-17	-6	3	12	21	30	41	50	61	70	81	90	99	108	117
6.2	-29	-17	-6	5	16	27	36	48	55	64	75	84	95	104	115
9.3	-40	-26	-11	0	10	21	30	39	50	59	70	79	90	99	109
12.4	-42	-31	-20	-6	7	18	27	36	46	55	66	75	86	95	106
15.5	-47	-35	-24	-9	3	14	23	32	42	52	63	72	82	91	100
18.6	-51	-38	-27	-13	0	10	19	30	39	48	59	68	79	88	99
21.7	-53	-40	-29	-15	-2	9	18	28	37	46	57	66	77	86	97
24.8	-56	-44	-3	-8	-4	7	16	27	35	45	55	64	75	84	95

Table 2 – Corrected Air Temperature for Wind (in miles per hour and °F)

2. Using the corrected air temperature as determined in Step 1, find the required Set Power using the graph on Figure 8. To do this:

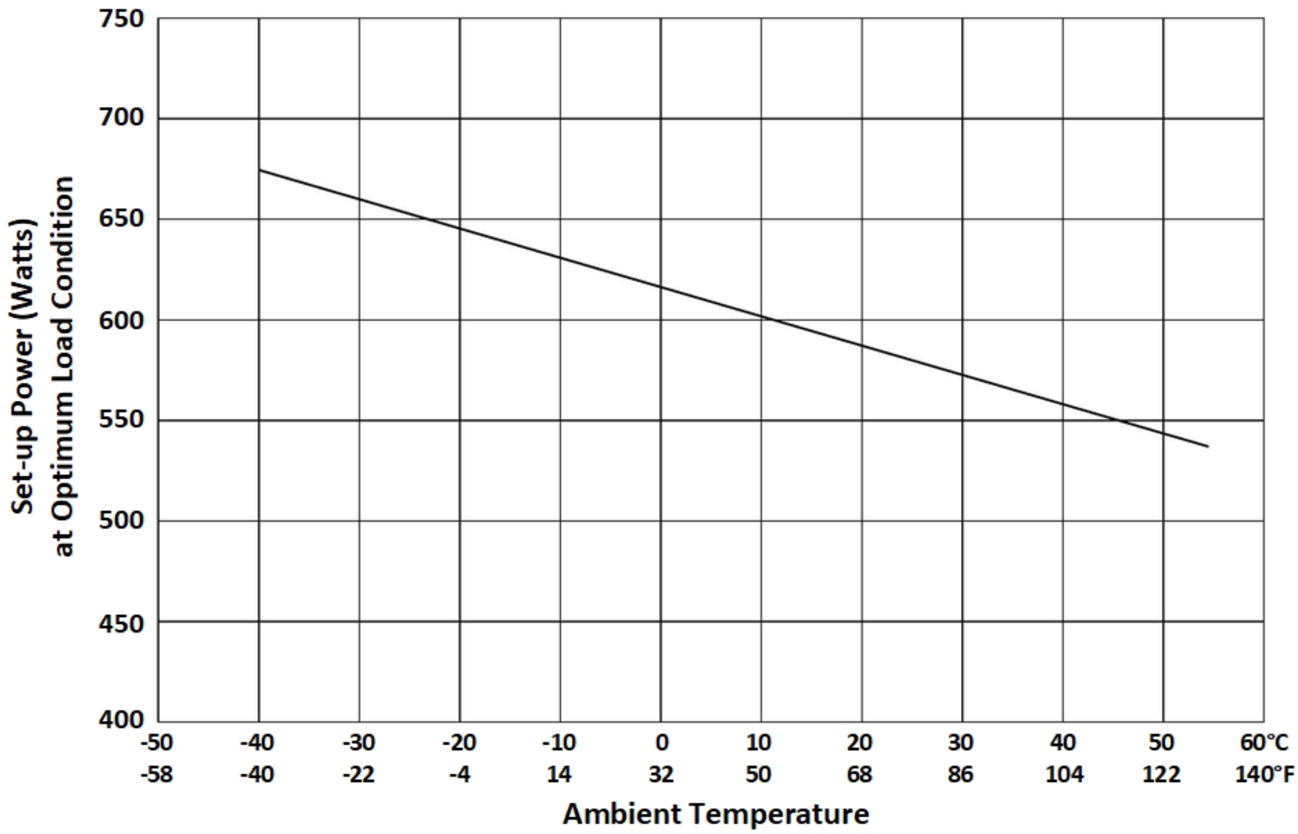
   a) Find the corrected temperature along the bottom of the graph labeled "Ambient Temperature".

   b) From that number, go up the graph and stop when the path touches the curve (diagonal line).

   c) From that intersection, follow a line to the numbers on the left labeled "Set Power".

   Continuing with the previous example, if the corrected air temperature is 27°F (-3°C), based on the graph on Figure 8, the Set Power is 620 W.

3. Enter this number in the Start-Up Data Sheet. Do not operate the TEG beyond this number.



Notes:
1. This curve is based on a typical Power Unit operating in calm air. Correction must be made for windy conditions.
2. Do not operate Power Unit above the curve. Always correct air temperature for wind.

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Figure 8 – Power as a Function of Ambient Temperature

WARNING! **Do not operate the TEG above the curve on Figure 8. This may result in damage to the Power Unit.**

4.1.2 START-UP

Before starting up, connect a voltmeter across terminals 6 (+) and 4 (-) of TB-1. This will measure the Power Unit voltage during start-up.

Connect the second voltmeter across Terminals 6 (+) and 7 (-) of TB-1. This will measure the Power Unit current (1 mV = 1 Amp).

Follow these steps to start-up the Model 8550-SD TEG:

1. Turn on the fuel supply to the TEG and observe the fuel pressure at the fuel pressure gauge. Refer to the Start-up Data Sheet and compare the observed fuel pressure to the adjusted fuel pressure as determined in Section 4.6.

   - If the pressure is lower, increase it by turning the screw on the pressure regulator clockwise until it reaches the correct pressure.

- If the pressure is higher, decrease it by turning the screw on the pressure regulator counterclockwise and venting the pressure through the burner by momentarily pressing the button on the Automatic Shut-off Valve.

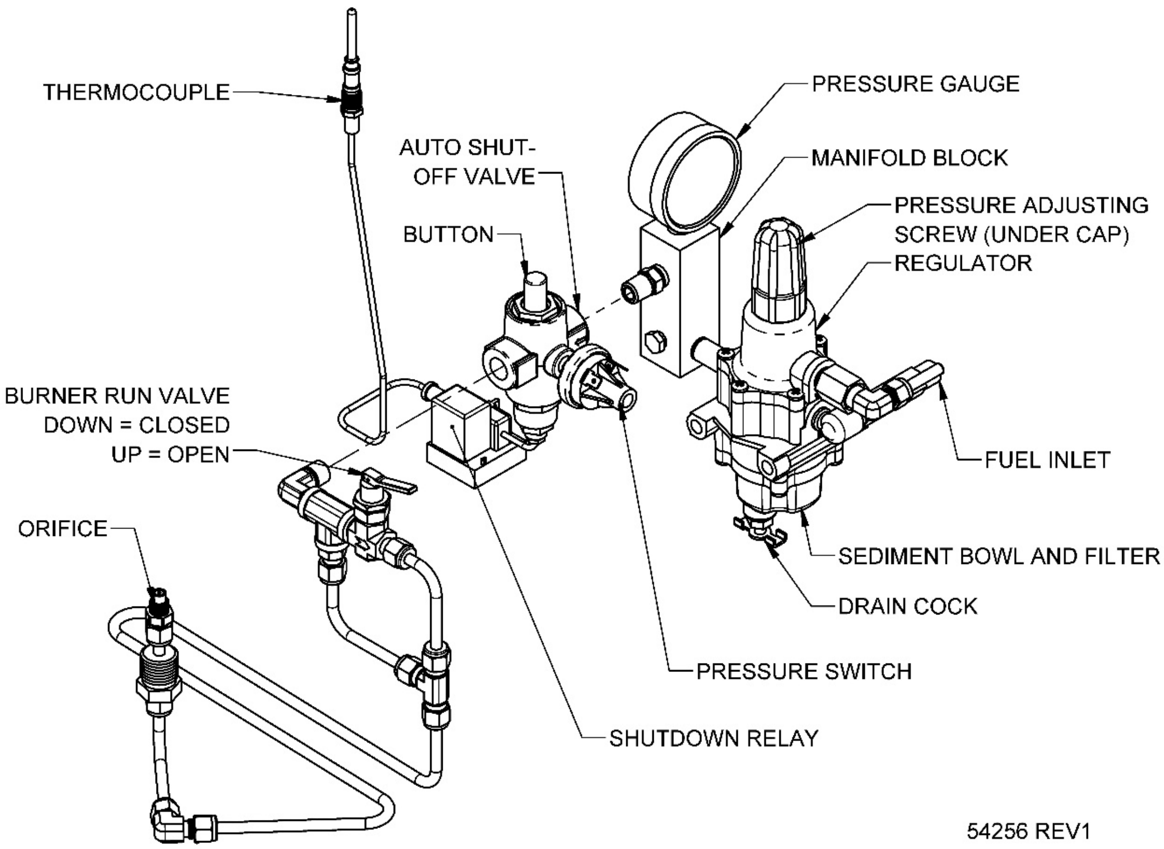

Figure 9 – Fuel System Components

2. Check the operation of the Ignition System by shorting together the terminals of the Pressure Switch. The Spark Igniter should produce a strong and rapid clicking sound. If it does not start clicking, troubleshoot the system as indicated in Section 6.6.
3. Check that the Burner Run Valve is closed (down).
4. Open the Automatic Shut-Off valve by pressing the button with one hand. **Keep this button pressed. Do not release until instructed (Step 8)**.

   The Spark Igniter should start clicking followed by a series of popping sounds from the unit as the burner ignites. The Power Unit voltage will start to rise slightly.
5. **Continue to hold down the button.**
   - If ignition does not occur within 5 seconds, release the button and check to make sure that fuel is reaching the burner. Confirm that the fuel lines were purged of air.
   - If fuel is reaching the burner, refer to Section 6.6 to troubleshoot the Ignition System.
6. As soon as combustion begins, slowly open the Burner Run Valve.

   The burner sounds will change and the Power Unit voltage will rise more rapidly.
7. **Continue to hold down the button**.

- ➢ If the flame goes out, close the Burner Run Valve to re-establish the flame and then re-open the valve slowly.

WARNING! **Do not allow the burner to operate while the Burner Run Valve is closed for more than 5 minutes. Open the Burner Run Valve as soon as the flame is audibly burning.**

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8. Observe the voltmeter while continuing to hold the button down. Five minutes after opening the Burner Run Valve, or as soon as the Power Unit voltage reaches 14 Volts, slowly release the Automatic Shut-off Valve.

   The internal electromagnet should hold the Automatic Shut-off Valve open.

   - ➢ If the valve does not stay open, immediately press the button again and hold it down for one more minute, then try to release it again. If the valve still does not stay open, refer to Section 6.8 to troubleshoot the Automatic Shut-off system.

Once the burner is started, proceed to Heat Up and Power Adjustment in the next section.

If the operation of the burner must be stopped, turn off the fuel supply at the external valve. Then close the Burner Run Valve. The Automatic Shut-off Valve will close when the burner thermocouple cools down.

WARNING! **Proceed to the Heat Up and Power Adjustment section as soon as the automatic shut-off valve remains open. Failure to do so may overheat the Power Unit.**

4.1.3 HEAT UP AND POWER ADJUSTMENT

It is normal for the heat pipes to make a crackling sound as they start to operate. Once the burner is operating, the Power Unit voltage will climb rapidly to the TEG's voltage setpoint (set to 27.1 V at the factory).

Continue to monitor the Power Unit voltage at terminals 6(+) and 4(-) of TB-1 for an hour. The voltage should remain at the voltage setpoint. Adjust the Power Conditioner if needed.

During heat up, the current will initially rise rapidly and then slow down as soon as the TEG approaches its operation point.

9. Fifteen minutes after ignition, check the tip of each heat pipe to check if they are getting warm.

   - ➢ If one or more heat pipes are not getting warm, check them again after an additional 10 minutes. If they still remain cold up to 2 inches (50 mm) from the tip, troubleshoot the cooling system as outlined in Section 6.3.

NOTE: **If it's too cold or too windy to assess the temperature of the heat pipes, check the cooling fins instead. If all the fins on a heat pipe are at about the same temperature, then the heat pipe is working well.**

---

10. Proceed to the next step to adjust the Power Unit output power to the Set Power as determined during Start-up and recorded on the Start-up Data Sheet.

The Power Unit output power can be measured by multiplying the Power Unit voltage with the Power Unit current. For example, if the Power Unit voltage is 25 V and the Power Unit current is 22.2 Amps, then the Power Unit output power is 555.0 Watts: **25.0 x 22.2 = 555.0 Watts**

11. Using the above formula, measure the output power and record it on the Start-Up Data Sheet at 15, 30, 40, 50, and 60 minutes after start-up.

WARNING! **Do not allow the Power Unit voltage to exceed 35 Volts. Turn off the fuel if the Power Conditioner fails to control the voltage.**

As the Power Unit output power climbs, ensure that it does not exceed the Set Power. The power level should be at around 70 to 80% of Set Power within 30 minutes after ignition.

- If the power is above 80% of Set Power after 30 minutes, continue to monitor the Power Unit output power. Be prepared to reduce the fuel pressure if the power rises above the Set Power level.
- If the power level rises to more than 10 watts above Set Power, initially reduce the pressure by 1 psi and wait 10 minutes, then determine if further adjustment is needed. Remember that it will take up to 10 minutes for the full effect of the fuel pressure change to stabilize. Record any changes in fuel pressure on the Start-Up Data Sheet.
- If the power level is less than 70% of Set Power after 30 minutes, the fuel pressure may be too low. Wait until the power level has stabilized and make the necessary adjustment.

NOTE: **Keep the cabinet door closed, as much as possible, during the warm-up period until the Power Unit output power stabilizes. It takes about one full hour for the power to stabilize.**

---

12. Review the recorded data on the Start-up Data Sheets and compare the Power Unit output power recorded at 60 minutes with that at 50 minutes. The two readings should be within 5 Watts of each other. If the power level is not yet stabilized, wait another 10 minutes.
13. Once the power level has stabilized determine if the Power Unit output power is within 5 Watts of the Set Power.
    - If the Power Unit output power is more than 5 Watts above Set Power, decrease the fuel pressure by approximately 0.25 to 0.50 psi (1.7 to 3.4 kPa), and wait 10 minutes. After 10 minutes, determine if further adjustment is needed.
    - If the Power Unit output power is more than 5 Watts below Set Power, increase the fuel pressure by approximately 0.25 to 0.50 psi (1.7 to 3.4 kPa), and wait 10 minutes.
    - If the Power Unit output power is more than 20 Watts below Set Power, increase the fuel pressure approximately 0.50 to 1.0 psi (3.4 to 6.8 kPa). After 10 minutes, determine if further adjustment is needed.
14. Once the Power Unit output power has stabilized to within 5 Watts of Set Power and stayed there for at least 15 minutes, proceed to the next section for Air Shutter Adjustment.

4.1.4 AIR SHUTTER ADJUSTMENT

After start-up, the air shutter will be in a fully opened position. The air shutter must be tuned for the site conditions to ensure optimal combustion. To test the air shutter during maintenance or service, start testing with the air shutter plate in a fully opened position.

Refer to Figure 10 to identify the parts and follow the steps below to adjust the air shutter.

NOTE: **The position of the cabinet door affects air intake. For these steps, open the cabinet door only to adjust the Air Shutter and keep the door closed as much as possible.**

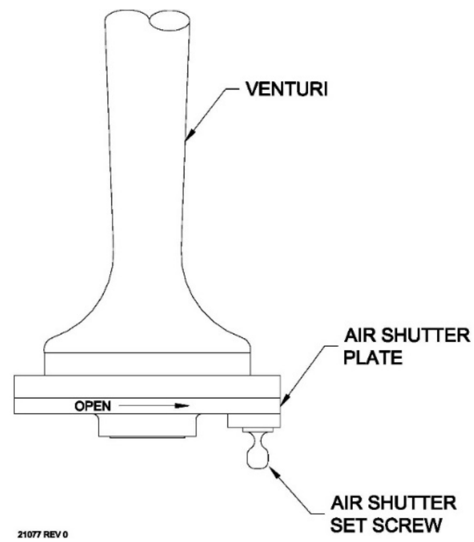

Figure 10 – Air Shutter Adjustment

1. With the air shutter plate initially fully opened, close the cabinet door for at least 15 minutes then take a power reading and record it on the Start-Up Data Sheet.
2. Close the air shutter by 1/8 inch (3 mm) from its current position.
3. Close the cabinet door and wait 10 minutes for the TEG to stabilize.
4. Take a power reading and compare it to the previous reading.
   - If the new power reading is higher than the previous reading, close the air shutter by another 1/8 inch (3 mm), wait 10 minutes, and then take another power reading.

     Continue closing the air shutter by 1/8 inch (3 mm) and checking the power every ten minutes until the power no longer rises, then proceed to the next step.
   - If the new power reading is lower than the initial reading, open the Air Shutter by 1/8 inch (3 mm) past the initial setting, wait 10 minutes, then take another power reading. If this power reading is the same or lower than the previous reading, then the Air Shutter is correctly adjusted. Proceed to Step 7.

     NOTE: **If the Air Shutter reaches its fully open position, then leave the Air Shutter at this position and proceed to Step 7.**

   - If this reading is the same as the previous reading, proceed to the next step.
5. Once the power reading has stabilized, open the Air Shutter by 1/4 inch (6 mm) from its current position. The Air Shutter is now optimally tuned for your ambient conditions and fuel supply.
6. Close the cabinet door and wait another 10 minutes for the TEG to stabilize.
7. Take a final power reading.
   - If the air shutter adjustment has caused your TEG's power to climb to more than 5 Watts above Set Power, decrease the fuel pressure to bring the power back to within 5 Watts of Set Power. Refer to Section 5.1.3, Step 13.

NOTE: **If the TEG is factory new or has just undergone a major overhaul, the Power Unit output power may drift slightly during the first few weeks of operation. It may be necessary to adjust the fuel pressure slightly to obtain Set Power after this time.**

4.2 APPLYING CUSTOMER LOAD

The TEG should now be operating at the correct power level. Before applying the customer load, ensure that all wire connections are tight and adjust the power conditioner output to the desired customer voltage as outlined in Section 9.

To apply customer load:

1. Connect the customer load to the TEG at terminals 2(+) and 4(-) of terminal block TB-1.
2. Turn the circuit breaker on the power conditioner to the ON position.
3. Close and latch the cabinet.

WARNING! **The Power Unit output must always remain connected with the Power Conditioner.**

A System Performance Log is located at the end of this manual. Use the log to monitor system performance each time the site is visited. This information is valuable for future reference. If the site is a multiple TEG installation, keep the log in a common maintenance area where service technicians can access it easily during maintenance checks.

5 SERVICE AND MAINTENANCE

WARNING! **Before attempting to service the Model 8550-SD TEG, review Sections 3, 5.1, 5.1.3, and the Power Conditioner manual in Section 9. Do not attempt to service the TEG unless you are thoroughly familiar with its operation.**

This maintenance frequency may vary depending on the site conditions including factors such as fuel purity, weather, and other environmental conditions. Under normal conditions, a properly installed Model 8550-SD TEG requires a maintenance check annually.

Perform the following series of service checks at least once per year:

- Power Check – this is the first step in any service visit. Refer to Section 5.1 – Power Check.
- Basic Service – Refer to Section 5.2 – Basic Service.

5.1 POWER CHECK

The purpose of performing a Power Check is to verify that the TEG is operating at the correct Set Power for the current ambient conditions.

Before performing a Power Check, determine the Set Power for your ambient conditions as outlined on Section 5.1.1. Review the Start-up Data Sheet to confirm Set Power and the System Performance Log to make sure that the TEG was left operating at Set Power during the last maintenance visit.

Perform a power check by doing the following:

1. Check the Power Unit voltage at Terminals 6(+) and 4(-) of TB-1.
2. Check the Power Unit current at terminals 6 (+) and 7 (-) of TB-1. The Current Shunt rating is 50 Amps (50 mV).
3. Calculate the Power Unit output power by multiplying the Power Unit voltage by the Power Unit current, then proceed as follows:
   - **If the Power Unit output power is within 10 Watts of Set Power**, the TEG is functioning well. Perform at basic service as outlined on Section 6.2.
   - **If the Power Unit output power is more than 10 Watts above Set Power**, reduce the fuel pressure by approximately 0.25 to 0.50 psi (1.7 to 3.4 kPa) and wait 10 minutes, then proceed with the basic service as outlined in Section 6.2.

     CAUTION! **Remember to adjust the fuel pressure during restart or before leaving the site, See Section 5.1.3 – Heat up and Power Adjustment. Do not continuously operate the TEG above Set Power.**

   - **If the Power Unit output power is more than 10 Watts below Set Power**, proceed to Step 4 to evaluate possible causes.
4. Review the System Performance Log and determine if the TEG was left operating at Set Power during the last service visit, remember that Set Power changes with ambient conditions.

- ➢ If the TEG was not left operating at Set Power during the last visit, investigate the reason for this. Check the System Performance Log for additional notes or remarks from the previous service check.
- ➢ If the TEG was left operating at Set Power during the last visit and is now not producing Set Power, consider the following causes:

  - **Change in fuel pressure:**

    Refer to the last entry in the log and determine if the fuel pressure has changed. If so, re-adjust the fuel pressure to the last entry.

    If this returns the Power Unit output power to within 10 Watts of Set Power, you can proceed with the basic service outlined in Section 5.2.

  - **Obstructed air flow:**

    Check for obstructions at the Heat Pipe fins, Air Inlet Screens, and Air Shutter. Perform the Air Shutter test, see Section 5.1.4.

    If this returns the output power to within 10 Watts of Set Power proceed to Section 6.2 – Basic Service.

  - **Change in fuel quality:**

    In order to maintain a constant output power, it is essential that the TEG be supplied with a fuel of constant heating value.

  - **Poor cooling by heat pipes:**

    Check to make sure that the Heat Pipe fins are not obstructed by debris or dust. Check that the Heat Pipe ends are warm. Test the cooling system as outlined in Sections 6.3.

  - **Change in customer load:**

    An overloaded TEG can see a minor to severe decline in output power and voltage. Verify that the connected load isn't attempting to draw more power than the TEG's Set Power.

If the above causes have been ruled out, the TEG may require more than just the basic service Keep the TEG operating for now and refer to Section 6.1.1 to isolate the cause of low Set Power condition.

5.1.1 LOW SET POWER DIAGNOSTIC

The procedures in this section are designed to isolate the cause for the Power Unit to have low Set Power. Perform these tests only if previous tests during the Power Check indicate that they are required.

For the following test to be accurate, the TEG must have been operating continuously at the customer voltage setpoint for the last 12 hours.

There are three basic reasons for the Set Power to be low. These are:

- low or inefficient heating by the burner and fuel system,
- poor or inefficient cooling, or
- a faulty or damaged Power Unit.

To perform the test:

1. Take a reading of the momentary open circuit as per the procedure in Section 6.9 – Power Unit Testing.
2. Calculate the open circuit voltage (V_{oc}) and internal resistance (R_{INT}) of the Power Unit as described in Section 6.9 – Power Unit Testing.
   - If the V_{oc} is above 56 Volts and R_{INT} is above 1.40 Ohms, the Power Unit is likely faulty. The Power Unit may still be able to operate at reduced output. Consult Global Power Technologies to determine the safe operating level for the Power Unit under your conditions.
   - If the V_{oc} is below 56 Volts and R_{INT} is above 1.30 Ohms, the Cooling System is likely faulty, see Section 6.3– Cooling System for further tests.
   - If the V_{oc} is below 56 Volts and R_{INT} is below 1.00 Ohms, the Burner or Fuel System is likely not providing enough heating.
     a) Perform the basic service outlined on Section 6.2,
     b) Check and replace the fuel orifice as outlined on Section 6.4, and
     c) Check the complete Burner System for obstructions and damage as outlined on Section 6.5.

     If after servicing and restarting, the Power Unit still does not come to Set Power, a change in the fuel quality is likely the cause.

     Increase the fuel pressure to obtain Set Power, being careful not to exceed the maximum V_{OC} and R_{INT} as determined in Section 6.9. It will take 10 minutes for a change in fuel pressure to take full effect.

WARNING! **Check the maximum V_{oc} and R_{INT} limits in Section 6.9 before increasing the fuel pressure. Do NOT exceed the maximum limits.**

5.2 BASIC SERVICE

Perform the following service checks at least once a year to ensure safe and prolonged performance of the Model 8550-SD TEG.

1. Inspect the Cooling System heat pipes. See to Section 6.3

   Record findings in the Heat Pipe Inspection Log located at the end of this manual. Create a new copy of this log for each inspection.
2. Replace the fuel filter in the pressure regulator, see Section 6.4 – Fuel System.
3. Drain the pressure regulator sediment bowl, see Section 6.4 – Fuel System.
4. Check the fuel orifice for clogging and replace if needed, see Section 6.4.
5. Remove debris, sand, and dust from the Heat Pipe fins, cabinet air intake screens, and cabinet interior.

6. Check all bolts and wire connections for tightness.
7. Restart the TEG as outlined on Section 5.1 – Ignition and Start-up Procedure and 5.1.3 – Heat Up and Power Adjustment.
8. Record the service and current operating parameters in the System Performance Log.

5.3 COOLING SYSTEM

In order to ensure the long-term reliability of the Model 8550-SD Thermoelectric Generator and to protect against heat pipe failures, we recommend yearly inspection of the heat pipes.

Overheating of the heat pipes on the Model 8550-SD can, over time, cause performance degradation issues and may eventually lead to heat pipe failure.

Overheating of the heat pipes can occur for several reasons including:

- Running the TEG at higher than rated fuel pressures,
- Blockage of the flow of cooling air across the fins,
- Elevated ambient air temperature exceeding the maximum rated temperature, or
- Running the TEG with poorly functioning heat pipes.

If a poorly functioning heat pipe is not identified, it can result in the accelerated degradation of that pipe as well as the surrounding heat pipes. Heat pipes on the TEG Model 8550-SD are serviceable components and should be replaced to prolong the life of the TEG. If you find any evidence of a poorly functioning heat pipe, please contact GPT.

5.3.1 HAND INSPECTION

Before performing this inspection, ensure that the TEG has been operating for at least one hour. If possible, choose a day that is calm and not windy.

This method involves touching the heat pipes with bare hands. This is a quick test to see if the heat pipes are working well. Perform this test first. If any of the heat pipes fail, then test them by taking their temperature profile as outlined in Section 5.3.2.

WARNING! **Be cautious when touching the heat pipe tips as these can be hot. Hover your hand over the heat pipes first to check for heat and only touch the heat pipe tips for no longer than one second.**

With the TEG in operation, hover your hand closely over the heat pipes to check for warmth. Refer to Figure 11.

A warm heat pipe tip is one that can only be comfortably touched for one second.

- If the heat pipe tip is too warm to hold, then it is in working condition and does not require further inspection.
- If any heat pipe does not feel warm up to 2 inches (50 mm) from the tip, perform a detailed check using the Detailed Inspection outlined on Section 6.3.2

On cold or windy days, when it is difficult to feel warm temperatures on the heat pipes, feel along the cooling fins of the Heat Pipe as well.

- ➢ If all the fins are about the same temperature, the Heat Pipe is working well.
- ➢ If one or more heat pipes feel much cooler than the rest of the heat pipes, check them using Detailed Inspection outlined on Section 5.3.2.

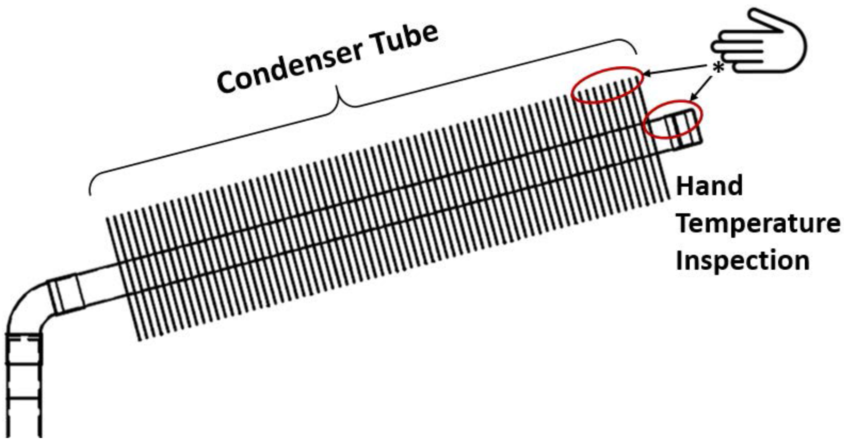

Figure 11 – Hand Temperature Inspection

5.3.2 DETAILED INSPECTION

A detailed inspection of the heat pipes is only required on heat pipes that do not pass the requirements of the hand temperature inspection (i.e., heat pipes that are not noticeably warm up to 2 inches (50 mm) from the tip.

Tool required:

- ✓ thermocouple meter: range up to 150°C (300°F) (example - Digital Multimeter with K type thermocouple adapter)
- ✓ surface temperature probe: > 50mm (2 in.) long, < 5 mm (0.2 in.) diameter (K type thermocouple probe)

Keep the TEG operating for at least an hour in calm weather conditions before taking the condenser tube's temperature profile. Make sure to take the surface temperature of the tube, not the fins or the air around the tube. Refer to Figure 12 for inspection points.

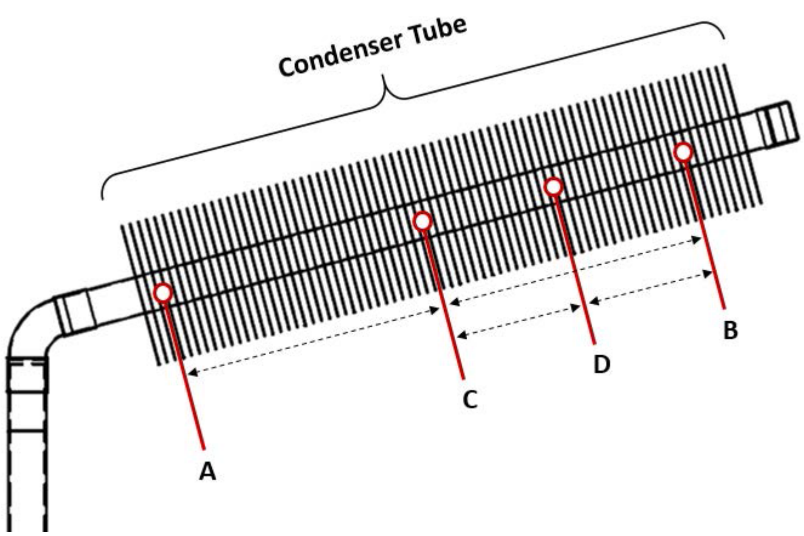

Figure 12 – Heat Pipe Condenser Tube Temperature Inspection Points

Follow the step-by-step guide outlined in the table below.

<table>
<tr><td colspan="6">Heat Pipe Detailed Inspection
> means greater than; < means less than</td></tr>
<tr><td rowspan="2">Step 1</td><td>Take temperatures at points A and B</td><td>T_A</td><td>T_C</td><td>T_D</td><td>T_B</td></tr>
<tr><td>Subtract T_B from T_A.
If $T_A – T_B$ > 20°C (36°F), proceed to step 2.
If $T_A – T_B$ < 20°C (36°F), the heat pipe is good. No further inspection required</td><td colspan="4">T_A - T_B =</td></tr>
<tr><td rowspan="2">Step 2</td><td>Only if required as per Step 1. Take temperatures at point C and D. Use step 1 temperature of point A .</td><td>T_A</td><td>T_C</td><td>T_D</td><td>T_B</td></tr>
<tr><td>Subtract T_C from T_A.
Subtract T_D from T_C.
If $T_A – T_C$ > 20°C (36°F) or $T_C – T_D$ > 15°C (27°F), replace heat pipe.
If $T_A – T_C$ < 20°C (36°F) and $T_C – T_D$ < 15°C (27°F), the heat pipe does not need immediate replacement, but should be monitored during annual inspections for further degradation.</td><td colspan="4">T_A - T_C =

T_C - T_D =</td></tr>
</table>

A problem should be suspected with any heat pipe that is operating at a temperature much lower than the rest of the heat pipes. Replacement of heat pipes should only be done by a factory trained technician, consult GPT for heat pipes replacement.

Remove and replace any heat pipe that is visually damaged.

CAUTION! **Do not operate the TEG if it has a damaged heat pipe.**

5.4 FUEL SYSTEM

WARNING! **Turn off the fuel supply at the external valve before performing service checks on the fuel system.**

The basic components of the fuel system are shown in Figure 13, note that some details may be different depending on the fuel system option on your TEG. Identify the components and their location on the TEG.

- ✓ Pressure regulator – regulates fuel pressure to the fuel orifice. A sediment bowl and drain cock are located on the bottom of the pressure regulator.
- ✓ Manifold and pressure gauge – monitors the fuel pressure to the fuel orifice.
- ✓ Automatic shut-off valve, sometimes referred to as safety shut-off valve
- ✓ Burner run valve
- ✓ Fuel orifice – a precision-jeweled orifice that controls the flow of fuel to the burner.

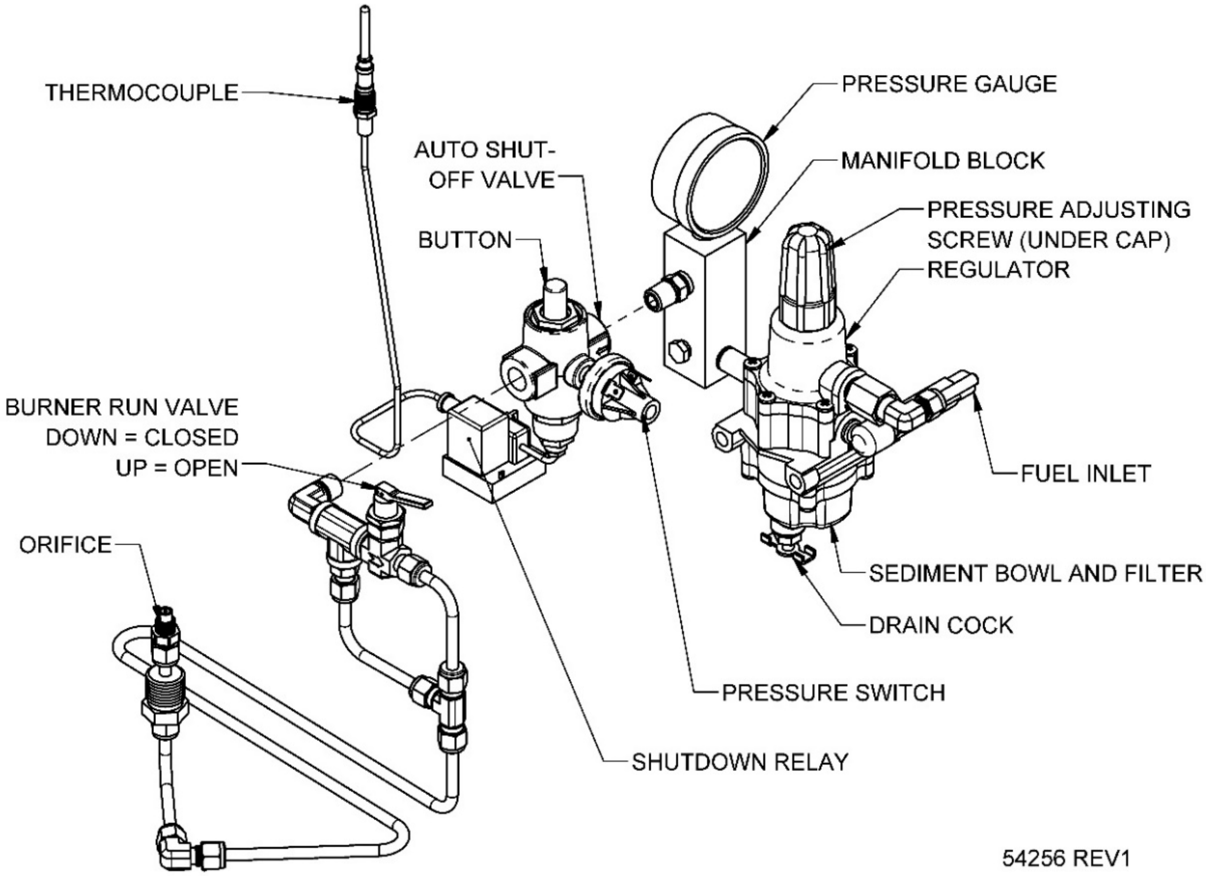

Figure 13 – Fuel System Components

5.4.1 DRAINING THE PRESSURE REGULATOR SEDIMENT BOWL

To drain the pressure regulator sediment bowl:

1. Open the drain cock located under the pressure regulator.
2. Using a small container, collect any liquid impurities that may have collected in the bowl.
3. After the bowl has drained, close the drain cock.

5.4.2 CHANGING THE FUEL FILTER

To change the fuel filter:

1. Remove the 4 socket cap screws that hold the bottom bowl on the pressure regulator.
2. Remove the bottom bowl and replace the filter element.
3. Check and replace the gasket if needed.
4. Carefully reassemble the regulator ensuring that the needle valve spring is properly placed over the needle valve centering cup in the regulator body.
5. Check for proper operation.
6. Check all joints for fuel leaks.

5.4.3 CHANGING THE FUEL ORIFICE

To change the fuel orifice:

1. Remove the fuel line and orifice assembly by turning the orifice mounting base.
2. Remove the orifice body from the assembly, see Figure 14.
3. Check the orifice hole. It should be free and clean of debris.
4. Replace the orifice body if needed.
5. Reassemble and check for leaks.

WARNING!

Check for leaks after performing any fuel system service.

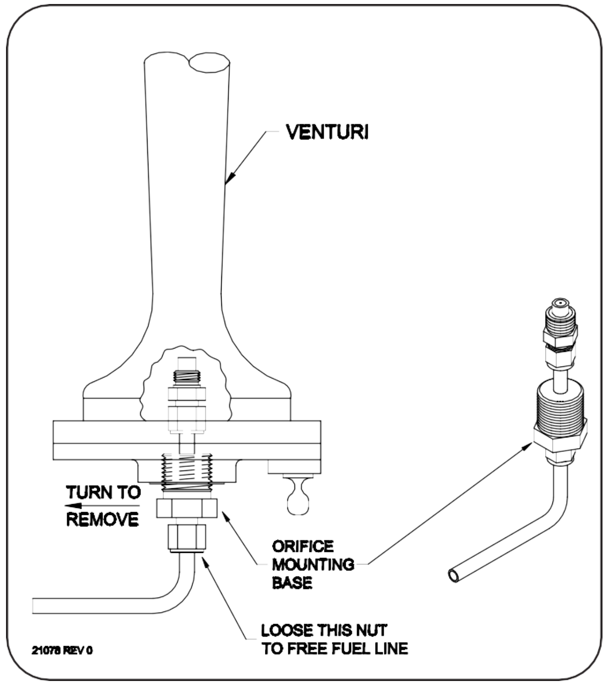

Figure 14 – Orifice Assembly Removal

5.5 BURNER SYSTEM

The Burner System should be disassembled only if a problem with burner operation is suspected.

The Burner System consists of the following components:

- ✓ The burner venturi and air shutter assembly which mixes combustion air and fuel.
- ✓ The burner plate assembly where combustion takes place.
- ✓ The exhaust stack assembly which collects and exhausts the exhaust gases.

Before disassembling the Burner System, remove the fuel orifice as per Section 6.4 and allow the burner to cool. Once the burner has cooled down, identify and locate the components from Figure 15 proceed with disassembly as follows:

1. Remove the venturi and air shutter assembly from the burner plate by turning the venturi, which is threaded into the burner plate assembly, counterclockwise.
2. Remove the air shutter from the venturi by closing the air shutter completely and removing the four screws located in the openings on the air shutter plate.
3. Remove the burner plate assembly by removing the four Burner Plate mounting screws then pulling the burner plate assembly down, out of the Power Unit.

Perform the following checks once the Burner System has been disassembled:

1. Check the air shutter assembly and venturi for corrosion or obstructions.
2. Check the flame holder screen, located in the venturi mounting fitting on the burner plate assembly, and the burner mantle for corrosion or obstructions.
   - ➢ If these parts are obstructed, clean them with a stiff wire brush.
   - ➢ If they are corroded, the burner must be repaired or replaced.

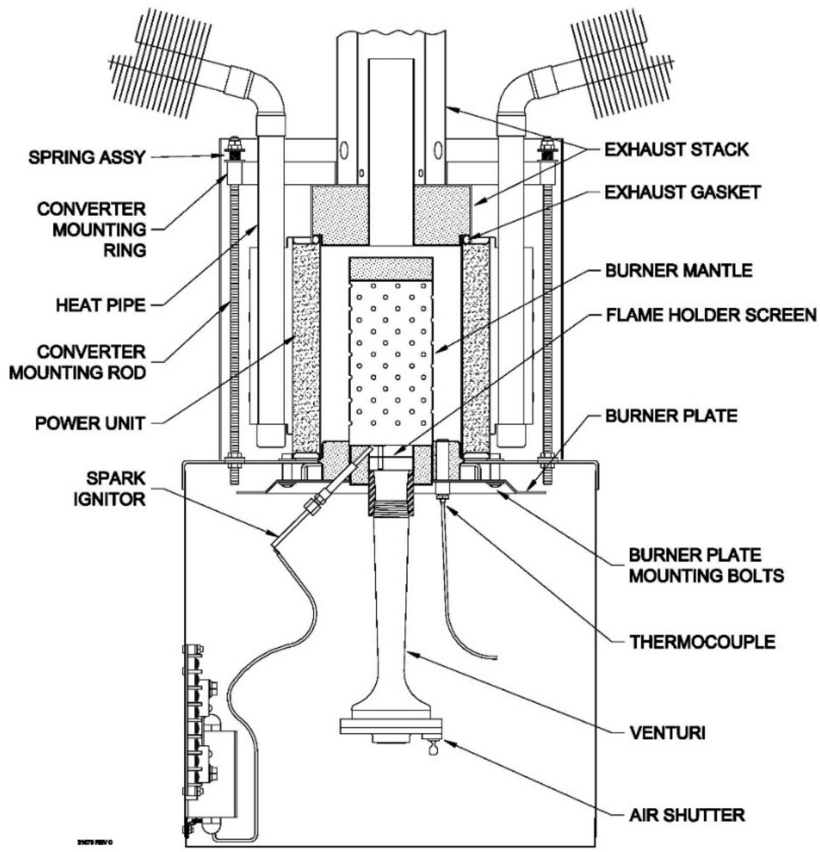

Figure 15 – Burner System Components

With the burner plate assembly removed, examine the exhaust stack through the Power Unit, remove any obstructions and check for corrosion.

If the exhaust stack is corroded, it must be replaced as follows:

1. Remove the converter shroud which covers the lower portion of the heat pipes. This can be accomplished without removing the heat pipe support frame.

NOTE: **Turn off the fuel supply at the external valve before performing service checks on the fuel system.**

2. Remove the four nut-and-spring assemblies that hold down the converter mounting ring. Before removing the converter mounting ring, mark its position so that it can be reinstalled in the same position.
3. Lift the exhaust stack off.

Before replacing the exhaust stack, check if the high temperature exhaust gasket is still in good condition and replace if necessary. To replace, tighten the spring assemblies that are holding the converter mounting ring in place until the springs are solid, then back off by about 5 turns (1/4 inch or 6 mm).

Always apply a high temperature nickel-based, anti-seize compound to the threads on the venturi before installing it. It is not necessary to tighten the venturi more than hand tight.

5.6 SPARK IGNITION (SI)

The Spark Ignition system consists of three major components:

- ✓ The spark electrode which ignites the gas.
- ✓ The Pressure Switch which turns on the system when there is fuel gas pressure in the fuel system.
- ✓ The SI Control Module which generates the high voltage pulse for the Spark Electrode and controls the function of the system.

Whenever there is adequate fuel pressure in the Fuel System, the Pressure Switch is closed. With the Pressure Switch closed, the SI Control Module will generate 12-kV pulses which will arc from the Spark Electrode. The SI Control Module will continue to generate the high voltage pulses until it senses the presence of flame at the Spark Electrode or until the Pressure Switch is opened.

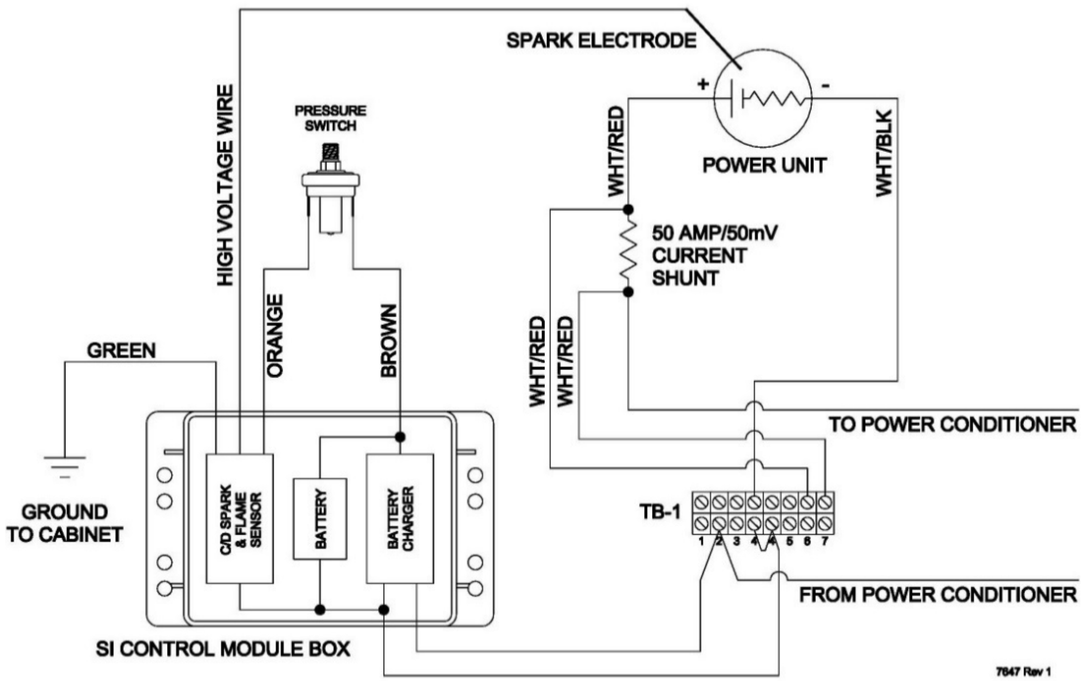

Figure 16 – Spark Ignition System Wiring

The Control Module contains a 2-Volt, 2.5-Amp hour rechargeable battery and a battery charger. A new fully charged battery provides approximately 16 hours of continuous sparking capability. Twenty minutes of recharging is sufficient for one start cycle. A completely discharged battery requires 16 hours of charging to fully recharge.

Figure 16 shows the Spark Ignition system wiring and Figure 17 shows the location of the Spark Ignition system components.

If the Spark Ignition System is malfunctioning, follow the procedure below to isolate the problem.

1. Check that the spark gap is correct. Loosen the fitting on the bottom side of the burner and slide the Spark Igniter Rod in until it touches the spark post, then pull back approximately 1/8 inch (3 mm).

   This should leave 2.24 to 2.40 inches (57 to 61 mm) extruding beyond the fitting, see Figure 17. Confirm that this is correct before proceeding.

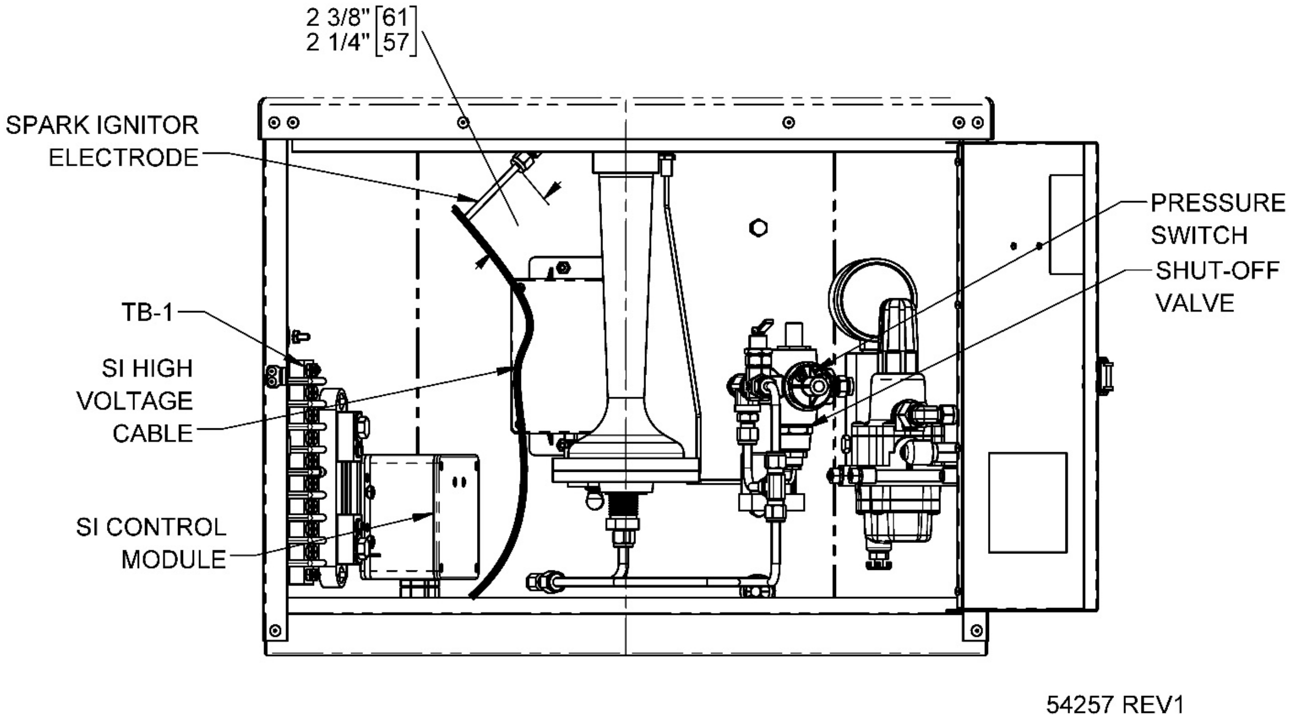

Figure 17 – Spark Ignition Components

2. Remove the orange wire from the pressure switch and isolate it so that it cannot come in contact with the other electrical connections to prevent high voltage shock.
3. Carefully remove the spark igniter electrode assembly, loosen the fitting, and slide out the electrode.
4. Inspect the spark igniter electrode for cracks in the ceramic tube. Check the rod that runs through the ceramic tube for continuity. Replace the spark igniter electrode if it is damaged.
5. To test the function of the SI Control Module, position the spark igniter electrode tip so that there is a 1/8-inch (3 mm) gap to the TEG cabinet. Then touch the orange wire connector to the Pressure Switch. Arcing should occur at the gap at the rate of about one per second. If arcing occurs the system is functioning well.

WARNING!

Do not touch the tip of the orange wire or allow it to come in contact with other electrical connections.

6. Check the Pressure Switch. The switch should close at fuel pressures greater than 16 kPa (2.5 psi). Replace the Pressure Switch if necessary.
7. Check the battery voltage by measuring the voltage between the brown wire at the Pressure Switch and the thin white/black wire at Terminal 4 on TB-1. The voltage should be greater than 2.0 Volts.
   - If the voltage is less than 2.0 Volts, recharge the battery. See procedure below.
   - If the battery does not hold voltage after a full 16-hour charge cycle, replace the battery and/or the SI Control Module.

The TEG may be jump-started to charge a depleted battery. To do this:

1. Remove the thin white/red and white/black wires from terminals 2 and 4 on TB-1 and apply a 12- to 30-Volt power source across these wires.
2. Start the TEG normally.
3. Reconnect the removed wires once the Fuel Shutoff Valve no longer requires the button to be manually held.

5.7 OVERTEMPERATURE SHUTDOWN SYSTEM

The purpose of the safety shutdown system is to shut off the fuel supply in the event of a Power Unit or cabinet overtemperature. Overtemperature conditions can occur if air flow across the heat pipes is restricted, ambient temperatures exceed maximum ratings, or from heat pipe failure.

The Overtemperature Shutdown system consists of the following main components:

- ✓ Six Shutdown Thermostats – Each thermostat is installed in a heat pipe block and protects two heat pipes. During an overtemperature event, the thermostat will cause the respective shutdown fuse to blow in the Shutdown Module.

NOTE: **Thermostats produced after September 2021 will come paired with an Adaptor Board that must be installed for proper operation.**

- ✓ Shutdown Module – This module houses the thermostat fuses and is powered directly from the power unit. If all six fuses are intact, and the power unit voltage is above 12.5 Volts, this Module will provide 12 Volts to energize the Shutdown Relay.
- ✓ Shutdown Relay Assembly – This assembly is situated between the burner thermocouple and the shut-off valve. When energized, it allows the thermocouple signal to pass through. If an overtemperature event occurs it will de-energize and interrupt the signal, thereby shutting off the fuel valve.
- ✓ Thermal Cut-off – This is a thermal fuse that is placed in line with the Shutdown Relay red power wire. While the six thermostats protect the heat pipes and power unit, the thermal cut-off protects the cabinet interior from overtemperature. If the cabinet gets too hot, this fuse will open and cause the shutdown relay to de-energize.

If an unexpected shutdown occurs, check the thermal cut-off and six shutdown fuses for continuity. If any of them have opened, then follow these maintenance steps:

1. Inspect all the heat pipes for damage and clean any debris.
2. Inspect the thermostat wiring for loose or broken wires.
   - ➢ If the thermostat is paired with an adaptor board, ensure that both quick-connect terminals are tight.
   - ➢ If the thermal cut-off opened, check the fuel system for leaks and ensure that the burner thermocouple fitting is tight.
   - ➢ If no obvious problems are observed, replace the blown shutdown fuses and/or thermal cut-off.

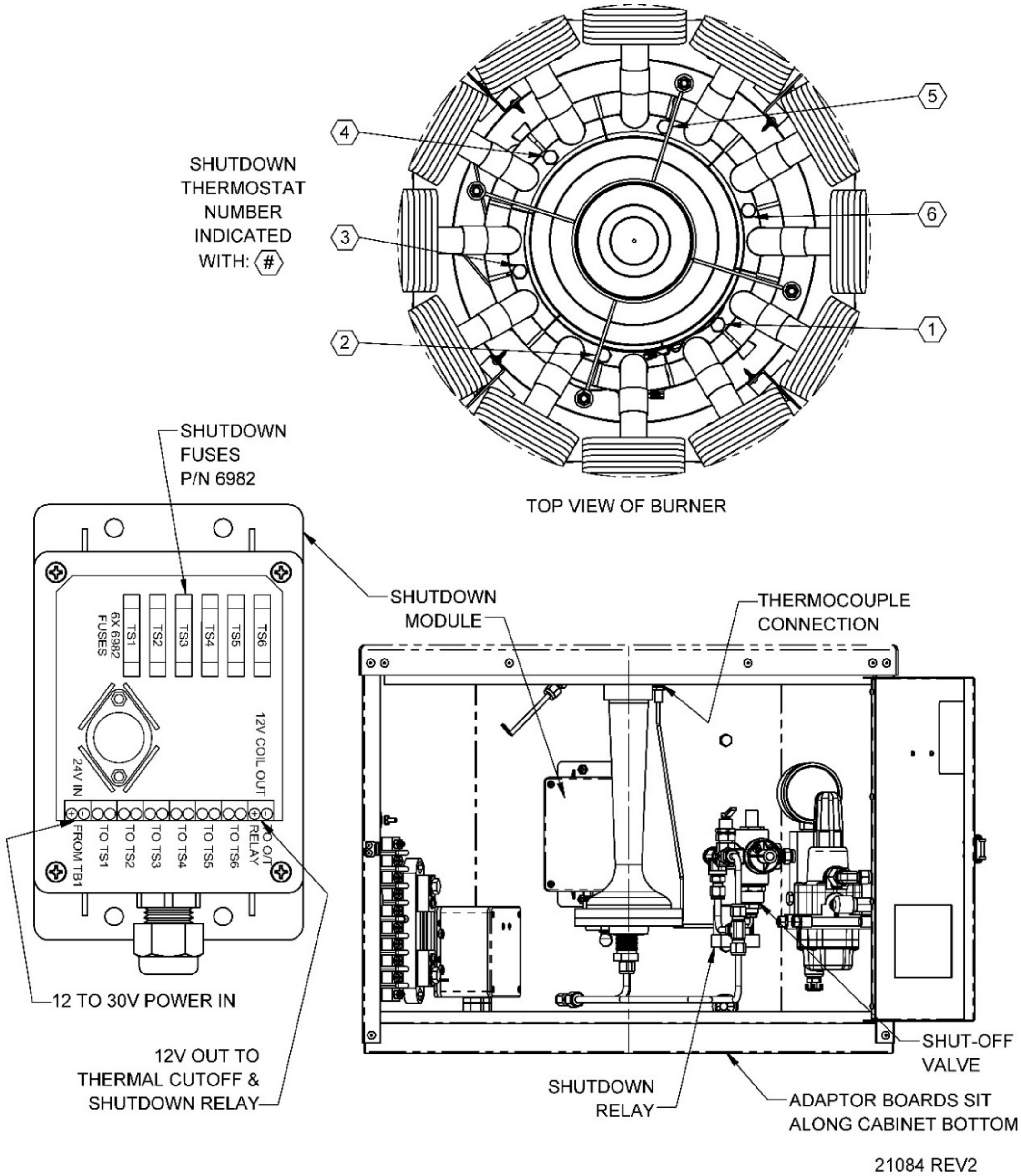

Figure 18 – Overtemperature Shutdown System

3. Restart the TEG as normal and run it for at least one hour.
4. Perform a heat pipe inspection, refer to Section 6.3. Check all heat pipes, paying extra attention to the heat pipes nearest to any thermostats that blew a shutdown fuse. Replace all underperforming heat pipes as necessary.
   - If any shutdown fuse repeatedly opens before the TEG fully heats up, the corresponding thermostat is likely damaged and should be replaced.

5.8 AUTOMATIC SHUT-OFF (SO)

The Automatic Shut-Off system is designed to turn off the fuel supply to the TEG in the event of a flame outage. The thermocouple will hold open the shut-off valve as long as good burner combustion is maintained. The thermocouple also interfaces with the Overtemperature Shutdown System and is interrupted if an overtemperature event occurs.

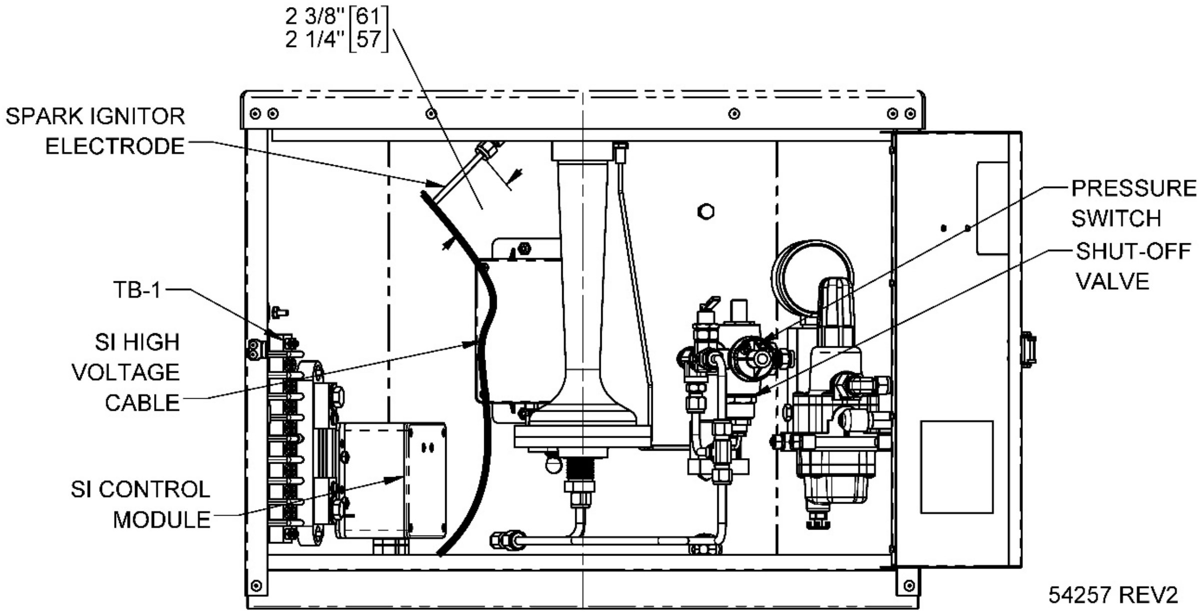

Figure 19 – Automatic Shut-off Components

If your Model 8550-SD TEG is experiencing intermittent shutdowns or does not start reliably, follow these steps to troubleshoot the Automatic Shut-Off system.

1. Check that the thermocouple sensor is installed correctly in the Burner Plate assembly.
2. Verify that the connection between the thermocouple and the Overtemperature Shutdown Relay Assembly is tight.
3. Ensure that the connection between the shutdown relay and the shut-off valve is tight.

If no installation issues are identified, verify system operation as follows:

1. Press and hold the button on the shut-off valve to start the TEG. Keep the button held down for the entire duration of these tests. Allow the power unit voltage to climb above 14 Volts before proceeding.
2. Disconnect the thermocouple fitting from the Shutdown Relay Assembly. Using a voltmeter, measure the voltage between the cap in the center of the thermocouple fitting and the sensor case. A healthy thermocouple will have a voltage between 15 and 30 millivolts. If the thermocouple signal falls below this range, or if no continuity is observed, then the thermocouple should be replaced.

NOTE: **When replacing the thermocouple and using anti-seize on the burner fitting, ensure that only high-temperature anti-seize is used.**

3. Reattach the thermocouple fitting to the Shutdown Relay Assembly. Then detach the connection between the Shutdown Relay and the Shut-Off Valve. Perform the same voltage measurement between the cap and the sensor case of this fitting. The millivolt reading should be about the same as the reading from the previous step. If the voltage reading drops significantly from the previous measurement, the Shutdown Relay may need replacement to prevent nuisance shutdowns.
4. If no voltage can be observed at all, then check the shutdown relay power. Refer to Section 4.3.

5. If the shutdown module is outputting at least 12 Volts and the thermal cut-off has not opened, then the shutdown relay is faulty and should be replaced.
6. If no problems have been detected with the thermocouple signal but the shut-off valve still cannot hold itself open, then the valve itself should be replaced.

NOTE:	**When replacing the Shut-off Valve, ensure that you do not introduce any thread sealing compound or other contaminants into the piping. Make sure to check for fuel leaks.**

5.9 POWER UNIT TESTING

The procedure below is designed to evaluate the conditions of the Power Unit and to determine its operating point. This procedure should only be done if a problem with the Power Unit is suspected, it serves no other purpose.

Open circuit voltage and internal resistance test:

The purpose of this test is to determine the momentary open circuit voltage (V_{oc}) of the Power Unit from which the internal resistance (R_{INT}) can be calculated. For this test to be accurate, the TEG must have been operating for the past 12 hours.

1. Measure and record the Power Unit current (I) at terminals 6(+) and 7(-) of TB-1.
2. Attach a voltmeter to read the Power Unit voltage at terminals 6(+) and 4(-) of TB-1. The voltmeter leads must be attached to these terminals because you will need both hands free to do the open circuit test.
3. Measure and record the Power Unit loaded voltage (V_L).

   Record the momentary open circuit Power Unit voltage (V_{oc}). This is best done by removing the positive lead (White/Red) from the bottom of the shunt. With one hand, hold the connector firmly to the shunt until you have removed the screw then remove the connector and take the voltage reading.

   The reading must be taken within 3 seconds. Immediately reconnect the wire to the shunt. DO NOT allow the Power Unit to remain in open circuit for more than 20 seconds.
4. Record the open circuit voltage. If you need to take the reading again, wait at least 10 minutes with the screws firmly reinstalled so that the Power Unit can stabilize.
5. Calculate the internal resistance (R_{INT}) using the equation:

$$R_{INT} = \frac{(V_{oc} - V_L)}{I}$$

Where:	R_{INT}	=	internal resistance in Ohms
	V_{OC}	=	Power Unit open circuit voltage
	V_L	=	Power Unit loaded voltage
	I	=	Power Unit load current

WARNING! **Do NOT allow the Power Unit to operate in the open circuit condition for more than 20 seconds.**

If this test was conducted because the Power Unit power was below Set Power, see Section 6.1.1 for test result diagnostic.

If the Power Unit is producing Set Power, the open circuit voltage (V_{oc}) should be in the range of 52 to 56 Volts, and the internal resistance (R_{INT}) should be in the range of 1.10 to 1.35 Ohms.

NOTE: **If the TEG has just been started in the last 10 hours or has been stopped and restarted several times in the past days, its internal resistance may be somewhat higher.**

The maximum operating limits are 56.5 Volts for open circuit voltage and 1.45 Ohms for internal resistance. If the Power Unit does not produce Set Power and problems with the Burner System, Fuel System, and Cooling System have been ruled out, increase the fuel pressure until one of the above limits or Set Power is reached. Remember that it will take at least 10 minutes for a change in fuel pressure to take full effect. See also sections 5.1.3 and 5.1.4.

If the Power Unit will not produce Set Power without exceeding these limits, or does not respond to increasing fuel pressure, the Power Unit may be damaged.

NOTE: **In some cases, the Power Unit may be operated at derated power, consult GPT for further information.**

WARNING! **Do not operate the Power Unit above Set Power, maximum open circuit voltage, or maximum internal resistance.**

---

6 TROUBLESHOOTING

When the TEG is not operating correctly it is necessary to determine which part is faulty. First ensure that all wires are making good contact and are connected correctly. Then isolate the customer load from the Power Conditioner. Refer to Table 6 as a guide to troubleshooting the TEG and consult the indicated sections of this manual for further information.

Table 3 – Troubleshooting Guide

Problem	Potential Cause	Possible Solution	Lookup Section
Burner does not ignite.	Air in fuel line	Purge fuel lines of air	*4.5*
	Supply gas pressure too low	Increase the gas supply pressure to the TEG.	*4.6*
	Burner Run Valve left open before starting	Close the Burner Run Valve	*5.1.2*
	Fuel filter dirty	Drain the regulator sediment	*6.4*
		Replace the fuel filter	*6.4.2*
	Fuel pressure adjustment incorrect	Adjust the burner fuel pressure	*5.1.2*
	Fuel Orifice plugged	Replace the fuel Orifice	*6.4.3*
	Fuel Orifice size incorrect		*6.4.3*
	Air Shutter adjustment incorrect	Tune the Air Shutter	*5.1.4*
	Incorrect Spark Electrode depth	Adjust the Spark Electrode depth	*4.4, 6.6*
	Spark Igniter battery depleted	Replace the Spark Ignition battery	*6.6*
	Spark Igniter faulty	Replace the Spark Igniter	*6.6*
Burner ignites but does not continue to burn.	Supply gas pressure too low	Increase the gas supply pressure to the TEG	*4.5, 4.6*
	Burner Run valve left closed after starting	Open the Burner Run Valve	*5.1.2*
	Fuel filter dirty	Drain the Regulator sediment	*6.4.1*
		Replace the fuel filter	*6.4.2*

Problem	Potential Cause	Possible Solution	Lookup Section
Burner ignites but does not continue to burn.	Fuel pressure adjustment incorrect	Adjust the Burner fuel pressure	*5.1.2, 5.1.3*
	Fuel Orifice plugged	Replace the fuel Orifice	*6.4.3*
	Fuel Orifice size incorrect	Replace the orifice with one in the correct size	*6.4.3*
	Air Shutter adjustment incorrect	Adjust the Air Shutter	*5.1.4*
	Thermostat fuses have blown	Inspect Heat Pipes and replace fuses	*6.3*
	Thermal Cut-off has opened	Inspect fuel system and replace Thermal Cut-off	*6.4*
	Poor thermocouple signal	Troubleshoot Shut-off System	*6.8*
	Shut-off Valve malfunctioning		*6.8*
Low output power or output voltage	Set Power incorrect	Determine proper Set Power for ambient conditions	*5.1.1*
	Heat Pipes not adequately cooling power unit	Maintain and/or replace Heat Pipes	*6.3*
	Fuel pressure adjustment incorrect	Adjust Burner fuel pressure	*5.1.2*
	Air-shutter adjustment incorrect	Adjust Air Shutter	*5.1.4*
	Output voltage adjustment incorrect	Adjust the output voltage screw on the Power Conditioner	*9.2.1*
	Power Unit damaged	Evaluate the power unit	*6.9*
Output power is too high	Fuel pressure adjustment incorrect	Adjust the Burner fuel pressure	*5.1.2*
Output voltage is too high	Output voltage adjustment incorrect	Adjust the output voltage screw on the Power Conditioner	*9.2.1*
	Power Conditioner is faulty	Replace The Power Conditioner	

7 PARTS LISTS

MODEL 8550-SD TEG PARTS LIST, 1 of 2

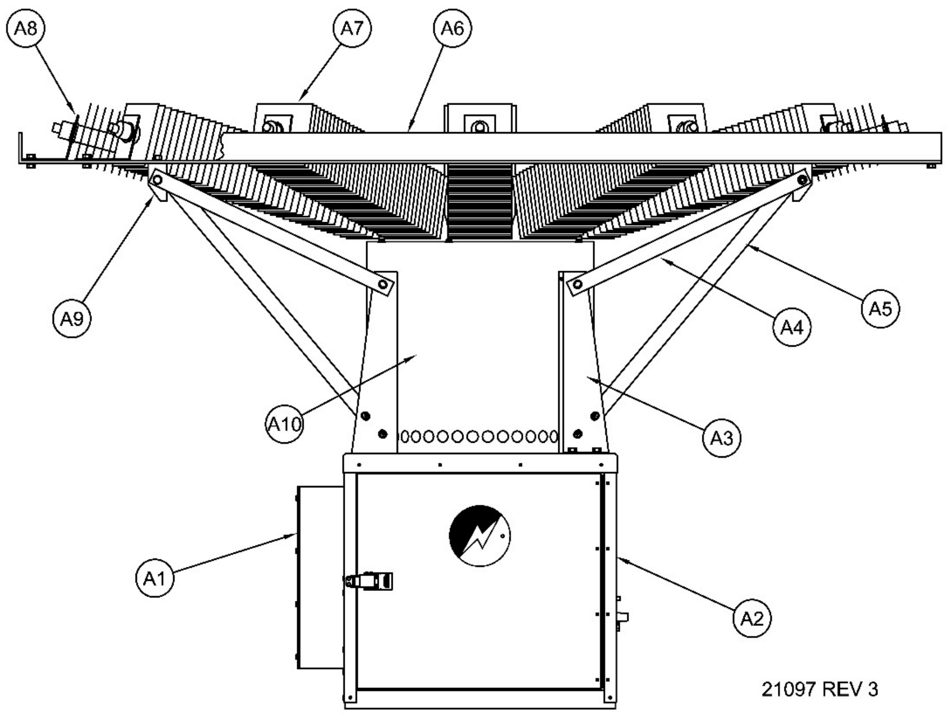

Figure 20 – Model 8550-SD TEG Parts List (1 of 2)

Item	Part No.	Description
A1	3162	Voltage Limiter, Model 6720
A2	21611	Cabinet Assembly
A3	6431	Support, Upright, Heat Pipe
A4	6394	Support Arm, Upper, Heat Pipe
A5	6395	Support Arm, Lower, Heat Pipe
A6	6393	Support Ring, Heat Pipe
A7	22895	Heat Pipe Assembly, Water/Methanol (Orange tip) *
	22896	Heat Pipe Assembly, Water/Ethanol (Black tip) *
	22897	Heat Pipe Assembly, Methanol (White tip) *
A8	6396	Heat Pipe Clip
A9	6397	Support Bracket
A10	6398	Converter Shroud

***NOTE:**

The Heat Pipe Assembly type will vary depending on the TEG type as follows:

- Warm Ambient uses 12 each of 22895 (orange tip)
- Cold Ambient uses 6 each of 22897 (white tip) alternating with 6 each of 22896 (black tip).
- Medium Ambient uses 12 each of 22896 (black tip)
- Check the colour of the tip of the Heat Pipe to determine which type to use.

MODEL 8550-SD TEG PARTS LIST, 2 of 2

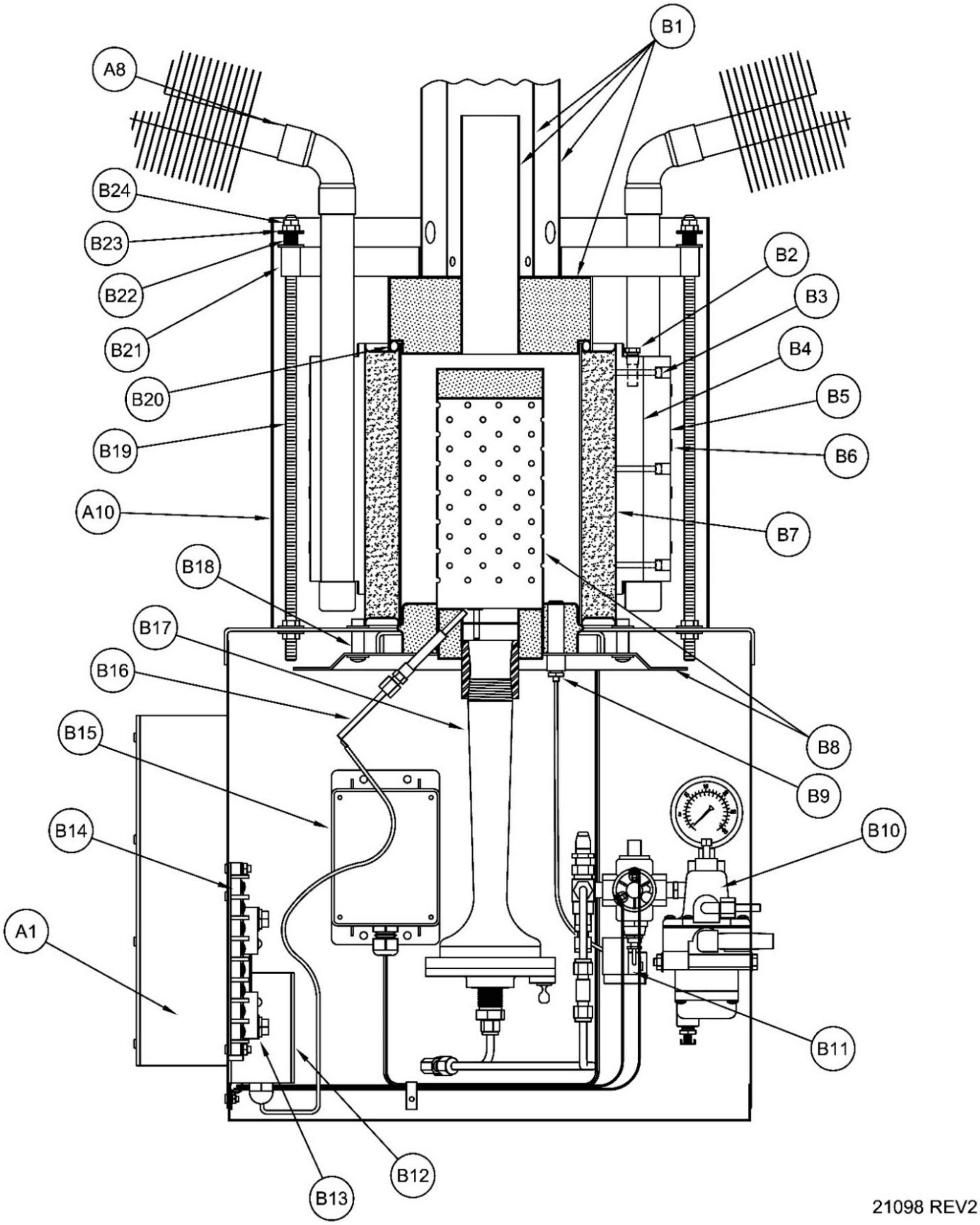

Figure 21 – Model 8550-SD TEG Parts List (2 of2)

Refer to Figure 21 for the following parts:

Item	Part No.	Description
B1	5406	Exhaust Stack Assembly, 8550
B2	302375	Thermostat, Shutdown, with Adaptor Board
B3	2104	Screw, Cap, Soc-H-Hex, 10-32 x 1”, SS
B4	21646	Shoe, Heat Pipe
B5	6462	Block, Heat Pipe
B6	6991	Clamp, Oetiker, 178-315SQ
B7	8906	Power Unit, 8550
B8	22490	Burner Assy
B9	177	Thermocouple, 24”
B10	22385	Fuel System, Natural Gas
	22384	Fuel System, Propane
B11	6978	Shutdown Relay Assembly
B12	67289	Spark Igniter Module Assembly
	27019	Battery, 2V, 2.5 AH, D size (inside B12)
B13	5238	Shunt, 50 Amp 50 mV, Bach 6709
B14	2110	Terminal Block, 8 Position
B15	6963	Shutdown Module, Overtemperature
B16	6768	Spark Electrode Assembly
B17	6418	Venturi
B18	6968	Stand Off, ½” Hex, 1/4-20 x 5/8”, SS
B19	6400	Mounting Rod, Converter
B20	5545	Exhaust Gasket
B21	6645	Converter Mounting Ring
B22	5576	Spring, Spae-naur 610-403
B23	5578	Washer, Flat, 5/16, SS
B24	5579	Nut, Hex, 5/16-18, SS

FUEL SYSTEM PARTS LIST

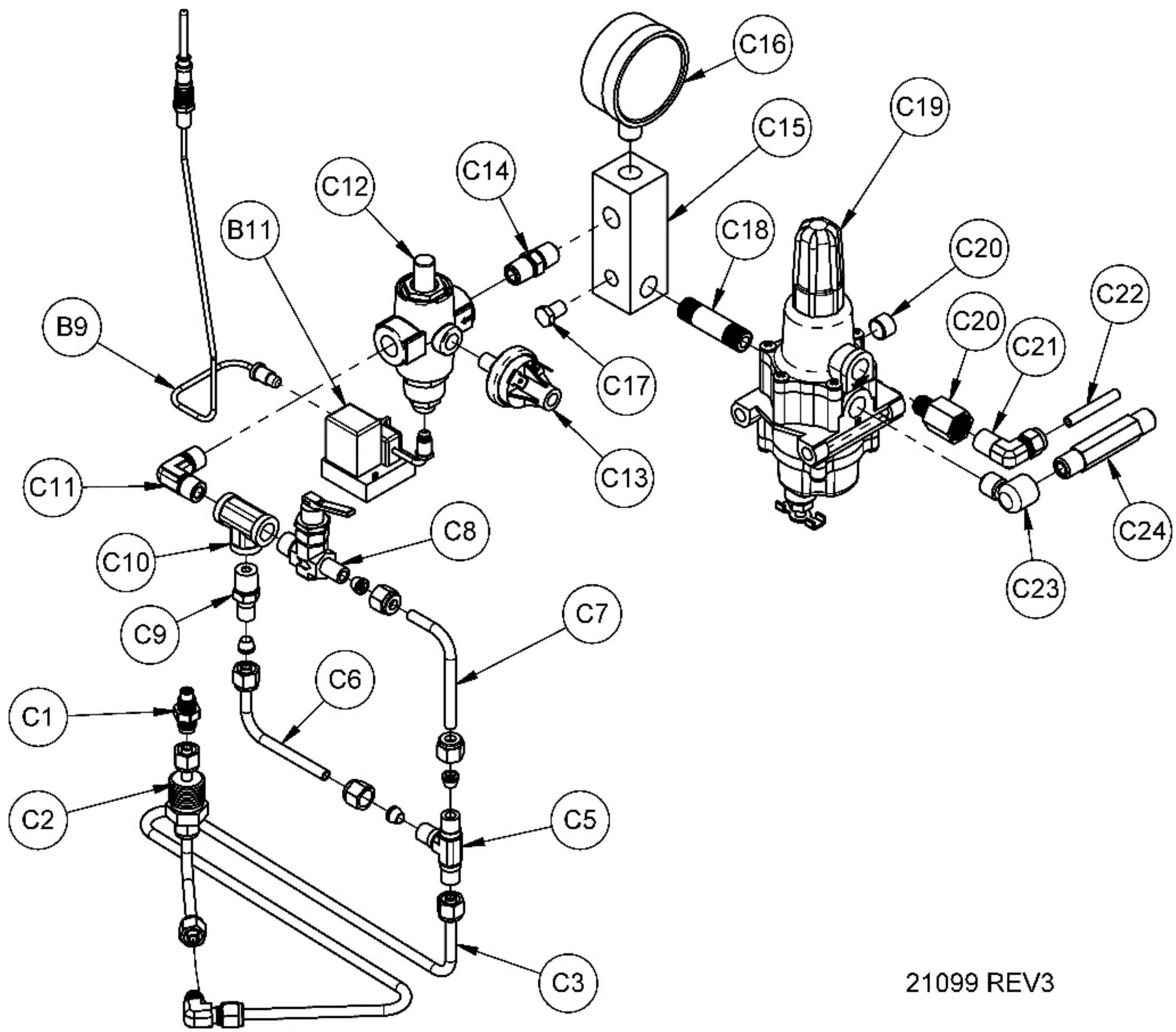

Figure 22 – Fuel System Parts List

Refer to Figure 22 to identify the following parts:

Item	Part No.	Description
C1	6434	Orifice, Propane, 0.040*
or	6433	Orifice, Natural Gas, 0.061*
C2	5897	Orifice Tube Assembly*
C3	301939	Fuel Hard Line Assembly
C5	5551	Union Tee, 1/4 TB, B-400-3, Brass
C6	24915	Tube, Start Circuit
C7	24916	Tube, Run Circuit
C8	5552	Valve, Toggle, Needle, B-IGM4-S4, Brass
C9	5549	Snubber, Propane, B4SMA-400W
or	5550	Snubber, Natural Gas, B4SMA-400L
C10	5048	Tee, 1/4 Female NPT, 101-B, Brass
C11	476	Elbow, 90, 1/4 Male NPT, Brass
C12	176	Valve, Shut-Off
C13	6471	Switch, Pressure, 1.5 PSI
C14	501	Nipple, Hex, 1/4 NPT x 1 1/2", Brass
C15	2100	Manifold Block
C16	406	Gauge, Pressure, 0-30 PSI
C17	432	Plug, Hex Hd, 1/8-27 NPT, Brass
C18	376	Nipple, 1/4 NPT x 2" Lg, Brass
C19	22359	Regulator, 3-20 PSI, Fisher 67CFR
C20	2360	Adaptor, 11/4 MNPT X 1/4 FNPT, SS
C21	20071	Elbow, 1/4 TB x 1/4 NPT, SS
C22	20122	Vent Tube Assy
C23	384	Elbow, Street, 1/4 NPT, Brass
C24	2154	Nipple, Hex, 1/4 NPT x 2" Lg, Brass
C25	22363	Filter Kit, Fisher 67CFR, 1F257706992 & T14057T0022

*Parts must be ordered separately from remainder of fuel system.

8 6720 VOLTAGE LIMITER FOR MODEL 8550-SD TEG

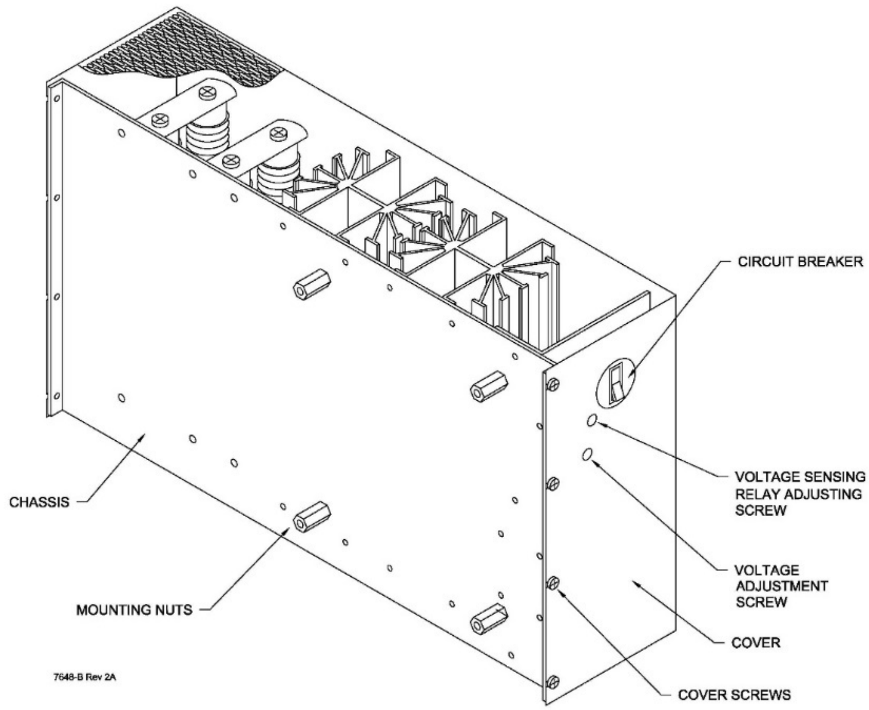

Figure 23 – 6720 Voltage Limiter

8.1 PRODUCT APPLICATION

The 6720 Voltage Limiter is an electronic device connected to the output of the TEG's Power Unit. It is a shunt regulator that is essential for power unit health. Its main functions are to:

- Shed unused power from the TEG's Power Unit to provide optimal load conditions and protect from overvoltage.
- Provide a constant-adjustable voltage to the Customer Load.
- Provide reverse current protection from customer load connections.
- Provide a Voltage Sensing Relay (VSR) that can be used for Low-Voltage-Alarm and/or Voltage-Good contacts in customer applications.

8.2 OPERATION

8.2.1 OUTPUT VOLTAGE ADJUSTMENT

Do not adjust the voltage limiter output voltage until the TEG is set up and operating in accordance with Section 5 of this manual.

1. Ensure that the TEG has been running for at least one hour to stabilize.
2. Disconnect all customer load connections from terminals 2 and 4 of TB-1.
3. Connect a voltmeter across terminal 2 (+) and 4 (-) of TB-1.
4. Using a small flat blade screwdriver, adjust the Voltage Adjustment Screw on the 6720 Limiter until the voltmeter reads your desired output voltage.
5. Remove the voltmeter and reconnect your customer load connections.

8.2.2 VOLTAGE SENSING RELAY ADJUSTMENT

The user-adjustable Voltage Sensing Relay allows the customer to monitor the status of the Model 8550-SD TEG. When the VSR is de-energized, the Common (COM) terminal is connected to the Normally Closed (NC) contact. When the VSR becomes energized, the Common terminal is instead connected to the Normally Open (NO) contact.

From the factory, the Model 8550-SD TEG VSR will be set so that the VSR will energize when the power unit voltage climbs above 23 Volts. The VSR also incorporates approximately 0.5 Volts of hysteresis, meaning once the VSR is energized the voltage would need to drop 0.5 Volts below the energize threshold for it to de-energize (22.5 Volts factory default).

The VSR contacts can be easily used to generate Low-Voltage-Alarm or Voltage-Good signals for customer equipment with the factory default 23 Volt VSR setpoint. For example, a connection between the COM and NC terminals indicates the voltage is below standard operating voltage, indicating a Low-Voltage-Alarm. Conversely, if a connection is observed between the COM and NO terminals, then the voltage is confirmed to be above the VSR threshold, indicating a Voltage-Good status.

The VSR energize threshold can be adjusted with the following procedure:

1. Ensure the TEG has been running for at least an hour to stabilize.
2. Disconnect all customer load connections from terminals 2 and 4 of TB-1.
3. Connect a voltmeter across terminal 2 (+) and terminal 4 (-) of TB-1.
4. Connect a multimeter across the COM (+) and NC (-) terminals of the VSR & Control Board within the 6720 Limiter. Set the multimeter to measure continuity (or resistance).
5. Using a small flat blade screwdriver, adjust the Voltage Adjustment Screw on the 6720 Limiter until the voltmeter reads your desired VSR energizing voltage.
6. Carefully adjust the Voltage Sensing Relay Adjustment Screw on the 6720 Limiter until the VSR energizes, as evidenced by the multimeter detecting continuity (under 1 Ohm) between the COM & NC terminals. You want to stop turning the screw the moment continuity changes. If you overshoot by too much, adjust the screw in the opposite direction until the VSR deenergizes, then try again.
7. Re-adjust the Voltage Adjustment Screw to return the customer output voltage to its proper setpoint.
8. Remove both meters and reconnect your customer load connections.

8.3 SERVICE

The all-solid-state high-reliability design of the Voltage Limiter renders it nearly maintenance free. Check for the following during the annual maintenance:

1. Obstruction of air flow through the heat sink area.
2. Output voltage level is correct. Reset, if necessary. See Section 5.1.3.
3. Tighten the wire connections at input and output of the power conditioner. Look for oxidized high resistance contacts. If any exist, clean and re-tighten.

8.4 6720 VOLTAGE LIMITER PARTS LIST

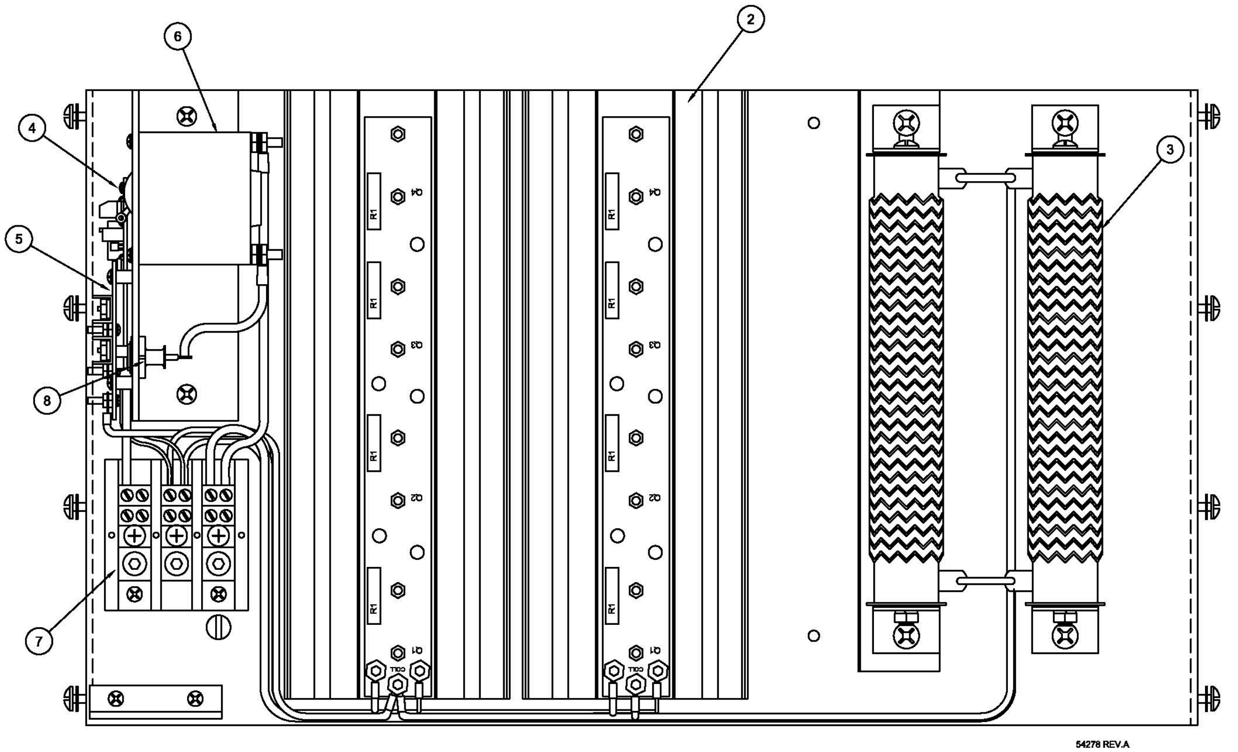

Figure 24 – 6720 Limiter Main Parts

Item	Part No.	Description
1	20184	Cover Assy, Limiter, 8550 (not shown, order separately)
2	3154	Heat Sink Assy
3	116	Resistor, 2 Ohm, 300 Watts, 10%
4	59056	Control & VSR Board, 24 Volt
5	61042	Driver Board
6	284	Circuit Breaker, 30 Amp
7	6714	Terminal Block, 3 Pole, Heavy Duty
8	2580	Output Diode

9 CATHODIC PROTECTION INTERFACE OPTION

The Cathodic Protection Interface System provides for easy adjustment and monitoring of power to a Cathodic Protection (CP) type load. The anode and cathode cables enter the cabinet at the bottom and connect directly to the heavy-duty terminal block. Refer to Figure 29 for locations and descriptions of the major components of the CP interface cabinet.

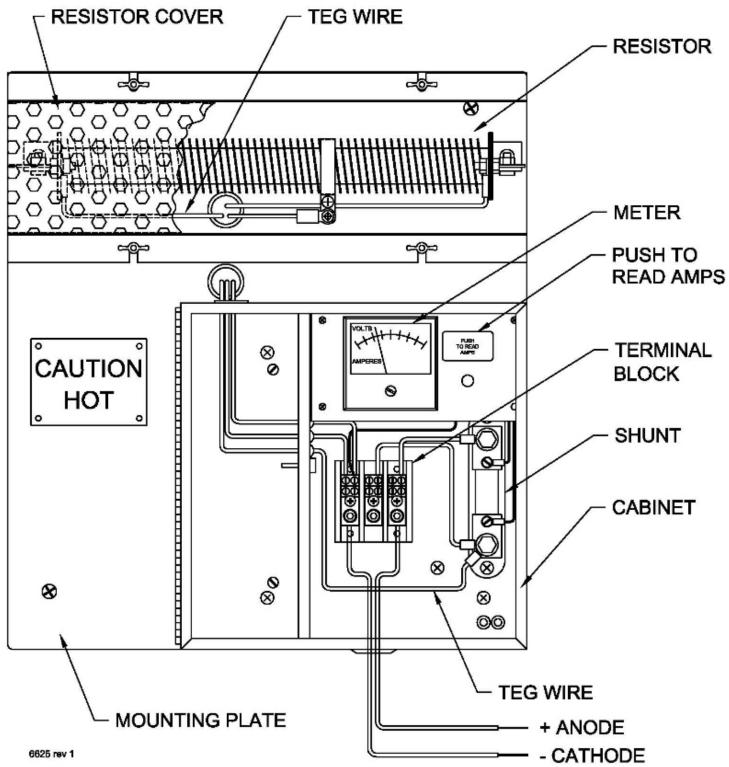

Figure 25 – Cathodic Protection Interface Panel

NOTE: **Do not allow current to the cathodic protection load to exceed 30 Amps as this will trip the circuit breaker.**

The Model CP8550-SD generator is not rated to supply more than 30 amps of current to the load. If total circuit resistance is less than 0.5 ohms then the 1000-watt variable resistor in the CP box should be wired in series with the circuit and adjusted so that current does not exceed 30 amps.

9.1 METER

The dual scale meter displays voltage at the terminal block, and current when the PUSH TO READ AMPS button is depressed. The meter is accurate to ±3% of full scale (50 mV) and is weatherproof.

9.2 CURRENT SHUNT

A shunt is used to measure the current to the terminal block. The voltage drop across the shunt is proportional to the current flowing through it. The current shunt is rated at 30 Amps = 50 mV.

9.3 ADJUSTMENT

A 0 to 1 ohm, 1000-Watt variable resistor located at the top of the CP panel may be used to adjust the output current of the CP interface. This resistor may be connected in series or parallel with the CP load based on site requirements. See Figure 30 for series connection and Figure 31 for parallel connection.

9.3.1 SERIES

The CP Interface panel is wired in Series configuration by default from the factory. By connecting the 1000-Watt resistor in series with the CP load, the maximum allowable power may be delivered to the CP load. This is achieved by moving the tap to the left side of the resistor. To reduce power to the CP load, slide the tap to the right.

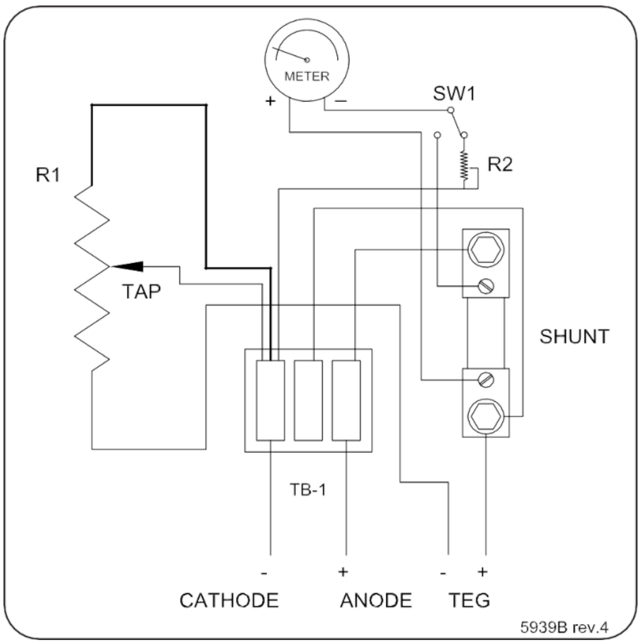

Figure 26 – Series Connection

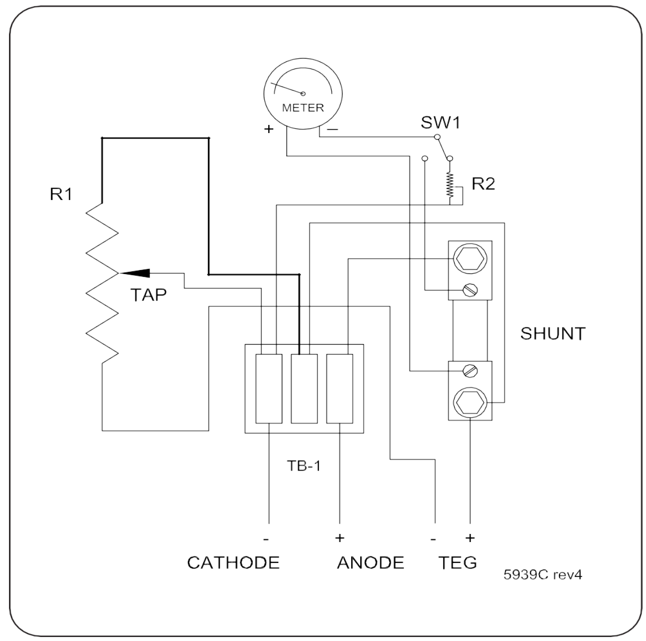

Figure 27 – Parallel Connection

9.3.2 PARALLEL

By connecting the 1000-Watt resistor parallel to the TEG, smaller levels of power may be delivered to the CP load. This is sometimes required to reduce hot spots on the anode. With the tap located at the right side of the resistor the output power will be zero. As the tap is moved to the left the power to the CP load is increased.

The change from series to parallel configuration is made by moving the wire coming from the right side of the 1000-Watt resistor, from the left position to the center position of the heavy-duty terminal block.

CAUTION!

For further information on Cathodic Protection applications, please contact Global Power Technologies

9.4 PARTS LIST – CATHODIC PROTECTION INTERFACE

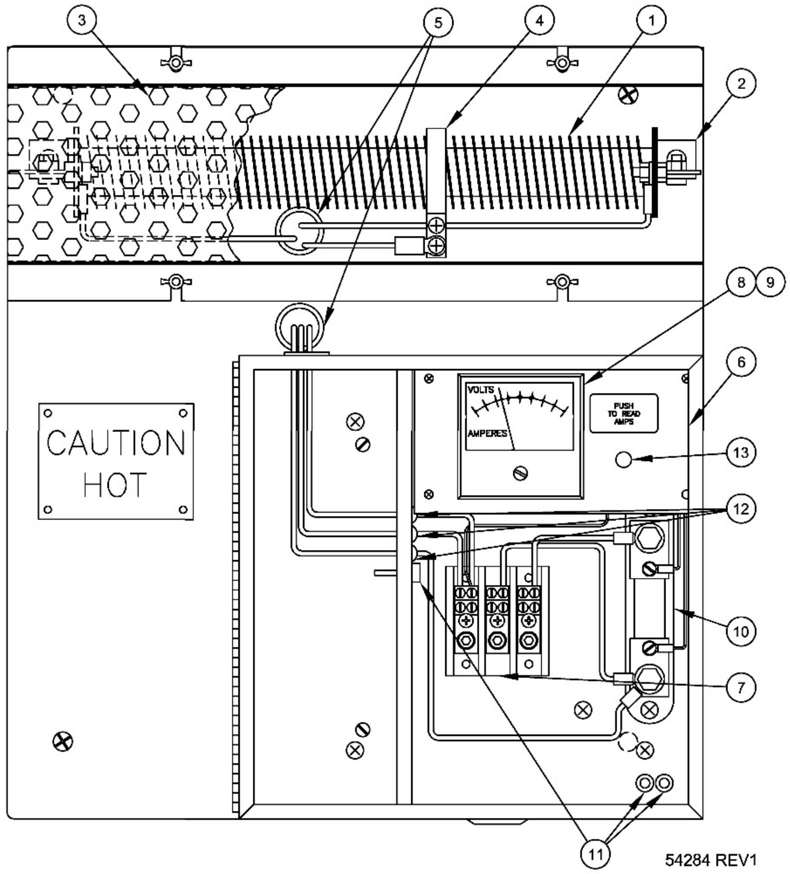

Figure 28 – Cathodic Protection Interface Assembly Parts

Item	Part No.	Description
1	6566	Resistor, 1 ohm, PFE5K1R00
2	21899	Mounting Bracket, Resistor
3	6594	Cover Assembly, Resistor
4	6608	Slide, Resistor
5	5014	Bushing, Universal, 1”
6	6634	Box, 8550 Cathodic Protection
7	6714	Terminal Block, Heavy Duty, 3 Pole
8	6226	Meter, 0-50 mV DC, 2.5” Custom Scale*
9	6221	Meter Face, 30V, 30A*
10	6217	Shunt, Type 766, 30 Amp, 50mV
11	3192	Plug, Bumper
12	23	Grommet, Rubber, 7/16”
13	2284	CP Meter Assembly

*Panel Meter (6226) comes with a blank face plate. Always order the Meter Face (6221) when replacing the Panel Meter.

APPENDIX A — WEIGHT, DIMENSIONS, AND ELECTRICAL SPECIFICATIONS

Figure 29 shows the Model 8550 TEG in its normal operating configuration. Physical size data is listed below.

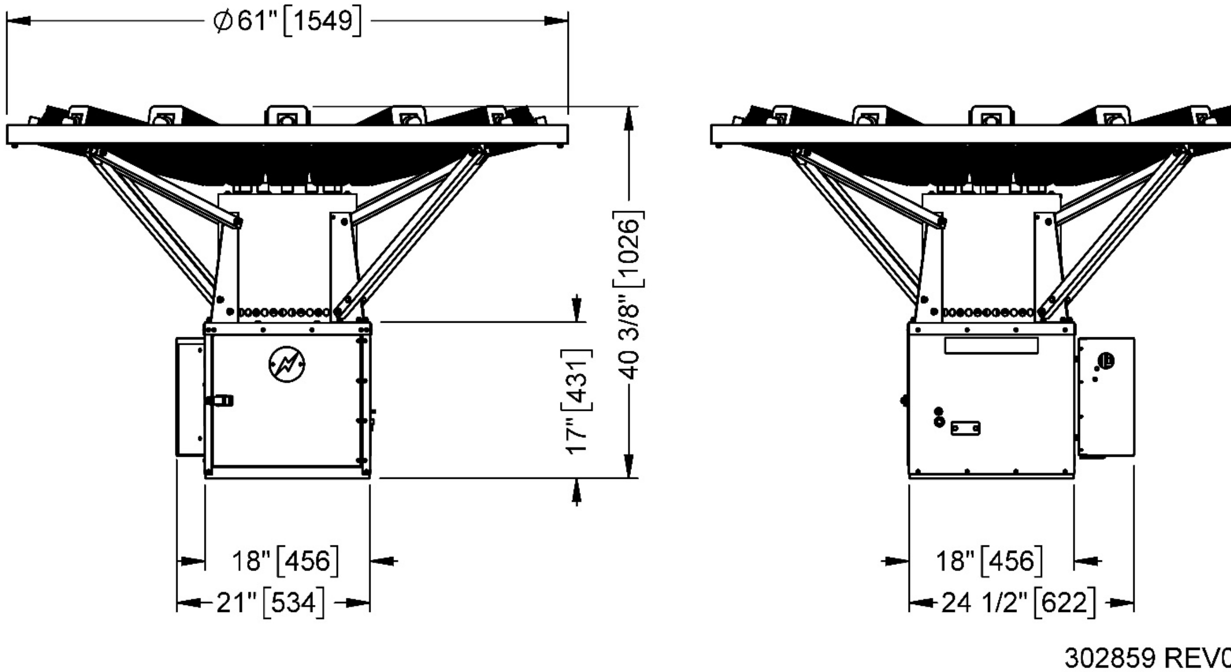

Figure 29 – Model 8550-SD TEG Dimensions

WEIGHT AND DIMENSIONS

Diameter of Top	61 in	155 cm
Overall Height	40 in	102 cm
Length of Lower Cabinet	18 in	46 cm
Width of Lower Cabinet	18 in	46 cm
Height of Lower Cabinet	17 in	44 cm
Weight (with Power Conditioner)	225 lb	102 kg

ELECTRICAL SPECIFICATIONS

Power Rating at 20°C
480 Watts @ 12 Volts
550 Watts @ 24 Volts
480 Watts @ 48 Volts

Output Adjustment Range		
12 Volt Models	=	11.4-12.6 Volts
24 Volt Models	=	24-30 Volts
48 Volt Models	=	47-57 Volts

APPENDIX B — PROCESS DESCRIPTION

A Thermoelectric Generator produces electrical power by directly converting heat energy to electrical energy with the use of thermocouples. A thermocouple is formed by a P type and an N type thermoelectric element joined electrically by a hot junction electrode. Adjacent thermocouples are joined electrically by cold junction electrodes.

Electrical power will continue to flow through the circuit as long as the temperature difference between the two ends of the thermocouple is maintained.

The Model 8550 Power Unit has a total of 325 thermocouples, each producing 87 mV at standard conditions, connected in series to produce 590 Watts at 28 Volts and 21 Amperes.

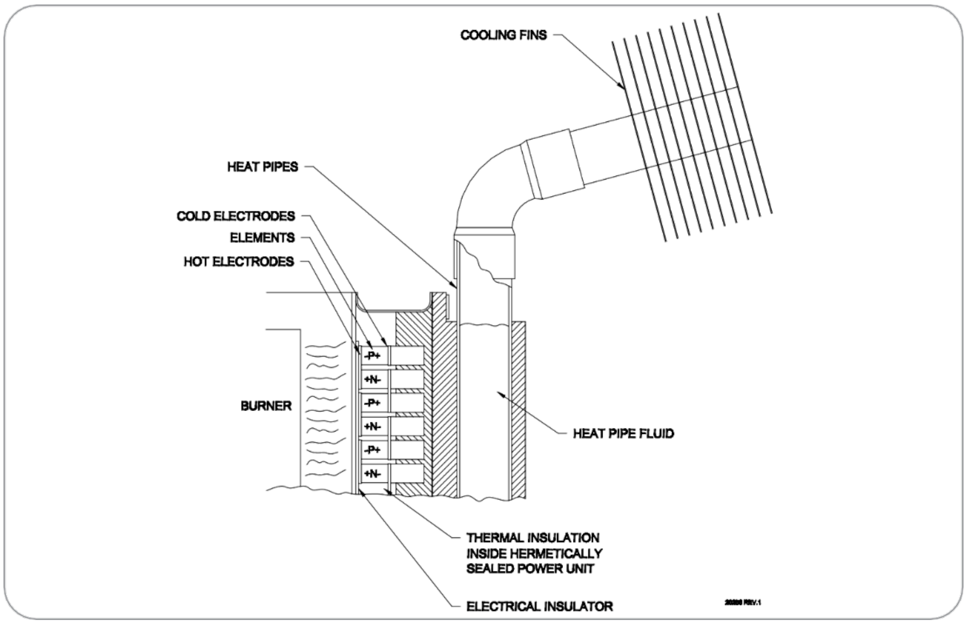

Figure 30 – Design Illustration

The hot junction of the thermocouples is maintained at 1000°F (538°C) or by a burner that operates on gaseous fuels. The burner operates at moderate fuel pressures, approximately 18 psi (124 kPa) for propane and 9 psi (62 kPa) for natural gas. The cold junction of the thermocouples is maintained at 235°F (163°C) by an array of heat pipes that transfer the heat to the ambient air.

The cold junction of the thermocouples is maintained at a lower temperature (163°C or 235°F) by an array of heat pipes that transfer the heat to the ambient air by natural convection. Each heat pipe is hermetically sealed and contains a measured amount of fluid in equilibrium with its vapour. As heat is applied to the fluid it, boils and then re-condenses in the condenser tube due to the cooling effect of the cooling fins. In this way, heat is efficiently transferred to the cooling fin.

The power unit must always be in a loaded condition. This is because under extended open circuit or high voltage conditions, the hot junction temperature may rise above the safe operating range. For this reason, the power unit must always remain connected to a power conditioner which will keep the power unit voltage within safe operating regions.

The temperature difference, and therefore the amount of power produced by the TEG, depends on both the rate at which fuel is supplied to the burner and the amount of cooling supplied by the ambient air. The operation of the TEG is controlled by the fuel pressure supplied to the burner.

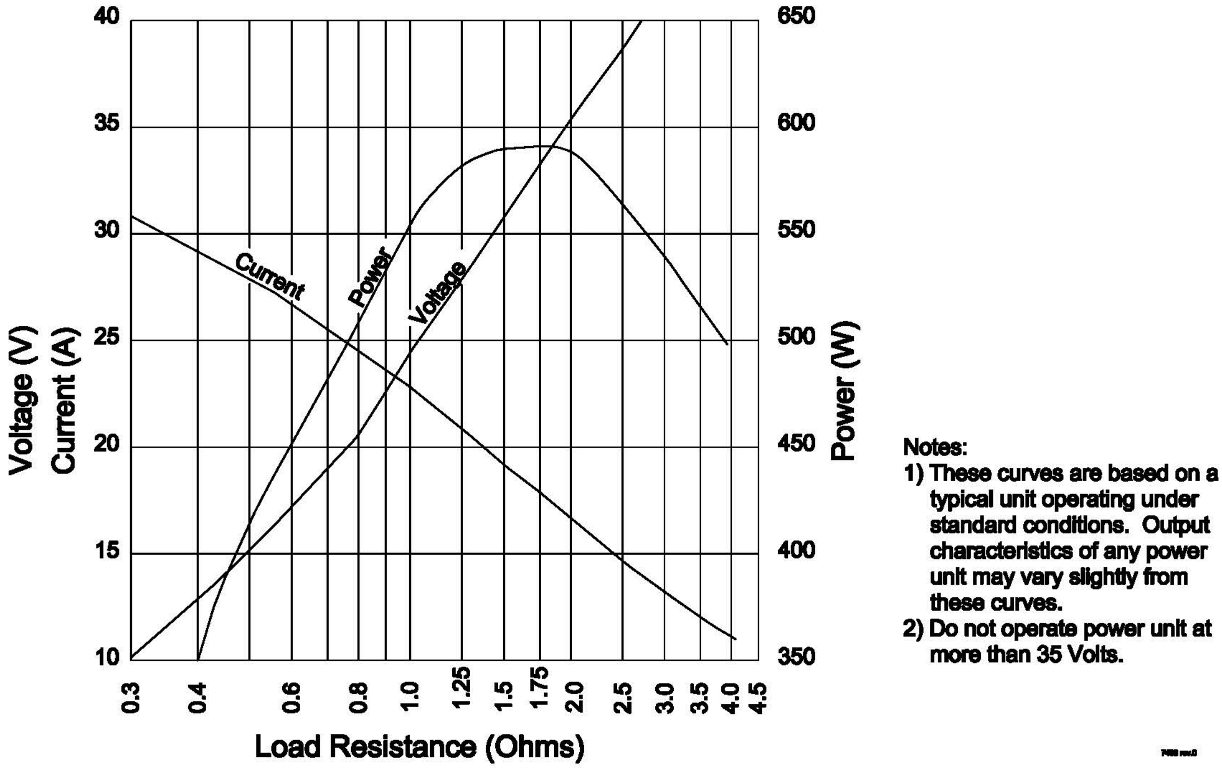

Figure 31 – Gross Power Unit Electrical Output Characteristics at 20°C, Beginning of Life (without Power Conditioner)

The typical gross electrical output of the Model 8550-TEG Power Unit at nominal ambient temperature is characterized in Figure 31. This figure demonstrates the importance of the Power Conditioner, which prevents the TEG from exceeding the customer voltage setpoint (user-adjustable with factory default of 27.1 Volts). This both ensures that the power unit operates within the optimal power region and that the maximum tolerable power unit voltage is not exceeded.

Operating voltages outside the nominal 24- to 30-Volt range are best achieved by connecting a DC-to-DC Converter to the output of the TEG. Nominal 12-Volt and 48-Volt DC-DC Converter options are available for the Model 8550-SD TEG. Consult GPT for assistance with finding the best system to suit your application.

The available power of a Model 8550-SD TEG is also a function of the amount of cooling supplied by the heat pipes, and this cooling is affected by both the ambient air temperature and the wind speed. The effect of wind will always be to increase the cooling effect, and therefore increase the available power. Refer to Section 5.1.1 for corrected air temperature for wind.

Whenever possible, set up and testing of the generator should be performed during periods of low wind, as these readings are generally more reliable than those using the wind speed corrections.

APPENDIX C — SYSTEM WIRING DIAGRAM

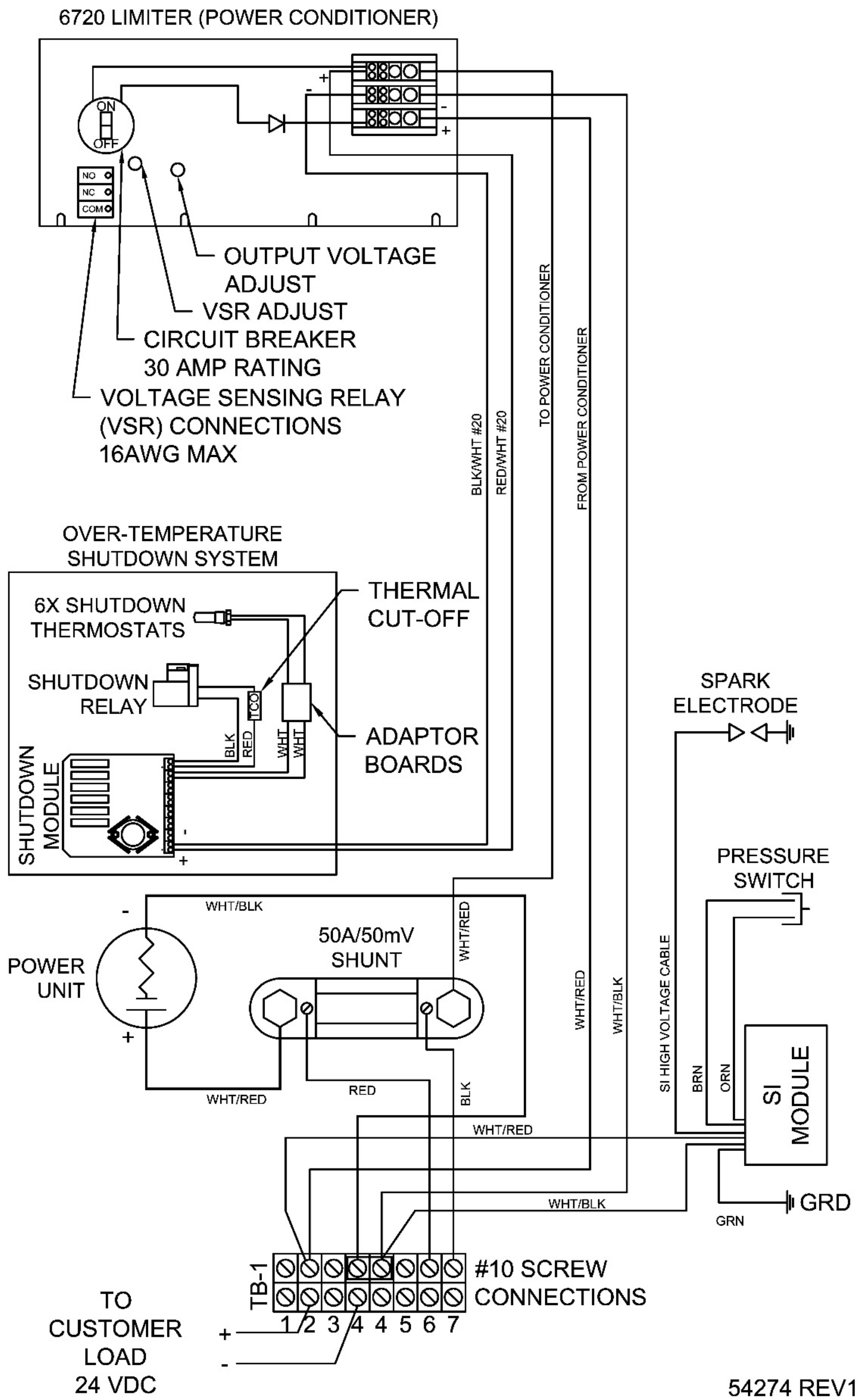

Figure 32 – Model 8550-SD TEG Wiring Diagram

8550 Thermoelectric Generator
Start-Up Data Sheet

Model #:	Serial #:	Fuel Type:

Start-Up By:	Date:
Ambient Temperature:	Ignition Fuel Pressure:
Corrected Air Temperature:	Operating Fuel Pressure:
Wind Speed:	Site Elevation
Set Power at Corrected Temperature:	Corrected Fuel Pressure for Elevation:

POWER LEVELS

Time		**Burner Fuel Pressure**	**Voltage (V)**	**Current (A)**	**Power (W)**
Start Time	*(Start)*				
	(15 minutes)				
	(30 minutes)				
	(40 minutes)				
	(50 minutes)				
	(60 minutes)				

Model 8550-SD TEG Performance Log

MODEL NO:	SERIAL NO:	FUEL TYPE:

Date	Time	Temperature (°C)	Wind Speed (km/h)	Corrected Temperature (°C)	Set Power (W)	Fuel Pressure (psi)	Voltage (V)	Current (A)	Power (W)	Remarks

Model 8550-SD TEG Performance Log

MODEL NO:	SERIAL NO:	FUEL TYPE:

Date	Time	Temperature (°C)	Wind Speed (km/h)	Corrected Temperature (°C)	Set Power (W)	Fuel Pressure (psi)	Voltage (V)	Current (A)	Power (W)	Remarks

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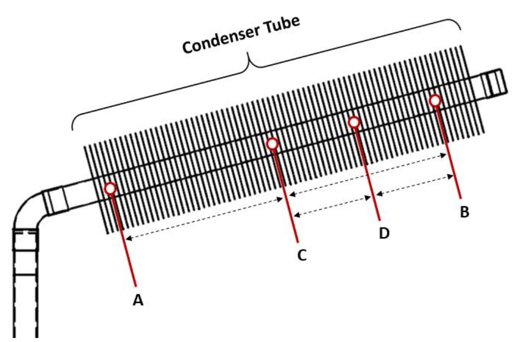
Heat Pipes Inspection Log

(Print a new copy for each inspection)

TEG Location:	Date:
Serial #:	Ambient Temperature:

Heat Pipe	**Hand Inspection***	**Detailed Inspection – see Section 3.5.2**						
	Heat Pipe Status	**Step 1**			**Step 2** (Only required as per Step 1)			
	P: Pass (No further inspection required) **F: Fail** (Proceed to Detailed Inspection)	T_A	T_B	$T_A - T_B$ **If** >20°C (36°F), go to Step 2 **If** <20°C (36°F), Good	T_C	T_D	$T_A - T_C$ **If** >20°C (36°F), Replace	$T_C - T_D$ **If** > 15°C (27°F), Replace
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

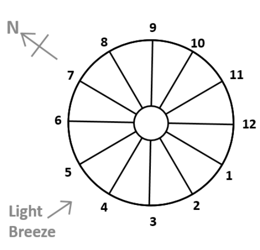
*Hand temperature inspection of Model 8550-SD TEG heat pipes is done to check that the heat pipe is warm, up to 2 inches (50 mm) from the tip.
If the inspection satisfies the hand inspection as per Section 3.5.1, the detailed inspection described in Section 3.5.2 is not required.

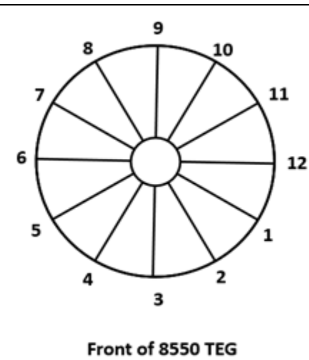


Heat Pipe Geographic Orientation Map and Wind Direction Diagram

Record the wind direction and geographic orientation of the TEG.

Example:





Notes:

Wind speed and direction:

(e.g., "light breeze from the west")