WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids near this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

• Do not try to light any appliance.
• Do not touch any electrical switch; do not use any phone in your building.
• Immediately call your gas supplier from a neighbour’s phone. Follow the gas supplier’s instructions.
• If you cannot reach your gas supplier, call the fire department.

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

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

WARNING: For Outdoor Use Only.
**AVERTISSEMENT:** Si l’information de ce manuel n’est pas suivie exactement, un incendie ou une explosion peut résulter entraînant des dégâts matériels, des blessures ou la perte de vie.

Ne pas entreposer ou utiliser de l’essence, d’autres liquides ou vapeurs inflammables à proximité de cet appareil ou d’aucun autre appareil.

**QUE FAIRE SI VOUS SENTEZ LE GAZ:**

- N’allumez aucun appareil.
- Ne touchez aucun commutateur électrique; n’utilisez pas le téléphone de votre bâtiment.
- Appelez immédiatement votre fournisseur de gaz d’un téléphone dans un bâtiment voisin, si possible. Suivez les instructions du fournisseur de gaz.
- Si vous ne pouvez pas atteindre votre fournisseur de gaz, appelez le service d’incendie.

L'installation et le service doivent être effectués par un installateur qualifié, une agence de service ou le fournisseur de gaz.

**AVERTISSEMENT:** L’installation inexacte, l’ajustement, le changement, le service ou l’entretien peuvent causer des dommages ou des dégâts matériels. Lisez les instructions d’installation, d’opération et d’entretien complètement avant d’installer ou entretenir cet équipement.

**AVERTISSEMENT:** Pour l’Usage Extérieur Seulement.
P-5100 THERMOELECTRIC GENERATOR
Operating Manual

NOTICE TO INSTALLER: These instructions shall be left with the consumer to retain them for future reference.
TABLE OF CONTENTS

1 ABOUT THIS MANUAL ............................................................................................................. 1
  1.1 HEALTH AND SAFETY .................................................................................................... 1
  1.2 TECHNICAL TERMS ....................................................................................................... 1
2 QUICK START PROCEDURE ................................................................................................. 3
  2.1 INSTALLATION .............................................................................................................. 3
  2.2 START UP ..................................................................................................................... 3
  2.3 ADJUSTMENT ............................................................................................................... 4
  2.4 PERFORMANCE LOG ................................................................................................... 4
3 TECHNICAL SPECIFICATIONS .......................................................................................... 5
  3.1 OVERVIEW .................................................................................................................... 5
  3.2 OPTIONS ....................................................................................................................... 5
  3.3 WEIGHTS AND MEASURES ........................................................................................ 7
  3.4 SYSTEM ......................................................................................................................... 8
  3.5 DATA PLATE .................................................................................................................. 8
  3.6 FUEL CONSUMPTION .................................................................................................. 9
  3.7 STANDARD SPECIFICATION FOR GASEOUS FUEL .................................................... 10
4 PROCESS DESCRIPTION ..................................................................................................... 11
  4.1 MODEL P-5100 THERMOELECTRIC GENERATOR ......................................................... 11
  4.2 CONVERTER LIMITER .................................................................................................. 16
  4.3 TEMPERATURE COMPENSATION .............................................................................. 17
  4.4 BLOCKING DIODE ....................................................................................................... 18
  4.5 OPTIONAL CATHODIC PROTECTION INTERFACE SYSTEM ........................................ 19
  4.6 OPTIONAL REMOTE START SYSTEM (TEG CONTROLLER BOARD) ............................ 19
  4.7 INTAKE AND EXHAUST FLAME ARRESTORS ............................................................. 23
  4.8 OPTIONAL VSR TERMINAL BLOCK ........................................................................... 24
5 INSTALLATION .................................................................................................................. 25
  5.1 PRECAUTIONS .............................................................................................................. 25
  5.2 TOOLS REQUIRED ...................................................................................................... 25
  5.3 UNPACKING ................................................................................................................ 26
  5.4 ASSEMBLING ............................................................................................................... 26
  5.5 MOUNTING .................................................................................................................. 27
  5.6 SUPPLYING FUEL ...................................................................................................... 28
  5.7 CONNECTING CUSTOMER LOAD ............................................................................... 30
  5.8 INSTALLATION OF OPTIONAL CP INTERFACE SYSTEM ........................................... 32
6 STARTUP AND SHUTDOWN ................................................................................................. 34
  6.1 BEFORE STARTING ...................................................................................................... 34
  6.2 TEG START-UP ............................................................................................................ 34
### TABLE OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall Dimensions of the P-5100 TEG</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Data Plate</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>P-5100 TEG General Assembly</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>P-5100 Fuel System General Assembly</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Burner General Assembly</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Model P-5100 Power Unit Electrical Output Characteristics</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>C/L General Assembly</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>CP Interface System General Assembly</td>
<td>18</td>
</tr>
<tr>
<td>9</td>
<td>TEG Controller Assembly</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>Assembling the P-5100 TEG</td>
<td>26</td>
</tr>
<tr>
<td>11</td>
<td>Model P-5100 Mounting Dimensions</td>
<td>27</td>
</tr>
<tr>
<td>12</td>
<td>Applying Thread Sealant</td>
<td>28</td>
</tr>
<tr>
<td>13</td>
<td>Setting up the P-5100 TEG</td>
<td>29</td>
</tr>
<tr>
<td>14</td>
<td>Wiring Diagram P-5100 for 12 or 24 V</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>Wiring Diagram P-5100 TEG for 12 or 24V with optional TEG Controller</td>
<td>31</td>
</tr>
<tr>
<td>16</td>
<td>Customer Load Connections</td>
<td>32</td>
</tr>
<tr>
<td>17</td>
<td>CP Installation</td>
<td>33</td>
</tr>
<tr>
<td>18</td>
<td>$V_{set}$ and Setup Power Versus Ambient Temperature</td>
<td>37</td>
</tr>
<tr>
<td>19</td>
<td>$V_{set}$ Versus Time After Ignition, Typical Response</td>
<td>38</td>
</tr>
<tr>
<td>20</td>
<td>Change in Fuel Gauge Pressure Versus Elevation Above Mean Sea Level</td>
<td>40</td>
</tr>
<tr>
<td>21</td>
<td>Change in $V_{set}$ Versus Air-Shutter Adjustment</td>
<td>41</td>
</tr>
<tr>
<td>22</td>
<td>Change in $V_{set}$ Versus Fuel Pressure Adjustment</td>
<td>44</td>
</tr>
<tr>
<td>23</td>
<td>CP Interface System, Series Wiring Diagram</td>
<td>47</td>
</tr>
<tr>
<td>24</td>
<td>CP Interface System, Parallel Wiring Diagram</td>
<td>47</td>
</tr>
<tr>
<td>25</td>
<td>Pressure Regulator</td>
<td>52</td>
</tr>
<tr>
<td>26</td>
<td>Burner Assembly Cross Section</td>
<td>55</td>
</tr>
<tr>
<td>27</td>
<td>Electrode Protrusion from Air Box Lid</td>
<td>58</td>
</tr>
<tr>
<td>28</td>
<td>Momentary Open Circuit Diagram</td>
<td>61</td>
</tr>
<tr>
<td>29</td>
<td>Model P-5100 TEG</td>
<td>66</td>
</tr>
<tr>
<td>30</td>
<td>Model P-5100 Burner</td>
<td>69</td>
</tr>
<tr>
<td>31</td>
<td>Model P-5100 Fuel System</td>
<td>71</td>
</tr>
<tr>
<td>32</td>
<td>Model P-5100 SS Fuel System</td>
<td>72</td>
</tr>
<tr>
<td>33</td>
<td>Model P-5100 Electrical</td>
<td>74</td>
</tr>
<tr>
<td>34</td>
<td>Cathodic Protection Interface Cabinet</td>
<td>76</td>
</tr>
<tr>
<td>35</td>
<td>CP Interface System, Series Wiring Diagram</td>
<td>77</td>
</tr>
<tr>
<td>36</td>
<td>CP Interface System, Parallel Wiring Diagram</td>
<td>78</td>
</tr>
<tr>
<td>37</td>
<td>Cathodic Protection System Parts Identification</td>
<td>79</td>
</tr>
<tr>
<td>38</td>
<td>Parts Table</td>
<td>80</td>
</tr>
<tr>
<td>39</td>
<td>HRS Option Overview</td>
<td>82</td>
</tr>
<tr>
<td>40</td>
<td>HRS Configuration</td>
<td>83</td>
</tr>
<tr>
<td>41</td>
<td>Model P-5100 HRS, Burner</td>
<td>84</td>
</tr>
</tbody>
</table>
1 ABOUT THIS MANUAL

This manual provides instructions for the operation and maintenance of the model P-5100 Thermoelectric generator.

1.1 HEALTH AND SAFETY

Correct operation and maintenance according to this manual is critical for proper equipment function and safety. Keep the following in mind when using these instructions.

1.1.1 Warnings

Throughout this manual you will notice paragraphs preceded by the text Warning. It is imperative that the advice in these paragraphs be adhered to, as failure to do so may result in personal injury or death and possible damage to the equipment.

1.1.2 Cautions

Throughout this manual you will notice paragraphs preceded by the text Caution. It is imperative that the advice in these paragraphs be adhered to, as failure to do so may result in damage to the equipment.

1.1.3 Trained Operators

Personnel performing installation, operation, and maintenance work should be properly trained in such functions.

1.2 TECHNICAL TERMS

An operator should be familiar with technical terminology. Terms of particular significance, defined for the model P-5100, are as follows:

Thermoelectric Generator (TEG): A device that produces electrical power through the direct conversion of heat energy to electrical energy.

Power Unit (PU): The hermetically sealed portion of the TEG that contains the thermoelectric materials and cooling fins.

Rated Power: Model P-5100 TEG produces 100 W when operating in an ambient temperature of 20°C (68°F). With the fuel flow held constant TEGs operating in ambient temperatures higher than 20°C (68°F) will see power output efficiency reduce, 0.4 W per °C (0.2 W per °F) of temperature change up to a maximum ambient temperature of 55°C (130°F). Conversely for temperatures lower than 20°C (68°F) power output efficiency will increase by 0.4 W per °C (0.2 W per °F) of temperature change.

Set-up Power: Power from the power unit for a specific ambient temperature. It is derived from voltage across a precision load, also known as $V_{set}$. 
**Set-up Voltage:** $V_{\text{set}}$ Voltage from the power unit for a specific ambient temperature, which is proportional to set-up power. Fuel flow to the burner is adjusted so that proper voltage exists, necessary temperature difference within the power unit maintained, to deliver required power.

**Open Circuit Voltage:** Voltage at the terminals of the power unit when no current is flowing, i.e. open circuit, which is related to the temperature across the thermoelectric materials inside the power unit.

When a power unit lead is suddenly disconnected, breaking the circuit to the load, the voltage measured across the power unit leaps up to a new value. This is known as the momentary open circuit voltage ($V_{oc}$).

**Measured $V_{\text{set}}$:** $V_{\text{set}}$ measured across the precision load on the output of the electronics without a customer load connected using a voltmeter.

**Required $V_{\text{set}}$:** $V_{\text{set}}$ needed to achieve rated power for the present ambient temperature.

**CP (Cathodic Protection):** Thermoelectric generators are used in impressed current systems for Cathodic corrosion protection of metallic structures such as pipelines.

**CP Interface System:** An assembly of electrical components system that acts as an interface between the TEG and the CP load, which also provides for adjustment and monitoring of power to the CP load.

**Converter/Limiter (C/L):** A specific electronic device attached between the generator and the load that converts one level of DC voltage to another and limits the power unit voltage.

**Manual Shutoff Valve:** A manually operated valve in the gas line for completely turning on or shutting off the gas supply to the TEG.

**Solenoid Valve (SV):** A electrically actuated valve that controls the gas supply to the burner. This Valve is operated by the Ignition Control Module.
2 QUICK START PROCEDURE

This section gives the key steps for setting up the TEG. It is for the operator who is already familiar with operating the TEG, having successfully completed Gentherm Global Power Technologies (GPT) TEG training course, and being a qualified service person with reasonable knowledge and experience with industrial fuel and electrical equipment.

2.1 INSTALLATION

Follow these steps to install the TEG:

1. Unpack the TEG from its shipping crate, keep the crate until the TEG is operational. Locate and identify the following items that were shipped with the P-5100 TEG:
   - 1 Fin Duct.
   - 1 Rain Cap.
   - 1 Exhaust Stack with Clamp.
   - 1 Thread Sealing Compound.
   - 7 Screws, #8 32 × 1/4 in. long, one spare.
   - 7 Washers, #8 External Lock, one spare.

   **NOTE:** Inspect the TEG for damage that may have occurred during shipping. Please report any damage as soon as possible as it may make the generator inoperable. Check with the factory before starting a damaged TEG.

2. Assemble the TEG as shown in Figure 3 and mount it on a firm and stable base, sufficiently high above ground level to prevent the TEG from being inundated with water.

3. Connect the fuel supply to the manual shutoff valve, 1/4” FNPT, using the thread sealant provided. Leak check the complete fuel supply system from the fuel supply line to the burner inlet using a commercial leak detector fluid such as Snoop®.

4. Connect the customer load:
   - connect the load to terminals 7 (+) and 8 (-);
   - C/L for CP applications connect the cathode and anode wires to the external CP interface box.

2.2 START UP

Follow these steps to start the TEG:

1. Ensure the battery is connected.
2. Open the manual shutoff valve.

**NOTE:** Once the TEG is started re-closing the manual shutoff valve will shut it off.
3. If the optional TEG controller board is installed, press the Start (S1) button or send a SCADA Start signal to the TEG controller board.

**NOTE:** Once the TEG is started pressing the Stop (S2) button or sending a SCADA Stop signal to the TEG controller board will stop it.

4. The Spark Ignition (SI) system should begin clicking after one second and the sound of combustion heard within 7 seconds. If the burner does not ignite wait 25 seconds for a second or third ignition trial. After a third trial the ignition control system will go into lockout mode.

**WARNING!** When the TEG is operating, surface temperatures near the thermopile, burner, exhaust stack and around the cooling fin duct may be more than 100°C. Avoid contact of skin and clothing with these areas when operating in and around the TEG.

### 2.3 ADJUSTMENT

Follow these steps to adjust the TEG:

1. Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.
2. Measure the $V_{set}$ voltage between terminals 5 (+) and 6 (-).
3. Check the measured $V_{set}$ value rises to that required, as per Power Output Evaluation section. Measured $V_{set}$ will level off after 1-hour from ignition. If the measured value is not in its normal operating range, then adjust the power output as per the Adjustment section.

**CAUTION!** Do not allow measured $V_{set}$ to exceed required $V_{set}$, determined in the Power Output Evaluation section, otherwise overheating may cause irreparable damage to the power unit.

**NOTE:** Details for adjusting the optional L/C and CP interface systems, if applicable, are in the Adjustment section.

### 2.4 PERFORMANCE LOG

Your TEG is now operating successfully, making available continuous electrical power to the load. It is recommended that a record be kept of the TEG’s performance and maintenance history. Each time adjustments are made, or servicing is carried out the details should be recorded. A blank TEG Performance Log is provided at the end of this manual.
3 TECHNICAL SPECIFICATIONS

This section gives the technical specifications for the Model P-5100 Thermoelectric generator.

3.1 OVERVIEW

The Model P-5100 Thermoelectric Generator (TEG) converts heat directly into electricity with no moving parts. It is a reliable, low maintenance source of DC electrical power for any application where regular utilities are unavailable or unreliable.

The Model P-5100 Thermoelectric Generator provides 127 Watts of electrical power from the power unit at the beginning of life and at an ambient temperature of 20ºC. This power is generated at a nominal 6 Volts, which can then be converted to other voltages using the voltage converter. The converter is 83% efficient which provides 104 Watts of net electrical power with a 12 Volt/24 Volt converter.

If the generator is to be operated at load conditions that force the output voltage to vary significantly from 5.5 Volts, then less than the rated power will be available to the load.

3.2 OPTIONS

**Mounting Stand**: The P-5100 can be conveniently mounted on any platform with four holes spaced as shown in Figure 11. It is important to mount the TEG at a height sufficient to prevent direct flooding or heavy snowfall from interfering with the flow of cooling air. A mounting stand is available from GPT.

**Cathodic Protection Interface (CP)**: The Cathodic Protection Interface option provides a termination point of cathode and anode cables up to 9 mm (00 AWG) in size, a meter to monitor the voltage and current of the CP circuit and an adjustable resistor to control the output power.

**Remote Start System (TEG Controller Board)**: The Remote Start option provides a method of starting and stopping the TEG either locally or remotely, using on-board buttons, SCADA signal interface or system measurements.

**Optional VSR Terminal Block**: The optional VSR terminal block is an additional wiring harness that provides the VSR and current measurement connection on a terminal block inside the TEG Cabinet as opposed to directly connecting to the electronic circuit board.

---

**NOTE**: Specifications shown are for standard configurations. Gentherm Global Power Technologies’ Integrated Systems Engineering Department is available to design installations meeting different specifications including custom voltages, fuel supply systems and nonstandard operating temperatures.
## Power output

| Power Ratings at the beginning of life, 20º C, 750 m above sea level available at the terminal strip including reverse current diode. | 100 Watts @ 14.1 Volts  
100 Watts @ 28 Volts |

## Electrical

| Adjustment | 12 V 12–18 Volts  
24 V 24-30 Volts |
| Reverse Current Protection | Yes, diode board is standard. |
| Output | Terminal block which accepts up to 8 AWG wire. Opening for 3/4” conduit in the base of the cabinet |

## Fuel

| Natural Gas | 9.4 m³/day (332 ft³/day) of Std. 1000 BTU / SCF (37.7 MJ/Sm³) gas |
| High BTU Natural Gas | 6.3 m³/day (222 ft³/day) of 1500 BTU / SCF (56.5 MJ/Sm³) gas  
7.8 m³/day (277 ft³/day) of 1200 BTU / SCF (45.2 MJ/Sm³) gas |
| Propane | 13.8 L/day (3.6 gal/day) |
| Maximum Supply Pressure | 344 kPa (50 psig) |
| Minimum Supply Pressure | 103 kPa (15 psig) |
| Fuel Connection | 1/4” MNPT |

## Environmental

| Ambient Operating Temperature Continuously Running TEG | Max. 55º C (130º F) Min. -40º C (-40 ºF) |

## Operating Conditions

| Unsheltered Operation |

## Materials of Construction

| Cabinet | 304 Stainless Steel |
| Cooling Type | Natural Convection |
| Burner | Meeker type, Inconel 600 |
| Fuel System | Brass, Aluminum & Stainless Steel |
3.3 WEIGHTS AND MEASURES

The following table gives the overall dimensions and weights of the TEG.

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>790 mm (31.11 in.)</td>
</tr>
<tr>
<td>Width</td>
<td>309 mm (12.17 in.)</td>
</tr>
<tr>
<td>Height</td>
<td>991 mm (39.12 in.)</td>
</tr>
<tr>
<td>Net Weight</td>
<td>60 kg (132 lb.)</td>
</tr>
<tr>
<td>Shipping Weight</td>
<td>83 kg (183 lb.)</td>
</tr>
<tr>
<td>Mounting Holes</td>
<td>267 mm wide × 457 mm deep (10.50 in. × 18.00 in.)</td>
</tr>
<tr>
<td>Mounting Hole Diameter</td>
<td>790 mm (31.11 in.)</td>
</tr>
</tbody>
</table>

*Figure 1 – Overall Dimensions of the P-5100 TEG*
### 3.4 SYSTEM

The following table gives the technical specifications for the SI system.

<table>
<thead>
<tr>
<th>Electrical SI Power Supply</th>
<th>Input Voltage</th>
<th>Minimum 5.5 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum 35.0 V DC</td>
</tr>
<tr>
<td>Power Input</td>
<td>8 Watts</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>14.0 VDC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SI</th>
<th>Spark Rate</th>
<th>10/second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial for Ignition</td>
<td>7 seconds</td>
<td></td>
</tr>
<tr>
<td>Number of tries for Ignition</td>
<td>3 trials until lockout</td>
<td></td>
</tr>
<tr>
<td>Inter-Purge Time</td>
<td>10 seconds</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spark Gap</th>
<th>Nominal</th>
<th>4.8 mm (0.19 in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>3.3 mm (0.13 in.)</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>6.3 mm (0.25 in.)</td>
<td></td>
</tr>
</tbody>
</table>

| Continuous Operating Time Without Charge | 120 minutes with full charged 6V, 5 Ah batteries @ 25ºC (75ºF) |

### 3.5 DATA PLATE

The data plate is on the inside of the cabinet door and includes vital information about the generator.

**Model Number:** The model number on the Data Plate is interpreted as follows:

![Model Number Interpretation]

**Fuel Type:**
- L = Propane
- N = Natural Gas
- H = High BTU Natural Gas

**Output Voltage:**
- 12 or 24 Volts

**SS = Stainless Steel Fuel System**

**CP = Cathodic Protection Interface**

**RS = Remote Start**
**Fuel Type:** an “X” will be marked in the appropriate box to show whether the generator is set to burn natural gas (CH\(_4\)) or propane (C\(_3\)H\(_8\)). Suitable orifices are available if changing the fuel type is necessary.

**Fuel Pressure, Power, Voltage:** The fuel pressure, gross power output and voltage across the precision load have been included for reference only. These are the conditions achieved at the Gentherm Global Power Technologies (GPT) factory before shipping. Note that the fuel pressure is recorded in kPa and that the pressure gauge must be adjusted for the altitude.

![Data Plate](image)

**Figure 2 - Data Plate**

### 3.6 FUEL CONSUMPTION

The P-5100 is certified to operate on commercial propane, or natural gas as described in the table below. The Fuel Consumption of the P-5100 at rated power is listed in the table below for various Fuels.

<table>
<thead>
<tr>
<th>Fuel Consumption at Rated Power</th>
<th>Propane*</th>
<th>Natural Gas**</th>
<th>High BTU Natural Gas***</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb./hr</td>
<td>0.64</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>gal/hr</td>
<td>0.15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>kg/hr</td>
<td>0.29</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L/hr</td>
<td>0.57</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ft(^3)/hr</td>
<td>5.45</td>
<td>13.8</td>
<td>9.2 – 11.5</td>
</tr>
<tr>
<td>m(^3)/hr</td>
<td>0.154</td>
<td>0.392</td>
<td>0.261 – 0.327</td>
</tr>
</tbody>
</table>
** At 20°C (68°F)
** At atmospheric pressure and 20°C (68°F), assuming an energy content of 37.3 MJ/m³ or 1000 BTU/ft³
*** At atmospheric pressure and 20°C (68°F), assuming an energy content of 45.2 - 56.5 MJ/m³ or 1200 - 1500 BTU/ft³

3.7 STANDARD SPECIFICATION FOR GASEOUS FUEL

1. Shall not contain any particulates larger than 30 μm diameter, including but not limited to sand, dust, gums, crude oil, and impurities.
2. Shall not have a hydrocarbon dew point more than 0°C (32°F) at 170 kPag (25 psig).
3. Shall not contain more than 115 mg/Sm³ (approx. 170 ppm) of H2S.
4. Shall not contain more than 60 mg/Sm³ (approx. 88 pmm) of Mercaptan Sulphur.
5. Shall not contain more than 200 mg/Sm³ (approx. 294 ppm) of total Sulphur.
6. Shall not contain more than 10% [CO2] and/or [N2] by volume, nor vary more than +/- 1% [CO2] and/or [N2] 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 gross heating value of:
   a) Natural Gas: 37 MJ/Sm³ (1000 BTU/cu. ft).
   b) High BTU Natural Gas: 45.2 – 56.5 MJ/Sm³ (1200 - 1500 BTU/cu. ft).
   c) Propane/LPG: 93 MJ/Sm³ (2500 BTU/cu. ft).
10. Shall not exceed 60°C (140°F) in temperature.
4 PROCESS DESCRIPTION

This section describes the function of the equipment, the process of generating power and available options.

4.1 MODEL P-5100 THERMOELECTRIC GENERATOR

The TEG generates electrical power from heat energy. The overall process is:

1. Provide fuel, mix it with air and ignite making heat available.
2. Warm the hot-end of a thermoelectric power unit using the available heat of combustion.
3. Cool the cold-end of the thermoelectric power unit using cooling fins.
4. Generate electrical power from the temperature difference created across thermoelectric materials housed within the power unit.
5. Make the electrical power available to the load.

The main parts of the model P-5100 TEG, with CP attached, are shown in Figure 3.

Figure 3 - P-5100 TEG General Assembly
4.1.1 Fuel System

Components making up the fuel system control the input of fuel to the burner. The primary control is a pressure regulator that modulates fuel manifold pressure to a metering orifice. The pressure regulator includes a sediment bowl with a manual drain cock and fuel filter to remove fuel impurities. The fuel filter has a resin impregnated cellulose element which prevents solid particles from damaging the regulator and downstream parts.

The outlet of the pressure regulator leads to a manifold on which is mounted a pressure gauge to monitor the fuel pressure, and a pressure switch for the SI module. The fuel flows through the manifold to the fuel line which connects to an orifice mounted on the front of the burner. The orifice contains a jewel with a precisely sized hole to meter the fuel flow into the burner. A solenoid valve (SV) is plumbed between the manifold and fuel line.

The solenoid valve is controlled by the Ignition Control System. The Ignition Control System opens the solenoid valve when the fuel pressure switch is Closed (fuel pressure is present) and closes the solenoid valve when fuel pressure switch is open (no fuel pressure) or the Ignition Control System does not detect combustion.

An optional NACE compliant stainless-steel fuel system is available as an option.
4.1.2 Spark Ignition Control System

The Ignition Control System consists of the following parts:

- Spark electrode
- Pressure switch
- Ignition control module (SI)
- Solenoid valve
- SI Power Supply
- Battery pack

When the manual ball valve is opened, fuel pressure causes the pressure switch (located in the fuel system) to close. The pressure switch is connected to the SI Controller’s ignition request input. If the optional TEG Controller board is installed, the pressure switch is connected to it instead of directly to the SI Controller board. The TEG Controller board sends the ignition request to the SI Controller board when the TEG is to be started. This causes the SI Controller board to power the SI module, indicated by the SI power indicator being on. When the SI module is powered and in combination with the absence of flame sensed at the spark electrode, the ignition control module (SI) generates sparks from the electrode to the combustion chamber plate, as well as opens the solenoid valve allowing gas to flow into the burner chamber, causing ignition to occur. Once combustion is detected, the SI will stop sparking and the SI will continue to monitor the presence of flame at the electrode. If the SI did not detect combustion for a period of 7 seconds, it will stop sparking and close the solenoid valve, wait for a 10 second purge period and then make another attempt at ignition.

The SI will attempt 3 ignition trials and if flame detection cannot be maintained, the SI will go into Lockout mode. The Lockout light on the SI Controller board will turn on and the SI will be powered down. The SI Controller board will have to be reset for another attempt at ignition, resetting the SI Controller board. The SI Controller board consumes more power when it is locked out than when it is waiting to start.

**NOTE:**

The certified Ignition Control Module (SI) is responsible for the ignition sequence and control of the fuel valve and spark generation.

**NOTE:**

The combustion control system contains a single 6V, 5.0 amp-hour monobloc rechargeable battery and a constant potential battery charger. A new fully charged battery provides approximately 120 minutes of operating time at 25°C. The SI Controller switches from battery voltage to generator power unit voltage after the output voltage exceeds 10 VDC. Completely discharged batteries will take approximately 20 hours TEG operation to regain 100% charge as long as the output load is not overloading the TEG.
4.1.2.1 Resetting the SI Controller Board

1. To reset the SI controller board, wait 10 seconds after the red light turns on, then press the on-board reset switch. If the pressure switch is still closed, the SI controller board will energize the SI and the SI will begin another three start trials.

2. If the optional TEG Controller board is installed;
   Press the Reset (S3) or send a SCADA Reset signal to the TEG Controller board.

4.1.3 Burner

The burner conveys gas from the fuel system, mixes it with air and transports the mixture to the combustion zone. Air passes through a flame arrestor, screening out insects and dust, and then through a venturi and air-shutter assembly allowing for adjustment of the air/fuel mixture. This mixture leaves the venturi and passes through a burner screen that anchors the flame. Combustion chamber format enables the uniform heating of the power unit hot-end. The main parts of the burner are shown in Figure 5.

![Burner General Assembly](image)

*Figure 5 – Burner General Assembly*

4.1.4 Power Unit

The power unit generates electric power from the direct conversion of heat energy into electrical energy. A temperature difference maintained across the power unit effects voltage, and power output. A burner maintains the hot side at a temperature of around 538°C (1000°F). Cooling fins, which transfer the heat to the surrounding air, maintain the cold side at a lower temperature of around 163°C (325°F). Adjusting the amount of fuel supplied to the burner varies the temperature difference and controls the power output.
Electrical output characteristics are shown in Figure 6. Power peaks in a broad load resistance range of 0.30-0.60 Ω. Rated power of 127 W gross is obtained when the power unit load resistance is within this range, at the beginning of the service life of the TEG.

**Figure 6 – Model P-5100 Power Unit Electrical Output Characteristics**

### 4.1.5 Cooling Fins and Fin Duct

Cooling of the thermopile is done by the free movement of ambient air through the cooling fins. A fin duct acts as a chimney, causing ambient air to rise through the cooling fins, thus helping transfer heat away from the thermopile.

---

**CAUTION!**

Keep cooling fins clean and duct work inlets and outlets clear of obstructions. Restricting the free flow of cooling air may cause damage to the power unit.

---

### 4.1.6 Cabinet

The power unit, burner and fuel system are enclosed in a stainless-steel cabinet.

---

**WARNING!**

Surface temperatures of the burner components may be greater than 100°C.
4.1.7 Optional TEG Mounting Stands (Pole or Bench Type)

The Pole Stand consists of a 76-inch-long piece of 3-inch diameter pipe with an “H” shaped bracket welded to one end which the TEG can be firmly attached to using 1/4 in. fasteners (not included). The Bench Stand consists of 3 in. by 3 in. and 2 in. by 2 in. aluminum angle sections that are assembled together to provide a sturdy structure to support the TEG.

4.2 CONVERTER LIMITER

A Converter/Limiter (C/L) is available for use with the model P-5100 TEG. It is intended for use with a model P-5050, or P-5100 TEG requiring either 12 or 24 V DC nominal output. It consists of two separate circuits operating together. The first is a DC/DC Converter that converts the input to 12 or 24V. The second circuit is a Regulating Voltage Limiter that regulates the voltage to a user selectable voltage. It includes overload, short circuit, two voltage sensing alarm relays and temperature compensation.

**Figure 7 - C/L General Assembly**

**Regulating (Voltage) Limiter:** A voltage limiting circuit is incorporated into the C/L, which regulates the Output voltage and provides a protective load for the power unit.

**Voltage Converter:** The voltage converter switches the input voltage to another level suitable for the load. Nominal 12 or 24 V settings can be selected, and the exact output voltage can be fine-tuned.
**Current Limiter:** Over load protection triggers when the load draws excess current. The result is a proportional drop in output voltage, fold-back current limiting. Short circuit protection is also designed into the C/L. A 15 second short circuit will not damage the generator or the C/L.

---

**CAUTION!**

If extended short circuit durations are anticipated, an in-line fuse should be placed on the output of the limiter converter. Use 10 A slow blow for the model P-5100-12 or a 5 A slow blow for the model P-5100-24 TEG.

---

**Voltage Sensing Relay:** Two independent Voltage Sensing Relays (VSRs) provide a set of contacts to indicate an alarm condition when the output voltage drops below a preset minimum. Low voltages, due to overloads, lack of fuel or a faulty generator, are detected by a voltage sensing circuit incorporated into the voltage limiter. When a low voltage condition is detected, the Voltage Sensing Relay (VSR) with connections NC (normally closed), NO (normally open) and COM (common) can be used to trigger an alarm or other processes. When the generator is above the trip voltage the connection between NO and COM is closed and the connection between NC and COM is open. If the generator is below the trip voltage, then the connection between NO and COM is open and the connections between NC and COM is closed. The trip voltage is adjusted by the pot labeled VSR 1 and VSR 2 adjust on the Limiter board.

**On Board Current Sense:** The C/L includes an onboard current sense that measures the customer load current. The output is across pin 3 (+) and pin 2 (-) of the J-vsg1 connector on the Regulating Limiter Board (see Figure 7) and is scaled at 100mV/A. The current sense has an accuracy of 10%. If the Remote VSR Terminal Block is installed the current sense output can be measured across TB3 7 (-) and 8 (+).

**Power Resistor:** When no load, or a very small load, is connected the TEG has more power available than needed by the load. This excess power is directed into a power resistor by the voltage limiter.

### 4.3 TEMPERATURE COMPENSATION

When required for charging lead acid batteries, temperature compensation can be enabled to allow the output voltage to vary with temperature. The output will be adjusted by approximately 5.5mV per Cell per °C (33mV/°C for the 12V Setting, 66mV/°C for the 24V setting).
To enable temperature compensation:
1. Ensure that a lead acid battery is part of the customer load connection circuit.
2. Set the SW1 dip switches on the regulating limiter board to the following positions:

<table>
<thead>
<tr>
<th></th>
<th>SW1 - switch 1</th>
<th>SW1 - switch 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp Comp ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Temp Comp OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

The regulating limiter board has an on-board temperature sensor which is either switched into or out of the operation. The output voltage will be adjusted by the effects of the temperature being measured on the board.

**NOTE:**
If the optional TEG Controller board is installed and system measurements desired to be used for start/stop control, an optional external temperature sensor can be attached to one of the posts of the battery. Note: there is no effect to the output voltage with this external temperature sensor.

**NOTE:**
If a battery is connected to the TEG without the blocking diode, then the TEG will draw power from the station battery if the TEG is off.

### 4.4 BLOCKING DIODE

A Blocking Diode is integrated into the C/L to allow multiple generators to be connected in parallel, or to allow one or more generators to be combined with alternative energy sources. It is connected in series with the output to prevent current from flowing back into the electronics from another power source.

*Figure 8 - CP Interface System General Assembly*
4.5 OPTIONAL CATHODIC PROTECTION INTERFACE SYSTEM

An optional cathodic protection interface system is available for use with the model P-5100 TEG. It provides for adjustment and monitoring of power to a Cathodic Protection (CP) load. The anode and cathode cables enter the cabinet at the bottom and connect directly to a heavy-duty terminal block. A 0 to 1 Ω 300-Watt variable resistor is provided for adjusting the output power applied to the CP system.

**Enclosure:** The CP interface system is enclosed within a weather resistant 304 SS enclosure. Enclosure features include a lock-able cabinet door, 1 in. conduit opening on the bottom for customer CP wires, and separate area within the enclosure for the variable power resistor.

**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.

4.6 OPTIONAL REMOTE START SYSTEM (TEG CONTROLLER BOARD)

An Optional Remote Start system (TEG Controller board) is available for use with the TEG. The TEG Controller board provides a method of starting and stopping the TEG either locally or remotely, using on-board buttons, SCADA signal interface or system measurements.

The pressure switch is connected to the TEG Controller when it is added to the system. Only if there is fuel available, by the closed pressure switch, will any requests be attempted.

The TEG Controller provides an ignition request signal to the spark ignition control system when it has been requested to start and removes the ignition request signal when it is requested to stop. During the time it is requesting ignition, the TEG Controller monitors the Lockout signal from the SI system. If it receives a Lockout signal, a reset must be received, either locally or remotely, before any start requests can be re-attempted.

---

**NOTE:** The certified Ignition Control Module (SI) is responsible for the ignition sequence and control of the fuel valve and spark generation.

Any button press causes the TEG Controller’s operating mode to be switched to Local mode. Any Auto or SCADA starts are ignored until the mode times out and switches back to Remote operating mode. Stop requests are always accepted and acted upon in either mode.

Turning Auto functionality on enables the system measurement-controlled operation in Remote mode. The TEG Controller board has a heartbeat, one of three L1, L2, or L3 indicators blinks when it is powered and operating with a supply voltage above 10Vdc. The board also has a low power sleep mode when there is no supply voltage, it is connected to the battery and sitting in standby or Lockout; the heartbeat is very short and less frequent to save battery power. Pressing the start button or display button will wake up the TEG Controller.
Figure 9 - TEG Controller Assembly
<table>
<thead>
<tr>
<th>Interface</th>
<th>Operation</th>
<th>Specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI1 - SCADA Start input</td>
<td>Signal received from the SCADA system to request a TEG start</td>
<td>5-36 Vin, 1-7mA</td>
</tr>
<tr>
<td>SI2 - SCADA Stop input</td>
<td>Signal received from the SCADA system to request a TEG stop</td>
<td>5-36 Vin, 1-7mA</td>
</tr>
<tr>
<td>SI3 - SCADA Reset input</td>
<td>Signal received from the SCADA system to request a reset of the Lockout state</td>
<td>5-36 Vin, 1-7mA</td>
</tr>
<tr>
<td>SI4 - SCADA Auto input</td>
<td>Signal received from the SCADA system to change the Auto Functionality On or Off</td>
<td>5-36 Vin, 1-7mA</td>
</tr>
<tr>
<td>SO1 - SCADA Run output</td>
<td>Signal to the SCADA system that the TEG is running. Blinks during startup</td>
<td>Up to 36V, 200mA contact closure</td>
</tr>
<tr>
<td>SO2 - SCADA Fuel output</td>
<td>Signal to the SCADA system that the fuel pressure switch is closed, indicating fuel available</td>
<td>Up to 36V, 200mA contact closure</td>
</tr>
<tr>
<td>SO3 - SCADA Lockout output</td>
<td>Signal to the SCADA system that the SI System failed to start</td>
<td>Up to 36V, 200mA contact closure</td>
</tr>
<tr>
<td>SO4 - SCADA Auto output</td>
<td>Signal to the SCADA system that the Auto functionality is on</td>
<td>Up to 36V, 200mA contact closure</td>
</tr>
<tr>
<td>SO5 - SCADA Local output</td>
<td>Signal to the SCADA system that the TEG is operating in the Local mode. SCADA start signals are ignored till the mode timeout switches back to Remote</td>
<td>Up to 36V, 200mA contact closure</td>
</tr>
<tr>
<td>S1 button - Start</td>
<td>Operator button to start the TEG</td>
<td></td>
</tr>
<tr>
<td>S2 button – Stop</td>
<td>Operator button to stop the TEG</td>
<td></td>
</tr>
<tr>
<td>S3 button – Reset</td>
<td>Operator button to reset the Lockout state</td>
<td></td>
</tr>
<tr>
<td>S4 button – Auto</td>
<td>Operator button to switch Auto functionality on or off</td>
<td></td>
</tr>
<tr>
<td>S5 button – Display</td>
<td>Operator button to turn on the display and toggle through measured values</td>
<td></td>
</tr>
<tr>
<td>S6 button – Adjust</td>
<td>Operator button to toggle through the adjust- able values. Up and Down buttons can be used to make changes to adjustable values</td>
<td></td>
</tr>
<tr>
<td>S7 button – Up</td>
<td>Operator button for incrementing an adjustment</td>
<td></td>
</tr>
<tr>
<td>S8 button – Down</td>
<td>Operator button for decrementing an adjustment</td>
<td></td>
</tr>
</tbody>
</table>
### Interface | Operation | Specs
--- | --- | ---
L1/L2/L3 Indicators | Voltage status indicators. Also, a blinking heartbeat |  
L4 Indicator | Future current measurement display |  
L5 Indicator | Future current measurement display |  
L6 Indicator | Future current measurement display, Blinking for Auto Start adjustment |  
L7 Indicator | Future current measurement display |  
L8 Indicator | Voltage supply measurement display |  
L9 Indicator | Future voltage measurement display |  
L10 Indicator | Future voltage measurement display, Blinking for Auto Stop adjustment |  
L11 Indicator | Future temperature measurement display |  
L12 Indicator | Negative value displayed on 7-segments |  
L13 Indicator | Local mode indicator |  
L14 Indicator | Future option display |  
L15 Indicator | Auto mode indicator |  
FE Fuse | Voltage supply fuse and adjacent fuse blown indicator | 2A fuse  
FB Fuse | Battery supply fuse and adjacent fuse blown indicator | 2A fuse

### 4.6.1 TEG Controller DIP Switches

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>SW4-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF (Reserved)</td>
</tr>
<tr>
<td>24V</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF (Reserved)</td>
</tr>
</tbody>
</table>

#### 4.6.1.1 Start the TEG using the TEG Controller Board
1. Press S1 (Start) or apply a remote SCADA Start signal across SI1 of the TEG Controller for a minimum of 10 seconds

#### 4.6.1.2 Stop the TEG using the TEG Controller Board
1. Press S2 (Stop) or apply a remote SCADA Stop signal across SI2 of the TEG Controller for a minimum of 10 seconds
4.6.1.3 Reset a Locked-Out SI Controller

1. Press S3 (Reset) or apply a remote SCADA Reset signal across SI3 of the TEG Controller for a minimum of 10 seconds
2. To start the TEG following a Reset, wait a minimum of 10 seconds then follow the steps specified above

4.6.1.4 Measurement Display on TEG Controller

1. Press S5 (Display) to enter the Display mode. Each press of S5 (Display) toggles through the available measurements, the corresponding indicator above the display will turn on.
2. Press S5 (Display) until the display goes off to exit the Display mode. It will also automatically time-out and exit Display mode.

**NOTE:** The Adjustment mode is not available until the Display mode is exited.

4.6.1.5 Adjustments on the TEG Controller

1. Press S6 (Adjust) to enter the Adjustment mode. Each press of the S6 (Adjustment) toggles through the available variables, the corresponding indicator above the display will blink.
2. Press S7 (Up) or S8 (Down) to make changes to the variable.
3. Press S6 (Adjust) until the display goes off to exit the Adjustment mode. It will also automatically time-out and exit Adjustment mode. All variable changes are saved upon exit of the Adjust mode.

**NOTE:** The Adjustment mode is not available until the Display mode is exited.

4.7 INTAKE AND EXHAUST FLAME ARRESTORS

The Model P-5050 and P-5100 are provided with flame arrestors (FA). The natural gas fueled Model P-5050N TEG and natural gas and propane fueled Models P-5100N, P-5100H and P-5100L TEGS with Flame Arrestors have been tested in compliance with API Recommended Practice 12N, for the Operation, Maintenance and Testing of Firebox Flame Arrestors as it applies to continuously run, gas fired, natural draft burners. Genthem Global Power Technologies (GPT) considers compliance with API 12N as evidence that the Flame Arrestors are adequate for use in unclassified areas.

The P-5050 L operating on propane does not meet the requirements of API 12N and is not recommended for applications requiring flame arrestors however GPT believes the addition of a factory installed flame arrester still provides enhanced safety, and as such, includes a factory installed flame arrester on all Model P-5050 TEGS.
It must be noted that if an area is defined as hazardous (i.e. may contain hazardous gases such as in a Class 1, Division 2 area) then TEG models 1120 & 1500 are the only GPT TEGs suitable for installation in these hazardous areas. The addition of a flame arrestors does not make the Models P-5050 N, P-5100 N, P-5100 H and P-5100 L TEGs suitable for use in a hazardous area. For hazardous area use, TEGs require reduced surface temperatures (below hazardous gas ignition temperatures), addition of air intake and exhaust flame arrestors, and other modifications.

It is the customers responsibility concerning the installed location and operation of a TEG (with or without a flame arrestor), and installations should comply with all applicable regulations.

4.8 OPTIONAL VSR TERMINAL BLOCK

An optional wiring harness with terminal block can be provided for easy access to the voltage sensing relay and current sense connections. This terminal connects to the regulating limiter VSR1, VSR2, and current sense outputs to a terminal block on the inside of the TEG cabinet. This option provides #6 screw terminals and will take up to wire size #10 AWG with an appropriate ring or fork terminal.
5 INSTALLATION
This section provides installation instructions for the Model p-5100 Thermoelectric Generator.

5.1 PRECAUTIONS

WARNING!
The installation must conform with local codes or, in the absence of local codes, with the CSA-B149.1 Natural Gas and Propane Installation Code and CSA B149.2, Propane Storage and Handling. The TEG must be kept clear and free from combustible materials, gasoline and other flammable vapors and liquids. Maintain 900 mm (36 in.) minimum clearances from combustible construction, to the top, sides and back, and install over a noncombustible floor.

WARNING!
Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been underwater.

WARNING!
The TEG, when installed must be electrically grounded in accordance with local codes, or in the absence of local codes, with the applicable provisions of the Canadian Electrical Code CSA C22.1. A grounding lug is provided on the sidewall of the cabinet for this purpose.

5.2 TOOLS REQUIRED
The following tools are required for installing the TEG:
- 1 - DC Voltmeter, accurate to ±0.1 V.
- 2 - Adjustable Wrenches, that will open to 16 mm (5/8 in.)
- 1 - Screwdriver, flat-head
- 1 - Screwdriver, Phillips
- 4 - Bolts & nuts, #1/4-20 for mounting
5.3 UNPACKING

Unpack the TEG from its shipping crate, keep the crate until the TEG is operational. Locate and identify the following items that were shipped with the P-5100 TEG:

- 1 - Fin Duct
- 1 - Rain Cap
- 1 - Thread Sealing Compound
- 16 - Screws, #8 32 × 1/4 in. long, one spare
- 16 - Washers, #8 External Lock, one spare

NOTE: Inspect the TEG for damage which may have occurred during shipping. Please report any damage as soon as possible as it may make the generator inoperable. Check with the factory before starting a damaged TEG.

5.4 ASSEMBLING

Follow these steps to assemble the TEG, see Figure 10:

1. Attach the fin duct using the #8 screws and washer supplied inserting the exhaust shield tap into the duct.
2. Attach the rain cap to the top of the cabinet, inserting the rain cap tap into the duct.

Figure 10 – Assembling the P-5100 TEG
5.5 MOUNTING

Mount the TEG to a firm and stable base, using 1/4-20 bolts of material suitable for the environment. See Figure 11 for mounting hole locations. The base must be level and sturdy enough to support the 83 kg (183 lb.) mass of the TEG.

CAUTION!

Operation of the TEG in locations where cooling air flow may be obstructed will cause overheating of the TEG. Allow a minimum of 150 mm (6 in.) clearance under the cooling fins and 900 mm (3 ft.) above the top of the fin duct. Locate the TEG to avoid flooding interfering with the flow of cooling air.

Figure 11 – Model P-5100 Mounting Dimensions
5.6 SUPPLYING FUEL

This topic describes how to connect the fuel supply and gives background information for consideration when providing fuel to the P-5100 TEG.

5.6.1 Connecting the Fuel Supply

The TEG has a 1/4 in. female NPT fuel inlet, i.e. connection to the TEG’s manual shutoff valve.

Follow these steps to connect the fuel supply:

1. Remove the any protective cap or plugs.
2. Apply thread sealant to the fuel line threads as per Figure 12.

![Figure 12 – Applying Thread Sealant]

NOTE: Thread sealant is recommended. Sealant must be approved for use with gaseous fuels. Tape is not recommended.

3. Connect the fuel line and test all joints for leaks using a commercial leak detector fluid such as Snoop®.

NOTE: The TEG and its manual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of the gas supply piping system at test pressures more than 3.5 kPa (0.5 psig).

The TEG must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures less than 3.5 kPa (0.5 psig).

4. Inspect the fuel lines and fittings to be sure they are free of foreign material.
5. Purge fuel lines of all air.

NOTE: All fuel piping must be in accordance with local regulations.
5.6.2 Fuel Considerations

**Fuel Types:** Fuel must be either natural gas or propane vapour. Check the TEG data plate for the fuel type, see Figure 2. Do not use a different type of fuel than indicated.

**Supply Pressure:** Make sure that fuel pressure is at least 100 kPa (15 psig) and will not exceed 344 kPa (50 psig). If it is expected that the fuel supply pressure will vary greatly, the use of an additional primary regulator is recommended. This will hold the input pressure relatively constant.

**Clean Fuel:** The fuel used to operate the P-5100 TEG must be clean and dry. See Technical Specifications section for full gas specifications. If dirty fuel is anticipated, then a customer supplied in-line fuel filter is recommended.

**Low Temperature:** Regulator freeze-off can be minimized by limiting, i.e. regulating, the incoming supply pressure to 138 kPa (20 psig). When using propane (C\(_3\)H\(_8\)) at temperatures below -30°C (-22°F) special consideration must be given to the low vapour pressure of the fuel.

---

*Figure 13 – Setting up the P-5100 TEG*
5.6.3 Propane/Natural Gas Supply Considerations

If remote Propane/LPG gas supply system is used, consider the following:

**Location:** Propane/LPG tanks and cylinders must be located outdoors in a well-ventilated area, at least 3 meters (10 ft) from the TEG unless directed otherwise by the local authority having jurisdiction.

**Mounting:** Each tank or cylinder must be set on a firm, level, waterproof base, located on consolidated ground at grade level. The base must extend at least 300mm (1 ft) from all sides of the tank or cylinder, must be designed to support the weight of the tank or cylinder and is subject to approval by the local authority having jurisdiction.

**Connection:** Tanks and cylinders are to be equipped with flexible connections to offset any movement affecting the piping or tubing.

5.7 CONNECTING CUSTOMER LOAD

---

*Figure 14 - Wiring Diagram P-5100 for 12 or 24 V*
Connect the customer load directly to the TEG using the following procedure. If an optional CP interface system is applicable, then see Installation of Optional CP Interface System topic in section 5.8.

Follow these steps to connect the customer load:

1. Bring the customer load wires through the provided hole in the bottom of the TEG cabinet using appropriate cable connectors for the wire or cable being used. Allow enough wire to connect to the terminal block TB-1. See Figure 16.

2. Connect the customer load wires to TB-1 terminals 7(+) and 8(-):
   12 or 24 V: see Figure 15 if TEG Controller present.
WARNING!
Customer load installation wiring must conform with local codes or, in the absence of local codes, with the applicable provisions of the Canadian Electrical Code CSA 22.1.
Use supply wires with a minimum wire gauge of 10 AWG copper wire, and a minimum temperature rating of 90 ºC.

CAUTION!
Connecting to some types of solar charge controllers may damage the TEG. Please contact Gentherm Global Power Technologies for advice on selecting and connecting a solar charge controller.

5.8 INSTALLATION OF OPTIONAL CP INTERFACE SYSTEM
The CP interface is normally shipped ready for operation, attached to the TEG. If it was shipped separately install as follows.

NOTE: Before installing inspect for obvious dents and broken components and advise the carrier, as applicable.

5.8.1 Attaching the CP Interface System To TEG
The standard mounting location is on the left side of the generator cabinet. To attach the CP interface system, remove the four nuts and lock washer provided and bolt it to the outside of the TEG, see Figure 17. Remove the fuel system and remove the baffle plate to gain access to the holes in the TEG cabinet for mounting the CP Interface System.
NOTE: Always mount the CP interface system in an upright position and allow the free flow of air through the unit.

5.8.2 TEG Wiring Interconnection

Wire the CP interface system directly to the TEG using the following procedure. Follow these steps to wire the CP interface system to the TEG:

1. Check the wiring diagram, Figure 14 or Figure 15 as applicable and choose the wiring diagram for your application.
2. Run the CP interface system wires to the TEG as per Figure 14 or Figure 15, as appropriate, and terminate to TB-1.

5.8.3 Connection of CP Load

Wire the CP load directly to the CP interface system. Feed the CP anode and cathode load cables into the CP box and terminate.
6 STARTUP AND SHUTDOWN

This section describes how to startup and shutdown the model P-5100 TEG.

6.1 BEFORE STARTING

Before starting the TEG perform these steps:

1. Make sure that all the connections in the fuel system are tight and have been checked for leaks.
2. Ensure the battery is connected.
3. To setup the TEG for power output evaluation, disconnect customer load from terminals 7(+) and 8(-) of TB-1. Connect a DC voltmeter to terminals 5(+) and 6(-) of TB-1. This will be measuring $V_{\text{set}}$.
4. If power output evaluation is not required, a DC voltmeter may be connected to terminals 7(+) and 8(-) of TB-1 to measure the output voltage.

6.2 TEG START-UP

Follow these steps to start the TEG using the Ignition Control System:

1. Supply fuel and open the manual shut-off valve.

**NOTE:** Once the TEG is started, re-closing the manual shut-off valve will stop it.

2. If the optional TEG Controller board is installed:
   
   Press the Start (S1) button or send a SCADA Start signal to the TEG Controller board.

**NOTE:** Once the TEG is started pressing the Stop (S2) button or sending a SCADA Stop signal to the TEG Controller board will stop it.

**WARNING!** When the TEG is operating, surface temperatures near the thermopile, burner, exhaust stack and around the cooling fin duct may be more than 100ºC. Avoid contact of skin and clothing with these areas when operating in and around the TEG.

6.3 SHUTDOWN

Thermoelectric generators are intended for continuous operation where reliable power is required without interruption. In case the TEG must be shut down temporarily for servicing or an emergency close the TEG manual shutoff valve.

If the optional TEG Controller board is installed, close the TEG manual shutoff valve, press the Stop (S2) button or send a SCADA Stop signal to the TEG Controller board.
7 POWER OUTPUT EVALUATION

Output power is the primary indication of correct setup, adjustment and operation of the TEG. This section describes how to determine if the TEG is providing rated power. Power output should be evaluated:

- during initial setup at site;
- adjusting a TEG;
- before and after servicing a TEG, and
- whenever altering the fuel’s heat of combustion.

NOTE:

Typical settings are:

- 28 to 34 kPa (4.0 to 5.0 psi) for natural gas (P-5100N),
- 48 to 55 kPa (7.0 to 8.0 psi) for high BTU natural gas (P-5100H ONLY),
- 41 to 48 kPa (6.0 to 7.0 psi) for propane (P-5100L).

NOTE: Good record keeping is necessary for long term follow-up. Use the TEG Performance Log, located at the end of this manual, for recording details each time adjustments are made, or servicing is carried out.

7.1 REQUIRED V_{set} OR SETUP POWER AT SITE

Power from the P-5100 TEG is produced by the difference in temperature between the burner and the cooling fins. This means the power output of the TEG is affected by the ambient temperature surrounding the generator at site. Power output increases when temperature falls and decreases when temperature climbs.

A decrease of 1ºC from the ambient temperature as indicated on the data plate effects a power increase of 0.4 W and similarly, a temperature climb of 1ºC from the ambient temperature as indicated on the data plate effects a power decrease of 0.4 W. This effect needs to be considering when setting-up the TEG.

7.1.1 Working-out Required V_{set} or Setup Power

Factory test data for setup power and voltage is marked on the data plate that is located inside the TEG cabinet door. These values are for a specific ambient temperature that is also indicated on the data plate. Reference Figure 18 for V_{set} adjustment with ambient temperature. They require correction for ambient temperatures different to that indicated. The following formulas apply:

**Equation 1** - \( V_{set} = V_{set\ ref} + [(T_{ref} - T) \times 0.00925] \)

Where:
- \( T \) = Ambient temperature, at site (ºC)
- \( T_{ref} \) = Reference ambient temperature, marked on Data Plate (ºC)
- \( V_{set\ ref} \) = Reference set-up voltage, marked on Data Plate (V)
- \( V_{set} \) = Set-up voltage, at site (V)
Equation 2 - $P_{set} = P_{setref} + [(T_{ref} - T) \times 0.4]$

Where:

- $T$ = Ambient temperature, at site (°C)
- $T_{ref}$ = Reference ambient temperature, marked on Data Plate (°C)
- $P_{setref}$ = Reference power marked on TEG Data Plate (W)
- $P_{set}$ = Rated power at new ambient (W)

**NOTE:**

Avoid setting-up the TEG to run at higher $V_{set}$ or rated power values, as its life may be affected. This method is suitable for ambient temperatures of up to 65.5°C (150°F). If in doubt contact Gentherm Global Power Technologies’ (GPT) Customer Service Department for guidance.

Example: Ambient temperature at site is 35°C. Set-up power of 127 W and $V_{set}$ of 6.8 V, 22°C is marked on the TEG Data Plate.

\[
V_{set} = V_{setref} + [(T_{ref} - T) \times 0.00925] \\
= 6.8 + [(22 - 35)] \times 0.00925] \\
= 6.8 + [(22 - 35)] \times 0.00925] \\
= 6.8 + [-13 \times 0.00925] \\
= 6.8 + [-0.1203] \\
= 6.8 - 0.1203 \\
= 6.68 V
\]

\[
P_{set} = P_{setref} + [(T_{ref} - T) \times 0.4] \\
= 127 + [(22 - 35)] \times 0.4] \\
= 127 + [(22 - 35)] \times 0.4] \\
= 127 + [-13 \times 0.4] \\
= 127 + [-5.2] \\
= 127 - 5.2 \\
= 121.8 W
\]

### 7.1.2 Determining $V_{set}$ And Rated Power Graphically

A good approximation to $V_{set}$ and rated power can be obtained from the chart shown in Figure 18. Knowing the ambient temperature, move up vertical to the line. Read the $V_{set}$ from the right side of the graph and rated power from the left side.
### 7.2 CHECKING $V_{\text{set}}$ OR SETUP POWER

$V_{\text{set}}$, i.e. setup power, can readily be checked by using a voltmeter or multi-meter to measure the stable setup voltage of the power unit. Use the following procedure, as appropriate, to check.

![Figure 18 - $V_{\text{set}}$ and Setup Power Versus Ambient Temperature](image)

#### 7.2.1 Examining $V_{\text{set}}$ Immediately after Ignition

Immediately after ignition the power unit warms, and the resulting temperature rise produces power.

Follow these steps to check $V_{\text{set}}$ after ignition:

1. Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.

2. Consult the data plate inside TEG door for the reference $V_{\text{set}}$ voltage and determine the required $V_{\text{set}}$ for the present ambient temperature. See Working-out Required $V_{\text{set}}$ or Setup Power topic above, or Alternative Method of Working-out Required $V_{\text{set}}$ or Setup Power.

3. Connect a voltmeter between terminals 5 (+) and 6 (-). This is the measured $V_{\text{set}}$ and should tend towards the required $V_{\text{set}}$. It will climb as shown in Figure 19.
4. $V_{\text{set}}$ will rise quickly at first then begin to level out. It will take at least one hour for the $V_{\text{set}}$ to level out. When no longer $V_{\text{set}}$ changes ($\pm 0.2 \text{ V in ten minutes}$) compare this value with required $V_{\text{set}}$. Measured $V_{\text{set}}$ should be within 0.2 V of that required.

**NOTE:** Typically, if the measured $V_{\text{set}}$ is greater than required $V_{\text{set}}$ then the fuel pressure needs to be reduced.

![Figure 19 - $V_{\text{set}}$ Versus Time After Ignition, Typical Response](image)

**7.2.2 Examining $V_{\text{set}}$ after Running for Some Time**

Once the TEG has been running for some time, typically more than an hour, with load attached the power unit will be warm.

Follow these steps to check $V_{\text{set}}$ after running for some time:

1. Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.

2. Consult the data plate inside TEG door for the reference $V_{\text{set}}$ voltage and determine the required $V_{\text{set}}$ for the present ambient temperature. See Working-out Required $V_{\text{set}}$ or Setup Power topic above, or Alternative Method of Working-out Required $V_{\text{set}}$ or Setup Power.
3. Connect a voltmeter between terminals 5 (+) and 6 (-). This is the measured \( V_{\text{set}} \) and should match the required \( V_{\text{set}} \) for the present temperature.

---

**CAUTION!**

Do not allow measured \( V_{\text{set}} \) to exceed that required \( V_{\text{set}} \), for present ambient temperature, otherwise overheating may cause irreparable damage to the power unit.

---

4. When the \( V_{\text{set}} \) measurement is completed, reattach the customer load to terminals 7 (+) and 8 (-) of TB-1.
8 ADJUSTMENT

This section describes how to adjust the Model P-5100 Thermoelectric generator.

Typical settings are:

- 28 to 34 kPa (4.0 to 5.0 psi) for natural gas (P-5100N),
- 48 to 55 kPa (7.0 to 8.0 psi) for high BTU natural gas (P-5100H ONLY),
- 41 to 48 kPa (6.0 to 7.0 psi) for propane (P-5100L).

NOTE: Good record keeping is necessary for long term follow-up. Use the TEG Performance Log, located at the end of this manual, for recording details each time adjustments are made, or servicing is carried out.

Figure 20 - Change in Fuel Gauge Pressure Versus Elevation Above Mean Sea Level
8.1 POWER OUTPUT ADJUSTMENT

TEG output power is controlled by the flow of air and fuel into the TEG. Use the following procedures to adjust the TEG’s power output in sequence given.

8.1.1 Adjustment for Elevation

Confirm the fuel gauge pressure is near to the pressure indicated on the data plate located on the inside of the cabinet doors. If the TEG is located at a different altitude than the factory, 792 m (2600 ft.), the fuel pressure will need to be different to obtain the same results also be different. Use Figure 20 to determine how much to adjust the fuel pressure.

Example: If the site elevation is 1000m (3281ft.) then 2.5 kPa (0.36 psig) must be added to the pressure on the data plate.

Follow these steps to adjust fuel pressure:

1. Remove the cover on the regulator and loosen the lock nut.
2. Turn the adjusting screw (clockwise to increase pressure) until the required change in pressure is obtained.
3. Tighten the lock nut and replace the cover on the fuel regulator.

8.1.2 Air-shutter Adjustment

Follow these steps to adjust the air-shutter:

1. Check $V_{set}$, see Power Output Evaluation Section 7, and record.
2. Open the doors and loosen the lock-nut on the air-shutter adjusting screw.
3. Turn the adjusting screw a quarter turn counterclockwise.

**NOTE:**

If the air-shutter adjustment is unknown and needs to be reset the following procedure may be used for its initial positioning:

1. Turn air adjusting screw counter clockwise until it is free from the Air Lid. This will completely close off air intake.

**NOTE:**

2. Turn air adjustment screw clockwise:
   - 8.5 to 9 turns for natural gas.
   - 6 to 8 turns for high BTU natural gas (P-5100H only)
   - 22 to 23 turns for propane.

4. This is generally a good starting point for air adjustment. After voltage has risen to a stable point, further adjustments can be made with 1/4-turn adjustments.
5. Close the doors, wait ten minutes then measure and record $V_{set}$.
   a. **If $V_{set}$ is greater than the original value or did not change**, the burner adjustment is air-rich, see Figure 21, turn the adjusting screw another quarter turn counter clockwise and wait ten minutes. Continue until you observe a slight decrease in $V_{set}$ then verify CO levels are below 800 ppm.
   b. **If $V_{set}$ is less than original value**, the burner adjustment is fuel-rich, see Figure 21. Notice that the peak of the graph is within one quarter of a turn, either direction, of the adjusting screw. Set the adjusting screw so that it is one-half turn clockwise, air-rich, verify CO levels are below 800 ppm.
6. Tighten the lock-nut.

8.1.2.1 Measuring CO Emissions Levels

The model P-5100 will not produce excessive amounts of CO if properly adjusted. Due to the open exhaust system of TEG, the CO measurement must be in the free air state. In a free air measurement, the allowable CO rate is 800 ppm however a correctly adjusted P-5100 will produce less than 120 ppm CO air free. To be able to determine the levels of air-free CO ppm, a combustion analyzer capable of measuring CO ppm and either CO$_2$ percentage, or O$_2$ percentage, is needed.

The equations used to calculate the air-free stage of CO are:
• For Natural Gas when using as measured CO\textsubscript{2} percentage, and CO\textsubscript{ppm}:

\[
CO_{AFppm} = \left( \frac{11.8}{CO_2} \right) \times CO_{ppm} \tag{1}
\]

• For Propane when using as measured CO\textsubscript{2} percentage, and CO\textsubscript{ppm}:

\[
CO_{AFppm} = \left( \frac{13.8}{CO_2} \right) \times CO_{ppm} \tag{2}
\]

• When using as measured O\textsubscript{2} percentage, and CO\textsubscript{ppm}:

\[
CO_{AFppm} = \left( \frac{21}{21-O_2} \right) \times CO_{ppm} \tag{3}
\]

Where:
- CO\textsubscript{AFppm} = Carbon monoxide, air-free ppm
- CO\textsubscript{ppm} = As-measured combustion gas carbon monoxide ppm
- O\textsubscript{2} = Percentage of oxygen in combustion gas, as a percentage
- CO\textsubscript{2} = Percentage of carbon dioxide in combustion gas, as a percentage

The model P-5100 does not produce excessive concentrations of CO if adjusted properly.

### 8.1.3 Fuel Pressure Adjustment

Once the air is adjusted, and if the fuel system and burner appear to be operating correctly, the fuel pressure may be slightly adjusted to match the measured \(V_{set}\) voltage with the required \(V_{set}\) value. Use Figure 21 to determine how much to adjust the fuel pressure.

**Example:**

Required \(V_{set}\) = 6.83 V  
Measured \(V_{set}\) = 6.5 V  
Difference = +0.33 V
Follow these steps to adjust fuel pressure:

1. Remove the cover on the regulator and loosen the lock nut.
2. Turn the adjusting screw (clockwise to increase pressure) until the required change in pressure is obtained.

3. Wait ten minutes then measure $V_{\text{set}}$ and record. If the TEG cannot be adjusted to match required $V_{\text{set}}$ value, then a problem exists with one of the TEG’s systems. If necessary, see Troubleshooting section for guidance.
4. Tighten the lock nut and replace the cover on the fuel regulator.

NOTE: Consult Data Plate Label Located on Inner Door for Reference Factory Fuel Pressure.
8.2 ADJUSTMENT OF CONVERTER/LIMITER

A C/L is available for use with the model P-5100 TEG. This text describes how to adjust the C/L, if applicable.

8.2.1 Output Voltage Adjustment

The C/L is factory set at either 14.1 V (Model P-5100-12) or 28.0 V (Model P-5100-24). If this requires adjusting use the following procedure.

Follow these steps to adjust the C/L output voltage:

1. Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1.
2. Connect a voltmeter between terminals 7 and 8 of TB-1 and measure the output voltage.
3. Adjust the output voltage by turning the output voltage adjustment pot shown in Figure 7.

8.2.2 Voltage Sensing Relay (VSR) Adjustment

The VSR provides a set of contacts to indicate an alarm condition when the output voltage drops below a pre-set minimum. It is factory set at 23.0V and 28.5V (Model P-5100-24) or 11.5V and 14.3V (Model P-5100-12). The VSR is rated for 2A at 30V DC and will take up to 14 AWG stripped wire. The Remote VSR Terminal Option will allow for a wire size of 10AWG with a ring or fork terminal termination.

To connect to the VSR outputs route the wire in through the hole provided in the bottom of the TEG cabinet and follow the main wiring harness around the loop and into the lower hole of the Electronics enclosure door. Continue to route the wires along the bottom of the electronics enclosure and then connect to the VSR terminals on the left side of the limiter board. Refer to Figure 7 for the connector pinout.

---

**NOTE:**
Due to the integrated blocking diode, set the no-load trip-point 0.5V higher than the required trip-point. For example, if an alarm is required when the output voltage drops to 23.0V at the customer load terminals. When making the point adjustment at no load conditions set it to trip at 23.5V, as measured at the customer load terminals. Under load conditions when the voltage drops to 23.0 V, as measured at the customer load terminals, the relay will trip.

Follow these steps to adjust the VSR set point:

1. Remove both the positive and negative wires from the customer load terminals.
2. Connect a DC voltmeter to the customer load terminals.
3. Set the output voltage to the desired alarm point value.
4. Place an ohmmeter between the common and normally open contact of the VSR.
5. Turn the VSR adjustment pot until the contacts open (the normally open contacts are closed when output voltage is above VSR trip-point).
6. Using the output voltage adjustment, raise output voltage to a value where the VSR will reset.
7. To re-check the trip-point, lower output voltage and monitor opening of the VSR contacts. Fine tune as required to achieve desire trip value.
8. Reset output voltage to the desired normal operating value. Factory setting is either 14.1 or 28.0 V.

8.3 ENABLING TEMPERATURE COMPENSATION

Enabled temperature compensation will vary the output voltage by approximately 33mV/°C for 12V and 66mv/°C for 24V. To Enable Temperature compensation, use the following procedure:

10. Remove the customer load.
11. Set/verify SW1 on the Limiter board to the following (default) configuration, to disable temperature compensation for adjustment of the output voltage:
   a. Switch 1 ON
   b. Switch 2 OFF
12. Connect a DC Voltmeter to the customer Load Terminals.
13. Turn the output voltage adjustment pot until the desired voltage is reached, per battery manufacturer’s recommended charging voltage for 25°C, with no temperature compensation.
14. Set SW1 on the Limiter board to the following configuration, to enable temperature compensation:
   a. Switch 1 OFF
   b. Switch 2 ON

8.4 ADJUSTMENT OF OPTIONAL CP INTERFACE SYSTEM

An optional CP interface system is available for use with the model P-5100 TEG. This text describes how to adjust the CP interface system, if applicable.

8.4.1 CP Power Output Adjustment

The 0-1Ω 300 W variable resistor, located inside the CP cabinet, may be used to adjust the output power from the CP interface. This resistor may be connected in series or parallel with the customer load. See Figure 23 for series connection and Figure 24 for parallel connection.

Adjusting the variable resistor can be done simply while the system is running, by loosening the slide ring on the resistor and moving it up or down on the resistor. Check the power changes by using the meters provided in the enclosure or using a hand held multi-meter to easily see the change in power when adjusting the variable resistor. Once the resistor has been adjusted to give the desired power output, check that all electrical connections are tight, and lastly recheck that the desired power output has not changed.
NOTE: TEG fuel pressure may be adjusted to fine tune the CP output. Fuel pressure within 10% of that marked on the data plate is recommended to prevent flame out.

Figure 23 - CP Interface System, Series Wiring Diagram

Figure 24 - CP Interface System, Parallel Wiring Diagram
8.4.1.1 Series Wiring
Series connection is achieved by connecting the 300 W resistor in series with the customer load as shown with the dark line. The maximum allowable power may be delivered to the CP load by moving the tap to the bottom of the resistor. To reduce power to the CP load, slide the tap upward.

8.4.1.2 Parallel Wiring
Parallel connection is achieved by connecting the 300 W resistor in parallel with the customer load as shown with the dark line, smaller levels of power may be delivered to the CP load. This may be required when hot spots occur on the anode of the CP circuit. With the tap located at the top of the resistor the output power will be zero. As the tap is moved down, the power to the CP load is increased.

Change from a series to parallel configuration by moving the wire running from the top of the 300 W resistor from the center terminal of the heavy-duty terminal block to the left terminal.

8.5 ADJUSTMENT OF THE OPTIONAL REMOTE START SYSTEM (TEG CONTROLLER)
The TEG Controller has an on-board 3 digit 7-segment display. It is used to display measured values as well as adjust some variables.

8.5.1 Measurement Display on TEG Controller
1. Press S5 (Display) button to enter the Display mode. Each press of the Display button toggles through the available measurements, the corresponding indicator above the display will turn on.
2. Press the Display button until the display goes off to exit the Display mode. It will also automatically timeout and exit Display mode.

NOTE: The Adjustment mode is not available until the Display mode is exited.

8.5.2 Adjustments on the TEG Controller
1. Press S6 (Adjust) button to enter the Adjustment mode. Each press of the Adjustment button toggles through the available variables, the corresponding indicator above the display will turn blink.
2. Press the S7 (Up) or (S8) Down to make changes to the variable.
3. Press the Adjust button until the display goes off to exit the Adjustment mode. It will also automatically timeout and exit Adjustment mode. All variable changes are saved upon exit of the Adjust mode.

NOTE: The Adjustment mode is not available until the Display mode is exited.
9 MAINTENANCE

This section describes how to maintain the model P-5100 TEG. Before attempting to maintain the TEG the qualified service person should be thoroughly familiar with its:

- technical specifications;
- process description;
- installation;
- startup and shutdown;
- power output evaluation, and
- adjustment.

**NOTE:**

Good record keeping is necessary for long term follow-up. Use the TEG Performance Log, located at the end of this manual, for recording details each time adjustments are made, or servicing is carried out.

9.1 RECOMMENDED PERIODIC MAINTENANCE

The TEG is a solid-state high-reliability device that requires very little maintenance. However, it does require periodic service checks to provide the years of trouble free service of which it is capable. The maintenance interval depends on the site conditions (fuel purity, environment, etc.) and must be established based on site records. Field experience indicates that a properly installed TEG usually requires maintenance only once a year.

At least once a year evaluate $V_{set}$ as per the procedure below. This should be the first procedure during any service visit and will determine what further service may be needed.

9.1.1 Tools and Parts Recommended for Routine Servicing

The following tools and parts should be available for routine servicing:

- 1 Multi-meter, including DC voltmeter accurate to ± 0.1 V (and Ohmmeter*).
- 1 Flat-head screwdriver.
- 1 Phillips screwdriver.
- 1 Wrench, 9/16 in.
- 1 Wrench, 1/2 in.
- 1 Wrench, 3/8 in.
- 1 Adjustable wrench, that will open to 16 mm (5/8 in.).
- 1 Fuel filter kit, part number 22363.
- 1 Fuel orifice: for natural gas service use orifice #8 (part number 690), for high BTU natural gas use orifice #10 (part number 6251), for propane service use orifice #7 (part number 689).
- 1 Battery 6V, 5.0 Ahr, Monoblock, part number 24559*.
- A combustion analyzer capable of measuring CO ppm and either CO$_2$ percentage, or O$_2$ percentage*

*not usually required but could be convenient for troubleshooting.
9.1.2 Evaluate $V_{set}$

This procedure describes how to evaluate $V_{set}$ and determine what further servicing could be needed. Follow these steps to evaluate $V_{set}$:

4. Check $V_{set}$, see Power Output Evaluation and record.
5. Compare measured voltage with required $V_{set}$ for present ambient temperature and act as follows:
   a) If measured voltage is more than 0.1 V above required $V_{set}$:
      The fuel pressure must be reduced. Proceed with Routine Service, Section 9.1.3. Remember to adjust the fuel pressure during restart or before leaving the site. See Adjustment Section 8.
   b) If measured voltage is within 0.1 V of required $V_{set}$:
      The TEG is functioning well and requires only a routine service. Proceed with Routine Service.
   c) If measured voltage is more than 0.1 V below required $V_{set}$:
      The cause must be determined. Refer to the last entry in the TEG Performance Log. From the log, check if the TEG was left operating at the correct $V_{set}$ during the last service visit. Remember that $V_{set}$ changes with ambient conditions. If the TEG was not left operating at the correct $V_{set}$ during the last visit, determine the reason for this. If the TEG was left operating at the correct $V_{set}$ during the last visit and is now not, consider the following plausible causes:

   **Change in Fuel Pressure**
   Refer to the last entry in the log and determine if the fuel pressure has changed. If the fuel pressure has changed, re-adjust the fuel pressure to the last entry. If this returns the measured voltage to within 0.1 V of required $V_{set}$ proceed with Routine Service.

   **NOTE:** A dirty fuel filter may cause a drop-in fuel pressure. A plugged fuel orifice will change fuel flow without a change in fuel pressure.

   **Change in Air Flow**
   Check for obstructions at the cooling fins and the air filter stabilizer. Adjust the air shutter, see Adjustment section. If this returns the measured voltage to within 0.1 V of required $V_{set}$ proceed with Routine Service.
Change in Fuel Quality
To maintain a constant output power, it is essential that the TEG be supplied with a constant heating value fuel. Proceed with Routine Service.

If the above causes have been ruled out the TEG may require more than just routine servicing. Keep the TEG operating for now and see the Troubleshooting Section for guidance.

9.1.3 Routine Service
Basic annual servicing is all that is required unless other maintenance is indicated by the $V_{set}$ evaluation.

Follow these steps to perform a routine annual service:
1. Stop the TEG and pause to let cool. See Startup and Shutdown Section 6.
2. Drain the pressure regulator sediment bowl. See Draining the Sediment Bowl Section 9.2.1.
3. Replace the fuel filter in the pressure regulator. See Fuel Filter Replacement Section 9.2.2.
4. Check the fuel orifice for clogging and replace if necessary. See Fuel Orifice Replacement Section 9.2.3.
5. Remove any debris, sand or dust from the cooling fins, air lid screens and cabinet interior. See Air Lid Screens Cleaning Section 9.3.1.
6. Check all bolts and wire connections for tightness.
7. Start the TEG. See Startup and Shutdown Section 6.
8. Check $V_{set}$, record and adjust if necessary. See Power Output Evaluation Section and Adjustment Section 8, as applicable. Record the final setup in the TEG Performance Log before leaving site.

9.2 FUEL SYSTEM MAINTENANCE
This text gives procedures for servicing the fuel system.

9.2.1 Draining the Sediment Bowl
Follow these steps to drain the regulator sediment bowl:
1. Shut off the fuel supply to the TEG and allow to cool.
2. Open the drain cock located on the underside of the TEG cabinet, any impurities will drain through the cock. (Place empty container beneath drain cock to prevent spillage inside the cabinet.)
3. Close drain cock.
4. Leak check the drain cock.
WARNING! Check for fuel leaks after any fuel system service.

9.2.2 Fuel Filter Replacement

Follow these steps to remove the fuel filter:
1. Shut off the fuel supply to the TEG and allow to cool.
2. Drain the sediment bowl by opening the drain cock. (Place empty container beneath drain cock to prevent spillage inside the cabinet.)
3. Remove the four screws from the bottom of the regulator.
4. Remove the filter, and gasket. See Figure 25.

Follow these steps to install the fuel filter:
1. Install the filter, and gasket onto the sediment bowl. See Figure 25.
2. Carefully replace the bottom of the regulator making sure the filter and gasket are in their proper position.
3. Align the sediment bowl with the regulator body, replace the four screws and tighten.
4. With the fuel pressure on, leak checks all regulator joints and fuel connections using a commercial leak detector.
NOTE: While the regulator is removed this can be a convenient time to check the orifice and clean the air lid screens. See Fuel Orifice Inspection and Air Lid Screens Cleaning topics below.

WARNING! Check for fuel leaks after any fuel system service.

9.2.3 Fuel Orifice Inspection

Follow these steps to inspect the fuel orifice:
1. Shut off the fuel supply to the TEG and allow to cool.
2. Disconnect the fuel line from the solenoid valve.
3. Disconnect the other end of the fuel line from the orifice from the lid of the air box.
4. Remove the orifice fitting from the lid of the air box.
5. Visually check the orifice hole. It should be free from any obstructions. Replace it if necessary. It is recommended a magnifying glass is used to aid with visual inspection.
6. Connect the orifice fitting to the flexible fuel line then thread the orifice back through the center of the air shutter. This only needs to be finger tight.

CAUTION! Always use the same size orifice as what was removed.
- Propane orifice (#7) - Part# 689
- Natural gas orifice (#8) - Part# 690
- High BTU Natural gas orifice (#10) – Part# 6251

7. Connect the fuel line to SV valve and orifice, then tighten the fuel line fittings.
8. Leak check all connections using a commercial leak detector.

WARNING! Check for fuel leaks after any fuel system service.
9.3  BURNER MAINTENANCE

This text gives procedures for servicing the burner.

9.3.1  Air Lid Screens Cleaning

The air lid screens on the lid of the air-box may become clogged with dust and insects thereby preventing the proper flow of air into the burner.

Follow these steps to clean the air lid screens:

1. Shut-off the fuel supply to the TEG and allow cooling.

---

**WARNING!** If TEG has not cooled sufficiently it can be very hot.

---

2. Disconnect the supply fuel line and fuel inlet valve.
3. Disconnect the solenoid wire terminal connection and the orange wire connections of the pressure switch electrical connections.
4. Remove fuel line between the solenoid valve and orifice fitting.
5. Remove the fuel system same as section 9.3.2 5.
6. Remove the 2 screws from each side of the cabinet baffle and remove baffle from cabinet.

---

**NOTE:** Try not to disturb the air shutter setting.

---

7. Remove the 2 wing nuts and 4 screws from air box lid.
8. Clean the screens by forcing air through it or washing in water.
9. Replace Air Box lid, cabinet baffle, fuel system and fittings.

---

**NOTE:** If the air shutter setting was disturbed turn the venturi adjusting screw as described in Section 8.1.2. This will set the adjustment in the correct range to begin balancing the air-fuel mixture when re-starting.

---

10. Before re-starting the TEG, leak check all fuel connections.
9.3.2 Inspection of Burner Components

Burner internals are maintenance free for most applications. If the required $V_{set}$ still cannot be achieved after servicing the fuel system, air filter and checking the cooling fins and air duct then it may be necessary to check and service the burner internals. The procedures below give the steps for inspecting the burner components.

Figure 26 - Burner Assembly Cross Section

Follow these steps to remove the burner:

1. Shut-off the fuel supply to the TEG and allow to cool.

   **WARNING!** If TEG has not cooled sufficiently it can be very hot.

2. Disconnect the supply fuel line and fuel inlet valve.
3. Disconnect the solenoid wire terminal connection and the orange wire connections of the pressure switch electrical connections.
4. Remove fuel line between the solenoid valve and orifice fitting.
5. Remove the 2 bolts mounting the fuel regulator to the cabinet wall and remove the fuel system.
6. Remove the 2 screws from each side of the cabinet baffle and remove baffle from cabinet.
NOTE: Try not to disturb the air shutter setting.

7. Disconnect the ignition wire from the spark electrode.
8. Loosen the wing-nut and slide the spark electrode out. See Figure 13.
9. Remove screws from sides of rain cap and remove rain cap.
10. Remove screws from top exhaust shield and remove exhaust shield.
11. Remove screws from exhaust arrestor and remove exhaust arrestor.
12. Remove the 2 screws mounting the exhaust stack to the burner back cover.
13. Remove the four wing-nuts holding the burner in place and remove the cabinet exhaust shield.
14. Slide the burner assembly out of the burner chamber.

Follow these steps to inspect the burner:
1. Check the venturi assembly. If it looks severely corroded it should be replaced. Make sure the venturi is properly located in the venturi tube (see Figure 5), and that the venturi is facing the proper direction.
2. Check the air screens for any dust and debris. If any are found it should be cleaned.
3. Check the burner screen.
4. Check the ceramic spacer.

Follow these steps to install the burner:
1. Reassembly is the reverse of disassembly.

NOTE: The orifice fitting only needs to be finger tight when threaded to the front of the air box lid.

2. Before re-starting the TEG, leak check all fuel connections.

WARNING! Check for fuel leaks after any fuel system service.

9.4 SI SYSTEM MAINTENANCE

The SI system may require occasional maintenance. If the SI system fails to ignite it must be checked and serviced as necessary. Use the procedures below to maintain the SI system. If arching occurs the SI system is functioning well. See wiring diagrams Figure 14 or Figure 15.
WARNING! Remove the orange wire from the pressure switch and make sure it cannot come into contact with other electrical connections to prevent high voltage shock.

9.4.1 Check the Spark Electrode

WARNING! Remove the 2-position screw connector from the SI Controller board plugged into the header labeled “IGN” to prevent accidental high voltage shock from the igniter cable.

Follow these steps to check the spark electrode:

1. Remove the spark electrode by loosening the wing-nut and sliding the electrode out, (see Figure 13).
2. Inspect the electrode for any cracks in the ceramic rod. If any cracks are found the electrode must be replaced.
3. Slide the electrode back into position through the burner back until it stops, and then pull it back 3 to 6 mm (1/8 to 1/4 in.). The ceramic rod should extend about 25 mm (1 in.) from the holding screw.
4. Tighten the wing-nut only until it is snug.

CAUTION! Do not over tighten the wing-nut or the ceramic rod will crack

5. Loosen the orange wire connectors from the terminals on the pressure switch and then short the circuit between the two terminals. Arcing should occur in the combustion chamber (making a clicking noise) at the rate of one per second.
9.4.2 Check the Pressure Switch

Follow these steps to check the pressure switch:

1. Remove the two wires from the pressure switch and connect a multi-meter across the pressure switch terminals, set to measure resistance (ohms). One lead attached to one terminal and the second lead attached to the other.

2. If there is no fuel pressure in the system, check the resistance measured across the switch is near infinity, which indicates the switch is open.

3. Provide fuel pressure to the switch by opening the manual gas valve and holding open the safety SO valve.

4. Check the resistance measured across the switch is near zero, which indicates the switch being closed. Replace the pressure switch if necessary.

**NOTE:** Switch should close at pressures above 13.8 kPa (2 psig).

5. Remove fuel pressure from the switch by closing the manual gas valve and use a wire to join the two removed pressure switch wires together. This will cause the system to attempt a start which will release the trapped fuel.

6. If the TEG Controller is installed, after joining the two pressure switch wires together, press the Start (S1) button to attempt a start to release the trapped fuel.

7. Check the resistance measured across the switch is near infinity, which indicates the switch being opened. Replace the pressure switch if necessary.

**NOTE:** Switch should open at pressures below 6.9 kPa (1 psig).

8. The SI controller must recognize that there is fuel available by the closed pressure switch condition before it will power the SI module.
9.4.3 Check the Battery Voltage
Follow these steps to check the battery voltage:
1. Open the front of the TEG, then open the cover door to the electronics, located inside the door assembly.
2. Locate the battery, see Figure 7.
3. Disconnect the brown wire from the battery, to remove the battery from the system. Measure the voltage of the battery, between the positive (white wire) and negative (previous location of the brown wire) terminals of the battery. The voltage should be greater than 6 V.
4. If the voltage is less than 6 V the battery assembly needs recharging or replacing. The SI Controller board will not function if the battery voltage is below 5.5 V.

9.4.4 Check the Operation of the Ignition Control Module and Spark Generation
Follow these steps to check the operation of the ignition control module and spark generation:
1. Verify electrode gap (1/8” - 1/4”), Section 9.4.1.
2. Start the TEG.
3. If arcing occurs, the ignition control module is functioning.
4. If no arcing occurs, verify on the SI Controller board that the SI Power indicator light is turn on. If it is on, check that the two boards are connected with good contact, otherwise replace the SI module.

9.4.5 Check the spark return path for the SI module
Follow these steps to check the spark return path for the SI module:
1. Verify that the green wire is connected between the electronics assembly and the spark return connection (near the high voltage coil) on the SI Controller board.
2. Verify that the TEG bonding wire is connected between the electronics assembly and the TEG cabinet.
3. Both connections are required for the SI module to properly detect flame recognition. See wiring diagrams Figure 14 or Figure 15 for reference.

9.4.6 Check Solenoid Valve
Follow these steps to check the solenoid valve:
1. If at the beginning of sparking, the solenoid is not heard to click open and no fuel can flow, unplug the solenoid valve connector at the solenoid in the TEG Cabinet, see Figure 4. Measure the voltage between the blue and brown wires; it should be around 12V when the SI module is sparking. If it is, replace the solenoid.
2. If not, measure the voltage on the solenoid connector of the SI Controller board, between the blue and brown wires when the SI module is sparking, and the SI valve indicator is on. If it is, replace the solenoid wiring harness. If it isn’t, replace the SI module.
9.5 CONVERTER/LIMITER EXAMINATION

The C/L normally requires no maintenance. If the TEG is producing required $V_{set}$ but it is not supplying expected power to the load, then the operation of the C/L should be checked and serviced as necessary. Use the procedures below to help determine if the C/L could be damaged.

9.5.1 Check Converter/Limiter Switch Settings

Check the selector switches are set correctly for the required output voltage, per Figure 7.

NOTE: Switch 2-1 should be ON for 12 V or OFF for 24 V nominal output.

9.5.2 Check Output Voltage from the Converter/Limiter

Follow these steps to check the output voltage from the C/L:

1. Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1.
2. Connect a voltmeter between terminals 7 and 8 of TB-1 and measure the output voltage.
3. Alter the output voltage by turning the output voltage adjustment pot shown in Figure 8. If the unloaded output voltage, measured across terminals 7 and 8, does not change when the adjustment pot is altered the C/L needs replacing.

NOTE: If the TEG produces required $V_{set}$, the C/L is operating properly, and it still will not provide expected lower to the load then the power unit should be checked.

9.6 POWER UNIT EXAMINATION

The power unit normally requires no maintenance. If after maintaining and adjusting all other systems TEG will not produce required power, consider examining the power unit. Use the procedures below to help determine if the power unit could be damaged.

9.6.1 Check for Internal Short

Follow these steps to check for an internal short:

1. Start the TEG.
2. Free-up terminals 1 (+) and 2 (-), i.e. remove all wires from these terminals except the white/red power unit lead connected to terminal 1 and the white/black power unit lead connected to terminal 2.
3. Connect a voltmeter to terminals 1 and 2.

WARNING! The following steps may cause sparking. If an internal short is present the jumper wire, see below, may arc to the chassis.
4. Run a jumper wire from terminal 2 to the TEG chassis and watch the voltage reading. Remove the jumper wire. Any fluctuation in voltage may indicate an internal short within the power unit.

5. Run a jumper wire from terminal 1 to the TEG chassis and watch the voltage reading. Remove the jumper wire. Any fluctuation in voltage may indicate an internal short within the power unit.

6. If an internal short is confirmed, with no other equipment connected, the power unit is damaged and will need replacing. If not and the TEG appears to be fully functional check the customer load is functioning correctly and is grounded properly.

9.6.2 Check Internal Resistance

Follow these steps to check the power unit’s internal resistance:

1. Start the TEG.
2. Disconnect the customer load from terminals 7(+) and 8(-) of TB-1.
3. Connect a voltmeter between terminals 5 (+) and 6 (-).
4. Pause for sufficient time to get a stable measurement of $V_{set}$ between terminals 5 and 6. 15 minutes is often sufficient if the TEG was already warm. 1 hour is often sufficient if the TEG was just started from cold.
5. Record $V_{set}$.
6. While observing the voltmeter display remove the Connection from Terminal 1 of TB1, creating an open circuit condition, and note the momentary voltage. On a digital multimeter this will be the first number displayed after removing the connection, within 2 seconds of removing the connection. Record the number as the momentary open circuit voltage (Voc). If this was not recorded quickly enough replace the connection and repeat steps 4 to 6 above.

![Diagram](image.png)

Figure 28 - Momentary Open Circuit Diagram
7. Measure the Voltage across Terminals 1 and 2 and record.
8. Calculate the internal resistance using the equations 3 and 4 below.
9. Check the internal resistance, Ri, is less than 0.375 W. If not, the power unit may be damaged.

**Equation 3**

$$I_L = 1.25 \frac{V_{set}}{R_L}$$

**Equation 4**

$$R_i = \frac{(V_{oc} - V_L)}{I_L}$$

Where:

- $R_i$ = Internal resistance (W)
- $V_{oc}$ = Momentary open circuit voltage (V)
- $V_L$ = Load voltage (V)
- $I_L$ = Load current (A)
- $R_L$ = Precision load resistance (OHM)
- $V_{set}$ = Voltage measured across terminals 5 and 6 (V)

**Example**

If the load voltage and momentary open circuit voltages were measured as 6.7 V and 12.2 V respectively and the precision load resistance was 0.375 OHM then:

$$I_L = 1.25 \frac{V_L}{R_L}$$
$$I_L = 1.25 \frac{5.361}{0.375}$$
$$I_L = 17.87 \text{ A}$$

$$R_{INT} = \frac{(V_{oc} - V_L)}{I_L}$$
$$R_{INT} = \frac{(12.2 - 6.7)}{17.87}$$
$$R_{INT} = 5.5 / 17.87$$
$$R_{INT} = 0.308 \text{ OHM}$$

Internal resistance is acceptable, < 0.308 OHM.

For further information or assistance, please contact the Customer Service Department at Gentherm Global Power Technologies.
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Possible Solution</th>
<th>Lookup Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Burner does not ignite</strong></td>
<td>Air in fuel line</td>
<td>Purge fuel lines of air</td>
<td>Installation</td>
</tr>
<tr>
<td></td>
<td>Supply gas pressure too low</td>
<td>Increase the gas supply pressure to the TEG</td>
<td>Installation</td>
</tr>
<tr>
<td></td>
<td>Fuel filter dirty</td>
<td>Drain the regulator sediment</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace the fuel filter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel pressure adjustment incorrect</td>
<td>Adjust the TEG fuel manifold pressure</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice plugged</td>
<td>Replace the fuel orifice</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice size incorrect</td>
<td>Replace the fuel orifice</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air filter dirty</td>
<td>Clean the air filter</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air-shutter adjustment incorrect</td>
<td>Adjust the air-shutter</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>SI system faulty</td>
<td>Maintain the SI system</td>
<td>Maintenance</td>
</tr>
<tr>
<td><strong>Burner will ignite but will not continue to burn</strong></td>
<td>Supply gas pressure too low</td>
<td>Increase the gas supply pressure to the TEG</td>
<td>Installation</td>
</tr>
<tr>
<td></td>
<td>Fuel filter dirty</td>
<td>Drain the regulator sediment bowl.</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace the fuel filter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel pressure adjustment incorrect</td>
<td>Adjust the TEG fuel manifold pressure</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice plugged</td>
<td>Replace the fuel orifice</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice size incorrect</td>
<td>Replace the orifice with one of the correct size</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Safety SOV valve malfunctioning</td>
<td>Check the safety SOV valve</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air filter dirty</td>
<td>Clean the air filter</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air shutter adjustment incorrect</td>
<td>Adjust the air-shutter</td>
<td>Adjustment</td>
</tr>
</tbody>
</table>
### TROUBLESHOOTING, continued

<table>
<thead>
<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Possible Solution</th>
<th>Lookup Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low output power or low voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_{\text{set}} ) adjustment incorrect</td>
<td>Determine required ( V_{\text{set}} ) for present ambient temperature at site and adjust</td>
<td>Power Output Evaluation and Adjustment</td>
</tr>
<tr>
<td></td>
<td>Airflow past cooling fins insufficient</td>
<td>Clean the cooling fins of any debris</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel filter dirty</td>
<td>Drain the regulator sediment bowl</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice plugged</td>
<td>Replace the fuel orifice</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel orifice size incorrect</td>
<td>Replace the orifice</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Fuel pressure adjustment incorrect</td>
<td>Adjust TEG fuel manifold pressure</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>Safety SOV valve malfunctioning</td>
<td>Check the safety SOV valve</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air filter dirty</td>
<td>Clean the air filter</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Air-shutter adjustment incorrect</td>
<td>Adjust air-shutter</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>C/L* damaged</td>
<td>Examine the C/L</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>C/L* adjustment incorrect</td>
<td>Adjust the C/L</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>Power unit damaged</td>
<td>Examine the power unit</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Output power is too high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel pressure adjustment incorrect</td>
<td>Adjust the TEG fuel manifold pressure</td>
<td>Adjustment</td>
</tr>
<tr>
<td>Output voltage is too high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L/C* damaged</td>
<td>Adjust the L/C</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>L/C* adjustment incorrect</td>
<td>Adjust the L/C</td>
<td>Adjustment</td>
</tr>
</tbody>
</table>

*applicable for L/C option only
11 PART LIST

This section lists the parts that form the equipment.

For parts and service please contact Gentherm Global Power Technologies’ Customer Service Department at:

GENTHERM GLOBAL POWER TECHNOLOGIES

Power where you need it.®

#16, 7875 - 57th Street SE
Calgary, Alberta T2C 5K7

Direct: (403) 720-1190
Fax: (403) 236-5575
Main: (403) 236-5556

E-mail: customer.service@gentherm.com
Web: www.genthermglobalpower.com
### 11.1 MODEL P-5100 TEG

**Figure 29 - Model P-5100 TEG**

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>61864</td>
<td>FUEL SYSTEM, P-5050/P-5100</td>
</tr>
<tr>
<td>or</td>
<td>62557</td>
<td>FUEL SYSTEM, SS, P-5050/P-5100</td>
</tr>
<tr>
<td>A2</td>
<td>2105</td>
<td>SCREW, CAP, HEX-HD, 1/4-20 X 3-1/2, SS, 1-1/2” THREAD</td>
</tr>
<tr>
<td>A3</td>
<td>557</td>
<td>WASHER, FLAT, 1/4” SS</td>
</tr>
<tr>
<td>A4</td>
<td>62064</td>
<td>BAFFLE, INNER CABINET, P-5050/P-5100</td>
</tr>
<tr>
<td>A5</td>
<td>7324</td>
<td>SCREW, Mach, P-H-P, 8-32 X 1/2, SS</td>
</tr>
<tr>
<td>A6</td>
<td>472</td>
<td>WASHER, Lock, EXT. #8, SS</td>
</tr>
<tr>
<td>A7</td>
<td>62124</td>
<td>EXHAUST SHIELD, OUTER, BACK, P-5100</td>
</tr>
<tr>
<td>A8</td>
<td>541</td>
<td>WASHER, LOCK, SPRING, 1/4, SS</td>
</tr>
<tr>
<td>A9</td>
<td>255</td>
<td>SCREW, MACH, P-H-P, 10-32 X 3/8 SS</td>
</tr>
<tr>
<td>A10</td>
<td>9696</td>
<td>WASHER, LOCK, SPRING, #10, 316 SS</td>
</tr>
<tr>
<td>A11</td>
<td>569</td>
<td>WASHER, FLAT, #10, SST</td>
</tr>
<tr>
<td>A12</td>
<td>61984</td>
<td>EXHAUST ASSY, P-5050/P-5100</td>
</tr>
<tr>
<td>A13</td>
<td>61569</td>
<td>GASKET, EXHAUST, P-5050/P-5100</td>
</tr>
</tbody>
</table>
## 11.1 MODEL P-5100 TEG (Cont’d)

![Figure 29 - Model P-5100 TEG](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A15</td>
<td>266</td>
<td>SCREW, CAP, SOC, 1/4-20 X 1/2 SS</td>
</tr>
<tr>
<td>A16</td>
<td>61993</td>
<td>CABINET ASSEMBLY, P-5050/P-5100</td>
</tr>
<tr>
<td>A17</td>
<td>62122</td>
<td>RAIN GUARD, P-5050/P-5100</td>
</tr>
<tr>
<td>A18</td>
<td>7410</td>
<td>SCREW, Mach, P-H-P, 8-32 X 1/4, SS</td>
</tr>
<tr>
<td>A19</td>
<td>63985</td>
<td>EXHAUST TUBE ASSY, NON FA, P-5050/P-5100</td>
</tr>
<tr>
<td>A20</td>
<td>62126</td>
<td>EXHAUST TUBE ASSY, P-5050/P-5100</td>
</tr>
<tr>
<td>A21</td>
<td>62065</td>
<td>LINER, EXHAUST, P-5050/P-5100</td>
</tr>
<tr>
<td>A22</td>
<td>62067</td>
<td>RAIN CAP ASSEMBLY, P-5050/5100</td>
</tr>
<tr>
<td>A23</td>
<td>62113</td>
<td>COVER ASSY, UPPER, FIN DUCT, P-5050/P-5100</td>
</tr>
<tr>
<td>A24</td>
<td>61561</td>
<td>FIN DUCT, UPPER, P-5100</td>
</tr>
<tr>
<td>A25</td>
<td>61559</td>
<td>FIN DUCT, LOWER, P-5100</td>
</tr>
<tr>
<td>A26</td>
<td>20535</td>
<td>SCREW, HEX HD, 1/4-20 X 5/8, SS</td>
</tr>
<tr>
<td>A27</td>
<td>62114</td>
<td>LEG, P-5050/P-5100</td>
</tr>
<tr>
<td>A28</td>
<td>8911</td>
<td>POWER UNIT, SEAT-IN, P-5100</td>
</tr>
<tr>
<td>A29</td>
<td>58496</td>
<td>ELECTRODE ASSY, SI, 5220</td>
</tr>
<tr>
<td>A30</td>
<td>600</td>
<td>NUT, WING, 8-32, SST</td>
</tr>
<tr>
<td>A31</td>
<td>266</td>
<td>SCREW, CAP, SOC, 1/4-20 X 1/2 SS</td>
</tr>
</tbody>
</table>
### 11.1 MODEL P-5100 TEG (Cont’d)

**Figure 29 - Model P-5100 TEG**

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A32</td>
<td>690</td>
<td>ORIFICE, 8,0.029,5120-N/5220-N</td>
</tr>
<tr>
<td>A33</td>
<td>689</td>
<td>ORIFICE, 7,0.021,5120-L</td>
</tr>
<tr>
<td>A34</td>
<td>62120</td>
<td>FUEL LINE, P-5050/P-5100</td>
</tr>
<tr>
<td></td>
<td>or 65821</td>
<td>FUEL LINE, SS FUEL SYSTEM, P-5050/P-5100</td>
</tr>
<tr>
<td>A35</td>
<td>611</td>
<td>NUT, HEX, 1/4-20, SS</td>
</tr>
<tr>
<td>A36</td>
<td>65176</td>
<td>LIMITER/CONVERTER ASSY, 12V, P-5050/P-5100 (OPTIONAL)</td>
</tr>
<tr>
<td>A37</td>
<td>65175</td>
<td>LIMITER/CONVERTER ASSY, 24V, P-5050/P-5100 (OPTIONAL)</td>
</tr>
<tr>
<td>A38</td>
<td>63515</td>
<td>LIMITER/CONVERTER ASSY, 12V, RS, P-5050/P-5100 (OPTIONAL)</td>
</tr>
<tr>
<td>A39</td>
<td>63516</td>
<td>LIMITER/CONVERTER ASSY, 24V, RS, P-5050/P-5100 (OPTIONAL)</td>
</tr>
<tr>
<td>A41</td>
<td>65209</td>
<td>CP INTERFACE ASSEMBLY P-5100 12 V (NOT SHOWN) (OPTIONAL)</td>
</tr>
<tr>
<td>A42</td>
<td>65246</td>
<td>CP INTERFACE ASSEMBLY P-5100 24 V (NOT SHOWN) (OPTIONAL)</td>
</tr>
<tr>
<td></td>
<td>56980</td>
<td>SENSOR, TEMPERATURE, TRISTAR TS-RTS (NOT SHOWN) (OPTIONAL)</td>
</tr>
</tbody>
</table>
## Part List

### 11.2 Model P-5100 Burner

![Figure 30 - Model P-5100 Burner](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>62117</td>
<td>Burner Back Ass'y, P-5050/P-5100</td>
</tr>
<tr>
<td>B2</td>
<td>62115</td>
<td>Insulation Support, P-5050/P-5100</td>
</tr>
<tr>
<td>B3</td>
<td>701</td>
<td>Spacer, Insulation</td>
</tr>
<tr>
<td>B4</td>
<td>693</td>
<td>Screen Holder, 5015/5030/5060/5120/1120</td>
</tr>
<tr>
<td>B5</td>
<td>873</td>
<td>Screen, Burner, 5120/1120</td>
</tr>
<tr>
<td>B6</td>
<td>694</td>
<td>Insert Ring, Burner, 5120/5060/5030/1120</td>
</tr>
<tr>
<td>B7</td>
<td>61869</td>
<td>Insulation Block, P-5050/P-5100</td>
</tr>
<tr>
<td>B8</td>
<td>61871</td>
<td>Spacer, Venturi, P-5050/P-5100</td>
</tr>
<tr>
<td>B9</td>
<td>62056</td>
<td>Venturi, P-5100</td>
</tr>
<tr>
<td>B10</td>
<td>61870</td>
<td>Burner Cover, P-5050/P-5100</td>
</tr>
<tr>
<td>B11</td>
<td>62118</td>
<td>Air Box Ass'y, W Intake Arrestors, P-5050/P-5100</td>
</tr>
<tr>
<td>B12</td>
<td>7004</td>
<td>Pin, Mounting, Si Electrode</td>
</tr>
<tr>
<td>B13</td>
<td>7005</td>
<td>Nut, Wing, 5/16-18, SS</td>
</tr>
<tr>
<td>B14</td>
<td>601</td>
<td>Nut, Wing, 10-32, SS</td>
</tr>
<tr>
<td>B15</td>
<td>63957</td>
<td>Nut, Lock, Hex, 10-32, 316SS</td>
</tr>
<tr>
<td>B16</td>
<td>63954</td>
<td>Air Shutter Ass'y, P-5050/P-5100</td>
</tr>
</tbody>
</table>
## 11.2 MODEL P-5100 BURNER (Cont’d)

![Model P-5100 Burner](62658 REV1)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B17</td>
<td>27901</td>
<td>WASHER, BOWED, 5 MM, A2 SS, Spaenaur 681-821</td>
</tr>
<tr>
<td>B18</td>
<td>61990</td>
<td>LID W/ ARRESTORS, ASSEMBLY, P-5050/P-5100</td>
</tr>
<tr>
<td>B19</td>
<td>00472</td>
<td>WASHER, Lock, EXT. #8, SS</td>
</tr>
<tr>
<td>B20</td>
<td>7324</td>
<td>SCREW, Mach, P-H-P, 8-32 X 1/2, SS</td>
</tr>
<tr>
<td>B21</td>
<td>609</td>
<td>NUT, HEX, 10-32, SST</td>
</tr>
<tr>
<td>B22</td>
<td>63956</td>
<td>SCREW, MACH, P-H-S, 10-32 X 2” SS</td>
</tr>
</tbody>
</table>
## 11.3 MODEL P-5100 FUEL SYSTEM

![Figure 31 - Model P-5100 Fuel System](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>24653</td>
<td>VALVE, BALL, 1/4 NPT, BRASS, CG/CSA/UL APP’D, 600# WOG</td>
</tr>
<tr>
<td>C2</td>
<td>62069</td>
<td>NIPPLE, 1/4 NPT X 6” LG. BRASS</td>
</tr>
<tr>
<td>C3</td>
<td>21569</td>
<td>ELBOW, Street 1/4 NPT, B-4-SE</td>
</tr>
<tr>
<td>C4</td>
<td>63312</td>
<td>REGULATOR, FISHER 67CFR, 0-20 PSI, UL 144 &amp; UL 252, P-5050/P-5100</td>
</tr>
<tr>
<td>C5</td>
<td>58949</td>
<td>PLUG, 1/4” NPT X 7/8” STEEL, UMBRAKO 1105766</td>
</tr>
<tr>
<td>C6</td>
<td>501</td>
<td>NIPPLE, HEX, 1/4 NPT X 1 1/8, BRASS</td>
</tr>
<tr>
<td>C7</td>
<td>61991</td>
<td>MANIFOLD BLOCK, FUEL SYSTEM, P-5050/P-5100</td>
</tr>
<tr>
<td>C8</td>
<td>691</td>
<td>GAUGE, Pressure, 0-15 PSI</td>
</tr>
<tr>
<td>C9</td>
<td>7996</td>
<td>NIPPLE, HEX, 1/8 NPT, 316 SS, SS-2-HN</td>
</tr>
<tr>
<td>C10</td>
<td>27927</td>
<td>VALVE, Solenoid, Burkert, 6013, 463305,2mm ORIFICE 2WAY NC /8FNPT, Brass</td>
</tr>
<tr>
<td>C11</td>
<td>20977</td>
<td>CONNECTOR, 1/4 TB X 1/8 MNPT, SS-400-1-2</td>
</tr>
<tr>
<td>C12</td>
<td>6471</td>
<td>SWITCH, PRESSURE 1.6 PSI, 76056-DB 1.6-0.5</td>
</tr>
<tr>
<td>C13</td>
<td>380</td>
<td>CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4</td>
</tr>
<tr>
<td>C14</td>
<td>61865</td>
<td>VENT TUBE ASSY, REGULATOR, SS P-5050/P-5100</td>
</tr>
<tr>
<td>C15</td>
<td>22363</td>
<td>FILTER KIT, FISHER 67 CFR (Not Shown)</td>
</tr>
</tbody>
</table>
### 11.4 MODEL P-5100 OPTIONAL STAINLESS-STEEL FUEL SYSTEM

Figure 32 - Model P-5100 SS Fuel System

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>21689</td>
<td>VALVE, BALL, 1/4” 2000 LB, 316 SS, V-TEK V2</td>
</tr>
<tr>
<td>D2</td>
<td>62559</td>
<td>NIPPLE, 1/4 NPT X 6” L, SS</td>
</tr>
<tr>
<td>D3</td>
<td>2356</td>
<td>ELBOW, STREET, 1/4 NPT, SS</td>
</tr>
<tr>
<td>D4</td>
<td>22364</td>
<td>REGULATOR, FISHER 67CFR, 0-20 PSI, SOUR GAS</td>
</tr>
<tr>
<td>D5</td>
<td>20428</td>
<td>PLUG, 1/4 NPT, HEX, 316 SS, SS-4-P</td>
</tr>
<tr>
<td>D6</td>
<td>2359</td>
<td>NIPPLE, HEX, 1/4 NPT X 1.5 LG, 316 SS</td>
</tr>
<tr>
<td>D7</td>
<td>61991</td>
<td>MANIFOLD BLOCK, FUEL SYSTEM, P-5050/P-5100</td>
</tr>
<tr>
<td>D8</td>
<td>691</td>
<td>GAUGE, Pressure, 0-15 PSI</td>
</tr>
<tr>
<td>D9</td>
<td>7996</td>
<td>NIPPLE, HEX, 1/8 NPT, 316 SS, SS-2-HN</td>
</tr>
<tr>
<td>D10</td>
<td>62558</td>
<td>VALVE, SOLENOID, BURKERT 6013, 6013-A02,0BBVANM81-5-012/DC-02, PD02, 2mm ORIFICE 2WAY NC 1/8 FNPT, SS</td>
</tr>
<tr>
<td>D11</td>
<td>20977</td>
<td>CONNECTOR, 1/4 TB X 1/8 MNPT, SS-400-1-2</td>
</tr>
<tr>
<td>D12</td>
<td>61849</td>
<td>SWITCH, PRESSURE, 1.6 PSI, NO, PLATED STEEL, HOBBS 76056-00000016-05</td>
</tr>
</tbody>
</table>
### 11.4 MODEL P-5100 OPTIONAL STAINLESS-STEEL FUEL SYSTEM (Cont’d)

**Figure 32 - Model P-5100 SS Fuel System**

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D13</td>
<td>380</td>
<td>CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4</td>
</tr>
<tr>
<td>D14</td>
<td>61865</td>
<td>VENT TUBE ASSY, REGULATOR, SS P-5050/P-5100</td>
</tr>
<tr>
<td>D15</td>
<td>22363</td>
<td>FILTER KIT, FISHER 67 CFR (Not Shown)</td>
</tr>
</tbody>
</table>
## 11.5 MODEL P-5100 ELECTRICAL

![Figure 33 - Model P-5100 Electrical](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>63035</td>
<td>BACK PAN, ELECTRICAL ENCLOSURE, P-5050/P-5100</td>
</tr>
<tr>
<td>E2</td>
<td>56227</td>
<td>SCREW, MACH, P-H-P, 6-32 X 1.5” LG, SS</td>
</tr>
<tr>
<td>E3</td>
<td>24554</td>
<td>NUT, LOCK, HEX, 8-32, NYLON INSERT, 316 SS</td>
</tr>
<tr>
<td>E4</td>
<td>7324</td>
<td>SCREW, MACH, P-H-P, 8-32 X 1/2, SS</td>
</tr>
<tr>
<td>E7</td>
<td>63136</td>
<td>STANDOFF, 6-32 M/F, 1/4” HEX, ALUM, 1.12” LG</td>
</tr>
<tr>
<td>E8</td>
<td>63096</td>
<td>SI BOARD, CHANNEL PROD, 2021-90, MICRO 50N-12-3-3-7-10-0</td>
</tr>
<tr>
<td>E9</td>
<td>254</td>
<td>SCREW, MACH, P-H-P, 8-32 X 3/8, SS</td>
</tr>
<tr>
<td>E10</td>
<td>472</td>
<td>WASHER, LOCK, EXT. #8, SS</td>
</tr>
<tr>
<td>E12</td>
<td>63205</td>
<td>TEG CONTROLLER ASSY, P-5050/P-5100</td>
</tr>
<tr>
<td>E13</td>
<td>7410</td>
<td>SCREW, MACH, P-H-P, 8-32 X 1/4, SS</td>
</tr>
<tr>
<td>E14</td>
<td>606</td>
<td>NUT, HEX, 8-32, SST</td>
</tr>
<tr>
<td>E15</td>
<td>52307</td>
<td>SCREW, MACH, P-H-P, 8-32 X 5/8”, SS</td>
</tr>
<tr>
<td>E16</td>
<td>64624</td>
<td>PCB ASSY, SI CONTROLLER</td>
</tr>
<tr>
<td>E17</td>
<td>25984</td>
<td>WASHER, LOCK, INTERNAL, #6, SS</td>
</tr>
<tr>
<td>E18</td>
<td>63137</td>
<td>SPACER, NYLON, 0.8125” LG, #6 HOLE DIGIKEY 492-1112-ND</td>
</tr>
</tbody>
</table>
## 11.5 MODEL P-5100 ELECTRICAL (Cont’d)

**Figure 33 - Model P-5100 Electrical**

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E19</td>
<td>604</td>
<td>NUT, HEX, 6-32, SST</td>
</tr>
<tr>
<td>E20</td>
<td>54087</td>
<td>SCREW, MACH, P-H-P, 6-32 X 1/4, SS</td>
</tr>
<tr>
<td>E21</td>
<td>63960</td>
<td>WASHER, RETAINING, SOUTHCO 09-6-1</td>
</tr>
<tr>
<td>E22</td>
<td>63959</td>
<td>SCREW, FAST LEAD, KNURLED, SS, SOUTHCO 09-13-102-26</td>
</tr>
<tr>
<td>E23</td>
<td>63039</td>
<td>DEAD FRONT, ELECTRICAL ASSY, P-5050/P-5100</td>
</tr>
<tr>
<td>E24</td>
<td>63126</td>
<td>PCB ASSY, LC DC/DC CONVERTER, MEDIUM POWER, P-5050/P-5100</td>
</tr>
<tr>
<td>E25</td>
<td>64879</td>
<td>PCB ASSY, LC DC/DC LIMITER, MEDIUM POWER, P-5050/P-5100</td>
</tr>
<tr>
<td>E26</td>
<td>58437</td>
<td>SCREW, CAP, HEX SOCKET, 8-32 x 3/8”, 18.8 SS</td>
</tr>
<tr>
<td>E27</td>
<td>24559</td>
<td>BATTERY, 6V, 5.0Ahr, MONOBLOC, AEI 108539</td>
</tr>
<tr>
<td>E28</td>
<td>63199</td>
<td>HIGH TEMP BATTERY, ASSY, P-5050/P-5100 (OPTIONAL)</td>
</tr>
<tr>
<td>E29</td>
<td>63961</td>
<td>NUT, CLIP-ON, SOUTHCO 09-43-101-24</td>
</tr>
<tr>
<td></td>
<td>65163</td>
<td>WIRING HARNESS, VOLTAGE SENSING RELAY (VSR), OPTION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P-5050/P-5100 (OPTIONAL) NOT SHOWN</td>
</tr>
<tr>
<td>E30</td>
<td>66222</td>
<td>FUSE, 3A, 32V GRAY MINI ATM</td>
</tr>
</tbody>
</table>
12  CATHODIC PROTECTION OPTION

12.1  INTRODUCTION

The Cathodic Protection Interface Provides for adjustment and monitoring of power to the CP load. The anode and cathode cables enter the cabinet at the bottom and connect directly to the heavy-duty terminal block. Refer to Figure 34 for locations and description of the major components of the CP Interface Cabinet.

12.1.1  Meter

The duel 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.

![Cathodic Protection Interface Cabinet Diagram](5939A_rev4)

*Figure 34 - Cathodic Protection Interface Cabinet*
12.1.2 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 rating corresponds to the ampere scale on the meter.

12.1.3 Adjustments
A 300-Watt variable resistor located inside the cabinet may be used to adjust the output power of the CP interface. This resistor may be connected in series or parallel with the TEG. See Figure 35 for series connection and Figure 36 for parallel Connections.

12.1.4 Series
By connecting the 300-Watt resistor in series with the TEG the maximum allowable power may be delivered to the CP load. This is achieved by moving the tap to the bottom of the resistor.

12.1.5 Parallel
By connecting the 300-Watt resistor in parallel with the TEG smaller levels of power may be delivered to the CP load. This may be required when hot spots occur on the anode. With the tap located at the top of the resistor the output power will be zero. As the tap is moved down, the power to the CP load is increased.

![Diagram](image-url)  
*Figure 35 - CP Interface System, Series Wiring Diagram*
Series and Parallel configurations are made by moving the wire at the top of the 300-Watt resistor from the left position to the center position of the heavy-duty terminal block.

Complete parts listings are given in the next five pages for the various Cathodic Protection Interface Systems available. The required system for various TEGs are listed below.

<table>
<thead>
<tr>
<th><strong>GPT TEG</strong></th>
<th><strong>Part No.</strong></th>
<th><strong>System Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>P-5050-12</td>
<td>65207</td>
<td>CP Interface Assembly, P-5050-12V</td>
</tr>
<tr>
<td>P-5050-24</td>
<td>65245</td>
<td>CP Interface Assembly, P-5050-24V</td>
</tr>
<tr>
<td>P-5100-12</td>
<td>65209</td>
<td>CP Interface Assembly, P-5100-12V</td>
</tr>
<tr>
<td>P-5100-24</td>
<td>65246</td>
<td>CP Interface Assembly, P-5100-24V</td>
</tr>
</tbody>
</table>
Figure 37 - Cathodic Protection System Parts Identification
### Figure 38 - Parts Table

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1839</td>
<td>BOX, CATHODIC PROTECTION SHELL</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>6714</td>
<td>TERMINAL BLOCK, HEAVY DUTY, 3POLE</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6218</td>
<td>METER FACE, 0-15V, 0-30A (FOR PANEL #65206 &amp; 65208)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6219</td>
<td>METER FACE, 0-20V, 0-10A (FOR PANEL #65209 &amp; 65207)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6220</td>
<td>METER FACE, 0-30V 0-5A (FOR PANEL #65245 &amp; 65246)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6217</td>
<td>CURRENT SHUNT, 30A, 50MV (FOR PANEL #65206 &amp; 65208)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6216</td>
<td>CURRENT SHUNT, 10A, 50MV (FOR PANEL #65209 &amp; 65207)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6215</td>
<td>CURRENT SHUNT, 5A, 50MV (FOR PANEL #65245 &amp; 65246)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>65210</td>
<td>RESISTOR, 0.5 OHM, 300 WATT, ADJUSTABLE</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>65211</td>
<td>RESISTOR, 1.5 OHM, 300 WATT, ADJUSTABLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65212</td>
<td>RESISTOR, 2.5 OHM, 300 WATT, ADJUSTABLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65213</td>
<td>RESISTOR, 8 OHM, 300 WATT, ADJUSTABLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65247</td>
<td>RESISTOR, 12 OHM, 300 WATT, ADJUSTABLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65248</td>
<td>RESISTOR, 50 OHM, 300 WATT, ADJUSTABLE</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1931</td>
<td>LABEL, PUSH TO READ AMPS</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>3192</td>
<td>PLUG, BUMPER</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>1947</td>
<td>GROMMET, RUBBER, 1/4” X 1/8”</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>2284</td>
<td>CP METER ADJUST ASSY</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1851</td>
<td>WEATHER STRIPPING, 3/8” X 1/8” THK</td>
<td>39</td>
</tr>
<tr>
<td>11</td>
<td>258</td>
<td>SCREW, MACH, P-H-P, 1/4 X 20 X 5/8, SS</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>473</td>
<td>WASHER, LOCK, EXT, 1/4, SS</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>611</td>
<td>NUT, HEX, 1/4-20, SS</td>
<td>8</td>
</tr>
<tr>
<td>14</td>
<td>606</td>
<td>NUT, HEX, 8-32, SS</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>208</td>
<td>TERM, RING, YELLOW, #10</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>201</td>
<td>TERM, RING, YELLOW, 1/4</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>202</td>
<td>TERM, RING, RED, 1/4</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>213</td>
<td>TERM, RING, RED, #6</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>569</td>
<td>WASHER, FLAT, 0.203 ID, 0.049 THK</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>86</td>
<td>MOUNTING HARDWARE, 300 W RESISTOR</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>156</td>
<td>WIRE, #10, WHT/BLK, TIN-PLT-COP</td>
<td>35</td>
</tr>
<tr>
<td>22</td>
<td>156</td>
<td>WIRE, #10, WHT/BLK, TIN-PLT-COP</td>
<td>8.5</td>
</tr>
<tr>
<td>23</td>
<td>2041</td>
<td>WIRE, #10, BRN, TIN-PLT-COP11</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>157</td>
<td>WIRE, #10, WHT/RED, TIN-PLT-COP</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>157</td>
<td>WIRE, #10, WHT/RED, TIN-PLT-COP</td>
<td>8</td>
</tr>
<tr>
<td>26</td>
<td>157</td>
<td>WIRE, #10, WHT/RED, TIN-PLT-COP</td>
<td>4.25</td>
</tr>
<tr>
<td>27</td>
<td>133</td>
<td>WIRE, #10, RED, TIN-PLT-COP</td>
<td>11</td>
</tr>
<tr>
<td>Item</td>
<td>Part No.</td>
<td>Description</td>
<td>QTY</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>28</td>
<td>2134</td>
<td>METER PANEL, CP, BRUSHED</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>6226</td>
<td>METER, GE/TCA, 251-324-ECXS BUTTON, RED, 61F-675, FOR ALCO SWITCH</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>255</td>
<td>SCREW, MACH, P-H-P, 10-32 X 3/8, SS</td>
<td>2</td>
</tr>
<tr>
<td>31</td>
<td>256</td>
<td>SCREW, MACH, P-H-P, 10-32 X 1/2, SS</td>
<td>6</td>
</tr>
<tr>
<td>32</td>
<td>25071</td>
<td>SCREW, MACH, P-H-P, 10-32 X 1/4, SS</td>
<td>6</td>
</tr>
<tr>
<td>33</td>
<td>00469</td>
<td>WASHER, LOCK SPRING, #8, SS</td>
<td>6</td>
</tr>
<tr>
<td>34</td>
<td>539</td>
<td>WASHER, LOCK, SPRING, #10, CAD</td>
<td>2</td>
</tr>
<tr>
<td>35</td>
<td>254</td>
<td>SCREW, MACK, P-H-P, 8-32 X 3/8, SS</td>
<td>7</td>
</tr>
<tr>
<td>36</td>
<td>468</td>
<td>WASHER, LOCK, INT, #8, SS</td>
<td>10</td>
</tr>
<tr>
<td>37</td>
<td>4795</td>
<td>LABEL, CATHODIC PROTECTION INTERFACE</td>
<td>1</td>
</tr>
</tbody>
</table>
13 HEAT RECOVERY SYSTEM (HRS) OPTION

13.1 INTRODUCTION

The Heat Recovery System (HRS) Option is available for P-5050 and P-5100. This option allows for waste heat recover, to warm building interiors where required, see Figure 38.

The TEG configured for the HRS application includes an HRS specific rain cap, exhaust tube assembly, and burner configuration. The ducts and legs are replaced with mounting bars for mounting to the HRS option, see Figure 39, Item G37.

13.2 INSTALLATION

Each HRS kit is provided with an installation manual to provide instruction for mounting the HRS to the exterior wall of the building. Refer to the Heat Recovery System (HRS) Installation Manual, part number 66683 to complete the HRS and TEG installation.

**WARNING!** Do not block air flow to duct openings. Doing so may cause over temperature as well as damage to TEG.

13.3 TEG OPERATION

Refer to Sections 2 - 10 of this manual for TEG operations
# 13.4 MODEL P-5100 HRS CONFIGURATION PARTS

![Figure 40 - HRS Configuration](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td></td>
<td>See Figure 29</td>
</tr>
<tr>
<td>G2</td>
<td>66634</td>
<td>BURNER ASSEMBLY, W/INTAKE ARRESTOR, HRS, P-5100</td>
</tr>
<tr>
<td>or</td>
<td>62121</td>
<td>BURNER ASSEMBLY, W/INTAKE ARRESTOR, P-5100</td>
</tr>
<tr>
<td>G3</td>
<td></td>
<td>See Figure 29</td>
</tr>
<tr>
<td>G4</td>
<td>65697</td>
<td>RAIN CAP ASSEMBLY, HRS, P-5050/5100</td>
</tr>
<tr>
<td>G5-G16</td>
<td></td>
<td>See Figure 29</td>
</tr>
<tr>
<td>G17</td>
<td>7410</td>
<td>SCREW, MACH, P-H-P, 8-32X1/4, SS</td>
</tr>
<tr>
<td>G18</td>
<td></td>
<td>See Figure 29</td>
</tr>
<tr>
<td>G19</td>
<td>62570</td>
<td>ELECTRODE ASSY, FLAME SENSING SI</td>
</tr>
<tr>
<td>or</td>
<td>58496</td>
<td>ELECTRODE ASSY, SI, 5220</td>
</tr>
<tr>
<td>G20</td>
<td>65698</td>
<td>EXHAUST TUBE ASSY, HRS, P-5050/P-5100</td>
</tr>
<tr>
<td>G21-G34</td>
<td></td>
<td>See Figure 29</td>
</tr>
<tr>
<td>G35</td>
<td>65709</td>
<td>RAIN DEFLECTOR, HRS, P-5050/P-5100</td>
</tr>
<tr>
<td>G36</td>
<td>65724</td>
<td>SCREW, HEX HD, 1/4-20 x 2, SS</td>
</tr>
<tr>
<td>G37</td>
<td>62131</td>
<td>MOUNTING BAR, HRS, P-5050/P-5100</td>
</tr>
</tbody>
</table>
### 13.5 MODEL P-5100 HRS BURNER PARTS

![Figure 41 - Model P-5100 HRS, Burner](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>62117</td>
<td>BURNER BACK ASSY, P-5050/P-5100</td>
</tr>
<tr>
<td>J2-J6</td>
<td></td>
<td>See Figure 30</td>
</tr>
<tr>
<td>J7</td>
<td>66630</td>
<td>INSULATION BLOCK, TOP ELECTRODE, P-5050/P-5100</td>
</tr>
<tr>
<td>J8-J9</td>
<td></td>
<td>See Figure 30</td>
</tr>
<tr>
<td>J10</td>
<td>66631</td>
<td>BURNER COVER, TOP ELECTRODE, P-5050/P-5100</td>
</tr>
<tr>
<td>J11</td>
<td>66635</td>
<td>AIR BOX ASSY, TOP ELECTRODE, P-5050/P-5100</td>
</tr>
<tr>
<td>J12-J17</td>
<td></td>
<td>See Figure 30</td>
</tr>
<tr>
<td>J18</td>
<td>66632</td>
<td>LID W/ ARRESTORS, ASSEMBLY, TOP ELECTRODE P-5050/P-5100</td>
</tr>
<tr>
<td>J19-J23</td>
<td></td>
<td>See Figure 30</td>
</tr>
</tbody>
</table>
## 14 TEG PERFORMANCE LOG

**MODEL NO:**  
TEG SERIAL NO:  
FUEL TYPE:  
LIMITER/CONVERTER SERIAL NO:  
CP INTERFACE SERIAL NO:  

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>AMBIENT TEMP</th>
<th>REQUIRED POWER (W)</th>
<th>REQUIRED $V^SET (V)$</th>
<th>MEASURED $V^SET (V)$</th>
<th>MEASURED POWER (W)</th>
<th>FUEL PRESSURE</th>
<th>OPEN CIRCUIT VOLTAGE (V)</th>
<th>MAINTENANCE REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 14 TEG PERFORMANCE LOG

Model No: [TEG SERIAL N]
Fuel Type: [INSERT FUEL TYPE]
Limiter/Converter Serial No: [INSERT SERIAL NO]
CP Interface Serial No: [INSERT SERIAL NO]

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>Ambient Temp °C</th>
<th>Required Power (W)</th>
<th>Required V&lt;sub&gt;SET&lt;/sub&gt; (V)</th>
<th>Measured V&lt;sub&gt;SET&lt;/sub&gt; (V)</th>
<th>Measured Power (W)</th>
<th>Fuel Pressure</th>
<th>Open Circuit Voltage (V)</th>
<th>Maintenance Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>